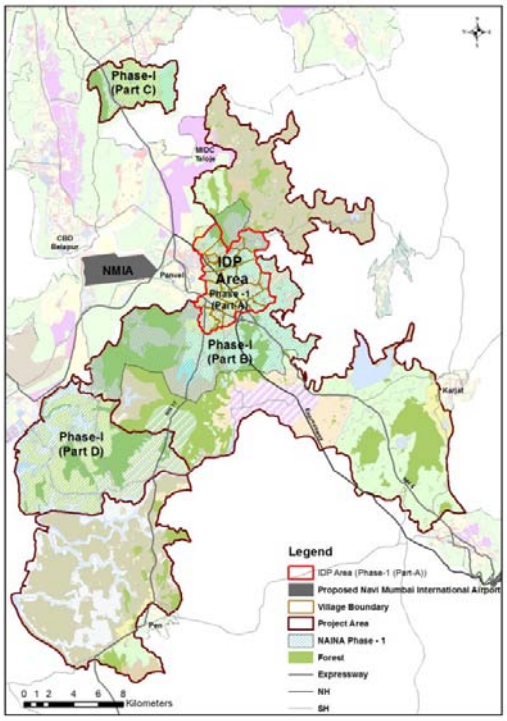
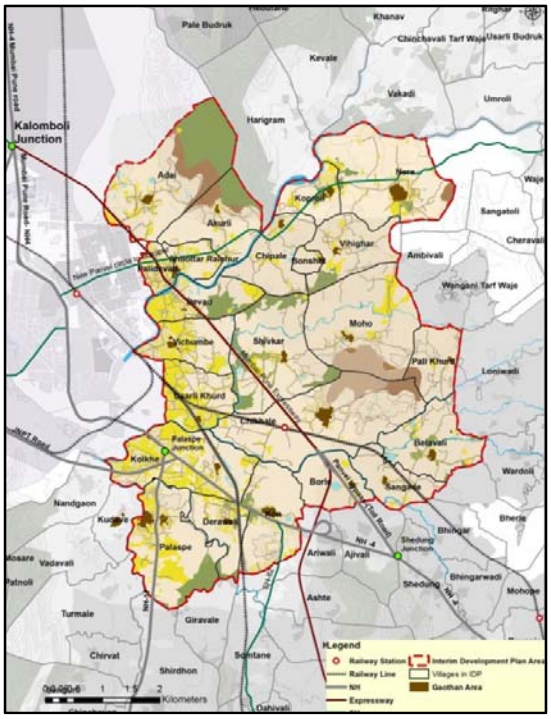
DRAFT INTERIM DEVELOPMENT PLAN

FOR PARTOF NAVI MUMBAI AIRPORT INFLUENCE NOTIFIED AREA (NAINA)
(23 Villages in Panvel Taluka)





CITY AND INDUSTRIAL DEVELOPMENT CORPORATION OF MAHARASHTRA LTD

SPECIAL PLANNING AUTHORITY FOR NAVI MUMBAI AIRPORT INFLUENCE NOTIFIED AREA

(Appointed by Government of Maharashtra under Section (40)(1)(b) of MR&TP Act 1966on 10th January 2013)

August, 2014

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AMC	Ambarnath Municipal Council
AKBSNA	Ambarnath, Kulgaon-Badlapur Surrounding Notified Area
CBD	Central Business District
CIDCO	City and Industrial Development Corporation of Maharashtra Ltd
CR	Central Railway
CRZ	Coastal Regulation Zone
CSIA	Chhatrapati Shivaji International Airport
CTS	Comprehensive Transport Study (known as TransForm)
DCR	Development Control Regulations
DEA	Department of Economic Affairs
DFC	Dedicated Freight Corridor
DMRC	Delhi Metro Rail Corporation
DP	Development Plan
DPR	Detailed Project Report
ELU	Existing Land Use
EIA	Environmental Impact Assessment
ES	Environmental Status
FOB	Foot Over Bridge
FSI	Floor Space Index
FY	Financial Year
GA	Growth Area
GIS	Geographical Information Systems
GoI	Government of India
GoM	Government of Maharashtra
GPS	Global Positioning System
HA	Hectare
JNPT	Jawaharlal Nehru Port Trust
KMCL	Karjat Municipal Council
KDMC	Kalyan Dombivli Municipal Corporation
KHMCL	Khopoli Municipal Council
KNT	Khopta New Town
MMC	Multi-Modal Corridor
MMCL	Matheran Municipal Council
MCGM	Municipal Corporation of Greater Mumbai
MIDC	Maharashtra Industrial Development Corporation
MESZ	Matheran Eco-Sensitive Zone
MISEZ	Mumbai Integrated Special Economic Zone
MJP	Maharashtra Jeevan Pradhikaran
MJPRCL	Mumbai-JNPT Port Road Company Limited
Mld	Million Litres/day
MMB	Maharashtra Maritime Board
MMR	Mumbai Metropolitan Region
MMRDA	Mumbai Metropolitan Regional Development Authority
MoEF	Ministry of Environment & Forest
MPC	Metropolitan Planning Committee
MR&TP Act	Maharashtra Regional and Town Planning Act, 1966
MSEDCo	Maharashtra State Electricity Distribution Company Ltd
MSRDC	Maharashtra State Road Development Corporation Limited

MSRTC	Maharashtra State Road Transport Corporation
MTHL	Mumbai Trans Harbour Link
MWSSB	Maharashtra Water Supply and Sewerage Board
UMTA	Unified Metropolitan Transportation Authority
MTHL	Mumbai Trans Harbor Link
MUD	Ministry of Urban Development
MUIP	Mumbai Urban Infrastructure Project
MUTP	Mumbai Urban Transport Project
NH	National Highway
NMIA	Navi Mumbai International Airport
NMMC	Navi Mumbai Municipal Corporation
NMSEZ	Navi Mumbai Special Economic Zone
NAINA	Navi Mumbai Airport Influence Notified Area
NSDP	Net State Domestic Product
NSSO	National Sample Survey Organization
NTDA	New Town Development Authority
NUTP	National Urban Transport Policy
O&M	Operations and Maintenance
OD	Origin Destination
PLU	Proposed Land Use
PPP	Public Private Partnership
PAMCL	Panvel Municipal Council
PMCL	Pen Municipal Council
PU	Phase/ Planning Unit
R&R	Resettlement & Rehabilitation
RP	Regional Plan
RTS	Rapid Transit System
SEZ	Special Economic Zone
SH	State Highway
SPA	Special Planning Authority
TMC	Thane Municipal Corporation
TPS	Town Planning Scheme
TPD	Tonnes per day
TRB	Transport Board
TTC	Trans Thane Creek
ULB	Urban Local Body
WFPR	Work Force Participation Rate

1. INTRODUCTION

1.1 BACKGROUND

CIDCO has been engaged in developing Navi Mumbai as a counter-magnet to Mumbai since 1970. The existing airport at Mumbai, was fast reaching saturation and scope for further enhancement of passenger and cargo handling facilities along with aircraft maintenance and city side facilities appeared very limited.

Therefore a second airport in the Mumbai Metropolitan Region (MMR) became crucial. The air travel demand forecasts indicated that demand will grow from 30 million passengers per annum in the year 2012-13 to over 100 million passengers per annum by 2030-31. The Mumbai airport alone will be unable to handle such an increase in demand. It was therefore imperative to build a second Airport for MMR. To meet the growing demands of air travel, following the policy of Greenfield airports in PPP mode, CIDCO initiated studies of locating the airport within Navi Mumbai and selected a location close to the mouth of Panvel Creek.

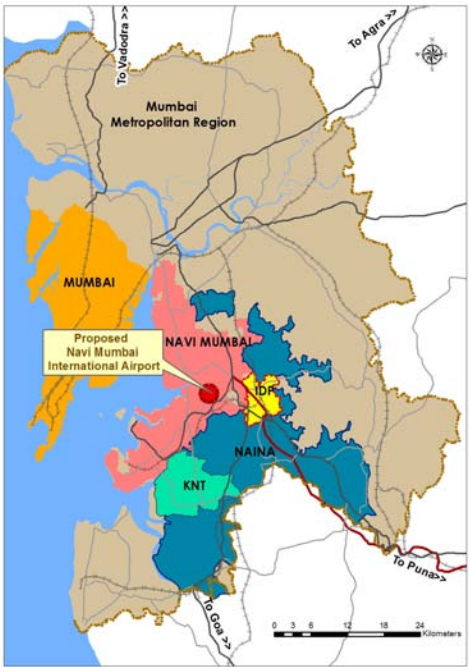

Figure 1-1: Location of NAINA in MMR

1.2 NAVI MUMBAI AIRPORT INFLUENCE NOTIFIED AREA (NAINA)

CIDCO successfully sought approvals for the proposed International Airport in Navi Mumbai from Government of Maharashtra, Ministry of Civil Aviation and Ministry of Environment & Forest, Government of India. While granting the Environmental and Coastal Regulations Zone (CRZ) clearances to the proposed Greenfield airport on 22nd November, 2010, Ministry of Environment & Forest (MoEF), Government of India, expressed concern about unplanned and haphazard development around Airport within 20 km of the airport. In pursuance of these concerns, Government of Maharashtra notified the area around the proposed airport, identified as "Navi Mumbai Airport Influence Notified Area (NAINA)" and appointed CIDCO as the Special Planning Authority (SPA) for the same[1].

[1] CIDCO was appointed as SPA for NAINA, by GoM under Section 40.1 (b) of MR&TP Act, 1966 through Govt. Notification No. TPS-1712/475/CR-98/12/UD-12 dated 10th January, 2013. It covers 270 villages (256 from Raigad District and 14 from Thane District of Maharashtra). The total area of NAINA is about 570 km^2.

NAINA comprises 270 revenue villages from Uran, Panvel, Karjat, Khalapur, and Pen Talukas of Raigad district and Thane Taluka of Thane district of Maharashtra. Out of which, 217 are full revenue villages. Remaining 54 are part revenue villages. Together, it has an area of approximately 56,172 ha (561sq.km).

1.3 NEED FOR INTERIM DEVELOPMENT PLAN (IDP)

For SPA, it is mandatory to prepare Development Plan (DP) within 3 years from the date of appointment under Section 21 of MR&TP Act, 1966. Given the extensive area of NAINA and the content and procedure of preparing Development Plan as laid down in the MR&TP Act, 1966 the preparation of full-fledged Development Plan would require considerable time. It is therefore decided to prepare an Interim Development Plan (IDP) for a part of NAINA as enabled by MR&TP Act 1966.

Testing of Innovative Land Development Model: An innovative concept that promotes voluntary land assembly, contributes land for public purposes, finances infrastructure development, has been developed by CIDCO for NAINA. However, this concept needs to be tested quickly in the real world, with regard to its applicability and acceptability by the landowners and developers in NAINA.

Development Pressure: At present, development is guided by the MMR Regional Plan (RP), which permits limited development around Gaothans. However, area near Panvel due to its proximity to Panvel, emerging major railway station and the proximity to proposed airport is experiencing relatively accentuated activity. To manage such development pressures, provisions of MMR RP are not adequate and legal provisions by way of IDP and Development Control Regulations (DCR) are considered to be necessary. Based on the above two considerations, it is proposed to prepare an (IDP) for part of NAINA as provided under section 32 of the MR&TP Act, 1966.

1.4 SELECTION OF IDP AREA

1.4.1 CRITERIA FOR SELECTION

The area covered in IDP is based on the following considerations:

a) **Proximity to Navi Mumbai -** CIDCO has provided adequate infrastructure facilities in Navi Mumbai Area. The IDP area was selected in such a way that existing infrastructure network of Navi Mumbai can be extended to the proposed development. Hence, an area was selected in congruity to Navi Mumbai.

b) **Availability of Transport Network-** The existing and proposed transport network is an important indicator for assessing the early potential for growth where new model of land development could be tested. The existing National Highways, State Highways, proposed Multi-Modal Corridor (MMC), proposed Mumbai-Vadodara Spur, existing suburban rail network and proposed metro network etc, were considered to delineate the IDP area.

c) **Development Pressure –** CIDCO as SPA receives proposals for Development Permission in NAINA. In addition to this, cases of Non-Agriculture (NA) permission are directed by Collector to CIDCO seeking their remarks. Further, Special Township Projects (STPs) and Rental Housing Scheme locations are also known to CIDCO which are good indicators of urbanization pressure for development.

1.4.2 EXTENT OF COVERAGE IN IDP

d) Based on the criteria explained above, the area for IDP is selected. It comprises 23 villages with an area of 3683.09 Ha. This comprises two part villages namely Nere and Vihighar. Remaining all are

full revenue villages. The list of villages along with geographical area details are given in Table 1-1 and Figure 1-2 depicts the location of IDP Area in NAINA. The term "Project Area" in this document refers to whole of "NAINA & KNT".

Table 1-1: List of Villages covered within IDP Area

Sl.No	Taluka	Village Name	GIS Area (Ha)[2]
1	Panvel	Adai	308.40
2	Panvel	Akurli	167.24
3	Panvel	Belavali	159.31
4	Panvel	Bonshet	20.15
5	Panvel	Borle	100.40
6	Panvel	Chikhale	357.17
7	Panvel	Chipale	132.45
8	Panvel	Derawali	90.97
9	Panvel	Devad	114.55
10	Panvel	Kolkhe	228.53
11	Panvel	Kon	168.24
12	Panvel	Koproli	76.25
13	Panvel	Moho	306.89
14	Panvel	Nere (Part Village)	291.63
15	Panvel	Palaspe	239.13
16	Panvel	Pali khurd	96.59
17	Panvel	Palidevad	40.82
18	Panvel	Sangade	94.53
19	Panvel	Shilottar Raichur	50.55
20	Panvel	Shivkar	262.57
21	Panvel	Usarli Khurd	123.05
22	Panvel	Vichumbe	118.25
23	Panvel	Vihighar (Part Village)[3]	135.42
		Total	**3683.09**

[2] Areas calculated in GIS platform

[3] Part of Vihighar & Nere village falling in MESZ, as indicated in NAINA Gazette Notification dated 10th January 2013

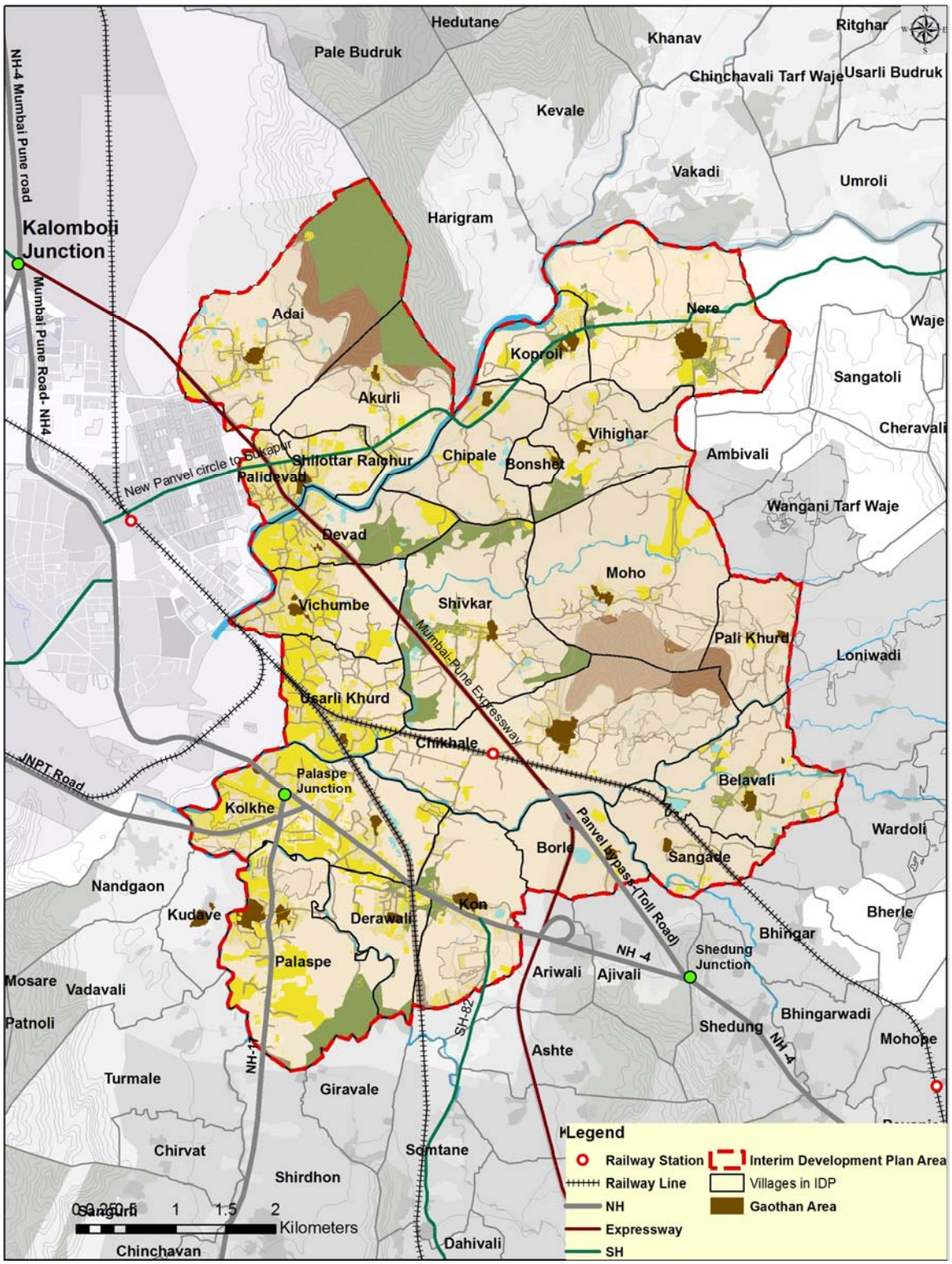

Figure 1-2: Villages covered in IDP Area

1.5 PROCEDURE AND CONTENT OF IDP AS PER MR&TP ACT, 1966

Preparation of IDP is enabled by the provisions under section 32 of the MR&TP Act, 1966. The timeline for IDP is given in Table 1-2.

Table 1-2: Procedure for preparation of IDP as per MR&TP Act, 1966

MR&TP Act, 1966 Clause No.	Description	Date/ Due date
40 (1) (b)	Appointment of SPA for Notified Area	10-01-13
23 (1)	Date of Declaration of Intention for preparation of DP	12-05-14
32/25	Carry out survey and Prepare Existing Land Use (ELU)	15-07-14
32/26(1)	Publish a Notice, Prepare & Publish Draft IDP	15-08-14
32/28(1)	Consideration of suggestion objection	4 Months
	• Receiving of Suggestion/ Objection	15-09-14
32/28(2)	• SPA to constitute Planning Committee (PC)	15-09-14
	• SPA to Forward Suggestion/ Objection to PC	15-09-14
32/28(3)	• PC to give hearing & prepare Report and submit to SPA	15-11-14
	• SPA to incorporate PC Report	15-12-14
32/30(1)	Submission of Draft IDP along with list of modification to Government for approval	09-01-15

Source: MR&TP Act, 1966

In terms of the content of IDP, the requirements stated in clauses (a), (b) and (c) of section 22 of MR&TP Act, 1966 are mandatory.

a) Proposals for allocating the use of land for purposes, such as residential, industrial, commercial, agricultural, recreational;

b) Proposals for designation of land for public purpose, such as schools, colleges and other educational institutions, medical and public health institutions, markets, social welfare and cultural institutions, theatres and places for public entertainment, or public assembly, museums, art galleries, religious buildings and government and other public buildings as may from time to time be approved by the State Government;

c) Proposals for designation of areas for open spaces, playgrounds, stadia, zoological gardens, green belts, nature reserves, sanctuaries and dairies.

Other discretionary features covered in IDP are transport and other infrastructure, DCR, estimates of cost of implementing IDP, estimates of revenue likely to be generated through various fees, charges and premium.

2. EXISTING PROFILE OF IDP AREA

2.1 INTRODUCTION

The chapter describes the location and regional setting of IDP Area. It also briefly describes the topography, soil conditions, climate and geomorphology and current demographic characteristics. The chapter also presents a brief description of existing land use of the IDP area including residential, commercial, industrial, agricultural, water bodies, forests, hills, vacant lands etc, based on analysis of existing land use survey and field observation. Further, assessment of social infrastructure facilities is also described including education, health, socio-cultural facilities to understand the availability of infrastructure in 23 villages. Besides, status of physical infrastructure such as water supply, sewerage, storm water drainage, solid waste management and power supply has been assessed.

Furthermore, existing road network with respect to NAINA and MMR has been given to understand the connectivity to other areas. 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 sub-region. Some of the major projects planned through various studies in the past which are relevant for the area have also been briefly described.

2.1.1 LOCATION, REGIONAL SETTING AND ENVIRONMENTAREA AND LOCATION

As mentioned in Chapter-1, the IDP area comprises 23 villages and accounts for about 6.3% of total NAINA area (56,172 ha). All these villages are from Panvel Taluka of Raigad District. The IDP area is located near New Panvel town, ONGC colony and Kalamboli junction. Major landmarks in the IDP area are Chikhale railway station and Palaspe Junction. The major roads passing through this area are NH-4, Panvel bypass road and Mumbai-Pune expressway. Geographical location of IDP Area is shown in Annexure 2-1.

2.1.2 REGIONAL SETTING

In terms of geography, the region extends from Adai, Akurli, Koproli and Nere villages in the North to Palaspe, Derawali and Kon at the South. The east-west spread is about 5 km from Vichumbe to Moho. The region is a mix of flat and hilly areas with Kalundre, Kirki and Gadhi rivers passing through and number of natural water bodies exists within the villages.

The area of IDP is located in the rapidly urbanising zone of NAINA around Panvel. Panvel Railway Station is the nearest and most efficient transit facility for the area. Majority of the villages are connected with and dependent on Panvel railway station for regional connectivity. Peripheral villages like Chikale, Moho, Palikhurd, Bonshet, Vihighar, and Nere are distant from Panvel railway station. Villages such as Kolkhe, Derawali, Kon, and Palaspe are connected by NH-4 and NH-17.

2.1.3 TOPOGRAPHY

The hill ranges are along Akurli and Adai villages (elevations ranging from 101 to 232 meters from MSL) while other parts are generally flat lands. Major hills are also between Chikhale, Moho and Palikhurd villages (elevations ranging from 71m to 89m from MSL). Map showing slope gradient of IDP area is shown in Annexure 2-2.

2.1.4 SOIL CONDITIONS

Soils in IDP area are formed from the Deccan trap. Depending on the topographical location, various types of these soils are grouped as khar or salt, coastal alluvial and lateritic soils. The forest soils are not used for agricultural purposes but yield valuable forest products such as teak-wood, hirda (Myrobalan), beheda, pepper, etc. However, these soils are heavily eroded due to grazing and cutting of the forest trees.

Major part of the IDP area is covered by the rice field, which are loamy in texture; yellowish or reddish grey in colour, neutral in reaction and almost devoid of lime. They are formed from the trap rock from the Sahayadri ranges under heavy rainfall and humid climatic conditions. The sub-soil water level is only 3 to 5 m deep. The salt contents of the well water are higher in the proximity of the sea; but due to excellent drainage, its use has not produced any deleterious effects. The soils are almost neutral or slightly on the alkaline side of neutrality.

2.1.5 GEOMORPHOLOGY

Raigad region has predominantly dark volcanic lava flows and laterites. These are spread out in the form of horizontal sheets or beds and constitute the innumerable spurs, hills and hill ranges; bold, flat topped ridges; lofty peaks and plateaus with impressive cliffs. These hill ranges and plateaus form a part of the Western Ghats. In the plains and valleys the lava flows occur below a thin blanket of soil of variable thickness. Because of their dominantly basaltic composition and the tendency to form flat-topped plateau, the lava are termed plateau basalts. Since these basaltic lava flows cover an extensive region in the Deccan and frequently present step-like appearance to the hills and ridges they are commonly termed as “Deccan traps”. The traps attain a thickness of nearly 750 to 850 m around Matheran and Raigad plateaus, respectively.

2.1.6 CLIMATE

The general climatic regime is fairly equitable since seasonal fluctuations of temperature are not significantly large. The moderating effects of the nearby sea and the fairly high amount of relative humidity in the atmosphere have restricted the variability.

- **Temperature:** The maximum day temperature ranges in between 28°C to 32°C while the minimum temperature ranges in between 17°C to 27°C.
- **Rainfall:** Majority of the rainfall in the region is from the South–West monsoon between June and September. In Raigad district, the average annual rainfall for the district as a whole is 3,028.9 mm (119.25"). The rainfall increases rapidly from the coast towards the Western Ghats on the eastern border of the district.

2.2 DEMOGRAPHIC & ECONOMIC PROFILE

2.2.1 POPULATION GROWTH

The IDP area has a population of 65,063 with an annual average growth rate (AAGR) of 6.7% as per 2011 census. The area has recorded fast growth since 1981, which is evident from Figure 2-1. Among the 23 villages, Devad has recorded the fastest growth (19.7%) followed by Vichumbe (19.3%) and Koproli the lowest (0.5%). Population of villages located near to Panvel railway station and having good connectivity and accessibility have larger population.

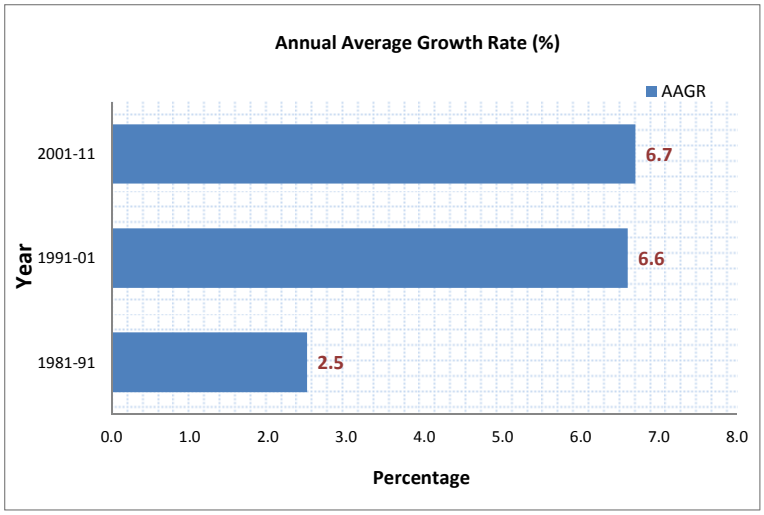

Figure 2-1: Annual Average Growth Rate of Population of IDP Area (%)

These villages are closely knit together and densely developed due to the provisions of 200m urban village schemes. The annual average growth rate in IDP area is shown in Table 2-1. Population distribution within IDP area is given in Annexure 2-3.

Table 2-1: Population and Annual Average Growth Rate, 1981 to 2011

Sl.No	Village	Population 1981	Population 1991	Population 2001	Population 2011	AAGR (%)		
						1981-91	1991-01	2001-11
1	Adai	1,222	1,396	1,976	3,358	1.4	4.2	7.0
2	Akurli	672	532	1,391	3,344	-2.1	16.1	14.0
3	Belavali	1,063	1,350	1,422	1,660	2.7	0.5	1.7
4	Bonshet	278	335	421	550	2.1	2.6	3.1
5	Borle	599	676	777	890	1.3	1.5	1.5
6	Chikhale	908	1,236	1,937	1,899	3.6	5.7	-0.2
7	Chipale	563	667	988	1,629	1.8	4.8	6.5
8	Derawali	461	649	926	1,205	4.1	4.3	3.0
9	Devad	583	706	1,082	3,210	2.1	5.3	19.7
10	Kolkhe	1,236	1,768	2,964	4,657	4.3	6.8	5.7
11	Kon	960	1,158	1,690	2,187	2.1	4.6	2.9
12	Koproli	270	378	974	1,026	4.0	15.8	0.5
13	Moho	1,031	1,266	1,535	1,822	2.3	2.1	1.9
14	Nere	1,987	2,303	3,221	3,569	1.6	4.0	1.1
15	Palaspe	1772	2,304	3075	5,086	3.0	3.3	6.5

Sl.No	Village	Population 1981	Population 1991	Population 2001	Population 2011	AAGR (%)		
						1981-91	1991-01	2001-11
16	Pali Kh	319	401	532	531	2.6	3.3	-0.02
17	Palidevad	526	1017	4900	9194	9.3	38.2	8.8
18	Sangade	576	727	724	871	2.6	0.0	2.0
19	Shilottar Raichur	328	662	2028	5796	10.2	20.6	18.6
20	Shivkar	1271	1514	1,946	2,464	1.9	2.9	2.7
21	Usarli Kh	477	643	1,114	2,608	3.5	7.3	13.4
22	Vichumbe	832	902	2,163	6,332	0.8	14.0	19.3
23	Vihighar	696	731	1,095	1,175	0.5	5.0	0.7
	Total	**18630**	**23321**	**38881**	**65063**	**2.5**	**6.7**	**6.7**

Source: Compiled from Census of India.

2.2.2 POPULATION STRUCTURE AND DISTRIBUTION

2.2.2.1 POPULATION DENSITY

The IDP area is closely located near Panvel urban area. Majority of population distributed in Gaothans and spread sporadically at peripheries of villages. Villages including Palideved, Shilottar Raichur, Devad and Vichumbe are densely populated and areas within 200m from Gaothans are relatively fast growing areas in the IDP area. Average population density recorded in IDP area is about 18 persons per hectare. Palideved and Shilottar Raichur villages are highly dense with of 226 and 116 persons/ha respectively (Refer Annexure 2-4). Figure 2-2 presents the population density by village in IDP area.

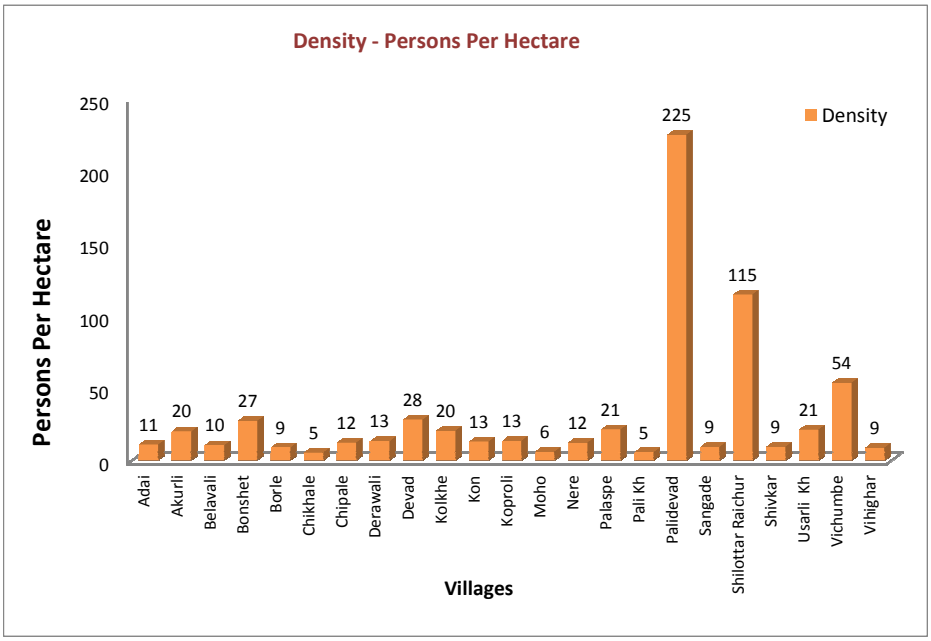

Figure 2-2: Population Density – Persons Per Hectare

2.2.2.2 SC & ST POPULATION

The share of Scheduled Castes (SCs) and Scheduled Tribes (STs) population account for 9.4% and 3.4% respectively. Amongst all villages, Palideved has the highest share of SC population (18.7%), followed by Vichumbe with 16.6%. Amongst STs, Derawali village has the highest share (17.2%) followed by Palideved with 13.5% (Refer Annexure 2-5 for SC and ST population by village).

2.2.2.3 LITERACY RATE

The IDP area has an average literacy rate of 73.8%, which is relatively high than the State and National average literacy rates of 72% and 64.8% as per 2011census. Among all villages, Palideved has highest literacy rate of 81.8% followed by Shilottar Raichur (78.5%), Chipale (78.5%). Refer Annexure 2-6 for literacy rates by village.

2.2.3 ECONOMIC BASE

In general, economic base of the villages is non-irrigated agriculture and its allied activities. However, villages located near Panvel area and along NH-17 and NH-4, have some service and manufacturing industries. This section presents briefly on major economic activities, occupational structure, workforce participation rate and employment pattern of IDP area as observed in census 2011.

2.2.3.1 MAJOR ECONOMIC ACTIVITES

The major non-agricultural economic activities such as logistic hubs, warehousing, other service industries are mainly concentrated in Kolkhe, Derawali and Palaspe villages. NH-17, NH-04 and Diva-Panvel rail line are the major transportation networks passing through these villages have created opportunities to develop these non-agricultural economic activities. Restaurants, hotels, banks, brick kilns have developed along either side of the Panvel-Matheran road at Palideved and Shilottar Raichur villages.

Devad, Vichumbe and Usarli Khurd are the villages influenced by Panvel given its local level commercial activities. Agricultural activities, local commercials such as flour mills, iron gills and fence fabrication units, brick kilns, construction activities are the other non-agricultural activities in rest of villages.

2.2.3.2 OCUPATIONAL STRUCTURE AND WFPR

The workforce participation rate (WFPR) in the IDP area is nearly 40% with a total of about 25,350 workers. Among the total workers, 87.4% are main workers and remaining are marginal workers. Bonshet and Chipale villages have the highest percentage of WFPR of 48% and 46% respectively. The work participation rate in this area reveals the predominance of migrant workers (see Annexure 2-7). Workforce participation rate is given in Figure 2-3.

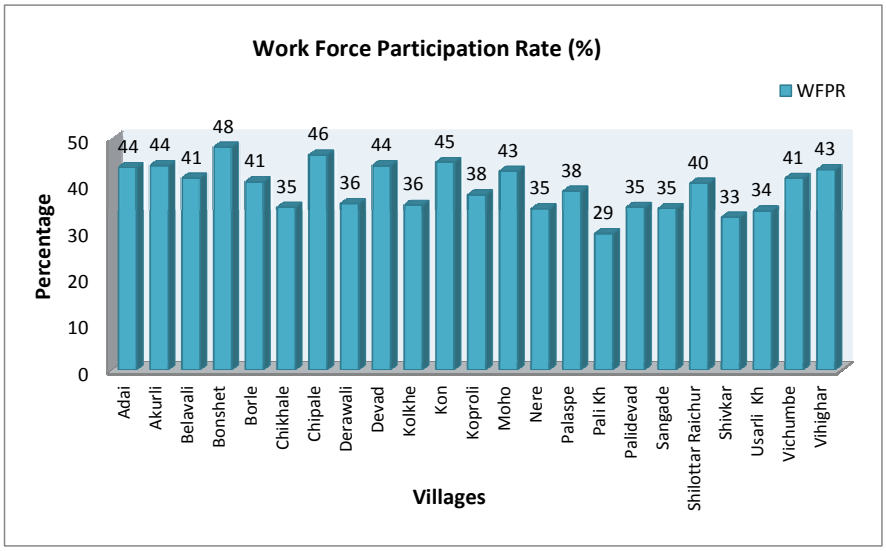

Figure 2-3: Work Force Participation Rate (%)

2.2.3.3 EMPLOYMENT PATTERN

Of the total workers of 25,350 in the IDP area, 13.4% of workers are engaged in cultivation, 3.8% of workers are agricultural labourers, 3.8% are household labourers and 79 % are others. Details of non-irrigated agriculture employment are given in Annexure 2-8.

2.3 EXISTING TRANSPORT NETWORK

2.3.1 REGIONAL ROAD NETWORK

The area is well connected mainly by inter-city roads (NHs, SHs, MDRs/ ODRs) with various Municipal Corporations/Councils and villages located in rest of NAINA and MMR. Existing road network of the area and connectivity to the rest of NAINA and MMR is given in Annexure 2-9. National Highways, State Highways and Mumbai-Pune Expressway are the major corridors which provide fast transport connectivity within the IDP Area.

The area has about 62.2 km of major road network which are inter-city/ sub-regional roads providing connectivity between IDP area and rest of NAINA and MMR. NH-04 and NH-17 and several State Highways traverse through this area. In addition, Mumbai-Pune Expressway also traverses through the area. It is important to mention that the area has good regional connectivity with Greater Mumbai, MMR.

The Mumbai-Pune Expressway, NH-4 and NH-17 are fairly maintained as they are the major regional roads. The condition of major roads is good as these are well maintained in most cases. The State Highways in the area, the most important being Panvel Matheran Road (SH-54) is narrow and is inconsistently maintained.

Of the total road network, National Highways (NH-4 and NH-17) together constitute nearly 8.8 km (14%) while State Highways make up for about 6.6 km (10.6%) of the total length. Besides National Highways and State Highways, nearly 6.4 km (10.3%) of the Mumbai-Pune Expressway also passes through the area. Major District roads constitute for 0.1 km (0.2%) and other roads aggregating to a length of about 40.3 km (64.8%) also passes through the area. A detailed breakup of the transportation network is presented in Table 2-2.

Table 2-2: Major Road Network Details in IDP Area

Road Category	Length in km	Percentage
Expressway	6.4	10.3
National Highways	8.8	14.1
State Highways	6.6	10.6
Major District Roads	0.1	0.2
Other Roads	40.3	64.8
Total	**62.2**	**100**

Source: Based on the available base map

Existing Condition of Mumbai-Pune Expressway

Existing Condition of NH - 04

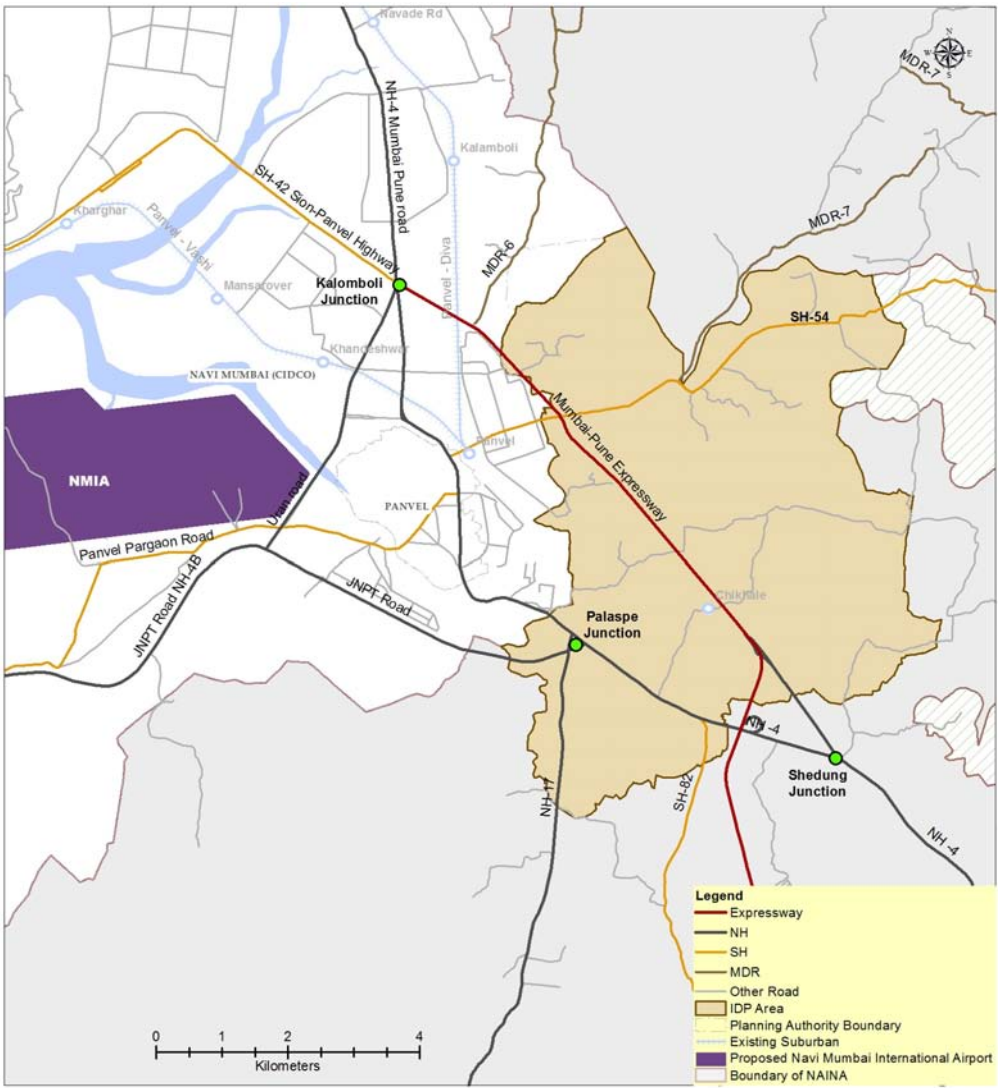

Figure 2-4: Existing Road Network within IDP Area

2.3.2 REGIONAL SUB-URBAN RAIL NETWORK

There are no existing suburban rail operations within the IDP area. However, Central Railway provides suburban rail services between Island city and Navi Mumbai through harbour line. The IDP Area is served by very limited suburban railway network i.e. through CST-Panvel suburban railway line, Vashi-

Thane suburban railway line and shuttle services on Diva-Panvel and Diva-Vasai-Virar corridors (see Figure 2-5). Total length of railway traversing through the area is about 9 km. The existing Panvel-Karjat line is about 5.3 km and the Panvel-Wadkhal line is about 3.7 km. presently these lines facilitate inter-city passenger and freight services. Suburban services are proposed along these lines.

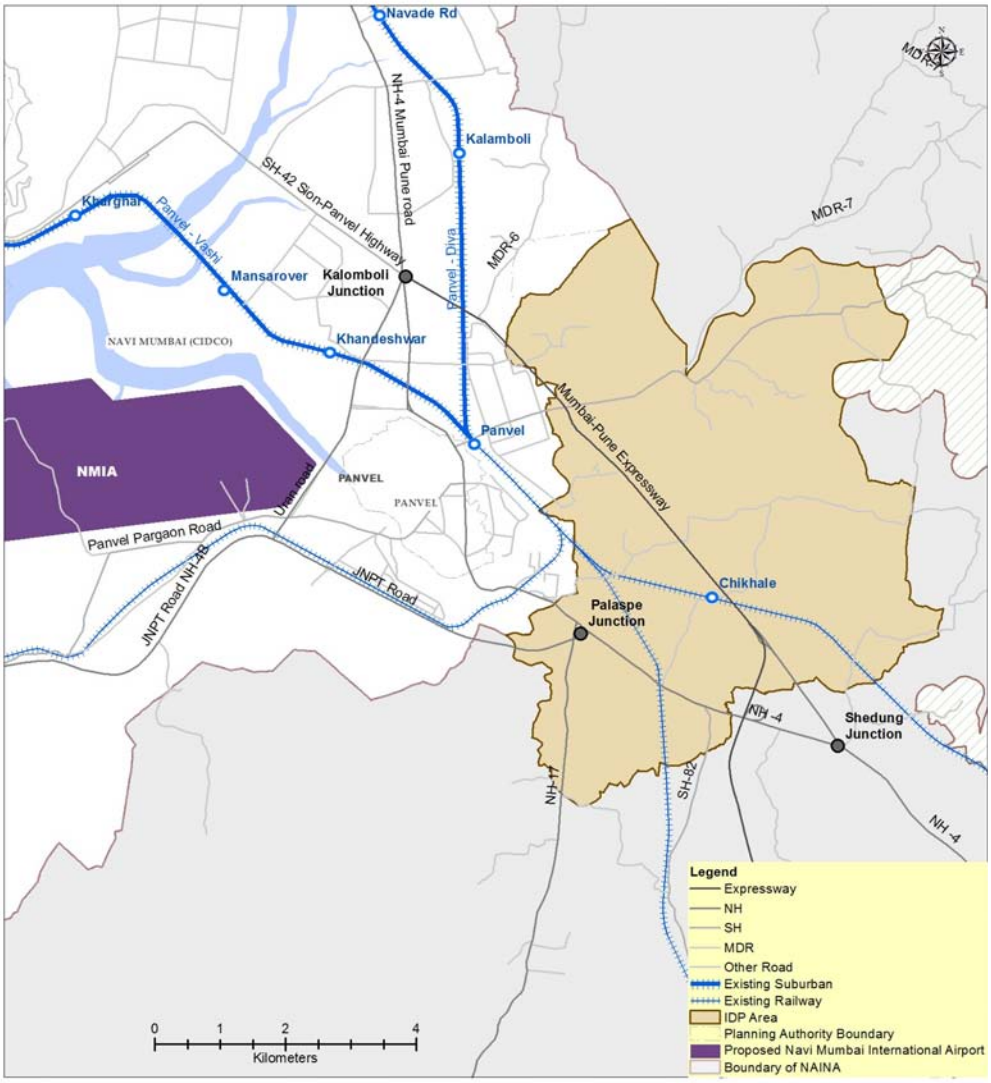

Figure 2-5: Existing Railway Network within IDP Area

Following are the important proposed/ committed areas of development under several past studies undertaken which would directly impact the IDP area (see Annexure 2-10).

a) **Proposed Road Network:** IDP Area shall have an enhanced regional road network connecting several parts of MMR and beyond with the following proposed/ committed road network;
   - Mumbai-Vadodara SPUR: The alignment of Mumbai-Vadodara Spur in MMR is under implementation by NHAI which starts in Virar and ends in Panvel. This corridor has been planned for fast movement of port related inter-city traffic (JNPT);
   - Multi-Modal Corridor (MMC): One of the major recommendations of Comprehensive Transport Study-MMR was the concept of development of MMC in MMR. MMRDA has planned MMC from Virar to Alibag (about 140 km) following the existing as well as the proposed highway corridors to provide a faster connectivity with the ULBs located outside

Greater Mumbai and increase the accessibility to inter-city freight traffic. MMRDA initiated the detailed feasibility study for the MMC corridor and the study is in progress. Part of the MMC traverses through the area and it provides good regional connectivity to NMIA as well as rest of NAINA;

In addition to above regional road/ highway connectivity, the IDP Area would include the new arterial/ sub-arterial/ local roads to provide the local travel needs and sub-regional travel needs.

b) **Proposed Transit (Suburban and Metro) Network**
   - **Metro Rail:** Presently, there is no Metro line operational in the area. Metro lines proposed in Navi Mumbai will impact the growth and connectivity of the IDP area. CIDCO has undertaken construction of the first Metro line in Navi Mumbai from Belapur to Pendhar which is proposed to be extended southwards up to NMIA. Also additional metro corridor between Mankhurd and Ghatkopar has been proposed which will be extended up to Panvel via NMIA, thus providing a fast metro connectivity between eastern suburbs of Greater Mumbai and Panvel. As part of the present study, it is proposed to extend the Mankhurd-NMIA-Panvel metro line into IDP.
   - **Suburban Rail Connectivity:** Existing Diva-Panvel line and Panvel-Karjat-Khopoli line are proposed to have regular suburban commuter transit as part of priority projects by MRVC. Anticipating huge population and employment growth in Navi Mumbai and surrounding areas and upcoming NMIA, MRVC has carried out detailed techno-economic feasibility for suburban operations from Vasai to Diva and Diva to Panvel as well as in-house technical feasibility study for the operation of suburban rail services from Panvel to Karjat as this corridor would serve the local as well as regional commuter traffic.

c) **Proposed MTHL**: The proposed Mumbai Trans Harbour Link (MTHL), which connects Sewri (in Island city of Mumbai) to Nhava Sheva (Main land) is planned with the basic objective of (a) development of Mainland and reducing pressure on Mumbai City; and (b) facilitate decongestion efforts by Improving connectivity between Island city and main land. MTHL along with Eastern Freeway (which is recently opened for traffic) on Island city side and existing & planned new roads (ex. Coastal road) on Main land side would provide fast connectivity to proposed NMIA and NAINA.

d) **Proposed NMIA:** Potential catchment of the NMIA is expected to be mainly MMR and areas neighbouring MMR. The pressure on Mumbai airport is not likely to get reduced in the coming years and Pune and Nagpur airports have very limited international flights. Thus the inflow of passengers to the NMIA is expected to be high and as a result the surrounding areas will have the potential for development.

e) **DMICDC:** Government of India (GoI) envisages developing dedicated freight corridor (DFC) between Delhi and Mumbai (originating from JNPT). Under this project, four strategic zones were identified viz. Zone A: Mumbai Metropolitan Region, Zone B: Potential Development Region, Zone C: Potential Growth Corridors and Zone D: Spill over Growth Region. The current NAINA & KNT fall under Zone C and Zone D of the DMICDC region, which adds to development potential.

