FINAL EIA REPORT

TOR REFERENCE: NO. 10-53/2020-IA-III DATED 29TH OCTOBER, 2020
BASELINE PERIOD: DECEMBER 2019 TO FEBRUARY 2020

ENVIRONMENTAL IMPACT ASSESSMENT

FOR ENVIRONMENTAL & CRZ CLEARANCE OF ON-GOING PROJECT FOR ESTABLISHMENT OF

NAVI MUMBAI INTERNATIONAL AIRPORT (NMIA)

AT ULWE, PANVEL TALUKA, RAIGAD DISTRICT, MAHARASHTRA

SUBMITTED TO:
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
(MOEF & CC), NEW DELHI

SUBMITTED BY:
NAVI MUMBAI INTERNATIONAL AIRPORT PVT. LTD. (NMIAL)

ENVIRONMENT CONSULTANT:
VIMTA LABS LIMITED, HYDERABAD
(QCI/ NABET ACCREDITED SR.NO.139)

SEPTEMBER 2021

PREFACE

M/s. Navi Mumbai International Airport Private Limited (NMIAL)

Terminal I B, CSI Airport, Santacruz, Mumbai-400099, Maharashtra.

ENVIRONMENTAL IMPACT ASSESSMENT

FOR

The Proposed Navi Mumbai International Airport (NMIA), at Ulwe, Navi Mumbai, Panvel Taluka, Raigad District, Maharashtra by M/s Navi Mumbai International Airport Private Limited.

For and on behalf of **Vimta Labs Limited**

Approved by: **M. Janardhan**

Signed :

Position : **Head & Vice President (Env)**

Date : 06th September, 2021

The report has been prepared in line with the prescribed TOR issued vide F. No. 10-53/2020-IA-III dated 29th October, 2020 issued by Ministry of Environment, Forest and Climate Change, New Delhi

This report has been prepared by **Vimta Labs Limited** with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

DECLARATION

Declaration by Experts Contributing to **Environmental Impact Assessment for the Proposed Navi Mumbai International Airport (NMIA), at Ulwe, Navi Mumbai, Panvel Taluka, Raigad District, Maharashtra.**

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA.

EIA Coordinator: Mr. M. Janardhan

Name: M. Janardhan

Signature & Date 2021/09/06

Period of Involvement: **March 2018 to September 2021**

Contact Information: **9000711309**

Functional Area Experts:

Sr. No.	Functional Areas	Name of the Expert/s	Involvement		Signature & Date
			Period	Task	
1	AP	M. Janardhan	**March 2018 to September 2021**	Selected AAQ stations based on IMD data. Identified the sources of pollution and suggested mitigation measures and management plan.	2021/09/06
2	WP	Bh. Durga Bhavani	**March 2018 to September 2021**	Selecting the water sampling locations. Identified the wastewater streams and effective treatment measures are suggested.	Bh. Durga Bhavani 2021/09/06
3	SHW	M. Janardhan	**March 2018 to September 2021**	Suggested effective management practices for solid and hazardous waste	2021/09/06
4	SE	Ch. Narendra	**March 2018 to September 2021**	Reviewed primary socio-economy field survey data and involved in preparation of socio-economic and demography	2021/09/06

Sr. No.	Functional Areas	Name of the Expert/s	Involvement		Signature & Date
			Period	Task	
				section.	
5	EB	Prof K. Bayapu Reddy	**September 2019 to September 2021**	Reviewed secondary and primary Ecological Survey data and identified impacts & suggested mitigation measures.	2021/09/06
6	HG	J. Rajendra Prasad	**March 2018 to September 2021**	Reviewed secondary and primary data and identified impacts & suggested mitigation measures.	Rajendra 2021/09/06
7	Geo	J. Rajendra Prasad	**March 2018 to September 2021**	Reviewed secondary and primary data and identified impacts & suggested mitigation measures.	Rajendra 2021/09/06
8	NV	M. Janardhan	**March 2018 to September 2021**	Predicted noise levels using Integrated Noise Model and also suggested mitigation measures.	2021/09/06
9	AQ	Bh. Durga Bhavani	**March 2018 to September 2021**	Conducted air dispersion modeling using AERMOD and determination of GLC's.	2021/09/06
10	LU	Dr. Y Rama Mohan	**March 2018 to September 2021**	Preparation of land use map using FCC of IRS RS-2 LISS-IV satellite imagery.	2021-09-06
11	RH	Rajgopal Krishnan	**March 2018 to September 2021**	Identified the hazards and recommended the suitable measures.	2021/09/06
12	SC	Prof K. Bayapu Reddy	**September 2019 to September 2021**	Reviewed primary and secondary soil analysis data and Identified the impacts and suggested suitable mitigation measures.	2021/09/06

Other Approved Category-B Experts involved in EIA Report preparation:

Sr. No	Functional Areas	Name of the Expert/s	Involvement		Signature & Date
			Period	Task	
1	HG & Geo	K. Rajeshwar	**March 2018 to September 2021**	Assisted in preparation of HG & Geo sections in the EIA report	K. Rajeshwar 2021/09/06
Team Member					
2	AP & NV	Swarup Kumar Samal	**September 2019 to August 2021**	Assisted in preparation of AP and NV sections in the EIA report.	**Left the Organization**

DECLARATION BY THE HEAD OF THE ACCREDITED CONSULTANT ORGANIZATION/ AUTHORIZED PERSON

I, **M. Janardhan** hereby, confirm that the above mentioned experts prepared the **Environmental Impact Assessment for the Proposed Navi Mumbai International Airport (NMIA), at Ulwe, Navi Mumbai, Panvel Taluka, Raigad District, Maharashtra.**

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA.

I also confirm that the consultant organization shall be fully accountable for any mis-leading information mentioned in this statement.

It is certified that no unethical practices, plagiarism involved in carrying out the work and external data / text has not been used without proper acknowledgement while preparing this EIA report.

Signature:

2021/09/06

Name: **M. Janardhan**

Designation: **Head & VP - Environment**

Name of the EIA consultant organization: **Vimta Labs Limited**

NABET Certificate No. & Issue Date: **NABET/EIA/1720/SA 088 Dated: April 16, 2019**.

Accreditation Validity till November 10, 2021 as per letter QCI/NABET/ACO/21/1912 Dated: August 11, 2021.

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Vimta
Driven by Quality. Inspired by Science.

UNDERTAKING BY CONSULTANT

M/s. Vimta Labs Limited has complied with all the prescribed Terms of Reference (ToR) issued by Ministry of Environment, Forest & Climate Change (MoEF&CC) vide letter F. No. 10-53/2020-IA-III dated 29th October, 2020 for Environmental Impact Assessment for the Proposed Navi Mumbai International Airport (NMIA), at Ulwe, Navi Mumbai, Panvel Taluka, Raigad District, Maharashtra by M/s Navi Mumbai International Airport Private Limited.

For Vimta Labs Limited

2021/09/06

M. Janardhan
Head & VP Environment

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ABBREVAITIONS

Abbreviation	:	Full Form
AAI	:	*Airports Authority of India*
AAIB	:	*Airport Accident Investigation Bureau*
ACSA	:	*Airports Company of South Africa*
AERP	:	*Airport Emergency Response Plan*
AECC	:	*Airport Emergency Command Center*
AGL	:	*Aeronautical Ground Lighting*
AHO	:	*Airport Health Organisation*
AMSL	:	*Aerial Mean Sea Level*
APCCF	:	*Additional Principal Chief Conservator of Forests*
APU	:	*Auxiliary Power Units*
ARC	:	*Aerodrome Reference Code*
ARFF	:	*Air Rescue and Fire Fighting*
ARP	:	*Airport Reference Point*
ART	:	*Aerodrome Reference Temperature*
ASI	:	*Archaeological Survey of India*
ASMGCS	:	*Advanced Surface Movement Guidance and Control Systems*
ASR	:	*Airport Surveillance Radar*
ATCT	:	*Air Traffic Control Tower*
ATM	:	*Air Traffic Movements*
BCAS	:	*Bureau of Civil Aviation and Security*
BEST	:	*Brihanmumbai Electricity supply and Transport Undertaking.*
BNHS	:	*Bombay Natural History Society*
BOS	:	*Back of Stand*
BRTS	:	*Bus Rapid Transit System*
CA	:	*Concessionaire Agreement*
CAGR	:	*Compound Aggregate Growth Rate*
CCC	:	*Communication Command Center*
CCO	:	*Continuous Climb Operations*
CCTV	:	*Comprehensive Closed-Circuit TV*
CCZM	:	*Color Coded Zoning Map*
CDA	:	*Continuous Descent Approach*
CIDCO	:	*City and Industrial Development Corporation of Maharashtra*
CNS	:	*Communication, Navigation and Surveillance*
COD	:	*Commercial Operation Date*
CRZ	:	*Costal Regulation Zone*
CSMIA	:	*Chhatrapati Shivaji Maharaj International Airport*
CTC	:	*Central Terminal Complex*
CTS	:	*Comprehensive Transport Study*
CTSU	:	*Comprehensive Transport Study Updation*
CWPRS	:	*Central Water and Power Research Station*
CZMP	:	*Coastal Zone Management Plan*
DBFOT	:	*Design, Build, Finance, Operate and Transfer*
DDFS	:	*Design Day Flight Schedule*
DEM	:	*Digital Elevation Model*
DFC	:	*Dedicated Freight Corridor*
DFO	:	*Divisional Forest Officer*
DGCA	:	*Directorate General of Civil Aviation*
DME	:	*Distance Measuring Equipment*
DMP	:	*Disaster Management Plan*
DVOR	:	*Doppler Very High Frequency*

Abbreviation	:	Full Form
ECBC Norms	:	*Energy Conservation Building Code Norms*
EEH	:	*Eastern Express Highway*
EERP	:	*Environmental Emergency Response Plan*
EHVT	:	*Extra High Voltage Transmission*
EIA	:	*Environmental Impact Assessment*
EMAR	:	*Eastern Main Access Road*
EMP	:	*Environment Management Plan*
EOC	:	*Emergency Operation Centre*
EPC CONTRACTOR	:	*Engineering, Procurement and Construction Contractor*
ESZ	:	*Eco Sensitive Zone*
FAA	:	*Federal Aviation Administration*
FCC	:	*False Colour Composite*
FETI	:	*Fire Explosion and Toxicity Index*
FGD	:	*Focus Group Discussion*
FSI	:	*Floor to Space Index*
GA:	:	*General Aviation*
GBAS	:	*Ground Based Augmentation System*
GMLR	:	*Ghatkopar Mankhurd Link Road*
GOM	:	*Government of Maharashtra*
GSDA	:	*Ground Water Surveys Development Agency*
GSE	:	*Ground Services Equipment*
HIS	:	*Inner Horizontal Surface*
HOS	:	*Head of Stand*
HSE	:	*Health Safety and Environment*
HTL	:	*High Tide Line*
HVAC	:	*Heating Ventilation and Air Conditioning System*
IATA	:	*International Air Traffic Association*
IBA	:	*Important Bird Area*
IBIS	:	*Bird Attack Information System*
ICAO	:	*International Civil Aviation Organization*
IDC	:	*Interest During Construction*
IIA	:	*Integrated Industrial Area*
ILS	:	*Instrument Landing System*
IMD	:	*Indian Meteorological Department*
INM	:	*Integrated Noise Model*
IPT	:	*Intermediate Public Transport*
IRPA	:	*Individual Risk Per Annum*
JNP	:	*Jawaharlal Nehru Port*
JVLR	:	*Jogeshwari Vikhroli Link Road*
KBS	:	*Karnala Bird Sanctuary*
KDMT	:	*Kalyan-Dombivili Municipal Transport Company*
KMC	:	*Khopta Municipal Council*
LAeq	:	*Equivalent Continuous Sound Pressure Level*
LAeqD	:	*Equivalent Continuous Sound Pressure Level (Weighed Night Time Average)*
LAeqN	:	*Equivalent Continuous Sound Pressure Level (Weighed Day Time Average)*
LASA	:	*Lea Associates South Asia*
LCC	:	*Low-Cost Carriers*
LISS	:	*Linear Imaging Self Scanning Sensor*
LOA	:	*Letter of Award*

Abbreviation	:	Full Form
LOS C	:	*Level of Service Concept*
LSIR	:	*Location Specific Individual Risk*
LTL	:	*Low Tide Line*
LTO	:	*Landing and Take-off Cycle*
MARS	:	*Multiple Aircraft Ramp Stand*
MCGM	:	*Municipal Corporation of Greater Mumbai*
MGL	:	*Mahanagar Gas Limited*
MHWN	:	*Mean High Water Neap*
MHWS	:	*Mean High Water Spring*
MJPRCL	:	*Mumbai JNPT Port Road Company Limited*
MLCP	:	*Multi-Level Car Park*
MMB	:	*Maharashtra Maritime Board*
MMCU	:	*Mumbai Mangrove Conservation Unit*
MMR	:	*Mumbai Metropolitan Region*
MMRDA	:	*Mumbai Metropolitan Region Development Authority*
MOCA	:	*Ministry of Civil Aviation*
MOEF&CC	:	*Ministry of Environment, Forests & Climate Change*
MPPA	:	*Million Passengers Per Annum*
MRO	:	*Maintenance Repair and Overhaul*
MSEDCL	:	*Maharashtra State Electricity Distribution Company Limited*
MSETCL	:	*Maharashtra State Electricity Transmission Company Limited*
MSEZ	:	*Matheran Eco-Sensitive Zone*
MSHIC	:	*Manufacture, Storage and Import of Hazardous Wastes*
MSL	:	*Mean Sea Level*
MSRDC	:	*Maharashtra State Road Development Corporation Limited.*
MSRTC	:	*Maharashtra State Road Transport Corporation*
MTHL	:	*Mumbai Trans-Harbour Link*
MTSU	:	*Mumbai Transformation Support Unit*
MUTP	:	*Mumbai Urban Transport Project*
MVRC/IR	:	*Mumbai Railway Vikas Corporation Limited/Indian Railways*
NAD	:	*Naval Armament Depot*
NAINA	:	*Navi Mumbai Airport Influence Area*
NAVAID'S	:	*Navigation Aids*
NCIIPC	:	*National Critical Information Infrastructure Protection Centre*
NEF	:	*Noise Exposure Forecast*
NFPA	:	*National Fire Protection Association*
NHAI	:	*National Highway Authority of India*
NIHL	:	*Noise Induced Hearing Loss*
NMIA	:	*The Navi Mumbai International Airport*
NMIAL	:	*Navi Mumbai International Airport Limited*
NMMC	:	*Navi Mumbai Municipal Council*
NMMT	:	*Navi Mumbai Municipal Transport Corporation*
NSRC	:	*National Remote Sensing Centre*
NTDA	:	*New Town Development Authority*
NTRO	:	*National Technical Research Organisation*
OLS	:	*Obstructions Limitation Surface*
OSHA	:	*Occupational Safety Health Assessment*
PAP	:	*Project Affected People*
PBB	:	*Passenger Boarding Bridge*
PCMC	:	*Pimpri Chinchwad Municipal Corporation*
PCMT	:	*Pimpri Chinchwad Municipal Transport Corporation*
PCU	:	*Passenger Car Units*

Abbreviation	:	Full Form
PIDS	:	*Perimeter Intruder Detention System*
PMC	:	*Panvel Municipal Council*
PPP	:	*Public Private Partnership*
PTB	:	*Passenger Terminal Building*
PUC	:	*Pollution Under Control*
PWD	:	*Public Works Department*
PWT	:	*Passenger Water Transport*
QRT	:	*Quick Response Team*
R&R	:	*Rehabilitation and Resettlement*
RA	:	*Risk Assessment*
RAT	:	*Runway Access Taxiways*
REET	:	*Rare or Endangered or Endemic or Threatened Species*
RESA	:	*Runway End Safety Area*
RET	:	*Rapid Exit Taxiways*
RF	:	*Reserved Forest*
ROFR	:	*Right of First Refusal*
RON	:	*Remote and Remain Overnight.*
ROW	:	*Right of Way*
SBR	:	*Sequential Batch Reactor*
SCLR	:	*Santacruz Chembur Link Road*
SDM	:	*State Disaster Management*
SIC	:	*Safety Investigation Co-ordinator*
SID	:	*Standard Instrument Departure*
SMR	:	*Surface Movement Radar*
SPL	:	*Sound Pressure Level*
SPOC	:	*Single Point of Contact*
SPV	:	*Special Purpose Vehicle*
STAR	:	*Standard Terminal Arrival Route*
SWD	:	*Storm Water Drainage*
SWM	:	*Solid Waste Management*
TAAM	:	*Total Airspace & Airport Modeller*
TAZ	:	*Traffic Assessment Zone*
TAZ	:	*Traffic Assessment Zone*
TCB	:	*Technical Co-operation Bureau*
TCFS	:	*Thane Creek Flamingo Sanctuary*
TMT	:	*Thane Municipal Transport Corporation*
TPCL	:	*Tata Power Company Limited*
TPD	:	*Tonnes Per Day*
URC	:	*Ulwe Recourse Channel*
USGBC	:	*United States Green Building Council*
VFD	:	*Valuable Frequency Drive*
VVMT	:	*Vasai Virar Municipal Transport Company*
WHR	:	*Waste Heat Recovery*
WMAR	:	*Western Main Access Road*

Executive Summary

1.0 Introduction

The Navi Mumbai International Airport (NMIA) is an on-going project, being developed by Navi Mumbai International Airport Ltd (NMIAL) as an international airport planned to cater to the growing air travel demand of Mumbai Metropolitan Region. The Navi Mumbai International Airport is located at the geographic center of Mumbai Metropolitan Region in Navi Mumbai, near Ulwe Node which is located in Panvel taluka of Raigad district of Maharashtra. The project scope includes development of an International Airport (in phases) with a capacity to handle minimum 60 million passengers per annum (MPPA) and 1.5 million tonnes (MT) of cargo per annum. The NMIA project is being developed for establishment of an international airport with state-of the art IATA benchmark level of service as well as climate resilient-carbon neutral airport of international category upon development to its full capacity.

The airport is being developed in compliance with Concessionaire Agreement of the project signed between The City and Industrial Development Corporation of Maharashtra (CIDCO) and NMIAL, and in compliance with applicable airport development norms of Airport Authority of India (AAI), International Civil Aviation Organization (ICAO), Directorate General of Civil Aviation, GoI (DGCA), etc. The onsite implementation work of NMIA project commenced in April 2017.

The Environmental Impact Assessment (EIA) Study of this on-going Navi Mumbai International Airport (NMIA) project is being submitted by NMIAL as part of its application for fresh Environmental and CRZ Clearance for this project in lieu of expiry of Environmental and CRZ Clearance granted to this project by Ministry of Environment, Forest and Climate Change (MoEF & CC) on 20th November, 2010 and Extension of Validity granted on 20th December, 2017 till 21st November, 2020 with CIDCO as project proponent. Scope of the project and site area of project in remains same as approved in Environmental and CRZ Clearance for the project in November 2010.

In 2017 after concluding open tender process for selection of private strategic partner to develop NMIA project on Public Private Partnership (PPP) model, CIDCO issued Letter of Award (LoA) to Mumbai Internal Airport Pvt. Ltd (MIAL) as Selected Bidder in October 2017. Navi Mumbai International Airport Pvt. Ltd. (NMIAL), a Special Purpose Vehicle (SPV) was formed for implementation of the project on Design, Build, Finance Operate, and Transfer (DBFOT) basis with MIAL holding 74% and CIDCO with 26% in the SPV. Concession Agreement for the project was signed between NMIAL and CIDCO on 8th January 2018, and State Support Agreement was signed between Govt. of Maharashtra, CIDCO and NMIAL on 8th January 2018. As per terms of Concession Agreement, NMIAL is required to ensure valid Environmental Clearance & compliances to EC conditions for the project relating to Airport Site measuring 1160 Ha. In view of this NMIAL submitted application for issue of fresh Environmental and CRZ Clearance in the name of NMIAL. CIDCO vide its letter No. CIDCO/ T&C/CT & CP/NMIA/1317 dated 10.2.2020 has granted NoC to NMIAL for the same. Approval of MoEF&CC for Transfer of Environment & CRZ Clearance from CIDCO to NMIAL was obtained vide letter No. F. No. 10-53/2009-IA-III dated 17th August 2020.

Although CIDCO has pursued for Forest Clearance for the project after EC was granted in Nov 2010, it was received in 2017. Therefore, the on-site work of the project started in April 2017. After obtaining all required approvals, CIDCO has commenced implementation of the project by initiating Predevelopment Works of the project including Land Development Works in April 2017, and these are nearly completed, and airport infrastructure works are to commence soon.

Cost of approx. Rs 5,478 Crores has already been incurred on on-going project work, which is 35% of Phase-I project cost of Rs 15,635 Crores. CIDCO has additionally incurred cost of Rs 1,813 Crores towards R & R and pre-development Cost of Rs 3,665 Crores. Thus, total of Rs 5,478 Crores has been incurred on the project till March 2021.

As the Pre-Development Works are completed, the construction of airport infrastructure is to be taken up by NMIAL as the Concessionaire of the project appointed by CIDCO. The project is to be implemented in four phases. The details are mentioned in **Table-1.**

TABLE-1
IMPLEMENTATION PHASES OF NMIA PROJECT- FOUR PHASES

Airport Development Phase	Passenger Terminal	Cumulative Passenger Handling Capacity (MPPA)
Phase – I	Terminal-1 – With West Pier	10
Phase – II	Terminal-1 – With West & East Pier	20
Phase – III	Terminal 2	40
Phase – IV	Terminal 3	60

1.1 Importance of the Project

The Navi Mumbai International Airport (NMIA) is being developed by Navi Mumbai International Airport Ltd (NMIAL) as an international airport planned to cater to the growing air travel demand of Mumbai region. The Navi Mumbai International Airport is located at the geographic center of Navi Mumbai in Ulwe Node of Navi Mumbai which is located within Panvel taluka of Raigad district of Maharashtra state.

Mumbai is the financial capital of India, and the capital city of the State of Maharashtra forms the largest urban center within the Mumbai Metropolitan Region (MMR). NMIA, will be the second airport for Mumbai Metropolitan Region area, and is located at Navi Mumbai. Enhancement of airport capacity to handle projected air traffic demand of MMR in future is critical for maintaining Maharashtra's leadership in attracting Foreign Direct Investment and cementing Mumbai's future as an International Financial Centre as annual air passenger traffic is expected to grow over 160 million by 2038. The Chhatrapati Shivaji Maharaj International Airport (CSMIA) alone will be unable to handle such an increase in demand. It is, therefore, imperative to build a second Airport for MMR.

1.2 Project Proponent

As described in introductory section, NMIA was conceived by the GoM and CIDCO was assigned the task of establishing the airport. CIDCO initiated the project planning and received EC in 20110 and CTE in 2015 as project proponent., and it commenced project implementation in 2017. Concurrently, as approved by GoI and GoM, CIDCO also initiated global tender / bidding process for development of NMIA as a PPP project, and after successful completion of this process CIDCO issued a Letter of Award (LoA) on 25th October 2017 to Mumbai International Airport Ltd (MIAL) as Concessionaire for the project. A Special Purpose Vehicle (SPV) Navi Mumbai International Airport Pvt. Ltd (NMIAL) was formed for execution of the project, and Concession Agreement was executed on 8th Jan 2018., between CIDCO on NMIAL. As per terms of this Concession Agreement NMIAL is to be granted Right of Way (RoW) by CIDCO to Airport Site area of 1160 ha and NMIAL shall be responsible for obtaining and complying with all applicable permits for the construction, operation and maintenance of the airport project. Therefore, NMIAL is now the project proponent for NMIA project, having received the approval of MoEF&CC for Transfer of Environment & CRZ Clearance from CIDCO to NMIAL vide letter No. F. No. 10-53/2009-IA-III dated 17th August 2020.

NMIAL is mandated under Concession Agreement to Design, Build, Finance, Operate and Transfer (DBFOT) the NMIA project for concession period of 30 years from the appointed date which is extendable for a further 10 years.

1.3 Statutory Clearances

The airport is being developed in compliance with airport development requirements provided by CIDCO in its Concessionaire Agreement of the project and in compliance with applicable airport development norms of Airport Authority of India (AAI), International Civil Aviation Organization (ICAO), Directorate General of Civil Aviation, GoI (DGCA), etc. The project area referred in this EIA study is limited to 1160 ha area earmarked for construction of the Airport and its Allied activities, and excludes area under off-site infrastructure, the Ulwe Recourse Channel or area for the relocation of the erstwhile EHVT lines passing through the Airport project site.

<u>EC Transfer</u>
The EC & CRZ Clearance for this area is transferred to NMIAL from CIDCO vide letter No. F. No. 10-53/2009-IA-III dated 17th August 2020.

<u>Status of EC and CRZ Clearance</u>
Environmental and CRZ clearance dated 22nd Nov 2010 was valid up to 21st November 2017 and later extension of validity granted vide Notification S.O. 4254(E) dated 27th Dec'2020 for validity up to 21st November 2020. Later in 2020, GoI, considering the adverse impact of on-going Covid-19 pandemic on project implementation, has extended validity of current Environmental Approval granted by MOEF for all on-going projects, which includes NMIA project, till 21st November 2021.

The Vimta Labs Limited, Hyderabad has been engaged by NMIAL to carry out the EIA study in accordance with the guidelines of MoEF&CC.

<u>Status of Consent to Establish</u>
Consent for Establishment" was obtained by CIDCO from MPCB vide letter dt. 14th Oct 2015 for Phase I (10 MPPA) which was valid up to 13th Oct 2020. Further, the validity of expired/ expiring consents has been deemed extended for all projects up to 31st Oct'21 by MPCB vide circular dated 6th May'21. Therefore, NMIA CTE Phase-I validity is also extended up to 31st Oct 2021. NMIAL has applied for grant of fresh CTE -Phase I & II (20 MPPA) vide letter dated 15th October 2020 and application is under process. The final meeting and presentation to Chairman MPCB was held in August 2021.

1.4 Status of CRZ

The CRZ notification S.O. 19 (E) dated 6th January 2011 has been amended to permit the development of NMIA in CRZ area by exempting the airport development from the list of prohibited activities under clause 3(i)(d). The development of NMIA in CRZ-I is permitted under clause 8 (I)(i)(f). Similarly, the development of NMIA in NDZ and CRZ-II area are permitted under clause 8 (III)(A)(iii)(m) and 8(III)(B)(x) respectively. CRZ mapping has been carried out by IRS Anna University, Chennai. The CRZ area is categorized based on approved CZMP of Raigad district as per MoEF&CC CRZ Notification, 2011 in accordance with condition stipulated in TOR issued for grant of fresh EC on 29th Oct 2020. The project area of 1160 Ha along with airport infrastructure and layout has been superimposed on scale of 1:4000 and 1:25000.

NMIAL, vide its letter dated 14th Feb'20 to MCZMA & letter dated 22nd May 2020 addressed to Hon District Collector, Raigad has objected to the draft CZMP (2019) for Panvel Taluka prepared by MCZMA wherein the draft CZMPs prepared do not reflect the current physical position on NMIA site. NMIAL vide its letter dated 14th Feb'20 to MCZMA has conveyed it's already mentioned the Suggestion/ Objection/ Clarification regarding Draft CZMP (2019) with respect to NMIA project site. NMIAL has requested MCZMA/District Collector to update the Draft CZMP (2019) to indicate correct existing site conditions at respective locations within NMIA Site.

1.5 Status of the Project

The NMIA project is being developed for establishment of an international airport with state-of the art IATA benchmark level of service as well as climate resilient-carbon neutral airport of international category with a capacity to handle a minimum of 60 million passengers per annum (60 MPPA) and about 1.5 million tonnes (1.50 MTPA) of cargo annually upon development to its full capacity. This is an on-going project where Pre-development Works including Land development Works of this on-going project are nearly completed and airport infrastructure works are to commence soon. Cost of approx. Rs 5,478 Crores has already been incurred on on-going project work, which is 35% of Phase-I project cost of Rs 15,635 Crores. CIDCO has additionally incurred cost of Rs 1,813 Crores towards R & R and pre-development Cost of Rs 3,665 Crores. Thus, total of Rs 5,478 Crores has been incurred on the project till March 2021.

❖ **Location Details and Environmental Setting**

This ongoing project is for establishment of the airport in site area of 1160 ha at Airport Reference Point (ARP) latitude 18° 59′ 40″ N and longitude 73° 04′ 13″ E, between Amra Marg and National Highway 4B (NH-4B). The project area includes land area under 8 revenue villages Targhar, Ulwe, Owle, Pargaon, Vadghar, Kopar, Vaghvali Khar and Pargaon Dungi.

❖ **Existing Connectivity to NMIA**

Road Connectivity
NMIA site is strategically located between two main arterial roads of Navi Mumbai, with 8 lane Amra Marg on its west and 6 lane NH-4B on its eastern edge. The site is also close to Mumbai Pune Expressway (Sion-Panvel Highway), and connected to it by Amra Marg. Primary access to NMIA site is planned from west (Mumbai), from Amra Marg and from NH-4B from eastern side. Further North, Amra Marg connects to Sion-Panvel highway and Vashi Bridge through Palm Beach Road. On southern side, Amra Marg connects to NH-4B which connects to Jawaharlal Nehru Port (JNP) to south west and Sion-Panvel highway through NH-4B towards north east.

Rail Connectivity

The existing sub-urban rail connectivity linkages to/around NMIA include Mankhurd-Vashi-Belapur-Khandeshwar-Panvel and Thane-Turbhe-Vashi-Nerul-Panvel rail lines which provide connectivity from Greater Mumbai and Thane, respectively. NMIA site is also accessible from existing Mankhurd-Belapur-Panvel & Thane-Panvel commuter rail corridors from Khandeshwar Railway Station in the east and from Targhar Railway Station on the Nerul-Uran Railway line, west of NMIA.

❖ **Land Use**

The land-use of the airport site is "International Airport & Allied Activities/Service Zone" as per the revised land use Notification of NMDP dated 21st March 2012, by GOM.

❖ **Land Requirement**

The land required for NMIA is comparable to international airports being developed or operated in India and abroad. The comparison of land requirement is given in **Table-2** below:

TABLE-2
COMPARISION OF AIRPORT LAND REQUIRMENT AT NMIA & GLOBAL AIRPORTS

Airport	Land (ha)	PAX (MPPA)	Cargo (MTPA)
Indira Gandhi International Airport, Delhi	2066	109	2.20
Kempegowda International airport, Bengaluru	1622	55	1.00
Rajiv Gandhi International Airport, Hyderabad	2223.7	50	0.575
Hartsfield–Jackson Atlanta International Airport*	1902	110.53	0.677
Singapore Changi Airport*	1300	68.3	2.01
London Heathrow Airport*	1227	80.9	1.50
Navi Mumbai International Airport, Navi Mumbai	**1160**	**60**	**1.50**
Chhatrapati Shivaji Maharaj International Airport, Mumbai	**812.44**	**50**	**0.70**

** The Airport operation capacities with regard to PAX and Cargo handling in 2019 are mentioned here.*

❖ **Status of Site Pre-Development**

NMIA pre-development works are nearly completed. The cutting & filling of rock from existing Ulwe Hill in site up to +5.5 m AMSL has been completed along with diversion of Ulwe river by construction of Ulwe Recourse Channel. The shifting of EHVT Lines by Tata Power is completed and shifting of EHVT Lines by MSETCL is in is due for completion by October 2021 end.

As on 11th June 2021, R&R has been completed to an extent of 97.3% by CIDCO, and almost all, except 71 structures of PAP families remain to be shifted from site.

1.6 Environmental Setting

The NMIA project site is located in Panvel taluka of Raigad district of Maharashtra state, situated west of Panvel city, almost within geographical center of Navi Mumbai and MMR with a longitude of 73°04'18" and latitude of 18°59'33". The environmental setting along with the topographical features of study area within the 15 km radius from the boundary of the airport is given in **Table-3.**

TABLE-3
ENVIRONMENTAL SETTING AROUND THE PROJECT SITE – 15 KM RADIUS

Sr. No.	Particulars	Details
1	Location	NMIA site is located taluka Panvel, district Raigad, Navi Mumbai between Amra Marg and NH-4B. Villages: Vadghar (Chinchpada), Kopar, Pargaon (Kohli), Pargaon-Dungi, Owale (Upper and Lower Owale+ Waghivali Wada), Ulwe (Ulwe + Ganeshpuri), Targhar (Targhar + Kombhadbuje), Waghivali-Khar
2	Coordinates of Airport Reference Point (ARP)	73°04′18″ E and 18°59′33″ N
3	Encompassing Latitude and Longitudes	73° 02′ 54″ E to 73° 05′ 39.61″ E 18° 58′ 44.61″ N to 19° 0′.57 16″ N
4	Topographic Sheets	E 43G13, E 43B4, E 43H1 (47 A/16, B/13, E/4, F/1)
5	Reference Metrological Station	IMD station at CSMIA, Santacruz
6	General Elevation above MSL	Present Elevation of the Airport Site after Pre-development works: +5.5 AMSL
7	Topography	Sloping towards NW.
8	Soil Type	Marine, Murrum, Rocks
9	Climatic Conditions (Based on Data (1917 to 2000) at the IMD Station at Santacruz(A) in Mumbai)	• Mean Temperature: Max. 38°C, Min. 12.9 °C • Total Annual Rainfall:1357.3 mm to 3784.9 mm • Wind Direction: Annual pre-dominant wind direction is from North-West. • Annual mean Humidity: 63 - 73%
10	Nearest Highways	SH-54 (on southern side), NH-4B (on eastern side), Amra Marg (Running on the western boundary of Airport site)
11	Nearest Railway Station	**Major Railway Station:** • Panvel Station on Central/Konkan Railway (4.5 km, E). **Suburban Railway:** • Targhar Station (on Seawoods-Uran Link) – (1 km, W) • CBD Belapur Station (on Panvel-CSMT Line)–(2 km, N) • Khandeshwar Station on (Panvel- Chhatrapati Shivaji Maharaj Terminus [CSMT] Railway Line) -(2.5 km, NE)
12	Nearest other airports	Chhatrapati Shivaji Maharaj International Airport (CSMIA), Mumbai (35 km).
13	Nearest Village/City	**Town: CBD Belapur** (0.5 km, N), Panvel (0.5 km, E)
14	Densely populated or built-up area	Navi Mumbai Municipal Corporation (NMMC) (Various nodes such as CBD Belapur, Seawoods, Kharghar) and Panvel/New Panvel town NMMC comprising Residential, Institutional and Commercial areas are located approximately 1km to the north of Project Site (Population approximately 11.2 Lakhs as per Census 2011). Panvel town is located to the east of site at about 1.5 km distance (Population approximately 1.95 Lakhs as per Census 2011)

Sr. No.	Particulars	Details
15	Ecologically sensitive zones (Distances and directions with respect to the Airport Project Site boundary)	• Thane Creek Flamingo Sanctuary Proposed ESZ 9.2 km, NW (Thane Creek Flamingo Sanctuary lies at 11 km, N). • Matheran Eco Sensitive Zone, 9.3 km, ENE. • Karnala Bird Sanctuary – 9.6 km, SE. • Karnala Bird Sanctuary ESZ – 2.5 km, SE.
16	Wetland, Mangroves, Feeding sites of Migratory Birds	• NRI Colony (3.5 km, WNW) • TCS Chanakya Wetlands (Wetlands, Mangroves about 4.5 km towards NW) • Panje, Funde (Wetlands, Mangroves about 11 km towards SW) • Bendkhal (Wetlands, Mangroves about 13km towards SSW) • NRI Wetlands (Wetlands, Mangroves about 3.5 km towards WNW) <u>Feeding sites of Migratory birds:</u> • Thane Creek Mudflats (9.8 km NW of site (Important Bird and Biodiversity Area (IBA)) • Mahul- Sewree Mudflats (14.3 km W of site (Important Bird and Biodiversity Area (IBA)
17	Forests (RF: Reserve Forests, PF: Protected Forests)	• RF near village Padekhar (1.8 km, S) • RF in Parsik Hills (4.5 km, N) • RF near village Jasai (4.6 km, S) • RF near village Narpoli (9.2 km, SE) • RF near village Thombrewadi (10.4 km, SE) • RF near village Kalambusre (12.6 km, S)
18	Nearest Hill	Ulwe hill – RL 82 m within the site
19	Notified Historical/ Archaeological/ Tourist Places	• Belapur Fort (0.82 km, NW) • Elephanta Caves, Gharapuri (11.3 km, W) • Karnala Fort (11.95 km, SE) • Prabalgadh Fort (13.94 km, E)
20	Defence and other related Establishments	Indian Navy, Naval Armament Depot (NAD) at Karanja- 14.5 km, SW
21	Major Water Bodies	▪ Ulwe River (Tidally influenced water body South of site (diverted channel) ▪ Panvel Creek and Estuarine portion of Gadhi River about the Site to the North and East, respectively. ▪ Gadhi River and Panvel creek (Tidally influenced water body North of site at 70 m distance) ▪ Panvel creek (Tidally influenced water body north of site at 300 m distance) ▪ NRI Wetlands (Wetlands, Mangroves about 3.5 km towards WNW) ▪ TCS Chanakya Wetlands (Wetlands, Mangroves about 4.5 km towards NW) ▪ Panje, Funde (Wetlands, Mangroves about 11 km towards SW) ▪ Bendkhal (Wetlands, Mangroves about 13 km towards SSW)
22	Seismic Zone	Zone-III as per IS: 1893 (Part-I) 2002.

2.0 Project Description

2.1 Airport Sector Profile

Air Traffic Forecast for Mumbai Metropolitan Region (MMR) indicates air passenger demand of more than 100 MPPA by 2028 and more than 200 MPPA by 2045. In view of this, there is an urgent need to expeditiously develop NMIA, as the second airport for Mumbai Metropolitan Region. NMIA project is conceptualised as part of India's first dual airport system for a city, operating two international airports within a single metropolitan region, in view of booming air traffic demand of Mumbai. NMIA is situated at Navi Mumbai (within MMR), while MMR is currently being served solely by CSMIA for commercial flights. When NMIA commences operations, MMR shall have a dual airport system.

CSMIA has experienced unprecedented annual growth in past two decades reflective of country's economic boom. CSMIA has undergone landside and airside expansion through a 2-billion-dollar airport modernization and expansion program from 2006 to 2014 to improve its airport infrastructure and passenger handling capacity. However, this landlocked airport with no room to spare is severely constrained both on its airside as well as landside area. Factors influencing the establishment of NMIA are primarily led by limitation of expansion of CSMIA beyond its ŧ planned capacity of 40 MPPA, which be able to serve max of 55 / 60 MPPA post implementation of capacity augmentation projects. In near future, the projected growth of the passenger flux within Mumbai will be too challenging for CSMIA based on its capacity. The impact of CSMIA capacity, resulting demand for NMIA and need for operation of a two-airport system, is presented in the following sections.

2.2 MMR Passenger Traffic Forecast

During the period of 2008 to 2019, the international and domestic traffic at CSMIA has increased from 25.9 million to 48.83 million passengers registering average growth rates of 6% and 9% in international and domestic categories, respectively. Similarly, in the same period, the total cargo traffic has increased from 0.53 MT to 0.93 MT recording an average growth rate of 6 %.

Further, traffic studies predicted a compound aggregate growth rate of 9.2% in the FY2020-25. Evidently, the passenger traffic in MMR is expected to increase to around 70-80 million passengers by FY2024, the time around which the NMIA is planned to commence its first phase of operations. The maximum operational capacity of CSMIA is to handle 60 million passengers annually and the airport shall not be able to serve beyond this capacity due to airfield constraints.

Based on traffic assessment of MMR, the unconstrained passenger traffic to and from the MMR is expected to reach approximately 80 MPPA by the time NMIA expectedly opens in FY2024, increasing to approximately 164 MPPA by 2037. Driven by a strong domestic economy and an expanding airline market, recent growth trends are expected to continue in the near-term. Over the time and as the market matures, the growth rates are expected to be moderate.

Thus, establishment of a second airport becomes indispensable to handle the growth in passengers in Mumbai Metropolitan Region.

2.3 NMIA Air Traffic Forecast

In line with traffic allocation model considered for forecast of air traffic passengers carried out by NMIAL, NMIA is forecasted to handle over 20 million passengers by the end of Phase-2 in FY2026. This would increase to just about 60 million passengers by FY2037 and about 90 million by 2058. In this scenario, the international passengers are forecasted to reach over 12 million passengers by FY 2037 and 22 million in FY 2058 and the Domestic passengers are forecasted to reach about 49 by FY2037 and 67 million by FY2058 respectively. Similarly, NMIA is forecasted to handle about 1 million tonnes of total freight by FY2037 and over 1.5 million tonnes by FY2058. International cargo is projected to reach about 660,000 tonnes by FY2037 and about 990,000 tonnes by FY2058 and Domestic cargo is forecasted to reach over 393,000 tonnes by FY2037 and about 560,000 tonnes by FY2058. A substantial part of General Aviation operations are proposed to be shifted to NMIA from CSMIA after NMIA operation begin, so as to meet the forecasted GA demand, as well as optimize CSMIA's airfield capacity for commercial passenger/cargo operations.

❖ **Air Traffic Movements (ATMs) Forecast**

NMIA is expected to have a peak hour runway capacity of 90 ATMs, considering two runways, which is expected to reach by FY2045 (based on opening year of FY2024), with passenger volumes of around 87 MPPA. After FY2045, limited passenger traffic growth is expected through aircraft up-gauging and load factor increases, reaching up to 90 MPPA in FY2058.

2.4 Airport Development Zones

As per the NMIA Master Plan, the project is planned to be developed in two basic airport zones, based on specific operational requirements of an airport and required infrastructure for them, i.e., airside zone and landside zone. These are described below:

Airside Zone: This comprises of entire airfield and operational area of NMIA inclusive of the two runways, taxiways, aircraft parking aprons, hangars, ATC Tower, radars , airside security gates , utilities, drains , green open areas and all necessary facilities for safe, efficient and secure aircraft operations; Passenger Terminals with passenger processing, retail, and other facilities contained within the terminal main processors and piers; Cargo with its airside warehousing / processing facilities, General Aviation Terminal, etc and other required uses**.**

Landside Zone: This comprises of the western, northern and eastern landside areas of airport located outside operational area/airside boundary of NMIA, including the terminal forecourt areas, Fuel facilities, landscaped green area, utilities drains, airport and airline offices, IMD facility, AAI Technical Block, CISF barracks, Police Station, Roads, Metro line and stations, bus terminal parking and various facilities for passengers, airport users and stakeholder required for airport, and landside transportation network.

The break-up of the land utilization for airside zone and landside zone of NMIA are given **Table-4.** Built-up area for Phase I and II (20 MPPA) will be 6,27,335.678 sq. m (Landside 3,04,370.761 + Airside 3,22,964.917 sq. m) and 14,13,069.17 sq. m (Landside 3,87,764.261 + Airside 10,25,304.917 sq. m) in final phase respectively.

TABLE-4
PROPOSED LAND USE STATEMENT OF NMIA

Sr. No	Land use Zone	Area (Ha)	Area (sqm)	% To Total Site Area
1	Airside Area	942.25	94,22,460.82	81.23
2	Landside Area	217.75	21,77,539.18	18.77
	Total Site Area	**1160.00**	**116,00,000.00**	**100.00**
Sr. No	**Land use (Airside + Landside)**	**Area (ha)**	**Area (sqm)**	**% to Total Site Area**
1	Facilities, pavements, building and structures	605.47	60,54,706.706	52.20
2	Green/open spaces	384.90	38,49,047.682	33.18
3	Transportation-roads, parking, metro	139.32	13,93,157.786	12.01
4	Utilities	10.12	1,01,209.816	0.87
5	Drains	20.19	2,01,878.0097	1.74
	Total Site Area	**1160.00**	**116,00,000.00**	**100.00**

Source: Pre-Feasibility Report, 2020

A brief summary of the key features of NMIA project along with its final phase operational configurations are presented in **Table-5**.

TABLE-5
KEY FEATURES OF NMIA

Sr. No.	Key Facility	Brief Description
1	**Central Terminal Complex (CTC)**	Development of three Passenger Terminals, each of 20 MPPA Capacity (**T1, T2** and **T3**)
2	**Runways**	Development of two Code 4F parallel runways in Final Phase (60 MPPA). The runways are each 3,700 m long and 60m wide and separated by 1,580 m to enable simultaneous & independent operations.
3	**Air Traffic Control Towers (ATCT)**	104 m High ATC Tower, located near Terminal 2 (almost in geographical center of NMIA Site) to be constructed with T2 Terminal construction in Phase III. For Phase 1 & 2, as approved by AAI - an interim ATC Tower, integrated with southern Aircraft Rescue and Fire Fighting (ARFF) facility shall built . The proposed location of interim ATCT was chosen as it provides the controllers unimpeded views over the apron and rest of airfield during Phases I/II.
4	**Airport Taxiway**	An efficient, dual, full length parallel taxiway system is proposed, as part of NMIA taxiway system for efficient aircraft movement of all types of aircrafts including Code C, Code E and Code F. Proposed Taxiway system shall maximize efficient flow of aircrafts to and from runways to terminals and provide operational flexibility in sequencing of arriving and departing aircrafts.
5	**Aprons**	Contact and Remote aprons have been planned to enable efficient operation for Code C, Code E and Code F aircrafts along with their movement, parking, plane-ing & de-plane-ing of passengers, baggage, and belly cargo. Adequate aprons & stands have been provided for commercial passenger aircraft, GA (General Aviation), Cargo and MRO (Maintenance Repair and Overhaul) as per projected demand.
6	**Isolation Pad**	An isolation pad, as per DGCA and security requirements, is provided for the parking of an aircraft that may be the subject of unlawful interference or needs isolation from normal airfield operations for other reasons.
7	**Communication, Navigation and Surveillance (CNS)**	NMIA will have Communication, Navigation, and Surveillance (CNS) systems capable of supporting 24/7 operations in all-weather conditions, consistent with the Concessionaire Agreement (of NMIA) and CNS/Air Traffic Movement agreement. CNS systems to be provided include: • Airport Surveillance Radar (ASR); • Surface Movement Radar (SMR); • Advanced Surface Movement Guidance and Control System (ASMGCS);

Sr. No.	Key Facility	Brief Description
		• Doppler VHF Omni directional Radio range and Distance Measuring Equipment (DVOR /DME); • Instrument Landing System (ILS); and • Ground Based Augmentation System (GBAS).
8	**Airside Roads**	An airside road system has been proposed in NMIA Master Plan ensuring efficient connectivity across the entire airfield, with expected airside vehicular traffic. The proposed airside road network includes: • Airside roads at the aprons, including head of stand (HOS) and back of stand (BOS) roads • Underground tunnel • Emergency airside roads • Perimeter Airside Roads
9	**Perimeter Security**	• Additional to the perimeter road and fence provided at NMIA, BCAS (Bureau of Civil Aviation Security of India) requires a Perimeter Intruder Detention System (PIDS) solution. In conformance with BCAS guidelines/rules, a detailed security system is planned, the particulars of which are addressed below: • A full-fledged Mandatory Primary Detection System containing: o Fiber Optic Mesh PIDS and/or Vibration Sensor based PIDS o Ground Surveillance Doppler Radar based PID o Infrared sensors o Taut Wire based PIDS o Microwave Sensors based PIDS o Power Fence • A comprehensive Closed-Circuit TV (CCTV) surveillance system • Main Control Room (where the PIDS & CCTV are connected)

2.5 Construction Material

As per the estimate, about 5.65 million cum. stone aggregates, 1.00 million tone Cement, 1.50 million cum. Sand (manufactured from crushing rock), 3,20,000 tone steel, 90,000 tone asphalt, will be required for the construction of the airport for ultimate capacity of 60 MPPA. During the construction of phase I & II, about 49.26 million cum of filling for levelling of the project area from 5.5m up to +8.0 m / +9.5 m AMSL (Airport platform level) will be required. Out of this total fill volume, filling of about 44.70 million cum (Approximate) shall be done consuming rock removed by cutting of the Ulwe hill within the Airport site, whereas remaining filling shall be met with borrowed material available from the locations nearby / around the Airport site. Any filling material required during subsequent airport development phases, will be sourced from outside of Airport site within the radius of 15 kms. Most of other major construction material such as Cement, Steel, Glass etc. will be sourced directly from leading manufactures within India. However certain specialized equipment and materials will be sourced from outside India based on functional requirements, design requirements, specifications, and quality requirements.

2.6 Resources Requirement

❖ Water Demand

The expected water requirement for the airport in the initial phase will be 6.57 MLD, which will increase to 9.39 MLD in the second phase. Thereafter, 15.79 MLD in 3rd phase and finally 21.82 MLD in phase-IV. The above water requirement will be met from the City & Industrial Development Corporation Maharashtra (CIDCO), from its existing water mains running along Amra Marg on western side of Airport. This will be supplemented by full recycle of treated sewage from STP which will be used for non-potable purposes. The total estimated water demand of 21.82 MLD is for Final Phase of 60 MPPA. As per earlier EIA report prepared by CIDCO through IIT Mumbai, total water demand was 41 MLD for final phase. NMIAL has optimised the water requirement substantially. Updated water demand of 21.82 MLD is well within the earlier approved total demand of 41 MLD.

❖ **Sewage Collection and Treatment Plants**

Sewage generated from each plot will be collected by gravity and sent to Sewage Treatment Plant for Treatment. The total sewage generation for the airport in Phase-I will be 2.7 MLD increasing to 4.7 MLD in Phase-II, 9.1 MLD in Phase-III and finally 13.3 MLD in Phase-IV. The Sewage will be treated in the sewage treatment plants based on the SBR technology followed with UF & RO in the respective area. The sewage Treatment plant capacity for Phase-I & II will be 5.5 MLD increasing to 11.25 MLD in Phase-III and finally 14.25 MLD in Phase-IV. The treated sewage water from the STP will be re-used for flushing, HVAC, Landscape etc.

❖ **Storm Water Drainage Network**

The storm water drainage network has been planned considering peak hour rainfall of 148 mm as suggested by CWPRS. This is well above earlier considered peak hour rainfall intensity. The SWD network & grading of drainage network is designed in a manner that the stormwater generated from NMIA area will be drained to north or north-east into Gadhi river or the Panvel Creek as recommend by MOEF & CWPRS. The water conservation measures and rainwater harvesting facility are integrated in the design of the Master Plan. The NMIA Drainage Master Plan has been studied / reviewed by CWPRS and approved in 2020.

❖ **Power Requirement**

The expected power requirement for the airport in the Phase-I is 27 MVA increasing to 36 MVA in Phase-II, 69 MVA in Phase-III and finally 96 MVA in Phase -IV. The power supply requirement will be met through from Maharashtra State Electricity Distribution Company Limited (MSEDCL). The total estimated DG power requirement will be 35.0 MVA in the final phase (Phase-IV, 60 MPPA) (considering 60 % diversity as DG capacity on over all proposed terminal loads). The combined Phase I&II power back-up demand is about 12 MVA to meet the power requirement in the event of power failure, which will be subsequently augmented in phased manner.

❖ **Solar Power Generation**

Based on the availability of the land & feasibility, solar plant planned at NMIA for final phase is 22.14 MW. This will be achieved through roof top as well as surface mounted solar panels.

❖ **Solid Waste Generation**

The solid waste generation for the airport in the Phase-I will be 17 TPD increasing to 29 TPD in Phase-II, 50 TPD in Phase-III and finally 72 TPD in Phase-IV. The Biodegradable waste will be treated to the bio-conversion Plant proposed at NMIA to form compost. Compost will be used for Landscaping at NMIA. Reusable, recyclable & hazardous waste will be sent to MPCB authorized vendors for further

Treatment. Non-degradable and inert wastes to be transported to the authorized waste disposal site of CIDCO at a Chaal, Taloja.

❖ **Fuel Demand and Fuel Storage**

The ATF Facility (Fuel Farm) is planned in the eastern part of NMIA North of Eastern Main Access Road. The estimated phase-wise peak fuel demand will be 6060 (Cum/day) & storage for estimated 5 days storage (50,000 KL) capacity. The ATF facility is planned. along with associated support facilities, control building, circulation, etc. Fuel to aircrafts shall be dispensed through an underground fuel hydrant system designed in accordance with applicable norms.

❖ **Rainwater Harvesting**

A rainwater harvesting pond is proposed along the main drain alignment path within W1 catchment, near the outfall within airside boundary at NW corner of NMIA Site. The area of proposed rainwater harvesting pond on area of 21,960 sqm with depth of 2.5 m below invert level and volume of pond is 29,747 cum. Weir is proposed at the pond outfall location to avert saltwater intrusion into the pond. Stored water will be used for landscape irrigation purposes. Shallow water bodies have been planned on either side of WMAR road landscape area for harvesting rainwater, in addition to the pond.

❖ **IT and Telecommunication Network**

NMIA IT Infrastructure will provide for IT, Security & Wireless Infrastructure and networks for airside & landside development like terminal and terminal forecourt, airfield and airside development, cargo facility, MRO, airport maintenance building, ARFF facility, police station, airport administration building, airport health organization, customs building, fuel farms, IMD facility, petrol pumps, GSE maintenance facility, ATC tower, GSE area, chiller plants etc including all other airport development and landside development of NMIA.

2.7 Implementation Schedule & Project Cost

Phase I & II construction of NMIA (Capacity 10 MPPA) is expected to be completed by December 2024. Phase II of the airport will be developed for additional capacity of 10 MPPA (Cumulative capacity 20 MPPA) with eastern pier. Subsequently, Phase-III and Final / Phase -IV will commence based on traffic triggers.

The total project cost mentioned in EC 2010 based on 2008-09 cost as given by CIDCO was Rs 8,722 Crores (Phase-I cost Rs 4424 Crores for 10 MPPA in 2015, Phase-II as Rs 1934 Crores for 25 MPPA in 2020, Rs 1728 Crores for 45 MPPA in 2025 for Phase-III and finally Rs 636 Crores in Phase-IV for 60 MPPA in 2030). In view of revised schedule of implementation of NMIA project, the updated total project cost of airport development (As of 31st March 2021) for infrastructure and facilities to be developed within 1160 ha of Site area is Rs.41,302 Cr, spread over in four phases i.e., Phase-I: Rs.15,635 Cr. (including cost of Pre- Development Works of Rs 3,665 Cr), Phase-II Rs. 3,539 Cr., Phase-III Rs.13,532 Cr. and finally Rs.8,596 Cr. This excludes the cost of works to be undertaken by CIDCO and other agencies for proposed works related to airport, but outside airport site of 1160 Ha. CIDCO has additionally incurred cost of Rs 1813 Crores towards R & R and pre-development Cost of Rs 3665 Crores. Thus, total of Rs 5478 Crores has been incurred on the project till March 2021. Cost of approx. Rs 5,478 Crores has already been incurred on on-going project work, which is 35% of Phase-I project cost of Rs 15,635 Crores.

3.0 Description of the Environment

To assess the baseline environmental status of the study area a comprehensive primary and secondary data collection programme was undertaken with respect to hydro-metrology, physiography, drainage, geology, land & soil quality, ambient water quality, air quality, metrology, noise, ecology, traffic and transportation, forest, socio-economic profile of people, land status and settlement, land use, places of historical importance and coastal zone regulation. The baseline environmental monitoring studies have been carried out within 10 km radius study area from NMIA airport boundary during December 2019 to February, 2020 representing winter season. The study findings in brief are given below:

3.1 Physiography of the Study Area

The physiography of the study area is a combination of rugged hills and coastal plains. Based on the geomorphology, the hydromorphic units identified in the study area consist of coastal plains, denuded hills, structural hills, and plateau. Cutting and filling in the site up to+ 5.5 m AMSL has been completed, except portion of Ulwe hill currently exists on site. The existing part of the Ulwe hill runs from north to south in the western half of the NMIA site. The project site is naturally sloping from Southwest towards Northeast. The study area consists of multiple natural features and varied topography, along with some existing uses/ activities in various pockets across the site including built- up land, hills, creeks & rivers, mud flats, mangroves, quarries, and open area. Navi Mumbai lies in Zone III of the seismic region. This is referred as moderate risk zone. Although there is no past record of any disaster in this region, earthquake of intensity between 5.0 and 6.9 on the Richter scale can occur in Zone III.

3.2 Drainage of the Study Area

The study area covering 10 km radius around project site before commencement of site pre-development activities exhibits majority of third order dendritic drainage pattern. Majority of the streams flow towards west and contribute to Thane and Panvel creeks. Some flow towards south and contribute to Karanja creek. Ulwe River which now traverses along the southern boundary as URC has been diverted from the project site and the URC now merges into Moha Creek in the west of the project site.

3.3 Land Use & Land Cover

The study area of 10 km around the project site features some hilly areas, and a mix of urban and semi-rural areas. Parsik Hill & Kharghar are visible on the north of the study area. Towards the east of the study area, almost 18 km away is the Matheran hill, most of which is under Reserved Forest zone and shows relatively dense vegetation. Some patches of Reserve Forest Karnala Bird Sanctuary are located at the southeast end of study area. Broken land refers to the part of land use which is formed as a result of the hill cutting activity carried out for the project. The hillock falling within the proposed airport site is being cut and remnants of broken land can be seen as a part of the site area.

The LU/LC study is based on High Resolution LISS IV Satellite image of date of pass 7th May 2020, was purchased from National Remote Sensing Center (NRSC), Hyderabad.

The proposed project site is located in the midst of open quarry like area and JNPT industrial area. As a result, stone quarries area (0.39 %) and industrial area (1.80%) are seen amongst the land use classes within study area. Southern side of the project site shows comparatively high altitude and that is the area where mixed vegetation (3.69%) is predominantly observed. Moderate dense vegetation (0.69%) and mixed vegetation (6.74%) are some of the other vegetation types observed within study area. Dense vegetation is a predominant class within the study area which is mainly observed in the southern side around Karnala bird sanctuary. Scrub land (9.91%) and open land (32.88%) are some of the dominant classes within study area. The vegetation cover in the agriculture land is about 0.27% and that of fallow land comprises of 6.19 % of overall land use.

Habitation covers rural settlement of 0.53% and since the site is in the vicinity of major urbanized developments like CBD Belapur, Kharghar, Vashi and Panvel, the class urban area constitutes 2.26% of the land cover.

A number of waterbodies (reservoirs/ ponds) are located throughout the study area which contribute to 0.98% of the land cover. Presence of Panvel creek and rivers correspond to the class Waterbody which comprises 16.05% of the land cover making it second most predominant class within the study area. Mangroves and mudflats including salt pans contribute to 9.35% of the land cover within study area. Study area also shows many marshy areas where water remains stagnated until summer as can be observed from the imagery. The total project area (1160 ha) has been identified as Airport and Allied Activities Zone in NMDP (Notification) of 2012.

3.4 Soil Environment

Primary survey for soil sampling has been carried out to understand the physico-chemical characteristics of the study area. The chemical and physical properties of the collected and analysed soil samples are mentioned below:

- All sampled soils representing the study area are almost neutral in reaction, with pH ranging from 6.46 to 6.79.
- Particle size analysis indicates that all soils are clayey in texture (68.2 % to 80.2%: clay content) with good water holding capacity (32.6 % to 44.1 %).
- The electrical conductivity of soils ranges between 286 to 394 µS/cm indicating that the soils are totally free from any salinity.
- The Organic Carbon (OC) and available K content of soils is low and ranges between 0.22 % to 0.42 % and 80 kg/ha to 120 kg/ha, respectively.
- Some soils (S-2, S-3 & S-3) are medium in available N content (0.012 % to 0.015 %) whereas others (S-5, S-6 & S-9) have a low content (0.0096 % 0.0098 %) of the same. However, soils S-7, S-8 and S-10 have a very deficient content of Nitrogen.
- The available P content of the soils is medium and ranges from 21 kg/Ha to 36 Kg/Ha. The contents of Cl (42 mg/Kg to 92 mg/Kg) and S (80 mg/Kg to 120 mg/Kg) are high but not detrimental to most of the crops.
- The content of Cl (42 mg/kg to 96.2 mg/kg) and S (46 mg/kg to 82 mg/kg) are high but not detrimental to most of the crops in the prevailing pH range of the soil.

- Wherever the contents of Zn, Mn, B, Mo and Cu (plant micronutrients) are Below Detection Level (BDL), the soils may require addition of the same in the form of fertilizer, depending on the nature of crops to be grown; and

- Heavy metals such as Pb, Hg and Ni are toxic for plant growth. However, as their contents are BDL, they do not pose any problem for crops in the presently sampled soils.

The limited area of cultivable soil in the immediate environs of the project periphery are fertile and have good physical properties for successful cultivation of suitable crops in the rainy (kharif) season, provided the other limiting factors of economy of scale, profitability, labor availability and marketability are favorable. In post-monsoon season the crucial limiting factor is the availability of irrigation facilities.

3.5 Climate and Meteorology

The project site experiences wet and dry climate with the influence of coastal wind pattern. The site-specific meteorological monitoring in the study period (winter season) has identified the meteorological parameters in the following ranges:

- Minimum and maximum temperatures recorded during the winter season (Dec 2019 - Feb 2020) range between 14.7^{o}C and 36.4^{0}C.

- During the period of observation, the relative humidity recorded ranged from 48% to 72% during the winter season.

- Total rainfall observed during the study period was 9.4 mm during the winter season of 5 days in December and 6 days in the month of January 2020.

- The site-specific meteorological study indicates that major winds are expected from west-northwest and south-east directions in the winter season. The pre-dominant downwind directions are in the east-south-east direction.

3.6 Air Environment

Ambient air quality monitoring was carried out at 12 locations during the study period. The summary of ambient air quality sampling and analysis is given below:

- The minimum and maximum concentration for PM_{10} were recorded as 56.3 $\mu g/m^3$ and 74.4 $\mu g/m^3$ respectively. The minimum and maximum concentration was recorded at Pargaon high school (AAQ7) and CIDCO office (AAQ2) respectively.

- The minimum and maximum concentration for $PM_{2.5}$ were recorded as 21.5 $\mu g/m^3$ and 32.5 $\mu g/m^3$ respectively. The minimum and maximum concentration was recorded at CIDCO Office, Kharghar, Sector-4 (AAQ8) and CIDCO Branch office, Sector-5 (Kalamboli)(AAQ5) respectively.

- The minimum and maximum SO_2 concentration were recorded as 10.9 $\mu g/m^3$ and 15.1 $\mu g/m^3$. The minimum and maximum concentration was recorded at Paragaon High school (AAQ7) and Ulwe Sector-3 (AAQ3) respectively.

- The minimum and maximum NO_2 concentration were recorded as 20.4 $\mu g/m^3$ and 27.6 $\mu g/m^3$. The minimum and maximum concentration was recorded at Paragoan High School (AAQ7) and Panvel market yard (AAQ12) respectively.

The concentrations of $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3, CO, NH_3, Pb, BaP, As, Ni and C_6H_6 are observed to be well within the NAAQ standards prescribed by Central Pollution Control Board (CPCB) for industrial and rural /residential zone. The values of VOC and HC are observed to be <0.1 ppm in the study area.

3.7 Noise Environment

Noise monitoring and analysis was carried out at 13 locations within the study area of 10 km radius. The noise level monitoring locations are covered within the funnel zone of the airport, sensitive locations, residential, industrial, and commercial areas. The daytime and night-time equivalent noise levels were recoded as per CPCB guidelines. The noise level monitoring results indicates that:

Industrial Area

- The daytime and night time readings are found to be within permissible limits for Industrial, area;

Commercial Areas

- The noise levels thus recorded at commercial areas were found to be in the range of 59.1 dB (A) to 64.0 dB (A). The minimum equivalent daytime noise level was recorded near CIDCO Guesthouse office, Panvel (N2) and the maximum noise level was recoded near CIDCO Bhavan at CBD Belapur, Sector-10 (N6). It is observed that the equivalent daytime noise levels are within the permissible limits at all commercial locations;

- The night time noise levels near commercial areas were found to be in the range of 52.2 dB (A) to 53.0 dB (A). The minimum equivalent night time noise level was recorded near Panvel Market Yard (N12) and the maximum noise level was recoded near CIDCO Office, Panvel (N2). It is observed that the equivalent night noise levels are within the permissible limits at all commercial locations.

Residential Area

- The day time noise levels near residential areas were found to was found to be exceeding 55dB (A) at location N3, N4, N5, N8 and N9. Similarly, the night time noise levels were found to be exceeding 45dB (A) at location N3, N4, N5, N8 and N9. This may be attributed to the proximity to the nearby roads bearing heavy traffic movement; and

Silence Zone

- The equivalent day time noise levels were observed to be 51.9 dB(A) near Pargaon High school (N7)-silence zone. The daytime noise levels were found have slightly exceeded the permissible limit of 50 dB (A) near silence zone. This may be attributed to the proximity to the nearby highway bearing heavy traffic movement.

- Similarly, the equivalent night time noise levels were observed to be 43.8 dB(A) near Pargaon High school (N7)-silence zone. The night time noise levels were found have slightly exceeded the permissible limit of 40 dB (A) near silence zone. This may be attributed to the proximity to the nearby highway bearing heavy traffic movement.

3.8 Water Environment

➢ *Surface Water Quality*

The baseline water quality status in the region is established by collecting and analyzing eight water samples from various locations.

The result of water quality analysis report does not show presence of heavy metals or toxicity. Presence of coliforms was observed in all the samples classifying these samples as Class C as per Inland Surface Water Standard (IS 2296-1982). The results were indicating that water from these surface water bodies is not fit for human consumption.

➢ *Ground Water Quality*

Ground water samples were collected from about eight locations during the study period. The brief of analysis reports is as given below:

- The analysis results of ground water samples showed the pH in range of 6.74 - 7.62 which are within the specified standard limits of 6.5 to 8.5.
- Turbidity of the samples ranged from 2.4-3.1 NTU respectively.
- Electrical conductivity of the samples ranged from 359.37-500 µS/cm
- The total hardness of the samples ranged from 194-295 mg/l which indicates that hardness concentration in all the ground water samples is well within the desirable limit of 200 mg/l.
- Calcium concentration ranged from 27.3 to 42.3 mg/l which indicates that calcium concentration in all the ground water samples is well within the desirable limit of 75 mg/l.
- Magnesium concentrations ranged from 16.7-23.40 mg/l where the acceptable limit is 30 mg/l.
- The total dissolved solids of the samples ranged from 194-295 mg/l where the acceptable limit is 500 mg/l.
- Chloride concentration is found to be between 23.8-31.7 mg/l where the desirable limit is 250 mg/l.
- Fluoride ranges form 0.5-0.9 mg/l where the desirable limits is within 1 mg/l.
- Range of sulphates concentration is found to be 3.6-6.2 mg/l where the desirable limit is 200 mg/l.
- Alkalinity in the groundwater samples varied from 128-195 mg/l where the desirable limit is 200 mg/l.
- Nitrate is in found in the range of 5.6-12.4 mg/l where the desirable limit is 45 mg/l.
- Bacteriological studies revealed the absence of *E. coli* in ground water samples. The total coliform counts are absent in all the samples against the standard limit of 10 MPN/100 ml.

Based on the above results, it is evident that all of the parameters in ground water fairly meet the desirable standard limits of IS:10500. The ground water quality in the study area does not indicate any industrial contamination.

➢ *Marine Water Quality*

Marine water quality in the study area was assessed at eight locations (including those in the modified creek areas) during the study period for physico-chemical, nutrient & biological parameters to know the status of water quality.

It was observed that:

- The pH value was in normal range, while DO & BOD values were strikingly low in upstream locations which may be due to discharge of various anthropogenic wastes. The total suspended solids were found to be quite high. Relative concentrations of Nitrate-Nitrite also indicate deterioration in water quality of the inner creek.
- BOD value suggests the presence of biologically oxidizable organic matter present in water body which comes as domestic sewage discharge from surrounding areas (villages, STPs of NMMC in Nerul) and effluents from CETP at MIDC Taloja.
- The vessel traffic along with constant various discharges in the water column provides insufficient time to re-settle suspended load, resulting into high suspended solids values;
- The creek bed was mainly composed of silty sand. The concentration of metals is reported to be negligible in the collected seawater samples.

3.9 Ecological and Avifauna Studies

Ecological study has been conducted for both terrestrial and aquatic eco-system. Flora and Fauna inventory including avi-fauna species of the study area has been conducted with the inventory of marine flora and fauna and phytosociological study. TCFS (Thane Creek Flamingo Sanctuary) Comprises 12 true mangrove species and 39 associate mangrove species. *Avicennia marina* was the dominant mangrove and most abundant species throughout the creek. Two variants of *Avicennia marina* namely *Avicennia marina var marina* and *Avicennia marina var accutissima*. Similarly, other species that were also reported during the study period.

Avian fauna and other relevant study have been conducted by Bombay Natural History Society (BNHS). CIDCO has extended the engagement of BNHS in 2018 by signing a MOU for a 10-year period (until 2028).

Bird hazard may have a plausible impact due to presence of bird feeding/roosting sites near the project site. BNHS had also conducted studies for movement pattern of the birds. The Waghiwali Island across the Panvel Creek to the north of the NMIA site is deemed as a suitable site for compensatory mangrove afforestation but found to be bird hazard risk. Therefore, *BNHS has strongly recommended to remove the condition on Mangrove Park to the North of the site, as it will attract birds towards the airport site.*

3.10 Demography and Socio-Economic Profile

The village-wise demographic data had been compiled based on primary and secondary data for 105 rural villages, 08 Census towns from Panvel tehsil, 01 census town from Uran tehsil and 01 Navi Mumbai Municipal corporation ward from Thane tehsil are falling within 10 km radius of the project area.

Rehabilitation & Resettlement

There are about 3,113 households who are being rehabilitated from 8 revenue villages in 10 settlements. Out of these, nine settlements are within airport site area of 1160 ha, and one is outside the airport site. CIDCO has already developed and allotted the land for setting up the 7 R&R pockets and Pushpak Nagar (R&R site) for resettlement of displaced villages. As on 11th June 2021, R&R has been completed to an extent of 97.3% by CIDCO, only 71 structures area remaining on site now.

4.0 Anticipated Environmental Impacts and Mitigation Measures

Environment Impact at various stages i.e., project design, construction phase and operation phase, its linkage across activities with respect to impact and classification and evaluation of impacts across the affecting environmental components with the various mitigation options have been comprehensively dealt with. Various activities having impact on environment for each stage has been identified. The various natural resources which have been identified to be likely affected are air, bio-diversity & forests, ecosystem, health and safety, land, noise, socio-cultural, waste and water & wastewater. Various mitigation measures to minimize the environment impact have been arrived.

4.1 Impact During Development Phase

Impacts and respective mitigation measures have been envisaged for every component of the environment. Impacts on air quality are likely to be for short duration, temporary and confined locally to the development site. Noise quality is expected to have minimum impact as equipment used will be properly maintained and workers will be provided with necessary protective equipment. Water quality of the surrounding area will not be degraded as generated sewage will be treated in STP and treated water will be recycled and reused during pre-development and post development activities. Solid waste and C&D waste will be disposed as per 2016 Management and Handling Rule.

The adverse impact on terrestrial and aquatic ecology can be compensated through implementation of afforestation programme outside the project site for the loss of trees and mangroves. Socio-economic conditions will be improved as R&R is being implemented as per policy formulated by GoM/CIDCO. The R&R package of CIDCO exceeds the requirement of right to fair compensation and transparency in land acquisition, rehabilitation, and resettlement (RFCTLARR) Act, 2013.

4.2 Impact during Operation Phase

Air quality will be controlled by adopting measures of air pollution control at the source level. Besides, continuous AAQMS will be installed at the project site to monitor the air quality. These measures will be implemented to keep the air quality well within the stipulated limits.

Noise levels will be maintained by implementing SOP for the operations to reduce and minimize the impacts of all noise generating sources. Water quality of treated sewage will meet the prescribed limits set by regulatory authorities. Treated water will be recycled and reused considering zero liquid discharge concept for plantation, toilet flushing and in HVAC for cooling purposes etc. Solid waste generated will be handled and disposed-off as per MSW Rules,2016 and Hazardous Waste (HW) as per HW Handling Rules'2016.

Terrestrial & aquatic ecology will be maintained with minimum impacts on its surrounding areas. BNHS has been engaged by CIDCO till 2028 to monitor the avifauna and ecology in the surroundings of the airport. Plantation and green cover/landscape is planned for 33% area of the project.

Solar panels to the tune of 22.14 MW will be installed to reduce the carbon footprint of the project. The installation of renewable energy component will help in reducing the air pollution and meeting the energy need of the project.

Positive socio-economic changes are anticipated as large number of local people will get both primary and secondary employment from the project, which will lead to socio-economic and regional development of the area.

Conservation plan and compensatory afforestation program outside project site will be implemented during the development and operational phase of the project, which will help in protection of avifauna, an important attribute of the airport projects.

Comprehensive mitigation measures have been envisaged in the environment management plan to ensure that the environmental quality is conserved, protected, and improved during the development and operational phase of the project.

4.3 Traffic Management

The land side traffic assessment of NMIA is integrated with air traffic demand and transport network development plans as per the comprehensive transport study (study conducted by MMRDA) of MMR. A detailed traffic management and traffic decongestion plan was drawn-up for NMIA considering the ingress and egress of traffic and its growth in 5 km radius of the airport boundary. The weighted volume/capacity ratio of the major road corridors connecting NMIA are predicted based on the modelling of road traffic data and the level of service is assessed for understanding the extent of traffic congestion within 5 km radius of the airport site

Based on the detailed traffic study, it is determined through predictive modelling that, the NMIA, weighted V/C ratio assessed for the base year 2017 is 0.33 (LOS B) and for the horizon period up to 2041 would vary from 0.10 to 0.22 (LOS B). Looking at the level of service offered by the major roads in the NMIA delineated study area, the weighted V/C suggests an average of LOS B i.e., such flows and congestion levels on the urban roads are good and the same should be maintained for the future to serve the region much better in terms of service quality.

4.4 NMIA Parking Demand and Management

Parking demand for passengers, taxi staging and employees is estimated at each of the passenger terminals of NMIA for each phase of the airport operations. The parking requirement for each of the terminals for all phases and at remote parking areas and Multi-Level Car Parks (MLCPs) are planned 100 m away from Terminal facades. Separate parking areas is proposed for short, long term private parking and taxi staging.

5.0 Analysis of Alternative Sites

This is an on-going project and has already received Environmental and CRZ Clearance in 2010 based on EIA study which presented Analysis of Alternative sites carried out by CIDCO. The current proposal does not require any additional land, and there is no change in location of site as approved in EC of 2010, based on Analysis of Alternative Sites submitted at the time. Moreover, based on EC condition, CIDCO has already changed the landuse of airport Site to 'Airport and Allied Activities' 'by amending Development Plan of Navi Mumbai vide GoM Notification in March 2012. Therefore, Analysis of Alternative Sites is not relevant at this stage of the project.

6.0 Environmental Monitoring Program

- **Environmental Quality Monitoring**

Environmental monitoring will be carried out during developmental and operational phase of the project. NMIAL will be regularly monitoring environmental quality parameters for the NMIA which will include ambient air, noise, wastewater, drinking water, terrestrial and aquatic ecology etc as well as DG set emissions. The ambient air quality will be monitored in accordance with National Ambient Air Quality Standards (NAAQS) Notification, 2009 and Director General Civil Aviation (DGCA) Civil Aviation Requirements (CAR) on Climate Change Initiatives and Local Air Quality Monitoring in Civil Aviation, 2015. Noise levels will be monitored as per The Noise Pollution (Regulation and Control) Rules 2000 and DGCA CAR on Noise Management of Aircraft Operations at Airports, 2014.

- **Integrated Noise Monitoring System (NMS)**

NMIAL will install a comprehensive Noise Monitoring System (NMS) at NMIA to monitor & measure the noise generated due to aircraft operations. Permanent and mobile Noise Monitoring stations (NMT) will be installed on 24x7 basis.

- **Continuous Ambient Air Quality Monitoring Station**

During NMIA operation, Continuous Ambient Air Quality Monitoring Stations (CAAQMS) will be installed to measure NAAQS parameters, while HC and VOCs will be monitored once in every month within the airport premises. Meteorological parameters like temperature, humidity, rainfall, wind-speed and wind-direction, cloud cover and solar radiation will be measured along with air quality parameters.

- **Environmental Monitoring and Reporting Schedule**

Environmental Statement of environmental audit and compliance to EC and CRZ clearance conditions shall be prepared during operations and shall be submitted at the end of each financial year-ending to the state pollution control board and to regional office of MoEF&CC.

7.0 Additional Studies

The following additional studies have been conducted as part of the EIA study and in compliance with ToR conditions:

- A Quantitative Risk Assessment (QRA) study has been conducted for the ATF Tankage and Fuel Hydrant System and recommendations are addressed.
- The R&R studies are conducted by CIDCO and the PAFs had been rehabilitated as per the compensation package has been approved by the GoM.
- The hydrogeological study of the project has been conducted by GSDA, GoM for identification of the impact in the project influence area and the recommendations are address in the project design aspects.
- The drainage pattern and the flood risk of the project has been assessed through modelling studies by CWPRS. The drainage mater plan of the project has been reviewed by CWPRS and approved.
- The floral and faunal baseline of NMIA has been established by BNHS along with special emphasis on the impact on migratory birds due to the project and a conservation plan is being implemented; and
- The air traffic and land traffic assessment has been carried out for Airport design and phase-wise capacity development as well as land side traffic management and decongestion.

7.1 Storm Water Drainage Plan

As Per Environmental and CRZ Clearance (EC) granted on 22nd November 2010, the storm water generated from NMIA area to be drained to North or North East into Gadhi River and no storm water generated from project area shall be discharged into the diverted Ulwe River channel. The drainage design of NMIAL is reviewed & approved by CWPRS. The drainage concept for NMIAL is based with strategy that storm runoff draining from south to north and north east into Gadhi River. For draining the water from central catchment area an open rainwater channel is proposed in between airside and landside boundary, which allows for effective drainage network and harvesting system. As a pollution control measure before discharging the storm water to the water way channel/pond, Oil - water separator units are proposed. Silt ponds are proposed near every outfall location to prevent the silt getting into the receiving water bodies. Comprehensive Drainage Master plan of NMIA has been prepared and entire area development planned accordingly. This is submitted to MOEFCC by CIDCO as part of EIA report 2017. Additionally, CIDCO has completed storm water drainage studies for villages near NMIA through CWPRS for management of floods.

7.2 Disaster Management Plan

A Disaster Management Plan (DMP) for Navi Mumbai International Airport Plan has been evolved to tackle the emergency at airport in accordance with the Act, Rule and Codal provision of DGCA, ICAO, Bureau of Civil Aviation Security. The DMP describes the technical as well as non-technical emergency at the airport and the organizational set-up for emergency response, resources and applicable response actions.

7.3 Aerodrome Emergency Response Plan (AERP)

A comprehensive Aerodrome Emergency Response Plan (AERP) is formulated, which will be in place for NMIA airport before commencement of the airport operations. The AERP will be comprehensively prepared for specifying role of various groups / organizations/ agencies and plan of disaster management during various types of emergencies / disasters like in-flight mass casualties, medical emergencies, aircraft accidents, various fires on ground, accidents involving dangerous goods, natural disaster management, unlawful act of seizure of aircraft etc.

8.0 Project Benefits

NMIA project has been envisaged in view of CSMIA operating beyond its planned capacity and Mumbai Metropolitan Region (MMR) traffic forecast indicating demand of over 160 MPPA by 2038, there is an imperative requirement for a Greenfield airport for Mumbai to sustain the requirements of booming Indian aviation sector. The NMIA project is also expected to induce various economic and income earning opportunities for PAPs in the area.

The project aims to generate direct and indirect employment opportunities in the operation phase and in construction phase, local people, and people from PAFs will be benefited from employment options generated from construction activities.

The proposed airport project at Navi Mumbai shall cater to future aviation needs of MMR region in terms of air space management and airport operations to derive maximum benefits for passengers, stakeholders, all other airport users and surrounding communities.

8.1 CSR Activities

CSR activities of NMIAL emphasis lies on following vital thematic areas as per the Companies Act, 2013 and required funds will be made available to undertake the following activities in the project:

- Education – Promotion of education for under-privileged children, support the socially backward, and assisting / helping differently-abled people and local community;
- Training & Skill development – To socially & economically backward for their livelihood;
- Eradication of hunger, malnutrition, or poverty – To socially & economically underprivileged people;
- Environment - Ensuring environmental sustainability, ecological balance, protection of flora and fauna and the conservation of natural resources;
- Gender Equality and Empowering Women - Promoting gender equality and empowering women;
- Promotion of healthcare and sanitation - Providing preventive health care for socially backward and under privileged;
- Contributing to relief projects (to be identified as per need of time);
- Protecting Heritage, Art & Culture - Protecting art and culture; and
- Awareness – Creating awareness on all important aspects among the society.

NMIAL as a part of CSR activities intends to undertake tree plantation/afforestation near Jite Village in Raigad District of Maharashtra, to contribute towards enhancing sustainable environment. The proposed site is located 28.2 km from Navi Mumbai on Highway No. NH 66. NMIAL has requested the Forest Department, GoM for allotment of approximately 50.620 ha of land for taking up new plantation. NMIAL intends to plant about 14000 trees outside the project site.

8.2 Training & Development of PAPs

CIDCO, JNPT and NMIAL are jointly planning to launch a Skill Development Program for the surrounding areas of NMIA, JNPT and other areas. This program is planned to develop management skills among people of the area to upgrade the quality of life in view of various logistic projects such as JNPT SEZ, Airport logistic Park etc., are planned. NMIAL, being part of this program, had identified skill building courses pertaining to the aviation and airport logistic sector.

Additionally, departmental courses are also planned for upgrading the skills of people working in the airport sector. These courses are offered by Airport Council International (ACI) and The International Air Transport Association (IATA) which would be organized by NMIAL under skill building development. Details of these courses are discussed in the EIA Report.

9.0 Environmental Cost Benefit Analysis

The financial analysis of the project has been carried out based on the estimation of operating cost (OPEX), capital costs (CAPEX) for different planning horizons. The revenues from aeronautical and non-aeronautical sources are considered for the above analysis. Financial analysis done by NMIAL indicates that the project is more than capable to start generating cash from first year.

10.0 Environment Management Plan

A comprehensive Environment Management Plan (EMP) is evolved based on the existing environmental condition and impact assessed, enumerating the set of measures to be taken during development and operation period to eliminate or offset adverse environmental impact or to reduce them to acceptable level. The NMIAL has established and endorsed Environmental Policy committed to developing and managing the Greenfield NMIA in an environmentally sustainable manner and implementation of environmentally friendly measures in development and operations of project.

The environmental management framework at NMIA is based on a system of continuous learning and improvement. Individual components of the environmental management framework are updated as required to ensure consistency with regulations and evolving best practice standards. The Environmental Management Plan (EMP) covers the design, development, commissioning, and operation and maintenance phases of each project component. This will not only meet the regulatory compliance requirements but will also conform to the highest standards of sustainable practices, energy, and environmental conservation. Environmental action plan will be formulated keeping in view the EMP and conditions prescribed in the Environment Clearance, Consent to Establish and other approvals given by Environmental Regulatory Authorities.

10.1 Green Space & Landscape Development

Green Space & Landscape development is an integral part of NMIA Master Plan, which is an important element of its environmental sustainability measure. The total green space area proposed is 384.90 ha, i.e., 33.18 % of airport site area of 1160 ha, including green/open spaces on airside and landside of NMIA. The proposed green spaces shall be developed as per their contextual and functional requirements, and overall environmental and landscape planning approach. NMIAL intends to plant about 14,000 trees on 50.620 ha of land outside the project site on land provided by Forest Dept. near Jite Village in Raigad District of Maharashtra.

10.2 Storm Water Management

The storm water drainage strategy covers safety from flooding, compliance to EC (2010) conditions and CWPRS guidelines, cost effective and efficient drainage system. This includes to integrate rainwater harvesting system also. The proposed storm water system will follow the principle of south to north, and south to north-east for transfer of storm water. The storm water will not be allowed to reach the Ulwe Recourse Channel as per the EC (2010) condition.

10.3 Traffic Management

The land side traffic assessment of NMIA is integrated with air traffic demand and transport network development plans as per the comprehensive transport study (study conducted by MMRDA) of MMR. A detailed traffic management and traffic decongestion plan was drawn-up for NMIA considering the ingress and egress of traffic and its growth in 5 km radius of the airport boundary. The weighted volume/capacity ratio of the major road corridors connecting NMIA are predicted based on the modelling of road traffic data and the level of service is assessed for understanding the extent of traffic congestion within 5 km radius of the airport site.

10.4 Budget for Environment Management Plan

The Environmental Management Plan (EMP) consists of description of the administrative aspects of ensuring that mitigative measures are implemented and their effectiveness monitored, after approval of the EIA. The capital cost for EMP during the development phase have been estimated to be Rs 82.66 crores while the annual recurring cost will be Rs. 1.66 crores. The EMP cost during the operation phase has been calculated to be Rs. 189.86 crores as capital cost and Rs. 17.65 crores annual recurring cost.

11.0 Disclosure of Consultants

M/s. Vimta Labs Limited, Hyderabad [Vimta] have been assigned the responsibility of preparation of Environmental Impact Assessment (EIA) and Environment Management Plan (EMP) for various environmental components, which may be affected due to the development and operation of the proposed airport project as per the approved Terms of Reference. Besides this, there are other international & national of repute consultants who have contributed in their respective field for preparation of Environment Management Plan, Airport Master Planning, Engineering, Utility Planning and Design, etc appointed by CIDCO and NMIAL. Vimta Labs is a NABET accredited Environmental Consultant for carrying out EIA Airport sector for Category ‘A’. Further, M/s Vimta Labs Ltd. has taken the services of M/s. Aditya Environmental Services Private Limited, Mumbai, which is a NABL approved organization for the baseline data generation within the study area of 10 km radius for one season.

Chapter-1
Introduction

1.0 INTRODUCTION

The Navi Mumbai International Airport (NMIA) is being developed by Navi Mumbai International Airport Ltd (NMIAL) as an international airport planned to cater to the growing air travel demand of Mumbai Metropolitan Region. The Navi Mumbai International Airport is located at the geographic center of Mumbai Metropolitan Region in Navi Mumbai, near Ulwe Node which is located in Panvel taluka of Raigad district of Maharashtra state. The project is for development of an International Airport with a capacity to handle minimum 60 million passengers per annum (MPPA) and 1.5 million tonnes (MT) of cargo per annum. The airport is being developed in compliance with Concessionaire Agreement of the project signed between CIDCO and NMIAL, and in compliance with applicable airport development norms of Airport Authority of India (AAI), International Civil Aviation Organization (ICAO), Directorate General of Civil Aviation, GoI (DGCA), etc. The onsite implementation work of NMIA project commenced in April 2017.

The construction of the NMIA is planned on site area of 1160 ha. In this regard, Government of Maharashtra (GoM) vide Notification No TPS 1711/2495/CR-202/11/UD-12 dated 21st March 2012 CIDCO has incorporated "International Airport & Allied Activities / Service Zone" in Navi Mumbai Development Plan (NMDP) for development of NMIA and has accordingly modified the land use of the airport site.

This chapter presents the introductory information about NMIA project. It covers project related information with regard to the following aspects of the EIA study:

- The importance of the project to India and benefits thereof.
- Brief Historical background of the project.
- Identification of the Project including brief project understanding (development approach, configuration, status of project implementation/completed works and covenants in place) and introduction of Project Proponent.
- The status of approvals obtained for the project in connection with the key stakeholders (including authorities and regulatory agencies relevant to the project establishment and operation).
- Significance of the Project including purpose of EIA study.
- The environmental setting of the project in an influence area covered within 10 km radius from the project site boundary. The project index map and the relevant study area maps, CZMP and HTL/LTL demarcation maps and satellite image of project site (captured in GOOGLE EARTH™) with boundary demarcations and current land use status (aerial visuals) of the site.
- Details of the regulatory and the administrative and legal background of the project.
- The scope of the study and baseline data collection in cognizance of project specific site sensitivities and specificity of the identifiable project impacts and in line with the generic and specific ToR conditions issued by MOEF&CC; and
- Overall structure of the EIA Report and brief understanding of chapter-wise addressing of study aspects and covering minimum and notwithstanding the key aspects mentioned in Appendix III of 2006 EIA Notification.

1.1 Importance of NMIA Project[1]

Mumbai is the financial capital of India, and the capital city of the State of Maharashtra forms the largest urban center within the Mumbai Metropolitan Region (MMR). Bustling with a population of more than 20 million, the MMR is recognized as one of the most populous urban areas in India. Also, Mumbai is an important economic hub; it is also recognized as the financial, business and entertainment center of India. The Mumbai Metropolitan Region (MMR) spreads over 6,640 sq. km. consists of 9 Municipal Corporations viz. Greater Mumbai, Thane, Kalyan-Dombivali, Navi Mumbai, Ulhasnagar, Bhiwandi- Nizamapur, Vasai-Virar, Mira-Bhayandar and Panvel; and 9 Municipal Councils viz. Ambarnath, Kulgaon-Badalapur, Matheran, Karjat, Khopoli, Pen, Uran, Alibaug and Palghar, along with more than 1,000 villages in Thane, Raigad and Palghar Districts. The Mumbai Metropolitan Region Development Authority (MMRDA) is responsible for the overall planning and development of the MMR. The administrative map of the MMR showing project site is presented in **Figure-1.1.**

NMIA, will be the second airport for Mumbai Metropolitan Region area, and is located at Navi Mumbai. Enhancement of airport capacity to handle projected air traffic demand of MMR in future is critical for maintaining Maharashtra's leadership in attracting Foreign Direct Investment and cementing Mumbai's future as an International Financial Centre as annual air passenger traffic is expected to grow over 160 million by 2038. The Chhatrapati Shivaji Maharaj International Airport (CSMIA) alone will be unable to handle such an increase in demand. It is, therefore, imperative to build a second Airport for MMR.

Typically, airports have multiplier effect on local economy and employment generation. Navi Mumbai International Airport (NMIA) has a considerable employment generation potential. Once completed, it will create skilled and non-skilled, direct, and indirect job opportunities. Employment is likely to be generated in the sectors such as Construction, Terminal operations, Airside operations, Cargo & Logistics, Ground operations, Ground handling, Aircraft maintenance, Food and Beverages (F&B), Hospitality, Security, Operation of Flight Kitchens, etc. apart from creating opportunities for pilots and airline operators, etc. Also, the airport will boost warehousing and industrial development along the Mumbai-Pune corridor. This will help in retaining and attract further investment in this region. The airport is also likely to attract an investment in the vicinity of MMR through improved logistics and quicker access through air travel.

The air traffic demand of MMR is presently served by the Chhatrapati Shivaji Maharaj International Airport (CSMIA). Since 2002, CSMIA has experienced unprecedented annual traffic growth which is reflective of the country's economic boom, growing deregulation and a rise in India's Low-Cost Carriers (LCC). To accommodate growing demand and to provide for the changing demand in its capacity, CSMIA has undergone a major modernization and development program since 2006. However, CSMIA is surrounded by dense urban areas and is severely land constrained with no opportunity to expand and develop additional aviation infrastructure. Although operational improvements are in progress, yet CSMIA is close to reaching its operational limit. Therefore, the urgency to build a new airport within MMR was deemed to be of paramount nature and an imminent urgent requirement.

[1] *Based on the information available in the MMRDA, CSMIA and CIDCO Websites.*

Source: MMRDA, Mumbai, Govt. of Maharashtra

FIGURE-1.1:
ADMINISTRATIVE MAP OF MUMBAI METROPOLITAN REGION (MMR) SHOWING PROJECT SITE

1.2 Project Significance

Presently, Mumbai is served by Chhatrapati Shivaji Maharaj International Airport (CSMIA), the second busiest airport in India handling nearly 14% of air passenger traffic and 27% of air cargo volumes of the country in 2018-19. CSMIA has experienced unprecedented annual growth in the past two decades reflective of country's economic boom. However, this landlocked airport with no room to spare is severely constrained both on its airside as well as landside. CSMIA has undergone a 2-billion-dollar airport modernization and expansion program from 2006 to 2014 to improve its airport infrastructure to increase airport capacity. This has helped increase CSMIA capacity from earlier about 22 MPPA in 2007 to over 48 MPPA in 2018-19. However, the air passenger demand of MMR region is now projected to be over 160 MPPA by 2038. Moreover, CSMIA has been handling traffic in excess of its planned capacity for past few years (Pre-Covid). The air passenger traffic handled by CSMIA in 2015 was 37 MPPA, 2016 was 42 MPPA, 2017 was 45 MPPA, 2018 was 48 MPPA and in 2019 was 49 MPPA.

Thus, NMIA is intended to serve as the second airport for Mumbai Metropolitan Region (MMR), which is presently served solely by CSMIA. As CSMIA is expected to soon get saturated. Therefore, there is an urgent need for a new Greenfield airport for MMR.

To maximize runway utilization for increasing passenger handling capacity at CSMIA, it has been considered that a part of General Aviation (GA) operation at CSMIA will be shifted to NMIA following opening of the new airport. Additionally, it is anticipated that NMIA will be attractive option for aircraft owners, particularly when the Mumbai Trans-Harbour Link (MTHL) is built, connecting NMIA with South Mumbai.

1.3 Identification of the Project

1.3.1 Project Proponent

Mumbai International Airport Pvt Ltd (MIAL), a project SPV with AAI as one of the partners, is operating Mumbai's CSMIA since 2006. MIAL participated in bidding process for the NMIA project with the Right of First Refusal (RoFR) for construction, operation, and maintenance of Greenfield airport at Navi Mumbai and was selected as the preferred bidder by CIDCO in October 2017.

1.3.2 NMIAL – The Concessionaire

The Greenfield International airport at Navi Mumbai was planned to be developed in Public Private Partnership (PPP), and 'Navi Mumbai International Airport Pvt Ltd (NMIAL)" is a Special Purpose Vehicle (SPV) company deemed as the "Concessionaire" of the NMIA project. NMIAL was incorporated for development of Navi Mumbai International Airport with CIDCO holding 26% share and MIAL holding 74% share in the SPV. Based on the Concessionaire Agreement signed between CIDCO and NMIAL, NMIAL is mandated to Design, Build, Finance, Operate and Transfer (DBFOT) the NMIA project for concession period of 30 years from the appointed date which is extendable for a further 10 years.

1.3.3 City and Industrial Development Corporation of Maharashtra Limited – The Authority

CIDCO is a public limited company, wholly owned by the Government of Maharashtra (GoM) and incorporated under the Companies Act, 1956. CIDCO was designated as a New Town Development Authority under the Maharashtra Regional & Town Planning Act, 1966 for planning & development of Navi Mumbai City. CIDCO was the Nodal Agency appointed by the Government of Maharashtra in 2008 and has obtained all clearances for the project including Environmental clearance. The pre-development works at site were initiated by CIDCO in April 2017. After conclusion of the global bidding process for this prestigious project in 2017, CIDCO issued the Letter of Award (LoA) on 25th October 2017 to Mumbai International Airport Ltd (MIAL) appointing MIAL as Concessionaire for the project. A Special Purpose Vehicle (SPV) Navi Mumbai International Airport Pvt. Ltd (NMIAL) was formed for execution of the project. While, MIAL holds 74% stake, CIDCO holds the remaining 26% share in the SPV.

1.3.4 Engagement of Approved & Independent EIA Study Consultants/ Experts

M/s. Vimta Labs Limited, Hyderabad [Vimta] a QCI NABET accredited organization. Vimta have been assigned the responsibility of preparation of Environmental Impact Assessment (EIA) and Environment Management Plan (EMP) for various environmental components, which may be affected due to the construction and operation of the proposed airport project as per the approved Terms of Reference. Further, M/s Vimta has taken the services of M/s. Aditya Environmental Services Private Limited, Mumbai, which is a MoEFCC recognized /NABL accredited laboratory for the baseline data generation within the study area of 10 km radius for one season.

1.3.5 Project Background

- **City and Industrial Development Corporation of Maharashtra (CIDCO)**

City and Industrial Development Corporation of Maharashtra (CIDCO) is the Nodal Agency appointed by Government of Maharashtra to undertake development of the Greenfield airport project at Navi Mumbai. CIDCO as a project proponent had received Environmental and CRZ clearance for this project vide letter no. F. No. 10-53/2009-IA.III dated 22nd Nov 2010 which was valid up to 21st Nov 2017 and later extension of validity was obtained vide letter dated 20th December 2017 valid up to 21st November 2020. GoI, considering the adverse impact of on-going Covid-19 pandemic on project implementation, extended validity of current Environmental Approval granted by MOEF for all on-going projects, including NMIA project, till 21st November 2021. Copies of Environmental Clearance, validity of extension and the said GoI Notification are attached as **Annexure-I [A], I [B] & I[C]**.

- **Development Works Taken-Up by CIDCO & Implementation Status**

Pre-Development Works of NMIA project, including Land Development Works were commenced at site by CIDCO (as Project Proponent) in April 2017 after receiving Forest Clearance. Most of the Pre-Development Works of NMIA project have been completed, and few works are nearing completion. The total estimated cost of the project (for all phases) is about Rs. 41,302 Crores[1]. Till 31st March 2021,cost of

[1] *As estimated till March 2021*

approx. Rs 5,478 Crores has already been incurred, which is 35% of Phase-I project cost of Rs 15,635 Crores. This includes pre-development cost of Rs 3,665 Crores and cost incurred by CIDCO of Rs 1813 Crores towards R & R.

The schedule of project implementation of NMIA had extended, as Forest Clearance was received on 24th April 2017 and the on-site project activities could not be started prior to this date. Based on updated schedule, the Phase 1 of NMIA shall be completed by December 2024.

- **Concession Agreement (CA)**

As per terms of the Concession Agreement dated 08.01.2018 signed between CIDCO and NMIAL, NMIAL is to be granted Right of Way (RoW) by CIDCO to Airport Site area of 1160 ha and NMIAL will be responsible for obtaining & complying with all applicable permits for the construction, operation, and maintenance of the airport project within, & applicable to airport site of 1160 ha.

1.3.5.1 Present Proposal

The NMIA project is being developed for establishment of international airport with state-of the art airport facilities with a capacity to handle a minimum of 60 MPPA and 1.5 MTPA of cargo, upon development to its full capacity in Final Phase. This is an on-going project where Pre-Development Works including Land Development Works of this on-going project are nearing completion and airport infrastructure works are to commence soon.

1.3.5.2 Transfer of EC from CIDCO to NMIAL

CIDCO was granted Environmental and CRZ Clearance for NMIA project in November 2010. As per terms of the Concession Agreement, NMIAL's responsibility for compliance to conditions of MOEF Environmental Approval, is limited to the conditions applicable / to be implemented within 1160 ha of Airport Site of NMIA.

CIDCO, vide its letter dated 10th February 2020 granted NOC for 'Transfer of EC' to NMIAL for this ongoing project. Based on this, NMIAL submitted online application to MoEF&CC (along with Form-7) vide application no. IA/MH/MIS/236/2009 dated 16th July 2020 for Transfer of EC. The approval of MoEF&CC for Transfer of EC from CIDCO to NMIAL has been obtained vide letter No. F. No. 10-53/2009-IA-III dated 17th Aug 2020.The copy of Transfer of EC from CIDCO to NMIAL is enclosed in **Annexure-II**. The validity of the EC is extended till 21st Nov 2021 by MOEFCC vide notification dated 18th Jan 2021 **Annexure-I [C]**. RO- MOEFCC has visited site and submitted Certified Compliance Report dated 31st Mar 21 attached in **Annexure-I[E]**.

NMIAL shall develop the airport within 1160 ha of Project Site in four phases and will be responsible for obtaining & complying with applicable permits for the construction, operation, and maintenance of the airport within project site area. CIDCO shall comply with conditions of EC which are to be implemented outside airport Site. This has been confirmed by CIDCO vide its letter dated 10th February 2020 to NMIAL and vide NMIAL's letter dated 18th February 2020.

1.3.5.3 Terms of Reference for Fresh Environmental Clearance

As the EC for the project granted in November 2010 was to expire in November 2020 (and as further extension of this EC was not possible under current EIA Notification 2006), NMIAL had submitted online application for fresh EC & CRZ Clearance for the project, on 24th May 2020 for issuance of TOR. The application for ToR was appraised in the 55th Meeting of Expert Appraisal Committee (Infra-2) of MoEF&CC and the TOR has been granted vide letter F.No. 10-53/2020-IA-III dated 29th October,2020 with the exemption of Public Hearing as per para 7(ii) of EIA Notification, 2006 and its subsequent amendments for preparation of EIA/EMP report.

Based on the approved Terms of Reference, detailed EIA/EMP study has been carried out for grant of fresh EC and CRZ clearance. The copy of the granted ToR letter and its compliances are given in **Annexure-III**.

1.3.6 NMIA Development Approach

The development of NMIA project is proposed on 1160 ha of site area. The proposed airport will be built in four phases as given below in **Table-1.1**.

TABLE-1.1:
PROJECT IMPLEMENTATION PHASES

Terminal	Phase	Capacity (MPPA)	Cumulative Capacity (MPPA)
T1	Phase-I	10	20
	Phase-II	10	
T2	Phase-III	20	40
T3	Phase-IV	20	60

Source: NMIA Master Plan (May 2019)

1.3.6.1 Pre-Development Works and Preparatory Studies & Investigations

Pre-Development Works were initiated by CIDCO (in the capacity as Project Proponent before appointment of NMIAL as Concessionaire) in April 2017. Most of the project planning, design work as well as Pre-Development works have been completed, while few works are nearing completion:

1) Cutting and Filling of Rock within the NMIA site up to +5.5 m AMSL of Ulwe Hill (within NMIA site) has been completed.
2) Construction of Ulwe River Recourse Channel is completed.
3) Shifting of EHVT Lines from NMIA site by Tata Power is completed and shifting of EHVT Lines by MSETCL is in progress.
4) Training of Gadhi River is in progress.

The status and progress of Pre-Development Works completed by the month of June 2021 is presented in **Table-1.2**

TABLE-1.2:
STATUS OF NMIA PROJECT WORK

Sr. No.	Project Aspect	Remarks
1	Project Site / Land Availability	Right of Way for 99.65% (1156 ha/ 1160 ha) has been granted by CIDCO to NMIAL.
2	Project Master Plan	The Master Plan of the project was prepared and has been approved by: 1. CIDCO as the Authority for NMIA Project, and as the Special Planning Authority of Navi Mumbai. 2. Bureau of Civil Aviation and Security (BCAS, GoI). 3. DGCA and AAI. 4. Ministry of Civil Aviation, Govt. of India (MoCA). 5. CWPRS for NMIA Drainage Master Plan 6. Various Central & State govt agencies All approvals obtained by NMIA are addressed in Table-1.5.
3	Project Designs	The project designs are completed and submitted to CIDCO (Authority).
4	Airport Drainage Master Plan of NMIA and incorporation of CWPRS Recommendations	The Storm water Management System of NMIA-Master Plan was been completed on 6th May 2019. Review of Drainage Master Plan of NMIA (prepared by NMIAL) and its surrounding areas has been approved by CWPRS, GoI based on 1-D, 2-D Mathematical and Physical Model studies for the airport and its vicinity based on 100 years rainfall return period. CWPRS has granted its approval and recommendations to the Airport Drainage Master Plan on 23rd June 2020.
5	R&R of the Project Affected People (PAP)	As on 11th June 2021, R&R has been completed to an extent of 97.3% by CIDCO, and almost all, except 71 PAP families have to be rehabilitated by CIDCO.
6	Geo-Technical Study	Geo-Technical survey was completed in May 2019 and findings of the same are considered for airport design. The soil type was identified in different stratum (in project wide area) based on analysis of core-samples (of boreholes) and specific geo-technical studies had been conducted at different areas of NMIA facilities like terminal buildings, landside facilities, airside facilities, proposed project office area etc. by standard methods of investigation and analysis. The overall planning of NMIA has been influenced by geo-technical conditions (based on geo-technical investigation) of the project site.
7	Hydrogeological Study	The detailed hydrogeological study of the project has been undertaken by Ground Water Surveys Development Agency of Maharashtra, (GSDA, GoM) and the investigations were completed and submitted in January 2010. The recommendations have been considered for the Pre-development activities undertaken by CIDCO.

Sr. No.	Project Aspect	Remarks
8	Regional and Local Transport Connectivity Plan	A "*Regional and Local Transport Connectivity Plan for Navi Mumbai International Airport*" was prepared and the final recommendations were submitted on January 2012. Further the Final "Detailed Traffic Management and Decongestion Plan for Navi Mumbai International Airport (NMIA)" has been submitted to MoEF&CC after incorporating the views/observations/suggestions received from the Stakeholders. Stakeholders' views/observations/comments received from stakeholders and suggested actions/way-forward are presented in the detailed report. The Final Report was submitted to MoEF&CC on 24th April 2020.
9	Avi-Fauna Baseline Study and Bird Hazard Management Studies	The specific condition 7 I (xxxi) of Environmental Clearance CRZ Clearance granted to NMIA (dated 22ndNovember, 2010 and subsequent renewal on 20thDecember, 2017) stipulates that, "CIDCO (as Project Proponent then) shall conduct the baseline survey of Avian fauna before the start of construction and the details shall be put every three months on the website in association with Bombay Natural History Society [BNHS]". Hence, CIDCO had engaged the services of BNHS over a three-year period (2012 to 2014) to do base line survey of avian fauna over different seasons and present their findings in the form of quarterly and summarized annual reports. The final Avian Fauna studies presented here are based on the sampling conducted by BNHS from December 2015 to January 2017. Further, CIDCO has extended the engagement of BNHS in 2018 by signing a MOU for a 10-year period (until 2028) to undertake flagging and tagging, identify bird movements and prepare management plan for active management.
10	Air-Traffic Assessment Studies	A detailed Air Traffic Forecast Study for appropriate case-scenarios (Base case and Conservative case) for NMIA has been conducted and submitted to CIDCO. The said traffic forecast is incorporated in the Master Plan of NMIA.
11	Pre-Development and Site Development Works including site clearance, cut & fill works, relocation of existing utility structures (like High Tension Lines), water body diversion, etc.	The following major pre-development works are completed/in progress: • Cutting & filling of rock from existing Ulwe Hill in site up to +5.5 m AMSL has been completed. • Diversion of Ulwe River passing through the project site and Construction of Ulwe Recourse Channel is completed. • Training of Gadhi River is in progress; • Shifting of EHVT Lines by Tata Power is completed and shifting of EHVT Lines by MSETCL is in progress.

Source: NMIAL, June 2021

Photographs showing status of completion of various predevelopment works are enclosed as **Figure 1.2 (A-D)**.

1.3.6.2 Airport Development:

As per the Master Plan of NMIA, the project is being developed in two major zones based on specific operational requirements of an airport, i.e., airside and landside zones as explained below:

Airside Zone: This comprises of Airfield with runways, taxiways, aircraft parking aprons and all necessary facilities for safe and secure aircraft operations; Passenger Terminals with passenger processing, retail, and other facilities contained within the terminal main processors and piers; Cargo with its airside warehousing/ processing facilities and other complimentary activities not associated with the passenger terminals; General Aviation; Air Traffic Control Towers, etc. The entire Airside Zone is bound/enclosed within Operational Area boundary wall.

Landside Zone: This comprises of the western, northern, and eastern landside areas, including the terminal forecourt areas, and various passengers, stakeholder facilities required for airport, and landside transportation network. Northern landside area shall be developed in later phases of airport development.

FIGURE-1.2 (A):
CUTTING OF ULWE HILL AT PROJECT SITE

FIGURE-1.2(B):
TIME SERIES PHOTOGRAPHS SHOWING STATUS OF CUTTING OF ULWE HILL

FIGURE-1.2 (C):
TIME SERIES PHOTOGRAPHS SHOWING STATUS OF CONSTRUCTION OF ULWE RECOURSE CHANNEL (URC)

FIGURE-1.2(D):
PHOTOGRAPHS SHOWING WORK COMPLETION STATUS OF PROJECT SITE

1.3.6.3 Project Related Activities (Outside NMIA Concession Area)

Project related activities/works outside 1160 ha are being implemented by CIDCO in the surrounding area (as per EC of 2010) including Ulwe River Recourse Channel, shifting of EHVT lines, development of off-site area for airport related activities, off-site physical and social infrastructure, Re-Habilitation & Resettlement, and utility lines required for airport.

Key Features of NMIA

A summary of the key identifiable structural of NMIA project along with its final phase operational configurations are presented in **Table-1.3** for the purpose of project identification**.**

TABLE-1.3:
KEY FEATURES OF NMIA

Sr. No.	Key Identifiable Structures	Operational Capacity at Final Phase (60 MPPA)
1	**Central Terminal Complex (CTC)**	Development of 3×20 MPPA Capacity Terminals (**T1, T2** and **T3**)
2	**Runways**	Development of two Code 4F[1] parallel runways by Final Phase (60 MPPA), consistent with CA. The runways are each 3,700m long and 60m wide and separated by 1,580m to facilitate simultaneous independent operations.
3	**Air Traffic Control Towers (ATCT)**	Near Terminal 2 (located almost in geographical center of NMIA Site) is the most preferred location of final phase ATC Tower, however, as this ATCT can be constructed only with T2 Terminal construction in Phase III; an interim ATC tower will be located at the southern side of the Aircraft Rescue and Fire Fighting (ARFF) facility has been planned in consultation with Airport Authority of India (AAI), to serve the airport until construction of northern runway and Terminal 2 is completed. The proposed location of interim ATCT was chosen as it provides the controllers unimpeded views of the Runways ends, the apron and rest of airfield during Phases I/II.
4	**Airport Taxiway System**	An efficient taxiway system including Code C, Code E and Code F aircraft accessible taxi planes configured to maximize efficient flow of aircraft to and from runways and provide operational flexibility in sequencing of aircraft departures catering up to a minimum final phase capacity of 60 MPPA is planned.
5	**Aprons**	Contact and Remote apron areas designs have been configured to allow Code C, Code E and Code F aircraft accessible parking, loading and unloading of passengers, baggage, and belly cargo, as well as aircraft servicing. Adequate aprons for commercial passenger aircraft, GA (General Aviation), Cargo and MRO (Maintenance Repair and Overhaul) have been configured at NMIA.
6	**Isolation Pad**	In accordance with the relevant standards, an isolation pad is provided for the parking of an aircraft that may be the subject of unlawful interference or needs isolation from normal airfield operations for other reasons. A minimum 100m safety zone from other aircraft parking positions, buildings or public areas is provided around the isolation pad. The isolation pad provided at NMIA Master Plan has been planned for up to ICAO Code F aircraft type
7	**Communication, Navigation and Surveillance (CNS)**	NMIA will have Communication, Navigation, and Surveillance (CNS) systems capable of supporting 24/7 operations in all-weather conditions, consistent with the Concessionaire Agreement (of NMIA) and CNS/Air Traffic Movement agreement. CNS systems to be provided include:

[1] *ICAO has an international code system, referred to as Aerodrome Reference Code (ARC), to specify the standards for individual airport facilities, suitable for use by aircraft with a range of performances and sizes. The proposed runway and associated infrastructure of NMIA has been designed to ARC Code 4F in accordance with the CA. This code is suitable to accommodate Airbus A380 and the next generation of large aircraft as well as all current aircraft types.*

Sr. No.	Key Identifiable Structures	Operational Capacity at Final Phase (60 MPPA)
		• Airport Surveillance Radar (ASR1, ASR2 and ASR3). • Surface Movement Radar (SMR). • Advanced Surface Movement Guidance and Control System (ASMGCS). • Doppler VHF Omni directional Radio range and Distance Measuring Equipment (DVOR/ DME). • Instrument Landing System (ILS); and • Ground Based Augmentation System (GBAS).
8	**Airside Roads**	An airside road system has been proposed in NMIA Master Plan ensuring efficient connectivity across the entire airfield, with expected airside vehicular traffic. The proposed airside road network includes: • Airside roads at the aprons, including head of stand (HOS) and back of stand (BOS) roads. • Underground tunnel • Emergency airside roads • Perimeter Airside Roads
9	**Perimeter Security**	• Additional to the perimeter road and fence provided at NMIA, BCAS (Bureau of Civil Aviation Security of India) requires a Perimeter Intruder Detention System (PIDS) solution. In conformance with BCAS guidelines/rules, a detailed security system is planned, the particulars of which are addressed below: • A full-fledged Mandatory Primary Detection System containing: o Fiber Optic Mesh PIDS and/or Vibration Sensor based PIDS. o Ground Surveillance Doppler Radar based PID. o Infrared sensors o Taut Wire based PIDS. o Microwave Sensors based PIDS. o Power Fence • A comprehensive Closed-Circuit TV (CCTV) surveillance system • Main Control Room (where the PIDS & CCTV are connected)

Source: NMIA Master Plan (May 2019)

A detailed description of the project based on the NMIA Master Plan is presented in the 2nd Chapter of this report.

1.3.7 Land Requirement for NMIA

The construction of the Navi Mumbai International Airport (NMIA) is under implementation in an area of 1160 ha. Establishment of NMIA at Navi Mumbai, as the second airport for Mumbai, located within 150 km radius of CSMIA, was approved by MoCA, GoI vide letter no. AV.24011/1/95-VB (Vol.VI) dated 6th July 2007.

The airport has also received "No-Objection" from Ministry of Defence, GoI for setting up the airport at Navi Mumbai subject to specific conditions vide letter no. 3(15)/07/D(Air-II) dated 11th October 2010.

The land required for NMIA is comparable to international airports being operated in India and abroad. The comparison of land utilization is given in **Table-1.4** below:

TABLE-1.4:
COMPARISION OF SIZE OF SITE AREA OF OTHER AIRPORTS WITH NMIA

Airport	Land (ha)	PAX (MPPA)	Cargo (MTPA)
Indira Gandhi International Airport, Delhi	2066	109	2.20
Kempegowda International airport, Bengaluru	1622	55	1.00
Rajiv Gandhi International Airport, Hyderabad	2223.7	50	0.575
Hartsfield–Jackson Atlanta International Airport*	1902	110.53	0.677
Singapore Changi Airport*	1300	68.3	2.01
London Heathrow Airport*	1227	80.9	1.50
Navi Mumbai International Airport, Navi Mumbai	**1160**	**60**	**1.50**
Chhatrapati Shivaji Maharaj International Airport, Mumbai	812.44	50	1.0

** The Airport operation capacities with regard to PAX and Cargo handling in 2019 are mentioned here.*

1.3.8 Statutory Clearances Obtained

In addition to EC and CRZ Clearance, other approvals (**Table-1.5**) prior and post the approval of the project Environmental Clearance (EC) of NMIA, were taken by CIDCO and NMIAL as required for the project, and the list is enclosed as **Annexure IV**.

TABLE-1.5:
STATUTORY CLEARANCES OBTAINED FOR NMIA PROJECT

Sr. No.	Approval	Letter Number	Date of Approval	Annexure
1	Approval from Ministry of Civil Aviation (MoCA), Govt. of India	No.AV.24011/1/95-VB(Vol.VI)	6th Jul 2007	**IV [A]**
2	Approval from State Cabinet, Govt. of Maharashtra	CID-3307/1549/LT-144/07/N10	30th Jul 2008	**IV [B]**
3	Approval from Ministry of Defence, Govt of India	No. 3(15)/07/D(Air-II)	11th Oct 2010	**IV [C]**
4	Environmental and CRZ Clearance granted to NMIA (MoEF&CC)	F. No. 10-53/20091AM1	22nd Nov 2010	**IV [D]**
5	Wildlife Clearance (from the Wildlife Division, MoEF&CC, GoI	F. No. 6-43/2007 WL-I	1st Aug, 2013	**IV [E]**
6	Permission for Removal of Mangroves (Order from Hon'ble Bombay High Court)	Notice of Motion No. 419 of 2011 in PIL No. 87 of 2006	29th Oct, 2013	**IV [F]**
7	Forest Clearance Stage I (From MoEF&CC, GoI)	No. 8-95/2012-FC (Stage I)	17th Dec, 2013	**IV [G]**

Sr. No.	Approval	Letter Number	Date of Approval	Annexure
8	Wildlife Clearance (from the Wildlife Division, MoEF&CC, GoI")	F. No. 6-48/2015(Amendment)	30th Jun 2015	**IV [H]**
9	Consent to Establishment (Maharashtra Pollution Control Board)	1.0/BO/CAC-Cell/EIC-RD¬3145-15/CE/CAC-12995	14thOct, 2015	**IV [I]**
10	Forest Clearance Stage II (From MoEF&CC, GoI)	No. 8-95/2012-FC (Stage II)	24thApr, 2017	**IV [J]**
11	Extension of Environmental and CRZ Clearance of NMIA (from MoEF&CC)	F. No. 10-53/20091AM1	20th Dec 2017	**IV [K]**
12	Approval/ NoC from Water Supply Dept. CIDCO for Water Supply to NMIA	CIDCO/EE(Hetwane) /2018/322	3rd Aug, 2018	**IV [L]**
13	In-Principal Approval to NMIA Master Plan for Construction of Navi Mumbai International Greenfield Airport at Navi Mumbai by Director General of Civil Aviation (DGCA), Govt. of India	AV.20024/40/2003-AL	28th Aug, 2018	**IV [M]**
14	In-Principal Approval to NMIA Master Plan for Construction of Navi Mumbai International Greenfield airport at Navi Mumbai by Bureau of Civil Aviation Security (BCAS), Govt. Of India	CAS-6/2018/Div-Ops-I/Navi Mumbai (E-135357)	28thAug, 2018	**IV [N]**
15	Approval of Airports Authority of India (AAI) for Siting of ATC, NAVAIDS / DVOR, CNS/ ATM of NMIA	NM-18011/1/2018/CNS-O&M	31st Oct 2018	**IV [O]**
16	Verification & Validation certificate of OLS Survey of NMIA received from AAI on 10 Dec' 18.	AAI/ASC/06/2018	10th Dec 2018	**IV [P]**
17	Approval/NoC from MSETCL for Power Supply to NMIA	MSETCL/CO/STU/EHV Cons/ NMIA/NO13379	27thDec, 2018	**IV [Q]**
18	Permission from Maharashtra Maritime Board (MMB), GOM for installation of runway approach lights for Northern runway of NMIA in Gadhi River.	MMB/CEO/HGR/T-194/NMIA-Runway Light/NOC/8252	27th Dec, 2018	**IV[R]**
19	Approval of CWPRS for NMIA Drainage Master Plan (The hydraulic design of drainage channels proposed in CIDCO Report on "Storm Water Management system for five villages abutting to the south boundary of NMIA",)	A.P.Y.P/CIDCO/2019 /434 /318	18thJul,2019	**IV [S]**
20	Approval of Bureau of Civil Aviation Security (BCAS), Govt. Of India for	CAS-6/2018/ Div-Ops-I/Navi Mumbai (E-135357)	26th Jul, 2019	**IV [T]**

Sr. No.	Approval	Letter Number	Date of Approval	Annexure
	Construction of Terminal-1 Building on NMIA			
21	Approval/ NOC of Fire Dept. CIDCO for Location of Air Rescue & Fire Fighting Stations (ARFF) of NMIA	CIDCO/FIRE/HQ/2019/542	30th Sept 2019	**IV [U]**
22	Fire NOC from Fire Dept. CIDCO for Construction of Terminal-1 Building on NMIA	CIDCO/FIRE/HQ/665/2019	20th Dec 2019	**IV [V]**
23	Approval from FRRO Mumbai, Bureau of Immigration (BoI), for Provision of space in Terminal-1of NMIA	No. 9445/FRRO/MUM/AP/2019	30th Dec 2019	**IV [W]**
24	Approval/NOC from Airports Authority of India (AAI) for Phase -1 Buildings of NMIA	NOC RECEIVED FOR 63 BLDGS.	23rdJun, 2020	**IV [X]**
25	Approval of CWPRS for NMIA Drainage Master Plan (Revised SWD system report (June 2019) prepared by NMIAL and submitted to CWPRS vide email dated 20.06.2019 and requested. CWPRS vide email dated 03.07.2019 to carry out additional review study of SWD report (2019) of M/s NMIAL.)	A.P.Y.P/NMIAPL/2020	23rd Jun, 2020	**IV [Y]**
26	Transfer of EC & CRZ Clearance in the name of NMIAL from CIDCO	F. No. 10-53/2009-IA-III	17th Aug 2020	**IV [Z]**

1.4 Brief History of NMIA

The Government of Maharashtra (GoM) rightly assessed that the future growth of air passenger traffic within MMR could not be handled by a single airport (CSMIA) at Mumbai and initiated the process of planning for second airport within MMR, beginning with the identification of a suitable site for a domestic airport. This was responsibility was assigned to CIDCO, as the competent authority to undertake all required studies.

Under the aegis of CIDCO, the initial site feasibility study was conducted by M/s. RITES for the preparation of a Techno-Economic Feasibility Study (TEFS) conducted by M/s. Carter & Burgess Inc. (USA) for development of a domestic airport. The TEFS report was submitted to Govt. of India in 1997.

A Committee was constituted in 1998 by the Ministry of Civil Aviation, Govt. of India for selection of a suitable site for the second airport for Mumbai. The current site at Ulwe, Navi Mumbai within Panvel taluka of Raigad district was preferred over Rewas-Mandawa and Mhapan in Raigad District, which were identified as alternate locations for the TEFS report.

Considering the projected air travel demand of the MMR region, CIDCO, initially proposed the plan for a domestic airport. Although, later in 2000, on recommendation of Govt. of Maharashtra, the CIDCO's proposal was revised (enclosing pre-feasibility report detailing air travel demand, project facilities, phasing, costing and financial viability with dual runway) and submitted to the Ministry of Civil Aviation (MoCA), Government of India (GoI). The revised proposal envisaged building a second international airport within MMR, and the same was submitted to the Ministry of Civil Aviation (MoCA) for approval.

Navi Mumbai International airport is located in Panvel taluka of Raigad district of Maharashtra, and is located at an aerial distance of about 40km east of South Mumbai /Nariman Point , approximately 35 km south-east of CSMIA. (**Figure-1.3**) The Ministry of Civil Aviation, GoI along with the Airport Authority of India, constituted a technical team to examine the pre-feasibility report prepared by CIDCO. The team concluded that the Navi Mumbai site is operationally feasible for locating the second International Airport for Mumbai, and suggested to conduct studies such as geological/geo-technical, hydrological, traffic and environmental studies etc. along with the studies related to the inter-operability of two international airports within MMR.

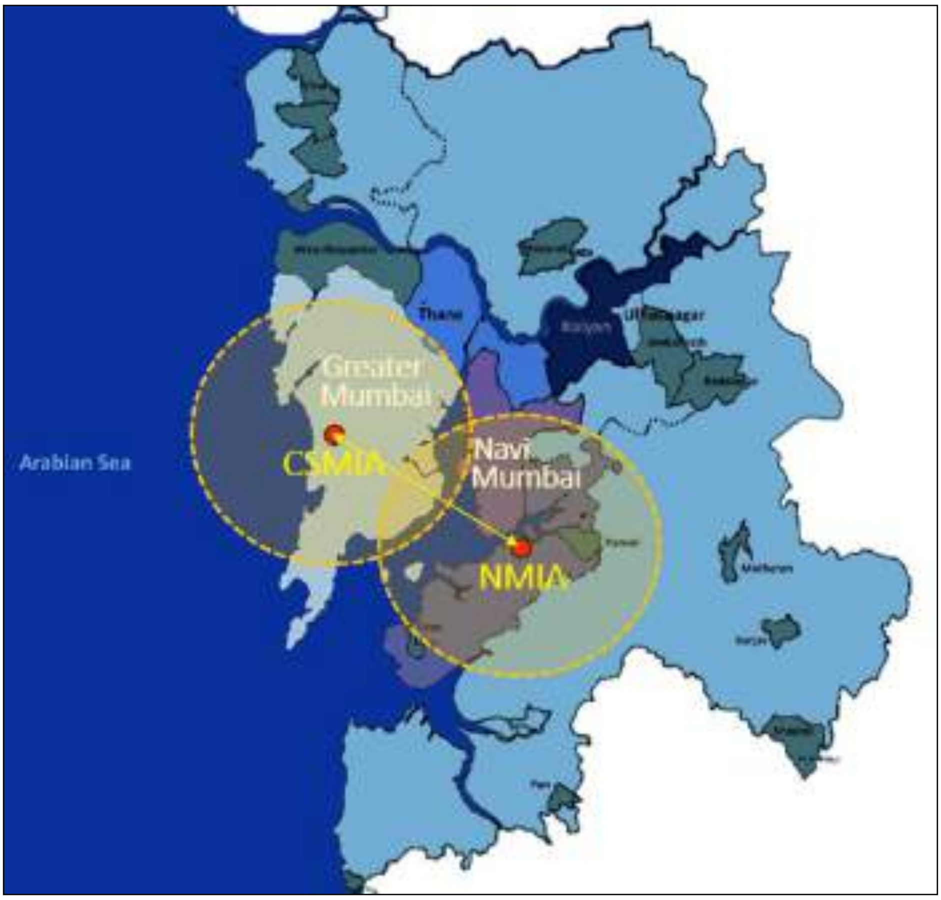


FIGURE-1.3:
LOCATION OF EXISTING AND PROPOSED AIRPORT ON MAP OF MUMBAI METROPOLITAN REGION (MMR)

A techno-economic feasibility study was conducted in 2001, by CIDCO, inter-alia, to address the issues raised by the above technical team which included Geological/ geo-technical, hydrological, aeronautical, traffic and environmental studies and submitted the report to AAI. All the clarifications sought by the AAI were reconciled and finally narrowed down to only two points i.e. the provision of parallel independent runways with a spacing of 1035 m and carrying out the simulation study to establish the conflict free operation of Mumbai and Navi Mumbai Airports (the proposed new airport).

CIDCO carried out the exercise and accommodated parallel, independent runways with 1035 m spacing between the center line of two runways. As part of this study, CIDCO also carried out a one-dimensional hydro-geological/drainage study with the help of Central Water and Power Research Station (CWPRS), Pune.

Further, a simulation study for assessing the inter-operability of Mumbai international Airport (i.e. CSMIA) and the proposed Navi Mumbai international Airport was carried out by Technical Cooperation Bureau (TCB) of International Civil Aviation Organization (ICAO) with their sub-contractor NAV CANADA in two parts i.e. the first being a simulation using TAAM, second part a real–time simulation in 2007. The study concluded that with appropriate procedures in place, simultaneous and independent operation of both airports is safe and feasible.

Upon the positive findings of the simulation study, the Union Cabinet in the Ministry of Civil Aviation, Govt. of India, granted "In Principle" approval in July, 2007 for development of second airport at Navi Mumbai on public private-partnership basis based on the Project Feasibility & Business Plan report submitted by Govt. of Maharashtra. The Govt. of Maharashtra also granted approval in July 2008 for the development of Navi Mumbai International Airport and appointed CIDCO as a Nodal Agency for implementation.

Thereafter, CIDCO as the Project Proponent conducted an EIA study and received Environmental and CRZ Clearance for this Project in 2010 valid up to 2017 and later obtained Extension of Validity up to 22nd November 2020. The schedule of project implementation of NMIA was delayed as the Forest Clearance was received in 2017 and the project on-site activities could not take place prior to this.

After an open global bidding process, CIDCO selected MIAL and issued Letter of Award to MIAL on 25th October 2017 to design, build, finance, operate, and transfer, in accordance with terms of Concession Agreement. The Concession Agreement was signed between CIDCO and NMIAL on 8th January 2018. As per the Concession Agreement (CA), NMIAL is to develop the airport over site area of 1160 ha and will be responsible for obtaining and complying with all applicable permits for the construction, operation and maintenance of the airport project, applicable to and to be implemented within airport site of 1160 Ha.

Concurrently, the Pre-Development Works including Land Development Works for the project were commenced on site by CIDCO (as Project Proponent) in April 2017 after receiving Forest Clearance.

1.5 Environmental Setting of NMIA

The NMIA project site is located in Panvel taluka of Raigad district of Maharashtra state , west of Panvel city, almost within geographical center of Navi Mumbai and MMR with a longitude of 73°04'18" and latitude of 18°59'33". The environmental setting along with the topographical features of study area within the 15 km radius from the boundary of the airport is given in **Table-1.6.**

TABLE-1.6:
ENVIRONMENTAL SETTING AROUND PROJECT SITE – 15 KM RADIUS

Sr. No.	Particulars	Details
1	Location	NMIA site is located in taluka Panvel, district Raigad, Navi Mumbai between Amra Marg and NH-4B. Villages: Vadghar (Chinchpada), Kopar, Pargaon (Kohli), Pargaon-Dungi, Owale (Upper and Lower Owale+ Waghivali Wada), Ulwe (Ulwe + Ganeshpuri), Targhar (Targhar + Kombhadbuje), Waghivali-Khar
2	Coordinates of Airport Reference Point (ARP)	73°04'18" E and 18°59'33" N
3	Encompassing Latitude and Longitudes	73° 02' 54" E to 73° 05' 39.61" E 18° 58' 44.61" N to 19° 0'.57 16" N
4	Topographic Sheets	E 43G13, E 43B4, E 43H1 (47 A/16, B/13, E/4, F/1)
5	Reference Metrological Station	IMD station at CSMIA, Santacruz
6	General Elevation above MSL	Present Elevation of the Airport Site after Pre-development works: +5.5 AMSL
7	Topography	Sloping towards NW.
8	Soil Type	Marine, Murrum, Rocks
9	Climatic Conditions (Based on Data compiled over 30 years (1917 to 2000) at the IMD Station at Santacruz(A) in Mumbai)	• Mean Temperature: Max. 38°C, Min. 12.9 °C • Total Annual Rainfall:1357.3 mm to 3784.9 mm • Wind Direction: Annual pre-dominant wind direction is from North-West. • Annual mean Humidity: 63 - 73%
10	Nearest Highways	SH-54 (on southern side), NH-4B (on eastern side), Amra Marg (Along western boundary of Airport site)
11	Nearest Railway Station	**Major Railway Station:** • Panvel Station on Central/Konkan Railway (4.5 km, E). **Suburban Railway:** • Targhar Station (on Seawoods-Uran Link) – (1 km, W) • CBD Belapur Station (on Panvel-CSMT Line) – (2 km, N) • Khandeshwar Station on (Panvel- Chhatrapati Shivaji Maharaj Terminus [CSMT] Railway Line) -(2.5 km, NE)

Sr. No.	Particulars	Details
12	Nearest other airports	Chhatrapati Shivaji Maharaj International Airport (CSMIA), Mumbai (35 km).
13	Nearest Village/City	**Town: CBD Belapur** (0.5 km, N), Panvel (0.5 km, E)
14	Densely populated or built-up area	Navi Mumbai Municipal Corporation (NMMC) (Various nodes such as CBD Belapur, Seawoods, Kharghar) and Panvel/New Panvel town NMMC comprising Residential, Institutional and Commercial areas are located approximately 1km to the north of Project Site (Population approximately 11.2 Lakhs as per Census 2011). Panvel town is located to the east of site at about 1.5 km distance (Population approximately 1.95 Lakhs as per Census 2011)
15	Ecologically sensitive zones (Distances and directions with respect to the Airport Project Site boundary)	• Thane Creek Flamingo Sanctuary Proposed ESZ 9.2 km, NW • Thane Creek Flamingo Sanctuary lies at 11 km, NW. • Matheran Eco Sensitive Zone, 9.3 km, ENE. • Karnala Bird Sanctuary – 9.6 km, SE • Karnala Bird Sanctuary ESZ -2.5 km, SE •
16	Wetland, Mangroves, Feeding sites of Migratory Birds	• NRI Colony (3.5 km, WNW) • TCS Chanakya (4.5 Km, NW) <u>Feeding sites of Migratory birds:</u> • Thane Creek Mudflats (9.8km NW of site (Important Bird and Biodiversity Area (IBA)) • Mahul- Sewree Mudflats (14.3 km W of site (Important Bird and Biodiversity Area (IBA)
17	Forests (RF: Reserve Forests, PF: protected Forests)	• Reserve Forest near village Kopar/ Vitthalwadi/ Vadghar (0.5 km, S) • RF near village Padekhar(1.8km, S) • RF in Parsik Hills (4.5km, N) • RF near village Jasai (4.6km, S) • RF near village Narpoli (other side of railway line, Konkan Railway) (9.2 km, SE) • RF near village Narpoli (10 km, SE) • RF near village Thombrewadi (10.4 km, SE) • RF near village Kalambusre (12.6km, S)
18	Nearest Hill	Ulwe hill – RL 82 m within the site
19	Notified Historical/ Archaeological/ Tourist Places	• Belapur Fort (0.82 km, NW) • Elephanta Caves, Gharapuri (11.3 km, W) • Karnala Fort (11.95 km, SE) • Prabalgadh Fort (13.94 km, E)
20	Defence and other related Establishments	Indian Navy, Naval Armament Depot (NAD) at Karanja- 14.5 km, SW
21	Major Water Bodies	▪ Ulwe River (Tidally influenced water body South of site, diverted channel) ▪ Panvel Creek and Estuarine portion of Gadhi River to the North and East, respectively.

Sr. No.	Particulars	Details
		▪ Gadhi River and Panvel Creek (Tidally influenced water body North of site at 70m distance) ▪ Panvel Creek (Tidally influenced water body north of site at 300m distance) ▪ NRI Wetlands (Wetlands, Mangroves about 3.5 km towards WNW) ▪ TCS Chanakya Wetlands (Wetlands, Mangroves about 4.5 km towards NW) ▪ Panje, Funde (Wetlands, Mangroves about 11kmtowards SW) ▪ Bendkhal (Wetlands, Mangroves about 13km towards SSW)
22	Seismic Zone	Zone-III as per IS: 1893 (Part-I) 2002.

The NMIA Site has wetland habitat including mangroves, mudflats, and creek near its northern edge**.** The mangrove habitat abutting the northern boundary of the project site around the Waghivali village falling with project influence area of 10 km, is part of the contiguous wetland habitat and extends along the banks of Panvel and Thane creeks. Based on the recent progress in Pre-Development Works, northern edge of the project site has been reclaimed and levelled up +5.5 AMSL except at few places. Requisite approvals from the concerned authorities like MoEF&CC, MCZMA and Forest Department, GoI, have been obtained by CIDCO for these works of airport development.

The location map of the project site is presented in **Figure-1.4**. The study area map of the project site (including Eco-Sensitive Zones and environmentally sensitive areas within 10 km and 15 km radius from project boundary) is given in **Figure-1.5 (A&B)**.

Current Status of the Site

The Google Image with demarcation of within 10 km radius (study area) map is shown in **Figure-1.6** and the close-up of the project site (aerial view) showing status, key nearby (and associated) features of the project is presented in **Figure-1.7**. The geographical boundary coordinates of NMIA project site are given in **Table-1.7** and **Figure 1.7**

TABLE-1.7:
NMIA SITE BOUNDARY COORDINATES

Corner	Latitude	Longitude
A	18° 59’ 58.515” N	73° 02’ 09.877” E
B	19° 00’ 12.199” N	73° 03’ 41.008” E
C	19° 00’ 02.511” N	73° 03’50.896” E
D	19° 00’ 11.133” N	73° 04’ 58.721” E
E	18° 59’30.168” N	73° 05’ 38.699” E
F	18° 59’ 09.394” N	73° 05’24.035” E
G	18° 58' 45.83" N	73° 02' 19.10" E

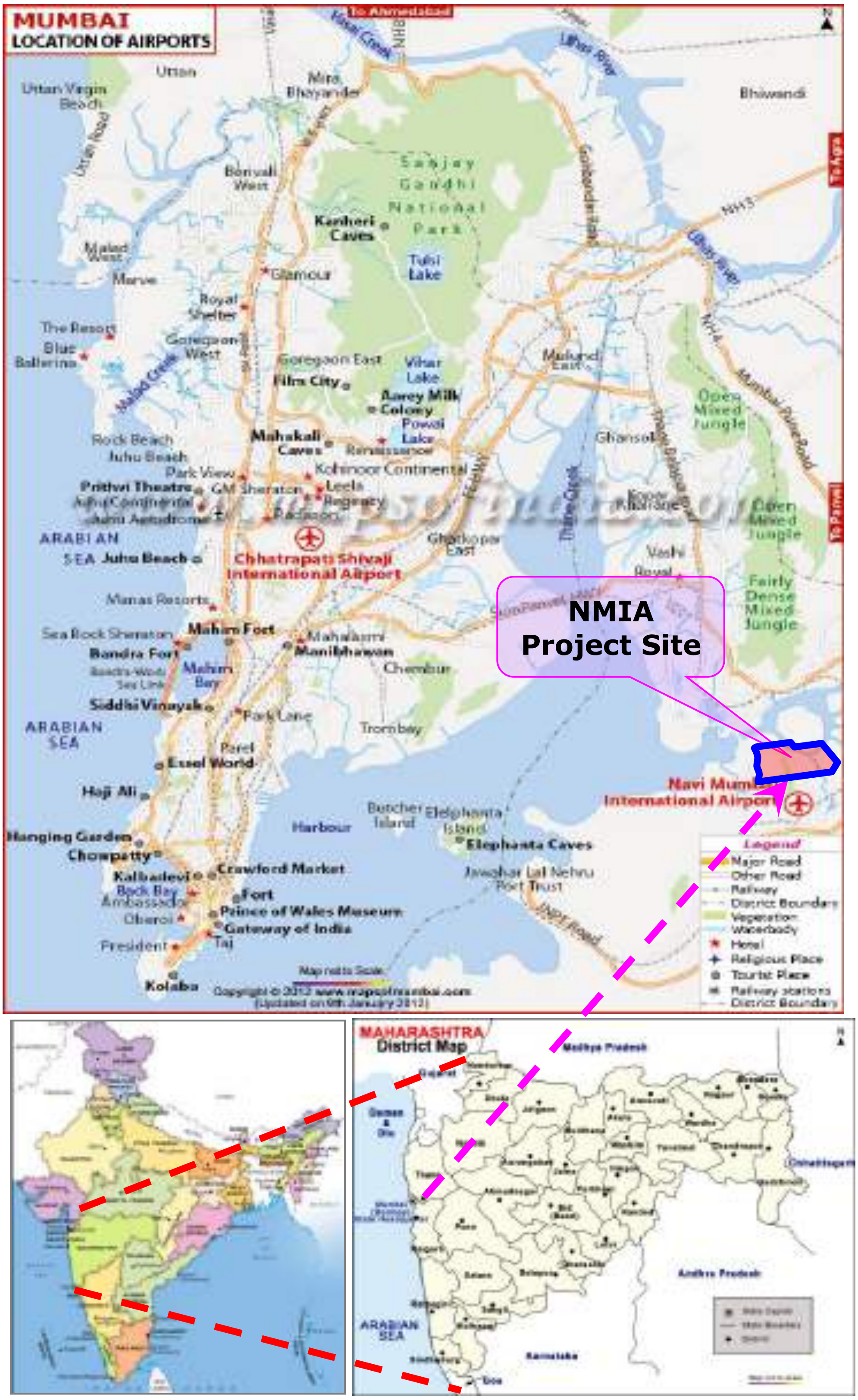


FIGURE-1.4:
INDEX MAP SHOWING PROJECT SITE

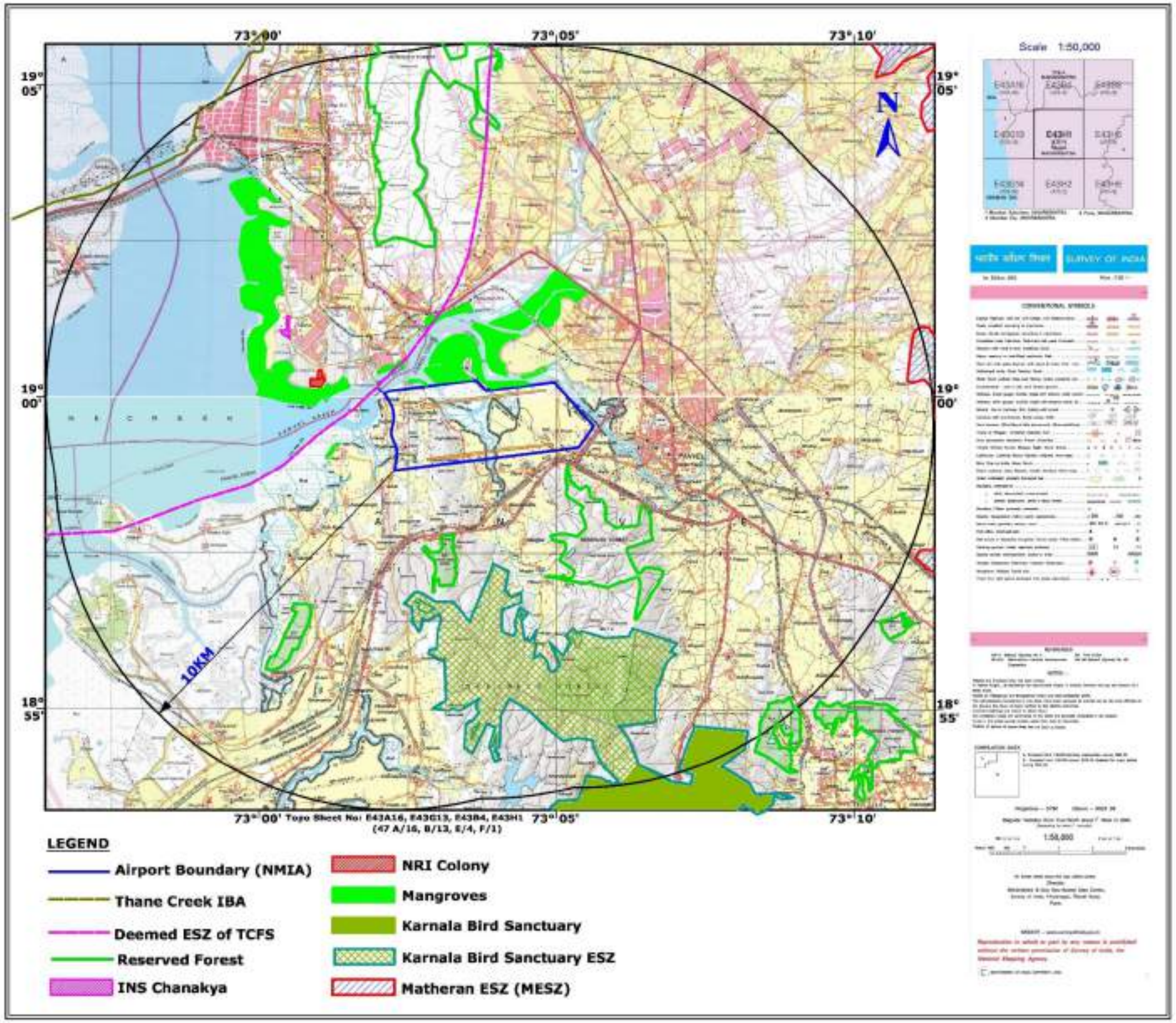


FIGURE-1.5 (A):
TOPOSHEET OF STUDY AREA (10 KM) SHOWING SITE AND ECO-SENSITIVE ZONES FEATURES

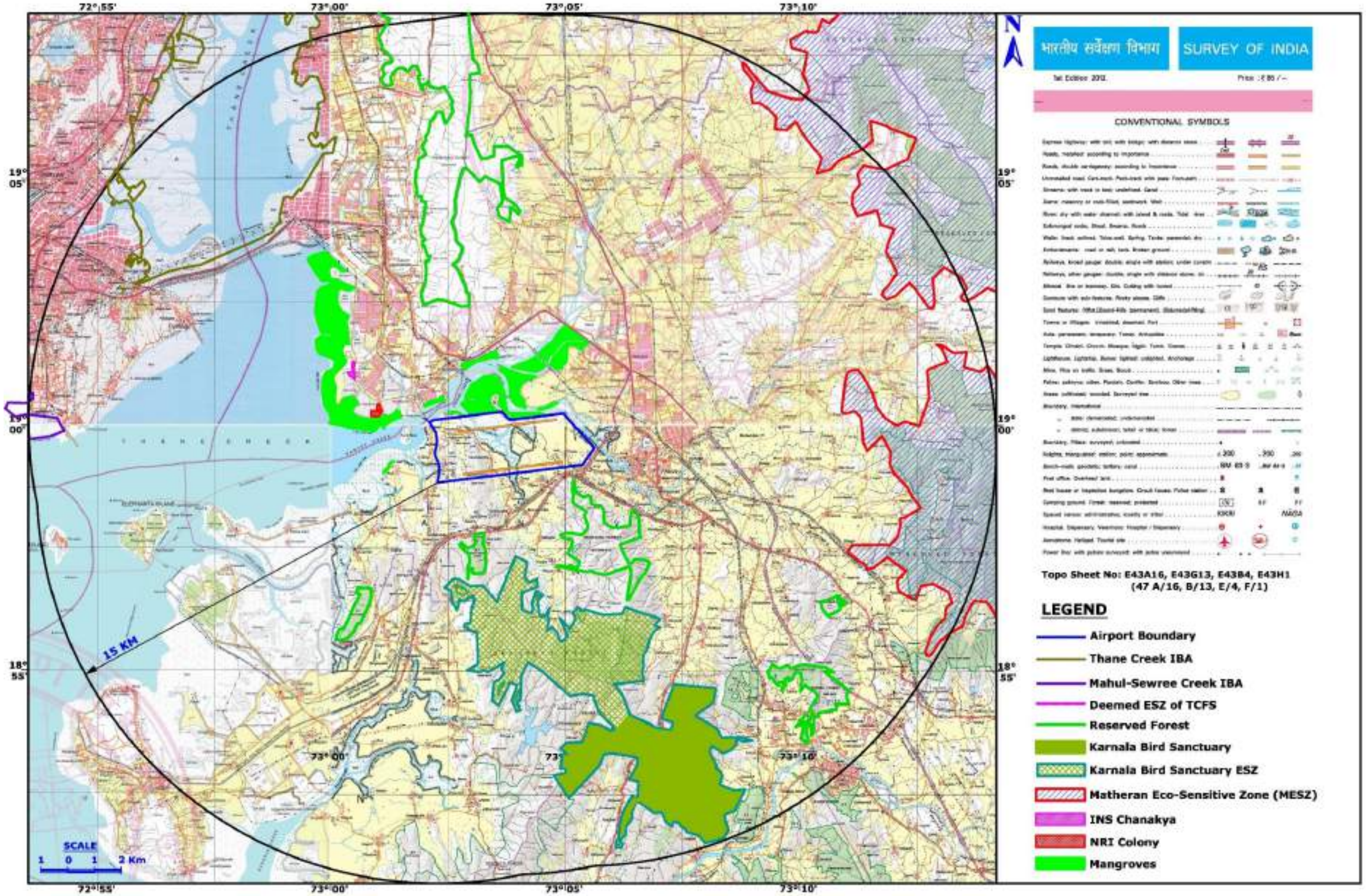


FIGURE-1.5 (B):
TOPOSHEET OF 15 KM VICINITY SHOWING ECO-SENSITIVE FEATURES AROUND SITE

FIGURE-1.6:
GOOGLE EARTH IMAGERY SHOWING STUDY AREA (10KM) AROUND PROJECT SITE

Geographical Coordinates of the Boundary of NMIA Project Ste		
Corner	Latitude	Longitude
A	18° 59′ 58.515″ N	73° 02′ 09.877″ E
B	19° 00′ 12.199″ N	73° 03′ 41.008″ E
C	19° 00′ 02.511″ N	73° 03′50.896″ E
D	19° 00′ 11.133″ N	73° 04′ 58.721″ E
E	18° 59′30.168″ N	73° 05′ 38.699″ E
F	18° 59′ 09.394″ N	73° 05′24.035″ E
G	18° 58' 45.83" N	73° 02' 19.10" E

FIGURE-1.7:
GOOGLE IMAGERY-DEPICTING PROJECT SITE STATUS AND NEARBY FEATURES IN MAY 2020

1.6 Status of CRZ

The CRZ Notification S.O. 19 (E) dated 6th January 2011 was amended to permit the development of NMIA in CRZ area by exempting the airport development from the list of prohibited activities under clause 3(i)(d). The development of NMIA in CRZ-I is permitted under clause 8 (I)(i)(f). Similarly, the development of NMIA in NDZ and CRZ-II area are permitted under clause 8 (III)(A) (iii)(m) and 8(III)(B)(x) respectively. Currently, the EC and CRZ Clearance of NMIA is valid up to 21st November 2021 as per MoEF&CC notification dated 18th January 2021.

Based on 2010 EC conditions, extensive hydrological modelling studies have been done through CWPRS, Pune, following which the erstwhile Ulwe River has been diverted out of airport site into Ulwe Recourse Channel (length 3.2 km) which has been developed south of NMIA. Institute of Remote Sensing (IRS) conducted field verification survey during November 2020 and observed that Ulwe River, which was passing through NMIA site, has been diverted outside southern boundary of NMIA site by constructing a Ulwe Recourse Channel (URC).

CIDCO received the permission for Mangrove clearance within project development area from Bombay High Court. The Bombay High court passed Order dated 23rd Oct 2013 in Notice of Motion No. 419 of 2011 in PIL No. 87/2006 for clearing Mangroves at the site and accordingly CIDCO has cleared existing Mangroves and planted compensatory Mangrove plantation.

Due to filling and reclamation activities in project site, no mangroves or intertidal zone remains within NMIA site. CRZ mapping has been carried out by IRS Anna University, Chennai. Institute of Remote Sensing (IRS) conducted field verification survey during November 2020 and observed that major portion of the land has been filled up and that Ulwe River, which was passing through NMIA site, has been diverted outside southern boundary of NMIA site by constructing a Ulwe Recourse Channel (URC). This was in variance with the land use as seen in approved CZMP of 2011 and the draft CZMP of 2019, prepared for the area. Hence, during IRS field verification survey. IRS has mapped the present status of project site showing reclaimed land, diverted Ulwe River etc. which is shown in **Figure-1.8.**

CRZ mapping has been carried out by IRS Anna University, Chennai. The CRZ area is categorized based on approved CZMP of Raigad district as per CRZ Notification, 2011 in accordance with condition stipulated in TOR issued for grant of fresh EC on 29th Oct 2020. The project area of 1160 Ha along with airport infrastructure and layout has been superimposed on scale of 1:4000 and 1:25000. The detailed CRZ mapping report is included in this report as **Annexure-XV**.

The CRZ map of the Project Site super imposed on the approved CZMP as per CRZ 2011 is prepared by IRS which is shown in **Figure-1.9 (A .** This indicated that an area of 545.4 Ha of land was affected by CRZ as per the approved CZMP of 2011. However, the above area has been reclaimed as permitted by MoEFCC vide various approvals granted to the project.

Draft CZMP of 2019 prepared by NCSM for MCZMA under the CRZ Notification of 2019 yet indicates the land status as existed prior to start of land development works.

NMIAL, vide its letter dated 14th Feb'20 to MCZMA & letter dated 22nd May 2020 addressed to Hon District Collector, Raigad has objected to the draft CZMP (2019) for Panvel Taluka prepared by MCZMA wherein the draft CZMPs prepared do not reflect the current physical position on NMIA site. NMIAL has conveyed its Suggestion/ Objection/ Clarification regarding Draft CZMP (2019) with respect to project site which is enclosed as **Annexure – XV [A]**. NMIAL has requested MCZMA/District Collector to update the Draft CZMP to indicate correct existing site conditions at respective locations within NMIA Site.

This EIA report is prepared based on available CRZ maps (based on approved CZMP of 2011) since that is the best map available and is yet not amended to show the present site physical condition.

Since part of the site is covered under CRZ and as the activity (viz setting of Airport) requires Environmental clearance under EIA Notification 2006, the project requires Environmental and CRZ clearance and the procedure given under EIA Notification 2006 shall prevail as per clause 4.2 (ii) (a) of CRZ Notification 2011.

Application is submitted for obtaining recommendation of MCZMA under the CRZ Rules 2011 and present site physical condition presented in **Figure 1.8** & with IRS delineation showing status as per approved CZMP of 2011 in **Figure 1.9 (A)**. Also as required under the CRZ notification 2011, map showing 10 km around project site superimposed on approved CZMP 2011 is presented as **Figure 1.9 (B).**

1.7 Purpose of EIA Study

As per the Environmental Impact Assessment Notification dated 14th September 2006 and 1st December 2009, the proposed airport project falls under Category 'A' under project type 7(a) and requires Environmental Clearance (EC) to be obtained from Ministry of Environment, Forest, and Climate Change (MoEF&CC) upon the expiry of the previous EC. *Since part of the site is covered under CRZ and also as the activity (viz setting of Airport) requires Environmental clearance under EIA Notification 2006, the project requires Environmental and CRZ clearance and the procedure given under EIA Notification 2006 shall prevail as per clause 4.2 (ii) (a) of CRZ Notification 2011.*

Since the previous EC & CRZ clearance of NMIA (earlier held by CIDCO) was to expire on 21st November 2020, a fresh application was submitted by NMIAL to MOEF&CC along with Form-I and PFR vide proposal no. IA/MH/MIS/154209/2020 dated 24th May 2020.

As per Clause-9A of recent MoEF&CC Notification vide S.O No. 221 (A) dated 18th Jan 2021, the validity of Environment and CRZ clearance granted to NMIA project vide F.No.10-53/2009 stands further extended up to 21st November 2021.

The scoping meeting was held in MoEF&CC during 24th September 2020 for determining the Terms of Reference for carrying out detailed EIA/EMP studies for the proposed project which is under implementation. Based on the ToR conditions, stipulated by MoEF&CC vide letter F.No.10-53/2020-IA-III on 29th October 2020 with the exemption of the Public Hearing, the detail EIA/EMP Report has been prepared. The EIA study is in continuation to the Comprehensive EIA study submitted by CIDCO (2017) as a compliance to the EC and CRZ clearance granted for this project.

FIGURE-1.8:
PRESENT STATUS OF PROJECT SITE SHOWING RECLAIMED LAND, DIVERTED ULWE RIVER ETC. (SOURCE -IRS CRZ STUDY REPORT)

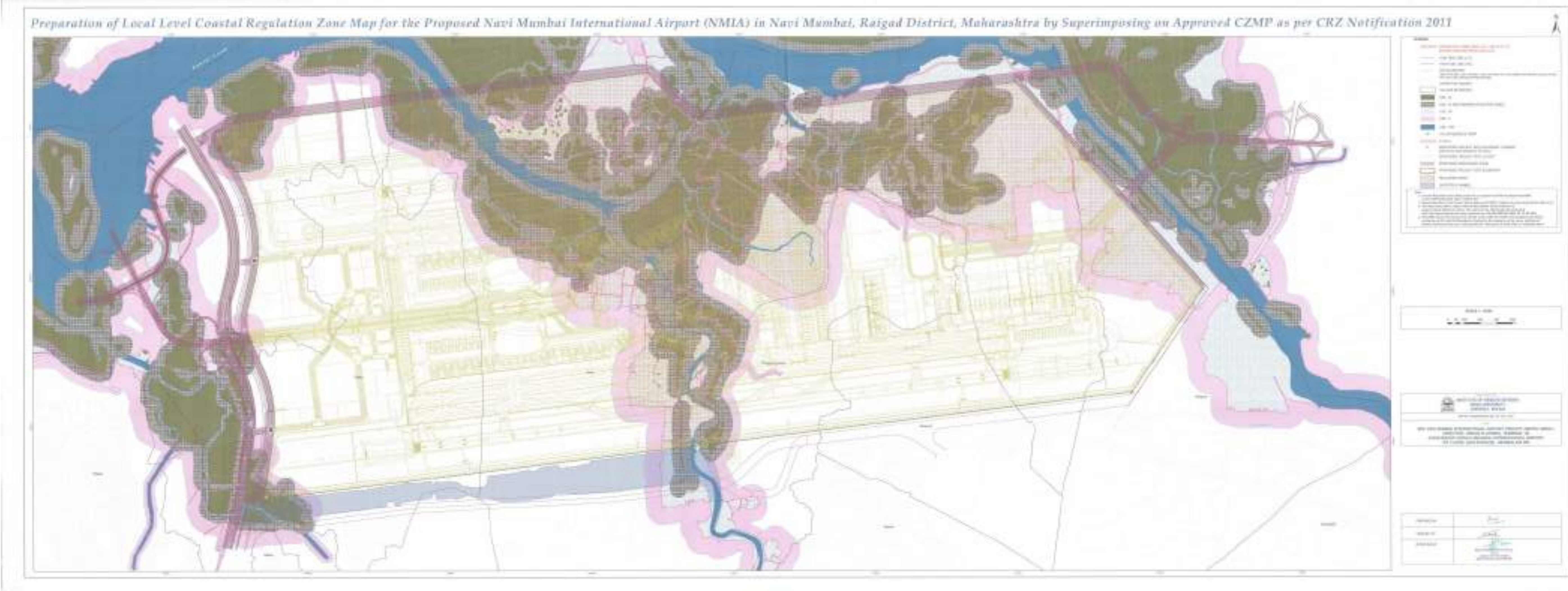


FIGURE-1.9 (A):
LAYOUT OF PROJECT SITE SUPER IMPOSED ON THE APPROVED CZMP AS PER CRZ 2011 (SOURCE -IRS CRZ STUDY REPORT)

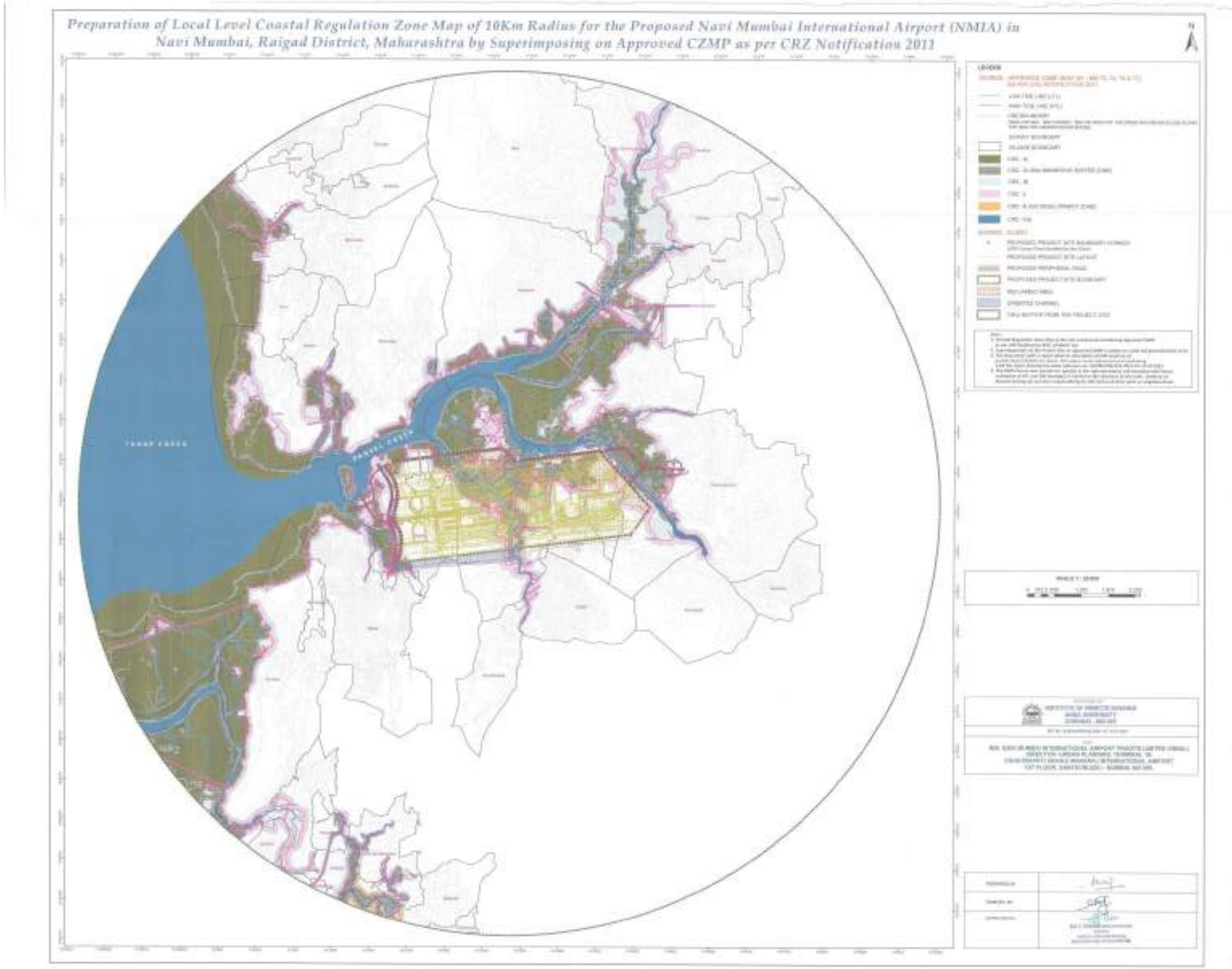


FIGURE-1.9 (B):
MAP SHOWING 10 KM RADIUS AROUND PROJECT SITE SUPERIMPOSED ON APPROVED CZMP 2011 (SOURCE -IRS CRZ STUDY REPORT)

1.8 Scope of EIA Study

With a view to assess the environmental impacts due to the proposed greenfield international airport project of NMIA (which is under implementation), the EIA Report for various environmental components including air, noise, water, land and biological components has been prepared along with suitable Environment Management Plan (EMP) for mitigating adverse impacts. This EIA report is prepared based on the specific and generic TOR conditions issued by MoEF&CC vide letter F.No. 10-53/2020-IA-III dated 29th October 2020 and based on season baseline environmental monitoring carried out in the study area of 10 km radius. Modelling exercises have been carried out to predict and evaluate impacts due to proposed project. Mitigation measures have been proposed on the basis of impact evaluation. The scope of the study broadly includes:

- Generating field sampling results of environmental attributes to establish the baseline environmental status.
- Collate and compile secondary data including socio-economic data from published literature / Government publications.
- Estimate pollution loads that would be generated by the proposed project.
- Predict incremental levels of pollutants in the study area due to the proposed project.
- Validate the predicted pollution load with respect to the present pollution load due to airport operations.
- Evaluate the predicted impacts on the various environmental attributes by using scientifically developed and widely accepted Environmental Impact Assessment modelling methodologies.
- Prepare an EIA report, complying to all the TOR conditions issued by MoEF&CC.
- Prepare an Environment Management Plan (EMP) to mitigate the predicted impacts.
- To identify critical environmental attributes required to be monitored and suggest Post Project Monitoring Plan; and
- To carry out Risk Assessment (RA) and prepare the Disaster Management Plan (DMP).

1.9 Methodology of EIA Study

Reconnaissance survey was conducted by the consultants and along with the concerned project officials and sampling locations were identified on the basis of:

- Comparison of primary and secondary baseline information and drawing inferences thereof.
- Predominant wind directions in the study area as recorded by India Meteorological Department (IMD) at Mumbai (Santacruz);
- Air dispersion modelling study of the airside and landside traffic.
- Noise dispersion modelling study of the airside and landside traffic.
- Detailed hydrogeological studies conducted for the greenfield project.
- Existing topography, location of surface water bodies like ponds, canals, creeks and rivers.
- Location of villages/towns/sensitive areas; and
- Areas which represent baseline conditions.

The field observations are used to:

- Evaluate the environmental impacts through modeling techniques.
- Identify extent of negative impacts on community/natural resources; and
- Identify mitigation measures and monitoring requirements.

The study also provides framework and institutional strengthening for implementing the mitigation measures. Field studies have been conducted during winter season (December 2019 to February 2020) to determine existing conditions of various environmental attributes. The monitoring details and scope of work are outlined in **Table-1.8**.

TABLE-1.8:
ENVIRONMENTAL ATTRIBUTES AND FREQUENCY OF MONITORING

Sr. No.	Attributes	Sampling Locations	Parameters	Frequency
1	Meteorology	1	Wind speed, direction, temperature, relative humidity, rainfall, solar radiation	One hourly recording of wind speed, wind direction, temperature (One non-monsoon season)
2	Ambient Air Quality	12	As per NAAQS, 2009; PM_{10}, $PM_{2.5}$,NO_2, SO_2, CO, NH_3, O_3, C_6H_6, BAP, Pb, Ni, As	24 hourly sample, twice a week and CO and O_3-8-hourly samples twice a week for 13 weeks.
3	Water Quality (ground water)	8	As per IS: 10500 parameters	Once during study period for existing ground water sources.
4	Soil Quality	10	pH, Conductivity, Texture, N, K, P, Organic Matter, SAR, Organic carbon, Cl, Na, Ca, SO_4, Fe, Hg	Once during study period
5	Noise Levels	13	L_{day}, L_{night}, L_{dn}, (Unit as dB(A))	Once during the study period (24-hourly)
6	Surface water quality	8	Physico-chemical, nutrients, pollution parameters (metals, oil), biological etc	Once during study period
7	Marine water quality [Panvel creek-sub-tidal and benthic)	8	Physico-chemical, nutrients, pollution parameters (metals, oil), biological, phyto-plankon, zoo-plankton etc.	Once during study period
8	Ecology (Terrestrial and Aquatic)	3	Identification of floral and faunal species and endangered species diversity	Once during study period
9	Land use	Based on satellite imagery and ground truthing and secondary published data			
10	Demography and Socio-economic studies	Based on data collected through primary field surveys, from secondary sources like Census of India-2011 and Socio-Economic survey conducted for NMIA and R&R Study conducted by CIDCO.			
11	Geology & Hydro geology and Flood Risk Assessment (of project site and the nearby low-lying areas due to flooding chance in the nearby water bodies in the catchment of Creeks) based on 100 years rainfall return data	Based on special studies carried out GSDA, GoM and (1-D & 2-D) modelling studies conducted by CWPRS and study recommendations for incorporation into design constraints of the comprehensive drainage master plan of NMIA.			
12	Environmental Impact Assessment	Impacts on various environmental attributes including air, water, soil, noise, land use. Based on various environmental modeling techniques and descriptive checklists			
13	Environment Management Plan	EMP for various parameters including post project monitoring. Descriptive checklists for EMP and Post Project Monitoring			

Sr. No.	Attributes	Sampling Locations	Parameters	Frequency
14	Risk Assessment and Disaster Management Plan	1. Identification of all kinds of risks associated the airport and detailed modelling of quantitative risks associated with potentially fire hazard/fire explosion risk with following objectives: • Quantify risks identified with major accident hazards (primarily for gas dispersion, explosion overpressure, fire and smoke and toxic gas, if applicable). • Plot Risk Contours for individual risk and FN curve for societal risk due to ONGC gas pipeline. • Evaluate acceptability of the risks. • Compare risk levels against risk-acceptance criteria and provide practical and effective risk control and mitigation measures, as required. • Carry out Fire risk assessment and Consequence Analysis for the identified hazards covering Escalation analysis and Impact analysis; and • Provide conclusions and demonstrate that risks are ALARP when recommendations are implemented, if any. 2. Preparation of Disaster Management Plan for NMIA based on risk identification for construction and operation activities of the airport.		

The methodology adopted for monitoring and analysis is given in **Annexure-V**.

1.10 Administrative and Legislative Background

The proposed project is covered under several environmental legislations. Brief details of the applicable environmental standards are given in **Annexure-VI**.

1.11 Organization of the Report

The report has been divided into twelve chapters as specified in Appendix-III of EIA Notification, 2006 and presented as follows. The Executive Summary will precede the Chapters and the ToR compliance is addressed as an annexure:

Chapter-1: Introduction

This chapter covers comprehensive details about the proposed airport project including objective and justification of the project, environmental settings, site details and scope of the EIA study.

Chapter-2: Project Description

This chapter addresses the details of the NMIA project (which is under implementation) in context with the capacities, phasing, traffic, utilities and services, infra-structural facilities, sources of pollution and proposed mitigation measures.

Chapter-3: Description of the Environment

This chapter illustrates the description of the existing environmental status of the study area with reference to the prominent environmental attributes. The study area covers 10 km from the airport project boundary.

Chapter-4: Anticipated Environmental Impacts and Mitigation Measures

This chapter covers the detailed impact of the airport project on different environmental components during implementation and operation phase of the project. The chapter also deals with the measures to be adopted to mitigate the adverse impacts of the proposed project development and underscores the areas of concern, which need mitigation measures.

Chapter-5: Analysis of Alternatives (Technology & Site)

The chapter details the alternative sites for the airport project and technologies available and considered.

Chapter-6: Environmental Monitoring Program

Environmental monitoring requirements for effective implementation of mitigatory measures during implementation and operational phase.

Chapter-7: Additional Studies

The chapter describes various additional studies associated with the project which includes public consultation, social impact assessment, R&R action plans hazard identification & analysis and consequence analysis and Disaster Management Plan. Further, Airport Emergency Response Plan (AERP) is also covered under this Chapter.

Chapter-8: Project Benefits

The chapter describes various social benefits of the project to the community in the vicinity and as well as to the region.

Chapter-9: Environmental Cost-Benefit Analysis

Cost-Benefit Analysis in environmental perspective, if recommended at the stage of scoping.

Chapter-10: Environment Management Plan (EMP)

The chapter describes responsibility of management for environment. It describes the environment management measures, institutional requirement and budget provisions for the implementation of EMP measures. Further, environmentally sustainable measures which are integral part of the project design are addressed.

Chapter-11: Summary and Conclusion

This chapter gives the summary of the report with observations and conclusions.

Chapter-12: Disclosure of Consultants Engaged

The list of various experts involved in preparation of the present EIA/EMP report is given along with brief introduction of the Consultancy Organization/s involved in EIA report. Further, details of the special studies carried out for the purpose of airport development and clearances are briefly addressed.

Chapter-2
Project Description

2.0 PROJECT DESCRIPTION

This chapter provides description of the project along with current and forecasted MMR passenger traffic demand for conservative case and base case scenarios, and planning of NMIA based on the above assessment. It also elaborates the key features of airside and landside planning of NMIA Master Plan, proposed airport amenities and facilities, utilities, and resource requirements along with details of support facilities essential for operation of the airport.

Further, this chapter highlights the essential environmental controls planned to be installed as an integral part of NMIA Master Plan, as environmental and climate mitigation measures adopted for the project.

2.1 Need of NMIA Project

Traffic Forecast for Mumbai Metropolitan Region (MMR) indicates air passenger demand of more than 100 MPPA by 2028 and more than 200 MPPA by 2045 (refer Table-2.1). In view of this, there is an urgent need to expeditiously develop NMIA, as the second airport for Mumbai Metropolitan Region.

NMIA project is conceptualized as part of India's first dual airport system for a city, operating two international airports within a single metropolitan region, in view of booming air traffic demand of Mumbai. NMIA is situated at Navi Mumbai (within MMR), while MMR is currently being served solely by CSMIA for commercial flights. When NMIA commences operations, MMR shall have a dual airport system.

CSMIA has experienced unprecedented annual growth in past two decades reflective of country's economic boom. CSMIA has undergone landside and airside expansion through a 2-billion-dollar airport modernization and expansion program from 2006 to 2014 to improve its airport infrastructure and passenger handling capacity. However, this landlocked airport with no room to spare, is severely constrained both on its airside as well as landside areas. Factors influencing the establishment of NMIA are primarily led by limitation of expansion of CSMIA beyond its planned capacity of 40 MPPA, which be able to serve max of 55 / 60 MPPA post implementation of capacity augmentation projects. In near future, the projected growth of the passenger demand of Mumbai will be too challenging for CSMIA to handle due its capacity limitation. The impact of CSMIA capacity, resulting demand for NMIA and need for operation of a two-airport system, is presented in the following sections.

2.1.1 CSMIA Traffic Performance

In the period between 2008 and 2019, the international and domestic air passenger traffic at CSMIA has increased from 25.9 million to 48.83 million passengers (**Figure-2.1**) registering average growth rates of 6% and 9% in international and domestic categories, respectively. Similarly, in the same period, the total cargo traffic has increased from 0.53 MT to 0.93 MT recording an average growth rate of 6 %.

Source: CSMIA: https://csmia.adaniairports.com/business-airlines.aspx#traffic-performance

FIGURE-2.1
CSMIA TRAFFIC PERFORMANCE

Further, traffic studies predicted a compound aggregate growth rate of 9.2% in the FY 2020-25 (**Table-2.4**). Evidently, the passenger traffic in MMR is expected to increase to around 70-80 million passengers by FY 2024 (**Table-2.2**), the time around which the NMIA is planned to commence its first phase of operation. The maximum operational capacity of CSMIA is expected around 55 to 60 million passengers annually, and the airport shall not be able to serve beyond this capacity due to airfield constraints. Thus, establishment of a second airport becomes indispensable to handle the growth in air passengers in MMR.

Thus, the need for establishing a second airport is justified by the trends in the passenger traffic demand. The passenger traffic forecast of MMR and subsequently that of NMIA is summarized in the following section of this report.

2.1.2 Operation of NMIA and CSMIA within MMR

In view of the need for second airport for MMR, CIDCO sought approval of Ministry of Civil Aviation (MoCA) for development of NMIA. A technical committee was constituted by MoCA along with the technical team of Airport Authority of India (AAI) to review the Pre-feasibility of a new airport within MMR (conceptualized by GoM and prepared by CIDCO on behalf of GoM). The technical team recommended carrying out a simulation study to establish the conflict free operation of the CSMIA and the new Greenfield airport later named as NMIA amongst other important studies for its establishment.

CIDCO, then carried out the exercise and accommodated parallel, independent runways with 1580m spacing between the center line of two runways. The Technical Co-operation Bureau (TCB) of International Civil Aviation Organization (ICAO) with their sub-contractor NAV CANADA developed a simulation study in two parts: the first being a fast time simulation using Total Airspace & Airport Modeller (TAAM) and the second part a real–time simulation under the supervision of Airports Authority of India. The simulation study concluded that with appropriate procedures in place, simultaneous and independent operation of both airports is safe and feasible. Upon the completion of above requisite studies, the "In-Principle" approval for development of Navi Mumbai International Airport on Public-Private-Partnership basis was granted by the Ministry of Civil Aviation (MOCA), Govt. of India on 6th July 2007 (**Annexure IV [A]**). Approval from State Cabinet Govt. of Maharashtra on 30th July 2008 (**Annexure IV [B]**).

2.2 Passenger Traffic Forecast

The air traffic forecast drives the demand for the type and size of facilities required for the airport and the appropriate phasing of these facilities. This section presents MMR level and NMIA level annual traffic forecast based on the proposed NMIA opening date in FY 2024 and extends over the planning horizon of the Concession period. The traffic forecast is described below starting from the MMR level traffic and narrowing down to the CSMIA followed by NMIA, with expected traffic trigger dates for phase-wise terminal & airport development. Traffic Forecast Study for NMIA was done by InterVistas, a leading global consultant in aviation traffic studies.

2.2.1 MMR Traffic Forecast

To develop the projections of future activity in passenger traffic, a forecast methodology (**Figure-2.2**) has been adopted that blends a macro-economic forecast model, relating historic passenger traffic to key socio-economic variables for the entire MMR, with a traffic allocation model that allocates traffic over the individual airports based on airport capacities, planned infrastructure and expected commercial flight operations.

The traffic allocation model is based on the capacity of the existing CSMIA airport at various phases of NMIA development, planned NMIA infrastructure, as well as factors that are known to drive a passenger's preference to use a particular airport. Using the macro-economic forecast model and allocation model, the future share of NMIA in relation to the region's passenger traffic has been forecasted.

The historic traffic performance of MMR region based on the CSMIA operations is given **Table-2.1** and the projections of passenger traffic forecast based on the above methodology is given in **Table-2.2** below.

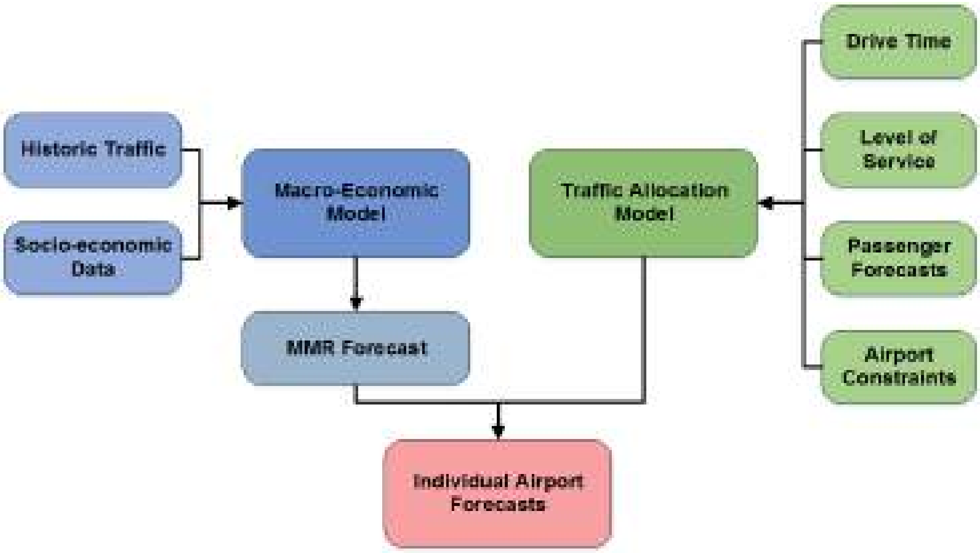


FIGURE-2.2
MMR TRAFFIC FORECAST METHODOLOGY

TABLE-2.1
HISTORIC TRAFFIC PERFORMANCE IN MMR REGION (IN MILLION)

Year	Domestic	International	Passengers	Growth (%)
FY1981	2.41	2.63	5.05	-
FY1991	3.76	4.33	8.10	-
FY2001	7.00	5.17	12.17	5.30
FY2002	6.52	4.76	11.29	-7.30
FY2003	7.17	5.08	12.26	8.60
FY2004	7.94	5.33	13.28	8.40
FY2005	9.57	6.08	15.66	17.90
FY2006	11.68	6.72	18.41	17.50
FY2007	14.90	7.34	22.24	20.90
FY2008	17.88	7.98	25.86	16.30
FY2009	15.31	8.11	23.43	-9.40
FY2010	17.37	8.23	25.6	9.30
FY2011	19.99	9.07	29.07	13.50
FY2012	21.04	9.70	30.74	5.80
FY2013	20.27	9.93	30.20	-1.80
FY2014	21.88	10.34	32.22	6.70
FY2015	25.20	11.43	36.63	13.70
FY2016	30.04	11.62	41.67	13.70
FY2017	32.71	12.44	45.15	8.40
FY2018	34.85	13.64	48.49	7.40
FY2019	34.09	14.74	48.83	0.70

Source: NMIAL

TABLE-2.2
MMR AGGREGATE PASSENGER FORECAST (IN MILLION)

Year	Domestic	International	Passengers
FY2020	38.74	16.67	55.41
FY2021	40.78	18.42	59.20
FY2022	43.43	20.36	63.79
FY2023	48.42	22.29	70.71
FY2024*	53.36	24.63	77.99
FY2025	58.70	27.10	85.80
FY2026	63.40	28.72	92.12
FY2027	68.47	30.45	98.92
FY2028	72.58	32.27	104.85
FY2029	76.93	34.21	111.14
FY2030	80.78	35.92	116.70
FY2035	103.10	45.84	148.94
FY2040	130.06	58.01	188.07
FY2045	156.55	70.88	227.43
FY2050	179.38	83.49	262.87
FY2055	195.56	94.78	290.34
FY2058	201.06	100.48	301.54

Source: InterVistas Report for Traffic Demand Study for NMIA
** FY 2024 is the horizon year for commencement of First-Phase of NMIA*

2.2.1.1 Compound Aggregate Growth Rate (CAGR)

The CAGR of MMR traffic based on its historic performance is presented in **Table-2.3** and the forecasted (simulated) growth trend is outlined in **Table-2.4** below.

TABLE-2.3
MMR HISTORIC TRAFFIC GROWTH RATE (%)

Year	Overall CAGR
1980-2003	4.30
2003-2007	18.10
2003-2008	12.00
2008-2018	7.60

Source: NMIAL

TABLE-2.4
MMR AGGREGATE PASSENGER TRAFFIC FORECAST (IN MILLION)

Year	CAGR (%)
FY2016-20	7.30
FY2020-25	9.20
FY2025-30	6.30
FY2030-35	5.00
FY2035-40	4.80
FY2040-45	3.90
FY2045-50	2.50

Source: NMIAL

Based on above projections, the unconstrained passenger traffic to and from the MMR is expected to reach approximately 80 MPPA by the time NMIA expectedly opens in FY 2024, increasing to approximately 164 MPPA by 2037. Driven by a strong domestic economy and an expanding airline market, recent growth trends are expected to continue in the near-term. Over the time and as the market matures, the growth rates are expected to be moderate.

2.2.2 NMIA Traffic Forecast

2.2.2.1 Traffic Forecast Model

As shown in **Figure-2.2**, the traffic allocation model combines and blends the results of three individual approaches with consideration to airport capacities as below:

- Spill-based approach;
- Airline choice model; and
- Airport choice model.

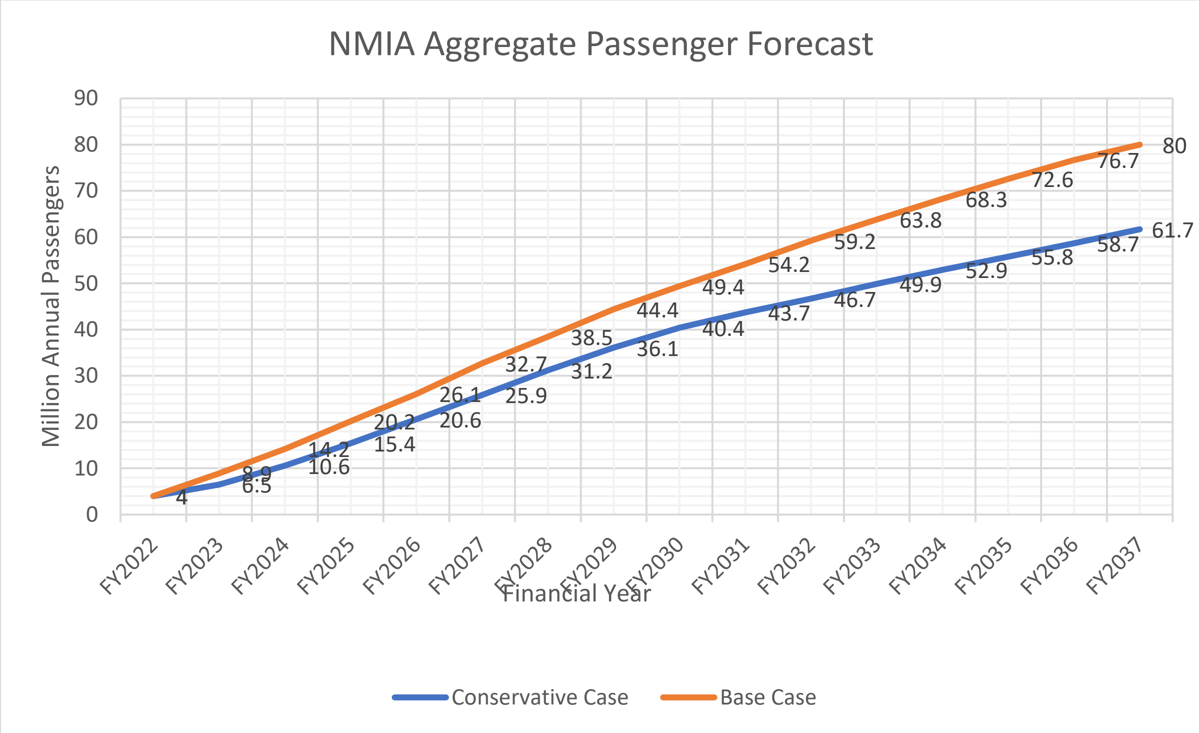
As the existing CSMIA airport reaches capacity, the spill-based approach assumes the spill (e.g., excess demand) will overflow to NMIA to the extent airlines introduce new flights there. The following are key assumptions made under the traffic allocation model for NMIA forecasts:

- NMIA is expected to become operational in FY 2024.
- CSMIA is projected to accommodate all MMR passenger traffic until the opening of NMIA in FY 2024; and
- The proportion of MMR traffic 'spill' varies between the 'Conservative Case' and 'Base Case' scenarios while overall demand remains the same.

Case Scenarios

Considering the preliminary nature of current MMR growth strategies, a "Conservative" case forecast traffic scenario assumes a gradual build-up of mainly domestic traffic as carriers introduce flight capacity to the new airport while the "Base" case forecast scenario projects traffic numbers on the assumption that NMIA starts de-peaking in the initial years due to MMR forecast demand and sees higher throughput from aircraft up gauging and higher passenger load factors. Although, the Conservative Case traffic forecast has been adopted for project planning purposes, it is because the Conservative Case traffic forecast has a growth rate more akin with that of a new greenfield airport operating in a two-airport system.

Figure-2.3 presents a comparison of the forecast under two scenarios: Base and Conservative. These scenarios were forecasted using the same assumptions about the maximum capacity of both airports. The primary difference between them is that the base case scenario reaches 60 million passengers in 2031-32, while the conservative case gets there 5 years later.



Source: NMIA PFR

FIGURE-2.3
NMIA AGGREGATE PASSENGER FORECAST
(BASE CASE VERSUS CONSERVATIVE CASE)

2.2.2.2 NMIA Passenger Traffic Forecast (Conservative Case)

The passenger demand forecast for NMIA was envisaged by allocating forecasted demand for the entire MMR system between CSMIA and NMIA. The primary assumptions used were:

- NMIA will begin operating at early 2024.
- CSMIA will retain a slight advantage over NMIA through the planning horizon from the point of view of most users (passengers and airlines) as long as it remains uncongested and can offer available slots during peak domestic hours; and
- NMIA should be able to handle up to 199,000 annual commercial ATM and approximately 38 peak hour ATM per runway when handling 60 million annual passengers.

NMIAL is planning NMIA with initial capacity of 10 MPPA in Phase-I, any increase in traffic at NMIA in the opening year, beyond the current traffic forecast (spill of 10.6 MPPA from CSMIA) shall be catered to at NMIA. NMIAL is committed to serve all the traffic attracted by NMIA from its opening day, and the airport is planned considering this. **Table-2.5** below presents the allocation process of MMR region, CSMIA and NMIA.

TABLE-2.5
CSMIA & NMIA AGGREGATE PASSENGER TRAFFIC FORECAST (MILLION)

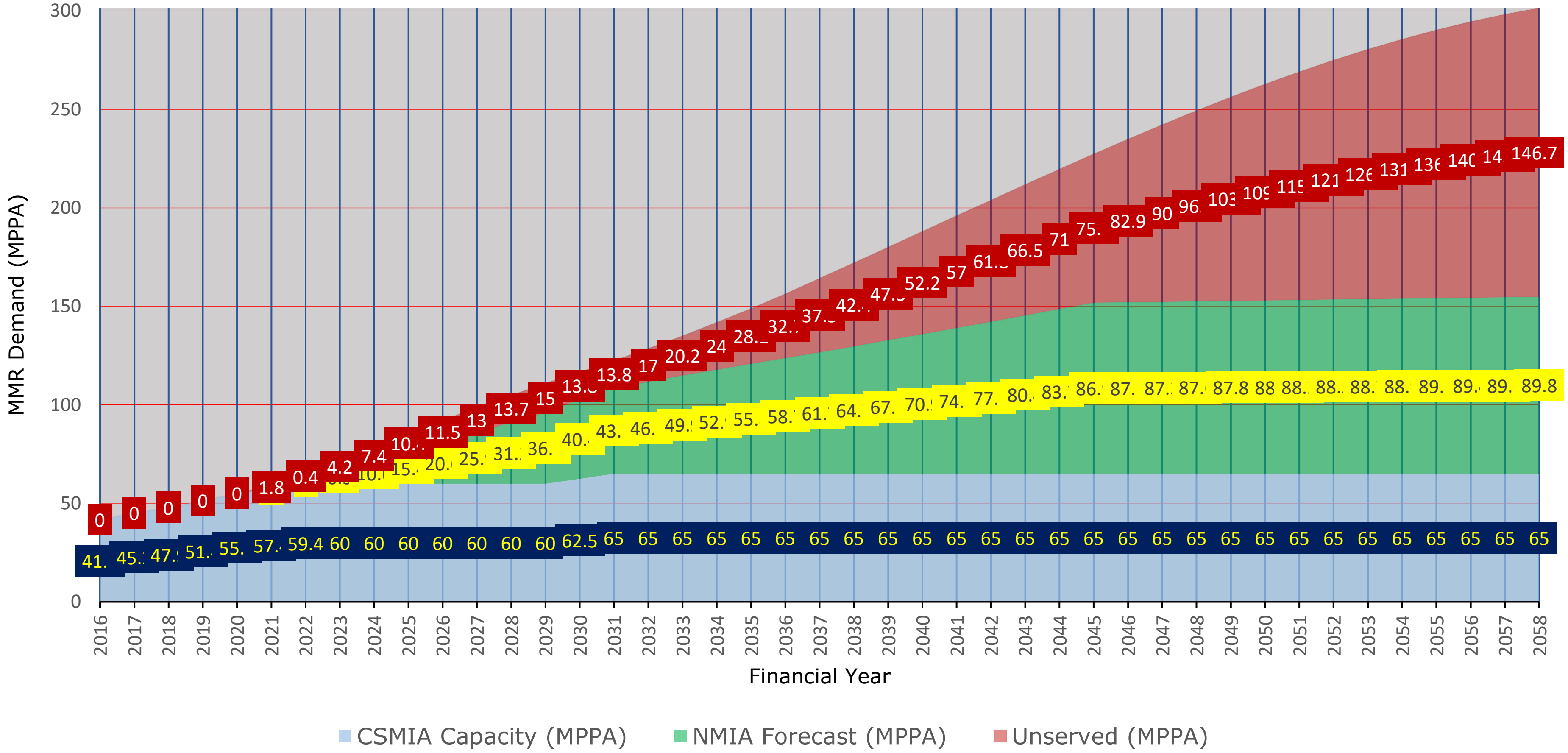
Year	MMR Demand (Million)	Growth (%)	CSMIA Capacity (Millions)	Growth (%)	NMIA Allocation (Millions)	Growth (%)
2016	41.7	-	41.7	-	-	-
2017	45.2	0.1	45.2	8.4	-	-
2018	47.9	6.1	47.9	6.1	-	-
2019	51.4	7.2	51.4	7.2	-	-
2020	55.1	7.3	55.1	7.3	-	-
2021	59.2	7.4	57.4	4.2	-	-
2022	63.8	7.8	59.4	3.5	4.0	-
2023	70.7	10.9	60.0	1.1	6.5	61.1
2024	**78.0**	**10.3**	**60.0**	**0.0**	**10.6**	**63.4**
2025	85.8	10.0	60.0	0.0	15.4	44.9
2026	**92.1**	**7.4**	**60.0**	**0.0**	**20.6**	**34.1**
2027	98.9	7.4	60.0	0.0	25.9	25.7
2028	104.9	6.0	60.0	0.0	31.2	20.5
2029	111.1	6.0	60.0	0.0	36.1	15.9
2030	116.7	5.0	62.5	4.1	40.4	11.7
2031	122.5	5.0	65.0	4.1	43.7	8.2
2032	**128.7**	**5.0**	**65.0**	**0.0**	**46.7**	**7.0**
2033	135.1	5.0	65.0	0.0	49.9	6.8
2034	141.9	5.0	65.0	0.0	52.9	6.0
2035	149.0	5.0	65.0	0.0	55.8	5.5
2036	156.4	5.0	65.0	0.0	58.7	5.3
2037	**164.2**	**5.0**	**65.0**	**0.0**	**61.7**	**5.1**
2040	188.1	4.4	65.0	0.0	70.9	4.6
2045	227.4	3.5	65.0	0.0	86.9	3.9
2050	262.9	2.6	65.0	0.0	88.0	0.3
2055	290.4	1.6	65.0	0.0	89.1	0.3
2058	301.5	1.1	65.0	0.0	89.8	0.3

Source: NMIA Air Traffic Study (May, 2018)

Since CSMIA will be operating at its capacity throughout the forecast period, almost the entire growth in demand for the system will have to be absorbed by NMIA. Domestic and international passengers will then be allocated proportionally between the two airports, as it is considered that at this time there is no basis for assuming a specific concentration of either domestic or international passengers at either CSMIA or NMIA. **Figure-2.4** graphically illustrates the allocation process, with the top line representing the aggregate demand for the MMR system.

2.2.2.3 Summary of NMIA Passenger Traffic Forecast (Conservative Case)

In line with traffic allocation model **(Table-2.5 and Figure-2.4** above), NMIA is forecasted to handle over 20 million passengers by the end of Phase 2 in FY 2026. This would increase to just about 60 million passengers by FY 2037 and about 90 million by 2058. In this scenario, the international passengers are forecasted to reach over 12 million passengers by FY 2037 and 22 million in FY 2058 and the Domestic passengers are forecasted to reach about 49 by FY 2037 and 67 million by FY 2058.



Source: NMIA Air Traffic Study

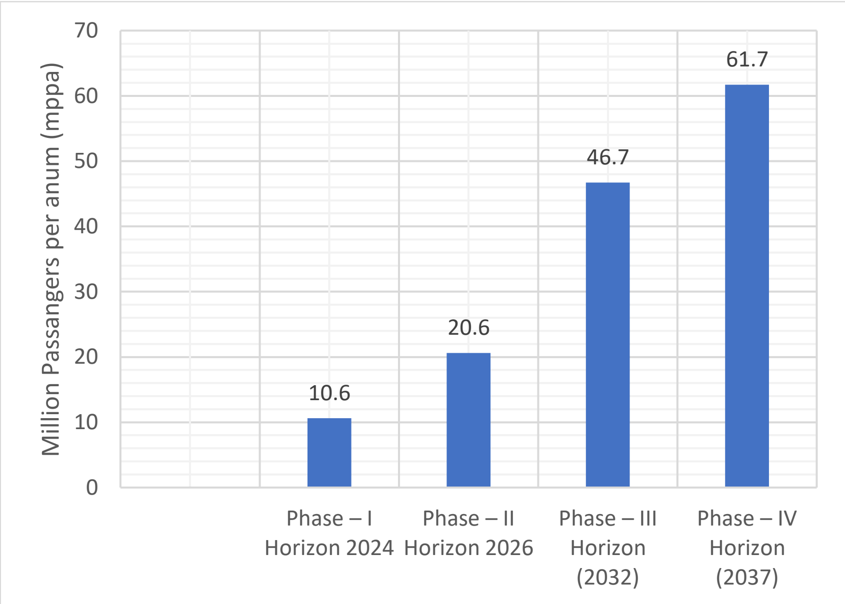
FIGURE-2.4
ALLOCATION OF PASSANGERS IN MMR AIRPORT SYSTEM

Therefore, the travel demand in the horizon years 2026 (Phase-I & II), 2032 (Phase-III) and 2037 (Phase-IV) based on the traffic forecast is summarized below (**Table-2.6**) and is graphically presented in **Figure-2.5.**

TABLE-2.6
NMIA AGGREGATE PASSENGER FORECAST

Airport Development	Operational Terminal	Planned Horizon Year	Passenger Forecast (MPPA)		Total Passenger Forecast (International & Domestic) [MPPA]
			International	Domestic	
Phase – I Phase – II	Terminal 1	2026	2.9	17.7	20.6
Phase – III	Terminal 2	2032	8.9	37.8	46.7
Phase – IV	Terminal 3	2037	12.7	49.0	61.7

Source: NMAI Air Traffic Study



Source: NMIA Air Traffic Study (May, 2018)

FIGURE-2.5
SUMMARY OF TRAFFIC DEMAND IN THE HORIZON YEARS OF NMIA

2.3 Cargo Forecast

To establish the aggregate unconstrained forecast of air cargo for the MMR region, a method similar to that used for passenger forecast was utilized. It blends top down with bottom-up approach. The top-down forecast approach focuses on the demand-side and uses two methods of predicting air cargo traffic at the national level:

- Independent studies, e.g.: Boeing – World Air Cargo Forecast, Airbus – Global Market Forecast: Freight and;

- Elasticity model – multiple regression analysis to model relationship between independent variables (i.e., domestic GDP, international GDP, total trade) and air cargo volumes.

The bottom-up approach focuses on supply-side where future air cargo volumes are expected to be driven by capacity in the form of belly freight and full freighters at CSMIA and NMIA. **Table-2.7** presents a summary of the aggregate air cargo forecast for the MMR airport system for the planning years.

TABLE-2.7
MMR CARGO FORECAST

Year	Cargo (T)
FY2018	890,000
FY2019	996,984
FY2020	1,118,128
FY2021	1,226,457
FY2022	1,462,725
FY2023	1,620,073
FY2024	1,858,189
FY2025	2,067,387
FY2030	2,911,406
FY2035	3,904,332
FY2040	4,873,038
FY2045	5,704,139
FY2050	6,397,197
FY2055	6,994,014
FY2058	7,291,887
Compound Annual Growth Rate	
FY2016-22	14.9%
FY2022-25	12.2%
FY2025-30	7.1%
FY2030-35	6.0%
FY2035-40	4.5%
FY2040-45	3.2%
FY2045-55	2.1%
Overall CAGR FY2022-58	**4.6%**

Source: NMIA Air Traffic Study (May, 2018)

As observed in the above table, air cargo volumes in the MMR are predicted to grow from 0.8 million metric tonnes in FY 2017 and potentially reach up to 7 million metric tonnes by FY 2057.

2.3.1 NMIA Cargo Forecast

NMIA is expected to attract migration of non-scheduled and scheduled freighter operations e.g. DHL and FedEx, etc. In addition, NMIA belly cargo volumes are expected to grow according to the number of passenger air services introduced, particularly wide body passenger flights that provide significant cargo uplift capabilities. The air cargo forecast indicates following key factors:

- Belly cargo will have a greater share of the NMIA air cargo volumes over dedicated freighter movements; and

- Upon opening in 2022, express carrier freighters are expected to be the first to shift from CSMIA to NMIA, drawn by its greater operational efficiency and modern warehouse facilities.

Both types of cargo stop growing once NMIA reaches its maximum number of air traffic movement. For its part, CSMIA is allowed to continue growing until it reaches its estimated capacity for cargo turnover of 3 million tonnes.

Upon establishment of MMR passenger forecast, similar approach has been considered for NMIA air cargo forecasts. The cargo forecast of NMIA in juxtaposition of CSMIA Cargo handling capacity, combining belly freighter and full freighter cargos is outlined in **Table-2.8** below.

TABLE-2.8
NMIA CARGO ALLOCATION IN THOUSAND TONNES

Year	MMR Demand (Thousand tonnes)	Growth (%)	CSMIA capacity (Thousand tonnes)	Growth (%)	NMIA (Thousand tonnes)	Growth (%)
2018	890.0	11.1	890.0	11.1	-	-
2019	997.0	12.0	997.0	12.0	-	-
2020	1,118.1	12.2	1,118.1	12.2	-	-
2021	1,226.5	9.7	1,226.5	9.7	-	-
2022	1,463.0	19.3	1,339.2	9.2	123.5	-
2023	1,620.1	10.7	1,443.3	7.8	171.9	39.2
2024	1,858.2	14.7	1,554.3	7.7	288.6	67.8
2025	2,067.4	11.3	1,672.6	7.6	370.7	28.5
2026	2,232.8	8.0	1,754.9	4.9	430.0	16.0
2027	2,400.5	7.5	1,840.2	4.9	481.2	11.9
2028	2,566.1	6.9	1,928.7	4.8	546.1	13.5
2029	2,735.7	6.6	2,020.4	4.8	609.1	11.5
2030	2,911.4	6.4	2,115.3	4.7	671.8	10.3
2031	3,095.5	6.3	2,213.4	4.6	724.8	7.9
2032	3,286.1	6.2	2,314.8	4.6	771.5	6.4
2033	3,482.4	6.0	2,419.5	4.5	824.4	6.9
2034	3,687.3	5.9	2,527.5	4.5	878.6	6.6
2035	3,904.3	5.9	2,638.9	4.4	934.4	6.4
2036	4,125.9	5.7	2,753.7	4.3	992.6	6.2
2037	4,340.1	5.2	2,871.9	4.3	1,053.6	6.1
2038	4,514.1	4.0	2,971.2	3.5	1,107.0	5.1
2039	4,694.6	4.0	3,070.2	3.3	1,161.3	4.9
2040	4,873.0	3.8	3,070.2	0.0	1,216.4	4.7
2041	5,048.5	3.6	3,070.2	0.0	1,272.3	4.6
2042	5,220.1	3.4	3,070.2	0.0	1,328.9	4.4
2043	5,387.2	3.2	3,070.2	0.0	1,386.1	4.3
2044	5,548.8	3.0	3,070.2	0.0	1,443.6	4.2
2045*	**5,704.1**	**2.8**	**3,070.2**	**0.0**	**1,501.4**	**4.0**
2046	5,852.4	2.6	3,070.2	0.0	1,505.2	0.3
2047	5,992.9	2.4	3,070.2	0.0	1,509.0	0.3
2048	6,130.7	2.3	3,070.2	0.0	1,512.7	0.3
2049	6,265.6	2.2	3,070.2	0.0	1,516.5	0.3
2050	6,397.2	2.1	3,070.2	0.0	1,520.3	0.3
2051	6,525.1	2.0	3,070.2	0.0	1,524.1	0.3
2052	6,649.1	1.9	3,070.2	0.0	1,527.9	0.2
2053	6,768.8	1.8	3,070.2	0.0	1,531.8	0.2

Year	MMR Demand (Thousand tonnes)	Growth (%)	CSMIA capacity (Thousand tonnes)	Growth (%)	NMIA (Thousand tonnes)	Growth (%)
2054	6,883.9	1.7	3,070.2	0.0	1,535.6	0.2
2055	6,994.0	1.6	3,070.2	0.0	1,539.4	0.2
2056	7,098.9	1.5	3,070.2	0.0	1,543.2	0.2
2057	7,198.3	1.4	3,070.2	0.0	1,547.0	0.2
2058	7,291.9	1.3	3,070.2	0.0	1,550.8	0.2

Source: NMIA Air Traffic Study (May,2018)
**2045 is the horizon year in which the combined cargo handling capacity of NMIA reaches 1.5 MT*

Based on above, the reiteration of NMIA belly freighter and full freighter cargo forecast classified into domestic and international categories and the CAGR thereof is presented in **Table-2.9** below.

TABLE-2.9
NMIA AIR CARGO FORECAST CAGR (%)
CONSERVATIVE CASE (THOUSANDS OF TONNES)

Year	Domestic		International		Combined		Total
	Belly	Freighter	Belly	Freighter	Belly	Freighter	
FY2022	29	21.9	4.6	68	33.6	89.9	123.5
FY2023	45.7	28.5	5.9	91.8	51.6	120.3	171.9
FY2024	80	33.3	14.1	161.1	94.2	194.4	288.6
FY2025	112.7	38.6	28.6	190.8	141.3	229.4	370.7
FY2030	198.1	64.7	130.4	278.5	328.5	343.2	671.8
FY2035	265.8	92.2	243.2	333.0	509.1	425.2	934.3
FY2040	322.3	126.7	379.9	387.3	702.3	514.0	1216.3
FY2045	376.8	165.5	531.1	427.8	907.9	593.3	1501.3
FY2050	381.0	168.1	537.8	433.3	918.9	601.4	1520.3
FY2055	385.3	170.7	544.6	438.6	929.9	609.4	1539.3
FY2058	387.8	172.3	548.6	441.9	936.5	614.2	1550.8
CAGR (%)							
FY2022-25	57.2	20.8	83.9	41.1	61.4	36.7	44.2
FY2025-30	11.9	10.9	35.5	7.9	18.4	8.4	12.6
FY2030-35	6.1	7.3	13.3	3.6	9.2	4.4	6.8
FY2035-40	3.9	6.6	9.3	3.1	6.6	3.9	5.4
FY2040-45	3.2	5.5	6.9	2.0	5.3	2.9	4.3
FY2045-50	0.2	0.3	0.2	0.3	0.2	0.3	0.3
FY2050-55	0.2	0.3	0.2	0.2	0.2	0.3	0.2
FY2055-58	0.2	0.3	0.2	0.2	0.2	0.3	0.2
Overall CAGR (%)							
FY2022-58	7.5	5.9	14.2	5.3	9.7	5.5	7.3

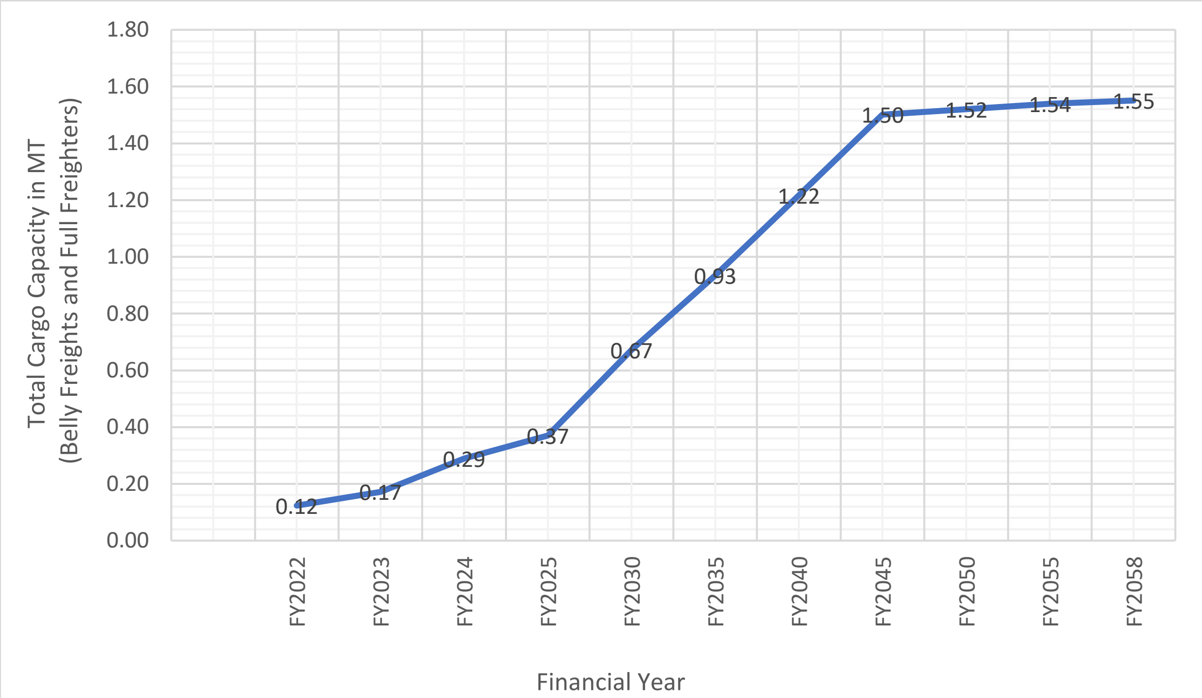
Source: NMIA Air Traffic Study (May, 2018)

The primary results are:

- NMIA is forecasted to handle about 1 million tonnes of total freight by FY 2037 and over 1.5 million tonnes by FY 2058,
- International cargo is projected to reach about 660,000 tonnes by FY 2037 and about 990,000 tonnes by FY 2058,

- Domestic cargo is forecasted to reach over 393,000 tonnes by FY 2037 and about 560,000 tonnes by FY 2058.

The NMIA cargo forecast is graphically presented in **Figure-2.6** below.



Source: NMAI Air Traffic Study

FIGURE-2.6
NMIA CARGO (BELLY FREIGHT & FULL FREIGHTER) FORECASTS

2.4 Air Traffic Movements (ATMs) Forecast

NMIA is assumed to have a maximum hourly capacity of 90 ATMs per hour considering two runways, which is expected to reach by FY 2045 (based on opening year of FY 2022), with passenger volumes of around 87 MPPA. After FY 2045, limited passenger traffic growth is expected through aircraft up-gauging and load factor increases, reaching up to 90 MPPA in FY 2058. Based on the above, a NMIA Conservative Case traffic forecast scenario is derived where:

- Growth at CSMIA is broadly the same as the base case until it reaches a capacity of 60 MPPA in FY 2023. CSMIA is projected to grow from 60 to 65 MPPA over two years when additional operational capacity is made available in FY 2030;
- Cargo volumes at NMIA are forecast to reach 1.5 million tonnes in FY 2045 with small growth to 2058; and
- GA movements in the MMR are forecast to reach 37.5 daily departures by 2058.

The peak hour passenger forecast for the Conservative Case is outlined in **Table 2.10** below.

TABLE-2.10
NMIA PEAK HOUR PASSENGER FORECAST (THOUSANDS) CONSERVATIVE CASE

Year	Domestic			International			Combined		
	Arrival	Departure	2-way	Arrival	Departure	2-way	Arrival	Departure	2-way
FY2023	1.11	1.18	1.84	0.29	0.37	0.60	1.29	1.19	2.15
FY2024	1.55	1.64	2.57	0.43	0.54	0.88	1.80	1.67	3.00
FY2025	2.00	2.11	3.31	0.60	0.74	1.22	2.32	2.16	3.87
FY2026	2.44	2.57	4.05	0.78	0.96	1.57	2.84	2.66	4.73
FY2027	2.92	3.08	4.85	1.00	1.23	2.02	3.43	3.21	5.71
FY2028	3.38	3.56	5.61	1.25	1.55	2.53	4.01	3.75	6.67
FY2029	3.78	3.98	6.29	1.52	1.87	3.06	4.54	4.24	7.55
FY2030	4.13	4.35	6.85	1.73	2.13	3.48	4.98	4.66	8.29
FY2031	4.41	4.65	7.34	1.83	2.25	3.68	5.32	4.98	8.86
FY2032	4.68	4.93	7.78	1.91	2.36	3.86	5.64	5.27	9.38
FY2033	4.94	5.20	8.21	2.05	2.52	4.12	5.96	5.57	9.92
FY2034	5.18	5.45	8.60	2.18	2.68	4.39	6.26	5.85	10.42
FY2035	5.40	5.69	8.98	2.31	2.85	4.66	6.55	6.13	10.90
FY2036	5.63	5.93	9.36	2.45	3.02	4.93	6.84	6.40	11.39
FY2037	5.86	6.17	9.73	2.59	3.19	5.22	7.14	6.68	11.88
FY2058	7.03	7.35	11.69	3.18	2.84	6.27	8.64	8.15	14.38

Source: NMIA Air Traffic Study (May, 2018)

The aircraft movement (ATM) forecasts are derived from the passenger and cargo forecasts presented above. The NMIA forecast of average passengers per aircraft is presented in **Table-2.11** below.

TABLE-2.11
FORECAST OF AVERAGE PASSENGER PER AIRCRAFT

Year	Domestic	International
FY2022	156	82
FY2023	151	148
FY2024	152	142

Year	Domestic	International
FY2025	152	134
FY2026	152	138
FY2027	153	142
FY2028	153	145
FY2029	153	146
FY2030	154	147
FY2031	154	148
FY2032	154	149
FY2033	154	151
FY2034	154	152
FY2035	155	153
FY2036	155	155
FY2037	155	156
FY2038	155	158
FY2039	155	159
FY2040	155	160
FY2041	156	161
FY2042	156	163
FY2043	156	164
FY2044	156	165
FY2045	156	166
FY2046	156	168
FY2047	157	169
FY2048	157	170
FY2049	157	171
FY2050	157	173
FY2051	157	174
FY2052	157	175
FY2053	158	176
FY2054	158	178
FY2055	158	179
FY2056	158	180
FY2057	158	181
FY2058	158	183

Source: NMIA Air Traffic Study (May, 2018)

Based on above information, the summary of the annual and daily NMIA passenger aircraft movement forecast for all types of aviation is presented in **Table-2.12** below.

