VMRDA

FACE OF CHANGE

VISAKHAPATNAM METROPOLITAN REGION
DEVELOPMENT AUTHORITY

DRAFT MASTER PLAN FOR VMR 2041

VOLUME 1
MAIN REPORT

JUNE 2021

सत्यमेव जयते

GOVERNMENT OF ANDHRA PRADESH

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1 DRAFT MASTER PLAN 2041

1.1 BACKGROUND

Visakhapatnam Metropolitan Region (VMR), comprising of 4,873 sq.km, refers to the 'development area' of the Vishakhapatnam Metropolitan Region Development Authority (VMRDA) constituted under the provision of section 4, APMR&UDA Act 2016. As stipulated in the section 5 – Functions of the authority – "Planning - *to prepare and revise the Perspective Plan [PP], Master Plan [MP], Infrastructure Development Plan [IDP] or Area Development Plan or Zonal Development Plan duly carrying out surveys in order to achieve ecological balance for sustainable development and for providing other facilities for liveable environment*", the preparation of Master Plan for the horizon year 2041 has been initiated in the year 2016. The Master Plan 2041 has been prepared in conformity with the VMR Perspective Plan 2051 as stipulated in the section 11 of APMR&UDA Act 2016. This document is the statutory draft Master Plan 2041 for VMR that has been prepared with due regard to the provisions of section 11 of APMR&UDA Act 2016.

VMR has been one of the two Metropolitan regions of the Andhra Pradesh State. In addition to the two Metropolitan regions, 14 Urban Development Authorities (UDAs) have been declared in the Andhra Pradesh State (Figure 1-1).

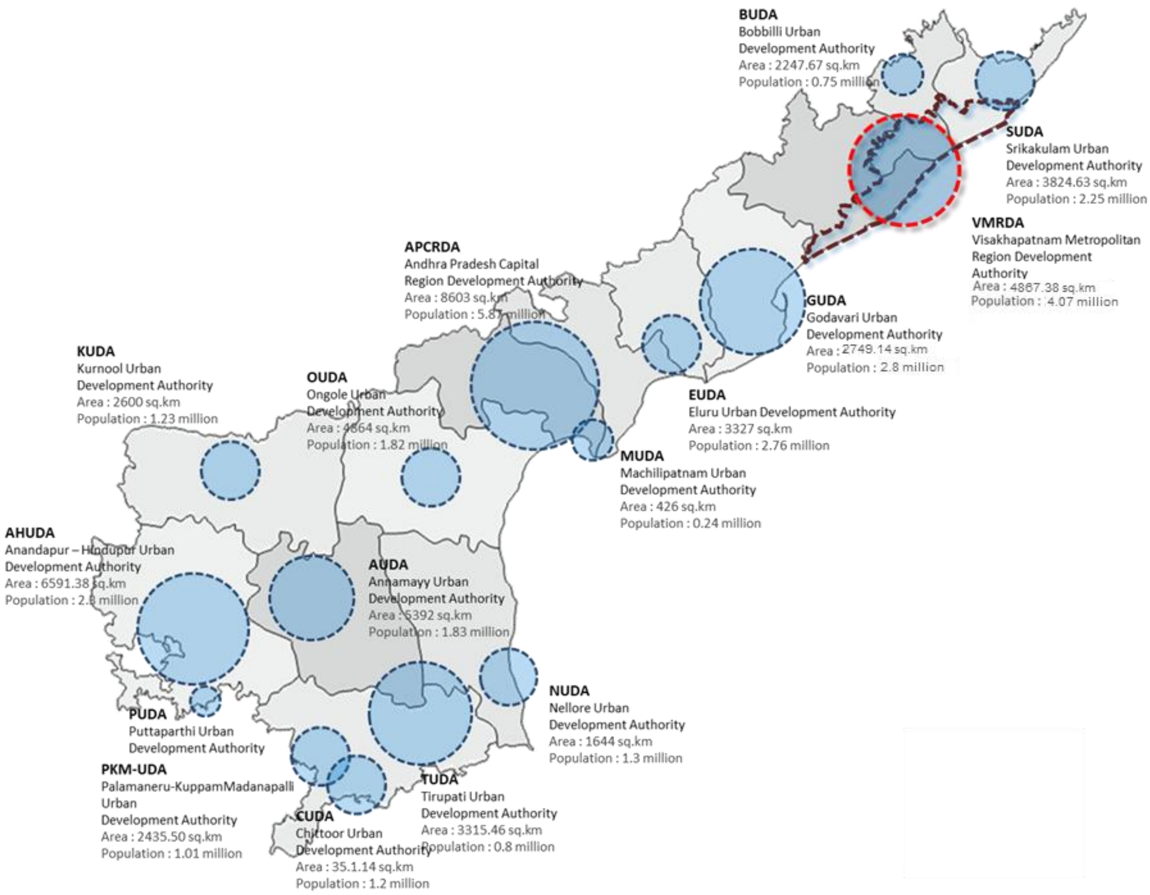


Figure 1-1: Development Authorities of Andhra Pradesh

1.2 PREPARATION OF MASTER PLAN

The detailed preparation of Master Plan 2041 highlighting the key stages, consultations, and outcomes have been illustrated Figure 1-2. The Master Plan 2041 has considered the vision, policies, schemes, and programmes that government have been implementing in VMR to retain the position of Vishakhapatnam as a global investment destination in the state of Andhra Pradesh. The notable infrastructure investments being implemented include Visakhapatnam-Kakinada Petroleum, Chemicals and Petrochemicals Investment Region (VK-PCPIR), Visakhapatnam Chennai Industrial Corridor (VCIC), Bhogapuram greenfield international airport, SMART Cities Mission, AMRUT Mission, etc.,

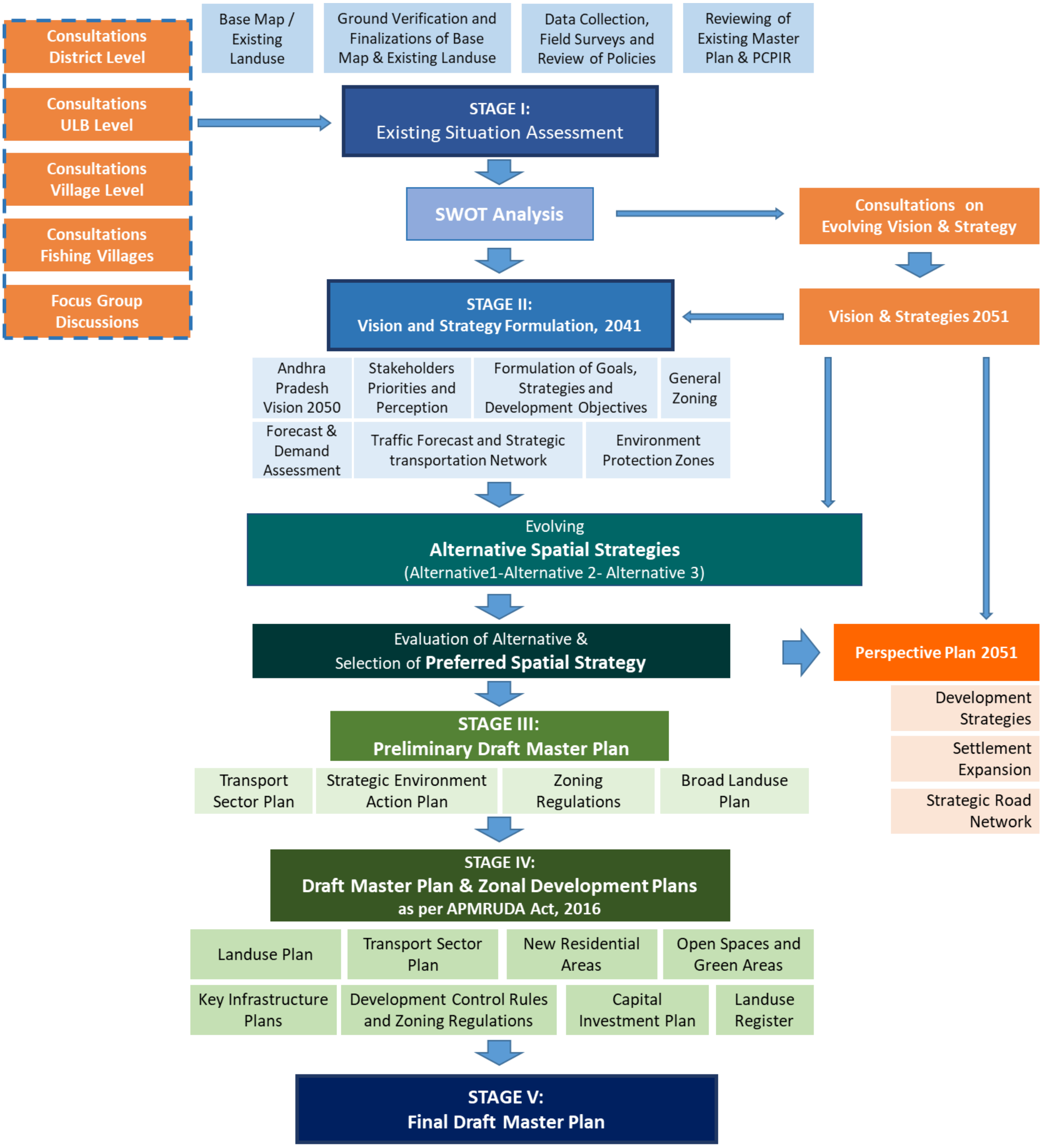


Figure 1-2: Preparation of Master Plan 2041

1.3 OBJECTIVES OF MASTER PLAN

The Master Plan 2041 for VMR, aims at sustainable development by evolving a vision and road map for promoting future spatial development. The Master Plan will be a constitutional instrument as it conforms to the provisions stated in the APMR&UDA Act 2016. The objectives of the Master Plan 2041 (Figure 1-3) are as follows:

1. **Review and integration of in-force Master Plan:** This Master Plan reviewed and appraised the plans within VMR.
2. **Integration of existing and proposed development within VMR:** Andhra Pradesh State', global destination for investments in the AP state, Smart City, AMRUT, Bhogapuram greenfield international airport, VK-PCPIR, SDA Draft Master Plan, VCIC corridor and others. All these projects/programmes will have an impact on development structure of VMR. The potential implications of these projects have been assessed and integrated in this Master Plan.
3. **A Road Map for promoting future growth:** Prepare a Master Plan, in accordance with provisions of APMR&UDA Act 2016, envisaging a compact land use plan, considering potential growth and emerging development pressure. To provide a road map for promoting future growth in a planned manner for the VMR.
4. **Environmental Sustainability:** VMR known for its natural resources need to be protected. Prepare a sustainable Master Plan, avoiding potential implications on environmental resources including coastal resources, water bodies, forest areas, bio-diversity areas, and agriculture areas.
5. **Locational Plan:** Through a realistic estimated demand, prepare a Master Plan, which suggests appropriate locations for future employment areas, new growth centers, counter magnets, and provide adequate land for developing infrastructure including public transportation system, water supply system, waste water and solid waste management system and disposal areas, power supply, institutional, social and recreational facilities.
6. **Participatory and Consultative Plan:** Prepare a Master Plan, by developing vision and goals from the discussions with citizens and various stakeholders. It is a shift-over from traditional approach to citizen focused and market-driven approach to build a livable city. Various modes of communication are adopted to inform, engage, educate and envision the development of VMR for 2041.
7. **Investment Plan and Resource Mobilization Strategies:** Prepare a Master Plan, which identifies key infrastructure projects, estimated investment, resource mobilization strategies and realistic implementation plan. To facilitate VMRDA and GoAP, in resource mobilization and implementation of short, medium and long-term projects translated from Master Plan.
8. **Planning strategies on conservation zones and archaeological protection areas:** To protect/ conserve and facelift various archaeological/ heritage and culturally significant areas.
9. **Housing Strategies:** to facilitate affordable housing, social housing in VMR modern concepts of Mixed-Use spines, Growth Corridors, Transit Oriented Development, integration of land use and transportation, urban renewal Urban Design Principles and others shall be adopted.

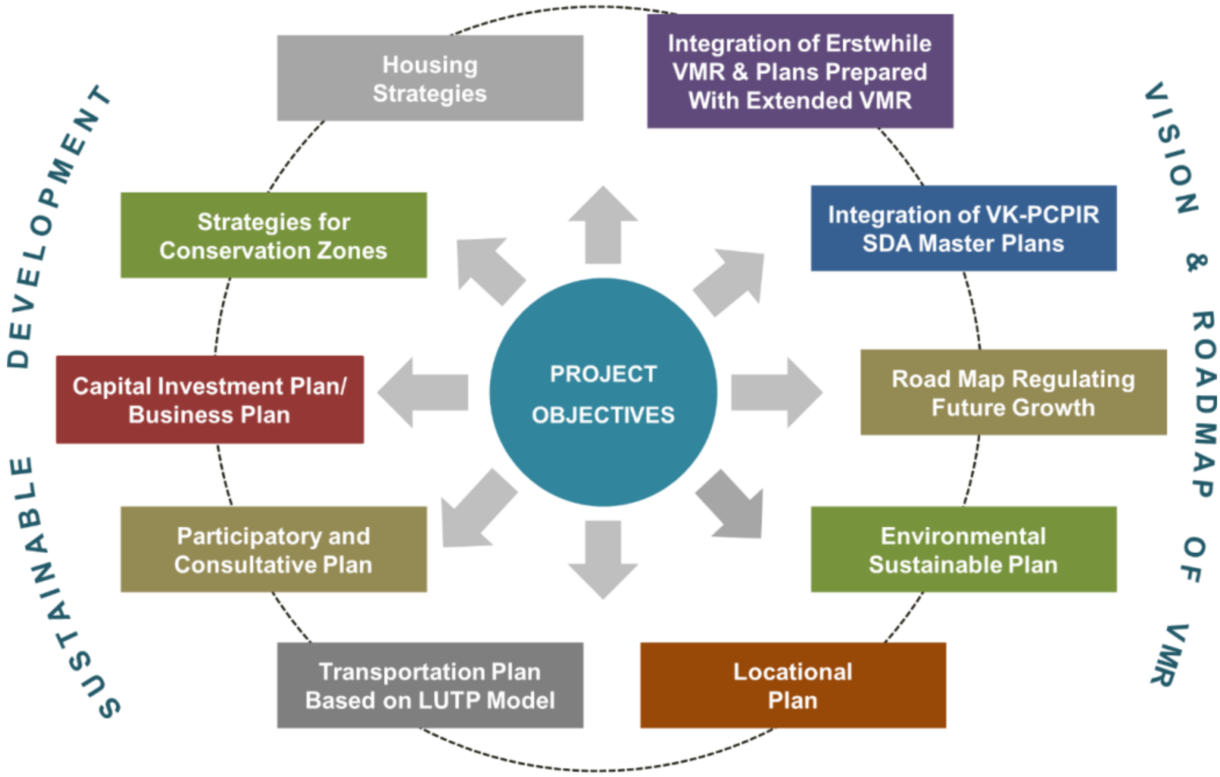


Figure 1-3: Objectives of the Master Plan 2041

1.4 STRUCTURE OF THE REPORT

VOLUME 1 – Draft Master Plan - 2041: This volume presents the context of VMR in overall national, state and district perspective to contextualise the development of the region. Its objective is to present the existing situation of the region in terms of the physical, social, economic, and environmental parameters and overall SWOT analysis. The volume also presents the vision, strategies, and stakeholder aspirations for the region. It finalises the strategies adopted in terms of population, employment, landuse, transportation, and environmental sustainability for the region. The strategies are further translated into spatial plans in the form of Master Plan for horizon year 2041. The chapterisation is accordingly indicated below.

Chapter 1: Background

Chapter 2: Regional Setting

Chapter 3: Demography & Socio-Economic Characteristics

Chapter 4: Environmental Characteristics

Chapter 5: Review of Key Economic Sectors

Chapter 6: Existing Land Use, 2018

Chapter 7: Traffic & Transportation Sector Scenario

Chapter 8: Physical Infrastructure

Chapter 9: Housing and Real Estate Scenario

Chapter 10: Social Infrastructure Facilities

2 REGIONAL SETTING

The purpose of this chapter is to present the initial understanding of project area and its surroundings. The chapter also presents the linkages of the study area with the rest of the state and its regional characteristics with respect to the districts of the study area. There are various advantages as well as issues for the area with respect to its regional location. This chapter examines in detail these aspects to enable further understanding of the VMRDA in its regional context.

2.1 SIGNIFICANCE OF THE REGION

Visakhapatnam Metropolitan Region (VMR) is one of the largest urban development regions in Andhra Pradesh State. Figure 1-1 shows the UDAs of Andhra Pradesh with its area. Recent dynamics in the state reveals the significance of the region at state level, while the international connectivity through major port, airport and proposed airport makes it a gateway to global market. Post bifurcation, Visakhapatnam has been the focus of development and has been in top priority as per the state investment agenda.

Its advantageous location coupled with export-import facilitation by the ports played key role in attracting major investments in industrial, real estate and tourism sectors. Visakhapatnam is a major urban node for all level of facilities in the region and this city serves as a nodal center for Visakhapatnam-Kakinada Petroleum, Chemicals and Petrochemicals Investment Region (VK-PCPIR) as well as Visakhapatnam Chennai Industrial Corridor (VCIC).

2.2 REGIONAL NETWORK & CONNECTIVITY

The VMR is well connected with road, rail, air and sea ports. It is located on the 'Golden Quadrilateral' with the NH-16 traversing through out the length of the VMR connecting Kolkata in the East and Chennai in the South. Vizianagaram is also well connected to National Highway through NH 26. The region is also well connected with State Highways and Major District Roads (MDRs), Arterial roads to access other Transport nodes rail and sea ports (see Figure 2-1).

The Chennai - Howrah main line of Indian Railways along the East Coast traverses through the VMR with rail sidings to Visakhapatnam Port, Gangavaram Port, NTPC and Visakhapatnam Steel Plant. The VMR is served by the East Coast Railway upto Duvvada on Northern stretch of the region and South-Central Railway towards the southern stretch.

Air connectivity to the VMR is through airports at Visakhapatnam and Rajahmahendravaram. The airport in Visakhapatnam is a naval base airport while the Rajahmahendravaram airport is a civilian airport. Majority of the traffic from these airports is limited to passenger traffic. The Visakhapatnam airport is located at a distance of 7 Km from city on NH-16. The upcoming international airport at Bhogapuram at a distance of 40 km from the city of Visakhapatnam.

VMR has an advantage of being served by two major ports of Visakhapatnam (Visakhapatnam Port and Visakhapatnam Container Terminal), and Gangavaram Port. Situated on the east coast of India, Visakhapatnam serves as the gateway for waterways for the state of Andhra Pradesh. Visakhapatnam has one of the country’s biggest ports and oldest Shipyard. The Visakhapatnam port is one of the busiest ports in India.

Connectivity to Visakhapatnam and Gangavaram Port was developed under the National Highways Development Program (NHDP), port connectivity project by National Highway Authority of India (NHAI). Visakhapatnam Port is connected at a distance 12 km and Gangavaram Ports at 3.5 km to NH-16 through a 12 km.

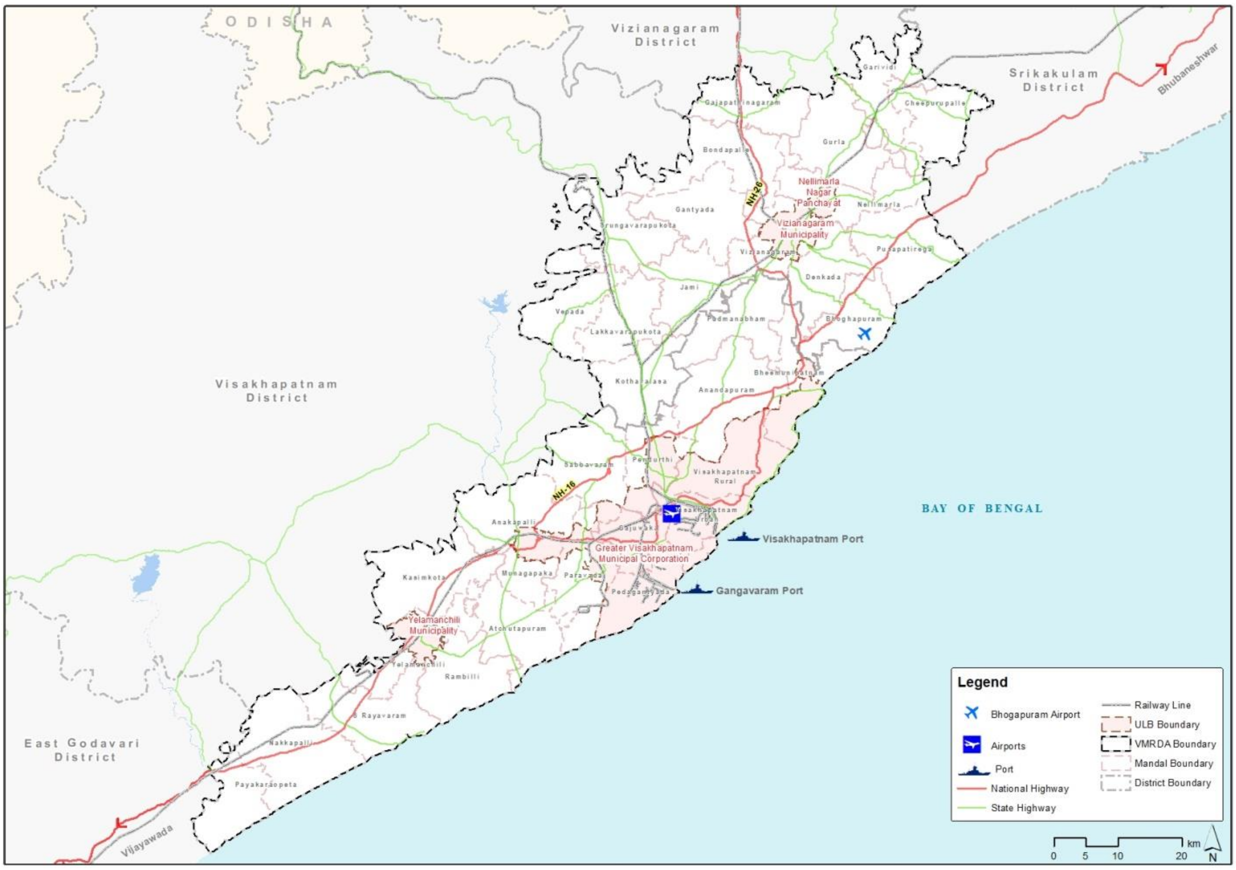


Figure 2-1: Location and Regional Connectivity of VMR

2.3 KEY POTENTIALS OF VMR

VMR has a well-connected road network. The National Highway 16 acts as the main spine along the entire VMR. The VMR is also bestowed with strategic railway network. The proposed metro rail corridor in the region creates a huge impact on the current real estate and promotes new development all along the corridors. The proposed International Airport at Bhogapuram area, the Greenfield International Airport provides the opportunity to the citizens of the region to connect with different parts of the country and the world.

The VMR provides an opportunity to expand existing ports with an extended coastal stretch. Connectivity between the ports and hinterland with good logistic infrastructure plays a major role in industrial growth. The VCIC and VK-PCPIR corridor, which starts from Visakhapatnam to Kakinada paves a way for stimulating industrial development all along the corridor.

Large parcels of land are available in the VMR, which can be developed in a planned manner through land pooling and developing the necessary infrastructure. The land parcels available in the southern part of the region from Visakhapatnam towards Yelamanchili and Nakkapalli can boost development of industrial establishments with the influence of VCIC and VK-PCPIR, also utilizing the available vacant lands in APIIC.In the northern part Boghapuram influence area can boost development. The northern parts of the region are rich agriculture lands with high yielding capacities which should be conserved from urbanization and promote agro based industries nearby.

The picturesque landscape and the fascinating beaches all along the region have a huge potential to attract a large tourist footfall and boost local economies. Along with the natural features, there are many historic and religious places which are present in the region that invites religious tourism. The health city in Arilova of Visakhapatnam caters to the medical needs of the surrounding states for medical tourism.

2.4 KEY INITIATIVES & PROJECTS OF NATIONAL & STATE IMPORTANCE

VISAKHAPATNAM – CHENNAI INDUSTRIAL CORRIDOR

The VCIC, part of East Coast Economic Corridor (ECEC), promoted by Government of India in partnership with Asian Development Bank (ADB), is the first coastal economic corridor in the country. It is aligned with the golden quadrilateral and covers more than 800 kilometers of the state of Andhra Pradesh's coastline. The VCIC is poised to play a critical role in driving India's economy and to further integrate the Indian economy with the dynamic global production network of East and Southeast Asia. Greater connectivity and economic integration between South and Southeast Asia are likely to contribute to significant benefits for both sub-regions and foster regional cooperation. As a coastal corridor, VCIC can provide multiple access points to international gateways to these geographies. Figure 2-2 shows the delineated area of the VCIC.

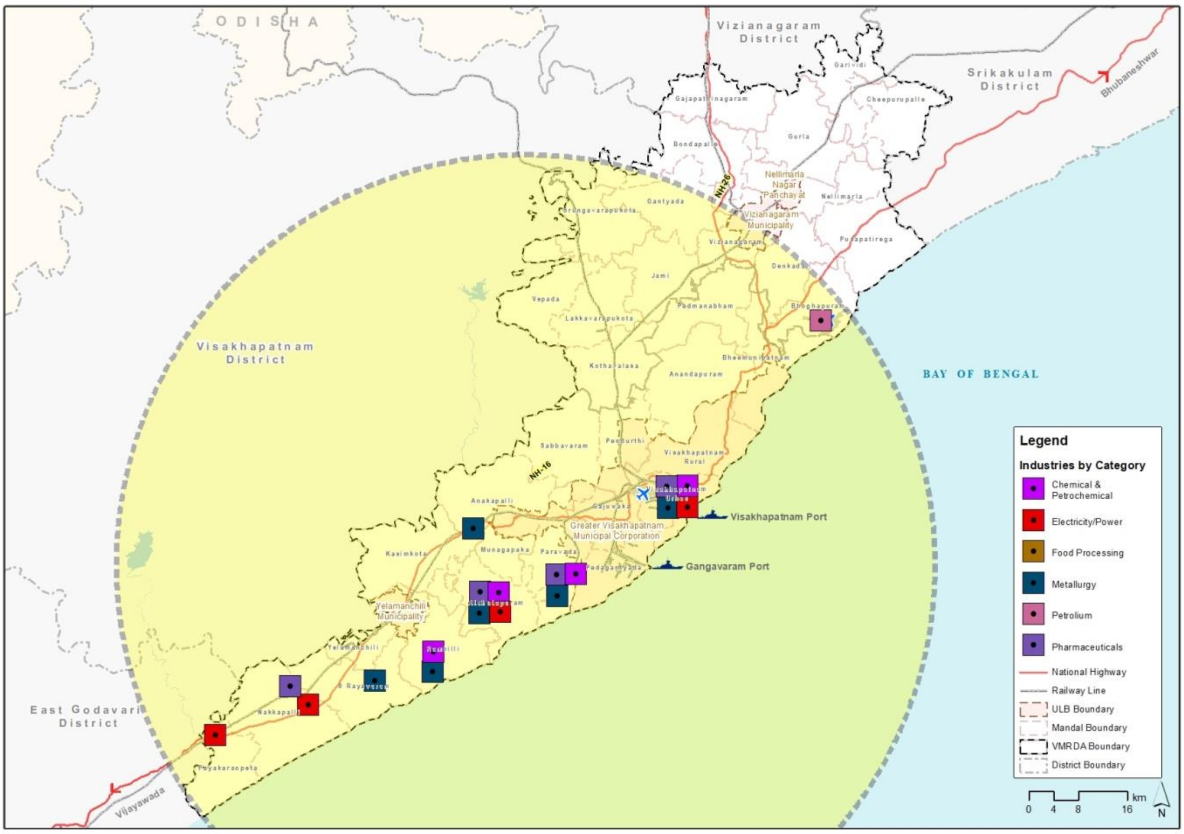


Figure 2-2: VCIC region

The expected impact of VCIC will be an increased contribution of the manufacturing sector to the state's GDP, trade, and employment. VCIC has the advantage of a long coastline, the presence of key ports and urban agglomerations, and a workforce that will help it achieve the following industrial transformation objectives:

- Achieve accelerated industrial output
- Expand employment opportunities
- Increase labor productivity & wages
- Diversify the range of manufacturing products
- Expand exports over the next two decades

- Link the corridor with Global Production Networks

These objectives are aimed to be achieved by stimulating economic activities, increased connectivity with global production network and improved transport connectivity.

The current industrial output of the corridor of ~14 USD billion supported through the envisaged interventions under VCIC program is expected to rise to ~USD 295 billion over a period of 30 years in comparison to ~USD 117 billion expected in the business-as-usual scenario.

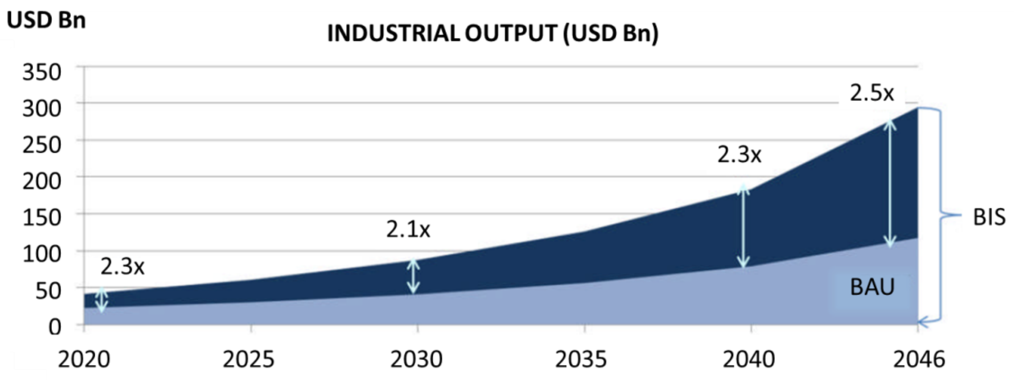


Figure 2-3: Industrial output in Business as usual and Business induced scenarios

VCIC has identified its projected targets as follows:

- Increase the share of manufacturing GDP to 16% by 2020
- Increase the manufacturing GVA (Gross Value Addition) by 30% by the end of projection period
- Generate additional 15 lakh jobs by 2025 in manufacturing sector
- Support the firms to achieve structural scaling up.

As a part of industrial development, the corridor focuses on seven industries that have attracted an investment of more than ₹ 30,000 crore over the past decade with recent shift to high value-added industries. The corridor thus emerges as one of the strategic programs to achieve the long-term state objectives of industrial development. The focus sectors are:

- Chemical and Petro-chemical
- Metallurgy
- Textiles
- Food processing
- Pharmaceutical
- Automobiles
- Electronics

Based on these priority sectors, VCIC envisages high contribution to the manufacturing GVA of the corridor.

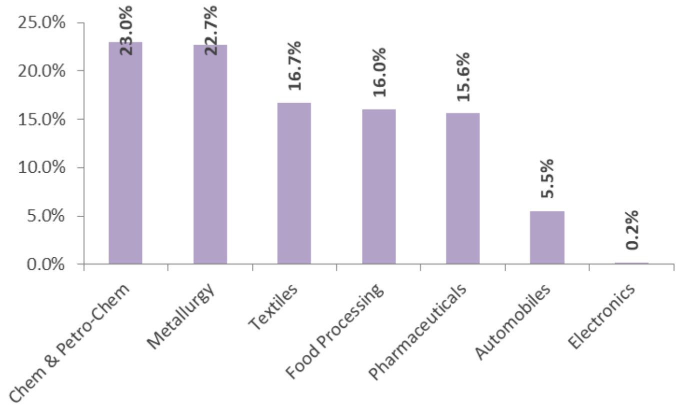


Figure 2-4: Investment in priority sectors in the corridor (2005-15)

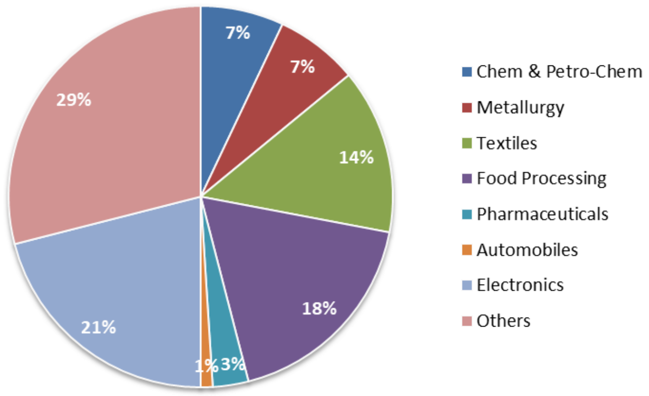


Figure 2-5: Contribution to Corridor's manufacturing Gross Value Addition

Key locations that will drive this output include Visakhapatnam the largest hub for manufacturing sector in the corridor contributing 49% of the industrial output. Though the development of the corridor shall provide the opportunity for dispersing this output, there are nodes identified in VCIC for focused development of industries (Figure 2-6). The identified nodes within VMR are the Visakhapatnam and the Kakinada node.

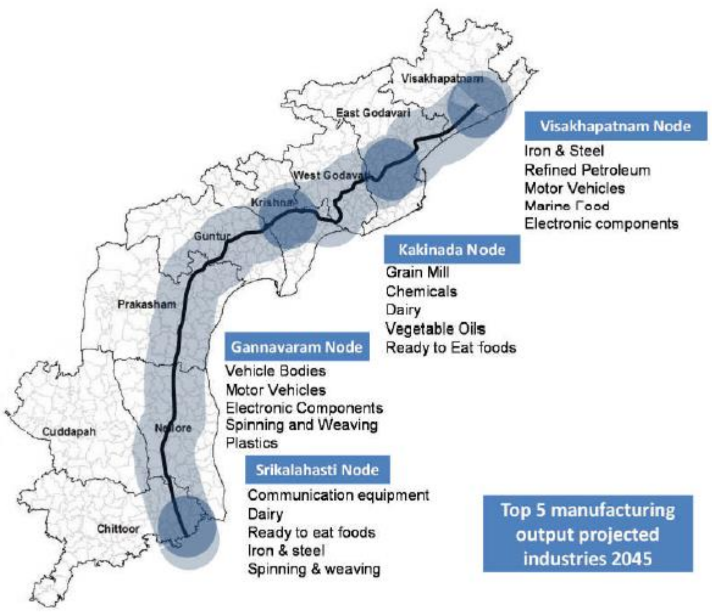


Figure 2-6 VCIC Nodes with priority industries (2045 projection)

Visakhapatnam Node: Strategically located with key access points to the eastern and central hinterlands of India, it is located close to Visakhapatnam and Gangavaram ports. Coal, iron ore, and petroleum are the major types of cargo handled by the node. These ports' cluster is expected to reach its capacity threshold by 2025 itself, despite the assumed commencement of the Bhavanapadu port. The existing plans for augmenting the cargo handling capacity of ports in the cluster may thus need to be advanced to handle the forecast increase in throughputs. From the aspect of airport infrastructure, Visakhapatnam airport is also the largest airport in VCIC. An airport in Visakhapatnam is likely to have the least competition from regional airports (i.e. Hyderabad, Bangalore and Chennai) as they are located more than 400 km away. The proposed airport at Bhogapuram is thus well positioned to cater to the increased air passenger traffic in the future and become a regional aviation hub for the state. The major concern for the road network is the hinterland gateway connectivity, indicative of poor connectivity to Chhattisgarh and Telangana. The development of the industries in the node has taken place due to the port and national highway connectivity. The present spread of industries is depicted in map.

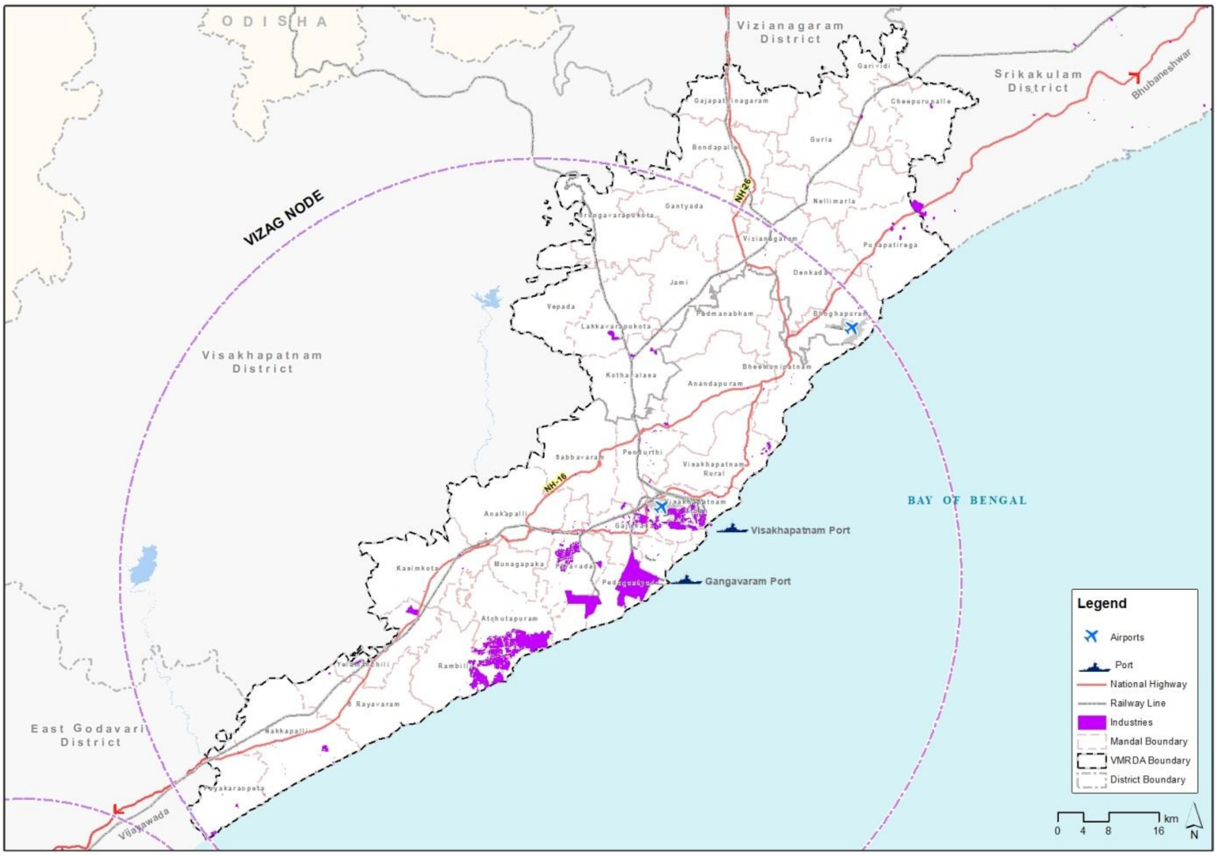


Figure 2-7 Present spread of industries in the Visakhapatnam Node

The airport is foreseen to see steep growth in traffic, with the passenger share among VCIC airports expected to double to 15% by 2045. The current airport capacity is however expected to be sufficient in the medium term. Immediate intervention is recommended in improving the intra-node road network and connectivity to Telangana in the short-term. The railway sections in the node are among the most congested sections of Vijayawada division, with utilization levels ~140% of charted capacity. The proposed implementation of anti-lock braking system for enhancing the track capacities should be prioritized on these sections. In the scenario of increased industrialization and implementation of PCPIR, freight handled by the railways is expected to increase. But the high utilization of existing railway infrastructure will impact the logistic transport system in the node. The benefits of both rail and roadways are present in the node as seen in Figure 2-7.

Visakhapatnam node houses more than 2,700 industries (under the shortlisted sectors) providing employment of more than 190,000 direct jobs. This is the most industrialized node of the corridor presently generating a manufacturing output of nearly 49% of the entire corridor. The district of Visakhapatnam presently contributes maximum to the GSDP in manufacturing sector and also the maximum output of State's manufacturing.

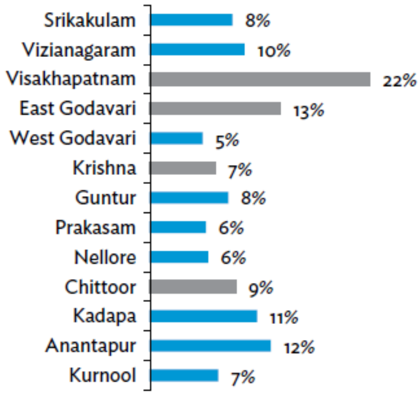


Figure 2-8: Manufacturing sector's contribution to GSDP by District.

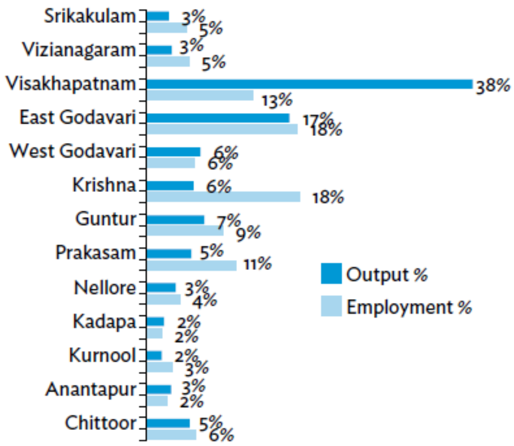


Figure 2-9: Contribution to State's manufacturing output and employment by district

For the targeted growth in the manufacturing sector, the estimation of investment of majorly depending on the incremental demand of industrial land for the manufacturing projects followed by the investment on infrastructure projects like logistics hubs, transportation projects and water supply projects. A shortlist of projects relevant to the VCIC under the sector specific policies has been populated in the following Table 2-1.

Table 2-1: Industrial Projects at VCIC Nodes (as per various industrial / sectoral policies) influencing VMR

Project Description	Relevant Sector	Mandal	District
Proposed Aerocity at Bhogapuram spread over 7500 acres	Aerospace & Defense	Bhogapuram	Vizianagaram
Plan to Develop food testing labs in Sri Venkateswara University in Iupati, Andhra University in Visakhapatnam and upgradation of testing lab in JNTU, Kakinada	Food Processing		Visakhapatnam,
GoAP envisages developing an Information Technology and Investment Region (ITIR) in Visakhapatnam with two clusters to be developed as Electronic Hubs (Visakhapatnam to be	IT & Electronics		Visakhapatnam

Project Description	Relevant Sector	Mandal	District
developed as electronic Mega Hub of the state)			
Growth of APSEZ at Atchutapuram spread over 5,595 Acres	Multi Sector	Atchutapuram	Visakhapatnam
Development of AP-PCPIR along VCIC covering an area of 250 sq.km. planned for manufacturing facilities	Petroleum, Chemicals and Petro-chemicals		Visakhapatnam and East Godavari (between Visakhapatnam and Kakinada)
Development of Eco-Industrial Parks – within existing 4 industrial parks (based on study under the International Climate Initiative)	Multi Sector (MSME)		Across Corridor
Development of MMPL by VPT on an area of 500 Acres with an estimated investment of INR 600 Crore	Logistics and Supply Chain	Anakapalli	Visakhapatnam

Source: VCIC Development Plan

Beyond the projects stated above, other projects identified by various departments for industrial development proposed under the corridor program have been shown in the list below with their estimated capital cost. These projects have been identified and shortlisted by various agencies like APIIC, GVMC, Department of Industries etc.

Table 2-2: Projects identified by various departments for industrial development

Name of the Project	Description of the Project	Project Cost (INR Crores)
AP SEZ-Water supply distribution	95 MLD Bulk Water Supply and 5 MLD Water Treatment Plant	240.9
AP SEZ-Water supply distribution	Balance Internal Water Supply Distribution System (12.35 km)	7.61
AP SEZ-Storm water drains	Balance Storm Water Drainage System (17.5 km)	36.1
AP SEZ-Utility corridor	Utility Corridor/Cable Duct (45 km)	134.5
AP SEZ-CETP	Common Effluent Treatment Plant (CETP) – 3 MLD	133.6

Source: VCIC Development Plan

Several industrial clusters have been studied in the node to analyze the potential of development in the sectors. These clusters were Bheemunipatnam Cluster, Pydibheemavaram Cluster, Atchutapuram Cluster and Nakkapalli Cluster among others. Emphasis has been given on the Anakapalli cluster due to its potentials for the factors like connectivity, availability of workforce, surrounding industrial scenario like presence of JNPC and other manufacturing units outside the industrial park.

Priority sectors in Visakhapatnam node with their estimated output and employment over the projection period are presented in Table 2-3. Anakapalli shall be one of the potential destinations given the limited land for developing industries in Visakhapatnam city.

Table 2-3: Target industries and estimated employment (average output) in Visakhapatnam Node

Priority Sectors	Estimated Output (2046) (USD Million)	Estimated Employment (2046) (Nos)	Average Output / Employee (₹ Lakh)
Iron & Steel Industry	16,151	142,102	68

Refined Petroleum Products	13,143	25,289	311
Motor Vehicles	4,600	53,509	52
Marine Processing	3,690	218,790	10
Electronic Components	2,972	139,409	12
TOTAL	**40,556**	**579,099**	

Source: VCIC Development Plan

The challenge faced by the industrial clusters which may be similar in case of the clusters in the node has been identified under the heads of Business operation, Industrial infrastructure and supply chain. For these issues, a list of projects has been recommended.

Projects recommended at Anakapalli cluster for industrial development are:

- Saturating capacity of Visakhapatnam port coupled with inadequate land calls for augmenting capacity through high-capacity evacuation PEM with least turnaround time
- Minimizing dirty cargo operations by shifting them to Gangavaram port and expanding container cargo capacity at Visakhapatnam port
- Augmentation of rail capacity supported by rake availability between Visakhapatnam and Gangavaram serving primarily the local region
- Present civil aviation at Visakhapatnam airport may be augmented to introduce support facilities for cargo services
- Development of a Common Facilities Center dedicated to sectors like Pharmaceuticals, Iron & Steel, Food Processing, Electronics that provides common facilities like testing centers, R&D labs, common processing areas (pay per use based), incubation center for micro and start-up enterprises with IT facilities (location may be situated between Pedagantyada and Anakapalli
- Prioritize and develop the Raiwada and Yeleru water supply / canal project on fast track to bridge the water demand gap creating a surplus to service future demand
- Industrial water being supplied by VIWSCO to ensure reliability quality and a 100 MLD desalination plant planned at Pudimadaka should be realized faster
- Airport may introduce testing labs and approval facilities to service pharma sector cargo demand
- Restoration and De-silting of the source reservoirs and lakes (Yeleru reservoir, Atchutapuram)

Augmenting the last mile connectivity through following road projects

- 4-lane to 6 lane conversion of entire stretch on NH-16 from Visakhapatnam to Rajamahendravaram.
- Four / Six Lane conversion of the Anakapalli-Pendurti- Anandapuram bypassing Visakhapatnam
- Four / Six lane conversion of existing 48 km stretch bypassing Visakhapatnam and providing direct connectivity between NH-16 and Visakhapatnam Port.

- Improving the linkage between – Bheemunipatnam – Sabbavaram – Narsipatnam – Koyyuru – Addateegala – Rampachodavaram – Maredumili – Chinturu - Joining NH 326 connecting to Chhattisgarh
- Improving the linkage between Visakhapatnam – Tallapalem – Narsipatnam –Chintapalli – Sileru - Uppersileru – Donkarai – Mothigudem – Lakkavaram -Chinturu

These projects are aimed at developing the industrial scenario in VCIC and which will in-turn influence growth in the VMR by attracting investment. VMRDA being the authority for development projects through the Master Plan will lead to an overall development of the entire region including the disjointed projects, which comes as government initiatives.

SAGAR MALA PROJECT

The Government of India with the Ministry of Shipping has rightly identified Sagar mala as a crucial infrastructure initiative whose development has the potential to boost India's GDP by 2%.

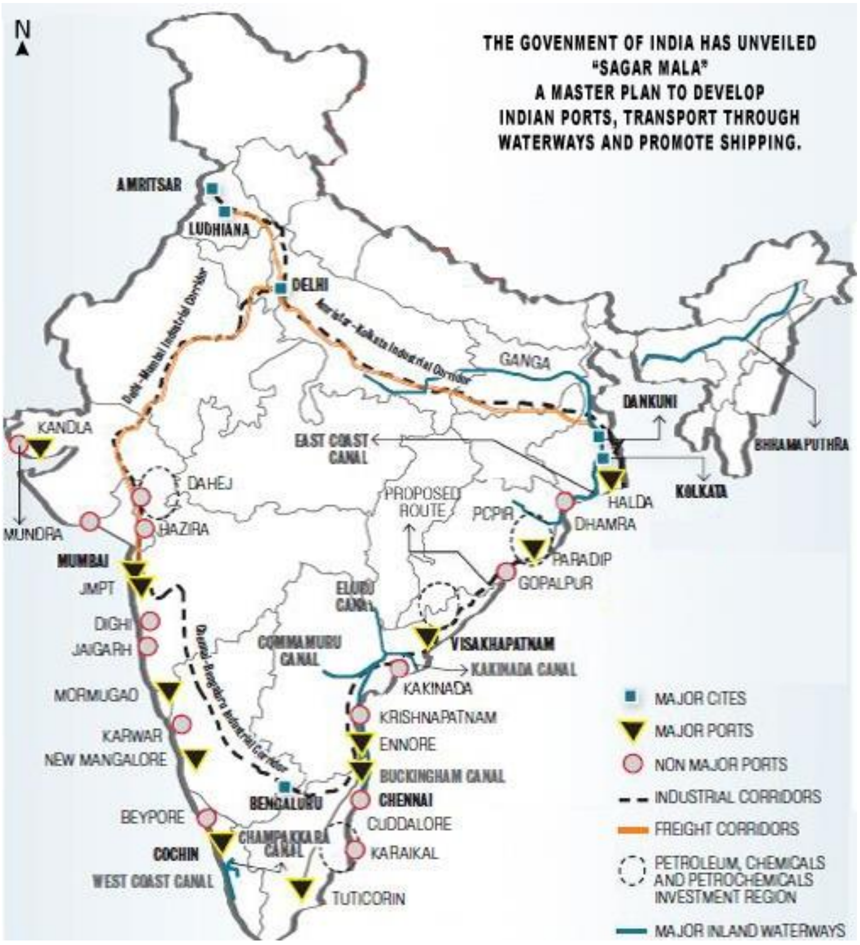


Figure 2-10: Sagar Mala Project Network Map

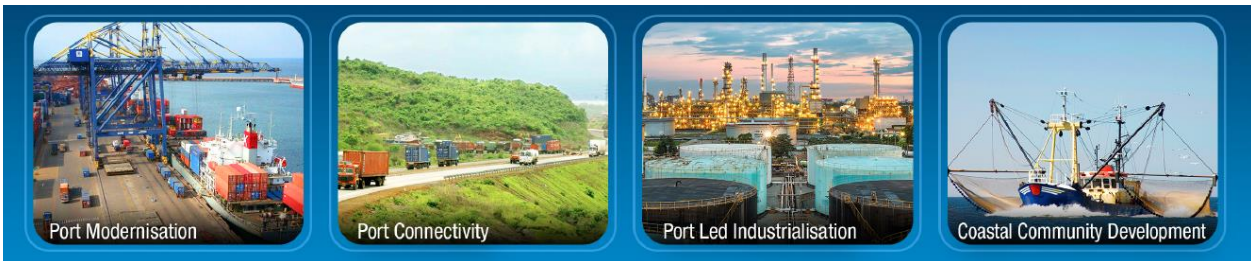
Source: Sagar mala National Perspective Plan

With the long coastline of 7,516.6 km, the Indian ports handle 90% of the export-import trade volume. Inspite of this, railways contribute 9% to the GDP, the road sector contributes 6%, whereas the ports' share of GDP is only 1%. This contradiction reflects the vast potential for development of coastal cities and ports.

India has 12 major ports and about 200 non-major ports with the cargo traffic expected to grow from 976 MMT in 2012 to 1,758 MMT by 2017. But India suffers from poor port linkages, under performance of existing port infrastructure and lack of developed infrastructure near ports, for value addition of inbound or outbound merchandise. Along with this, an inefficient inter-modal transport connectivity results in high cost of logistics and exports. The share of merchandise trade in GDP for India is only 42%, quite low as compared to European countries where it is above 70%. The Sagarmala project aims to improve this.

The Sagarmala Project has three clear objectives:

- Supporting port-led development with pro-active policy initiatives and providing institutional framework to assist all stakeholders.
- Modernizing port infrastructure.
- Developing integrated transport infrastructure for connecting the coast to the hinterland.



Under the project, 12 smart cities will be developed near ports with an investment of ₹50,000 crore. These will be integrated townships that will have affordable housing and implement green initiatives for sustainable living.

Coastal Economic Zones (CEZs) will be established near coastal locations to boost economic activities. These CEZs will be planned with modern support infrastructure and adequate fiscal incentives to attract investment.

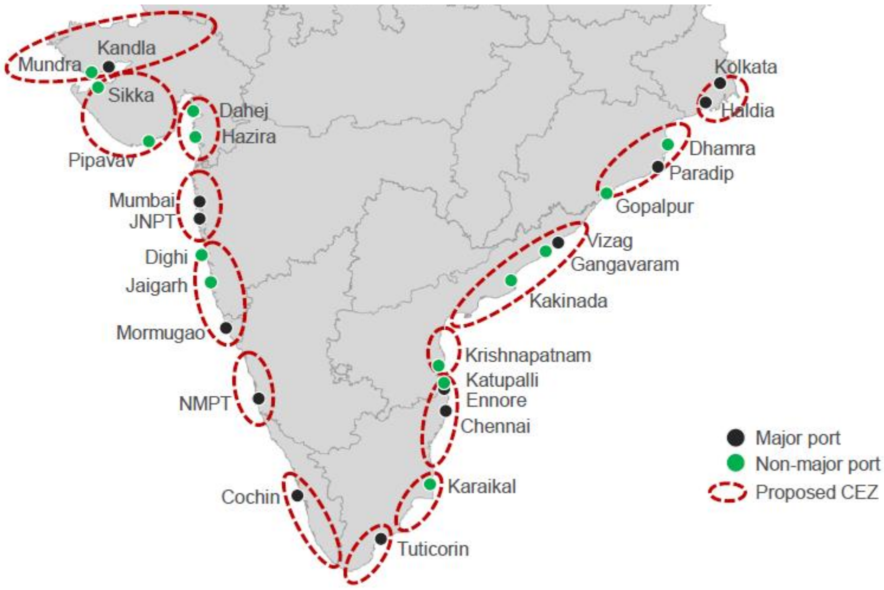


Figure 2-11: Proposed coastal economic zones under Sagar Mala Proposed

Source: Sagarmala National Perspective Plan

The potential benefits that the coastal states will receive from the project are:

- Development of Coastal Economy
  - Integrating the coastal economy with the ports through development of Coastal Economic Regions & projects with synergies to Coastal Industrial Corridors
  - Development of port-based smart cities and other urban infrastructure to improve standards of living

- Implementation of skill development/livelihood generation projects for coastal community development, E.g. – Coastal Tourism Development projects (Lighthouses & Mainland Islands) – Fisheries sector development

► Maritime Sector & Infrastructure Development

- Modernization/capacity expansion of existing ports and creation of greenfield ports to reduce bottlenecks for future growth
- Development of port evacuation (road/ rail/inland waterways) and logistics infrastructure to reduce overall logistics cost and to increase cargo movement to-and-from the hinterland
- Development of maritime sector leading to new economic activity in the region - e.g. Ship Building and Repair Cluster

► Easing the Project Development Process

- Integrated approach to project identification and implementation through coordination between Line Ministries, State / UT Governments and Private Agencies
- Easing of policy and institutional bottlenecks for – Obtaining project approvals – Accessing project funding and implementation partners – Project implementation and monitoring

Union Minister for Shipping, Road Transport, and Highways announced allocation of ₹ 8,400 crore to Andhra Pradesh under the Sagarmala project. Of the ₹ 8,400 crore, a sum of ₹ 3,000 crore would be spent on LNG terminal at Kakinada, Coastal Food Export berth there at the cost of ₹ 150 crore, ₹100 crore for additional oil jetty at the Visakhapatnam Port. The union minister also announced the development of a stacking yard at Visakhapatnam, and facilities at Vadarevu.

The state is ahead in proposing a number of projects to be taken up under Sagarmala. High level meetings were held on Friday, 24th February 2017 at AP secretariat on Sagarmala programme and the National Perspective Plan (NPP) for comprehensive development of coast line and the maritime sector. Andhra Pradesh, with India's second longest coastline of 974 km comprising 1 major and 4 operational non-major ports, has the opportunity to create international gateways with the rest of the world. The Andhra Pradesh government has proposed as many as 36 projects to be taken up under Sagarmala project.

Major part of the economy of VMR is dependent on the ports and supporting logistics. Moreover, the region has a 251 km long coastline which will be largely affected by the Sagar Mala project. Making provision for the new proposed ports and the rejuvenation of the existing ports will increase the throughput. This has to be supported with the infrastructure through Master Plan proposals to make the projects successful as well as to take the maximum benefits of the upliftments. The provision for the increase in flow of traffic will be taken into consideration and the impact of these projects on the urban life to be regulated.

BHARATMALA PROJECT

Bharatmala Pariyojana is a project for the roads and highways sector that focuses on optimizing efficiency of freight and passenger movement across the country by bridging critical infrastructure gaps through effective interventions like development of Economic Corridors, Inter Corridors and Feeder Routes, National Corridor Efficiency Improvement, Border and International connectivity roads, Coastal and Port connectivity roads and Green-field expressways.

The highlights of the project are:

► Improvement in efficiency of existing corridors through development of Multimodal Logistics Parks and elimination of choke point

► Enhance focus on improving connectivity in North East and leveraging synergies with Inland Waterways

- Emphasis on use of technology & scientific planning for Project Preparation and Asset Monitoring
- Delegation of powers to expedite project delivery - Phase I to complete by 2022
- Improving connectivity in the North East

Key features of the scheme:

- Improving the quality of roads - The launch of the scheme has been done for bring a new wave of development in the nation in the form of well-maintained and developed roads. Under this project, the construction of roads, in all parts of the nation will be undertaken.
- Total road construction - As per the draft of the scheme, government and the ministry will strive to complete new roads, which will add up to a whopping 34,800 kms.
- Integrated scheme - The Bharatmala is the name that is given to the road development and it will include many other related schemes as well. With the completion of all the schemes, the overall success of the scheme will be guaranteed.
- Total tenure of the program -The central government has the plans of finishing the scheme within a span of five years. Thus, all is set for finishing the first phase before the end of 2022.
- Segmentation in phases - Due to the sheer magnitude and spread of the scheme, it will be divided into seven distinct phases. As of now, the first phase in under construction.
- Constriction on a daily basis - To finish the first phase in time, the respective department has made efforts of constructing at least 18 km of path on a daily basis. To beat the clock, inued efforts are being made to raise it to 30 km/day.
- Different categories of road construction - It has been highlighted in the official draft of the scheme that to provide better connectivity, the construction of various categories of roads will be undertaken.
- Multi-source of finding - One source will not be enough for funding a mammoth project. Thus, the government will have to depend on other sources for generating adequate money to meet the expenses.

Categories of projects coming under Bharatmala

- Economic Corridor - As per the guidelines of the road construction project, the construction of 9,000kms of Economic Corridors will be undertaken by the central government.
- Feeder Route or Inter Corridor - The total length of the roads, which fall under the Feeder Route or Inter Corridor category, is a whopping 6000kms.
- National Corridor Efficiency Improvement – 5,000kms of roads, constructed under the scheme will fall in the category of National Corridor for the better connection between roads.
- Border Road and International Connectivity - Connecting the cities and remote areas, which are situated in the border regions, the project has kept provision for constructing 2,000kms roads that fall in the Border Road or International Connectivity category.
- Port Connectivity and Coastal Road - To connect the areas that are dotted along the shorelines and important ports, the central government has ordered the construction of 2,000km of roads.
- Greenfield Expressway - The main stress will be given on the construction and development of Greenfield Expressway for better management of traffic and freight.

- Balance NHDP Works - Under the last segment, the project will see a construction and maintenance of about 10,000kms of new roads.

Sections in VMR that are to be taken up in the first phase of Bharatmala project are:

- Raipur-Visakhapatnam Economic Corridor development
- Lane expansions and flyover in Visakhapatnam under Chennai Kolkata corridor
- Four lane Beach Road of 30.00 Km connecting Gangavaram Port to the SEZ proposed at Atchuthapuram in Visakhapatnam District
- Development of greenfield bypass road for better connectivity of Gangavaram port in Visakhapatnam District.

3 DEMOGRAPHY & SOCIO-ECONOMIC CHARACTERISTICS

The analysis of population characteristics and trends of development that have taken place over the last three decades are presented in this chapter. It also presents possible reasons for the growth trends, spatial spread of various communities within VMR to assess the existing situation and guide future course of the project.

3.1 POPULATION GROWTH TRENDS

VMR has witnessed an increase in population from 3.62 million in 2001 to 4.07 million in 2011 according to Census of India. Urban area has an increase in population from 1.48 million in 2001 to 1.94 million in 2011 while rural area has decrease in population from 1.87 million in 2001 to 1.8 million in 2011.

VMR experiences annual average growth rate of 1.2% which is same that of the state. Urban area has an average annual growth rate of 2.7%. In the last two decades VMR has experienced a decline in growth rate from 16.4 % (census 2001) to 11.2% (census 2011) which is slightly higher than that of the state's growth rate (9.2%) and significantly lower than that of country's growth rate (17.64%) according to census 2011.

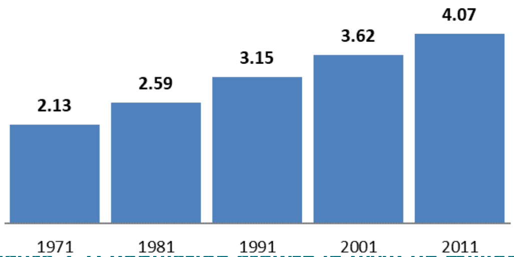


Figure 3-1: Population growth in VMR (in million)

Dynamic increase in growth rate is witnessed in mandals of, Garividi and Yellamanchili is evident in growth trends of last two decades. By virtue of high number of metallurgical industries in Garividi which also has major connectivity of state highway junction and railways. Yellamanchalli, on the other hand being an urban centre has attracted population by virtue of its connectivity with national highways and presence of urban infrastructure. Visakhapatnam district have higher growth rate due to more concentration of industries which form the main source of employment opportunity and economic activities in this region.

Visakhapatnam district has higher growth rate due to more concentration of industries which forms the main source of employment opportunity and economic activities in this region.

3.2 POPULATION DISTRIBUTION AND DENSITY

VMR has an urban population of 55.8% and rural population of 44.2%. Visakhapatnam district has 70% of VMR's population followed by Vizianagaram with 30% Greater Visakhapatnam Municipal Corporation has greater share of Urban population. Visakhapatnam district has highest share of Rural population 51% followed by 49% of Vizianagaram.

Population density of VMR is 819 persons per sq.km which is much higher than the Nation's (382 persons per sq.km) and state's density (308 persons per sq.km) according to Census 2011.Visakhapatnam district has higher density of 1058, persons per sq.km owing to its rapid development and highest share of urban area while Vizianagaram has a density of about 536 persons per sq.km.

Visakhapatnam rural mandal has greater increase in density during 2001 - 2011 due to upcoming projects and development of three IT hills and SEZ located in this region. Pedagantayada mandal experiences burgeoning density while Munagapaka mandal also has significant increase in density due to the establishment of three large scale (chemical, automobile and power) industries near Munagapaka.

Table 3-1: Population Density in districts of VMR (Persons per sq.km.)

DISTRICTS	1991 persons per sq.km	2001 persons per sq.km	2011 persons per sq.km
Vizianagaram	474	498	536
Visakhapatnam	767	938	1,058

Source: Primary Census Abstract Andhra Pradesh 1991, 2001, 2011

3.3 MIGRATION

Visakhapatnam being a port city attracted more industries in the region. In late 80's steel plant was established. Many other industrial giants like HPCL, Andhra petrochemicals, Essars steel, etc., came up in the region. This led to migration in search of employment opportunity during 1991 to 2001, which ultimately resulted in higher population growth rate. During 2001 to 2011 it is observed that not much of big players came into picture, providing bulk employment and the existing industries had already employed the required number of people and did not provide with much additional employment. Hence the growth rate was lower compared to that of the previous decade. IT/ITES which was expected to generate higher employment did not meet the expectation and is still getting delayed to take off. The inadequate infrastructure and current government policies are greater drawbacks weighing down the venture of IT sector.

3.4 SOCIO-ECONOMIC CHARACTERISTICS

LITERACY LEVELS

According to census, VMR has 63% literacy rate which is lesser than the state and national literacy rate of 67.41% and 64.8% respectively. Among the districts Visakhapatnam has higher. Significant increase in decennial literacy rate is observed in mandals adjoining the urban areas like Garividi and Cheepurupalli in the north of VMR and Payakaraopeta, Rambilli, Atchutapuram and Munagapaka.

Male and Female literacy rate is higher in Visakhapatnam district. Male literates are less in mandals of Nakkapalli (24%) and Pusapatirega (25%) while female Literacy rate is less in Gurla mandal (17.6%) and Pusapatirega (17.9%) in Vizianagaram district.

OCCUPATIONAL STRUCTURE

Work force participation rate of VMR is 41% (Census 2011). Vizianagaram has higher work force participation rate of 46.6% followed by 45.8%. Visakhapatnam district has major work force in secondary and tertiary sector. Other than House hold industries have 72.3% of the workforce in Visakhapatnam district. Visakhapatnam houses more secondary sector industries which is responsible for huge share of employment. Port, railways and logistics also contributes to considerable employment in tertiary sector. Primary workers (24.3%) constitute of major agriculture and substantial workforce is involved in fishing activities. Vizianagaram (56.6%) has highest share of primary workers. The North of the region is more fertile and majorly an agrarian economy. The secondary sector employment in Vizianagaram has 43.4% of the total workforce.

3.5 URBAN CENTRES AND SETTLEMENT SYSTEM

URBAN CENTERS

VMR has 4 urban centres currently, among which 2 urban centres each are located in Visakhapatnam and Vizianagaram district. Visakhapatnam district had a high growth (65%) in urban population from 1991 to 2001 whereas the other district had less growth. (Table 3-2)

In the decennial year 2001-2011, Vizianagaram and Visakhapatnam districts had moderate growth in urban population. It is evident that because of the rapid developments that had taken place in Visakhapatnam district.

Table 3-2: Number of Urban Centers and Urban Population in districts of VMR

DISTRICTS	Number of Urban Centers			Urban Population		
	1991	2001	2011	1991	2001	2011
Vizianagaram	1	1	1	1,61,331	1,76,023	2,43,285
Visakhapatnam	3	4	2	8,78,454	14,53,090	19,14,220
TOTAL	4	5	3	1039785	1629113	2157505

Source: Primary Census Abstract Andhra Pradesh 1991, 2001, 2011

Though Visakhapatnam district has moderate growth rate, GVMC had high increase in growth rate due to the extension of GVMC jurisdiction that includes Gajuwaka. Minimal growth has been recorded in other urban centres of VMR excluding Vizianagaram. (Table 3-3).

Table 3-3: Urban Population in VMR and its percentage share to total

Urban Areas	Urban Population			% Share to Total		
	1991	2001	2011	1991	2001	2011
Vizianagaram	1,61,331	176,023	2,43,285	13.9%	10.1%	10.4%
Bheemunipatnam	42,061	48,664	55,082	3.6%	2.8%	2.4%
Visakhapatnam	7,52,037	10,42,388	17,33,501	64.7%	59.7%	74.3%
Gajuwaka	-	2,76,552	-	0.0%	15.8%	0.0%
Anakapalli	84,356	85,486	94,762	7.3%	4.9%	4.1%
Yelamanchili	-	-	30,875	0.0%	0.0%	1.3%
TOTAL Urban Population	1039785	1629113	2157505	**100%**	**100%**	**100%**

Source: Primary Census Abstract Andhra Pradesh 1991, 2001, 2011

NOTE: As per census 2001 Amadalavalasa did not qualify to be an Urban Centre. Gajuwaka became part of GVMC as per census 2011

SETTLEMENT SIZES AND PATTERN

In VMR, there had been a major increase in population in villages, which leads to increase in size of the settlement. The major decrease in number of small sized villages (<1000 population) had been recorded in 1991-2001 and in 2001-11, decrease in both small and medium sized villages (< 1000 & 1000-2500 population) is seen. More shifts are evident in number of small and medium sized villages to large villages (2500-5000 population) in 2001-11 (Table 3-4).

Shift from small to large level villages is evident in Vizianagaram and Visakhapatnam districts in two decades, which shows the increase in population from less than 1,000 to more than 2,500. Increase in number of towns (5000-10,000 population) had been witnessed within two decades in Vizianagaram followed by Visakhapatnam districts.

Table 3-4: Settlement sizes in Districts of VMR

Districts	Range	1991	2001	2011
Vizianagaram	<1000	202	189	183
	1000-2500	221	232	225
	2500-5000	78	77	87
	5000-10000	15	19	21
	10000 & above	5	4	5
	Total	**521**	**521**	**521**
Visakhapatnam	<1000	115	109	98
	1000-2500	155	148	144
	2500-5000	76	85	96
	5000-10000	24	29	30
	10000 & above	4	3	6
	Total	**374**	**374**	**374**

Source: Primary Census Abstract Andhra Pradesh 1991, 2001, 2011

SETTLEMENT HIERARCHY

GVMC is the only metropolitan city with population range of 10 - 50 lakh within VMR. Vizianagaram Municipal Corporation falls under the category of medium town as per URDPFI guidelines. It is evident that small towns in Visakhapatnam district is high, revealing substantial development taking place in this region in recent years. Vizianagaram has higher number of villages depicting comparatively lesser scale of urbanisation in this district (Table 3-5).

Table 3-5: Settlement Hierarchy in VMR

District	Village	Small Town - I	Small Town - II	Medium Town - I	Medium Town - II	Large City	Metropolitan city-I
	<5000	5,000 - 20,000	20,000-50,000	50,000 to 1,00,000	1 lakh to 5 lakh	5 lakh to 10 lakh	10 lakh to 50 lakh
VIZIANAGARAM	495	25	2	0	1	0	0
VISAKHAPATNAM	338	34	3	0	0	0	1
Grand Total	833	59	5	0	1	0	1

Source: Primary Census Abstract Andhra Pradesh 1991, 2001, 2011

3.6 KEY CHALLENGES

Visakhapatnam being the biggest urban area in the region acts as a pull factor and attracts more migrants in search of employment and better services. The rural area is experiencing a very low growth rate because of the shift to urban areas for better quality of life and lesser per capita income in the rural areas. Majority of the rural shift will end up in slums by virtue of low cost housing facilities and affordability. Growing population will create load on the current infrastructure facilities and will result in unorganized growth if not planned and organized in prior. The huge availability of human resource is an asset that is not well channelized for the development of the VMR.

3.7 CONCLUSION

Urbanisation is skewed in Visakhapatnam. High population growth rates are observed in specific mandals showing increased urbanization induced by the industrial growth. Larger share of population in the age group of 10 - 25 years (28%) is foreseen as potential work force. Of 4 ULBs within VMR 2 in Vizianagaram, and 2 in Visakhapatnam districts. Channelization of available human resource and accommodating the increasing population without compromising on the quality of life is possible only through planned development considering the needs of future growth within in VMR.

4 ENVIRONMENTAL CHARACTERISTICS

This chapter presents the existing natural, physical, biological, and environmental features of VMR. The VMR located in confluence of hills and coast in a tropical climatic region, it has a rich and sensitive ecology / environment. The Master Plan assessed climate, coastal environment, water bodies, mangroves, flora and fauna within VMR and presented in this chapter.

4.1 INTRODUCTION

Preservation of existing beauty and diversity of the environment within VMR is necessary along with the desired development. Haphazard development insensitive to the environmental conditions lead to the ecological calamities and disasters. In the process of development, preservation of sensitive natural systems in the area is necessary.

The data in need for this analysis is collected from various secondary sources like district handbooks, ground water data by CGWB, EIA reports in the region prepared for various projects. Oceanography, ecological sensitivity and environmental quality of the area is compositely studied considering different parameters such as waves, tides, currents, reserve forests, air, surface, ground and marine water qualities in the study area for better understanding of the existing environmental status. The baseline environment of the study region defined by the physical, natural, and ecological features including the quality of various environmental parameters are studied and presented in the following sections sequentially.

4.2 CLIMATE

The climate of the VMR is characterized by three different seasons namely summer, rainy and winter. This region has high humidity nearly all around the year with an oppressive summer and good seasonal rainfall. This region gets most of its rainfall from South-West and North-East monsoons. As this whole region is along the coastal, line it has a moderate winter. The climate of the hilly places of the region is different to that of the plains.

As per Köppen – Geiger climate classification the coastal area of Andhra Pradesh State falls under Tropical mega thermal climatic category. The system is based on the concept that native vegetation is best expression of climate. Climatic zone boundaries have been selected considering vegetation distribution in the area. This classification combines annual average and monthly averages of temperatures and precipitations, and the seasonality of precipitation. Köppen – Geiger Climate Classification scheme broadly divides the climates of the world into five major Climate types, several types and Sub - types; each type is denoted by a capital letter.

A. Tropical moist climates: all months have average temperature above 18o

B. Dry climates: with deficient precipitation during most of the year

C. Moist mid-latitude climates with mild waters

D. Moist mid – latitude climates with cold winters

E. Polar climates with extremely cold winters and summers

The considered Study region of VMR in Coastal Andhra Pradesh falls under Tropical moist climates, further in sub groups it is classified under Tropical wet and dry or Savanna Forest (Aw). This type of climate is mostly observed in outer margins of tropical zone, but occasionally in an inner tropical zone such as Coastal Andhra.

The districts of VMR exhibit the characteristics of tropical climate. It has primarily tropical rainy to sub – humid type of climate. Temperature observed is normally less along the coast getting warmer as observed along the plains, and cools when it reaches the hills of Eastern Ghats. The temperature, wind, relative humidity, and rainfall are studied in the following sections.

WIND

India has four seasons Summer, North – East Monsoon, South West monsoon, and Winter. The vegetation, irrigation of the crops is majorly driven by monsoons. NE winds start past Himalayas travel through central India and pass Deccan plateau and obstructed by Western Ghats, again cooled down and diverted by sea. They enter in the south of the India and obstructed by Eastern Ghats, leading to precipitation in the southern India.

Thus, the study area experiences a variety of winds from NE direction to South West direction depending on the period and existing scenario of the area. The prominent wind directions observed in the three districts of the VMR are SW, NE, S, N, and W with mean wind speeds of 9 kmph in Visakhapatnam area; 9.5 kmph in Vizianagaram area; (Table 4-1).

Table 4-1: Predominant wind directions, Mean wind speeds, % of calm winds observed in VMR

District	Predominant wind direction	Mean Wind speed (kmph)	Calm wind speed (%)
Visakhapatnam	SW, S, N, W	9	16.67
Vizianagaram	SW, NE	9.5	15.50

Source: Secondary sources from reports on Study area

The percentage of calm winds observed along the 2 coastal districts of study area of Andhra Pradesh are 16.67% and 15.50%, for Visakhapatnam and Vizianagaram, Districts respectively. The observed wind direction is taken into consideration in designing the residential townships and other allied activities in the study area.

CYCLONES

In the districts of VMR Vizianagaram and Visakhapatnam have a history of experiencing cyclones and storm surges. In India cyclones are classified into five categories as

i. Tropical depressions wind speeds between 31 and 61 kmph (17 to 33 knots)

ii. Tropical cyclones if the winds speeds range between 62 and 89 kmph (34 to 48 knots)

iii. Severe cyclonic storm when wind speeds range between 89 and 118 kmph (48 to 63 knots)

iv. Very severe cyclonic storm with wind speeds ranging between 119 and 221 kmph (64 & 119 knots)

v. Super cyclonic storm when wind speed exceeds 221 kmph (119 knots)

Cyclone Hud-Hud in October 2014 that had devastated Visakhapatnam city is a very severe cyclonic storm; a total of 9 cyclones had crossed with in the vicinity of coast line along Visakhapatnam.

RAINFALL

Rainfall distribution for Visakhapatnam and Vizianagaram districts for the period from 1999 to 2011 is analyzed in the Table 4-2. It is observed that the annual rainfall varies between 1000-1200 mm. This region receives between 60-70% of the rainfall in the North-East monsoon, 20-25% in the South-west monsoon, and 8-15% during summers. September and October are the wettest month of the year in the VMR of Visakhapatnam, and Vizianagaram districts. Thus, VMR gets abundant rainfall especially during the months from June – October.

Mandal wise rainfall is observed to be ranging from 986.6 mm in Rambili mandal to 1,431.6mm in Padmanabham mandals of Visakhapatnam district. The wettest months for the VMR are September and October.

Table 4-2: Annual Average Rainfall distribution and % of Rainfall in NE and SW monsoons in VMR

District	Average Annual Rainfall (Mm)	Rainfall Range Monthly (Mm)	% Rainfall North East Monsoon	% Rainfall South West Monsoon	% Rainfall Summer	Wettest Month
Visakhapatnam	1,137.8	0-207.5	60.36	24.36	14.3	October
Vizianagaram	1,136.4	0-209.7	64.32	21.96	12.45	September

Source: District profiles from Central ground water board, and Statistical Handbooks of the districts

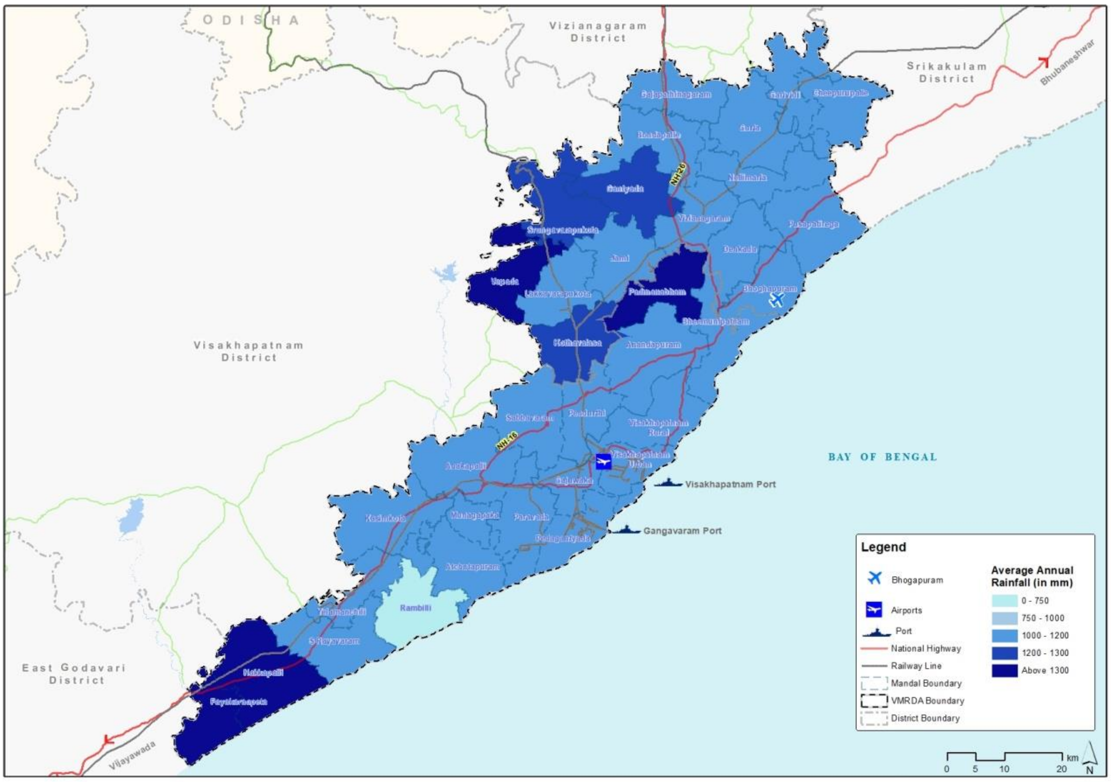


Figure 4-1: Annual average rainfall at Mandal level

Source: Annual Average rainfall data from district statistical handbooks

TEMPERATURE AND RELATIVE HUMIDITY

The districts have differing climatic conditions in different parts. Near coast the air is moist and relaxing but gets warmer towards the interior and cools down in the hilly areas on account of elevation and vegetation. The months from April to June are the warmest months. The mean maximum and minimum temperatures in VMR are following a trend of increase in temperature from month January to May, and a decreasing trend from May to December as narrated in the Table 4-3. The hottest month identified is May in summer with mean maximum temperature ranging 36.2 °C and 34°C; coldest month observed is January with a mean minimum temperature ranging 18°C and 17.3°C. After May till december the temperatures are observed to be in a decreasing trend because of the effect of the monsoons.

Table 4-3: Monthly mean maximum and minimum temperatures in VMR by districts

Month	Visakhapatnam		Vizianagaram	
	Mean max (°C)	Mean min (°C)	Mean max (°C)	Mean min (°C)
Jan	27.2	17.5	28.9	18
Feb	29.2	19.3	31.3	19.9
Mar	31.2	22.6	33.8	23
Apr	32.8	25.9	35.3	26.1
May	34	27.8	36.2	27.7
Jun	33.7	27.4	35.3	27.3
Jul	32	26	32.9	26.1
Aug	31.6	26	32.7	26
Sep	30.9	25.6	32.5	25.6
Oct	29.3	24.5	31.7	24.3
Nov	31	21.2	30.4	21.6
Dec	27.7	18.3	28.9	19.7

Source: Statistical Handbooks of all three districts

A lowest of 0^0C at lambasingi to a highest of 48^0C in Rajahmundry is recorded in these districts, but they do not fall in the study area taken up for VMR.

Table 4-4: Max temperature, Min Temperature, and relative humidity in VMR

District	Temp Max (° C)	Temp Min (° C)	Relative Humidity (%)
Visakhapatnam	41.3	13.7	69 to 79
Vizianagaram	44.2	23.5	62 to 79

Source: Statistical Handbooks of districts

Relative humidity levels in the VMR are ranging from 60% to 80% in less in warmer and cooler months, and rising in the time of monsoons in Visakhapatnam and Vizianagaram Districts.

SEISMICITY

As of June 2014 India is classified into four seismic zones based on the probability of occurrence of an earth quake, they are termed as Zone – II (Least active), Zone – III (Moderate), Zone – IV, (high), Zone – V (Highest) as of 2014.

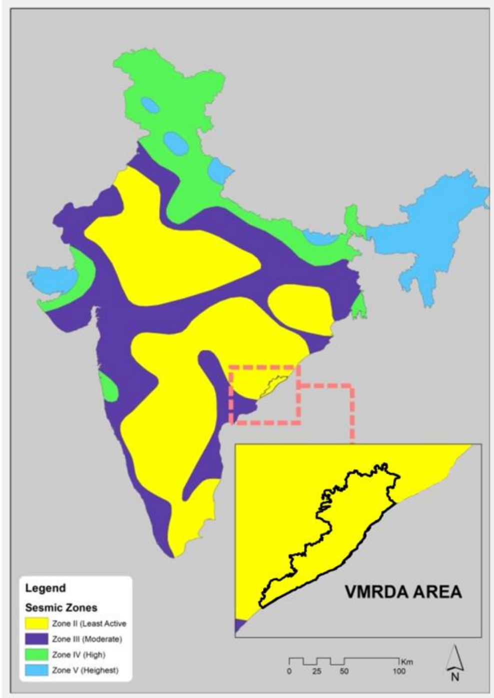


Figure 4-2: Seismic zones of India

Of these seismic zones two zones are observed in Andhra Pradesh they are zone – II, and Zone – III, as shown in the Figure 4-2. Remaining state is under Zone – II which is least active. The VMR is under Zone – II which is least active.

4.3 DISASTER VULNERABILITY

People around the world are prone to frequent and intensive hazards due to the global climate change scenario and human interventions. Particularly, the coastal communities are always prone to various long-term coastal hazards like sea-level rise, shoreline changes, and short-term hazards like tsunami cyclone and storm surge. VMR has 250 km long coastline and total coastal area spread over 550 km^2 comprising the 2 coastal districts. Andhra Pradesh state is prone to various natural hazards, especially cyclone and associated storm surges. There is an extreme loss of life and damage to properties caused by these cyclones. During the past 40 years the coast experienced many cyclones including depression, cyclone surge, and severe cyclone surges. Therefore, the area has been considered for this social vulnerability study to identify the cyclone vulnerable villages. Geospatial applications are used in this study for spatial and non-spatial data processing and spatial analysis along with CRZ considerations. The study indicated that the areas lying 500m from the coast lie in high and moderate risk zones, to be observed under high vulnerability.

4.4 WATER RESOURCES

VMR has an abundant source of water in the form of rivers, rivulets and canals passing through the area and in the end draining into the Bay of Bengal of the East Coast. Because of its location of the area on the downhill of the Eastern Ghats surface, ground water and drains have a natural gravitational line of flow. Because of the abundance of the water bodies there is a generous supply of water throughout year by means of surface and ground water. Surface water in the area is mainly utilized for irrigational purposes, industrial purposes and treated drinking water supply for population of ULB's. Municipal administrations of the VMRutilize water from major rivers, and reservoirs in the area to cater to the water demand of the people. Ground water in the area is majorly utilized for the domestic water necessities of the people in rural and semi urban areas, irrigational and industrial purposes.

Ground water in the area is majorly utilized for the domestic water necessities of the people in rural and semi urban areas, irrigational and industrial purposes.

SURFACE WATER

The minor rivers from south to the north of the VMRare Yeleru reservoir, Pampa river, Thandava river, Varaha river, Sarada river, Meghadri gedda reservoir, Peddagedda, Gosthani river, Champavathi, Kandivalasa gedda, Pedda gedda (Figure 4-3).

The Other principal water sources in this region are Suvarnamukhi, Vegavati, Champavati, Gosthani, Kandivalasa, Mahendratanaya, Bahuda, and Kumbikotagedda. Main canals passing along VMR are Yeluru and Polavaram canals.

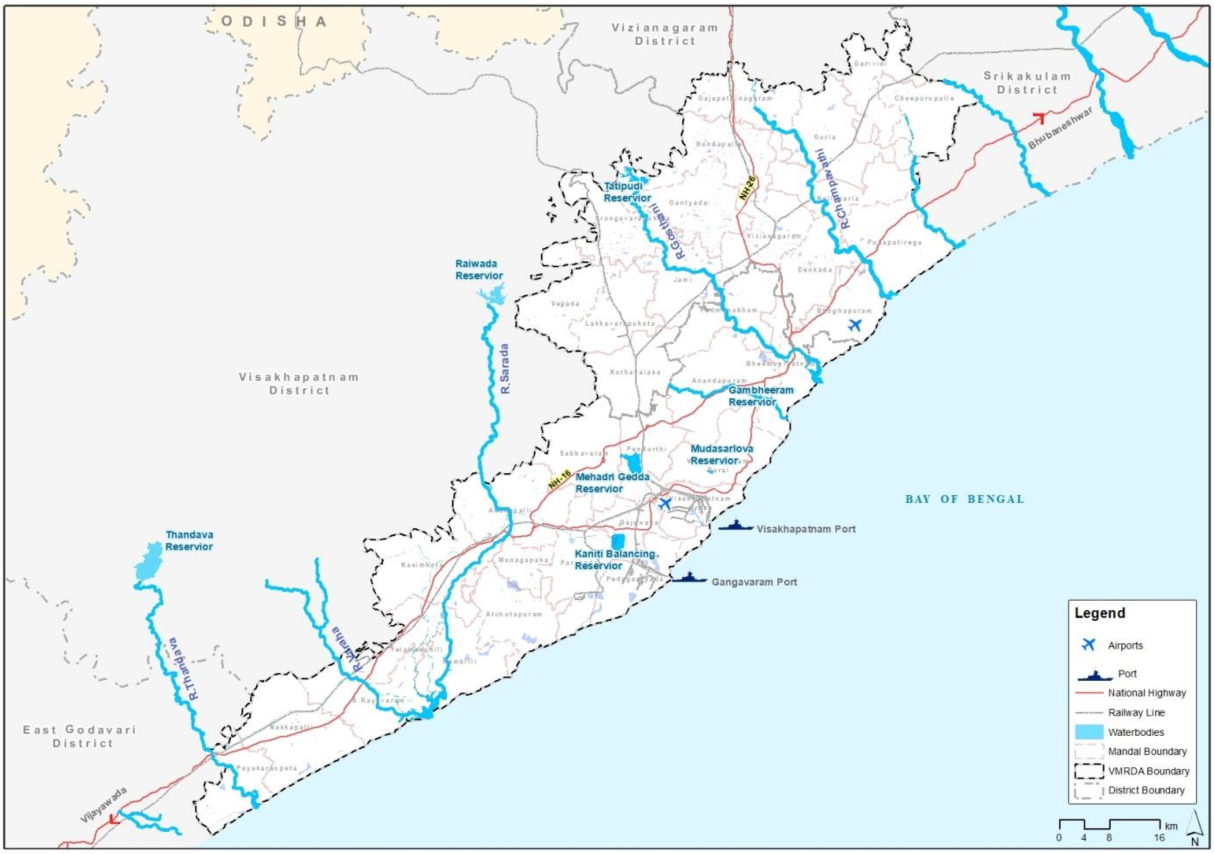


Figure 4-3: Rivers and water bodies in VMR

GROUND WATER

The yield capacities in Visakhapatnam district Visakhaptnam rural, Visakhaptnam urban, Sabbavaram, Pendurthi, Pedagantyada, Parawada, Padmanabham, Nakkapalli, Gajuwaka Bheemili, and Anandapuram, mandals are solely dependent on surface water supplied from ULB's. In Vizianagaram district Vepada, Vizianagaram, Lakkavarapukota, Kothavalasa, Garividi, and cheepurupalli are not using ground water.

4.5 COASTAL ENVIRONMENT

COASTAL REGULATORY ZONE

Issued under the Environment (Protection) Act, 1986, and in supersession of coastal regulation zone notification 2011, draft CRZ notification 2018; Central government has initiated to conserve and protect the unique environment of coastal stretches, marine areas, livelihood of fishermen and other local communities.

Coastal stretches have been defined in Coastal Regulation Zone (CRZ) and restrictions have been imposed on industries, operations and processes within the CRZ. The CRZ regulations are imposed on

i. Land areas from High Tide Line (HTL) to 500m on landward side of the sea front
ii. Land ward area between HTL to 50m or width of creek, whichever is less on landward side along the tidal influenced water bodies that are connected to sea and the distance upto which the salinity measured is 5 ppt during driest period of the year
iii. The intertidal zone between HTL and LTL
iv. Water and bed area between the LTL to the territorial water limit (12Nm)

For the better conservation and protection of coastal areas, the CRZ area is classified to four major categories, which are sub categorized furthur as detailed below.

a. CRZ-I A: The areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast such as Mangroves, Corals and Coral reefs, Sand dunes, Biologically active mudflats, National parks, marine parks, Sanctuaries, Reserve forests, Salt marshes, Turtle nesting grounds, Horse shoes crab habitats, etc.
b. CRZ –I B: The inter tidal zone between Low tideLine (LTL) and High tide Line (HTL)
c. CRZ-II: The areas that have been developed up to or close to the shoreline within the existing municipal limits or in other existing legally designated urban areas which are substantially built-up with a ratio of builtup plots to the total plots being more than 50% and has been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains.
d. CRZ-III A: Land area that are relatively undisturbed (rural areas) and those do not fall under CRZ-II are considered for CRZ-III. In CRZ-III, the areas with population density more than 2161 per Sq.km as per 2011 census are considered in CRZ-III A
e. CRZ-III B: The CRZ-III areas with population desnsity less than 2161 persons per Sq,km as per 2011 census are considered for CRZ-III B
f. CRZ-IV A: The water area and sea bed area between LTL up to 12 nautical miles on seaward side
g. CRZ-IV B: The water ara and bed area between LTL at the bank of the tidal influenced water body to the LTL on the opposite side of the bank, extending from mouth of water body to influence of sea tide (salinity 5ppt during driest season of the year)

PROHIBITED ACTIVITIES IN CRZ

The activities elucidated furthur are in general prohibited in entire CRZ. The activities are

i. Setting up of new industries, expansion of existing industries, operations, processes
ii. Manufacture/handling of oil, storage/disposal of hazardous substances
iii. Setting up of new fish processing units
iv. Land reclamation, bunding/disturbing natural course of sea water
v. Discharge of untreated waste or effluents from industries, cities or towns and other settlements
vi. Dumping of city or town wastes including construction debris, flyash and others
vii. Port and harbour activities in high eroding parts of the coast
viii. Mining of sand, rock and other sub-strata materials
ix. Altering active sand dunes
x. Disposal of palstic and other inert wastes such as glass bottles

PERMISSIBLE ACTIVITIES IN CRZ

a. CRZ – I A: Eco tourism activities such as mangrove walks, nature trails etcas approved in CZMP (Coastal Zone Management Plan). Construction of roads is allowed for exceptional cases such as defence, stratergic purposes and public amenities. For effected magrove or other vegetation covers in the process, three times the area effected is to be taken up for compensatory plantation
b. CRZ – I B: Land reclamation activities are permitted for foreshore activities like ports, harbours, jetties, wharves, Quays, Slipways, bridges, and sea links etc. Projects for defense, stratergic purposes. Land reclaimed may be permitted for public utilities like mass rapid transit system, construction and

installation of all necessary public utilities or infrastructure. Storage of non-hazardous cargo, Hatchery and natural fish drying, treatment facilities for waste and effluents, salt harvesting and desalination plants

c. CRZ – II: Construction of building for residential, school, hospitals, institutions, offices, public places etc shall be permitted only on ladward side of existing road or authorized fixed structures. Development of vacant plots in designated areas for construction of beach resorts/hotels permitted as per guidelines. Temporary tourism facilities along beaches such as wash rooms, change rooms, shower panels etc.
d. CRZ – III: Agriculture, horticulture, gardens, pastures, parks, playfields, and forestry. Construction of dispensaries, schools, public spaces, bridges, roads, infrastructure facilities as permitted by CZMA. Facilities required for local fishing communities such as fish drying yards, auction halls, net mwnding yards, boat building yards, ice plant, crushing units etc.
e. For CRZ – III areas beyond Non-development Zone (NDZ), development of vacant plots in designated areas for construction of beach resorts/hotels. Public amenities and fishing related infrastructure.
f. CRZ – IV: Traditional fishing and allied activities, Land reclamation/bunding for foreshore activities, defense projects, erosion control measures, non-conventional energy sources associated activities, storage of non-hazardous cargo, facilities for intake of cooling water and outfall for discharge of treated waste water from thermal power plants. Weather radar monitoring stations, pipelines, conveying system including transmission lines.