2.3.3 LOCAL ROAD NETWORK

The local road network is primarily formed by the dense village roads that connect the existing Gaothan settlements to each other. These roads are not more than 6 m in width in most cases. The Panvel-

Matheran Road (SH 54 and proposed SH 103[1]) in the north acts as major connector for many Gaothan settlements such as Shilottar Raichur, Palidevad, Akurli, Chipale, Koproli and Nere. Another road in the north-south direction passing through Sangade, Belavali, and Pali Khurd and Nere villages connects Panvel Matheran road (SH 54) to Shedung Junction. The connectivity to existing settlements from Mumbai-Pune Expressway needs crossing-over. Underpasses and over bridges are present in various locations to facilitate the same. Within the settlements, vehicular roads are minimal and pedestrian pathways form the network. Village level road network in shown in Annexure 2-11.

Some village roads in the intensely developed areas near the major regional roads are well-developed and well-maintained. Village roads that are comparatively in the interior areas away from major regional roads are mostly narrow kuccha roads. The pedestrian pathways within the settlements are well maintained and paved in some cases.


Existing Condition of village roads in intensely developed villages


Existing Condition of village roads in the interiors

2.3.4 BUS SYSTEM

The important bus services used are from the New Panvel Bus Depot and N.M.M.T. Bus Stand in New Panvel to the west of Village Shilottar Raichur and the Bus stand near Shedung Junction. These are outside the IDP area. Palaspe Phata Bus Station in Kolkhe village is a major location for bus services within the IDP area. The services from Palaspe Phata Bus Station provide for Kolkhe and Kon villages along NH-4 and Palaspe along NH-17. The bus services from New Panvel provide services to some villages along Panvel Matheran Road.

The villages along Panvel Matheran Road that have bus services are Shilottar Raichur, Palidevad, Koproli and Nere. Shedung Bus Depot provides bus services in the north-south direction up to Panvel-Matheran Road (SH 54) in village Nere passing through Sangade and Belavali villages in the IDP area. Palaspe Bus Stand along the NH-17. The NMMT provides services from Vashi to Khopoli along NH-4

[1] Road Development Plan 2001-2021, Raigad District Panvel Taluka (PWD)

and from Panvel to Karjat, Khopoli and Rasayani. No known bus services are available in Chikhale, Moho, Shivkar, Borle, Pali Khurd, Bonshet, Vihighar, Chipale, Adai, Akurli, Devad, Vichumbe, Usarli Khurd and Derawali villages. In some villages, where areas are well developed private bus services have been provided as in the case of Mahalaxmi Nagar in Nere village.

2.3.5 LOCAL SUB-URBAN RAILWAY NETWORK

The existing railway lines do not provide suburban rail services. Suburban services are proposed along Panvel-Karjat and Panvel-Wadkhal lines. An existing railway station is present in Chikhale village.

2.3.6 TERMINAL FACILITIES

Bus Terminal facilities such as Palaspe Phata Bus Station in Kolkhe village are present. Nearby Bus Terminals are New Panvel Bus Depot and NMMT. Bus Stand in New Panvel to the west of Village Shilottar Raichur and the Bus Stand near Shedung Junction are present.

2.3.7 PARKING FACILITIES

There are no formal public parking areas in the area. Private vehicles such as cars and two-wheelers are parked within private plots of the owners. Privately owned/ maintained truck parking facilities available in Palaspe and Kolkhe villages.


Localised Parking Areas available within villages

2.3.8 SUMMARY

It is expected that, once the Navi Mumbai International Airport is developed, which is going to trigger the growth of the area, the traffic characteristics are expected to undergo a major change. In addition, the development within the area would need further development of transport network and enhanced regional transport connectivity through suburban rail expansion, metro corridors, and highway corridors.

2.4 EXISTING LAND USE

The existing land use forms the basis for preparation of IDP and is mandatory as per MR&TP Act, 1966. This section on existing land use presents methodology adopted for carrying out survey, analysis of various land uses etc.

2.4.1 SURVEY METHODOLOGY

CIDCO appointed an agency to carry out existing land use (ELU) survey for the part area of NAINA. Extent of area covered under the scope of ELU survey is 294 sq.km. This IDP area is part of ongoing ELU survey area.

2.4.2 SCOPE OF SURVEY

The broad scope of existing land use survey entrusted to a survey agency is as follows;

a) Topographical Survey using Laser Scanning (LiDAR) Technology
b) Collection of Ground Control Points
c) Carrying out and setting up bench marks & reference pillars / stones
d) Contouring
e) Land Use survey
f) Data Processing: All types of Data collected / generated / procured
g) During the survey shall be processed with Digital Elevation Model (DEM) ,
h) Digital Surface Model (DSM) & Processing of Cadastral plans, Satellite Image Processing
i) Preparation of Survey plans / Base map.
j) Preparation of Existing Land Use Map

2.4.3 DISTRIBUTION OF LAND USE

The major land use in the IDP area is non-irrigated agriculture. Environmentally sensitive areas such as forests, hills and water bodies are present. Existing built-up area includes residential, commercial, industrial, public and semi-public land uses. The development within the IDP area is sparse. Comparatively, dense development is in Gaothans. Table 2-3 shows a detailed area statement for the IDP Area.

Table 2-3: Area Statement of Existing Land Use (in Ha)

Sl. No.	Land Use	Area in Ha.	% of Total IDP Area
A	**Non-developable Land**		
1	Forest	230.00	6.245%
2	Water Bodies	86.92	2.360%
3	Steep Hill Slopes (20% and above)	148.96	4.045%
4	Quarry	0.08	0.002%
5	Transport Network*	129.63	3.520%
	Sub-Total of non-developable land	**595.60**	**16.17%**
B	**Existing Built-up Area (Redevelopable Land)**		
6	Residential	411.35	11.170%
7	Commercial	99.36	2.698%
8	Industrial	66.53	1.806%
9	Mixed Use	26.90	0.730%
10	Public and Semi-public Amenities	18.38	0.499%
11	Public Utilities and Facilities	1.75	0.048%
	Sub-Total of existing built-up land	**624.27**	**16.95%**
C	**Developable Land**		
12	Non-irrigated Agricultural	2015.12	54.718%
13	Vacant Land	423.87	11.510%
14	Hill Area (below 20% slope)	9.65	0.262%
15	Recreational	14.21	0.386%
	Sub-Total of developable land	**2462.86**	**66.88%**
D	**Total IDP Area (A+B+C)**	**3683**	**100.00%**

** Transport Network includes existing roads, railways, under-pass, over bridge, etc.*

Source: Based on ELU Survey

The land uses are described in brief.

Largely the area is under agricultural use with 54.71%. Especially the land around Gaothans is primarily agricultural. The agricultural land falls in four categories; cropped land, fallow land, poultry farms and plantation/ vegetated land.

The dense residential areas are in 23 Gaothans. High-rise apartment buildings have developed around Gaothans. The residential development away from Gaothans is sparse. The area under residential use is 11.17% of the total IDP area.

The commercial activities are concentrated along the NH-4. Few commercial uses are also observed along NH-17 and SH-54 (Panvel-Matheran Road). The land under commercial use amounts to 99.36 Ha (2.7%).

Large industrial areas of logistic activities are observed at Palaspa Junction and Palaspa area. Some scattered industrial uses are also seen in the area. These areas amount to 66.53 Ha (1.8%) of the total IDP area. The public and semi-public amenities include the social infrastructure in the IDP area. It includes educational, health care and socio-cultural facilities in the area. The total land under these uses is 18.38 Ha which is approximately 0.5% of the total IDP area. The public utilities include the water supply system, sewerage system, storm water drainage, power supply and solid waste management. The utilities also include necessities such as bus terminus facilities, water treatment plants, overhead water tanks, electric substations, etc. in the IDP area. The area of public utilities in the IDP area is 1.75 Ha (0.05%) which is inadequate. The existing land use pattern within the IDP area is shown in Figure 2-6.

The IDP area comprises a few environmentally sensitive areas such as forests, various water bodies and hills. The details for the same are given below.

a) **Forests:**
An area of 230.00 Ha is under forest as per cadastral records. It is 6.2% of the total IDP area.

b) Water bodies:
Total area of water bodies in the IDP area is 86.92 Ha which includes rivers, lakes, ponds and perennial streams. The important rivers flowing through the IDP area are Kalundre/ Gadhi River and Kirki River. The area under water bodies is approximately 2.4% of the total IDP area.

c) Hills:
Total area of hills in the IDP area is 158.62 Ha. The hill slopes are steep in most areas. Area of hills with slope of 20% and above is 148.96 Ha while the remainder of hills is 9.65 Ha with gradual slopes. Hills are 4.3% of total IDP area.

The IDP area has fairly large parcels of vacant land i.e. where no particular activities take place and are not under any specific use. The area of such land is 423.87 Ha, which amounts to 11.5% of total IDP area.

The IDP area also has other land uses such as mixed use, recreational spaces and quarry. The land under these uses is very less.

a) **Mixed Use:**
This category of use includes land where a number of uses take place simultaneously such as residential and commercial or any other. Land under such uses is 26.90 Ha which is 0.73% of the total IDP area.

b) Recreational Spaces:
The area of land under recreational uses such as playgrounds, parks, gardens, etc is negligible in the IDP area. It is 14.21 Ha which amounts to only 0.4% of the IDP area.

c) Quarry:
A small land area is used for quarrying which is 0.08 Ha which amounts to be negligible percentage.

The transportation network in the area includes the road network and railway network the details for which are given below.

a) **Roads:**
A number of major roads traverse through the IDP area. The Mumbai-Pune Expressway passes through the area. National Highways, NH-4 towards Khalapur, NH-4B towards JNPT and NH-17 towards Goa also pass through the area. The Panvel-Matheran Road (SH-54) passes in the north in the east-west direction. The local network is formed by the major district roads, other district roads and village roads.

b) Railway:
The existing railway lines in the IDP area are Panvel-Karjat line and Panvel-Pen line of the Konkan Railway. There is presently no suburban rail network in the IDP area. Chikhale Railway Station is present in the central part of IDP area.

The total area of transportation in the IDP area is 129.63 Ha, which is 3.5%. The details of transportation network are explained in subsequent sections. The IDP area also has a number of proposals from the CTS study and other authorities for roads, railway services and metro services.

Legend used for showing existing land use is shown in Annexure 2-12.

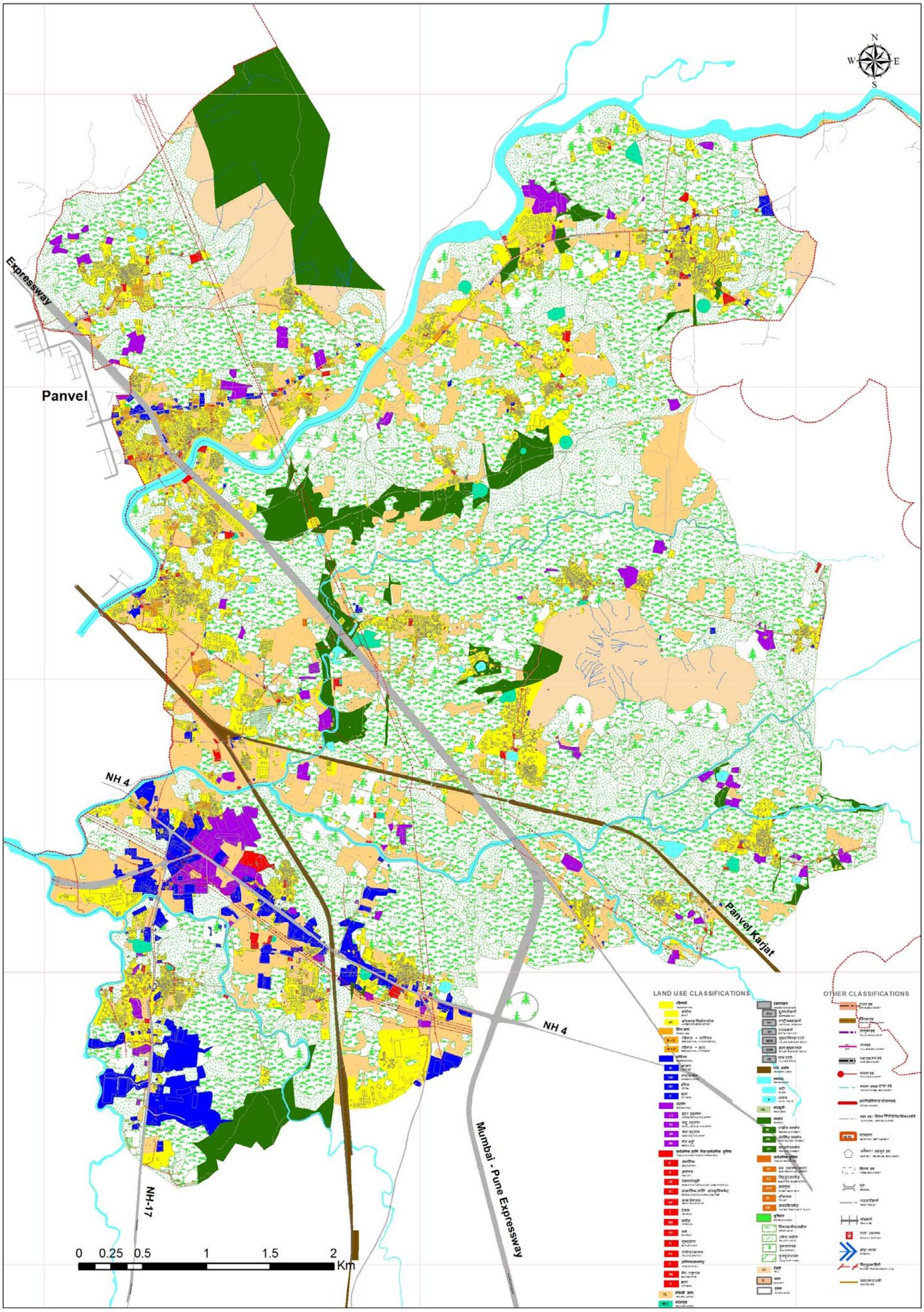

Figure 2-6: Existing Land Use Distribution in IDP Area, 2014

2.4.4 LAND AVAILABLE FOR DEVELOPMENT

The land available for development has been calculated based on the existing land uses mentioned and detailed in the section above. Environmentally sensitive areas such as water bodies and forests are excluded. Physically undevelopable areas such hills with steep slope (20% slope and above) are not included in the developable area. Land under existing transportation network is also not included towards developable land. Existing built-up areas are excluded from the developable land.

As derived in Table 2-3, the land available for development is 2463 Ha that is 67% of the total IDP area.

2.4.5 CONCLUSION

The IDP area is predominantly non-irrigated agriculture in nature. The western area of the IDP, which is in contiguity with Panvel area has maximum existing built-up area. The IDP area has no organized recreational areas.

Table 2-4 shows the comprehensive area statement for the existing land use and land available for development. All further calculations for proposed land uses are based on this land available for development i.e. 2463 Ha which is 67% of total IDP area.

Table 2-4: Summary of Land Availability in IDP Area

Sl. No.	Description	Area (in Ha)	% of total IDP Area
A	Total IDP Area	3683.00	100.00
B	Non-developable Land	595.60	16.17
C	Existing built-up area	624.27	16.95
D	**Land available for development [A-(B+C)]**	**2462.86**	**66.88**

Source: Land Use Survey, 2014.

2.6 SOCIAL INFRASTRUCTURE

2.6.1 EDUCATIONAL FACILITIES

Educational facilities such as primary schools, upper primary schools, senior secondary schools, colleges and universities are assessed. The analysis is based on the statistics collected from District Primary & Secondary education departments, Raigad district and State Board of Secondary and Higher Education, Maharashtra. A total of 20 Primary schools and 28 anganwadis are located within 23 villages of IDP area. 3 Degree colleges are located at Devad, Pali Khurd and Vichumbe villages. Village wise number of educational facilities existing is given in Annexure 2-13. Number of educational facilities available with in IDP Area is given in Table 2-5.

Table 2-5: Number of Educational facilities available in IDP Area

Category	Numbers
No.of Primary Schools (I to IV)	20
No.of Upper Primary Schools (V to VII)	06
No. of Senior secondary Schools (VIII to X)	08
No.of Anganwadi Centers	28
No.of Colleges	03
Total	**65**

Source: District Primary & Secondary Edu Depts and State Board of Secondary and Higher Education, Maharashtra.

Zilla Parishad Primary and Secondary School in Shivkar Village

Primary School in Belavali Village

2.6.2 HEALTH FACILITIES

Assessment has been carried out with respect to health facilities such as dispensaries, sub-centres; primary health centres (PHCs) and rural hospitals. Health facilities have been assessed with an intention to understand the adequacy of health facilities for 2011 population. The analysis is based on the information collected from Public Health Department of Maharashtra.

There are 4 sub-centres and 20 PHCs located with minimum infrastructure facilities. Several private clinics located apart from the government facilities, which are not accounted in statistics. Few villages such as Vichumbe, Nere, Devad, Adai, and Bonshet have basic health facilities. Panvel area is the nearest place for all kinds of health emergencies. Village wise number available of health facilities is given in Annexure 2-14. Number of available health facilities is given in Table 2-6.

Table 2-6: Number of Health facilities available in IDP Area, 2014

Category	Numbers
Sub-Centers	04
PHCs	20
Total	**24**

Source: Public Health Department of Maharashtra

Private Clinic located at Belavali Village

Private Clinic located at Adai Village

2.6.3 COMMERCIAL FACILITIES

Small scale commercial establishments selling commodities of daily consumption are present in almost all the 23 villages. Commercial establishments such as grocery shops, medical shops, flour mills, vegetable shops are observed in villages. Apart from these, the major commercial activities such as Banks, Hotels and restaurants are located at Palaspe junction and along the Panvel-Matheran Road. Panvel is the nearest wholesale and retail shopping area.

Local Commercial shops located at Adai village

Local Commercial shops located at Vichumbe

2.6.4 SOCIO-CULTURAL FACILITIES

Socio-cultural facilities such as cinema theatres, sports complexes, and clubs are not observed within the villages of IDP area. However, other socio-cultural facilities such as community halls, school playgrounds etc. serve the needs. Panvel is the nearest destination for major cultural activities.

Recreational space with open stage in Vichumbe village

Community Recreational space in front of temple in Vihighar village

2.6.5 RECREATIONAL FACILITIES

Recreational areas such neighbourhood parks, city scale parks are not located within this area. However, the major source of open spaces is school grounds. Some of the Zilla Parishad schools have playgrounds attached. Some of the residential colonies, societies and housing complexes are maintaining their own parks and play grounds within their premises.

2.6.6 SUMMARY

The IDP area being semi-rural in nature does not have a well-developed social infrastructure. At present, facilities seems to be sufficient to 2011 census population and there is the need to be improve infrastructure in existing social facilities.

2.7 PHYSICAL INFRASTRUCTURE

2.7.1 WATER SUPPLY

81% of the population of the IDP area has access to drinking water within habitation and around 2% of the population has water availability within villages. However, around 17% of the population has to fetch water from outside of the village from nearby sources. Around 58% of the population has access to safe water. Around 2% of the population has to source the water from more than one source where at

least one source is unsafe. Besides, around 3% of the population is dependent on unsafe source of water. Tables showing drinking water source, potability and location are given in Tables 2-7, 2-8 and 2-9.

The analysis has been carried out with the following important aspects of water

- Source- Ground water, Surface water
- Quality- Water is safe or not
- Distance – within habitation, within village and outside of village

Table 2-7: Drinking Water Source

Water Source	No. of Villages	Population	Population %
Surface Water	16	48,480	74.51
Ground Water	3	4,901	7.53
Ground Water / Surface Water	4	11,682	17.95
Total	**23**	**65063**	**100.00**

Source: Web Site (30-4-14)- National Rural Drinking Water Programme - Ministry of Drinking water Sanitation , Govt of India and Census 2011

Table 2-8: Drinking Water –Potability

Water Quality	No. of Villages	Population	Population %
Safe	12	38,731	59.53
Unsafe	1	1,899	2.92
Not tested	10	24,433	37.55
Total	**23**	**65063**	**100.00**

Source: Web Site (30-4-14) National Rural Drinking Water Programme - Ministry of Drinking water Sanitation, Govt. of India and Census 2011.

In the IDP area adjoining existing Panvel 20 villages receive water from surface sources. Around 91% of the population is getting surface water.

Table 2-9: Access to Drinking Water - Location

Water Availability	No. of Villages	Population	Population %
Within habitation	16	52,224	80.27
Within Village	02	1,557	2.39
Outside Village	05	11,282	17.34
Total	**23**	**65,063**	**100.00**

Source: Web Site (30-4-14) National Rural Drinking Water Programme - Ministry of Drinking water Sanitation, Govt. of India and Census 2011.

The available data indicates that within the IDP area, around 81% of the population has access to water within habitation and around additional 2% population gets it within village. However, around 17% of the population gets water for domestic from area outside of their villages. Around 58% of the population has access to safe quality of water. Around 2% of population has access to more than one water source, and at least one of the available sources is unsafe. However, around 3% of the population is dependent on water sources which are not safe for domestic use. Figures showing drinking water source, safe/ unsafe, availability are given in Annexure 2-15.

2.7.2 SEWERAGE

Maharashtra is the first state in the country to launch a state-wide programme for reforming the water supply and sanitation sector. The implementation of the following reforms is an integral part of the Jalswarajya project being implemented with assistance from the World Bank in the state since 2003.

The IDP area is mainly rural in character. As on date, there is no sewerage system. In 2001, more than 60% of rural population in Raigad district was not having toilets within premises. Census 2011 indicates that the number has come down and it is varying between 45 to 60 %. However, as there is no sewerage system, generally, the toilets are connected to individual septic tanks and the effluent is disposed off in the nearby drains or opens area.

2.7.3 STORM WATER DRAINAGE

The drainage in the IDP area has not been a major issue, due to the peculiar location of the area. It has hills on one side where the rain fall received is drained with high speed of water flowing through rivulets, nallas, valleys, and rivers into the sea, falling on the other side of the area.

After development, the area may be susceptible for flooding because the area receives very heavy rain fall. Chitale committee report ("Fact Finding Committee Report on Mumbai Floods") explains that the annual rainfall of the meteorological sub division of Konkan and Goa (2,980 mm) is heavy. There have been instances when as much as half of the annual rainfall was recorded in a single a day. It can be understood that the IDP area will be prone to flooding after development if adequate measures are not taken in advance. Urban flooding is fundamentally different from rural flooding, as developed catchments are formed and flooding occurs in a short time. But urban drainage is one of the most neglected areas.

2.7.4 SOLID WASTE MANAGEMENT

There is no systematic solid waste management system in villages. The waste generated in the rural area is disposed off/ dumped in the nearby area. Being within carrying capacity of the nature the same is recycled without having any adverse impact on the habitats. However, with urbanization, the scale of waste generation is likely to increase and cannot be left unattended.

2.7.5 POWER SUPPLY

The entire IDP area is provided with electricity by the Maharashtra State Electricity Distribution Company (MSEDCo) Ltd. through 22/11KV substations and lines. MSETCL operates a transmission network of 39,871 Circuit KM of transmission lines and 559 EHV Substations with 89,178 MVA transformation capacities. This infrastructure constitutes most of the inter-regional as well as intra-regional electric power transmission system in the State.

As per available information, Maharashtra State Electricity Distribution Company Ltd (MSEDCL) during the discussion that all the villages have been electrified barring few padas, which were not accessible.

3. ENVISIONING FUTURE

3.1 VISION FOR NAINA

NAINA & KNT depend upon the economic base provided by Taloja Industrial Area, NMIA and Panvel and JNPT. However, all three are outside the NAINA and KNT limits having their own immediate hinterlands to capture the growth impulses of these economic inputs and the expanding housing market of Mumbai and Navi Mumbai. NAINA will have to acquire a competitive edge over other areas in MMR.

The vision for NAINA and KNT could therefore be:

"A Competitive, Inclusive and Sustainable City within MMR that can offer enriching environment for living, learning and work"

3.2 POPULATION ESTIMATIONS

3.2.1 METHODOLOGY

The conventional methods of trend projection (arithmetic, geometric) etc, are not suitable for NAINA (and its part areas) as the population growth is likely to occur on the account of new economic inputs like NMIA, expansion of JNPT, an emerging rail link at Panvel and warehousing activities at Kalamboli, expanding housing market of Mumbai/ Navi Mumbai aided by infrastructure provision by CIDCO. Therefore, Shift and Share method has been used to estimate the population of NAINA & KNT for the horizon year 2034.

Similar method was adopted for MMR Regional Plan 1996-2011 as well. This is essentially a step down or "from whole to part" approach. Since NAINA and KNT are integral parts of MMR, the method helps to estimate its population, considering the likely spill over population from other constituent areas such Navi Mumbai, Panvel, Thane, Kalyan-Dombivali, Ulhasnagar etc, and likely potential of NAINA and KNT to absorb the shifts. Three scenarios have been worked out such as Low, Medium and High for estimating population. Accordingly, the estimated population of NAINA & KNT would range from 22 lakhs to 29 lakhs by the year 2034. The estimated population of NAINA & KNT is presented in Table 3-1 below.

Table 3-1: Estimated Population of NAINA & KNT in Low Growth Scenario (in Lakhs)

Jurisdiction	Population 2011	Estimated Base Year Population (2014)	Estimated Population		
			2021	2031	2034
NAINA	3.5	3.7	5.1	13.2	17.9
KNT	0.6	0.6	1.3	3.4	4.6
Total (NAINA + KNT)	**4.1**	**4.3**	**6.4**	**16.6**	**22.5**

3.2.2 DISPOSITION OF CITIES

The estimated population is likely to concentrate in the proximity to three major economic inputs viz. Taloja Industrial Area, NMIA at Panvel, an emerging rail link at Panvel and warehousing activities at Kalamboli and JNPT. Phasing of these concentrations is shown in Figure 3-1.

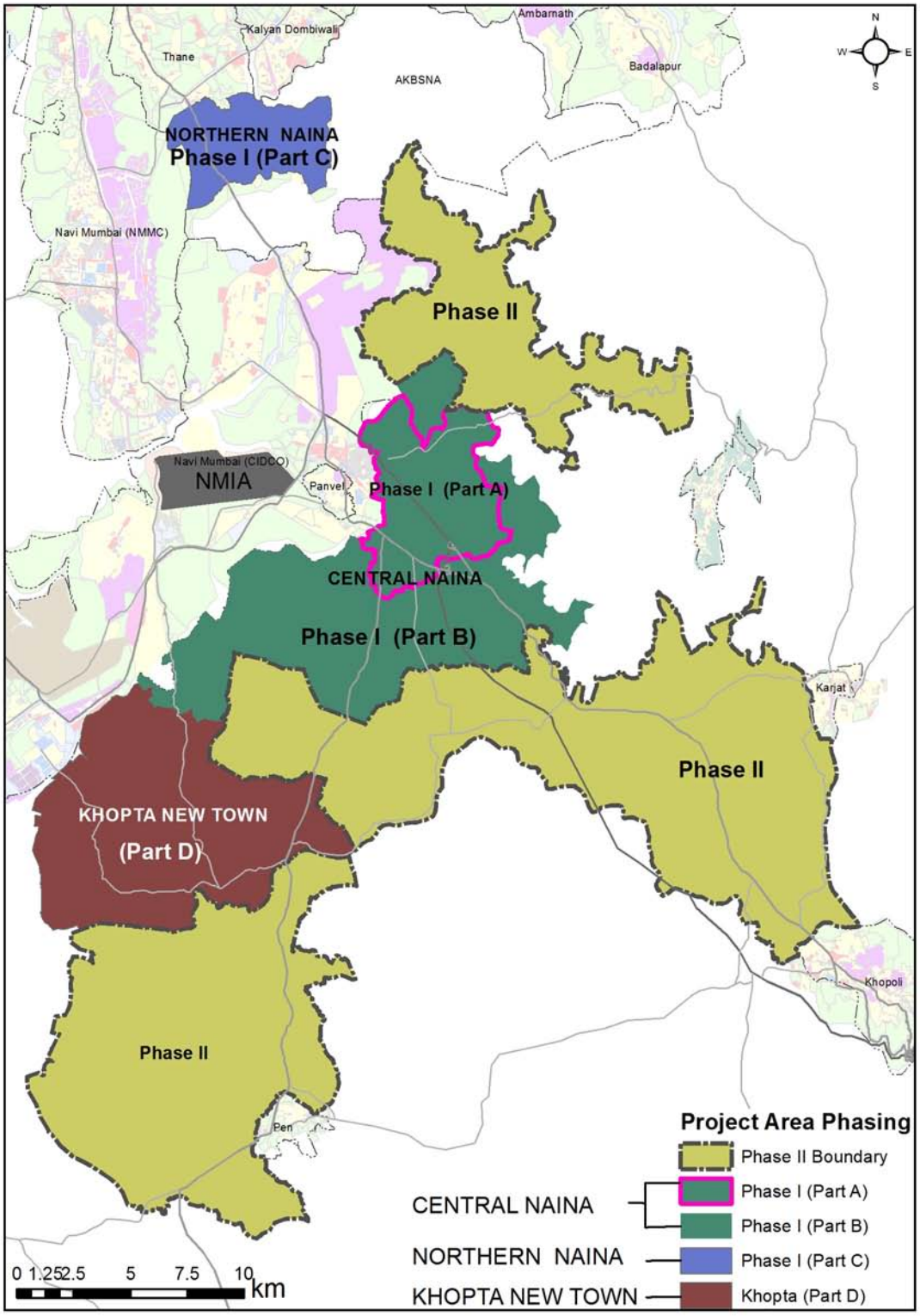

Figure 3-1: Phasing of NAINA & KNT and location of IDP

These concentrations are considered as cities and their estimated populations are given in Table 3-2 below.

1. Central NAINA – Phase I (Part A+B)
2. Northern NAINA – Phase I (Part C)
3. Khopta New Town – Phase I (Part D)

Table 3-2: Estimated Population among Phases (in Lakhs)

Phasing	Cities	Population 2011	Estimated Base Year Population (2014)	Estimated Population		
				2021	2031	2034
Phase I	Central NAINA (adjoining Panvel)	1.1	1.2	1.9	7.5	10.7
	Northern NAINA (adjoining Taloja MIDC)	0.2	0.2	0.7	2.8	4.0
	KNT (adjoining JNPT) (34 Villages)	0.6	0.6	1.3	3.4	4.7
	Sub-Total	**1.9**	**2.0**	**3.9**	**13.7**	**19.4**
Phase II	Rest of NAINA	2.2	2.4	2.6	2.9	3.1
Phase I + Phase II	**Total**	**4.1**	**4.4**	**6.5**	**16.6**	**22.5**

Source: Census of India 2011, and Estimated beyond 2011

3.2.3 ESTIMATED POPULATION FOR IDP AREA

The present IDP area is an integral part of one such city namely Central NAINA. Present population of 23 villages is about 0.65 lakh as per 2011 census. The IDP area is expected to be fast growing area in NAINA as this area is located in Phase-I (Part A) among the other areas. The estimated population of Central NAINA is 10.7 lakh by the horizon year 2034. Of which, IDP area population is estimated to be 6.2 lakh. Estimated population of Central NAINA is given in Table 3-3.

Table 3-3: Distributed Population of Central NAIN (in Lakhs)

Phasing	Population 2011	Estimated Base Year Population (2014)	Estimated Population		
			2021	2031	2034
Phase I (Part A) – IDP Area	0.6	0.7	1.1	4.3	6.2
Phase I (Part B)	0.4	0.4	0.8	3.2	4.5
Total	**1.0**	**1.1**	**1.9**	**7.5**	**10.7**

Source: Census of India 2011, and Estimated beyond 2011

Further, estimated population of IDP has been verified against physical availability of land, using several parameters such as net land available for development, per capita area required for amenities/utilities, per capita built-up area required for living, and FSI. Estimated population coming up based on these calculations is more or less similar to what is arrived out of shift and share method. Table 3-4 explains how population has been verified with the population arrived by Shift and Share method.

Table 3-4: Estimated Population for IDP Area in NAINA

Sl.No		Description	Details
A	Population (2011)	Population of 23 villages	65,063
B	Estimated Population (2034)	Net Plot Area (sq.m)	14,489,974
		Per Capita area required for Amenities (sq.m)	6.25
		Per Capita built-up area requirement (sq.m)	20.0
		FSI	1.00
		Formula for Population Estimation	NP = P' x PCPP + ((P' x

Sl.No		Description	Details
			BUA)/FSI)
		Estimated Population by 2034	**551,999**
	Total (A+B)	**Estimated + Existing Population**	**617,062**
		Rounded of Population Figure	**6.2 Lakhs**

Source: Census of India 2011, and Estimated beyond 2011

Note:

NP - Net Plot Area

P' - Population

PCPP - Per Capita Amenity Space Required Per Person (Per capita space required for all amenities, utilities & open spaces has been calculated based on the CIDCO Norms)

BUA - Built-up Area Required Per Person (Dwelling Unit Size assumed for EWS is 40 sq.m, and 90 sq.m for others)

FSI - Floor Space Index (Arrived based on the assumption that, 80% of area with 1.2 FSI will be occupied by Land Assembly Model and 20% with 0.6 FSI by Individual developments)

Further planning has been done based on 6.2 lakhs estimated population.

4. REQUIREMENT OF PUBLIC PURPOSES

4.1 PLANNING NORMS

Spatial norms for provision of infrastructure have been laid down by Government of Maharashtra 1979, by UDPFI guidelines in 1996 and draft revision in 2014. In addition, CIDCO has also adopted a set of norms for planning in Navi Mumbai. A comparative statement of these norms and standards is given in Annexure 4-1. For estimation of social amenities and public utilities, it is proposed to adopt the CIDCO's Navi Mumbai norms. Where CIDCO norms are not available, other standards have been considered. Requirement of such facilities by the year 2034 is given in Table 4-1.

Table 4-1: Estimated demand and area requirement for Social Facilities

	Facilities	1 for Population	Area Requirement as per adopted Norms (Ha)	Estimated Demand by 2034	Area Requirement (Ha)
A	**Educational Facilities**				
	Balwadi/ Creche	12,000	0.05	52	2.6
	Primary & Secondary School (Building area)	10,170	0.40	61	24.4
	Colleges	125,000	1.00	05	5.0
	Professional Colleges/Technical College	125,000	2.00	05	10.0
	Sub-Total				**42.0**
B	**Health Facilities**				
	Clinic	10,000	0.06	62	3.7
	Dispensary/PHC	25,000	0.15	25	3.8
	General Hospital	100,000	0.50	07	3.5
	Super Specialty Hospital	250,000	2.00	03	6.0
	Sub-Total				**17.0**
C	**Social and Cultural Facilities**				
	Library	10,000	0.05	62	3.1
	Multipurpose Hall	10,000	0.20	62	12.4
	Health Club & Gymnasium	10,000	0.10	62	6.2
	Religious	10,000	0.15	62	9.3
	Working Women hostel	100,000	0.30	07	2.1
	Daily Bazaar	10,000	0.10	62	6.2
	Community center	100,000	0.20	07	1.4
	Sub-Total				**40.7**
D	**Public Facilities**				
	Police Station	100,000	1.00	07	7.0
	Fire Brigade and Allied services	200,000	1.00	04	4.0
	Burial/Cremation Ground	500,000	4.00	02	8.0
	Sub-Total				**19.0**

E	**Parks/ Play Grounds**				
	School Play grounds	10170	0.60	61	36.6
	Parks & Play Grounds	10,000	3.00	62	186.0
	City Park	500,000	50.00	02	60.0
	Sub-Total				**282.6**
	Total (A+B+C+D+E)				**401.3**

4.2 ESTIMATED REQUIREMENT

This section presents estimated demand for proposed social infrastructure facilities such as educational, health facilities, open spaces and other amenities. It includes estimated demand and its area requirement for the facilities required by the horizon year 2034. CIDCO Navi Mumbai norms have been adopted to project the requirements.

4.2.1 EDUCATIONAL FACILITIES

Demand estimation carried out for educational facilities which include balwadi/ Creche, primary & secondary schools, colleges and professional institution/ technical colleges. It is estimated that, by the year 2034, about 61 Schools and 52 balwadies would be needed to cater to the basic educational requirement. Similarly about 05 Colleges and 05 Professional Colleges would be needed by the year 2034. Estimated demand and area requirement for educational facilities is given Table 4-2.

Table 4-2: Estimated demand and area requirement of Educational Facilities, 2031

Grouping of Facilities	Facilities	Estimated Demand			Area Requirement (in Ha.)		
		2021	2031	2034	2021	2031	2034
Balwadi/Creche	Balwadi/Creche	15	39	52	0.8	2.0	2.6
School	Primary & Secondary School	17	46	61	6.8	18.4	24.4
Higher Education	Colleges	02	04	05	2.0	4.0	5.0
	Professional Colleges/Technical College	02	04	05	4.0	8.0	10.0
Total Area					**13.6**	**32.4**	**42.0**

Note: As per education trend observed in Navi Mumbai, it is suggested to have integrated/ composite schools (from pre-primary to higher secondary).

4.2.2 HEALTH FACILITIES

As far as the health infrastructure is concerned, 07 general hospitals and 03 super speciality hospitals would be needed to cater the needs of population by the year 2034. Two general hospitals with an area of 2.5 ha each has been proposed as against 07 to consolidate the total land. This would facilitate the city level medical needs at two significant locations. The Estimated demand of health facilities and area requirement is given in Table 4-3.

Table 4-3: Estimated demand and area requirement of Health Facilities, 2034

Grouping of Facilities	Facilities	Estimated Demand			Area Requirement (in Ha.)		
		2021	2031	2034	2021	2031	2034
Health Facilities	Clinics	17	46	62	1.0	2.8	3.7
	Dispensary/PHC	07	19	25	1.1	2.9	3.8
	General Hospital	02	05	07	1.0	2.5	3.5
	Super Specialty Hospital	01	02	03	2.0	4.0	6.0
	Total				**5.1**	**12.2**	**17.0**

4.2.3 SOCIAL AND CULTURAL FACILITIES

The social and cultural facilities, includes religious facilities, community halls, working women hostels, daily bazaar/Market complexes. As per the adopted norms, 62 daily bazar complexes would be needed. Requirement of all social and cultural facilities is given in Table 4-4.

Table 4-4: Estimated demand and area requirement of Social and Cultural Facilities

Grouping of Facilities	Facilities	Estimated Demand			Area Requirement (in Ha.)		
		2021	2031	2034	2021	2031	2034
Facility Center	Library	17	46	62	0.9	2.3	3.1
	Multipurpose Hall	17	46	62	3.4	9.2	12.4
	Health Club & Gymnasium	17	46	62	1.7	4.6	6.2
Religious	Religious	17	46	62	2.6	6.9	9.3
Hostel	Working Women hostel	02	05	07	0.6	1.5	2.1
Daily Bazar	Daily Bazar	17	46	62	1.7	4.6	6.2
Community center	Community center	02	05	07	0.4	1.0	1.4
	Total				**11.2**	**30.1**	**40.7**

Social amenities and public utilities can be distributed among the authority involved in development (Special Planning Authority) and developments can come up through private developer by way of obtaining development permissions as explained in Development Control Regulations. Some city level or larger scale facilities which are mandatorily to be provided have been shown in IDP. Facilities kept for private development are not shown in IDP.

4.2.4 PUBLIC UTILITIES

Requirement of public utilities has been worked out. The utility includes fire stations/ police stations and burial grounds. 07 Police Post/Chowky, 04 Fire stations etc would also be needed. Requirement of all utilities is given in Table 4-5.

Table 4-5: Estimated demand and area requirement of public utilities, 2034

Grouping of Facilities	Facilities	Estimated Demand			Area Requirement (in Ha.)		
		2021	2031	2034	2021	2031	2034
Police & Fire Station	Police Station	02	05	07	2.0	5.0	7.0
	Fire Brigade and Allied services	01	03	04	1.0	3.0	4.0
Burial/Cremation Ground	Burial/Cremation Ground	01	01	02	4.0	4.0	8.0
	Total				**7.0**	**12.0**	**19.0**

4.2.5 PARKS AND PLAY GROUNDS

Parks and play grounds are essential facilities. It is estimated that, 62 neighbourhood parks and 02 city level parks will be needed for the area taken up to cater to the requirements of horizon year population. (Refer Table 4-6).

Table 4-6: Estimated demand and area requirement of parks and play grounds, 2014

Grouping of Facilities	Facilities	Estimated Demand			Area Requirement (in Ha.)		
		2021	2031	2034	2021	2031	2034
Parks/ Play Grounds	School Play ground	17	46	61	10.2	27.6	36.6
	Parks/ Play Grounds	17	46	62	51.0	138.0	186.0

	City level Park	01	01	02	50.0	50.0	60.0
	Total				**101.0**	**188.0**	**246.0**

4.3 DISTRIBUTION OF SOCIAL INFRASTRUCTURE

It is important to mention that, the distribution of above estimated facilities among the SPA-NAINA, developments through Layouts/ NAINA scheme etc will have to be differentiated. Following Table 4-7 explains about how the estimated social amenities and public utilities shown in Interim Development Plan. It is distributed that, some mandatory city level infrastructure such as City Park, crematorium/ burial grounds, police station, fire station, general hospital etc have to be provided by authority responsible and they have been shown in IDP. Some facilities such as daily bazar, colleges and schools are envisaged to come through development permissions where private developers shall be encouraged.

Part percentage of parks and play grounds are mandatory to come up within layouts and NAINA schemes (further details of NAINA scheme are given chapter 8 of this report). Abbreviations as well as colour code used while spatially locating required social infrastructure facilities and list of reservations is given in Annexure 4-2.

Table 4-7: Amenities & Utilities shown in Interim Development Plan

Distribution	Social Amenities	Public Utilities	Parks and Play Grounds
100% designated in IDP	• Dispensary/Primary Health Centre • General Hospital • Community Centre	• Police station • Fire station • Burial Ground	• Parks and play grounds • City Level Park[1]
50% designated in IDP / 50% by developer	• Daily Bazaar • College • Schools		• School play grounds
100% from Layouts and NAINA Schemes	• Balwadi/ Creche • Professional Colleges • Clinics • Super Specialty Hospital • Religious • Library • Multipurpose Hall • Health Club & Gymnasium • Working Women Hostel		• 10% of parks within layouts/ NAINA Scheme

[1] UDPFI Norm adopted for estimation of City Park Requirement

5. PROPOSED TRANSPORT NETWORK PLAN

5.1 PROPOSED TRANSPORTATION NETWORK

Transportation network for IDP cannot be developed in isolation. A broad transport network is therefore developed for entire NAINA & KNT as a part of Structure Plan. This has taken into account recommendations of Comprehensive Transport Study (CTS) for MMR. The transportation network for the IDP area is further developed in the context of Structure Plan. There are a number of public transport and road corridors proposed in the CTS, which can provide regional connectivity in NAINA and KNT with respect to rest of the MMR. Necessary realignments of proposals given in the CTS are recommended in the light of proposed Structure Plan for NAINA and KNT.

It is imperative to mention that the proposed transportation plan has been developed to guide the future development of the whole of NAINA & KNT. However, the same shall be amended based on site condition while preparing the DP. Annexure 5-1 presents the Proposed Transportation Plan for Project Area (NAINA & KNT together)

The proposed network is described in the following sections.

- CTS Proposals for NAINA and KNT;
- Additional Urban Transport Network in NAINA and KNT to improve transit and road access in the light of proposed Structure Plan;
- RoWs Treatment of important Public Transport and Road Corridors.