TABLE-2.12
SUMMARY OF PASSENGER AIRCRAFT MOVEMENT FORECAST OF NMIA

Horizon Year	Domestic	International	Total	Cargo	Other	Total (Annual)	Total (Daily*)
FY2024	63,811	6,350	70,160	5,841	13,943	89,944	228
FY2026	1,16,096	20,771	1,36,867	7,748	15,184	159,798	426
FY2030	2,11,140	53,960	2,65,100	10,052	17,765	292,917	774
FY2037	3,16,624	81,155	3,97,778	13,244	22,446	433,468	1194
FY2058	4,26,107	1,22,196	5,48,303	16,630	27,382	592,314	1569

** Total Peak Day Aircraft Movements – NMIA Air Traffic Study by Intervista*
Source: NMIA Air Traffic Study (May, 2018)

In addition to the annual and daily ATM forecasts of passenger aircrafts presented above peak hour forecasts were also prepared for commercial passenger ATMs, which are shown in **Table-2.13** below and is represented graphically in **Figure-2.7.**

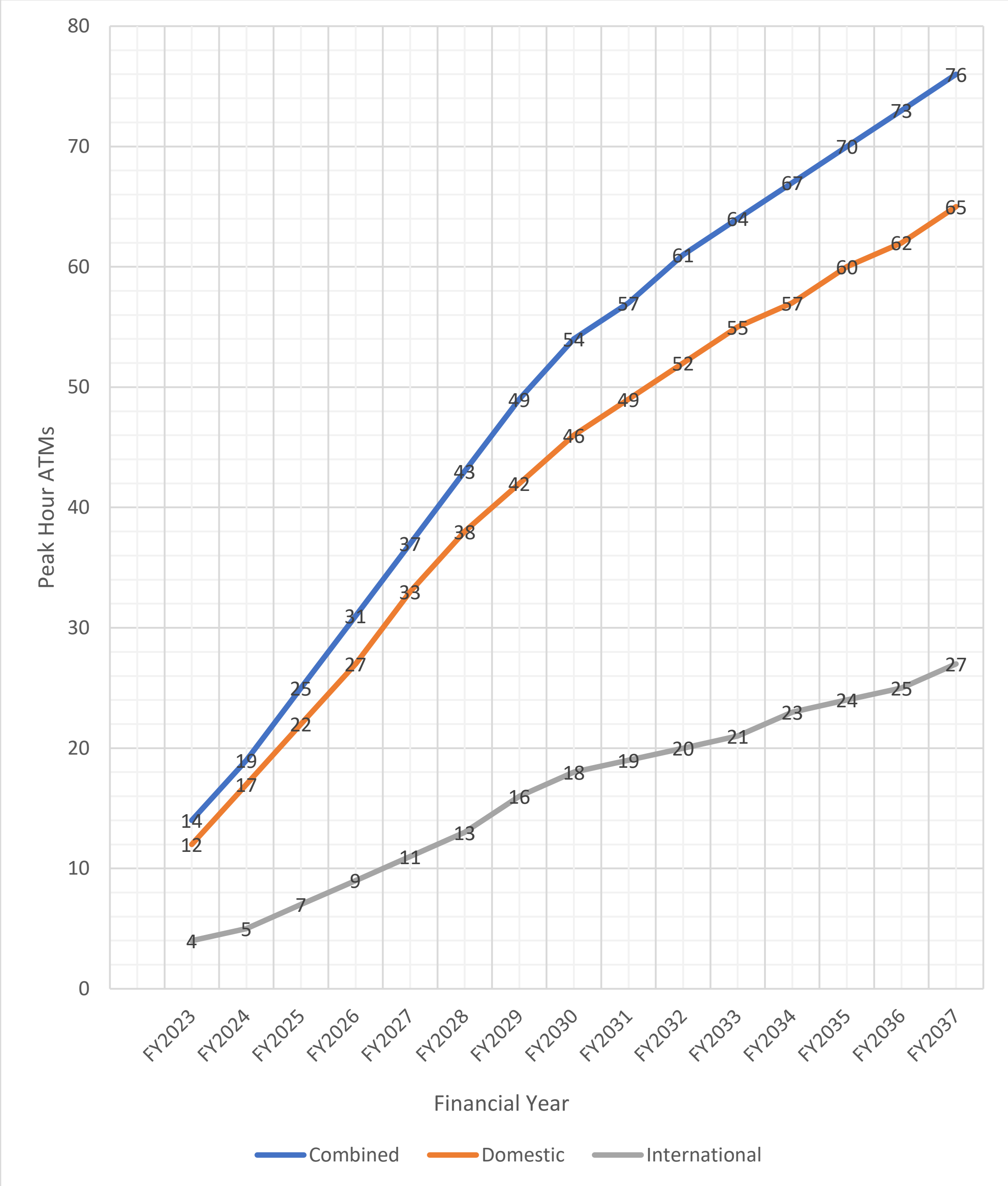
TABLE-2.13
PEAK HOUR COMMERCIAL AIRCRAFT MOVEMENTS
CONSERVATIVE CASE

Year	Domestic			International			Combined		
	Arrival	Departure	2-way	Arrival	Departure	2-way	Arrival	Departure	2-way
FY2023	7	7	12	2	2	4	7	9	14
FY2024	10	10	17	3	3	5	10	13	19
FY2025	13	13	22	4	4	7	13	17	25
FY2026	16	16	27	5	5	9	16	20	31
FY2027	20	20	33	6	7	11	19	24	37
FY2028	23	23	38	8	8	13	23	28	43
FY2029	25	25	42	9	10	16	26	32	49
FY2030	28	28	46	10	11	18	28	35	54
FY2031	29	29	49	11	12	19	30	37	57
FY2032	31	31	52	11	12	20	32	39	61
FY2033	33	33	55	12	13	21	34	41	64
FY2034	34	34	57	13	14	23	36	43	67
FY2035	36	36	60	14	15	24	38	45	70
FY2036	37	37	62	15	15	25	40	47	73
FY2037	39	39	65	15	16	27	41	49	76
FY2058	45	45	75	21	22	37	53	55	90

Source: NMIA Air Traffic Study (May, 2018)

The primary results for the conservative case forecast of commercial passenger aircraft are:

- Total commercial aircraft movements are expected to reach over 397,000 by FY 2037 and about 548,000 in FY 2058;
- International commercial aircraft movements are forecasted to reach 81,155 in FY 2037 and 122,196 in FY 2058;
- Domestic aircraft movements are forecasted to increase to 316,624 movements in FY 2037 and 426,107 movements in FY 2058; and
- Peak hour 2-way aircraft movements of domestic and international commercial aircrafts are expected to increase to about 17 in FY 2024 to 65 in FY 2037 and 5 in FY 2024 to 27 in FY 2037 respectively.



Source: NMIA Air Traffic Study

FIGURE-2.7
NMIA PEAK HOUR PASSENGER AIR TRAFFIC MOVEMENTS FORECST

2.4.1 NMIA General Aviation (GA) ATM Forecast

In order to maximize runway utilization for increasing passenger handling capacity at CSMIA, it has been considered that all GA operations at CSMIA shall be relocated to NMIA at opening of the new airport. A summary of NMIA forecast ATMs for both for GA operation in Conservative Case scenarios is shown in **Table-2.14** and is graphically shown in **Figure-2.8.**

General Aviation operations do not continue at CSMIA post FY2022, and all GA traffic is instead planned to be relocated to NMIA to meet the forecasted GA demand, as well as optimize CSMIA's airfield capacity for commercial passenger/cargo operations.

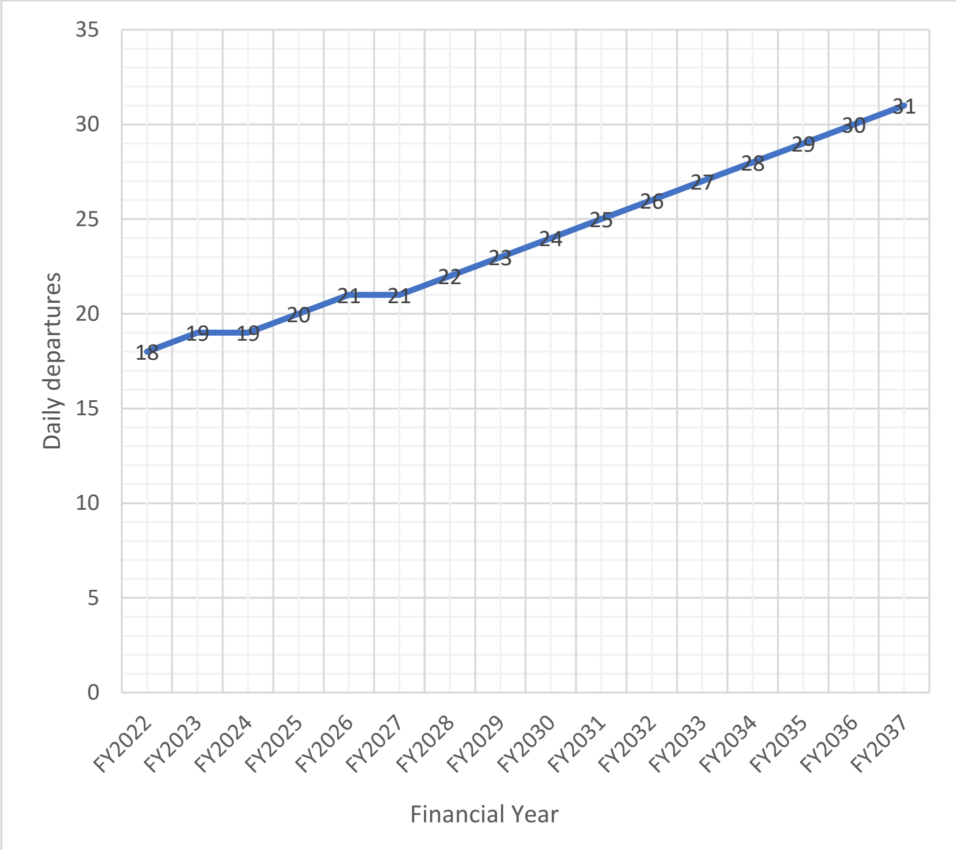
TABLE-2.14
NMIA GA AIR TRAFFIC MOVEMENT FORECAST

Year	Annual GA ATMs	Avg GA Dep/Day	Year	Annual GA ATMs	Avg GA Dep/Day
FY2022	10,010	18	FY2040	24,263	33
FY2023	13,578	19	FY2041	24,870	34
FY2024	13,943	19	FY2042	25,487	35
FY2025	14,381	20	FY2043	26,112	36
FY2026	15,184	21	FY2044	26,744	37
FY2027	15,657	21	FY2045	27,382	38
FY2028	16,361	22	FY2046	27,382	38
FY2029	17,064	23	FY2047	27,382	38
FY2030	17,765	24	FY2048	27,382	38
FY2031	18,461	25	FY2049	27,382	38
FY2032	19,150	26	FY2050	27,382	38
FY2033	19,831	27	FY2051	27,382	38
FY2034	20,503	28	FY2052	27,382	38
FY2035	21,163	29	FY2053	27,382	38
FY2036	21,811	30	FY2054	27,382	38
FY2037	22,446	31	FY2055	27,382	38
FY2038	23,065	32	FY2056	27,382	38
FY2039	23,668	32	FY2058	27,382	38

Source: NMIA Air Traffic Study (May, 2018)

2.5 Existing Infrastructure

Development of Navi Mumbai is planned to accommodate a population of over 20 lakhs and employment of 8 lakhs, to relieve the pressure of urban expansion in Mumbai. Navi Mumbai is expected to absorb the future growth in population, business and commercial activities of MMR. Development of greenfield airport at Navi Mumbai leading to creation of large-scale employment and business opportunities, shall provide required boost to attract population from Mumbai & MMR to Navi Mumbai. The availability of physical and social infrastructure in Navi Mumbai, centrally located & well connected large suitable site for airport development with least rehabilitation & re-settlement makes Navi Mumbai International Airport project technically suitable and financially attractive for overall development of Navi Mumbai and MMR.



Source: NMIA Air Traffic Study

FIGURE-2.8
NMIA GENERAL AVIATION DAILY AIR TRAFFIC MOVEMENTS FORECASTS

2.5.1 Proposed Site

The Mumbai Metropolitan Region (MMR) spreads over an area of 4,355 sq. km and comprises Greater Mumbai, Thane, Kalyan, Vasai-Virar and Navi Mumbai. Navi Mumbai is being developed as a counter magnet to Mumbai city. Navi Mumbai International Airport (NMIA) site is located about 40 km east of South Mumbai / Nariman Point and about 35 km south-east from Chhatrapati Shivaji Maharaj International Airport (CSMIA) in Panvel taluka, Raigad district of Maharashtra. The site is situated in center of Navi Mumbai, at Airport Reference Point (ARP) latitude 18° 59′ 40″ N and longitude 73° 04′ 13″ E, (**Figure-2.9**) between Amra Marg and National Highway 4B (NH-4B). The business districts of Belapur and Vashi, the main commercial hubs of Navi Mumbai, are in close proximity of NMIA to north & northwest side respectively, while Jawaharlal Nehru Port (JNP) and Navi Mumbai Integrated Industrial Area/ SEZ are located south of NMIA. IT parks and industrial areas at Airoli, Ghansoli are located further north of Vashi and industrial area and warehousing hubs of Kalamboli and Taloja are located within 5 km to 10 km to north-east of NMIA.

2.5.2 NMIA Land Area

NMIA site area of 1160 ha is spread across eight revenue villages in Panvel taluka of Raigad district and had nine existing village gaothans within site. The relocation of existing village gaothans has been taken up by CIDCO, and most of these have been relocated & re-settled outside NMIA site. **Table-2.15** presents settlements / gaothans which existed on airport site.

TABLE-2.15
SETTLEMENTS ON NMIA SITE AREA

Sr. No.	Revenue Village	Village Gaothan
1	Targhar	Kombadbhuje
		Targhar
2	Ulwe	Ulwe
		Ganeshpuri
3	Owle	Waghavali Wada
		Owale (Upper & Lower)
4	Pargaon	Kohli
5	Kopar	Kopar
6	Vadghar	Chinchpada
7	Vaghavali Khar	-
8	Pargaon Dungi	-

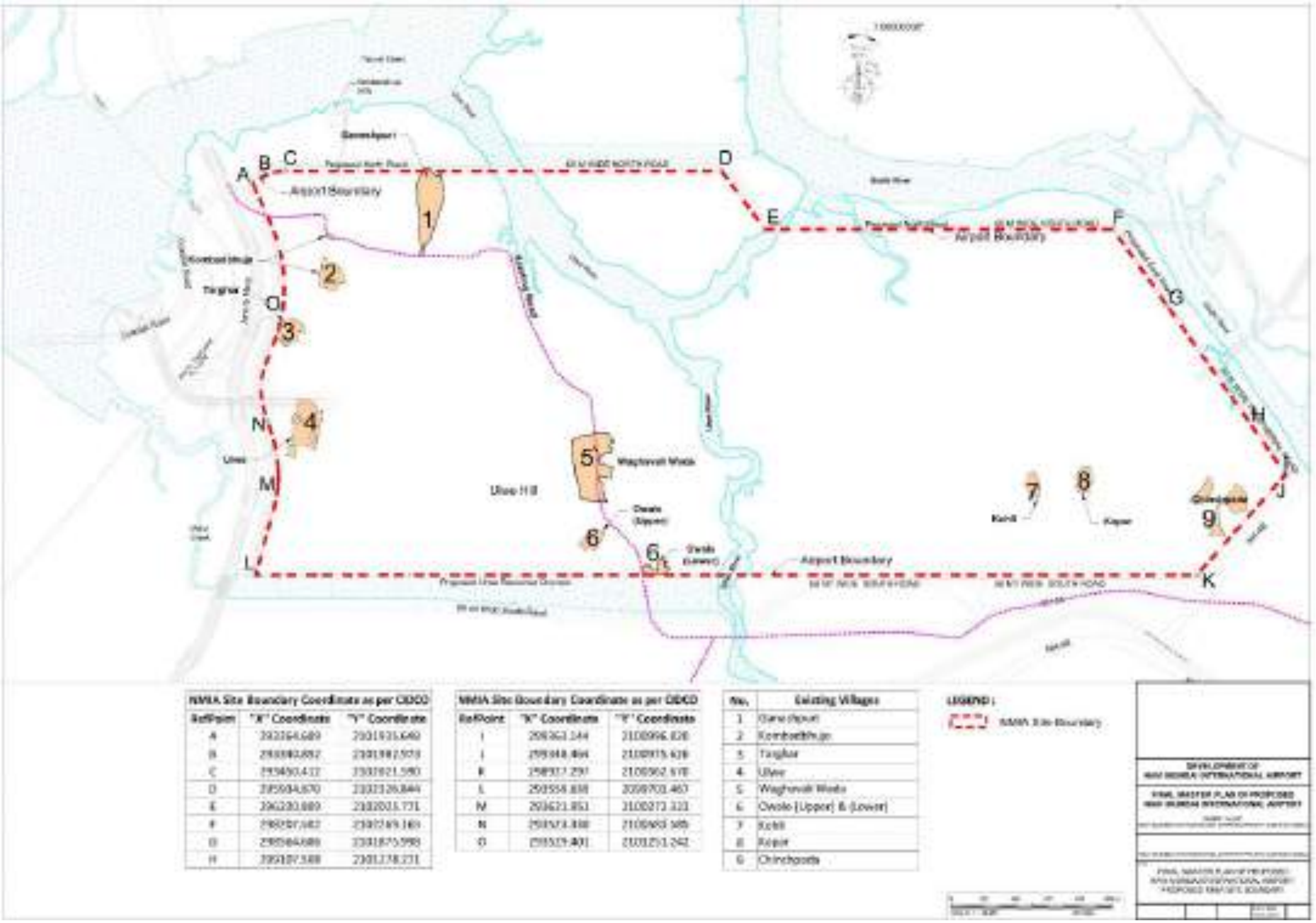
Source: Master Plan (May, 2019)

2.5.3 Site Physical Features (Before Commencement of Pre-development Works)

NMIA site area is inclusive of land under nine village gaothans also contained identifiable physical features like Ulwe River and Ulwe Hill (part located within NMIA site). The site consisted of multiple natural features and varied topography, along with some existing uses/ activities in various pockets across the site.

The NMIA site was earlier characterized by varied natural topography, hydrology and soil types as it is located in the coastal region adjoining Panvel creek. In general, the site slopes from the south and the west towards the east and the north, with large variations in the existing levels. The NMIA site exhibited multiple natural features like low lying areas in the northern, central and western parts of the site. Ulwe hill with an elevation of over 82 m is located in the western part of the site and the Ulwe River was located in the central part, and it flowed from the south to the north across the site.

Gadhi River flows east to west along eastern boundary of airport site. The airport land rises towards south and west, but more steeply on the western side towards ridge of Ulwe Hill. There is an existing road, which starts from north-west corner of the site, linking the village gaothans and eventually connects to Uran-Panvel Road on southern part of site but this road shall be de-commissioned once airport construction work commences on site. **Figure-2.10** presents the existing features (prior to project Pre-Development Works) and **Figure-2.11** provides photos of NMIA site conditions.



Source: Master Plan (May, 2019)

FIGURE-2.9
NMIA SITE [BEFORE PRE-DEVELOPMENT WORKS]

Source: Master Plan (May, 2019)

FIGURE-2.10

NMIA PHYSICAL FEATURES (PRIOR TO SITE PRE-DEVELOPMENT WORKS)

Source: Master Plan (May, 2019)

FIGURE-2.11
NMIA SITE CUTTING OF ULWE HILL DURING PRE-DEVELOPMENT STAGE

2.5.4 Right of Way

In accordance with the Concessionaire Agreement, NMIAL shall develop the airport within 1160 ha area. CIDCO has granted Right of Way (RoW) for 1156 ha (out of 1160 ha) to NMIAL, which is about 99% of the project site area and work for handing over the balance 1 % of land is in process. As per CA terms, NMIAL is to Design, Build, Finance, Operate and Transfer (DBFOT) the Navi Mumbai International Airport over a concession period of 30 years, which is further extendable by 10 years.

2.5.5 Site Pre-Development Works

Pre-Development Works of NMIA project, including Land Development Works were commenced at site by CIDCO (as Project Proponent) in April 2017 after receiving Forest Clearance. Most of the Pre-Development Works of NMIA project have been completed, and few works are nearing completion. Cutting & filling of rock from existing Ulwe Hill in site up to +5.5 m AMSL has been completed. The diversion of Ulwe River and construction of Ulwe Recourse Channel is completed, while training of Gadhi River is in progress and shifting of EHVT Lines by Tata Power is completed. The shifting of EHVT Lines by MSETCL is in progress and is expected to be completed by August / September 2021. The progress site pre-development works, and the present condition of the site is described in Chapter-1 **(Section-1.3.6 and Figure-1.2)**

2.5.6 Site Accessibility

NMIA site is strategically located between two main arterial roads of Navi Mumbai, with 8 lane Amra Marg on west and 6 lane NH-4B on its eastern edge. The site is also close to Mumbai Pune Expressway (Sion-Panvel Highway), connected to it by Amra Marg.

NMIA is thus connected to Mumbai, Thane, rest of Navi Mumbai and surrounding region by existing major arterial roads, highways and sub-urban rail (Partially commissioned). In near future, metro rail shall connect NMIA to Mumbai, Thane and Kalyan-Dombivali. NMIA site is presently accessible from South Mumbai by Eastern Freeway to Chembur and then via Sion-Panvel Highway and Palm Beach Road to Amra Marg. In near future, Mumbai Trans Harbour Link (MTHL), a 22-km long bridge across Thane creek from Sewri in Mumbai to Ulwe in Navi Mumbai, shall directly connect NMIA to South Mumbai. The MTHL project is scheduled for completion by 2023.

Primary access to NMIA site is planned from west, from Amra Marg and from NH-4B from eastern side. Further North, Amra Marg connects to Sion-Panvel highway and Vashi Bridge through Palm Beach Road. On southern side, Amra Marg connects to NH-4B which connects to Jawaharlal Nehru Port (JNP) to south west and Sion-Panvel highway through NH-4B towards north east. In immediate vicinity of proposed airport, Amra Marg, NH-4B has 3+3 lane configuration while Sion-Panvel Highway has been widened to 5+5 lane configuration. There is no direct access to the airport from SH-54.

NMIA site is also accessible from existing Mankhurd-Belapur-Panvel & Thane-Panvel commuter rail corridors from Khandeshwar railway station in northeast and from Targhar railway station in the west on the Nerul-Uran Railway line. Part of Seawoods-Uran suburban line, up to Khar/Kopar station has been commissioned.

Sion-Panvel Highway and Thane-Belapur Road (SH-42) are the major regional road linkages in the north providing connectivity to the road traffic coming from Greater Mumbai and Thane respectively, with Amra Marg (NH-348-A) along with Palm-Beach Road establishing access to NMIA.

In later phases of its development and operation, NMIA connectivity shall be further enhanced to Mumbai by proposed Mumbai Trans Harbour Link (MTHL) and Metro rail, which are being jointly developed by CIDCO and MMRDA. Similarly, road expansion and metro connectivity from east, from NH-4B to airport site boundary, across Gadhi River shall be completed by CIDCO. Water transport connectivity is also an important possibility and shall be explored in future, with a jetty near North Road of NMIA, to be used to bring in construction materials during construction phase and later for movement for cargo to and from Mumbai during operations phase. Maharashtra Maritime Board (MMB) had granted permission to NMIAL in 2018 for use of existing jetty located near NMIA site. The site connectivity of NMIA site location explained above is illustrated in **Figure-2.12**.

Another connectivity of arterial road of 7Km length, called North Road is being developed by CIDCO. It starts at the Amra Marg junction and runs on the northern boundary of airport, finally connecting to NH-4B with a clover-leaf junction. This road would provide the accessibility to aeronautical activities including Defence enclave and support facilities located to the north of northern runway of NMIA. This North Road traverses mainly over an area of category CRZ I and II area as approved in CZMP. MCZMA has granted CRZ approval vide letter no. F.No 10-53/2009-IA-III 26th December 2018 with respect to this section of the North Road along the northern boundary of NMIA to be developed by CIDCO as part of off-site physical infrastructure of NMIA.

The list of existing road and rail networks connectivity to NMIA is presented in **Table-2.16** below:

TABLE-2.16
EXISTING ROAD AND RAIL NETWORK CONECTIVITY TO NMIA

1	Existing Road Network Connectivity	2	Existing Railway Network Connectivity
	• Sion - Panvel Expressway • Mumbai-Pune Expressway • Amra Marg • NH- 4B • SH-54 • Thane-Belapur • Palm beach Road		• Line 1 –Metro • Harbor Line • Trans Harbor Line • Central Line • Western Line

Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA).

Source: Master Plan (May, 2019)

FIGURE-2.12
REGIONAL TRANSPORT CONNECTIVITY OF NMIA

2.6 Development around NMIA

Navi Mumbai International Airport (NMIA) site is located in Panvel taluka of Raigad district of Maharashtra. NMIA comes under planning jurisdiction of CIDCO. Business districts of Belapur and Vashi, main commercial hubs of Navi Mumbai are in close proximity of NMIA to north, while Jawaharlal Nehru Port (JNP) and Integrated Industrial Area (IIA, formerly Navi Mumbai SEZ) are to the south of NMIA. IT parks, corporate parks and industrial areas at Airoli, Ghansoli are located further north of Vashi and industrial area and warehousing hubs of Kalamboli and Taloja are located within 5 to 10 km to north-east of NMIA.

2.6.1 Area of Influence

Ministry of Environment, Forest & Climate Change (MoEF&CC), GoI had accorded Environmental and CRZ clearance for establishment of International Air Port in Navi Mumbai on 22nd November, 2010. While according to clearance the MoEF&CC, GOI has stipulated certain conditions. Specifically, the specific EC condition No. XXVII (I) of construction Phase mandates, that "*The Master Plan/Development Plan of Navi Mumbai shall be revised and re-casted in view of the Airport development to avoid unplanned haphazard growth around the airport.*"

Therefore, CIDCO, has assessed the impacts of the project beyond 10 km radius of project site considering the requirements of airport, airport connectivity infrastructure, proximity to eco-sensitive zones, etc. The assessment estimated that the area encompassing the 560 square kilometres within 372 villages (256 in Raigad district and 17 in Thane district) up to 25 km would be influenced by the construction and operation of the new Greenfield airport of NMIA. This area is termed as Navi Mumbai Airport Influence Area (NAINA), and Govt. of Maharashtra, vide Notification No.: TPS-1712/475/CR98/12/UD-12 dated 10th January 2013 (**Annexure-VII**), has appointed CIDCO as the Special Planning Authority for NAINA. The boundaries of NAINA as defined in the notification are as below:

North: The northern boundary of village Nitalas touching the boundary of AKBSNA (Ambernath, Kulgaon-Badlapur, and surrounding notified area), boundary of Matheran Eco-Sensitive Zone (MSEZ) passing through village Wangani Tarf Taloje;

East: Boundary of MESZ passing through village Wanigani Tarf Taloje upto village Wavarle; then Western boundary of Karjat Municipal Council, then railway line passing through Karjat Municipal Council up to MMR boundary.

South: MMR boundary from north-west corner of Khalapur Municipal Council to Pen Municipal Council, the north to west boundary of Pen Municipal Council, MMR boundary from west corner of Pen Municipal Council to tehsil boundary of Pen, then along the boundary of Pen Tehsil up to village Vittalwadi; and

West: Along periphery of Khopta new town from village Vittlawadi to Kanthavali and further along the periphery of Navi Mumbai to village Nitlas.

2.6.1.1 Land Use Pattern in the Project Corridor

Further, complying to the EC & CRZ Clearance granted by MoEF&CC vide letter dated November 22, 2010 for establishment of NMIA, GoM vide Notification No TPS 1711/2495/CR-202/11/UD-12 (**Annexure-VIII**) dated 21st March 2012 amended the Navi Mumbai Development Plan (NMDP) incorporating new landuse designated as "International Airport & Allied Activities / Service Zone" for NMIA Site area of 1160 ha, and changed the land use of NMIA site accordingly. The Modified Land Use Map of NMIA Site area as per Navi Development Plan is presented in **Figure-2.13.**

2.6.2 Planned Local & Regional Connectivity in MMR

2.6.2.1 Proposed Local Transport Connectivity Plan for NMIA

Major catchment area of NMIA shall be Mumbai mainland, especially central and eastern suburbs and Island city, which shall generate major share of air passengers for NMIA. Existing connectivity between Navi Mumbai and Mumbai is through Sion-Panvel Highway which has been widened to 5+5 lanes. Connectivity to Island city is proposed through MTHL which is under construction. MTHL shall connect to Ulwe coastal road, to be constructed by CIDCO. Interchange is proposed on Western main entry of NMIA to connect seamlessly with Amra Marg and Ulwe Coastal Road. Location of NMIA provides opportunity to maximize accessibility for its catchment areas from its western, northern and eastern direction. NMIA passenger catchment area is predominantly located to west of NMIA, therefore maximum passengers shall access NMIA from western side via Amra Marg and to facilitate same, existing and proposed airport connectivity infrastructure in NMIA Master Plan has Central Terminal Complex with principal passenger terminals / facilities dependent on main airport access from western part of airport.

Cargo, MRO, GA, Fuel Farm and other ancillary airport uses are proposed on eastern part of NMIA site with separate access, thus ensuring segregation of passenger and non-passenger vehicular movement to large extent. For convenience of passengers from eastern part of Navi Mumbai to Central Terminal Complex, an eight-lane North Road along northern boundary of NMIA is being developed by CIDCO, connecting Amra Marg on west and NH-4B on east.

A large number of proposals have been made by different implementing agencies towards improving the transport system in MMR. The list of existing road and rail networks connectivity to NMIA and committed transportation projects and status is presented in **Table-2.17** below:

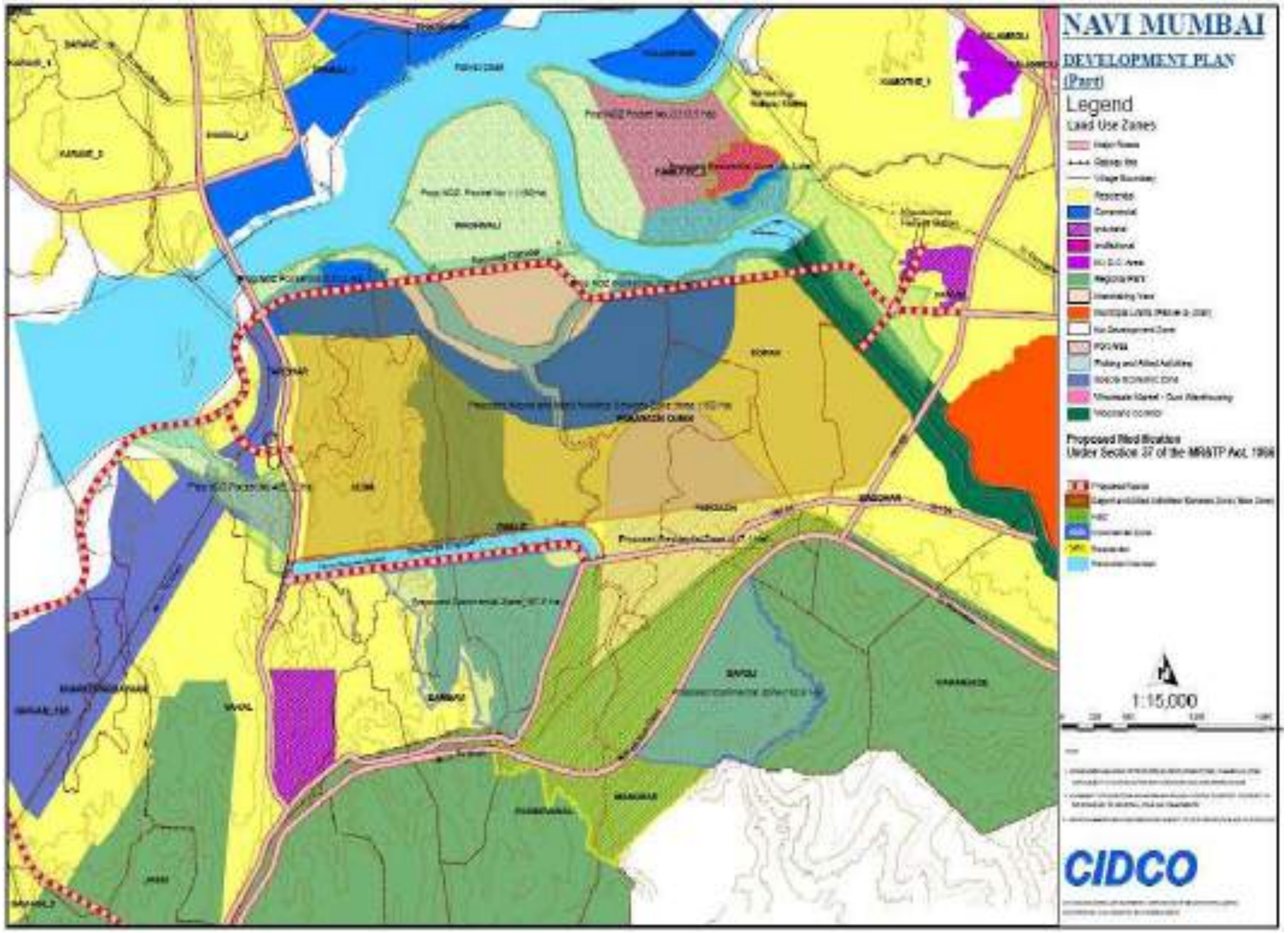


FIGURE-2.13

MODIFIED LAND USE PLAN OF NAVI MUMBAI DEVELOPMENT PLAN (NMDP)

TABLE-2.17
COMMITTED TRANSPORTATION
PROJECTS AND THEIR STATUS IN MMR

COMMITTED/PROPOSED TRANSPORTATION PROJECTS AND THEIR STATUS IN MMR			
Code	**Name**	**Status**	**Implementation Year**
Sub-Urban Rail			
S3	Panvel-Karjat Rail Line	DPR completed	2026
51	Seawoods —Uran Rail Line	Under Construction	2021
S5	Diva-Panvel Rail Line	DPR completed	2025
S6	CSMT— Panvel Rail Line	DPR is in progress	2026
Metro Rail			
M19	Sewri-Prabhadevi-3.5 Siddhivinayak-Jambhulpada (MTHL)	DPR is Completed	2031
M14	Belapur-Taloja-Pendhar	Under Construction	2021
M16	MIDC to Khandeshwar	DPR is Completed	2026
M17	Khandeshwar to NMIA	DPR is Completed	2031
M8	CSIMA - NMIA Fast	DPR in Progress	2026
M20	MTHL Spur to NMIA	DPR is Completed	2031
Highway Corridor			
H3	MTHL	Under Construction	2024
H5	Multi Modal Corridor	DPR in progress	2026
H18	Spine Corridor in NAINA	Proposed in NAINA DP	2035
H2O	Belapur to MMC (Taloja	Proposed in Naina DP	2031
H29	CIDCO Coastal Road	DPR Completed by CIDCO	2024
H11	Radial-5 (Turbe-Taloja-Ustane)	DPR Completed by CIDCO for (Turbhe to Taloja) / Proposed in RP	2026
H12	Mumbai-Vadodara Spur	Under Construction	2026

Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA)

All these projects put together with existing transport network shall significantly improve transport connectivity to the NMIA, both at the regional and local level. A "Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA)" elaborating above aspects, prepared for NMIA (by Lea Associate South Asia Pvt. Ltd.) is presented in **Annexure-IX** of this report.

2.6.2.2 Proposed Multi Modal Regional Transport Connectivity Plan for NMIA

It is important to note that the proposed transport plan for MMR 2041 includes sub-urban rail corridors, metro corridors, monorail corridors, dedicated bus lanes / BRTS and highway / expressway corridors, which provide both regional as well as local transport connectivity to the NMIA. While evolving the plan, the specific needs of NMIA have been kept in mind to satisfy the ground access needs of NMIA air passengers and cargo.

Further, it is important to note that the projects planned by various planning authorities/agencies in MMR (MMRDA, MSRDC, CIDCO, PWD, Municipal Corporations, Municipal Councils, etc.) have been incorporated in the connectivity plan appropriately by integrating and ensuring continuity of the corridors. In addition to the land-based transport modes, Passenger Water Transport routes between Island city/ Thane/ Mira- Bhayander / Vasai-Virar/ Kalyan-Dombivali and

NMIA / Belapur are also included in the overall plan to enhance the regional transport connectivity to NMIA. The recommended multi modal regional transport connectivity plan is presented in **Figure-2.14**.

Towards improving the local transport connectivity, improvements to the roads and grade separation facilities at major intersections in the vicinity of the airport is proposed to improve the traffic operating service levels on the road network. The proposed enhanced transport connectivity will provide faster access/egress to/from the proposed NMIA as well as additional transport infrastructure for the other road or public transport users.

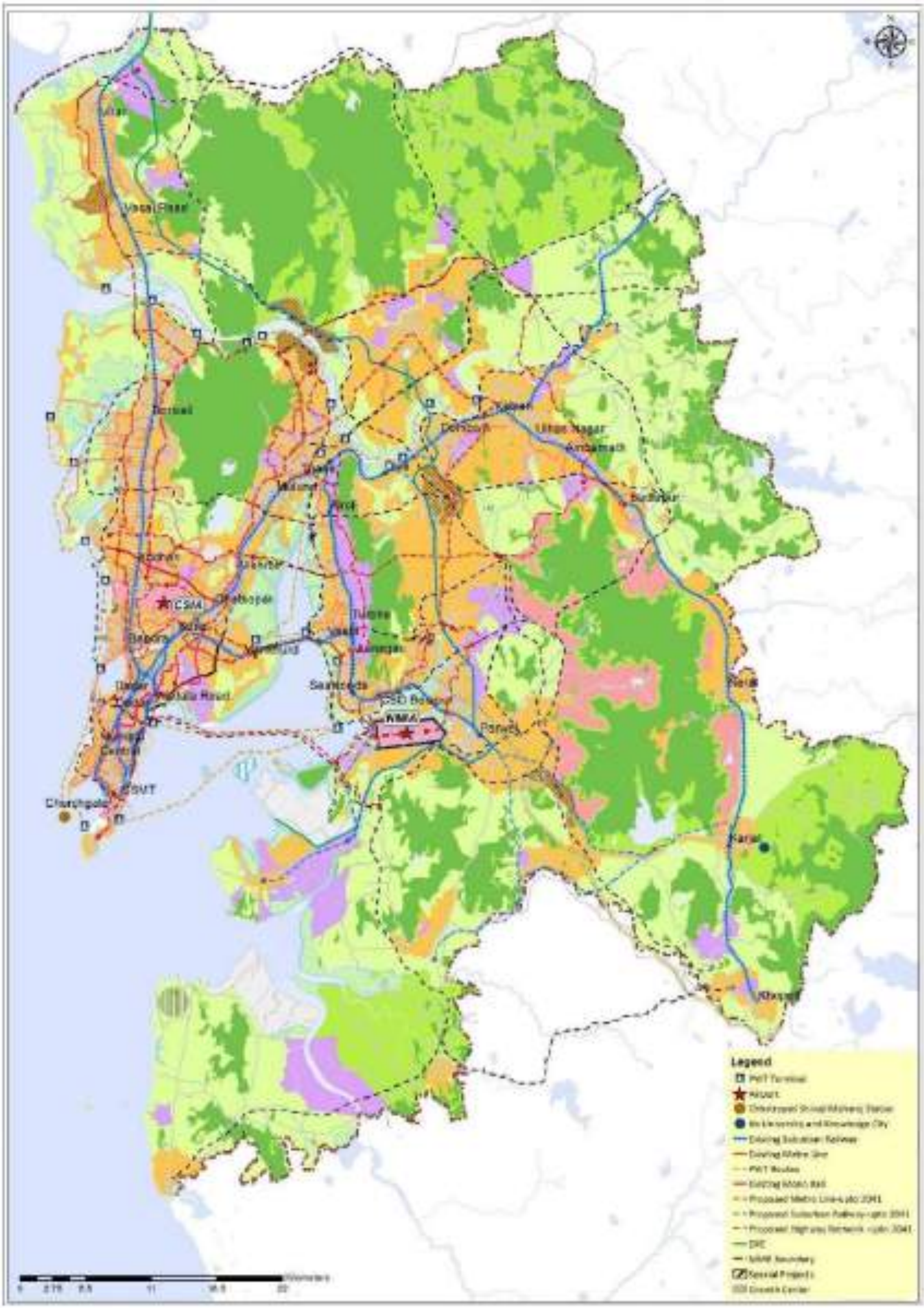
Time taken to travel between two points is considered as a good determinant of level of service any facility provides. This is true in case of transport connectivity to NMIA also. Travel time is estimated for the horizon year 2041, for the proposed network, by considering factors such as mode of transport, transport network connectivity, traffic levels on road system, public transport system characteristics (frequency, capacity, speed, etc.) and time and day of travel.

CTS for MMR Updation Study database is used, as the above is required to be done for MMR. It may be noted that in CTS for MMR Updation Study, MMR was divided into nineteen clusters. The proposed NMIA is located in Uran, NMNT CIDCO. The remote places of Navi Mumbai cluster from the proposed NMIA location are at a distance of about 25 km. However, major residential and commercial centres are located within a radius of 10 km from NMIA and these may further intensify once NMIA operations begin.

Assessment of travel times by various major modes, from different TAZs, to the NMIA is done considering the proposed multi modal transport network and travel demand assessed (using EMME software) for the horizon year 2041. Average travel distance and travel times from various clusters of MMR to NMIA are presented in detail in **Annexure-IX**. Following are the inferences of the above analysis:

1) Sub-urban rail system provides connectivity between various clusters of MMR to NMIA excluding C15: Khopta, C19: Alibaug Municipal Council and some of the rural areas of MMR. Suburban is a preferred mode of transport from different clusters of MMR to NMIA and vice versa as compared to other modes of transport, for most of the Clusters (excluding C3: Eastern Suburbs, C6: KDMC, AKBSNA, Ulhasnagar, KBMC, AMCC, 15: Khopta and C17: Rest of MMR). The average travel time is about 46 minutes;

2) Metro provides connectivity between various clusters of MMR to NMIA excluding C13: MSRDC, C18: Matheran, Karjat, Khopoli and C19: Alibaug Municipal Council and some of the rural areas of MMR. The average travel time is about 55 minutes (Minimum from C8: Uran, NMNT CIDCO which is about 13 minutes and maximum from C7: Vasai-Virar which is about 138 minutes). Thus, after the suburban metro is the preferred mode of transport mode from various clusters where it provides connectivity, to NMIA;



Source: Detailed Traffic Management and Traffic Decongestion Plan for NMIA, April, 2020; LASA

FIGURE-2.14
MULTI MODAL REGIONAL TRANSPORT CONNECTIVITY PLAN FOR NMIA

3) Bus provides transport connectivity to from all the clusters of MMR to NMIA and average travel time is about 80 minutes (Minimum from C8: Uran, NMNT CIDCO which is about 21 minutes and maximum from C11: Mira-Bhayander which is about 122 minutes);

4) Road connectivity is available from all the cluster of MMR to NMIA and average travel time is about 69 minutes;

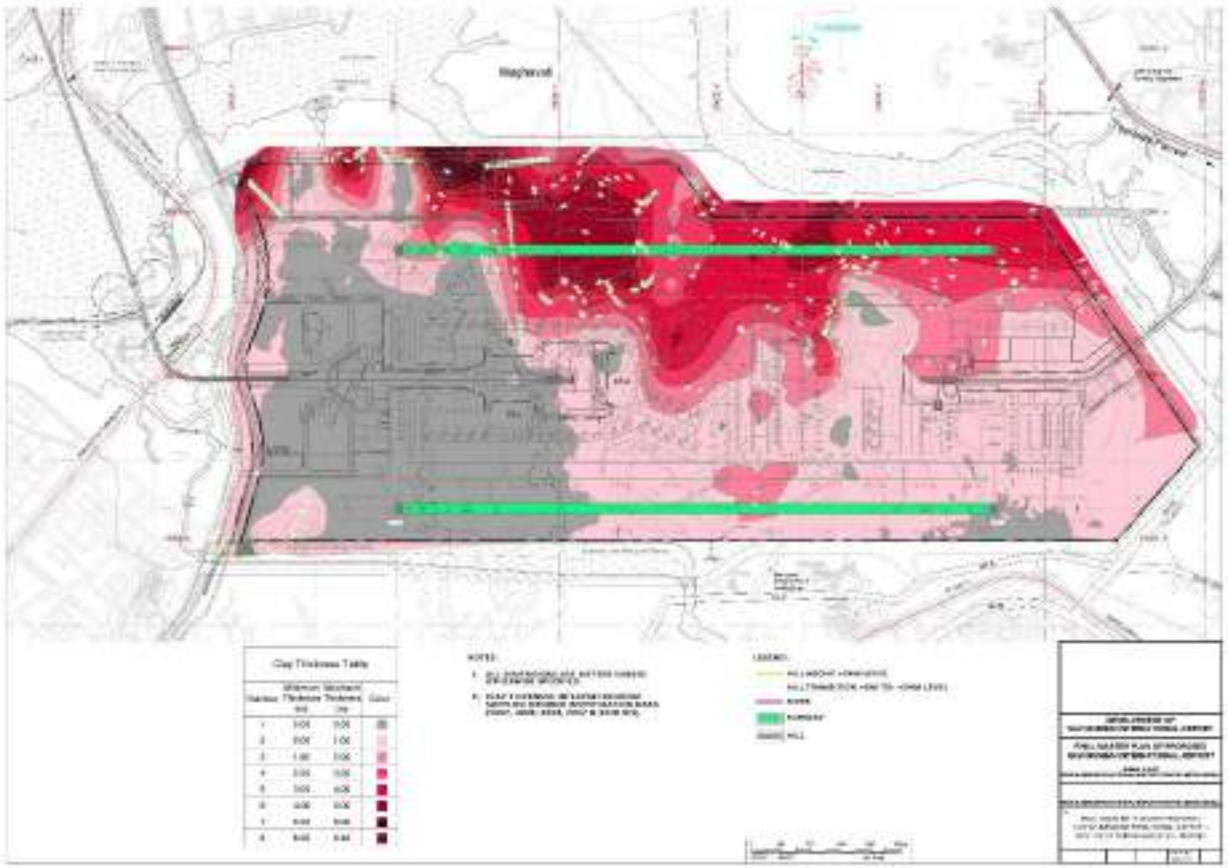
5) The average travel times from various clusters to NMIA by sub-urban, metro/ monorail, Bus and Car/Taxi is about 46 minutes, 55 minutes, 80 minutes and 69 minutes respectively. Thus, the average travel times by bus mode from various clusters to NMIA is higher as compared to all other modes.

6) The range of travel time from the remotest places of MMR to NMIA by different modes is 94 to 138 minutes; and

7) Average travel time by PWT mode from Island city (Radio Club/ Ferry Wharf terminals) to NMIA is about 40 minutes, which includes waiting time at the terminals (by Hovercraft). PWT take less time to reach NMIA from Island city by Hovercraft and it would greatly supplement with other modes. Travel time in 20 minutes bands using transit modes (sub-urban/ metro/ monorail/ bus) and by road using private vehicles (car/ two-wheeler) or IPT modes (Taxi/ Auto) from various TAZs to proposed NMIA (considering the proposed multi modal transport network for the horizon year 2041 and travel demand). It can be seen that, the travel time from the remotest places of MMR by transit modes (sub-urban/ metro/ bus) is about 140 minutes and by private vehicle/ IPT modes is about 100 minutes. However, substantial air travel demand to the proposed NMIA is located within travel time of about 80 minutes.

2.7 Pre-Development Works

Pre- Development Works refer to the site development / enabling works undertaken by CIDCO to prepare the site for airport development. The soil types, ground strata and ground levels differed across NMIA site, with a rocky/firm soil stratum in western and large part of southern site areas. Soft to medium stiff marine clay with variable stratum thickness was noticed in marshy and riverbed zones. In general, thickness of this stratum varied between 0.5 m and 2.0 m on east side of site, but thicker clay beds seem to be located on north boundary of site where maximum thickness of marine clay may be around 6.0 to 8.0 m. The existing geological condition of the site is presented **Figure-2.15.**



Source: Master Plan (May, 2019)

FIGURE-2.15
NMIA-EXISTING GEOLOGICAL CONDITIONS

A detailed geo-technical study was conducted and based on which, it was planned to cut the Ulwe hill and rock from this hill cutting to be used as fill material for site filling up to + 8.0m to +9.5m AMSL. As on Dec 2019, the site has been filled up to +5.5m AMSL while balance hill cutting, and site filling is in progress. For undertaking this cutting and filling works, which are part of the Pre-Development Works, CIDCO awarded the Land Development Contracts for 4 packages (**Figure-2.16**), i.e., Package-I & II, Package-III and Package-IV from south to north.

Source: Master Plan (May, 2019)

FIGURE-2.16
NMIA LAND DEVELOPMENT PACKAGES

As part of the Package-I & II of Pre-Development work in June 2019, the diversion of Ulwe River was completed by constructing a new 120 - 200 m wide channel outside southern boundary of NMIA site. Land Development contracts include cutting of existing Ulwe Hill and filling of respective designated sites areas to a level platform, achieving levels of 5.5 m AMSL in fill areas and cutting the hill to 8 m AMSL. Part of remaining portion of Ulwe Hill to south of Site within the project area. A part of the contiguous Ulwe hill outside NMIA site boundary currently exists and constitutes penetration of Inner Horizontal Surface (IHS) and Transitional Surface of southern runway of NMIA. This part of Ulwe Hill will be cut by CIDCO to ensure obstacle free, complaint approach path for southern runway. CIDCO has received Environment Clearance for this work from SEIAA, Maharashtra and this work is in on-going stage.

2.8 Proposed Infrastructure

While the approach to the development of the NMIA site is primarily influenced by the location and orientation of the two runways, it is also significantly influenced by external connectivity and the existing site conditions. The location of NMIA provides opportunity to maximize its accessibility for its catchment areas from its western, northern, and eastern direction. NMIA passenger catchment area is predominantly located to west of NMIA, therefore maximum passengers shall access NMIA from western side via Amra Marg and MTHL. In view of the existing and proposed airport connectivity infrastructure and proximity of NMIA to the catchment areas of South Mumbai via the proposed MTHL, eastern suburbs of

Mumbai, central and northern areas of Navi Mumbai via Amra Marg, there is a clear advantage in locating the principal passenger terminals/facilities on the western part of the airport site, in the form of a Central Terminal Complex.

Similarly, with existing cargo /port traffic movement on NH-4B on eastern side of NMIA site, there is a clear advantage in locating Cargo, MRO, GA, Fuel Farm and other ancillary airport uses on the eastern part of NMIA site with separate access, thus ensuring segregation of passenger and non-passenger vehicular movement to a large extent. However, feasibility and convenience of passengers from eastern part of Navi Mumbai to Central Terminal Complex is also retained via North Road in initial phase and possibly a passenger terminal on eastern part of NMIA in future.

As mandated in CA, NMIA is planned with two entrances to NMIA for passengers to reach Terminals. Primary entrance is from western side of NMIA, from Amra Marg, and second entrance is from eastern side from NH-4B.

The locations of T1, T2, T3, are finalized based not only on landside road access, but also decided based on considerations of increasing airside capacity, aircraft stands and efficiency of taxiway system. The proposed mid-field cross taxiways provide maximum efficiency and also provide remote stands closer to Terminals. Therefore, Terminal T2 is located centrally within the proposed Master Plan, to provide overall airport efficiency and eventual airport capacity. NMIAL has however considered connectivity between T1, T2, and T3 and apron on east, via an airside underground tunnel. This shall be used for passengers post their check-in and security, and for movement of belly cargo across western and eastern aprons. This tunnel shall be constructed in Phase-III of the project with construction of north runway.

The overall planning of NMIA is also influenced by non-availability of land in northern half of the site in Phase I and II. As Phase-I development demands only a single runway, the decision to whether initially develop northern runway or southern runway has been fundamental to the overall planning of NMIA. This decision has been influenced by the existing site conditions and the challenges associated with schedule of Pre-Development Works. Earlier, it was indicated that northern runway shall be developed first, as it was considered that the challenges associated with the relocation of the villages located in southern part of the site outweigh the challenges associated with settlement of filling and consolidation of existing site in northern half of site. With additional understanding being gained with regards to geotechnical variations in site conditions of NMIA, with northern part of the site requiring considerable ground improvement along with large quantities of filling, and time needed for consolidation and settlement of fill. Although CIDCO awarded three contracts for Land Development Works, including ground improvement and cutting/filling in 2016, the work on Packages III and IV (northern part of site) would require time for consolidation and settlement of fill. This in turn shall impact the implementation work and program for runway, taxiways and apron construction if developed in northern part of the site. Conversely the extent of filling required in the southern part of the site is less, ground levels are higher and sub-soil strata is firm/rocky thus not requiring ground improvement work, reducing the risk from settlement. In view of this, NMIAL has planned Terminal-1 on rocky base of existing hill, thus avoiding the need for any ground improvement or soil consolidation. Phase-I development on southern part of site shall expedite project implementation.

2.9 Airport Master Plan

2.9.1 Airport Facilities

In accordance with preferred development approach, driven primarily by airport connectivity to site, existing site conditions and intent to maximize time available for development of Phase-I airport infrastructure, facilities within airport master plan have then been planned with following overarching criteria to enhance and ensure:

1. Operational Safety;
2. Airport Capacity;
3. Operational Efficiency & Resilience;
4. Passenger Service;
5. Accessibility;
6. Land Use Efficiency;
7. Flexibility; and
8. Phased Development.

This has required the master plan to incorporate optimal arrangement and balance between four principal constituents of Master Plan; the airside, terminals, landside facilities and cargo development, along with various other support facilities that contribute towards a successful modern international airport.

NMIA Master Plan has been planned in two zones as described below:

Airside Zone: This comprises of Airfield with runways, taxiways, aircraft parking aprons and all necessary facilities for safe and secure aircraft operations; Passenger Terminals with passenger processing, retail, and other facilities contained within the terminal main processors and piers; and Cargo with its airside warehousing /processing facilities and other complimentary activities not associated with the passenger terminals; General Aviation; MRO, etc.

Landside Zone: This comprises of the western, northern and eastern landside areas, including the terminal forecourt areas, and various passengers, airport users and stakeholder facilities required for airport, and landside transportation network. Northern landside area, shall be developed in later phases of airport development when land is available for utilization.

The Master Plan of NMIA in each phase is shown in **Figure-2.17 (A, B, C & D)**.

FIGURE-2.17 (A)
PHASE-I (10 MPPA) DEVELOPMENT

FIGURE-2.17 (B)
PHASE-II (20 MPPA) DEVELOPMENT

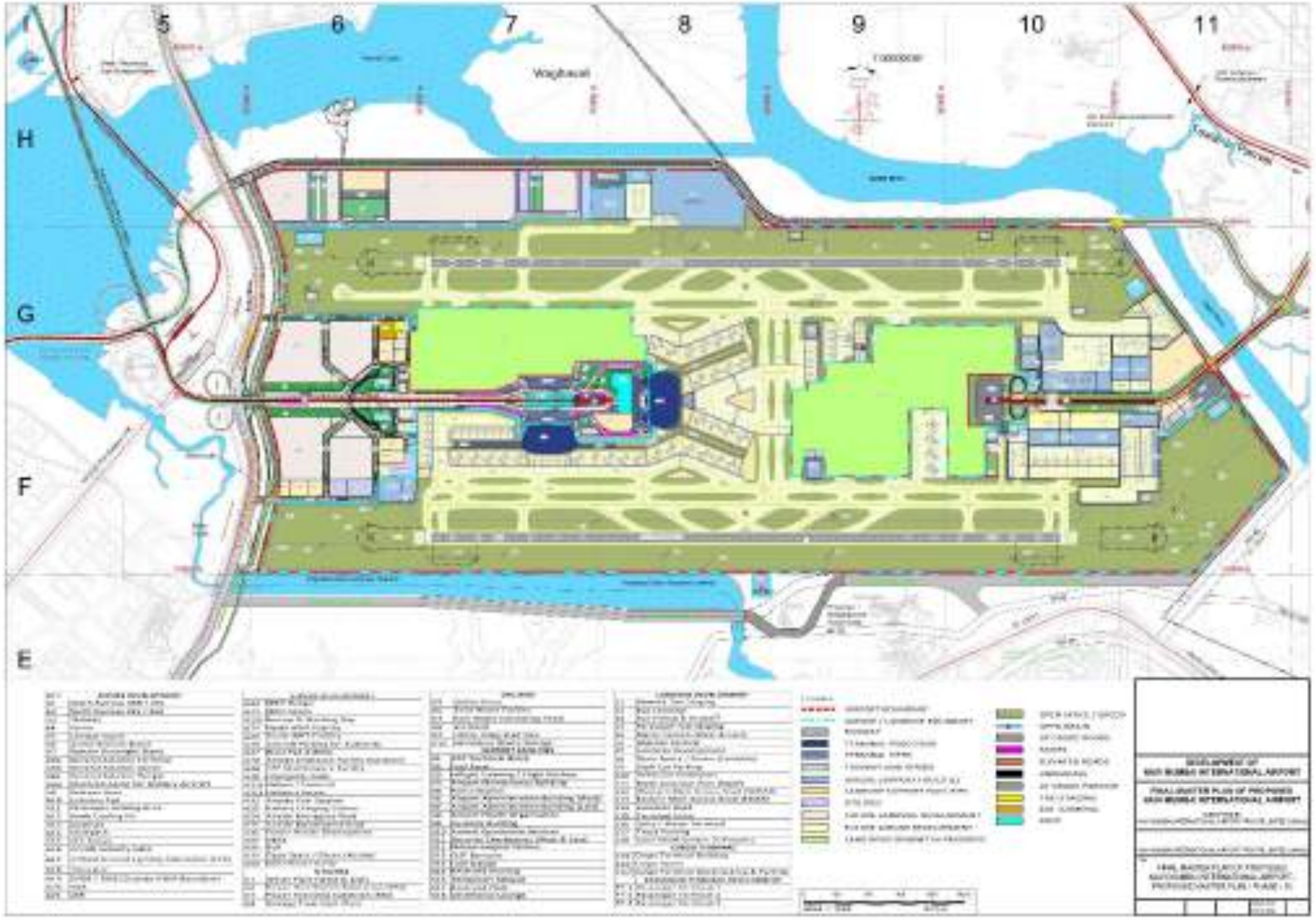


FIGURE-2.17 (C)
PHASE-III (40 MPPA) DEVELOPMENT

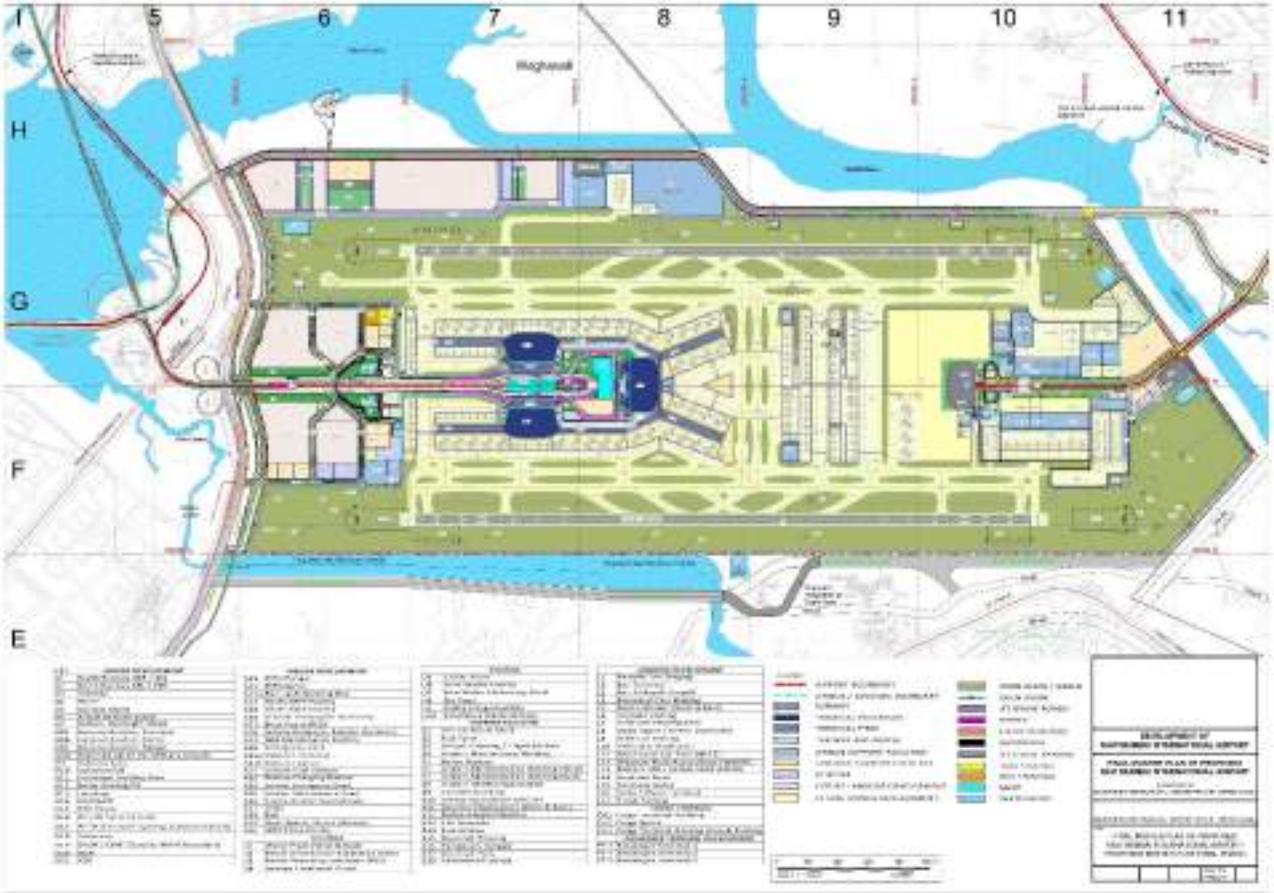


FIGURE-2.17 (D)
FINAL PHASE (PHASE IV - 60 MPPA) DEVELOPMENT

2.9.2 Construction Plan

The project development envisages construction activities involving site preparation, transportation of construction materials, equipment and construction of the infrastructure. It is envisaged that there would be some effect on the existing environment:

- Ground improvement works;
- Construction of sea wall/Retaining wall along the boundary of the site; and
- Shifting/ relocation of the utilities.

Construction Material

Indigenous construction material found in and around the region will be used for construction purposes. For Phase – I & II, aggregate will be manufactured by crushing rock excavated from Ulwe hill within the airport site. In subsequent airport development phases aggregate and sand will be sourced from various suppliers of aggregates.

Rocks removed by cutting of the Ulwe hills within the airport site will be used as filling material, whereas part filling with murrum will be met from outside through suppliers of construction aggregate. The other raw materials like cement & steel will be brought from nearby commercial entities. A batching/ready mix plant is proposed within the airport site during construction phase. Major construction activities will be land development and concreting for which bulk raw material is available with the airport area.

Construction Equipment and Material

Within the aforementioned zones, the Master Plan has the following four key\functional areas of airport:

a) Airfield Development;
b) Terminal Development;
c) Landside Development; and
d) Cargo Development.

NMIA will comply with Fly Ash notification issued under the EP Act of 1986 plans to utilize fly-ash products in the range of 50,000 Tonnes in construction of Phase-I and 1,00,000 Tonnes in the construction of final Phase-IV. Besides, the following material will be available for the civil structures:

- Stone aggregates;
- Cement;
- Crushed sand;
- Asphalt;
- Fly ash; and Murrum.

In addition to above, these materials are also required for terminal building, cargo buildings, and other ancillary buildings. Other materials required for construction of building such as aluminum frame works, glazing and other finishing material are available in Mumbai. Navi Mumbai and also in other part of India. Certain material such as glass for external façade/glazing may be required to be procured from other countries, if necessary.

About 5.65 million cum stone aggregates, 1.00 million tonnes cement, 1.50 million cum sand, 3,20,000 tonnes of steel, 90,000 tonnes asphalt will be required for construction of airport for ultimate capacity of 60 MAP. During the construction, about 4,92,60,000 cum of filling will be required for leveling of the project area up to + 8.0 m to +9.5 m AMSL (Airport platform level). Out of this total fill volume, filling of about 44.70 million cum (approximate) will be completed with rock removed by cutting of the Ulwe hill within the airport site, whereas, remaining filling will be met with borrowed material available from the locations nearby/ around the airport site. Requirement of construction material is given below in **Table-2.18**. Most of other major construction material such as cement, steel, glass etc. will be sourced directly from leading manufacturers within India.

TABLE-2.18
REQUIREMENT OF CONSTRUCTION MATERIAL

Sr.No	Material	Quantity		Source
		20 MPPA	60 MPPA (Cumulative)	
1	Cement (MT)	3,50,000	10,00,000	Ultratech, ACC, Ambuja, Grasim, KJ, Dalmia
2	Steel (MT)	1,00,000	3,20,000	SAIL, TISCO, RINL, JSW
3	Sand (Cu.m)	5,00,000	15,00,000	Sand will be manufactured by crushing rock excavated from Ulwe hill within the airport site
4	Metal (Cu.m)	20,00,000	56,50,000	Vendor
5	Glass (Sq.m)	40000	1,35,000	Saint Gobain, Modi Glass, Asahi India, China Southern Glass (CSG), Sanghai, Pilkington
6	Aluminium (MT)	950	3,000	Jindal Aluminum Limited, Hindalco, Nalco, Indal Bhoruku
7	Asphalt (MT)	30,000	90,000	BPCL, HPCL, HINCOL, MRPL

Source: NMIA

Majority of raw materials will be bought in bulk from the bulk storage facilities in the vicinity and other parts of Maharashtra and other states and transported to site by land / road /water way.

Further, certain specialized equipment and materials will be sourced from outside India based on functional requirements, design requirements, specifications and quality requirements. All such imported materials will be shipped to ports or airports through sea / air transport and further, and brought to site by road. Water transport connectivity is also an important possibility and shall be explored in future, with use of existing a jetty near north road, located outside NMIA site but close to it, to be used to bring in materials during construction phase and later for movement for cargo to and from Mumbai during operations phase.

NMIAL has received approval of Maharashtra Maritime Board (MMB) for use of this existing jetty to ferry materials for construction of airport. This will reduce truck traffic on busy roads surrounding the site.

2.9.3 Airfield Development

The prime determinant of long-term capacity of an airport is its airfield system. Safeguarding long-term airfield capacity is, therefore, a paramount objective in planning of NMIA in order to maximize the ultimate capacity of the airport. At each step-in development of NMIA Master Plan this has been a guiding principle, and facilities have been planned to achieve this objective. Accordingly, two parallel runways with separation of 1580 m, capable of independent simultaneous operations, have been provided with a taxiway system that achieves an efficient movement of aircraft in airfield, minimizing taxi distance, maximizing flexibility of routing and avoiding conflict between taxiing aircraft and those manoeuvring on and off aircraft apron parking positions so avoiding unnecessary delays. In addition, a system of parallel taxiways Rapid Exit Taxiways (RETs), runway access points and other link taxiways have been provided to achieve an efficient taxiway flow, allowing re-sequencing of departing aircraft by air traffic control and to minimize the runway occupancy time. The taxiway system has been designed to avoid single points of failure and to provide ATC with multiple choices when routing aircraft to and from runways and so providing an enhanced degree of operational resilience and flexibility.

All aspects of airfield have been planned to meet regulatory requirements associated with airfield operations and design. ICAO has an international code system to specify the standards for individual Airport facilities, suitable for use by aircraft with a range of performances and sizes. The proposed runway and associated infrastructure have been designed to Aerodrome Reference Code 4F in accordance with CA. This provides NMIA with capability to accommodate large aircrafts, as represented by Airbus A380 and B747-800 aircraft types. In addition, NMIA will be provided with a full suite of Communications, Navigation and Surveillance (CNS) systems to enable a minimum of CAT I operations including DVOR, ASR, SMR and a CAT I ILS allowing airfield to operate safely and efficiently at night under most weather conditions. ATCT and ARFF facilities sized for largest aircraft types operating at NMIA have been optimally located within center of the airfield where they provide maximum coverage to airfield operations.

Aircraft parking aprons have been provided in line with forecast demand at each development phase, in an appropriate mix of contact, active remote and remain overnight (RON) stands to support efficient airline operations, provide a high level of passenger service and to meet requirements of CA. Space on aprons not being utilized by aircraft parking has been allocated to ground service equipment (GSE) parking to support timely and efficient aircraft turnaround.

In each development phase an appropriate mix of Code C, E and F stands has been provided to meet anticipated fleet mix within air traffic forecast and to achieve a degree of resilience in event of aircraft technical problems. Contact stands are linked to terminal buildings and piers by aero-bridges and fixed links to enable passengers to directly access their aircraft. Remote stands will be accessed by bus via a comprehensive airside road system with all aircraft aprons being provided with HoS, BoS and inter-stand roads. In later phases, areas of remote stands in the center of airfield will be accessed by an airside underpass to avoid the need for vehicles to cross taxiway system, thus not effecting aircraft flows at peak times and maintaining a high level of safety and reducing risk of taxiway incursions.

2.9.4 Terminal Development

The location of passenger terminals has been driven by need to achieve a high degree of accessibility for passengers travelling by public and private transportation, and to provide easy access to aircrafts, and from runways to aircraft parking stands adjacent to terminal. The passenger terminals are planned in a cluster in a Central Terminal Complex (CTC) accessed from Western Main Access Road (WMAR) starting from Amra Marg, located on western side of airport, where existing and proposed transportation facilities connect NMIA to Mumbai as well as Navi Mumbai. CTC is located equidistant between the two runways to accommodate proposed parallel taxiway system, and to provide identical airfield infrastructure to northern and southern terminals. Creation of a cluster of passenger terminal complex has benefit of enabling terminals to share and make maximum use of facilities, both airside and landside, which is not only efficient in terms of facility provision but also helps in accommodating inevitable peaks in demand and in responding to fluctuations in traffic forecast and airline profile. Importantly in case of NMIA, this creates a landside Forecourt which contains a multi-modal transport hub that is fundamental to achieving desired level of public transport patronage.

The CTC is planned to accommodate a minimum annual passenger handling capacity of 60 million annual passengers (MPPA) in final phase. The terminal capacity is planned in three terminal buildings to provide maximum flexibility to respond to passenger demand, minimize walking distances, and maintain passenger service levels to at least IATA LOS C[1]. It also lends itself to an incremental or phased development as each terminal is of a scale that enables them to be completed in one or two phases, unlike larger terminals which can only be developed in multiple phases, with resultant disruption to operations. While all the three terminals shall share multi-modal hub for parking and public transportation facilities, they will each have separate kerb sides and landside access from forecourt roadway system on Western Main Access Road (WMAR) entering to create simple and direct access for passengers with clear and unambiguous way finding. All three terminals shall be multi-level, providing full range of passenger processing, support and commercial facilities expected at a modern international airport and will be designed in consultation with relevant stakeholders to ensure that all regulatory and operational concerns are considered. The current terminal configuration is planned specifically to maximize airside frontage for aircraft contact stands to maximize passenger service, provide airline flexibility and to provide the stands required to support maximum runway capacity.

[1] *IATA LoS C stands for International Air Traffic Association (IATA), Level of Service Concept (LoS C)*

Terminal-1 shall commence operations as an integrated domestic + international terminal so that it can respond to initial forecast traffic demand and airline route development during Phases-I and II, with facilities sized to an annual capacity of 20 MPPA. Terminal-1 is planned as a two and a half storey configuration with departures located above arrivals. Terminal-2 will also be an integrated domestic + international terminal with an annual capacity of minimum 20 MPPA, but upon its opening it will become the main international terminal of NMIA so that international operations can be efficiently consolidated in a single terminal which has the potential to access a greater number of wide-bodied stands. At this stage, Terminal-1 will switch to solely domestic operations and is specifically designed with this change in mind. Terminal-3 shall be similar in nature to Terminal-1 with a 20 MPPA capacity and solely domestic operations.

2.9.5 Cargo Development

NMIA is ideally located within MMR to perform an important role in supporting cargo industry in the region, and airport cargo operations can provide steady revenue stream at the airport. Cargo is therefore viewed as a critical airport activity at NMIA and has been treated as such in airport master plan. The air cargo facility is planned on eastern part of airport, with direct access form NH-4B, where it shall have both excellent landside and airside access. Also, as passenger terminal is planned with access from western part of airport, cargo vehicular traffic shall be segregated from passenger vehicular traffic. It will still, however, retain a robust airside road connection with the passenger aircraft aprons of CTC in western and central part of NMIA, to facilitate efficient movement of belly-hold cargo. The proposed cargo development of NMIA is planned within airside area of NMIA, i.e. part of Airside Development.

The proposed cargo facility will have International Cargo and Domestic Cargo operations as part of an integrated cargo complex, serving both belly cargo and freighter cargo. To facilitate long-term development, the cargo complex has been planned north of southern runway, with all required supporting infrastructure elements and ancillary facilities including access roads, truck staging areas, truck loading docks, cargo operational facilities and warehouses for International Cargo - import, export, transit cargo, domestic cargo, express /courier cargo, perishable cargo, air mail, hazardous cargo, etc., along with cold storage, inspection facilities, cargo offices, custom offices, etc. The proposed cargo complex facilities shall be, as far as possible, of flexible and modular design, thus enabling the facilities to be adapted to the needs of the users and expanded as required in line with growth in cargo volumes and the changing trends and demands of the market. The proposed location for the cargo facility in east of NMIA site, has been selected to provide adequate development space and excellent landside and airside access for this critical activity. As described above, as initial phases of NMIA will be developed in southern half of NMIA site, the proposed cargo complex is proposed in southern half of eastern part of NMAI. Therefore, evening in Phase-1 and II, the cargo facility shall be available for operations, on eastern side of airport with access to southern runway.

2.9.6 Landside Development

Landside Development of NMIA includes all transportation infrastructure, facilities, utilities, open space/green areas etc. located on landside area of NMIA. The landside development of NMIA has been planned to provide world class airport landside infrastructure to all passengers, airport users, stakeholders and visitors to NMIA. The proposed landside uses & facilities are planned to not only complement each other as per their functional requirements as part of overall airport operations but are also planned with consideration to achieve required level of segregation between uses in terms of nature of the traffic they generate and their transportation access arrangements. In contemporary global context, all major airports have evolved beyond their basic roles as transport nodes into drivers of local & regional economic development enabling financial growth & promoting travel, tourism, hospitality, trade, cargo, etc leading to employment and revenue generation for local / regional economy. Southeast Asia and China (Hong Kong, Shanghai, Singapore, Dubai etc.) have demonstrated the potential of airport hubs as economic drivers. Landside development of NMIA is planned to support such enhanced role for NMIA, leading to increased potential in employment generation and business opportunities. Landside development areas of NMIA are planned in western, northern and eastern areas of airport, close to external airport access roads like Amra Marg on west, North Road in north and National Highway NH-4B in east. Therefore, each of the proposed landside area has excellent, but separate surface access, and traffic is not centralized in any one direction or location. Also, as several of airport facilities have interface with surrounding city fabric as well as with airport, they have been located strategically on outward areas of airport site.

2.9.6.1 Airport Access and Entrances

The main passenger access to NMIA is planned from Amra Marg in west, providing access to Central Terminal Complex zone via a major new junction interchange to be developed by CIDCO on Amra Marg at NMIA entrance. Passengers shall use Western Main Access Road (WMAR) for direct access to CTC landside area without need for passing through any further junctions. Most of the key airport facilities are planned on north and south of WMAR, such as utility plants, airport management offices, hotel, airlines offices, other related offices and facilities, reserved services, police station, ceremonial lounge, etc. These facilities have alternative road access, by separate roads further segregating their traffic from passenger activities. The second main airport access, called Eastern Main Access Road (EMAR) is planned in eastern part of airport site, via a new bridge over Gadhi River connecting airport with NH-4B. It will provide access to NMIA Cargo, MRO, GA, Fuel Farm and other facilities located on the eastern part of airport site, thus ensuring segregation of heavy cargo and MRO vehicular traffic from passenger traffic on west.

In addition to providing excellent highway access for NMIA, increased role of public transport and maximization of its modal share, is a key thrust area in planning of NMIA transportation strategy which includes buses and proposed metro links as part of mass rapid transport facility for airport. Maximization in use of public transport is not only more sustainable than private transport, but it will also help reduce traffic on roads to and from airport reducing congestion.

Two elevated metro lines are proposed in Master Plan of NMIA, with two metro stations, terminating at NMIA. One metro station is proposed within CTC landside area, for metro line coming from Mumbai (from western side of NMIA) , with convenient pedestrian access to all three terminals for passengers and staff. The second metro line, coming from eastern side of Navi Mumbai, shall lead to metro station in eastern forecourt of NMIA, providing access to staff and visitors to cargo and other facilities in the area and supporting the future development of the east side facilities. Within CTC the metro station shall be focal point for a multi modal transport hub which will integrate all modes of transport within a single facility conveniently located between three terminal buildings. This will help promote integrated use of all public transport modes by passengers, visitors and staff. A star category hotel is proposed in CTC area serving the passengers, staff, visitors etc, within walking distance of terminals.

While maximizing use of public transport is a key theme for NMIA, it is passenger choice and convenience, accordingly each terminal planned with conventional arrival and departure kerbs for taxis, cars and buses, providing passengers with choice of services they would expect. Critically, however, at NMAL a similar level of passenger experience will be available via metro station based multi-modal hub, offering passengers far greater choice than usual. The support facilities planned for NMIA form an important and integral part of overall Landside development, and are essential to serve the needs of passengers, stakeholders, employees, users and visitors of airport. To optimize use of space within planned airport development, facilities have been arranged in such a way to maximize efficient utilization of available land and increase flexibility for future expansion. It has also been necessary to consider height restrictions within airport due to Obstacle Limitation Surfaces (OLS) associated with runways and navigational aids on airfield.

2.9.7 Airport Peak Hour Planning & Design Parameters

Summary of the airport peak hour levels for which the airport has been planned in four development periods/phases is given in **Table-2.19**.

TABLE-2.19
PEAK HOUR PLANNING & DESIGN PARAMETERS

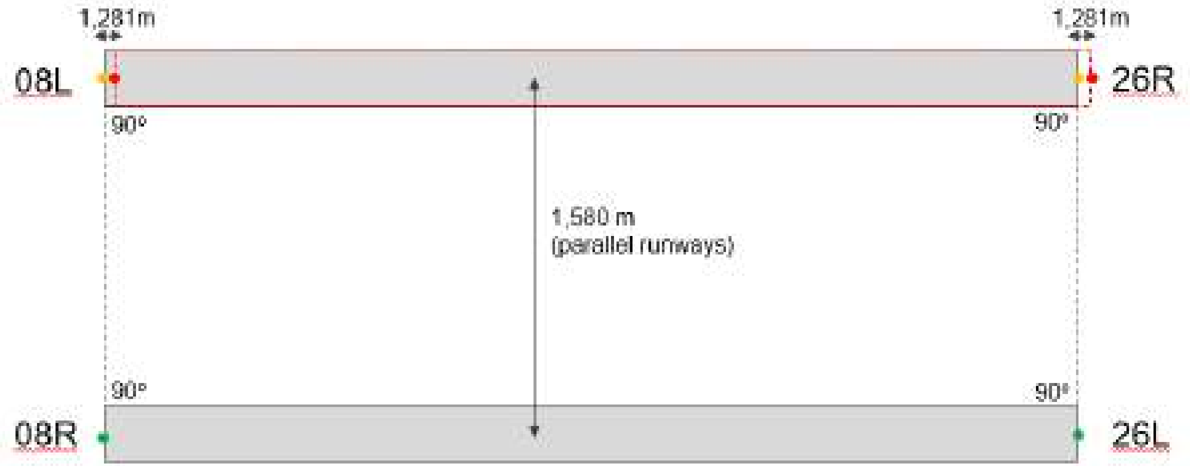
Particulars	10 MPPA	20 MPPA	40 MPPA	60 MPPA
International Commercial Aircraft Operations	6,350	20.771	53.960	81.155
Domestic Commercial Aircraft Operations	63.811	1,16.096	2.11.140	3.16.624
Total Commercial Aircraft Operations	70,161	1,36,867	2,65,100	3,97,779
Cargo Aircraft Operations	5,841	7,748	10,052	13,244
Other Type of Aircraft Operations (GA)	13,943	15,184	17,765	22,446
Total Aircraft Operations	89,945	1,59,799	2,92,917	4,33,469
International Terminal Commercial Passengers (million)	0.9	2.9	7.9	12.7
Domestic Terminal Commercial Passengers (million)	9.7	17.7	35.2	49.0
Total Terminal Commercial Passengers (million)	10.6	20.6	46.7	61.7
Total Passengers (million)	10.6	20.6	46.7	61.7
International Commercial Aircraft Peak Hour	5	9	18	27
Domestic Commercial Aircraft Peak Hour	17	27	46	65
Total Commercial Aircraft Peak Hour	19	31	54	76
International Departure Commercial Aircraft Peak Hour	3	5	11	16
Domestic Departure Commercial Aircraft Peak Hour	10	16	28	39
Total Departure Commercial Aircraft Peak Hour	13	20	35	49

Particulars	10 MPPA	20 MPPA	40 MPPA	60 MPPA
International Arrival Commercial Aircraft Peak Hour	3	5	10	15
Domestic Arrival Commercial Aircraft Peak Hour	10	16	28	39
Total Arrival Commercial Aircraft Peak Hour	10	16	28	41
Arrival Aircraft Peak Hour	10	16	28	41
Departure Aircraft Peak Hour	13	20	35	49
Total Aircraft Peak Hour	19	31	54	76
International Passenger Peak Hour	884	1,574	3,483	5,220
Domestic Passenger Peak Hour	2,573	4,047	6,854	9,730
Total Passenger Peak Hour	3,003	4,726	8,290	11,883
International Departure Passenger Peak Hour	539	962	2,129	3,189
Domestic Departure Passenger Peak Hour	1.643	2.566	4.346	6.170
Total Departure Passenger Peak Hour	1,672	2,656	4,658	6,677
International Arrival Passenger Peak Hour	430	781	1.727	2.587
Domestic Arrival Passenger Peak Hour	1.550	2.436	4.125	5.858
Total Arrival Passenger Peak Hour	1,804	2,839	4,980	7,139
Total International Cargo (tonnes)	175.2	258.4	409.0	659.8
Domestic Cargo (tonnes)	113.3	171.6	262.8	393.9
Total Cargo (tonnes)	288.5	430.0	671.8	1053.7

Source: Pre-Feasibility Report

2.9.8 Runways

In ultimate phase, the airfield will consist of two parallel runways with 083º east northeast – 263º west southwest orientations located on northern and southern part of airport site and designated as 08L/26R and 08R/26L respectively with a take-off available distance of 3,700 m and 60 m of runway width to accommodate super-jumbo A380 aircraft (**Figure-2.18**). In addition to strengthened pavement of 60 m wide the runway will include shoulders 7.5 m wide at each side of the runways. Beyond runway ends, blast pads of 60 x 60 m at both ends of the runway are provided with objective of protecting from blast erosion. The terrain around runway will be graded as per ICAO standards to provide adequate runway strip with a longitudinal slope not exceeding 1.5% and downward transversal slope not exceeding 2.5%. At both ends of runway strip, a rectangle area of 240 m long x 120 m wide is planned as Runway End Safety Area (RESA).



Source: Master Plan (May, 2019)

FIGURE-2.18
NMIA RUNWAY STAGGER FROM CA AND CCZM COORDINATES

For NMIA runway ends, the WGS84 coordinates used in CA and CCZM (Refer **Table-2.20**) led to runway ends being staggered by 1.281 m. It is important to note that coordinates in CA and CCZM did not change the bearing of runways relative to each other (they remain parallel) and result in runways less than 3,700 m. For NMIA Master Plan, it was determined to shift north runway marginally to west to align with south runway for the following reasons. No change to south runway location is proposed and it remains consistent with CA and CCZM. The coordinates for runway ends are proposed under master plan are outlined in **Table-2.21** and **Table-2.22** below. The NMIA Runway System is presented in **Figure-2.19** below.

TABLE-2.20
RUNWAY END COORDINATES IN CIDCO MASTER PLAN, CA AND CCZM

Coordinate Source	Runway	Geographic		UTM	
		Latitude	Longitude	Easting	Northing
CIDCO CA	08L	18°59'47.58	73°02'45.39	2101587.9910	294300.8914
CCZM		18°59'47.58	73°02'45.39	Not Provided	
CIDCO CA	26R	19°00'03.56	73°04'50.76	2102038.9076	297973.3122
CCZM		19°00'03.56	73°04'50.76	Not Provided	
CIDCO CA	08R	18°58'56.66	73°02'52.56	2100019.6123	294492.1734
CCZM		18°58'56.66	73°02'52.56	Not Provided	
CIDCO CA	26L	18°59'12.63	73°04'57.92	2100470.529	298164.5942
CCZM		18°59'12.63	73°04'57.92	Not Provided	

Source: Master Plan (May,2019)

TABLE-2.21
SOUTH RUNWAY COORDINATES (NO CHANGE FROM CA AND CCZM)

Runway Orientation	08R	26L
Bearing (Magnetic)	083°	263°
Latitude / Longitude	18º58′56.66″ N, 73º 02′ 52.56″ E	18º 59′ 12.63″ N, 73º 04′ 57.92″ E
Easting / Northing (WGS 84)	294492.1735 E, 2100019.6123 N	298164.5943 E, 2100470.529 N

Source: Master Plan (May, 2019)

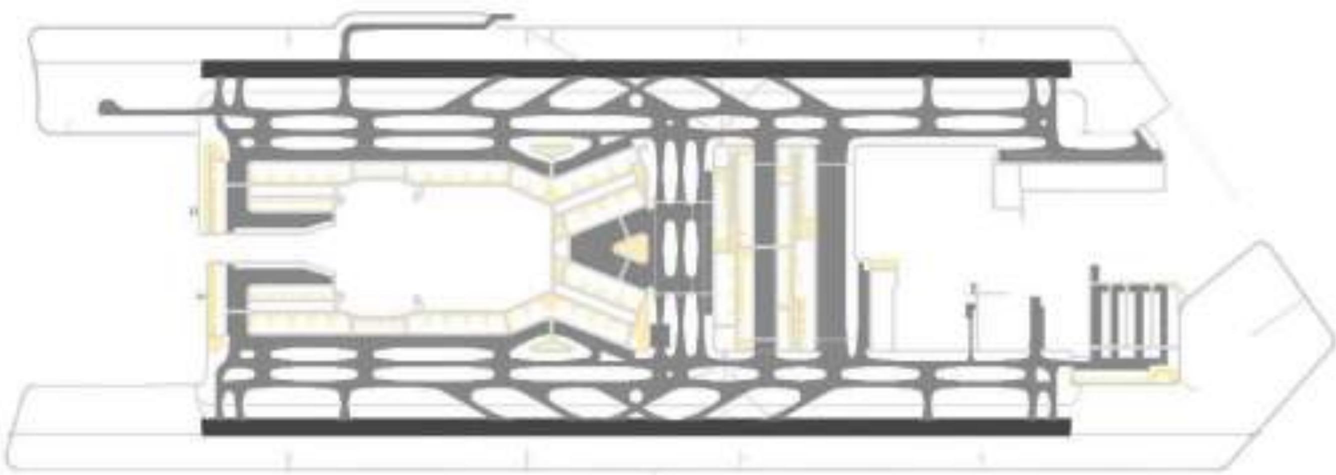
TABLE-2.22
NORTH RUNWAY COORDINATES

Runway Orientation	08L	26R
Bearing (Magnetic)	083°	263°
Previous (CA and CCZM)		
Latitude / Longitude	18º59′47.58″ N, 73º02′45.39″ E	19º00′03.56″ N, 73º04′50.80″ E
Easting / Northing (WGS 84)	2101587.9910 E, 294300.8914 N	2102038.9076 N, 297973.3122 E
Proposed		
Latitude / Longitude*	18º 59′ 47.58″ N, 73º 02′ 45.39″ E	19º 00′ 03.56″ N, 73º 04′ 50.76″ E
Easting / Northing (WGS 84)	294299.620 E, 2101587.835 N	297972.041 E, 2102038.751 N

Source: Master Plan (May,2019)

2.9.8.1 Runway Exits

In order to optimize runway occupancy time to an efficient level of approximately 50 seconds, both runways will be provided with three rapid exits for each approach configuration at an angle of 30º located at 1,570 m, 1,910 m and 2,250 m from each runway threshold. Also, two perpendicular runway exits at each runway end will be provided after third RET at 3,132 m complying with taxiway separation distances. For all runway exits, both perpendicular and at-angle, the taxiway width will be 23 m plus paved shoulders at each side of the connectors of 10.5 m wide. The runway exits will be protected of any obstacle within a strip of 51 m and providing a graded area of 22 m with a transverse slope not exceeding 2.5% upward or 5% downward from the taxiway center-line at each side of the connectors.



Source: Master Plan (May, 2019)

FIGURE-2.19
NMIA RUNWAY SYSTEM

2.9.8.2 Runway Threshold Elevations

The runway elevations have been established with consideration to the final grading plan and are outlined in **Table-2.23** below. The elevations for south runway have been confirmed as part of Phase I/II airside design process. The elevations for north runway may be subject to change based on final levels following predevelopment works and following the airside design process at later stage.

TABLE-2.23
RUNWAY THRESHOLD ELEVATIONS

Phase	**Phase-I & II**		**Phase-III**	
Runway	**Southern Runway**		**Northern Runway**	
	08R	**26L**	**08L**	**26R**
Elevation m AMSL	9.61	9.10	9.10	9.10

Source: Master Plan (May, 2019)

2.9.8.3 Runway Length Validation

The current Aerodrome Reference Temperature (ART) of 34.6°C for CSMIA has been adopted for NMIA based on relatively close proximity of the two airports. The assessment considered current ART of 35°C as well as 37°C to account for an increase in average temperatures (e.g. climate change) and to be conservative. According to ICAO Aerodrome Design Manual Part 1, runway length required can be increased at a rate of 7% per 300 m change in elevation, which means 0.02% per each additional meter of elevation. Therefore, for analysis purposes, sea level

(0 ASML) has been assumed as the resultant change required for calculation due to runway elevations of 9.10 m AMSL and 9.61 m AMSL is negligible at NMIA.

Findings of runway length validation study are summarized in **Table-2.24**, with aircraft types that may be restricted by current planned runway length of 3,700 m highlighted in red.

TABLE-2.24
REQUIRED RUNWAY LENGTH VALIDATION STUDY

Aircraft Type	Engine Type	100% MTOW (Kg)	Required Runway Length (m)	
			35°C	37°C
Airbus A319-100	CFM56	75,500	2468	2,515
Airbus A319-100	IAE V2500	75,500	2,310	2,354
Airbus A3191·4	CFM56	15,500	2,468	2,515
Airbus A319NI	IAE V2500	75,500	2,310	2,354
Airbus A320	CFM56	78,000	2,336	2,381
Airbus A320	IAE V2500	78,000	2,336	2,381
Airbus A320N	CF11+156	79,000	2.468	2,515
Airbus A320N	IAE V2500	79,000	2.468	2,515
Airbus A321	CFM56	93,500	2,756	2,809
Airbus A321	IAE V2500	93,500	2,888	2,943
Airbus A321N	CFM56	93,500	2,756	2,809
Airbus A321 N	IAE V2500	93,500	2,888	2,943
Airbus A340-600	RB211 TRENT 556	380,000	3,770	3,841
Airbus A350-900	typical engine	280,000	3,071	3,130
Airbus A380-800	Trent900	575,000	3,360	3,424
Airbus A380-800	GP7200	575,000	3,308	3,371
Boeing 737-800	LEA P-1B25	82,190	2,783	2,836
Boeing 737-800	LEAP-1B28	82,190	2,240	2,282
Boeing 737-800	CFM56-7B24	79,016	2,625	2,675
Boeing 737-900	CFM56-7B24	79,016	3,113	3,173
Boeing 747-400	CF6-80C2B1F	396,894	3,313	3,376
Boeing 747-400	PW4056	396,894	3,313	3,376
Boeing 747-400	RB211-524G	396,894	3,313	3,376
Boeing 747-800	GENx-2B67	447,696	3,434	3,499
Boeing 777-200	Baseline	242,630	2,487	2,535
Boeing 777-200	Height Gross Weight	286,900	3,203	3,264
Boeing 777-200LR	GE 90-110B1L engines	347,452	3,360	3,424
Boeing 777-300	GE 90k	299,370	4,074	4,152
Boeing 777-300	GE 98k	299,370	3,544	3,611
Boeing 777-300ER	GE 90-115BL engines	351.535	3,371	3,435
Boeing 787-900	typical engine	227,930	3,465	3,531
Boeing 787-900	typical engine	252,651	3,203	3,264

Source: Master Plan (May, 2019)

2.9.8.4 Mode of Operations

At NMIA, direction of regional prevailing winds is from west, hence east-west orientation of both runways is designed. Therefore, it is expected that westerly operations would be predominant operating direction of NMIA runways, similar to that of CSMIA. In a multi-runway system, runways can be operated in variety of modes:

- Segregated Mode (arrivals and departures on separate runways) or Mixed Mode (arrivals and departures on each runway); and/or

- Terminal Mode (aircraft arrive and depart from runways closest to the Terminal) or Compass Mode (arrived arrive and depart from runway closest to their origin/destination).

2.9.8.5 Phase I/II (10/20 MPPA) Runway

The southern part of airport and south Runway 08R/26L will be developed first. Runway 08R/26L will be 3,700 m and 60 m wide, capable of accommodating Code F aircraft in accordance with the CA. Land on Runway 26L end (east end) will be safeguarded for a potential maximum 200 m extension to ensure there is no load penalty to any aircraft ultra-long-haul flights and protect future opportunities.

2.9.9 Taxiways/ Taxi lanes

Each runway at NMIA is planned to have two parallel taxiways, designed to accommodate up to ICAO Code F aircraft type. A parallel taxi lane on northern and southern sides of CTC are designed to accommodate Code E aircraft, to serve Terminals 1, 2 and 3 aircraft stands; subject to final Terminal and apron designs. Three sets of cross-field taxiways are provided to connect northern and southern runways with one set capable to accommodate up to Code F aircraft.

2.9.9.1 Rapid Exit Taxiways (RETs)

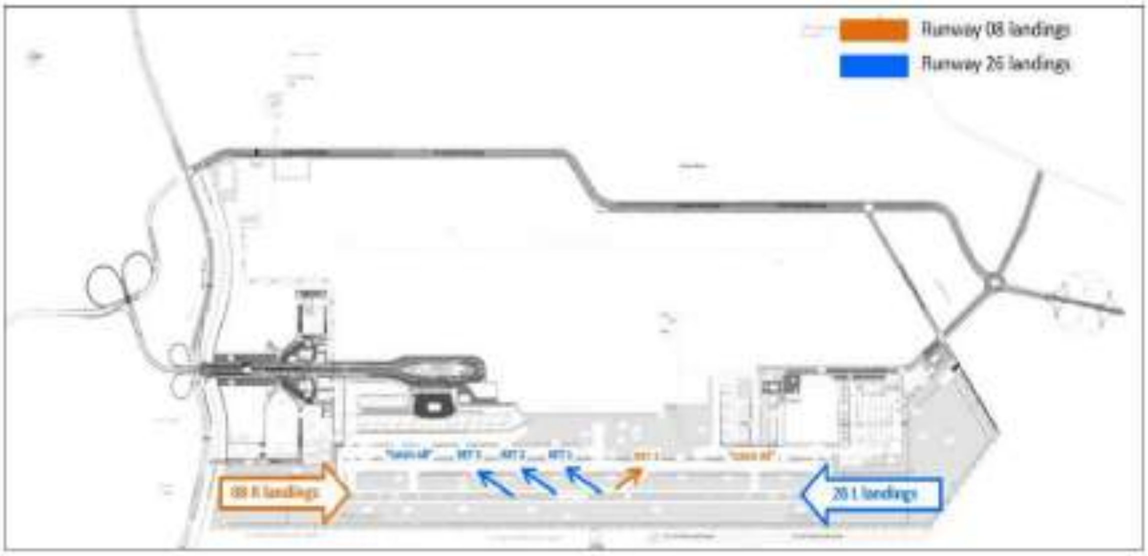
Rapid Exit Taxiways (RETs) are taxiways that are angled to allow aircraft to exit the runway at higher speeds than perpendicular taxiways. The RET locations are directly related to airport’s fleet mix, percentage of operations for each aircraft type and threshold speed of each aircraft. Aircraft types have been grouped by their ICAO aircraft code.

2.9.9.2 RET Locations

The RET locations for Initial Phases and Final Phase are shown **Figure-2.20** and **Figure-2.21** respectively. The proposed RET locations will be revalidated in case of changes in assumed NMIA fleet mix. The RET distances will be at RET-1 (1570 m), RET-2 (1910 m) and RET-3 (2250 m) respectively.

2.9.9.3 Runway Access Taxiways (RATs)

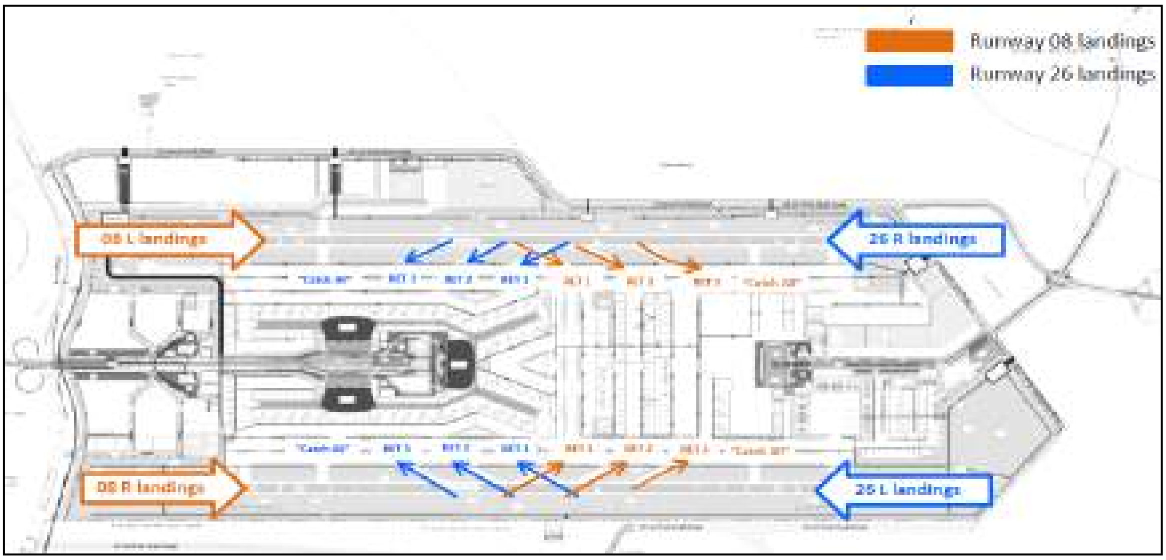
Dual Runway Access Taxiways (RATs), are provided at each runway end as shown in **Figure-2.22**. A separation of 91 m separation has provided to accommodate ICAO Code F operations on each RAT. When runways are used in opposite direction, RATs may be used as exit taxiways by aircraft (typically large, heavy aircraft) that need to extend beyond RETs or other exit taxiways. The dual RATs are separated by 91 m from each other with a runway holding position established on the taxiways at 107.5 m perpendicular to Runway centerline so that the holding aircraft do not interfere with the operation radio navigation aids. The RATs width is 23 m, extended 10.5 m with pave shoulders and protected of any obstacle within a strip of 51 m with a graded area of 22 m so that the transverse slope does not exceed 2.5% upward or 5% downward from the taxiway centerline at each side. Blue elevated edge lights will be installed at shoulder curvature of the RATs.



Source: Master Plan (May, 2019)

FIGURE-2.20

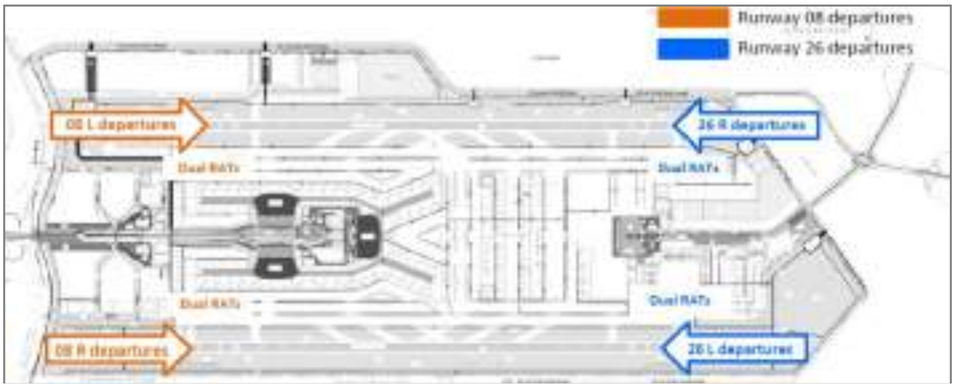
RET LOCATIONS – 10/20 MPPA



Source: Master Plan (May, 2019)

FIGURE-2.21

RET LOCATIONS – 60 MPPA



Source: Master Plan (May, 2019)

FIGURE-2.22
LOCATION OF DUAL ENTRY/ACCESS TAXIWAYS – 60 MPPA

2.9.9.4 Intersection Take-Off

One additional 90° ("Catch All") taxiway will be provided at each runway between the RETs and RATs for purposes of:

- Allowing intersection take-off by aircraft requiring a shorter take-off distance; and
- Allowing heavy aircraft which miss the RETs to exit before the end of the runway.

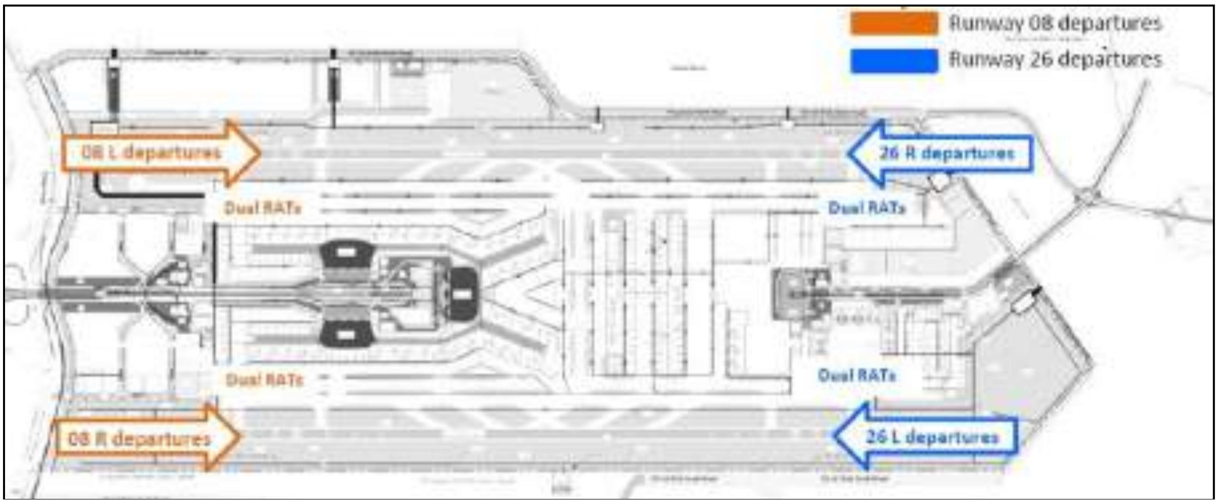
These additional Entry/Exit Taxiways are to improve sequencing of aircraft, reduce runway occupancy time and increase capacity. The location of these exits is at 3,132 m from the runway end.

2.9.9.5 Taxiway Circulation and Flow

The proposed NMIA taxiway system has been planned to provide safe and efficient and safe movement across the planned airfield. The taxiway system has been planned to ensure circulation for Code F aircraft, compliant with the CA. **Figure-2.23** and **Figure-2.24** illustrate expected taxiway circulation in Final Phase for each potential runway direction and mode.

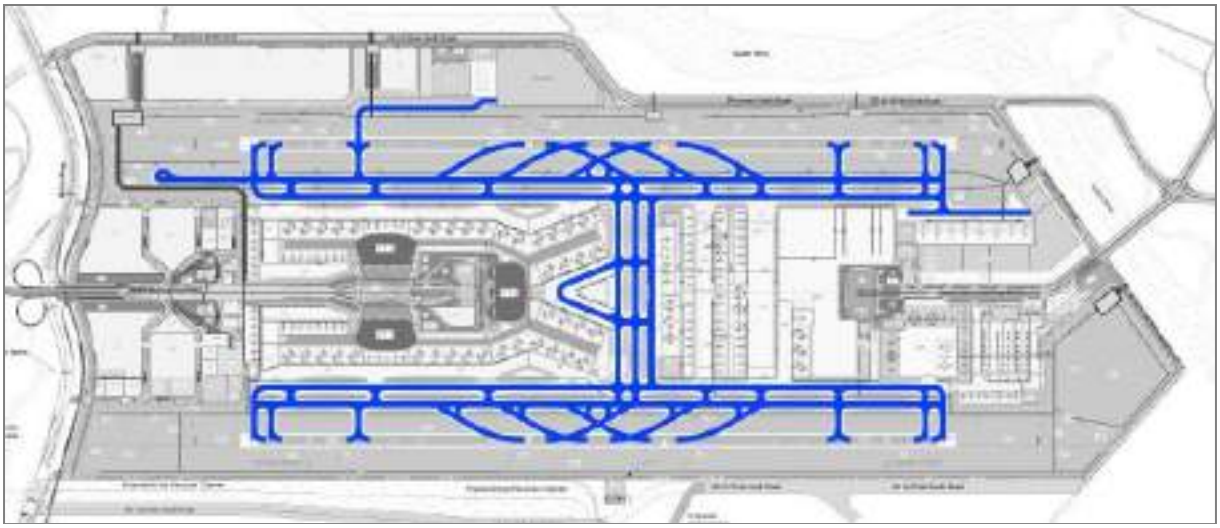
Phase - I & II

The planning of the taxiway system has been done holistically, keeping in mind Final Phase capacity of 60 MPPA and maintaining flexibility for potential future changes. For Phase-I&II, taxiway system on southern part of site will be developed to support south runway and allow efficient movement of aircraft between southern runway, T1, cargo, GA and other support facilities on eastern part of airport.



Source: Master Plan (May, 2019)

FIGURE-2.23
INTERSECTION TAKE-OFF LOCATIONS – 60 MPPA



Source: Master Plan (May, 2019)

FIGURE-2.24
NMIA CODE-F TAXI ROUTING – 60 MPPA

The Phase-I & II taxiway system is shown in **Figure-2.25**.

Source: Master Plan (May,2019)

FIGURE-2.25
NMIA TAXIWAY SYSTEM – PHASE I/II (10/20 MPPA)

In Phase-I&II, the taxiway system is planned to be configured by the following elements:

- One full length Code F parallel taxiway;
- One partial Code F parallel taxiways (dual parallel taxiways in the CTC and on the eastern side of the airport);
- Code E taxi lane in the CTC (Central Terminal Complex) giving access to the contact stands at Terminal-I;
- Dual Code C taxi lane/taxiway at the western side of Terminal-I, giving access to Code C stands allocated at the western pier;
- Access to proposed isolation pad and to the interim Cargo Facility, MRO and GA and other support areas on south-east side of airfield; and
- The interim Cargo Facility is serviced by a Code F taxiway. The GA area is serviced by a Code C taxiway.

As the majority (about 85%) of aircraft operations are arrivals from east, all three RETs will be developed for Runway 26L. For Runway 08R (arrivals from the west), initial development will include RET 2 with RET 1 and RET 3 developed at a later stage subject to actual demand and fleet mix. Dual RATs will be provided from initial delivery of the south Runway 08R/26L.

2.9.10 Navigational Aids

Both runways will be equipped with both elevated and inset lights for at-all-time operations consisting of a CAT I for Runway 26L and 26R whereas CAT II for Runway 08R and 08L approach system before each runway threshold which comprises a row of lights along the extension of the runway center line to a distance of 900 m. The runway lighting system is completed with runway center line inset lights, as recommended by DGCA CAR for precision approach category I and II when the runway is used by aircraft with high landing speeds or the distance between runway edge lights is greater than 50 m and runway edge elevated lights at both sides of the runway.

Also, runway threshold lights and runway end lights will be installed. Blue elevated taxiway edge lights will be installed at each runway exit and taxiways curvature. A PAPI approach slope indicator system of a 4-element wing bar placed on the left side of runway 26L, 08L and right side of runway 26R, 08R will be installed. With the exception of runway 08R, all runway approaches are equipped with Instrument Landing System antennas which consists of a localizer (LOC) antenna located 305 m where the runway 08R localizer (LOC) antenna located 505 m from the associated runway end and a glide path (GP/DME) antenna located 120.5 m from runway center line and 300 m from runway threshold at the side of the runway offering the least possibility of signal reflections.

The approach lights of runway 08L on eastern side of NMIA shall be located within waterway of Gadhi River due to inadequate space within airport site in north-eastern part. NMIAL has received approval of Maharashtra Maritime Board in this regard.

As NMIA is expected to accommodate significant levels of air traffic in Final Phase and beyond, with aircraft separation as low as 3 NM, a total of three ASR facilities have been planned after assessment of simulation studies by AAI to ensure adequate performance and redundancy.

Land for the two ASRs located outside NMIA site and for DVOR is being allotted by concerned authorities, i.e., CIDCO and Collector Raigad District to AAI in this regard, while construction of these facility shall be done by NMIAL.

2.9.11 Aircraft Parking Aprons

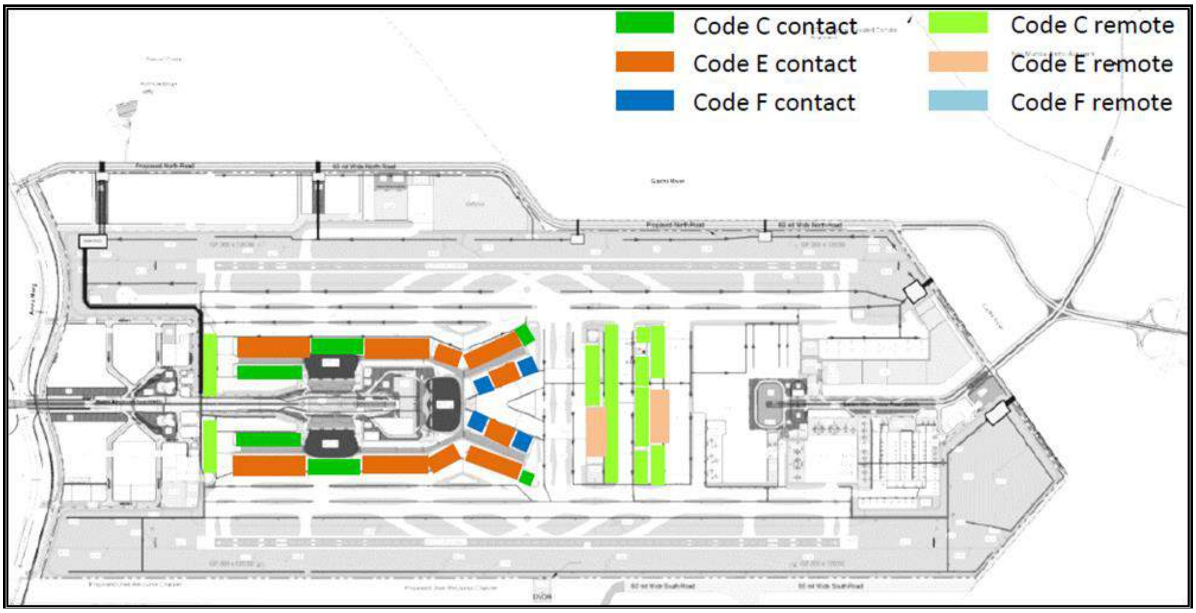
2.9.11.1 Commercial Apron

The main aircraft parking aprons associated to the northern and southern airfield will consist of an approximated paved area of 13,11,450 m^2, which includes the following:

- a large area for aircraft positions.
- vehicle service roads on apron.
- On-stand & off-stand ground handling equipment stage zones; and
- push-back truck areas.

To serve passengers with a suitable pier service level of about 90% of annual passengers, as per the CA, it is anticipated that 30 Multiple Aircraft Ramp Stand (MARS) positions, which are able to accommodate two Code C aircraft (Boeing 737 or Airbus A320 size) at the same time or servicing one aircraft of the size of a Boeing 747 or Airbus A340, 48 narrow-body (or Code C) aircraft parking contact stands will be required. These MARs positions contain 4 Code F MARS (A380) stands.

A vehicle service road between the aircraft parking stands and the pier of 15 m wide with 3 lanes will serve for ground vehicle manoeuvres on the commercial apron. The location of commercial parking aprons is presented in **Figure-2.26** below:



Source: Master Plan (May, 2019)

FIGURE-2.26
COMMERCIAL PARKING APRON

The apron taxiway system will consist of:

- All the code E stands has a taxi lane at 40 m from its back of stand road which mainly run parallel to the dual parallel taxiway. The same taxi lane is well connected with second parallel taxiway with 5 connectors and code F cross field taxiway also;
- All code F stands with its adjacent code E stands east of terminal 2 has a taxi lane at 51 m from its back of stand road connected with code F cross-field taxiway; and
- All code C stands has a taxi lane at 22.5 m from its back of stand road except the stands in middle of code E. Western remote and contact code C stands have dual code C apron taxiway system.

Eastern remote aircraft parking apron are well merged with cross field taxiways connecting both side of parallel taxiways. In this way, the commercial apron will benefit of a better control and flexibility of the aircraft manoeuvres to avoid apron congestions and delays. There will be 85 remote code C stands including 26 remain overnight (RON) stands located in close proximity from the contact stand borderline.

The remote parking stands east and west side of the terminal complex cover an area around 41,50,000 m^2, including aircraft stand, aircraft tow truck zone, on stand GSE, apron service road. If any Code E/F aircraft is requested to be parked at a remote position, it must be placed at designated MARS parking position provided. Blue elevated edge lights will be installed at the shoulder curvature of the commercial apron.

2.9.11.2 General Aviation Apron

The general aviation (GA) area of 21.873 ha is proposed to be located at the south east side of the airport taking advantage of Eastern Airport Access Road without interfering with passenger traffic on western entrance of airport. GA apron will have an area of 1,90,850 m^2. Additionally, future area of 3.09 ha is reserved for helicopter operation in northern part to ensure flexibility and safeguarding for future development. Northern heliport apron will have 30,992 m^2.

2.9.11.3 Cargo Apron

The cargo apron, located at the north-east side of the commercial apron and north side of the airport eastern main access road, will be connected from the northern commercial aprons by a taxiway of 23 m wide plus shoulders of 10.5 m wide. The development of the airside tunnel connecting both the eastern and western aprons will be implemented to improve connectivity between cargo and passenger operations. The cargo apron covered 1,27,400 m^2 is designed to accommodate 8 wide-body freighters.

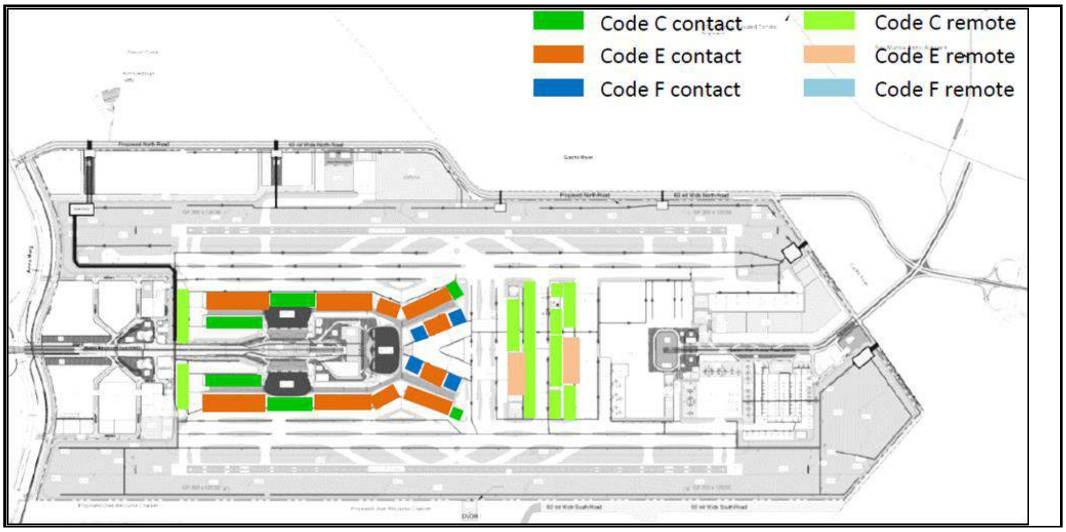
2.9.11.4 Aircraft Aprons

Contact and remote apron areas have been configured to allow aircraft parking, loading and unloading of passengers, baggage, and belly cargo, as well as aircraft servicing. Adequate aprons for commercial passenger aircraft, GA (General Aviation), Cargo and MRO (Maintenance Repair and Overhaul) will be developed at NMIA site.

2.9.11.5 Passenger Aircraft Aprons

The requirement of aircraft stands has been estimated using peak hour runway aircraft movements, fleet mix and length of time that an aircraft would stay on the stand. A Design Day Flight Schedule (DDFS) was developed for 20 MPPA which forms the basis of initial phases of stand demand. Additional stands for maintenance, and aircraft which remain at the airport for long periods of time, have been factored into this requirement; however, these positions may not be co-located with the passenger terminal. The CA requires that 80% of gates are to be provided with a passenger boarding bridge (PBB), and that ratio of contact stands to remote stands, which are in active use, has been calculated at 80% with a reduction due to aircraft types such as Q400 or ATRs not being able to utilize a contact stand.

The requirement of aircraft stands has been computed based on the Stand-Demand method. The calculated forecast aircraft stand demand for NMIA in the Final Phase is shown in **Table-2.25**. The proposed provision of commercial aircraft stands at NMIA in the Final Phase is illustrated in **Figure-2.27.**



Source: Master Plan (May, 2019)

FIGURE-2.27
PROPOSED AIRCRAFT STAND PROVISION – 60 MPPA

In order to maximize efficiency and flexibility to adapt to future potential changes, all wide body stands have been planned as MARS stands which can accommodate either two narrow body aircraft simultaneously or one wide body aircraft. Additionally, it is important to note that to finalize the stand count and provide maximum future flexibility and robustness, the provision of active Code E stands, which are intended to be contact only, for the final phase has been considered along with the allocation of domestic and international flights by terminal. It is proposed that Terminals 1 and 3 will process and handle domestic passengers while Terminal 2 will process and handle all international passengers and a share of the domestic traffic. However, it is also proposed that the eastern piers of Terminals 1 and 3 may have swing capability to handle international flights during the international peak. The provision of Code E stands at Terminal 1 and 3 has been balanced considering the final phase domestic Code E demand to safeguard against Terminal 3 becoming Code E heavy and also more options in terms of splitting the traffic to manage the capacity at peak times as well as airline allocation.

TABLE-2.25
NMIA FORECAST STAND DEMAND

Stand Type	60 MPPA		
	Contact	Remote	Total
Code C	48	59	107
Code E	26	0	26
Code F	4	0	4
RON Stands (Code C)	-	26	26
Code C Equivalents	108	85	193

Source: Master Plan (May, 2019)

2.9.12 Passenger Terminal Building [PTB]

NMIA is planned with cluster of three Passenger Terminal Buildings designed as an integrated Central Terminal Complex to serve minimum 60 MPPA airport capacity. The Central Terminal Complex (CTC) located in center of the airport is planned with

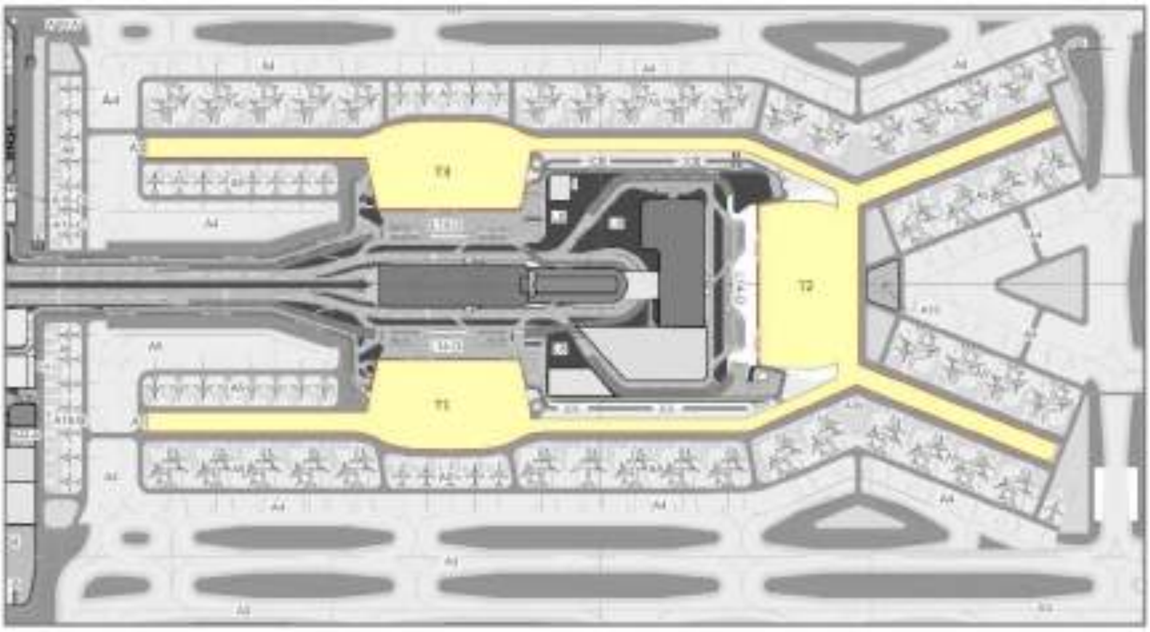
9 + 9 lane main access road from western side connected directly to Mumbai by MTHL and Amra Marg. Designed by globally acclaimed architectural firm Zaha Hadid & Associates the CTC consisting of Terminal-1 and future Terminals 2 and 3 each with capacity of 20 MPPA, will be developed in phases in accordance with traffic demand. All the three terminals shall be inter-connected with capability to act as a single terminal with three processors. Terminal-1 is designed to handle 20 million annual passengers (MPPA) and will serve both domestic and international passengers in initial phases and can be converted into purely domestic terminal in future, after Terminal-2 is operational as an integrated terminal with both domestic and international traffic. Terminal-3 shall be identical to Terminal-1 in design, capacity and aircraft stand provision. The **Table-2.26** below provides forecasted number of passengers (annual and peak hour) for each phase.

TABLE-2.26
NUMBER OF PASSENGERS PER DEVELOPMENT PHASE

Year/ Phase	Opening Phase-1	Short-Term Phase-2	Medium-Term Phase-3	Long-Term Phase-4
Total Annual Passengers	10,592,258	20,580,049	47,325,286	60,300,000

Source: Master Plan (May, 2019)

Figure-2.28 below shows Central Terminal Complex (CTC) plan with footprint area of approximately 2,04,500 sqm. A number of terminal concepts were studied and three terminal cluster in "U" concept, was selected. This concept consists of a central terminal complex (CTC) with connected piers most of them parallel to runways. Also, this concept enables incremental phasing of terminal development with minimal or no impact on ongoing landside and airside operations when subsequent phases terminal development is under implementation.



Source: Master Plan (May, 2019)

FIGURE-2.28
CENTRAL TERMINAL COMPLEX (CTC) PLAN

Terminal-1 will be a five-level facility for processing both, international and domestic passengers with main access from north side served by the loop road system of CTC, with Multi-Level Car Park [MLCP] in center. The key functional areas of Terminal-1 at each level are given below:

A. Basement Level (-5.2 m):

- Baggage break-up area;
- Offices and mechanical, electrical and plumbing rooms; and
- Utilities tunnel connecting central utility plant.

B. Level 0, Arrivals (+0.0 m):

- Remote gate lounges & bus pick-up;
- Remote gate bus drop-off and arrival corridor access;
- Baggage make-up area;
- International baggage claim and government inspections;
- Domestic baggage claim;
- Concessions area;
- Exit passport control and Customs Hand Baggage Screening;
- Medical Screening, and APHO Offices;
- Reserved lounge (International & Domestic);
- Offices and MEP, & IT Rooms;
- Ramp / Airline support;
- Transit/Transfer Area (Int’l to Dom & Dom to Int’l);
- Day Hotel & Lounge;
- Ground transportation curb;
- Concessions;
- Meeters / Greeters area and Concessions; and
- Pick-up area with F&B, Car, taxi, Bus kerbs.

C. Level 1, Arrivals Mezzanine (+5.5 m)

- Arrivals corridor (International & Domestic);
- Arrival passenger access from concourses to claim areas;
- In-line explosive detection screening areas;
- Bridge connections between terminals, access to parking areas and Metro station;
- Offices, Storages and MEP, & IT Rooms;
- Contact gate fixed connection bridges;
- Transit/Transfer airline counters;
- Transit/Transfer security and concourse access; and
- Airport Operational Control Center (AOCC).

D. Level 2, Departures (+11.0 m)

- Drop Off Kerb for Cars, Taxis, Buses with F&B area;
- Ticketing Counters;
- Well-wishers area;
- Passenger check-in Lobby;
- Concessions
- Immigration counters (Outbound);
- Security screening;
- Departure passenger access to concourses; and
- Contact gate departure lounges.

E. Level 3, Departure Mezzanine

- Business Class lounges (Domestic & International)

2.9.12.1 Passenger Flows

Planning, design, sizing and location of all facilities required for processing passengers and their baggage, along with public amenities and spaces needed to operate the Terminal effectively are based on operational standards at Indian airports with specific reference to procedures, norms and standards advised by statutory agencies such as Ministry of Civil Aviation (MoCA), Directorate General of Civil Aviation (DGCA), Central Board of Excise and Customs, Bureau of Immigration, Bureau of Civil Aviation Security (BCAS), Central Industrial Security Force (CISF), International Air Transport Association (IATA) and International Civil Aviation Organization (ICAO). The Terminal is planned as per following passenger flows:

- International Departures;
- Domestic Departures;
- International Arrivals;
- Domestic Arrivals;
- Domestic – Domestic Transfers;
- International– International Transfers;
- Domestic – International Transfers; and
- International – Domestic Transfers.

2.9.13 Cargo Facility

Cargo facility of NMIA includes cargo aircraft apron, processing warehouse facilities for import, export, transit, courier cargo for various items including perishable, pharma and cold storage along with operational facilities for cargo operators, airport operator, custom, cargo agents and trade etc. The proposed cargo facility has been planned to include and facilitate international cargo (import, export and transit), domestic cargo, express/courier cargo, perishable and non-perishable cargo, air mail, valuable cargo, cold storage and hazardous cargo.

The proposal cargo development is planned in south-eastern part of airport site with airside access from south runway and landside access from EMAR. Proposed cargo buildings are planned to be flexible and with modular design enabling the facilities to be expanded as required in line with growth in cargo volumes. Due to short period of time between 10 MPPA and 20 MPPA phases the building and landside support areas will be developed to 20 MPPA size in Phase-I. The air cargo facility is planned with import, export, transit, courier cargo for various items including perishable, pharma, cold storage along with operational facilities for cargo operators, airport operator, custom, cargo agents and trade etc. and their required airside and landside access.

The Phase-I and II facility is to provide 3 Code E stands and 1 Code F stand with a supporting taxi lane. The facility will handle all cargo freight up to completion of the second runway.

2.9.14 Maintenance, Repair and Overhaul (MRO) Facility

Maintenance, Repair and Overhaul (MRO) Maintenance, Repair and Overhaul (MRO) refers to buildings, apron and associated support facilities for maintenance and testing of aircraft. Unlike facilities which can be planned in-line with forecasted growth (i.e., terminals, fuel farm, cargo), MRO requirements are subject to demands from airlines utilizing the airport, and more importantly their need for MRO operations. The required area for aircraft maintenance, including apron, hangars, engine run up bay, aircraft washing area airside and landside circulation and support/ancillary facilities, is planned in northern half of the airport on eastern side. The aircraft maintenance facilities are estimated to provide space for two hangars. In accordance with the CA, required area is proposed for Maintenance, Repair and Overhaul (MRO) facilities, and this shall be developed in phases. The proposed eastern location enables a separate access from NH-4B from east, segregating MRO vehicular traffic from passenger traffic on main access road in the west, thus relieving congestion as airport grows.

2.9.15 General Aviation (GA) Facility

A General Aviation (GA) facility is required to process and service General Aviation aircraft and passengers. This includes a terminal, aircraft hangars and an apron area. GA traffic comprises corporate, charter, government and privately-owned aircraft operations that tend to use generally smaller Code A & B type aircrafts and at times smaller Code C aircrafts. The general aviation (GA) facility is planned at the south east part of the airport taking advantage of Eastern Airport Access Road without interfering with passenger traffic on western entrance of airport. Additionally, future area of 4 ha is reserved for helicopter operation in northern part to ensure flexibility and safeguarding for future development. The GA apron will have an area of 1,90,850 m^2 and northern heliport apron will have 30,992 m^2.

The proposed eastern location of GA shall enable a separate access from NH-4B from the east, segregating all GA vehicular traffic from passenger traffic on Main Access Road in the west, thus relieving congestion. This location will also enable quick and efficient access to Southern runway with minimal impact on commercial airside operations.

Moreover, as discussed with MoCA, CIDCO and GoM, in view of GoM encouraging air taxis helicopter fleet in MMR, a dedicated heliport shall be required outside NMIA. CIDCO needs to identify a location (in Navi Mumbai outside NMIA area) for the same, considering NMIA approach path and OLS. Helicopter operations in initial phase are assumed to use the main runway, but with minimal impact on commercial aircraft operations. In long term upon completion of second runway, an area in northern part of site has been safeguarded for GA.

In Phases-I and II, GA and Helicopter operations will share apron, terminal and landside facilities, for which the following layout will be sufficient. Once helicopter operations shift, the facility can solely be used by GA operations. Beyond 20 MPPA, upon completion of second runway, it is intended that helicopter section shall shift to northern part of site safeguarded for general aviation facility, providing flexibility for both facilities to expand further in future, as required.

2.9.16 Air Traffic Control Tower

Based on discussions with AAI, NMIA is planned with two ATC towers. An interim ATC tower shall be built in Phase-1 and subsequently in Phase-3 the final ATC Tower shall be constructed. The interim ATC tower located at southern ARFF facility has been planned in consultation with AAI to serve the airport until construction of northern runway and Terminal 2 as the final ATC tower is designed as part of Terminal-2.

A controller's eye height of 33 m AGL (43m AMSL) provides adequate visibility of the airfield during early development and achieves a controller's view angle of incidence of greater than 0.8° at the runway extremities. The final ATC Tower is planned to be located near Terminal-2, central part of the airfield. The airside location for ATC Tower provides greatest security, and full visibility of airfield and airspace. A controller eye height of 105 m above ground level was chosen to minimize areas of limited visibility and achieve a controller's view angle of incidence of greater than 0.8° at the runway extremities.

2.9.17 GSE Maintenance Facility

The GSE maintenance area will include garages, workshops, rest rooms, break areas, mess facilities, storage rooms, paint booths, waste disposal, offices and employee parking and required facilities. The proposed GSE maintenance compound will have an overall size of about 75,507 m^2. The proposed maintenance facility shall be developed in phases to meet growing demand and proposed Built up area is 21,860 sqm in Phase 1 & 2 and cumulative area of 79,750 sqm in Final Phase. The layout of the GSE maintenance area within NMIA.

2.9.18 Airport Maintenance Building

The airfield maintenance area will be located on the south-west side of the airfield close to the south-west remote aircraft parking apron. The facilities are planned to include workshop(s), storage, vehicle and equipment parking areas and staff parking. The proposed maintenance compound will have an overall size of 9,390 m^2.

2.9.19 Authority Facilities

NMIA master plan has area earmarked for use of Authorities aircrafts near GA terminal. This facility includes a hangar and independent apron area to park a Code B aircraft and a helicopter. Plot area of 5,528 sqm is proposed as compliance to CA requirements of safeguarding for operations undertaken by authority with adequate space for a Code B aircraft and a helicopter and equivalent hangar and landside circulation.

2.9.20 Airport Administration Building

Airport Administration Building (West)

An airport administration building is proposed in western part of NMIA to house the offices of NMIAL, airlines and other stakeholders necessary for operation of airport. The facility shall also accommodate offices, banks, restaurant and other required facilities. Airport Administration Building (West) is proposed on a plot measuring 9,720 sqm with total BUA of this facility is expected to be about 29,820 sqm spread on about G+10 floors. The facility shall be developed in two phases with half of the facility of about 29,820 sqm to be developed in Phase-I& II (20 MPPA).

Airport Administration Building (East)

An airport administration building is also required in eastern part of NMIA to house offices of NMIAL, of Cargo operating airlines, related Government Agencies and other stakeholders necessary for operation of Cargo. The facility proposed on a plot measuring 7,045 sqm with built-up area of 30,660 sqm in a G+10 floors building shall also accommodate banks, restaurant, and other required facilities. The facility shall be built by Cargo Concessioner to be appointed by NMIAL. Part of this building shall be built in Phase-I& II with area of about 13,780 sqm.

2.9.21 <u>Reserved Services Housing</u>

A plot in northern landside area of NMIA, measuring 10,110 sqm (1.011 ha) has been earmarked for Reserved Services Housing as mentioned in the CA. NMIAL shall develop Reserved Housing in two phases, with 100 flats being developed in Phase I (10 MPPA) and balance 100 flats to be developed in Phase III (40 MPPA). The Built-Up Area of this facility in Final Phase shall be 24,100 sqm

2.9.22 <u>Airport Health Organization (AHO)</u>

An Airport Health Organization (AHO) would ensure implementation of International Health Regulation, International Sanitary regulation and Indian Aircraft (Public Health) Rules at NMIA as well as respond to any health-related queries or issues at the airport. An AHO facility is usually located on landside area of airport within close proximity to terminal complex for quick and efficient access if required. A plot for Airport Health Organization (AHO) has therefore been planned as part of western landside area of NMIA on plot area of 2,510 sqm, within close proximity of main terminal complex. The proposed built-up area of this facility shall be 1,500 sqm.

2.9.23 <u>Airport Security</u>

As part of Master Planning for NMIA, all security aspects have been considered, and required security infrastructure has been planned. NMIAL has received approval from Bureau of Civil Aviation (BCAS) for proposed NMIA Master Plan. The key elements of proposed security infrastructure include:

- Security Check Post / Naka on Main Airport Access Roads;
- Car parking (100 m) away from Terminal facades);
- Airside Security Gates and Access Control;
- Perimeter Security;
- Police Station and offices for Security Agencies;
- Isolation Bay;
- Bomb Cooling Pit; and
- Watch Towers.

NMIA securities infrastructures in the final phase (60 MPPA) is shown in **Figure-2.29**.

2.9.23.1 Access Road Security

Security Check Posts / Naka's are planned on both the western and eastern main access roads with space for required support infrastructure and equipment including, fortified morchas, shelter/cover, CCTV, tyre killers, bollards, communication systems.

2.9.23.2 Car Parking

The car park planning has considered separate areas for private vehicles, taxi staging and employees. All parking areas/Multi-Level Car Parks (MLCLs) are planned 100 m away from terminal facades. Separate parking areas is proposed for short, long term private parking and taxi staging. A Multi-Level Car Parking (MLCP) for terminal is planned during Phase-I of airport development. This MLCP shall be integrated with a Central Multi-Modal Transport Hub (public transport) with suitable pedestrian connections to terminals T1 and T3 kerbs and other activity areas. This shall be 100 m away from Terminals. Limited airport taxis shall be considered for staging at the forecourt of each of the terminals, as most taxis shall be stationed at remote staging away from forecourt areas for long term parking/staging; second MLCP is planned for Terminal T2, 100 m away from its facade.

2.9.23.3 Airside Security Gates

Airside Security Gates are planned to control and ensure secure movement of only authorized/required persons, vehicles and other equipment or goods between the landside and airside areas. Emergency gates to be used in the event of any emergency are planned near each runway end.

2.9.23.4 Perimeter Security

A perimeter airside road of 7.5 m width (2 lanes of 3.75 m) will be provided for patrolling all along internal perimeter airside area of NMIA. A Perimeter Security Wall, as per BCAS requirements, of 2.4 m in height and 0.6 m of concertina coil overhang has been planned. This Perimeter Security Wall shall be illuminated at a minimum essential level in accordance with DGCA regulations. For Phase-I, the Perimeter Security Wall is approximately 15,000 m long. Furthermore, external roads, to be constructed by CIDCO, are planned outside airport to facilitate patrolling from external side of NMIA.

2.9.23.5 Police Station

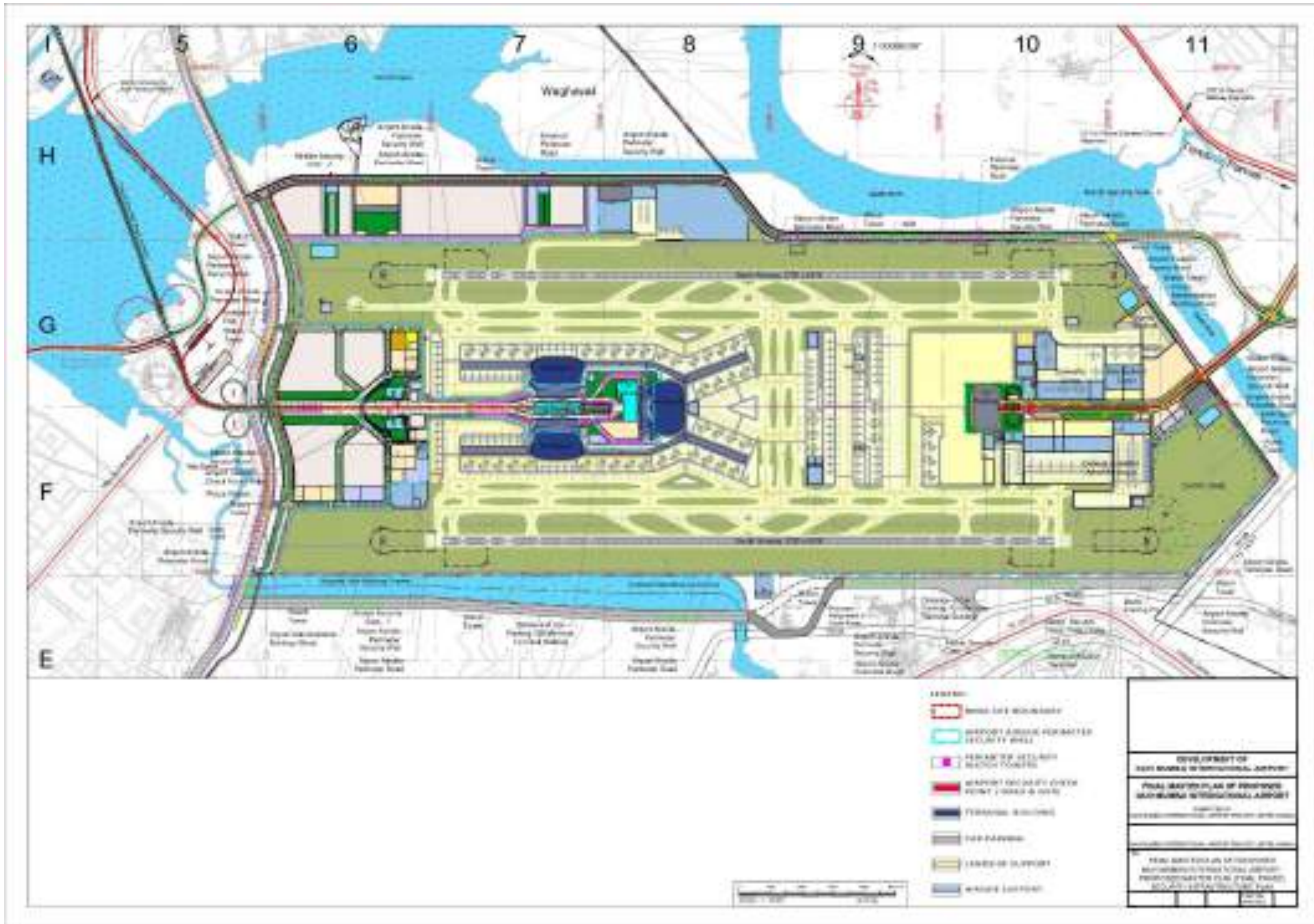
As part of NMIA Master Plan, a police station is proposed, located on the western side of the airport. As required by Navi Mumbai Police Department the proposed Police Station is located on periphery of airport, to be also accessible to people outside airport. The proposed police station includes facilities such as offices for various police officers, meeting rooms, training rooms, a canteen, a gym, lockers, showers, toilets, interview rooms, detention rooms, a reception, an MEP, equipment storage, and car parking. The location of the Police Station will facilitate quick and efficient access to all parts of the airport. Airport Administrative Building (West) shall accommodate offices of BCAS and CSIF at NMIA, including pass section.

2.9.23.6 Isolation Pad

An Isolation pad for parking of an aircraft that might be known to be subject of unlawful interference, or which for other reasons needs isolation from normal airfield operations, has been provided at each phase of development. The proposed location of isolation pad ensures a safety zone of 100 m from other aircraft parking positions, buildings or public areas. The isolation pad has been planned for up to ICAO Code F aircraft.

2.9.23.7 Bomb Cooling Pit

A bomb cooling pit is required in order to deal with suspected explosive devises if found in proximity of airport or an aircraft. It is designed to contain a blast and thus prevent sharpnel from damaging other infrastructure and aircraft. A bomb cooling pit is provided from Phase-I in accordance with applicable regulations and CA. The bomb cooling pit is located on airside in south-east area of airport site and is not proposed to be relocated in subsequent phases. The bomb cooling pit has been planned to be 15 m x 10 m with no other objects within a radius of 100 m from the pit.



Source: Master Plan (May, 2019)

FIGURE-2.29
NMIA PROPOSED SECURITY INFRASTRUCTURE PLAN – 60 MPPA

2.9.23.8 Defence Facilities

Area for accommodating defence agencies requirement is planned near northern runway. The facility is planned in line with CA requirements on 16.201 ha area and will be developed by defence independently. The facility is expected to have hangar, helicopter or aircraft parking stands, office. The proposed site separates all commercial and defence movements on both airside and landside. As northern runway shall be developed in Phase-III, until then the operational requirements of defence agencies shall be accommodated within the GA/MRO proposed area south-east part of airport site with access to southern runway.

Land Reserved for CISF Barracks

Although the CA does not specifically mention provision of plot for CISF Barracks, a plot area of 9940 sqm has been reserved for dormitories of CISF bachelor personnel. The built-up area of this facility shall be 21,840 sqm.

2.9.23.9 Animal Quarantine

Livestock and livestock products can be imported as cargo through an airport. Upon arrival, the said consignments must be referred by Customs for Animal Quarantine Clearance to be compliant with quarantine health rules of the Government of India. Animal Quarantine facility is planned in close proximity of cargo complex on a land area of 990 m^2 with built-up area of 400 sqm, as this will be the point of entry for all animals that are required to undergo this process.

2.9.23.10 Plant Quarantine

Plants can be imported as cargo through an airport. Upon arrival, the said consignments must be referred by Customs for Plant Quarantine Clearance to be compliant with quarantine health rules of the Government of India. Plant Quarantine facility is planned in close proximity of cargo complex on a land area of 1040 m^2 with built-up area of 400 sqm, as this will be the point of entry for all plants that are required to undergo this process.

2.9.23.11 Air Rescue and Fire Fighting (ARFF)

Two ARFF stations are required to serve the dual runway system. Location of ARFF is crucial as vehicles are required to access the runway thresholds and all movement areas within a 3-minute criterion. Therefore, a central location, with one facility in north and one in south are planned on airside of NMIA to provide ICAO Category 10 coverage in accordance with relevant standards and terms of CA and need to safeguard for ICAO Code F. Rescue equipment will be adequate to meet DGCA CAR requirements. The minimum number of ARFF vehicles will be three subjects to completed 'Task Resource Analysis'. A paved emergency access road of 5 m wide for single direction and 7 m wide at curves will be provided from the locations of the ARFF facilities to both runways. A communication and alerting system will be provided linking the ARFF station with the control tower and ARFF vehicles.

Aircraft Rescue and Fire-Fighting (ARFF) facility is required to house ARFF vehicles, staff and equipment for use in emergency situations. The facility is located and designed to ensure all potential emergencies on the airfield can be reached within the regulatory requirements. The facility is planned to include a building, watch tower (non-satellite), fire tender parking, staff areas for welfare, and parking for ARFF, as well as storage of water, extinguishing agent, and firefighting equipment. It provides adequate space to support a minimum of 3 ARFF vehicles and their respective supporting staff and equipment.

2.9.24 Other Facilities/ Future Landside Facilities

Emergency services such as fire, medical, police, petrol pumps, and security will be accommodated on site in accordance with the CA. In addition to these facilities, required facilities as part of overall airport development, including those for passenger, employees and visitors of airport shall be planned in northern and western landside areas of NMIA. These facilities are indicated as Future Landside Development in NMIA Master Plan and the proposed Land Use plan. Land area for Post and Telegraph Sorting Office and Post Office has been reserved on landside area of NMIA, if required. However, this facility will have to be constructed by Post & Telegraph Dept. at their cost if or when it is required.

2.9.24.1 Temporary Helipad

A temporary helipad was constructed in February 2018 in north-west corner of airport site. This temporary helipad shall be retained till Phase-III. The temporary helipad has been designed in accordance with ICAO and DGCA CAR criteria. Emergency services (e.g. fire tender and ambulance) are also provided on stand-by during a helicopter operation. The area designated for temporary helipad is approximately 4.570 ha and the construction cost of helipad shall be part of project cost for Phase-I of the project.

2.9.24.2 Terminal Hotel

NMIA Terminal Hotel has been planned near Terminal T1, accessed from Terminal Forecourt roadways and Western Main Access Road (WMAR). A dedicated approach road branching off from Forecourt loop road, provides access to Hotel plot, measuring about 19,440 sqm. This hotel shall be built in Phase-II with built-up area of about 42,000 sqm. The main entrance to the hotel has been planned from north, leading to entrance foyer & drop-off area. Additional entry/exits have also been planned to south-east & north-west corners of the plot to facilitate service-related circulation. A pedestrian underpass has also been planned for pedestrian connectivity for the passengers from Terminal-1.

The hotel has been planned to be a G+9 storey Five-Star category hotel with about 375 rooms within a height of 37 m AGL. The proposed Hotel shall be a RCC framed structure with approximate built-up area of 37,885 sqm, excluding basement for accommodating Services, BOH and Parking.

2.9.24.3 Project Office

NMIAL Project Office has been planned on north-west part of airport site, along the proposed north road. An approach road branching off from Amra Marg shall provide access to Project Office plot. There is plan to provide direct access to this plot from proposed north road. A site measuring 32,375 sqm has been designated for Project Office. The Project Office shall house office space for NMIAL Project Team along with consultants, etc. The proposed Built-Up area of the facility is proposed to be 10,000 sqm approximately. The entire facility shall be developed in Phase-I.

2.9.24.4 Customs Building

A Customs facility is proposed to accommodate their offices associated with cargo operations at NMIA. Although operational Custom offices shall be located in Cargo Terminal, a separate Customs Building is proposed for integrated office complex of Senior Custom officials. Therefore, the location is planned in close proximity to the cargo complex on plot area of 3,280 sqm. The development of Customs Building shall be undertaken and operated by Customs, at its own cost. The proposed built-up area of Custom Building is 6,500 sqm, which may be further increased by Customs Department as per their requirement.

2.9.24.5 Airside Roads

NMIA Master Plan is proposed with an airside road system to ensure efficient connectivity across the entire airfield.

2.9.24.6 Airside Roads on Apron

Apron area is generally provided with Head of stand road (HOS) of 15 m (3 lanes of 5 m width), while some remote apron with limited traffic have 10 m wide. Back of stand road (BOS) of 10 m (2 lanes of 5 m) and inter-stand road of 10 m (2 lanes of 5 m) wide provided with required separation between edge of road and wing tip of the nearest parked aircraft. These service road design has considered 30kph, max longitudinal gradient and typical cross fall 2.5%, max super elevation 3% and 1m shoulder wherever required.

2.9.24.7 Perimeter Airside Roads

Perimeter road width varying between 5m/7.5m/10m widths depending on the traffic load in proposed in Master Plan. Its design has considered 40 kph, max longitudinal gradient and typical cross-fall 2.5%, max super elevation 5% and 1m shoulder wherever required.

2.9.24.8 Underground Tunnel

NMIA Master Plan proposes two vehicular underpasses to connect CTC, and remote stands in central airfield to eastern airside facilities (Cargo, MRO, and GA) and facilitate movement of passengers, staff, equipment and other goods across airport in a safe, efficient and secure manner. The tunnel width proposed is 15 m - road 10 m wide with 0.750 m footpath and side drain at either side. Vertical clearance of 5.5m is planned and reserves ramp length of 260 m.

2.9.24.9 Emergency Airside Roads

Emergency access road of 5 m wide for single direction and 7 m wide at curves is provided in the master plan for movement of ARFF vehicles. Its design has considered 80 kph, 50 kph on curves, max longitudinal gradient and typical cross fall 2.5%, max super elevation 5% and 1m shoulder wherever required.

2.9.24.10 Triturator

Triturator facility is proposed, where waste from aircraft vacuum toilets will be received through lavatory trucks and triturating process (grinding/shredding) is completed before being disposing the waste into the sewerage system. The facility has been strategically located with consideration to:

- Catchment areas and minimum travel time and crossing of taxiways and taxi lanes;
- Proximity to main utilities connection points and facilities; and
- Under the ultimate scenario a total of 3 triturator facilities are proposed.

2.9.25 Laydown Area, Labour Colony, Crushers & Stacking Area

A laydown area for receipt, transfer and storage of construction material during project development phases is designated in the northern and central part of the project area. The airport operations will start after establishment of Phase-I development in the southern side along with the southern runway. The designated laydown areas along with the construction labour camp location, crushing & stacking areas, etc. related to project construction activities are shown in **Figure-2.30**.

2.9.26 Green Space & Landscape Development

Green Space & Landscape development is an integral part of NMIA Master Plan, and an important element of its environmental sustainability measure. The total green space area proposed is 384.90 ha, i.e. 33.18 % of airport site area of 1160 ha, including green/open spaces on airside and landside of NMIA. The proposed green spaces shall be developed as per their contextual and functional requirements, and overall environmental and landscape planning approach. The proposed Green Space & Landscape development is planned considering key airport related constraints, such as;

1. Bird Menace: Trees and shrubs attract insects and birds which are potential threat to aircraft operations within and around airport. This requires careful selection of trees to be planted on airport premise, as a part of Airport safety measures. The proposed Green Space & Landscape development is planned considering this.

2. Height Restrictions: Development of green areas and planting of trees including their types (height at maturity) is guided by height restrictions imposed by Airport Authority of India. Hence any type of dense vegetations with very high trees cannot be developed in vicinity of airport. The proposed Green Space & Landscape development is planned considering this.

3. Restrictions in Operational Area: As part of airport operational requirements almost 80% of total NMIA land area is defined as Airside or Operational Area where in regular movement of flight movement demands clear and safe area, without any form of vegetation except grass, which may affect the flight operations due to birds attracted by vegetation. The proposed Green Space & Landscape development is planned considering this.

Key objective of proposed Green Space & Landscape development of NMIA is to create a unique, world class green environment for NMIA drawing inspiration from local landscape ensuring sustainability, and offering a memorable experience for passengers, staff and visitors alike. This synergy is an important part of airport's environmental system including rain water harvesting and attenuation strategy.

Indicative drawings of proposed Plan of Central Green & Forecourt Plaza in Phase I & II, and Final Phase are provided in **Figure-2.31** and **Figure-2.32** respectively.

NMIA landscape development aims to achieve:

- A generous green framework of landscape parks and open spaces responsive to natural environment and climate of the place;
- Development of ponds/water bodies, by harvesting rainwater in most of the open/green spaces to ensure sustainability and regeneration of natural environment of the place; and
- An identifiable green envelope with distinctive landscape features and ambience. Integration of ponds, water bodies, artwork, signage, lighting as part of landscape development to create a holistic green environment.

Proposed landscape concept is based on a framework of free-flowing green spaces, and terraces creating a visual rhythm along movement path of users, and a distinct sequence of lotus ponds resulting in a unique visual and environmental impact. This fabric of landscape spaces shall unify the development into a natural green envelope and impart a distinct identity to NMIA. The proposed Green Space & Landscape development shall be implemented in phases and the typology and hierarchy of proposed green spaces include:

2.9.26.1 Green Turf

The large open space in the airside area of NMIA shall be developed as natural green turf, with required gradings. This shall be no-development zone. The natural green turf shall firmly hold the top soil, prevent its erosion and simultaneously ensure percolation of run-off water for recharge of underground water table. Water retention ponds are planned as part of this green area on airside. This area shall be planned with some shrubs & plants at selected locations as per requirement, and according to height restrictions & bird menace considerations.

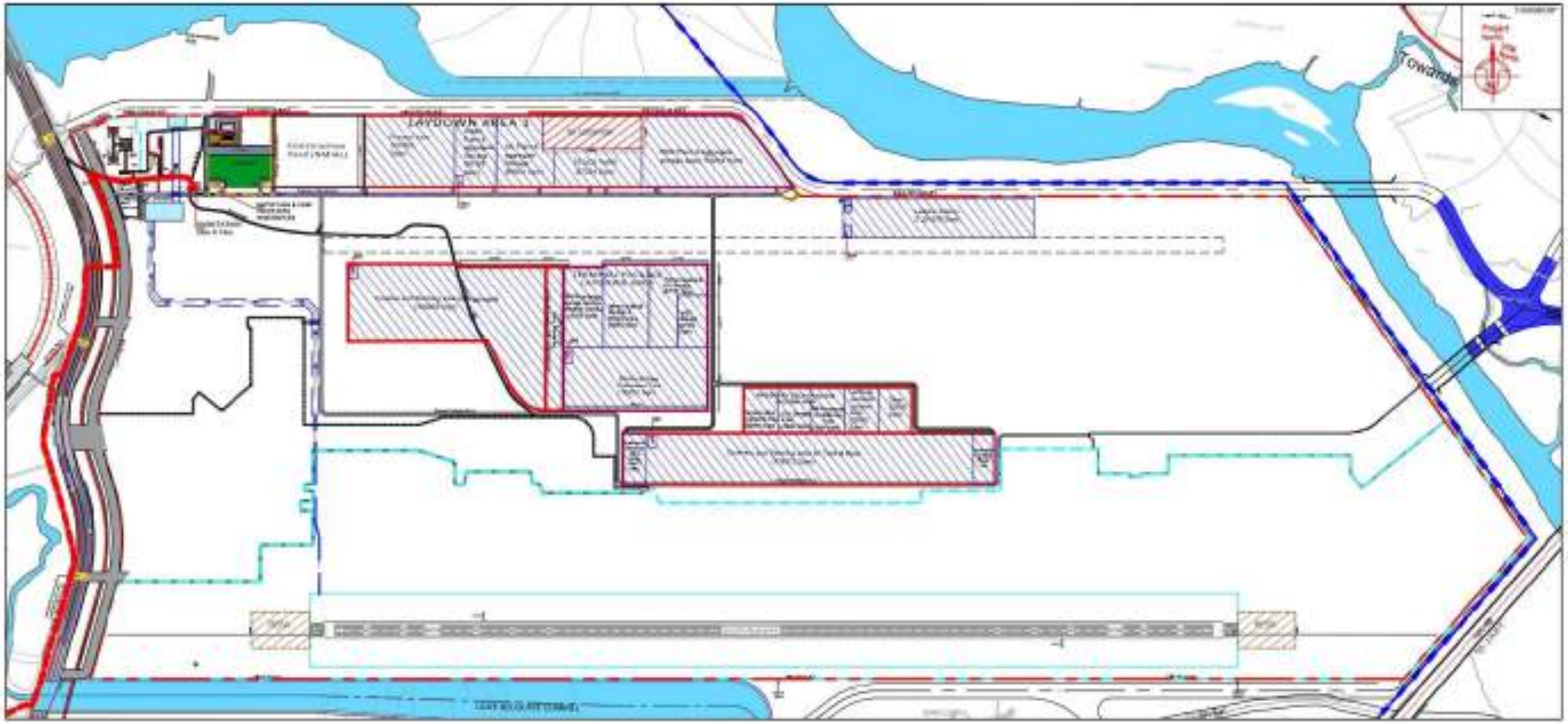


FIGURE-2.30
LAYDOWN AREA, LABOUR COLONY, CRUSHERS & STACKING AREA

FIGURE-2.31
NMIA PROPOSED CENTRAL GREEN PARK PLAN –PHASE I & II

Source: NMIA PFR, 2020

FIGURE-2.32
NMIA PROPOSED CENTRAL GREEN PARK PLAN – 60 MPPA

2.9.26.2 Central Green

A large central green area is planned along Western Main Access Road (WMAR) of NMIA. This central linear green area is proposed for dense plantation of various types of native species at selected locations according to height restrictions & bird menace considerations. The vastness of this green area along with its central location shall make it a major environmental feature of proposed airport development. It is designed as a large, wide linear landscape park on both sides of WMAR with lotus ponds and expansive landscape development on undulating, free flowing landforms with plantation. This landscape area shall serve as central park for all users of airport, as well as visitors. It shall have dense plantation of trees & vegetation up to 8-10 m height/permissible height. Several ponds and water features shall be developed as part of this central green to harvest rainwater from western & northern catchment of airport site. The water body & green vegetation together shall lead to creation of pleasant, aesthetic and sustainable green development. A similar, abbreviated version of green development is planned along Eastern Main Access Road (EMAR) of NMIA.

2.9.26.3 Parks / Gardens

Two large landscaped parks, with large water bodies and lotus ponds are planned near proposed Gateway Entrance to NMIA, along WMAR. Several smaller parks are planned on landside area on west and eastern part of NMIA. These shall provide green cover, accessible green space for airport users at walking distance of their work areas. Small ponds and water bodies shall be part of this category of green areas, providing rain water harvesting, water for landscape and other non-potable uses.

2.9.26.4 Forecourt Green Plaza

Large landscape green space is planned between the three terminals of NMIA in Central Terminal Complex with terrace garden on proposed MLCP buildings, access directly from the terminals as well as from ground level, open for all passengers, staff and visitors alike. Located in the heart of NMIA, the Forecourt Green Plaza is an elevated landscape garden, a raised pedestrian area that will link together the three Terminals and provide an attractive public space for passengers arriving and departing. Visitors arriving by public or private transport, including metro will experience a lush landscape punctuated by artwork and water features at key locations along their path. The vertical surface of MLCP buildings are planned as green walls with shrubs and creepers.

2.9.26.5 Green Avenues

Continuous greens with trees, shrubs are planned along all the roads of NMIA, including WMAR & EMAR. In addition to the three types of green areas mentioned above, trees and dense vegetation shall be planted along all major roads, offering green cover and shade to users and also assisting in encouraging pedestrian movement within airport site area. Continuous plantation of trees and shrubs is planned along the boundary of NMIA, and within RoW of Amra Marg on western side, and north road on northern side of NMIA.

2.9.26.6 Landscape within Buildings

All three terminals of NMIA are planned with landscape areas within them, creating natural green environment using green walls, shrubs, water features, etc. Some buildings like MLCPs are designed as a landscape covered buildings, with green vegetation engulfing the external faced of the structure.

2.9.26.7 Phasing

In Phase-I and II, a part of Central Green along Western Main Access Road (WMAR) shall be developed, as only the outer three lanes of WMAR shall be constructed along with footpath, in this phase. Similarly, first two lanes of EMAR shall be constructed and the green space south of EMAR shall be developed. The full Central Green on WMAR shall be developed in Phase-III, along with the lotus ponds and other water bodies, green terrace landscape along with full expansion of WMAR.

2.9.27 Summary of Airside/ Landside Amenities and Facilities

Principal and ancillary uses in the Land Use zones shall be as under:

a) Airside Zone
b) Landside Zone

2.9.27.1 Airside Zone

The following facilities will be there in the airport zone:

- Runways, Taxiways, Aprons, aircraft parking stands, aircraft hangars, etc.

- Terminals – Passenger, Cargo and General Aviation Terminals; with all requisite sub-uses, services and utilities like Check-in Counters, Baggage Handling, Airlines Counters/Offices, Airport Management Offices, Security Area/Offices, Restaurants, Bars, Retail Shops, Kitchens, Immigration and Custom Offices, Baggage Claim, Utility (water, power, sewerage, IT, telecom, etc) & Air-conditioning Plants & Networks, Baggage Make-up Area, Lounges, AOCC, Training Centers, IT Systems and Offices, Security Gates, Security & Police Offices, Bank & Post Office Counters, Residential Accommodation/ Guest Rooms / Day Hotel, Hotel, Gymnasium, Art Gallery, Aquarium, Health/Emergency Service/ Medical Centers, Radio & Television, Media Broadcast & Recording Centers, VVIP & VIP Lounges, Parking, Multi-level Car Parking, Safe Deposit Vaults, Foreign Exchange Facilities, Travel & Tourism Offices, Ground Transport Service Center, Hotel, etc.

- ATC Tower, ATS Offices, MET Offices, Hangars, Warehouses, Workshops, Security Offices/installations, Fire Station, Water Storage & Pumping Stations, Power Substations, Septic Tanks & STPs, Offices (Radar, ATC, Airlines, Airport Security, etc.), NAVAIDs, Radar Installations. Aircraft, Maintenance Workshops, Mechanical Workshops, Vehicle Maintenance Workshops, GSD- Ground Service Depots, ULD Parking, Vehicle Parking, Internal Roads, Security Gates, Airline Support Offices & Warehouses, Cargo Warehouses, Cargo Cold Storage, Bulk Cargo (perishable, non-perishable, vegetable, pharmaceuticals, meat and other cold storage materials) Storage, Ground Support Equipment Area, Transport Workshops, Stores of all kinds, etc.

- Flight Kitchens, Staff Canteens, Staff Kitchens, Staff Dinning Lounges, Restaurants/Eating-houses/establishments for preparation and sale of eatables for staff, Convenient Store, Medicine Store, Stationery Store, etc.

- Bulk storage of ATF/Petrol/Kerosene/LPG/Storage of Liquefied Petrol and Gas Cylinders (bottled gas) & other such products; Fuel Farm Clinics, Dispensaries, Emergency Service/Medical Centers, Crèches;

- Offices, including Airport Operation/Management Offices, Airline Offices, Police Stations, Telephone Exchanges, Government Offices, Posts & Telegraph Offices, Banks, Cargo Offices, Cargo Warehouses, Bank/Post Office Extension Counters, Dormitory, etc.

2.9.27.2 Landside Zone

The following facilities will be established in the land side zone of the airport.

- Residential, Guest Houses, Barracks, Dormitories, Lodging and Boarding Houses, etc.
- Shops, Offices, Stores, Restaurants, Bars, Eating-houses, F&B establishments for preparation and sale of eatables, Departmental stores, etc. Offices, Banks, ATMs, Safe Deposit Vaults, Foreign Exchange Facilities, Travel & Tourism Offices, Corporate Offices etc. Hotels, Motels and Club Houses; Convention Center, Exhibition Center, Multiplexes.
- Bulk storage of ATF/Petrol/Kerosene/LPG/Storage of Liquefied Petrol and Gas Cylinders (bottled gas) & other such products; Fuel Farm, Storage of obnoxious or hazardous materials.

- Flight Kitchens, Staff Canteens, Staff Kitchens, Staff Dinning Lounges, Restaurants/Eating-houses/, etc.

- Clinics/Dispensaries, Polyclinics, Health Centers, Gymnasiums, and Institutions for health care, Hospitals, Multi-specialty Hospitals and Medical Facilities, etc. Educational Institutions /Skill Dev Centers, Training Centers, Community Halls, Crèches, Community Centers, Libraries, Art Gallery, Museums, Auditoria, Theatres, etc.

- Police Stations, Central and State Government Security Agencies' Offices, Telephone Exchanges, Government Offices, Posts, Telegraphs, Temple, etc.
- All roads, Skywalks, Flyovers, underpasses, Public Utilities, Electrical Sub-stations, Water Storage Tanks, Receiving Station, Fire Station, Water Treatment Plant, Pumping Station, Sewage Treatment Plant, Solid Waste Disposal Plant, Bus Parking, Bus Stations, Metro Stations, Taxi Parking & Staging Areas, Multi-level Car Parking areas, Ground Transport Service Centers, Strom Water Drains, Retention /Holding Ponds, etc.
- Fair Ground, Swimming Pool, Sports Complex, Exhibition Ground, Temple, Gymnasia, Stadia, Theme Park, etc.

The land-use statement of the NMIA site is presented in **Table-2.27** and the detailed land use break-up of the NMIA airport site is presented in **Table-2.28** below . The NMIA land use zones and Land use plan is shown in **Figure-2.33 (A&B).**

TABLE-2.27
NMIA PROPOSED LAND USE SUMMARY

Sr. No	Land use Zone	Area (Ha)	Area (sqm)	% To Total Site Area
1	Airside Area	942.25	94,22,460.82	81.23
2	Landside Area	217.75	21,77,539.18	18.77
	Total Site Area	**1160.00**	**116,00,000.00**	**100.00**
Sr. No	**Land use (Airside + Landside)**	**Area (ha)**	**Area (sqm)**	**% to Total Site Area**
1	Facilities, pavements, building and structures	605.47	60,54,706.706	52.20
2	Green/open spaces	384.90	38,49,047.682	33.18
3	Transportation-roads, parking, metro	139.32	13,93,157.786	12.01
4	Utilities	10.12	1,01,209.816	0.87
5	Drains	20.19	2,01,878.0097	1.74
	Total Site Area	**1160.00**	**116,00,000.00**	**100.00**

Source: Pre-Feasibility Report, 2020

TABLE-2.28 (A)
DETAILED LANDUSE BREAK-UP & AREA STATEMENT OF AIRSIDE

NAVI MUMBAI INTERNATIONAL AIRPORT (AIRSIDE)						
	Proposed Airport Facility, Infrastructure and Amenities (20 MPPA & 60 MPPA)					
No.	**Land use/Facility /Amenity/Infrastructure**	**20 MPPA**		**60 MPPA**		**Total BUA (Sq.mtrs)**
		Proposed Land Area (ha)	**Proposed BUA (Sq.mtrs)**	**Proposed Land Area (ha)**	**Proposed BUA (Sq.mtrs)**	
	AIRSIDE AREA					
	AIRSIDE DEVELOPMENT					
Al/A2	Runway	**27.750**	**0.000**	**55.500**	**0.000**	**0.000**
A3	Taxiway	**51.151**	**0.000**	**152.938**	**0.000**	**0.000**
A4/A5/A6/ A7/A33	Apron Area	**28.823**	**0.000**	**131.145**	**0.000**	**0.000**
A8a	GA Terminal Building	1.189	5700.000	1.189	0.000	5700.000
A8b	GA Terminal Apron	10.450	0.000	10.450		0.000
A8c-A	General Aviation Hangar	0.467	4672.917	0.467	0.000	4672.917
A8c-B	General Aviation Hangar	1.132	11322.000	1.132	0.000	11322.000
A8c-C	General Aviation Apron/Hangar	0.000	0.000	5.440	0.000	0.000
A8c-D	General Aviation Apron/Hangar	2.544	0.000	2.776	0.000	0.000
A8d / A9	Reserved Apron for Military Aircraft (including Defence)	0.419	0.000	0.419	0.000	0.000
	Sub Total of General Aviation	**16.201**	**21694.917**	**21.873**	**0.000**	**21694.917**
A9	Defence Area	0.000	0.000	15.583	32600.000	32600.000
A10	Isolation Pad	0.820	0.000	2.933	0.000	0.000
A11	Passenger Holding Area	0.020	0.000	0.020	0.000	0.000
Al2	Bomb Cooling Pit	0.015	0.000	0.015	0.000	0.000
A13	Localiaser	0.000	0.000	0.000	0.000	0.000
Al4	Glidepath	0.000	0.000	0.000	0.000	0.000
Al5	ATC Tower (Permanent - T2)	0.000	0.000	0.428	5700.000	5700.000
Al6-A	Airside Security Gate South East	0.035	500.000	0.035	0.000	500.000
Al6-B	Airside Security Gate South West	0.046	500.000	0.046	0.000	500.000
Al6-C	Airside Security Gate North East	0.062	500.000	0.051	0.000	500.000
Al6-D	Airside Security Gate North West	0.000	0.000	0.035	500.000	500.000
	Sub Total of Airside Security Gate	**0.142**	**1500.000**	**0.166**	**500.000**	**2000.000**
Al8-A	Trichurator South West	0.019	0.000	0.019	0.000	0.000
Al8-B	Trichurator South East	0.019	0.000	0.019	0.000	0.000
Al8-C	Trichurator North West	0.000	0.000	0.019	0.000	0.000

NAVI MUMBAI INTERNATIONAL AIRPORT (AIRSIDE)						
Proposed Airport Facility, Infrastructure and Amenities (20 MPPA & 60 MPPA)						
No.	**Land use/Facility /Amenity/Infrastructure**	**20 MPPA**		**60 MPPA**		**Total BUA (Sq.mtrs)**
		Proposed Land Area (ha)	**Proposed BUA (Sq.mtrs)**	**Proposed Land Area (ha)**	**Proposed BUA (Sq.mtrs)**	
Al8-D	Trichurator North East	0.019	0.000	0.019	0.000	0.000
	Sub Total of Trichurator	**0.058**	**0.000**	**0.077**	**0.000**	**0.000**
Al9	DVOR / DME (Out side the NMIA Boundary)	1.375	300.000	1.375	0.000	300.000
A20-A	SMR North West	0.000	0.000	0.023	100.000	100.000
A20-B	SMR South East	0.120	100.000	0.120	0.000	100.000
	Sub Total of SMR	**0.120**	**100.000**	**0.143**	**100.000**	**200.000**
A21-A	ASR (Out side the NMIA Boundary) at (West Side)	0.968	650.000	0.146	0.000	650.000
A21-B	ASR (Inside Airside Boundary)	0.142	650.000	0.142	0.000	650.000
A21-C	ASR (Out side the NMIA Boundary) at Matheran Hill	0.146		0.146		0.000
A22-A	Space for Authority Hangar (South East)	0.553	5550.000	0.553	0.000	5550.000
A22-B	MRO Hangar South East	0.000	0.000	2.541	25500.000	25500.000
A22-C	MRO Hangar South East	0.000	0.000	4.509	35000.000	35000.000
A23-A	Run-up & Washing Bay	0.000	0.000	2.194	0.000	0.000
A23-B	MRO Apron	0.000	0.000	4.555	0.000	0.000
	Sub Total of MRO	**0.000**	**0.000**	**13.799**	**60500.000**	**60500.000**
A24	North ARFF Facility	0.000	0.000	0.518	3780.000	3780.000
A25	South ARFF Facility (With Temporary ATC)	0.932	5000.000	0.932	0.000	5000.000
	Sub Total of ARFF Facility	**0.932**	**5000.000**	**1.450**	**3780.000**	**8780.000**
A26	Aircraft Parking For Authority (South East)	0.355	0.000	0.355	0.000	0.000
A27-A	Blast Pad & RESA (South West)	3.930	0.000	3.930	0.000	0.000
A27-B	Blast Pad & RESA (South East)	3.930	0.000	3.930	0.000	0.000
A27-C	Blast Pad & RESA (North West)	0.000	0.000	3.930	0.000	0.000
A27-D	Blast Pad & RESA (North East)	0.000	0.000	3.930	0.000	0.000
	Sub Total of Blast Pad & RESA	**7.860**	**0.000**	**15.720**	**0.000**	**0.000**
A28	Airside Employee Facility (Canteen)	0.272	1600.000	0.272	0.000	1600.000
A29-A	GSE Maintenance Facility South West	2.023	21860.000	2.023	0.000	21860.000
A29-B	GSE Maintenance Facility North East	0.000	0.000	0.854	8020.000	8020.000
A29-C	GSE Maintenance Facility North East	0.000	0.000	0.786	7320.000	7320.000
A29-D	GSE Maintenance Facility North East	0.000	0.000	0.507	5410.000	5410.000
A29-E	GSE Maintenance Facility North West	0.000	0.000	3.381	37140.000	37140.000
	Sub Total of GSE Maintenance Facility	**2.023**	**21860.000**	**7.551**	**57890.000**	**79750.000**
A30-A	Emergency Gate South West	0.000	0.000	0.000	0.000	0.000
A30-B	Emergency Gate South East	0.000	0.000	0.000	0.000	0.000
A30-C	Emergency Gate North West	0.000	0.000	0.000	0.000	0.000
A30-D	Emergency Gate North East	0.000	0.000	0.000	0.000	0.000
	Sub Total of Emergency Gate	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
A31-A	Heliport Terminal (North Side)	0.000	0.000	0.9Sl	5950.000	5950.000
A31-B	Heliport Apron	0.000	0.000	3.099	0.000	0.000
	Sub Total of Heliport	**0.000**	**0.000**	**4.051**	**5950.000**	**5950.000**
A32-A	Airside Fuel Station South West	0.198	80.000	0.198	0.000	80.000
A32-B	Airside Fuel Station South East	0.227	80.000	0.227	0.000	80.000
	Sub Total of Airside Fuel Station	**0.425**	**160.000**	**0.425**	**0.000**	**160.000**
A36	Future Airside Development (South East)	0.000	0.000	33.513	0.000	0.000
A37	GBAS	0.000	0.000	0.000	0.000	0.000
A38	RVR	0.000	0.000	0.000	0.000	0.000

NAVI MUMBAI INTERNATIONAL AIRPORT (AIRSIDE)						
Proposed Airport Facility, Infrastructure and Amenities (20 MPPA & 60 MPPA)						
No.	Land use/Facility /Amenity/Infrastructure	20 MPPA		60 MPPA		Total BUA (Sq.mtrs)
		Proposed Land Area (ha)	Proposed BUA (Sq.mtrs)	Proposed Land Area (ha)	Proposed BUA (Sq.mtrs)	
A40-A	INTO Plane Facility (South side)	0.186	400.000	0.186	0.000	400.000
A40-B	INTO Plane Facility (South side)	0.186	400.000	0.186	0.000	400.000
	Sub Total of INTO Plane Facility	**0.372**	**800.000**	**0.372**	**0.000**	**800.000**
	Support Facilities					
S4	Airport Maintenance Building (South West)	0.939	5000.000	0.939	0.000	5000.000
S10-A	Animal Quarantine Services	0.099	300.000	0.000	0.000	300.000
S10-B	Plant Quarantine Services	0.104	300.000	0.000	0.000	300.000
S16	Temporary Helipad (Upto Phase Ill) (North Side)	1.475	0.000	0.000	0.000	0.000
	Sub Total of Support Facilities	**2.618**	**5600.000**	**0.939**	**0.000**	**5600.000**
	Cargo Terminal					
CA1-A & CA3-A	Cargo Terminal Building, Docking Area and Parking (Domestic)	3.394	20000.000	5.647	16900.000	36900.000
CA1-B & CA3-B	Cargo Terminal Building, Docking and Parking Area (International)	5.333	31500.000	7.586	16900.000	48400.000
CA1-C & CA3-C	Cargo Terminal Building, Docking Area and Parking(Courier)	0.970	5750.000	0.970	0.000	5750.000
CA2-A	Cargo Apron (North east)	0.000	0.000	2.644	0.000	0.000
CA2-B	Cargo Apron (South east)	10.096	0.000	10.096	0.000	0.000
	Sub Total of Cargo Terminal	**19.793**	**57250.000**	**26.943**	**33800.000**	**91050.000**
	Passenger Terminal Development					
PT1	Passenger Terminal-1	4.582	200000.000	4.582	0.000	200000.000
PT2	Passenger Terminal-2	0.000	0.000	5.052	300000.000	300000.000
PT3	Passenger Terminal-3	0.000	0.000	4.582	200000.000	200000.000
PT4	Passenger Terminal-4	0.000	0.000	0.000	0.000	0.000
PT-A	Pier Terminal-1 (With Tl)	1.530	0.000	1.530	0.000	0.000
PT-B	Pier Terminal-1 (With Tl)	0.577	0.000	0.577	0.000	0.000
PT-C	Pier Terminal-2 (With T2)	0.000	0.000	0.956	0.000	0.000
PT-D	Pier Terminal-2 (With T2)	0.000	0.000	1.414	0.000	0.000
PT-E	Pier Terminal-2 (With T2)	0.000	0.000	1.414	0.000	0.000
PT-F	Pier Terminal-2 (With T2)	0.000	0.000	0.956	0.000	0.000
PT-G	Pier Terminal-3 (With T3)	0.000	0.000	0.577	0.000	0.000
PT-H	Pier Terminal-3 (With T3)	0.000	0.000	1.530	0.000	0.000
	Sub Total of Passenger Terminal Development	**6.689**	**200000.000**	**23.171**	**500000.000**	**700000.000**
	SUB TOTAL OF AIRSIDE DEVELOPMENT	**167.135**	**321764.917**	**510.078**	**700820.000**	**1022584.917**
	UTILITIES					
A17-A	Airfield Ground Lighting Substation (CCR) South East	0.180	600.000	0.180	0.000	600.000
A17-B	Airfield Ground Lighting Substation (CCR) South West	0.185	600.000	0.185	0.000	600.000
A17-C	Airfield Ground Lighting Substation (CCR) North East	0.000	0.000	0.180	760.000	760.000
A17-D	Airfield Ground Lighting Substation (CCR) North West	0.000	0.000	0.180	760.000	760.000
U10	Hazardous Waste Storage (South East)	0.115	0.000	0.115	0.000	0.000
	SUB TOTAL OF UTILITIES	**0.480**	**1200.000**	**0.840**	**1520.000**	**2720.000**
	TRANSPORTATION - ROADS, PARKING					
A34	Airside Emergency Road	18.850	0.000	49.541	0.000	0.000
A35	Airside Maintenance Road	3.307	0.000	6.659	0.000	0.000
	Road next to Cargo (East)	0.000	0.000	1.508	0.000	0.000
	Sub Total of Airside Road	**22.157**	**0.000**	**57.708**	**0.000**	**0.000**

NAVI MUMBAI INTERNATIONAL AIRPORT (AIRSIDE)						
Proposed Airport Facility, Infrastructure and Amenities (20 MPPA & 60 MPPA)						
		20 MPPA		60 MPPA		
No.	**Land use/Facility /Amenity/Infrastructure**	**Proposed Land Area (ha)**	**Proposed BUA (Sq.mtrs)**	**Proposed Land Area (ha)**	**Proposed BUA (Sq.mtrs)**	**Total BUA (Sq.mtrs)**
	Parking & Underpass					
L6-A	At Grade Parking	0.000	0.000	0.049	0.000	0.000
L6-B	At Grade Parking	0.120	0.000	0.044	0.000	0.000
L6-C	At Grade Parking	0.039	0.000	0.074	0.000	0.000
L9	Staff Car Parking (Airside)	0.000	0.000	0.073	0.000	0.000
L10	Vehicular Underpass	0.000	0.000	0.000	0.000	0.000
	Sub Total of Parking & Underpass	**0.158**	**0.000**	**0.240**	**0.000**	**0.000**
	SUB TOTAL OF TRANSPORTATION	**22.315**	**0.000**	**57.948**	**0.000**	**0.000**
	OPEN SPACE / GREEN					
A39	Open Space I Green Area (Airside)	241.926	0.000	355.658	0.000	0.000
	SUB TOTAL OF OPEN SPACE / GREEN	**241.926**	**0.000**	**355.658**	**0.000**	**0.000**
	DRAIN & PONDS					
	Airside Drain	6.489	0.000	13.808	0.000	0.000
U7-A	Rain Waster Harvesting Pond (North West)	0.000	0.000	1.190	0.000	0.000
U8-B	Silt Pond (South East)	1.014	0.000	1.014	0.000	0.000
U8-D	Silt Pond (North East)	0.000	0.000	0.3SS	0.000	0.000
U8-E	Silt Pond (North East)	0.000	0.000	0.355	0.000	0.000
U8-F	Silt Pond (North East)	0.000	0.000	1.000	0.000	0.000
	SUB TOTAL OF DRAIN & PONDS	**7.503**	**0.000**	**17.723**	**0.000**	**0.000**
	TOTAL AIRSIDE AREA	**439.358**	**322964.917**	**942.246**	**702340.000**	**1025304.917**

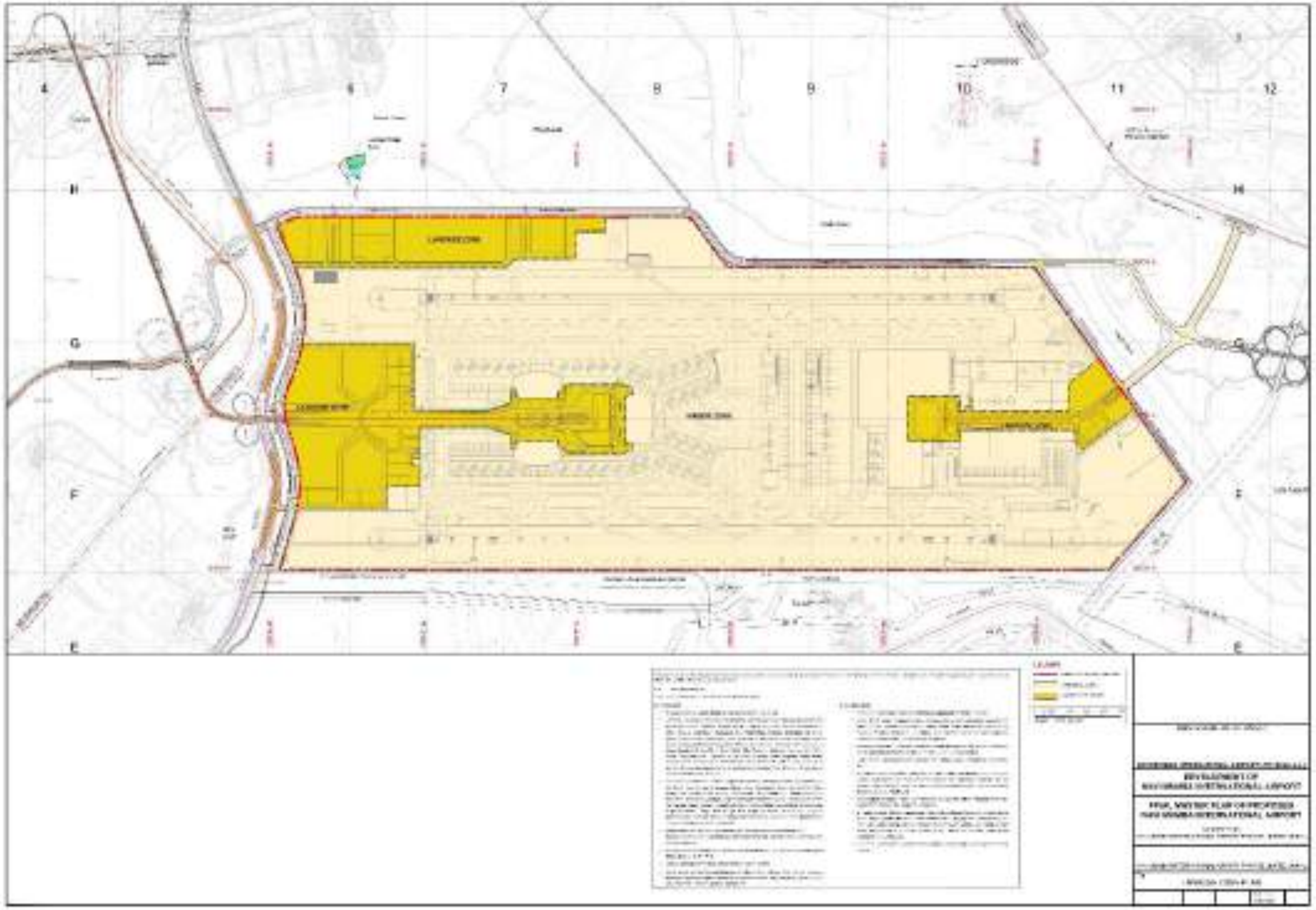
TABLE-2.28 (B)
DETAILED LANDUSE BREAK-UP & AREA STATEMENT OF LAND SIDE

NAVI MUMBAI INTERNATIONAL AIRPORT (LAND SIDE)						
Proposed Airport Facility, Infrastructure and Amenities (20 MPPA & 60 MPPA)						
		20 MPPA		60 MPPA		
No.	**Land use/ Facility/Amenity/Infrastructure**	**Proposed Land Area (ha)**	**Proposed BUA (Sq. mtrs)**	**Proposed Land Area (ha)**	**Proposed BUA (Sq.mtrs)**	**Total BUA (Sq.mtrs)**
	LANDSIDE AREA					
	SUPPORT FACILITIES					
S1	ATC Technical Block	0.405	5400.000	0.405	0.000	5400.000
S2	Fuel Farm	6.569	10000.000	6.569	0.000	10000.000
S3-A	Inflight Catering, I Flight Kitchen	1.186	4200.000	1.186	0.000	4200.000
S3-B	Inflight Catering, I Flight Kitchen	0.609	4200.000	0.609	0.000	4200.000
	Sub Total of inflight Catering / Flight Kitchen	**1.795**	**8400.000**	**1.795**	**0.000**	**8400.000**
SS	Police Station	0.506	1500.000	0.506	0.000	1500.000
S6	Airport Administration Building (West)	0.972	29820.000	0.972	0.000	29820.000
S7	Airport Administration Building (East)	0.705	13780.000	0.705	16880.000	30660.000
	Sub Total of Airport Administration Building	**1.677**	**43600.000**	**1.677**	**16880.000**	**60480.000**
S8	Airport Health Organization	0.251	1500.000	0.251	0.000	1500.000
S9	Customs Building	0.328	3250.000	0.328	3250.000	6500.000
S10-A	Animal Quarantine Services	0.000	0.000	0.099	400.000	400.000
S10-B	Plant Quarantine Services	0.000	0.000	0.104	400.000	400.000
S11-A	Security Checkpoints North West	0.000	4.000	0.000	0.000	4.000
S11-B	Security Checkpoints South West	0.000	4.000	0.000	0.000	4.000
S11-C	Security Checkpoints North East	0.000	0.000	0.000	4.000	4.000
S11-D	Security Checkpoints North East	0.000	4.000	0.000	0.000	4.000
S11-E	Security Checkpoints South East	0.000	4.000	0.000	0.000	4.000
S11-F	Security Checkpoints South East	0.000	0.000	0.000	0.000	0.000
	Sub Total of Security Checkpoints	**0.000**	**16.000**	**0.000**	**4.000**	**20.000**
S12	Meteorological Station	0.810	1000.000	0.810	0.000	1000.000
S13	CSIF Barracks	0.994	13620.000	0.994	8220.000	21840.000
S14-A	Fuel Station North East	0.000	0.000	0.202	300.000	300.000

NAVI MUMBAI INTERNATIONAL AIRPORT (LAND SIDE)						
Proposed Airport Facility, Infrastructure and Amenities (20 MPPA & 60 MPPA)						
No.	**Land use/ Facility/Amenity/Infrastructure**	**20 MPPA**		**60 MPPA**		**Total BUA (Sq.mtrs)**
		Proposed Land Area (ha)	**Proposed BUA (Sq. mtrs)**	**Proposed Land Area (ha)**	**Proposed BUA (Sq.mtrs)**	
S14-B	Fuel Station South East	0.201	300.000	0.201	0.000	300.000
S14-C	Fuel Station North West	0.202	500.000	0.202	0.000	500.000
S14-D	Fuel Station South West	0.202	500.000	0.202	0.000	500.000
S14-E	Fuel Station North Side	0.201	300.000	0.201	0.000	300.000
S14-F	Fuel Station North Side	0.201	300.000	0.201	0.000	300.000
	Sub Total of Fuel Station	**1.008**	**1900.000**	**1.210**	**300.000**	**2200.000**
S15	Reserved Housing	1.011	12000.000	1.011	12100.000	24100.000
S17-A	Reserved Plots	0.607	0.000	0.607	0.000	0.000
S17-B	Reserved Plots	0.227	0.000	0.227	0.000	0.000
S17-C	Reserved Plots (Project Office) North Side	3.238	10000.000	3.238	0.000	10000.000
	Sub Total of Reserved Plots	**4.071**	**10000.000**	**4.071**	**0.000**	**10000.000**
S18	Ceremonial Lounge	0.398	1000.000	0.398	0.000	1000.000
	SUB TOTAL OF SUPPORT FACILITIES	**19.824**	**113186.000**	**20.230**	**41554.000**	**154740.000**
	LANDSIDE DEVELOPMENT					
L7-A	Landside Development (North Side)	0.000	0.000	7.457	0.000	0.000
L7-B-1	Landside Development (North Side)	0.000	0.000	2.316	0.000	0.000
L7-B-2	Landside Development (North Side)	0.000	0.000	21.457	0.000	0.000
L7-C	Landside Development	0.000	0.000	4.684	0.000	0.000
L7-D	Landside Development	0.000	0.000	10.809	0.000	0.000
L7-E	Landside Development	0.000	0.000	7.270	0.000	0.000
L7-F	Landside Development	10.006	0.000	10.006	0.000	0.000
L7-G	Landside Development	1.249	67420.000	1.249	0.000	67420.000
L7-H	Landside Development	0.303	21810.000	0.303	0.000	21810.000
L7-I	Landside Development	0.649	38950.000	0.649	0.000	38950.000
L7-J	Landside Development	0.261	0.000	0.261	0.000	0.000
L7-K-A	Landside Development	0.460	0.000	0.460	0.000	0.000
L7-K-B	Landside Development	0.223	0.000	0.223	0.000	0.000
L7-L	Landside Development	6.076	0.000	6.076	0.000	0.000
	Sub Total of Development	**19.226**	**128180.000**	**73.219**	**0.000**	**128180.000**
L15	Terminal Hotel	1.944	42000.000	1.944	0.000	42000.000
	SUB TOTAL OF LANDSIDE DEVELOPMENT	**21.171**	**170180.000**	**75.164**	**0.000**	**170180.000**
	UTILITIES					
U1-A	Water Plant South West	0.966	456.000	0.966	902.500	1358.500
U1-B	Water Plant South East	0.112	36.000	0.112	108.000	144.000
	Sub Total of Water Plant	1.078	492.000	1.078	1010.500	1502.500
U2-A	Power Distribution Substation (DSS) South East	0.410	2100.000	0.410	0.000	2100.000
U2-B & U3	Power Distribution & Receiving Sub-station (DSS & RSS)	1.SOO	3168.000	1.SOO	19S9.000	S127.000
	Sub Total of DSS & RSS	1.910	5268.000	1.910	1959.000	7227.000
U4-A	Sewage Treatment Plant North West	0.271	0.000	0.271	0.000	0.000
U4-B	Sewage Treatment Plant South West	1.316	24S0.761	1.316	680.000	3130.761
	Solid waste facility (in 20 MPPA)					0.000
U4-C	Sewage Treatment Plant South East	0.537	180.000	0.537	275.000	455.000
	Sub Total of Sewage Treatment Plant	2.124	2630.761	2.124	955.000	3585.761
U5-A	Chiller Plant (South Side)	0.518	4394.000	O.518	0.000	4394.000
U5-B	Chiller Plant (North Side)	0.000	0.000	0.199	3985.000	3985.000
	Sub Total of Chiller Plant	0.518	4394.000	0.717	3985.000	8379.000
U6-A	Solid Waste Facility South east	0.110	300.000	0.110	300.000	600.000
U6-B	Solid Waste Facility North Side	0.000	0.000	1.79S	6980.000	6980.000
	Sub Total of Solid Waste Facility	0.110	300.000	1.905	7280.000	7580.000
U9-A	Utility Integrated plot (South Side)	0.000	0.000	0.000	0.000	0.000
U9-B	Utility Integrated plot (North Side)	0.000	0.000	1.S46	0.000	0.000
	Sub Total of Utility Integrated plot	0.000	0.000	1.546	0.000	0.000
	SUB TOTAL OF UTILITIES	5.741	13084.761	9.281	15189.500	28274.261
	TRANSPORTATION -ROADS, PARKING, METRO					
L1	Remote Taxi Staging (North West)	0.607	350.000	0.607	0.000	350.000
L2-A	Bus Terminal	0.860	820.000	0.860	0.000	820.000
L2-B	Bus & Truck Parking	0.000	0.000	2.072	250.000	250.000
L3	Bus Pickup & Dropoff	0.682	0.000	1.043	0.000	0.000
L4	Forecourt Taxi Staging	0.000	0.000	0.000	0.000	0.000
	Sub Total of Bus, Taxi & Truck Parking	**2.149**	**1170.000**	**4.583**	**250.000**	**1420.000**
L5-A	Metro Station (East)	0.000	0.000	0.000	10000.000	10000.000
L5-B	Metro Station (West)	0.000	0.000	0.000	10000.000	10000.000
L6-D	At Grade Parking	0.043	0.000	0.043	0.000	0.000
L6-E	At Grade Parking	0.064	0.000	0.064	0.000	0.000

NAVI MUMBAI INTERNATIONAL AIRPORT (LAND SIDE)						
Proposed Airport Facility, Infrastructure and Amenities (20 MPPA & 60 MPPA)						
No.	**Land use/ Facility/Amenity/Infrastructure**	**20 MPPA**		**60 MPPA**		**Total BUA (Sq.mtrs)**
		Proposed Land Area (ha)	**Proposed BUA (Sq. mtrs)**	**Proposed Land Area (ha)**	**Proposed BUA (Sq.mtrs)**	
L6-F	At Grade Parking	0.000	0.000	3.347	0.000	0.000
L6-G	At Grade Parking	0.196	0.000	0.196	0.000	0.000
L6-H	At Grade Parking	0.111	0.000	0.111	0.000	0.000
L6-J	At Grade Parking (North Side)	1.000	0.000	1.000	0.000	0.000
	Sub Total of At Grade Parking	**1.414**	**0.000**	**4.761**	**0.000**	**0.000**
L11-A	Multi-Level Car Parking (MLCP) (TI)	2.151	6500.000	2.151	0.000	6500.000
L11-B	Multi-Level Car Parking (MLCP) (T2)		0.000		6400.000	6400.000
	Sub Total of Multi Level Car Parking	**2.151**	**6500.000**	**4.442**	**6400.000**	**12900.000**
L12	Western Main Access Road (WMAR)	12.991	0.000	24.138	0.000	0.000
L13	Eastern Main Access Road (EMAR)	5.499	0.000	8.194	0.000	0.000
L14-A	Western Landside Road	13.506	0.000	16.473	0.000	0.000
L14-B	Eastern Landside Road	1.993	0.000	3.177	0.000	0.000
L14-C	Northern Landside Road	2.069	0.000	9.7S8	0.000	0.000
L14-D	Pickup & Dropoff Area (Landside of Terminal)	1.323	0.000	3.726	0.000	0.000
	Access Road to A21-B (ASR)	0.191	0.000	0.000		0.000
	Sub Total of Road	**37.571**	**0.000**	**65.466**	**0.000**	**0.000**
L17	Truck Parking	2.043	250.000	2.043	0.000	250.000
	SUB TOTAL OF TRANSPORTATION	**45.328**	**7920.000**	**81.295**	**26650.000**	**34570.000**
	OPEN SPACE / GREEN					
L8	Open space I Green Area	28.749	0.000	29.247	0.000	0.000
	SUB TOTAL OF OPEN SPACE / GREEN	**28.749**	**0.000**	**29.247**	**0.000**	**0.000**
	DRAINS & PONDS					
	Landside Drain	6.489	0.000	0.735	0.000	0.000
U7-A	Rain Waster Harvesting Pond (North West)	1.190	0.000	0.000	0.000	0.000
U7-B	Rain Waster Harvesting Pond (North West)	0.503	0.000	0.503	0.000	0.000
U7-C	Rain Waster Harvesting Pond (South West)	0.503	0.000	0.503	0.000	0.000
	Sub Total of Rain Waster Harvesting Pond	**2.196**	**0.000**	**1.006**	**0.000**	**0.000**
U8-A	Silt Pond (North Side)	0.369	0.000	0.369	0.000	0.000
U8-C	Silt Pond (North Side)	0.000	0.000	0.3SS	0.000	0.000
	Sub Total of Silt Pond	**0.369**	**0.000**	**0.724**	**0.000**	**0.000**
	SUB TOTAL OF DRAINS & PONDS	**2.565**	**0.000**	**2.465**	**0.000**	**0.000**
	Total Landside Area	**123.377**	**304370.761**	**217.681**	**83393.500**	**387764.261**
L18	Land Development in Progress	597.192	0.000	0.000	0.000	0.000
	NMIA Site area being part of Road (North Road)	0.073	0.000	0.073	0.000	0.000
	Total Airside + Landside Area	**562.735**	**627335.678**	**1159.927**	**785733.500**	**1413069.178**
	Total Airport Area	**1160.000**	**627335.678**	**1160.000**	**785733.500**	**1413069.178**
U2-A	Power Distribution Substation (DSS) South East	0.410	2100.000	0.410	0.000	2100.000
U2-B & U3	Power Distribution & Receiving Substation (DSS & RSS)	1.500	3168.000	1.500	1959.000	5127.000
	Sub Total of DSS & RSS	**1.910**	**5268.000**	**1.910**	**1959.000**	**7227.000**
U4-A	Sewage Treatment Plant North West	0.271	0.000	0.271	0.000	0.000
U4-B	Sewage Treatment Plant South West	1.316	24S0.761	1.316	680.000	3130.761
	Solid waste facility (in 20 MPPA)					0.000
U4-C	Sewage Treatment Plant South East	0.537	180.000	0.537	275.000	455.000
	Sub Total of Sewage Treatment Plant	**2.124**	**2630.761**	**2.124**	**955.000**	**3585.761**
U5-A	Chiller Plant (South Side)	0.518	4394.000	0.518	0.000	4394.000
U5-B	Chiller Plant (North Side)	0.000	0.000	0.199	3985.000	3985.000
	Sub Total of Chiller Plant	**0.518**	**4394.000**	**0.717**	**3985.000**	**8379.000**
U6-A	Solid Waste Facility South east	0.110	300.000	0.110	300.000	600.000
U6-B	Solid Waste Facility North Side	0.000	0.000	1.79S	6980.000	6980.000
	Sub Total of Solid Waste Facility	**0.110**	**300.000**	**1.905**	**7280.000**	**7580.000**
U9-A	Utility Integrated plot (South Side)	0.000	0.000	0.000	0.000	0.000
U9-B	Utility Integrated plot (North Side)	0.000	0.000	1.S46	0.000	0.000
	Sub Total of Utility Integrated plot	**0.000**	**0.000**	**1.546**	**0.000**	**0.000**
	SUB TOTAL OF UTILITIES	**5.741**	**13084.761**	**9.281**	**15189.500**	**28274.261**
	TRANSPORTATION -ROADS, PARKING, METRO					
L1	Remote Taxi Staging (North West)	0.607	350.000	0.607	0.000	350.000
L2-A	Bus Terminal	0.860	820.000	0.860	0.000	820.000
L2-B	Bus & Truck Parking	0.000	0.000	2.072	250.000	250.000
L3	Bus Pickup & Dropoff	0.682	0.000	1.043	0.000	0.000
L4	Forecourt Taxi Staging	0.000	0.000	0.000	0.000	0.000
	Sub Total of Bus, Taxi & Truck Parking	**2.149**	**1170.000**	**4.583**	**250.000**	**1420.000**

NAVI MUMBAI INTERNATIONAL AIRPORT (LAND SIDE)						
Proposed Airport Facility, Infrastructure and Amenities (20 MPPA & 60 MPPA)						
No.	Land use/ Facility/Amenity/Infrastructure	20 MPPA		60 MPPA		Total BUA (Sq.mtrs)
		Proposed Land Area (ha)	Proposed BUA (Sq. mtrs)	Proposed Land Area (ha)	Proposed BUA (Sq.mtrs)	
L5-A	Metro Station (East)	0.000	0.000	0.000	10000.000	10000.000
L5-B	Metro Station (West)	0.000	0.000	0.000	10000.000	10000.000
L6-D	At Grade Parking	0.043	0.000	0.043	0.000	0.000
L6-E	At Grade Parking	0.064	0.000	0.064	0.000	0.000
L6-F	At Grade Parking	0.000	0.000	3.347	0.000	0.000
L6-G	At Grade Parking	0.196	0.000	0.196	0.000	0.000
L6-H	At Grade Parking	0.111	0.000	0.111	0.000	0.000
L6-J	At Grade Parking (North Side)	1.000	0.000	1.000	0.000	0.000
	Sub Total of At Grade Parking	**1.414**	**0.000**	**4.761**	**0.000**	**0.000**
L11-A	Multi-Level Car Parking (MLCP) (TI)	2.151	6500.000	2.151	0.000	6500.000
L11-B	Multi-Level Car Parking (MLCP) (T2)		0.000		6400.000	6400.000
	Sub Total of Multi Level Car Parking	**2.151**	**6500.000**	**4.442**	**6400.000**	**12900.000**
L12	Western Main Access Road (WMAR)	12.991	0.000	24.138	0.000	0.000
Ll3	Eastern Main Access Road (EMAR)	5.499	0.000	8.194	0.000	0.000
L14-A	Western Landside Road	13.506	0.000	16.473	0.000	0.000
L14-B	Eastern Landside Road	1.993	0.000	3.177	0.000	0.000
L14-C	Northern Landside Road	2.069	0.000	9.758	0.000	0.000
L14-D	Pickup & Dropoff Area (Landside of Terminal)	1.323	0.000	3.726	0.000	0.000
	Access Road to A21-B (ASR)	0.191	0.000	0.000		0.000
	Sub Total of Road	**37.571**	**0.000**	**65.466**	**0.000**	**0.000**
L17	Truck Parking	2.043	250.000	2.043	0.000	250.000
	SUB TOTAL OF TRANSPORTATION	**45.328**	**7920.000**	**81.295**	**26650.000**	**34570.000**
	OPEN SPACE / GREEN					
L8	Open space I Green Area	28.749	0.000	29.247	0.000	0.000
	SUB TOTAL OF OPEN SPACE / GREEN	**28.749**	**0.000**	**29.247**	**0.000**	**0.000**
	DRAINS & PONDS					
	Landside Drain	6.489	0.000	0.735	0.000	0.000
U7-A	Rain Waster Harvesting Pond (North West)	1.190	0.000	0.000	0.000	0.000
U7-B	Rain Waster Harvesting Pond (North West)	0.503	0.000	0.503	0.000	0.000
U7-C	Rain Waster Harvesting Pond (South West)	0.503	0.000	0.503	0.000	0.000
	Sub Total of Rain Waster Harvesting Pond	**2.196**	**0.000**	**1.006**	**0.000**	**0.000**
U8-A	Silt Pond (North Side)	0.369	0.000	0.369	0.000	0.000
U8-C	Silt Pond (North Side)	0.000	0.000	0.355	0.000	0.000
	Sub Total of Silt Pond	**0.369**	**0.000**	**0.724**	**0.000**	**0.000**
	SUB TOTAL OF DRAINS & PONDS	**2.565**	**0.000**	**2.465**	**0.000**	**0.000**
	Total Landside Area	**123.377**	**304370.761**	**217.681**	**83393.500**	**387764.261**
L18	Land Development in Progress	597.192	0.000	0.000	0.000	0.000
	NMIA Site area being part of Road (North Road)	0.073	0.000	0.073	0.000	0.000
	Total Airside + Landside Area	**562.735**	**627335.678**	**1159.927**	**785733.500**	**1413069.178**
	TOTAL AIRPORT AREA	**1160.000**	**627335.678**	**1160.000**	**785733.500**	**1413069.178**



Source: Master Plan (May, 2019)

FIGURE-2.33 (A)
NMIA LAND USE ZONES PLAN

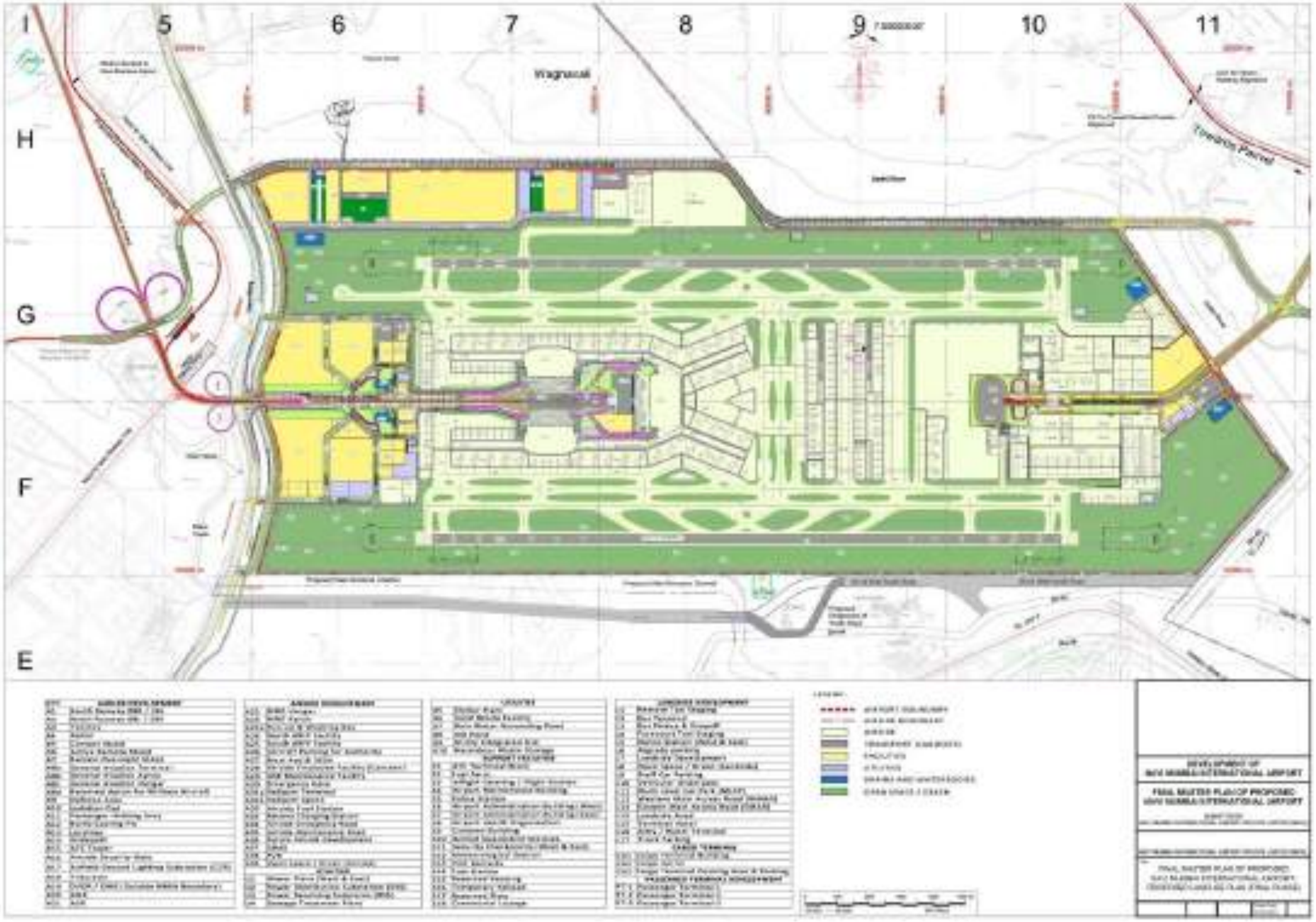


FIGURE-2.33 (B)
NMIA LAND USE PLAN

2.10 Project Implementation

As per current Air Traffic Forecast MMR traffic in 2037 is projected to be around 164.2 MPPA. CSMIA's eventual capacity is expected to be around 55 to 60 MPPA. Considering current stated ultimate phase of NMIA capacity of 60 MPPA, the balance MMR traffic may be unserved traffic, unless NMIA capacity is enhanced beyond 60 MPPA.

The proposed overall implementation strategy is based on project development requirements in accordance with the Concession Agreement (CA), existing site conditions, status of Pre-Development Works and implementation schedule of Pre-Development Works. The NMIA Master Plan has been prepared in accordance with terms and requirements of Concession Agreement and it provides for a fast and efficient phased implementation. However, certain pre-requisites need to be met to enable Concessionaire to meet the schedule during Development Period and Construction Period up to the Commercial Operation Date (COD).

NMIA construction of Phase I (Capacity 10 MPPA) is expected to be completed by December 2024. Subsequently, Phase II of the airport will be developed for additional capacity of 10 MPPA (Cumulative capacity 20 MPPA) and is expected to be completed by April 2026.

2.10.1 Adherence to Concessionaire Agreement (CA)

Phasing and Implementation of NMIA in various phases shall be driven by terms of CA. Phase-I development is based on effective and faster implementation of project, with due consideration to existing site conditions, and schedule of Pre-Development Works. For Phasing and implementation beyond Phase-I, the CA stipulates that for subsequent phases of development, the Concessionaire shall initiate Construction Works for subsequent Phases after Phase-I, within 3 (three) months, upon the earlier occurrence of any one of the following traffic triggers:

(a) Actual Peak Hour passengers exceeds the design Peak Hour passengers for 50% (fifty percent) of the time in a period of 6 (six) months on a rolling basis; and

(b) Annual passenger traffic in any Accounting Year is projected to exceed 75% (seventy-five percent) of the design throughput capacity of the Airport, by considering the observed traffic growth rate over the preceding 6 (six) month period.

2.10.2 Phase-wise Project Implementation

The proposed implementation plan of different phases has been developed based on traffic forecast prepared by NMIAL for implementation of NMIA project. The actual implementation of Phases beyond Phase-I COD may change based on the achievement of required airport traffic trigger which will impact the forecast commencement dates for these Phases. The detailed Implementation timelines for each phase will be provided as part of the Development plans to be submitted before the commencement of respective phase.

Phasing implementation beyond Phase-I COD will remain flexible to respond to the actual traffic growth/ trigger and operational requirements at NMIA.

2.10.3 Project Cost Estimation

The total project cost mentioned in EC 2010 based on 2008-09 cost as given by CIDCO was Rs 8,722 Crores (Phase-I cost was indicated as Rs 4424 Crores for 10 MPPA in 2015, Phase-II as Rs 1934 Crores for 25 MPPA in 2020, Rs 1728 Crores for 45 MPPA in 2025 for Phase-III and finally Rs 636 Crores in Phase-IV for 60 MPPA in 2030). In view of revised schedule of implementation of the project, the updated total project cost of airport development (as of 31st March 2021) for infrastructure and facilities to be developed within 1160 ha of Site area is Rs.41,302 Cr, spread over in four phases i.e. Phase-I: Rs.15,635 Cr. (including cost of Pre- Development Works of Rs 3,665 Cr), Phase-II Rs. 3,539 Cr., Phase-III Rs.13,532 Cr. and finally Rs.8,596 Cr. This excludes the cost of works to be undertaken by CIDCO and other agencies for proposed works related to airport, but outside airport site of 1160 Ha. This cost is for works to be undertaken by NMIAL. Cost of approx. Rs 3,665 Crores has already been incurred on ongoing pre- development work, which is 23.5 % of Phase-I project cost of Rs 15,635 Crores. CIDCO has additionally incurred cost of Rs 1813 Crores towards R & R. Thus, total of Rs 5478 Crores has been incurred on the project till March 2021 (35% of Phase I cost).

The total capital expenditure on airport development, consisting of airport aeronautical facilities for 60 million passengers per annum design capacity works out to Rs. 41,302 Crores [at FY 2021 prices]. The cost break-up is given in **Table-2.29.**

TABLE-2.29
NMIA PROJECT COST BREAK-UP

Sr. No.	Description of Item	Phase I Cost (Cr)	Phase II Cost (Cr)	Phase III Cost (Cr)	Phase IV Cost (Cr)
A	**Pre-development Works** (includes Re-routing of Extra High Voltage Transmission Lines passing through the Site, Tata Power EHVT Line, MSETCL EHVT Line & Civil Works) - by CIDCO	**3,665**	-	-	-
B	**Airport Development Works (Project facilities to be developed by NMIAL)**				
1	Site preparation and earthworks (Cut & Fill Works)	1,900	-	108	30
2	Airside Development	1,530	320	2,577	1,040
3	Passenger Terminal Building Development	2,541	459	4,169	3,000
4	Landside Development	698	102	1,681	511
5	Support Facilities	366	634	679	86
6	Utilities	450	-	515	388
7	Cargo, Fuel Farm, MRO etc.	495	805	1,022	933

Sr. No.	Description of Item	Phase I Cost (Cr)	Phase II Cost (Cr)	Phase III Cost (Cr)	Phase IV Cost (Cr)
8	Technical Services, Preliminaries & Insurance Permits, Building Approval Charges (payable to CIDCO)	1,106	376	1,129	629
9	Water Resource Development Charges (Payable to CIDCO)	-	-	-	920
10	Contingency @ 7%	425	400	594	377
	Sub Total	**9,511**	**3,096**	**12,474**	**7,914**
C	Pre-operative Cost	**503**	**20**	**490**	**268**
D	Interest During Construction	**1,301**	**423**	**567**	**415**
E	Pre-operative exp paid to CIDCO	**110**	**-**	**-**	**-**
F	Concession fee paid to CIDCO (FY 19-22)	**30**	**-**	**-**	**-**
G	Working capital Margin	**515**	**-**	**-**	**-**
	Total	**15,635**	**3,539**	**13,531**	**8,597**
	GRAND TOTAL (for all Phases)				**41,302**

2.10.4 Overall Project Progress

2.10.4.1 Construction Progress

CIDCO as the project proponent of NMIA, received the EC & CRZ clearance in 2010. The site Pre-development Works including clearance of land, vegetation and buildings and other land development works were commenced by CIDCO in 2017 after receiving Stage-II Forest Clearance from MoEF&CC in April 2017.

Progress of Site Pre-development Works

The land development works completed at the site include:

- Ulwe Recourse Channel (URC) has been completed and the Ulwe River has been diverted in June, 2019;

- Cutting of a part of Ulwe Hill and filling of this rock within the site up to + 5.5 m AMSL has been completed. Balance Hill cutting and filling up to average + 8.5 m to +9 AMSL is to commence soon;

- NMIA project site is contiguous with some mangroves, mudflats and creeks abutting its northern boundary, near Waghivali village is part of the contiguous wetland habitat that extends along the banks of Panvel and Thane Creeks. CIDCO received the permission for Mangrove clearance within project development area from Bombay High Court. The Bombay High court passed Order dated 23rd Oct, 2013 in Notice of Motion No. 419 of 2011 in PIL No. 87/2006 for clearing Mangroves at the site and accordingly CIDCO has cleared existing Mangroves and planted compensatory Mangrove plantation.

- Training of Gadhi River is in progress.

- Shifting of EHVT Lines by Tata Power is completed and shifting of EHVT Lines by MSETCL is in progress.

NMIA Construction Works Implementation Schedule

The airport infrastructure construction work by NMIA, for Phase I development, was planned to be carried out from FY 2020 to be completed by FY 2022. However, the commencement of construction works for Phase I has been delayed due to additional time required by CIDCO for completion of R&R implementation. Based on present status airport infrastructure construction work by NMIA shall commence from FY 21-22 and will be completed by FY 24-25 for the Phase I. The Phase -I (airport capacity of 10 MPPA) and Phase-II (with additional 10 MPPA airport capacity) of the proposed NMIA development by NMAIL shall be taken up consecutively. Phase-I and Phase-II shall be clubbed for implementation, and NMIAL under process of obtaining fresh Consent to Establish (CTE) from MPCB in this regard, as current CTE of the project is for Phase -I capacity of 10 MPPA. Phase-I of NMIAL is expected to be completed by end of FY 24-25, thereafter Phase-II will be completed in FY 25-26. Subsequently, Phase-III and Final / Phase -IV will commence based on traffic triggers.

2.10.4.2 Rehabilitation and Resettlement Progress

Rehabilitation and Resettlement Plan (R & R Plan) is one of the most important aspects of the Navi Mumbai International Airport (NMIA) Project, which attains the aspiration of local people and establishes the relationship between local people and project proponent. The R & R plan has therefore been aimed to fulfil the aspiration, rights and privileges of local people and comprehensive social development. There are about 3113 households being rehabilitated from 7 revenue villages in 10 settlements, out of these nine villages are within airport site area of 1160 ha and one is outside.