All states and union teritories should have a Coastal Zone management Plan (CZMP) devised/prepared for proceeding related to coastal areas. Presently, 80 villages are along the coast line in the CRZ of VMR. The CRZ area is needed to be demarcated and only permitted establishments are to be allowed in the regulatory zone. At present any industry, resorts/hotels that are proposed to be constructed in CRZ have to take clearance from the State Pollution Control Board (APPCB) and the conditions fixed for the clearance need to be complied.

The treated effluents of major industries/ SEZ's are being released into the sea at 13 locations (Table 4-5). The disposal of these effluents into the sea is also regulated and monitored by APPCB; the treated effluents of respective industries are stored in designed tanks at the sites. Once in a week /fortnight based on quantity generated; samples are taken from these tanks by Regional offices for quality analysis and permitted to release if the effluent is as per PCB norms given during clearance.

Table 4-5: Outfall locations in the CRZ of the VMR

Sl. No.	Industry/ SEZ	Latitude	Longitude
1.	Hetero Infrastructure SEZ Ltd	17 21' 07"	82 44'31"
2.	SMS Pharmaceuticals Limited Ltd	18 02'11.24"	83 37'1.22"
3.	Industrial Pharma Complex by Vijaya sri Organics Ltd	18 04'10"	83 40'35"
4.	Lan tech Pharmaceuticals Ltd	18 04'25"	83 41'25"
5.	Hyacinth Pharma Ltd	18 05' 18"	83 04' 51"
6.	GVMC sewage release outfall	17 42' 51.24"	83 19' 26.54"
7.	APSEZ, Outfall I	17 31'35"	83 04'00"
8.	APSEZ, Outfall II	17 31'06"	83 02'45"
9.	APSEZ, Outfall III	17 31'18"	83 03'13"
10.	NKSEZ, Outfall I	17 21'01"	82 43'02"
11.	NKSEZ, Outfall II	17 20'00"	82 41'05"
12.	NKSEZ, Outfall III	17 19'25"	82 39'55"
13.	NKSEZ, Outfall IV	17 21'24"	82 43'51"

Source: From Secondary sources in reports on Study area

Other than these outfall locations a total of 20 projects (industries, ports, jetties, hotels and resorts) are in the CRZ mostly in CRZ– III, in some cases in both CRZ – II, and CRZ – III; As per the projects that have applied for CRZ clearance to the AP Pollution Control Board. In the Coastal regulatory Zone of the Study area in any locations hatcheries, fishermen villages, mega or small industries are observed along the coast line with in 200m of HTL. Presently National Institute of Oceanography (NIO, Visakhapatnam) is preparing a CRZ zones map for the VK – PCPIR part of VMR for further notification and clearance of area as per regulations.

COASTAL EROSION AND ACCRETION

The landward displacement of the short line caused by the forces of waves and currents is termed as coastal erosion. Natural forces such as wind, waves and currents are constantly shaping the coastal regions. A regular and cyclic phenomenon like erosion and deposition is prevalent in many parts of Andhra Pradesh Coast. Coastal erosion is one of the major reasons for deterioration of coastal Zones.

The AP coast has frequently been affected by Cyclone and inundated by storm surges. The Tsunami in 2004 and various cyclones, including Phailin and Hudhud, have drastically changed the beach profiles making them vulnerable to erosion, drowning deaths due to increased slope at the coast, and significant changes in the local wave climate. Many coastal areas along the AP coast are now distorted with the changed scenario.

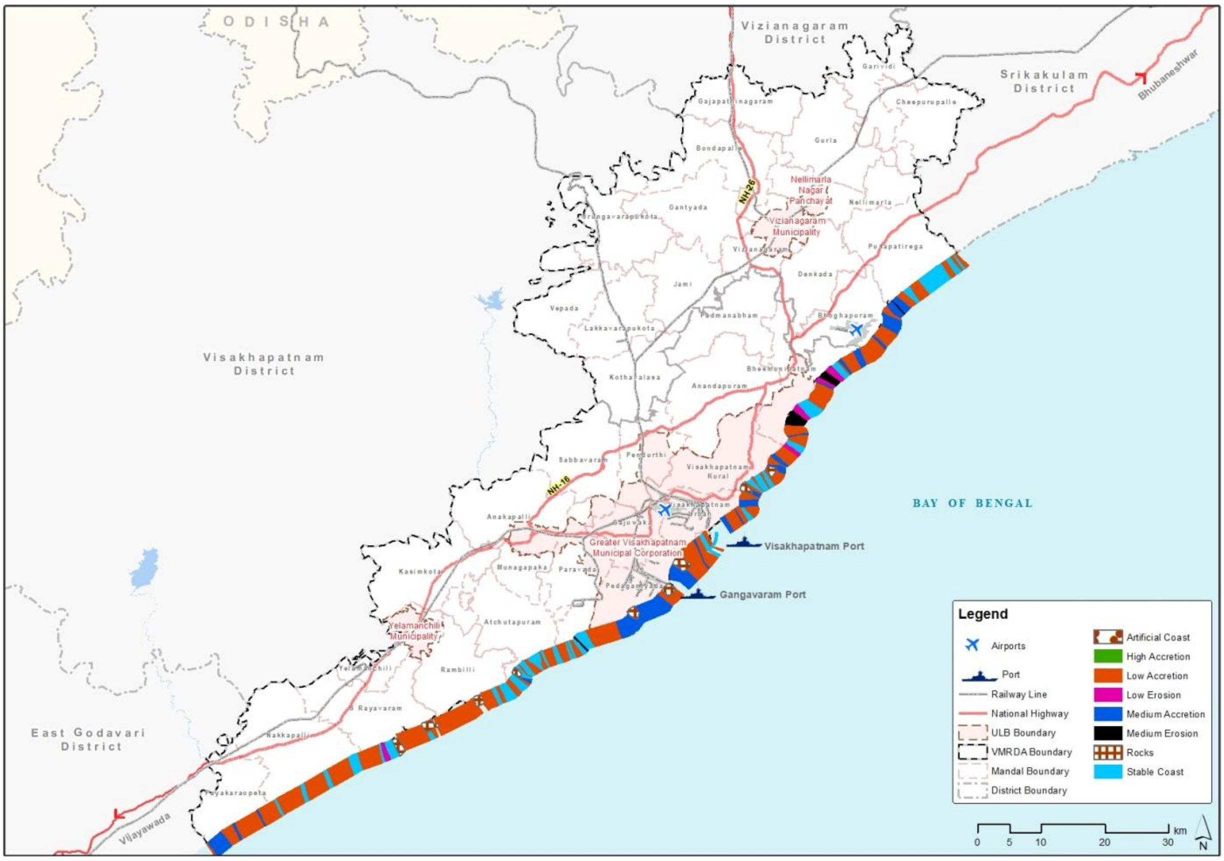


Figure 4-4: Erosion & Accretion along the coastal region of VMR

Source: Districtwise shoreline changes in AP from National centre for Sustainable Coastal Management, MoEF & CC

As per oceanography experts around 9.2 percent of the 973.3 km-coastline in Andhra Pradesh has been facing erosion. The VMR inheriting 251.3km, contributes to 25.8% of AP's Coastline. Heavy erosion has been noticed at Visakhapatnam and Bheemunipatnam beaches in Visakhapatnam district (Figure 4-4).

The coastal line in this region is undergoing both erosion and accretion. Medium erosion is observed in all two districts, Cheepulupada, J. V. Agarharam, Cheepurupalle (east), of Visakhapatnam district; Kongavanipalem of Vizianagaram.

WAVE SURGE AND FLOODABLE AREAS

The coast of VMR is highly prone to cyclones, and VMR has many water bodies draining to the coast. In this scenario early warning maps are prepared by Andhra Pradesh State Development Planning Society for facing a probable storm surge, flood, and drought in the state of Andhra Pradesh. Topo sheets updated under this section for storm surge, flood prone areas are collected for VMR.

WAVE SURGE

The probable area of the coast in VMR that could be affected by wave surge induced during a Super Cyclonic Storm of wind speed 235 Kmph is studied in this section. The information for this observation is collected from Storm surge inundation maps prepared by Andhra Pradesh State Development Planning Society.

A possible area that could be damaged by wave surge during a super cyclone of 235 kmph and tropical cyclone of 65 kmph are identified in the maps. Coast line of VMR is not affected by a 65 kmph Tropical cyclone, So the probable area that could be effected by a 235 kmph super cyclone is studied for VMR. As shown in the Figure 4-5, the highly effected area are coastal mandals and river mouths of major rivers.

In Visakhapatnam district coastal mandals Payakaraopeta, Nakkapalli, S. Rayavaram, Rambilli, Atchutapuram, Parawada, Pedagantyada, Visakhapatnam Urban, Visakhapatnam Rural, and Bheemunipatnam are prone to damage of which Payakaraopeta and Bheemunipatnam show chances for major damage.

Vizianagaram district is the least effected district of VMR because of a storm surge as it only has two mandals, Bhogapuram, and Pusapatirega along the coast. This is also the reason for having no cyclone land fallings along the coast of Vizianagaram district. Figure 4-5.

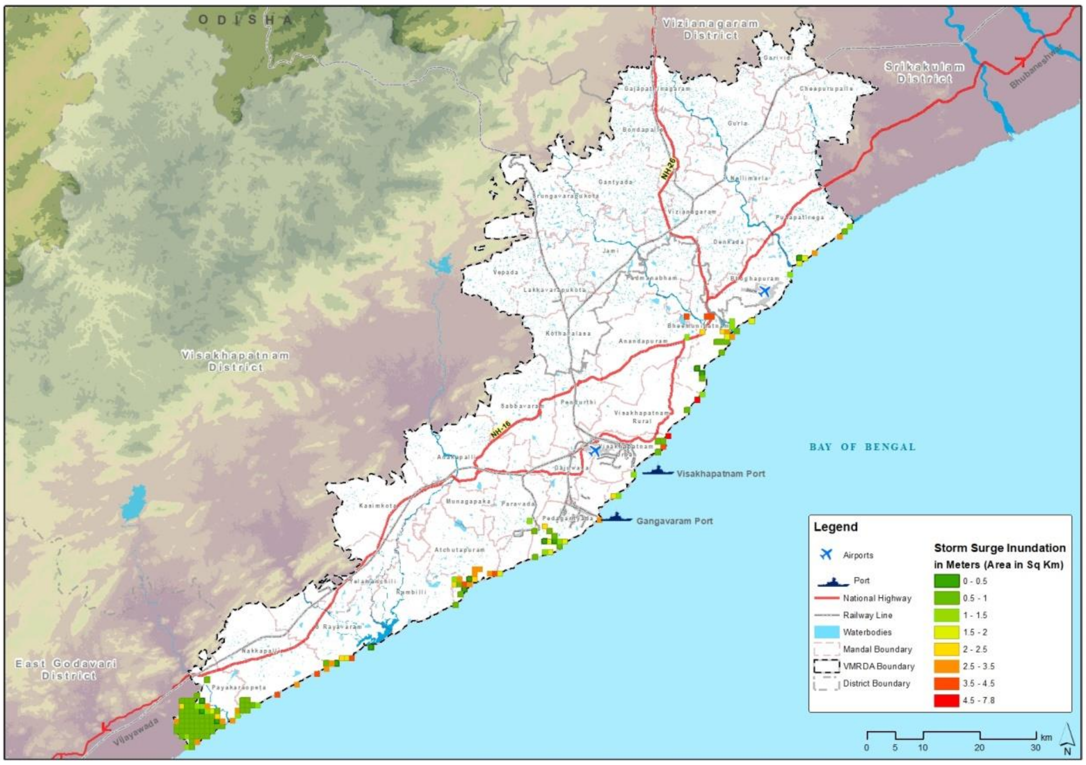


Figure 4-5: Storm surge inundation in VMR for a super cyclone of 235 kmph speed

Source: Storm surge Inundation map prepared by Andhra Pradesh State Development Planning Society (APSDPS)

FLOODABLE AREAS

Minor rivers that pass through the study area are Gosthani, Sarada, Varaha, Thandava, Champavathi, and other major geddas. A probable flood inundation map minor rivers Gosthani, Pedderu, Varaha, Sarada, Thandava, and pampa are prepared for a probable flood of 100 year return period

A probable flood inundation map for both rivers at 100 years and 2 years return period is prepared from the inundation map collected from flood inundation map by Andhra Pradesh State Development Planning Society. List of villages that could possibly affected in the flood inundation are added in the Appendix B.

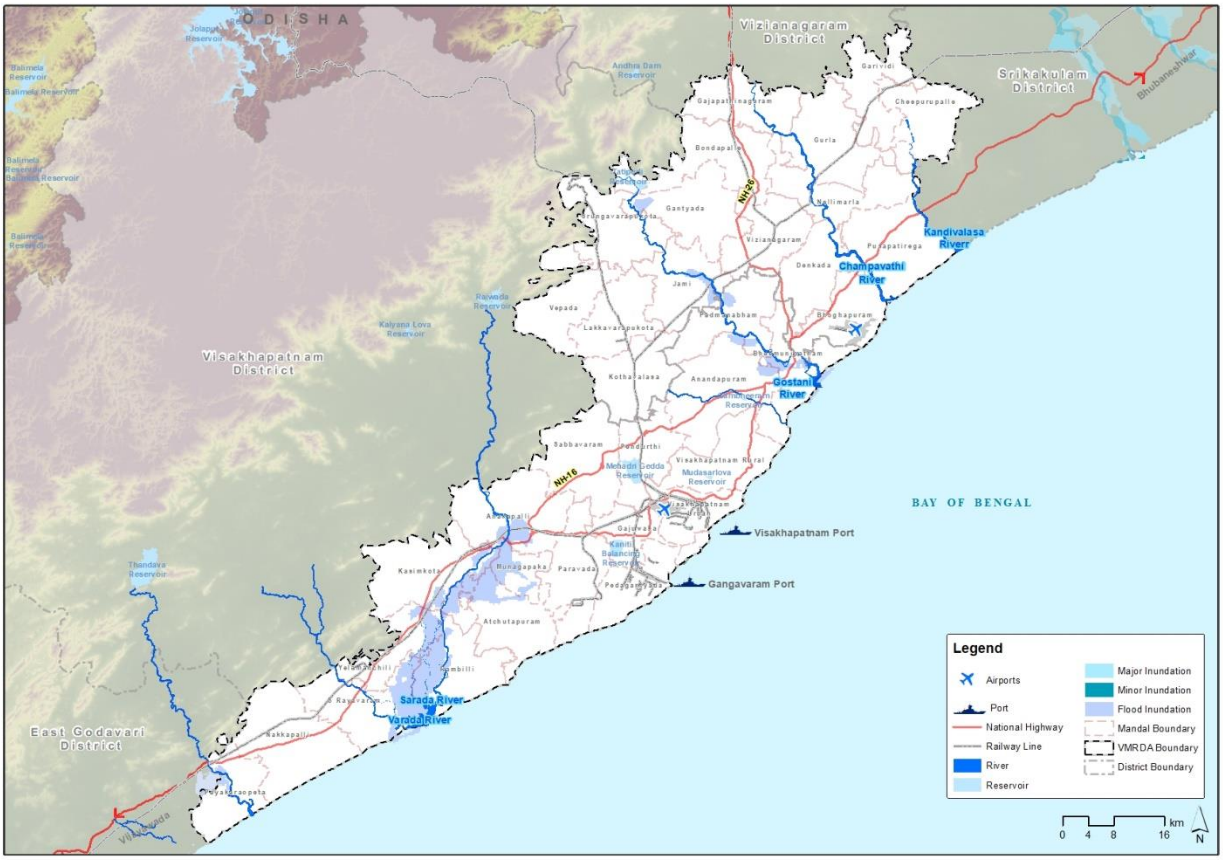


Figure 4-6: Probable flood inundation area for river at peak discharges in VMR

Source: Probable Flood Inundation map prepared by Andhra Pradesh State Development Planning Society (APSDPS)

DRAINAGE

The study region has few minor non – perennial rivers following their natural terrain draining into the Bay of Bengal. As we observed earlier in ground water table lineament in the study are majorly from NE – SW draining in to Sea. The study area also has many geddas collecting water from catchments and follows their natural stream / channel to drain into Bay of Bengal. The study area has many reservoirs like Meghadrigedda, Kanithi, Mudasarlova, Gambheeram, Tatipudi. As VMR is monsoon dependent area in case of heavy rains in a short duration Flood prone areas as shown in the Figure 4-6 are likely to be most affected areas in the study area.

4.6 ENVIRONMENTALLY SENSITIVE AREAS & BIODIVERSITY

An ecologically sensitive area is a bio – climatic unit home for many diverse species of flora and fauna endemic to the area. Western Ghats and Eastern Ghats are such bio reserves in Southern India. These areas are affected by locally caused human impacts, which are causing irreversible changes in the structure of biological communities. Some such ecologically sensitive areas that are in the VMR in need of conservation are discussed in this section.

RESERVE FORESTS

The forest of Andhra Pradesh is mostly deciduous in nature and its canopy density widely changes in different months. This region has an area of 54,304.19 hectares as forest area. As per Champion and Seth's classification, the forests of this Region fall into the following classes- Tropical Semi Evergreen Forests, Tropical Moist Mixed Deciduous Forests, Tropical Dry Deciduous Forests, Tropical Dry Evergreen Scrub, Tropical Thorn Forests and Dry Savanna Forests.

In Vizianagaram and Visakhapatnam districts it is in Eastern Ghats and hills in an area of 15848.57 ha and 38455.62 ha respectively, with Visakhapatnam district having the highest area as forest in the study area. (Figure 4-7).

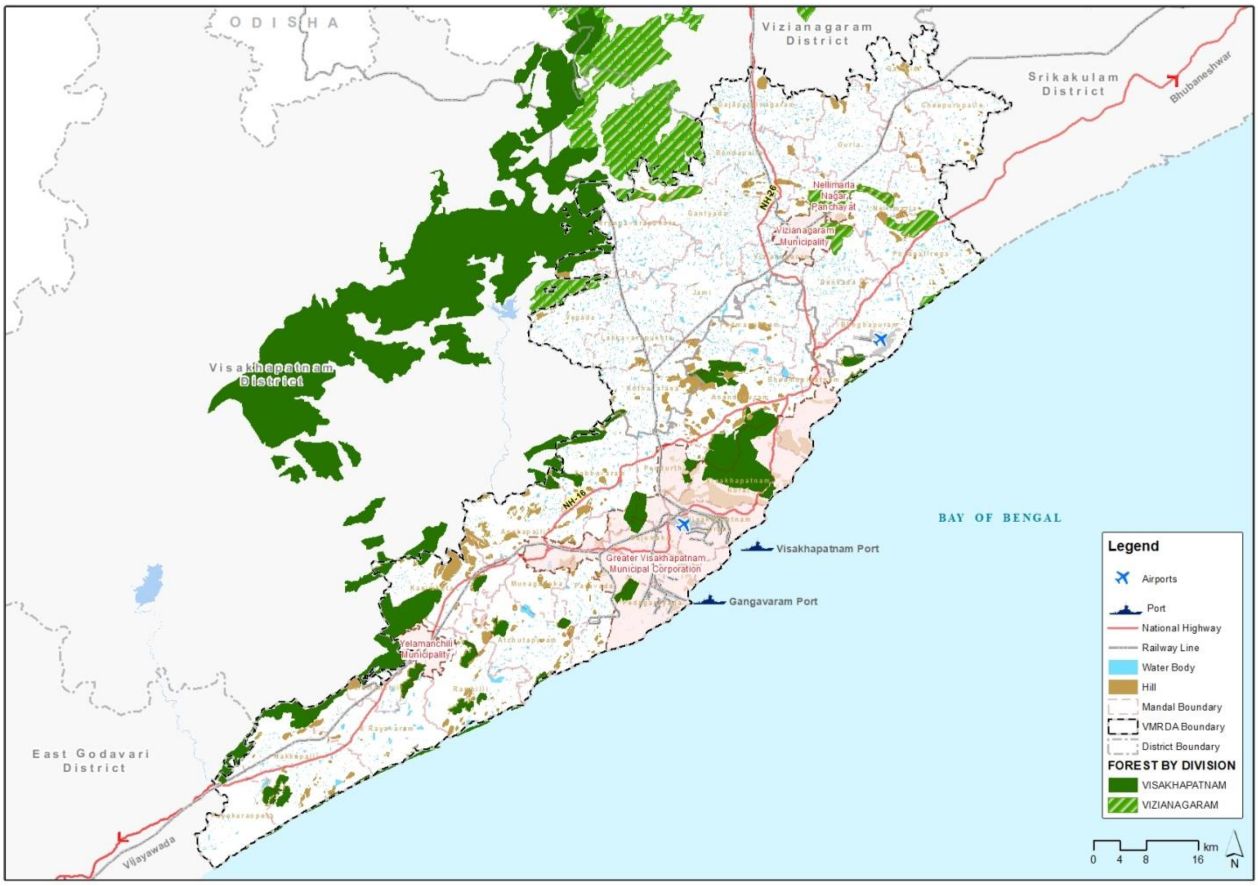


Figure 4-7: Forest cover map in VMR

The Forest area in VMR is under Visakhapatnam division with Visakhapatnam and Vizianagaram circles.

The vegetation cover of the forest areas in India are classified into 6 types. They are,

i. VDF – HL: Very Dense Forest in Hill Areas

ii. PF – HL/WB: Other than very dense forest in hilly areas or 20m buffer around streams or water bodies
iii. VDF – PL: Very dense forest in Plain areas
iv. MDF – PL: Moderate dense forest in plain areas
v. OF/SF – PL: Open/Scrub Forest in plain areas
vi. NF – PL: Non-Forest in plain areas

Table 4-6: Vegetation cover in the forest areas of VMR by circles

Division/ Circle	VDF-HL	PF-HL/WB	MDF-PL	OF/SF-PL	NF-PL	Total (Ha)
Visakhapatnam	1.12	24,048.73	2,778.99	8,222.35	3,404.43	38,455.62
Vizianagaram	0	11,303.35	1,731.48	2,407.58	406.16	15,848.57
Total	1.12	35835.77	4510.47	13179.15	5376.83	58903.34

Study area has highest area of its Forest vegetation cover as (PF HL/WB) Other than very dense forest in hilly areas or 20m buffer around streams or water bodies (Table 4-6).

VMRhas 1.12 Ha of its area as VDF-HLin Nakkapalli mandal; 36794. 91 Ha PF-HL/WBwith highest area in Srungavarapukota mandal (4471.81 ha) and smallest in Anakapalle (1.06 ha); 14900.24 ha of OF/SF – PL, highest in Anandapuam (1639.13 ha) and lowest in Bhogapuram mandal (2.17 ha); 5578.74 ha in NF - PL highest in Gara mandal (591.39 ha) and lowest in Gantyada manadal (0.18 ha). Mandal wise compartment vegetation covers are included in the Appendix C.

FLORA AND FAUNA

In VMR a total of 526 species of flora, 36 families and 86 species of mangrove trees, 34 species of mammals, 10 species of amphibians, 108 species of avi fauna, and 22 species of reptiles are identified excluding the species of flora and fauna in protected areas like Kambalakonda and Kondakarla sanctuaries.

In the fish hatcheries, 8 types of fishes are cultivated they are Barbus, Carps, Cat fishes, common carbs, Murrel, Mullets, Prawns, and Hilsa. 18 species of fresh water fishes are identified either caught or reported in the VMR. 62 species of marine fishes are identified in the sea waters of VMR.

A total of 15 groups and 142 species of macrobeths, 28 groups, 270 species of Meso Zooplankton; 5 groups of Phytoplankton, 10 groups of Zoo Plankton are identified in VMR.

MANGROVES

Mangroves are a group of trees and shrubs that live along the coastal areas inter tidal zones and estuarine systems where river join sea. Andhra Pradesh state has a long and smooth coastal line of 973.3 km with continuous inundation due to storm surges. AP coast line is segregated into three types Rocky coast (North of Godavari Delta), Vegetated coast of Krishna and Godavari delta, Sandy coast of South of Krishna Godavari basin. VMR has Rocky coast comprising of tidal creeks, and small patches of wetlands at the mouth of rivers like Sarada, Vamsadhara, and Nagavali.

The Krishna Godavari deltaic region, and Coringa Wild life Sanctuary cover major mangrove population and cover of the state, VMR has very small patches with light vegetation covers. The study has mangroves at 6 locations, they are Pentakonda mangrove swamp, PudimadakaMangroove swamp, Sarada River estuary mangroves, Visakhaptnam mangroves, Sabbammapeta mangroves, Kuppili mangroves in kotapalem reserve forest. 36 families and 86 species of mangrove trees are found in VMR.

Figure 4-8: Pudimadaka Mangrooves

KAMBALAKONDA WILDLIFE SANCTUARY

It is a forest located near Visakhapatnam. It is under the control of Andhra Pradesh Forest Department since March 10, 1970. Earlier the land was under the control of Maharajah of Vizianagaram. It was named after the local hillock Kambalakonda. It is a dry evergreen forest mixed with scrub and meadows and covers an area of 71.39 sq. km. The indicator species is the Indian leopard.

Figure 4-9: Kambalakonda Wildlife Sanctuary

The sanctuary maintains very rich bio-diversity comprising of 73 tree species, 39 species of herbs and shrubs, and 18 species of climbers, 2 species of bamboos and 7 species of grasses, 23 mammal species, 7 species of reptiles and more than 90 species of birds. the Sanctuary harbors large variety of flora and is characterized by a scrub jungle the major tree species of the area are Ficus banghlensis, Acacia lucophloea, Acacia chundra, Sapindusemarginatas, and Wrightiatinctoria.

The area harbors a rich faunistic diversity which includes Panther, Bear, Wild Boar, Sambhar, Barking Deer, Mouse Deer, Spotted Deer, Jackal, and Wild Dog.

KONDAKARLA BIRD SANCTUARY

Located at a distance of 48 kilometers from Visakhapatnam, the Kondakarla Bird Sanctuary in the Kondakarla village (Atchuthapuram mandal), is the largest fresh-water lake in the state of Andhra Pradesh. The sanctuary, surrounded by green hills, with 70 species of endemic and migratory birds.

Figure 4-10: Kondakarla Bird Sanctuary

This lake is a home to winged visitors and a feeding and breeding habitat to migratory birds other than home Avifauna. 19 families, 27 species of aquatic plants are identified in and around the sanctuary; 19 families, 60 species of Zooplankter are identified from the littoral and limnetic regions of the lake.

INDIRA GANDHI ZOOLOGICAL PARK

It is one of the protected national parks of the country situated in the Kambalakonda Wild life sanctuary of Visakhapatnam in an area of 250ha (625 acres). This park is a house for 92 species, 851 in number of fauna and avifauna in 63 enclosures. It has 29 species, 272 numbers of mammals; 11 species, 91 numbers of birds; 52 species, 488 numbers of birds.

The zoo park has different sections for birds, reptiles, mammals, ungulates, primates, carnivores, lesser carnivores. Primate section is home for various species of monkeys such as common langur, rhesus monkey, bonnet monkey, and exotic fauna like Mandrills, Olive baboons, and sacred baboons. Carnivores section holds tigers, lions, panthers, and lesser carnivores are wild dogs, hyenas, jackals, and wolves. Reptiles section has water monitor lizards, land tortoises, pythons, and snakes. The Hippopotamus is one of the important attractions for children in the zoo. Other attraction is walkthrough aviaries designed by Salim Ali, birds section is a wonderful collection of bird species of Eastern Ghats. They are Rosy pelicans, Grey pelicans, Love birds, Ducks, Peacocks, Budgerigars, Cockateels, and Painted storks.

This park suffered a major loss due to cyclonic storm Hud Hud on Oct 12, 2014. The park experienced a major plantation loss at once about 40% of the trees have been completely uprooted, remaining 60% also suffered heavy damages. A total of 11 animals died and about 180 birds/ reptiles escaped from the damaged enclosures.

TURTLE NESTING GROUNDS

Majorly four species of marine turtles having significant nesting/ feeding grounds observed along Indian coast line, they are Leather Sea turtle (Dermochelys Coriacea), Green turtle (Cheloniamydas), Hawhsbill turtle (Eretmochelys imbricate), and Oliver ridley (Lepidochelys Olivacea). Of these Species Oliver Ridley turtles have a special habit coming back to their place of birth in the time of breeding and nesting.

The importance of the Oliver ridley turtles are that they present themselves as a flagship species for the vast kind of habitats they occupy. The habitats are coral reef eco systems, sea grass meadows, open seas, and sandy beaches. In Indian Sub – continent the threats faced by Oliver ridley turtles are a representative of the threats faced by other coastal flora and fauna. The Oliver ridley Sea Turtles are considered the most abundant turtles, still globally their number has declined by more than 30% from historic levels. These are presently considered endangered because of the few nesting sites in the world.

CONSERVATION

Eggs laid by the mother turtles are conserved in two ways by in – situ conservation and ex – situ conservation. In in – situ conservation eggs are protected in their natural Habitat, where as in ex – situ conservation eggs are moved out of their natural habitat like hatcheries. In both cases once the baby hatchlings emerge, they are helped to sea

Table 4-7: Sea turtle consevation record in the past 6 years by VSPCA

S. no	Year	Area	No. of nests	No. of Eggs	No. of Hatchlings released	No. of undeveloped Eggs	No. of dead Hatchlings
1	2010-2011	Visakhapatnam	184	19,966	16,183	1,713	2,070
2	2011-2012	Visakhapatnam	181	21,343	13,460	7,116	764
3	2012-2013	Visakhapatnam	187	22,362	13,722	6,209	2,431
4	2013-2014	Visakhapatnam	319	37,078	34,056	2,726	1,140
5	2014-2015	Visakhapatnam	320	38,793	33,495	3,294	2,004
6	2015-2016	Visakhapatnam	343	39,604	32,742	4,263	2,559
7	2016-2017	Visakhapatnam	705	78,494	65,044	9,777	3,675
8	2017-2018	Visakhapatnam	677	77,344	70,360	6,136	2,842

Source: Annual Turtle Conservation reports of Visakhapatnam Society for Protection and Care of Animals (VSPCA)

Main threats being faced by the sea turtles are toxic substances being released in to the sea, use of fishing nets without turtle escape, eggs being consumed by predators such as dogs, and foxes. One other major threat is consumption of adults which is observed in other countries than India.

4.7 ENVIRONMENTAL QUALITY STATUS

AMBIENT AIR QUALITY

In the recent year, studies have been conducted to understand the effect of pollutants, as well as RSPM (2.5) on the health of the people that are exposed to high concentrations of pollutants for long periods. The conclusions of these studies say that over a million deaths in India are due to the direct consequence of air pollution. It is also the cause for more than one million pre-mature births in the last year of India.

ANNUAL AVERAGE CONCENTRATIONS FROM APPCB DATA

For strategical planning of any region an understanding of Ambient air quality is mandatory. In that light Ambient Air Quality Monitoring concentrations of RSPM, SO2, NOx, and NH3 for last 7 years from the year 2011 to2017 are observed in the VMR. The data being collected in Visakhapatnam from National Air Quality Monitoring Programme (NAMP) and Port stations. The locations of the NAMP stations studied are ESI hospital(s), Mindi (R), Seethammadhara (R), Gnanapuram (R), Police Barracks (C), Industrial Estate (I), Pedagantyada (I), and Ramky (I). Locations of PORT monitoring Stations are St'Alyosius School, St'John's Parish School, MCV /AOB.

The ambient air quality in the VMR are compared relative to Indian Ambient Air quality standards. The standards are detailed seperately for Ecologically sensitive areas, and other industrial, residential, rural and others (Table 4-8).

Table 4-8: Air pollutant limits as per National Ambient Air quality Standards

Pollutant	Industrial, Residential, Rural and other areas		Ecologically sensitive area (notified by central government)	
	Annual*	24 hours**	Annual*	24 hours**
PM_{10}	60	100	60	100
$PM_{2.5}$	40	60	40	60
SO_2	50	80	20	80
NO_x	40	80	30	80

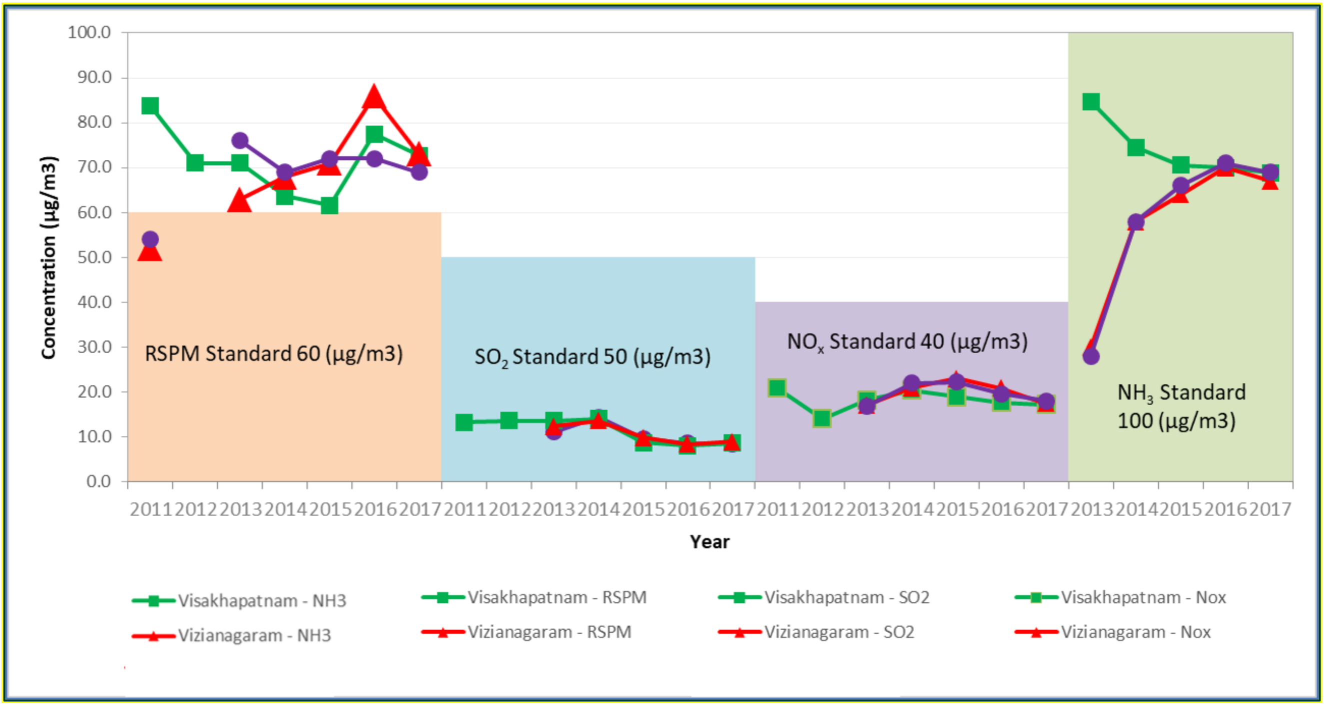
Source: National Ambient Air quality standards as per Air (Prevention and control of Pollution) act, 1998 of GoI

Annual: Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals*

*24 hours**: 24 hourly or 08 hourly or 1 hourly monitored value as applicable, shall be complied with 98% of the time, they may exceed limits but not on two consecutive days of monitoring.*

The monthly Average of Ambient Air quality monitoring at NAMP monitoring stations in Visakhapatnam and Vizianagaram. SO2, NOx, RSPM and Ammonia, levels that are monitored by APPCB are analyzed (Figure 4-11).

As per the study of the air quality in the region for last 7 consecutive years it is observed that the RSPM concentrations are higher than standard in the whole region, and highest concentration is observed in year 2016. SO2, NOx, and NH3 concentrations are less than standards and in a fluctuating trend.



Source: Ambient Air quality data from APPCB regional offices in Visakhapatnam and Vizianagaram

Figure 4-11: Annual Average Concentrations (µg/m3) of RSPM , SO_2, NO_x, and NH_3 at NAMP monitoring stations from 2011 to 2017

The higher RSPM concentrations in the region are due to higher concentration of industries such as HNPCL, Port activities, Visakhapatnam steel plant and others. Mitigatory measures need to be adopted for reducing the RSPM levels with augmenting green covers and better filtering of effluents before release to atmosphere.

PARTICULATE MATTER CONCENTRATIONS

To understand the pollution levels in the other non - NAMP monitored areas of the VMR a rigorous exercise of is done to extract ten ambient air quality sample locations from the air quality monitoring study conducted samples in various EIA reports submitted to AP Pollution Control Board.

The sample locations identified are either near SEZ's, near Reserve forest, ports, or near coast. The PM 2.5, PM10, SO2, NOx concentrations of ambient air monitored in these locations is taken as reference for air quality in the project area (Figure 4-12).

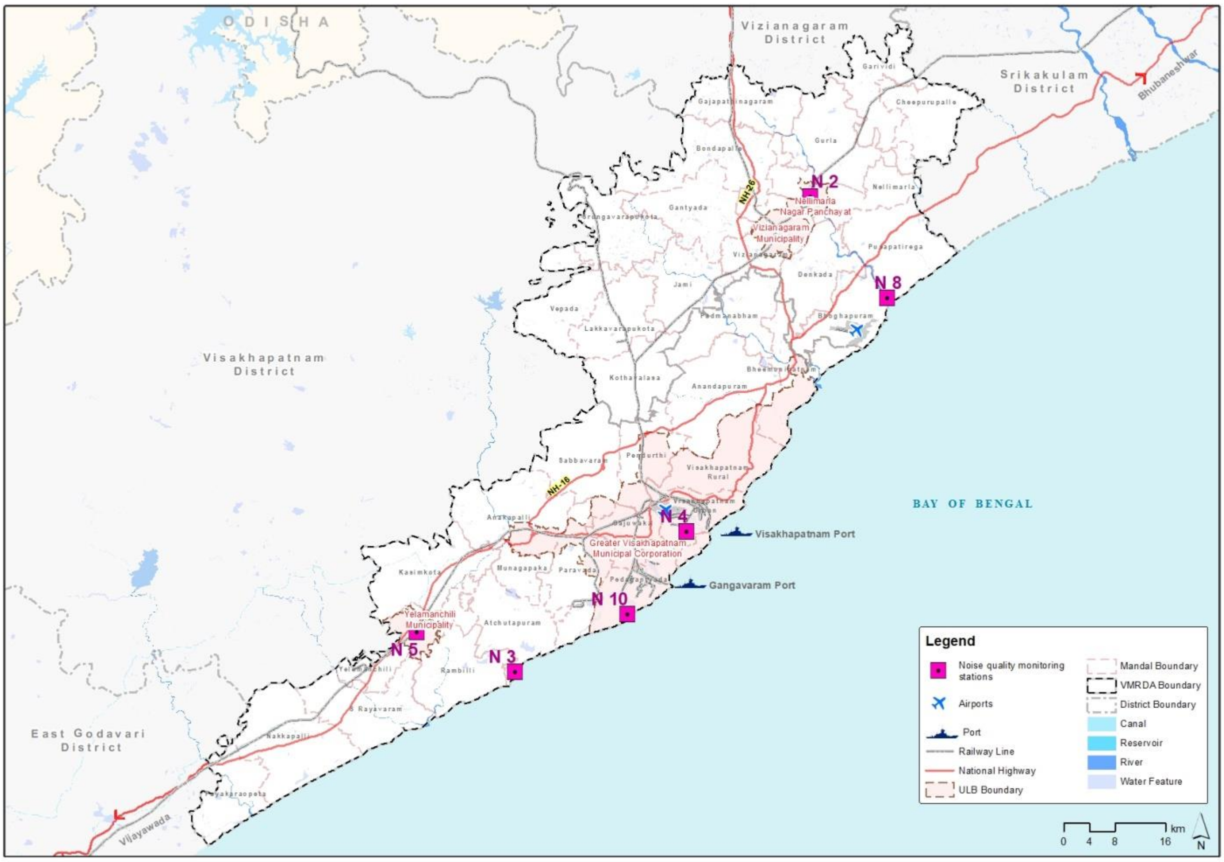


Figure 4-12: Noise quality Sample locations in VMR

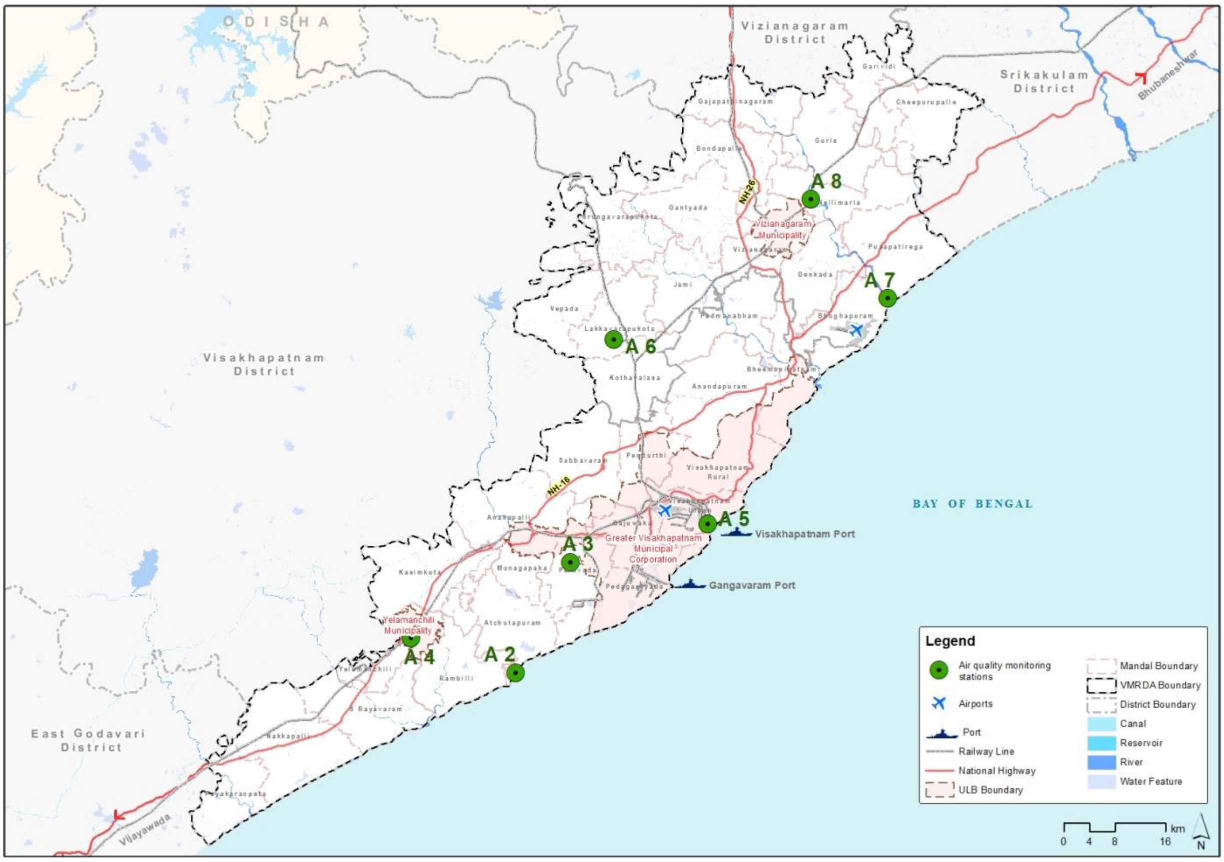


Figure 4-13: Air quality Sample locations in VMR

The particulate matter concentrations in the sample locations are under standards when compared to concentrations of pollutants for an exposure period of 24 hours. The locations taken for ambient air quality monitoring is listed in the Table 4-9. (Figure 4-12)

Table 4-9: Ambient air quality sampling locations

Location No	Name
A2	Pudimadaka
A3	JNPC parawada
A4	Yelamanchili
A5	port administrative building
A6	Srirampuram
A7	Konada
A8	Nellimarla

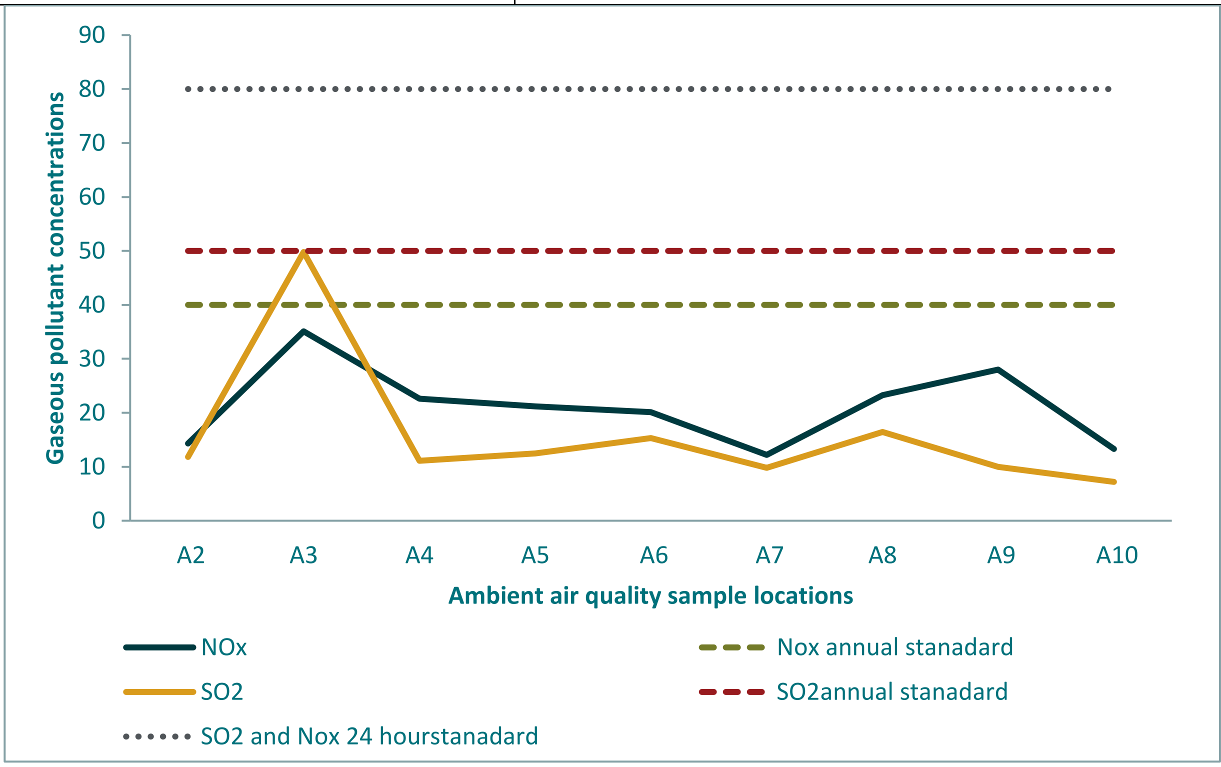


Figure 4-14: Concentrations of $PM_{2.5}$ and PM_{10} at ambient air quality sample locations in VMR

Both PM2.5 and PM10 concentrations observed at the ambient air quality monitoring locations in the study area are compared with *24 hour exposure standards of 60 and 100 (µg/m3) for PM2.5 and PM 10 respectively, and *annual exposure standards 40 and 60 (µg/m3) for PM2.5 and PM10 respectively (Figure 4-14).

PM2.5: Relative to *Annual standards, the PM2.5 concentrations at JNPC Parawada, Visakhapatnam port administrative building, and Nellimarla are higher than standard; relative to *24 hour exposure standards, the PM2.5 concentrations at JNPC Parawada are higher than standard concentrations.

PM10: Relative to *Annual standards, the PM10 concentrations at JNPC Parawada, Visakhapatnam port administrative building and Nellimarla, are higher than the standard; relative to *24 hour exposure standardsPM10 concentration at JNPC parawada is almost equal to the standard concentrations.

GASEOUS POLLUTANTS

To determine the gaseous pollutants concentrations in the VMR the concentrations of SO2, and NOx at the ambient air sample locations are observed, and these concentrations are compared to *annual exposure standards 50 and 40 (µg/m3) for SO2, and NOxrespectively and *24 hour exposure standards of 80 (µg/m3) for both SO2, and NOx.

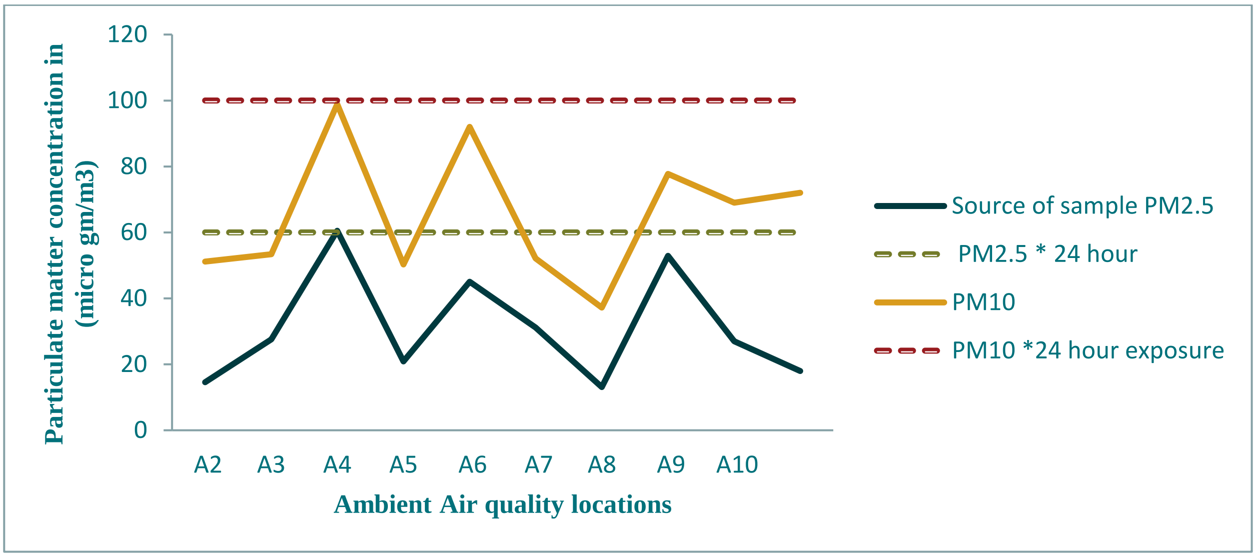


Figure 4-15: Concentrations of NO_x, and SO_2 at Ambient air quality sample locations in VMR

SO2: relative to *Annual standards the concentration of SO2 at JNPC parawada is almost equal to the standard; relative to * 24-hour standards SO2 concentrations in all sample locations are below standards. NOx: relative to both annual and 24 hour standards the concentrations of NOx are within the limits (Figure 4-15).

AMBIENT NOISE QUALITY

Noise pollution can be a serious health to all living beings either humans or animals and birds. The Government of India has developed noise pollution (regulation and control) rules 2000 to overcome the issue of noise pollution. Standards for Ambient noise quality are shown in for residential, commercial, industrial and silent zones during both day and night. Ten samples are taken study noise standards in both day and night for the study area.

Table 4-10: Noise levels at the sample locations identified

Noise Location no	Location name	Day Noise levels dB (A)	Night noise levels dB (A)
N2	Nellimarla MIMS	51	43.2
N3	Pudimadaka	45.7	42.5
N4	HPCL inside control room	82	79.2
N5	Yelamanchili	46	33
N7	Sreerampuram	53	44
N8	Konada	48	38
N10	Appikonda	50.5	41.8

The noise regulation standards as per Noise Pollution (regulation and Control) rules, 2000 are listed in the Table 4-11

Table 4-11: Noise level standards

Category of area /Zone	Limits in dB(A)	
	Day time	Night time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence zone	50	40

Source: Noise pollution (Regulation and Control), Rules, 2000 as per GoI

The noise locations identified, and actual noise levels at the sample locations are listed in the Table 4-10, and marked in the Figure 4-12. In the ten sample locations noise levels are observed to be higher in Industrial areas, and commercial areas within the study area. Especially noise levels in HPCL are higher than permissible limits for 8-hour exposure period. Other residential and sensitive areas are well within the limits during both day and night times.

INLAND WATER QUALITY

Water is used for domestic, drinking, irrigation and industrial purposes majorly in the study area. Due to unscientific disposal of industrial effluents by some of the industries a frequent quality check of surface waters is necessary considering the industrial and infrastructural growth anticipated in the study region in this regards water quality of both surface rivers and ground water are analyzed.

GROUND WATER

Ground water quality in the study is on deteriorating trend in the study especially ground water in the Visakhapatnam district is most affected. When compared to IS 10500: 2003, when pH values of the ground water were in a range of 7.26 to 8.9. Whereas the permissible limits are 6.5 – 8.5. In all the regions of the VMR the ground water seems to have high concentration of total dissolved solids than the permissible limits (Figure 4-16). Total hardness was also found out to be more than permissible limits in almost all the regions. Of which Visakhapatnam area has highest levels of TDS and TH concentrations. Even though high concentration of TDS is not harmful to human health, utilization of ground water also without proper treatment is not recommendable.

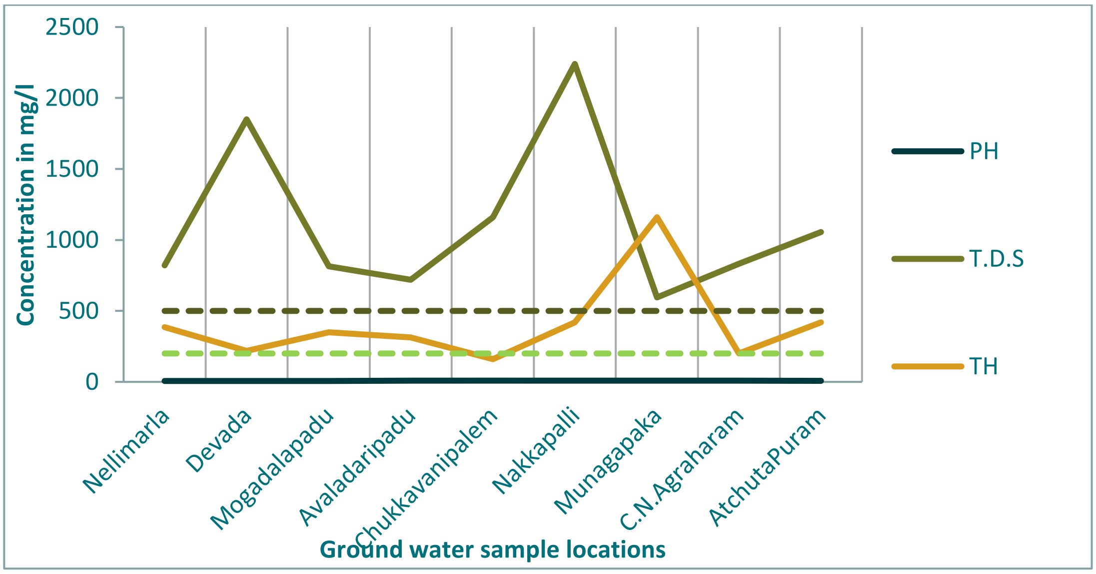


Figure 4-16: pH, TDS, and TH concentrations at GW sample Locations

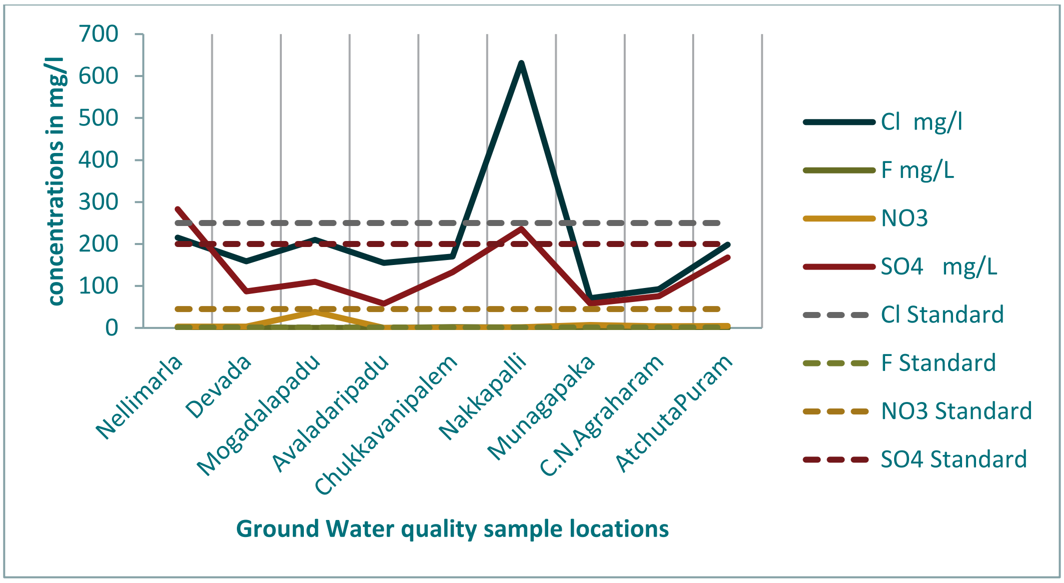


Figure 4-17: Cl, F, NO3 - N, SO4 concentrations at GW sample locations

Nitrate and fluoride concentrations in the study were found out in permissible limits in all regions, whereas chloride and fluoride concentrations were found out to be higher in Visakhapatnam and Vizianagaram areas (Figure 4-17). The sample locations identified for quality analysis of ground water in VMR are shown in the Figure 4-18.

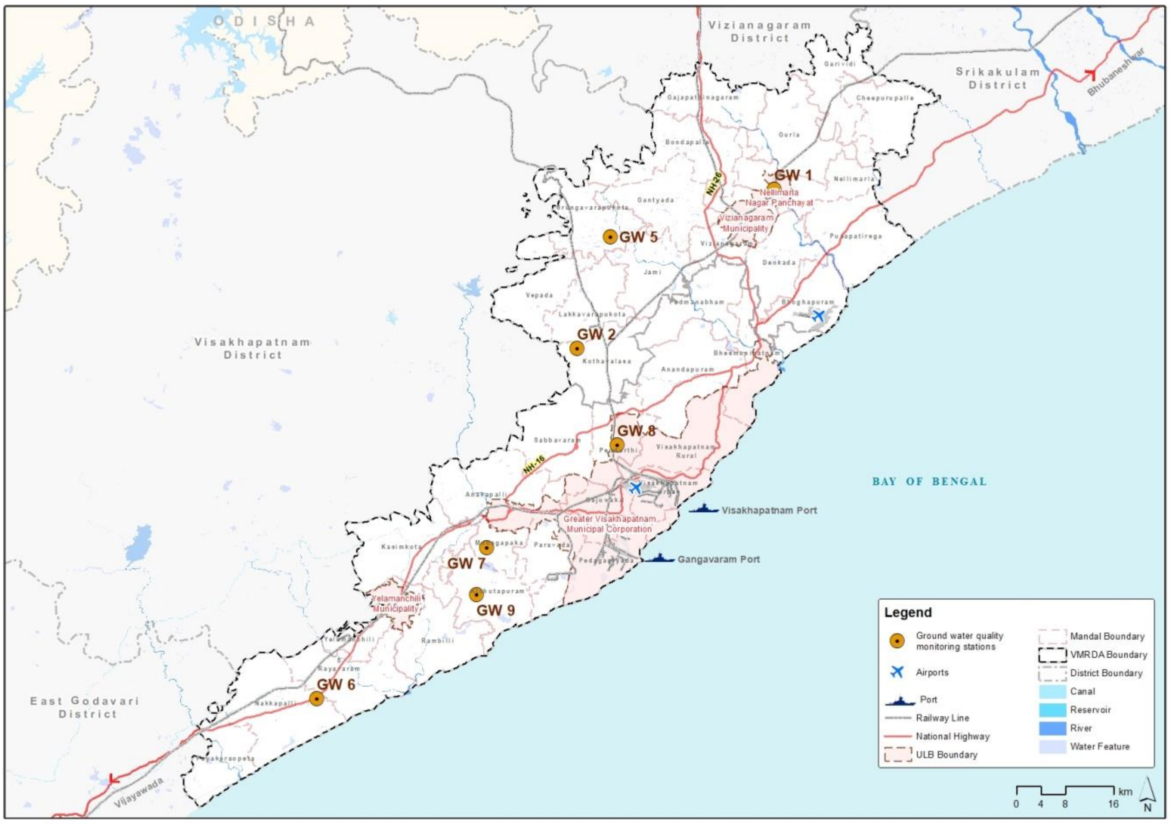


Figure 4-18: Ground water quality sampling locations

Considering all parameters ground water in the Visakhapatnam is found to be most polluted especially in Nakkapalli, Munagapaka, and Atchutapuram mandals w.r.t permissible limits. Ground water quality was found to have deteriorated rapidly in Visakhapatnam area. This was mainly due to the nature of aquifer rocks which have a natural accumulation of the salts due to the presence of alkaline and laterite rocks. Considering all parameters, the quality of ground water in the study area suggests suitable treatment of water to make them potable. A map of identified ground water sampling locations is added in the Figure 4-18.

SURFACE WATER QUALITY

Water quality indicators are considered as specified in IS 10500: 2003 standards. pH values were found to be in a range of 7.22 to 8.2. Identified rivers water quality is within the limits. Iron concentration is found to be high in Kanithi and Meghadri gedda reservoir. Total dissolved solids, Total hardness, chloride, Fluoride, Sulphate, and Nitrate were found out to be in permissible limits. Due to the pollutants in the water it is mandatory to treat the water before use to make it potable for any necessary purpose. The sample locations identified for the surface water quality analysis in VMR are shown in the Figure 4-12.

Considering all variables water is found out to be most polluted near Payakaraopeta, Visakhapatnam, and along the coast High salinity is observed due to sea water intrusion. Though high levels of the salinity, TDS and alkalinity may cause health hazards, measures have to be taken to avoid further contamination in surface water by strictly monitoring the water quality.

MARINE WATER QUALITY

Marine water is an important factor for the existing SEZ’s and ports, and other major projects. This is because of the fact that most of the core industries along the coast are dependent on water. The coastal water is highly vulnerable to contamination because of the industrial concentration pollution along the coast. Power generation industry, petroleum industries are dependent on this source. Effluent discharge from core and ancillary industries are being monitored. All the industries that are releasing effluents into the sea after treatment are being stored into storage tanks. Every week samples from these tanks are collected by AP pollution control board and analyzed. Only after confirming the effluents are up to the standards they are allowed to be released into the sea.

In case of zoo plankton, phytoplankton, and macro benthos are high in coastal waters. At present the marine ecosystem is in good health recording high plankton, benthic diversity, and individual count. It is under the impact of effluents that are being released in to the sea through the outfalls by some of the mega industries along the coast. So, a continuous monitoring of marine water quality, and ecosystem health is necessary to preserve the bio – diversity of the sea. In this regard, sample locations are identified along the coast of the VMR to analyze the Sea water quality (Figure 4-19).

At present, the quality of marine environment is healthy. pH is nearly alkaline ranging between 7.2 to 8.2. All other physio – chemical parameters are same as terrestrial water and within acceptable limits.

Figure 4-19: Marine water sample locations in VMR

CONCLUSION

Environmental quality within VMR is studied from the secondary information collected from published studies. As a result, a composite status of air, ground water, surface water, noise levels, and marine sea water quality levels are obtained. In all the parameters except marine water quality Visakhapatnam and VK-PCPIR areas are most polluted zones because of vast industrial cluster concentration which are consuming the existing natural resources at high rate. This is leading to the imbalance in the existing environmental quality of the region. Immediate actions to analyze the existing pollution levels and taking necessary pollution mitigation measures is necessary to avoid further deterioration of environmental quality of the region.

5 REVIEW OF KEY ECONOMIC SECTORS

The purpose of this chapter is to understand the economy of the region. The contribution of various districts to the economy of the region have been analysed in the light of the economy of the state as indicated in the regional economic base. The analysis evolves the key sectors of economy based on which the planning parameters like workers, employment, WFPR etc., will be determined during the further stages of the study during employment and population projections.

5.1 INTRODUCTION

India is presently the third largest economy of the world having a Gross Domestic Product of ₹ 794.47 lakh crores ($10.57 trillion) based on purchasing power parity as per International Monetary Fund estimates for 2018. Since economic liberation of India in 1991, it has achieved an average growth rate of 6-7% in GDP. It has grown at an impressive rate of 8.2 in the first quarter of FY 2018-2019.

Service sector contributes to the major portion of the Indian economy in 2016-2017 as per constant prices of 2011-12. Total GDP being ₹121.65 lakh crores, the tertiary sector contribution amounts to about ₹60 lakh crores with a share of 53.77% whereas the secondary sector has a share of 31.12% contributing around ₹34.75 lakh crores and primary sector having the lowest contribution of 15.11% and with a gross value addition of ₹16.84 lakh crores. This shows the flourishing of the service sector in India with major economic activities of real-estate and financial services.

According to the current prices, the Gross Value Added by the State of AP is ₹6.75 lakh crores for FY 2016-17 and ₹5.32 lakh crores as per constant price of 2011-2012. This constitutes 5% of the National GVA. The sector-wise contribution shows a similar trend as of India as a whole. Service sector has a leading contribution of 46%. But primary sector is the second largest contributor in the state economy with a share of 28% very close to the secondary sector contribution of 27%. This composition of the state economy will be subject to change due to the influence of rapid urbanisation, the effects of bifurcation of Andhra Pradesh and policy boost from State Government.

Visakhapatnam has taken momentum as a port city and due to the locational advantage; it has gradually evolved as an industrial hub. A rapid growth in the manufacturing sector has been evident in the last four decades starting from major anchor industries like Hindustan Shipyard, Hindustan Petroleum Corporation Ltd., Bharat Heavy Plates and Vessels (now under BHEL), Visakhapatnam Steel Plant, NTPC, etc. With influence from key projects like Visakhapatnam Chennai Industrial Corridor, Petroleum Chemical and Petrochemical Investment Region and Sagarmala, there will be a boom in employment generation in manufacturing sector.

5.2 CONTRIBUTION OF VMR TO DISTRICT & STATE ECONOMY

Visakhapatnam being a port city and having a good global and hinterland connectivity has evolved as an industrial town with manufacturing sector flouring around the city. The city by virtue of its urbanisation due to the economic activities has also developed the tertiary sector. Manufacturing activity forms the stronghold for the regional economy along with the transportation and logistics. Real-estate sector also comes up as a major contributor to the economy in VMR.

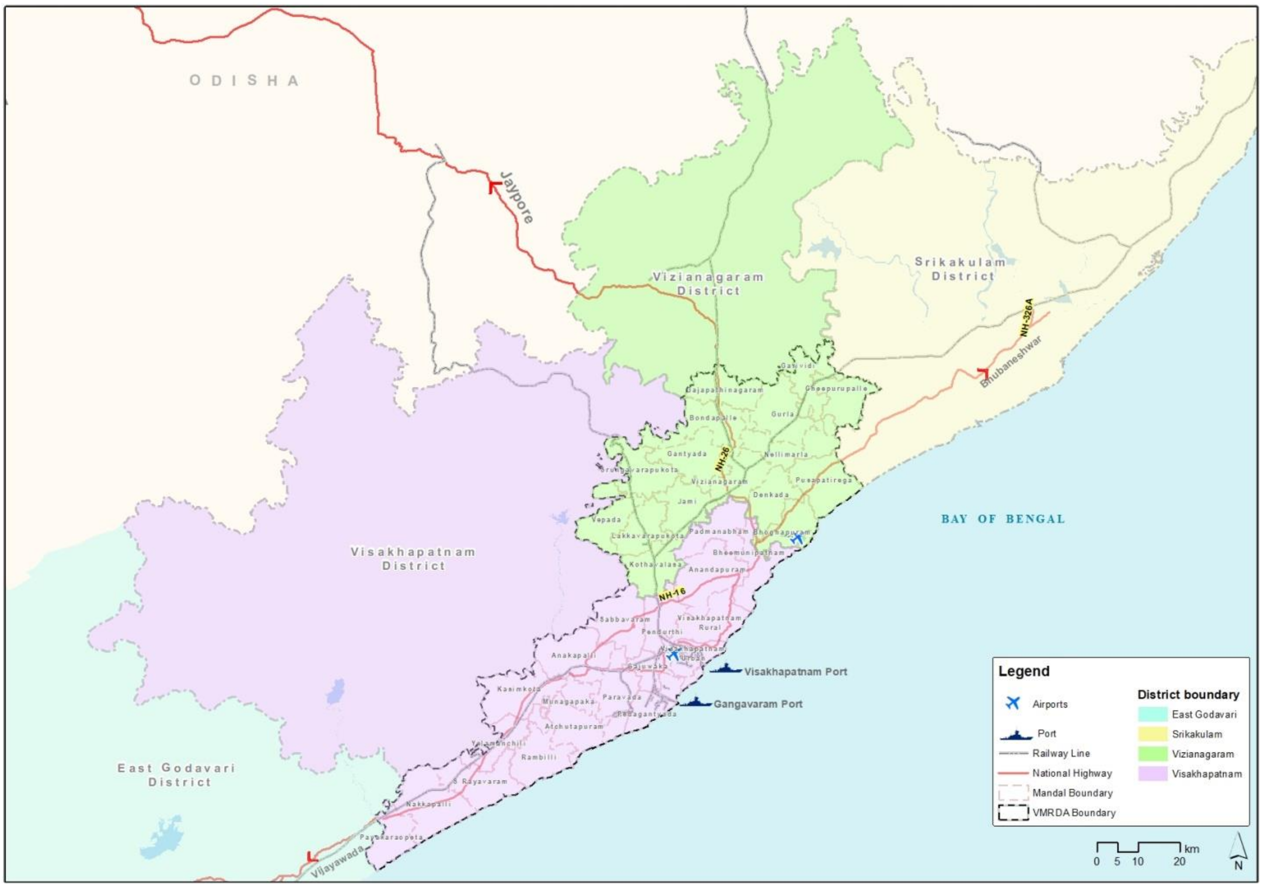


Figure 5-1: VMR by districts

Two districts of VMR have been contributing significantly to the domestic product.

Vizianagaram District: Agriculture is the major producer of district income, after Trade and Hotels. Because of the new airport which is going to be established in Bhogapuram, the economy is likely to get a boost, especially in areas of industries and tertiary sector.

Visakhapatnam district: This district has better connectivity in this entire region by land, sea and air. Due to the city's ideal location between major road and rail corridors, especially the Chennai - Kolkata corridor, the industrial sector has been showing major development. Further earmarking land for various industries, establishment of various SEZ and IC also contributed to the increase in industries. The district has two major ports of which one has been established recently to reduce the load on the existing port of Visakhapatnam. Agriculture has least share and contributes least to the district income, when compared with the other districts in the region.

5.3 AGRICULTURE

The primary sector contributes 23.1% to the GSDP of Andhra Pradesh, of which the project region alone constitutes 8.1% (which includes the entire districts of Vizianagaram and Visakhapatnam). As per Census 2011, nearly 41% of the working persons of these 35 mandals of VMRare engaged in agriculture sector. About 55% of the VMRis under agriculture majorly contributed by Vizianagaram district.

After analysing the agriculture sector of VMR, it is found that Vizianagaram district is the most fertile area which has more agricultural land and good irrigation facilities.

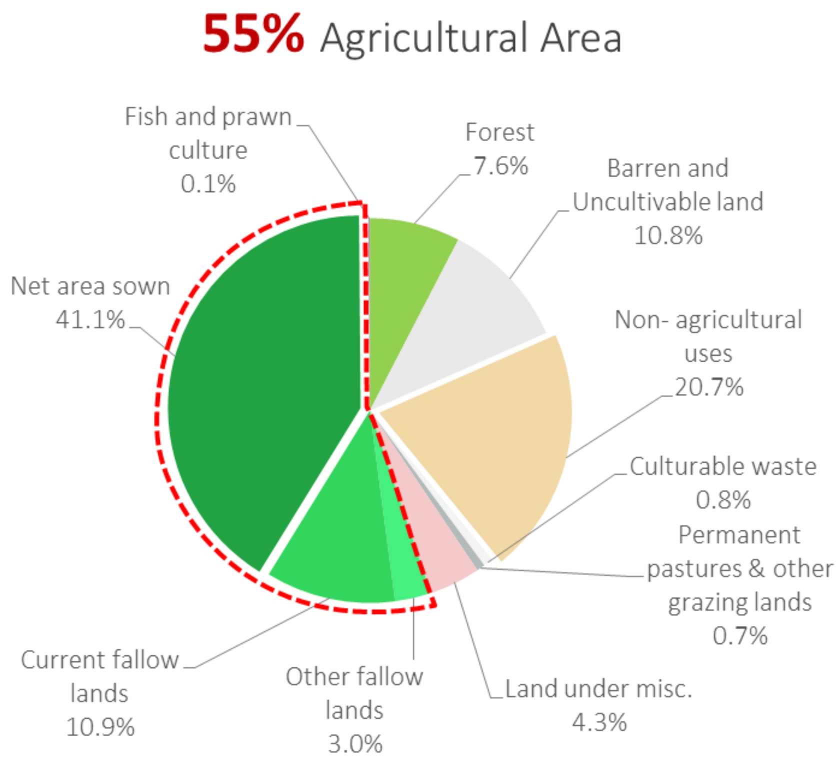


Figure 5-2: Land under agricultural use in VMR

A detailed analysis has been done at mandal level taking the parameters of total Agricultural Area, total Cropping Area, Cropping Intensity, total Irrigated Area, Irrigation Intensity and Land Holdings per farmer. Figure 5-3 shows the agricultural potential area.

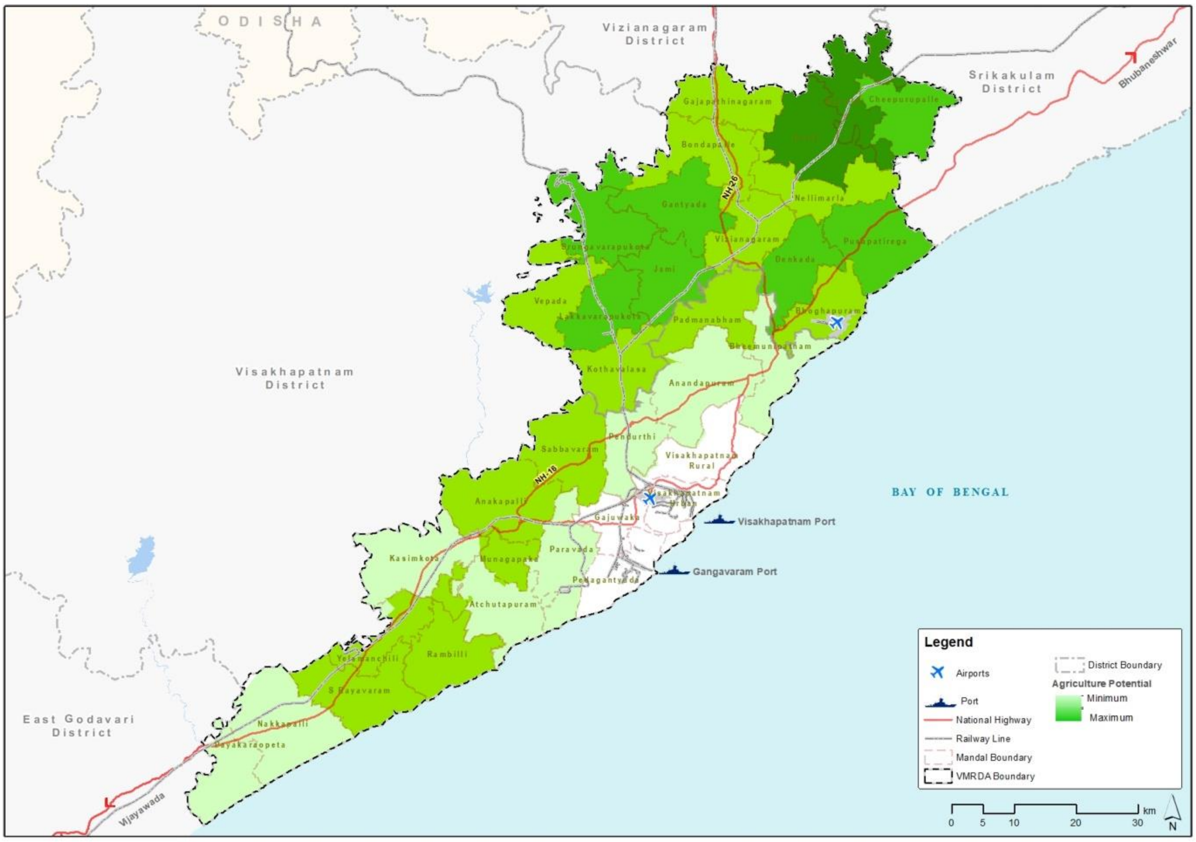


Figure 5-3: Agriculture potential mapping in VMR

Visakhapatnam (urban) mandal has zero agricultural activities since it is fully urbanized. Urban farming on roof gardens can be encouraged, which has more potential to increase agricultural activities.

Gajuwaka, Pendurthi and Sabbavaram mandals of Visakhapatnam and Vizianagaram mandal of Vizianagaram district are the least agricultural potential areas in VMR. This can be increased by effective use of resources and utilizing various schemes of state and central government for the seeds and soil fertility.

5.4 FISHERIES

Fisheries are one of the traditional occupations and major source of economy for coastal population in India. This sector provides 4.93% to GSDP, of which, 6.5% alone is from the project region. The economic contribution of VMRto the State Agriculture sector has increased from 5.8% in 2010-11 to 6.5% in 2012-13.

In VMR, sea food industry is growing over years and is one of the growth engines in Agriculture sector identified by Government of Andhra Pradesh (GoAP). There has been a shift from traditional crafts used for fishing to motorized and mechanized crafts which boosted the economy of the fisheries sector and the livelihood of the fishermen.

VMR has a coastline of 252 kms, which is 25.8% of total state coast length. There are 80 fishing villages depending on fishing as their livelihood. (Marine Fishing Census-2010).

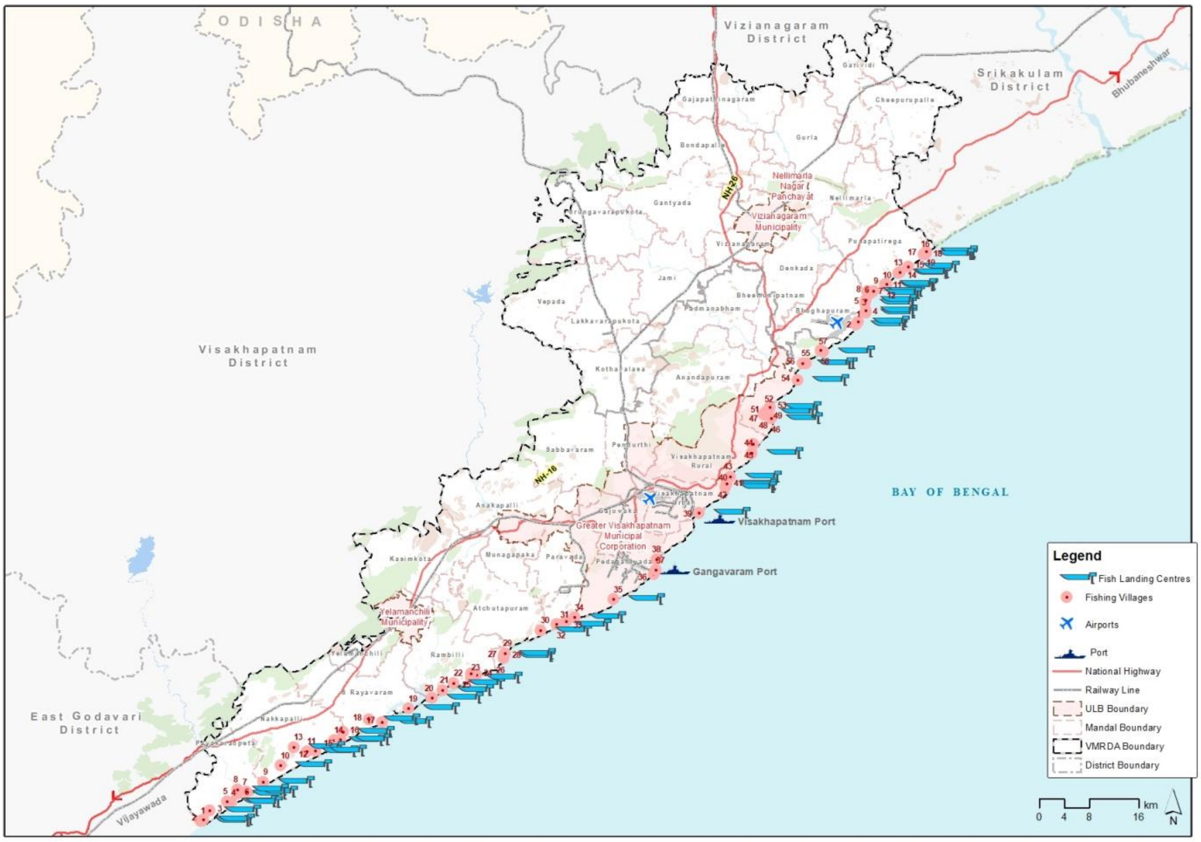


Figure 5-4: Local markets and facilities provided to fishermen community

5.5 INDUSTRIES

Transformation of Visakhapatnam into a large manufacturing hub has taken place over the last four decades along with supporting infrastructure and ancillary base. Major industries such as Hindustan Shipyard, Hindustan Petroleum Corporation Ltd., Bharat Heavy Plates and Vessels (now under BHEL), Visakhapatnam Steel Plant, NTPC, etc., with large base of supporting ancillary industries have been setup in the decades of ’81 and ‘91. This transformation continued with advent of Special Economic Zones (for instance, AP SEZ, in

Visakhapatnam district) which has boosted the investment in industries in recent years. Presently, the industrial sector of VMRcontributes 22% to the GVA by the industrial sector of state and 5.9% to the total GVA.

The VMRhas a strong industrial base with distinct typology of industries which has been influenced by the factors like the presence of port like the Visakhapatnam port, Gangavaram port and Kakinada deep water port, the availability of resources of agricultural produce like jute, rice, sugar, cashew and even fisheries, minerals in the Eastern Ghats and petroleum in the Krishna-Godavari basin, availability of labor and the exposure to the global market. These have induced the development of industries like metal and metal fabrication and machinery manufacturing, food processing units, textile industry, petroleum and petrochemical units, and pharmaceutical and allied chemical manufacturing units.

The region has 7,316 manufacturing units, 23 industrial parks, 15 SEZs with total investment of ₹ 71 thousand crores and 2.3 lakhs employment. APIIC has 26,615 acres of land in the region out of which 38% is not yet allotted and can be used for future developments.

With the help of the initiatives of Andhra Pradesh Government through agencies like APIIC and facilities like single window clearances for setting up manufacturing units, the state is at a leading position at ease of doing business (EoDB) and is attracting large investments even from the global market Figure 5-5 and Figure 5-6 shows the location of large and mega industries and industrial parks in VMR respectively.

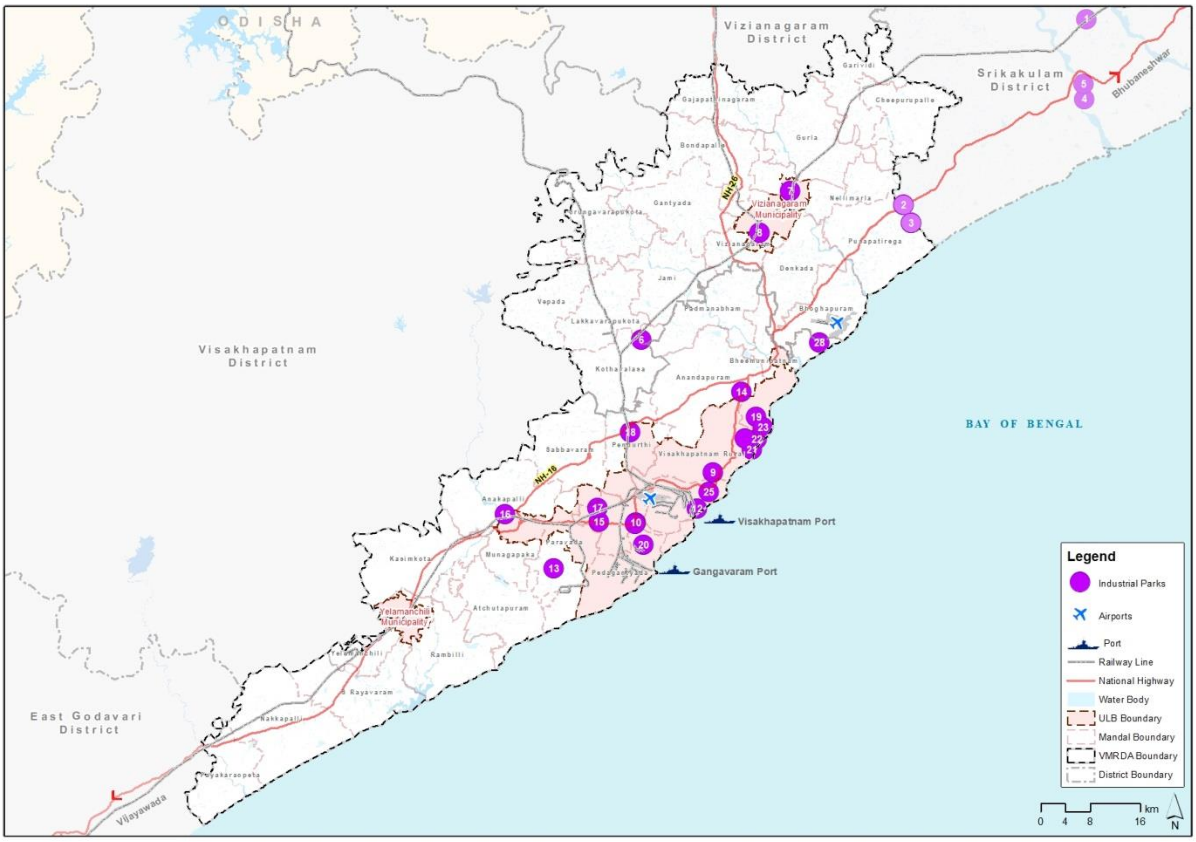


Figure 5-5: Location of Large and Mega Industries in VMR

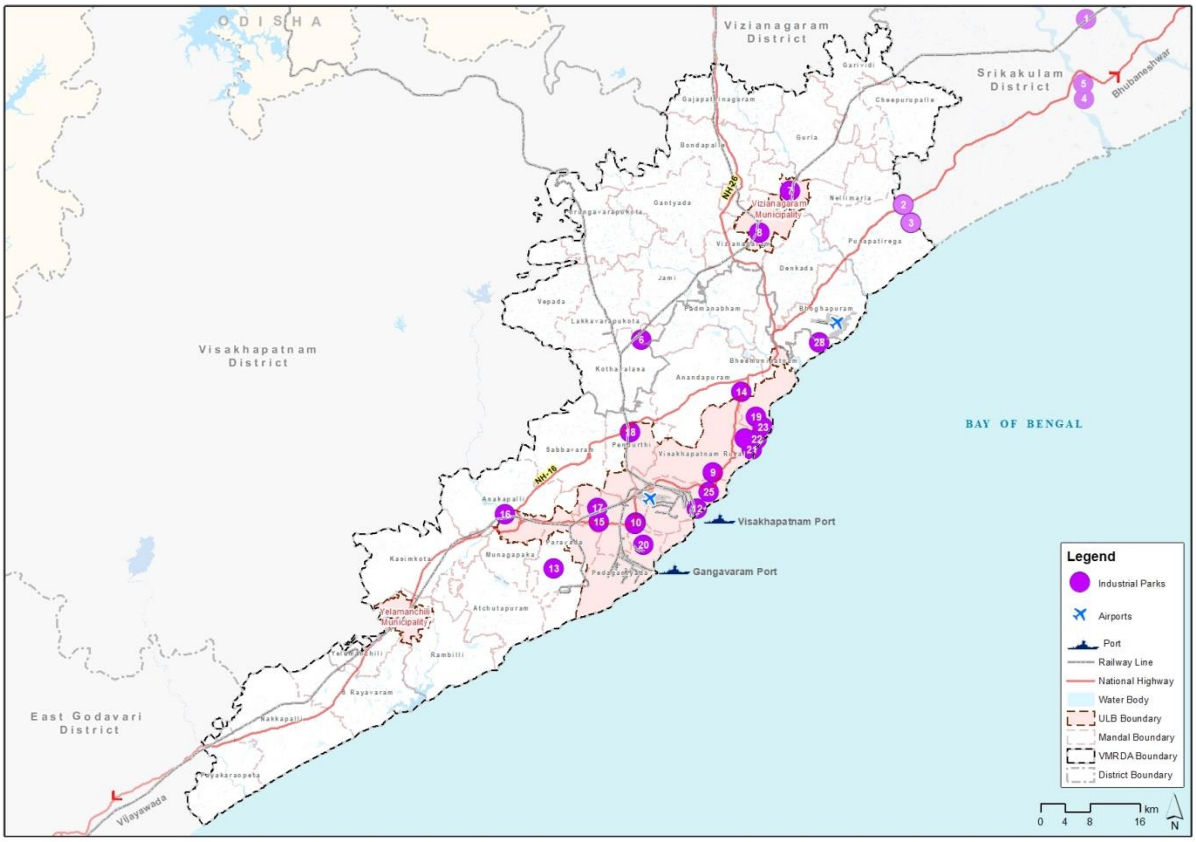


Figure 5-6: Location of Industrial Parks in VMR

With the help of the initiatives of Andhra Pradesh Government through agencies like APIIC and facilities like single window clearances for setting up manufacturing units, the state is at a leading position at ease of doing business (EoDB) and is attracting large investments even from the global market.

5.6 PORTS AND SUPPORT LOGISTICS

There are two sea ports falling within the VMR, Visakhapatnam port and Gangavaram port and Kakinada deep sea port is about 10 km from the region. Hence, within the influence of the project area, three major ports, a container terminal and two fishing harbours are present.

Visakhapatnam Port is located at $17^{0}41'$ N and $83^{0}18'$ E, is almost equidistant from Kolkata and Chennai ports. Figure 5-7 shows the location of the port. The port is a premier port in the country, in terms of annual traffic (cargo throughput). There is also a fishing harbour, spread over in 38 ha of area, which is presently being used by local fishermen for fishing related activities and as shelter for their launches/crafts. Visakhapatnam port facilities in inner and outer harbours are presented in Table 5-1.