5.1.1 CTS RECOMMENDED PROPOSALS IN NAINA AND KNT

As stated above, recommended public transport and road corridors of the CTS, which pass through the Project Area (NAINA & KNT together) are important to provide regional connectivity in Project Area with respect to rest of MMR. Key proposals, which shall influence urban structure of Project Area and specifically to the IDP area are as follows:-

- **MMC:** The proposed MMC is an important corridor, which connects various parts of the Project Area right from north end to south end. The MMC is a multimodal corridor, which will provide public transport and road based connectivity to important parts of MMR between Vasai Road/ Virar to Uran. As part of the Structure Plan for Project Area, MMC is proposed for realignment in the northern parts of the Project Area to enable its efficient use with respect to proposed development. Service roads will be provided along the MMC on both sides to provide local access for the proposed development. The RoW proposed for the MMC is approximately 100m to accommodate metro, regional road traffic, and service roads on both sides. Approximately 11 km of length of MMC from the North of Village Akurli up to Village Belavali in the South passes through the IDP area.
- **Metro Network:** There is an extensive network proposed for metro to connect Navi Mumbai and other sub-urban towns to main economic centres in Greater Mumbai. The proposed metro

network in the adjoining areas of NAINA and KNT is aimed at connecting CBD of Belapur, Kharghar Township, Taloja MIDC Industrial Area, NMIA, JNPT, Uran, Panvel. Some of these important proposed metro corridors with respect to the Project Area are as follows:

- Mankhurd-Vashi-Narthengaon (M17)
- Vashi-Belapur-NMIA-Panvel (M18)
- Targhar-Kharkopar-Nhava Sheva-Dronagiri (M19)
- Kharkopar-Dhutum-Pirkone-Shirkhi-Vadkal (M20)
- Dronagiri-Pirkone-Jite (M21)
- Shirki-Washi-Jite (M22)

Location of above metro corridors is shown in Annexure 5-2.

It is important to mention that CTS was carried out prior to notifications of NAINA and KNT by the Government of Maharashtra, project came into existence hence it is desirable that some of the metro corridors are extended and coordinated with the proposed Structure Plan for the IDP area.

It is recommended that metro link proposed up to Panvel is extended into the IDP Area near Panvel, which can culminate with MMC to enable Transit Oriented Development (TOD).

- **Sub-Urban Rail Network:** Following two proposed sub-urban rail corridors passing through the IDP Area.
  - **Panvel-**Karjat Sub-urban Corridor (S4); and
  - **Panvel-**Rasayani Sub-Urban Corridor along Konkan Railway (Panvel-Jite-Thal: S2).

  It is important and desirable to implement on short-term needs, Panvel-Karjat Sub-urban rail corridor to facilitate development within the IDP Area.

- **Freeway and Arterial Road Network:** A number of freeways and arterial roads linking the IDP area are already proposed in CTS, which is of regional importance and an important part to extend quality road connectivity in the Project Area hence needs to be realized on short to medium term basis.

- **Other Important Links relevant to the IDP Area:** Among the other proposals in CTS and other studies, the important transport links of the IDP Area are Mumbai Trans Harbour Link (MTHL), Mumbai-Vadodara Spur, and NMIA. These transport nodes and links will trigger to advance the development within the IDP area.

5.1.2 ADDITIONAL URBAN TRANSPORT NETWORK WITHIN THE IDP AREA

To further expand public transport and road network in the Project Area with respect to CTS proposals following strategies and network are adopted.

- Redesign the MMC cross-section to suit connectivity needs of the IDP Area. It is proposed to provide service corridors along the MMC on both sides to adequately meet local traffic demand. Typical cross-section of the MMC is given in subsequent sections.

- A spinal road is proposed to meet Project Area's traffic needs. A RoW is proposed to be reserved for longterm needs for a spinal road, which will connect MMC and NH-4 to eastern end of the

Project Area along Mumbai-Pune Expressway. A RoW of 60 m is proposed for the spinal road. Its cross section in given in the following section.

- Hierarchical Road Network: A hierarchical road network is proposed to provide access into various parts of the Project Area with road network having RoWs for Sub-Arterials as 60m and 45m, sector roads and local access roads as 35m and 27m and 20m respectively.
- It is proposed that for Phase I development existing road network comprising Mumbai-Pune Expressway, NH-4 and SH-54, be utilized to provide transport access in to the IDP Area. Necessary modification and entry points are proposed in order to facilitate Phase 1 development.

5.1.3 PROPOSED ROWS FOR TRANSPORT AND ROAD CORRIDORS

A hierarchical road network is proposed to provide access into various parts of the IDP Area with road network having RoWs for Sub-Arterials as 60 and 45m, sector roads and local access roads as 35 m, 27m and 20m respectively. Proposed transport network is shown in Figure 5-1. Typical cross sections of all transport corridors are given in Annexure 5-3.

Table 5-1: Length of Proposed Roads with RoW in IDP Area

Sl.No	Category of Road	Existing/ Proposed for Widening (length in m)	Newly Proposed (length in m)	Total (length in m)
1	MMC + SPUR (126 m RoW)		6,089	6,089
2	MMC + Spine (120 m RoW)		4,706	4,706
3	SPUR (100 m RoW)		1,236	1,236
4	SH (Proposed 45 m RoW)	6,558		6,558
5	Proposed Road 60 m (Spine)		1,473	1,473
6	Proposed Road 45 m (with Metro)		4,338	4,338
7	Proposed Road 35 m RoW	1,498	6,555	8,053
8	Proposed Road 27 m RoW	655	12,201	12,856
9	Proposed Road 20 m RoW	2,060	13,603	15,663
10	Proposed Road 15 RoW		9,081	9,081
11	Proposed Road 12 RoW		6,591	6,591
12	Proposed Road 9 RoW		11,624	11,624
13	Proposed Road 7.5 RoW		803	803
14	Proposed Road 6 RoW		10,035	10,035
15	Proposed Road 4.5 RoW		4,358	4,358
	Total	**10,771**	**92,694**	**103,465**

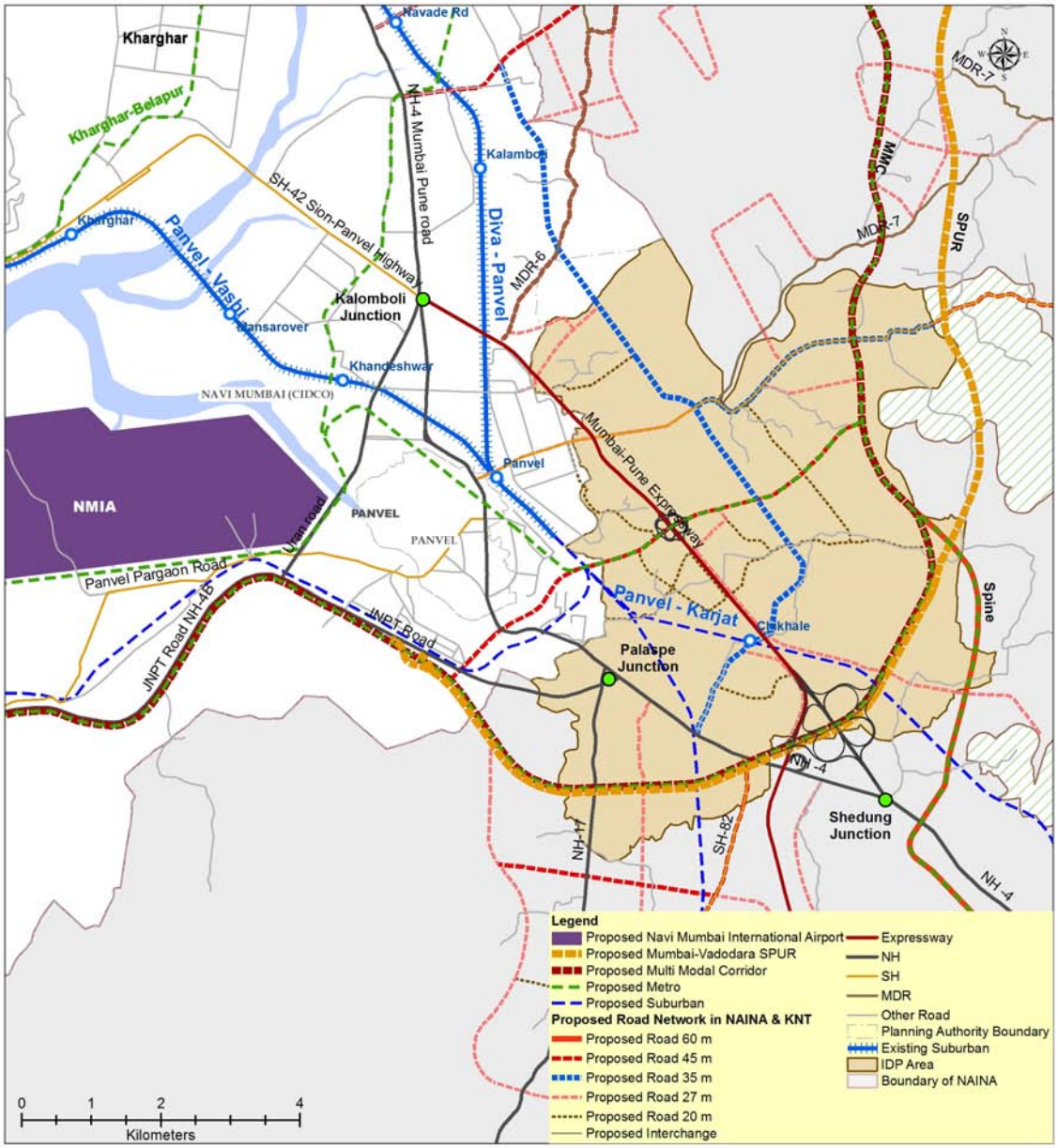

Figure 5-1: Proposed Hierarchical Road Network in IDP Area

5.1.4 METRO LINK EXTENSION TO IDP AREA

A metro link connecting Panvel to IDP (from west to east) area has been proposed to connect proposed MMC. Proposed metro link is shown in Figure 5-2.

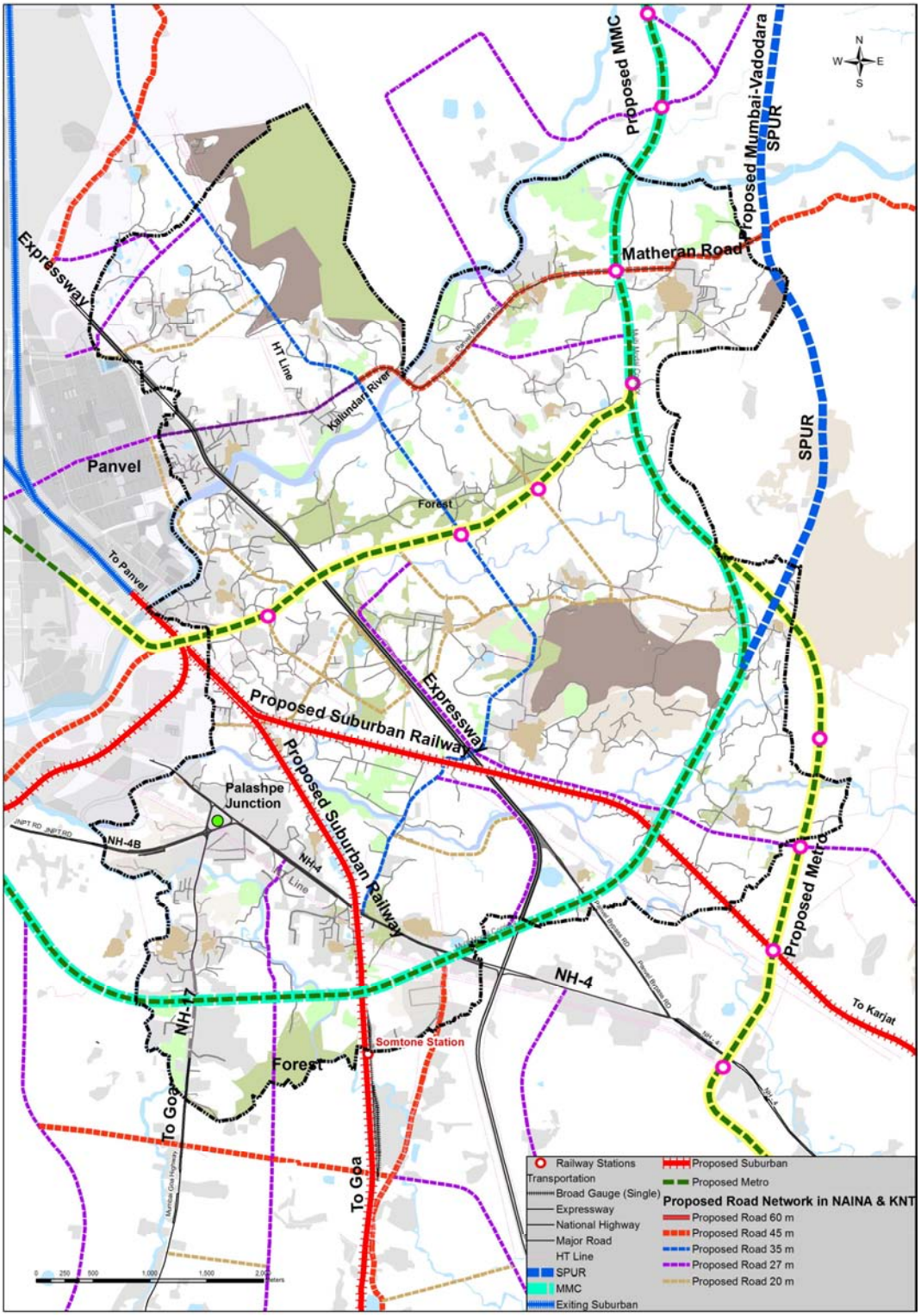

Figure 5-2: Metro Link from West to East to Panvel and MMC in IDP Area

6. PROPOSED LAND USE

6.1 KEY CONSIDERATIONS OF THE PLAN

The structure of the proposed land use for IDP Area is evolved around following considerations.

6.1.1 PROPOSED ENTRY/EXIT POINTS TO THE IDP AREA

To enhance the better accessibility from the existing and the proposed road network, the Plan proposes seven entry/exit locations to the IDP area. They are very much essential in terms of local and regional connectivity. Figure 6-1 depicts the locations of entry/ exit points to the IDP Area.

1. Mumbai-Pune Expressway near Vichumbe Village;
2. NH-4B near Karanjade;
3. NH-4 near ONGC Hospital;
4. NH-4 near Kon Village;
5. Gurudwara Road Panvel ;
6. MMC; and
7. SH-54.

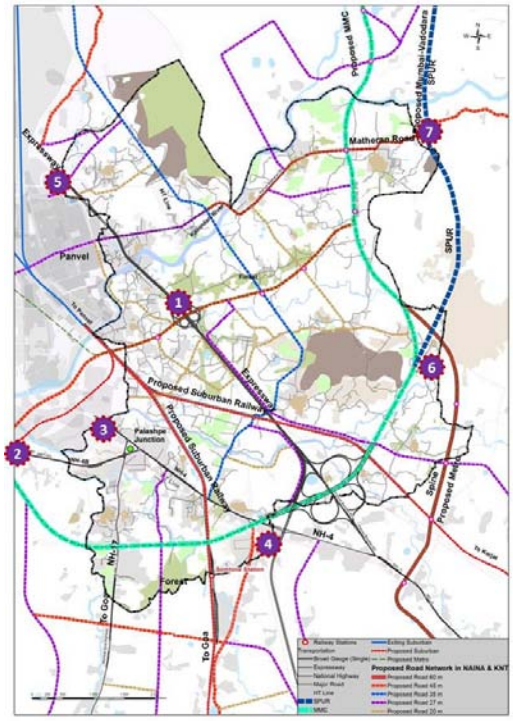

Figure 6-1: Location of Entry/ Exit points to the IDP Area

6.1.2 PROTECTION OF NATURAL AREAS

The IDP Area is partially located in the hilly terrain of Western Ghats, which has sensitive areas of natural and economic importance. Protecting these natural areas is important to regional ecological importance of MMR and Western Ghats.

As part of the protection strategy, the IDP proposes following areas to be protected from urban development. Hills with more than 20% gradient;

- Natural drainage Rivers and Nalas with buffers;
- Protected Forests; and
- Water bodies with buffers.

The above-mentioned areas will be an important ecological layer of the IDP Area and more detailed studies may be promoted to ensure the well-being of natural and environmental values of these areas.

These areas may be used for passive recreational activities. Summary of environmental sensitive areas is given in Table 6-1. Location of these features is shown in Annexure 6-1.

Table 6-1: Summary of Environmentally Sensitive Areas in IDP Area

Sl.No.	Land Use	Area (in Ha)	% of total IDP area
1	Forests	230.00	6.2
2	Water bodies	86.92	2.4
3	Steep hill slopes (20% and above)	148.96	4.0
	Total	**465.9**	**12.65**

6.1.3 LEVERAGING EXISTING AND PROPOSED ECONOMIC NODES IN AND AROUND THE IDP AREA

The IDP Area is located in proximity to important existing and proposed economic nodes. Leveraging these economic nodes to provide support economic and social infrastructure is important to bring success to the development of IDP Area. These major economic nodes are as follows:

- Upcoming NMIA;
- An emerging rail link at Panvel and warehousing activities at Kalamboli;
- CBD, Navi Mumbai; and
- Taloja Industrial Area.

Provision of efficient transport network particular public transport and high quality infrastructure would help IDP to capture the growth impulses of these economic opportunities.

6.1.4 TRANSIT ORIENTED DEVELOPMENT (TOD)

Transit Oriented Development is an integrated approach of transport and land use planning leading to compact, high density developments located around public transit nodes such as metro stations, railway stations or multimodal transit hubs. The development has a rich mix of land uses including commercial, residential, and institutional; designed to maximize the access to transit and non-motorized transport. The term transit includes variety of modes including Metro rail, suburban rail, light rail, road based public transport etc. and a mix of all these gives rise to a variety of land use patterns around the transit corridors and nodes. The proposed growth centres are located along the transit route in the form of TOD.

CTS carved out a vision for MMR's future transportation as a seamless, integrated system for safe and convenient commuter travel throughout the region with a strong emphasis on public transport. In order to support the anticipated economic development in MMR and subsequent inter-related transport challenges given by population and employment growth, 'Transit First' was considered as a guiding principle in preparation of the transport plan for MMR.

With this vision, the CTS identified major Transport Networks for MMR to serve multiple growth centres identified within the region. Other important aspects of the Plan are capacity enhancement of existing suburban and metro corridors, connecting major existing and planned activity centres of the region providing exclusive bus lanes to reinforce rail-based transit with a higher order road based public transport systems.

During the CTS Study, NAINA was not envisaged as a region of intensive urban development. Therefore, in light of delineation of NAINA as a separate region under influence of NMIA and new urban development strategies being devised for the region, calls for augmenting the transit network proposed under CTS.

Based on Mumbai and Navi Mumbai experience and also other international regional planning practices, economic growth of the region is maximized by effective public transit connectivity. Given that the major economic drivers of the IDP area including NMIA, JNPT and Industries (Taloja MIDC, Kalamboli) actually lie outside the region, it is very critical to integrate these economic and employment centres with the region through public transport.

Thus, promoting TOD is the key aspect of the transport and land use plan of the Project Area as a whole and the IDP Area in particular.

6.1.5 INTEGRATION OF GAOTHANS & EXPANSION AREAS

The Gaothans are developed and the expansion areas are developing rapidly. To achieve planned urban development integration of Gaothans and their expansion area is necessary. Road network and social and physical infrastructure is provided for the same.

Such a strategy would enable integration of the village settlements to the urban structure of the IDP Area, hence leading to a healthy planned urban development.

6.2 LOCATION OF GROWTH CENTRES

- The 15 % land reserved for growth centre, development charges and OCSDC shall be the main sources of revenue for funding City & Peripheral level infrastructure.
- The FSI permissible on growth centre lands shall be 1.7, at par with the FSI potential of the participants in 'NAINA scheme'.
- The Growth centre shall not be used for EWS/LIG housing or development of Social facilities.
- The Growth centre land shall not be allotted for any request of land by Govt./Semi-Govt. Agency at concessional prices.
- In Growth Centre component, no amenity space needs to be provided.
- Only internal and layout roads and open spaces will be required to be provided without losing FSI potential.

6.3 BROAD AND FLEXIBLE ZONING

Though concept of zoning is important, rigid land use zoning concepts are gradually becoming an obsolete idea in urban planning and in the context of role of private developers in Mumbai. Hence, it is desirable to promote the concept of zoning with flexibility to promote compatible land uses in various zones. Idea is to promote flexible zoning, especially when the SPA intends to promote common infrastructure and urban development in the IDP Area with major role from developers and other real estate entrepreneurs.

6.3.1 FLEXIBLE ZONING

As suggested in Structure Plan document of NAINA & KNT, the concept of flexible zoning is evolved for land use plan of the IDP Area. In each zone compatible land uses are defined under preferred, permitted, and prohibited uses. The concept of flexible zoning is to encourage enabling of flexible environment for private sector led development and to tap market demand with changing economic scenario.

As a part of overall land use structure of the Project Area (NAINA and KNT), the area is delineated into nine zones which are N1 to N7, LDZ (Limited Development Zone) and DDZ (Deffered Development Zone). The developable area of 2463 ha, as indicated in Table 2.3 is divided into following land use zones.

- **N1: Predominantly Residential:** The zone is aimed at promoting residential townships and support social infrastructure. Compatible functions to that of residential development would be permitted in N1.
- **N2: Growth Centre:** The zone is aimed to promote commercial and business activities.
- **N3: Mixed Use Zone:** The zone is aimed to promote mixed use activities, which can be located along areas of higher accessibility where land uses and activities related to public and economic importance can be located.
- **N4: Urban Village:** The zone around 200m of existing inhabitated Gaothans.
- **N5: Recreational Zone:** The zone is aimed to promote open spaces and recreational activities.

The permissible use in each zone are classified as permissible, permissible with conditions and prohibited.

The conditions are as follows:

No.	Details
1	Should abut road of minimum 18 m width
2	Independent Building/If mixed use in same building then separate access
3	Only manufacturing of bricks, earthen pots, country tiles etc.
4	i) Should not be located within the distance of 90 m. from any junction of roads having min. width 12 m. each from nearest gate of a school, hospital, theatre, place of assembly or stadium. ii) Restrictions imposed by Ribbon Development Rules, IRC, MoRTH shall apply. iii) Petrol filling station shall not be sited on the convex side of a road curve. In case the curve is not very sharp and cars moving out of the station are completely visible to the traffic from a distance of at least 90 m. and vice versa, a petrol station may be permitted on such a convex curve.
	General Conditions for all development
	i) In case of plots fronting on National Highway, State Highway and Major District Roads, the building line shall be as per Ribbon Development Rules shall apply ii) A stadium shall generally accommodate 400 m. running track.
Existing plantation, orchards shall continue as a use irrespective of surrounding land use zone. The FSI will be as per the adjoining zone. The FSI can be loaded on the continuous adjoining land.	

6.3.2 PROPOSED LAND USE

The gross area of IDP is 3683 Ha, out of which the developable area is 2463 Ha. This developable area includes 25% reservations towards proposed roads (13 %), parks and playgrounds (8 %), amenities and utilities (4%). 15% of the developable area is reserved for growth centres. The social facilities and amenities include burial/cremation grounds, community centre, fire station, police station, college,

school, play grounds, daily bazaar, general hospital, and primary health centre. Map showing proposed land use zoning is given in Figure 6-2.

Open spaces:

The open spaces proposed in the IDP can be categorized as active and passive open spaces.

a) **The passive open spaces** include forests, river, and water bodies. The passive open spaces work out to be 9.5 % of the gross IDP area. These open spaces will serve as lungs spaces for the city and works out to 5.67 sq.m. per person (considering 6.2 lakh estimated population).

b) **The active open spaces** in IDP comprise two forms, viz., IDP reservations; and open spaces through layout permissions. The active open spaces reserved in IDP are 5.3% on gross IDP area (i.e. 8% on developable land area), which works out to be 3.15 sq.m. per person (considering 6.2 lakh estimated population). As mentioned in the DCRs, each land holding having area more than 0.4 Ha, shall require providing open spaces @ 10%. It is assumed that 80% of the land available with land owners (i.e. 60% of developable land) will be having aggregations more than 0.4 Ha. Thus, 48% of the developable land (80% of 60%) will be having land area more than 0.4 Ha. Therefore, the open spaces through layout permissions of these lands will be 3.14%, which works out to be 1.86 sq.m. per person (considering 6.2 lakh estimated population).

Considering passive and active open spaces, the open space per person of the gross IDP area is about 10 sq.m. per person.

The proposed land use distribution of developable area is given in Table 6-2.

Table 6-2: Area Statement for Proposed Land Use

Sl.No.	Land Zone / Use	Area in Ha	% of Developable Land
1	N1 – (Predominantly Residential)	1268	
2	N2 – Growth Centre	375	15%
3	N3 – Mixed Use	461	
4	N4 – Urban Village	521	
5	N5 – Parks and Playgrounds	32	
6	Reservations – Amenities & Utilities	77	4%
7	Reservations – Parks / Playgrounds	196	8%
8	Proposed Roads	325	13%
	Total of Developable Land*	**2463**	
	N2-Growth Centre, Proposed Roads & Reservations to be contributed to SPA-NAINA account for 40% of Developable Land		**40%**
** Developable Land is a sum of 1 to 8 above less existing built-up areas*			

6.4 SECTORS

The IDP area is divided into ten (10) sectors. The division of sectors is based on the existing and proposed physical features such as rivers, railway line, proposed and existing roads. The sectors were divided considering the geographical area and population. The average area of each sector is 350 Ha. The estimated population of each sector is approximately 60,000. Map showing delineation of sectors is given in Annexure 6-3.

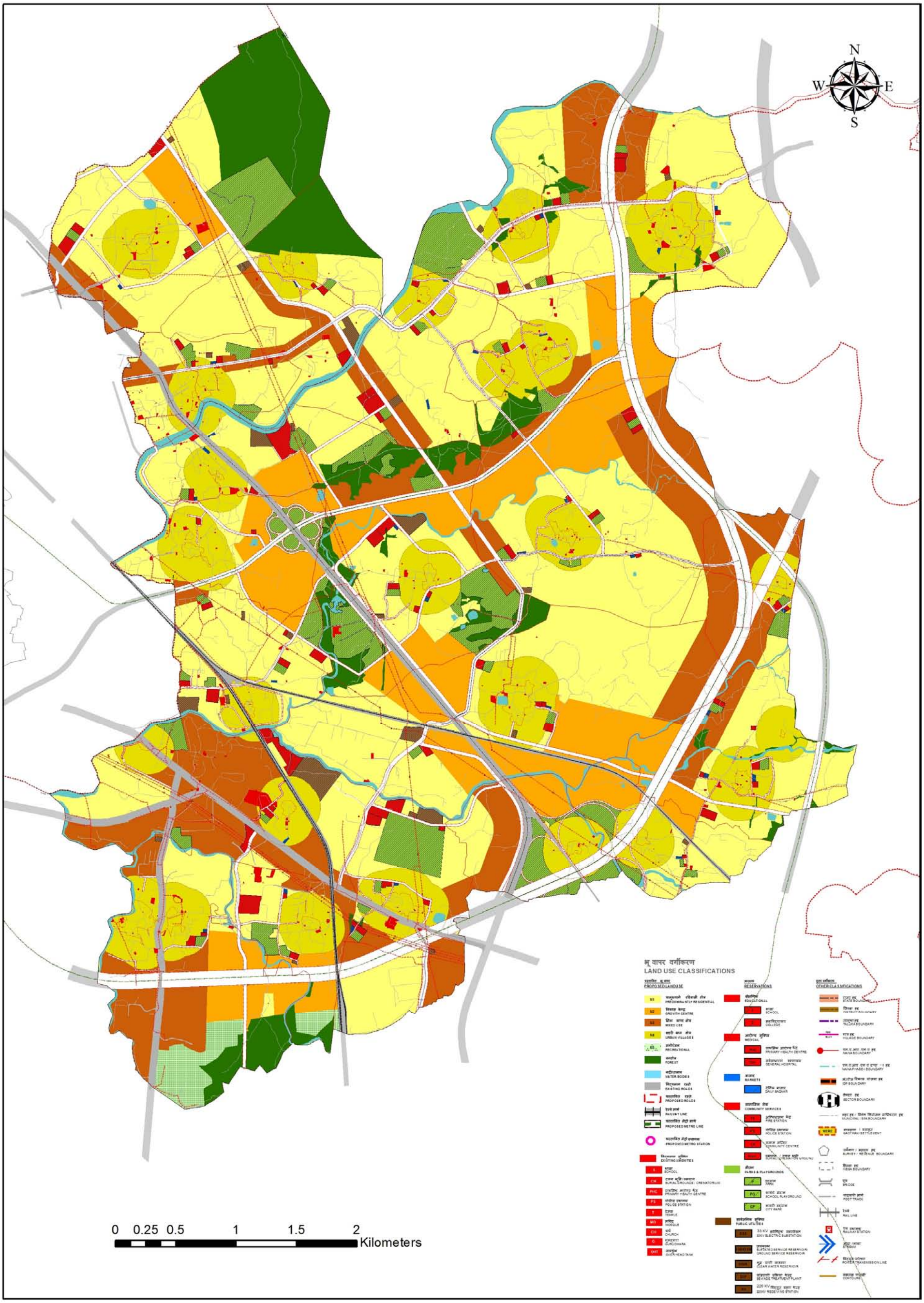

Figure 6-2: Proposed Land Use Distribution in IDP Area, 2014

7. PHYSICAL INFRASTRUCTURE

7.1 INTRODUCTION

The physical infrastructure components considered for development of proposed IDP Area have been presented below:

- Water Supply;
- Sewerage and recycling;
- Drainage, and river training;
- Solid Waste Management; and
- Power supply.

7.2 WATER SUPPLY

7.2.1 GROSS WATER DEMAND

Based upon the existing and proposed residential, commercial (employment), horticulture and firefighting demand, the gross water demand for the IDP area has been worked out.

For working out fresh water demand at consumer end, the quantity of recycled water from Tertiary Treatment Plants (TTPs) after subtracting the losses in the supply system has been deducted from the total demand. For working out, gross water demand 28 percent losses in distribution and transmission system has been considered as per norms prescribed by CIDCO for design of water supply system.

Based upon above norms the demand for total IDP area works out as 93 mld, and if the recycling is not considered the demand of fresh water shall be as high as 178 mld. The detailed calculations are shown in Table 7-1.

Table 7-1: Water Demand for IDP Area

Particulars of users	Population / Area in Ha			Rate of Supply in lpcd	Water Demand in mld		
	2016	2031	2034		2016	2031	2034
Residential	90000	460000	620000	180	16.20	82.80	111.60
Employment	22995	91980.4	229951	45	1.03	4.14	10.35
Fire fighting	100*(P)^0.5	0.95	2.14	2.49			
Industries	116.79				116.79	116.79	15000
Urban Greens	11.70	116.96	251.39	52200	0.61	6.11	13.12
Total					**20.55**	**96.94**	**139.31**
Recycled Water to be used for Urban greens, fire-fighting & flushing					9.46	47.74	66.96
Net Fresh Water Demand at consumer end					11.08	49.20	72.35

Distribution, Treatment & Transmission losses 28%	3.10	13.78	20.26
Total Demand at source with recycling	**14.19**	**62.98**	**92.61**
Demand without recycling	**26.30**	**124.08**	**178.32**

7.2.2 SOURCES OF WATER

It is understood that the CIDCO is presently gets water from Hetawane dam and MJP to meet the water demand of its New Town Development Authority (NTDA) Area. The availability from these sources is nearly 265 mld. A project from Balganga dam is under execution, which is likely to be completed by 2016. The availability from this source shall be 350 mld. Besides, a new source from proposed Kondhane dam is under consideration. CIDCO is expecting to get 250 mld of water from this source by 2026. CIDCO has worked out year wise demand of its developed/ developable area (other than NAINA) from 2015 to 2030. Based on this data, a statement showing demand, availability and excess has been prepared and shown in Table 7-2.

Table 7-2: Demand/Availability of Water in CIDCO area

Year	Demand in mld	Source	Present Status of source	Available Water in mld	Excess in mld
2015	**251**	Hetawane Dam	Existing	150	**14**
		MJP	Existing	115	
		Total		**265**	
2016	**274**	Hetawane Dam	Existing	150	**341**
		MJP	Existing	115	
		Balganga Dam	Under Execution (likely to be completed by 2016)	350	
		Total		**615**	
2021	**487**	Hetawane Dam	Existing	150	**128**
		MJP	Existing	115	
		Balganga Dam	Under Execution (likely to be completed by 2016)	350	
		Total		**615**	
2026	**667**	Hetawane Dam	Existing	150	**198**
		MJP	Existing	115	
		Balganga Dam	Under Execution (likely to be completed by 2016)	350	
		Kondhane Dam	Under Consideration (expecting to get water by 2026)	250	
		Total		**865**	
2030	**780**	Hetawane Dam	Existing	150	**85**
		MJP	Existing	115	
		Balganga Dam	Under Execution	350	
		Kondhane Dam	Under Consideration (expecting to get water by 2026)	250	
		Total		**865**	

It is evident that CIDCO will have excess of water with respect to demand of NTDA Area 2016 onwards (if proposed sources are developed as expected). Ultimately, in the year 2030, CIDCO shall be having 85 mld of water in excess of NTDA Area's demand. The ultimate demand of IDP Area in the horizon year 2034 is calculated as 93 mld and the demand in 2031 is only 63 mld as shown in Table 7-1. Thus, the demand of IDP Area can well be met from excess water available from CIDCO sources till the year 2033-34. However, for beyond 2034, some other sources will be required to be tapped to meet

the demand of 8 mld for IDP area. However, this is subject to maximum utilization of recycled with right from the beginning.

7.2.3 PROPOSED SOURCES OF WATER

As per proposals of Balganga Water Supply Scheme (350 mld) of CIDCO, the water drawn from the dam is proposed to be treated at Nidhiwali Water Treatment Plant, from where it shall be pumped to a Break Pressure Tank, and then shall be transferred to Master Balancing Reservoir (MBR) near VAHAL through 2500 mm diameter Pipe line. The detailed note on water supply demand is given in Annexure 7-1.

7.3 SEWERAGE COLLECTION, TREATMENT AND RECYCLING SYSTEM

7.3.1 ESTIMATION OF SEWAGE GENERATION

The Sewage Collection and recycling system is planned and designed to collect, treat, and recycle all the domestic sewerage and industrial effluent generated from the IDP Area. There are three possible options for collection and treatment of Sewage including Tertiary Treatment and recycling. These are discussed below:

- **Sewage and Sullage both are treated by developer of the plot at plot level:** This has the disadvantage, that STPs will be located near the residential areas, secondly, it will not be possible to monitor the quality of treated water as form large number of STPs. On the other hand Sewage from Gaothans and small plots has to be treated at community level STPs, which will again involve infrastructure cost. This also have the problem that how the waste effluent from so many STPs shall be carried to suitable disposal points.
- **Sullage is treated at developer level and Sewage is carried to Community level STPs:** This will again have the problem of monitoring the quality of treated water being supplied, and sullage from Gaothans / small plots as stated above.
- **Sewage and Sullage both are taken to community STPs and treated water recycled:** A comprehensive sewage collection system, along with community STPs / TTPs and recycling system is developed. Though this will involve some extra infrastructure cost on account of collection system and distribution of recycled water this is the safest way of treating the total sewage. In this system the tertiary treated water can precisely be distributed to urban greens / parks, different industries for washing and for flushing use in residential areas.

As prescribed in CPHEEO manual, it is assumed that 80% of water actually supplied at consumer end for domestic use and 60% of water supplied to industries be generated as Sewage/ waste water. While working out sizes of collection system and capacity of Sewage Treatment Plant, provision has been kept for 20% infiltration through sewer lines. But while calculating the water available for recycling, the infiltration has not been considered, assuming that during summers and winters the infiltration shall almost be negligible. Accordingly, the sewage generated capacity of STPs and Tertiary Treatment Plants (TTPs) required has been worked out and shown in Table 7-3.

Table 7-3: Sewage Generated, Capacity of STPs & TTPs required

Sewage Generation & Treatment Plants Capacity	2016	2031	2034
Sewage Generation in mld	17.23	85.01	118.86
Capacity of STPs required	17.00	85.00	119.00
Capacity of TTPs Required	12.00	57.00	80.00

The recycled water shall primarily be used for proposed urban greens as horticulture requirement and the remaining shall be used in industries mainly for cleaning/washing and in residential areas for flushing etc.

Considering the topography of the area, pace of development and land use of IDP, the entire IDP area is divided into 5 Sewerage Zones. The related Tertiary Treatment Plant is also proposed to be installed on the side of STP. The Capacity of STPs and TTPs proposed zone wise is being given in Table 7-4.

Table 7-4: Zone wise Capacity of proposed STPs and TTPs in IDP Area

Sewerage Zone	Capacity of STP	Capacity of TTP
Sewerage Zone-1	36.89	24.8
Sewerage Zone-2	19.04	12.8
Sewerage Zone-3	20.23	13.6
Sewerage Zone-4	16.66	11.2
Sewerage Zone-5	26.18	17.6
Total Capacity	**119.00**	**80.00**

7.3.2 SEWAGE COLLECTION SYSTEM

The Sewage/Effluent collection system is provided to collect the domestic sewage / industrial waste water from the residential/industrial areas and to convey it to the proposed Sewage Treatment Plant of that zone. Since industrial waste water is very meagre in quantity, thus common collection system is provided for sewage and waste water collection. The zoning and collection network is proposed in such a way that the flow of sewage follows natural slope and conveys the sewage to treatment plant (located at the lowest elevation) under gravity flow. The location of Sewage Treatment plants along with Tertiary Treatment Plants is given in Annexure 7-1.

The Sewage Collection system is being proposed at sector level roads only. The internal sewers including laterals shall be provided by the land developers themselves, which shall further be connected to trunk sewerage system. The detailed note on sewerage system is given in Annexure 7-1.

7.3.2.1 SEWAGE / WASTE WATER TREATMENT AND TERTIARY TREATMENT PLANT

It is proposed to provide conventional Activated Sludge Process type of Sewage / Treatment Plant. The plant shall comprise Coarse screen chamber, Sewage pumping station, Fine screen chamber, Grit chamber, Oil and Grease traps, Activated sludge type Aeration Chamber with Fluidized Bed Reactor or Moving Bed Biofilm Reactor, Secondary Sedimentation tank, Air Blowers, Sludge pumps, and Sludge drying mechanism.

The Tertiary Treatment Plant (TTP) shall comprise pre-chlorination chamber, rapid gravity sand filters and post chlorination mechanism. The TTPs are designed to receive an inflow of 85% of Sewage generated assuming 15% losses in STP. The losses in TTP are taken as 5%.

7.3.2.2 REUSE OF TERTIARY TREATED WATER

The Sewage treated in STP and then the secondary water treated in Tertiary Treatment Plant in each zone shall be collected in individual Clear water reservoir, wherefrom it shall be pumped for horticulture / industrial use and for flushing in the same zone. The water shall be collected by individual users in their ground tanks for their use. Provision has been taken for Clear water reservoirs, pumping machinery and distributaries rising mains DI Pipe class K-9.

7.4 RIVERS AND ROAD SIDE DRAINAGE

Two major rivers and a small nalla of about 8 to 15 meters width are passing through IDP area, a detailed map showing these rivers is given in Annexure 7-1.

In general the drainage of the area is from North East (where high hills are seen) towards South West. Terrain of the area is plain except to follow the drainage pattern towards rivers. The levels range between 32 to 24 meters on Eastern boundary of IDP and 5 m to 12-13 meters on Western boundary. Though in the hilly terrain in North East of IDP, but outside IDP boundary the levels range between 400 to 500 m on hill peaks. The details about these rivers are given below:

- **Gadhi or Kalundri River:** It has two tributaries. On one of the tributaries is Gadheshwar dam at the foot hills. One of the tributary as well as the main river passes through IDP area. The river flows from North East to South West direction. The river originates from the hills on the North East side of IDP area. All drainage from the north east side of IDP area goes to this river/ its tributaries.
- **Kolkhewadi River:** This River flows from East to west through southern part of IDP area. The levels range from 30 m to 8 meters except for the hilly terrain. It meets with the Gadhi River outside IDP area and finally discharges in to the sea.
- One small nala of about 8 to 15 meters in width also passes through IDP area. It flows from East of IDP area to south and finally meets the Kokhewadi River. It is very much meandering in nature and divides the total IDP area almost in two equal halves.

The rivers flowing in IDP area were checked for flooding at critical intensity of rain fall. It was done as per empirical formulae suggested by Indian Meteorological Department. It was found that in general no flood situation is seen in IDP area.

Methodology adopted for checking the rivers for flooding

CIDCO had provided topographic data along these rivers. The survey was reported to be carried out for study of rivers by CWPRS for the proposed project of new International Airport near Panvel. Based on these survey levels, "L" Sections and Cross-sections along the rivers were generated and used for analysing maximum water level at major / critical points during maximum intensity of rain fall.

Analysis for Maximum Intensity of rain fall:

The data for maximum one day rain fall at Santacruz rain gauge station from the year 1950 to 2005 and at Colaba rain gauge station from the year 1901 to 2005 were made available by CIDCO. The hourly rain fall data for 26th July 2005 for these stations was also provided. Based on these data, the maximum intensity of rainfall at 100 years return period was worked out as per norms and procedure recommended by Indian Meteorological Department.

However, the maximum hourly rain fall at other stations within Mumbai did not record such a high rain during any hour on the day. The highest rain fall recorded at other stations on 26th July 2005 is as follows:

Table 7-5: Maximum hourly Rainfall at Other stations in Mumbai (26th July 2005)

Rain gauge station	Time	Hourly rain fall (mm)
Panvel	12 to 13 hrs	76.0
Kharghar	10 to 11 hrs	105.0
Nerul	14 to 15 hrs	72.5

Rain gauge station	Time	Hourly rain fall (mm)
Vashi	07 to 08 hrs	100.0
CBD Belapur	09 to 10 hrs	105.0

Thus by using the suggested Table (Annexure 7-1) for conversion of 944.2 mm point rainfall in to areal rainfall for a recorded 16 hours duration and for 125 sq km catchment, the coefficient for maximum one day areal rainfall for the catchment reads as 93% (By interpolation of 100 and 150 sq km area). Therefore, the suggested maximum areal rainfall in 24 hours for 100 years return period comes as 878.1 mm.

So, the Critical intensity of rainfall as per IMD recommendations is = 0.16 x 878.1 = 140.49 mm per hour. Intensity as per analysis of IIT Mumbai:

7.4.1 ROAD SIDE DRAINAGE

The Storm water drainage system is provided to collect the rain water with in the project area and to cater it to the natural drains / rivers within the project area which in turn are discharging in to the Arabian Sea on west of NAINA. The area in general is having a slope from North East to South West direction. Due care has to be taken during design of drainage system, that the drains flow along the natural slope of ground, to avoid unwanted earth work during construction. The drainage system shall be proposed on both sides of proposed roads.

As the drains are discharging in to the natural drains with in project area, it is proposed to create few water harvesting structures at suitable locations. For this, it is proposed to construct low height weirs of 1.5 m, based on the adjoining contours. The rain water collected from the proposed drains shall be stored in these weirs. This will help in improving general water table in the area, and will also give a good aesthetic and environmental view in the green buffer surrounded with woods.

Design Criteria and Parameters

The design of storm water drainage system is to be based on IRC - SP: 50 (Guide Lines for Urban Drainage). This involves:

- Calculating the total discharge that the system will be required to drain off.
- Fixing the slope and dimensions of the drain to have adequate capacity to carry the discharge and afford proper maintenance.

The discharge is dependent upon intensity and duration of precipitation characteristics of the area, and the time required for such flow to reach the drain. The storm water flow for this purpose has been determined using the rational method, as suggested in IRC – SP: 50 for road side drains.

The road side drains are not to be designed for the peak flow of rare occurrence; however it is necessary to provide sufficient capacity to prevent too frequent a flooding of the drainage area. However it is recommended that road side drains be designed for 2 years return period, and the natural drains passing nearby for a 5 year return period. However, CIDCO in its guide lines circulated has recommended that Sectoral and Nodal drains be designed for 10 years return period, thus drains shall be designed for 10 years return period.

The detailed note on proposed drainage system is given in Annexure 7-1.

7.5 SOLID WASTE MANAGEMENT

7.5.1 PROJECTED QUANTITY OF SOLID WASTE GENERATION

This section deals with the projection of solid waste generation with respect to the projected population of the IDP area and per capita waste generation. The population projections made in this report and a per capita waste generation rates (of 600 gm per capita for resident population) are used for estimating future waste generation trends. The rate of waste generation throughout the horizon year of 2011-2034 is considered uniform i.e. 600 gm per capita per day. The following table shows the projected quantity of waste generated. As per the projections, the total population in the year 2034 will be 6 lakhs while the quantity of waste generation will be around 360 tons per day.

Sr. No.	Particulars/year	2021	2031	2034
1	Projected population	110,000	430,000	620,000
2	Solid waste generation tpd	120	300	360

7.5.2 SOURCES OF SOLID WASTE GENERATION

The main sources of solid waste generation will be residential areas, commercial areas, hotels, institutional areas, markets and other such areas. There are no industries proposed in the IDP hence it is unlikely that substantial industrial waste will be generated. The other sources of waste generation are street sweeping, drain de-silting activities, tree cuttings and leaf litter from gardens and opens spaces and construction wastes/ debris.

7.4.2 COMPOSITION OF WASTE

The area being a green-field development, no data on composition of waste is available. Hence standards mentioned in the CPHEEO manual are assumed for composition of waste which is further used for calculating the area required for landfill site.

Sr. No.	Parameter	% of waste as per CPHEEO Manual
1	Total organic content	44.57
2	Paper	2.91
3	Rubber, leather & synthetics	0.78
4	Glass	0.56
5	Metals	0.33
6	Inert Materials	43.59

7.4.3 STAGES OF WASTE MANAGEMENT

The key stages of solid waste management include collection, transportation, transfer station or storage (if required), treatment and disposal. These are briefly described in the following sections.

7.4.4 WASTE COLLECTION

Door-to-door collection: Door-to-door collection of waste is recommended in all the areas. The waste collection shall be carried out using compactors, in gaothan areas or those having narrow street widths small compactors or containerised push carts may be allowed. Each such push cart will have four HDPE containers of 1m x 0.69m x 0.15m size. The push cart for door to door collection will be provided with a bell so that the residents will be alerted of the arrival of the cart for emptying their waste containers into the containers of the cart. The sanitary workers shall collect the waste from

domestic, commercial and other areas in such congested zones. Solid waste should be collected within 24 hours of generation.