The rehabilitation sites have been planned and developed near the airport, outside project area of 1775 ha as approved in EC of 2010 for the project. The Rehabilitation & Resettlement is being carried out as per the GR issued by Government of Maharashtra (GoM). The land requirement for airport site is 1160 ha, with additional 615 ha for off-site infrastructure. In addition, CIDCO has already acquired and developed the land for setting up the R&R pockets that includes Pushpak Nagar (R&R site) and R&R pockets for resettlement of displaced villages. The land requirement for the project inclusive of R&R of project affected families is presented in **Table-2.30** below:

TABLE-2.30
LAND DETAILS OF R&R FOR PROJECT

Sr. No.	Particulars	Details	
		Pocket Area	**Area (ha)**
1	Land for R&R Pockets	R&R Pocket-1	21
		R&R Pocket-2	40
		R&R Pocket-3	15
		R&R Pocket-4	27
		R&R Pocket-5	18
		R&R Pocket-6	28
		R&R Pocket-7	13
		Total (ha)	**162**
2	Land for Pushpak Nagar and Off-site Infrastructure	**121 ha**	

Source: CIDCO

2.10.4.3 Expenditure Incurred on R&R Activities

CIDCO has incurred cost of Rs 1813 Crores for R&R for NMIA project. The break-up of expenditure incurred is presented in **Table-2.31** below:

TABLE-2.31
COST INCURRED BY CIDCO FOR R&R FOR PROJECT

Sr. No.	Particulars	Cost Incurred in INR in Crores
1	Development of Pushpak Nagar	**262**
2	Development of 7 R&R Pockets	**1026**
3	Monetary compensation for construction of houses, shifting expenses, rental for 2 years and cash incentive	**525**
	Total	**1813**

Source: CIDCO

A detailed R&R report is prepared by CIDCO is presented in **Annexure-X** of this report. Also, the details of R&R provisions, compensation to project affected families are as per the GR issued by Government of Maharashtra (GoM) in reference to the project benefits is presented in Chapter-8 of this report. The current status of R&R implementation (as on 11th June,2021) is presented in **Table-2.32** below:

TABLE-2.32
STATUS OF REHABILITATION & RESETTLEMENT (AS ON 11th June,2021)

Sr. No.	Village Name	Total Allotments in R&R	No. of Structures	Allotments Executed	Demolished Structures	Possession of Plots given	Percentage of Demolished Structures	Percentage of Allotments	Structure Remaining
1	Chinchpada	517	478	445	470	424	98.3	86.1	8
2	Kopar	302	283	273	282	249	99.6	90.4	1
3	Kolhi	216	196	209	195	194	99.5	96.8	1
4	Ulwa	524	499	465	475	444	95.2	88.7	24

Sr. No.	Village Name	Total Allotments in R&R	No. of Structures	Allotments Executed	Demolished Structures	Possession of Plots given	Percentage of Demolished Structures	Percentage of Allotments	Structure Remaining
5	Ganeshpuri	214	208	208	208	195	100.0	97.2	0
6	Kombadbhuje	370	325	288	295	273	90.8	77.8	30
7	Varcheowale	357	338	327	338	314	100.0	91.6	0
8	Waghivliwada	99	96	99	96	90	100.0	100.0	0
9	Targhar	213	210	204	203	187	96.7	95.8	7
Total		**2812**	**2633**	**2518**	**2562**	**2370**	**97.3**	**90**	**71**

Source: CIDCO

The status of rehabilitation and resettlement activities as on 11th June 2021 is summarized below:

- Out of 2633 structures identified within the project area, 97.3% (2562 structures) of them are demolished and only 71 structures are remaining;
- Plots 2518 allotments have been executed, which amounts to 90% of the total allotments (2812);
- Total 2370 possessions of plots to the PAPs have been executed; and
- The demolition of remaining structures and execution of proposed allotments are in progress.

2.11 Utilities

The proposed utilities system planned for NMIA forms an integral part of overall airport development. The proposed utilities are planned in relation to airside, terminal and landside requirements of NMIA. The proposed utility systems for NMIA shall be developed in phases, in accordance with demand in respective phases. Overall airport wide utility demand is based on passenger and cargo traffic, and benchmarked against similar international and Indian airports. Systems such as water storage, power station, sewage treatment facilities and solid waste management will be developed in modular fashion. Initial infrastructure development of these systems will provide capacity for Phase-I & II, with additional modules added in later phases as per demand. The proposed utilities will include:

1. Electrical / Power Supply & Distribution;
2. Water Supply, Storage & Distribution;
3. Sewage Collection & Treatment;
4. Storm Water Drainage;
5. Solid Waste Collection, Treatment & Disposal;
6. IT & Telecommunication Distribution; and
7. Aviation Fuel Storage and Distribution & PNG distribution system.

2.11.1 Electrical Power

The power requirement for NMIA shall be sourced from Maharashtra State Electricity Distribution Company Limited (MSEDCL). The power demand is estimated based on benchmarking with similar Indian & International Airports.

The total power demand for NMIA is within the power demand approved as part of Environmental Clearance of the project. The total estimated power demand of 96

MVA is for Final Phase of 60 MPPA. The phase-wise electrical power demand of NMIA is presented in **Table-2.33**.

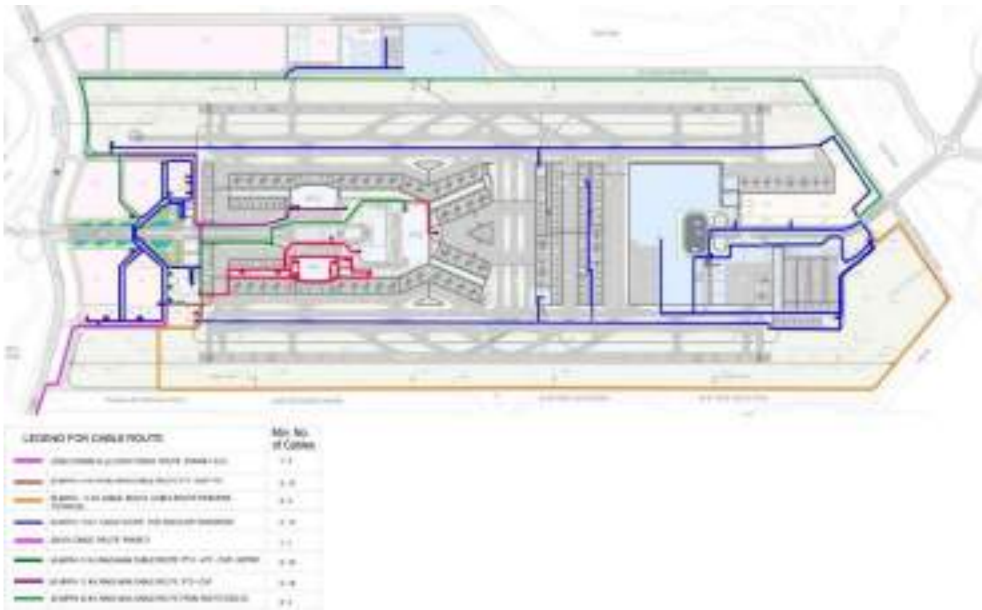
TABLE-2.33
PHASE-WISE POWER DEMAND OF NMIA

Grid Particulars	Power Demand (MVA)			
	Phase-I	Phase-II	Phase-III	Phase-IV
220/33/11kV GIS substation at NMIA	27	36	69	96

Source: NMIAL

2.11.1.1 DG Power

The total estimated DG power requirement will be 35.0 MVA in the final phase (Phase-IV, 60 MPPA) (considering 60 % diversity as DG capacity on over all proposed terminal loads). The combined Phase I&II power back-up demand is about 12 MVA. The final phase power network is presented in **Figure-2.34** below:



Source: Pre-Feasibility Report, 2020

FIGURE-2.34
NMIA POWER NETWORK IN FINAL PHASE

2.11.1.2 Solar Power Generation

The solar plant will create significant environment benefits over its lifetime. Based on the availability of the land & feasibility solar plant planned at NMIA for final phase is 22.14 MW. The solar power facilitation at NMIA is given **Table-2.34** below:

TABLE-2.34
NMIA SOLAR POWER GENERATION PROPOSED FACILITATION

Sr. No.	Location	Area Proposed (sq.mt.)	Area in Acre	Solar Power Generation (MW)
1	Terminal 1 – Roof Top	30,000	7.5	1.64
2	Terminal 2 – Roof Top	45,000	11	2.64
3	Terminal 3 – Roof Top	30,000	7.5	1.64
4	Parallel to South Runway - Ground Mounted	150,000	37	8.2
5	Parallel to North Runway - Ground Mounted	150,000	37	8.2
		Total	100	22.14

Source: NMIAL

2.11.2 Water Demand

The water requirement for NMIA shall be sourced from CIDCO, from its existing water mains running along Amra Marg on western side of airport. This will be supplemented by full recycle of treated sewage from STP which will be used for non-potable purposes. Detailed water demand estimation has been carried out for different facilities considering total persons, area, Aircraft numbers, HVAC Tonnage, garden area, housing dwellings etc. for different planning phases as applicable. The key airport facilities proposed in NMIA will be as given below:

1. Passenger Terminal Building [PTB];
2. Airport and Airline Administration.
3. Air Cargo.
4. Aircraft Maintenance.
5. Ground Support Equipment (GSE) Workshop.
6. Flight catering.
7. Aircraft Rescue and Fire Fighting (ARFF) and Fire Fighting.
8. Defence Facility.
9. Multimodal Hub; and
10. Reserved Housing.

The water requirement will be for domestic use (by passengers, staff and visitors) , and non-domestic purposes, (viz flushing, HVAC make-up and for landscape. Water is also used for hangars, aircraft washing, GSE and cargo area The detailed water demand estimation for each Phase is worked out and presented below. The total estimated water demand for Final Phase of 60 MPPA is 21.82 MLD.

The detailed phase-wise water demand of NMIA is presented in **Table-2.35** The Water Balance diagram for Phase IV (60 MPPA) is presented in **Figure-2.35.**

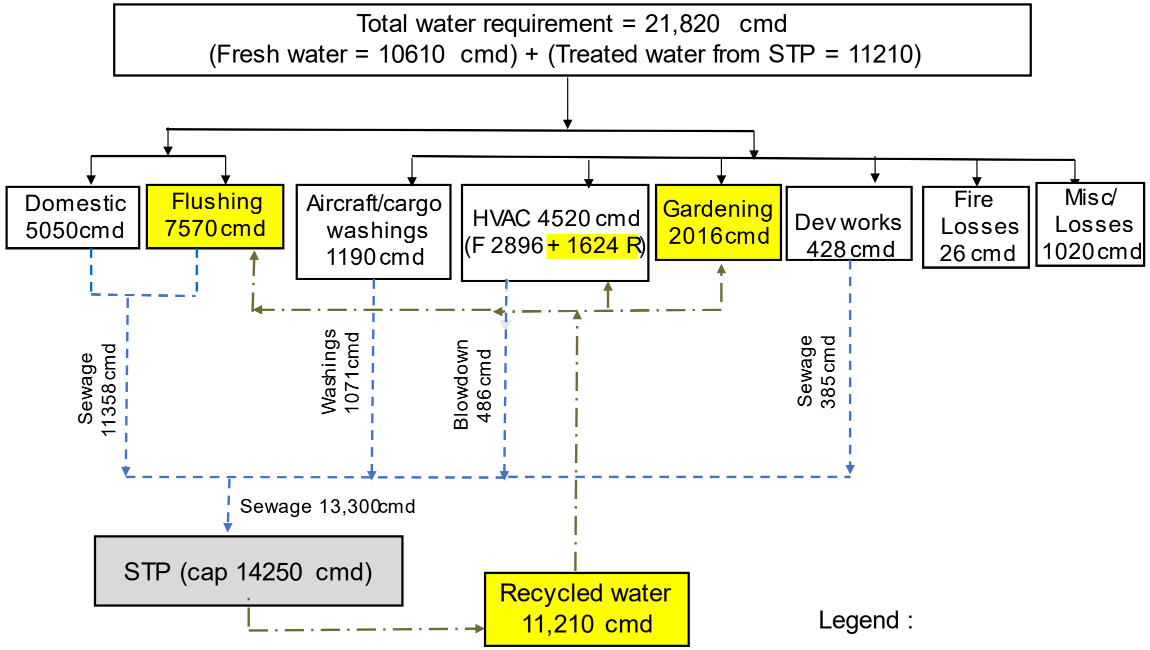
TABLE-2.35
PHASE-WISE WATER DEMAND OF NMIA

Sr. No.	Phase	Potable Water Demand (MLD)	Non-Potable Water Demand (MLD)	Total Demand (MLD)
1	Phase-I: 10 MPPA	2.25	4.32	6.57
2	Phase-II: 20 MPPA	4.925	4.465	9.39
3	Phase-III: 40 MPPA	7.38	8.41	15.79
4	Phase-IV: 60 MPPA	10.61	11.210	21.82

Source: NMIAL

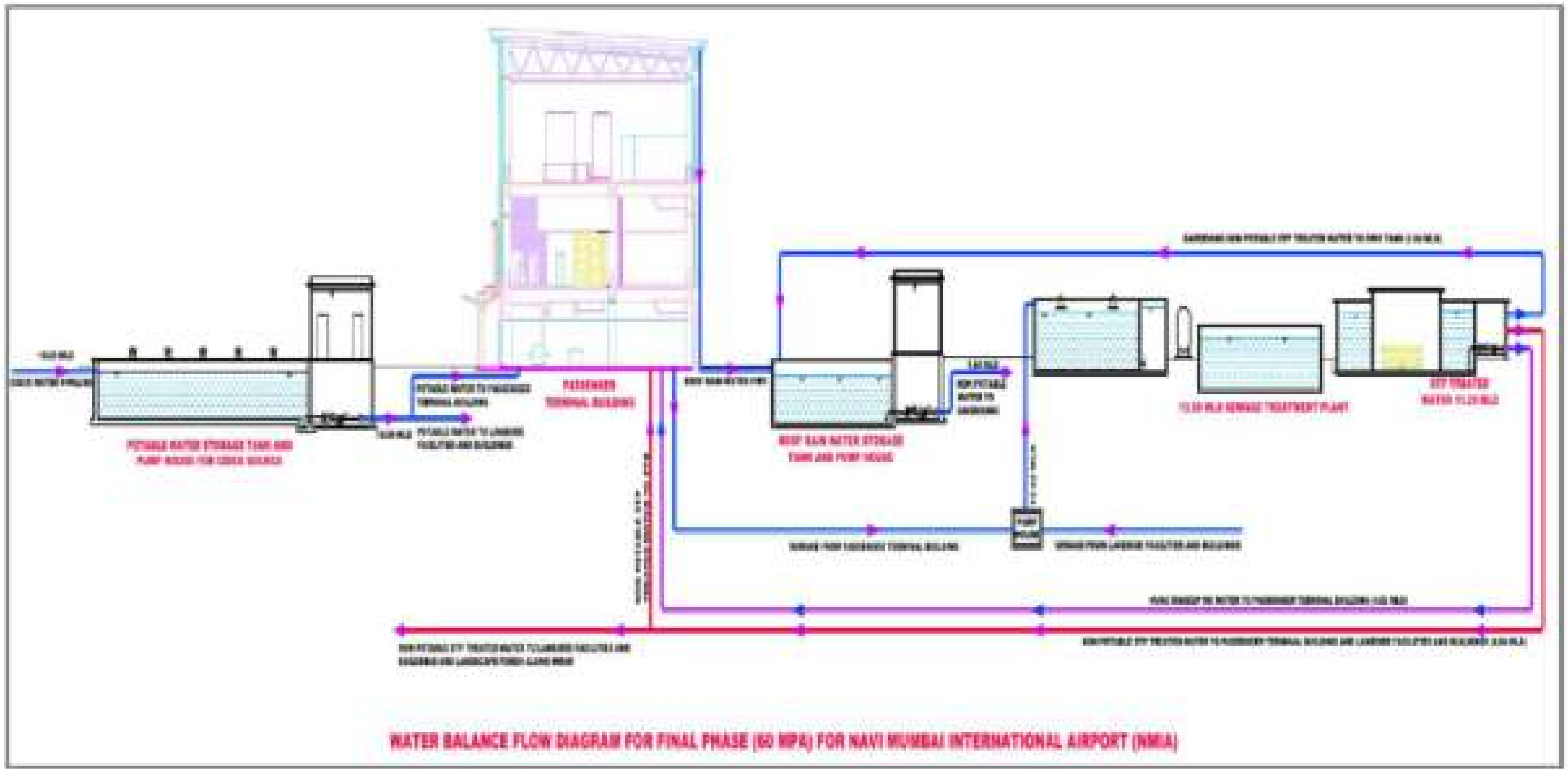
As per earlier EIA report prepared by CIDCO through IIT Mumbai, total water demand was 41 MLD for final phase. Therefore, updated water demand of 21.82 MLD is well within the earlier approved total demand of 41 MLD. The water balance and water flow diagram are given in **Figure-2.35** and **Figure-2.36** respectively and the water supply network is presented in **Figure-2.37** for the final phase (60 MPPA). The water conservation measures and Rainwater Harvesting facility are discussed later in Section-2.11.1**.**

Water Balance Chart for 60 MPPA



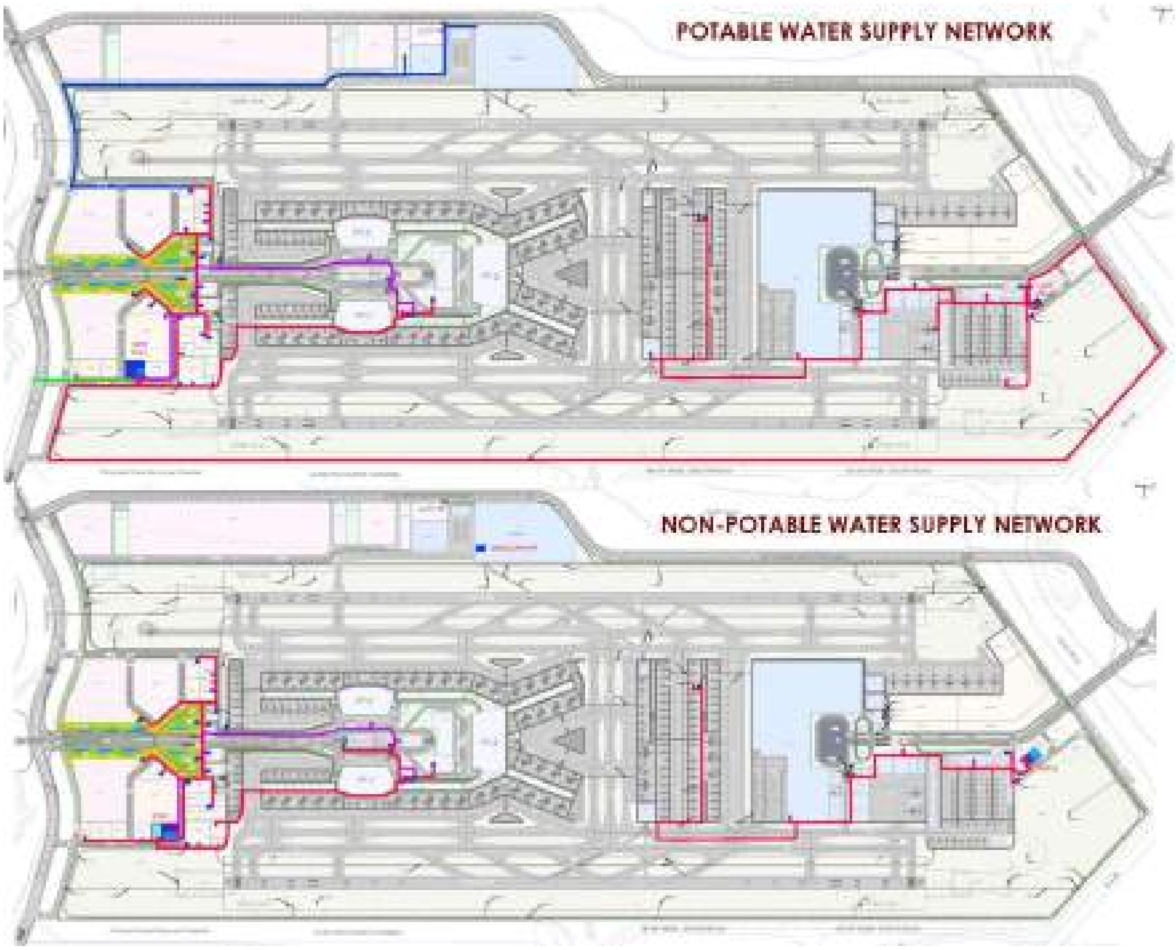
Treated Water from STP will be recycled fully for flushing/cooling/ gardening as per need and site will be ZERO LIQUID DISCHARGE

FIGURE-2.35
FINAL PHASE WATER BALANCE DIAGRAM OF NMIA



Source: Pre-Feasibility Report, 2020

FIGURE-2.36
FINAL PHASE WATER FLOW DIAGRAM OF NMIA



Source: Pre-Feasibility Report, 2020

FIGURE-2.37
POTABLE AND NON-POTABLE WATER SUPPLY NETWORK OF NMIA
(FINAL PHASE-60 MPPA)

2.11.3 Wastewater Generation & Treatment

The total estimated sewage generation of 13.30 MLD is for Final Phase of 60 MPPA as per Water Balance Diagram Fig 2.35. The phase-wise sewage generation is given in **Table-2.36** below:

TABLE-2.36
PHASE-WISE SEWAGE GENERATION OF NMIA

Cumulative Sewage generation from different facilities within NMIA (MLD)	Phase-I	Phase-II	Phase-III	Phase-IV
	10 MPPA	20 MPPA	40 MPPA	60 MPPA
	2.70	4.70	9.10	13.30

Source: NMIAL

2.11.3.1 Sewerage Network

Sewage generated from each plot will be collected by gravity and sent to Sewage Treatment Plant for Treatment. Sewerage Network for final Phase (60 MPPA) is presented in **Figure-2.38** below. The entire airport is divided in three zones and sewage generated in each zone (West/East and North) will be taken to the STP catering to that zone.

2.11.3.2 Sewage Treatment

Wastewater generated from hangars, aircraft washings, Cargo & GSE workshop will be passed through Screens, Oil-Water separator & Grit Chamber. Overflow will be sent to STP for further treatment.

STP Scheme

- Advanced Sequential Batch Reactor (SBR)
- Pressure sand filter + Activated carbon filter
- Disinfection (online chlorination followed by UV sterilizer)
- Ultra-filtration (UF) &
- Reverse Osmosis (RO)

SBR treatment technology has been selected since, it is a batch process, it can take variable flows of sewage and there is a better control over treated water quality. Same technology has been already implemented in CSMIA, Mumbai and the quality of treated effluent is well below 10 mg/l BOD.

Sewage treatment plants will be modular based on the sewage load and shall be augmented in each phase as per requirement.

Entire Treated Water from STP will be recycled & used for Flushing/Cooling and landscape & there will be Zero Liquid Discharge (ZLD)

The phase-wise Sewage treatment plant will be designed and constructed to cater following manner (**Table-2.37**):

TABLE-2.37
PHASE-WISE STP SEWAGE TREATMENT AT NMIA

Phases	West Zone STP (MLD)	East Zone STP (MLD)	North Zone STP (MLD)	Cumulative Capacity (MLD)
Phase – I & II	4.5	1.0	-	5.5
Phase – III	8.5	2.0	0.75	11.25
Phase – IV	11.0	2.5	0.75	14.25
Treatment Technology	Sequential Batch Reactor (SBR)			

Source: Pre-Feasibility Report, 2020

STP Plant Configuration

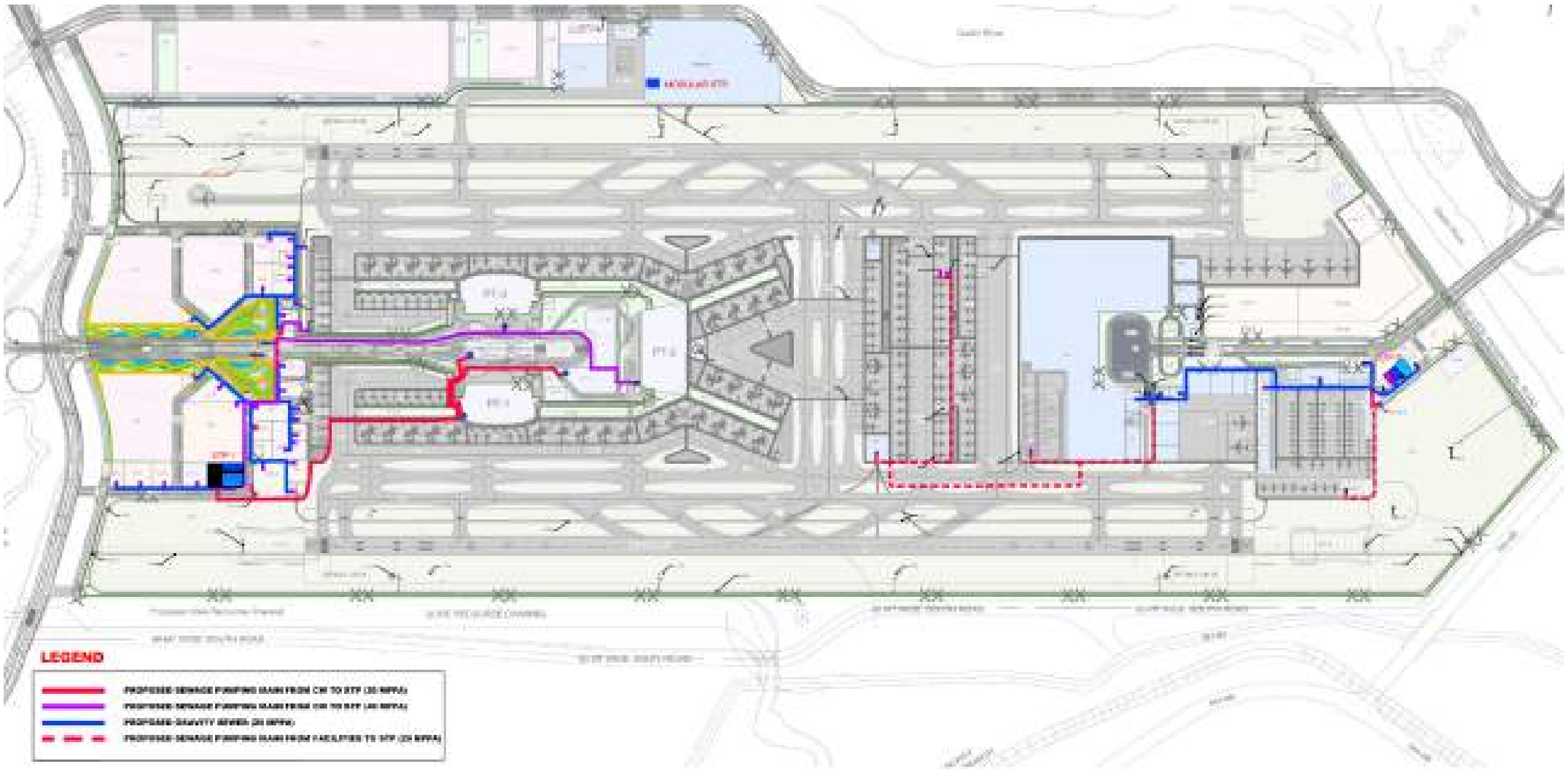
Major development of airport in the initial phases will happen towards the west and east side of airport, whereas last phase of development will happen towards the north side of airport. Considering the developmental phases and sewage generation in each phase, it has been proposed to provide three separate STPs. One STP will be located on west side of airport whereas second STP will be located on east side of airport and third modular STP for defence & SWM at north side of airport development. The STP layouts in the western and eastern side of NMIA in the final phase are presented in **Figure-2.38** and **Figure-2.39** respectively. The location of all three STPs with sewer network is shown **Figure-2.40.**

Source: Pre-Feasibility Report, 2020

FIGURE-2.38
STP LAYOUT OF WESTERN SIDE IN FINAL PHASE

Source: Pre-Feasibility Report, 2020

FIGURE-2.39
STP LAYOUT OF EASTERN SIDE IN FINAL PHASE



Source: Pre-Feasibility Report, 2020

FIGURE-2.40
STPs LOCATIONS IN EAST, WEST AND NORTH & SEWER NETWORK

2.11.4 Storm Water Drainage Network

Planning of storm water drainage system for NMIA is one of the most important part of the overall airport planning. The formation level and the grading levels of NMIA are based on the recommended minimum levels as per Central Water and Power Research Station (CWPRS) report. The updated review summary of the study conducted by CPWRS is presented in **Annexure-XI** of this report. The objectives of NMIA storm water master plan is to:

- To provide safe discharge of flood water from the project area without flooding.
- To comply with EC & CWPRS guidelines for storm water run-off discharge.
- To provide cost effective and maintainable drainage system; and
- To harvest rainwater through rainwater harvesting ponds.

2.11.4.1 Guidelines for Grading and Storm Water Drainage Strategy

Environmental Clearance (EC) granted in Nov 2010 requires that the storm water generated from NMIA area to be drained to north or north-east into Gadhi River and no storm water generated from project area shall be discharged into the diverted Ulwe River channel and or into Moha creek and Amra Marg on western side. The drainage concept for NMIAL is based with strategy that storm run-off draining from south to north and northeast. For draining the water from central catchment area an open rainwater channel is proposed in between airside and landside boundary, which allows for effective drainage network and harvesting system. As a pollution control measure before discharging the storm water to the water way channel/pond, oil-water separator units are proposed in the drain from airside, before the airside drain joins the main drain on airside to intercept the rainwater and separate the oil. Silt ponds are proposed near every outfall location to prevent the silt getting into the receiving water bodies.

2.11.4.2 Drainage Strategy

The proposed master plan is in conformance with above mentioned requirements and also considers the mandatory design requirements in respect of drainage slopes for apron, runway taxiway and pavements in between. The minimum transverse slope on runways and taxiway pavements have been retained as 1.5%, and for aprons the typical slope of 0.5% is adopted. The pavements will also have slope variations in both transverse and longitudinal directions to comply with the mandatory slope requirements and to prevent flat spots at junctions. Following the CWPRS recommendation, proposed master plan adopts as a basis the minimum taxiway edge level has been maintained as +8.0 m. The finished floor level of the Passenger Terminal would be +9.5 m and that of other buildings will be not lower than +9.0 m to avoid flooding. The rainwater harvesting system is planned by run-off generated from building terrace areas and storing in rain water harvesting tank at MLCP, RWH ponds and water bodies in landscape areas. An open RWH pond is planned within W1 catchment on the NW corner. Weir is proposed at the pond outfall location to avert salt water intrusion into the pond. Stored water shall be used for landscape irrigation purposes. Necessary pollution control measures have been complied with (oil water separators and flame traps, silt ponds). Drainage network for landside developmental areas have been planned and connected to the main drain running from airside before discharging to outfall. Roadway drains follow the road profile and adjacent ground profile. To meet the drainage requirements in open areas, interim drainage channels are proposed which will be developed as per phase wise requirements. Site grading and land development are planned such that the surface run-off from plots reaches the drain network and to main drain / outfall by gravity.

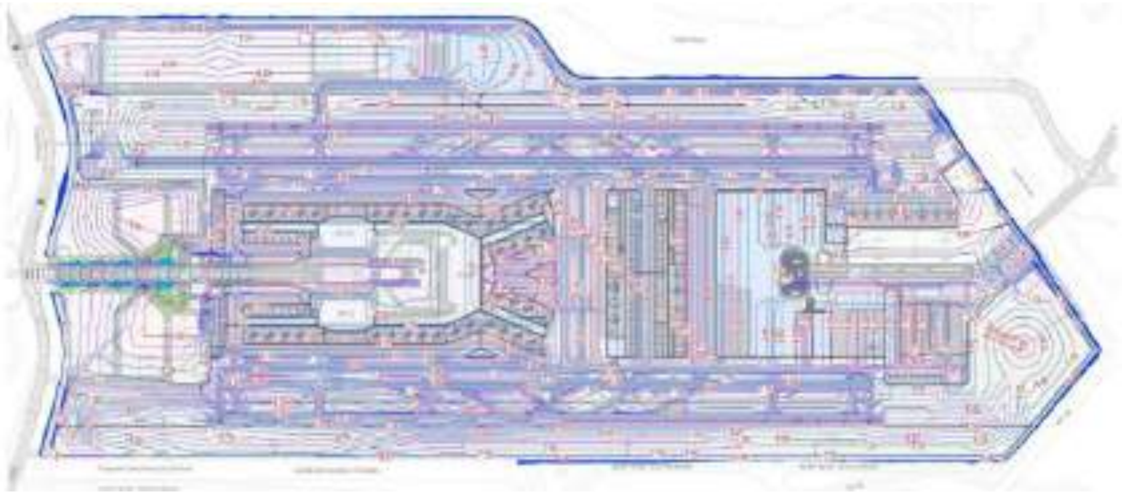
2.11.4.3 Grading Concept Plan for 60 MPPA Phase

The proposed master plan is designed in line with drainage slopes of apron, run taxiway and pavements. The minimum traverse slope on runways and taxiway pavements has been retained up to 1.5 % and for aprons the typical slope of 0.5 % is adopted. The pavements will comply with the mandatory slope requirements of slope variations in both transverse and longitudinal directions and to prevent flat spots at junctions.

Based on CWPRS recommendation, proposed master plan adopts as a basis that the minimum Taxiway edge level will be maintained as + 8.0 m. The finished floor level of the passenger terminal will be +9.5 m and that of other buildings will be not be lower than + 9.0 m to avoid flooding. The rainwater harvesting system is planned by run-off generated from building terrace areas and storing in rain water harvesting tank at MLCP, RWH ponds and water bodies in landscape areas. An open RWH pond is planned within W1 catchment on the NW corner. Weir is proposed at the pond outfall location to avert salt water intrusion into the pond. Stored water shall be used for landscape irrigation purposes.

Necessary pollution control measures have been complied with oil water separators and flame traps, silt ponds. Drainage network for landside developmental areas have been planned and connected to the main drain running from airside before discharging to outfall. Roadway drains follow the road profile and adjacent ground profile.

To meet the drainage requirements in open areas, interim drainage channels are proposed which will be developed as per phase wise requirements. Site grading and land development are planned such that the surface run-off from plots reaches the drain network and to main drain/outfall by gravity. The grading concept plan for 60 MPPA phase is shown in **Figure-2.41.**



Source: Pre-Feasibility Report, 2020

FIGURE-2.41
GRADING CONCEPT PLAN FOR 60 MPPA

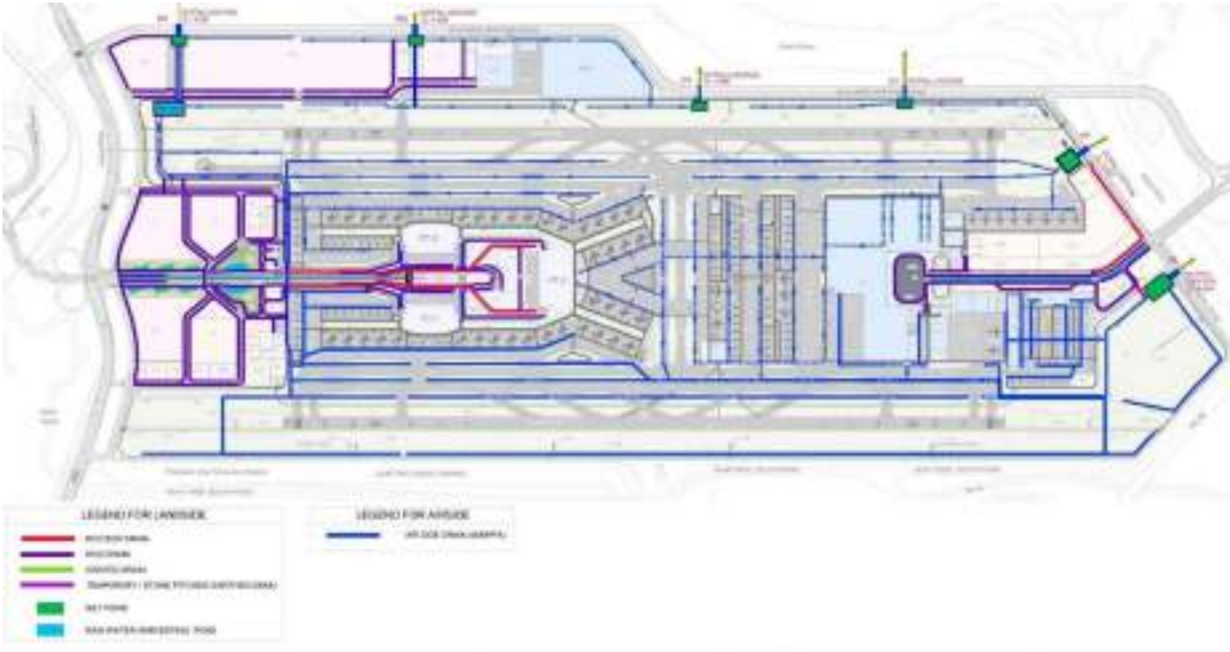
2.11.4.4 Drainage Concept

The proposed storm water drainage system is divided into three areas:

- **Airfield**: The water generated from the runway, taxiway and areas in between is led into the parallel drains and are supplemented by box/pipe culvert wherever it crosses taxiways and roads;
- **Apron**: Slot drains and collector drains have been provided along with oil water separator before it connects to the main drainage network; and
- **Landside**: Drains are provided below the foot path or open areas as per final grading.

Main Rainwater harvesting pond is planned in the north-west corner of airside along the main drain alignment. Shallow water bodies have been planned as landscape features on either side of main access road. To harvest rain water from Terminal roof, RWH tank has been proposed near MLCP.

A plan depicting the main drain alignment, rain water pond, silt ponds and outfall locations (W1, W2, C1, E1, NE, & SE) is shown in **Figure-2.42** below.



Source: Pre-Feasibility Report

FIGURE-2.42
MAIN DRAIN ALIGNMENT, RAIN WATER POND, SILT PONDS AND OUTFALL LOCATIONS

2.11.4.5 Hydrological Criteria

The following section narrates the methodology/approach adopted for computing the run-off volumes.
The drainage system is designed based on rainfall intensity 148.1 mm/hr for 1 in 100-year return period as per CWPRS & MOEF&CC recommendation:

Coefficient of Run-off:

- The value of the run-off coefficients depends upon the catchment characteristics such as property of soil, type of ground cover etc. Considering the land use plan for both aeronautical and non-aeronautical zones the land use is categorised as paved areas, built-up areas and open areas for run-off computation. Due to prolonged monsoon and higher intensity rainfall in Mumbai, the coefficient of run-off considered as follows;
- Steep bare rock and water tight pavement surface (concrete or bitumen) = 1.00
- Loam largely cultivated or turfed (unpaved areas within the airside) = 0.35

2.11.4.6 Manning's Equation & Coefficient

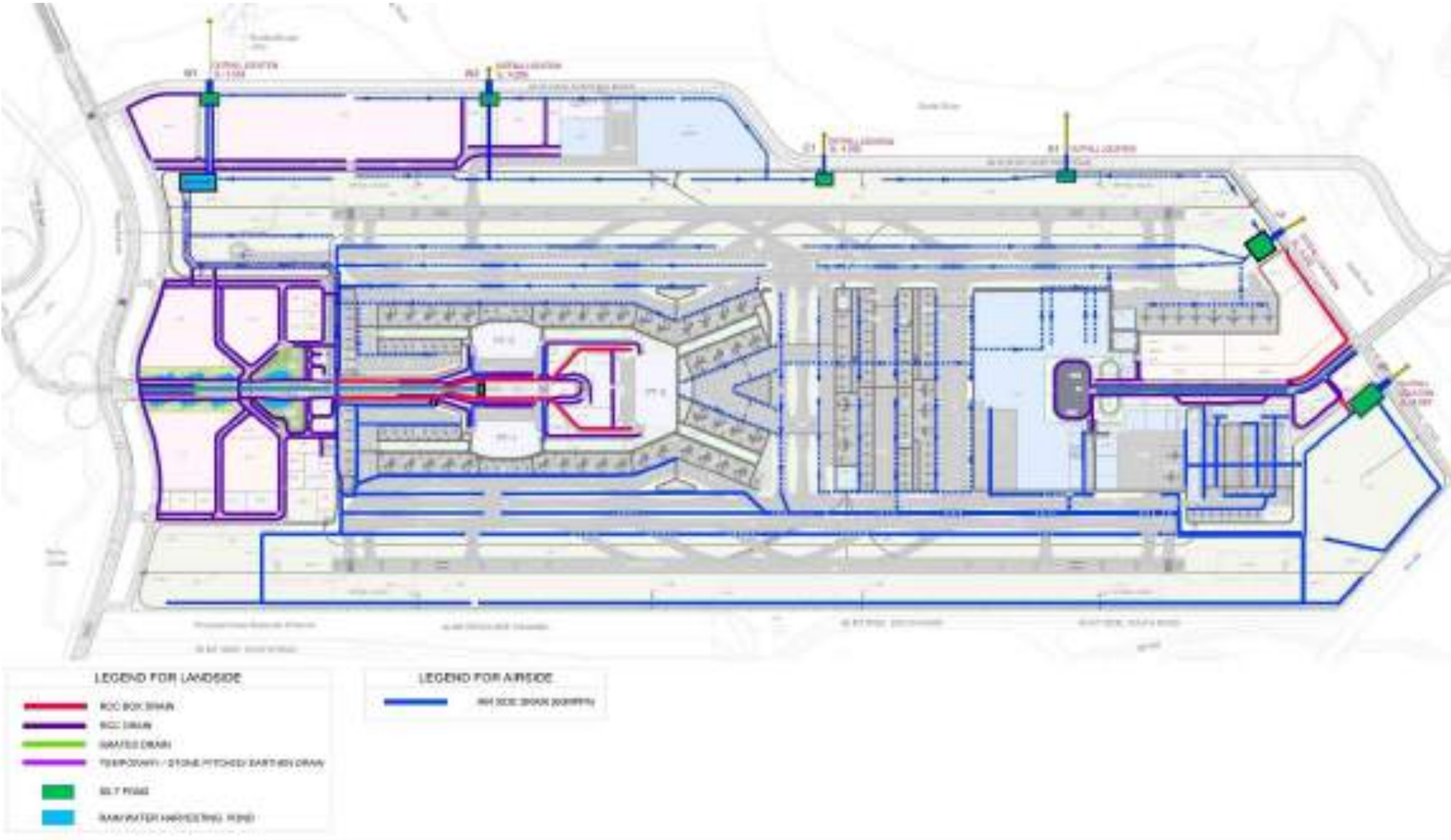
Hydraulic design of the drainage system is determined using the conventional Manning's equation. Manning's roughness 'n' for concrete drains considered is between 0.013 to 0.015 and for grassed areas is normally taken as 0.03.

2.11.4.7 Watershed Delineation and Outfall Locations

Watershed delineation is carried out considering the existing topography, grading plan, the overall developmental master plan and the phasing plans. Considering the airside developmental requirements, reduce number of crossing below the runway area, Total 6 nos. of outfalls are identified. The entire airport area is delineated into Six (6) catchments areas. Catchment IDs have been assigned for each of the catchment areas. The details of the catchment area as follows (**Table-2.38**). Integrated Drainage Network Plan of final Phase-IV is shown in **Figure-2.43**.

TABLE-2.38
DETAILS OF CATCHMENT AREA & DISCHARGES REACHING EACH OF THE DRAINAGE OUTFALLS AND INVERT LEVELS

Sr. No.	Catchment ID	Outfall Nos.	Catchment Area (Ha)	Discharge Cum/Sec (For 1 in 100-year RP)	Proposed IL at Airport Boundary, M
1	W1	1	445	126.3	3.518
2	W1	2	79	22.18	4.200
3	C1	3	28	6.03	4.200
4	E1	5	33	2.11	4.500
5	NE	6	203	71.93	4.222
6	SE	6A	372	103.91	3.974



Source: Pre-Feasibility Report, 2020

FIGURE-2.43
INTEGRATED DRAINAGE NETWORK PLAN -FINAL PHASE

2.11.5 Solid Waste Management

Solid Waste Management (SWM) System is planned for Navi Mumbai International Airport (NMIA) to ensure hygienic and healthy living / working environment at the airport. The major solid waste contributing facilities include terminals, cargo and other airport related buildings. The characteristics of the solid waste generated is of typical municipal waste along with hazardous wastes from specific facilities, consisting of plastic, metal, paper, cardboard, pet bottles, used oils and bio-medical waste. For effective management of solid waste generated from these activities, it is essential to have a Solid Waste Management Plan or Conceptual Plan addressing various functional aspects of Solid Waste Management (SWM). Solid Waste Management Plan is aimed at managing the generation, storage, and disposal of municipal solid waste and hazardous waste generated. Solid Waste Management Plan includes detailed program for reduction of waste generation, increase recycling/ reuse of waste and dispose waste through scientific approach.

Demand Estimation

Detailed solid waste demand estimation was done based on benchmarking study considering references from similar developments in other locations in the country and overseas. The estimated total municipal solid waste generation quantity in final Phase is calculated as 72 TPD while, hazardous waste is expected to generate in the range 2.50 TPD and Bio-medical waste in the range of 0.05 TPD in the final phase of the airport. The break-up of phase-wise municipal solid waste including handling capacities is presented in the **Table-2.39** below.

TABLE-2.39
MUNICIPAL SOLID WASTE GENERATION (PHASE-WISE CAPACITIES)

Sr. No.	Development Phase	Cumulative Capacity (TPD)
1	Phase I-10 MPPA	17.0
2	Phase II-20 MPPA	29.0
3	Phase III-40 MPPA	50.0
4	Phase IV-60 MPPA	72.00

Source: NMIAL

Design, Codes and Laws

Following codes/standards will be adopted while execution of the tasks in solid waste management. The general rules and regulations applicable for municipal solid waste and hazardous waste given by Ministry of Environment and Forests (MoEF&CC), GOI.

- Municipal Solid Wastes (Management and Handling) Rules, 2016.
- Bio-medical Waste (Management and Handling) Rules, 2016.
- Hazardous Wastes (Management and Handling) Rules, 2016.

Rules pertaining to management of municipal solid wastes in Schedule-II of Municipal Solid Wastes (Management and Handling) Rules, 2016, will be followed.

Collection and storage of bio-medical waste, hazardous wastes, done as specified by the rules and disposal as specified and regulated by the State Pollution Control Board (SPCB). The design of waste processing center, treatment and waste recovery facility will be made as per guidelines given by CPHEEO in manual on Municipal Solid Waste Management.

2.11.5.1 Solid Waste Management Methodology

The wastes generated have to be managed after segregation by identifying the appropriate method of management. Recyclable wastes such as paper, glass, metal, plastics (from domestic and commercial activities), wood, waste oil and solvents (from maintenance and engineering operations), kitchen wastes and vegetable oils (from restaurants, food courts etc) has to be effectively done. The green wastes from landscape / gardens shall be used in bio conversion processes. The three R's; popularly known method of Solid Waste Management shall be implemented at all users end irrespective of the activities involved.

The following tasks are accounted as part of solid waste management methodology:

- Identification of waste generation sources.
- Waste collection, storage & transportation.
- Waste segregation, handling and processing.
- Waste quantification and characterization; and
- Treatment & disposal of wastes.

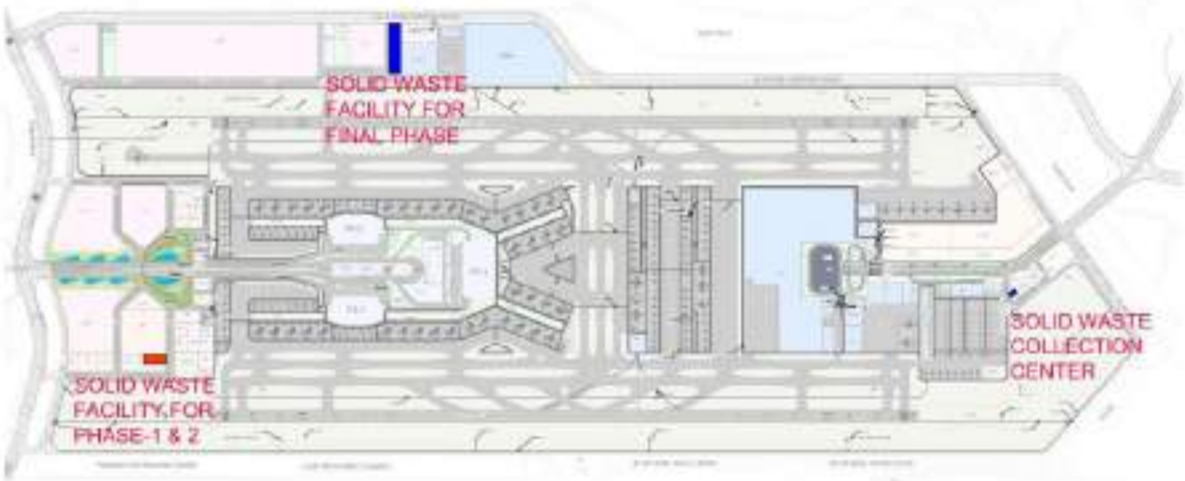
The proposed principle of solid waste management is presented in **Table-2.40** below:

TABLE-2.40
PROPOSED PRINCIPLE FOR SOLID WASTE MANAGEMENT

Sr. No.	Waste Type	Collection and Storage	Method of Disposal
1	Bio-degradable waste	Collection and storage in storage yards	Will be sent to the bio-conversion plant proposed at NMIA to form compost which will be used for landscaping at NMIA
2	Reusable, recyclable & hazardous waste	Collection and storage in closed rooms at ambient temperatures	To be taken away by MPCB authorized vendors
3	Non-biodegradable & inert wastes	Collection and storage in closed rooms at ambient temperatures	To be transported to the authorized waste authorized waste disposal site of CIDCO

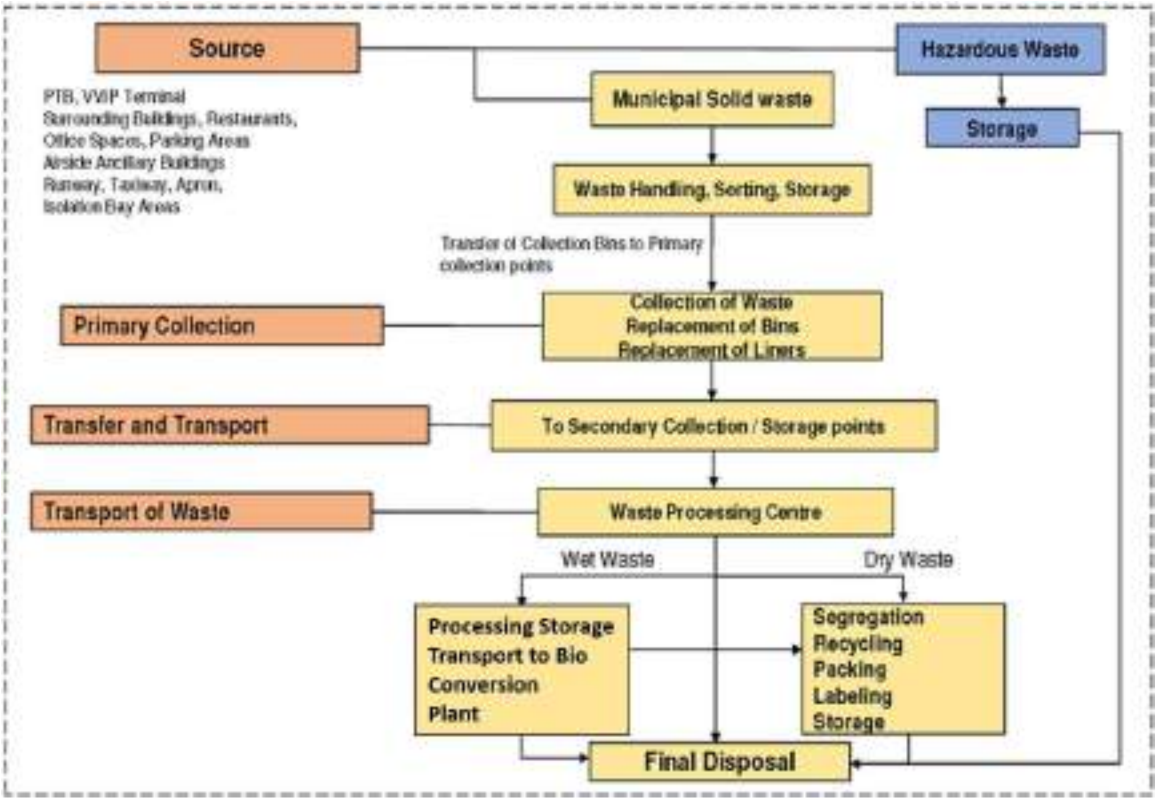
Source: Pre-Feasibility Report, 2020

The layout plan showing details of identified location for solid waste processing center in NMIA is presented in **Figure-2.44** and the solid waste handling is presented in **Figure-2.45**.



Source: Pre-Feasibility Report, 2020

FIGURE-2.44
LAYOUT PLAN SHOWING DETAILS OF IDENTIFIED LOCATION FOR SOLID WASTE PROCESSING CENTER



Source: NMIAL

FIGURE-2.45
SOLID WASTE HANDLING AND MANAGEMENT SYSTEM

2.11.6 IT & Telecommunication System

The proposed NMIA IT Infrastructure Master Plan shall provide IT, Security & Wireless Infrastructure and networks for airside & landside development like terminal and terminal forecourt, airfield and airside development, cargo facility, MRO, airport maintenance building, ARFF facility, police station, airport administration building, airport health organization, customs building, fuel farms, IMD facility, petrol pumps, GSE maintenance facility, ATC tower, GSE area, chiller plants etc including all other airport development and landside development of NMIA. The cable routing for IT Network in different phases and for land side ad airside are shown in **Figure-2.46** to **Figure-2.48** respectively.

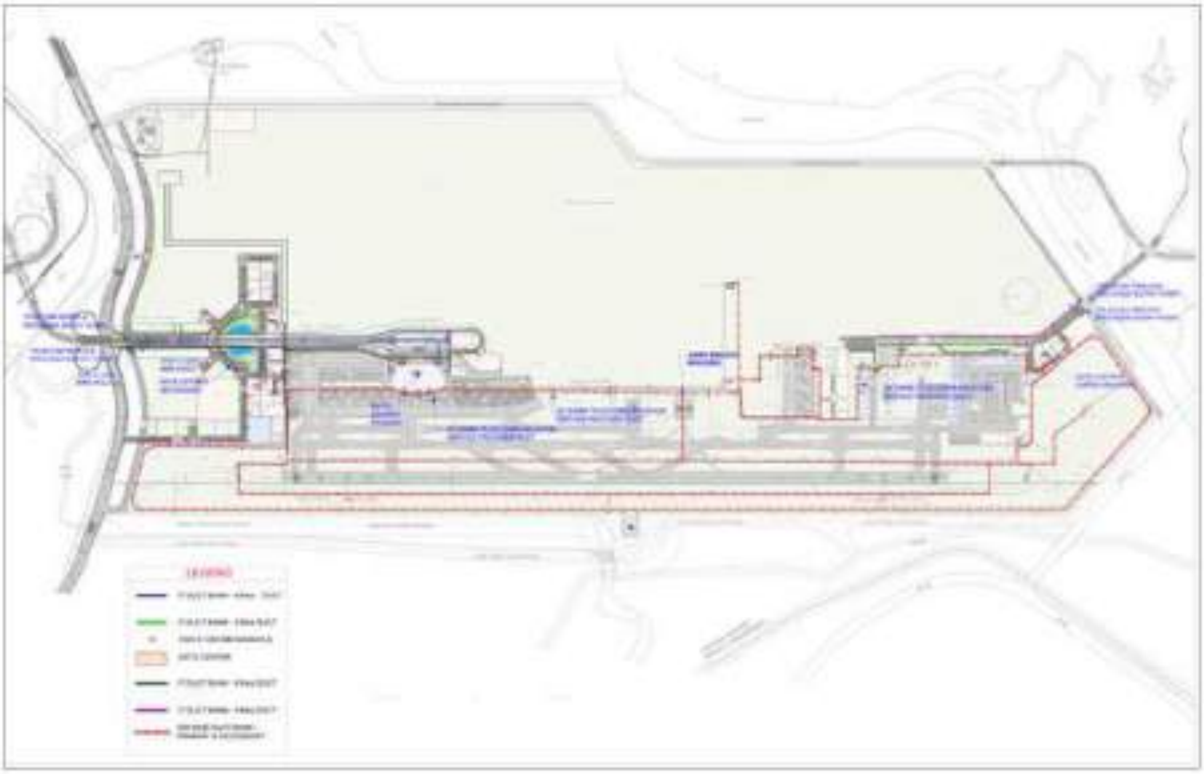


FIGURE-2.46
IT CABLE ROUTING FOR THE PROPOSED LOADS OF 10 & 20 MPPA

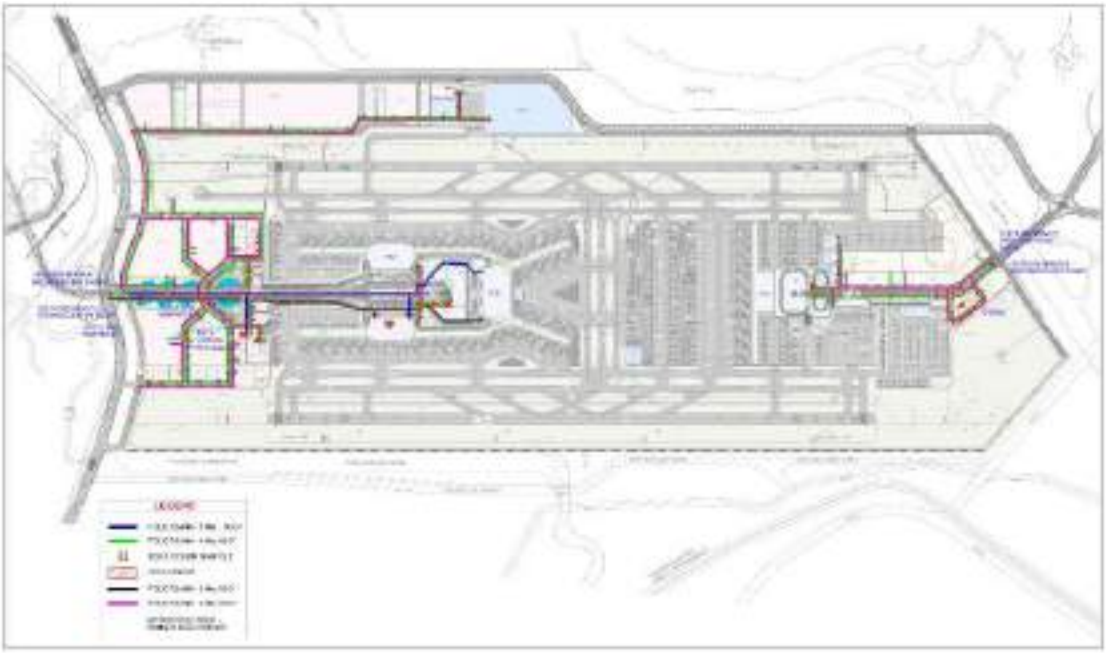
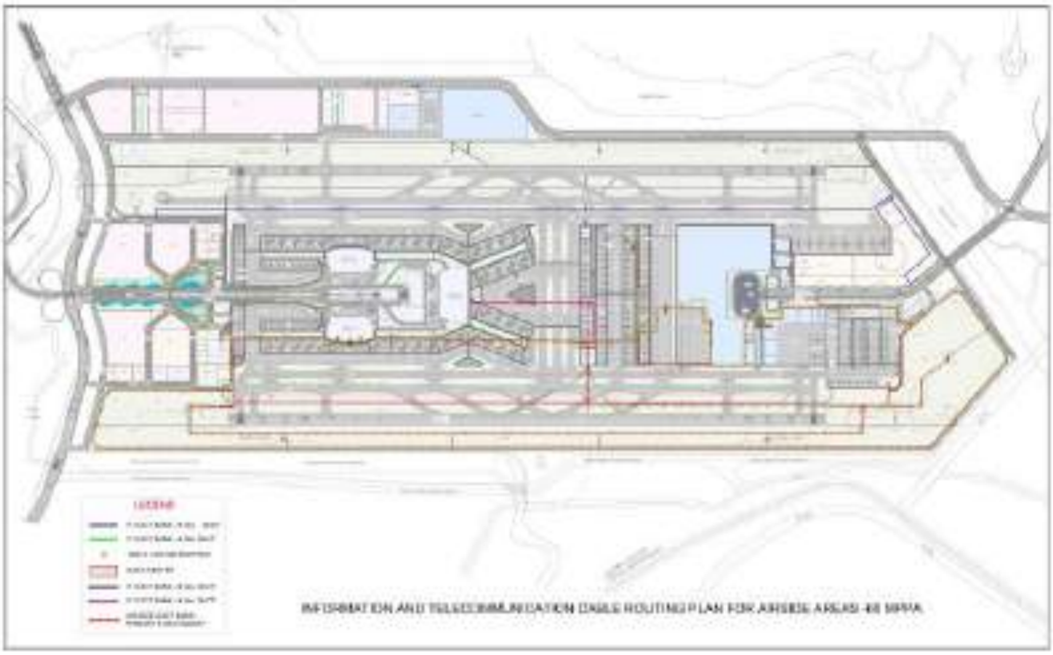


FIGURE-2.47
IT CABLE ROUTING FOR THE PROPOSED LOADS OF 60 MPPA-LANDSIDE



Source: Pre-Feasibility Report, 2020

FIGURE-2.48
CABLE ROUTING FOR THE PROPOSED LOADS OF 60 MPPA -AIRSIDE

2.11.7 ATF Facility (Fuel Farm & Hydrant System)

The ATF Facility (Fuel Farm) is planned in the eastern part of NMIA North of Eastern Main Access Road. The ATF facility along with associated support facilities, control building, circulation, etc. is planned. Fuel to aircrafts shall be dispensed through an underground fuel hydrant system designed in accordance with applicable norms. The required fuel infrastructure for the initial phases is planned to be built prior to commencement of Phase-I of airport and the facility will then be expanded in phases to meet demand.

The location of fuel facility is crucial, as it influences both incoming supply lines and potential fuel transmission lines from the facility to apron. In earlier phases, it must allow the flexibility for bowsers to supply the airfield to augment hydrant network while it is being developed. Therefore, the facility is located close to airfield, with access to an airside gate for quick and efficient entry to apron. NMIA Fuel System provision has been structured as follows:

- NMIA fuel supply;
- NMIA fuel demand & storage; and
- NMIA fuel hydrant system.

The fuel storage parameters have been determined based on following applicable norms:

- US National Fire Protection Association (NFPA) standards on Airport Terminal Buildings, Fuelling Ramp drainage and loading Walkways, as stated in the Concession Agreement (CA);
- OISD Standard 235 Storage, Handling, Refueling and Fire Fighting at Aviation Fuelling Stations;
- JIG 2 (issue 12); and
- EI 1540 Design, construction, Commissioning, maintenance and Testing of Aviation fuel Facilities.

The aviation fuel facility at NMIA is planned at the eastern part of airport site near eastern main entrance in close proximity of incoming fuel supply pipeline route. The fuel received will be settled and stored at NMIA Fuel Farm, and from there will be distributed to aircraft fuelling points via airport's fuel hydrant system. The fuel tanks are grouped inside bunds or dyked enclosures for safety and environmental reasons. Below is a list of some key considerations for planning layout of fuel storage

Tanks arranged in rows so that each tank is approachable from road surrounding the enclosure (OISD-STD-235);

- Separation distance between fuel tanks is 12 m (Table 22.4.2.1, NFPA30-2008);
- Separation distance between tanks and aviation fuelling station boundary wall shall be no less than 20 m (OISD-STD-235);
- Control Room be located in a non-hazardous area; and
- Fuel tanks height must not interfere with the Obstacle Limitation Surfaces.

Fire Water

- Fire water system has to be designed to meet the fire water flow requirements of fighting the single largest fire scenario; and
- Fire station, firewater storage and firewater pump house shall be located at a safe place away from hazardous areas (OISD-235) fuel hydrant system.

2.11.8 Fuel Demand & Fuel Storage

Fuel demand is estimated for initial phases based on DDFS (Design Day Flight Schedule) and for subsequent phases it is estimated based upon the annual ATMs and forecasted mix of narrow and wide-bodied aircraft movements. An average tank capacity has been calculated for Code C, E and F aircraft and an average uplift of 40% applied. The average uplift is based upon assumption that 80% of traffic is domestic and 20 % international and 70% of the air traffic at NMIA is narrow bodied and 30% is wide bodied.

The summary of the estimated phase-wise peak fuel demand and storage for estimated 5 days storage capacity provided in fuel farm is presented in **Table-2.41** below:

TABLE-2.41
PHASE-WISE FUEL DEMAND & STORAGE FACILITY

Particulars	20 MPPA	40 MPPA	60 MPPA
Storage Capacity	30000 KL	30000 KL	50000 KL
Day’s coverage	14.9	7.2	8.3
Peak Demand (cum/hr)	780	1320	1860
Fuel Usage (Cum/day)	2020	4040	6060

Source: NMIAL

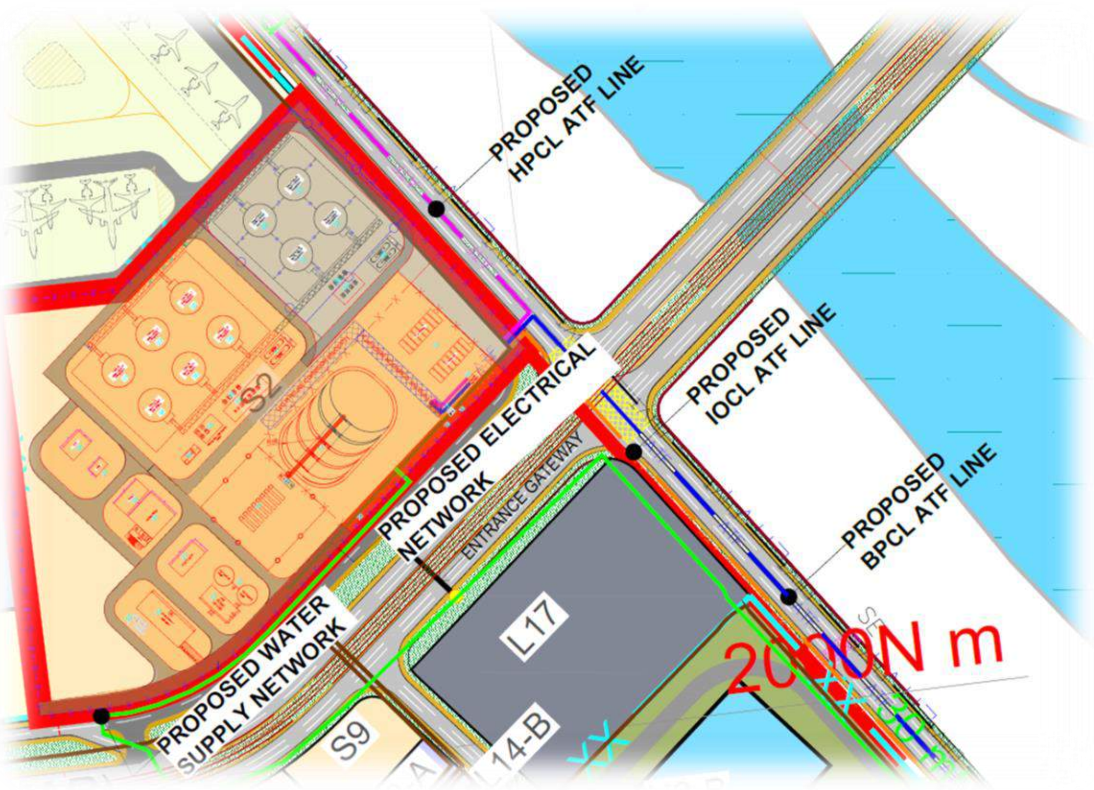
As per the final master plan of NMIA, the project is being developed in two major zones based on specific operational requirements of an airport, i.e. airside and landside zones as explained below:

2.11.8.1 Airside Zone

This comprises of Airfield with runways, taxiways, aircraft parking aprons and all necessary facilities for safe and secure aircraft operations; Passenger Terminals with passenger processing, retail, and other facilities contained within the terminal main processors and piers; Cargo with its airside warehousing / processing facilities and other complimentary activities not associated with the passenger terminals; General Aviation; Air Traffic Control Towers, etc. The entire Airside Zone is bound/enclosed within Operational Area boundary wall.

2.11.8.2 Landside Zone

This comprises of the western, northern and eastern landside areas, including the terminal forecourt areas, and various passengers, stakeholder facilities required for airport, and landside transportation network. Northern landside area, shall be developed in later phases of airport development. Based upon the projections, it has been planned that NMIA shall be supplied by about four pipelines to be introduced in phases. The expected route incoming fuel supply pipelines to NMIA Fuel Farm are indicated in **Figure-2.49**.



Source: NMIAL

FIGURE-2.49
FINAL PHASE (60 MPPA) ATF FUEL FARM
AND INCOMING FUEL SUPPLY PIPELINE ROUTING

2.11.9 PNG System

Piped natural gas will be supplied from Mahanagar Gas Limited (MGL) MRS (Metering and Regulating Station) to NMIAL consumer at appropriate pressure. From MRS to building main header pipe will be laid underground with anticorrosive wrapping and coating to prevent corrosion due to contact with soil. Underground pipe will be connected in riser pipe which is located outside periphery of the building. Bypass line arrangement will be provided in ground level between underground piping to main riser pipe to facilitate for emergency shutdown. It ensures uninterrupted gas flow in case at any maintenance and leakage in filter and main gas meter, which is fixed in main riser pipe. In this occurrence, bypass line with lockable valve act as a temporary operating line to ensure continuous gas flow.

2.12 Resource Optimization, Recycling/ Reuse Opportunities

Navi Mumbai International Airport being the latest green field airport planned in the country, has the advantage of processing latest technology, new infrastructure which have been chosen considering need for resource optimization, recycling & reuse. Most of the equipment and systems adopted at design stage of NMIA are latest generation products.

2.12.1 Energy Conservation Measures & Environmental Sustainability

NMIA is planned to be developed as a Green Airport, with key objective of Environmental Sustainability to be achieved through, optimization in resource consumption through following measures:

- Energy Optimization.
- Utilization of Solar Energy.
- Natural Day Lighting.
- Re-Cycling of Waste.
- Water Balance.
- Water Harvesting.
- Plantation & Landscape.
- Metro & Water Transport.
- Environment Management.

NMIA is planned with objective to be one of the most resource efficient & green airport in the world. It has been planned to achieve environmental sustainability through resource optimization, recycling & reuse. This approach has been adopted at planning & design stage, and hence Demand for Resources for NMIA has been optimized, and is much lesser than the earlier demand estimates worked out by IIT, Mumbai as part of EIA studies which formed the basis of the earlier EC granted in November 2010. The resource optimisation is through planning and design is given **Table-2.42** below:

TABLE-2.42
RESOURCE OPTIMIZATION THROUGH PLANNING & DESIGN

Utility	Total Demand/Generation	As per earlier EIA done by IIT Mumbai in 2009-10
Electric Power (Grid)	96 MVA	190 MVA
DG Power	35.0 MVA	-
Solar Power	22.14 MW	-
Water Demand	22 MLD	41 MLD
Sewage Generation	13.3 MLD	-
STP Capacity	14.25 MLD	30 MLD
Fuel Demand (ATF)	6292 Cum/Day	-

Source: NMIAL

2.12.1.1 Energy Conservation

Energy consumption will be minimized through the usage of following energy efficient materials and systems. The highest level of energy saving potential will be achieved by using of the modern technology. Following energy conservation measures will be adopted at Navi Mumbai International Airport.

- Higher insulation levels in walls and roofs;
- High performance glazing;
- Efficient lighting design;
- Efficient HVAC system;
- Demand control ventilation using occupancy sensors;
- Artificial lighting control via daylight sensor; and
- Adoption of high efficiency light fittings.

2.12.1.2 High Efficiency Equipment

By selecting high efficiency generators, fuel efficient diesel engines, high efficiency transformers etc. during design stage ensures that the overall efficiency of the power system will be very high.

2.12.1.3 Solar Power Generation

The solar plant will create significant environment benefits over its lifetime. Based on the availability of the land & feasibility solar plant planned at NMIA for final phase is 22.14 MW.

2.12.1.4 Compliance to ECBC Guidelines

At the proposed Terminals and Ancillary Buildings necessary Green Building measures will be followed for minimum conservation of energy in line with "Energy Conservation Building Code –2017", "National Building Code 2016" and ASHRAE requirements. The Terminal is targeted to achieve LEED Certification Gold from the United States Green Building Council (USGBC), and all other building shall follow a minimum energy requirement as per ECBC. The building falls under the category of Assembly, and the energy conservation measures which will be adopted are described in in ECBC compliance statement of NMIA (**Annexure-XII**).

2.12.2 Water Conservation, Recycling & Reuse

2.12.2.1 Re-Generation

Navi Mumbai International Airport will regenerate 51% of its total water consumption through treated water from Sewage Treatment Plant. The state-of-Art latest technology will be adopted for Sewage Treatment Plant. The technology adopted is Advanced Sequential Batch Reactor (SBR) with Ultra Filtration and Reverse Osmosis (RO). The treated water from STP will be used for landscaping, Flushing and air-conditioning. Treated water available from STP will be 11.2 ML per day at Phase-IV.

2.12.2.2 Sludge Drying

Navi Mumbai International Airport also proposes sludge drying beds to generate manure from sewage treatment plant will be used for landscape Irrigation.

2.12.2.3 Rain Water Harvesting

A rainwater harvesting pond is proposed along the main drain alignment path. The area of proposed rain water harvesting pond is 21,960 sqm and depth 2.5 m below invert level and the volume of pond is 29,747 cum. Weir is proposed at the pond outfall location to avert salt water intrusion into the pond. Stored water shall be used for landscape irrigation purposes. The interlinked water bodies and ponds which drain the water into the main RWH pond is given in **Table-2.43** below and the layout of the RWH system along with the main drainage alignment and outfall locations is shown in **Figure-2.50** and RWH pond are shown in **Figure-2.51.**

TABLE-2.43
RAINWATER HARVESTING CATCHMENT PONDS

Sr. No.	Pond Location	Pond ID	Storage Volume (Cum)
1	1-North of MAR*	WN1	1422
2	2- North of MAR	WN2	1511
3	3- North of MAR	WN3	1550
4	4- North of MAR	WN4	3376
5	1-South of MAR	WS5	1540
6	2- South of MAR	WS6	1651
7	3- South of MAR	WS7	1741
8	4- South of MAR	WS8	3344

Source: NMIA Final Master Plan [May 2019]
** MAR stands for Main access road*

2.12.2.4 Variable Frequency Drive (VFD) & Hydro Pneumatic System

Water supply system involves pumping of water directly from pump houses to consumers by using Variable frequency drive (VFD) & hydro-pneumatic system which ensures the operation of pumps always on its best efficiency point irrespective of the loading.

2.12.2.5 Automatic Operation

In sewage collection wells all pumps will be operated in auto mode by using cleaning sensors regularly to optimize the operation time of these pumps. Also, in STP, aeration tank, DO level will be monitored through sensors which avoids continuous running of aerators.

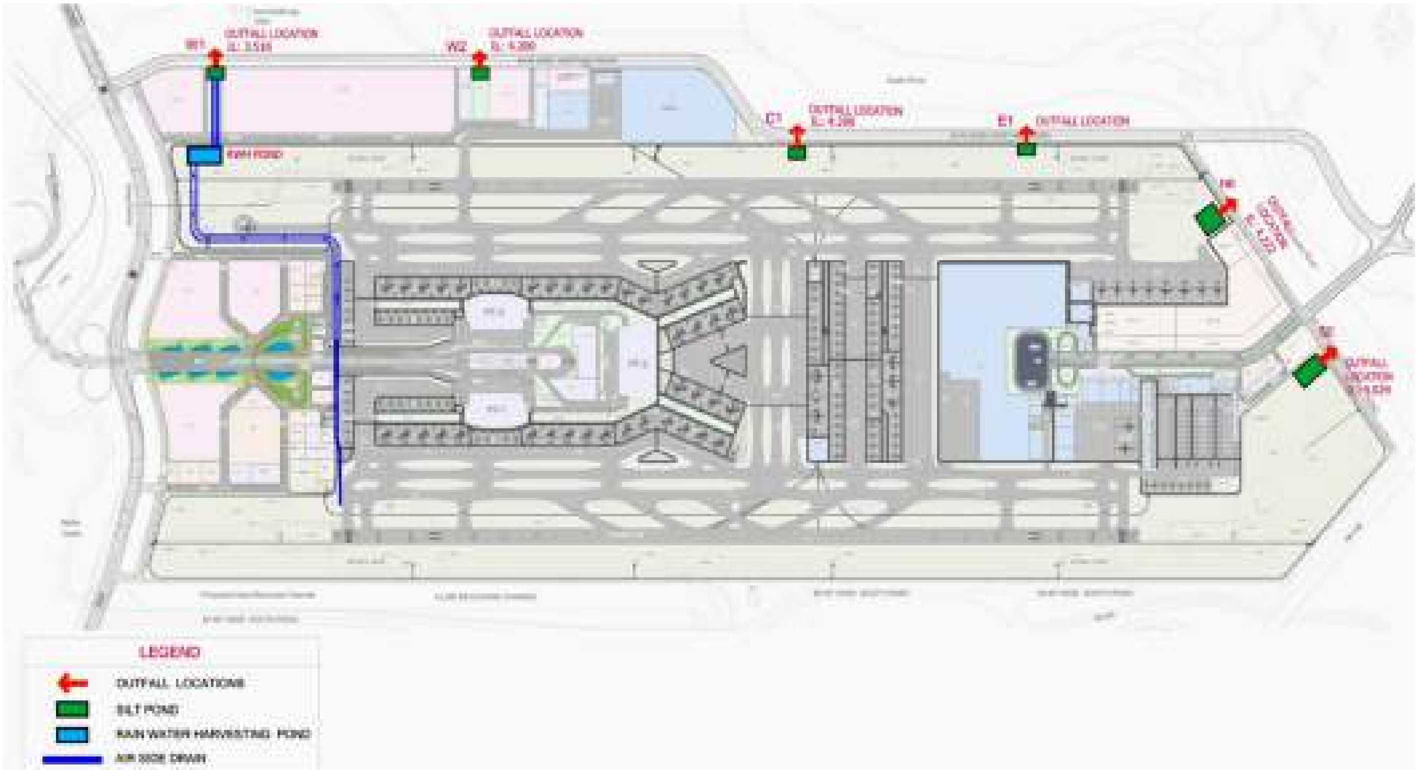
2.12.2.6 Solid Waste Management

Solid Waste Management System of NMIA is planned to ensure hygienic and healthy living/ working environment at the airport, along with recycling and re-use of waste. The major solid waste contributing facilities include terminals, hospitality, cargo and other airport related buildings. The characteristics of the solid waste generated is of typical municipal waste along with hazardous wastes from specific facilities, consisting of plastic, metal, paper, cardboard, pet bottles, used oils and bio-medical waste.

Non-hazardous waste from proposed infrastructure development includes metals, food & sludge from STP etc. Solid Waste Management Plan is aimed at managing the generation, storage, and disposal of municipal solid waste and hazardous waste generated. Solid Waste Management Plan includes detailed program for reduction of waste generation, increase recycling / reuse of waste and dispose waste through scientific approach

2.12.2.7 Fly-ash Utilization

NMIA will comply with Fly Ash notification issued under the E.P. Act of 1986 and plans to utilize fly-ash products in the range of 50,000 Tonnes in construction of Phase-I and 1,00,000 Tonnes in the construction of final Phase-IV.



Source: Pre-Feasibility Report, 2020

FIGURE-2.50
MAIN DRAIN ALIGNMENT, RAIN WATER POND, SILT PONDS AND OUTFALL LOCATIONS

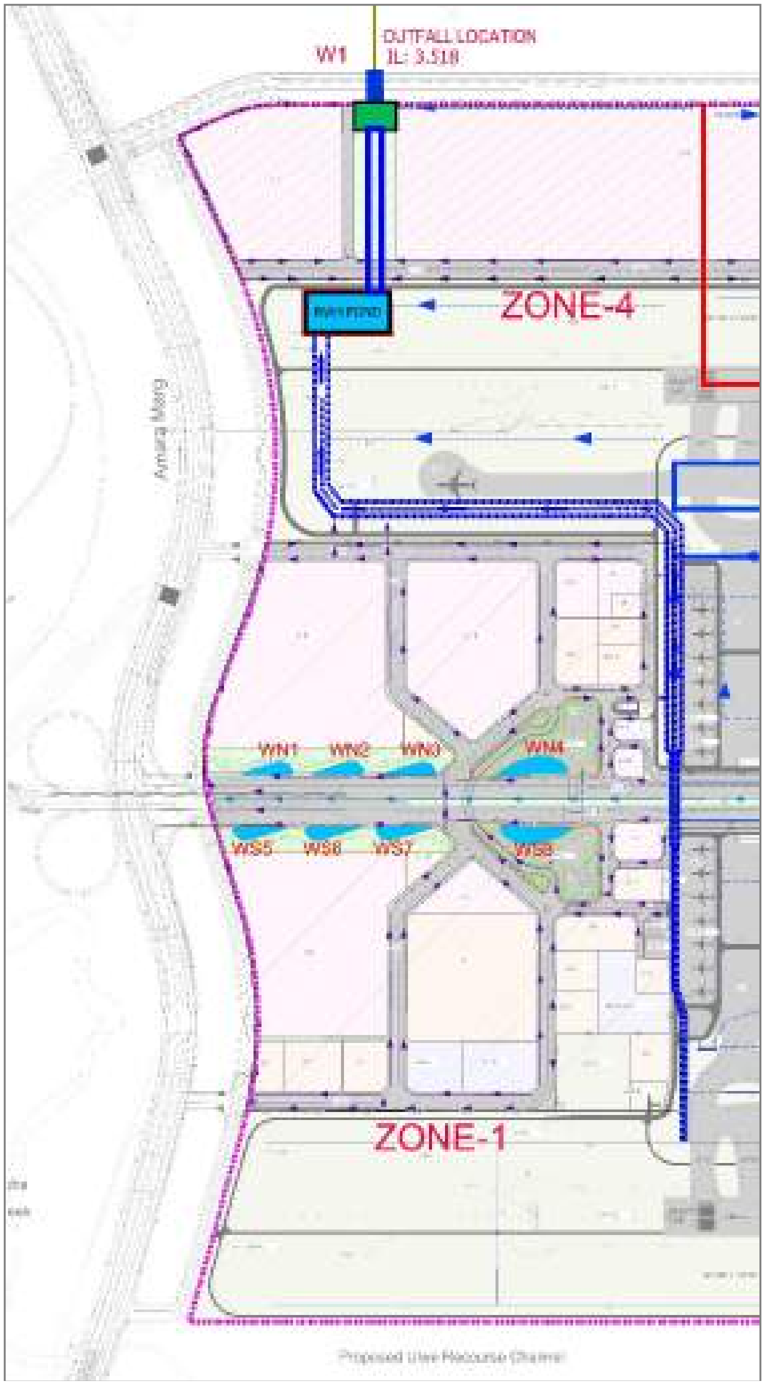


FIGURE-2.51
RWH PONDS LOCATIONS

Chapter-3
Description of the Environment

3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 Introduction

This chapter illustrates the description of the existing baseline environmental status of the study area with reference to the prominent environmental attributes. The study area covers 10 km radius around the Navi Mumbai International Airport (NMIA) boundary.

This study has been carried out in continuation with the EIA study conducted in 2010 and later in 2017 by CIDCO, and as per TOR issued for fresh Environmental Clearance by MOEF&CC dated 29th October 2020.

Information in the study area was collected by undertaking primary surveys through field visits, monitoring and laboratory analysis. To assess the existing baseline environmental conditions of the 10 km study area, primary and secondary data collection was undertaken with respect to climate, hydro-geological aspects, atmospheric conditions, water quality, marine water quality, soil quality, ecology& biodiversity, land use pattern and socio-economic profiles of people. The project location falls in Panvel taluka of Raigad district, Maharashtra.

This report incorporates the baseline data monitored for three months from 1st December 2019 to 29th February 2020, representing winter season. Secondary data was collected from various Government and Semi-Government organizations.

3.2 Regional Setting

Mumbai's insular growth has given rise to haphazard development in several pockets leading to unplanned growth of residential, commercial, and industrial structures. Therefore, aligning of development plans implemented by different urban local bodies and planning authorities was imperative for effective development of any large-scale infrastructural project.

The Navi Mumbai is part of the suburban region of Mumbai, within the MMR. The regional development plans are aligned with the long-term development of NMIA defining its influence zone, which includes the regional plan for Mumbai Metropolitan Region 2016-2036, development plan for NAINA and Khalapur smart city concept plan. The hinterlands of the NMIA project and the Jawaharlal Nehru Port Trust (JNPT) near Nahva are under the planning jurisdiction of CIDCO as the New Town Development Authority.

3.2.1 Local Land-Use Pattern

The area in the immediate vicinity of NMIA is under jurisdiction of CIDCO, as New Town Development Authority. The entire development inNavi Mumba and around NMIA is well regulated, controlled and is in accordance with Develoment Plan of Navi Mumbai. Any development in Navi Mumabi can commence only after the due approval and permission of CIDCO. Development Plan of Navi Mumbai with detailed land use (given in **Annexure-VIII**) has been notified by Govt of Maharashtra. NMDP provides land use zones for various urban uses based on the requirements of the city, sensitivity and utilitarian aspects, in following categories:

- **No Development Zone**: Includes such areas as parts of creek contiguous creek mudflats and backwater areas spread over and area of 616.24 ha.

- **Airport and Allied Activities/Services Zone**: Spread in an area of 1160 ha identified as the airport core zone.

- **Modified Commercial Zone**: In addition to existing commercial zones, modifications are proposed in an area of 351.46 ha will be allowed for development of commercial activities.

- **Modified Residential Zone**: In addition to the existing residential zones, modifications are proposed in an area of 441.9 ha will be allowed for residential developments; and

- **Proposed Infrastructure (Recourse Chanel/Transportation Corridor) Modification**: The area is modified to include the recourse channel and accommodate expansion of transport corridors or major roads proposed as off-site infrastructure development for NMIA is modified to include 99.8 ha to the existing plan of Navi Mumbai.

3.2.2 Project Site Connectivity

Navi Mumbai is one of the vibrant sub-regions in MMR in terms of population and employment growth. MMRDA, CIDCO, MSRDC, etc. have planned number of transportation projects to provide the regional connectivity to Navi Mumbai which is between NAINA and Mumbai by integrating and ensuring continuity of the corridors. The existing and planned NMIA site connetivty is explained in detail **section 2.5.6** and **2.6.2.2** of **Chapter 2**. A detailed traffic management and decongestion plan has been conceived for aligning the overall regional connectivity of Navi Mumbai with NMIA and optimise the system of transport to and fro NMIA. The "*Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA)*" elaborating above aspects is attached in **Annexure-IX** of this report.

3.3 Geology and Hydrogeology

3.3.1 Physiography/ Topography

3.3.1.1 Physiography of Raigad District

The project area occurs along the northern tip of district Raigad. On regional scale, Raigad district falls under Konkan region which is divided into the Coastal region and the Inland division or Sahyadri Range. The proposed project (airport site) and the study area fall in the coastal region.

The project area is observed in the form of a vast plain land. It shows the highest portion along its central portion, which is in the form of a terminal part of a relict ridge trending in N – S direction and having an elevation of about 105 m above mean sea level (m, amsl). The surrounding portion descends to an altitude of 1 m along its eastern boundary. Even though central portion of the project area forms a terminal part of a relict ridge, the same has been opened at number of places by stone quarries and stone crusher units (as observed in adjoining area) to supply the construction material to the developmental activities in surrounding region. Due to this, the erstwhile ridge has been drastically reduced in its dimensions.

3.3.1.2 Physiography of the Study Area

The physiography of the study area is a combination of rugged hills and coastal plains. Based on the geomorphology, the hydromorphic units identified in the study area consist of coastal plains, denuded hills, structural hills, and plateau. Cutting and filling in the site up to+ 5.5 m AMSL has been completed. The existing part of the Ulwe hill runs from north to south in the western half of the NMIA site. The project site slopes naturally from Southwest towards Northeast.

The study area earlier consisted of multiple natural features and varied topography, along with some existing uses/ activities in various pockets across the site including built- up land, hills, creeks & rivers, mud flats, mangroves, quarries, and open area. Post Pre-Develoment Works, and Land Development Works, the site is now flat at +5.5m AMSL without any features.

3.3.1.3 Physiography of the Project Site

NMIA site is characterized by varied natural topography, hydrology, and soil types as it is in coastal region adjoining Panvel Creek. It exhibits various features like erstwhile Ulwe River, Ulwe hill (with an elevation of over 100 m in Western part) and nine village gaothans in pre-development phase (in the year 2017).

As of now, the site has undergone major topographic changes. Ulwe River has been diverted out of airport site and Ulwe recourse channel (length 3.2 km) located to the southern side of NMIA airport and the channel to the north of site as secondary channel for Gadhi River has been trained along the northern boundary of NMIA.

The existing Ulwe hill is being cut and the muck generated during cutting is being used to level the site. As on date, cutting and filling in the site upto +5.5 m AMSL has been completed and it will be further levelled up to 8.0 m to 9.0 m AMSL. Only a portion of Ulwe hill currently exists on site which is to be cut to fill the site from +5.5 MSL to 8.5 m AMSL.

The topography of the site is hillock and flat terrain. The site has been levelled upto +5.5m AMSL by cutting the hillock. The site of the slope is from south and west towards east and north, with large variations in existing levels. The cutting of Ulwe hill for site filling (during 2017 through 2020) is shown in **Figure-3.3.1.**

FIGURE-3.3.1
TIME SERIES PHOTOGRAPHS SHOWING STATUS OF CUTTING OF ULWE HILL

3.3.1.4 Contour

Hilly structures within the project site are in the process of alteration and work related to site development was observed at the time of site visit. The overall terrain shows undulations and predominant hilly structures visible within the project site and towards north, north-east and south of the study area. Contours are closely spaced, and steep slopes are seen in few areas. Several small hills are spread across the study area whereas a dominant hill can be observed at south side where Karnala sanctuary is located. On the north, the Parsik hill range can be seen extending vertically. The highest point within the 10 km radius study area around the project site is within the Parsik hill range and is about 405 m above mean sea level. The lowest point is at 0 m above mean sea level. Part of the Matheran hills can be seen on the north-east of the study area.

Within the project site, it is observed that majority of the contours are altered in the recent years. Due to rapid changes on site due to ongoing site development works, the contour is constantly changing. A 5 m interval contour map based on available elevational data is prepared for a 10 km study area around the project site and is shown in **Figure-3.3.2**. The map depicts presence of the remaining of the hilly structure within project site due to ongoing hill cutting activity. Other portions of the site are in the process of being filled and levelled.

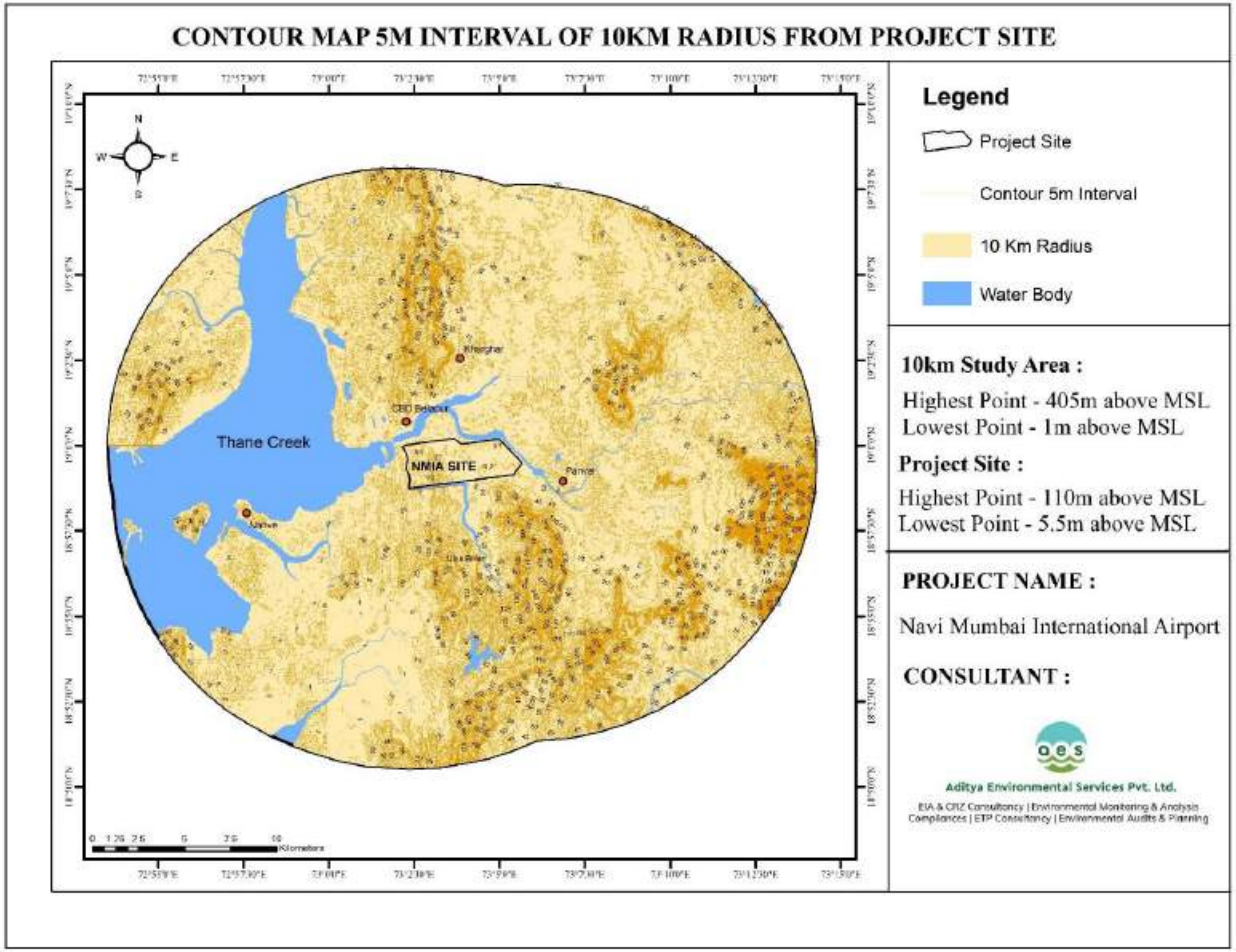


FIGURE-3.3.2
CONTOUR MAP OF STUDY AREA OF PROJECT SITE

3.3.2 Drainage

3.3.2.1 Drainage Pattern of the Raigad District

All the Rivers of the drainage system of Raigad district are flowing westerly. The drainage system of the district may be divided into three groups as follows:

- The northern region: Drained by rivers Panvel, Ulhas, Patalganga and Amba.
- The central region: Drained by Kundalika, Mandad; and
- The south region: Savitri and its tributaries.

3.3.2.2 Drainage of the Study Area

The study area covering 10 km radius around project site before commencemet of site pre-development activities exhibits majority of third order dendritic drainage pattern is shown in **Figure-3.3.3.** Majority of the streams flow towards west and contribute to Thane and Panvel creeks. Some flow towards south and contribute to Karanja creek. Ulwe River which now traverses along the southern boundary as URC has been diverted from the project site and the URC now merges into Moha Creek in the west of the project site.

Some of the minor streams that flow towards north contribute to Thane creek. The Kalundre River, Kolkewadi River, Kasadi Nadi and Ransai Nadi are some of the significant rivers within study area. Number of lakes viz. Adai Lake, Khandeshwar lake, holding ponds, New Panvel Lake, Ballaleshwar lake, Panvel Municipality Lake, Panvel market lake, Israli talab, Karave lake, Darave lake, Belapur lake, Agroli lake, Ransai dam and Seawood lake etc located in the study area.

3.3.2.3 Drainage of the Project Site

The site located in the coastal region adjoining Panvel creek. Ulwe River located in central part flowing south to north across the site before the commencement of Pre-development Works. Presently, Ulwe Recourse Channel has been constructed along the southern boundary of the airport site as shown in Figure-3.3.3. Gadhi River flows east to west along eastern and northern boundary of the airport site. The general slope of the study area is towards north and north-east.

3.3.3.3 Flood Risk Analysis

As per the EC & CRZ Clearance (2010) condition [7 (I) vi of specific conditions], the Drainage Master Plan of NMIA for surface drainage and flood protection was prepared for a minimum 100 years return period for rainfall as worst-case scenario while addressing above aspects examined thoroughly including hydro-geological and environmental aspects of the project to avoid flooding of low-lying areas near the airport.

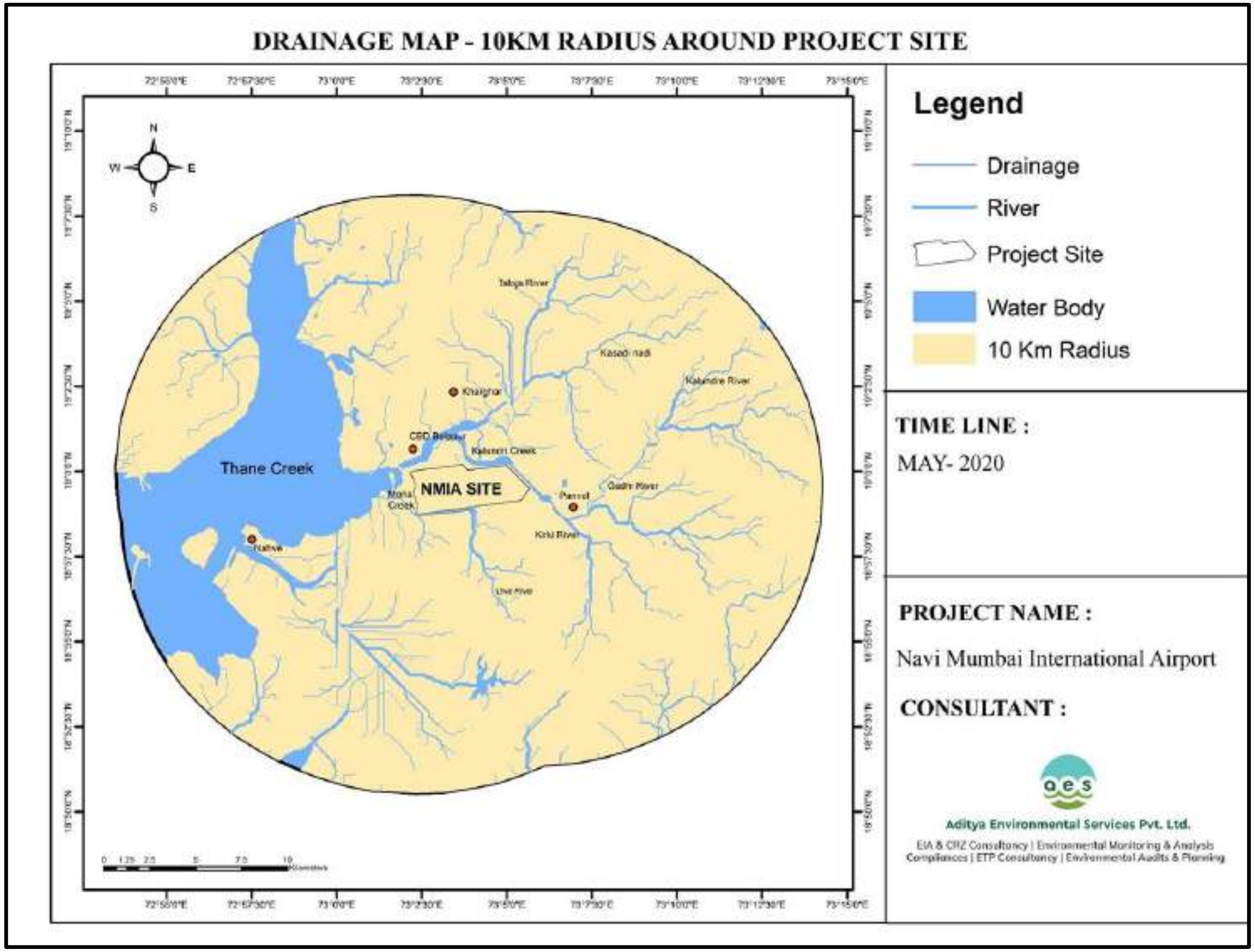


FIGURE-3.3.3
DRAINAGE MAP OF STUDY AREA OF PROJECT SITE

The drainage master plan prepared by NMIAL was then reviewed by CWPRS for approval and update through several stages. CWPRS, Pune has carried out 1-D, 2-D Mathematical and Physical Model studies for the airport and its vicinity based on 100 years return period and the recommendations were incorporated into to the stormwater drainage masterplan of NMIA. NMIA drainage system is approved and validated by CWPRS. NMIAL has designed NMIA drainage system while CIDCO has parallelly designed the Drainage Master Plan of surrounding areas by incorporating CWPRS Recommendations.

The general slope of the site is from south to north and north-east. It is recommended by MoEF&CC through EC & CRZ clearance (2010) that the stormwater generated from NMIA site area shall be drained towards north (into the creek) or into the Gadhi River towards northeast of the project site, while no stormwater shall be discharged into the diverted Ulwe River (now called Ulwe Recourse Channel) or into the Moha Creek and Amra Marg towards western side of the project site. Accordingly, the NMIA drainage was designed to discharge the run-off from south to north and north-east of the project site.

3.3.3 Geotechnical Investigations

Stratum1: Boulder filling layer was observed at few borehole locations up to an average depth of 4.5 m.

Stratum 2: Overburden Soil-Dense silty sand mixed with gravels: Overburden soil layer was found to be available only at few boreholes. This layer appears at ground surface having depths varying from 0.3 m to 4.0 m. At one borehole location, this layer appears below boulder filling layer between depths 4.5 m to 4.8 m.

Stratum 3: Very stiff to hard sandy silty clay: Silty clay layer was available at few borehole locations below boulder filling layer at 3.5 m, 4.0 m, 3.0 m, 2.0 m and 4.5 m depth. Thickness was between 5.0 m and 6.5 mat few and extending up to 8.0 m to 11.0 m depth below existing ground levels.

Stratum 4: Completely Weathered Rock (Hard Murrum): At few borehole locations, this layer exists at ground surface and extends up to 4.5 m to 7.0 m depth and at few locations, this layer appears between 8.5 m to 10.5 m and 9.0 m to 10.0 m depths below silty clay layer. At some locations, this layer exists below boulder filling layer and having thickness varying from 0.7 m to 2.0 m.

Stratum 5: Highly Weathered Basalt Bed Rock: Highly weathered basalt rock layer is available almost at all borehole locations. At few borehole locations, this layer exists directly at ground surface whereas at balance bore hole locations this layer is available below one of the top four stratums. Thickness of this stratum varies from 1.0 m to 4.5 m. Only at boreholes BH-20 location thickness of this stratum is 11.5 m. This layer is classified as highly weathered rock stratum.

Stratum 6: Compact Basalt Bed Rock: Below highly weathered rock layer is available compact basalt bed rock layer.

Conclusions: It was observed that at maximum bore hole locations, stratum 5 i.e., highly weathered basalt bed rock stratum or stratum 6 i.e., compact basalt bed rock stratum is available at shallow depths. Hence for maximum facility buildings, shallow isolated footing foundation can be adopted resting on/in either highly weathered basalt rock stratum or compact basalt.

3.3.4 Geology

Geological Setup: Deccan Trap Basalt of upper Cretaceous to lower Eocene period is the sole rock formation in this area. This rock occupies considerable portion of the Central India, covering significant portion in states of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Chhattisgarh, and Karnataka. Nearly 82% of geographical area of Maharashtra state alone is made up of this rock. This rock is formed due to solidification of lava flows owing their origin to volcanic eruption. In the study area too, three layers of this rock, separated from each other by an intervening layer of soft, weathered rock and soil are observed.

The site of the proposed project is made up of basaltic rock. The “Hard” nature of this rock has been reflected in the topographical signature in the form of a ridge. This hard rock is being mined out small quarries and stone crusher units in this area. The NMIA team had carried out the Geotechnical investigations in the entire project area. According to the geotechnical report, the surrounding low-lying area shows presence of moderately to highly weathered basaltic rock up to variable depth of 3 m to almost 10 m or even more depth below ground level.

3.3.5 Hydrogeology

Groundwater Occurrence: The topography, as well as the subsurface rock were found to obstruct the groundwater formation. The study area occupies a moderately sloping, highly undulating land occupying the water divide. It is comprised of Deccan trap basaltic rock. Primarily, this rock has low porosity and permeability and hence, is considered as “Hard” from groundwater occurrence point of view. The hilly terrain helps in more run-off which is further aided by “Hard” nature of the basaltic rock. Both these factors are found to play vital role in poor groundwater occurrence in the study area. The hydrogeological map sourced from District brochure of Raigad district Ground Water Information (Published by Minitry of Water Resources, CGWB in the year 2013) is shown in **Figure-3.3.4.**

The Hydrogeological Study in the Impact Zone for Navi Mumbai International Airport was carried out by Groundwater Survey and Development Agency, (GSDA) Water Supply & Sanitation Department, Govt. of Maharashtra.

In the project area, the groundwater occurs both under pheratic i.e., water table condition, providing water to open dug wells and semi-confined condition tapped by means of bore wells.

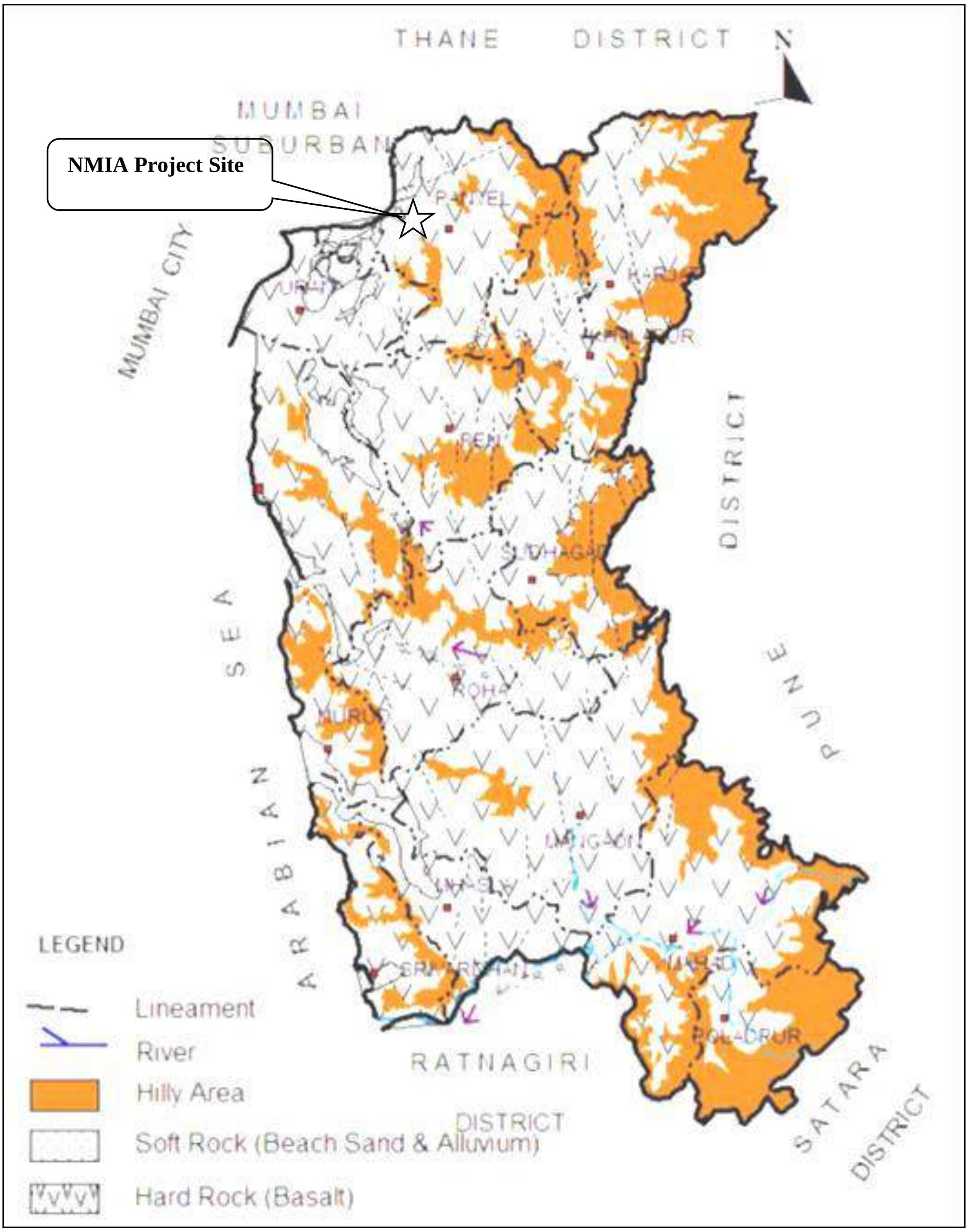


FIGURE-3.3.4
HYDRO-GEOLOGY MAP OF RAIGAD DISTRICT

Dug Wells: The dug wells in study and surrounding area are found to be located particularly in the ravines and low-lying gully portions and along the surface water courses. This is an effort to harvest the rainwater which is available seasonally. However, they are not used at all and hence are in abandoned condition. They are found to be 8 m to 10 m in depth below ground level (bgl). The static water level (pre-monsoon) in this region is reported to be ranging from 8.5 to 9.0 m bgl, while the same (post monsoon) is observed to be almost at par with the ground level. These structures are largely found to be used as domestic water source only. Due to occurrence of hard rock at shallow depths, these features are less preferred.

Bore Wells: The study and surrounding area host few bore wells. They are found to tap the semi-confined and confined aquifer in this area. They are reported to be 100 to 120 m in depth bgl. Majority of bore wells are fitted with hand pumps while few are installed with low-capacity pumps as per requirement. These structures also are primarily used for domestic purpose.

The occurrence, movement and distribution of groundwater can be better understood when studied in smaller units called watersheds. Based on physiography and drainage, GSDA divided the whole State into 1505 Elementary Watersheds. The study area falls mainly in 3 Westerly Flowing (WF) watersheds i.e., WF-40, WF-42, and WF-36.

WF 42 - This watershed also comes under Raigad district. One mini watershed i.e., 42/1 falls in the study area.

WF 36 - This watershed comes under Thane district. One mini watershed 36/2 falls in study area. About 11 towns coming under Navi Mumbai Municipal Corporation are covered in this mini watershed. This mini watershed is located in the north of study area. Panvel Creek divides the watershed from the airport area.

WF-40 - This watershed covers Panvel city and comes under Raigad district. It is divided into 9 mini-watersheds and are named as WF 40/1, 40/2, 40/3, 40/4, 40/5, 40/6, 40/7, 40/8 and 40/9. The mini-watershed WF 40/7 covers the proposed airport site and is the focus of the study. Whereas the other mini watersheds partially cover the Impact Zone.

The major portion of the study area is covered in WF-40 watershed. The study findings are explained below:

- Diversion of Ulwe River: This River forms the main drainage of mini watershed WF 40/7. The water holding capacity of the aquifer in the mini watershed is limited, hence the dug wells yield less, due to which there are no agricultural activities in Rabi Season. Few farmers cultivate vegetables. The run-off in the Ulwe River can be reduced by construction of few water conservation structures from village Garade to village Bhangarpada.

- The 49 water quality network stations indicate that the water quality of Panvel city, Taloja and Ulwe have very high TDS ranging from 2000 ppm to 14,000 ppm. High concentration of chloride is found near Turbhe, Kamothe and Kharghar area. The unconfined aquifers are yielding sweet water, but in some cases the deeper confined aquifers are polluted, due to sea water intrusion and industrial waste from the industrial area.

- The ground water level observed in observation wells indicates that there is a rising trend which shows that the optimal uses of water for agriculture is not done. The stage of development indicates that there is a further scope of ground water uses. Due to urbanization, drinking water is supplied through pipe water scheme. Hence, the dependency on ground water is reduced.

In the project area, the groundwater occurs both-under phreatic i.e., water table condition, providing water to open dug wells and semi-confined condition tapped by means of bore wells.

Currently, the villages around the project area get the daily water from municipal supply. This supply has been reported to be adequate by the local population. Hence, groundwater is rarely used in this region.

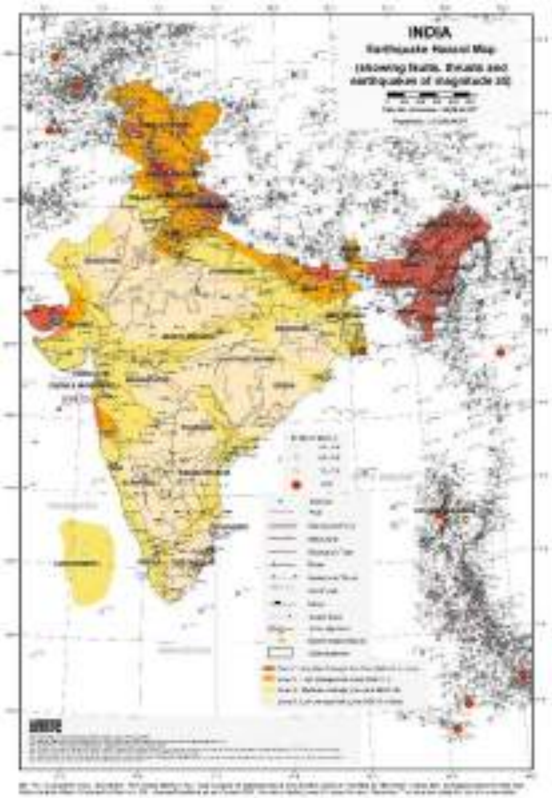
The NMIA project does not intend to use the ground water in both phases of development and operation. The water required for the NMIA project will be sourced from CIDCO from its existing water mains running along Amra marg on western side of the airport. CIDCO has planned to take water from the nearby Hetavane dam. However, Panvel area shows 23.23% groundwater development and hence is categorized as “SAFE” for further groundwater utilization by Central Groundwater Board (Ministry of Water Resources, Government of India).

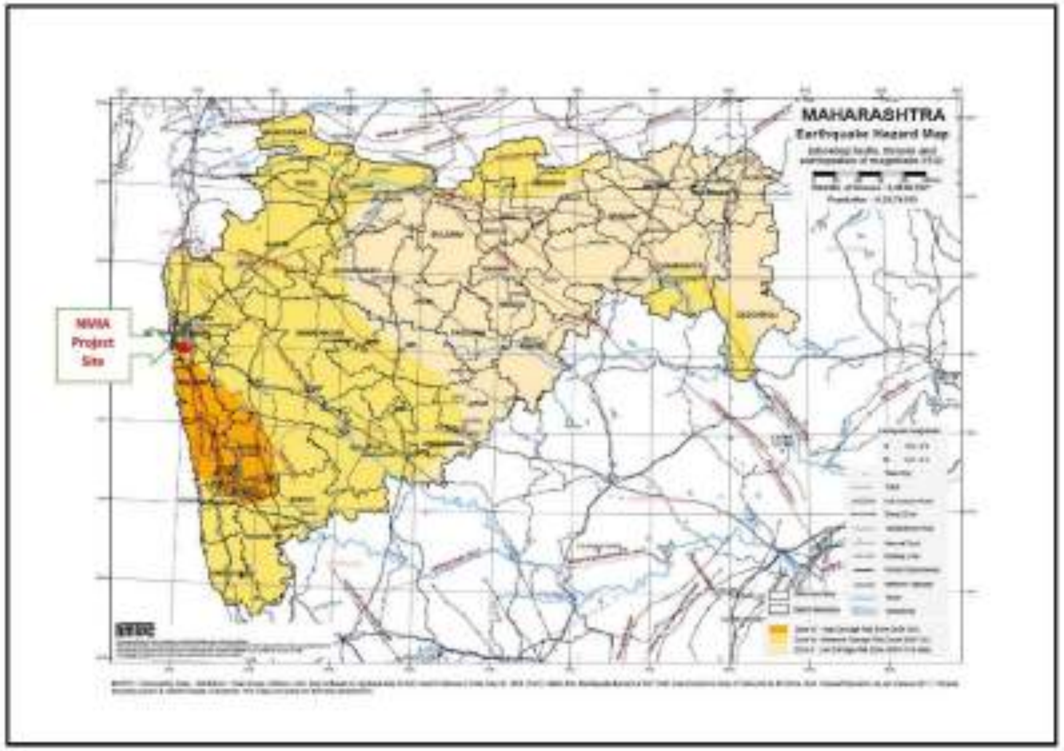
3.3.6 Seismic Stability

The earthquake zoning map of India divides India into 4 seismic zones (Zone 2, 3, 4 and 5) based on available information. According to the present zoning map, Zone 5 expects the highest level of seismicity.

Navi Mumbai lies in Zone III of the seismic region. This is referred as moderate risk zone. Although there is no past record of any disaster in this region, earthquake of intensity between 5.0 and 6.9 on the Richter scale can occur in Zone III.

Earthquake disasters can be averted with the construction of seismic proof buildings. The seismic zoning map of India and Maharshtra is shown in **Figure-3.3.5.**





Source: IMD & MoHUA web site

NMIA Project Site

<u>FIGURE-3.3.5</u>

<u>NMIA LOCATION MARK ON SEISMIC ZONES MAP OF INDIA & MAHARASHTRA</u>

3.4 Land Use/Land Cover

The study area of 10 km around the project site features hilly areas, forests, and a mix of urban and rural areas. Presence of hill ranges is visible, the Parsik hills on the North of the study area which run from the north to the south and further across the Panvel creek. Towards the south of the study area is the Matheran hill, most of which is under Reserved Forest zone and shows relatively dense vegetation. The Karnala Bird Sanctuary is located at the southeast end of the 10km study area. Few other patches of Reserve Forest can also be observed other than that on Parsik hills. Broken land refers to the part of land use which is formed as a result of the hill cutting activity carried out for the project. The hillock falling within the proposed airport site is being cut and remnants of broken land can be seen as a part of the site area.

The Panvel creek runs approximately at the center of the study area just adjoining the North boundary of the proposed site, where as the Thane creek is located further northwest of the study area. Mangroves are located around these and other brackish water bodies like the estuarine portion of Gadhi River which abuts the Site on the East. Besides these, mudflats (Thane Creek Mudflats, TCS Chanakya mudflats, NRI Wetlands) and saltpans are also observed along coastlines areas.

Besides the five Rivers namely, Taloja, Kasadi, Ulwe, Gadhi and Kalundri riveflowing through the study area. There are several lakes namely Adai Lake, Khandeshwar Lake, Holding ponds within Navi Mumbai area, New Panvel Lake, Ballaleshwar Lake, Panvel Municipality Lake, Panvel market lake, Israli talab, Karave Lake, Darave Lake, Belapur Lake, Agroli Lake, Mango Garden Lake, Seawood Lake etc. within the study area. The Ransai dam is the major reservoir within study area whereas numerous other smaller waterbodies can also be observed.

The State Highway (SH-54) and National Highway (NH-4), Uran road, Sion Panvel link road, Mumbai Pune Expressway, National Highway (NH-4C), Palm Beach road, JNPT road, Thane Belapur road and Edapally-Panvel NH-66 highway are some of the important roads within the study area.

Majority of the area to the North of the site is urbanized. The TTC MIDC is located at the base of the Parsik hills between the Thane creek and falls to the North of the study area. The Taloja Industrial area is located to the Northeast of the site and JNPT industrial area is located to the south of the site. Major urban nodes of Navi Mumbai namely CBD Belapur, Seawoods, Kharghar, Panvel, New Panvel town etc. are located to the North and Northeast of the site. Southern side of the site is mostly rural in character with upcoming urbanized areas of the Uran node. Mining area and industrial sheds for freight containers from JNPT are predominant features in this area.

LandUse/Land Cover Study

The LU/LC study is based on High Resolution LISS IV Satellite image of date of pass 7th May 2020, was purchased from National Remote Sensing Center (NRSC), Hyderabad, the particulars of which are given below:

Satellite Data : High Resolution Resource sat 2 LISS IV
Satellite Sensor : L4FMX
Spatial Resolution : 5.8 m
Path and Row : Path 94, Row 59 Sub scene B & D
Date of pass : 7th May 2020

The digital classification technique is used for the extraction of the land use/ land cover information from the imagery. A land use land cover map of 10 km radius around the project site is prepared and the same is described below.

The land use status of the project during the ongoing Pre-Development phase of the project (during May 2020) has been prepared covering sixteen different land use land cover classes are extracted from the satellite image and 4 classes are identified from SOI Toposheets and overlapped as a single LULC map covering twenty classes in all as can be seen in **Table-3.4.1.** Landuse classification is broadly as per NRSA classification system, however, project specific categories are introduced as appropriate, considering the nature of the site.

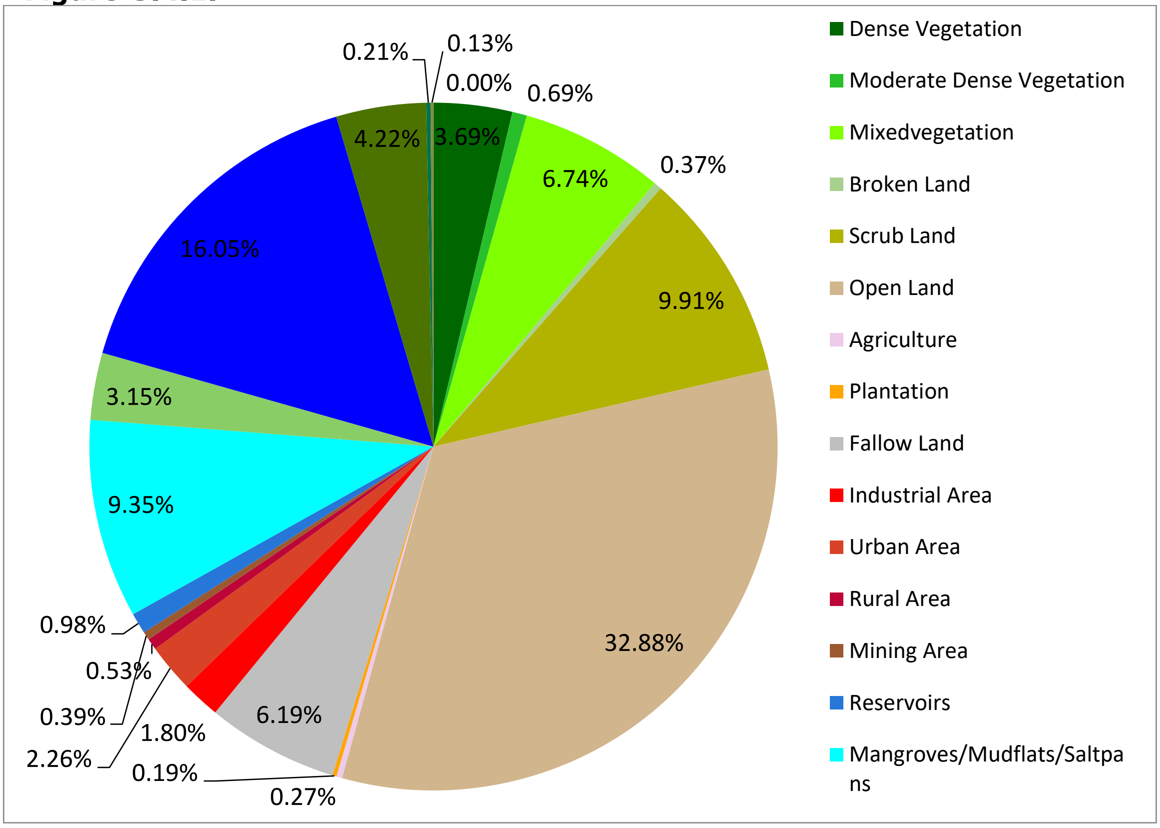
TABLE-3.4.1
LAND USE CLASSES AND STATISTICS OF STUDY AREA OF PROJECT SITE

Sr No.	LU-LC Class	Area in Ha	Area in Sq. km	(%) Percentage
1	Dense Vegetation	1,767.56	17.68	3. 69
2	Moderate Dense Vegetation	329.51	3.30	0.69
3	Mixed Vegetation	3,229.72	32.30	6.74
4	Broken Land	177.41	1.77	0.37
5	Scrub Land	4,749.22	47.49	9.91
6	Open Land	15,759.63	157.60	32.88
7	Agriculture	131.34	1.31	0.27
8	Plantation	90.58	0.91	0.19
9	Fallow Land	2,967.66	29.68	6.19
10	Industrial Area	860.44	8.60	1.80
11	Urban Area	1,084.31	10.84	2.26
12	Rural Area	254.13	2.54	0.53
13	Mining Area	186.39	1.86	0.39
14	Reservoirs	471.03	4.71	0.98

Sr No.	LU-LC Class	Area in Ha	Area in Sq. km	(%) Percentage
15	Mangroves/ Mudflats/ Saltpans	4,479.69	44.80	9.35
16	Open Scrub Forest	1,510.56	15.11	3.15
17	Waterbody	7,689.91	76.90	16.05
18	Dense Mixed Forest (Toposheet)	2,023.29	20.23	4.22
19	Open Forest (Toposheet)	98.75	0.99	0.21
20	Reserve Forest (Toposheet)	63.36	0.63	0.13
Total		47,924.46	479.24	100.00

Source: LULC Area statistics covering 10km study area using May 2020 LISS IV imagery around Proposed Navi Mumbai International Airport Project, Navi Mumbai

The graphical representation of statistics under land use classes is shown in **Figure-3.4.1.**



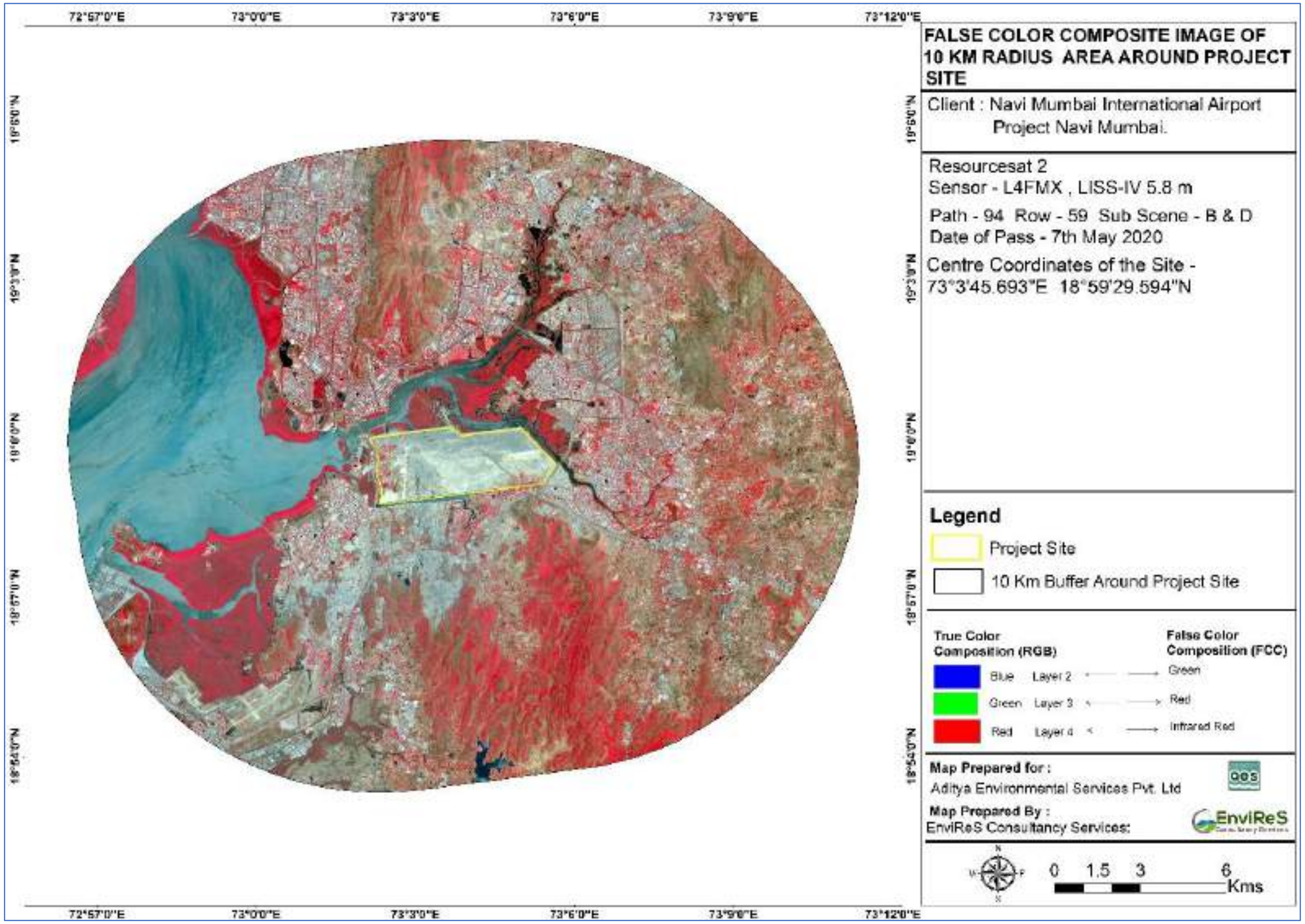
Source: LULC Area statistics covering 10km study area using May 2020 LISS IV imagery and SOI OSM around Proposed Navi Mumbai International Airport Project, Navi Mumbai

FIGURE-3.4.1
PIE CHART OF LULC CLASSES AROUND 10 KM RADIUS OF PROJECT SITE

From the LULC map, the most dominant class within the 10 km study area is Open Land covering about 32.88%. The proposed project site is located within this open land and consists of a part of broken land which is formed as a result of the hill cutting activity carried out for the project site. This area covers about 0.37% of the study area. Mining area (0.39%) and industrial area (1.80%) are seen amongst the land use classes within study area. Mining area also includes small open quarries which are used to extract stone for construction purposes. Southern side of the study area shows comparatively high altitude and that is the area where dense vegetation (3.69%) is predominantly observed. Dense vegetation is a predominant class within the study area which is mainly observed in the southern side around the eco sensitive zone (ESZ) of the Karnala bird sanctuary. Moderate dense vegetation (0.69%) and mixed vegetation (6.74%) are some of the other vegetation types observed within study area. Scrub land (9.91%) is also seen within study area. Reserve Forest areas within the study area were demarcated by referring to SOI toposheets. It was seen that the classes Open Forest and Reserve Forest covered 0.21% and 0.13% respectively of the study area. The class Dense Mixed Forest comprised 4.22% of the study area.As the satellite image is captured in the month of May 2020, vegetation cover on agricultural land (0.27%) was also observed. Fallow land comprises of 6.19% of overall land use. It is observed that very few farmers continue farming rice, hence the land remains fallow for part of the year. Remnants of past agricultural activities can be seen near the dislocated villages towards the southeast of the site. Habitation covers rural settlement of 0.53% and since the site is in the vicinity of major urbanized developments like Kharhar, Vashi and Panvel, the class urban area constitutes 2.26% of the land cover.

A number of waterbodies (reservoirs/ ponds) located throughout the study area contribute to 0.98% of the land cover. Presence of Panvel creek and rivers correspond to the class Waterbody which comprises 16.05% of the land cover making it second most predominant class within the study area. Mangroves and mudflats including salt pans contribute to 9.35% of the land cover within study area. Study area also shows many marshy areas where water remains stagnated until summer as can be observed from the imagery.

The geo-referenced False Colour Composite (FCC) Resourcesat-2 satellite image is **Figure-3.4.2**. The land use/landcover of 10 km radius of the study area is shown in **Figure-3.4.3.**



FIGURE–3.4.2

GEO-REFERENCED FALSE COLOUR COMPOSITE (FCC) RESOURCESAT-2 SATELLITE IMAGE OF STUDY AREA

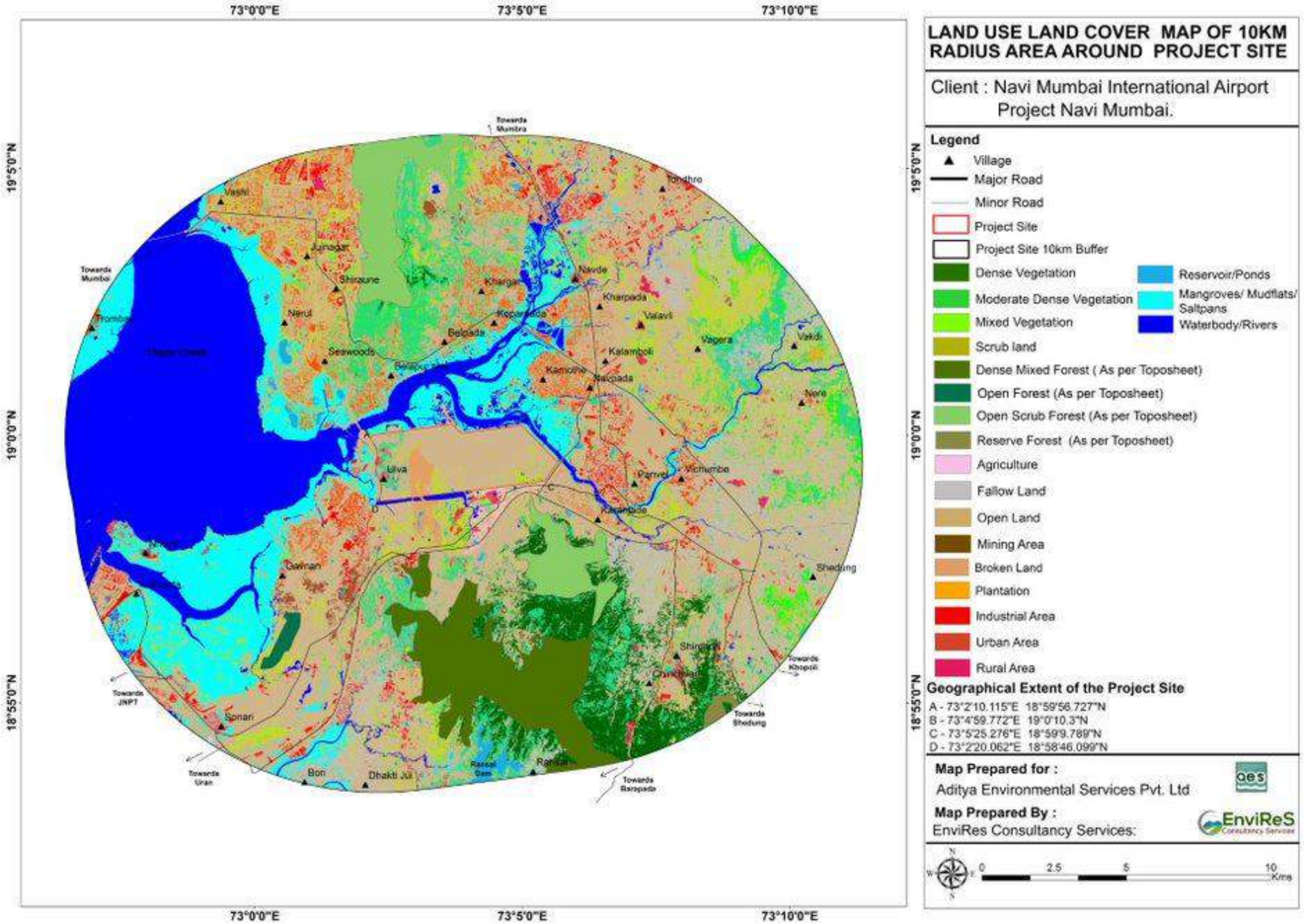


FIGURE-3.4.3
LANDUSE/ LANDCOVER MAP OF 10 KM RADIUS OF STUDY AREA

3.4.1 Proposed Land Use of the Project Site

The land use pattern in the vicinity of NMIA has been modified by NMDP declaring a zoning plan (**Annexure-VIII**) as "Airport and Allied Activities/Services Zone" Spread in an area of 1160 ha identified as the airport core zone. The principal and ancillary uses in the Land Use zones shall be as under after the development of NMIA will be broadly classified based on its uses as Airside Zone and Landside Zone. The proposed land-use statement of the NMIA site for the final phase is given in **Table-3.4.2**

TABLE-3.4.2
PROPOSED LAND USE AREA OF NMIA

Sr. No	Land use Zone	Area (Ha)	Area (sqm)	% To Total Site Area
1	Airside Area	942.25	94,22,460.82	81.23
2	Landside Area	217.75	21,77,539.18	18.77
	Total Site Area	**1160.00**	**116,00,000.00**	**100.00**
Sr. No	**Land use (Airside + Landside)**	**Area (ha)**	**Area (sqm)**	**% to Total Site Area**
1	Facilities, pavements, building and structures	605.47	60,54,706.706	52.20
2	Green/open spaces	384.90	38,49,047.682	33.18
3	Transportation-roads, parking, metro	139.32	13,93,157.786	12.01
4	Utilities	10.12	1,01,209.816	0.87
5	Drains	20.19	2,01,878.009	1.74
	Total Site Area	**1160.00**	**116,00,000.00**	**100.00**

3.5 Soil Quality

3.5.1 Soil Quality of Study Area

A very small extent (5 %) of the study area consists of cultivable soils primarily developed from Deccan basaltic rocks after weathering and erosion, as well as from coastal alluvium. A small area is prone to salinity due to tidal ingress from the creek opening into the Arabian Sea. A major part of the area (around 60%) consists of "barren/ undulating" and partly hilly soil material geologically developed from basaltic lava flows of Upper Cretaceous and Eocene age which is either used for quarrying of basaltic rock and earth material or left in the form of uncultivable "scrub/open" land. The basalts are usually dark grey to grey and bluish grey in colour and are hard, compact, rough, and fine to medium grained in texture.

Kharif rice is the major staple food crop grown in the study area, under rain-fed conditions. No major irrigation projects are in the region. Hence, rainy season vegetables are grown in upland soils where soils are well drained. Rabi vegetables and other crops are grown to a limited extent where water for irrigation is available from tanks, ponds, and open wells. Main plantation crops are coconut, mango, areca, sapota, chikku, banana, pineapple etc. in descending order of area under cultivation. The undulating "open/scrub" land may have basaltic soil cover which is fertile but not cultivable due to rough topography, "uneven/shallow" soil depth etc. As per the National Bureau of Soils and Land Use Survey (ICAR), such soils are classified under the soil orders of Inceptisols and Entisols.

3.5.2 Selection of Soil Sampling Locations

It is essential to determine the potential of soil in the area and identify the current impacts of urbanization and industrialization on soil quality and predict impacts, which may arise due to the proposed project. Accordingly, a study of assessment of the baseline soil quality has been carried out.

For studying soil profile of the region, sampling locations were selected to assess the existing soil conditions in and around the airport project area representing various land use conditions. The physical, chemical, and heavy metal concentrations were determined. The samples were collected by ramming a core-cutter into the soil up to a depth of 90 cm.

The present study of the soil profile establishes the baseline characteristics, and this will help in future identification of the incremental concentrations if any, due to the operation of the airport project. The sampling locations have been identified with the following objectives:

- To determine the baseline soil characteristics of the study area.
- To determine the impact of mixed development on soil characteristics; and
- To determine the impact on soils more importantly from agricultural productivity point of view.

Considering the type of the proposed project described above, its direct impact on agricultural soils within the study area, during project construction and operation phases is not expected beyond an angular distance of 2 km from the project site boundaries.

However, the original "soil/ land/ water" ecosystem and hydrology (including the biodiversity) of the entire project site occupying 1160 ha will be lost to accommodate the airport and allied infrastructure. Besides an additional area ~ 25 % of the project site beyond its boundaries is prone to change in of its original 'LU/LC' to supply the earth material needed for the airport as well as to accommodate spin-off facilities required to support airport operations.

Ten composite soil samples representing the project site and other predominant "LU/LC" classes of land within the study area of 10 km radius from the site boundaries were collected and analyzed. The description and locations of the said ten soil sampling locations are described in **Table-3.5.1**and shown in **Figure-3.5.1.** The soil analysis results and standard classification are given in **Table-3.5.2**and **Table-3.5.3**respectively**.**

TABLE-3.5.1
SOIL SAMPLING LOCATIONS

Sampling Stations	Soil Sampling Locations	Distance (km)	Direction
S1	Near Ulwe Gaothan (Project Site)	-	-
S2	Reserved Forest Area near Pargaon	1.3	SSE
S3	Gavan Pata	2.3	SW
S4	Near Vindhane Village	9.0	SSW
S5	Shirdhon	7.5	SE
S6	Korpoli Village	6.5	E
S7	Aaikar Colony (Belapur)	2.4	NNW
S8	Padgha Village	6.2	NE
S9	Shiravane Phata	6.0	NNW
S10	Near Turbhe MIDC	9.0	NNW

Description of Soil Sampling Locations

Soil samples were collected from the following locations & the site description is given below:

- Project Office (S1): The site is an open land with earthwork and other construction activity.
- Reserved forest near Pargaon (S2): This sampling location falls within a reserved forest area.
- Gavan Phata (S3): The land use is mix of wild vegetation.
- Near Vindhane Village (S4): Site represents uncultivated agricultural land with no irrigation source.
- Shirdhon (S5): The site represents land with wild dense vegetation.
- Koproli (S6): The site represents fallow agricultural land cultivated only under rain-fed conditions.
- Aaikar Colony (Belapur) (S7): Soil sample is collected from open/barren land.
- Padgha village (S8): Soil sample is collected from agricultural plantation land coconut and fruit trees.
- Shiravane Phata (S9): The area represents the scrub land.
- Near Turbhe MIDC (S10): The area represents agricultural plantation land under mango, jackfruit, and other fruit trees.

FIGURE-3.5.1
SOIL SAMPLING LOCATIONS MAP

TABLE-3.5.2
SOIL ANALYSIS RESULTS

Sr. No	Parameters		Result										Method of Analysis
			S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	
1	pH@25°C		6.72	6.62	6.78	6.46	6.72	6.64	6.72	6.73	6.79	6.66	IS 2720 (part 26); RA2011
2	Conductivity @25°C, µS/cm		392	346	382	287	394	314	384	388	322	286	IS-14767; RA 2016
3	Texture		Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	IS 2720 (part 4); RA2010
4	Moisture content, %		4.8	4.2	3.8	3.5	4.4	3.2	4.0	3.6	3.5	3.4	IS 2720 (part 2); RA2015
5	Particle size, %	Clay	72.6	71.2	72.6	68.2	72.6	80.3	72.6	68.6	70.8	72.6	IS 2720 (part 4); RA2010
		Silt	8.4	9.6	6.9	11.4	9.6	9.2	8.8	9.4	12.3	8.4	
		Fine sand	17.0	19.2	20.5	20.4	17.8	10.5	18.6	22.0	16.9	17.0	
6	Organic Carbon, %		0.42	0.26	0.28	0.26	0.32	0.22	0.22	0.25	0.22	0.23	IS 2720 (part 22); RA2015
7	Water Holding Capacity, %		42.8	40.6	42.6	44.1	38.6	35.1	32.6	40.1	36.2	36.7	AESPL/LAB/SOP/S-10; 02.05.18
8	Chloride, mg/kg		82.3	86.1	78.9	88	96.2	68.4	43	46.8	42	42.3	EPA Method 9253:1994
9	Available Phosphorus, kg/Ha		28.1	24.2	24.3	32	35.7	30.1	21	32.5	24	32	AESPL/LAB/SOP/S-08; 02.05.18
10	Available Nitrogen, %		0.0096	0.0146	0.0116	0.0124	0.0096	0.0098	0.0082	0.0068	0.0096	0.00116	AESPL/LAB/SOP/S-06; 07.05.19
11	Available sulphur, mg/kg		60	82	68	80	54	52.7	59	62	46	58	EPA Method 9038:1986
12	Potassium as K, kg/ha		100	90	80	120	80	90	80	100	80	90	IS 9497: 1980: 2015
13	Exchangeable Na, %		0.06	0.06	0.08	0.05	0.10	0.06	0.08	0.10	0.07	0.06	IS 9497: 1980: 2015
14	Calcium as Ca, meq/l		24	32	42	32	42	38	30	36	46	22	EPA Method7000 B.2:2007
15	Magnesium as Mg, meq/l		16	18	26	18	22	18	14	22	24	16	EPA Method7000 B.2:2007
16	Color		Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Munsell Color Chart
17	Bulk Density, g/cc		0.86	0.90	0.82	0.92	0.90	0.92	0.86	0.90	0.88	0.86	AESPL/LAB/SOP/7.2.1.2/S-16 Issue No-01, 30/11/19
18	CEC meq/100g		1.2	1.2	1.6	1.0	2.0	1.2	1.6	2.0	1.4	1.2	IS: 2720 (Part 24):1976: 2015
19	Nitrate Nitrogen, ppm		<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	Soil Testing of India
20	Manganese as Mn, mg/kg		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	EPA Method 3050 B. 2:1996
21	Copper as Cu, mg/kg		126	108	116	<0.04	<0.04	96	80	<0.04	<0.04	<0.04	EPA Method 3050 B. 2:1996
22	Zinc as Zn, mg/kg		24	16	46	30	<0.04	20	24	<0.04	<0.04	<0.04	EPA Method 3050 B. 2:1996
23	Boron as B, mg/kg		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	EPA Method 3050 B. 2:1996
24	Molybdenum as Mo, mg/kg		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	EPA Method 3050 B. 2:1996
25	Lead as Pb, mg/kg		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	EPA Method 3050 B. 2:1996
26	Nickel as Ni, mg/kg		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	EPA Method 3050 B. 2:1996
27	Mercury as Hg, mg/kg		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	EPA Method 3050 B. 2:1996

TABLE-3.5.3
STANDARD SOIL CLASSIFICATION

Sr. No.	Soil Test	Classification
1	pH	<4.5 extremely acidic 4.51- 5.50 very strongly acidic 5.51-6.00 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.0 strongly alkaline 9.01 very strongly alkaline
2	Salinity electrical conductivity (µmhos/cm) (1ppm = 640 µmho/cm)	Up to 1.00 average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)
3	Organic carbon (%)	Up to 0.2: very less 0.21-0.4: less 0.41-0.5 medium, 0.51-0.8: on an average sufficient 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (Kg/ha)	Up to 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (Kg/ha)	Up to 15 very less 16-30 less 31-50 medium, 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient
6	Potash (Kg/ha)	0 -120 very less 120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Hand Book of Agriculture, Indian Council of Agricultural Research

Observations

The depth of the soils at the said locations was found to be > 1.5 m. The chemical and physical properties of the collected soil samples lead to following inferences:

1) The depth of the soil profiles at all sampling locations is adequate (>1.5 m) for growth of plants provided other limiting factors such as water scarcity, flooding, soil salinity, soil alkalinity, heavy metal toxicity, anoxic conditions, plant nutrients' deficiency etc. are absent.

2) All sampled soil representing the study area are almost neutral in reaction, with pH ranging from 6.46 to 6.79, indicating no constrains of "salinity/ alkalinity" whatsoever and predisposition of soils to very good response to fertilizer

application and plant availability of essential major plant nutrients (N, P, K, Ca, Mg & S) and trace elements (Fe, Mn, Zn, Cu, B and Mo).

3) Particle size analysis indicates that all soils are clayey in texture (68.2% to 80.3%: clay content) with good water holding capacity (32.6% to 44.1%). Expectedly, the soil moisture content in the soil samples at the time of collection of the same, in peak dry season, varied from 3.2% to 4.8%.

4) The electrical conductivity of soils ranged between 286 and 394 microS/cm indicating that the soils are totally free from any salinity related issues.

5) The organic carbon (OC) and available K content of soil is low and ranged from 0.22% to 0.42% indicating less to medium in the study area and 80 kg/ha to 120 kg/ha respectively.

6) Some soils (S2, S3 & S4) are medium in available N content (0.012% to 0.014%) whereas others (S5, S6 & S9) have a low content (0.0096% to 0.0098%) of the same. However, soil S7, S8 and S10 highly deficient in nitrogen. This is expected in this region because of the monsoon dominated climate where leaching of nutrient during the high rainfall period is very high and soil moisture during the long dry and hot summer period (January to May) is very low.

7) The available P content of the soils is medium and ranges from 21 kg/ha to 35.7 Kg/ha. The phosphorus content in the study area falls in less to medium category.

8) The content of Cl (42 mg/kg to 96.2 mg/kg) and S (46 mg/kg to 82 mg/kg) are high but not detrimental to most of the crops in the prevailing pH range of the soil.

9) The reported levels of Zn ranging from 20 mg/Kg to 46 mg/Kg for soil sampled at locations S-1, S-2, S-3, S-4, S-6 and S-7 and Cu ranging from 80 mg/ Kg to 126 mg/Kg for soil sampled at locations S-1, S-2, S-3, S-6 and S-7 are extremely high and hence toxic for growth of all crops. Normally Zn content of more than 5 mg/kg and Cu content of more than 3 mg/kg are very high and seldom reported in agricultural soils. Such levels are possible only if the soils are contaminated. This may be due to dumping in these areas with soils which are from unknown sources.

10) Wherever the contents of Zn, Mn, B, Mo and Cu (plant micronutrients) are Below Detection Level (BDL), the soils may require addition of the same in the form of fertilizer, depending on the nature of crops to be grown.

11) Heavy metals such as Pb, Hg and Ni are toxic for plant growth. However, as their contents are BDL, they do not pose any problem for crops in the presently sampled soils.

In conclusion the cultivable areas available within the study area in the immediate environs of the project periphery are fertile and have good physical properties for successful cultivation of suitable crops in the rainy (kharif) season, provided the other limiting factors of economy of scale, profitability, labor availability and marketability are favorable. In post-monsoon season the crucial limiting factor is the availability of irrigation facilities.

3.6 Meteorology

The meteorological data recorded during the study period is very useful for proper interpretation of the baseline information as well as for input prediction models for air quality dispersion. Historical data on meteorological parameters will also play an important role in identifying the general meteorological regime of the region. The year may broadly be divided into four seasons:

- Winter season : December to February
- Pre-monsoon season : March to May
- Monsoon season : June to September
- Post-monsoon season : October to November

Onsite monitoring was undertaken for various meteorological variables to generate the site-specific data. The central meteorological station was installed at the site at a height of approximately 10.0 m above ground level to record wind speed, direction, relative humidity, temperature, and rainfall is monitored by rain gauge. Primary date at the site was collected at every hour continuously from 1st December 2019 to 29th February 2020 representing winter season.

The data generated is then compared with the meteorological data generated by nearest India Meteorological Department (IMD) station located at Mumbai (Santacruz) (A) located at an aeriel distance of 20 km from the project site. The available meteorological data of IMD, Mumbai (Santacruz) (A) station has been collected and analyzed.

3.6.1 Secondary Data Collected from IMD-Mumbai (Santacruz) (A)

Secondary data from IMD - Mumbai (Santacruz) (A) has been collected for atmospheric pressure, temperature, relative humidity, rainfall, wind speed and direction. The data at IMD is usually measured twice a day viz., at 08:30 and 17:30 hr. The IMD station at Mumbai (Santacruz) (A) is at an aeriel distance 20.0 km from the project site in the NW direction.

The monthly maximum, minimum and average values are collected for all the parameters except wind speed and direction. The collected data is tabulated in **Table-3.6.1**.

TABLE-3.6.1
CLIMATOLOGICAL DATA (1971-2000) STATION: [IMD-MUMBAI (SANTACRUZ) (A)]

Month	Atmospheric Pressure (mb)		Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)
	08:30 Hrs	17:30 Hrs	Max	Min	08:30 Hrs	17:30 Hrs	Monthly Total
January	1012.9	1009.9	34.5	12.9	68	49	0.2
February	1011.9	1008.8	35.9	13.9	65	47	0.3
March	1010.5	1007.1	38.0	17.0	66	51	0.0
April	1008.5	1005.1	37.4	21.3	70	60	0.1
May	1006.8	1003.7	36.1	24.0	69	65	11.5
June	1003.2	1000.9	34.8	23.0	80	75	501.7
July	1002.9	1001.2	31.9	23.3	86	82	776.4
August	1004.4	1002.6	31.2	23.4	86	81	535.6

Month	Atmospheric Pressure (mb)		Temperature (^0C)		Relative Humidity (%)		Rainfall (mm)
	08:30 Hrs	17:30 Hrs	Max	Min	08:30 Hrs	17:30 Hrs	Monthly Total
September	1007.2	1004.6	33.2	22.8	85	77	342.6
October	1009.4	1006.3	36.1	20.6	75	65	84.2
November	1011.4	1008.3	35.6	17.5	62	55	18.0
December	1013.1	1010.0	34.5	14.6	62	52	3.0
Total							**2273.6**

1] Temperature

The winter season starts from December and continues till the end of February. December is the coolest month with the maximum temperature at 35.9^{0}C and the minimum temperature at 12.9^{0}C. Both the night and day temperatures increase rapidly during the onset of the pre-monsoon from March to May.

During pre-monsoon season, the maximum temperature (March) was observed to be 38.0 ^{0}C with the minimum temperature (March) at 17.0^{0}C. The maximum temperature in the monsoon season (June) observed to be 34.8^{0}C whereas the minimum temperature was observed to be 22.8^{0}C. By the end of September with the onset of post-monsoon, the day temperatures increase slightly, with the maximum temperature at 36.1^{0}C and the minimum temperature at 17.5^{0}C.

2] Relative Humidity

The relative humidity at 08:30 hr was observed to be with a maximum of 86% and a minimum of 62%. Similarly, at 17:30 hr, the value was observed to be with a maximum of 82% and a minimum of 47%. Generally, the weather during other seasons was observed to be dry.

3] Atmospheric Pressure

The station level atmospheric pressure was recorded throughout the year. The maximum pressure observed was 1013.1 mb at 08:30 hr and of 1010.0 mb at 17:30 hr, with the maximum pressure occurring during the winter season, in the month of December.

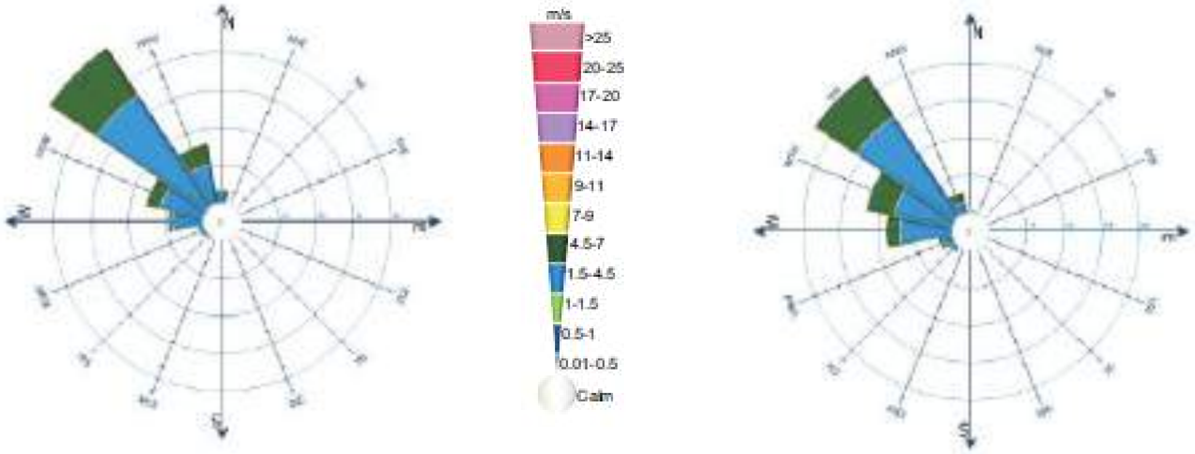
The minimum pressure observed was of 1002.9 mb at 08:30 and of 1000.9 mb at 17:30, with the minimum pressure occurring during the month of June in the monsoon season. The average pressure level in all other months was found to be in the range of 1005.7 to 1008.5. It can be seen from the data that not many variations are observed in the average atmospheric pressure levels. The pressure levels are found to be consistent over the region.

4] Rainfall

The average annual rainfall based on the past 30 years data for a period of 1971-2000, was observed to be 2273.6 mm. The monsoon sets in the month of June and continues till mid-September. The maximum amount of rainfall (776.4 mm) was observed in the month of July.

5] Wind Speed/Direction

Generally, light to moderate winds prevail throughout the year. The seasonal and annual wind roses are presented in **Figure-3.6.1** to **Figure-3.6.5**.



MARCH **WIND SPEED** **APRIL**

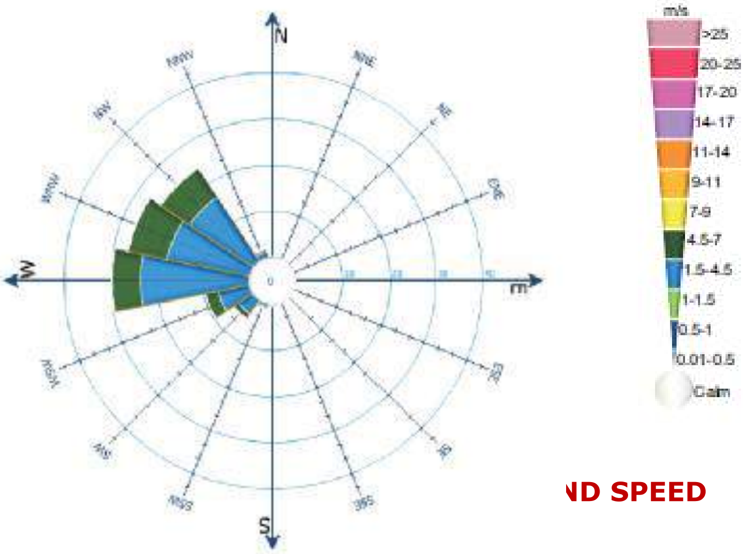


FIGURE-3.6.1
WINDROSE–PRE-MONSOON SEASON [IMD-MUMBAI (SANTACRUZ) (A)]

6) Cloud Cover

During the winter and the post-monsoon seasons, it was observed that the skies are generally very clear. In the pre-monsoon season, generally light clouds were observed in the evenings, with clear mornings. During the monsoon season, both in the mornings and evenings, the skies were found to be clouded.

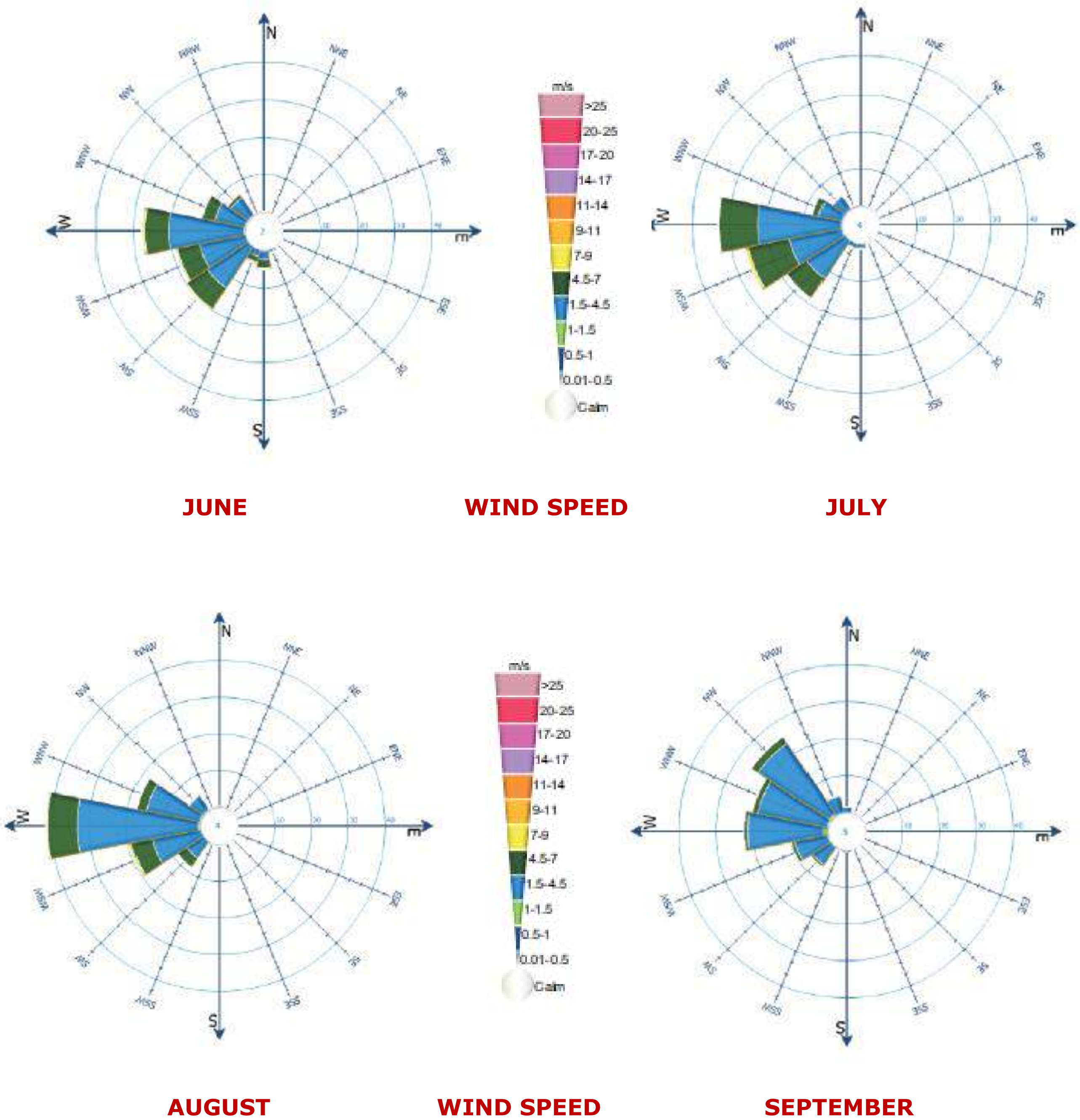
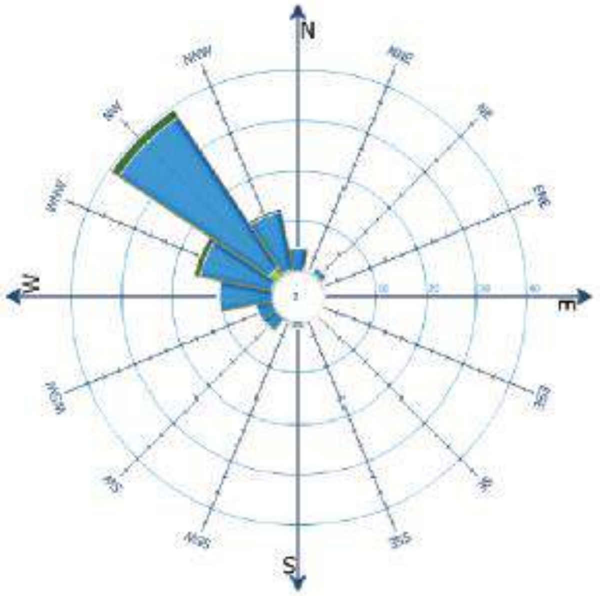
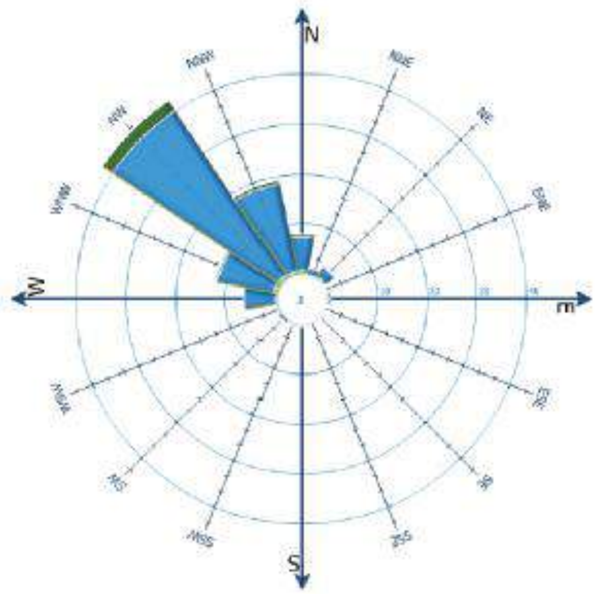


FIGURE-3.6.2
WINDROSE–MONSOON SEASON [IMD-MUMBAI (SANTACRUZ) (A)]



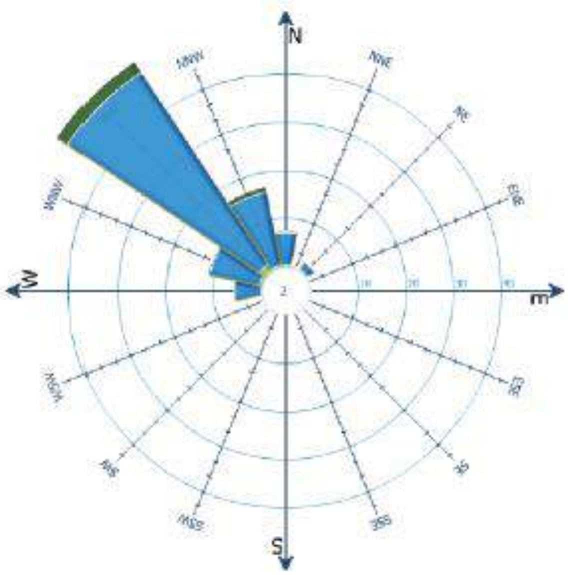
OCTOBER

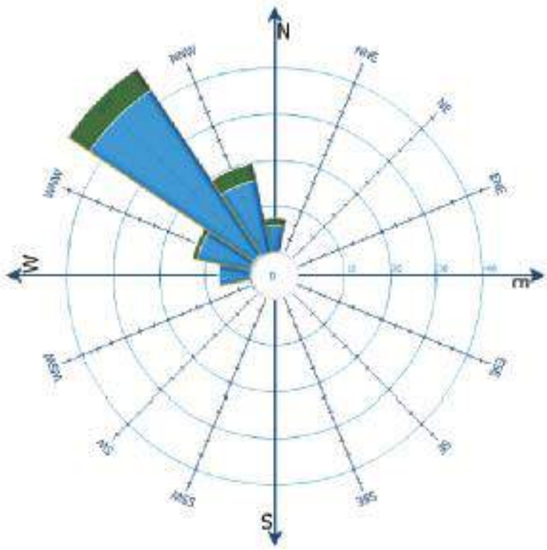
WIND SPEED



NOVEMBER

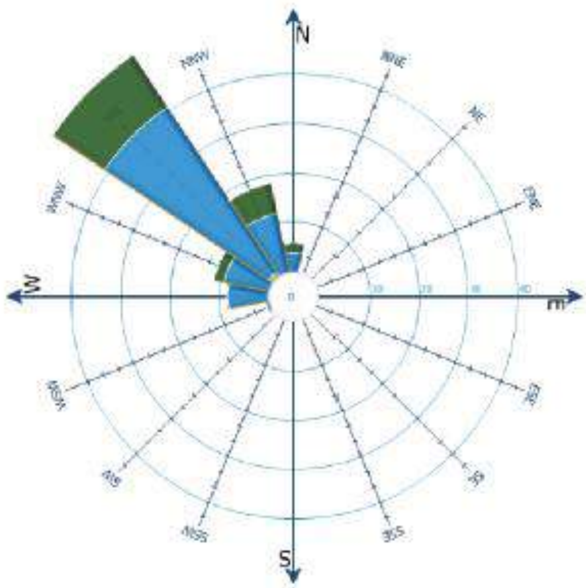
FIGURE-3.6.3
WINDROSE–POST MONSOON SEASON [IMD-MUMBAI (SANTACRUZ) (A)]





DECEMBER

JANUARY



WIND SPEED

FEBRUARY

FIGURE-3.6.4
WINDROSE–WINTER SEASON [IMD-MUMBAI (SANTACRUZ) (A)]

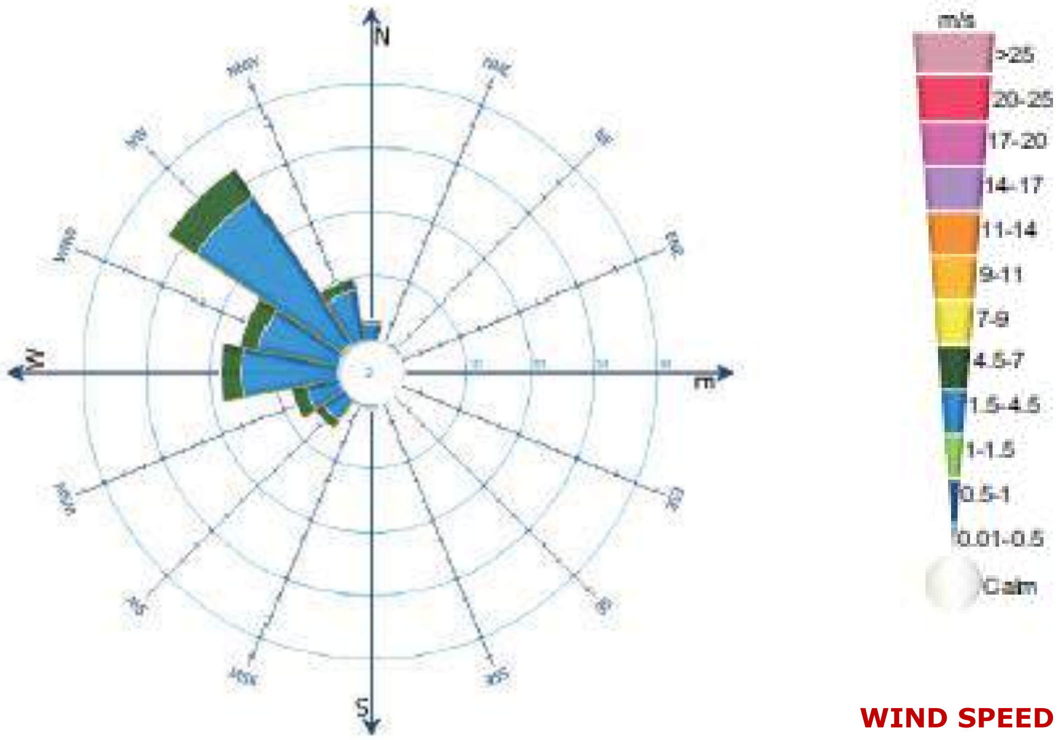


FIGURE-3.6.5
ANNUAL WINDROSE [IMD-MUMBAI (SANTACRUZ) (A)]

3.6.2 Site Specific Meteorology

On-site monitoring was undertaken for various meteorological variables in order to generate the site-specific data. Data was collected at site every hour continuously from 1st December 2019 to 29th February 2020 during the winter season. The meteorological parameters like wind speed, wind direction and temperature were recorded on hourly interval during study period. The relative humidity was recorded twice a day (08:30 hour and 17:30 hour). Rainfall was recorded on every 24 hours at 08:30 hours during study period. The data generated is then compared with the meteorological data generated by nearest India Meteorological Department (IMD) stations located at IMD - Mumbai (Santacruz) (A). The recorded meteorological data at the site is presented in **Table-3.6.2.**

1] Temperature

Minimum and maximum temperatures recorded during the winter season (Dec 2019 - Feb 2020) range between 14.7°C and 36.4°C.

2] Relative Humidity

During the period of observation, the relative humidity recorded ranged from 48% to 72% during the winter season.

TABLE-3.6.2
SUMMARY METEOROLOGICAL DATA OF PROJECT SITE

Month	Temperature (^0C)		Relative Humidity (%)		Rainfall (mm)	Cloud Cover (%)	Atmospheric Pressure (mb)	
	Min	Max	Min	Max			Min	Max
	Winter Season							
December, 2019	16.9	33.2	54	65	7.9	18	1009.5	1014.3
January, 2020	14.7	32.8	50	72	1.5	10	1008.8	1013.5
February, 2020	17.2	36.4	48	68	0	3	1007.7	1011.2
Range	**14.7 – 36.4**		**48 - 72**		**9.4**	**3-18**	**1007.7 – 1014.3**	

3] Rainfall

Total rainfall observed during the study period was 9.4 mm during the winter season of 5 days in December and 6 days in the month of January 2020.

4] Atmospheric Pressure

During the period of observation, the atmospheric pressure recorded ranged from 1007.7 (mb) to 1014.3 (mb) during the winter season.

5] Cloud Cover

The highest cloud cover (18%) was observed in the month of December 2019, as observed within the study period.

6] Wind Speed/Direction

Winter Season

Predominant winds from WNW direction were observed for 31.8% of the total time. In the SE direction winds were observed for 18.4% of the total time, whereas in W direction, the winds were observed for 14.3% of the total time. In other directions, the percentage frequencies observed as N (11.5%), NW (8.1%), NNW (4.7%), ESE (2.7%), NNE (1.8%), E (1.3%), NE, SSE & S (0.5%), ENE (0.4%) and SSW, SW & WSW (0.2%) Calm conditions prevailed for 2.9% of the time.

The wind rose for the study period representing winter season (Dec 2019 - Feb 2020) is given in **Table-3.6.3** and shown in **Figure-3.6.6.**

TABLE-3.6.3
SUMMARY OF PRODOMINANT WIND DIRECTION FOR STUDY PERIOD

Wind Speed / Direction	Winter Season
First Predominant Wind Direction	WNW (31.8%)
Second Predominant Wind Direction	SE (18.4%)
Third Predominant Wind Direction	W (14.3%)
Calm Condition (%)	2.9%

Note: Numbers in parenthesis indicates percentage of time wind blows

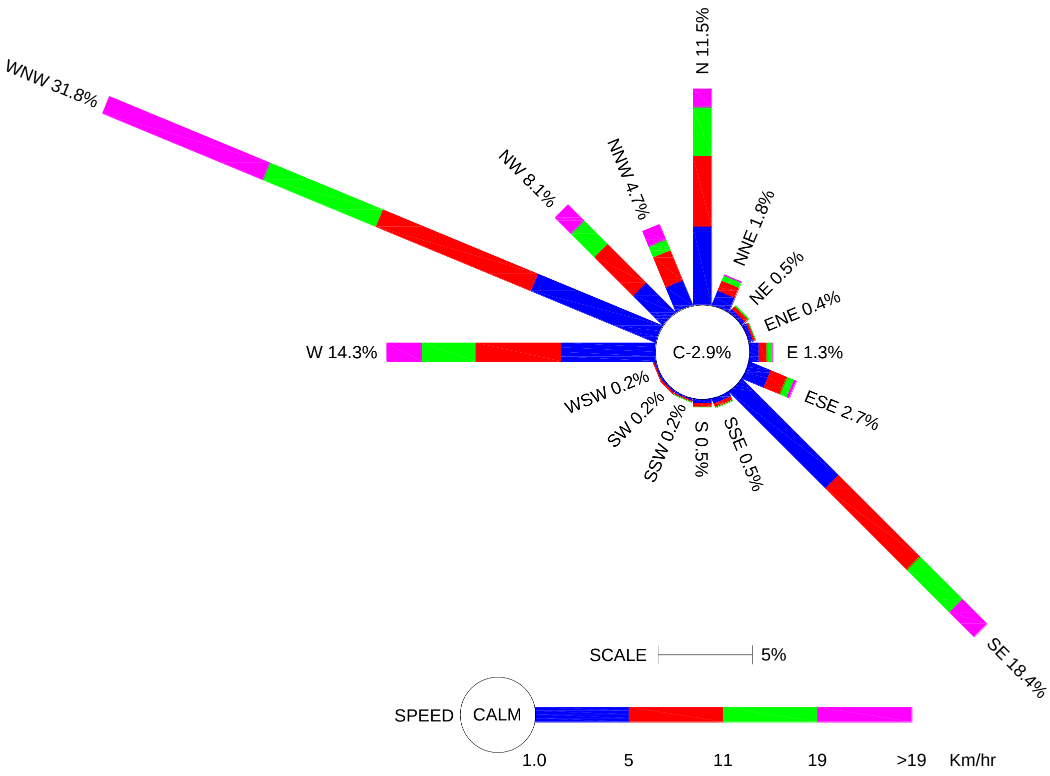


FIGURE-3.6.6
SITE SPECIFIC WIND ROSE FOR STUDY PERIOD

3.7 Ambient Air Quality

The ambient air quality with respect to the study zone of 10 km radius around the proposed project forms the baseline information. The various sources of air pollution in the region are industrial, traffic, urban and rural activities. The study area represents mostly rural and partly semi-urban and industrial environment.

This section describes the selection of sampling locations, methodology adopted for sampling, analytical techniques, and frequency of sampling. The monitoring was carried out for study period 1st December 2019 to 29th February 2020 representing winter season and results are attached as **Annexure-XIII.**

A reconnaissance survey was conducted on the site to obtain an understanding of the existing ambient air quality. Study of land-use pattern and activity/ development pattern within core zone (10 km) of site, indicates that major sources of air pollution are dust generation due to ongoing hill cutting activity, pre-development works at the airport site and traffic along the site boundary due to transportation of excavated materials for ongoing site development works at NMIA site.

3.7.1 Methodology Adopted for Air Quality Survey

3.7.1.1 Selection of Sampling Locations

The baseline status of the ambient air quality has been assessed through a scientifically designed ambient air quality monitoring network. The design of monitoring network in the air quality surveillance programme have been based on the following considerations:

- Meteorological conditions on synoptic basis.
- Topography of the study area.
- Representatives of regional background air quality for obtaining baseline status; and
- Representatives of likely impact areas.

Ambient air quality was assessed to understand baseline status of air environment and to find the impact of surrounding activities on the air quality in the project site. Ambient air quality in the area around the site was monitored for winter season for 24-hour average. Monitoring was carried out at twelve locations within the 10 km study area including the project site. The environmental setting of the monitoring locations is given in **Table-3.7.1**.

Ambient air quality data for all the parameters as stipulated under 16th November 2009 CPCB Notification. Standards as per the National Ambient Air Quality Standards (NAAQS) published by CPCB have been considered. The study area map depicting Ambient Air Quality (AAQ) locations is shown in **Figure-3.7.1.**

TABLE-3.7.1
AMBIENT AIR QUALITY MONITORING STATIONS

AAQ Stations	AAQ Monitoring Locations	Distance (km)	Direction	Environmental Settings
A1	NMIA Project Site office	-	-	Industrial
A2	CIDCO office, Panvel	2.6	E	Commercial
A3	Ulwe, Sector-5	1.3	W	Residential
A4	Gavan Phata water tank	2.2	SW	Residential
A5	CIDCO Branch office, Sector-5 (Kalamboli)	3.9	NE	Residential
A6	CIDCO Bhavan, CBD Belapur, Sector-10	2.4	NNW	Commercial
A7	Pargaon high school	0.3	S	Residential-rural
A8	CIDCO Office, Khargar, Sector-4	3.2	N	Residential
A9	CIDCO guest house	0.9	NW	Residential
A10	Shirdhon	7.5	SE	Residential

AAQ Stations	AAQ Monitoring Locations	Distance (km)	Direction	Environmental Settings
A11	Herdilia IT Park in TTC Industrial Area	5.8	NNW	Industrial
A12	Panvel market yard	3.7	SE	Commercial

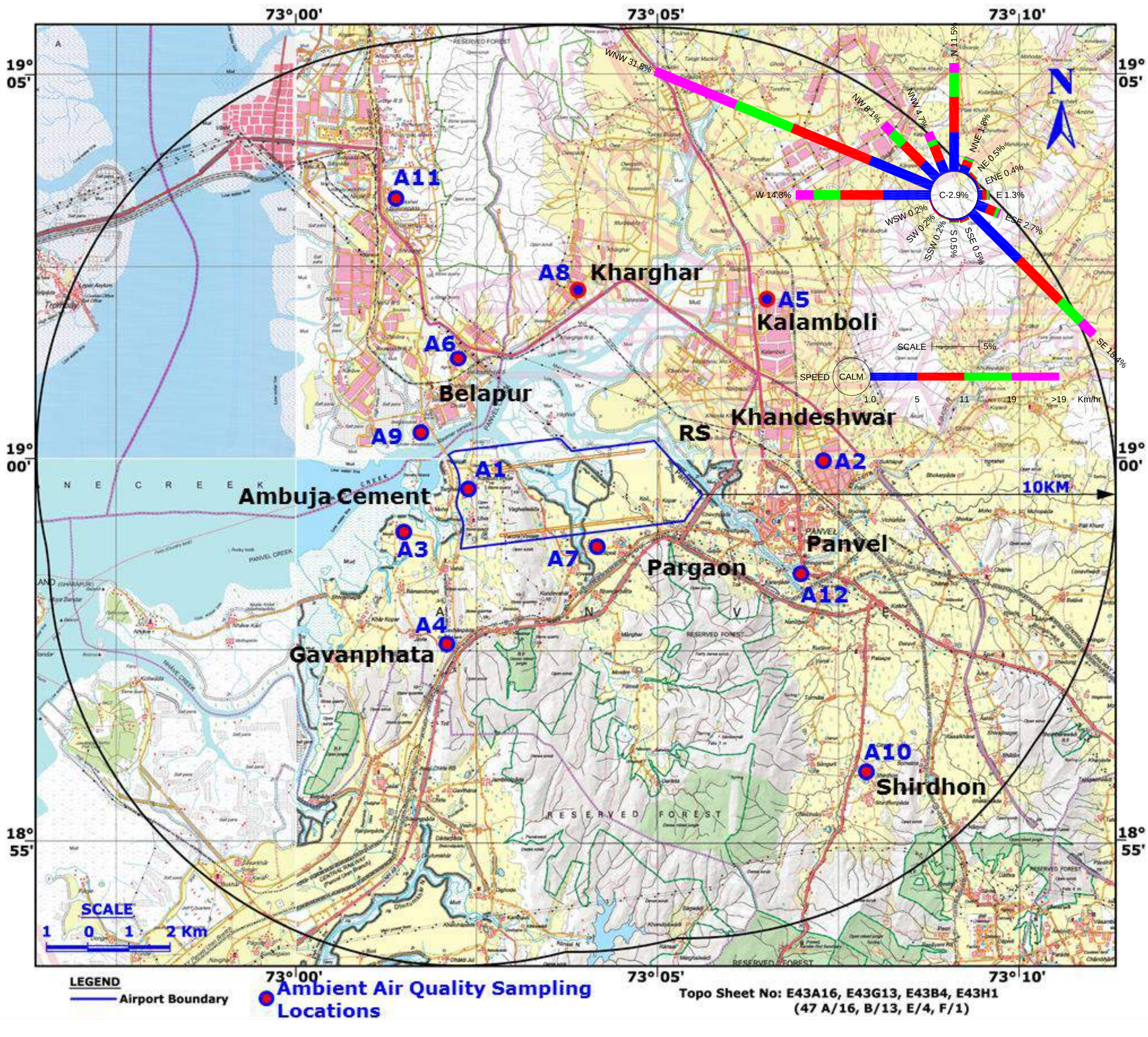


FIGURE-3.7.1
AMBIENT AIR QAULITY MONITORING LOCATIONS OF STUDY AREA

3.7.1.2 Justification for Selection of Sampling Locations

The Respirable Dust Sampler (RDS) and Fine Dust Samplerare placed for each sampling location to monitor the concentration of pollutants. A brief description of the sampling locations is presented hereunder:

NMIA Project Site office (AAQ1): This sampling station is located near the site office. The main objective to select this location is to assess the concentration of pollutants within premises of airport boundary. This will also be useful for assessing the conformity to standards of the ambient air quality after operation of airport. Predevelopment Works are under way at the time of monitoring.

CIDCO office, Panvel (AAQ2): This sampling station is located at about 2.6 km in east direction of the project site. The station is located in the airport funnel area to assess the concentration of pollutants in rural / semi-urban residential and commercial area. This location represents crosswind direction.

Ulwe, Sector-5 (AAQ3): This sampling station is located at a distance of about 1.3 km in west direction of the proposed project. The station is located in the airport funnel area to assess the concentration of pollutants in rural / semi-urban residential and commercial area. This location represents cross wind direction.

Gavan Phata Water Tank (AAQ4): This sampling station is located at a distance of about 2.2 km in south west direction of the proposed project. The objective for selection of this location is to assess the concentration of pollutants in the residential area. This location represents cross wind direction.

CIDCO Branch office, Sector-5 (Kalamboli) (AAQ5): This sampling station is located at a distance of about 3.9 km in north east direction of the proposed project. The objective for selection of this location is to assess the concentration of pollutants in the residential area. This location represents cross wind direction. The surrounding conditions represent mostly commercial activities.

CIDCO Bhavan, CBD Belapur, Sector-10 (AAQ6): This sampling station is located at a distance of about 2.4 km in NNW direction of the proposed project. The objective for selection of this location is to assess the concentration of pollutants in the commercial/ residential area. This location represents upwind direction. The surrounding conditions represent commercial/ residential area.

Pargaon high school (AAQ7): This sampling station is located at a distance of about 400m to the south of the southern runway. The objective for selection of this location is to assess the concentration of pollutants in cross wind direction as it is located very close to the airport boundary.

CIDCO Office, Kharghar, Sector-4 (AAQ8): This sampling station is located at a distance of about 3.2 km in north direction of the proposed project. The objective for selection of this location is to assess the concentration of pollutants in the residential area. This location represents cross wind direction.

CIDCO Guest House (AAQ9): This sampling station is located at a distance of about 0.9 km in North West direction of the proposed project. The objective for selection of this location is to assess the concentration of pollutants in the residential area. This location represents up-wind direction.

Shirdhon (AAQ10): This sampling station is located at a distance of about 7.5 km in south east direction of the proposed project. The objective for selection of this location is to assess the concentration of pollutants in the residential area. This location represents down-wind direction. This location is also close to Karnala Bird sanctuary.

Herdilia IT Park in TTC Industrial Area (AAQ11): This sampling station is located at a distance of about 5.8 km in NNW direction of the proposed project. The objective for selection of this location is to assess the concentration of pollutants in the industrial area. This location represents up-wind direction.

Panvel market yard (AAQ12): This sampling station is located at a distance of about 3.7 km in SE direction of the proposed project. The objective for selection of this location is to assess the concentration of pollutants in the residential/commercial area. This location represents downwind direction.

3.7.2 Frequency and Parameters for Sampling

Ambient air quality monitoring has been carried out with a frequency of two days per week during study period. The baseline data of air environment was monitored for parameters mentioned below as per revised MoEF&CC notification dated 16th November 2009:

- Particulate matter (PM_{10}).
- Particulate matter ($PM_{2.5}$)
- Sulphur dioxide (SO_2);
- Nitrogen dioxide (NO_2);
- Carbon monoxide (CO);
- Ozone (O_3);
- Ammonia (NH_3);
- Lead (Pb);
- Benzo(a) pyrene (BaP) in particulate phase;
- Arsenic (As);
- Mercury (Hg);
- Nickel (Ni);
- Benzene (C_6H_6);
- Volatile Organic Carbon (VOC); and
- Hydro Carbon (HC).

3.7.2.1 Sampling and Analytical Techniques

Particulate Matter (PM_{10})

Respirable dust samplers APM-460 BL attached with APM-151 instruments have been used for sampling of respirable dust (<10 microns) and gaseous pollutants like SO_2 and NO_2.

PM_{10} (<10μ) present in ambient air is drawn through the cyclone. Coarse and non-respirable dust (>10μ) is separated from the air stream by centrifugal forces acting on the solid particles. These separated particulates fall through the cyclone's conical hopper and collect in the sampling cup placed at the bottom of the cyclone. The fine dust (<10 microns) forming the respirable fraction passes through the cyclone and is retained by the filter paper.

A tapping is provided on the suction side of the blower to provide suction for sampling air through a set of impingers. Samples of gases are drawn at a flow rate of 0.2 litres per minute (lpm). The air samples were analysed as per standard methods specified in IS: 5182.

Particulate Matter ($PM_{2.5}$)

APM 550 Fine Particulate Sampler ($PM_{2.5}$) attached with impactor have been used for sampling of fine particulate (<2.5 microns).

An electrically powered air sampler draws ambient air at a constant volumetric flow rate (16.7 lpm) maintained by a mass flow/ volumetric flow controller coupled to a microprocessor into specially designed inertial particle-size separator (i.e., cyclones or impactors) where the suspended particulate matter in the $PM_{2.5}$ size ranges is separated for collection on a 47 mm polytetrafluoroethylene (PTFE) filter over a specified sampling period. Each filter is pre-weighed (after conditioning) and post-weighted after sampling to determine the difference of weight due to the particulate matter.

- ***Duration of Sampling***

The sampling duration for PM_{10}, $PM_{2.5}$, SO_2 and NO_2 is twenty-four hourly continuous samples per day and CO and O_3 are sampled for 8 hours continuously thrice a day. This is to allow a comparison with the present revised standards mentioned in the latest Gazette Notification of the Central Pollution Control Board (CPCB) (November 2009).

3.7.2.2 Method of Analysis

The air samples were analyzed as per standard methods specified by Central Pollution Control Board (CPCB), IS: 5182 and American Public Health Association (APHA).

3.7.2.3 Instruments used for Sampling.

Dust samplers were used for monitoring PM_{10} (<10 microns), $PM_{2.5}$ and gaseous pollutants like SO_2, NO_2, NH_3& O_3 were collected through wet chemical absorbing reagents in gaseous attachment. NDIR Spectroscopy have been used for the estimation of CO.

3.7.2.4 Sampling and Analytical Techniques

The techniques used for ambient air quality monitoring and limit for minimum detectable levels are given in **Table-3.7.2.**

3.7.2.5 Duration of Sampling

$PM_{2.5}$ and PM_{10} have been estimated by gravimetric method. Modified West and Gaeke method (IS-5182 Part-II, 1969) has been adopted for estimation of SO_2. Jacobs-Hochheiser method (IS-5182 Part-IV, 1975) has been adopted for the estimation of NO_2. The ambient air quality parameters along with their frequency of sampling are given in **Table-3.7.3.**

TABLE-3.7.2
TECHNIQUES USED FOR AMBIENT AIR QUALITY MONITORING

Sr. No.	Parameters	Techniques	Technical Protocol	Minimum Detection Limit ($\mu g/m^3$)
1	$PM_{2.5}$	Fine dust sampler (Gravimetric method)	IS-5182 (Part-IV)	10.0
2	PM_{10}	Fine dust sampler (Gravimetric method)	IS-5182 (Part-IV)	5.0
3	Sulphur dioxide	Improved West and Gaeke method	IS-5182 (Part-II)	4.0
4	Nitrogen dioxide	Jacob & Hochheiser	IS-5182 (Part-VI)	10.0
5	Carbon monoxide	FID technique (Gas chromatography)	IS-5182(Part-X)	50
6	Ozone	UV-Vis Spectroscopic Analysis	ASTM-D	2.0
7	Ammonia	UV-Vis Spectrophotometry	ASTM-D	10.0
8	Benzene	GC-MS/GC	IS-5182	1.0
9	Benzo (O) Pyrene	GC-MS/GC	IS-5182	0.1 ng/m^3
10	Arsenic	ICP-MS	IS-5182	0.001
11	Nickel	ICP-MS	IS-5182	0.001
12	Lead	ICP-MS	IS-5182	0.1
13	VOC	Thermal desorption Capillary C/MS Analytical Procedure	EPA TO-17	0.1 (ppm)
14	HC	GC-MS	IS-5182 (Part-XVII)	0.1 (ppm)

TABLE-3.7.3
MONITORED PARAMETERS AND FREQUENCY OF SAMPLING

Parameters	Sampling Frequency
Particulate matter (PM_{10})	24 hourly sample twice a week for three months
Particulate matter ($PM_{2.5}$)	24 hourly sample twice a week for three months
Sulphur dioxide (SO_2)	24 hourly samples twice a week for three months
Nitrogen dioxide (NO_2)	24 hourly samples twice a week for three months
Carbon monoxide (CO)	8 hourly samples for 24 hours twice a week for three months
Ozone (O_3)	8 hourly samples for 24 hours twice a week for three months
Ammonia, NH_3	24 hourly sample twice a week for three months
Benzene, C_6H_6	24 hourly sample twice a week for three months
Benzo(a)pyrene (BaP)	24 hourly samples twice a week for three months
Arsenic (As)	24 hourly sample twice a week for three months
Nickel (Ni)	24 hourly sample twice a week for three months
Lead (Pb)	24 hourly sample twice a week for three months

3.7.2.6 Sampling Results

The sampling and analysis results are given in **Table-3.7.4. (A&B)**

TABLE-3.7.4 (A)
ANALYSIS RESULTS OF AMBIENT AIR QUALITY MONITORING

Sr No.	Location	PM_{10} (µg/m³)				$PM_{2.5}$ (µg/m³)				SO_2 (µg/m³)				NO_2 (µg/m³)			
		Min	Max	Avg	98%	Min	Max	Avg	98%	Min	Max	Avg	98%	Min	Max	Avg	98%
AAQ1	Site office	56.8	68.4	63.2	68.3	21.6	26.0	24.0	26.0	12.3	14.1	13.3	14.1	22.9	26.2	24.6	26.2
AAQ2	CIDCO office, Panvel	60.6	74.4	67.4	73.6	22.5	31.2	26.3	30.7	11.7	14.5	13.3	14.5	22.0	27.3	24.8	27.2
AAQ3	Ulwe, Sector-5	58.1	71.2	65.4	71.1	21.7	27.2	24.8	27.2	11.9	15.1	13.5	14.9	21.7	27.3	24.8	27.3
AAQ4	Gavan Phata water tank	62.8	73.2	67.3	72.8	24.2	29.0	26.1	28.4	11.6	14.7	13.2	14.6	21.6	26.8	24.4	26.8
AAQ5	CIDCO Branch office, Sector-5 (Kalamboli)	62.7	73.3	69.0	73.1	24.5	32.5	27.3	31.9	11.4	14.8	13.5	14.8	21.3	27.5	25.1	27.5
AAQ6	CIDCO Bhavan, CBD Belapur, Sector-10	58.0	72.2	66.1	72.0	22.6	28.2	25.6	28.1	11.7	14.0	12.9	13.9	21.8	26.0	23.8	25.9
AAQ7	Pargaon high school	56.3	67.9	62.1	67.8	21.9	26.7	24.1	26.6	10.9	13.7	12.3	13.7	20.4	25.6	22.9	25.6
AAQ8	CIDCO Office, Kharghar, Sector-4	56.7	72.8	65.8	72.4	21.5	27.7	24.8	27.4	11.3	14.2	12.8	14.2	21.0	26.8	23.8	26.6
AAQ9	CIDCO guest house	62.5	73.0	67.8	72.7	23.4	27.7	25.7	27.6	12.1	14.4	13.3	14.3	22.5	26.9	24.8	26.8
AAQ10	Shirdhon	57.3	68.2	63.1	68.2	21.8	26.0	23.9	26.0	11.5	14.1	13.2	14.1	21.4	26.2	24.3	26.2
AAQ11	Herdilia IT Park in TTC Industrial Area	58.6	71.0	65.0	70.9	22.0	27.4	24.6	27.1	12.0	14.2	13.1	14.2	22.3	26.4	24.4	26.4
AAQ12	Panvel market yard	57.1	72.8	64.0	71.9	21.6	28.2	24.3	27.6	11.4	14.3	13.0	13.3	21.3	27.6	24.3	27.2
Range		**56.3-74.4**				**21.5-32.5**				**10.9-15.1**				**20.4-27.6**			
NAAQ Standards		**100**				**60**				**80**				**80**			

Sr No.	Location	CO (µg/m³)				O_3 (µg/m³)				Ammonia (µg/m³)			
		Min	Max	Avg	98%	Min	Max	Avg	98%	Min	Max	Avg	98%
1	Site office	150	340	250	330	<2.0	<2.0	<2.0	<2.0	14.8	22.5	18.9	22.4
2	CIDCO office, Panvel	210	430	310	430	<2.0	<2.0	<2.0	<2.0	14.6	21.4	17.6	21.0
3	Ulwe, Sector-5	170	360	260	360	<2.0	<2.0	<2.0	<2.0	14.7	20.5	17.9	20.3
4	Gavan Phata water tank	180	420	270	420	<2.0	<2.0	<2.0	<2.0	13.7	22.5	16.6	21.7
5	CIDCO Branch office, Sector-5 (Kalamboli)	180	430	320	430	<2.0	<2.0	<2.0	<2.0	14.2	23.5	18.8	22.7
6	CIDCO Bhavan, CBD Belapur, Sector-10	170	430	280	430	<2.0	<2.0	<2.0	<2.0	15.7	23.0	19.7	22.9
7	Pargaon High school	150	310	220	310	<2.0	<2.0	<2.0	<2.0	14.5	21.7	18.1	21.7
8	CIDCO Office, Kharghar, Sector-4	160	420	290	420	<2.0	<2.0	<2.0	<2.0	13.1	22.5	17.9	21.7
9	CIDCO guest house	170	420	270	400	<2.0	<2.0	<2.0	<2.0	15.6	22.7	19.4	22.7
10	Shirdhon	170	350	250	350	<2.0	<2.0	<2.0	<2.0	14.1	21.4	18.0	21.4

Sr No.	Location	CO (µg/m³)				O_3 (µg/m³)				Ammonia (µg/m³)			
		Min	Max	Avg	98%	Min	Max	Avg	98%	Min	Max	Avg	98%
11	Herdilia IT Park in TTC Industrial Area	150	400	240	390	<2.0	<2.0	<2.0	<2.0	15.1	22.5	19.2	22.5
12	Panvel market yard	160	370	280	370	<2.0	<2.0	<2.0	<2.0	13.8	23.5	18.6	23.1
	Range	**150-430**				<2.0				**13.1-23.5**			
NAAQ Standards		**2000**				**100**				**400**			

TABLE-3.7.4 (B)
ANALYSIS RESULTS OF AMBIENT AIR QUALITY MONITORING

Sr No.	Location	Benzene (µg/m³)	B(a)P (ng/m³)	As (ng/m³)	Pb (µg/m³)	Ni (ng/m³)
1	Site office	<1.0	<0.1	<1.0	<0.1	<1.0
2	CIDCO office, Panvel	<1.0	<0.1	<1.0	<0.1	<1.0
3	Ulwe, Sector-5	<1.0	<0.1	<1.0	<0.1	<1.0
4	Gavan Phata water tank	<1.0	<0.1	<1.0	<0.1	<1.0
5	CIDCO Branch office, Sector-5 (Kalamboli)	<1.0	<0.1	<1.0	<0.1	<1.0
6	CIDCO Bhavan, CBD Belapur, Sector-10	<1.0	<0.1	<1.0	<0.1	<1.0
7	Pargaon high school	<1.0	<0.1	<1.0	<0.1	<1.0
8	CIDCO Office, Kharghar, Sector-4	<1.0	<0.1	<1.0	<0.1	<1.0
9	CIDCO guest house	<1.0	<0.1	<1.0	<0.1	<1.0
10	Shirdhon	<1.0	<0.1	<1.0	<0.1	<1.0
11	Herdilia IT Park in TTC Industrial Area	<1.0	<0.1	<1.0	<0.1	<1.0
12	Panvel market yard	<1.0	<0.1	<1.0	<0.1	<1.0
Range		<1.0	<0.1	<1.0	<0.1	<1.0
NAAQ Standards		**5.0**	**1.0**	**6.0**	**1.0**	**20.0**

3.7.3 Observation of Air Quality Results

The minimum and maximum concentration for PM_{10} were recorded as 56.3μg/m^3 and 74.4 μg/m^3 respectively. The minimum and maximum concentration was recorded at Pargaon high school (AAQ7) and CIDCO office (AAQ2) respectively.

The minimum and maximum concentration for $PM_{2.5}$ were recorded as 21.5 μg/m^3 and 32.5 μg/m^3 respectively. The minimum and maximum concentration was recorded at CIDCO Office, Kharghar, Sector-4(AAQ8) and CIDCO Branch office, Sector-5 (Kalamboli)(AAQ5) respectively.

The minimum and maximum SO_2 concentration were recorded as 10.9μg/m^3 and 15.1μg/m^3. The minimum and maximum concentration was recorded at Paragaon High school (AAQ7) and Ulwe Sector-3 (AAQ3) respectively.

The minimum and maximum NO_2 concentration were recorded as 20.4μg/m^3 and 27.6μg/m^3. The minimum and maximum concentration was recorded atParagoan High School (AAQ7) and Panvel market yard (AAQ12) respectively.

The minimum and maximum CO concentration were recorded as 150μg/m^3 and 430μg/m^3. The minimum and maximum concentration was recorded at site office (AAQ1), Pargaon high school (AAQ7), Herdilia IT Park in TTC Industrial Area (AAQ11) and CIDCO office Panvel (AAQ2), CIDCO branch office, Sector-5 (Kalamboli) (AAQ5), CIDCO Bhavan, CBD Belapur, Sector-10 (AAQ6).

The concentrations of $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3, CO, NH_3, Pb, BaP, As, Ni and C_6H_6, are observed to be well within the NAAQ standards prescribed by Central Pollution Control Board (CPCB) for industrial and rural /residential zone. The values of VOC and HC are observed to be <0.1 ppm in the study area.

3.8 Noise Level Survey

The physical description of sound concerns its loudness as a function of frequency. Noise in general is sound which is composed of many frequency components of various types of loudness distributed over the audible frequency range. Various noise scales have been introduced to describe, in a single number, the response of an average human to a complex sound made up of various frequencies at different loudness levels. The most common and universally accepted scale is the A weighted Scale which is measured as dB (A). This is more suitable for audible range of 20 to 20,000 Hz. The scale has been designed to weigh various components of noise according to the response of a human ear.

The impact of noise sources on surrounding community depends on:

- Characteristics of noise sources (instantaneous, intermittent, or continuous in nature). It can be observed that steady noise is not as annoying as one which is continuously varying in loudness.

- The time of day at which noise occurs, for example high noise levels at night in residential areas are not acceptable because of sleep disturbance; and
- The location of the noise source, with respect to noise sensitive land use, which determines the loudness and period of exposure.

The environmental impact of noise can have several effects varying from Noise Induced Hearing Loss (NIHL) to annoyance depending on loudness of noise. The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the total noise generated by the Airport operations around it.

3.8.1 Identification of Sampling Locations

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. Noise at different noise generating sources has been identified based on the activities in the village area, ambient noise due to traffic and the noise at sensitive areas like hospitals and schools.

The noise monitoring has been conducted for determination of noise levels at thirteen locations in the study area. The environment setting of each noise monitoring location is given in **Table-3.8.1** and shown in **Figure-3.8.1**.

TABLE-3.8.1
DETAILS OF NOISE MONITORING LOCATIONS

Monitoring Station	Noise Monitoring Locations	Distance (km)	Direction	Environmental Setting
N1	Site office (Project Site)	-	-	Industrial
N2	Near CIDCO Office, Panvel *(Funnel Zone)*	2.6	E	Commercial
N3	Ulwe, Sector-5 *(Funnel Zone)*	1.3	W	Residential
N4	Gavan Phata water tank	2.2	SW	Residential
N5	CIDCO branch office, Sector-5 (Kalamboli)	3.9	NE	Residential
N6	CIDCO Bhavan, CBD Belapur, Sector-10	2.4	NNW	Commercial
N7	Pargaon high school	0.3	S	Silence
N8	CIDCO office, Kharghar, Sector-4	3.2	N	Residntial
N9	CIDCO Guesthouse, Kille Gaothan	0.9	NW	Residential
N10	Shirdhon	7.5	SE	Residential
N11	Herdilia IT Park in TTC Industrial area	5.8	NNW	Industrial
N12	Panvel market yard *(Funnel Zone)*	3.7	SE	Commercial
N13	Near Karnala bird sanctuary	10.0	SSE	Residential

FIGURE-3.8.1
NOISE MONITORING LOCATIONS MAP

3.8.2 Methodology of Data Generation

3.8.2.1 Instrument Used for Monitoring

Noise levels were measured using integrated sound level meter manufactured by Quest Technologies, USA (Model No.2900). The integrating sound level meter is an integrating/logging type with frequency range of 31.5 to 16000 Hz. This instrument is capable of measuring the Sound Pressure Level (SPL), L_{eq}.

3.8.2.2 Method of Monitoring

Noise level monitoring was carried out continuously for 24 hours with one-hour interval starting at 06:00 hrs to 06:00 hrs next day. During each hour, L_{eq} were directly computed by the instrument based on the sound pressure levels. Lday (L_d), Lnight (L_n) and Ldn values were computed using corresponding hourly L_{eq} of day and night respectively.

3.8.2.3 Parameters Measured During Monitoring

For noise levels measured over a given period of time, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time certain noise levels are exceeding the time interval. The notation for calculation of L_{eq} is described below:

Day-Night Sound Level (L_{dn}):

The noise rating developed for community noise from all sources is the Day-Night Sound Level (L_{dn}). It is similar to a 24 hr equivalent sound level except that during nighttime period (10 pm to 6 am) a 10 dB (A) weighting penalty is added to the instantaneous sound level before computing the 24 hr average.

This nighttime penalty is added to account for the fact that the noise during night, when people are usually in sleep, is judged as more annoying than the same noise during the day time.

The L_{dn} for a given location in a community may be calculated from the hourly L_{eq}'s, by the following equation.

$$L_{dn} = 10 \log\{1/24[16(10^{L_d/10}) + 8(10^{(L_n+10)/10})]\}$$

Where L_d is the equivalent sound level during the daytime (6 am to 10 pm) and L_n is the equivalent sound level during the nighttime (10 pm to 6 am).

3.8.3 Noise Monitoring Analysis

The statistical analysis is done for measured noise levels at thirteen locations during winter season from 1stDecember 2019 to 29thFebruary 2020. The parameters are analyzed for L_{day}, L_{night}, and L_{dn}. These results are tabulated in **Table-3.8.2.**

3.8.4 Method of Noise Monitoring

Sound Pressure Level (SPL) measurements were recorded at all locations. The readings were taken for every hour for 24 hours. The day noise levels have been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all the locations covered in 10 km study area.

TABLE-3.8.2
NOISE MONITORING RESULTS OF STUDY AREA

Location No.	Noise Monitoring Locations	Day Time L_{eq} [dB(A)]	Nighttime L_{eq} [dB(A)]	Day-Night Sound Level (L_{dn})	Environmental Setting
N1	Site office [Project Site]	59.2	53.7	61.5	Industrial
N2	Near CIDCO Office, Panvel [Funnel Zone]	59.1	53.0	61.0	Commercial
N3	Ulwe, Sector-5 [Funnel Zone]	58.8	53.0	60.9	Residential
N4	Gavan Phata water tank	63.3	51.6	62.7	Residential
N5	CIDCO branch office, Sector-5 (Kalamboli)	60.7	53.0	61.7	Residential
N6	CIDCO Bhavan, CBD Belapur, Sector-10	64.0	52.7	63.6	Commercial
N7	Pargaon high school	51.9	43.8	52.7	Silence
N8	CIDCO office, Kharghar, Sector-4	62.8	54.1	63.6	Residntial
N9	CIDCO Guesthouse, Kille Gaothan	58.6	48.8	58.7	Residential
N10	Shirdhon	53.6	42.6	53.3	Residential
N11	Herdilia IT Park in TTC Industrial area	64.4	59.2	66.8	Industrial
N12	Panvel market yard [Funnel Zone]	63.1	52.2	62.8	Commercial
N13	Near Karnala bird sanctuary	50.2	44.2	52.2	Residential

Ambient Noise Standards			
Noise Pollution (Regulation and Control) Rules, 2006			
Area Code	**Category of Area**	**Noise Levels (dB (A) Leq (Limits)**	
		Day time	**Night time**
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	50	40

Source : Ambient Noise Standards of CPCB

3.8.5 Observation of Results

a) Day time Noise Levels (L_{day})

Industrial Zone

The daytime noise levels were recorded at two industrial locations, i.e., N1 (project site) and N11 (Herdilia IT Park in TTC Industrial Area). The equivalent daytime noise levels were observed to be in the range of 59.2 dB (A) to 64.4 dB (A) at the time of monitoring. The minimum equivalent noise level was observed near project office (N1) and maximum noise level is observed at N11 (Herdilia IT Park in TTC Industrial Area). The daytime noise levels were observed to be within permissible limits at the time of monitoring.

During daytime higher noise levels may be expected at the construction site of the airport. The workers accessing the project site are advised to use personal protective equipment like earmuffs/ear plugs for noise attenuation.

Commercial Zone

The equivalent day time noise levels within the noise monitoring locations near commercial areas monitored near 3 locations viz., near CIDCO office at Panvel (N2), near CIDCO Bhavan at Sector-10 in CBD Belapur (N6) and near Panvel Market yard in Panvel (N12). The locations are choosen to understand the status of basline noise levels at commercial locations in the vicinity of the project site. Also, the locations N2 and N12 falling with NMIA funnel zone are specifically choosen to represent the baseline noise levels and later assess the impact due to aircraft movements in these areas.

The noise levels thus recorded was found to be in the range of 59.1 dB (A) to 64.0 dB (A). The minimum equivalent daytime noise level was recorded near CIDCO Guesthouse office, Panvel (N2) and the maximum noise level was recoded near CIDCO Bhavan at CBD Belapur, Sector-10 (N6). It is observed that the equivalent daytime noise levels are within the permissible limits at all commercial locations.

Residential Zone

The equivalent day time noise levels within the noise monitoring locations near residential areas were monitored near 7 locations viz., Ulwe sector 5 (N3), Gavan Phata water tank (N4), CIDCO Branch Office at Kalamboli (N5), CIDCO office at Khargar in Sector-4 (N8), CIDCO Guest House Kille Gavthan (N9), Shirdhon(N10) and near Karnala Bird Sanctuary (N13). The locations are choosen to understand the status of basline noise levels in the nearby residential communities in the vicinity of the project site. Also, the locations N3 is falling with NMIA funnel zone are specifically choosen to represent the baseline noise levels and later assess the impact of aircraft movements in these areas.

The noise levels thus found out to be in the range of 50.2 dB (A) to 63.3 dB (A).The maximum equivalent day time noise levels were observed to be 63.3 dB (A) at the residential area near Gavan Phata water tank (N4) and the minimum was observed to be 50.2 dB (A) near Karnala bird sanctuary (N13) The day time noise levels were found to was found to be exceding 55dB (A) at location N3, N4, N5, N8 and N9. This may be attributed to the proximity to the nearby roads bearing heavy traffic movement.

Silence Zone

The equivalent day time noise levels were observed to be 51.9 dB (A) near Pargaon High school (N7). The daytime noise levels were found have slightly exceeded the permissible limit of 50 dB (A) near silence zone. This may be attributed to the proximity to the nearby highway bearing heavy traffic movement.

b) Night Noise Levels (L_{night})

Industrial Zone

The nighttime noise levels were recorded at two industrial locations, i.e., N1 (project site) and N11 (Herdilia IT Park in TTC Industrial Area). The equivalent daytime noise levels were observed to be in the range of 53.7 dB (A) to 59.2 dB (A) at the time of monitoring. The minimum equivalent noise level was observed near project office (N1) and maximum noise level is observed at N11 (Herdilia IT Park in TTC Industrial Area). The nighttime noise levels were observed to be within permissible limits at the time of monitoring.

Commercial Zone

The equivalent nighttime noise levels within the noise monitoring locations near commercial areas monitored near 3 locations viz., near CIDCO office at Panvel (N2), near CIDCO Bhavan at Sector-10 in CBD Belapur (N6) and near Panvel Market yard in Panvel (N12). The locations are choosen to understand the status of basline noise levels at commercial locations in the vicinity of the project site. Also, the locations N2 and N12 falling with NMIA funnel zone are specifically choosen to represent the baseline noise levels and later assess the impact due to aircraft movements in these areas.

The noise levels thus recorded was found to be in the range of 52.2 dB (A) to 53.0 dB (A). The minimum equivalent nighttime noise level was recorded near CIDCO office, Panvel (N2) and the maximum noise level was recoded near CIDCO Bhavan at CBD Belapur, Sector-10 (N6). It is observed that the equivalent night noise levels are within the permissible limits at all commercial locations.

Residential Zone

The equivalent nighttime noise levels within the noise monitoring locations near residential areas were monitored near 7 locations viz., Ulwe sector 5 (N3), Gavan Phata water tank (N4), CIDCO Branch Office at Kalamboli (N5), CIDCO office at Khargar in Sector-4 (N8), CIDCO Guest House Kille Gavthan (N9), Shirdhon (N10) and near Karnala Bird Sanctuary (N13). The locations are choosen to understand the status of basline noise levels in the nearby residential communities in the vicinity of the project site. Also, the locations N3 is falling with NMIA funnel zone are specifically choosen to represent the baseline noise levels and later assess the impact of aircraft movements in these areas.

The noise levels thus were found in the range of 42.6 dB (A) to 54.1 dB (A). The maximum equivalent day time noise levels were observed near CIDCO Office, Khargar (N8) and the minimum noise levels were observed near Sirdhon (N10). The nighttime noise levels were found to was found to be exceding 45 dB (A) at location N3, N4, N5, N8 and N9. This may be attributed to the proximity to the nearby roads bearing heavy traffic movement.

Silence Zone

The equivalent nighttime noise levels were observed to be 43.8 dB(A) near Pargaon High school (N7). The daytime noise levels were found have slightly exceeded the permissible limit of 40 dB (A) near silence zone. This may be attributed to the proximity to the nearby highway bearing heavy traffic movement.

3.9 Water Environment

Selected water quality parameters of surface and ground water resources in the study area have been studied for assessing the water environment and evaluate anticipated impact of the airport project. Understanding the water quality is essential in preparation of environmental impact assessment and to identify critical issues with a view to suggest appropriate mitigation measures for implementation.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters.
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict impact on water quality by this project and related activities.

The information required has been collected through primary surveys and secondary sources.

3.9.1 Surface Water Sampling

- *Existing Surface Water Quality Details*

During the field survey, few ponds were observed within the study area i.e., in village Bambavi on south-west, Khalcha Owale and at Pargaon at south east. Number of stream and nallahs also flow downhill and join the Thane and Panvel creek, which forms wetland comprising mangroves and other vegetation depending upon soil cover and supports vivid avifauna. Fishing was observed near Thane and Panvel creek and few of the freshwater streams which merge into these creeks.

The study area includes water bodies - Panvel creek and some part of Thane creek on the northwest side; Taloja, Kasadi, rivers on the north and north-west, Ulwe River (thru Recourse Channel) on south of airprot, respectively. Gadhi and Kalundri rivers flow along the Southeastern (SE) side of the project site and merges into Panvel creek. Ulwe River (thru Recourse Channel) is located on south of airprot.