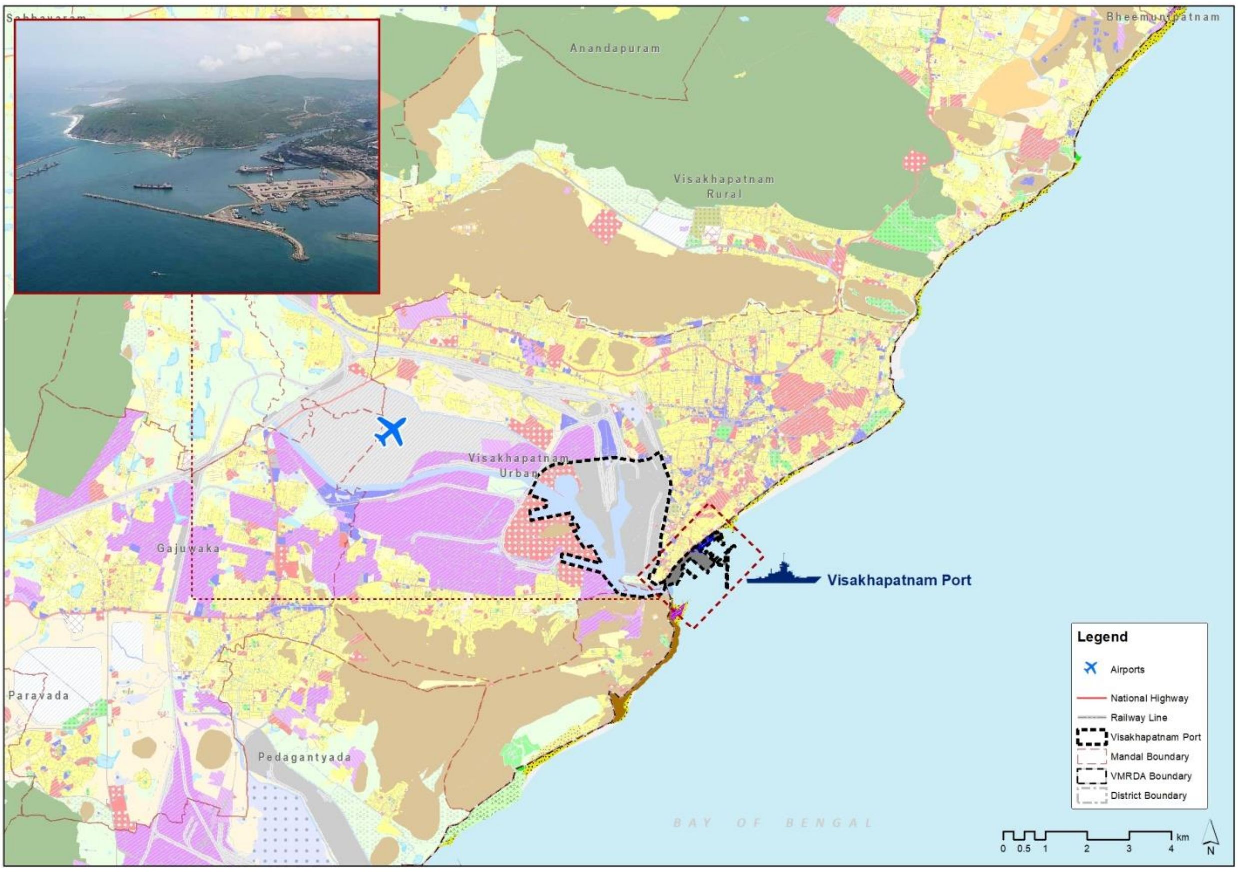


Figure 5-7: Visakhapatnam Port Area

Table 5-1: Visakhapatnam Port Trust facilities

Sl. No.	Port facilities	Inner Harbor	Outer Harbor
1	Water Spread (Hectares)	100	200
2	Maximum Draft (in meters)	14.50	18.10
3	Length (in meters)	230 LOA	320 LOA
4	Beam (in meters)	32.5	50
5	Vessel Class	PANAMAX	Super Cape (up to 2 lakh DWT)

Sl. No.	Port facilities	Inner Harbor	Outer Harbor
6	Number of Berths	18	6

Source: Visakhapatnam Port Trust Annual Report, 2018

Visakhapatnam port majorly handles POL, iron ore, Fertilizer, Thermal Coal and Cooking Coal. Table 5-2 shows the principal commodity wise cargo traffic handled at Visakhapatnam Port for the years 2011-16 (Figure 5-8).

Table 5-2: Principal commodity wise cargo Traffic handled at Visakhapatnam Port (in lakh tonnes)

Sl. No	Period	POL	Iron Ore & Pellets (Export)	Fertilizer		Coal		Container		Others
				Finished	Raw	Thermal (Export)	Coking	Tonnage	TEUs	
1	2011 - 12	184.4	161.54	37.17	8.32	31.89	67.8	42.14	234	100.5
2	2012 - 13	150.4	123.09	20.23	5.65	29.51	68.35	45.54	247	104.56
3	2013 - 14	10.09	129.99	17.71	7.95	27.44	69.28	49.16	262	109.37
4	2014 - 15	146.4	83.01	18.38	7.2	27.79	60.74	43.73	248	99.12
5	2015 - 16	169.4	59.79	19.96	7.99	33.93	50.81	51.45	293	96.78
6	2016-17	166.04	114.20	18.86	7.76	34.71	42.82	64.28		120.50
7	2017-18	160.50	106.46	19.53	9.20	29.48	57.64	68.35		125.86

Source: Visakhapatnam Port Trust Annual Report, 2018

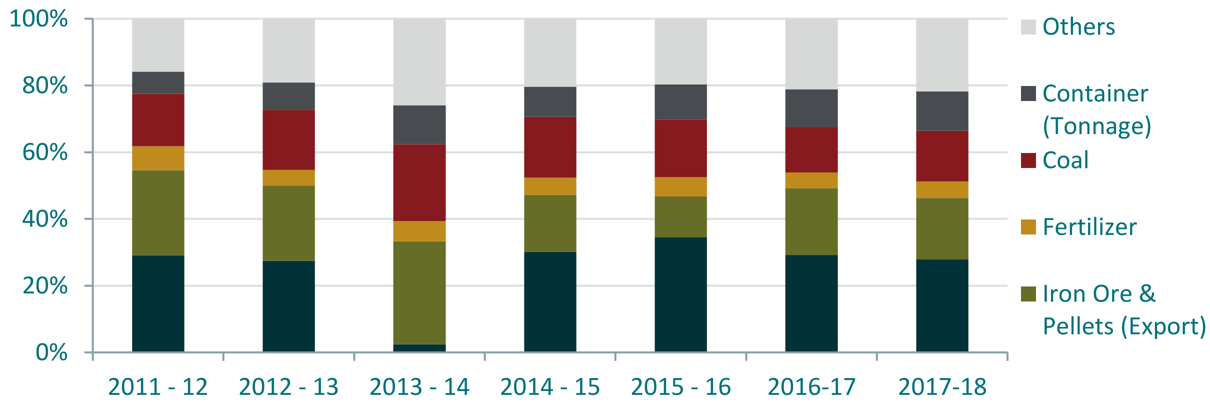


Figure 5-8: Commodity wise cargo Traffic handled at Visakhapatnam Port

Source: Visakhapatnam Port Trust Annual Report, 2018

Major development projects planned / initiated are as given below:

1. Development of East Quay – 1A berth in inner harbor for handling thermal / steam coal with a capacity of 7.36 MTPA;
2. Upgradation of Ore Handling Complex (OHC) and creation of new facility (West Quay 1) for handling iron ore with a capacity of 23 MTPA;
3. Extension of Visakhapatnam Container Terminal in the outer harbor with a capacity of 0.54 MTEUs and thus, enhancing the capacity to 2 MTEUs;

4. Installation of mechanized fertilizer handling facility at East Quay – 7 berth in inner harbor with a capacity of 5.21MTPA;
5. Development of West Quay North berth (WQ – 7&8) in inner harbor with a capacity of 6.29 MTPA;
6. Replacement of existing East Quay berths to cater to 14.5 meters draft vessels i.e., (E.Q. 2,3,4,5) with a capacity of 6.00 MTPA;
7. Installation of Harbor Mobile cranes at East Quay and West Quay berths;
8. Development of Grade separation at Convent Junction through a flyover;
9. Development of multi model logistic hub as Joint Venture with M/s Balmier Lawrie & Co. in 100 acres of Visakhapatnam Port Trust land;
10. Development of multi modal logistic hub by M/s CONCOR in 100 acres of Visakhapatnam Port Trust land;
11. Establishment of Container Freight station (CFS) on Visakhapatnam Port Trust land by Visakhapatnam Container Terminal Pvt Ltd.;
12. Revamping of R&D yard to Railway standards; and
13. Electrification of Railway tracks of coal terminals.

Gangavaram Port is located within 15 km south of Visakhapatnam Port. Figure 5-7 shows the location of the port. It is a newly developed greenfield port, which started operation in August 2008. It is a Joint Venture (JV) between the State Government of Andhra Pradesh and a consortium led by Mr.D.V.S. Raju. Exports and Imports Cargo traffic handled by Gangavaram Port from 2009-10 to 2015-16 is given in Table 5-3.

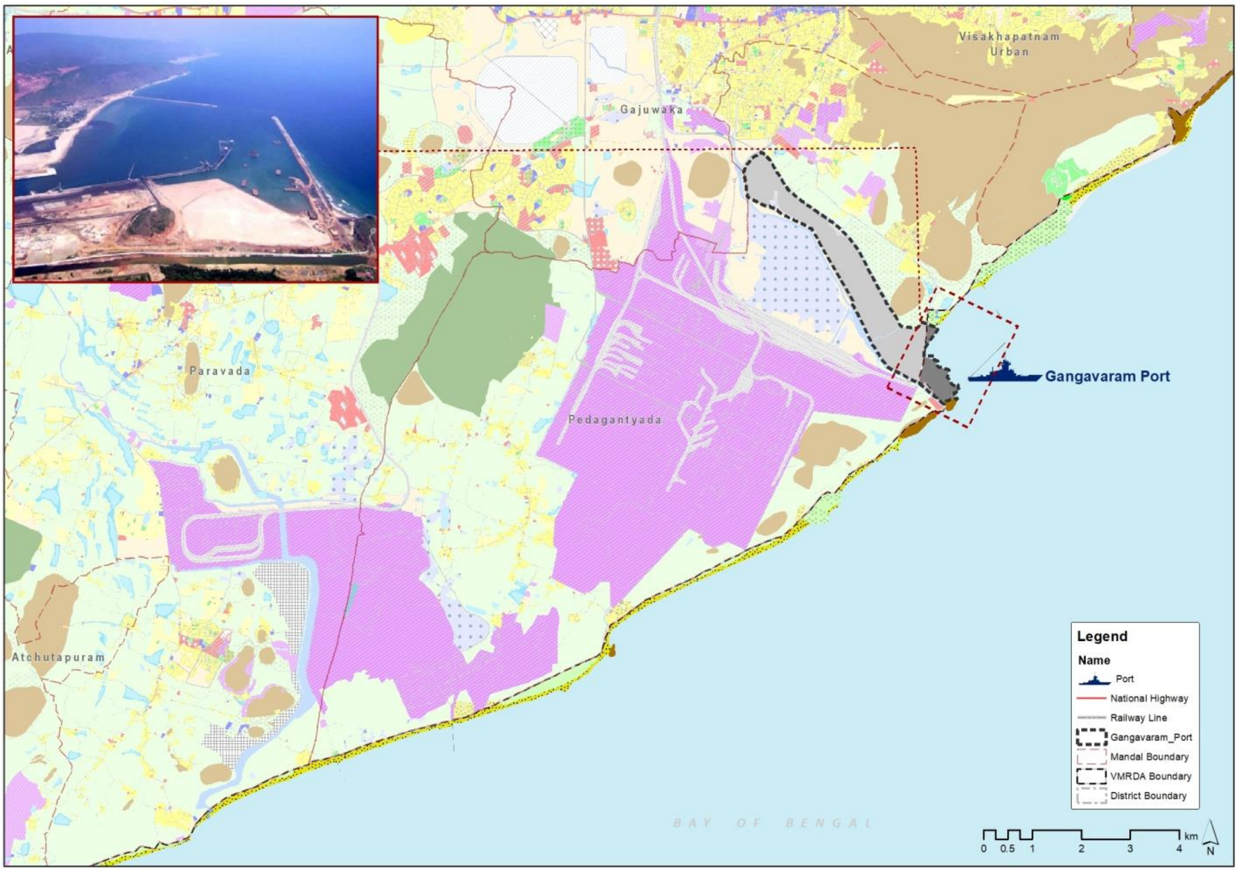


Figure 5-9: Gangavaram Port Area

Table 5-3: Exports and Imports Cargo traffic handled by Gangavaram Port

Sl. No.	Year	Imports & Exports in MMT
1.	2009-10	12.58

Sl. No.	Year	Imports & Exports in MMT
2.	2010-11	13.91
3.	2011-12	13.99
4.	2012-13	13.10
5.	2013-14	15.81
6.	2014-15	20.74
7.	2015-16	19.33

Source: Gangavaram Port Limited Office

To improve connectivity to port, following proposals were submitted to Government of Andhra Pradesh and Director of Ports.

- Widening of existing 4 lanes road to 6 lane road connecting NH-16.
- From NH-16 to Port entry gate existing 2 lanes to 4 lanes.
- 4 lane beach road of 30 km connecting Port to Atchutapuram SEZ.

Coastal Railway line around 35 km from Gangavaram Port to Atchutapuram SEZ connecting NTPC Simhadri, Hinduja Power Plant, Brandix, Pharma Park and other upcoming industries along the sea coast.

Besides the two functional ports, which are large and medium, two minor ports are proposed within the VMR.

- Bheemunipatnam about 29 km north east of the port of Visakhapatnam and is proposed to be developed as minor port on the southern bank near the mouth of river Gosthani. It is proposed to develop Bheemunipatnam as a satellite terminal for the Visakhapatnam Port.
- Kalingapatnam is about 83 km north east of the port of Visakhapatnam. The port is proposed on the southern bank of the estuary of river Vamsadhara near its confluence with the sea. It is proposed to be developed as lighterage port which is stated to be suitable for development of good deep water, all weather port by Department of Port, GoAP.
- Nakkapalli is proposed to be commissioned as a minor port situated in Nakkapalli village of Visakhapatnam district within VK-PCPIR region. M/s. ANRAK Aluminum Limited has been permitted for the construction of a captive jetty.

Meanwhile, high-level committee appointed by the Union Shipping Ministry for setting up a second major sea port in the state of Andhra Pradesh. Apart from Nakkapalli, Duggarajapatnam of Nellore District and Ramayyapatnam in Prakasam district are selected as the probable sites for the second major port in the state. If Nakkapalli gets selected as the site for a second major sea port in the state, it could impact the region in a large way.

Visakhapatnam is the only place where logistic hub is located in the region. It has both Container Freight Station and Inland Container depot. Visakhapatnam ICD is a Combined (Both Exim & domestic) container terminal. Container Freight Station, Visakhapatnam has started functioning in Dec ‘02. The new depot has started functioning April ‘05 for both Exim and Domestic Traffic. The Clearing and Forwarding Service (CFS) area is adjacent to VPT and hardly 3 km away from Visakhapatnam Railway Station. It has got a natural advantage in terms of connectivity to both Port and Hinterland.

M/S. Balmer Lawrie & Co Ltd (BL), in joint venture with Visakhapatnam Port Trust, have proposed to develop a Multi-Modal Logistics Hub (MMLH) at Visakhapatnam in an area of 60 acres which is located near NH-16, adjacent to the port connectivity road. As per the officials of Visakhapatnam Port the project is under active consideration of the Govt. of India and is expected to take off soon.

5.7 MINING

Mining forms one of the major sectors of economy with the rich resources of minerals in the region owing to the Eastern Ghats and the coastline. Minerals like bauxite, manganese graphite, chromite, iron, copper-lead-zinc, apatite, mica, precious and semiprecious stones, granite (natural and commercial varieties), feldspar, quarts and quartzite, beach sand places and ochres are commonly found in this whole region which extends from Odisha in the north through Andhra Pradesh to Tamil Nadu and some portion in Karnataka.

The state of Andhra Pradesh alone produces 48 industrial minerals with extensive resources of building materials. It stands first in the value of mineral production, contributing 9 to 10 per cent (Rs. 6,583 crores) of the country's mineral value production and approximately Rs.800 crores by way of foreign exchange. It produces about 80 million tonnes of industrial minerals and 8 million cubic meters of dimensional stones and building material.

The project region consisting of the two districts has reserves of significant quantities of minerals like manganese, quartz and quartzite, various kinds of clay and beach sand. Minor minerals like gravel, granite, sand, road metal and building stones are available in abundance. The minerals found in the three districts are given in Table 5-4.

Table 5-4: List of minerals available in the Project Region

District	Mineral Resources
Vizianagaram	Manganese, Limekankar, Quartzite, Moulding Sand, Road Metal/Building Stone, Colour Granite, Gravel/Earth etc.,
Visakhapatnam	Apatite, Laterite, Bauxite, Heavy Mineral Beach Sands, Semi-precious Stones, Clays, Colour Granite, Road Metal/Building Stone, Colour Granite, Gravel/Earth etc.

Source: Department of Mines and Geology

Figure 5-10: Minerals predominantly mined in VMR

The production of major minerals in the districts of Vizianagaram are of similar quantities while the amount of extraction in Visakhapatnam district is comparatively much low (Table 5-5). But the scenario is just the reverse for the production of minor minerals in the region. The cause of this disparity may be the presence of huge reserves of minor minerals located in the Visakhapatnam district.

Table 5-5: Major mineral production in the Project Region in 2013-2014

District	Major Minerals		Minor Minerals	
	Production 2013-14 (Lakh Tonnes)	Value 2013-14 (Rs. Lakhs)	Production 2013-14 (Lakh Tonnes)	Value 2013-14 (Rs. Lakhs)
Vizianagaram	6.1	525.9	3.8	1536.1
Visakhapatnam	0.3	16.0	19.0	1,036.2

Source: District Statistical Handbooks

The production value in major minerals for three years from 2011 to 2014 has increased gradually in Vizianagaram. But in the case of Visakhapatnam district both the production quantity and value has decreased over the years. This is shown in Figure 5-11.

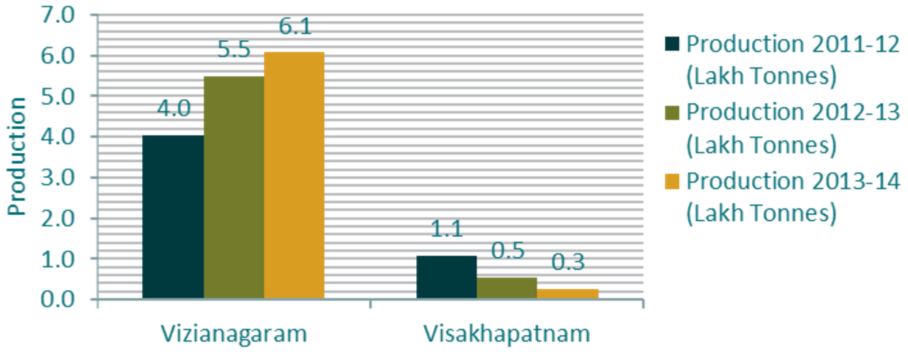


Figure 5-11: Production of Major Minerals in Project Region

The scenario is opposite in the case of minor minerals with decreasing productivity in Vizianagaram while Visakhapatnam experiencing fluctuation (Figure 5-12).

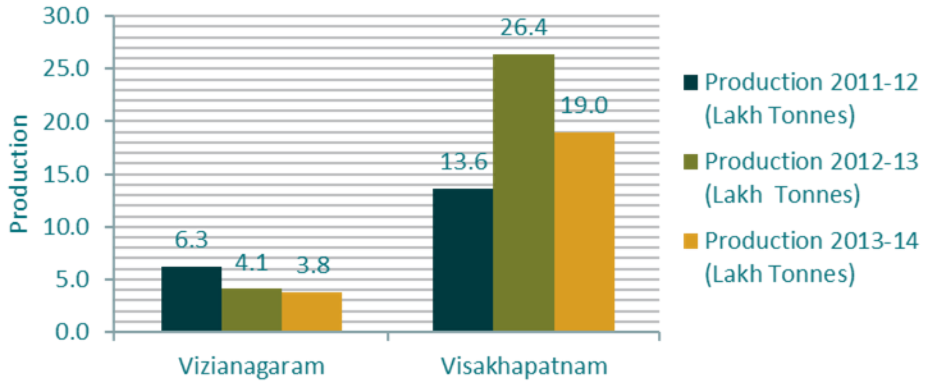


Figure 5-12: Production of Minor Minerals in Project Region

The availability of the major minerals in the districts is assessed by the quantity of production of each mineral in the respective districts. Manganese dominates in the mining sector in Vizianagaram.

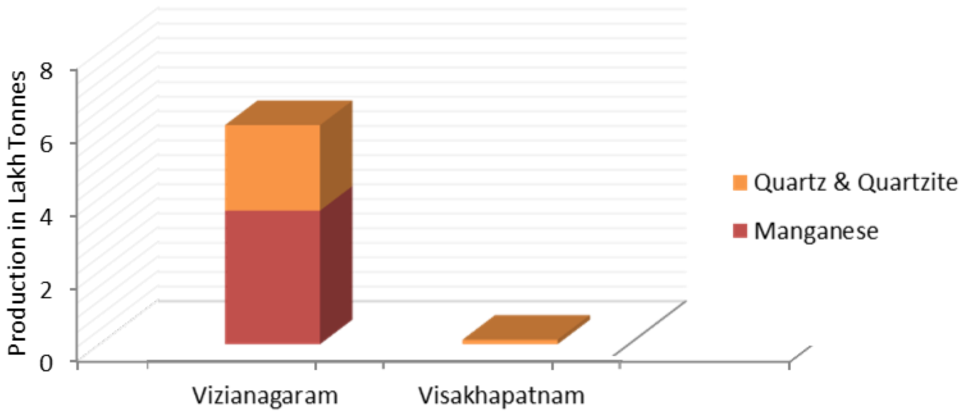


Figure 5-13: Distribution of major minerals in the Project Region

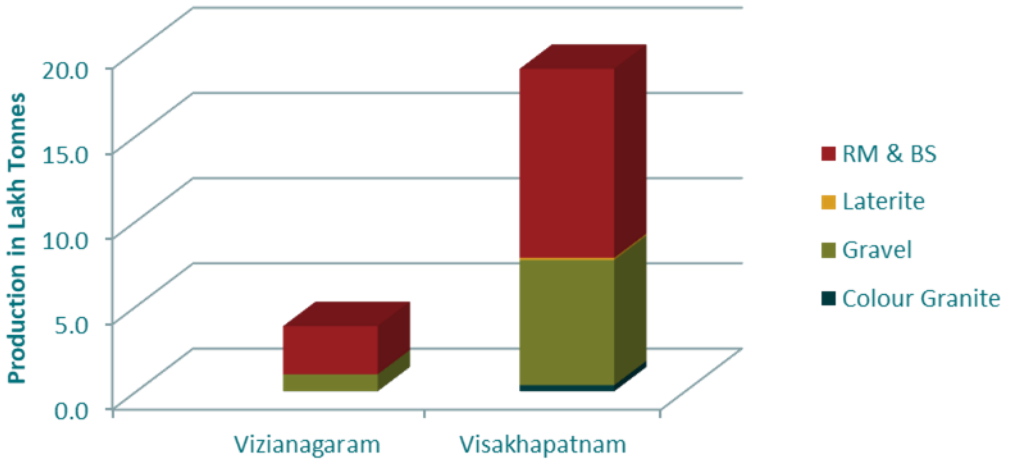


Figure 5-14: Distribution of minor minerals in the Project Region

The VMR falls in the Northern Segment of the Eastern Ghats which has a narrow, rocky coast between Ichapuram and Tuni and a small portion of the Central segment. Therefore, there is a major mineral deposit that falls in the VMR, viz. Bheemunipatnam deposit. These deposits are rich in minerals namely ilmenite, garnet, sillimanite, zircon, pyriboles, etc which are collectively called beach placer. Ilmenite is an important ore in making titanium dioxide pigment, titanium sponge, titanium chloride and titanium metal. Figure 5-15 shows the availability of minerals in the VMR.

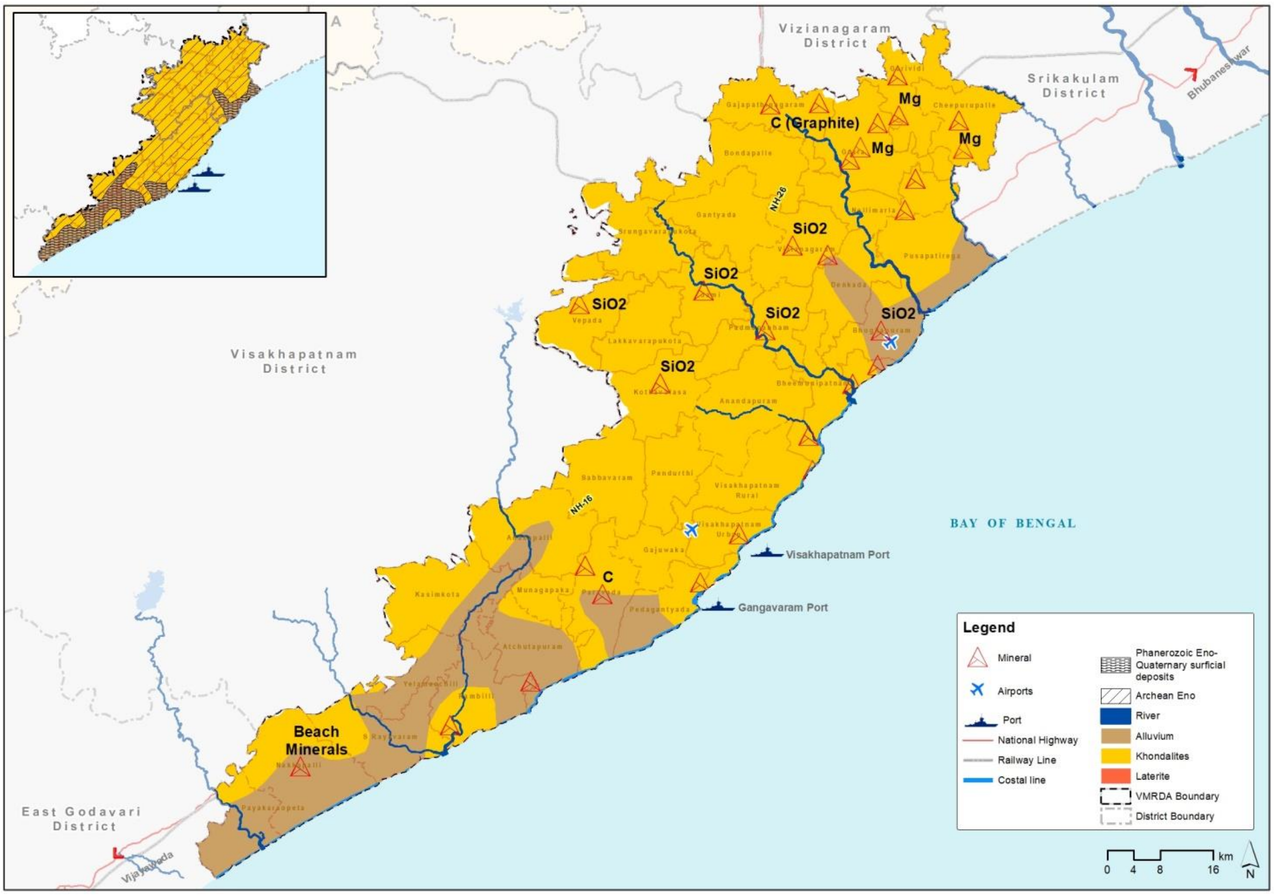


Figure 5-15: Mineral map of VMR

According to the District Domestic Products of the 2 individual districts, two districts have seen a downfall in the domestic product. This may have happened due to the ban on the sand mining in river beds during the last few years because of over exploitation and theft. The detail of the district domestic product is given in Table 5-6

Table 5-6: District Domestic Product of Mining and Quarrying year 2011 to 2013

District Domestic Product in Mining and Quarrying (in Rs. Crores)			
DISTRICT	2010-2011	2011-2012	2012-13
Vizianagaram	41	20	22
Visakhapatnam	929	210	225
VMR Districts	970	230	247
State GSDP	4,560	5,314	5,692

Source: Directorate of Economics and Statistics, Andhra Pradesh

Presently VMR has large availability of manganese, quartz and quartzite and the minerals from beach sand. There is high availability of bauxite in the region, which is still unexploited due to the regulations under Agency Tracts Interest and Land Transfer Act, 1917. The large productivity of road metals and building stones are consumed by the rapid urbanization in the surrounding area. Colour granite is also mined in considerable quantity which finds export demands. With the recent notification of including 31 minerals under state jurisdiction will benefit the state government more from the revenue from mining sector.

5.8 TOURISM & HERITAGE

VMR covers a long coast line and a large region comprising various scenic spots, culturally rich religious destinations and several master pieces of great architectural heritage. Along with the urban attractions in tourist destinations, there are untouched rural scenic spots and relatively less exploited heritage structures located in rural hinterland that offer great potential to generate economic and employment opportunities. The city of Visakhapatnam can be considered as the nucleus for tourist activity in this region.

The VMR offers naturally, ecologically, culturally and religiously diverse variety of tourist destinations that present scope to explore continuously. The tourist destinations that are present in the region can be mainly classified into the following:

- Resorts / Beach front
- Religious Tourism
- Cultural Tourism
- Hill Stations
- Nature / Eco-Tourism
- Adventure Tourism

BEACH FRONT

Sprawling along the coastal line with varied topographical features the VMR offers various options for eco tourists. The coastal line embracing the VMR has a variety of beaches that have stark differences from one another. The meeting point of the land and sea is ornamented with bays that offer visual grandeur for urban beach fronts to ride, relatively shallow beaches that are favourable for water sports, rocky beaches that would offer tranquil atmosphere to spend the leisure time. The rocky mounds near to the beaches have been the adobes of the Buddhist monks from the times immemorial.

The popular beaches adjoining the city of Visakhapatnam and Bheemili offer a varied experience to different tourists with in a span of 30 km. These include the quiet and untouched Yarada beach that welcomes troops of tourists on a family trip, the active Rama Krishna Beach, quite Rushi Konda and Bheemili beaches. Along this 30 km corridor there are many resorts and five-star hotels that are developed in the recent years. This beach front also has parks that attract many city dwellers in the evening. Apart from the existing parks the tourism department and the municipality has proposals to develop it into a continuous stretch of beach front with parks and promenades under the World Bank Disaster resilience program. The other beaches like Appikonda offer clean waters nearby few religious shrines that attract the regional tourists.

Out of the two districts in VMR, Vizianagaram has the shortest coastal line thus falls short of many beach front recreations, yet the Mukkam beach and Chintapalle beach are marked as the beautiful beaches in this district.

Rama Krishna Beach

Yarada beach

Rushi Konda Beach

Chintapalle Beach

Baruva Beach

Muthayalammapalem beach

RELIGIOUS TOURISM

BUDDHIST SOJOURN

The region was a cradle of Mahayana phase of Buddhism. Many mounds and hills that are near to the rivers or along the sea side were homes to the monks who practiced Buddhism. During their stay the monks built many structures of Stupas and Viharas which stand imposing even today.

The Sankaram Village 40 km away from the Visakhapatnam city has the dotted hill side with the small rock Stupas dating back to 2nd Century BC. This Buddhist site is under the maintenance of Archaeological Survey of India. Along the Bheemili beach road there are two Buddhist sites called Bavikonda and Thotla Konda are located. The prolific finds of Buddhist period were excavated here. Further down the Bheemili Road is the Pavurala Konda, where there are 16 awe inspiring rock cut cisterns meant for water harvesting. These three sites are presently maintained by the State Archaeology Department.

Ramatheertham, a noted Buddhist site is located in Nellimarla Mandal of Vizianagaram District . Spread out on three bare granite hills, Bodhikonda, Durgakonda and Gurubhaktula Konda are remains of an ancient Jain temple and an extensive Buddhist monastery that dates back to 3rd century BC. About 118 km from Visakhapatnam in the Srikakulam District is the village called Salihundam which housed a busy Buddhist centre that attracted many monks from all over. Apart from the Stupas and relics the giant monastic complex is a sight to behold.


Sankaram


Thotla Konda


Bavikonda


Ramatheertham


Salihundam


Kalingapatnam

TEMPLES AND SHRINES

There are many temples in Vizianagaram district, which contribute to major tourist activity in the district. The Pyditalli Ammavari temple is the most visited temple where the Pyditalli festival is celebrated at a massive scale in the month of October after the Dussehra in Vizianagaram town. The huge temple complex built for Lord Rama illustrating the Ramayana called Ramanaaryanam located on the way to Srungavarapu Kota from Vizianagaram town attracts many visitors. Apart from these there are temples located in the scenic spots like Punyagiri temple in S.Kota and Mani Nageswara Alayam in Kallepalli witness huge crowds in the months of November where pilgrims come on a picnic or a day tour to these temples in the scenic spaces.

After the temple of Lord Venkateswara in Tirupathi, the Varaha Lakshmi Narasimha Swamy Temple in Simhachalam temple is the most visited in the State of Andhra Pradesh. Along with the great architectural character the view of the city of Visakhapatnam from the hill of Simhachalam gives delight to the pilgrims. The temple of Kanaka Mahalakshmi located in the old town of the Visakhapatnam attracts many visitors from the region in the month of December. There are some of the oldest temple complexes in the places like Panchadarla. ISKCON is presently constructing a temple for the Lord Krishna on the way to Rushikonda.

The Sun temple located in Arasavilli is the second temple for the "'Sun God'' in India. It is visited by many pilgrims who pray the sun god for good health. The ancient temples of Madhukeswara Swamy in Sri Mukhalingam and Sri Kurmanatha Swamy temple in Sri Kurmam attract many pilgrims in the auspicious months of Hindu calendar. These two temples are great architectural marvels in stone construction.

The church on the Ross hill and the Dargah called Ishaq Madina in the old city of Visakhapatnam attract many visitors from the city and the regions. The Baba Dargah in the Vizianagaram town is witnessed by many Muslim and Hindu tourists in the three districts of Vizianagaram and Visakhapatnam and Srikakulam. The Jamia Masjid in the Firdausi garden sprawling for about 150 acre in the town of Srikakulam where the largest burial ground for the Muslim community is located next to the big Mosque.



Simhachalam | Sirimanu in Pyditalli festival | Ramanarayanam



Arasavilli temple | Sri Mukhalingam | Ross hill Church

CULTURAL TOURISM

ARTS AND CRAFTS

The brass ware made in Budithi village in Srikakulam is famous for its fine detailing. The finest Khadi woven in the village called Ponduru is famous from Gandhi period and is exported to many foreign countries.

The Vizianagaram town has been the home to many performing arts like music dance and drama. There are many famous music artists in classical music, Great dancers of Kuchipudi and Bharatanatyam hail from this place. Etikoppaka is famous for its age-old tradition of wooden carvings.



Etikoppaka Toys | Budithi brass ware | Ponduru cotton


Bobbili Veena | Music college in Vizianagaram

FESTIVALS AND FAIRS

Vizianagaram: The department of Tourism and the district administration celebrate a three day annual festival called Vizianagaram utsavalu where many art and cultural programs are conducted in the different venues. This Utsav is celebrated with the vision to celebrate the richness of the past and to support the people to take it forward to future generations.

The Visakha Utsav: The AP tourism department and the district administration conduct the Visakha Utsav in Visakhapatnam city along the beach road and some other venues. The Folk-dance forms and flower show and active stage along the beach road for showcasing different performing arts. The beach road is pedestrianized with vibrant art and cultural shows and decorations. This attracts people from other towns and the people of Visakhapatnam at massive numbers to the beach road.

As the two districts in VMR contain significant tribal population with indigenous knowledge in medicine and art forms annual tribal festivals or" Girijana Utsavalu" are celebrated in Seethammapeta of Srikakulam, Parvathipuram of Vizianagaram, Araku and Paderu of Visakhapatnam. Though these areas are out of VMR, there is a significant regional tourist activity that is associated with the VMR.

HERITAGE STRUCTURES

The region is rich in Buddhist heritage that was dating back to Mahayana period. There are many religious temples which are great architectural heritage belonging to different time periods. The remnants of the dynasties that have ruled this area in different time periods are present in the forms of forts and palaces of Jamindars and Kings. The houses of great freedom fighters and poets are heritage where the association with these eminent personalities is celebrated till date. Many institutions in the region are built under different rulers and British which still continue to work as colleges and other offices of government and Private. The details of the heritage monuments in the region are presented in the chapter covering heritage and conservation in this report.

Visakha Utsav

Vizianagaram Utsav

Sikkolu Sambaralu

Visakhapatnam Collectorate

Vizianagaram fort

Sher Mohammadpuram

MUSEUMS

The artefacts and the historical evidences of the three districts are mostly stored in the Visakha Museum located on the beach Road in Visakhapatnam. A 17th century Dutch building in Kiralampudi Layout is converted to Museum in 1991. This houses the great naval history of Visakhapatnam and archaeological objects and the pictures narrating the story of Visakhapatnam. State Archaeology department is opening up a new district museum in Vizianagaram district.

HILL STATIONS

Araku is one of the most important tourist destinations in Andhra Pradesh. The pleasant hill station is famous for its scenic gardens with lush green nature, valleys, waterfalls and streams. It is situated at a distance of 112 km from Visakhapatnam. The journey to Araku valley on the Eastern Ghats with thick forest on either sides is itself highly interesting and pleasant. The trip to Araku includes covering the locations like Chaparai, Padmapuram gardens, viewpoint, and coffee plantations. The resort at Anantagiri gives a wonderful experience to the visitors. There are many tourist packages which are originating in Visakhapatnam and are covering few destinations like Anantagiri and Araku in a circuit.

NATURE OR ECO TOURISM

NATURAL AND SCENIC AREAS

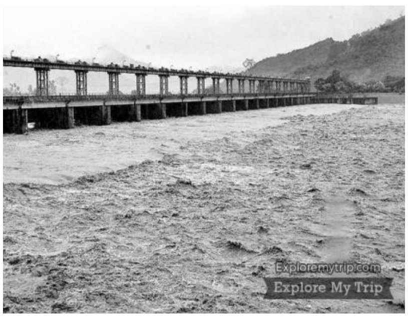
The city of Visakhapatnam and the surrounding scenic spaces attract many tourists for a short retreat. The hill next to the Visakhapatnam Port called Dolphin Nose, Kailasagiri hill, Erramatti Dibbalu or Red sand hills and the large reservoir in Mudasarlova are the scenic spots which attract the visitors to the nature from the busy urban areas. The other places like Thatipudi reservoir, Thotapalli reservoir, Jhanjhavathi rubber dam are built on the water bodies on the Vizianagaram district are scenic spaces where there are some tourist refreshments that rejoice the tourists in the tourists who come here for short trip. There are facilities like boating and cottages arranged by AP tourism. The Indira Gandhi Zoological Park in Visakhapatnam and the bird sanctuary in Kondakarla Ava present the experience of Biodiversity to the nature lovers. The forest trial and trekking in the Kambalakonda hills offer a good nature experience to the visitors. Telineelapuram is a village located 65 km from Srikakulam in Tekkali Mandal, while Telukunchi is at a distance of 115 km from Srikakulam in Ichchapuram Mandal. Every year, over 3,000 Pelicans and Painted Storks visit from Siberia to these villages during September and stay on till March. It is a paradise for bird observers.

Araku

Tyda

Thatipudi reservoir

Thotapalli barrage



Gotta barrage

Telineelapuram

Tyda is a small village nestling in the wooded hills of the Eastern Ghats, on the way to Araku from Visakhapatnam. Tyda is located 75 km from Visakhapatnam. This place is a natural bounty of flora and fauna.

The place is over 3,200ft. the Padmapuram gardens, Chaparai, coffee plantations are most visited tourist spots in this area.

ADVENTURE TOURISM

Apart from the Visual appeal to the visitors the city of Visakhapatnam is also offering other water sports at Rushi Konda Beach Boating and fishing at Visakhapatnam Fishing Harbour. Recently the Scuba Diving also encouraged in the Visakhapatnam sea waters where visitors get to experience the fun of scuba diving and see the marine fauna in the months between October to March.

Rushi Konda

Boating near fishing harbour

Scuba diving

Rural tourism is given particular thrust to showcase arts, crafts, sculpture, handloom, textiles and other skills in village locations that have core competence to develop as distinct economic and tourist destinations exploiting local special talent and resources. Tourism attributed to medical services, health, wellness, study and science centres for education purpose is growing significantly creating new centres of importance and focus of attention.

5.9 TOURISM DESTINATIONS

Potential tourism attractions within VMR are detailed in Appendix D. Figure 5-16 presents their spatial location.

The monthly foot falls recorded at the different destinations indicate the most visited destinations in both districts to be religious destinations. According to the destination wise Tourist foot falls recorded and the existing tourist Infrastructure available in destinations of VMR, it is seen that temple of Sri Varaha Narasimha Swamy located at Simhachalam is recorded to be the destination with highest footfall, whereas the Pyditalli Ammavari temple is most visited in Vizianagaram. The Ramanarayanam in Vizianagaram is recorded as the second most visited destination in the recent two years. Most foreign footfall is recorded in the beaches along Visakhapatnam and the Buddhist Monuments located along the coast in Visakhapatnam and Bheemili.

With the scenic landscapes and a number of proposed tourism development projects (Appendix D) in the pipeline, VMR has the potential of turning into a world class tourism destination in the future years. It is also going to be a significant contributor to the economy once the sector works in a more organized manner.

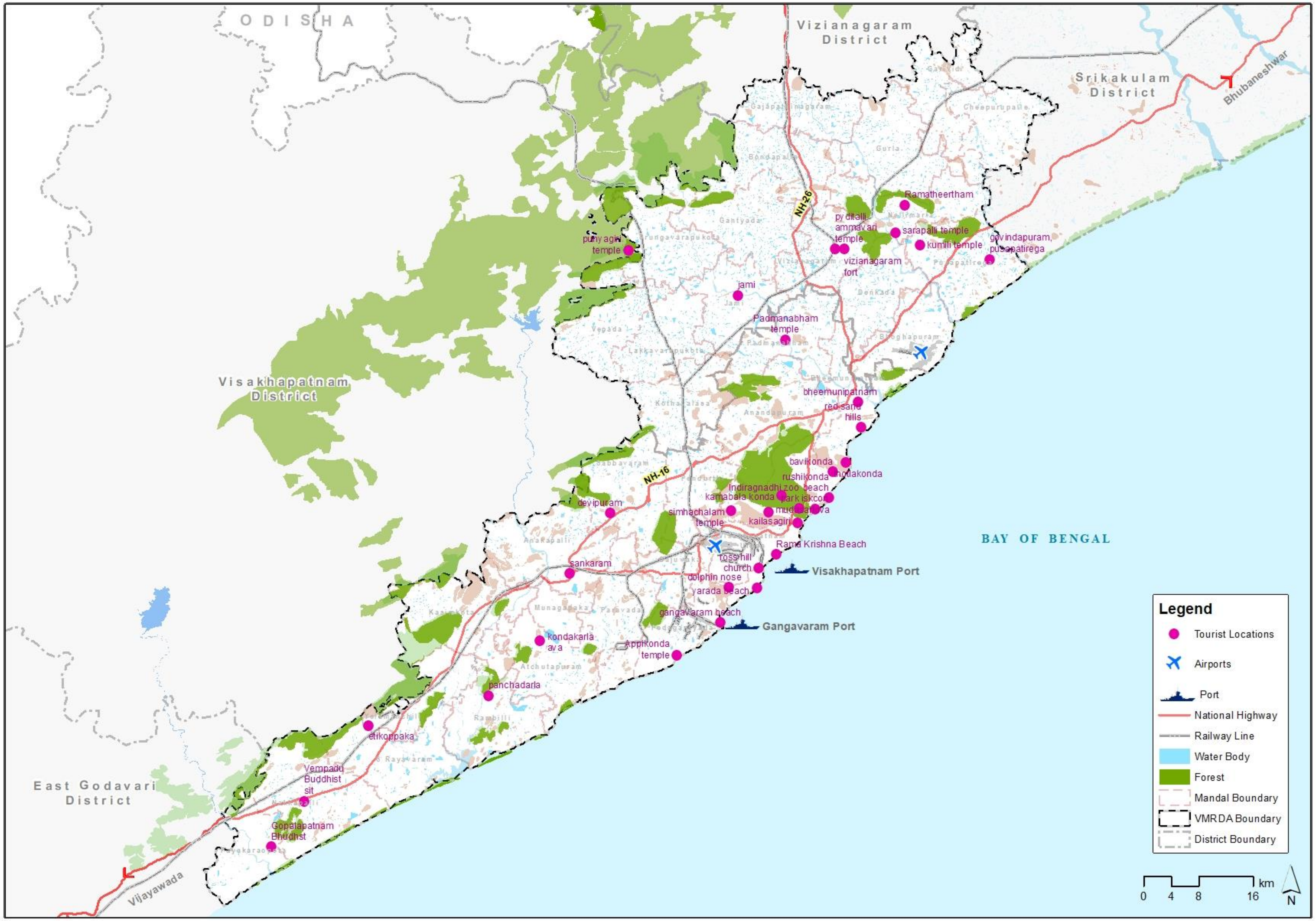
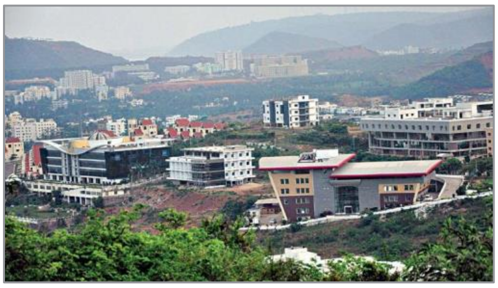


Figure 5-16: Map showing the tourism locations in VMR

5.10 OTHER KEY SECTORS

IT / ITES



Visakhapatnam being an established IT hub and also with the Fintech valley, the city has already started development in Rushikonda to attract IT companies. There are 3 IT Hills where site has been developed for IT companies to put their units. Though the growth has not been very high but there are number of big firms operating from the area.

The stakeholder consultation has suggestions like improving the existing infrastructure at Rushikonda along with public amenities and identifying new IT industry region for the future like Rajam.

UNORGANIZED LOCAL BUSINESSES

Unorganised sector forms a major part of the economy specially at a regional level, where rural areas with higher involvement in the primary sector economy has allied activities based on agricultural produce manufacturing edible end products. These areas develop indigenous skills which has high potential in boosting the local economy.

In VMR, the gross value added by the unorganised manufacturing sector is 15% of the manufacturing sector in the region. This is a significant amount considering the high contribution of VMR in secondary sector. Unorganised sector in this region also includes various kinds of downstream ancillary industries for the established large industries. The contribution of unorganised sector is graphically produced in Figure 5-17. However, there are various prominent indigenous products and household industrial clusters that have developed in the region from history. The same has been depicted in Figure 5-18.

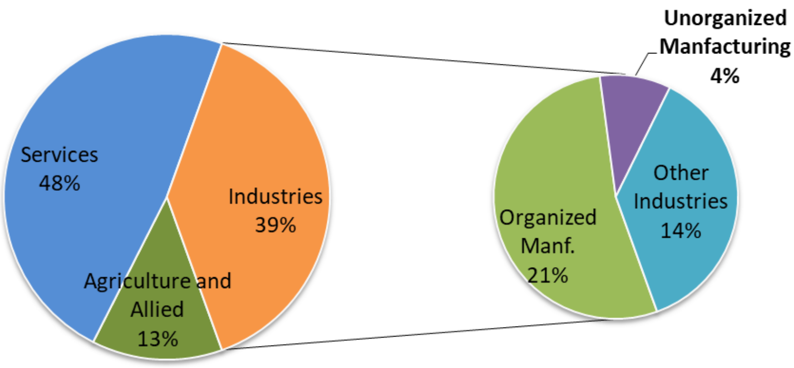


Figure 5-17: Contribution of Unorganised sector in the Economy of VMR

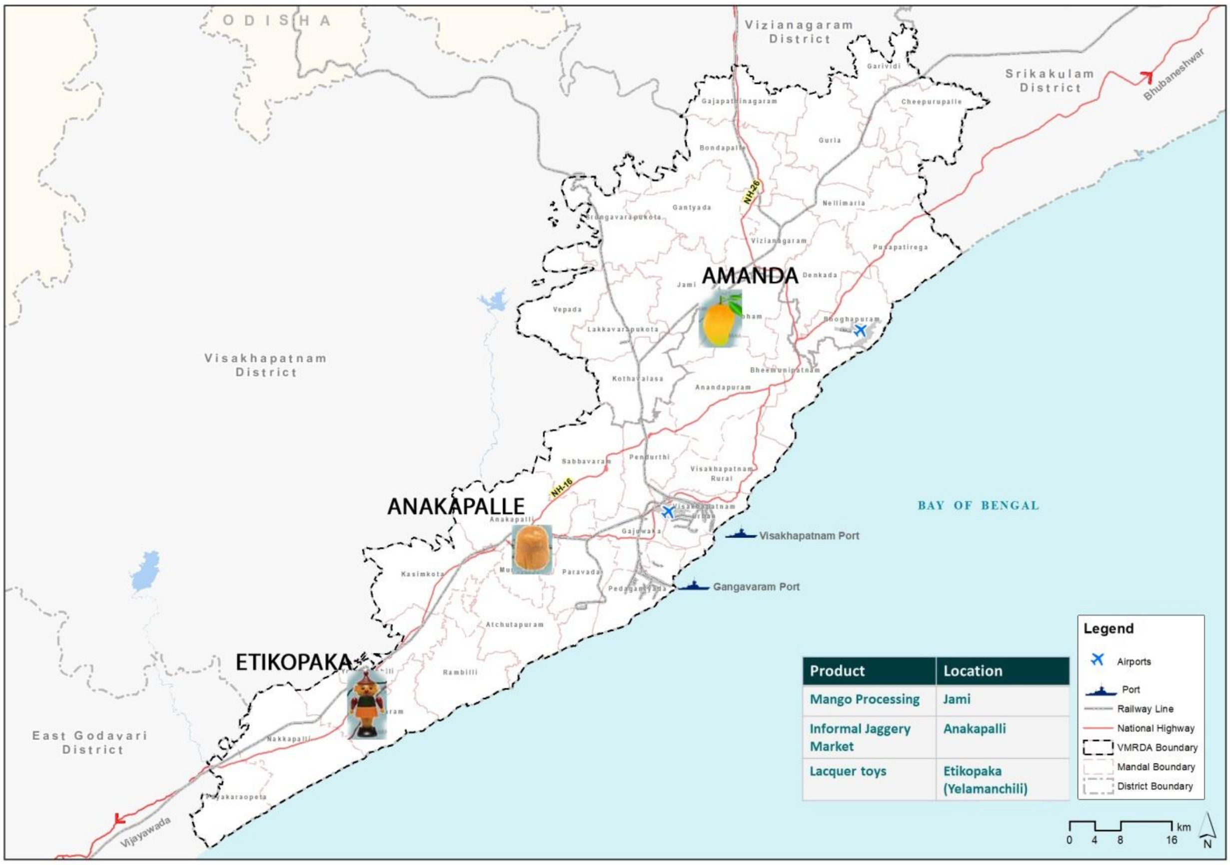


Figure 5-18: Indigenous unorganised sector and products of VMR

Conclusion

The VMR has a strong industrial base with distinct typology of industries which has been influenced by the factors like the presence of port like the Visakhapatnam port and Gangavaram port, the availability of resources of agricultural produce like jute, rice, sugar, cashew and even fisheries, minerals in the Eastern Ghats and petroleum in the Krishna-Godavari basin, availability of labor and the exposure to the global market. These have induced the development of industries like metal and metal fabrication and machinery manufacturing, food processing units, textile industry, petroleum and petrochemical units, and pharmaceutical and allied chemical manufacturing units. The warehousing and logistics have also been very active complementing the port and manufacturing activities with the given global and hinterland connectivity.

With the help of the initiatives of Andhra Pradesh Government through agencies like APIIC and facilities like single window clearances for setting up manufacturing units, the state is at a leading position at ease of doing business and is attracting large investments even from the global market. The prospect of the tertiary sector is enormous with the brilliant connectivity. IT industries is bound to flourish with the proactive initiatives, the scenic coast and Easter Ghats makes a great tourism attraction and real estate boomed. The education, health and hospitality sector has also seen a rise in the recent years. With the varied kind of investments in the recent time apart from the regular investment as per the trend, it is important to streamline the growth to ensure a sustainable development of the potential sectors and the overall economy of the VMR.

6 EXISTING LAND USE, 2018

This chapter briefly presently the methodology adopted in preparation of existing land use for VMR, various tools and techniques exercised, along with analysis of urban & rural areas. Base map is one of the major outputs of the Master Plan preparation process. The base map provides the spatial information needed for preparation of various developmental proposal and preparation of Master Plan and zonal development plans. The base map is prepared based on the satellite imagery procured for the area and site visits conducted for ground truthing. Apart from the satellite imagery and ground truthing, several maps and layers are collected and brought to a common scale to generate the base map is prepared to include all the latest available data. All data will be collected together and placed in a Geodatabase that can assist the users in extracting necessary information in the shortest possible time. This section outlines the process for base map preparation that will be adopted.

6.1 INTRODUCTION

Base map is one of the major outputs of the Master Plan preparation process. The base map provides the spatial information needed for preparation of various developmental proposals and preparation of Master Plan. The base map is prepared based on the satellite imagery procured for the area and site visits conducted for ground truthing. Apart from the satellite imagery and ground truthing, several maps and layers are collected and brought to a common scale to generate the base map is prepared to include all the latest available data. All data will be collected and placed in a Geodatabase that can assist the users in extracting necessary information in the shortest possible time. These layers help in identifying the environmentally sensitive areas, areas which are already developed and the lands which are available for future development.

6.2 PREPARATION OF BASE MAP

The preparation of a good base map is crucial for the project based on which the spatial analysis is carried out. The methodology adopted for the preparation of Base map and existing land use is represented in the Figure 6-1 and Figure 6-2 respectively. Existing land use is interpreted through visual interpretation techniques from satellite Imagery using ESRI's ArcGIS. Various sources such as google maps and other open geo-spatial databases available have been used for interpretation and cross referencing. The process involves various steps like procurement of High-Resolution Satellite Imagery, rectification of the satellite imagery through DGPS Survey, collection and overlay of secondary data from various departments, vectorization of data and landcover, which is further verified through ground level surveys.

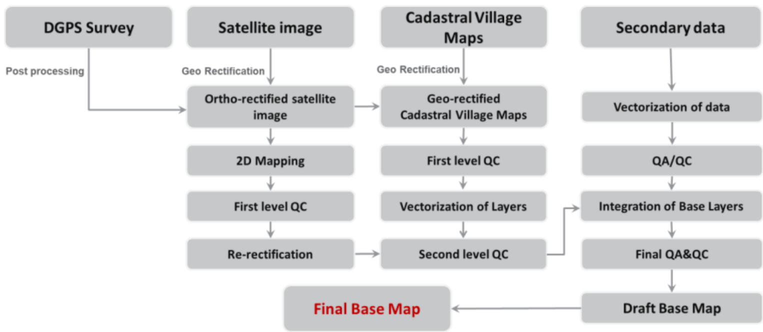


Figure 6-1: Methodology for preparation of Base Map

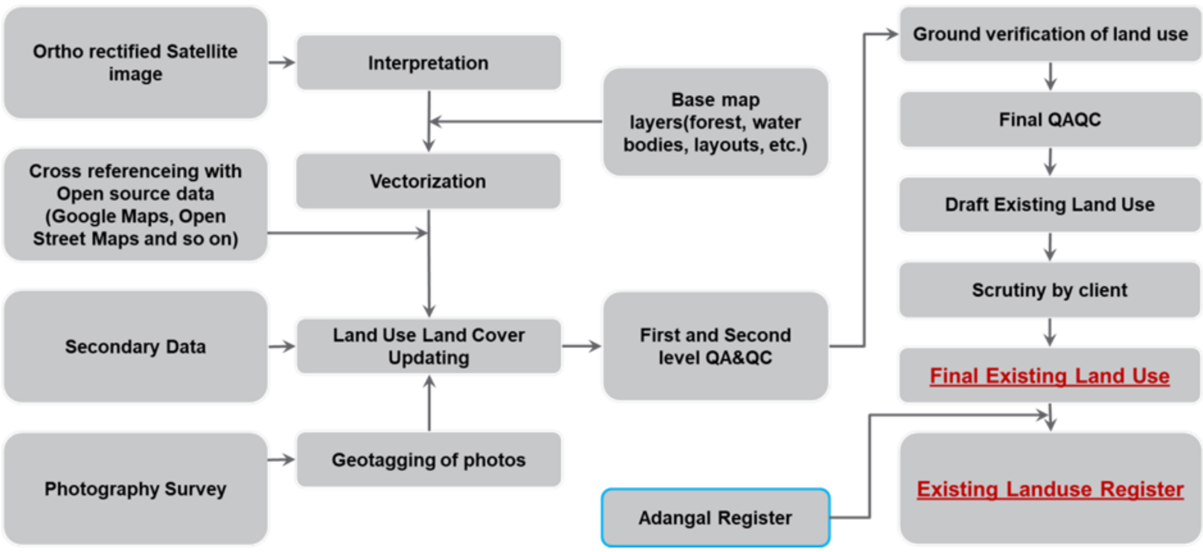
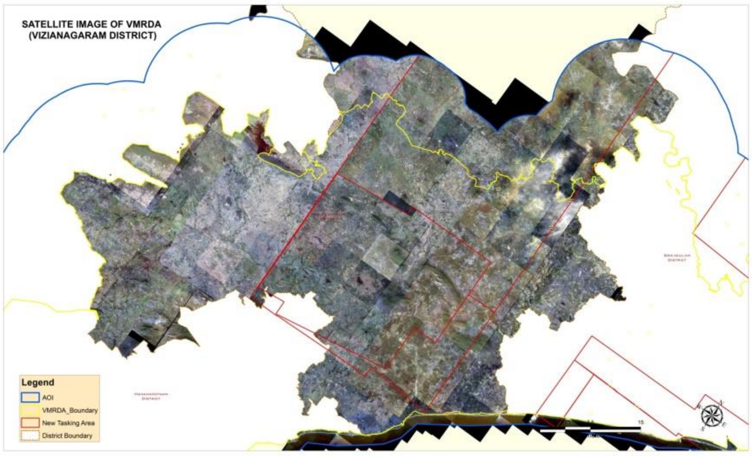


Figure 6-2: Methodology for the preparation of Existing Land Use

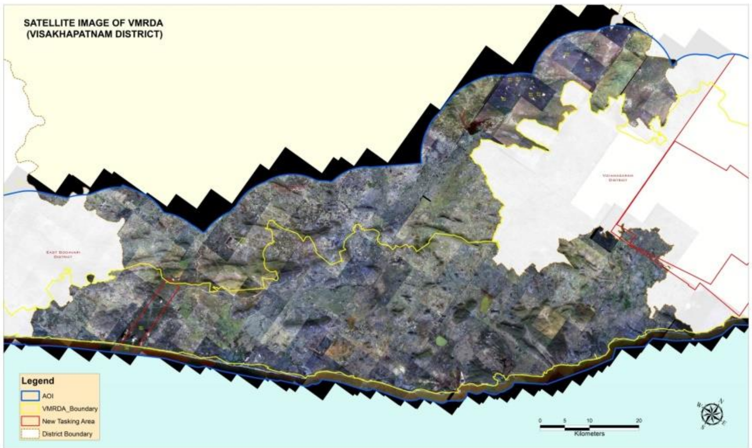
SATELLITE IMAGERY OF THE PROJECT AREA:

The satellite imagery for the project area was procured for an area of 4873.3 Sq. Kms with VMR and an average buffer of 2 km on all sides. The imagery used is captured during the period of 2015 and 2017.

Satellite imagery for the district of **Vizianagaram** has been procured for an area of **2,209.8 Sq.Kms**. this consists of **16 Mandals and 539 villages.**



Satellite imagery for the district of **Visakhapatnam** has been procured for an area of **2,663.5 Sq.Kms**. this consists of **19 Mandals and 463 villages.**



DGPS SURVEY

GPS known as Global Positioning System is a collection of number of satellites in the space GPS signals coming from satellites down to the ground have to travel through layers of the earth's atmosphere, so they are subjected to delays this effects errors in the measured position. Although DGPS is an enhancement to the GPS system, based on the satellite technology can have the nominal location accuracy of 5 meter whereas DPGS can bring accuracy around 1 meter. A total of 1081 GCPs have been taken collected to rectify the Satellite Imagery which includes around 100 secondary control points and 6 Survey of India benchmarks across the VMR.

All the benchmark points are connected to the International GNSS Service Station (IGS) located in Hyderabad. Baselines have been formed for all the GCPs using the triangulation method and a minimum of three baselines are formed for each of the GCPs.

Figure 6-3: DGPS Survey

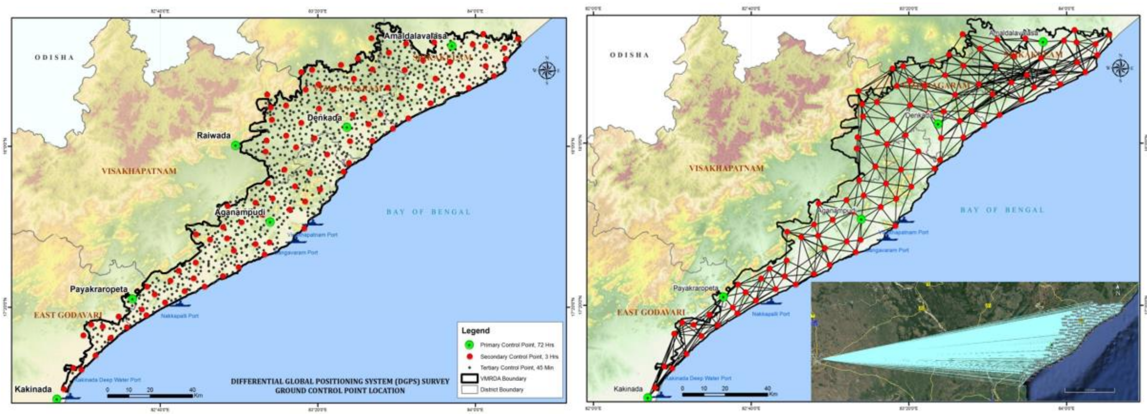


Figure 6-4: Maps showing GCPs and their triangulation

DIGITIZATION AND ADDITION OF FEATURES

The elevation data and toposheets from Survey of India are used for extracting all the natural features from the satellite imagery. The Revenue Village Maps are superimposed on the geo-rectified Satellite imagery for vectorization of various layers along with the village survey boundaries.

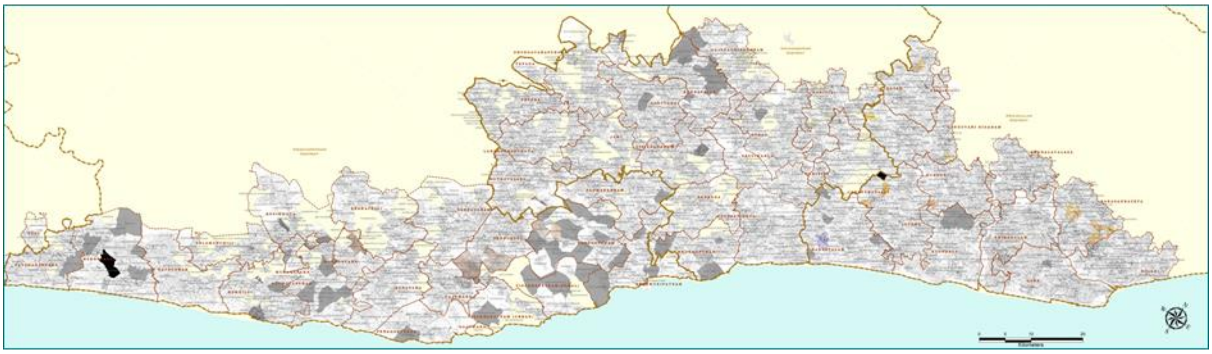


Figure 6-5: Geo rectified revenue village map superimposed on ortho-rectified satellite imagery

The approved layouts provided by VMRDA are geo-referenced and vectorised on the satellite imagery. A total of more than 3,750 layouts (including VMRDA, DTCP, LRS and EWS from the year 1983 to 2020) have been incorporated into the base map.

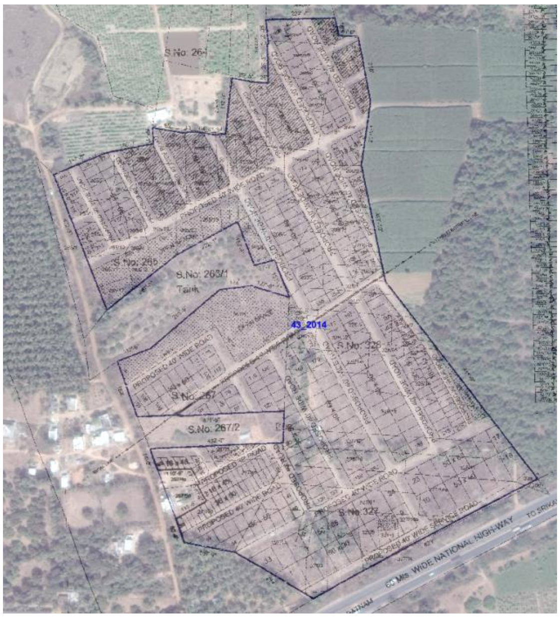


Figure 6-6: Geo-referencing Approved Layout

Figure 6-7: Vectorization of Approved Layout

- Digitization of landuse and land cover over the processed satellite imagery.
- Digitization of various built up elements like roads, building footprints, government offices, temples, burial grounds etc. along with the natural features such as hills, waterbodies, forests, etc. on the satellite imagery.
- Overlay of revenue villages on satellite imagery in cognisance with survey boundaries, survey numbers, village and Mandal boundaries

- All the features are further scrutinized using ground truthing and ground verification under Quality Assessment and Quality control (QA/QC). With the inputs received through the site visits involving the officials and the client, the draft base map is rectified, and the final base map is generated. The Existing Landuse is prepared by overlaying various landuse components on the base map.

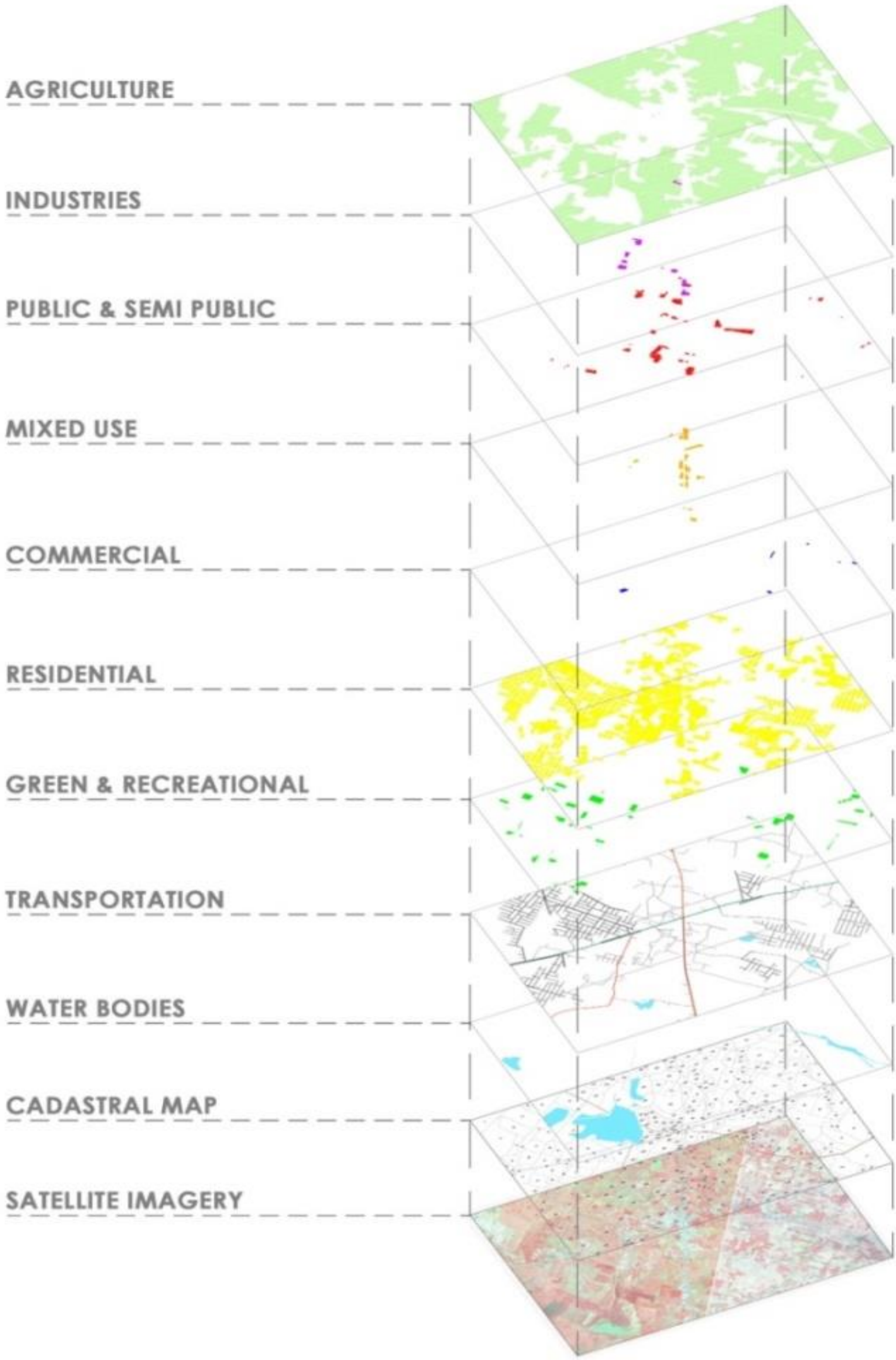


Figure 6-8: Overlapping of various layers to arrive at an accurate landuse map

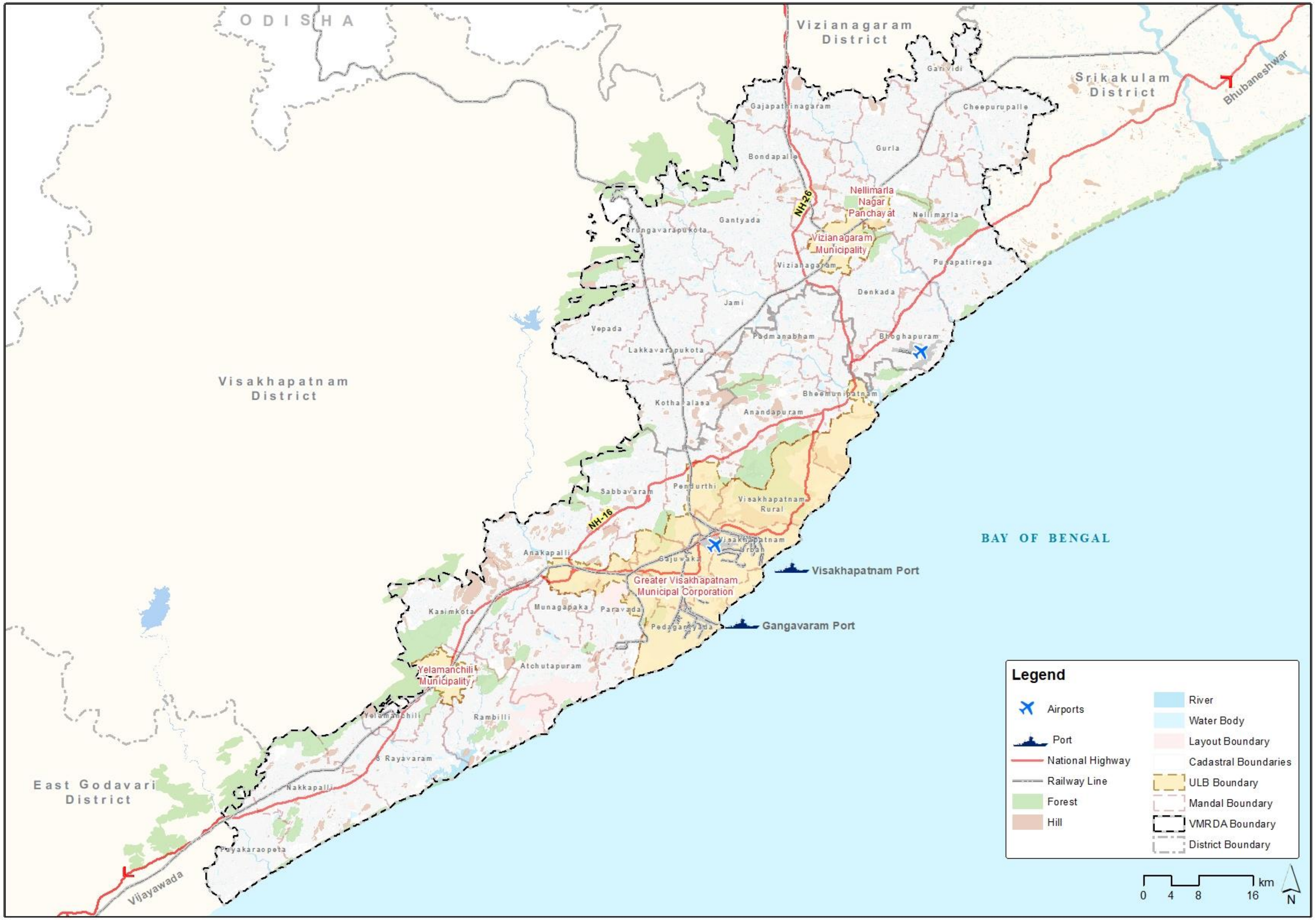


Figure 6-9: Base Map of VMR

6.3 EXISTING LANDUSE PLAN – VMR

The erstwhile VMR has a total area of 1,721 Sq.Km until 2008, which includes 5 urban centers viz., Visakhapatnam, Vizianagaram, Anakapalli, Bheemunipatnam and Gajuwaka and 287 villages.

The revised project area of VMR has a total geographical area of 4867.38 Sq.Kms consisting of 4 Urban Local Bodies and 896 villages spread across two districts viz., Vizianagaram and Visakhapatnam. After carefully analyzing the region, the existing land use is prepared using more than 40 land uses as shown in Figure 6-10 comprising of more than 110 layers in ArcGIS.

Figure 6-10: Image showing various landuse layers generated in the ELU

The Existing Land Use for VMR can be categorized into three broad heads viz. Environmental Sensitive Areas, Developed Areas and Areas available for Development.

Table 6-1: Existing Land Use Statement of VMR 2019

S.No	LANDUSE CATEGORY	VMR		
		Area in Ha	%	% of Development Area
A.	**Environmental Sensitive Area**	**115304**	**24%**	
1	Forest	37641	8%	
2	Hills	38011	8%	
3	Sandy Area	1420	0%	
4	Water Bodies	38232	8%	
B.	**Developed Areas**	**75982**	**16%**	**100%**
1	Commercial	1004	0.2%	1%
2	Communications	32	0.01%	0.04%
3	Industries	14263	3%	19%
4	Mixed Use	721	0.1%	1%
5	Public & Semipublic	4121	1%	5%
6	Public Utilities	509	0.1%	1%
7	Recreational	4700	1%	6%
8	Residential	34188	7%	45%
9	Transportation	16445	3%	22%
C.	**Areas Available for Development**	**293059**	**60%**	
1	Agriculture	290290	60%	
2	Vacant	2770	1%	
Total		486,783		

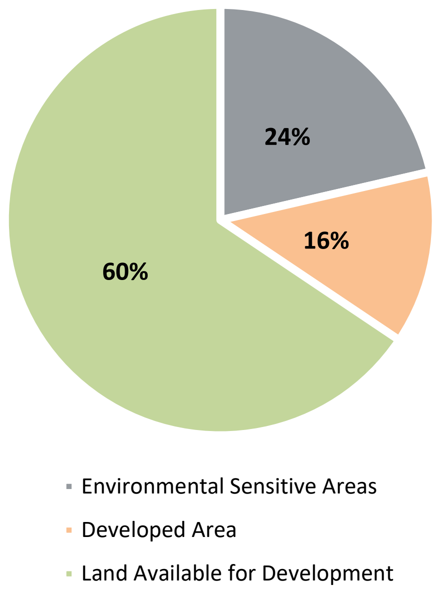


Figure 6-11: ELU in Broad Categories of VMR

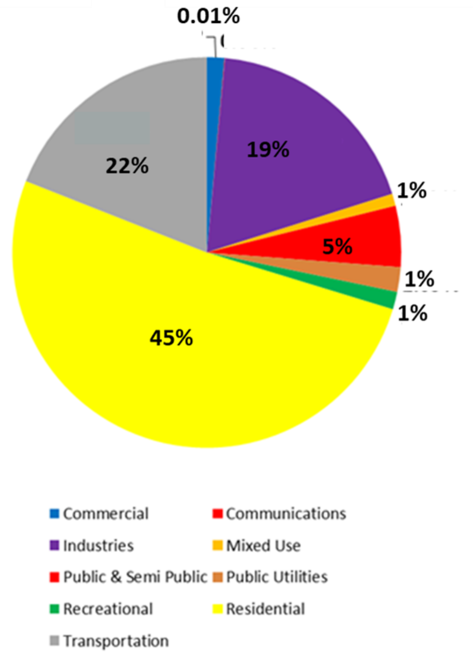


Figure 6-12: ELU in Developed Areas of VMR

VMR has about 24% of Environmentally Sensitive areas in the total area which include Forests, Hills, Water bodies and Sandy areas in the region. Whereas, the developed areas like Residential, Commercial, Industrial, Mixed-Use, Public and Semi-Public, Recreational, Utilities and Transportation constitute around 16% of the entire region. The rest of the region comprises of mostly Agriculture and allied activities which is also the predominant land use having about 61% of the entire region. Among the developed areas, Residential sector forms about 45%.

Based on the above Table 6-1, these are some key inferences from ELU of VMR:

- Agriculture is the predominant landuse with about 65% of the entire region.
- More than 38 Sq.Kms of rich natural water bodies comprising of lakes and rivers can be found in the region which comprises to 8% of the total area.
- Within the developed areas of VMR, more than 45% is of residential landuse accounting from the large urban local bodies in the three districts, majorly Greater Visakhapatnam Municipal Corporation (GVMC), Vizianagaram Municipal Corporation (VMC).
- Transportation and Industrial are the second and third largest landuse after Residential landuse respectively followed by Public and Semi-Public usage, in the developed areas of the region.
- Industries are majorly concentrated in and around the urban areas of the region.

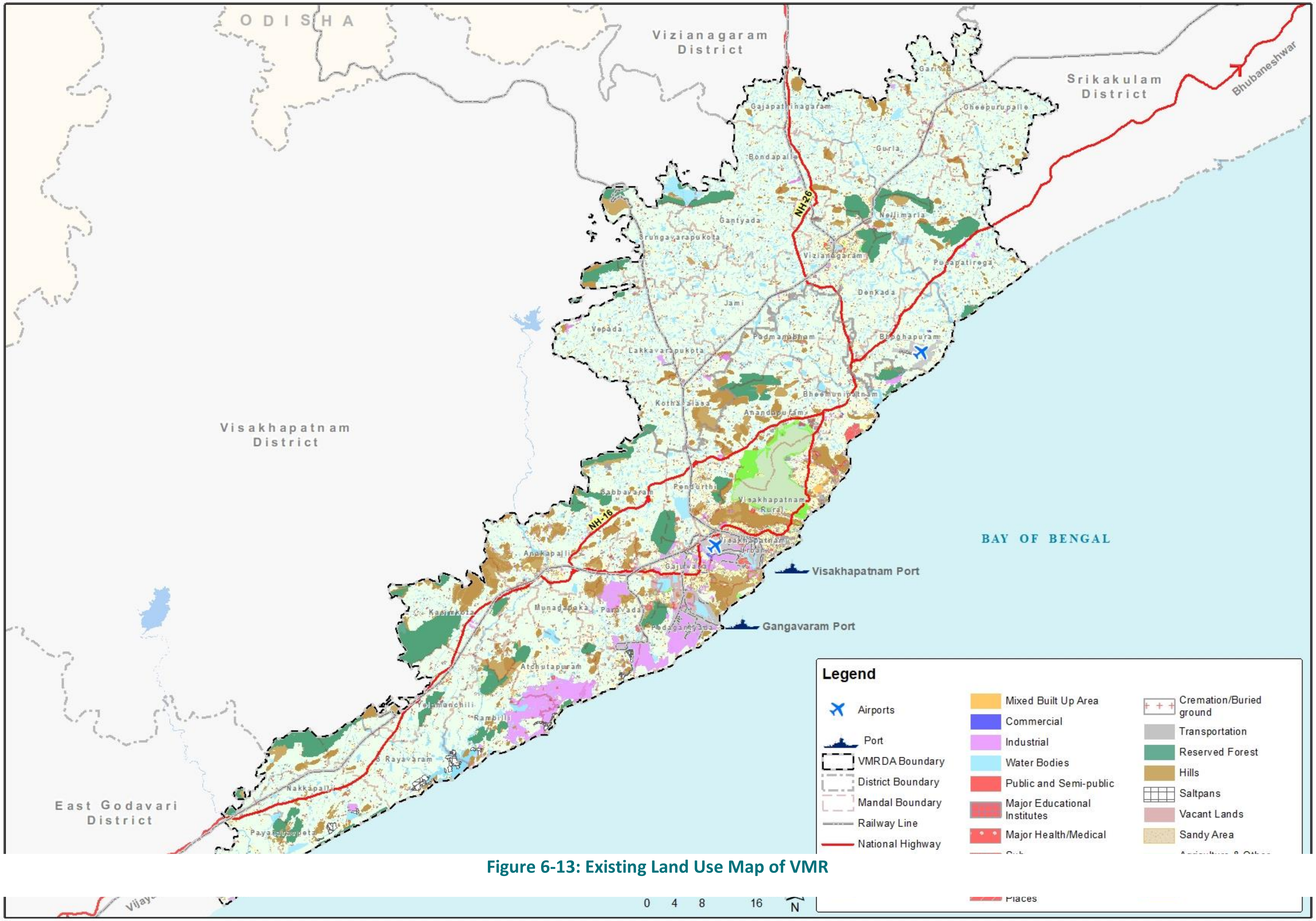


Figure 6-13: Existing Land Use Map of VMR

6.4 EXISTING LANDUSE PLAN – URBAN CENTERS

There are 4 urban local bodies in VMR viz., Greater Visakhapatnam Municipal Corporation (GVMC), Vizianagaram Municipal Corporation (VMC), Yelamanchili Municipality, and Nellimarla Nagar Panchayat. The total area under these ULBs is 779 Sq.Kms, which accounts to around 12% of VMR.

More than 42% of the area is developed and around 28% is available for future development. The lands which are available for development are mostly used for agriculture and allied activities.

Table 6-2: Showing Existing Land Use Statement of Urban Areas in VMR 2018

S.No	LANDUSE CATEGORY	URBAN		
		Area in Sq.Kms	%	% of Developed Area
A.	**Environmental Sensitive Areas**	**227.37**	**29.18**	
1	Forests	86.74	11.13	
2	Hills	103.21	13.24	
3	Sandy Area	2.05	0.26	
4	Water bodies	35.38	4.54	
B.	**Developed Areas**	**328.77**	**42.19**	**100.00**
1	Commercial	6.75	0.87	2.05
2	Communications	0.27	0.03	0.08
3	Industries	64.68	8.30	19.67
4	Mixed Use	6.51	0.84	1.98
5	Public & Semi Public	24.19	3.10	7.36
6	Public Utilities	7.35	0.94	2.24
7	Recreational	8.39	1.08	2.55
8	Residential	152.41	19.56	46.36
9	Transportation	58.22	7.47	17.71
C.	**Areas Available for Development**	**223.07**	**28.63**	
1	Agriculture	205.09	26.32	
2	Vacant	17.98	2.31	
	TOTAL	**779.21**	**100.00**	

KEY INFERENCES:

- Though there are many natural features, extended waterfront and scenic places present in the region, the recreational use is limited to a mere 2.5% in the urban areas as compared to the recommended value of 14 – 16 percent according to URDPFI guidelines.
- GVMC has the largest ULB area in the region which has huge natural features like Reserved Forests and Hills.
- A major portion of the developed areas are under Industrial landuse amounting to nearly 20% of it, which is significantly higher as most of them are within the urban areas.
- The transportation comes third with 17.7% constituting of the vast lands allocated to the Railways, Port and the Airport.

6.5 MAJOR ISSUES

ENVIRONMENTALLY SENSITIVE ZONES:

More than 29% of the urban areas come under environmentally sensitive areas. With the steady growth in port and Industrial sectors, which are the two main economies in the region, VMR faces problems like encroachment of ecologically sensitive areas like hills and water bodies. Furthermore, these natural environments are prone to pollution from the haphazard development of industries near them.

Scarcity of land within the urban areas lead to unplanned commercial and residential development along the region's extended coastline, which is prone to storm surges and cyclones, without any consideration of buffer zones mandated by CRZ norms.

DEVELOPED AREAS:

More than 50% of the population lives in the urban areas of the region. Urban Sprawl can be observed along the national and state highways in the region, which go beyond the ULB boundaries leading to fragmented development. This in turn has a negative implication in providing quality urban transportation service.

Many state level and central level PSUs in the city has created scarcity of land for development.

Many industrial estates, clusters, ports are not fully occupied increasing the amount of under-utilized land in the urban areas.

LANDS AVAILABLE FOR DEVELOPMENT:

The region is privileged with vast fertile agricultural lands which have a high yielding capacity and can produce up to 2 to 3 crops per annum. They constitute up to 65% of the land in the region, which are susceptible to change from the rapid urbanization, sprawl and non-agricultural based industrial growth.13% of this is available for development.

7 TRAFFIC & TRANSPORTATION SECTOR SCENARIO

Master Plan for VMR is being prepared based on analysis of several secondary data, mapping & analysis, while it is being strongly supported by extensive field surveys on key aspects of transport. This chapter while presenting the secondary information on transportation in the region, it strongly emphasizes the transportation surveys and presents the summary analysis of mobility levels of passenger and good movements, travel desire lines, parking, intersections, passenger and goods terminal surveys. Further, Calibration and Validation of travel demand models has been carried out by making use of secondary and primary survey data and Base Year (2018) travel demand and network analysis is presented in this chapter.

7.1 INTRODUCTION

Transport sector is one of the important sectors in preparation of Master Plan. Investments needs point of view, similar studies indicate that, about 70% to 80% overall infrastructure cost of the city/ region is for traffic & transport infrastructure. In the past, transport sector plans are broadly road based. However, with the advent of alternative public transport technologies i.e. bus, BRTS, LRT/ metro neo/ metrolite/ metro/, suburban train/ commuter rail, etc. which have higher capacity to handle the travel demand, lead to detailed traffic & transport analysis in assessment of Transportation infrastructure for the plan period. In fact, higher population and employment densities can be achieved around/ along the high capacity public transport corridors. With time, transportation planning discipline also evolved and now travel demand modeling approaches and software tools available for detailed travel demand analysis and transport network assessment. Transport sector strategies and plans prepared by making use of the calibrated travel demand models and following the NUTP 2014 Guidelines, URDPFI Guidelines, etc. and the details are presented in the following sections.

7.2 EXISTING TRANSPORT NETWORK IN VMR

Transportation is the lifeline for development of VMR. The region is endowed with a very well-developed inter-city transport network by all modes of transport – road, rail, air and sea. Being a coastal region and having natural harbour it has added advantage of three major ports in the region and its vicinity. In terms of road and rail network, the region is well connected by the national highways and trunk rail network. Within the region, various sub-regions/ urban settlements are well connected through a combination of NHs, SHs, MDRs, ODRs and Village Roads. Within the urban areas, the road network is reasonably well established. Existing transport network in VMR is described in the following sections.

7.3 REGIONAL ROAD TRANSPORT NETWORK

NATIONAL HIGHWAYS

The VMR spread across two districts has a road network of 2,400 km approximately (Ref. Figure 7-1). NH- 16 (erstwhile NH- 5) is the major corridor, which connects the Project Area to the rest of the nation. This corridor is the life line for the Project Area, which traverse through the east coast of the states of Andhra Pradesh, Tamil Nadu and Odisha. NH 16 has 6 lane-divided carriageway and this highway forms a part of the Golden Quadrilateral project undertaken by National Highways Development Project (NHDP).

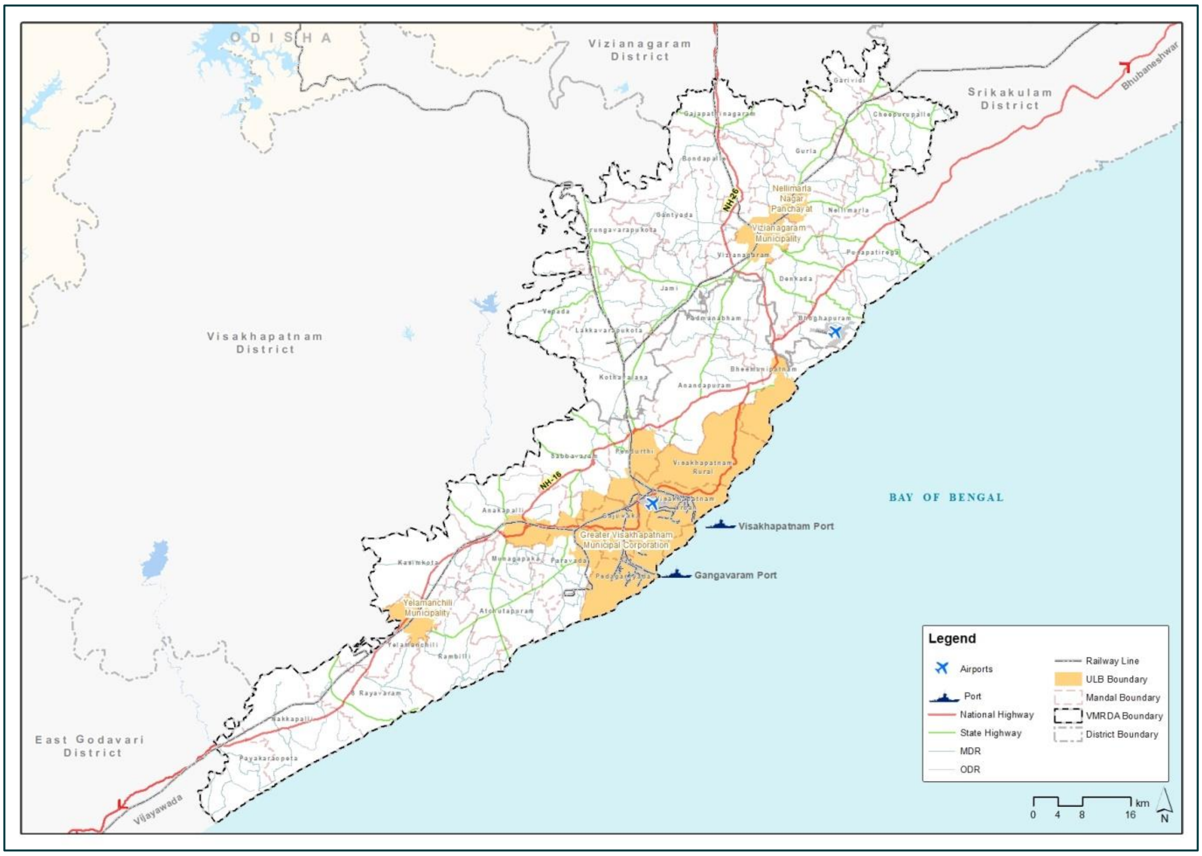


Figure 7-1: Transport Connectivity of the VMR

Under NHDP Phase V, the Anakapalli-Anandapuram via Sabbavaram road is converted into a six-lane and referred as National Highway (NH- 16). It would serve as a by-pass road for the passage of through traffic going towards Visakhapatnam. The former NH 16 stretch, Anakapalli-Visakhapatnam-Anandapuram Highway, passing through the city, would be an urban road under GVMC jurisdiction.

Apart from the NH-16 the other National Highway, which starts at junction on NH-16 near Thagarapuvalasa approximately 50 km north east of Visakhapatnam is NH-26 (erstwhile NH-43). It bypasses Vizianagaram and further leads to Jagdalpur and finally terminates at Raipur in the state of Chhattisgarh (Ref.Figure 7-2).

NH-16 near Visakhapatnam | NH-26 near Vizianagaram

Figure 7-2: National highways traversing through VMR

STATE HIGHWAYS

The VMR has approximately 490 km of State Highways. Major State Highways are as follows:

a. SH-157 starting from Gajuwaka and traverses through Parawada and Atchuthapuram to reach Yelamanchili and further to NH-16. It is a two-lane road, which serves the traffic from NTPC, APSEZ, Steel Plant and Pedagantyada IDA;
b. SH-39 (Visakhapatnam-Ananthagiri-Araku) connects Visakhapatnam City to the Araku hill station; and
c. SH-9 (Bheemunipatnam-Pendurthi-Chodavaram-Narsipatnam) connects Bheemunipatnam town to the Narsipatnam which is divisional headquarters of Narsipatnam. Presently a section of this State Highway between Anandapuram and Sabbavaram is NH-16.