Litter Bins: In addition to the door to door collection, litter bins are recommended to be provided in public places such as gardens, bus stops, at regular intervals on streets in commercial and institutional areas. These may be provided at 50 m interval or as per the land use and density of people. The capacity may be around 0.02 cu. M. but may vary depending on the waste generation.

Street Sweeping: Street sweepers shall be assigned with fixed individual beats and 'pinpoint' work according to the density of the area to be swept. The following standards may be considered. The main roads and high-density areas shall be cleaned every day. The low-density areas can be cleaned on alternate days. Drain de-silting will be done on need basis.

Sr. No.	Description	Norm (road length/ sweeper)
1	High density areas (commercial, institutional etc.)	250m – 300m
2	Low density area	650m – 700m

Wherever bulk quantity of bio-degradable waste is generated such as vegetable markets, gardens, leaf litter etc. facilities for on-site composting should be explored.

7.4.5 SEGREGATION OF WASTE AT SOURCE

At present, the IDP area is rural in character, and there exist a system of solid waste management. Segregation of waste at source shall be implemented primarily in residential areas, where door to door collection of waste is proposed. Separate collection and storage of the biodegradable and non-biodegradable fraction, dry and wet waste of the waste from households, shops and restaurants shall be carried out by the sanitary workers. For this purpose, the residents would be asked to store the biodegradable and non-biodegradable waste separately. Also, the push-carts/ compactors would be provided with two separate compartments in different colours for collection of the bio-degradable and non-biodegradable waste. Awareness programs should be conducted to train the people about the segregation of waste at household level. It is mandatory to segregate waste into bio-degradable and non-biodegradable as per the Municipal Solid Waste Management (MSW) Rules 2000.

7.4.6 TRANSPORTATION

The MSW Rules 2000 stipulate that carrying solid waste in open vehicles is not permissible. Thus mechanical compactors of adequate capacity will be used. These usually have a capacity of 6 to 8 cu. m. For congested areas mini-tipper of 1.8 cu. m. capacity can be used.

7.4.7 TREATMENT AND DISPOSAL

The characteristics and quantity of solid waste generated primarily influence the disposal options. A review of the solid waste analysis results for most Indian towns and cities indicate that nearly 50% of the waste generated is organic in nature, as per CPHEEO Manual it is 45%. In terms of the quantity, this works out to about 162tpd for the terminal year of 2034. The organic component of the waste (45% of the total waste) shall be composted and the rest of the waste shall be land filled.

The other technology options will not be suitable, due to the following reasons

Incineration: Due to low calorific value and high moisture content, this technology is not suitable for Indian Solid waste. Also capital, O&M costs will be very high.

Pyrolysis and Gasification: This process involves thermal decomposition at high temperature and besides recovering energy from the waste will ensure proper destruction of waste is possible. But due to the composition of the waste and high moisture content the application of this process is only limited.

Pelletisation: Making fuel pellets is another option. Low calorific value wastes will not be suitable unless ingredients are added to increase calorific value. While a few Pelletisation plants are operating in India, long periods of project development and establishment are the hindrances in their large scale replicability at this stage.

Bio-Chemical Conversion: This is based on decomposition of organic matter to produce methane Gas. Anaerobic digestion in closed container can produce bio-gas to the tune of 50 to 150 m3 per tonne of waste .Gas can be used for cooking, heating, or generation of electricity. Several schemes of bio-methanation plants are being planned in India.

Considering the limited experience of above technologies, the daily quantity of waste generated and also as the surrounding areas being predominantly rural, it can be safely presumed that the composting will be suitable and will find a good market within the region.

The proposed disposal strategy for IDP area will be:

- Compost the organic fraction of the waste – 162 tons/day for the terminal year 2034
- Sanitary land filling of inorganic fraction of waste and 20% compost rejects (240 tons/day in year 2034)
- Encouraging local level aerobic composting and
- Educating the community on 4R strategy (Reduce, Reuse, Recycle and Recover)

Sections below discuss the various aspects of implementing the above strategy.

7.4.8 LAND REQUIRED FOR DISPOSAL SITE

Area requirement for the composting and land fill sites is assessed for the terminal year 2034. At 360 tons per day, the (45%) waste for composting works out to be 162 tons per day, and that for the land filling is 230 tons (including 20% compost rejects) by the design year. The design capacities have therefore been considered as 162 tons for composting and 230 tons for land-filling.

As summarised in below, the area required for disposal of waste for IDP area works out to a total of 5.5 ha. This comprises 0.5 ha of land for composting and 5 ha for land filling of the inorganic waste. These area calculations form the basis for identifying the new disposal site or assessing the adequacy of the proposed composting site. Summary is given in Table 7-6 below.

Table 7-6: Summary of land required for disposal site

Sr. No.	Component	Specification	Area requirement
A	**Windrow Composting**		
1	Capacity of plant	162 tons/day = 262 m^3 (1 ton = 1.67 m^3)	
	Type of composting	Manual Aerobic	
	Area for windrows for 21 days fermentation period	21 nos of 2.0 X 1.5 m Height, Length of Windrows – 88 m	55.8x88 =4910.4 m^2 Say 5000 (0.5 ha)
	Spacing of windrows	0.6 m	
B	Sanitary landfill	230 tons/day (198 tons/day inorganic + 32 tons/day compost reject)	
1	**Assumptions**		
	Landfill life	15 years	
	Waste Density	0.85 t/ m^3 (as per CPHEEO)	
	Landfill height	20 m	
	Volume of daily cover and settlement	0.1 (as per CPHEEO)	
	Volume of liner and cover	0.125(as per CPHEEO)	
2	**Landfill area calculation**		
a	Total waste generation	722700 tons	
b	Total Volume of waste generation	850235 m^3	
c	Volume of daily cover	85024 m^3	
d	Volume of liner and cover	106279 m^3	
e	Volume available due to settlement	85024 m^3	
f	Landfill volume	956514 m^3 (b+c+d-e)	
g	Landfill area	47826 m^2	47826 m^2 (4.78 ha) Say 5 ha
Note: The above estimates for area requirement are preliminary estimates and are expected to vary during the DPR stage			

A suitable landfill based on above requirements will be identified outside the IDP area while preparing the Development Plan for entire NAINA area. The MoEF and MPCB guidelines for identifying land fill sites will be taken into account.

7.4.9 BIOMEDICAL WASTE

Bio medical waste is the waste material generated from the hospitals, dispensaries & pathological laboratories located within the IDP area. The bio medical waste has to be collected, transported & disposed off in the manner & methods as suggested under Bio-medical waste (M & H) Rules 1998. It is clearly mentioned in this rule that the 'occupier' (a person who has control over the concerned institution / premises) of an institution generating bio-medical waste (e.g., hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank etc.) shall be responsible for taking necessary steps to ensure that such waste is handled without any adverse effect to human health and the environment.

In no case bio-medical waste shall be mixed with municipal solid waste. In most existing cities large hospitals have their own incineration plants and common incineration plants are set up by local

authorities. There are designated agencies for collection and transportation of bio-medical waste which is then brought to the common incinerator/ disposal site. The total bio-medical waste generation is 357 kg/ day for the IDP area as worked out below. This is not a substantial quantity, however a common incinerator may be provided at the land fill site or if such a facility is set up by one of the super speciality/ general hospital it can be used by the other on payment. A hazardous waste disposal site is available at Taloja operated by private agency. The bio-medical was can also be disposed off at the Taloja site.

Sr. No.	Medical facility	No. of hospitals	Area per hospital ha	Total area sq.m.	*No. of beds @ 100 sq. m./bed	#Biomedical waste generation @0.375 kg/bed
1	Nursing Home / PHC	-	25	250000	250	94
2	General Hospital	6	0.5	30000	300	113
3	Super speciality hospital	2	2.0	40000	400	150
	Total	**8**	**27.5**	**320000**	**950**	**357**

*As per UDPFI Guidelines, # As per CPHEEO Manual

7.4.10 HAZAORDOUS WASTE

There are no industries proposed in the IDP area that are likely to generate hazardous waste. Moreover hazardous waste generated if any from construction sites or any other use, such as spent oil swabs, used oil barrels etc will be collected by the authorised agency and disposed at the Common Hazardous Waste Treatment Storage and Disposal Facilities (CHWTSDF) at Taloja as per the provisions of the Hazardous Waste Management and Handling Rules, 2008.

7.1 POWER SUPPLY REQUIREMENT

The following standards have been adopted for the estimation of power requirement for the planning area.

Domestic Demand

- 1.5 KW per household for EWS/LIG
- 3.0 KW per household for MIG
- 4.0 KW per household for HIG

Commercial and Industrial Demand

- 1 KW per Shop
- 10 KW per Service Industrial Unit

Social Facilities and Public Utilities Demand

- Social Facilities – 50 KW per 7500 persons
- Public Utilities – 120 KW 7500 persons

7.4.10.1 DEMAND ESTIMATION

Based on the above standards the broad estimate for power supply for IDP Area for the terminal year 2034 is given below. The estimated population for the terminal year 2034 is 0.62 million.

Residential Demand

Sr. No.	Household	Percentage	No. of households	Total Power requirement MW
1	EWS/LIG	30	41333	62
2	MIG	50	68889	207
3	HIG	20	27556	110
	Total	**100**	**137778**	**379**

Commercial Demand

Sr. No.	Shops and Service Industries	Unit per 1000 persons	Estimated units	Power requirement per unit in KW	Total Power requirement MW
1	Shops	20	12400	1	12.4
2	Service Industries	2	1240	10	12.4
	Total	**-**	**-**	**-**	**24.8**

Social Facilities and Public Utilities Demand

Sr. No.	Facility	KW per 7500 persons	Total Power Requirement MW
1	Social	50	4
2	Public Utility	120	2
	Total	**-**	**6**

The total power supply requirement therefore works out to 410 MW say 400 MW. The power will be sourced from MSETCL. The total land area required for electric substations has been worked out in the physical infrastructure demand which is about 3.8 ha.

8. LAND DEVELOPMENT MODEL – NAINA SCHEME

8.1 INTRODUCTION

This section explains the rationale of search for alternative land development models and the recommends a suitable model for NAINA.

8.2 APPROACHES FOR PLANNED DEVELOPMENT

The key objectives of planned urban land development are:

- To obtain land for public purposes – physical and social infrastructure
- To ensure inclusive growth by providing housing to the poor, and
- To raise finances by either capturing land value gains that occur on account of provision of infrastructure or adopting the principle of 'growth pays for growth'.

The two conventional approaches to planned development have been the Development Plan model and the Bulk Land Acquisition Model. The DP has been largely used in existing towns and cities such as Mumbai and Thane etc. whereas Bulk Land Acquisition has been found suitable for Greenfield development like in Navi Mumbai or capital cities like Chandigarh or Gandhinagar. Each has its merits and demerits.

The DP designates particular parcels of land for public purposes, which can then be compulsorily acquired. In this process landowners who lose their land bear the cost and the benefits accrue to the others. DP typically does not attempt to capture land value gains that accrue on account of such benefits. Bulk land acquisition on the other hand can potentially ensure that all three objectives of planned urban land development are achieved. However large scale compulsory land acquisition is increasingly becoming difficult.

In case of land pooling and land readjustment the burden of providing land for public purposes and infrastructure is equitably cast on all landowners. The merit of this method the land remains with the original land owners except that required for public purposes. The traditional Town Planning Schemes relied on capturing 50% of land value gains to finance implementation of TPS. The Gujarat model of development plans/ town planning schemes, in addition allow planning authorities to retain land that could be sold for financing TPS. In the Korean model of land readjustment 'cost equivalent' land was retained by planning authority. .

Since in case of NAINA effective legal framework is not available, an innovative model based on voluntary participation incentivised through appropriate DCRs is necessary.

8.2.1 SUMMARY

It is necessary to appreciate that each approach will some advantages and some disadvantages. The models can be grouped into three categories. The salient features of each are explained below based on land acquisition, land value capture and finances.

1. In conventional development plans planning authorities have to acquire land designated for public purposes with additional responsibility of rehabilitating the displaced persons. The land value gains cannot be captured in this model. Hence external funds are necessary.

2. Voluntary land pooling primarily responds to the demands of the market. As the approach is voluntary there may be holdouts by certain landowners, which may frustrate the development leading to uncertain outcomes. Incentives for participation in the scheme as well as some disincentives for not participating are necessary to make the scheme attractive and ensure maximum participation. Retaining land for subsequent sale by planning agency could raise resources for financing the development.

3. Development of new towns with 100% acquisition of land is faced with the same problems of land acquisition and rehabilitation of displaced persons although planned and inclusive development is possible in this method. The land value gains can also be fully captured.

For NAINA a model belonging to category 2 above has to be developed.

8.3 EXISTING REAL ESTATE SCENARIO

Since the intended model is market dependent an appreciation of current real estate market is desirable. The land prices in Navi Mumbai and surrounding areas, including that of CIDCO have been increasing steadily. The announcement of the development of Navi Mumbai International Airport has further fuelled the increase in real estate prices. The average price for residential flats in the area around Panvel is about Rs.5400 per sq. ft. As per the ASR the land prices in Vichumbe village were Rs. 27,60,000 per Ha in 2013 and are Rs. 31,74,000 per ha in 2014, which shows an increase of 15%. Substantial development is happening in the form of Urban Village Schemes, Special Townships, Rental housing schemes.

The existing and proposed transport network such as NH4, NH4B, Mumbai –Pune Expressway, proposed Alibag-Virar Multi Modal Corridor, Panvel – Karjat suburban rail, Vasai-Diva- Panvel suburban rail, doubling of tracks between Panvel and Roha by Konkan Railway are further fuelling the real-estate prices. Besides this the Delhi-Mumbai Industrial Corridor, Dedicated Freight Corridor and Mumbai – Bengaluru Industrial Corridor are likely to act as impetus for rise in the real estate and land prices. Thus it is very likely that with provision of basic infrastructure for planned development in place, land values may increase rapidly that could be tapped for financing development. .

8.4 PROPOSED LAND DEVELOPMENT MODEL FOR NAINA

After studying various development models adopted across country, including Special Township schemes and development approaches adopted by CIDCO in the past particularly at Waluj a base model was proposed. This model underwent rigorous scrutiny based on inputs received from various stake-holders. The model is now coined as 'NAINA Scheme'.

Its key principles are:

a) Incentivize aggregation: Since bulk land acquisition is difficult and time-consuming, SPA-NAINA will have to incentivize land aggregation by owners. The incentives to be given are

additional FSI on aggregation, compared to low FSI for individual plot developments. Discount in infrastructure development charges, comprehensive Environment Clearance, provision of supporting infrastructure by SPA-NAINA and deemed N.A. permission. Minimum area of aggregated land eligible for NAINA Scheme shall be 10Ha.

b) Sharing of Land: The owner/ developer will retain 60% of the land and 40 % land shall be surrendered to SPA-NAINA "free of cost by consent agreement" for providing roads, open spaces, amenities and growth centre. The permissible FSI for the entire plot will be 1.00, which can be consumed on the 60 % of retained land resulting net FSI of 1.7 for the retained land. If more than 40% land area is affected by reservations, landowner is to be compensated for loss of land in excess of 40% by allotting alternative land elsewhere s within same sector. Alternatively in lieu of land, the options of onsite-TDR or monetary compensation would also available.

c) Raising Finances: The finances required for developing city-level infrastructure will be raised from development charges, are leviable under the MRTP Act, 1966. The prescribed are proposed to be enhanced by 5 times. The second source of revenue will be disposal of 15 % land reserved for growth centre. The outcome of NAINA Scheme being market dependent is intrinsically uncertain. To overcome the risk and uncertainty of outcome following strategy is proposed:

- Land designated for roads, amenities and growth centre as shown on the PLU of IDP shall be notified for compulsory acquisition
- NAINA Schemes can be formulated incorporating roads and amenity reservations. These will be counted towards 40% of the land to be surrendered to SPA-NAINA
- Landowners whose land is notified for acquisition for growth centre if willing to contribute 40% of the land free of cost, will be compensated for 60% of the land by way of TDR and alternate land in the ratio of 1/3:2/3.

d) Inclusionary housing: Additional 20% BUA, over & above BUA generated on 60% land, shall necessarily be constructed for EWS/LIG housing and this additional FSI is being permitted free of cost. The constructed tenements of EWS/LIG will be handed over to CIDCO at pre-determined rates.

8.4.1 PROVISION OF LOCAL INFRASTRUCTURE:

The internal layout of 60% of the land retained by the landowner shall follow the standard layout regulations in terms of provision of internal roads, infrastructure, recreational open space and local amenities. FEATURES OF THE PROPOSED MODEL

a) Area requirement: Considering the existing situation and market scenario promoting townships on smaller areas than those proposed in Special Township Policy would be feasible. Minimum land area or land aggregation required for participating in 'NAINA Scheme' is 10 Ha.

b) Permissible Uses: Uses permissible on owner's land are Residential, Commercial, R+C, Hotels, Offices etc. The whole of retained land can also be used for institutions like residential schools, hospitals, college with hostel, research and development institutions etc.

c) Development of Growth Centres: Growth centres will act as catalysts for urban development and these will be designated in the development plan based on various parameters such as proximity to transport network, existing urban centres and development potential.

d) FSI and BUA for 'NAINA Scheme':

Particulars	Area of land (Ha.)	Permissible BUA in Ha	FSI
Total Area of Scheme	**10.00**	**10.00 (Constructed on the land retained with the owmer)**	**1.00**
Land with owner	**6.00**	**10.00**	**1.70**
EWS/LIG (20%)	-	2.00-	0.20
Land with CIDCO	**4.00**	**-**	**-**
Growth Centre	1.50	2.55	1.7
Amenities	0.50	0.5	1.0
Roads	1.00	0.00	0.00
Open Spaces	1.00	0.00	0.00
Total Area	**10.00**	**15.05**	

8.4.2 LOW INCOME HOUSING

It will be mandatory for every land owner to construct 20% of the BUA on his land as low income housing. This 20% BUA will not be counted in the FSI of 1.7 granted to him. The dwelling units for low income housing shall have carpet area not exceeding 30 sq.m each. Such dwelling units shall never be allowed to be merged into larger dwelling units. These units will be handed over to SPA-NAINA at a predetermined rate.

8.4.3 OPTIONS FOR NON-PARTICIPATING LAND OWNERS

For landowners unwilling to participate in NAINA-Scheme, the FSI shall be 0.5 and no additional FSI on payment of premium or by any other mean shall be granted for such non-participants. But for those whose layouts are less than 10 ha and are ready to surrender their lands under reservations, instead of going through acquisition process, additional FSI of 0.2 will be permissible on surrender of the reservations under acquisition.

All the non-participants have to pay Development charges as per Section 124(B) of the Act and Offsite City Service Delivery Charges (OCSDC) @ 25% at the time of issuing Commencement Certificate, 25% at time of granting Occupancy Certificate and 50% on completion of major road infrastructure.

All lands above 4000 sq. m. will attract provisions of low income housing, which will be provided as detailed in 9.3.3.4.

8.4.4 INTEGRATING EXISTING POLICIES

The study of existing plans and policies has revealed that the MMR Regional Plan 1996-2011 and certain other policies of the Government of Maharashtra have implications on the development of the region. These will have to be effectively integrated in the proposed development model to achieve proper development of the plan area. The key policies that need to be integrated are the Urban Village Schemes, Special Township Policies in MMR and Rental housing scheme of MMRDA. The details of these have been explained in Chapter 9.

8.4.5 DEVELOPMENT GUIDELINES FOR GROWTH CENTRE LANDS

e) The FSI permissible on growth centre lands shall be 1.7, at par with the FSI of land retained by the landowners in 'NAINA scheme'.

f) No amenity space shall be provided in Growth Centres.

g) Only internal and layout roads and open spaces will be required to be provided without losing FSI potential.

h) The Growth centre shall not be used for EWS/LIG housing or development of Social facilities.

i) The Growth centre land shall not be allotted for any request of land by Govt./Semi-Govt. Agency at concessional prices.

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9. SALIENT FEATURES OF DEVELOPMENT CONTROL AND PROMOTION REGULATIONS

9.1 INTRODUCTION

The Development Control and Promotion Regulations are a mechanism to facilitate the implementation of the Interim Development Plan and carry out planned development. The DCPRs are largely based on the "Standardized Development Control and Promotion Regulations for Regional Plans" prepared by the Urban Development Department, Government of Maharashtra. These DCPRs have been contextualised for the IDP.

9.2 OPTIONS FOR DEVELOPMENT

For the purposes of DCPRs, IDP Area has been divided into four categories viz; Gaothan, Urban Villages, NAINA-Scheme and Non-NAINA Scheme.

Development in Gaothans: Gaothans will be as defined in the MLRC Code Section 122 and as shown on the IDP. As Gaothans are built areas it is expected that mostly redevelopment proposals will come for approval. No FSI is proposed; instead built-form will be controlled by footprint and number of storey. Existing footprint will have to be retained and maximum two storeys are permissible including ground floor. To facilitate wider access ways buildings abutting such existing access ways less than 4.5 in width will be setback by 2.25 m from the centreline of the existing access. Most exiting uses will be continued.

Urban Villages: Urban villages are areas of 200 m around existing inhabited gaothans as marked on the IDP. As per the existing MMR Regional Plan these areas are permitted an FSI of 1 and building height of 13.5 m. This regulation has been retained in order not to deprive the land owners of the existing development potential. The land holdings in these areas are small and hence they may not be able to aggregate to 10 ha land to be part of the NAINA-Scheme, though there is no restriction on them forming part of the Scheme if they manage to aggregate such land partly within 200 m and partly outside 200m . Furthermore considering the land-holding pattern a smaller land assembly scheme is proposed for urban villages. If the owners aggregate a minimum of 4 ha land they will retain 60% of the land and contribute 40% of land to SPA-NAINA.W ithin the land retained by the landowners open spaces at 10% of the land will have to be provided however provision of amenity space will be optional.

NAINA-Scheme: The minimum area required for participating in NAINA scheme shall be 10 ha and 40% land will be surrendered to SPA-NAINA free of cost. Developer will be allowed to use FSI of entire land on balance 60% of retained land. There will be a two-stage approval process. In first stage an Outline Development Permission will be granted based on verification of details of ownership, and

proposed allocation of land to be surrendered to SPA –NAINA. Final Permission will be granted based on detailed layout plan, building plans, infrastructure availability, project report etc. Depending upon the size of the scheme and the number of dwelling units proposed a graded range of amenities to be developed by the developer has been proposed. This will include basic education and health facilities. In case developer surrenders built amenity to SPA-NAINA, TDR equivalent to construction value based FSI of developed amenity shall be awarded to developer.

Incentive FSI for larger aggregation of land is proposed in NAINA scheme as given below;

Gross Area of NAINA Scheme (ha)	Gross FSI	FSI land retained by developer
10-25	1.00	1.7
25-40	1.08	1.8
Above 40	1.14	1.9

Individual Plots (Non- NAINA Scheme): The FSI permissible for such developments will be 0.5 and layout regulations as per Standardized Regulations for DCPR for RP are applicable.

Special Township Scheme: In case of already approved schemes Development Charges payable or paid as per Chapter VI-A will be payable by the developer. In case of new proposals developer will have to surrender 15% land as decided by SPA-NAINA. This 15% will be exclusive of IDP reservations if any. SPA-NAINA will be approving and sanctioning authority after grant of Locational Clearance under Rule 7(a), i.e. for Letter of Intent under Rule 7(b) and Final Approval under Rule 7 (c).

Rental Housing: OCSDC at 2 times the standard rate shall be charged in instalments as decided by the SPA-NAINA from time to time.

9.3 FEES, CHARGES AND PREMIUMS

Development charge: The development charge is proposed to be increased by 5 times the existing rates prescribed in MR&TP Act.

Offsite City Service Delivery Charges (OCSDC): These are charges framed by SPA-NAINA, payable to SPA-NAINA by persons seeking development permission who would be using the city-level physical and social infrastructure developed by SPA-NAINA without contributing any land to SPA-NAINA. The IDP area being largely rural and green-field area there is no physical and social infrastructure available necessary for urban development. In order to generate revenue for SPA-NAINA to provide this infrastructure it is proposed to levy OCSDC. This OCSDC will be charged in urban villages and development that are not under NAINA scheme.

9.4 OTHER SALIENT FEATURES

- There will be no restrictions on height of the building, except those governed by Civil Aviation and Fire Safety Act whichever is less
- Definition of amenity amended to exclude public utilities
- Rules for tree plantation :
  - Every plot of land shall have at least 1 tree for every 100 sq. m or part thereof
  - Recreational open spaces shall have at least 5 trees for every 100 sq. m.
- Rules for size of hoardings and fees and deposit charged for erecting hoarding
- Existing quarry to be permitted as on-going activity, no new quarries will be permitted

10. BLOCK ESTIMATES & FINANCING DEVELOPMENT

10.1 INTRODUCTION

It is necessary to have fair estimate of the expected revenue and the expenditure for the proposals envisaged in the IDP. Accordingly, the MRTP Act 1966 under section 26(v) specifies that the plan should contain "an approximate estimate of the cost involved in acquisition of lands required by the Planning Authority for the public purposes, and also cost of works as may be necessary". In case of a SPA engaged in Greenfield development having no recourse to tax revenues, it is imperative to prepare a financing plan for implementing the IDP.

10.1.1 COST OF DEVELOPMENT

All the lands shown on the plan as reservations and Growth Centre will be acquired. This area is about 961 Ha. This includes area under roads, public utilities, social facilities, amenities and growth centres. Presently the highest non NA stamp duty RR rates applicable in IDP is about Rs 400 per m^2. Considering the rate to be double of this, the acquisition cost would be about Rs 800 per m^2. Further, it is expected that only 20% land need to be acquired under LARR 2013 and balance 80% will accrue by way of land assembly. Accordingly, the approximate cost of land acquisition would be about Rs. 150 Crs.

The demand for amenities was assessed and has been discussed in detail in chapters 4 & 7. The estimates for the facilities and amenities, which have to be provided by Government Agencies has been worked out as per SOR of CIDCO wherever possible, issued in the year 2012-13, with suitable price escalation added to it to bring the cost at 2014-15 level. For other items, the block costs have been used for estimation. The summary of estimated cost is given in Table 10-1.

Table 10-1: Cost of development (Rs in Crores)

Sl.No	DESCRIPTION	AMOUNT	LEVEL		
			CITY	PERIPHERIAL	Total
1	**Land Acquisition**			**150**	**150**
	Land Rate 0.78 Cr / Ha				
2	**POWER**	731	250	481	731
	220 KV	160			
	Transmission Line	90			
	Internal Distribution	481			
3	**SOLID WASTE MANAGEMENT**	13	13		13

Sl.No	DESCRIPTION	AMOUNT	LEVEL		
			CITY	PERIPHERIAL	Total
	for composting	3			
	landfill site	10			
4	**WATER SUPPLY**	1084	848	236	1084
	Infrastructure (with recycling)	236			
	Source Development	848			
5	**SEWERAGE SYSTEM**	303	0	303	303
	Sewage Treatment & Collection	220			
	Recycling Cost	83			
6	**DRAINAGE**	194	0	194	194
	Road side drains	146			
	others nala diversion	48			
	Training of Rivers	0			
7	**ROADS**	1641	287	1354	1641
	Various widths of DP roads	1354			
	MMC	287			
8	**Metro**	2560	2560		2560
9	**Sub Urban Railway**	376	376		376
10	**Open Space**	36		36	36
11	**OTHER INFRASTRUCTURE**	275		275	275
	Crematorium/Burial ground	158			
	Fire station	15			
	Fire Tenders & equipment's	40			
	Bus Terminus	7			
	Police Station	55			
	TOTAL		4334	3029	7364
12	**ESTABLISHMENT & ADMINISTRATION EXPENDITURE**	ADDED @10 % ON YEARLY BASIS AFTER ANALYSING YEARLY EXPENDITURE			
13	**INTEREST @9% PER ANNUM** WOULD BE ADDED ON THE LOAN REQUIRED FOR THE CONSTRUCTION OF INFRASTUCTURE				

It has been assumed that infrastructure would be provided from 2015 to 2028. In the initial period, basic infrastructure work (road, water supply, sewerage, drainage, power etc) will be taken up on priority. The provision for Metro has been considered from the year 2024 onwards. From the analysis it is clear that in the initial period, the fund requirement for infrastructure would be more than the revenue and hence the fund would be borrowed from the market. After accounting for items listed at Sr No 11 & 12 the Net

Present Value (NPV) of the estimated infrastructure cost is Rs 10441 Cr. For detailed costing, refer Annexure 10-1

10.2 REVENUE SOURCES

10.2.1 REVENUE FROM DEVELOPMENT CHARGE

The MRTP act 1966 Chapter VI-A provides for Development Charge to be levied by Planning Authority, which can be used only for the purpose of providing public amenities, maintenance and improvement of the area. The development charge is payable by the applicant coming forward for development permission. It is applied on land coming for development and proposed built up area separately. For land the rate specified by the Act is 0.5% of the Stamp Duty Ready Reckoner rate for land. Similarly, for proposed built up area, the rate is 2.0% of the Stamp Duty Ready Reckoner rate for land.

The total area for IDP is about 3683 Ha., of which, undevelopable and already built up area and developable area account for 630 Ha, 647 Ha and 2,406 Ha respectively. Considering the applicable basic rate of development charge is Rs 100/- per m^2 the potential revenue from Development Charge will be about Rs 901Cr. The NPV for the same would be about Rs 400/- Cr. The total cost of development of infrastructure is estimated about Rs 10441 cr. Even if the development charge is increased by several fold (say 5 times) the anticipated revenue would be only to the order of Rs 4,505 Cr and the NPV of the same would be about Rs 1,998/- Cr. It is evident that Development Charge alone will not be sufficient to meet the cost of infrastructure. Due to such huge gap in revenue and expenditure, it is very clear that the Plan will remain on paper and it cannot be implemented unless additional sources of revenue are tapped. Accordingly, CIDCO has proposed additional sources for funding of infrastructure namely development and sale of land is growth centres.

10.2.2 REVENUE FROM OTHER SOURCES

In order to generate additional resources, Growth Centre of 15% of the developable land has been proposed in the IDP. This land would be developed and disposed of in the market.

10.2.3 SALE OF LAND IN GROWTH CENTRES

The Growth Centres (GC) are shown in the IDP. These Growth Centres account for about 361 Ha (15% of the area expected to be available for development). Land in GC would be leased by CIDCO for mixed land use. If the revenue generated is @ 12000/- per m^2, the revenue available for funding the infrastructure would be to the order of Rs 17,603/- Crs. The NPV of the same by discounting @9% yearly would be about Rs 6,693/- Cr.

10.2.4 REVENUE FROM SALE OF SOCIAL PLOT

The social facility plots are given on concessional rates to other government bodies / trusts to develop the facility. However, these plots are not provided free of cost. After considering this factor, it is expected that sale of social facilities would generate about Rs 1,668/- crs. The NPV of the same by discouting @9% yearly would be about Rs 717/- Cr.

10.2.5 OFFSITE CITY SERVICE DELIVERY CHARGES (OCSDC)

From all the above sources of revenue, the expected fund (NPV) is about Rs 9,408 Crs, whereas the expenditure (NPV) is expected to be about Rs 10,441/- Cr. The deficit is about Rs 1033 Cr. In view of this, it is necessary to identify some additional sources of revenue. From the Table 10-2 it is evident that the expenditure on the facilities to be provided within the city (peripheral infrastructure) can be met with the above revenue. However, it will not be possible to provide major city level infrastructures like Water

Source development (construction of Dam); Trunk distribution lines, Mass Rapid Transit System (Metro) etc.

In view of above, it is proposed to recover additional revenue from OCSDC. The rate of OCSDC has been given in the Table 10-2.

Table 10-2: OCSDC Charges

Sl.No	Description (NPV Rs in Crs)			
1	Total cost of Infrastructure	Rs	10,441	Crs
2	Revenue from other sources	Rs	9,408	Crs
3	Balance required from OCSDC	Rs	1,033	Crs
4	Land available for Developable		2,400	Ha
5	Land for OCSDC (less than 20% need to pay OCSDC)		450	Ha
	20% of developable land = 0.2x 2400= 480 Ha. sa			
6	Required rate to meet expenses	Rs	2,295 (say 2,300)	PER M^2

This OCSDC would be leviable only on those applicants who do not participate in city development by way of providing part of their land to the SPA. Such charge is proposed to be levied on development not conforming to NAINA Scheme. The revenue on account of OCSDC will therefore vary depending upon public response to NAINA Scheme.

10.3 IMPLEMENTATION STRATEGY

10.3.1 INFRASTRUCTURE BY CIDCO

CIDCO has developed Navi Mumbai and has vast experience in city development. CIDCO will take up construction and development of infrastructure works i.e. roads, water supply, sewerage, drainage.

10.3.2 INFRASTRUCTURE BY OTHER GOVERNMENT AGENCIES

There are few facilities and amenities which are under the domain of other government agencies e.g. power by MSEDCL & MAHATRANSCO, Police, Indian Railways etc. In such cases, CIDCO will provide land at concessional rate to these government agencies and request them to take up work related to their field.

10.4 DYNAMICS OF REVENUE

Although the costs have been estimated at 2014-15 prices the actual costs at current prices will depend upon the year in which the works are executed. The uncertainty of revenues is of higher degree as they are dependent upon the movement of land prices in time and corresponding quantum of development. The financing scheme of implementation of IDP therefore needs to be tested in terms of a cash flow analysis over 15 year period with reasonable assumptions. For details, see Annexure 10.1.

The summary of the revenue and expenditure is given in Table 10.2:

Table 10-3: Summary of Revenue and Cost (Net Present Value)

Sl.No	DESCRIPTION	Rs in Cr
A	REVENUE FROM ALL SOURCES	
1	REVENUE FROM DEVELOPMENT CHARGE (NPV)	1997.99
2	REVENUE FROM GROWTH CENTER (SALE OF LAND- NPV)	6692.84
3	REVENUE FROM OCSDC (NPV)	1882.82
4	SALE OF SOCIAL FACILITY (NPV)	717.65

5	NPV OF REVENUE FROM ALL SOURCES	A	11291.30
B	NET PRESENT VALUE OF ALL EXPENSES	B	10441.37
C	NPV (A - B)		849.93
D	Internal Rate of Return (IRR)		17%

From the annexure 10-1, it can be seen that in the initial period (2015 to 2020), the anticipated expenditure on infrastructure projects would be more than the revenue in the corresponding years. The revenue starts exceeding the anticipated expenditure on infrastructure from the year 2021 onwards. However, accounting for the backlog for the period 2015-2020, the year on year (y-o-y) positive opening balance is expected from the year 2028. With the assumptions cited in the annexure, the NPV of the project is estimated to be Rs. 849 Crores and the IRR works out to be about 17%. Thus it may be inferred that the proposed development including its NAINA scheme based financing model is financially viable.

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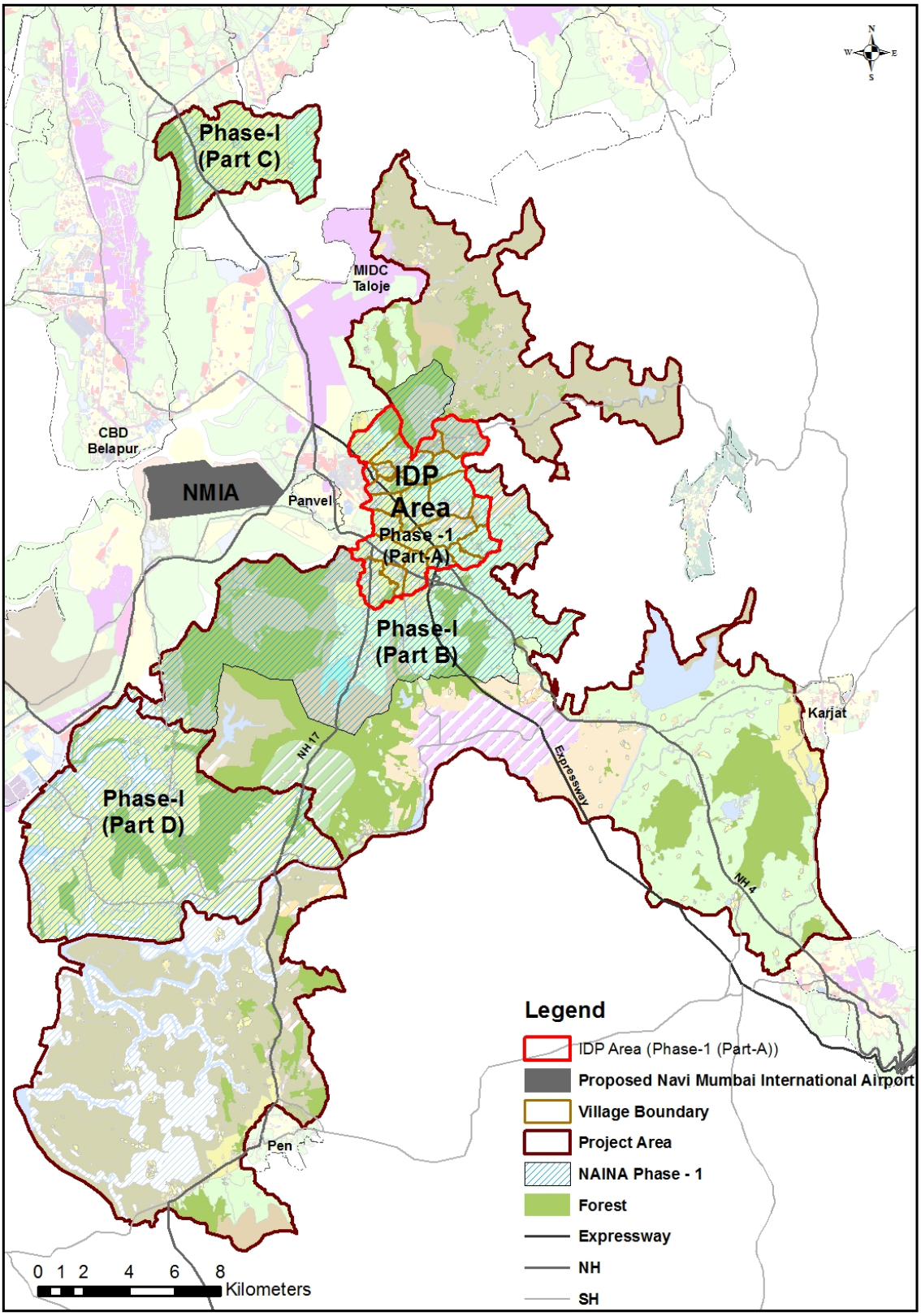
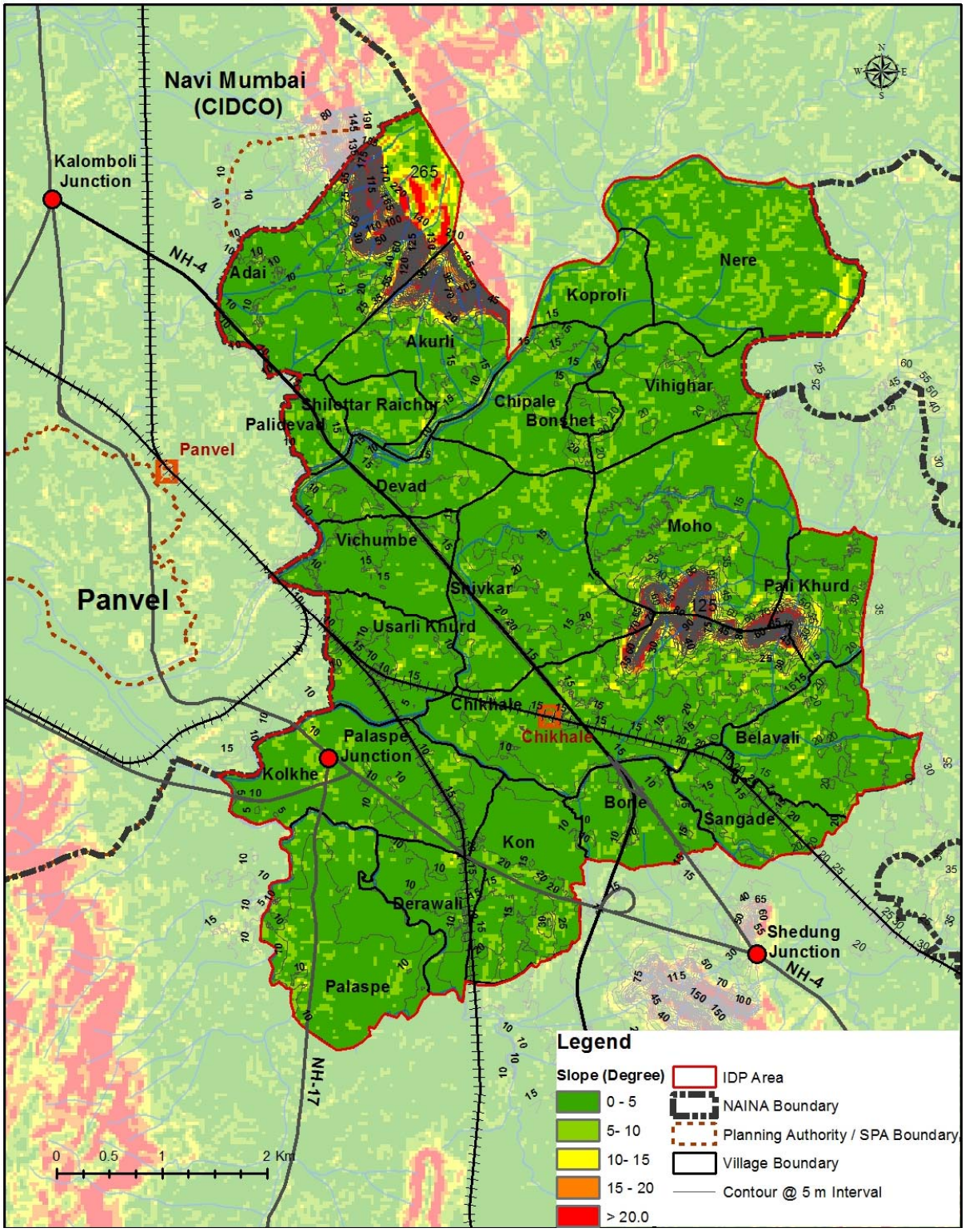
ANNEXURES

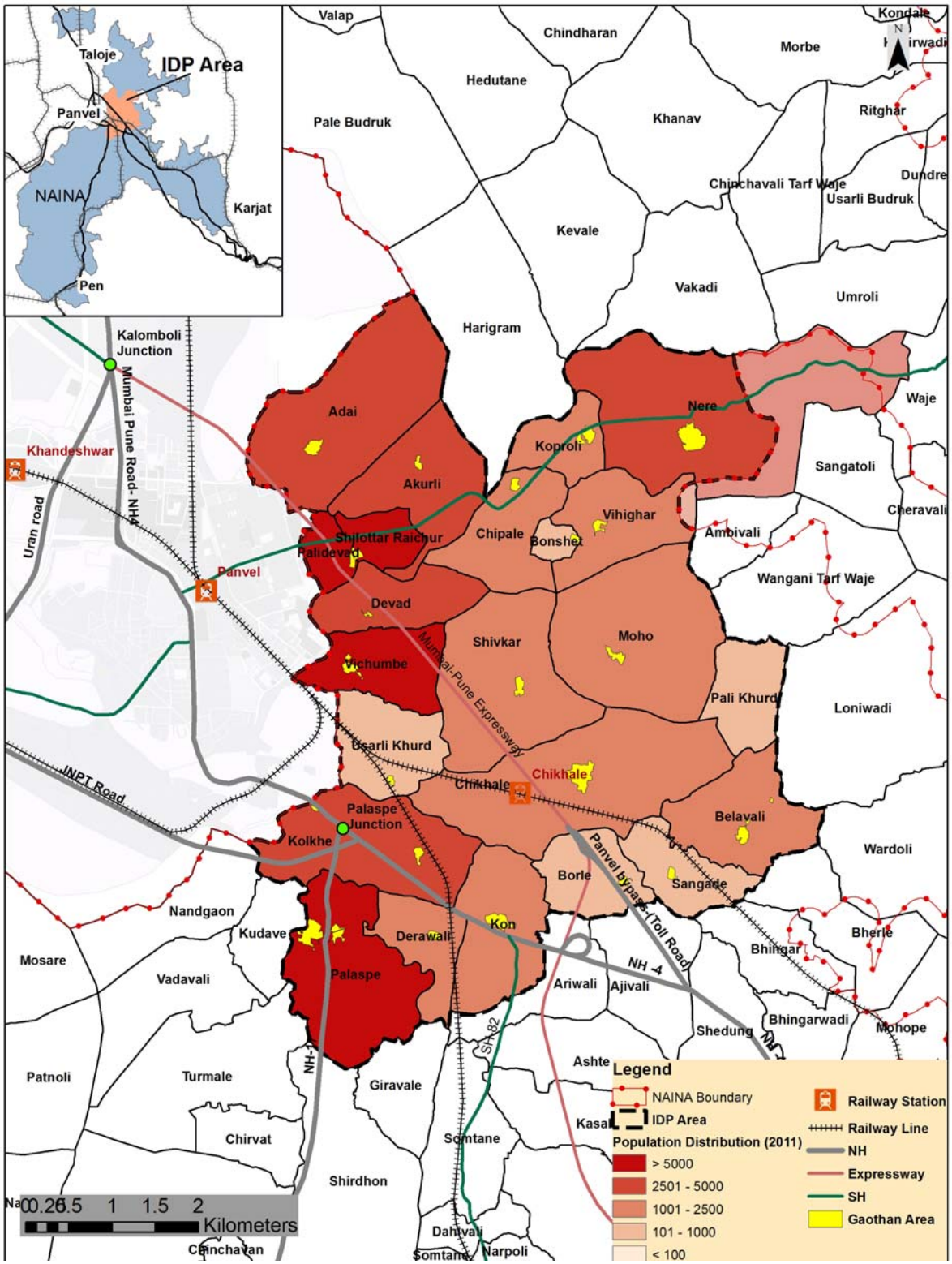
ANNEXURE 2-1: MAP SHOWING IDP AREA LOCATION IN NAINA