Some creeklets were noticed on west side of project site. The drainage area of Panvel creek includes four main river basinsas described below:

Gadhi River: Gadhi River is the main river of Panvel creek originating on western side of Matheran hill ranges at an altitude of 400 m. It joins the river Morbe, a major tributary at about 12 km from origin. The independent catchment of Gadhi River upto Kalundri junction is about 123 sq.km. Between Kalundri confluence and Vaghiwali island, an additional catchment of about 30 sq.km. Tidal effect reaches some distance upstream of NH-4 bridge on Gadhi, Kalundri, Kasadi and Taloja River.

Kalundri River: This is one of the major tributaries of Gadhi River. The total independent catchment area upto Gadhi junction is about 95 sq.km.

Kasadi-Taloja River: Kasadi is the main river in this valley originating at an altitude of 600 m. It flows for a distance of 18 km till it joins Taloja river, the main tributary. The independent catchment area of Kasadi and Taloja basin upto confluence is 60 sq.km and 80 sq.km respectively.

Ulwe River: Before diversion, Ulwe River had a catchment of about 35sq. km to the south of Vaghiwali island. The Ulwe River diversion channel starting at about 200 m downstream of SH-54 bridge and ending at Amara Marg to join Moha creek, has been completed by CIDCO as per previous EC & CRZ clearance granted by MOEFCC.

Recoursing of Ulwe River

Recoursing of Ulwe River by CIDCO has been an important part of the airport development work, which is crucial for the hydrology of the study area. Earlier the Ulwe River flowed in north-south direction, dissecting the proposed west to east runways at right angle. This rivulet is now diverted in east to west direction along and outside south boundary of the airport site, as part of the Pre-Development Works of NMIA.

3.9.2 Analysis Methodology

Reconnaissance survey was undertaken, and monitoring locations were finalized based on:

- Drainage pattern.
- Location of residential areas representing different activities/likely impact areas.
- Likely areas, which can represent baseline conditions.

Eight surface water and eight ground water sources in the study area were examined for physico-chemical, heavy metals and bacteriological parameters to assess the effect of industrial activities and other activities on surface and ground water. The samples were analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA).

Samples for chemical analysis were collected in polyethylene carboys. Samples collected for metal content were acidified with 1ml HNO_3. Samples for bacteriological analysis were collected in sterilized glass bottles. Selected physico-chemical and bacteriological parameters have been analyzed for projecting the existing water quality status in the study area. Parameters like temperature, dissolved oxygen (DO) and pH were analyzed at the time of sample collection.

In addition to the above, water quality of Panvel Creek, Thane Creek and Kasadi River were separteley analyzed and data presented along with the baseline status of marine environment.

The methodology for sample collection and preservation techniques was followed as per the Standard Operating Procedures (SOP) mentioned in **Table-3.9.1**.

TABLE-3.9.1
STANDARD OPERATING PROCEDURES (SOP) FOR WATER SAMPLING AND ANALYSIS

Parameter	Sample Collection	Sample Size	Storage/ Preservation
pH	Grab sampling Plastic /glass container	50 ml	On site analysis
Electrical conductivity	Grab sampling Plastic /glass container	50 ml	On site parameter
Total suspended solids	Grab sampling Plastic /glass container	100 ml	Refrigeration, can be stored for 7 days
Total dissolved solids	Grab sampling Plastic /glass container	100 ml	Refrigeration, can be stored for 7 days
BOD	Grab sampling Plastic /glass container	500 ml	Refrigeration, 48 hrs
Hardness	Grab sampling Plastic /glass container	100 ml	Add HNO_3 to pH<2, refrigeration; 6 months
Chlorides	Grab sampling Plastic /glass container	50 ml	Not required; 28 days
Sulphates	Grab sampling Plastic /glass container	100 ml	Refrigeration; 28 days
Sodium, Potassium	Plastic container	100 ml	Not required; 6 months
Nitrates	Plastic containers	100 ml	Refrigeration; 48 hrs
Fluorides	Plastic containers only	100 ml	Not required; 28 days
Alkalinity	Plastic/ glass containers	100 ml	Refrigeration; 14 days
Ammonia	Plastic/ glass containers	100 ml	Add H_2SO_4 to pH>2, refrigeration, 28 days
Hexavalent Chromium, Cr^{+6}	Plastic/ glass rinse with 1+1 HNO_3	100 ml	Grab sample; refrigeration; 24 hrs
Heavy metals (Hg, Cd, Cr, Cu, Fe, Zn, Pb etc.)	Plastic/ glass rinse with 1+1 HNO_3	500 ml	Filter, add HNO_3 to pH>2; grab sample; 6 months

Source: Standard Methods for the Examination of Water and Wastewater, Published By APHA, AWWA, WEF 19th Edition, 1995

Analytical Techniques

The sampling and analytical techniques are given in **Table–3.9.2.**

TABLE-3.9.2
ANALYTICAL TECHNIQUES FOR WATER SAMPLING AND ANALYSIS

Parameter	Method
pH	APHA-4500-H^+
Colour	APHA-2120 C
Odour	IS: 3025, Part-4
Temperature	APHA-2550 B
Dissolved oxygen	APHA-4500 O
BOD	APHA-5210 B
Electrical conductivity	APHA-2510 B
Turbidity	APHA-2130 B
Chlorides	APHA-4500 Cl^-
Fluorides	APHA-4500 F^-
Total dissolved solids	APHA-2540 C
Total suspended solids	APHA-2540 D
Total hardness	APHA-2340 C
Sulphates	APHA-4500 SO_4^{-2}
Arsenic	APHA-3120 B/ APHA-3114 B/ APHA-3500 As
Calcium	APHA-3120 B/ APHA-3500 Ca
Magnesium	APHA-3120 B/ APHA-3500 Mg
Sodium	APHA-3120 B/ APHA-3500 Na
Potassium	APHA-3120 B/ APHA-3500 K
Manganese	APHA-3120 B/ APHA-3500 Mn
Mercury	APHA-3112 B/ APHA-3500 Hg
Selenium	APHA-3120 B/ APHA-3114 B/ APHA-3500 Se
Lead	APHA-3120 B/ APHA-3500 Pb
Copper	APHA-3120 B/ APHA-3500 Cu
Cadmium	APHA-3120 B/ APHA-3500 Cd
Iron	APHA-3120 B/ APHA-3500 Fe
Zinc	APHA-3120 B/ APHA-3500 Zn
Boron	APHA-4500 B
Coliform organisms	APHA-9215 D
Alkalinity	APHA-2320 B

3.9.3 Description of Surface Sampling Locations

The sampling sites are selected for upstream of Ulwe River, Kurki River, Malang River and Kalundre River (SW1, SW3, SW5, SW8). Other surface water samples were collected from pond water of respective villages (SW2, SW4, SW6, and SW7). Domestic activities are observed in pond water of respective villages (SW2, SW4, SW6).

The surface water quality samples were collected from eight locations as part of the baseline studies during winter. The surface water sampling locations are listed below in **Table-3.9.3** and the result of analysis is shown in **Table-3.9.4.** The study area map showing surface water sampling locations is given in **Figure-3.9.1.**

TABLE-3.9.3
SURFACE WATER SAMPLINGLOCATIONS

Sampling Locations	Surface Water Sampling Locations	Distance (km)	Direction
SW1	River water - Upstream Ulwe River	1.3	S
SW2	Pond water – near HOC colony	1.8	E
SW3	River water - Upstream Kurki River – Near Karanjade	3.8	SE
SW4	Pond water – Chikhale village	6.9	ESE
SW5	River water - Upstream Kalundre River – Near Akurli village	6.3	NE
SW6	Pond water – Near Kanthavali village	9.2	S
SW7	Pond water – Turbhe village	8.25	NNW
SW8	River water – Baba Malang River –Near Taloja sector 11	8.2	NNE

FIGURE-3.9.1
SURFACE WATER SAMPLING LOCATIONS MAP

TABLE-3.9.4
RESULT OF SURFACE WATER QUALITY ANALYSIS

Sr. No.	Parameters	UoM	Results								Tolerance Limits for Inland Surface Waters (IS 2296-1982)				
			SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	Class-A	Class-B	Class-C	Class-D	Class-E
1	pH	-	6.68	7.14	6.88	6.92	6.82	6.95	7.05	6.76	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
2	Dissolved Oxygen (DO)	mg/l	6.2	5.8	6.3	5.6	6.3	5.8	5.4	6.2	6.0	5.0	4.0	4.0	--
3	BOD @20°C 5days ($BOD_{5\ Day}$)	mg/l	8	16	6.8	12	4.8	10	12	6.2	2.0	3.0	3.0	--	--
4	Colour, Hazen	Hazen	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10	300	300	--	--
5	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Unobjec-tionable	--	--	--	--
6	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agree-able	--	--	--	--
7	Total Dissolved Solids (TDS)	mg/l	251	263	289	327	292	311	302	345	500	--	1500	--	2100
8	Hardness as $CaCO_3$	mg/l	176	185	209	222	236	198	212	267	300	--	--	--	--
9	Calcium (Ca)	mg/l	37.8	38.4	44.1	46.3	47.6	39.7	41.3	52.7	200	--	--	--	--
10	Magnesium (Mg)	mg/l	19.8	21.6	24	25.8	28.5	23.9	26.4	32.8	100	--	--	--	--
11	Copper (Cu)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.5	--	1.5	--	--
12	Iron (Fe)	mg/l	0.08	0.12	0.038	0.16	0.041	0.046	0.042	0.033	0.3	--	50	--	--
13	Manganese (Mn)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.5	--	--	--	--
14	Chlorides as (Cl^-)	mg/l	36.5	29.6	41.7	50.6	39.5	55.2	52.1	48.5	250	--	600	--	600
15	Sulphate as (SO_4^{2-})	mg/l	9.7	10.6	12.3	10.8	8.6	11.7	14.76	9.7	400	--	400	--	1000
16	Nitrates (NO_3^-)	mg/l	1.9	2.3	1.2	3.6	1	0.8	1.6	0.7	20	--	50	--	--
17	Fluorides as (F^-)	mg/l	0.8	0.5	0.9	0.6	0.8	0.7	0.38	0.8	1.5	1.5	1.5	--	--
18	Phenolic Compound	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.002	0.005	0.005	--	--
19	Mercury (Hg)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	--	--	--	--
20	Cadmium (Cd)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	--	0.01	--	--
21	Selenium (Se)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	--	0.05	--	--
22	Arsenic (As)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.2	0.2	--	--
23	Cyanides (CN^-)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.05	0.05	--	--
24	Lead (Pb)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.1	--	0.1	--	--
25	Zinc (Zn)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15	--	15	--	--

Sr. No.	Parameters	UoM	Results								Tolerance Limits for Inland Surface Waters (IS 2296-1982)				
			SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	Class-A	Class-B	Class-C	Class-D	Class-E
26	Hexavalent Chromium (Cr^{6+})	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.05	1.0	0.05	--	--
27	Anionic detergents	mg/l	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.2	1.0	1.0	--	--
28	Ploy-Aromatic Hydrocarbons (PAH)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.2	--	--	--	--
29	Mineral oil	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.01	--	--	--	--
30	Barium (Ba)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.0	--	--	--	--
31	Silver (Ag)	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.05	--	--	--	--
32	Pesticides	µg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absen t	--	--	--	--
33	Insecticides	mg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--	--	Absent	--	--
34	Oil & Grease	mg/l	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	--	--	0.1	0.1	--
35	Free Ammonia as N	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	1.2	--
36	Sodium Adsorption Ratio (%)	%	2.71	4.19	2.78	3.36	2.04	3.92	3.87	1.56	--	--	--	--	26
37	Alkalinity	mg/l	162	176	198	210	205	189	195	239					
38	Boron (B)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	--	--	--	--	2
39	Sodium (Na)	mg/l	18.5	19.1	24.6	29.2	13.2	31.8	28.1	21.9	--	--	--	--	--
40	Potassium (K)	mg/l	8.7	4.3	8.4	9.2	6.1	11.7	10.4	4.8	--	--	--	--	--
41	Electrical conductance (EC) at 25 °C	µS/cm	453.12	453.12	546.87	593.75	546.87	562.5	562.5	640.62	--	--	--	1000	2250

Microbiological Analysis

Parameter	UoM	Result								Tolerance Limits for Inland Surface Waters			Method of Analysis
		SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	Class-A	Class-B	Class-C	
Coliforms	MPN/100	>1600	>1600	>1600	>1600	>1600	>1600	>1600	>1600	50	500	5000	APHA 2017 (9221-B)

3.9.4 Analysis of Surface Water

The discussion on the analytical results of water samples is presented in the following sections.

3.9.4.1 Observation of Surface Water Quality

- The results of surface water sample analysis indicate that the pH value was observed to be in the range of 6.68 to 7.14.
- Dissolved oxygen was observed in the range of 5.4 to 6.3 mg/l.
- Electrical conductivity of surface water samples was observed to be in the range of 453.12 µS/cm to 640.62 µS/cm.
- The total hardness was found to be in the range of 176mg/l to 267 mg/l.
- TDS was found to be in the range of 251-345 mg/l.
- The chloride concentration was observed in the range of 29.6 mg/l to 55.2mg/l.
- Sulphates were found to be in the range of 8.6mg/l to 14.76 mg/l.
- Fluoride content was found to be in the range of 0.38 mg/l to 0.9 mg/l.
- Potassium was found in the range of 4.3 to 11.7 mg/l.
- Sodium was observed in the range of 13.2 to 31.8 mg/l.
- Nitrate was observed in the range of 0.7 mg/ to 3.6 mg/l.
- Alkalinity was observed in the range of 162 mg/l to 239 mg/l.
- Bacteriological studies revealed that the total coliform count is measured >1600 MPN/100 ml.

The quality of Surface water falls under 'Class C' and above as per Tolerance Limits for Inland Surface Water Standard (IS 2296-1982).

3.9.5 Ground Water Sampling & Analysis

The study area to the north and east of the aiprot site comprises of wel developed areas under NMMC and PMC as well as various nodes of CIDCO. This area has well developed piped water supply network and underground sewerage network connected to the STPs. Thus, the ground water samples were collected from eight locations as part of the baseline studies in the areas to south ad south-east which are pre-domimantly rural in character. The ground water monitoring stations are given in **Table-3.9.5.** The ground water sampling locations are depicted in **Figure-3.9.2.** The results of ground water quality analysis are given in **Table-3.9.6.**

Ground Water: The ground water samples were collected from the village open wells/ bore wells surrounded by the habitation. The major activities of the ground water are drinking and domestic usage.

TABLE-3.9.5
GROUND WATER SAMPLING LOCATIONS

Ground Water Samples	Locations (Open Well/Bore Well)	Distance (km)	Direction
GW1	Project site	-	-
GW2	New Panvel Estate	2.8	E
GW3	Ulwe Sector-5	1.4	WSW
GW4	Dapoli	0.4	S
GW5	Jasai village	5.5	SSW
GW6	Shirdhon	8.0	SSE
GW7	Padgha village	6.5	NE
GW8	Turbhe village	8.9	NNW

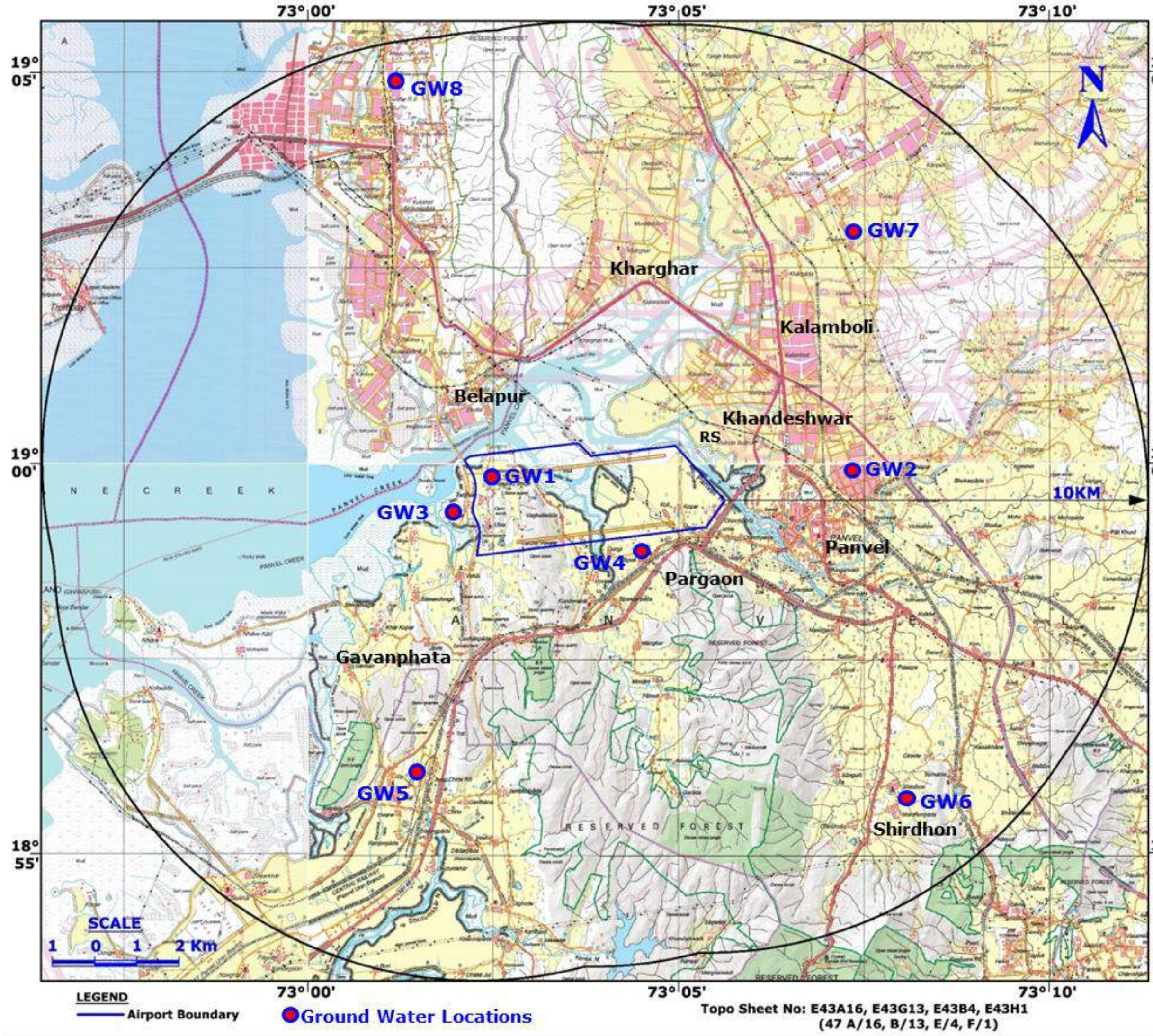


FIGURE-3.9.2
GROUND WATER SAMPLING LOCATIONS MAP

TABLE -3.9.6
RESULTS OF GROUND WATER QUALITY ANALYSIS

Sr. No.	Parameters	UoM	Result								Limits (IS 10500:2012)		Method of Analysis
			GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	Desirable	Permissible	
1	Colour	Hazen	<5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	5 Max	15 Max	IS-3025(P-4) RA2017
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	IS-3025(P-5) RA2017
3	pH @25°C	-	7.62	7.24	7.28	7.06	6.92	6.88	7.22	6.74	6.5 – 8.5	No Relaxation	IS-3025(P-11) RA2017
4	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	IS-3025(P-8) RA2017
5	Turbidity	NTU	2.8	2.6	2.4	3.1	2.8	2.6	2.6	3	1 Max	5 Max	IS-3025(P-10) RA2017
6	Total Dissolved Solid (TDS)	mg/l	194	218	253	231	216	295	289	247	500 Max	2000 Max	IS-3025(P-16) RA2017
7	Aluminum (Al)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03 Max	0.2 Max	IS-3025(P-55) RA2019
8	Ammonia (NH_3)	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5 Max	No Relaxation	IS-3025(P-34) RA2019
9	Detergents	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2 Max	1.0 Max	APHA-2017(5540-C)
10	Barium (Ba)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.7 Max	No Relaxation	APHA-2017(3111-D)
11	Boron (B)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.5 Max	1.0 Max	IS-3025(P-57) RA2017
12	Calcium (Ca)	mg/l	27.3	32.1	38.4	31.3	35.8	42.3	41.5	38.6	75 Max	200 Max	IS-3025(P-40) RA2019
13	Chloramines	mg/l	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	4.0 Max	No Relaxation	APHA-2017(4500CL-G)
14	Chlorides (Cl^-)	mg/l	25.3	29.6	31.7	24.5	23.8	28.3	31.0	29.1	250 Max	1000 Max	IS-3025(P-32) RA2019
15	Copper (Cu)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05 Max	1.5 Max	IS-3025(P-42) RA2019
16	Fluoride (F^-)	mg/l	0.6	0.8	0.7	0.5	0.8	0.7	0.6	0.9	1.0 Max	1.5 Max	IS-3025(P-60) RA2019
17	Residual Free Chlorine (RFC)	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.2 Min	1.0 Min	IS-3025(P-26) RA2019
18	Iron (Fe)	mg/l	0.033	0.003	0.034	0.036	0.04	0.042	0.038	0.034	1.0 Max	No Relaxation	IS-3025(P-53) RA2019
19	Magnesium (Mg)	mg/l	16.7	17.4	19.3	22.1	20.5	23.4	21.7	20.2	30 Max	100 Max	IS-3025(P-46) RA2019
20	Manganese (Mn)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.1 Max	0.3 Max	IS-3025(P-59) RA2019
21	Mineral oil	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5 Max	No Relaxation	IS-3025(P-39) RA2019
22	Nitrate (NO_3^-)	mg/l	12.4	8.6	9.4	6.2	5.6	8.3	11.5	8.6	45 Max	No Relaxation	IS-3025(P-34) RA2019
23	Phenolic Compounds	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.001Max	0.002Max	IS-3025(P-43) RA2019
24	Selenium (Se)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01 Max	No Relaxation	IS-3025(P-56) RA2019

Sr. No.	Parameters	UoM	Result								Limits (IS 10500:2012)		Method of Analysis
			GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	Desirable	Permissible	
25	Silver (Ag)	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1 Max	No Relaxation	APHA-2017(3111-B)
26	Sulphate (SO_4^{2-})	mg/l	4.6	5.4	3.7	4.2	3.6	6.2	5.1	4.8	200 Max	400 Max	IS-3025(P-24) RA2019
27	Sulphide (S^{2-})	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.05 Max	No Relaxation	IS-3025(P-29) RA2019
28	Alkalinity	mg/l	128	131	153	158	159	195	182	171	200 Max	600 Max	IS-3025(P-23) RA2019
29	Hardness	mg/l	137	152	175	169	174	202	193	180	200 Max	600 Max	IS-3025(P-21) RA2019
30	Zinc (Zn)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	5 Max	15 Max	IS-3025(P-49) RA2019
31	Cadmium (Cd)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.003 Max	No Relaxation	IS-3025(P-41) RA2019
32	Cyanide (CN^-)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05 Max	No Relaxation	IS-3025(P-27) RA2019
33	Lead (Pb)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01 Max	No Relaxation	IS-3025(P-47) RA2019
34	Mercury (Hg)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001 Max	No Relaxation	IS-3025(P-48) RA2019
35	Molybdenum (Mo)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07 Max	No Relaxation	APHA-2017(3111-D)
36	Nickel (Ni)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02 Max	No Relaxation	IS-3025(P-54) RA2019
37	Arsenic (As)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01 Max	No Relaxation	IS-3025(P-37) RA2019
38	Chromium (Cr)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05 Max	No Relaxation	IS-3025(P-52) RA2019
39	Sodium (Na)	mg/l	19.1	15.2	14.9	12.6	11.3	17.8	19.8	17.6	NS	NS	APHA-2017(3111-B)
40	Potassium (K)	mg/l	1.3	2.1	2.6	5.3	3.6	7.4	4.6	6.8	NS	NS	APHA-2017(3111-B)
41	Electrical Conductivity (EC) at 25 °C,	µS/cm	359.37	375	421.87	406.25	406.25	500	484.37	453.13	NS	NS	IS-3025(P-14) RA2019
Microbiological Analysis													
42	Coliform	Present	Present	Present	Present	Present	Present	Present	Present	Absent	Absent	-	APHA 9221 B 23rd Edition 2017
42	*E. Coli*	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	-	APHA 9221 G-2 23rd Edition 2017

3.9.6 Analysis of Ground Water

- The analysis results of ground water samples showed the pH in range of 6.74 - 7.62 which are with the specified standard limits of 6.5 to 8.5.
- Turbidity of the samples ranged from 2.4-3.1 NTU respectively.
- Electrical conductivity of the samples ranged from 359.37-500 μS/cm
- The total hardness of the samples ranged from 194-295 mg/l which indicates that hardness concentration in all the ground water samples is well within the desirable limit 200 mg/l.
- Calcium concentration ranged from 27.3 to 42.3 mg/l which indicates that calcium concentration in all the ground water samples is well within the desirable limit 75 mg/l.
- Magnesium concentrations ranged from 16.7-23.40 mg/l where the acceptable limit is 30 mg/l.
- The total dissolved solids of the samples ranged from 194-295 mg/l where the acceptable limit is 500 mg/l.
- Range of chlorides concentration is found to be 23.8-31.7 mg/l where the desirable limit is 250 mg/l.
- Fluoride ranges form 0.5-0.9 mg/l where the desirable limits is within 1 mg/l.
- Range of sulphates concentration is found to be 3.6-6.2 mg/l where the desirable limit is 200 mg/l.
- Iron concentration in groundwater varied from 0.033-0.042mg/l where the desirable limit is 0.3 mg/l.
- Alkalinity in the groundwater samples varied from 128-195 mg/l where the desirable limit is 200 mg/l
- Nitrate is in found in the range of 5.6-12.4 mg/l where the desirable limit is 45 mg/l.
- Bacteriological studies revealed the absence of *E. coli* in ground water samples. The total coliform counts are absent inall the samples against the standard limit of 10 MPN/100 ml.

Based on the above results, it is evident that all of the parameters in ground water fairly meet the desirable standard limits of IS: 10500. The ground water quality in the study area does not indicate any industrial contamination.

3.10 Ecology and Bio-Diversity

The specific condition 7 I (xxxi) of Environmental Clearance CRZ Clearance granted to NMIA (dated 22nd November, 2010 and subsequent renewal on 20th December, 2017) stipulates that, "CIDCO (as Project Proponent then) shall conduct the baseline survey of Avian fauna before the start of construction and the details shall be put every three months on the website in association with Bombay Natural History Society [BNHS]". Hence, CIDCO had engaged the services of BNHS (2012 to 2014 and 2015 to 2017) to do base line survey of avian fauna over different seasons and present their findings in the form of quarterly and summarized annual reports. The final Avian Fauna studies presented here are based on the sampling conducted by BNHS from December 2015 to January 2017.

The above study is interpreted in a report is covered in two parts, i.e., *Baseline Documentation of Flora and Fauna of Karnala Bird Sanctuary (KBS) and Navi Mumbai International Airport (NMIA) Project Area for Preparation of Conservation and Preservation Plan, Part I and II.* It is presented in **Annexure-XIV**. Further, BNHS is continually conducting similar studies for NMIA on behalf of CIDCO and the quarterly and annual reports are published in their website. This is an on-going study and will continue till 2028.

The current EIA study addresses the ecological bassline study conducted for NMIA in its study area based on primary and secondary survey. It is described below.

3.10.1 Bio-geographical Setting

As per Champion and Seth's 1968 classification, following forest types are generally found in the study area.

Moist Mixed Deciduous Forests: These are found on the hill slopes and valleys, dominant species in this type *are Pterocarpus marsupium (Bija), Salmalia malabaricum (Semal), Terminalaia bellarica (Behada), Dalbergia latifolia (Shishum), Syzigium cumini (Jambul), Terminalia tomentosa (Ain), Lagerstroemia parviflora (Bondara)* etc.

Southern Tropical Semi-Evergreen Forests: Forests of this type occur mostly on upper hill slope from 450 m to 1050 m above the MSL. In Western Ghats dominant species are *Terminalia paniculata (Kinjal), Memocylon umbellatum (Anjani), Terminalia chebula (Hirda), Syzigium cumini (Jambul), Olea diocea (Parjamun), Mangifera indica (Mango), Actinodaphne hookeri (Pisa)*, etc.

Littoral and Swamp Forests: These are found along the creeks and estuaries. Vegetation here is adapted to saline environment. Although comparatively area under cover is marginal, these forests are important for protection of sea coast and marine life. Prominent species are *Avicennia marina, Rhizophora mucronata and Sonneratia alba*. Some associated species are also found.

According to 'India State of Forest Report, 2019', Forest Survey of India; forest cover in Raigad district is reported to be 41.1% of geographical area. Area (km^2) distribution of forest cover is presented below in **Table-3.10.1**.

TABLE-3.10.1
FOREST COVER IN RAIGAD DISTRICT

Geographical Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	Scrub
7,152	13	1,250	1,676	2,939	78

Forest cover in terms of canopy density is classified as very dense, moderately dense, open and scrub forest. Defining criteria of each class is given below:

Irrespective of vegetation cover, some portion of vegetation cover in study area are notified as Reserve Forest and Protected Forest. There are 24 protected forests and 8 reserved forests within the study area are given in **Table-3.10.2** and **Table-3.10.3** respectively.

TABLE-3.10.2
LIST OF PROTECTED FORESTS FALLING IN STUDY AREA

Sr. No.	Name of Forest	Area (ha)	Direction
1	Ambivali	4.09	E
2	Belpada	70.84	N
3	Ashte	59.87	SE
4	Chirley	50.70	S
5	Dahivali	9.48	NE
6	Devad	57.15	NE
7	Harigram	182.81	NE
8	Kevali	135.30	NE
9	Koproli	11.65	NE
10	Manghar	80.70	S
11	Mosale	21.29	S
12	Nandangaon	62.60	SE
13	Owe	62.18	N
14	Palaspe	29.43	SE
15	Padge	19.63	NE
16	Palibhadrak	14.48	NE
17	Pendhar	5.15	N
18	Pali	14.48	SE
19	Sangurle	141.87	SE
20	Shivkar	47.98	E
21	Somatade	34.41	SE
22	Tembhode	45.45	NE
23	Vindhane	14.39	S
24	Veshvi	14.44	S
	Total	**1190.37**	

TABLE 3.10.3
LIST OF RESERVE FORESTS IN STUDY AREA

Sr. No.	Name	Area (ha)	Direction
1	Belpada	106.60	N
2	Jambhipada	127.04	S
3	Nanoshi	80.53	S
4	Ransai	605.00	NE
5	Mosare	40.46	S
6	Turmale	128.00	SE
7	Manghar	40.46	S
8	Owe	466.92	N
	Total	**1595.01**	

3.10.2 Baseline Survey of the Study Area

Study area is covered within radial distance of 10 km from proposed site as shown in **Figure-3.10.1**. It encompasses part of Panvel and Uran talukas of Raigad district and Thane taluk of Thane district and small part of Mumbai district. Spread of study area is shown (black polygon) on Open Series Maps viz. E43H1, E43B4, E43G13 & E43A16 (published by Survey of India).

Ecology & Biodiversity study pertaining to Environmental Impact Assessment report for development of Navi Mumbai International Airport located along southern bank of Gadhi River, spread over 8 revenue villages viz. Kopar, Owale, Pargaon, Paragaon-dungi, Targhar, Ulwe, Vadghar and Waghivali-khar, Taluka Panvel, District Raigad was carried out in Winter 2019-2020.

Survey Methodology: The study was carried out by visiting locations at dusk, day and dawn, taking care that representative locations of all habitats were covered. Geographical coordinates were marked at important locations and geo-tagged photographic evidence were collected using Global Positioning System. Listing of species was done based on actual sighting, interviewing locals, indirect evidences, literature survey, data collected from forest officials and internet references.

During survey, total 16 locations (4 locations for each habitat) were visited for phyto-sociological studies. 10m X 10m quadrant for trees, 5m X 5m for shrubs & 1m X 1m for herbs and grass species were established. Data collected is used to determine Species Richness, Species Composition and Shannon-Weiner Diversity Index by standard methods.

Field visits reveal that, most of the study area has plane terrain except at places like Parsik Hills, Taloja Hills and Karnala Hills where it is undulating. Besides dense vegetation on hills /Reserved Forest, study area possesses habitats like, water bodies, agricultural fields and human settlements. These habitats have different characteristic which supports typical composition of flora and fauna within them.

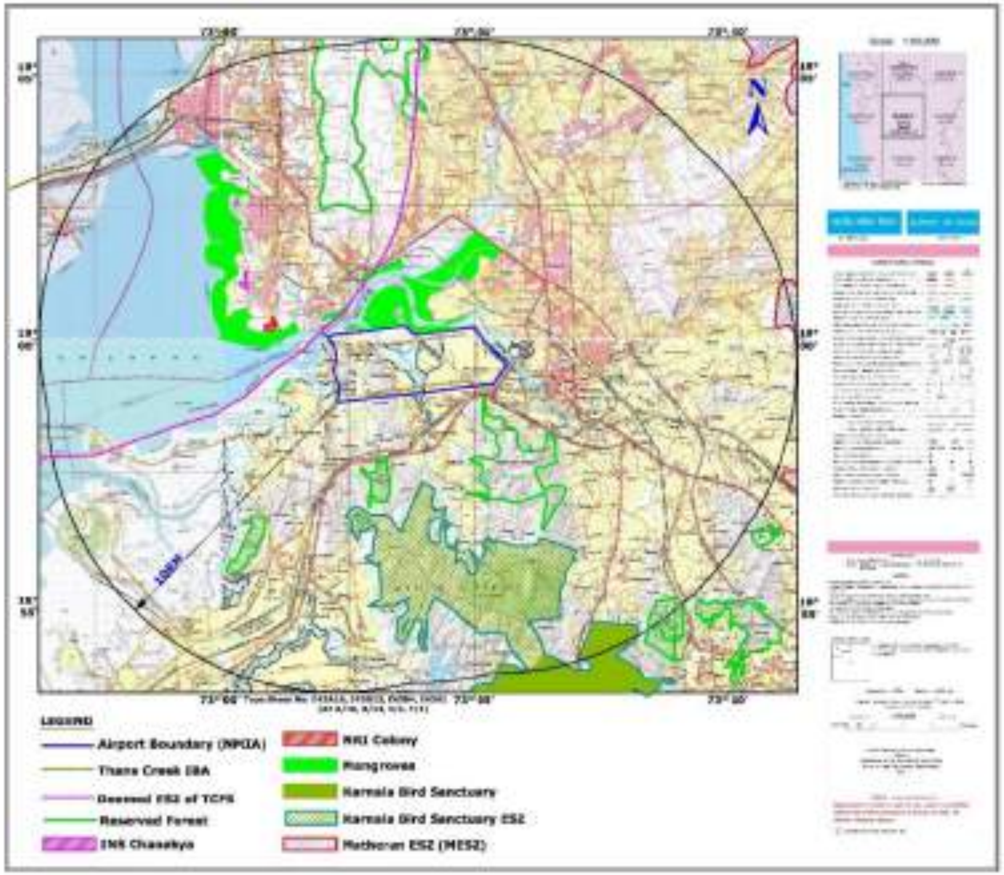


FIGURE-3.10.1
TOPOSHEET OF STUDY AREA (10 KM) SHOWING SITE AND ECO-SENSITIVE ZONES FEATURES

3.10.2.1 Dense Vegetation

Dense Vegetation: Most of the hills (except places like Karnala) in study area has sparse vegetation. At many places, it was observed that, vertical continuity of vegetation disturbs as slope becomes steeper or occurrences of rocky outcrops intermittently and appears as barren patches. Most of the parts of these hills are notified as Reserved Forest and covers approximately 26 % of total study area. Except Karnala, most of the forest areas are accessible to human and surrounded/ encroached by human settlements. Karnala hills are remained undisturbed due to legal protection offered by Wildlife Protection Act 1972 as Sanctuary

Karnala Bird Sanctuary

Karnala Bird Sanctuary is notified vide WLP-1667/34846/Y/ dated 06th May 1968 and WLP-1099/C.R./126/F-1 dated 23rd January 2003 by Department of Revenue and Forest, Government of Maharashtra. It is located in Panvel Taluka towards southern part of study area, spread over an area of 12.11 km^2. The sanctuary is a part of Western Ghats & has Mix Deciduous Forest with five micro habitats viz. Grass strips, Riparian, Evergreen, Deciduous & Rocky. The location of the Karnala Bird Sanctuary (Sanctuary boundary and the ESZ boundary) with respect to the study area boundary are shown in the **Figure-3.10.2**.

FIGURE-3.10.2
LOCATION OF KARNALA BIRD SANCTUARY & ITS ESZ AREA WITHIN STUDY AREA

Human interfering activities such as quarrying, chopping trees for firewood (easterly villages) were observed during survey. These activities exert pressure or adversely affect reserve forests nearby. Stone crushing units and heavy traffic in southwest region of study area caused heavy dust load on leaves.
Phyto-sociological study reveals trees dominate over shrubs and herbs. Diversity index is found to be moderate.

The species richness and diversity index (Shannon-Weiner Diversity Index) for three three layers of vegetation in the dense forest area is shown in **Figure-3.10.3**

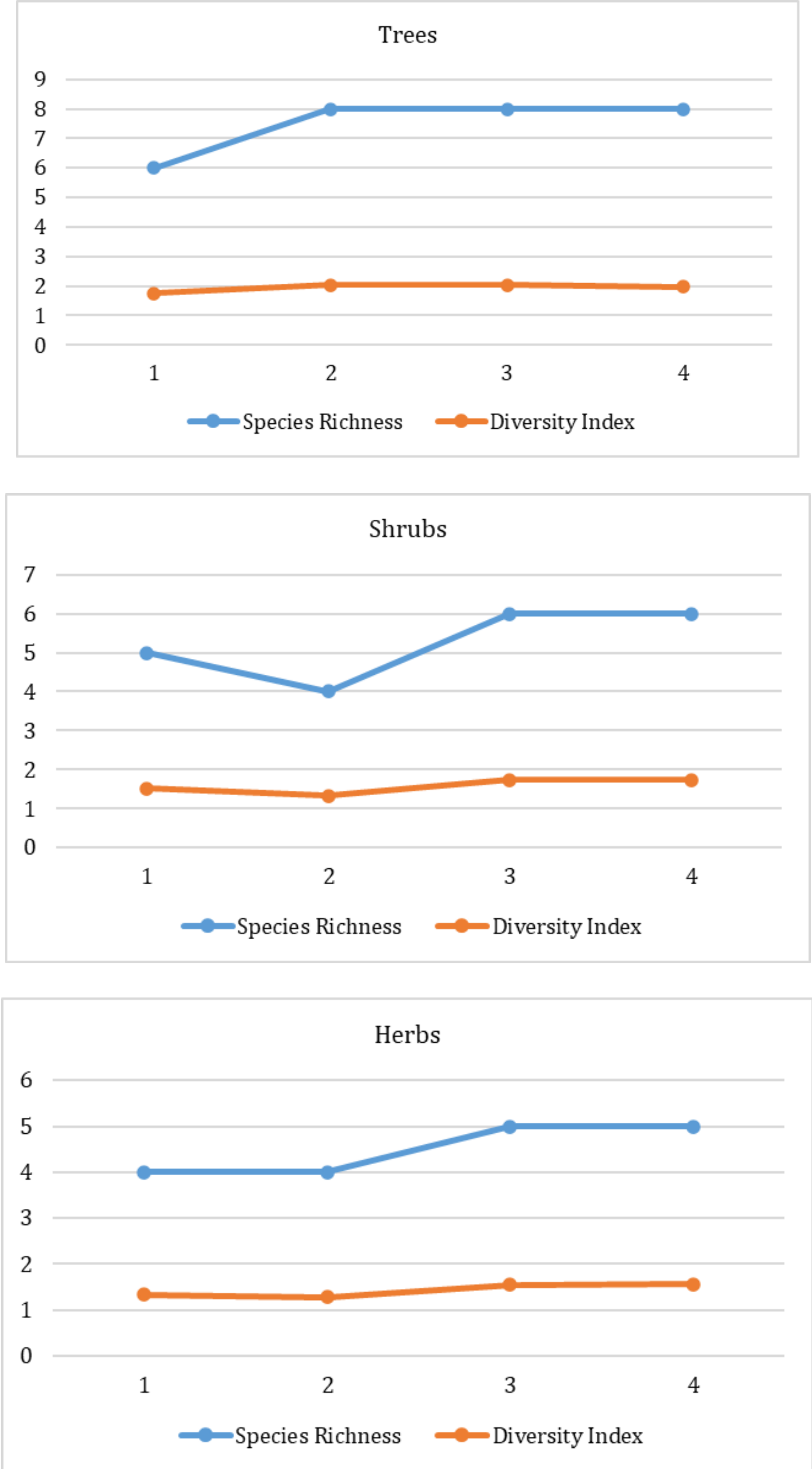


FIGURE-3.10.3
DIVERSITY INDEX IN DENSE VEGETATION OF STUDY AREA

The diversity index of this forest is given in Table-3.10.4

TABLE-3.10.4
DIVERSITY INDEX IN DENSE VEGETATION OF STUDY AREA

Trees	Quadrants of Study Area			
	1	2	3	4
Species Richness	6	8	8	8
Diversity Index	1.75	2.04	2.03	1.97
Shrubs	1	2	3	4
Species Richness	5	4	6	6
Diversity Index	1.52	1.33	1.73	1.73
Herbs	1	2	3	4
Species Richness	4	4	5	5
Diversity Index	1.33	1.28	1.55	1.56

Graphs showing the species composition of trees, shrubs, herbs and climbers at each location are shown in**Figure-3.10.4**, **Figure-3.10.5** and **Figure-3.10.6**.

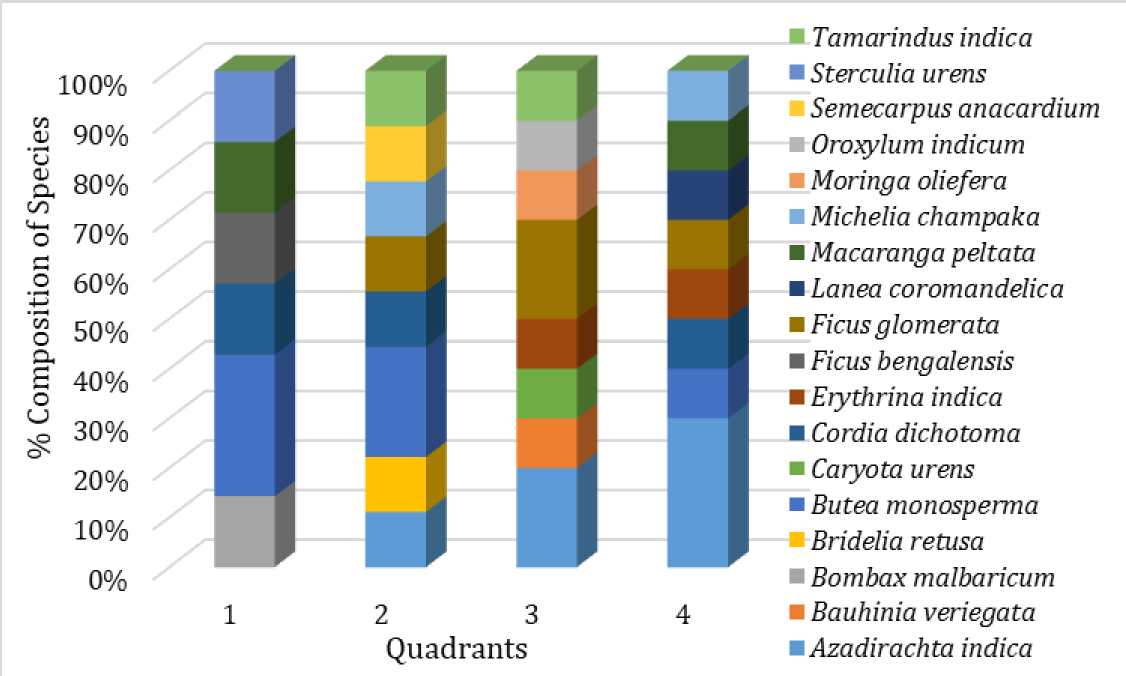


FIGURE-3.10.4
TREE SPECIES COMPOSITION IN DENSE VEGETATION OF STUDY AREA

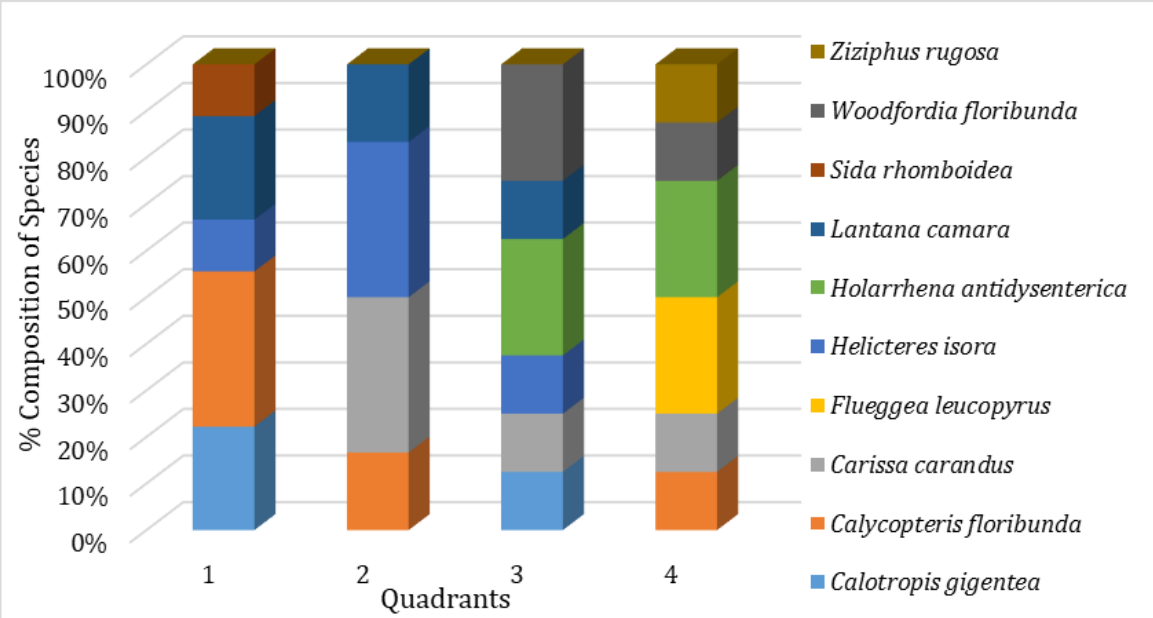


FIGURE-3.10.5
SHRUB SPECIES COMPOSITION IN DENSE VEGETATION OF STUDY AREA

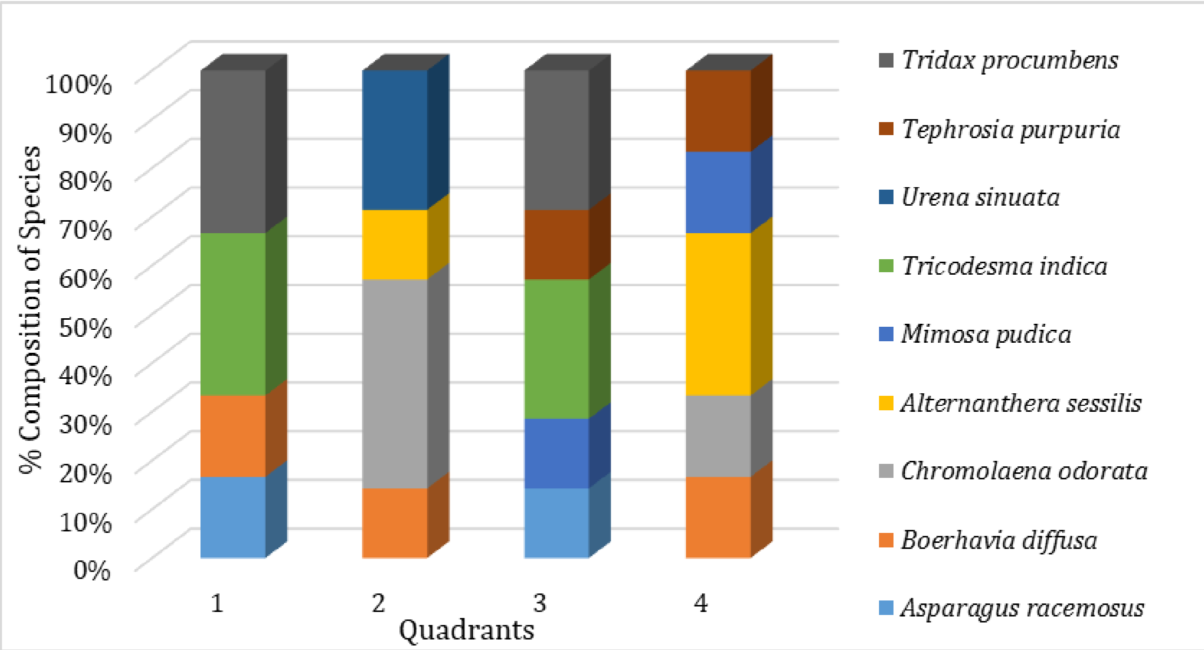


FIGURE-3.10.6
HERB SPECIES COMPOSITION IN DENSE VEGETATION OF STUDY AREA

3.10.2.2 Human Settlements

Human Settlements: Human habitation in study area is mix of urban and rural in nature. Villages in study area are found situated by the agriculture pastures, some are surrounded by townships and some at base of hills and along major roads.

Typical plant species are grown in and around habituated areas. These species are intentionally planted for the purpose of beautification, shade, protection from stray/grazing animals and for food value. Similarly, faunal species of interest such as cattle, domestic animals/ birds were inhabited. Besides these, gardens developed in townships, e.g., Central Park and Golf Course in sector 23 of Kharghar, green belts in industrial areas, orchards show artificial plantation of monocultures. These exhibit different kinds of species composition. Open spaces/ waste areas, plants exist naturally, both supports respective fauna and constitutes part of biodiversity. Open/waste areas adjacent to human settlement, road-side plantation etc. are also considered in this habitat.

Ongoing industrial, commercial, developmental activities and heavy vehicular traffic in the region also affected flora as leaves are observed to be heavily impregnated with dust load, which may reduce the productivity.

Phyto-sociological study reveals shrubs dominate flora followed by trees and herbs. This may be because of plantation of vegetation in selective manner. Diversity index is varying from moderate to poor.

Species composition of trees, shrubs, herbs at each location are sown in **Figure-3.10.7**, **Figure-3.10.8** and**Figure-3.10.9.**

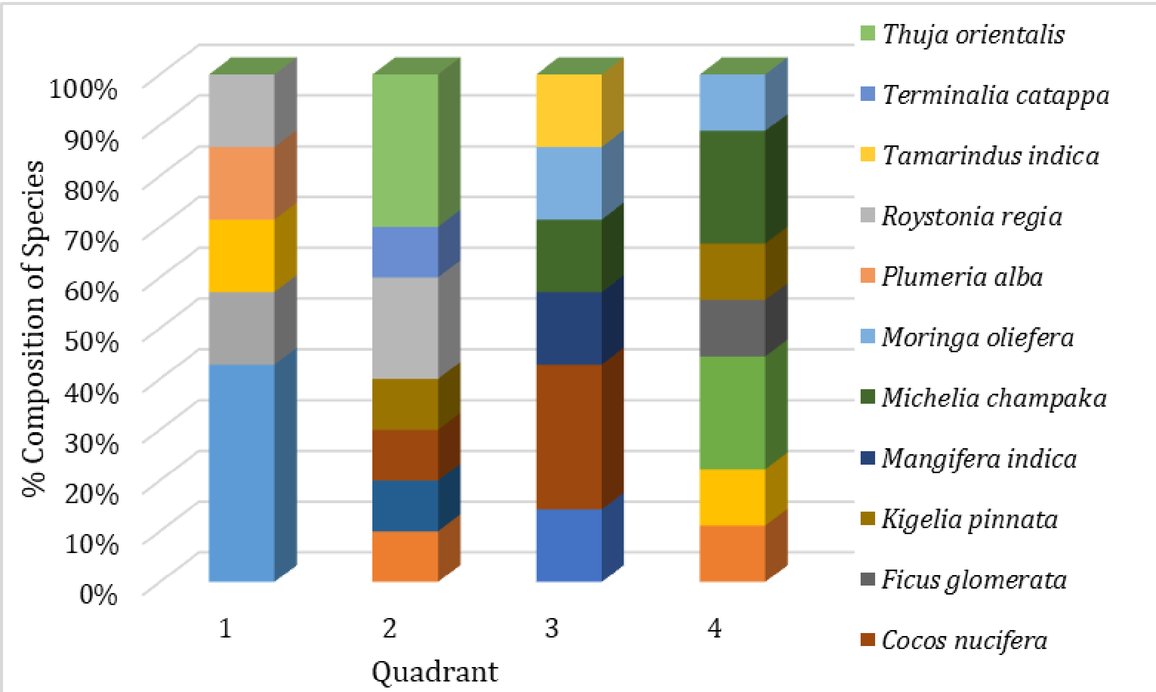


FIGURE-3.10.7
TREE SPECIES COMPOSITION IN HUMAN SETTLEMENTS OF STUDY AREA

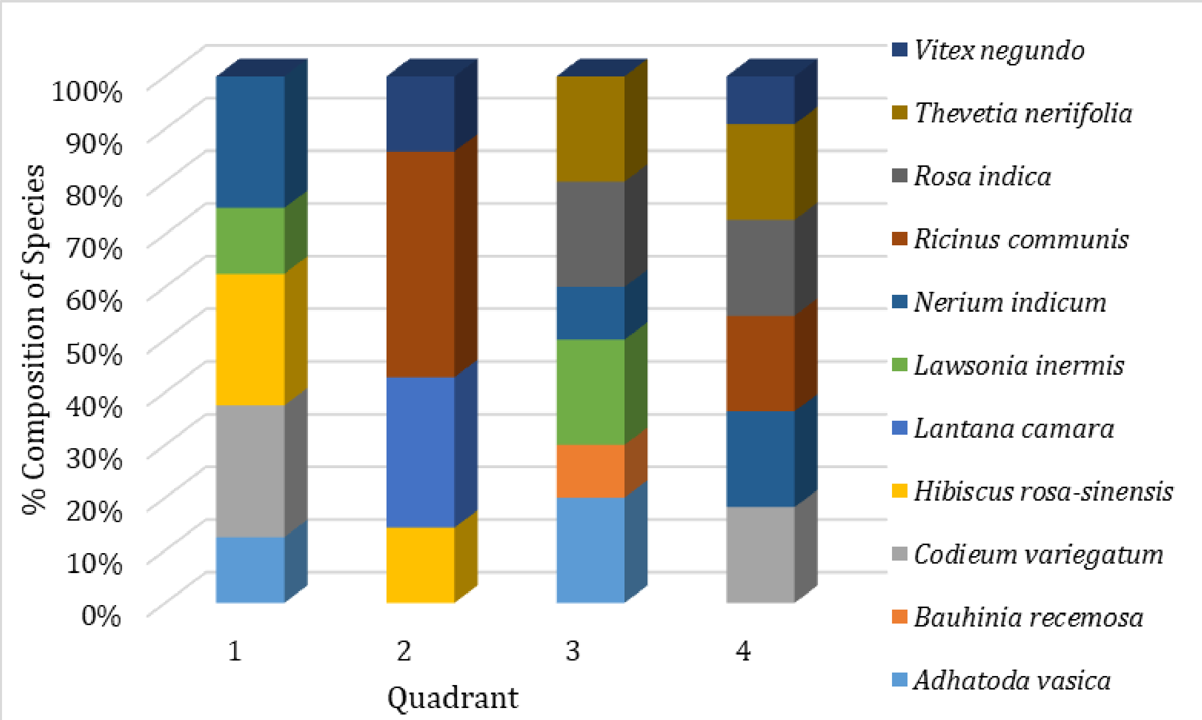


FIGURE-3.10.8

SHRUB SPECIES COMPOSITION IN HUMAN SETTLEMENTS OF STUDY AREA

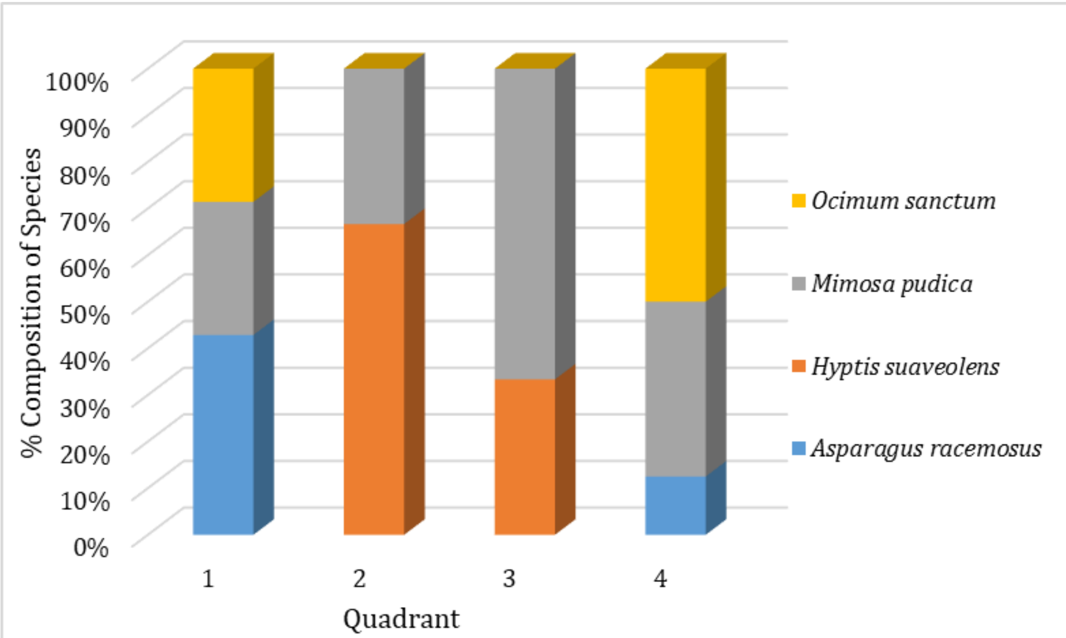


FIGURE-3.10.9

HERB SPECIES COMPOSITION IN HUMAN SETTLEMENTS OF STUDY AREA

The species richness and **Figure-3.10.11.** Species richness and diversity index of trees, shrubs and herbs are shown in **Figure-3.10.10.**

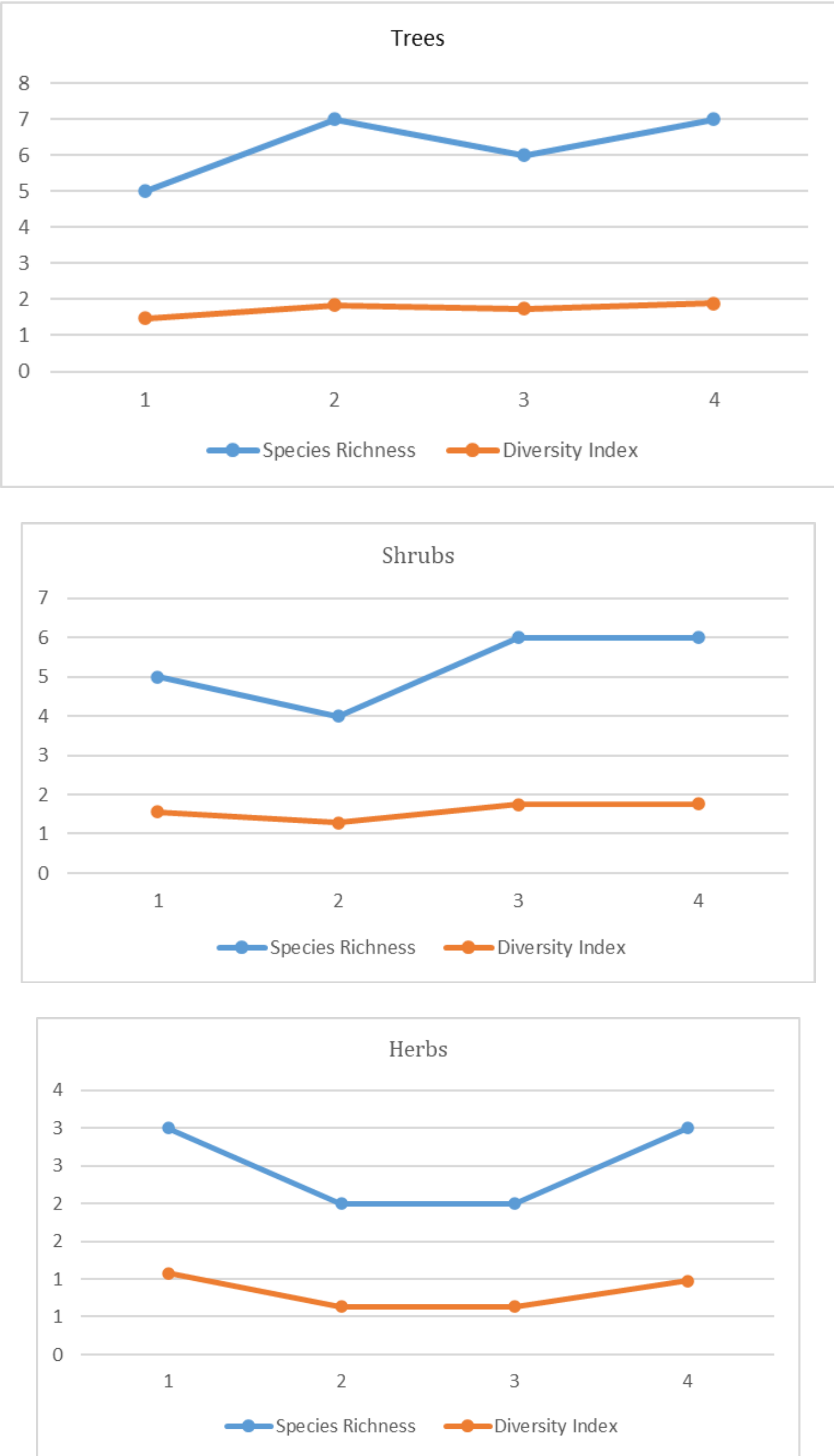


FIGURE-3.10.10
DIVERSITY INDEX IN HUMAN SETTLEMENT OF STUDY AREA

The species diversity index (Shannon-Weiner Diversity Index) of the vegetation of the human settlement area is given in **Table-3.10.5.**

TABLE-3.10.5
DIVERSITY INDEX IN HUMAN SETTLEMENT OF STUDY AREA

Trees	**1**	**2**	**3**	**4**
Species Richness	5	7	6	7
Diversity Index	1.48	1.83	1.75	1.89
Shrubs	1	2	3	4
Species Richness	5	4	6	6
Diversity Index	1.56	1.28	1.75	1.77
Herbs	1	2	3	4
Species Richness	3	2	2	3
Diversity Index	1.08	0.64	0.64	0.97

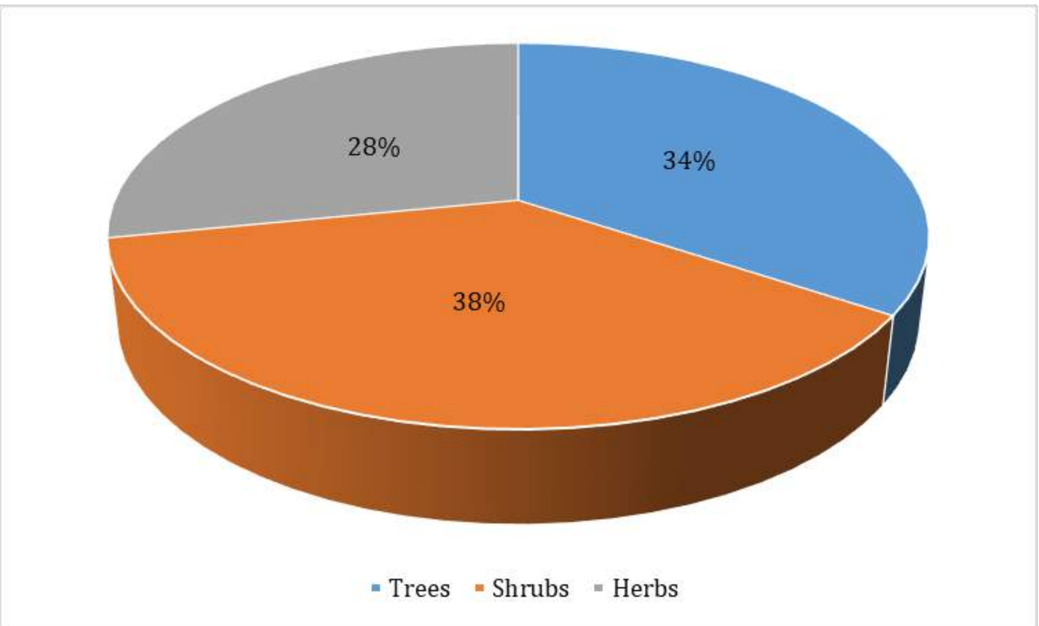


FIGURE-3.10.11
PIE CHART OF VEGETATION IN HUMAN SETTLEMENT AREA

3.10.2.3 Agaricultural Fields

Agricultural Fields: Agricultural fields in study area are seen towards foothills and inbetween open area. Total agricultural land in study area contributes about 25%. Major crop in the region is Rice, however secondary crops like Wari, Nagali etc. are alos grown in the field. In addition to agriculture crops, vegetable and horticultural crops were also grown. Besides, animal husbandry is also practiced in study area. Towards eastern part of study area, agriculture fields were observed with plantation along boundary imparting good biodiversity value to the habitat. Agriculture in south-western part of study area is having specialized habitat because of close proximity to sea with high saline soil. Farmers in this region, grow only salinity resistance variety of rice.

3.10.2.4 Water Bodies

Water Bodies: Drainage in the area is mainly passing through Panvel creek to which Ulwe, Gadhi, Kalundri, Ghot, Kasadi etc. are tributaries confluencing at different locations. Due to undulating terrain, number of small stream/ nallah and rivers are flowing to downhillsthat finally joins the creek. Entire stretch of Panvel creek is saline with Mangroves observed in the study area. Small ship Building, repairing/ docking activitie were noticed near Moha-Belapur at the entrance of Panvel creek. Holding ponds, wetlands, mudflats were present towards western part of study area. Flocks of waders and other migratory birds were seen feeding/ perching in these areas. Bird movement is observed during the study period subject to tidal conditions. Details of bird movement are well explained in 'Baseline Documentation of Flora and Fauna of Karnala Bird Sanctuary and Navi Mumbai International Airport Project Area. The same has been used for preparation of Conservation and Preservation Plan', Part II, Prepared by BNHS. The report states:

Following actions are recommend to conserve, the biodiversity of Navi Mumbai International Airport (NMIA) area, which will minimise damages to the wildlife found in the NMIA area and the landscape in general.

1. The immediate concern related to the NMIA project is the populations of water birds close to the airport site. There are six major sites – NRI (Non-Residential Indian) complex, Delhi Public School (DPS), Training Ship Chanakya (TSC), Panje, NSPS (Nava Sheva Police Station) and Jasai, where large aggregations of birds are observed. NRI, TSC and DPS are very close to the airport site (about 6 km aerial distance towards NW) and though the birds inhabit these sites throughout the year. Large number of individuals are seen in December and January. On the other side, birds at Panje, NSPS and Jasai are found in less numbers and these sites are comparatively located at a longer distance from airport site (about 15 kmaerial distance towards SW), hence are considered to be of little concern.

   The study indicates that there is a high probability of bird movement between the study sites and it appears that tidal height and water depth in temporary water pools created by local fishermen govern this movement. The movement of tidal influenced birds is very high during high tide and they congregate at these sites to feed and rest. During our study, apart from tidal birds, there were large populations of non-tidal birds, which moved less between the sites as they did not influence the tide, at NRI and Panje Funde.

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   In a single day, the average maximum numbers of birds counted (including all the sites) were about 10,861. Therefore, looking at this large numbers of birds and their local movement, NMIA authority are adviced that they should be cautious during high tide from December to February month so as to avoid bird hit calamities.

2. BNHS strictly suggest that proponent should protect and conserve following biologically important habitats,

   A. Wetland - NRI (Non-Residential Indian) complex, Delhi Public School (DPS), Training Ship Chanakya (TSC), Panje, NSPS (Nava Sheva Police Station) and Jasai where large aggregations of birds are observed.
   B. Key links and corridors in the landscape identified in this study.
   C. Karnala Bird Sanctuary (KBS) and notified Ecological Sensitive Zones.

Maintaining the current state of this landscape especially wetlands and Protected Areas is essential for the air safety of upcoming Navi Mumbai International Airport (NMIA). Any changes in the current state of these areas will result into more erratic movement of the birds in the landscape between feeding and roosting sites, which may jeopardise the air safety of NMIA.

1. CIDCO will provide the support for building infrastructure in existing protected sites such as KBS and Matheran.

2. CIDCO will support the Forest Department of Maharashtra and BNHS financially to restore degraded habitats in the identified corridors, key links and species rich areas.

3. BNHS has strongly recommended to remove condition of developing Mangrove Park to the North of the site (Waghivali island), as it will attract birds towards the airport site.

4. CIDCO has extended the engagement of BNHS by signing a MoU for 10 years period (until 2028) to undertake the following works:

   A. Flagging and tagging.
   B. To identify bird movements; and
   C. To prepare management plan for active management.

5. BNHS will be involved even when the airport operation starts and can advise to take Active Management measures during the period.

3.10.2.5 Thane Creek Flamingo Sanctuary (TCFS)

Thane Creek Flamingo Sanctuary is one of the sites with significant conservation and economic values in Maharashtra. It is Maharashtra's second marine Sanctuary after Malvan Marine Sanctuary in Sindhudurg. It is located in Thane creek between Mumbai nd Navi-Mumbai cities. It is spread over an area of1690 hectares that comprises of 896 Ha of mangrove and 794 Ha of adjacent waterbody of the creek. At present, it is under the administrative control of Divisional Forest Officer (DFO), Mumbai Mangrove Conservation Unit (MMCU)under Additional Principal Chief Conservator of Forests (APCCF), Mangrove Cell, Mumbai. ESZ boundary of Flamingo Sanctuary is located 9.2 Km away from the NMIA project boundary.

3.10.2.6 Plantation Done at Various Places

HOFF (Head of Forest Forces, Maharashtra state, Nagpur) has visited site on 12th Dec 2018 and reviewed the compliance to Forest clearance.

Hon. Mumbai High CourtOrder dated 29th October 2013 (Notice of Motion No. 419 of 2011 in PIL No. 87 of 2006), has permitted clearance of 108.5 Ha subject to condition that they will develop Mangroves over 245 Ha at location Exhibit F and protection of 370 Ha also at location Exhibit F as per Affidavit dated 18th August 2011 filed by CIDCO.

Details of EC compliance are as follows:

1. Compensatory Mangrove Plantation over 109 ha done to NE of site on S. No. 27, village Kolhekhar in between Jui creek and Taloja creek through the Mangrove Cell of State Forest Department.
2. Mangrove afforestation completed by CIDCO in 320 ha + 60 ha + 20 ha area = 400 ha area through Forest Development Corporation of Maharashtra (FDCM)
3. BNHS, in its report (Feb 2019) on baseline Avi Fauna Survey (over last 5 years) recommended:

- To develop and protect other suitable sites to the south and west of NMIA for congregator birds.
- Mangrove Park should be located away from the airport influence zone considering the bird hazard issue.
- Waghivali Island has populace staying on it.

Considering the above and that Waghivali island (245 ha) is yet inhabited, it is protected as NDZ for the time being and mangroves in the area are/will be retained in their natural state. Thus, condition given for permitting Mangrove clearance Mangrove Plantation & Protection as imposed by Hon. Mumbai High Court& EC is fully complied.

Fishing is also occupation in coastal villages like Diwalegaon and other such villages. Details of fisheries are given in marine section.

Though, each above identified habitat experiences similar climatic conditions, they differ in edaphic conditions, location, use/interference of human and shows variation in floral composition. These members of flora support different kinds of fauna associated with it. Some species are present in more than one habitat. List of flora observed/reported within study area is presented in **Table-3.10.6,** with respect to different habitats described earlier. Similarly, list of fauna is presented in **Table-3.10.7.** This is as per Baseline Documentation of Flora and Fauna of Karnala Bird Sanctuary (KBS) and Navi Mumbai International Airport (NMIA) Project Area for Preparation of Conservation and Preservation Plan.

TABLE-3.10.6
LIST OF PLANT SPECIES OBSERVED WITHIN STUDY AREA

(Source: BNHS Suvey Report)

Sr. No.	Scientific Name	Common/ Local Name	Family	Dense Vegetation	Human Settelement	Agricultural Fields	Water Bodies
	Trees						
1	*Acacia auriculiformis*	Earleaf Acacia	Mimosaceae		T		T
2	*Albizia saman*	Rain Tree	Mimosaceae		T		
3	*Artocarpus heterophyllus*	Jackfruit, Katahal	Moraceae		T	T	
4	*Azadirachta indica*	Neem	Meliaceae	T	T	T	
5	*Bauhinia veriegata*	Kanaraj	Caesalpiniaceae	T	T		
6	*Bombax malbaricum*	Silk Cotton Tree, Shalmali	Bombacaceae	T			
7	*Bridelia retusa*	Spinous Kino Tree, asana	Phyllanthaceae	T			
8	*Butea monosperma*	Flame of the Forest, Palash	Fabaceae	T			
9	*Carica papaya*	Papaya	Caricaceae		T		
10	*Caryota urens*	Fishtail palm	Arecaceae	T	T		
11	*Cassia fistula*	Amaltas	Caesalpiniaceae		T		
12	*Cocos nucifera*	Coconut/ Naral	Palmae		T		
13	*Cordia dichotoma*	Indian cherry, Lasora	Boraginaceae	T			
14	*Erythrina indica*	Indian Coral Tree, Pangara	Fabaceae	T	T		
15	*Eucalyptus sp.*	Nilgiri	Myrtaceae	T		T	
16	*Ficus bengalensis*	Banyan tree, Vat	Moraceae	T	T		
17	*Ficus glomerata*	Umbar	Moraceae	T	T		
18	*Ficus religiosa*	scared fig/Pimpal	Moraceace	T	T		
19	*Garcinia indica*	Kokam	Clusiaceae	T			
20	*Gliricidia sepium*	Mother of cocoa	Fabaceae	T	T	T	
21	*Gmelina arborea*	Gamhar	Verbenaceae	T			
22	*Grewia tiliifolia*	Dhaman	Tiliaceae	T			
23	*Kigelia pinnata*	Sausage tree	Bignoniaceae		T		
24	*Lagerstroemia speciosa*	Pride of India, Taman	Lythraceae	T	T		
25	*Lanea coromandelica*	Indian Ash Tree, Mohin	Anacardiaceae	T			
26	*Lucena leucocephala*	Subabhul	Mimosaceae			T	
27	*Macaranga peltata*	Chand Kal	Euphorbiaceae	T			
28	*Mangifera indica*	Mango, aam	Anacardiaceae	T	T	T	
29	*Michelia champaka*	Golden Champa	Magnoliaceae	T	T		
30	*Mitragyna parviflora*	Kaim, Kalam	Rubiaceae	T			
31	*Moringa oliefera*	Drumstick tree	Moringaceae	T	T	T	

Sr. No.	Scientific Name	Common/ Local Name	Family	Dense Vegetation	Human Settelement	Agricultural Fields	Water Bodies
32	*Muntingia calabura*	--	Muntinginaceae		T		
33	*Neolamarckia cadamba*	Kadam, Kadamb	Rubiaceae	T	T		
34	*Oroxylum indicum*	Broken Bones Tree, Tayitu	Bignoniaceae	T			
35	*Peltophorum pterocapum*	Sonmohar	Caesalpinaceae		T		
36	*Phyllanthus emblica*	Amla	Euphorbiaceae	T	T	T	
37	*Pithecellobium dulcii*	Vilayti chinch	Mimosaceae			T	
38	*Plumeria alba*	Chafa	Apocynaceae		T		
39	*Pongamia pinnata*	Pongam Tree, Karanj	Fabaceae	T	T		
40	*Randia dumatorum*	Gela	Rubiaceae	T			
41	*Roystonia regia*	Royal palm	Palmae		T		
42	*Semecarpus anacardium*	Varnish tree, bhilawan, bibba	Anacardiaceae	T		T	
43	*Sterculia urens*	Indian-tragacanth, Kulu	Sterculiaceae	T			
44	*Syzygium cumini*	Jamun	Myrtaceae	T	T	T	
45	*Tamarindus indica*	Tamarind, Imli , Chinch	Caesalpiniaceae	T	T	T	T
46	*Tectona grandis*	Sag (Teak)	Verbenaceae	T		T	
47	*Terminalia belerica*	Baheda	Combretaceae	T		T	
48	*Terminalia catappa*	Indian Almond/Deshi Badam	Combretaceae	T	T	T	
49	*Thespesia populnea*	Indian tulip tree	Indian tulip tree	T	T	T	T
50	*Thuja orientalis*	Morpankhi	Thujaceae		T		
51	*Trema orientalis*	Indian Charcoal Tree/Gio	Ulmaceae	T			
52	*Ziziphus jujuba*	Bor	Rhamnaceae	T			
	Shrubs						
1	*Adhatoda vasica*	Vasaka	Acanthaceae		S	S	
2	*Aegiceras corniculata*	-	Myrsinaceae				S
3	*Amorphophallus campanulatus*	Suran	Araceae		S	S	
4	*Avicennia marina*	Tiwar	Verbanceae				S
5	*Bauhinia recemosa*	Apta	leguminosae	S	S		
6	*Calotropis gigentea*	Crown Flower, Safed aak	Asclepiadaceae	S			
7	*Calycopteris floribunda*	Paper flower climber, Ukshi	Combretaceae	S			
8	*Capsicum annuum*	Chilly/ Mirchi	Solanaceae			S	
9	*Carissa carandus*	Karawandi	Apocynaceae	S	S	S	
10	*Codieum variegatum*	Croton	Euphorbiaceae		S		
11	*Euphorbia quadrangularis*	--	Euphorbiaceae			S	
12	*Flueggea leucopyrus*	Pandharphali	Phyllanthaceae	S			
13	*Helicteres isora*	Murad sheng	Sterculiaceae	S			
14	*Hibiscus rosa-sinensis*	Jaswand	Malvaceae		S		

Sr. No.	Scientific Name	Common/ Local Name	Family	Dense Vegetation	Human Settelement	Agricultural Fields	Water Bodies
15	*Holarrhena antidysenterica*	Kala Kuda	Apocynaceae	S		S	
16	*Lantana camara*	Ghaneri	Verbenaceae	S	S		
17	*Lawsonia inermis*	Henna, Mehendi	Lythraceae	S	S		
18	*Musa paradisiaca*	Banana	Musaceae			S	
19	*Nerium indicum*	Kanher	Apocynaceae		S		
20	*Opuntia sp.*	Fadya nivdung	Euphorbiaceae			S	
21	*Ricinus communis*	Erund/ Castor	Euphorbiaceae		S	S	
22	*Rosa indica*	Guab	Rosaceae		S		
23	*Salvadora persica*	Miswak	Salvadoraceae				S
24	*Sida rhomboidea*	Kurumthoti	Malvaceae	S			
25	*Thevetia neriifolia*	Bitty	Apocynaceae		S		
26	*Vitex negundo*	Nirgundi	Verbenaceae		S		S
27	*Woodfordia floribunda*	Dhaiti	Lythraceae	S			
28	*Ziziphus microphylla*	--	Rhamnaceae	S			
29	*Ziziphus rugosa*	Toran	Rhamnaceae	S			
	Herbs						
1	*Acanthus ilicifolius*	-	Acanthaceae				H
2	*Alternanthera sessilis*	--	Amaranthaceae	H			
3	*Argemone mexicana*	Satyanashi	Papaveraceae	H			
4	*Asparagus racemosus*	Shatavari	Asparagaceae	H	H	H	
5	*Boerhavia diffusa*	Hog weed/Punarnava	Nyctaginaceae	H			
6	*Canna indica*	Kradal	Cannaceae				H
7	*Chromolaena odorata*	--	Asteraceae	H			
8	*Colocasia esculanta*	Alu	Araceae			H	H
9	*Cyperus rotundus*	Cyperus	Cyperaceae				H
10	*Hyptis suaveolens*	--	Bilabiatae		H		
11	*Ipomoea carnea*	Besharam	Convolvulaceae				H
12	*Jussiaea suffruiticosa*	Pan lavang	Onagraceae				H
13	*Mimosa pudica*	Touch me not/ laajalu	Mimosaseae	H	H		
14	*Ocimum sanctum*	Holy Basil, Tulas	Lamiaceae		H		
15	*Sessuvium Portulacastrum*	-	Portulacaceae				H
16	*Tephrosia purpuria*	--	Fabaceae	H			
17	*Tricodesma indica*	Indian Borage, Chota Kulpha	Boraginaceae	H			
18	*Tridax procumbens*	Dagadi	Asteraceae	H			
19	*Urena sinuata*	hibiscus burr, Van Bhendi	Malvaceae	H			
	Climbers						

Sr. No.	Scientific Name	Common/ Local Name	Family	Dense Vegetation	Human Settelement	Agricultural Fields	Water Bodies
1	*Antigonon leptopus*	Ice-cream creeper	Polygonaceae		C		
2	*Bougainvillea spectabilis*	Bougainvellia	Nyctaginaceae		C		
3	*Clitoria ternatia*	Gokarn	Fabaceae		C		
4	*Cryptolepis buchanani*	-	Asclepiadaceae	C			
5	*Ficus repens*	-	Moraceace		C		
6	*Hemidesmus indicus*	Anantamul	Asclepiadaceae	C		C	
7	*Ipomoea aquatica*	Nalichi bhaji	Convolvulaceae				C
8	*Ipomoea pes-tigridis*	Tiger Foot Morning Glory	Convolvulaceae	C			
9	*Marsdenia volubilis*	cotton milk plant	Asclepidaceae	C			
10	*Quisqualis indica*	Rangoon creeper	Combrataceae		C		
11	*Thunbergia purpurea*	Morning glory	Convolvulaceae		C		
12	*Tinospora cordifolia*	Gulve (Amarvel)	Menispermaceae	C		C	
13	*Vitis repanda*	Nandanvel	Ampelideae	C			
	Epiphytes						
1	*Cuscuta reflexa*	Giant Dodder, Amar bel	Convolvulaceae		E		
	Ferns						
1	*Adiantum capilus veneris*	Maiden hair fern	Pteridaceae		F		
2	*Nephrolepis exeltata*	Sword fern	Lomariopsidaceae		F		
	Grasses						
1	*Bambusa bamboo*	Bamboo	Poaceae	G		G	
2	*Coix lachyma-jobi*	-	Poaceae			G	
3	*Cynodon dactylon*	Durva	Poaceae		G		
4	*Eragrostis unioloides*	Siteche pohe	Poaceae	G	G		
5	*Oplismenus burmannii*	Venupatrika	Poaceae	G	G		
6	*Oryza sativa*	Rice	Poaceae			G	

LetterT, S, H, C, G etc. Indicates presence of species in respective habitat
Source: BNHS Survey Report

TABLE 3.10.7
DURING SURVEY LIST OF FAUNA OBSERVED WITHIN STUDY AREA

Sr. No.	Scientific Name	Common/ Local Name	Family	Schedule
	Mammals			
1	*Lepus nigricolis*	Black napped hare	Leporidae	IV
2	*Bubalus bubalis*	Buffalo	Bovidae	
3	*Felis catus*	Cat	Felidae	
4	*Bos indicus*	Cow	Bovidae	
5	*Canis lupus familiaris*	Dog	Canidae	
6	*Pteropus giganteus*	Flying fox	Pteropodidae	IV
7	*Capra hircus*	Goat	Bovidae	
8	*Semnopithecus entellus*	Langur	Cercopithecidae	II
9	*Funambulus palmarum*	Squirrel	Sciuridae	
10	*Sus scrofa*	Wild boar	Suidae	III
	Reptiles			
1	*Calotes versicolor*	Common Garden Lizard	Agamidae	
	Birds			
1	*Accipiter badius*	Indian Shikra	Accipitridae	IV
2	*Acridotheres tristis*	Common Myna	Sturnidae	IV
3	*Actitis hypoleucos*	Common Sandpiper	Scolopacidae	IV
4	*Amaurornis phoenicurus*	White-breasted Waterhen	Rallidae	IV
5	*Anas poecilorhyncha*	Indian Spot-billed Duck	Anatidae	IV
6	*Anastomus oscitans*	Asian openbill stork	Ciconiidae	IV
7	*Anthus rufulus*	Paddy field Pipit	Motacillidae	IV
8	*Apus apus*	Common swift	Apodidae	IV
9	*Ardea cinerea*	Grey heron	Ardeidae	IV
10	*Ardea modesta*	great egret	Ardeidae	IV
11	*Ardea purpurea*	Purple Heron	Ardeidae	IV
12	*Ardeola grayii*	Indian pond heron	Ardeidae	IV
13	*Bubulcus ibis*	Cattle Egret	Ardeidae	IV
14	*Calidris ferruginea*	Curlew Sandpiper	Scolopacidae	IV
15	*Casmerodius albus*	Great Egret	Ardeidae	IV
16	*Centropus sinensis*	Greater Coucal	Cuculidae	IV
17	*Charadrius mongolus*	lesser sand plover	Charadriidae	IV
18	*Chlidonias hybrida*	Whiskered Tern	Laridae	IV
19	*Chroicocephalus genei*	Slender-billed Gull	Laridae	IV
20	*Cinnyris asiaticus*	Purple Sunbird	Nectariniidae	IV
21	*Columba livia*	Blue rock pigeon	Columbidae	IV
22	*Copsychus saularis*	Magpie Robin	Muscicapidae	IV
23	*Coracias benghalensis*	Indian Roller	Coraciidae	IV
24	*Corvus splendens*	House Crow	Corvidae	V
25	*Dicrurus macrocercus*	Black Drongo	Dicruridae	IV
26	*Egretta garzetta*	Little Egret	Ardeidae	IV
27	*Egretta gularis*	western reef heron	Ardeidae	IV
28	*Eudynamys scolopacea*	Koel	Cuculidae	IV
29	*Fulica atra*	Eurasian Coot	Rallidae	IV
30	*Galerida deva*	Crested lark	Alaudidae	IV
31	*Gelochelidon nilotica*	Gull-billed Tern	Laridae	IV
32	*Halcyon smyrnensis*	White-throated Kingfisher	Alcedinidae	IV
33	*Himantopus himantopus*	black-winged stilt	Recurvirostridae	IV
34	*Hirundo smithii*	Wire-tailed swallow	Hirundinidae	IV
35	*Hydroprogne caspia*	Caspian Tern	Sternidae	IV

Sr. No.	Scientific Name	Common/ Local Name	Family	Schedule
36	*Larus cachinnans*	Caspian Gull	Laridae	IV
37	*Larus ridibundus*	Black-headed Gull	Laridae	IV
38	*Merops orientalis*	green bee-eater	Meropidae	IV
39	*Mesophoyx intermedia*	Intermediate Egret	Ardeidae	IV
40	*Milvus migrans*	Black Kite	Accipitridae	IV
41	*Mirafra erythroptera*	Indian bush lark	Alaudidae	IV
42	*Mycteria leucocephala*	Painted Stork	Ciconiidae	IV
43	*Numenius arquata*	Eurasian Curlew	Scolopacidae	IV
44	*Numenius phaeopus*	Whimbrel	Scolopacidae	IV
45	*Passer domesticus*	House sparrow	Passeridae	IV
46	*Phalacrocoraxfuscicollis*	Indian Cormorant	Phalacrocoracidae	IV
47	*Phalacrocorax niger*	Little Cormorant	Phalacrocoracidae	IV
48	*Phoeniconaias minor*	Lesser Flamingo	Phoenicopteridae	I
49	*Phoenicopterus roseus*	Greater Flamingo	Phoenicopteridae	I
50	*Ploceus philippinus*	Baya	Ploceidae	IV
51	*Pluvialis squatarola*	Grey Plover	Charadriidae	IV
52	*Prinia Socialis*	Ashy prinia	Cisticolidae	IV
53	*Psittacula krameri*	Rose ringed Parakeet	Psittaculidae	IV
54	*Pycnonotus cafer*	Red vented Bulbul	Pycnonotidae	IV
55	*Pycnonotus jocosus*	Red whiskered bulbul	Pycnonotidae	IV
56	*Saxicoloides fulicata*	Indian Robin	Muscicapidae	IV
57	*Tachybaptus ruficollis*	Little Grebe	Podicipedidae	IV
58	*Tringa nebularia*	Common Greenshank	Scolopacidae	IV
59	*Tringa stagnatilis*	Marsh Sandpiper	Scolopacidae	IV
60	*Tringa totanus*	Redshank	Scolopacidae	IV
61	*Turdoides striata*	Jungle babbler	Leiothrichidae	IV
62	*Vanellus indicus*	Red-wattled lapwing	Charadriidae	IV
	Butterflies			
1	*Tirumala limniace*	Blue Tiger	Nymphalidae	IV
2	*Graphium Agamemnon*	Tailed Jay	Papilionidae	IV
3	*Delias eucharis*	Common Jezebel	Pieridae	IV
4	*Pachliopta hector*	Crimson Rose	Papilionidae	IV
5	*Tarucus indica*	Common pierrot	Lycaenidae	IV
6	*Eurema hecabe*	Common Grass Yellow	Pieridae	IV
7	*Danaus chrysippus*	Plane Tiger	Nymphalidae	IV
8	*Delias eucharis*	Common Jezebel	Pieridae	IV
9	*Junonia almanac*	Peacock pansy	Nymphalidae	IV
10	*Neptis laeta*	Common Sailer	Nymphalidae	IV
11	*Acraea terpsicore*	Tawny Coster	Nymphalidae	IV

Source: BNHS Survey Report

3.11 Marine Water Environment

3.11.1 Reconnaissance Survey for Marine Environment

The airport site is situated on south bank of the Panvel Creek. The hydrographic survey details prevailing at site is provided in navigational chart no. 211 for ‘Satpati to Dighi Harbour in a limited sense. Additional details are available in chart no. 911/2007 prepared by Maharashtra Maritime Board (MMB) presenting region from Belapur to Vaghini of Panvel creek, drawn to the scale of 1:5000.

The entire creek region has silty-clay bed as sediment deposits brought by freshet discharge from the river. While entering the mouth, obviously there is a sand bar formed by the interaction of the tidal currents and the sediment process at the mouth of the tidal inlet. Due to prevailing water shallow depths over the bar and the meandering shape of the creek, navigational difficulties are experienced through the entrance to the creek. Along both the banks of the creek, there are several jetties being in operation by private agencies, while due to presence of sediment deposits, there are several mangrove plants observed along the banks.

3.11.1.1 Physical Oceanography

Thane creek further branches into Panvel creek, which further branches to Belapur creek, where the site lies on south bank of Belapur creek.

Thane creek is a northern branch of the Mumbai creek. At the creek mouth, Bed material being dominated by silty clay in this region, the bed slope is correspondingly gentle. It is also experienced that from the open sea, wave propagation inside Mumbai creek is limited and further as it travels further inside the creek, lots of wave energy gets dissipated and the wave amplitude is further reduced. That is why Mumbai Port is known as a natural port. Further due to saturation of the workload, Jawaharlala Nehru Port (JNP) was developed in Thane creek at Nhava Sheva islands. The tidal range in Thane creek is around 4.5 m to 5.5 m and accordingly the creek has ability of self-maintenance of its shape. Obviously, the maintenance dredging of BPT as well as JNPT is of negligible quantity. It is observed from the survey chart that the creek has very good depths of water along its centerline. Water depths of 5 to 6 m are available below chart datum right upto Diwalegaon junction, which is on north bank of creek facing opposite to Site.

Just near Diwalegaon junction, Belapur creek gets initially bifurcated into two parts, one moving south while the other moves along the northern boundary. Due to flow separation and dominance of the sediments in the creek, there are island formations on both braches of the creek. Similarly, there is an elongated island, adjacent to Site with broad head on the South and sharp end on the northwards. This separates the flow in this branch into two parts. The western part close to Diwale is having good depths (4 m below CD) as compared to the eastern branch (2 to 3 m below CD). Further east of the Vaghivali is the large accretion of sediments leading to island formation in this area, surrounding Vaghivali village. Similarly, the northern branch also further gets bifurcated into three branches due to formation of islands. These creeks are narrow in width but have good depths along the center.

Based on the navigational charts and MMB detail survey chart, it is observed that creek is completely free from any problem of wave disturbance but there is dominant sedimentation process prevailing in the creek. The bed region has some rock outcrops only at the entrance to Mumbai creek, while the entire creek from Mumbai creek mouth to Thane or Panvel and further is mainly of silty clay. Obviously, sediments brought by the rivers/drains tend to get accumulated along the banks of the creek hence, all along the banks, there are mangrove developments under natural process. It is necessary to take care and formulate accordingly by leaving essential margins and distances from the mangroves satisfying rules and regulations of the Environment Protection Act.

Deepening of the channel though is not required, however possibility of sediment accretion along the banks due to rerouting of Ulwe River & training near Gadhi River mouth & in vicinity due to site reclamation during pre-development of project should be considered. Hence, it is essential to keep close watch on silting process of the channels and training of Gadhi River. Considering the existing depths and width of the channel, no wave disturbance in the creek is observed near the site and right from its origin of Mumbai creek to Diwalegaon junction.

3.11.1.2 Tides

Tidal observations are not taken in recent years near the proposed site. However, the predicted tide table regularly published by the Maritime Board of Maharashtra (MMB), provides information on the predicted values of high water and low water for entire year along with time of occurrence. The tidal station at Appolo Bundar, which is located in close proximity of the site has been taken under consideration. Similarly, the navigational chart 211 also provides information on the tides. The values of tidal water levels with respect to the Chart Datum indicated on the navigational chart no. 211 can be considered for this site also, which are given in **Table-3.11.1** below:

TABLE-3.11.1
CHART DATUM AS PER CHART NO 211

Details of Chart Datum	Value (m) (CD)
MHWS (Mean High water spring)	4.20
MHWN (Mean High water Neap)	3.30
MSL (Mean Sea Level)	2.50
MHLN (Mean High Water Neap)	1.80
MLLS (Mean High Water Spring)	1.00

It is clear from the values of mean HWL and LWL indicated above that the tidal range is quite good, just around 1.5m (Neap tide) to 3.20 m (spring tide).

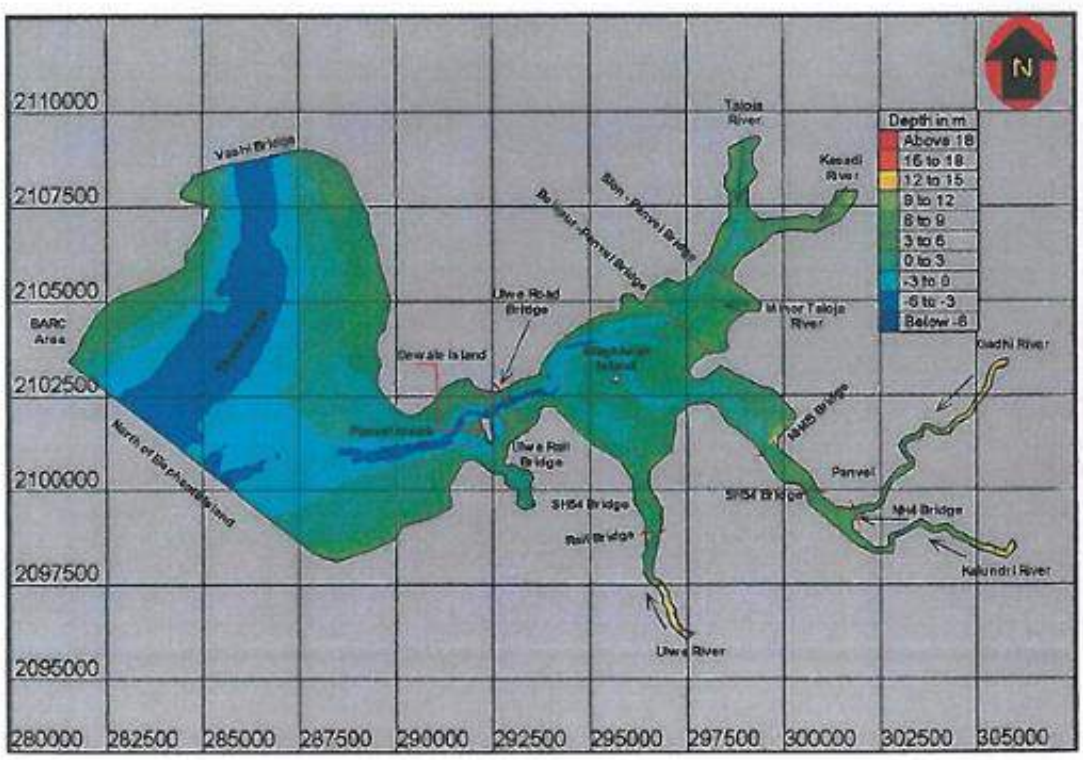
Tidal Currents

The tidal currents are driven by the tidal amplitude. Obviously if the tidal range is good, the tidal currents will also be of medium magnitude accordingly (say 0.4 to 0.5 m/s or so).

The coastline at the creek mouth is aligned almost North-South. Thus, waves approaching from Southwest direction will approach at an angel to the shoreline resulting in creating littoral currents. Due to sediment supply provided by the river discharge, corresponding littoral transport will also appear accordingly. During monsoon season, along with the fresh discharge brought from the upstream region and surrounding region of the creek, large quantity of the sediments will flow in the creek system and gets discharged to the creek, which tends to be accreted along the banks of the creek. However, the sediments get ultimately transported with fresh discharges to the sea and accretion does not go on building unlimited. There is a tendency of accretion taking place, wherever there is flow separation and large shallow sediment deposit may be the result at number of locations inside the creek.

Bathymetry of the Project Surrounding

Downstream all five rivers merge into Panvel Creek. Bathymetric chart indicates that depth of past Ulwe River basin passing through project site is ranging from minimum of -3 m to +3 m at proposed Airport site. However, bathymetric depth of Panvel creek channel is indicated to be in the range of -6 m to -3 m (**Figure-3.11.1**).



Source: CWPRS Technical Report No. 5384; March, 2016; Mathematcal Model Studies for Modified Layout of Proposed International Airport at Panvel, Navi Mumbai.

FIGURE-3.11.1
BATHYMETRY CHART OF PANVEL CREEK NEAR PROJECT SITE

3.11.1.3 Waves

Site is located in southern bank of Panvel creek along the west coast of India and various drains & river debauching in creek and ultimately to Arabian sea. The Arabian Sea and correspondingly the west coast of India is relatively calm in comparison to the Bay of Bengal. The Arabian Sea is rough only during the monsoon months of June-September. Rest of the year, the Arabian Sea is quite calm. The waves get propagated from the deep sea to reach the coast. The low-lying area extends over a large region in front of the shore, in this region. While waves propagate from the deep water to shallow region, it has to undergo the process of shoaling, refraction, diffraction during which considerable energy dissipation takes place. The project site being located well inside the Panvel creek, it will have practically no effect from waves & will not experience any disturbance even during monsoon.

The ship reported data from IMD for last 50 years period was studied and it was observed from the analysis of the data that:

- The maximum significant waves in the open sea, of 3.5 m to 4.5 m are seen to propagate from the deep sea with wave period of 10 to 14 seconds from westerly direction.
- The percentage of occurrence of these significant westerly waves varies from 20% to 40%. The amplitude reduced quite low.
- It is experienced that wave disturbance in Mumbai creek is not of considerable amplitude even in monsoon months. As a result, the waves get further filtered out and near site in Penvel creek no wave disturbance is experienced even during monsoon months.

3.11.1.4 Mangroves

The mangrove flora best known for their bio-richness, is well diversified in the study area. There are 13 species of mangroves and mangrove associates found in Maharashtra Coast. The faunal composition with 206 species of birds, 30 species of reptiles, 13 species of crabs, 7 species of prawns and 20 species of fish identified so far in the area is diverse in nature. The mangrove species reported are, in proximal zone *Avicennia sp, Sonneratia Caseolaris*. Middle zone has *Ceriops tagal, Rhizophora sp*and*Bruguiera sp*. The mangroves in the Panvel Creek are shown in following **Figure-3.11.2**.

FIGURE-3.11.2
IDENTIFIED MANGROVES NEAR PANVEL CREEK

These creeks have patches of mangrove coverage along the banks; it also attracts birds like gulls, avocets and curlews. For the purpose of listing, species present in area adjacent to/ on bank of water bodies are also considered & presented in Ecology biodiversity section.

As per Environmental and CRZ Clearance condition 7 (I) (iv) requires the plantation and protection of mangroves over an area of 615 ha (including Mangrove Park of 245 Ha at Waghivali island + 310 Ha to the North East + 60 Ha on the west near Moha creek). NMDP to be modified in this respect; accordingly, mangrove plantation over 370 ha is completed at respective places through Mangrove Cell, Govt. of Maharashtra. But, due to unavailability of land on Waghivli Island

Mangrove Park of 245 ha could not develop. There are bunds created by locals to restrict ingress of tidal water in to habituated area during hightide. This is one of the reasons of non-fulfillment of condition. However, NMDP is amended to earmarked area of 616.2 ha in four No Development Zone pockets as Mangrove Patches. This amended NMDP Map is approved by Government of Maharashtra vide G.R. dated 12th March 2012, map is shown **Figure No. 2.13** in **Chapter - 2.**

Mangroves within site have been removed in order to develop the airport. However, there is need to develop off-site infrastructure in order to efficiently support the functioning of the airport. This involves area of 108.67 ha of Mangrove land (together for airport site and off-site infrastructure development). This loss of mangrove cover will be compensated by providing double the area of loss of mangroves in accordance with the Hon. Mumbai High Court.As per Environmental and CRZ clearance obtained in November 2010, the mangrove plantation should be carried out on Vaghivali island admeasuring 245 ha. But, according to BNHS, this will attract birds leading to congregation and resulting into bird hazard. Therefore, it is opined that, condition of developing Mangrove Park at Waghivali needs to be reconsidered or examined further.

Details of mangroves and forest areas involved are given **Table-3.11.2**.

TABLE-3.11.2
AREA OF FOREST & MANGROVES

Sr. No.	Head	Area (Ha)
1	Mangrove area within site	98.0
2	Mangrove area in off-site infrastructure	10.607
3	Total Mangrove area	108.607
4	Forest land	141.4565
5	**Total Forest Area**	**250.0635**

As per Environmental and CRZ Clearancecondition 7 (I) (iii) requires permission to be obtained from Hon. Mumbai High Court and Clearance under Forest Conservation Act; accordingly, forest clearance vide F.No. 8-95/2012-FCdated 17th December 2013 (stage-I) and 24th April 2017 (stage-II) clearances are obtained for total area of 250. 0635 ha including Mangrove area – 108.607 ha. and Forest land - 141.4565 ha. Similarly, 250.0635 ha Degraded Forest Land taken up in Alibaug, Dahanu and Shahpur Division and total of 670,073 trees planted through Forest Department.

3.11.2 CRZ Mapping

CRZ mapping has been carried out by IRS Anna University, Chennai. The CRZ area is categorized based on MoEF&CC CRZ Notification, 2011. The project area of 1160 Ha alongwith airport layout has been superimposed on scale of 1:4000 and 1:25000. The detailed CRZ mapping report is included in this report as **Annexure-XV**.

Based on 2010 EC conditions, extensive hydrological modelling studies have been done through CWPRS, Pune, following which the erstwhile Ulwe River has been diverted out of airport site into Ulwe Recourse Channel (length 3.2 km) which has been developed south of NMIA. Institute of Remote Sensing (IRS) has conducted field verification survey during November 2020. It is observed that Ulwe River which was passing through NMIA site was diverted outside southern boundary of NMIA site by constructing an Ulwe Recourse Channel (URC).

CIDCO received the permission for Mangrove clearance within project development area from Bombay High Court. The Bombay High court passed Order dated 23rd Oct 2013 in Notice of Motion No. 419 of 2011 in PIL No. 87/2006 for clearing Mangroves at the site and accordingly CIDCO has cleared existing Mangroves and planted compensatory Mangrove plantation. Due to filling and reclamation activities in project site, no mangroves or intertidal zone was observed within NMIA site during IRS field verification survey. IRS has prepared CRZ map considering the present status of project site indicating the NMIA Master Plan along with reclaimed land, diverted Ulwe River is presented in **Figure-1.8** of **Chapter -1**

NMIAL has objected to the draft CZMP for Panvel Taluka prepared by MCZMA. NMIAL vide its letter dated 14th Feb'20 to MCZMA has already mentioned the Suggestion/ Objection/ Clarification regarding draft CZMP (2019) with respect to NMIA project site which is enclosed as ***Annexure – XV [A].*** *NMIAL has requested MCZMA to update the draft CZMP to indicate correct existing site conditions at respective locations within NMIA Site, particvualy the diversion of Ulwe River outside NMIA site area.*

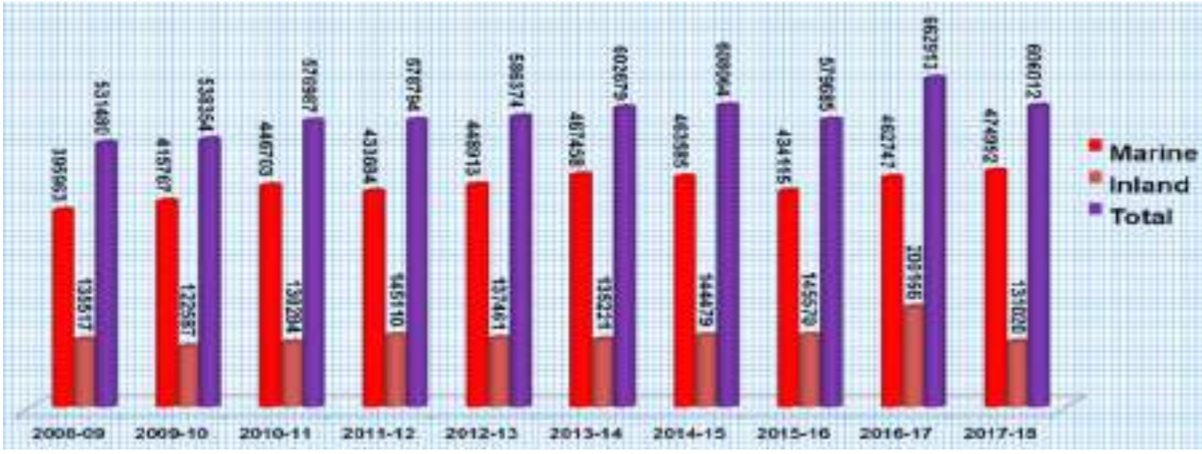
3.11.3 Fishing

Maharashtra is one of the major coastal states in India and Marine sector dominates the fishery sector. It has 720 Km long coastal line spread all over the five maritime districts viz. Thane, Mumbai and Suburban, Raigad, Ratnagiri and Sindhudurg. The continental shelf area upto 40 fathoms i.e., 55,529 sq.kms (50% of the total continental shelf) is being exploited. Marine sector is divided into 25 Zones along 5 districts and 173 landing centers.

The total fish potential of state is estimated at 6.0 lakh tonnes with marine fish production estimated at 4.75 lakh tonnes during the financial year 2017-18. About 49 varieties of marine fish species are recorded in Maharashtra state. The percentage of the Marine fish production to state potential is 78% during the year 2016-18.

In the decade from 2008-09 to 2017-18, total fish production for 2017-18 is estimated at 6,06,013 T with decrease of -8.58% over the previous year, inland fish production decreased by -34.54% & Marine fish production increased by 2.64% over the previous year. This is graphically presented in **Figure-3.11.3**.

Marine fish landings in Maharashtra during the year 2017-18 was estimated at 4,74,992 tonnes worth Rs. 6,288 crores registering an increase of 12,245 tonnes i.e., 2.58% compared to 2016-17 (4,62,747 tonnes). The landings in 2016-17 was an increase of 1.02% compared to 2013-14 (4,67,458 tonnes). Major fishing gears that supported the Marine fish landings was Trawlnet Mechanised boats in the state during the year 2017-18. Trawl fishing, Bagnet fishing, Gillnet fishing, Purseine, longliness and Rampan fishing are the principal fishing methods adopted. The list of fish species found is Maharashtra are given in **Table-3.11.3**.



Source: Fish Production Report 2017-18, Department of Fisheries, Gov of Maharashtra, Mumbai

FIGURE-3.11.3
FISH PRODUCTION (MT) OF MAHARASHTRA BETWEEN 2008-09 TO 2017-18 YEARS

TABLE-3.11.3
FISH SPECIES FOUND IN MAHARASHTRA STATE

Sr.No.	Scientific/Group Name	Common/English Name	Local Name in Marathi
1	*Anchoviella*	Golden Anchovye	Mandelli
2	*Black Pomfrets*	Black Pomfrets	Halwa
3	*Bregmaceros / Macelelendi*	Unicorn cod.	Tendali
4	*Carangids Small*	Other Carangids	Kokari, Toki
5	*Caranx*	Horse Mackerel	Kharba Bangada
6	*Cat Fishes*	Cat Fish	Shingada
7	*Cephalopoda*	Cuttle Fish	Mhakul
8	*Chirocentrus*	Silver bar/Walf Heming	Karli & Datali
9	*Eels*	Eels	Wam
10	*Elasmobranchs*	Shark & Rays	Mushi & Pakat
11	*Harpodon Nehereus*	Bombay Duck	Bombil
12	*Hilsa Ilisha / Toli*	Hilsa Shad & Giant Herrings	Bhing &Palla
13	*Lactarius*	Big-Jawed Jumper	Soundala
14	*Leiognathus*	Pony Fish	Khap
15	*Lobsters*	Lobster	Shewand
16	*Mackerel*	Indian Mackerel	Bangada
17	*Non-Penaeid Prawns*	Shrimp	Jawala, Karandi
18	*Other Clupeids*	White Sardines	Bhiljee, Khavali, Paturdi
19	*Otolithes species*	Cracker	Dhoma, dhodi
20	*Penaid Prawns*	Prawn	Kolambi
21	*Perches*	Groupers	Karkara, Khajura, Heum, Gobra
22	*Polynomids*	Thread Fins	Dadha & Rawas
23	*Pomfrets*	Pomfret	Saranga

Sr.No.	Scientific/Group Name	Common/English Name	Local Name in Marathi
24	*Red Snapper*	Red Snapper	Tamb
25	*Ribbon Fishes*	Ribbon Fish	Bala & Wakti
26	*Sardines*	Sardines & Oil Sardines	Pedwa, Pedi & Tarali
27	*Sciaenids*	Jew Fish & Dori	Ghol & Koth
28	*Seer Fishes*	Seer Fish	Surmai, Towar
29	*Soles*	Soles	Lep, Bhakas
30	*Thrissocles*	Mustached Anehovy	Kati
31	*Tunnies*	Tuna	Gedar, Kupa
32	*Upenaids Sp.*	Goat Fish	Chirati, Rane
33	Miscellaneous	Miscellaneous (Others)	Sankirna (Itar)

Over centuries, fishing villages in Maharashtra have evolved from primary fishing communities, Kolis & Bhandaris, and coastal culture and have sustained in the modern urban settings. In this coastal belt number of fishing villages exists with minor or negligible facilities too, while only few i.e., 173 landing centers are registered, have been extended with basic infrastructure facilities by various departments.

Mumbai, Thane & Navi Mumbai are important coastal cities that sustain rich fishery diversity despite being highly urbanized. Even today small fishing localities/villages exist in these urban areas and have retained their character. Fishing is the main occupation of a major percentage of population in these villages for a number of years; hence the significance of fishery cannot be ignored. But, over the years the tremendous growth in anthropogenic causes like widespread industrialization, developmental activities, population pressure, etc., off Mumbai, Thane & Raigad has made this sensitive eco-system vulnerable.

Over centuries fishing villages evolved from primary fishing communities, Kolis & Bhandaris, and coastal culture to coastal city. The site is surrounded with 5 fishing villages (**Figure-3.11.4**);

1. Ulwa-Moha - registered fish landing center in Mora karnja Zone, Raigad District. On left of Project site

2. Diwalegaon - registered fish landing center in Uttan Zone, Thane District. Bank Opposite in Belapur/Panvel Creek to Project Site in north.

3. Waghivali – non-registered minor fishing village with basic jetty facility in Gadhi River, Raigad District, along north boundary of project site

4. Jui - non-registered minor fishing village with basic jetty facility, Panvel, Thane District, Opposite to North-east boundary of project site across Gadhi River

5. Koliwada in Old Panvel- non-registered minor fishing village in upstream of Gadhi River, Panvel, Thane District, opposite to South-east corner of site

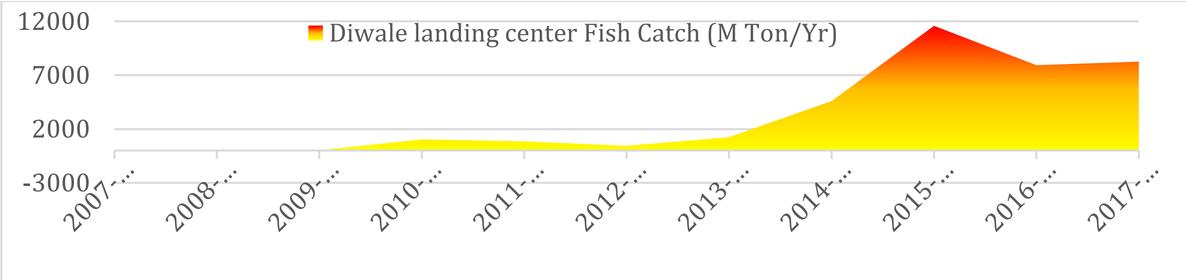
FIGURE-3.11.4
FISHING VILLAGES AROUND PROJECT SITE

The available Yearly fish catch/production comparison for 10 years (**Table-3.11.4**) was studied through graphical representation as below for the 2 registered landing centers viz, Diwale & Ulwa-Moha, which reveals gradual increase in yearly fish catch in few years. The growth of fish production is shown graphically in **Figure-3.11.5**.

TABLE-3.11.4
HISTORICAL DATA FOR MARINE FISH PRODUCTION AND NO. OF BOATS OPERATING IN DIWALE & ULWA-MOHA CENTERS, MAHARASHTRA (2007-2018)

Year	Diwale			Ulwa Moha		
	Fish Catch M Ton/Yr	Mech Boats	Non Mech Boats	Fish Catch M Ton/Yr	Mech Boats	Non Mech Boats
2007-2008	-	-	-	114	52	22
2008-2009	-	-	-	68	61	13
2009-2010	12	35	-	85	55	20
2010-2011	1035	15	10	79	55	15
2011-2012	846	12	20	64	55	15
2012-2013	442	16	40	70	62	18
2013-2014	1248	25	50	133	62	22
2014-2015	4586	140	50	95	65	25
2015-2016	11585	231	0	57	65	15
2016-2017	7932	231	50	215	63	6
2017-2018	8263	180	60	175	63	9

(Source: Fish Production Report 2017-18, Department of Fisheries, Gov of Maharashtra, Mumbai)



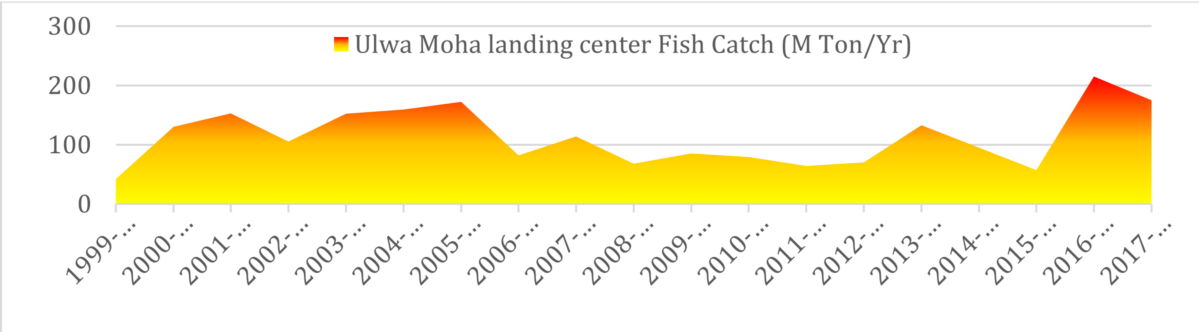


FIGURE-3.11.5
GRAPH OF FISH CATCH (M TON/ YR) AT DIWALE& ULWA-MOHA JETTY

Despite the existing stress on marine ecosystem in study area, the ongoing project activity of construction/operation phase seems to have least possible impact on marine fishing.

3.11.4 Interpretation of Marine Environment Samplig and Anlysis

3.11.4.1 Marine Water/Marine Sediment Sampling Locations)

Marine water quality in the study area was assessed in winter season for basic physico-chemical, nutrient & biological parameters to know the ststus of water quality.

The health status of surrounding marine environment was studied via spot samplings at Kalundre/ Gadhi River (W1 & W2), Panvel Creek (W3 to W6), Thane Creek (W7 & W8) at both Surface-Bottom levels considering the known number of anthropogenic & pollution causing sources in these natural courses. While in the at Ulwe Recourse Channel (W9 to W12) tidal spots were done with only surface level sampling due to inaccessibility by boat. Hence the analysis results are presented in separate tables along-with respective observations & discussions under subsequent sections. The description of marine sampling location is shown in following **Table-3.11.5**.

TABLE-3.11.5
DESCRIPTION OF MARINE SAMPLING LOCATIONS

Sr. No.	Sampling Location Code	Name of the Water Body	Geographic Coordinates
1	W1	Kalundre River	18°59'7.52"N;73°6'16.84"E
2	W2		19°0'16.55"N;73°5'0.82"E
3	W3	Panvel Creek	19°0'59.61"N;73°3'24.97"E
4	W4		19°1'27.79"N;73°4'19.29"E
5	W5		19°0'9.25"N;73°2'7.22"E
6	W6		18°59'39.26"N;73°1'11.75"E
7	W7	Thanke Creek	19°02’37.00” N;72°58’38.00” E
8	W8		19°00’23.40” N;72°57’ 23.60” E
9	W9	Moha Creek	18°58'41.88"N;73° 2'12.96"E
10	W10	Ulwe Re-course Channel	18°58'47.84"N;73° 2'42.96"E
11	W11		18°58'47.20"N;73°2'57.55"E
12	W12	Ulwe River	18°58'45.51"N;73°3'55.83"E

Sampling locations are presented in **Figure-3.11.6** and analysis results are shown **Table-3.11.6.**

3.11.4.2 Marine Water/Marine Sediment (Analysis Results)

Mairne Water/Sediment Quality Results

The station-wise laboratory analysis results of marine water quality and sediment quality around the proposed site including tidally influenced rivers and water bodies like Kalundre River, Ulwe River and Ulwe Re-course Channel is givenin **Table-3.11.6. (A-C)**

FIGURE-3.11.6
MARINE WATER SAMPLING LOCATIONS MAP

TABLE-3.11.6 (A)
MARINE WATER QUALITY ANALYSIS (KALAKUNDRE RIVER, PANVEL CREEK AND THANE CREEK)

Location	Kalundre River		Panvel/ Belapur Creek								Thane Creek			
	W1	W2	W3		W4		W5		W6		W7		W8	
Level	S	S	S	B	S	B	S	B	S	B	S	B	S	B
Depth(m)	0.5	2	4		3.5		5		6		10		8	
AT °C	31	33	35		33		33.3		30		30		31	
WT °C	30	32	34.6	33.3	32	31	32	31.1	28.1	27.1	26.8	25	28.1	27.7
pH	7.3	7.4	7.7	7.3	7.4	7.4	7.3	7.5	7.6	7.6	7.5	7.5	7.7	7.8
Salinity ppt	9.5	15.7	24.5	26.5	20.3	24.7	30.6	30.8	32.2	32.2	32.6	34.3	34.8	33.9
TDS (mg/l)	1790	17960	26980	28910	23270	27190	32620	33380	33830	34870	33750	34020	36090	36150
Turbidity (NTU)	5.9	9.2	8.9	10.1	6.9	7.6	8.9	10.2	6.3	8.4	8.6	9.1	7.9	10.2
SS (mg/l)	64	77	137	185	101	190	116	117	117	164	193	225	122	143
DO (mg/l)	1.9	1.9	4.3	3.7	3	3.4	1.9	2.1	2.2	2.6	2.4	2.6	2.1	2.1
BOD (mg/l)	1.7	1.7	2.6	3.4	2.8	2.8	1.5	1.1	1.3	1.9	1.5	1.7	1.5	1.7
NO2-N (µmol/l)	0.89	1.04	1.94	2.3	1.2	1.3	3.21	3.14	3.2	2.71	3.42	2.82	1.87	1.35
NO3-N (µmol/l)	0.58	3.22	19.26	16	12.8	15.82	30.4	25.54	34.64	34	31.3	29.5	28.94	28.72
NH4-N (µmol/l)	3.6	1.7	6.8	6.2	4.6	3.2	5.2	4.2	1.4	2.6	13.6	11.5	2.8	1.7
PO4-P (µmol/l)	2.23	2.19	2.12	2.24	2.78	3.13	1.03	0.83	0.68	0.69	1.12	1.87	0.53	0.6
Phenol (µg/l)	15.4	38.4	39.8		58.6		12.9		20.6		15.8		52.8	
PHc (µg/l)	3	3.7	4.1		4.8		3.7		3.2		4.5		3	

TABLE-3.11.6 (B)
MARINE WATER QUALITY ANALYSIS (MOHA CREEK, ULWE-RECOURSE CHANNEL AND ULWE RIVER)

Location	Moha Creek		Ulwe Re-course Channel				Ulwe River	
Tide-Level	W9		W10		W11		W12	
Parameters	HT -S	LT -S	HT -S	LT -S	HT -S	LT -S	HT -S	LT -S
AT °C	27.4	30.4	27.5	30.2	27.8	30.2	28	30.0
WT °C	26.9	28.9	26.9	29.1	26.8	29.0	26.8	29.2
pH	7.4	7.5	7.8	7.9	8.0	7.8	7.9	7.5
Salinity ppt	13.3	14.4	8.9	8.4	5.2	4.9	0.8	0.6
TDS (mg/l)	15720	15040	10530	9950	8780	6210	1220	960
Turbidity (NTU)	16.8	11.6	11	9.2	8.1	6.4	5.6	4.2

Parameters \ Location / Tide-Level	Moha Creek		Ulwe Re-course Channel				Ulwe River	
	W9		W10		W11		W12	
	HT -S	LT -S	HT -S	LT -S	HT -S	LT -S	HT -S	LT -S
SS (mg/l)	412	398	296	264	186	164	92	50
DO (mg/l)	1.0	0.6	1.3	0.7	1.0	1.1	1.2	1.5
BOD (mg/l)	0.6	0.2	0.5	0.3	0.4	0.5	0.5	0.2
NO2-N (µmol/l)	0.47	0.43	0.10	0.08	0.09	0.07	0.06	0.12
NO3-N (µmol/l)	37.30	36.72	27.52	25.70	30.44	30.15	14.16	16.57
NH4-N (µmol/l)	24.2	32.6	17.5	25.4	6.0	8.6	5.6	7.9
PO4-P (µmol/l)	2.3	2.0	1.8	1.5	0.8	0.7	0.3	0.3
Phenol (µg/l)	68.2	66.6	52.9	50.8	19.5	20.2	83.5	10.2
PHc (µg/l)	2.4	2.2	1.7	1.9	1.2	1.1	0.3	0.6

TABLE-3.11.6 (C)
SUB-TIDAL SEDIMENT QUALITY ANALYSIS

Parameters \ Locations		Kalundre River		Panvel Creek				Thane Creek		Moha Creek	Ulwe Re-Course Channel		Ulwe River
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12
pH		HARD BOTTOM	**6.8**	6.3	6.6	6.9	6.2	6.0	6.3	6.52	6.78	6.69	6.9
Texture %	Sand		1.6	1.8	1.1	2.4	8.2	2.8	42	65	53	32	
	Silt		60.4	68.8	80.8	72.6	80.2	58	35	27	34	48	
	Clay		38	29.4	18.1	25	11.6	39.2	23	8	13	20	
Organic carbon %			1.95	1.05	1.87	1.02	1.21	1.31	1.6	1.66	2.34	0.18	1.99
Zinc as Zn, µg/g			109	153	141	157	178	206	196	14.496	11.036	1.924	9.998
Chromium as Cr, µg/g			85	82	105	110	122	130	127	< 0.04	< 0.04	< 0.04	< 0.04
Cadmium as Cd, µg/g			0.2	0.1	0.4	0.3	0.5	0.4	0.6	< 0.04	< 0.04	< 0.04	< 0.04
Lead as Pb, µg/g			10.5	9.5	12.2	11.9	12.1	13.3	13.7	1.6	< 0.04	0.7	1.5
Mercury as Hg, µg/g			0.09	0.11	0.16	0.11	0.1	0.11	0.22	0.16	0.11	0.09	0.06
PHC, µg/g			0.9	1.1	1.2	1.6	1.5	1.4	1.7	0.018	0.011	0.011	0.009

3.11.4.3 Interpretation of Anlysis Results (Marine Water Quality)

The water temperature followed a routine comparable trend with that of Air temperature.

The pH value was in normal range, while DO values were observed on lower side - lowest values were in upstream locations (W1 & W2) which can be due to extended monsoons & discharge of various anthropogenic wastes. Similarly, the pH value was in normal range, with much lower salinity as we move towards upstream (station W12). DO within lower range further to it BOD was much lower. This may be due to minimum tidal flow and restrictions in free flow in the channel due to ongoing activities over this channel. The BOD values show no typical trend, except that the values at W3 & W4 in Belapur creek were higher than the rest of observations. Higher BOD values at W3 and W4 maybe due to discharge of treated effluents of Taloja CETP and discharges from NMMC STP in the area.

The total suspended solids were found quite high (Thane creek & Belapur creek mouth locations). The vessel traffic along with constant various discharges in the water column provides insufficient time to re-settle suspended load, and results in high Suspended Solids values. Dissolved solids and salinity values showed a trend from being lowest near Kalundre/ Gadhi River (SE of site) station W1 to being highest near the mouth of Panvel creek and are in expected range. Similarly, the total suspended solids were quite very high from mouth region i.e., in Moha creek, & URC Channel & low in Ulwe River location. The dissolve solids are in expected range & found comparable wrt salinity & other salts. The ongoing hill cutting & levelling activities near the water column must have led to high suspended load, resulting in high Suspended Solids values.

The lowest values of TDS at upstream stations of W1 (Kalundre) & W12 (Ulwe) are comparable with the low Salinity, suspended solids & Turbidity with also lower ionic components present therin.

Relative concentrations of Nitrate -Nitrite in locations W1 to W8 also indicates deterioration in water quality of the inner creek. While, relative concentrations of Nitrites in locations W9 to W12 were explicitly low while Nitrate values were very high indicating either source or active microbial growth in this channel. Comparatively high presence of Ammonia near Mouth region indicates sewer or domestic influx from nearby village-residents & also stagnancy with limitation in free flow

Phosphates, Phenols & PHc are within expected range. Overall water quality was comparable with earlier historical data in the region & indicates water quality is under stress or degrading. Although, Phosphates, Phenols & PHc near mouth region showed higher phenol values while PHcwas comparatively lower than rest of creek values. Overall data in the region indicates water quality is under stress due to ongoing activities at site & some domestic sources in Moha creek & upstream Ulwe River. Also, the channel is under stress due to the temporary number of bunds over it, restricting the free tidal flow.

3.11.4.3 Interpretation of Anlysis Results (Marine Sediment Quality)

The creek bed was mainly composed of silts & clay sediments. Overall, the concentration of metals varied in the expected ranges. Though certain metal values are noteworthy & must have been contributed by effluents from industries that of chlor-Alkali-metal dye-fertilizers etc and by sewage discharges.

Similarly, in mouth of Moha creek &upstream Ulwe River creek bed is mainly composed of (Sand) Gravel, silts & lesser clay, while Rocky strata is observed in URC channel. The sediment texture consisted of rocks cuts like gravel/pebbles due to newly formed channel through hill cutting hence sand (pebbles, gravels & rock cuttings) composition dominated in URC channel. The sediment texture observed at the bottom of URC is shown in **Figure-3.11.7**.

Overall, the concentration of metals & TOC varied in the expected ranges.

FIGURE-3.11.7
SEDIMENT TEXTURE AT URC BOTTOM

3.11.4.4 Interpretation of Anlysis Results (Biotoc Component)

Specific biological components of different trophic levels such as microbes, phytoplankton, Zooplankton and Benthos were studied to know marine ecosystem. Analysis results are presented in subsequent paragraphs.

- Microbiology

Based on Microbes count analysis in marine water quality and sediment qaulity (**Table-3.11.6 -D & E**), it is found that of Coliform microbes were present at all stations in water column & sediment with irregular trend. Amongst upstream locations, W1 was observed with comparatively higher value, while highest coliform counts were observed in Thane Creek & Panvel creek mouth. Presence of Coliform in upstream stations is attributed to disposal of sewage from surrounding habitations, while values at downstream & creek mouths are due to various untreated/ partially treated point domestic discharges in both Panvel & Thane creeks. Coliform counts in sediment were higher than that in sub tidal water column and the overall results confirms existing anthropogenic pressures.

TABLE-3.11.6 (D)
MICROBIAL COUNTS IN SURFACE WATER & SEDIMENTS (KALUNDRE RIVER, PANVEL & THANE CREEK)

Locations / Parameters	Kalundre River		Panvel Creek				Thane Creek	
	W1	W2	W3	W4	W5	W6	W7	W8
Total Coliform in Water (No x 10^3/ml)	14	8	3	4	12	22	60	26
Total Coliform in Sediment (No x 10^3/g)	No Sediment Sample due to Hard Bottom at W1	11	9	22	68	180	240	140

TABLE-3.11.6 (E)
MICROBIAL COUNTS IN SURFACE WATER & SEDIMENTS (MOHA CREEK, ULWE RE-COURSE CHANNEL & ULWE RIVER)

Locations / Parameters	Moha creek		Ulwe Re-course Channel				Ulwe River	
	W9		W10		W11		W12	
	HT	LT	HT	LT	HT	LT	HT	LT
Total Coliform in Water (No x 10^3/ml)	10.9	8.7	14.5	11.0	16.7	13.4	22.7	17.2
Total Coliform in Sediment (No x 10^3/g)	19.0		13.7		12.5		21.0	

The gradually increasing trend of total coliform from Moha creek mouth to Ulwe upstream shows sewage intrusion or discharges from Ulwe River, while the presence of higher coliform counts in sediment at Moha creek & Ulwe River along with fewer at Ulwe channel may be due to poor flushing.

❖ Phytoplankton

The Subtidal phytoplankton population and generic diversity observed at the sampling locations is given in**Table-3.11.7 (A & B)** and phytoplankton generic composition is given in **Table-3.11.8 (A & B)**.

TABLE-3.11.7 (A)
SUBTIDAL AREA PHYTOPIGMENTS, POPULATION AND GENERIC DIVERSITY

Location		Kalundre River		Panvel/ Belapur Creek				Thane Creek	
Parameter	Water Level	W1	W2	W3	W4	W5	W6	W7	W8
Chlorophyll- a (mg/m^3)	S	2.7	1.3	4.0	5.4	5.4	5.8	6.7	2.6
	B			2.7	2.7	1.3	1.4	4.18	1.34
Phaeophytin (mg/m^3)	S	3.9	11.8	7.2	18	1.1	16.3	5.5	11.5
	B			8.6	16	1.5	6.1	0.5	1.5
Cell Count (No x 10^4/L)	S	65.8	59.0	394	451	25.3	22.4	5.8	4.1
	B			304.5	485.4	22.4	13.4	32.2	4.3
Total Genera (No.)	S	19	16	11	15	15	15	13	19
	B	-	-	10	15	14	13	13	15
Major Genera	S	*Scenedesmus Actinastrum Navicula Tetraspora*	*Thalassiosira Skeletonema Chaetoceros Scenedesmus*	*Thalassiosira Chaetoceros Skeletonema Leptocylindrus*	*Thalassiosira Skeletonema Chaetoceros Nitzschia*	*Skeletonema Thalassiosira Chaetoceros Pleurosigma*	*Skeletonema Thalassiosira Pleurosigma Chaetoceros*	*Thalassiosira Pleurosigma Skeletonema Nitzschia*	*Skeletonema Thalassiosira Nitzschia Pleurosigma*
	B	-	-	*Thalassiosira Skeletonema Chaetoceros Leptocylindrus*	*Thalassiosira Skeletonema Leptocylindrus Chaetoceros*	*Chaetoceros Pleurosigma Thalassiosira Nitzschia*	*Skeletonema Pleurosigma Nitzschia Chaetoceros*	*Skeletonema Thalassiosira Pleurosigma Coscinodiscus*	*Skeletonema Thalassiosira Nitzschia Rhizosolenia*
Shannon Index	S	1.74	1.25	0.88	0.79	1.21	0.78	1.73	2.99
	B	-	-	0.62	0.37	0.66	0.83	0.33	1.74

TABLE-3.11.7 (B)
SUBTIDAL AREA PHYTOPIGMENTS POPULATION AND GENERIC DIVERSITY (MOHA CREEK, ULWE RE-COURSE CHANNEL & ULWE RIVER)

Locations	Moha creek		Ulwe Re-course Channel				Ulwe River	
Tide-Level	W9		W10		W11		W12	
Parameter	HT -S	LT -S	HT -S	LT -S	HT -S	LT -S	HT -S	LT -S
Chlorophyll-a (mg/m^3)	1.07	1.3	2.1	0.53	1.6	0.27	3.5	2.1
Phaeophytin (mg/m^3)	0.01	0.01	0.01	0.01	0.01	0.003	0.02	0.04
Cell Count (No x 10^3/L)	52.0	18.4	8	12.8	8.8	7.2	66.4	8.8
Total Genera (No.)	13	8	8	14	6	7	14	8
Major Genera	*Pseudonitzschia Leptocylindrus Navicula spirulina*	*Skeletonema Pleurosigma Thalassiosira Nitzschia*	*Nitzschia Navicula Thalassiosira Pleurosigma*	*Navicula Leptocylindrus Rhizosolenia Thalassiothrix*	*Oscillatoria Navicula Pleurosigma Coscinodiscus*	*Tetraspora Gyrosigma Nitzschia Thalassiosira*	*Euglena Scenedesmus Anabaena Navicula*	*Leptocylindrus Coscinodiscus Pleurosigma Nitzschia*
Shannon Index	1.56	1.12	2.03	1.75	1.54	1.75	1.99	1.89

TABLE-3.11.8 (A)
MARINE WATER PHYTOPLANKTON GENERIC PERCENTAGE COMPOSITION (KALUNDRE RIVER, PANVEL & THANE CREEKS)

Location	Kalundre River		Panvel/ Belapur Creek								Thane Creek			
Station & Water Level	W1	W2	W3		W4		W5		W6		W7		W8	
	Sur	Sur	Sur	Bot	Sur	Bot	Sur	Bot	Sur	Bot	Sur	Bot	Sur	Bot
Thalassiosira	0.0	56.31	53.81	82.76	70.96	90.65	29.75	2.14	8.57	0.60	45.83	1.24	9.80	11.11
Navicula	18.25	0.54	0.02	0.03	0.30	0.15	0.0	0.71	0.36	0.0	4.17	0.0	0.0	0.0
Skeletonema	1.46	23.41	40.61	6.57	24.66	8.24	56.33	0.0	82.50	81.55	13.89	94.29	33.33	50.00
Nitzschia	1.34	0.14	0.06	0.0	0.76	0.05	0.32	2.14	0.36	3.57	6.94	0.25	9.80	9.26
Prorocentrum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.92	0.0
Chaetoceros	0.0	13.91	5.18	9.46	2.39	0.18	6.65	87.14	2.14	1.19	0.0	0.0	1.96	0.0
Ceratulina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.85
Ceratium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.96	0.0
Pinnularia	0.0	0.0	0.0	0.0	0.0	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pleurosigma	0.0	0.14	0.02	0.03	0.02	0.02	2.85	3.57	2.50	7.74	15.28	1.24	5.88	1.85
Rhizosolenia	0.0	0.0	0.0	0.0	0.0	0.0	0.32	0.36	0.0	0.60	0.0	0.0	1.96	7.41
Thalassionema	0.0	0.0	0.0	0.0	0.0	0.0	0.32	0.0	0.36	0.60	0.0	0.50	3.92	1.85
Gyrosigma	0.12	0.14	0.02	0.03	0.02	0.08	0.32	0.36	0.0	0.60	2.78	0.25	0.0	1.85
Coscinodiscus	0.0	0.0	0.0	0.03	0.02	0.18	0.63	0.36	0.36	0.60	2.78	0.50	1.96	1.85
Noctiluca	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.96	1.85
Guinardia	0.0	0.54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphiprora	0.0	0.0	0.02	0.0	0.02	0.03	0.32	0.36	0.36	0.0	0.0	0.0	0.0	0.0
Cyclotella	0.0	0.81	0.04	0.24	0.04	0.0	0.95	1.43	0.36	1.19	1.39	0.0	1.96	0.0
Ditylum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.36	0.0	0.0	0.0	0.0	1.85
Surirella	0.0	0.0	0.0	0.0	0.0	0.02	0.32	0.36	0.71	0.0	1.39	0.25	0.0	0.0
Leptocylindrus	1.95	1.09	0.20	0.84	0.18	0.28	0.0	0.0	0.36	0.60	1.39	0.25	1.96	1.85
Scenedesmus	42.58	1.36	0.0	0.0	0.14	0.07	0.0	0.0	0.0	0.0	0.0	0.0	7.84	0.0
Biddulphia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.36	0.36	0.0	1.39	0.25	1.96	1.85
Peridinium	0.0	0.0	0.02	0.0	0.0	0.0	0.32	0.36	0.36	0.60	0.0	0.25	1.96	1.85
Bacteriestrum	0.0	0.0	0.0	0.03	0.0	0.0	0.32	0.0	0.0	0.0	1.39	0.50	1.96	0.0
Pediastrum	1.34	0.14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oscillatoria	0.73	0.14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anabaena	0.0	0.14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euglena	0.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Actinastrum	21.29	1.09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Staustratum	0.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.96	0.0
Tetraspora	3.28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cymbella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cosmarium	0.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tetrahedron	0.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lyrella	0.12	0.0	0.0	0.0	0.0	0.0	0.32	0.36	0.0	0.0	0.0	0.0	0.0	0.0
Closterium	0.12	0.0	0.0	0.0	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Synedra	3.16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.60	0.0	0.0	0.0	0.0
Phacus	0.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fragillaria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agmenellum	1.82	0.0	0.0	0.0	0.0	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Triceratium		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	1.39	0.25	3.92	3.70
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

TABLE-3.11.8 (B)
MARINE WATER PHYTOPLANKTON GENERIC PERCENTAGE COMPOSITION (MOHA CREEK, ULWE RE-COURSE CHANNEL & ULWE RIVER)

Locations / Tide-Level / Genera	Moha creek		Ulwe Re-course Channel				Ulwe River	
	W9		W10		W11		W12	
	HT -S	LT -S	HT -S	LT -S	HT -S	LT -S	HT -S	LT -S
Gyrosigma	1.5	4.3	10.0	0	0.0	11.1	0.0	9.1
Nitzschia	1.5	4.3	20.0	0	0.0	11.1	4.8	9.1
Thalassiosira	1.5	4.3	10.0	0	0.0	11.1	1.2	9.1
Skeletonema	1.5	69.6	0.0	0	0.0	0.0	0.0	0.0
Pleurosigma	1.5	4.3	10.0	0	9.1	0.0	6.0	9.1
Thalassiothrix	0.0	4.3	0.0	6.3	0.0	0.0	0.0	0.0
Cymbella	1.5	4.3	0.0	0.0	0.0	0.0	0.0	0.0
Rhizosolenia	0.0	4.3	0.0	12.5	0.0	11.1	0.0	9.1
Navicula	7.7	0.0	20.0	43.8	18.2	0.0	6.0	0.0
Leptocylindrus	18.5	0.0	10.0	12.5	9.1	0.0	1.2	36.4
Coscinodiscus	0.0	0.0	10.0	6.3	9.1	0.0	0.0	9.1
Lithodesmium	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0
Guinardia	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0
Spirulina	4.6	0.0	0.0	6.3	0.0	0.0	0.0	0.0
Tetraspora	0.0	0.0	0.0	0	0.0	44.4	0.0	0.0
Peridinium	0.0	0.0	0.0	0	0.0	11.1	2.4	9.1
Oscillatoria	0.0	0.0	10.0	0	45.5	0.0	0.0	0.0
Pseudonitzschia	55.4	0.0	0.0	0	0.0	0.0	0.0	0.0
Planktoniella	1.5	0.0	0.0	0	0.0	0.0	0.0	0.0
Lauderia	1.5	0.0	0.0	0	0.0	0.0	0.0	0.0
Melosira	1.5	0.0	0.0	0	0.0	0.0	0.0	0.0
Syendra	0.0	0.0	0.0	0	9.1	0.0	0.0	0.0
Euglena	0.0	0.0	0.0	0	0.0	0.0	43.4	0.0
Closterium	0.0	0.0	0.0	0	0.0	0.0	4.8	0.0
Pediastrum	0.0	0.0	0.0	0	0.0	0.0	3.6	0.0
Staustratum	0.0	0.0	0.0	0	0.0	0.0	1.2	0.0
Scenedesmus	0.0	0.0	0.0	0	0.0	0.0	10.8	0.0
Anabaena	0.0	0.0	0.0	0	0.0	0.0	10.8	0.0
Agmenellum	0.0	0.0	0.0	0	0.0	0.0	2.4	0.0
Actinastrum	0.0	0.0	0.0	0	0.0	0.0	1.2	0.0
Total	100.0	100.0	100.0	100	100	100.0	100.0	100.0

❖ Phytoplankton Analysis (Kalundre River, Panvel & Thane Creeks)

The Chlorophyll-a ranges from 1.3-6.7 mg/m3, with showing lowest chlorophyll at surface level of W2 and highest chlorophyll at surface level of W7; phytoplankton population density ranges from 4.1-485.4 x 104/l, with Lowest value at surface - bottom level of W8 and highest at Surface - bottom level of W4; total generic groups range from 10-29 nos., showing lowest at Bottom level of W3 and highest at Surface of W8. Total Generic groups observed across all 8 location of study region are 42, of which, Thalassiosira, Skeletonema, Chaetoceros, Nitzschia and Leptocylindrus are the most common, followed by other genera like Pleurosigma, Coscinodiscus, Gyrosigma, Cyclotella.

Dominant phytoplankton population, which were found in the waterbody mostly comprise chain type, namely Chaetoceros, Skeletonema and Nitzschia; and small disc shaped majorly Thalassiosira.

Fresh water genera, like Scenedesmus, Pediastrum, Euglena, Staurastrum, Agmenellum, Fragillaria, Closterium etc, few of these have pictorial depiction as below (**Figure-3.11.8**).

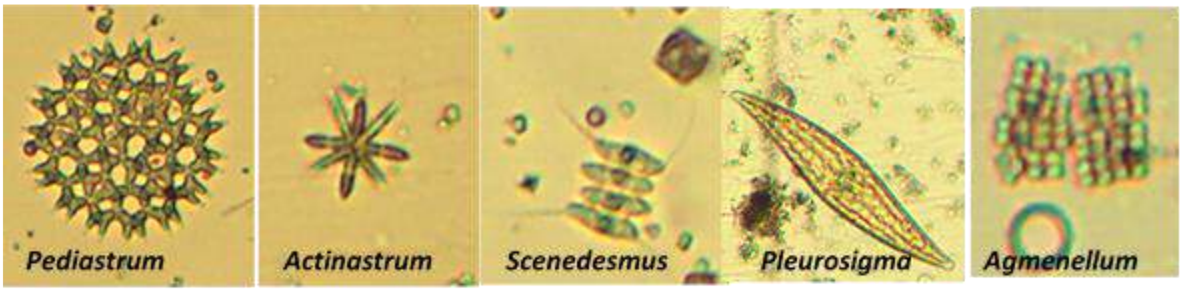


FIGURE-3.11.8
PHYTOPLANKTON STUDIED AT KALUNDRE RIVER, PANVEL & THANE CREEKS

Graphical representation of chlorophyll and phytoplankton population and genera is given in figures below (**Figure-3.11.9**).

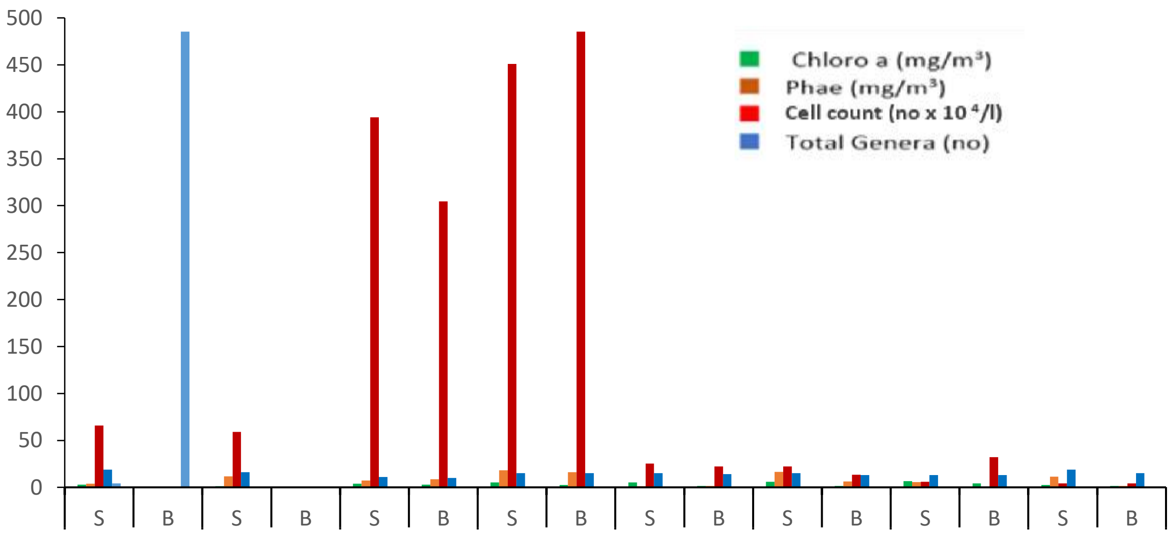


FIGURE-3.11.9
PHYTO-PIGMENTS, CELL COUNT AND DEPICTS DIVERSITY AT KALUNDRE RIVER, PANVEL & THANE CREEKS

The above graph of phyto-pigments, cell counts & total genera represent typical noteworthy impacts at W4 –W3 & W7-W8 respectively.

❖ Phytoplankton Analysis (Moha Creek, Ulwe Re-Course Channel & Ulwe River)

The Chlorophyll-a ranges from 0.27-3.5 mg/m^3, with low chlorophyll in W11 during Low Tide and highest chlorophyll at W12 during High Tide at surface level respectively; phytoplankton population density ranges from 7.2-66.4 x 10^3/l, Lowest in W11 during Low Tide and highest in W12 during High Tide respectively at surface level. Total generic groups range from 6-14 nos., showing lowest 6 nos. at surface level of W11 during Low Tide and highest at Surface level of W10 during Low Tide and W11 during High Tide as 14 nos. respectively. Total Genera were noted as 30 nos. of which, Thalassiosira, Navicula, Nitzschia and Leptocylindrus are the most common Genera noted in all 4 stations in Ulwe River Course followed by other genera like Gyrosigma, Pleurosigma, Coscinodiscus as other major genera. Fresh water phytoplankton Scenedesmus, Pediastrum, Euglena, Staurastrum, Agmenellum, Actinastrum, Closterium etc. were noted only at W12 during High Tide only which confirms influence of freshwater at stn 12 in Ulwe River. Other fresh water phytoplankton observed is Oscillatoria which was found at W10 & W11 only during High Tide.

Fresh water genera, like Scenedesmus, Pediastrum, Euglena, Staurastrum, Agmenellum, Fragillaria, Closterium etc, few of these have pictorial depiction as below (**Figure-3.11.10**).

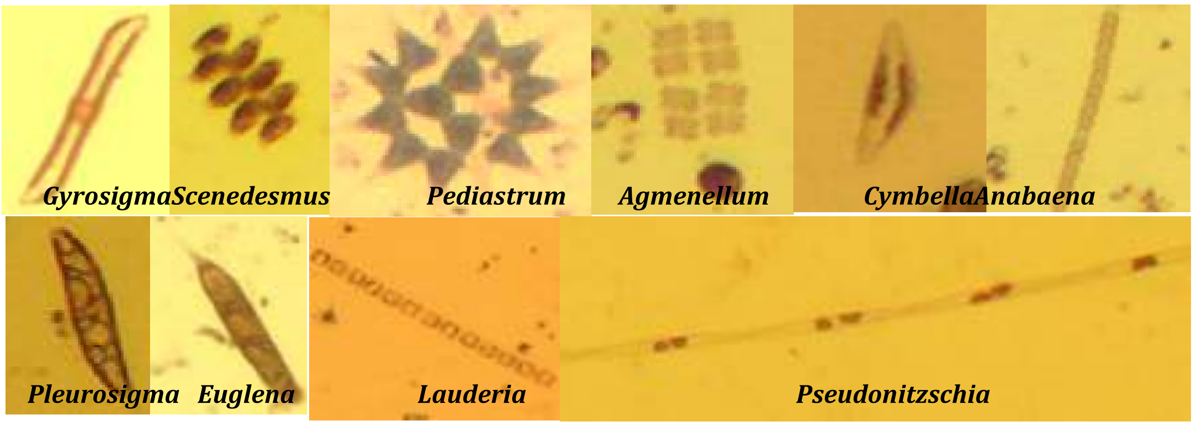


FIGURE-3.11.10
PHYTOPLANKTON STUDIED AT MOHA CREEK, ULWE RE-COURSE CHANNEL & ULWE RIVER)

Graphical representation of chlorophyll and phytoplankton population and genera is given in figures below (**Figure-3.11.11**).

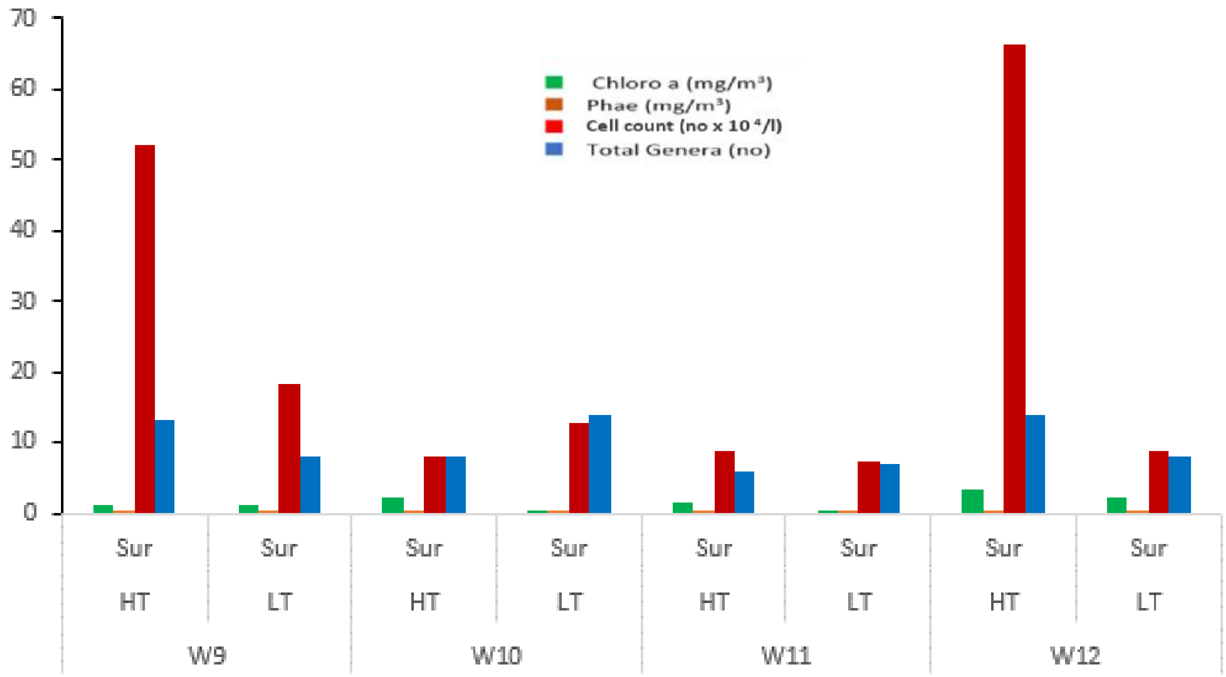


FIGURE-3.11.11
PHYTO-PIGMENTS, CELL COUNT AND DEPICTS (MOHA CREEK, ULWE RE-COURSE CHANNEL & ULWE RIVER)

❖ Zooplankton

In winter 2020, the zooplankton biomass & population density varied broadly with an average faunal diversity. It is shown in **Table-3.11.9 (A & B)** and **Table-3.11.10**. **(A & B)**

TABLE-3.11.9 (A)
ZOOPLANKTON STANDING STOCK OF MARINE WATER SAMPLE

Locations	Biomass (ml/100m^3)	Total Population (NOx 10^3/100m^3)	Total Groups (no)	Major Groups	Shanon Diversity Index
W1	12.50	703	6	Cladocera Copepoda Polychaetes	0.30
W2	2.50	66	2	Cladocera Copepoda	0.509
W3	2.50	1680	4	Copepoda Polychaetes Gastropods	0.02
W4	10.00	321	2	Copepoda Gastropods	0.01
W5	7.81	33	4	Copepoda Medusae Polychaetes	0.10

Locations	Biomass ($ml/100m^3$)	Total Population (NOx $10^3/100m^3$)	Total Groups (no)	Major Groups	Shanon Diversity Index
				Gastropods	
W6	1.71	32	10	Copepoda Medusae Decapoda larvae	0.11
W7	62.96	194	14	Copepoda Decapoda larvae Ctenophora	0.33
W8	6.03	66	14	Copepoda Decapoda larvae Chaetognaths	0.37
Min - Max (Avg)	1.71 - 62.96 (13.251)	32 - 1680 (387)	2.00 - 14.00 (7)	Copepoda, Cladocera Decapoda larvae Medusae	0.01 - 0.51 (0.219)

TABLE-3.11.9 (B)
ZOOPLANKTON STANDING STOCK OF MARINE WATER (MOHA CREEK, ULWE RE-COURSE CHANNEL& ULWE RIVER)

Station location	Biomass ($ml/100m^3$)	Total Population (nox $10^3/100m^3$)	Total Groups (no)	Major Groups	Shanon Diversity Index
W9 (HT)	NIL				
W10 (HT)	NIL				
W11 (HT)	0.04	0	4	Cladocera Copepoda Foraminiferans Amphipods	1.24
W11 (LT)	0.03	0	2	Gastropods Copepoda	0.64
W12 (HT)	0.06	1	6	Cladocera Copepoda Ostracods Prawn larvae	1.61
W12 (LT)	2.74	4	6	Copepoda Cladocera Ostracods Gastropods	1.39
Min Max Av	0.00-2.74 0.359	0-4 1	0-6 2	Cladoceran Copepods Gastropods Ostracods	0.00-1.61 0.609

TABLE-3.11.10(A)
ZOOPLANKTON PERCENTAGE COMPOSITION OF MARINE WATER (KALUNDRE RIVER, PANVEL & THANE CREEKS)

Location		Kalundre River		Panvel/ Belapur Creek				Thane Creek		%
Sr No	Groups	W1	W2	W3	W4	W5	W6	W7	W8	
1	*Acetes* Sp	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.01
2	Amphipods	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.01
3	Appendiculareae	0.00	0.00	0.00	0.00	0.00	0.05	0.11	0.04	0.03
4	Bivalve	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Chaetognaths	0.00	0.00	0.00	0.00	0.00	0.01	1.15	0.61	0.22
6	Cladocera	93.10	79.39	0.00	0.00	0.00	0.00	0.00	0.00	21.56
7	Copepoda	5.27	20.61	99.70	99.84	98.07	98.44	93.69	92.03	75.96
8	Ctenophora	0.00	0.00	0.00	0.00	0.00	0.00	1.59	0.02	0.20
9	Decapoda larvae	0.00	0.00	0.00	0.00	0.00	0.42	2.59	5.62	1.08
10	Doliolum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	Fish Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.44	0.06
12	Fish Larvae	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01
13	Foraminiferans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	Gastropods	0.00	0.00	0.03	0.16	0.04	0.23	0.04	0.10	0.07
15	Heteropods	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	Isopods	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00
17	Lamellibranch	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.13	0.04
18	*Lucifer sp*	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.31	0.11
19	Medusae	0.07	0.00	0.03	0.00	1.80	0.61	0.06	0.51	0.38
20	Polychaetes	0.28	0.00	0.24	0.00	0.09	0.02	0.09	0.07	0.10
21	Prawn larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	Pteropods	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Rotifers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	Salp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Siphonophores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Stomatopods	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	Mysids	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	Cumacean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	Ostracods	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
30	Others	1.21	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.16
	Total	100	100	100	100	100	100	100	100	100

TABLE-3.11.10(B)
ZOOPLANKTON PERCENTAGE COMPOSITION OF MARINE WATER (KALUNDRE RIVER, PANVEL & THANE CREEKS)

Location		Kalundre River		Panvel/ Belapur Creek				Thane Creek		%
Sr No	Groups	W1	W2	W3	W4	W5	W6	W7	W8	
1	*Acetes* Sp	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.01
2	Amphipods	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.01
3	Appendiculareae	0.00	0.00	0.00	0.00	0.00	0.05	0.11	0.04	0.03
4	Bivalve	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Chaetognaths	0.00	0.00	0.00	0.00	0.00	0.01	1.15	0.61	0.22
6	Cladocera	93.10	79.39	0.00	0.00	0.00	0.00	0.00	0.00	21.56
7	Copepoda	5.27	20.61	99.70	99.84	98.07	98.44	93.69	92.03	75.96
8	Ctenophora	0.00	0.00	0.00	0.00	0.00	0.00	1.59	0.02	0.20
9	Decapoda larvae	0.00	0.00	0.00	0.00	0.00	0.42	2.59	5.62	1.08
10	Doliolum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	Fish Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.44	0.06
12	Fish Larvae	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01
13	Foraminiferans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Location		Kalundre River		Panvel/ Belapur Creek				Thane Creek		%
Sr No	**Groups**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	
14	Gastropods	0.00	0.00	0.03	0.16	0.04	0.23	0.04	0.10	0.07
15	Heteropods	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	Isopods	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00
17	Lamellibranch	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.13	0.04
18	*Lucifer sp*	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.31	0.11
19	Medusae	0.07	0.00	0.03	0.00	1.80	0.61	0.06	0.51	0.38
20	Polychaetes	0.28	0.00	0.24	0.00	0.09	0.02	0.09	0.07	0.10
21	Prawn larvae	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	Pteropods	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Rotifers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	Salp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Siphonophores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Stomatopods	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	Mysids	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	Cumacean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	Ostracods	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
30	Others	1.21	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.16
	Total	100	100	100	100	100	100	100	100	100

❖ Zooplankton Analysis (Kalundre River, Panvel & Thane Creeks)

Copepoda, Cladocerans, Decapod larvae & Medusae were common observed groups. The standing stock at Panvel creek upstream location shows lower group diversity as compared to Thane creek stations. Cladoceran, Polychaete groups were overtaken by decapod larvae, Medusae & ctenophores when compared from upstream locations to Panvel creek mouth & in Thane creek.

Graphically the zooplankton standing stock was found productive & divergent at many locations & typically optimum at Thane creek & Panvel creek mouth (**Figure-3.11.12**).

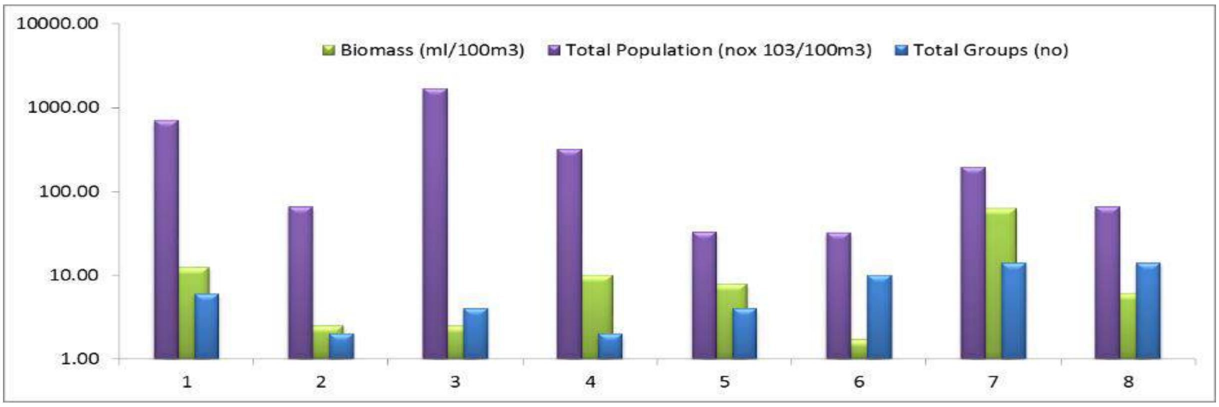


FIGURE-3.11.12
GRAPHICAL REPRESENTATION OF ZOOPLANKTON STANDING STOCK (KALUNDRE RIVER, PANVEL & THANE CREEKS)

❖ Zooplankton Analysis (Moha Creek, Ulwe Re-Course Channel & Ulwe River)
Cladocerans Copepoda & Ostracods were common observed groups. The standing stock in mouth location (Moha Creek) shows "NIL" while low presence

is seen in rest of URC channel locations & better biomass, population & group were observed at Ulwe River (Upstream) Location. The weak presence of zooplankton is supported by low DO & also lower phytoplankton population in overall URC locations.

The below **Figure-3.11.13** shows certain zooplankton groups found during sample analysis in study area, Winter 2020.

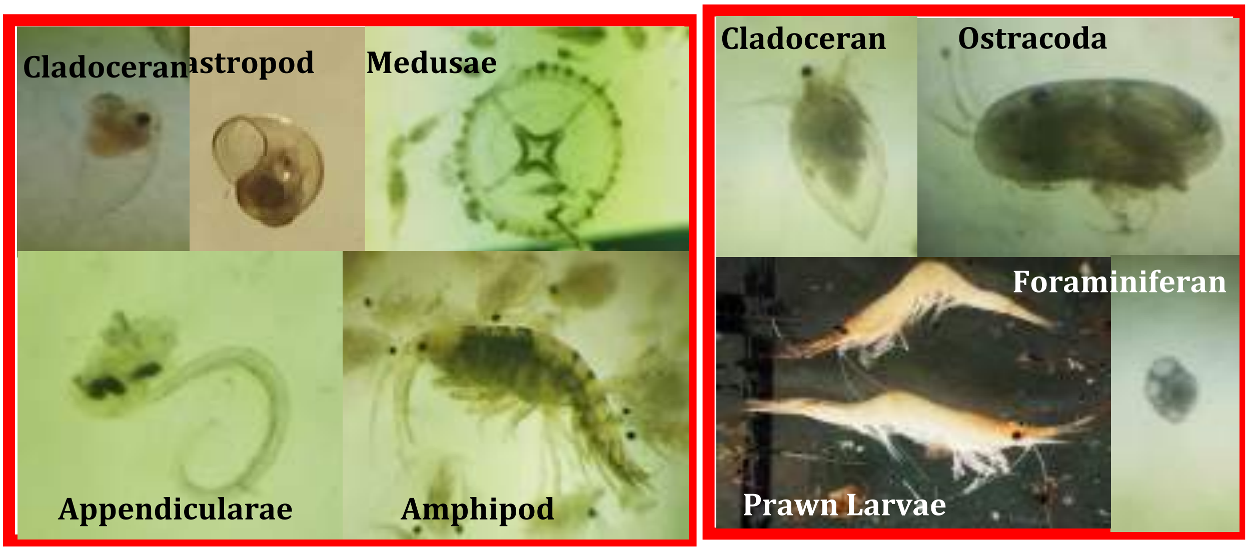


FIGURE-3.11.13
COMMON ZOOPLANKTON IDENTIFIED MARINE SAMPLE
KALUNDRE RIVER, PANVEL & THANE CREEKS, MOHA CREEK, URC & ULWE RIVER

Graphically the zooplankton standing stock at Moha Creek, URC and Ulwe River is shown below (**Figure-3.11.14**).

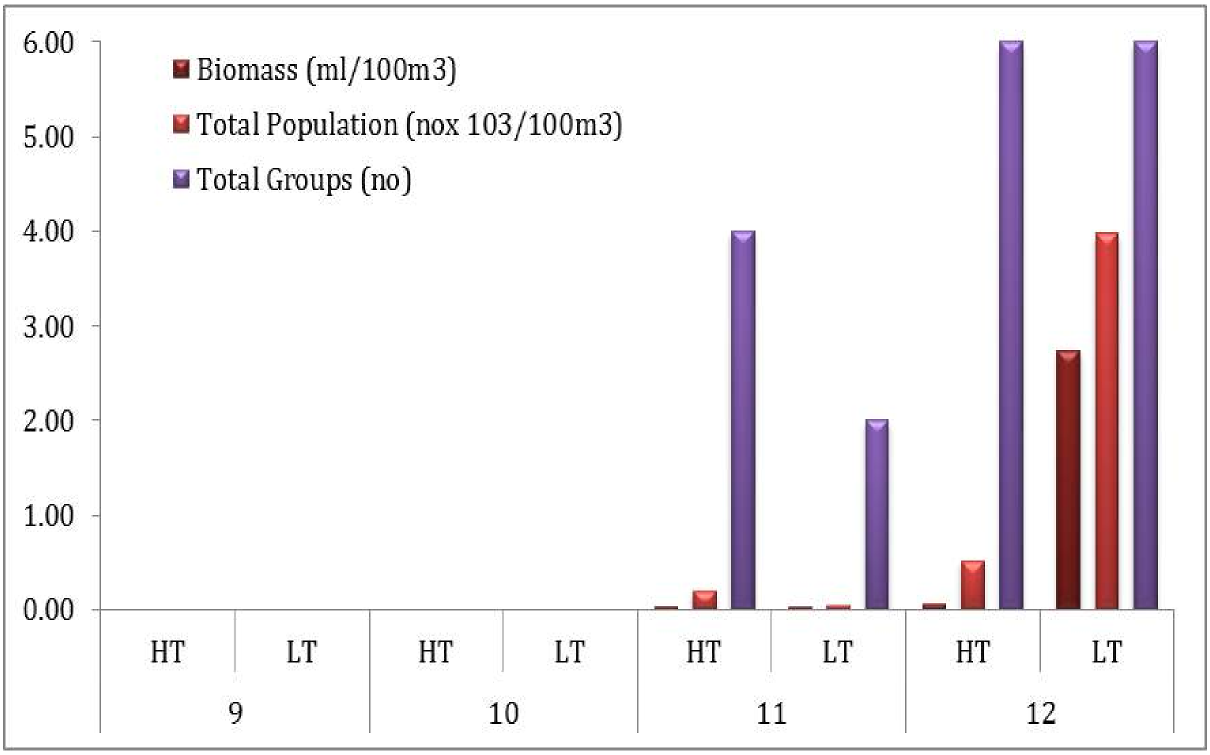


FIGURE-3.11.14
GRAPHICAL REPRESENTATION OF ZOOPLANKTON STANDING STOCK (KALUNDRE RIVER, PANVEL & THANE CREEKS)

Benthos

Based and sampling and anlayis, the population sub-tidal macrobenthos is given in **Table-3.11.11 (A & B)** and the percentage composition of the sub-tidal benthics are given in **Table-3.11.12 (A & B).**

TABLE-3.11.11 (A)
MACROBENTHOS, POPULATION DENSITY
(KALUNDRE RIVER, PANVEL & THANE CREEKS)

Station Location	Biomass (gm/ m2)	Population Density (no x 102/m2)	Total Faunal Groups	Major faunal group	Shanon Diversity Index
W1	HARD BOTTOM				
W2	3.89	37.91	1	Polychaetes	0.000
W3	505.34	150.81	3	Pelecypods, Gastropod, Polychaetes	0.891
W4	66.38	107.07	1	Polychaetes	0.000
W5	2.31	24.16	2	Polychaetes, Gastropod	0.204
W6	14.90	5.83	2	Polychaetes,	0.520

Station Location	Biomass (gm/ m2)	Population Density (no x 102/m2)	Total Faunal Groups	Major faunal group	Shanon Diversity Index
				Sipuncula	
W7	0.96	2.92	1	Polychaetes	0.000
W8	0.42	3.75	1	Polychaetes	0.000
Min - Max (Av)	0.00 - 505.34 (74.27)	0.00 – 150.81 (41.56)	1 – 3 (1)	Polychaetes, Gastropods, Amphipod	0.201

TABLE-3.11.11(B)
MACROBENTHOS, POPULATION DENSITY
(MOHA CREEK, ULWE RE-COURSE CHANNEL& ULWE RIVER)

Station Location	Biomass (gm/m^2)	Population Density ($nox10^2/m^2$)	Major faunal group	Faunal Group	Shanon Diversity Index
9	20.55	37.08	Polychaete Gastropod	3	0.169
10	158.27	117.90	Pelecypods Gastropod	3	0.116
11	0.00	0.00	Polychaete Polychaete	0	0.000
12	0.04	1.67	Amphipod Oligochaetae	2	0.347
Min Max Av	0.0-158.27 (44.71)	0.0-117.90 (39.16)	Polychaete, Gastropods, Bivalve, Amphipod	0-3 (2)	0-0.34 (0.16)

TABLE-3.11.12(A)
SUBTIDAL BENTHIC PERCENTAGE COMPOSITION
(KALUNDRE RIVER, PANVEL & THANE CREEKS)

Station Location	Kalundre River		Panvel/ Belapur Creek				Thane Creek	
	W1	W2	W3	W4	W5	W6	W7	W8
Polychaete	Hard Bottom	100.0	11.88	100.00	94.83	78.57	100.00	100.00
Pelecypods		-	62.98	0.00	0.00	0.00	0.00	0.00
Sipuncula		-	0.00	0.00	0.00	21.43	0.00	0.00
Gastropod		-	25.14	0.00	5.17	0.00	0.00	0.00
Total		100.0	100.0	100.00	100.00	100.00	100.00	100.00

TABLE-3.11.12 (B)
SUBTIDAL BENTHIC PERCENTAGE COMPOSITION
(MOHA CREEK, ULWE RE-COURSE CHANNEL& ULWE RIVER)

Locations		Moha creek	Ulwe Re-course Channel		Ulwe River	%
Sr No	Groups	9	10	11	12	
1	Polychaete	96.63	0.00	0.00	0.00	32.21
2	Pelecypods	0.00	97.88	0.00	0.00	32.63
3	Crab	1.12	0.00	0.00	0.00	0.37
4	Amphipod	0.00	0.71	0.00	50.00	16.90

Locations		Moha creek	Ulwe Re-course Channel		Ulwe River	%
Sr No	Groups	9	10	11	12	
5	Gastropod	2.25	1.41	0.00	0.00	1.22
6	Oligochaetae	0.00	0.00	0.00	50.00	16.67
	Total	100.00	100.00	0.00	100.00	100.0

It is observed based on macro-benthos studies at URC shows typical observation wrt to newly made connecting channel from Moha creek to Ulwe River. Though the faunal group diversity was observed low yet the noteworthy "re-instating" of benthic biota on rock cuttings at W10 was observed. The Moha creek location had number of mangroves & the benthic fauna here was entirely dominated by polychaetes. The Benthos at W11 & W12 was near to NIL, this may be due to the continuous ongoing Hill cutting & land levelling activities in proximity.

Macro benthos studies showed indifferent benthic pattern. The faunal group diversity observed is low. The benthic fauna was entirely dominated by polychaetes except at W3.

The percentage population are represented in graphical form in **Figure-3.11.15 (A & B)** and common benthic fauna found at sampling locations is shown in **Figure-3.11.16 (A & B).**

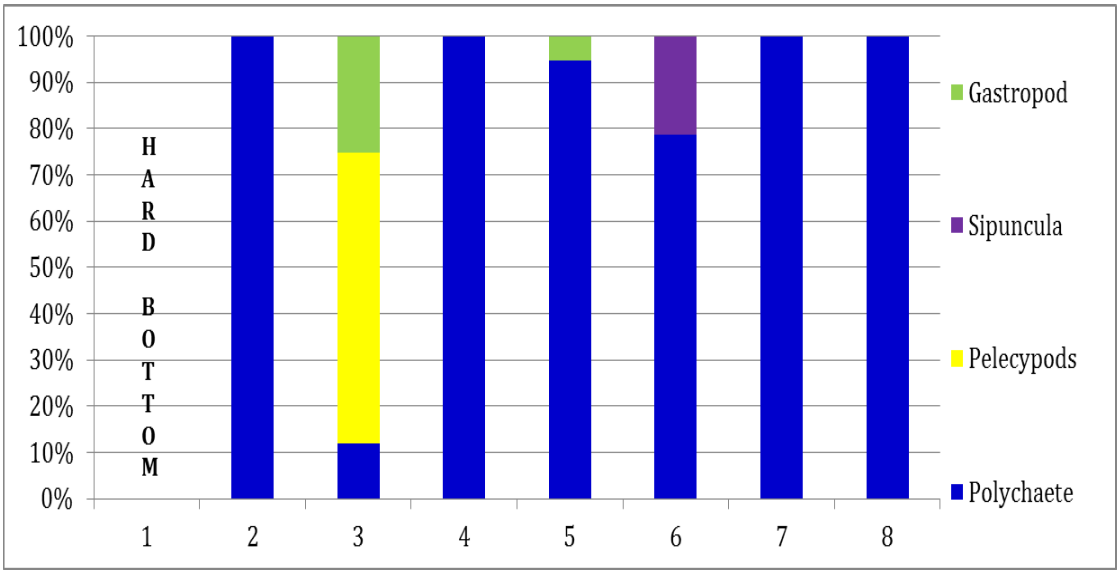


FIGURE-3.11.15(A)
SUBTIDAL BENTHIC FAUNA PERCENTAGE
(KALUNDRE RIVER, PANVEL & THANE CREEKS)

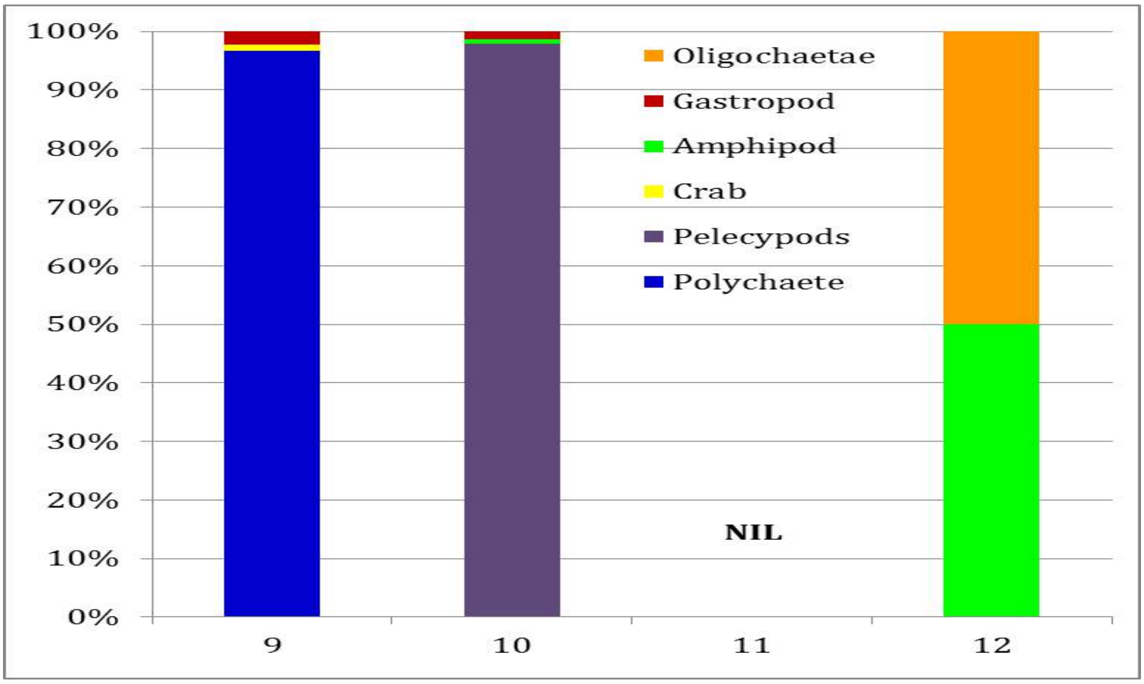


FIGURE-3.11.15(B)
BENTHIC FAUNA PERCENTAGE
(MOHA CREEK, ULWE RE-COURSE CHANNEL & ULWE RIVER)

FIGURE-3.11.16 (A)
IDENTIFIED COMMON BENTHIC FAUNA
(KALUNDRE RIVER, PANVEL & THANE CREEKS)

FIGURE-3.11.16 (B)
COMMON BENTHIC FAUNA IDENTIFIED (MOHA CREEK, ULWE RE-COURSE CHANNEL & ULWE RIVER)

3.12 Socio-Economic Environment

The demographic and socio- economic conditions prevailing in the 10 km radius of the NMIA project at Ulwe in Panvel tehsil of Raigad district and part of the project study area falling within the Thane tehsil in Thane district of Maharashtra state, is described in this section.

The methodology adopted for the socio-economic as well as demographic status study mainly includes primary survey, review of published secondary data (District Census Statistical Handbooks- 2011, 2001 and Primary Census Abstract of Census-2011, 2001) with respect to rehabilitation & resettlement (R&R) of the project affected families, post resettlement survey, distribution of population, population density, household size, sex ratio, social stratification, literacy rate and occupational structure in the project study area defined within 10 km radius from the airport project boundary.

Available physical infrastructure like communication and road transport facilities, drinking water facilities, road network facilities, drainage facilities, electric power distribution facilities and social infrastructure encompassing educational facilities, health facilities, banking facilities, community development, opportunities, available contractual works to local communities and direct and indirect employment findings are presented in **Annexure-XVI.**

3.12.1 Social Impact Assessment

Government of Maharashtra through CIDCO decided to develop the Second Airport for MMR Region at Navi Mumbai called Navi Mumbai International Airport (NMIA). The project is going to affect some households, minor business activities and structures located within airport site area and the same are required to be relocated. Most of the households have been rehabilitated as on date, from the identified households in 8 revenue villages in 10 settlements. Out of these 10 settlements, nine settlements are within airport site area of 1160 ha and one is outside. Keeping in view the R & R policy of the Government of Maharashtra and the National Policy of Resettlement and Rehabilitation, Social Impact Assessment (SIA) study was conducted by DHI (India) on behalf of CIDCO year of 2010. The Social Impact Assessment was carried out in all 10 affected settlements covering 8 revenue villages. Based on the 2011 census, the population of these settlements is 15,579, spread over 3113 households.

3.12.2 CIDCO R & R Package

3.12.2.1Land Acquisition of the Project

Maximum land acquisition in this area was undertaken between 1970-1975 and post 1994 when a Government Resolution dated 6thMarch 1990 was passed. CIDCO has acquired the lands held by the original residents of the Navi Mumbai and developed the city. Firstly, the compensation was paid in terms of money and thereafter under 12.5% scheme as per Section 37 of Maharashtra Regional and Town Planning Act, 1966 is given in **Annexure-XVII**. The details of the land acquisition process are given in R&R Report of CIDCO (**Annexure X**).

3.12.2.2 R&R Entitlement

The salient features of the approved policy of Land Acquisition and Rehabilitation & Resettlement as per Govt. Resolution dated 1stMarch 2014 and 28thMay 2014 (called as CIDCO R&R Package) are given below. CIDCO has additionally incurred cost of Rs 1813 Crores towards R&R. The entitlements of the R&R are given in **Table-3.12.1.**

TABLE-3.12.1
ENTITLEMENTS OF THE R&R

Type of Impact	Entitlement
Impact on land-economic displacement	Allotment of 22.5% gross land (i.e., net land of 15.75% excluding the land required for Infrastructural development) with 2.00 FSI for those who are eligible under 12.5% scheme (OR).
	Allotment of 10% gross land (i.e., net land of 7.00% excluding the land required for Infrastructural development) with 2.5 FSI for those who are not eligible under 12.5% scheme.
Impact on structure-physical displacement	Allotment of developed plot, three times the roof area of self-residing structure which existed on September 2013 within the project area, with pre-approved 1.5 FSI within the 7 designated R&R pockets in vicinity of the airport site. Built up area in multi storied structure will be considered for determining entitlement.
Common to all eligible impacted entities	• Allotment of 100 shares of NMIAL of face value of INR 10 each to Khatedar (plot owner) family and structure holder. • Financial aid for construction of new structure at INR1000/ sq. ft for equivalent area of existing structure for all eligible structures in project area. • Developed plot of equivalent area will be allotted in lieu of structures being used for commercial purpose in project area.

Type of Impact	Entitlement
	• The persons who are using the structure for commercial as well as residential purpose will be permitted to utilize 15% FSI for commercial purpose. • One-time subsistence allowance of INR0.36 lacs @ INR 3000 per month for 1 year to each structure holder family. • One-time financial assistance of 750 days of agriculture labour wages per structure holder family. • INR 50,000/-one-time financial assistance for transportation. • Permission to take away all types of old material by the structure holder. • All non-refundable amounts and deposits are waived off. • Free of cost vocational training. • Allotment of reclamation works of the amount of 50% through the registered contractors to whom CIDCO has awarded contracts. • The minimum plot area to be allotted would be 40 sq.m & the maximum would be 700 sq.m (maximum limit of 700 sqm was removed by CIDCO subsequently).
Additional incentives	• Rental allowance @ INR 12/sq. ft. for 18 months. • Demolition incentive @INR 500 per sq. ft. (for vacating structures on or before 15 January 2019).
Common infrastructure	Govt./Semi Govt. complex at the relocated place of project affected persons: Complex shall be developed by CIDCO for following govt./semi govt. offices at the relocation place of the project affected persons. • Gram Panchayat Office • Talathi Office • Post Office • Bank • Social Temple Social amenities provision as per the criteria of CIDCO: Following social amenities shall be provided by CIDCO at the relocation place of project affected persons. • School & Public Garden • Religious complex with open space for festivals/ celebrations • Cremation Ground • Bus Stop • Market

Source: CIDCO

<u>Unit of Entitlement</u>

The unit for compensation in the CIDCO's R&R scheme is 'Structure' and not a family/ household/ individual. As a result, there are families with separate kitchens, separate ration cards, and separate entry/exit doors from one another that have been considered as one entity based on the eligibility criteria.

It is observed that roughly 2% to 5% of impacted structures had more than one household residing in them. The compensation for following components is calculated as per the area of land acquired. Therefore, the amount is mutually distributed as per the area occupied by separate households under a common roof:

- Allocation of developed land;
- Construction assistance;
- Transportation allowance; and
- Demolition allowance.

3.12.3 Brief Description of 12.5% Scheme

The Govt. vide its order dated 6thMarch, 1990 announced the 12.5% scheme and extended it to all PAPs. In this scheme, the PAP is given back developed land, which is 12.5% of the land acquired from an individual. Out of the 12.5% entitlement, 30% is reserved for social facilities and public utilities. Thus, net allotment would be 8.75% of the land acquired from him. The plot allotted to the individual has 1.5 FSI and 15% commercial component permissible on the plot.

The PAPs who benefited under the Gaothan Expansion Scheme could apply for this scheme as well. The PAP can develop the plot himself or enter into an agreement with the developer for development. The 12.5% scheme became fully functional in 1994 through the Urban Development Department Government Resolution dated 28thOctober, 1994.

It should be noted that during this phase of land acquisition, only agricultural or non-residential land was acquired. No residential area was acquired. The land acquisition entailed only economic displacement of PAPs. As a consequence, the local villagers continued use of residential structures. In certain cases where development activities by CIDCO were not commenced, local villagers continued using such land for livelihood activities. The outcome of above procedures resulted in CIDCO holding ownership of 853 hectares already in its possession out of the total 1160 ha of land notified for airport site in 2011.

Allowances are paid in three instalments, with the first instalment being disbursed before demolition. The three instalments are paid as:

Instalment-1: One-time subsistenceallowance INR 36,000/-per building and one time750 days aagricultural wages per building – INR 1,24,500/-. This totals to INR 1,60,500/-. Allhouseholds get the first instalment of the same value i.e., INR 1,60,500/-.

Instalment-2: 50% of one-time assistance for construction INR1000 per sq. ft. This amount is based on total plinth / built-up area of the impacted structure.

Instalment-3: Remaining 50% of one-time assistance for construction INR1000 per sq. ft. plus INR 50, 000 as transportation allowance.

In addition, rental allowance, and demolition incentive (for which 15thJanuary 2019 was the cut-off for demolition rate) allowances are also paid to eligible households which have shifted out of their structures. Data on these two assistances were not made available. However, it was reported during consultations that all households who shifted out of their structures have been provided these allowances.

Procedure for Allotment of Plots

The allotment of plots was done by CIDCO as per eligibility of the PAP through location lottery within the village layout. These CDICO lotteries were awarded in a transparent manner using software approved by Standardization Testing and Quality Certification Directorate (STQC), Pune, Govt. of India. The lottery process was carried out in presence of PAPs along with live webcasting so that the PAPs can view the lottery draw through internet. Four lottery draws were done for locational allotment of Plots. After the plot was allotted, each PAP was required to be physically present at the location of allotted plot. In presence of PAPs, CIDCO measured the plot size along with preparation of photo documentation. Finally, the plot was handed over to PAPs with signatures of all concerned parties.

3.12.4 Vadghar R&R Pocket-1&2

The State Highway No. 54 divides this R & R pocket into two segments. The area of R&R Pocket-1 is 40 ha and R&R Pocket-2 is 21 ha. The villages being rehabilitated to these pockets are Chinchpada, Kopar, Kolhi and Vaghivalivada. This area is proposed to be developed with all necessary facilities required for the village resettlement. Based on site visit and observations, these pockets are in most advanced stage of rehabilitation with almost all infrastructural activities in scope of CIDCO completed. This includes roads, electricity and water connections, drainage system, common facilities such as schools, health centers, government offices etc. It was also found that various plot holders have started construction of multi-storied buildings in allotted plots.

3.12.5 Varche Owale R&R Pocket-3

Varche Owale is being resettled along NH-4B in Vadghar R&R Pocket east of NMIA. The total area identified for this pocket is 15 ha. This area is proposed to be developed with all necessary facilities required for the village with almost all infrastructural activities in scope of CIDCO completed. This includes roads, electricity and water connections, drainage system, common facilities such as schools, health centers, government offices etc.

3.12.6 Vahal R&R Pocket-4, 5 & 6

CIDCO has earmarked Vahal R&R pocket 4, 5 & 6 at Sector-24, 25 & 25A of Ulwe node at Vahal, south of NMIA. The gross area of these pockets is 27 ha, 18 ha & 28 ha respectively. The villages to be rehabilitated in this pocket are Ulwe, Targhar, Kombadbhuje and Ganeshpuri. This area is also proposed to be developed with all necessary facilities required for the village resettlement. These pockets have recently witnessed construction activities by PAPs on their allotted plots.

3.12.7 Kundevahal R&R Pocket-7

The location of Vaghivali R&R pocket i.e., Pocket-7 has been shifted closer to Vahal R&R Pockets 4, 5 & 6 after discussions with villagers of Vaghivali. Details on new location are not shared by CIDCO.

3.12.8 Pushpak Nagar – An Overview

CIDCO has earmarked 221 ha of land and designated this area as Pushpak Nagar for allotment of plots under 22.5% scheme as per decision of the Govt. of Maharashtra dated 1stMarch, 2014. This land is located to the south of NMIA on existing NH-4B at a distance of 0.5 km from NMIA boundary. Civic amenities with good infrastructure facilities have been developed at this location. The 139 m wide joint corridor of NH-4B and Virar Alibaug Multi-Modal Corridor passes along Pushpak Nagar.

The Multi-Modal Corridor is proposed with all surface transportation facilities like Expressway, Metro Rail, Bus Rapid Transport System (BRTS), service roads and buffer zone. Out of 221 ha of land, about 49.77% land will be used for residential purpose (110 ha) and 4.5% land will be used for residential + commercial purpose (10 ha). Out of the remaining land, 7.85% land will be used for social facilities (17.44 ha), 26.80% will be used for transport facilities (59.55 ha), 7.76% land will be used for greenery and open spaces (17.25 ha) and 3.32% land will be retained as water bodies (6.76 ha).

The plots allotted at this place will have average Floor Space Index (FSI) of 2. The development work of this area consists of land development, provision of storm water drains, laying of water supply lines, construction of roads, laying of power supply line with sub-station and provision of sewerage network with treatment plant and treated water supply network. Currently, activities such as site-levelling, road construction, plot boundary marking, drainage and sewerage system are underway at Pushpak Nagar.

Pushpak Nagar is one of the 14 townships of approved Navi Mumbai Development Plan, earmarked accommodating activities supporting the development and operation of airport. An area of about 221ha is proposed for area development, consisting of plots residential, residential + commercial, physical & social facilities such as education, playground, health, garden, transport & communication, and water body. The residential area is about 120 ha. The balance area of about 110 ha is required for development infrastructure works such as multi-modal highway, construction of roads, development of playgrounds, gardens, and beautification of existing water body. The land use classification of Pushpak Nagar is given in **Table-3.12.2.**

TABLE-3.12.2
LAND USE CLASIFICATION - PUSHPAK NAGAR

Sr. No.	Land Use	Area in ha	%
1	Residential	110.86	48.20
2	Residential plus commercial	10.22	4.44
3	Social facilities	20.40	8.87
4	Transport	64.51	28.05
5	Green and open area	17.25	7.50
6	Water body	6.76	2.94
	Total	**230.00**	**100**

Source: CIDCO

3.12.9 Primary Social Survey

Primary data was collected through household survey and Focus Group Discussion (FGD) from the field for sampling location purpose, selection of villages/ town/ wards in 10 km radial area map within all directions was considered. Four types of segments were covered as given below:

1. General urban population going to be affected due to NMIA (covered under FGD).

2. General rural population going to be affected due to NMIA (covered under FGD): These groups were assessed to understand the views of the population other than PAPs are going to be affected due to NMIA.

3. Project affected population (covered under post resettlement survey): This group was assessed to understand the views of the PAPs after R&R, status of living standard, availed infrastructure facilities in the resettlement area, occupation satisfaction level, QOL after resettlement etc.

4. Project affected population still not be relocated/ resettled (covered under general survey): This group was assessed in order to understand the current infrastructure facilities at present location, occupation, reason for not shifting in resettlement area/ not accepting the compensation etc., in addition to living standard, occupation satisfaction level, QOL etc.

Description of sampling locations for socio-economic survey within the above segments is given in **Table-3.12.3.**

TABLE-3.12.3
PRIMARY SOCIO-ECONOMIC SURVEY LOCATION

Sr. No	Survey Location	Distance from nearest Project Boundary in km (Approx.)	Direction
Survey location for post resettlement survey (pocket wise)			
1	R&R pocket 1	0.12	South East
2	R&R pocket 2	0.15	South
3	R&R pocket 3	0.72	South
4	R&R pocket 4	0.96	South West
5	R&R pocket 5	1.76	South West
6	R&R pocket 6	1.90	South West
7	R&R pocket 7	2.10	South
Survey location for FGD & official information (urban area)			
1	Old Panvel	0.95	East
2	Navi Mumbai	5.85	North
Survey location for FGD & official information (rural area)			
1	Wahal	0.45	South West
2	Chipale	5.95	East
3	Gavhan	3.80	South West

Sr. No	Survey Location	Distance from nearest Project Boundary in km (Approx.)	Direction
4	Nanoshi	5.35	South
5	Veshvi	6.50	South
6	Moho	0.70	West

Findings from Primary Survey

Findings regarding basic infrastructure and social facilities are below:

- **Caste**: Majority of the population belongs to OBC category. SC & ST population is less in these villages.

- **Drinking water**: Nearabout 90% villages connected through tap water facility for drinking water purpose. Water supplied through CIDCO, MIDC & Gram Panchayat.

- **Sanitation**: 95% villages had personal toilets with septic tank, common toilets also present in villages. Data shows sanitation facility is satisfactory. Drainage facility is observed both open & closed type in the villages.

- **Education:** Almost all surveyed villages availed primary & middle school facility. For all types of higher education Panvel is main center for surveyed villages.

- **Medical facilities**: All villages have access to primary health sub center & primary health center in the range of 2-4 km. For major illness, villagers preferred Panvel& Belapur City.

- **Garbage disposal**: Majority of the villages have house to house garbage collection facility. Garbage bin facility is also provided by gram panchayats in these villages.

- **Transportation**: All types of transportation facility available in the villages. Majority of the population depend on Govt & Pvt Bus facility, auto etc. Road condition is good in the villages. Railway station is availed in the range of 4-15 km at Belapur, Panvel & Khandeshwar.

- **Market**: Market facility availed in the range of 4-10 km. Villagers preferred Panvel city for all type of shopping purpose.

- **Power**: All surveyed villages are well connected through power facility & using for all type of domestic purpose.

- **Employment**: Major employment pattern of the surveyed village are industrial workers, labourers&private job holders. Very few people engaged in cultivation related activity. In pocket no 1& 2 and 4, 5 & 6 some populations are engaged in fishing related activities. Respondents reported unemployment is the major issue in their villages.

- **Income Patten**: Daily wage of labourers earn in the range of Rs.500-700 per day of work. Cultivation related workers get daily wage in the range of Rs.200-400.Those workers who are engaged in industrial work, private jobs etc. get monthly salary based on their work.

- **House Pattern**: Majority of the houses in the surveyed area are in the pakka form. During discussion with respondents, it has been revealed that 5-10% households in the surveyed area are living in rented house.

- **Women's Status**: The majority of the women in the surveyed villages are housewives, very few women are working in the private sector and household industry. In R&R pocket 1&2 & 4,5& 6 some women are engaged in fish marketing and labor work

- **Cooking Fuel**: Main cooking fuel in the villages is LPG. 90% households had connections of LPG. Other fuel sources are wood chip, coal, cow dung cake etc.

Awareness & Opinion from Respondents

All respondents are aware about the proposed project and its area and its activities. Villagers expressed mixed opinion (positive & negative) regarding the proposed project, the same has been summarized as below:

Positive Impact: Economic growth, transportation, skilled worker development, lifestyle change, residential &commercial development, local youth employment, employment opportunities in the services sectors, better quality of life, small scale business development and rural development.

Negative Impact: Air pollution, traffic problem, noise pollution due to construction related activities, solid waste &disposal facility not proper, road network problem, Loss of agriculture, fish business less than & agricultural loss, Fishing business is completely closed down dueto heavy rainfall, water cloggingdue to flood like situation.

Expectation of Local People from Project Authority

The expectations of the local people from the project authorities include provision of medical facilities, drinking water filter plant through CIDCO, road development, drainage lines, community halls, proper and adequate environment management, women empowerment, fish & vegetables market, new jetty for fishermen community, solid waste & disposal facility, employment for local youth, village development, land for garbage disposal, land for cremation, higher education facilities.

Concerns or grievances reported by respondents.

- Loss of local culture.
- Water issue.
- Change in land use pattern; and
- Loss of mangroves & vegetation.

Suggestion from Respondents

- Skill Development to be undertaken for youth of PAP community to assist them in seeking employment in industrial, logistic sector
- New Jetty for fishermen community.
- Proper environment management.
- MIDC development; and
- Increase in health education.

Post R&R general survey for the project, few of the families are yet to shift, and focus group discussions FGD questionnaires of primary field survey are given in **Annexure-XVIII, Annexure-XIX**and **Annexure-XX** respectively.

The indicative photographs of field survey if shown in **Figure-3.12.1.**

FIGURE-3.12.1
PHOTOGRAPHS OF SOCIAL FIELD SURVEY

3.12.10 R&R Status

Keeping in view of the R & R policy of the Government of Maharashtra and the National Policy of Resettlement and Rehabilitation, Social Impact Assessment (SIA) study was conducted by DHI (India) on behalf of CIDCO in the year of 2010. The Social Impact Assessment was carried out in all 10 affected settlements covering 8 revenue villages. Based on the 2011 census, the population of these settlements was 15,579 and spread over 3,113 households.

R&R package was approved vide UDD, GoM G.R. dated. 1st March 2014 and 28th May 2014 for rehabilitation of families falling in the proposed airport site. The package exceeds the requirements of LARR 2013 and provides special incentives for shifting/relocation.

As on 11th June 2021, Total 5,262 structures demolished, and 2370 plots given possession and remaining were in process by CIDCO and about 97.3% demolition work has been realized and about 71 structures are remaining.

Rehabilitation & Resettlement (R&R) status as on 11th June 2021 of the project affected families is given in **Table-3.12.4.** The Rehabilitation & Resettlement is being carried out as per the GR issued by Government of Maharashtra (GoM). CIDCO has incurred cost of Rs 1813 Crores for R&R for NMIA project **Table-3.12.5.**

TABLE-3.12.4
R&R STATUS OF PROJECT AFFECTED FAMILIES

S. No.	Village Name	Total Allotments in R&R	No. of Structures	Allotments Executed	Demolished Structures	Possession of Plots given	% of Demolished Structures	Percentage of Allotments	Structures Remaining
1	Chinchpada	517	478	445	470	424	98.3	86.1	8
2	Kopar	302	283	273	282	249	99.6	90.4	1
3	Kolhi	216	196	209	195	194	99.5	96.8	1
4	Ulwa	524	499	465	475	444	95.2	88.7	24
5	Ganeshpuri	214	208	208	208	195	100.0	97.2	0
6	Kombadbhuje	370	325	288	295	273	90.8	77.8	30
7	Varcheowale	357	338	327	338	314	100.0	91.6	0
8	Waghivliwada	99	96	99	96	90	100.0	100.0	0
9	Targhar	213	210	204	203	187	96.7	95.8	7
Total		**2812**	**2633**	**2518**	**2562**	**2370**	**97.3**	**90**	**71**

Source: CIDCO

TABLE-3.12.5
COST INCURRED BY CIDCO FOR R&R FOR THE PROJECT

Sr. No.	Particulars	Amount in Rs. Crores
1	Development of Pushpak Nagar	262
2	Development of 7 R&R Pockets	1026
3	Monetary compensation for construction of houses, shifting expenses, rental for 2 years and cash incentive	525
	Grand Total	**1813**

Source: CIDCO

3.12.11 Review of Demographic and Socio-Economic Profile based on Secondary Data

The villagewise demographic data of 105 rural villages, 08 Census towns from Panvel tehsil, 01 census town from Uran tehsil and 01 Navi Mumbai Municipal corporation ward from Thane tehsil are falling within 10 km radius of the project area. As per the 2001, 2011 census rural village and urban area data is given in **Annexure-XXI**. The salient features of the demographic and socio-economic conditions areanalyzed and described in the following sections.

3.12.11.1 Demography

As per the 2001 census, the total population of the study area is 10, 79, 216. The population reported as per the 2011 census is 18, 21, 089. Overall, around 68.7% more decennial growth is reported in the study area. The growth rate of population in the study area comparatively reported more than the growth rate of nation (India 17.7%).

Distribution of Population

As per 2011 census the study area consisted of 18, 21, 089 persons inhabited in study area. The distribution of population in the study area is shown in **Table-3.12.6.**

TABLE-3.12.6
STUDY AREA DISTRIBUTION OF POPULATION

Particulars	As Per 2011 Census				As Per 2001 Census			
	0-3 km	3-7 km	7-10 km	0-10 km	0-3 km	3-7 km	7-10 km	0-10 km
No. of Households	101555	320103	18461	440119	49859	181374	13812	245045
Male Population	225977	711409	44322	981708	119925	441065	35181	596171
Female Population	199499	601098	38784	839381	101928	349047	32070	483045
Total Population	425476	1312507	83106	1821089	221853	790112	67251	1079216
Male Population (0-6 years)	27569	80919	5587	114075	16523	58293	5379	80195
Female Population (0-6 years)	24974	73381	5277	103632	15322	53580	5087	73989
Total Population (0-6 years)	52543	154300	10864	217707	31845	111873	10466	154184
% of 0-6 years population	12.35	11.76	13.07	11.95	14.35	14.16	15.56	14.29
Average Household Size	4.19	4.10	4.50	4.14	4.45	4.36	4.87	4.40
% of males to the total population	53.11	54.20	53.33	53.91	54.06	55.82	52.31	55.24
% of females to the total population	46.89	45.80	46.67	46.09	45.94	44.18	47.69	44.76
Sex Ratio (no of females per 1000 males)	883	845	875	855	850	791	912	810
Child Sex Ratio (no of females per 1000 males (0-6 years))	906	907	945	908	927	919	946	923
Density	3733	9210	444	4104	1947	5544	359	2432

Source: Census of India 2001 and 2011

- **Average Household Size**

The study area has a household size of 4.14 as per 2011 census, which has decreased from 4.40 in 2001. This is mainly due to population control measures, health awareness programs.

- **Population Density**

The density of population reveals that the study area has an overall density of 4104 persons per km^2 (PP km^2) as per 2011 census reports. In comparison to state the study area population density is more than the state population density. (Maharashtra State 365) this is mainly due to 08 Census towns from Panvel tehsil, 01 census town from Uran tehsil and 01 Navi Mumbai Municipal corporation ward from Thane tehsil are falling within 10 km radius of the project area. The proportion of urban and rural population is urban population 16, 26, 540 (89%) rural population 1, 94, 549 (11%).

- **Sex Ratio**

The configuration of male and female indicates that the males constitute to about 53.91% and females to 46.09% of the total population as per 2011 census records. The study area on an average has 855 females per 1000 males as per 2011 census reports and 810 as per 2001 census. In comparison to the state urban sex ratio (Maharashtra Urban-903) the study area has recorded low sex ratio.

3.12.11.2 Social Structure

In the study area, as per 2011 census, 8.16% of the population belongs to Scheduled Castes (SC) and 2.71% to Scheduled Tribes (ST).

In the study area,5.13% population belongs to SC population as per 2001 census and increased by 3.03% in 2011 census. Further, 3.12% population belongs to ST population as per 2001 census and decreased by 0.41% in 2011 census. Overall, the data of social stratification reveals that the SC and ST % to population is more than 10% as per 2011 census. The SC and ST community are marginalized, and they are considered at low level of social strata and calls for a special attention in corporate social responsibility plan and corporate environment responsibility plan for improving their socio-economic status apart from preservation and protection of their art, culture and traditional rights of livelihood.

The distribution of population by social structure is shown in **Table-3.12.7.**

TABLE-3.12.7
DISTRIBUTION OF POPULATION BY SOCIAL STRUCTURE

Particulars	As Per 2011 Census				As Per 2001 Census			
	0-3 km	3-7 km	7-10 km	0-10 km	0-3 km	3-7 km	7-10 km	0-10 km
Schedule caste population	32,761	1,12,816	3,039	1,48,616	8,727	45,874	781	55,382
Schedule Tribes population	13,699	28,685	6,934	49,318	9,175	17,970	6,475	33,620

Particulars	As Per 2011 Census				As Per 2001 Census			
	0-3 km	3-7 km	7-10 km	0-10 km	0-3 km	3-7 km	7-10 km	0-10 km
Schedule caste (SC) population % to the total population	7.70	8.60	3.66	8.16	3.93	5.81	1.16	5.13
Schedule Tribes (ST) population % to the total population	3.22	2.19	8.34	2.71	4.14	2.27	9.63	3.12
Total SC and ST population	46,460	1,41,501	9,973	1,97,934	17,902	63,844	7,256	89,002
% To the total SC and ST population	10.92	10.78	12.00	10.87	8.07	8.08	10.79	8.25
Total Other Backward (OBC) population	3,79,016	11,71,006	7,31,33	16,23,155	2,03,951	7,26,268	59,995	9,90,214
% To the total OBC population	89.08	89.22	88.00	89.13	91.93	91.92	89.21	91.75
Total population	4,25,476	13,12,507	83,106	18,21,089	2,21,853	7,90,112	67,251	10,79,216

Source: Census of India 2001 and 2011

3.12.11.3 Literacy Levels

The data of study area reveals the literacy rate of 89.40% as per 2011 census, which is found to be more than the literacy rate of the district (Raigad district 83.1 and Thane district 84.5%). The distribution of literate and literacy rate in the study area is given in **Table-3.12.8.**

TABLE-3.12.8
DISTRIBUTION OF LITERATES AND LITERACY RATES OF STUDY AREA

Particulars	As Per 2011 Census				As Per 2001 Census			
	0-3 km	3-7 km	7-10 km	0-10 km	0-3 km	3-7 km	7-10 km	0-10 km
Male Population	2,25,977	7,11,409	44,322	9,81,708	1,19,925	4,41,065	35,181	5,96,171
Female Population	1,99,499	6,01,098	38,784	8,39,381	1,01,928	3,49,047	32,070	4,83,045
Total Population	4,25,476	13,12,507	83,106	18,21,089	2,21,853	7,90,112	67,251	10,79,216
Male Population (0-6 years)	27,569	80,919	5,587	1,14,075	16,523	58,293	5,379	80,195
Female Population (0-6 years)	24,974	73,381	5,277	1,03,632	15,322	53,580	5,087	73,989
Total Population (0-6 years)	52,543	1,54,300	10,864	2,17,707	31,845	1,11,873	10,466	1,54,184
Total Population above 7 years	3,72,933	11,58,207	72,242	16,03,382	1,90,008	6,78,239	56,785	9,25,032
Male literates (7+ years)	1,85,829	5,83,519	34,040	8,03,388	94,204	3,45,813	25,615	4,65,632
Female literates (7+ Years)	1,51,922	4,52,916	25,233	6,30,071	67,773	2,28,670	17,383	3,13,826
Total literates (7+ Years)	3,37,751	10,36,435	59,273	14,33,459	1,61,977	5,74,483	42,998	7,79,458
Male literacy rate (%) to the total literates	55.02	56.30	57.43	56.05	58.16	60.20	59.57	59.74

Particulars	As Per 2011 Census				As Per 2001 Census			
	0-3 km	3-7 km	7-10 km	0-10 km	0-3 km	3-7 km	7-10 km	0-10 km
Female literacy rate (%) to the total literates	44.98	43.70	42.57	43.95	41.84	39.80	40.43	40.26
Average Male Literacy to the total population (%)	49.83	50.38	47.12	50.11	49.58	50.99	45.11	50.34
Average female Literacy to the total population (%)	40.74	39.10	34.93	39.30	35.67	33.72	30.61	33.93
Total Literacy rate (%) to the total population	90.57	89.49	82.05	89.40	85.25	84.70	75.72	84.26

Source: Census of India 2001 and 2011

The percentage of male literates to the total literates of the study area works out to be 56.05%. The percentage of female literates to the total literates, which is an important indicator for social change, is observed to be 43.95% in the study area as per 2011 census records.

3.12.11.4 Occupational Structure

The occupational structure of residents of work participation rate in the study area is studied with reference to main workers, marginal workers and non-workers. The main workers include 10 categories of workers defined by the Census Department consisting of cultivators, agricultural laborers, those engaged in live-stock, forestry, fishing, mining and quarrying, manufacturing, processing and repairs in household industry; and other than household industry, construction, trade and commerce, transport and communication and other services.

The marginal workers are those workers engaged in some work for a period of less than six months during the reference year prior to the census survey. The non-workers include those engaged in unpaid household duties, students, retired persons, dependents, beggars, vagrants etc.; institutional inmates or all other non-workers who do not fall under the above categories.

As Per 2011 Census, total work participation in the project study area is 39.70% and the non-workers constitute 60.30% of the total population respectively. The distribution of workers by occupation indicates that the non-workers are the predominant population. The female non-workers to the total non-workers are 62.85% and male non-workers are 37.15%. The main workers to the total workers are 90.57% and the marginal workers constitute to 9.43% to the total workers. The occupational structure of the study area is shown in **Table-3.12.9.**

TABLE-3.12.9
OCCUPATIONAL STRUCTURE OF STUDY AREA

Particulars	As Per 2011 Census				As Per 2001 Census			
	0-3 km	3-7 km	7-10 km	0-10 km	0-3 km	3-7 km	7-10 km	0-10 km
Total Population	4,25,476	13,12,507	83,106	18,21,089	2,21,853	7,90,112	67,251	10,79,216
Total workers	1,60,593	5,28,488	33,874	7,22,955	78,882	3,02,257	27,668	4,08,807

Particulars	As Per 2011 Census				As Per 2001 Census			
	0-3 km	3-7 km	7-10 km	0-10 km	0-3 km	3-7 km	7-10 km	0-10 km
Total main workers	1,44,367	4,82,971	27,453	6,54,791	70,179	2,77,506	19,474	3,67,159
Total Marginal workers	16,226	45,517	6,421	68,164	8,703	2,4751	8,194	41,648
Total Non-workers	2,64,883	7,84,019	49,232	10,98,134	1,42,971	4,87,855	39,583	6,70,409
Non-Workers Male	97045	292358	18561	407964	54125	185453	15785	255363
Non-Workers Female	167838	491661	30671	690170	88846	302402	23798	415046
Work participation rate (%)	37.74	40.27	40.76	39.70	35.56	38.25	41.14	37.88
% of main workers to total workers	89.90	91.39	81.04	90.57	88.97	91.81	70.38	89.81
% of marginal workers to total workers	10.10	8.61	18.96	9.43	11.03	8.19	29.62	10.19
% of non-workers to total population	62.26	59.73	59.24	60.30	64.44	61.75	58.86	62.12
% of Male Non-Workers to the total Non-workers	36.64	37.29	37.70	37.15	37.86	38.01	39.88	38.09
% of Female Non-Workers to the total Non-workers	63.36	62.71	62.30	62.85	62.14	61.99	60.12	61.91

Source: Census of India 2001 and 2011

3.12.11.5 Economic Category Wise Distribution of Workers

In the study area, main workers classification is 1.04% of agricultural laborers, 94.67% of other workers, 2.00% of cultivators and 2.29% of household industry workers. The other workers are predominant population and household industry are second dominant population. It was observed in primary survey 94.67% of other workers in main workers are mostly employed in study area factories as a factory worker, engineering goods, software solutions, chemicals, and plantation workers, those engaged in trade, commerce, banking, business, construction, and transport.