SH-157 near Yelamanchili

SH-39 near Kothavalasa

Figure 7-3: State highway traversing through VMR

OTHER ROADS

These roads form the major roads for the urban areas and the rest of the settlements in the VMR. The next hierarchical roads such as Major District Roads (MDRs), Other District roads (ODRs) consist of approximately 1,700 km in the VMR. Figure 7-1 shows the transport network in the VMR.

PORT CONNECTIVITY CORRIDORS

Visakhapatnam Port has port connectivity road about 12 km (including 4.87 km ROB), developed by NHAI from Convent Junction to Sheela Nagar Junction. This would be further extended by 12.43 km to meet NH-16 at Sabbavaram, under NHDP Phase V. The Gangavaram Port also has port connectivity corridor with 4 lane 3.8 km long road developed by GoAP. Under Bharatmala programme, as a Port connectivity corridor, a four-lane beach road (30 km) will connect Gangavaram Port and SEZ at Atchuthapuram.

7.4 RAILWAY NETWORK

Chennai - Howrah main line of the Indian railways, serves the VMR. Currently, it falls under the jurisdiction of both South Central Railway (SCR) and East Coast Railway (ECoR). Figure 7-4 shows the railway network within the VMR and its surroundings. Approximately 350 km of railway network and 775 km of railway lines exists within the VMR.

a) SCR has its Jurisdiction from Duvvada in Gajuwaka Mandal towards Rajahmundry under Vijayawada Division;
b) ECoR has its jurisdiction towards Visakhapatnam from Duvvada and further leading to Howrah, under Waltair Division in VMR

c) In ECoR, Rail network from Chennai Howrah main line branches out at Kothavalasa towards Araku and at Vizianagaram towards Rayagada;

d) Apart from the main line, there are sidings to Visakhapatnam Port, Gangavaram Port, NTPC, CONCOR and Visakhapatnam Steel Plant. Existing Sidings in Waltair Division are given in Table 7-1;

e) South Coast Railway (SCoR) is formed as a new zone with Waltair Division merging with Vijayawada Division along with Guntur and Guntakal Divisions. Visakhapatnam will be headquarters for the SCoR; and

f) The proposal of new passenger line/goods line sanctioned within the Division is:

- 3rd line between Vizianagaram to Bhadrak (Andhra Pradesh - Odisha)
- 3rd line between Vizianagaram to Titlagarh (Andhra Pradesh - Odisha) including tieline between Gotlam to Nellimarla
- 3rd line between Visakhapatnam to Gopalapatnam
- 4th line between Kottavalasa to Visakhapatnam
- Doubling of Kothavalasa - Kirandul (Andhra Pradesh - Odisha - Chattisgarh)

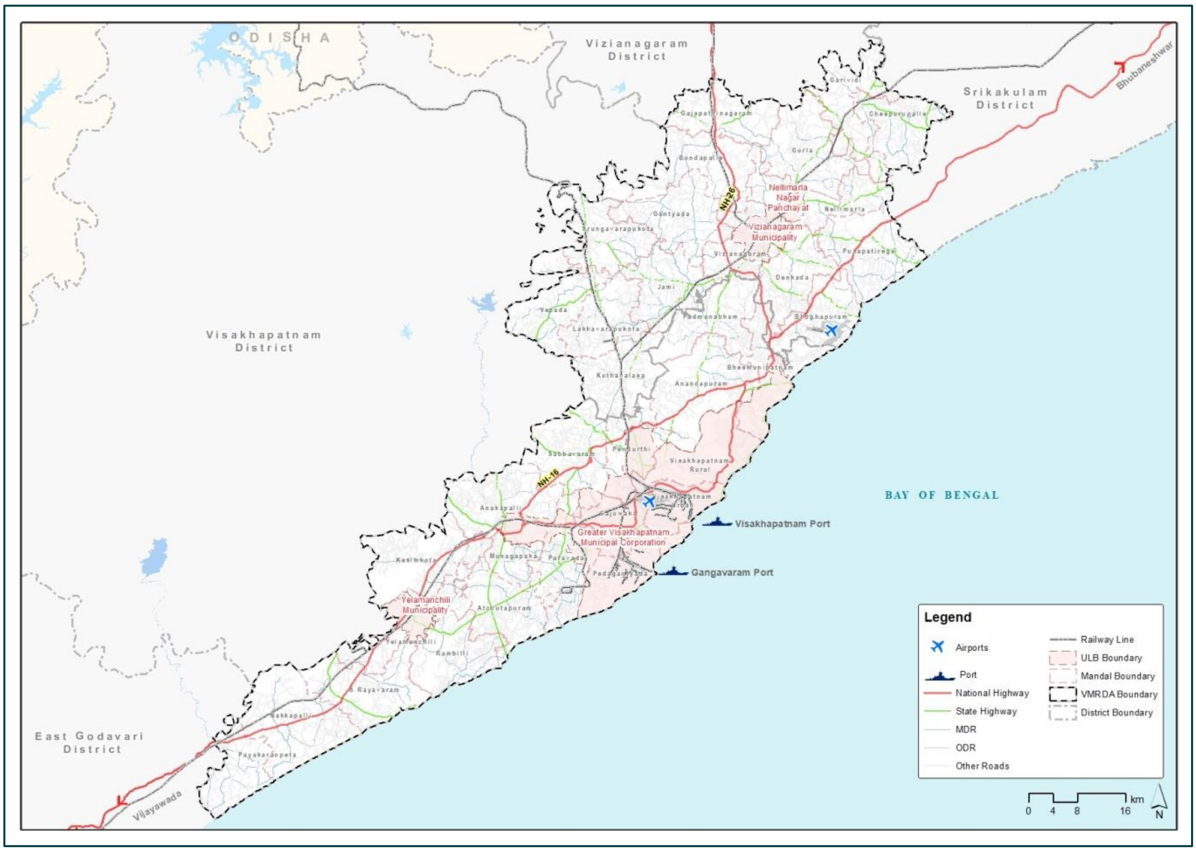


Figure 7-4: Railway Network in VMR

Table 7-1: Existing Sidings in Waltair Division

Sl. No.	Siding Name	Name of the Siding Owner	Serving Station
1	VZP	VPT Railways	Waltair Marshaling Goods Yard (WMY)
2	CONCOR	Containers Corporation of India Ltd	Vishakapatnam Coaching Yard (VSKP)
3	VSPS	Rastriya Ispath Nigam Limited	Visakhapatnam Steel Plant Siding (VSPS)
4	STPP (NTPC)	National Thermal Power Corporation Ltd	Duvvada (DVD)
5	PSAS	Andhra Cements Ltd	Simhachalam North (SCMN)
6	APSWC's Investors	AP State ware Housing Corporation Ltd	Pendurthi (PDT)
7	FACOR	Ferro Alloys Corporation Ltd	Garividi (GVI)
8	VSPV	Visakhapatnam Sea Port Pvt Ltd/VSKP	Visakhapatnam Port (VZP)

Source: Divisional Railway Manager Office, Waltair Division

7.5 AIR CONNECTIVITY

The functional airport within the Project Area is Visakhapatnam airport (Ref.Figure 7-5); it is a domestic airport where international operations have started recently. Visakhapatnam airport is located at a distance of 7 km from city close to NH-16. It is connected by flights to major capital cities (Hyderabad, Bengaluru, Chennai, Mumbai, New Delhi, Kolkata, Ahmedabad, Bhubaneswar and Raipur) and other cities (Vijayawada, Tirupati, Coimbatore, Kochi, Mangalore, Agartala, Port Blair) of India. International flights are operated to Dubai, Singapore and Kuala Lumpur. As per the AAI statistics, the number of passengers handled during 2018-19 is 2.8 million, the number of aircrafts handled is 24,182 and cargo tonnage is 3,513. Due to growing air traffic at the airport, the AAI has made plans to construct six additional aircraft parking bays by extending the apron. N5 taxi track will be commissioned in the airport soon. After commissioning with the new taxi track and expansion of the terminal building, aircraft movements and passenger occupancy are expected to rise.

GREENFIELD BHOGAPURAM INTERNATIONAL AIRPORT LIMITED

Government of Andhra Pradesh has planned to build a Greenfield international airport near Bhogapuram in Vizianagaram District. A Special Purpose Vehicle, Andhra Pradesh Airports Development Corporation Ltd. (APADCL) formerly known as Bhogapuram International Airport Company Limited (BIACL), will implement the Airport Project. The upcoming Airport site is located 40 kms from Visakhapatnam in North East direction on NH-16 and 25 kms from Vizianagaram via NH-26. The site is located in East-West direction near Bhogapuram Village, on the East of NH-16 towards the coast line.

The Greenfield International Airport at Bhogapuram provides the opportunity to the citizens of the region to connect with different parts of the world. The new airport was announced in February 2015. Once Bhogapuram airport becomes operational, Airports Authority of India will close Visakhapatnam airport for 30 years. As part of first phase of project, total land required for Airport construction is 2,624 acres out of which 2,400 acres have already been acquired for which Environmental clearance was issued in April 2017. With this, AP Govt. awarded work to M/s GMR airports Limited to develop and operate Bhogapuram Airport.

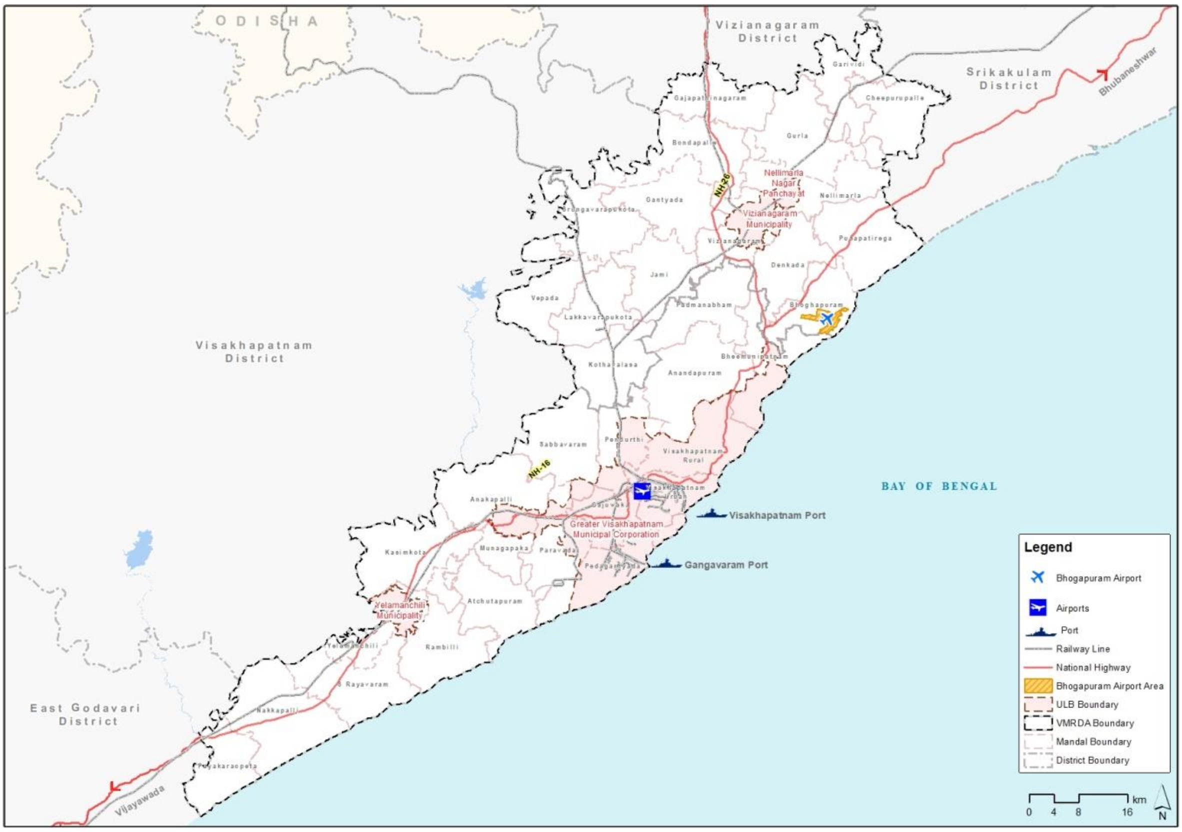


Figure 7-5: Visakhapatnam Airport and Bhogapuram Airport in VMR

7.6 PORTS AND FISHING HARBOURS

There are two major sea ports falling within the VMR. Hence, within the influence of the project area, two major ports, a container terminal and one fishing harbour are present.

Visakhapatnam Port is located at 17^{0}41’ N and 83^{0}18’ E, is almost equidistant from Kolkata and Chennai ports. The port is a premier port in the country, in terms of annual traffic (cargo throughput). There is also a fishing harbour, spread over in 38 ha of area, which is presently being used by local fishermen for fishing related activities and as shelter for their launches/crafts. Visakhapatnam port facilities in inner and outer harbours are presented in Table 7-2.

Table 7-2: Visakhapatnam Port Trust facilities

Sl. No.	Port facilities	Inner Harbor	Outer Harbor
1	Water Spread (Hectares)	100	200
2	Maximum Draft (in meters)	14.50	18.10
3	Length (in meters)	230 LOA	320 LOA
4	Beam (in meters)	32.5	50

5	Vessel Class	PANAMAX	Super Cape (up to 2 lakh DWT)
6	Number of Berths	18	6

Source: Visakhapatnam Port Trust Annual Report 2017-18

Visakhapatnam port majorly handles POL, iron ore, Fertilizer, Thermal Coal and Coking Coal. Table 7-3 shows the principal commodity wise cargo traffic handled at Visakhapatnam Port for the years 2011-18 (Figure 7-6).

Table 7-3: Principal commodity wise cargo Traffic handled at Visakhapatnam Port (in lakh tonnes)

Sl. No	Period	POL	Iron Ore & Pellets (Export)	Fertilizer		Coal		Container		Others
				Finished	Raw	Thermal (Export)	Coking	Tonnage	TEUs	
1	2011 - 12	184.4	161.54	37.17	8.32	31.89	67.8	42.14	234	100.5
2	2012 - 13	150.4	123.09	20.23	5.65	29.51	68.35	45.54	247	104.56
3	2013 - 14	10.09	129.99	17.71	7.95	27.44	69.28	49.16	262	109.37
4	2014 - 15	146.4	83.01	18.38	7.2	27.79	60.74	43.73	248	99.12
5	2015 - 16	169.4	59.79	19.96	7.99	33.93	51.07	51.45	293	96.78
6	2016-17	166.04	114.20	18.86	7.76	34.71	42.82	64.28		120.50
7	2017-18	160.50	106.46	19.53	9.20	29.48	57.64	68.35		125.86

Source: Visakhapatnam Port Trust Annual Report 2017-18

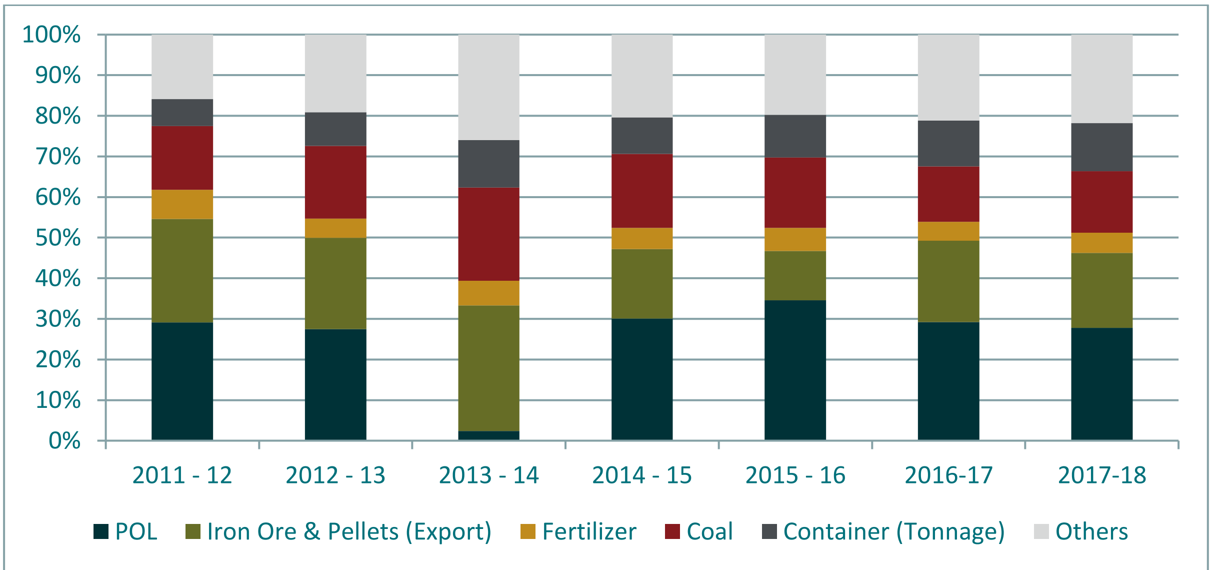


Figure 7-6: Principal commodity wise cargo traffic handled at Visakhapatnam Port

Port of Visakhapatnam has contemplated the following expansion plans:

a) Extension of Container terminal on DBFOT in the outer harbor
b) Construction of Cruise terminal in the outer harbour
c) Additional oil jetty OR-3 along with OR-I & 2 berths
d) Mechanisation of WQ.7&8 berths
e) Development of Covered Storage for bulk cargoes
f) Development of Free Trade warehousing zone

Gangavaram Port is located within 15 km south of Visakhapatnam Port. It is a newly developed greenfield port which started operation in August 2008. It is a Joint Venture (JV) between the State Government of Andhra Pradesh and a consortium led by Mr. D.V.S. Raju. Exports and Imports Cargo traffic handled by Gangavaram Port from 2009-10 to 2015-16 is given in Table 7-4.

Table 7-4: Exports and Imports Cargo traffic handled by Gangavaram Port

Sl. No.	Year	Imports & Exports in MMT
1.	2009-10	12.58
2.	2010-11	13.91
3.	2011-12	13.99
4.	2012-13	13.10
5.	2013-14	15.81
6.	2014-15	20.74
7.	2015-16	19.33

Source: Gangavaram Port Limited Office

To improve connectivity to port, following proposals were submitted to Government of Andhra Pradesh and Director of Ports.

i. Widening of existing 4 lanes road to 6 lane road connecting NH-16.
ii. From NH-16 to Port entry gate existing 2 lanes to 4 lanes.
iii. 4 lane beach road of 30 km connecting Port to Atchutapuram SEZ.

Coastal Railway line around 35 km from Gangavaram Port to Atchutapuram SEZ connecting NTPC Simhadri, Hinduja Power Plant, Brandix, Pharma Park and other upcoming industries along the sea coast.

Besides the two functional ports, which are large and medium, two minor ports are proposed within the VMR.

a) Bheemunipatnam about 29 km north east of the port of Visakhapatnam and is proposed to be developed as minor port on the southern bank near the mouth of river Gosthani. It is proposed to develop Bheemunipatnam as a satellite terminal for the Visakhapatnam Port.
b) Kalingapatnam is about 83 km north east of the port of Visakhapatnam. The port is proposed on the southern bank of the estuary of river Vamsadhara near its confluence

with the sea. It is proposed to be developed as lighterage port which is stated to be suitable for development of good deep water, all weather port by Department of Port, GoAP.

c) Nakkapalli is proposed to be commissioned as a minor port situated in Nakkapalli village of Visakhapatnam district within VK-PCPIR region. M/s. ANRAK Aluminum Limited has been permitted for the construction of a captive jetty.

Meanwhile, high-level committee appointed by the Union Shipping Ministry for setting up a second major sea port in the state of Andhra Pradesh. Apart from Nakkapalli, Duggarajapatnam of Nellore District and Ramayyapatnam in Prakasam district are selected as the probable sites for the second major port in the state. If Nakkapalli gets selected as the site for a second major sea port in the state, it could impact the region in a large way.

7.7 LOGISTIC HUBS

Visakhapatnam is the only place where logistic hub is located in the region. It has both Container Freight Station and Inland Container depot. Visakhapatnam ICD is a Combined (Both Exim & domestic) container terminal. Container Freight Station, Visakhapatnam has started functioning in Dec '02. The new depot has started functioning April '05 for both Exim and Domestic Traffic. The Clearing and Forwarding Service (CFS) area is adjacent to VPT and hardly 3 km away from Visakhapatnam Railway Station. It has got a natural advantage in terms of connectivity to both Port and Hinterland.

Visakhapatnam Port Trust has set up a Multimodal Logistic Hub viz., Visakhapatnam Port Logistic Park Ltd., (VPLPL) as a Joint Venture with M/s. Balmer Lawrie & Ltd., in an area of 53 acres of Port land. The Project is operational w.e.f. March, 2019.

Visakhapatnam Port Trust is contemplating to develop a Free Trade Warehousing Zone in area of 100 acres. VPT has entrusted preparation of TEFR to M/s. IPA.

7.8 TRAFFIC SURVEYS AND ANALYSIS

Based on the review of past studies, database assembled by the consultants, site reconnaissance visits etc., data gaps are identified for carrying out travel demand modeling and transport network analysis to provide inputs on traffic & transportation infrastructure for Master Plan preparation for the VMR. The following primary traffic and transportation surveys are identified. The survey locations and process of each of these surveys have also been discussed with VMRDA Staff during the meetings held in September and November 2016:

a) Classified traffic volume count and OD surveys at Outer Cordon locations for 24 hrs[1]. (14 Nos.);
b) Classified traffic volume count and OD surveys at Inner Cordon locations for 24 hrs. (8 Nos.);
c) Classified traffic volume count at Screen lines for 24 hrs. (29 Nos.);
d) Classified turning movement count surveys for 12 hrs. (40 Nos.);
e) Road network inventory survey of strategic network (about 2,800 km);
f) Speed & Delay surveys (about 2,800 km);

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1 *The ToR states conducting (a) 7 Day TVC and 1 Day OD at 3-5 locations, 3 Day TVC and 1 Day OD at 10 locations, 1 Day TVC and 1 Day OD at 5 locations and 1 Day TVC at 75 locations. However, with our past rich experience of working in many urban areas in India and abroad, on several comprehensive transportation studies and master plans, we strongly opine that conducting 7 –day and 3-day OD surveys and volume counts do not yield any advantageous results, rather 1-day OD and TVC at more number of locations will provide adequate results. Given this, we have proposed same approach here too. Similarly, on field visit to the Project area, the number of locations of each of the surveys have been revised/increased, reflecting current conditions.*

g) Parking surveys for 16 hrs. (60 Nos.);
h) Public Transport Terminal Surveys: Inter City Bus (6 Nos.);
i) Goods Terminal Surveys: Truck Terminals and Visakhapatnam Port entry/exit locations for 24 hrs. (Classified volume count and OD Survey) (15 Nos.);
j) Goods Terminal Surveys: Railway freight terminals for 24 hrs. (Classified volume count and OD Survey) (5 Nos.);
k) Airport Terminal Surveys: Traffic Count and OD Survey of air passengers for 24 hrs;
l) Establishment and Workplace Based Surveys (53 establishments and 1,100 samples); and
m) Home Interview Surveys/ Household Surveys (30,000 household samples).

A brief description of traffic survey locations and traffic analysis and findings is documented in Appendix J.

7.9 BASE YEAR TRAVEL DEMAND MODELING AND NETWORK ANALYSIS

The road network not only helps in modeling the private modes travel demand but also serves as the basis to model goods traffic and road based public transport trips by bus/ BRTS. EMME software (Equilibre Multimodal Multimodal Equilibrium) which is used world over in more than 100 countries for transport network analysis has been used for travel demand modeling and transport network analysis in the present study. In EMME, transit routes are not maintained as separate database files. Instead, a transit route (such as a bus route) is represented by identifying the highway links forming a bus route.

Consequently, many local roads in the urban area were added to the road network to represent bus routes serving the neighborhoods. The transit route system was coded to include access/egress and transfers to represent generalised travel time/cost by public transport system.

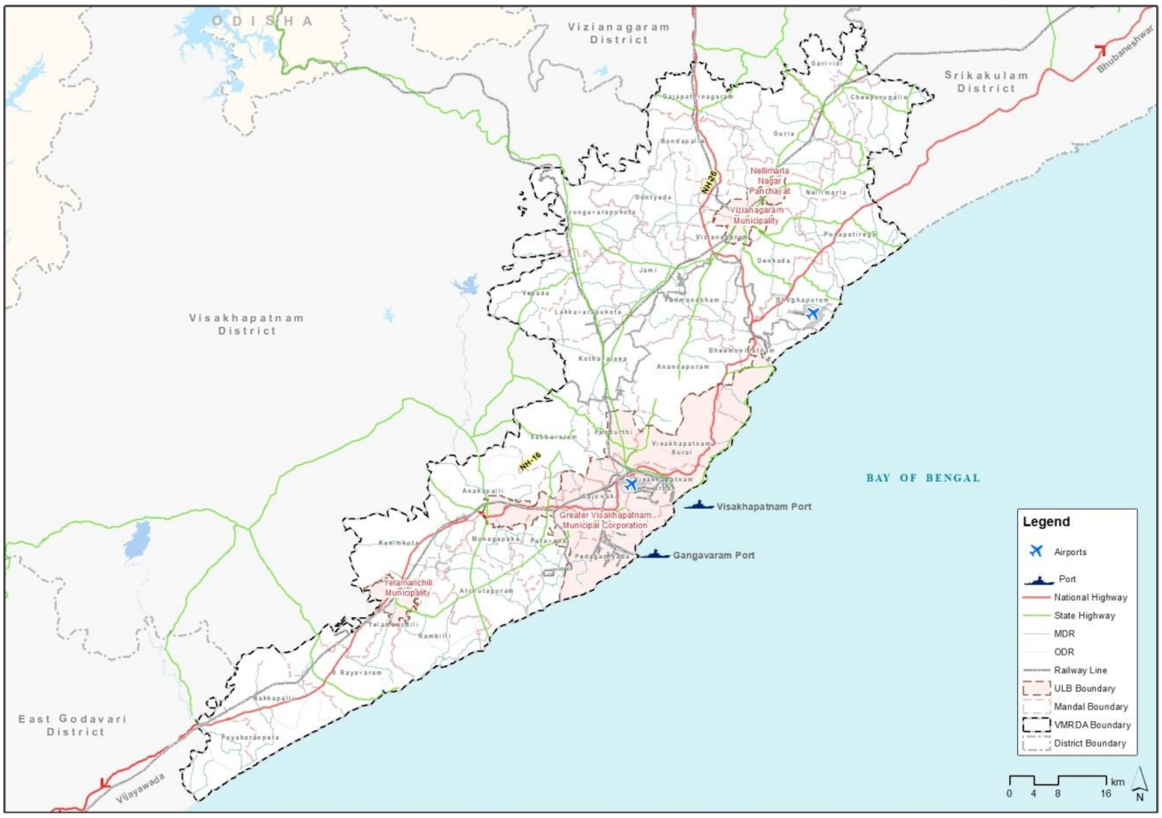


Figure 7-7: Road Network of VMR considered for the Base Year

Centroid connectors, notional links from the centroid of TAZ, are created using the ARCGIS automated connector placement process. This created centroid connectors are used to do network skimming. The automated ARCGIS process can be applied in one of two ways. It can either draw one or more centroid connectors to the closest line layer nodes; or it can draw a single centroid connector by breaking the closest line and inserting a node which is then used mainly to accept the centroid connector. When ARCGIS is used to draw connections to the closest node, most of the connections are made at intersections. Attaching centroid connectors to line segments is more desirable because the connectors could be used to represent local road loading points. Consequently, ARCGIS was used to develop the centroid connectors by placing a single connector to the closest line layer segment.

It is not desirable to have centroid connectors attached to Highways, flyover/ramp or expressway facilities. Therefore, prior to using the ARCGIS process, a selection set of roads eligible to receive centroid connectors is made. When ARCGIS automated process is used, the centroid point ID is made to be identical to the node ID in the line layer network. This provides consistency in later modeling steps when trip tables are assigned on to the line layer network.

The first generation of the line layer (highway network) was completed by placing one centroid connector per zone. Where appropriate, additional connectors have been added manually to provide multiple connectors per zone. In addition, automated connectors were removed when the connectors were placed inappropriately after reviewing access, local road network, and development density.

Within the major commercial/employment areas and most of the urban zones, additional walking connectors are introduced. These connectors enhanced transit accessibility and serve to represent cross block pedestrian movements which cannot be accommodated by the highway centroid connectors.

7.10 OPERATIONAL CHARACTERISTICS OF BUS SYSTEMS

Bus route system is coded and updated based on APSRTC provided schedules. Each route is coded as having two travel directions: inbound/up and outbound/down. The headway data is also taken from the APSRTC provided schedules. The road network catering to buses is shown in Figure 7-8. APSRTC is operating with a fleet strength of 1,208 and operating nearly 174 routes with route length of nearly 13,260 km operating on 1,342 km of road network in VMR which is 35% of the overall VMR road network considered in the study.

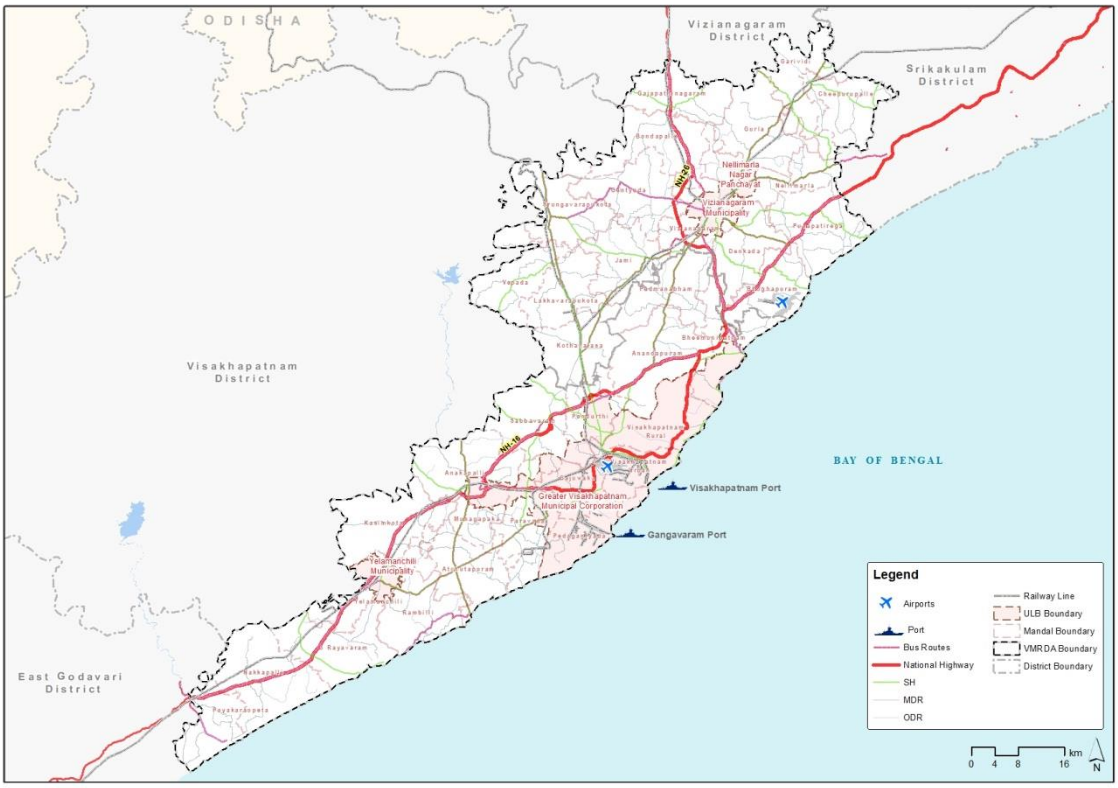


Figure 7-8: Intra-city Bus Network of VMR

7.11 FARE MODELS

The traffic on the network is assigned by incorporating travel cost in terms of value of travel time. The direct cost of travel or out-of-pocket expenses has been modeled separately for all the modes. In case of public transport modes and intermediate public transport modes, the direct cost has been taken as the fare charged (in INR.), while for the private vehicles, the vehicle operating cost has been estimated and considered as the direct cost component in the generalised cost of travel. The fare structures operating in the base year are considered for developing the fare models.

7.11.1.1 Public Transport Modes: Bus

The public transport bus service in the VMR is provided by APSRTC. Base fare is INR 5.9 and 8.6 for ordinary and metro services respectively with minimum distance of 2 kms and the per km distance fare is INR 0.59 and 0.61 for ordinary and metro services respectively. The fare model assessed from the fare structure of APSRTC operated buses is as follows:

Weighted *Fare Model for Ordinary Services*		
	Paise	***INR***
D<2 km	589	5.89
D>2 km	589+59*(D-2)	5.89+0.59*(D-2)
Weighted *Fare Model for Metro Services*		
	Paise	***INR***
D<2 km	855	8.55
D>2 km	855+61*(D-2)	8.55+0.61*(D-2)
(D – Distance in km)		

7.11.1.2 Intermediate Public Transport

In the case of Intermediate Public Transport in VMR, there are basically two modes viz. Auto Rickshaw and Taxi. Both these modes have separate fare structure and on that basis two separate fare models were developed in terms of minimum fare and fare per km, since in VMR most of the services are on shared basis with fixed routes, the per km fare is less compared with cities like Hyderabad were shared auto rickshaw service are at very few places. Base fare of auto rickshaw is INR 20 with minimum distance of 1.6 kms and the per km distance fare is INR 5. Base fare of taxi is INR 51 with minimum distance of 3 kms and the per km distance fare is 14 rupees. Fare modes for Auto and Taxi modes are as follows:

Fare Model for Auto		
	Paise	***INR***
D<1.6 km	2000	20.00
D>1.6 km	2000+500*(D-1.6)	20.00+5.00*(D-1.6)
(D – Distance in km)		
Fare Model for Taxi		
	Paise	***INR***
D<2.0 km	5126	51.26
D>2.0 km	5126+1440*(D-3)	51.26+14.40*(D-3)

7.11.1.3 Private Vehicles (Two Wheelers and Four Wheelers/Car)

In the case of private vehicles (Two Wheelers and Four wheelers/Cars), the average operating cost per km has been considered as the direct cost of travel. The average operating cost was adjudged separately for two-wheelers and four-wheelers which accounted for the running fuel cost, maintenance cost, insurance and road tax of the vehicle. On this basis, an average operating cost for the base year was estimated at INR 6 and INR 15 per km for two-wheeler and four wheelers/cars respectively.

7.12 VALIDATION OF BASE YEAR TRAVEL DEMAND

a) For validation of travel demand estimated for the Base Year, 7 screen lines with 25 locations are identified as part of the study for conducting the classified traffic volume counts;
b) Classified traffic count surveys are carried out at 25 screen line locations for 24 hours manually; and
c) The summary of screen line locations and its traffic characteristics are discussed in Appendix J.

7.13 FRAMEWORK FOR TRAVEL DEMAND MODEL

The process followed for estimation of travel demand for the Base Year and development of travel demand models is illustrated in Figure 7-9 and described in the following sections.

7.13.1.1 Travel Demand Models

This section documents the work undertaken for formation of Travel Demand Models as per the modelling framework given the goals and objectives of the study, along with the identified issues and constraints. The travel demand model estimation and its application process is included in the following steps:

1. Assembly of model estimation data sets from the household and other survey trip records, zonal data;
2. Model estimation using all zonal alternatives for each purpose and mode using analytical tools; and
3. Model validation at each stage.

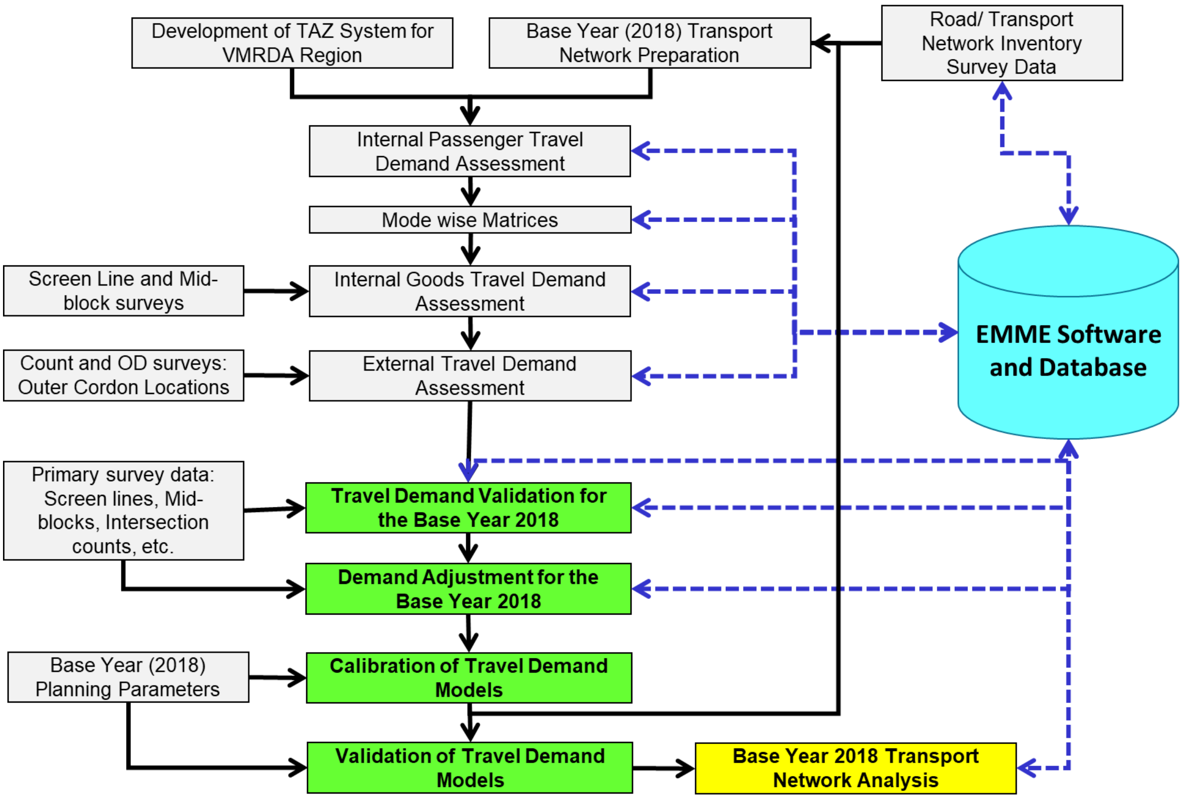


Figure 7-9: Travel demand Validation and Calibration for the Base Year

Base Year (2018) internal travel desires – passenger travel by car, two-wheeler, auto, taxi and bus are shown in Figure 7-10. External travel by passenger vehicles (excluding bus), Bus and goods vehicles assessed from Outer Cordon surveys analysis is presented in Figure 7-11, Figure 7-12 and Figure 7-13 respectively. A snap shot of the daily and peak hour assigned traffic flows in the Base Year (2018) expressed in PCUs are presented in Figure 7-14 and Figure 7-15 respectively. Level of Service on road network is presented in Figure 7-16. A snapshot of the daily and peak hour Bus passenger flows on the road network is shown in Figure 7-17and Figure 7-18 respectively. Details on Calibration and Validation of Travel Demand Models are elaborated in Appendix K.

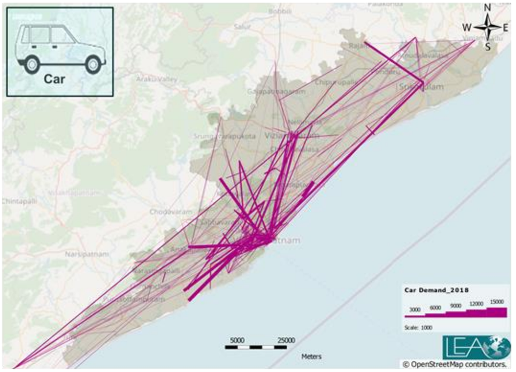
7.13.1.2 Summary on Base Year (2018) Travel Demand Modelling

Summary of the observations of validation process are presented as follows:

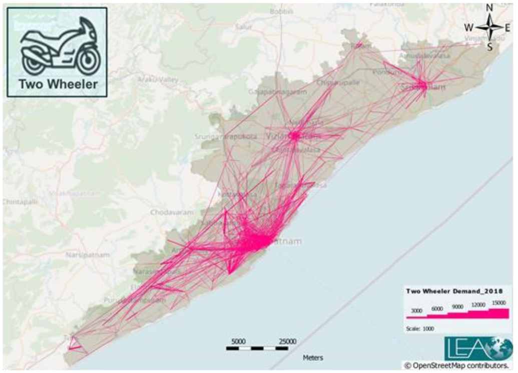
a) Base year road network for VMR was prepared using RNI data and ArcGIS. The network includes all roads of regional significance, including all Highways, Expressways and Arterials within the study area. A total length of base year road network is 3,871 kms. Further bus route network, rail system network and their services have been coded based on the data provided by APSRTC and SCR/ECR;
b) Fare models were developed for various modes (bus, train, auto and taxi) and operating costs (for private vehicle modes i.e. two-wheeler and car);
c) APSRTC is operating with a fleet strength of 1,208 and operating nearly 174 routes with route length of nearly 13,260 km operating on 1,342 km of road network in VMR which is 35% of the overall VMR road network considered in the study;

d) Travel demand models were developed based on primary and secondary database, HIS database, transport network and updated fare models;
e) Base Year daily travel demand for VMR is 4 million and the modal share of public transport by Bus and Rail 23.9% and 1.2% respectively, modal share of Intermediate Public Transport i.e. by auto and taxi is 2.1% and 27.2% respectively and Private vehicles by TW and Car is 35.3% and 10.3% respectively; and
f) Due to inadequate public transport, the dependency on informal public transport mode i.e. auto rickshaw, which caters to the mobility needs of the VMR population. It has more than public transport share;
g) Parts of urban areas in VMR, especially GVMC area is congested which needs road network improvements, alternative roads and promotion of public transport.

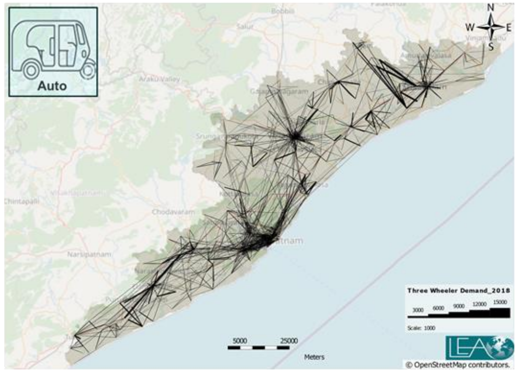
It is pertinent to mention here that, travel demand and network analysis for the Base Year (2018) has been carried out considering the Erstwhile VMR as explained above and updating the same considering the revised study area of 4873.35 sqkm, will not much affect the calibration of travel demand models. However, the Base Year travel demand for the revised study area is expected to be lower which is estimated is about 3.2 millions/day.



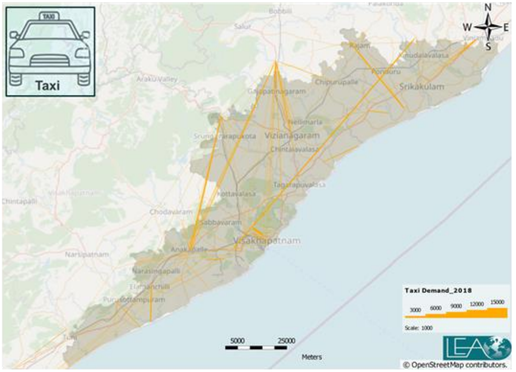
4.13 lakh person trips/day
Mode share: 10.3%



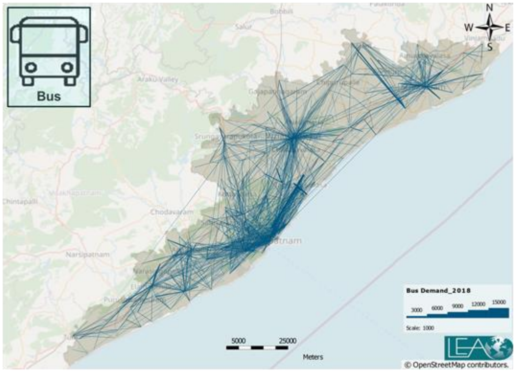
14.17 lakh person trips/day
Mode share: 35.3%



10.92 lakh person trips/day
Mode share: 27.2%



0.86 lakh person trips/day
Mode share: 2.1%



9.58 lakh person trips/day
Mode share: 23.9%

40.16 lakh person trips/day

Figure 7-10: Base Year (2018) Travel Desires – Internal Travel by Passenger Vehicles

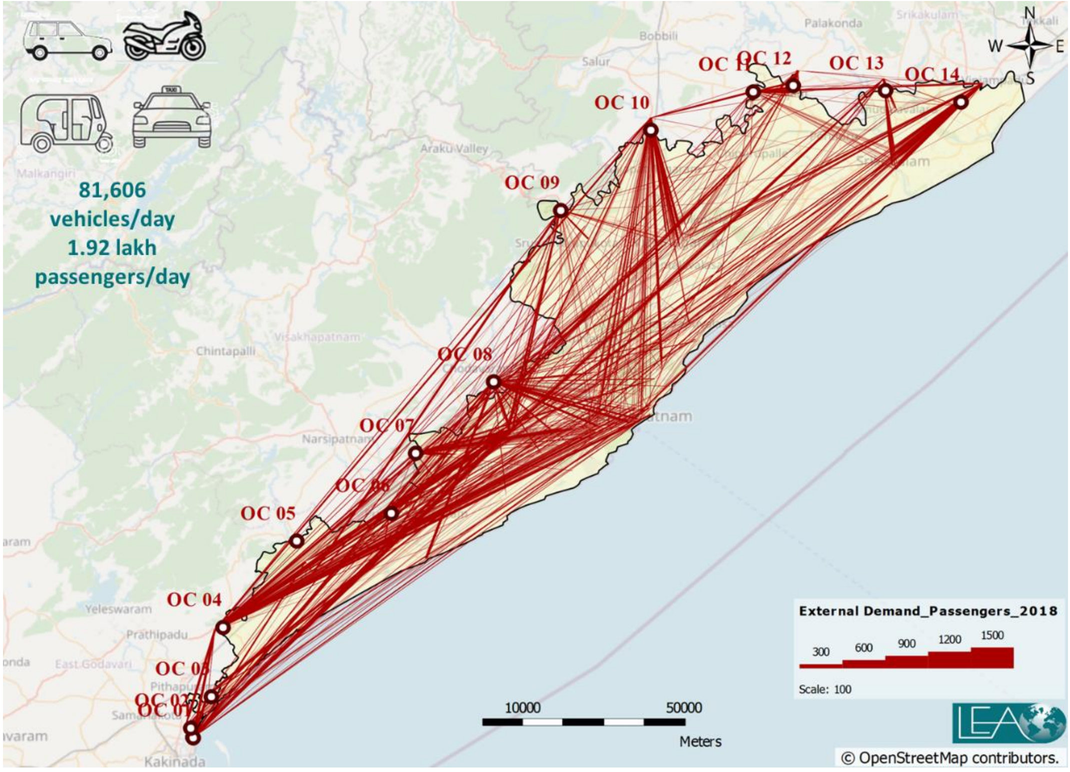


Figure 7-11: Base Year (2018) Travel Desires – External Travel by Passenger Vehicles (Excluding Bus)

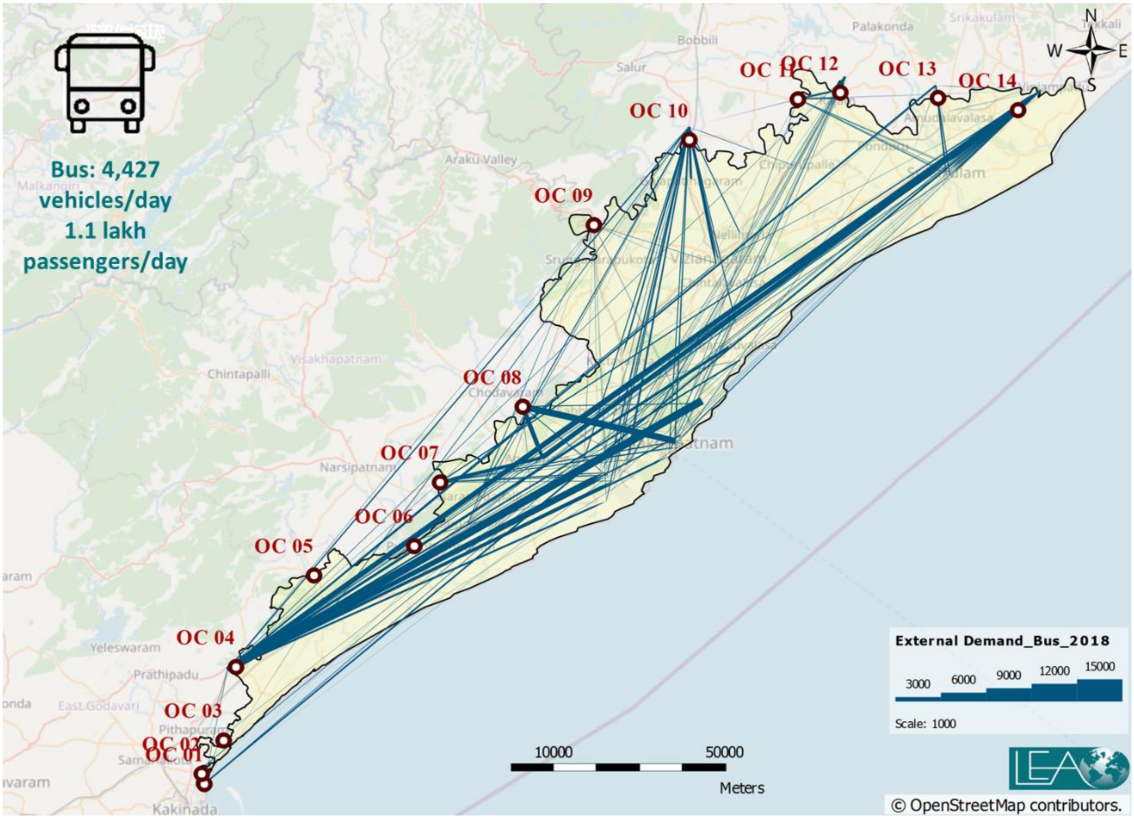


Figure 7-12: Base Year (2018) Travel Desires – External Travel by Bus

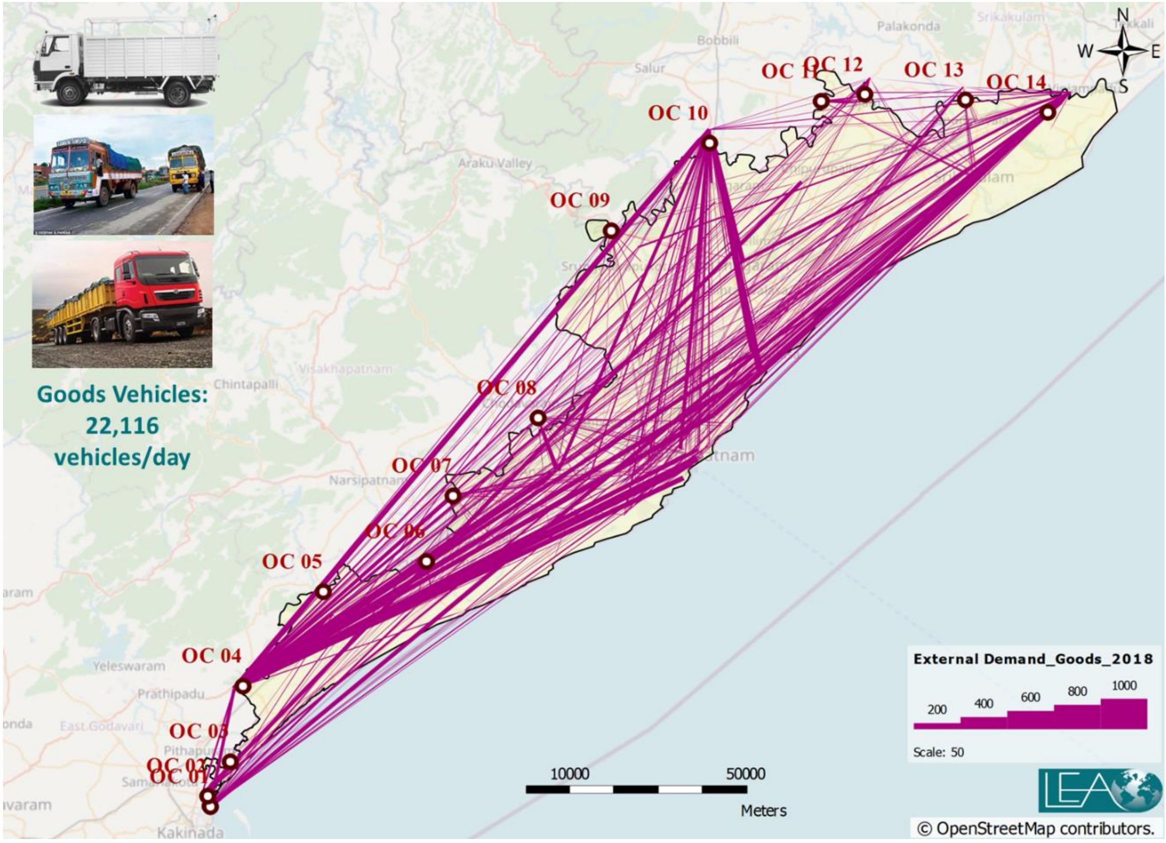


Figure 7-13: Base Year (2018) Travel Desires – External Travel by Goods Vehicles

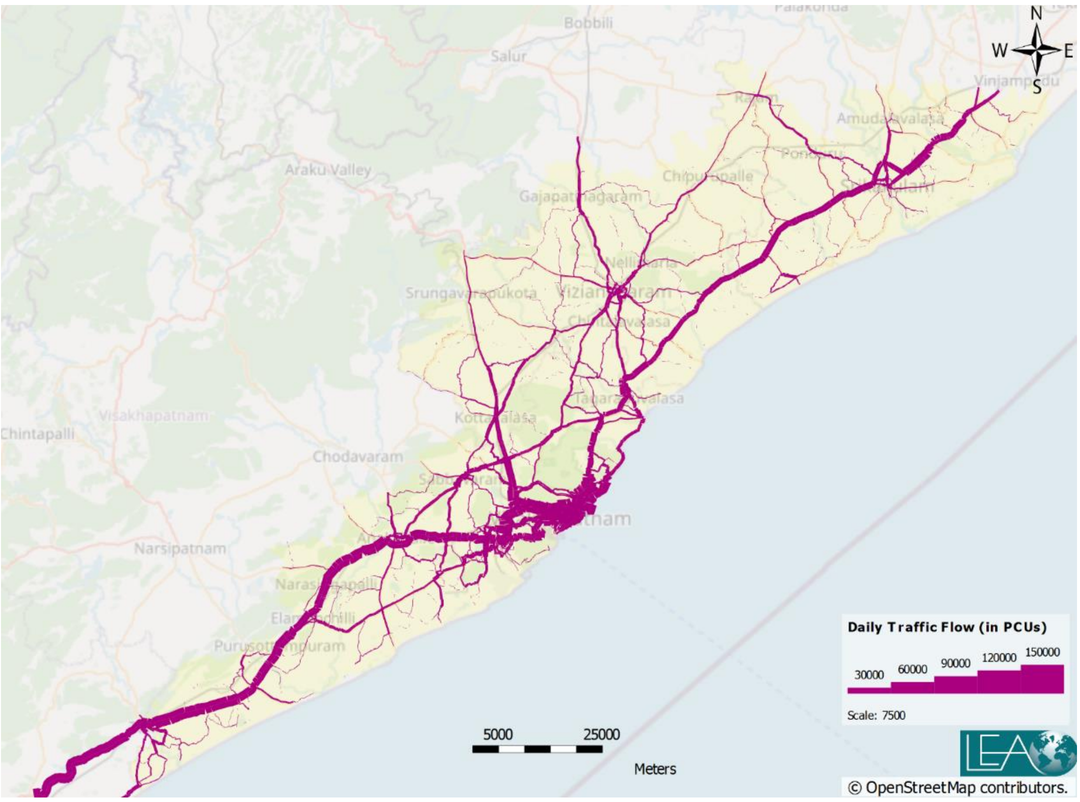


Figure 7-14: Daily Assigned Traffic flows on Road Network in the Base Year (2018)

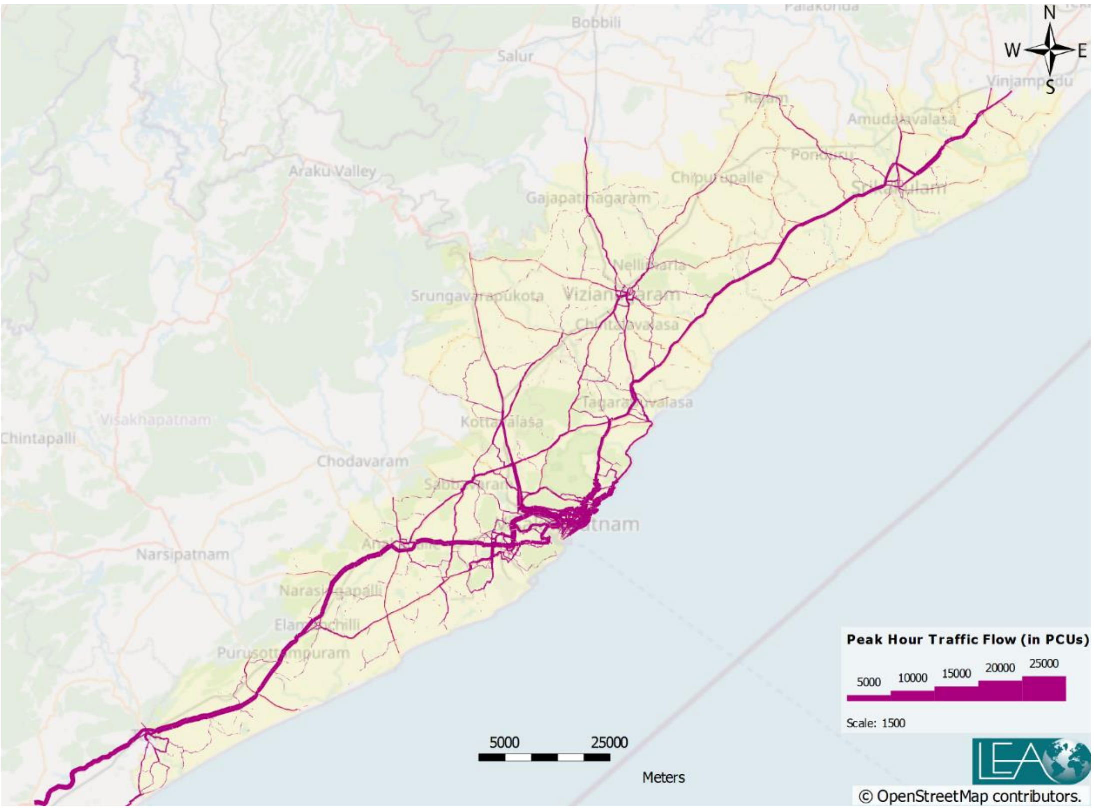


Figure 7-15: Peak Hour Assigned Traffic flows on Road Network in the Base Year (2018)

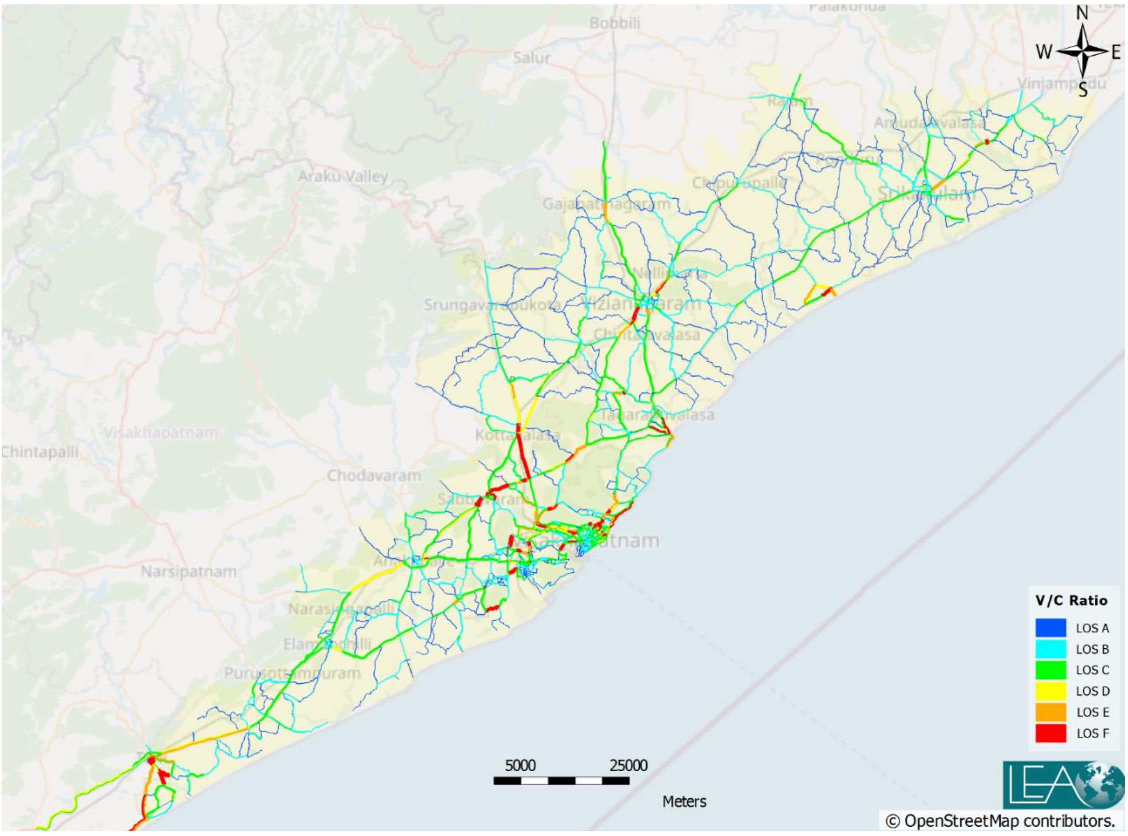


Figure 7-16: Level of Service on Road Network in the Base Year (2018)

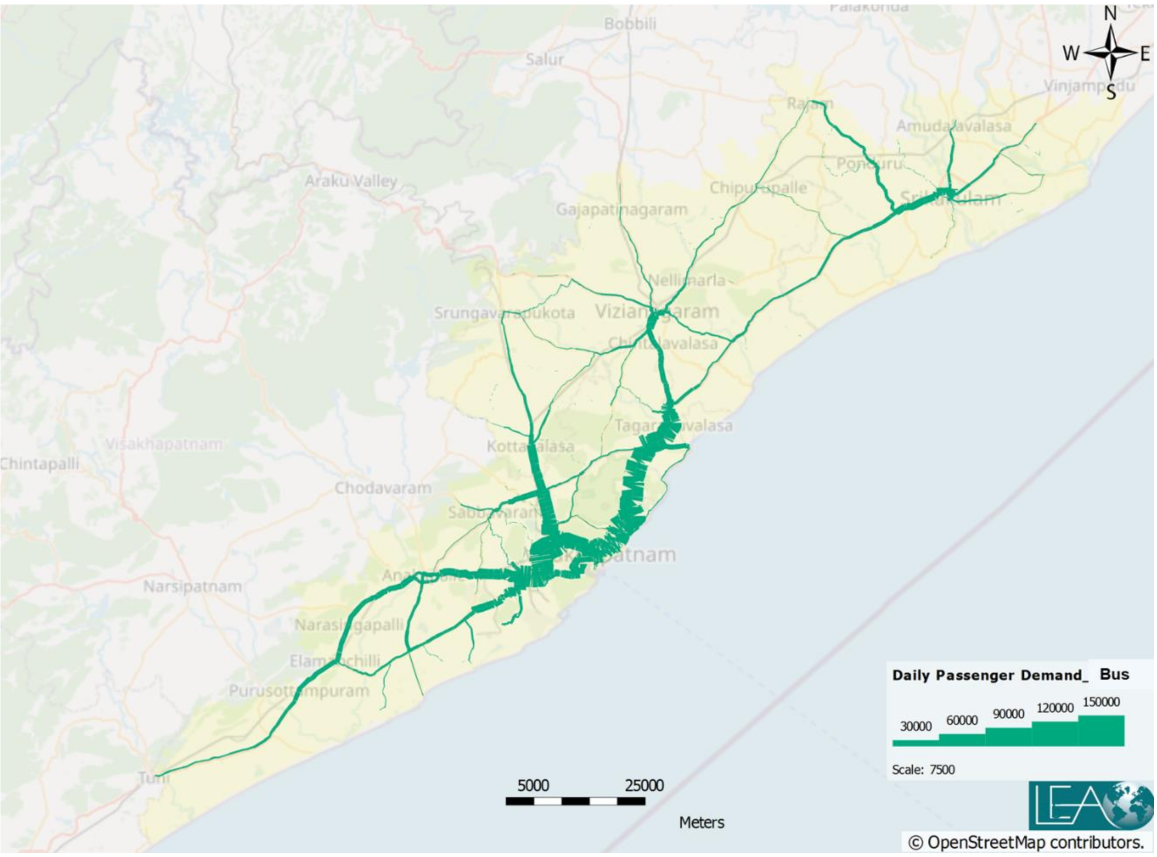


Figure 7-17: Daily Assigned Bus Passenger Flows in the Base Year (2018)

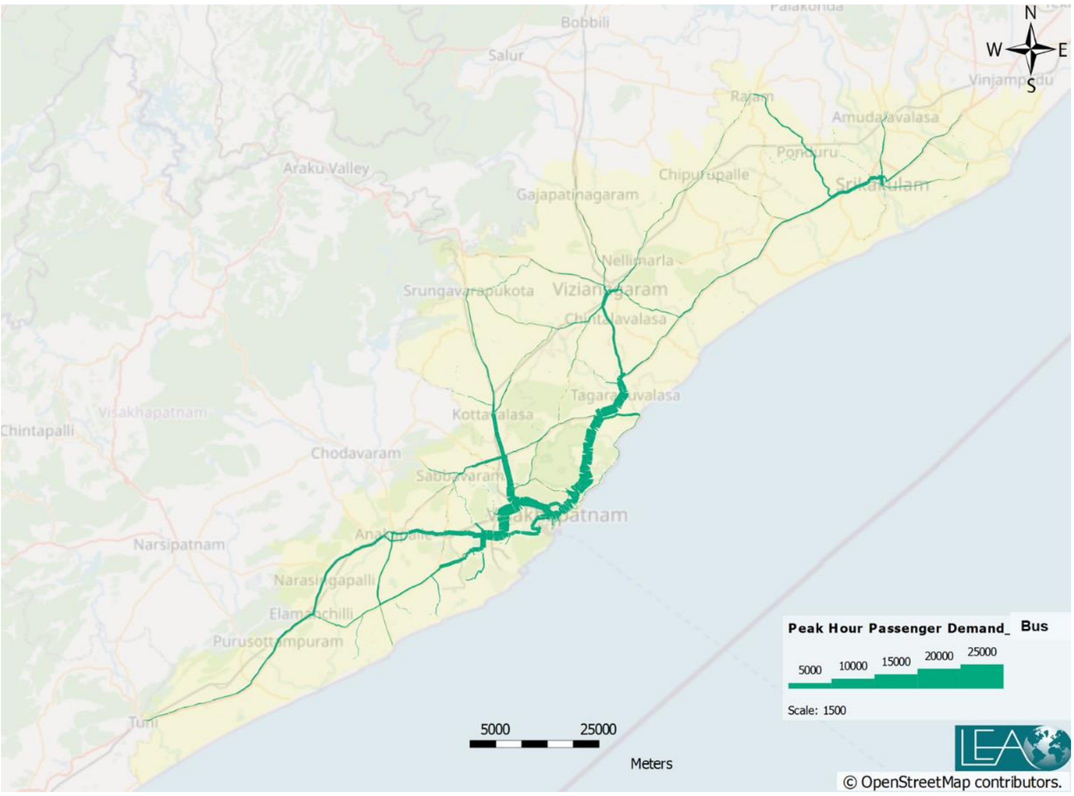


Figure 7-18: Peak Hour Assigned Bus Passenger Flows in the Base Year (2018)

8 PHYSICAL INFRASTRUCTURE

This chapter presents the status of key physical infrastructure facilities including water supply system, waste water management system, storm water, solid waste management, and power supply. The analysis also establishes the current demand and supply gaps.

8.1 WATER SUPPLY

BROAD HYDROLOGICAL SCENARIO

Rainfall

The annual rain fall data for last 13 years for the districts in VMR is given in Table 8-1. Accordingly, the average rainfall in Vizianagaram district 1,151.4 mm and in Visakhapatnam district 1,113.40 mm.

Table 8-1: Rainfall Data for VMR for last 13 years

District	Vizianagaram	Vishakhapatnam
Year	**mm**	**mm**
2004	1,034.50	989.70
2005	1,336.50	1,490.40
2006	1,273.40	1,279.80
2007	1,224.70	1,130.30
2008	1,069.30	906.80
2009	1,032.40	734.30
2010	1,647.90	1,702.60
2011	1,017.60	867.50
2012	1,296.90	1,217.90
2013	1,028.30	1,082.50
2014	1,204.40	1,092.60
6/15- 11/15	903.60	1,035.60
6/16 - 2/17	895.60	944.20
Average	**1,151.16**	**1,113.40**

Source: CM Dashboard, AP

Surface water

The region is drained through several rivers and streams all originating from the hillocks on North – West side of VMR and draining to Bay of Bengal in the South – East. A map showing all the rivers and water bodies with in and around VMR is being depicted in Figure 8-1.

Accordingly a district wise list of major water bodies having their influence on VMR has been prepared and shown in Table 8-2: below:

Table 8-2: District wise list of Water Bodies

District	Rivers	Reservoirs	Streams
Srikakulam	Vamsadhara		Pedda Gedda
	Nagavali		Kandivalasa Gedda
Vizianagaram	Champavati	Tatipudi	Kandivalasa Gedda
	Gosthani		
Vishakhapatnam	Sarada	Gambheeram	Gambheeram
	Varaha	Mudasarlova	Mudasarlova
	Thandava	Meghadri Gedda	Narava Gedda
		Kanithi	Thandava Canal (L & R)
		Kondakarla lake	
		Thandava	
East Godavari		Yeleru (Outside VMR but supplying to VMR)	Yeleru Canal
		Pampa	Polavaram Left Canal
		Polavaram (Outside VMR but supplying to VMR)	

Source: ULBs, Irrigation Department

Figure 8-1: Major Rivers / Water bodies in VMR

In addition, there are several small streams originating from the hills on North West side of VMR. These streams meet the major rivers in the area and discharge in to the Bay of Bengal and some of them discharge in local reservoirs / Ponds.

Ground water

A wide variety of geological formations occur in the region, ranging from the oldest Archaean crystalline rocks to recent alluvium. The Charnockites and Khondalites (predominant type of Archaean rocks) occur in an extensive belt of Vizianagaram, and Visakhapatnam districts. They are underlain by Gneissic complex with Crystalline Granites in almost 97% of the area.

The Central Ground Water Board is regularly conducting the Ground Water Level monitoring through scientific surveillance system to observe the periodic and long-term changes in ground water regime. The ground water booklet issued by CGWB, depicts that:

- Depth of water level between 2 to 5 m below ground is more prevalent almost in 80% of the region.
- Water level range of 2 to 5 m bgl is observed mostly in coastal areas of the region.
- Depth of water level varying between 10 m to 20 m bgl is noticed in small isolated patches of Visakhapatnam district.

The ground water occurrence and availability are largely governed by the state of cementation and compaction of formation, which control the pore volume. A sizable proportion of population in the region is dependent on ground water for drinking and other house hold utilities, besides its use in irrigation at large. Due to limited cost-effective treatment options for chemically / bacteriologically polluted ground water, the affected source is generally lost for drinking and house hold utilities.

The quality of ground water is some parts of the region, particularly the shallow ground water, is changing as a result of human activities. Though ground water is less susceptible to bacterial pollution, but many unseen dissolved minerals and organic constituents are present in water in various concentrations. The presence of Chlorides, Fluorides and Nitrates beyond acceptable limit is harmful. The Table 8-3 below gives the concentration of various Chemical parameters exists in Ground water for the districts of VMR. The table is based on the test results depicted in Ground Water Year Book 2014-15 for Andhra Pradesh state, issued by Central Ground Water Board. The table also gives an outlook for acceptable limits for these parameters for ready reference:

Table 8-3: Concentration of Chemical Parameter

District		pH	Cl	NO_3	F
			mg/L		
Acceptable Limit		6.5 to 8.5	250	45	1.0
Permissible limit in absence of alternate source		6.5 to 8.5	1000	45	1.5
Vizianagaram	Maximum	8.98	4313	248	1.40
	Minimum	7.39	270	0.0	0.20
	Average	8.14	1115	51	0.61
Visakhapatnam	Maximum	9.08	3960	565	2.70
	Minimum	7.54	58	0.0	0.00
	Average	8.12	1068	63	0.49

Source: Ground Water Year Book 2014-15

From above it is revealed that maximum concentration levels are beyond the permissible limit in all the districts. Even the Average values too cross the maximum allowable concentrations, thus the ground water is not suitable for human consumption.

On the other hand, some of the mandals in above 2 districts of VMRdo fall in Critical / Semi critical and over exploited category. Thus further extraction is not advisable. Table 8-4 shows the number of mandals in each district falling in safe and other categories. Accordingly, it will be seen that, in Vizianagaram district all 16 mandals fall in safe category. While in Visakhapatnam district Kasimkota, Munagapaka and Atchutapuram mandals fall in over exploited category with stage of development as 190%, 150% and 140% respectfully. One mandal namely Yelamanchilli falls in Semi critical category with stage of development as 77%. Thus 31 mandals out of 35 in the district fall in safe category.

Table 8-4: Mandals in each district falling in safe and other categories

Sl. No	District	NO. OF MANDALS IN DIFFERENT CATEGORIES				
		Safe	Semi Critical	Critical	Over Exploited	TOTAL
1	Vizianagaram	16	0	0	0	16
2	Visakhapatnam	39	1 No. (Yelamanchili 77%)	0	3 Nos. (Kasimkota-190%, Munagapaka-150%, Atchutapuram-140%)	43

Source: Ground Water Data, CGWB-2008

WATER SUPPLY

Urban Water Supply

The VMR comprises total of four urban local bodies as detailed below:

Municipal Corporations

- Greater Visakhapatnam Municipal Corporation
- Vizianagaram Municipal Corporation

Municipalities

- Yelamanchili Municipality

Nagar Panchayat

- Nellimarla Nagar Panchayat

Norms for water supply in urban centres:

As per CPHEEO manual and URDPFI guide lines issued by Ministry of Urban Development Government of India the norms for domestic water supply to urban centres at consumer end should be considered as follows:

- For Mega cities (population above 10 lac) : 150 LPCD at consumer end
- For cities below 10 lac population where sewerage

- system is existing or contemplated : 135 LPCD at consumer end

Water resources to the urban centres are the existing reservoirs and the infiltration wells along the rivers near urban centres. The water sources for the ULBs are listed below respectively.

Table 8-5: Water sources of Urban Local Bodies of VMR

Urban Local Body	Water Source
Greater Visakhapatnam Municipal Corporation and related industries	Yeleru Left main canal, Raiwara reservoir, Meghadri Gedda Reservoir, Gambheeram Gedda Reservoir, Mudasaralova Reservoir, Thatipuri Reservoir, Gostani River & Sarda River
Vizianagaram Municipality	Infiltration wells in River Gosthani and River Champavati
Yelamanchili Municipality	Infiltration wells in River Varaha and Bore wells in town
Nellimarla Nagar Panchayat	Infiltration wells in River Champavati and Open Wells

Source: Urban Local Bodies, Public Health Department

The water supply status in the ULBs has been summarised in Table 8-6.

Table 8-6: Summary of water supply in Urban Local Bodies

Urban Local Body	Present Population	Desired Service level LPCD	Demand in MLD	Source Capacity MLD	Actual Production MLD	UFW	Supply at consumer end MLD	Gap	Present Service Level LPCD	Capacity of SRs ML		Coverage by HH Connection	WTP Capacity MLD		NRW
										Reqd	Exist		Reqd	Exist	
GVMC (Domestic)	20,35,000	150	305	403	301	15%	192	37%	94.2	107	126	77%	446	358	30%
Floating & Comm			31				13								
GVMC (Small Indstries)			52				51								
Dist. Losses			58												
GVMC (Indus) Bulk			252	252	252		252								
GVMC Total			698	**655**	**553**		**508.0**								
Vizianagaram Municipality	2,70,000	135	37	17.2	17.2	15%	14.6	60%	54.1	12.8	13.7	41%			35%
Yelamanchili	36,700	135	5.0	2.0	2.0	15%	1.7	65%	46.8	1.7	1.6	9%			65%
Nellimarla Nagar Panc.	24,400	135	3.3	2.3	2.3	15%	2.0	40%	81.2	1.1	2.31	64%			45%

Source: SLIP-2018 and "At a Glance" statements from respective Urban Local Bodies, 2019

Inferences drawn from the assessment of present scenario of water supply are as follows:

- Water supply is not adequate in any of the ULBs.
- UFW is not considered by the ULBs other than GVMC, while working out service level in LPCD.
- Capacities of Service Reservoirs are adequate for present supply in all the ULBs.
- Distribution network has different types of pipes (CI, AC, DI, HDPE, etc) resulting high UFW, while it is recommended to provide DI pipes class K-7 to reduce UFW.
- Additional and adequate source of water is required to meet even the present demand, which is possible by getting water from Polavaram Dam project (Through Indra Sagar Left main canal).

RURAL WATER SUPPLY

Rural Water Supply and Sanitation Department is the nodal agency in the state for providing drinking water facilities in rural areas of state. The drinking water facilities are being provided with various types of schemes such as bore wells with hand pumps/ single phase motors, direct pumping schemes, MPWS schemes, PWS schemes and CPWS schemes (all piped schemes). Almost all the villagers have access to hand pump scheme.

As per 73rd amendment on devolution of powers to local bodies, all Single Village Schemes (SVSS) are being maintained by Gram Panchayats, Multiple Village Schemes (MVS) by Zila parishads and hand pumps are being maintained by Mandal Parishads. RWS Department is providing technical support to these agencies. The Gram Panchayats/ Mandal and Zila Parishads receive 13th Finance Commission Funds for O & M of drinking water supply schemes in their areas. The various water supply schemes instrumental for supplying drinking water to the rural areas are being described below:

Single Village Scheme: In the case of SVS, it is a small dedicated scheme for a single village with local source like open well or bore well.

Multiple Village Scheme: MVS is expected to cover more than one village / Gram Panchayat with a ground / surface source.

The Water Supply Schemes are further classified as:

PWSS: Piped Water Supply Schemes which provide water to single village from source like bore wells and other sources where only chlorination treatment is given.

MPWS: Mini-Protected Water Supply Scheme, which provides water to single village from local source like open well or bore well with a single point distribution.

CPWS: Comprehensive Piped Water Supply Scheme, where source of water is surface source and treated water is supplied to multiple villages under a single project.

Other than the above discussed schemes, the State Government has taken a policy decision to implement "NTR Sujala Pathakam" to provide safe & potable water of 20 litres for Rs.2.00 to each household, to address the issue of drinking water quality in some of the villages,. The program was officially launched on 2nd October, 2014 and so far 618 plants have been installed.

These water supply projects are developed under the rural water supply programmes such as "National Rural Drinking Water Programme (NRDWP)" and "National Bank for Agriculture and Rural Development (NABARD)".

The district wise coverage of villages with different type of water supply schemes is being illustrated in Table 8-7, and the graphical representation is shown in Figure 8-2.

Table 8-7: Coverage of villages in VMR under different type of Water Supply Schemes

District	Total Notified Villages	Villages covered with different water Supply Schemes					Villages with HP schemes	% Villages Covered by Water Supply schemes	% Villages Covered by Hand Pump schemes
		SVS	PWS	MPWS	CPWS	Total			
Viziangaram	512		290	97	130	323	189	63.09%	36.91%
Visakhapatnam	403		252	197	17	303	100	75.19%	24.81%
Total	915	0	542	294	147	626	289	68.4%	31.6%

Source: Rural water supply and sanitation, Panchayat Raj

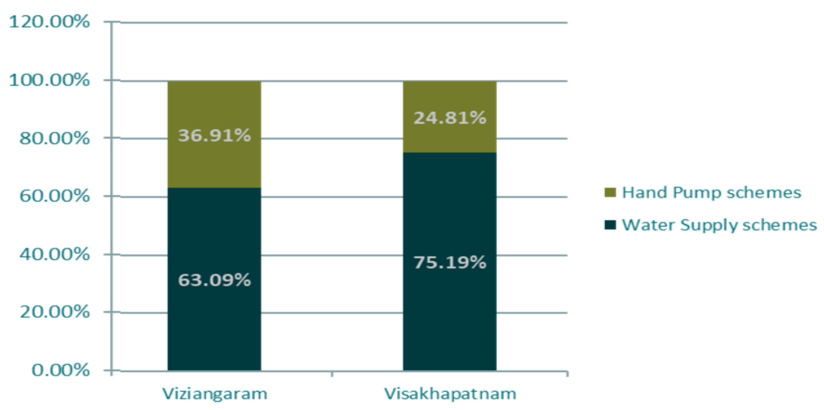


Figure 8-2: Percentage of villages covered under different water schemes in VMR

The status of water supply in rural areas is presently been assessed by Rural Water Supply department based on present service level, which categorise the settlements based on the service level of water supplied in litres per capita per day. The classification used is being shown below:NSS/NC: No Safe Source/Not Covered

i. PC-1: (upto 9 lpcd)
ii. PC-2: (10-19 lpcd)
iii. PC-3: (20-29 lpcd)
iv. PC-4: (30-39 lpcd)
v. FC: Fully Covered

Accordingly, it is seen that 32% of villages are fully covered with 40 lpcd service level. The classification of all the villages with in VMR as informed by RWSS this year is shown in Figure 8-3.

The inferences from the present scenario of Rural Water Supply system in VMR are:

- The service level benchmarks considered for rural area is 40 lpcd. However, the benchmark has to be raised to 70 lpcd (as per National Drinking Water Program-2013, issued by Ministry of Drinking Water & Sanitation, Government of India) and the same will be considered for demand assessment in VMR villages.
- Coverage of Villages under Piped Water Schemes is hardly 24 to 55%, while all the villages need to be covered with piped water supply system. The same shall be considered in the infrastructure proposals for VMR.

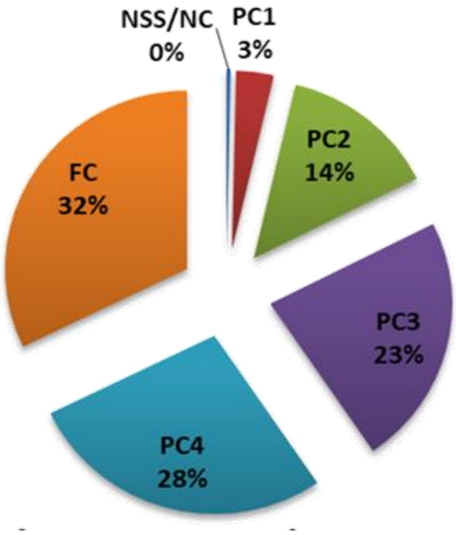


Figure 8-3: Rural water supply status

Source: RWSS, 2018

8.2 SEWAGE / WASTE WATER MANAGEMENT

URBAN SEWERAGE SYSTEM

Greater Visakhapatnam Municipal Corporation (GVMC)

The present population of GVMC is 20,35,000 peoples. Accordingly, the required water supply to the town @ 150 LPCD service level and to industries with in town works out to 388 MLD. Based on this the generation of sewerage is envisaged to be around 310 MLD. But presently only the treatment plants of total 161.5 MLD capacity are operational and hardly 130 MLD of sewage is reaching to these plants for treatment.

The entire GVMC area has been divided into 20 sewerage blocks. These blocks are excluding the areas of Bheemunipatnam and Anakapalli which has been recently added to the municipal corporation area. A sewerage network of 316 km length is spread over the city in 72 wards of GVMC. But only 249 km is connected to Sewage Treatment Plants (existing and under construction). The newly added areas of GVMC are not covered by the collection network. Out of the existing network of 316 km, around 110 km is under sized and need augmentation. It is informed that presently only 20% of the households are connected to sewerage collection system.

There are total 16 number Sewage Treatment Plant in the city, which are operatiol at present. The total capacity of these plants is 107.50 MLD as shown below:

- At Appughar : 25 MLD
- At Mudasarlova : 13 MLD
- Old City : 38 MLD
- At VPT : 10 MLD
- 13 Mini STPs at different locations : 31.50 MLD
- At Narava (operational) : 54 MLD
- Total Capacity of Plants working : 171.50 MLD

In addition to above following new Sewage Treatment Plants are under construction in GVMC, after that the total capacity would be (171.50 + 57) = 228.50 MLD:

- At Narava (under construction) : 54 MLD

- At Pardesipalem : 2.0 MLD
- At Rabulacheruvu : 1.0 MLD
- Total cap of Plants under construction : 57 MLD

Apart from these STPs, there has been DPRs prepared for another 177.69 MLD.

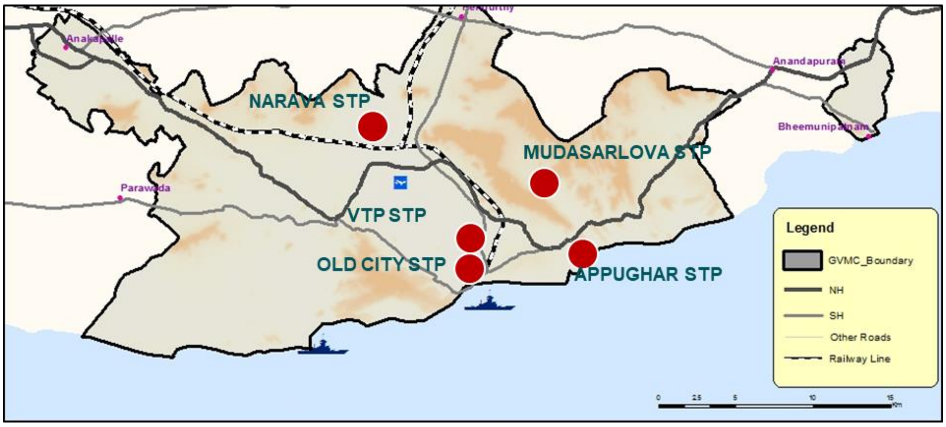


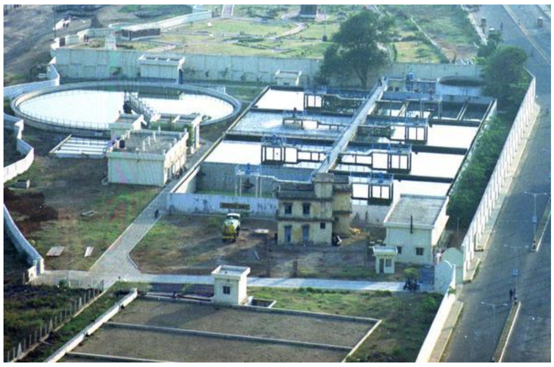
Figure 8-4: Locations of Sewage Treatment Plants in GVMC

Aeration tanks

Clarifier tank

13 MLD STP at Mudsarlova

38 MLD Sewage Treatment Plant at Old City



25 MLD STP at Appughar

Inlet chamber

Screen Chamber

Detrious Tank

Aeration Tank

54 MLD STP at Narava (under construction)
Figure 8-5: Pictures of STPs in GVMC

Table 8-8: Present Status and Gap Assessment for Sewerage System in GVMC

Particulars	Unit	Required as per Norms	Present Scenario	Gap
Population (Census 2011)			1,883,345	
Present Population			2,035,000	
Sewage Generation envisaged	MLD		310	
Households with Sewerage Network		4,36,300	85,357	350943
Length of roads/ streets v/s length of sewer lines	km	2251.61	316	1935.61
Area Served by Collection Network	Wards	72	42	30 wards + Bheemli and Anakapalli

Particulars	Unit	Required as per Norms	Present Scenario	Gap
Sewage Treatment Plants	MLD	310	161.5	148.5
Service Levels				
Coverage of sewerage network services (House Hold services)		100%	21.6%	78.4%
Efficiency of Sewage collection		100%	43.62%	56.38%
Efficiency of Sewage Treatment: Adequacy of sewerage treatment		100%	52%	48%

Source: SLIP-2018 and "At a Glance" statements from GVMC, 2019.

Apart from Greater Visakhapatnam Municipal Corporation none of the other ULBs presently have sewerage system. At present no separate sewer lines are laid in urban areas. The raw excreta or the outflow from septic tanks is being disposed through open drains. However, DPRs have been prepared for extension of sewerage system in GVMC, and new sewerage system in Viziangaram ULB. Other ULBs have prepared DPRs for Septage management through truck transport.

Table 8-9: Present Status summary for Sewerage & Sanitation System in VMR

ULBs	STP capacity/Sewage Generation MLD		Sewer lines based on road length		HH coverage	Coverage of latrines
	Reqd.	Existing	Reqd.	Existing		
Greater Visakhapatnam Municipal Corporation (GVMC)	310	161.5	2252	316	43.6%	98%
Vizianagaram Municipality	29.6	0	256	0	0	90%
Yelamanchili Municipality	4	0	95	0	0	88%
Nellimarla Nagar Panchayat	2.6	0	32	0	0	24%

Source: SLIP-2018 and "At a Glance" statements from respective Urban Local Bodies, 2019.

RURAL SEWERAGE SYSTEM

There is no formal sewerage system / underground drainage system available in rural area of VMR. The extent of sewerage system is limited to GVMC. Hence, people are either dependent on individual household latrines with septic tanks or having two-pit latrines. A fair part of population is practicing open defecation. The discharge from septic tanks as well as from katchha latrines /2– pit latrines is connected to open drains (pucca / katcha) which flow into adjoining water bodies, thereby polluting them. This practice is not only having negative impact on environment but also effecting hygiene and health of local inhabitants. Open defecation is prevalent in rural areas of VMR, depreciating the heigene level and is critical for women as they are forced to go out only in late evening or in early morning. There is chance of social nuisance as well as biological impact on women health.

If we look at the district wise statistics of the three districts coming under VMR, the percentage of households in rural area having individual latrines is highest in Vizianagaram (26.90%), followed by Visakhapatnam (23.76%).

Inferences drawn from the assessment of present scenario of sewerage system in VMR are as follows:

- GVMC alone has a Sewerage System out of 4 Urban Local Bodies.
- For gap assessment capacity of STPs required has been worked out based on water demand for present population as per norms.
- No sewerage system in any part of rural area.
- Since figures with individual latrines in Rural area is very low. open defecation is prevalent in all the three districts.

8.3 STORM WATER DRAINAGE

Most Indian cities lack in adequate storm water drainage system, which results in flooding and inundation in habituated areas. Numerous factors account for poor drainage system in our cities. The most common of them are:

- Poor maintenance and timely cleaning/ de-silting of city drains.
- Blockage of city drainage system by solid waste.
- Changes in land use, which result in blockage of natural water ways.
- Blockage of Natural Drainage system by agricultural wastes, silt arising from both natural erosion and construction activities, indiscriminate land filling.

The existing situation of drainage system in urban centres of VMR has been analysed based upon the data provided by concerned ULBs and available in SLIP. The comprehensive statement discussing the details and gaps in each ULB has been provided in the Table 8-10 below. The demands have been assessed based on the Service Level Benchmarks laid down by MoUD.

In the urban areas of VMR most of the drains are open drains and waste water from domestic households is released into the drains, as there is no other separate Sewerage Network. In monsoon season due to regular or sudden rains low altitude areas get water logged, in VMR highest area getting water logged is observed in Nellimarla with 50%, and lowest in Vizianagaram with 12.27%. All these gaps need to be filled by augmenting the Storm water drainage Network of the ULB’s in the region.Table 8-10: Existing service levels of Storm water drainage in VMR ULBs

ULB	Incidence of Sewerage mixing in the Drains	Incidence of Water logging
MoUD Standards	**0%**	**0%**
GVMC	22.75%	14.66%
VMC	14.53%	12.27%
Yelamanchili	5%	40%
Nellimarla	50%	50%

Source: SLIP reports of AMRUT & NON - AMRUT ULB's for 2018 and discussion with ULBs

Percentage coverage of Storm Water Drainage network in the urban areas varies from lowest 5% in Yelamanchili to highest 54% in Nellimarla. Since coverage in Yelamanchili ULB is hardly 5%, the incidences of sewage mixing with drains is also seen as high as 40%. Gap in the network for each ULB is also calculated and presented in the Table 8-11. For GVMC, and Yelamanchili new proposals are in DPR Stage and yet to be implemented.