ANNEXURE 2-2: MAP SHOWING SLOPE GRADIENTS OF TOPOGRAPHY



ANNEXURE 2-3: MAP SHOWING POPULATION DISTRIBUTION WITHIN IDP AREA



ANNEXURE 2-4: POPULATION DENSITIES IN IDP AREA BY VILLAGE

Sl.No	Village Name	Population 2011	Area (ha.)	Density
1	Adai	3,358	308.40	11
2	Akurli	3,344	167.24	20
3	Belavali	1,660	159.31	10
4	Bonshet	550	20.15	27
5	Borle	890	100.40	09
6	Chikhale	1,899	357.17	05
7	Chipale	1,629	132.45	12
8	Derawali	1,205	90.97	13
9	Devad	3,210	114.55	28
10	Kolkhe	4,657	228.53	20
11	Kon	2,187	168.24	13
12	Koproli	1,026	76.25	14
13	Moho	1,822	306.89	06
14	Nere	3,569	291.63	12
15	Palaspe	5,086	239.13	21
16	Pali Kh	531	96.59	05
17	Palidevad	9,194	40.82	226
18	Sangade	871	94.53	09
19	Shilottar Raichur	5,796	50.55	116
20	Shivkar	2,464	262.57	09
21	Usarli Kh	2,608	123.05	21
22	Vichumbe	6,332	118.25	54
23	Vihighar	1,175	135.42	09
Total		**65,063**	**3683.09**	**3683.09**

Source: Census of India

ANNEXURE 2-5: SC, ST POPULATION IN IDP AREA BY VILLAGE

Slno.	Village	Population 2011	SC	%	ST	%
1	Adai	3,358	445	0.7	101	0.2
2	Akurli	3,344	246	0.4	51	0.1
3	Belavali	1,660	02	0.0	03	0.0
4	Bonshet	550	03	0.0	19	0.0
5	Borle	890	-	0.0	03	0.0
6	Chikhale	1,899	35	0.1	19	0.0
7	Chipale	1,629	04	0.0	36	0.1
8	Derawali	1,205	96	0.1	380	0.6
9	Devad	3,210	18	0.0	12	0.0
10	Kolkhe	4,657	464	0.7	168	0.3
11	Kon	2,187	205	0.3	99	0.2
12	Koproli	1,026	44	0.1	61	0.1
13	Moho	1,822	65	0.1	93	0.1
14	Nere	3,569	27	0.0	21	0.0
15	Palaspe	5,086	387	0.6	202	0.3
16	Pali Kh	531	423	0.7	202	0.3
17	Palidevad	9,194	1,142	1.8	297	0.5
18	Sangade	871	24	0.0	-	0.0
19	Shilottar Raichur	5,796	961	1.5	95	0.1
20	Shivkar	2,464	74	0.1	24	0.0
21	Usarli Kh	2,608	412	0.6	170	0.3
22	Vichumbe	6,332	1,012	1.6	152	0.2
23	Vihighar	1,175	22	0.0	-	0.0
Total		**65,063**	**6,111**	**9.4**	**2,208**	**3.4**

Source: Census of India

ANNEXURE 2-6: LITERACY RATES IN IDP AREA BY VILLAGE

Slno.	Village	Population 2011	Literates	%
1	Adai	3,358	2,251	3.5
2	Akurli	3,344	2,502	3.8
3	Belavali	1,660	1,220	1.9
4	Bonshet	550	375	0.6
5	Borle	890	591	0.9
6	Chikhale	1,899	1,461	2.2
7	Chipale	1,629	1,279	2.0
8	Derawali	1,205	849	1.3
9	Devad	3,210	2,288	3.5
10	Kolkhe	4,657	3,575	5.5
11	Kon	2,187	1,585	2.4
12	Koproli	1,026	756	1.2
13	Moho	1,822	1,311	2.0
14	Nere	3,569	2,613	4.0
15	Palaspe	5,086	3,964	6.1
16	Pali Kh	531	352	0.5
17	Palidevad	9,194	7,517	11.6
18	Sangade	871	605	0.9
19	Shilottar Raichur	5,796	4,550	7.0
20	Shivkar	2,464	1,719	2.6
21	Usarli Kh	2,608	2,039	3.1
22	Vichumbe	6,332	4,856	7.5
23	Vihighar	1,175	855	1.3
Total		**65,063**	**49,113**	**75.5**

Source: Census of India

ANNEXURE 2-7: WORK FORCE PARTICIPATION RATE IN IDP AREA BY VILLAGE

Sl.No	Village	Population	Total Workers		WFPR	Non Workers	
			No.	%		No.	%
1	Adai	3,358	1,465	2.3	2.3	1,893	2.9
2	Akurli	3,344	1,473	2.3	2.3	1,871	2.9
3	Belavali	1,660	686	1.1	1.1	974	1.5
4	Bonshet	550	264	0.4	0.4	286	0.4
5	Borle	890	361	0.6	0.6	529	0.8
6	Chikhale	1,899	666	1.0	1.0	1,233	1.9
7	Chipale	1,629	754	1.2	1.2	875	1.3
8	Derawali	1,205	432	0.7	0.7	773	1.2
9	Devad	3,210	1,413	2.2	2.2	1,797	2.8
10	Kolkhe	4,657	1,655	2.5	2.5	3,002	4.6
11	Kon	2,187	978	1.5	1.5	1,209	1.9
12	Koproli	1,026	387	0.6	0.6	639	1.0
13	Moho	1,822	780	1.2	1.2	1,042	1.6
14	Nere	3,569	1,239	1.9	1.9	2,330	3.6
15	Palaspe	5,086	1,958	3.0	3.0	3,128	4.8
16	Pali Kh	531	156	0.2	0.2	375	0.6
17	Palidevad	9,194	3,223	5.0	5.0	5,971	9.2
18	Sangade	871	303	0.5	0.5	568	0.9
19	Shilottar Raichur	5,796	2,330	3.6	3.6	3,466	5.3
20	Shivkar	2,464	812	1.2	1.2	1,652	2.5
21	Usarli Kh	2,608	893	1.4	1.4	1,715	2.6
22	Vichumbe	6,332	2,615	4.0	4.0	3,717	5.7
23	Vihighar	1,175	507	0.8	0.8	668	1.0
Total		**65,063**	**25,350**	**39.0**	**39.0**	**39,713**	**61.0**

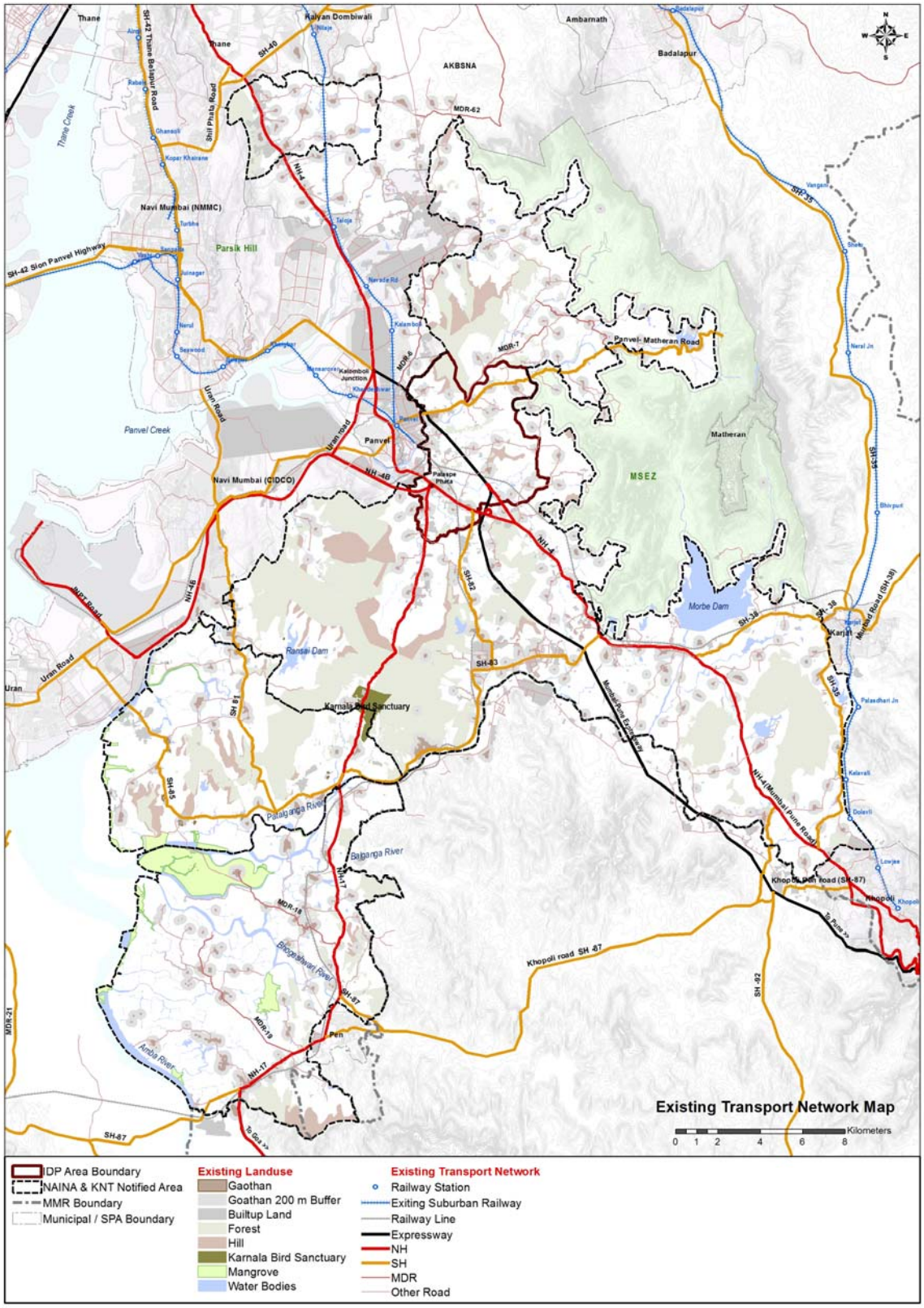
Source: Census of India

ANNEXURE 2-8: EMPLOYMENT PATTERN BY VILLAGE

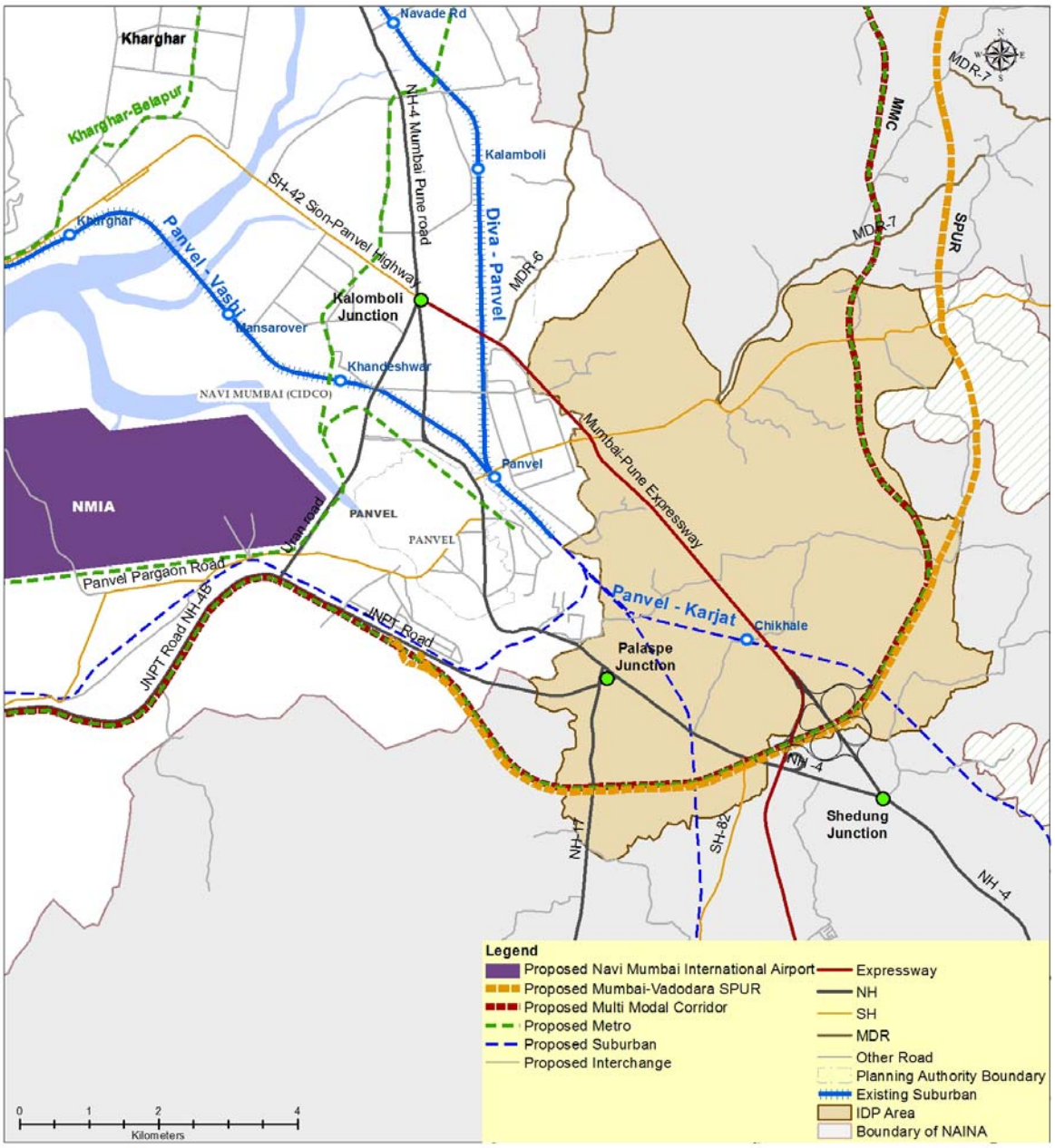
Sl.No	Village	Cultivators		Agriculture		Households		Others		Total
		Nos.	(%)	Nos.	(%)	Nos.	(%)	Nos.	(%)	
1	Adai	184	5.36	39	3.97	69	7.01	1,173	5.73	1,465
2	Akurli	224	6.52	22	2.24	106	10.76	1,121	5.48	1,473
3	Belavali	381	11.09	33	3.36	20	2.03	252	1.23	686
4	Bonshet	23	0.67	02	0.2	08	0.81	231	1.13	264
5	Borle	139	4.05	77	7.83	04	0.41	141	0.69	361
6	Chikhale	136	3.96	83	8.44	43	4.37	404	1.97	666
7	Chipale	99	2.88	12	1.22	13	1.32	630	3.08	754
8	Derawali	81	2.36	07	0.71	24	2.44	320	1.56	432
9	Devad	77	2.24	20	2.03	39	3.96	1,277	6.24	1,413
10	Kolkhe	75	2.18	34	3.46	83	8.43	1,463	7.15	1,655
11	Kon	237	6.9	73	7.43	10	1.02	658	3.22	978
12	Koproli	32	0.93	25	2.54	09	0.91	321	1.57	387
13	Moho	228	6.64	104	10.58	01	0.1	447	2.18	780
14	Nere	214	6.23	74	7.53	57	5.79	894	4.37	1,239
15	Palaspe	146	4.25	35	3.56	58	5.89	1,719	8.4	1,958
16	Pali Kh	91	2.65	53	5.39	-	0	12	0.06	156
17	Palidevad	34	0.99	17	1.73	117	11.88	3,055	14.93	3,223
18	Sangade	63	1.83	74	7.53	06	0.61	160	0.78	303
19	Shilottar Raichur	183	5.33	92	9.36	164	16.65	1,891	9.24	2,330
20	Shivkar	235	6.84	16	1.63	18	1.83	543	2.65	812
21	Usarli Kh	84	2.45	31	3.15	16	1.62	762	3.72	893
22	Vichumbe	247	7.19	24	2.44	98	9.95	2,246	10.98	2,615
23	Vihighar	185	5.39	25	2.54	08	0.81	289	1.41	507
Total		**3,398**	**100**	**972**	**100**	**971**	**100**	**20,009**	**100**	**25,350**
(%)		**13.4**		**3.8**		**3.8**		**79**		**100**

Source: Census of India

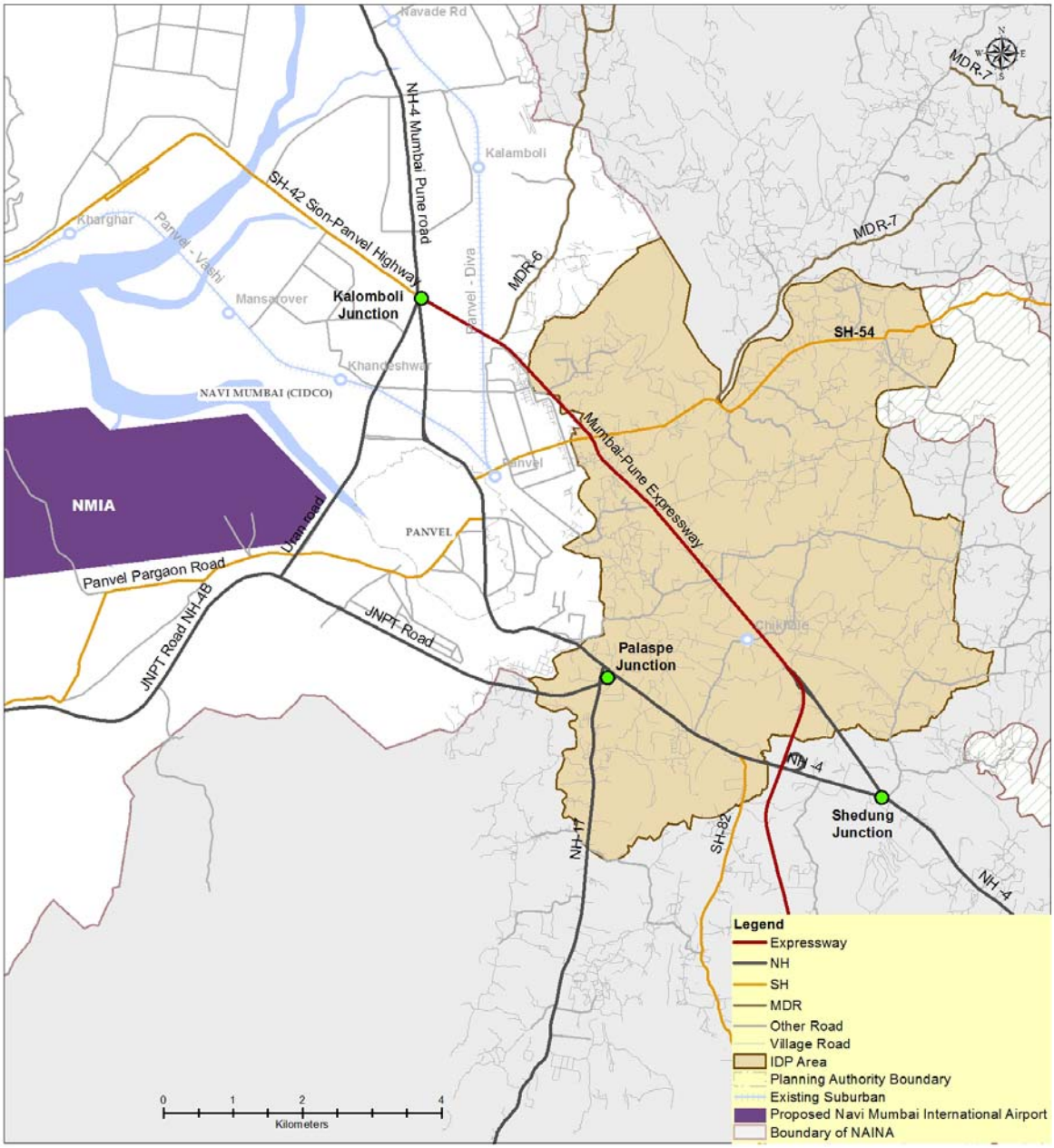
ANNEXURE 2-9: MAP SHOWING EXISTING TRANSPORT NETWORK AT NAINA & REGIONAL LEVEL



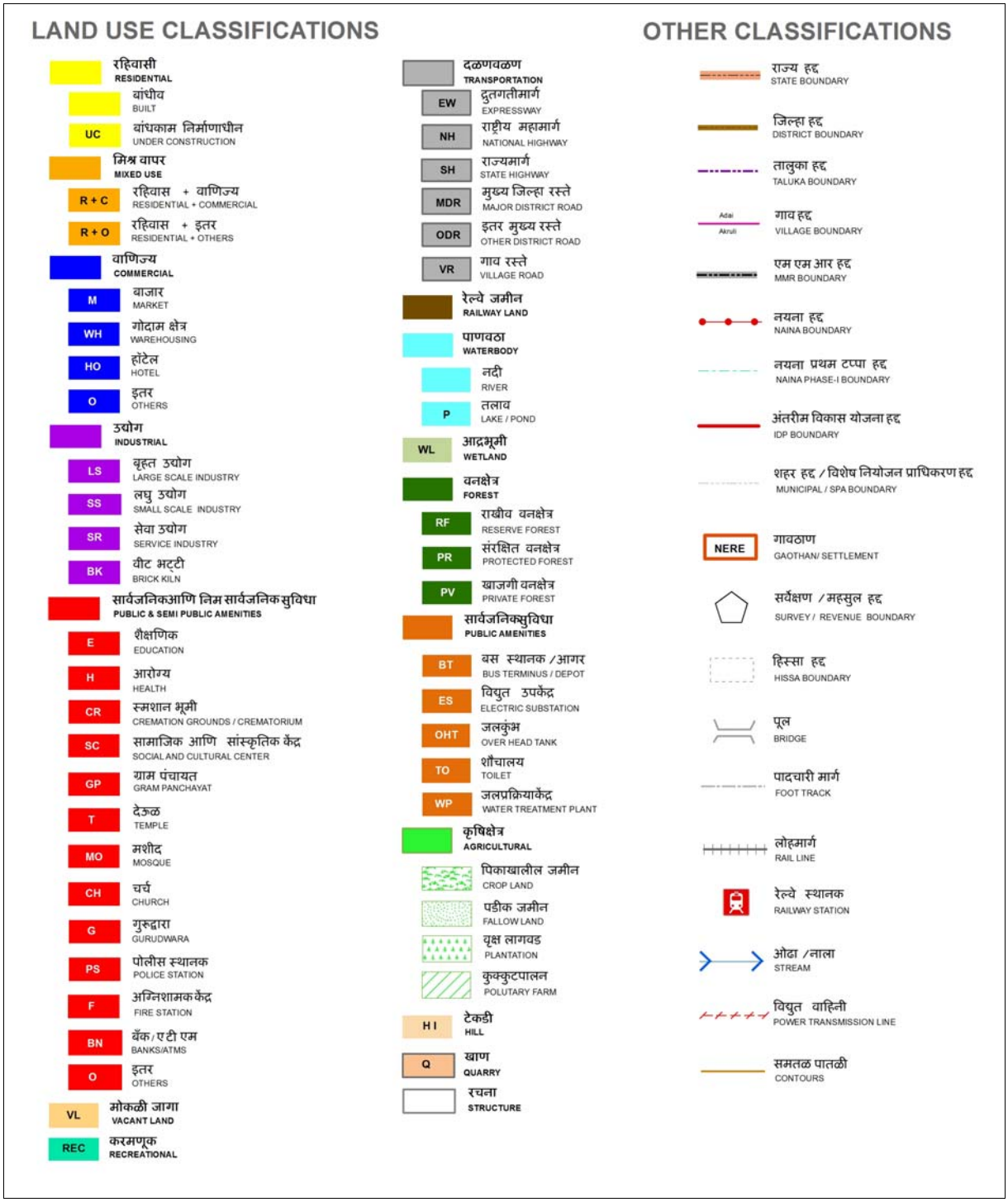
ANNEXURE 2-10: PROPOSED/ COMMITTED REGIONAL TRANSPORT NETWORK



ANNEXURE 2-11: EXISTING LOCAL ROAD NETWORK



ANNEXURE 2-12: LEGEND USED FOR EXISTING LAND USE MAP



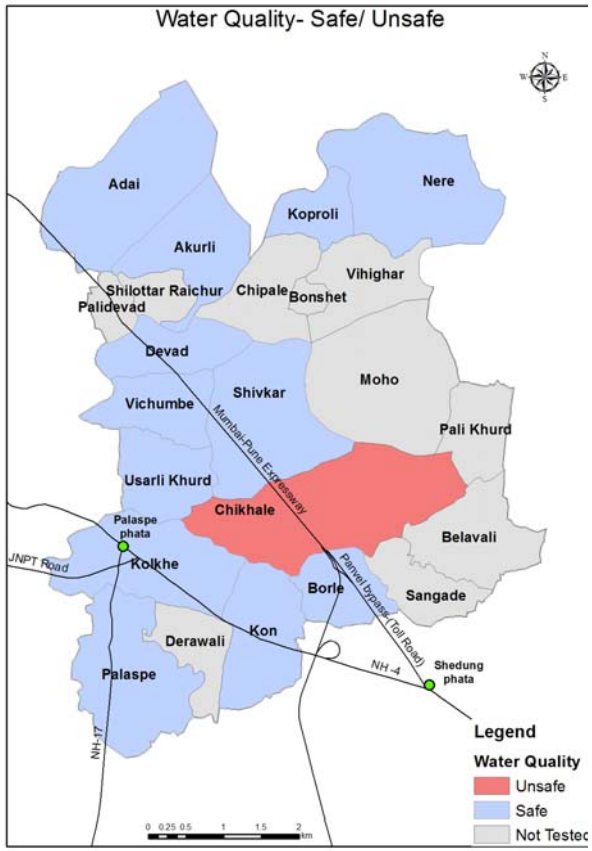
ANNEXURE 2-13: NUMBER OF EDUCATIONAL FACILITIES BY VILLAGE

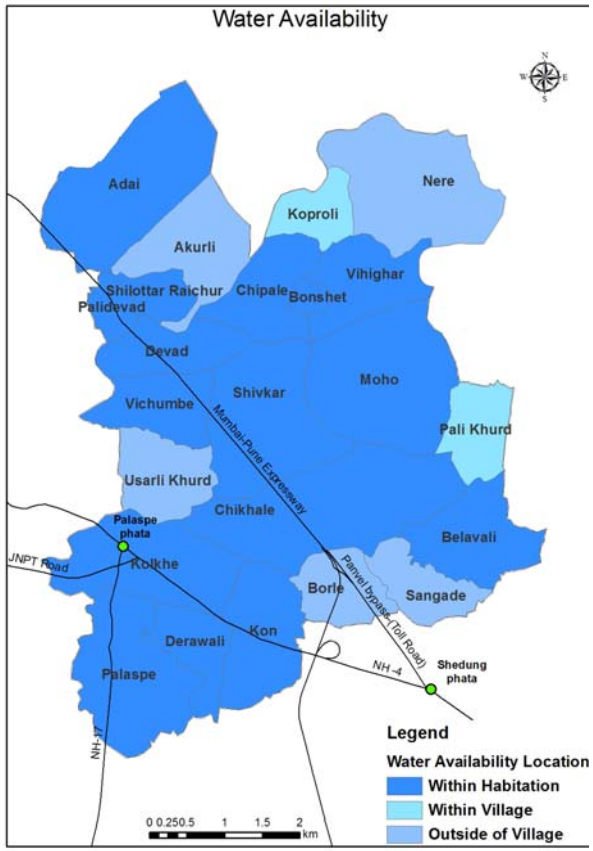
Slno.	Village name	No.of Primary Schools	No.of Upper Primary Schools	No.of Senior secondary Schools	No.of Anganwadi Centers	No.of Colleges
1	Adai	-	01	01	03	-
2	Akurli	01	-	-	01	-
3	Belavali	01	-	01	02	-
4	Bonshet	01	-	-	-	-
5	Borle	01	-	-	01	-
6	Chikhale	-	01	02	-	-
7	Chipale	02	-	-	02	-
8	Derawali	01	-	-	-	-
9	Devad	01	-	-	01	01
10	Kolkhe	01	01	-	02	-
11	Kon	01	-	01	01	-
12	Koproli	01	-	-	01	-
13	Moho	-	01	-	-	-
14	Nere	02	-	01	03	-
15	Palaspe	01	-	01	02	-
16	Pali Kh	01	-	-	04	-
17	Palidevad	-	01	-	01	-
18	Sangade	01	-	-	01	01
19	Shilottar Raichur	-	-	-	-	-
20	Shivkar	01	-	01	02	-
21	Usarli Kh	02	-	-	-	-
22	Vichumbe	-	01	-	02	01
23	Vihighar	01	-	-	01	-
Total		20	06	08	28	03

ANNEXURE 2-14: NUMBER OF HEALTH FACILITIES BY VILLAGE

Slno.	Village name	Sub-Centers	PHCs
1	Adai	-	05
2	Akurli	-	-
3	Balavali	-	-
4	Bonshet	-	01
5	Borle	-	-
6	Chikhale	-	-
7	Chipale	-	-
8	Derawali	-	-
9	Devad		01
10	Kolkhe	01	01
11	Kon	01	-
12	Koproli	-	-
13	Moho	-	-
14	Nere	01	01
15	Palaspe	-	-
16	Palidevad	-	-
17	Sangade	-	-
18	Shilottar Raichur	-	-
19	Shivkar	-	-
20	Usarli Kh	-	-
21	Vichumbe	-	11
22	Vihighar	-	-
23	Pali Khurd	01	-
	Total	**04**	**20**

ANNEXURE 2-15: MAPS SHOWING SOURCE, QUALITY AND AVAILABILITY OFF WATER





ANNEXURE 4-1: COMPARISON OF VARIOUS SPATIAL PLANNING NORMS AND STANDARDS

Sl.No	Facilities		Comparison															Finally Adopted		
			UDPFI			New URDPFI (2013)			1979 GR Norms			CIDCO(Navi Mumbai) Norms			Waluj Nagar Project Draft Development plan			CIDCO(Navi Mumbai) Norms & 1972 GR Norms		
			Popn	Area (sqm)	PCPP (sqm)	Popn	Area (sqm)	PCPP (sqm)	Popn	Area (sqm)	PCPP (sqm)	Popn	Area (sqm)	PCPP (sqm)	Popn	Area (sqm)	PCPP (sqm)	Popn	Area (sqm)	PCPP (sqm)
A	**Social Amenities**																			
1	Balwadi/Creche	Balwadi/Creche	2,500	800	0.32	5,000	200	0.04	Nil			Nil			12,000	500	0.04	12,000	500	0.04
2	Facility center	Public Health Center/Polyclinic	100,000	2,000	0.02	100,000	2,000	0.02				Nil			Nil			10,000	600	0.06
		Library (community hall and library)	15,000	2,000	0.13	15,000	2,000	0.13	10,000	500	0.05	Nil			10,000	500	0.05	10,000	500	0.05
		Multipurpose Hall	Nil			Nil			Depending upon the needs			Nil			Nil			10,000	2,000	0.20
		Health Club & Gymnasium (Meditation or Spiritual Center)	100,000	5,000	0.05	100,000	5,000	0.05	Depending upon the needs			Nil			Nil			10,000	1,000	0.10
3	School	Primary & Secondary School	5,000			5,000			10,000	19,000	1.90	10,170			12,000	16,000		10,170		
		Building		2,000	0.40		2,000	0.40		6,500	0.65		4,000	0.39		6,000	0.50		4,000	0.39
		Play Grounds		2,000	0.40		2,000	0.40		12,500	1.25					10,000	0.83		6,000	0.59
4	Higher Education	Degree Colleges	125,000	40,000	0.32	100,000	50,000	0.50	Nil			125,000	10,000	0.08	12,000	12,500	1.04	125,000	10,000	0.08
		Professional Colleges/Technical College	1,000,000	40,000	0.04	1,000,000	60,000	0.06	Nil			125,000	20,000	0.16	12,000	12,000	1.00	125,000	20,000	0.16
5	Health Facilities	Dispensary/Public Health Center	15,000	800	0.05	15,000	800	0.05	10,000	2,500	0.25	25,000	1,500	0.06	12,000	5,000	0.42	25,000	1,500	0.06
		General Hospital	250,000	60,000	0.24	500,000	60,000	0.12	Nil			100,000	5,000	0.05	20,000	5,000	0.25	100,000	5,000	0.05
		Super Specialty Hospital/Intermediate hospital(Category-A)	100,000	37,000	0.37	100,000	37,000	0.37	Nil			250,000	20,000	0.08	Nil			250,000	20,000	0.08
6	Community hall	Community Hall	Nil			Nil			10,000	500	0.05	100,000	2,000	0.02	38,000	2,000	0.05	100,000	2,000	0.02
7	Hostels	Working Women hostel	Nil			1,000,000	1,000	0.00	Nil			100,000	3,000	0.03	Nil			100,000	3,000	0.03
8	Social Cultural centers	Religious	Nil			1,000,000	40,000	0.04	Nil			10,000	1,500	0.15	Nil			10,000	1,500	0.15
9	Daily Bazaar/ Market Complex	Vegetable Market	Nil			Nil			10,000	2,000	0.2	10,000	1000	0.10	12,000	2,000	0.17	10,000	1,000	0.10
		Fish/Meat Market	Nil			Nil			Nil						12,000	2,000	0.17			
		Rationing shops	Nil			Nil			Nil						Nil					
		Flour mills	Nil			Nil			Nil						Nil					
		Milk Booths	Nil			5,000	150	0.03	Nil						Nil					
		Post office/Head post office with delivery office	500,000	1,500	0.00	500,000	1,500	0.00	Nil						12,000	500	0.04			
10	Weekly Markets/ Hawker's Markets	Weekly Markets/ Hawker's Markets	Nil			100,000	4,000	0.04	Nil			Nil			Nil			100,000	4,000	0.04
B	**Public Utilities**																			
11	Fire station/ Police station	Police post/ Chowky	90,000	15,000	0.17	50,000	3,200	0.06	Nil						12,000	500	0.04	100,000	10,000	0.10
		Fire Brigade and Allied services	200,000	10,000	0.05	100,000	10,000	0.10	Depending upon the needs						12,000	500	0.04	200,000	10,000	0.05
12	Cremation	Burial Ground/Cremation Ground	500,000	5,000	0.01	500,000	40,000	0.08	Depending upon the needs						Nil			500,000	40,000	0.08
C	**Parks and Play Grounds**																			
16	Parks and open spaces	Play fields/Neighborhood Play fields	Play fields mentioned along schools			5,000	15,000	3.00	1,000	4,000	4.00				12,000	1,500	0.13			
		Parks/Neighborhood parks				5,000	10,000	2.00	1,000	2,000	2.00				12,000	10,000	0.83			
		Open space	10,000	100,000	10.00	10,000	100,000	10.00				10,000	30,000	3.00				10,000	30,000	3.00
		City level open spcae/Park				1,000,000	1,000,000	1.00										500,000	500,000	1.00
	Sub Total				**10.00**			**16.00**			**6.00**			**3.00**			**0.96**			**4.00**
D	**Per Capita Space Required**																			
	Social Amenities				2.35			2.26			4.35			1.04			4.56			2.20
	Public Utilities				0.23			0.24			0.00			0.00			0.08			0.23
	Parks and Play Grounds				10.00			16.00			6.00			3.00			5.62			4.00
	Total				12.58			18.50			10.35			4.04			4.56			6.43

Note: PCPP – Per Capita Spaced Required Per Person

ANNEXURE 4-2: ABBREVIATIONS USED FOR SPATIALLY LOCATING SOCIAL INFRASTRUCTURE FACILITIES

Category of facilities (Colour Code)	Facility description	Abbreviation used
EDUCATIONAL	School	**S**
	College	**C**
MEDICAL	Primary Health Centre	**PHC**
	General Hospital	**GH**
MARKETS	Daily Bazaar	**DB**
COMMUNITY SERVICES	Fire Station	**FS**
	Police Station	**PS**
	Community Centre	**CC**
	Burial / Cremation Ground	**BG/C**
PARKS & PLAY GROUNDS	Park/ Play Ground	**P**
	School Play Ground	**PG**
	City Park	**CP**
PUBLIC UTILITIES	33KV ELECTRIC SUBSTATION	**ESS**
	220 KV RECEIVING STATION	**RS**
	CLEAR WATER RESERVOIR	**CWR**
	ELEVATED SERVICE RESERVOIR/ GROUND SERVICE RESERVOIR	**ESR/GSR**
	SEWAGE TREATMENT PLANT	**STP**

Notes:

1. The PLU map has been prepared from the base map prepared by superimposition of cadastral maps and physical features depicted from satellite imagery. Reservations have been proposed on this base map. The area of reservation and location in survey numbers are tentative. The area of the reservation would be finalized after on-site demarcation.
2. In case of any discrepancy, the survey map of the reservation under reference by the DSLR showing the reservation, physical feature (if any) and survey number, Hissa number boundary would be considered final.
3. There are cases wherein survey number, hissa number are not available on the revenue map used for preparation of base map. In such cases, shall be referred to the DLSR for incorporating the necessary data.

P – Indicates Part Survey Number

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
1	Sector 1	1 _ C	1.240	Adai	131(P), 133(P), 134(P), 6(P)
2	Sector 1	2 _ CC	0.280	Shilottar Raichur	45(P)
3	Sector 1	3 _ CP	28.740	Adai	59(P), 60(P), 61(P), 62(P), 63(P), 64(P), 65(P), 69(P), 79(P), 80(P), 81(P), 82(P), 83(P)
4	Sector 1	4 _ DB	0.080	Akurli	14(P), 15(P), 16(P), 18(P), 19(P), 20(P)
5	Sector 1	5 _ DB	0.110	Shilottar Raichur	45(P)
6	Sector 1	6 _ DB	0.110	Adai	118(P), 122(P)
7	Sector 1	7 _ ESR/GSR	0.340	Akurli	228(P), 229(P), 232(P), 236(P), 240(P)
8	Sector 1	8 _ ESS	0.300	Akurli	222(P), 232(P), 233(P), 234(P), 235(P), 236(P), 237(P)
9	Sector 1	9 _ ESS	0.200	Adai	42(P), 47(P), 49(P)
10	Sector 1	10 _ ESS	0.220	Shilottar Raichur	45(P)
11	Sector 1	11 _ FS	1.040	Adai	40(P), 41(P), 42(P), 50(P)
12	Sector 1	12 _ P	2.140	Shilottar Raichur	45(P), 46(P)
13	Sector 1	13 _ P	0.730	Akurli	98(P)
			1.230	Shilottar Raichur	12/A(P), 22(P), 23(P)
14	Sector 1	14 _ PG	1.470	Shilottar Raichur	45(P)
15	Sector 1	15 _ PG	0.630	Akurli	4(P), 34(P)
16	Sector 1	16 _ PG	0.560	Adai	83(P), 90(P), 92(P)
17	Sector 1	17 _ PG	0.700	Adai	134(P), 5(P), 6(P)
18	Sector 1	18 _ PHC	0.160	Akurli	11(P), 12(P)

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
19	Sector 1	19 _ PHC	0.170	Shilottar Raichur	45(P)
20	Sector 1	20 _ PHC	0.160	Shilottar Raichur	10(P), 46(P), 49(P)
21	Sector 1	21 _ PHC	0.150	Adai	103(P), 104(P), 91(P)
22	Sector 1	22 _ PS	0.980	Akurli	80(P), 81(P), 82(P), 89(P), 91(P)
23	Sector 1	23 _ S	0.640	Adai	4(P), 5(P), 6(P)
24	Sector 1	24 _ S	0.400	Shilottar Raichur	45(P)
25	Sector 1	25 _ S	0.410	Akurli	33(P), 11(P), 34(P)
26	Sector 1	26 _ S	0.460	Adai	103(P), 104(P), 90(P), 91(P), 92(P)
27	Sector 1	27 _ STP-3	2.010	Akurli	60(P), 64(P), 65(P), 66(P), 76(P), 80(P)
28	Sector 2	28 _ CC	0.220	Vichumbe	216(P), 218(P)
29	Sector 2	29 _ CP	15.160	Shivkar	149(P), 150(P), 151(P), 153(P), 168(P), 173(P), 174(P), 175(P), 176(P), 177(P), 178(P), 179(P), 180(P), 182(P), 183(P), 185(P), 186(P), 188(P), 205(P), 206(P), 207(P), 88(P), 89(P)
			4.110	Usarli Khurd	63(P), 64(P), 76(P), 77(P)
			1.100	Vichumbe	75(P), 77(P)
30	Sector 2	30 _ DB	0.160	Devad	43(P), 44(P), 62(P)
31	Sector 2	31 _ DB	0.090	Devad	78(P), 8(P), 9(P)
32	Sector 2	32 _ DB	0.090	Usarli Khurd	86(P), 87(P)
33	Sector 2	33 _ ESR/GSR	0.250	Usarli Khurd	66(P), 67(P), 68(P), 69(P), 71(P), 76(P)
34	Sector 2	34 _ ESS	0.210	Usarli Khurd	19(P), 25(P), 45(P), 46(P)

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
35	Sector 2	35 _ P	3.700	Vichumbe	24(P), 27(P), 28(P), 29(P), 54(P), 62(P), 63(P), 64(P), 65(P), 66(P), 67(P), 68(P)
36	Sector 2	36 _ PG	0.640	Devad	10(P), 11(P), 12(P), 13(P), 14(P), 17(P), 9(P)
37	Sector 2	37 _ PG	0.630	Usarli Khurd	75(P), 79(P), 86(P), 87(P)
38	Sector 2	38 _ PG	0.620	Usarli Khurd	137(P), 138(P), 30(P)
39	Sector 2	39 _ PHC	0.260	Devad	73(P), 78(P)
40	Sector 2	40 _ PHC	0.150	Usarli Khurd	68(P), 69(P), 70(P), 71(P)
41	Sector 2	41 _ PHC	0.160	Vichumbe	29(P), 54(P)
42	Sector 2	42 _ PS	0.890	Usarli Khurd	77(P), 78(P), 81(P)
43	Sector 2	43 _ S	0.420	Usarli Khurd	137(P), 138(P), 30(P)
44	Sector 2	44 _ S	0.430	Devad	10(P), 9(P)
45	Sector 2	45 _ S	0.520	Usarli Khurd	75(P), 79(P), 86(P), 87(P)
46	Sector 3	46 _ BG/C	3.900	Devad	75(P), 76(P), 78(P)
47	Sector 3	47 _ DB	0.110	Devad	65(P), 69(P)
48	Sector 3	48 _ DB	0.160	Chipale	40(P), 48(P)
49	Sector 3	49 _ ESR/GSR	0.720	Chipale	53(P), 55(P), 57(P), 59(P)
50	Sector 3	50 _ ESS	0.210	Devad	78(P), 81(P), 83(P)
51	Sector 3	51 _ GH	2.750	Chipale	59(P), 62(P), 63(P), 68(P), 69(P)
52	Sector 3	52 _ P	1.510	Shivkar	276(P)
53	Sector 3	53 _ P	2.720	Shivkar	285(P), 298(P), 299(P), 300(P), 301(P), 302(P), 303(P), 304

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
54	Sector 3	54 _ P	0.550	Chipale	60(P)
			5.260	Devad	100(P), 94(P), 95(P), 96(P), 97(P), 98(P)
55	Sector 3	55 _ P	2.950	Devad	78(P), 79(P), 80(P), 81(P), 82(P), 89(P)
56	Sector 3	56 _ P	1.890	Vichumbe	24(P), 64(P), 68(P), 69(P), 70(P), 72(P), 73(P)
57	Sector 3	57 _ PG	0.670	Chipale	53(P), 59(P), 61(P)
58	Sector 3	58 _ PG	0.660	Chipale	22(P), 23(P), 24(P)
59	Sector 3	59 _ PHC	0.240	Moho	14(P)
60	Sector 3	60 _ S	0.390	Chipale	61(P), 62(P)
61	Sector 3	61 _ S	0.390	Chipale	22(P), 24(P)
62	Sector 3	62 _ STP-2	2.000	Devad	69(P), 75(P), 76(P)
63	Sector 4	63 _ CC	0.270	Chipale	1(P)
64	Sector 4	64 _ DB	0.090	Chipale	3(P)
65	Sector 4	65 _ DB	0.090	Vihighar	42(P), 46(P), 48(P)
66	Sector 4	66 _ DB	0.120	Bonshet	20(P), 21(P), 22(P)
67	Sector 4	67 _ DB	0.110	Koproli	1(P)
68	Sector 4	68 _ ESR/GSR	0.010	Koproli	5(P)
			0.230	Vihighar	29(P)
69	Sector 4	69 _ ESS	0.250	Koproli	16(P), 17(P)
70	Sector 4	70 _ P	0.010	Moho	14(P)
			2.580	Vihighar	72(P), 74(P), 95(P), 96(P)

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
71	Sector 4	71 _ CP	0.550	Chipale	2(P), 3(P)
			20.660	Koproli	13(P), 14(P), 15(P), 16(P), 17(P), 18(P)
72	Sector 4	72 _ PG	0.010	Koproli	4(P), 5(P)
			0.690	Vihighar	29(P)
73	Sector 4	73 _ PG	0.690	Nere	102(P), 103(P), 104(P)
74	Sector 4	74 _ PG	0.040	Bonshet	29(P), 31(P)
			0.620	Vihighar	15(P), 4(P), 5(P), 6(P), 7(P), 8(P), 9(P)
75	Sector 4	75 _ PHC	0.170	Vihighar	16(P), 2(P)
76	Sector 4	76 _ PHC	0.200	Koproli	1(P)
78	Sector 4	78 _ PHC	0.160	Chipale	18(P), 20(P), 23(P)
79	Sector 4	79 _ PS	0.980	Koproli	6(P)
			0.0004	Vihighar	29(P)
80	Sector 4	80 _ S	0.0001	Koproli	4(P)
			0.0013	Nere	50(P)
			0.400	Vihighar	29(P)
81	Sector 4	81 _ S	0.390	Vihighar	15(P), 16(P), 4(P), 5(P), 7(P), 9(P)
82	Sector 4	82 _ S	0.420	Nere	101(P), 102(P), 103(P), 99(P)
83	Sector 5	83 _ C	1.080	Nere	166(P), 167(P), 172(P), 85(P)
84	Sector 5	84 _ DB	0.120	Nere	1(P), 18(P)
85	Sector 5	85 _ DB	0.100	Nere	253(P), 254(P), 367(P), 368(P)