In the study area, marginal workers classification is 4.59% of agricultural laborers, 85.04% of other workers, 5.56% of cultivators and 4.80% of household industry workers. The other workers are predominant population and agricultural laborersare second dominant population. It was observed in primary survey 85.04% of other workers in marginal workers are mostly employed in study area factories as a factory worker, engineering goods, software solutions, chemicals and plantation workers, those engaged in trade, commerce, banking, business, construction and transport. The economic category wise distribution of workers of the study area is shown in **Table- 3.12.10.**

TABLE-3.12.10
ECONOMIC CATEGORY WISE DISTRIBUTION OF WORKERS OF STUDY AREA

Particulars of Work Participation	0-3 km	3-7 km	7-10 km	0-10 km	Percentage %
Total workers	1,60,593	5,28,488	33,874	7,22,955	100
Main workers Total	1,44,367	4,82,971	27,453	6,54,791	100
Main workers Cultivators	2,319	4,903	5,882	13,104	2.00
Main workers Agricultural Laborers	1,039	4,028	1,731	6,798	1.04
Main workers Household Industry Workers	2,935	11,053	1,025	15,013	2.29

Particulars of Work Participation	0-3 km	3-7 km	7-10 km	0-10 km	Percentage %
Main workers Other Workers	1,38,074	4,62,987	18,815	6,19,876	94.67
Marginal workers Total	16,226	45,517	6,421	68,164	100
Marginal workers Cultivators	770	1,615	1,407	3,792	5.56
Marginal workers Agricultural Laborers	459	1,280	1,392	3,131	4.59
Marginal workers Household Industry Workers	638	2,038	596	3,272	4.80
Marginal workers Other Workers	14,359	40,584	3,026	57,969	85.04
Marginal workers Other Workers 3 - 6 months Total	14485	40112	4,609	59,206	100
Marginal workers Cultivators 3 - 6 months	729	1488	1,150	3,367	5.69
Marginal workers Agricultural Laborers 3 - 6 months	427	954	912	2,293	3.87
Marginal workers Household Industry Workers 3 - 6 months	500	1615	171	22,86	3.86
Marginal workers Other Workers 3 to 6 months	12829	36055	2,376	51,260	86.58
Marginal workers Other Workers 0-3 months Total	1741	5405	1,812	8,958	100
Marginal workersCultivators 0-3 months	41	127	257	425	4.74
Marginal workers Agricultural Laborers 0-3 months	32	326	480	838	9.35
Marginal workers Household Industry Workers 0-3 months	138	423	425	986	11.01
Marginal workers Other Workers 0-3 months	1,530	4,529	650	6,709	74.89

Source: Census of India 2011

The economic category wise distribution of the workers is shown in **Figure-3.12.2.**

3.12.11.6 Urban Study Area Manufacturing Commodities

It was observed in primary survey 94.67% of other workers in main workers are mostly employed in study area factories as a factory worker, engineering goods, software solutions, chemicals, and plantation workers, those engaged in trade, commerce, banking, business, construction and transport. The rural study area all rural villages are not falling in fisherman villages as per Fisherman Census Maharashtra, 2010. In primary survey, Owle village people have requested to construct jetty which is their third manufacturing commodity. The details of urban study area manufacturing commodities are shown in **Table- 3.12.11.**

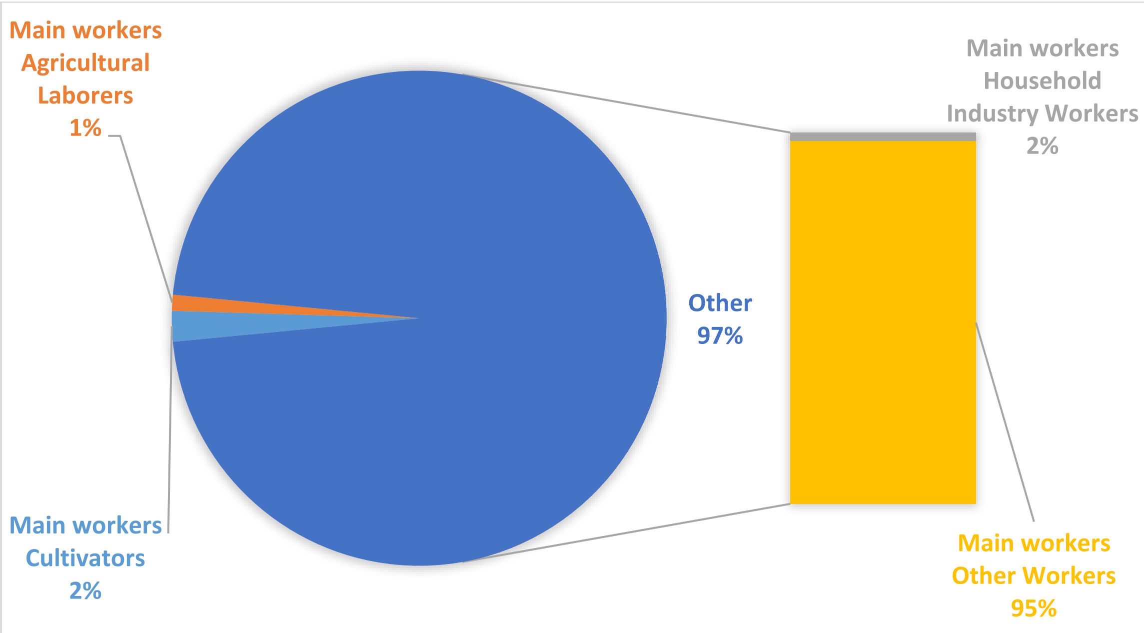


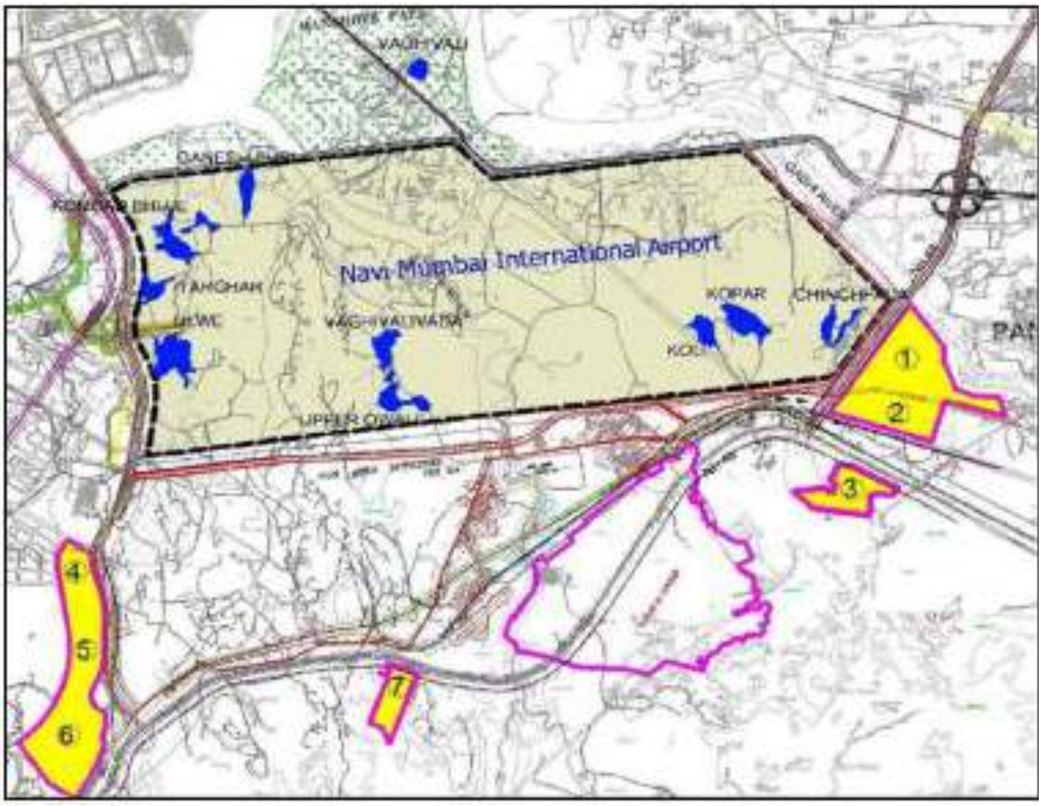
FIGURE-3.12.2
ECONOMIC CATEGORY WISE DISTRIBUTION OF WORKERS

TABLE-3.12.11
URBAN MANUFACTURING COMMODITIES OF STUDY AREA

Sr. No	Town Name	Manufactured Commodity (First)	Manufactured Commodity (Second)	Manufactured Commodity (Third)
0-3 km Panvel tehsil, Raigad district, Maharashtra				
1	Panvel (MCl)	Ayurvedic Medicine	Bullock Cartwheels	Surgical Instruments
2	Panvel tehsil Raigad (CT)	Rice	Agricultural Produce	Vegetables
3	Palidevad (CT)	N/A	N/A	Rice
4	Vadghar (CT)	N/A	N/A	N/A
5	Owle (CT)	Rice	Stone Mining	Fishing
3-7 km Panvel tehsil, Raigad district, Maharashtra				
6	Talode Panchnad (CT)	N/A	N/A	Vegetables
7	Kharghar (CT)	N/A	N/A	N/A
8	Kalundre (CT)	N/A	N/A	N/A
Thane tehsil, Thane district, Maharashtra				
9	Navi Mumbai (M Corp.)	Engineering Goods	Chemicals	Software Solutions
Uran tehsil, Raigad district, Maharashtra				
10	Jasai (CT)	N/A	N/A	Rice

Source: Census of India 2011

The areas earmarked offsite for infrastructure planned to be developed for R&R of NMIA displaced people is shown in **Figure-3.12.3** below.



Note: The Blue highlights the displaced Village-Gaothans and yellow high-lighted and pink boundary areas are R&R pockets and Pushpak Nagar respectively.

FIGURE-3.12.3
OFFSITE INFRASTRUCTURE PLANNED FOR R&R POCKETS

3.12.12 Conclusion

There are about 3,113 households who are being rehabilitated from 7 revenue villages in 10 settlements. Out of these, nine settlements are within airport site area of 1160 ha and one is outside the airport site.

- The rehabilitation sites are being planned and developed near the airport, outside project area of 1160 ha as approved in EC of 2010 for the project.
- The Rehabilitation & Resettlement is being carried out as per the GR issued by Government of Maharashtra (GoM).
- CIDCO has already acquired and developed the land for setting up the 7 R&R pockets and Pushpak Nagar (R&R site) for resettlement of displaced villages.
- As on 11th June 2021, Total 2562 structures have been demolished, and 2370 plots given possession and remaining are in process by CIDCO; about 97.3% demolition work has been realized and about 71 structures are remaining.
- CIDCO has already incurred cost of Rs.1813 crore for R&R of NMIA Project.

Chapter-4

Anticipated Environmental Impacts and Mitigation Measures

4.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This chapter presents identification and evaluation of anticipated environmental impacts likely to occur due to development and operation of NMIA. At this stage, the site pre-development activities are nearing completion. The identification of environmental impacts is based on the reference of national environmental standards and the terms of reference issued after appraisal of the project proposal by the concerned EAC members and MoEF&CC.

A detailed assessment of environmental impact arising from the project implementation has been carried out using practical tools and modelling software as appropriate. The impacts are based on the anticipated effect of the project activities on the baseline environmental and social status of influence area.

The NMIA project is already under implementation, therefore the activities related to the establishment of the proposed airport can be broadly classified into three stages, viz., pre-development, development, and operation of the proposed greenfield airport. The impacts due to the project are apprised for environmental and social aspects concerned with:

- The effect on the land acquisition due to the project.
- The degree of change anticipated in the soil quality within the influence area.
- Ambient Air Quality of the project influence area.
- Change in noise levels due to development and operation of the airport and its impact on the project sensitivities.
- Surface and marine water quality of the water bodies within the influence area.
- The impact upon the hydrogeology and the groundwater water quality due to project implementation.
- Impacts due to incremental traffic in different horizon years and its management and decongestion plan.
- Impact on the ecology and biodiversity within the influence area; and
- Improvement in socio-economic status of the project influenced population.

The mitigation measures are addressed based on the degree of impact assessed during the EIA study and based on project specific information. The mitigation measures are addressed for each of the project environmental and social aspect categorically.

4.1 Impact Identification and Classification

The proposed project is likely to create impact on the environment during site pre-development, development of the airport and operation of the airport. The activities in pre-development are aimed to deliver an encumbrances free land levelled to the required height for development of the airport. The development of the airport includes construction and commissioning of the airport in planned phases.

The airport operations will commence after development of the Phase-I which will establish part commissioning of terminal T-1. The remaining structures of the related to development of Phase-II construction works will be in progress parallel to the operation of the airport. The T-1 terminal will be completed in the second phase and commencement of the full operation of T1 will be established while Phase-III development is in progress. The list of activities that are likely to take place at various phases of the project is given in **Table-4.1**.

Similarly, with commencement of each phase of airport operations will run parallel to the development of remining airport structures. The impacts due to development (including site pre-development) and operation of the project are addressed separately for activity-wise consolidation of impacts and mitigations.

TABLE-4.1
LIST OF PHASE WISE PROJECT ACTIVITIES

List of Activities-Facilities/Phasing	Pre-Development	Development Phase - I	Operation Phase-I/ Development Phase –II	Operation Phase I and II/ Development Phase –III	Operation Phase I, II and III/ Development Phase –IV
Land acquisition and R&R	√	-	-	-	-
Recourse Channel	√	-	-	-	-
Cutting of hillock	√	-	-	-	-
Land Development	√	-	-	-	-
Shifting of EHVT lines	√	-	-	-	-
Construction of compound wall	-	√	-	-	-
Runway	-	√	√	-	-
Runway Exits	-	√	√	-	-
Bypass Holding Bays	-	√	√	-	-
Taxiway	-	√	√	-	-
Navigational Aids	-	√	√	-	-
Commercial Apron	-	√	√	√	√
Long-Term Aircraft Parking	-	√	√	√	√
General Aviation	-	√	√	√	√
Cargo Apron	-	√	√	√	√
Passenger Terminal	-	√	√	√	√
Air Cargo Building	-	√	√	√	√
Roadway system	-	√	√	√	√
Vehicular and Cargo Parking	-	√	√	√	√
Technical Building and ATC Tower	-	√			
Fuel Farm	-	√	√	√	√
ARFF	-	√	√	√	√
Catering	-	√	√	√	√
Ground Handling Equipment Maintenance	-	√	√	√	√
Airfield Maintenance Area	-	√	√	√	√

4.2 Impacts Due to Development of NMIA

The impacts and mitigations due to pre-development and development of the project are addressed in this section.

The site pre-development involves preparation of the site to deliver an encumbrances free site for development of the airport. The status of the clearing of site encumbrances in site pre-development activity is as follows:

- Rehabilitation and resettlement of the project affected families is nearing completion and about 97.3% is completed as on 11th June 2021;
- The construction of the Ulwe Recourse Channel has been completed, and the erstwhile Ulwe River is diverted from the project corridor;
- The shifting of EHVT Lines by Tata Power has been completed and shifting of EHVT Lines by MSETCL is in progress; and
- The clearance of vegetation in the site is nearing completion.

Development of the airport includes activities like transportation of construction material and equipment, deployment of temporary structures like portable cabins and sheds, increase in the population of construction workforce, higher movement of vehicles, construction of civil structures and other construction related activities.

The impact due to pre-development and development of the airport are addressed together as project development activities proceed immediately, which is dependent upon the completion of site pre-development. To minimize these impacts, it is required to undertake the appropriate preventive and remedial measures which are outlined in the following sections.

4.2.1 Land Acquisition Status

The impact due to land acquisition may be anticipated due to displacement of the local inhabitants, relocation of settlements, change in social structure and ecological changes due to change in the land use during the project implementation. The impacts are primarily localised in spatial scale and long-term in temporal scale.

The entire land for the Project including land for airport site i.e., 1,160 ha has been acquired by CIDCO. There are no changes envisaged to the airport land requirements. It has been reported by CIDCO that land acquisition for related infrastructure development is a dynamic activity under CIDCO's town-planning schemes with changing requirements of development plans. This includes additional land requirement for highway and road expansion, commuter railway and other means of transport which are considered as part of the off-site infrastructure being developed for NMIA. Therefore, the current land required for the project is has been completely acquired. Any new changes for airport-related land requirement will be notified by CIDCO and updated in future assessments as and when commissioned.

The NMIA project site comprising of 1160 ha has been registered as 'Airport and Allied Activities' area notified by Government of Maharashtra in March 2012 through implementation of the Navi Mumbai Development Plan. About 99.65 % of RoW has been transferred from CIDCO to NMIAL while transfer of remaining 0.35 % is in progress. The site pre-development activities started from 2017 after receiving the forest clearance

The project affected people have been compensated at par. The impact due to land acquisition has been mitigated to the extent possible by rehabilitating the PAPs and providing land and monetary compensations as per the provision of R&R Entitlement of CIDCO. The R&R entitlement package exceeds the requirements of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act 2013. The project will create ample employment/entrepreneurial opportunities while addressing environmental concerns and sustainable growth in the vicinity of project through alignment of urban planning and implementation programs of several Special Planning Authorities/ Urban Local Bodies. The project is anticipated to have positive impact on the socio-economic development of the PAPs and nearby communities through generation of employment opportunities.

Several urban local bodies in the vicinity of the project have aligned their urbanisation plans with NMIA development. This will improve the infrastructure in the vicinity of NMIA benefiting nearby population.

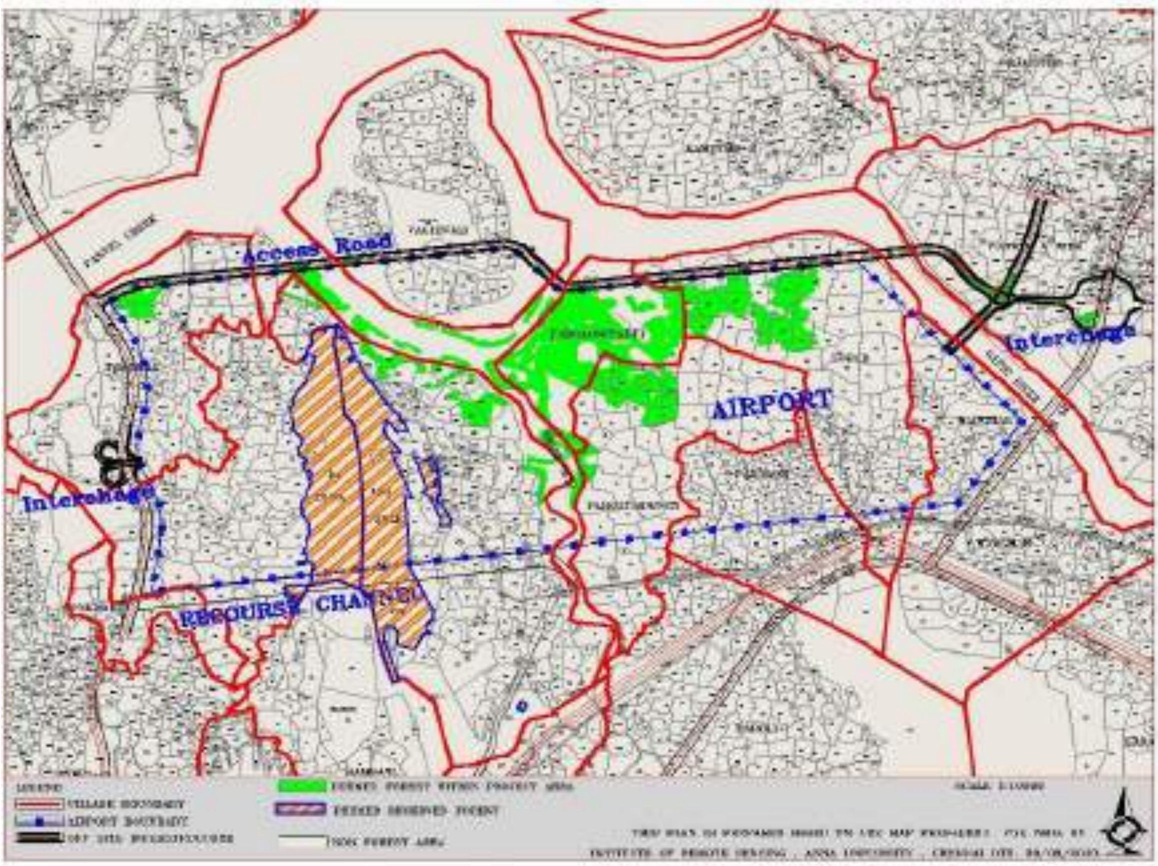
Also, it is envisaged that about 33% of the airport site will be dedicated to green space and landscape development for aesthetic and ecological improvement of the project site.

4.2.2 Impact on Land Use and Topography

Major changes in the land use and topography of the project site has been realized during the site pre-development. No significant impacts are anticipated during the project development as project development does not envisage additional use of land or change in physiography of the project site. Impacts due to development activities and mitigation measures are addressed separately in this section. The site pre-development is nearly completed, and the impacts and mitigations are already addressed.

4.2.2.1 Impacts and Mitigation Measures Undertaken during Site Pre-Development

NMIA site of 1160 ha was characterized by varied natural topography, hydrogeology and soil types as site is located in a coastal plain adjoining the Panvel Creek. The natural slope of the site is towards east and north, with large variations in existing levels. The rivers in the project study area are mostly westerly flowing. The land use pattern prior to the commencement of the land development is given in **Table-4.2.** The land use map of the project site prior to commencement of NMIA Pre-Development is shown in **Figure-4.1** and topography and land use map of the project site of site pre-development works is shown in **Figure-2.10** of **Chapter-2** respectively.



Source: NMIAL

FIGURE-4.1
LAND USE PRIOR TO THE PRE-DEVELOPMENT OF NMIA (2009)

TABLE-4.2
LAND USE AREA PRIOR TO PRE-DEVELOPMENT (2017)

Type of Land	Total Area (Ha)	Percentage (%)
Agriculture	104.86	9.04
Mangrove	98.14	8.46
Open (Urbanizable) area	406.93	35.08
Built up	49.76	4.29
Quarry	65.42	5.64
Creek/River	54.87	4.73
Hill	46.05	3.97
Mud flats	333.96	28.79
Total	1160.00	100.00

Source: NMIAL-PFR 2020

The impacts due to topographic changes in the landform can be anticipated due to the changes in the natural physiography of the project site that has been realized through site pre-development activities. The status of site pre-development of the project due to site physiographic changes is given below:

- Land acquisition process was undertaken by CIDCO and villagers from nine gaothan settlements are being rehabilitated and resettled at R&R colonies/township developed by CIDCO at three locations outside the airport site. Out of these 10 settlements, nine settlements are within airport site area of 1160 Ha and one is outside.

- As on 11^{th} June 2021, Total 2,562 structures demolished, and 2370 plots given possession (2518 allotments have been executed) and remaining were in process by CIDCO and about 97.3% demolition work has been realized and about 71 structures are remaining.

- The land within the project area consisted of 141.56 ha of forest land and 98 ha of mangrove forest which has been cleared and compensatory afforestation has been taken up as per EC Conditions.

- Extensive hydrological modelling (1D and 2D Modelling) studies have been done by CWPRS, Pune and following which, the erstwhile Ulwe River has been diverted out of airport site and Ulwe Recourse Channel (length 3.2 km) has been relocated to the southern side outside NMIA airport and the channel to the north of site as secondary channel for Gadhi River has been trained.

- A Comprehensive Drainage Master plan of NMIA has been prepared and development of the entire area is planned accordingly. Additionally, CIDCO has completed storm water drainage studies for villages near NMIA through CWPRS for management of floods.

- The EHVT lines passing through the site have been partially translocated, while the remaining works are in progress.

- In April 2017, CIDCO initiated the site pre-development works. The hillocks in the airport area have been flattened and leveled to make the runway by controlled blasting in stages.

- Cutting of a part of Ulwe hill and filling of this rock within the site up to +5.5 m AMSL has been completed. Balance hill cutting and filling up to average +8.0 m +9.5 AMSL was undertaken. Cutting and off-site disposal of balance rock is on-going which is being undertaken by CIDCO; and

- Due to Land Development Works undertaken since April 2017 the current topography of major part of airport Site of 1160 ha is flat, leveled as shown in **Figure-1.6** of **Chapter-1**.

4.2.2.2 Mitigation Measures Implemented During Site Pre-Development

The environmental risk associated with the project activity were assessed during the previous EIA study and the mitigation measures were implemented during site pre-development for sustainable development of the project. The mitigation measures implemented to mitigate the impact due to changes in the land-use and topography of the site are as below:

- The grading concept plan and drainage network of the project site has been aligned towards north and north-east of the project site as per the recommendations of MOEF&CC for safe discharge of the stormwater generated in the project site and avoid flooding of the low-lying areas in the vicinity of the project site.

- The loss of vegetation cover in the project site is compensated as per the conditions stipulated by EC and CRZ Clearance and FC as well. The directives on compensatory afforestation and status of the afforestation have been addressed along with the impacts and mitigations measures along with the impacts upon ecology and biodiversity of the project.

- It is envisaged in the project master plan that about 33% of the land available for the project site will be utilized for development of green cover as open green spaces.

- The project associated activities involve shifting of EHVT lines by underground cables along the boundary of the airport and connect both the ends to the existing overhead lines outside the airport area by installing terminal gantry. This is being carried out by CIDCO. The transmission lines will pass through some areas under CRZ-I, II and III. Extra High Voltage Transmission (EHVT) lines of TPCL are already rerouted and that of MSETCL passing through the project site are being re-routed through underground/at grade cabling and on bridges over mud flats, push through culvert and river/ creek crossings near the Airport periphery. Re-routing of EHTV lines will clear the site from encumbrances required for development and operation of the airport. The CRZ clearance for the above activity has been obtained by CIDCO and the conditions set by CRZ committee are being implemented by CIDCO.

- The debris generated from the construction activities will be re-used and remaining wastes will be handed over to authorized vendor for further disposal.

- Specific laydown areas, crushing & stacking area and labour camp, specific traffic route and separate entry and exist gates are planned for optimal utilization of space and transport facilities during concurrent development and operation of the project. It is shown in **Figure-2.32** of Chapter 2.

4.2.3 Impact on Soil

Airport development include cutting of existing Ulwe hill and filling of respective designated sites area leveled up to +5.5 AMSL has been completed, in the final stage elevation achieving +8.0 to +9.5 AMSL. The land pre-development work involving cutting/ blasting of the Ulwe hill and filling of the project site has been initiated by CIDCO. In the present condition, the project site has been evenly covered with aggregates/ fill material generated from the cutting of the Ulwe hill and filling up of the project site up to +5.5 AMSL. During development phase, the impact on the project site and nearby areas may be anticipated due to soil contamination. The following impacts are anticipated:

- Fugitive emissions from HEMM and other mass transport vehicles like leakage of engine oil or fuel.
- Leakage of lubricants in the workshop areas.
- Soil contamination due to discriminate throwing of asbestos based material during construction.
- Leakage of polluted water or chemical substances into soil.
- Indiscriminate release of vehicle wash water containing oily/ lubricating substances, etc.

4.2.3.1 Mitigation Measures

The hazardous materials used during the construction may include petrol, diesel, and paints. These materials shall be stored and handled according to the guidelines specified under Manufacture, Storage, and Import of Hazardous Chemical Rules (MSHIC) and Hazardous Wastes Storage, Handling and Transportation Rules of MoEF&CC. Various mitigation measures proposed to check soil contamination are:

- To prevent soil contamination likely to result from the oil spill and dripping from vehicles, an oil spill containment system will be implemented.
- Contaminated soil due to spillage of lubricants, fuel oil, paints, etc. will be collected and disposed with the hazardous waste.
- The construction material/ chemicals shall be managed as per SOPs/SDS protocols to avoid spillage.
- Minimize the use of asbestos based material and appropriate collection and segregation of asbestos waste to be practiced as per HWM rules.
- Diesel/oil to be used for various development activities shall be stored in designated storage yards to reduce the spills into unwarranted areas.
- Segregation, collection, storage, and disposal of waste material generated during development phase to minimise its impact on soil quality.
- Use an identified area for undertaking any repair and maintenance of vehicles/equipment.
- Dyke enclosures shall be provided which can contain complete contents of the largest tanks.
- Diesel and other fuels shall be stored in separate dyke enclosures.
- Wherever possible, hazardous raw materials to be substituted by non-hazardous materials, e.g., cleaning solvents can be replaced with film-free bio-degradable cleaners, usage of non-chlorinated strippers instead of strippers containing methylene chloride and substitution of water-based paints for oil-based ones.
- Separate storage of waste paints and thinners, contaminated rags, and brushes to facilitate recycling and reuse. Rags could be laundered for reuse.
- Installation of on-site recycling equipment to be considered by large painting sub-contractors.
- Vehicle maintenance area will be designed to prevent contamination of ground water by accidental spillage of oil; and
- Maintaining appropriate inventory control.

Apart from localized constructional impacts within airport site, no adverse impact on the soil in the surrounding area is anticipated.

4.2.4 Impacts on Drainage

The project site is drained by 5 westerly flowing rivers including Taloja river and Kasadi River in the north, Kalundri and Gadhi River in the east and Ulwe River which has been diverted and the URC flows along the southern and western boundary of the project site before joining the Panvel Creek in the west. Taloja River and Kasadi River joins together to form Panvel Creek. Gadhi and Kalundri Rivers joins together and meet the Panvel Creek at village Waghvali. Garada nala and another streams form Ulwe River which joins Panvel Creek in the south near village Dungi.

The major impacts on the drainage pattern were anticipated for the project pre-development phase due to diversion of the Ulwe River and training of the Gadhi River. The Ulwe River had a small catchment of only 35 sq. km. A hydrogeological study has been conducted by GSDA in 2010 to address the risks associated with the river diversion works.

It is concluded in the hydrogeological survey conducted by GSDA that the aquifers within the Ulwe River watershed have limited water holding capacity based on the assessment of the yield in the monitoring wells. Therefore, the diversion of Ulwe River near the creek will not have substantial impact on the groundwater levels. Similarly, it is also observed that the tidal waters in the Gadhi River reaches the confluence of Kalundri and Kolkhewadi River in the upstream. This ensures that the training of the Gadhi River is not anticipated to impact the groundwater levels in that watershed.

The site pre-development was commenced after getting the EC & CRZ Clearance and all other necessary statutory clearance. The diversion of the Ulwe River has been accomplished while observing all necessary EC conditions. The airport site has been reclaimed and the site is raised up to +5.5 AMSL based on the stability studies recommendations.

The construction of the airport is anticipated to have minimal impact on the drainage patter of the study area while appropriate mitigation measures are recommended for sustainable development of the airport.

4.2.4.1 Mitigation Measures

- As per environmental and CRZ clearance (EC) granted on 22nd November 2010, the storm water generated within NMIA are to be drained to north or north-east into Gadhi River or Panvel Creek. The natural slope of the project area is towards north and north-east.

- The drainage design was approved by CWPRS. The drainage concept is based with strategy that storm run-off draining from south to north and northeast into Gadhi River. For draining the water from central catchment area an open rainwater channel is proposed in between airside and landside boundary, which allow for effective drainage network and harvesting systems.

- The construction of the drainage network and the grading concept will be in line with the MoEF&CC recommendations mentioned in the EC and CRZ Clearance conditions.

- As a pollution control measure before discharging the storm water to the water way channel/pond, oil-water separator units are proposed. Silt ponds are proposed near every outfall location to prevent the silt getting into the receiving water bodies.

- The drainage design of NMIA will be integrated with the drainage master plan of the nearby areas of NMIA to reduce the impact of flooding. CWPRS has reviewed and approved the drainage plan of NMIA while identifying the maximum probable run-off rate of 148.1 mm/hr based on 100 years rainfall return; and

- The unconfined aquifers within the Panvel and Taloja industrial areas are reported to have occasional saltwater intrusion, therefore groundwater abstraction is to be avoided in any case.

4.2.5 Impact on Air Quality

The site pre-development activities have been completed. The main sources for impact on air quality are anticipated during the development phase of the project. In this period the deployment, operation, and movement of HEMMs at the site will generate dust during the hill cutting and crushing, site filling and leveling, grading, foundation works, transportation of construction aggregate/material to the project site from various sources, drilling operation etc. Similarly, the controlled blasting activities will be undertaken with appropriate mitigation measures to reduce dust emissions. The dust emitted during these activities depends upon the type of soil being excavated and the ambient humidity levels. However, the impact during the development phases will be localized and short-term in nature till the completion of the development activities and construction demobilization.

Mobile sources of air pollutants are anticipated from emission of vehicles and equipment deployed during the development phase is likely to result in marginal increase in the level of SO_2, NO_x, PM, CO, and unburnt hydrocarbons. The impact of such activities would be temporary and restricted to the development phase. The impact will be confined within the project boundary and is expected to be negligible outside the proposed project site.

Stationary sources of air pollutants are anticipated from the operation of the DGs, crushers and ready-mix concrete plants. The major impacts of the crushers and the RMC plants will be basically from the emissions of particulate matter and dust which will be confined to a localized area from the proposed temporary location of the facility. The DG operations will be used for back-up purpose and will be used in case of power failure. No continuous emissions are anticipated from DG operations.

4.2.5.1 Mitigation Measures

The following measures will be implemented during the development phase to reduce the impact on the ambient air quality:

- Hill cutting will be undertaken with appropriate safety measures and appropriate measures will be implemented during mechanized cutting to reduce fugitive emissions.
- Bench cutting will be carried out after assessing the slope stability of the benches to avoid landslide.
- Wet drilling technologies will be implemented to reduce dust emissions.
- Vehicles accessing the project site will be checked regularly for valid Pollution Under Control (PUC) certificates.
- Water sprinkling shall be carried out at the construction sites with regular intervals e.g., excavation, material handling, dust emissions from RMC, etc. to suppress dust.
- Dust emissions from crushers can be controlled with implementation of dust control measures in the crushers like use of dust containment enclosure and water spraying for reduction of fly dust.
- Also, the crusher areas should be paved to reduce re-entrainment of settled dust on the unpaved road, reducing the drop height near the crushing area and covering the potential dust emissions sources to reduce transportation of dust material.
- The welding activities will be limited and thus emissions thereof will be insignificant, although personnel involved in welding shall use appropriate PPE to abet the impact due to emissions during the welding activity.
- Use of asbestos based material will be restricted; and
- All the construction sites shall be barricaded and camouflaged adequately.

Adopting techniques like, air extraction equipment, and covering scaffolding, hosing down road surfaces and cleaning of vehicles can reduce dust and vapour emissions. Measures include appropriate containment around storage tanks and materials stores to prevent spillages entering watercourses.

The other measures to reduce the air pollution on site are:

- Sprinkling of water and fine spray from nozzles to suppress the dust in the roads.
- On-Road- Inspection should be done for black smoke generating machinery.
- Promotion of use of cleaner fuel should be done.
- All DG sets should comply emission norms notified by MoEF&CC.
- Use of covering sheet to prevent dust dispersion at buildings and infrastructure sites, which are being constructed.
- All vehicles accessing the construction site will be properly maintained adequate maintenance complying with PUC.

Material storages / warehouses –should be taken to keep all material storages adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions. Fabrics and plastics for covering piles of soils and debris is an effective means to reduce fugitive dust.

4.2.5.2 Management of Dust Emission due to Transportation

Construction area consists of large open area. To reduce dust emission due to vehicle movement:

✓ Vehicle access area will be limited by use of designated pathway.

- ✓ Speed limit of 20 km/ hr. is fixed for vehicles, and speed monitoring is done.
- ✓ Vehicles wheel washing will be carried out.
- ✓ All aggregate transporting vehicles will be covered to prevent emission of dust; and
- ✓ Speed bumps are commonly used to ensure speed reduction. In cases where speed reduction cannot effectively reduce fugitive dust, it may be necessary to divert traffic to nearby paved areas.

4.2.5.3 Impact Due to Construction Traffic

During development phase, particulate matter will be the main pollutant, which would be generated from the site development activities and vehicular movement on the road. Further, concentration of NO_x and CO may also slightly increase due to increased vehicular traffic movement. However, the increase in ambient concentrations of air quality will be negligible. The increment in concentration is expected to be negligible and insignificant which will be localized in nature. As most of the construction equipment will be mobile, the emissions are likely to be fugitive. The dust generated will also be fugitive in nature, which can be controlled by suitable mitigation measures like sprinkling of water.

The impacts will be temporary and localized in nature and the areas outside the project site premises are not likely to have any adverse impact with respect to ambient air quality.

4.2.6 Impact Water Resources and Quality

The Ulwe Recourse Channel (URC) has been completed and commission, the water quality in the recourse channel is sampled and analyzed in the study period. Since the recourse channel has a small catchment and finally drains into the Moha creek, the water quality in URC is also impacted by the back waters from the creek.

The impact on water quality in the URC and modified creeks area due to pre-development and construction activities based on sampling and analysis is discussed below:

- Overall data in the region indicates water quality is under stress due to ongoing activities at site & some domestic sources in Moha creek & upstream Ulwe river. Also, the channel is under stress due to the temporary number of bunds over it, restricting the free tidal flow.

- The creek bed was mainly composed of silts & clay sediments. Overall, the concentration of metals varied in the expected ranges. Though certain metal values are noteworthy & must have been contributed by effluents from industries and by sewage discharges.

- Similarly, in mouth of Moha creek &upstream Ulwe River creek bed is mainly composed of (Sand) Gravel, silts & lesser clay, while Rocky strata is observed in URC channel. The sediment texture consisted of rocks cuts like gravel/pebbles due to newly formed channel through hill cutting hence sand (pebbles, gravels & rock cuttings) composition dominated in URC channel. The sediment texture observed at the bottom of URC is shown in **Figure-3.11.7** in **Chapter-3.**

- Overall, the concentration of metals & TOC varied in the expected ranges.

The development phase would involve water requirements for the following activities:

- Site preparation: Involves levelling for infrastructure development.
- Water is required for dust settlement, consolidation, compaction, and curing.
- Construction of building infrastructure involves water for construction activities and domestic and other water requirements for labour and staff onsite.

During the development phase, water will be required for construction purposes. It is also proposed to adopt the techniques and equipment's, which will further help in reduction of water demand during construction. Therefore, the impact on the water resources during the development phase would be temporary in nature.

Impact on water quality during development phase is possible due to sewage generated from the construction workforce stationed at the site. The construction site sanitation facilities will be linked to the mobile STPs for treatment and disposal of sanitary sewage generated by the workforce. Based on phase-wise development, the amount of sludge generated from the STPs can be utilized as manure in new plantation in Jite Village Forest Department allotment of approx. 125 acres of land. Hence, there will be no impact on water resources.

However, during construction activity in rainy season, the water quality is likely to be affected due to the construction work and loosening of topsoil. This is likely to increase the suspended solids in the run-off during heavy precipitation. To reduce the impact on water quality, temporary sedimentation pond will be constructed for the settlement of the suspended matter.

4.2.6.1 Mitigation Measures

- Monitoring of water usage at construction camps to prevent wastage.
- Ensuring there are no chemical or fuel spills at water body crossings.
- Ensuring that the STP at construction camps/ sites and the proposed facilities are properly designed to handle peak wastewater load and properly maintained.
- Tracking of consumption and installing water meter at any new water abstraction source.
- The project envisages no abstraction of groundwater either in construction or operation phases.
- Vehicle/heavy machinery washing at the site will be prohibited; and
- Contaminated oil from wash water from workshops/maintenance yards shall be separated out and decanted water will be reused.

4.2.6.2 Wastewater Management at Labour Camp

- Domestic sewage from labour colony is treated in Sewage Treatment Plant and recycled for water sprinkling to suppress the dust.

- Wastewater will be recycled and reused for dust suppression.
- Municipal solid waste from labour camp and office areas will be disposed-off on daily basis to authorized agencies; and
- Separate storage areas are identified for other waste materials generated and will be disposed through authorized dealers.

4.2.7 Impact on Noise Environment

Heavy construction traffic for loading and unloading, fabrication and handling of equipment and construction materials are likely to cause an increase in the ambient noise levels. At the peak of the construction, marginal increase in noise levels is expected to occur locally at the construction site. The activities, which produce periodic noise, are as follows:

- Foundation construction including pile driving; and
- Infrastructure construction.

The typical noise levels of some construction equipment are given in **Table-4.3.**

TABLE-4.3
TYPICAL NOISE LEVELS OF CONSTRUCTION EQUIPMENT

Particulars	Noise Levels dB(A) [at Source]
Earth Movers	
Front End Loaders	72-84
Backhoes	72-93
Tractors	76-96
Scrapers, Graders	80-93
Pavers	86-88
Trucks	82-94
Material Handlers	
Concrete mixers	75-88
Concrete pumps	81-88
Cranes (movable)	75-86
Cranes (derrick)	86-88
Stationary Equipment	
Pumps	69-71
Generators	71-82
Compressors	74-86

The peak noise levels from continuous construction activity may be about 85-90 dB (A). Since the nearest habitation areas are located outside the airport premises, the construction noise levels are considered to have insignificant impact on community. However, the potential noise impact on the workers/employees needs to be mitigated.

Blasting operations can have unacceptable impulsive noise in the range of 115 dB (A) or higher and impact due to vibration. Although controlled blasting (bottom initiation) and NONEL technologies will be practiced reducing vibration and noise levels and it also helps arrest the fly-rock effectively. This will ensure that blasting activities will have minimal impact on nearby habitations. This is a temporary activity which will be limited to pre-development phase only.

4.2.7.1 Mitigation Measures

Overall, the impact of noise generated on the environment is likely to be insignificant, reversible, and localized in nature. Community noise levels are not likely to be affected because of the vegetation and likely attenuation due to the physical barriers. The following recommendations shall be implemented:

- Provision of silencers at the exit of noise source on the machinery.
- Construction equipment with minimum noise will be chosen.
- Vehicles and construction equipment with internal combustion engines without proper silencer will not be allowed to operate at the construction site.
- Regular maintenance of construction equipment.
- The use of damping materials such as thin rubber/lead sheet for wrapping the workplaces like compressors, generator sheets.
- Shock absorbing techniques will be adopted to reduce impact.
- Inlet and outlet mufflers will be provided which are easy to design.
- Ear plugs will be provided to the workers working in high noise level areas.
- Stationary equipment such as ready-mix plant, hot mix plant, cement storage plant will result in noise generation. It will be ensured that the minimum distance of operation from stationary source are meeting CPCB standards. Hence, no considerable impact is envisaged on the surrounding community during development phase; and
- Construction activities involving operation of high noise generating machinery will be generally avoided between 10 pm and 6 am.

4.2.7.2 Mitigation Measures for Quarrying/Blasting

Most of the quarry and blasting with respect to hill cutting has been completed except a part of the hill still being cut to level the project area. Noise will be generated due to blasting operations of hills / hill cutting activity on site. However, it will be a one-time activity lasting for short duration. As the nearest settlements are more than 1 km away, the impact of the generated noise level on the surrounding population will be temporary in nature.

The impact of noise due to blasting may be suffered by the people accessing the workplace. Therefore, as per DGMS guidelines, controlled blasting shall be carried out by licensed contractors under strict supervision. All blasting during Ulwe hill cutting must be carried out in a proper manner in accordance with best practices to minimize likelihood of adverse impacts. The blasting activities shall be conducted in a cordoned-off area. NONEL, a safe technology for controlled blasting will be used to avoid possible damage from impact of blasting and. The following mitigation measures will be observed while blasting:

- Blasting is well planned with large numbers being fired infrequently than a few blasts daily. No blasting will be carried out at night.
- Before controlled blasting, the surrounding villages will be made alert and the villagers and domestic animals will be offered safe place away from the project site; and
- Blasting will be carried out by approved blasters and blasting induced vibration shall be measured using a seismograph.

- Necessary safety and control measures will be implemented as per DGMS guidelines and safe distance will be maintained before blasting activity is commenced.

4.2.7.3 Control of Noise from Road Traffic and DG sets

Management measures include the following:

- Regular maintenance of vehicles to reduce noise levels.
- Personnel working in noisy areas will be provided with ear plugs/mufflers to reduce the noise impacts.
- The DG set will be provided with acoustic enclosures and exhaust mufflers for effective noise reduction of 25 dB (A) each.
- Sources of intermittent noise generating equipment such as compressors will be provided with appropriate acoustic barriers so that the noise level within 100 m of these facilities when in operation will be less than 70 dB (A); and

4.2.8 Impact due to Solid Waste Generation

The development phase waste will comprise of excavated and demolition material. The different types of wastes need to be handled as per their needs and regulatory requirements. It is not possible to dispose-off all type of wastes onto the land and has to be dealt with depending upon their type and characteristics. Building construction leads to generation of sand, gravel, concrete, stone, bricks, wood, metal, glass, polythene sheets plastic, paper etc. as waste.

The solid waste generated in the project site may be broadly classified as hazardous and non-hazardous wastes. In the absence of appropriate waste management practices, the impacts are anticipated as below:

- Inappropriate waste management will lead to the loss of site aesthetics and may cause freak accidents.
- Hazardous waste if not segregated and handled properly will lead to pollution load and serious health impacts in construction workers.
- Municipal waste if not handled properly may lead to air-borne or water borne diseases; etc.

4.2.8.1 Mitigation Measures

Hazardous and flammable materials such as diesel, fuel oil, lubricating oil during development phase should be stored properly as per the safety regulations. Combustible wastes should be burnt in a controlled manner and other category of wastes should be disposed of at identified dump site. Accidental spillages of oil from construction equipment and storage sites should be prevented.

Major solid waste generation from the premises is mostly municipal solid waste. Municipal solid waste from labour camp and office area are disposed on daily basis and will be handed over to authorized agency. Separate storage areas are identified for other waste materials generated and will be disposed through authorized agencies.

The sludge generated from the sewage treatment plant will be used as manure for greenbelt development.

To avoid any solid waste disposal problems, an effective solid waste management system by means of collection of wastes in different types of dust bins and transporting the same to the municipal dumping grounds by the contractors is proposed. Hazardous waste shall be handled as per the Hazardous Waste Handling Rule, 2016. Strict adherence to the established solid waste collection and disposal system will ensure clean environment during development period.

The blasting will result in breaking and fragmentation of hard rocks which will be utilized after crushing for filling purpose or converted to aggregates.

4.2.8.2 Management of Construction and Demolition Waste

Construction and excavation waste are the waste comprised of building materials, debris and rubble resulting from construction, re-modeling, repair, and demolition of any civil structure. Existing internal structures and boundary wall will be demolished as per functional requirement. The C&D waste generated during or prior to construction activities will be utilized within the site.

4.2.9 Impact on Terrestrial and Aquatic Ecology

The pre-development activities of the NMIA project site entails clearance of the site from any encumbrances and levelling of the site up to +5.5 AMSL for commencement of the project development. All forms of vegetation in the project site will be cleared upon completion of pre-development and the site will be completely reclaimed before the project development begins. At present, the site pre-development activities are nearing completion except some patches of vegetation can be observed in the northern and eastern boundaries of the project site. Although, cutting/felling of remaining trees in the project site is in progress. The status of the site physiographic conditions and vegetation cover prevailing in 2017 and the change observed in recent status of site is depicted in **Figure-4.2**.

The impact due to project pre-development occurred due to loss of the biodiversity and faunal habitat within the project site. Also, the loss of riverine ecosystem due to recourse of the Ulwe creek has impacted the local eco-system of the project corridor. Most of the area in project site is reclaimed and will be free from all encumbrances upon completion of site pre-development activities. The impact due to cutting/blasting of the remaining part Ulwe hill is anticipated to have minimal or no significant impact on the terrestrial fauna.

4.2.9.1 Impact on Aquatic Ecology

Based on sampling and analysis of marine water and sediment samples, detailed assessment of marine baseline condition has been addressed in **Chapter-3**. The study indicates reinstating benthic fauna in the URC as shown in **Figure-4.3**.-There was temporary impact due to construction and commission of URC which will subside over a period.

FIGURE-4.2
PROJECT SITE PHYSIOGRAPHY AND VEGETATION COVER BEFORE 2017 AND AFTER 2020 PRE-DEVELOPMENT

FIGURE-4.3
REINSTATING OF BENTHIC FAUNA IN URC

4.2.9.2 *Impact on Birds*

Geographically, NMIA site is surrounded by several Important Bird Areas (IBAs) within a radius of 15-km including wetland habitats, bird roosting sites and ecologically sensitive site of Karnala Bird Sanctuary (KBS). The creeks surrounding IBAs have patches of mangrove coverage along the banks, attracting birds like gulls, avocets, and curlews. Even Sand Mining operations were observed during samplings & surveys.

The concern pertaining to the noise generated at the project site may impact bird roosting/foraging sites close to the NMIA boundary. The impact due to noise will be upon the populations of waterbirds close to the airport site. Therefore, a detailed baseline documentation of flora and fauna of KBS and NMIA project area for preparation of conservation and preservation has been carried out and the report is submitted to CIDCO. The conservation activities of these areas are being implemented by CIDCO as per BNHS recommendations. These are mentioned below:

- Encouraging the local people and policymakers to maintain existing and potential water-bird habitats close to the mudflats to the extent possible.
- Protect and conserve nearby wetlands, key links, KBS and other ESZs.
- Building infrastructure in existing protected sites such as KBS and Matheran for conservation of avifauna.
- Reduce anthropogenic pressure on the existing habitats by providing alternatives for fuel wood and fodder; and
- Regular monitoring of the Important Bird Areas, key-links and ESZ.

4.2.9.3 Mitigation Measures

The project aims to offset the impact due to loss of flora and fauna associated with project site through compensatory afforestation as per the recommendation of MOEF&CC. This entails compensatory afforestation through plantation of trees and mangroves lost during site pre-development activities, the status of which is described below.

The Forest Clearance has been obtained vide letter no. F. No. 8-95/2012-FC for a total area of 250. 0635 Ha including Mangrove area – 108.607 ha. The forest land includes 141.4565 ha. The concerned EC conditions (EC & CRZ Clearance, 2010) for compensatory afforestation is mentioned below:

- EC Condition 7 (I) (iii) requires Permission to be obtained from Bombay High Court and Clearance under Forest Conservation Act; and
- EC Condition 7 (I) (iv) requires the plantation and protection of mangroves over an area of 615 ha (including Mangrove Park of 245 Ha at Waghivali island + 310 Ha to the Northeast + 60 Ha on the west near Moha creek). NMDP is modified in this respect.

4.2.9.4 Compliance to EC Conditions

- Area of 616.2 Ha has been earmarked in Modified Navi Mumbai Development Plan approved by GoM vide G.R. dt 12.03.12 in 4 NDZ pockets as Mangrove Patches.
- 250.0635 Ha Degraded Forest Land taken up in Alibaug, Dahanu and Shahpur Division and total of 670,073 trees planted through Forest Department.
- CIDCO has undertaken 109 Ha compensatory mangroves plantation to NE of site on S. No. 27, village Kolhekhar in between Jui creek and Taloja creek through the Mangrove Cell of State Forest Department; and
- HOFF (Head of Forest Forces, Maharashtra state, Nagpur) has visited site on 12th Dec 2018 and reviewed the compliance to Forest Clearance.
- Compensatory Mangrove Plantation done over 109 ha as per FC condition is done at village Kolekhar. Mangrove afforestation has been completed by CIDCO in 310 ha + 60 ha + 20 ha area = 390 ha area through Forest Development Corporation of Maharashtra (FDCM).

4.2.9.5 Present Status of Tree Cutting & Transplantation

Project has been granted permission from Tree Authority Committee, CIDCO for tree transplantation and cutting. The cutting/felling of tree at the project site is in progress. Cutting of 9053 trees has been completed out of total 9492 and 1493 trees were transplanted out of total 3319, which is shown in Table **Table-4.4.**

TABLE-4.4
STATUS OF TREE CUTTING & TRANSPLANTATION BY CIDCO

Sr. No	Particulars	Total Trees	Completed Work	Balance Work in Progress	Remarks
1	Tree cutting	9492	9053	439	No endangered species
2	Transplantation	3319	1493	1826	Transplantation carried out at Central Park (Kharghar), Central Jail (Taloja) and Ulwe Node by CIDCO

Source: CIDCO

The permission letters along with cutting & transplantation details is given in **Table-4.5.** The photographs of the tree plantation as part of the project compensatory afforestation of trees (apart from mangrove afforestation) are presented in **Figure-4.4** below. The transplantation of the trees is being carried out by expert horticulturists.

NMIAL has requested the Forest Department, GoM for allotment of approximately 50.620 ha (about 125 acres) of land for taking up new plantation. NMIAL intends to plant about 14000 trees outside the project site. The location map and phase-wise plantation site plan for NMIAL plantation outside the project area is shown in **Figure-4.5(A&B)**.

TABLE-4.5
DETAILS OF PERMISSIONS LETTERS FOR TREE TRANSPLANTATION/ CUTTING BY CIDCO

Sr. No	Village in Core Zone	Permission Letter- Tree Authority Committed, CIDCO	Transplanting	Cutting	Transplantation and Compensatory Plantation
1	Chinchpada	CIDCO/Hort/2018/456, dated 14th March, 2018	201	587	Maintain & protect the new tree plantation – 1174 no. of trees at Taloja Pachnand Node & transplant trees – 201 no. of trees for a period of 3 years
2	Varcha Owale and Waghivali wada	CIDCO/Hort/2018/457, dated 14th March, 2018	175	704	Maintain & protect the new tree plantation – 1408 no. of trees at Taloja Pachnand Node & transplant trees – 175 no. of trees for a period of 3 years
3	Kombadbhuje and Targhar (part-II)	CIDCO/Hort/2018/458, dated 14th March, 2018	316	737	Maintain & protect the new tree plantation – 1474 no. of trees at Panvel West & transplant trees – 316 no. of trees for a period of 3 years
4	Kolhi	CIDCO/Hort/2018/459, dated 14th March, 2018	374	956	Maintain & protect the new tree plantation – 1912 no. of trees at Taloja Pachnand Node & transplant trees – 374 no. of trees for a period of 3 years
5	Ulwe (Part-II)	CIDCO/Hort/2018/477, dated 28th March, 2018	755	1867	Advance plantation of 3734 no of trees carried out in Karanjade node (3000 trees) & panvel east (734 trees)
6	Kopar	CIDCO/Hort/2018/475, dated 28th March, 2018	495	1372	Plantation of 3734 no. of trees carried out in Karanjade and Panvel-Est Node against the new plantation to be carried out in lieu of cutting of 1372 no. of trees. To transplant 755 no. of existing trees in buffer zone of Taloja central jail at Kharghar.
7	Ulwe (Part-I)	CIDCO/Hort/2018/476, dated 28th March, 2018	509	1143	Maintain & protect the new tree plantation – 2286 no. of trees at Karanjade Node & transplant trees – 509 no. of trees at buffer zone of Taloja Central Jail at Kharghar for a period of 3 years
8	Ganeshpuri	CIDCO/Hort/2018/49, dated 30th May, 2018	202	948	To plant 1896 no of trees along the periphery of playground plant in Sec-R2 & Central Verge, 20 m vide road of Vadghar & 20 m wide road central verge, sect-25 , Vahal Navi Mumbai and transplant 202 trees long the periphery of sec-25, Vahal, Ulwe, Navi Mumbai.
9	Pargoan	CIDCO/Hort/2018/50, dated 30th May, 2018	292	1178	To plant 2356 no. of new plant at buffer zone of Taloja central jail and to transplant 292 no. at Sec-24, Vahal, Ulwe, Navi Mumbai
10	Amendment letter CIDCO/Hort/2018/100, dated 30th July, 2018		2298 no of trees at buffer zone of Taloja central jail, Kharghar		- Transplant of 1429 no. of trees at buffer zone of Taloja Central Jail, Kharghar - Transplantation of 869 no. of trees at sec-R3, Sec-R5, Sec-R2 etc New plantation- 700 no. of trees at green belt of Gadhi river, 850 no. of trees at coastal road, Dronagiri & 346 no. of trees at central verge of 20 m wide road at Vadghar and at road central verge, sect-25A, Vahal, Navi Mumbai

Source: CIDCO

FIGURE-4.4
PHOTOGRAPHS OF PLANTATION AS PART OF COMPENSATORY AFFORESTATION BY CIDCO

FIGURE-4.5 (A)
NMIAL PLANTATION PLAN OUTSIDE PROJECT SITE AT JITE VILLAGE

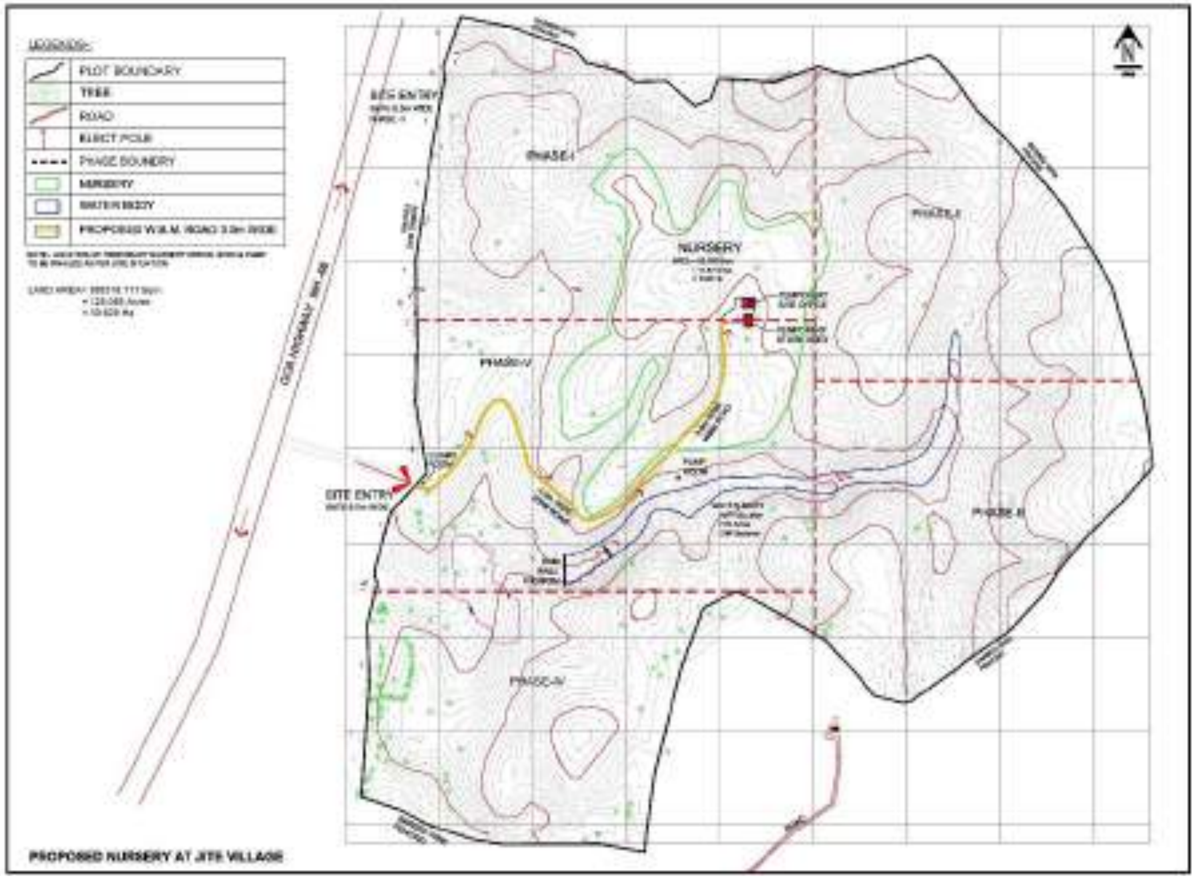


FIGURE-4.5 (B)
PHASE-WISE NMIAL PLANTATION PLAN OUTSIDE PROJECT SITE AT JITE VILLAGE

Thus, the entire land scape of the core area had been modified. The area is mostly barren now. The vegetation and flora of the core area that existed before 2017 had been lost. The project is going to cause fragmentation of the entire 1160 ha of the airport area by means of an impenetrable security wall. However, the area was not a part of any wildlife corridor and hence it is not going to lead to any kind of reproductive isolation of populations. Other mitigation measures to be followed during development phase to reduce the impact due to the construction activity are mentioned below:

- All noise generating equipment shall be properly maintained to reduce the source noise levels.
- Wastewater generated from the construction workforce will be treated in the STPs to be present during development phase and it will be reused for greenbelt development and dust suppression. Since no wastewater is proposed to be discharged outside airport premises, impact on aquatic ecology is likely to be negligible.
- Development of landscape and greenery in the landside will reduce the stress on noise levels due to airport activity to some extent; and
- The aircraft landing and take-off routes will be designed as per ICAO/AAI land use guidelines to minimize aircraft induced noise as low as reasonably possible.

4.2.10 Impact on Marine Environment

The water quality as observed of Creek is a result of the balance between the anthropogenic fluxes of pollutants emanating from domestic wastewater and variety of industries located along its eastern and western shores and removal of contaminants by natural processes.

The biological components like low chlorophyll, phytoplankton & zooplankton indicated stressed environment, while the benthic biota indicated the resumption of re-instating process.

The construction activity may result in the increase in the sediment deposit in the creek through storm run-offs. Once the Gadhi river channel is to be trained & the surrounding project related hill cutting/levelling like impactful activities completed, the smooth tidal flow shall allow the estuarine environment to balance itself. Ulwe river was passing through the project area before the predevelopment work.

4.2.10.1 Mitigation Measures

The altered marine ecology of the water bodies is monitored regularly during the predevelopment and will continue during development and operational phases of the project as per the EC and CRZ clearance conditions.

The sediment deposition during construction is not anticipated due to reclamation and alignment of project site as per CWPRS recommendations. However, turbidity during development phase will be monitoring by NMIA.

The mitigation measures are already in practice by CIDCO/NMIAL regarding mangrove afforestation are highlighted below:

4.2.10.2 Mangrove Afforestation

Loss of mangrove vegetation in NMIA site was 98 ha and mangroves in off-site infra was about 10.607 ha. The loss of mangroves in the project site is being compensated by CIDCO through mangrove transplantation as per MoEFCC conditions.

The plantation and protection of mangroves over an area of 615 ha (including Mangrove Park of 245 ha at Waghivali island + 310 ha to the Northeast + 60 ha on the west near Moha creek) was proposed initially. Area of 616.2 ha has been earmarked in modified developmental plan approved by Government of Maharashtra vide G.R. dt 12.03.12 in 4 NDZ pockets as Mangrove patches.

Additionally, Compensatory Mangrove Plantation is done over 109 ha as per FC condition (to compensate loss of mangroves) at village Kolhekhar with the help of the Mangrove Cell of State Forest Department. Mangrove afforestation has been completed by CIDCO in 310 ha + 60 ha + 20 ha area = 390 ha area through Forest Development Corporation of Maharashtra (FDCM).

4.2.10.3 Mangrove Regeneration Study

Following EC and CRZ 2010, condition No. XI, Mumbai University quantified the affected Mangrove and the same is incorporated in updated EIA Report. CIDCO prepared the Scheme for regeneration of Mangrove through M/s. Lewis Environment Services USA (LES)., and implementation of same is proposed to be carried out by CIDCO in consultation with the State Forest Department before the commencement of construction works of the airport. Discussions are in progress with the concerned division of Forest Department to commence work on site.

The team comprising members from CIDCO, LES and University of Mumbai during May 27th to 31st 2011, thoroughly surveyed the project areas to understand the geography of Navi Mumbai International Airport (NMIA) mangroves and status of natural tidal hydrology. Man-made barriers to the tidal flow were observed in the proposed regeneration areas near NMIA.

The Consultant, after detailed site survey, proposed a natural re-colonization program for mangroves, by reconnecting tidal channels, a summary of which is summarized below:

- Deconstruct bunds in filled former mangroves and restore tidal sheet flow.
- Establish marsh and mangrove topographic elevations.
- Reconnect historical tidal channels to restore tidal exchange.
- Remove fill in mangroves and restore the historical marsh/mangrove elevations.
- Allow natural re-colonization of mangroves.

Although, BNHS, in its Report (February 2019) on baseline Avi-Fauna Survey (over last 5 years) recommended the following:

- To develop and protect other suitable sites to the south and west of NMIA for congregator birds.
- Mangrove Park should be located away from the airport influence zone considering the bird hazard issue.
- Waghivali island has populace staying on it.

Considering the above and that Waghivali island (245 Ha) is yet inhabited, it is protected as NDZ for the time being and mangroves in the area are/will be retained in their natural state. Thus, condition given for permitting Mangrove clearance Mangrove Plantation & Protection as imposed by Bombay High Court & EC is fully complied.

Compensatory mangrove plantation area maps at village Kolekhar is shown in **Figure-4.6** and the map of plantation & compensatory afforestation of areas earmarked for mangroves plantation at different locations before BNHS recommendation is shown in **Figure-4.7**. Image showing mangrove plantation undertaken is given in **Figure-4.8** which is certified by DFO Conservation Cells. Actual mangrove plantations undertaken at various locations (except Waghivali island) around the project site are shown in the following **Figure-4.9**.

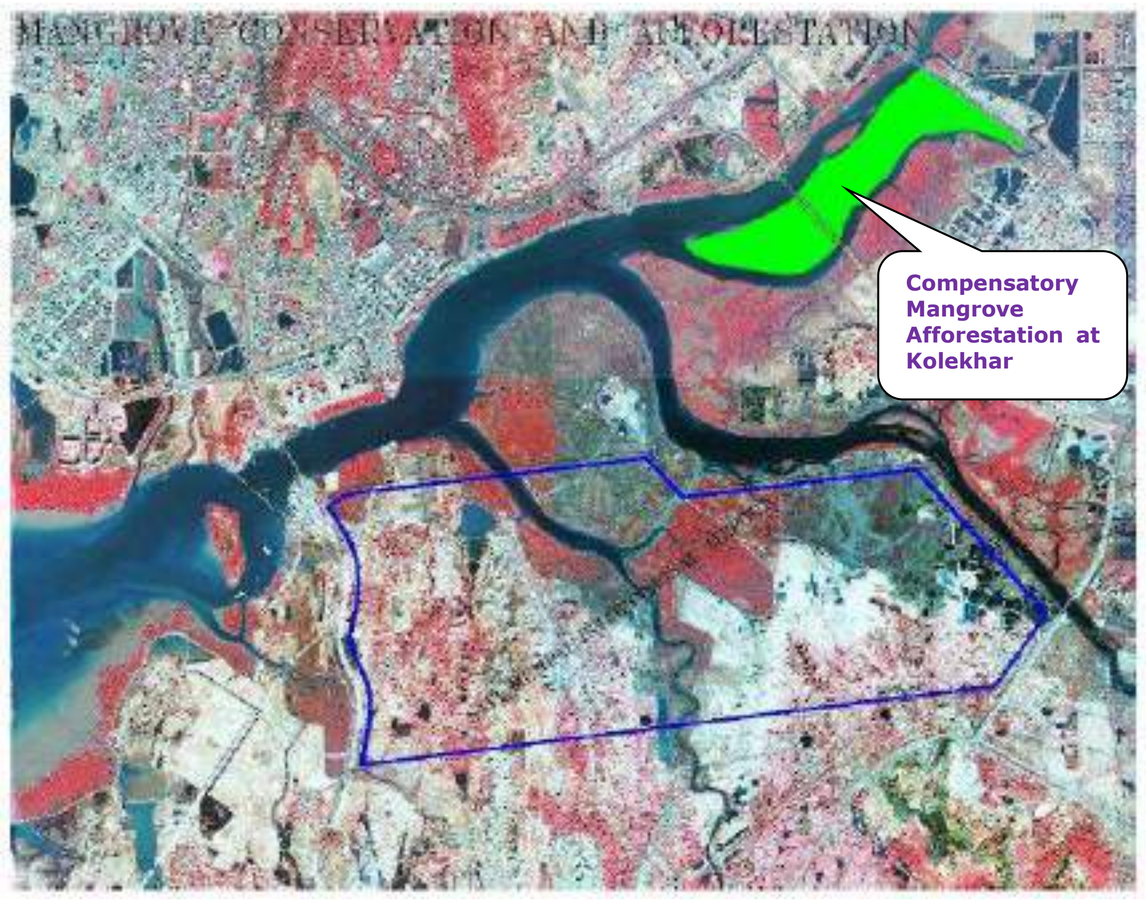


FIGURE-4.6
COMPENSATORY MANGROVE PLANTATION AT VILLAGE KOLEKHAR

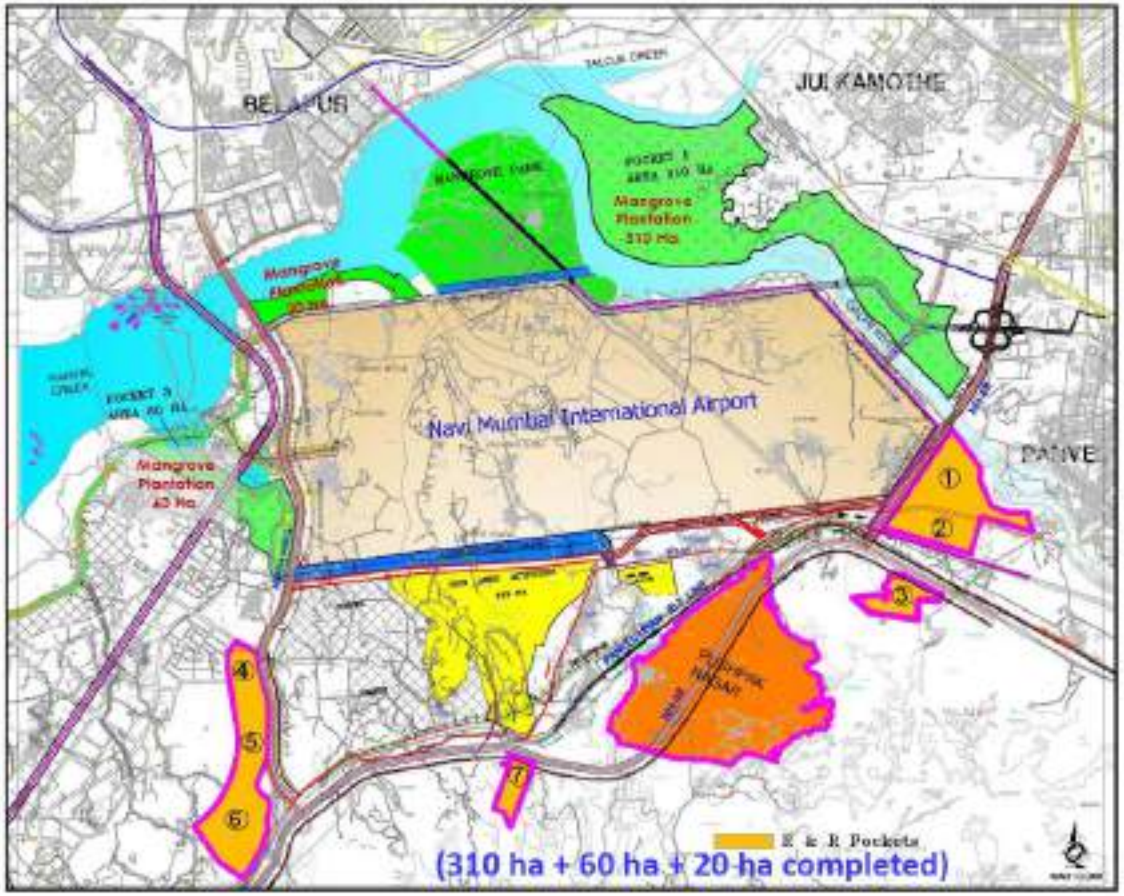


FIGURE-4.7
PLANTATION & COMPENSATORY AFFORESTATION MAP OF MANGROVES

FIGURE-4.8
DFO CERTIFIED MANGROVE PLANTATION MAP

FIGURE-4.9
PHOTOGRAPHS MANGROVE PLATATION UNDERTAKEN BY CIDCO

4.2.11 Demography and Socio-Economics

The impact of the proposed project will begin with the starting up of the construction activities at the site. The proposed construction will provide employment to considerable number of skilled, semi-skilled and un-skilled construction labourers. In normal circumstances, the local people will be given preference for the unskilled activities, as there are many construction laborers in the vicinity of the project and are expected to be available with normal wages.

4.2.11.1 Impact on Land

Acquisition of land is a key factor for timely completion of any infrastructure project. Therefore, proper assessment of the total land required, conducting a detailed survey of the land to be acquired, identification of persons affected by the project and finalization of compensation package are critical for timely land acquisition. Project affected families (PAFs) are going to be the main affected due to the establishment of the international airport. Land required for the airport project is 1160 ha.

4.2.11.2 Impact on Project Affected Persons

Impact on Project Affected Persons as per the census survey 2011, a total of 15,579 persons comprising 8030 males and 7549 females from 3113 families would be affected by the project.

4.2.11.3 Impact on Livelihood of the PAFs

The livelihood of 3113 families would be disrupted due to the construction of new airport in Navi Mumbai. The economic activities performed by the local people play an important role in the local economy. Thus, the airport project will largely affect them as they derive their livelihoods from locally based economic activities. Further, approximately 303 ha of agricultural land plots would also be affected due to land acquisition. Similarly, 16.58 ha in gaothans will also be affected. Consequently, there would be loss of livelihood depending on the area of land lost. All the 3113 families are required to be resettled. Shifting of the population from their native village to a new location may create additional impact on the livelihood of the affected persons.

4.2.11.4 Impact on Common Property Resources (CPRs)

The habitation along the road is invariably linked with the establishment of common property resources. A total of 37 CPRs are likely to be affected. These include religious structures, schools, Government structures and passenger shelters at bus stops. Efforts are required to minimize the impact on religious and community structures/places as far as possible as per the third schedule of the right to fair compensation and transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013.

Accordingly, CIDCO drafted an R&R Policy for the development of the airport project in February 2013. The approved policy of Land Acquisition and Rehabilitation & Resettlement as per Govt. Resolution dated 1st March 2014 and 28th May 2014 (referred as CIDCO R&R Package), CIDCO will provide all the common infrastructure facilities in all the R&R pockets.

4.2.11.5 Compensation Details

R&R package was approved vide Urban Development Department (UDD), GoM G.R. dated 1st March 2014 and 28th May 2014 for rehabilitation of families falling in the proposed airport site. The package exceeds the requirements of LARR 2013 and also provides special incentives for shifting/relocation.

The Rehabilitation & Resettlement is being carried out as per the GR issued by Government of Maharashtra (GoM). CIDCO has incurred cost of Rs 1813 Crores for for NMIA project (**Table-4.6**). The community facilities within the R&R Pockets are shown in **Figure-4.10.**

TABLE-4.6
COST INCURRED BY CIDCO FOR R&R

Sr. No.	Particulars	Amount in Rs. Crores
1	Development of Pushpak Nagar	262
2	Development of 7 R&R Pockets	1026
3	Monetary compensation for construction of houses, shifting expenses, rental for years and cash incentive	525
	Grand Total	**1813**

Source: CIDCO

As on 11th June 2021, 2562 structures were demolished and 2370 plots have been given possession (90%, i.e. 2518 allotments have been executed) and the remaining are in process by CIDCO. Total 97.3% of demolition has been realized and about 71 structures are remaining to be demolished.

4.2.11.6 Impact on Population

The sudden influx of large number of populations in search of employment is likely to bring inherent problems.

4.2.11.7 Impact on Employment

Project construction is expected to generate more than 5000 direct employment and double the figure indirect employment which will span across 4-5 years for each phase. It is anticipated that major labour force will be sourced from the local area. The Project Affect People will be benefited from the employment opportunities during construction and operation phase of NMIA. Provision of wage employment to the local populace during construction period of the project will solve the un-employment problem in the local area to some extent. This will enhance the income levels of the construction labourers and lead for their socio-economic well-being during the development phase of the proposed facility, which will be positive impact due to the project.

FIGURE-4.10
COMMUNITY FACILITIES CONSTRUCTED BY CIDCO AT R & R POCKETS

4.2.12 Impact Due to Traffic

The project development envisages increased movement of HEMMS like cranes, excavators, dozers, dumpers, etc., mass transport vehicles, trucks, motor cars, etc. Adequate road infrastructure is essential for reduction of traffic congestion and air and noise pollution to the extent possible.

A detailed traffic management and decongestion plan has been prepared to improve the traffic management and ease the traffic congestion to the required level. Several road infrastructure improvement projects are currently being implemented by the local urban bodies in the influence area of the project. An objective traffic management and decongestion plan is being implemented for NMIA is association with CIDCO in association with MMRDA through proposal of future connectivity projects under a Multi-Modal regional connectivity plan and by integrating to MMARDA's existing connectivity plan for MMR implemented through Comprehensive Transport Study (CTS) through the establishment of traffic management and decongestion plan for NMIA with the following objectives:

- Review and assessment of cumulative impact of all the development and increased inhabitation being carried out or proposed to be carried out by the Project or other agencies in this 5 km radius under different scenarios of space and time.
- Review of various traffic & transportation projects planned by CIDCO, MRVC, MMRDA, NHAI, PWD, JNPT, NMMC in MMR and updation of Multi modal regional connectivity plan.
- Prepare a detailed traffic management and traffic decongestion plan to ensure that the current level of service of the roads within a 5 km radius of the NMIA site is maintained and improved upon. To interact with various concerned stake holders by conducting stake holders meeting appropriately and preparing the final report incorporating the concerns of all the stake holders; and

- The proposed transport corridors as per CTS for MMR updation study, projects conceived by MMRDA as part of other studies, studies carried out by CIDCO, MRVC, MMRDA, etc. shall form the base for the study.

4.2.12.1 Construction Vehicle Traffic Circulation & Management Plan for NMIA

It is envisaged that the operation of NMIA after Phase-II will coincide with the construction of Phase III and Phase IV based on the prognosticated trigger dates. The movement of construction vehicles shall be segregated from the movement of passenger and other vehicles accessing operating airside. Therefore, a construction vehicle traffic management and maintenance plan are conceived for NMIA is presented below:

Airport development identifies several transportation activities during the construction as:

- Transportation of construction workers.
- Transportation of construction aggregates/excavated material.
- Transportation of solid and liquid hazardous and non-hazardous wastes.

Therefore, a traffic circulation and management plan for construction vehicles inside NMIA is intended to provide adequate proactive measures against identified possible traffic congestion and safety issues.
It also aims to implement traffic control measures ensuring efficient and safe movement of construction vehicles and pedestrians inside NMIA. To achieve this

objective of safe, smooth, congestion free as well as minimum impact of construction vehicles on air and noise, following traffic movement requirements shall be fulfilled at NMIA site.

- Route of vehicles inside NMIA worksite shall be shorter as far as possible.
- Riding surface of roads shall be smoother.
- Signage plan shall be demarcated throughout the road for guidance of the driver.
- Speed limits shall be imposed throughout site.
- Construction vehicles and employee vehicles shall have separate access to NMIA site.
- Pedestrian access at worksite and route shall be marked throughout the site for ensuring safety.
- Traffic islands, channelizers and speed humps shall be utilized to manage vehicle speeds.
- Mandatory induction for drivers of construction vehicle and visitors, who are permitted to enter the site with their vehicle, about site traffic rules, designated safe routes, parking areas, pedestrian exclusion zones and speed limits.
- Mandatory induction for visitors on the safety procedures for the workplace before they are allowed into areas where vehicles and powered mobile plant are used.
- Road users shall accommodate through and around the construction zones safely with minimum of delays.
- Traffic control and construction activities shall co-ordinate to provide for safe and efficient flow of traffic together with efficient, safe, and rapid progress of the construction activity.
- Driver training shall be mandatory for ensuring speed limits of vehicles to the desired levels on the approaches to and within the construction zones.
- All site roads, parking areas, pedestrian crossings, and other areas accessed by vehicles and pedestrians, shall be appropriately lit and designed to avoid extremes of light variation (i.e., moving from a brightly lit area to a dark one). Parking area, pedestrian walkways and Roads will have a minimum level of lighting as per National Lighting Code 2010.
- Traffic signage, lights, barriers and other traffic control devices, as well as the riding surface of diversions shall be maintained in a satisfactory condition till they are required. The temporary diversion road shall be kept free of dust by frequent applications of water, if necessary. If road for diverting construction vehicle is not available then, requirement of lane segregation, carriageway widening, and barricading shall be checked on the road were construction and passenger traffic ply together. NMIA construction vehicle Traffic Circulation is shown in **Figure-2.30** of **Chapter-2**.
- Contractors shall implement physical safeguards whenever reasonably practicable wherever pedestrians are required to cross vehicle routes. Measures may include the use of gates, barriers, and traffic lights. Safety barriers, in accordance with Indian Standard Codes, shall be constructed where

required as determined by site risk-based assessment. If physical barriers are not suitable, additional requirements to manage pedestrian safety include marked and sign-posted pedestrian crossings shall be located where required; and

- Pedestrians should be able to escape quickly from the safe and continuous pedestrian route in an emergency. Exclusion zones will be established inside NMIA for loading and unloading near construction area. Rules governing the use of spotters for directing loading/unloading vehicles will be established. Authorities shall at all times carry out work on the roads in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution.

4.2.12.2 Entry / Exit of Construction Vehicle

Construction vehicle shall access the NMIA worksite from Amra Marg Road & North Road as shown in **Figure-4.11**. Further, existing road will be used to connect with proposed 12 m wide road. The traffic movements inside NMIA will be bidirectional. The junction of existing roads will be developed for smooth and efficient flow of traffic in such a way that construction vehicles can turn safely at the junction. The turning radius, width of turning lanes and various other parameters of the junction will be properly developed. To guide and control the traffic approaching junctions and to also ensure safe and efficient circulation of traffic through the junctions various traffic control devices will be used such as Road sign, Road markings, signals, flashlight.

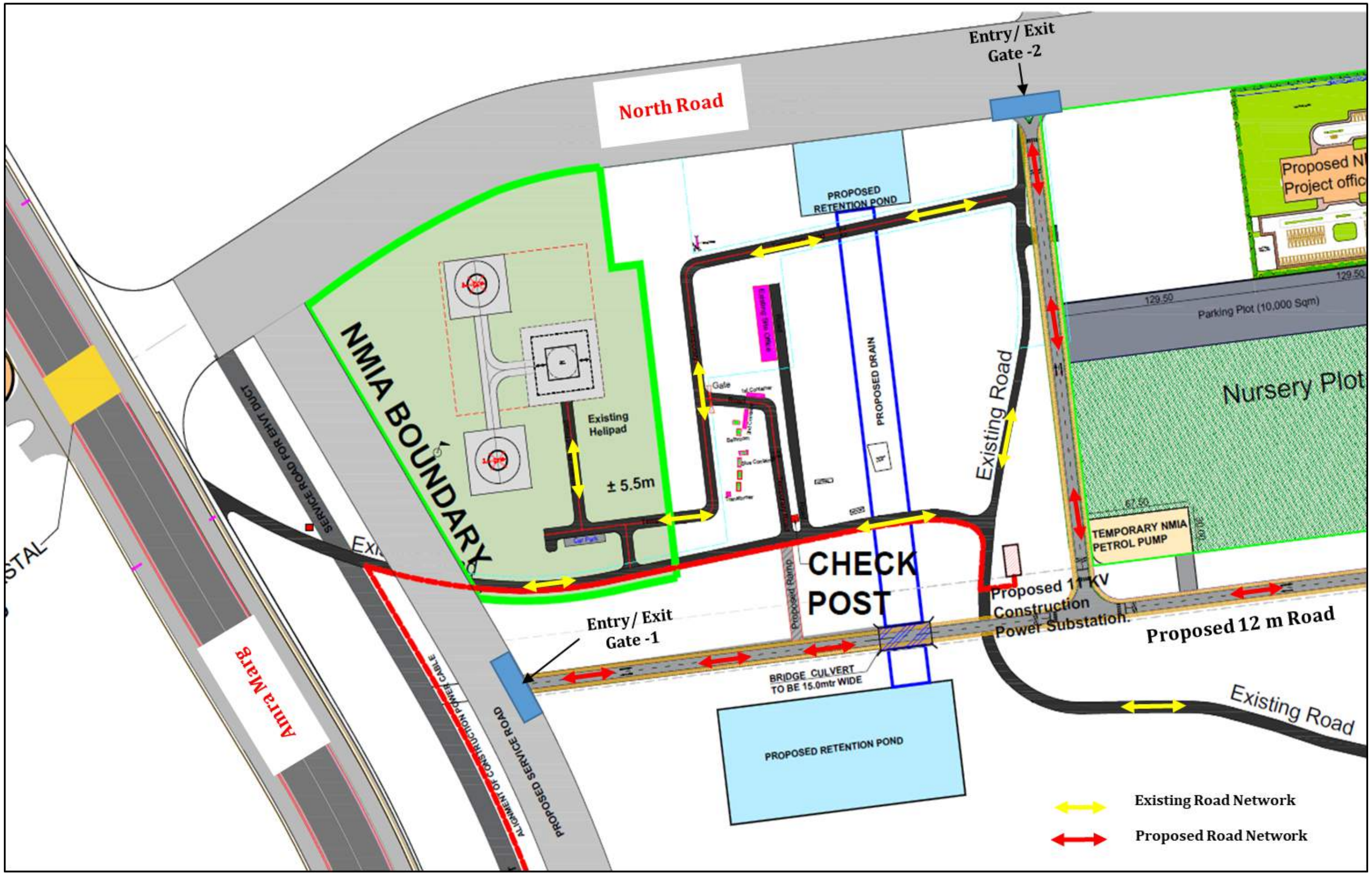


FIGURE-4.11

CONSTRUCTION VEHICLE ACCESS SITE FROM AMRA MARG & NORTH ROAD

4.3 Impacts during Operational Phase

The proposed project will have varying impact on environment during the operation phase. Both beneficial as well as potential adverse impacts may be expected on environment due to its various activities associated with the operation of the airport. The impact causing activities related to the operational phase on the environment are considered for impact assessment:

- Land use & Topography.
- Ambient Air Quality.
- Traffic Densities.
- Noise Levels.
- Water Resources.
- Water Quality.
- Soil Quality.
- Ecology; and
- Demography and Socioeconomics.

4.3.1 Impact on Land use and Topography

The current topography of major part of airport site is flat, levelled at +5.5 m AMSL. Only a portion of Ulwe Hill currently exists on Site which is being cut to fill the Site from +5.5.m AMSL to +8.0 m to +9.5 AMSL.

The major envisaged visual topographical changes would be due to the rise of terminal building, control tower etc. Thus, the present topography will be altered, and the site area will be maintained to aesthetically pleasant conditions. This will invite positive benefits in the form of land leveling and plantations in the airport vicinity areas. Landscaping and green covering activities will be further improved. This will have a positive impact on topography and aesthetics. No other major adverse impact on topography of the site is envisaged during the operation phase.

4.3.2 Impact on Air Quality

During the operational phase of the airport, the continuous air emissions are expected from aircraft engines during approach, landing, taxiing, take-off, and initial climb or collectively called as reference **Landing and Take-Off cycle (LTO cycle)**.

4.3.2.1 Time in Mode (TIM)

A landing/take-off (LTO) cycle incorporates all the normal flight and ground operation modes including descent/approach from a reference height above ground level (AGL), touchdown, landing run, taxi in, idle and shutdown, start-up and idle, checkout, taxi out, take-off and climb-out to the reference height. TIM provides estimates of the time each aircraft spends in each operational mode at a given airport. It should be noted that one LTO cycle consists of a landing and take-off (i.e. the sum of all landing movements and take-off movements, which is then divided by two). All flight and ground operations in the LTO cycle have been grouped into the four standard modes for which emission rates are taken for modelling considerations.

These modes are:

- The *approach* mode, for which emissions are estimated from 1000 m AGL to ground level.
- The *taxi/idle* mode, which applies to both incoming and outgoing aircraft during taxiing and idling operations.
- The *take-off* mode, which is defined as the period between commencement of acceleration on the tarmac and the aircraft reaching 200 m AGL, during which time the engine is operated at full throttle and fuel usage is at a maximum for any given engine and
- The *climb-out* mode, for which emissions are calculated for the period between 200 and 1000 m AGL.

Data that are required for estimating aircraft emissions are as follows:

- The location of airports, runways, landing and approach flight paths, and associated ground movements.
- The number of landing/take off (LTO) cycles for each of the aircraft types operating at these airports.
- The prevalence of the different types of engines (and numbers of engines) and APUs used by each aircraft type; and
- The time spent in each operating mode (approach, taxi/idle, take-off and climb-out) for the airport for estimating aircraft engine emissions; and the time spent in operating the APU at the airport.

The air pollutants of major concern from the aircraft emissions will be unburnt Hydrocarbons (HC), Carbon Monoxide (CO) and Oxides of Nitrogen (NO_X) as per ICAO guidelines. The emission height of 3 m is assumed for aircraft emissions, during normal taxiing condition of the aircraft.

The total estimated DG Power requirement will be 35.0 MVA (considering 60 % diversity as DG capacity on over all proposed terminal loads). Proposed DG sets are also considered for modelling. The impact on ambient air quality is assessed hereunder considering the following:

- The air quality impacts have been predicted for the proposed project assuming that the pollution due to the existing activities in an around the airport site has already been captured under baseline environmental monitoring.
- Air quality modeling have been carried out for all the four phases assuming phase wise development till ultimate final Phase: and
- Site-specific meteorological parameters have been recorded by using continuous recorders. Short-term 24-hourly incremental values (GLCs) were estimated using the site-specific meteorological data.

4.3.3 Air Pollution Modelling

For prediction of maximum Ground Level Concentrations (GLC's), the air dispersion modeling software (AERMOD version 7.1.0) was used. AERMOD is steady state advanced Gaussian plume model that simulates air quality and deposition fields up to 50 km radius. The model has been specifically adapted to incorporate an improved gradient-transfer deposition algorithm. Gravitational setting velocity and a deposition velocity are calculated for each class. Concentration and deposition are computed at all user-selectable receptor locations.

AERMOD is approved by USEPA and is widely used software. It is an advanced version of Industrial Source Complex (ISCST3) model, utilizes similar input and output structure to ISCST3 sharing many of the same features, as well as offering additional features. The model is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases and multiple sources including point, area, flare, line, and volume sources. For the short-term simulations, the concentrations were estimated at about 441 receptor points are chosen to obtain an optimum description of variations in concentrations over the study area under consideration. Dispersion modeling using AERMOD requires hourly site-specific meteorological data like wind direction, wind speed, temperature etc. Site specific data during winter season (1st December 2019 to 29th February 2020) at site have been used for executing modelling studies. The site-specific meteorological data is processed using AERMET processor.

4.3.3.1 Dispersion Model Input Data

The specific types of emission sources considered during the operational phase of the airport are given in **Table-4.7**.

TABLE-4.7
TYPES OF EMISSION SOURCES DURING OPERATIONAL PHASE

Sr. No.	Emission Source	Emission Calculation Basis	Dispersion Modeling Basis
A	Aircraft Activity	EDMS model (EPA approved emissions inventory)	AERMOD
	Auxiliary Power Units (APUs)		
	Ground Support Equipment (GSE)		

The calculations for the emissions generated by the aircrafts and allied activities have been done using Emissions and Dispersion Modeling System (EDMS) Version 4.5, developed by the Office of Environment and Energy, Federal Aviation Administration (FAA). The model is used to produce an inventory of emissions generated by sources on and around the airport or air base, and to calculate pollutant concentrations in these environments. EDMS incorporates Environment Protection Agency (EPA) approved emissions inventory methodologies. The input data for the considered sources has been described in following section:

4.3.3.2 Aircraft Activity

Aircraft activity is expressed in LTO cycles. Each LTO cycle consists of approach, landing, taxiing, queuing, take-off, climb out. The Times in Mode (TIMs), [i.e., the durations per LTO cycle that an aircraft spends in each of the four modes of aircraft operation: take-off, climbs out, approach and idle] are considered, based on the ICAO and Environmental Protection Agency (EPA) defaults. SO_2, NO_x, CO and HC are the major pollutants that will be emitted during the LTO cycle.

In ultimate phase, the airfield will consist of two parallel runways with 083º east northeast – 263º west southwest orientations located on northern and southern part of airport site and designated as 08L/26R and 08R/26L respectively with a take-off available distance of 3,700 m and 60 m of runway width to accommodate super-jumbo A380 aircraft. Phase wise break-up of runway operation is shown in **Table-4.8**.

TABLE-4.8
PHASE WISE BREAK-UP OF RUNWAY OPERATION

Phase	Million Passengers Per Annum (MPPA)	Runway
Phase-I	10 MPPA	South runway
Phase-II	20 MPPA	South runway
Phase-III	40 MPPA	South runway & north runway
Phase-IV	60 MPPA	South runway & north runway

Source: FMP 2019

The Times in Mode (TIMs), [i.e., the durations per LTO cycle that an aircraft spends in each of the four modes of aircraft operation: takeoff, climbs out, approach and idle] are considered, based on the ICAO and Environmental Protection Agency (EPA) defaults.

The emission factor data of EDMS is based on the ICAO Aircraft Engine Exhaust Databank and supplemented by engine emissions data provided directly from the manufacturer and, for older aircraft, the data provided and methodology in the EPA's AP-42, Part II, Section-1.

4.3.3.3 Auxiliary Power Units (APU)

Emissions are generated by Ground Support Vehicles (GSV) and Auxiliary Power Units (APUs) while the aircraft is parked at the gate. The LTO based study set-up has been selected, in which Ground Service Equipment (GSE) are assigned to aircraft and their operations depend on aircraft activity. Since the APU's are on-board aircraft, they are only modelled on an aircraft LTO basis.

APU's are most often on-board generators that provide electrical power to the aircraft while its engines are shut down. Some pilots start the on-board APU while taxiing to the gate but, for the most part, it is started when the aircraft reaches the gate. The on-board APU is, in effect, a small jet engine and the calculations for the emissions generated by it are similar to that of an aircraft engine operating in one power setting only.

4.3.3.4 GSE Assigned to Aircraft

Upon arrival at a gate, aircrafts are met by GSE to unload baggage and service the lavatory and cabin. While an aircraft is parked at a gate, mobile generators and air conditioning units may be in operation to provide electricity and conditioned air. Prior to aircraft departure, GSE are present to load baggage, food and fuel. When an aircraft departs from a gate, a tug may be used to push or tow the aircraft away from the gate and to the taxiway. Each GSE carries a default operational time in minutes associated with one complete LTO cycle of the aircraft.

GSE emission factors used by EDMS are derived from EPA's draft NONROAD model and are based on the following variables: fuel, brake horsepower and load factor. GSE emissions generated per LTO cycle are the product of the emission factor, horsepower, load factor and operating time.

4.3.3.5 Emissions Inventory- EDMS

An emissions inventory giving summary of the total pollutants generated by all active sources under study is prepared using ICAO. Both narrow-bodied and wide-bodied aircraft emissions have been considered during modelling. On the basis of peak hour input data and hourly, daily and monthly averages of aircraft operations for each of the identified sources. The emissions rates for each LTO given in **Table-4.9**.

TABLE-4.9
EMISSIONS RATES FROM AIRCRAFTS FOR EACH LTO

Expressed in g/s

Type of Aircraft	SO_2	NO_x	CO	HC	VOC	PM
A319	0.003	0.164	0.054	0.005	0.005	0.004
A321	0.004	0.141	0.052	0.012	0.013	0.004
A320	0.003	0.076	0.052	0.005	0.005	0.004
B727	0.006	0.101	0.229	0.069	0.075	0.005
B737	0.003	0.061	0.110	0.007	0.008	0.005
B757	0.006	0.198	0.098	0.002	0.002	0.005
A380	0.017	0.585	0.240	0.003	0.004	0.004
A310	0.006	0.074	0.054	0.005	0.005	0.004
B767	0.006	0.201	0.125	0.028	0.031	0.005
B747	0.014	0.362	0.226	0.023	0.025	0.005

Source: Calculations based on EPA

4.3.3.6 Presentation of Results

The modelling exercise has been carried out considering four phases (I, II, III & IV) where phase-IV is the ultimate phase with 60 MPPA with two operating runways south & north runways. For the short-term simulations for volume and point emission sources, the concentrations were estimated around 441 receptors to obtain an optimum description of variations in concentrations over the site in 10 km radius covering 16 directions. The predicted incremental GLCs for PM, SO_2, NO_2, CO, VOC and HC are presented in **Table-4.10 (A-D)** and the isopleths showing the incremental concentrations for Phase-I and Final Phase (Phase-IV) are shown in **Figure-4.12** to **Figure-4.23.** The isopleths showing the incremental concentrations for Phase-II and Phase-III are shown in **Annexure-XXII**.

TABLE-4.10 (A)
PREDICTED INCREMENTAL GROUND LEVEL CONCENTRATIONS FOR PHASE-I

Pollutant	Incremental Concentration ($\mu g/m^3$)	Distance (km)	Direction
SO_2	0.34	0.5	SE
NO_2	8.48	0.5	SE
CO	5.65	0.5	SE

Pollutant	Incremental Concentration ($\mu g/m^3$)	Distance (km)	Direction
HC	0.56	0.5	SE
VOC	0.62	0.5	SE
PM_{10}	0.45	0.5	SE

TABLE-4.10 (B)
PREDICTED INCREMENTAL GROUN LEVEL CONCENTRATIONS FOR PHASE-II

Pollutant	Incremental Concentration, ($\mu g/m^3$)	Distance (km)	Direction
SO_2	1.13	0.5	SE
NO_2	41.87	0.5	SE
CO	19.23	0.5	SE
HC	0.74	0.5	SE
VOC	0.79	0.5	SE
PM_{10}	0.67	0.5	SE

TABLE-4.10 (C)
PREDICTED INCREMENTAL GROUN LEVEL CONCENTRATIONS FOR PHASE-III

Pollutant	Incremental Concentration ($\mu g/m^3$)	Distance (km)	Direction
SO_2	1.31	0.5	SE
NO_2	46.96	0.5	SE
CO	19.70	0.5	SE
HC	0.74	0.5	SE
VOC	0.79	0.5	SE
PM_{10}	0.68	0.5	SE

TABLE-4.10 (D)
PREDICTED INCREMENTAL GROUN LEVEL CONCENTRATIONS FOR PHASE-IV

Pollutant	Incremental Concentration ($\mu g/m^3$)	Distance (km)	Direction
SO_2	1.31	0.5	SE
NO_2	47.04	0.5	SE
CO	19.73	0.5	SE
HC	1.09	0.5	SE
VOC	0.80	0.5	SE
PM_{10}	0.68	0.5	SE

- ***Resultant Concentrations after Implementation of the Project***

  - Phase-I (10 MPPA)

The runway towards south has been taken for estimating the predicted incremental ground level concentrations of air quality pollutants due to proposed airport project activity in phase-I with 10 MPPA. The maximum incremental GLCs due to the proposed project for the above pollutants are superimposed on the maximum baseline concentrations of the respective pollutants recorded during the study period to arrive at the likely resultant concentrations after implementation of the proposed airport project. The resultant ground level concentrations (baseline + incremental) are tabulated in **Table-4.11.**

TABLE-4.11: PHASE-I
RESULTANT GLC's (BASELINE +INCREMENTAL) s

Pollutant	Maximum AAQ Concentrations Recorded During the Study Period (μg/m³)	Incremental Concentration (μg/m³)	Resultant Concentration (μg/m³)	NAAQ Standards (μg/m³)
SO_2	15.1	0.34	15.44	80
NO_2	27.6	8.48	36.08	80
PM_{10}	74.4	0.45	74.85	100

As shown in above Table, it can be inferred that all the parameters will be within the prescribed standards.

- Phase-II (20 MPPA)

The runway towards south has been taken for estimating the predicted incremental ground level concentrations of air quality pollutants due to proposed airport project activity in phase-II with 20 MPPA. The maximum incremental GLCs due to the proposed project for the above pollutants are superimposed on the maximum baseline concentrations of the respective pollutants recorded during the study period to arrive at the likely resultant concentrations after implementation of the proposed airport project. The resultant ground level concentrations (baseline + incremental) are tabulated in **Table-4.12.**

TABLE-4.12: PHASE-II
RESULTANT GLC's (BASELINE +INCREMENTAL)

Pollutant	Maximum AAQ Concentrations Recorded During the Study Period (μg/m³)	Incremental Concentration (μg/m³)	Resultant Concentration (μg/m³)	NAAQ Standards (μg/m³)
SO_2	15.1	1.13	16.23	80
NO_2	27.6	41.87	69.47	80
PM_{10}	74.4	0.67	75.07	100

As shown in above Table, it can be inferred that all the parameters will be within the prescribed standards.

- Phase-III (40 MPPA)

The runway towards south and north have been taken for estimating the predicted resultant incremental concentrations of air quality pollutants due to proposed airport project activity in phase-III with 40 MPPA. The maximum incremental GLCs due to the proposed project for the above pollutants are superimposed on the maximum baseline concentrations of the respective pollutants recorded during the study period to arrive at the likely resultant concentrations after implementation of the proposed airport project. The resultant concentrations (baseline + incremental) are tabulated in **Table-4.13.**

TABLE-4.13: PHASE-III
RESULTANT GLC's (BASELINE +INCREMENTAL)

Pollutant	Maximum AAQ Concentrations Recorded During the Study Period ($\mu g/m^3$)	Incremental Concentration ($\mu g/m^3$)	Resultant Concentration ($\mu g/m^3$)	NAAQ Standards ($\mu g/m^3$)
SO_2	15.1	1.31	16.41	80
NO_2	27.6	46.96	74.56	80
PM_{10}	74.4	0.68	75.08	100

As shown in above Table, it can be inferred that all the parameters will be within the prescribed standards.

- Phase-IV (60 MPPA)

The runway towards south and north have been taken for estimating the predicted resultant incremental concentrations of air quality pollutants due to proposed airport project activity in phase-IV with 60 MPPA. The maximum incremental GLCs due to the proposed project for the above pollutants are superimposed on the maximum baseline concentrations of the respective pollutants recorded during the study period to arrive at the likely resultant concentrations after implementation of the proposed airport project. The resultant concentrations (baseline + incremental) are tabulated in **Table-4.14.**

TABLE-4.14: PHASE-IV
RESULTANT GLC's (BASELINE +INCREMENTAL)

Pollutant	Maximum AAQ Concentrations Recorded During the Study Period ($\mu g/m^3$)	Incremental Concentration ($\mu g/m^3$)	Resultant Concentration ($\mu g/m^3$)	NAAQ Standards ($\mu g/m^3$)
SO_2	15.1	1.31	16.41	80
NO_2	27.6	47.04	74.64	80
PM_{10}	74.4	0.68	75.08	100

As shown in above Table, it can be inferred that all the parameters will be within the prescribed standards.

Similar effort has also been made for predicted CO, HC and VOC concentration in all four phases of the project to compare the incremental, if found to be within the limit of stipulated standards for CO, HC and VOC. Isopleths for contribution of CO, HC and VOC concentrations are shown in figures with all four phases of the project. The same is shown in following **Table-4.15.**

TABLE-4.15: PHASE-I, II, III & IV
INCREMENTAL & RESULTANT GLC's OF CO, HC & VOC'S

Pollutant	Max. AAQ Concn. Recorded (μg/m³)	Incremental Concentration (μg/m3)				Resultant Concentration (μg/m³)				NAAQ Standards (μg/m³)
		Phase I	Phase II	Phase III	Phase IV	Phase I	Phase II	Phase III	Phase IV	
CO	430	5.66	19.24	19.70	19.73	435.7	449.2	449.7	449.73	2000
HC (ppm)	<0.10	0.57	0.74	0.74	1.10	0.57	0.74	0.74	1.10	-
VOC (ppm)	<0.10	0.62	0.79	0.80	0.80	0.62	0.79	0.80	0.80	-

The results indicated that the worst-case contribution of CO, HC and VOC's are very small in concentration and superimposition of these concentration over monitored maximum background concentrations are found to be within the stipulated standards.

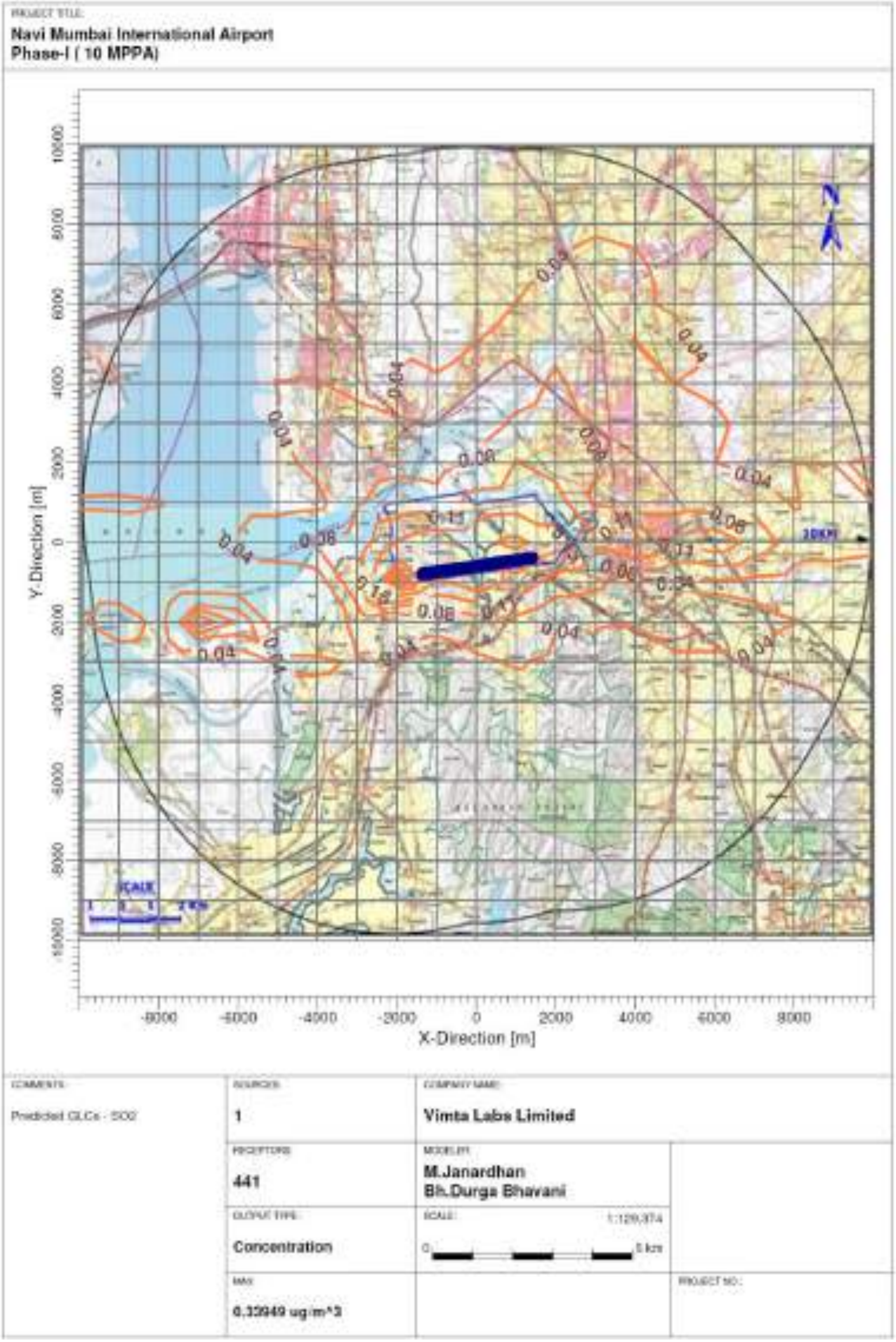


FIGURE-4.12:
PHASE-I ISOPLETHS OF INCREMENTAL CONCENTRATION FOR SO_2

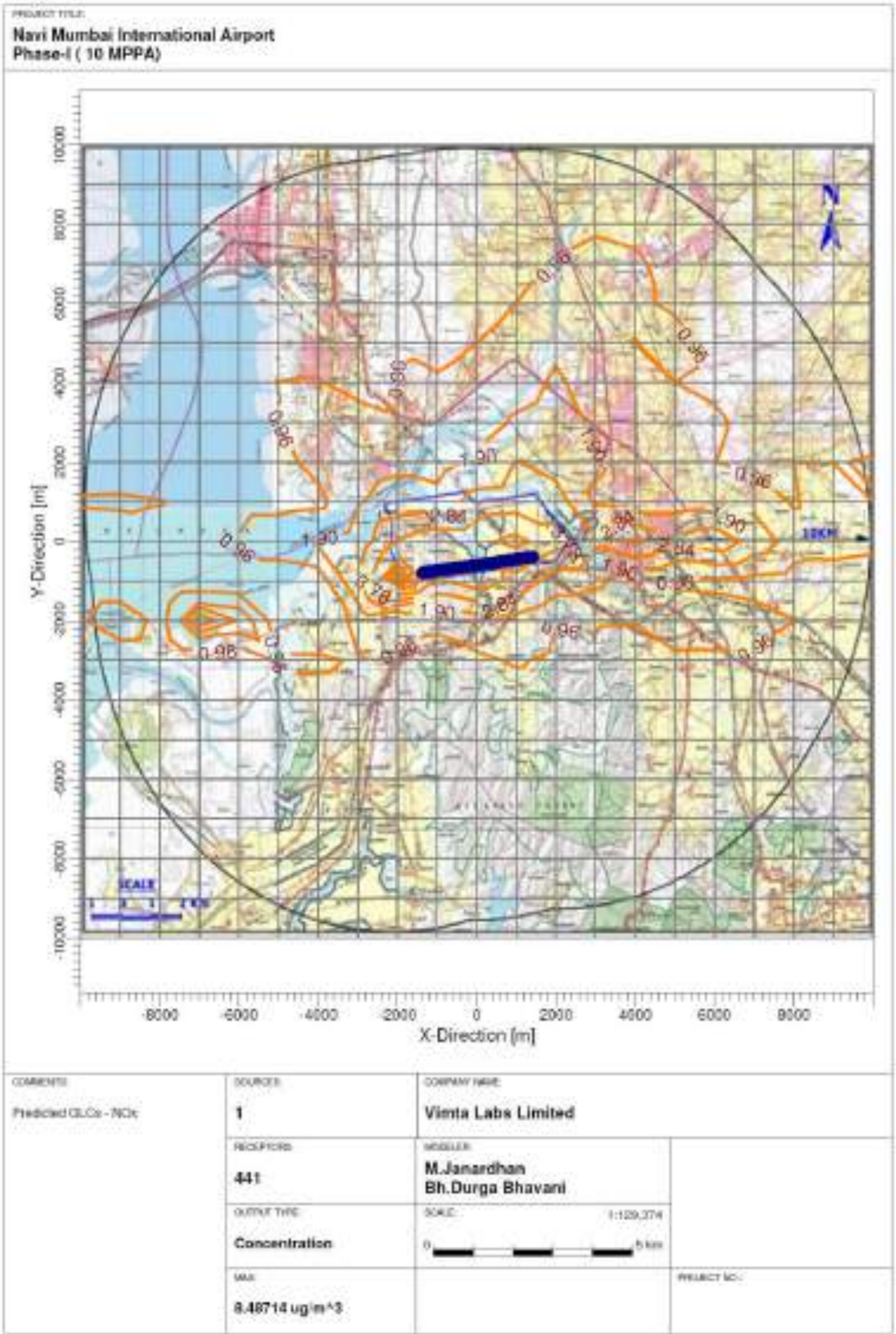


FIGURE-4.13: PHASE-I
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR NO_2

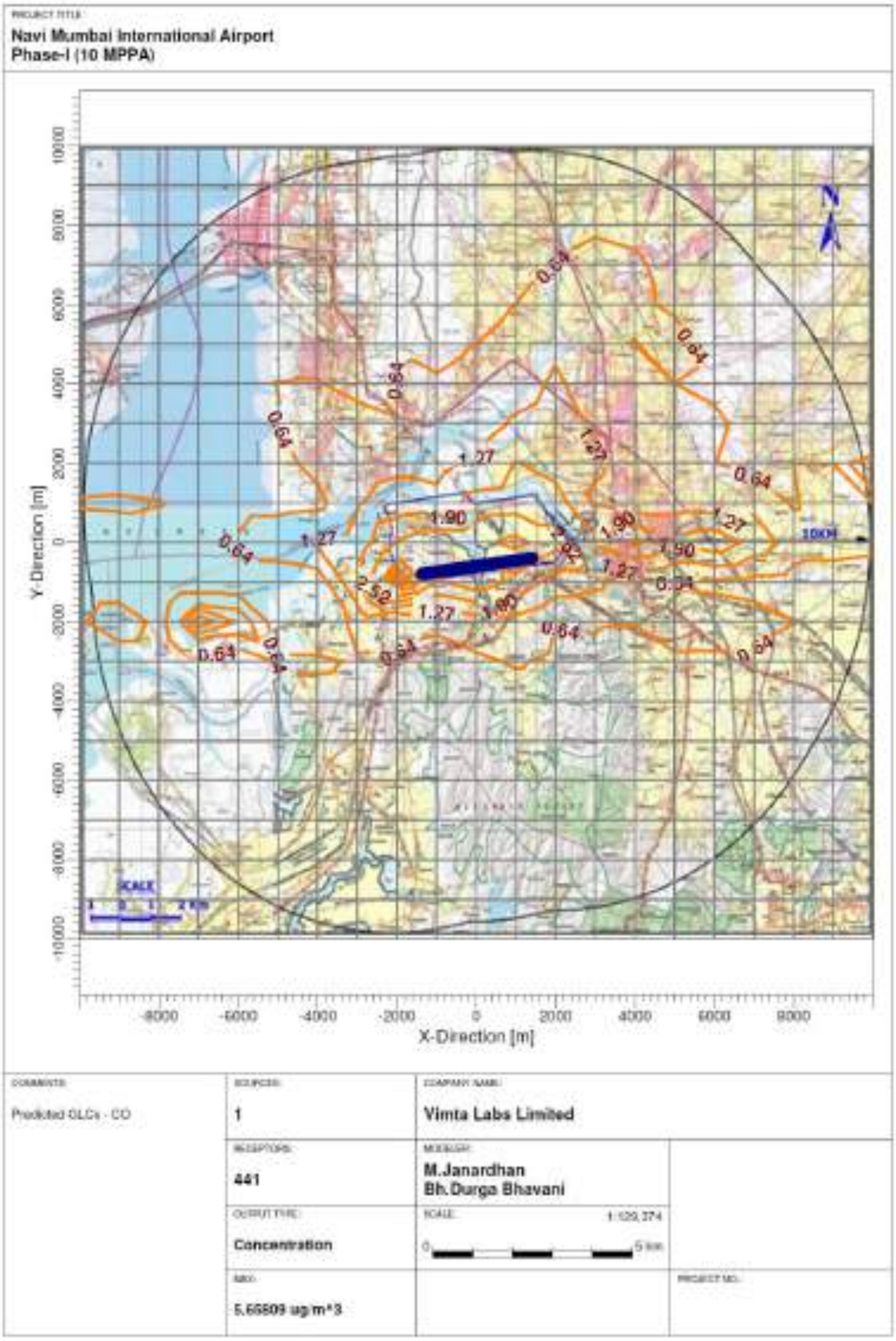


FIGURE-4.14: PHASE-I
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR CO

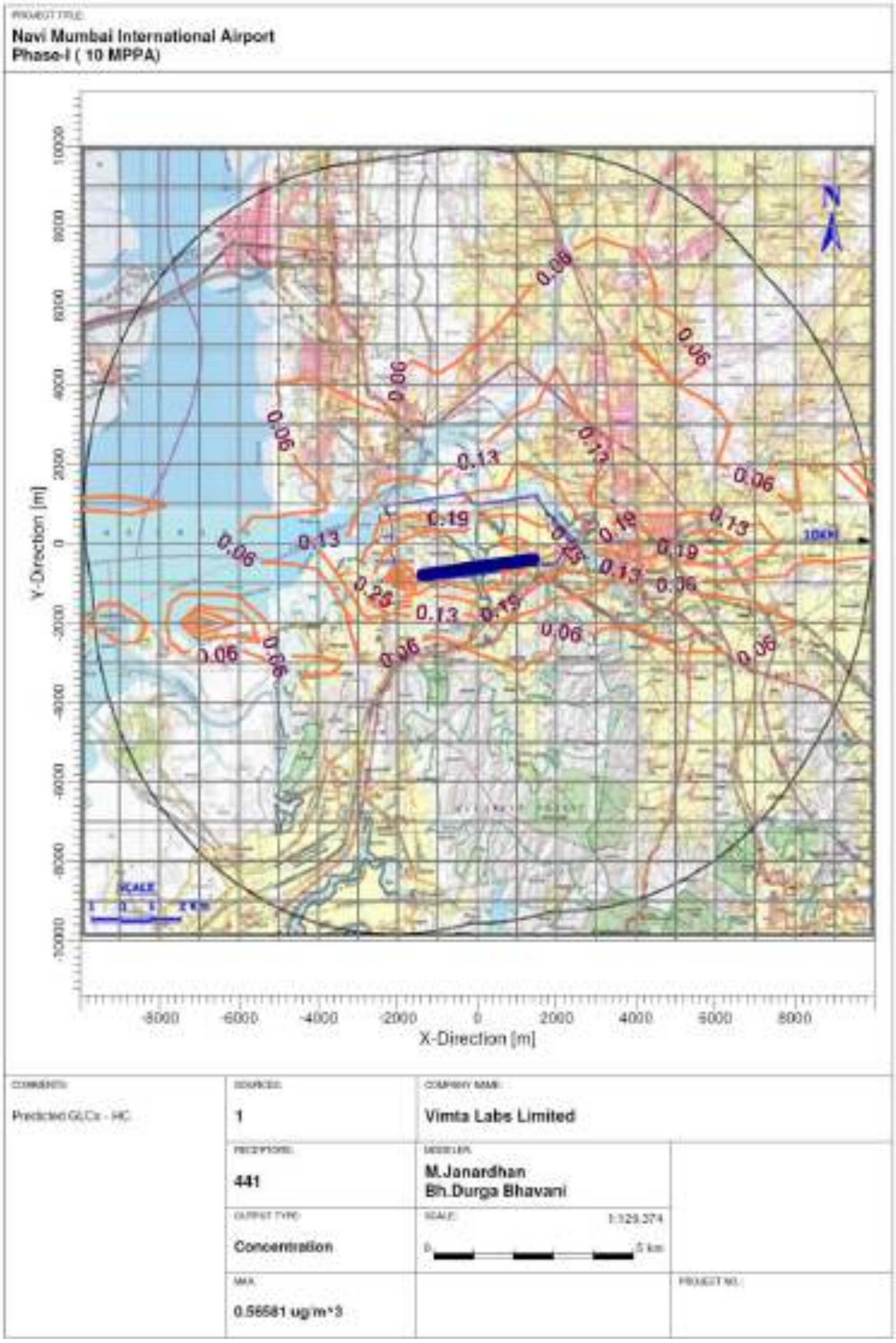


FIGURE-4.15: PHASE-I
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR HC

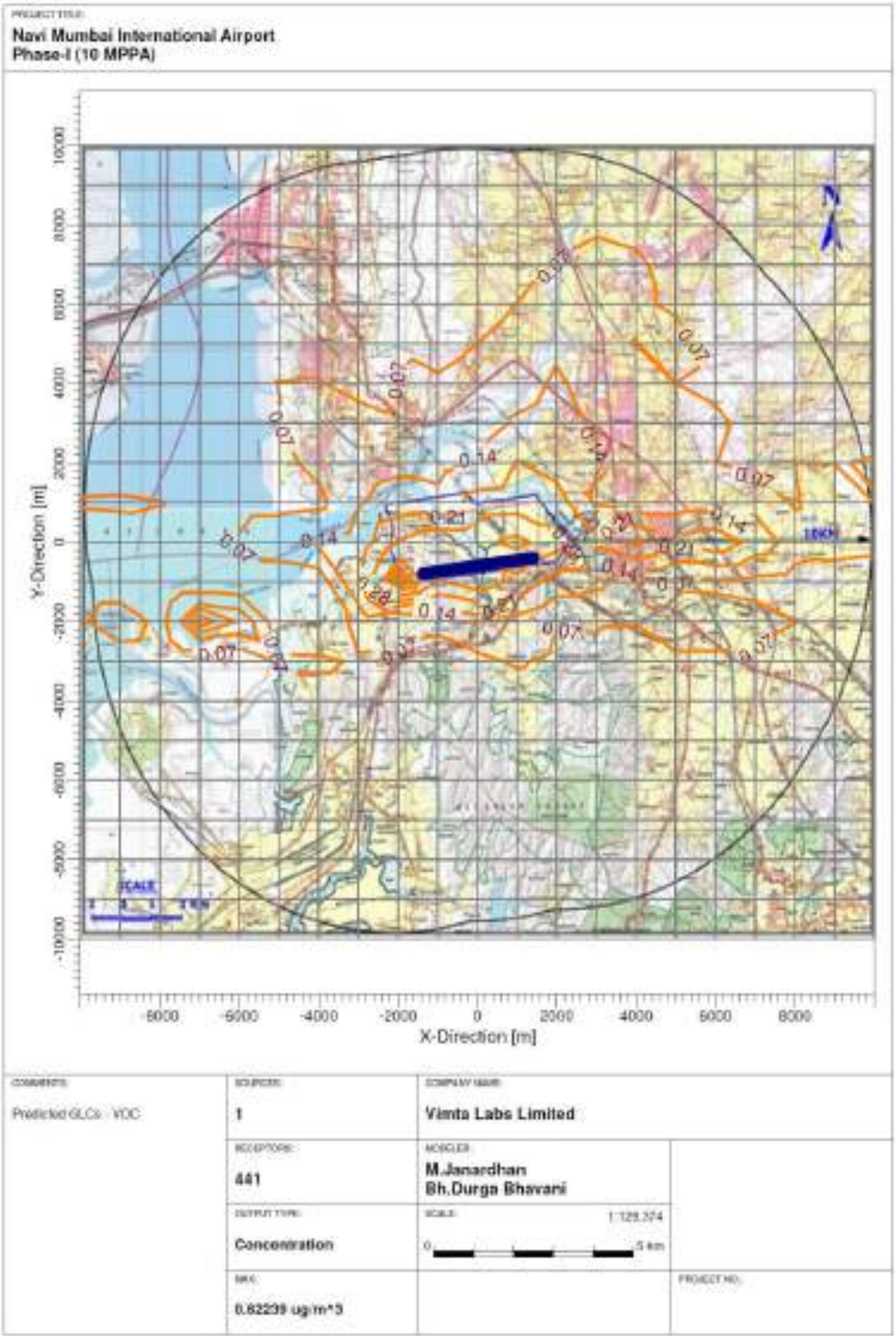


FIGURE-4.16: PHASE-I
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR VOC

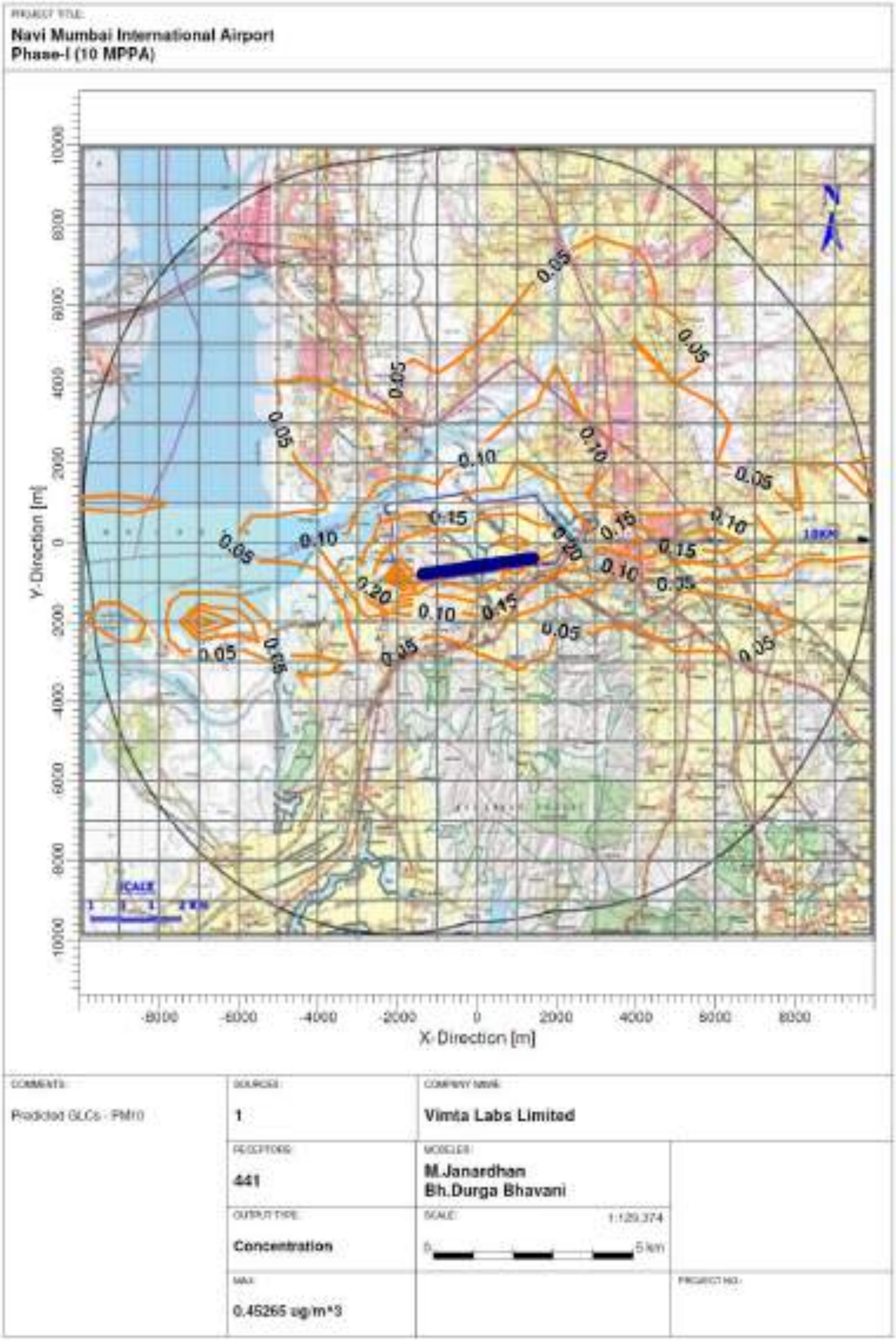


FIGURE-4.17: PHASE-I
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR PM_{10}

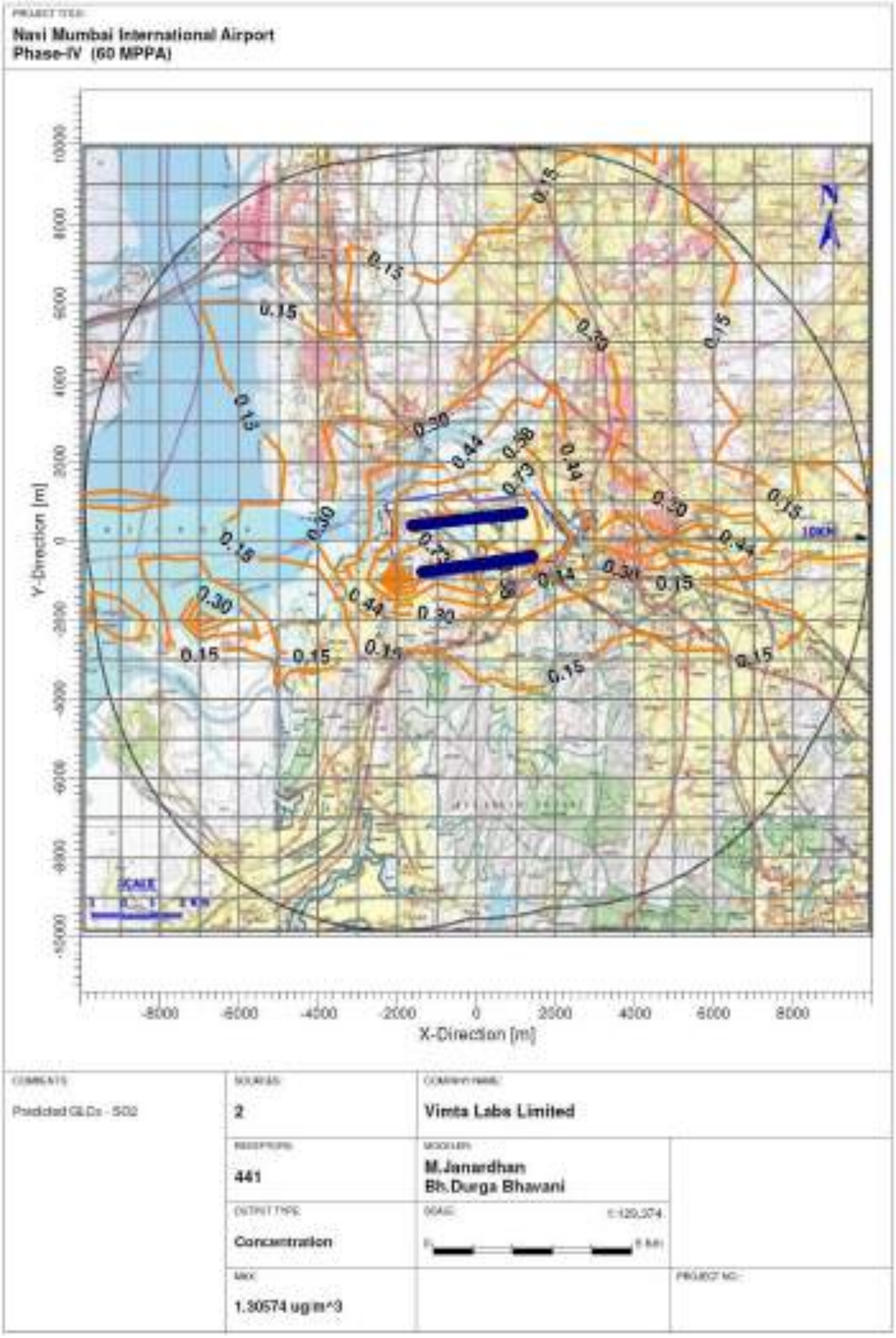


FIGURE-4.18: PHASE-IV
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR SO_2

FIGURE-4.19: PHASE-IV
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR NO_2

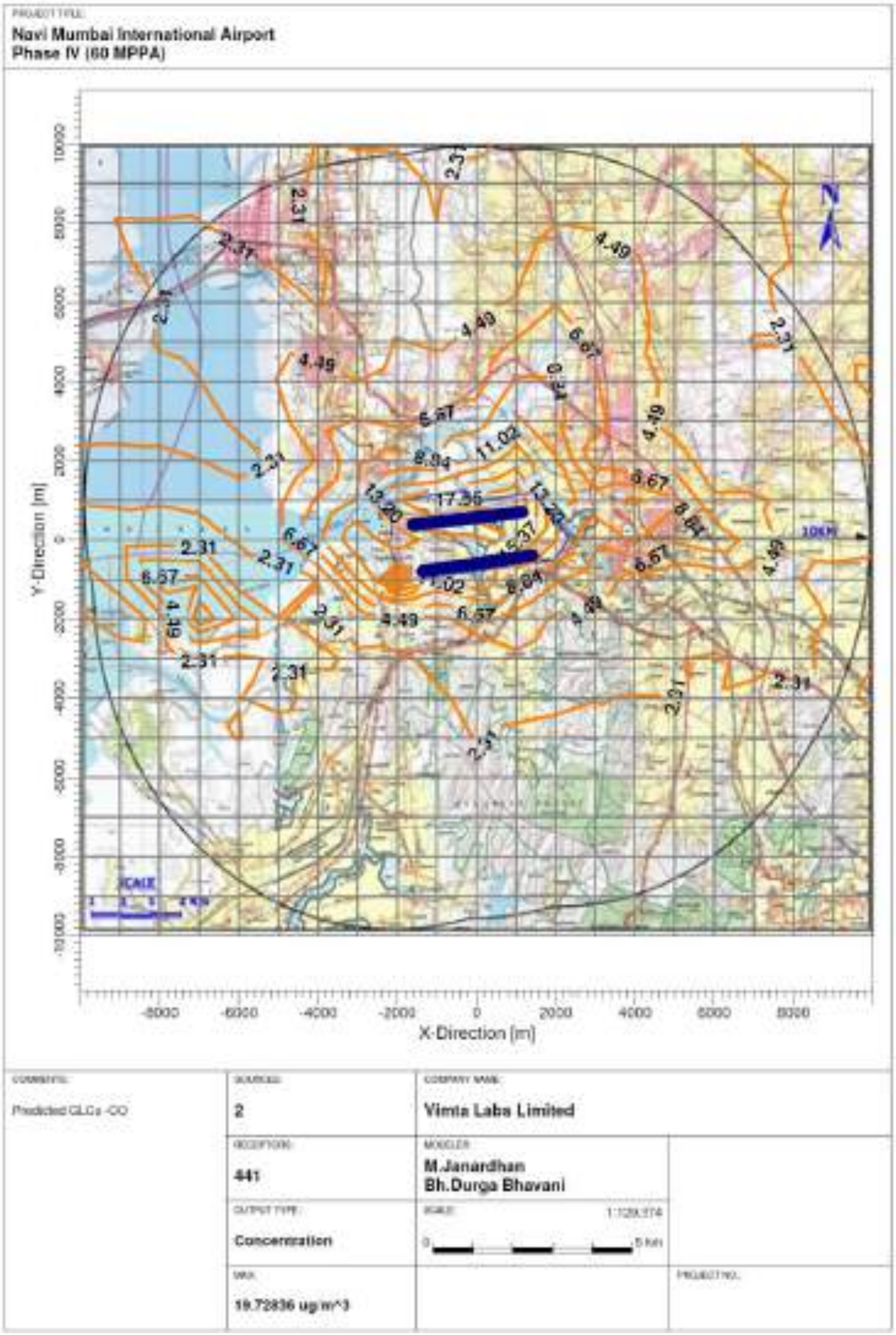


FIGURE-4.20: PHASE-IV
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR CO

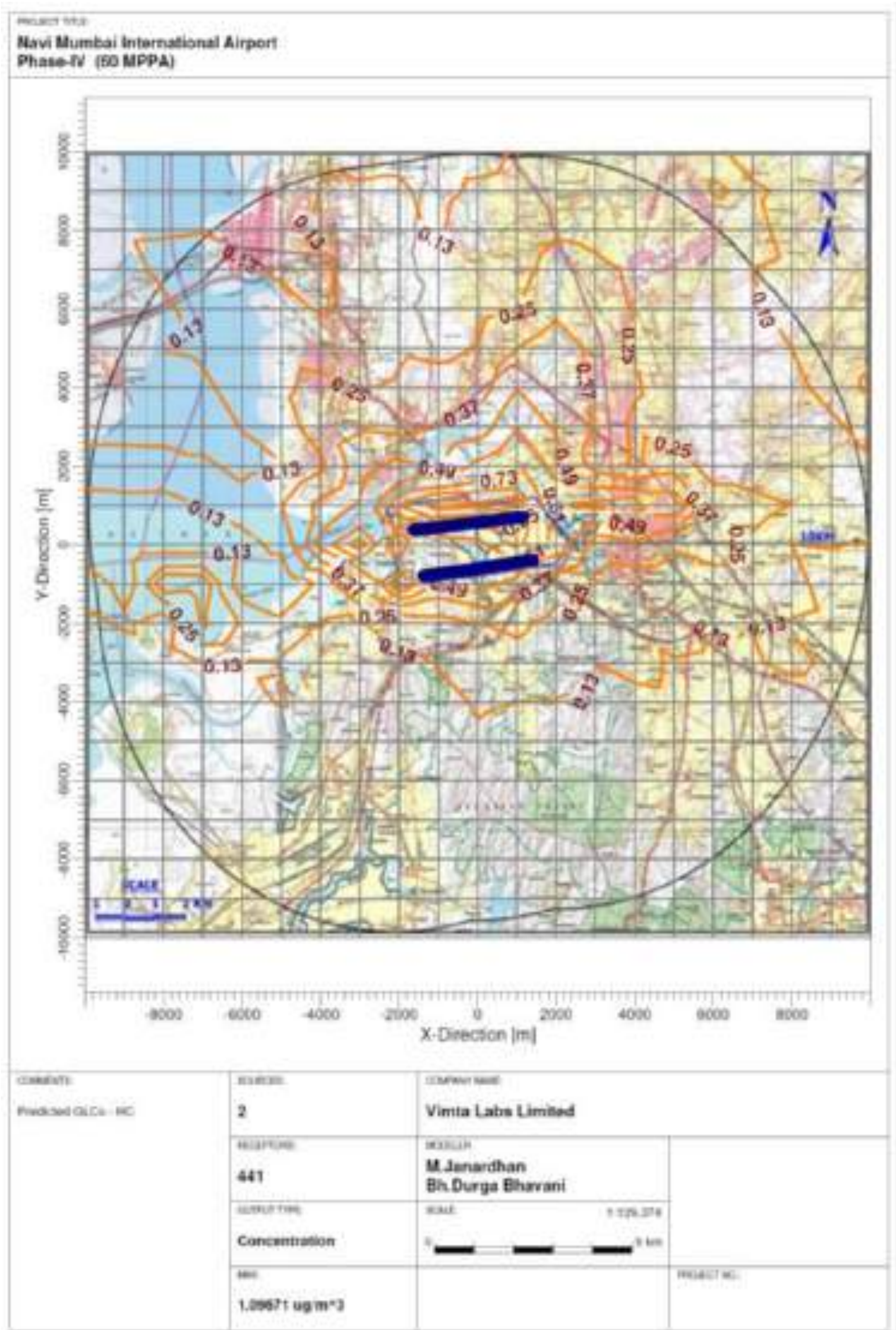


FIGURE-4.21: PHASE-IV
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR HC

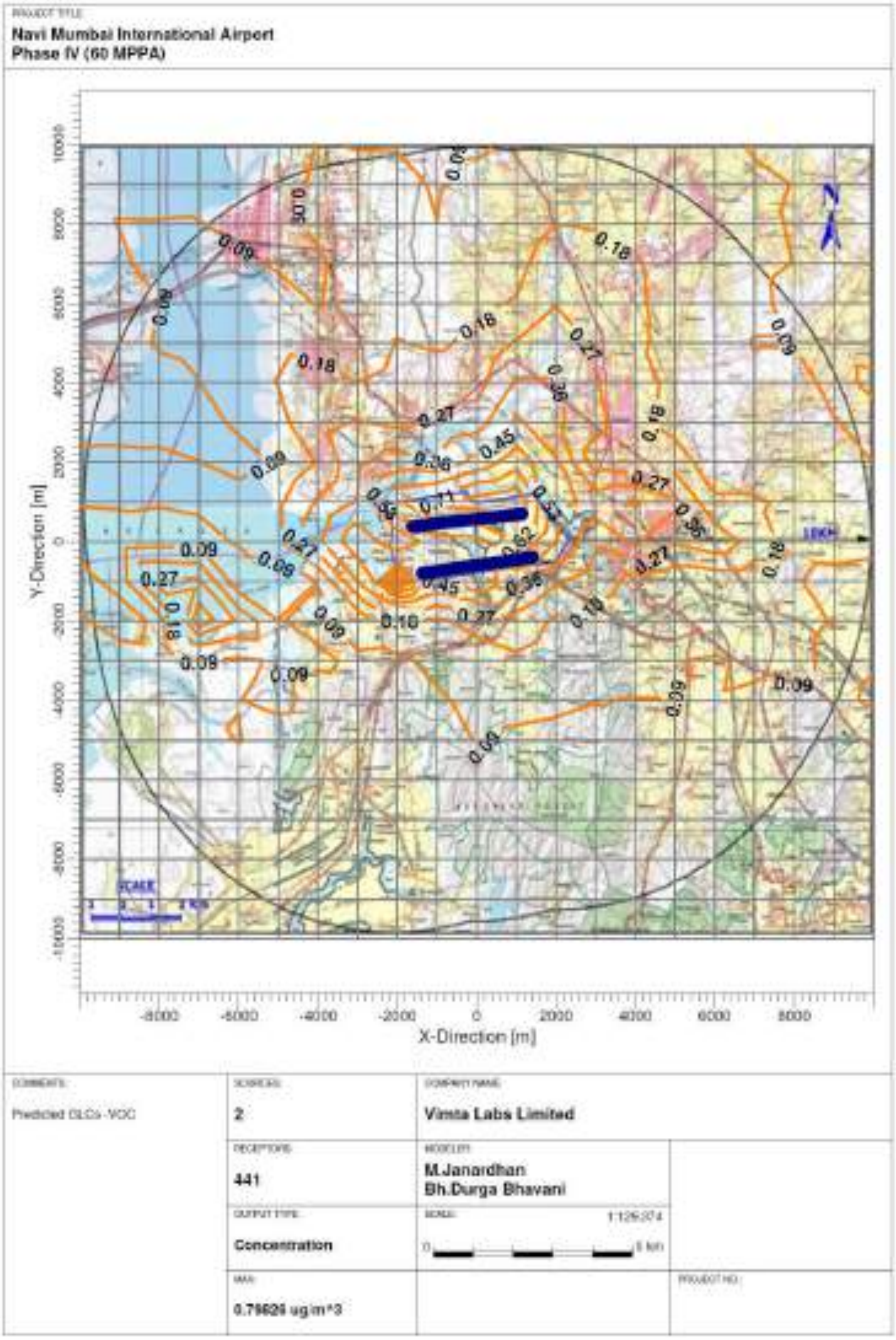


FIGURE-4.22: PHASE-IV
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR VOC

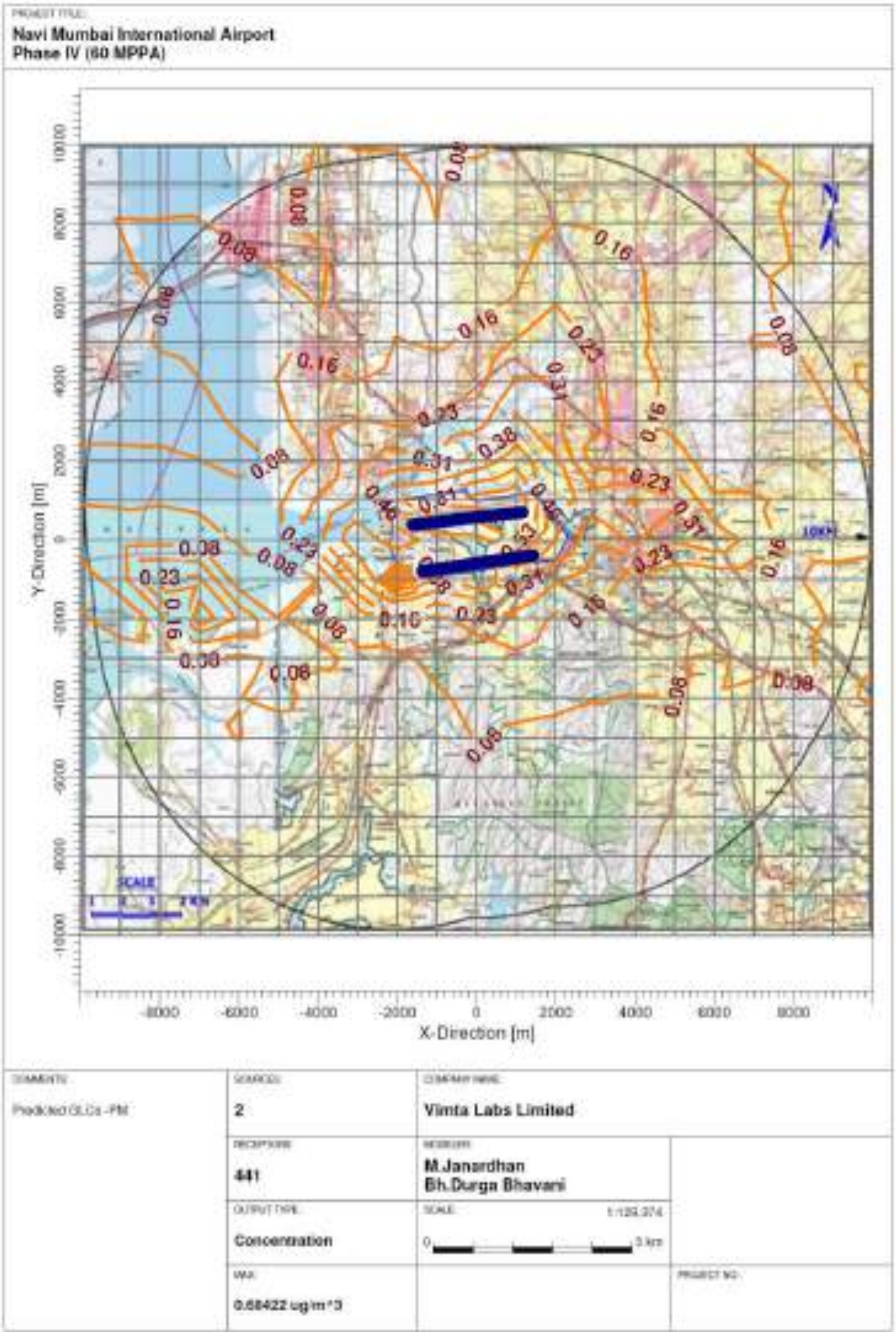


FIGURE-4.23: PHASE-IV
ISOPLETHS OF INCREMENTAL CONCENTRATION FOR PM_{10}

The main air pollution problem in the region is particulate matter originating from traffic and natural windblown dust (background level).

Monitoring of the gaseous concentrations of NO_2, CO and HC around the airport has been performed for the present situation and for future developments. The results indicate that the contribution from airport on local and regional air quality will be within the permissible norms.

Close to the roads and in the terminal areas, maximum concentrations of NO_2 and CO may reach levels may increase marginally but will be less than the NAAQS 2009 limits. The emissions from the airport activities alone will only, in very limited areas and for some specific peak hour, approach adverse levels.

NMIA airport may lead to impacts that will affect the population's exposure and well-being. This gives rise to undesired effects that are caused by the increase of dust levels. The increased dust levels are likely to cause health impacts and also impact the growth of vegetation.

The best form of mitigation from the point of view of NMIA airport would be to offer alternative forms of transportation to and from the airport to reduce the dependency on private car usage and enforce short term parking time zones outside to reduce idling time to a minimum.

Steps will be taken by the NMIA airport to improve public transport service and to successfully operate a shuttle bus service connecting airport to city.

Baseline data has been collected, allowing informed decisions to be made in the future regarding airport developments, road construction, residential development, and any unforeseen developments in the future.

4.3.3.7 Impacts on Nearest Habitation

Resultant AAQ due to Proposed Project

The predicted resultant ambient air quality has been obtained by superimposing incremental concentration over the maximum baseline air quality levels of winter season 2019-2020. The resultant ambient air quality of PM_{10}, SO_2, NO_x & CO for initial Phase-I [10 MPPA] & ultimate Phase-IV [60 MPPA] are given in **Table-4.16 (A-D)** to **Table-4.17(A-D)** respectively. Habitation in funnel zone shown in the following **Figure-4.24**.

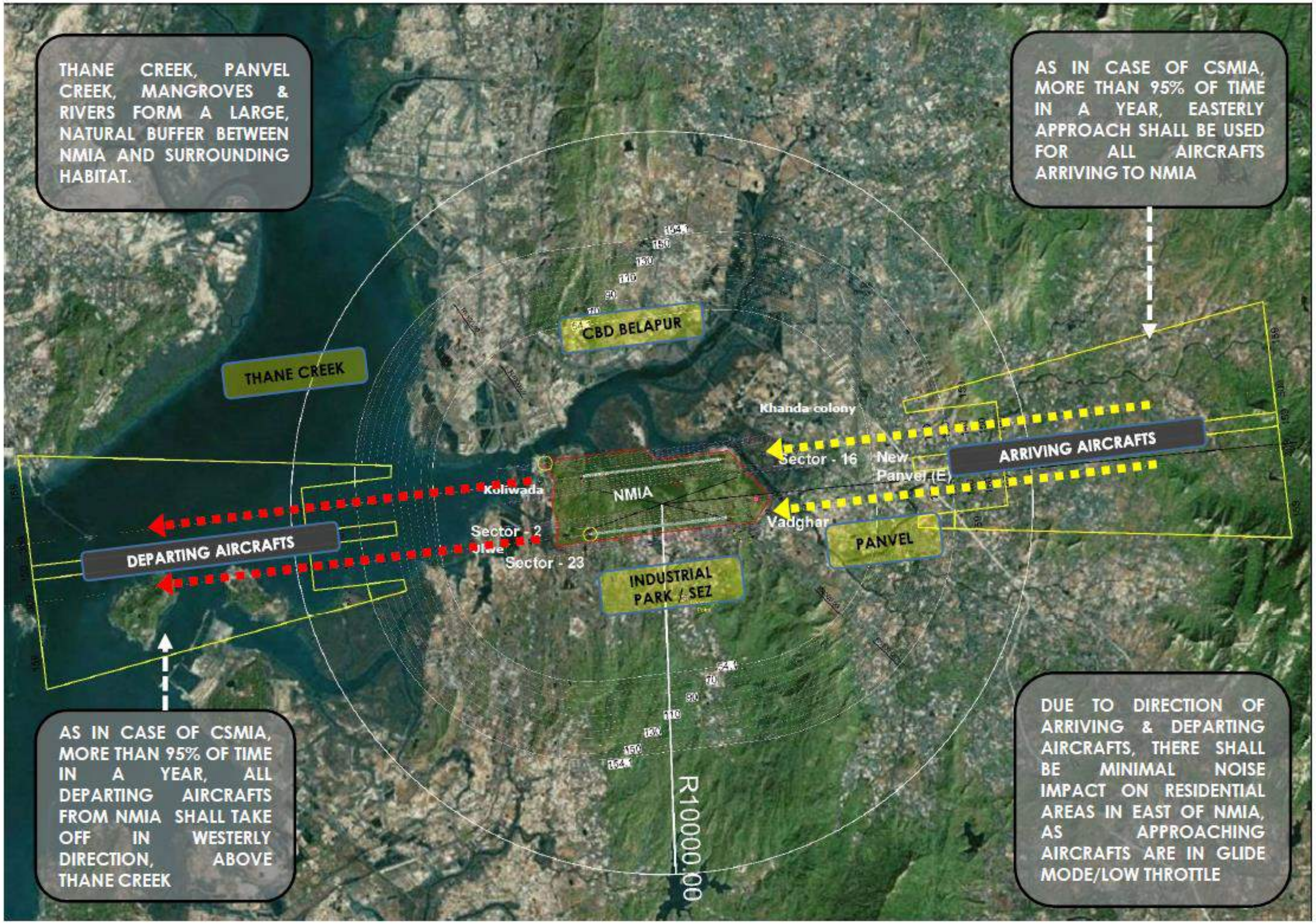


FIGURE-4.24
FUNNEL ZONE HABITATION MAP

TABLE-4.16 (A): PHASE-I: RESULTANT PM_{10} AT AAQ MONITORED LOCATIONS

Expressed in µg/m³

Code	Name of Location	PM_{10} Concentration			NAAQ Standards
		Baseline Concentration	Incremental GLC'S of PM_{10} Concentration	Resultant Concentration	
A1	Site Office	68.4	0.20	68.6	100
A2	CIDCO Office, Panvel	74.4	0.15	74.6	100
A3	Ulwe, Sector-5	71.2	0.15	71.4	100
A4	Gavan Phata Water Tank	73.2	0.05	73.3	100
A5	CIDCO Branch Office, Sector-5 (Kalamboli)	73.3	0.05	73.4	100
A6	CIDCO Bhavan, CBD Belapur, Sector-10	72.2	0.10	72.3	100
A7	Pargaon High School	67.9	0.20	68.1	100
A8	CIDCO Office, Kharghar, Sector-4	72.8	0.10	72.9	100
A9	CIDCO Guest House	73.0	0.10	73.1	100
A10	Shirdhon	68.2	<0.05	68.2	100
A11	Herdilia IT Park in TTC Industrial Area	71.0	<0.05	71.0	100
A12	Panvel Market Yard	72.8	0.10	72.9	100

TABLE-4.16 (B): PHASE-I: RESULTANT SO_2 AT AAQ MONITORED LOCATIONS

Expressed in µg/m³

Code	Name of Location	SO_2 Concentration			NAAQ Standards
		Baseline Concentration	Incremental GLC'S of SO_2 Concentration	Resultant Concentration	
A1	Site Office	14.1	0.11	14.2	80
A2	CIDCO Office, Panvel	14.5	0.08	14.6	80
A3	Ulwe, Sector-5	15.1	0.15	15.3	80
A4	Gavan Phata Water Tank	14.7	0.08	14.8	80
A5	CIDCO Branch Office, Sector-5 (Kalamboli)	14.8	0.04	14.8	80
A6	CIDCO Bhavan, CBD Belapur, Sector-10	14.0	0.08	14.1	80
A7	Pargaon High School	13.7	0.15	13.9	80
A8	CIDCO Office, Kharghar, Sector-4	14.2	0.08	14.3	80
A9	CIDCO Guest House	14.4	0.04	14.4	80
A10	Shirdhon	14.1	<0.04	14.1	80
A11	Herdilia IT Park in TTC Industrial Area	14.2	<0.04	14.2	80
A12	Panvel Market Yard	14.3	0.04	14.3	80

TABLE-4.16 (C): PHASE-I : RESULTANT NO_2 AT AAQ MONITORED LOCATIONS

Expressed in µg/m³

Code	Name of Location	NO2 Concentration			NAAQ Standards
		Baseline Concentration	Incremental GLC'S of NO2 Concentration	Resultant Concentration	
A1	Site Office	26.2	6.78	33.0	80
A2	CIDCO Office, Panvel	27.3	1.90	29.2	80
A3	Ulwe, Sector-5	27.3	6.78	34.1	80
A4	Gavan Phata Water Tank	26.8	0.96	27.8	80
A5	CIDCO Branch Office, Sector-5 (Kalamboli)	27.5	1.90	29.4	80
A6	CIDCO Bhavan, CBD Belapur, Sector-10	26.0	1.90	27.9	80
A7	Pargaon High School	25.6	3.78	29.4	80
A8	CIDCO Office, Kharghar, Sector-4	26.8	1.90	28.7	80
A9	CIDCO Guest House	27.7	1.90	29.6	80
A10	Shirdhon	26.0	<0.96	26.0	80
A11	Herdilia IT Park in TTC Industrial Area	24.6	<0.96	24.6	80
A12	Panvel Market Yard	28.2	1.90	30.1	80

TABLE-4.16 (D): PHASE-I : RESULTANT CO AT AAQ MONITORED LOCATIONS

Expressed in mg/m³

Code	Name of Location	CO Concentration			NAAQ Standards
		Baseline Concentration	Incremental GLC'S of CO Concentration	Resultant Concentration	
A1	Site Office	0.34	0.00034	0.34	2
A2	CIDCO Office, Panvel	0.43	0.00043	0.43	2
A3	Ulwe, Sector-5	0.36	0.00036	0.36	2
A4	Gavan Phata Water Tank	0.42	0.00042	0.42	2
A5	CIDCO Branch Office, Sector-5 (Kalamboli)	0.43	0.00043	0.43	2
A6	CIDCO Bhavan, CBD Belapur, Sector-10	0.43	0.00043	0.43	2
A7	Pargaon High School	0.31	0.00031	0.31	2
A8	CIDCO Office, Kharghar, Sector-4	0.42	0.00042	0.42	2
A9	CIDCO Guest House	0.42	0.00042	0.42	2
A10	Shirdhon	0.35	0.00035	0.35	2
A11	Herdilia IT Park in TTC Industrial Area	0.40	0.0004	0.40	2
A12	Panvel Market Yard	0.37	0.00037	0.37	2

TABLE-4.17 (A): PHASE-IV: RESULTANT PM_{10} AT AAQ MONITORED LOCATIONS

Expressed in µg/m³

Code	Name of Location	PM_{10} Concentration			NAAQ Standards
		Baseline Concentration	Incremental GLC'S of PM_{10} Concentration	Resultant Concentration	
A1	Site Office	68.4	0.53	68.93	100
A2	CIDCO Office, Panvel	74.4	0.31	74.71	100
A3	Ulwe, Sector-5	71.2	0.46	71.66	100
A4	Gavan Phata Water Tank	73.2	0.16	73.36	100
A5	CIDCO Branch Office, Sector-5 (Kalamboli)	73.3	0.23	73.53	100

Code	Name of Location	PM_{10} Concentration			NAAQ Standards
		Baseline Concentration	Incremental GLC'S of PM_{10} Concentration	Resultant Concentration	
A6	CIDCO Bhavan, CBD Belapur, Sector-10	72.2	0.23	72.43	100
A7	Pargaon High School	67.9	0.53	68.43	100
A8	CIDCO Office, Kharghar, Sector-4	72.8	0.16	72.96	100
A9	CIDCO Guest House	73.0	0.23	73.23	100
A10	Shirdhon	68.2	<0.08	68.20	100
A11	Herdilia IT Park in TTC Industrial Area	71.0	<0.08	71.00	100
A12	Panvel Market Yard	72.8	0.23	73.03	100

TABLE-4.17 (B): PHASE-IV : RESULTANT SO_2 AT AAQ MONITORED LOCATIONS

Expressed in $\mu g/m^3$

Code	Name of Location	SO_2 Concentration			NAAQ Standards
		Baseline Concentration	Incremental GLC'S of SO_2 Concentration	Resultant Concentration	
A1	Site Office	14.1	0.58	14.68	80
A2	CIDCO Office, Panvel	14.5	0.44	14.94	80
A3	Ulwe, Sector-5	15.1	0.44	15.54	80
A4	Gavan Phata Water Tank	14.7	0.15	14.85	80
A5	CIDCO Branch Office, Sector-5 (Kalamboli)	14.8	0.30	15.10	80
A6	CIDCO Bhavan, CBD Belapur, Sector-10	14.0	0.30	14.30	80
A7	Pargaon High School	13.7	0.73	14.43	80
A8	CIDCO Office, Kharghar, Sector-4	14.2	0.30	14.50	80
A9	CIDCO Guest House	14.4	0.30	14.70	80
A10	Shirdhon	14.1	<0.15	14.10	80
A11	Herdilia IT Park in TTC Industrial Area	14.2	<0.15	14.20	80
A12	Panvel Market Yard	14.3	0.30	14.60	80

TABLE-4.17 (C): PHASE-IV: RESULTANT NO_2 AT AAQ MONITORED LOCATIONS

Expressed in $\mu g/m^3$

Code	Name of Location	NOx Concentration			NAAQ Standards
		Baseline Concentration	Incremental GLC'S of NO2 Concentration	Resultant Concentration	
A1	Site Office	26.2	26.28	52.48	80
A2	CIDCO Office, Panvel	27.3	15.89	43.19	80
A3	Ulwe, Sector-5	27.3	26.28	53.58	80
A4	Gavan Phata Water Tank	26.8	5.51	32.31	80
A5	CIDCO Branch Office, Sector-5 (Kalamboli)	27.5	15.89	43.39	80
A6	CIDCO Bhavan, CBD Belapur, Sector-10	26.0	15.89	41.89	80
A7	Pargaon High School	25.6	26.28	51.88	80
A8	CIDCO Office, Kharghar, Sector-4	26.8	15.89	42.69	80
A9	CIDCO Guest House	27.7	10.70	38.40	80
A10	Shirdhon	26.0	<5.51	26.00	80
A11	Herdilia IT Park in TTC Industrial Area	24.6	<5.51	24.60	80
A12	Panvel Market Yard	28.2	10.70	38.90	80

TABLE-4.17 (D): PHASE-IV :
RESULTANT CO AT AAQ MONITORED LOCATIONS

Expressed in mg/m^3

Code	Name of Location	CO Concentration			NAAQ Standards
		Baseline Concentration	Incremental GLC'S of CO Concentration	Resultant Concentration	
A1	Site Office	0.34	0.013	0.35	2
A2	CIDCO Office, Panvel	0.43	0.009	0.44	2
A3	Ulwe, Sector-5	0.36	0.011	0.37	2
A4	Gavan Phata Water Tank	0.42	0.013	0.43	2
A5	CIDCO Branch Office, Sector-5 (Kalamboli)	0.43	0.007	0.44	2
A6	CIDCO Bhavan, CBD Belapur, Sector-10	0.43	0.007	0.44	2
A7	Pargaon High School	0.31	0.011	0.32	2
A8	CIDCO Office, Kharghar, Sector-4	0.42	0.007	0.43	2
A9	CIDCO Guest House	0.42	0.009	0.43	2
A10	Shirdhon	0.35	0.002	0.35	2
A11	Herdilia IT Park in TTC Industrial Area	0.40	0.002	0.40	2
A12	Panvel Market Yard	0.37	0.004	0.37	2

4.3.3.8 Impact on Sensitive Locations

Ecologically sensitive areas and forests found in the buffer zone of the NMIA up to a radius of 15 km from the core area is shown in **Table-4.18**. Karnala Bird Sanctuary, located in the buffer zone is a protected area and one of the very few remaining undisturbed forests in the Konkan region. It is mainly covered with moist deciduous forest but evergreen woody plants are found in the riparian zone. It is comparatively less species rich than Prabalgad–Matheran–Malanggad Hill Range.

Though species rich and part of the Western Ghats, Mumbai Metropolitan Region (MMR) is one of the highly developing regions in the World. Mumbai Metropolitan Region Development Authority (MMRDA), the planning authority for MMR, has predicted in their 40-year concept plan that the city would have 44 million (current population - 20.7 million) inhabitants by 2052, spread over 1050 sq. km, which is almost double the present area of 603 sq. km. This indicates that anthropogenic pressure on the natural habitats in the landscape, which are already under huge stress, would increase by manifolds in the near future and adversely affect many species.

TABLE-4.18
ENVIRONMENTAL SENSITIVE LOCATIONS 15KM AREA

Category	Name	Distance (km)	Nearest AAQ Monitoring Locations	Direction
Wildlife Sanctuaries	Karnala Bird Sanctuary	9.6	AAQ10	SE
	Karnala Bird ESZ Sanctuary	2.5	AAQ4	SE
	Thane Creek Flamingo Sanctuary ESZ	9.2	AAQ11	NW
Eco-sensitive area	Matheran Eco sensitive zone	9.3	AAQ5	ENE
Reserve Forests	Reserve Forest near Kopar village/Vitthalwadi Vadghar	0.5	AAQ12	S

Category	Name	Distance (km)	Nearest AAQ Monitoring Locations	Direction
	Reserve Forest near village Padekhar	1.8	AAQ4	S
	Reserve Forest in Parsik Hills	4.5	AAQ8	N
	Reserve Forest near village Jasai	4.6	AAQ4	S
	Reserve Forest near village Narpoli	9.2	AAQ10	SE
	Reserve Forest near village Thombrewadi	10.4	AAQ10	SE
	Reserve Forest near village Kalambusre	12.6	AAQ4	S
Notified historical/archaeological/tourist places	Belapur fort	0.82	AAQ9	NW
	Elephanta Caves, Gharapuri	11.3	AAQ3	W
	Karnala fort	11.95	AAQ10	SE
	Prabalgadh fort	13.9	AAQ2	E

The impact of air emissions due to the proposed project on the environmentally sensitive locations have been predicted by using modelling simulation and the results are provided in **Table-4.19 (A-D) to Table-4.20 (A-D).**

TABLE-4.19 (A) PHASE-I
PREDICTED PM_{10} GLC'S ON SENSITIVE LOCATIONS

Expressed in $\mu g/m^3$

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
A. Wildlife Sanctuaries				
Karnala Bird Sanctuary	68.2	<0.05	68.2	100
Karnala Bird ESZ Sanctuary	73.2	0.05	73.2	100
Thane Creek Flamingo Sanctuary ESZ	71.0	<0.05	71.00	100
B. Eco-Sensitive Area				
Matheran Eco sensitive zone	73.3	0.05	73.35	100
C. Reserve Forests				
R.F near Kopar village/Vitthalwadi Vadghar	72.8	0.10	72.9	100
R.F near village Padekhar	73.2	0.10	73.30	100
R.F in Parsik Hills	72.8	0.05	72.85	100
R.F near village Jasai	73.2	0.05	73.25	100
R.F near village Narpoli	68.2	0.05	68.25	100
R.F near village Thombrewadi	68.2	0.05	68.25	100
R.F near village Kalambusre	73.2	0.05	73.25	100
D.Notified Historical/Archaeological/Tourist Places				
Belapur fort	73.0	0.15	73.15	100
Elephanta Caves, Gharapuri	71.2	0.05	71.25	100
Karnala fort	68.2	0.05	68.25	100
Prabalgadh fort	74.4	0.05	74.45	100

TABLE-4.19 (B) PHASE-I
PREDICATED SO_2 GLC'S ON SENSITIVE LOCATIONS

Expressed in µg/m^3

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
A. Wildlife Sanctuaries				
Karnala Bird Sanctuary	14.1	0.04	14.14	80
Karnala Bird ESZ Sanctuary	14.7	0.04	13.74	80
Thane Creek Flamingo Sanctuary ESZ	14.2	0.04	14.24	80
B. Eco-Sensitive Area				
Matheran Eco sensitive zone	14.8	0.08	14.88	80
C. Reserve Forests				80
R.F near Kopar village/Vitthalwadi Vadghar	14.3	0.11	14.41	80
R.F near village Padekhar	14.7	0.04	14.74	80
R.F in Parsik Hills	14.2	0.04	14.24	80
R.F near village Jasai	14.7	0.04	14.74	80
R.F near village Narpoli	14.1	0.04	14.14	80
R.F near village Thombrewadi	14.1	0.04	14.14	80
R.F near village Kalambusre	14.7	0.04	14.74	80
D.Notified Historical/Archaeological/Tourist Places				
Belapur fort	14.4	0.08	14.48	80
Elephanta Caves, Gharapuri	15.1	0.04	15.14	80
Karnala fort	14.1	0.04	14.14	80
Prabalgadh fort	14.5	0.04	14.54	80

TABLE-4.19 (C) PHASE-I
PREDICATED NO_2 GLC'S ON SENSITIVE LOCATIONS

Expressed in µg/m^3

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
A. Wildlife Sanctuaries				
Karnala Bird Sanctuary	26.2	0.96	28.46	80
Karnala Bird ESZ Sanctuary	26.8	1.90	28.7	80
Thane Creek Flamingo Sanctuary ESZ	24.6	0.96	25.56	80
B. Eco-Sensitive Area				
Matheran Eco sensitive zone	27.5	0.96	28.46	80
C. Reserve Forests				80
R.F near Kopar village/Vitthalwadi Vadghar	21.3	2.84	24.14	80
R.F near village Padekhar	26.8	1.90	28.70	80
R.F in Parsik Hills	26.8	1.90	28.70	80
R.F near village Jasai	26.8	0.96	27.76	80
R.F near village Narpoli	26.2	0.96	27.16	80
R.F near village Thombrewadi	26.2	0.96	27.16	80
R.F near village Kalambusre	26.8	0.96	27.76	80
Notified Historical/Archaeological/Tourist Places				

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
Belapur fort	27.7	2.84	30.54	80
Elephanta Caves, Gharapuri	27.3	0.96	28.26	80
Karnala fort	26.2	0.96	27.16	80
Prabalgadh fort	27.3	0.96	28.26	80

TABLE-4.19 (D) PHASE-I
PREDICATED CO GLC'S ON SENSITIVE LOCATIONS

Expressed in mg/m^3

Name	Baseline Concentration (mg/m^3)	Incremental GLC's (mg/m^3)	Resultant Concentration (mg/m^3)	NAAQ Standards
A. Wildlife Sanctuaries				
Karnala Bird Sanctuary	0.35	0.00064	0.35064	2
Karnala Bird ESZ Sanctuary	0.42	0.00127	0.42127	2
Thane Creek Flamingo Sanctuary	0.40	0.00064	0.40064	2
B. Eco-Sensitive Area				2
Matheran Eco sensitive zone	0.43	0.00064	0.43064	2
C. Reserve Forests				
R.F near Kopar village/Vitthalwadi	0.37	0.00190	0.37190	2
R.F near village Padekhar	0.42	0.00127	0.42127	2
R.F in Parsik Hills	0.42	0.00127	0.42127	2
R.F near village Jasai	0.42	0.00064	0.42064	2
R.F near village Narpoli	0.35	0.00064	0.35064	2
R.F near village Thombrewadi	0.35	0.00064	0.35064	2
R.F near village Kalambusre	0.42	0.00064	0.42064	2
D. Notified Historical/ Archaeological/Tourist Places				
Belapur fort	0.42	0.00127	0.42127	2
Elephanta Caves, Gharapuri	0.36	0.00064	0.36064	2
Karnala fort	0.35	0.00064	0.35064	2
Prabalgadh fort	0.43	0.00064	0.43064	2

TABLE-4.20 (A) PHASE-VI
PREDICATED PM_{10} GLC'S ON SENSITIVE LOCATIONS

Expressed in $\mu g/m^3$

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
A. Wildlife Sanctuaries				
Karnala Bird Sanctuary	68.2	0.08	68.28	100
Karnala Bird ESZ Sanctuary	73.2	0.31	73.51	100
Thane Creek Flamingo Sanctuary ESZ	71.0	0.08	71.08	100
B. Eco-Sensitive Area				
Matheran Eco sensitive zone	73.3	0.16	73.46	100
C. Reserve Forests				
R.F near Kopar village/ Vitthalwadi Vadghar	72.8	0.31	73.51	100
R.F near village Padekhar	73.2	0.23	73.43	100
R.F in Parsik Hills	72.8	0.23	73.03	100
R.F near village Jasai	73.2	0.16	73.36	100
R.F near village Narpoli	68.2	0.08	68.28	100
R.F near village Thombrewadi	68.2	0.08	68.28	100

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
R.F near village Kalambusre	73.2	0.08	73.28	100
D.Notified Historical/ Archaeological/Tourist Places				
Belapur fort	73.0	0.61	73.61	100
Elephanta Caves, Gharapuri	71.2	0.08	71.28	100
Karnala fort	68.2	0.08	68.28	100
Prabalgadh fort	74.4	0.08	74.48	100

TABLE-4.20 (B) PHASE-IV
PREDICATED SO_2 GLC'S ON SENSITIVE LOCATIONS

Expressed in $\mu g/m^3$

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
A. Wildlife Sanctuaries				
Karnala Bird Sanctuary	14.1	0.15	14.25	80
Karnala Bird ESZ Sanctuary	14.7	0.30	15.00	80
Thane Creek Flamingo Sanctuary ESZ	14.2	0.15	14.35	80
B. Eco-Sensitive Area				80
Matheran Eco sensitive zone	14.8	0.15	14.95	80
C. Reserve Forests				
R.F near Kopar village/ Vitthalwadi	14.3	0.44	14.74	80
R.F near village Padekhar	14.7	0.30	15.00	80
R.F in Parsik Hills	14.2	0.30	14.50	80
R.F near village Jasai	14.7	0.15	14.85	80
R.F near village Narpoli	14.1	0.15	14.25	80
R.F near village Thombrewadi	14.1	0.15	14.25	80
R.F near village Kalambusre	14.7	0.15	14.85	80
D.Notified Historical/ Archaeological/ Tourist Places				
Belapur fort	14.4	0.58	14.98	80
Elephanta Caves, Gharapuri	15.1	0.15	15.25	80
Karnala fort	14.1	0.15	14.25	80
Prabalgadh fort	14.5	0.15	14.65	80

TABLE-4.20 (C) PHASE-IV
PREDICATED NO_2 GLC'S ON SENSITIVE LOCATIONS

Expressed in $\mu g/m^3$

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
A. Wildlife Sanctuaries				
Karnala Bird Sanctuary	26.2	5.51	31.71	80
Karnala Bird ESZ Sanctuary	26.8	15.89	42.69	80
Thane Creek Flamingo Sanctuary ESZ	24.6	5.51	30.11	80
B. Eco-sensitive area				80
Matheran Eco sensitive zone	27.5	10.70	38.20	80
C. Reserve Forests				
R.F near Kopar village/Vitthalwadi Vadghar	21.3	26.28	48.1	80
R.F near village Padekhar	26.8	21.09	47.89	80
R.F in Parsik Hills	26.8	15.89	42.69	80
R.F near village Jasai	26.8	5.51	32.31	80
R.F near village Narpoli	26.2	5.51	31.71	80

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
R.F near village Thombrewadi	26.2	5.51	31.71	80
R.F near village Kalambusre	26.8	5.51	32.31	80
D.Notified Historical/Archaeological/Tourist Places				
Belapur fort	27.7	26.28	53.98	80
Elephanta Caves, Gharapuri	27.3	5.51	32.81	80
Karnala fort	26.2	5.51	31.71	80
Prabalgadh fort	27.3	5.51	32.81	80

TABLE-4.20 (D) PHASE-IV
PREDICATED CO GLC'S ON SENSITIVE LOCATIONS

Expressed in mg/m^3

Name	Baseline Concentration	Incremental GLC'S	Resultant Concentration	NAAQ Standards
A. Wildlife Sanctuaries				
Karnala Bird Sanctuary	0.35	0.00231	0.35231	2
Karnala Bird ESZ Sanctuary	0.42	0.00667	0.42667	2
Thane Creek Flamingo Sanctuary ESZ	0.40	0.00449	0.40449	2
B. Eco-Sensitive Area				
Matheran Eco sensitive zone	0.43	0.00449	0.43449	2
C. Reserve Forests				2
R.F near Kopar village/Vitthalwadi Vadghar	0.37	0.00884	0.37884	2
R.F near village Padekhar	0.42	0.00449	0.42449	2
R.F in Parsik Hills	0.42	0.00667	0.42667	2
R.F near village Jasai	0.42	0.00449	0.42449	2
R.F near village Narpoli	0.35	0.00231	0.35231	2
R.F near village Thombrewadi	0.35	0.00231	0.35231	2
R.F near village Kalambusre	0.42	0.00231	0.42231	2
D.Notified Historical/ Archaeological/Tourist Places				
Belapur fort	0.42	0.01102	0.43102	2
Elephanta Caves, Gharapuri	0.36	0.00231	0.36231	2
Karnala fort	0.35	0.00231	0.35231	2
Prabalgadh fort	0.43	0.00231	0.43231	2

4.3.4 Traffic Assessment Study

The estimation of traffic volume on the road network leading to the airport site were obtained from secondary source. The projected growth rate was assessed between 2017 and 2041 (final horizon year). The adequacy of the road network was tested between 2010 to 2041 based on projected traffic volume and the carrying capacity of major roads and intersections connected to NMIA at different spatial scales (50 km to 5 km). The collection and comparison of baseline traffic data of CSMIA was used to prognosticate the projected traffic volume of NMIA with alternative scenarios of growth in the nearby urban/industrial pockets. Ultimately, the estimated level of service in the roads carrying the ingress/egress traffic of NMIA was identified. The detailed traffic study report is attached in **Annexure - IX**.

The land side traffic assessment of NMIA is integrated with air traffic demand and transport network development plans as per the comprehensive transport study

(study conducted by MMRDA) of MMR. A detailed traffic management and traffic de-congestion plan was drawn up for NMIA considering the ingress and egress of traffic and its growth in 5 km radius of the airport boundary. The weighted volume/capacity ratio of the major road corridors connecting NMIA are predicted based on the modelling of road traffic data and the level of service is assessed for understanding the extent of traffic congestion within 5 km radius of the airport site.

Further, the predictive air dispersion modelling was carried out to understand the ground level concentration of air pollutants emitted from vehicular exhaust of traffic access in all phases of the airport operation based on the traffic volume assessment. The details of the traffic analysis and its findings and recommendations are summarised below.

4.3.4.1Background

Mumbai Urban Transport Project (MUTP) was formulated by MMRDA for improvement of traffic and transport situation in MMR with the assistance of the World Bank. In the Phase-II implementation of MUTP, viz. MUTP II, MMRDA has carried out a Comprehensive Transport Study (CTS) for MMR, which recommended planned development of multi-modal transport system in MMR for the horizon period up to 2031. Also, CIDCO as the SPA/ NTDA for Navi Mumbai Region conceived the NMIA project to cater to increasing air passenger growth in MMR. CSMIA being the only airport within MMR is approaching its passenger handling capacity and could not be expanded further due to space constraint. The NMIA is planned to handle the spill traffic from CSMIA. NMIA is planned to be established in a phase-wise manner with commencement of terminal with passenger handling capacities upgrade to 10 MPPA, 20 MPPA, 40 MPPA and 60 MPPA through corresponding establishment of terminals T1, T2 and T3 respectively within the airport.

Environment clearance for NMIA was given by MoEF&CC in the month of November 2010 which also emphasized the improvement of transport connectivity at regional as well local level in view of the new Airport development. CIDCO, MMRDA and Mumbai Transformation Support Unit (MTSU) carried out a study i.e. "Preparation of Regional and Local Transport Connectivity for Navi Mumbai International Airport (NMIA)" during January, 2011 to January, 2012 through M/s LEA Associates South Asia Pvt. Ltd (LASA). The course of studies conducted by LASA considering improvement of transport infrastructure within Mumbai includes following studies delivered:

- Inception Report (January 2011);
- Draft Report on Alternative Regional Transport Corridors and Analysis for

  Enhanced Regional Transport Connectivity and Proposed Local Transport Network and Travel Demand Assessment for Enhanced Local Transport Connectivity (April 2011);

- NMIA Transport Connectivity: Functional Concept Designs (April 2011); and
- Draft Final Report (June 2011) were submitted.

Again, the Draft Final Report (Revised) (August 2011) were submitted incorporating the comments on DFR. CIDCO had circulated this to all the stakeholders and a meeting with them was organized. Consultants appropriately incorporated all the views and advice of all the stakeholders and submitted the Final Report in January 2012. CIDCO submitted the final report to all the stakeholders to consider and expedite implementation of recommendations of the Report and accordingly various works are in progress as of now.

The extension of the EC and CRZ Clearance of NMIA project was issued on 20th December 2017 has imposed as per:

- An additional condition (Condition No. II) that a detailed traffic management and traffic decongestion plan has to be prepared in order to ensure that the current level of service of the roads within 05 km radius of the project site is maintained and improved upon to be drawn up through an organisation of repute and specializing in transport planning.
- The above plan should consider the cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the project or other agencies within 5 km radius from the site under different scenarios of space and time; and
- The above plan shall be implemented to the satisfaction of the State Urban Development and Transport Department with the consent of all the concerned agencies.

Similar conditions are also imposed in the new ToR dated 29th October 2020 (specific condition no. xi) issued to carry out the EIA study for NMIA for revalidation of the EC beyond 21st November 2020.

As MMRDA is now updating CTS for MMR study through M/s LEA Associates South Asia Pvt. Ltd. (which was initiated in May 2017 and expected to get completed by end of 2018), CIDCO made a request to MMRDA to get the required study i.e. "Detailed Traffic Management and a Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA)" through M/s LEA Associates South Asia Pvt. Ltd.

CIDCO and MMRDA now envisage a comprehensive review of these projects with an objective of providing enhanced transport connectivity to the Navi Mumbai Airport. MMRDA has initiated the Updation of CTS for MMR study and the study is in progress and planned for completion by end of August 2019. Using the primary and secondary data collected, updated travel demand models, updated existing and proposed transport networks, etc. of CTS for MMR Updation study, it is envisaged updation of

"Regional and Local Transport Connectivity for Navi Mumbai International Airport (NMIA)" study analysis and recommendations and prepare "Detailed Traffic Management and a Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA)".

4.3.4.2 Traffic Management and Decongestion Plan for NMIA (within 5 km radius)

Study Approach:

The present report i.e., Final Report on "Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA)" is prepared after incorporating the views/ observations/ suggestions received from the Stakeholders on Draft Final Report. The overall approach for the study is planed 3 tasks and 19-sub-tasks a below:

Task-1: Review and assessment of cumulative impact of all the development and increased habitation being carried out by the project and other agencies in the 5 km radius under different scenarios of space and time:

- Delineation of the study area within 5 km radius of the NMIA for preparation of Traffic Management and Decongestion Plan.
- Review of the population and employment assessment and forecasts for the year 2017 and horizon period up to 2041 within the vicinity of 5 km radius from the proposed NMIA.
- Review of existing transport infrastructure within the vicinity of 5 km radius from the proposed NMIA.
- Assessment of level of service on road transport network within the vicinity of 5 km radius from the proposed NMIA (Year 2017) from CTS for MMR updation Study; and
- Framework for assessment of cumulative development impact of all the developments (land use and transport) for the horizon period up to 2041 within the vicinity of 5 km radius from the proposed NMIA.

Task-2: Review of various Traffic & Transportation Projects planned by CIDCO, MRVC, MMRDA, NHAI, PWD, JNPT, NMMC in MMR and updation of multi-modal regional connectivity plan:

- Review and status of various transportation projects (Road, Rail and Passenger Water Transport) relevant for Navi Mumbai International Airport.
- Review and status of project preparatory works carried out so far on metro connectivity between Mumbai and Navi Mumbai Airports and their extensions.

- Review and status of project preparatory works carried out so far on road, metro and Passenger Water Transport connectivity between Island City and Navi Mumbai Airport.
- Review and status of project preparatory works carried out so far on road and metro connectivity between other ULBs of MMR and Navi Mumbai Airport.
- Travel demand assessment for the metro connectivity between Mumbai and Navi Mumbai airports and their extensions.
- Travel demand assessment for the road, metro and Passenger Water Transport connectivity between Island City and Navi Mumbai Airport.
- Travel demand assessment for the road and metro connectivity between other ULBs of MMR and Navi Mumbai airports and their extensions.
- Updation of multi-modal regional connectivity plan for Navi Mumbai International Airport; and
- Recommend phased development of the multi-modal regional connectivity plan.

Task-3: Traffic Management and Traffic Decongestion Plan for the area within 5 km radius from the NMIA:

- Review of NMIA Master Plan.
- Preparation of existing transport network in the delineated study area and assessment of traffic volumes and level of service.
- Preparation of Concept Level Transport Network Master Plan for the delineated study area with all the regional linkages (road, metro, suburban and PWT) and local transport network connectivity considering improvement of intersections, flyovers/ elevated roads, etc.
- Transport network analysis for the horizon period up to 2041 under immediate (2021), short (2026), Medium (2031) and long term (2041); and
- Preparation of Detailed Traffic Management Plan and Traffic Decongestion Plan to ensure maintenance and improvement of current service level of all roads in the delineated study area.

4.3.4.3 Growth Scenarios and Assessment of Planning Parameters

Transport and land use are interconnected. The correlation between land use and transport network is addressed by assessing two alternative growth scenarios in vicinity of the NMIA project area as follows:

- Assessment of growth scenarios as per Draft Regional Plan (DRP) 2016-2036 Proposals:

- Assessment of growth scenarios as per Comprehensive Transport Study Updation (CTSU):

The details of the assessment of population growth in the identified growth centres are presented in detail in the 'Detailed *Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020'* based on which travel demand assessment and transport network analysis for NMIA local connectivity has been assessed.

4.3.4.4 Traffic Assessment Zones (TAZs)

The influence area (Updation of CTS of MMR) considered in the analysis in Greater Mumbai includes Nariman point, Fort, Ballard Estate, Byculla, Ferry Wharf, Mazgaon, Worli, Prabhadevi and Masjid and in Navi Mumbai are, Nerul, Sanpada, Vashi, Belapur and Seawoods.

The study area of 4,355 sq. km has been delineated into 19 clusters and 1,810 TAZ's. The clusters are formed such that it should include an entity like ULB/SPA for which the data is available and can be used suitably. The population and employment from ULB's and SPA areas has been derived at cluster level and further at TAZ level.

From 19 clusters, the study area is further delineated to 1,810 traffic analysis zones. The TAZ's are delineated based on factors such as road network compatibility, geographical boundary compatibility (District Judiciary boundary, Sector boundaries), homogeneous land use, transport access to zones etc. The weights of various land use and transport criteria to be allotted in the TAZ are on basis of zonal attractions factors for distribution of planning parameters. The weights allotted to the various land use and transport criteria for population and resident workers distribution in various TAZ's and its findings are presented in the detailed transport study which forms the basis of assessment of travel demand assessment.

4.3.4.5 Traffic Management and Decongestion (within 5 km radius of the NMIA)

Delineation of study area within 5 km radius from NMIA is very important for preparation of traffic management and decongestion plan. Based on the updated TAZ system and 5 km radius from NMIA boundary, for the sake of convenience compilation of planning parameters within the delineated study area, complete boundary of TAZs covering the 5 km radius from NMIA boundary are considered. Thus, the number of TAZs covered in the delineated study area is 111. Preliminary delineated study area is shown in **Figure-4.25** below. Approximate area covered is about 250 sq.km.

The existing road network as well as sub-urban corridors providing regional connectivity to the proposed NMIA need capacity enhancements to satisfy the growing travel demand in general and airport generated traffic in specific. Further, additional local road network is very much required to enhance the accessibility to the proposed NMIA. Approximate length of road network located within the delineated study area is about 318 km. The road network details within the delineated study is shown in **Figure-4.26** and the existing regional connectivity to NMIA is shown in **Figure-4.27.**

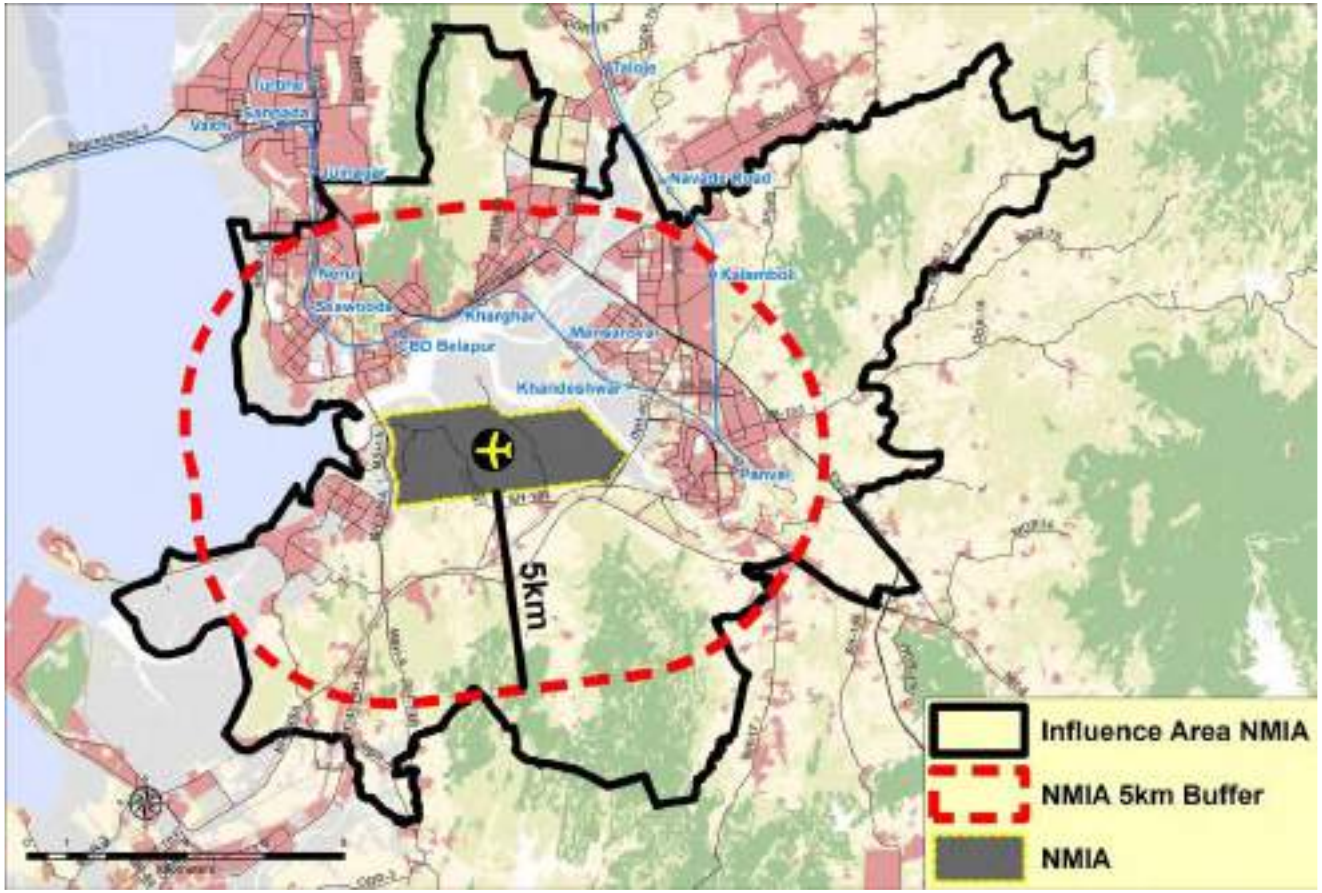
Proposed Junction Improvements/ Grade Separation Facilities

Some major junctions are also identified to understand traffic movements and functionality. The major intersections identified are presented in **Table-4.21** and shown in **Figure-4.28**.

TABLE-4.21
IDENTIFIED MAJOR INTERSECTIONS

Sr. No.	Name of the Intersection	No. of Arms	Leading to
1	Belapur Phata/Kille Junction	5	North – Amra Marg (NH 348 A)/Turbhe/ Vashi
2			South – Amra Marg/ NMI Airport/ JNPT
3			East – Sakal Bhavan marg/ Belapur
4			West – Palm Beach Road/ Vashi
5	Ghavan Phata	4	North – Amra Marg (NH 348 A)/ Airport/ Belapur
6			South-East – JNPT (NH-4B)
7			North-East – Kopar/ Panvel (SH-54)
8			South – SH-81
9	Kopar Junction	3	North –Amra Marg (NH 348 A)/ Airport/ Belapur
10			East – Palaspe village/ Pune
11			West – JNPT (NH-4B)
12	Palaspe Phata	4	North-West – Mumbai-Pune Road (NH-4)
13			South-East – NH-4 to Pune
14			South – NH-17 to Goa
15			South-West – to JNPT (NH-4B)
16	Kalamboli Intersection	5	North – Mumbai-Pune Road (NH-4)
17			North-West – Sion-Panvel Expressway/ Uran Phata
18			South-East – Sion-Panvel Expressway to Pune
19			South-West – NMIA / JNPT Road
20			South-East – Mumbai-Pune Road (NH-4)
21	Uran Phata	4	North – AMRA MARG (NH 348 A)/ Turbhe/ Vashi
22			North East- MIDC Service Road
23			South-West – Belapur
24			South – Sion-Panvel Expressway/ SH-42

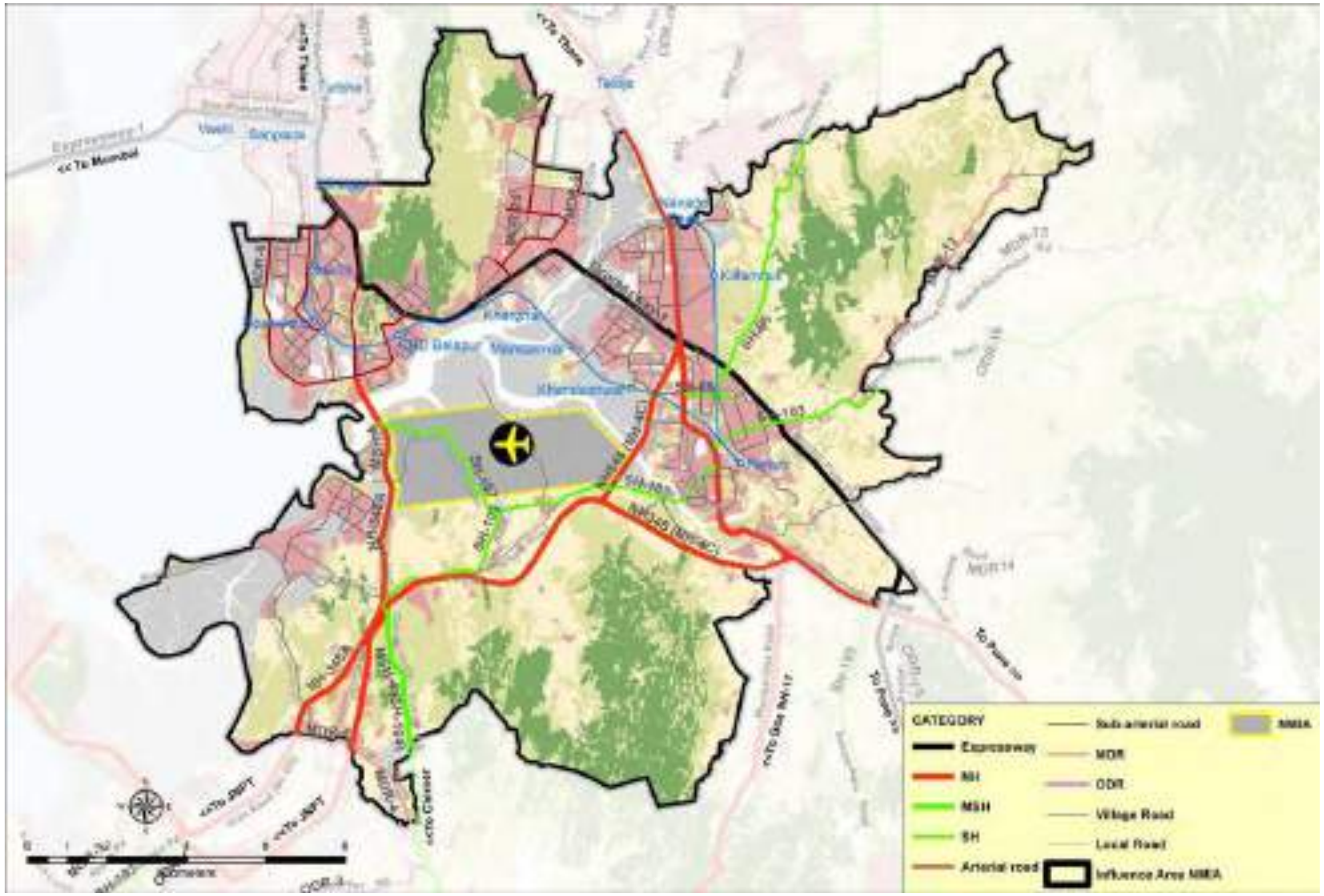
Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.



Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.

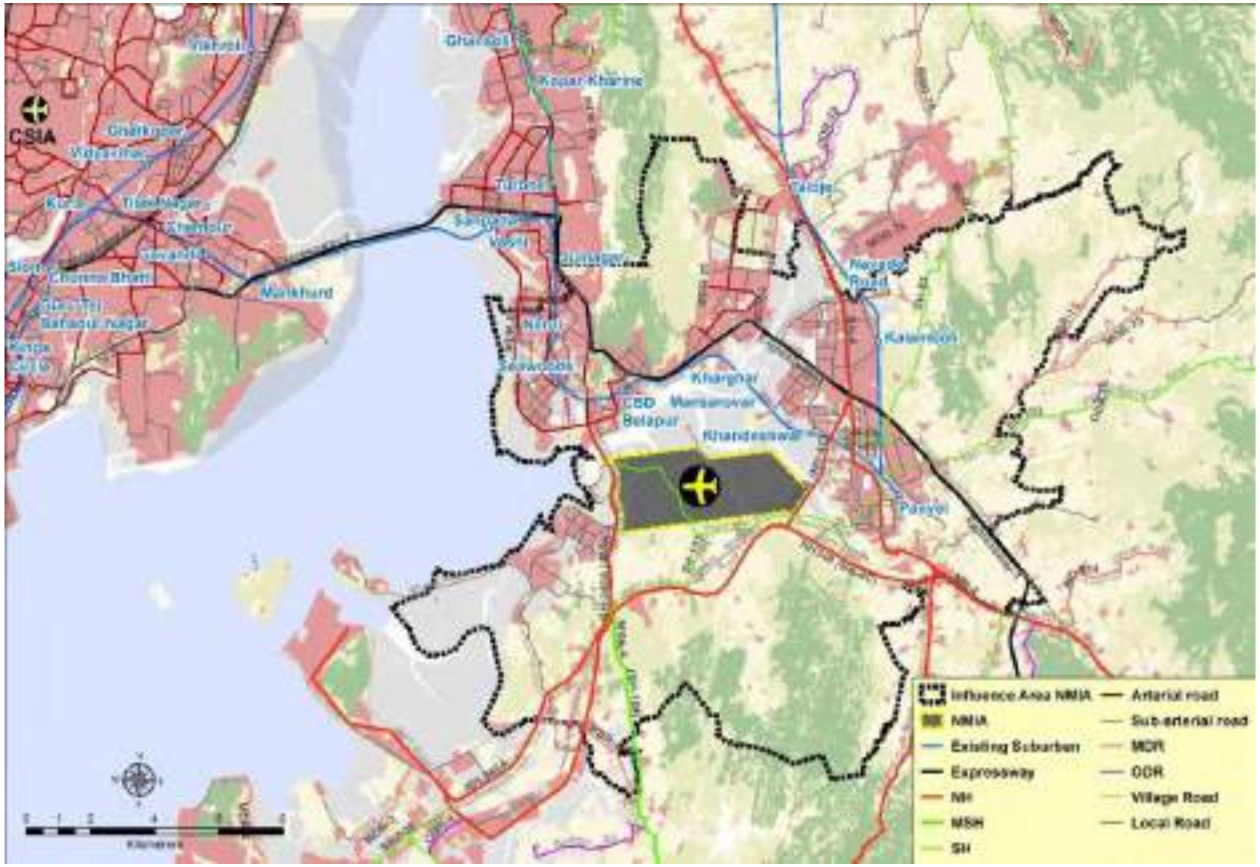
FIGURE-4.25

DELINEATION OF STUDY AREA WITHIN 5 KM RADIUS FROM NMIA



Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.

FIGURE-4.26
ROAD NETWORK IN DELINEATED STUDY AREA



Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.

FIGURE-4.27

EXISTING REGIONAL AND LOCAL TRANSPORT CONNECTIVITY: NMIA

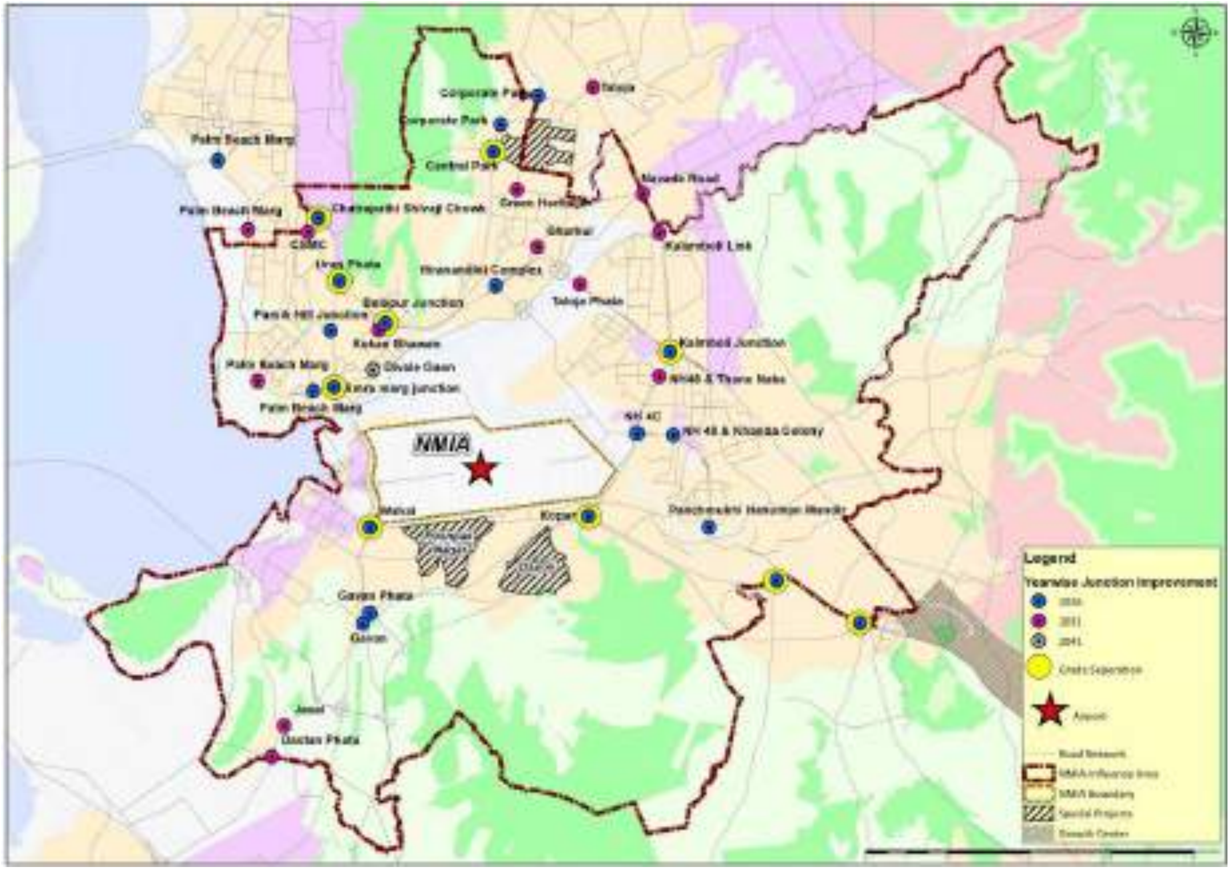
Consultants have identified 32 major junctions in the NMIA delineated study area (**Figure-4.29**) which warrant for intersection improvements by 2026. The junctions where total intersection volume is greater than 3,000 PCUs/hr in a particular horizon year within the delineated study area have been proposed for installation of traffic signal. In addition to above, the junctions where total intersection traffic is greater than 10,000 PCUs/hr have been proposed for grade separation. Total intersection traffic volumes in PCUs/ hr by horizon year wise i.e. 2026, 2031 and 2041 for DRP and CTSU scenarios are assessed from transport network analysis using EMME software and the details are presented in **Table-4.22**.

TABLE-4.22
TOTAL INTERSECTION VOLUME IN PCUS/HR AT MAJOR INTERSECTIONS IN DELINEATED STUDY AREA

Sr. No.	Name	DRP			CTSU			Recommended for Traffic Actuated Signal Conversion/ Installation or Grade Separation by
		2026	2031	2041	2026	2031	2041	
1	NH 4C	3,850	2,900	4,550	3,600	3,000	4,250	TAS: 2026
2	NH48 & Thane Naka	2,900	1,900	2,800	2,600	2,000	2,750	TAS: 2026
3	NH 48 & Khanda Colony	2,600	6,450	6,650	2,500	6,450	6,500	TAS: 2031
4	Kopar	9,050	9,150	13,500	8,100	9,200	14,100	TAS: 2026 and GS: 2026
5	Panchmukhi Hanuman Mandir*	3,300	6,550	7,450	3,300	6,550	7,500	TAS: 2026
6	Gavan Phata	4,350	3,900	6,050	4,250	4,300	6,650	TAS: 2026
7.1	Palm Beach Marg*	2,900	4,350	5,250	2,400	4,200	5,750	TAS: 2026
7.2	Palm Beach Marg*	2,250	3,750	4,800	2,000	3,650	4,550	TAS: 2031
7.3	Palm Beach Marg*	4,150	5,200	7,000	3,600	4,650	6,200	TAS: 2031
7.4	Palm Beach Marg*	5,700	5,750	7,950	5,050	5,650	6,900	TAS: 2026
8	Uran Phata*	9,100	12,300	13,750	6,650	11,750	13,750	TAS: 2026 and GS: 2026
9	Parsik Hill Junction*	2,950	2,900	3,950	2,650	2,700	3,500	TS: 2026
10	Amra Marg Junction*	9,550	9,650	16,100	7,900	9,350	13,850	TAS: 2026 and GS: 2026
11	Chatrapathi Shivaji Chowk*	9,350	12,450	14,650	8,650	12,000	13,550	TAS: 2026 and GS: 2026
12	CSMC	2,800	3,950	4,800	2,400	3,650	4,250	TAS: 2031
13	Divale Gaon	2,050	2,450	3,300	1,800	2,100	2,400	TAS: 2041
14	Kokan Bhawan*	2,150	2,900	3,700	1,900	2,650	3,200	TAS: 2031
15	Kalmboli Junction*	10,300	13,650	17,150	9,650	13,850	17,100	TAS: 2026 and GS: 2026
16	Gavan	5,950	6,700	7,350	3,950	6,650	7,950	TAS: 2026
17	Jasai	2,400	3,000	4,200	2,100	3,150	4,850	TAS: 2031
18	Dastan Phata	2,400	3,100	4,300	2,100	3,250	4,700	TAS: 2031
19	Kalamboli Link*	2,650	3,300	3,950	2,400	3,300	3,900	TAS: 2031
20	Taloja Phata*	2,050	5,850	5,900	1,900	5,800	5,800	TAS: 2031
21	Hiranandini Complex*	2,900	6,950	7,300	2,850	6,900	7,250	TAS: 2026
22	Belapur Junction*	5,636	9,889	11,170	5,183	9,638	10,730	TAS: 2026 and GS: 2031
23	Navade Road*	2,600	7,250	9,350	2,400	7,200	8,750	TAS: 2031
24	Wahal	9,450	9,100	11,850	8,750	8,750	12,000	TAS: 2026 and GS: 2026
25	Central Park	8,300	6,800	10,200	7,400	6,500	8,550	TAS: 2026 and GS: 2041
26	Green Heritage	2,550	3,000	4,000	2,400	2,950	3,800	TAS: 2031
27	Gharkul	2,500	3,000	3,950	2,350	2,800	3,850	TAS: 2031
28	Corporate Park-1	5,800	4,250	6,050	5,000	4,000	5,150	TAS: 2026
29	Corporate Park-2	5,500	2,850	4,500	4,750	2,700	3,800	TAS: 2026
30	Taloja*	2,200	3,100	3,850	2,000	3,050	3,650	TAS: 2031
31	Palaspe Phata	9000	11200	13100	8700	11200	13600	TAS: 2026 and GS: 2026
32	Kone Phata	4800	5800	6900	4700	6000	7100	TAS: 2026 and GS: 2041
Total PCC/Hr		165,986	205,289	261,320	147,933	201,538	252,180	

Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020; TAS: Traffic Actuated Signal; GS: Grade Separation
*Note: * The intersections where there are already signals are present, they are proposed for conversion to Traffic Actuated Signalling system.*

FIGURE-4.28
IDENTIFIED MAJOR TRANSPORT CORRIDORS AND MAJOR INTERSECTIONS

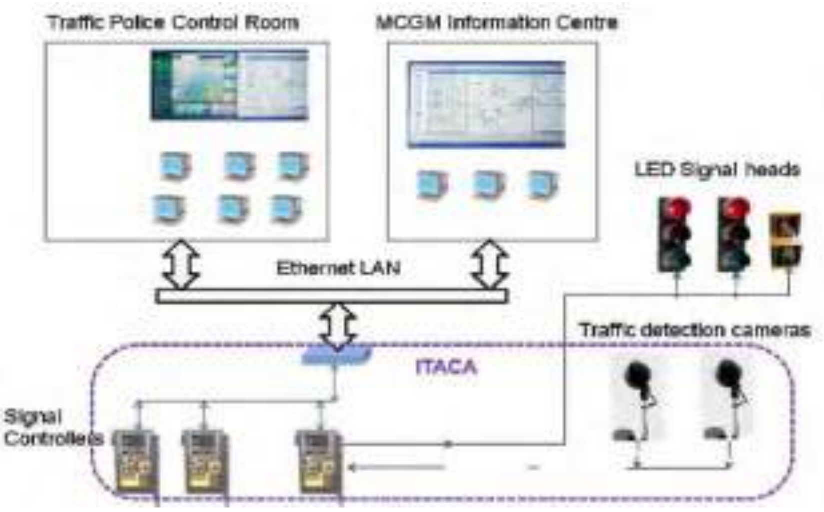


Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April, 2020.

FIGURE-4.29

IDENTIFIED MAJOR INTERSECTIONS IN DELINEATED STUDY AREA

For effective traffic monitoring and control within the NMIA delineated area, Area Traffic Control (ATC) System is proposed as shown in **Figure-4.30**.



Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.

FIGURE-4.30
AREA TRAFFIC CONTROL (ATC) SYSTEM PROPOSED FOR NMIA DELINEATED STUDY AREA

Within the delineated study area of NMIA, widening of existing roads and new/ missing links from study assessments are proposed to enhance the transport connectivity and to have very good traffic operating conditions during the horizon period up to 2041. Road network details are presented in **Table-4.23**. The capacity increase for the period up to 2041 would be about 40% considering the length and about 90% considering lane-km compared to base year 2017. Details on planning area wise widening of existing roads and new/ missing links for the horizon year 2041 are presented in **Table-4.24**.

TABLE-4.23
ROAD NETWORK DETAILS IN DELINEATED STUDY AREA

Sr. No.	Planning Area	Road Network 2017		Road Network 2026		Road Network 2031		Road Network 2041	
		Length (km)	Lane (km)	Length (km)	Lane (km)	Length (km)	Lane (km)	Length (km)	Lane (km)
1	NMIA	32.1	101.3	41.4	253.2	55.5	351.6	58.8	372.2
2	Navi Mumbai Municipal Corporation	65.1	317.9	73.1	357.7	73.1	357.7	77.2	382.8
3	Navi Mumbai (CIDCO Area: Pushpak Node, Dronagiri and Ulwe)	133.9	580.1	144.0	783.8	151.2	829.9	153.0	841.7
4	Panvel Municipal Corporation	86.9	248.1	136.5	640.0	143.6	684.0	154.9	757.4
	Total	318	1247.4	395	2034.7	423.4	2223.2	443.9	2354.1

Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.

TABLE -4.24
WIDENING OF EXISTING ROADS & NEW/ MISSING LINKS PLANNING FOR YEAR 2041

Sr. No.	Urban Local Body/Special Planning Authority Name	Widening (km)	New/Missing Link (km)
1	NAINA	5.91	96.25
2	NMMC	1.66	0
3	Navi Mumbai (CIDCO: Pushpak Node, Dronagiri and Ulwe)	28.64	63.24
4	Panvel	10.43	21.82
	Total	48.64	181.31

Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.

Proposed widening of existing roads, new/ missing links, and combined network of proposed widening of existing roads and new/ missing links for the horizon year 2041 are shown in **Figure-4.31**, **Figure-4.32** and **Figure-4.33** respectively.

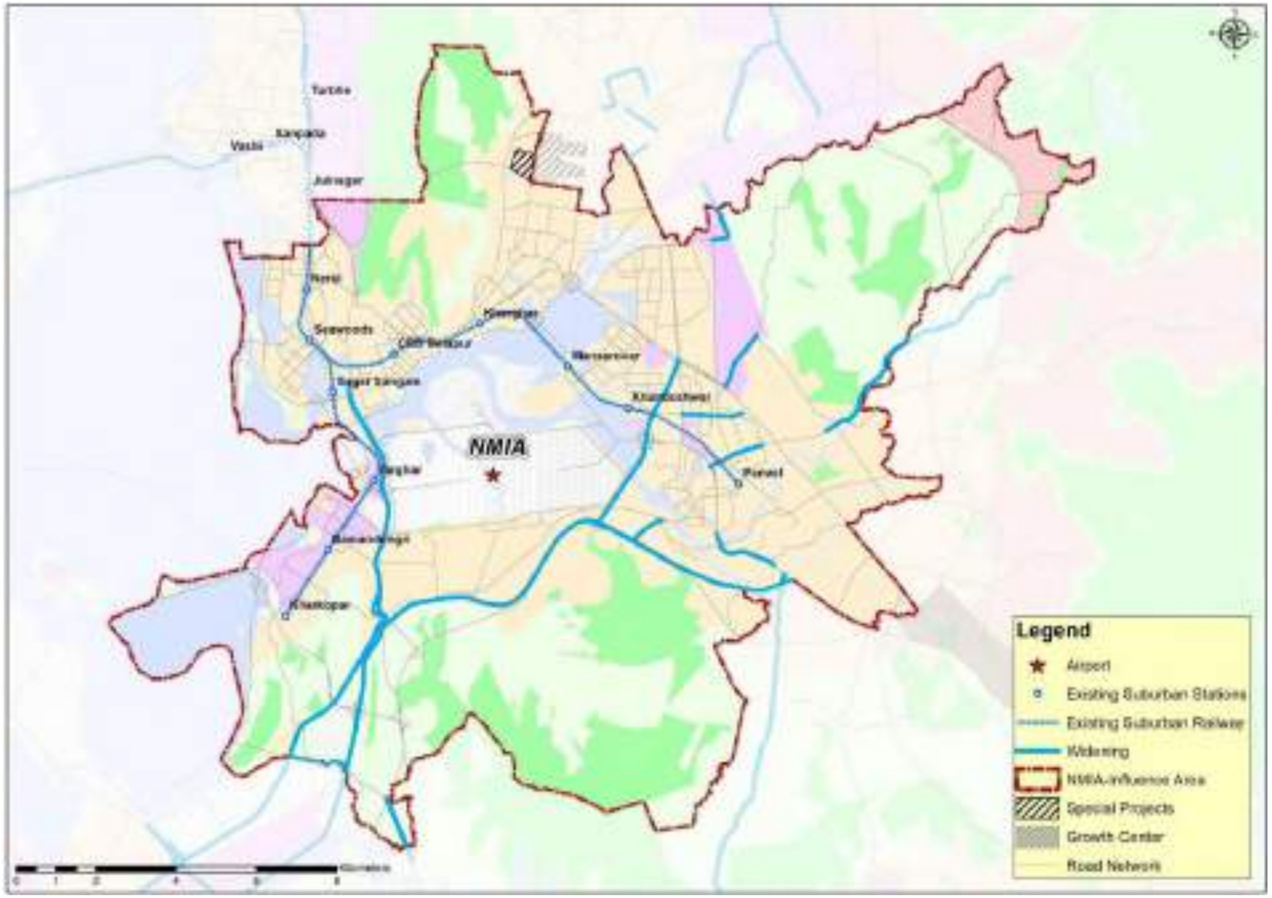


FIGURE-4.31
PROPOSED WIDENING OF EXISTING ROADS FOR HORIZON PERIOD UP TO 2041

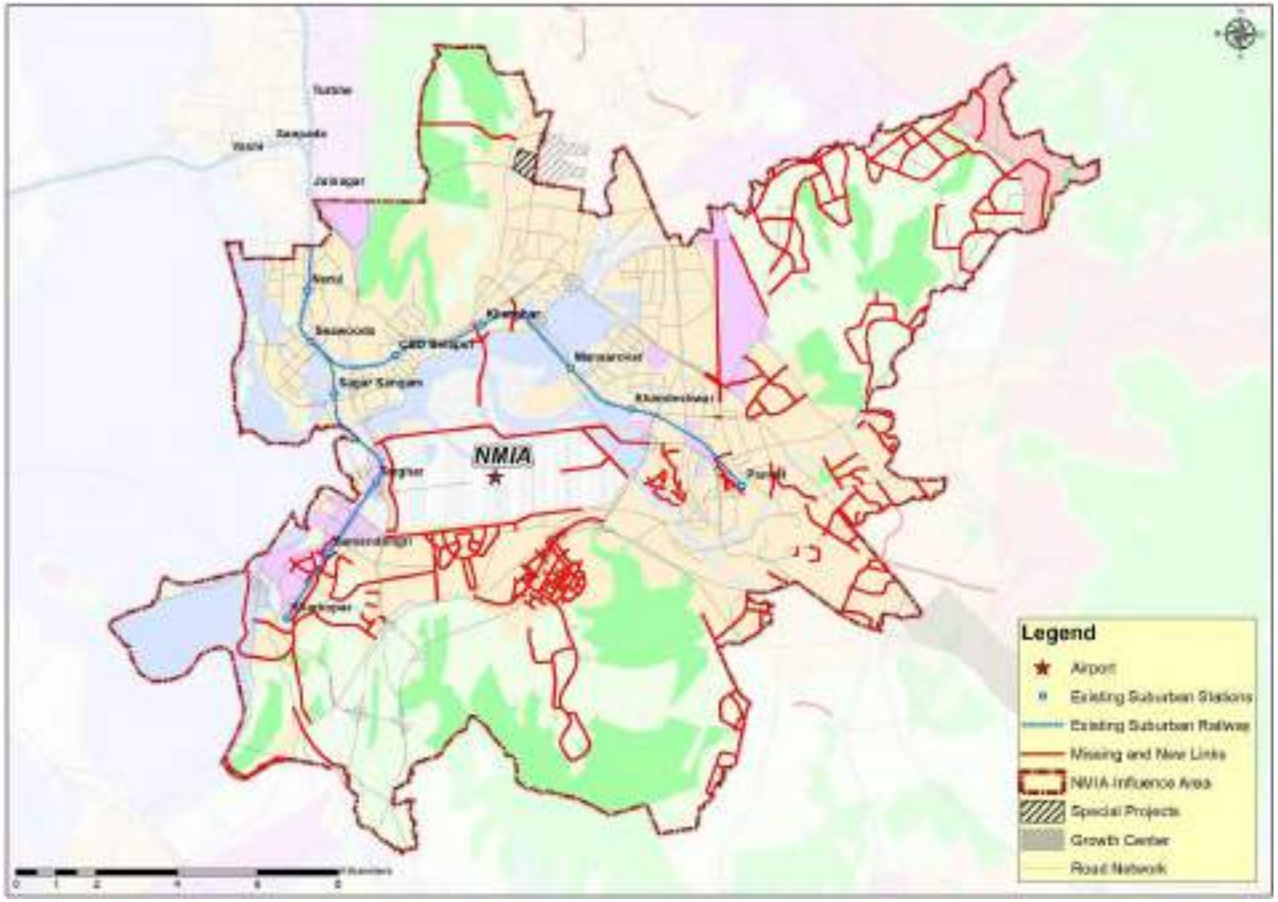


FIGURE-4.32
PROPOSED NEW/ MISSING LINKS FOR HORIZON PERIOD UP TO 2041

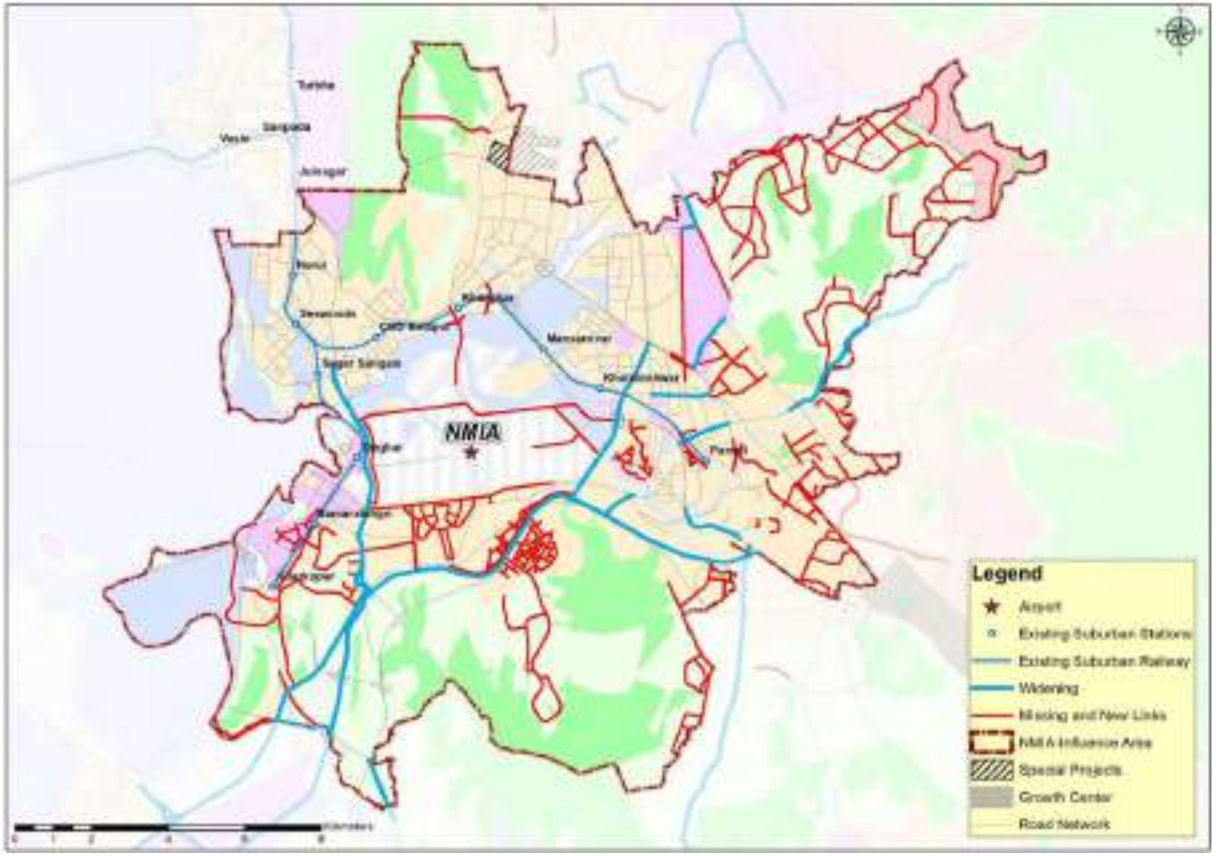


FIGURE-4.33
COMBINED NETWORK OF PROPOSED WIDENING OF EXISTING ROADS AND NEW/ MISSING LINKS FOR THE HORIZON PERIOD UPTO 2041

In the delineated study areas of both CSMIA and NMIA, the Consultants have assessed the volume to capacity ratios on the major roads across the various horizon years and the different scenarios and have been detailed in **Table-4.25**.