Table 8-11: Storm Water drains coverage in urban areas of VMR

Name of the ULB	Storm Water Drain coverage				Length of drains proposed in DPR's (in Km)
	Road network in KM	Existing Storm Water Drain length in Km	SWD coverage in %	Gap in network in Km	
GVMC	3,050	2,714.5	45%	3,385.5	238
VMC	256	69	13%	443	0
Yelamanchili	95	10	5%	180	166.7
Nellimarla	31.5	34	54%	29	0

Source: SLIP reports of AMRUT & NON - AMRUT ULB's for 2016 and discussion with ULBs

The rural area of VMR does not have designed /planned storm water drainage system. Incidence of flooding and inundation in low lying areas is observed in some of the villages during rains. The storm water is drained by existing natural drains. Pucca drains are only constructed near culverts or near thickly populated part.

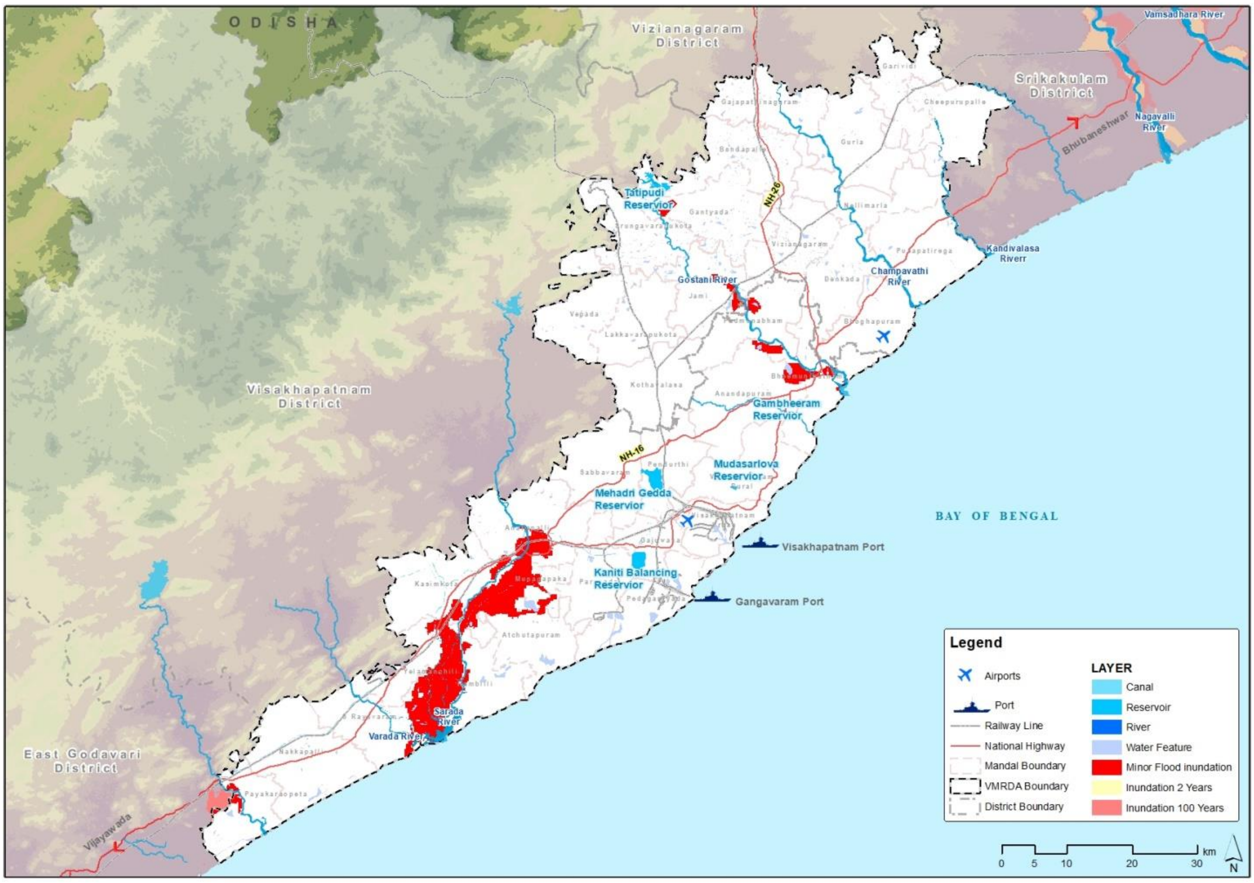


Figure 8-6: Probable Flood inundation map of major & minor rivers of VMR

Nearly 40 natural drains including rivers are draining storm water from VMR to Bay of Bengal. The major rivers in VMR are Eleru, Pampa, Thandava, Varaha, sarada, Gosthani and Champavathi, other natural drains draining the area are Narava gedda, kandivalasa gedda, and Pedda gedda. The villages that could be flooded along the rivers of Eleru, Pampa, Thandava, Varaha, sarada, Gosthani and Champavathi. The Andhra Pradesh

State Development and Planning Society (APSDPS), GoAP, has identified few villages near these rivers which fall in probable flood affected areas. A summary is being given in Table 8-12. These villages need to be provided with proper drainage system to avoid the inundation in future. A map showing these villages is shown in Figure 8-6

Table 8-12: Number of villages falling in probable floodable zones of VMR

River	Eleru & Pampa	Thandava	Sarada & Varaha	Gosthani	Meghadri gedda reservoir	Total
No. of villages	6	8	83	28	11	136

Source: APSDPS (Andhra Pradesh State Development and Planning Society) Flood prone villages list

CONCLUSION

Inferences drawn from the assessment of present scenario of storm water drainage in VMR are as follows:

- The percentage coverage by storm drains in ULBs ranges between 5% and 51%.
- DPR's are prepared in peace meals/ zone wise looking to priority.
- The natural drainage system in urban areas has been dislocated due to urbanisation. But in rural areas it is comparatively intact..Dumping of waste in open drains is seen both in urban & rural areas.
- Encroachments in water ways and blocking of drains with solid waste are the main reason of water logging and inundation in both urban & rural areas.
- Mixing of sewage with Storm water Drains is a one of the key issue raised during public consultation, as these drains join the sea without any treatment.

8.4 SOLID WASTE MANAGEMENT

The Solid waste generated in the region is categorized to three types such as municipal solid waste, hazardous waste and bio-medical waste. Each of these categorized wastes are managed differently by different authorities and treating/disposing units.

Municipal solid waste (MSW) – Waste generated from residential pockets of the region: The MSW generated is managed (i.e., collected, transported, treated/disposed) by local authorities like Municipal corporations, Municipalities, and Nagar Panchayats in urban areas and gram Panchayat in rural areas.

Major urban centres in the region are dominant waste generators, owing to the high concentration of the population living in them; relatively quantity of waste generated is also high. Generated waste from residential households, commercial areas, market places and road sweeping is collected by Local bodies; urban areas have an average collection efficiency of 95%. Collected waste is transported to the disposal site nearby to the areas. In urban areas with compost plants, the market waste and any segregated wet waste is taken to the compost plant. In others waste is dumped at the disposal site without any other treatment.

Table 8-13: Existing scenario of Solid Waste Management in urban areas

Local Bodies	Waste Generated (MTPD)	Dumping site	Transfer Station	Compost plant	WTE cluster
GVMC	1,000	Yes, at Kapulauppada, Bheemunipatnam	Yes	Yes	Construction to be started
VMC	120	Yes, at Gunupurupeta	Yes	Yes	Recently cancelled
Yelamanchili Municipality	16	Yes, at Seshukonda	No	No	No
Nellimarla Nagar Panchayat	12	Yes, at Gandhi nagar	No	No	Recently cancelled

Source: Respective ULBs

To scientifically treat and dispose the waste in an eco-friendly manner, GoAP has taken initiative and identified Waste to Energy (WTE) clusters by joining nearby urban areas for energy generation and scientific disposal of waste. VMRhas one such WTE cluster proposed in at Kapuluppada for GVMC, however Vizianagaram, and Nellimarla ULBs have been asked by the Govt to join GVMC cluster.

In rural areas, in some of the Gram Panchayats (GP) the solid waste is segregated and biodegradable waste is used for composting. The inert material and recyclable material are stored separately after segregation. While other GPs the waste is crudely disposed on out skirts of the village. Overall 25% of Villages of VMR has compost pits for management of solid waste in rural areas.

Hazardous waste (HW) – Management of hazardous waste generated by the industries is the responsibility of the particular industry itself. Either the waste is being handled by them or is being sent to other industries/ treatment facilities. The industries have to take authorization from the AP State pollution control board and dispose the waste according to the norms set by them

The hazardous waste generated by industries in VMR is treated by M/s. Coastal Waste Management Facility (CWMP), established by Ramky Enviro Engineers Limited (REEL) located in JNPC Parawada. It provides Treatment, Storage and Disposal Facility. The firm has to collect and transport the hazardous waste generated from the registered members from the districts of VMR region. About 260 thousand MT is treated per year in the region. Of the treated waste 26% is landfilled, 18% is incinerated, and 54% is recycled.

Bio-medical waste (BMW) from Hospitals–: Bio-medical waste generated from healthcare units is considered as potentially hazardous and disposal of such waste without treatment may pose serious environmental and public health risk. Thus, it has to be handled in a scientific discriminative manner. The generation of Hazardous waste is nearly 0.1 kg/ bed/ day. Presently nearly 700 MT/year waste is being treated by 2 distinct firms, who have established their plants for treatment of Bio-medical waste.

CONCLUSION

Inferences drawn from the assessment of present scenario of solid waste management in VMR are as follows:

- Present undergoing waste management scenarios for hazardous waste and Bio-medical waste management in the region are adequate
- For Municipal solid waste management, few issues are identified such as waste not being segregated, composting practices are unhealthy / unmonitored, waste is disposed crudely, some of the dumpsites in use does not have compound walls and waste weight monitoring systems, Burning of waste at the dumpsite, Inefficient use of available infrastructure in both urban and rural areas

8.5 POWER SUPPLY

PRESENT POWER NETWORK & FUTURE POWER SOURCES

Power supply is one of the vital factors for development and thriving of the VMR region with its vast Large & Mega industries and MSME industrial parks and pockets. Andhra Pradesh state receives 56% of the power within the state and remaining 44% from central power, Independent Power plants (IPP) and Captive power plants. The bulk power transmission in the state is done by two agencies POWERGRID, and APTRANSCO.

POWER DISTRIBUTION SYSTEM- APEPDCL

Power distribution in the region is handled by APEPDCL through a huge net-work of HT and LT power lines along with related sub stations. The present net -work of HT and LT lines in the region is being given in Table 8-14 below:

Table 8-14: Existing Power network in VMR

LINE	Visakhapatnam	Vizianagaram
400 K.V	1,193.26	0
220 K.V	869.35	80.33
132 K.V	1,502.55	255.64
33 K.V	1,262.5	679.45
11 K.V	4,425.67	6,243.67
Total HT Lines	9,253.33	7,259.09
L.T.LINE	12,725.87	13,063.52
G. Total	21,979.2	20,322.61

Source: APEPDCL

APEPDCL supplies power to different categories through the network consisting of 587 Sub-stations of 33 kV level, 2,322 feeders of 11 kV level and more than 1,27,487 distribution transformers of different capacities in 221 mandals in north coastal part of Andhra Pradesh as shown in

Table 8-15.

Table 8-15: No. of Sub-stations in APEPDCL Network

Sl.No.	Type of Sub Station	No. of Sub-stations
1	220 kV Sub-stations	15 Nos.
2	132 kV Sub-stations	55 Nos.
3	33 / 11 kV Sub-stations	587 Nos.
4	11 kV / 433 V Sub-stations	1,28,000 Nos.

Source: Data collected from APEPDCL

9 HOUSING AND REAL ESTATE SCENARIO

This chapter presents the current scenario of the housing and real estate sector. The direction of growth and development trends have been analysed though study of implementation of government housing schemes and realisation of layouts in VMR. A detailed assessment of the sector is done looking at the timeline of development and its spatial spread in the region.

9.1 INTRODUCTION

A certain minimum standard of housing is essential for a healthy and civilized existence. Starting from informal settlements to the high end villas, the fundamental function of housing remains the same, i.e. to shelter. Government of Andhra Pradesh has given prime importance for building houses from the past few decades. The Housing sector in VMR will be discussed in detail with focus on major urban areas like Visakhapatnam, and Vizianagaram.

Real estate sector has a crucial role in any economy. It also impacts various other allied sectors. The expenditure in the real estate sector impacts the expenditure and returns in other sectors atleast upto five times. The patterns of urbanisation in India have an effect on the real estate sector across all its segments of residential, commercial, and hospitality. The region with its bestowed natural beauty and existence of various topographical features along with excellent connectivity, offers opportunities for economic development under various kinds of projects in sectors of tourism, real estate, industries and others.

The increase in work opportunities in many urban areas has attracted the migrant working population. The increase in population has demanded a rise in the available housing stock. The situation is the same in every other region and VMR is no exception. The vast potential in this sector is in the waiting for exploitation. The increased need has created demand for housing along with commercial activity. After the bifurcation of the state into Andhra Pradesh and Telangana, the state of Andhra Pradesh has created mandate to attract the investments in the region. The complete assessment of current scenario of real estate industry of VMR is presented in the following sections.

9.2 HOUSING TRENDS AND DEMAND

HOUSING

The real estate development in housing sector can be segmented into private housing, rehabilitation resettlement housing colonies and public housing. The accelerated growth of IT/ITeS sector witnessed during the last decade across major cities (viz. Mumbai, Bangalore, Chennai, Hyderabad, etc.) has triggered the initialization of IT/ITeS activity in majority of the tier II cities (viz. Coimbatore, Visakhapatnam, Mysore, Pune, etc.) in India. IT/ ITeS development in Visakhapatnam is primarily attributable to factors such as availability of relevant manpower, lower manpower cost, availability of large land parcels at relatively cheaper rates, Government thrust to prioritize the sector, etc.

Over the last 5 – 6 years, the residential activity has witnessed spill over activity to suburban and peripheral locations in the city. This has been triggered with spurt in IT/ITeS led demand. With increasing population, escalating land values in established residential hubs, growth of IT/ITeS segment in Madhurawada – Pendurthi – Gajuwaka region, the real estate development activity in the residential segment is witnessing a gradual transition from the central areas to the suburban areas, and subsequently to the peripheral areas of the city.

REAL ESTATE

VMRDA is one of the biggest industrial investment regions in Andhra Pradesh having potential for many new ports like Kalingapatnam and Bheemunipatnam in addition to existing Visakhapatnam and Gangavaram ports. Along with the development of IT industries in Class II towns, the presence of industrial giants like Visakhapatnam Port Trust, Gangavaram Port, Visakhapatnam Steel Plant, NTPC, Pharma SEZ, Pharma City, APIIC industrial estates, APSEZ, Hetero SEZ, NFCL, GFCL, industrial hubs along with intermittent tourist attractions are main reasons for rapid and significant growth of real estate sector in the project area.

In VMRDA, the real estate development is being regulated / controlled by various Government Agencies. As per the AP Urban Areas (Development) Act 1975, the Visakhapatnam Urban Development Authority (VUDA) is empowered to regulate the development as per the Perspective Plan and Master Plan. However, VUDA delegated certain development control powers to the Municipal Corporation (GVMC) and municipality of Vizianagaram. Further, the Panchayats are empowered to approve the building plans to 10m height within the approved layouts and for all other categories VUDA reserves the rights for granting permission.

Real estate is also zooming in the wake of new developments with skyrocketing land prices in Visakhapatnam. Property developers, apart, group of Non-Resident Indians (NRIs) promising handsome investments have now turned their heads towards the port city. With the result, land prices have spiralled by 50 to 75%. What further boosted the rising land prices was the allotment by the State Government of vast stretches of valuable land to industries, software companies and development of Special economic zones (SEZs). Visakhapatnam has grown by leaps and bounds in recent years and improvements can be seen in every sector in the city. Here, the land prices range in between Rs.8,000 to Rs.10,000 per square yard. In the major locations like Dwarkanagar, it is as high as Rs. 30,000 to 40,000 per sq yard, with the development of several IT units and also the sanction of several new industrial parks such as Brandix Apparel City. The rates are according to the circle rates of AP Revenue department.

Wherever the APIIC industrial estates / industrial areas are declared as Industrial Area Local Authority (IALA) by the Government, are empowered by the VUDA to approve the plans subject to reimbursement of charges/fees to VUDA. Areas outside VUDA boundary and GVMC are being regulated by the Director of Town and Country Planning or Joint Director/Deputy Director as the case may be.

9.3 GROWTH DIRECTIONS

HOUSING

The public agencies such as VMRDA, APIIC, GVMC, KMC, APSHC, APHB along with private developers play an important role in the real estate development in all the three districts in VMR. The key public players and their role in development of real estate sector are as follows.

VMRDA regulates the development according to the plans and guides the private developers in developing layouts, housing schemes, integrated townships, apartments, commercial buildings/complexes and accords approval. VUDA takes up urban housing schemes, apartments, individual houses and row housing, etc., and developed land pooling schemes and joint venture projects of integrated township over 437 hectares. Out of the 52 layouts developed, few of them are integrated townships such as MVP Colony, Kappulappada, Madhavdhara, Madhurawada, Rushikonda, Kurmannapalem, Babametta and K.A.Petta at Vizianagaram etc. VUDA has developed many tourism projects and these are properties which are maintained and are a source of income to VUDA.VUDA has constructed many commercial complexes at many locations in Visakhapatnam, Vizianagaram, and Anakapalle.

Under housing activity 10, 841 housing units have been constructed and allotted in an extent of Ac.479 to a tune of Rs.68.50 Cr. Under sites services VMRDA has developed and allotted 10, 519 plots in an extent of Ac.1718 to a tune of Rs.27.20 Cr.

APIIC is a completely owned undertaking of Government of Andhra Pradesh. APIIC has assumed the role of facilitator and developed / constructed IT Tower (HSBC) at Visakhapatnam. The APIIC is the principle facilitator in mega projects like IT SEZ / APSEZ, VSEZ, VIWSCO, Gangavaram Port, convention centre, mega industrial parks and hardware parks etc.

The A.P Housing Board has constructed houses to provide shelter to the needy people with no loss no profit basis. Since beginning this division has constructed 7,221 houses of different types and allotted to general public. Of the total constructed houses, 4,580 in Visakhapatnam and 993 in Vizianagaram. The housing is mostly MIG in Visakhapatnam while Vizianagaram has mostly LIG category housing.

Andhra Pradesh Township and Infrastructure Development Corporation Limited (APTIDCO) was established as a government syndicate to take up the task of integrated township and Infrastructure development across the state of Andhra Pradesh. It is the state level nodal agency for Pradhan Mantri Awas Yojana (PMAY) with capabilities of holistic planning, development, financing and implementation of affordable housing in the state. At present, APTIDCO is involved in PMAY Housing for All Urban in the state. A total number of 27,806 houses were built in Visakhapatnam and 31,701 houses have been constructed in Vizianagaram under under AMRUT, PMAY and PMGAY. Figure shows the mandal wise implementation of housing schemes in VMR.

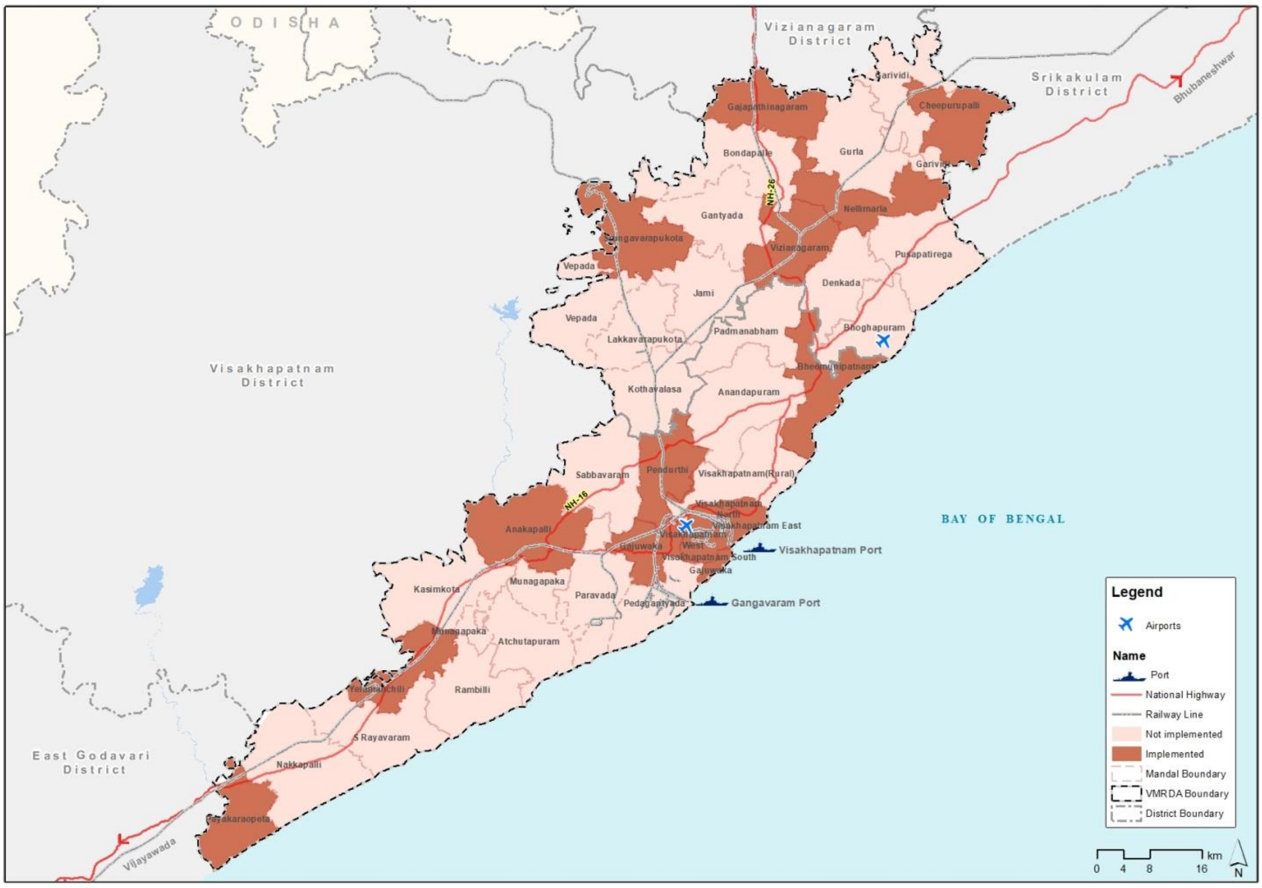


Figure 9-1: Housing schemes in mandals in VMR

Apart from the public sector organizations there are many private developers who have entered the field of construction. The city has witnessed the launch of a few large-scale residential developments (in excess of

100 units) offering improved amenities in the recent past viz. Indiabulls 'Sierra', Shriram Properties 'Panorama Hills', Oxygen Towers, etc. This trend is likely to gain momentum over the coming years with the entry of several reputed local and national developers, who have already acquired/ or in the process of acquiring lands in the city (viz. Omaxe, India Bulls, Bharat Infratech, etc. Most of the private developers like realtors who majorly work in developing the layouts are registered with Andhra Pradesh Real Estate Developers' Association (APREDA) and the builders who develop and deliver the completed projects are linked with The Confederation of Real Estate Developer's Associations of India (CREDAI) and VABA (Visakhapatnam Apartment Builders Association).

Layouts and development of them since the past 5 years gives a major trend of growth direction in VMR. In Visakhapatnam District maximum new layouts have emerged in mandals like Bheemunipatnam, Anandapuram, Anakapalli, Padmanabham, Parawada, Sabbavaram and Pendurthi with 102 Acres in Bheemunipatnam region only because of the recent spread of the city beyond Madhurawada and its nearness to the upcoming Bhogapuram Airport with road connectivity along the beach.

Vizianagaram has seen maximum upcoming of layouts in Bhogapuram, Denkada, Kothavalasa, Vizianagaram, Bondapalli, L.Kota and Vepada mandals in the last 5 years with the maximum of 102 acres in Bhogapuram because of its upcoming International airport proposal and connectivity to National Highway.

The highest area of lands in acres in Vizianagaram district comes under Vizianagaram Mandal followed by Bhogapuram, Denkada, Kothavalasa and L.Kota. The layouts mostly belong to Private followed by DTCP and APDPMS.

MANDAL	VIZIANAGARAM	BHOGAPURAM	DENKADA	KOTHAVALASA	L.KOTA
AREA IN ACRES	2,198	1,589	1,204	999	558

The highest area of lands in acres in Visakhapatnam district comes under Visakhapatnam Rural followed by Beeemunipatnam, Anandapuram, Pendurthi, Gajuwaka and Parwada. The layouts mostly belong to Private followed by DTCP and APDPMS.

MANDAL	VISAKHA RURAL	BHEEMUNIPATNAM	ANANDAPURAM	PENDURTHI	GAJUWAKA	PARAWADA
AREA IN ACRES	2,982.88	2,097.49	1,912.06	1,482.06	1,245.29	968.87

The Present growth trends of layouts show that in the last 5 years most layouts have come up in Atchutapuram, Yelamanchili, Anakapalli in the south, Pendurthi, Kothavalasa, Sabbavaram, Anandapuram and Lakkavarapukota in the west and Bheemunipatnam and Bhogapuram in the north. The trend shows the growth towards the proposed developments and projects coming up in future since maximum layouts are coming out towards Bheemunipatnam and Bhogapuram for the upcoming international airport.

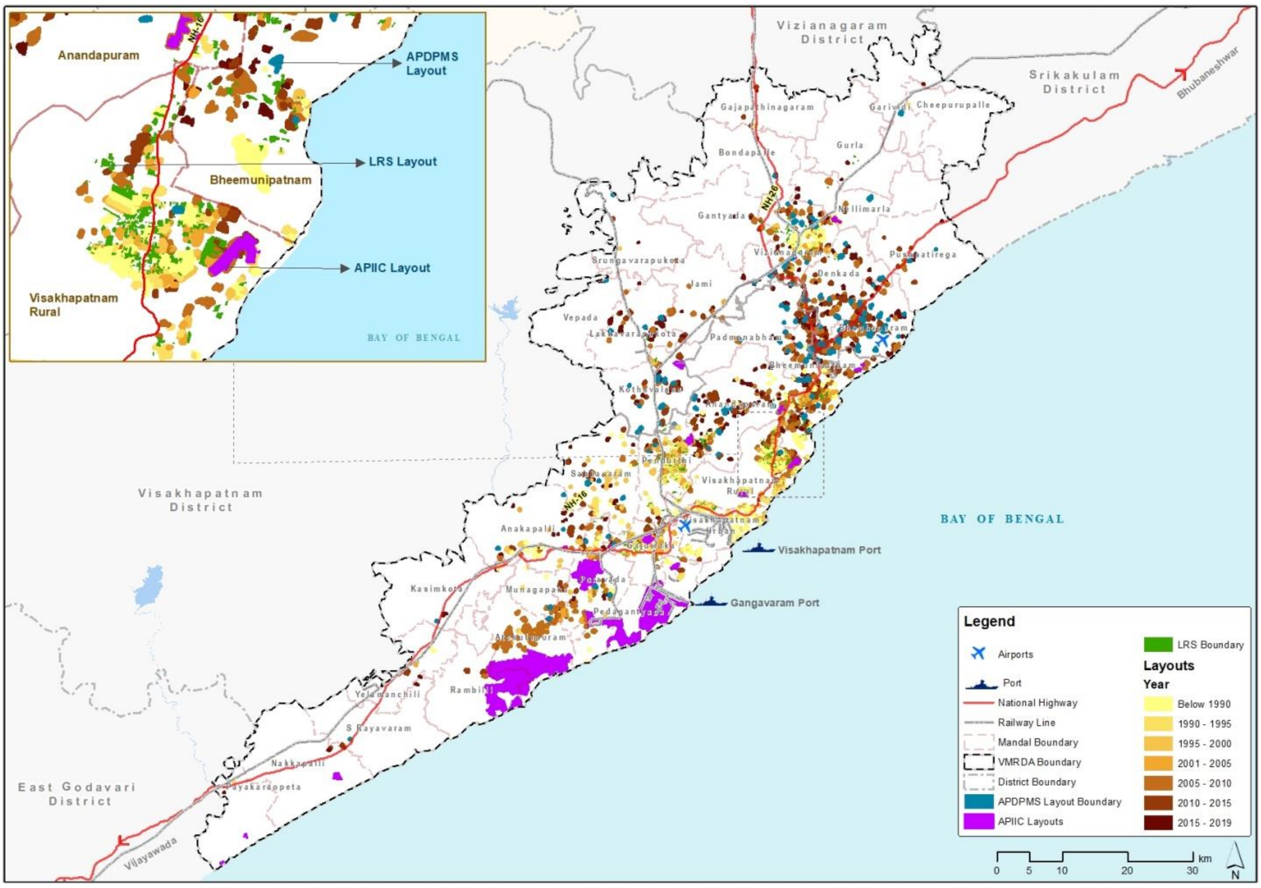


Figure 9-2: Growth trend of layouts in VMR

Real Estate

Property prices in Visakhapatnam got doubled in a span of a year. The most popular area is the stretch along the beach, Rushikonda to Bheemunipatnam. The market value of an acre near to Bheemunipatnam is around Rs. 60 lakh and the registration value is in the order of Rs. 9 to Rs. 15 lakh. Indeed, the registration value pushed to 75 per cent from 50 per cent from August 2006.

Civil works on the much-awaited six-laning of the 51-km Anandapuram-Anakapalli road via Pendurthi are all set to begin by June, in a major thrust to the construction of a bypass highway that would skirt Visakhapatnam city altogether. The state government seems intent on expediting the proposed 900-acre satellite township near Lankelapalem on the outskirts of Visakhapatnam. Observers are also of the opinion that the satellite townships in the outskirts are the need of the hours to expand the city on all sides, instead of further congesting the core city.

9.4 KEY CHALLENGES

VMR with an existing industrial base needs to be more competitive for being a lucrative investment destination. As per studies by CBRE, Development of Integrated 'Industrial Ecosystem' with World Class Industrial Real Estate Infrastructure should be promoted in the region to ensure better living conditions for the workforce who will be moving in based on major investments. Real estate development based on major employment attraction areas will reduce trip lengths and trip costs significantly, making economic theme nodes more successful.

Visakhapatnam region has already focused towards developing large scale Dedicated Industrial Corridors on a cross-country level. With National Highway 16 running along the full length of the region, VMR enjoys excellent connectivity to the port as well as the hinterland, facilitating industries to boom in the region. This gives ample hint to the real estate sector on the stretches to be focused on. The concentration of the development authority should also be aligned with the same to avoid scattered developments.

Industrial nodes such as DMIC, AKIC, BMIC with support from Dedicated Freight Corridors has already been figured as successful models in the country. Similar advantages have to be taken from the Visakhapatnam Chennai Industrial Corridor, which is a major opportunity for the region to tap investments and growth. VCIC has a node based development strategy which has identified certain nodes in the corridor. Pinpointing industrial land allocations and supporting real estate will accentuate the impacts of VCIC. The approach towards housing and real estate development in the industrial noes should be more of pre-envisaged supply push factor rather than a demand based pull factor.

New township Development and proposal of good quality infrastructure in the townships surrounding the potential industrial nodes should be considered as the key parameter for development in housing and real estate sector.

9.5 CONCLUSION

VMR has a vast scope of development in store for the region. Considering the major role, it is going play in the near future, housing and real estate are huge potentials and will be cheered by developers and investors. Slums seems to be major concern with the region but with effective implementation of the National and State level schemes to address the issue in slums and help them develop in terms of providing basic physical and social infrastructure, it has the potential to become one of the fast-developing regions in India. The kind of economic activity, the state is envisaging for this region, it will perhaps become the most sought destinations for commercial, employment and residential purposes focusing on livable and sustainable futuristic townships around the developing nodes.

10 SOCIAL INFRASTRUCTURE FACILITIES

The current scenario of social infrastructure and determining the gaps failing to meet the requirements in the project region. Assessment is carried out based on the norms stipulated in URDPFI guidelines, GoI, 2015.

10.1 EDUCATIONAL FACILITIES

Education and literacy play a vital role in development of socio-economic status of the region. Increase in literacy rates enhances both the economic and social indicators. Literacy rate of VMR is below the average levels of the State level and National level averages. However, literacy levels of Visakhapatnam are nearly equal to State average while other districts in VMR are below the average state literacy rate Prevailing situation of project area is analysed to understand and determine the gaps in these infrastructures in the project area.

Figure 10-1: Coverage of Education facilities

Distribution of School Educational: Elementary educational are higher in Vizianagaram District followed by Visakhapatnam District. Amongst the Urban areas, GVMC (299) has higher while Nellimarla has the least (31). As far as Rural mandals are concerned, Vizianagaram mandal have overwhelming school facility accounting for 449 schools while paucity exists in Ganguvarisigadam mandal (37).

Demand and Gap Assessment for School Education: Analysis at mandal level was carried out to assess the demand and gap for the existing situation according to norms from URDPFI guidelines, 2015.

Distribution of Higher Education : Higher education are distributed across the districts of VMR among which Vizianagaram district has greater share of colleges (67), medical colleges (4), other professional colleges (38) and nursing institutes (7) while Visakhapatnam has more number of Engineering colleges (19) and Technical education category(A) (49). Concentration of higher education is seen more in the urban centres. The Demand and Gap Assessment for Higher Education is presented in the following Table 10-1.

Table 10-1: Needs Assessment for school facilities in Urban areas of VMR

District Name	Sub District Name	Primary School			Senior Secondary School			School For Disabled		
		E*	D**	G***	E	D	G	E	D	G
Vizianagaram	Vizianagaram (Municipal Corporation)	89	148	-59	112	37	75	1	5	-4
	Nellimarla (Nagar Panchayat)	13	12	1	18	3	15	0	0	0
Visakhapatnam District	GVMC	138	1130	-992	161	282	-121	1	41	-40
	Yelamanchili (Municipality)	15	18	-3	29	4	25	0	0	0

*Source for Existing facilities: Town Directory, Census of India (2011), *Existing, **Demand & ***Gap. Demand and Gap are estimated wrt URDPFI Guidelines. Negative (-) values indicates gaps while positive value indicates surplus*

Note: Classification of Pre-Primary and Primary has been taken under single category of Primary school

LITERACY

According to census VMR has 62% literacy rate, which is lesser than the state and national literacy rate of 67.41% and 64.8% respectively. Among the districts Visakhapatnam has higher literates owing to the better urbanisation and presence of Municipal Corporation in these districts.

Table 10-2: Literacy rate of VMR

Mandals	2011		
	Male literacy rate	Female literacy rate	Total literacy rate
Vizianagaram	31%	24%	55%
Visakhapatnam	36%	31%	67%
VMR Literacy Rate (%)	**34%**	**28%**	**63%**

Source: Census of India 2011

SCHOOL ENROLMENT

The project districts as a whole have an average enrolment ratio of 84.5. Enrolment of boys are higher in all districts except for Vizianagaram. In the age group 11-15 years Vizianagaram records higher girl enrolment. This is due to better accessibility and more availability of lower order education in Vizianagaram.

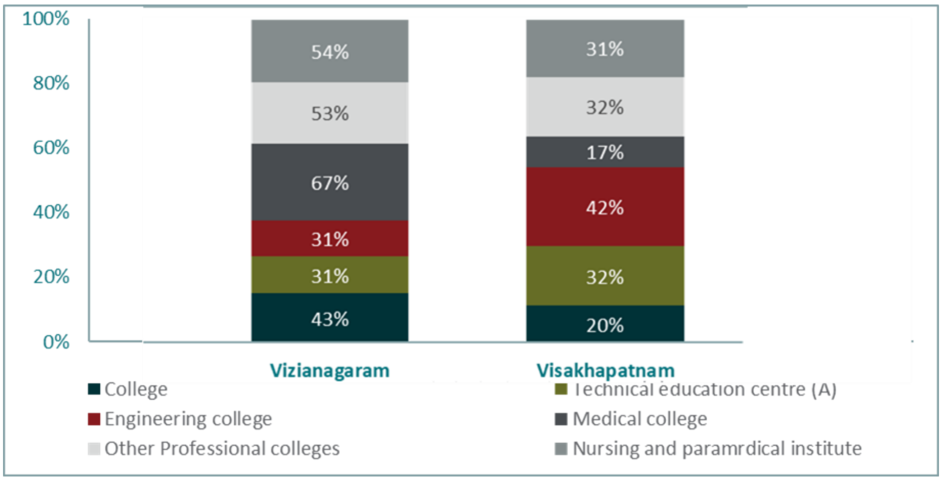


Figure 10-2: Distribution of Higher education in districts of VMR

Table 10-3: Gross enrolment ratio for project districts in classes I-V, VI-VIII and IX-X (ALL), 2016-17

District	Classes (I-V) (6-10 years)			Classes (VI-VIII) (11-13 years)			Classes (IX-X) (14 –15 years)		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Vizianagaram	80.29	74.96	77.68	79.7	80.98	80.33	73.87	79.37	76.51
Visakhapatnam	88.49	82.83	85.72	85.97	84.19	85.1	81.92	83.94	82.89

Source: Statistical Abstract-2017

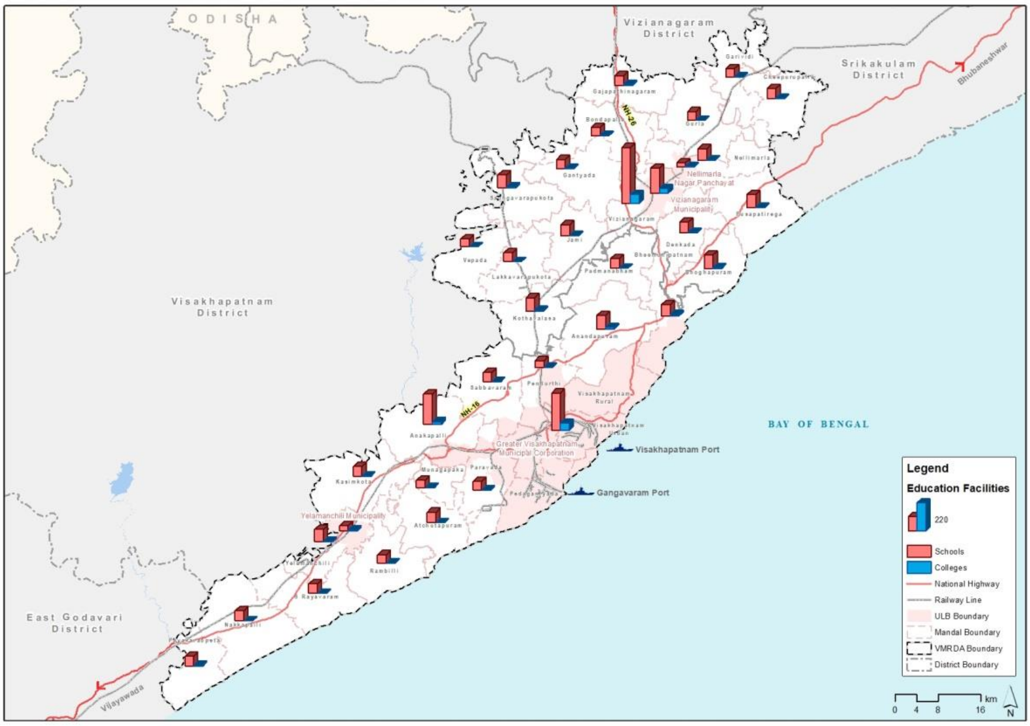


Figure 10-3 Distribution of Educational facilities in VMR

10.2 HEALTH FACILITIES

Healthcare: Visakhapatnam district followed by Vizianagaram district shares good proportionality of Health care infrastructure which majorly constitutes of Dispensary and Nursing home. Intermediate hospitals are more concentrated in Visakhapatnam district. Demand and gap assessment was carried out to identify the regions lacking facility in terms of health indicators.

Table 10-4: Need assessment of health care facilities in ULBs of Project Area

Sub District Name	Dispensary			Nursing Home			Veterinary Hospital		
	E*	D**	G***	E	D	G	E	D	G
Vizianagaram (M + Og)	170	17	153	3	5	-2	1	1	0
Nellimarla (Ct)	10	2	8	0	1	-1	1	1	0
GVMC	205	126	79	3	38	-35	3	4	-1
Yelamanchili (Ct)	10	3	7	0	1	-1	1	1	0

*Source for Existing facilities: Town Directory, Census of India (2011), *Existing, **Demand & ***Gap. Demand and Gap are estimated wrt URDPFI Guidelines Negative (-) values indicates gaps while positive value indicates surplus*

Note: Classification of Dispensary and Polyclinic has been taken under single category of Dispensary.

MORTALITY

Average Mortality/Death rate in VMR is 6.3. Vizianagaram district has higher mortality rate due to lesser availability of health. Visakhapatnam district being the most urbanised centre in the region has better access to health due to which the mortality rate in this district is comparatively lesser.

Table 10-5 Birth and Mortality/Death rate per 1000 population in VMR

District	Birth rate	Death rate
Vizianagaram	16.01	6.52
Visakhapatnam	14.43	6.07

Source: Census (Civil Registration System-2015)

MORBIDITY

Vizianagaram district has higher Morbidity rate due to poor sanitation and solid waste management. Vizianagaram district being more rural in nature lacks better urban infrastructure making it more prone to communicable diseases and unhealthy lifestyle. GVMC despite having better infrastructure has higher morbidity rate. This is due to 793 slums with unhygienic sanitation and open defecation practice in few fishing villages. These challenges of GVMC coupled with rural areas of Visakhapatnam have led to higher morbidity rate after Vizianagaram district.

Table 10-6 Morbidity rate per 1000 population in VMR

District	Morbidity
Vizianagaram	1.64
Visakhapatnam	1.38

Source: Statistical Abstract-2017

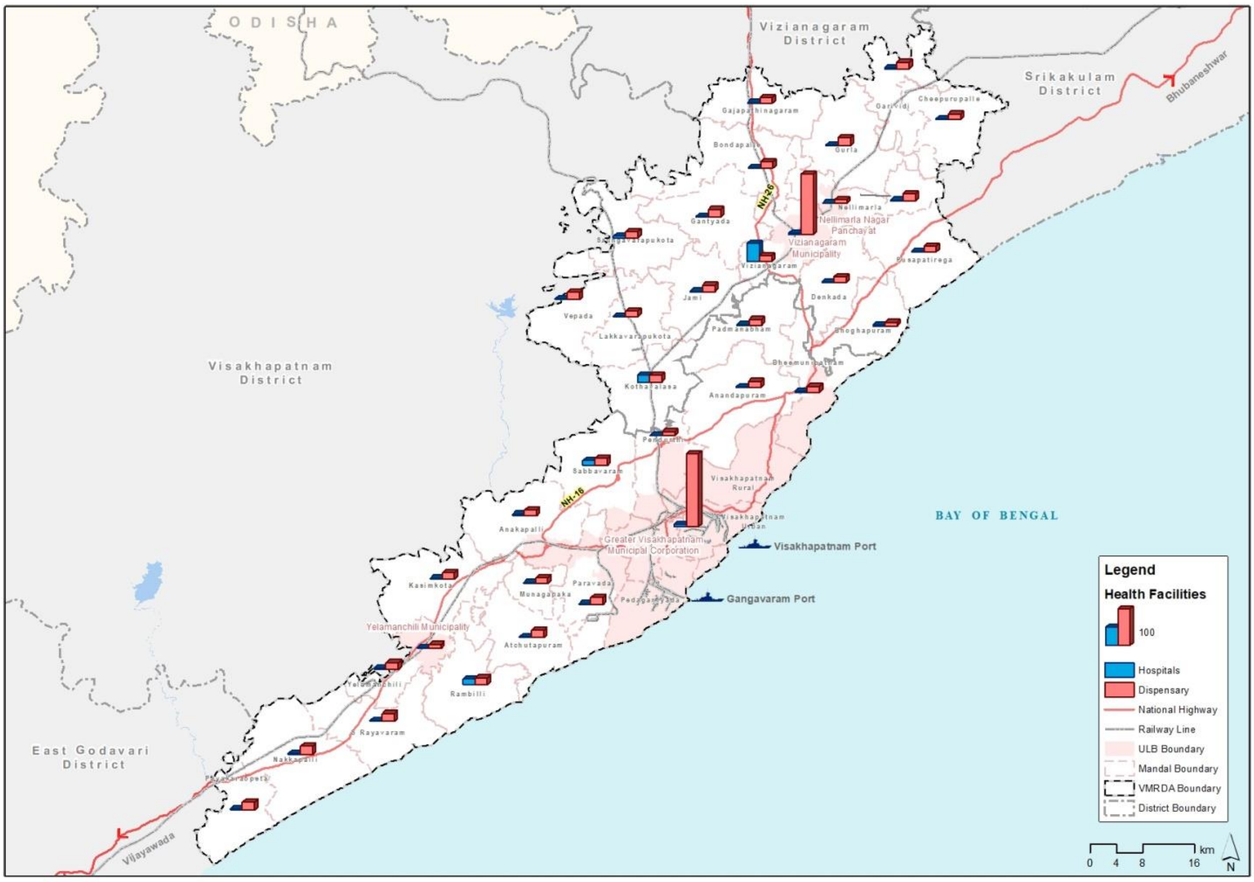


Figure 10-4: Distribution of Health care facilities in VMR

10.3 OTHERS

Socio Cultural: Regions with urban characteristics have few socio-cultural but still it does not meet the demand in the project area Most of the rural areas are devoid of these. A study of the distribution of Socio Cultural indicates that Anakapalli mandal has more number of Anganwadi and Library while cinema halls are more in Vizianagaram mandal. In VMR socio cultural are more in Visakhapatnam followed by Vizianagaram district. There is a need for the properly planned distribution of these due to the improper spread of in the project region. Demand and Gap Assessment of the socio-cultural assessments indicates the regions lacking facility.

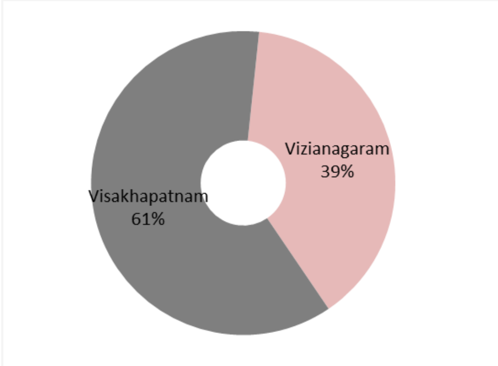


Figure 10-5 Share of petrol filling stations in VMR

Safety Management: VMR has 11 fire stations and 2 fire outposts. More number of fire station is located in Visakhaptnam district (7-fire station and 1 Fire outposts) followed by Vizanagaram (4-fire station and 1 Fire out posts) has the least number of fire stations.

A demand and gap assessment of fire stations in the study region has been conducted. It indicates that a Fire station should be located such that the Fire tenders are able to reach any disaster site within 3-5 minutes. Assessment based on URDPFI guidelines reveals that existing fire infrastructure present in the VMR is insufficient.

Fuel Stations: Visakhapatnam has higher share of fuel distribution services among the districts in project. Anakapalli has a greater number of filling stations. This is due to the large-scale mining taking place in Bowluvvada near Anakapalli and the large network of roads in the region which promotes movements of vehicle and transferring of goods.

Miscellaneous: Miscellaneous like Banks, Telephone exchange and post office depicts the standard of living of a region. It is visible that Visakhapatnam district has relatively higher in VMR. Significant number of banks and Post office is present in Vizianagaram district. Demand and Gap Assessment was carried out to identify the regions lacking other social infrastructure.

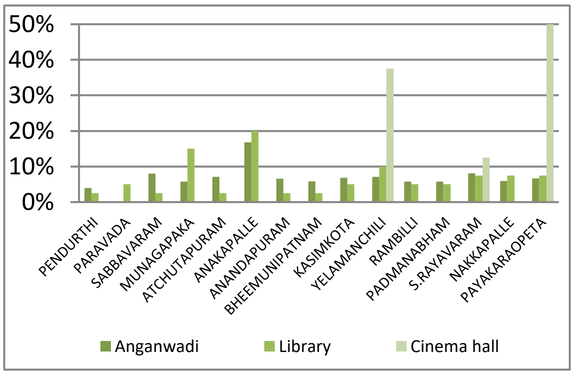


Figure 10-6 Socio Cultural facilities in mandals of Visakhapatnam district

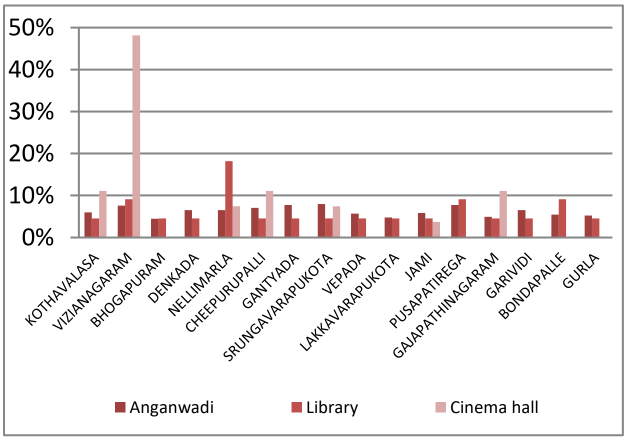


Figure 10-7 Socio Cultural facilities in mandals of Vizianagaram district

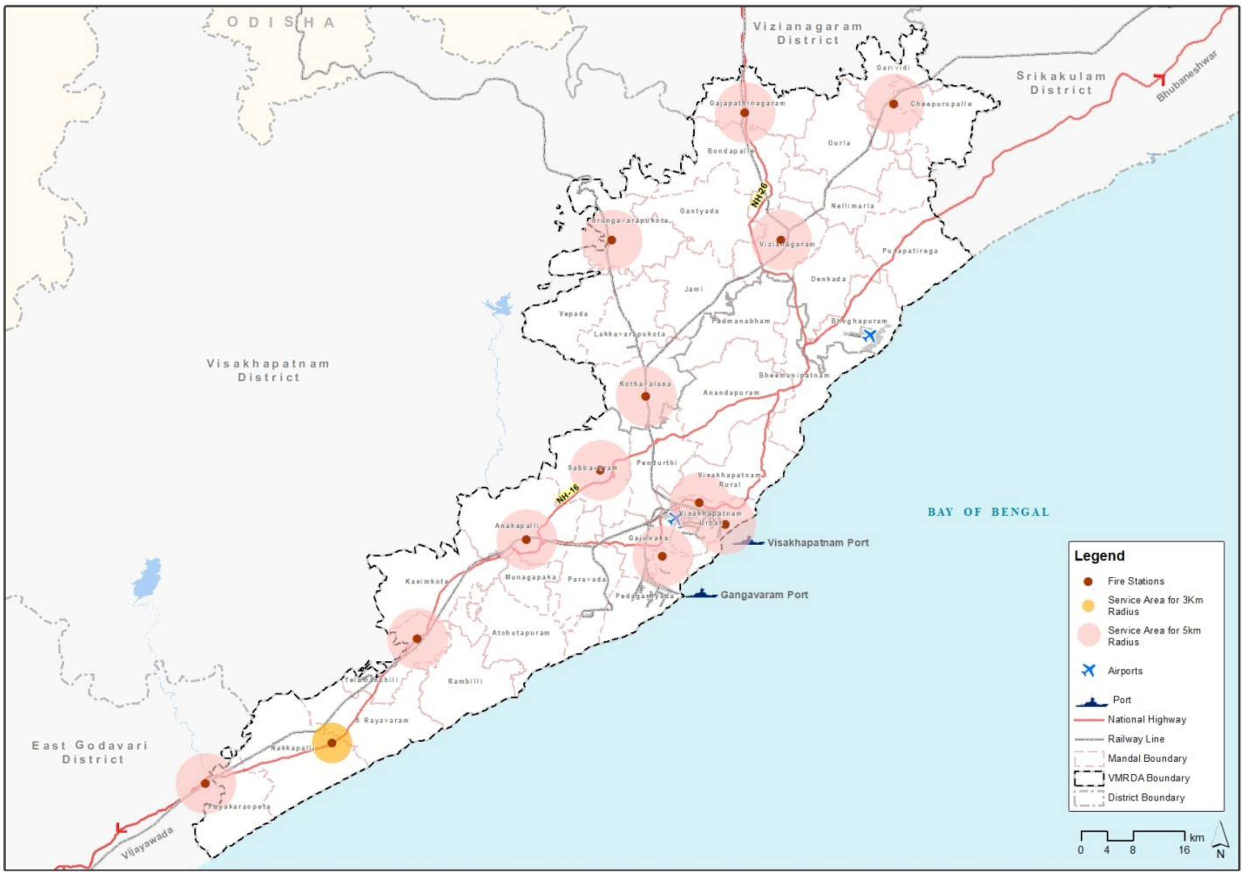


Figure 10-8: Distribution of Fire services

Quality of life in the region is associated with the factor of liveability. Social infrastructure is the key element of liveability which is enhanced by the amenities and services provided in an accessible range within the region. Assessment carried out in the VMR reveals that the project area has paucity in social infrastructure. Adequate provision of these to cater to the need of the VMR population is essential. There is a higher deficit in higher order and it is also observed that infrastructure like socio-cultural, safety management and basic postal infrastructure provision are not given due importance. Current demographic indicators show that there is more population belonging to the younger age group, this indicates the need for higher order education like technical education in the region with definite skill sets appropriate to make the best of the employment opportunities that are to be generated as per the recent dynamics in industrial sector.

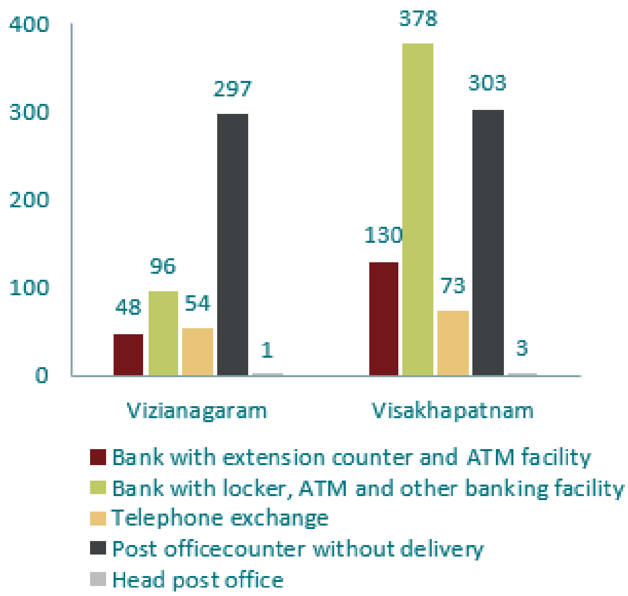


Figure 10-9: Share of miscellaneous facilities in districts of VMR

POVERTY

Vizianagaram district has higher share of people living below poverty line. This is due to the presence of more rural area which has more agricultural labours yielding lesser per capita income. In Visakhapatnam district urban poor forms the higher share of BPL population (Table 10-7).

Table 10-7 Percentage share of BPL population VMR

District	Percentage Share of BPL.
Visakhapatnam	26.1%
Vizianagaram	26.4%
VMR	26.6%

Source: Department of consumer affairs, food & civil supplies, Andhra Pradesh, august-2018

10.4 CONCLUSION

The assessment determined the need for social infrastructure facilities that are required within VMR to enhance the quality of life.

11 SWOT ANALYSIS

The Strengths, Weakness, Opportunities and Challenges (SWOC) of the region highlights various dominant and determining factors which provide strategic guidelines for further planning and proposed development. Based on various studies and surveys conducted in comparison with global benchmarking developments the following SWOT of the region is discussed.

01
Strengths

- Geographical Advantage with Natural features
- Good Connectivity
- Well connected Port and Hinterland
- State's Dynamic Vision and Policies
- Potential Development like IT Hub, Etc.
- Major Tourist Hub in the State with rich Heritage
- Potential Workforce Participation
- Diverse Economic Characteristics

03
Opportunities

- Potential development of SEZs and Industrial Parks
- Deep waters along East Coast facilitate Shipping Activities
- Upcoming Metro and International Airport Boost Infrastructure and Real Estate
- Smart City Initiative of GVMC
- Potential for Agro-based and Film Industry
- Business tourism through MICE Infrastructure development

02
Weaknesses

- Underutilized Ports
- Unoccupied Industrial Clusters
- Occupational Shift from Primary Sector
- Inadequate distribution of Infrastructure In Rural Areas

04
Threats

- Prone to Environmental factors
- Depletion of Natural Resources
- Reduced Air Quality due to high industrial activity
- Unplanned Growth
- Encroachment of Water Bodies
- Inadequate quality of life

11.1 STRENGTHS

The Region has a Geographical advantage with natural features like forests, hills, rivers and natural harbour. Its advantageous location coupled with export-import facilitation by the ports played key role in attracting major investment in industrial sector, real estate and tourism sectors.

Good Connectivity: The region is endowed with a very well-developed transport network by all modes of transport – road, rail, air and sea. Being a coastal region and having natural harbours it has added advantage of major ports like Visakhapatnam, Gangavaram and nearness of Kakinada port, a container terminal and two fishing Harbours in the region and its vicinity. In terms of road and rail network, the region is well connected by the national highways (NH-16 and NH-26) and trunk rail network (South Coast and South Central Railways).

National Highway – 16

Visakhapatnam Airport

Visakhapatnam Railway Station

Connectivity between ports and Hinterland: Good connectivity that exists between the ports and hinterlands with better logistics is a major factor for Industrial growth. Visakhapatnam Port connects to NH – 16 by a 12 Km (including 4.87 km ROB) port connectivity road, developed by NHAI. The Gangavaram Port also directly connects to NH – 16 by a new 4 lane 3.8 km long road developed by GoAP.

The potential development of Visakhapatnam into IT hub, and Educational Hub: The ITES and IT sector is growing at a good pace in the city of Visakhapatnam. The IT Special Economic Zone and incubation center is located in Rushikonda Hills of the city. There are many national and multi–national IT/ITes and banking firms such as Mahindra Satyam, Wipro, Kenexa, Infotech, IBM, Sutherland, and HSBC etc. Software exports from Visakhapatnam has been increasing at a fast pace over years.

Major Tourist Hub: Visakhapatnam is a major tourist hub on the east coast of the country owing to its scenic beauty carrying heritage effervescence retained through early settlements. The region comprises of various scenic spots, culturally rich religious destinations and several master pieces of great architectural heritage. Along with the urban attractions in tourist destinations, there are untouched rural scenic spots and relatively less exploited heritage structures located in rural hinterland that offer great potential to generate economic and employment opportunities. The city of Visakhapatnam can be considered as the nucleus for tourist activity in this region.

Many people migrating from rural areas to the urban areas. The minor yield in agriculture lead many people migrate to cities in search of new jobs. With the increase in new projects, the migrated human resources highlight upon the potential workforce participation.

The region has a **balanced regional economy** with diverse economic characteristics throughout. The region is home for various state-owned heavy industries and a steel plant. Apart from accommodating various international IT and banking firms, the region is a hub for iron ore and other minerals which are exported to China and other countries.

11.2 WEAKNESSES

The ports and logistics hubs in the region are underutilized.

Many industrial clusters within the industrial corridors still remain unoccupied.

There is an occupational shift from primary sectors of economy such as fishing and allied activities due to the decreased yield and lack of proper infrastructure facilities.

Due to modernization, many People do not want to continue with agriculture due to instability and would like to switch to other sectors (industries preferably) if provided with better opportunities. The unutilized agriculture lands are further converted into different landuse based on their requirement.

The inadequate and improper distribution of Physical and Social Infrastructure facilities in rural areas which are experiencing a very low growth rate because of the shift to urban areas for better quality of life and lesser per capita income in the rural areas. Majority of the rural shift will end up in slums by virtue of lowcost housing facilities and affordability.

11.3 OPPURTUNITIES

Potential development of new establishments such as SEZs and Industrial parks in the available vacant plots already demarcated for industrial growth. Large parcels of land are available in the region which can be developed in a planned manner through land pooling and developing the necessary infrastructure. The land parcels available in the southern part of the region from Visakhapatnam towards Yelamanchili and Nakkapalli can boost development of industrial establishments with the influence of VCIC and VK PCPIR, also utilizing the significantly vacant lands in APIIC. The northern parts of the region are rich agriculture lands with high yielding capacities which should be conserved from urbanization and promote agro based industries nearby.

Deep waters on the East Coast of this region can facilitate more shipping activities.

The proposed metro connection along with the Greenfield International Airport at Bhogapuram will offer a big boost to infrastructure and real estate and promotes new development all along the corridors. The proposed International Airport at Bhogapuram area provides the opportunity to the citizens of the region to connect with different parts of the country and the world.

VCIC and VK-PCPIR corridors runs within the region and would stimulate vibrant economic activities. VKPCPIR has already attained the special status under special development authority and attracts investments. This special investment area status is retained and is delineated as a separate zone. Visakhapatnam Chennai Industrial Corridor (VCIC) investment projects also influences this area strengthening its industrial base. Most of the large and mega industries are to be located in this zone.

Smart City Initiatives for GVMC under SCM of GoI is on ABD Area (5.45 Sq. Km) involving Chinna Waltair, Andhra University and Maharanipeta etc. and few select pockets in GVMC Area along with Pan City smart city components such as Smart Schools, Smart Poles, Safety and Surveillance, and Centralized Command and Control Centre etc.

The region has huge Potential for growth of industries such as Agro-Based and film industries. The region's vast extent of agriculture land to support in providing raw materials for Agro based industries. The picturesque and scenic natural features attract the film industry.

The Tourism policies and incentives creates a conducive environment for development of the available potential in the region

Development of MICE Infrastructure would attract domestic as well as foreign tourists for business.

11.4 CHALLENGES / THREATS

Region is prone to various environmental factors like floods, storm surges, cyclones and coastal erosions due to various man-made and natural interventions.

Depletion of Natural resources and pollution of natural courses due to unscientific mining, deforestation, hillock encroachments. Due to unscientific mining, loss of forest cover, encroachments in hillocks due to urban development, have had implications on protection of natural areas and pollution of natural courses. VMR contains mineral wealth, mining sites, hillocks with wildlife, forest cover

Air quality depletion due to open bulk cargo handling at ports and high concentration of industrial activities in Visakhapatnam city. Mining, open dumping of bulk cargo, open conveying of minerals for industrial activities from the port areas, pharmaceutical industrial wastes are serious cause of concern to quality of life and public health

Unplanned Regional Growth affecting the quality of life and framework/form of the region. There are significant cases of patches of urban development, probably all approved, without proper urban infrastructure and transport network affecting the quality of life and image of the region. Many areas between the urban centers and highways with propensity for growth are becoming focus of unplanned development.

Encroachment of water bodies leading to the loss of natural drainage features. With the steady growth in port and Industrial sectors, which are the two main economies in the region, VMR faces problems like encroachment of ecologically sensitive areas like hills and water bodies. Furthermore, these natural environments are prone to pollution from the haphazard development of industries near them.

The waning and migrating human resources who are not attracted by the existing quality of life in terms of the available facilities and opportunities. Although VMR is blessed with long sea front or coastline, the public and recreational space image of seafront in Visakhapatnam is limited. It carries lot more potential. This situation is resulting due to inadequate space availability in congested areas, coastal erosion, transport connectivity, and provision of visitors, recreational, tourism facilities along with urban design of schemes for waterfronts. Currently, city or region as a whole does not carry an image of a sea front or waterfront city. The city's image is highly connected with ports and industrial activities, which has limited appeal to general public and tourists.

12 VMR VISION FOR 2041

The chapter presents the VMR Vision for 2041 developed based on extensive stakeholder consultations that were carried out during the stages of preparation of Master Plan. The outcomes of the consultation have been presented in Appendix F as a background to this chapter. Furthermore, the chapter also presents the structured themes, goals and their linkage to United Nations Sustainable Development Goals.

12.1 VISION 2041

VMR will be the destination for global trade and investment in the state of Andhra Pradesh. The key settlement Vishakhapatnam will function as an international gateway by expanding access to foreign markets through the existing and proposed transport infrastructure. This will be supported by inducing theme-based development of economic nodes.

Settlements will be self-reliant in terms of basic facilities and services. This will be guided by the proposed settlement hierarchy to achieve decentralized and balanced distribution of facilities and infrastructure services in the settlements of VMR

Quality of life will be improved through interventions including urban renewal of existing urban areas, efficient utilization of transport and utility infrastructure, better management of environmental resources, adoption of climate resilient sustainable practices and smart technologies.

The cultural identity of local communities will be protected through interventions including protection of heritage structures, adaptive reuse of selected precincts, and cultural tourism development particularly to support rural settlements.

"By 2041, VMR will become a vibrant and economic hub as a global investment, tourism and heritage destination and provide improved quality of life in an inclusive manner along with smart, sustainable, green and clean infrastructure and resilient environment"

12.2 GOALS

The VMR Vision for 2041 has been structured into 5 core themes with 7 goals to overcome the issues identified from existing situation analysis, stakeholder aspirations as well anticipated future challenges.

- **Theme:1** - Delivering Strategic Spatial Development
    - Goal:1 - Create cohesive fully serviced settlements within VMR that are resilient to the effects of climate change and facilitate range of choices to live, work, and leisure.
- **Theme:2** - Delivering Growth and Prosperity
    - Goal:2 - Promote economic development of the VMR by introduction of high value-added activities, facilitating competitive sites, incentives for investment, and leveraging on the strengths of each area.
    - Goal:3 - Promote economic productivity of the VMR by investments in knowledge and innovation sector.
- **Theme:3** - Managing the Environment – Natural and Cultural Heritage

- Goal:4 - Protect and enhance the natural, cultural and marine sensitive areas and they are well integrated with the future development.
- Goal:5 - Promote sustainable use of agricultural, water and mineral resources to achieve self-sufficiency.

▶ **Theme:4** - An Efficient Transportation System

- Goal:6 - Develop integrated transportation system within the VMR that is viable, sustainable, efficient and safe for passengers and freight.

▶ **Theme:5** - An Efficient Infrastructure System

- Goal:7 - Develop efficient infrastructure system within the VMR that adapts sustainable practices, smart technologies, renewable resources and resilient to the anticipated effects of climate change.

LINKAGE TO UN SUSTAINABLE DEVELOPMENT GOALS

“Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." emanated by the Brundtland Commission of the United Nations on March 20, 1987.

The United Nations Sustainable Development Goals - “17 SDGs to Transform Our World” are a blueprint for achieving a better and more sustainable future for all (Table 12-1). The goals recognize that ending poverty must go hand-in-hand with strategies that build economic growth and address a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection.

Table 12-1: UN Sustainable Development Goals

1 NO POVERTY	No Poverty	End poverty in all its forms everywhere
2 ZERO HUNGER	Zero Hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3 GOOD HEALTH AND WELL-BEING	Good Health and Well-being	Ensure healthy lives and promote well-being for all at all ages
4 QUALITY EDUCATION	Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5 GENDER EQUALITY	Gender Equality	Achieve gender equality and empower all women and girls
6 CLEAN WATER AND SANITATION	Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all
7 AFFORDABLE AND CLEAN ENERGY	Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all

Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation
Reduced Inequalities	Reduce inequality within and among countries
Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable
Responsible Consumption and Production	Ensure sustainable consumption and production patterns
Climate Action	Take urgent action to combat climate change and its impacts
Life below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Peace, Justice and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Partnerships for the Goals	Strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development

Source: UN SDGs

The VMR Draft Master Plan 7 Goals are aligned directly with 13 or indirectly with 11 international committed UN SDGs (

Table 12-2). The alignment will enable to measure the progress made towards achieving each of the 17 UN SDGs.

Table 12-2: Alignment of VMR DMP Goals with the UN SDGs

VMR Draft Master Plan Goals	Links with UN SDGs	
	Direct Links	Indirect Links
Goal:1 - Create cohesive fully serviced settlements within VMR that are resilient to the effects of climate change and facilitate range of choices to live, work, and leisure.	3 Good Health and Well-Being; 8 Decent Work and Economic Growth; 11 Sustainable Cities and Communities; 13 Climate Action	4 Quality Education; 5 Gender Equality; 10 Reduced Inequalities; 16 Peace, Justice and Strong Institutions
Goal:2 - Promote economic development of the VMR by introduction of high value-added activities, facilitating competitive sites, incentives for investment, and leveraging on the strengths of each area.	1 No Poverty; 8 Decent Work and Economic Growth; 9 Industry, Innovation and Infrastructure	4 Quality Education; 5 Gender Equality; 10 Reduced Inequalities; 16 Peace, Justice and Strong Institutions
Goal:3 - Promote economic productivity of the VMR by investments in knowledge and innovation sector.	4 Quality Education; 9 Industry, Innovation and Infrastructure	8 Decent Work and Economic Growth
Goal:4 - Protect and enhance the natural, cultural and marine sensitive areas and they are well integrated with the future development.	14 Life Below Water; 15 Life on Land	3 Good Health and Well-Being; 11 Sustainable Cities and Communities; 13 Climate Action
Goal:5 - Promote sustainable use of agricultural, water and mineral resources to achieve self-sufficiency.	2 Zero Hunger; 12 Responsible Consumption and Production; 14 Life Below Water; 15 Life on Land	3 Good Health and Well-Being; 11 Sustainable Cities and Communities; 8 Decent Work and Economic Growth; 13 Climate Action
Goal:6 - Develop integrated transportation system within the VMR that is viable, sustainable, efficient and safe for passengers and freight.	9 Industry, Innovation and Infrastructure; 11 Sustainable Cities and Communities; 13 Climate Action	3 Good Health and Well-Being; 5 Gender Equality; 7 Affordable and Clean Energy; 8 Decent Work and Economic Growth; 10 Reduced Inequalities
Goal:7 - Develop efficient infrastructure system within the VMR that adapts sustainable practices, smart technologies, renewable resources and resilient to the anticipated effects of climate change.	6 Clean Water and Sanitation; 7 Affordable and Clean Energy; 12 Responsible Consumption and Production; 13 Climate Action	3 Good Health and Well-Being; 11 Sustainable Cities and Communities; 17 Partnerships for the Goals; 9 Industry, Innovation and Infrastructure

Source: UN SDGs and consultants' assessment

13 ECONOMIC DEVELOPMENT STRATEGY & PRODUCT MIX

The chapter presents the economic development strategy for VMR developed based on assessment of national, state and regional economic environment and the strengths of the VMR that have been presented in Appendix G as a background to this chapter.

Goals and objectives of strategic economic development of VMR are discussed below:

13.1 GOAL

VMR Draft Master Plan Goals	Links with UN SDGs	
	Direct Links	Indirect Links
Goal:2 - Promote economic development of the VMR by introduction of high value-added activities, facilitating competitive sites, incentives for investment, and leveraging on the strengths of each area.	1 NO POVERTY; 8 DECENT WORK AND ECONOMIC GROWTH; 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	4 QUALITY EDUCATION; 5 GENDER EQUALITY; 10 REDUCED INEQUALITIES; 16 PEACE, JUSTICE AND STRONG INSTITUTIONS
Goal:3 - Promote economic productivity of the VMR by investments in knowledge and innovation sector.	4 QUALITY EDUCATION; 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	8 DECENT WORK AND ECONOMIC GROWTH

13.2 OBJECTIVES

1. To develop theme based economic nodes that are benefitted by clustering of economic activities to capture agglomeration externalities and realize economic growth;
2. To increase opportunities for local labour force by enhancing their skills;
3. To facilitate competitive sites and incentives for attracting FDI and private investments to VMR;
4. To promote high-value added economic activities that leverage on the strengths of VMR; and
5. To encourage research, innovation and start-ups to support the economic development of VMR.

13.3 STRATEGIES

Strategy 1: VMR will develop and deliver infrastructure to support its competitive advantages in focused and high value-added sectors The specific sectors that will have receive the thrust and have better possibilities to grow in the investment and resource environment of the region are:

- Food & Beverages
- Non-metallic Mineral Products
- Aerospace & Defence
- Shipbuilding and Ship Repair
- Basic and Fabricated Metal Products
- Auto and Auto Components
- Machinery & Equipment

- Electrical and Consumer Electronics
- Chemicals and Pharmaceuticals
- Textiles and Wearing Apparel
- Leather and Leather Products

Strategy 2: VMR has been Andhra Pradesh's largest and most globally connected industrial and trade node that has a highly diverse economic base, with strengths in industries, tourism, education, railways, and port-related activities. To remain attractive and prosperous flexible choice of well serviced employment lands are made available for ready investments and future expansion across VMR

- Economic nodes have been identified each is anchored by a specialised activity as listed Figure 13-1: Proposed Economic Nodes in VMR
- Table 13-1.
- The specialised economic nodes enable location of businesses in close proximity to each other (agglomeration), which allows them to get productivity and efficiency gains through large customer bases, knowledge sharing and access to skilled workers.

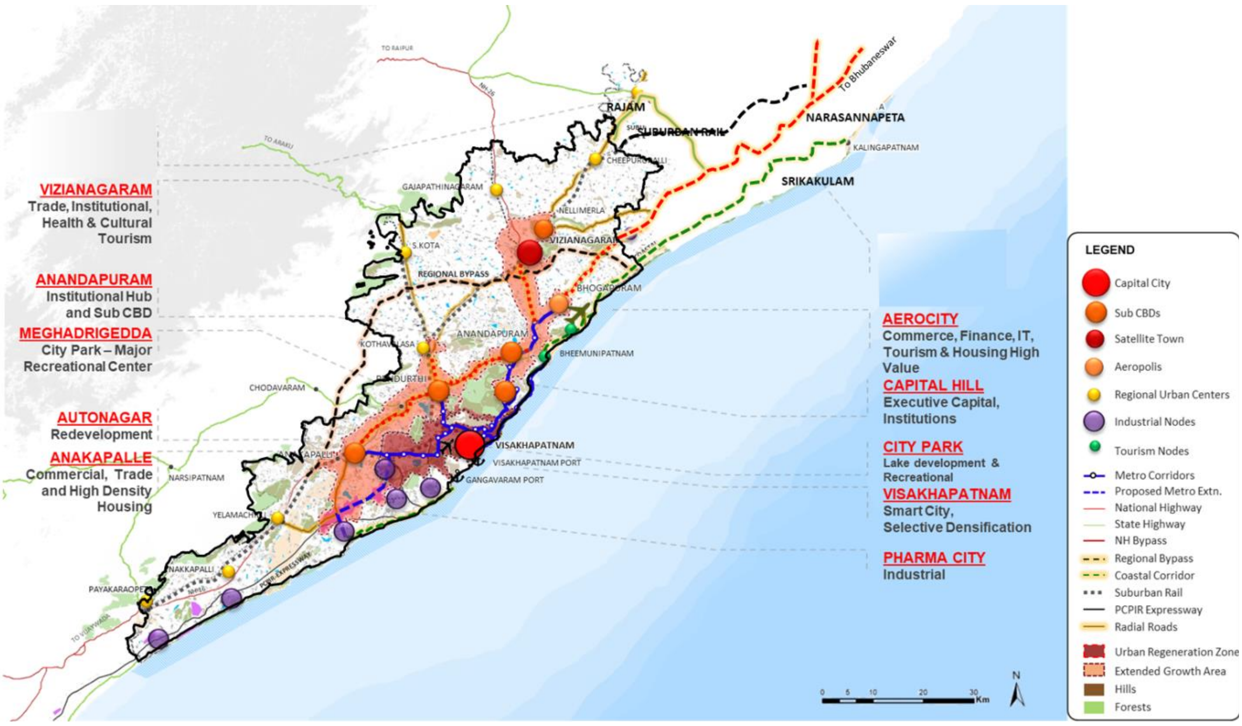


Figure 13-1: Proposed Economic Nodes in VMR

Table 13-1: Proposed Economic Nodes in VMR

Sl. No.	Economic Node	Specialised activities	Greenfield / Expansion
1.	Visakhapatnam	Smart city with selective densification;	Urban Regeneration
2.	Aerocity	Commerce, finance, IT, tourism, and high value housing	Greenfield

Sl. No.	Economic Node	Specialised activities	Greenfield / Expansion
3.	Pharma City	Industrial;	Expansion
4.	Vizianagaram	Trade, institutional, health, and cultural tourism	Urban Regeneration
5.	Beach road - Bheemunipatnam to Kalingapatnam connecting the Bhogapuram airport	Tourism development node	Greenfield
6.	Autonagar	Redevelopment	Urban Regeneration
7.	Anakapalli	Commercial, trade, and high-density housing	Urban Regeneration
8.	Anandapuram	Institutional hub and sub-CBD	Greenfield
9.	Meghadrigedda	City Park – major recreation centre	Conservation and Beautification
10.	Konada	Tourism development node	Greenfield
11.	Bheemunipatnam/ Mullakaddu	Tourism development node	Greenfield
12.	Chinthapalli	Fisheries development node	Expansion
13.	Muthayalammapalem	Fisheries development node	Expansion
14.	Pudimadaka	Fisheries development node	Expansion
15.	Revvupolavaram	Fisheries development node	Expansion
16.	Rajayyapeta	Fisheries development node	Expansion
17.	Venkatanagaram	Fisheries development node	Expansion
18.	Chinnamangamaripeta	Fisheries development node	Expansion

Strategy 3: Each node needs different approach to support their growth that varies depending on their profiles, competitive strengths, roles, and stages of development. However, each node will be facilitated with high levels of amenity to attract business and workers including public transportation

- Designated economic node shall be developed with high value amenity including but not limited to business incubators, tenants with flexible work and meeting spaces, water supply, sewerage, effluent treatment, energy, next-generation communications—from fixed and wireless broadband, cloud computing, augmented reality applications, solid waste management, access roads, public transportation, and others.
- Clean technologies shall be adapted in infrastructure, buildings, wherever possible to decrease the carbon footprint.
- Development of common infrastructure will also reduce the time and resources of individual investor towards approvals/ NOCs from respective authorities while the capital investment and O&M of such facilities may be recovered by levy of appropriate charges from all the users. Being a common facility, the charges will be comparatively lower.
- This will also encourage the start-ups, small and medium enterprises with access to range of support services and networks to establish and grow their businesses.

Strategy 4: Governments shall continue to invest on education and skill development of local people of all age groups particularly next generation to support development of local jobs and local business.

- This will develop strong local economies and ease pressure on transport infrastructure by providing employment close to home.
- Economic productivity of local people will be increased thereby purchasing power that has multiplier effect on the economy.
- Capacity to self-rely will be enhanced rather dependency on migrant labour.
- Attract firms that require high knowledge human resource for innovation and research activities, unique blend of knowledge- and research-based activity will help existing businesses, such as the advanced manufacturing, and produce products and services that are competitive in the global market.
- The investments in knowledge and skill development will also attract students from regional, national, and international by creating a platform for knowledge sharing.

Strategy 5: Effective governance mechanisms, ease of doing business enable to turn the global investors focus to VMR

- Developing the economic nodes will require sustained, coordinated action by all levels of government, the private sector, and the community.
- As the settlements of VMR grow, planning will help achieve a better balance between jobs and population growth across the VMR and provide a basis for collaboration with local governments.
- Land pooling schemes and clearances for better investment environment
- Augmentation of tourist facility Infrastructure at all important tourist attractions and drawing up overall plan to address wayside amenities and facilities all along the stretches of major corridors of the VMR Region.

14 POPULATION AND EMPLOYMENT FORECAST

The chapter presents forecast of economy, employment and population of VMR upto 2041. The chapter also presents the distribution of the population and employment by Policy zones.

14.1 ECONOMY OF VMR

VMR is the one of the most important economic hubs of Andhra Pradesh. The current economy of the VMR constitutes mix of manufacturing, knowledge sector, financial and business, agriculture encompassing traditional and modern techniques, fisheries, and other service sector.

Visakhapatnam's gowth took momentum as a port city and due to the locational advantage; it had gradually evolved as an industrial hub. A rapid growth in the manufacturing sector has been evident in the last four decades starting from major anchor industries like Hindustan Shipyard, Hindustan Petroleum Corporation Ltd., Bharat Heavy Plates and Vessels (now under BHEL), Visakhapatnam Steel Plant, NTPC, etc. With influence from key projects like Visakhapatnam Chennai Industrial Corridor, Petroleum Chemical and Petrochemical Investment Region and Sagarmala, there will be a boom in employment generation in manufacturing sector.

Visakhapatnam being a port city and having a good global and hinterland connectivity has evolved as an industrial town with manufacturing sector flourishing around the city. The city by virtue of its urbanization due to the economic activities has also developed the tertiary sector. Manufacturing activity forms the stronghold for the regional economy along with the transportation and logistics. Real-estate sector also comes up as a major contributor to the economy in VMR. Three districts of VMR have been contributing significantly to the domestic product.

14.2 DELINEATION OF POLICY ZONES

The potential spatial growth in VMR by 2041 will not be uniform throughout. For instance, the growth potentials of current Visakhapatnam city and its extended area will be significantly different from rest of VMR. The type of economic activities and its locational advantages in south of Visakhapatnam city will be different from north of the city and towards Vizianagaram district. To help capture a realistic future intervention, VMR has been divided into 8 policy zones as follows.

1. Vizianagaram-Nellimarla Zone
2. Bhogapuram Airport and influence Zone
3. Vizianagaram Rural Zone
4. Visakhapatnam Expansion Zone
5. Visakhapatnam City (Part) Zone
6. Visakhapatnam Industrial Zone
7. Yelamanchili Zone
8. Visakhapatnam Rural Zone

Vizianagaram-Nellimarla zone: Vizianagaram is the closest urban local body located near GVMC. Nellimarla Nagar panchayat is adjoining Vizianagaram municipality with urban characteristics and therefore clubbed with Vizianagaram municipality and treated as a single entity. Urban regeneration of the core area in both Vizianagaram and Nellimarla and mixed-use corridors is identified.

Bhogapuram and Surrounding Zone: The influence area with proposed green field airport is delineated as a separate zone. This zone will have more business and trade related developments and will have world class amenities to address the needs of both domestic and international business travellers.

Rural zones-Visakhapatnam, and Vizianagaram: The rural zones of the region are classified into three zones. This area will have traditional economic base of Agriculture with less industrial and institutional interventions. These areas will be provided with basic amenities catering to the demand for the horizon year.

Visakhapatnam Expansion Zone: Area adjoining the Visakhapatnam City (Part) Zone has more potential for urbanization and is considered as one of the major growth areas providing residential area and service sector based employment. NH-16 is passing through this zone. This zone has lot of scope for institutional development and has the influence of industrial areas (steel plant and many ancillary industries)

Visakhapatnam City (Part) Zone: Existing municipal area along with few urbanisable adjoining villages near Bheemunipatnam is considered. This zone is the most urbanized zone consisting of major infrastructure and services. Densification of this zone by Transit Oriented Development and developing the underutilized vacant land is addressed. Urban regeneration pockets are identified to ease the crowding and traffic congestion.

Visakhapatnam Industrial Zone: The area situated south of Visakhapatnam city where predominantly petroleum, petro-chemical, pharmaceutical metals and machinery industries are in operation and has an increasing potential to consolidate and further expand industries in the same/similar segments. Visakhapatnam Chennai Industrial Corridor (VCIC) investment projects also influences this area strengthening its industrial base. Most of the large and mega industries are to be located in this zone. Hazardous industries of VMR region will be confined to this zone to prevent mix with other land use.

Yelamanchili Zone: The smaller urban area of Yelamanchili is identified as separate zones considering the existing urbanization and proposed employment pockets to sustain and contribute to the local economy.It is pertinent to mention that the 6 out of 8 Policy Zones have been identified as Zonal Development Plan Areas (ZDP Areas) as follows;

- ZDP1 - Vizianagaram-Nellimarla Zone
- ZDP2 - Bhogapuram Airport and Influence Zone
- ZDP3 - Visakhapatnam Expansion Zone
- ZDP4 - Visakhapatnam City (part) Zone
- ZDP5 - Visakhapatnam Industrial Zone
- ZDP6 - Yelamanchili Zone

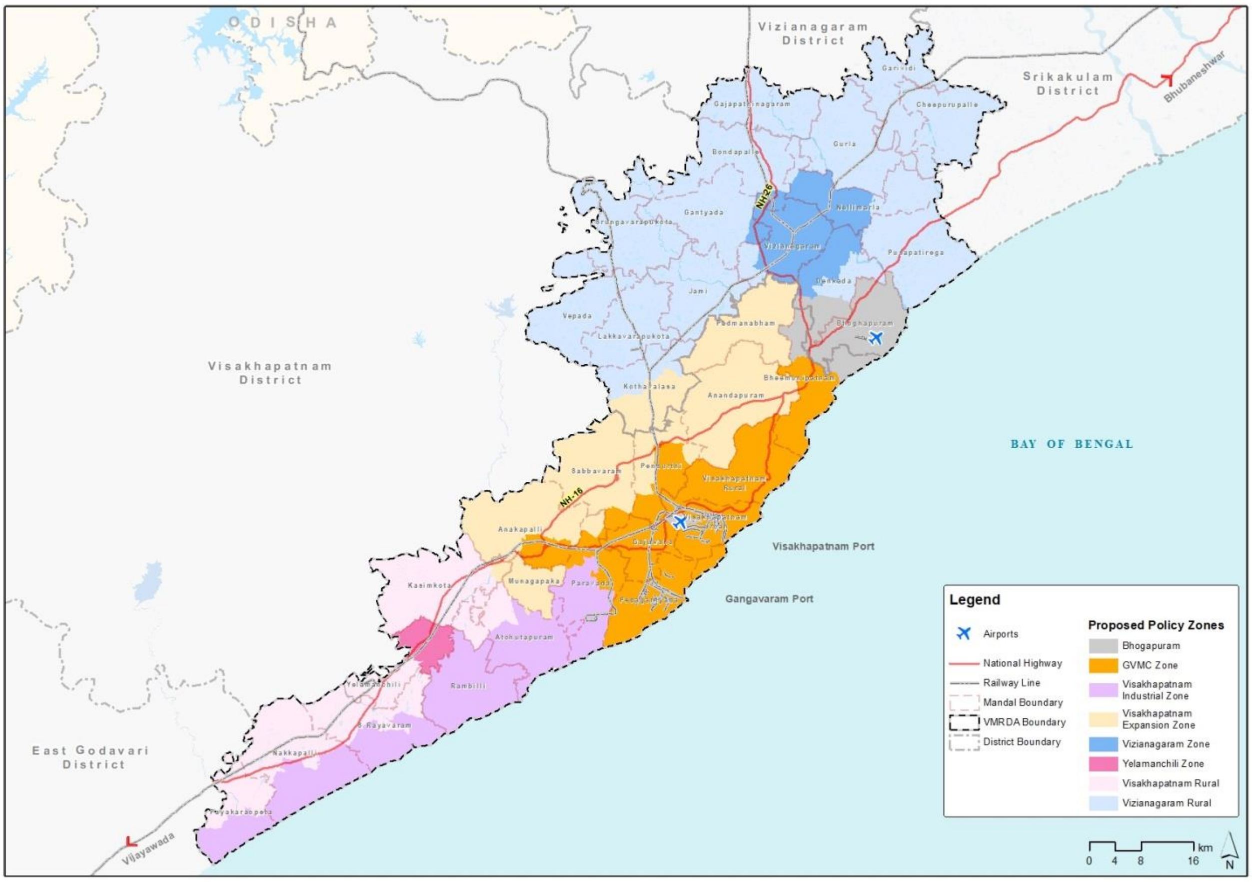


Figure 14-1: Policy Zones in VMR, 2041

14.3 WORKERS AND EMPLOYMENT FORECAST

The forecast of workers and employment were made considering (a) expansion plans of key industrial houses; (b) ongoing economic development projects and their investment and likely jobs; (c) VCIC and its potential investments and employment generation; (d) VK-PCPIR and its potential investments and employment generation; (e) Sagarmala project; (f) Bhogapuram Airport and its impacts; MoUs signed with AP State and its impacts and so forth.

It is evident that an additional 1.9 million jobs will be generated in VMR from 2018 to 2041. Of which, nearly 98.5% of them will reside within VMR and balance 1.5% of them will commute from outside VMR for jobs (Table 14-1).

Table 14-1: VMR: Current and forecast of Workers, Employment, 2018-2051

Sl, No	Item	2018	2041	Additional (2018-41)
1	**Total Population**	4,297,218	**7,330,000**	
2	Additional Population	224,504	3,030,270	3,032,782
3	**WFPR**	**33%**	**43%**	
4	**Workers**	1,427,595	**3,130,000**	**1,702,405**
4a	Primary Sector Workers	36%	21%	
4b	Secondary Sector workers	21%	30%	
4c	Tertiary Sector workers	43%	49%	

Sl, No	Item	2018	2041	Additional (2018-41)
5	Employment (Jobs)	**1,465,756**	**3,177,000**	**1,996,179**
6	No. of jobs serving for outside VMR	**38,161**	**47,000**	

Source: Consultant's estimates.

Employment forecast is estimated to be around 38.4 lakhs in 2041 including those commuting from the adjoining VMR consisting majorly of the local workforce. VMR will house about 37.8 lakh workers. The workforce partition rate of VMR is estimated to be 42%. Tertiary sector is expected to have higher proportion with about 49% workers followed by secondary sector 30% and primary 21%.

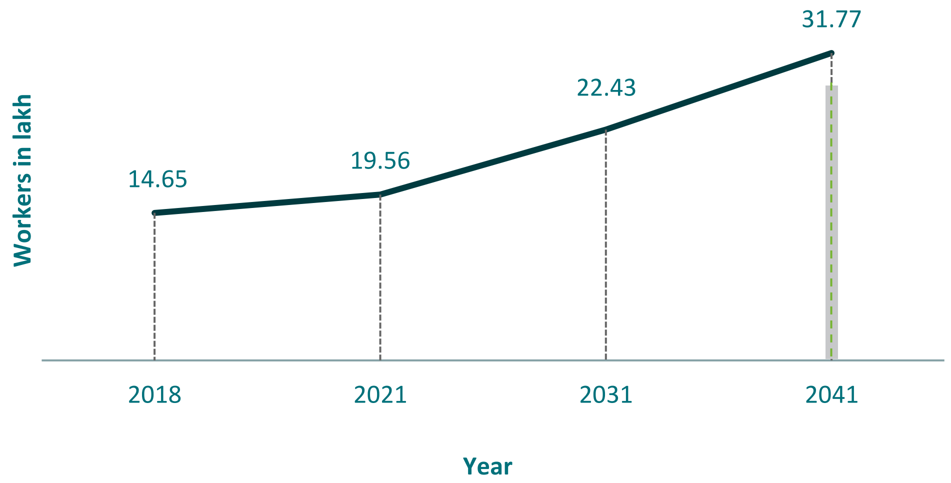


Figure 14-2: Workers Forecast, 2018-2041

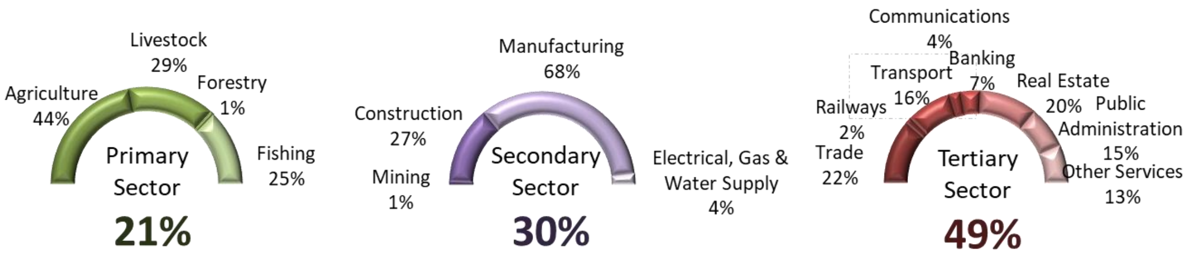


Figure 14-3: Workers by major economic sector

Service sector has the major share of workers in all the urban zones except Visakhapatnam Industrial Zone (VIZ). VIZ has higher share of secondary workers. The well-connected transport network will enable work-based shifts to Visakhapatnam Industrial Zone from GVMC and Visakhapatnam Expansion zone (VEZ) as well, allowing the workforce to commute on a daily basis. The coastal urban zones have substantial workers involved in fishing activities, which is included in primary sector. Bhogapuram Airport and influence Zone is envisaged as Aerocity consisting of service-based economy. The rural zones of Vizianagaram will have more agro-based economy. Therefore, the primary sector workforce will constitute higher share in these rural zones (Table 14-2)

Table 14-2: VMR: Resident workers by Policy Zone, 2018-2041

Sl. No	Zone	2018		2041	
		WPR (%)	Workers	WPR (%)	Workers
1	Visakhapatnam City (Part) Zone	30.7%	613,188	38.8%	1,097,000
2	Visakhapatnam Industrial Zone	36.0%	97,099	45.5%	316,000
3	Yelamanchili Zone	29.9%	13,699	37.7%	55,000
4	Visakhapatnam Expansion Area	32.1%	144,948	40.6%	396,000
5	Visakhapatnam Rural Zone	33.7%	94,478	42.6%	188,000
9	Vizianagaram-Nellimarla Zone	29.2%	106,115	36.9%	328,000
10	Bhogapuram Airport and influence Zone	34.1%	30,728	43.1%	211,000
11	Vizianagaram Rural Zone	35.2%	281,820	44.5%	426,000
	VMR	**33.2%**	1,382,075	42.0%	3,017,000

Source: Consultant's Estimates.