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
86	Sector 5	86 _ ESS	0.270	Nere	178(P), 182(P), 201(P)
87	Sector 5	87 _ P	2.840	Nere	11(P), 12(P), 13(P), 15(P), 17(P), 21(P), 22(P), 23(P), 24(P), 25(P), 30(P), 31(P), 32(P), 54(P), 9(P)
88	Sector 5	88 _ PG	0.590	Nere	375(P), 378(P)
89	Sector 5	89 _ PG	0.600	Nere	157(P), 159(P), 168(P), 169(P), 170(P)
90	Sector 5	90 _ PHC	0.170	Nere	7(P), 8(P), 9(P)
91	Sector 5	91 _ PHC	0.180	Nere	253(P), 367(P), 368(P)
92	Sector 5	92 _ S	0.460	Nere	375(P), 376(P), 378(P)
93	Sector 5	93 _ S	0.470	Nere	157(P), 167(P), 168(P), 169(P), 170(P), 172(P), *
94	Sector 6	94 _ C	1.060	Moho	136(P), 23(P)
95	Sector 6	95 _ CC	0.250	Shivkar	114(P), 115(P), 128(P)
96	Sector 6	96 _ CP	0.190	Chikhale	140(P), 141(P)
			0.040	Moho	105(P), 63(P)
			17.480	Shivkar	15(P), 19(P), 20(P), 21(P), 22(P), 23(P), 24(P), 26(P), 29(P), 32(P), 36(P), 37(P), 38(P), 39(P), 40(P), 41(P), 42(P), 43(P), 44(P), 45(P), 46(P), 47(P), 48(P), 49(P), 50(P), 51(P), 52(P), 53(P), 54(P), 56(P), 57(P), 58(P), 60(P), 61(P), 62(P), 63(P), 64(P), 65(P), 66(P), 67(P), 69(P), 70(P), 71(P), 73(P)
97	Sector 6	97 _ DB	0.120	Moho	103(P)
98	Sector 6	98 _ DB	0.110	Shivkar	250(P), 252(P)
99	Sector 6	99 _ DB	0.100	Moho	3(P)

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
100	Sector 6	100 _ DB	0.130	Shivkar	114(P), 121(P), 127(P)
101	Sector 6	101 _ ESS	0.220	Shivkar	149(P), 183(P)
102	Sector 6	102 _ FS	1.070	Shivkar	211(P), 251(P), 252(P), 255(P), 256(P)
104	Sector 6	104 _ P	0.700	Moho	109(P), 110(P)
105	Sector 6	105 _ P	0.190	Shivkar	168(P), 259(P)
			2.230	Vichumbe	63(P), 64(P), 72(P), 73(P), 75(P)
106	Sector 6	106 _ PG	0.600	Moho	49(P), 50(P), 51(P), 52(P), 57(P)
107	Sector 6	107 _ PG	0.550	Shivkar	129(P), 134(P), 136(P), 137(P), 139(P), 140.141(P), 142(P)
108	Sector 6	108 _ PG	0.610	Moho	136(P), 23(P), 24(P)
109	Sector 6	109 _ PHC	0.150	Moho	3(P), 4(P), 6(P), 7(P)
110	Sector 6	110 _ PHC	0.160	Shivkar	121(P), 122(P)
111	Sector 6	111 _ PS	1.180	Shivkar	210(P), 211(P), 256(P)
112	Sector 6	112 _ S	0.600	Moho	110(P), 103(P)
113	Sector 6	113 _ S	0.400	Moho	50(P), 52(P)
114	Sector 6	114 _ S	0.440	Shivkar	134(P), 136(P), 139(P)
115	Sector 6	115 _ S	0.470	Moho	136(P), 23(P), 24(P)
116	Sector 6	116 _ STP-4	2.660	Shivkar	237(P), 238(P), 239(P), 240(P), 241(P), 242(P), 250(P), 252(P), 284(P), 310(P)
117	Sector 7	117 _ CC	0.210	Chikhale	8 (P)
118	Sector 7	118 _ DB	0.110	Moho	63(P), 87(P)

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
119	Sector 7	119 _ DB	0.090	Chikhale	8(P), 9(P)
120	Sector 7	120 _ ESR/GSR	0.340	Moho	105(P), 63(P)
121	Sector 7	121 _ ESS	0.260	Chikhale	70(P), 77(P)
122	Sector 7	122 _ P	0.840	Moho	100(P), 63(P), 91(P)
123	Sector 7	123 _ P	8.560	Borle	112(P), 117(P), 118(P), 119(P), 12(P), 123(P), 127(P), 128(P), 129(P), 134(P), 135(P), 136(P), 137(P), 138(P), 139(P), 140(P), 141(P), 142(P), 15(P), 23(P), 24(P), 25(P), 26(P), 27(P), 28(P), 29(P), 30(P), 31(P), 32(P), 39(P), 55(P)
			5.180	Sangade	113(P), 117(P), 119(P), 120(P), 121(P), 122(P), 124(P), 126(P), 127(P), 128(P), 129(P), 130(P), 140(P), 141(P), 142(P), 143(P), 144(P), 146(P), 147(P), 148(P)
124	Sector 7	124 _ PG	0.660	Chikhale	66(P), 67(P), 68(P), 8(P), 9(P)
125	Sector 7	125 _ PG	0.610	Chikhale	1(P), 142(P), 143(P)
126	Sector 7	126 _ PHC	0.160	Chikhale	8(P)
127	Sector 7	127 _ PHC	0.170	Moho	87(P)
128	Sector 7	128 _ S	0.530	Chikhale	66(P), 67(P)
129	Sector 7	129 _ S	0.490	Chikhale	142(P)
130	Sector 8	130 _ BG/C	3.810	Kolkhe	168(P), 173(P), 174(P), 28(P), 36(P), 37(P), 38(P), 39(P)
131	Sector 8	131 _ C	1.320	Kon	109(P), 110(P), 17(P), 19(P), 20(P)
132	Sector 8	132 _ CC	0.250	Kon	42(P), 44(P), 45(P)
133	Sector 8	133 _ CP	22.370	Kon	10(P), 11(P), 110(P), 12(P), 13(P), 14(P), 17(P), 18(P), 19(P), 22(P), 23(P), 24(P), 25(P), 26(P), 29(P), 34(P),

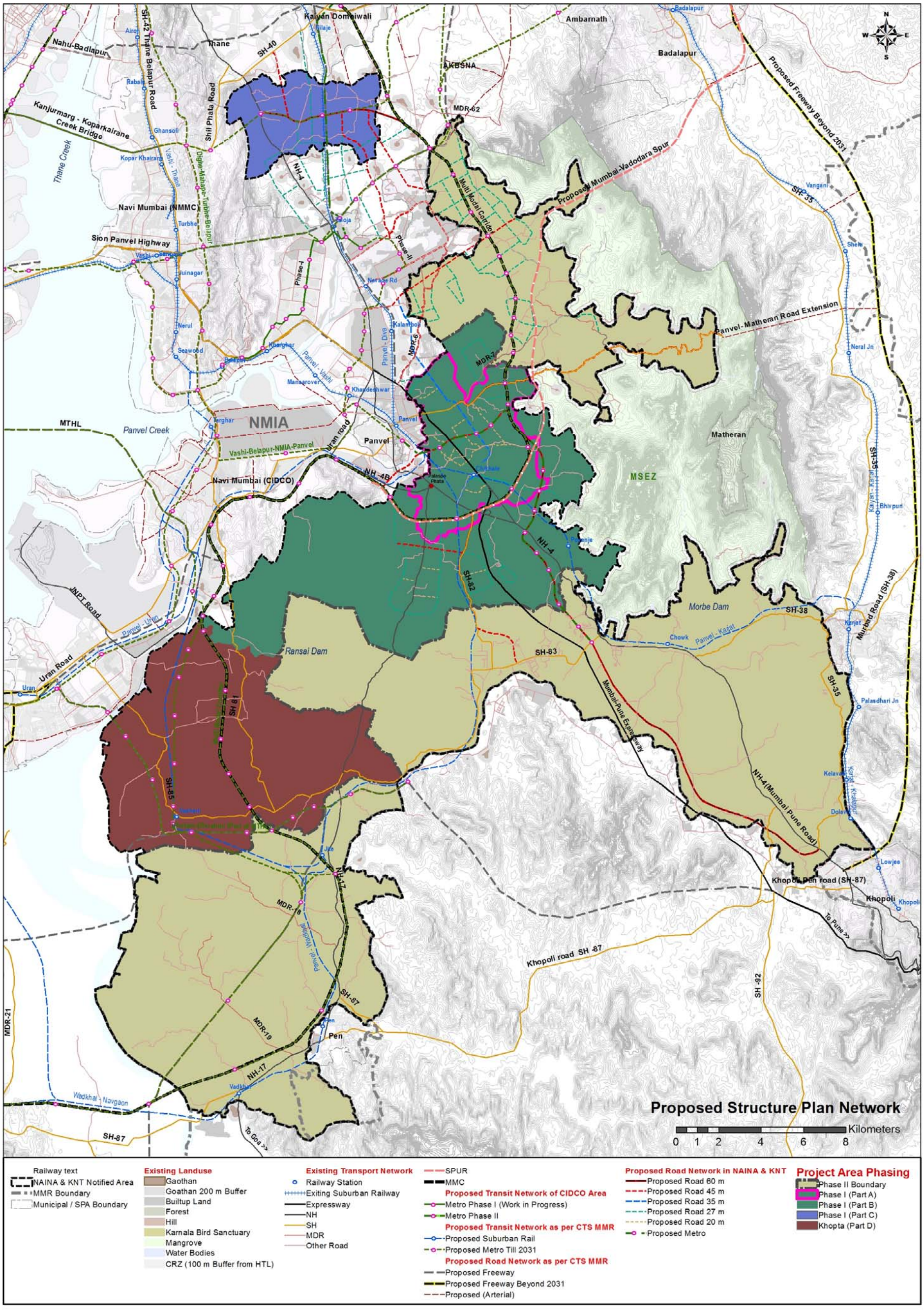
Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
					35(P), 36(P), 37(P), 38(P), 73(P)
134	Sector 8	134 _ CWR	6.880	Chikhale	168(P), 174(P), 175(P), 176(P), 181(P), 182(P), 183(P), 184(P), 185(P), 186(P), 201(P), 202(P), 203(P), 28(P)
			0.010	Kolkhe	*
135	Sector 8	135 _ DB	0.110	Kon	1(P)
136	Sector 8	136 _ DB	0.180	Kon	101(P)
137	Sector 8	137 _ ESS	0.200	Kon	73(P)
138	Sector 8	138 _ ESS	0.260	Kon	19(P), 22(P)
139	Sector 8	139 _ FS	1.020	Kon	14(P), 15(P), 16(P), 17(P)
140	Sector 8	140 _ P	0.580	Kon	100(P), 101(P)
141	Sector 8	141 _ PG	0.570	Kon	1(P), 103(P), 104(P), 105(P), 107(P), 3(P)
142	Sector 8	142 _ PG	0.590	Kon	100(P), 101(P), 97(P), 98(P)
143	Sector 8	143 _ PG	0.680	Chikhale	102(P), 103(P), 104(P)
144	Sector 8	144 _ PHC	0.160	Kon	101(P)
145	Sector 8	145 _ PHC	0.180	Kon	108(P), 25(P), 26(P), 28(P)
146	Sector 8	146 _ PS	1.060	Kon	110(P), 15(P), 16(P), 17(P)
147	Sector 8	147 _ RS	1.910	Chikhale	101(P), 102(P)
148	Sector 8	148 _ S	0.400	Kon	1(P), 107(P)
149	Sector 8	149 _ S	0.560	Chikhale	102(P), 104(P), 99(P)
150	Sector 8	150 _ S	0.420	Kon	100(P), 101(P), 97(P)

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
151	Sector 8	151 _ STP-5	2.110	Kon	108(P), 111(P), 19(P), 20(P), 21(P), 22(P), 25(P)
152	Sector 9	152 _ CC	0.260	Belavali	53(P), 54(P), 55(P)
153	Sector 9	153 _ DB	0.140	Belavali	125(P), 189(P)
154	Sector 9	154 _ DB	0.180	Belavali	51(P), 52(P), 53(P)
155	Sector 9	155 _ DB	0.100	Pali Khurd	6(P), 8(P)
156	Sector 9	156 _ DB	0.100	Sangade	86(P)
157	Sector 9	157 _ DB	0.110	Belavali	240(P), 165(P)
158	Sector 9	158 _ ESS	0.190	Sangade	51(P), 68(P), 69(P), 83(P)
159	Sector 9	159 _ P	4.760	Borle	157(P), 158(P), 159(P), 160(P), 161(P), 162(P), 163(P), 164(P), 166(P), 167(P), 17(P), 18(P), 19(P)
			1.830	Sangade	109(P), 110(P), 111(P), 94(P), 95(P), 96(P), 97(P)
160	Sector 9	160 _ P	2.910	Pali Khurd	6(P), 8(P), 9(P)
161	Sector 9	161 _ P	0.020	Sangade	111(P)
162	Sector 9	162 _ PG	0.560	Pali Khurd	6(P), 7(P), 8(P)
163	Sector 9	163 _ PG	0.670	Belavali	48(P), 49(P), 50(P)
164	Sector 9	164 _ PG	0.650	Sangade	49(P), 50(P), 51(P), 52(P), 53(P)
165	Sector 9	165 _ PG	0.670	Belavali	239(P), 240(P), 165(P)
166	Sector 9	166 _ PG	0.200	Sangade	86(P), 87(P), 88(P), 89(P)
167	Sector 9	167 _ PHC	0.160	Belavali	125(P)
168	Sector 9	168 _ PHC	0.150	Pali Khurd	6(P)

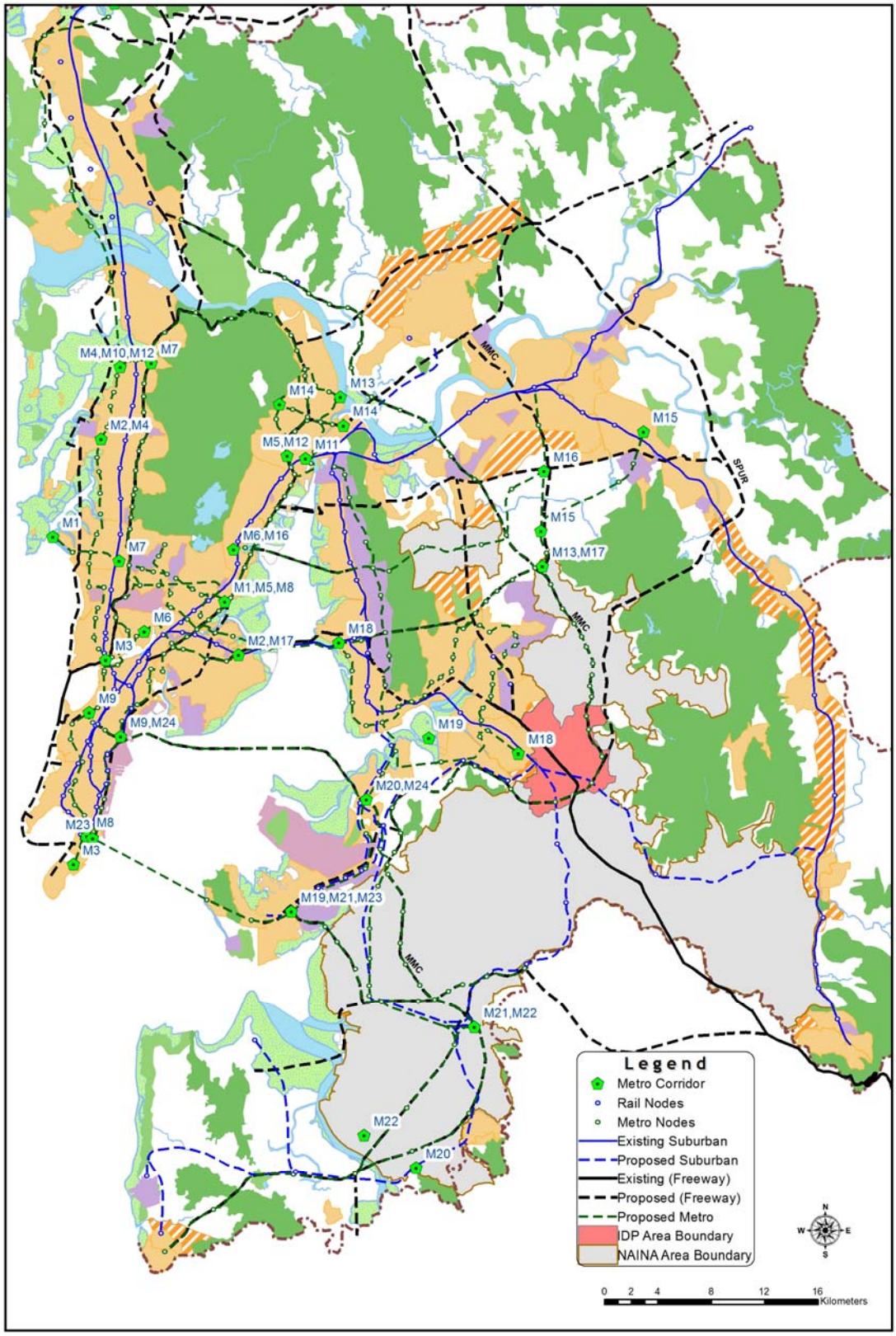
Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
169	Sector 9	169 _ PHC	0.110	Sangade	51(P), 86(P)
170	Sector 9	170 _ PHC	0.150	Belavali	249(P), 250(P), 251(P)
171	Sector 9	171 _ PS	0.930	Belavali	105(P), 113(P), 114(P), 115(P), 116(P), 117(P), 118(P), (P)
172	Sector 9	172 _ S	0.410	Pali Khurd	6(P), 8(P)
173	Sector 9	173 _ S	0.400	Belavali	1(P), 2(P), 3(P), 49(P), 50(P)
174	Sector 9	174 _ S	0.420	Belavali	238(P), 239(P), 240(P)
175	Sector 10	175 _ CC	0.210	Kolkhe	148(P), 150(P), 151(P), 152(P)
176	Sector 10	176 _ DB	0.120	Derawali	45(P), 47(P)
177	Sector 10	177 _ DB	0.100	Palaspe	43(P)
178	Sector 10	178 _ DB	0.120	Kolkhe	1(P)
179	Sector 10	179 _ ESR/GSR	0.110	Derawali	103(P), 104(P), 105(P), 112(P)
180	Sector 10	180 _ ESS	0.230	Usarli Khurd	155(P), 157(P), 158(P)
181	Sector 10	181 _ ESS	0.210	Palaspe	12/13(P)
182	Sector 10	182 _ FS	1.060	Kolkhe	48(P), 49(P), 50(P), 51(P), 52(P), 57(P), 58(P), 59(P), 227(P)
183	Sector 10	183 _ GH	2.680	Derawali	20(P), 22(P), 23(P), 24(P), 25(P), 26(P), 33(P), 40(P)
184	Sector 10	184 _ P	1.870	Kolkhe	75(P), 77(P), 78(P), 79(P)
			0.060	Palaspe	*
185	Sector 10	185 _ P	3.330	Kolkhe	110(P), 119(P), 120(P), 121(P), 123(P)

Sl.No	Sector	Reservation Number	Area (Ha)	Village Name	Survey Numbers
186	Sector 10	186 _ P	4.030	Derawali	128(P), 130(P), 131(P), 132(P), 133(P), 134(P), 135(P), 136(P), 137(P), 138(P), 139 (P), 20(P), 21(P), 25(P)
			0.040	Palaspe	48(P)
187	Sector 10	187 _ P	0.630	Usarli Khurd	105(P), 150(P)
188	Sector 10	188 _ PG	0.630	Palaspe	42(P), 43(P), 51(P)
189	Sector 10	189 _ PG	0.580	Usarli Khurd	112(P), 113(P), 114(P)
190	Sector 10	190 _ PG	0.620	Derawali	105(P), 106(P), 124(P), 128(P), 129(P), 130(P), 136(P)
191	Sector 10	191 _ PG	0.400	Kolkhe	135(P), 137(P), 147(P)
192	Sector 10	192 _ PHC	0.150	Derawali	45(P)
193	Sector 10	193 _ PHC	0.150	Palaspe	43(P)
194	Sector 10	194 _ PS	1.070	Usarli Khurd	102(P), 103(P), 104(P), 106(P), 107(P), 156(P), 157(P)
195	Sector 10	195 _ S	0.380	Derawali	105(P), 106(P), 112(P), 114(P), 115(P)
196	Sector 10	196 _ S	0.380	Usarli Khurd	113(P)
197	Sector 10	197 _ S	0.530	Palaspe	42(P), 43(P)
198	Sector 10	198 _ S	0.400	Kolkhe	135(P), 146(P), 147(P), 148(P), 152(P)
199	Sector 10	199 _ STP-1	1.920	Usarli Khurd	101(P), 107(P), 108(P), 109(P)
			272.870		

ANNEXURE 5-1: PROPOSED TRANSPORTATION PLAN FOR PROJECT AREA (NAINA & KNT TOGETHER)

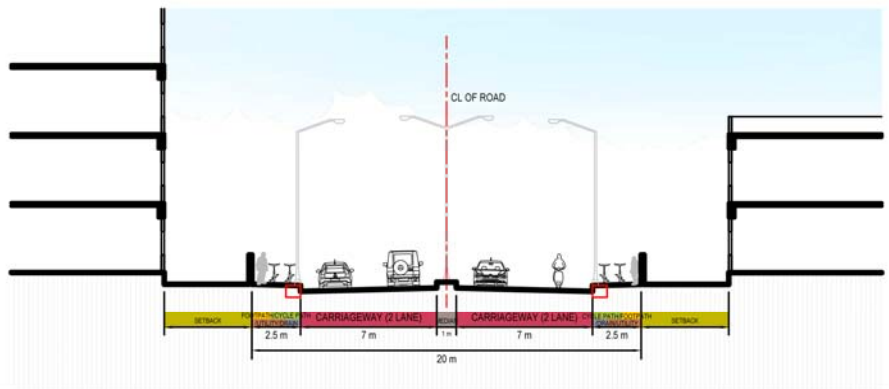


ANNEXURE 5-2: IMPORTANT PUBLIC TRANSPORT AND ROAD CONNECTIVITY IN CTS WITH RESPECT TO THE IDP

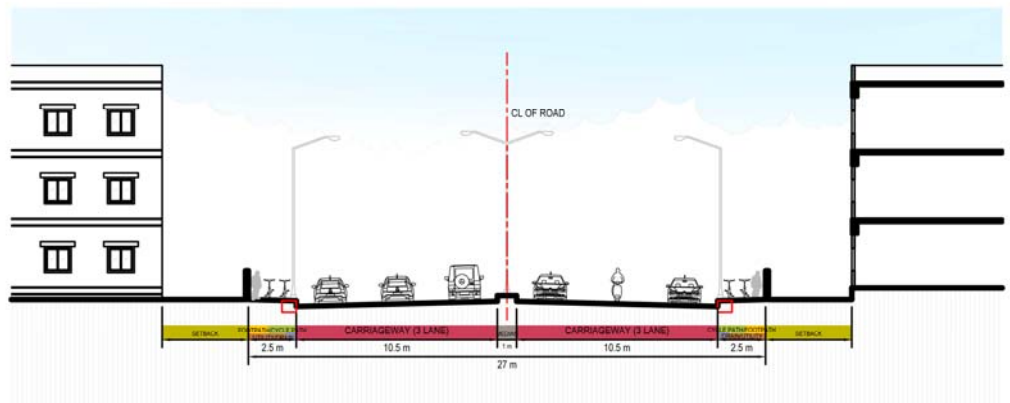


ANNEXURE 5-3: TYPICAL ROAD CROSS SECTIONS OF PROPOSED TRANSPORT CORRIDORS

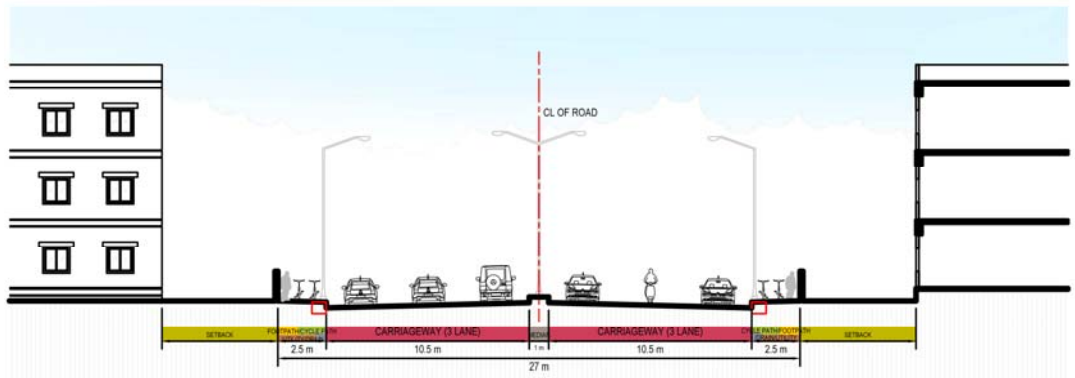
20 m WIDE ROAD WITH CYCLE PATH AND 2-LANE CARRIAGEWAY



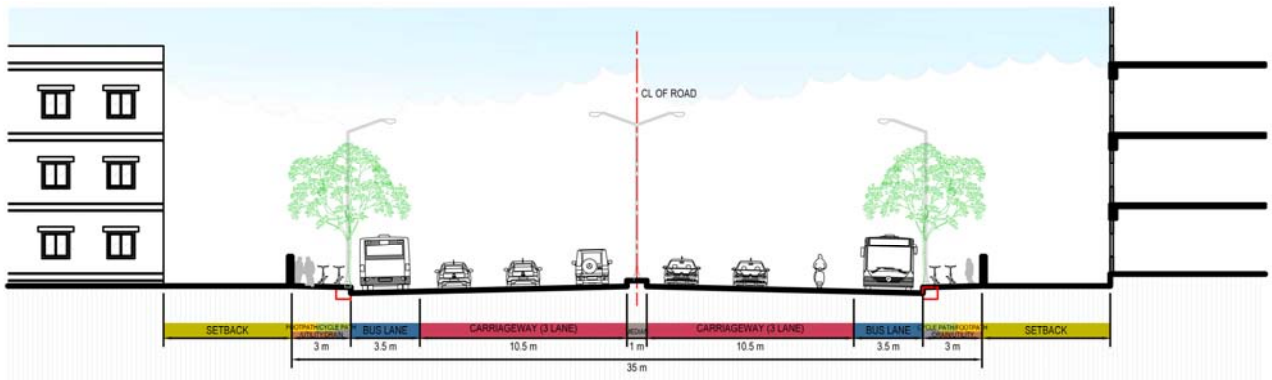
A 27 m WIDE ROAD WITH CYCLE PATH AND 3-LANE CARRIAGEWAY



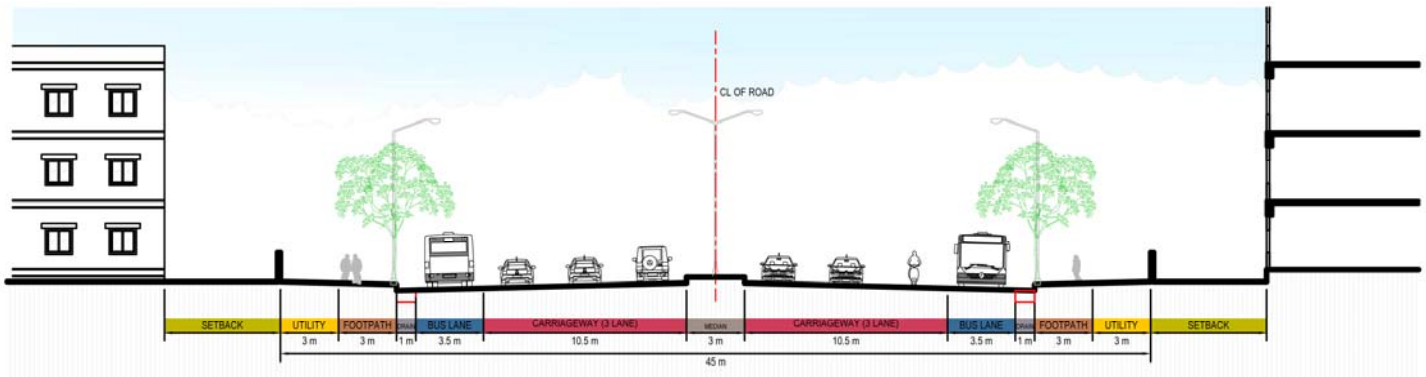
B 27 m WIDE ROAD WITH CYCLE PATH AND 3-LANE CARRIAGEWAY



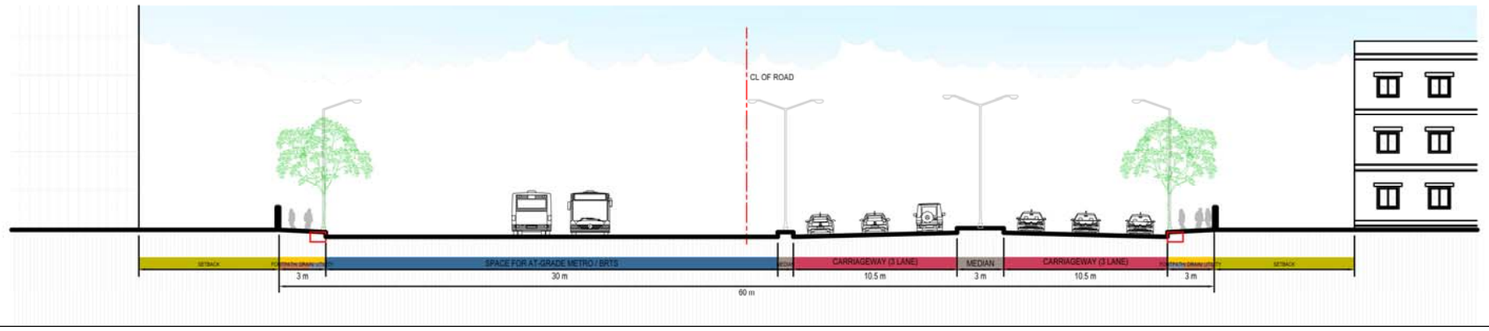
35 m WIDE ROAD WITH 4-LANE CARRIAGEWAY



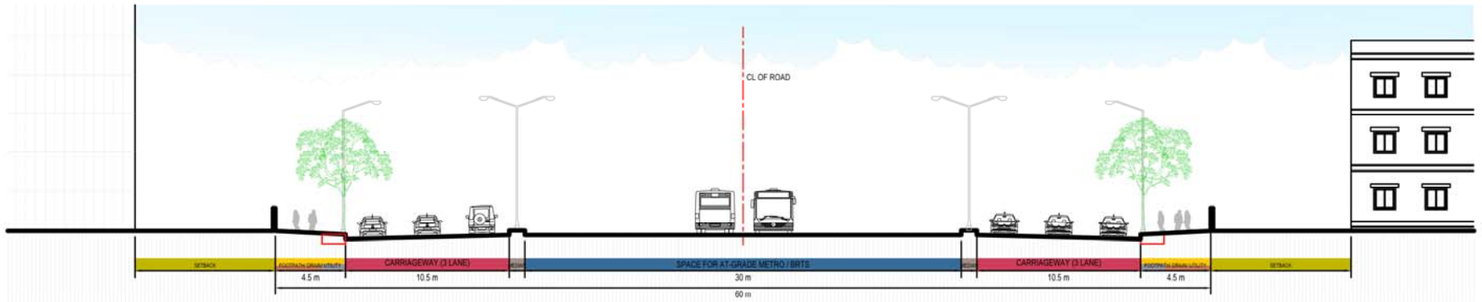
45 m WIDE ROAD WITH 4-LANE CARRIAGEWAY



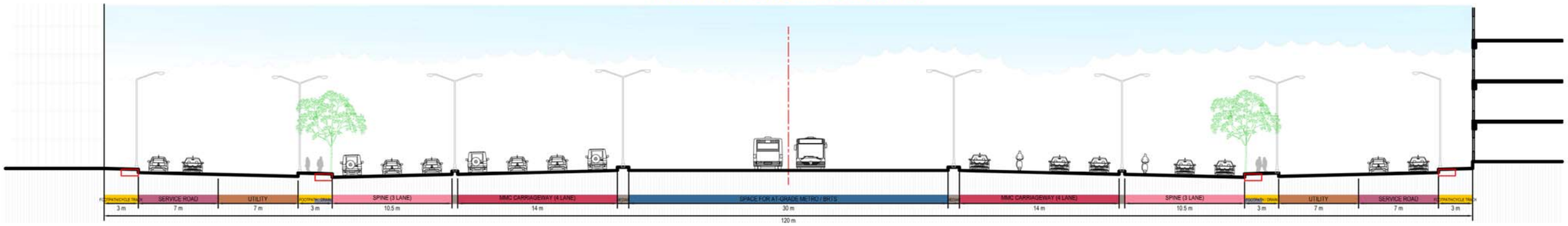
60 m WIDE ROAD WITH 3-LANE CARRIAGEWAY



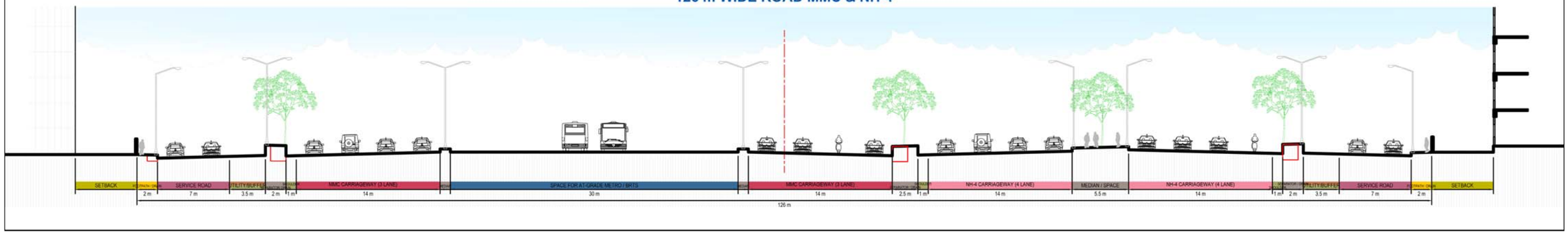
60 m WIDE ROAD WITH METRO / BRTS AT THE CENTRE



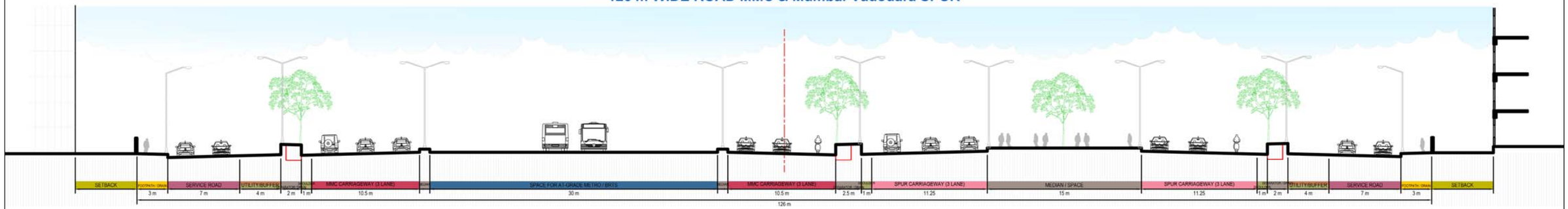
120 m WIDE ROAD MMC AND SPINE



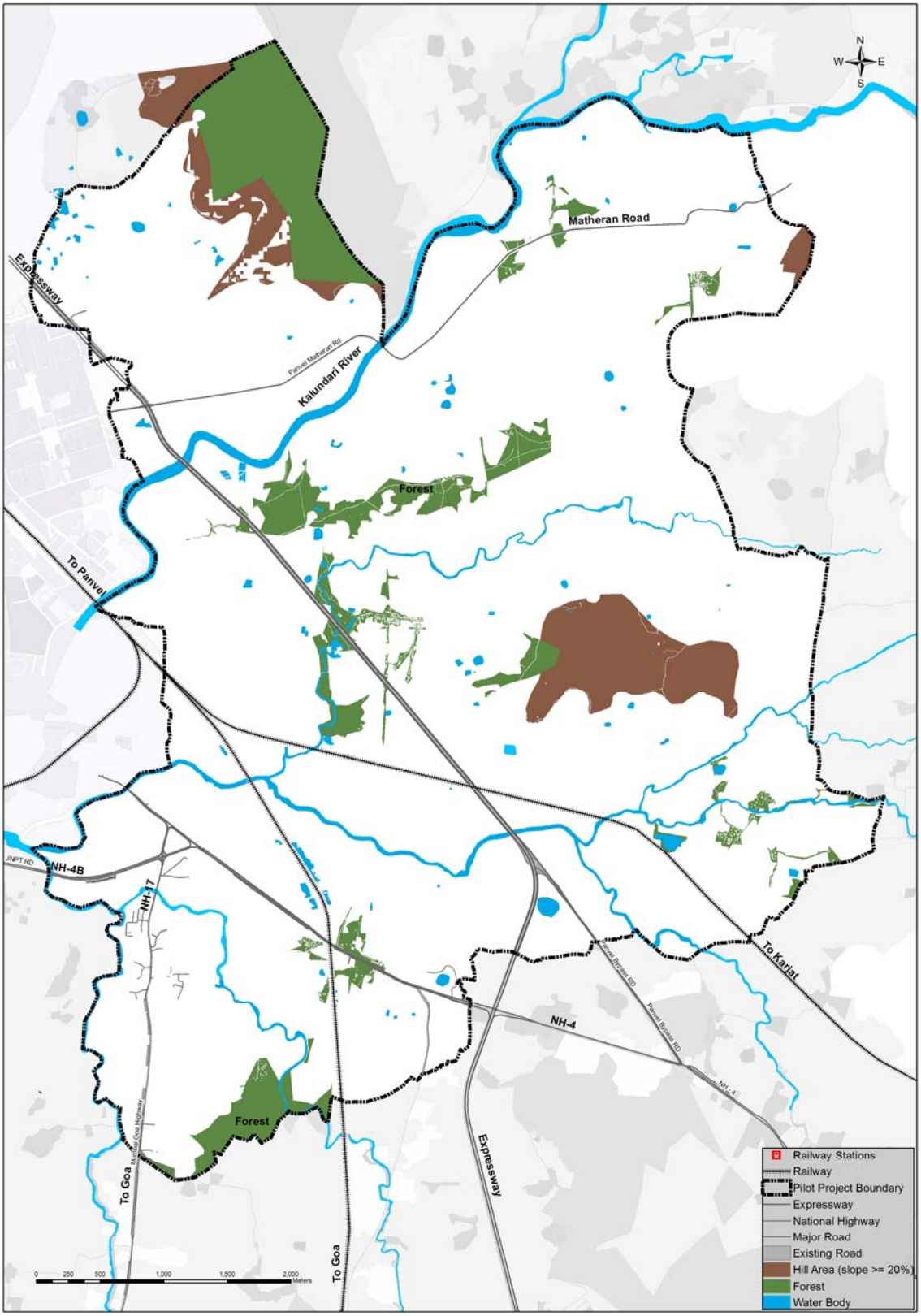
126 m WIDE ROAD MMC & NH-4



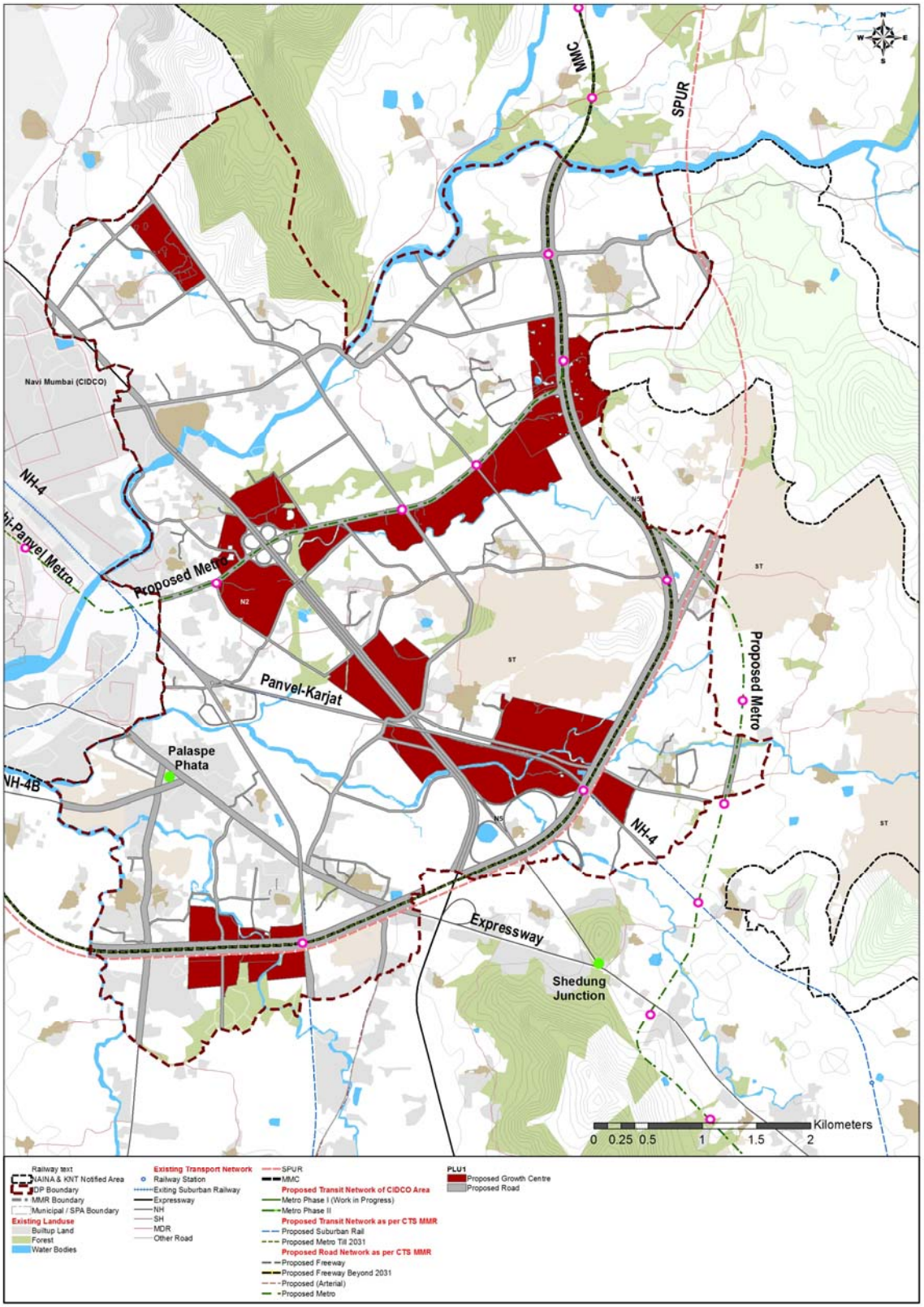
126 m WIDE ROAD MMC & Mumbai-Vadodara SPUR



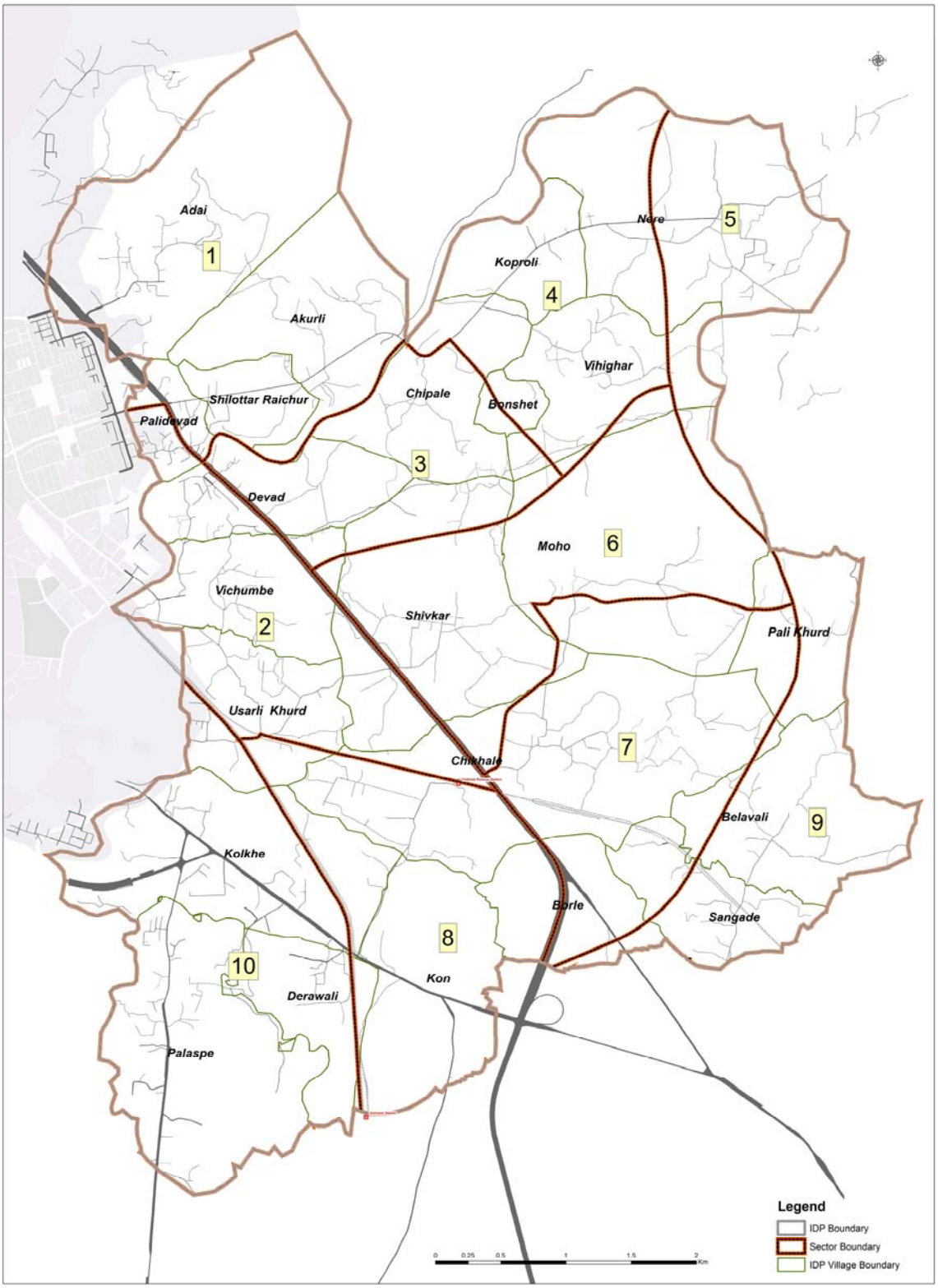
ANNEXURE 6-1: DETAILS AND LOCATION OF PROTECTED/ ENVIRONMENT SENSITIVE AREAS



ANNEXURE 6-2: PROPOSED GROWTH CENTRES ALONG PUBLIC TRANSPORT NODES AND CORRIDORS



ANNEXURE 6-3: SECTOR BOUNDARIES



ANNEXURE 7-1: DETAILED NOTE ON WATER SUPPLY, SEWERAGE AND STORM WATER DRAINAGE

INTRODUCTION

Provision of state of the art physical infrastructure is important for achieving desired quality of life in IDP Area. The aim is to develop new physical infrastructure for adequately meeting the demand for water supply, sewerage network, drainage, solid waste management and power distribution and also to mitigate with the probable flood situation in the area. In principle, it is aimed to provide independent infrastructure network within the IDP area which can be developed independently by the development authority. This trunk infrastructure network can be further extended into developable land parcels by the land developers.