TABLE-4.25
WEIGHTED VOLUME/CAPACITY RATIO OF MAJOR ROADS CONNECTING TO CSMIA AND NMIA WITHIN DELINEATED STUDY AREA

Sr. No.	Airport	Road Name	Length (km)	2017	2026 – DRP	2026 – CTSU	2031 – DRP	2031 – CTSU	2041– DRP	2041 – CTSU
1	CSMIA	WEH	38.59	0.79	0.39	0.41	0.38	0.40	0.39	0.42
2		Sion-Panvel Highway	2.63	1.03	0.55	0.54	0.64	0.66	0.67	0.69
3		JVLR	10.92	0.77	0.41	0.43	0.58	0.60	0.59	0.63
4		SV Road	13.76	0.93	0.49	0.50	0.52	0.54	0.53	0.57
5		SCLR	9.19	0.69	0.40	0.40	0.41	0.44	0.42	0.46
6		Andheri Ghatkopar Eastern Express Highway	9.15	1.01	0.64	0.67	0.85	0.88	0.86	0.92
7		Link Road	1.58	0.73	0.35	0.36	0.52	0.53	0.52	0.55
8		LBS MARG	12.72	1.08	0.50	0.51	0.63	0.66	0.63	0.66
9		Sahar Elevated Road	5.25	0.19	0.15	0.16	0.17	0.19	0.17	0.20
10		Weighted		0.83	0.49	0.51	0.59	0.62	0.60	0.64
1	NMIA	Sion Panvel Highway	17.55	0.62	0.29	0.27	0.49	0.48	0.56	0.55
2		SH 54	14.09	0.18	0.19	0.18	0.23	0.24	0.31	0.33
3		SH 104	3.67	0.01	0.02	0.02	0.02	0.02	0.02	0.02
4		Palm Beach Road	6.78	0.44	0.17	0.15	0.24	0.22	0.33	0.29
5		NH-4C	4.56	0.15	0.23	0.21	0.16	0.16	0.25	0.24
6		NH-4	5.96	0.25	0.19	0.18	0.28	0.28	0.32	0.32
7		Mumbai Pune Expressway	10.87	0.30	0.27	0.25	0.23	0.24	0.34	0.37
8		JNPT Road (NH4B)	15.72	0.63	0.21	0.20	0.21	0.22	0.34	0.36
9		Amra marg	7.40	1.09	0.31	0.28	0.41	0.41	0.53	0.53
10		Weighted		0.33	0.12	0.10	0.12	0.14	0.17	0.22

Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.

Level of Service (LOS)

The Indian Highway Capacity Manual (INDO-HCM, 2017) defines level of service as a qualitative measure, describing operational conditions within a traffic stream and their perception by drivers / passengers. LOS definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety. Six levels of service are recognised, and these are designated from A to E with LOS A representing the best operating condition i.e., free flow and the LOS E the worst i.e. forced or breakdown flow or saturated flow.

The objective of LOS is to relate the traffic service quality to a given flow rate of traffic. It is a term that designates a range of operating conditions on a particular type of facility. Speed has been considered as the principal factor affecting the LOS of an urban road segment under ideal conditions. Stream speed has been considered as the basic parameter for the estimation of LOS. **Table-4.26** describes the Level of Service w.r.t volume/capacity ratios and their respective percentages of free flow speed.

TABLE-4.26
LEVEL OF SERVICE V/C RATIOS & PERCENTAGES OF FREE FLOW SPEED

Level of Service (LoS)	Volume/Capacity Ratio	Percentage of Free Flow Speed
LoS A	<=0.15	>=84
LoS B	0.15 – 0.45	83 – 76
LoS C	0.46 – 0.75	75 – 59
LoS D	0.76 – 0.85	58 – 41
LoS E	0.86 – 1.00	40 – 22
LoS F	> 100	< 22

Source: Detailed Traffic Management and Traffic Decongestion Plan For Navi Mumbai International Airport (NMIA), April 2020.

In case of CSMIA, weighted Volume/Capacity (V/C) ratio assessed for the base year 2017 is 0.83 (LOS D) and for the horizon period up to 2041 would vary from 0.49 to 0.64 (LOS C) which is very good. All the major roads have seen a betterment in terms of the congestion level which is due to the massive 167 km metro network which is under construction in Greater Mumbai and available before 2026. Also, major highway network which improves the east-west connectivity, and the Municipal Corporation of Greater Mumbai (MCGM) coastal road has helped by taking up the major share of the long-distance trips.

In case of NMIA, weighted V/C ratio assessed for the base year 2017 is 0.33 (LOS B) and for the horizon period up to 2041 would vary from 0.10 to 0.22 (LOS B) which is very good. In the case of NMIA delineated area, the major roads have seen good volumes from the internal trips of MMR which was not the case in the base year 2017, where most of the road-based trips were the External good being attracted by JNP. The new attractions like the proposed Navi Mumbai-Special Economic Zone, JNP-Special Economic Zone, Kharghar Corporate Park and the Airport itself have made more trips being attracted within the delineated study area. Looking at the level of service offered by the major roads in the NMIA delineated study area, the weighted V/C suggests an average of LOS B i.e., such flows and congestion levels on the Urban Roads are good and the same should be maintained for the future in order to serve the region much better in terms of service quality. To better understand the local connectivity the Consultants generated travel time contours which suggest that the NMIA delineated boundary can be traversed within 20 minutes from NMIA for the base year 2017 and horizon year 2041 are shown in **Figure-4.34.**

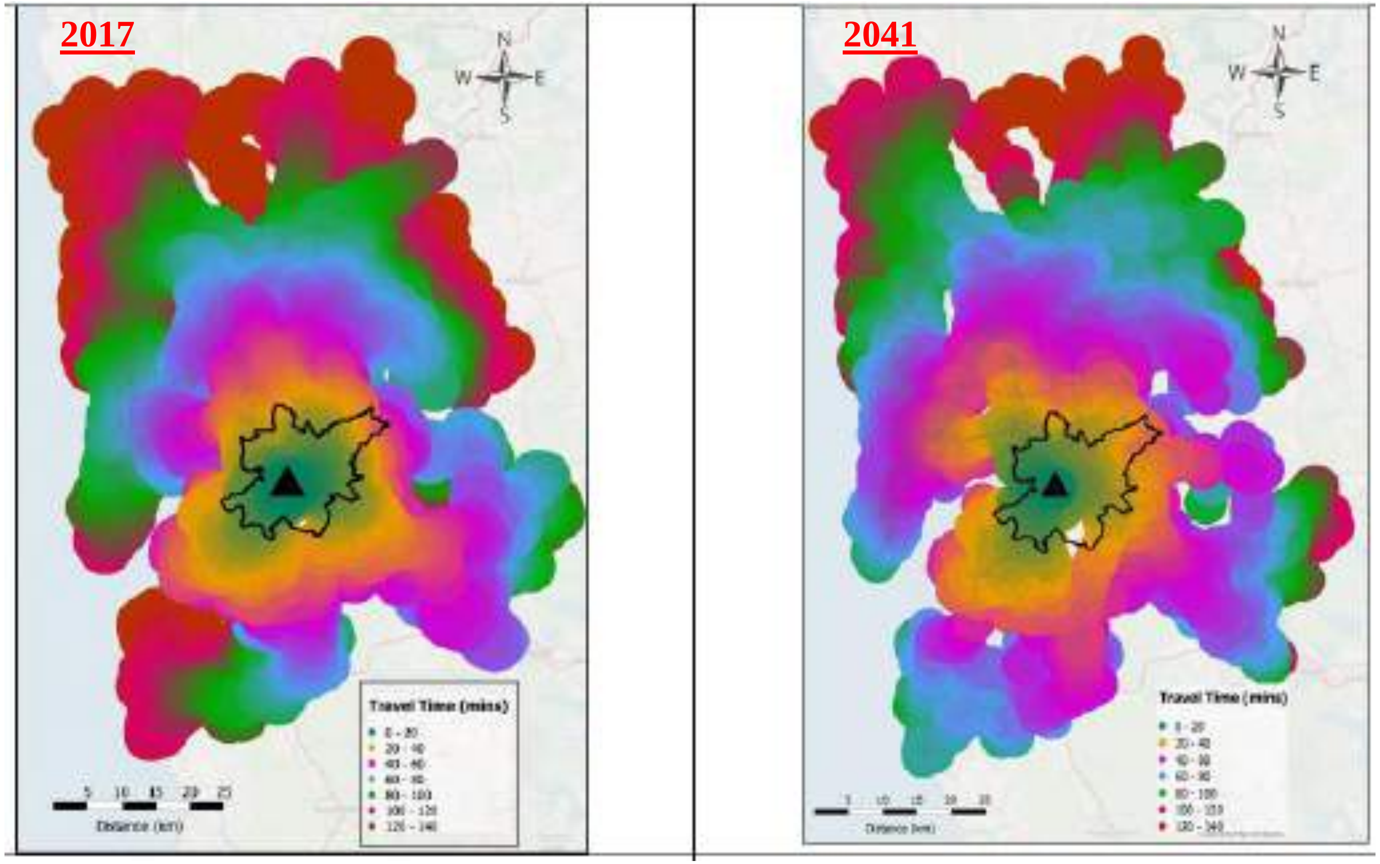


FIGURE-4.34
AVERAGE TRAVEL TIME FROM VARIOUS TAZS OF MMR TO PROPOSED NMIA ON ROAD SYSTEM – 2017 & 2041

The multi-model enhanced regional transport connectivity and local transport connectivity presented in the detailed report include some of the committed projects and some of the proposed projects. Phasing of projects is done considering the ongoing implementation of some projects, projects' preparatory works carried out by various planning and implementing organisations, etc. Preliminary phasing of committed and proposed transportation projects including broad cost estimate is presented in the detailed report.

It is important to note that the NMIA, as developed, will be one of the integral parts of MMR transport system and shall be functioning to meet the regional and national air travel needs. It is further important to note that projects committed, and projects contemplated, along with additional enhancements suggested for regional and local connectivity should be developed in the larger perspective to make NMIA a success by meeting the assessed travel needs. It is also important to note that all this investment on connectivity will not be just for NMIA, but the corridors will also be serving larger regional and local travel demands.

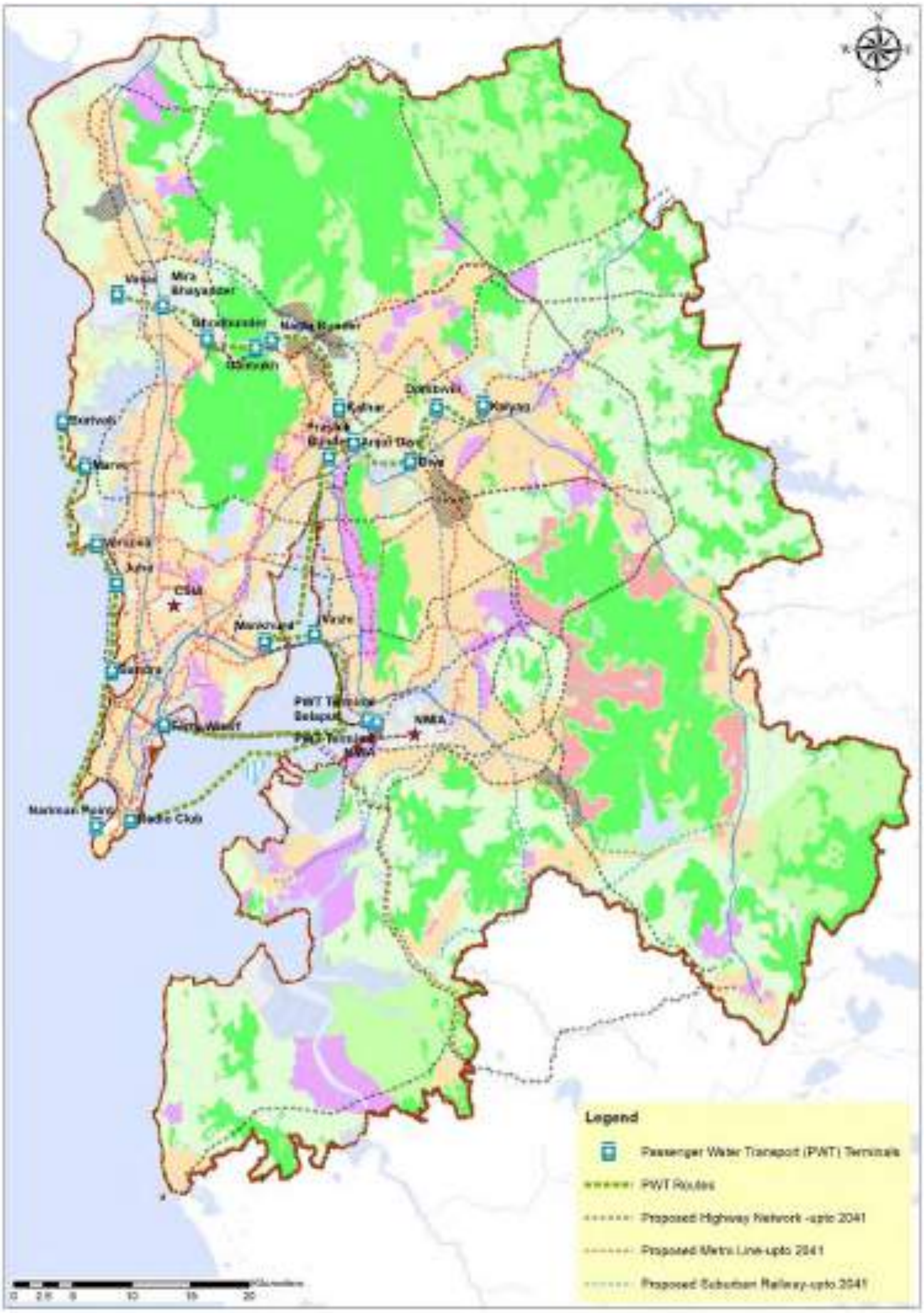
Multi Modal Hub in any region or urban area plays vital role in holistic development. It triggers development in a much-planned manner. Also, it provides easy shift in different modes of transport which keeps the journey linked. The CTS report is based on a transit first policy and hence these actions that encourage the use of public Transport support this policy. Six potential nodes i.e., Thane, Vasai Road Kalyan, Panvel, Dushmi and Sewri have been identified based on the proposed network of horizon year 2041 and proposed inter-city passenger terminals. These nodes have great potential to contribute in regional and urban development. Positioning of these nodes in MMR is also parallel to support regional planning strategy to have polycentric development in region.

The positioning of NMIA in the present and future connected networks are shown in **Figure-4.35** and **Figure-4.36** below.

The multi-modal hubs proposed are shown in **Figure-4.37**.

Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.

FIGURE-4.35
POSITIONING OF NMIA WITH PRESENT AND FUTURE COMMITTED TRANSPORT NETWORK



Source: Detailed Traffic Management and Traffic Decongestion Plan for Navi Mumbai International Airport (NMIA), April 2020.

FIGURE-4.36
PROPOSED PASSENGER WATER TERMINALS WITHIN MMR

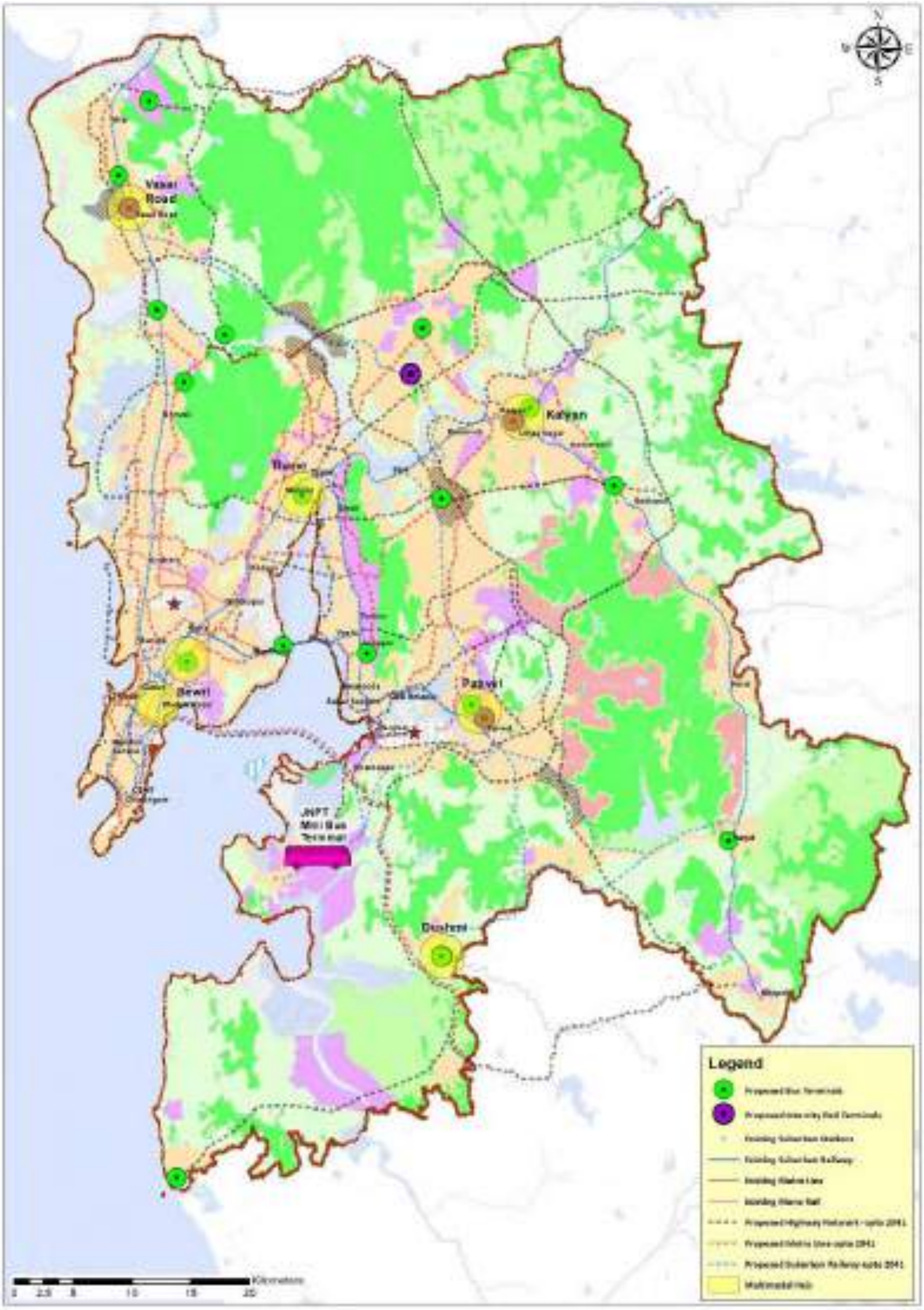


FIGURE-4.37
IDENTIFIED POTENTIAL LOCATION FOR MULTI-MODEL HUB

4.3.4.7 Traffic Connectivity and Management Plan (NMIA)

All passenger traffic shall access NMIA through the Western entry leading to central terminal complex-terminals through Western Main Access Road (WMAR) whereas cargo traffic shall access the cargo terminal through eastern airport entrance. Amra Marg will be widened to eight lane configurations shall provide access on the West of NMIA. Mumbai Trans harbor link (MTHL) shall connect Mumbai mainland with Navi Mumbai at Nhava Sheva, southwest of NMIA. Connectivity from Nhava Sheva to NMIA is proposed through six lane Ulwe Coastal Road which shall connect to Amra Marg (underneath the flyover near northwest corner of NMIA site). The required external connectivity to NMIA is indicated in **Figure-4.38** and **Figure-4.39**.

Direct Connectivity from Ulwe Coastal Road to NMIA is planned through the direct ramp of proposed Western Entrance Partial Clover leaf interchange. The interchange is proposed to be constructed by MJPRCL as part of Package V project which is in DPR stage. However, concept plan for the coastal road provided by CIDCO has an at grade junction on Ulwe Coastal Road and therefore does not provide seamless connectivity to NMIA. The concept needs to be revised to include suitable interchange at the Ulwe Coastal junction with ramps seamlessly connecting to the direct ramp of Western Entrance interchange leading directly into NMIA with 3+3 lane main access road from west.

The two-lane incoming and outgoing ramps from Amra Marg need to be merged in the 3+3 lane flyover coming from Coastal Road, thus effectively creating a 5+5 lane airport access. The indicative plan of this arrangement is shown in **Figure-4.40**.

On the Eastern side, arterial connectivity shall be provided by NH-4B which shall be connected to the Eastern Access Road through Eastern roads planned by CIDCO which shall be open to traffic in Phase I. Eastern entry interchange connecting to NH 4B shall also be operational by First Phase. East West connectivity between NH 4B and Amra Marg shall be through the eight lanes North Road being constructed by CIDCO. On Southern side, NH-4B shall connect to Amra Marg through Ghavan interchange. Considering the above, traffic assignments are made for the horizon year i.e., Final Phase of NMIA development.

Coastal Road, Elevated Link Road to NMIA from Coastal Road, half Cloverleaf interchange on Amra Marg is extremely essential for commission of NMIA and CIDCO / NHAI / MJPRCL need to complete this in time for Phase-I operation of NMIA.

Similarly, completion of Eastern Access Road to NMIA across Gadhi river, North Road are critical for Phase-I operation of NMIA.

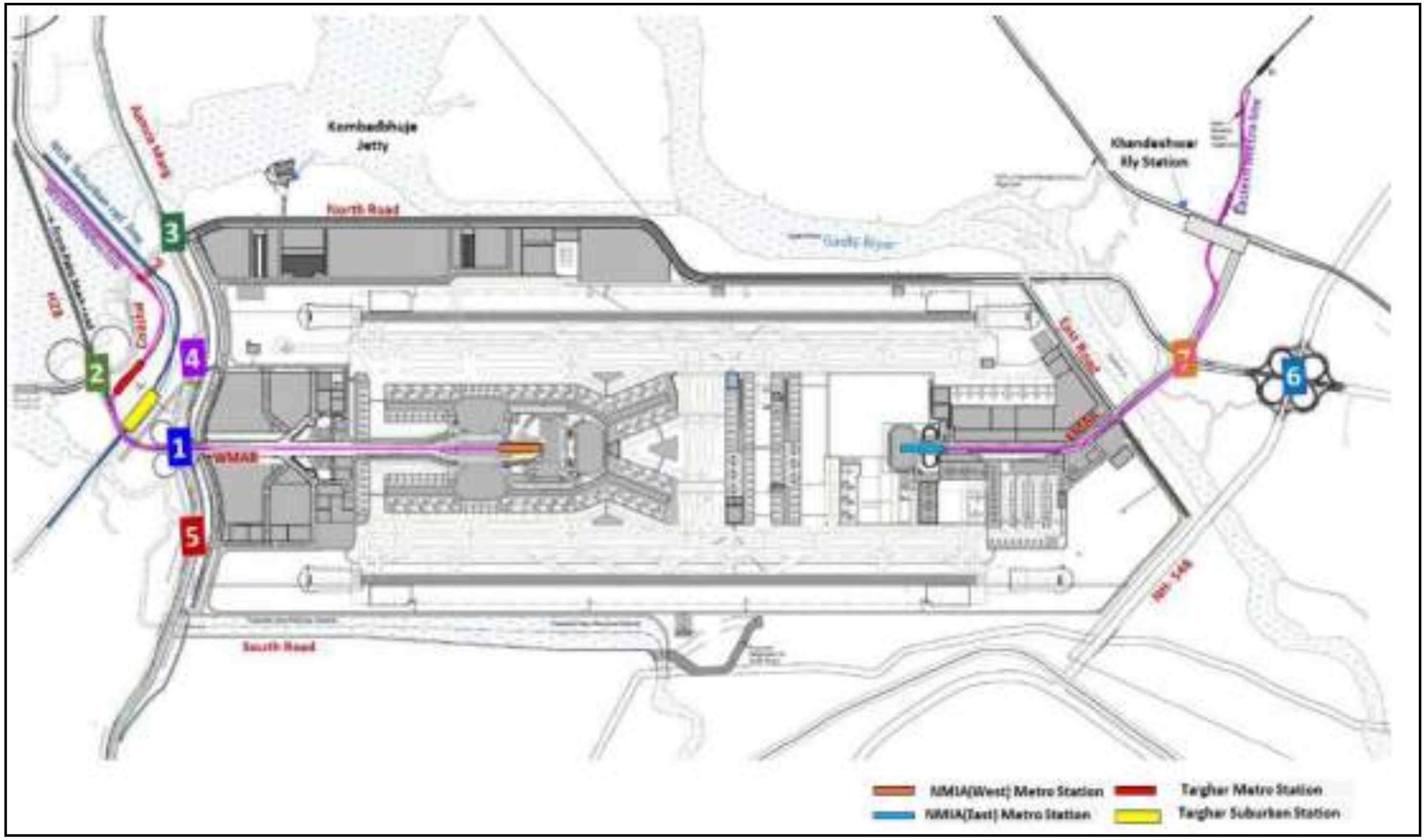


FIGURE-4.38
NMIA EXTERNAL ROAD NETWORK

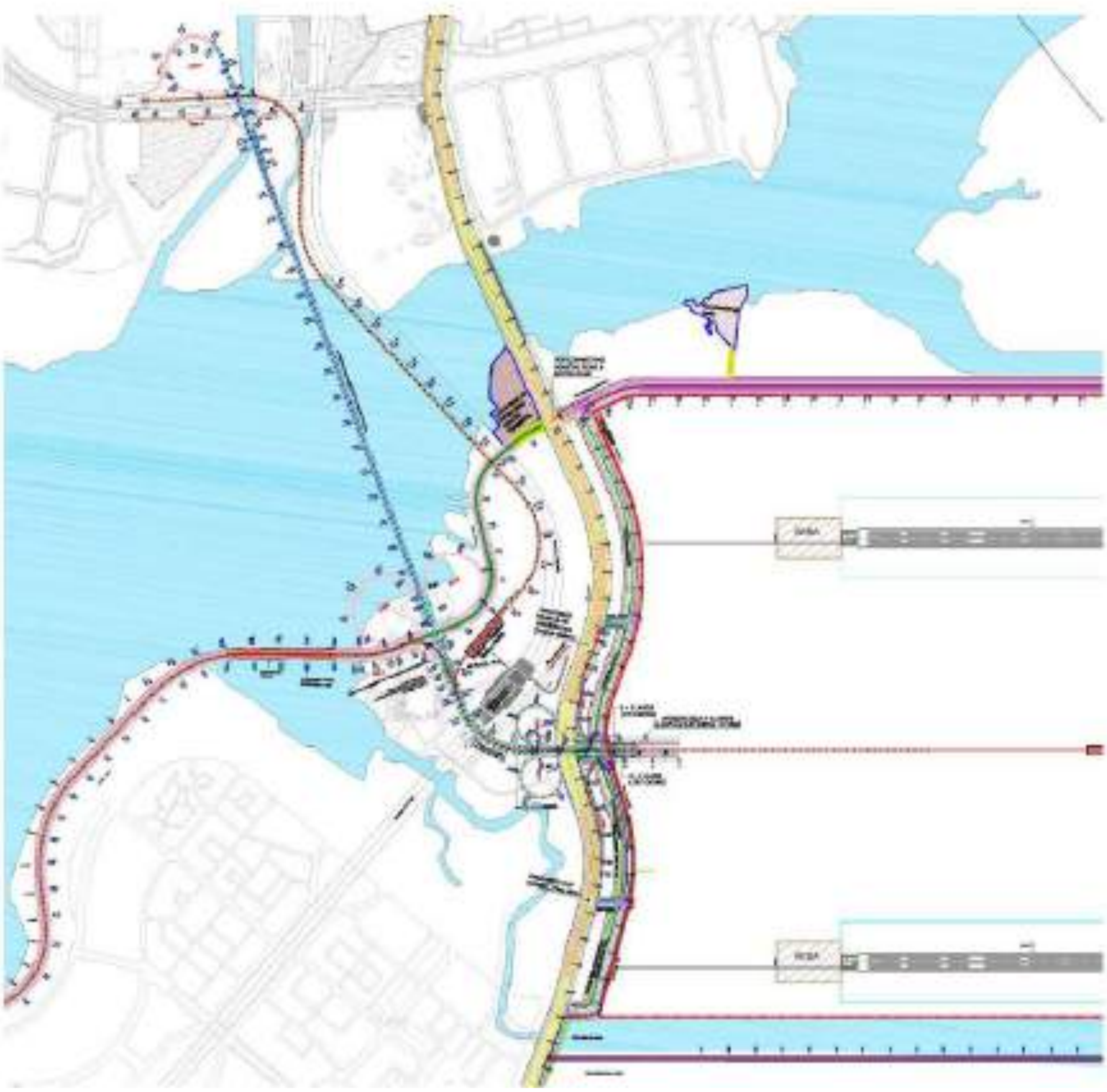


FIGURE-4.39 (A)
WESTERN ACCESS CONNECTIVITY TO NMIA

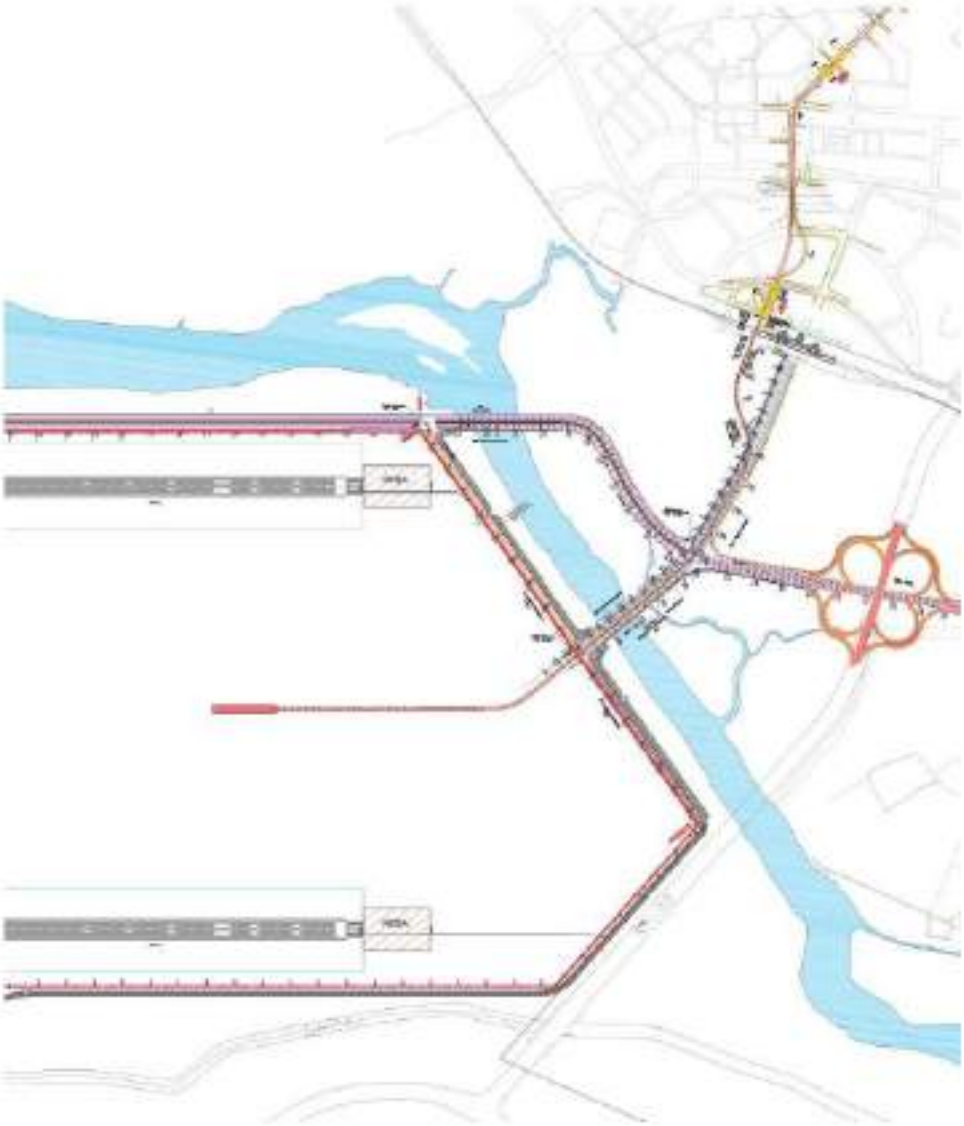


FIGURE-4.39 (B)
EASTERN ACCESS CONNECTIVITY TO NMIA

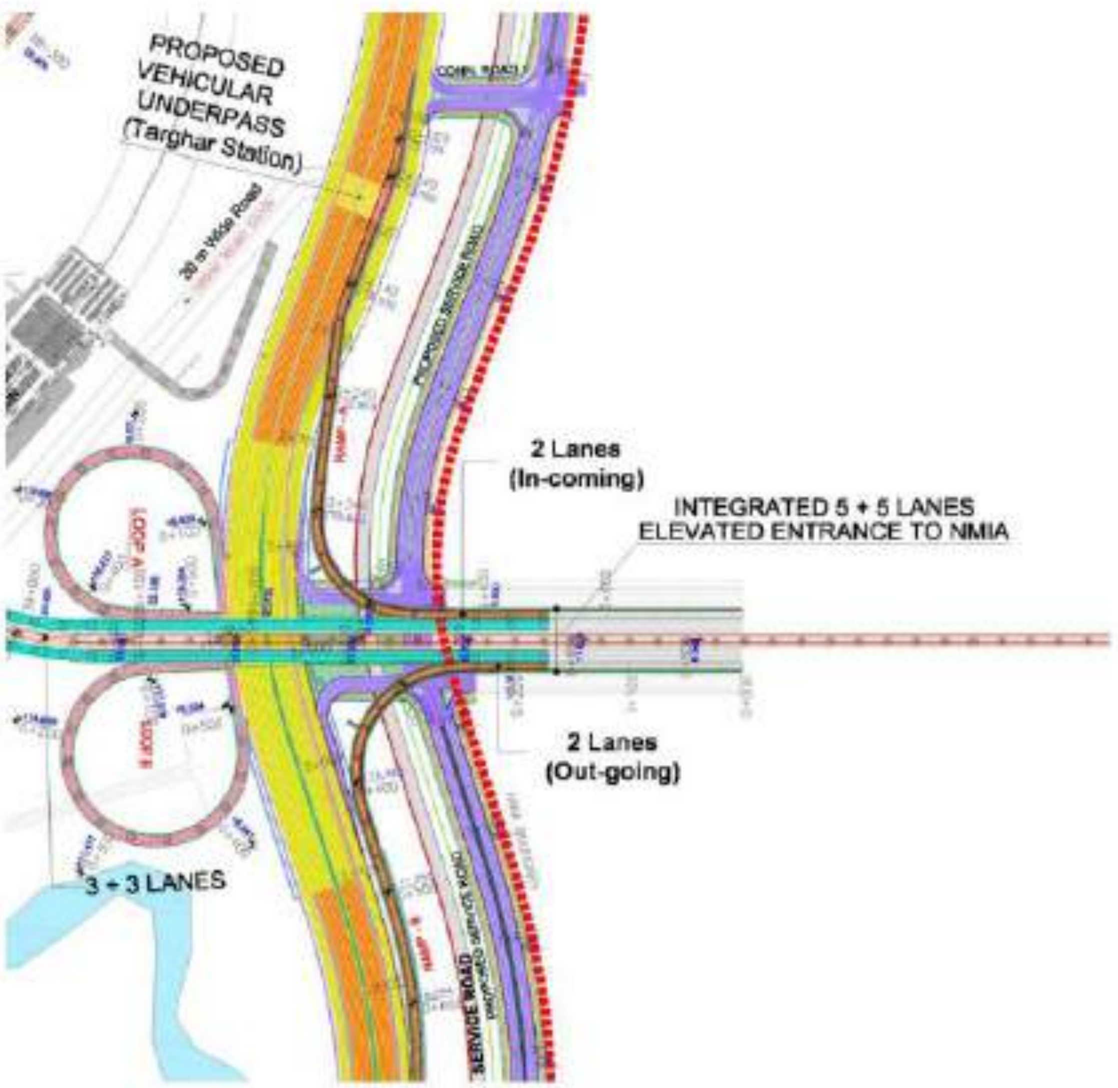


FIGURE-4.40
INDICATIVE PLAN FOR TWO LANE INCOMING AND OUTGOING RAMPS FROM AMRA MARG TO NMIA

The details of assessment for immediate access requirements at airport are presented in the detailed Traffic Assessment Report. The estimated peak traffic in each direction and lane requirement at various sections of the key access roads considering airport and non – airport traffic is presented in **Table-4.27**.

TABLE-4.27
PEAK DIRECTION TRAFFIC ON EXTERNAL ROADS AND LANE REQUIREMENTS

Road	Link No.	Peak Direction Traffic (PCUs)			No of Lanes available	LOS
		Airport Traffic	Non- Airport Traffic	Total		
Ulwe Coastal Road	1	2,856	1,161	4,017	3	D
	4	535	2,523	3,058	3	C
Amra Marg	5	4,204	6,583	10,787	6	F
	6	3,905	5,516	9,421	7	D
	12	888	5,211	6,099	6	C
North Road	18	1,331	2,241	3,572	4	C
	20	758	1,761	2,519	4	B
	21	497	1,761	2,258	4	B
South Road	19	32	2,251	2,283	3	C
Airport access road from NH-548 (previously NH-4B)	24	1,341	2,608	3,949	3	D
NH-548 (previously NH-4B)	25	629	4,656	5,285	4	D
	26	598	4,346	4,944	4	D

Source: Master Plan (May, 2019)

The following observations are made from the traffic assignment on external roads:

- As expected, contribution of Airport traffic on the external roads is maximum on links closer to the airport such as Ulwe Coastal Road south of the interchange to Airport (Link 1) (71%).

- External roads carry large share of non-airport traffic generated by JN Port, proposed Industrial, Commercial and Residential areas to South of NMIA. It is pertinent to note that Amra Marg, at its most congested section (Link 5), carries only 43% of Airport traffic.

- Level of Service on Amra Marg is worst on the section between Killa Junction and North Road Junction (Link 1) and shall cause stop and go traffic flow conditions, with LOS F. Level of Service on Amra Marg between North Road Junction and Western Interchange Airport entry point is also low. In order to maintain LOS C, a lane requirement of 9 lanes in each direction is required. Evidently, RoW of Amra Marg cannot accommodate the above requirement of horizon year;
- Amra Marg which is essentially the lifeline of JNP traffic, present traffic (due to residential and commercial uses) and proposed developments planned towards the South and South West of NMIA would thus become unserviceable. Need for planning an alternate arterial connectivity for this area is thus inevitable;

- Taking cognizance of the above, the ongoing CTS for MMR has recommended a Higher Order Highway facility from Mankhurd to NMIA which shall be grade separated along the existing Palm Beach road that spans across the Panvel creek and connects to the Western Entry Interchange of NMIA. Such a facility shall relieve Amra Marg of congestion;

- Traffic Assignments were carried out on a revised network that included new connectivity between Palm Beach Road and NMIA. Peak hour Assignment on major links indicate traffic diversion of about 3000 PCU in the peak direction onto the new link thus relieving congestion on Amra Marg as well as providing seamless travel to developments around NMIA;

- Level of Service on NH-548 (previously NH-4B) is also lower at LOS D during peak hour. However, airport traffic is very low (11.3%) compared to other traffic on NH 548.

- Lane requirements for immediate access roads and interchange ramps providing immediate access to NMIA based on peak traffic assignment are presented in **Table-4.28**.

TABLE-4.28
LANE REQUIREMENT FOR NMIA ACCESS ROADS
BASED ON PEAK TRAFFIC ASSIGNMENT ON MAJOR ACCESS ROADS

Road	Link No.	Peak Direction Traffic (PCUs)	Lane Requirements+ (Each Direction)
Ulwe Coastal Road Interchange Exit Ramp (South)	2A	2,811	2 with LOS D
Ulwe Coastal Road Interchange Exit Ramp (North)	2B	305	2
Ulwe Coastal Road Interchange Entry Loop	3	2,725	2 with LOS D
Amra Marg Interchange Entry Ramps	7	2,744	2 with LOS D
	8	895	2
Amra Marg Interchange Exit Ramps	9	2,005	2
	10	748	2
Amra Marg Interchange Direct Ramp	11	3,116 (Without Palm Beach link)	3
		5154 (with Palm Beach Link)	4 with LOS D
Service road connections with Amra Marg	13	764	2
	16	952	2
Western Main Access Road	15A	6,558	6
	15B	6,507	6

Road	Link No.	Peak Direction Traffic (PCUs)	Lane Requirements+ (Each Direction)
Western Service Road (south of WMAR)	14	291	2
Western Service Road (north of WMAR)	17	523	2
Eastern Main Access Road	22	1,274	2
East Road	23	329	2
At grade access to MAR (entry)	28	1,325	2
At grade access to MAR (exit)	29	1,705	2

Source: FMP, 2019

+ Minimum lane requirement is considered as 2 lanes keeping in mind emergency requirement for broken down vehicles

NMIA Parking Demand and Management

Car & Taxi Parking Demand

Parking demand for passengers, taxi staging and employees is estimated at each of the passenger terminals of NMIA. The parking requirement for each of the terminals for all phases and at remote parking are presented in **Table-4.29**. All parking areas/Multi-Level Car Parks (MLCLs) are planned 100m away from Terminal facades. Separate parking areas is proposed for short, long term private parking and taxi staging. A Multi-Level Car Parking (MLCP) for terminal is planned during Phase I of airport development. This MLCP shall be integrated with a Central Multi-Modal Transport Hub (public transport) with suitable pedestrian connections to terminals T1 and T3 kerbs and other activity areas. Limited airport taxis shall be considered for staging at the forecourt of each of the terminals, as most taxis shall be stationed at remote staging away from forecourt areas for long term parking/staging; second MLCP is planned for Terminal T2, 100 m away from its facade.

TABLE-4.29
PARKING DEMAND ALLOCATION AT FORECOURT AND REMOTE AREA

Category	Parking Demand (ECS)			
	Phase I	Phase II	Phase III	Final Phase
Terminal 1				
Forecourt – Passenger + Employee	726	1,420	1,118	980
Forecourt - Taxi Staging	100	200	200	200
Remote - Taxi Staging + Employee	395	771	473	321
Sub Total	**1,221**	**2,391**	**1,790**	**1,501**
Terminal 2				
Forecourt – Passenger + Employee	-	-	1,790	1,697
Forecourt - Taxi Staging	-	-	300	300
Remote - Taxi Staging + Employee	-	-	785	627
Sub Total	-	-	**2,875**	**2,625**
Terminal 3				
Forecourt – Passenger+ Employee	-	-	-	967
Forecourt - Taxi Staging	-	-	-	200

Category	Parking Demand (ECS)			
	Phase I	Phase II	Phase III	Final Phase
Remote - Taxi Staging + Employee	-	-	-	314
Sub Total	**-**	**-**	**-**	**1,481**
Grand Total	**1,221**	**2,391**	**4,666**	**5,607**

Bus Bay Demand

The estimated bus bay requirement at each of the terminals at forecourt and remote bus depot are presented in **Table-4.30.** In addition, it is proposed to provide two bus bays at each of the terminals for inter-terminal shuttle bus. In the case of the remote bus depot, additional five bays are considered for parking of shuttle buses. The remote demand is used to estimate the area required for parking of buses at remote bus depot.

TABLE-4.30
BUS STATION BAY REQUIREMENT

Category	Bus Bay Demand			
	Phase I	Phase II	Phase III	Final Phase
Forecourt Bus Bays				
Terminal 1	2	5	4	4
Terminal 2	-	-	6	5
Terminal 3	-	-	-	4
Total	**2**	**5**	**10**	**13**
Total with shuttle buses	**4**	**7**	**14**	**19**
Remote Bus Depot				
Terminal 1	8	15	12	11
Terminal 2	-	-	19	17
Terminal 3	-	-	-	11
Total	**8**	**15**	**31**	**39**
Total with shuttle buses	**13**	**20**	**36**	**44**

Cargo Demand

The truck parking spaces required at the cargo terminal are estimated based on the peak freight vehicles and are presented in **Table-4.31**.

TABLE-4.31
TRUCK PARKING REQUIREMENT

Vehicle	*Truck Parking Demand (Vehicles)*			
	Phase I	*Phase II*	*Phase III*	*Final Phase*
Truck Spaces	*39*	*50*	*95*	*140*

4.3.4.8 NMIA Landside Traffic Assessment

NMIA Road Network and Traffic Flow

Road network within NMIA has been planned to ensure smooth access and circulation of traffic within its boundaries, cognizant of the phase wise needs for various categories of users which shall serve by multiple modes of transport. The road network will be developed in stages, catering to traffic levels based on travel demand during various phases maintaining acceptable levels of service at all times. Travel through junctions on the network shall not cause undue delay to the user and at the same time be safe through the use of traffic calming measures.

NMIA Internal Road network has evolved through an iterative procedure involving travel demand modelling and land use planning in close coherence with the requirements during each phase of NMIA development. A hierarchical internal road network is proposed for NMIA, with Main Access Road providing access to the Terminals, important access roads providing key access to facilities and other access roads providing secondary connectivity to other facilities within it. NMIA internal road network has the following three hierarchical levels:

1. Main Access Roads - Western Main Access Road (WMAR) and Eastern Main Access Road (EMAR) are the highest order roads inside NMIA providing key access to Western and Eastern Terminals. All Passenger traffic to the Airport Terminals will be carried by WMAR. All traffic to cargo terminals and facilities in the Eastern side will be served by the EMAR;
2. Important Access Roads - Important access roads provide key access to facilities. These roads either connect to the main access roads or directly to external arterial roads and carry substantial traffic thus distributing the traffic within NMIA; and
3. Other Access Roads - Other access roads connect to individual land parcels or provide alternate connectivity and carry lesser traffic providing last mile connectivity are as follow:

   NMIA Traffic Flow – Western Side: Western Main Access Road (WMAR), the major road on the Western side of NMIA shall operate as a one-way loop providing access to Terminal Forecourt, as well as facilities on the Western side. During Phase-I and Phase-II, entry and exit to the facilities on North of WMAR shall be solely through WMAR via WEW5.

   Western Facilities on the South of MAR shall be accessible through the Westbound carriageway of WMAR and accessible through a Southern link (WEW4) from Aamra marg. A subway/underpass links North and South of MAR providing conflict free movement. Access and Circulation Plan for Phase 1 and Phase 2 are same except for the development of a new link (WNS7) on the South of WMAR. The circulation in phases III & IV will remain same. However, additional access will be developed providing direct access to North of MAR facilities via Aamra Marg. Also, North NMIA facilities will be developed with access from the North Road and other access from the NMIA Western Service Road (**Figure-4.41A & B**).

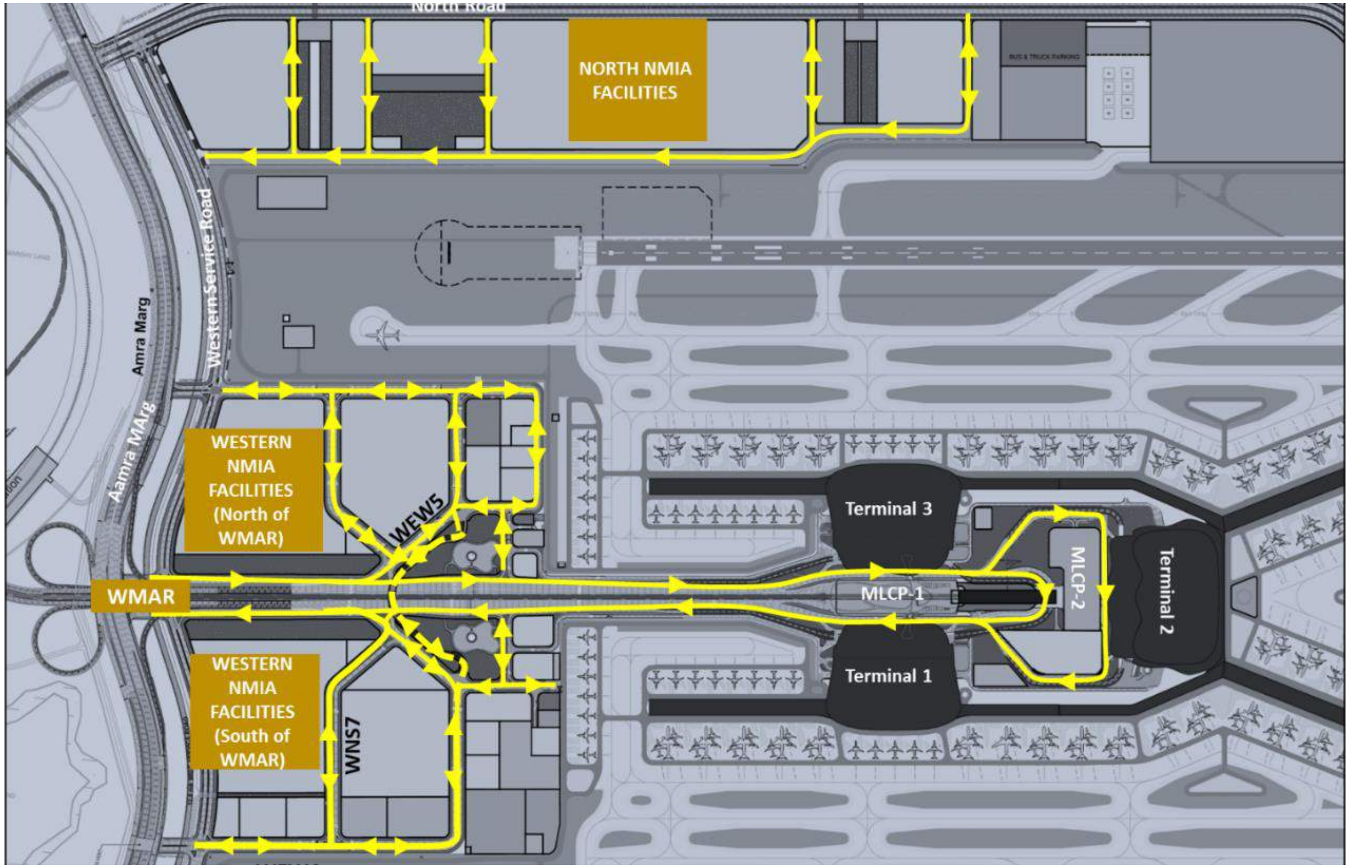


FIGURE-4.41 (A)

TRAFFIC CIRCULATION PLAN FOR WESTERN CLUSTERS OF NMIA-PHASE-III & FINAL PHASE

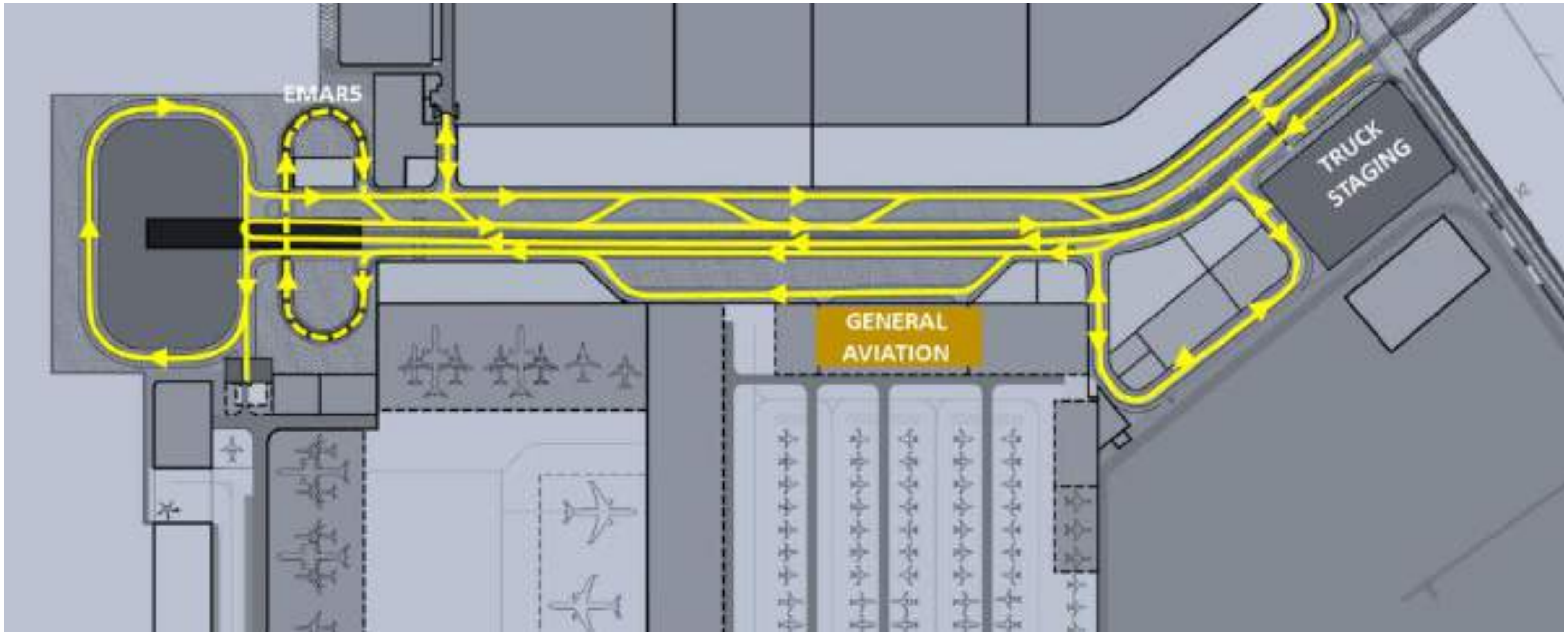


FIGURE-4.41 (B)
TRAFFIC CIRCULATION PLAN FOR EASTERN CLUSTERS OF NMIA-PHASE-III & FINAL PHASE

NMIA Traffic Flow – Eastern Side: Eastern Main Access Road (EMAR) shall operate as one-way loop providing connectivity to cargo related facilities and general aviation terminal on the Eastern side of NMIA. There are no new links planned to develop in Phase-II over Phase I. Hence the traffic circulation will be same in Phase I & II. During Phase-III, service road to the North of Eastern MAR will be developed providing connectivity to the Cargo terminals and other facilities to the North of EMAR. The circulation of previous phases will be maintained. North-South subway (EMAR5) connecting Service roads on the either side of EMAR will be developed during Phase-IV.

4.3.4.9 Incremental Traffic due to the Proposed Project

Baseline study on traffic volume outside area and the observed speed has been carried out during the study period. The anticipated additional traffic volume has been assessed assuming the movement of aircrafts.

With the implementation of the proposed project in a phased manner, the traffic is likely to increase on the road network near the airport and its surroundings. The impact of the traffic is assessed on the basis of:

1. Incremental traffic due to the proposed project; and
2. Impact on air quality.

The extent of traffic impact, at any given time will depend upon,

- The rate of vehicular emission within a given stretch of the road; and
- The prevailing meteorological conditions.

The impacts have strong temporal dependence as both these factors vary with time. The temporal dependence would have diurnal, seasonal as well as long term components. Further, air pollution dispersion modeling was done considering the existing as well as the proposed traffic due to project using the line source model i.e., AERMOD model.

There will be incremental traffic due to the airport project. The selected corridors play important role in establishing connectivity with NMIA and its future interventions are going to be critical in immediate to medium term with the opening of the new airport. The major transport corridors and intersections considered for modelling are given below in **Table-4.32** and identified major intersections are given in **Table-4.33**.

TABLE-4.32
IDENTIFIED MAJOR TRANSPORT CORRIDORS

Road Corridor	From	To	Length in km	Lane Configuration
Palm beach marg	Sion-Panel Intersection (Vashi)	Belapur Phata	8.9	6 lane divided carriageway
Amra Marg	Uran Phata	Belapur Phata	2.3	4 lane divided carriageway

Road Corridor	From	To	Length in km	Lane Configuration
	Belapur Phata	Gavan Phata	6.0	4 lane divided carriageway
NH4B	Gavan Phata	Palaspe Phata	12.3	4 lane divided carriageway
	Kalomboli intersection	Kopar Junction	4.5	4 lane divided carriageway
NH4	Palaspe Phata	Kalomboli intersection	7.2	4 lane divided carriageway
Sion Panvel Highway	Kalomboli intersection	Uran Phata	10	6 lane divided carriageway

Source: LEA Associates

TABLE-4.33
IDENTIFIED MAJOR INTERSECTIONS

Name of Intersection	No. of Arms	Leading to
Belapur Phata	4	North-Amra marg/Turbhe/Vashi South-Amra Marg/NMIA/JNPT East-Sakal Bhavan marg/Belapur West-Palm Beach Road/Vashi
Gavan Phata	5	North-Amra Marg/Airport/Belapur South-East – JNPT (NH-4B) North East-Kopar/Panvel (SH-54) West-JNPT (NH-4B)
Kopar Junction	3	North- Amra Marg/Airport/Belapur East-Palaspe village/Pune West – JNPT (NH-4B)
Palaspe Phata	4	North-West-Mumbai –Pune Road (NH-4) South East-NH-4 to Pune South-NH-17 to Goa South-West to JNPT (NH-4B)
Kalamboli Intersection	5	North- Mumbai Pune Road (NH-4) North-West-Sion Panvel Expressway/ Uran Phata South-West-NMIA/JNPT Road South-East-Mumbai Pune Road (NH-4)
Uran Phata	4	North-Amar marg/Turbhe/Vashi North East-MIDC Service Road South-West-Belapur South Sion-Panvel Expressway/SH-42

Source: Lea Associates

The identified major corridors and intersections are shown in **Figure-4.42**.

FIGURE-4.42
TRANSPORT CORRIDORS AND INTERSECTIONS

4.3.4.10 Impact of Traffic on Air Quality

During operation phase of the proposed project, considerable number of vehicles will be running on roads, and these will cause air and noise pollution along the roads. Proper maintenance of vehicles while meeting the permissible emission levels will limit the air pollution. Also ensuring functioning of silencers will ensure low noise levels from the vehicles.

Details of Mathematical Modeling

For prediction of maximum Ground Level Concentrations (GLC's), the air dispersion modeling software (AERMOD version 7.1.0) was used. AERMOD is steady state advanced Gaussian plume model that simulates air quality and deposition fields up to 50 km radius. AERMOD is approved by USEPA and is widely used software. It is an advanced version of Industrial Source Complex (ISCST3) model, utilizes similar input and output structure to ISCST3 sharing many of the same features, as well as offering additional features. The model is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases and multiple sources including point, area, flare, line and volume sources. Dispersion modeling using AERMOD requires hourly meteorological data. Site specific data is used for executing modeling studies. The site-specific meteorological data is processed using AERMET processor.

- ***Model Input Data***

The predictions of traffic volume incremental concentrations of CO, NOx, HC & PM due to additional traffic assumed are estimated based on site specific meteorological conditions and line source. The emission rates as inputs to the line source model are calculated based on "Bharat Stage-IV Standards".

The model setup details are presented in **Table-4.34** below.

TABLE-4.34
TRAFFIC MODEL SET-UP

Sr. No.	Parameter	Details
1	Model Name	AERMOD (Version 7.1.0)
2	Model Type	Steady state Gaussian Plume Air Dispersion model
3	Topography	Flat
4	Averaging Time	24 hours
5	Source Type	Line Source (mesh size – 50%)
6	Boundary Limits	5 km X 5 km
7	Co-ordinate System	Uniform Cartesian Grid
8	Receptor Height	0
9	Anemometer	10 m
10	Surface meteorological data	Site Specific data processed by AERMET
11	Upper air Data	Upper air Estimator using AERMET processor

- ***Model Predictions***

The predicted HC, CO, NOx and PM_{10} concentrations from vehicular traffic are presented in **Table-4.35 (A to D)** and the isopleths showing the concentrations are given in **Figure-4.43** to **Figure-4.50.**

TABLE-4.35 (A)
PHASE-I: TRAFFIC EMISSION PREDICTIONS

Parameter	Emission factor (g/km/hr/vehicle)	Emission in (g/s)	Prediction (µg/m^3)
CO	2.27	3.60	5.41
NOx	0.082	0.13	2.38
PM	0.0045	0.01	0.11
HC	0.16	0.25	4.54

TABLE-4.35 (B)
PHASE-II: TRAFFIC EMISSION PREDICTIONS

Parameter	Emission factor (g/km/hr/vehicle)	Emission in (g/s)	Prediction (µg/m^3)
CO	2.27	7.20	10.82
NOx	0.082	0.26	4.32
PM	0.0045	0.01	0.210
HC	0.16	0.51	8.65

TABLE-4.35 (C)
PHASE-III: TRAFFIC EMISSION PREDICTIONS

Parameter	Emission factor (g/km/hr/vehicle)	Emission in (g/s)	Prediction (µg/m^3)
CO	2.27	14.40	21.64
NOx	0.082	0.52	9.73
PM	0.0045	0.03	0.541
HC	0.16	1.01	18.39

TABLE-4.35 (D)
PHASE-IV: TRAFFIC EMISSION PREDICTIONS

Parameter	Emission factor (g/km/hr/vehicle)	Emission in (g/s)	Prediction (µg/m^3)
CO	2.27	21.59	32.40
NOx	0.082	0.78	14.00
PM	0.0045	0.04	0.75
HC	0.16	1.52	27.50

The ultimate phase predictions reveal that the maximum NOx and CO concentration of 14.00 µg/m^3 and 32.40 µg/m^3 (considered concentration per hour) likely to occur at 100 m from the centre of the road. The CO and NOx concentrations are likely to be within the limits when compared with NAAQS for CO (4000 µg/m^3) and WHO standard of 400 µg/m^3 for hourly average for NOx. Hence, it is assumed that the impact on the present ambient air quality will be within the limits due to the additional traffic from the proposed project.

The estimated peak traffic in terms of PCUs, when compared to the stipulated standards by IRC for traffic capacity of the roads and it can be observed that the existing road network is adequate. IRC recommendations are provided in **Table-4.36**.

TABLE-4.36
IRC RECOMMENDATIONS ON PCU CAPACITY-

Sr.No	Category of Road	Maximum PCU/day
1	Two lane roads (7 m) with earthen shoulders	15,000
2	4- lane highway with earthen shoulders	35,000

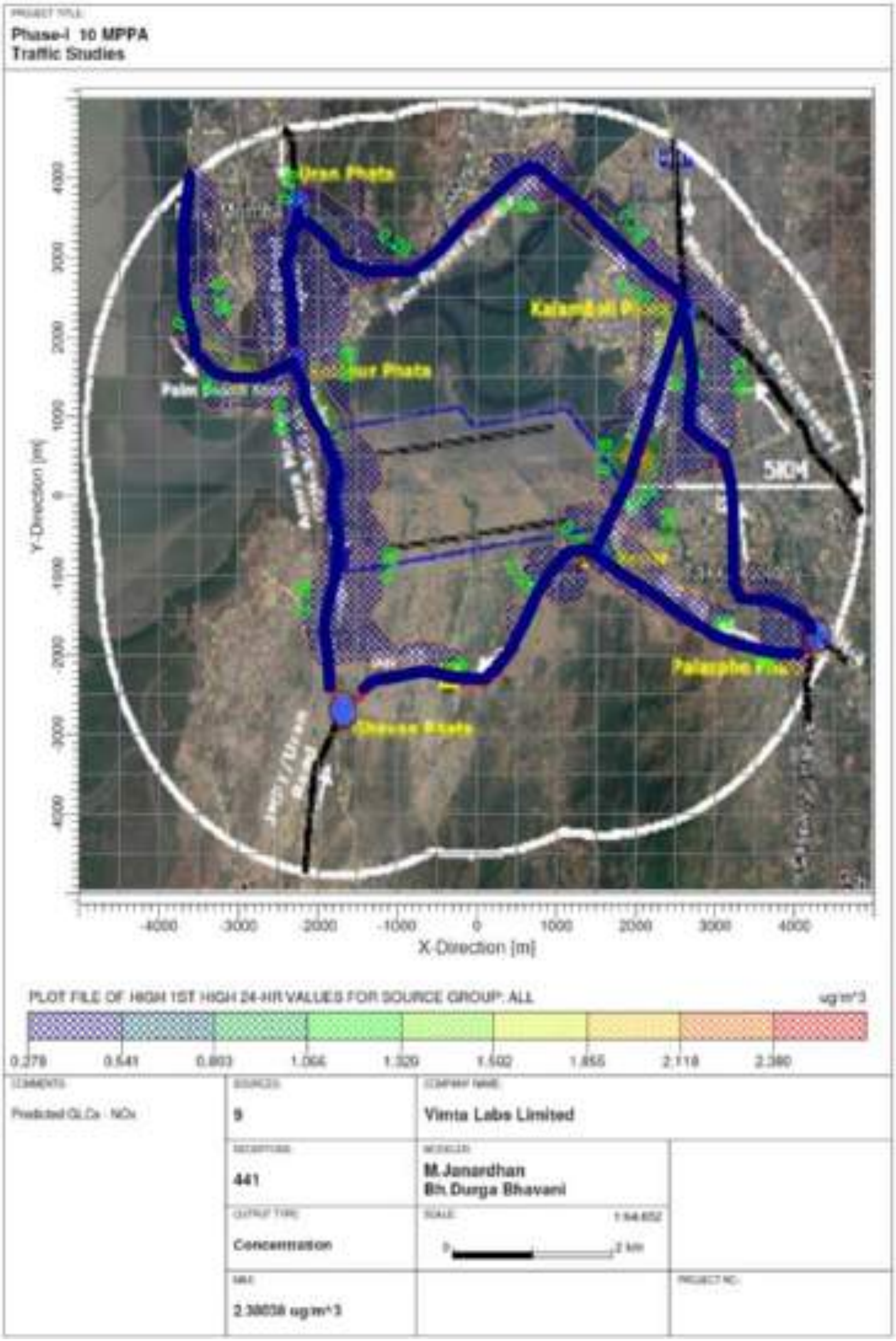


FIGURE-4.43: PHASE-I
TRAFFIC MODEL PREDICATED GLC FOR NO_2

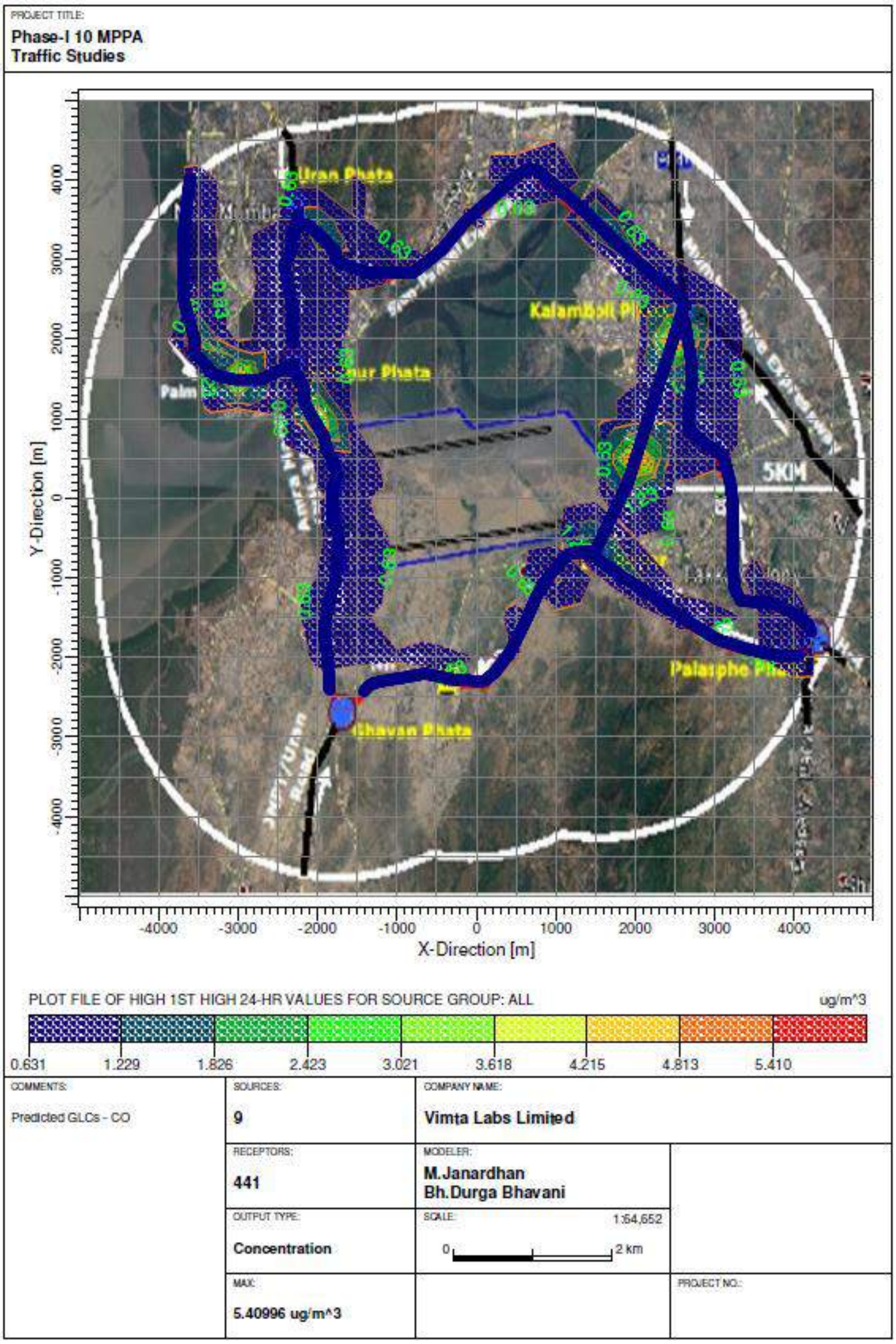


FIGURE-4.44: PHASE-I
TRAFFIC MODEL PREDICATED GLC FOR CO

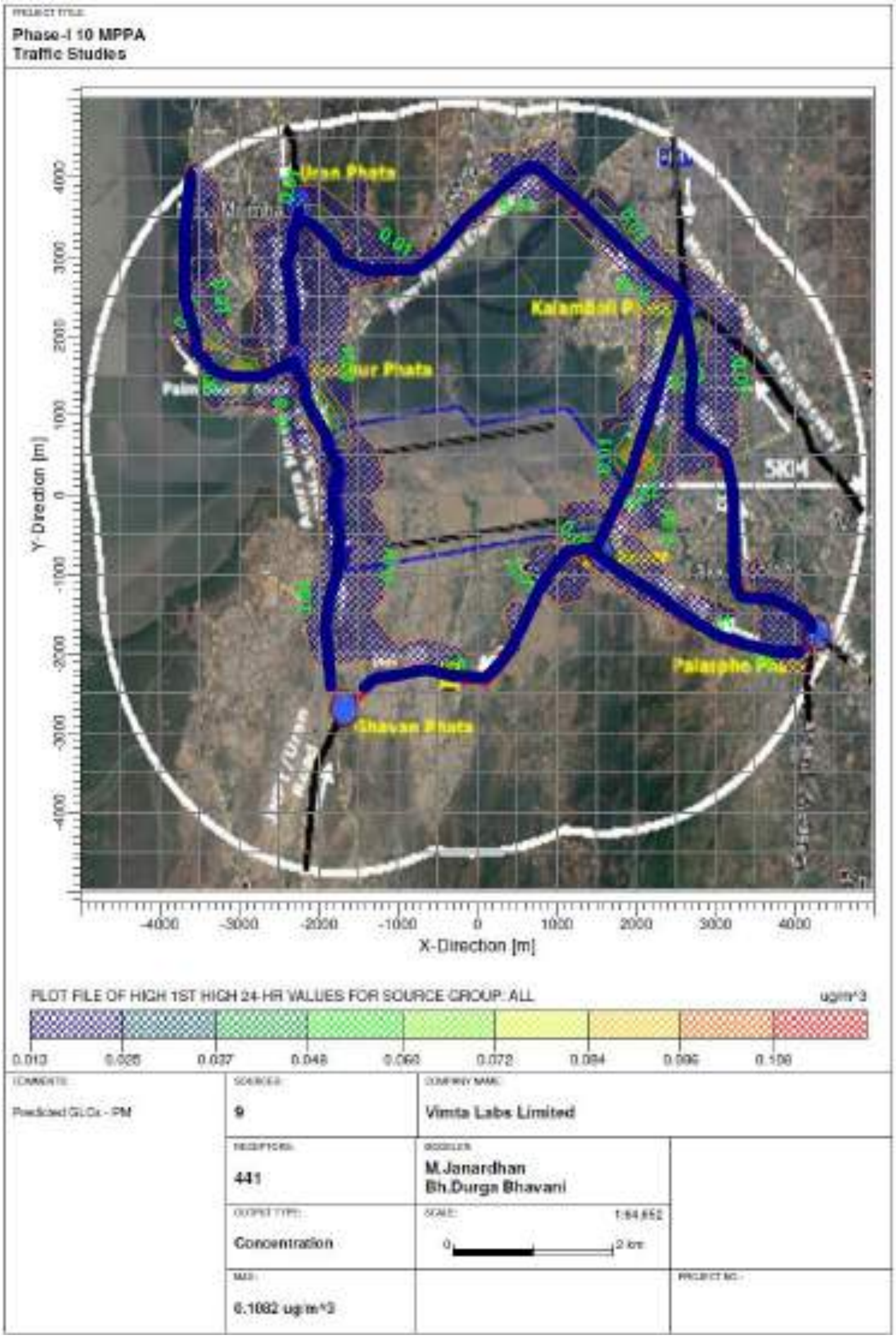


FIGURE-4.45: PHASE-I
TRAFFIC MODEL PREDICATED GLC FOR PM10

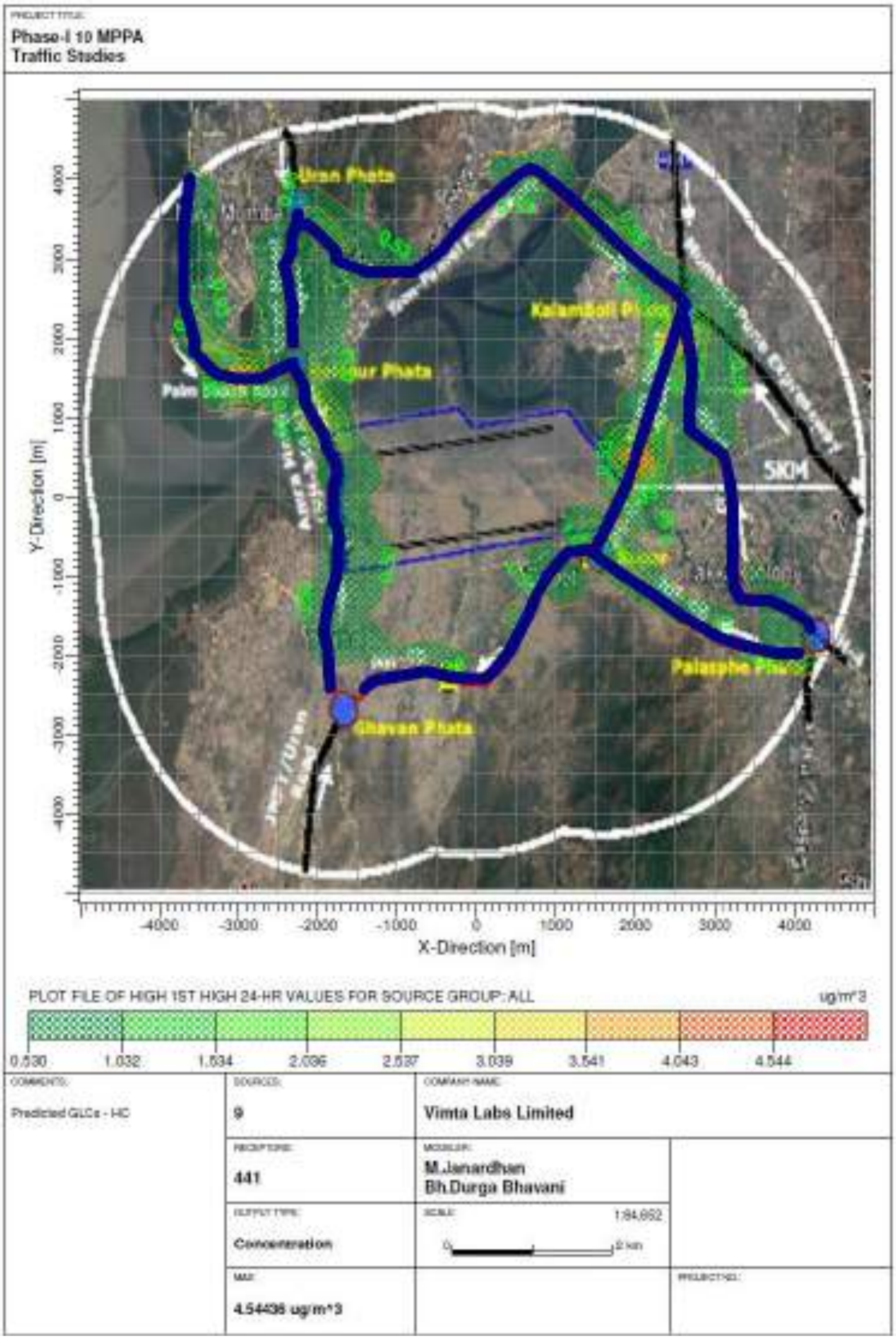


FIGURE-4.46: PHASE-I
TRAFFIC MODEL PREDICATED GLC FOR HC –

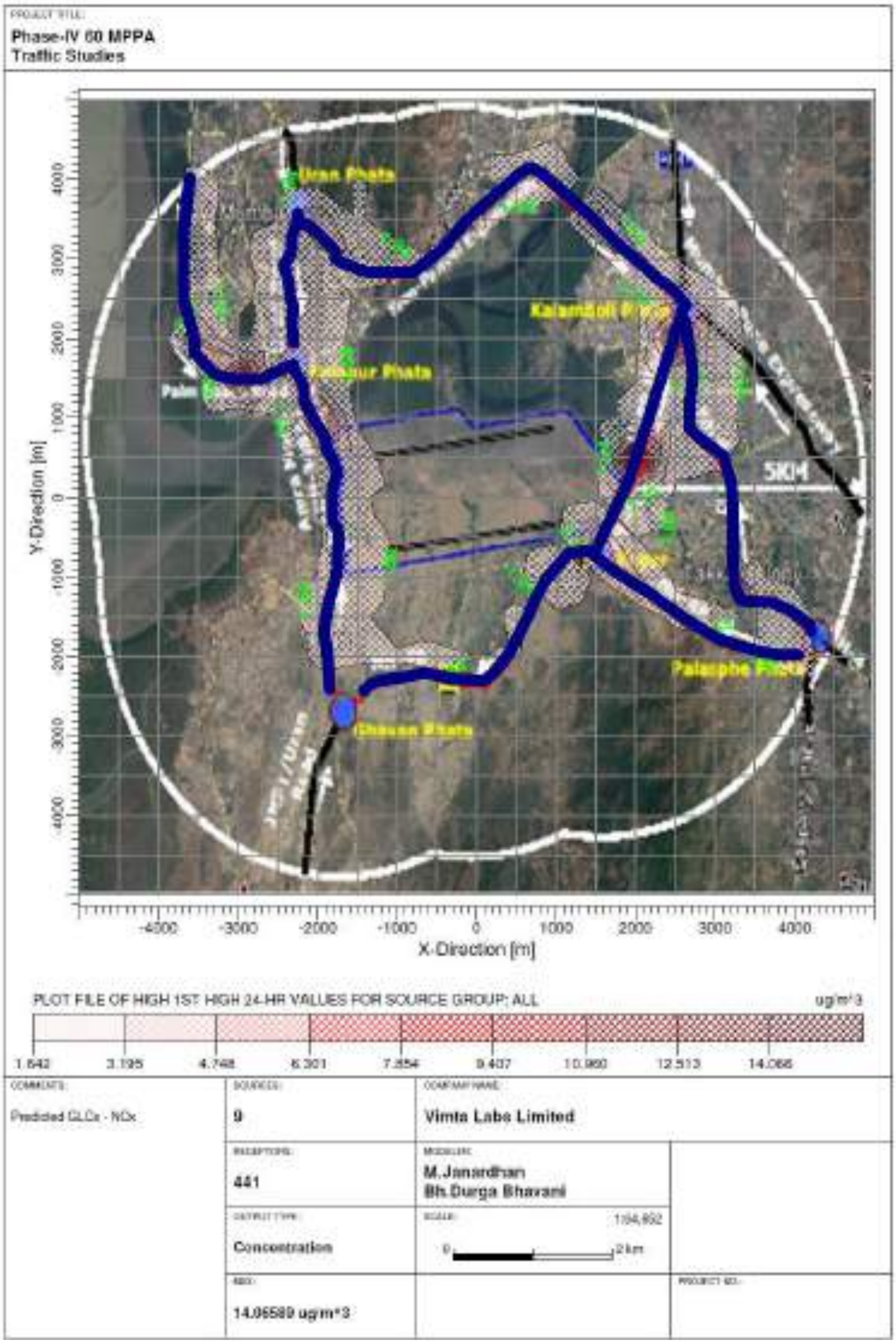


FIGURE-4.47: PHASE-IV
TRAFFIC MODEL PREDICATED GLC FOR NOx–

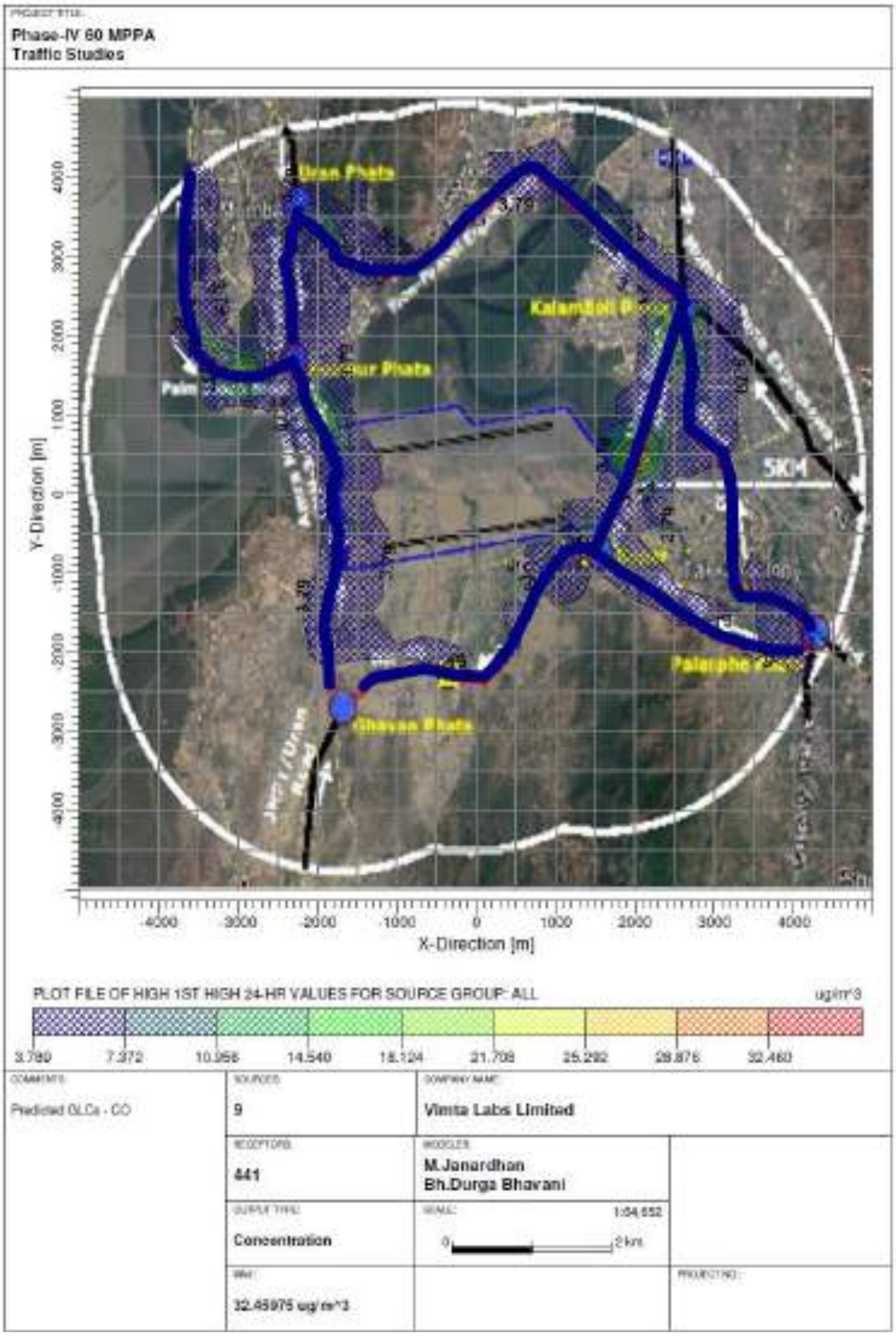


FIGURE-4.48: PHASE-IV
TRAFFIC MODEL PREDICATED GLC FOR CO

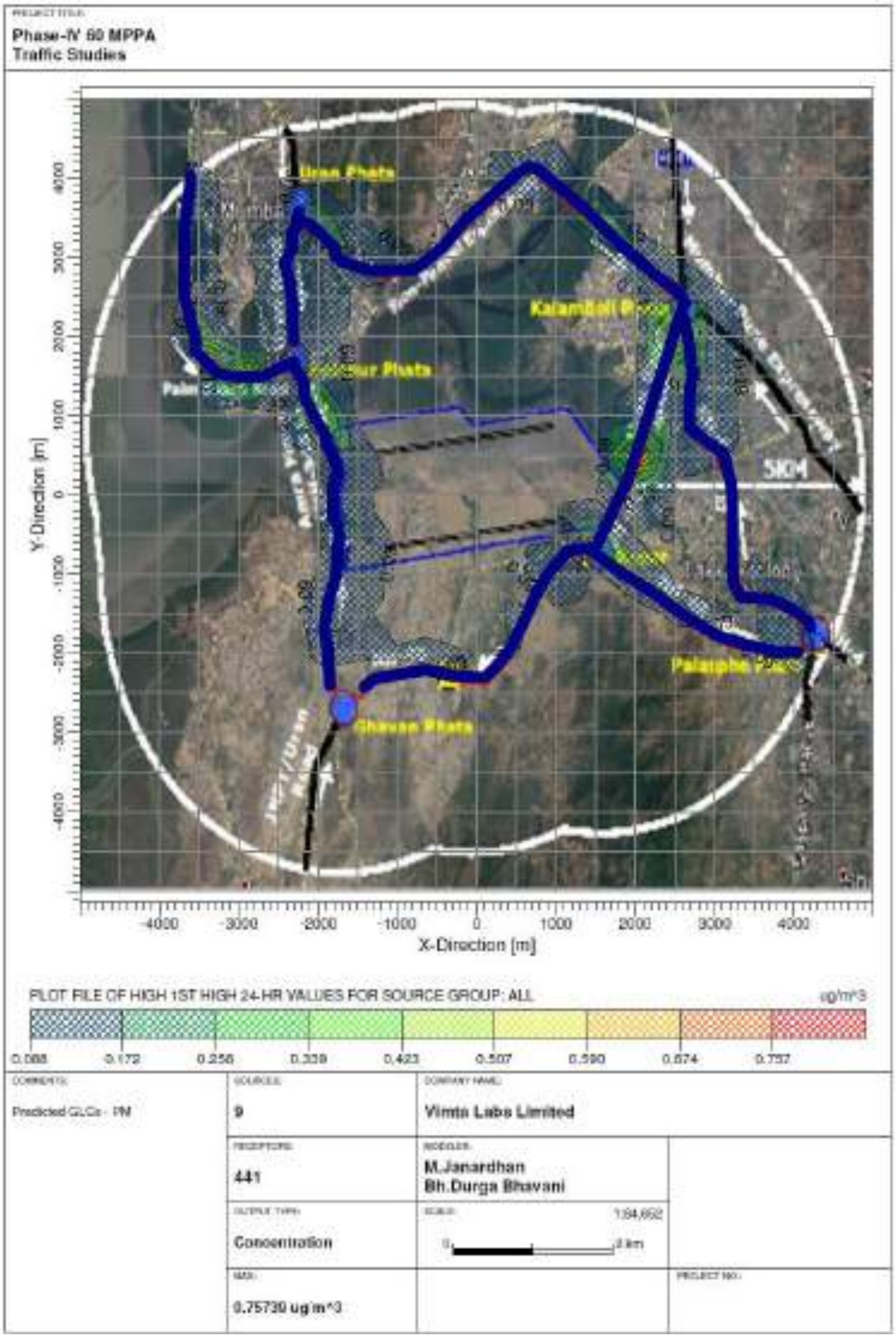


FIGURE-4.49: PHASE-IV
TRAFFIC MODEL PREDICATED GLC FOR PM10

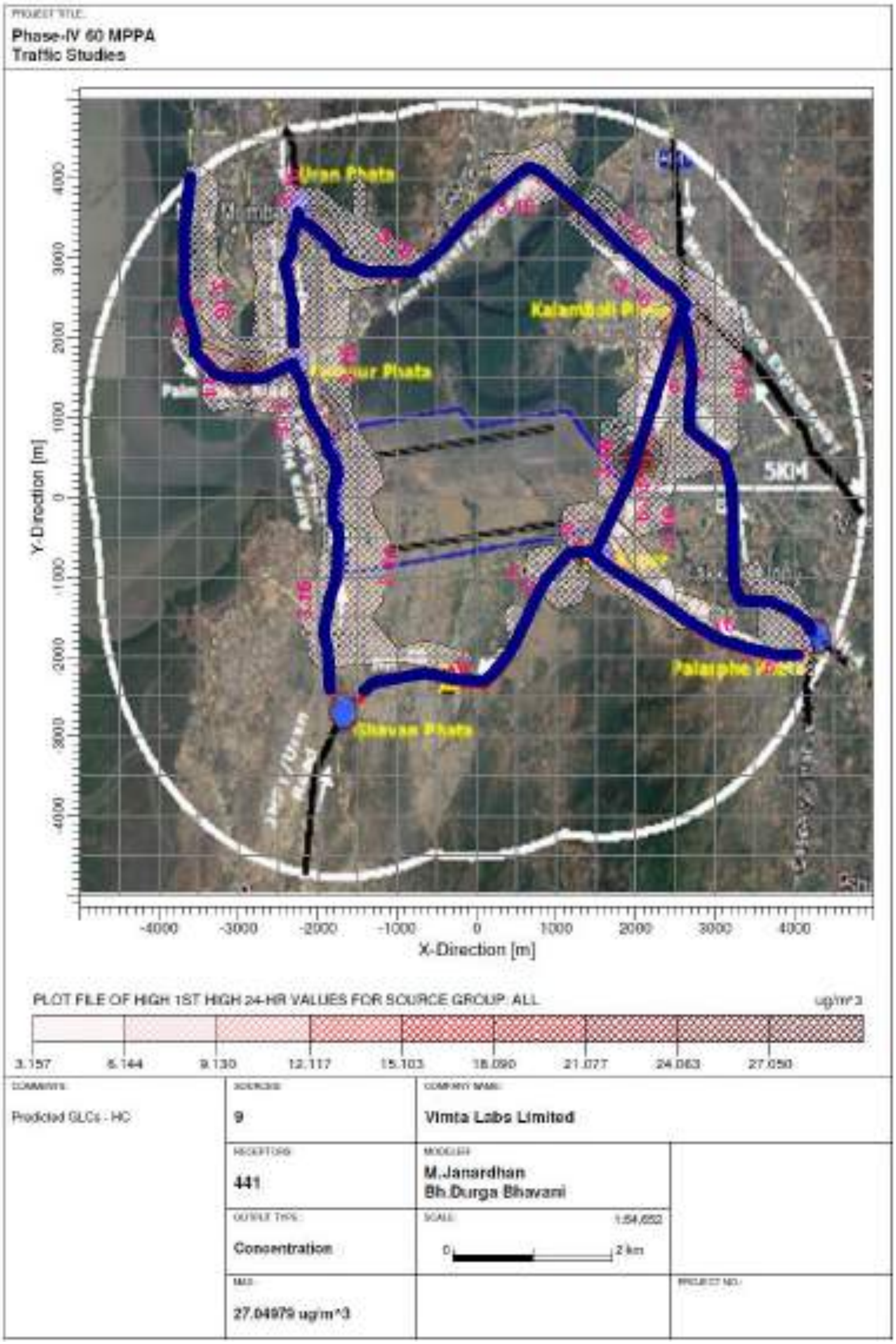


FIGURE-4.50: PHASE-IV
TRAFFIC MODEL PREDICATED GLC FOR HC

4.3.4.11 Impact on Air Quality due to Vehicular Movement Within the Airport

The impact on the air quality due to vehicular movement within the airport has been assessed for the worst-case scenario. The major source of emissions are exhaust emissions from the vehicles plying within the airside and landside of the airport. The traffic management will be implemented through optimization of the traversal routes and parking facilities as per the detailed traffic study conducted by LEA Associates referred in previous sections.

The maximum movement of vehicles at the peak hour has been assessed based on peak hours ATMs. The peak hour vehicular movement (expressed in PCU) in land side and airside (GSEs movement before and after landing of aircrafts) is calculated in the final phase (60 MPPA) of the airport operation considering the service times, travel time and peak hour ATMs of the aircrafts. The traffic forecast model using VISSIM software module has been used to arrive upon the traffic data. The peak hour vehicles land side and airside roads are given **Table-4.37(A)** and **Table-4.37(B)** respectively.

TABLE-4.37 (A)
FINAL PHASE PEAK HOUR VEHICLES MOVEMENT IN LAND SIDE

Mode of Transportation	Vehicle / Hour
Car	5311
Taxi	4139.5
Two Wheeler	3296
Bus	980
Auto	0
Rail/Metro-Walk	-
Total	13727

Source: NMIA

TABLE-4.37
FINAL PHASE PEAK HOUR GSE VEHICLES MOVEMENT IN AIRSIDE

Type of GSE	Total
Tug	25
Mobile GPU	7
Catering Truck	44
Lower deck cargo holder	7
Fuel truck	40
Conveyor Belt	81
Potable water vehicle	25
Baggage bulk train	148
Lavatory vehicle	57
Belly cargo ULD	0
A/C unit	9
Passenger stairs	17
Line maintenance car	25
Crew vehicle	37
Dispatcher/supervisor	48

Type of GSE	Total
PRM lift	0
PRM vehicle	4
Cleaning truck	40
Remote buses	39
Total	**653**

Source: NMIA

- ***Model Input Data***

For prediction of maximum Ground Level Concentrations (GLC's), the air dispersion modeling software (AERMOD version 9.9.5) was used. The predictions of traffic volume incremental concentrations of CO, NOx, HC, $PM_{2.5}$ and PM_{10} due to calculated traffic assumed in final phase of airport operation are estimated based on site specific meteorological conditions and line source emissions from peak hour peak vehicles estimated in land side and air side. The model inputs considered for assessment of impact on air quality due to movement of vehicles within the airport are:

- Based on traffic study total estimated peak vehicular movement in land side is 13727 units and in airside is 653.
- The distance of traversal by GSEs in airside is about 6.2 km along a 7 m wide tarmac road.
- The distance of traversal by land side vehicles assumed based on the length of the Easter main access road having a distance of 3.2 km along an 8+8 lane dual road of total 28 m width.
- Emission rates are calculated for CO, NOx, HC & PM based on CPCB Emission factors as CO – 1 g/km, PM – 0.02 g/Km, NOx – 0.14 g/km, HC – 0.039 g/km.
- Emission factors for passenger cars: HC + NO_X combined – 0.19 g/km (78% taken for NO_X & 22% for HC); and
- The emission rates thus calculated are given in **Table-4.38**.

TABLE-4.38
VEHICULAR EMISSION RATES

Parameter	Landside Emission in (g/s)	Airside Emission in (g/s)
CO	12.35	1.127
NOx	1.729	0.157
PM_{10}	0.247	0.022
$PM_{2.5}$	0.074	0.006
HC	0.557	0.05

- ***Model Predictions***

The peak GLCs of CO, NOx, $PM_{2.5}$, PM_{10} and HC during peak airside & landside traffic movement in the final phase (60 MPPPA) of the airport operations are given in **Table-4.39**. The isopleths of the line sources emissions within airport operational area due to maximum vehicular movement is shown in **Figure-4.51**. to **Figure-4.55.** vehicles

TABLE-4.39
EMISSION PREDICTIONS AIRSIDE & LANDSIDE VEHICLES (LINE SOURCES)

Parameter	Prediction (µg/m³)
CO	87.5
NOx	31.6
PM_{10}	1.75
$PM_{2.5}$	0.527
HC	10.2

The ultimate phase predictions reveal that the maximum NOx and CO concentration of 31.6 $\mu g/m^3$ and 87.5 $\mu g/m^3$ (considered concentration per hour) likely to occur at 100 m from the center of the road. The CO and NOx concentrations are likely to be within the limits when compared with NAAQS for CO (4000 $\mu g/m^3$) and WHO standard of 400 $\mu g/m^3$ for hourly average for NOx. Hence, it is assumed that the impact on the present ambient air quality will be within the limits due to vehicular movement within the airport.

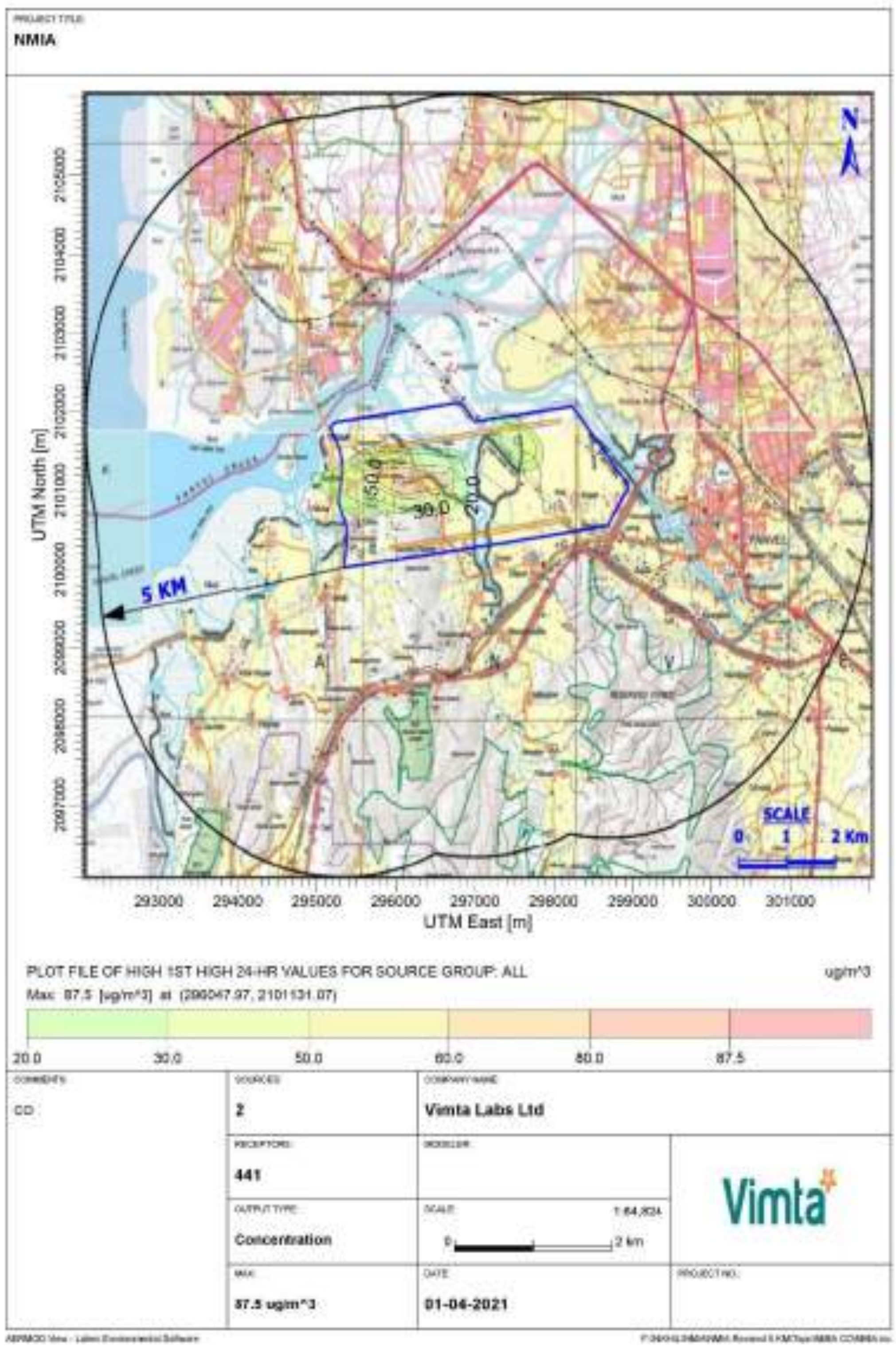


FIGURE-4.51
FINAL PHASE ISOPLETHS OF VEHICULAR MOVEMENT WITHIN AIRPORT FOR CO

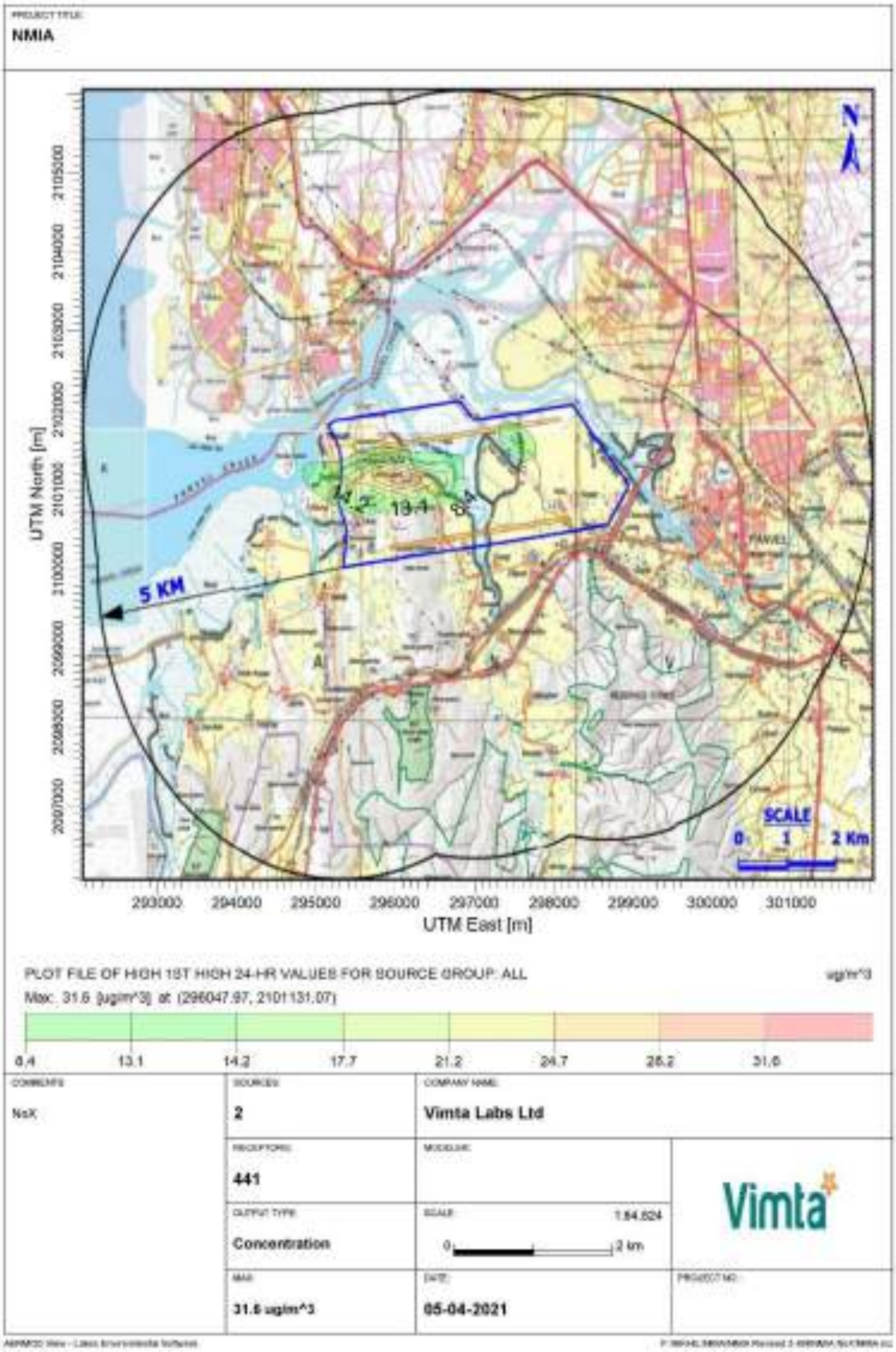


FIGURE-4.52

FINAL PHASE ISOPLETHS OF VEHICULAR MOVEMENT WITHIN AIRPORT FOR NO_X

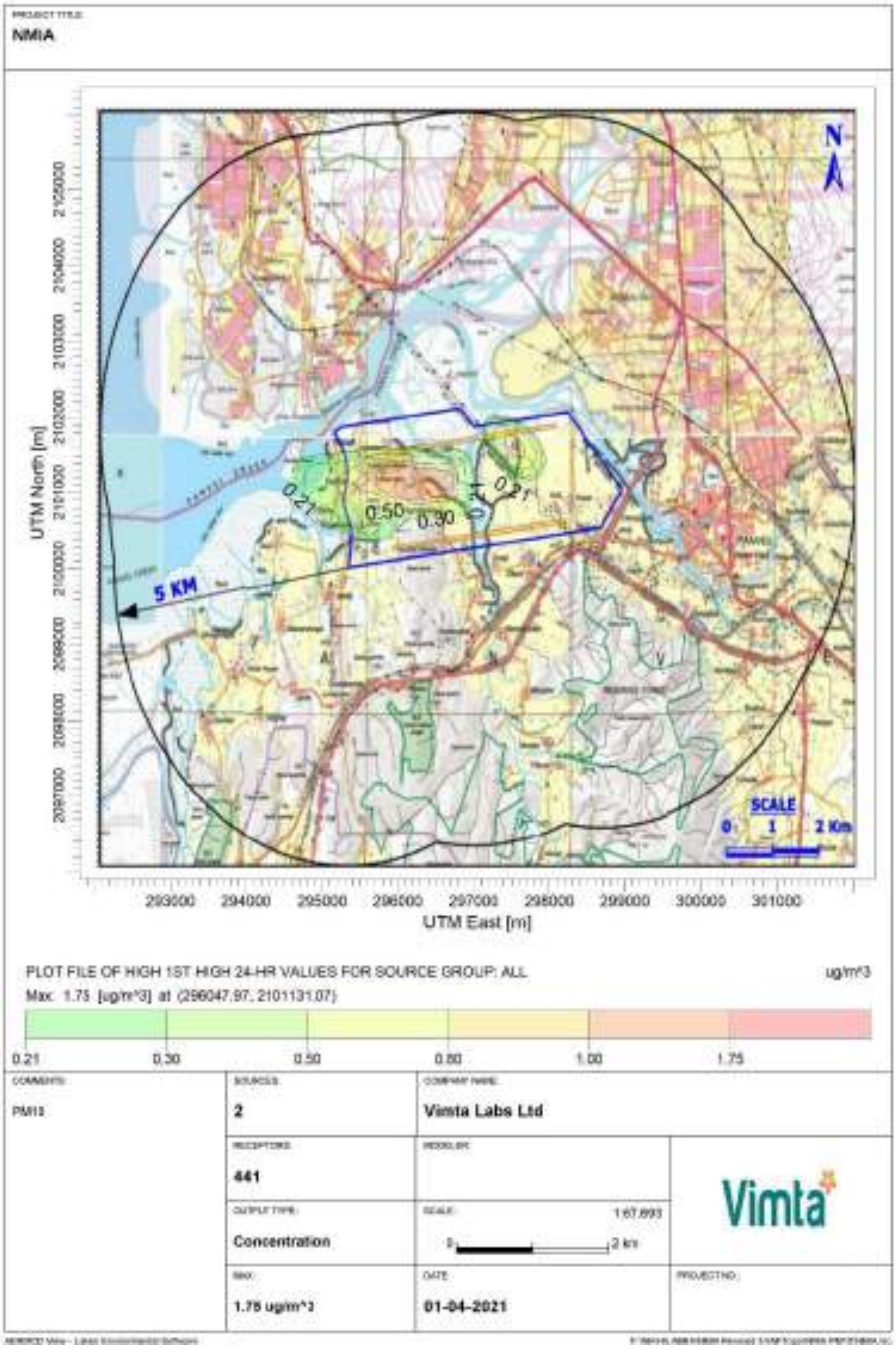


FIGURE-4.53
FINAL PHASE ISOPLETHS OF VEHICULAR MOVEMENT WITHIN AIRPORT FOR PM_{10}

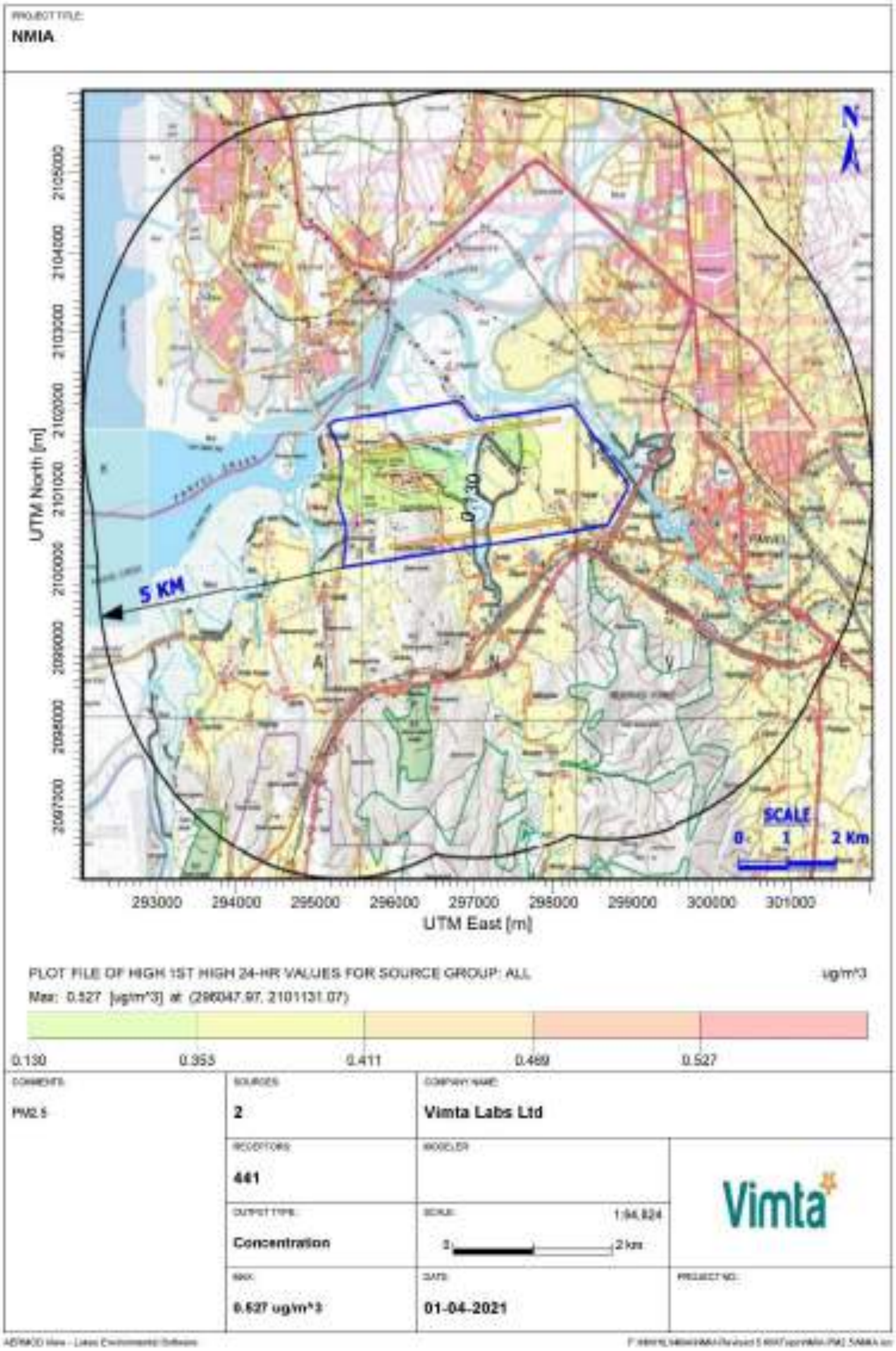


FIGURE-4.54
FINAL PHASE ISOPLETHS OF VEHICULAR MOVEMENT WITHIN AIRPORT FOR $PM_{2.5}$

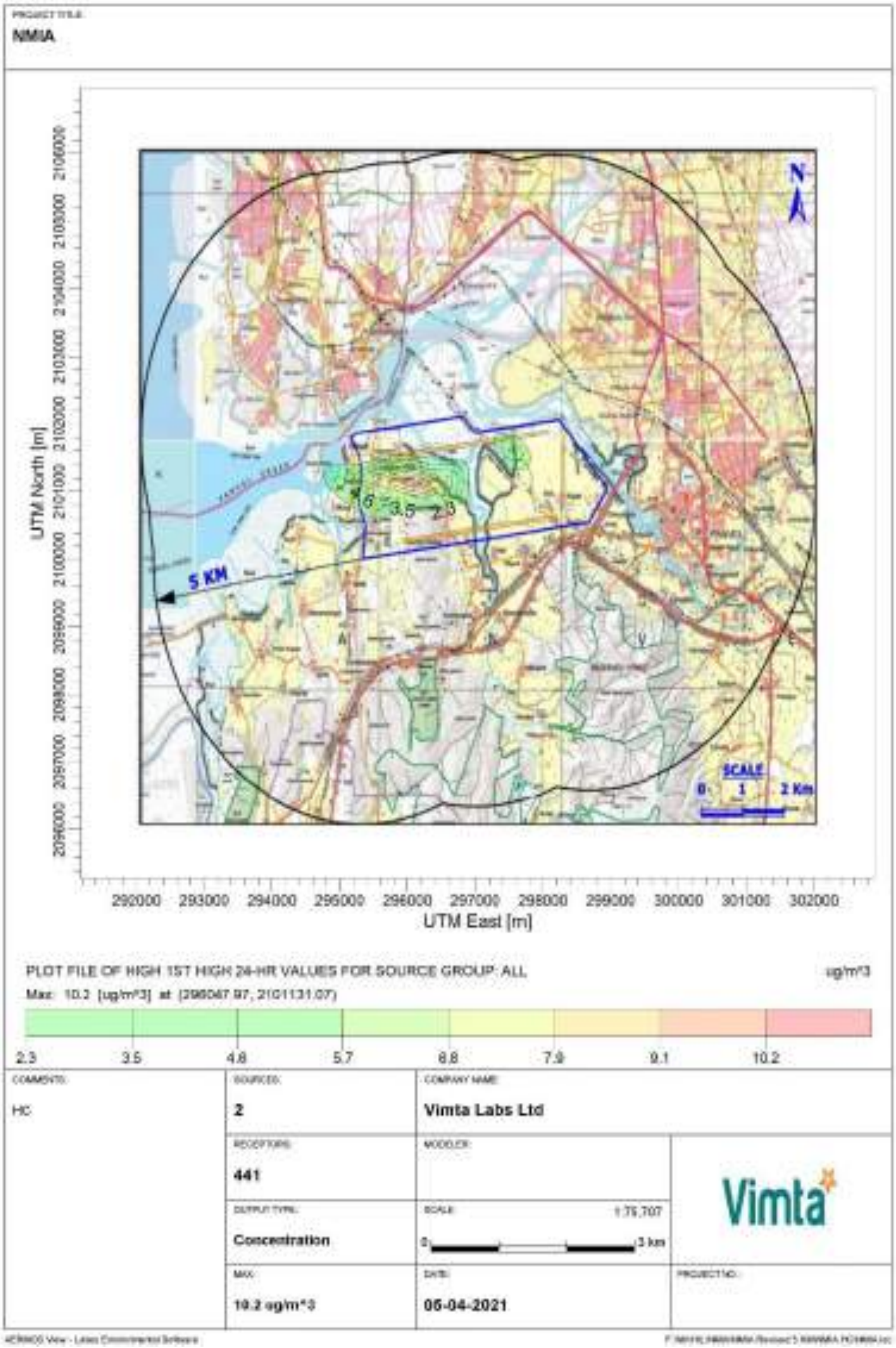


FIGURE-4.55
FINAL PHASE ISOPLETHS OF VEHICULAR MOVEMENT WITHIN AIRPORT FOR HC

4.3.4.12 Study Recommendations

NMIA, the new green field airport, if developed as contemplated, is going to be one of the major value additions to MMR and its transport system and also to India. It will form an invaluable asset to the nation. It needs serious attention and consideration for comprehensive and co-ordinated development in a prioritized and systematic manner.

As already noted, NMIA will cater to the travel needs of air passengers from not only MMR but also area beyond it. Planning and implementation of capital-intensive projects like the regional and local transport connectivity needs urgency, significant co-ordination with other organisations for ensuring effective operation of airport by providing efficient ground transport access by various modes of transport from and to various parts of MMR as well as from/to outside of MMR. Serious efforts by various stakeholders are in progress and further momentum is required.

Below, in brief, are some of the action points for consideration of CIDCO and GoM for their consideration as identified for better management of traffic and reduce traffic congestion to the extent possible:

- High Level Committee (Task Force) is already set-up by GOM under the chairmanship of Chief Secretary for implementation of the proposed connectivity to NMIA.

- Intensive coordination with NHAI/ Mumbai JNPT Port Road Company Limited (MJPRCL)/ MSRDC for timely completion of works under planning and implementation stage.

- Coordination with NMMC, PCMC, PWD, NHAI, Traffic police etc. for timely implementation of intersection improvements, traffic signal installation, grade separated facilities, enforcement etc. as proposed in the study under local transport connectivity plan.

- Coordination with MSRDC for implementation of 3rd Thane Creek Bridge.

- Coordination with NMMC, PCMC, PWD, NHAI, etc. for carrying out further Detailed Feasibility Study/ Detailed Project Report as appropriate for the proposed widening of existing roads and development of new/ missing links within the 5 km delineated area as proposed in the study under local transport connectivity plan.

- Prepare Detailed Feasibility Study/ Detailed Project Report as appropriate for the additional road corridor parallel to Palm Beach Marg (Coastal Road or elevated road on creek side or elevated road along the median) in coordination with NMMC, MMRDA, NMIAL, etc.

- Initiate dialogue with NMMT, BEST, TMT, KDMT, VVMT, PCMT, MSRTC etc. when implementation of NMIA reaches to near completion, for operation of bus routes providing connectivity to NMIA from various parts of MMR.

- o Initiate dialogue with NMMC for operation of bus feeder services between NMIA and nearby suburban railway stations (Khandeshwar, Kharghar, Panvel, Targhar, etc.).
- o Expedite execution of Navi Mumbai Metro (CIDCO);
- o Coordination with MRVC/ IR and MMRDA for implementation of CSMT-Panvel fast sub-urban rail corridor along harbour line, sub-urban rail operations on Vasai-Diva and Diva-Panvel sections and doubling of Tracks on Panvel-Karjat for running sub-urban operations (CTS for MMR Updation Study Proposal)
- o Coordination with MMRDA for integrated design of metro corridors M3: Colaba-Bandra-SEEPZ, M19: Prabhadevi-Sewri-Jambulpada and M20: MTHL spur to NMIA to facilitate operation of metro services from Colaba to NMIA and vice versa.
- o Prepare Corridor Development Plans of Green Corridors, as feasible, for all the identified Local Connectivity and some Regional Corridors and then preparing DPRs for implementation, to enhance the image of MMR and NMIA; and
- o MMRDA to take up responsibility for development of Regional Truck Terminal as per CTS for MMR Updation Study.

4.3.5 Impact on Water Resources and Quality

4.3.5.1 Fresh Water Requirement & Source:

The water requirement for NMIA shall be sourced from CIDCO, from its existing water mains running along Amra Marg on western side of airport. The estimated water supply demands are calculated based on applicable standards and also by taking benchmark data from best practices of other airports in the region (other demands which include GSE, cargo, defense and hangars are calculated based on suitable assumptions and gathered data for different airports). Detailed water demand estimation has been carried out for different facilities considering total persons, area, aircraft numbers, HVAC tonnage, garden area, housing dwellings etc. for different planning phases as applicable. Water requirement details during aircraft maintenance, handling of ground support equipment, flight catering and airport and airline administration are detailed below:

The water requirement for the project shall be sourced from CIDCO through existing water supply line which is located along Amra Marg, on western side of the airport site. The cumulative water demand estimated is 9.39 MLD for Phase I & II and 21.82 MLD for Final Phase. The EC Clearance has been received for a total water demand 41 MLD is now optimized to 21.8 MLD in the final phase.

The summary break-up of potable water and non-potable water as arrived for NMIA is given in **Table-4.40** & **Table-4.41**.

TABLE-4.40
WATER DEMAND ANALYSIS

Sr. No.	Type of Use	Unit	Water Supply Rate (Lit/Unit)	Total Water Demand (Potable + Non-Potable)							
				Phase - I (10 MPPA)		Phase - II (20 MPPA)		Phase - III (40 MPPA)		Final Phase-IV (60 MPPA)	
				Value	Demand (MLD)	Value	Demand (MLD)	Value	Demand (MLD)	Value	Demand (MLD)
1	Passengers	Persons	20	27397	0.55	54794	1.10	109589	2.19	164384	3.29
2	Visitors	Persons	15	41096	0.62	82192	1.23	164385	2.47	246578	3.70
3	Air Cargo	m^2	5	37643	0.19	37643	0.19	82412	0.41	127180	0.64
4	Aircraft maintenance	Aircraft	8000	5	0.04	10	0.08	15	0.12	20	0.16
5	GSE workshop	m^2	7	13578	0.10	22837	0.16	39311	0.28	55784	0.39
6	Flight catering	Passengers	6	27397	0.16	54794	0.33	109589	0.66	164384	0.99
7	Fire fighting										
	a) ARFF	LS	---	---	0.300	---	0.300	---	0.300	---	0.300
	b) Fire fighting	LS	---	---	0.432	---	0.432	---	0.432	---	0.432
8	Office staff	Persons	45	11000	0.50	22000	0.99	44000	1.98	66000	2.97
9	Defence	m^2	7	0	0.00	0	0.00	73105	0.51	109658	0.77
10	Housing	Persons	150	1000	0.15	2000	0.30	2000	0.30	2000	0.30
11	MLCP										
	a) Office	Persons	45	483	0.02	483	0.02	483	0.02	483	0.02
	b) Retail	m^2	10	1000	0.01	1000	0.01	1000	0.01	1000	0.01
12	Hotel	Rooms	1500	380	0.57	380	0.57	380	0.57	380	0.57
13	HVAC make-up	Ton	200	6330	1.27	9355	1.87	16175	3.24	22590	4.52
14	Irrigation / landscaping										
	a) Indoor	m^2	6	1270	0.01	2540	0.02	6350	0.04	8890	0.05
	b) Outdoor	m^2	6	252033	1.51	252033	1.51	279704	1.68	307375	1.84
15	Provision made for pond make-up water	m^2	6	21000	0.126	21000	0.126	21000	0.126	21000	0.126
Sub Total =				---	**6.54**	**---**	**9.23**	**---**	**15.33**	**---**	**21.07**
Sub-Total excluding Fire				---	**5.81**	**---**	**8.50**	**---**	**14.59**	**---**	**20.34**

Sr. No.	**Type of Use**	**Unit**	**Water Supply Rate (Lit/Unit)**	**Total Water Demand (Potable + Non-Potable)**							
				Phase - I (10 MPPA)		**Phase - II (20 MPPA)**		**Phase - III (40 MPPA)**		**Final Phase-IV (60 MPPA)**	
				Value	**Demand (MLD)**	**Value**	**Demand (MLD)**	**Value**	**Demand (MLD)**	**Value**	**Demand (MLD)**
Allowance for other requirements and losses etc. @ 5% (MLD)					0.29	---	0.43	---	0.73	---	1.02
Add 5% of fire demand as loss (MLD)					0.04		0.04		0.04		0.04
Total per day demand (MLD)				---	**6.14**	**---**	**8.96**	**---**	**15.36**	**---**	**21.39**
16	Commercial Development										
	a) L7-10	0.43		---	0.43	---	0.43	---	0.43		0.43
Total per day demand (MLD) including Commercial				---	**6.57**	**---**	**9.39**	**---**	**15.79**	**---**	**21.82**

TABLE-4.41
PHASE WISE WATER DEMAND OF NMIA

Sr. No.	**Project Phasing**	**Potable Demand (MLD)**	**Non-Potable Demand**	**Total Demand (MLD)**	**Wastewater Generation (MLD)**
1	Phase - I: 10 MPPA	2.25	4.32	6.57	2.70
2	Phase - II: 20 MPPA	4.925	4.465	9.39	4.70
3	Phase - III: 40 MPPA	7.38	8.41	15.79	9.10
4	Final Phase: 60 MPPA	10.61	11.21	21.82	13.30

4.3.5.2 Wastewater Generation & Handling

Sewage generated at various sources within the airport facility will be conveyed by Sewerage Network to the Sewage Treatment Plant (STP) for further treatment. The treatment technology envisaged for 20 MPPA is advanced Sequential Batch Reactor (SBR) with dual media filter and ultra-filtration. Since it is a batch process, it can take shock loads of raw sewage quality and there is a better control treated water quality. Hence, advanced SBR technology has been considered.

Greasy waste output from catering will be provided with preliminary treatment for Oil & Grease removal within the plot boundary of the specific facility. After preliminary treatment, this wastewater will be transferred to common STP for further treatment. As airport will be developed in phases, cumulative capacity of the sewage generation as per water demand calculations, under each phase is specified in **Table-4.42**.

TABLE-4.42
PHASE WISE SEWAGE GENERATION & TREATMENT

Phase	Phase I	Phase II	Phase III	Phase-IV
	10 MPPA	20 MPPA	40 MPPA	60 MPPA
Cumulative Sewage Generation (MLD)	2.70	4.70	9.10	13.30
STP Technology	SBR	SBR	SBR	SBR

Source: FMP, 2019

The total estimated sewerage generation of 13.30 MLD is for final phase of 60 MPPA. The final total sewage generation of NMIA after final phase of development considering all landside development shall be 22 MLD. As per Environmental Clearance (EC, 2010) from MOEFCC for the STP capacity approved is 30 MLD. Therefore, even considering in airport's final phase development in future, additional sewerage generation shall be well within the EC approved total STP capacity of 30.0 MLD. Sewage flows and STP capacity in the north side are given in **Table-4.43.**

TABLE-4.43
SEWAGE FLOWS & STP CAPACITIES NORTH SIDE OF NMIA

Descriptions	Sewage Flow (MLD)		
	P - I &P -II 20 MPPA	P - III 40 MPPA	Final-60 MPPA
Modular STP and SWM on West Side Development of NMIA			
Sewage from West Side Airport Development	0.02	0.5	0.26
STP capacity provided at each phase	0	0.75	0

Source: FMP, 2019

Total estimated sewage generation from these developments is 13.3 MLD for Final Phase. Major development of airport in the initial phases will happen towards the west and east side of airport; whereas last phase of development will happen towards the north side of airport. Considering the developmental phases and sewage generation in each phase, it has been proposed to provide two separate STPs. One STP will be located on west side of airport whereas second STP will be located on east side of airport. **Table-4.44** presents the cumulative sewage treatment capacities expected in different phases. The STP flow diagrams and layouts are shown in **Figure-4.56** to **Figure-4.59.**

TABLE-4.44
SEWAGE TREATMENT CAPACITIES

Development Phase	Western STP Capacity (MLD)	Eastern STP Capacity (MLD)	Northern STP Capacity (MLD)	Total (MLD)
Phase I & II	4.50	1.00	-	5.50
Phase-III	8.5	2.0	0.75	11.25
Phase-IV	11.0	2.5	0.75	14.25

Source: PFR

4.3.5.3 Liquid Waste from Aircraft

Considering the possibility that liquid waste from the aircrafts (also known as Blue water) may pose hazards for plants and animals, it will be separately collected and adequately sanitized before sending to a sewage treatment plant for further treatment. The wastes will initially be collected in various designated collection pits. From collection pits, wastes will be transferred to equalization tanks through suction tanker for sanitization. Sanitized wastes will then be transferred to STP by pumping for further treatment.

4.3.5.4 Sludge Disposal

Screenings and grit collected inside the STP will be sent for disposal. Sludge generated inside the STP will be dewatered to reduce the volume. Dewatered biological sludge can be used as fertilizer depending on the requirement. Excess sludge will be disposed to MSW site at Chaal, Taloja.

4.3.5.5 Water Conservation, Recycle-Reduce-Reuse

Re-cycled water storage shall be provided at STPs as given in **Table-4.45**. No treated water will be disposed to nearby water bodies and will be segregated from stormwater channels. The output of the STP will be fed to the re-cycled water storage tank. The storage capacity considered at STPs is to meet half day requirement.

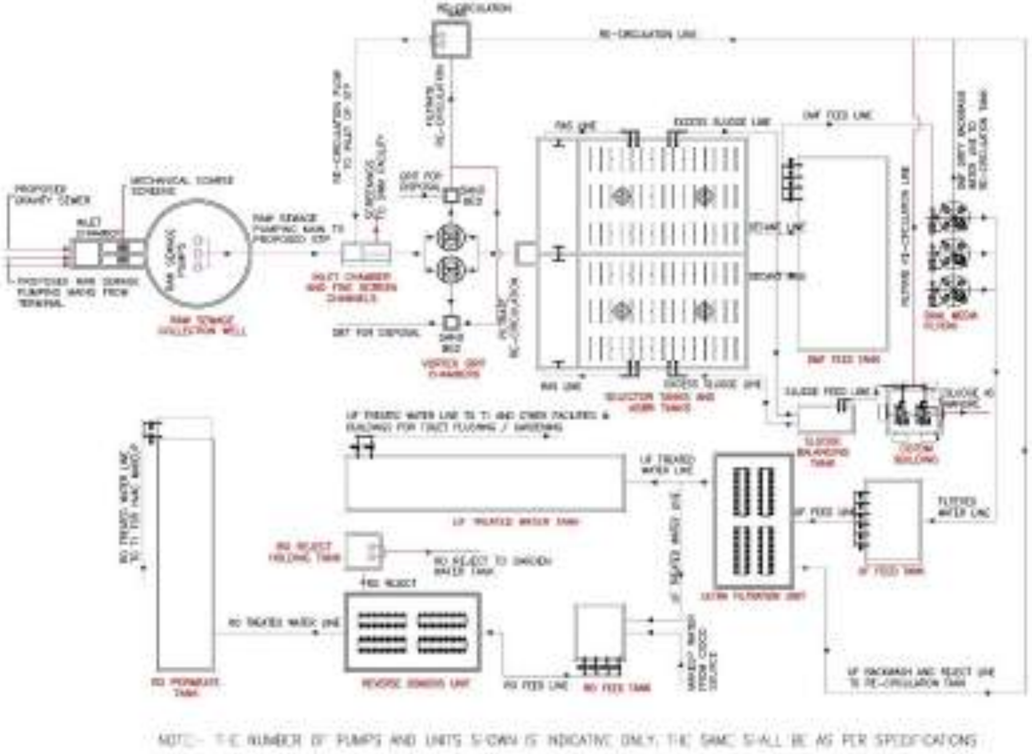


FIGURE-4.56
FLOW DIAGRAM FOR WESTERN SIDE STP

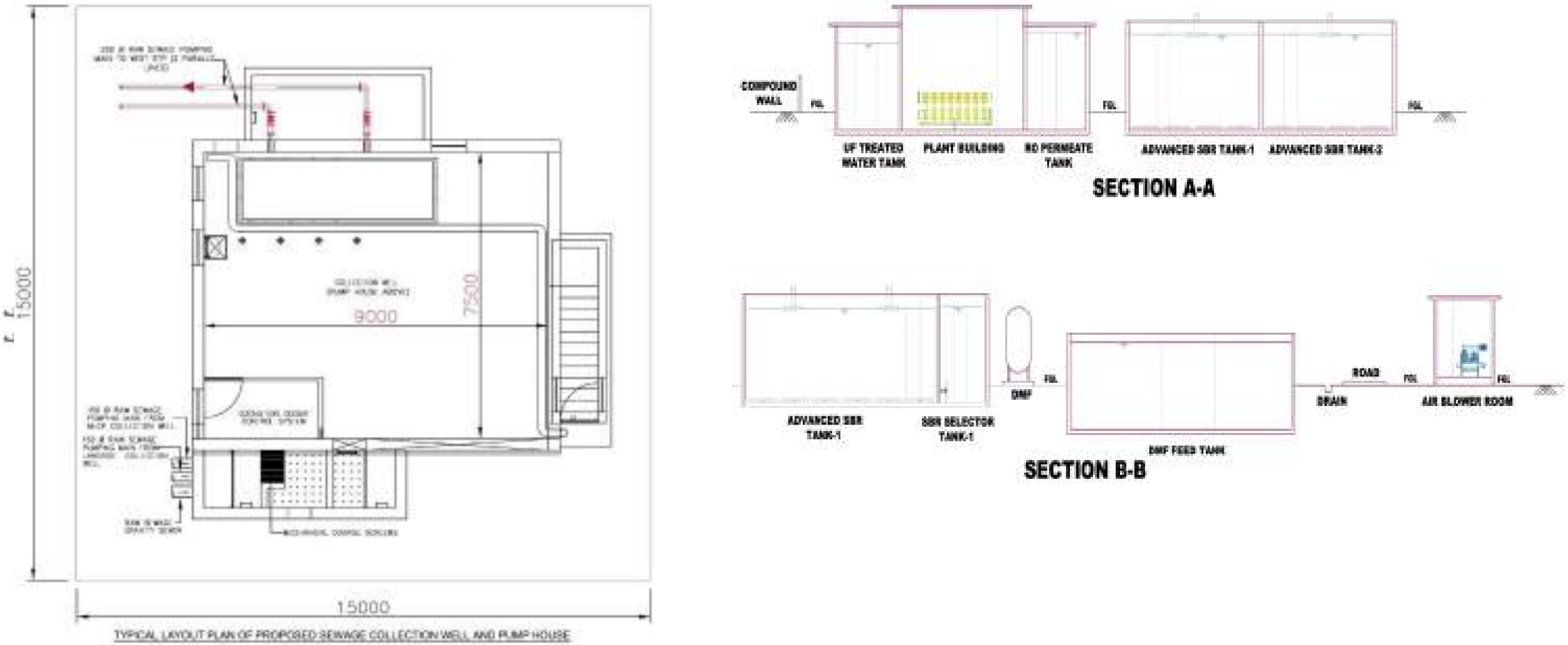


FIGURE-4.57
STP LAYOUT WITH SECTIONS FOR WESTERN SIDE

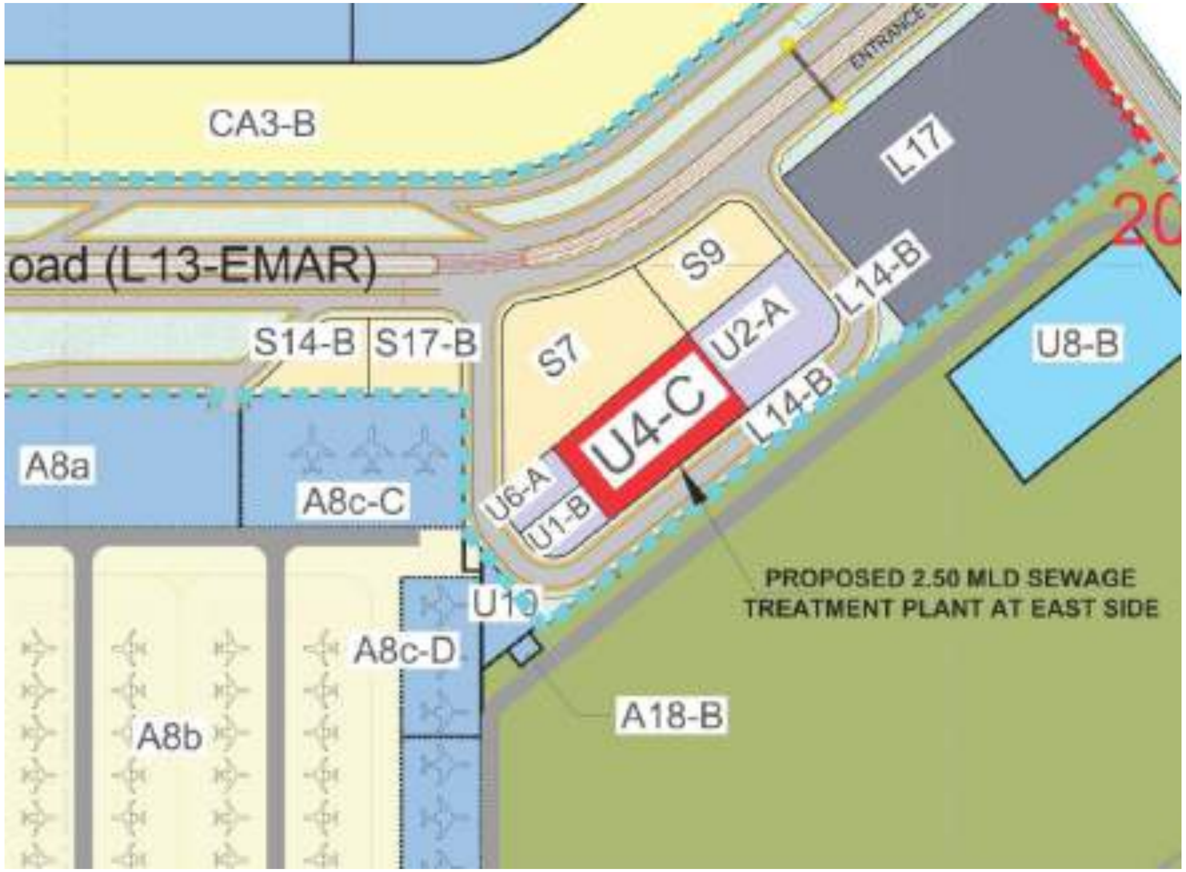


FIGURE-4.58
LOCATION OF STP FOR EASTERN SIDE

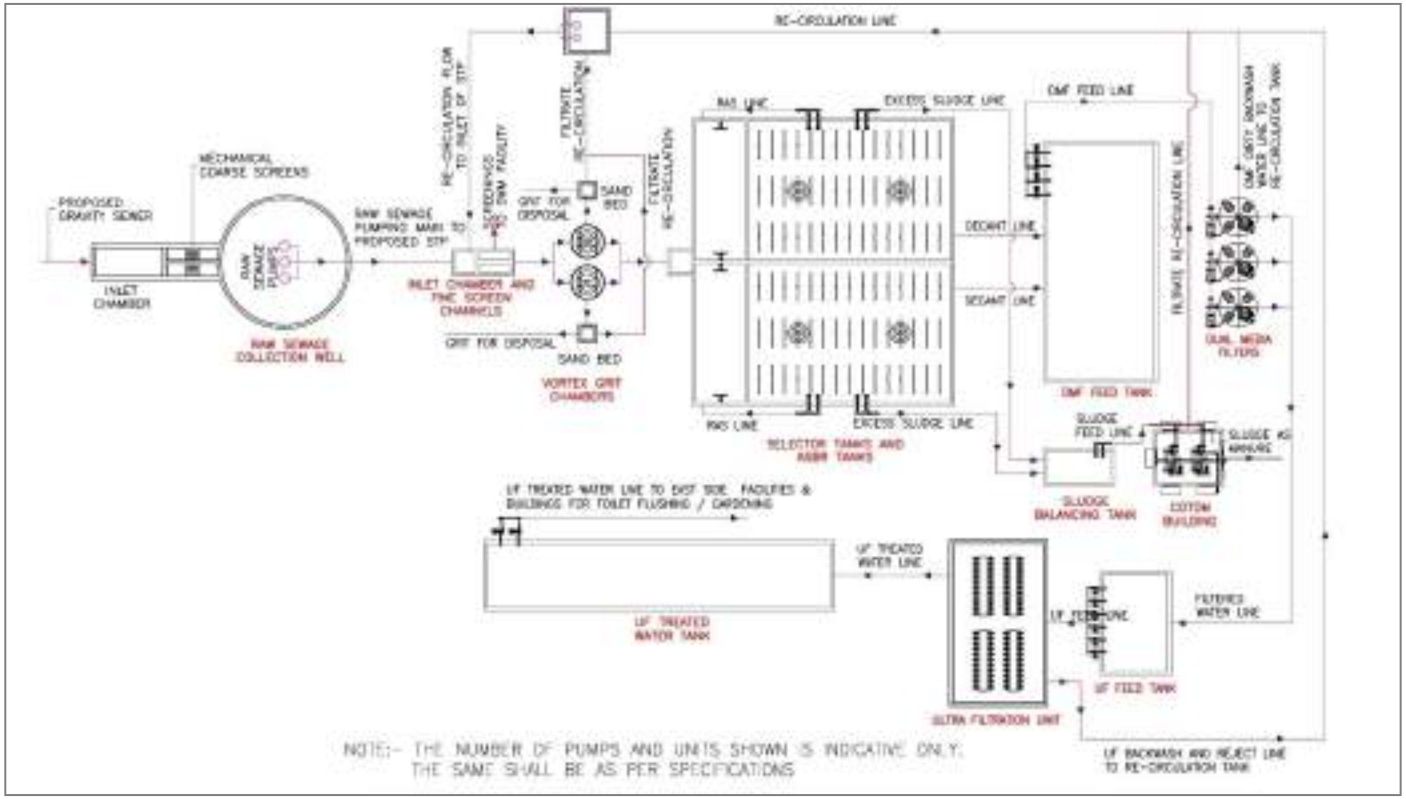


FIGURE-4.59
FLOW DIAGRAM OF EASTERN SIDE STP

TABLE-4.45
RECYCLED WATER STORAGE TANKS AT STPS

Sr. No.	Description	Tank Capacity Provided (m^3)		
		P-I & P-II 20 MPPA	P-III 40 MPPA	Final 60 MPPA
A) West Side STP (STP-1)				
1	Gardening / Flushing	2000	800	700
2	HVAC Make-up	1100	750	700
B) East Side STP (STP-2)				
1	Gardening / Flushing	250	0	250

Source: FMP, 2019

❖ Regeneration

NMIA will regenerate 51% of its total water consumption through treated water from STP. The state of art latest technology will be adopted in the design of the STP. The technology envisaged is Advance Sequential Batch Reactor (ASBR) with Ultra Filtration (UF) and Reverse Osmosis (RO). The treated water from STP will be used for landscaping, flushing, and air-conditioning. Treated water available from STP will be 11.2 ML per day at Phase-IV.

❖ Sludge Drying

NMIA also proposes sludge drying beds to generate manure from STP for horticulture and land scape development at NMIA.

❖ Rainwater Harvesting

A rainwater harvesting pond is proposed along the main drain alignment path. The area of proposed rainwater harvesting pond is 11,899 sqm and depth of 2.5 m below interval level and the volume of pond is 29.747 cum. Weir is proposed at the pond outfall location to avert saltwater intrusion into the pond. Stored water will be used for landscape irrigation purposes.

❖ Variable Frequency Drive (VFD) & Hydro Pneumatic System

Water supply system involves pumping of water directly from pump houses to consumers by using variable frequency drive (VFD) & hydro pneumatic system which ensures the operation of pumps always on its best efficiency point irrespective of the loading.

❖ Automotive Operation

In sewage collection wells all pumps will be operated in auto-mode by using cleaning sensors regularly to optimize the operation time of these pumps. Also, in STP, aeration tanks, DO level will be monitored through sensors to avoid continuous running of aerators.

4.3.5.6 Storm Water Management

Storm Water Drainage (SWD) system for NMIA is one of the most important part of the overall airport planning. The objectives of NMIA storm water drainage plan are:

- To provide safe discharge of flood water from the project area without flooding.
- To comply with EC & CWPRS guidelines for storm water run-off discharge.
- To provide cost effective and maintainable drainage system; and
- To harvest rainwater through rainwater harvesting ponds or ground water collection.

The proposed Storm Water Drainage System is divided into three areas:

- Airfield: The water generated from the runway, taxiway and areas in between is led into the parallel drains and are supplemented by box/pipe culvert wherever it crosses taxiways and roads.
- Apron: Slot drains with flame trap chambers and collector drains have been planned along with oil water separator before it connects to the main drainage network.
- Landside: Drains are provided below the foot path or open areas as per final grading.

Main Rainwater harvesting pond is planned in the north-west corner of airside along the main drain alignment. Shallow water bodies have been planned as landscape features on either side of main access road. To harvest rainwater from Terminal roof, RWH tank has been proposed near MLCP. A plan shows the main drain alignment, rainwater pond, silt ponds and outfall locations (W1, W2, C1, E1, NE, & SE).

For Airside Drainage Infrastructure

- For airfield area drainage planning and design, the hhorizontal & vertical sighting constraints criteria specified for storm drainage system have been considered;
- The entire drainage system is designed to cater for 1 in 100 year storm event;
- The HFL of the river estuaries mentioned in the CWPRS study report considered as basis for determining the site grading requirements and corresponding drainage outfall.;
- All the 6 nos. of outfalls - on north and east side are planned taking into consideration of 1 in 100 years HFL of Gadhi River. No outlets connected to Ulwe River recourse channel (as per MoEF directions);
- Main drains designed based on 148.1 mm/hr for 1 in 100 year flood Return Period value;
- Run-off coefficients considered as per IRC SP-50;
- Manning's coefficient "n" as per IRC SP-42 : 2014;
- Drains in airfield area has been planned as per DGCA guidelines;
- Drains in Apron area has been designed as per NFPA 415.

For Landside Drainage Infrastructure

- For landside drainage, the drain network, routing and disposal arrangement systems are planned in line with the main/primary drains alignment, invert levels of the main drain from airside and outfall invert;
- Site grading and development of plots will be carried out such that the surface run-off reaches the main drainage system by gravity;
- Landside drainage networks are planned as per the land use master plan. Temporary / Enabling drains are planned as per phasing;
- The run-off calculations are as per land area development of the landside plots as per the NMIAL land use plan;
- The drainage system designed to cater for the rain fall intensity of 1 in 100 year return period which is 148.1 mm/hour rainfall;
- All drainage structures are with RCC construction catering for vehicular live loads applicable as per IRC;
- Phase wise development of plots and drainage construction works shall be integrated with drainage master plan network; and
- Cross drainages are proposed across road to establish inter connectivity with the network.

4.3.5.7 Rainwater Harvesting Measures

A rainwater harvesting pond is proposed along the main drain alignment path within W1 catchment, near the outfall within airside boundary at NW corner. The area of proposed rainwater harvesting pond is 11,899 sqm and depth 2.5 m below invert level and the volume of pond is 29,747 cum. Weir is proposed at the pond outfall location to avert saltwater intrusion into the pond. Stored water shall be used as per water balance for landscape irrigation purposes.

Shallow water bodies have been identified on either side of WMAR Road (Plot L8) landscape area. In the initial phases, only the two gate way ponds on either side of WMAR road (near VUP location) will be developed and both the ponds are interlinked through RCC Hume pipe NP4 class is proposed and the remaining shallow ponds alongside WMAR will be developed in the subsequent phases. All the ponds are interlinked and the overflow from last RWH pond will be disposed-off to nearby roadway drains. The inlet and outlet arrangement from the water bodies into the nearby roadway drains are planned.

The run-off generated from the contributory catchment area for the landscape ponds are inadequate to meet the evaporation requirement of these ponds requiring separate make-up water pipelines are planned to meet the water requirements during non-monsoon season and landscape aspects from the gateway ponds. The details of water requirement computation statement for the landscape water bodies are appended below in **Table-4.46.** The water required for MAR ponds is 0.117 MLD amounting to 29,250 cum for 250 non-rainy days can be accommodated by pumping water from north side RWH pond. To harness the rainwater run-off from the terminal building and MLCP buildings RCC UG sump tank is proposed near MLCP building. The detention time and volume of the sump tank is computed as per IGBC guidelines. The location of RWH ponds and UG sump tank is shown in **Figure-2.51** of Chapter-2. The integrated drainage plan is shown in **Figure-2.43** of Chapter-2.

TABLE-4.46
DETAILS OF WATER REQUIREMENT COMPUTATION STATEMENT FOR LANDSCAPE WATER BODIES

Sr. No.	Pond Location	Pond ID	Pond Top Area (Sq.m)	Pond Bottom Area (Sq.m)	Avg. Depth (m)	Storage Volume (Cum)	Daily Evaporation losses considering 6 mm/day	Daily Evaporation losses in MLD	Make-up Water Qty Required/day in MLD	Total Make-up Water Qty Required/day in MLD
1	1-North of MAR	WN1	1649	721	1.2	1422	9.89	0.010	0.010	**0.052**
2	2- North of MAR	WN2	1738	781	1.2	1511	10.43	0.010	0.010	
3	3- North of MAR	WN3	1780	804	1.2	1550	10.68	0.011	0.011	
4	4- North of MAR	WN4	3503	2124	1.2	3376	21.02	0.021	0.021	
5	1-South of MAR	WS5	1771	796	1.2	1540	10.63	0.011	0.011	**0.055**
6	2- South of MAR	WS6	1887	865	1.2	1651	11.32	0.011	0.011	
7	3- South of MAR	WS7	1968	933	1.2	1741	11.81	0.012	0.012	
8	4- South of MAR	WS8	3474	2099	1.2	3344	20.84	0.021	0.021	

4.3.6 Impact on Noise Levels

Airport infrastructures are not only fundamental centers of activity that drive the economy and social and cultural development, as well as being the backbone and integrating element of regions and states, they are also entities that interact with the environment on which they are built.

The need to make the development of air transport compatible with the conservation of natural integrity and quality of life in the airport surroundings requires an action plan based on balance between economic, social and environmental factors, which allow us to move closer to a sustainable development model.

Specifically, noise pollution is one of the main environmental aspects caused by airport activity. For this reason, reducing noise levels to a minimum and protecting the quality of life in populations near airports has become one of the top priorities.

During the operational phase, aircraft movements will be the major source of noise pollution from the proposed project. Noise will also be generated from the traffic and standby DG sets, but will be very less and localized in comparison to the noise from the aircraft, which can be felt at longer distance also. Hence, noise from the aircraft movement at the international airport has been considered for the noise dispersion modeling.

The noise emanating from aircraft operations depends upon a number of factors including type of aircraft, overall number of daily take-offs and landings, specific flight procedures, topography etc.

4.3.6.1 Noise Modeling

To predict the impact on the existing noise levels in the study area due to the proposed project, the Integrated Noise Model (INM), Version 6.0 developed by Federal Aviation Administration (FAA), Office of Environment and Energy, USA is used. This model has in-built information on the various latest new generation aircrafts and has capability of assessing changes in noise impact resulting from new or extended runways or runway configurations, new traffic demand and fleet mix, revised routings and airspace structures, alternative flight profiles and modifications to other operational procedures like reverse thrust.

- ❖ The main sources of noise that will occur at and in the vicinity of the Navi Mumbai International Airport (NMIA) include aircraft operations associated with departures and approaches; and
- ❖ Landing, departures, taxiing and idling operations will predominantly produce the most amount of high intensity airport associated noise.

Based on traffic forecast for NMIA, projected for passenger demand for NMIA by 2023-24 is 10 MPPA, in 2025-26 it shall be 20 MPPA, in 2031-32 it shall be 40 MPPA and 2036-37 it shall reach 60 MPPA (**Table-4.47**). Thus, NMIA is planned to be implemented in 4 phases.

TABLE-4.47
NMIA PASSENGER TRAFFIC FORECAST

Terminal	Phase	Capacity (MPPA)	Cumulative Capacity (MPPA)
T1	Phase-I	10	20
	Phase-II	10	
T2	Phase-III	20	40
T3	Final Phase (Phase-IV)	20	60

Source: NMIA

The peak hour forecast for commercial passenger aircrafts are outlined below in **Table-4.48**.

TABLE-4.48
NMIA PEAK PASSENGER AIRCRAFT MOVEMENT FORECAST

	Domestic			International			Combined		
	Arr	Dep	2-way	Arr	Dep	2-way	Arr	Dep	2-way
FY2022	0	0	0	0	0	0	0	0	0
FY2023	7	7	12	2	2	4	7	9	14
FY2024	10	10	17	3	3	5	10	13	19
FY2025	13	13	22	4	4	7	13	17	25
FY2026	16	16	27	5	5	9	16	20	31
FY2027	20	20	33	6	7	11	19	24	37
FY2028	23	23	38	8	8	13	23	28	43
FY2029	25	25	42	9	10	16	26	32	49
FY2030	28	28	46	10	11	18	28	35	54
FY2035	36	36	60	14	15	24	38	45	70
FY2040	42	42	71	17	18	30	46	52	83
FY2045	45	45	75	21	22	37	53	55	90
FY2050	45	45	75	21	22	37	53	55	90
FY2055	45	45	75	21	22	37	53	55	90
FY2058	45	45	75	21	22	37	53	55	90

Aircraft Mix

The forecast peak day profiles identified aircraft by ICAO code groups. The aircrafts have different noise characteristics depending on the engines used or the configuration of aircraft. For the purpose of the noise modeling, the aircrafts have been segregated into two types namely wide-bodied and narrow-bodied aircrafts. The narrow body aircraft types include aircrafts like A319, A321, A-320, B727, 737, 757 etc. and wide-bodied aircrafts include aircrafts like A380, A310, B767, 747 etc. Phase wise break-up of aircraft movements for narrow and wide-bodied aircrafts is given in **Table-4.49**.

TABLE-4.49
PHASE-WISE BREAK-UP OF AIRCRAFT MOVEMENTS

Phases	Year	Combined	90%	10%
			Narrow Body Aircrafts	Wide Body Aircrafts
I	FY2022	0	0	0
II	FY2023	14	13	1
	FY2024	19	17	2
III	FY2025	25	23	3
	FY2026	31	28	3
	FY2027	37	33	4
IV	FY2028	43	39	4
	FY2029	49	44	5
	FY2030	54	49	5
	FY2035	70	63	7
	FY2040	83	75	8
	FY2045	90	81	9
	FY2050	90	81	9
	FY2055	90	81	9
	FY2058	90	81	9

Source: NMIA, Invistas Report

Runways

NMIA will have two code 4F parallel runways in final phase (60 MPPA). The runways will be each of 3,700 m long and 60 m wide and separated by 1,580 m to facilitate simultaneous independent operations. The elevation for south runway has been confirmed as part of Phase-I/II airside design process. The elevation for north runway may be subject to change based on final levels following pre-development works. For the dual runway scenario, it is assumed 50%-50% departures and arrivals operations will be by both the runways. The phase-wise runway details following the airside design process in given in **Table-4.50**.

TABLE-4.50
RUNWAY THRESHOLD ELEVATIONS

Phase	Phase I & II		Phase III & IV	
Runway	08R	26L	08L	26R
Elevation m AMSL	9.61	9.10	9.10	9.10

In the prediction of noise levels due to the project, operation of two runways has been considered. The parallel runway is proposed at a distance of 1580 m. For the noise modeling exercise, it is assumed that the aircraft will follow standard procedures of flying for approaches and departures as defined in the model, INM 6.0. Modelling simulations have been carried considering 92% landing will be from east side and the balance 8% from west side of the runway. The following inputs are given to the model:

- Runway orientation; and
- Aircraft fleet mix.

Model Results

The model is executed to estimate values of A-weighted exposure-based noise metrics viz., LAEQD (Audible Range Weighted Daytime Average), LAEQN (Audible

Range Weighted Nigh Time Average) and LAEQ (Audible Range Weighted 24 hr Average). For the noise modeling, four scenarios have been considered:
1. Phase-I (10 MPPA)
2. Phase-II (20 MPPA)
3. Phase-III (40 MPPA); and
4. Phase-IV (60 MPPA).

Scenario I: 10 MPPA

During phase-I with 10 MPPA only the southern runway will be operational. From **Figure-4.60 to Figure-4.62**, it can be observed that the movement of aircrafts (ATMs) on the southern runway. During daytime, the contours of 60 dB(A) will be confined to airport boundary. The noise contours outside the airport boundary will be less than 60 dB(A) during day time. Similarly, during night time up to 55 dB(A) will be confined to the airport boundary. The noise contours outside airport boundary will be less than 55 dB(A). The night time operations will be a major concern as the background noise levels will be absent leading to sleep disturbance.

Scenario II: 20 MPPA

During phase-II, with 20 MPPA only the southern runway will be operational. From **Figure-4.63 to Figure-4.65**, it can be observed that the movement of aircrafts (ATMs) on the southern runway. During daytime, the contours of 60 dB(A) will be confined to airport boundary. The noise contours outside the airport boundary will be less than 60 dB(A) during day time. Similarly, during night time up to 55 dB(A) will be confined to the airport boundary. The noise contours outside airport boundary will be less than 55 dB(A). The night time operations will be a major concern as the background noise levels will be absent leading to sleep disturbance.

Scenario III: 40 MPPA

During phase-III, with 40 MPPA both southern and northern runways will be operational. From **Figure-4.66 to Figure-4.68,** it can be observed that the movement of aircrafts (ATMs) will be 50:50 each. During daytime, the contours of 60 dB(A) will be confined to airport boundary. The noise contours outside the airport boundary will be less than 60 dB(A) during day time. Similarly, during night time upto 55 dB(A) will be confined to the airport boundary. The noise contours outside airport boundary will be less than 55 dB(A). The night time operations will be a major concern as the background noise levels will be absent leading to sleep disturbance.

Scenario IV: 60 MPPA

During phase-IV, with 60 MPPA both southern and northern runways will be operational. From **Figure-4.69 to Figure-4.71,** it can be observed that the movement of aircrafts (ATMs) will be 50:50 each. During daytime, the contours of 65 dB(A) will be confined to airport boundary. The noise contours outside the airport boundary will be less than 65 dB(A) during day time. Similarly, during night time up to 55 dB(A) will be confined to the airport boundary. The noise contours outside airport boundary will be less than 55 dB(A). The night time operations will be a major concern as the background noise levels will be absent leading to sleep disturbance.

The noise levels and area of influence for the four scenarios is given **Table-4.51 to Table-4.54.**

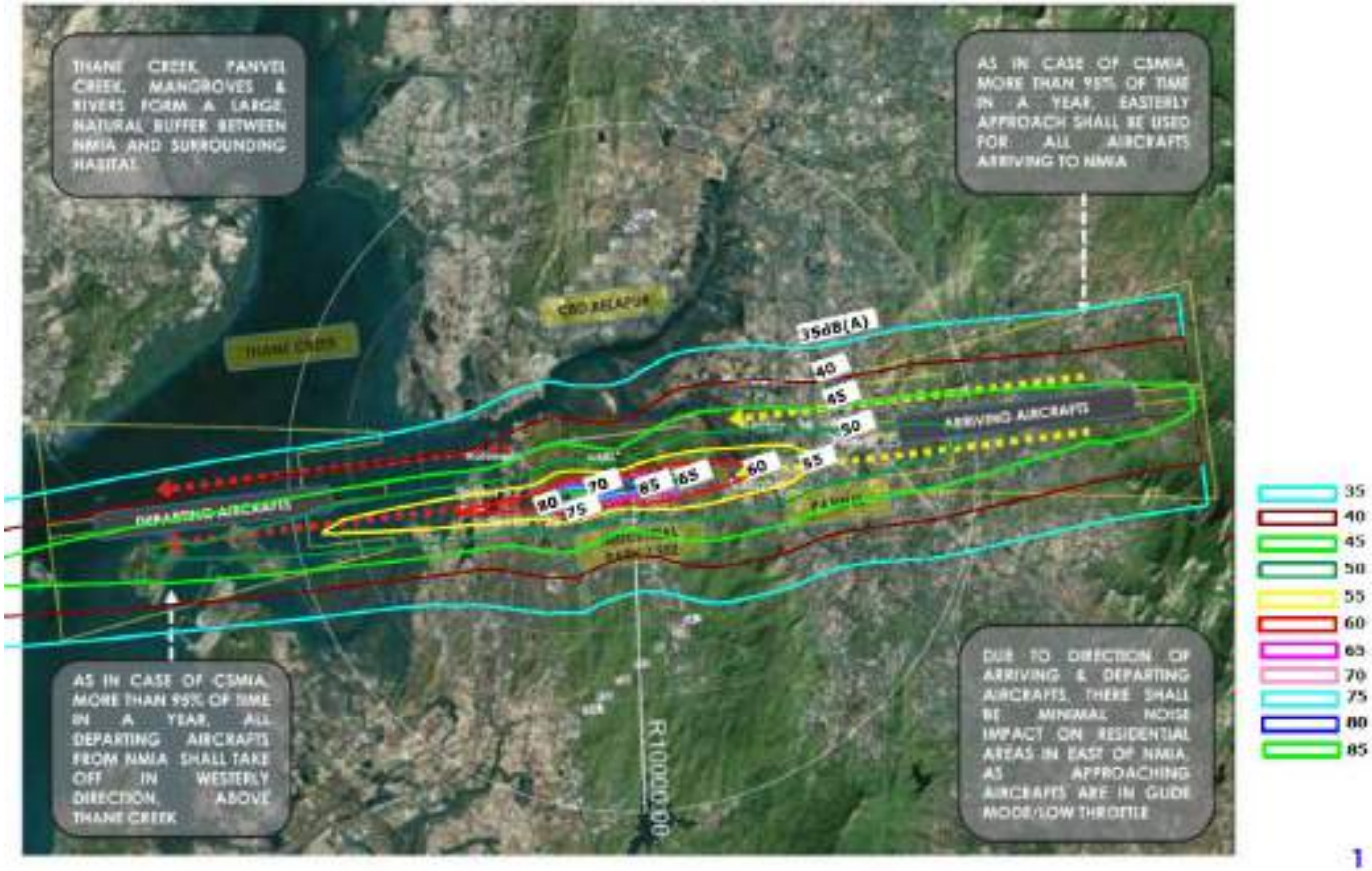


FIGURE-4.60
SCENARIO-I: 10 MPPA
NOISE CONTOURS -LAEQ

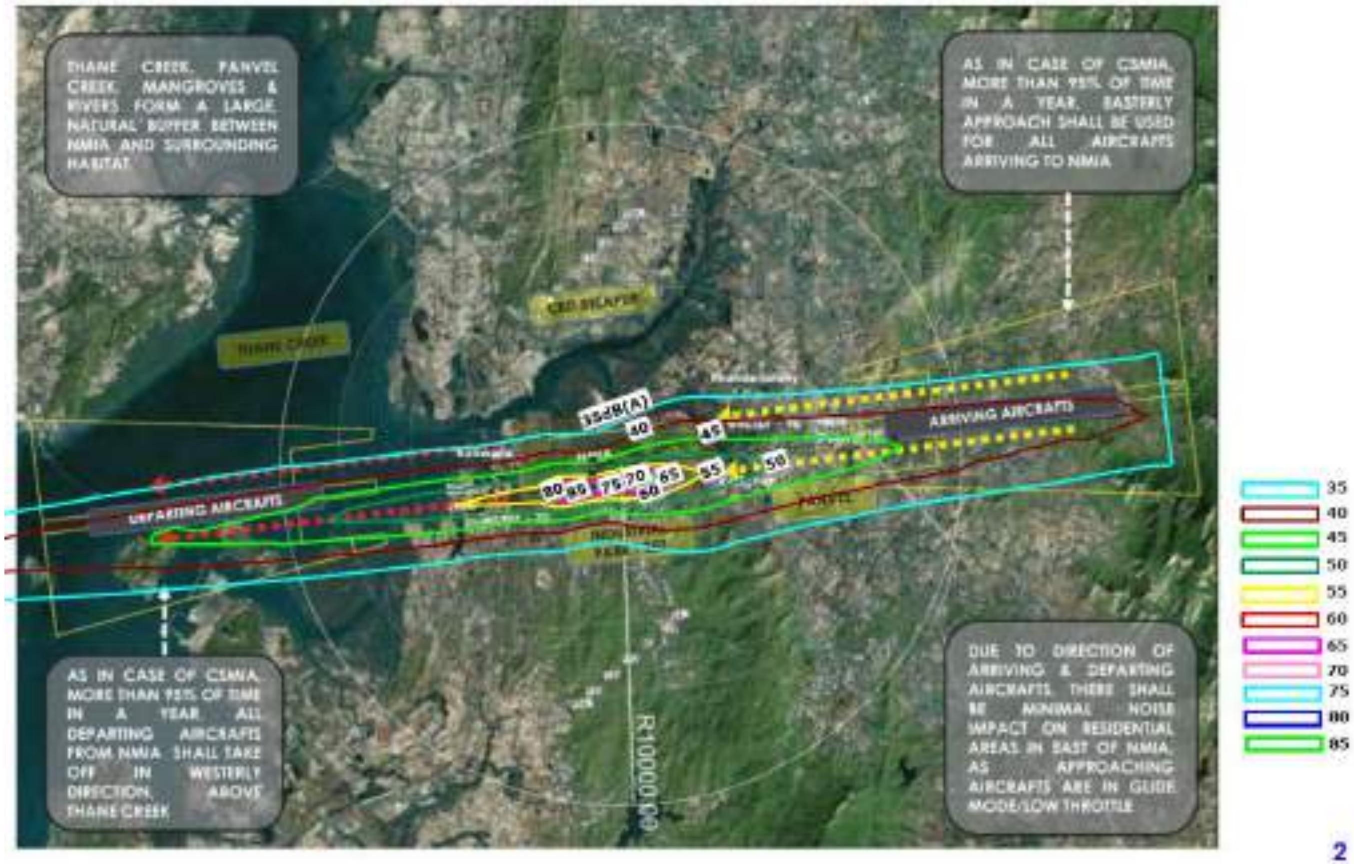


FIGURE-4.61
SCENARIO-I: 10 MPPA
DAY TIME AVERAGE NOISE LEVEL CONTOURS

FIGURE-4.62
SCENARIO-I: 10 MPPA
NIGHT TIME AVERAGE NOISE LEVEL CONTOURS

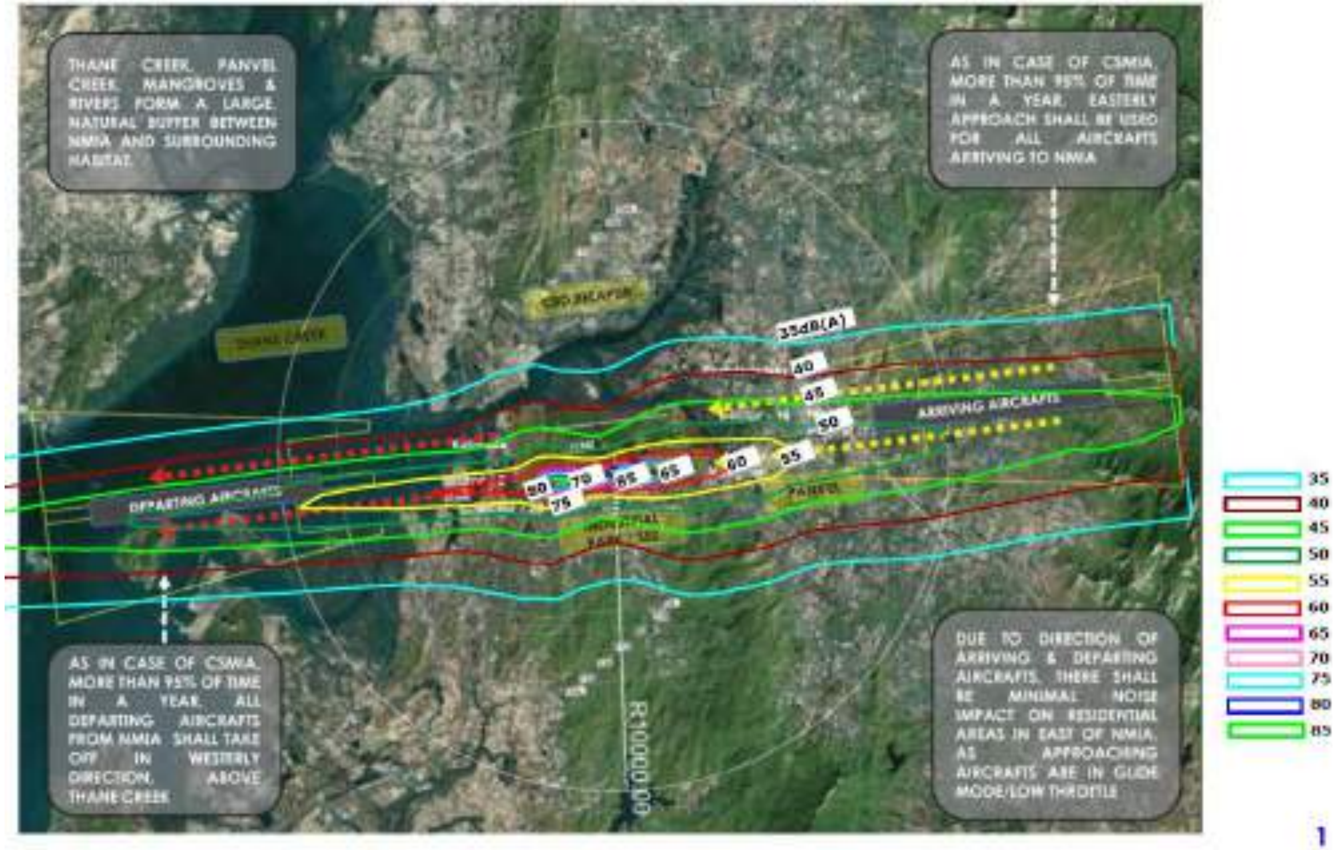


FIGURE-4.63
SCENARIO-II: 20 MPPA
NOISE CONTOURS -LAEQ

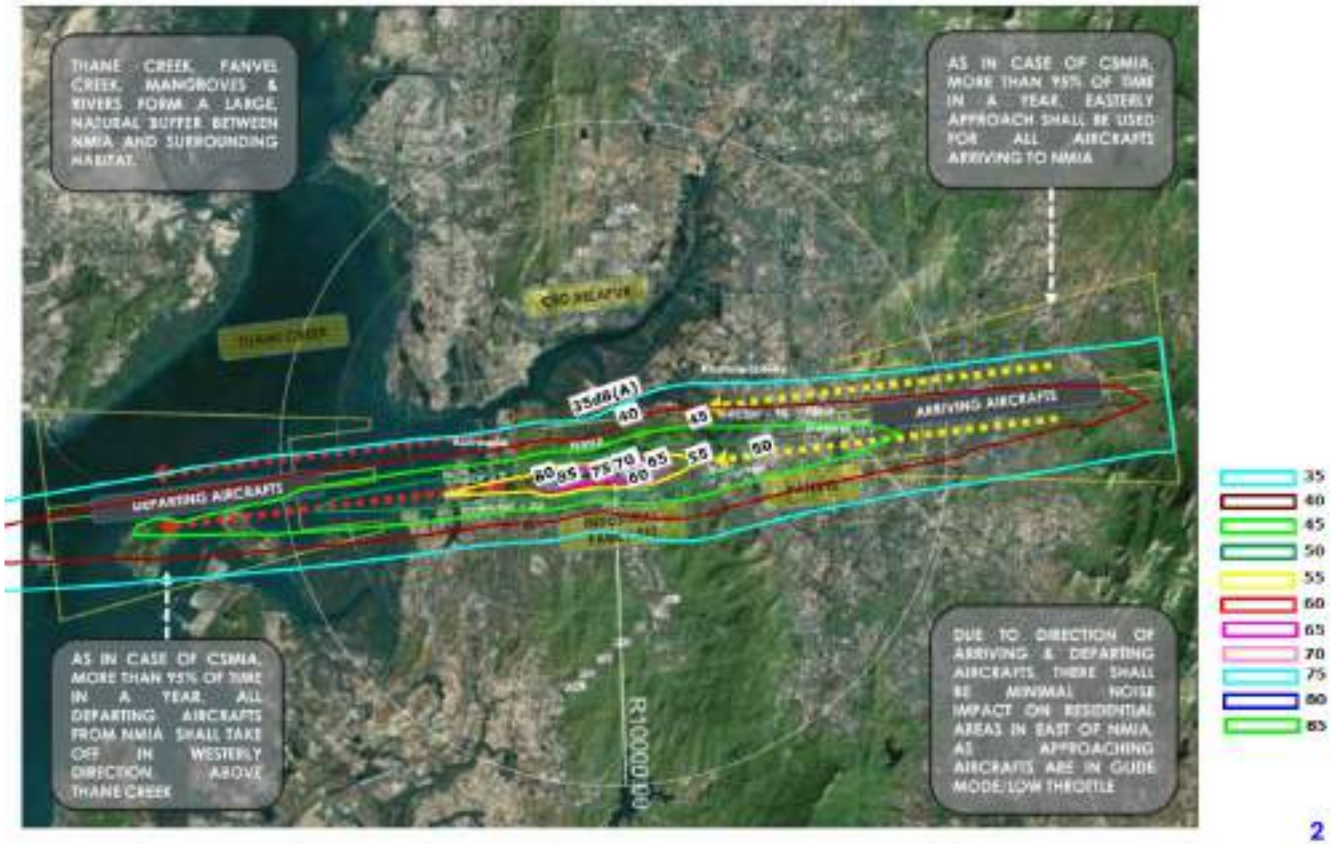


FIGURE-4.64
SCENARIO-II: 20 MPPA
DAY TIME AVERAGE NOISE LEVEL CONTOURS

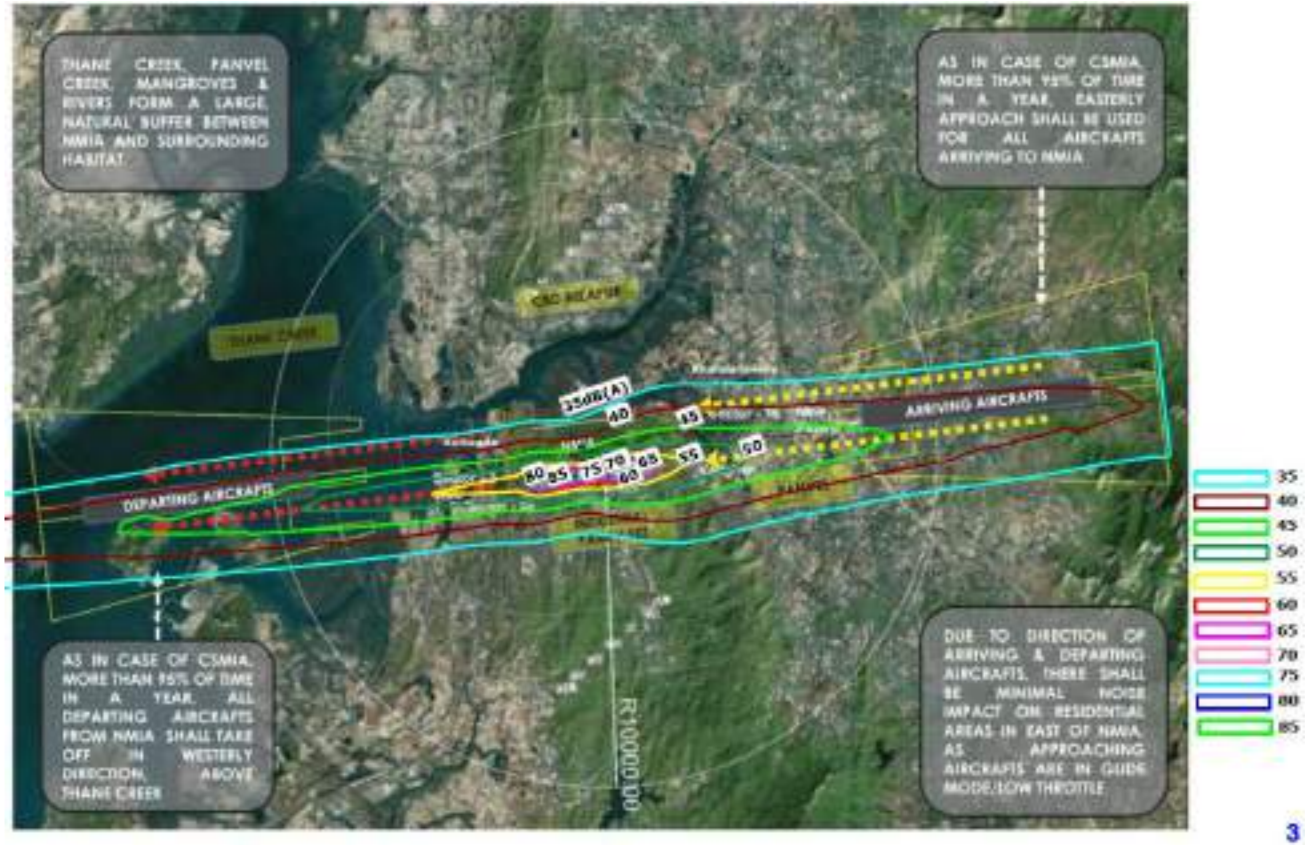


FIGURE-4.65
SCENARIO-II: 20 MPPA
NIGHT TIME AVERAGE NOISE LEVEL CONTOURS

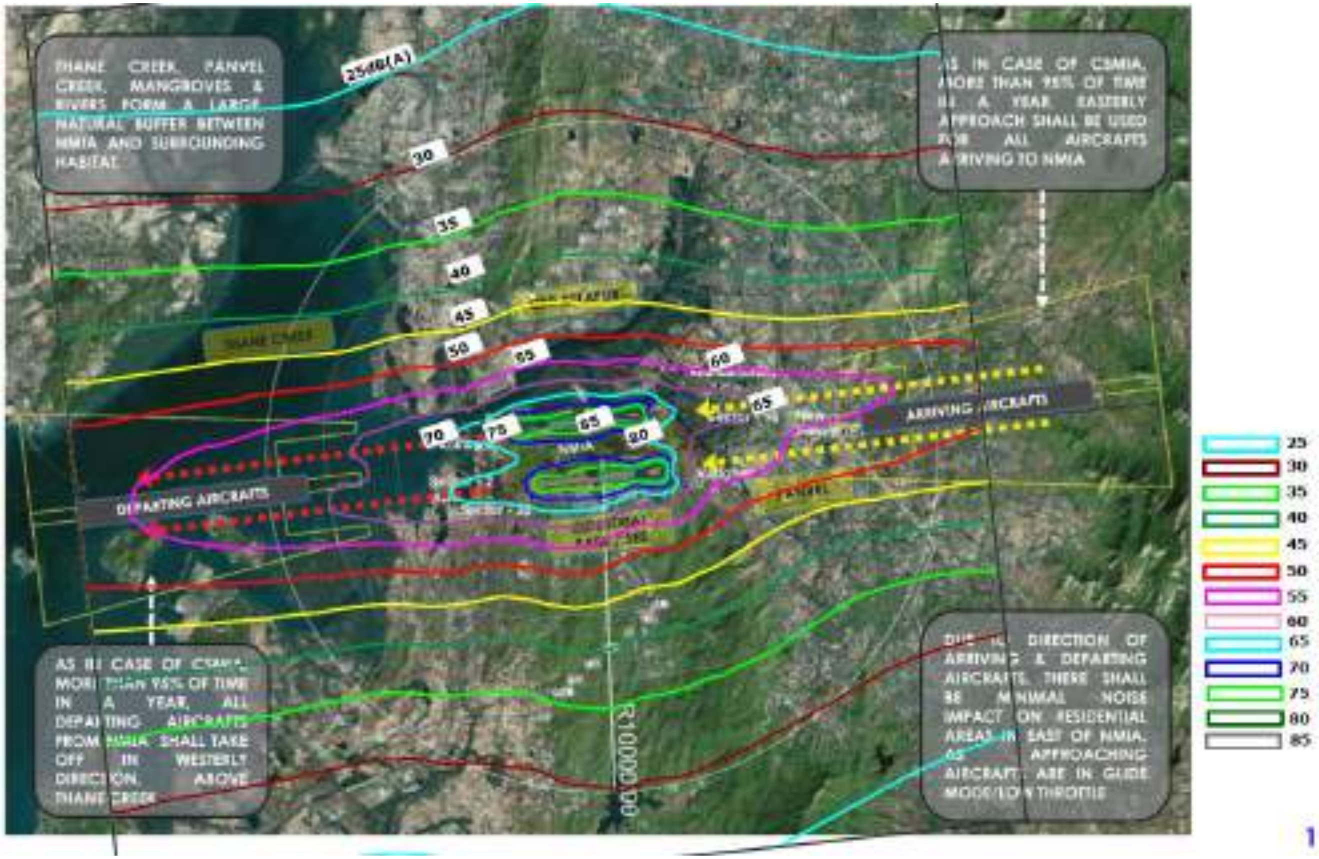


FIGURE-4.66
SCENARIO-III: 40 MPPA
NOISE CONTOURS -LAEQ

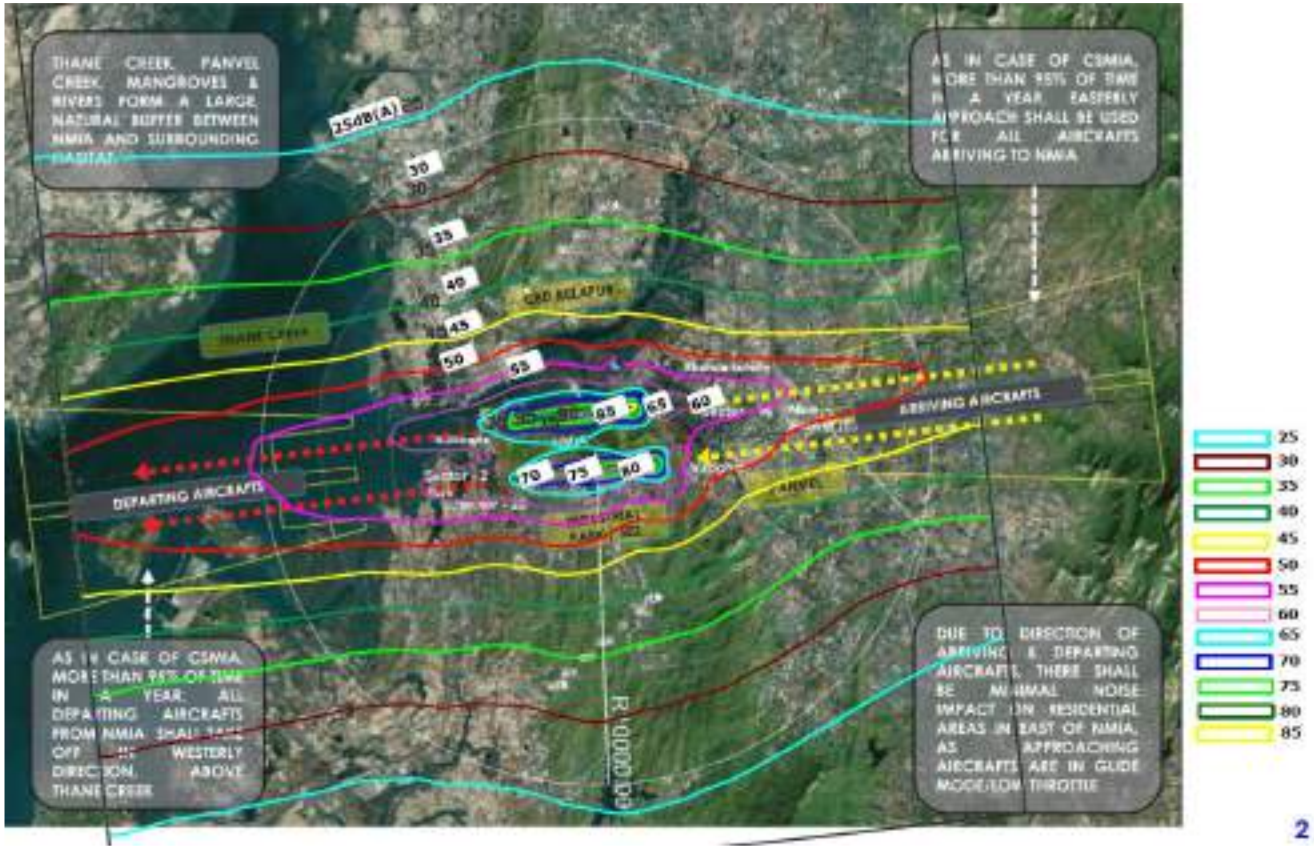


FIGURE-4.67
SCENARIO-III: 40 MPPA
DAY TIME AVERAGE NOISE LEVEL CONTOURS

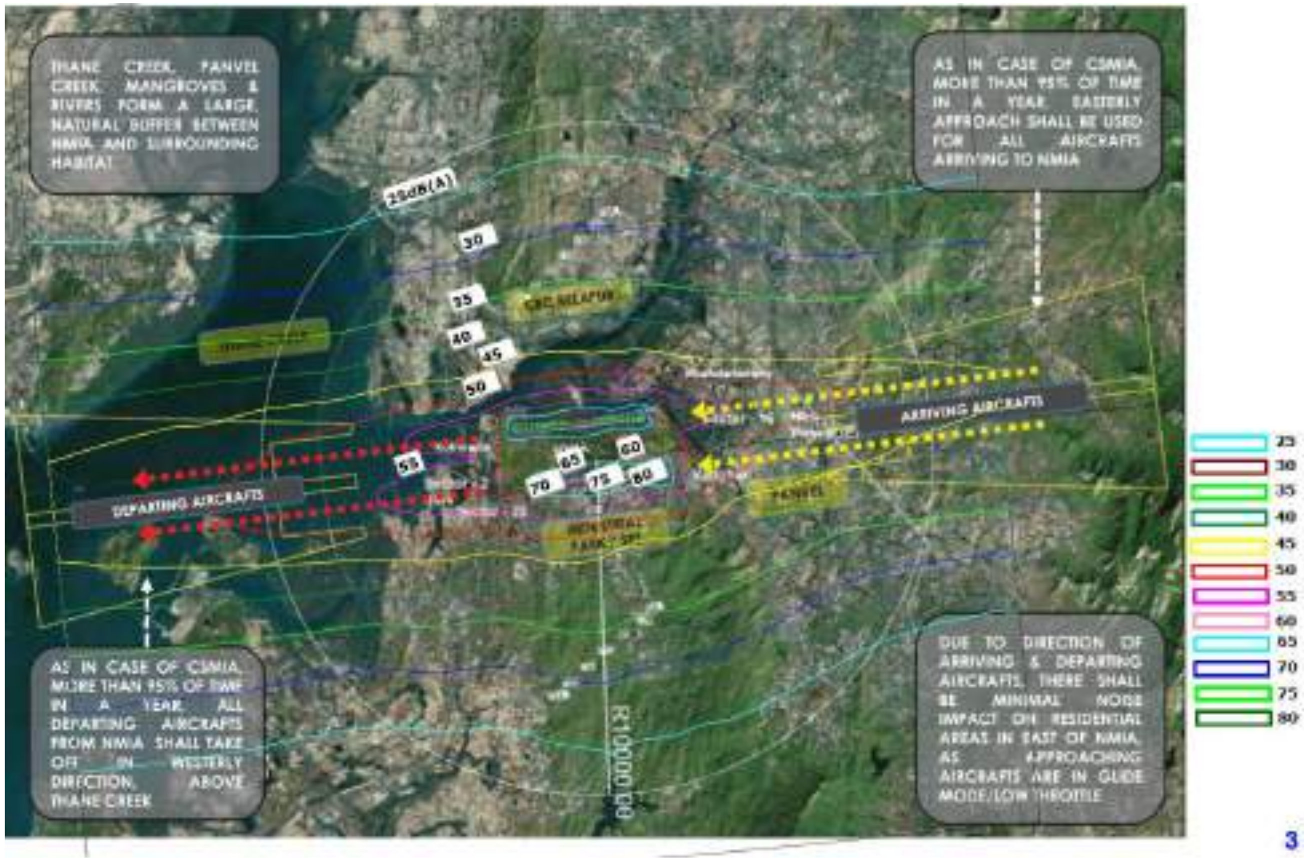


FIGURE-4.68
SCENARIO-III: 40 MPPA
NIGHT TIME AVERAGE NOISE LEVEL CONTOURS

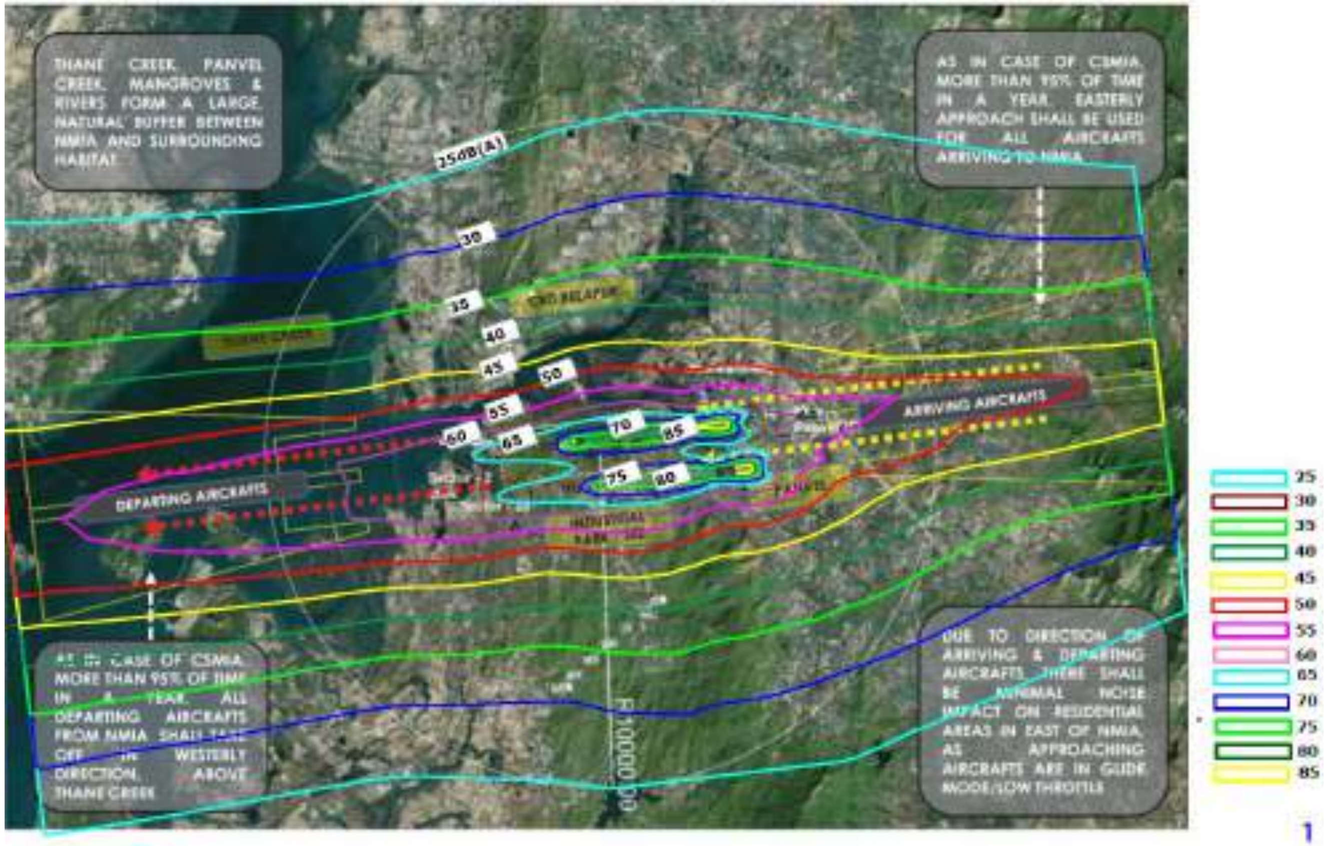


FIGURE-4.69
SCENARIO-IV: 60 MPPA
NOISE CONTOURS -LAEQ

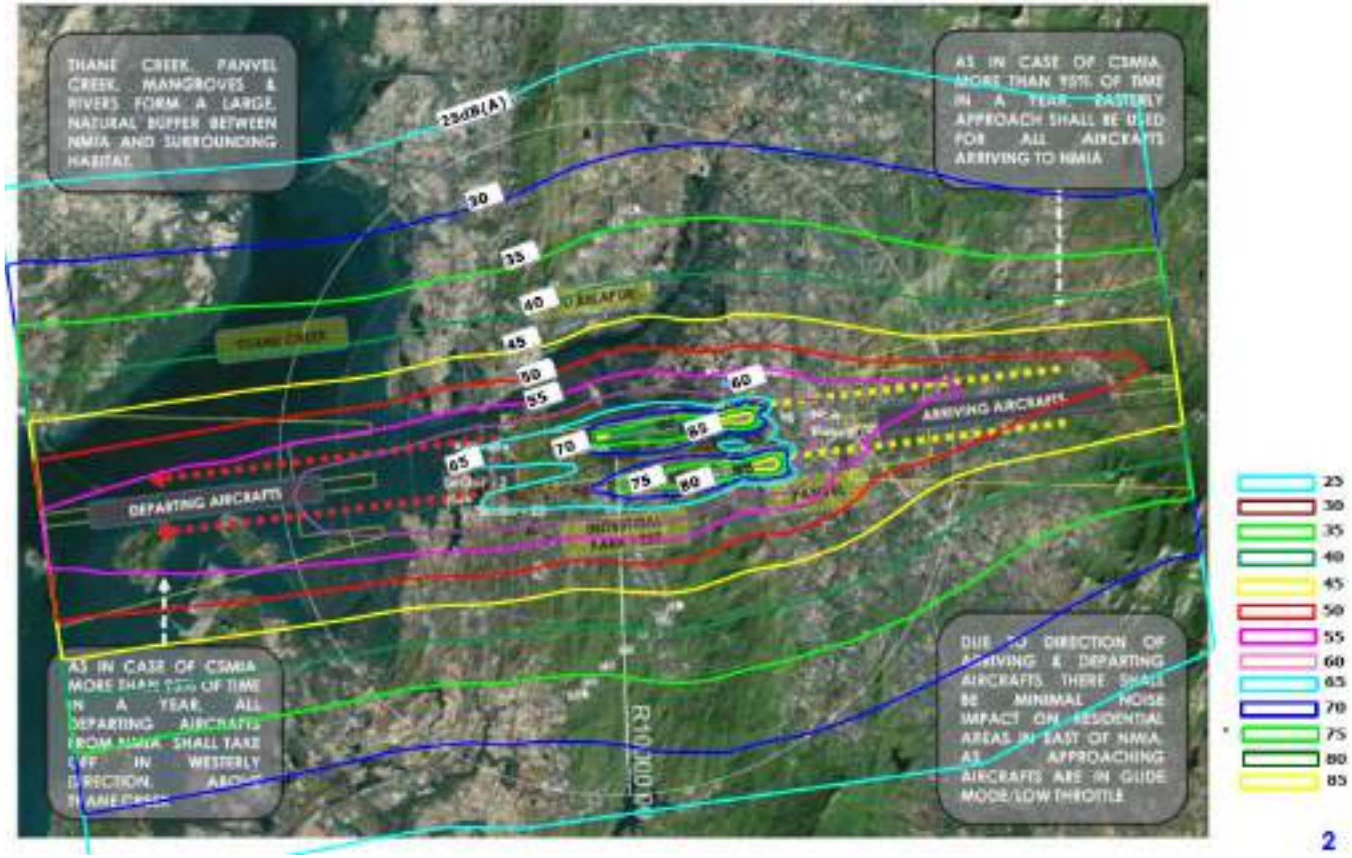


FIGURE-4.70
SCENARIO-IV: 60 MPPA
DAY TIME AVERAGE NOISE LEVEL CONTOURS

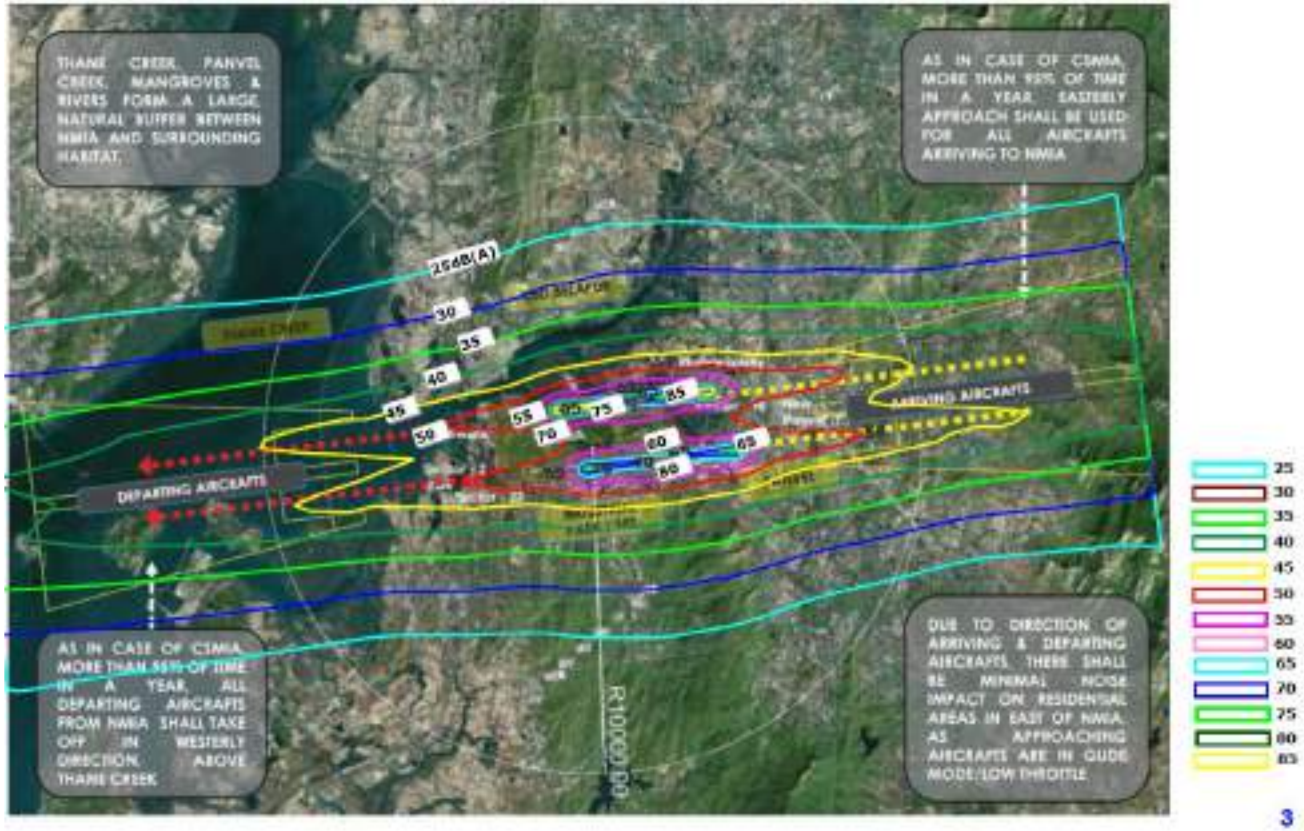


FIGURE-4.71
SCENARIO-IV: 60 MPPA
NIGHT TIME AVERAGE NOISE LEVEL CONTOURS

TABLE-4.51
NOISE LEVELS AND AREA OF INFLUENCE: PHASE-I

Sr. No	Noise Levels in dB(A)	Area of Influence in km²		
		LEAQD (Day Time)	LEAQN (Night Time)	LEAQ (24 Hour Equivalent)
1	85	0.5	0.4	0.5
2	80	0.7	0.6	0.7
3	75	0.8	0.7	0.8
4	70	1.6	1.2	1.1
5	65	3.2	2.8	2.9
6	60	5.5	4.5	5.1
7	55	8.9	8.1	8.5

Source: Output data of INM Model

TABLE-4.52
NOISE LEVELS AND AREA OF INFLUENCE: PHASE-II

Sr. No	Noise Levels in dB(A)	Area of Influence in km²		
		LEAQD (Day Time)	LEAQN (Night Time)	LEAQ (24 Hour Equivalent)
1	85	0.5	0.4	0.5
2	80	0.7	0.6	0.7
3	75	0.8	0.7	0.8
4	70	1.6	1.2	1.1
5	65	3.2	2.8	2.9
6	60	5.5	4.5	5.1
7	55	8.9	8.1	8.5

Source: Output data of INM Model

TABLE-4.53
NOISE LEVELS AND AREA OF INFLUENCE: PHASE-III

Sr. No	Noise Levels in dB(A)	Area of Influence in km²		
		LEAQD (Day Time)	LEAQN (Night Time)	LEAQ (24 Hour Equivalent)
1	85	0.5	0.4	0.5
2	80	0.7	0.6	0.7
3	75	0.8	0.7	0.8
4	70	1.6	1.2	1.1
5	65	3.2	2.8	2.9
6	60	5.5	4.5	5.1
7	55	8.9	8.1	8.5

TABLE-4.54
NOISE LEVELS AND AREA OF INFLUENCE DURING-PHASE-IV

Sr. No	Noise Levels in dB(A)	Area of Influence in km^2		
		LEAQD (Day Time)	LEAQN (Night Time)	LEAQ (24 Hour Equivalent)
1	85	0.4	0.5	0.4
2	80	0.5	0.8	0.5
3	75	0.8	1.0	0.7
4	70	1.4	1.6	1.2
5	65	2.1	2.4	2.3
6	60	4.9	5.2	4.8
7	55	9.2	8.6	8.8

Source: Output data of INM Model

The areas which are likely to be impacted by the air movements will increase in and likely to worsen the situation, as seen from the simulation, it can be practically inferred that the magnitude of change in noise impacts in terms of future flight frequency is likely to vary the consequence and may affect population. The residential colonies falling within the funnel zone like those in Panvel, near Ulwe Sector-5 and near Panvel Market Yard will be affected, particularly since the international peak hours occur in the late evening and night and the domestic peak hours occur during day time in the morning and at the end of the day.

However, the noise modeling has been executed based on the assumption that the all the type of aircrafts will be operated which is not the case. There will be a scope for some further modest improvement in take-off/landing noise from future aircraft/engine designs which will further reduce the noise levels.

The outputs of the modeling exercise for this scenario are presented in scaled contours in **Figure-4.73** to **Figure-4.76** above and the area of influence of the predicted incremental noise levels are given in **Table-4.51** to **Table-4.54** above.

After comparing the scenarios, it can be concluded that the Phase I has lesser noise impact on the nearby settlements compared to other phases. It may be noted here that the aircraft induced noise levels are short lived and exists only during the take-off and landings of the aircrafts. The aircraft induced noise levels at the boundary of the airport are less than 70 dB(A), which is within the CPCB standards applicable for industrial zone.

4.3.6.2 Results of Aircraft Noise Modeling

Impact on Habitation

The Leq is the equivalent continuous sound level, which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is necessary because sound from noise source often fluctuates widely during a given period of time. The noise impact on habitation in funnel zone is given below **Table-4.55 (A to D)**.

TABLE-4.55 (A): PHASE-I: RESULTANT NOISE LEVELS IN FUNNEL ZONE

Expressed in dB(A)

Code	Name of Location	L_{day} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Day
N1	Site office (Project Site)	59.2	35.0	59.2	75
N2	Near CIDCO Office, Panvel (Funnel Zone)	59.1	45.0	59.3	65
N3	Ulwe, Sector-5 (Funnel Zone)	58.8	45.0	59.0	55
N4	Gavan Phata water tank	63.3	45.0	63.4	55
N5	CIDCO branch office, Sector-5 (Kalamboli)	60.7	35.0	60.7	55
N6	CIDCO Bhavan, CBD Belapur, Sector-10	64.0	35.0	64.0	65
N7	Pargaon high school	51.9	35.0	52.0	50
N8	CIDCO office, Kharghar, Sector-4	62.8	65.0	67.0	55
N9	CIDCO Guesthouse, Kille Gaothan	58.6	35.0	58.6	55
N10	Shirdhon	53.6	35.0	53.7	55
N11	Herdilia IT Park in TTC Industrial area	64.4	35.0	64.4	75
N12	Panvel market yard (Funnel Zone)	63.1	45.0	63.2	65
N13	Near Karnala Bird Sanctuary	50.2	35.0	50.3	55

Code	Name of Location	L_{night} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Night
N1	Site office (Project Site)	53.7	35.0	53.8	70
N2	Near CIDCO Office, Panvel (Funnel Zone)	53.0	40.0	53.2	55
N3	Ulwe, Sector-5 (Funnel Zone)	53.0	55.0	57.1	45
N4	Gavan Phata water tank	51.6	35.0	51.7	45
N5	CIDCO branch office, Sector-5 (Kalamboli)	53.0	35.0	53.1	45
N6	CIDCO Bhavan, CBD Belapur, Sector-10	52.7	35.0	52.8	55
N7	Pargaon high school	43.8	60.0	60.1	40
N8	CIDCO office, Kharghar, Sector-4	54.1	35.0	54.2	45
N9	CIDCO Guesthouse, Kille Gaothan	48.8	35.0	49.0	45
N10	Shirdhon	42.6	35.0	43.3	45
N11	Herdilia IT Park in TTC Industrial area	59.2	35.0	59.2	70
N12	Panvel market yard (Funnel Zone)	52.2	40.0	52.5	55
N13	Near Karnala Bird Sanctuary	44.2	35.0	44.7	45

TABLE-4.55 (B): PHASE-II: RESULTANT NOISE LEVELS IN FUNNEL ZONE

Expressed in dB(A)

Code	Name of Location	L_{day} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Day
N1	Site office (Project Site)	59.2	35.0	59.2	75
N2	Near CIDCO Office, Panvel (Funnel Zone)	59.1	40.0	59.2	65
N3	Ulwe, Sector-5 (Funnel Zone)	58.8	55.0	60.3	55
N4	Gavan Phata water tank	63.3	45.0	63.4	55
N5	CIDCO branch office, Sector-5 (Kalamboli)	60.7	35.0	60.7	55
N6	CIDCO Bhavan, CBD Belapur, Sector-10	64.0	35.0	64.0	65
N7	Pargaon high school	51.9	55.0	56.7	50

Code	Name of Location	L_{day} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Day
N8	CIDCO office, Kharghar, Sector-4	62.8	35.0	62.8	55
N9	CIDCO Guesthouse, Kille Gaothan	58.6	35.0	58.6	55
N10	Shirdhon	53.6	35.0	53.7	55
N11	Herdilia IT Park in TTC Industrial area	64.4	35.0	64.4	75
N12	Panvel market yard (Funnel Zone)	63.1	50.0	63.3	65
N13	Near Karnala Bird Sanctuary	50.2	35.0	50.3	55

Code	Name of Location	L_{night} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Night
N1	Site office (Project Site)	53.7	35.0	53.8	70
N2	Near CIDCO Office, Panvel (Funnel Zone)	53.0	40.0	53.2	55
N3	Ulwe, Sector-5 (Funnel Zone)	53.0	50.0	54.8	45
N4	Gavan Phata water tank	51.6	45.0	52.5	45
N5	CIDCO branch office, Sector-5 (Kalamboli)	53.0	35.0	53.1	45
N6	CIDCO Bhavan, CBD Belapur, Sector-10	52.7	35.0	52.8	55
N7	Pargaon high school	43.8	65.0	65.0	40
N8	CIDCO office, Kharghar, Sector-4	54.1	35.0	54.2	45
N9	CIDCO Guesthouse, Kille Gaothan	48.8	35.0	49.0	45
N10	Shirdhon	42.6	35.0	43.3	45
N11	Herdilia IT Park in TTC Industrial area	59.2	35.0	59.2	70
N12	Panvel market yard (Funnel Zone)	52.2	45.0	53.0	55
N13	Near Karnala Bird Sanctuary	44.2	35.0	50.3	45

TABLE-4.55 (C): PHASE-III: RESULTANT NOISE LEVELS IN FUNNEL ZONE

Expressed in dB(A)
Expressed in dB(A)

Code	Name of Location	L_{day} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Day
N1	Site office (Project Site)	59.2	70.0	70.3	75
N2	Near CIDCO Office, Panvel (Funnel Zone)	59.1	60.0	62.6	65
N3	Ulwe, Sector-5 (Funnel Zone)	58.8	60.0	62.5	55
N4	Gavan Phata water tank	63.3	55.0	63.9	55
N5	CIDCO branch office, Sector-5 (Kalamboli)	60.7	40.0	60.7	55
N6	CIDCO Bhavan, CBD Belapur, Sector-10	64.0	45.0	64.1	65
N7	Pargaon high school	51.9	75.0	75.0	50
N8	CIDCO office, Kharghar, Sector-4	62.8	40.0	62.8	55
N9	CIDCO Guesthouse, Kille Gaothan	58.6	55.0	60.2	55
N10	Shirdhon	53.6	35.0	53.7	55
N11	Herdilia IT Park in TTC Industrial area	64.4	30.0	64.4	75
N12	Panvel market yard (Funnel Zone)	63.1	45.0	63.2	65
N13	Near Karnala Bird Sanctuary	50.2	30.0	50.2	55

Code	Name of Location	L_{night} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Night
N1	Site office (Project Site)	53.7	70.0	70.1	70
N2	Near CIDCO Office, Panvel (Funnel Zone)	53.0	55.0	57.1	55
N3	Ulwe, Sector-5 (Funnel Zone)	53.0	60.0	60.8	45
N4	Gavan Phata water tank	51.6	50.0	53.9	45
N5	CIDCO branch office, Sector-5 (Kalamboli)	53.0	40.0	53.2	45
N6	CIDCO Bhavan, CBD Belapur, Sector-10	52.7	45.0	53.4	55
N7	Pargaon high school	43.8	70.0	70.0	40
N8	CIDCO office, Kharghar, Sector-4	54.1	35.0	54.2	45
N9	CIDCO Guesthouse, Kille Gaothan	48.8	50.0	52.5	45
N10	Shirdhon	42.6	25.0	42.7	45
N11	Herdilia IT Park in TTC Industrial area	59.2	30.0	59.2	70
N12	Panvel market yard (Funnel Zone)	52.2	45.0	53.0	55
N13	Near Karnala Bird Sanctuary	44.2	25.0	44.3	45

TABLE-4.55 (D): PHASE-IV: RESULTANT NOISE LEVELS IN FUNNEL ZONE

Expressed in dB(A)

Code	Name of Location	L_{day} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Day
N1	Site office (Project Site)	59.2	60.0	62.6	75
N2	Near CIDCO Office, Panvel (Funnel Zone)	59.1	70.0	70.3	65
N3	Ulwe, Sector-5 (Funnel Zone)	58.8	65.0	65.9	55
N4	Gavan Phata water tank	63.3	65.0	67.2	55
N5	CIDCO branch office, Sector-5 (Kalamboli)	60.7	50.0	61.1	55
N6	CIDCO Bhavan, CBD Belapur, Sector-10	64.0	50.0	64.2	65
N7	Pargaon high school	51.9	70.0	70.1	50
N8	CIDCO office, Kharghar, Sector-4	62.8	45.0	62.9	55
N9	CIDCO Guesthouse, Kille Gaothan	58.6	55.0	60.2	55
N10	Shirdhon	53.6	35.0	53.7	55
N11	Herdilia IT Park in TTC Industrial area	64.4	40.0	64.4	75
N12	Panvel market yard (Funnel Zone)	63.1	65.0	67.2	65
N13	Near Karnala Bird Sanctuary	50.2	30.0	50.2	55

Code	Name of Location	L_{night} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Night
N1	Site office (Project Site)	53.7	55.0	57.4	70
N2	Near CIDCO Office, Panvel (Funnel Zone)	53.0	55.0	57.1	55
N3	Ulwe, Sector-5 (Funnel Zone)	53.0	50.0	54.8	45
N4	Gavan Phata water tank	51.6	50.0	53.9	45
N5	CIDCO branch office, Sector-5 (Kalamboli)	53.0	45.0	53.6	45

Code	Name of Location	L_{night} Levels			CPCB Norms
		Baseline Noise Levels	Incremental Noise	Resultant Noise	Night
N6	CIDCO Bhavan, CBD Belapur, Sector-10	52.7	40.0	52.9	55
N7	Pargaon high school	43.8	65.0	65.0	40
N8	CIDCO office, Kharghar, Sector-4	54.1	30.0	54.1	45
N9	CIDCO Guesthouse, Kille Gaothan	48.8	40.0	49.3	45
N10	Shirdhon	42.6	25.0	42.7	45
N11	Herdilia IT Park in TTC Industrial area	59.2	25.0	59.2	70
N12	Panvel market yard (Funnel Zone)	52.2	60.0	60.7	55
N13	Near Karnala Bird Sanctuary	44.2	25.0	44.3	45

4.3.6.3 Noise Exposure Forecast

Flight patterns by aircraft type and frequency are determined for NMIA by using master plan. The duration and frequency of noise that will be generated are estimated and noise level contours are drawn on a map of the airport area. The Noise Exposure Forecast (NEF) contours for the ultimate phase – 60 MPPA has been derived by the distance from site to the center of the area covered by the principal runways. NEF-30 contour at any distance of less than the distance between the NEF-30 and NEF-40 is normally acceptable. The comparison of the area falling under NEF-30, 35 and 40 are given below in **Table-4.56.**

- The impact of noise having the sensitive 30, 35 and 40 NEF [Noise Exposure Forecast] contours for all the four phases;
- Zoning restrictions would protect the future development from having noise sensitive activities locating in areas where noise exposure would exceed the 30 NEF contour; and
- A quick comparison of the area falling under different contours indicates that the land area affected by aircraft noise increases as the airport traffic increases.