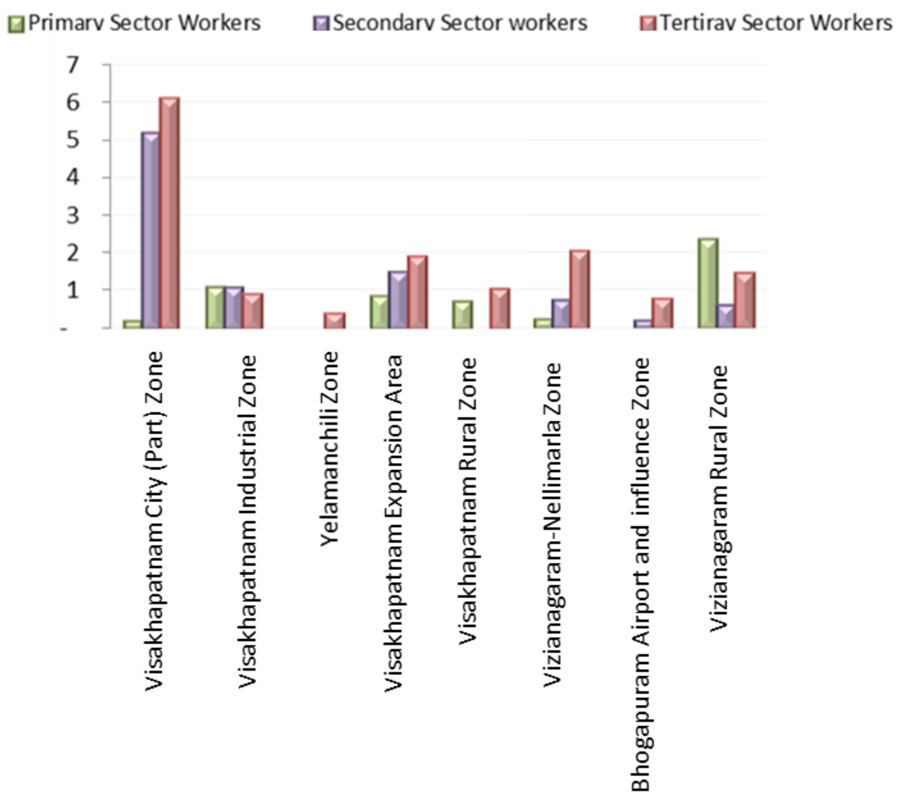


Figure 14-4: Resident Workers by zone in VMR, 2041

14.4 POPULATION FORECAST

The region experiences positive transition encompassing rapid increase in the economy. This phenomenon is likely to provide huge employment opportunities as discussed in (Section 6.3). It will lead to substantial shift in population in search of employment apart from providing employment to the local force. Therefore, traditional methods of Population forecast are inappropriate to estimate population for 2041. The region is experiencing a business-induced scenario. Hence, a plausible forecast method is devised considering the natural increase and the migrant Population.

VMR is forecasted to have population of 73.3Lakhs by the horizon year. Additional population of about 30.03 lakhs is estimated for 40.7 lakhs of 2018. The crude birth rate and crude death rate analysis revealed about 67.8 lakh natural increase in population will be encountered. On considering the business induced scenario, induced population will account for about 22.2 lakh.

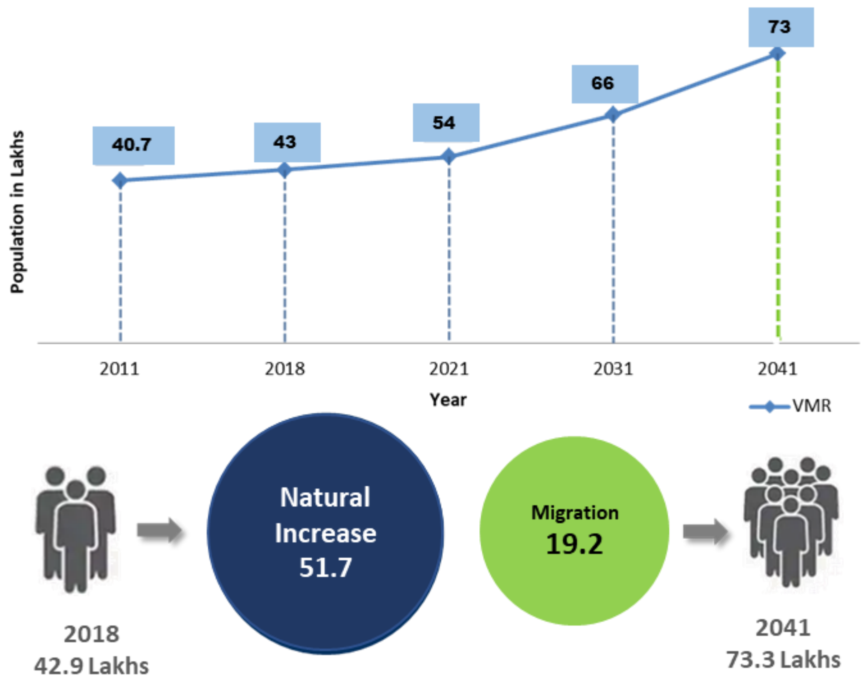


Figure 14-5: Population Forecast

Visakhapatnam City (Part) Zone will continue to have the highest share of population with 28.9 lakhs followed by adjoining Visakhapatnam expansion zone with 10.7 lakhs. Induced population is accommodated in the urban zones as they are provided with urban infrastructure facilities and connectivity to the employment areas. Smaller urban zones like Yelamachili will have considerable induced population. Rural zones of Visakhapatnam and Vizianagaram will experience only natural increase following the trend. (Table 14-3)

Table 14-3: VMR: Summary on Total population by Policy Zone, 2018 to 2041

Sl.No.	Zone	Base year 2018	% Share	2041	
				Population	%
1	Visakhapatnam City (Part) Zone	1,940,191	45.15%	2,737,000	37.34%
2	Visakhapatnam Industrial Zone	269,547	6.27%	694,000	9.47%
3	Yelamanchili Zone	45,878	1.07%	146,000	1.99%
4	Visakhapatnam Expansion Area	439,171	10.22%	975,000	13.30%
5	Visakhapatnam Rural Zone	280,216	6.52%	441,000	6.02%
9	Vizianagaram-Nellimarla Zone	388,905	9.05%	889,000	12.13%
10	Bhogapuram Airport and influence Zone	158,364	3.69%	490,000	6.68%
11	Vizianagaram Rural Zone	774,946	18.03%	958,000	13.07%
	VMR	**4,297,218**	**100%**	**7,330,000**	**100%**

Source: Consultant's Estimates.

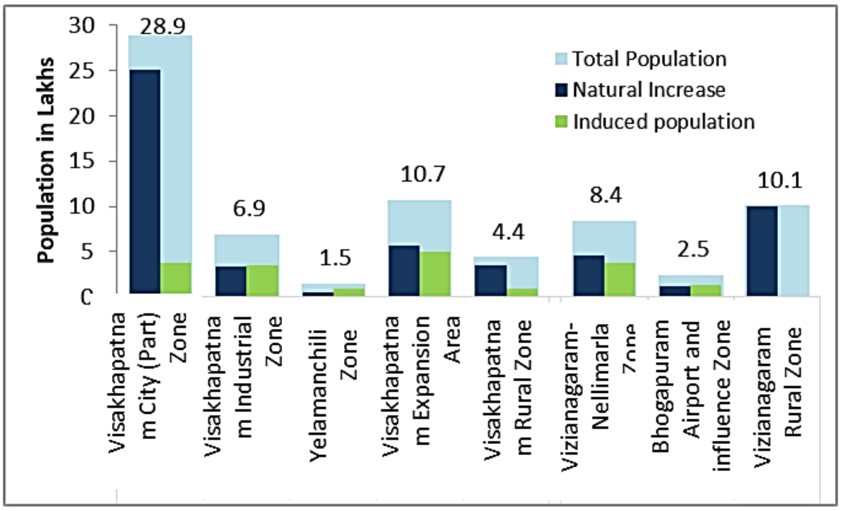


Figure 14-6: VMR Population Forecast by Zone, 2041

Visakhapatnam expansion zone will be a major growth area accommodating about 26%of induced population because of its proximity to employment nodes and GVMC. Visakhapatnam city (part) Zone will accommodate about 19% of induced population owing to the land availability for development. Visakhapatnam Industrial zone (being the biggest employment nodes) will accommodate 18% of induced population in the planned townships and residential pockets. Vizianagaram zone will accommodate 20% (Figure 14-7).

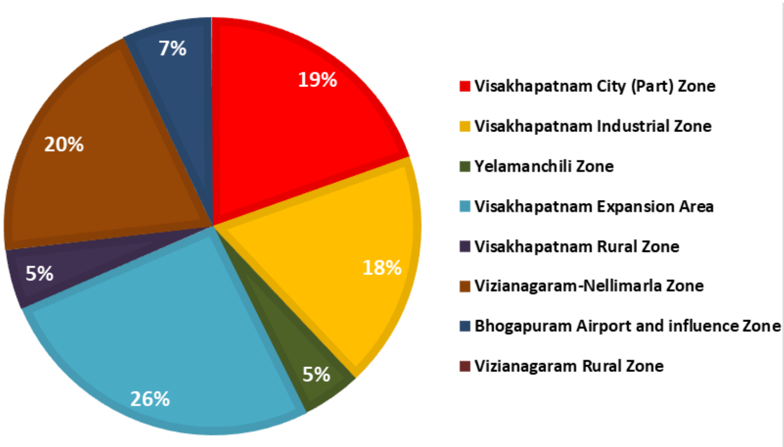


Figure 14-7: Share of Induced Population, 2041

15 DELIVERING STRATEGIC SPATIAL DEVELOPMENT

The chapter presents the spatial development strategies for VMR based on the assessment of existing situation of urban and rural areas, benchmarking studies on global cities, alternative spatial growth scenarios that have been developed for VMR. The background to the the spatial development strategies have been presented in Appendix H. The chapter also presents the preferred spatial strategy that has been evolved based on integration of merits of the three spatial growth alternatives presented earlier in Preliminary Draft Master Plan report.

15.1 GOAL

Goals and objectives of strategic spatial development of VMR are discussed below:

VMR Draft Master Plan Goals	Links with UN SDGs	
	Direct Links	Indirect Links
Goal:1 - Create cohesive fully serviced settlements within VMR that are resilient to the effects of climate change and facilitate range of choices to live, work, and leisure.		

15.2 OBJECTIVES

1. To ensure the settlements are resilient to the impacts of anticipated climate change through adaption, and mitigation measures;
2. To achieve self-reliance in terms of basic facilities and services in both urban and rural settlements;
3. To achieve decentralised and balanced development by inducing economic activities, supporting residential and community facilities in identified settlements of VMR;
4. To enhance quality of life through urban renewal, smart city principles and efficient utilisation of brownfield lands rather greenfield lands;
5. To facilitate affordable housing choices by increasing densities at selected economic nodes, TOD nodes and promoting greenfield expansion;
6. To create cohesive communities that facilitate opportunities for interaction and development with no bar of socio-economic status, gender inequalities, and physical abilities; and
7. To control developments in areas including vulnerable to disasters, environmentally sensitive and culturally significant.

15.3 STRATEGIES

Strategy 1: Master Plan had delineated and designated VMR into 11 policy zones reflecting their growth opportunities and interventions to guide future investments on infrastructure and services for achieving decentralized and balanced development within VMR (Figure 15-1). The proposed urban policy zones (8 out of 11) will be furthermore detailed in the Zonal Development Plans by VMRDA within the framework of Master Plan. THE ZDPS reflect the strategic interventions across the five core themes of Master Plan spatial, economic, environmental, transportation and infrastructure.

- **GVMC Zone**: The most urbanised area of VMR, where the proposed interventions focus on enhancing the quality of life, infill development, urban renewal, and TOD.
- **Visakhapatnam Expansion Zone**: The potential area for housing and institutional development well connected by NH – 16, where the proposed interventions include greenfield expansion in designated economic nodes, and settlements.
- **Visakhapatnam Industrial Zone**: The area under special development authority to attract investments from VCIC, heavy and hazardous industries, the proposed interventions include reduce the impact of these industries and associated activities on the environment and health of citizens through mitigation measures.
- **Green Field area**: The potential greenfield area to be developed with focus on global trade and investments, business tourism – MICE (Meetings, Incentives, Conferences and Exhibitions), and hospitality.
- **Vizianagaram Zone**: The existing district headquarters will enhance its infrastructure and service delivery to retain local people and investments. Furthermore, the interventions include development of economic node, urban renewal, increased connectivity, enhanced quality of life, and protection of productive agricultural land.
- **Yelamachili Zone**: The existing mandal headquarters will be enhancing its infrastructure and services delivery to attract potential economic activities and growth.
- **Rural Zones of Visakhapatnam and Vizianagaram**: The rural areas of VMR will retain their rural character and traditional economic base. The basic facilities and services will be provided to attain self-reliance, increase economic productivity, skill development and connectivity.

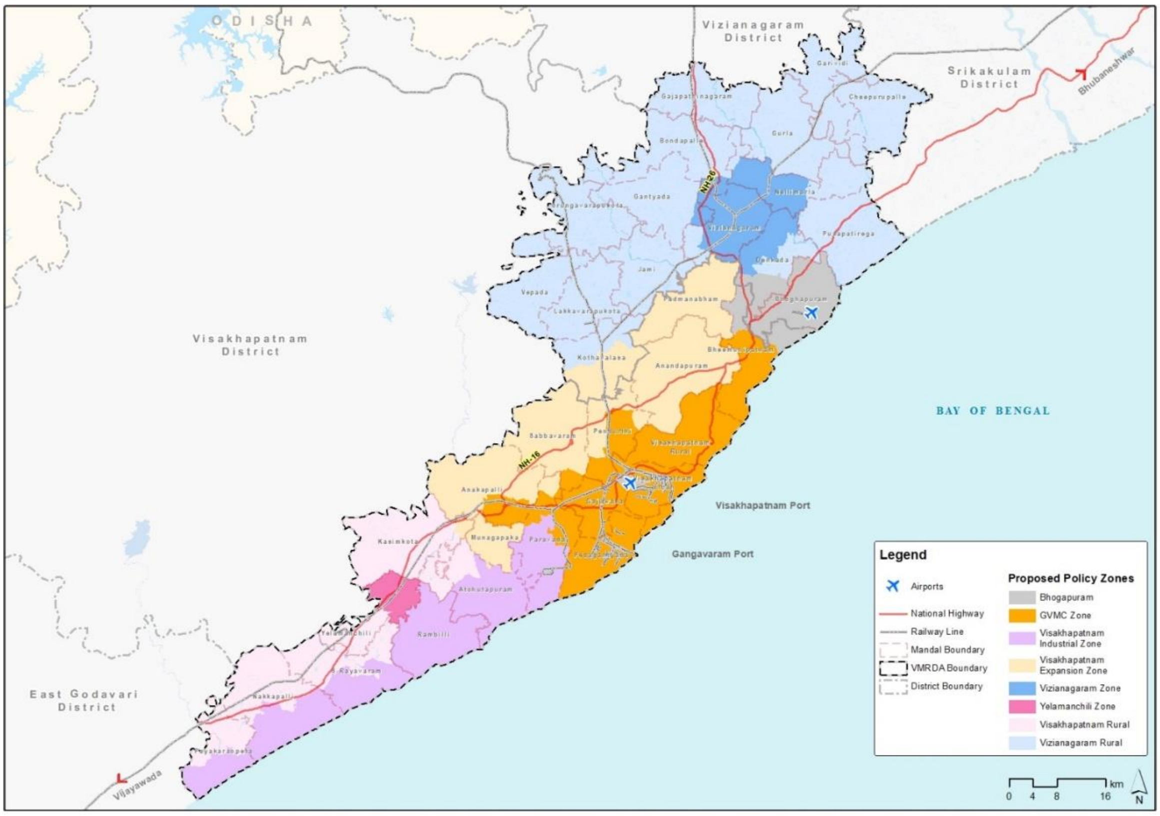


Figure 15-1: Policy Zones in VMR

Strategy 2: Settlement structure and hierarchy strengths the VMR's competitiveness for jobs and investment. The level of facilities required to achieve basic self-sufficiency at each settlement will be guided by the defined settlement hierarchy (Figure 15-2). The settlement hierarchy of development is based on the proposed population distribution at each settlement and their location in VMR. The 6 levels of settlement hierarchy structure with their role in service delivery is presented in Table 15-1. The level of community facilities and services is aligned with the hierarchy of social infrastructure development recommended in the URDPFI guidelines of Government of India.

Table 15-1: Proposed Settlement Hierarchy

Sl. No.	Settlement hierarchy (Population range)	Role
1	Mother City (>10 Lakh)	Andhra Pradesh state, centre of economic growth and the state's major interface with the global trade through its international airport and sea port. Vishakhapatnam will remain a favourable destination for economic activities with focus on high value-added industries, and tourism. The economic productivity will be improved by knowledge and innovation. Vishakhapatnam will also continue to facilitate energy, infrastructure, community services and facilities to the state and nation. The higher order facilities include but not limited to the universities, CNG stations, fuel stations, traffic and police control rooms, police security forces, disaster management centre, electric crematorium, rehabilitation centre.
2	Regional Centres (3 – 5 Lakh)	District headquarters will continue to deliver the administrative services, community services, and facilities. The level of facilities and services include but not limited to the engineering, technical, professional, medical, nursing, pharmaceutical and other specialized colleges, orphanages, working women hostels, night shelters, socio-cultural/ exhibition grounds, science centre, sub-city park, sub-city level multipurpose ground, divisional sports centre, police line, police battalion, district jail, civil defense, wholesale market. The facilities and services will be enhanced or increased in numbers appropriate to meet the demand of population within their service area. They will provide flexible range of lands for economic development with focus on mixed use, commercial, institutional, health, and cultural tourism.
3	Sub-regional centres (1 – 3 Lakh)	Sub-regional centres will emerge as facility centre with level of facilities and services include but not limited to the general hospital, veterinary hospital, old age home, district park, district level multi-purpose ground, district centre, cremation and burial ground, head post office with administrative and delivery office for the settlements within their service area of 15 km.

Sl. No.	Settlement hierarchy (Population range)	Role
		They enhance their connectivity to higher order settlements for accessing higher order facilities and services.
4	Service centres (20,000 – 1 Lakh)	Service centres are identified to serve with level of facilities and services include but not limited to the integrated schools with/ without hostel facilities, school for physically challenged, colleges, nursing home, child and maternity centre, polyclinic, intermediate clinics, specialty hospital, diagnostic centre, dispensary for pets, centre for learning arts, recreational club, community parks, multi-purpose ground, gas godown, police post, police station, fire station, community centre with service centre, weekly markets, dobi ghats, bank with locker and other facilities for their residents and settlements within service area of <10 km. The Services centres will be well connected with the sub regional centres or nearest regional centres.
5	Central villages (15,000 - 20,000)	Central villages will have community facilities including senior secondary schools, dispensary, library, community hall, neighbourhood park, neighbourhood play area, local shopping including service centre, post office counter without delivery, and bank facility with extension counters and ATM facility to provide higher order services to the villages within service area of <5 km. The Services centres will be well connected with the nearest higher order centres.
6	Villages (< 15,000)	Villages will be provided with basic amenities and infrastructure services that include Pre-primary up to primary school, anganwadi, Community room, religious facility, housing area park, residential unit play area, milk distribution, and convenience shopping. The Villages will be well connected with the nearest higher order centres.

Source: Consultants' assessment and Appendix N of URDPFI Guidelines, 2014. Volume II B. Ministry of Urban Development

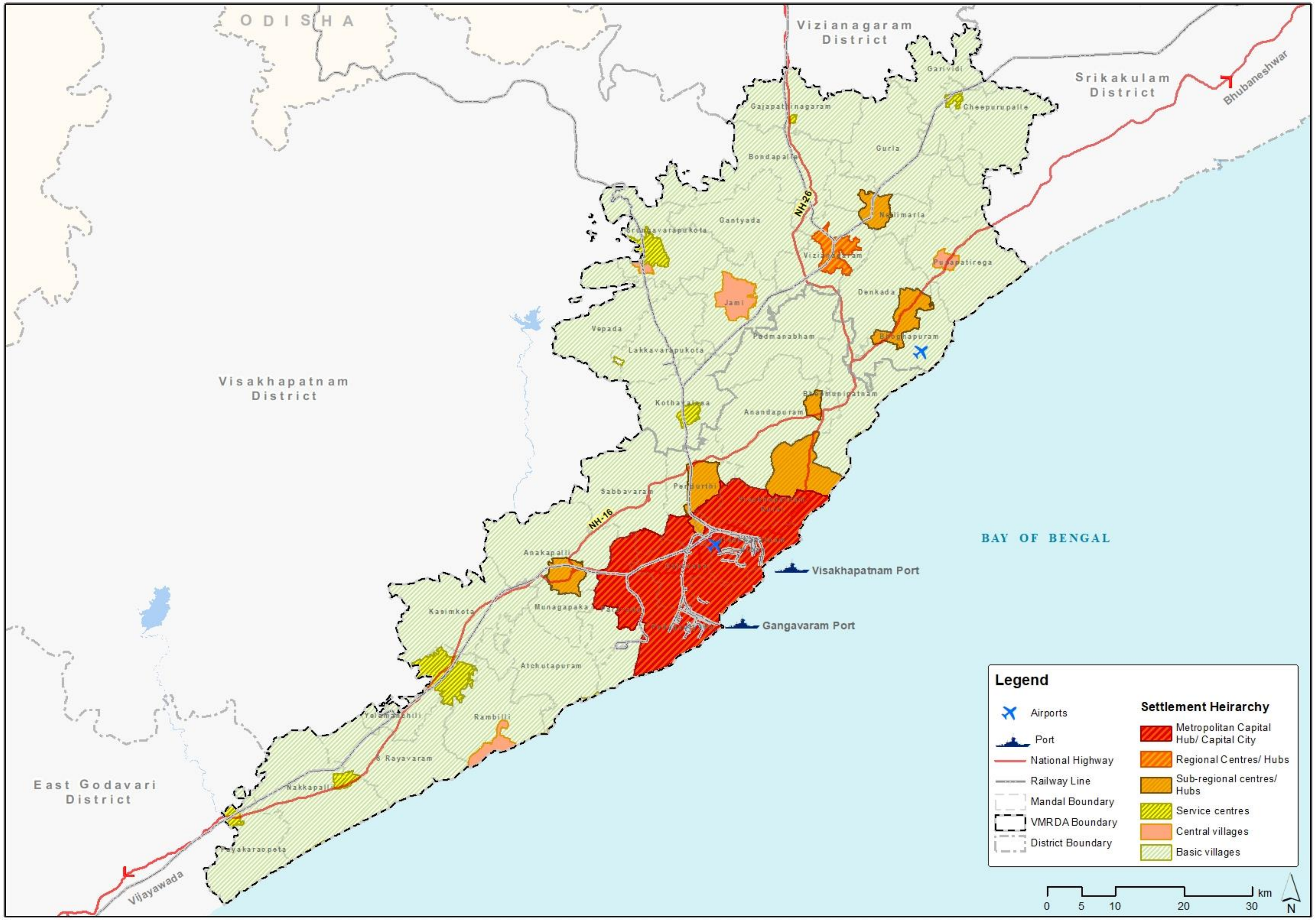


Figure 15-2: Settlement Hierarchy in VMR, 2041

Strategy 3: Plan for the urban renewal of designated urban precincts to deliver high-quality, distinct and diverse neighbourhoods offering a mix of uses. Urban renewal precincts will facilitate underutilized lands to create opportunities for the urban areas to grow and accommodate more jobs and housing. Urban renewal interventions will also enhance the quality of life, land and rental values of the properties. The designated urban renewal precincts are GVMC and Vizianagaram, city core areas and other areas as presented in Figure 15-3 with the proposed interventions listed below:

- Repurpose the underutilised or unutilised sites with emphasis on government lands and former industrial areas to create jobs and accommodate growth;
- Develop mixed-use neighbourhoods that offer a range and choice of housing, economic and other services that are resilient to the predicted effects of climate change and hazards;
- Offer a high level of amenity, public and communal space, public transport connectivity and integrate with the surrounding neighbourhoods;
- Early planning for utility ducts, fibre-ready facilities, and wireless infrastructure eliminating the need for the costly and resource consuming retrofitting of pathways;
- Develop complete streets to increase safety; and
- Cultural heritage will be protected and conserved, where possible innovative approaches will be applied to repurpose heritage precincts, ensuring new developments will add value to their rich legacy.

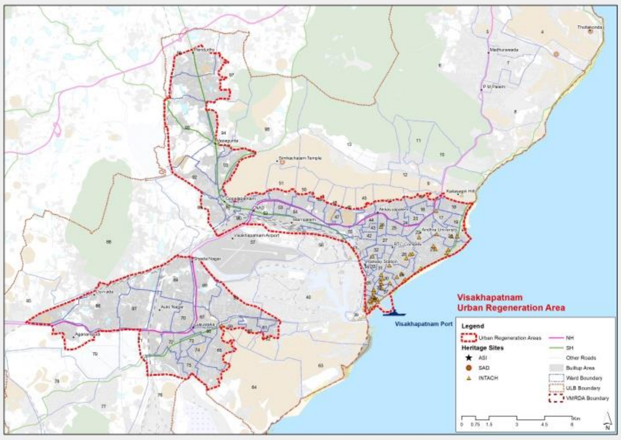


Figure 15-3: GVMC Urban Regeneration Area

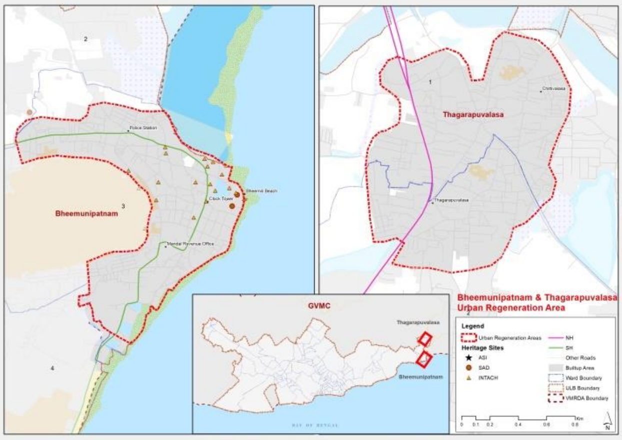


Figure 15-4: Bheemunipatnam Urban Regeneration Area

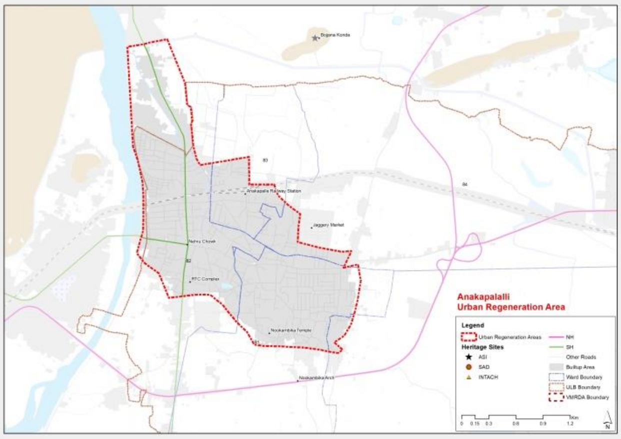


Figure 15-5: Anakapalli Urban Regeneration Area

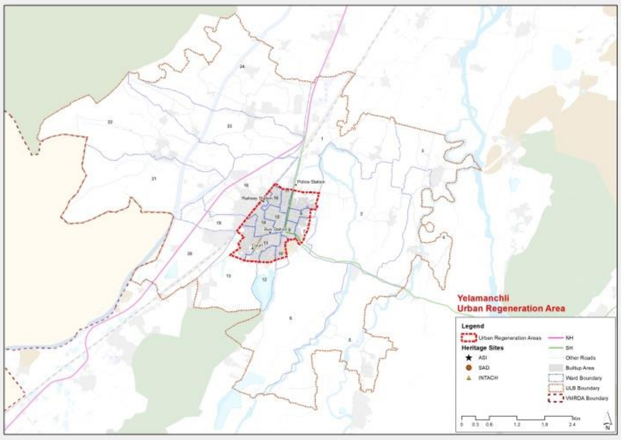


Figure 15-6: Yelamanchili Urban Regeneration Area

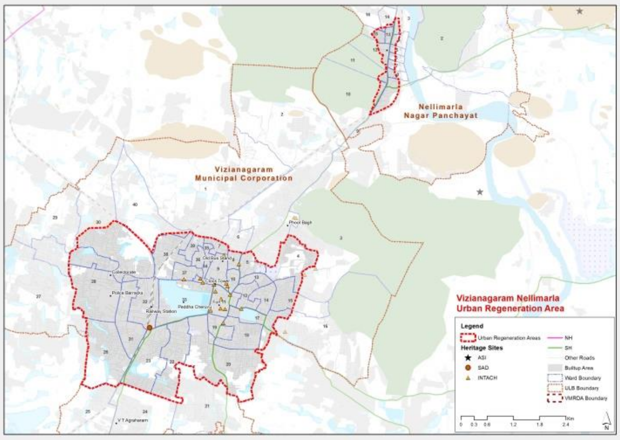


Figure 15-7: Vizianagaram Urban Regeneration Area

Strategy 4: Define urban and rural growth boundaries that include expansion areas and new greenfield developments (Figure 15-8). These boundaries will enable to

- control urban sprawl;
- increase the housing densities in designated places including TODs, urban renewal areas, and greenfield expansion areas;
- creating more consolidated settlements that increase access to infrastructure services and public transport; and
- protecting the productive agricultural land.

Figure 15-8: Existing and Proposed Settlement Boundaries

Strategy 4: Plan for residential areas and define expected housing needs across VMR.

- Demand for housing land is assessed at policy zone level considering the need for new housing development of temporary, dilapidated, no exclusive room based on Census 2011 and projected population by 2041. The demand estimated also considered 40% of land required for developing necessary facilities and services including open spaces, buffer zones, transportation, physical infrastructure and community facilities (Table 15-2).

Table 15-2: Residential land demand by policy zone for the horizon year 2041

Proposed Policy Zones	Housing units (no. in Lakhs)	Residential Land Demand (Area in Sq.km.)				
Urban Zones	-	HIG 25%	MIG 35%	LIG 30%	EWS 10%	Total 100%
GVMC	5.03	25	35	30	10	101
Visakhapatnam Industrial Zone	1.76	9	12	11	4	35
Yelamachili	0.41	2	3	2	1	8
Visakhapatnam Expansion Area	2.66	13	19	16	5	53
Vizianagaram	1.90	10	13	11	4	38
Bhogapuram	0.55	3	4	3	1	11

Proposed Policy Zones	Housing units (no. in Lakhs)	Residential Land Demand (Area in Sq.km.)				
Urban Zones	-	HIG 25%	MIG 35%	LIG 30%	EWS 10%	Total 100%
Rural Zones	-	10%	35%	40%	15%	100%
Visakhapatnam Rural	0.91	2	6	7	3	18
Vizianagaram Rural	1.78	4	12	14	5	36
VMR	**17.94**	**90**	**126**	**108**	**36**	**360**

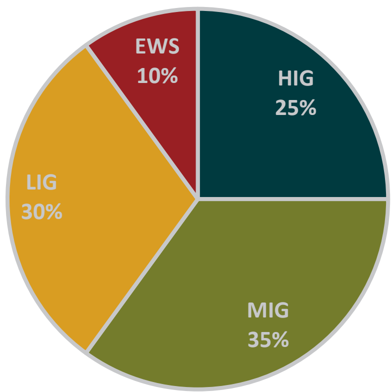
Source: Consultants' assessment

- The proposed social housing in urban and rural policy zones is presented in Table 15-3.

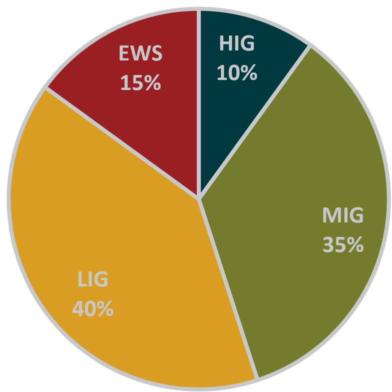
Table 15-3: Proposed social housing

Proposed Policy Zones

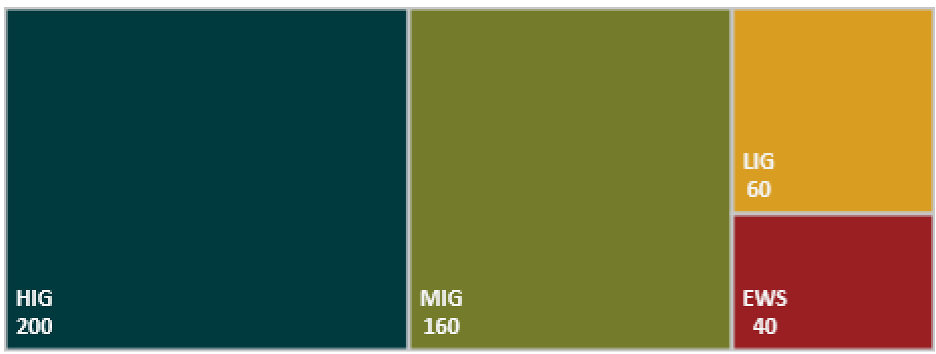
Urban Zones



Rural Zones



Size of dwelling units (Sq.m)



Source: Consultants' Assessment

- Planned residential areas create a market to capture ongoing and substantial new housing opportunities near jobs, services, and transport (Figure 15-8). The planned residential areas 852 sq.km. include 297 sq.km of brownfield areas and 555 sq.km of proposed greenfield expansion area. The greenfield expansion area is higher than the forecasted demand of 310 sq.km (Table 15-2) to facilitate flexibility, choice of affordable housing land. Furthermore, the proposed expansion areas can also accommodate growth beyond 2040 as the land demand assessed does not consider the dimension of densification and brownfield development. Planned residential areas include the following:

- Brownfield – urban renewal areas, general densification areas, TODs, mixed use areas, social housing, and in-situ slum redevelopment areas;
- Greenfield – transit led development along existing/ proposed transport corridors, proposed economic nodes, settlement expansion areas; and
- 3 to 5 km on both sides of bypass to NH-16. Vizianagaram Anandapuram-Pendurthi-Anakapalli-and Atchutapuram; and
- Settlement expansion area of 150 m from the existing settlement boundaries for the villages.
- To provide greater certainty, the General Development and Promotion Regulations (GDPR) of this Master Plan illustrate the housing land development options including townships, layouts, gated communities, social housing, group housing and others. Furthermore, the GDPR will also define the mandatory social housing, open and communal spaces, infrastructure facilities and services, buffer zones in a way that the development is sustainable and integrated with the surrounding development.

Strategy 5: Plan to reduce the likely impact of natural hazards and adapt to climate change

- New developments shall be away from the identified natural hazard risk areas (Figure XX). Where risk is unavoidable, such as in existing developments, necessary measures for risk-mitigation and risk-adaptation strategies will be implemented aligning with the national and state disaster, coastal zone management, and emergency management plans;
- The provisions of General Development and Promotion Regulations (GDPR) of this Master Plan and state building regulations will be playing key role in reducing the level of exposure to a natural hazard by influencing where and how development occurs;
- Critical infrastructure projects will be sited, designed and constructed to withstand the impacts of natural hazards and they shall be resilient to the effects of climate change. Furthermore, they shall be adapting technologies and process that reduce carbon footprints; and
- Communities' ability to deal with the risk and emergencies shall be enhanced through awareness programmes and involving in developing the framework to reduce or avoid the risk.

Strategy 6: Plan for liveable and inclusive settlements with amenities at an accessible distance.

- VMRs distinctive natural landscapes and urban spaces will be encouraged for creation of memorable, well-designed places that reflect regions legacy and liveability;
- Natural beaches, lakes, streams, rivers and other significant water edge's will be developed as parks and open spaces supporting health and well-being of local communities. They also attract tourists, socio-cultural events, businesses and revenue to the local economy;
- Quality of built-environment, public spaces and amenity will be guided to create places that are accessible, safe for people of all abilities, ages and cultures;
- The provisions of GDPR including mixed-use zone and greater mix of uses at varying densities will create opportunities for local business and new jobs and deliver better access to local services and facilities;
- Spaces needed for social infrastructure facilities (Appendix I) will be designated at an accessible distance to all members of the community to meet their social, health, education, cultural and community needs;
- Provisioning of community facilities both by public, private, and NGOs should explore innovative opportunities for maximising their efficiency. For instance, using school buildings outside school hours and co-locating aged-care and childcare centres; and

- Cemeteries and crematoria need to be provided in sensitively chosen locations to cater for all faiths.

FINAL and preferred SPATIAL STRATEGY

Three alternative strategies were conceptualized for structuring the VMR. All the alternatives possess merits in address existing ground conditions and development potentials of the region. These merits were thoroughly assessed through MCAF based comparative assessment of the alternatives. It is concluded that to arrive at preferred strategy for VMR ideally need to integrate the key qualities and strengths of all the three alternatives. Hence, a preferred strategy for VMR is evolved by integrating strengths and merits of the three alternatives in addressing the potential of the region.

To reiterate, Alternative 1 focused on transit led compact development in the region, while Alternative 2 focus on promoting planned development in areas having propensity for urban growth on urban fringes of the city, and Alternative 3 focus on balanced and decentralized development in the region. Behind the three alternatives there is an existing context and ground realities that led to the theme-based biases in the alternatives to structure the region. Hence, it considered desirable that quality and strengths of the three alternatives are turned into an integrated development strategy/preferred strategy for VMR to arrive at a spatial development vision for the region.

In the light of recent strategy of Government of Andhra Pradesh to decentralize, Visakhapatnam is an affirmation of a vision to carry balanced and decentralized development in the state. The thrust on the Visakhapatnam city is going to polarise the development in the region and especially in areas between Vizianagaram and GVMC Area. To realise the objective of balanced and decentralized development in VMR, creating a regional structure is integral to the preferred strategy that integrates both existing and new urban and rural development.

The preferred strategy focuses on urban regeneration of existing cores of Visakhapatnam city and other key cities, planned development on urban fringes of existing cities, and economic and urban growth in satellite cities. Such a strategy takes care of stakeholders’ aspirations, need to modernizing the existing cities through modern transport and urban infrastructure, and capitalizes on areas having propensity for urban growth.

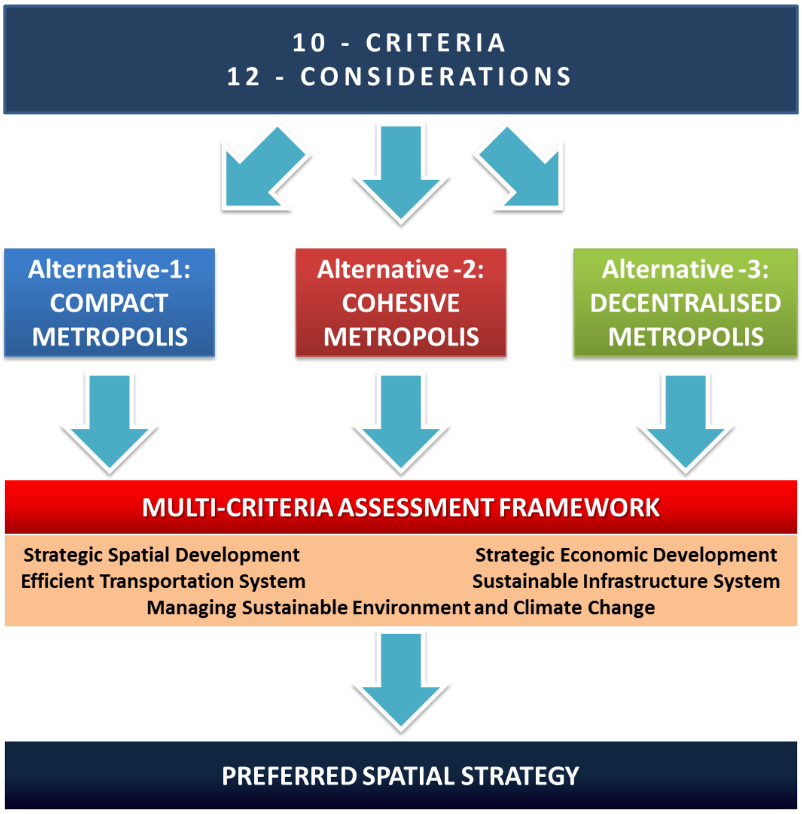


Figure 15-9: Formulation of Preferred Spatial Strategy from the three alternative spatial strategies.

URBAN FORM AND STRUCTURE

VMR looks forward to being a city of the future which is a great place to live, work, and leisure. In addition, it is desirable to promote the region for safety from natural disasters, protects its environmental assets and agriculture lands, and promote balanced and sustainable development. Provision of modern and missing infrastructure in urban centres and rural areas is key to achieve the objective. In the preferred strategy, urban areas and rural settlements in VMR are given strong focus to achieve comprehensive development of the region.

Current urban and regional structure of VMR is established around the mother city of Visakhapatnam and other key cities of Vizianagaram, Anakapalli, and Pendurthi. Current focus of upcoming investments in the region is in Bhogapuram, Anandapuram, Pendurthi, Sabbavaram and Anakapalli and VCIC Industrial Node in Atchutapuram and Nakkapalli, which is likely to turn this region into a high growth trajectory. It is likely that VMR will become an economic powerhouse of the region hence needs structure approach to achieve planned development.

LAND AVAILABILITY FOR FUTURE GROWTH

Majority of the area in VMR comes under rural character. Visakhapatnam is the major city and Vizianagaram have comparatively less built-up. 65% of the land comes under agricultural use while only around 10% is the developed area. Though there is abundant available land for urban growth, it is intended to restrict the growth within delineated future expansion area to have a compact development along transit corridors.

Protecting natural areas such as coastline, rivers and drainage basins, forests, hillocks, water bodies, and improving urban hydrology was one of the key suggestions that came clearly from the stakeholders' consultations. In addition, environmentalists, politicians, and NGOs put emphasis on protecting agriculture lands as VMR contain large irrigated and agriculturally fertile areas. Agro and food processing is one of the key economic activities of the region. Approximately 960 Sq. km (15%) is current spread of developed areas in VMR and in the proposed Master Plan additional 980 Sq. km area is added as the new growth areas. Focus in the Master Planning of VMR is on compact development and densification of existing areas to achieve urban population of 67.2 lakhs by 2041 as against current urban population of 25 lakh only. The existing agriculture area and environmentally sensitive areas which require protection to retain economic, scenic and environmental significance of the region.

PROPOSED URBAN STRUCTURE AND SETTLEMENT HIERARCHY

The urban growth is envisaged in contiguous manner in and around existing urban centres, with present cities and towns acting as theme-based centres and sub-CBDs. The proposed airport, metro lines and the industrial nodes in the south will create a major axis of development in north-south direction. Bhogapuram, Vizianagaram fall in the extended area of urban fabric in the north of mother city. These along with Anakapalli, Anandapuram and Pendurthi will act as a sub-CBDs reducing the load on mother city.

15.4 PREFERRED STRATEGY

The urban growth is envisaged in a contiguous manner in and around existing urban centres, with present cities and towns acting as theme-based centres and sub-CBDs. The proposed airport, metro lines and the industrial nodes in the south will create a major axis of development. The mother and other important cities in the region will act as economic and human development resource centres along with hierarchical settlement pattern.

The core areas of GVMC and other cities of the region currently has majority of the urban population of 24 Lakhs, will undergo major re-densification and urban regeneration process to accommodate additional population. This will further boost the role of the proposed metro which would operate through the core areas of its cities. The structure will also emphasize on theme-based development of settlements, based on present and proposed economic significance. The planned urban development in the region will possess qualities of being compact urban cities and settlements, served with public transit corridors, with healthy relationship between built and natural environment. The following aspects and components form conceptual structure for the VMR.

- **Mother City:** Mother City of Visakhapatnam continues to be most important city of VMR and plays role of main CBD, knowledge centre, tourism and logistics anchor of VMR. Satellite cities and regional centers needs to be well connected with the mother city to retain economic interdependence between Visakhapatnam and other urban centres.
- **New Urban Development Axis:** A New Urban Development Axis through greenfield areas development up to 3 to 5 km on both sides of bypass to NH-16 is created by connecting Vizianagaram-Anandapuram-Pendurthi-Anakapalli-and Atchutapuram through spatial around a public transport corridor.
- **Vizianagaram-**Satellite City: Vizianagam, a historic city, will received renewed economic and spatial development focus, as a result of, proximity to Bhogapuram Aerocity. Vizianagaram will have high quality public transit corridors connecting to the mother city of Visakhapatnam and Bhogapuram aerocity.

- **Transit Led Urban Structure:** Public transit led urban structure through Metro and BRT and Bus Based Corridor will thread urban development axis and satellite urban centres in VMR. It is recommended that metro network which is conceived between Bhogapuram International Airport and Anakapalli in three phases is further extended upto Atchutapuram-APIIC SEZ from Lankelapalem to support the emerging urban axis between the airport, existing CBD of Visakhapatnam, and the mega Industrial Cluster under VCIC at Atchutapuram. Existing and expansion of BRTS network can be organized to provide last mile connectivity and to the sub-CBDs with respect to the metro network. The public transit axis will be supported with NMT and other para transit modes to promote development in the influence area of 1-5 km along the public transit corridors.

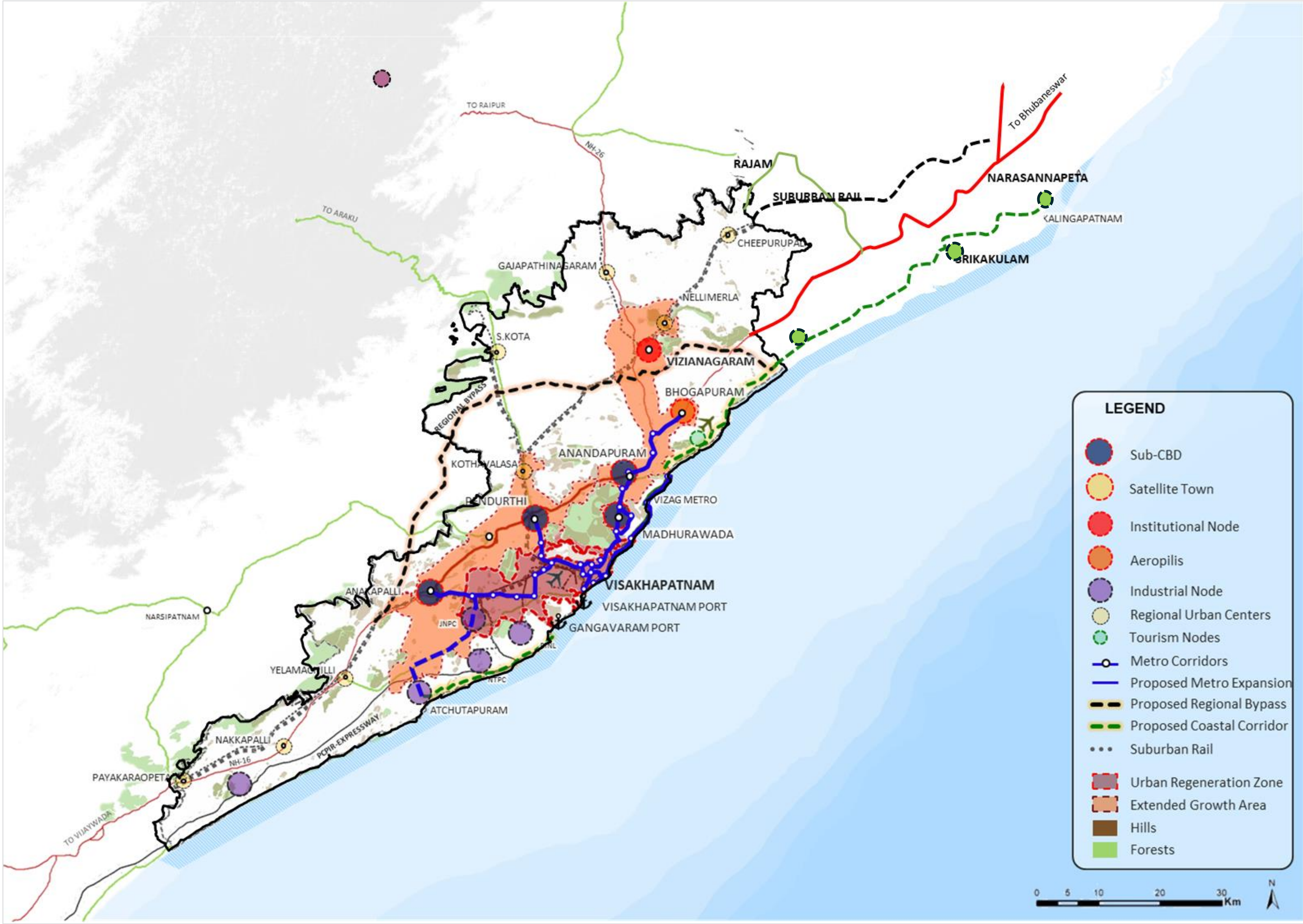


Figure 15-10: Preferred Strategy focuses on mother city and TOD led urban development along the Metro Corridor, NH-16, and carrying out increased public transit connectivity to the satellite cities to have balanced development in VMR.

To support the metro network between Bhogapuram Aerocity-Existing CBD of Visakhapatnam-Atchutapuram Mega Industrial Cluster, Transit Oriented Development (TOD) is proposed in 1-5 km corridor on both sides of the metro. Last mile connectivity is to be provided by NMT modes upto 1 km and upto 3-5 km by BRTS/Bus Routes on both sides of the corridor. Higher density development at an average of 200 to 300 pph can be promoted in the influence area of the metro corridor in Greenfield and opportunity-based sites within existing city.

Theme based New Economic Nodes and Sub CBDs: Number of theme based economic nodes and Sub CBDs will be developed along the axis and at nodal locations. Knowledge and cultural city at Vizianagaram, Bhogapuram Aerocity, a new township at Anandapuram, Pendurthi-Kothavalasa Sub CBD and light industry and residential township, Sabbavaram Knowledge and Mixed-Use node, Anakapalli trade and mixed-use town, and Mega Industrial Cluster at Atchutapuram under VCIC will be key theme based clusters/nodes to establish the new urban axis.

Balanced and Networked City Region: The new urban axis while having urban transit (BRTS) of its own will be networked with the mother city through BRTS or Bus based connections. Commuter rail and radial roads will connect the regional centres to the mother city integrating the whole area within the network.

Beach Road as a Parallel Leisure and Tourism Axis: The proposed Beach Road development between RK Beach to Beemunipatnam is proposed to be further extended with select tourism nodes development and networking existing tourism destinations in VMR. Reinforce connectivity between NH-16 and Beach Road and in the process restructure mobility in Already developed areas.

Integration of Committed and Proposed Projects in VMR: This preferred strategy integrates proposed and committed major projects like Bhogapuram Aerocity, Beach Road Tourism Project, VCIC Mega Industrial Cluster at Atchutapuram, RTC Complex, BRTS Network, Visakhapatnam metro and under implementation bypass to NH-16 will largely play the role of much needed bypass to the city.

Hierarchical Regional Development: Balanced and hierarchical development in VMR by promoting economic and planned development in second order cities and regional centres to cater for both urban and rural areas. Networking of urban and rural resource centres through hierarchical road and public transit is important and will enable balanced development of the region.

Protection of Natural and Agriculture Areas: The preferred strategy will relieve pressure on existing development adjoining natural sites hence help in protection and integration of natural environment for leisure and tourism activities. Protecting agriculture lands is integral to protection of agro economy of the region.

Figure 15-11: Sustainable urbanisation of the region with balance between natural resource conservation and their utilisation

Urban Transport Network

Mobility corridors in VMR linking mother city and other urban centers: The mobility structure of VMR is based on the following major corridors

- **Turning old National Highway to Public Transit Corridor in GVMC Area**: The major axis for the whole region, including the section going through the core city and to be converted into a public transit corridor.
- **Current National Highway Bypass becoming Urban Corridor**: Connecting Anandapuram, Pendurthi, Sabbavaram and Anakapalli, will be a parallel and major urban corridor serving the future growth areas and the sub-CBDs having BRTS based public transit.
- **Beach Corridor:** The existing beach road from Coastal Battery to Bheemunipatnam will be extended till Kalingapatnam in Srikakulam via Bhogapuram along the coastline. The beach corridor will also work as emergency access and evacuation link in times of cyclones etc.
- **PCPIR Expressway**: Serving all the heavy industries clusters in the PCPIR area along with the planned townships, the express will be major alternative to the National Highway 16, with regular connectors to the NH-16.
- **Regional Bypass to VMR:** Current bypass to NH-16 only provides partial relief from through goods and other traffic passing through VMR hence there is need to promote new bypass to VMR which is also provide regional connectivity to the satellite cities. A conceptual alignment of the bypass is proposed here which can also take into account larger state level strategic road planning and improvement.
- **Radial Roads:** The radial roads will connect the mother city with the satellite and regional urban centers. Major State Highways has been identified for widening to the towns of Rajam, Cheepurupalli, Gajapathinagaram, Srungavarapukota and Parawada. Twelve radial corridors are identified for improving public transit within VMR in east-west direction.
- **Regional Connectors**: Regional urban centers will be inter-connected by regional connectors, by widening identified MDRs and ODRs to connect rural settlements, nodal villages, and mandal headquarters.
- **Suburban Railway**: Utilisation of railway connectivity from VMR to towns of Amadalavalasa, Srungavarapukota and Tuni.
- **Metro and Urban Transit Corridor:** Approximately 150 km of metro based public transit network is proposed under the preferred strategy which will promote the north-south urban development axis in VMR. This includes the revised alignment of phase wise development of metro corridors branching towards Bhogapuram, Pendurthi and Anakapalli with a proposed extension till Atchutapuram which is a major employment node.
- **BRTS Network:** Last mile connectivity with respect to metro network will be in the form of BRTS and Bus based public transit loops connecting to metro nodes in 5 km influence area of the metro corridor. .
- **NMT Network:** As part of the CMP and Carbon Neutral Mobility Plan (CNMP) for Visakhapatnam NMT network is proposed and will be integrated under the preferred strategy. It is proposed to have additional NMT network within 1km on both sides of metro network to promote walking and other cleaner forms of para transit.
- **Connectivity to Mandal Headquarters:** All mandal headquarters in VMR would be connected with improved road RoWs (30/24 M) with respect to main urban transport network.

- **Port Connectivity Improvement:** Modernization of ports and improving connectivity to ports is important to overall economic development and putting the region on global investment platform. To improve connectivity to ports is an on-going effort in VMR and will be further reinforced as part of the Master Plan. Existing and proposed locations for truck terminals and warehousing would be integrated through improved road network.
- **ISBT and ICBTs:** In context of inter city and region bus-based travel demand location of ISBTs and ICBTs would be identified in VMR in the next phase of the Master Planning.
- **Road Network Improvement:** In Visakhapatnam city and VMR as a whole where traffic condition of roads is congested and deteriorating hence improved and hierarchical road network of RoWs of 80m, 60m, 45m, 30m, and 24 m would be proposed in existing and greenfield developments.

Figure 15-20: Sustainable urbanisation of the region with a balance between natural resource conservation and their utilisation

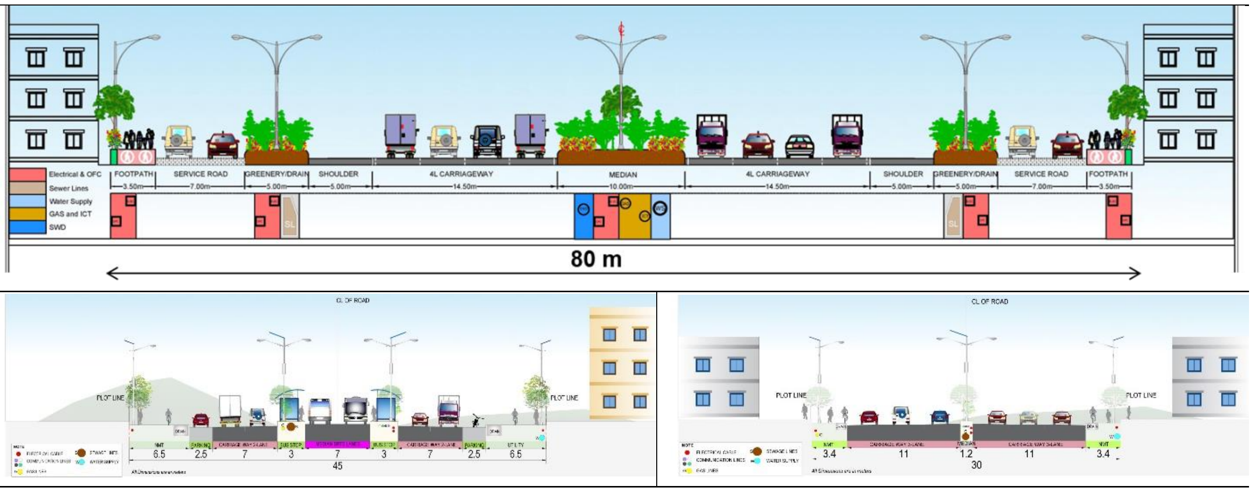


Figure 15-21: Hierarchical road network of RoWs of 80m, 60m, 45m, 30m, and 24m will be planned in VMR to streamline the mobility and safety aspects

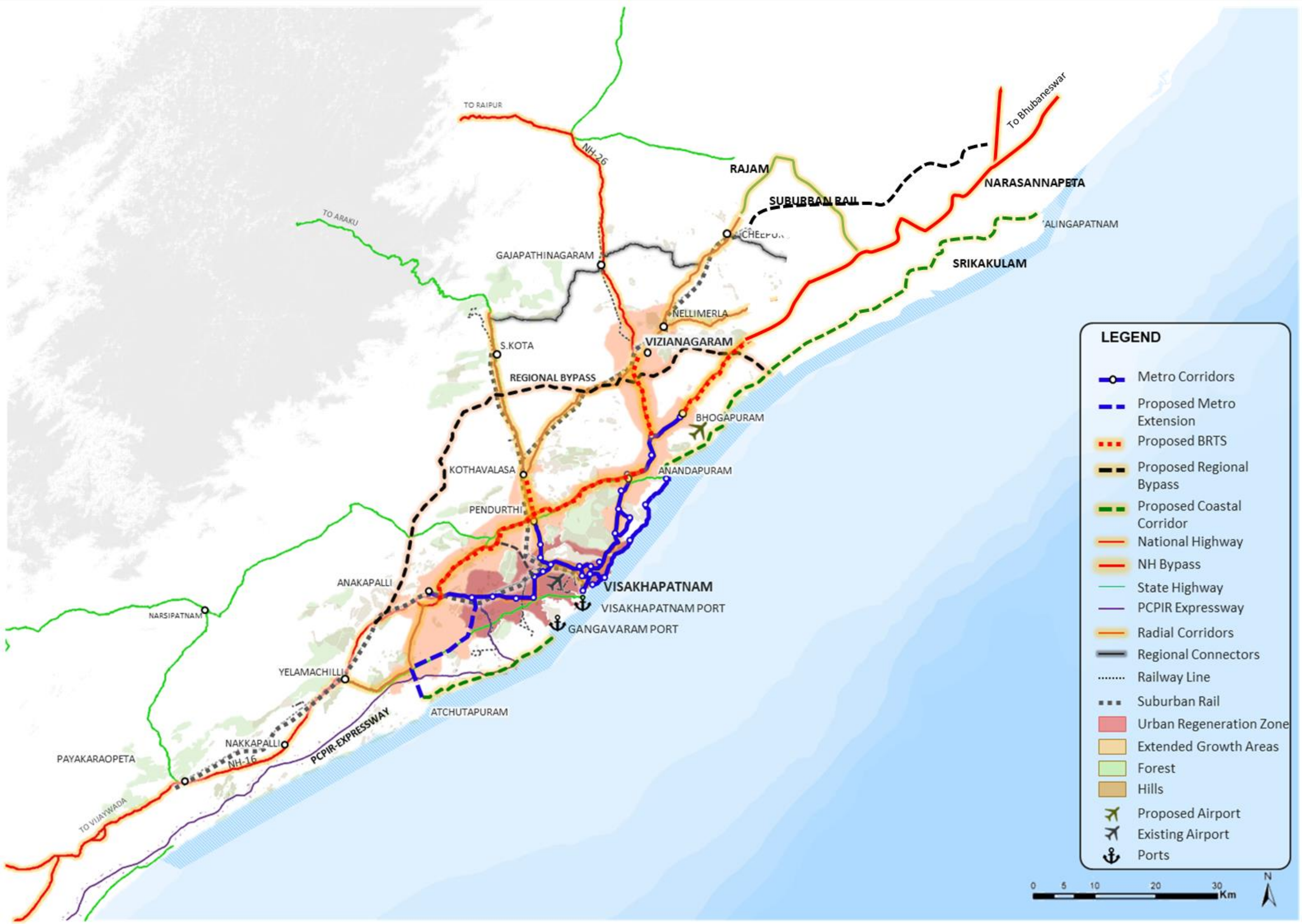


Figure 15-12:The key aspects of urban transport network for the Preferred Strategy comprises a bypass to VMR, Metro link between Aerocity-Visakhapatnam-VCIC Mega Cluster, and BRT or Bus based public transit on radial corridors connecting to the Satellite cities/towns.

URBAN FORM AND IMAGEABILITY

In principle, the preferred strategy promotes transit led compact city form for the mother city and protects natural environment around the mother city. The satellite cities/towns will develop around theme based economic role with compact urban form to protect maximum agricultural lands as possible under the scenario. Urban densities of 200 pphs are desirable in the satellite towns and cities. The key aspects of urban form and imageability under this alternative are as follows.

- **Transit led TOD Development:** The north-south Urban Axis between Bhogapuram Aerocity and Mega Industrial Cluster at Atchutapuram will structured hence form the image ToDs along the corridor. The corridor can accommodate close to 2 million population with average density of 200-300 pph in built up areas.
- **Radial Corridors:** To link the new urban axis/corridor to the mother city twelve radial corridors are proposed along with provision of bus based public transit.
- **City Beautiful:** VMR and Visakhapatnam has bountiful natural resources including 170 km of coastline. As an idea to promote transit led compact mother city under this alternative natural areas and maximum agricultural land would be protected to retain the image and characteristic of city beautiful and natural environment of VMR.
- **Modernizing the Existing City Cores through Retrofitting and Urban Regeneration:** To improve the quality of work and living environment in existing city, many of on-going and committed proposals like area development, smart city, public transit, NMT, and redevelopment would be integrated in the plan along with identification of potential new proposals to modernize the existing city.
- **Connected nodes and Regional centers:** While each node is envisaged with an economic role and developed in a compact and planned manner. Under this alternative Vizianagaram will be knowledge, cultural and tourism town. Anakepalle will grow as business and trade hub and the satellite towns connected to the mother city through BRTS and Bus based public transit hence giving an image of highly connected and public transit led region.
- **Theme based Economic Nodes and Sub CBDs:** To make the region economically sustainable new theme-based knowledge, mixed use, industrial, and commercial nodes (Sub CBDs) would be developed to promote proximity between work and home along new growth corridors
- **Theme Based Tourism Destinations:** Araku Valley as a global level MICE (though it is located outside the VMR), Health and Leisure tourism destination with world class tourism infrastructure and Visakhapatnam playing a role of a mother city, Buddhist Circuit based tourism infrastructure improvement, integration of Beach Corridor for Leisure and Coastal Tourism, and Hindu Pilgrimage destinations with tourism infrastructure improvement in Vizianagaram, Simhachalam, and Annavaram etc., development of Theme Parks, and Eco Tourism near wildlife sanctuaries. The beach corridors and tourism infrastructure can play an anchor role for tourism development in the region.
- **Resilient City:** As stated earlier VMR is subjected to natural disasters from cyclones, floods, and climate change. Planning to reduce economic, human, and urban infrastructure losses would be essential. Hence, areas prone to floods and storm surge will be identified based on available studies and not subjected to high value and vulnerable urban development. The beachfront development with necessary stringent regulations to resist wind speed of cyclones and destruction from storm surge would create idea of city on a seafront, which is not very imageable at present.

IDENTIFICATION OF POTENTIAL KEY PROJECTS

To realise the key components of the Master Planfor the VMR following projects and development components will form critical urban and regional structure of the Perspective Plan for VMR.

- Detailed project feasibility for Transit Led TOD Corridor between Bhogapuram Aerocity-Existing CBD-and Industrial Mega Cluster at Atchutapuram under VCIC.
- Detailed project feasibility for BRTS led development of New Urban Axis/Corridor between Vizianagaram-Anandapuram-Pendurthi-Anakapalli-and Atchutapuram through land pooling and land development strategies.
- Development Plans for Improvement and Development of the twelve radial corridors between the new urban axis along the bypass to NH-16, mother city, and the Beach Corridor.
- Detailed Development Plan for Development of a 150 km new corridors between Atchutapuram-Anakapalli-Pendurthi-Vizianagaram having 60-90 m RoW with public transit connecting the satellite cities.
- Detailed Feasibility studies for Tourism destinations development and expansion of Araku Valley, Buddhist Circuit, Hindu Pilgrimage destinations, Beach and coastal tourism, and eco-tourism etc.
- Implementation of Beach Road development project for recreational, tourism, and other mixed-use development
- Detailed Study and Macro level area planning for Resilient city planning and framing related development regulations to reduce losses in vulnerable areas.
- A comprehensive Rural Development Agenda as recommended in the Chapter 22.
- Detailed Development and Urban Regeneration Plans for modernization of existing city core areas through opportunity-based retrofitting, urban renewal, and integration of committed and proposed projects smart city and urban transit improvement studies along the proposed metro.
- Detailed Project Report for Bypass development to VMR on medium to long term basis. A conceptual alignment for the bypass is proposed in the preferred strategy.
- Detailed Project Reports for Development of Ring Roads on perimeter of Vizianagaram, , and Anakapalli cities.

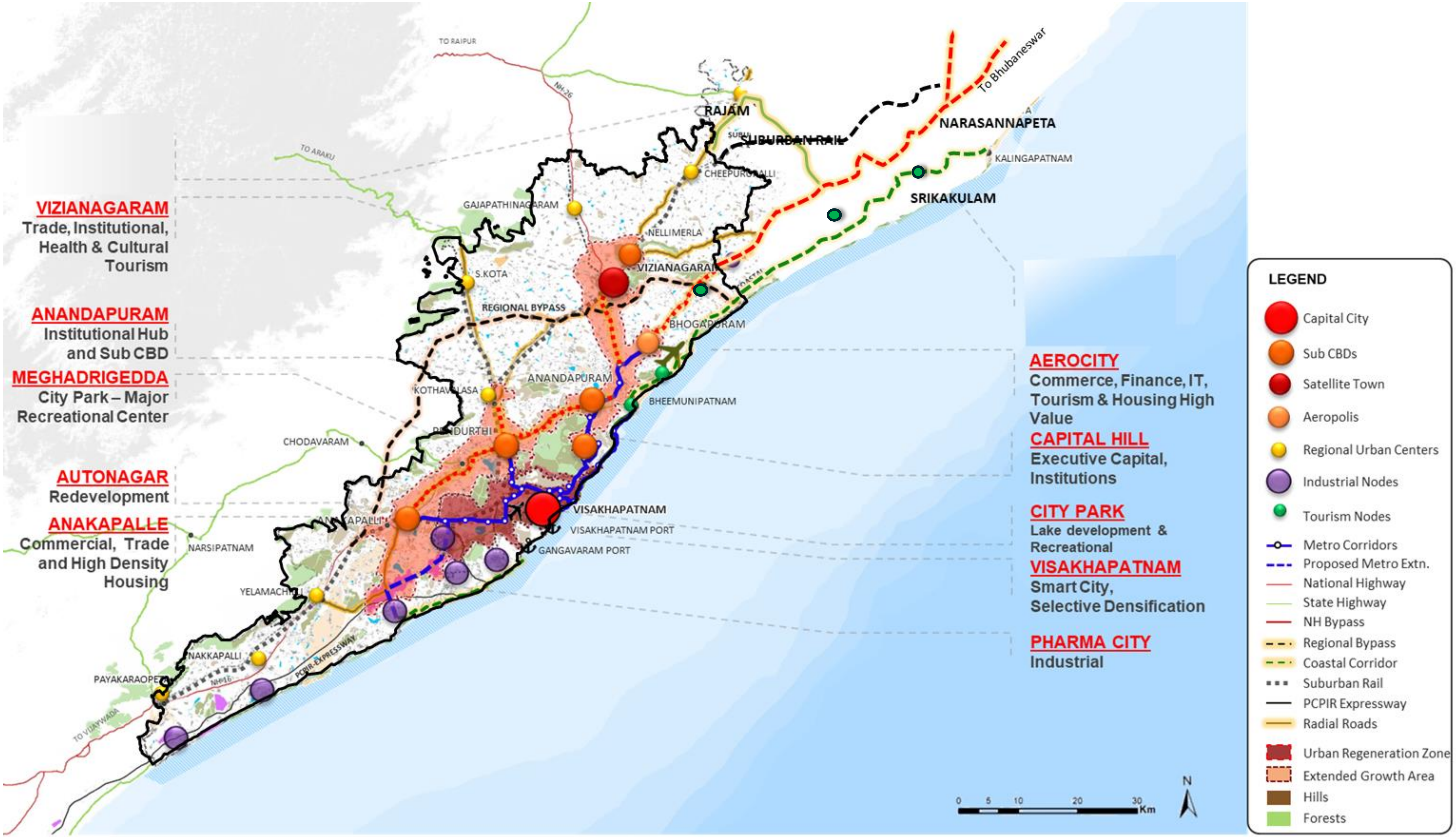


Figure 15-13: Preferred Strategic Plan for VMR promotes an idea of compact cities, hierarchical settlements, and balanced regional development.

16 TRANSPORTATION SECTOR STRATEGIES & PLAN

This chapter focuses on the future proposals of transportation network in VMR. A detailed description of the network with enhancement of public transportation is presented with special emphasis on Travel Demand Modeling and Transport Network Analysis for Horizon Year. It also comes up with an action plan for implementation of transport sector plan.

16.1 GOAL

As stated in Chapter 13, Goals set for achieving transportation system in VMR align directly with 3 UN SDGs and indirectly with 5 UN SDGs.

VMR Draft Master Plan Goals	Links with UN SDGs	
	Direct Links	Indirect Links
Goal:6 - Develop integrated transportation system within the VMR that is viable, sustainable, efficient and safe for passengers and freight.		

16.2 OBJECTIVES

The objectives of providing an efficient transportation system of VMR are:

a) To increase the capacity of transportation system to tackle existing gap and forecasted demand;

b) To facilitate viable choice of transportation systems that can promote freight and passenger connectivity between resource centres and potential market centres (local to global);

c) To expand public transit connectivity and associated infrastructure within VMR that can result in decreased travel time;

d) To develop complete streets that enable safe use and support mobility for all users;

e) To develop transportation system integrated with the proposed land use and intensity of activity within VMR;

f) To promote sustainable choices of transportation systems/ technologies that reduce carbon emissions and encourage healthy lifestyles; and

g) To increase the efficiency of transportation system by adapting smart technologies including intelligent transportation system.

The long-term and medium-term transportation strategies and transportation plans for VMR have been evolved considering the above stated goals and objectives. The details are presented in the following sections.

16.3 LONG-TERM & MEDIUM-TERM TRANSPORTATION STRATEGIES

The following considerations have been formulated while evolving long-term and medium-term transportation strategies:

a) The strategies must be visionary as well as practical and be policy driven. The VMR is a complex and evolving urban and regional area in the state undergoing profound economic and social change, the strategies and related plans may have to embody transportation solutions, priorities and investments which cater to more than one potential long-term future;

b) The transport strategies must consider the current economic, social, environmental, cultural, pilgrim, tourist, land use and transport development situation and trends for municipal corporation area of Visakhapatnam, municipalities of Vizianagaram, Amadalavalasa and Yelamanchili and Nellimarla Nagar Panchayat and rural areas of VMR;

c) The strategies must be economically viable but from a broad perspective. The benefits of good transportation extend far beyond traditional indicators such as reduced travel time and cost. Among other factors, good transportation can promote increased job opportunities and reduced housing costs by increasing accessibility to greater variety of housing and employment choices. These can be realized through transportation strategies/ plans evolved based on sustainable transport principles;

d) The strategies must ensure the maintenance of the existing transportation services in a state of good repair and promote positive change to overcome critical capacity deficiencies to support economic growth and urban expansion;

e) The transport strategies must address the movement of people and goods and goods within, into and out of the study area in accordance with the NUTP, 2014;

f) The transport strategies must promote sustainable transport – by reducing dependence on private transport i.e. Two-wheeler and Car through improved land use-transport integration and creation of a more non-motorised and public transport friendly development. Thus, more emphasis on Public transport and NMT infrastructure and propose “Public Transport and NMT First Policy”;

g) The plan must be supportive of a “healthy VMR” but must recognize the increasing public demands for greater mobility and freedom of choice of travel mode. Any consideration of constraining private transport mobility carries the obligation of providing a reasonably comparable alternative public transport mode;

h) The strategies should ensure that high quality transport consisting of urban freeways and different types of transit systems (Bus/ BRTS/ Suburban/Metro), that predominately serves middle/ higher income segments of the community, should be user funded and implemented at no or little financial or social risk to the public at large particularly the poor;

i) Strategies and plans must improve public safety which may require constraints on the freedom of movement or greater user protection, discipline and enforcement;

j) Immediate attention and allocation resources needed should be given to pedestrian travel and safety. It is the largest and most sustainable form of urban travel but suffers from severe degradation and neglect. It has been given very low priority from a level of service and safety standpoint;

k) The transportation strategies must address the institutional changes required for effective implementation of the proposed transport infrastructure in VMR;

l) The strategies should perhaps promote the premise that transportation infrastructure capital needs to meet growth demands, should be substantially paid for by growth, i.e. possibly Development Charges; and

m) The strategies should promote the mobilization of financial resources from a wide spectrum of other urban activities that benefit from an improved or well-maintained transport infrastructure.

16.4 PROPOSED TRANSPORT NETWORKS

VMR has privilege of having very good external transport network connectivity with road, rail, air and sea modes of transport. For 2041, a planned transport network needs to be developed for enabling safe and quick movement of all types of vehicular modes with VMR. Providing Hierarchical road network connecting different points of region with adequate right of ways will ensure smooth movement of both passenger and goods vehicles.

Improved Regional Connectivity between Mother City and Satellites from NHs and SHs and between the towns and cities in VMR and rest of the state is more important and the same has been considered while evolving the transport network plan.

Public transport has an important role to play catering to various socio-economic segments of the society and these systems are environmentally sustainable. With proper plan, there will be modal shift from private vehicles to public transport, thus leading to reduced traffic congestion and improved environment. It results in socio-environmental benefits including reduced pollution, transport costs, and travel time, as well as increased accessibility and mobility.

16.4.1 STRATEGIC REGIONAL ROAD NETWORK

For a region like VMR, where connectivity should be strong enough to cater horizon year traffic, improved and hierarchical road network of RoWs of 90m, 80m, 70m, 75m, 60m, 45m, 40m, 36m, 30m, and 24m has been proposed. Wherein, 90m Row is Visakhapatnam Steel Plant Road from its Gate at Kurmannapalem to inside of Plant. For vehicle movements that are not destined in VMR and for speedy movement of vehicles through the region, hierarchical networks viz., National Highway 16 and Regional Bypass are proposed; for those bound to the region, Coastal Corridor and PCPIR Expressway which connects major activity centres in the region are proposed. These proposed strategic regional road networks for the horizon year 2041 is presented in Figure 16-1. These higher order roads are followed by the City perimeter Roads, Ring Roads/NHs, Arterial roads, Beach Road, Major Roads, Sub-arterial roads and Collector roads acting as Regional Connectors and Regional Corridors connecting large number of growth centres, collecting and distributing from and to them. Other roads take off from these roads providing complete accessibility in the region. These higher order roads are followed by the City perimeter Roads, Ring Roads/NHs, Arterial roads, Beach Road, Major Roads, Sub-arterial roads and Collector roads network for the horizon year 2041 is presented in Figure 16-2. Description on the proposed transport network is presented in the following sections and summary of their road lengths is shown in Table 16-1.

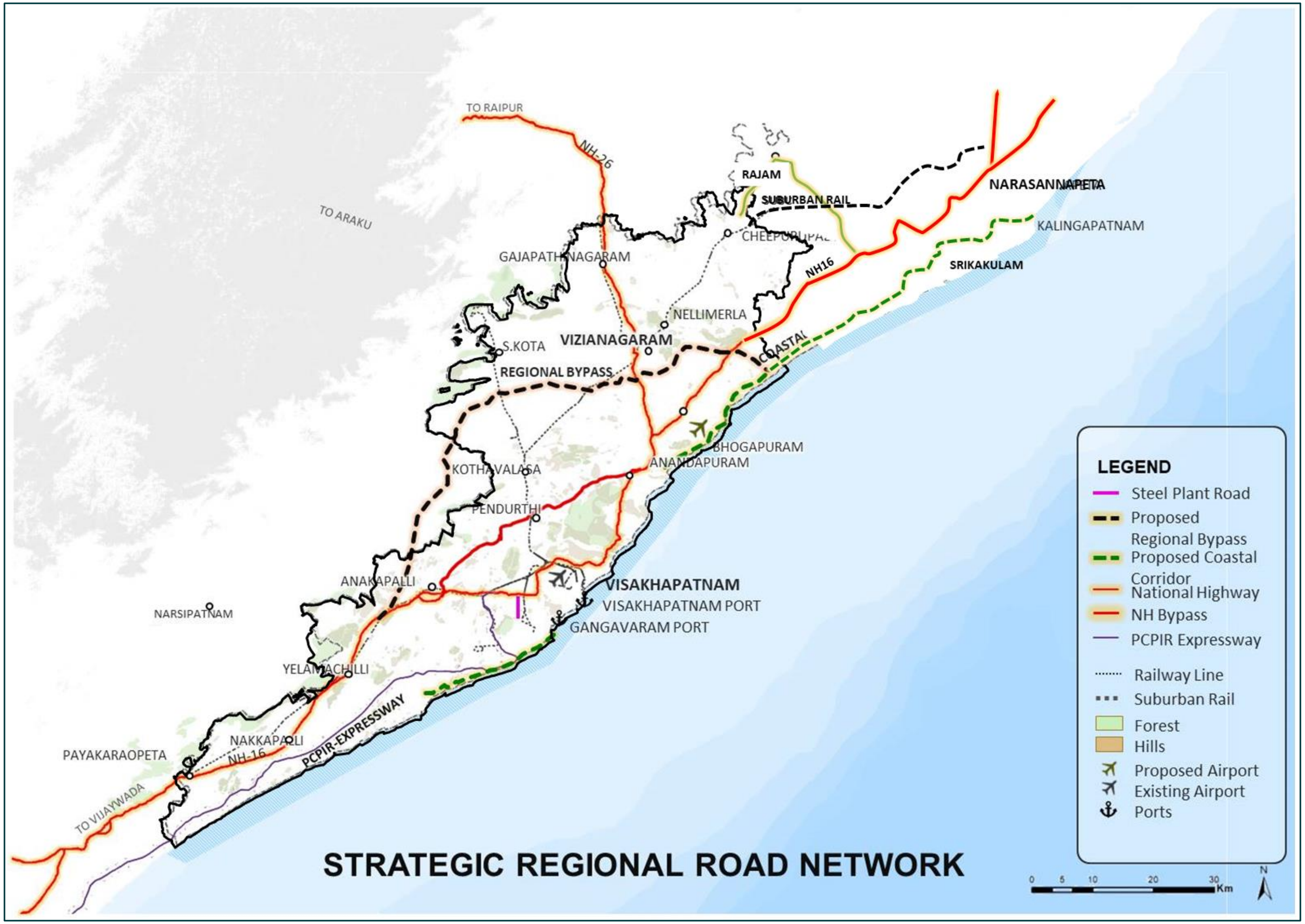


Figure 16-1: Strategic Regional Road Network for the Horizon Year 2041

16.4.1.1 National Highway 16

NH-16 (Kolkata to Chennai) passes through VMR from Narasannapeta in Srikakulam District to Payakaraopeta in Visakhapatnam District. In between, it connects Anandapuram, Pendurthi, Sabbavaram and Anakapalli. It is one of the major corridors serving the future growth areas and the sub-CBDs. Development of a New Bypass to NH-16, which will also incorporate strategic roads, conceived under State Roads Improvement Programme.

16.4.1.2 PCPIR Expressway

Serving all the heavy industries clusters in the PCPIR area along with the planned townships, the expressway of 75m RoW will be a major alternative to the National Highway 16, with regular connectors to the highway.

16.4.1.3 Proposed Regional Bypass

As the urban growth will spread over NH-16 bypass in the near future, the regional bypass will be used to avoid the urban area interference with the freight movement. Current bypass to NH-16 only provides partial relief from through goods and other traffic passing through VMR hence there is need to promote new bypass to VMR, which is linked to the satellite cities. A conceptual alignment of the bypass is proposed by the Master Plan considering larger state level strategic road planning and improvement. The Regional Bypass starts from Tuni along NH-16 to south of Anakapalli, stretching northwards via Lakkavarapukota, bypassing Vizianagaram and joining NH 16 near Pusapatirega and further to the beach corridor at Chintapalle village in Pusapatirega mandal. Development of this 250 km new corridor having 80m RoW will have public transit connecting the urban areas. Apart from Regional Bypass, NAD junction to Anandapuram (Erstwhile NH-16) road stretch is proposed with 80m RoW and the road connectivity form Lankelapalem junction to Parawada junction in the Pharma city is also of 80m RoW.

16.4.1.4 Proposed Coastal Corridor

The existing beach road from Coastal Battery to Bheemunipatnam will be extended till Chintapalle village in Pusapatirega mandal via Bhogapuram along the coastline having 60m RoW. The proposed Beach Road development has tourism nodes and existing tourism destinations in VMR. The Master Plan proposes another coastal road connectivity from Thallapalem on Anakapalli Pudimadaka road to Gangavaram Port.

16.4.1.5 Proposed City Perimeter Roads, Ring Roads/NHs (60m RoW)

a) Extending Vizianagaram Bypass (NH 26) upto Munginaplli to connect Regional Bypass via Nellimarla
b) Connectivity from Gotlam to Manapuram
c) Connectivity from Kapuluppada to NH-16 at Tallavalasa
d) Connectivity from Dora Thota road to Coastal corridor at Kummaripalem
e) Connectivity from Sabbavaram to Regional Bypass at K.Kotapau
f) Extending Port connectivity corridor Sheelanagar to Sabbavaram upto Konisa in VMR (further extends upto Sunki)
g) Connectivity from Gajuwaka MRO office to Steel Plant Police Station via Jug Junction
h) Yelamanchili Southern Bypass from Kokkirapalli on NH-16 to Yerravaram On NH-16

i) Connectivity from Nehru Park near Telugu Thalli Statue to Yelamanchili Southern Bypass

j) Connectivity from Ootagedda junction to Vada Cheepurupalli

k) Connectivity from Nakkapalli to Vempadu via Chukalvari Lakshmipuram and Donivani Lakshmipuram

l) Connectivity from Pedarambhadrapuram to Satyammathalli Temple via Rajavaram and Kumarapuram.

m) Connectivity from Payakaraopeta to Pedarambhadrapuram to NH -16 at S. Annavaram

16.4.1.6 Proposed Arterial, Beach Road, Major Roads, Sub- Arterial and Collector Roads (45m, 40m, 36m, 30m and 24m RoW)

The proposed Arterial roads, Beach Road, Major Roads, Sub-arterial roads and Collector roads with respective 45m, 40m, 36m, 30m and 24m RoWs inter-connecting regional urban centres, mother city and major landuse activities are presented in Figure 16-2.

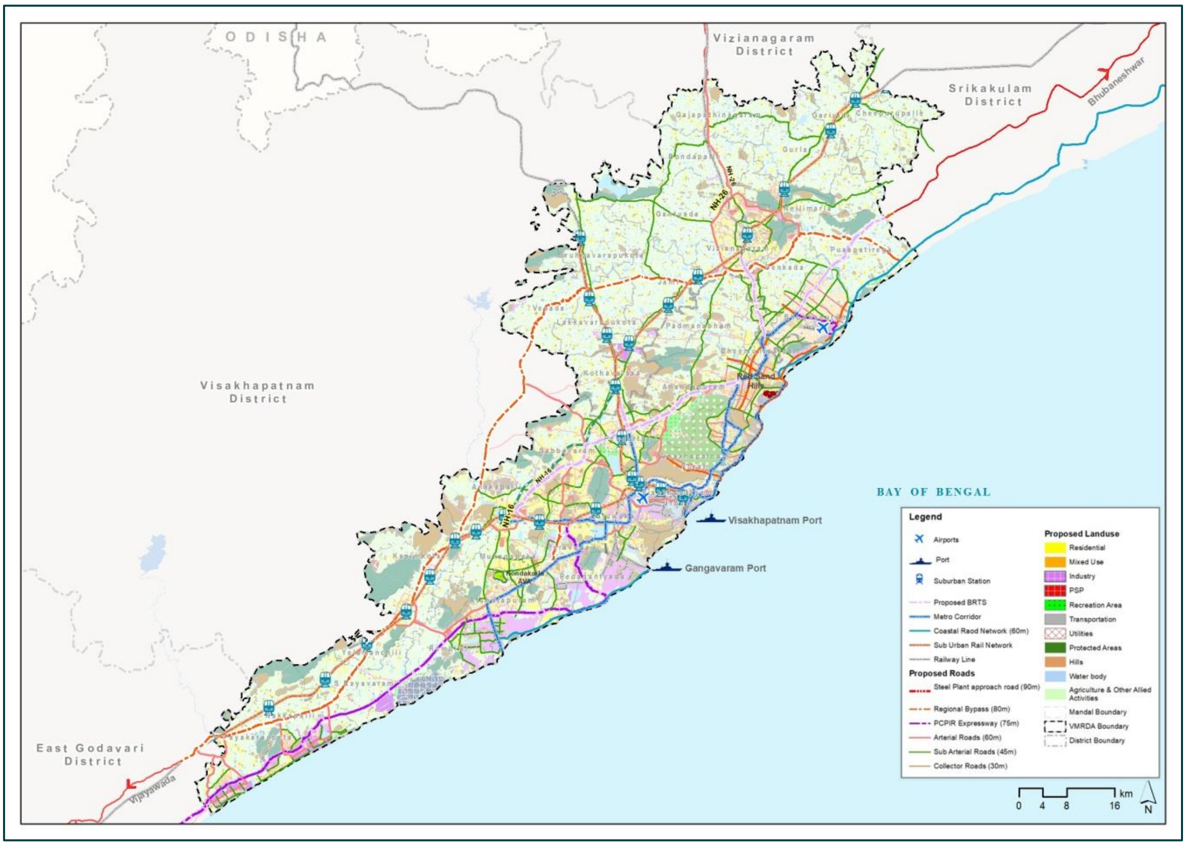


Figure 16-2: Proposed Arterial, Beach Road, Major Road, Sub Arterial and Collector Roads (60m, 45m, 40m , 36m, 30 and 24m RoW)

Table 16-1: Lenth (km) of Proposed Strategic Road Network

Category	RoW (m)	Total Length (km)
Steel Plant Road	90	6
Regional Bypass	80	204
Coastal Roads	70	21
PCPIR Expressway	75	148
City Perimeter/Ring Roads/NHs	60	467

Arterial Roads	45	814
Beach Road	40	16
Major Road	36	130
Sub-Arterial Roads	30	724
Collector Roads	24	618

16.4.2 PROPOSED PUBLIC TRANSPORTATION SYSTEMS

16.4.2.1 Enhanced Public Transport System

The mass transit network forms part of the Perspective Plan's integrated public transport network. To address future needs, high quality mass transit should be integrated with wider public transport system. The development of this public transport system considers how different modes contribute different parts of the public transport offering to meet VMR needs. This is best represented as a public transport hierarchy, which provides the steps to development of the complete, integrated public transport system. As outlined in this chapter the proposed public transport hierarchy for VMR include metro rail, LRT, suburban rail, BRT and then the conventional bus network. These public transport systems shall be adequately provided with last-mile connectivity infrastructure i.e. NMT infrastructure (Ref. Figure 16-3). More details on the proposed public transport systems are presented in the following sections.

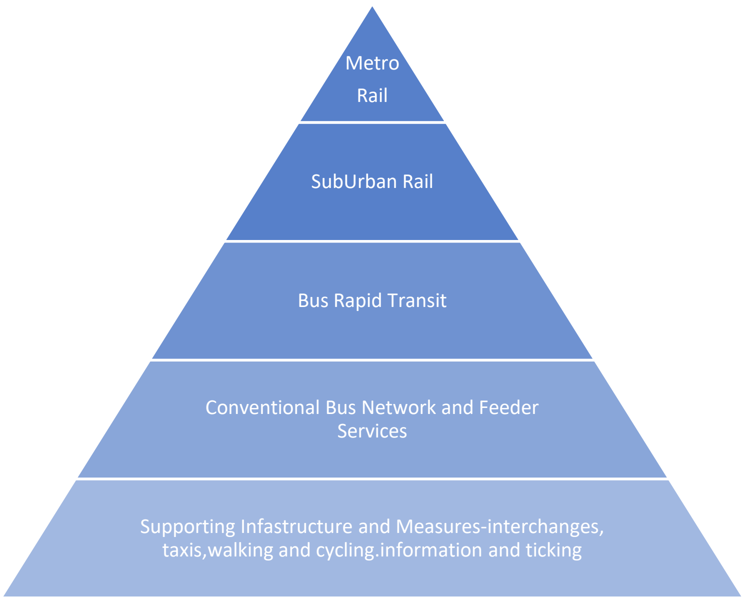


Figure 16-3: Public Transport Hierarchy

16.4.2.2 Proposed Metro Network

A full-fledged passenger railway can transport passengers in a congested urban area from one point to another in the largest number and in the shortest time in comparison with other modes of transport such as private vehicles, and buses, and even BRT. This is particularly true during peak periods when a large number of workers commute between their home and workplace, consequently creating traffic congestion. These can carry a large number of passengers at a high speed, undisturbed by traffic congestion. An illustration of the system is presented in Figure 16-4.

Figure 16-4: Rail Transport System

Due to a rail system's ability to attract a large number of trip makers along a fixed corridor, land use along the corridor often becomes denser (particularly at nodes). Land use becomes more concentrated along the corridor. This Transit Oriented Development (TOD) is in line with the public transport policies already outlined and therefore is a key component in making rail a successful component of the integrated public transport system.

When development sites have improved access to other parts of the urban area through the delivery of the passenger rail system, land prices and property values will increase from competition to locate activities along the corridor. Railways are expensive to build, but if increases in property values can be captured and pay for the cost, at least in part, the overall cost to the provider can be much lower. This practice of "value capture" is most prominent in Japan.

Andhra Pradesh Metro Rail Corporation Limited (APMRC) has prepared a metro rail Master Plan for the area under the aegis of the Visakhapatnam Metropolitan Region Development Authority (VMRDA). Visakhapatnam Metro Rail Project will be taken up in three phases during which work on corridors in different routes would be commenced. Approximately 140 km of metro based public transit network is proposed under this alternative which will promote the north-south urban development axis in VMR. It is proposed in three phases and the details are presented in Table 16-2 and the proposed metro network is shown in Figure 16-5.