The demand assessment for all the major components has been worked out based on the best engineering practices.

The major trunk infrastructure components considered for development of proposed IDP Area of NAINA have been presented below:

Water Supply,

Sewerage and recycling,

Drainage, and river training

Solid Waste Management

Power

Water Supply

Availability of sustainable source of water with related infrastructure facilities is prime necessity for any modern and sustainable development. But prior to exploring for a sustainable source it is utmost necessary that actual water demand is worked out precisely based on alternate standards, bench marks and acceptable norms. The piped water supply has to be designed to provide adequately for:

Domestic needs: Including drinking, cooking, bathing, and washing, flushing of toilets, and individual gardening / air conditioning.

Demand for the employment in various work places: For Institutional needs.

Industrial use: For existing and proposed industries.

Horticulture needs: For public parks and urban greens.

Fire Fighting needs.

Unaccounted for Water: Including distribution losses, treatment losses and transmission losses.

The physical infrastructure for water supply is to be designed based on spot to spot demand. Thus for arriving at total water demand, the spatial demand with respect to location of residential, commercial, institutional and industrial complexes has been considered. Thus the proposed land use of complete IDP area has been identified and based on the land use the demand has been worked out and compiled.

Adopted Norms and Standards

Norms for domestic water demand

The quantity of water required in the houses for drinking, cooking, bathing, washing etc. is termed as domestic water demand.

The Environmental Hygiene Committee suggested certain optimum service levels for communities based on different population groups. The code of Basic Requirements of Water Supply, Drainage and Sanitation

(BIS: 1172), as well as the National Building Code recommends a minimum of 135 lpcd service level for communities where the residents are provided with full flushing system for excreta disposal. The Manual of Water Supply and Treatment, issued by CPHEEO (Central Public Health and Environmental Engineering Organization), Ministry of Urban Development, and Government of India has recommended the domestic water demand as shown in below Table.

Table: Norms for domestic water demand as per CPHEEO manual

Classification of Towns	Recommended Water Supply Levels
Towns provided with piped water supply but without sewerage system	70 litres per capita per day
Cities provided with piped water supply where sewerage system is existing/ contemplated	135 litres per capita per day
Metropolitan and Mega Cities provided with piped water supply where sewerage system is existing/ contemplated	150 litres per capita per day

The UDPFI guidelines, issued by Ministry of Urban Affairs and Employment, Government of India, have also prescribed the standards for domestic water supply in urban areas. These are being illustrated in below Table.

Table: Standards for Domestic Water Supply as per UDPFI Guide lines

Sl. No.	Aspect	Size of Town (based on population)		
		Small (<50000)	Medium (>50000)	Large & Metro (> 10,00,000)
1	Absolute Minimum	70 lpcd	70 -100 lpcd	135 lpcd
2	Desirable	100 lpcd	135–150 lpcd	150-200 lpcd

CIDCO has also prescribed the design norms for design of water supply systems, which prescribes a domestic water demand of 180 lpcd. The design population of IDP of NAINA area for plan horizon year is nearly 6.20 lakh. Thus based upon above three guide lines and standards prescribed by CIDCO, the domestic water demand has been worked out taking 180 lpcd service level at consumer end.

Norms for Employment Population

The water requirement for the persons working in different commercial establishments, offices, factories and educational institutions have also to be considered while working out water demand. The CPHEEO manual as well as UDPFI guide lines prescribe a service level of 45 lpcd for the employment population. Thus the same has been considered while working out the total water demand.

Norms for Industrial Water Demand

The Industrial Demand varies upon type of Industries likely to be established in the region, based upon the market assessment, raw material availability, logistics and other support facilities. The industries manufacturing leather & leather products, fine quality paper, beverages, tobacco and related products, gas and steam generation, basic chemicals, textile dying industries etc. are termed as high water intensive units. While the industries involved in manufacture of cotton textile (spinning / weaving), silk and man-made fibre, jute and other vegetable fibre, printing and publishing, rubber and plastic products, non-metallic mineral products, basic metal and alloy industries, metal products and parts, electronics etc. are termed as low water intensive units. While the demand for high water intensive units goes as high as 60,000 to 1,00,000 litres per hectare, the demand for low water intensive units ranges between 10,000 to 30,000 litres per hectare

For assessment of water demand for industries in IDP area, the type of industries in existing area was surveyed. It was noticed that the existing industries are generally Ware houses and a very few are small dry

metal processing units, thus a water demand of 15,000 litres per hectare has been considered for the existing industries in IDP area.

Horticulture Water Demand

Provision has also been kept for horticulture water demand for green parks and urban greens proposed. The demand has been worked out at 67000 litres per hectare, for 60% of proposed green area and 30000 litres per hectare for balance 40% of the green area as per DSIIDC norms.

Fire-Fighting Demand

As per CPHEEO manual the fire-fighting demand is to be taken based on the formula:

Fire-fighting demand in kl/day = 100 x P^0.5 (where P is the population in thousands)

Thus the same has been worked out as per above standards and added to total demand

Recycling and Reuse of Water

To reduce the fresh water demand recycling of domestic and industrial waste water is considered. The sewage generation has been taken as 80% of the water supplied for domestic use, as suggested in the Manual of Sewerage and Sewage Treatment, issued by CPHEEO, Ministry of Housing and Development, Government of India. The waste water from industries is taken as 60% of the water supplied to industries.

The infiltration in conveyance system has been kept as 20% of daily flow as prescribed by CIDCO in their norms looking to intensive rains in the area. Provision has been kept for losses in STP and Tertiary Treatment Plants, while working out availability of water for recycling. The recycled water is proposed to be used to meet the horticulture demand for urban greens, fire fighting and balance water is to be supplied to industries for washing and for flushing purposes in residential area.

Gross Water Demand

Based upon the existing and proposedresidential, commercial (employment), horticulture and firefighting demand, the gross water demand for the IDP area has been worked out.

For working out fresh water demand at consumer end, the quantity of recycled water from Tertiary Treatment Plants after subtracting the losses in the supply system has been deducted from the total demand. For working out gross water demand 28 percent losses in distribution and transmission system has been considered as per norms prescribed by CIDCO for design of water supply system.

Based upon above norms the demand for total IDP area works out as 93 mld, and if the recycling is not considered the demand of fresh water shall be as high as 178 mld. The detailed calculations are shown in below Table.

Table: Water Demand for IDP Area

Particulars of users	Population / Area in Ha			Rate of Supply in lpcd	Water Demand in mld		
	2016	2031	2034		2016	2031	2034
Residential	90000	460000	620000	180	16.20	82.80	111.60
Employment	22995	91980.4	229951	45	1.03	4.14	10.35
Fire fighting	100*(P)^0.5	0.95	2.14	2.49			
Industries	116.79				116.79	116.79	15000
Urban Greens	11.70	116.96	251.39	52200	0.61	6.11	13.12
Total					20.55	96.94	139.31
Recycled Water to be used for Urban greens, fire-fighting & flushing					9.46	47.74	66.96

Net Fresh Water Demand at consumer end	11.08	49.20	72.35
Distribution, Treatment & Transmission losses 28%	3.10	13.78	20.26
Total Demand at source with recycling	14.19	62.98	92.61
Demand without recycling	26.30	124.08	178.32

SOURCE OF WATER

It is understood that the CIDCO is presently gets water from Hetawane dam and MJP. The availability from these sources is nearly 265 mld. A project from Balganga dam is under execution, which is likely to be completed by 2016. The availability from this source shall be 350 mld. In addition a new source from proposed Kondhane dam is under consideration. CIDCO is expecting to get 250 mld of water from this source by 2026. CIDCO has worked out year wise demand of its developed/ developable area (other than NAINA) from 2015 to 2030. Based upon this data a statement showing demand, availability and excess has been prepared and shown in below Table.

Table: Statement showing Demand/Availability of Water in CIDCO area

Year	Demand in mld	Source	Present Status of source	Available Water in mld	Excess in mld
2015	251	Hetawane Dam	Existing	150	14
		MJP	Existing	115	
		Total		265	
2016	274	Hetawane Dam	Existing	150	341
		MJP	Existing	115	
		Balganga Dam	Under Execution (likely to be completed by 2016)	350	
		Total		615	
2021	487	Hetawane Dam	Existing	150	128
		MJP	Existing	115	
		Balganga Dam	Under Execution (likely to be completed by 2016)	350	
		Total		615	
2026	667	Hetawane Dam	Existing	150	198
		MJP	Existing	115	
		Balganga Dam	Under Execution (likely to be completed by 2016)	350	
		Kondhane Dam	Under Consideration (expecting to get water by 2026)	250	
		Total		865	

2030	780	Hetawane Dam	Existing	150	85
		MJP	Existing	115	
		Balganga Dam	Under Execution	350	
		Kondhane Dam	Under Consideration (expecting to get water by 2026)	250	
		Total		865	

It is observed from above table, that CIDCO will have excess of water with respect to demand of Navi Mumbai 2016 onwards (if proposed sources are developed as expected). Ultimately in the year 2030, CIDCO shall be having 85 mld of water in excess of Navi Mumbai demand. The ultimate demand of IDP Area NAINA in the horizon year 2034 is calculated as 93 mld and the demand in 2031 is only 63 mld. Thus the demand of IDP Area can well be met from excess water available from CIDCO sources till the year 2033-34, but onwards from 2034. Some other source will be required to be tapped to meet the demand of 8 mld for IDP area. However this is subject to maximum utilization of recycled with right from the beginning.

PROPOSED sources of water

As per proposals of Balganga Water Supply Scheme (350 mld) of CIDCO, the water drawn from the dam is proposed to be treated at Nidhiwali Water Treatment Plant, from where it shall be pumped to a Break Pressure Tank, and then shall be transferred to Master Balancing Reservoir (MBR) near VAHAL through 2500 mm diameter Pipe line. Proposed water sources are depicted in below Figure.

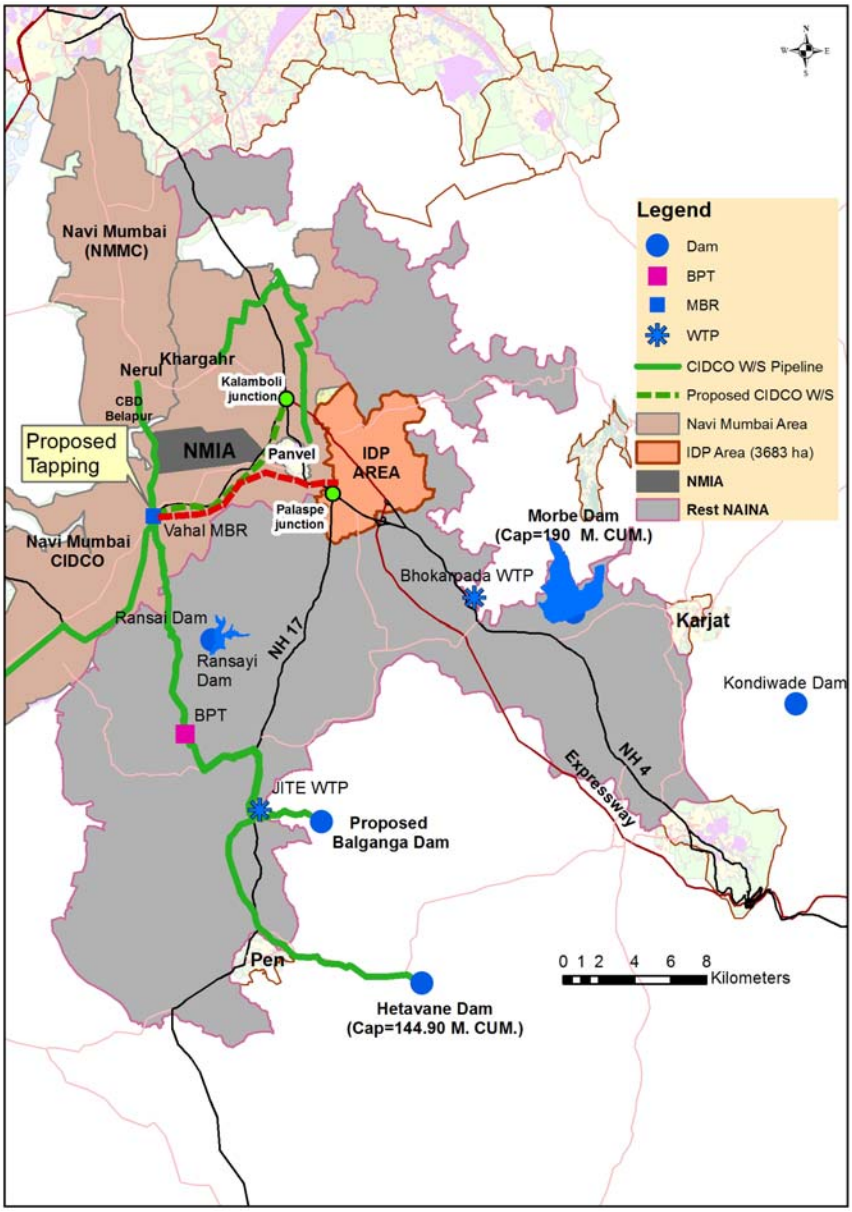


Figure: Map showing Balganga WS Project and proposed tapping at VAHAL MBR

It is proposed to draw the demand of IDP Area (92.6 mld) from this MBR. The water from this MBR is proposed to be collected in a clear water reservoir within IDP Area. The site of clear water reservoir is proposed near Kolke village. Looking to the available head between proposed MBR at VAHAL and site of CWR it is proposed to draw water from this MBR under gravity to IDP CWR. The pipe line is proposed to be laid along JNPT road (NH-4B). Total length of pipe line works out as 14500 meters.

Based upon the difference of levels between MBR and CWR, the size of gravity pipe line required has been worked out. Accordingly it is proposed to lay 1000 mm diameter Ductile Iron pipe line class-K9/ MS pipe line with inside cement mortar lining total 14500 meters long. The capacity of CWR has been kept equivalent to 8 hours storage, based on 22 hours pumping. Accordingly the capacity of CWR is proposed as 33.70 ml.

The complete IDP area has been subdivided in 6 number distribution zones, looking to the topography of the area. The capacity of Service Reservoirs has been worked out as per mass demand curve assuming 24 hours water supply and based upon the zone water demand calculated as per zonal land use. Five out of proposed six service reservoirs are Elevated Service Reservoirs (ESRs) while the Service Reservoir at

zone-4 is ground reservoir proposed on hillock. The zonal demand and capacity of service reservoirs proposed is being given in below Table.

Table: Zonal Demand & Capacity of SRs

Zone Name	Demand in mld	SR Cap in ml
Zone-1 / OHT-1	0.150	13.89
Zone-2 / OHT-2	0.096	8.89
Zone-3 / OHT-3	0.091	8.43
Zone-4 / GLSR-4	0.358	33.15
Zone-5 / OHT-5	0.135	12.50
Zone-6 / OHT-6	0.170	15.74
Total	1.000	92.61

The Water from the CWR is proposed to be pumped to different Service Reservoirs through network of pumping mains. The size of all pumping main has been derived as per the criterion laid down in CPHEEO manual for Economical design of pumping mains, taking into consideration the capital investment and the capitalized investment for power charges. For working out economical size, per meter cost for seven nearby sizes of pipe has been worked out, considering bare cost of pipe, excavation of trenches, cost of specials / valves, laying and jointing etc and most economical pipe size worked out from them.

The economical size of pipe lines so worked out are been checked for the surge pressure encountered in the system. Even though the system has been checked for surge pressure, provision has been kept for zero velocity valves and air cushion valves for extra safety. Accordingly it is proposed to lay rising mains from 250 mm to 700 mm diameter. The pumping mains are proposed to be laid with Ductile Iron Pipe class K-9. The size of pipe line so worked out and proposed for laying in different reaches (nodes) is being shown in below Table.

Table: Proposed sizes of clear water rising mains

Nodes		Type of Pipe	Distance	Demand	Pipe dia
J-3	O-1	DI- Class K-9	1168	14.30	300
J-3	O-2	DI- Class K-9	2096	9.15	250
O-3	J-3	DI- Class K-9	446	23.46	400
O-4	O-3	DI- Class K-9	1859	32.13	450
J-2	O-4	DI- Class K-9	2022	66.27	600
J-2	O-5	DI- Class K-9	736	12.87	300
J-1	J-2	DI- Class K-9	1327	79.14	700
J-1	O-6	DI- Class K-9	3410	16.21	300

The water from CWR shall be pumped to different service reservoir by Centrifugal pumping sets. Initially the Clear water pumping station shall be installed with pumping sets to meet the demand of the year 2031 only. Thus it is proposed to install 6 number pumping sets capable to discharge 198.8 litres / sec at 120 meters head coupled with 370 kw squirrel cage induction motor, out of which 4 number shall be working and 2 shall be standby. Later after 2031, the pumping sets are required to be replaced having a capacity of pumping 292.33 litres per second at 125 meters head coupled with 560 KW electric motor. Provision has also been kept for necessary electric switch gears, and power connection. The location of CWR and complete network of pumping mains is shown in below Figure.

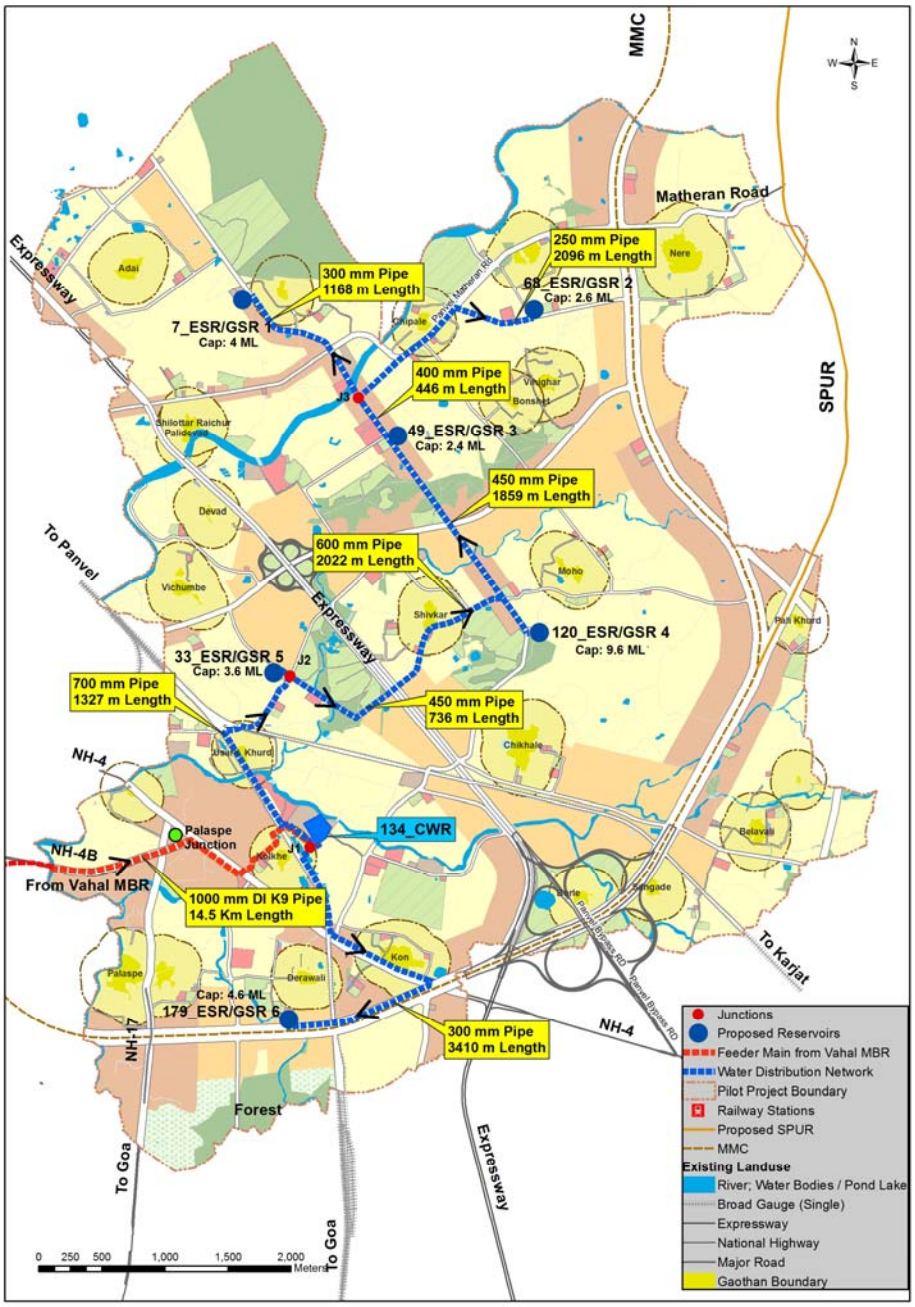


Figure: Proposed Network of Clear Water Rising Mains

Provision has been kept for HT Power line up to pumping station along with sub-station, electric cabling and metering etc. Provision has also been kept for trunk distribution system on sector level roads only as shown in drawing above.

Sewerage Collection, Treatment and Recycling System

Estimation of Sewage Generation

The Sewage Collection and recycling system is planned and designed to collect, treat, and recycle all the domestic sewerage and industrial effluent generated from the IDP - NAINA Area. There are three possible options for collection and treatment of Sewage including Tertiary Treatment and recycling. These are discussed below:

Sewage and Sullage both are treated by developer of the plot at plot level: This has the disadvantage, that STPs will be located near the residential areas, secondly it will not be possible to monitor the quality of treated water as form large number of STPs. On the other hand Sewage from Gaothans and small plots has to be treated at community level STPs, which will again involve infrastructure cost. This also have the problem that how the waste effluent from so many STPs shall be carried to suitable disposal points.

Sullage is treated at developer level and Sewage is carried to Community level STPs: This will again have the problem of monitoring the quality of treated water being supplied, and sullage from Gaothans / small plots as stated above.

Sewage and Sullage both are taken to community STPs and treated water recycled: A comprehensive sewage collection system, along with community STPs / TTPs and recycling system is developed. Though this will involve some extra infrastructure cost on account of collection system and distribution of recycled water this is the safest way of treating the total sewage. In this system the tertiary treated water can precisely be distributed to urban greens / parks, different industries for washing and for flushing use in residential areas.

As prescribed in CPHEEO manual, it is assumed that 80% of water actually supplied at consumer end for domestic use and 60% of water supplied to industries be generated as Sewage/ waste water. While working out sizes of collection system and capacity of Sewage Treatment Plant, provision has been kept for 20% infiltration through sewer lines. But while calculating the water available for recycling the infiltration has not been considered, assuming that during summers and winters the infiltration shall almost be negligible. Accordingly the sewage generated capacity of STPs and Tertiary Treatment Plants required has been worked out and shown in below Table.

Table: Sewage Generated, Capacity of STPs & TTPs required

Sewage Generation & Treatment Plants Capacity	2016	2031	2034
Sewage Generation in mld	17.23	85.01	118.86
Capacity of STPs required	17.00	85.00	119.00
Capacity of TTPs Required	12.00	57.00	80.00

The recycled water shall primarily be used for proposed urban greens as horticulture requirement and the remaining shall be used in industries mainly for cleaning/ washing and in residential areas for flushing etc.

Looking to the topography of the area, pace of development and land use of IDP, the entire IDP area is divided into 5 Sewerage Zones. The related Tertiary Treatment Plant is also proposed to be installed on the side of STP. The Capacity of Sewage Treatment Plants and Tertiary Treatment Plants proposed zone wise is being given in below Table.

Table: Zone wise Capacity of proposed STPs and TTPs

Sewerage Zone	Capacity of STP	Capacity of TTP
Sewerage Zone-1	36.89	24.8
Sewerage Zone-2	19.04	12.8
Sewerage Zone-3	20.23	13.6
Sewerage Zone-4	16.66	11.2
Sewerage Zone-5	26.18	17.6
Total Capacity	119.00	80.00

Sewage Collection System

The Sewage / Effluent collection system is provided to collect the domestic sewage / industrial waste water from the residential / industrial areas and to convey it to the proposed Sewage Treatment Plant of that

zone. Since industrial waste water is very meagre in quantity, thus common collection system is provided for sewage and waste water collection. The zoning and collection network is proposed in such a way that the flow of sewage follows natural slope and conveys the sewage to treatment plant (located at the lowest elevation) under gravity flow. The location of Sewage Treatment plants along with Tertiary Treatment Plants is shown in below Figure.

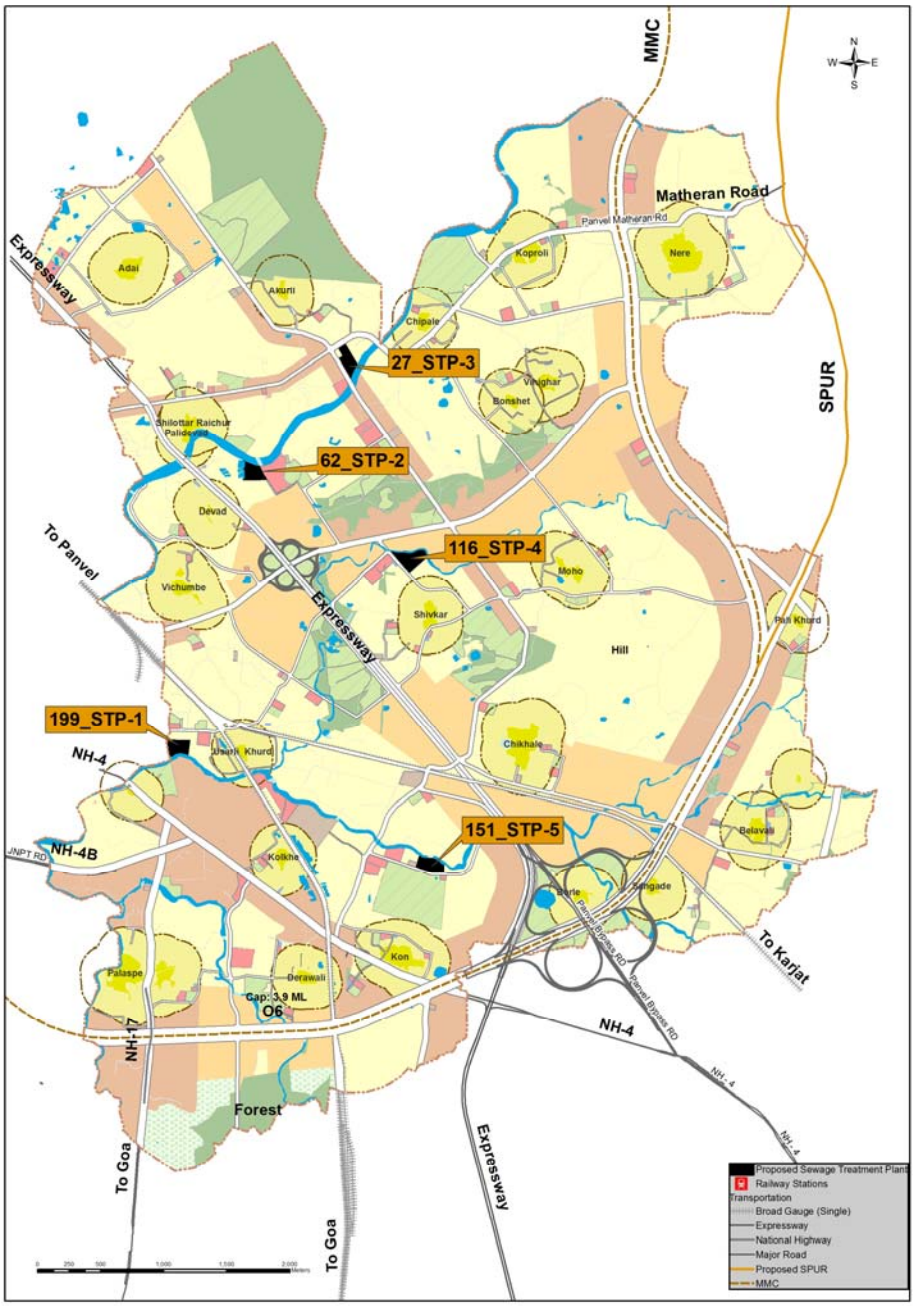


Figure: Map showing Location of Sewage and Tertiary Treatment Plants

The Sewage Collection system is being proposed at sector level roads only. The internal sewers including laterals shall be provided by the land developers themselves, which shall further be connected to trunk sewerage system. The sewage collection network is based on following parameters, as per the recommendations in the manual of Sewerage and Sewage Treatment issued by CPHEEO, Ministry of Housing Government of India:

Minimum velocity at designed peak flow	: 0.8 meters / sec
Maximum velocity in SW Pipes	: 1.4 meters / sec
Maximum velocity in RCC / HDPE Pipes	: 2.5 meters / sec
Max. depth of flow in sewers at ultimate peak flow	:
Up to 400 mm sewer	: half full
400 to 900 mm sewer	: 2 /3rd full
Above 900 mm sewer	: 3/4th full
Minimum size of sewer	: 160 mm
Maximum spacing of Man holes	
Up to 300 mm sewer	: 30 meters
Above 300 mm sewer	: 90 meters
Additional manholes	: At every junction, change of Alignment/ gradient/ size.
Size of man holes	
Up to 1.5 metres depth	: 900 mm dia.
1.5 to 2.5 mtrs depth	: 1000 mm dia
Above 2.5 mtrs depth	: 1200 at bottom & 900 at top
Formula adopted for design	: Manning's Formula

V = 1 / n X R 2/3 X S 1/2

Here

V = Velocity in meters

R = Hydraulic mean depth = WA / WP

S = Hydraulic slope in M / meter

N = Manning's coefficient

= 0.012 for SW Pipes

= 0.011 for RCC / PSC pipe

SEWAGE / WASTE WATER TREATMENT AND TERTIARY TREATMENT PLANT

It is proposed to provide conventional Activated Sludge Process type of Sewage / Treatment Plant. The plant shall comprise of Coarse screen chamber, Sewage pumping station, Fine screen chamber, Grit chamber, Oil and Grease traps, Activated sludge type Aeration Chamber with Fluidized Bed Reactor or

Moving Bed Biofilm Reactor, Secondary Sedimentation tank, Air Blowers, Sludge pumps, and Sludge drying mechanism.

The Tertiary Treatment Plant (TTP) shall comprise pre-chlorination chamber, rapid gravity sand filters and post chlorination mechanism. The TTPs are designed to receive an inflow of 85% of Sewage generated assuming 15% losses in STP. The losses in TTP are taken as 5%.

Reuse of Tertiary Treated Water

The Sewage treated in STP and then the secondary water treated in Tertiary Treatment Plant in each zone shall be collected in individual Clear water reservoir, wherefrom it shall be pumped for horticulture / industrial use and for flushing in the same zone. The water shall be collected by individual users in their ground tanks for their use. Provision has been taken for Clear water reservoirs, pumping machinery and distributaries rising mains DI Pipe class K-9.

RIVERS AND ROAD SIDE DRAINAGE

GENERAL topography and Rivers

Two major rivers and a small nalla of about 8 to 15 meters width are passing through IDP-NAINA area, a detailed map showing these rivers is shown in below Figure.

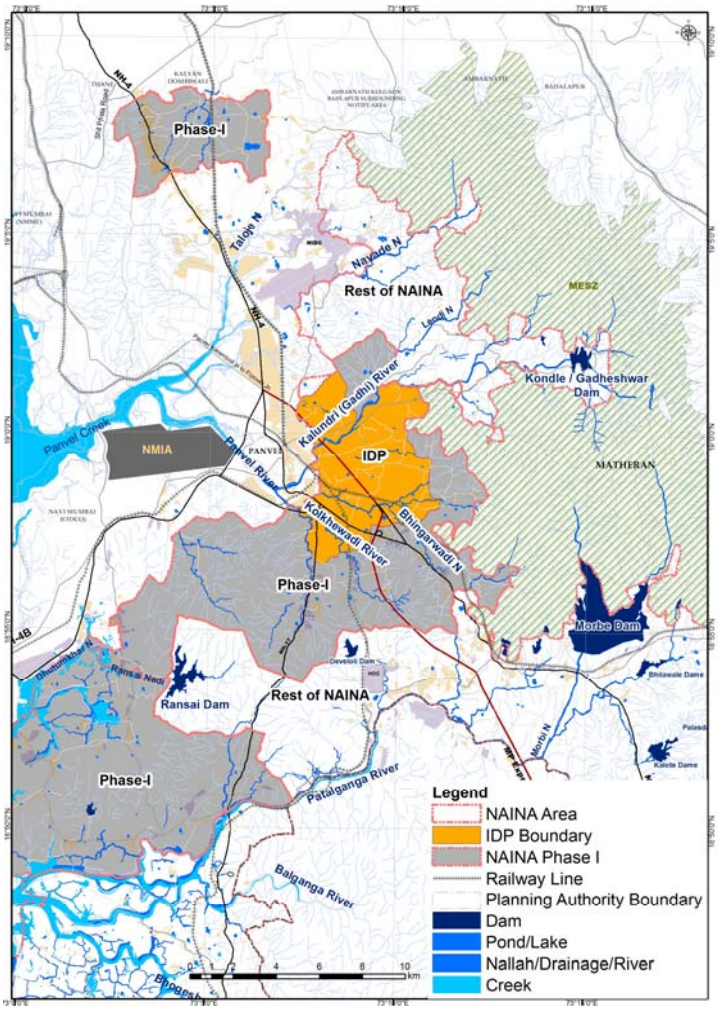


Figure: Map showing the rivers flowing through IDP Area

In general the drainage of the area is from North East (where high hills are seen) towards South West. Terrain of the area is plain except to follow the drainage pattern towards rivers. The levels range

between 32 to 24 meters on Eastern boundary of IDP and 5 m to 12-13 meters on Western boundary. Though in the hilly terrain in North East of IDP but outside IDP boundary the levels ranges between 400 to 500 meters on hill peaks. The details about these rivers are being given below:

Gadhi or Kalundri River: It has two tributaries. On one of the tributaries is Gadheshwar dam at the foot hills. One of the tributary as well as the main river passes through IDP area. The river flows from North East to South West direction. The river originates from the hills on the North East side of IDP area. All drainage from the north east side of IDP area goes to this river/ its tributaries.

Kolkhewadi River: This River flows from East to west through southern part of IDP area. The levels range from 30 m to 8 meters except for the hilly terrain. It meets with the Gadhi River outside IDP area and finally discharges in to the sea.

One small nala of about 8 to 15 meters in width also passes through IDP area. It flows from East of IDP area to south and finally meets the Kokhewadi River. It is very much meandering in nature and divides the total IDP area almost in two equal halves.

The rivers flowing in IDP area were checked for flooding at critical intensity of rain fall. It was done as per empirical formulae suggested by Indian Meteorological Department. It was found that in general no flood situation is seen in IDP area.

Methodology adopted for checking the rivers for flooding

CIDCO had provided topographic data along these rivers. The survey was reported to be carried out for study of rivers by CWPRS for the proposed project of new International Airport near Panvel. Based on these survey levels, "L" Sections and Cross-sections along the rivers were generated and used for analysing maximum water level at major / critical points during maximum intensity of rain fall.

Analysis for Maximum Intensity of rain fall:

The data for maximum one day rain fall at Santacruz rain gauge station from the year 1950 to 2005 and at Colaba rain gauge station from the year 1901 to 2005 were made available by CIDCO. The hourly rain fall data for 26th July 2005 for these stations was also provided. Based on these data the maximum intensity of rainfall at 100 years return period was worked out as per norms and procedure recommended by Indian Meteorological Department.

Table: Maximum one day rainfall at Santacruz and Colaba rain gauge stations

Santacruz				Colaba					
Year	Rainfall (mm)	Year	Rainfall (mm)	Year	Rainfall (mm)	Year	Rainfall (mm)	Year	Rainfall (mm)
1950	154.9	1985	223.6	1901	144.3	1936	133.9	1971	291.2
1951	129.5	1986	194.5	1902	151.6	1937	93.5	1972	175.6
1952	308.6	1987	125.7	1903	127.8	1938	181.1	1973	171.6
1953	310.6	1989	144.9	1904	86.4	1939	231.6	1974	575.6
1954	256.0	1990	150.2	1905	82.3	1940	163.1	1975	417.2
1955	183.4	1991	399.0	1906	119.1	1941	105.2	1976	123.5
1956	175.8	1992	215.4	1907	254.5	1942	178.6	1977	184.4
1957	161.5	1993	312.4	1908	129.3	1943	203.5	1978	175.7
1958	241.2	1994	157.2	1909	120.1	1944	181.1	1979	206.2
1959	176.0	1995	180.0	1910	304.0	1945	246.4	1980	125.9

1960	121.2	1996	171.7	1911	111.3	1946	217.4	1981	241.6
1961	157.8	1997	346.2	1912	164.3	1947	265.4	1982	180.9
1962	212.4	1998	211.5	1913	201.9	1948	172.7	1983	173.4
1963	192.6	1999	134.4	1914	178.1	1949	432.8	1984	544.3
1964	137.8	2000	351.5	1915	248.9	1950	147.8	1985	345.5
1965	372.9	2001	161.0	1916	165.6	1951	138.4	1986	128.7
1966	291.3	2002	186.0	1917	148.6	1952	156.7	1987	153.9
1967	201.1	2003	192.9	1918	135.6	1953	173.7	1989	138.2
1968	173.8	2004	187.4	1919	277.4	1954	249.9	1990	421.2
1969	201.4	2005	944.2	1920	182.4	1955	149.4	1991	477.6
1970	194.0			1921	216.2	1956	222.3	1992	175.9
1971	244.6			1922	215.1	1957	158.2	1993	206.9
1972	203.0			1923	304.8	1958	233.4	1994	148.6
1973	163.2			1924	85.6	1959	134.1	1995	162.8
1974	375.2			1925	116.8	1960	238.3	1996	165.4
1975	223.4			1926	147.1	1961	144.5	1997	244.2
1976	264.7			1927	216.9	1962	199.0	1998	261.9
1977	136.8			1928	250.7	1963	189.1	1999	233.0
1978	156.9			1929	170.9	1964	112.1	2000	243.7
1979	139.1			1930	548.1	1965	249.4	2001	184.9
1980	151.1			1931	242.8	1966	156.5	2002	138.3
1981	318.2			1932	174.0	1967	179.7	2003	147.7
1982	275.6			1933	153.2	1968	58.6	2004	159.6
1983	253.4			1934	118.9	1969	109.6	2005	865.4
1984	240.1			1935	148.3	1970	288.8		

Table: Hourly Rainfall Data for 26th July 2005

Powai Rain gauge station			Santacruz rain gauge station		
Date	Time	Rain fall (mm)	Date	Time	Rain fall (mm)
26/07	15 hrs	90.0	26/07	15 hrs	100.2
26/07	16 hrs	136.0	26/07	16 hrs	190.3
26/07	17 hrs	91.0	26/07	17 hrs	90.3
26/07	18 hrs	83.0	26/07	18 hrs	100.4

26/07	19 hrs	77.0	26/07	19 hrs	95.0
26/07	20 hrs	109.0	26/07	20 hrs	72.2
26/07	21 hrs	120.0	26/07	21 hrs	60.2
26/07	22 hrs	123.0	26/07	22 hrs	22.2
26/07	23 hrs	20.0	26/07	23 hrs	18.4
26/07	24 hrs	44.0	26/07	24 hrs	40.0
27/07	1 hrs	96.0	26/07	1 hrs	42.5
27/07	2 hrs	32.0	26/07	2 hrs	33.7

It shows that the maximum hourly intensity of rain on 26th July 2005 was recorded at 16 hrs, which was 136 mm at Powai rain gauge and 190.3 mm at Santacruz rain gauge station.

But the maximum hourly rain fall at other stations within Mumbai did not record such a high rain during any hour on the day. The highest rain fall recorded at other stations on 26th July 2005 is as follows:

Table: Maximum hourly Rainfall at Other stations in Mumbai (26th July 2005)

Rain gauge station	Time	Hourly rain fall (mm)
Panvel	12 to 13 hrs	76.0
Kharghar	10 to 11 hrs	105.0
Nerul	14 to 15 hrs	72.5
Vashi	07 to 08 hrs	100.0
CBD Belapur	09 to 10 hrs	105.0

The Indian Metrological Department, in its Flood Estimation guide lines issued vide No. K8M/19/1992 (CWC and IMD) for West Coast Region, Konkan and Malabar, has suggested the procedure for conversion of one day rainfall at a rain gauge station to Areal rain fall for a given return period. The maximum rain fall recorded in a day on both Colaba and Santacruz stations can easily be taken as the maximum rain fall at 100 years or more return period, since no such heavy rainfall is observed in a day during past 115 years. The storm duration on 26th July 2005 lasted for about 16 hours.

Thus by using the suggested table for conversion of 944.2 mm point rainfall in to areal rainfall for a recorded 16 hours duration and for 125 sq km catchment, the coefficient for maximum one day areal rainfall for the catchment reads as 93% (By interpolation of 100 and 150 sq km area). Therefore the suggested maximum areal rainfall in 24 hours for 100 years return period comes as 878.1 mm.

Table - 6

POINT TO AREAL RAINFALL RATIOS (PERCENTAGES)

Area in Sq. km	Storm Duration in hours																								Area in Sq. km
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0
50	87.00	89.50	92.00	93.00	94.00	95.00	95.33	95.67	96.00	96.33	96.67	97.00	97.01	97.08	97.15	97.17	97.21	97.25	97.29	97.33	97.38	97.42	97.46	97.50	50
100	81.00	84.50	88.00	89.00	90.00	91.00	91.50	92.00	92.50	93.00	93.50	94.00	94.04	94.08	94.15	94.17	94.21	94.25	94.29	94.33	94.38	94.42	94.46	94.50	100
150	76.00	80.00	84.00	85.33	86.67	88.00	88.58	89.17	89.75	90.33	90.92	91.50	91.58	91.67	91.75	91.83	91.92	92.00	92.08	92.17	92.25	92.33	92.42	92.50	150
200			80.50	82.17	83.83	85.50	86.08	86.67	87.25	87.83	88.42	89.00	89.17	89.33	89.50	89.67	89.83	90.00	90.17	90.33	90.50	90.67	90.83	91.00	200
250			77.50	79.33	81.17	83.00	83.75	84.50	85.25	86.00	86.75	87.50	87.67	87.83	88.00	88.17	88.33	88.50	88.67	88.33	89.00	89.17	89.33	89.50	250
300						81.00	81.83	82.67	83.50	84.33	85.17	88.00	86.17	86.33	86.50	86.67	86.83	87.50	87.17	87.33	87.50	87.67	87.83	88.00	300
350						79.00	79.92	80.83	81.75	82.67	83.58	84.50	84.71	84.92	85.12	85.33	85.54	85.75	85.96	86.17	86.38	86.58	86.79	87.00	350
400						77.50	78.50	79.50	80.50	81.50	82.50	83.50	83.71	83.92	84.12	84.33	84.54	84.75	94.96	85.17	85.38	85.58	85.79	86.00	400
450						76.00	77.08	78.17	79.25	80.33	81.42	82.50	82.71	82.92	83.12	83.33	83.54	83.75	83.96	84.17	84.38	84.58	84.79	85.00	450
500						75.00	76.08	77.17	78.25	79.33	80.42	81.50	81.71	81.92	82.12	82.33	82.54	82.75	92.96	83.17	83.38	83.58	83.79	84.00	500
600												80.00	80.21	80.42	80.62	80.83	81.04	81.25	913.46	81.67	81.88	82.08	82.29	82.50	600
700												77.50	77.83	78.17	78.50	78.83	79.17	79.50	79.83	80.17	80.50	80.83	81.17	81.50	700
800												77.00	77.29	77.58	77.88	78.17	78.46	78.75	79.04	79.33	79.63	79.92	80.21	80.00	800
900												76.00	76.29	76.58	76.88	77.17	77.46	77.75	78.04	78.33	78.63	78.92	79.21	79.50	900
1000												75.00	75.29	75.58	75.88	76.17	76.46	76.75	77.04	77.33	77.63	77.92	78.21	78.50	1000
1100												74.00	74.33	74.67	75.00	75.33	75.67	76.00	76.33	76.67	77.00	77.33	77.67	78.00	1100
1200												73.00	73.38	73.75	74.13	74.50	74.88	75.25	75.63	76.00	76.38	76.75	77.13	77.50	1200
1300																								77.30	1300
1400																								77.00	1400
1500																								76.50	1500
2000																								75.00	2000
2500																								75.00	2500

Ref. - Flood estimationreport for west coast region , Konkan and Malbar coast sub zones 5a and 5b, report No. K8M/19/1992 of CWC and IMD

Now the Hourly distribution Co-efficient of areal rainfall as per table suggested by IMD reads 0.16.