TABLE-4.56
AREA FALLING NEF CONTOUR VALUES

Stage	Area Within 30 NEF Contour	Area Within 35 NEF Contour	Area With 40 NEF Contour
Units	**Sq.km^2**	**Sq.km^2**	**Sq.km^2**
Phase-I	7	5	3
Phase-II	8	5	4
Phase-III	13	11	8
Phase-IV	18	14	10

Based on ICAO standards, future aircraft noise impacts are measured using the Noise Exposure Forecast (NEF). NEF contours considered are 30, 35 & 40 NEF contours. Land areas outside the 30 NEF contour are considered to be exposed to aircraft noise higher than 40 NEF. The NEF contours provided have been modelled as individual directions as the airport is planned to operate predominately in one direction all day by switches direction depending on the season. In present scenario, it is assumed that both runways having equal operational aircrafts handling capabilities for the entire day. Hence, the mixed traffic was assigned so as to split it equally among both runways.

NEF on Ecological Sensitive Locations

- ✓ The maximum-level-based noise output has been used in noise modelling for NMIA;
- ✓ Map shown below presents the noise contours (NEF) in the vicinity of the airport obtained from the INM model;
- ✓ The covered area also includes the Karnala Bird Sanctuary located 9.6 km south east from the NMIA site;
- ✓ From the maps, Karnala Bird Sanctuary will be exposed to a maximum noise level of less than 15 NEF during the long-term operation of the NMIA airport; and
- ✓ The noise level perceived at the Karnala Bird Sanctuary is about 10 dBA Leq.

Impact of Noise upon Elephanta Caves (Gharapuri, 11.3 km West)

The Elephanta Caves are located at about 11.3 km west of the NMIA project site. In the proposed airport, the pre-dominant landings will be from the east (about 92%). So, the take-offs will be in the westerly direction. The estimated altitude of the flights near the Elephanta caves will above 500 m. The aircraft induced noise contours will be less than 15 NEF. Thus, it can be concluded that aircraft noise will have very negligible impact.

LAND USE GUIDANCE'S (LUG) ZONES

- ✓ In 1977, United States Federal Aviation Administration (FAA) issued Advisory Circular on Noise control and land use compatibility and planning AC 150/50201-1.
- ✓ It describes land use guidance's (LUG) zones corresponding to aircraft noise of varying levels as measured by four different noise metrics as given in table below;
- ✓ It also includes suggested land use noise sensitivity guidelines;
- ✓ According to the LUG noise metrics classification, the Karnala Bird Sanctuary would be in the Land Use Guidance Zone A which is within permissible limits;
- ✓ As regards to the small area falling in Funnel, near the airport on either side for which the standard instrument arrival and departure procedure will be so designed to minimize the noise limits within permissible limits.

Landuse guidance chart for airport noise interpolation given in **Table-4.57**.

TABLE-4.57
LANDUSE GUIDANCE CHART FOR AIRPORT NOISE INTERPOLATION

LAND USE GUIDANCE ZONES (LUG)	NOISE EXPOSURE CLASS	INPUTS: AIRCRAFT NOISE ESTIMATING METHODOLOGIES				HUD NOISE ASSESSMENT GUIDELINES (1977)	SUGGESTED NOISE CONTROLS
		Ldn DAY-NIGHT AVERAGE SOUND LEVEL	NEF NOISE EXPOSURE FORECAST	CNR COMPOSITE NOISE RATING	CNEL COMMUNITY NOISE EQUIVALENT LEVEL		
A	MINIMAL EXPOSURE	O TO 55	O TO 20	0 TO 90	O TO 55	'CLEARLY ACCEPTABLE'	NORMALLY REQUIRES NO SPECIAL CONSIDERATIONS
B	MODERATE EXPOSURE	55 TO 65	20 TO 30	90 TO 100	55 TO 65	'NORMALLY ACCEPTABLE'	LANDUSE CONTROLS SHOULD BE CONSIDERED
C	SIGNIFICANT EXPOSURE	65 TO 75	30 TO 40	100 TO 115	65 TO 75	'NORMALLY UNACCEPTABLE'	NOISE EASEMENTS, LAND USE, AND OTHER COMPATIBILITY CONTROLS RECCOMENDED
D	SEVER EXPOSURE	75 & HIGHER	40 & HIGHER	115 & HIGHER	75 & HIGHER	'CLEARLY UNACCEPTABLE'	CONTAINMENT WITHIN AIRPORT BOUNDARY OR USE OF POSITIVE COMPATIBILIYU CONTROLS RECCOMENDED

Noise Mitigation Measures

- ✓ NMIAL will take-up mitigating measures for any impacts on the surrounding community due to the operations and to comply with the applicable regulatory requirements;
- ✓ NMIAL will implement noise abatement procedures post study based upon the International Civil Aviation Organization (ICAO) Guidelines;
- ✓ Noise modeling and contouring is done for effective analysis and further implementation of noise abatement measures; and
- ✓ NMIAL ensure that the ambient noise levels are in compliance with applicable regulatory requirements.

Noise Abatement Measures

- ✓ Construction of rapid exit taxiways which reduces taxing time of the aircraft.
- ✓ Single engine taxiing.
- ✓ Implementation of reverse thrust procedure.
- ✓ Continuous Descent Approach (CDA).
- ✓ Continuous Climb Operations (CCO).
- ✓ Dedicated engine run-up area.
- ✓ Fixed electrical ground power & pre-conditioned air at all aerobridges.
- ✓ Restriction on use of Auxiliary Power Units (APUs); and
- ✓ Initiatives for implementing silent terminal concept to reduce indoor noise levels.

The negative impact of aircraft noise, in particular around airport, may increase. More and more people suffer not only from annoyance, but recent studies indicate that intermediate and high noise levels also contribute to physiological and psychological effects that in extreme cases can cause severe health problems. The aircraft industry has launched an ambitious plan for the next 15 years to reduce the noise emission levels from aircraft by as much as 20 dB(A). Even if this goal can be reached, reduced noise emission levels for new aircraft will have little or no influence on the total noise situation around airports in future. This is due to a slow renewal rate for aircraft combined with an increase in passenger volume. In order to stay competitive and to cope with an increasing number of neighborhood complaints and noise-impact related constraints, airport will have to look for novel solutions to reduce noise emission levels. The International Civil Aviation Organization (ICAO) has defined a four-point "balanced approach" that includes:

- Reduction of noise at source:

  The new and latest aircrafts which are designed with minimum source noise levels shall be allowed at the airports.

- Land-use-planning

  Proper land use planning with super-imposition of probable noise contours will help reduce the noise induced health impacts.

- Noise abatement operational procedures

Of all the activities that take place in an airport, the main sources of noise are aircraft take-off and landing operations. In this regard, the measures put into practice aimed at reducing the inconvenience, the noise causes for the surrounding population are set out in the framework of the "balanced approach" adopted by the International Civil Aviation Organisation (ICAO) in the resolution of Assembly A33-7 of October 2001 and ratified by resolution A36-2 of September 2007.

The balanced approach provides ICAO contracting States with an internationally agreed approach to dealing with the problem of noise in airports. The approach comprises four main elements: reduction of noise at the source, land-use planning and management, noise-reduction procedures and operations and restrictions on aircraft operations. This line of work is complemented by adopting other measures that are equally important, such as ongoing impact assessments carried out by control and monitoring systems, information provided to local authorities, stakeholders and the general public on aspects of the environment, the collaboration of various sector agents which allow to identify areas of improvement, and the implementation of corrective measures through noise abatement plans which guarantee the fulfilment of noise quality objectives inside buildings.

The noise levels of the airport will be around 60 dB(A) near the boundaries and about 85-90 dB(A) near the runway during aircraft movement. The specifications for procuring major noise generating machines/ equipment will include built in design requirements to have minimum noise levels meeting Occupational Safety & Health Association (OSHA) requirement. Appropriate noise barriers/shields, silencers will be provided, wherever feasible.

The practices proposed for noise attenuation are as follows:

- Strict adherence to DGCA/ICAO prescribed environmental guidelines & circulars on airport operations.
- Restricted usage of ground engine run-ups to reduce noise.
- Restricted use of thrust reversal while landing of aircraft to minimize noise in lateral direction.
- Aircrafts with certified engines only shall be allowed to land and take-off to the extent possible to reduce the noise impacts on the surroundings.
- Dual nozzle in the aircraft will reduce the noise levels.
- Proper scheduling of the aircrafts to minimize the noise levels.
- Switching off as many engines as possible during idling and taxing.
- Proper maintenance of ground servicing equipment.
- Use of damping materials such as thin rubber/ lead sheet for wrapping the workplaces like compressor room, DG room etc.;
- Maintenance of vehicles to reduce noise levels.
- Personnel working in noisy areas shall be provided with ear plugs/mufflers to reduce the noise impacts;
- The DG sets shall be provided with acoustic enclosures and exhaust mufflers for effective noise reduction of 25 dB(A) each;
- Sources of intermittent noise generating equipment such as compressors will be provided with appropriate acoustic barriers so that the noise level within 100 m of these facilities when in operation will be less than 70 dBA; and
- Noise attenuating green belt / green cover shall be developed for effective reduction in noise wherever feasible taking local meteorology into consideration.

4.3.6.4 Impact Due to Noise from Aircraft Operations on Archaeological/ Eco-Sensitive Sites Within Study Area of NMIA

The fringe area i.e. study area around the proposed airport falling between 10 to 20 km radius revealed that there are 3 places of historic importance, aesthetic, cultural including sensitive area namely the Elephanta caves, Karnala bird sanctuary and Matheran Eco-sensitive Area. Similarly, the ESZ boundary of the Thane Creek Flamingo Sanctuary (TCFS) falls at a distance 9.2 km North-West of the project boundary while the TCFS is present beyond the study area boundary of the project. The anticipated impacts due to construction activity es explained below:

- Elephanta caves lies at 11.3 km west at Gharapuri island from NMIA project site and falls outside study area. The island is named after a colossal elephant found in the island, which is popularly known as ‘Gharapuri’. The Elephanta site fails in the landing and take-off funnel of Navi Mumbai International Airport. Based on the assessment of the flight path, it is estimated that the position of aircraft during takeoff/landing/missed approach/circling above the Elephanta site would be more than 500 m. The construction development of the airport will have no impact on Elephanta island as it lies on a detached landform (in an island) away from the NMIA project area.

- Karnala Bird Sanctuary (KBS) is situated along the Mumbai-Goa-Konkan National Highway No.17 and is 9.6 km south-east of the project site and falls within the study area. The Karnala Bird sanctuary does not fall within the funnel zone of NMIA. Although, the ESZ boundary of the KBS lies at 2.5 km South-East of the project boundary. It may be affected by the enhancement of multi-modal transport corridor in the influence zone of the NMIA. Noise nuisance may be caused due to increased traffic in the nearby roads and construction activities thereof; and

- Matheran Eco-sensitive zone is located at distance of 9.3 km ENE of NMIA boundary. The mentioned site falls in the fringe of landing and takeoff funnel of Navi Mumbai International Airport. Standard instrument arrival and departure procedure shall be designed to minimise the noise levels within the permissible limits for the area falling in the funnel near the airport on either side. The matter has been already taken up with AAI/DGCA to work out SID & STAR.

- TCFS ESZ boundary and the TCFS does not fall within the funnels zone of the NMIA landings and take-offs, therefore impact due to noise from the aircrafts is not anticipated.

4.3.7 Impact Due to Solid Waste

Solid Waste Management System is planned for Navi Mumbai International Airport (NMIA) to ensure hygienic and healthy living/ working environment at the airport. In this section, the approach for managing waste from airport facilities with associated activities like source of waste generation, types of waste generated, management of the generated waste and disposal methods are explained.

The major solid waste contributing facilities include terminals, hospitality, cargo and other airport related buildings. The characteristics of the solid waste generated is of typical municipal waste along with hazardous wastes from specific facilities, consisting of plastic, metal, paper, cardboard, pet bottles, used oils and bio-medical waste. Non-hazardous construction and demolition waste from proposed infrastructure development include metals, wood, food, asphalt and debris.

4.3.7.1 Estimation of Solid Waste Quantity Phase-Wise

The estimated total solid waste generation quantity for Phase-I (10 MPPA) is about 17.00 Tonnes / Day, Phase-II (20 MPPA) is about 29.00 Tonnes / Day, Phase-III (40 MPPA) is about 55.00 Tonnes / Day, Final Phase (60 MPPA) is about 77.00 Tonnes / Day. This works out to about 0.4 to 0.6 kg/passenger/ day. The area requirement for solid waste management are given in **Table-4.58.**

TABLE-4.58
AREA REQUIREMENT FOR SOLID WASTE HANDLING FACILITY

Sr No	Developmental Phases	Quantity (Tonnes/ Day)	Area Required (Sq. m)
1	Phase – 1 10 MPPA	17.00	2652
2	Phase – 2 20 MPPA	29.00	4524
3	Phase – 3 40 MPPA	50.00	7800
4	Final Phase 60 MPPA	72.00	11232

Note: Area as calculated is based on about 60 Sq. m /T for handling + 60 sqm / T for processing/ Treatment and additional 30% of buffer zone considered.

4.3.7.2 Solid Waste Management

The wastes generated have to be managed after segregation by identifying the appropriate method of management. Recyclable wastes such as paper, glass, metal, plastics (from domestic and commercial activities), wood, waste oil and solvents (from maintenance and engineering operations), kitchen wastes and vegetable oils (from restaurants, food courts etc.) must be effectively done. The green wastes from landscape/ gardens shall be used in bio-conversion processes. The three R's; popularly known method of Solid Waste Management shall be implemented at all users ends irrespective of the activities involved.

Concept of R3 – Reduce Reuse Recycle

The following tasks are accounted as part of solid waste management:

- Identification of waste generation sources;
- Waste collection, storage & transportation;
- Waste segregation, handling and processing;
- Waste quantification and characterization; and
- Treatment & disposal of wastes to authorized recyclers.

The planned functional elements of Solid Waste Management (SWM) are as shown below in Figure-2.45 of Chapter-2**.** The phase-wise estimation of solid waste generation is given in **Table-4.59.**

TABLE-4.59
ESTIMATED SOLID WASTE GENERATION QUANTITY

Sr. No.	Waste Generation	Unit	Unit Generation Rate (Kg/Unit)	Phase-I 10 MPPA		Phase-II 20 MPPA		Phase-III 40 MPPA		Final Phase 60 MPPA		Remarks
				Value	Quantity (Tonnes/D)	Value	Quantity (Tonnes/D)	Value	Quantity (Tonnes / Day)	Value	Quantity (Tonnes / Day)	
1	Food waste and garbage from Terminal & PTB	Passenger	0.14	27397	3.836	54794	7.671	109589	15.342	164384	23.014	Unit quantity as per bench marked data
2	Flight Catering Facilities	Passenger	0.04	27397	1.096	54794	2.192	109589	4.384	164384	6.575	Unit quantity as per bench marked data
3	Cargo Handling	Tonnes of Cargo	4.27	-	2.000	-	5.000	-	9.000	-	14.000	Unit quantity as per Revised Mater Plan Report by Master Plan Report
4	Aircraft Maintenance	ATM	1	2115	2.115	3557	3.557	6123	6.123	8689	8.689	Unit quantity as per benchmarked data (ie 1 Kg / ATM
5	GSE	ATM	0.1	2115	0.211	3557	0.356	6123	0.612	8689	0.869	Unit quantity as per benchmarked data (ie. 100 g / ATM)
6	Medical Waste	Passenger	0.0003	27397	0.008	54794	0.016	109589	0.033	164384	0.049	Unit quantity as per bench marked data
7	Sludge from STP	STP capacity (MLD)	667	3	2.001	5	3.335	9	6.003	13	8.671	Unit quantity as per estimated capacity data
8	Separated Oil from STP	STP capacity (MLD)	83	3	0.249	5	0.415	9	0.747	13	1.079	Unit quantity as per estimated capacity data
9	Oily Waste	ATM	0.21	1000	0.210	2000	0.420	4000	0.840	6000	1.260	Unit quantity as per Revised Mater Plan Report by Master Plan Report
10	Other Solid Waste	LS	-	-	5	-	5.75	-	6.61	-	7.6	Considering 5.0 Tons. 15% increment is considered for future phases
Total Quantity (Tonnes / Day)					**16.73**		**28.71**		**49.70**		**71.81**	
Unit quantity per passenger (Kg/Passenger /Day)					**0.61**		**0.52**		**0.45**		**0.44**	

4.3.7.3 Solid Waste Management Plan

Waste Segregation & Storage

The best practice involved in effective solid waste management is the source segregation, safe storage, efficient transport and scientific disposal of waste. The municipal solid waste can be classified as paper waste, plastics, food waste and general waste from domestic / corporate activities. Source segregation from these sources can be achieved at ease with awareness and educating the users. These wastes have to be collected separately with provision of individual collection bins with labels and proper coding to avoid mixing of wastes. The hazardous waste shall be collected in separate storage bins and handled with proper care to avoid cross contamination. The method of source segregation will ease the handling, transportation, storage and processing of solid waste.

Primary Collection

The primary collection bins shall be placed within the premises of source of waste generation of various sizes depending on the quantity of waste generated. Wet waste shall be collected in bins with liners material to avoid leakage and fouling of waste in bins. The filled bins shall be brought outside and placed on roadside kerb every start of the day to ease the collection vehicle to pick-up the wastes. These bins are collected in scientific manner and transferred to solid waste processing centre.

Secondary Storage / Collection

The waste collected at primary collection points shall be transferred to a secondary collection / storage point if any. As airport operations run 24/7, it is necessary to establish secondary storage stations to avoid SWM activities interfering with the latter. All the primary bins shall be emptied into the large container of same category at secondary storage stations. The bins and containers shall be of sufficient capacity to handle the total waste generated in day. The collection activity shall be carried out once every day covering all the sources of generation.

Waste Processing Centre

The quantity of different types of waste is estimated after every day's collection activity. The recyclables and reusable materials are separated and stored separately. The remaining waste that has to be disposed is packed / stored for further process. The dry wastes are packed with proper labeling and shall be sent for land filling / treatment planned in situ.

The wet waste mostly the food waste along with green waste shall be sent to in-house bio-gas plant for bio-gas generation.

The waste processing center will be constructed to handle the waste generated by means of scientific methods of segregation, recycling and processing. The waste processing centre will house different cells with sufficient space required for all the activities of segregation, recycling, storage and processing of waste. The categorized waste shall be taken to the respective handling cells with container to store waste for final disposal.

Handling & Processing Locations

During Phase-I & II, a plot adjacent to proposed Sewage Treatment Plant (Plot No. U4) has been allocated for the solid waste management in the south-west of the airport. For the final establishment of the solid waste management system during the final phase of the project, Plot No. U6 north to the northern runway, has been identified. During Phase III, when the area to the north of the northern runway becomes available, the facility will be relocated to a similar sized but more appropriately located plot in the north of the airport further away from other facilities.

For catering to the requirement of eastern side, a collection center is allocated adjacent to the plot U4 on eastern side. The collected waste will be transported to the SWM facility in the western side for segregation and disposal. The layout plan showing details of identified location for solid waste processing center is shown in **Figure-4.72** and **Figure-4.73.** The solid waste collection and processing in the final phase is given in **Figure-4.74** and Figure-2.44 of Chapter-2.

FIGURE-4.72
LAYOUT PLAN SHOWING DETAILS OF IDENTIFIED LOCATION FOR SOLID WASTE PROCESSING CENTRE FOR PHASE–I AND PHASE–II

FIGURE-4.73
LAYOUT PLAN SHOWING DETAILS OF IDENTIFIED LOCATION FOR SOLID WASTE PROCESSING CENTRE FOR PHASE–III AND PHASE–IV

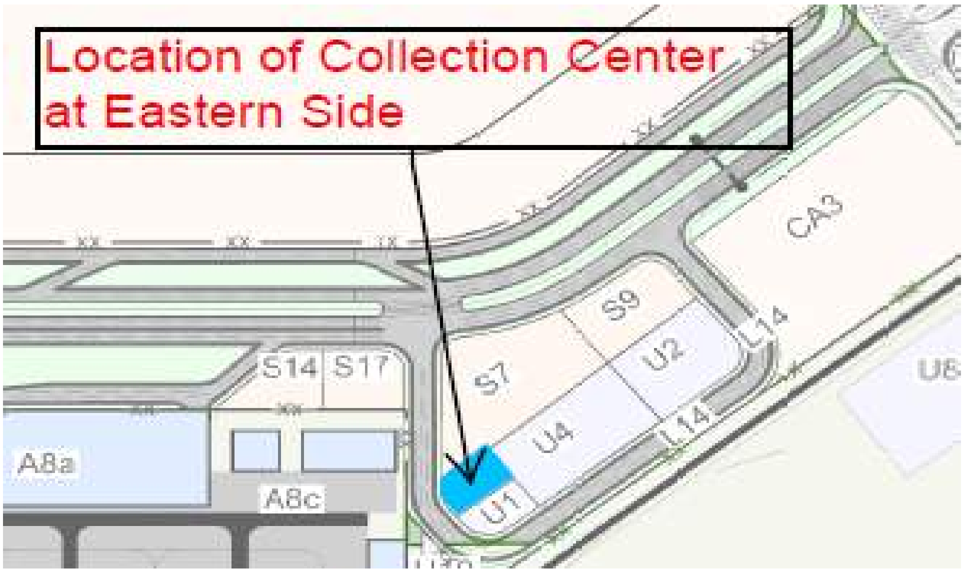


FIGURE-4.74
LAYOUT PLAN SHOWING DETAILS OF IDENTIFIED LOCATION FOR SOLID WASTE COLLECTION CENTRE

Collection Schedule and Routing Plan

The collection of waste is scheduled at daytime convenient to transport and processing of wastes. The locations of primary collection points / transfer stations is identified based on the land use and existing utility buildings. The routing of vehicle shall be planned to cover the major portion of the airport facilities at once avoiding repetitive traverse on the same route.

4.3.7.4 Detailed Solid Waste Management Plan

The components of Solid Waste Management Plan can be elucidated in **Figure-4.75** as below:

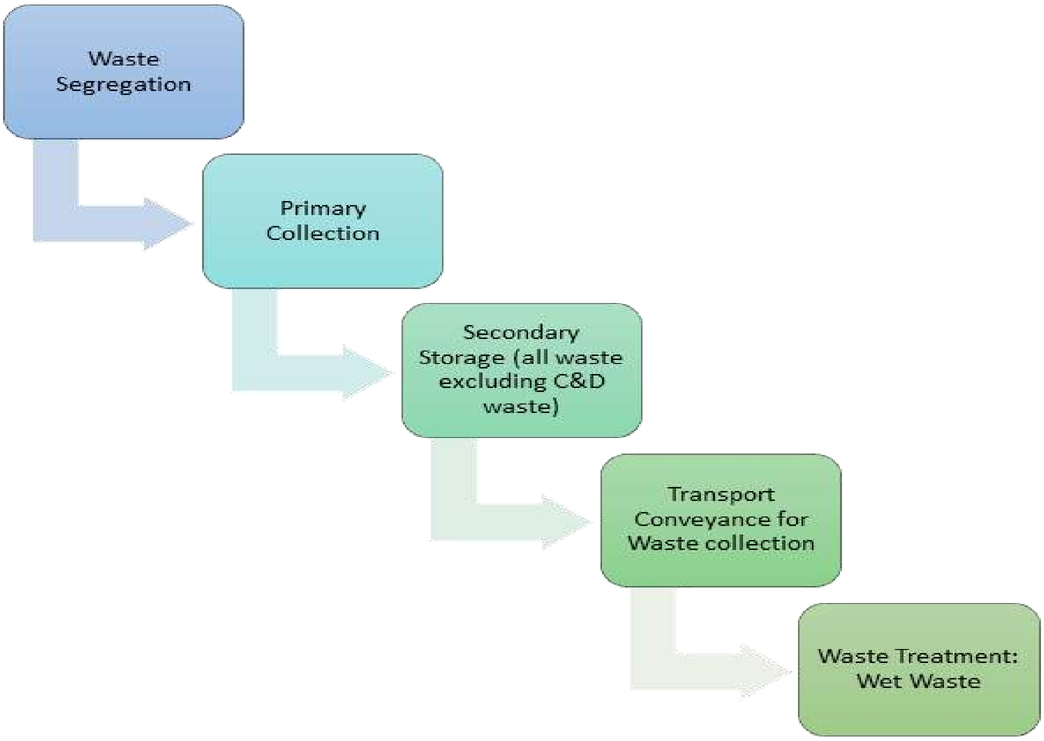


FIGURE-4.75
WASTE MANAGEMENT PLAN COMPONENTS

Waste Segregation

The best practice involved in effective solid waste management is the source segregation, safe storage, efficient transport and scientific disposal of waste. As per MoEF&CC guidelines in SWM 2016 4 (a); bulk generators of waste are required to segregate and store the waste generated by them in three separate streams namely bio-degradable, non-biodegradable and domestic hazardous wastes. The different streams of wastes will be collected separately with provision of individual collection bins with labels and proper coding to avoid mixing of wastes. The waste segregation guidelines are shown in **Figure-4.76.**

De-Plane Waste

For handling the sanitary waste generated from the aircrafts, Triturator facility is proposed, where waste from aircraft vacuum toilets will be received through lavatory trucks and triturating process (grinding/shredding) is completed before being disposing the waste into the sewerage system. The facility will be strategically located with consideration to:

- Catchment areas and minimum travel time and crossing of taxiways and taxi lanes;
- Proximity to main utilities connection points and facilities; and
- Under the ultimate scenario, a total of 3 Triturator facilities are proposed.

FIGURE-4.76
WASTE SEGREGATION

Other De-planed waste includes "galley waste" – materials typically collected by airline caterers as part of the de-catering process, including compactor boxes, waste carts (bags), food carts and bonded carts – which will be segregated as degradable and non-bio-degradable and will be managed along with the MSW collected at the airport.

The hazardous waste shall be collected in separate storage bins and handled with proper care to avoid cross contamination. The method of source segregation will ease the handling, transportation, storage, and processing of solid waste. As per the Municipal Corporation of Greater Mumbai, every generator of Municipal Solid Waste shall separate the waste at source of waste generation into the following six categories and shall store separately, without mixing it for delivery in authorized private/ public receptacles:

- Bio-degradable (wet) waste;
- Specified hazardous waste;

- Bio-medical waste;
- Construction and demolition waste;
- Bulk garden and horticulture waste including recyclable tree trimmings; and
- All other no bio-degradable (dry) waste including recyclable and non-recyclable waste.

Primary Collection

The primary collection bins shall be placed within the premises of source of waste generation of various sizes depending on the quantity of waste generated.

Proper collection bins are vital to the success of the recycling program. For these reasons, the decision of what bins to purchase, how they are labeled, and where they will be located is the most important decision to be made.

The type of collection bins used at airports is as unique as the airports. Some airports choose all-in-one systems that include compartments for recyclables and trash. Other airports use modular systems. A new trend in bins is the inclusion of advertising to utilize space above the bins to earn revenues.

- The best bins are those with clear labelling and design features that limit contamination;
- Be sure that each visible side of the bin is labelled;
- Mark the bins with words and pictures, so they are understandable to international passengers;
- Often, labelling "bottles and cans" rather than "glass, plastic, and aluminium" gives a stronger message, reducing confusion and contamination;

- The bag choice for inside of the bins is important as well. Using different coloured liners for the recycling bins allows the cleaning crew to easily keep track of what is recyclable and which central collection container it goes in;
- Other options include clear, see-through liners or half clear/half-colored liners;
- Placement of bins in high traffic areas and areas of material generation is important;
- Always place recycling containers next to trash cans to reduce contamination;
- It is important to check the waste bins often enough to keep them from overfilling and discouraging people from using the recycling bins for trash;
- Another way to prevent contamination is to buy bins with distinct openings (round for bottles and cans, slotted for paper) and different colored tops;
- Wet waste shall be collected in bins with liners material to avoid leakage and fouling of waste in bins;
- The filled bins shall be brought outside and placed on roadside kerb every start of the day to ease the collection vehicle to pick up the wastes; and
- These bins are collected in scientific manner and transferred to solid waste processing center.
- Implementation of waste management program to handle and manage all types of waste including solid waste, hazardous waste, bio-medical waste, battery waste, Plastic waste, e- waste etc.

During development and operation phase E-waste shall be collected and disposed in accordance E-waste Management Rule, 2016. Bio-medical wastes shall be collected and disposed in accordance with Biomedical Waste (Management and Handling) Rules, 2016.

Secondary Storage / Collection

The waste collected at primary collection points shall be transferred to a secondary collection or storage point if any. As Airport operations run 24/7 it is necessary to establish secondary storage stations to avoid SWM activities interfering with the latter. All the primary bins shall be emptied into the large container of same category at secondary storage stations. The bins and containers shall be of sufficient capacity to handle the total waste generated in day. The collection activity shall be carried out once every day covering all the sources of generation. The waste bin types are shown in **Figure-4.77.**

Storage Strategy for Waste Streams (Excluding Wet Waste)

In the project context, all waste streams (except wet waste) would be stored and channeled through authorized vendors for recycling and end disposal. The dry waste such as paper, plastics, metal, glass, textiles and other packaging materials shall be stored temporarily before disposal to authorized recyclers or vendors. Hazardous, medical, E-waste and other wastes shall be stored in a dedicated area and shall be disposed with authorized vendors.

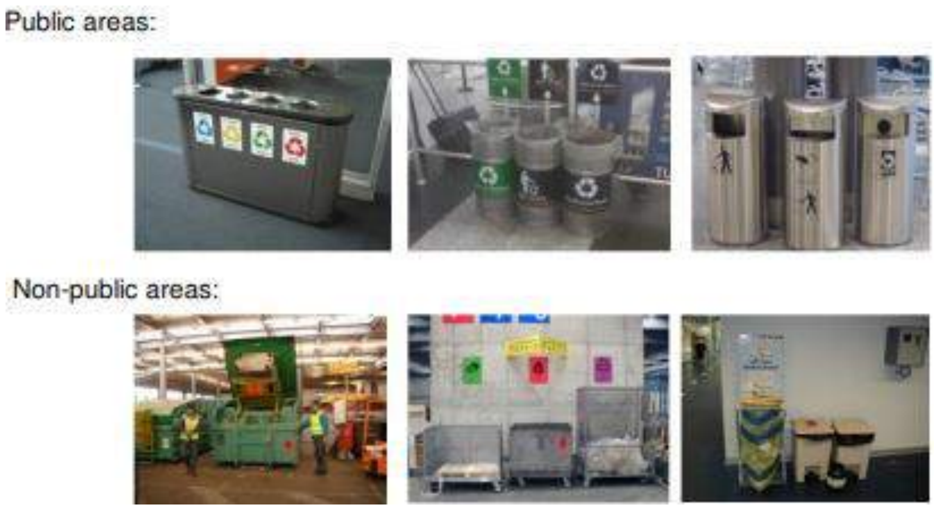


FIGURE-4.77
WASTE BIN TYPES

The recyclables have an economic value and hence needs to be transferred to authorized recyclers frequently once adequate quantities are generated (one truck load). This area contains flammable and hazardous waste. Hence the location must be equipped with appropriate safety and alarm systems. For calculating the area required for recyclables, the max. Height of stacking is considered to be 1.5 m. The density of recyclables is considered to be 0.15 t/m^3 and an additional buffer of 20% for storage. The calculations are for storage space required for 1 day of operations, which means at the end of 24 hours the authorized vendors need to come and take away the stored waste on a daily basis. To account for unavoidable delays and circumstanced, there should be buffer space of 300 m^2 provided to allow for storage of dry waste for one extra day, thereby having enough space for two days of storage. The dry waste segregation and storage site lay out is shown in **Figure-4.78** and **Figure-4.79.**

FIGURE-4.78
DRY WASTE SEGREGATION AND STORAGE SITE LAYOUT

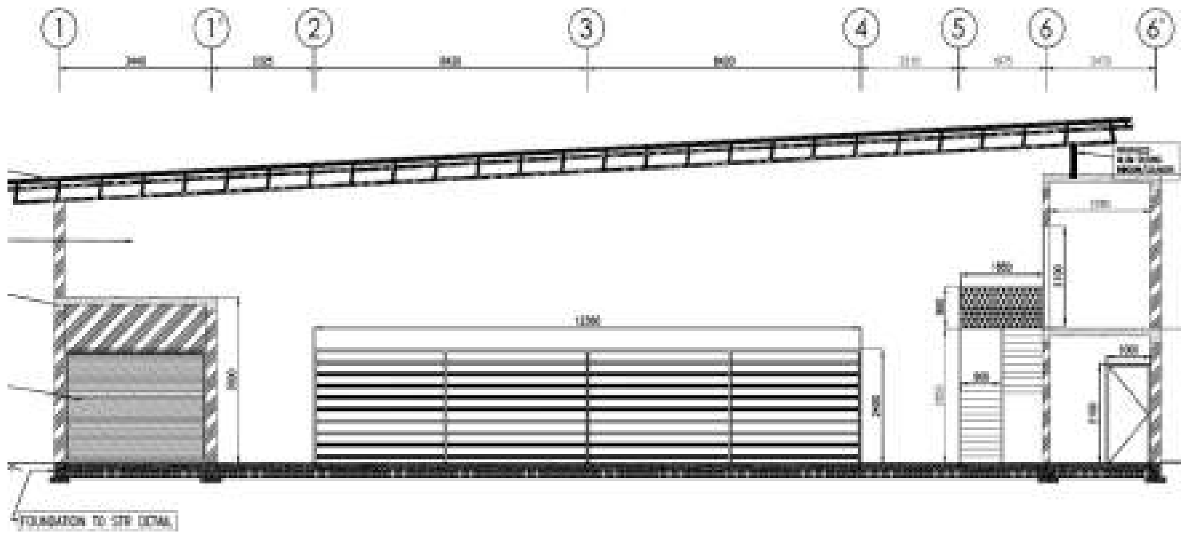


FIGURE-4.79
DRY WASTE BUILDING SECTION

4.3.7.5 Waste Treatment

The treatment objectives of the project will aim at treating all the organic waste within the project by anaerobic (bio-gas) treatment. The dry waste and recyclables will be stored separately in a facility and sent to authorized recyclers. The hazardous, medical and E-waste will be transferred to authorized vendors. The C&D waste generated during or prior to construction activities will be utilized within the site.

Treatment of Wet or Organic Waste

The technology options available for processing the wet solid waste are based on either bio conversion. The bio-conversion process is applicable to the organic fraction of wastes (wet waste), to form compost or to generate biogas such as methane (bio-methanation) and residual sludge (manure).

Anaerobic Digestion

The process of Aerobic Digestion (AD) for organic waste treatment produces bio-gas. While this is economically more viable and requires less space, it requires skilled operation. Biogas is produced by anaerobic digestion or fermentation of bio-degradable materials such as bio-mass, manures, sewage, municipal waste, green waste and plant material and energy crops. This type of biogas comprises primarily methane and carbon dioxide. Anaerobic digesters also function as a waste disposal system, even for human waste, and can, therefore, prevent potential sources of environmental contamination and the spread of pathogens. Industries and institutions are also made possible, from the sale of surplus gas to the provision of power for industry; therefore, bio-gas may also provide the user with income generating opportunities. The bio-gas can be used to directly generate electricity to power the establishment that is generating the waste. The extra wet waste will be disposed at CIDCO treatment plant at Chaal Taloja. The anaerobic system is shown in **Figure-4.80.**

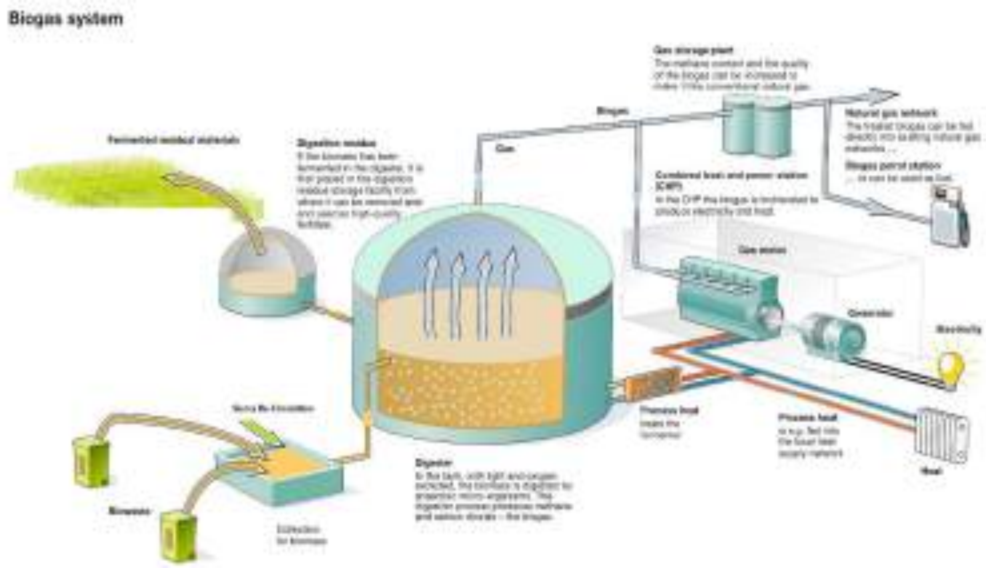


FIGURE-4.80
ANAEROBIC SYSTEM

The working of the anaerobic system is as follows:

- The wet waste is collected, segregated and sorted in the wet waste segregation area.
- A segregated pure wet waste is then sent into a crusher/ macerator unit where the waste is pulped to form a homogenous mixture.
- The pulped *waste* is then sent to the inlet tank.
- The inlet tank further slurry recirculation and mixing is done.
- From the inlet tank the mixture is piped into the main digester.
- The gas generated is sent into gas collection chamber for storage, scrubbing and re-routed to end use.
- The slurry formed in the main digester is sent to a de-watering system.
- The liquid phase, having a very high amount of nitrogen, is re-routed to STP; and
- The solid phase obtained after dewatering is a good compost fertilizer for gardening, agriculture and landscaping purposes.

The anaerobic digestion details of solid waste system are given in **Table-4.60.**

TABLE-4.60
AIRPORT SOLID WASTE STREAM - ANAEROBIC DIGESTION

Phases	Cum Quantity of Waste	Organic Waste	Biogas Expected	Power Requirement
	TPD	TPD	m^3/day	HP
Phase-I	17	9	330	8.2
Phase-II	29	14	550	13
Phase-III	50	23	937	22
Phase-IV	72	34	1369	30

Sludge Treatment after Digesting

After decomposition, sludge obtained can be directly used as fertilizer for airport landscaping. It is suggested that the sludge is first dewatered through screw press or centrifuge method. The food and kitchen waste bring a lot of protein and fat into the bio-gas process. This leads to a high amount of nitrogen and carbon in the sludge. The nitrogen stays in the sludge in a highly concentrated form, which could lead to over-fertilization of the soil. Once dewatered, the nitrogen content in final output fertilizer is lowered, and the resulting nitrogen rich water obtained can be sent to STP. The sludge dewatering system is shown in **Figure-4.81.** The layout of treatment of wet waste (initial phase) is shown in **Figure-4.82.**

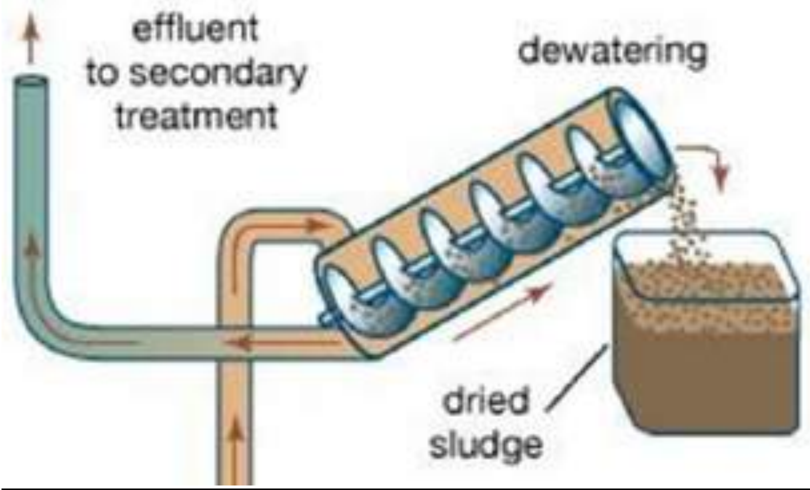


FIGURE-4.81
DE-WATERING OF SLUDGE

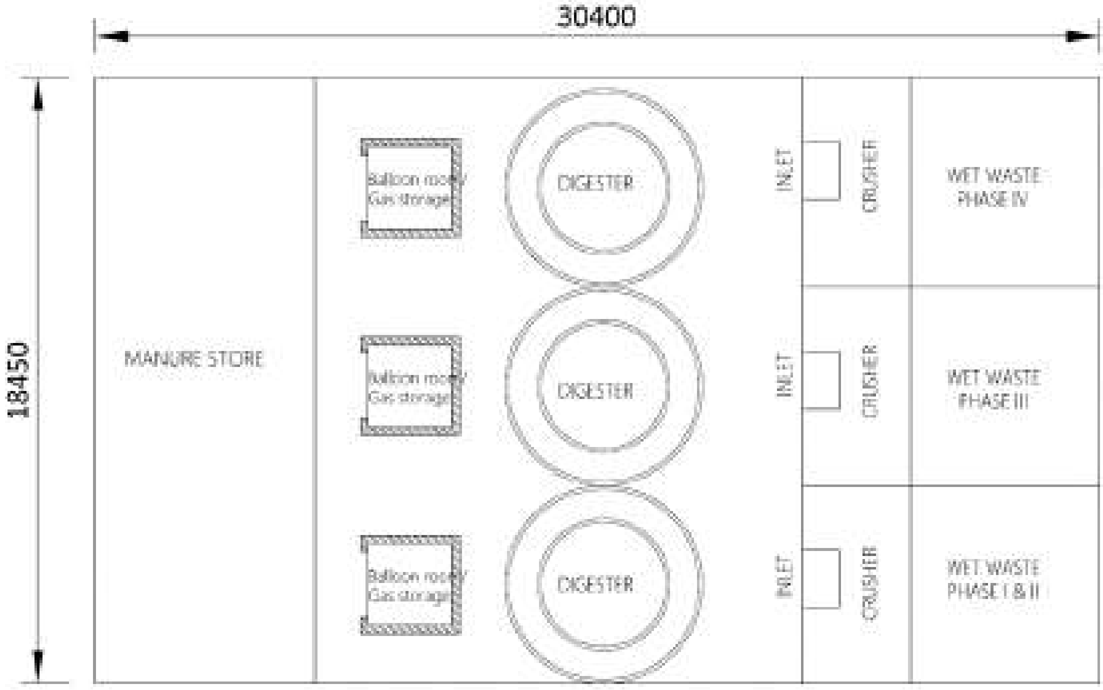


FIGURE-4.82
LAYOUT FOR TREATMENT OF WET-WASTE (INITIAL PHASE)

The lay out plan for solid waste management for the western side is shown in **Figure-4.83.** The layout of solid waste management plan for the final phase is shown in **Figure-4.84.**

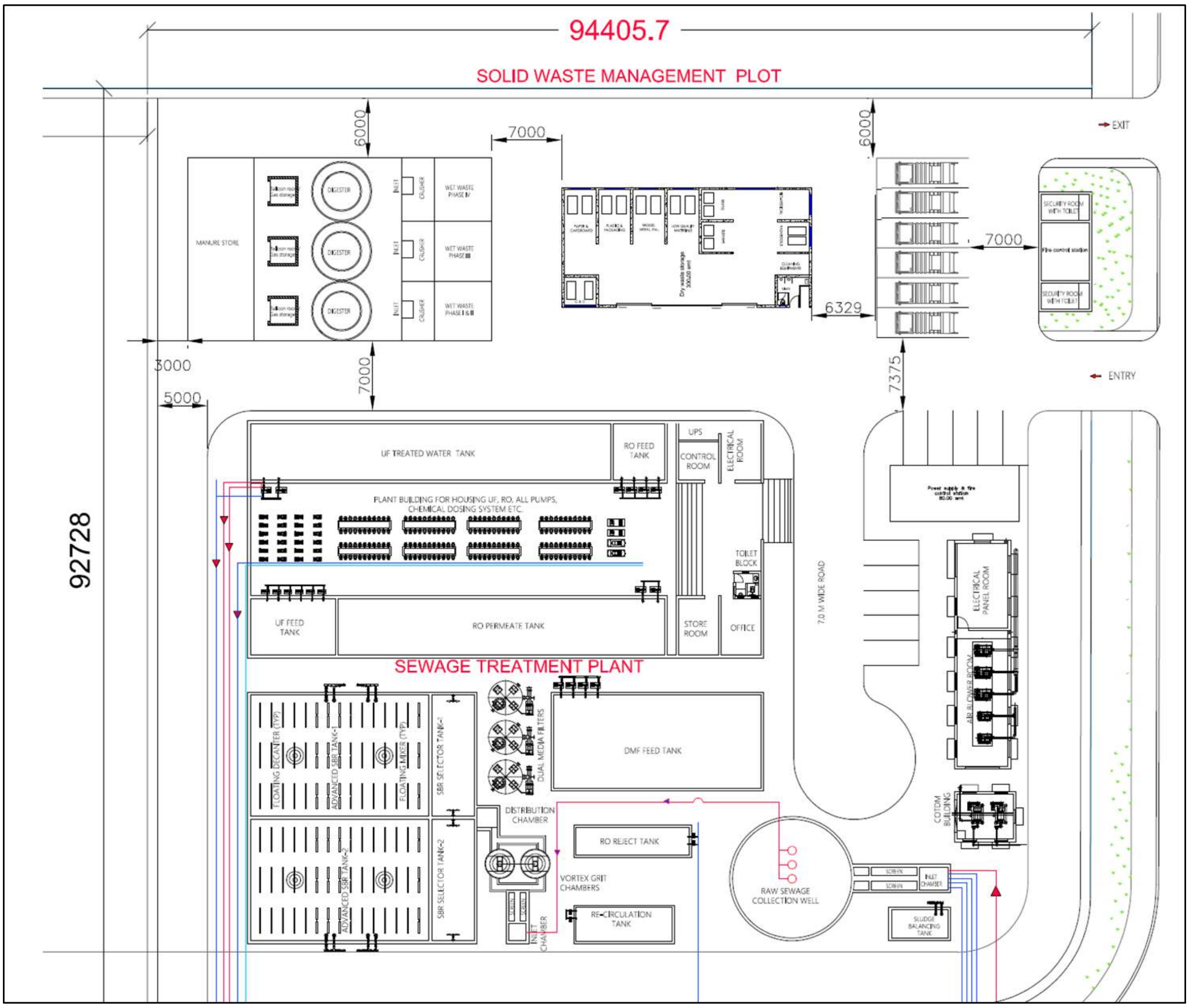


FIGURE-4.83
LAYOUT PLAN SHOWING DETAILS OF SOLID WASTE MANAGEMENT FACILITY IN WESTERN SIDE

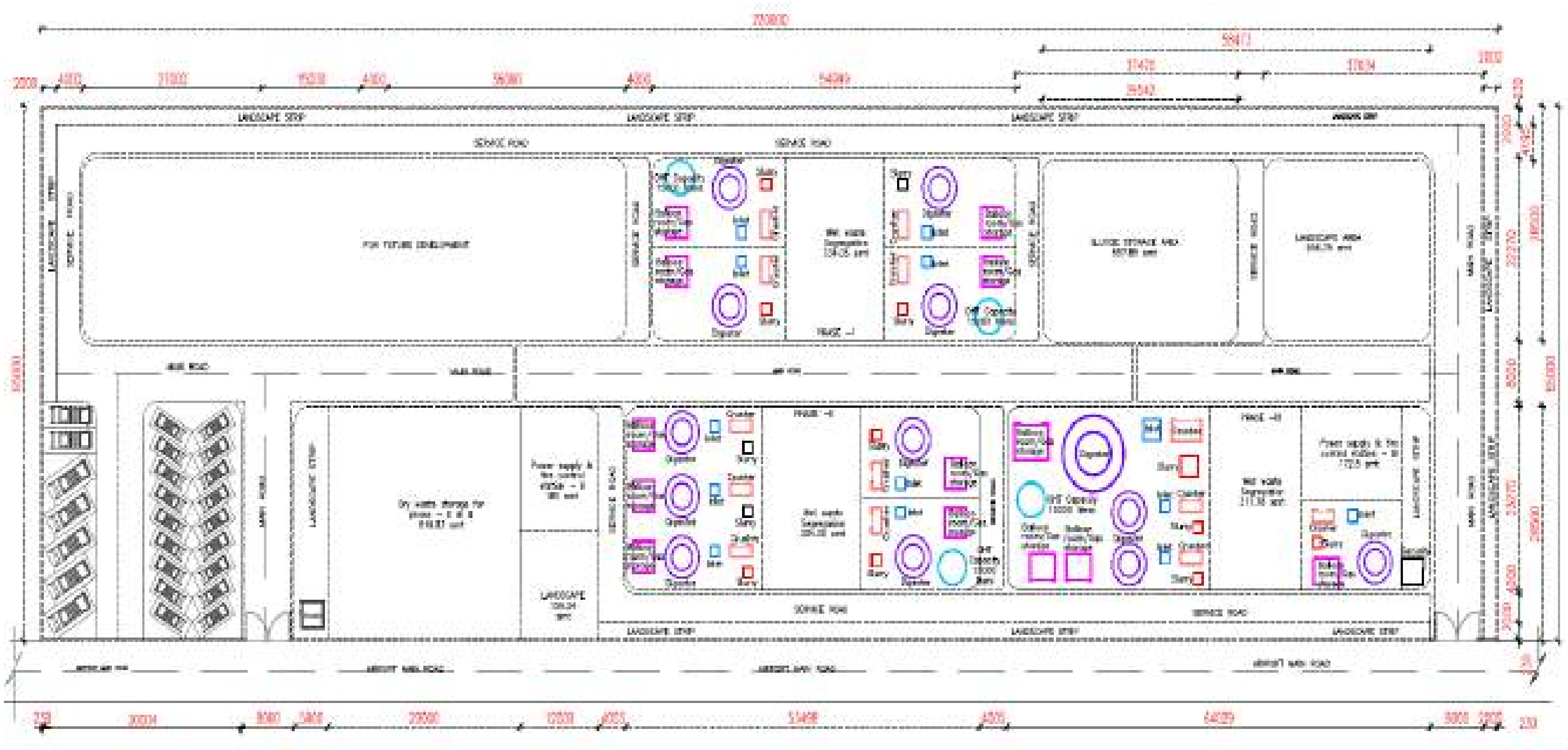


FIGURE-4.84

LAYOUT PLAN SHOWING DETAILS OF SOLID WASTE MANAGEMENT FACILITY FOR FINAL PHASE

4.3.8 Impact on Terrestrial and Aquatic Ecology

Prediction of impacts is based both on the direct and indirect; short-term as well as long-term; irreversible and irreversible impacts that are most likely to occur owing to the proposed activity during establishment and operation. The ecological factors that are considered most significant as far as the impact on flora and fauna are concerned:

- Whether there shall be any reduction in species diversity or loss of any rare or endangered or threatened species.
- Whether there shall be any habitat loss or fragmentation.
- Whether there shall be any additional risk or threat to the rare or endangered or endemic or threatened (REET) species.
- Whether there shall be any impairment of ecological functions such as (i) disruption of food chains, (ii) decline in species population and or (iii) alterations in predator-prey relationships.

As stated in the introduction, the project is under development. The EC and CRZ Clearance for NMIA was received in 2010 and Stage-I &II Forest Clearance was received in 2017; the site development activities has started since then. The entire land scape of the core area had been modified. Upon completion of the site pre-development, the project area will be fully reclaimed free from any encumbrances. The flora and fauna of the core area that existed before 2017 will be replaced by the new landscape and vegetation that will be developed during the airport construction and operation. However, the project area was not a part of any wildlife corridor or eco-sensitive zones.

4.3.8.1 Impact on Avi-Fauna

Practice has shown that airport operations have a serious impact on the bird ecology. Taking bird strikes as an example, according to the Bird Attack Information System (IBIS) (ICAO, International Civil Aviation Organization, 2018), 97,751 reports were received from 91 states about strikes occurring in 105 states and territories from 2008 to 2015, with an average annual number of 12,219 strikes, twice the average annual number between 2001 and 2007. This indicates that the ecological impact of the civil aviation industry on birds has become increasingly serious in recent years.

Very effective are structural solutions and barriers that deter birds in a passive way by reducing the attractiveness of the airport infrastructure to birds. The effect of the use of these methods is a long-term reduction of the number of birds at the airport and, consequently, reduction of the risk of bird strikes. These methods certainly do not eliminate all birds from the zone of airport operations and should be supplemented with a range of dispersal methods. These methods should involve a mobile patrol equipped with acoustic (shell crackers, propane cannons), visual (flares), and physical (trained birds of prey) scaring devices. No one technique is 100% effective, hence many techniques should be used in combination. Scaring techniques should be used selectively and in rotation to avoid habituation. Selection of bird-control methods depends on the intensity and character of the problems with birds. Hence, it is very important for airport personnel to monitor the occurrence and movements of birds at the airport and in the vicinity of it, and to record all collisions of birds with aircraft, their severity and bird species involved. An analysis of the variation in the risk of collision with reference to the time of the day and year, and the phase and height of flight makes it possible to adapt the programme for bird management to variable environmental conditions.

4.3.8.2 Greenbelt/Green Cover/Land Scape Development

Green Space & Landscape Development

Green Space & Landscape development is an integral part of NMIA Master Plan, and an important element of its environmental sustainability measure. The total green space area proposed is 384.90 ha, i.e. 33.18 %of airport site area of 1160 ha, including green/open spaces on airside and landside of NMIA. The proposed green spaces shall be developed as per their contextual and functional requirements, and overall environmental and landscape planning approach. The proposed green space & landscape development is planned considering key airport related constraints, such as:

1. Bird Menace: Trees and shrubs attract insects and birds which are potential threat to aircraft operations within and around airport. This requires careful selection of trees to be planted on airport premise, as a part of airport safety measures. The proposed green space & landscape development is planned considering this.

2. Height Restrictions: Development of green areas and planting of trees including their types (height at maturity) is guided by height restrictions imposed by Airport Authority of India. Hence, any type of dense vegetations with very high trees cannot be developed in vicinity of airport. The proposed green space & landscape development is planned considering this.

3. Restrictions in Operational Area: As part of airport operational requirements almost 80% of total NMIA land area is defined as Airside or Operational Area where in regular movement of flight movement demands clear and safe area, without any form of vegetation except grass, which may affect the flight operations due to birds attracted by vegetation. The proposed green space & landscape development is planned considering this.

Key objective of proposed green space & landscape development of NMIA is to create a unique, world class green environment for NMIA drawing inspiration from local landscape ensuring sustainability and offering a memorable experience for passengers, staff and visitors alike. This synergy is an important part of airport's environmental system including rainwater harvesting and attenuation strategy. Indicative drawings of proposed Plan of Central Green & Forecourt Plaza in Phase I & II, and Final Phase are provided in **Figure-2.31** and **Figure-2.32** of **Chapter-2** respectively.

NMIA landscape development aims to achieve:

- A generous green framework of landscape parks and open spaces responsive to natural environment and climate of the place.

- Development of ponds/water bodies, by harvesting rainwater in most of the open/green spaces to ensure sustainability and regeneration of natural environment of the place; and

- An identifiable green envelope with distinctive landscape features and ambience. Integration of ponds, water bodies, artwork, signage, lighting as part of landscape development to create a holistic green environment.

Proposed landscape concept is based on a framework of free-flowing green spaces, and terraces creating a visual rhythm along movement path of users, and a distinct sequence of lotus ponds resulting in a unique visual and environmental impact. This fabric of landscape spaces shall unify the development into a natural green envelope and impart a distinct identity to NMIA. The incremental GLCs of the air pollutants were assessed which will have insignificant impact on the terrestrial or aquatic eco-system.

4.3.9 Impact on Socio-Economic Development

4.3.9.1 Impact on Population Growth

As per the 2001 census, the total population of the study area is 10, 79, 216. The population reported as per the 2011 census is 18, 21, 089. Overall, around 68.7% more decennial growth is reported in the study area. The proportion of urban and rural population is urban population 16, 26, 540 (89%) and rural population 1, 94, 549 (11%). Mumbai, also called Bombay, is the capital city of the state of Maharashtra in India, and it's the most populous city in India. Mumbai is the 4th most populous city in the world and one of the populous urban regions in the world. The most recent census was conducted in India during 2011, which put Mumbai's Urban Agglomeration at 2,07,48,395 while the city itself recorded a population of 1,24,78,447. The next national census is scheduled for 2021. By 2030, Mumbai and Navi Mumbai will have an estimated population of 28 million.

4.3.9.2 Impact on Employment

The proposed airport will have a potential of about 15,000 temporary employment and about 90,000 permanent employments. Socio-economic opportunities for business and employment for people in Navi Mumbai and Mumbai metropolitan region, skill development and technical expertise enhancement possibilities due to influx of aviation related institutions will be developed in Navi Mumbai region. The financial benefits envisioned from the project are over 50,000 direct & indirect employment due to aviation business leading to stimulation of economic growth in Mumbai metropolitan region outside the Mumbai city. Stimulation of local economy due to direct & indirect impact of aviation and related business, large investments around the proposed airport by other agencies due to the development of Navi Mumbai International Airport.

The environmental benefits will include reduction in congestion in the Mumbai city, creation of environmentally friendly and sustainable infrastructure in and around NMIA like metro rail network, wide road network, well planned drainage, new STPs, large gardens and green areas, decongestion, and enhancement of environmental conditions around the existing CSMIA. The project will also generate opportunities for self-employment by creating entrepreneurial opportunities for ancillary services to the airport. Finally, it is perceived that the living standards and lifestyle of the PAPs will improve after the establishment of the airport.

4.3.10 Energy Optimization Measures

Energy consumption is optimized to 96 MVA against the approved 190 MVA as per EC (2010). The following various optimization measures will be implemented:

- Higher insulation levels in walls and roofs.
- High performance glazing.
- Efficient lighting design.
- Efficient HVAC system.
- Demand control ventilation using occupancy sensors.
- Artificial lighting control via daylight sensors.
- Adoption of high efficiency light fittings.
- Installation of sensor-based pumps which operate in auto-mode.
- Use of high efficiency generators, fuel efficient diesel engines and high efficiency transformers.
- Implementation of ECBC guidelines.
- Solar power generation of 22.14 MW to substitute the conventional fuel-based power.

Chapter-5
Analysis of Alternatives (Technology and Site)

5.0 ANLYSIS OF ALTERNATIVES [TECHNOLOGY AND SITE]

5.1 Introduction

Analysis of alternatives is a key approach of the EIA study for identification of the project, considering the no-development option; and if project is conceived, the extent/ capacity/ production levels are to be established. The analysis narrows down on the choices for selection of site, project configuration, technological selection and/ or other key aspects of the project either subjective or arbitrary in nature. The analysis of alternatives often reflects upon narrow project objectives, agency agendas, and predilection toward a proposed action while such choices have broad organizational/ economic benefits. The ultimate idea of analysis of alternatives is to optimize the project impacts to the minimum while realizing the project and thereby establishing a sustainable approach from the conception stage itself. Therefore, the analysis of alternatives is foreclosed because the EIA typically starts after an agency has already finalized the project. Plus, earlier strategic decisions that determined the project may not have been subjected to the EIA process. Consequently, inadequate alternatives can undermine the goals of EIA study to encourage more environmentally sound and publicly acceptable actions.

The analysis of alternatives of NMIA project is addressed in the following sections focusing on the following three key aspects of the project deemed relevant for this study include:

1. No Development Option: Explains whether the realization of project is essential in the current scenario.

2. Alternative Sites: The site selection of NMIA project has been completed. Assessment of alternate sites, the proposed locations and the comparative analysis of their advantages and dis-advantages, etc. were discussed in the EIA study conducted in 2010 and later again in during the comprehensive EIA study conducted in 2017. Based on this analysis, the location of NMIA project has been finalized and the project pre-development activities have been initiated after obtaining the Environmental Clearance, Forest Clearance and other required clearances and permits.

3. Selection of Standards: Standards by which the NMIA project is designed to serve as an international airport.

As a prelude to this chapter, alternative analyses carried out in the conception stage of this project is delineated in the background section below:

5.2 NMIA Project Background

Considering growing infrastructural demand within MMR, especially rise in air travel demand of the city population, the Government of Maharashtra originally proposed establishment of a domestic airport as the second airport within the MMR of Mumbai city which was later upgraded to setting-up of an international airport at the behest of Govt. of Maharashtra (GoM).

Earlier, upon assignment of GoM, CIDCO along with a host of other agencies carried out a series of studies which primarily include techno-economic feasibility studies beginning with site selection and called upon other associated/subsequent studies deliberating the configuration of the proposed airport, conflict free management of dual airport systems (within the MMR), drainage studies, etc. While, in this initial phase, the site selection studies culminated into identification of three alternative sites (Navi Mumbai site and Rewas-Mandawa site and Mhapan site) for the new airport.

Further, a Committee was constituted in 1998 by the Ministry of Civil Aviation, Govt. of India to identify suitable site for second airport for Mumbai narrowed down upon Navi Mumbai site, provided a parallel runway system shall be realized for establishing an international airport. Therefore, CIDCO revised its original proposal (for a domestic airport) incorporating the provision for a parallel runway and made a presentation for development of Navi Mumbai International Airport (NMIA). The proposal of CIDCO was considered financially viable, environmentally less disturbing, supported by the local people and was later approved by the Committee.

The CIDCO being assigned as the authority for establishment of NMIA applied for and received approvals from the key stakeholders of the project including Airport Authority of India, MoEF&CC, Ministry of Civil Aviation, etc. to establish the NMIA project. As on date, all covenants essential for the progress of the project are in place and several agencies including the project authority (CIDCO) and the Concessionaire (NMIAL) along with their third-party consultants are keeping a keen eye upon systematic development of the project at the Ulwe area of Navi Mumbai.

The pre-development works at the site and implementation of R&R of the project affected families are nearly completed. As on 11th June 2021, about 71 structures are remaining to be moved from the site.

5.3 No-Development Option

The NMIA project was conceived after foreclosure of suitable site selection and the associated project feasibility studies prior to EC and CRZ clearance, 2010. The project was conceived by the GoM as a prudential plan for future infrastructural demand within MMR. The traffic scenario of MMR which compels the establishment of a NMIA like airport is based on the forecast assumptions developed from the best-known intelligence and careful analysis and experience over the course of several years although it is always difficult to determine how these factors might vary. The traffic scenario of MMR indicates that CSMIA which is the only serving airport within MMR region is predicted to it maximum capacity of 60 MPPA while MMR air traffic passenger forecast will exceed this. Also, CSMIA cannot be expanded beyond its maximum design capacity of 60 MPPA due to space constraints of its airport site. This makes establishment of NMIA project imperative to match growing traffic demand of MMR, which is one of the most populous metropolises of India.

5.4 Alternative Sites

NMIA is an on-going project which has already received Environmental and CRZ Clearance in 2010 based on EIA study which presented analysis of alternative sites carried out by CIDCO.

The current proposal does not require any additional land and there is no change in location of site as approved in EC of 2010, based on analysis of alternative sites submitted at that time. Moreover, based on EC condition (Condition No. XXVII [I]), CIDCO has already changed the land use of airport Site to 'Airport and Allied Activities' by amending Development Plan of Navi Mumbai vide GoM Notification in March 2012 (GoM Notification No. TPS 1711/2495/CR-202/11/UD-12 dated 21st March 2012).

5.5 Technology Advancements in Aircrafts

The project under implementation is airport infrastructure project. The airport master plan has been prepared incorporating all the environmentally sustainable measures, which have discussed in **Chapter-2**.

However, there are various technological advancement in the aircraft design, which will have a bearing on the air emissions, noise levels which are discussed in the following sections.

5.5.1 Airbus A340-600

- The Airbus A340-600 in flight is the global performer. The A340-600 also includes state-of-the-art technologies such as weight-saving composite structures; a fuel-saving aerodynamic design; along with pilot-friendly cockpits, flight controls and systems – all of which significantly enhance the A340-600's long-range capabilities and overall cost-efficiency.

- The A340-600 is ideal for replacing competing aircraft, with 20 per cent lower fuel per trip and a more modern cabin with the latest technology. True to Airbus' unique family concept, it also offers an exceptional degree of operational commonality with all of the company's fly-by-wire aircraft – allowing pilots to transition from one type to another with minimum training time.

- The A340 Family's enduring quality is further proof of the cutting-edge design, innovation and manufacture at the heart of Airbus aircrafts. This aircraft continues to fly and delight passengers that used to the highest standards of comfort while offering significant advantages to airlines and operators.

5.5.2 Boeing 777-300

This aircrafts area designed for low operational costs and derive maximum Productivity.

- A testament to the power of digital design, the 777 Freighter benefits from the same integrated onboard systems, advanced materials, aerodynamics and powerful engines as the most recent 777 passenger airplanes.

- The state-of-the-art Cargo handling system features compact rollers and reliable power drive units that air cargo carriers favor. The system gives operations unsuppressed flexibility to optimize loads for the maximum advantage of 777 Freighter volume, Lift and Range.

5.5.2.1 Efficient Structure, Materials and Systems

- Structural efficiency keeps the 777 Freighter empty weight to a minimum, for exceptional fuel economy, low noise, quick climb to cruise and maximum revenue payload capability. The advanced wing features a system that automatically redistributes aerodynamic load on the wing, should maneuvers that produce high wing loads be required. This maneuver load alleviation system allowed engineers to design a wing that is exceptionally light for its load bearing capacity.

- Advanced materials used strategically throughout the airplane help make the structure durable, efficient and easy to maintain. System integration keeps spare parts lists to a minimum and simplifies maintenance. The world's most powerful jet engines provide access to widespread cargo markets and the efficiency to serve both long and short-haul markets economically.

The 777 Freighter is Cleaner, Quitter, and More efficient.

- 16% reduction in carbon emissions as per CAEP/6 limit;
- 16% more fuel efficient;
- Below CAEP/6 limits for NO_x
- Meets stage 4/ QC2 noise levels 85dBA noise contours;
- Getting quieter with each generation;
- Based on a proven, Reliable Platform;
- Significantly lower fuel costs;
- Lowest trip cost for any large freighter; and
- World's largest & most capable twin-engine freighter.

Thus, the proposed airport will be operating with most advanced aircrafts. The airline operators will be using the more fuel-efficient aircrafts, which in turn will have less air emissions and less noise levels at the source level.

5.6 Alternatives for Energy Conservation

NMIA is planned to be developed as Green Airport, with key objective of Environmental Sustainability to be achieved through, optimization in resource consumption through following measures:

- Energy Optimization
- Utilization of Solar Energy
- Natural Day Lighting

- Re-Cycling of Waste
- Water Balance
- Water Harvesting
- Plantation & Landscape
- Metro & Water Transport
- Environment Management

NMIA is planned with objective to be one of the most resource efficient & green airport in the world. It has been planned to achieve environmental sustainability through resource optimization, recycling & reuse. This approach has been adopted at planning & design stage, and hence Demand for Resources for NMIA has been optimized, and is much lesser than as approved in EC of 2010.

At the proposed Terminals and Ancillary Buildings necessary Green Building measures will be followed for minimum conservation of energy in line with "Energy Conservation Building Code –2017", "National Building Code 2016" and ASHRAE requirements. The Terminal is targeted to achieve LEED Certification Gold from the United States Green Building Council (USGBC), and all other building shall follow a minimum energy requirement as per ECBC. The building falls under the category of Assembly, and the energy conservation measures which will be adopted are described in in ECBC compliance statement of NMIA

As an airport for future, NMIA will be developed as a green airport, with a key objective of environmental sustainability through energy optimization, recycling of waste, reduction in carbon footprint, utilization of solar energy, natural day-lighting along with other sustainable measures in planning, development and operations of NMIA.

The solar plant will create significant environment benefits over its lifetime. Based on the availability of the land & feasibility solar plant planned at NMIA for final phase is 22.14 MW. Solar energy to the maximum extent will be used, and the possibility of wind energy will be explored to minimize the usage of conventional energy sources.

5.7 Water Conservation, Recycling & Reuse

Re-Generation:

Navi Mumbai International Airport will regenerate 51% of its total water consumption through treated water from Sewage Treatment Plant. The state-of-Art latest technology will be adopted for Sewage Treatment Plant. The technology adopted is Advanced Sequential Batch Reactor (SBR) with Ultra Filtration and Reverse Osmosis (RO). The treated water from STP will be used for landscaping, flushing and air-conditioning. Treated water available from STP will be 11.2 ML per day at Phase-IV.

Sludge Drying:

Navi Mumbai International Airport also proposes sludge drying beds to generate manure from sewage treatment plant will be used for landscape Irrigation.

Rain Water Harvesting:

A rainwater harvesting pond is proposed along the main drain alignment path. The area of proposed rain water harvesting pond is 11,899 sqm and depth 2.5 m below invert level and the volume of pond is 29,747 cum. Weir is proposed at the pond outfall location to avert salt water intrusion into the pond. Stored water shall be used for landscape irrigation purposes.

5.8 Level of Service

The Airport is being developed to a state-of-the-art international airport complying with IATA LOS 'C' service benchmark to an extent where the lead time within airport services will be reduced to acceptable standards thereby reducing resource utilization though optimization and which will lead to minimization of project footprint as low as reasonable possible.

Chapter-6
Environmental Monitoring Program

6.0 ENVIRONMENTAL MONITORING PROGRAM

6.1 Introduction

The NMIA airport project was granted EC & CRZ clearance with several conditions to be complied with. As part of the compliance, several special studies have been carried out that includes CWPRS, GSDA, BNHS, traffic studies. Currently, project is in implementation phase (Pre-development Works had started in 2017 and nearing completion) and while site environmental monitoring activities are in progress since 2015 and the half yearly compliance reports are being submitted by NMIAL to MoEF&CC and MPCB. The status of the project activities with respect to site pre-development activities is explained in Section-1.3.6, Chapter-1.

This chapter identifies the aspects of monitoring the effectiveness of mitigation measures (including the measurement methodologies, frequency, location, data analysis, reporting schedules), basis and identification of the site environmental monitoring plan envisaged for the project development and operation phases in line with the standards/guidelines mandated in EIA 2006 Notification and as per the CPCB standards.

6.2 Basis of Environmental Monitoring Plan

The basis of the environmental monitoring is as per the conditions stipulated under the EC & CRZ clearance of 2010 and Extension of Environmental and CRZ Clearance of NMIA on 20th December 2017. The EC & CRZ conditions already being complied, and the new conditions as stipulated in the ToR issued and their status and/or implementation plan in the proposed monitoring plan during the development and operation phases of the airport are given in **Table 6.1**:

TABLE-6.1
BASIS OF NMIA ENVIRONMENTAL MONITORING PLAN

Sr. No.	ToR Conditions stipulated by 55th EAC Committee	Reference No.	Status of Compliance/Implementation Plan
Environmental and CRZ Clearance granted NMIA (MoEF&CC) vide letter no. F. No. 10-53/2009IA.III 22nd November 2010 and Extension of Environmental and CRZ Clearance of NMIA (MoEF&CC) vide letter no. F. No. 10-53/2009IA.III 20th December 2017			
1	Systemic and periodic monitoring should be done for various Environmental parameters such as Air, Noise, Soil & Water, marine water	Specific Condition. I. Construction Phase [vii]	CIDCO had appointed a Laboratory recognized by MOEFCC, for monitoring the various environmental parameters since 2011 of air, noise, surface and ground water & soil, on monthly basis around the airport and reports were submitted to MOEF&CC along with six monthly reports. NMIAL has continued the monitoring for Air & noise (9 stations) and Ground water sampling (5 locations) on monthly basis. Marine/ Surface

Sr. No.	ToR Conditions stipulated by 55th EAC Committee	Reference No.	Status of Compliance/Implementation Plan
			water (10 stations), & soil sampling (5 locations) on quarterly basis. Suitable monitoring activities will be adopted during the project development and operation phases also.
2	Risk assessment plan and disaster management plan should be prepared and with periodic compliance of safety measures. All the risks associated/ resultant risk during various stages of development (like planning, construction, operation) are managed within the airport area.	Specific Condition. I. Construction Phase [xxii]	Risk assessment plan and disaster management plan is in place during Pre-development stage. NMIAL has prepared an On-site Emergency Management Plan and Disaster management Plan for the development and operational phase. Risk Assessment & Disaster Management Plan will be updating periodically. The Airport Emergency Response Plan (AERP) will be developed in accordance with guideline of DGCA, which will be implementing procedures would be reviewed and updated to ensure compliance with relevant regulations and applicable state and local emergency plans. Based on the Quantitative Risk Assessment of ATF Tank Farm (pool fire risk based on the Fire Explosion and Toxicity Index (FETI)) is prepared by NMIAL addressing the on-site and offsite emergencies typically including incidences of flight disasters/accidents, hijacking, hostile situations, etc, of the airport during the operation phase.
3	The compliance report of the monitoring committee shall be made 'public' at all stages (planning, construction, operation) to ensure effective monitoring and compliance of conditions.	7. Specific Condition. I. Construction Phase [xxiv]	CIDCO had earlier submitted that six monthly compliance report along with monitoring report was uploaded on website of CIDCO link https://cidco.maharashtra.gov.in/navi_mumbai_airport#gsc.tab=0 under Pre- Development tab and made available for public. After approval of MoEF&CC for Transfer of Environment & CRZ Clearance from CIDCO to NMIAL has been obtained vide letter No. F. No. 10-53/2009-IA-III dated 17th August 2020, onwards NMIAL uploaded on NMIA website EC Compliance Report at the following link. https://nmiairport.co.in/assets/docs/NMIA_EC_Report.pdf

Sr. No.	ToR Conditions stipulated by 55th EAC Committee	Reference No.	Status of Compliance/Implementation Plan
			RO- MOEFCC has visited site and given Certified compliance Report dated 31.03.21
4	Turbidity during construction To be monitored and kept within the limit by taking suitable precautions during construction.	7. Specific Condition. I. Construction Phase [xxx]	It is in progress; the Turbidity during pre-development and development period is being monitored. The monitoring has been continued by NMIA during the development & Operation phase.
5	CIDCO shall conduct the baseline survey of avian fauna before the start of construction and the details shall be put up every 3 months on the website in association with BNHS	7. Specific Condition. I. Construction Phase [xxxi]	BNHS has been appointed by CIDCO to do the periodic base line survey of avian fauna and quarterly as well as annual reports placed on CIDCO'S website. CIDCO and BNHS have also signed a 10-year MOU (signed on 12th September 2018 valid up to 2028) to track Bird movements and advice regarding overall development of Navi Mumbai to ensure adequate habitats are maintained for the sustenance and growth of birds and do not endanger flight movements.

Regular monitoring of environmental parameters is of immense importance to assess the status of the environment during development and operation of the airport. With the knowledge of baseline conditions, the monitoring program will serve as an indicator for any deterioration in environmental conditions due to development and operation of the NMIA greenfield airport project, to enable taking up suitable mitigation steps in time to safeguard the environment. Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by monitoring. Regular and continuous monitoring for the environmental attributes will help in identifying any gaps in the implementation of the mitigation measures and will thus help in making suitable changes and improvement in the mitigation measures as required.

Regular monitoring program of the environmental parameters during the life of the project is essential to consider the changes in the environmental quality.

6.3 Environmental Monitoring and Reporting Procedure

Monitoring shall confirm that commitments are being met. This may take the form of direct measurement and recording of quantitative information, such as amounts and concentrations of discharges, emissions, and wastes, for measurement against statutory standards, consent limits or targets. It may also require measurement of ambient environmental quality in the vicinity of a site using ecological/ biological, physical, and chemical indicators. Monitoring may include socio-economic interaction, through local liaison activities or even assessment of complaints.

6.3.1 Objectives of Monitoring

The objectives of environmental post-project monitoring are to:

- Verify effectiveness of planning decisions.
- Measure effectiveness of operational procedures.
- Confirm statutory and corporate compliance; and
- Identify unexpected changes (if any).

6.4 Environmental Monitoring Schedule

Environmental monitoring schedules are prepared, covering various phases of project advancement, such as development phase and regular operational phase.

6.4.1 Monitoring Schedule during Development Phase

Since the project is in the implementation phase (site pre-development works are in progress), the environmental monitoring at the site and in its vicinity are being regularly carried out to check non-compliance to environmental standards and appropriate mitigation measures are implemented towards abetment of environmental pollution. The generic environmental monitoring that needs to be undertaken during project development phase is given in **Table-6.2** and will be integrated with the current environmental monitoring program being undertaken during the pre-development stage.

6.4.2 Monitoring Schedule during Operational Phase

During the operational stage, continuous air emissions are envisaged from aircrafts, GSE, ground traffic, DG powerhouse. Wastewater is envisaged from the sanitary units and other aircraft operational areas. Further, solid waste such as municipal solid waste, hazardous solid waste and non-hazardous solid waste are envisaged from passenger terminal buildings, ATF storage and handling areas. The noise generated during the flight landing and take-off cycles and its impact in the funnel zone and on nearby habitat areas is also one of the key aspects of noise monitoring to be considered.

The following attributes which merit regular monitoring based on the environmental setting and nature of project activities are listed below:

- Source emissions and ambient air quality.
- Groundwater Levels and ground water quality.
- Surface water and wastewater quality (water quality, effluent & sewage quality etc).
- Marine water quality (in modified creek areas and other back water influence areas).
- Solid and hazardous waste characterisation.
- Soil quality.
- Noise levels (aircraft induced, equipment and machinery noise levels, occupational exposures, and ambient noise levels); and
- Ecological preservation and afforestation.

The monitoring program during the development & operation phase is detailed in **Table-6.2.** This shall be in line with the EC and CRZ clearance conditions and as recommended by MPCB in their consent conditions and shall be monitored and reported periodically.

TABLE-6.2
ENVIRONMENTAL MONITORING PLAN DEVELOPMENT & OPERATION PHASE OF NMIA

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
1	**Ambient Air Quality**	HEMM/Mass Transport vehicles: • Pollution Under Control (PUC) and fitness.	Pollution Under Control (PUC) certificate as per the Central Motor Vehicles Rule, 1989	• The vehicles must have valid Pollution Under Control (PUC) certificate as per the Central Motor Vehicles Rule, 1989. • Additionally, fitness levels of the vehicles to be maintained by the vehicle's owners/operators through regular maintenance of wear and tear. • Vehicle trips to be minimized to the extent possible • All the construction equipment shall be operated within specified parameters.	Scheduled Vehicles accessing the project area at the entry point.	Not Applicable	Periodic / PUC Certificate Display on vehicles
		DG Sets: Gaseous (source) emissions Parameters: • PM • SO_2, • NMHC, • CO, and • NOx	Emission Standards for Diesel Engines (Engine Rating more than 0.8 MW (800 KW) were notified by the Environment (Protection) Third Amendment Rules 2002, vide G.S.R. 489 (E), dated 9th July, 2002 at serial	Maintenance of DG set emissions to meet stipulated standards.	DG House or mobile DG stations as per the availability within the construction site.	DG House or mobile DG stations as per the availability within the airport site.	Periodic / monthly during site clearance & construction activities and in line with G.S.R. 489 (E), dated 9th July, 2002.

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
			no. 96, under the Environment (Protection) Act, 1986.				
		All parameters as per the NAAQS: • PM_{10}, • $PM_{2.5}$, • Sulphur dioxide (SO_2), • Nitrogen dioxide (NO_2), • Carbon monoxide (CO), • Ozone (O_3), • Ammonia NH_3, • Lead (Pb), • Arsenic (As), • Nickle (Ni), • B(a)P • Benzene (C_6H_6)	National Ambient Air Quality Standards (MoEFCC Notification G.S.R 826 (E), dated 16.11.2009)	**Development Phase** Ambient Air Quality Monitoring **Operation Phase** Installation of Continuous Ambient Air Monitoring Stations (CAAQMS) and Ambient Air Quality Monitoring. HC and VOCs to be monitored once in every month within the airport premises.	The following tentative locations are proposed for ambient air quality monitoring: • Near Saraswathi Vidya mandir, Pargaon Village • At Site, near site office. • Killi Gavthan near CIDCO Guest House. • Panchsheel Guest House near Navi Mumbai Municipal Corporation. • near Ulwe Gaothan. • Varcha Olwe Anuj Office. • Jui village. • Dapoli village. • Ulwe node. • Near Kopar village. • Panvel, • Waghivali Further, one location near labour camp area inside/outside the airport premises to be monitored.	Inside the Airport premises for continuous air quality monitoring. Further, the following tentative locations are proposed for ambient air quality monitoring: • Near Saraswathi Vidya mandir, Pargaon Village • At Project site, Near NMIA office. • Killi Gavthan near CIDCO Guest House. • Panchsheel Guest House near Navi Mumbai Municipal Corporation. • Near Targhar Railway station. • Varcha Olwe Anuj Office. • Jui village. • Dapoli village. • Ulwe node.	24 hourly samples. Twice in a week in-line with CPCB guidelines for ambient air quality monitoring. (NAAQS 2009) The monitoring will be done for the entire life of the project during development & operation. Phase **Operation Phase** Set up of one Continuous Online Air Monitoring station (CAAQMS) for hourly data recording.

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
						• Near Kopar village.	
	Ambient Air Quality	Work zone air contamination for parameters like CO, CO_2, VOCs	As per SPCB/ CPCB standards	Contaminants like VOCs to be reduced by proper ventilation process	Not Applicable	Work zone areas like offices, cubicles etc.	Once in a month.
		Parameters as per ICAO guidelines (HC, Pb, SO_2, CO, NOx and VOCs) and GHG Emissions	ICAO guidelines for Aircraft air emissions. As per section-10 of DGCA Civil Aviation Requirements (CAR) and its Amendment/ Revision.	Gaseous emissions from aircrafts engines shall be within ICAO guidelines	Not Applicable	Random checks on different aircrafts	Random checks GHG emission to be reported annually as per DGCA guidelines.
2	**Meteorology**	Micro-meteorological parameters to be monitored at one central location continuously with provision for auto-data logging system for the following parameters: 1. Wind speed and direction 2.Rainfall 3.Cloud cover	-	Monitoring of Meteorological parameters along with the AAQ monitoring.	The Meteorological station will be installed at a sufficient height with no encumbrances in the line of sight near Project site AAQ monitoring location.	The Meteorological station will be installed at a sufficient height with no encumbrances in the line of sight near Project Site AAQ monitoring locations.	Continuous Micro-meteorological parameters to be monitored at one central location continuously with provision for auto-data logging system.

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
		4.Temperature 5.Humidity 6.Solar radiation					
3	**Noise Levels**	Workplace Noise Level: [Hourly noise level for 24 hours covering L_{10}, L_{50}, L_{90}, Leq (24 hours), Leq (day); and Leq (night)	The Noise Pollution (Regulation and Control) Rules, 2000. Noise Limit for Generator Sets run with Diesel were notified by Environment (Protection) second Amendment Rules vide GSR 371(E), dated 17th May 2002 at serial no.94 and its amendments. Noise standards in the work environment are specified by Occupational Safety and Health Administration (OSHA-USA)	Development Phase Noise to be monitored in ambient air within the NMIA construction area. List of all noise generating machinery/equipment on-site along with the age to be prepared. Equipment to be maintained in good working condition all the time. DGs should be provided with acoustic enclosures and noise barriers and proper maintenance of the DG sets should be carried out to avoid deterioration of the noise levels emitted from the DGs. Night working is to be avoided or to be minimized to the extent possible Adequate acoustic control measures such as silencers, barricades etc	Noise to be monitored within the airport premises representing the project area. Three locations at the boundary (including landing and take-off funnel areas), One location near vehicle pass-by areas near entry point, One or Two locations near regular active construction areas as per the activity, One or more than One location near DG installation area. One location near labour camp area inside the Airport premises.	-	Regular during the construction activities. Spot noise levels and hourly noise level for 24 hours.

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
				Equipment logs, vehicle log books and working hour schedules to be maintained.			
		Ambient Noise Level: [LEQ [Hourly noise level for 24 hours]. The noise scales should be L_{10}, L_{50}, L_{90}, L_{eq} (24 hr), Leq day, Leq night.	The Noise Pollution (Regulation and Control) Rules, 2000. Noise standards in the work environment are specified by Occupational Safety and Health Administration (OSHA-USA) Noise Limit for DG Sets run with Diesel were notified by Environment (Protection) second Amendment Rules vide GSR 371(E), dated 17th May 2002 at serial no.94 and its amendments. Operation Phase	Development Phase Noise to be monitored in ambient air outside the NMIA construction area at nearby sensitivities. Operation Phase NMIAL will install a comprehensive Noise Monitoring System (NMS) at NMIA to monitor & measure the noise generated due to aircraft operations. Permanent and mobile Noise Monitoring terminals (NMT) will be installed in on either end of the main runway.	About ten locations inside and outside the airport construction site (inclusive of 1160 ha), perimeter preferably at: The proposed ambient noise level monitoring locations can be at: • Near Saraswathi Vidya mandir, Pargaon • Project Site. • Killi Gavthan near CIDCO Guest House; • Panchsheel Guest House near Navi Mumbai Municipal Corporation; • Sidharth Nagar near Ulwe Gaothan; • Varcha Olwe Anuj Office; • Jui village;	About 10 locations within and outside the Airport premises. The locations shall be finalized as per the recommendations of MPCB and MoEFCC EC conditions. The proposed ambient noise level monitoring locations can be at: • Near Saraswathi Vidya mandir, Pargaon Village. • Project site. • Killi Gavthan near CIDCO Guest House. • Panchsheel Guest House near Navi Mumbai Municipal Corporation;	Once in a month. The ambient noise levels to be monitored continuously for 24-hour duration with one-hour interval. The daytime noise levels to be accounted for 6 am to 10 pm and night-time noise levels to be accounted between 10 pm to 6 am

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
			Noise limits for Busy airports shall be considered as per MoEF&CC Noise Standards published for airport noise limits vide Notification G.S.R. 568(E) dated 18th June 2018. As per section-10 of DGCA Civil Aviation Requirements (CAR) and its Amendment/ Revision.		• Dapoli village; • Ulwe node; • Near Kopar village. And source noise monitoring near DG sets (1m from the source)	• Varcha Olwe Anuj Office; • Jui village; • Dapoli village; • Ulwe node; And source noise monitoring near DG sets (1m from the source)	
		Online Noise Level Monitoring	-	The noise events will be monitored 24x7 assigned to individual aircraft movement.	Not Applicable	Permanent and mobile Noise Monitoring terminals (NMT) will be installed in on either end of the main runway.	Continuously using Permanent and mobile Noise Monitoring terminals (NMT). The noise monitoring at the runway ends (both runway ends) shall be continuous and it shall be connected to

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
							the Central Data Centre.
4	**Vibration Monitoring**	Blast Vibration Monitoring has to be carried out for permissible Peak Particle Velocity (PPV in Hz) as per the DGMS Technical (S & T) Circular No. 7 of 1997.	DGMS Technical (S & T) Circular No. 7 of 1997.	Blasting monitoring will be conducted through engagement of certified vibration monitoring experts at the time of blasting.	Vibration monitoring will be carried out at applicable locations near the blasting site as per he DGMS Technical (S & T) Circular No. 7 of 1997	Not Applicable	Once each time during the blasting activity in progress.
5	**Ground Water**	**I. Physical Parameters:** pH, Temperature, Turbidity, EC, Salinity **II. Chemical Parameters:** DO, BOD, COD, Magnesium Hardness, Alkalinity, Chloride, Sulphate, Fluoride, Sodium, Potassium, total nitrogen, Total phosphorus, Phenol	IS:10500 specified parameters	The locations of groundwater monitoring wells are selected based on: • Local Drainage pattern; • Location of residential areas representing different activities/likely impact areas; and • Likely areas, which can represent present conditions.	Five Locations as below: i. Open well at Waghivaliwada ii. Open well at Koli iii. Open well at Kopar iv. Open well at Chinchpada v. Open well at Pargaon	4 Locations as below: i. Waghivali ii. Jui iii. Dapoli iv. Panvel	Once in a month. Samples can be collected as Grab samples.

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
		III. Heavy Metals: Fe, Zn, Mg, Mn, Cd, Cr, Hg **IV. Bacteriological parameters:** Coliform count					
6	**Surface/ Marine Water**	**I. Physical Parameters:** pH, Temperature, Turbidity, EC, Salinity **II. Chemical Parameters:** DO, BOD, COD, Magnesium Hardness, Alkalinity, Chloride, Sulphate, Fluoride, Sodium, Potassium, total nitrogen, Total phosphorus, Phenol. **III. Heavy Metals:** Fe, Zn, Mg, Mn, Cd, Cr, Hg **IV. Bacteriological Parameters:**	The surface samples will be compared with the primary water quality standards (Indian standards for Inland Surface Water (IS; 2296, 1982)) framed by Central Pollution Control Board and also with other relevant guidelines to assess the compliance.	The locations of surface water/marine monitoring locations are selected based on: • Local Drainage pattern. • Location of residential areas representing different activities/likely impact areas; and • Likely areas, which can represent present conditions. • Modified creek areas (Panvel creek)	Eleven Locations will be selected tentatively: i. Extreme end of Gadhi River (upstream) ii. Near Chinchpada village (2 km from W1) in Gadhi River iii. Near Jui Village (1.8 km from W2) in Gadhi River iv. At Junction of Ulwe and Gadhi Rivers (1.8 km from W3) in Gadhi River v. Near Vaghivali village (2 km from W4) in Gadhi River vi. Near CBD Belapur (1.2 km from W5) in Panvel Creek vii. Vaghivali Creek Junction (800 m from W6) in Gadhi River viii. Near Rathi Bunder ix. Mouth of Panvel Creek x. Ulwe River Near Owle Village xi. At the downstream of URC near Moha Creek		Once in three months. Samples can be collected (Surface & Bottom Sample) as Grab samples.

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
		Coliform count **V. Marine Biology:** Phyto-plankton & Zoo-plankton, macro-benthos & meo-benthos					
7	**Soil Quality**	**I. Physical parameters:** pH, Classification of soil, Texture and Conductivity **II. Chemical parameters:** TOC, Total Nitrogen, Phosphorus, Sulphate, Chloride, Ca, Na, Potassium **III. Heavy metals:** Fe, Zn, Mg, Mn, Cd, Cr, Hg	The homogenized soil samples will be analysed as IS: 2720 and Methods of Soil Analysis, Part-1, 2nd edition, 1986 of (American Society for Agronomy and Soil Science Society of America) for physical and chemical characteristics.	The locations are identified based on following objectives: • To determine the soil characteristics of the study area. • To determine the impact of development on soil characteristics; and • To determine the impact on soils more importantly from agricultural productivity point of view.	Following Eight Locations are proposed. i. Kombadbhuje ii. Koli iii. Chinchipada iv. Project Site office v. Pargaon vi. Ganeshpuri vii. Vaghivliwada viii. Ulwe	Following five Locations are proposed. i. Within project site ii. Ulwe iv. Pargaon v. Waghiwali	Once in three months. The samples to be collected at three depths in each location with the help of Augur and homogenized.

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
8	**Wastewater**	**I. Physical Parameters:** pH, Temperature, Turbidity **II. Chemical Parameters:** TSS, TDS, BOD, COD, Ammoniacal nitrogen, Phosphorus, MLSS, MLVSS, oil & grease **III. Bacteriological Analysis:** Coliform Count	The treated wastewater quality should follow the parameters and sampling routine as per CTE and CTO.	No untreated discharge to be made to surface water, groundwater, or soil. Visual inspection of unauthorised wastewater discharge to be conducted randomly and accidental releases to be checked.	Based on visual observation at potential discharge locations	Suitable locations at aeronautical and non-aeronautical areas within the airport	Once in a month and random visual inspections. Development/ Operation phase STPs inlet/ outlet monitored as per CTE/ CTO standards.
9	**Storm Water**	**Operation phase:** - Cleaning of Drains and Cross Drainage Structures and silt trap chambers are proposed to arrest sediment deposit in the outfall streams.	-	Cleaning shall be to the satisfaction of concerned incumbents of NMIAL/PMC. Silt ponds are proposed near every outfall location to prevent the silt getting into the receiving water bodies.	Not Applicable	At all storm water drains within the airport.	Before every monsoon and/or once a year at least.
10	**Soil Erosion**	Development Phase: -Effective cover in place.	-	Protect topsoil stockpile where possible at edge of site.	Potential soil erosion areas.	Not Applicable	At periodic intervals during

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
							construction activities
11	**Waste Management**	Comprehensive Waste Management Plan should be in place and available for inspection on-site.	Comprehensive Waste Management Plan should be in place and be available for any inspection on-site. Compliance with Solid Waste Management (SWM) Rules, 2016 and Hazardous Wastes (Management and Handling Rules), 2016 and its subsequent amendments E-Waste (Management) Rules, 2016 and its amendment. Bio-medical Waste Management Rules, 2016 Battery Waste Management Rules, 2020	Implement waste management plan that identifies and characterizes every waste arising associated with proposed activities and which identifies the procedures for collection, handling & disposal of each waste arising.	-	-	Periodic check during construction activities & operation phase.
12	**Record Keeping**	Equipment logs	-	List of all air/noise generating machinery onsite (including DG sets) along with age to be	Mobile and stationary DG installation locations and near other regular construction machinery operation		Once a month

Sr. No.	Aspect	Parameters for Monitoring	Standard	Action to be Followed	Environmental Monitoring Locations		Frequency of Monitoring
					Development Phase	Operation Phase	
				prepared. List of Vehicles including HEMMs accessing the construction area. Equipment to be maintained in good working order. Night working is to be minimized	areas and entry and exit points of access roads from approach. Other source noise levels within the construction site to be included if noticed.		
13	**Non-routine events and accidental releases**	Mock drills and records of the same	-	Plan to be drawn up, considering likely emergencies and steps required to prevent/limit consequences.	-		Periodic during construction activities
14	**Health**	All relevant parameters including HIV	-	Employees and migrant labour health check-ups	-		Regular check-ups (pre-employment and six monthly for regular employees)

6.5 Reporting Schedules of the Monitoring Data

It is proposed that voluntary reporting of environmental performance with reference to the EMP will be undertaken.

The environmental monitoring cell shall co-ordinate all monitoring programs at site and data thus generated shall be regularly furnished to the state and central regulatory agencies.

The compliance of conditions stipulated in EC and CRZ clearances shall be reviewed & compliance report shall be submitted to the MPCB and regional office of MoEF&CC on six-monthly basis.

Additionally, reporting of AAQ, noise levels and GHG emissions will be done to DGCA as per section-10 of DGCA Civil Aviation Requirements (CAR) and its Amendment/Revision.

Similarly, an Environmental Statement of environmental audit and compliance with EC and CRZ clearance conditions shall be prepared for the entire year of operations and shall be submitted at the end of each financial year-ending on 31st March of every year to the state pollution control board officials and to regional office of MoEFCC.

6.6 Monitoring Methods and Data Analysis of Environmental Monitoring

CIDCO/ NMIAL is already carrying out the regular monitoring for environmental attributes during the Pre-Development Works. This will be continued and suitably strengthened for further phase-wise development and operation suitably and in line with EC and CRZ conditions.

NMIAL is regularly monitoring environmental quality parameters for the NMIA which include ambient air, noise, surface/ marine, and ground water, drinking water etc as well as DG set emissions in development. The ambient air quality is monitored in accordance with National Ambient Air Quality Standards (NAAQS) notification, 2009 and noise is being monitored as per The Noise Pollution (Regulation and Control) Rules 2000. The monitored reports are submitted to various government authorities, namely Maharashtra Pollution Control Board (MPCB), Ministry of Environment, Forest, and Climate Change (MoEF&CC), Airport Authority of India (AAI), Directorate General of Civil Aviation (DGCA) on regular basis. Section-10 of DGCA Civil Aviation Requirements (CAR) and its Amendment/Revision will be followed for monitoring in operation phase.

All environmental monitoring and relevant operational data will be stored in a relational database and system. This will enable efficient retrieval and storage and interpretation of the data. Regular data extracts and interpretive reports are being sent to the regulator on six monthly basis and record of acknowledgements shall be maintained for future reference.

6.6.1 Air Quality Monitoring and Data Analysis

6.6.1.1 DG Set Stack Monitoring

The emissions from all standby DG set stacks shall be monitored at time of its operation only. The exit gas temperature, velocity and air pollutant concentrations shall be measured. Any unacceptable deviation from the design and standard values shall be thoroughly examined and appropriate action shall be taken. Air blowers shall be checked for any drop-in exit gas velocity. Wet scrubber, if required & installed, will be monitored as per DG's set parameter. DG sets monitoring will be performed as per parameters set by MoEF&CC/ MPCB requirements and DG sets notifications.

6.6.1.2 Ambient Air Quality Monitoring

The ambient air quality data is already being monitored by NMIAL as part of compliance of the existing EC & CRZ clearance. The similar set-up shall be continued and augmented as required during the development phase and operation phase of the airport. Ambient Air Quality monitoring will be performed as per MoEF & CC/MPCB requirements and Notifications.

The ambient air quality monitoring network has been established through a scientifically designed AAQM network and is based on the following considerations:

- Meteorological conditions on the synoptic scale.
- Topography of the study area.
- Representatives of regional background air quality; and
- Representatives of the likely impact areas.

The ground level concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_X and other parameters as per NAAQs 2009 in the ambient air shall be monitored at regular intervals in and around airport. Any abnormal rise shall be investigated to identify the causes and appropriate action shall be initiated. Green cover shall be developed for minimising dust propagation.

Continuous (Online) Ambient Air Quality Monitoring Stations

NMIAL will also install online continuous Ambient Air Quality Monitoring in the vicinity of airport, preferably near airside area during operation. The ambient air quality will be monitored for 24x7 for meteorological parameters (wind speed, wind direction, humidity, rainfall, cloud cover, solar insolation, etc.) PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, O_3 and other parameters as specified under 2009 CPCB Notification.

6.6.2 Water and Wastewater Quality Monitoring and Data Analysis

To ensure a strict control over the water consumption, flow meters to be installed for all major inlets. All leakages and excess consumption will be identified and rectified. In addition, periodic water audits will be conducted to explore further possibilities for water conservation and become water positive. In the proposed project, low flow water fixtures will be implemented as per green building guidelines. STP treated wastewater will be used internally for landscaping development/ horticulture, flushing, HVAC system.

The water quality (surface, ground and marine) within the study area is being monitored as part of the compliance to the EC and CTE conditions of the airport project. Reports are regularly submitted to regulatory authorities. The sampling locations have been selected based on the considerations such as drainage pattern, locations of possible impact areas, major nallahs such as Ulwe nallah, Gadhi nallah and creeks.

The water quality will be continued to be monitored during the development and operation of the airport and suitable augmentation as required will be done.

Water quality monitoring will be performed as per MoEF&CC and MPCB requirements for both development and operation activities. Drinking water qualities will be monitored as per IS:10500 standards.

6.6.2.1 Monitoring of Wastewater Streams

All the wastewater streams at the airport will be regularly analysed for flow rate and physical and chemical characteristics. Such analysis will be carried out for wastewater at the source of generation, at the point of entry into the wastewater treatment plant and at the point of final discharge/use. These data is properly documented and compared against the design values/standards for any necessary corrective action.

Methods prescribed in "Standard Methods for Examination of Water and Wastewater" prepared and published jointly by American Public Health Association (APHA), American Water Works Association (AWWA) is preferred. Wastewater Quality monitoring will be performed as per MoEF&CC and MPCB requirements.

6.6.3 Noise Levels

Under the existing EC, noise levels are being monitored in the airport project site and in the surrounding locations of the airport site. The data thus monitored is regularly submitted to the regulatory authorities.

The noise monitoring locations have been identified based on the activities in the project area, inhabited areas, industrial areas, major traffic junctions and sensitive receptors such as schools, hospitals, and other ecologically sensitive areas.

Thus, the noise level monitoring will be continued during development and operation phases of the airport with suitable augmentation.

Noise levels in the work zone environment such as airside and landside will be monitored. The frequency shall be once in a month in the work zone. Similarly, ambient noise levels near habitations shall also be monitored with online noise monitoring units. Audiometric tests should be conducted periodically for the employees working close to the high noise sources.

Continuous (Online) Noise Level Monitoring Systems

Further, continuous online noise monitoring in the funnel zones of all the runways (both sides) will be monitored by installing the aircraft noise monitoring systems as per DGCA requirements. These on-line noise data recording instruments will be connected to the Central Data Centre.

NMIAL will install a comprehensive Noise Monitoring System (NMS) at NMIA to monitor & measure the noise generated due to aircraft operations. Permanent and mobile Noise Monitoring terminals (NMT) will be installed in the vicinity of airport premises in landing & take-off paths of the south and north runways. The noise events will be monitored 24x7 assigned to individual aircraft movement. The noise data will be used to access the noise pollution due to aircraft movement as well as the effect of background noise on the community.

6.6.4 Soil Quality

Under the existing EC/CTE conditions, soil quality is being monitored in the airport project site and in the surrounding locations of the airport site. The data thus monitored is regularly submitted to the regulatory authorities.

The soil sampling locations have been identified with the following objectives:

- To determine the existing soil quality within the airport project site and within the study area.
- To determine the impact of the airport Pre-Development Works, construction works and operations of the airport.
- To determine the impact on soils more importantly from the agricultural productivity point of view and also greenbelt/green cover sustainability point of view.

Thus, the soil quality monitoring and analysis will be continued during development and operation phases of the airport with suitable augmentation.

Chapter-7
Additional Studies

7.0 ADDITIONAL STUDIES

This chapter describes various additional studies associated with the project which include Public Consultation, Hazard Identification & Analysis and Consequence Analysis and Disaster Management Plan including Aerodrome Emergency Response Plan (AERP), Rehabilitation & Resettlement Studies, Storm Water Drainage Studies, Hydro-geological Studies, Bird Management Studies etc.

As per TOR issued by MoEF&CC vide letter No. F No. 10-53/2020-IA-III dated 29th October 2020, various additional studies have been carried out. The details include the following:

- Risk Assessment (RA) and Disaster Management Plan (DMP) including the Aerodrome Emergency Response Plan (AERP);
- Rehabilitation Resettlement (R&R) of project affected people/families as the project involved displacement of indigenous population;
- Storm Water Drainage studies conducted by Central Water and Power Research Station (CWPRS), Pune;
- Hydrogeological study in the impact zone of NMIA, study conducted by Groundwater Surveys and Development Agency, India;
- Bird Management studies conducted Bombay Natural History Society (BNHS)) as the project lies near eco-sensitive zones with bird roosting and feeding areas; and
- A Regional and Local Transport Connectivity Plan for NMIA is prepared to address the traffic management and decongestion within the impact area of NMIA and the same has been discussed with the key stakeholders of the project and the final report is submitted to MoEF&CC.

The afore-mentioned additional studies have been carried out with respect to the NMIA project as part of the compliance to the EC & CRZ conditions (2010). The gist of the additional studies is discussed in following sections while the study reports are enclosed as annexures to this Report.

As per the Terms of Reference (MOM) dated 29th October, 2020, the EAC ***exempted the project from requirement of Public Hearing as per para 7(ii) of EIA Notification, 2006 and its subsequent amendments for preparation of EIA/EMP report.”***

Therefore, Public Hearing is not conducted in this EIA study.

7.1 Risk Assessment & Disaster Management Plan (Development Phase)

7.1.1 Introduction

Disaster of any kind during development phase could jeopardize progress of the project. In fact, disaster is a serious emergency that arises either by natural calamities or by manmade incident, mostly without prior warning and cause widespread loss of life, inflicts injuries, damage property, destroy materials, and in addition inflict negative impacts on the environment.

Disaster management is a continuous process that aims to manage and minimize hazards. Therefore, identification of threats, their possible impact, preventive measures and plan to deal with such situations are integral part of Disaster Management Plan. The various actions which are required in DMP are summarized in the **Figure-7.1** and are discussed below.

Figure – 7.1
DISASTER MANAGEMENT CYCLE

Prevention:

Actions and measures taken to avoid the incident and to minimize impact on human, health, property & environment. The very purpose is to avoid occurrence of an incident at site. Careless approach and indifferent attitude are the main deterrence in operation and surveillance at construction site.

Mitigation:

Undertake all possible measures that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies.

Preparedness:

These activities are to increase a community's ability to respond when a disaster occurs. Typical preparedness measures include developing mutual aid agreements and memorandums of understanding with various stakeholders, conducting disaster exercises to reinforce training and test capabilities, and presenting all-hazards education campaigns.

Response:

Actions carried out immediately before, during and immediately after a hazard impact, which are aimed at saving lives, reducing economic losses, and alleviating suffering.

Recovery:

Actions taken to return a community to normal or near-normal conditions, including the restoration of basic services and the repair of physical, social and economic damages. Typical recovery actions include debris clean-up, rebuilding of roads and bridges and key facilities, and sustained mass care for displaced human and animal populations.

Disaster management has its own advantages. Some of these are:

- Reduces the effects of a disaster;
- Gives the chance to survive, no matter what kind of a disaster occurs and irrespective of when it occurs;
- Reduces the probability of uncertainties of close encounters to unexpected and dangerous natural events;
- Minimizes the effects of the accident on people and property;
- Initiate the rescue and medical treatment of casualties;
- Brings the incident under control;
- Preserves relevant records and equipment for the subsequent enquiry into the cause and circumstances of the emergency;
- Helps in investigation and take steps to prevent recurrence of similar incidents;
- Helps in communication and collaboration with statutory (local and state) authorities, etc.

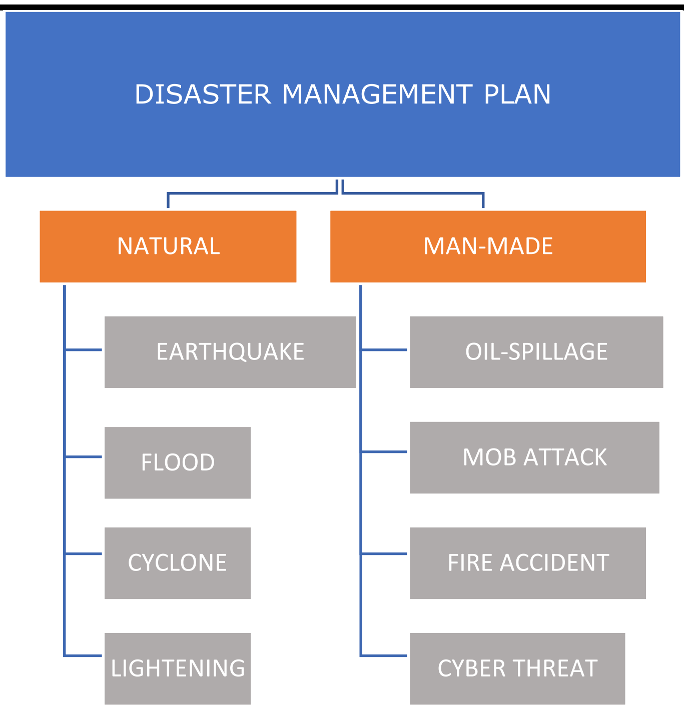
Any sincere and responsive proponent will have to have DMP separately for the development phase of large infrastructure project like NMIA project. The DMP, for development phase, has adopted the following structure, as shown in the **Figure-7.2** which is based on possible incidences that might occur at the existing site.

7.1.2 Types of Disaster

7.1.2.1 Natural Disasters

Natural Disasters are often sudden & intense and results in considerable destruction, injuries & death disrupting normal life as well as the process of development.

1. **Earthquake:** Seismic Environment & Precautions: As per the Seismic Zoning Map of India, NMIA area falls under Seismic Zone-III. The structural design shall be certified as per IS reference code 1893 – 1984 and IS 13920-1993 criteria for earthquake resistant design of structures.



Source: NMIAL

FIGURE – 7.2
DISASTER MANAGEMENT PLAN FOR DEVELOPMENT PHASE

2. **Cyclones:** Cyclones are caused by atmospheric disturbances around a low-pressure area distinguished by swift and often destructive air circulation. They are usually accompanied by violent storms and bad weather. There is no history of any cyclone in the project area. However, workers and all concerned shall be advised to stay in the shelter in tightly secured windows and doors and stop working at site in such circumstances. The glass windows/doors etc. should be covered with paper/cardboards to avoid spread of broken glasses due to flying objects outside.

3. **Floods:** Mitigation measures to manage flood disasters during development phase:

   - Storm water system would be checked and cleaned periodically;
   - Mapping the areas within or leading in or out of the building that will be water logged, flooded or isolated due to the flood. The areas will be marked after completion of the project (as final ground levels etc. will be available after completion).
   - Dewatering pumps are to be installed at vulnerable locations; and
   - Drains are designed to carry run-off generated during heavy rainfall with slit arresting pit.

4. **Lightening:** Lightning is an atmospheric electrostatic discharge accompanied by thunder which typically occurs during thunderstorms and sometimes during dust storms. It often leads to physical damage to the building and employees. It can also lead to short circuits, failure of power supply and fire. Impact due to lightening can be mitigated through Lightning arrestor systems is to be provided to abate the impact of lightning hazard.

7.1.2.2 Man Made Disasters

These disasters are often sudden and could be fatal to human life & property but occur due lack of adequate surveillance, inadequate awareness & training to manpower and inefficient administrative control.

1. **Fire**

- Fires on the Ground (Fires involving any buildings or storage area). Fire may occur at any of the storage and buildings area;
- During a fire occurrence, however small it may appear to be, person who discovers it shall raise the fire alarm via the nearest manual call point;
- If no manual call point is readily available, raise the alarm by other available means;
- Inform the site safety officer immediately of the exact location of the fire; and
- Operate a suitable fire extinguisher where readily available, or any water hose reel within range.

Response in case of fire include:

- Required response during in the event of a fire should be described in signs located in the lobby.
- On sighting a fire, it should be immediately informed to the Fire In charge giving the exact location and type of fire in detail.
- Initiate the Emergency Response Team for Fire.
- If the fire is small, engage in extinguishing the fire using the nearest fire extinguisher.
- Guide the Emergency Response Team staff to the emergency assembly point.
- The Emergency Response Team should immediately inform the nearest dispensary and security force. If required a fire tender should be summoned.
- The response team should immediately move to the point of fire and take all necessary steps to stop the fire. If the fire is not controllable and spreads then the manager in charge should inform the district authorities and call for external help.

Instructions for Workers or Occupants

- Get out of area or location as quickly and as safely as possible;
- Use the stairs to escape. When evacuating, stay low to the ground;
- If possible, cover mouth with a cloth to avoid inhaling smoke and gases;
- Close doors in each room after escaping to delay the spread of the fire if in a room with a closed door;
- If smoke is pouring in around the bottom of the door or if it feels hot, keep the door closed;

- Open a window to escape or for fresh air while awaiting rescue;
- If there is no smoke at the bottom or top and the door is not hot, then open the door slowly;
- If there is too much smoke or fire in the hall, slam the door shut;
- Stay out of damaged structure; and
- Check that all wiring and utilities are safe.

2. Mob Attack

Mob can be defined as "crowd which develops into a mob when all or most of its members have been instilled with a purpose and intent to carry out that purpose regardless of the consequences".

Roles and Responsibilities of Security for Mob Management

- To abide by the laws, and local regulations in place at the venue;
- To exert peer pressure on miscreants involved in fighting, pushing, provoking crowds etc. which may lead to heightened safety risks; and
- To report emerging situation.

Mitigation Measures

- To inform the local issues to the Security Head, Police, and Local administration;
- To constitute various focused group/committees viz. traffic control, people flow control, information, medical assistance, food, water & sanitation etc.;
- To help in search & rescue and to provide first aid in case of emergency;
- To mobilize local resources (food, shelter, vehicles etc.) in case of disaster; and
- To assist in relief distribution and recovery.

3. Oil Spill- Due to handling Petroleum Products at Onsite Petrol Pump

- Strict supervision of petrol pump personnel during unloading of Petroleum products in storage tanks, loading of tanks, should be carried out;
- Any change/replacement /removal, addition etc in facility instrument /valve /setting /cut-off/trip /alarms setting must be ensured of safe operation and updated in P&ID;
- Integrity of instrumentation, facilities must be ensured periodically through calibration and other verification measures;
- In case of major change in process parameter /facility, risk analysis study must be carries out;
- Maintenance of pumps must be done as per standard;
- Mechanical seal of pipeline, flange joints of valves should be regularly monitored to prevent any leakage;
- Visual inspection of pipeline must be done regularly to locate leaks;
- MSDS of petroleum products should be followed while handling & storage;
- Earthing must be provided on the pipeline & storage tanks and should be checked regularly;
- All the hydrant points should be easily accessible. All should be in working

condition;
- Maintenance of all firefighting systems should be done on regular basis as per schedule developed at Depot;
- Back washing of strainer should be done in regular interval to avoid chocking; and
- All Electrical Equipment & their installation should be as per OISD standard; and
- All electrical fittings should be flame-proof type.

7.1.3 Risk Assessment and Mitigation Measures

Risk assessment study deals with identifying and evaluating the magnitude of impending risks to which the neighboring population is exposed due to occurrence of accidents involved in the project construction and development. The following are identified:

Hazard Identification: Physical, Chemical, Mechanical, Electrical, Vibration & occupational health hazards during development phase.

Risk of body injury, Injury to eyes, fatal accident, Fire and explosion, Hearing loss etc.

Considering risks involved during development phase, Vulnerability analysis is carried out which is shown in **Table-7.1** and mitigation measures to be implemented are given in **Table-7.2.**

TABLE-7.1
VULNERABILITY ANALYSIS DURING DEVELOPMENT PHASE

Aspect	Air Pollution	Water Pollution	Noise Pollution	Soil Pollution	Occupational Hazard
A. Material Handling:					
Cement	+M	-	-	+M	+M
Steel	-	-	+	-	+M
Sand/ Fine Dust	+H	-	-	-	-
Stone	-	-	-	-	+L
Wood	-	-	--	-	-
Glass	-	-	-	-	+H
Hardware	-	-	-	-	-
Colour	-	+M	-	+M	-
B. Construction Machinery					
Rotary Driller	+L	-	+L	-	+L
Mixers	+M	-	+M	+L	+M
Excavator/ Dumper	+L	-	+L	-	+M
Material Lift	-	-	+M	-	+M

Source: NMIAL

Risk Factor: + : Positive, - : Negative, L: Low, M: Medium, H: High

TABLE-7.2
RISK AND MITIGATION MEASURES DURING DEVELOPMENT PHASE

Sr.No.	Operations	Risk	Mitigation Measures
1	Construction/material Hoists	Personal injury Accidents	• Only approved hoist to be used by trained employees with safe area demarcation. • Use of PPA/PPE
2	Portable electrical equipment	Burn/ fatal	• To be checked before use by approved electrical safety official. • Use of PPE/PPA
3	Hazardous substances	Fire, explosion Toxic release Unhygienic Dust.	• Storage of Bulk Fuel. Paints, Plastic Plywood Combustible in a isolated protected areas. • Use of PPE/PPA • To ensure adequate training
4	Scaffolding	Fall from Height Fatal accident	• Introduction of working on height permit system. • PPE/PPA/safety harness/Training
5	Ladders	Accident, Injury	• Proper selection and inspection. • PPE/PPA, Training
6	Material Lifts	Accidental, Injury Even Fetal	• Inspection by competent person. • Safe work instruction • Cordoning of material lift areas • Training for correct use • Use of PPE/PPA
7	Hoists	Accidental, Injury	• Inspection by competent person. • Safe work instruction • Cordoning of hoist areas • Training for correct use • Use of PPE/PPA
8	Using tools/ equipment with moving part(s)	Nipping and pinching Injury to Hand Electrical Shocks Leg Injury	• Proper selection of Hand tool Periodic Inspection • Use of proper hand glove • PPE/PPA. • Adequate training. • Safety guard in case of Grinder
9	• Using tools/equipment that vibrate • Electrical wiring • Asbestos removal Welding	• Vibration hazard • Electrical shock • Asbestosis Eye, Body Burns	• Inspection by competent person, Ergonomic training, • Use of PPE/PPA and Safety Guards

Sr.No.	Operations	Risk	Mitigation Measures
		Toxic gases, inhalation	
10	Working around electrical installations/ working near traffic / working at a height (>3m) /Working in isolation. Working in a confined space/ demolition work	Electrical shocks, Injury Fatal accident Hazard of toxic Gases inhalation	• Work by authorized trained person, Indian electrical safety rules to be fallowed. • Follow work permit system, • Use of PPE/PPA
11	Work environment 1. Noise 2. Dust/fumes/ vapours /gases 3. Extreme temperatures 4. Slippery surfaces/trip hazards 5. Poor ventilation/air quality A poorly designed work area for the project/task	Accidental Injury, Occupational Hazards. Rashes Burn Skin deceases	• Enclose noise source, • Lubrication, • Minimum time exposure, • Use of PPE/PPA, • Good House-keeping, • Illumination survey, • Adequate trainings

Source: NMIAL

7.1.4 Mitigation for Other Risk & Hazard Areas (Development Phase)

- After safety officer inspection tower crane shall be operated under the direction of EHS engineer. Electrical cables & its condition & working shall be examined by competent person periodically. Fork and sling will be examined by engineer and worker before operating. Certified employee will be appointed for job;

- Trained & experienced employee will be appointed for gas cutting & welding activities. Appropriate safety measures will be taken for cylinder storage and its equipment's. Pressure regulator valve, nozzles, blow pipe, flexible hose and flash back arrester shall be checked by safety officer before workers operating. Appropriate PPE's shall be given to employee & also will ensure its use. Hand held helmet with filter lens shall be provided to welding/cutting operator to prevent his eye vision;

- Trained & experienced employee will be appointed for bar bending & cutting activities. Sufficient space will be provided for job. Appropriate PPE's shall be given to employee & also will ensure its use;

- Trained & experienced employee will be appointed for ply cutting & drilling. Sufficient space will be provided for job. Appropriate PPE's shall be given to employee & also will ensure its use;

- Safety belt, harness and lifeline with PPE's shall be provided to workers working at height. Such activities will be carried out under safety supervisor's supervision;

- All noise creating machines shall be installed with insulation & rubber padding;

- All the materials should be stacked on the leveled ground, all the materials should be stacked, providing good aisles between them for receiving the materials; and

- Storage of LPG Cylinders & Oxygen Cylinders shall be stored as per relevant Acts & Rules there under;

- Diesel (above 1000 liters) & Petrol above 32 litres shall be stored as per The Petroleum Act.

7.2 Risk Assessment & Disaster Management Plan (Operation Phase)

The ICAO Accident Prevention Programme Manual defines Risk as 'the *potential for adverse consequences resulting from a hazard*'. It is the probability that during a defined period of activity, the hazard will result in an accident with definable consequences. It is the likelihood that the hazard(s) potential to cause harm will be realized. Risk Assessment is a systematic process aimed at removing or minimizing hazards at workplace to make it safer and healthier. Risk Assessment involves the following steps:

- Identification of Hazard(s);
- Analyze / Evaluate the risk associated with the Hazard (s); and
- Determine appropriate measures to eliminate or control the Hazard.

Although, where risk is concerned, there is no such thing as absolute safety. Risks have to be managed to a level "As Low as Reasonably Practicable" (ALARP). This means that the risk must be balanced against the time, cost, and difficulty of taking measures to reduce or eliminate the risk. The same approach will be adopted by NMIAL in addressing the risks associated with project which includes generic as well as specific risks associated with the project. While the environment & social/climate change related impacts associated with project are addressed in Chapter-4 and other stand-alone studies carried out for the project, the risks related to certain plausible hazards that may affect the airport and that pose acute and fatal hazards, has immediate impacts on the airport operations in general, are addressed in this section.

7.2.1 <u>Introduction</u>

Hazard analysis involves the identification and quantification of various probable hazards (unsafe conditions) that may occur at the airport. On the other hand, risk analysis deals with the identification and quantification of risks, the airport equipment/facilities and personnel exposed to, due to the accidents resulting from the hazards present at the airport. Hazard occurrence may result in on-site implications like:

- Fire and/or explosion;
- Leakage of flammable material;
- Crash landing;
- Bomb threat; and
- Natural calamities like earthquake, cyclone etc.

Incidents having off-site origins can be:

- Air raids; and
- Crashing of aircrafts i.e., while landing or take-off.
- Terrorist Attack

Other incidents, which can also result in a disaster include:

- Agitation/forced entry by external group of people;
- Sabotage;
- Hijacking; and
- Cyber threats.

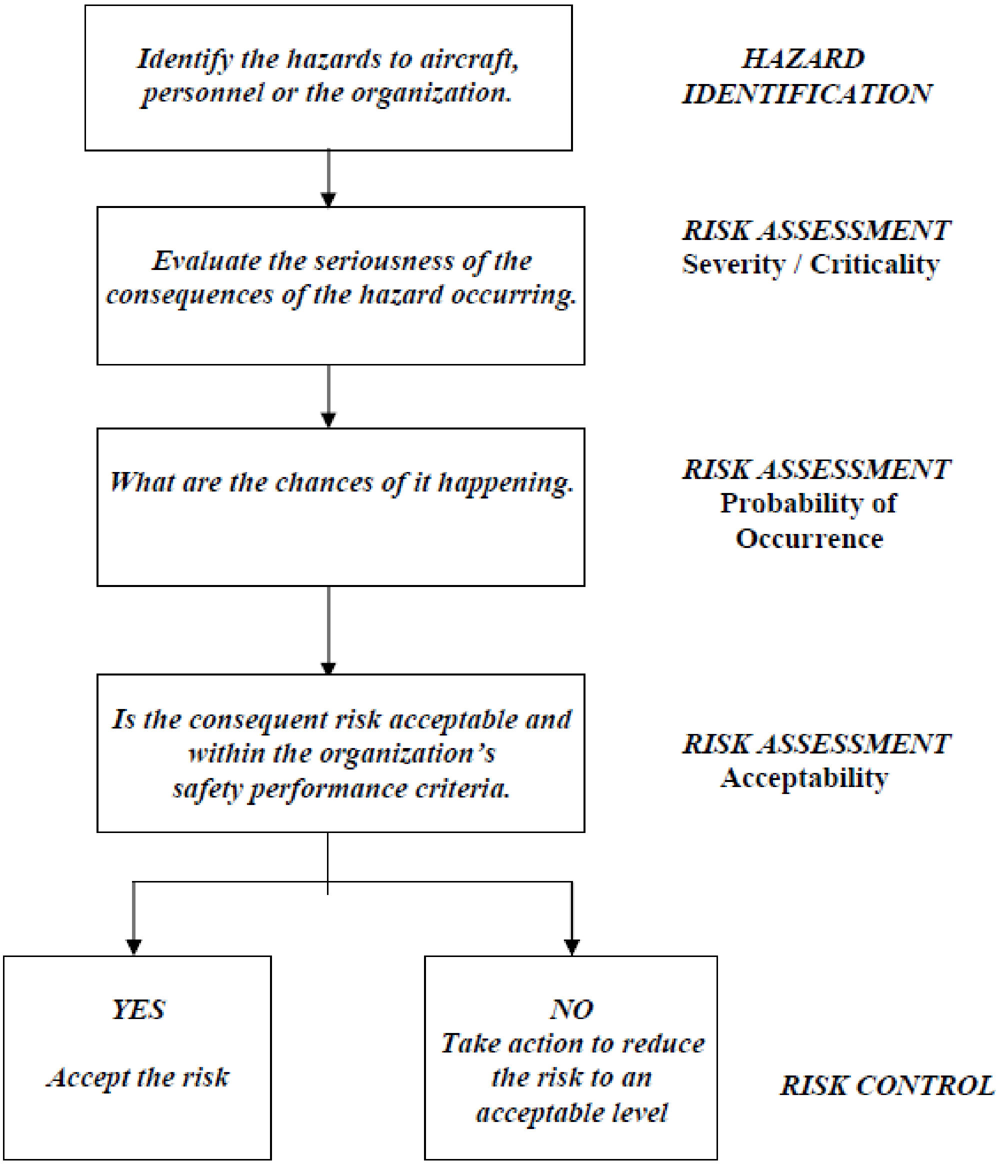
7.2.2 Hazard Identification

Traditional hazard analysis models have been adopted by NMIAL's providence of risks associated; typically, the SHEL (S - Software, H - Hardware, E - Environment, L - Live ware) model is a practicable model for risk assessment inherently practiced in aviation industry. Further, this section addresses the maximum credible accident analysis and consequence analysis either qualitatively or quantitatively, which gives a broad identification of risks involved in the airport operation.

Identification of hazards at the project site is of primary significance in the analysis, quantification and cost-effective control of accidents. A classical definition of 'hazard' states that hazard is in fact the characteristic of system that presents potential for an accident. Hence, all the components of a system need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. This section is addressed in assessing the risks associated with airport rescue operations during emergency situations that may arise from activities of acute nature like, fire explosions, bomb threats, hijacking, sabotage, trespassing, etc. which may result in inhospitable conditions.

7.2.3 NMIA Risk Management

As per the ICAO Accident Prevention Programme Manual, 2005, Risk Management is defined as, '*the identification, analysis and elimination (and/or control to an acceptable level) of those hazards, as well as the subsequent risks that threaten the viability of an organization*'. In other words, risk management facilitates the balancing act between assessed risks and viable risk control. It is an integral component of safety management programs. Risk management involves a logical process of objective analysis, particularly in the evaluation of the risks. However, in striving for the highest level of safety, it must be accepted that absolute safety is unachievable. An overview of the process for Risk Management is summarized in the flow chart at **Figure-7.3.**



Source: ICAO Accident Prevention Programme Manual, 2005

FIGURE-7.3
RISK MANAGEMENT PROCESS

7.2.3.1 Cyber Threats Management

Airports Authority of India recommends assessment of various threat actors and perceived threats to the Air Navigation Systems (ANS). An ANS cyber security policy is implemented through internal audit and mitigation plans for the Communications and Navigation Systems (CNS) /Air Traffic Management (ATM) systems. Implementation of this policy will mitigate the threats and reduce the impact and provide continuous operations in line with government policy guidelines issued by National Critical Information Infrastructure Protection Centre (NCIIPC) and National Technical Research Organization (NTRO).

CNS/ATM system infrastructure protection refers to the protection of the CNS/ATM system infrastructure through information and communication technology security, physical security and personnel security. It also includes the provisions for continuity of service during an emergency or disasters. Facilities include control centers and airports. Equipment includes communications, navigation and surveillance (CNS) and information systems.

The 40th Session of the ICAO Assembly adopted Assembly Resolution A40-10 – *Addressing Cybersecurity in Civil Aviation*. The resolution addresses cybersecurity through a horizontal, cross-cutting and functional approach, re-affirming the importance and urgency of protecting civil aviation's critical infrastructure systems and data against cyber threats and calls upon States to implement the ICAO Cybersecurity Strategy. The cyber-security system of airports is integrated with ICAO guidelines for global benchmarking.

<u>Mitigation Measures</u>

Cyber security policies of an organization can be effective, provided all its employees and stakeholders understand their value and exhibit a strong commitment towards implementing them. NMIA can play a key role in keeping organizations safe in cyberspace by applying the following points:

- Taking ownership of the security risk posed by employees and stakeholders
- Creating cyber security awareness
- Information sharing
- Ensuring that security measures are practical and ethical
- Identifying employees and stakeholders who may present a particular risk

7.2.3.2 Preparedness Against Terrorist Attacks and Unauthorized Trespassing

A perimeter airside road of 7.5 m width (2 lanes of 3.75 m) has been provided for patrolling all along internal perimeter airside area of NMIA. A Perimeter Security Wall, as per BCAS requirements, of 2.4m in height and 0.6m of concertina coil overhang has been planned. This Perimeter Security Wall shall be illuminated at a minimum essential level in accordance with DGCA regulations. For Phase I, the Perimeter Security Wall is approximately 15,000m long. Furthermore, external roads, to be constructed by CIDCO, are planned outside airport to facilitate patrolling from external side of NMIA.

Additional to perimeter airside road and security wall, a Perimeter Intruder Detention System (PIDS) has been planned, in accordance with BCAS requirements (AVESEC Circular 5-2017 CCTV and PIDS), containing:

- A mandatory Primary Intruder Detection System consisting of one, or a combination, of:
    - Fibre Optic Mesh PIDS or Vibration Sensor based PIDS.
    - Vibration Sensor based PIDS.

- Ground Surveillance Doppler Radar based PID.
- Infrared sensors.
- Taut Wire based PIDS.
- Microwave Sensors based PIDS; and
- Power Fence.
- A comprehensive CCTV surveillance system; and
- Main Control Room (where the PIDS & CCTV are connected).

The perimeter airside road and security wall have been located to allow sufficient area for required PIDS.

7.2.4 Fire Explosion Risk and Consequence Modelling

While, chances of fire explosions due to the presence of flammable substances (fuel storage) pose a major and immediate risk to the airport operation is addressed quantitatively in the subsequent sections, the management of all other on-site and off-site emergencies along with fire explosion risks are addressed comprehensively in the Disaster Management Plan (DMP) of NMIA.

Identification of hazards at the project site is of primary significance in the analysis, quantification and cost-effective control of accidents. A classical definition of 'hazard' states that hazard is in fact the characteristic of system that presents potential for an accident. Hence, all the components of a system need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident.

The consequence modelling and the fire risk explosion is performed using DNV GL proprietary software PHAST 8.2. PHAST is a consequence and impact assessment module integrated within DNV GL risk calculation software SAFETI.

7.2.4.1 ATF Tankage and Fuel

Aviation fuel at NMIA is planned to be dispensed through an underground fuel hydrant system designed in accordance with relevant standards. The required fuel infrastructure for the initial phases is planned to be built prior to opening of airport and the facility will then be expanded in phases to meet demand. The location of fuel facility is crucial, as it influences both incoming supply lines and potential fuel transmission lines from the facility to the apron. In earlier phases, it must allow the flexibility for bowsers to supply the airfield to augment hydrant network while it is being developed. Therefore, the facility is located close to airfield, with access to an airside gate for quick and efficient entry to the apron.

NMIA Fuel System provision is structured as follows:

- Fuel supply;
- Fuel demand & storage; and
- Fuel hydrant system.

NMIA Fuel Supply

Based upon the projections, it has been planned that NMIA shall be supplied by about four pipelines to be introduced in phases. An indicative route has been identified for the location of incoming fuel supply pipelines from south-western part of airport boundary to the proposed location of NMIA fuel farm, as shown in **Figure-7.4**.

Source: NMIAL

FIGURE-7.4
FINAL PHASE ATF FUEL FARM
AND INCOMING FUEL SUPPLY PIPELINE ROUTING

Fuel Demand & Fuel Storage

The summary of the estimated phase-wise peak fuel demand & storage for estimated 5 days storage capacity provided in fuel farm is presented in **Table-7.3** below:

TABLE-7.3
DETAILS OF FUEL DEMAND & STORAGE FACILITY

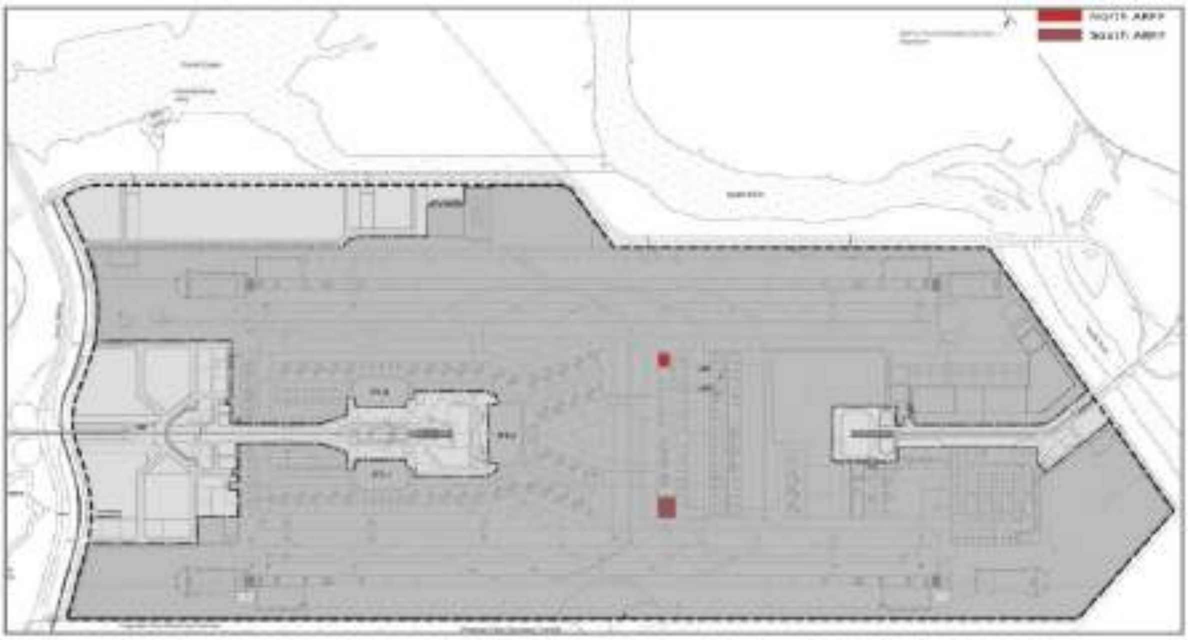
Particulars	20 MPPA	40 MPPA	60 MPPA
Storage Capacity	30000 KL	30000 KL	50000 KL
Day's coverage	14.9	7.2	8.3
Peak Demand (cum/hr)	780	1320	1860
Fuel Usage (Cum/day)	2020	4040	6060

Source: NMIAL

7.2.4.2 Air Rescue and Fire Fighting System [ARFF]

Two ARFF stations are required to serve the dual runway system. Location of ARFF is crucial as vehicles are required to access the runway thresholds and all movement areas within a 3-minute criterion. Therefore, a central location, with one facility in north and one in south are planned on airside of NMIA to provide ICAO Category 10 coverage in accordance with relevant standards and terms of CA and need to safeguard for ICAO Code F. Rescue equipment will be adequate to meet DGCA CAR requirements. The minimum number of ARFF vehicles will be three; this is subject to the outcome of completed 'Task Resource Analysis' (ref. DGCA, AD AC NO. 03 of 2017).

A paved emergency access road of 5 m wide for single direction and 7 m wide at curves will be provided from the locations of the ARFF facilities to both runways. A communication and alerting system will be provided linking the ARFF station with the control tower and ARFF vehicles. The location of both air rescue and firefighting facilities in northern and southern half of airport site is shown in **Figure-7.5.**



Source: NMIAL

FIGURE-7.5
AIR RESCUE AND FIREFIGHTING FACILITY (60 MPPA)

Aircraft Rescue and Fire-Fighting (ARFF) facility is required to house ARFF vehicles, staff and equipment for use in emergency situations. The facility is located and designed to ensure all potential emergencies on the airfield can be reached within the regulatory requirements. The facility is planned to include a building, watch tower (non-satellite), fire tender parking, staff areas for welfare, and parking for ARFF, as well as storage of water, extinguishing agent, and firefighting equipment. It provides adequate space to support a minimum of 3 ARFF vehicles and their respective supporting staff and equipment.

The ARFF facilities will be phased with the first building constructed to support the southern runway in Phase-I. A second ARFF (satellite) facility is planned to the north of first station once second runway is completed. Location of ARFF is crucial as vehicles are required to access the runway thresholds and all movement areas within a 3-minute criterion. Therefore, a central location, with one facility in north and one in south, ensures all regulatory criteria is upheld. Based on intended runway phasing at NMIA, the ARFF will be split into two phases.

The main ARFF building is required in opening phase to support southern runway. Until the second runway is completed, the facility is also required to double up as a temporary ATC Tower, which means southern facility must be positioned to ensure the tower does not exceed the OLS height limitations. Based on this, the facility will be located at a distance of at least 432 m from the runway centerline.

ARFF and Emergency Roads

The location of the ARFF facilities is driven by regulatory requirements at both International and Indian level. International standards and recommended practices are published by the International Civil Aviation Organisation (ICAO). As a signatory state to the International Convention on Civil Aviation, Indian regulations and standards, are enacted by the Indian Government and enforced by the Directorate General of Civil Aviation (DGCA). With respect to aviation firefighting, the key international reference is *ICAO Annex 14 Aerodromes Volume I Aerodrome Design and Operations (Annex 14-I)*. Annex 14-I outlines the requirement for an Aerodrome Emergency Plan which must include appropriate specialist rescue services to be able to respond to emergencies where an aerodrome is located close to water and/or swampy areas and where a significant portion of approach or departure operations takes place over these areas. ICAO Annex 14 states the following for planning of the fire station location:

- The operational objective of the rescue and firefighting service shall be to achieve a response time not exceeding three minutes to any point of each operational runway in optimum visibility and surface conditions;
- It is recommended that response times should not exceed two minutes to any point of each operational runway in optimum visibility and surface conditions;
- Optimum conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination to include water;
- Other vehicles are required to respond no more than one minute after the first responding vehicle(s); and
- In cases whereby, the response time cannot be achieved, satellite fire stations may be proposed.

Response time is considered in this case to be the time between the initial call to rescue and firefighting service, and the time when first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50 percent of the discharge rate. Further to this, response time criteria as per DGCA CAR, Section-4, Series-B, and Part-1 are as below:

- A response time not exceeding three minutes shall be maintained by the rescue and fire-fighting services for any point of each operational runway and for any other part of the movement area.
- The operational objective of the rescue and fire-fighting service shall be to achieve a response time not exceeding two minutes to any point of each operational runway, in optimum visibility and surface conditions.

Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination e.g. water, ice or snow. A significant aspect of an emergency response plan is the development and layout of the airside road system. An emergency road system is required to support the ARFF and emergency vehicles to ensure the criteria can be upheld. With regard to emergency road regulatory requirements, ICAO Annex 14 states that:

- Emergency access roads should be provided on an aerodrome where terrain conditions permit their construction, so as to facilitate achieving minimum response times. Particular attention should be given to the provision of ready access to approach areas up to 1000 m from the threshold, or at least within the aerodrome boundary;
- Where a fence is provided, the need for convenient access to outside areas should be considered. Aerodrome service roads may serve as emergency access roads when they are suitably located and constructed. Therefore, various points connecting the perimeter road to the aerodrome service roads are required, including crash gates around the runway ends in case of runway-end excursions;
- Emergency access roads should be capable of supporting the heaviest vehicles which will use them and be usable in all weather conditions. Roads within 90 m of a runway should be surfaced to prevent surface erosion and the transfer of debris to the runway. Sufficient vertical clearance should be provided from overhead obstructions for the largest vehicles; and
- Access into the operational runway area is direct and clear, requiring a minimum number of turns.

Assumptions and Parameters

As a result of the above, with regard to emergency road network at NMIA, following assumptions and parameters have been considered:

- Emergency vehicles will have full access to commercial airside roads (i.e. HOS and BOS roads);
- Both runways are to have a parallel road running between runway and inner parallel taxiway spanning full length of runway for emergency access and inspection vehicles;

- Both runways are to have emergency roads extending a minimum of 1000 m from runway threshold, or at least up to the airport boundary whereby a crash gate should be located, for emergency response vehicle use;

- North-South Crossfield taxiways are required to have crossings in both north and south to prevent use of airside tunnel in an emergency as the tunnel may be congested. These surface level crossings may also be used by other airside vehicles if tunnel is temporarily out of operation in future;

- An emergency road is required directly connecting the ARFF facilities to runways for use in major emergencies, as well as a direct connection to northern ancillary area via northern perimeter road;

- Roads should be positioned to ensure the shortest, yet fastest route to runway thresholds is achieved. This may include angled roads that do not run parallel to the airside system, but enable a more direct route to be achieved;

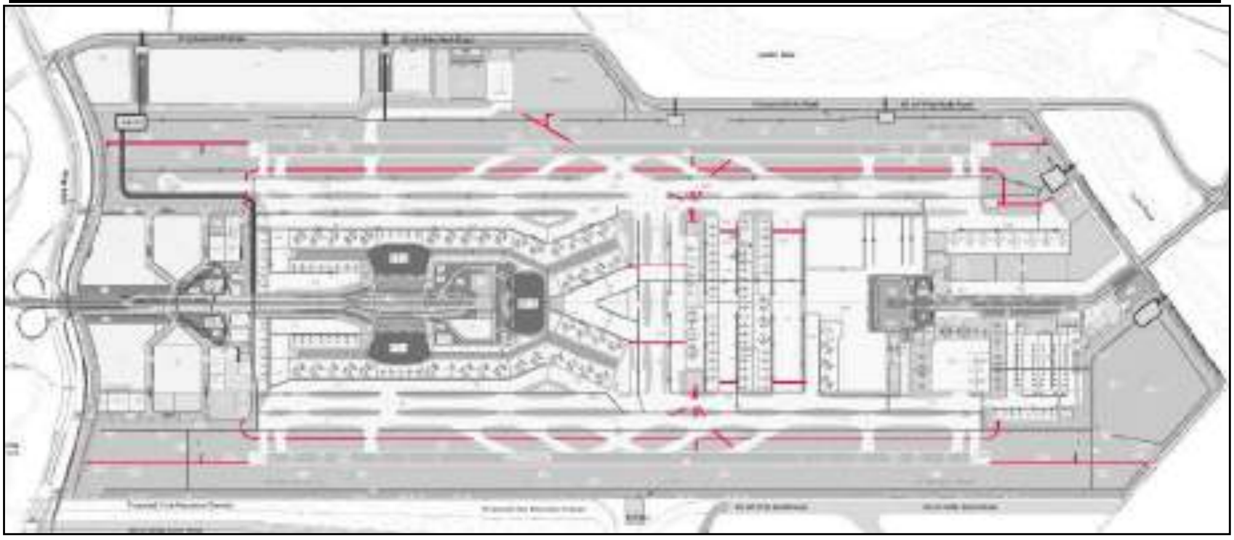
- Where routes require crossing of RETs or Entry/Access Taxiways, alternative routes should be developed where possible to ensure vehicles are able to enter the runway in all scenarios, in case aircraft are required to hold on these areas until emergency has been cleared;

- For roads running parallel to runways a width of 7 m has been assumed. For other roads solely used by emergency vehicles such as those linking the ARFF facilities to runways, only a 5 m width would be required for single direction vehicle movements. This ensures flexibility is maintained, as in some cases vehicles may be moving at high speeds and so additional road width is required for safety purposes;

- Where required, roads are to be curved, as opposed to operating a 90 degree turn, to ensure emergency response vehicles can maintain high speeds when responding to an incident; and

- In case of a major emergency, response vehicles will be given full clearance to access runway and taxiway system, with all aircraft movements being temporarily halted until incident has been further assessed.

The airside road network to be used by emergency vehicles is shown in **Figure-7.6**. The full airside road network available to other vehicles, as well as emergency services, has been indicated with the primary emergency roads, separate from the apron/terminal roads.



Source: NMIAL

FIGURE-7.6
PROPOSED NMIA AIR SIDE EMERGENCY ROAD NETWORK

7.2.4.3 Identification of Major Hazardous Units

Hazardous substances may be classified into three main classes: flammable substances, unstable substances and toxic substances. The ratings for a large number of chemicals based on flammability, reactivity and toxicity have been given in NFPA Codes 49 and 345 M. HSD will be required for the DG operations. Under the Petroleum rules 2002, ATF and HSD are categorized as Petroleum Class B. Characteristics of ATF and HSD fuel are given in **Table-7.4.**

TABLE-7.4
PROPERTIES OF FUELS TO BE USED AT AIRPORT

Fuel	Codes/Label	TLV	FBP	FP	UEL	LEL
		°F			%	
ATF	Flammable liquid	Not listed	572	38	7.0	0.2
HSD*	Flammable liquid	Not listed	360	32	5.0	0.5

TLV : Threshold Limit Value   *FBP : Final Boiling Point*
FP : Flash Point   *UEL : Upper Explosive Limit*
LEL : Lower Explosive Limit

*Note: The HSD storage and quantification is not defined in the current stage, therefore the risk assessment only includes ATF incoming, supply and storage facilities as plausible hazard units.

The ATF fuel storage capacities and tankages in the proposed airport are given in the following **Table-7.5.** The approved integrated ATF fuel farm facility at NMIA is shown in **Figure-7.7**.

TABLE-7.5
DETAILS OF FUEL FARM (ATF) STORAGE FACILITY

Particulars	20 MPPA (Phase-I & II)	40 MPPA (Phase-III)	60 MPPA (Phase-IV)
Number of Tanks (Total)	6	6+4	
Storage Capacity	30,000 KL	30,000 KL	50,000 KL
Day Coverage	14.9	7.2	8.3
Peak Demand (cum/Hr)	780	1320	1860
Fuel Usage (Cum/day)	2020	4040	6060
Tank Dimension	D:18 m; H :20 m	D:18 m; H :20 m	
Type of Tank	All tanks are similar type: Circular tanks with Dome		

Source: NMIAL

7.2.4.4 Quantitative Risk Assessment

The scope of work of this Quantitative Risk Assessment (QRA) is to cover the Fuel Tank Farm at NMIA. The scope of work includes:

- Compiling data inputs.
- Carrying out QRA modelling; and
- Issuing Draft and Final reports.

The risk to life is to be calculated as "Individual Risk" and "Group Risk".

Individual Risk: It is represented by iso-risk contours, which show the geographical distribution of risk to an individual. It is assumed that the individual is continuously present at that location, out of doors and does not shelter or try to escape.

Group Risk: It is represented by FN curves (stands for the frequency (F) of events which causes at least N fatalities (N) on log scales), which show the cumulative frequency distribution of accidents causing different numbers of fatalities. The FN curve therefore indicates whether the Group risk to the facility is dominated by relatively frequent accidents causing small numbers of fatalities or low frequency accidents causing many fatalities.

The detailed QRA Report along its appendices are enclosed in **Annexure-XXIII**.

FIGURE-7.7
LAYOUT ATF FUEL FARM STORAGE FACILITY

Facility Scope of Work

The scope of study includes identification of hazard in the following units:

- ATF Storage Tanks 5,000 KL capacity - 6 Nos.
- ATF Storage Tanks 5,000 KL capacity - 4 Nos.
- Tank associated piping/ header.
- 4 Nos. of Incoming pipelines.
- Filtration Unit.
- Main Hydrant Pump.
- Fuel Loading Pumps; and
- Tanker Loading / Unloading Facility.

The HSD storage and quantification is not defined at the current stage. However, the HSD will be required for the emergency diesel generator sets only which will be a back-up facility. Hence, the risk assessment includes ATF storage and facilities associated with it.

Study Approach

The QRA study shall involve estimating the frequency of potentially hazardous events, failures and uncontrolled release of hydrocarbon, including toxicity, overpressure, flash fire and jet fire, and calculating the consequences of such incidents. The results will then be combined with information on the expected exposure of persons to the events being studied to establish a risk of injury or death. The QRA process is divided into, but not restricted to, the following main elements:

- Identification of hazards and their causes within the facility.
- Definition of failure scenarios.
- Analysis of the potential consequences of each scenario.
- Calculation of the expected likelihood of occurrence of each scenario.
- Summation of scenarios to produce a measure of risk.
- Identification of key risk drivers associated with the facility.
- Consideration of the significance of the resultant risk levels, if appropriate, mitigation measures to meet COMPANY criteria and recommendations; and
- Interpretation of the calculated risk to draw relevant and practical conclusions.

The study is based on the premises of a traditional Quantitative Risk Assessment. The key components of a QRA are illustrated in **Figure-7.8**:

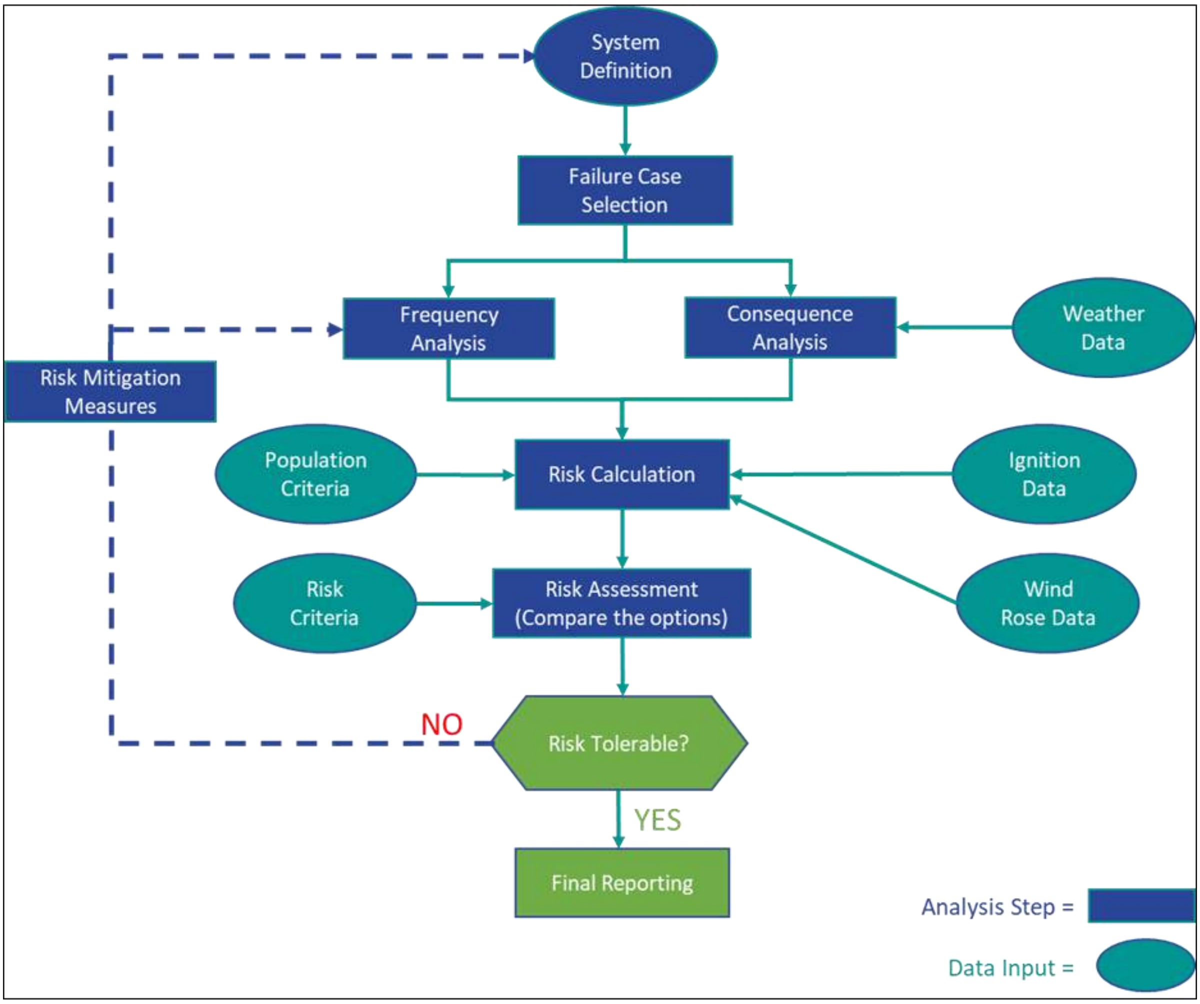


FIGURE-7.8
QUANTITATIVE RISK ASSESSMENT METHODOLOGY

Study Inputs

The following data are used in this QRA study:

- Plant data: The details of storage tanks and fuel usage/demand in each phase of NMIA Tank farm as per **Table-7.3** and **Table-7.5** above are considered.
- Meteorological data: The consequences of releases of flammable materials into the atmosphere are strongly dependent upon the rate at which the released material is diluted and dispersed to safe concentrations. The local meteorology is important in two respects. Firstly, the wind direction determines whether a release drifts towards or away from vulnerable locations. Secondly, the actual weather conditions, in terms of wind speed and stability (a measure of atmospheric turbulence), determine how quickly the flammable plume

disperses to lower non-hazardous concentrations. Therefore, site specific wind speed and wind direction (IMD data) and the stability/wind-speed categories (based on Pasquill Stability Class) are compiled for the QRA.

- Population data: People also act as potential ignition sources and thus the population data around the ATF tank farm are compiled for QRA.
- Ignition source: Ignition of a hydrocarbon release is influenced by a large number of parameters, at least some of which are not well understood, or not amenable to quantification. However, the total number of ignited hydrocarbon releases is well documented, and in principle, a good estimate of the frequency of ignition is available. However, it should be noted that there is always some uncertainty in this estimate.

The above metrics are quantified in the detailed QRA report attached as **Annexure-XXIII.**

Modelling

The consequence analysis and fire risk assessment as part of the QRA of NMIA includes physical effect modelling of:

- Passive, jet and heavy/ dense gas dispersion using the Unified Dispersion Model (UDM version 2).
- Jet Fire Modelling.
- Pool Fire Modelling.
- Vapour Cloud Explosion Modelling; and
- Toxic Gas Dispersion.

The purpose of fire risk assessment study is to characterize fully the radiant heat associated with credible fire hazards for the NMIA facilities. The study provides further supporting information to ensure risk-based decision making related to Fire Protection Design and verify requirements for followings:

- An active fire protection system (e.g., water spray systems, deluge systems, sprinkler systems) for equipment and ATF tank to assist against escalation from a fire scenario as applicable.
- Passive fire protection of structures and equipment containing large hydrocarbon inventory, if applicable.
- Requirement of Firefighting system (Firewater monitors and fire hydrant); and
- Deluge protection on equipment containing large hydrocarbon inventory.

Risk Indicators

The risk indicators have been used to present the individual risk as Location Specific Individual Risk (LSIR) and Individual Risk Per Annum (IRPA).

Study Results and Discussions

Individual Risk:

The risk indicators have been used to present the individual risk as Location Specific Individual Risk (LSIR) and Individual Risk Per Annum (IRPA).

LSIR is used to indicate risk at a particular location. It is the risk for an individual who is positioned there for 24 hours per day, 365 days per year. It is a standard output from a QRA. In QRA study, the geographical variation of LSIR is represented by risk contour plots and used for land-use planning. Since in reality people do not remain continually at one location, this is not a realistic risk measure. While IRPA is more realistic estimation of risk, for an individual, taking account of them being at different locations for different duration of time at/near the facility. Risk estimates from QRA are normally converted to this form before comparing with risk criteria or historical data.

The maximum individual risk contours are in the order of 10^{-3} per year represented by red colour in the **Figure-7.9**. The risk quantification is presented in the detailed QRA Report report attached as **Annexure-XXIII**.

Societal Risk:

The results of FN curves (**Annexure-XXIII**) show that the societal risk is negligible. There is potential of some events which may cause multiple fatalities; however, the cumulative frequency of such events is well below the negligible risk criteria set for this analysis.

Consequence Analysis Results:

Based on the consequence modelling, it is ascertained that for the scenarios involving release of ATF, pool fire is the main consequence. Gas dispersion, flash fire and jet fire are not significant. There are no vapour cloud explosion results.

The consequence analysis results tabulated in **Appendix-3**, and graphs are presented in Appendix 4 of the QRA report enclosed in **Annexure-XXIII**.

Pool Fire Risk Assessment

The objective of Pool Fire Risk Assessment is to identify the Passive Fire Protection (PFP) requirements for the facility. The assessment for PFP draws upon the results from the fire risk assessment, which details the consequence modelling results of identified fire scenarios.

The heat radiation contours based on pool fire risk assessment are shown in **Figure-7.10**, **Figure-7.11** and **Figure-7.12**.

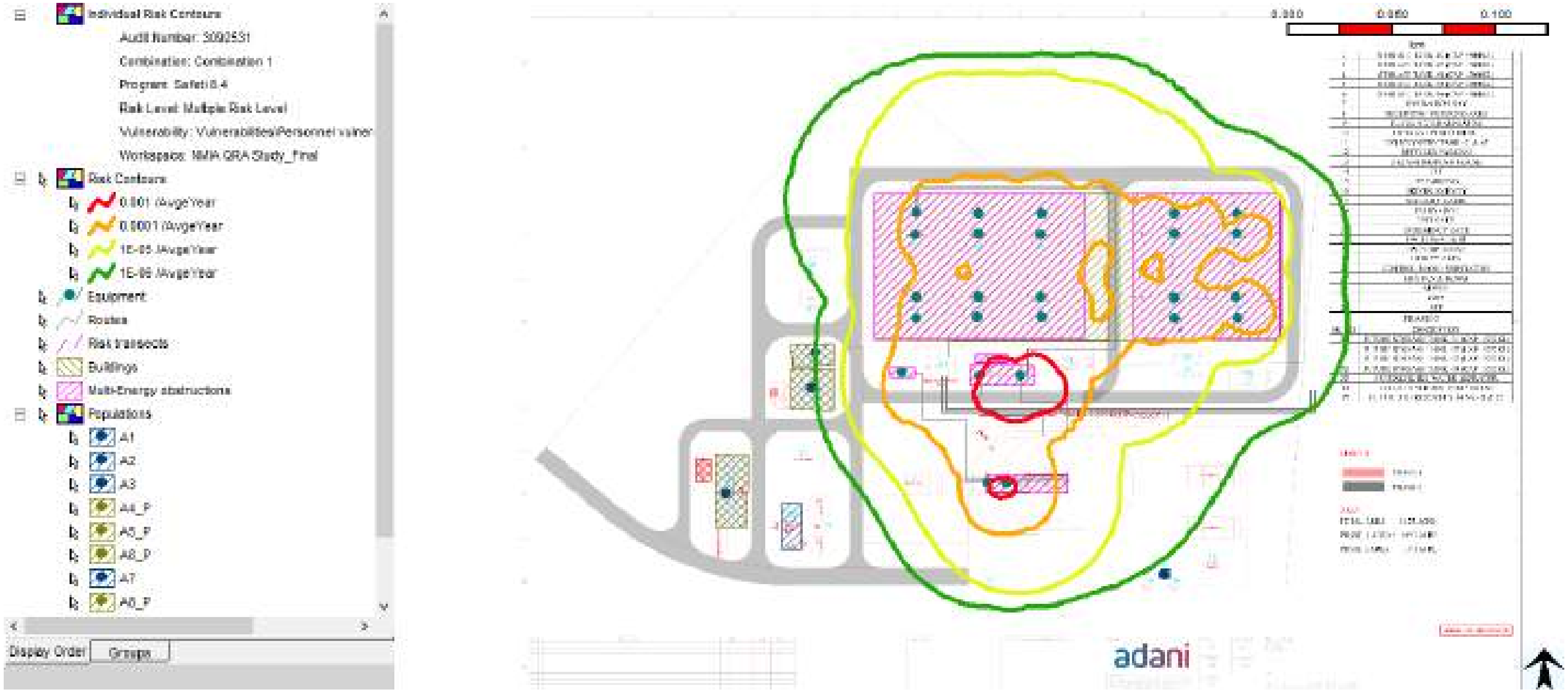


FIGURE-7.9
OVERALL ISO RISK CONTOUR

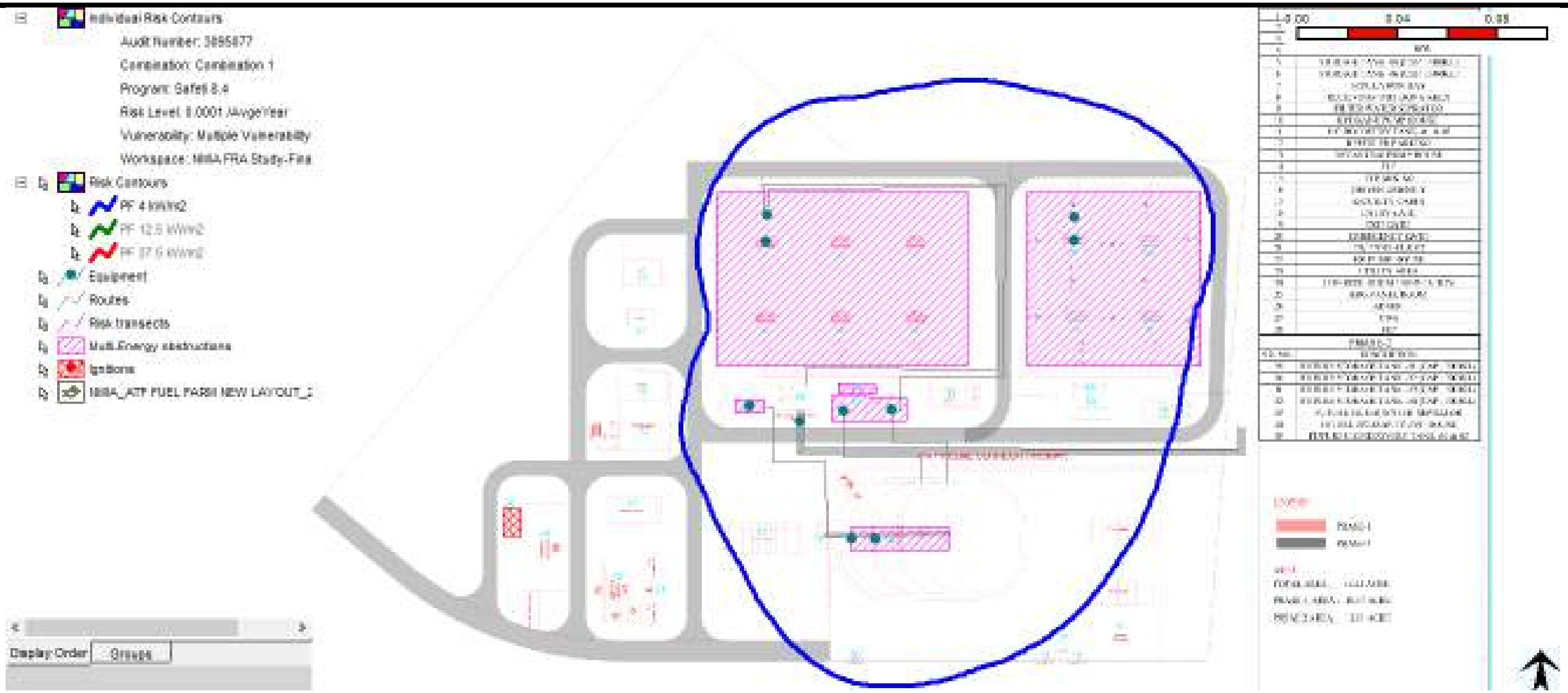


FIGURE-7.10
HEAT RADIATION (4 kW/m^2) EXTENT FROM POOL FIRE SCENARIO FOR 1E-04/YEAR

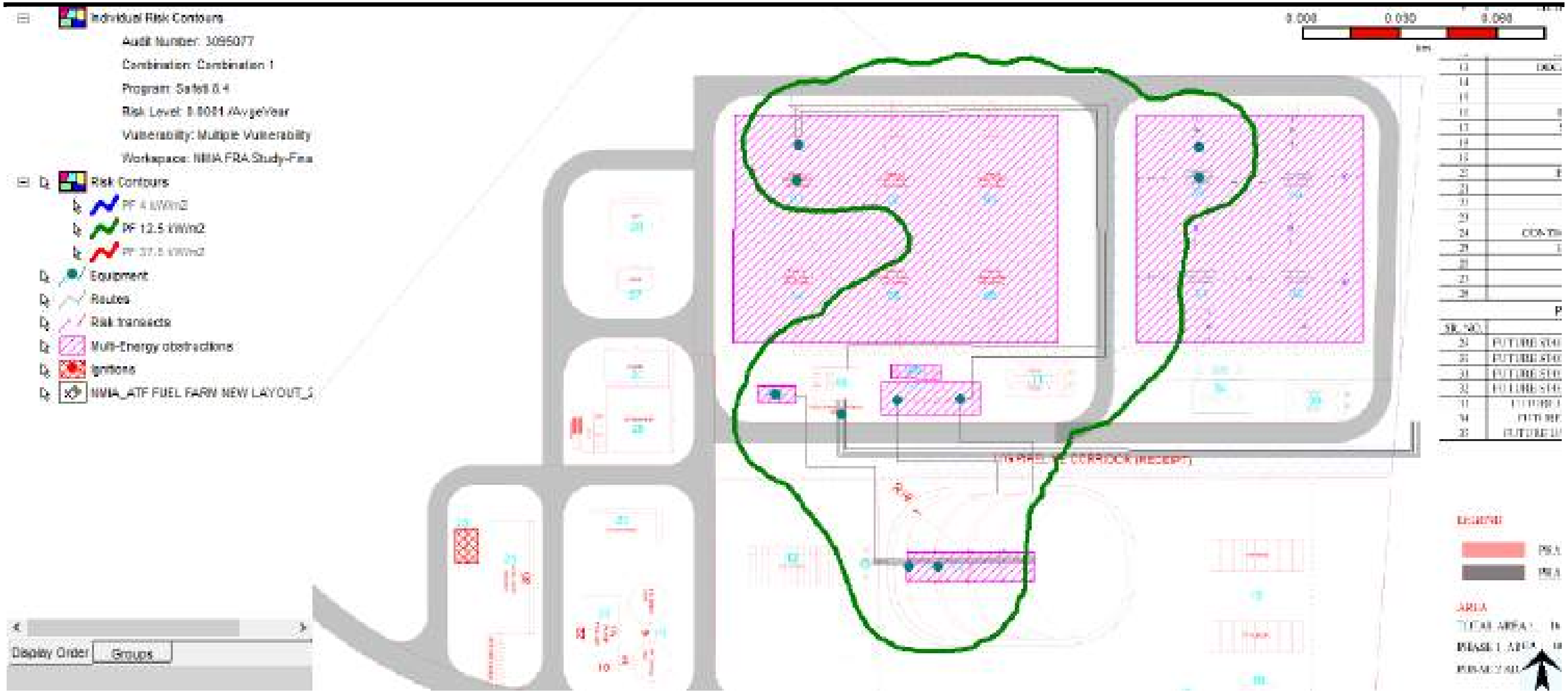


FIGURE-7.11

HEAT RADIATION (12.5 kW/m^2) EXTENT FROM POOL FIRE SCENARIO FOR 1E-04/YEAR

FIGURE-7.12
HEAT RADIATION (37.5 kW/m^2) EXTENT FROM POOL FIRE SCENARIO FOR 1E-04/YEAR

The Passive Fire Protection [PFP] assessment indicates:

- Pool from a release will be assessed to identify the heat radiation 37.5 kW/m^2 extent of pool fire (10 min).
- Determine the fire proofing needs for 1E-04/year contour, if required.
- The results also indicate that Emergency Responders (ER's) wearing appropriate PPE should be able to carry out longer duration operation if subjected to between 3-6 kW/m^2 (within 4 kW/m^2 contour map). One monitor (remotely operated elevated monitors / locally operated grade level monitor) will be available outside 12.5 kW/m^2 exposed area; and
- Heat Radiation (4 kW/m^2 and 12.5 kW/m^2) extent from credible jet fire scenario for 1E-04/year contour is not realized.

Conclusion and Recommendation

A qualitative review was performed for possible accidents that may occur, based on industry fire accident experience or judgment where necessary. Potential failure scenarios are developed based on hazard identification and QRA studies conducted for the NMIA ATF Tank Farm, considering the nature of process, materials being processed and handled. The following conclusion is drawn based on the QRA:

- Individual risk members of the public are within 10^{-6} per year which is in the safe zone as per the Risk Tolerability Criteria.
- The highest individual risk to personnel working in the tank farm is 3.52E-05 per year which is in the lower part of ALARP region as per required standards;
- The societal risk is in the lower part of ALARP region for events involving up to 2 fatalities, and in acceptable region for events involving 3 fatalities. No event with higher than 3 fatalities is predicted.
- As such, the ATF Tank Farm facility at NMIA meets the criteria for individual risk and societal risk.
- The tank farm facility inside the international airport will have all necessary provisions for fire protection.
- The following observations are drawn on from the results of consequence analysis:
  - ➢ There is no impact on any of the airport buildings from any of pool fire scenarios.
  - ➢ In case of ATF tank surface fire, radiation intensity of 37.5 kW/m^2 which can cause damage does not impact the adjacent tanks as presented in Appendix-4 of the QRA report enclosed in **Annexure-XXIII**.
  - In case of dyke fire ATF tank, thermal radiation intensity does not reach 37.5 kW/m^2 and thermal radiation intensity of 4 kW/m^2 falls well within the NMIA Tank Farm boundary; and
  - In case of dyke fire ATF tank, the fire water storage tanks and pump house may be subject to fire radiation intensity exceeding 4 kW/m^2.
- The following observations are made on the results of fire risk analysis:

- The fire risk contour of 1E-04/ year frequency for heat radiation intensity 4 kW/m^2 covers the whole tank farm, pump house and filling bays. However, the administration building, storeroom and electrical rooms are outside the contour.
- The fire risk contour of 1E-04/ year frequency for heat radiation intensity 12.5 kW/m^2 covers the whole tank farm, pump house and filling bays. However, the buildings are outside the contour. It is concluded that all buildings are safe in case of fire in any of the tank and pumps.
- The fire risk contour of 1E-04/ year frequency for heat radiation intensity 37.5 kW/m^2 covers mainly main hydrant pumps and loading/unloading facility. Hence, there is no requirement of passive fire protection (PFP) of tanks etc.

Based on the above conclusion, the following recommendations are made in order to ensure that the risks at the ATF tank farm facility of NMIA are maintained as low as reasonably practicable:

1. Provision of adequate instrumentation and controls for overfill protection of storage tanks in the tank farm on the same lines as specified in OISD 244.
2. Provision of 2 Nos. portable type medium expansion foam generators (MEFG) for fighting dyke fires.
3. Provision of jumbo water curtains to shield the fire water pump house and storage tanks in case of dyke fire in ATF tank.
4. Provision for stoppage of oil transfer pumps by emergency shut down (ESD) system from a safe location in case of any leakage/fire.
5. Implementation of emergency response plan to be for the NMIA ATF Tank farm.

7.2.5 Disaster Management Plan

Based on the identified disasters above (Section-7.2.1), a Disaster Management Plan for the on-site risks/disasters is prepared for Navi Mumbai International Airport for dealing with emergency situations. Aviation emergency occurs at or near airports; therefore, integrating the activities of local and airport emergency service becomes a major issue for planning and implementation. Planning of an effective response to disaster at or near an airport places a particular requirement for co-ordination between emergency services, for both short-term and long-term response.

A Disaster Management Plan (DMP) is an integral part of an airport operation for effective and safe management of technical and non-technical emergencies. This is important for effective management of an emergency situation to minimize losses to people, property and both at and around the airport. The objectives of the emergency planning are to describe the airport's emergency response organization, the resources available and applicable response actions. Thus, the objectives of emergency response plan can be summarized as follows:

- Rapid control and containment of the hazardous situation;
- Minimizing the risk and impact of an event/accident; and
- Effective rehabilitation of the affected persons, and prevention of damage to property.

The DMP will be prepared in accordance with the Civil Aviation requirement laid down by the Director General of Civil Aviation (DGCA), the National Disaster Management Act, 2005, the National Building Code as well as various code provisions of the International Civil Aviation Organization (ICAO) including other International Conventions and Acts.

Under the Aircraft Rules 1937, Part XI, Rule 81 and Civil Aviation Requirements (CAR), Section-4, Series „B", Part-I, an aerodrome operator is required to establish an Aerodrome Emergency Response Plan (AERP) commensurate with the aircraft operations and other activities conducted at the aerodrome. To meet this requirement and other necessary obligations stipulated by Director General Civil Aviation (DGCA), Navi Mumbai International Airport Ltd (NMIAL) who will operate Navi Mumbai International Airport (NMIA), will prepare an Aerodrome Emergency Response Plan (AERP) based on the standards set by DGCA in CAR and ICAO guidelines in Air Service Manual before commencement of Airport operations. At that stage will be dovetailed with the disaster management plan of NMMC.

The Aerodrome Emergency Response Plan will be conceptualized for NMIA in line with intellect and experience drawn from the Disaster Management Plan of CSMIA airport. The capacities of the both airports (CSMIA and NMIA) will be similar once fully established and having same geo-climatic conditions. Hence, the AERP under implementation at CSMIA will be very handy in dealing with any similar situations at NMIA. The NMIA AERP details the plans for command, communication and coordination functions amongst the agencies responsible for providing response to emergencies that take place at Navi Mumbai International Airport. The AERP serves as the key Disaster Management Plan (DMP) document encompassing all emergencies related to the airport. This on-site emergency response plan will be dovetailed with the on-site management plan for the district in co-ordination with the district authorities.

The AERP is comprehensively prepared for specifying role of various groups / organizations/ agencies and plan of disaster management during various types of emergencies / disasters like in-flight mass causalities, medical emergencies, aircraft accidents, various fires on ground, accidents involving dangerous goods, natural disaster management, unlawful act of seizure of aircraft etc. The following most likely disaster scenarios will be considered in the AERP.

Different types of emergencies are: emergencies involving aircraft, emergencies not involving aircraft, medical emergencies or combinations of these emergencies.

A) Emergencies Involving Aircraft

1) Accident - Aircraft on-airport
2) Accident - Aircraft off-airport a) Land b) Water
3) Incident - Aircraft in flight a) Severe air turbulence b) Decompression

c) Structural failure
4) Incident - Aircraft on ground
5) Incident - Sabotage including bomb threat
6) Incident - Unlawful seizure

B) Emergencies Not Involving Aircraft

1) Fire - Structural
2) Sabotage including bomb threat
3) Natural disaster
4) Dangerous goods
5) Medical emergencies

C) Compound Emergencies

1) Aircraft/structures
2) Aircraft/ fuelling facilities
3) Aircraft/aircraft
4) Terrorist Attack

The Aerodrome Emergency Response Plan (AERP) for the proposed NMIA for various scenarios and are briefed below. This AERP will be suitably approved by the concerned authorities.

7.2.5.1 Aircraft Accident Outside Airport Rescue and Fire Service Turnout Area

An Aircraft Accident which has occurred outside airport fire service turnout area i.e. more than 5 km in the approach path and more than 2 km in other areas around the airport boundary.

➢ Intimation by ATC

Air Traffic Control (ATC) will normally be the first organization to become aware that an aircraft has been lost at sea/land. The ATC will then inform the combat agency and JCC.

➢ Combat Authority

Indian Coast Guard: On notification of an aircraft accident at sea (Coast line) by ATC or third party operate in accordance with Indian Coast Guard procedure.

Indian Navy: On notification of an aircraft accident at deep sea by ATC or third party operate in accordance with Navy procedures.

Local Fire Service: On notification of an aircraft accident on land by ATC or third party, operate in accordance with the local authority procedure.

➢ Support Agencies

- Affected Airline.
- Air Traffic Control (ATC).
- Civil Defence.

- Coast Guard.
- Customs.
- Aircraft Accident Investigation Bureau (AAIB).
- Director General of Civil Aviation (DGCA).
- Immigration.
- Indian Air Force.
- MCGM Disaster Management Cell.
- National Disaster Management Authority (NDMA).
- National Disaster Response Force (NDRF).
- Doctor/Hospital/Ambulance.
- NMIAL depts. such as ARFF, JCC etc.
- Mumbai/Navi Mumbai Fire Brigade.
- Mumbai Port Authority/JNPT.
- Quarantine.
- State Disaster Management Authority (SDMA); and State Police.

7.2.5.2 Aircraft Accident Within Airport Fire Service Turnout Area

An Aircraft Accident which has occurred on or in the vicinity of the airport i.e., within the airport boundary, or within an area up to 5 km in the approach path and areas up to 2 km around the airport boundary.

➢ Declaration of Emergency

- Escalation of a previously declared local Standby or Full Emergency: (Under this scenario, it must be considered that the ARFF vehicles will be in their pre-determined positions).
- ATC raises the crash bell and confirms situation of the same on Radio Transmission on determining that aircraft has most probably met with an accident short of the runway.
- A totally unexpected aircraft accident within the Airport Fire Service Turnout Area: - ATC or airport is informed by a 3rd party of the aircraft accident. ATC to confirm the likelihood of such an accident after which ATC raises the crash bell.
- ATC or Fire Watch Tower witnesses the aircraft accident. Whoever reacts first raises the crash / fire bell.

➢ By ATC

- By immediate activation of the crash bell to sound continuously with a steady tone;
- To Airport ARFF with a call to the Fire Watch Tower and to the Joint Control Centre (JCC) on the Hot Line and RT.

➢ Combat Agency

- Accident on airport – NMIAL Aerodrome Rescue and Fire Fighting (ARFF).

- Accident off airport – Navi Mumbai/Mumbai Fire Brigade.

➢ Support Agencies

Internal Agencies (On Airport)

➢ **NMIAL Departments**

- Air Rescue and Fire Fighting [ARFF] System.
- Joint Control Centre (JCC).
- Airside Ground Maintenance.
- Terminal Operations.
- Medical Service.
- Landside Operations.
- Engineering and Maintenance (Civil & Electrical).
- Motor and transport Dept.; and
- Corporate communication.

➢ **Internal Stakeholders**

- Affected Airline & its nominated Ground Handlers.
- ATC.
- CISF.
- Customs.
- Immigration.
- AAI.

➢ **External Agencies**

- Civil Defence.
- Chaplaincy/Clergy.
- Navi Mumbai/Mumbai Fire Brigade.
- Hospital and Ambulance services.
- Quarantine.
- State Police.
- MCGM – Disaster Management Cell.
- State Disaster Management Authority.
- NDRF.
- NDMA.

Defined roles of agencies /departments involved are discussed in subsequent sections.

7.2.5.3 Airports Authority of India (AAI)

Air Traffic Control (ATC):

- Act as a warning & notification agency for an incident or emergency involving aircraft or another emergency.

- Manage air traffic in the area of the incident or emergency; and
- Support the incident or emergency rescue and recovery operations as required.

General Manager (Aerodrome) NMIA AAI

Will ensure that all concerned logbooks and messages pertaining to Air Traffic Control are sealed and handed over to the AAI Official after the accident.

General Manager (Communications) AAI

On receipt of information of an air accident the GM (Communications) will seal all documents and tapes pertaining to the Air Traffic Control after the accident.

7.2.5.4 NMIAL Emergency Preparedness

General:

All departments of NMIAL will provide resources to assist in the combat of the emergency.

NMIAL Director Operations or His Representatives:

- Shall respond to and manage the Airport Emergency Control Centre (AECC)/ CCC with prime objective to establish the main point of co-ordination between events that are unfolding at the combat zone and other areas involved with the handling of the Incident/accident; and
- Initiate the recovery and restoration process.

Airport Operation Services

➢ Aerodrome Rescue and Fire Fighting (ARFF).

- As the combat agency, respond to and carry out the rescue and firefighting as defined in the departmental SOP"s/working instructions.
- Provides the on-scene commander for all fire related incidents and other non - security related emergencies on airport.
- Provides and establishes the FCP.
- Provide transportation officer & manage transportation to and from the accident/ incident site.
- On direction of the on-scene commander set-up an appropriate site for a triage area.
- Provide assistance to AAIB as per the requirement.
- Ensure minimal disturbance of wreckage other than required for firefighting and rescue; and
- Act as the initial combat agency for dangerous goods incidents till the arrival of Navi Mumbai/Mumbai Fire Brigade/concerned responding agency.

➢ Joint Control Committee [JCC]

- Provides the necessary communication network and does the initial emergency notification.
- Opens and activates the AECC/CCC.
- Co-ordinate with terminal management and stakeholders and provide transportation at accident site.
- Coordinates with stakeholders for effective handling of emergency and maintaining business continuity; and
- Ensure updating of ANTS system.

➢ Airside Safety

- Activate rendezvous point.
- Select and establish a helipad in liaison with ATC and FCP.
- Provide "Follow Me" services for responding agencies and personnel within the confines of the airport.
- Activate disabled aircraft removal plan.
- Co-ordinate with stakeholders/external agencies and authorities through JCC, for smooth & effective handling of emergency and restoration of operations.
- Assist AAIB and DGCA authorities in investigation and preservation of evidence; and
- Escorting external emergency responding vehicles to and from rendezvous point to staging area/accident site.

➢ Terminal Management

- Activate the meeters and greeter's area as well as survivor's reception area and re-union areas in the affected terminal; and
- In support of the affected airline staff, render assistance to meeters and greeters as well as passengers of an accident.

➢ NMIAL Medical, Hospital & Ambulance Services

- During a full emergency, accident or when required, staff the casualty centre.
- Provide pre-hospital care and transportation for all injured persons.
- Make hospital care accessible to all injured.
- Provide medical assistance to manage and operate triage area at the incident site and provide triage In-charge.
- Liaise with medical & hospital services to determine the level of response required to satisfactorily manage all the injured.
- Provide AECC/ CCC with the destination of the injured persons.
- Provide medical assistance in holding area, meeters & greeters area; and
- The NMIAL medical officer shall obtain pathological sample (blood and urine) of cockpit crew, in the presence of DGCA / police personnel.

- Landside Operations

- Liaise with Govt. agencies, trade unions, taxi unions, etc. for smooth passenger movement at the landside.
- Ensure smooth flow of vehicular traffic at the landside and in the car parking areas; and
- Provide facilitation services, as required, including entry passes, to different emergency response agencies/individuals in co-ordination with NMIAL security.

- Safety

- The nominated Safety Investigation Coordinator (SIC) from safety department shall act as a Single Point of Contact (SPOC) in case of any aircraft accident/incident.
- The SIC shall ensure that initial actions are carried out at the accident site in coordinated manner and the evidence are not destroyed; and
- The SIC shall initiate immediate actions required to facilitate investigation, till the arrival of investigator nominated by the DGCA/AAIB, while the search and rescue operations are still under-way.

- NMIAL Security

Send representatives at gates to facilitate the entry of external emergency responding agencies to the airside. However, the requirement of AEP should be made available to NMIAL security by concern departments.

A strict screening and surveillance should be carried out at the passenger and cargo entrance of NMIA. The analysis of the screening and surveillance results will enable to take appropriate mitigation measures to avoid the similar incidents of 26/11 Taj Mahal Hotel, Mumbai terrorist attack.

The Airport authorities may coordinate and take the help of support agencies mentioned in section *7.2.5.1.* The same is integrated with the organogram of the off-site and on-site Disaster Management Plan (DMP).

- Engineering and Maintenance

- Ensure adequate provision of lighting at the accident site; and
- Make arrangement for 2 coaches and 2 medium vehicles such as jeeps/cars.

7.2.5.5 External Emergency Responding Agencies

Affected Airline and Nominated Handling Agent

The affected airline and its nominated handling agent shall implement their emergency procedures which shall include the following:

- Respond to each of the areas, with a representative for liaison, at the FCP, AECC/CCC, casualty centre, holding area, survivor's reception area, reunion area, meeter's and greeter's area and hospitals. Immediately establish a survivor's reception area, reunion area and meeters and greeters in the terminal for welfare, care and reuniting passengers and relatives in coordination with NMIAL terminal manager and CISF.

- Immediately provide a full and comprehensive passenger and cargo manifest along with details of any dangerous goods to the chairman of AECC/CCC, on-scene commander at the FCP, casualty centre and survivors reception area.

- Provide technical and engineering support to the FCP for safety advice and salvage of aircraft.

- Provide security staff and airline medical officer(s) to the on-scene commander for deployment to the triage area for care of the injured.

- Dispatch coaches to the accident site to transport passengers from accident site to required location. Uninjured passengers will be transported only after being assessed by an attending Doctor.

- Make a list of uninjured passengers including addresses, contact numbers for accountability, care and counselling and forward the same to AECC/CCC.

- Ensure that crew is escorted to the casualty centre, for pathological samples, in presence of DGCA / Police.

- Provide a public relations liaison officer and media coordinator to work in coordination with the NMIAL authorities.

- Coordinate with immigration and customs to minimize delays in the clearance of passengers and crew.

- Coordinate the collection of all baggage's with the customs and police after obtaining clearance from the Inspector of Accidents (AAIB).

- Provide desired reservation requirements for onward passenger's i.e., hotel accommodations, air transportation or other mode of transportation, etc.

- Provide wooden coffins and transportation for the deceased in coordination with police.

- Quarantine and seal all documents pertaining to the flight crew and aircraft; and

- Co-ordinate with the police to provide necessary support to next of kin of the passengers.

Bureau of Civil Aviation Security (BCAS)

- BCAS is the state organization, responsible for regulating and overseeing aviation security in India. The BCAS is the regulatory authority and will provide the aerodrome entry permits to the approved emergency responding agency representatives, such as police, civil defence, customs, immigration, Navi Mumbai/Mumbai fire brigade, defence forces (army, navy and air force), state disaster management authority, MCGM disaster management cell, and hospitals & coast guard during an aircraft/airport emergency/accident. This responsibility for issuance of AEPs are delegated to NMIAL security AEP section during an aircraft/airport emergency/accident; and

- In-case of aircraft/airport accident, where emergency responding agencies are from other nations, the BCAS/NMIAL security shall provide aerodrome entry permits depending on case-to-case basis.

Central Industrial Security Force (CISF)

On receipt of information regarding an emergency the CISF shall:

- Mobilize the forces and ensure dispatch to site. Immediately provide minimum 50 trained staff to assist rescue work at the accident site.

- Inform state police through CISF control room /SOCC.

- Coordinate with city police control room for additional resources.

- Ensure that the operations of the aerodrome rescue and firefighting services are facilitated and not interfered with, hindered, or obstructed in any way.

- Depute senior representative to attend the AECC/CCC when established.

- Issue appropriate instructions to Gate No. 1 and 5 to ensure the responding fire brigade appliances, ambulances, doctors and paramedical staff are allowed to enter the operational area immediately under the guidance of the "Follow Me" service or escort provided by the apron control.

- Set-up approx. 100 m cordon around the accident site including any wreckage trail and ensure that only persons authorized by the on-scene commander enter the site until the area is declared "SAFE" by the on-scene commander under the guidance of inspector of accident (AAIB).

- Restrict access to essential services/personnel only in the entire and ensure ground marks associated with the accident are not obliterated.

- The officer in charge of cordon area in consultation with on scene commander will allow volunteers responding to the accident site to different areas as per requirement.

- Ensure that there is no interference or disturbance to wreckage other than is required by the ARFF in the course of firefighting and rescue.

- When the area has been declared safe ensure that only authorized officials are permitted to enter the cordoned off area until such time that clearance is given by inspector of accident (AAIB) or his/her authorized representative; and

- Isolate the crew from the passengers and have them medically assessed at the triage area/ casualty centre.

Chaplaincy/Clergy/Priests and Counsellor

In the event of an emergency provide counselling, pastoral care & chaplaincy services to the airport community and victims of a disaster.

Civil Defence

- If requested provide manpower, logistic and resources to the agency combating the emergency for carrying out emergency response and recovery operation; and
- Provide a liaison officer to attend the AECC/CCC, when established.

City Fire Service & other Mutual Aid Fire Services

- The Navi Mumbai fire brigade will on notification by the ARFF or air traffic control of an emergency.

- Respond to the nominated transportation point at Gate-1 or Gate-5 and wait for an escort by the "Follow Me" vehicle to the rendezvous point at D7 or incident site / static water supplies.

- The senior Mumbai fire brigade officer on-site will liaise with the ARFF senior officer on-site at the forward command post to assist emergency operations.

- To provide mutual aid resources to the ARFF when required in an airport emergency. They should provide sufficient no. of fire fighters, appliances, and equipment's as per their procedure.

- Provide a full response to dangerous goods incident on the airport. If a HAZMAT incident involves an aircraft the Mumbai fire brigade is required to consult ARFF/NMIAL dangerous goods expert and the affected airline before intervention.

- When a non-aviation incident is beyond the resources of the ARFF and may affect the category of the airport, then ARFF on-scene.

- Commander may request Mumbai fire brigade to take control of the operation; and

- Assist in any other response or recovery operations for which Mumbai fire brigade training and equipment is suitable.

Customs Service

In the event of an emergency involving an international aircraft.

- If requested provide mobile clearance team.
- Provide information to passengers on customs matters.
- Liaise with the incident management team in relation to processing baggage and cargo; and
- Ensure responsibilities are fulfilled as detailed in SOP.

BARC, Mumbai (for Chemical, Biological, Radioactive Emergency)

On receipt of information regarding an emergency at the airport, BARC, Mumbai will:

- Immediately dispatch the quick response team to an airport emergency.
- Depute the concerned functional expert to report to NMIA AECC/CCC for expert advice; and
- Remain in contact with AECC/CCC or concerned officials for any assistance or requirements.

DGCA and AAIB (Aircraft Accident Investigation Bureau)

In case of any aircraft accident / incident, the DGCA / AAIB will carry out functions as mentioned in the Aircraft (Investigation of Accidents and Incidents) Rules, 2012 enjoying the powers mentioned there under.

Immigration Service

In the event of an emergency involving an international aircraft:

- If requested provide a mobile clearance team.
- Provide information to passengers in relation to immigration matters; and
- Ensure responsibilities are fulfilled as detailed in SOPs.

Indian Coast Guard

On notification of an accident at seacoast line the Indian Coast Guard will assume command and control of the search and rescue operation:

- Notify and coordinate with Indian navy and other support agencies for search and rescue operation.
- Notify the Mumbai port authority and Jawaharlal Nehru Port Trust (JNPT), naval hospital for necessary logistic support.
- Facilitate AAIB to carryout investigation process; and

- The Maritime Rescue Coordination Centre Mumbai (MRCC) should regularly update the AECC/CCC /JCC and the airlines local emergency control centre about emergency Operations and survivors.

Indian Navy

On notification of an accident at deep sea the Indian navy will assume command and control of the search and rescue operation:

- Notify and coordinate with Indian coast guard and other support agencies for search and rescue operation.
- Notify the Mumbai Port Authority, Naval Hospital for necessary logistic support.
- Facilitate AAIB to carryout investigation process; and
- The Navy Emergency Coordination Centre Mumbai should regularly update the AECC/CCC /JCC and the Airlines local emergency control centre about emergency Operations and survivors.

National Disaster Response Force (NDRF)

On receipt of information regarding an emergency at the airport which requires NDRF assistance, the NDRF Emergency Operation Centre In-charge shall:

- Immediately depute the nearest Quick Response Team (QRT) to respond to the accident such as nuclear, biological, radiological, chemical accident etc.
- Inform to concerned NDRF Sr. official to report to CSI airport AECC/CCC for coordination; and
- Remain in contact with the AECC/CCC or concerned officials for any assistance or requirements.

NMMC Disaster Management Cell

On receipt of information regarding an emergency at the airport, the NMMC Emergency Operation Centre (EOC) In-charge shall:

- Immediately inform the concerned response agencies such as fire, police and NMMC hospitals etc to respond to the accident site.
- Immediately inform respective ward level EOC for necessary action and co-ordination.
- Intimate the concerned NMMC representative to report to AECC/CCC for coordination; and
- Remain in contact with the AECC/CCC or concerned officials for any assistance or requirements.

Quarantine Service

In the event of an emergency involving an international aircraft:

- If requested, provide a mobile clearance team.
- Provide information to passengers in relation to quarantine matters; and
- Liaise with the affected airline and on-scene commander to arrange processing of baggage, cargo, and livestock.

State Disaster Management (SDM) Cell

On receipt of information regarding an emergency at the airport, the SDMA Emergency Operation Centre (EOC) In-charge shall:

- Immediately inform the concerned response agencies such as NDMA, NDRF, Collector's office and other state and national governments emergency responding agencies to respond to the accident.
- Immediately inform to the MCGM (EOC) for necessary action and co-ordination.
- Depute a senior official as its representative to report to AECC/CCC for coordination; and
- Remain in contact with the AECC/CCC or concerned officials for any assistance or requirements.

State Police

On receipt of information regarding an emergency at the airport, the Sr. Inspector/Officer in Charge of the Airport and Panvel Police stations shall:

- Immediately mobilize the force and ensure its dispatch to the accident site, rendezvous point, casualty centre, holding area, media centre, meeters & greeters' area, etc.
- Depute a senior officer to AECC/CCC when established.
- Depute a senior officer to attend the forward command post to liaise and coordinate the emergency response operation.
- Liaise with CISF.
- Take appropriate steps to maintain law and order on the landside of the terminals and airport boundary.
- Coordinate with the traffic police and develop a "Traffic Plan" to ensure access and egress to and from the airport for emergency service vehicles.
- Remain in touch with the terminal manager of the affected terminal or the AECC/CCC for any assistance or requirements.
- Ensure a representative is available at all concerned hospitals.
- Provide necessary support to the concerned staff of airlines & NMIAL for the deceased passenger handling.

- To assist the airline staff in informing the next to kin about the information of death of concerned passenger; and
- To carry out "Panch-Nama" and to assist post-mortem of the deceased accident victims.

7.3 Rehabilitation and Resettlement (R&R)

Keeping in view of the R & R policy of the Government of Maharashtra and the National Policy of Resettlement and Rehabilitation, Social Impact Assessment (SIA) study was conducted by DHI (India) on behalf of CIDCO in the year of 2010. The Social Impact Assessment was carried out in all 10 affected settlements covering 7 revenue villages.

R&R package was approved vide UDD, GoM G.R. dated. 1st March 2014 and 28th May 2014 for rehabilitation of families falling in the proposed airport site. The package exceeds the requirements of LARR 2013 and provides special incentives for shifting/relocation.

7.4 Storm Water Drainage Studies of NMIA

7.4.1 Introduction

The Environmental Clearance (EC) received for NMIA in 2010 directs that the stormwater generated from NMIA site area shall be drained to towards north (into the creek) or into the Gadhi river towards northeast of the project site, while no stormwater shall be discharged into the diverted Ulwe river (now called Ulwe Recourse Channel) or into the Moha Creek and Amra Marg towards western side of the project site. Accordingly, the NMIA drainage concept was designed to discharge the runoff from south to north and north-east of the project site.

Therefore, Drainage Master Plan of NMIA for surface drainage and flood protection was prepared for a minimum 100 years return period for rainfall as worst-case scenario while addressing above aspects examined thoroughly including hydro-geological and environmental aspects of the project to avoid flooding of low-lying areas near the airport.

The drainage master plan prepared by NMIAL was then reviewed by CWPRS for approval and update through several stages. CWPRS, Pune has carried out 1-D, 2-D Mathematical and Physical Model studies for the airport and its vicinity based on 100 years return period and the recommendations were incorporated into to the stormwater drainage masterplan of NMIA. NMIA drainage system is approved and validated by CWPRS. NMIAL has designed NMIA drainage system while CIDCO has parallelly designed the Drainage Master Plan of surrounding areas by incorporating CWPRS Recommendations.

7.4.2 CWPRS Review Summary

NMIAL had referred CWPRS, for review of 'Storm Water Drainage System Report (June 2018) for NMIA, Navi Mumbai". CWPRS had submitted the Technical Report No. 5724 dated July 2019 for the said study. Meanwhile, NMIAL made modifications in the Storm Water Drainage (SWD) system of proposed NMIA and prepared a revised SWD system report in June 2019. NMIAL submitted revised SWD system report (June 2019) and requested CWPRS to carry out additional review study for SWD report. NMIAL submitted the final revised SWD report (November 2019) vide email dated 21st November 2019 incorporating some minor modifications. The additional review study has been carried out for M/s NMIAL revised SWD report (November 2019). The data required for carrying out review study was submitted by NMIAL to CWPRS vide email dated 13th January 2020.

The additional review study of Storm Water Drainage system prepared by M/s NMIAL for revised SWD report (November 2019) has been carried out by CWPRS. The observations have been presented in this Technical Report. Moreover, mathematical model runs have been carried for some identified drainage channels adjacent to the runways and aprons in order to examine their adequacy. CWPRS officials along with NMIAL officials carried out a site visit on 6th September 2019 for the Strom Water Drainage studies for Navi Mumbai International Airport. The detailed report is enclosed as **Annexure-XI.**

7.4.3 Study Findings

In hydrological practices, Gumbel distribution is generally adopted for EVA of rainfall whereas Log Normal and Log Pearson Type - 3 (LP3) distributions for flood estimation and Weibull distribution for assessment of low-flows (Bobee and Ashkar, 1991; Naghavi et al., 1993; CWC, 2010). However, in the present study, Gumbel and LP3 distributions are adopted for EVA of rainfall so as to maintain compatibility with earlier CWPRS TR No. 4665 of October 2009. Parameters of the Gumbel and LP3 distributions are determined by Maximum Likelihood Method (MLM) and further used for estimation of Extreme Rainfall (ER) for different return periods.

EVA of daily and hourly rainfall data available adopting Gumbel and LP3 distributions (using MLM) was carried out. The adequacy of fitting of Gumbel and LP3 distributions to ADMR and AHMR series were evaluated through A2 test and by the fitted curves of estimated ER. The outlier like event of July 2005 observed at Santacruz site clearly shows impact on the whole EVA. Based on EVA results of daily and hourly rainfall, the estimated 1-day and 1-hour maximum rainfall for different return periods viz. 10-year, 50-year, 100-year and 1000-year obtained.

By applying the procedures, parameters of Gumbel and LP3 probability distributions were determined and used for estimation of ER for different return periods from 1.01-year to 1,000-year. The EVA results of Santacruz and Colaba sites giving the estimated ER and 95% confidence limits for different return periods obtained from Gumbel and LP3 distributions.

For storm water drainage system, M/s CH2M (A Consulting organization appointed by NMIAL for Storm Water Drainage System Design) has adopted the rainfall intensity as **148.1 mm/hr** using LP3 Distribution for 100-year return period. M/s CH2M has adopted the run-off co-efficient as 1.0 for paved surface and 0.35 for unpaved areas within the airside which appears to be appropriate. The study findings based on mathematical models are presented in detail in the CPWRS Technical Report (Review Report).

7.4.4 Recommendations & Conclusions By CWPRS

From the detailed review of Storm Water Drainage Master Plan Report and analysis of the results by carrying out mathematical modeling, following recommendations / conclusion are drawn by CWPRS:

1. The airport master plan prepared by NMIAL (updated in November 2019) has been used as basis for the development of initial Storm Water Drainage (SWD) scheme.

2. It is recommended that SWD development of NMIA may be undertaken in accordance with applicable codes, specific conditions and overall standard Airfield drainage requirement laid down by competent authorities viz. ICAO, DGCA CAR"s, MoEFCC, MPCB etc.

3. Design storm is a crucial factor in deciding the size of drainage channel. There are not much standard guidelines available for adopting design storm for airport drainage system. As discussed in Para-6, in accordance with the Ministry of Environment and Forests recommendation entire drainage system should be designed for minimum 100-year return period rainfall.

4. For storm water drainage system, M/s CH2M / M/s NMIAL has adopted the rainfall intensity as 148.1 mm/hr using LP3 Distribution for 100-years return period.

5. M/s CH2M / M/s NMIAL has adopted the run-off co-efficient as 1.0 for paved surface and 0.35 for unpaved areas within the airside which appears to be appropriate.

6. M/s CH2M / M/S NMIAL has adopted Soil Conservation System (SCS) design method for calculating storm run-off. The SCS method has been used Additional Review of Storm Water Drainage Study for NMIA, Navi Mumbai. CWPRS, Technical Report No., March 2020 51 interchangeably with Natural Resources Conservation Services (NRCS) a division of U.S. Department of Agriculture by use of Hydrological Modeling Software Sewer-GEMS version V8i (Select Series 4) for modeling of Watersheds within the airport boundary appears to be appropriate.

7. For the hydraulic design of drainage channel conventional Manning's Equation has been used. Manning's roughness 'n' has been considered as per IRC SP42:2014 to be between 0.013 and 0.015 for concrete drains. Time of concentration of 15 min considered in airside network i.e., network between Runway and Taxiway (or) between taxiways and 10 min considered for drainage network in Apron portion, are found to be appropriate.

8. Catchment wise (W1, W2, C1, E1, NE, SE) modeling results for proposed open drain as well as box drain for the run-off generated from rainfall corresponding to 100 years return period are presented in this report. It could be observed from mathematical model results that highest water level in the upstream side of drains will be above the ground level for the run-off generated from rainfall

corresponding to 100-year return period rainfall, which will spill over adjoining ground surface.

9. The comparative results of predicted highest water (by HEC-RAS model and Sewer GEMS model) for some of the identified drainage channels adjacent to the runways and aprons are presented in this report.

10. From the analysis of mathematical model results it is seen that there may be flooding / spreading on the over banks / ground in case of overtopping of drains / channels. However, the result shows that flooding water may not spread up to the proposed RL of runway/ Aprons corresponding to discharge / run-off resulting from 100-year return period rainfall.

11. From the results of mathematical model, it is observed that the predicted maximum velocity could be 4.69 m/s, which is within the permissible limit for concrete drains.

12. Due to outfall constraint, the bed slope of maximum numbers of proposed drainage channels are mild hence low velocities are expected during non-monsoon period. Regular and periodic maintenance / cleaning of the complete drainage channel is essential.

13. There are inherent limitations associated with mathematical model which may creep in some amount of uncertainty and may affect reliability of the final estimated flood levels to some extent.

7.5 Hydrogeological Study of NMIA

7.5.1 Introduction

Detailed hydrogeology report was prepared by Ground Water Survey and Development Agency (GSDA), Maharashtra in the year 2010 and the detailed report is enclosed as **Annexure-XXIV.**

The impact on hydrogeology is studied within a radius of 10 sq.km. from the boundary of NMIA core airport site and covers about 100 villages from Panvel and Uran talukas of Raigad district and Thane taluka of Thane district. At present River Ulwe and River Gadhi are flowing through the proposed site before commencing the Pre-Development Works. Training of River Gadhi and diversion of river Ulwe has been purposed. It is essential to find out the impact of these activities on groundwater. To study groundwater impact, one has to study the hydrogeology of the area, so that occurrence, movement and distribution of groundwater can be interpreted.

7.5.2 Study Findings

River Ulwe forms the main drainage in mini watershed WF 40/7. The different streams originating around the hills of village Garada join together to form the river Ulwe. The river has different names at different places. It passes through village Garada, Balewadi, Nanoshi, Patnoli, Mosare, Manghar, Bhangarpada and finally joins the creek at village Dungi. Mini watershed WF 40/7 is of prime importance, because the airport site is located in this mini-watershed.

Kalundri river and Kolkhewadi river meet in the southern part of Panvel city and further it meanders and meets Panvel Creek. The river in this part is re-named as Gadhi or Panvel River. The tidal water reaches the upstream of this river as well as the upstream of Kalundri and Kolkhewadi rivers. The training of Gadhi river will have no effect on the groundwater regime in the mini-watersheds WF 40/5 and WF 40/6.

The average depth of dug wells is 6 to 7 m below ground level. The present Groundwater level ranges from 1.30 m to 2.5 m bgl. It is observed that the wells go dry in from the month of March or yield very little water in summer.

This area is underlain by hard massive basalt below 5.00 m which is impervious with no primary porosity. Hence, the weathered portion is limited. The water holding capacity of the aquifer is limited to weathered portion only. Due to this there is no irrigation during Rabi Season. Few farmers cultivate vegetables on the limited available groundwater.

Few drinking water Borewells have been drilled up to the depth of 60 to 75 m. bgl. Very few borewells are successful, but the quality of borewells is not potable. Below 30 m the confined aquifer is brackish. At village Garada, which is located in the hills, it is observed that the borewell is yielding brackish water. This indicates that the sea water intrusion has taken place in the confined aquifer. As the sweet water is less dense than brackish water, it has formed lenses up to certain depths.

The geology is not favorable for dug wells as well as borewells hence it is observed that these is no scope for irrigation in this mini-watershed.

To have sustainable and continuous flow of groundwater, it is necessary to have non-monsoon recharge through water conservation structures. These structures if constructed on the stream at regular intervals will recharge the groundwater naturally during non-monsoon period.

Another advantage of water conservation structure is that they will reduce the surface water run-off that is reaching the creek near airport site. The diversion of this stream will not have any adverse impact on the groundwater regime in the mini watershed. Few K.T. weirs are recommended in the forest area of Garada and Belewadi villages and also along the river up to Bhangarpada. The locations will be given after detailed verification in Phase-II of the survey work.

7.5.3 Recommendations

The development of groundwater potential by means of dug wells and borewells is severely restricted in view of the rugged and hilly nature of the terrain in the Eastern & Southern part of study area. The plains in the west of study area are covered with mud land and creek water. After due observations, following conclusions and recommendations are made.

Rising Water Table: From the pre-monsoon and post-monsoon groundwater levels of 4 observation wells it is observed that there is a rising trend which indicates that optimal usage of groundwater for agriculture is not done. The stage of development indicates that there is further scope for groundwater usages. Due to urbanization, drinking water is supplied through pipe water supply schemes hence the dependency on groundwater is reduced. The density of wells in these elementary watersheds is just 1.7 well per sq.km.

Ground Water Quality: Groundwater quality is the main issue in Panvel city and Taloja Industrial area. The unconfined aquifers are yielding sweet water, but in some cases the deeper confined aquifers are polluted, due to sea water intrusion and industrial waste.

Water Conservation Structures: The dug wells, though fully saturated during monsoon are not sustainable and dry up in early summer due to geological constraints. To make these wells sustainable, additional non-monsoon recharge is essential so that continuous recharge will take place against withdrawal. This can be achieved only through construction of water conservation structures, on the existing drainage. Ulwe river, Kalundri river, Kolkhewadi river and Taloja river and Navadi river are best suitable for this purpose. These structures will also help in reducing surface run-off, which otherwise this will have some impact on the proposed site.

Desilting of Panvel Creek and Gadhi River, Navadi River and Taloja River: Through the years Gadhi river and its tributaries Taloja river and its tributaries have deposited large amount of silt near the confluence of these two rivers. It is observed that due to silting, the water spread area has increased converting the land into mud plains. It is suggested that desilting of Panvel creek up to Gadhi and Taloja river will reduce water spread area in the proposed airport site. The desilting will also have no adverse impact on the groundwater regime in all the mini watersheds. In fact, it will create more space for the accommodation of freshwater in the surrounding areas.

Rowing Channel: The Gadhi river after training at the proposed location will be suitable for International Standard Rowing Channel of length 2300 m, width 110 m and height 3.5 m. If this is considered, then Rowing channel will be ready with no extra cost. Further, Rowing channel will have no adverse impact on Groundwater regime in the mini watersheds.

7.6 Avian Fauna Studies by BNHS

7.6.1 Introduction

The specific condition 7 I (xxxi) of Environmental Clearance & CRZ Clearance granted to NMIA (dated 22nd November 2010 and subsequent renewal on 20th December, 2017) stipulates that, "CIDCO (as Project Proponent then) shall conduct the baseline survey of Avian fauna before the start of construction and the details shall be put every three months on the website in association with Bombay Natural History Society [BNHS]". Hence, CIDCO had engaged the services of BNHS (2012 to 2014 and 2015 to 2017) to do base line survey of avian fauna over different seasons and present their findings in the form of quarterly and summarized annual reports. The final Avian Fauna studies presented here are based on the sampling conducted by BNHS from December 2015 to January 2017.

Further, CIDCO has extended the engagement of BNHS in 2018 by signing a MOU for a 10-year period (until 2028) to undertake flagging and tagging, identify bird movements and prepare management plan for active management.

The aforesaid study is interpreted in a report is covered in two parts, i.e., *Baseline Documentation of Flora and Fauna of Karnala Bird Sanctuary (KBS) and Navi Mumbai International Airport (NMIA) Project Area for Preparation of Conservation and Preservation Plan, Part I and II.* It is presented in Annexure-XIV. Further, BNHS is continually conducting similar studies for NMIA on behalf of CIDCO and the quarterly and annual reports are published in their website. This is an on-going study and will continue till 2028.

The current EIA study addresses the Avian Fauna bassline study conducted for NMIA and its recommendations for conservation and preservation of sensitive biota around NMIA may be impacted by the establishment of the said project.

7.6.2 Study Findings

The detailed study finding are presented in the BNHS report addressing the baseline documentation of flora and fauna (Annexure-XIV) submitted to CIDCO. Further, a summary of ecological baseline of NMIA based on the BNHS report and the current reconnaissance of the site is addressed in the Chapter-3 of this report.

7.6.3 Study Recommendations

The recommendations made by BNHS with regard to the conservation and preservation of biodiversity in and around NMIA is presented in the said BNHS report and the **Chapter-4** (Assessment of Environmental Impacts and Mitigation Measures) of this report as well. Of all recommendations, the concurrent recommendations of BNHS with regard of sensitive bird species and the imminent bird hazard risk is summarized below.

7.6.3.1 Sensitive Bird Species near NMIA

Of all the species, the bird species near the project site are deemed most sensitive to NMIA construction and operation. Also, bird hazard is a plausible impact due to presence of bird feeding/roosting sites near the project site.

A total number of 167 species of birds including aquatic birds were identified during the ecological survey during different seasons. The airport site was essentially a wetland with creek and mudflats and so it was foraging ground of waders and many migratory birds.

The bird species frequenting the most are waders who generally visit the area during Winter (October to May). Flamingos are rarely seen. The movement of birds is seen to be subject to tidal cycle. Birds need roosting and feeding sites for their survival. NMIA site (wetland) was serving as high tide feeding ground whereas, terrestrial vegetation, mangroves within/around site serve as roosting site. There are 3 large sized roosting sites in the eastern coast of Thane creek – 2 are in the north-west (along Thane Creek) (TS Chanakya and NRI colony) and 1 to the southwest (near Panje Funde). The overall approach is to conserve the 3 existing roosting sites – this has resulted in cancellation of several prestigious projects like the Golf course on wetland area to the north-west.

Initial BNHS studies for movement pattern of the birds, shows crisscross across the creek (the Eastern seafront). The mudflats to the west at Sewree are active birding sites but will not be affected by aircraft movements since the aircraft during take-off takes a 30-degree angle and will be at more than 6000 ft by the time they are over Sewree. The birds generally fly at heights lower than 5000 ft.

7.6.3.2 Bird Hazard Risk

BNHS was commissioned by CIDCO to undertake a long-term monitoring (2018 to 2028) and management of the project site based on the presence of sensitive bird species near NMIA. The scope of work and MoU between CIDCO and BNHS was accorded, some of the key aspects of which stipulates that:

- Developing a genetic library of precise species identification of Bird Hazard cases by standardizing DNA barcoding techniques for accurate identification of birds and exploring patterns of bird strike events; and
- Development of measures to reduce bird strike and practical solution to reduce impacts of developmental activities on bird and long-term conservation efforts.

<u>BNHS Recommendation so far:</u>

While the above study is in progress, the following aspects are addressed by BNHS through a presentation made to CIDCO with regard mangrove forest management related to the project:

While granting the Environment & CRZ clearance for Navi Mumbai International Airport, MoEF&CC had stipulated a specific condition (S*pecific Condition 7 I (xi) of Environmental & CRZ Clearance granted to NMIA (on 22nd November 2010 and later upon renewal on 20th December 2017)*) regarding the quantification of mangroves in the airport area and the proposed compensatory mangrove park. Therefore, CIDCO prepared the Scheme for regeneration of Mangrove through M/s. Lewis Environment Services USA., and implementation of same is proposed to be carried out by CIDCO in consultation with the State Forest Department before the commencement of construction works of the airport.

The Waghiwali Island across the Panvel Creek to the north of the NMIA site is deemed as a suitable site for compensatory mangrove afforestation is still under discussion.

BNHS has strongly recommended to remove the condition on Mangrove Park to the North of the site, as it will attract birds towards the airport site.

7.7 CRZ Study

The CRZ notification S.O. 19 (E) dated 6th January 2011 has been amended to permit the development of NMIA in CRZ area by exempting the airport development from the list of prohibited activities under clause 3(i)(d). The development of NMIA in CRZ-I is permitted under clause 8 (I)(i)(f). Similarly, the development of NMIA in NDZ and CRZ-II area are permitted under clause 8 (III)(A) (iii)(m) and 8(III)(B)(x) respectively. Currently, the EC and CRZ Clearance of NMIA is valid up to 21st November 2021 as per MoEF&CC notification dated 18th January 2021.

CRZ mapping has been carried out by IRS Anna University, Chennai. The CRZ area is categorized based on MoEF&CC CRZ Notification, 2011. The project area of 1160 Ha along with airport infrastructure and layout has been superimposed on scale of 1:4000 and 1:25000. The detailed CRZ mapping report is included in this report as **Annexure-XV**.