Table 16-2: Phase-wise development plan of Visakhapatnam Metro Alignments

Phase	S.No	Corridor	Length in kms.	Total Length in kms
Phase-1	1	Kommadi to Steel Plant (on NH-16) via NAD, Gajuwaka	34.23	46.42
	2	Gurudwara to Old Post Office via RTC Complex, Raja Ram Mohan Roy Road	5.29	
	3	Thatichetlapalem to China Waltair via Railway Station, RTC Complex, Asilmetta Jn, Siripuram Jn	6.9	
Phase-2	1	Law College Jn to Mariakvalasa via Madhurawada, IT Park	8.21	77.31
	2	Kommadi to Anandapuram Jn via NH16	8.3	

	3	Anandapuram Jn to Bhogapuram Airport - Approach Road (At grade)	17	
	4	NAD Jn to Pendurthi	10.2	
	5	Visakhapatnam Steel Plant to Anakapalli Railway Station (At grade)	18.2	
	6	Old Post Office to Rushikonda Beach via Beach Road, GITAM University	15.4	
Phase-3	1	Rushikonda Beach to Bheemili beach via Thotla Konda, Beach Road	16.4	16.4
				140.13

The Master Plan recommends that metro network, which is conceived between Bhogapuram International Airport and Anakapalli in three phases is further extended upto Pudimadaka near Atchutapuram-APIIC SEZ from Steel Plant Gate in Kurmannapalem (34.9 km) to support the emerging urban axis between the airport, existing CBD of Visakhapatnam, and the mega Industrial Cluster under VCIC at Atchutapuram (Ref. Figure 16-6). Adding this corridor the Metro corridors length sums up to 175 km. Metro being the major public transit corridor, existing and expansion of BRTS network can be organized to provide last mile connectivity and to the sub-CBDs with respect to the metro network. The public transit axis will be supported with NMT and other paratransit modes to promote development ranging between 3-5 km influence areas of the axis/corridor.

16.4.2.3 Proposed Suburban Rail Network

For passenger transit in VMR, utilisation of railway connectivity from Visakhapatnam to towns of Vizianagaram, Srungavarapukota and Tuni Sub urban rail system will facilitate. The proposed sub-urban rail network is presented in Figure 16-7.

Metro Corridors					
Phase	S.No.	Corridor	Length in (Kms.)	Total Length in (Kms.)	Year of Planning
Phase-1	1	Kommadi to Steel Plant (on NH-16 via NAD, Gajuwaka	34.23	46.42	2020-2024
	2	Gurudwara to Old Post Office (via RTC Complex, Raja Ramohan Roy Road)	5.29		
	3	Thatichetlapalem to Chinawaltair (viz Rly Station RTC Complex, Asilmetta Jn., Siripuram Jn.	6.9		
Phase-2	1	Law College Jn. to Marikavalasa (via Madhurawada, IT Park)	8.21	77.31	2023-2028
	2	Kommadi to Anandapuram Jn. (viz NH-16)	8.3		
	3	Anandapuram Jn. to Bhogapuram Airport (Approach Road)-Atgrade	17		
	4	NAD Jn. to Pendurthi	10.2		
	5	Vizag Steel Plant to Anakapalli Railway Station (via NH-5) Atgrade	18.2		
	6	Old Post Office to Rushikonda Beach (via Beach Road, Lumbini park, GITAM University)	15.4		
Phase-3	1	Rushikonda Beach to Bheemili beach (via Thotla konda, Beach Road)	16.4	16.4	2027-2029
				140.13	

Figure 16-5: Proposed Metro/ metrolite/ LRT Network

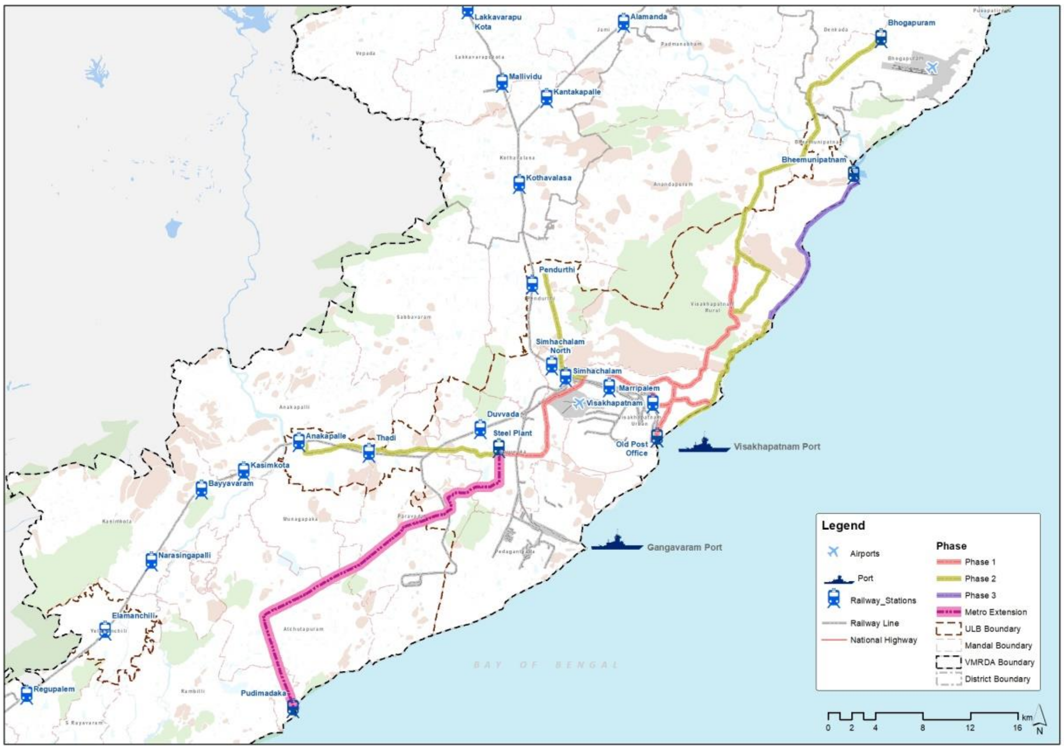


Figure 16-6: Proposed Metro Extension from Steel Plant to Pudimadaka

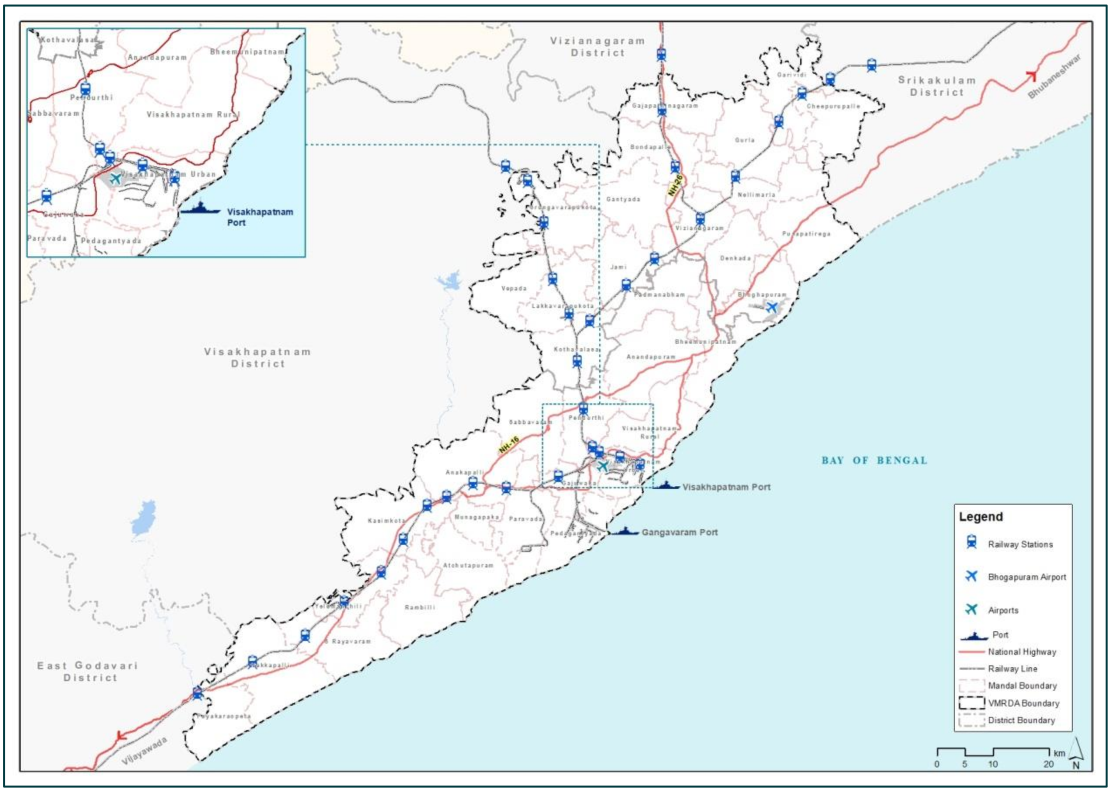


Figure 16-7: Proposed Suburban Rail Network

16.4.2.4 Bus Rapid Transit System (BRTS)

As identified in the proposed public transport hierarchy, BRT has an important role to play in providing the mass transit network required for VMR. This form (Figure 16-8) of low-cost mass transit has proved to be pivotal in many cities around the world including Indian cities, aiding cities in moving away from the model of public company bus transport, with its associated problems (e.g., overstaffing, underfunding, problems with spare parts), and away from a poorly regulated private sector based on second hand minibuses.

Figure 16-8: Bus Rapid Transport System Infrastructure

The new urban axis while having urban transit (BRTS) of its own will be networked with the mother city through BRTS or Bus based connections along major radial corridors to the mother city and proposed metro network, hence creating an idea of highly networked city region. Last mile connectivity with respect to metro network will be in the form of BRTS or Bus based public transit loops connecting to metro nodes in 5 km influence area of the metro corridor.

Pendurthi Transit Corridor (PTC) and Simhachalam Transit Corridor (STC) are the two existing BRTS corridors. Adding to Metro Corridors, for last mile connectivity and connectivity to the satellite towns BRTS would be extended and other bus based network will be linked to the metro transit network. For this, Pendurthi will be connected to Kothavalasa (45m RoW), NH16 bypass – Anakapalli to Anandapuram (60m RoW), Thagarapuvalasa to Vizianagaram (60m RoW) and Bhogapuram to Pydibheemavaram (80m RoW) as proposed BRTS corridors. Proposed BRTS system in the study area is presented in Figure 16-9.

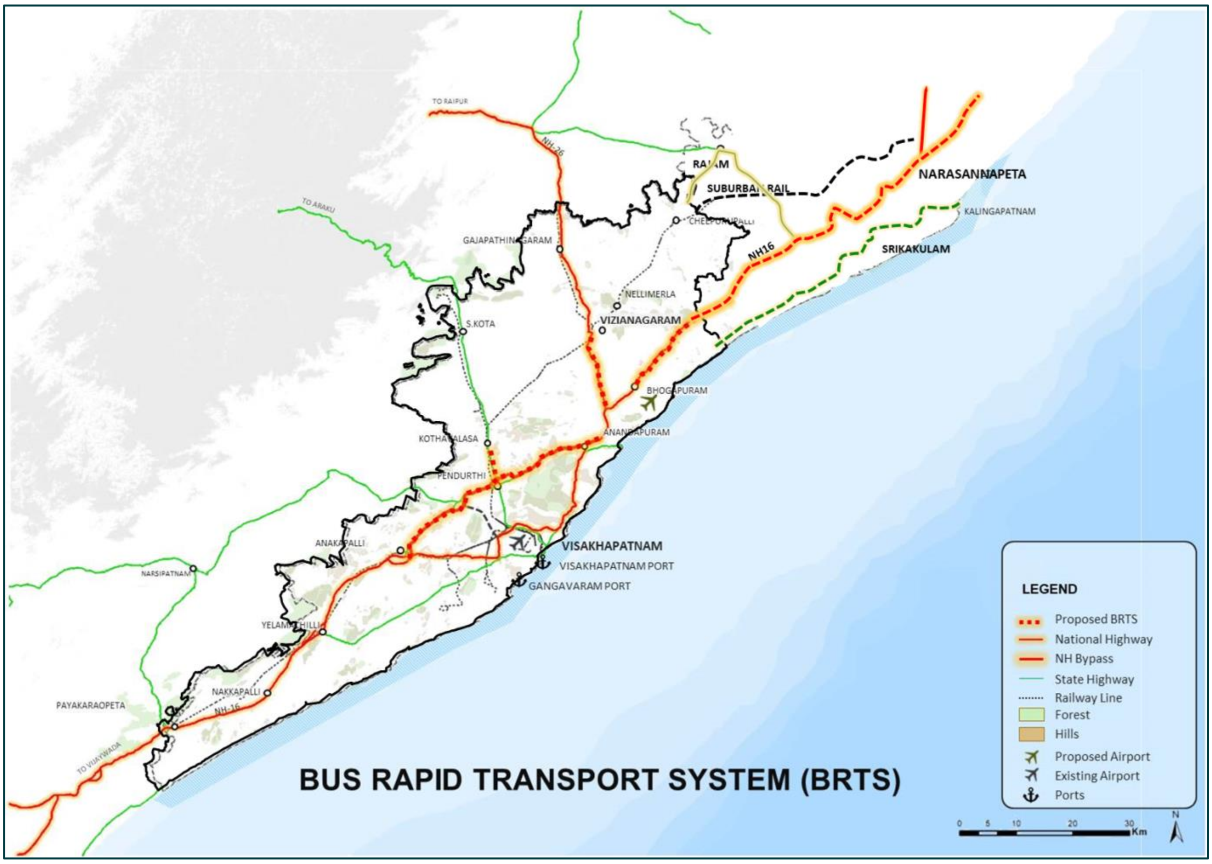


Figure 16-9: Proposed BRTS Network

For effective implementation of the proposed transport network, it would be prudent to have typical cross sections for different RoWs and the same are developed based on the following considerations:

a) Requirement of functions of the road link/ corridor like Perimeter Road, BRTS, Roads located in Industrial areas, etc.;

b) Specific requirement of Bus stops in case of BRTS corridors;

c) Requirement of service lanes depending on the location;

d) NUTP, 2014 and IRC guidelines on footpaths;

e) Pedestrian and NMT requirements;

f) Placement of utilities;

g) On-street parking requirement; and

h) Widening requirements.

Cross section elements of proposed typical cross sections is presented in Table 16-3. Proposed typical cross sections are presented in Appendix L.

Table 16-3: Cross Section Elements of Proposed Typical Cross Sections

Location	Category	Regional Bypass		VKPCPIR Expressway			City Perimeter Road		Ring Road/NHs	Ring Road/NHs	Ring Road/NHs with 2 Lane BRTS	Arterial Roads				Sub Arterial Roads	Sub Arterial Roads with 2 Lane BRTS	Collector Roads	Access Streets		Local Streets
				a) Township and Industrial Area	b) One Side Township	c) Non Builtup Area						Industrial	Residential	Residential	With BRTS						
		1.a	1.b	2.a	2.b	2.c	3.a	3.b	4	5	6	7	8	9	10	11	12	13	14.a	14.b	15
RoW (m)		80		75			60		60	60	60	45	45	45	45	30	30	24	18		12
Lanes		10 LDC	8 LDC + SLs	6 LDC + SLs	6 LDC	6 LDC	8 LDC	6 LDC+SLs	8 LDC	10 LDC	8 LDC + 2 Lane BRTS	4 LDC + SLs	6 LDC + SLs	6 LDC	4 LDC + 2 Lane BRTS	4 LDC	4 LDC + 2 Lane BRTS		4 LDC	2 LC +Parking	2 LC
LHS	Footpath (m)		3.50	2.25	2.50			2.50	2.00	2.00	2.50	3.00	2.50	3.00	2.50	2.00	2.00	2.00		2.00	
	Cycle Track (m)			3.00	3.00				2.50		2.50			4.00	2.50	2.50		2.50	1.75	2.00	2.5
	Parking (m)										3.00				3	3.00					
	Service Lane (m)		7.00	5.50	5.50			7.00	7.00	7.00		7.50	6.00								
	Green/ Drain/ Divider (m)	11.00	5.00		5.00	5.00	8.00	5.00	3.00	2.00		3.00	2.00	3.00							
	Shoulder (m)	5.00	5.00				3.00	3.00	-	-											
	Carriageway (m)	18.00	14.50	11.00	11.00	11.00	14.50	11.00	14.50	18.00	14.50	7.50	11.00	11.00	7.50	7.00	7.00	7.00	7.00	7.00	7.00
Middle	Median (m)	12.00	10.00	1.50	1.50	5.00	9.00	3.00	2.00	2.00		3.00	2.00	3.00		1.00		1.00	0.50		
	Bus Stop (m)										3.50				3.50		2.50				
	BRTS Lanes (m)										8.00				7.00		7.00				
	Bus Stop (m)										3.50				3.50		2.50				
RHS	Carriageway (m)	18.00	14.50	11.00	11.00	11.00	14.50	11.00	14.50	18.00	14.50	7.50	11.00	11.00	7.50	7.00	7.00	7.00	7.00		
	Shoulder (m)	5.00	5.00				3.00	3.00	-	-											
	Green/ Drain/ Divider (m)	11.00	5.00			5.00	8.00	5.00	3.00	2.00		3.00	2.00	3.00							
	Service Lane (m)		7.00	5.50	5.50			7.00	7.00	7.00		7.50	6.00								
	Parking (m)										3.00				3	3.00				3.00	
	Cycle Track (m)			3.00					2.50		2.50		2.50	4.00	2.50	2.50		2.50	1.75	2.00	2.5
	Footpath (m)		3.50	2.25				2.50	2.00	2.00	2.50	3.00		3.00	2.50	2.00	2.00	2.00		2.00	
Utility Corridor (m)				30.00	30.00	38.00															
Total		80.00	80.00	75.00	75.00	75.00	60.00	60.00	60.00	60.00	60.00	45.00	45.00	45.00	45	30.00	30.00	24.00	18.00	18.00	12.00

16.5 TRAVEL DEMAND MODELING AND TRANSPORT NETWORK ANALYSIS FOR MASTER PLAN

The process that would be followed in assessment of traffic & transport infrastructure needs of VMR and proposed transportation plans for the long term i.e. for the horizon year 2051 (Perspective Plan) and the medium term i.e. horizon year 2041 which are inputs for the Master Plan are presented in this section. Approach and method for travel demand assessment and network analysis for Long Term (2051): Perspective Plan and Medium Term (2041): Master Plan is presented in Figure 16-10 . The steps followed are as follows:

a) Population and employment forecasts for the horizon period upto 2051 and spatial distribution;
b) Preparation of conceptual transport network for the horizon year 2051 (Long-term) including mass transport corridors based on the Perspective Plan;
c) Assessment of planning parameters at TAZ level for the horizon year 2051;
d) Travel demand and network analysis by using calibrated travel demand models for the horizon year 2051;
e) Recommended traffic & transport infrastructure for the horizon year 2051;
f) Travel demand and network analysis for the horizon year 2041 by using the recommended transport network for horizon year 2051, planning parameters for the horizon year 2041 and assess transport network for the horizon year 2041; and
g) Recommended traffic & transport infrastructure for the horizon year 2041.

Planning Parameters for the horizon years 2051 and 2041: Population and employment forecast for the VMR for the horizon year 2051 and 2041 are the major inputs for the travel demand analysis. The details are presented in Chapter 6 of this volume.

Conceptual Transport Network for the horizon year 2051: The Conceptual transport network for VMR i.e. Perspective Plan was prepared within the set goal for providing an effeicent transportation system. While evolving the Conceptual plan, base year transport network, committed traffic & transportation projects by various stakeholders/ ULBs, transport network assessed based on proposed landuse, base year transport network analysis, etc. have been considered. Conceptual transport network evolved for the horizon years 2051 are shown in Figure 16-11.

TAZ wise planning parameters for the Horizon Year 2051: TAZ wise planning parameters shall be assessed considering the proposed landuse, proposed transport network, etc.

Transport Network Analysis for the Horizon Year 2051: It is pertinent to mention here that, assessment of adequate/ optimal transport network for the horizon year 2051 is an iterative process as transport network and distribution of planning parameters are interdependent. Consultants shall carryout the transport network analysis considering the conceptual transport network/ perspective plan on supply side and travel demand assessed using the travel demand on demand side. Based on the operating speeds, assigned traffic volume and Volume/ Capacity Ratio on road network, passenger loadings and boarding/ alighting on public transport network, etc., conceptual transport network shall be modified (increased/ decreased) in such a way that, it is neither too much nor too low. Output of the analysis i.e. Transport network proposals shall be recommended for inclusion in the Perspective Plan.

Transport Network Analysis for the Horizon Year 2041: Travel demand and network analysis for 2041 followed shall be similar to 2051 analysis as described above. Output of the analysis i.e. Transport network proposals have been recommended for inclusion in the Draft Master Plan.

Terminals: Inter City Bus Terminals, Truck Terminals, Depots/ Workshops for bus and mass transit systems, etc. shall be assessed and area requirements and tentative locations shall be arrived and inclusion of the same in Draft Master Plan.

Assessment of Investments on Transport Sector: The cost of horizon year transport network (road widening, missing/ new links, bus system, BRTS/metro/LRT/Suburban train, terminals, traffic management measures shall be estimated based on the unit rates, compiled from the Consultants own experience on similar projects, DPR studies on BRTS projects, Feasibility/ DPR studies on metro/ LRT/ suburban lines, etc.

Travel demand and network analysis for the Horizon Years 2051 and 2041 has been carried out considering the erstwhile VMR as explained above and further described in the following sections. Transport infrastructure assessments made based on the travel demand and network analysis are still applicable for the revised study area of 4873.35 sqkm as well. Hence, the same analysis has been retained in this document. However, the transport network assessments in terms of lengths, terminal requirements, cost estimates are updated appropriately considering the revised study area and the details presented in the following sections.

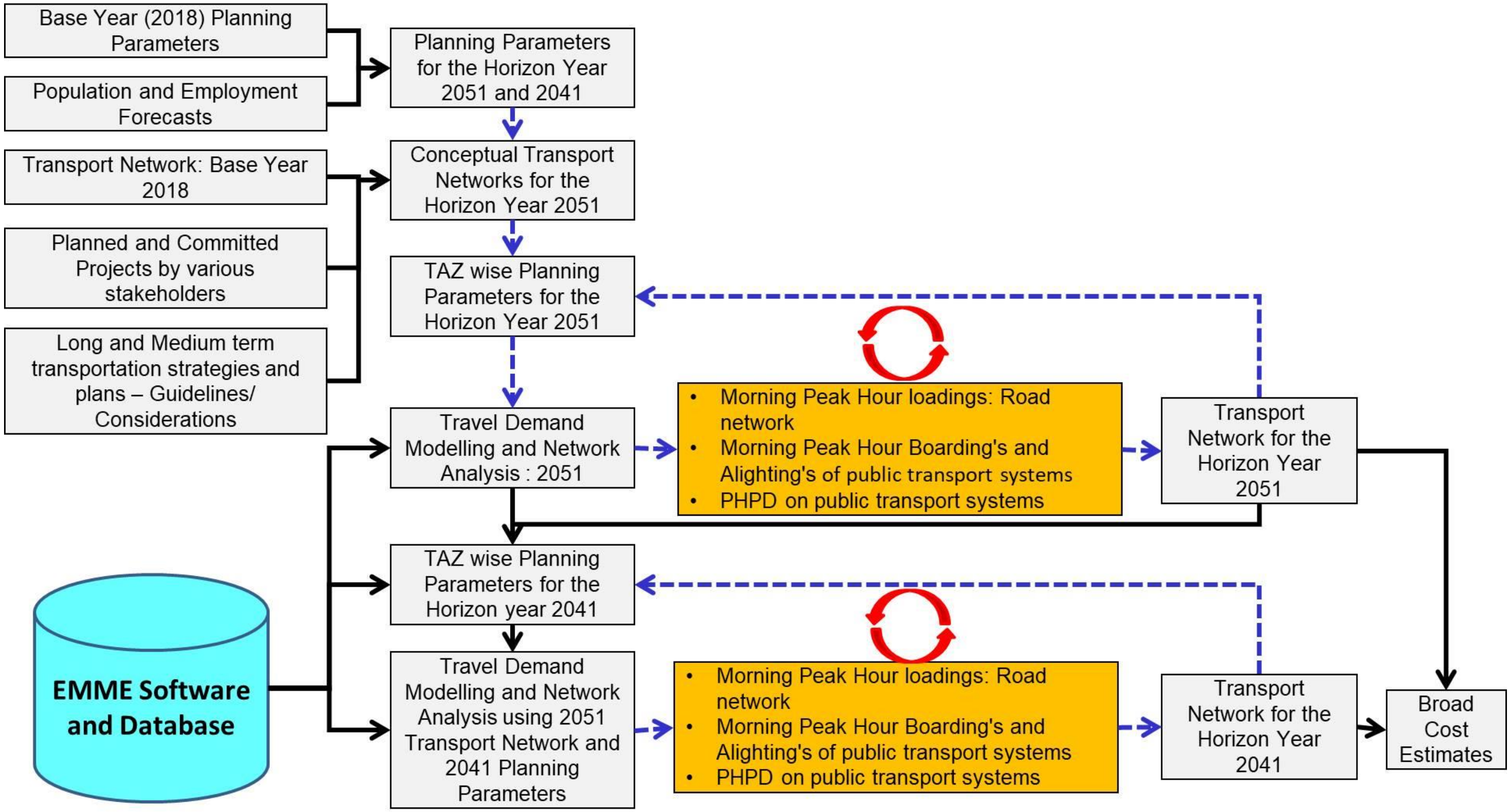


Figure 16-10: Approach and Method for Travel Demand Forecast and Network Analysis for Draft Master Plan

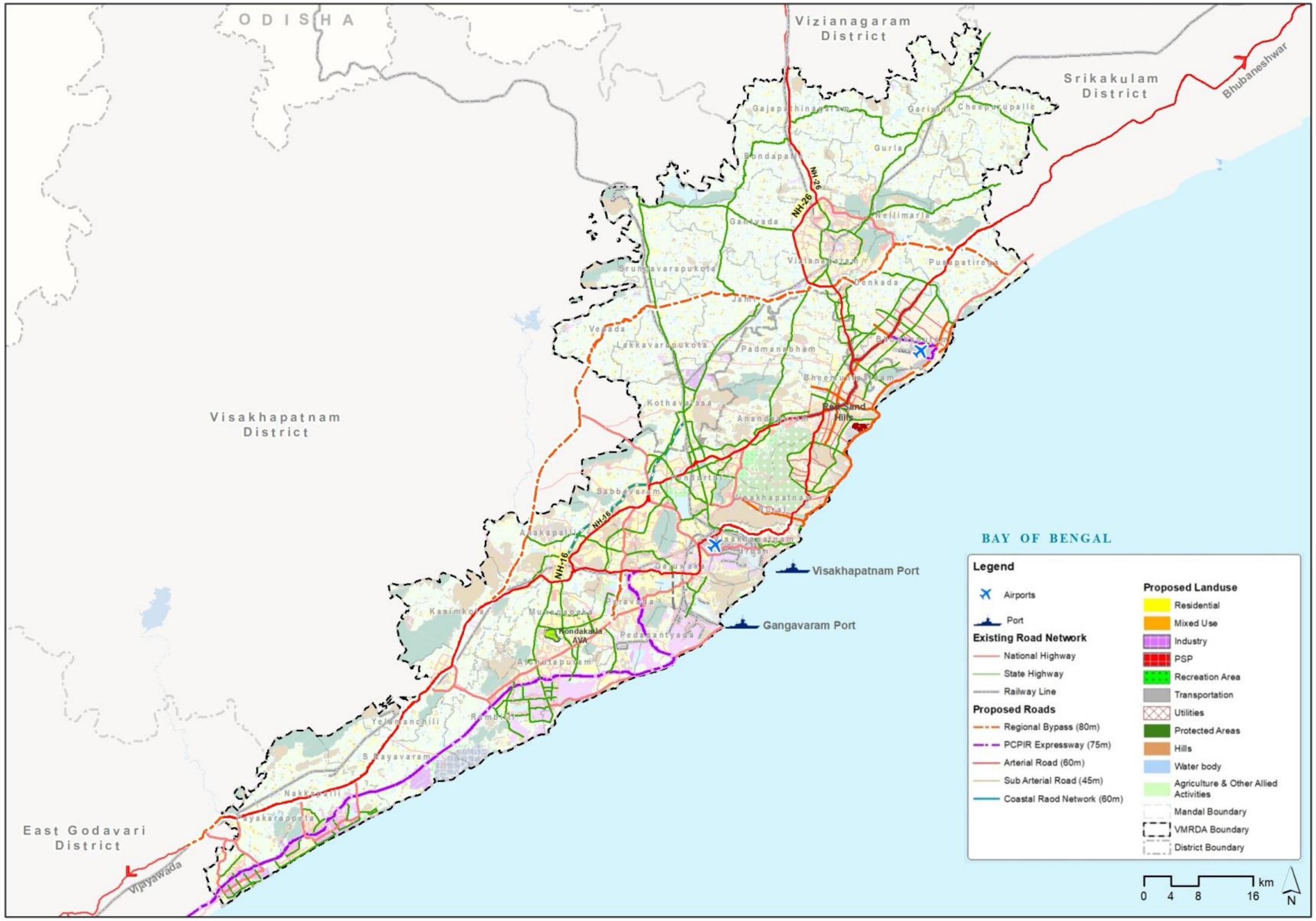


Figure 16-11: Conceptual Transport Network for VMR for the Horizon Year 2051 Transport Network Analysis

16.5.1 TRAVEL DEMAND MODELING AND TRANSPORT NETWORK ANALYSIS FOR HORIZON YEAR 2041

Travel demand models (i.e. trip generation and attraction equations, distribution equations and mode choice equations) purpose wise and mode wise travel demand for the entire VMR for the Horizon Year 2051 has been estimated based on the calibrated models developed. Purpose wise and mode wise internal passenger travel demand for VMR for the horizon year 2041 in terms of number of trips per day and shares are presented in Table 16-4 and Table 16-5 respectively. Summary of the estimated travel passenger demand by vehicle type wise, GVMC-GVMC, GVMC-RoVMR, RoVMR-GVMC and RoVMR-RoVMR for daily of Horizon Year 2041 is presented in Table 16-6.

Table 16-4: Purpose wise and Mode wise Internal Passenger Travel Demand in no. of trips for the Horizon Year 2041

Mode/Purpose	No. of Trips_2041				
	HBW	HBE	HBO	NHB	Total
Car	213,873	146,144	80,293	8,131	448,441
Two-Wheeler	706,948	558,721	250,811	24,782	1,541,262
Auto Rickshaw	1,568,260	810,747	558,727	927	2,938,661
Taxi	631,061	54,106	29,140	20,684	734,991
Bus	273,063	1,368,770	206,929	4,338	1,853,100
Metro	2,981,810	202,531	183,735	3,260	3,371,336
Train	62,245	24,719	19,282	1,040	107,286
Total	6,437,260	3,165,738	1,328,917	63,162	10,995,077
%	58.5%	28.8%	12.1%	0.6%	100%

HBW: Home Based Work; HBE: Home Based Education, HBO: Home Based Other and NHB: Non-Home Based

Table 16-5: Purpose wise and Mode wise Internal Passenger Travel Demand in % for the Horizon Year 2041

Mode/Purpose	No. of Trips_2041				
	HBW	HBE	HBO	NHB	Total
Car	3.3%	4.6%	6.0%	12.9%	4.1%
Two-Wheeler	11.0%	17.6%	18.9%	39.2%	14.0%
Auto Rickshaw	24.4%	25.6%	42.0%	1.5%	26.7%
Taxi	9.8%	1.7%	2.2%	32.7%	6.7%
Bus	4.2%	43.2%	15.6%	6.9%	16.9%

Metro	46.3%	6.4%	13.8%	5.2%	30.7%
Train	1.0%	0.8%	1.5%	1.6%	1.0%
Total	100%	100%	100%	100%	100%

Table 16-6: Passenger Travel Demand (Daily trips) – Horizon Year 2041

Mode	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total
Car	239,601	39,045	31,633	138,161	448,440	7.7%	3.1%	1.8%	2.8%	4.1%
Two-Wheeler	627,941	116,471	164,108	632,742	1,541,262	20.3%	9.2%	9.3%	13.0%	14.0%
Auto Rickshaw	968,315	220,248	371,620	1,378,476	2,938,659	31.3%	17.4%	21.0%	28.3%	26.7%
Taxi	125,519	86,033	188,241	335,105	734,898	4.1%	6.8%	10.6%	6.9%	6.7%
Bus	433,848	273,648	387,301	758,397	1,853,194	14.0%	21.6%	21.9%	15.6%	16.9%
Metro/ metrolite/LRT	683,893	517,182	586,693	1,583,568	3,371,336	22.1%	40.9%	33.2%	32.5%	30.7%
Train	13,042	13,374	38,691	42,179	107,286	0.4%	1.1%	2.2%	0.9%	1.0%
Total	3,092,159	1,266,001	1,768,287	4,868,628	10,995,075	100.0%	100.0%	100.0%	100.0%	100.0%
Car	53.4%	8.7%	7.1%	30.8%	100.0%					
Two-Wheeler	40.7%	7.6%	10.6%	41.1%	100.0%					
Auto Rickshaw	33.0%	7.5%	12.6%	46.9%	100.0%					
Taxi	17.1%	11.7%	25.6%	45.6%	100.0%					

Bus	23.4%	14.8%	20.9%	40.9%	100.0%
Metro	20.3%	15.3%	17.4%	47.0%	100.0%
Train	12.2%	12.5%	36.1%	39.3%	100.0%
Total	28.1%	11.5%	16.1%	44.3%	100.0%

The following inferences have been made:

a) Daily motorised travel demand in VMR is 10.99 million compared to 4 million of Base year 2018, thus there is an increase of 2.74 times;

b) HBW and HBE are the dominant purposes with 58.5% and 28.8% respectively followed by HBO and NHB with 12.1% and 0.6% respectively;

c) The mode-split of trips within VMR indicate that, the major modes are metro/ metrolite/ LRT (30.7%), Auto Rickshaw (26.7%) followed by Bus with 16.9%; and

d) Public transport share i.e. trips by bus, metro/metrolite/LRT and train (as main mode) is about 48.5% compared to 25.1% observed in Base Year 2018. It is pertinent to mention here that, higher level of public transport share can be achieved through proposed expansion of bus route network, proposed metro/ metrolite/ LRT transport network and proposed suburban train corridors. Overall IPT and Private vehicles shares are about 33.4% and 18.1% respectively.

Goods traffic movement within the GVMC as well as it's interaction with rest of the VMR and country needs to be modeled as part of the overall travel demand modeling for Horizon Year 2041. Travel demand for the for the Horizon Year 2041 has been estimated and summary of the estimated daily goods vehicle travel demand of goods trips by vehicle type, GVMC-GVMC, GVMC-RoVMR, RoVMR-GVMC and RoVMR-RoVMR for the Horizon Year 2041 is presented in Table 16-7. The following inferences can be made from the results:

a) Daily vehicle trips within VMR in the Horizon Year 2041 is 42,973 compared to 24,538 observed in the Base year 2018, thus there is an increase of 1.75 times; and

b) The mode-split of trips of the Horizon Year 2041 within GVMC indicate that, the major mode is LCV with nearly 50.8% followed by MAV (22.3%), 3 Axle (18.9%) and the rest is by 2 Axle (8.0%).

Table 16-7: Goods Travel Demand (in vehicles trips) – Horizon Year 2041

Mode	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total
LCV	5,554	4,697	4,497	3,807	18,555	50.8 %	43.0%	39.0 %	39.7 %	43.2 %
2 Axle	879	2,252	1,936	1,126	6,193	8.0%	20.6%	16.8 %	11.7 %	14.4 %

Mode	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total
3 Axle	2,073	2,133	2,303	2,069	8,578	18.9%	19.5%	20.0%	21.6%	20.0%
MAV	2,437	1,836	2,793	2,581	9,647	22.3%	16.8%	24.2%	26.9%	22.4%
Total	10,943	10,918	11,529	9,583	42,973	100.0%	100.0%	100.0%	100.0%	100.0%
LCV	29.9%	25.3%	24.2%	20.5%	100.0%					
2 Axle	14.2%	12.1%	10.4%	6.1%	33.4%					
3 Axle	24.2%	11.5%	12.4%	11.2%	46.2%					
MAV	25.3%	9.9%	15.1%	13.9%	52.0%					
Total	25.5%	25.4%	26.8%	22.3%	100.0%					

Horizon year 2041 travel desires – passenger travel by car, two-wheeler, auto, taxi, bus, metro and train are shown in Figure 16-12. External travel by passenger vehicles (excluding bus), Bus and goods vehicles forecasted by using econometric method is presented in Figure 16-13, Figure 16-14 and Figure 16-15 respectively. A snap shot of the daily and peak hour assigned traffic flows in the Base Year (2018) expressed in PCUs are presented in Figure 16-16 and Figure 16-17 respectively. Level of Service on road network is presented in Figure 16-18. A snapshot of the daily and peak hour Bus passenger flows on the road network is shown in Figure 16-19 and Figure 16-20 respectively. Looking at the level of service offered by the road network with the proposed road network and public transport systems, the road network is operating at very good level of service. Looking at the transit assignment loadings, proposed BRTS corridors and metro/ metrolite/ LRT corridors are getting reasonably good passenger loadings and they needs to be implemented in a phased manner by 2041. In case of sub-urban train system, the passenger loadings are relatively low and shuttle services by making use of existing inter-city railway tracks wherever feasible can be considered and later full-fledged sub-urban rail system needs to be operated by 2051 with dedicated tracks. Above network analysis has been carried out for Horizon Year (2041), considering the erstwhile VMR as explained above. Updating the same considering the revised study area of 4873.35 sqkm, it will not much affect the calibration of travel demand models. However, the Horizon Year (2041) travel demand for the revised study area is expected to be lower which is estimated is about 3.2 millions/day. Considering the revised area of 4873.38 sqkm, as it will not much affect the calibration of travel demand models, Horizon Year travel demand for the revised study area is updated and expected to be 8.9 millions/day.

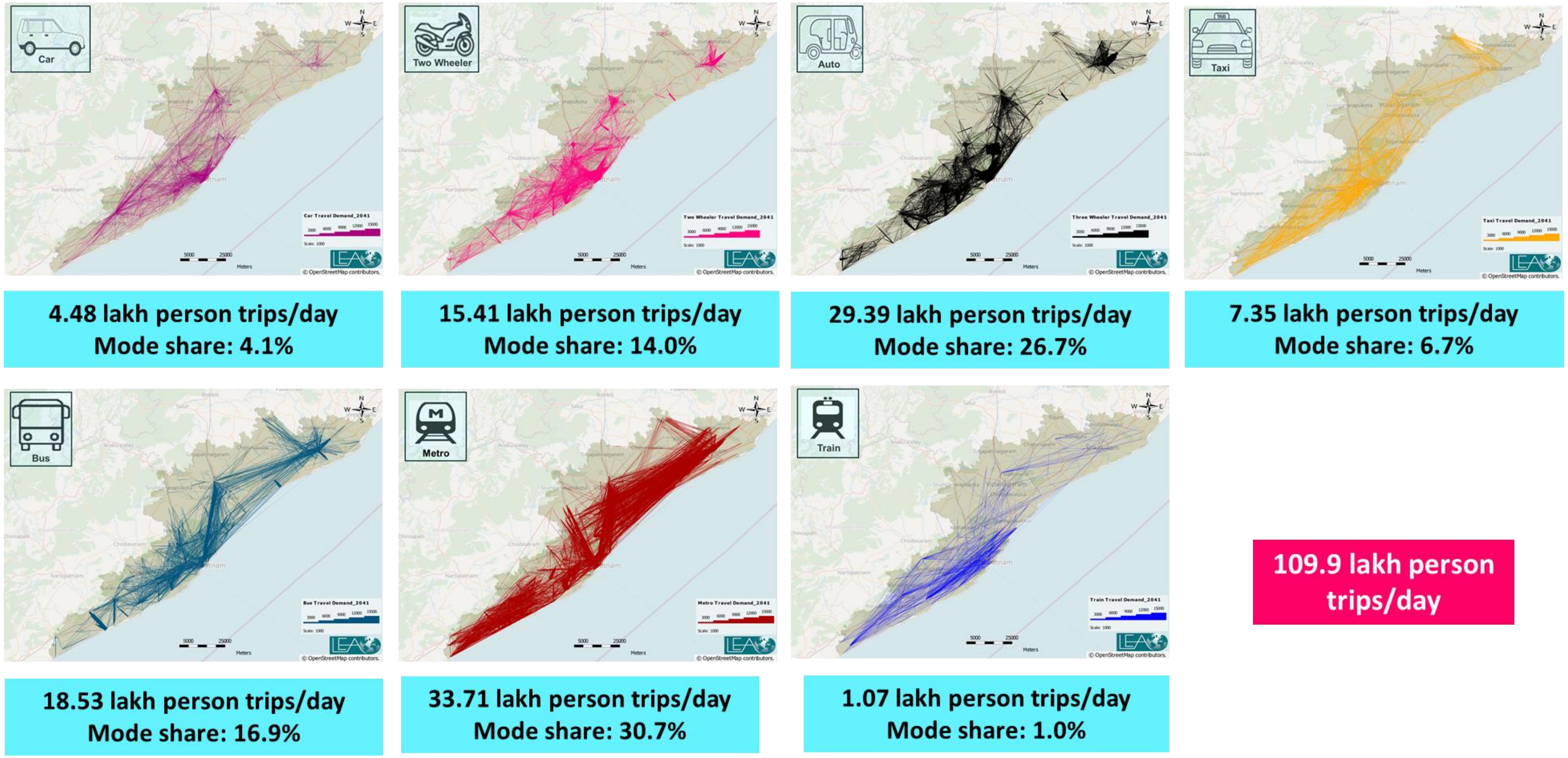


Figure 16-12: Horizon Year 2041 Travel Desires – Internal Travel by Passenger Vehicles

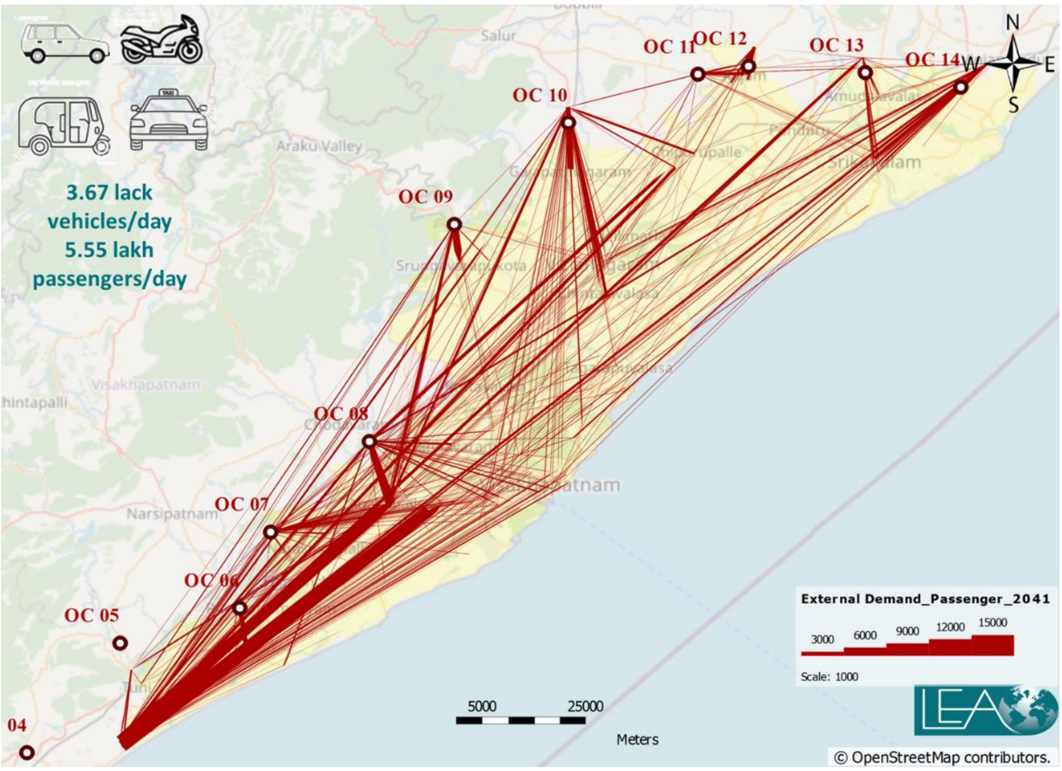


Figure 16-13: Horizon Year 2041 Travel Desires – External Travel by Passenger Vehicles (Excluding Bus)

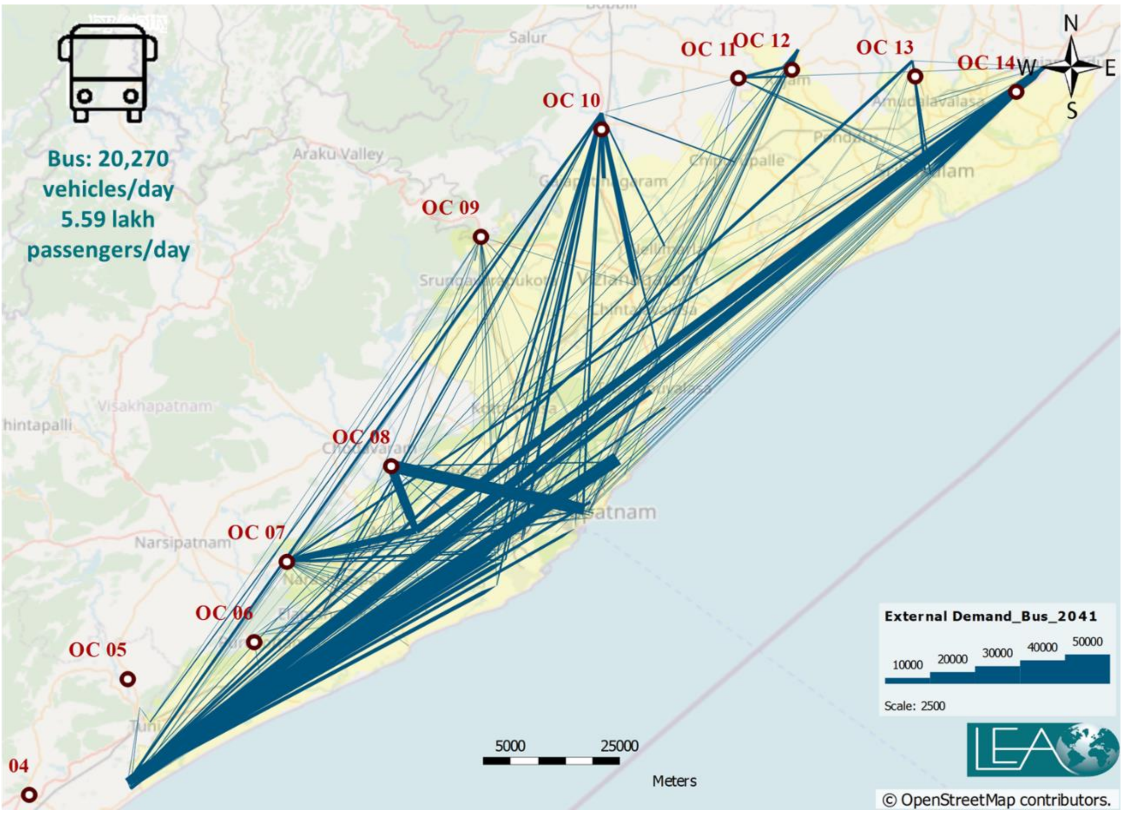


Figure 16-14: Horizon Year 2041 Travel Desires – External Travel by Bus

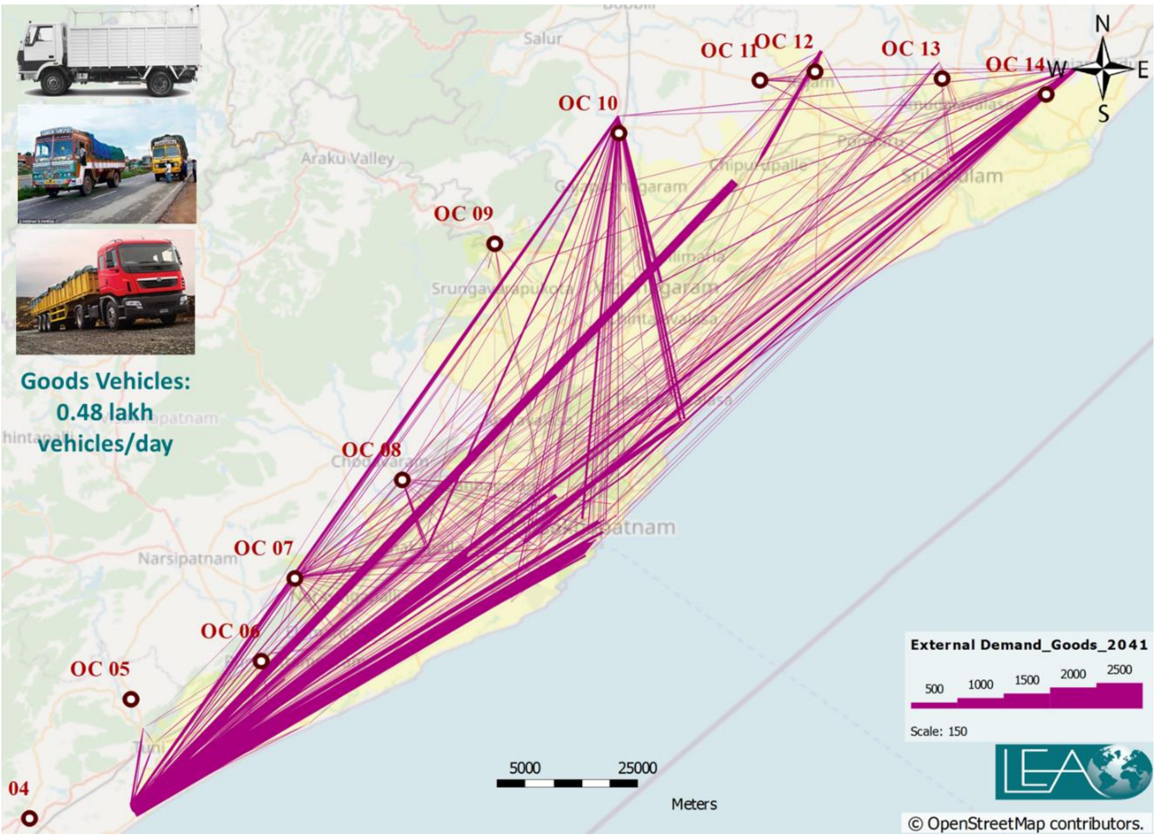


Figure 16-15: Horizon Year 2041 Travel Desires – External Travel by Goods Vehicles

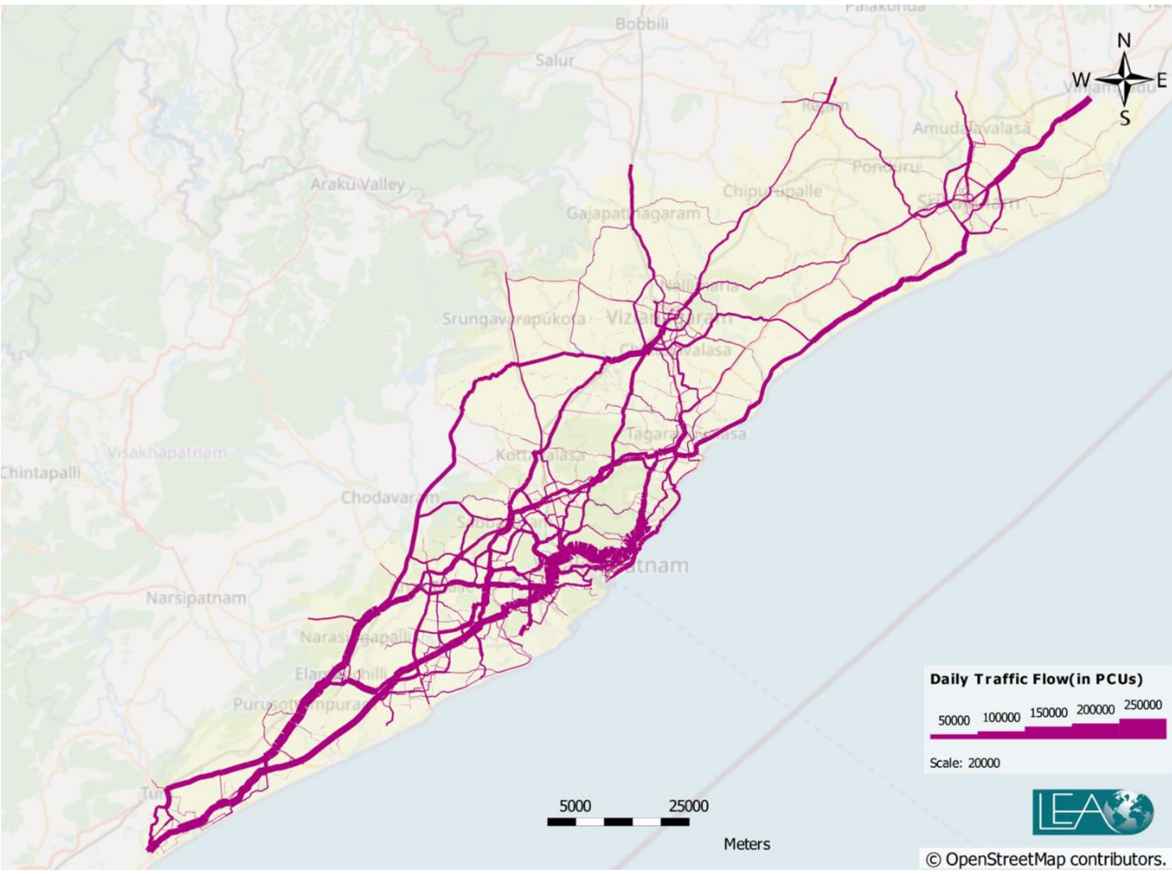


Figure 16-16: Daily Assigned Traffic flows on Road Network in the Horizon Year 2041

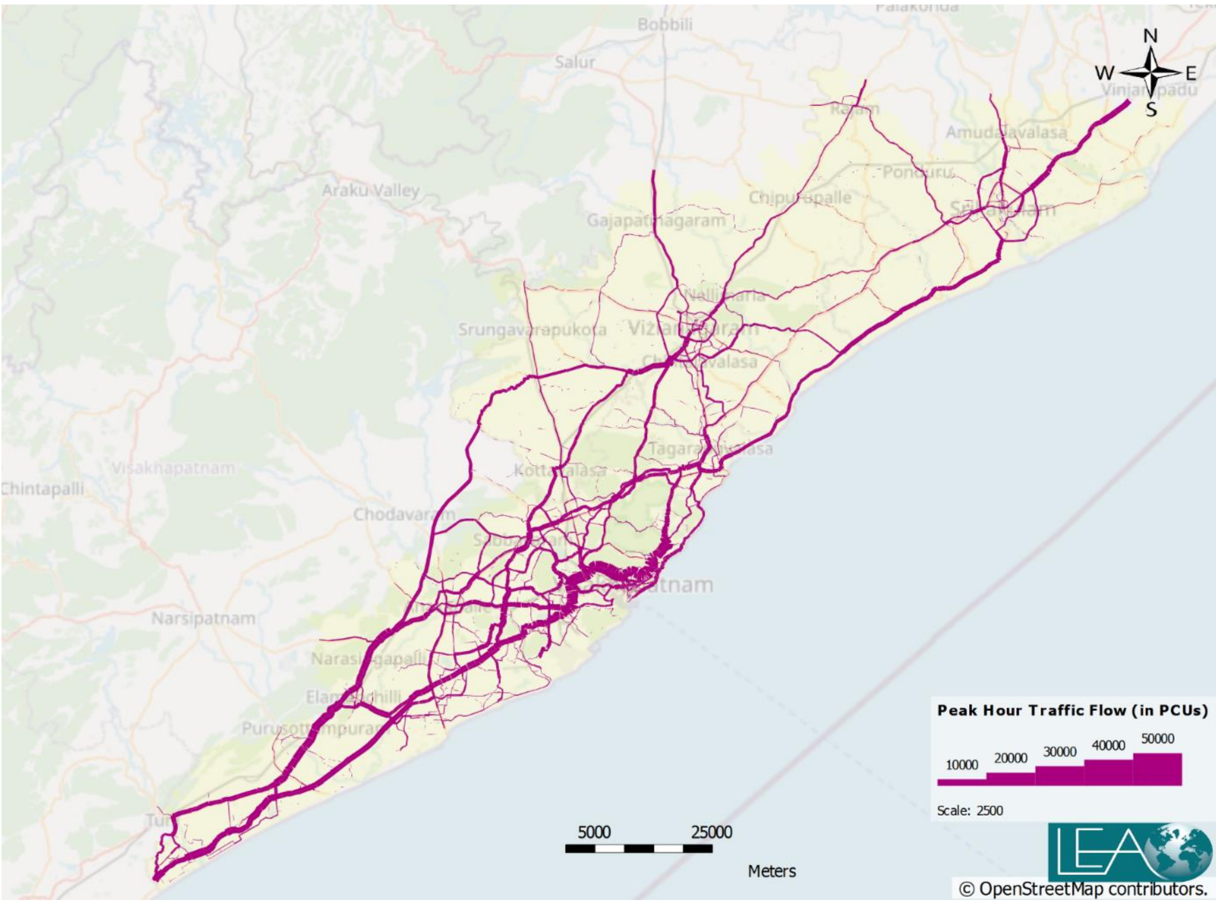


Figure 16-17: Peak Hour Assigned Traffic flows on Road Network in the Horizon Year 2041

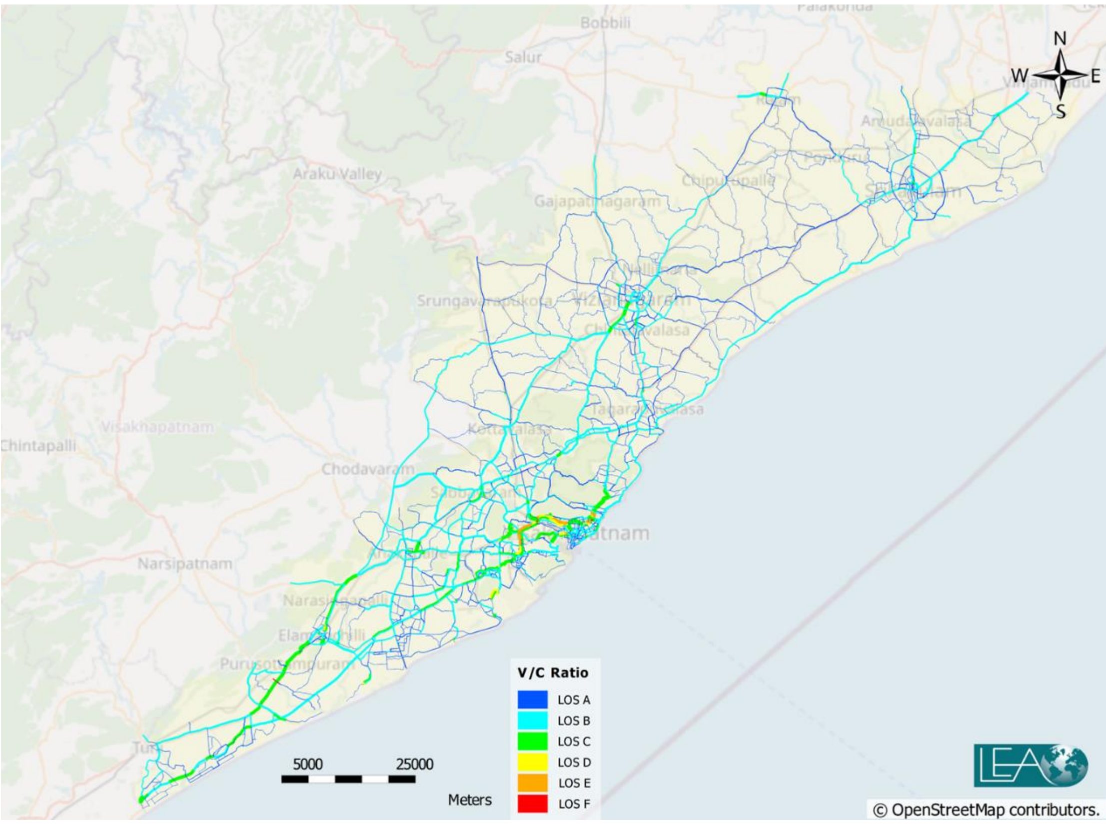


Figure 16-18: Level of Service on Road Network in the Horizon Year 2041

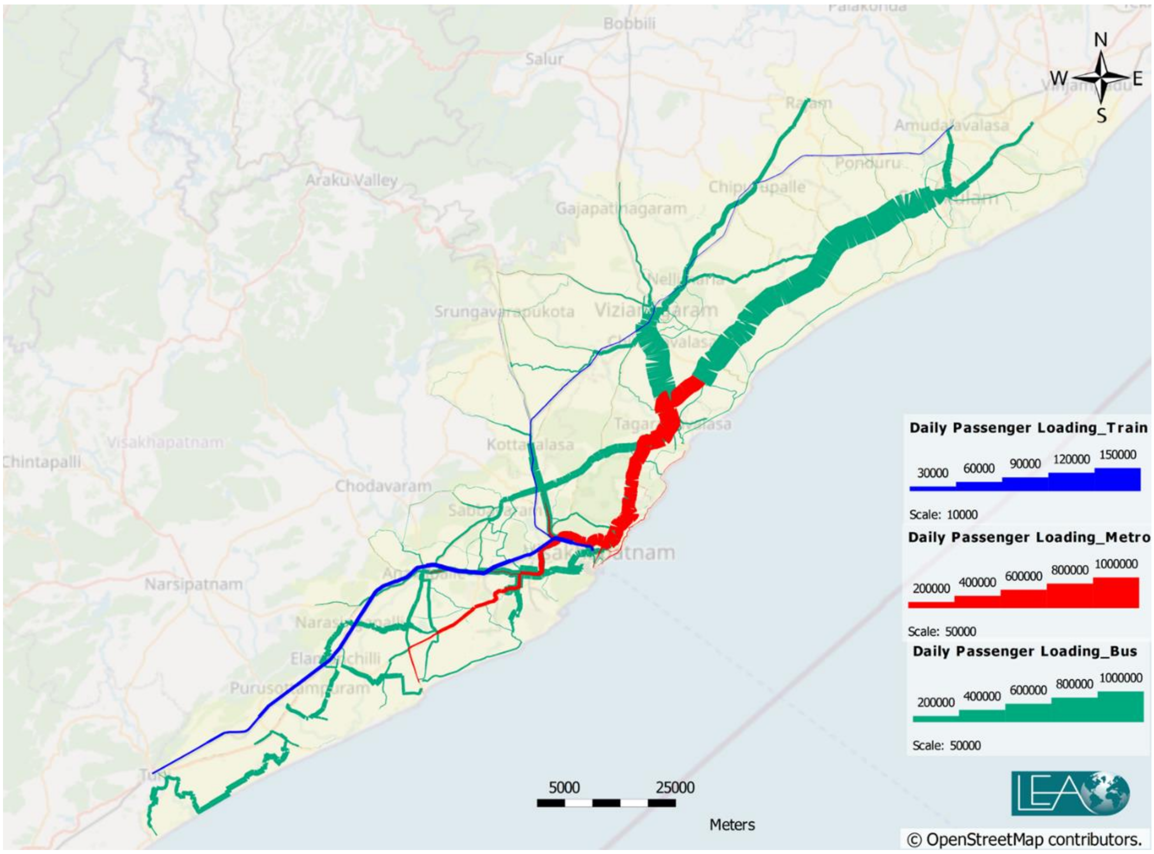


Figure 16-19: Daily Assigned Transit Passenger Flows in the Horizon Year 2041

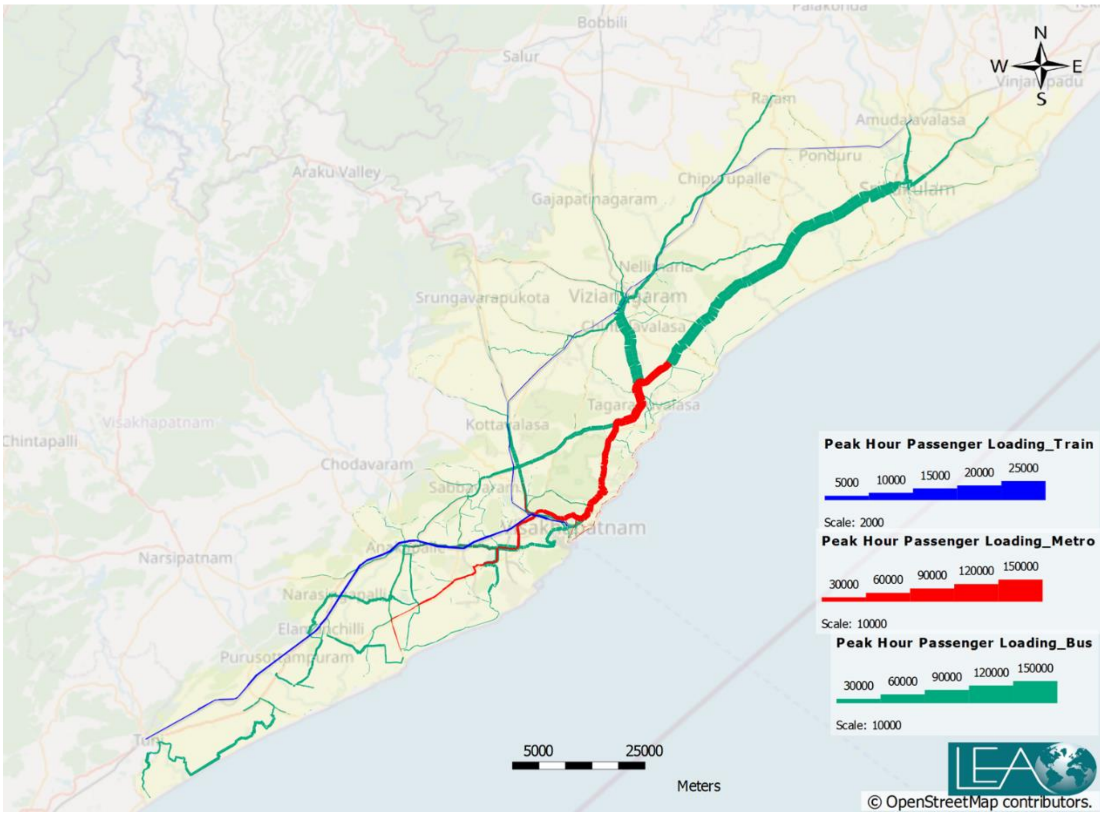


Figure 16-20: Peak Hour Assigned Transit Passenger Flows in the Horizon Year 2041

16.5.2 PROPOSED TRANSPORT NETWORK FOR THE HORIZON YEAR 2041

Carriageway requirements for each of the proposed road links for the horizon year 2051 and 2041 has been assesed based on the travel demand modeling and transport network analysis as described in the above sections. Above analysis is carried out for erstwhile VMRDA area, considering the revised area the travel demand is arrived. However, proposals are recommended based on revised VMR of 4873.35 sqkm. As part of the Master Plan preparation, transport sector plan is further prepared considering the travel demands by motorised travel, non-motorised travel, etc. and accordingly RoWs for each road links is proposed for the horizon year 2041. Proposed transport network for the horizon year 2041 is presented in Figure 16-21. Salient features of the proposed transport are as follows:

a) Travel demand modeling and transport network analysis carried out for the base year (2018) and horizon year (2041) indicates that, additional road network length of about 1,156 km and widening of existing roads to the tune of 1,200 km is required. Considering widening of existing roads and new roads, the additional network length would be 14,000 lane-km for the horizon period upto 2041;

b) To promote public transport in VMR, extensive bus route network covering major road network, major origin and destinations is proposed for the horizon period upto 2041. It is recommended that, as the road network is expanded, bus route system needs to be expanded. It is expected that, travel demand by bus is expected increase from 9.58 lakh/day (2018) to 18.53 lakhs/day. Bus fleet procurement and bus terminals/ depots are proposed to keep pace with the demand;

c) Potential corridors for BRTS is identified based on bus passenger demand for the horizon year 2041. Additional corridors proposed for BRTS is about 122 km (Anandapuram to Anakapalli: 47.8 km; Penduthri to Kothavalasa: 8.5 km; Vizianagaram to Thagarapuvalasa: 14.3 km and Bhogapuram to Pydibheemavaram: 22.2 km). Benchmarking studies on BRTS studies/ projects (International and National) are presented in Appendix L. It would be prudent to further carryout feasibility studies for the same;

d) Metro/ metrolite/ LRT / Tram network along the existing/ proposed roads is proposed for a length of 175 km;

e) MTS/ Suburban services are proposed along the existing inter-city railway lines (Tuni to Duvvada (SCR): 79.5; Duvvada to Vizianagaram (ECoR): 64.49 km and Kothavalasa to Srungavarapukota (ECoR): 26 km) length of which is about 170.0 km. It is recommended to start shuttle services by 2041 by making use of existing inter-city railway tracks wherever feasible and later full-fledged sub-urban rail system needs to be operated by 2051 with dedicated tracks. It would be prudent to further carryout feasibility studies for the same.

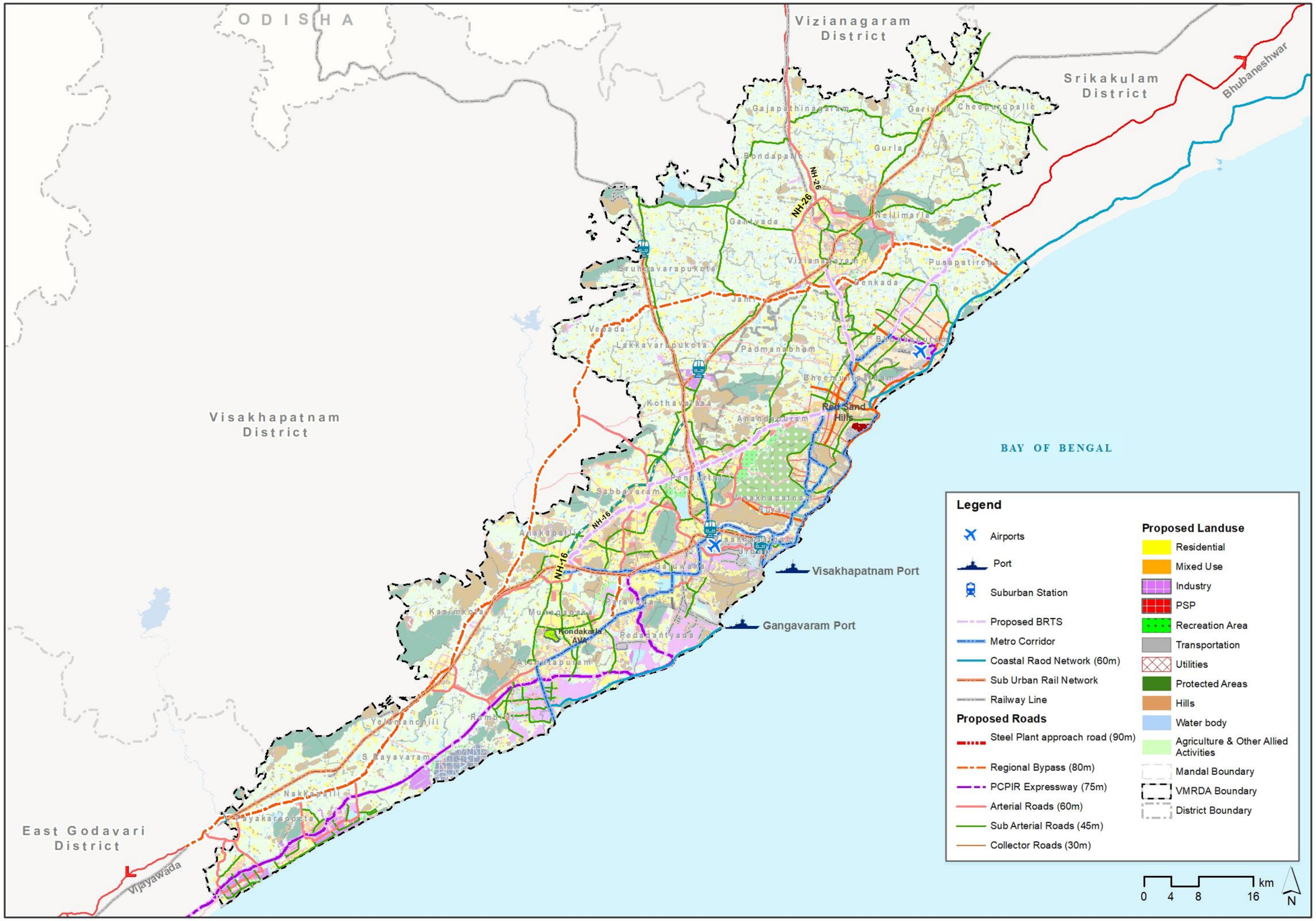


Figure 16-21: Proposed Transport Network for the Horizon Year 2041

16.5.3 PROPOSED TERMINALS

16.5.3.1 Inter City Bus Terminals/ Inter State Bus Terminals

There are 4,900 buses per day are coming from various places from outside of VMR entering daily. All these buses come to various bus stands in the VMR viz., Visakhapatnam, Vizianagaram, Anakapalli and S.Kota Bus Stands. With the increase in travel demand and increase in passenger trips, additional intercity terminals are required to cater horizon year demand. These interstate and intercity buses can be stopped outside of the respective areas by providing Inter City Bus Terminals (ICBTs) on all the routes. Route wise estimated bus trips and Passenger trips for the period upto 2051 are presented in Table 16-8 and Table 16-9 respectively.

Table 16-8: Route wise projected Bus trips for 2051

	2018		2031		2041		2051	
Location Name	ENTRY	EXIT	ENTRY	EXIT	ENTRY	EXIT	ENTRY	EXIT
OC-4,NH-16 (Near Sitampeta)	720	761	944	998	1,150	1,216	1,397	1,476
OC-5,Tuni-Narsipatnam road, D Polavaram	111	107	126	122	140	135	154	149
OC-6,Narsipatnam-Darlapudi Road	23	23	36	36	50	50	68	68
OC-7,Narsipatnam-Anakapalli Road	186	185	225	224	258	257	295	294
OC-8,Chodavaram - Anakapalli Road	316	291	330	304	341	314	353	325
OC-9,SH 39, North of Bowdara Junction	59	59	83	83	106	106	136	136
OC-10,Jeypore - Vizianagaram Rd	296	298	444	447	597	601	803	808
OC-11,SH 36, Rambhadrapuram - Rajam Road	123	103	185	155	249	209	336	282
OC-12,Rajam-Palakonda Road	179	179	260	260	342	342	450	450
OC-13,SH-37, Palakonda - Srikakulam Road	81	79	124	121	169	165	232	226
OC-14,NH-16 (Near Parlakhemundi Junction)	361	364	520	525	680	686	891	898
Total Buses	2,455	2,449	3,277	3,273	4,084	4,081	5,115	5,112

Table 16-9: Route wise projected Passenger trips for 2051

	2018		2031		2041		2051	
Location Name	ENTRY	EXIT	ENTRY	EXIT	ENTRY	EXIT	ENTRY	EXIT
OC-4,NH-16 (Near Sitampeta)	11,220	11,786	18,759	19,705	27,488	28,874	39,282	41,263
OC-5,Tuni-Narsipatnam road, D Polavaram	2,238	2,535	3,641	4,124	5,223	5,916	7,309	8,278
OC-6,Narsipatnam-Darlapudi Road	166	230	311	431	493	683	753	1,043
OC-7,Narsipatnam-Anakapalli Road	4,255	4,361	6,801	6,971	9,610	9,850	13,193	13,522
OC-8,Chodavaram - Anakapalli Road	2,682	4,240	3,935	6,222	5,216	8,246	6,742	10,658
OC-9,SH 39, North of Bowdara Junction	1,554	1,153	2,691	1,996	4,055	3,009	5,962	4,423
OC-10,Jeypore - Vizianagaram Rd	6,250	10,471	11,283	18,902	17,529	29,368	26,515	44,422
OC-11,SH 36, Rambhadrapuram - Rajam Road	2,255	1,951	4,072	3,523	6,339	5,485	9,620	8,323
OC-12,Rajam-Palakonda Road	4,552	3,727	8,064	6,602	12,370	10,128	18,483	15,133
OC-13,SH-37, Palakonda - Srikakulam Road	1,840	1,771	3,356	3,230	5,265	5,068	8,060	7,757
OC-14,NH-16 (Near Parlakhemundi Junction)	4,668	5,280	8,223	9,301	12,551	14,196	18,693	21,144
Total Passengers	41,680	47,505	71,135	81,007	106,140	120,823	154,610	175,967

Presently the bus stands are congested with present demand and needs to be upgraded with world class facilities to meet the future needs particularly on special occasions.

As per past experiences of the consultant the standards considered for estimating the terminal demand are one inter-city Bus Terminal for 0.5 lakh passengers/ day and area requirement of 3 hectares per unit.

For a population of 8.3 million and 10,000 bus trips (2051), expected number of bus passenger-trips comes out to be around 3.3 lakhs per day. Currently there are 4 nos. of existing bus terminals facilitating inter-state buses. For 2051, additional 3 nos. of bus terminals will be required for horizon year demand. Proposed ICBT Locations and Land Requirements for the Horizon Period upto 2051 are presented in Table 16-10 and the ICBT locations are shown in Figure 16-22.

Table 16-10: Proposed ICBT Locations, Land Requirements and Proposed area for the Horizon Period upto 2051

Sl. No.	ICBT Locations	Required Area (in ha)	Proposed Area (in ha)	Remarks
1	Akkireddypalem	3	14	ICBT & Depot
2	Anandapuram	3	8	ICBT & Depot
3	VT Agraharam, Vizianagaram	3	13	ICBT & Depot

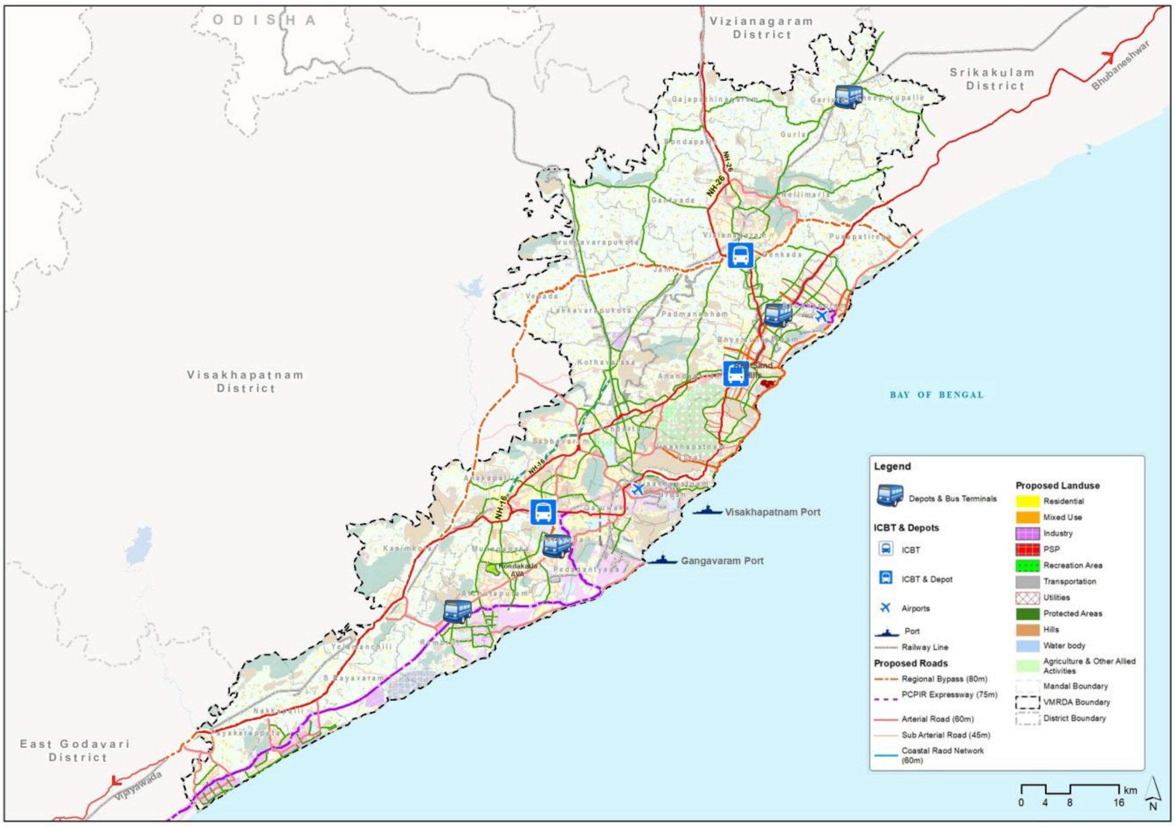


Figure 16-22: Proposed Locations for Inter City Bus Terminals (ICBTs) for the Horizon Period upto 2051

16.5.3.2 Intra-city Bus Terminals and Depots

For Intra-city movement of bus passengers, bus terminals have been proposed in VMR. The details of bus terminals and their respective depots are presented in Table 16-11.

Table 16-11: Proposed Intra-city Bus Terminals & Depots

Sl. No.	Locations	Proposed Area (in ha)	Remarks

1.	Atchuthapuram	3	Bus Terminal & Depot
2.	Cheepurupalli	3	Bus Terminal & Depot
3.	Parawada	3	Bus Terminal & Depot

16.5.3.3 Major Truck Terminals/ Logistic Parks

A truck terminal is an intermittent rest area with in-built facilities caters to long and short haul goods vehicles passing through highways. These truck terminals are required for the efficient movement of freight vehicles within the VMR so that congestion is limited. Truck Terminals need to be provided near various sensitive areas which attract heavy vehicles and also at the outskirts. Classified traffic volume count and OD surveys of commercial vehicles carried out at Outer Cordon locations and forecasts of intercity travel by bus warrants for truck terminals in VMR. The identified locations for truck terminals are mentioned in the following section.

There is a huge truck movement in VMR and due to presence of Visakhapatnam Port Trust, Gangavaram Port, Steel Plant, NTPC and various major industries, where most of the truck movement is destined to these facilities. Approximately, equal share of entry and exit of goods traffic is observed with highest share is observed at OC-4 at Payakaraopeta location on NH-16 with 42% followed by OC-14 near Parlakhemudi Junction near Narasannapaeta with 21%.In terms of tonnage, the highest share is observed at OC-4 at Payakaraopeta location on NH-16 with an 14,221 tons followed by OC-14 near Parlakhemudi Junction near Narasannapaeta with 7,026 tons. For the estimated trucks for 2051, the land requirement for major truck terminals is 150 hectares in 2051 is given in Table 16-12 and the locations for these proposed Truck Terminals shown in Figure 16-23. Additional to these 50 hectares of minor truck terminals are required to facilitate goods movement within VMR for various industrial purposes. 25 hectares of the land is required for each of these Proposed Minor Truck Terminals in VMR for 2051 are estimated in Table 16-13and locations for these terminals are shown in Figure 16-23. Further project preparatory works needs to be carried out for timely implementation of the proposed truck terminals.

Table 16-12: Proposed Major Truck Terminals and Land requirements for 2051

Sl. No.	Road	VMR Region Destined Trucks in 2051	Tonnes	Land Area Required in ha	Proposed Area in ha	Proposed Major Truck Terminal Location
1.	OC- 4, NH-16 (Near Payakaraopeta)	13,000	35,000	100 ha	100 ha	Logistic Park – near Nakkapalli
2.	OC-11, SH 36, Rambhadrapuram - Rajam Road	10,000	31,000	50 ha	50 ha	MTT 1 – Major Truck Terminal, Gajapathinagaram
3.	OC-12, Rajam-Palakonda Road					

Table 16-13: Proposed Minor Truck Terminals

Sl. No.	Road	Land required in ha	Proposed Minor Truck Terminal Location
1.	OC-5, Tuni-Narsipatnam road, D Polavaram	25	mtt 1-Minor Truck Terminal 1 near EdullaBonangi
2.	OC-6, Narsipatnam-Darlapudi Road		
3.	OC-7, Narsipatnam-Anakapalli Road		
4.	OC-8, Chodavaram - Anakapalli Road		
5.	OC-9, SH 39, North of Bowdara Junction	25	mtt 2- Minor Truck Terminal 2 near Mudapaka
6.	OC-10, Jeypore - Vizianagaram Rd		

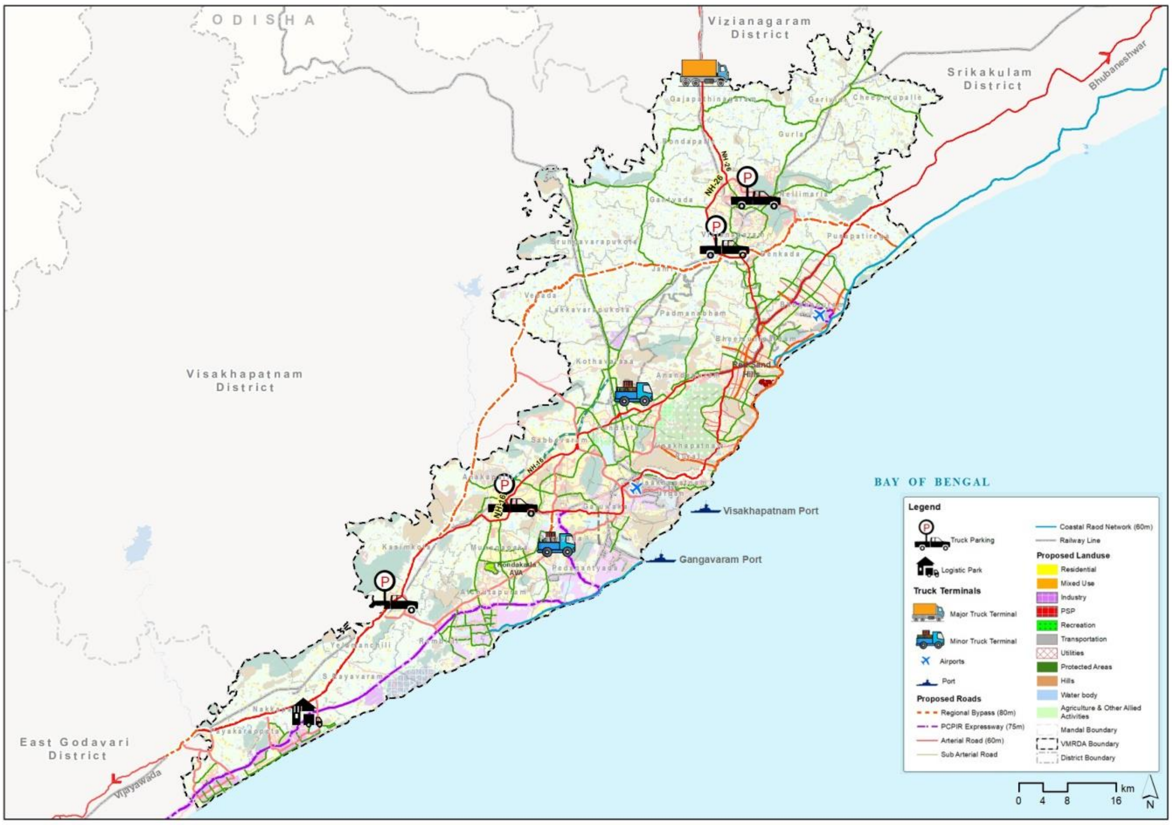


Figure 16-23: Proposed Major and Mini Truck Terminals for the horizon period upto 2051

16.5.4 TRAVEL DEMAND MODELING AND TRANSPORT NETWORK ANALYSIS FOR HORIZON YEAR 2051

Travel demand models (i.e. trip generation and attraction equations, distribution equations and mode choice equations) purpose wise and mode wise travel demand for the entire VMR for the Horizon Year 2051 has been estimated based on the calibrated models developed. Purpose wise and mode wise internal passenger travel demand for VMR for the horizon year 2051 in terms of number of trips per day and shares are presented in Table 16-14 and Table 16-15 respectively. Summary of the estimated passenger travel demand by mode wise, GVMC-GVMC, GVMC-RoVMR, RoVMR-GVMC and RoVMR-RoVMR for daily of Horizon Year 2051 is presented in Table 16-16.

Table 16-14: Purpose wise and Mode wise Internal Passenger Travel Demand in no. of trips for the Horizon Year 2051

Mode/Purpose	No. of Trips_2051				
	HBW	HBE	HBO	NHB	Total
Car	249,976	140,489	89,226	9,659	489,350
Two-Wheeler	749,864	485,882	255,671	26,696	1,518,113
Auto Rickshaw	1,944,230	824,608	601,392	1,152	3,371,382
Taxi	725,636	51,750	31,857	26,923	836,166
Bus	428,902	1,703,750	243,965	6,365	2,382,982
Metro	3,526,940	236,207	215,738	4,680	3,983,565
Train	118,704	18,249	22,547	1,510	161,010
Total	7,744,252	3,460,935	1,460,396	76,985	12,742,568
%	60.8%	27.2%	11.5%	0.6%	100%

HBW: Home Based Work; HBE: Home Based Education, HBO: Home Based Other and NHB: Non-Home Based

Table 16-15: Purpose wise and Mode wise Internal Passenger Travel Demand in % for the Horizon Year 2051

Mode/Purpose	No. of Trips_2051				
	HBW	HBE	HBO	NHB	Total
Car	3.2%	4.1%	6.1%	12.5%	3.8%
Two-Wheeler	9.7%	14.0%	17.5%	34.7%	11.9%
Auto Rickshaw	25.1%	23.8%	41.2%	1.5%	26.5%
Taxi	9.4%	1.5%	2.2%	35.0%	6.6%
Bus	5.5%	49.2%	16.7%	8.3%	18.7%
Metro	45.5%	6.8%	14.8%	6.1%	31.3%
Train	1.5%	0.5%	1.5%	2.0%	1.3%
Total	100%	100%	100%	100%	100%

Table 16-16: Passenger Travel Demand (Daily trips) – Horizon Year 2051

Mode	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total
Car	241,506	40,630	33,017	174,205	489,358	7.3%	2.8%	1.7%	2.9%	3.8%
Two-Wheeler	562,897	107,134	152,422	695,689	1,518,142	16.9%	7.4%	7.9%	11.5%	11.9%
Auto Rickshaw	1,145,390	242,143	359,798	1,624,138	3,371,469	34.4%	16.6%	18.7%	26.9%	26.5%
Taxi	165,726	112,051	190,035	368,314	836,126	5.0%	7.7%	9.9%	6.1%	6.6%
Bus	501,922	363,515	478,920	1,038,349	2,382,706	15.1%	25.0%	24.9%	17.2%	18.7%
Metro/ metrolite/LRT	690,541	568,393	659,856	2,064,874	3,983,664	20.8%	39.1%	34.4%	34.2%	31.3%
Train	19,778	20,750	46,021	74,463	161,012	0.6%	1.4%	2.4%	1.2%	1.3%
Total	3,327,760	1,454,616	1,920,069	6,040,032	12,742,477	100.0%	100.0%	100.0%	100.0%	100.0%
Car	49.4%	8.3%	6.7%	35.6%	100.0%					
Two-Wheeler	37.1%	7.1%	10.0%	45.8%	100.0%					
Auto Rickshaw	34.0%	7.2%	10.7%	48.2%	100.0%					
Taxi	19.8%	13.4%	22.7%	44.1%	100.0%					
Bus	21.1%	15.3%	20.1%	43.6%	100.0%					
Metro	17.3%	14.3%	16.6%	51.8%	100.0%					
Train	12.3%	12.9%	28.6%	46.2%	100.0%					
Total	26.1%	11.4%	15.1%	47.4%	100.0%					

The following inferences have been made:

a) Daily motorised travel demand in VMR is 12.74 million compared to 4 million of Base year 2018, thus there is an increase of 3.17 times;

b) HBW and HBE are the dominant purposes with 60.8% and 27.2% respectively followed by HBO and NHB with 11.5% and 0.6% respectively;

c) The mode-split of trips within VMR indicate that, the major modes are metro/ metrolite/ LRT (31.3%), Auto Rickshaw (26.5%) followed by Bus with 18.7%; and

d) Public transport share i.e. trips by bus, metro/metrolite/LRT and train (as main mode) is about 51.2% compared to 25.1% observed in Base Year 2018. It is pertinent to mention here that, higher level of public transport share can be achieved through proposed expansion of bus route network, proposed metro/ metrolite/ LRT transport network and proposed suburban train corridors. Overall IPT and Private vehicles shares are about 33% and 15.8% respectively.