So the Critical intensity of rainfall as per IMD recommendations comes as = 0.16 x 878.1 = 140.49 mm per hour. Intensity as per analysis of IIT Mumbai:

The Indian Institute of Technology, Powai Mumbai, has conducted an study in the year 2012. The report was prepared after considering the critical flood scenario of 26th July 2005. In this report it is suggested that following critical intensity of rain fall be adopted for design of major natural drains / diversion channels in Mumbai.

Table: Return Period and Intensity of Rain (mm/hr)

Return Period	Intensity of rain (mm/ hr)
2 Years	55.2
5 Years	74.9
10 Years	87.9
50 Years	117.0
100 Years	129.0
200 Years	141.0

Table - 8

HOURLY DISTRIBUTION CO-EFFECIATIONTS OF AREAL RAINFALL

TIME HOURS	DISTRIBUTION CO EFFICEIANTS FOR DIFFERENT STORM DURATION OF 2 -24 HOURS																								TIME HOURS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
24																								1.00	24
23																							1.00	0.98	23
22																						1.00	0.98	0.96	22
21																					1.00	0.98	0.96	0.94	21
20																				1.00	0.98	0.96	0.94	0.92	20
19																			1.00	0.98	0.95	0.93	0.91	0.89	19
18																		1.00	0.98	0.95	0.93	0.91	0.89	0.87	18
17																	1.00	0.98	0.95	0.92	0.90	0.88	0.86	0.84	17
16																1.00	0.98	0.96	0.92	0.90	0.88	0.86	0.84	0.82	16
15															1.00	0.98	0.95	0.93	0.89	0.87	0.85	0.83	0.81	0.79	15
14														1.00	0.97	0.95	0.93	0.91	0.86	0.84	0.82	0.80	0.78	0.76	14
13													1.00	0.97	0.95	0.92	0.90	0.88	0.83	0.81	0.79	0.77	0.76	0.74	13
12												1.00	0.97	0.95	0.92	0.89	0.87	0.85	0.80	0.78	0.76	0.74	0.72	0.70	12
11											1.00	0.98	0.94	0.91	0.88	0.86	0.84	0.82	0.77	0.74	0.72	0.70	0.69	0.68	11
10										1.00	0.97	0.95	0.90	0.87	0.85	0.83	0.81	0.78	0.73	0.71	0.69	0.67	0.65	0.64	10
9									1.00	0.97	0.94	0.91	0.86	0.84	0.82	0.79	0.77	0.75	0.68	0.66	0.64	0.62	0.61	0.60	9
8								1.00	0.97	0.94	0.90	0.87	0.82	0.79	0.77	0.75	0.73	0.70	0.64	0.63	0.60	0.58	0.57	0.55	8
7							1.00	0.96	0.92	0.89	0.85	0.82	0.77	0.75	0.73	0.70	0.68	0.65	0.60	0.58	0.56	0.54	0.53	0.51	7
6						1.00	0.96	0.91	0.87	0.84	0.80	0.77	0.72	0.69	0.67	0.65	0.63	0.60	0.54	0.53	0.51	0.49	0.48	0.46	6
5					1.00	0.96	0.89	0.85	0.80	0.77	0.73	0.70	0.65	0.62	0.80	0.57	0.55	0.53	0.48	0.46	0.44	0.42	0.41	0.40	5
4				1.00	0.95	0.90	0.82	0.77	0.72	0.69	0.65	0.62	0.57	0.54	0.52	0.50	0.48	0.45	0.41	0.40	0.38	0.36	0.35	0.34	4
3			1.00	0.96	0.87	0.81	0.71	0.66	0.62	0.59	0.55	0.51	0.47	0.44	0.42	0.40	0.38	0.35	0.33	0.32	0.30	0.29	0.28	0.27	3
2		1.00	0.91	0.81	0.73	0.66	0.56	0.53	0.49	0.46	0.43	0.39	0.36	0.33	0.30	0.28	0.27	0.26	0.24	0.23	0.21	0.20	0.19	0.19	2
1		0.82	0.68	0.57	0.50	0.45	0.36	0.31	0.30	0.28	0.26	0.24	0.19	0.18	0.17	0.16	0.15	0.13	0.12	0.12	0.12	0.11	0.10	0.10	1

Ref. - Flood estimationreport for west coast region , Konkan and Malbar coast sub zones 5a and 5b, report No. K8M/19/1992 of CWC and IMD

Here it can be seen that the computed value of critical intensity of rain fall as per para-9 is in fairly good agreement with the computed values of IIT Mumbai as shown in para above.

Intensity as per NATU Committee:

CIDCO had set up a Technical Expert Committee, called Natu Committee for review of Storm Water Drainage System in Mumbai and to suggest remedial measures to avoid flooding. The committee has suggested Hydraulic and Hydrological Norms for the design of Storm Water Drains in New Mumbai. These norms have been circulated by Engineering Design Circle-II of CIDCO. These norms suggest that a Storm Intensity of 164.8 mm/hour be adopted for design of Diversion channels having a catchment area of 10 to 15 sq km.

The below Table, the comparison of critical intensity computed as per IMD norms, computed by IIT Mumbai, and recommended by NATU committee:

Table: Intensity of Rain fall computed by different methods / Agencies

Computed as per IMD Norms	140.49 mm / hour
Computed by IIT Mumbai in 2012	141.00 mm / hour
Recommended by NATU Committee	164.80 mm / hour

From above it can be revealed that the value for critical intensity of rain fall suggested by NATU Committee and being adopted by CIDCO for design of drains is slightly (about 15%) on higher side then the computed values as per IMD norms and as computed by IIT Mumbai. But to be on safer side the norms as circulated by CIDCO are being adopted for the design of Storm Water Drains in NAINA area.

Thus the design of Storm Water Diversion Channels in NAINA area has been designed taking the Intensity of Rain fall as 164.8mm / hour.

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Thus from the above it can be observed that there is increasing trend at both the rain gauge stations for annual maximum daily rainfall series.

Hourly rainfall data analysis

Hourly rainfall data from year 1969 to 2008 for both the rain gauge station was collected from India Metrological Department (IMD) and the basic statistical analysis using gumbell distribution with maximum likelihood method of estimation for both rain gauge stations has been carried out and the results are presented at **Table 3**.

Table 3 : Basic statistics for hourly rainfall

Basic statistics	Colaba (1969-2008)	Santacruz (1969-2008)
Number of years of observations	40	40
Minimum	28.3	27
Maximum	113	190
Mean	56.9	60.4
Standard deviation	20.9	31.3
Median	51.4	49.9
Coefficient of variation (Cv)	0.366	0.518
Skewness coefficient (Cs)	1.26	2.61
Kurtosis coefficient (Ck)	3.49	9.58

The maximum rainfall intensity at Santacruz rain gauge station is 190 mm/hr whereas at Colaba rain gauge station it is 113 mm/hr. Thus, the rainfall at both the rain gauge stations which are only 27 km apart varies in spatial as well as temporal manner substantially.

For the effective decision support system to the hydrologist and engineers, the analysis of annual maximum hourly rainfall series for prediction of rainfall estimates for various return periods was carried out using gumbell distribution with maximum likelihood method of estimation. The results are presented in **Table 4**.

Table 4 : Rainfall estimates for different return periods

Return period (years)	Colaba (mm/hr)	Santacruz (mm/hr)
2	53.1	55.2
3	60.8	64.5
5	69.4	74.9
10	80.1	87.9
20	90.5	100
50	104	117
100	114	129
200	124	141

550

Time of Concentration

The time of concentration is the time required for a drop of water to run from the most remote point in the catchment to the point for which the runoff is being estimated. The time of concentration is based upon two catchment characteristics, first the length of catchment (L) and the difference in level from

upstream to outlet of catchment (H). This can be derived by three formulas known as Bhatnagar formula, Kirpich formula and the California formula. The basic formula in all the three is the same, except the value of constant is different in different formula.

The basic formula for Time of Concentration is Tc = {xL^3/H}^y

Here Tc = Time of Concentration in hrs

L = Length of catchment in km

H = Difference of level in meters

x and y are the constants, having different value in different formula

The value of x and y in different formula is as follows:

Formula	Value of "x"	Value of "y"
Bhatnagar Formula	2.45	0.343
Kirpich Formula	0.80	0.385
California Formula	1.19	0.385

A comparison of all the three formula has been done taking in to consideration different catchment characteristics for rivers. It has been revealed that the values with Bhatnagar formula are the highest, and Kirpich formula is the lowest. The California formula gives the values in between two. CWPRS and CWC have suggested to use California formula. Thus the Time of Concentration in our calculations have been worked out as per California formula.

Critical Intensity of Rainfall

The critical intensity for a catchment is that maximum intensity which can occur in a time interval equal to the time of concentration. This critical intensity multiplied by the catchment area above shall give us the total runoff at the point of consideration. The critical intensity can be worked out by the formula

Ic = I .{2 / (tc+1)}

Here Ic = Critical Intensity of rainfall in cm / hr

I = Intensity of rainfall in cm / hr

tc = Time of concentration

Based upon the Intensity of rainfall 16.48 cm / hour analysed above, the Critical Intensity has been worked out for different time of concentration, which has been used in the design of runoff.

Runoff Coefficient

The runoff coefficient is the function based on the surface of the catchment. The major criteria need to be considered are porosity of the soil, area shape and size of catchment, vegetation cover, surface storage and the initial state of wetness of soil. For different type of catchment surface different values of runoff coefficient are recommended in relevant BIS. The runoff coefficient for different type of surface in catchment is given below Table.

Table: Run off coefficient for different type of surface

Type of surface	Runoff Coefficient
Steep / Bare rock surface	0.90
Paved surfaces in city	0.90
Rock and Steep slopes but wooded	0.80

Plateaus (Lightly wooded)	0.70
Clayey soils, stiff and bare	0.60
Clayey soils, stiff and lightly covered	0.50
Loamy, lightly cultivated or covered with woods	0.40
Loamy largely cultivated	0.30
Sandy soil, light growth	0.20
Sandy soil, covered with heavy bush	0.10

When we look for the area within the catchment of rivers in project boundaries, it is found that the rivers do originate from nearby hills which are partially wooded and then flow through project area. The slopes are also very steep. Thus up to the foot hills a run off coefficient of 0.0.85 shall be considered. Onwards from the foot hills the soil is partially clayey and loamy. But as per plan the complete area has to be urbanised. After urbanisation almost 90% of the area shall either be constructed or paved for paths, roads etc. Only 9 to 10% of the area is likely to be left as urban greens/ woods. Thus for remaining project area a run off coefficient of 0.90 has to be considered.

But CIDCO in the design parameters circulated by them has suggested to adopt a Run off coefficient of 0.93 for 10-15 sq km catchment. Though it seems to be on higher side, but is being adopted to be on safer side.

Coefficient of Rugosity

The coefficient of rugosity is the factor which depends upon the surface of stream/ river/ channel. The BIS recommends following factors to be considered for different surfaces.

Table: Coefficient of Rugosity for different type of channel surface

S No	Channel surface	Coefficient of Rugosity
	Natural Streams	
1	Clean, Straight banks, full stage, no rifts or deep pools	0.025
2	Same as (1), but some weeds and stones	0.030
3	Meandering, some pools and shoals, clean	0.035
4	Same as (3), lower stages, more ineffective slope and sections	0.040
5	Lined channels	0.020
6	Channels with rubble pitching	0.030

Looking to the situation of river as seen at site, the rivers are meandering and at several places having ineffective slopes. Thus the rugocity coefficient of 0.040 is to be adopted. CIDCO has also recommended to adopt a rugosity coefficient of 0.040 in the design criteria circulated by them. But for the part where development within IDP-NAINA area is to be undertaken, it is proposed to train the river including creating a regular slope by dredging and filling, This shall be provided with concrete floor and masonary lining on side slopes. The sides shall be provided with weep holes so that it does not affect the ground water environment of the area. This will result in smooth flow and quick transfer of water from the project area. On the other hand some of the land on sides of river can be reclaimed, which can be used for construction of roads along river. On the side of these roads urban greens or woods can be generated to give a pleasant environment in project area.

Thus for the part of river within project area, where the river is proposed to be trained a rugocity coefficient of 0.020 shall be adopted.

Flood Discharge

The flood discharge in a particular section of river shall depend on the Critical intensity of rain fall, Catchment area intercepted by that section and run off coefficient of the catchment. The formula used shall be:

Q = 0.028 x P x A x Ic

Here Q = Flood discharge in Cum / sec

P = Run off coefficient of catchment

A = Area of catchment intercepted in hectares

Ic = Critical Intensity of rainfall in cm per hour for related time of concentration

Flood level in a section

After calculating the flood discharge, the flood levels in a particular section shall be worked out based on the formula of conveyance factor and slope of the stream. For this the velocity of flow in the section under consideration shall be worked out. The velocity shall be dependent on the slope of stream, rugocity coefficient, Area of stream and the perimeter.

The Velocity of flow= V= (R^0.667 x S^0.5) / n

Here R= Hydraulic mean depth

= Area / Wetted Perimeter of the stream at the section

S= Slope of catchment = Length of catchment/ Fall in m

n= Coefficient of rugocity

Based upon the velocity, the area required to accommodate the flood encountered is worked out, which in turn gives the level in the river at the time of flood in particular section. For this we have applied the formula:

The Flood discharge = Q = A x V

Here A = Area of stream

V = Velocity of water in the stream

Based upon above calculations the flood level in the river is worked out and has been checked with the ground level in surrounding area.

It is found that at critical/ junction points a minimum free board of 300 to 1500 mm is available. Thus based on the calculations made with above empirical formulae, no flood situation is seen within IDP Area. However as already suggested CIDCO must go for 1-D and 2-D mathematical model study of these rivers to rule out the likely possibility of flood situation in the area before going for urban development.

Thus as suggested in previous paragraphs, the stretch of rivers within the IDP- Area has to be trained and lined, after river model study.

The detailed calculations for some of the nodes considered critical and analysed for flood have been shown in the below images.

No.307

CIDCO/EE(PP-I)/SE(D)II
4th December, 1992.

Sub: Hydraulic & Hydrological norms for the design of S.W. Drains in New Bombay.

The Technical Experts Committee headed by Shri S.V. Natu has modi some of the hydraulic & hydrological parameters for the design of S.W. D Systems in New Bombay.

The revised norms which are given below shall form part of the development control regulation in order to have uniformity in the designs fro various agencies. These norms shall supercede the earlier hydraulic and hydrological norms circulated.

4.6.1 a) TIDE LEVELS :

Apollo Bunder highest tide	:	2.89 MGTS
Panvel Creek upto Waghavli	:	3.25 MGTS
Thane Creek	:	3.25 MGTS
Dronagiri facing Bombay/Harbour	:	2.89 MGTS
Karanja Creek upto Khopta	:	3.25 MGTS

(The values assumed for Thane Creek Bridge, Railways and National Highwa bridges and Airoli bridges : 3.19 MGTS. The observations carried out in 1973 by CIDCO at NOCIL Jetty show that, there is difference of + 0.3 M. between tide at NOCIL Jetty and that at Apollo Bunder).

b) TIDE TIMING :
20 minutes lag for Thane, Kalwa and Karanja Creeks over Apollo Bunder tide timing.

c) TIDE VELOCITY :
2 M/sec. for Panvel, Thane and Karanja Creeks.

d) TIDE CYCLE :
Tide cycle is same as observed at Apollo Bunder.

e) TIDE PROFILE :
I) The tide profile observed in Thane, Panvel and Karanja Cree is similar to Apollo Bunder. The highest of spring and nee levels are same as Apollo Bunder values. In monsoon, the l tide water observed in the Creek (Panvel, Thane) are highe

Contd..

- 2 -

about 0.25 M and hence the following values are recommended in design.

The maximum low tide : (-) 0.25 MGTS

The lowest low tide : (-) 1.25 MGTS

II)The tide cycle is same as observed at Apollo Bunder.

III)Gain or recession rate of tide time	Gain or recession of tide in fraction of difference in low & high tide (h)
1. 1st hour	1/12 h.
2. 2nd hour	1/6 h.
3. 3rd hour	1/4 h.
4. 4th hour	1/4 h.
5. 5th hour	1/6 h.
6. 6th hour	1/12 h.

4.6.2 Designs Storm Return Period :

a) Sectoral Drains & Nodal Drains	10 Years.
b) Diversion Channel (for catchment area less than 1 Km^2)	10 Years.
c) Diversion Channel (for catchment area between 1 to 10 Sq.Km.)	25 Years.
d) Diversion Channel (for catchment area beyond 10 Sq.Km.)	50 Years.
e) C.D. Works for major city roads	50 Years.
f) C.D. works for railway & National/State Highway. (as recommended by CWPC)	50 Years.
g) C.D. Works for Arterial Roads	25 Years.
h) Holding Pond for Dutch Method of Reclamation.	10 Years.

Contd....3/-

4.6.3 Time of Concentration :

a) Sectoral Drains & Nodal Drains : 30 minutes

b) Catchment area upto 1 Sq.Km. : 30 minutes

c) Catchment area from 1 Sq.Km. to 10 Sq.Km. : 1 hour

d) Catchment area from 10 Sq.Km. to 15 Sq.Km. : 1 ½ hours

e) Catchment area from 15 to 25 Sq.Km. : 2 hours.

f) Above time of concentration shall be cross checked by following formula and lower of two values be adopted for design :

$$Tc = 60 \frac{(11.9L^3)^{0.385}}{H}$$

Tc = Time of Concentration (Minutes)

L = Length of longest water course (Miles)

H = Elevation difference in ft. of U/s & D/s points of the water course.

g) Catchment area beyond 25 Sq.Km....(The formula recommended by CWPC are to be followed)

h) C.D. Works for railway and National/State Highway and major city roads :
(same as above)

4.6.4 a) Storm Intensity :

$$i = \frac{KT^X}{t^e}$$

i = Intensity of storm in cm/hr.

K = 6.4 for storm period upto 1 hour.
= 8 for storm duration between 1 to 5 hours.

X = 0.25

e = 0.48 for storm duration less than 1 hour
= 0.63 for storm duration between 1 to 5 hours.

t = Duration of rainfall in hours.

T = Storm return period in years.

Contd...4/-

b) Standard hyetograph with 10 years return period storm to be followed for design of holding pond. The hyetograph gives initial rainfall of 3.3 cm./hr. per hour followed by that of intensity 8.9 cm./hr. for two hours tapering to 3.3 cm./hr. in last one hour for 10 year return period storm.

4.6.5 Run-off Coefficient :

a) $C = (0.4925)\ (2.170)^{\log 10^{I/2.5}}$

C = Runoff Coefficient

I = Intensity of storm in cm./hr.

b) C = 0.8 for sectoral and nodal developed areas. (for holding pond calculations)

c) Duration of rainfall = Time of Concentration.

4.6.6 Storm Run-off :

(Catchment area less than 25 Sq.Km.)

R = CIA

C = Run-off Coefficient

I = Intensity of storm in M/sec.

A = Catchment area in Sq.M.

4.6.7 Coefficient of Rugocity :

a) Natural river	- 0.04
b) Nalla/Unlined	- 0.035
c) Lined channel	- 0.02
d) Box type R.C.C. drain	- 0.02
e) Channel with rubble pitching	- 0.03

4.6.8 Free Board for Bridges and Channels :

Ref: IRC-5-1970

Vertical clearance for high level bridges having flat soffits.

Discharge in M^3/Sec.	Minimum vertical Clearance in mm.
Upto 0.3	150
Above 0.3 and upto 3.0	450
Above 3.0 and upto 30.0	600
Above 30.0 and upto 300.0	900
Above 300.0 and upto 3000.0	1200
Above 3000.0	1500

Contd...5/-

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4.6.9 Hydrological parameter for Design of Storm Water Disposal System :

Sr.No.	Design Description	Storm Return Period	Storm Intensity Cm./hr.(I)	Run-Off Coefficient (C)
(a)	Sectoral drains & Nodal drains.	10 years	15.87	0.92
(b)	DIVERSION CHANNEL :			
	i) Catchment area less than 1 Sq.Km.	10 years	15.87	0.92
	ii) -do- 1 to 10 Sq.Km.	25 years	14.31	0.89
	iii) -do- 10 to 15 Sq.Km.	50 years	16.48	0.93
	iv) -do- 15 to 25 Sq.Km.	50 years	13.75	0.87
(c)	C.D. WORK FOR MAJOR CITY ROAD & NATIONAL/STATE HIGHWAYS			
	i) For catchment area below 1 Sq.Km.	50 years	23.73	1.00
	ii) -do- 1 to 10 Sq.Km.	50 years	17.02	0.94
	iii) -do- 10 to 15 Sq.Km.	50 years	16.48	0.93
	iv) -do- 15 to 25 Sq.Km.	50 years	13.75	0.87
(d)	C.D. WORK FOR ARTERIAL ROAD :			
	i) Catchment area below 1 Sq.Km.	25 years	19.96	0.99
	ii) -do- 1 to 10 Sq.Km.	25 years	14.31	0.89
	iii) -do- 10 to 15 Sq.Km.	25 years	13.85	0.86
	iv) -do- 15 to 25 Sq.Km.	25 years	11.56	0.82

SE(Design-II)

CE&GM(Tech.)

c.c. to: CT&CP
ACE(Railways)
ACE(I)
ACE(II)

Road side drainage

The Storm water drainage system is provided to collect the rain water with in the project area and to cater it to the natural drains / rivers within the project area which in turn are discharging in to the Arabian Sea on west of NAINA. The area in general is having a slope from North East to South West direction. Due care has to be taken during design of drainage system, that the drains flow along the

natural slope of ground, to avoid unwanted earth work during construction. The drainage system shall be proposed on both sides of proposed roads.

As the drains are discharging in to the natural drains with in project area, it is proposed to create few water harvesting structures at suitable locations. For this it is proposed to construct low height weirs of 1.5 metrs, based on the adjoining contours. The rain water collected from the proposed drains shall be stored in these weirs. This will help in improving general water table in the area, and will also give a good aesthetic and environmental view in the green buffer surrounded with woods.

Design Criteria and Parameters

The design of storm water drainage system is to be based on IRC - SP: 50 (Guide Lines for Urban Drainage). This involves:

Calculating the total discharge that the system will be required to drain off.

Fixing the slope and dimensions of the drain to have adequate capacity to carry the discharge and afford proper maintenance.

The discharge is dependent upon intensity and duration of precipitation characteristics of the area, and the time required for such flow to reach the drain. The storm water flow for this purpose has been determined using the rational method, as suggested in IRC – SP: 50 for road side drains.

The road side drains are not to be designed for the peak flow of rare occurrence; however it is necessary to provide sufficient capacity to prevent too frequent a flooding of the drainage area. However it is recommended that road side drains be designed for 2 years return period, and the natural drains passing nearby for a 5 year return period. But CIDCO in its guide lines circulated has recommended that Sectoral and Nodal drains be designed for 10 years return period, thus drains shall be designed for 10 years return period.

Rain fall intensity

It has been observed that shorter the duration of critical rainfall, the greater would be the expected average intensity during that period. Say during a 30 minute rainfall, some 5 minute period will have average rain fall intensity greater than that of the whole storm. The critical duration of rainfall will be which produces maximum runoff. This duration has been taken equal to the time of concentration.

Thus based upon the rainfall data from Indian Meteorological department, and rational analysis of the data, Critical Design Intensity of Rain fall for 10 years return period has been worked out, which comes as 87 mm / hour.

Based on above values, and Empirical formula as per IRC- SP-13, a table of design rainfall intensity for different values of time of concentrations prepared for adopting in the design of drain.

Time of concentration

The time of concentration shall be taken as the time required for a drop of water to run from the most remote point of the road surface to the point for which the runoff is being estimated. The time of concentration shall be worked out based upon the empirical formula in IRC – SP – 13.

Run off coefficient

The coefficient of runoff is the portion of precipitation that makes its way to the drain. Its value depends upon, permeability of the surface, type of ground cover, shape and size of catchment area, the topography and geology. As per recommendation of IRC-SP-50, the following values have to be adopted for the design of storm water drains in PEMH area:

Residential Area	:	0.60
Industrial Area	:	0.55

Open / Parks	:	0.15
Roads	:	0.90

Rational Formula adopted for estimating Peak Run-off rates

The IRC – SP: 50: 1999, recommends, that for the smaller water sheds following rational formula is to be used for estimating peak run-off rates:

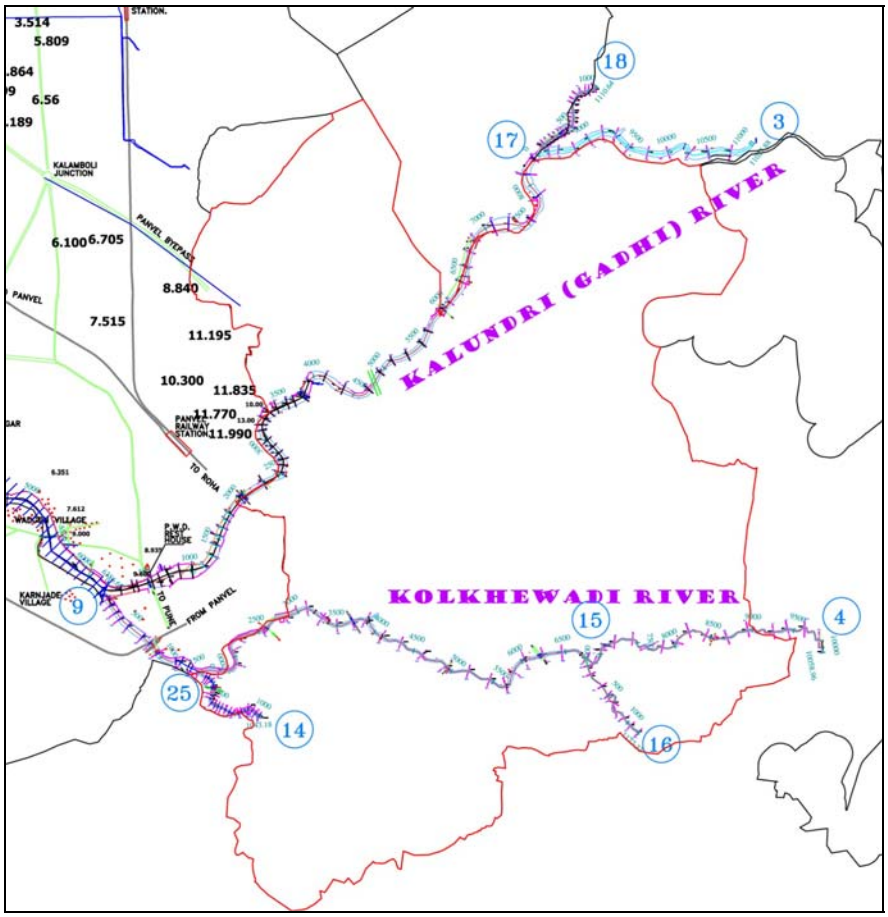
$$Q = 0.028\ PAIc$$

Here: Q = Design peak run off rate in cum / sec.

P = Coefficient of run-off for catchment characteristics.

A = Area of catchment in hectares.

Ic = Critical intensity of rainfall in cm per hour for the selected return period and the duration



Node Number		Details about the stretch	Chainage at Start	Chainage at End	Length of stretch	Existing Bed Level		Proposed Bed Level		Bed Width	Width at proposed HFL	Free Board Proposed	Av. Water Depth	HFL		Av. Area of Section	Perimeter	Area / Perimeter	Bed Fall	Bed Slope	Coeff. Of Roughocity	Velocity "V"	Capacity "Q"	Max. length of catch-ment	Slope of catch-ment	Over land flow time "to"	Flow time within stretch "td"	Time of concen-tration "tc"	Intensity of rain fall	Storage coeff.	Run off coeff.	Cathment area Intercepted	Sub-Catch-ment flow "q"	Capacity of river / channelQ"	Drain section & slope adopted is OK or not	Minimum Ground level	Free Board available	Chances of flooding Yes / No
From	To					Start	End	Start	End					Start	End																							
			(m)	(m)	L (m)	(m)	(m)	(m)	(m)	B (m)	(m)	(m)	d (m)	D (m)	D (m)	A (m2)	P (m)	A/P	(m)	S	n	m/sec	cumecs	kms	m/m	(min)	(min)	(min)	mm/hr	(Cs)	(C)	(Ha)	cumecs	cumecs	OK / Error	(m)	(m)	
As per CIDDCO Norms and 164.8 mm/hr Intensity of Rainfall																																						
15-Apr	14-Apr	Natural	9898	9628	270	29.84	26.6	29.84	26.6	20	98	0.5	2.35	32.19	28.95	45.6	98.1	0.46	3.24	0.012	0.04	1.64	74.98	3.8	0.171	592	2.7	594.5	30.24	0.995	0.93	577.7	44.92	75	OK	29.57	0.62	No
14-Apr	13-Apr	Natural	9628	9426	202	26.6	24.77	26.6	24.77	13	135	0.5	2.25	28.85	27.02	41.8	135.1	0.31	1.83	0.009	0.04	1.09	45.56	4	0.163	639	3.1	642.5	28.17	0.995	0.93	605.8	43.88	45.6	OK	27.56	0.54	No
13-Apr	12-Apr	Natural	9426	9266	160	24.77	21.05	24.77	21.05	28.5	92	0.5	1.21	25.98	22.26	26.8	92	0.29	3.72	0.023	0.04	1.67	44.86	4.16	0.158	678	1.6	680.1	26.72	0.995	0.93	639.9	43.97	44.9	OK	22.78	0.52	No
12-Apr	11-Apr	Lined Channel	9266	8947	319	21.05	18.65	21.05	18.65	6	12	0.5	1.78	22.83	20.43	16	13	1.23	2.4	0.008	0.02	4.99	79.96	4.48	0.146	761	1.1	761.8	24.09	0.995	0.93	672.8	41.67	80	OK	21.04	0.61	No
11-Apr	1-Apr	Lined Channel	8947	6859	2088	18.65	7.8	18.65	7.8	6	12	0.5	2	20.65	9.8	18	13.2	1.36	10.85	0.005	0.02	4.43	79.74	6.57	0.101	1364	7.9	1372.3	13.81	0.995	0.93	1568.5	55.7	79.7	OK	13.75	3.95	No
Hills	16/10	Natural	1360	1165	195	11.6	10.62	11.6	10.62	13	85	0.5	1.96	13.56	12.58	96	85.1	1.13	0.98	0.005	0.04	1.92	184.5	7.95	0.057	2123	1.69	2124.7	9.05	0.995	0.93	1049.1	24.43	184.5	OK	15.3	2.72	No
16/10	16/2	Lined Channel	1165	50	1115	10.62	8.01	10.62	8.01	5	10	0.5	2.19	12.81	10.2	16.4	11.6	1.41	2.61	0.002	0.02	3.04	49.97	9.07	0.05	2595	6.1	2601.1	7.43	0.995	0.93	1130.5	21.6	50	OK	13.25	3.05	No
16/1	15/1	Lined Channel	6763	1677	5086	8.46	3.29	8.46	3.29	20	60	0.5	2.14	10.6	5.43	85.6	60.2	1.42	5.17	0.001	0.02	2.02	172.52	14.15	0.032	5141	42.1	5183.1	3.77	0.995	0.93	4731	45.89	172.5	OK	6.94	1.51	No
14/20	14/1	Lined Channel	1060	0	1060	5.2	3.29	5.2	3.29	10	20	0.5	2.14	7.34	5.43	32.1	20.9	1.54	1.91	0.002	0.02	2.83	90.77	6.5	0.023	2379	6.25	2385.4	8.09	0.995	0.93	4152.8	86.37	90.8	OK	6.94	1.51	No
25/12	25/1	Lined Channel	1450	0	1450	3.29	1.72	3.29	1.72	30	60	0.5	2.14	5.43	3.86	96.3	60.3	1.6	1.57	0.001	0.02	2.25	216.5	15.6	0.042	5204	10.75	5214.5	3.75	0.995	0.93	8883.9	85.66	216.5	OK	5.89	2.03	No
18/1	18/20	Natural	1110	0	1110	16.24	12.84	16.24	12.84	7	25	0.5	1.48	17.72	14.32	23.7	25.2	0.94	3.4	0.003	0.04	1.33	31.4	11.16	0.015	5254	13.95	5268	3.71	0.995	0.93	2770	26.44	31.4	OK	16.18	1.86	No
17/12	17/1	Natural	11028	8500	2528	21.04	12.92	21.04	12.92	20	85	0.5	2.58	23.62	15.5	135.5	85.2	1.59	8.12	0.003	0.04	1.93	261.45	9.5	0.08	2286	21.83	2307.5	8.35	0.995	0.93	7649.3	164.34	261.4	OK	17.86	2.36	No
Sep-53	2-Sep	Lined Channel	8500	0	8500	12.92	1.49	12.92	1.49	30	60	0.5	2.31	15.23	3.8	104	60.4	1.72	11.43	0.001	0.02	2.63	273.91	18	0.042	6105	53.76	6159.1	3.18	0.995	0.93	12423	101.58	273.9	OK	5.4	1.6	No
1-Sep	Sep-00	Natural	6386	6000	386	1.49	0.9	1.49	0.9	60	100	0.5	2.9	4.39	3.8	232	100.4	2.31	0.59	0.002	0.04	1.71	396.4	18.39	0.041	6343	3.77	6346.8	3.09	0.995	0.93	12653	100.45	396.4	OK	5.9	2.1	No

ANNEXURE 10-1: CASH FLOW ANALYSIS

FINANCIAL VIABILITY ANALYSIS FOR IDP PART OF CENTRAL NAINA					
SN	BASIC ASSUMPTION	QUANTITY	UNIT	QUANTITY	UNIT
1	LAND RATE - NON NA (Highest rate in IDP as per Ready Recknor)	0.39	Rs/ha (crores)	390	Rs/ M^2
2	LAND ACQUISITION RATE - DOUBLE OF NON NA RATE	0.78	Rs/ha (Cr)	780	Rs/ M^2
3	LAND RATE - NA (Highest rate in IDP as per Ready Recknor)	4	Rs/ha (crores)	4000	Rs/ M^2
4	SALE PRICE LAND RATE	12	Rs/ha (crores)	12000	Rs/ M^2
5	SF LAND SALE RATE	0.5	of sale price	6000	Rs/ M^2
6	OFF SITE CITY DEVELOPMENT CHARGE	2.3	Rs/ha (crores)	2300	Rs/ M^2
7	INCREASE IN COST	0.09	PER YEAR	1.09	Factor
8	INCREASE IN LAND SALE RATE UPTO 2020	0.12	PER YEAR	1.12	Factor
9	INCREASE IN LAND SALE RATE BEYOND 2020	0.15	PER YEAR	1.15	Factor
10	OPEN SPACE DEVELOPMENT RATE	0.1	Rs/ha (crores)	100	Rs/ M^2
11	%AGE OPTING NAINA SCHEME	80%			
12	BASIC RATE OF DEVELOPMENT CHARGE			500	Rs/ M^2
13	RATE OF BORROWING - INTEREST RATE	9%	PER YEAR		
14	SHARE OF CIDCO IN MMC (ROAD AND METRO COST)	50%	BALANCE 50% BY MMRDA		
15	FOR SUB URBAN RAILWAY CIDCO WILL SHARE	67%			

Sources of Revenue

A	REVENUE FROM DEVELOPMENT CHARGE				REVENUE (Rs Cr)		
Sr No	Year	Land %age coming for Developement	Equivalent Area coming up for development *	Development Charge Rs/M2	Revenue from DC Rs in Cr	Discounting Factor	NPV
1	2015	3	85.9	500.0	42.9	1.0000000000	42.9
2	2016	3	85.9	560.0	48.1	0.9174311927	44.1
3	2017	5	143.2	627.2	89.8	0.8416799933	75.6
4	2018	5	143.2	702.5	100.6	0.7721834801	77.7
5	2019	5	143.2	786.8	112.6	0.7084252111	79.8
6	2020	7	200.4	881.2	176.6	0.6499313863	114.8
7	2021	7	200.4	1013.3	203.1	0.5962673269	121.1
8	2022	7	200.4	1165.3	233.6	0.5470342448	127.8
9	2023	9	257.7	1340.2	345.3	0.5018662797	173.3
10	2024	9	257.7	1541.2	397.2	0.4604277795	182.9
11	2025	9	257.7	1772.3	456.7	0.4224108069	192.9
12	2026	9	257.7	2038.2	525.2	0.3875328504	203.5
13	2027	7	200.4	2343.9	469.8	0.3555347251	167.0
14	2028	7	200.4	2695.5	540.3	0.3261786469	176.2
15	2029	4	114.5	3099.9	355.0	0.2992464650	106.2
16	2030	4	114.5	3564.8	408.3	0.2745380413	112.1
		100	2863.3		4505.1		1998.0
NOTE	1	* Equivalent Area Factors --Residential-1, Commercial-2, Industrial-1.5					

B	REVENUE FROM GROWTH CENTER (SALE OF LAND)					REVENUE (Rs Cr)	
Sr No	Year	Rate of Land Sale Rs/M^2	%age of land available for sale	Land sale year-wise ha	LAND SALE Estimated receipts Rs.Cr	Discounting Factor	NPV land sale revenue
1	2015	12000	0	Dev. Period	0	1.0000000000	0.0
2	2016	13440.0	0	Dev. Period	0	0.9174311927	0.0
3	2017	15052.8	0	Dev. Period	0	0.8416799933	0.0
4	2018	16859.1	0	Dev. Period	0	0.7721834801	0.0
5	2019	18882.2	5.0	18.0	340.8	0.7084252111	241.4
6	2020	21148.1	5.0	18.0	381.7	0.6499313863	248.1
7	2021	24320.3	5.0	18.0	438.9	0.5962673269	261.7
8	2022	27968.4	5.0	18.0	504.8	0.5470342448	276.1
9	2023	32163.6	10.0	36.1	1161.0	0.5018662797	582.7
10	2024	36988.2	10.0	36.1	1335.2	0.4604277795	614.8
11	2025	42536.4	10.0	36.1	1535.4	0.4224108069	648.6
12	2026	48916.8	10.0	36.1	1765.8	0.3875328504	684.3
13	2027	56254.4	10.0	36.1	2030.6	0.3555347251	722.0
14	2028	64692.5	10.0	36.1	2335.2	0.3261786469	761.7
15	2029	74396.4	10.0	36.1	2685.5	0.2992464650	803.6
16	2030	85555.9	10.0	36.1	3088.3	0.2745380413	847.9
			100.0	361.0	17603.4		6692.8

C	REVENUE FROM OCSDC				REVENUE (Rs Cr)		
Sr No	Year	Land %age coming for Developement	LAND AREA (HA)	Rate (Rs/m2)	TOTAL	Discounting Factor	NPV
1	2015	3	17.3	2300.0	39.7	1.0000000000	39.7
2	2016	3	17.3	2576.0	44.5	0.9174311927	40.8
3	2017	3	17.3	2885.1	49.8	0.8416799933	41.9
4	2018	5	28.8	3231.3	93.0	0.7721834801	71.8
5	2019	5	28.8	3619.1	104.1	0.7084252111	73.8
6	2020	5	28.8	4053.4	116.6	0.6499313863	75.8
7	2021	7	40.3	4661.4	187.8	0.5962673269	112.0
8	2022	7	40.3	5360.6	215.9	0.5470342448	118.1
9	2023	7	40.3	6164.7	248.3	0.5018662797	124.6
10	2024	10	57.5	7089.4	408.0	0.4604277795	187.8
11	2025	10	57.5	8152.8	469.1	0.4224108069	198.2
12	2026	10	57.5	9375.7	539.5	0.3875328504	209.1
13	2027	10	57.5	10782.1	620.4	0.3555347251	220.6
14	2028	5	28.8	12399.4	356.8	0.3261786469	116.4
15	2029	5	28.8	14259.3	410.3	0.2992464650	122.8
16	2030	5	28.8	16398.2	471.8	0.2745380413	129.5
		100	575.4		4375.6		1882.8

D	REVENUE FROM SALE OF SF P					REVENUE (Rs Cr)	
SALE OF SOCIAL FACILITY							
Sr No	Year	Land %age coming for Developement	Area	Rate (50% of Land rate) Rs/m2	Revenue Rs Cr	Discounting Factor	NPV
1	2015	3	2.5	6000	15.1	1.0000000000	15.1
2	2016	3	2.5	6720.0	17.0	0.9174311927	15.6
3	2017	3	2.5	7526.4	19.0	0.8416799933	16.0
4	2018	5	4.2	8429.6	35.4	0.7721834801	27.4
5	2019	5	4.2	9441.1	39.7	0.7084252111	28.1
6	2020	5	4.2	10574.1	44.5	0.6499313863	28.9
7	2021	7	5.9	12160.2	71.6	0.5962673269	42.7
8	2022	7	5.9	13984.2	82.3	0.5470342448	45.0
9	2023	7	5.9	16081.8	94.6	0.5018662797	47.5
10	2024	10	8.4	18494.1	155.5	0.4604277795	71.6
11	2025	10	8.4	21268.2	178.8	0.4224108069	75.5
12	2026	10	8.4	24458.4	205.6	0.3875328504	79.7
13	2027	10	8.4	28127.2	236.5	0.3555347251	84.1
14	2028	5	4.2	32346.3	136.0	0.3261786469	44.4
15	2029	5	4.2	37198.2	156.4	0.2992464650	46.8
16	2030	5	4.2	42777.9	179.8	0.2745380413	49.4
		100	84		1667.8		717.7

Expenditure Pattern
INFRASTUCTURE HEAD

COST (Rs Cr)	LAND	POWER	SWM	WS	SEWER	DR	ROAD	SUB URBAN	METRO	OPEN SPACE	OTH	SUB TOTAL	EST & ADM COST 10% PER YEAR	SUB TOTAL + EST	INTEREST	TOTAL	Discounting Factor	Present value of cost (Rs Cr)
	150.2	731.3	13.0	1083.9	303.0	194.0	1641.1	376	2560.3	36.4	275	7363.7						
Year	2.0	5.0	5.0	10.0	10.0	10.0	10.0	5	5.0	7.0	5							
2015	75.1			108.4	30.3	19.4	164.1			5.2	59.8	462.3	46.2	508.5	37.0	545.5	1.0	545.5
2016	81.8	159.4	2.8	118.1	33.0	21.1	178.9	89.4		5.7	65.2	755.6	75.6	831.1	105.2	936.4	0.91743119	859.0
2017		173.8	3.1	128.8	36.0	23.0	195.0	97.4		6.2	71.1	734.4	73.4	807.8	173.1	980.9	0.84167999	825.6
2018		189.4	3.4	140.4	39.2	25.1	212.5	106.2		6.7	77.5	800.5	80.0	880.5	247.4	1127.9	0.77218348	870.9
2019		206.5	3.7	153.0	42.8	27.4	231.6	115.7		7.3	84.5	872.5	87.2	959.7	302.2	1262.0	0.70842521	894.0
2020		225.0	4.0	166.8	46.6	29.8	252.5	126.2		8.0		858.9	85.9	944.8	349.7	1294.6	0.64993139	841.4
2021				181.8	50.8	32.5	275.2			8.7		549.1	54.9	604.0	354.4	958.4	0.59626733	571.5
2022				198.1	55.4	35.5	300.0					589.0	58.9	647.9	351.4	999.2	0.54703424	546.6
2023				216.0	60.4	38.7	327.0					642.0	64.2	706.2	280.1	986.3	0.50186628	495.0
2024				235.4	65.8	42.1	356.4		1321.3			2021.1	202.1	2223.2	298.8	2522.0	0.46042778	1161.2
2025									1440.2			1440.2	144.0	1584.3	230.6	1814.9	0.42241081	766.6
2026									1569.9			1569.9	157.0	1726.8	133.6	1860.4	0.38753285	721.0
2027									1711.2			1711.2	171.1	1882.3	12.8	1895.1	0.35553473	673.8
2028									1865.2			1865.2	186.5	2051.7	0.0	2051.7	0.32617865	669.2
2029									0.0			0.0	0.0	0.0	0.0	0.0	0.29924647	0.0
2030												0.0	0.0	0.0		0.0	0.27453804	0.0
	309.1	1690.4	35.0	2740.6	773.3	498.7	4144.3	534.9	10473.0	91.2	358.2	16358.8	1487.2		2876.4	19235.2		10441.4

YEARWISE EXPENDITURE PATTERN

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
COST	508.5	831.1	807.8	880.5	959.7	944.8	604.0	647.9	706.2	2223.2	1584.3	1726.8	1882.3	2051.7	0.0	0.0
REVENUE	97.8	109.5	158.6	229.0	597.3	719.4	901.4	1036.6	1849.3	2295.8	2640.1	3036.2	3357.4	3368.2	3607.2	4148.3
PROFIT/ LOSS	-410.8	-721.6	-649.2	-651.5	-362.5	-225.4	297.4	388.7	1143.1	72.6	1055.9	1309.3	1475.1	1316.5	3607.2	4148.3
IRR	**17.1%**															
OPENING BALANCE	-410.8	-1169.33	-1923.78	-2748.44	-3358.29	-3885.98	-3938.31	-3904.04	-3112.26	-3319.79	-2562.70	-1484.04	-142.52	1161.20	4872.89	9459.71
VALUE WITH INTEREST	-447.7	-1274.57	-2096.92	-2995.80	-3660.53	-4235.72	-4292.75	-4255.40	-3392.36	-3618.57	-2793.35	-1617.61	-155.35	1265.71	5311.45	10311.08
	37.0	105.2	173.1	247.4	302.2	349.7	354.4	351.4	280.1	298.8	230.6	133.6	12.8	-104.5	-438.6	-851.4
INTEREST	37.0	105.2	173.1	247.4	302.2	349.7	354.4	351.4	280.1	298.8	230.6	133.6	12.8	0.0	0.0	0.0

SUMMARY OF FINANCILA ANALYSIS

					NPV	
1	REVENUE FROM DEVELOPMENT CHARGE				1998.0	Rs Cr
2	REVENUE FROM GROWTH CENTER (SALE OF LAN				6692.8	Rs Cr
3	REVENUE FROM OCSDC				1882.8	Rs Cr
4	SALE OF SOCIAL FACILITY				717.7	Rs Cr
5	**NPV of All Receipt**			**11291**	**Rs Cr**	
6	**NPV of All Expenses**			**10441**	**Rs Cr**	
7	**NPV**			**850**	**Rs Cr**	
8	**IRR**			**17%**		