Based on 2010 EC conditions, extensive hydrological modelling studies have been done through CWPRS, Pune, following which the erstwhile Ulwe River has been diverted out of airport site into Ulwe Recourse Channel (length 3.2 km) which has been developed south of NMIA. Institute of Remote Sensing (IRS) has conducted field verification survey during November 2020. It is observed that Ulwe River which was passing through NMIA site was diverted outside southern boundary of NMIA site by constructing a Ulwe Recourse Channel (URC).

CIDCO received the permission for Mangrove clearance within project development area from Bombay High Court. The Bombay High court passed Order dated 23rd Oct 2013 in Notice of Motion No. 419 of 2011 in PIL No. 87/2006 for clearing Mangroves at the site and accordingly CIDCO has cleared existing Mangroves and planted compensatory Mangrove plantation. Due to filling and reclamation activities in project site, no mangroves or intertidal zone was observed within NMIA site during IRS field verification survey. IRS has prepared CRZ map considering the present status of project site indicating the NMIA master plan along with reclaimed land, diverted Ulwe River is presented in **Figure-1.8** of **Chapter -1.**

NMIAL has objected to the draft CZMP for Panvel Taluka prepared by MCZMA. NMIAL vide its letter dated 14th Feb'20 to MCZMA & letter dated 22nd May 2020 address to Hon. District Collector, Raigad has already mentioned the Suggestion/ Objection/ Clarification regarding draft CZMP (2019) with respect to NMIA project site which is enclosed as **Annexure – XV [A]**. NMIAL has requested MCZMA/ District collector to update the draft CZMP (2019) to indicate correct existing site conditions at respective locations within NMIA Site.

7.8 Traffic Management and Decongestion Plan

The estimation of traffic volume on the road network leading to the airport site were obtained from secondary source. The projected growth rate was assessed between 2017 and 2041 (final horizon year). The adequacy of the road network was tested between 2010 to 2041 based on projected traffic volume and the carrying capacity of major roads and intersections of connected to NMIA at different spatial scales (50 km to 5 km). The collection and comparison of baseline traffic data of CSMIA was used to prognosticate the projected traffic volume of NMIA with alternative scenarios of growth in the nearby urban/industrial pockets. Ultimately, the estimated level of service in the roads carrying the ingress/egress traffic of NMIA was identified. The detailed traffic study is carried out by LEA Associates South Asia Private Ltd. in association with MSRDC and CIDCO. A high-level committee (Task Force) is already set up by the Govt. of Maharashtra under the chairmanship of Chief Secretary for implementation of the proposed connectivity to NMIA. The detailed traffic study report is attached in **Annexure - IX.**

The land side traffic assessment of NMIA is integrated with air traffic demand and transport network development plans as per the comprehensive transport study (study conducted by MMRDA) of MMR. A detailed traffic management and traffic de-congestion plan was drawn up for NMIA considering the ingress and egress of traffic and its growth in 5 km radius of the airport boundary. The weighted volume/capacity ratio of the major road corridors connecting NMIA are predicted based on the modelling of road traffic data and the level of service is assessed for understanding the extent of traffic congestion within 5 km radius of the airport site.

Further, the predictive air dispersion modelling was carried out to understand the ground level concentration of air pollutants emitted from vehicular exhaust of traffic access in all phases of the airport operation based on the traffic volume assessment. The details of the traffic analysis and its findings and recommendations are summarised in **Section-4.3.4** in **Chapter-4.**

Chapter-8
Project Benefits

8.0 PROJECT BENEFITS

8.1 Introduction

The NMIA was envisaged after a series of studies conducted by GoM and its stakeholders while addressing ensuing project liabilities like conflict free operation, strategic siting, and long-term planning horizons. NMIAL (SPV) was formed for implementation of the project on Design, Build, Finance Operate, and Transfer (DBFOT) basis. As per terms of Concession Agreement NMIAL granted Right of Way (ROW) by CIDCO for project relating to Airport site measuring 1160 ha. NMIAL will be developing each phase of this airport as per the terms of Concession Agreement and approved Master plan, which is currently in implementation phase. The transfer of EC & CRZ Clearance of the airport core zone area (encompassing 1160 ha) from MOEF&CC to NMIAL was received 17th August 2020 for airport development.

Proposed Airport infrastructure, brings in a lot of associated developments like augmentation of infrastructural development through consolidated land development schemes, augmentation of transport infrastructures, utilities, and CSR activities towards emancipation of economically weaker sections etc. within the airport influence area. This will directly benefit the financial as well as socio-economic condition of the project affected people as well as other prospective business owners and nearby communities which in turn helps in economic development of the country.

Another important benefit of the project is the financial benefit to the exchequer through tax revenues and largescale direct and indirect employment. The Airport also acts as a major transport infrastructure for travelers and tourists, business owners, prospective investors, etc. thereby contributing to the country's economy at large.

This chapter identifies with benefits of the NMIA project in light of the relevant and applicable regulations including the details of the Corporate Social Responsibility (CSR) activities undertaken by CIDCO before the transfer of EC & CRZ Clearance of NMIA in the name of NMIAL on 17th August 2020.

8.2 NMIA Development Strategy

The benefits of NMIA project are consolidated through the synergistic activities of several planning authorities assigned within the Navi Mumbai region. The benefits of the NMIA project are realised only when the planning bandwidths of different planning authorities and urban local bodies are aligned together, which forms the basis of the development strategy of the NMIA. The NMIA project has been undertaken to safeguard longer-term capacity of airport so it is able to cater to potential higher traffic demand of MMR in future by City and Industrial Development Corporation of Maharashtra Limited also known as CIDCO as the New Town Development Authority (NTDA).

CIDCO was incorporated on 17th March 1970 under the Indian Companies Act, 1956. By February 1970 the government notified for acquisition of privately-owned land covering 86 villages and measure 15,954 ha within the present limits of Navi

Mumbai. Land belonging to further 9 villages, measure 2,870 ha, was additionally designated in August, 1973 for inclusion in the project area. In March 1971, CIDCO was designated as the New Town Development Authority for the Navi Mumbai region. In October 1971, CIDCO undertook to prepare and publish a Development Plan as required by the Maharashtra Regional and Town Planning Act (1966) and has continued to serve Navi Mumbai region in different capacities.

When GoM envisaged the requirement of a second airport within MMR region, CIDCO was assigned the task of establishing the new greenfield airport (now called NMIA), the location of which was identified at Ulwe region in Panvel taluka within Navi Mumbai. While according to clearances for NMIA project, the MoEF&CC, GOI has stipulated an EC condition No. XXVII (I) for construction Phase. It mandates, that "*The Master Plan/Development Plan of Navi Mumbai shall be revised and re-casted in view of the Airport development to avoid unplanned haphazard growth around the airport.*"

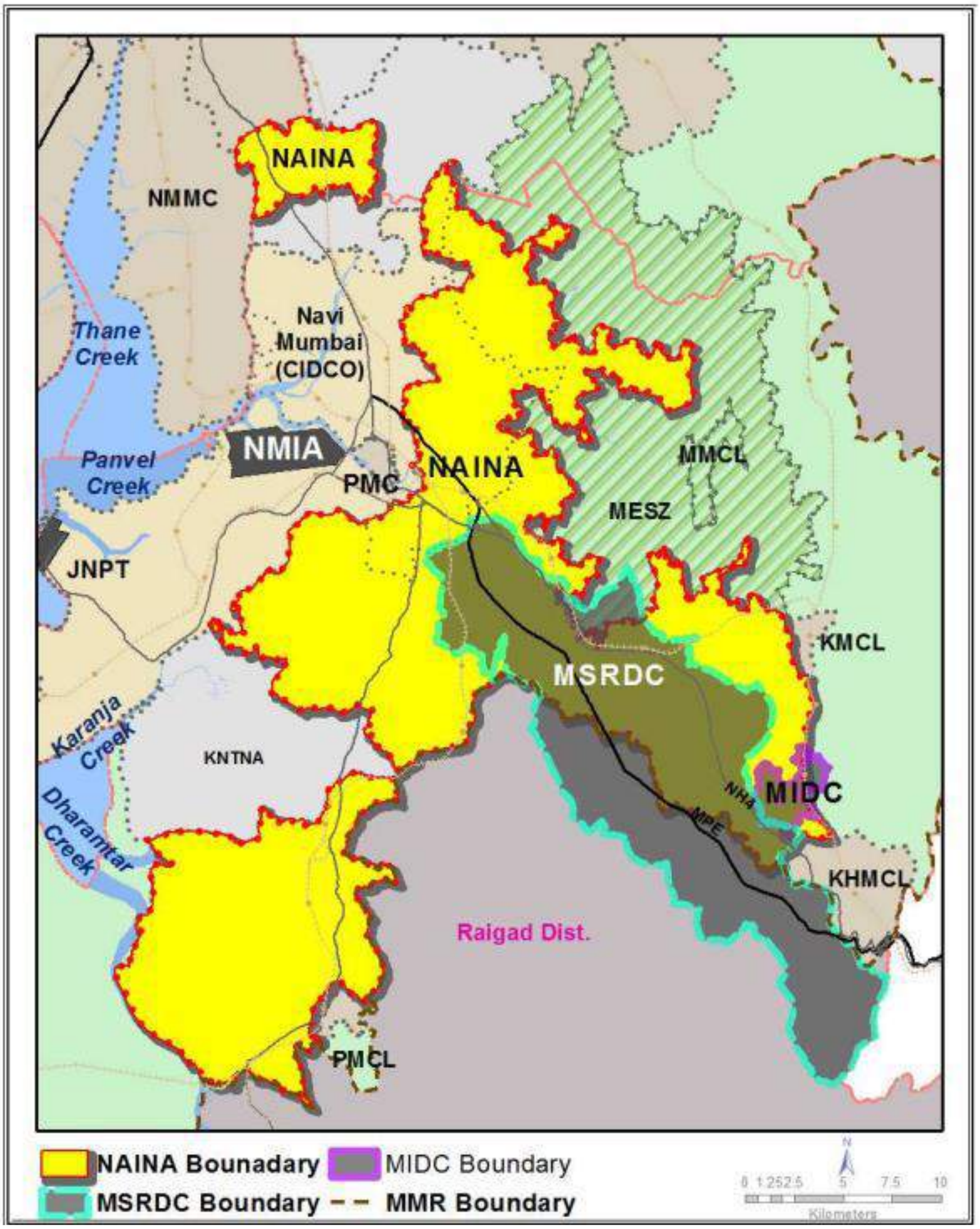
Therefore, CIDCO further assessed the impacts of the project beyond 10 km radius of project site considering the regulations of Airport Authority of India, the requirements of Airport, connectivity infrastructure, proximity to eco-sensitive zones, operation of various planning authorities within MMR etc. The assessment estimated that the area encompassing the 560 square kilometres within 372 villages (256 in Raigad district and 17 in Thane district) up to 25 km would be influenced by the construction and operation of the new Greenfield Airport (NMIA).

Accordingly, the Govt. of Maharashtra, vide Notification No.: TPS-1712/475/CR98/12/UD-12 dated 10th January 2013 (**Annexure-VII)**, through appointment of CIDCO as the Special Planning Authority, (SPA) of that area so identified as Navi Mumbai Airport Influence Area (NAINA). The map showing the area of influence defined as per NAINA is presented in **Figure-2.14** in **Chapter-2.** CIDCO was appointed as the Special Planning Authority for the NIANA region for aligned development of the NIANA region and to urbanize NAINA as a greenfield city benefiting from the nearby development infrastructures.

NAINA shares its boundary with Thane Municipal Corporation (TMC) and Ambernath Kulgaon Badlapur Special Notified Area (AKBSNA) in north, Matheran Eco-sensitive Zone (MSEZ) on east, Khopoli and Kajat Municipal Council, area under MSRDC as SPA, Pen Municipal Council on south and Dharmtar creek, Khopta New Town, Navi Mumbai (CIDCO) and Navi Mumbai Municipal Corporation on west.

Subsequently, through a series of Corrigendum Notifications, GoM reassigned the area under NIANA. The areas reassigned from NIANA were incorporated into MSEZ and other SPAs like MSRDC and MIDC. NAINA now comprises of 224 villages with an area of 47409.3 ha (474 km^2); the final list of 224 villages is given in **Annexure-VII.** The extent of NAINA along with MESZ and other SPAs and Urban Local Bodies is given **Figure-8.1**.

NAINA enjoys proximity of Navi Mumbai and will benefit from the proximity of Navi Mumbai International Airport (NMIA), JNPT (Jawaharlal Nehru Port Trust) and proposed transport corridors viz. Multi Modal Transport Corridor, Mumbai Trans Harbour Link (MTHL), Dedicated Freight Corridor (DFC), etc. However, NMIA site falls outside NAINA limits, having its own immediate hinterlands to capture the growth impulses of the nearby economic hubs like JNPT, Taloja Industrial Area etc. Thus, NMIA falls under the planning catchment of CIDCO as the New Town Development Authority of Navi Mumbai.



Source: Draft Development Plan for NAINA, (2014 – 2034) issued by CIDCO on November 2016.

FIGURE-8.1
MAP SHOWING NAINA REGION IN THE VICINITY OF OTHER SPECIAL PLANNIG AUTHORITIES' AREAS

8.2.1 Local Planning Objectives

Planning concept of NMIA development is driven by the objective to ensure maximization of capacity of Navi Mumbai International Airport for future. Also, in line with previous EC & CRZ clearance (2010) conditions of NMIA (Condition 7 I (xxvii), it was conditioned by MoEF&CC that the Master Plan/ Development Plan of Navi Mumbai shall be revised and recast in view of the Airport Development to avoid and unplanned and haphazard growth around the airport),with reference to additional stipulated in ToR issued on 29th October 2020 which reads condition No. (xx) *"A detailed management plan,-drawn up in consultation with the competent District Authorities, shall be submitted for the regulation of unauthorized development and encroachments within 5 Km radians of the Airport*."

To prevent the haphazard development in the surrounding areas of NMIA, CIDCO has proposed the SPA-NAINA, that will be developed over 474 sq. km of land surrounding the NMIA and cover 210 villages of Raigad. Therefore, the Urban Development Department of GoM as per the provision of Maharashtra Regional Town Planning Act, has modified the land use of the area in immediate vicinity of NMIA site including that of NMIA site which was previously defied under the Navi Mumbai Development Plan (NMDP). GoM vide Notification No TPS 1711/2495/CR-202/11/UD-12 dated 21st March 2012 has incorporated "International Airport & Allied Activities / Service Zone" in NMDP and changed the land use in surrounding area. The revised land use map of the NMDP along with the said notification of NMDP is enclosed in **Annexure-VIII**. The above planning strategy has been realised while keeping in mind the EC & CRZ conditions stipulated by MoEF&CC and are incorporated in the Concessionaire Agreement between CIDCO and NMIAL as the compliance conditions to abide by for the Concessionaire, i.e., NMIAL while CIDCO acts as the Authority of the NMIA project as per the said covenant. The project benefits in furtherance to the above planning strategy is explained in the following sections.

8.3 Project Benefits

The proposed airport project at Navi Mumbai shall cater to future aviation needs of MMR region in terms of air space management and airport operations to derive maximum benefits for passengers, stakeholders, all other airport users and surrounding communities. The direct and indirect benefits of the NMIA project are broadly classified into the following categories:

- Projected Financial Benefits.
- Social Benefits due to project CSR activities and R&R activities.
- Socio-Economic Benefits due to infrastructure development within influence area of NMIA; and
- Environment and sustainability efforts.

The above aspects are elaborated in the following sections.

8.4 Projected Financial Benefits

Direct Benefits

The major financial revenue generated by airport are accounted as aeronautical and non-aeronautical revenues parts of which is paid out as tax revenues to the government exchequer. Considering collection of tax revenue of INR 3490 million in 2012-13 when CSMIA was handling more than 40 MPPA and handling cargo up to 0.8 MTPA", NMIA was planned to be developed to a 60 MPPA airport with 1.5 MT cargo handling capacity. A dedicated GA operations terminal is envisaged to generate similar enormous revenues to the government exchequer.

In-direct Benefits

In addition, NMIA is planned to generate about 50,000 direct & indirect employment due to aviation business, leading to stimulation of economic growth within MMR outside Mumbai city. The project will also stimulate local economy in the vicinity of NMIA is expected to grow rapidly due to direct & indirect impact of aviation and related businesses. The project will also attract large scale investment opportunities around proposed airport by other parties due to airport development.

8.5 Infrastructure Development

Direct Benefits

The most important benefit of NMIA project can be holistically explained by the idea that establishment of NMIA will ease the traffic load of CSMIA while handling additional air traffic growing in the MMR region due to its growth rate. This growth trajectory of the MMR region is explained in the **Chapter-2** (Section-2.2 Passenger Traffic Forecast) of this EIA Report which explains that NMIA will accommodate the spill traffic from CSMIA and the NMIA will be developed as an international airport which indicates that both domestic and international traffic in CSMIA will be eased simultaneously. Also, the financial analysis done by NMIAL indicates that the project is more than capable to start generating cash from first year.

Also, as CSMIA has reached its saturation point, it is planned that the GA traffic from CSMIA will be shifted to NMIA in order to maximize the runway utilization in order to optimally cater to increasing passenger handling at CSMIA. The GA operations are planned to be fully relocated to NMIA once the NMIA commences operation. NMIA Master Plan includes provision for a dedicated GA terminal which can handle more than 27,000 ATMs per annum when fully developed and this is in addition to the planned 3 commercial terminals to come up in its final phase.

In-direct Benefits

Other indirect benefits of NMIA project can be identified by the allied infrastructure development and land development schemes planned to be implemented or in progress. These will be integrated with NMIA for better connectivity and reducing the travel time from other regions.

The existing infrastructure doesn't hold enough carrying capacity to adapt to the infrastructural demands of NMIA operation. The proposed development as per the planning horizons of the urban local bodies and SPAs in the vicinity of NMIA is explained in the following sections. Since the influence area of NMIA project is practically beyond 10 km radius of the project boundary, the development is thus addressed in larger space compared to that of existing infrastructure in the study area.

8.5.1 Transport and Connectivity

EC & CRZ Clearance conditions (2010) and also as per the present ToR, issued on dated 29th Oct 2020, conditions which directs development of transport infrastructure to be adopted in connection with NMIA project are given below:

- Condition 7 I (xviii): Prepare Detailed Traffic Management Plan.
- Condition 7 I (xix): Necessary Road (National and State Highways) and rail connectivity shall also be upgraded to handle the increased passenger and cargo traffic;
- Condition 7 I (xx): Improve public transportation including dedicated road / MRTS corridors to access to Airport. Energy Efficient dedicated rail based public transport facility; suburban/ metro train in particular, may be created between the Santa Cruz and the Navi Mumbai Airport in addition to all other links connecting various parts of Mumbai city; and
- EC Extension Condition No. 3(ii): A detailed traffic management and traffic decongestion plan, to ensure that the current level of service of the roads within a 05 km radius of the project site is maintained and improved upon, shall be drawn up through an organization of repute and specializing in Transport Planning within the next 6 months. This should be based on the cumulative impact of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in this 05 km radius from the site under difference scenarios of space and time and shall be implemented to the satisfaction of the State Urban Development and Transport Departments with the consent of all the concerned implementing agencies.
- Specific ToR Condition [29th October 2020] No. (xi): An assessment of the cumulative impact of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in the core area, shall be made for traffic densities and parking capabilities in a 05 km radius from the site. A detailed traffic management and a traffic decongestion plan drawn up through an organization of repute and specializing in Transport Planning shall be submitted with the EIA. The Plan to be implemented to the satisfaction of the State Urban Development and Transport Departments shall also include the consent of all the concerned implementing agencies.

CIDCO and MMRDA has appointed M/S. Lea Associates South Asia Pvt Ltd. (LASA), a specialised third-party consultant to carry out the required study for this purpose. Study was completed by LASA and same was discussed with all the Stakeholders and Final report was submitted to MOEF&CC on July 14, 2020. The recommendations of LASA report are also incorporated into the design constraints of NMIA.

A detailed airside and landside traffic study in the vicinity of the NMIA project site was conducted by NMIAL in line with the prior EC conditions to gauge the impact of additional load development on nearby infrastructure and its carrying capacity. The overall existing transport infrastructure of NMIA and the proposed future multi-modal transport facilities of Navi Mumbai area which will transform the landside transport in the vicinity of NMAI project, will help contain the additional load due to phase-wise development of NMIA were studied in detail and the assessment of the same is presented in the landside and airside traffic study reports of NMIA.

The multi-modal landside transport facilities planned by several developmental agencies as part of Navi Mumbai Development Plan (NMDP) will eventually help considerably reduce the travel time to NMIA (like MTHL project, metro rail route connecting to NMIA, proposed water transport facilities etc.). The summary of planned regional transport connectivity to NMIA is given in **Table-8.1**.

8.5.2 Land Development

The area in the immediate vicinity of NMIA falling within the CIDCO as New Town Development Authority will be segregated, and all developments will be commenced after the approval and permission of CIDCO as the authority. A detailed zoning plan (the zoning plan land use map is given in **Annexure-VIII**) has been notified by as per NMDP which distributes the areas based on their sensitivity and utilitarian aspects into following categories:

1. No Development Zone: Includes such areas as parts of creek contiguous creek mudflats and backwater areas spread over and area of 616.24 ha.
2. Airport and Allied Activities/Services Zone: Spread in an area of 1160 ha identified as the Airport Core Zone;
3. Modified Commercial Zone: In addition to existing commercial zones, modifications are proposed in an area of 351.46 ha will be allowed for development of commercial activities.
4. Modified Residential Zone: In addition to the existing residential zones, modifications are proposed in an area of 441.9 ha will be allowed for residential developments; and
5. Proposed Infrastructure (Recourse Chanel/Transportation Corridor) Modification: The area is modified to include the recourse channel and accommodate expansion of transport corridors or major roads proposed as offsite infrastructure development for NMIA is modified to include 99.8 ha to the existing plan.

TABLE-8.1
PLANNED REGIONAL TRANSPORT CONNECTIVITY TO NMIA

Sr.No	Sector	Project	Connectivity	Development Stages	Benefits/Objectives
1	**Highway Corridors**	Virar-Alibaug Multi Modal Corridor (MMC)	• Virar-Alibaug Multi Modal Corridor of **126 km**, it will connect Following Corridors. o NH-8, o Bhiwandi bypass, o NH-3, o NH-4 o NH4B, o Mumbai-Pune Expressway, and o NH-17, etc.	**Phase: I** From Navghar near Vasai Virar to Chirner near JNPT (about 79 km) **Phase: II** From Chirner to Alibaug, (about 47 km)	• The Development of Virar-Alibaug Multi Modal Corridor will be useful for development of NMIA • JNPT Port • MTHL • Dedicated Freight Corridor (DFC) This Corridor will carry all the traffic from JNPT towards Navi Mumbai and Thane outside the city and will help reduce traffic congestion within the city.
		Mumbai Trans Harbour Link (MTHL)	• It will connect Sewri (in Island city of Mumbai) to Nhava Sheva (Mainland). • The total length of the link will be **22 km** • It consists of approach roads, viaducts on inter-tidal zone, bridge across the Harbour and interchanges at Sewri and Chirle	In total of **22 km** Connectivity **16.5 km** of the MTHL will be in the sea and **5.5 km** on land. It will be developed in **Three** phases. **Phase: I** **10.38 km** long bridge, spanning across Thane Creek and Sewri Interchange. **Phase: II** **7.807 km** long bridge portion across Thane Creek and the Shivaji Nagar interchange **Phase: III** **3.613 km** long viaduct and interchanges that connect SH 52 and 54 and NH 4B at Chirle, Navi Mumbai.	• Development of Mainland and reducing pressure on Mumbai City. • Facilitate decongestion efforts by Improving connectivity between Island city and mainland;

Sr.No	Sector	Project	Connectivity	Development Stages	Benefits/Objectives
		Mumbai-Vadodara Expressway Spur in MMR - Virar to Panvel	This Expressway starts in Virar and ends in Panvel.		Main Objective of this Expressway for fast movement of port related inter-city traffic (JNPT).
		Coastal Road Belpada (Jawaharlal Nehru Port Trust - JNPT) To Amra Marg at Panvel	Main Connectivity and Description Of this **Coastal Line** is: This coastal road alignment takes off from **Aamra Marg** immediately after **Panvel Creek Bridge** and it passes below **Nerul-Uran railway line** and runs near to Ambuja Cement Jetty crosses the creek at **village Mahu.** Besides It crosses Nahwa road at **Shivajinagar**, runs along coast and foothill of Jasai and finally joins proposed road at **JNPT boundary** near village Belpada.	The ROW of Coastal Road is 60m having 3 lane dual carriageway with median of 5 m and 2.5 m paved pathway. The total length of coastal road is **10.106 km** and airport road is **1.2 Km.** This Project Develops in Two Phases: **Phase: I** From the junction of Amra Marg to the interchange with MTHL at Shivaji Nagar, including airport link road. **5.8 km** will be developed in this Phase along with airport connectivity of 1.2 km. **Phase: II** From Shivaji Nagar to JNPT (Belpada).	The coastal road will connect airport. The median adopted for airport link is 14 m in view of accommodating future MTHL rail line.
2	**Metro Corridors**	Belapur-Taloja-Khandeshwar-NMIA Metro	This Metro corridor will Connects Total No**. 21 Stations.**	This Metro corridor to be developed in four phases: **Phase: I** CBD Belapur Terminal, Sector-7, CBD Belapur, CIDCO Science Park (Kharghar), Utsav Chowk (Kharghar), Sector-11 (Kharghar), Sector-14 (Kharghar), Central Park, Pethpada, Sector-34 (Kharghar), Panchanand and Pendhar Terminal (under construction)	

Sr.No	Sector	Project	Connectivity	Development Stages	Benefits/Objectives
				Phase: II Khandeshwar, Sector-10 (Kamothe), Sector-2E (Kalamboli), Sector-13 (Kalamboli), Sector2E (Kalamboli), Kasadi, MIDC Station 1 and MIDC Station 2 **Phase: III** Interlink between Pendhar and MIDC **Phase: IV** Connectivity from Khandeshwar to NMIA.	
		Taloja / Pendhar to Kalyan Dombivali	It Would provide connectivity between **Kalyan and NMIA** by Belapur – Pendhar–Kalamboli–Khandeshwar metro line and the proposed Taloja-Kalyan metro corridor.	Length of this Corridor is 23kms.	
		Metro Corridor from Prabhadevi/ Sewri to Nhava and NMIA	the length of Prabhadevi to Sewri metro corridor is **4.9 km** (underground) and, Length of metro corridor from Sewri to Chirle is about **21.6 km** CTS for MMR updation study proposed MTHL Spur to NMIA which is about **5 km**	This metro line is required in **fourth phase** of NMIA development i.e. after year 2031	It would reinvigorate the economic growth of the region by encouraging new investments in infrastructure projects such as ports, new international airport, IIA, etc. in mainland.
		Chhatrapati Shivaji Maharaj International Airport (**CSMIA**) to Navi Mumbai International Airport **(NMIA)**	The Connectivity between CSMIA to NMIA, is a part of Metro Connectivity between Navi Mumbai and suburbs of Greater Mumbai, which is recommended by CIDCO/MMRDA based on the LOCAL transport connectivity Survey.		CSMT-Panvel fast corridor to enhance the suburban rail connectivity between Island city and Navi Mumbai. CSMT-Panvel fast corridor and CSMIA – NMIA Metro line will have a common corridor from Mankhurd towards NMIA.

Sr.No	Sector	Project	Connectivity	Development Stages	Benefits/Objectives
3	**Suburban Corridors**	Nerul-Seawoods-Uran Sub-urban Railway Line	It's a Nerul/Belapur-Seawood- Uran Rail Corridor and total length of the corridor is 27 km and consists of 10 stations.	It would be developed in Two Phases: **Phase: I** A 12-km section from Nerul to Kharkopar **Phase: II** From Kharkopar to Uran Provisions are made for one arm of the railway line to go to CBD Belapur station.	This Railway line is in the backdrop of major projects coming in the Southern part of Navi Mumbai to accelerate the growth of southern region of Navi Mumbai.
		Panvel-Diva-Vasai-Virar Corridor	This is an Existing Corridor Between Panvel and Vasai. Total Distance is about **76 km**. Connecting Stations: 15 Average Interstate Distance: 5.5km		It will provide seamless connectivity between North Western suburbs and Navi Mumbai.
		CSMT-Panvel Fast Corridor on Harbour Line	It's a Fast Corridor CSMT-Panvel Harbour line. The length of the Corridor is about **48 km** Connecting Stations:11 Spur to the proposed NMIA from Seawoods station.	The corridor will be integrated with CSMIA-NMIA metro corridor from Mankhurd to NMIA. This line shall be implemented by year 2026.	The daily ridership on the corridor for the years 2021, 2031 and 2041 is expected to be 8 lakh, 10.8 lakh and 13 lakh passengers respectively
		New Suburban Corridor between Panvel-Karjat	A solitary line **28.15 km** track interfaces Panvel with Karjat.		This caters only to goods and a few long-distance passenger trains.
4	**Passenger water Transport (PWT)**		It has been Considered as Inland water transport through the Ulhas River from Kalyan to Vasai via Thane. Similarly, PWT routes from Navi Mumbai to South Mumbai have also been considered.		To improve transport situation in MMR

Source: NMIA Traffic Study

The land falling within NAINA area is planned to be developed in two phases with a planning horizon of more than 20 years to optimally urbanize as a greenfield city. The land development scheme in NAINA is planned by CIDCO through enactment of an innovative Land Development Model 'NAINA – a voluntary land pooling scheme'. The essential features of this model are:

a) Land is assembled into a minimum size.
b) 25% of the land is surrendered to the planning authority for provision of roads and infrastructure and 15% of land is surrendered to planning authority towards its land bank; and
c) FSI for 60% of land retained by the developing entity is enhanced to compensate for the surrendered land.

The land required for infrastructure would become available under NAINA model free of cost. The finances required for developing city-level infrastructure will be raised from development charges, as leviable under the MRTP Act, 1966. The prescribed development charges are enhanced to facilitate funding. The second source of revenue is disposal of 15% land reserved as growth centre in Development Plan. For those who are not participating in NAINA scheme, FSI linked premium will be applicable to have parity in contribution for development of infrastructure, Details of the same are given in DCPR.

The project affected families will be entitled to a R & R package approved vide UDD, GoM G.R. dated 1st March 2014 and 28th May 2014 for rehabilitation of families falling in airport site. The package exceeds the requirements of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (RFCTLARR) and also provides special incentives for shifting/relocation.

The land development scheme for PAFs as per R&R entitlement is proposed as follows:

- Allotment of 22.5% gross land (i.e., net land of 15.75% excluding the land required for Infrastructural development) with 2.00 FSI for those who are eligible under 12.5% scheme; or

- Allotment of 10% gross land (i.e., net land of 7.00% excluding the land required for Infrastructural development) with 2.5 FSI for those who are not eligible under 12.5% scheme; and

- Allotment of developed plot, three times the roof area of self-residing structure which existed on September 2013 within the project area, with pre-approved 1.5 FSI within the 7 designated R&R pockets in vicinity of the airport site. Built up area in multi storied structure will be considered for determining entitlement.

8.6 Socio-Economic Benefits

NMIA falls within CIDCO's jurisdiction which makes it the key stakeholder as well as the authority for aligning the social development of the area within the influence area of NMIA. The social development is rooted to the economic development.

Some of the key socio-economic benefits induced by implementation of NMIA project are:

- Providing alternate air transport facility to unserved population in Navi Mumbai and MMR Region.
- Socio-economic opportunities for business and employment population in Navi Mumbai and MMR region.
- Skill development and technical expertise enhancement possibilities due to influx of aviation related institutions in Navi Mumbai due to NMIA.
- Rehabilitation and Resettlement of the project affected people while providing them development opportunities as per R&R entitlement.
- Infrastructure development in the vicinity of NMIA project through augmentation of transport and connectivity in the vicinity of NMIA; and
- Introduction of new land development schemes through consolidation of land through land-pooling schemes and through offering attractive financing schemes for development.

The CIDCO's philosophy for a holistic socio-economic development in the influence area of NMIA and other socio-economic benefits like employment contribution of NMIA are elaborated in the following sections.

8.6.1 CIDCO's Development Philosophy

Key objectives of NMIA Development Model

In line with the growth pattern of MMR region, CIDCO's broad objectives behind setting-up of NMIA on the behest of GOM and undertaking several other developmental projects within the satellite city of Navi Mumbai were:

- To reduce the growth rate of population in Greater Mumbai; to attract some of Mumbai's population and absorb immigrants who would otherwise come to Mumbai.

- To reduce traffic congestion and burden on Mumbai's physical infrastructure such as road transport, mass rapid transportation system.

- To provide physical and social services which would raise living standards and reduce disparities in the amenities available to different sections of the society.

- To provide an environment which permits the citizens of the proposed new city to live fuller and richer life, free of physical and social tensions commonly associated with urban living.

- To facilitate efficient and rational distribution of industries over the State, balancing development of urban centers in the hinterland; and

- To provide training and all possible facilities to the existing local people in the project area, to enable those to adapt to the new urban setting.

CIDCO's Social Service Department

CIDCO's Social Services Department takes care of facilitating available social infrastructure needs of the people across various nodes of Navi Mumbai. The vital departmental responsibility deals with allocation of plots for various types of social facilities. Plots are allotted considering the requirement of residents for balanced growth and development plots under the various categories of social facilities are allotted at subsidized rates to the registered public charitable Trust/Government bodies. During the financial year 2018-2019, this department allotted 3 plots (which were further sub-allotted) for various Social Welfare Facilities.

CIDCO's Rehabilitation Department

The Rehabilitation Department is headed by the Manager (Rehabilitation), reporting to the vice-Chairman & Managing Director and is assisted by several senior and middle management level incumbents. The CIDCO Rehabilitation Department performs several functions, some of which are highlighted below:

- Issuing stipend for PAPs' children.
- Imparting computer training for PAPs' wards (Microsoft office, MS-CIT, CC. in programming PC Maintenance & Hardware Networking CC. in Accounting & Office Automation);
- Allotting land for PAPs' trust for school & colleges, community center, mahila mandals and temples etc.; and
- Facilitating for financial aids to construct schools & colleges by PAP trust.

8.6.2 Direct and Indirect Employment Benefits

The proposed airport will have a potential of about 15,000 temporary employment and about 90,000 permanent employments. Socio-economic opportunities for business and employment for people in Navi Mumbai and Mumbai metropolitan region, skill development and technical expertise enhancement possibilities due to influx of aviation related institutions will be developed in Navi Mumbai region. The financial benefits envisioned from the project are over 50,000 direct & indirect employment due to aviation business leading to stimulation of economic growth in Mumbai metropolitan region outside the Mumbai city. Stimulation of local economy due to direct & indirect impact of aviation and related business, large investments around the proposed airport by other agencies due to the development of Navi Mumbai International Airport. Also, during construction phase, the EPC contractors are likely to use unskilled laborers from the nearby settlements. People in the project locality will be benefited from employment opportunities for skilled and semi-skilled personnel based on their competency.

The environmental benefits will include reduction in congestion in the Mumbai city, creation of environmentally friendly and sustainable infrastructure in and around NMIA like metro rail network, wide road network, well planned drainage, new STPs, large gardens and green areas, decongestion, and enhancement of environmental conditions around NMIA site. The project will also generate opportunities for self-employment by creating entrepreneurial opportunities for ancillary services to the airport. Finally, it is perceived that the living standards and lifestyle of the PAPs will improve after the establishment of the airport.

The sectoral employment opportunities in the construction and operation phase employment opportunities are given in **Table-8.2** and **Table-8.3** respectively.

TABLE-8.2
EMPLOYMENT OPPORTUNITIES - CONSTRUCTION PHASE

Sr. No	Roles	Nature of Job	Qualification
1	Projects	Project Controls, Procurement & Contracts, Design, Project Planning, Airport Systems	BE/ B.Tech, Diploma (Depending on nature of Job)
2	Construction	HSE & QA QC, Interior, Terminal/Landside/Airside Construction, MEP	BE/ B.Tech, Diploma (Depending on nature of Job)
3	Projects IT	Business Systems, Airport systems and Communications, Applications Infrastructure and Communication, CCTV monitoring	Diploma/ B.Tech/ B.E - Computer Science/Electronics
4	Security	Landside Security, Prevention of Encroachment, Vehicle & Traffic Management, Intelligence & Vigilance, Liaison, Documentation,	Graduation
5	Support Functions/ Corporate	HR, Finance & Accounts, Legal	Professional Courses

Source: NMIAL

TABLE-8.3
EMPLOYMENT OPPORTUNITIES- OPERATION PHASE

Sr. No	Roles	Nature of Job	Qualification
1	Engineering & Maintenance	Providing Experienced Civil Engineers for carrying out Engineering Quality and Quantity Verification work at Airport	B.Tech/ B.E, Diploma , ITI
2	Terminal Operations	Providing Food and Beverage services at Reserve lounge, Helper Activities, Lost & Found, Trolley Maintenance at Terminal	HSC & Graduation (Depending on nature of job)
3	Facilities	Providing Facade Cleaning Services, House Keeping Services Maintenance of Toilet Blocks, Landside areas,	10th, HSC & Graduation (Depending on nature of job)

Sr. No	Roles	Nature of Job	Qualification
		Landscape Maintenance, Pest Control at Airport	
4	Security & Landside	Passenger Management Services, Traffic Management, Taxi Management, Tub Management, Support Staff for CSIF	HSC. & Graduation (Depending on nature of job)
5	Land Management	Parking Services	HSC.
6	Baggage Handling	Maintenance of Baggage Handling System (Technical Roles)	Diploma, Technical Graduation (Depending on nature of job)
7	Support functions	All regular activities pertaining to airport	Professional Courses

Source: NMIAL

8.6.3 Skill Development in the Surrounding Area

CIDCO, JNPT and NMIAL are jointly planning to launch a Skill Development Program for the surrounding areas of NMIA, JNPT and other areas. This program is planned to develop management skills among people of the area to upgrade the quality of life in view of various logistic projects such as JNPT SEZ, Airport logistic Park etc., are planned. NMIAL, being part of this program, had identified skill building courses pertaining to the aviation and airport logistic sector. Details of these courses are given in **Table-8.4**.

TABLE-8.4
PLANNED SKILL DEVELOPMENT COURSES FORSURROUNDING AREA OF NMIA

Course Name	Diploma in Air Cargo Management	Diploma in Airport & Ramp Operations	Diploma in Ground Handling	Diploma in Logistics Management	IATA Cargo Introductory Course	Forklift Safety Training
Duration	4 Months	4 Months	6 Months	6 Months	4 Months	6 Days
Course Content	Industry Org., Aviation Geography, IATA Cargo Agent & Cargo Agency Operations, Air Cargo Acceptance, Cargo Automation	Aviation & Non- Aviation activities, Airport Facilities Management, Airport Layout & operations, apron operations, Aircraft handling, turnaround procedures, emergency handling, Cargo loading and unloading	CRM, Airport Ground Handling, Computerized Reservation System	Air Cargo Management, Sea Cargo Management, Logistics Management	Industry Regulations, Use of Guides, ULD Handling, Cargo Booking procedures etc.	Classification, Forklift Physics, Forklift operations, Drivers Guide
Eligibility	10+2	10+2	10+2	10+2	SSC	Minimum 8th Pass
Job Opportunities	Freight Forwarders, Cargo Agent, Ground Handling Agent, etc.	Ramp Operators & Airport Ground Handlers	Reservation Counter, Airport Operation Executives, Ground Handling Executives	Clearing & Forwarding executives, Warehouse staff etc.	Freight Forwarders, Clearing & Forwarding agencies	Forklift Operator
Course Fees	Rs. 20,000/- +18% Service Tax	-	-	Rs.34,000/- + 18% Service Tax	USD 313 for IATA Kit (Printed) and Coaching fee Rs.20,000/- + 18% ST	Rs. 10000
Offered by	Trade Wings Institute of Management headoffice@twinstitute.com 022 22875231	Trade Wings Institute of Management headoffice@twinstitute.com 022 22875231	Trade Wings Institute of Management headoffice@twinstitute.com 022 22875231	Trade Wings Institute of Management headoffice@twinstitute.com 022 22875231	Trade Wings Institute of Management headoffice@twinstitute.com 022 22875231	Forklift Academy of India, Pune info@forkliftacademyindia.com 9833133773

Source: NMIAL

Course Name	**Dangerous Goods Regulation (DGR) Training**	**Aviation Fire Fighting Course**	**Post Graduate Diploma in Airport Ground Services**	**Post Graduate Diploma in Aviation & Hospitality Services**	**Backhoe Loader Operation &. Maintenance Mobile Crane Operations & Maintenance; Poclain Hydraulic Excavator Operation & Maintenance; Dozer Operation & Maintenance; Forklift Operation & Maintenance; Tower Crane Operation & Maintenance; Heavy Crane Operation & Maintenance**
Duration	DGR Cat 1, 3, 6 – 6 Days DGR Cat 5,7,8 – 2 Days DGR Cat 9,12 – 1 Day	5 months	1 Year	1 Year	2 Months / 1 Month
Course Content	DGR for Cargo acceptance Staff, storage and Handling, Passenger & Security (All Personnel involved in Transport)	Firefighting and rescue equipment, Introduction to ARFF operations, Airport Emergency Plan over view, Emergency medical services & first aid	Passenger Relationship Management, Ground Operations and Personal Grooming.	modules in Aviation, Grooming, Communication, Inter-personal Skills and Interview preparation.	Operation of the Machines
Eligibility	Minimum 12th Pass	Minimum 12th Pass	Graduate	Graduate	Graduate
Job Opportunities	Airlines / Ground Handling	Fire Fighters	Airlines, Ground Handlers	Airlines, Airport, Hotels, Customer Service roles	-
Course Fees	-	Rs. 130000/-	-	-	-
Offered by	MIAL Cargo Training dept. & airlines	Fire Training Centre (FTC), Delhi & FTC Kolkata	Frankfinn Institute of Air Hostess Training +91-22-26706039 / 40 / 41	Frankfinn Institute of Air Hostess Training, NIHAM, AMEGO	Construction Sites

Source: NMIAL

Additionally, departmental courses are also planned for upgrading the skills of people working in the airport sector. These courses are offered by Airport Council International (ACI) and The International Air Transport Association (IATA) and would be organized by NMIAL under skill building development are given in **Table-8.5**.

TABLE-8.5
DEPARTMENTAL SKILL DEVELOPMENT COURSES- NMIA

Sr. No.	Course Name	Target Depts.	Offered by
1	Runway Incursion Awareness & Prevention	Airside	ACI
2	ACI-ICAO Aerodrome Certification	Safety, Emergency Managers	ACI
3	Emergency Planning & Crisis Management	Aerodrome Rescue & Fire Fighting	ACI
4	Working with Annex 14	Airside Operations	ACI
5	Apron Management	Airside Operations	ACI
6	Airside Safety & Operations	Airside Operations	ACI
7	Advanced Safety Management Systems	Safety, Emergency Managers	ACI
8	Emergency Planning and Crisis Management	Aerodrome Rescue & Fire Fighting	ACI
9	Safety Management Systems	Safety	ACI
10	Airport Safety Management Systems Implementation	Safety	ACI
11	Airport Collaborative Decision Making (A-CDM)	Airport Safety Managers	ACI
12	ACI-ICAO Management of Airport Security	Security	ACI
13	Quality Management in Airport Security	Quality	ACI
14	Airport Security Operations	Security	ACI
15	Airport Environmental Management	Environment	ACI
16	DGR Course - 6 Days / 2 Days	Cargo	IATA
17	Cargo Warehouse Course	Cargo	IATA
18	Cargo Security Awareness	Cargo	IATA
19	Air Cargo Management	Cargo	IATA

Source: NMIAL

8.6.4 Corporate Social Responsibility (CSR)

Corporate Social Responsibility (CSR) was introduced through Section 135 of the Companies Act of 2013. Along with the amendments made to the Act in 2019, Section 135 has also been further modified for few more social activities. NMIAL strongly believes that it is our responsibility to uplift and foster strong relationships with the society we operate in, therefore we are committed to conducting our operations in a socially responsible manner. We, at NMIAL as Company, committed to make Corporate Social Responsibility (CSR) a key business process for sustainable development on one hand and aims to supplement the Government's efforts towards enhancing the welfare measures of the society on the other. CSR activities of NMIAL emphasis lies on following vital thematic areas as per the Companies Act, 2013 and required funds will be made available to undertake the following activities in the project:

1) **Education** – Promotion of education for under-privileged children, support the socially backward, and assisting / helping differently-abled people and local community.
2) **Training & Skill development** – To socially & economically backward for their livelihood.
3) **Eradication of hunger, malnutrition or poverty** – To socially & economically underprivileged people.
4) **Environment** - Ensuring environmental sustainability, ecological balance, protection of flora and fauna and the conservation of natural resources.
5) **Gender Equality and Empowering Women** - Promoting gender equality and empowering women
6) **Promotion of healthcare and sanitation** - Providing preventive health care for socially backward and under privileged
7) **Contributing to relief** projects (to be identified as per need of time).
8) **Protecting Heritage, Art & Culture** - Protecting art and culture
9) **Awareness** – Creating awareness on all important aspects among the society

8.6.4.1 Proposed Afforestation/ Tree Plantation by NMIAL (Programme Under CSR)

NMIAL as a part of CSR activities intends to undertake tree plantation/afforestation project on land provided by Forest Dept. near Jite Village in Raigad District of Maharashtra, to contribute towards enhancing sustainable environment.

The proposed site is located 28.2 km from Navi Mumbai on Highway No. NH 66. NMIAL has requested the Forest Department, GoM for allotment of approximately 50.620 ha of land for taking up new plantation. NMIAL intends to plant about 14000 trees outside the project site. The location map and phase-wise plantation site plan for NMIAL plantation outside the project area is shown in **Figure-4.5 (A & B)** in **Chapter-4.**

Also, with a view to accelerate Afforestation work on the degraded forest areas within the State of Maharashtra the Government has decided to implement the "Programme of Afforestation" with participation of private sector through involvement of Expert Agency and Forest Department, as per the directives and guidelines of the Government of India, under National Forest Policy of 1988 and subsequent Government Resolution in Revenue and Forest Department No. FLD 2011/CR.167/F-10 dated 23/9/2011. NMIAL with expert agency, Mumbai International Airport Ltd. (MIAL) desires to voluntarily participate and assist

Government in implementation of the said "Programme of Afforestation" in the degraded forest land at Village Jite of Alibag division in District Raigad.

Mumbai International Airport Limited (MIAL) team has successfully delivered landscape development, renovation and maintenance since 2007, and has expertise and experience in plantation of tress, transplantation, development of intensive landscape- indoor as well as outdoors, softscape, irrigation along with extensive knowledge of plant nursery management and propagation techniques helping management in reducing cost and dependencies. MIAL team has proficiency in design, procurement, sustainable development and maintenance. MIAL Horticulture team has successfully conducted tree transplantation and afforestation programme from 2007 to 2017 on area in excess of 25 acres at CSMIA and over 150 acres Kempegowda International Airport (KIA).

8.6.4.2 Direct Project Benefits from R&R Activities

Rehabilitation & Resettlement (R&R) status of the project affected families is given in **Table-3.12.4 of Chapter-3.** CIDCO has incurred cost of Rs 1813 Crores for R&R for NMIA project. The R&R pockets including the Pushpak Nagar are being developed as per the R&R entitlement and some of the community structures that have been constructed within R&R pockets by CIDCO are shown in **Figure-4.10** of **Chapter-4.**

As on 11th June 2021, Total 5,262 structures demolished, and 2370 plots given possession and remaining are in process by CIDCO and about 97.3% demolition work has been realized and about 71 structures are remaining.

8.6.4.3 NMIAL Community Services

Proposed Greenfield Airport project shall employee local people to the extent possible and they will be indirectly benefited by the development of the project. The photographs of CSR activities undertaken for community development by NMIAL are shown in **Figure-8.2**.

FIGURE-8.2
PHOTOGRAPHS OF NMIAL CSR ACTIVITIES

Chapter-9
Environmental Cost Benefit Analysis

9.0 ENVIRONMENTAL COST BENEFIT ANALYSIS

9.1 Introduction

NMIA is a strategic project which will offer a spectrum benefits in addition to augmenting airport services within the MMR region. The financial analysis of the project has been carried out based on the estimation of operating cost (OPEX), capital costs (CAPEX) for different planning horizons. The revenues from aeronautical and non-aeronautical sources are considered for the above analysis. It is inferred from the detailed analysis that the project is more than capable of maintaining cash flow/ generate cash from the first year of its commencement.

As per SO 1533 dated 14th September 2006, the chapter on environmental cost benefit analysis is to be prepared if prescribed at scoping stage.

The scope of the EIA/EMP has been prescribed vide the Terms of Reference (TOR) issued by MoEF&CC vide Letter F. No.10-53/2020-IA-III dated 29th October 2020. The conditions enlisted in the ToR does not specifically mention that Cost-Benefit Analysis (CBA) to be addressed.

However, some important benefits derived from the project are given in the following section.

9.2 Key Benefits

The development strategy of NMIA was aligned with the development of its influence area having its spatial extent in an area spread over 25 km radius from the NMIA project boundary. The host of benefits expected from NMIA also includes development of NAINA greenfield city and number of important transport connectivity projects and business corridors for holistic development.

Since benefits of NMIA project are detailed in Chapter-8, few other important benefits are highlighted below:

- Augmentation of Airport services within the MMR region with the only metropolis in India having a two-airport system both of international category.
- The Airport is being developed to a state-of-the-art international airport complying with LOS ‘C’ service benchmark to an extent where the lead time within airport services will be reduced to acceptable standards thereby reducing resource utilization though optimization and which will lead to minimisation of project footprint as low as reasonable possible.
- The airport will minimize the dependency on conventional sources of energy by utilization of solar energy and optimizing energy demand through compliance to ECBC guidelines.
- The airport is planned to achieve Carbon Neutral status as per ICAO standards in a phased manner similar to that of CSMIA and other major airports around the world thereby reducing the carbon emissions to the extent possible.

- The transport infrastructure within the influence area of NMIA project is being augmented by committing to and in progress of several multi-modal transport and connectivity projects in-order to micro-manage the traffic level in the project influence area, the whole process being reviewed by a High-Level Committee (HLC) constituted by Government of Maharashtra; and

- The development strategy of NMIA will induce simultaneous development of nearby areas on socio-economic and infrastructural verticals foreseeing which, several urban local bodies and special planning authorities have aligned their development strategy with that of NMIA development horizon for planned urbanisation like through commencement of several other projects like NAINA project, MTHL project etc.

Chapter-10
Environment Management Plan

10.0 ENVIRONMENT MANAGEMENT PLAN

The Environmental Management Plan (EMP) covers the design, construction, commissioning, and operation and maintenance phases of each project component. The EMP identifies the key environmental issues across the project and provides strategy, plans and process for managing them effectively. EMP is required to ensure sustainable development of the project on the designated site, and its surrounding area. EMP is an all-encompassing plan, which has active participation and contribution of all concerned agencies involved in the project in its implementation, like project proponent - NMIAL, project Authority CIDCO and State Government agencies like Maharashtra Pollution Control Board, Maharashtra Maritime Board (MMB) etc.

The Environment Management Plan enumerates the set of mitigation and management measures to be implemented during development and operation of the airport. The EMP is devised in the form of an action plan which can be termed as 'The Management Action Plan' and aims at controlling pollution and any disturbances at the source level to the extent possible, with the available built-in and design technologies, followed by control and treatment (end of the pipeline) measures before they are discharged into the environment.

Judicious implementation of the Environment Management Plan by the project authorities is required to mitigate the impacts of the proposed airport project (both during development as well as during operation) on the surrounding environment. The Management Action Plan aims at controlling pollution at the source level to the maximum possible extent with the available and affordable technology followed by treatment measures. Specifically, the EMP lays stress on key environmental aspects and issues of the project during operation phase by:

- Identifying potential environmental impacts.
- Recommending mitigation measures for the adverse impacts.
- Identifying opportunities for enhancement measures.
- Providing an organizational framework for operating Environment Management System and other functions of the project by assigning roles and responsibilities for environmental monitoring and management.
- Formulating Environmental Action Plans (EAPs) which specify mitigation, periodic and annual monitoring activities during project implementation and operation; and
- Budgetary estimates for implementation of the mitigation and management measures.

To monitor and achieve robust commitments to legal compliances and environmental management system requirements, NMIAL will follow stringent compliance evaluation process through compliance manager software, legal register, register of consent terms & conditions etc. All the applicable legal requirements will be evaluated for compliance at regular intervals.

NMIAL will conduct internal & external assessments/audits at defined frequency of all sub-departments, regular inspections, audits & trainings of the agencies like

Ground Services Departments (GSDs), airlines etc., which will be conducted to check the compliance of the environmental regulatory requirements.

The earlier chapters identified measures for environmental protection especially for providing the necessary pollution control to comply with the standards stipulating the limits for emitting pollutants in air, water or on land so that the assimilative capacity is not exceeded. Standards are stipulated by various regulatory agencies to limit the emission of pollutants in air and water. Similarly, a mandatory practice is recommended for preparing an Environment Statement each year to reduce the quantities of wastes.

10.1 Environment Management System (EMS)

An Environment Management System (EMS) is a set of management principles intended to identify, evaluate, monitor, and reduce the negative environmental impacts of an organization's activities. It benefits an organization by offering a systematic approach for assessing and controlling ongoing activities, increasing environmental awareness, and complying with relevant regulation. An EMS provides many different and useful tools for detecting, understanding, and managing those elements involved in its activities, products and services which have the potential to impact the environment.

The main objective of an EMS is to effectively reduce the impacts of an organization's activities on the environment through a systematic management practice. To mitigate its environmental impacts, an organization has to plan in advance, create a corporate environmental policy and implement different sets of action.

In the present report, the Environment Management System (EMS) is discussed for the proposed airport development, including facilities at airport terminal to ensure that the activities and services conform to the carrying capacity (supportive and assimilative capacity). This is based on Bureau of Indian Standard Specification IS: 13967 (1993): Environmental Management Systems - Specification (equivalent to British Standard BS 7750).

Since the Environment Management Policy precedes an environment system, the Environment Policy of NMIA is presented in **Figure-10.1.** The Environment Management Plan (EMP) of NMIA will be envisaged and guided by the Environment Management Policy of NMIA notwithstanding the elaboration of specific requirements of the project development and operation phases for implementation purpose.

Considering the magnitude of the project and the involvement of various stakeholders, a dedicated Environment Management System (EMS) is essential for effective and efficient implementation and co-ordination within NMIAL management.

It is envisaged that the Environment Management at NMIA shall involve a system of checks and balances through continuous inspection and monitoring of environment, health & safety standards, regular assessment of methods/processes & records and review for further improvements at policy level.

This will also facilitate to identify gaps which lead to update guidelines and to undertake remedial measures as well. Proactive & preventive measures on Environment, Health and Safety shall be thoroughly implemented during development and operation phases of NMIA. The Environment Management System at NMIA will adhere to ISO 14001 and other applicable international standards and compliance of conditions of various environmental and other related approvals shall be rigorously monitored through proper documentation. All reports, statutory compliances and corrective measures taken for improvements, information on incidents and investigation reports, complaints and action taken reports, monitoring reports, achievements, etc., will be made available in the system. The interaction, inputs, and flow of information from various teams/departments into EMS are shown in the **Figure-10.2** below.

Navi Mumbai International Airport

ENVIRONMENT POLICY

Navi Mumbai International Airport Private Limited (NMIAL) is committed to developing and managing the greenfield Navi Mumbai International Airport (NMIA) in an environmentally sustainable manner. We shall continually endeavour to achieve environmental sustainability and social responsibility with our business goals. NMIAL is committed towards achievement of goals of sustainability and implementation of environmentally-friendly measures in development and operations of NMIA.

In the development and operation of Navi Mumbai International Airport, NMIAL will:

- Communicate its Environment Policy to all persons working for or on behalf of the organization and make it available to the public;
- Identify and mitigate environmental impacts associated with airport activities;
- Ensure compliance with applicable environmental laws and regulations, and adopt best practices;
- Prepare, issue, communicate and implement an Environment Management Plan and identify to the airport community any opportunities for improvement ;
- Regularly monitor and report on environmental performance;
- Integrate environmental considerations into processes, decision making and work practices related to planning, design, construction, maintenance and operation of airport facilities and services as part of the Environmental Management Plan;
- Make sincere efforts to prevent pollution and minimize release of pollutants into air, water, marine water and ground;
- Monitor noise levels within airport and in surrounding areas;
- Minimize consumption of non-renewable energy and enhance usage of renewable energy;
- Assist our staff and stakeholders to accept responsibility for their actions and to comply with their environmental obligations through promotion of this policy and implementation of an Environment Management Plan;
- Develop an Environmental Management System assigning responsibilities within the organization for monitoring environmental performance;
- Be sensitive to the expectations of our partners, stakeholders and the community regarding the environmental aspects related to this airport;
- Take social initiatives for welfare of local community, promote cooperation with local authorities and community around the airport;

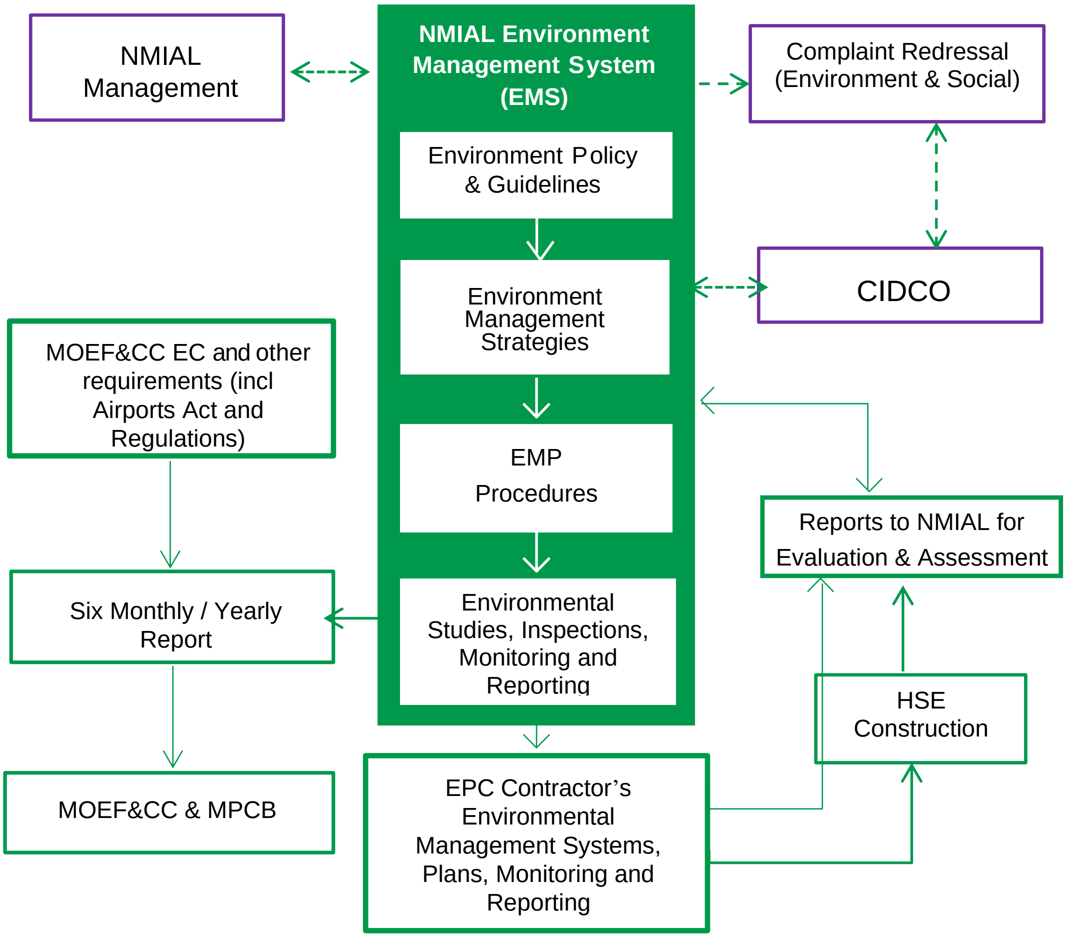
Ensuring a Green Environment for the Future

G V Sanjay Reddy
Managing Director

Date: 15th September, 2019

Source: NMIAL

FIGURE-10.1
ENVIRONMENT POLICY OF NMIA



Source: NMIAL

FIGURE-10.2
NMIAL ENVIRONMENT MANAGEMENT SYSTEM (EMS) FRAMEWORK

10.2 Institutional Framework of EMP

The Environment Management Framework of NMIA encompasses both Environment Management Plan (EMP) and Disaster Management Plan (DMP) for NMIA. The DMP of NMIA is addressed in Chapter-7 along with the Risk Assessment. This chapter addresses the environment management plan of the NMIA for development/ construction and operation aspects of the project. The development of NMIA has started in 2017 with commencement of land development works which is currently in progress.

The airport is planned to be developed in four phases. The phase-wise development of NMIA will be based on traffic projections in the successive years. Each phase will be realised with commencement of operations in partly capacitated or fully capacitated terminal development while balance development activity of the next phases may be in progress. As defined in Airport Master Plan, and in accordance with Concession Agreement (CA), the proposed NMIA development shall be implemented in four phases:

- Phase I: 10 MPPA Capacity, with Terminal T1 (part).
- Phase II: 20 MPPA Capacity, with Terminal T1 (full).
- Phase III: 40 MPPA Capacity, with Terminal T2; and
- Final Phase: 60 MPPA Capacity, with Terminal T3 (Final Phase).

The phasing implementation beyond Phase I & II Commercial Operation Date will remain flexible to respond to the actual traffic growth/ trigger and operational requirements at NMIA. The phase-wise development of key components of airport is given in **Table-10.1**.

TABLE-10.1
PHASE-WISE AIRPORT DEVELOPMENT

Phase/Year Particulars	Phase I (2024 - 25)	Phase II (2025 - 26)	Phase III -	Phase IV -
Runway Dimensions	3700 m × 60 m (Runway South)	-	3700 m × 60 m (Runway North)	-
Passenger Terminal - Area (sq. m) - Capacity (MPPA)	1,85,000 sq. m 10 MPPA	2,00,000 sq. m 20 MPPA	5,00,000 sq. m 40 MPPA	7,00,000 sq. m 60 MPPA
Cargo Terminal - Area (sq. m) - Capacity (tons)	57,250 sq. m 2,63,954 tons	57,250 sq. m 5,71,176 tons	91,050 sq. m 11,57,535 tons	91,050 sq. m 14,91,946 tons

An institutional framework is envisaged for implementation of the EMS through issue of a functional environment management plan. The EMP will be functional through development, and operational phases.

The phasing implementation beyond Phase I & II commercial operation date will remain flexible to respond to the actual traffic growth/ trigger and operational requirements at NMIA. Therefore, the Phase-III and Phase-IV development activities will coincide with Phase-I and Phase-II operations. Thus, the EMP for development activities will remain in practice during the development of Phase-III and Phase-IV even while Phase-I and Phase-II are under operation.

10.2.1 Institutional Framework

Different management strategies are required for procurement and supply of material, hiring contractors, construction activities, safety of material and manpower, environment management etc., during development and operation phases. Each stakeholder shall design and develop their respective management strategy and/ or strategies as per the mandate assigned. And these shall be implemented in synergy to accomplish timely completion of the project. NMIAL, EPC contractor & sub-contractor/s are the main stakeholders in the project implementation within the airport site area of 1160 ha and the responsibilities of each are outlined in the following sections.

NMIAL and CIDCO are jointly implementing the project with specific responsibilities. Prior to commencement of development of airport infrastructure within 1160 ha of core site area, CIDCO is responsible for preparation of the site by way of Pre-Development Works. CIDCO shall complete the hand over the site to NMIAL on completion of Pre-Development Works and R & R of all nine villages within the airport site for its development.

In addition to the Pre-Development Works, CIDCO is also responsible for:

- Planning and implementation of overall storm water drainage network in area around the site.
- Study of avifauna and biodiversity.
- Airport connectivity by implementing road, metro and water transit and upgradation of transport network around the airport.
- Conducting High Level Advisory and Monitoring Committee (HLAMC), Govt. of Maharashtra, meetings regularly; and
- Development of compensatory mangrove plantation and protection.
- Approval from Tree Authority for cutting and Transplantation of Trees.

NMIAL and its EPC Contractor/s for execution of development work within the airport site shall be responsible for implementation of all project's developmental activities, including environmental protection measures. In addition to the EPC contractor, certain specialized jobs are likely to be awarded to other contractors/concessionaires, for example:

- Concessionaires may be appointed by NMIAL for the planning, design, development and operation of fuel farm, fuel hydrant system and fuel stations.
- Landscape/ Horticulture contractor will be appointed by NMIAL for implementation of landscape, horticulture works, and their maintenance.
- Concessionaire for Flight kitchens will be appointed by NMIAL for planning, design, development and operation of their own buildings and associated infrastructure; and
- Concessionaire for Cargo shall be appointed by NMIAL for planning, design, development, and operation of International and Domestic cargo facilities.

The **Figure-10.3** below broadly shows division of responsibilities amongst the key agencies involved and their broad scope.

The responsibilities for implementation of various control measures are outlined in this document. The generic responsibilities of the three key agencies are outlined below.

10.2.2 Responsibilities of CIDCO

CIDCO had issued letter to NMIAL on 10th February 2020 agreeing to sharing of responsibilities between CIDCO and NMIAL and a NOC for NMIAL to seek transfer of EC, with advice to NMIAL to submit application to MOEF&CC for fresh EC. As some conditions are to be fulfilled by CIDCO were not clearly spelt out in CIDCO's letter of 10th Feb 2020, NMIAL replied to CIDCO vide its letter dated 18th Feb 2020, clarifying on the sharing of responsibilities between CIDCO and NMIAL for compliance of conditions of EC. CIDCO reiterated its advice to NMIAL to submit application for the project vide its letter dated 17th March 2020.

- CIDCO shall continue to be responsible for compliance of EC conditions applicable to/ to be implemented in/ related to all areas outside Airport Site of

1160 ha, including development of mangrove park, compensatory mangrove plantation etc and for Rehabilitation and Resettlement of villagers. Whereas NMIAL shall be responsible for compliance of EC conditions applicable to/ to be implemented in/ related to Airport Site area of 1160 ha.

- After the grant of NOC by CIDCO vide letter dated 10th February 2020 to NMIAL for obtaining fresh EC & CRZ clearance from MOEF&CC, NMIAL has submitted its application accordingly. In view of this, the followings are to be complied by CIDCO: -

  ✓ Compliance with the requirements as per EC and other applicable legislation for portions outside the site area of 1160 ha.
  ✓ Compliance of environmental norms and applicable permits by the contractors appointed by CIDCO.; and
  ✓ Development of all required infrastructure for NMIA and its maintenance outside 1160 ha of Airport Site Area.

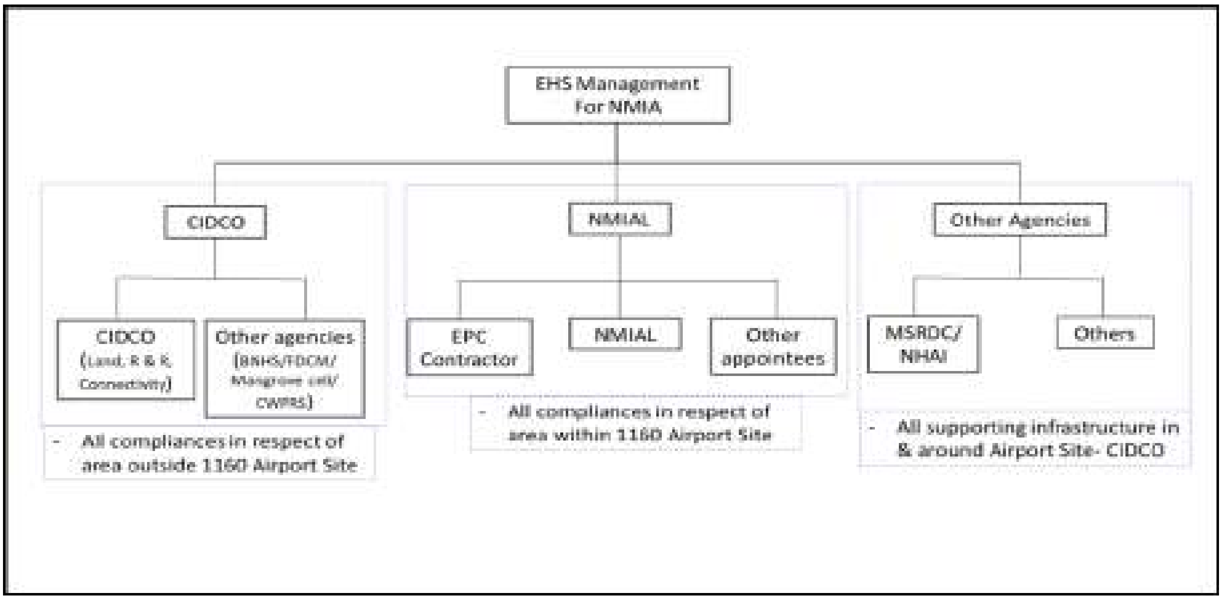


FIGURE-10.3
KEY AGENCIES RESPONSIBLE FOR ENVIRONMENT MANAGEMENT

10.2.3 Responsibilities of NMIAL

The responsibility of NMIAL with respect to the project core area (1160 ha) are:

- Compliance with the requirements as per EC and other applicable legislations for 1160 ha.
- Preparation of Environment Policy and relevant guidelines as per requirement.
- Formulation, development and updating of Environment Management Plan for successive phases of development including specific provisions for contractor/s.
- Overall implementation, reporting and maintenance of EMP development phase under the EIA notification.
- Provision of necessary resources and staff to meet contractual terms.

- Induction programmes and customised training to achieve awareness of the EMP development phase and procedures related to applicable tasks.
- Ensure inclusion of provisions for environment management, including compliance with the EMP development phase in the relevant contracts.
- Establishment of reporting and document management procedures as documented in EMP.
- Coordination and monitoring of responsibilities and compliances by the EPC Contractor & sub-contractor/s.
- Coordination with CIDCO for monitoring the progress of implementation of EMP by CIDCO for its project obligations as per EC.
- Soliciting support of HLAMC and all other relevant agencies for necessary action towards their respective responsibilities.
- Coordination of, sourcing and monitoring the progress of implementation of EMP by other agencies for its project obligations.
- Establishment of Environment Management team within the company to manage the implementation of EMP development phase, as well as sustainability program; and
- Setting-up of monitoring systems (including reporting, compliance, assessment/audit, and document management procedures) and redressal system.

10.2.4 Responsibilities of EPC Contractor

- Preparation of EMP for his area of work (physical area as well as environmental impact area) in accordance with contract and submission to NMIAL for approval of the same before commencement of project.
- Implementation of the EMP for development phase as applicable to each work area and activity.
- Ensuring that all their activities including those of EPC's sub-contractors are carried out in accordance with the Contractor's EMP.
- Ensuring compliance always with the requirements of applicable legislations and relevant standards as outlined in this document, and all requirements of this EMP for development phase and Contractor's EMP.
- Induction programmes and customised training of staff in environment management.
- Establishment of monitoring and implementation system for EMP.
- Ensuring that the relevant documents are populated and maintained.
- Regular liaison with NMIAL Environment & SD and HSE teams regarding progress on implementation of EMP development phase.
- Obtaining permits and licenses as required for construction work and /or as directed by NMIAL and ensure compliance thereof.
- Setting-up an EMC to monitor environment management and ensure that the EMP development phase is strictly implemented.
- Ensuring that their personnel including management, staff, supervisors, sub-contractors, and workers are appropriately trained, supervised and have the necessary experience and competency to implement the requirements of the Contractor's EMP.
- Ensuring that toolbox talks, and environment committee meetings are regularly conducted.

- Reporting to NMIAL of any change in the conditions of the environment or construction practices change materially from that as anticipated under the EMP development phase or contractor's EMP.
- Undertake corrective and preventative measures in response to non-conformance with the contractor's EMP and ensure that required measures are implemented in a timely manner; and
- Monitor environmental parameters on daily basis to ensure adherence to the standards, specifically to check work zone pollutants (Dust, PM_{10}, $PM_{2.5}$) levels, noise levels, vibration levels near drilling & blasting sites, STP inlet-outlet quality in labour camp, etc., through approved and accredited third-party consultants.

The requirement to implement the EMP in development phase by the EPC contractor (and their sub-contractor/s)) is implicit, and included in the EPC contract, for the works permits issued under the law and by contractual obligation. During the development phase, the EPC contractor will be required to have an in-house Environment Management Cell (EMC) and HSE team on board. Day to day environment management and monitoring of safety will be the responsibility of the contractor's in-house team.

10.2.5 Organogram for NMIAL Environment Management

Responsibility for implementation of the EMP development Phase rests with NMIAL within 1160 ha at the overall project level, and with any contractors (including sub-contractors) undertaking the works for the site at the micro-level.

The contractors will be required to have an in house EHS team and prepare an Environment Management Plan (detailing the scope of work assigned, the relevant environmental protection measures to be undertaken in line with this document, and specific roles and responsibilities for implementation) for the work they propose to do at site. This document will be called the contractor's EMP. The contractor will not be allowed to commence any work at site unless the contractor's EMP is reviewed and approved by the NMIAL.

NMIAL Environment Management & Sustainable Development (EM & SD) Team will be led by Head (EM & SD) with a site Health and Safety and Environment (HSE) Team headed by General Manager (HSE). The Head – EM & SD shall report to the Director (Planning) & Head – HSE shall report to Director (Construction), who in turn report to CEO, NMIAL.

NMIAL Environment & SD Management will comprise the following:

- An Environment and Sustainable Development (EM & SD) team which shall undertake and complete all environment related studies, compliances/returns and related documents and their timely submission to the applicable relevant statutory authorities. This team will be responsible to obtain or renew all required environmental permits and clearances in a timely manner.

- It shall engage approved and accredited third-party consultants to undertake environmental monitoring and analysis, aid with regulatory compliances, conducting studies and obtaining clearances; and

- HSE team will supervise and monitor the functioning of EPC contractors and sub-contractors. This team will conduct regular inspections and audits to ensure that the EMP development phase and the contractor's EMP are fully implemented. It will also ensure compliance with safety norms as per the relevant applicable law and conduct various HSE related training programs regularly to cover the entire work force, including that of the EPC contractor.

The Organogram for Environment & Sustainable Development Management is presented below in **Figure-10.4.**

10.2.6 Stakeholder Management

Stakeholder consultation is a well-established component of sound environment management. NMIAL will hold regular internal consultation meetings. It will also conduct consultation with Government departments and other external stakeholders as required. The schedule for stakeholder consultation relevant to the EMP development phase is summarised in **Table-10.2** below:

Community Engagement

Community engagement shall be led by the NMIAL Public Relations Team in coordination with the Head – EM & SD. Based on the nature of issues, these shall be escalated with NMIAL, and referred to CIDCO, Collector-Raigad, or other local authorities as applicable. Any intervention/decision required to be taken by NMIAL shall be conveyed to all concerned stakeholders or community members.

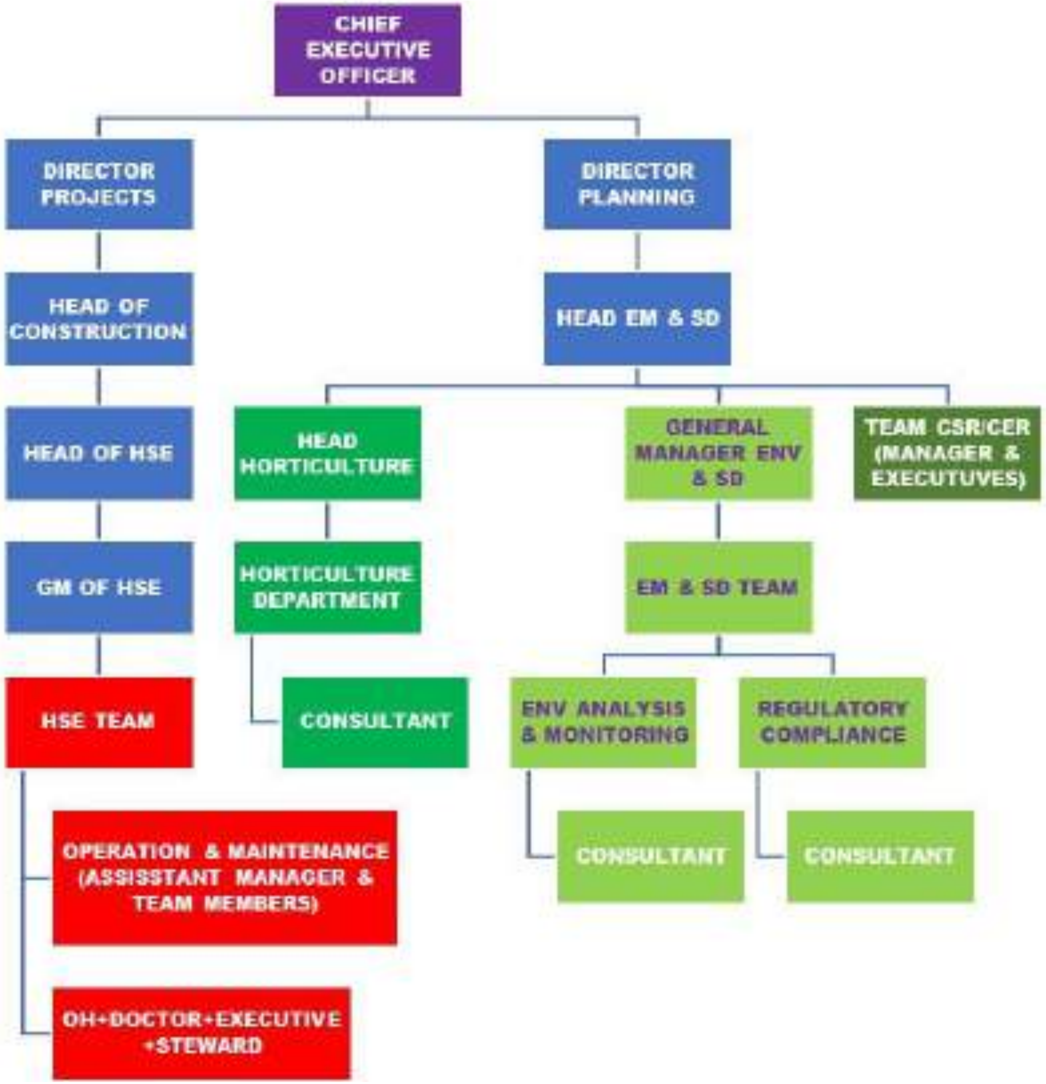


FIGURE-10.4
NMIAL ORGANOGRAM FOR ENVIRONMENT & SUSTAINABLE DEVELOPMENT MANAGEMENT TEAM

TABLE-10.2
STAKEHOLDER CONSULTATION SCHEDULE

Stakeholder Meeting	Schedule
Internal	
NMIAL Environment Management Committee	Monthly
NMIAL Project Safety Committee	Monthly
NMIAL EPC Review	Monthly
External	
Environment & SD meetings with Environmental Consultants	Quarterly
High Level Advisory & Monitoring Committee with CIDCO	Quarterly
High Power Committee on Forest	Six Monthly
Regional Office, MOEFCC Nagpur, CPCB Pune & MPCB	Six Monthly

10.2.7 Incident Management

It is mandatory for all NMIAL staff and contractors to report all Health, Safety and Environment incidents and complaints for investigation. Incidents are defined as events that result (or are likely to result in) environmental damage. They must be reported to the concerned HSE staff of NMIAL immediately for deploying control measures. These include uncontained spills (regardless of volume), air emissions, sudden discharges, and wildlife hazards.

All incidents are recorded within the NMIA Environment & Safety Management System (ESMS) and shall be subject to an initial investigation and corrective actions shall be identified if warranted. For incidents resulting in potential contamination, these actions include immediate groundwater and/or soil sampling and analysis and may result in the development and implementation of a remediation programme.

Complaints associated with site development activities and related to dust, noise and vibration may be received via:

- A direct notification from the complainant to NMIAL or through local authorities. If applicable, the Environment & Safety Managers advises the relevant contractor for investigation and action within 24 hours of the complaint being received.
- A direct notification to the contractor from the complainant. The contractor is to advise the Environment & Safety Managers (or in their absence, a representative of management) within 24 hours of the complaint being received, providing adequate details to assist in the initial investigation and advise of actions proposed to rectify the issue.

The NMIAL Environment Incident Report Form shall be mandatory for reporting environmental incidents and complaints to NMIAL management (written notification via email or contractor-specific reporting templates will also be supplemented and initial verbal notification can be used in the event of an emergency). The information provided will be utilised by NMIAL to populate the Environment & Safety Management System, which will serve as an Electronic Incident Register.

10.2.8 Development Phase Emergency Response PLAN at Site

Development phase Emergency Response Plan (ERP) shall be developed by the EPC contractor to ensure effective and efficient arrangements for the response to, and recovery from, an emergency at project site during the development period. This includes emergency response plans for potentially polluting events such as fuel and oil spills, fire, discharge of polluted water in natural drains and hazardous materials. The ERP will be focused on emergencies associated with construction activities, allowing emergency services personnel to respond as appropriate. Similarly, as there is no central emergency response or spill control team based at site, spill response (and subsequent remediation) is the responsibility of the contractors and sub-contractor.

10.2.9 Important Contact Details

Contact details of key stakeholders of the environment management cell will be maintained and updated.

10.3 Environment Management Plan

10.3.1 Components of EMP

An Environment Management Plan (EMP) is part of EIA report, and it envisages management plan to assess adverse impacts of project and to identify mitigative measures required to be implemented at site of the project during development & operation phases. Considering the importance and size of NMIA project which has two distinctive phases i.e., development and operation phases, NMIAL has prepared EMP for developmental phase as well to set high standards. It is well known fact that development phase is a continuous activity in the aviation projects and after completion of certain vital facilities, operation of aviation commences. Indeed, both development and operational activities run parallel at project site after some time. And thus, elements of management plan of development phase are extended in the operation phase also and is given in **Table-10.3** below.

TABLE-10.3
ELEMENTS OF MANAGEMENT PLAN FOR DEVELOPMENT & OPERATION PHASE

Sr. No.	Management Activities	Development Phase	Operation Phase
1	Air & Water quality & Noise level	Yes	Yes
2	Hazardous Materials Management	Yes	Yes
3	Solid waste & Hazardous waste	Yes	Yes
4	Energy Management	Yes	Yes
5	Construction Waste	Yes	Yes (due to some redevelopment works)
6	Topsoil & Erosion and Sediment Control	Yes	No (Landside area plantation area and at airside around runway area)
7	Flora and Fauna Management (including bird management)	Yes	Yes

8	Training & Awareness to staff, workers, stakeholders and public	Yes	Yes

10.3.2 Development Phase Environment Management Plan

The summary of anticipated adverse environmental impacts and mitigation measures during development phase are given in **Table-10.4**.

TABLE-10.4
ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES DEVELOPMENT PHASE

Discipline	Potential Impacts	Mitigative Measures/ Remarks
Excavation	❖ Erosion of exposed surfaces ❖ Vehicles moving over exposed areas track soil onto local roads. ❖ Wind moving over exposed surfaces causes erosion of exposed surfaces and raises dust. ❖ Water moving over exposed surfaces causes erosion and sedimentation of drains and streams. ❖ Works within a water course causes sedimentation. ❖ Removal of soil uncovers contaminated materials. ❖ Poor control of the method of disposal of excavated materials allows the materials to be dumped or disposed to an inappropriate landfill.	❖ Excavation must be carried out in a way which keeps topsoil and underlying soils separate to prevent the potential contamination of subsoil. ❖ As far as practicable, reduce the volume of waste spoil generated from earthworks. ❖ Reinstate generated spoil on site at the construction of ground disturbing work wherever possible. After reinstatement of spoil, the ground surface must by stabilized.
Stockpiling material	❖ Water movement over stockpiled material causes erosion and sedimentation of drains and streams. ❖ Wind movement over stockpiled material causes erosion and fugitive dust. ❖ High angle of repose of stockpiles causes them to collapse leading to increased erosion and generation of fugitive dust	❖ Stockpiles must be located at least 20 m away from drainage inlets, open drains. ❖ Stormwater must be diverted (Re-routed) around stockpiles. Provision of diversion channels around the stockpiles for diversion of storm water has to be made. ❖ Sediment retention structures must be placed downslope of any stockpile. ❖ Stockpiles managed to reduce the risk of bird attraction. ❖ Stockpiles must be stabilized to prevent erosion of material by wind and water.

Discipline	Potential Impacts	Mitigative Measures/ Remarks
Operation of equipment	❖ Poorly maintained equipment causes air emissions that exceed air quality standards. ❖ Poorly maintained equipment or failure to fit recommended noise suppression equipment causes noise and vibrations. ❖ Operations outside designated work hours cause noise pollution that may impact on neighbor's sleep	❖ Periodic maintenance of equipment ❖ Replacement of the old and out-lived machinery with the new machinery/equipment. ❖ Equipment to be handled and operated by the designated and adequately trained operators. ❖ Construction equipment has to be operated only during the designated timings such that any possible community impact can be avoided.
Storing chemicals and liquid fuels on site	❖ Inappropriate location of chemical stores, poorly stored chemicals and poor handling practices cause spills that contaminate soil, drains, streams and groundwater. ❖ MSDS not held on site may lead to inappropriate handling, use or storage of chemicals causing spills that contaminate soil, drains, streams, and groundwater.	❖ Chemical storage areas must include secondary containment controls such as permanent or portable bunding in accordance with regulatory requirements. ❖ Frequent chemical use and handling areas must be located on impervious hardstand with appropriate bunding so that any accidental spills can be confined and immediately cleaned-up. ❖ Compliance to the requirements of the MSDS must be ensured.
Importing fill material	❖ Poor quality control during importation of fill material allows contaminated material to be imported to site resulting in a contaminated site	❖ Fill material imported to site should be fully contained using suitably designed vehicle to avoid any spillage or contamination of the project site.
Storage of wastes (solids & liquids)	❖ Improper location of waste storage areas and / or poor practices when storing waste materials allows them to escape and litter surrounding land, drains and streams. ❖ Poorly stored food scraps/food waste attracts birds and create the possibility of an aviation hazard	❖ Storage of wastes (solids & liquids) should be done at pre-identified and designated locations only. ❖ The waste storage sites should be clearly earmarked and to be located away from the main operating areas. ❖ The waste storage areas to be adequately fenced with controlled access to authorized personnel only.

Discipline	Potential Impacts	Mitigative Measures/ Remarks
Disposal of wastes	❖ Poor control of waste disposal causes wastes to be dumped or taken to an inappropriate waste disposal facility leading to contamination of land and streams.	❖ Disturbed areas must be reinstated as soon as practicable with ground cover/surfacing suitable for the site conditions.
Erosion and sediment control	❖ Water contamination ❖ Soil contamination ❖ Blockage / obliteration of drainage channels	❖ Earthwork and ground disturbing activities to be planned and staged to reduce the duration and extent of exposed soils. ❖ Weather forecasts must be considered when planning earthworks and ground disturbing activities. Where practicable, earthworks and ground disturbing activities must be avoided during periods of heavy rainfall or high winds. ❖ Silt loads must be treated as close to their source as possible using effective sediment traps
Interference with the natural drainage of the local ecosystem	❖ The proposed alignment will have similar physiographic characteristics so as to keep the existing characteristics of the regime in the new recourse channel of the creek. ❖ Hence, the interference would be of a minor nature and would stabilize in the long run.	❖ Regular monitoring of the specified parameters of the local water bodies will be done
Interference with the surrounding terrestrial and aquatic ecosystem	❖ Generated effluent or pollutants may cause impact on terrestrial and aquatic ecosystem	❖ The effluents/sanitary wastewater needs to be treated appropriately before their discharge. ❖ Regular monitoring of the specified parameters of the terrestrial and aquatic ecosystem will be done
Flooding in other low-lying areas	❖ The change of river flow is inevitable and during the development, due care will be taken so to maintain the required hydraulic flow to avoid water logging in the	❖ Regular monitoring of any flooding, if reported is to be done. ❖ Water flow and flood gauzing stations to be established at suitable locations

Discipline	Potential Impacts	Mitigative Measures/ Remarks
	upstream and also any water logging in the project area during development phase. ❖ Ulwe river has already been diverted through Ulwe Recourse Channel	
Hill Cutting & Blasting	❖ The excavated material/ construction debris from hill cutting	❖ Will be used for leveling of project area and land development to the maximum extent. ❖ Surplus, if any will be disposed of in a pre-designated approved site. ❖ Blasting carried out during daytime only. ❖ Controlled blasting with low explosive per charge is being implemented under supervision of CIMFR
Mobile Crushers/ Mobile RMC	❖ Major impacts from operation of crushers and RMC plants are due to dust generation from the loading and handling terminals, etc. and will be localized in nature.	❖ The operation of Mobile Crushers/ Mobile RMC will be temporary and need based. Therefore, appropriate dust control measures like water sprinkling will be adopted.
Sediment run-off	❖ The contamination of estuarine body would occur mostly during the development phase and airport due to re-suspension of sediments or dust from construction site, both of which are temporary. ❖ Sediment run-off may lead to damage of local aquatic ecosystems.	❖ To minimize the impacts of dredging/ channelization, proper route alignment, carrying out dredging and excavation in stages so as to maintain the water flow and during high tide will be done. ❖ The proposed alignment will have similar physiographic characteristics to keep the existing characteristics of the regime in the new recourse channel of the creek. The enhanced turbidity is a temporary phenomenon occurring during the water course diversion. ❖ Proper silt trap system will be developed & maintained

10.3.2.1 Air Quality Management-Development Phase

Activities during development works likely to cause air pollution may include:

- Hill cutting, drilling, and blasting.
- Site filling and levelling.
- Operation of mobile crushers/ RMC facility
- Excavation for foundation of buildings.
- Loading and unloading of construction materials and construction debris.
- Vehicle movement; and
- Gaseous emissions from DG sets.

These activities contribute to generation of particulate matter and gaseous emissions such as oxides of nitrogen and carbon monoxide. The following control measures shall be implemented on project site to reduce the emissions.

Drilling Operations

Central Institute of Mining and Fuel Research (CIMFR) has been appointed by CIDCO as experts for management of blasting work on site. It is being ensured that when the blast holes are drilled, the cuttings from the holes are flushed out of the holes by passing the compressed air through drill rods and these cuttings are allowed to fall outside the collar of the blast hole by means of blowers. The dust thus generated during drilling is suppressed and allowed to settle in the form of a cone near the collar of the blast hole itself by use of water during drilling so that the air is not polluted by the blasting/drilling. Wet drilling will be practiced to the extent possible.

Blasting at Ulwe Hill Site

Controlled blasting with low explosive per charge is being implemented under supervision of CIMFR and the following control measures are adopted:

- Drilling machines equipped with sharp drill bits for drilling holes.
- Blasting carried out during daytime only.
- Dry drilling equipment with dust collection system being used; wet drilling being adopted to the extent possible.
- Appropriate equipment's used for excavation and hauling of materials which generate minimal noise as well as dust.
- Proper maintenance of the construction machinery and vehicles.
- The fugitive dust generated due to the movement of trucks reduced by regular sprinkling of water along the roads within the site.
- During high winds, excavation and transportation operations suspended.
- Good housekeeping practiced at the construction site.
- Maintaining the speed levels of the vehicle within the project site.
- All construction equipment's are operated within specified design parameters.
- Vehicle trips minimized to the extent possible.
- The DG sets and other construction equipment's, machinery and vehicles maintained properly; and
- Ambient air quality within the premises will be monitored as per the environmental monitoring plan.

10.3.2.2 Water Quality Management-Development Phase

Wastewater

The wastewater will be generated at the camp site and from labor camps. The following control measures will be followed in the project site to prevent the water contamination:

- Wastewater generated from the construction camp will be treated in the package sewage treatment plants, which will be reused for dust suppression and plantation/greenbelt.
- Odor, if any shall be managed as per Guidelines on Odor Monitoring & Management Rules by CPCB.
- No discharge will be made to surface water and groundwater.
- The construction site will be provided with infrastructure facilities for the work force.
- Wastewater generated from parking area will be treated and reused; and
- Proper care will be taken so that there is no water logging in the development phase.

Storm Water

Adequate measures will be taken for prevention of water logging around construction site and contamination of surface water from sediments, spillages of oil, fuel etc. Any excavation work will be carried out non monsoon season. Creation of permanent water discharge channels will be developed to avoid flooding within airport site or in the low-lying area in vicinity of airport. Drainage system with proper silt trap system will be developed & maintained.

10.3.2.3 Solid Waste Management

The solid waste from the project includes leftovers from hill cutting material, construction and demolition wastes, packaging materials, oil & grease, paints, or other hazardous waste. The following control measures will be adopted for the management:

- The excess cut material will be disposed at identified approved sites.
- The topsoil will be collected at designated place and can be used for the greenbelt/green cover development plan within the project area.
- STP dried sludge will be used for manure in plantations within the airport landscape.
- Proper guidelines with respect to handling the waste generated from any untoward accidents of spillage of fuel or oil will be developed.
- Spill kits will be made available at the project site for collection of spilled waste and will be disposed through authorized agency.

- The solid waste from the construction camp and the workers canteen will be collected at designated area within the project site and will be disposed through authorized agency.

- Hazardous waste will be disposed as per the Hazardous Waste (Handling and Disposal) Rules, 2016 and amendments thereof.

- Construction and demolition waste generated during development phase shall be handled as per The Construction and Demolition (C&D) Waste Management Rules, 2016 notified vide G.S.R. 317(E) 29th March 2016 by the Ministry of Environment, Forest, and Climate Change (MoEF&CC).

- The Solid Waste Management (SWM) Rules, 2016 will be strictly adhered to as applicable.

- During the construction phase of the project, fly ash may be utilized as per Fly ash Management and Handling Rules, 2016 in cement mix, reclamation, backfilling, construction of road/embankment and culverts.

- NMIA will comply with Fly ash Management and Handling Rules and utilize fly-ash products in the range of 50,000 tonnes in construction of Phase-I&II and 1,00,000 tonnes in the construction of final Phase-IV.

10.3.2.4 Noise Level Management

The increase in noise levels is envisaged during the development phase of the project. The major noise generating sources are:

- Drilling, blasting, cutting, crushing, and filling.
- Construction equipment's and movement of vehicles; and
- Operation of DG sets.

The following control measures will be adopted on project site to reduce the noise levels:

- Deep hole blasting restricted to daytime hours only.
- Noise levels controlled by using optimum explosive charge per hole and milli-second delay detonators and proper stemming to prevent blow out of holes.
- Optimum charge per delay used to control fly rock and ground vibration.
- Primary blasts designed such that boulder generation will be minimum.
- Secondary blasting will be avoided.
- Blasting carried out as per the DGMS.
- Blasting done only during daytime.
- Speed of vehicles running inside the project site will be limited to moderate the speed to prevent undue noise.
- Equipment and vehicles maintained in good working condition and handled with due precautions.
- Noise generating equipment provided with suitable enclosures and intake silencers.
- Workers will be provided with personal protection equipment such as ear plugs and muffs at noisy places.

- Diesel generator sets provided with acoustic enclosures; and
- Night working minimized to the possible extent.
- Works /activities having potential to generate significant levels of noise to be planned and undertaken during standard working hours.
- Distances to be maximised between locations of noise generating works, if possible, to reduce noise impacts.
- Vehicles movements - speed limits on all access roads and tracks to be adhered to.
- Screens, enclosures, barriers, exhaust silencers/ mufflers for vehicles are to be installed for noise control.
- All plant, equipment and vehicles must be turned-off when not in use,
- Use of PPE at blasting, cutting, and drilling areas and other construction sites.

10.3.2.5 Traffic Management

During the pre-development and development phase of the project, the major traffic is due to the transportation of excavated rocks/debris from the hill cutting, construction raw materials and construction debris. However, there are no major residential areas near the immediate vicinity of the project site. A construction vehicle traffic circulation and management plan has been conceived for safe movement of transportation vehicles. Following measures are adopted on project site for traffic management:

- Movement of the construction vehicles shall be in accordance with the transport circulation and management plan of NMIA.
- Moderate vehicle speeds maintained to avoid any nuisance to the nearby residents.
- Proper barricade and signage made along the transportation route to avoid any accidents.
- Adequate parking facility will be provided.
- Adequate washing facility provided for vehicles within the project site.
- Periodical maintenance of vehicles carried out so that source noise levels are under control; and
- All the vehicles to be environmentally compliant with PUC certificates.

10.3.2.6 Infrastructure Facilities

Necessary infrastructure facilities will be made available for the construction workers and the following measures will be taken up:

- Adequate security arrangement made to ensure that the project authorities will provide necessary security to work force.
- At workplace, first aid facilities maintained at a readily accessible place where necessary appliances including sterilized cotton wool etc. will be available.
- Signage board provided for depicting safety measures.
- Ambulance facilities kept readily available at workplace to take injured person to the nearest hospital.
- Emergency preparedness plan drawn-up, considering likely emergencies and steps required to prevent/limit consequences.
- Proper fire-fighting facilities maintained at the sight; and
- Employees and migrant labour health check-ups conducted at the project site.

10.3.2.7 Environment Management Strategy

NMIAL shall incorporate comprehensive environmental management and pollution control strategies in airport design, development, and operations. This will not only meet the regulatory compliance requirements but will also conform to the highest standards of sustainable practices, energy, and environmental conservation. Environmental action plan will be formulated keeping in view the EMP and conditions prescribed in the Environment Clearance, Consent to Establish and other approvals given by Environmental Regulatory Authorities.

The environment management, strategy, and its implementation by respective stakeholder of the project development & operation phase is presented in **Table-10.5** below:

TABLE-10.5
ENVIRONMENT MANAGEMENT STRATEGY, OBJECTIVES AND ITS IMPLEMENTATION DEVELOPMENT / OPERATION PHASE

<table>
<tr><th>Sr No</th><th>Environment Policy</th><th>Management Strategy and Objectives</th><th>Measures/ SOP
(Development Phase)</th><th>Measures/ SOP
(Operation Phase)</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Communicate its Environment Policy to all persons working for or on behalf of the organization and make it available to public</td><td rowspan="2">COMMUNICATION MANAGEMENT:

Fostering knowledge & awareness of Environment Policy and Environmental Information to airport staff, stakeholders, EPC contractors/ sub-contractors and surrounding society/ public</td><td colspan="2">Training
1) Corporate induction program for employees.
2) Tailor made training program for stakeholder /contractors’ staff relevant to their role and responsibilities; and
3) Environmental Policy on Intranet and website.</td></tr>
<tr><td colspan="2">Awareness
1) Awareness in the form of celebration of environmental events, exhibitions, and distribution publicity materials; and
2) Environment Policy and Awareness reports on website.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Identify and mitigate environmental impacts associated with airport activities</td><td rowspan="2">AIR QUALITY

1) Minimise air emissions from ground activities.

2) Comply with Standards prescribed in approvals, State and MOEF&CC laws & guidelines and other related laws.</td><td colspan="2">1) Monitoring of Ambient air quality and fugitive dust emissions at workplace.
2) Permitting vehicles with valid PUC Certificates at site.
3) Adequate stack height of DG Sets as per norms.
4) Ensuring use of PPE.</td></tr>
<tr><td>5) SOP for stone crusher's & blasting dust management - Mitigate by fogging, sprinklers, suction hoods, rising dust arrest curtains / barriers etc.
6)During transportation of construction materials properly covered by tarpaulin sheets.

7)No burning of any materials in open spaces.</td><td>5) Single engine taxing and reduced taxing would be effective in reducing emissions from aircrafts.

6)Proper vehicles/car parking facilities and traffic flow to avoid traffic congestion.

7) Online monitoring of Ambient Air Quality (AAQ) at site and monthly monitoring surrounding area including landing-take-of funnel zone to be carried as per rules.</td></tr>
</table>

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
			8)Labour camps to be provided clean fuel (LPG) for cooking. 9)Dust suppression on access road and NMIAL, EPC Contractor/ Sub-Contractors internal roads and wheel wash facility at strategic points including workshop/s. 10)Fact sheets on quantification of water use for dust suppression to be maintained and submitted. 11)Monthly monitoring of ambient air quality (AAQ) to be carried as per rules; 12)Implementation of traffic management plan incorporating movement of construction vehicles/ heavy machinery, road safety and maintenance schedule of vehicles. 13)Earth moving and/or excavation works not to be carried out high wind events; and	8)Implementation of airside traffic management plan incorporating movement of buses/ cars, road safety and maintenance schedule of airside vehicles.
		WATER QUALITY 1) Comply with parameters prescribed by State & Central authorities for surface & ground water and treated wastewater. 2) Achieving Zero Discharge concept by maximum use within airport.	1) Water to be used efficiently, and work should be planned to minimise generation of wastewater on site. 2) If wastewater cannot be reused on-site, to be disposed-off in accordance with regulatory requirements. 3) A proactive groundwater monitoring program is being implemented to ensure ground water quality is not polluted in the vicinity of surrounding villages due to project activities. 4) Monthly monitoring of surface/ ground water and treated sewage water quality to be carried as per rules;	
			5) Use of treated wastewater for flushing, dust separation and plantation.	5) Collection of wastewaters from Airliners, workshops & canteen, and treatment in the STPs of the Airport.

<table>
<tr><th>Sr No</th><th>Environment Policy</th><th>Management Strategy and Objectives</th><th>Measures/ SOP (Development Phase)</th><th>Measures/ SOP (Operation Phase)</th></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td></td><td>6) Storm water must be diverted from work areas to prevent sedimentation and pollution and disposed of as per laws.

7) Fact sheets on quantification of water use for dust suppression, plantation, flushing/ washing etc. to maintained and submitted.

8) Run-off from fuelling area, internal roads, vehicle parking areas, etc. will be passed through silt pits & oil interceptor.</td><td>6) Water conserving fixtures to be installed to minimise generation of wastewater from the sources.

7) Fact sheets on quantification of generated water use from Airliners & other sources and sent for treatment to be maintained and submitted.

8) Run-off from fuelling area, internal roads, vehicle parking areas, etc. will be passed through oil interceptor before treatment/disposal as per rules.</td></tr>
<tr><td rowspan="2">NOISE LEVEL MANAGEMENT

1) To minimise the impact of noise levels and avoid nuisance to surrounding area.

2) To comply with standards prescribed in approvals.</td><td colspan="2">1) Works /activities having potential to generate significant levels of noise to be planned and undertaken during standard working hours.

2) Distances to be maximised between locations of high noise generating works and if possible, to reduce noise impacts by applying preventive measures.

3) Vehicles movements-speed limits on all access roads and tracks to be adhered to.

4) DG sets with acoustic enclosures;</td></tr>
<tr><td>5) Use of PPE at blasting, cutting, and drilling areas and other construction sites.

6) Screens, enclosures, barriers, exhaust silencers/ mufflers for vehicles are to be installed for noise control; and

7) All plants, equipment's and vehicles must be turned off when not in use.</td><td>6)Distances to be maximised between locations of high noise generating works and if possible, to reduce noise impacts by applying preventive measures.

7)Vehicles Movements-Speed limits on all access roads and tracks to be adhered to.

8) Terminal Buildings will be made soundproof.

9) Use of PPE for ground workers would be using ear protective devices and there would be rotation of workers;</td></tr>
</table>

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
		SOIL MANAGEMENT Prevent soil pollution from developmental activities & reuse of excavated soil at site.	1) Proactive quarterly monitoring of soil quality is being carried out to prevent soil pollution.	
			2) Excavation must be carried out in a way which keeps topsoil and underlying soils, if any, separate to prevent the potential contamination of subsoils. 3) Reduce the volume of waste spoil generated from earthworks if practicable. 4) The number and size of stockpiles must be minimised as far as possible; 5) Sediment retention structures must be placed downslope of stockpile. 6) Earthwork and ground disturbing activities must be planned and staged to reduce the duration and extent of exposed soils. 7) All sediment control measures must be maintained for the duration of activity; 8)Storm water pits along established roadways subject to sediment deposits must be fitted with appropriate sediment controls. 9) Silt loads must be treated (trapping/ desilting and reuse of silt) as close to their source as possible. 10) Stormwater must be diverted around work areas to prevent sedimentation and pollution. 11) Proactive quarterly monitoring of soil	-

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
			quality is being carried out to prevent soil pollution.	
		SOLID WASTE MANAGEMENT: MUNICIPAL WASTE 1)To carry out the management of waste in accordance with regulatory requirements of SWM Rules, 2016. 2)To promote sustainable management of resources. 3)To reduce waste disposed of to landfill. 4) To optimise the use of sustainable materials. 5)To reduce contamination of waste to reuse/ recycling.	1)Collection & segregation of solid waste generated from offices, workshops, labour camps, canteens etc. and prioritisation of waste hierarchy- avoidance Reduction, Reuse, Recycling and Disposal. 2) Disposal of segregated waste to MSW site and authorized recyclers / vendors. 3)Designated waste management areas to be established for sorting of wastes and storage into designated containers. 4) Waste bins must contain labels which are large, clearly visible and in good condition. 5)Waste collection is to be carefully planned to avoid the attraction of animals and birds. 6) To comply with the guidelines of Solid Waste Management (SWM) Rules, 2016.	
			7)All remaining waste like metal, paper, plastic wastes, debris, and cuttings shall be collected from the site as soon as particular construction activity is over.	7) All cleaning waste must be removed off an aircraft in a suitable, sealed container / garbage bag and moved waste handling area of NMIA site. 8) All metal, paper, plastic wastes, debris, and cuttings shall be collected from the site as soon as particular activity is over. 9) No waste to be placed in any waste bin on the fire station apron or anywhere on the movement area. 10) Bio-degradable waste will be treated at Bio conversant plant planned at NMIA & manure will be used for landscaping
		CONSTRUCTION & DEMOLITION WASTE MANAGEMENT	1) It is to be ensured that a minimum of 50%-80% (Minimum benchmark set for initial phase) of construction waste will be reused or recycled at site	Not Applicable

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
		1) To promote integrated approach for reuse of construction and demolition waste for reduction of environmental impact on natural resources. 2) To carry out the management of waste in accordance with regulatory requirements.	2) Waste disposal report to be generated and submitted indicating: - Identify each waste stream produced; - The quantities of each waste stream disposed of; and - The quantities of each waste stream recycled. 3)C&D waste will be managed inline to C&D waste rules 2016.	
		Bio-medical Waste Management	1)Medical waste from the medical room and ambulances to be collected. 2) Fact sheets of bio-medical waste generated to be maintained by NMIAL 3) Bio-Medical wastes will be handled and disposed as per the Bio-medical waste handling and disposal Rules 2016 of CPCB.	

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
		HAZARDOUS WASTE MANAGEMENT (HWM) 1) To carry out the management of waste as per regulatory requirements and also fulfil requirement for storage & handing of fuels and chemicals. 2)To promote sustainable management of resources. 3) To reduce waste disposed of to HW landfill. 4)To reduce the level of contamination in waste for reuse/ recycling. 5) To prevent and minimise environmental impacts due to spills event and fire. 6) To reduce the use of hazardous substances for minimise generation of HW. 7) Periodical review and update of HW disposal system.	1) Fact sheets of hazardous materials and waste generated to be maintained by EPC contractor / contractors as per Hazardous Waste Rules, 2016. 2) Reduction in hazardous materials use and hazardous waste generation. 3) Storage of hazardous materials (diesel, used oil, paint waste, concrete additives, contaminated soil, adhesives, varnish, solvents, fluorescent light tube, lead acid battery, synthetic mineral fibres (SMF) etc.) & wastes at secured designated impervious hard stand sites to prevent fire and spill hazards. 4) All such designated such sites must be located at reasonable distance of sensitive areas such as water bodies and Terminals. 5) Solid and liquid HW to be segregated from general waste and disposed of as per rule. 6) Implement best-practice for prevention and management of hazardous materials; and 7) Spill kits and fire prevention equipment's to be readily available and relevant personnel trained in their use. 8) All hazardous waste generated should be managed in line to HWM rules 2016, & its amendments.	
				9) Empty Extinguishing Media containers discarded tools and equipment, Discarded PPE, Discarded Vehicle parts, batteries, and tyres etc to be collected Fire Station and ATC Complex.
		E-WASTE MANAGEMENT 1) To carry out the management of e-waste in accordance with regulatory requirements.	1) All E waste generated, should be managed inline to EWM rules 2016 and Fact sheets of e-waste materials and e-waste generated to be maintained by EPC contractor/ contractors. 2) Designated e-waste management areas to be established for sorting of e-wastes and storage into designated containers. 3) Collection and transportation off-site to authorised recycling facility or vendor/s.	

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
		2) To promote Reduce, Recycle and Reuse through adequate environment management plan.	4) All E waste generated should be managed inline to EWM rules 2016, & its amendments.	
3	Ensure compliance with applicable environmental laws and regulations, and adopt best practices	**COMPLIANCE MANAGEMENT** 1) To comply with regulatory requirements for meeting environmental standards, 2) Submission of Compliance and analytical reports to statutory agencies as per schedule. 3) Set minimum limit of environmental standards as benchmark.	1)Toolbox talks, pre-start meetings and targeted training will be provided to site personnel, contractor/ sub-contractors as required. 2) Monthly monitoring reports for air, soil, noise, ground & surface water to be prepared by contractor, sub-contractors and NMIAL. 3)Environment team, Contractors / sub-contractors will ensure periodic monitoring and compliance of standards as per schedule and submit report to NMIAL. 4)NMIAL Environment & SD team will undertake site inspections and evaluate the effectiveness of mitigation measures described in the EMP and, if warranted, modify the measures. 5) Proactive approach for monitoring of surface & ground water, soil quality is being initiated to ensure contamination of natural resources of surrounding.	

<table>
<tr><th>Sr No</th><th>Environment Policy</th><th>Management Strategy and Objectives</th><th>Measures/ SOP
(Development Phase)</th><th>Measures/ SOP
(Operation Phase)</th></tr>
<tr><td>4</td><td>Prepare, Issue, communicate and implement an Environment Management Plan and identify to the airport community on opportunities for improvement</td><td>EMP IMPLEMENTATION

1) Ensuring compliance with applicable environmental legislative requirements.

2) Identification of non-conformances of mitigative measures and management plans, its recording and feedback for improvement

3) Identification of airport community (stakeholders, contractors / sub-contractors) to keep abreast of best environmental management practices and emerging technology used in the field.</td><td colspan="2">1)Communicate with personnel and contractors regarding site specific environmental issues, its implementation and compliance with the EMP;

2)New actions required to address potential environmental issues associated with implementation of the master plan if any;

3) Environmental awareness and training to all staff regarding Environmental Policy.

4) Interaction with stakeholder for awareness environment & policies/ guidelines pertaining to environment.

5)Ensure that staff and stakeholders attend customised environmental training/ workshops/ seminars relevant to their role and responsibilities in implementing EMP.

6)Ensure that sufficient information about environmental risk is provided to relevant personnel.

7) An assessment of reports for environmental impacts periodically including methods/procedures/mitigation measures used to minimise impacts.

8) Identification of additional measures required, if any.</td></tr>
<tr><td>5</td><td>Regularly monitor and report on environmental performance</td><td>ENVIRONMENTAL PERFORMANCE

1) To comply with regulatory requirements for meeting environmental standards,</td><td colspan="2">1) Maintaining monthly monitoring reports and annuals returns as per environmental laws;

2) Display monitoring results at strategic location;

3) Assessment & evaluation of environmental performance against set benchmarks for improvements.</td></tr>
</table>

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
		submission of analytical reports to statutory agencies as per approvals; 2) Proactive participation of every employees, stakeholders in monitoring program/plan as per role and responsibilities; 3) Setting-up of benchmarks for environmental performance	4) Monitoring of air, water, noise, soil and marine quality, hazardous waste, construction & demolition waste, and other solid waste as per monitoring plans.	4) Monitoring of air, water, noise, soil, and marine quality, HW, C&D waste and other solid waste as per monitoring plans.
6	Integrate environmental considerations into processes, decision making, and work practices related to planning, design, construction, maintenance and operation of airport facilities and services as part of the Environment Management Plan	**DVELOPMENTAL MANAGEMENT** Optimization of money, time, and quality for completion of development / construction phase	1) Integration of concept of green building features for climate resilient development; 2) Communication of issues to concern for improvement.	
7	Make sincere efforts to prevent pollution and minimize release of pollutants into air, water, marine water, and ground	**ENVIRONMENT IMPACT MANAGEMENT** 1) Strict adherence to environmental guidelines and standards. 2) Proactive incentives & punitive actions on environmental performance	1) SOP for monitoring, implementation of preventive measures for air, water, soil, noise levels, groundwater, marine water and surface water and waste management to and minimise pollution to be followed by EPC & other stakeholders. 2)SOP for employees of NMIAL & stakeholders with punitive actions and proactive rewards. 3) A proactive groundwater and marine/surface monitoring program are being implemented to ensure ground water quality is not polluted in the vicinity of surrounding villages due to project activities.	
8	Monitor noise levels within airport and in surrounding areas	**NOISE LEVEL MONITORING**	1) Works /activities having potential to generate significant levels of noise to be planned and undertaken during standard working hours;	

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
		1) To minimise the impact of noise emissions and avoid nuisance to surrounding area. 2) To comply with standards prescribed in approvals	2)Distances to be maximised between locations of noise generating works, if possible, to reduce noise impacts. 3)Vehicles movements - speed limits on all access roads and tracks to be adhered to 4)DG Sets with acoustic enclosures. 5) Screens, enclosures, barriers, exhaust silencers/ mufflers for vehicles are to be installed for noise control; 6)All plant, equipment and vehicles must be turned-off when not in use; 7) Monthly monitoring of noise levels within airport in surrounding areas as per law and submission of reports.	
			8) Use of PPE at blasting, cutting, and drilling areas and other construction sites;	8) Noise monitoring of Aircraft will be monitored as per DGCA CAR Guidelines
9	Minimize consumption of non- renewable energy and enhance usage of renewable energy	**RENEWABLE ENERGY** 1) Installation of alternative source energy 2) Efficient use of energy	1) Solar panel / windmills (small rotating types) may be used; 2) Common open areas will be installed with solar lamps; 3) Detail list of do's & don'ts shall be practiced in day to day working for energy saving. 4) Airport buildings will be designed and constructed as Green Buildings and will be compliant to ECBC guidelines of 2017. 5) Benchmark for energy consumptions to be set-up for improvements	
10	Assist NMIAL staff and stakeholders to accept responsibility for their actions, and to comply with their environmental obligations through promotion of this policy	**EMP COMPLIANCE** 1) By monitoring and complying with all applicable environmental laws, policies and standards and, where possible, exceeding the requirements imposed by them.	1)Toolbox talks, pre-start meetings and targeted training to site personnel for environment management. 2)Communicate with personnel and contractors regarding site specific environmental issues and compliance with the EMP. 3)Ensure that staff and stakeholders attend customised environmental training/ workshops/ seminars relevant to their role and responsibilities in implementing EMP.	

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
	and implementation of Environment Management Plan	2) Ensuring compliance with applicable environmental legislative requirements; 3) Coordinate the implementation of environmental management measures during work; 4) Ensure non-conformances are identified, recorded and reported.	4)SOP will be drawn for any additional or new activities and the associated risk, impact and environmental procedures that have been established, or are required; and 5) An assessment of the environmental impacts and of the methods/procedures/mitigation measures used to minimise these environmental impacts. 6)Identification of additional measures required.	
11	Develop Environment Management System assigning responsibilities within the organization for monitoring environmental performance	**ENVIRONMENT MANAGEMENT SYSTEMS** 1) The EMS provides system for the management of environmental impacts within airport site & its surrounding. It includes requirements for implementation, monitoring and review, and ensuring a cycle of continuous improvement of environmental performance.	1)Monitor those appropriate resources and expertise are devoted to the safety, security, and environment functions. 2) SOP for reporting environmental incidents and emergency events 3) Guidelines indicating do's & don'ts are in place which are to be followed at site during development work;	3) Guidelines indicating do & don'ts are in place which are to be followed at site during development work and operational phase. 4) A Safety Management System (SMS) must be drawn-up and submitted to NMIAL airside services.
12	Be sensitive to the expectations of our partners, stakeholders and the community regarding environment aspects related to this airport.	**Airport Community- Env Expectations/ Environment Sustainability** 1)Develop understanding & partnerships with partners and stakeholders to achieve Environmental sustainability 2) Develop stakeholders & community partnerships that	1) Environmental awareness and interaction with NMIAL partners, stakeholders regarding environmental aspects and achievements. 2)Regular communication (meetings/ workshop/ customised training etc.) with stakeholders & other partners, contractors & sub-contractors to address site specific environmental issues.	2) Airport terminal buildings will be designed and constructed as Green Buildings and will be compliant to ECBC guidelines of 2017. 3) Use of energy efficient building material & glass. 4) Use of LED lamps.

Sr No	Environment Policy	Management Strategy and Objectives	Measures/ SOP (Development Phase)	Measures/ SOP (Operation Phase)
		deliver improvements to our local environment.		5) Use of solar power to the extent possible.
13	Take social initiatives for welfare of local community, promote co-operation with local authorities and community around the airport.	**CORPORATE SOCIAL RESPONSIBILITY** Developing and maintaining strong links with local community and all key stakeholders for need based welfare activities in a continuous responsible manner.	Activities such as cleanliness, skill development, training PAP, health & education etc., are required under CSR. These will be implemented as per the CSR policy of NMIAL.	SOP for CSR will be prepared addressing the skill development, training, PAP, health & education.

10.3.3 Operation Phase Environment Management Plan

During operation phase, the impacts on the various environmental attributes should be mitigated using appropriate pollution control and management measures. The Environment Management Plan prepared for the proposed project aims at minimizing the pollution at source.

10.3.3.1 Land Management

- Geologically, the project area lies in Deccan trap composed of hard massive basalt rock and will not initiate any instability problems – landslide/subsidence etc. This region is very stable portion of peninsular shield. Hence, the operation will not have any impact with regard to the stability of the structure.

- Based on the recommendation of CWPRS report, Master drainage plan of airport and surrounding area has been prepared including the issue of management of run-off and associated risks and accordingly the grading concept and drainage network will be designed to reduce the inundation risk within the airport.

- As per the study carried out by CWPRS, reclamation for development of International Airport at Ulwe on left bank of Panvel Creek along with other CIDCO development indicate marginal rise in the water levels in the Panvel creek reach along the proposed airport boundary. Along the Ulwe creek however, the rise in the water levels will be slightly over 1.2 m due to recourse channel along the longer route with flatter slope. The safe-grade elevation for the proposed international airport complex comprising airstrips, ATC tower building, and all other important structures may be kept at RL 8.0 to 8.5 m. The remaining area could be reclaimed by filling in slope or by terracing with levels varying from RL 8.5 to 6.5 m;

- Proper guidelines with respect to handling the waste generated from any untoward accidents of spillage of fuel or oil would be developed. This would include procedures for excavating the contaminated site and disposal to an authorized secured hazardous waste landfill.

- The entire region surrounding the project area being a part of the Mumbai Metropolitan Region is already undergoing a rapid development and to a great extent agricultural lands are getting converted into sites for residential purpose. Also, the whole area surrounding the project area does exclusively rain-fed agriculture and grows only paddy. At most places during the non-monsoon period wild growth of grasses is observed. The fact that agriculture is not very productive/ profitable in the project and surrounding area is evident from the fact that the surface soil is being stripped off for brick making.

- The airport area and its surrounding land is managed by CIDCO as per NMDP land use notification to avoid unauthorized encroachment and unplanned development within the influence area of the airport to match the carrying capacity and consolidated urbanization within the airport influence area.

- A traffic de-congestion and management plan is drawn for NMIA through upgradation of major intersections connecting the airport through introduction of traffic actuated signal systems and grade separations as per requirement to avoid congestion and significantly reduce traffic levels while maintaining a minimum Level of Service - B benchmark in road traffic.

10.3.3.2 Air Pollution Management

The air pollution generating sources during the operation phase include aircrafts emissions, emissions from Auxiliary Power Units (APU), Ground Support Equipment (GSE), Ground Access Vehicles (GAV), emissions due to the passenger transport and emissions from the diesel generator sets. The following control measures will be followed to reduce the air emissions:

- Aircrafts will be operated in accordance with ICAO/USEPA standards to ensure aircraft emissions are within specified standards.

- Furthermore, DGCA through its circular 3 & 4 of 2003 has laid down guidelines for measurement and monitoring at airports, including noise mapping, validation, action plan, noise reporting, carbon emissions, and local air quality monitoring. Aviation noise limits have also been proposed by DGCA.

- DG sets with proper acoustic enclosures and complying with the standards would only be used.

- Periodic monitoring of DG set emissions will be carried out and to be serviced regularly.

- Vehicles moving within the airport will be maintained and emission checks will be carried out on regular interval.

- The vehicles moving within the airport premises (both land side and airside) will be environmentally complaint and will be certified with Pollution Under Control (PUC) checks at regular intervals.

- Continuous ambient air quality monitoring system will be installed for monitoring the ambient air quality of the region, if required and to check the effectiveness of the EMP followed at airport.

- All the transport corridors leading to airport namely NH-4, NH-4B, Aamra Marg and Sion Panvel Highway have sufficient right of way to absorb the increase in traffic by widening the roads as and when required.

- Vehicles that come to the site will be restricted (mandatory) by emission-controlled certification and efficient engine conditions (Bharat VI).

- The contribution from idling of engine at the signals would be minimized by providing wider roads and bridges (including over bridge) that connects to NMIA.

- Appropriate design of access roads to avoid traffic jams to reduce air pollution.

- Providing suitable green belt/green cover to reduce the impact of air pollution.
- Appropriate dust suppression measures will be implemented within the project site during controlled blasting, construction, material handling and transportation. The prospective contractors shall make provision for water sprinkling at the construction site.
- Hi-tech equipment will be used for controlled blasting excavation and hauling of materials which will generate minimal noise as well as dust. This aspect will be covered as part of tender conditions.
- Machinery and equipment will be maintained in good working condition and construction materials and machineries will be handled with due precautions. All vehicles and construction equipment with internal combustion engines in use will be maintained for effective combustion to reduce carbon particles, CO, and HC emissions.
- Air and noise mitigation options will be implemented by defining the approach landing and take-off procedures in a manner to minimize impact. Accordingly, SID & STAR to minimize the impact in the funnel during operation of airport.
- Aerobridges would be used for passenger transportation at NMIA and hence a very minimal amount of emissions are also likely to occur from the service vehicles operating inside the airport; and
- The service vehicle numbers, and duration of operation would be significantly low for passenger transport. Present day battery/electrically charged vehicles would be used by airport operators for ground service equipment and cargo so that air quality levels are maintained within the permissible limits.

10.3.3.4 Traffic Management

The land side traffic assessment of NMIA is integrated with air traffic demand and transport network development plans as per the comprehensive transport study (study conducted by MMRDA) of MMR. A detailed traffic management and traffic decongestion plan was drawn-up for NMIA considering the ingress and egress of traffic and its growth in 5 km radius of the airport boundary. The weighted volume/capacity ratio of the major road corridors connecting NMIA are predicted based on the modelling of road traffic data and the level of service is assessed for understanding the extent of traffic congestion within 5 km radius of the airport site.

Based on the detailed traffic study, it is determined through predictive modelling that, the NMIA, weighted V/C ratio assessed for the base year 2017 is 0.33 (LOS B) and for the horizon period up to 2041 would vary from 0.10 to 0.22 (LOS B) which is very good. In the NMIA delineated area, the major roads have seen good volumes from the internal trips of MMR which was not the case in the base year 2017, where most of the road-based trips were the external good being attracted by JNP. The new attractions like the proposed Navi Mumbai Integrated Industrial Area (NMIIA), JNP-Special Economic Zone, Kharghar Corporate Park, and the Airport itself have made more trips being attracted within the delineated study area. Looking at the level of service offered by the major roads in the NMIA delineated study area, the weighted V/C suggests an average of LOS B i.e., such flows and congestion levels on the urban roads are good and the same should be maintained for the future to serve the region much better in terms of service quality.

Some of the action points for consideration of CIDCO and GoM for their consideration as identified for better management of traffic and reduce traffic congestion to the extent possible are given below:

1. High Level Committee (Task Force) is already set-up by GOM under the chairmanship of Chief Secretary for implementation of the proposed connectivity to NMIA.

2. Intensive coordination with NHAI/ Mumbai JNPT Port Road Company Limited (MJPRCL)/ MSRDC, MMRDA & CIDCO for timely completion of works under planning and implementation stage.

3. Coordination with NMMC, PCMC, PWD, NHAI, CIDCO, traffic police etc. for timely implementation of intersection improvements, traffic signal installation, grade separated facilities, enforcement etc. as proposed in the study under local transport connectivity plan.

4. Coordination with MSRDC for implementation of 3rd Thane creek bridge.

5. Coordination with NMMC, PCMC, PWD, NHAI, CIDCO etc. for carrying out further Detailed Feasibility Study/ Detailed Project Report as appropriate for the proposed widening of existing roads and development of new/ missing links within the 5 km delineated area as proposed in the study under local transport connectivity plan.

6. Prepare Detailed Feasibility Study/ Detailed Project Report as appropriate for the additional road corridor parallel to Palm Beach Marg (Coastal Road or elevated road on creek side or elevated road along the median) in coordination with NMMC, MMRDA, NMIAL, etc.

7. Initiate dialogue with NMMT, BEST, TMT, KDMT, VVMT, PCMT, MSRTC etc. when implementation of NMIA reaches to near completion, for operation of bus routes providing connectivity to NMIA from various parts of MMR.

8. Initiate dialogue with NMMC for operation of bus feeder services between NMIA and nearby suburban railway stations (Khandeshwar, Kharghar, Panvel, Targhar, etc.).

9. Expedite execution of Navi Mumbai Metro (CIDCO).

10. Coordination with MRVC/IR and MMRDA for implementation of CSMT-Panvel fast sub-urban rail corridor along harbour line, sub-urban rail operations on Vasai-Diva and Diva-Panvel sections and doubling of Tracks on Panvel-Karjat for running sub-urban operations (CTS for MMR Updation Study Proposal).

11. Coordination with MMRDA for integrated design of metro corridors M3: Colaba-Bandra-SEEPZ, M19: Prabhadevi-Sewri-Jambulpada and M20: MTHL spur to NMIA to facilitate operation of metro services from Colaba to NMIA and vice versa.

12. Prepare corridor development plans of green corridors, as feasible, for all the identified local connectivity and some regional corridors and then preparing DPRs for implementation, to enhance the image of MMR and NMIA.

13. MMRDA to take-up responsibility for development of Regional Truck Terminal as per CTS for MMR Updating Study.

14. Prepare Detailed Feasibility Study/ Detailed Project Report as appropriate for implementation of regional Passenger Water Transport (PWT) routes providing connectivity from Island city, Thane, Kalyan-Dombivali, etc. to NMIA in coordination with MSRDC, Mumbai Port Trust (MbPT), Maharashtra Maritime Board (MMB), MMRDA, etc.

15. Involvement of Navi Mumbai Traffic Police at all stages i.e., from planning stage to execution stage for effective coordination.

16. Secure encroachment removal along major transportation corridors and restore capacities to move people and vehicles safely and effectively.

17. Implement measures to protect long term transportation corridors (protection of Right of Way).

18. Development of land parcels around the NMIA periphery will have to be strictly controlled to avoid unauthorized occupation or wrongful land use that may cause congestion and obstruction in construction of approach roads towards the NMIA.

19. Land required to develop the proposed interchanges (especially under local connectivity) need to be blocked for future use.

20. Implement policies to promote Transit Oriented Development; and

21. As the NMIA project nears completion, coordinate with Mumbai Railway Vikas Corporation (MRVC)/ Indian Railways (IR) for increasing the frequency of sub-urban trains and operation of 12 coach rakes on CSMT-Panvel line and Seawoods-Uran line of harbour line.

NMIA Parking Demand and Management

Parking demand for passengers, taxi staging and employees is estimated at each of the passenger terminals of NMIA for each phase of the airport operations. The parking requirement for each of the terminals for all phases and at remote parking areas and Multi-Level Car Parks (MLCPs) are planned 100 m away from Terminal facades. Separate parking areas is proposed for short, long term private parking and taxi staging.

10.3.3.5 Water Pollution Management

The airport operation will generate sewage from various airport facilities such as terminals, facility buildings, cargo, etc. The effluent laden with oil and grease is envisaged from the GSE area, cargo, hangars, aircraft maintenance, etc. The following control measures will be followed to maintain a proper wastewater management system:

- Two main STPs (During Phase-I & II: 1.0 MLD on eastern side and 4.5 MLD in the west; During Final Phase – 2.5 MLD in the east and 11.00 MLD in the west) will be installed on the project site in the western and eastern side of the airport to treat the wastewater.
- In Phase-III & IV, a third STP is planned in the north with a capacity of 0.75 MLD.
- The total sewage generation for the project will be 13.3 MLD. This will be treated in Advanced Sequential Batch Reactor (SBR) technology with DMF, and Ultra-filtration followed with RO based STPs in the respective areas. The treated sewage water will be re-used for flushing, HVAC, irrigation of horticulture, washing of floors, spraying water on the road, etc. The possibility of new technologies will also be explored in future phases for better management practices.
- Odour, reported if any from STP areas shall be managed as per Guidelines on Odour Monitoring & Management Rules by CPCB, May 2008.
- Treated water will be reused for green belt development, cooling system, flushing and floor washing to reduce the freshwater resource requirement.
- The possibilities of new technologies will also be explored in future phases for better management practices.
- The treated water will be utilized within the project premises to the maximum extent and will not be discharged outside the airport boundary.
- The effluent wastewater envisaged from GSE area, cargo, hangars, aircraft maintenance hangers, Fuel Farm will be passed through oil and grease interceptors and then routed to STP.
- Settling tanks, blow down tanks and neutralization pits will be cleaned regularly to avoid clogging.
- In addition to the above control measures, the following water conservation measures will be adopted within the airport premises:
- Use of low flow fixtures and appliances for reduced water consumption such as low flush water closets and cisterns.
- Water saving shower head flow controls, spray taps and faucet aerators and photo-sensitive taps.

- The storm water from paved areas will be routed to the water harvesting structures to recharge the ground water table.
- The storm water from the previous area will also be routed to the rainwater harvesting structures.
- The storm water treatment facility will be located at an appropriate site keeping in view the slope contours and collection point at the most convenient point.
- The storm water in rainy season will be harvested to maximum extent possible to reduce the water requirement.
- Dry cleaning process in workshop and maintenance area to clean the oil spillages.
- Smart irrigation system that uses daily, weather data, slope, soil types, planting coefficients, and precipitation and infiltration rates to calculate actual water requirements on a daily basis.
- Water will be supplied through closed conduits only; and
- Creating awareness among the employees on water conservation.

<u>Storm Water Management</u>

The storm water drainage strategy covers safety from flooding, compliance to EC (2010) conditions and CWPRS guidelines, cost effective and efficient drainage system. This includes to integrate rainwater harvesting system also. The proposed storm water system will follow the principle of south to north, and south to north-east for transfer of storm water. The storm water will not be allowed to reach the Ulwe Recourse Channel as per the EC (2010) condition.

<u>Water Conservation Measures: Rainwater Harvesting</u>

A rainwater harvesting pond is proposed along the main drain alignment path within W1 catchment, near the outfall within airside boundary at NW corner. The area of proposed rainwater harvesting pond is 21,960 sqm and depth 2.5 m below invert level and volume of pond is 29,747 cum. Weir is proposed at the pond outfall location to avert saltwater intrusion into the pond. Stored water will be used for landscape irrigation purposes. Shallow water bodies have been identified on either side of WMAR road landscape area.

10.3.3.6 Noise Pollution Management

❖ Control on the vehicular noise level – speed and vehicle conditions would be done by:

  - Identification of structures and population vulnerable to noise level increase and remedial measures such sound proofing.
  - Tree corridor and sound barrier at the NMIA boundary in containing noise level.

- Observation of no horn zone in NMIA premises; and
- Battery operated service vehicles within the airport.

❖ Control on the aircraft noise level would be done by:

- Insistence of International code on noise level during take-off and taxing by the aircraft operators.
- Noise level contouring and identification of areas in the take-off and landing sections.
- Discussion with people concerned over the runway operation and noise level reduction and execution of mandatory activities of DGCA and ICAO.

❖ Based on the community consensus and noise studies an implementation plan based on noise abatement plan and noise compatibility plan may be established to comply with permissible level of noise as per the noise sensitivity zones as per FAA, LUG notification.

❖ Standard instrument arrival and departure procedure shall be designed to minimize the noise levels within the permissible limits for the area falling in the funnel near the airport on either side.

❖ The runway pavement shall be designed taking into consideration subsoil condition beneath so as to minimize noise/vibration.

The most effective method of mitigating noise sources - other than cessation of the source activity or use of source controls would include installation of sound barriers or also called noise barrier or sound wall or sound berm or acoustical barrier. Mostly sound barriers are exterior structure designed to protect sensitive land uses from noise pollution. Some of the barrier which may be examined for feasibility of use, are:

❖ Earth berm constructed solely of excess earth from grading pads for a residential development.

❖ An elongated outdoor acoustic barrier erected around the periphery of the airport, for reflecting and absorbing sounds emanating from the airport. The acoustic barrier could be made of a variety of materials like wood, reinforced concrete or plastic materials, or combinations and placed zigzagged serpentine structures and parallel to longitudinal passages. It would have an elliptical cross-section and necessary to have a coating layer of sound absorbing material affixed to at least one face thereof facing the direction of a source of sound to be absorbed. Such a sound barrier must have a noise reduction factor of at least about 0.5, and preferably 0.8-0.85. The Sound absorbing noise barrier wall would be in-accordance with the current AASHTO ‘‘Guide Specifications for Structural Design of Sound Barriers’’. Various standards for sound absorbing characteristics (ASTM-423), sound transmission loss verification (ASTME 90-90), sound absorbing panel requirements (ASTM E- 84) need to be meet.

❖ Ambient noise levels would be closely monitored during operation phase. Adequate measures should be made to reduce ambient air and noise level during construction phase, so as to conform to the stipulated standards by CPCB/ MPCB.

Noise Monitoring System

- The runway end noise levels at both ends of the runway in the funnel zones to be monitored with continuous noise monitoring equipment and it should be connected to the data centre.
- The noise data is used to assess the noise pollution due to aircraft movement as well as the contribution of background noise.
- The system helps to plan and implement the necessary noise abatement procedures and programs to ensure proper noise management.

Noise Abatement Techniques

To control the noise level generated, NMIAL will implement various noise abatement techniques / procedures as briefed below:

- Construction of rapid exit taxiways which reduces taxing time of the aircraft.
- Single engine taxiing.
- Implementation of reverse thrust procedure.
- Continuous Descent Approach (CDA).
- Continuous Climb Operations (CCO).
- Dedicated engine run-up area.
- Fixed electrical ground power & pre-conditioned air at all aerobridges.
- Restriction on use of auxiliary power units; and
- Initiative of silent terminal to reduce indoor noise.

10.3.3.7 Solid Waste Management

During the operational phase, two types of waste would be generated namely the municipal solid waste and the hazardous waste. Solid waste would be generated from the garbage/food waste from the restaurants, airport operations and paper and packaging waste generated in cargo section. The major solid waste contributing facilities include terminals, cargo, and other airport related buildings. The characteristics of the solid waste generated is of typical municipal waste along with hazardous wastes from specific facilities, consisting of plastic, metal, paper, cardboard, pet bottles, used oils and bio-medical waste.

The estimated total municipal waste generation quantity in final phase is estimated to be about 72 TPD while hazardous waste is expected to be generated in the range 2.50 TPD and bio-medical waste in the range of 0.05 TPD in the final phase of the airport.

The hazardous waste that would be generated include the oily sludge generated from STP, separated oil from oily wastewater treatment units and any waste generated due to spill containment in any untoward event. The major solid waste contribution will be from airport passengers, staffs, cargo handling sections, aircraft maintenance, GSE area etc.

Solid Waste Management Methodology

The wastes generated have to be managed after segregation by identifying the appropriate method of management. Recyclable wastes such as paper, glass, metal, plastics (from domestic and commercial activities), wood, waste oil and solvents (from maintenance and engineering operations), kitchen wastes and vegetable oils (from restaurants, food courts etc.) has to be effectively done. The green wastes from landscape / gardens shall be used in bio-conversion processes. The three R's; popularly known method of solid waste management shall be implemented at all users ends irrespective of the activities involved.

The following tasks are considered as part of solid waste management methodology:

- Identification of waste generation sources.
- Waste collection, storage & transportation.
- Waste segregation, handling and processing.
- Waste quantification and characterization; and
- Treatment & disposal of wastes.

The proposed principle of solid waste management is presented in **Table-10.6** below:

TABLE-10.6
PROPOSED PRINCIPLE FOR SOLID WASTE MANAGEMENT

Sr. No.	Waste Type	Collection and Storage	Method of Disposal
1	Bio-degradable waste	Collection and storage in storage yards	Will be sent to the bio-conversion plant proposed at NMIA to form compost which will be used for landscaping at NMIA
2	Reusable, recyclable & hazardous waste	Collection and storage in closed rooms at ambient temperatures	To be taken away by MPCB authorized vendors
3	Non-biodegradable and inert wastes	Collection and storage in closed rooms at ambient temperatures	To be transported to authorized waste disposal site of CIDCO.

The solid waste management plan, which will be followed during the airport operation is listed below:

- The solid waste generated during operation phase will be collected, segregated, dried, transported, disposed, and treated in a scientific manner, considering the integrated approach.
- Wastes will be segregated into bio-degradable and recyclable wastes at the source of generation and stored separately in appropriately designed wastes storage facilities.
- Adequate quantity and sizing of dustbins will be maintained throughout the airport area during the operation stage to receive solid wastes as and when generated.

- The collection bins will be regularly sprayed with disinfectants.
- The solid waste transporting vehicles will be adequately covered to prevent any spillages during transportation.
- The wet waste (bio-degradable) generated within the airport premises will be treated by bio-composting process and the manure thus generated will be used for horticulture within the site.
- Sewage sludge to be generated from the STPs will be dried and used as manure for horticulture purpose.
- Paper and cardboard wastes, plastic wastes, metal wastes and other recyclable wastes from the cargo handling areas will be disposed through authorized recyclers.
- The e-waste will be stored separately in the complex and disposed through authorized recyclers approved by the State/Central Pollution Control Boards or will be disposed back to the manufacturer through buy-back system.
- The sanitary sludge generated from STPs will be used as organic manure.
- Hazardous wastes generated in the complex will be stored in secured place with adequate secondary containment and labelling as per the requirements of HWM Rules.
- Appropriate records of hazardous wastes generation and disposal will be maintained as per the requirements of HWM Rules.
- Fire extinguishers near storage of hazardous wastes will be installed.
- The used oil and oil-contaminated wastes, spent fuels and lubricants will be handed over to authorized recyclers/re-refiners; and
- All stipulated procedures as per the Solid Waste Rules (SWM, 2016) and the Hazardous Waste Handling and Management Rules would be strictly adhered to.
- All hazardous wastes will be managed through Hazardous Waste Rules 2016 and Bio-Medical Waste management Rules 2016 will be implemented for handling and management of bio-medical waste.

E-Waste Management

The e-waste generated at the NMIA will be segregated and disposed-off as per the "Implementation Guidelines for E-Waste (Management) Rules, 2016" of CPCB while adhering to the E-Waste (Management) Amendment Rules, 2018 (MoEF&CC G.S.R. 261(E) dated 22nd March 2018).

Generally, the e-wastes are end of the life electrical and electronic equipment (EEE) are referred in two categories of namely (i) IT and Tele-communication Equipment and (ii) Consumer Electricals and Electronics such as TVs, Washing Machines, Refrigerators Air Conditioners and Fluorescent and other mercury containing lamps are covered under these Rules. The e-waste generated at NMIA will be collected and segregated and handed over to the authorized recyclers.

In addition to the above, e-waste bins will be placed near the passenger commuter areas, office administrative blocks, etc. to encourage segregation of e-waste and disposal in specific e-waste bins only.

- Bio-Medical Waste & Single used Plastic

Bio-medical wastes shall be collected and disposed in accordance with Biomedical Waste (Management and Handling) Rules, 2016. NMIA have banned single use plastic items including disposable cutlery made up of thermocol, Polyethylene terephthalate (PET/ PETE) bottles, plastic bags, straws, bubble wrap etc.

10.3.3.8 Biodiversity & Forest

The alternative mangrove plantation site identified at Waghiwali on north of airport. An area of 245 ha is being developed as Mangrove Park by CIDCO. Similarly, work on 370 ha of land earmarked for green zone for regeneration of mangrove has been completed by CIDCO. Further as per Forest Clearance condition, the area admeasuring 109 ha, is identified at village Kolhekhar in between Jui Creek and Taloja creek. Thus, against loss of 98.13 ha of Mangroves, total 724 ha area is reserved for plantation, protection, and regeneration of mangroves.

Loss of local estuarine biodiversity is a temporary phase during the construction of recourse channels for of Ulwe creek. The channelization activities are being designed to keep the eventual flow characteristics as close to the original natural flow. It is expected that the biodiversity would equilibrate and resettle during the course of time. Existing mangroves at Waghiwali will not only ensure regeneration of mangroves but also regeneration of aquatic flora & fauna associated with mangroves that will add to biodiversity of the region.

To compensate for the loss of vegetation, compensatory vegetation and plantation programme will be undertaken within the airport area. This is the mandatory space required to be kept vacant for safety reasons as well as the space reserved for green belt in the vicinity of airport, respectively. Species selected for plantation programme will be native, fast growing, ornamental and provide shade. The entire plantation undertaken will be non-fruit bearing trees so as to reduce any bird menace during the operation phase.

The study area is rich in diversity of avifauna species. These avifauna are very sensitive to the operational activities of aviation industry. Therefore, monitoring of avifauna species is important for management planning. The diversity status of avifauna monitored regularly will help in formulating the conservation plan of the avifauna species in long run.

There was no wildlife, observed during the field survey. There was no mention of rare or endangered wildlife species in the area in the reports of the State Forest Department. Hence, there will not be any disturbance and displacement of wildlife as a result of project activities.

Bird Management Plan

The NMIA site used to be wetland once upon a time, hence CIDCO had engaged BNHS (Bombay Natural History Society) over a three-year period (from 2012 to 2014) to do baseline survey of avian fauna over different seasons and present their findings in the form of quarterly and summarized annual reports. BNHS (Established in 1883) is one of the oldest scientific organisations in India working for nature conservation with a primary goal to spread awareness about nature through science-based research, conservation advocacy, education, scientific publications, nature tours and other programmes. All their quarterly and annual reports from 2012-2014 are available for review on the CIDCO website.

Further, CIDCO has extended BNHS' engagement by signing a MoU for 10-year period until 2028 to undertake flagging and tagging, identify bird movements and prepare management plan for active management. This period has been chosen in order to ensure that the BNHS remains involved beyond the commencement of airport operations and can advise active management measures during the period. Other premium agencies responsible for infrastructure development (like MCGM and MMRDA) have also signed similar MoUs with BNHS in view of the large-scale developmental projects underway in various parts of the MMRDA area. The project is being monitored at highest level by the Chief Ministers office. BNHS is using PTT technology for the first time in India for Geo-tagging (presently started with 3-4 large species and will be extended further). It is also planned to use Isotope coding to create a database of birds and bird species.

<u>Findings so far:</u>

The airport site was essentially a wetland with creek and mudflats and so it was foraging ground of waders and many migratory birds. The bird species frequenting the most are waders who generally visit the area during Winter (October to May). Flamingos are rarely seen. The movement of birds is seen to be subject to tidal cycle. Birds need roosting and feeding sites for their survival. NMIA site (wetland) was serving as high tide feeding ground whereas, terrestrial vegetation, mangroves within/around site serve as roosting site. There are 3 large sized roosting sites in the eastern coast of Thane creek–2 are in the north-west (along Thane Creek) (TS Chanakya and NRI colony) and 1 to the south-west (near Panje Funde). The overall approach is to conserve the 3 existing roosting sites – this has resulted in cancellation of several prestigious projects like the Golf course on wetland area to the north-west. Initial BNHS studies for movement pattern of the birds, shows criss-cross across the creek (the Eastern seafront). The mudflats to the west at Sewree are active birding sites but will not be affected by aircraft movements since the aircraft during take-off takes a 30-degree angle and will be at more than 6000 ft by the time they are over Sewree. The birds generally fly at heights lower than 5000 ft.

There are other airports around the world where such active Bird Management has been carried out – Pudong airport, Shanghai; Japan and Brisbane have airports in wetlands and are taking such active management measures. BNHS has been strongly recommending removing condition on Mangrove park to the north of the site, at Waghivali island due to concern of it attracting birds.

<u>Recommended Management Measures</u>

CIDCO

- To ensure that there are no garbage dumps in nearby vicinity or in-flight landing/take off path since they attract birds (Note: *CIDCO has planned nearest Solid Waste dumping site at Chal*, *near Taloja, which is about 16 km to the NE of this site*);

- Carefully evaluate bird movement issue in case of developing any ponds in nearby area. (Note: *study in progress by BNHS using Geotagging, PTT labelling etc. over next ten-year period*); and

- Protecting the three roosting sites–*This is being, and shall continue to be ensured at highest level by the State Wildlife Board and by various planning agencies in the region viz CIDCO, MMRDA, MCGM and NMMC).*

NMIAL

- To select green belt species carefully to make the airport site bird unfriendly.

- Use of air guns to scare away birds.

- Due to development at airport site, some roosting and feeding sites are not available. Geography of surrounding area has limited scope from availability of such sites. BNHS has identified few sites like NRI colony and INS Chanakya located towards north of NMIA and Panje, Funde located in south of NMIA. These sites need to be conserved and developed as roosting/feeding site for local avian fauna, in order safeguard operations of NMIA.

- Anticipating bird hazards, fruit bearing species to be avoided in green belt around site.

10.3.3.9 Green Space & Landscape Development

Green Space & Landscape development is an integral part of NMIA Master Plan, which is an important element of its environmental sustainability measure. The total green space area proposed is 384.90 ha, i.e., 33.18 % of airport site area of 1160 ha, including green/open spaces on airside and landside of NMIA. The proposed green spaces shall be developed as per their contextual and functional requirements, and overall environmental and landscape planning approach.

NMIAL has requested the Forest Department, GoM for allotment of approximately 125 acres of land for taking up new plantation. NMIAL with expert agency, Mumbai International Airport Ltd. (MIAL) desires to voluntarily participate and assist Government in implementation of the said "Programme of Afforestation" in the degraded forest land at Village Jite of Alibag division in District Raigad. NMIAL intends to plant about 14,000 trees outside the project site.

The proposed green space & landscape development is planned considering key airport related constraints, such as:

<u>Bird Menace</u>

Trees and shrubs attract insects and birds which are potential threat to aircraft operations within and around airport. This requires careful selection of non-fruit bearing trees to be planted on airport premise, as a part of airport safety measures. The proposed green space & landscape development is planned considering avoiding the bird menace.

Height Restrictions

Development of green areas and planting of trees including their types (height at maturity) is guided by height restrictions as per aviati0n norms of Airport Authority of India & ICAO. Hence any type of vegetation with high trees shall not be developed in vicinity of airport. The proposed Green Space & Landscape development is planned considering this.

Restrictions in Operational Area

As part of airport operational requirements almost 80% of total NMIA land area is defined as airside or operational area where in regular movement of flight movement demands clear and safe area, without any form of vegetation except grass. Otherwise, this may affect the flight operations due to birds attracted by vegetation. The proposed green space & landscape development is planned considering ease of flight operations.

10.3.3.10 Matheran Eco-Sensitive Zone

The Matheran Eco-Sensitive Zone is located at about 9.3 km east of proposed project site. The above site falls in the fringe of landing and take-off funnel of Navi Mumbai International Airport based on its distance from the airport the position of aircraft during take-off/ landing/ missed approach /circling, will be more than 500 m. Standard instrument arrival and departure procedure shall be designed to minimise the noise levels within the permissible limits for the area falling in the funnel near the airport on either side. The matter has been already taken-up with AAI/ DGCA to work out Standard Instrument Departure (SID) & Standard Terminal Arrival Route (STAR) and in line instrument flight rules of AAI/DGCA.

10.3.3.11 Energy Management (Solar, Wind, ECBC Norms)

NMIA will be developed as a green airport, with key objective of environmental sustainability to be achieved through, optimization in resource consumption through adoption of following measures:

- Energy Optimization
- Utilization Of Solar/ Wind Energy
- Natural Day Lighting
- Re-Cycling of Waste
- Water Balance
- Water Harvesting
- Plantation & Landscape.
- Metro & Water Transport
- Environment Management

Airports consume significant levels of energy for space cooling in terminals, external and internal lighting systems, and the operation of luggage conveyance system. The proposed airport will adopt the following energy conservation measures:

- Provision of skylights for Passenger Terminal Building - utilizes sunlight throughout the day without use of artificial lighting.
- Provision of glass (double seal) façade – allows natural light into the building and restricts heat entry.
- Provision of Variable Frequency Drives (VFDs) to HVAC secondary pumps.
- Provision of VFDs to STP air blowers.
- Provision of dual lighting system for main access roads.
- Provision of metal halide bulbs instead of florescent lamps.
- Provision of Waste Heat Recovery (WHR) system to chillers; and
- Provision of energy efficient chilling system with non-CFC based refrigerants.

Solar energy to the maximum extent will be used and the possibility of wind energy will be explored to minimize the usage of conventional energy sources.

The proposed solar plant will create significant environmental benefits over its lifetime. Based on the availability of land & feasibility, solar plant both roof top and ground mounted system planned for the tune of 22.14 MW at NMIA for the final phase.

Energy Conservation Building Code (ECBC), 2017 Compliance

The proposed airport project will comply with standards included in NBC for lighting levels, HVAC, comfort levels, natural ventilations, and other system performance criteria. Other requirements of ECBC 2017 like building envelope, heating ventilation and air conditioning system, lighting schedule will be considered during the construction and operational phase of the NMIA project. As an airport for future, NMIA will be developed as a green airport, with key objective of environmental sustainability through energy optimization, re-cycling of waste and water, reduction in carbon footprint, utilization of solar energy, natural daylighting along with other sustainable measures included in planning, development and operations of NMIA. The detailed ECBC compliance of NMIA is given Annexure-XII ECBC.

10.3.3.12 Community Engagement Plan

Community engagement shall be led by the NMIAL public relations team in coordination with the Head – EM & SD. Based on the nature of issues, these shall be escalated with NMIAL, referred to CIDCO, Collector-Raigad, or other local authorities as applicable. Any intervention/decision required to be taken by NMIAL shall be conveyed to all concerned stakeholders or community members.

10.3.3.13 Incidents and Complaints

It is mandatory for all NMIAL staff and contractors to report all Health, Safety and Environment incidents and complaints for investigation.

Incidents are defined as events that result (or are likely to result in) environmental damage. They must be reported to the concerned HSE staff of NMIAL immediately for deploying control measures. These include uncontained spills (regardless of volume), air emissions, sudden discharges, and wildlife hazards.

All incidents are recorded within the NMIA Environment & Safety Management System (ESMS) and shall be subject to an initial investigation and corrective actions shall be identified if warranted. For incidents resulting in potential contamination, these actions include immediate groundwater and/or soil sampling and analysis and may result in the development and implementation of a remediation programme.

Complaints associated with site construction activities and related to dust, noise and vibration may be received via:

- A direct notification from the complainant to NMIAL or through local authorities. If applicable, the Environment & Safety Managers advises the relevant contractor for investigation and action within 24 hours of the complaint being received; and

- A direct notification to the contractor from the complainant. The contractor is to advise the Environment & Safety Managers (or in their absence, a representative of management) within 24 hours of the complaint being received, providing adequate details to assist in the initial investigation and advise of actions proposed to rectify the issue.

The NMIAL Environment Incident Report Form shall be mandatory for reporting environmental incidents and complaints to NMIAL management (written notification via email or contractor-specific reporting templates will also be supplemented and initial verbal notification can be used in the event of an emergency). The information provided will be utilised by NMIAL to populate the Environment & Safety Management System, which will serve as an Electronic Incident Register.

10.3.3.14 Airport Emergency Response Plan (AERP)

The Airport's Emergency Plan will be developed in accordance with guidelines of DGCA. The implementing procedures would be reviewed and updated to ensure compliance in accordance with relevant regulations and applicable laws of state and local emergency plan. Head- Airside Management, NMIAL will have the overall responsibilities of ensuring compliance, preparation, revision, and implementation of AERP.

AERP defines procedures for timely and coordinated response, rescue and recovery operation while handling an airport emergency with the objective of minimizing the effects of emergency particularly in respect of saving lives and maintaining aircraft operations. The purpose of this AERP is to set forth the procedures for coordinating the response of different agencies and services, both on and off the aerodrome, to handle various aircraft related and non-aircraft related emergencies anticipated at Navi Mumbai International Airport. AERP also spells out the duties and responsibilities of the various personnel/agencies associated with handling airport emergencies.

10.3.3.15 Reporting Strategies

The Environment Management Cell (EMC) will be led by Head (EM & SD) along with site HSE team headed by GM (HSE) which will be assisted by Environmental GM/ Managers/ Engineers, Chemists, HSE Team, Horticultural Experts, and biologist. The Head EM & SD shall report to the Director (Urban Planning) who in turn reports to the Top Management.

The responsibilities of all will be defined and accordingly they will carry out specific activities. The reporting plan will be developed according to hierarchy of EMC. The reporting strategy at the NMIA from lower to upper level in the hierarchy (based on their roles, responsibilities, and designation) will be as follows:

- The Engineer/Scientist (Water & Sanitation, Safety, laboratory services and Horticulture) will prepare monthly analysis and progress report of their respective work areas and will report to Senior Manager (EM & SD).
- Senior manager/Scientist (Engineering) and Senior Manager (Sciences) will be senior staff and therefore at the upper level in the hierarchy. They will evaluate the monthly reports and finalize reports before submitting to the higher-ups.
- The final reviewed & updated progress will be submitted to Director (Urban Planning) including top management.
- The six monthly & annual reports will be submitted to SPCB, CPCB, MOEFCC, AAI & DGCA.

10.3.3.16 Management Strategies & Objectives (Operation Phase)

A large infrastructure project involves coordination and cooperation of diverse stakeholders, including Governmental Agencies, Statutory Agencies, Promoter Agency, Concessionaire, Private Sector Companies, Contractors and Sub-contractors, Designers, Suppliers and Vendors. Management of the same for successful execution of the project therefore presents unique challenges. It requires the application of a variety of management strategies, processes, tools and techniques.

Primarily, considering aims & objectives of policies of Environmental, Safety & Occupational Health of NMIAL, an Environmental implementation Strategy is developed for project. Specific objectives & detailed SOPs for environmental domain which includes water, air & noise, solid waste, hazardous waste, biodiversity, energy etc., will also be designed accordingly before commencement of works at site. All strategies & sub-strategies invariably will have Management Plans with identification of issues, remedial measures and responsibilities and Strategic Environment Management Plan for construction will be detailed out by EPC contractors and reviewed by NMIAL Keeping these facts and goals of Environment Policy, following **Table-10.5** shows management strategies and objectives of each goal of policy for operation phases. Broad Standard Operative Procedures (SOPs) are also identified with responsibilities of implementor/s.

While the SOPs for environment management are developed specifically for construction and operation phase, it is envisaged that construction activities in Phase II, III and IV will be in progress while Phase-I operations are in progress. Therefore, the Contractor's CEMP will be integrated with the operation phase EMP implemented by NMIAL. Following key aspects shall be addressed while both construction and operation of the airport are in progress:

- The vehicle access and traversal within the airport will be well segregated addressing specific entry/exit gates for construction vehicles and airport passengers/cargo operators.
- Airport security systems will be upgraded to facilitate simultaneous construction and operation of the airport while addressing risks related to security breach.
- Pollution management, especially dust and noise abetment from development and operation of the airport shall be regularly monitored and negative impacts thereof shall be mitigated as per EMP.
- Regular EHS mock drill and safety inductions will be conducted for readiness; etc.

10.4 EMP Budgetary Allocation

The budget of monitoring, implementation of mitigation and environment management plan to mitigate the potential adverse impact during development and operation phase has been worked out. The detail of the expenditure on environmental measures during development and operation of NMIA is given in the **Table-10.7** below:

TABLE-10.7
BUDGET ALLOCATION FOR EMP MEASURES DURING DEVELOPMENT & OPERATION PHASE OF NMIA

Sr. No	Factors	Indicative Activities	Development Phase		Operation Phase		Total Cost of EMP
			Capex	Recurring Cost/Annum	Capex	Recurring Cost/Annum	
			Lum Sum Cost in INR Crores				
1	Air pollution control measures	Water sprinkling, Barricading, Pollution under Control checks for vehicles	-	0.1	-	-	
2	Environmental Monitoring Services-	Ambient air & Noise monitoring, Ground & Surface water Analysis Vibration, Marine Water and Soil sampling	-	0.5	-	0.8	
3	Online Monitoring Station	Online Air monitoring (CAAQMS two stations)	-	-	2	0.2	
		Noise Monitoring (4 Station)	-	-	1.3	0.5	
		Metrological/ Weather Station	0.1	0.01	-	0.01	
4	Sewage Treatment Plant	Installation of STP for treating domestic sewage	26.0	0.15	-	0.5	

Sr. No	Factors	Indicative Activities	Development Phase		Operation Phase		Total Cost of EMP
			Capex	Recurring Cost/Annum	Capex	Recurring Cost/Annum	
			Lum Sum Cost in INR Crores				
5	Solid Waste Management Facility	Construction of SWM facility, Construction of hazardous waste and e-waste storage area	0.6	0.05	-	0.05	
		Installation of organic waste converters and Handling and management of all types of wastes. Operation Phase	0.5	0.1	0.35	0.5	
6	Landscaping & Greenbelt Development	Within the project site	0.2	-	1.0	0.3	
7	Rainwater harvesting Pond	Within the project site	14.0	-	-	0.1	
8	Mobile Health Unit	Within the project site	0.25	0.05	-	0.1	
9	Energy Conservation	Installation of solar lights, Use of LED lights, Energy Efficient Building	40.0	0.4	-	5	
		Use of battery-operated vehicles	-	-	10	1	
10	Fire Fighting & PPE	Civil works and Equipment's and PPE, other support vehicles	1.0	0.25	75	7.5	
11	Airport Carbon Accreditation	carbon emission inventory, optimization, and sequestration	-	-	-	0.25	
12	Installation Solar Panels	Installation on roof top	-	-	100	0.5	
13	Environmental Awareness and Training	Environmental Awareness and Training		0.05		0.1	
		Total Cost Capex	**82.65**		**189.65**		**272.3**
		Total Cost Opex		**1.66**		**17.41**	**19.07**
		Grant Total	**82.65**	**1.66**	**189.65**	**17.41**	**291.37**

Chapter-11
Summary & Conclusion

11.0 SUMMARY AND CONCLUSION

The Navi Mumbai International Airport is located at the geographic center of Navi Mumbai in Ulwe Node of Navi Mumbai which is located within Panvel taluka of Raigad district of Maharashtra state. The project is for development of an International Airport with a capacity to handle minimum 60 million passengers per annum (MPPA) and 1.5 million tonnes (MT) of cargo per annum. The phase-wise passenger handling capacities of NMIA are given in **Table-11.1**.

TABLE-11.1
NMIA PHASE-WISE PASSENGER HANDLING CAPACITIES

Airport Development	Commercial Terminal	Cumulative Passenger Handling Capacity (MPPA)
Phase – I	Part Operation of Terminal-1(T1)	10
Phase – II	Full Development of Terminal-1 (T-1)	20
Phase – III	Terminal 2 (T-2)	40
Phase – IV	Terminal 3 (T-3)	60

The NMIA project is currently under implementation stage. The airport site of 1160 ha has been reclaimed and the site is elevated to +5.5 AMSL. The erstwhile Ulwe river passing through the entire site has been diverted through the southern and western boundary, which joins the Moha creek.

The commissioning of Phase-I operations of NMIA with part operation of Terminal-1 (T1) and southern runway is expected in 2024.

Importance of the Project

The Navi Mumbai International Airport is being implemented to augment airport services within Mumbai Metropolitan Region and cater to growing urbanization needs of Mumbai. NMIA will be operating as a second international airport in addition to the already operating CSMIA at Santacruz, Mumbai.

Based on current growth trajectory within MMR, the passenger traffic in MMR is expected passenger traffic is expected to grow over 160 million by 2038. The Chhatrapati Shivaji Maharaj International Airport (CSMIA) alone will be unable to handle such an increase in demand. It is therefore imperative to build a second Airport for MMR. Therefore, NMIA’s gradual passenger growth will be based on the spilled traffic of the existing CSMIA.

To maximize runway utilization for increasing passenger handling capacity at CSMIA, it has been considered that a part of General Aviation (GA) operation at CSMIA will be shifted to NMIA following opening of the new airport. Additionally, it is anticipated that NMIA will be attractive option for aircraft owners, particularly when the Mumbai Trans-Harbour Link (MTHL) is built, connecting NMIA with South Mumbai.

NMIA Background

NMIA was conceived by the GoM and CIDCO was assigned the task of establishing the airport. The establishment of NMIA was perceived to be having an overlapping catchment with already operating CSMIA. Therefore, MoCA upon its review of CIDCO's proposal for the new greenfield airport in such proximity recommended carrying out a simulation study to establish the conflict free operation of both airports, viz. CSMIA and NMIA.

The simulation study for conflict-free inter-operability of both airports, i.e., CSMIA and NMIA, Technical Cooperation Bureau (TCB) of International Civil Aviation Organization (ICAO) with their sub-contractor NAV CANADA in two parts i.e., the first being a simulation using TAAM, second part a real–time simulation in 2007. The study concluded that with appropriate procedures in place, simultaneous and independent operation of both airports is safe and feasible.

Upon the positive findings of the simulation study, the Union Cabinet in the Ministry of Civil Aviation, Govt. of India, granted "In Principle" approval in July,2007 for development of second airport at Navi Mumbai on public private-partnership basis based on the Project Feasibility & Business Plan report submitted by Govt. of Maharashtra.

Statutory Clearances

The airport is being developed in compliance with airport development requirements provided by CIDCO in its Concessionaire Agreement of the project and in compliance with applicable airport development norms of Airport Authority of India (AAI), International Civil Aviation Organization (ICAO), Directorate General of Civil Aviation, GoI (DGCA), etc.

EC & CRZ Clearance and Transfer of EC

Environmental and CRZ clearance for project area was received on 22nd November 2010 valid up to 21st November 2017 and later extension of validity granted vide Notification S.O. 4254(E) dated 27th Dec'2020. GoI, considering the adverse impact of on-going Coivd-19 pandemic on project implementation, has extended validity of current Environmental Approval granted by MoEF&CC for all on-going projects, which includes NMIA project, till 21st November 2021.

As part of project area of NMIA, it includes airport and allied activities zone within 1160 ha which will include the aeronautical services only. This part will be developed by NMIAL as the project proponent. The EC & CRZ Clearance for this area is transferred to NMIAL from CIDCO vide letter No. F. No. 10-53/2009-IA-III dated 17th August 2020.

11.1 Location Details and Environmental Setting

The project envisages the establishment of the airport in 1160 ha at Airport Reference Point (ARP) latitude 18° 59′ 33″ N and longitude 73° 04′ 18″ E, between Amra Marg and National Highway 4B (NH-4B). The project area included 8 revenue villages Targhar, Ulwe, Owle, Pargaon, Vadghar, Kopar, Waghivali Khar and Pargaon Dungi.

Land use

The land-use of the airport site has been changed to "International Airport & Allied Activities/Service Zone" as per the revised land use notification of NMDP dated 21st March 2012.

Environmental Setting

The major environmental sensitivities within 15 km radius from the project boundary is summarized below:

- NAINA enjoys proximity of Navi Mumbai and has influence of Navi Mumbai International Airport (NMIA), JNPT (Jawaharlal Nehru Port Trust), and proposed transport corridors viz. Multi Modal Corridor, Mumbai Trans Harbor Link (MTHL), Dedicated Freight Corridor (DFC), SPUR, etc.
- Karnala Bird Sanctuary is located 9.6 km towards south-east, its ESZ boundary is located 2.5 km towards south-east and Thane Creek Flamingo Sanctuary ESZ is located towards 9.2 km north-west from the project site.
- Panvel Creek is located at north-west boundary. Ulwe river is recourse towards southwest boundary of the project area.
- The boundary of the Matheran Eco-sensitive Zone is located at a distance of 9.3 km ENE of the project site.
- The Elephanta Caves at the Gharapuri is located at 11.3 km west of the project boundary; and
- Other project sensitivities include reserve forests, mangrove patches and mudflats, etc. are identified in the study area map of this report.

11.2 Project Description

As per the final master plan of NMIA, the project is being developed in two major zones based on specific operational requirements of an airport, i.e., airside and landside zones as explained below:

Airside Zone: This comprises of Airfield with runways, taxiways, aircraft parking aprons and all necessary facilities for safe and secure aircraft operations; Passenger Terminals with passenger processing, retail, and other facilities contained within the terminal main processors and piers; Cargo with its airside warehousing/ processing facilities and other complimentary activities not associated with the passenger terminals; General Aviation; Air Traffic Control Towers, etc. The entire Airside Zone is bound/enclosed within Operational Area boundary wall.

Landside Zone: This comprises of the western, northern, and eastern landside areas, including the terminal forecourt areas, and various passengers, stakeholder facilities required for airport, and landside transportation network. Northern landside area shall be developed in later phases of airport development.

11.2.1 NMIA Site Connectivity

NMIA site is strategically located between two main arterial roads of Navi Mumbai, with 8 lane Amra Marg on west and 4 lane NH-4B on its eastern edge. The site is also close to Mumbai Pune Expressway (Sion-Panvel Highway), connected to it by Amra Marg.

NMIA is thus connected to Mumbai, Thane, rest of Navi Mumbai and surrounding region by existing major arterial roads, highways and sub-urban rail (Partially commissioned). In near future, metro rail shall connect NMIA to Mumbai, Thane and Kalyan-Dombivali. NMIA site is presently accessible from South Mumbai by Eastern Freeway to Chembur and then via Sion-Panvel Highway and Palm Beach Road to Amra Marg. In near future, Mumbai Trans Harbour Link (MTHL), a 22-km long bridge across Thane creek from Sewri to Ulwe, shall directly connect NMIA to South Mumbai.

Primary access to NMIA site is from west by Amra Marg, and by NH-4B from east. Further North, Amra Marg connects to Sion-Panvel highway and Vashi Bridge through Palm Beach Road. On southern side, Amra Marg connects to NH-4B which connects to Jawaharlal Nehru Port (JNP) to southwest and Sion-Panvel highway through NH-4B towards northeast. In immediate vicinity of proposed airport, Amra Marg, NH-4B have 3+3 lane configurations while Sion-Panvel Highway is being widened to 5+5 lane configuration. There is no direct access to the airport or connectivity from the south of airport or from SH-54 to the airport.

NMIA site is also accessible from existing Mankhurd-Belapur-Panvel & Thane-Panvel commuter rail corridors from Khandeshwar railway station in northeast and from Targhar railway station in the west on the Nerul-Uran Railway line. Part of Seawoods-Uran suburban line, up to Khar/Kopar station has been commissioned.

Sion-Panvel Highway and Thane-Belapur Road (SH-42) are the major regional road linkages in the north providing connectivity to the road traffic coming from Greater Mumbai and Thane respectively, with Amra Marg (NH-348-A) along with Palm-Beach Road establishing access to NMIA.

In later phases of its development and operation, NMIA connectivity shall be further enhanced to Mumbai by proposed Mumbai Trans Harbour Link (MTHL) and Metro rail, which are being jointly developed by CIDCO and MMRDA. Similarly, road expansion and metro connectivity from east, from NH-4B to airport site boundary, across Gadhi River shall be completed by CIDCO. Water transport connectivity is also an important possibility and shall be explored in future, with a jetty near North Road of NMIA, to be used to bring in construction materials during construction phase and later for movement for cargo to and from Mumbai during operations phase. Maharashtra Maritime Board (MMB) has granted permission to NMIAL for use of existing jetty located near NMIA site.

Another connectivity of arterial road having length of 7 Km is being developed by CIDCO. It starts at the Amra Marg junction and runs on the northern boundary of airport, finally connecting to NH-4B with a clover-leaf junction. This road would provide the accessibility to aeronautical activities such as general aviation, Defence enclave, Low-cost carriers (LCC) Terminal, dedicated cargo terminal, MRO, and support facilities to the north of northern runway. This road traverses mainly over an area of category CRZ I and II area as approved a per CZMP. MCZMA has granted CRZ approval vide letter no. F. No 10-53/2009-IA-III 26th December 2018 with respect to this section of the northern arterial road along the northern boundary of NMIA; to be developed by CIDCO as part of off-site physical infrastructure of NMIA.

11.2.2 Resources Requirement

- **Land Requirement**

NMIAL shall develop the airport within 1160 ha of project site and will be responsible for obtaining & complying with applicable permits for the development, operation, and maintenance of the airport project within project site area as per the Concessionaire Agreement signed between NMIAL and CIDCO.

- **Water Demand**

Water Demand

The water requirement for NMIA shall be sourced from CIDCO, from its existing water mains running along Amra Marg on western side of airport. The total estimated water demand is 21.80 MLD for the Final Phase of 60 MPPA. The phase-wise water demand of NMIA is given in **Table-11.2**.

TABLE-11.2
PHASE-WISE WATER DEMAND

Sr. No.	Phase	Potable Water Demand (MLD)	Non-Potable Water Demand (MLD)	Total Demand (MLD)
1	Phase-I: 10 MPPA	2.25	4.32	6.75
2	Phase-II: 20 MPPA	3.83	5.56	9.39
3	Phase-III: 30 MPPA	7.38	8.41	15.79
4	Phase-IV: 40 MPPA	10.6	11.20	21.80

Source: NMIAL

Sewage Collection and Treatment Plants

The total estimated sewage generation is 13.30 MLD and STP will be designed for 14.25 MLD capacity up to the Final Phase of the project.

Sewage Treatment

Sewage treatment plant will be designed to cater following requirements:

- Sewage treatment plants will be based on Advanced SBR technology followed by Ultra Filtration (UF) and Reverse Osmosis (RO) processes.
- Treatment will be provided to reuse the treated sewage for (i) Flushing and (ii) Irrigation of horticulture (iii) HVAC and (iv) Other uses.

- **Storm Water Drainage Network**

The storm water drainage network and the grading of drainage network is designed in a manner that the stormwater generated from NMIA area will be drained to north or north-east into Gadhi river or the Ulwe Creek.

The water conservation measures and rainwater harvesting facility are discussed and considered for this project.

- **Solid Waste Generation**

The solid waste generation for the airport zone in the Phase-I will be 17 TPD increasing to 29 TPD in Phase-II, 50 TPD in Phase-III and finally 72 TPD in Phase-IV. The Biodegradable waste will be treated to the bio-conversion Plant proposed at NMIA to form compost. Compost will be used for Landscaping at NMIA. Reusable, recyclable & hazardous waste will be sent to MPCB authorized vendors for further Treatment. Non-degradable and inert wastes to be transported to the authorized waste disposal site of CIDCO at a Chaal, Taloja for further Treatment.

- **Power Requirement**

The power requirement for NMIA shall be sourced from Maharashtra State Electricity Distribution Company Limited (MSEDCL). The total estimated power demand is 96 MVA for the final phase of 60 MPPA.

- **Solar Power Generation:**

Based on the availability of the land & feasibility, solar plant planned at NMIA for final phase is 22.14 MW.

- **Fuel Demand and Fuel Storage**

The summary of the estimated final phase (60 MPPA) usage will be 6292 (Cum/day) with estimated 5 days storage capacity will be 50,000 cum using 10 tanks. Each ATF Tank will have a design capacity of 5,000 cum.

- **IT and Telecommunication Network**

NMIA IT Infrastructure will provide for IT, Security & Wireless Infrastructure and networks for airside & landside development like terminal and terminal forecourt, airfield and airside development, cargo facility, MRO, airport maintenance building, ARFF facility, police station, airport administration building, airport health organization, customs building, fuel farms, IMD facility, petrol pumps, GSE maintenance facility, ATC tower, GSE area, chiller plants etc including all other airport development and landside development of NMIA.

11.3 Baseline Environmental Status

The baseline environmental monitoring studies have been carried out within 10 km radius study area from NMIA airport boundary during December 2019 to February, 2020. The study findings are given below:

11.3.1 Land Use & Land Cover

The land use status of the project during the ongoing Pre-Development phase of the project (during May 2020) has been prepared covering sixteen different land use land cover classes are extracted from the satellite image and 4 classes are identified from SOI Toposheets and overlapped as a single LULC map covering twenty classes in all**.** The satellite image is captured in the month of May 2020. Land use classification is broadly as per NRSA classification system; however, project specific categories are introduced as appropriate, considering the nature of the site.

From the 10 km LULC map, the most dominant class within the 10km study area is Open Land covering about 32.88%. The proposed project site is located within this open land and consists of a part of broken land which is formed because of the hill cutting activity carried out for the project site. Dense vegetation is a predominant class within the study area which is mainly observed in the southern side around the eco sensitive zone (ESZ) of the Karnala bird sanctuary.

Remnants of past agricultural activities can be seen near the dislocated villages towards the southeast of the site. Fallow land comprises of 6.19% of overall land use. It is observed that very few farmers continue farming rice, hence the land remains fallow for part of the year. Remnants of past agricultural activities can be seen near the dislocated villages towards the southeast of the site. Habitation covers rural settlement of 0.53% and since the site is in the vicinity of major urbanized developments like Kharghar, Vashi and Panvel, the class urban area constitutes 2.26% of the land cover.

Several waterbodies (reservoirs/ ponds) located throughout the study area contribute to 0.98% of the land cover. Presence of Panvel creek and rivers correspond to the class Waterbody which comprises 16.05% of the land cover making it second most predominant class within the study area. Mangroves and mudflats including salt pans contribute to 9.35% of the land cover within study area. Study area also shows many marshy areas where water remains stagnated until summer as can be observed from the imagery.

The total project area (1160 ha) has been modified as Airport and Allied Activities (NMDP notification dated 21st March 2012) and site has been reclaimed.

11.3.2 Soil Environment

Primary survey for soil sampling has been carried out to understand the physico-chemical characteristics of the study area. The depth of the soils at sampling locations has been observed to be > 1.5 m.

All sampled soil representing the study area are almost neutral in reaction, with pH ranging from 6.46 to 6.79. The electrical conductivity of soils ranged between 286 and 394 μs/cm indicating that the soils are totally free from any salinity related issues.

The organic carbon (OC) and available K content of soil is low and ranged from 0.22% to 0.42% indicating less to medium in the study area and 80 kg/ha to 120 kg/ ha respectively.

Some soils (S2, S3 & S4) are medium in available N content (0.012% to 0.014%) whereas others (S5, S6 & S9) have a low content (0.0096% to 0.0098%) of the same. However, soil S7, S8 and S10 highly deficient in nitrogen. This is expected in this region because of the monsoon dominated climate where leaching of nutrient during the high rainfall period is very high and soil moisture during the long dry and hot summer period (January to May) is very low.

The available P content of the soils is medium and ranges from 21 kg/ha to 35.7 Kg/ha. The phosphorus content in the study area falls in less to medium category. Also, the content of Cl (42 mg/kg to 96.2 mg/kg) and S (46 mg/kg to 82 mg/kg) are high but not detrimental to most of the crops in the prevailing pH range of the soil.

In short, the limited areas of cultivable soil in the immediate environs of the project periphery are fertile and have good physical properties for successful cultivation of suitable crops.

11.3.3 Climate and Meteorology

The project site experiences wet and dry climate with the influence of coastal wind pattern. The site-specific meteorological monitoring during winter' 2019-20 has identified the meteorological parameters in the following ranges:

- Minimum and maximum temperatures recorded to be 14.7°C and 36.4°C, relative humidity recorded in the range from 48% to 72%. Total rainfall observed during the study period was 9.4 mm. The winds were blowing from west-northwest and south-east directions; and
- The winds are blowing predominantly from west-northwest (first pre-dominant) and south-east (second pre-dominant) directions in the winter season.

11.3.4 Ambient Air Quality

Ambient air quality monitoring was carried out at 12 locations during the study period. The summary of ambient air quality sampling and analysis is given below:

- The minimum at Pargaon high school and maximum at concentration for PM_{10} were recorded as 56.3 $\mu g/m^3$ at Pargaon high school and 74.4 $\mu g/m^3$ at CIDCO office, respectively. The minimum and maximum concentration for $PM_{2.5}$ were recorded as 21.5 $\mu g/m^3$ and 32.5 $\mu g/m^3$ respectively.
- The minimum and maximum SO_2 concentration was recorded as 10.9 $\mu g/m^3$ and 15.1 $\mu g/m^3$.

- The minimum and maximum NO_2 concentration was recorded as 20.4 μg/m^3 and 27.6 μg/m^3.
- The minimum and maximum CO concentration were recorded as 150 μg/m^3 and 430 μg/m^3.
- The concentrations of $PM_{2.5}$, PM_{10}, SO_2, NO_2, O_3, CO, NH_3, Pb, BaP, As, Ni and C_6H_6 are observed to be well within the NAAQ standards prescribed by Central Pollution Control Board (CPCB) for industrial and rural /residential zone.

11.3.5 Noise Levels

Noise monitoring and analysis was carried out at 13 locations within the study area of 10 km radius. The noise level monitoring locations are covered within the funnel zone of the airport, sensitive locations, residential, industrial and commercial areas. The daytime and nighttime equivalent noise levels were recoded as per CPCB guidelines.

The noise level monitoring results indicates that:

Industrial area

- The daytime and nighttime readings are found to be within permissible limits for Industrial, area;

Commercial areas

- The noise levels thus recorded at commercial areas were found to be in the range of 59.1 dB (A) to 64.0 dB (A). The minimum equivalent daytime noise level was recorded near CIDCO Guesthouse office, Panvel (N2) and the maximum noise level was recoded near CIDCO Bhavan at CBD Belapur, Sector-10 (N6). It is observed that the equivalent daytime noise levels are within the permissible limits at all commercial locations.

- The night-time noise levels near commercial areas were found to be in the range of 52.2 dB (A) to 53.0 dB (A). The minimum equivalent night-time noise level was recorded near Panvel Market Yard (N12) and the maximum noise level was recoded near CIDCO Office, Panvel (N2). It is observed that the equivalent night noise levels are within the permissible limits at all commercial locations.

Residential area

- The daytime noise levels near residential areas were found to was found to be exceeding 55dB (A) at location N3, N4, N5, N8 and N9. Similarly, the night-time noise levels were found to be exceeding 45dB (A) at location N3, N4, N5, N8 and N9. This may be attributed to the proximity to the nearby roads bearing heavy traffic movement; and

Silence zone

- The equivalent day time noise levels were observed to be 51.9 dB(A) near Pargaon High school (N7)-silence zone. The daytime noise levels were found have slightly exceeded the permissible limit of 50 dB (A) near silence zone. This may be attributed to the proximity to the nearby highway bearing heavy traffic movement.

- Similarly, the equivalent night-time noise levels were observed to be 43.8 dB(A) near Pargaon High school (N7)-silence zone. The night-time noise levels were found have slightly exceeded the permissible limit of 40 dB (A) near silence zone. This may be attributed to the proximity to the nearby highway bearing heavy traffic movement.

It is observed that the equivalent noise levels are within the permissible limits at all commercial locations. Higher noise levels are also observed near Pargaon School (Sensitive Zone) at the time of monitoring.

11.3.6 Water Quality

➢ *Surface Water Quality*

The result of water quality analysis report does not show presence of heavy metals or toxicity. Presence of coliforms was observed in all the samples classifying these samples as Class C as per MPCB water quality Standards for best designated uses. The results were indicating that water from these surface water bodies is not fit for human consumption, Fish & Wildlife Propagation.

➢ *Ground Water Quality*

- The analysis results of ground water samples showed the pH in range of 6.74 - 7.62. Turbidity of the samples ranged from 2.4-3.1 NTU and electrical conductivity of the samples ranged from 359.37-500 µS/cm.

- The total hardness of the samples ranged from 194-295 mg/l, Calcium concentration ranged from 27.3 to 42.3 mg/l, Magnesium concentrations ranged from 16.7-23.40 mg/l, total dissolved solids of the samples ranged from 194-295 mg/l, Chlorides concentration is found to be between 23.8-31.7 mg/l, Fluoride ranges form 0.5-0.9 mg/l, Range of sulphates concentration is found to be 3.6-6.2 mg/l, Iron concentration in groundwater varied from 0.033-0.042mg/l, Alkalinity in the groundwater samples varied from 128-195 mg/l and Nitrate is in found to be in the range of 5.6-12.4 mg/l. The results indicated that all the ground water samples are well within the desirable limit.

- Bacteriological studies revealed the absence of *E. coli* in ground water samples. The total coliform counts are absent in all the samples against the standard limit of 10 MPN/100 ml.

Based on the above results, it is evident that all of the parameters in ground water fairly meet the desirable standard limits of IS:10500. The ground water quality in the study area does not indicate any industrial contamination.

- *Marine Environment*

Marine water quality in the study area was assessed at twelve locations (including those in the modified creek areas) during the study period for physico-chemical, nutrient & biological parameters to know the status of water quality. Specific biological components of different trophic levels such as microbes, phytoplankton, Zooplankton and Benthos were studied to know marine ecosystem.

Marine Water Quality

The water temperature followed a routine comparable trend with that of Air temperature.

The pH value was in normal range, while DO values were observed on lower side-lowest values were in upstream locations (W1 & W2) which can be due to extended monsoons & discharge of various anthropogenic wastes. Similarly, the pH value was in normal range, with much lower salinity as we move towards upstream (station W12). DO within lower range further to it BOD was much lower. This may be due to minimum tidal flow and restrictions in free flow in the channel due to ongoing activities over this channel. The BOD values show no typical trend, except that the values at W3 & W4 in Belapur creek were higher than the rest of observations. Higher BOD values at W3 and W4 maybe due to discharge of treated effluents of Taloja CETP and discharges from NMMC STP in the area.

The total suspended solids were found quite high (Thane creek & Belapur creek mouth locations). The vessel traffic along with constant various discharges in the water column provides insufficient time to re-settle suspended load, and results in high Suspended Solids values. Dissolved solids and salinity values showed a trend from being lowest near Kalundre/ Gadhi river (SE of site) station W1 to being highest near the mouth of Panvel creek and are in expected range. Similarly, the total suspended solids were quite very high from mouth region i.e., in Moha creek, & URC Channel & low in Ulwe River location. The dissolve solids are in expected range & found comparable w. r. t. salinity & other salts. The ongoing hill cutting & levelling activities near the water column must have led to high suspended load, resulting in high Suspended Solids values.

Relative concentrations of Nitrate -Nitrite in locations W1 to W8 also indicates deterioration in water quality of the inner creek. While relative concentrations of Nitrites in locations W9 to W12 were explicitly low while Nitrate values were very high indicating either source or active microbial growth in this channel. Comparatively high presence of Ammonia near Mouth region indicates sewer or domestic influx from nearby village-residents & also stagnancy with limitation in free flow.

Phosphates, Phenols & PHC are within expected range. Overall water quality was comparable with earlier historical data in the region & indicates water quality is under stress or degrading. Although, Phosphates, Phenols & PHC near mouth region showed higher phenol values while PHC was comparatively lower than rest of creek values. Overall data in the region indicates water quality is under stress due to ongoing activities at site & some domestic sources in Moha creek & upstream Ulwe river. Also, the channel is under stress due to the temporary number of bunds over it, restricting the free tidal flow.

Marine Sediment Quality

The creek bed was mainly composed of silts & clay sediments. Overall, the concentration of metals varied in the expected ranges. Though certain metal values are noteworthy & must have been contributed by effluents from industries that of chlor-Alkali-metal dye-fertilizers etc. and by sewage discharges.

Similarly, in mouth of Moha creek &upstream Ulwe River creek bed is mainly composed of (Sand) Gravel, silts & lesser clay, while Rocky strata is observed in URC channel. The sediment texture consisted of rocks cuts like gravel/pebbles due to newly formed channel through hill cutting hence sand (pebbles, gravels & rock cuttings) composition dominated in URC channel.

Overall, the concentration of metals & TOC varied in the expected ranges.

11.3.7 Ecological and Avifauna Studies

Ecological study has been conducted for both terrestrial and aquatic ecosystem. Flora and Fauna inventory including ai-fauna species of the study area has been included in the report in Chapter-3. The inventory of marine flora and fauna and phytosociological study has also been conducted.

TCFS (Thane Creek Flamingo Sanctuary) Comprises 12 true mangrove species and 39 associate mangrove species. *Avicennia marina* was the dominant mangrove and most abundant species throughout the creek. Two variants of *Avicennia marina* namely *Avicennia marina var marina* and *Avicennia marina var accutissima*. Similarly, other species that were also reported during the study period.

Baseline survey of Avian fauna was conducted before the start of construction and details were disclosed every three months at the website in association with Bombay Natural History Society [BNHS]".

Avian fauna and other relevant study have been conducted by BNHS. CIDCO has extended the engagement of BNHS in 2018 by signing a MOU for a 10-year period (until 2028).

Bird hazard may have a plausible impact due to presence of bird feeding/roosting sites near the project site. BNHS had also conducted studies for movement pattern of the birds.

The Waghiwali Island across the Panvel Creek to the north of the NMIA site is deemed as a suitable site for compensatory mangrove afforestation but found to be bird hazard risk. Therefore, BNHS has strongly recommended to remove the condition on Mangrove park to the North of the site, as it will attract birds towards the airport site.

11.3.8 Demography and Socio-Economic Profile

The village-wise demographic data had been compiled based on primary and secondary data for 105 rural villages, 08 Census towns from Panvel tehsil, 01 census town from Uran tehsil and 01 Navi Mumbai Municipal corporation ward from Thane tehsil are falling within 10 km radius of the project area.

Rehabilitation & Resettlement

There are about 3,113 households who are being rehabilitated from 7 revenue villages in 10 settlements. Out of these, nine settlements are within airport site area of 1160 ha and one is outside the airport site. CIDCO has already acquired and developed the land for setting up the 7 R&R pockets and Pushpak Nagar (R&R site) for resettlement of displaced villages. CIDCO has already incurred cost of Rs.1813 crores for R&R of NMIA Project.

As on 11th June 2021, a total of 2562 structures have been demolished, and 2518 plots given possession and remaining are in process by CIDCO. Total 97.3% demolition work has been realized and about 71 structures are remaining.

11.4 Anticipated Environmental Impacts and Mitigation Measures

The potential environmental impacts due to NMIAL airport during development and operations have been assessed in detail. These include likely impact on air quality, noise, water quality, solid waste, ecology, avifauna and socio economics, etc. The impacts of the project in terms of quality and quantity are expected in both development and operational phases as mentioned below:

- **Impact During Development Phase**

Impacts and respective mitigation measures have been envisaged for every component of the environment. Impacts on air quality are likely to be for short duration, temporary and confined locally to the development site. Noise quality is expected to have minimum impact as equipment/construction vehicles used will be properly maintained and workers will be provided with necessary protective equipment. Water quality of the surrounding area will not be degraded as generated sewage will be treated in STP and treated water will be recycled and reused during pre-development and post development activities. Solid waste will be disposed as per the SOP of existing disposal method and as per C&D Management and Handling Rule’2016.

The adverse impact on terrestrial and aquatic ecology can be compensated through implementation of afforestation programme for the loss of trees and mangroves.

Socio-economic conditions will be improved as R&R is being implemented as per policy formulated by GoM/CIDCO. The R&R package of CIDCO exceeds the requirement of right to fair compensation and transparency in land acquisition, rehabilitation, and resettlement (RFCTLARR) Act, 2013.

- **Impact During Operation Phase**

Air quality will be controlled by adopting measures of air pollution control at the source level. Besides, continuous AAQMS will be installed at the project site to monitor the air quality. These measures will be implemented to keep the air quality well within the stipulated limits.

Noise levels will be maintained by implementing SOP for the operations to reduce and minimize the impacts of all noise generating sources. Water quality of treated sewage will meet the prescribed limits set by regulatory authorities. Treated water will be recycled and reused considering zero liquid discharge concept for plantation, dust suppression, toilet flushing and in HVAC for cooling purposes etc. Solid waste generated will be handled and disposed-off as per MSW Rules,2016 Bio-Medical Wastes and Hazardous Waste Management and Handling Rules'2016.

Terrestrial & aquatic ecology will be maintained with minimum impacts on its surrounding areas. BNHS has been engaged by CIDCO till 2028 to monitor the avifauna and ecology in the surroundings of the airport. Plantation and green cover/ landscape is planned for 33.18% area of the project. It has been assessed through air and noise quality modelling that the sensitive areas will have minimal impacts due to airport operation.

Solar panels to the tune of 22.14 MW will be installed to reduce the carbon footprint of the project. The installation of renewable energy component will help in reducing the air pollution and meeting the energy need of the project. Positive socio-economic changes are anticipated as large number of local people will get both primary and secondary employment from the project, which will lead to socio-economic and regional development of the area.

Impact on marine is assessed based on baseline environmental monitoring conducted in Winter 2020. It is that the biological components like low chlorophyll, phytoplankton & zooplankton indicated stressed environment, while the benthic biota indicated the resumption of re-instating process. Once the channel is trained & the surrounding project related hill cutting/levelling like impactful activities completed, the smooth tidal flow shall allow the estuarine environment to balance itself.

Conservation plan and compensatory afforestation program will be implemented during the development and operational phase of the project, which will help in protection of avifauna, an important attribute of the airport projects. In addition to this, NMIAL has requested the Forest Department, GoM for allotment of approximately 50.620 ha (about 125 acres) of land for taking up new plantation. NMIAL intends to plant about 14000 trees outside the project site.

Comprehensive mitigation measures have been envisaged in the environment management plan to ensure that the environmental quality is conserved, protected, and improved during the development and operational phase of the project.

The project development and implementation phase may lead to increased traffic load and haphazard development in the influence area of the project. Such impacts are being mitigated through a detailed landside traffic study which addresses management of traffic and traffic decongestion through developmental projects like MTHL, improvement of road capacity through improvement of road infrastructure, introduction of multimodal communication systems, etc. The study considers the impact due to increase in traffic and nearby population (due to urbanisation) due to phase-wise development of the project.

11.5 Environmental Monitoring Program

- **Environmental Quality Monitoring**

Environmental monitoring will be carried out during developmental and operational phase of the project. NMIAL will be regularly monitoring environmental quality parameters for the NMIA which will include ambient air, noise, wastewater, drinking water, terrestrial and aquatic ecology etc as well as DG set emissions. The ambient air quality will be monitored in accordance with National Ambient Air Quality Standards (NAAQS) Notification, 2009 and Director General Civil Aviation (DGCA) Civil Aviation Requirements (CAR) on Climate Change Initiatives and Local Air Quality Monitoring in Civil Aviation, 2015. Noise levels will be monitored as per The Noise Pollution (Regulation and Control) Rules 2000 and DGCA CAR on Noise Management of Aircraft Operations at Airports, 2014.

- **Integrated Noise Monitoring System (NMS)**

NMIAL will install a comprehensive Noise Monitoring System (NMS) at NMIA to monitor & measure the noise generated due to aircraft operations. Permanent and mobile Noise Monitoring stations (NMT) will be installed on 24x7 basis.

- **Continuous Ambient Air Quality Monitoring Station**

During NMIA operation, Continuous Ambient Air Quality Monitoring Stations (CAAQMS) will be installed at 4 locations (at the boundary and within the airport) to measure NAAQS parameters, while HC and VOCs will be monitored once in every month within the airport premises. Meteorological parameters like temperature, humidity, rainfall, wind-speed and wind-direction, cloud cover and solar radiation will be measured along with air quality parameters.

- **Environmental Monitoring and Reporting Schedule**

Environmental Statement of environmental audit and compliance to EC and CRZ clearance conditions shall be prepared during operations and shall be submitted at the end of each financial year-ending to the state pollution control board and to regional office of MoEF&CC.

11.6 Environment Management Plan

Navi Mumbai International Airport Ltd (NMIAL) is a responsible corporate and is committed to environmental conservation and protection. NMIAL will constantly take comprehensive measures to prevent the pollution and enhance the environmental performance of NMIA operations.

11.7 Additional Studies

The following additional studies have been conducted as part of the EIA study and in compliance with ToR conditions:

- A QRA study has been conducted for the ATF Tankage and Fuel Hydrant System and recommendations are addressed.
- The R&R studies are conducted by CIDCO and the PAFs had been rehabilitated as per the compensation package has been approved by the GoM.
- The hydrogeological study of the project has been conducted by GSDA, GoM for identification of the impact in the project influence area and the recommendations are addressed in the project design aspects.
- The drainage pattern and the flood risk of the project has been assessed through modelling studies by CWPRS. The drainage master plan of the project has been reviewed by CWPRS and approved.
- The floral and faunal baseline of NMIA has been established by BNHS along with special emphasis on the impact on migratory birds due to the project and a conservation plan is being implemented; and
- The air traffic and land traffic assessment has been carried out for Airport design and phase-wise capacity development as well as land side traffic management and decongestion.

11.8 Aerodrome Emergency Response Plan (AERP)

A comprehensive Aerodrome Emergency Response Plan (AERP) is formulated, which will be in place for NMIA airport. The AERP is comprehensively prepared for specifying role of various groups / organizations/ agencies and plan of disaster management during various types of emergencies / disasters like in-flight mass casualties, medical emergencies, aircraft accidents, various fires on ground, accidents involving dangerous goods, natural disaster management, unlawful act of seizure of aircraft etc.

11.9 Project Benefits

The proposed airport project at Navi Mumbai shall cater to future aviation needs of MMR region in terms of air space management and airport operations to derive maximum benefits for passengers, stakeholders, all other airport users and surrounding communities. The benefits of the NMIA project are broadly classified as below:

- Projected Financial Benefits;
- Social Benefits due to project CSR activities and R&R activities; and
- Socio-Economic Benefits due to infrastructure development within influence area of NMIA.

The project will be generated direct and indirect employment opportunities in the development and operation phase for local people, and people from PAPs.

11.10 Conclusion

The NMIA project is an on-going critical airport infrastructure project for which environment and CRZ clearance was received in 2010 and further extended in 2017. As per Clause-9A of recent MoEF&CC Notification vide S.O No. 221 (A) dated 18th Jan 2021, the validity of Environment and CRZ clearance granted to NMIA project vide F.No.10-53/2009. GoI, considering the adverse impact of on-going Covid-19 pandemic on project implementation, has extended validity of current Environmental Approval granted by MOEF for all on-going projects, which includes NMIA project, till November 2021.

NMIA will be the second airport for Mumbai Metropolitan Region area, which is essential for enhancement of airport capacity to handle projected air traffic demand of MMR in future in order to maintain Maharashtra's leadership in attracting Foreign Direct Investment. Thus, cementing Mumbai's future as an International Financial Centre as annual air passenger traffic is expected to grow over 160 million by 2038. The Chhatrapati Shivaji Maharaj International Airport (CSMIA) alone will be unable to handle such an increase in demand. Phase-I & Phase- II of NMIA is expected to be completed & operation in FY 24-25 & FY 25- 26 respectively. Phase-III and Final / Phase -IV will commence based on traffic triggers. These three terminals will handle the total traffic capacity of 60 MPPA with cargo handling capacity of 1.5 MTPA. This is particularly important as NMIA shall be required to serve growing demand of MMR region in long run during the operations of Navi Mumbai International Airport

Ambient air and noise quality of the surrounding area is found to be well within the NAAQ standards prescribed by CPCB. The impacts have been predicted quantitatively and qualitatively as well, and adequate control measures have been suggested accordingly. The likely adverse impacts due to the development and operation of the airport will be mitigated by judicious implementation of the environment management plan. Therefore, overall surrounding environment will be conserved, protected, and improved due to implementation of the airport project.

The proposed project will provide direct and indirect employment to a large number of personnel; generate considerable revenue for the financial capital of India. This project will give impetus for development of metro rail, connectivity and improvement of road traffic, waterways for public and port development. This will also generate significant ancillary and indirect employment in the region.

Thus, in view of major benefits from the project, the on-going NMIA project will improve socioeconomics, infrastructure, connectivity and overall aesthetics in the surroundings of the NMIA.

Chapter-12
Disclosure of Consultants Engaged

12.0 DISCLOSURE OF CONSULTANTS

12.1 Introduction

Studies were carried out by several institutions of different disciplines during the preparation of the EIA/EMP report based on the Expert Appraisal Committee (EAC) prescribed Terms of Reference.

NMIAL has retained M/s. Vimta Labs Limited, Hyderabad a MoEF&CC recognized and NABET accredited laboratory for carrying out environmental monitoring studies during Pre-Development phase of the proposed project on monthly basis. M/s. Vimta Labs Limited in association with M/s. Aditya Environmental Services Pvt. Ltd. (Mumbai, Maharashtra) as local associate has carried out the baseline monitoring studies at site.

12.2 Vimta Labs Limited-Environment Consultant

Vimta Labs Limited is a leading multi-disciplinary testing and research laboratory in India. Vimta provides contract research and testing services in the areas of environmental assessment, analytical testing, clinical research, pre-clinical (animal) studies, clinical reference lab services, advanced molecular biology services and research & development studies.

The **Environment Division** has been in the forefront of its vision to provide better environment through guiding and assisting the industry for sustainable development. A stalwart in the mission to protect and preserve the natural resources on earth for future generations, it offers extensive research and consultancy services in the field of environment. With its rich experience, multi-disciplinary expertise and with the support of its state-of the-art analytical equipment, the services offered by the division are wide ranging and encompasses entire gamut of environment management and monitoring services. With its emphasis on quality services over the years, it has evolved itself into a single reference point in India for comprehensive environmental services.

12.2.1 The Quality Policy

- Vimta is committed to good professional practices and quality of operations in its testing, validation and research services;
- Vimta shall ensure customer satisfaction by maintaining independence, impartiality and integrity in its operations;
- Vimta shall provide the services in accordance with national and international norms;
- Vimta shall implement quality systems as per ISO/IEC 17025 and applicable Good Laboratory Practices (GLPs) & Good Clinical Practices (GCPs), to generate technically valid results/data; and
- Vimta shall ensure that all its personnel familiarize with the policies and procedures of the quality system and implement the same in their work.

12.2.2 Major Milestones and Accreditations

- 1984–Registered with an initial investment of Rs.200,000 = 00
- 1985–Recognized by ISI (now known as Bureau of Indian Standards)
- 1987–Qualified by the criteria of Ministry of Environment and Forests, India and was notified as one of the first 14 Standard Environmental Laboratories published in the Gazette of India
- 1988–Licensed for carrying out tests on Drugs and Pharmaceuticals
- 1991–Accredited by NCTCF, DST, Government of India (the forerunner of NABL)
- 1995–Accredited by NABL, India under its revised scheme, certified by Standards Australia, Quality Assurance Services as per ISO/IEC Guide 25 and ISO 9002
- 1996–GLP Compliance
- 1998–Accreditation by GOSSTANDART and joint venture for certification of Food Exports with ROSTEST, Russia
- 1998–World Bank Recognition
- 2002–ANVISA Brazil Certification
- 2003–USFDA accepts Vimta Bioequivalence study report. Showcased Vimta at AAPS (USA) and ICSE-CPHI (Germany)
- 2003–Recognized by Saudi Arabian Standards Organization
- 2004–Enters Gulf Market-Executes a contract for environmental consultancy in Kuwait
- 2006–Expands its overseas activities. Undertakes environmental assignment in Saudi Arabia
- 2006–Undertakes environmental impact assignment in Tanzania, Africa
- 2008–Has been Pre-Qualified by World Health Organization (WHO)
- 2009–Undertaken environmental impact assessment studies in Cameroon, Africa
- 2010 – Quality Council of India/NABET Accreditation.

12.2.3 Services Offered

Spread over 70,000 sq. ft lush green garden premises at Cherlapally, Hyderabad (India), the scientifically designed and meticulously groomed infrastructural facility of the Central Laboratory of **VIMTA** has the most sophisticated instruments backed by an excellent team of professionals.

Over 150,000 sq. ft. of world class research laboratory is also under operation at MN Park-Genome Valley, Hyderabad (India). Having all the facilities under one roof is perhaps the only one of its kind in South Asia in the contract testing and research sector.

Vimta offers services under the following specializations:

- Environment;
- Analytical;
- Clinical Reference Lab;
- Clinical Research;
- Preclinical;
- Molecular Biology; and
- Research and Development.

The environment division of VIMTA Labs Limited (VLL) has its presence all over India and other countries including a strong association with international consultants like Japan Bank for International Cooperation (JBIC), Kennametal Inc. - USA, Rudal Blanchard – UK, E&E Solutions – Japan, NAPESCO & Kuwait National Petroleum Corporation – Kuwait, Marafiq and Haif Consultants – Saudi Arabia and others. Vimta Labs Limited has the following credentials:

- Recognition by BIS, India;
- Recognition by Ministry of Environment Forests and Climate Change, Govt. of India and various State Pollution Control Boards (wherever applicable);
- Recognition by Department of Science & Technology, Govt. of India (NABL);
- Accreditation by QCI/NABET;
- Recognition by Ministry of Defence, Govt. of India;
- Recognition by APEDA, Ministry of Commerce, Govt. of India;
- Recognition by Saudi Arabia Standard Organization (SASO), Saudi Arabia;
- Recognition from NEMC, Tanzania;
- Accreditation by NCTCF;
- Certification from Standard Australia;
- Recognition from ANVISA Brazil;
- Recognition from USFDA;
- Quality Assurance Services as per ISO/IEC 17025;
- Quality Assurance Services as per ICH Guidelines; and
- Recognition by World Health Organization (WHO).

National Accreditation Board for Education and Training

NABET

QCI

QCI/NABET/ENV/ACO/21/1912

Aug. 11, 2021

To
Vimta Labs Ltd.,
142, IDA Phase-II, Cherlapally
Hyderabad - 500 051

Sub.: Extension of Validity of Accreditation till November 10, 2021– regarding
Ref.: Certificate no. NABET/EIA/1720/SA 088

Dear Sir/Madam,

This has reference to the accreditation of your organization under QCI-NABET EIA Scheme, the validity of **Vimta Labs Ltd.** is hereby extended till November 10, 2021 or completion of assessment process, whichever is earlier.

The above extension is subject to the submitted documents/required information with respect to your application and timely submission and closure of NC/Obs. during the process of assessment.

You are requested not to use this letter after expiry of the above stated date.

With best regards,

[A K Jha]
Sr. Director, NABET

Institute of Town Planners India, 6th Floor, 4-A, Ring Road, I.P Estate, New Delhi-110 002, India
Tel. : +91-11-233 23 416, 417, 418, 419, 420, 421, 423 E-mail : ceo.nabet@qcin.org Website : www.qcin.org

National Accreditation Board for Testing and Calibration Laboratories

(A Constituent Board of Quality Council of India)

26.06.2020

Extension in Validity of Accreditation

<u>NABL Policy</u>: It is decided to extend the validity of accreditation for a period of one year to all conformity assessment bodies (CABs) where renewal of accreditation is to take place and accreditation validity date is between 01.01.2020 and 30.06.2022 **subject to the following**:

1. Providing satisfactory documents based on NABL-218 wrt compliance to the requirements of the relevant Standard and NABL requirements.
2. The CABs are required to conduct additional internal audit to ensure compliance with the standard requirements (by increasing the existing frequency of their audit plan) and submit the document.
3. The CABs are required to provide control charts and trends for assuring the validity of results.
4. CABs are required to provide an undertaking to undergo unannounced assessment (onsite and/or remotely, depending on the situation) and actions as per NABL-216 thereof, at any point of time during the validity period.
5. Making payment of **annual accreditation fee** for the extended period.

Examples:

• Accredited CABs with date of issue 15.01.2018 and valid till 14.01.2020, then their Accreditation validity will be extended till 14.01.2021.

• Accredited CABs with date of issue 15.02.2019 and valid till 14.02.2021, then their Accreditation validity will be extended till 14.02.2022.

• Accredited CABs with date of issue 15.06.2020 and valid till 14.06.2022, then their Accreditation validity will be extended till 14.06.2023

NOTE:

1. The above will be applicable to the laboratories for which transition to ISO/IEC 17025:2017 version has been completed. For the laboratories which are accredited as per ISO/IEC 17025:2005 version, they have to undergo transition assessment (onsite and/or remotely, depending on the situation) and follow transition plan defined.
2. The above is not applicable to CABs where there will be a change in name of CAB and/or legal identity change and/or Premises change.
3. Also, **the above is not applicable to the CABs which are not registered in portal** (exemption- International accredited CABs).
4. Routine assessments will take place for any scope extension /addition.
5. Payment due to NABL can be deferred (postpone the payment) upto a period of Six (6) months. There will be no waive-off of any fee for any CABs. If payments are not made, then action as per procedure (NABL-216) will be initiated. There will be no relaxations wrt payment from 01.01.2021.

N.Venkateswaran
CEO, NABL

NABL House, Plot 45, Sector 44, Gurugram 122 002, Haryana, India
Tel. No.: +91-124-4679700 (30 lines) • Fax: +91-124-4679799 • Website: www.nabl-india.org

12.2.4 Environment Division

Environment essentially being a multi-disciplinary science, the range of services offered by the division are also comprehensive and caters to the needs of industry, pollution control agencies, regulatory authorities and in a larger pursuit of a green globe. The services under environment include:

- Site selection and liability studies;
- Environmental impact assessments;
- Environment management plans;
- Carrying capacity based regional studies;
- Environmental audits;
- Solid and hazardous waste management;
- Risk assessment (MCA, HAZON, HAZOP) & disaster management plans;
- Occupational health and safety, industrial hygiene;
- Environmental monitoring for air, meteorology, water, soil, noise, ecology and socio-economics;
- Industrial emission source monitoring;
- Offshore sampling and analysis of marine water and sediments;
- Marine ecological studies;
- Marine impact assessment;
- Rehabilitation and resettlement studies;
- Forestry and ecological studies;
- Geological and hydro-geological studies;
- Land use /land cover studies based on remote sensing;
- Socio-economic studies;
- Due diligence studies;
- Industrial epidemiological studies;
- Wasteland management studies; and
- Study on bio-indicators.

The services under environmental chemistry include:

- Analysis of water, wastewater, soil, solid waste, hazardous waste as per international codes;
- Source emissions and work zone air/noise quality monitoring;
- Analysis of dioxins and furans;
- Analysis of SVOCs, VOCs, PAH, BTEX, AOX, PCB’s, TCLP metals, TOC etc.;
- Categorization of hazardous waste; and
- Pesticide residue analysis.

12.2.5 Facilities of Environment Division

Vimta-Environment division is located in scientifically designed central laboratory with the state-of-the-art modern facilities to offer vide range of services in indoor and outdoor monitoring and analytical characterization in the field of environment. Further, it is ably supported by highly skilled and experienced team of professionals in the fields of science, engineering, ecology, meteorology, social planning, geology & hydro-geology and environmental planning. Besides the regular monitoring equipment such as fine dust samplers, respirable dust samplers (RDS), automatic weather monitoring stations, stack monitoring kits, personal samplers, noise level meters, portable water kits etc, the other major specialized equipment include:

- Monostatic sodar–designed by National Physical Laboratory, GOI;
- Integrated noise level meters–Quest, U.S.A;
- Flue gas analyzers–Testo, Germany;
- 113-A Gravimetric dust sampler-Casella, London;
- ICP OES Perkin Elemir, USA;
- Gas liquid chromatographs with FID, ECD & pFPD–Varian, USA;
- Gas chromatograph with mass detector–Varian, USA;
- Atomic Absorption Spectrometer [AAS]–Varian, USA;
- PAS-AFC-123 instrument;
- High Performance Liquid Chromatograph (HPLC);
- Laser particle size analyzer;
- Bomb calorimeter;
- Polarographs;
- X-ray fluorescent spectrometer;
- Flame photometer;
- Carbon sulphur analyzer;
- Computerized fatigue testing machine;
- Electronic universal testing machine;
- Fourier transmission infrared spectroscope; and
- Water flow current meter – make Lawrence & Mayo.


HIGH RESOLUTION GAS CHROMATOGRAPHS

12.2.6 Quality Systems

The basic fact that environment division and its supporting site laboratories are accredited by NABL (IS0-17025) and Ministry of Environment, Forests and Climate Change, India and by other international bodies stand testimony to its emphasis on Quality Systems.

The details of the persons involved in the preparation of present EIA/EMP report are presented below:

DETAILS OF PROJECT TEAM INVOLVED IN CURRENT EIA/EMP STUDY – VIMTA LABS LTD

Sr. No.	Name	Qualification	Position	Contribution in Current EIA	Expertise/Functional Area	Experience
In House Experts						
1	Mr. M. Janardhan	M.Tech (Env. Engg)	Vice President & Head (Env)	EIA Coordinator	EC for Sector- 29 & FAE for AP, AQ, NV & SHW	About 29 years of experience in the field of Environmental Management and Environmental Engineering
2	Dr. B Chandra Sekhar	M. Sc. Ph. D	Associate Vice President (Env)	Expert	FAE for AQ	About 21 years of experience in the field of Environmental Management and Environmental Engineering
3	Mr. G. V. Raghava Rao	M. Tech. (Env)	Manager (Env)	Expert	FAE for AP, ISW & MSW	About 19 years of experience in the field of Environmental Management and Environmental Engineering
4	Ms. Bh. Durga Bhavani	M.Tech (Env. Mngt.), M. Sc (Env Science), LLB	Assistant Manager	Expert	FAE for AQ & WP	About 18 years of experience in the field of Environmental Management and Environmental Chemistry
5	Mr. K. Rajeshwar	MSC. Applied Geology	Sr. Scientist	Expert	FAE–HG & Geo	About 13 years of experience in the field of geology and Hydrogeology
6	Mr. Ch. Narendra	M.S.W	Group Leader	Expert	FAE-SE	About 9 years of experience in the field of Social Impact Assessment Studies
7	Ms. D Svega	M. Tech. (Env.)	Environmental Engineer	Expert	FAE-WP	About 8 years in the field of Environment Management and Engineering.
8	Mr. Swarup Kumar Samal	B Tech. (Env. Engg.)	Environmental Engineer	Team Member	TM for AP & NV	About 8 Years of Experience in EIA study and Environmental Management
9	Mr. K Sudarshan	M. Tech. (Env.)	Environmental Engineer	Team Member	TM for AP	About 1 year of experience in in the field of Environmental Management and Environmental Engineering
10	Mr. Anup Nikhil Balaji	M. Tech. (Env.)	Environmental Engineer	Team Member	TM for AQ	About 3 years of experience in Environment and Air Dispersion Modeling
11	Mr. J. Ramakrishna	I.T.I (Civil)	Engineer	Cartography	--	About 20 years of experience in the field of environmental management and civil drawings
12	Mr. P. Niranjan Babu	B. Com	Dy. Manager	Secretarial Support	--	About 31 years of experience in the field of environmental monitoring and secretarial support
Empaneled Experts						
13	Mr. J. Rajendra Prasad	M.Sc. (Applied Geology)	Empaneled Expert	Expert	FAE- HG, Geo & LU	About 20 years of experience in the field of land-use and land-cover, satellite data interpretation and detailed hydrology & hydrogeology (representing multi-tech services)
14	Mr. Rajgopal Krishnan	M.Tech (Chemical Engineering)	Empaneled Expert	Expert	FAE for RH	About 46 years of experience in the field of risk assessment and hazardous management
15	Prof. K. Bayyapu Reddy	M.Sc., Ph.D	Empaneled Expert	Expert	FAE for EB & SC	About 45 years of experience in the field of Ecology and Biodiversity and Soil Conservation

Sr. No.	Name	Qualification	Position	Contribution in Current EIA	Expertise/Functional Area	Experience
16	Mr. Dr. Y. Ramamohan	M. Sc, Ph.D	Empaneled Expert	Expert	FAE for LU	About 18 years of experience in land use & remote sensing

FAE – Functional Area Expertise

SC - Soil Conservation
GEO – Geology
AP – Air Pollution
AQ – Air Quality (Modeling)
WP – Water Pollution
EB – Ecology and Biodiversity
RH – Risk and Hazardous Waste Management
NV – Noise and Vibrations
LU/LC- Land use and land cover
SHW – Solid and Hazardous Waste
SE – Socio-Economic
HG – Hydrogeology

12.2.7 Details of Additional Studies Conducted For NMIA

A number of additional studies have been conducted to address specific ToR conditions and for operational requirement of NMIA. Such studies have been conducted by institutes/organizations of repute having expertise in sectoral aspects. Some of the important studies are highlighted below:

Central Water and Power Research Station (CWPRS)

The Coastal & Offshore Engineering Laboratory of CWPRS is engaged for carrying out the physical model study by extending the existing Mumbai model to cover the airport area and to carry out the tidal model study to determine the best hydraulically suited shape of reclamation for the proposed airport;

The review of the drainage master plan of NMIA, flood risk assessment has been studied and recommendations are issued by CWPRS. The drainage pattern and grading concept plan are designed as per CWPRS and MoEF&CC recommendations.

Bombay Natural History Society (BNHS)

The terrestrial ecology and bio-diversity studies in the nearby eco-sensitive zone has been conducted by BNHS with special emphasis on the avi-fauna. Further BNHS has been engaged by CIDCO to monitor the avi-fauna behaviour and implement a conservation plan appropriate for NMIA.

Intervistas Consulting (InterVistas)

A detailed air traffic forecast study has been carried by Intervistas Consulting in association with NMIAL for a period between 2018 and 2058 till the final phase development of the airport. The study findings have been submitted to CIDCO to identify the phase-wise passenger/cargo handling capacity in each phase of the NMIA terminal operations.

Lea Associates South Asia Pvt Ltd (LASA)

A detailed traffic management and de-congestion plan for NMIA was carried out by M/s.LEA Associates South Asia Private Limited, India in association with MSRDC and CIDCO. The study intends to assess the level of service in the important traffic junctions and connecting roads to NMIA in the future while addressing appropriate infrastructure development projects for traffic decongestion within 5 km of the airport boundary.

Groundwater Survey & Development Agency (GSDA)

GSDA, Govt. of Maharashtra, was engaged in conducting the hydro-geological study of the project study area and the impact of river diversion on local drainage pattern and groundwater levels. The study findings and recommendations were addressed in the design of the NMIA master plan.