Goods traffic movement within the GVMC as well as it's interaction with rest of the VMR and country needs to be modeled as part of the overall travel demand modeling for Horizon Year 2051. Travel demand for the for the Horizon Year 2051 has been estimated and summary of the estimated daily goods vehicle travel demand of goods trips by vehicle type, GVMC-GVMC, GVMC-RoVMR, RoVMR-GVMC and RoVMR-RoVMR for the Horizon Year 2051 is presented in Table 16-17. The following inferences can be made from the results:

a) Daily vehicle trips within VMR in the Horizon Year 2051 48,701 compared to 24,538 observed in the Base year 2018, thus there is an increase of 1.98 times; and

b) The mode-split of trips of the Horizon Year 2051 within GVMC indicate that, the major mode is LCV with nearly 50.6% followed by MAV (22.3%), 3 Axle (19.0%) and the rest is by 2 Axle (8.0%).

Table 16-17: Goods Travel Demand (in vehicles trips) – Horizon Year 2051

Mode	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total
LCV	6,279	5,310	5,084	4,304	20,977	50.6%	42.9%	38.9%	39.6%	43.1%
2 Axle	993	2,544	2,187	1,272	6,996	8.0%	20.6%	16.7%	11.7%	14.4%
3 Axle	2,360	2,429	2,622	2,356	9,767	19.0%	19.6%	20.1%	21.7%	20.1%
MAV	2,769	2,086	3,173	2,933	10,961	22.3%	16.9%	24.3%	27.0%	22.5%
Total	12,401	12,369	13,066	10,865	48,701	100.0%	100.0%	100.0%	100.0%	100.0%
LCV	29.9%	25.3%	24.2%	20.5%	100.0%					

Mode	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total	GVMC-GVMC	GVMC-ROVMR	RoVMR - GVMC	RoVMR - RoVMR	Total
2 Axle	14.2%	12.1%	10.4%	6.1%	33.4%					
3 Axle	24.2%	11.6%	12.5%	11.2%	46.6%					
MAV	25.3%	9.9%	15.1%	14.0%	52.3%					
Total	25.5%	25.4%	26.8%	22.3%	100.0%					

Horizon year 2051 travel desires – passenger travel by car, two-wheeler, auto, taxi, bus, metro and train are shown in Figure 16-24. External travel by passenger vehicles (excluding bus), Bus and goods vehicles forecasted by using econometric method is presented in Figure 16-25, Figure 16-26 and Figure 16-27 respectively.

A snap shot of the daily and peak hour assigned traffic flows in the Base Year (2018) expressed in PCUs are presented in Figure 16-28 and Figure 16-29 respectively. Level of Service on road network is presented in Figure 16-30. A snapshot of the daily and peak hour Bus passenger flows on the road network is shown in Figure 16-31 and Figure 16-32 respectively. Looking at the level of service offered by the road network with the proposed road network and public transport systems, the road network is operating at very good level of service. Looking at the transit assignment loadings, proposed BRTS corridors, metro/ metrolite/ LRT corridors and suburban rail corridors are getting reasonably good passenger loadings. Above network analysis has been carried out for Horizon Year (2051), considering the erstwhile VMR as explained above. Updating the same considering the revised study area of 4873.38 sqkm, it will not much affect the calibration of travel demand models. However, the Horizon Year (2051) travel demand for the revised study area is expected to be lower which is estimated is about 3.2 millions/day. Considering the revised area of 4873.38 sqkm, as it will not much affect the calibration of travel demand models, Horizon Year travel demand for the revised study area is updated and expected to be 10.1 millions/day.

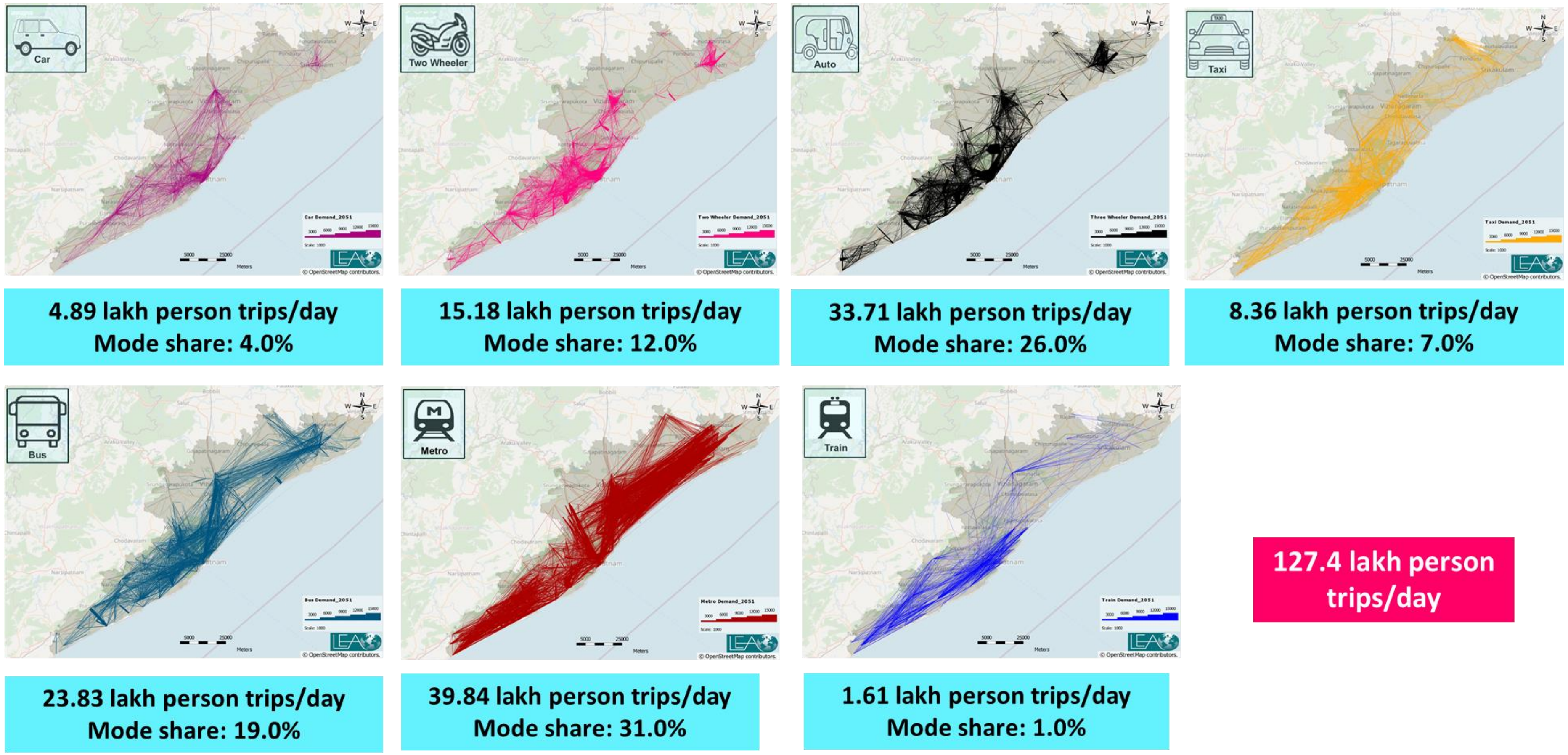


Figure 16-24: Horizon Year 2051 Travel Desires – Internal Travel by Passenger Vehicles

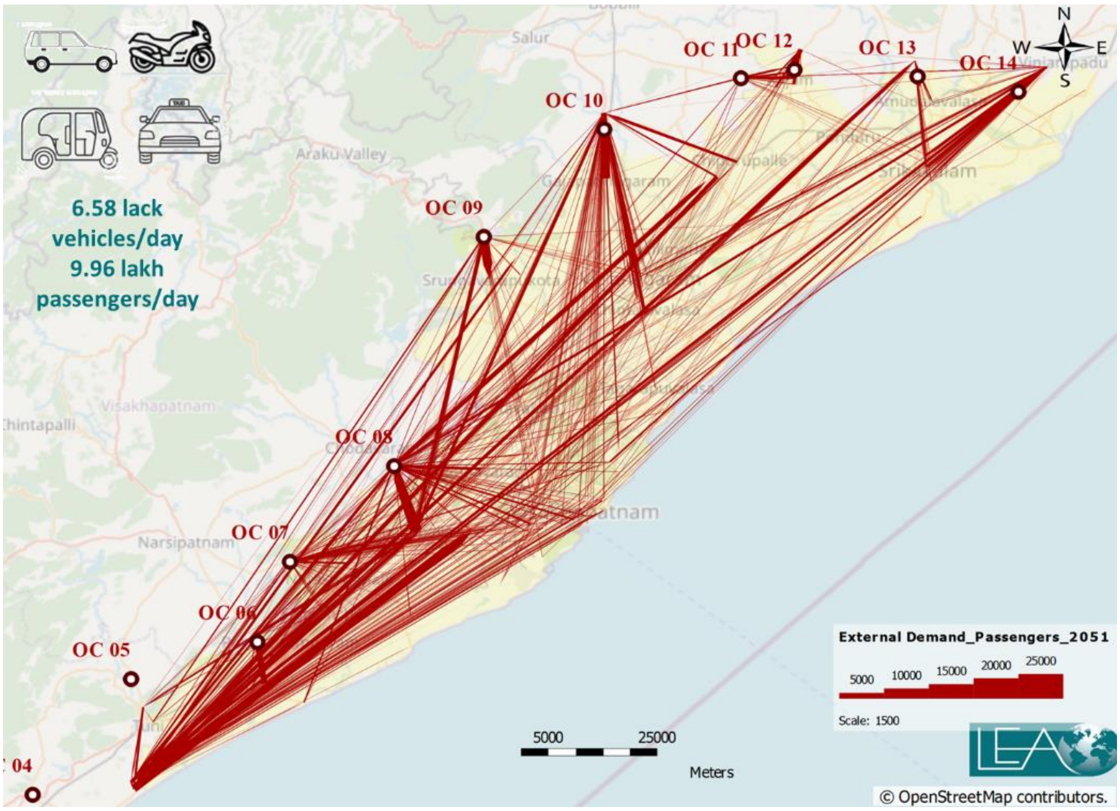


Figure 16-25: Horizon Year 2051 Travel Desires – External Travel by Passenger Vehicles (Excluding Bus)

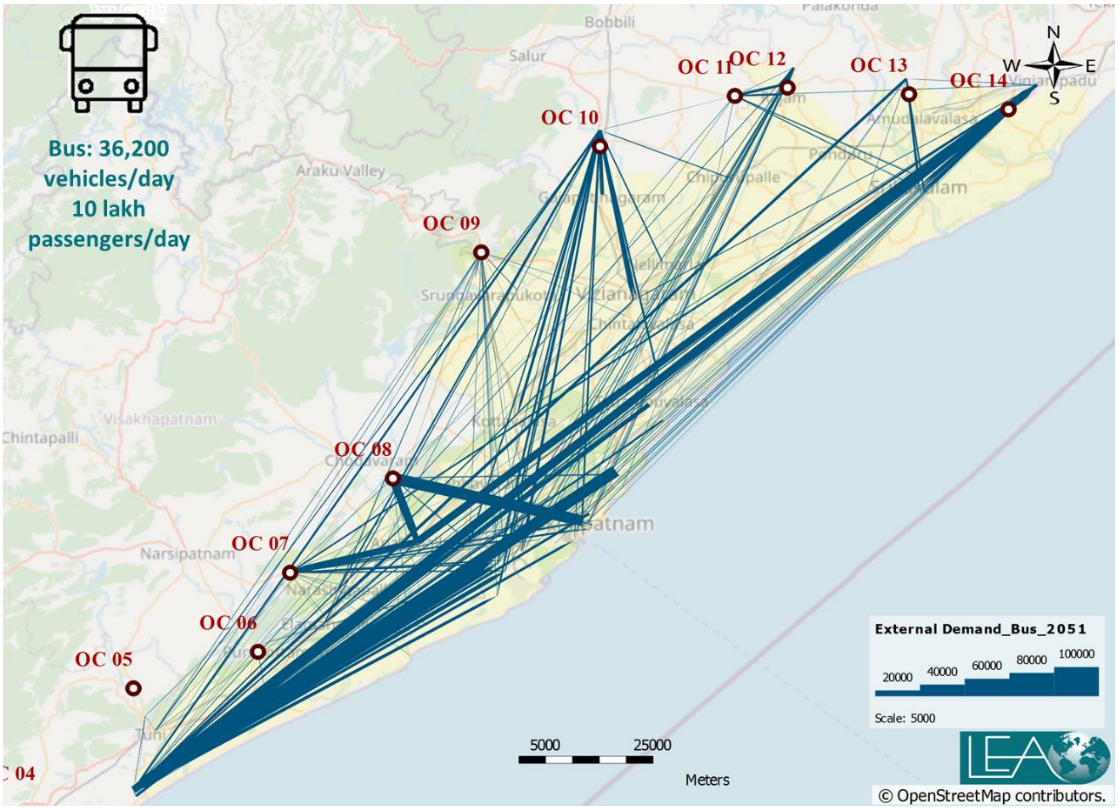


Figure 16-26: Horizon Year 2051 Travel Desires – External Travel by Bus

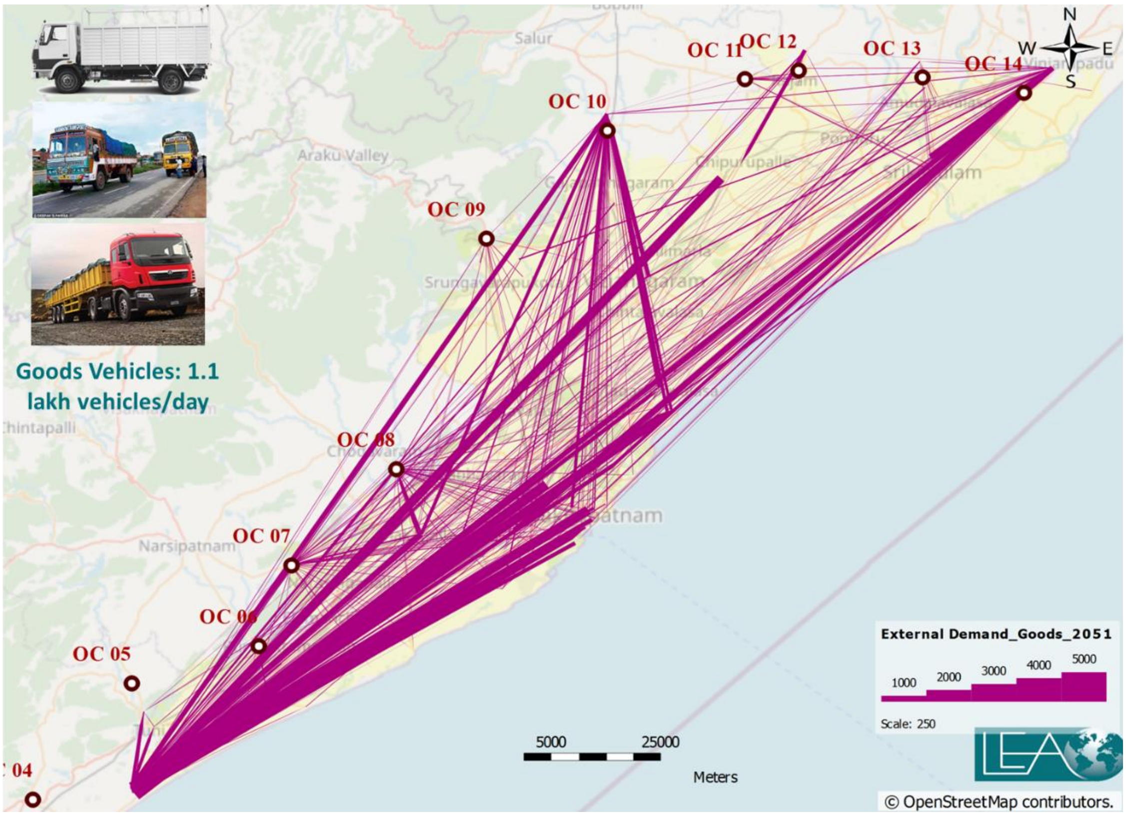


Figure 16-27: Horizon Year 2051 Travel Desires – External Travel by Goods Vehicles

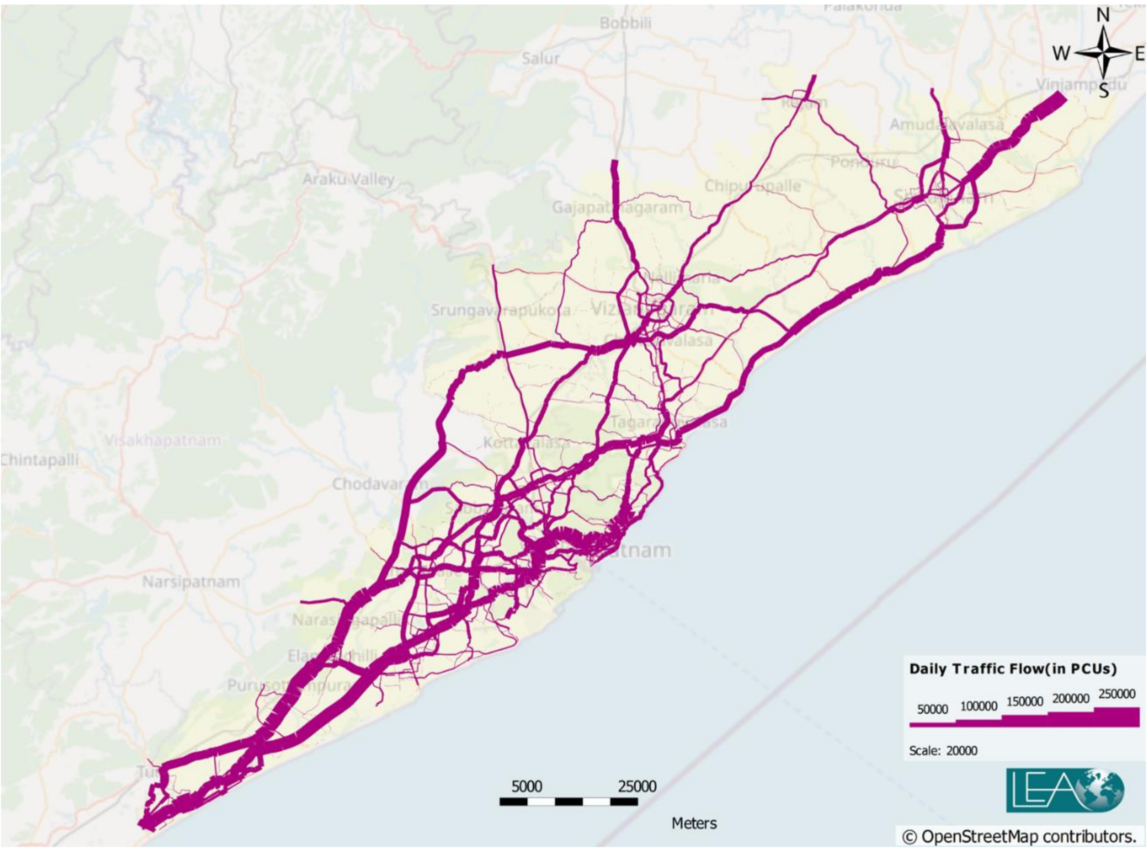


Figure 16-28: Daily Assigned Traffic flows on Road Network in the Horizon Year 2051

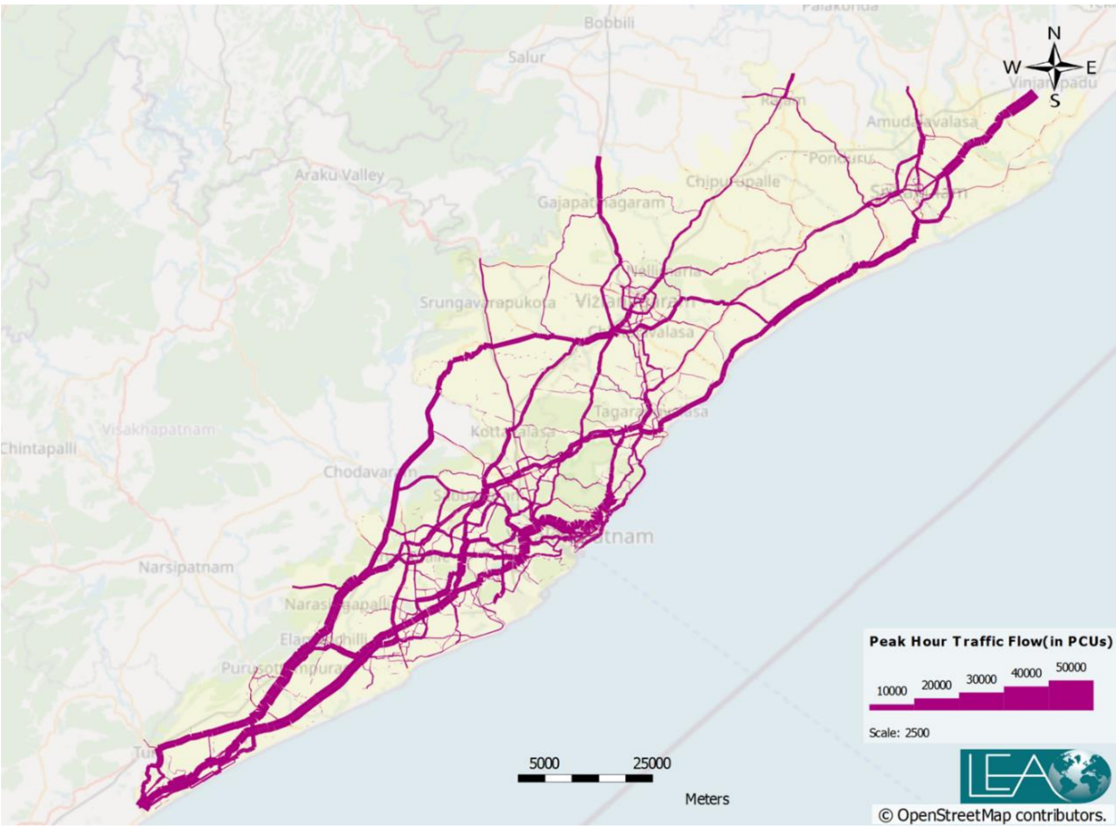


Figure 16-29: Peak Hour Assigned Traffic flows on Road Network in the Horizon Year 2051

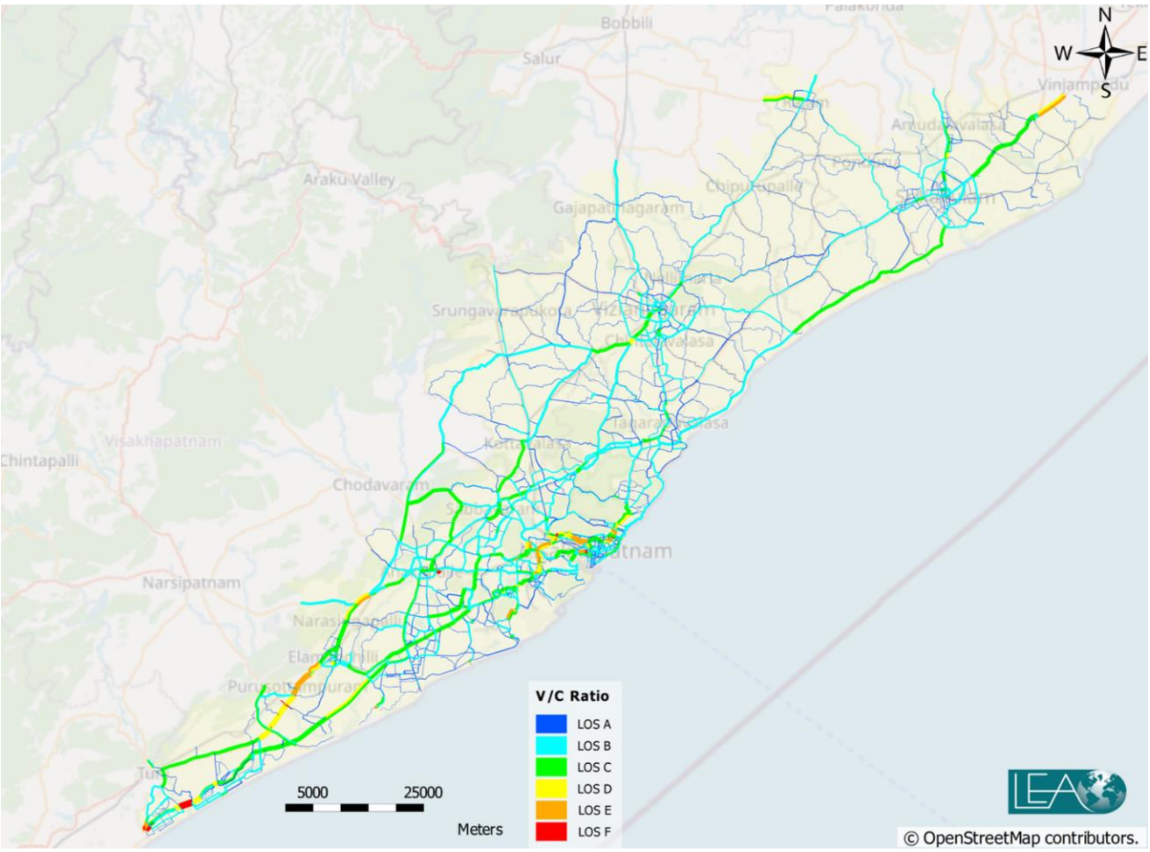


Figure 16-30: Level of Service on Road Network in the Horizon Year 2051

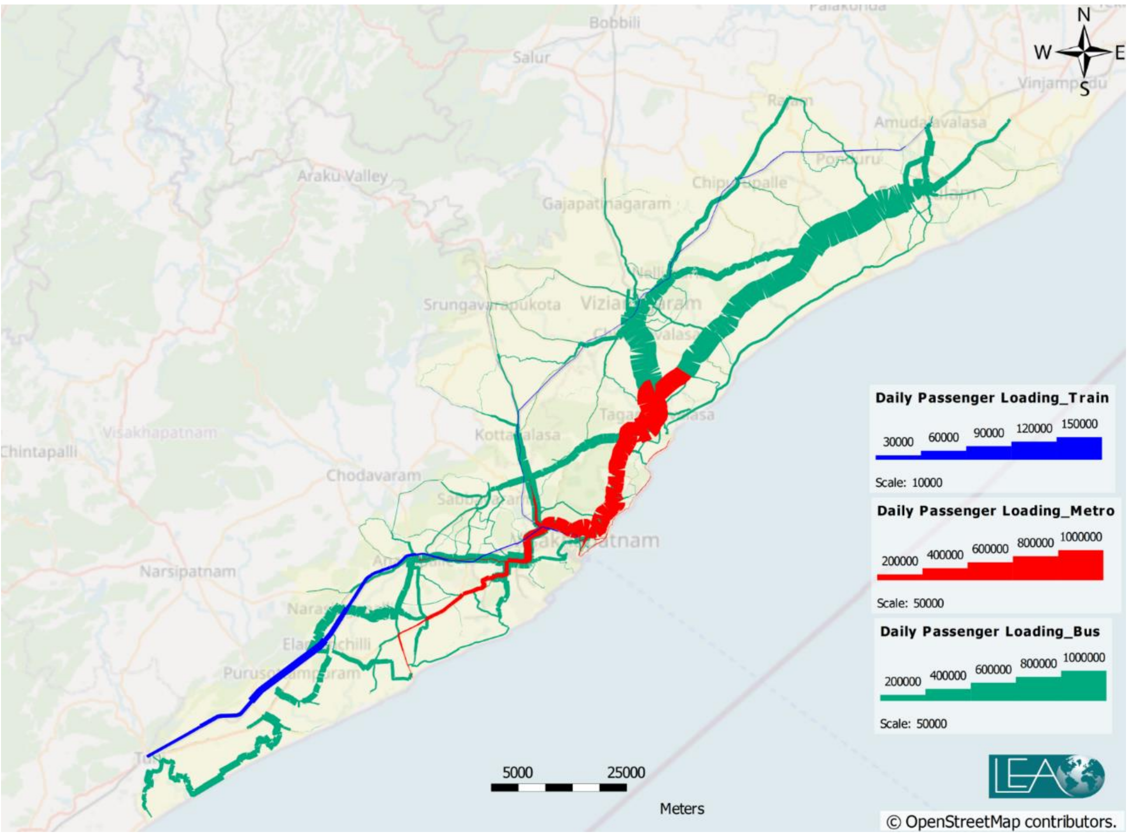


Figure 16-31: Daily Assigned Bus Passenger Flows in the Horizon Year 2051

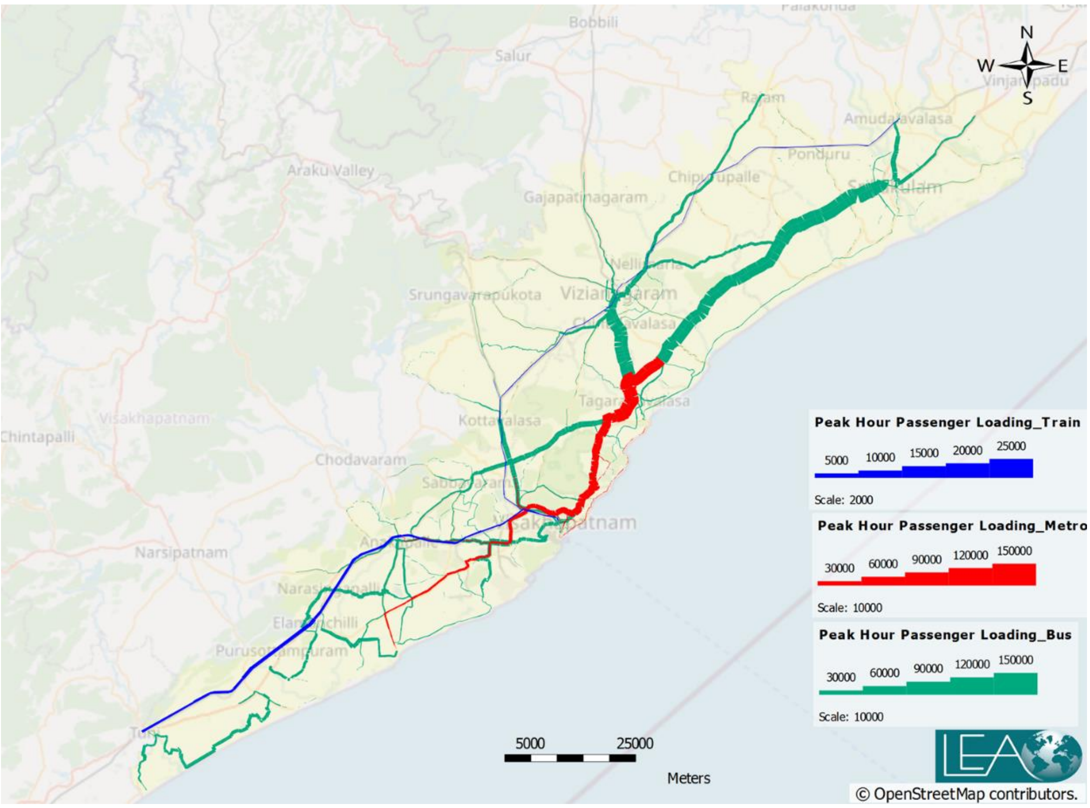


Figure 16-32: Peak Hour Assigned Bus Passenger Flows in the Horizon Year 2051

16.5.4.1 Truck parking areas

In vicinity of proposed industrial area, truck parking areas are proposed and their details are presented in Table 16-18.

Table 16-18: Truck Parking areas near proposed Indsutrial areas

Sl. No.	Locations	Proposed Truck parking area, in ha
1.	Vizianagaram Industrial Area 3	10
2.	Vizianagaram Industrial Node 1	6
3.	Anakapalli	6
4.	Yelamanchili	4

16.6 ACTION PLAN FOR IMPLEMENTATION OF PROPOSED TRANSPORT SECTOR PLAN

The action plan for implementation of transport sector plan would begin by considering, approving and adopting study recommendations on Master Plan. The suggested action plan is given under:

a) Secure encroachment removal along major transportation corridors and restore capacities to safely and effectively move people and vehicles;
b) Introduce travel demand management measures and short-term traffic & transportation proposals: Intersection improvements, footpath facilities, at-grade and grade separated pedestrian facilities (FoBs/ Subways/ Skywalks), Flyovers, road widening, etc.;
c) Prepare Detailed Feasibility Study and Project Reports as appropriate for widening of existing roads and laying of new roads;
d) Prepare Detailed Feasibility Study and Project Reports as appropriate for proposed BRTS, Suburban/ MMTS and Metro/metrolite/LRT in VMR;
e) Prepare Detailed Feasibility Study and Project Reports as appropriate for proposed Inter-City Bus Terminals, Logistic Park, Major Truck terminals and Mini Truck terminals;
f) Implement measures to protect long term transportation corridors (protection of Right of Way);
g) Interaction with stakeholders for carrying out project preparatory works and implementation of proposed public transport proposals: Expanding bus route network including bus fleet, bus depots & workshops, BRTS corridors including bus fleet, bus depots & workshops, Metro/ metrolite/ LRT and Suburban rail system;
h) Interaction with stakeholders for carrying out project preparatory works and implementation of proposed inter-city bus terminals/ Inter State Bus Terminals and Truck terminals;
i) Creation of Unified Metropolitan Transport Authority (UMTA) for VMR at the earliest as per NUTP 2014 and other guidelines issued by Ministry of Housing and Urban Affairs (MoHUA);
j) Further studies and strategies to promote the mobilization of financial resources from a wide spectrum of other urban activities that benefit from an improved or well-maintained transport infrastructure; and
k) Further studies and strategies on institutional change and capacity building for effective planning and delivery of proposed traffic & transport infrastructure; and Review and updating of transport investment plans and priorities every 5 years.

17 MASTER PLAN DEVELOPMENT STRATEGY & PROPOSED LAND USE PLAN, 2041

The chapter illustrates components of the Draft Master Plan, 2041 for VMR, which includes disposition of key economic nodes, residential and support social infrastructure, and state of the art road hierarchical public transport, and other urban trunk infrastructure. Areas protected under current central and state legislations are integrated and form part of the proposed land use. The chapter concludes with delineation of ZDPs areas for important cities and urban centres in VMR, for which separate eight ZDPs documents are prepared.

17.1 PROPOSED ECONOMIC NODES

VMR is the one of the most important economic hubs of Andhra Pradesh. The current economy of the region constitutes mix of manufacturing, knowledge sector, financial and business, agriculture encompassing traditional and modern techniques, fisheries, and other service sector. The Master Plan leverages the existing economic opportunities and available resources to embrace sustainable economic and spatial development in the region. The economic activities are spread across the VMR region in a balanced manner and are identified into different nodes and areas based on the theme functions including integration of existing economic hubs in VMR. The following sections illustrate the proposed economic nodes and areas in VMR.

INDUSTRIAL NODES

Manufacturing sector is one of the most important economic activities of the region. It is currently the highest contributor to the GDP of the state. The region houses three giant proposed projects like Sagarmala, VCIC and VK-PCPIR, strengthening the existing industrial base with urban and social infrastructure and improved connectivity. VMR with its already existing industrial base will further expand manufacturing activities and continue to be the dominant economic force in the region. New industrial areas are identified based on opportunities of available industrial lands in existing industrial estates and other urban areas to create a balanced economic base for the region. The Master Plan envisages location of majority of large industries south of dolphin hills (in Visakhapatnam Industrial Zone), while other cleaner and resource based white industries are distributed in other parts of the region. As a whole, 177.5 sq. km industrial areas are proposed in the VMR.

VIZIANAGARAM INDUSTRIAL NODES

In principle, white industries are proposed in Vizianagaram and new industrial areas are located along NHs,SHs, and important arterial roads. The non-hazardous resource based medium and small scale industries will be permitted in these areas. This industrial use constitute about 2-5% of the proposed developed areas in Vizianagaram. In Vizianagaram, identified industrial areas will be having medium to small-scale industries with access from the highways and or major arterial roads. Approximately 3 Sq. km of industrial nodes are propsoed in Vizianagaram.

VISAKHAPATNAM AND PARTS OF VK-PCPIR INDUSTRIAL NODES

Visakhapatnam, especially parts of VK-PCPIR, is the major industrial zone in the region, and all large and mega industries will be permitted in the Visakhapatnam Industrial Zone. This will be placed strategically away from the settlement area as per the policies guidelines of GoAP for locating industrial areas. VK-PCPIR region will have minimal settlement area due to nature of industries located here. Existing hazardous industries located within the GVMC limits will be relocated away from the settlement area. Major arterial road network with PCPIR Expressway and connectivity from NH-16 is proposed in VIZ to facilities logistic access to facilitate the mega industrial zone of VMR.

Smaller pockets proposed under industrial use at Kothavalasa and Yelamachili will house with focus on MSME industries to create employment at local level. Kothavalasa falls in the expansion zone of Visakhapatnam, owing to the nearness to GVMC and source sources, only white/cleaner MSME industries will be located in these industrial nodes. An industrial pocket of 10 Sq.km is proposed in the north of Kothavalasa town.

Other small-scale industries, which are non-pollution oriented (white Industries), will be allowed to operate in other work and mixed use areas.

BUSINESS AND TRADE NODES

A number of business and trade hubs are proposed in VMR to provide adequate land for business and financial activities, which are generally concentrated in the CBDs and Sub CBDs of VMR. In already existing business and trade centres, measures for improvement of connectivity, public transport, and other support infrastructure provision will be implemented. These specific areas are earmarked to contain the activity within the planned zone. The Master Plan envisages a number of mixed-use nodes to encourage flexibility in land utilization for businessing and financial activities and other support infrastructure.

Mixed use is more advantageous as the area can be developed for multiple compatible purposes with economic importance. In VMR, mixed-use nodes are majorly used for commercial and business purposes, including public and private developments. Mixed-use nodes proposed in VMR are of varying hierarchical order. The Master Plan envisages approximately 77 sq. km of mixed-use development, which is approximately 1.2% area of VMR and approximately 4% of the developed areas in VMR. The proposed Business and Financial nodes are proposed in following hierarchy.

- CBDs
- Sub-CBDs
- District centers and Community centers.
- Along with selective Mixed-use Corridors

VISAKHAPATNAM BUSINESS AND TRADE NODES

Business and trade are the one of the major potential economic development areas in Visakhapatnam, which are proposed as mixed-use land parcels in a decentralized and nodal fashion. These land parcels will serve the role of Sub-CBDs, District and Community Centres level requirement of commercial and other mixed uses. Major road corridors are identified having mixed use provision on both sides of the major roads. This encourages more commercial activities along the public transport corridors.

VIZIANAGARAM NODE

In Vizianagaram, an inner ring road is proposed in the Master Plan. The inner ring will help decongest the core and improve access in current perimeter of the city core. Mixed-use corridor is proposed along the inner ring road along a proposed bus-based quality public transport corridor. In addition, an outer ring road is proposed. Along the important radials connecting the two rings, major mixed-use and business nodes, having commercial activities and areas are proposed.

BHOGAPURAM NODE

The proposed greenfield International Airport at Bhogapuram promotes airport centric development for commercial, financial, and business tourism in the adjoining area marked as the aerocity. The node will emerge as a dynamic economic node with retail, hospitality, business, finance, convention centers. This node will attract aviation linked business on global and national levels. This region is well connected with the core city by road and proposed metro enabling easy flow of passenger traffic. The aerocity is proposed to be connected by a metro in Phase 3 in VMR. Approximately 7.4 Sq. km area is proposed for the Aerocity.

TOURISM AREAS

The region has vast potential for diverse tourism products covering the interests of all visitors and citizens of the area. From the existing situation assessment, it is observed that tourism potential of the region is underutilized. To tap the tourism potential, it is proposed to have an organized and structured framework and identification of tourism areas with support infrastructure. Tourism areas include multiple independent service sectors. To tap potential of tourism in the region along with support infrastructure four major tourism nodes across the region are proposed. These nodes are located along the coast and in proximity of existing tourist spots (Figure 17-1). The current concept plan for Beach Corridor between Visakhapatnam and Beemunipatnam is integrated in the Master Plan for VMR. The Plan recommends exploration of coastal corridor in VMR for tourism and recreational development and along with connecting heritage tourism sites falling along the coastline in VMR. The Master Plan proposes following tourism areas, that are well connected with transport infrastructure and equipped with infrastructure needs for the tourists.

- **Konada Node:** Located in Konada village of Vizianagaram district along the beach corridor near Champavathi River. It has an approximate area of 3.1 Sq.km and is less than 15 km from the proposed Greenfield airport at Bhogapuram. The node can also provide facilities for development for business tourism and MICE.
- **Bheemunipatnam Node:** Located in Mullakaddu village of Bheemunipatnam along the beach corridor near Gosthani River, the proposed area for the node is 1.15 Sq.km and is well connected with SH-144.
- Tourism facility of 1 sqkm at the pristine beach of Muthayalammapalem in Cheepurupalli East village of Paravada
- Simillar tourism node in Pedateenarla village of Nakkapalli Mandal with an area of 1 sqkm.

Heritage Tourism: VMR is dotted with numerous heritage sites, as part of the Master Plan for VMR, 160 heritage sites and properties of national, regional, and local importance are identified. It is proposed to enhance the key heritage sites in a phased manner to promote heritage tourism at these locations. Important sites are archaeological sites related to Buddhism, historic core areas of Vizianagaram near the fort, Devasthanam and Kailasagiri, and Bheemunipatnam, which are proposed as focus areas for promoting heritage tourism.

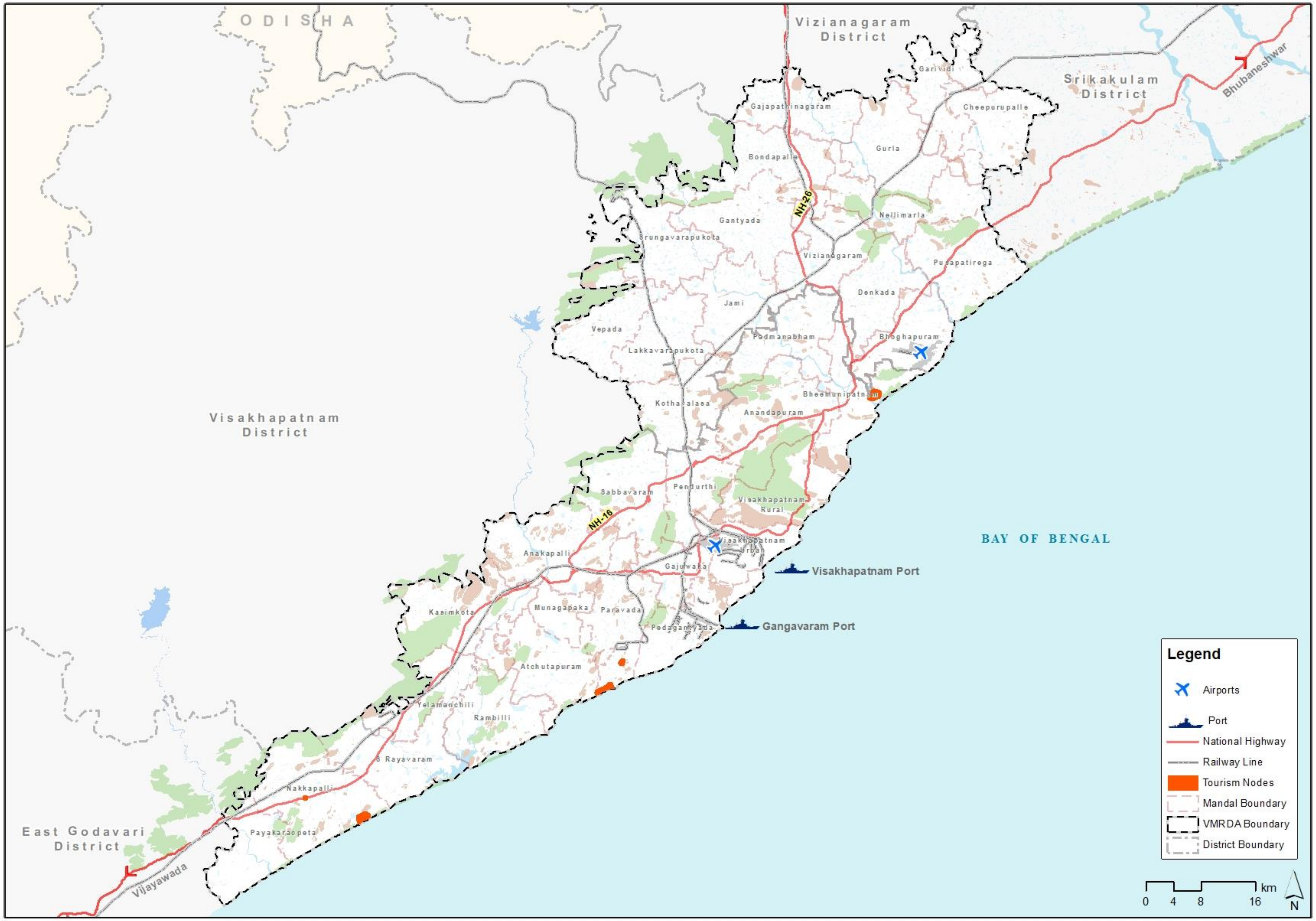


Figure 17-1: Proposed Tourism Nodes of VMR, 2041

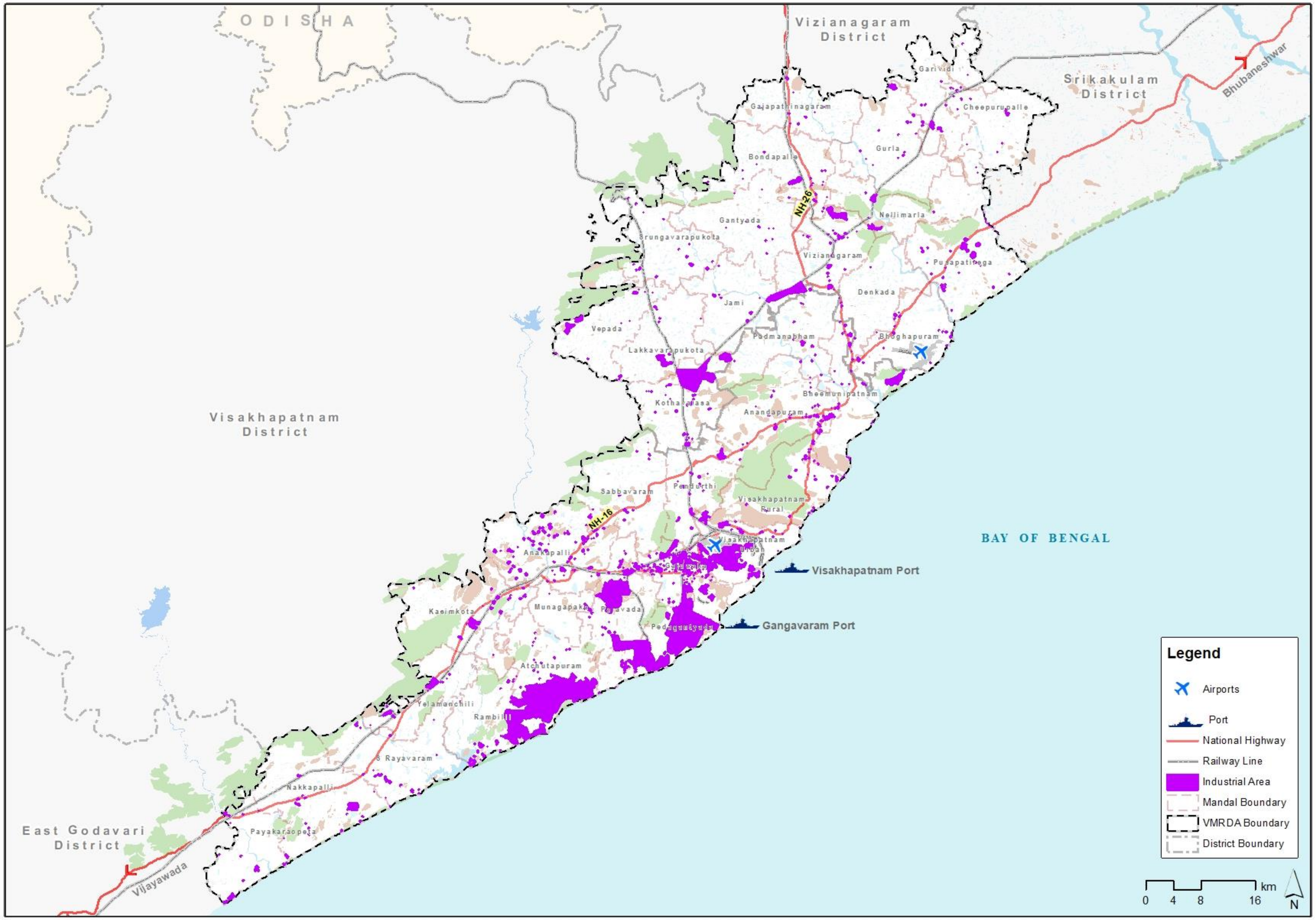


Figure 17-2: Proposed Industrial Areas and Nodes of VMR, 2041

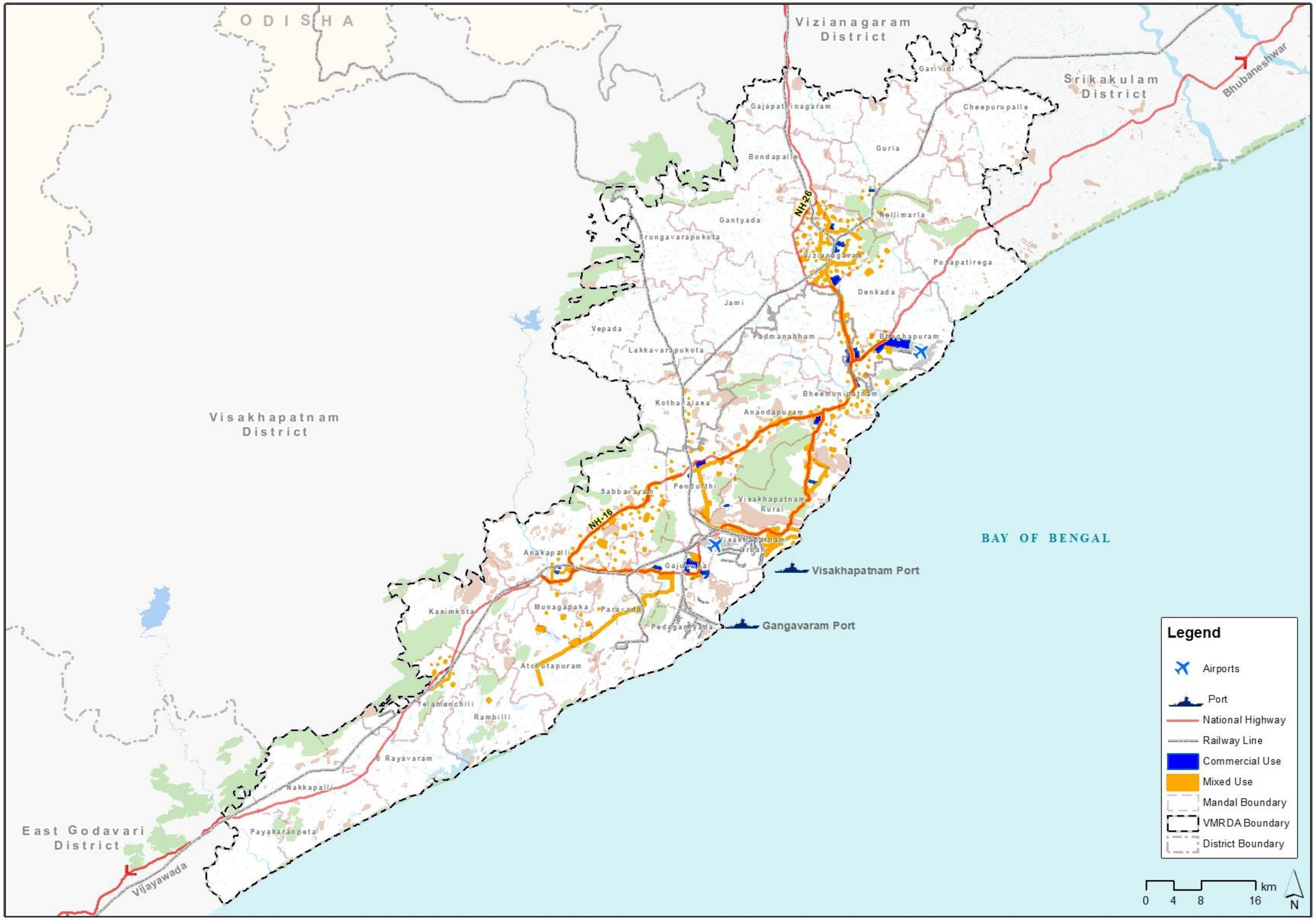


Figure 17-3: Proposed Commercial and Mixed Use Areas and Nodes of VMR, 2041

FISHERY DEVELOPMENT NODES

VMR has a long coastline dotted with 80 fishing villages. Fishing is one of the traditional occupations in the region contributing substantially to the GDP and is the source of raw material for many food-processing industries in VMR. Export activities are done to many countries apart from serving the local demand. Hence, due importance is given to conserve and harness the traditional occupation in the Master Plan. Following ten (7) development nodes for fisheries are proposed in the Master Plan.

Vizianagaram district

- Chinthapalli

Visakhapatnam district

- Muthayalammapalem
- Pudimadaka
- Revvupolavaram
- Rajayyapeta
- Venkatanagaram
- Chinnamangamaripeta

These nodes will be equipped with higher order facilities like marina, cold storage facilities, drying platforms, processing area, workshop and market. The nodes will be located major fish landing center for the villages in its vicinity. The catch is stored or distributed from these nodes. The nodes will be well connected with port and regional markets. This would enable the dealers with easy transfer of excess catch for domestic distribution or export.

Developing adequate fisheries facilities for marina, cold storage, fish processing, and marketing at the proposed fisheries nodes.

17.2 PROPOSED LAND USE STRATEGIES AND PLAN, 2041

The proposed land use creates a balanced development structure in VMR as a whole and puts emphasis on both urban and rural areas. The proposed land use is arrived at based on preferred spaial strategy for VMR, that was discussed in Chapter 15. The key focus areas of the proposed Land Use Plan are arrived at based on following objectives.

- To create a balanced economic, social infrastructure, and spatial development in the region;
- To develop an integrated fragmented development taking places in perimeter areas of existing urban centres to promote an idea of planned development and integrate new development areas with existing city core areas;
- To promote hierarchy of road network in VMR;
- To contain industries falling in Red and Orange category only in Visakhapatnam Industrial zone and other cleaner and white industries are proposed outside the Visakhapatnam Industrial zone;
- To improve urban and public transport connectivity within major and between urban centres along good quality bus based rural areas connectivity;
- To leverage public transport to promote transit-oriented development along the proposed metro and BRT corridors;
- To promote compact developments and hierarchy of settlements in VMR;
- To carryout urban regeneration in city core areas to improve liveability and economic vitality;
- To protect areas of environmental and cultural heritage importance through the Master Plan; and
- To make VMR more climate resilient by protecting areas of environmental sensitivity. It is recommended to carry out more detailed and macro level climate resilient and management plan for key areas of VMR having higher risks to climate change aspects.

The existing land use in the core urban areas will undergo urban regeneration and transformation whereas the peripheral areas of growth are delineated based on demand and future projections for the horizon year 2041.

Presently (2018-19), the total developed area in VMR is 963 sq. km, which is around 15% of the total area of the VMR. Considering the environmentally sensitive areas, optimum population density, protection of agricultural land, physiological features, transit corridors and growth trends new growth areas has been judiciously delineated, which is leading to adding a new growth area of 980 sq.km to the existing development. The total proposed developed areas in VMR are approximately 30% of total area of the VMR.

Visakhapatnam and Vizianagaram are proposed as the major growth centers where adequate land has been allocated for the urban activities as per the projected population and employment. New employment areas, apart from the existing employment areas, have been proposed in the new growth areas of each urban center, which will act as sub-CBDs (Central Business Districts). To provide the basic amenities, adequate pockets of lands has been identified for public and semi-public uses, to develop health, education and other related social facilities. Heavy and hazardous industries will be developed away from the urban areas, and will be restricted to Visakhapatnam Industrial Zone. To promote planned development, the urban settlement will be contained within the expansion area boundaries to avoid haphazard growth and provide adequate infrastructure for the people residing hence ensuring better quality of life.

GENERAL LAND USE ZONING

The proposed land use plan shall guide the grant or refusal of the permission and shall be enforceable by the VMRDA and the other Urban Local bodies.

All village approach roads will be widened up to 18m (60ft) in RoW irrespective of whether they are shown in the Master Plan or not. In cases, the road widening inside/ along the settlement area as shown in the Master Plan is subject to all possibilities. Whenever any proposal is being considered for the site abutting to a village road, the minimum RoW shall be maintained as 18m (if not proposed for higher RoW in the Master Plan) and in case of any shortage in the existing RoW, the widening shall be proposed for 18m (or for higher RoW if proposed in the Master Plan) duly showing the affected portion on either sides of road and to that extent the affected portion shall be shown in the proposed site duly taking over the same by the Local Authority by way of registered gift deed before issuing the Development Permission.

The implementation and enforcement of the Master Plan shall be in accordance with the Zoning Regulations herein prescribed.

The Land Use Zoning Regulations contain the following classification.

Table 17-1: Proposed Landuse Classification

	Category	Sub-Category
1	Residential Use Zone	
2	Commercial Use Zone	
3	Mixed Use Zone	
4	Industrial Use Zone	Existing Industrial Areas Proposed Industrial Areas
5	Public and Semi-Public Use Zone	Government & Semi Government Facilities Educational Facilities Health Facilities Religious Facilities Crematorium / Burial Ground / Grave Yard Proposed Facility Areas
6	Public Utilities Use Zone	Existing Public Utilities Proposed Public Utilities
7	Recreational Use Zone	Existing Parks & Play Grounds Proposed Recreational/ Green Buffers
8	Transportation Use Zone	Existing Transportation Infrastructure Proposed Transportation Infrastructure
9	Agriculture Use Zone	
10	Special Area Use Zone	
11	Protected Use Zone	Blue Zone (Water Bodies) Green Zone (Forest) Brown Zone (Hills) National Park/ Eco-Sensitive Area/ Bio-Diversity Area/ Zoological Park Sea/River Accreted Land

EMPLOYMENT AREAS & GROWTH CENTRES

The existing employment areas has been retained except the hazardous industries which has come inside the urban areas due to past urban growth and needs to be relocated to the industrial areas allocated away from the urban settlements. In the Visakhapatnam Industrial Zone, already land has been identified by APIIC in Paravada, Atchutapuram, Rambilli, Nakkapalli and Payakaraopeta for development of industries. These areas also come under the influence of VCIC, which will give further boost to the growth. APIIC have close to 26,000 acres of industrial estates in VMR, out which 40% of the land is unutilized. Hence, with improvement of industrial infrastructure and investment scenario in VMR, these sites can be put to industrial use to strengthen the industrial economy of the region. In principle, majority of the land banks of APIIC are located south side of Visakhapatnam city hence reinforcing these sites with improved connectivity, industrial infrastructure, residential and social infrastructure make them marketable. The Master Plan proposes townships near these industrial clusters to provide adequate housing and amenities for the population these employment nodes are going to attract.

The commercial establishments are located within the urban areas with a multiple CBD distribution of economic activities largely through mixed use. As the existing CBD will continue its function, new sub-CBDs have been propsoed at potential locations to decentralize the activities based on locational advantages. The new employment areas and nodes are identified in the urban expansion areas along major transit corridors to ensure seamless connectivity to the settlement cores as well as people commuting from outside the main urban centres for work and other purposes. Figure 17-2 and Figure 17-3 shows the proposed industrial and mixed-use areas, which will attract employment.

Table 17-2: Existing and Proposed Additional Employment Areas in respective zones

Zone	Landuse	Existing (Ha)	Proposed (Ha)	Total Area (Ha)	Location
Bhoghapuram and Surrounding Zone	Industrial	238	0	238	
	Mixed Use	3	562	565	Near Bhogapuram Airport
	Commercial	50	124	174	
GVMC	Industrial	6,343	0	6,343	PCPIR area near Paravada and Pedagantyada
	Mixed Use	543	2,165	2,708	Madhurawada, Pendurthi, Anakapalli
	Commercial	544	0	544	
Visakhapatnam Expansion	Industrial	434	24	458	
	Mixed Use	31	1,423	1,454	Sabbavaram, Anandapuram, Sontyam
	Commercial	140	0	140	
Visakhapatnam Rural	Industrial	189	0	189	
	Mixed Use	18	5	23	
	Commercial	46	0	46	
Vizianagaram Rural	Industrial	926	964	1,890	Near Kothavalasa
	Mixed Use	35	6	41	
	Commercial	74	0	74	

Zone	Landuse	Existing (Ha)	Proposed (Ha)	Total Area (Ha)	Location
Vizianagaram	Industrial	139	155	294	Korukonda on Vizianagaram-Jami road
	Mixed Use	73	906	979	Venugopalapuram on North and Chelluru on South of Vizianagaram on NH 26. Another on North of Nellimarla
	Commercial	68	171	239	
Visakhapatnam Industrial	Industrial	6,849	855	7,704	Land allocated by APIIC for industrial development in Paravada, Atchutapuram, Rambilli and Nakkapalli
	Mixed Use	27	958	985	Townships envisaged in VKPCPIR at Atchutapuram and Nakkapalli
	Commercial	63	45	108	
Yelamanchili	Industrial	1	90	91	Yerravaram at southwest corner of the town along highway and rly. line
	Mixed Use	7	65	72	North and South of the railway station well connected to the highway
	Commercial	10	41	51	

Source: Existing and Proposed Preliminary Draft Land Use

RESIDENTIAL AREAS & NEIGHBOURHOODS

The residential areas and township will be developed with an idea of new urbanism and liveable communities where adequate public transport connectivity, social infrastructure, open spaces and parks, basic amenities and safe living environment is provided. The urban growth areas will contain the future residential areas for majority of the four million additional populations by 2041. There will be focused regeneration of the city cores to achieve optimum re-densification along public transit corridors. New neighbourhoods will come in the peripheral region in favourable directions supported by necessary amenities. Area requirements have been estimated (shown in Section 18.4 of this report) and land parcels have been identified for institutional uses to provide the social infrastructure. The road network upto 18 m RoW has been shown serving these growth areasFigure 17-4 shows the Urban expansion and Institutional areas proposed for 2041.

Table 17-3: Existing and Proposed Additional Institutional and Residential areas in respective zones

Zone	Landuse	Existing (Ha)	Proposed (Ha)	Total Area (Ha)
Bhogapuram	Institutional	105	104	209
	Residential	2,026	2,894	4,920
GVMC	Institutional	2,883	575	3,458
	Residential	12,178	3,872	16,050
Visakhapatnam Expansion	Institutional	903	1,524	2,427
	Residential	5,566	13,849	19,415
Visakhapatnam Rural	Institutional	129	101	230

Zone	Landuse	Existing (Ha)	Proposed (Ha)	Total Area (Ha)
	Residential	1,994	4,749	6,743
Vizianagaram Rural	Institutional	1,568	36	1,604
	Residential	6,026	15,565	21,591
Vizianagaram	Institutional	445	495	940
	Residential	3,638	3,626	7,264
Visakhapatnam Industrial zone	Institutional	242	613	855
	Residential	3,548	9,040	12,588
Yelamanchili	Institutional	36	80	116
	Residential	318	694	1,012

Source: Existing and Proposed Land Use

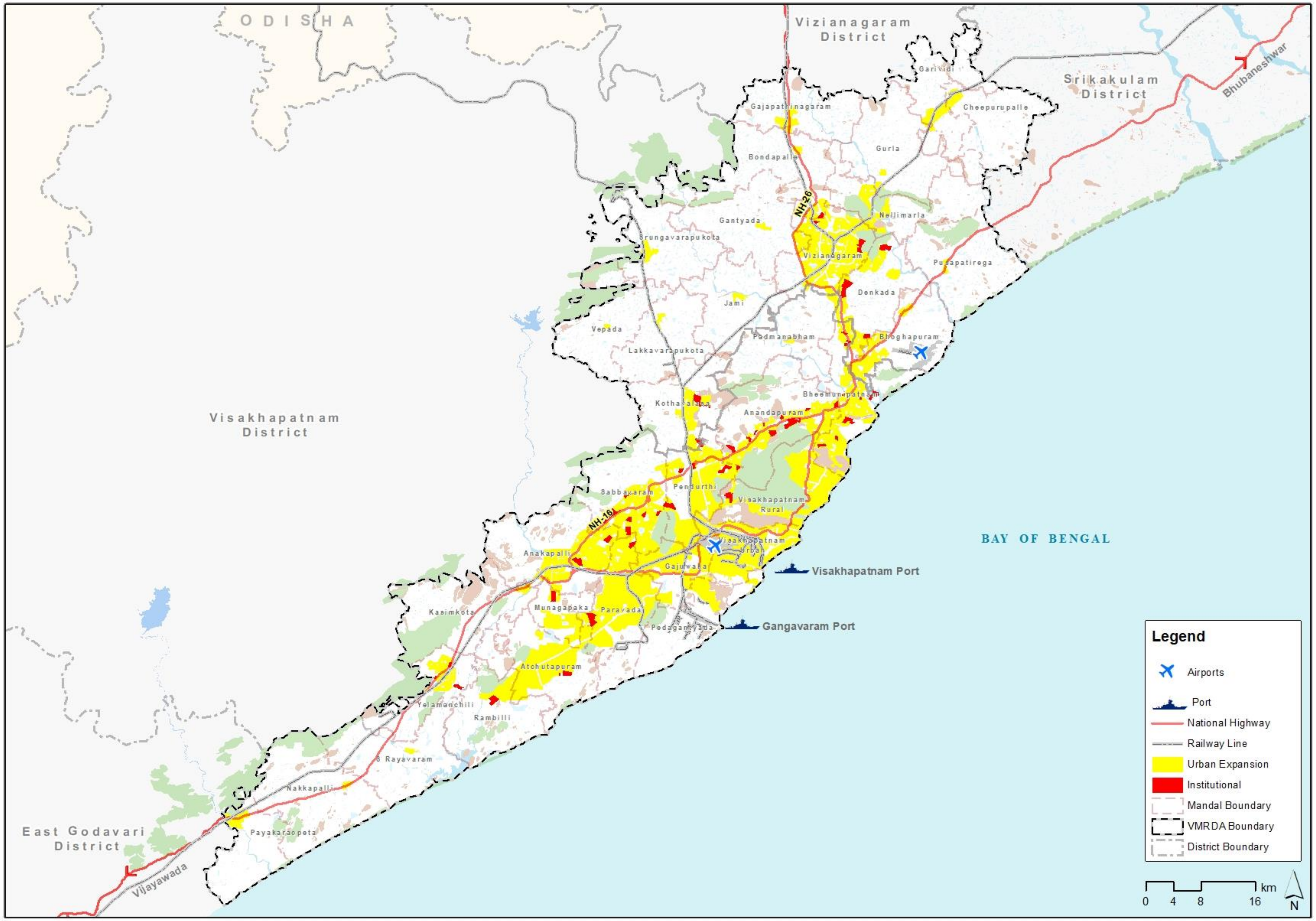


Figure 17-4: Proposed Urban Expansion and Institution Areas of VMR, 2041

LOGISTIC AND TRANSPORT AREAS

Visakhapatnam port demands for an efficient logistical support, which will handle the freight movement smoothly with minimum clash with the normal traffic. Port connectivity to the NH bypass has been considered for smooth movement of freight from the port areas to the National Highway covering the CONCOR Logistic Park. The 80 m wide proposed regional bypass will divert through traffic with a major truck terminal of 100 ha area and minor truck terminals with 25 ha are proposed at key locations for interaction with the hinterland.

Presently, there are four interstate bus terminals, which are located in the core areas of Srikakulam, Vizianagaram, Visakhapatnam and Anakapalli. Four new bus terminals will be proposed to avoid the interstate buses from entering the busy city cores. More details of logistic and transport infrastructure is given in Chapter 16.0 of this report.

TOURISM AND RECREATIONAL AREAS

Blessed with natural scenic landscape, VMR has vast potential for tourism and recreation development. To tap the tourism potential apart from facilitating a better regional connectivity, a beach road is proposed from Bheemunipatnam, which connects the Bhogapuram airport as well. Tourism nodes are identified along the proposed beach road at the confluence of the rivers Gosthani at Mullakaddu and Champavati at Konada. Apart from these there are two more tourism facility centers proposed at the Visakhapatnam Industrial Zone at Muthayalammapalem and Pedateenarla.

Table 17-4: Proposed Tourism Nodes

Tourism Node	Area (Ha)
Confluence of River Champavati at Konada	291.4
Confluence of River Gosthani at Mullakaddu	67.3
Muthayalammapalem in Cheepurupalli East village of Paravada	100
Pedateenarla village of Nakkapalli Mandal	90

Recreational spaces at urban and neighbourhood levels are identified as the buffer areas for the waterbodies in the whole VMR. These buffer areas will be developed as parks and urban greens and used for community recreation. Separate playgrounds and stadiums for sports have been incorporated like the large sports complex already under construction in Vizianagaram. Figure 17-1 shows proposed tourism nodes in VMR.

In addition, heritage tourism is proposed which can having anchor facilities at the proposed tourism nodes along the Coastal/Beach corridor in VMR.

UTILITIES

The expansion of the existing cities will require augmentation of physical infrastructure to support the increased population. These utilities are part of government asset and government land will primarily be used. An inventory of 22A lands has been documented to locate utilities and utilities are to developed in phase wise for project implementation. A detailed assessment of the urban utilities has been presented in Chapter 20 of this report.

ECOLOGICAL SENSITIVE AREAS AND AGRICULTURE

Ecological sensitive areas are given top-most priority for protecting from any kind of development. All such areas including forests, hills, rivers, waterbodies, wetland, sandy areas, etc. are mapped based on their cadastral data so as to provide statutory protection. An area of 1,374 sq.km of protected areas has been preserved as it is. Additional buffer area has been demarcated to waterbodies as per GO No. 119, proposing the buffer areas for recreational use.

The urban growth areas are also consciously limited to strictly demand based land allocation to restrict encroachment of agricultural lands crucial for food security and economy of primary sector. The more details on environmental protection and climate change aspects are given in Chapter 21.

DEVELOPMENT OF MANDAL HEADQUARTERS AND SETTLEMENTS EXPANSION AREA

As part of the Proposed Land Use Plan for VMR Region, Mandal headquarters and settlement expansion strategies are part of the Draft Master Plan. These strategies are targeted at promoting planned growth t around these Mandal headquarters and village settlements.

- **Mandal Headquarters as Urban Areas:** Mandal headquarters are treated as urban areas hence a well-defined expansion area and land use will be proposed for the Mandal headquarters by VMRDA.
- **Economic Role of Mandal Headquarters:** Mandal headquarters are treated as important employment areas with economic base for education and health facilities, commercial and shopping facilities, skill development centres, government offices, micro and small-scale white industries, and any other non-polluting economic functions etc.
- **Transport Connectivity to Mandal Headquarters:** Mandals Headquarters are proposed to be connected with improved roads having two to four lanes with 18m to 24m RoWs. Bus based public transport connectivity is proposed to all mandal headquarters with respect to the mother and important cities in VMR.
- **Settlements Expansion Area:** There are large numbers of village settlements that exist in VMR. In order to ensure planned development in these settlements, a defined Settlement Expansion Zone around the existing boundary of the settlement is recommended for Settlement Expansion and the same is integrated into the Draft Master Plan.

17.3 PROPOSED LAND USE 2041

The details of Proposed Land Use Plan are given in Table 17-4 and Figure 17-4 which indicate disposition of various land uses in urban and rural areas. As a whole, 1,943 sq. km is proposed for urban development, which is approximately 30% of the VMR. The projected urban population for VMR is 6.72 million by 2041 and as a whole region will have overall density of 35 pph in urban area. The main highlights of the Proposed Land Use Plan for VMR are:

- Urban Development Area form 33% of the VMR, hence, idea is to promote planned and compact development in the region and overall density for urban areas will be 35 with respect to projected urban population of 6.72 million by 2041. The average net densities of over 200pph in residential areas. With increase in densities in residential areas, 300 to 500 pph, the proposed urban areas can accommodate beyond 10.0 million populations.
- 43% of VMR Region is protected/retained as agriculture lands and 23% area is protected as environmentally sensitive areas.
- Hierarchical employment nodes and concept of mixed land use is given high priority to allow flexible use of land in urban nodes and employment areas as against rigid land uses.
- Strong Urban and rural area economic and functional integration through public and road-based transportation networking.
- Hierarchical road network and hierarchical settlement and urban centres pattern is proposed in the region.
- Based on the Proposed Land Use Plan the mother city of Visakhapatnam will continue to work a main economic hub which is well networked with other cities and urban centres in the region.
- Mandal Headquarters and rural settlements are integrated in the Master Plan through transport network and economic activities with defined settlement expansion area.
- Amongst the developed areas in the predominant Proposed Land Uses indicate 20% is Residential and dominant Land Use, followed by 4% for Industrial Use, and 4% for transportation, and 2% for tourism and recreational areas, and Mixed Land Uses are approximately 2% of VMR. Other proposed land uses include 2% for PSP and 0.2% as Commercial Use. As stated earlier, approximately 70% of VMR is either in the form of agriculture lands and Environmentally Protected Areas.

Table 17-4: Proposed Land Use details of the Master Plan 2041, VMR

S.No	PLU Category	Area (in Sq Km)	Share within Urbanised Area	Overall Share
1	Residential	957.81	59%	20%
2	Commercial	21.26	1%	0.2%
3	Mixed Use	75.44	5%	2%
4	Industrial	181.3	11%	4%
5	Public and Semi Public	96.38	6%	2%
6	Public Utilities	9.42	1%	0%
7	Recreational / Tourism	97.22	6%	2%
8	Transportation	187.76	12%	4%
	Urbanised Area	1,627	**100%**	33%
9	Protected Area (Forests and Hills)	725.25		15%
10	Water Bodies	366.96		8%
11	Agriculture	2078.09		43%
	Sub Total	3,176		
Grand Total		**4,873.38**		

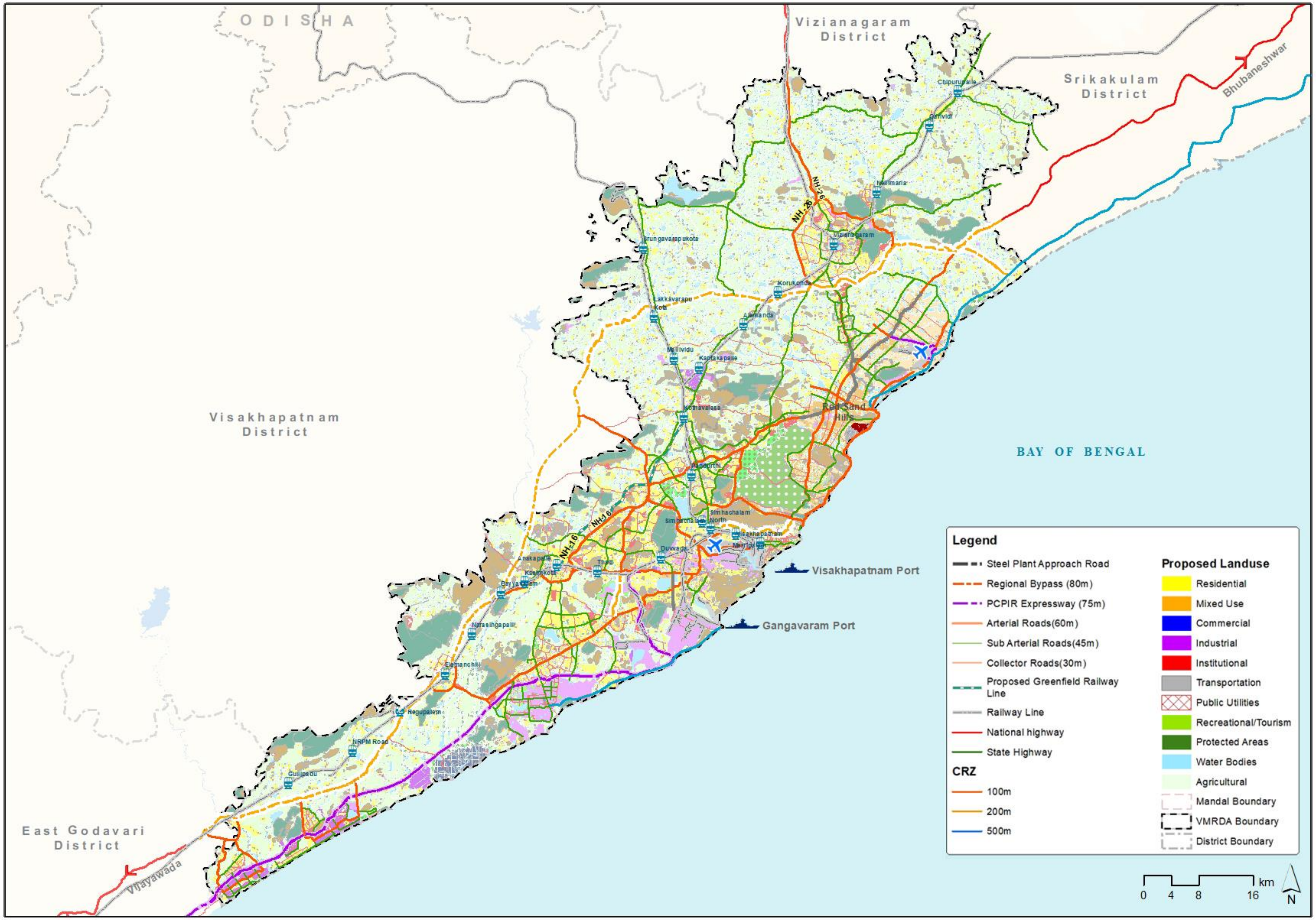


Figure 17-7: Proposed Land Use Plan, VMR-2041 (Map Change)

18 HOUSING & SOCIAL INFRASTRUCTURE REQUIREMENTS

18.1 HOUSING TRENDS AND DEMAND

As per census 2011, VMR has 1,035,056 households with an average household size of 4. The total number of census houses within the VMR is 1,307,291 lakh houses which indicate that many houses are lying vacant or not in a liveable condition. Having forecasted the total population, employment by 2041 and its intermediate decadal years for VMR and by policy zones, the housing demand is estimated. The approach to housing demand estimation is as follows;

1. Analysis of existing situation of housing and the prevailing demand of housing based on income levels, categories and affordability.
2. URDPFI guidelines and norms followed to benchmark and forecast the demand of housing. Prevailing market trends are taken in to consideration.
3. Estimated existing shortage is calculated and additional dwelling units required by policy zones for the projected population is calculated.
4. Additional Housing demand based on various income groups calculated for 2021, 2031 and 2041.

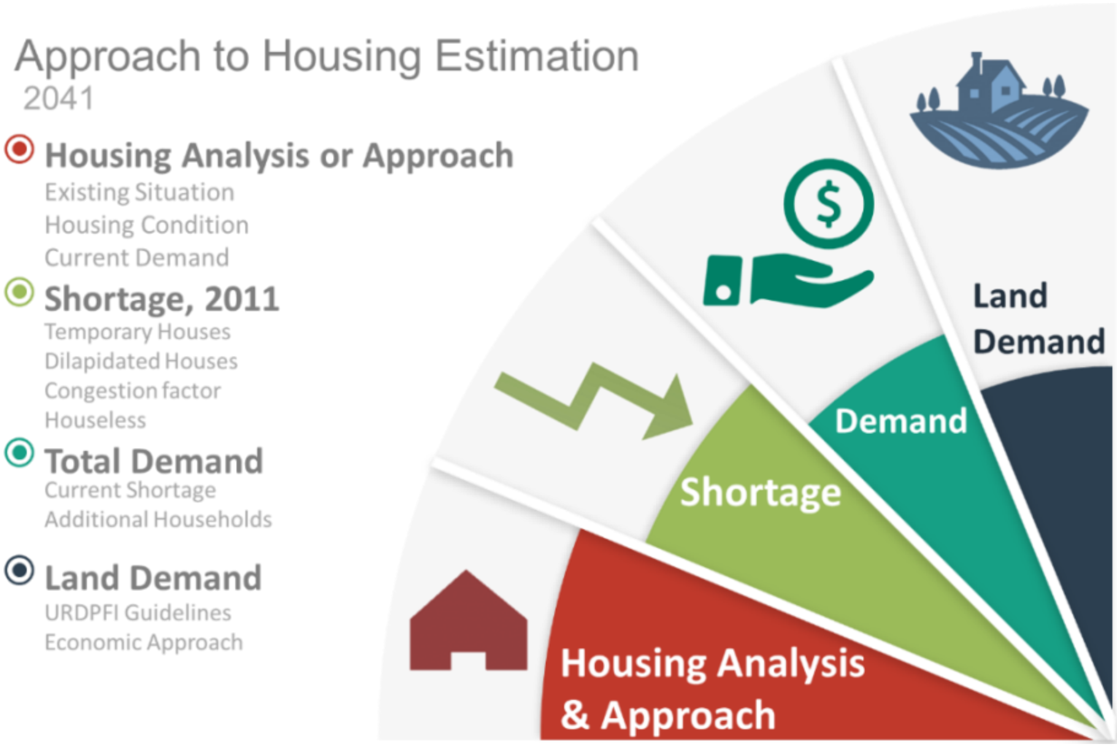


Figure 18-1: Housing Estimation Calculation

The housing demand for 2041 after considering the current housing shortage is estimated (Table 18-1 and Table 18-2). The highest demand is found in GVMC zone since it will undergo re-densification in the future with upgraded transit corridors and BRTS corridors with gentrification of the old core city. The second most demand is predicted in Visakhapatnam Expansion Area, which has been considered as outer growth areas for future development followed by the area around upcoming Bhogapuram Airport.

Table 18-1: Estimation of Households by Policy Zones in VMR, 2041

Zone	Population	Households	Census Houses	Population	Total number of HHs (2011)			Additional HHs				Total Requirement by 2041
	2011			2018	Temporary	Delapidated	No Exclusive room	2018	2021	2031	2041	
Visakhapatnam City(Part) Zone	1,918,256	479,564	609,448	1,996,624	73,145	7,335	8,522	19,592	33,785	138,468	222,573	311,576
Visakhapatnam Industrial Zone	238,558	59,640	75,792	269,547	12,592	1,433	2,574	7,747	5,051	40,478	105,997	122,595
Yelamachili	42,071	10,518	13,366	45,878	2,617	489	332	952	2,755	8,777	25,116	28,554
Visakhapatnam Expansion Zone	418,833	104,708	133,067	450,897	22,405	2,763	2,699	8,016	12,144	63,524	153,954	181,821
Visakhapatnam Rural	265,400	66,350	84,320	280,216	18,859	2,014	1,567	3,704	3,327	21,663	40,182	62,623
Vizianagaram-Nellimarla	332,491	83,123	109,367	363,448	10,232	1,596	1,763	7,739	7,268	42,521	118,684	132,274
Bhogapuram Airport and influence Zone	85,549	21,387	28,140	90,205	4,368	320	747	1,164	1,586	7,910	39,050	44,484
Vizianagaram Rural	771,557	192,889	253,791	800,403	49,174	6,225	6,320	7,212	23,519	33,627	52,013	113,732
VMR	4,072,715	1,018,179	1,307,291	4,297,218	193,392	22,175	24,524	56,126	89,435	356,968	757,569	997,659

Table 18-2: Estimation of Housing Demand by Policy Zones in VMR, 2041

	Total Requirement	Share of				Net Land Requirement + 40% gross area			
Urban	**2041**	**25% HIG**	**35% MIG**	**30% LIG**	**10% EWS**	**HIG (200 sq.m)**	**MIG (160 sq.m)**	**LIG (60 sq.m)**	**EWS (40 sq.m)**
GVMC	311,576	77,894	109,051	93,473	31,158	15,609,934	21,853,907	18,731,920	6,243,973
Visakhapatnam Industrial Zone	122,595	30,649	42,908	36,779	12,260	6,142,027	8,598,838	7,370,433	2,456,811
Yelamachili	28,554	7,138	9,994	8,566	2,855	1,430,534	2,002,748	1,716,641	572,214
Visakhapatnam Expansion Area	181,821	45,455	63,637	54,546	18,182	9,109,210	12,752,894	10,931,052	3,643,684
Rajam	12,149	3,037	4,252	3,645	1,215	608,690	852,166	730,428	243,476
Vizianagaram	132,274	33,069	46,296	39,682	13,227	6,626,949	9,277,729	7,952,339	2,650,780
Bhogapuram	44,484	11,121	15,569	13,345	4,448	2,228,640	3,120,096	2,674,368	891,456
Rural	0	10% HIG	35% MIG	40% LIG	15% EWS	HIG (200 sq.m)	MIG (160 sq.m)	LIG (60 sq.m)	EWS (40 sq.m)
Visakhapatnam Rural	62,623	6,262	21,918	25,049	9,393	1,254,960	4,392,359	5,019,839	1,882,440
Vizianagaram Rural	113,732	11,373	39,806	45,493	17,060	2,279,180	7,977,129	9,116,719	3,418,769
VMR	**547,083**	**110,317**	**191,478**	**181,760**	**63,525**	**22,107,629**	**38,372,373**	**36,424,745**	**12,730,605**

Key considerations in estimation of housing demand are:

- The average household size assumed is 4.
- Number of dwelling units has been subdivided according to income category and land requirement has been considered accordingly i.e. EWS, LIG, MIG, and HIG.
- According to URDPFI guidelines, the planning needs to undergo proposal of housing in a ratio of 25:35:30:10 in Urban and 10:35:40:15 in Rural for HIG, MIG, LIG and EWS respectively for the required total households.

18.2 LAND DEMAND

Estimation of total land requirement for housing has been made considering EWS units as 40sq.m, LIG units as 60sq.m, MIG units as 125sq.m, and HIG units as 200sq.m. Besdies, a 40% gross area has been added to the net area for circulation (20%), buffer area (5%), amenities (5%) and parks and open spaces (10%).

Considering this footprint, a total area of 36,000 ha has been calculated for the future residential demand in VMR. The land demand by policy zone s shown in detail in Table 18-2.

The total land demand along with the existing residential landuse has also been compared to check sufficient landbank is available. It can be concluded that ample residential land will be available throughout VMR except for Visakhapatnam Rural and Yellamanchali because of agricultural land.

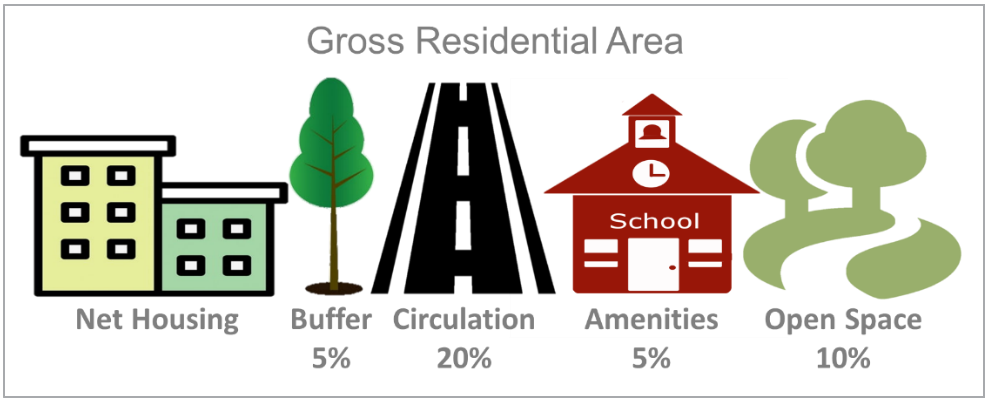


Figure 18-2: Gross Land Requirement for future Housing

This gross land requirement will include the following infrastructure and facilities:

- Planned residential areas which can facilitate the upcoming population.
- All social infrastructure facilities including educational facilities, health facilities, institutional uses, recreational and open spaces and commercial facilities in planned neighbourhoods and in all villages in accordance with norms suggested in URDPFI guidelines.
- Integration of existing settlement, occupied and un-occupied residential layouts with planned residential townships.

18.3 HOUSING GROWTH PROPOSAL

Across VMR the characteristics of housing development will vary for different policy zones due to its unique character. The detail housing development is as follows

1. Township Development- Townships can be proposed in industrial clusters of VKPCPIR like Nakkapalli and Atchutapuram, Industrial nodes near Mungapaka, Sabbavaram, Kothavalasa. Government owned areas like Bhogapuram will also be suitable for industrial development as per VMR and Parastatel organisations. housing policies.
2. Layouts and Gated Community- This type of housing can be a success in Vizianagaram peripheral areas along with Visakhapatnam Expansion areas.
3. Urban Housing & Real Estate- All areas undergoing regeneration such as GVMC, and Vizianagaram core can provide real estate development and high-rise high-density housing, to facilitate the upcoming TOD development and gentrification of the core cities.
4. Slum Rehabilitation- EWS and slum rehabilitation can apply to areas of Anandapuram, Pendurthi, Sabbavaram in phased manner due to its regional connectivity and strategic location.

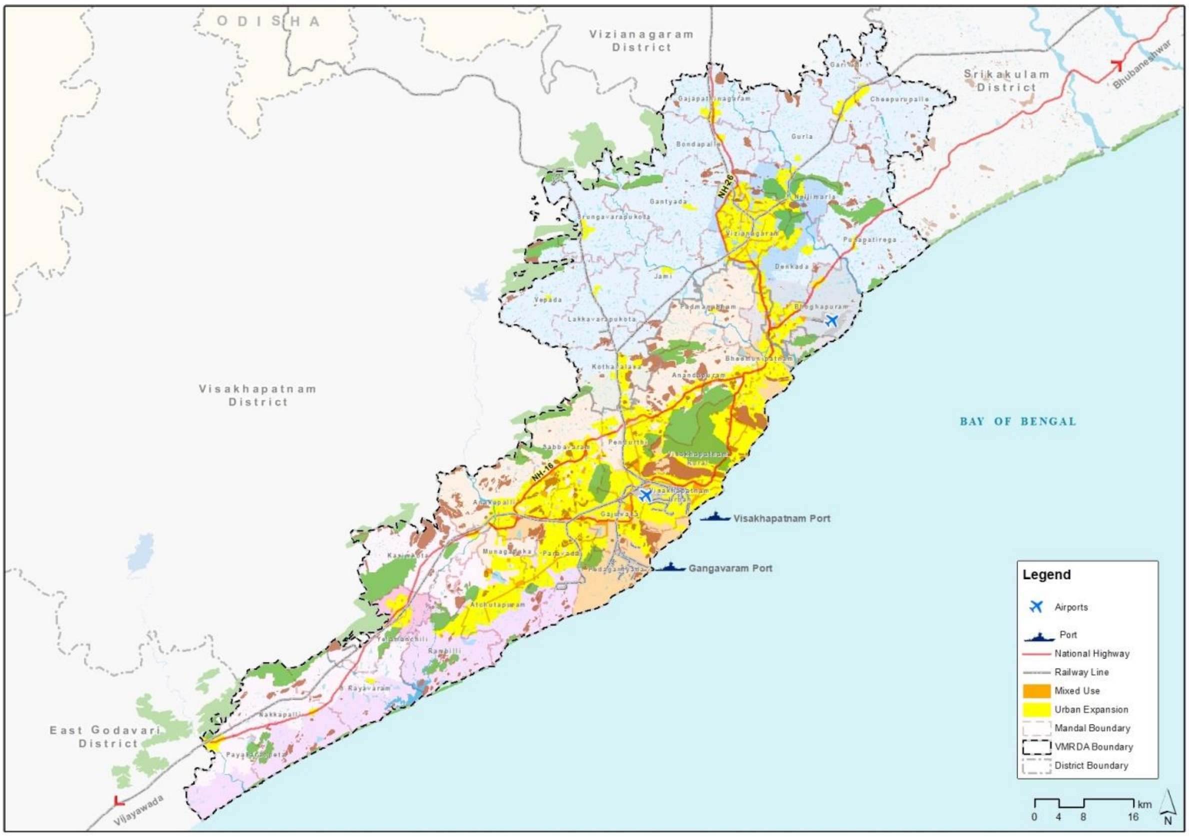


Figure 18-3: Proposed housing areas

18.4 SOCIAL INFRASTRUCTURE REQUIREMENTS

URDPFI guidelines are adopted, to estimate the demand for the population forecasted in horizon year. The social infrastructure demand in both area and number of facilities is estimated and location for the same is identified, VMR has an area of 4867.38 sq.km, of which, 1.8% area is required for provision of Social infrastructure facilities including Education, Health, Recreational, Commercial, Socio-cultural and Miscellaneous(Banks, post office etc.).

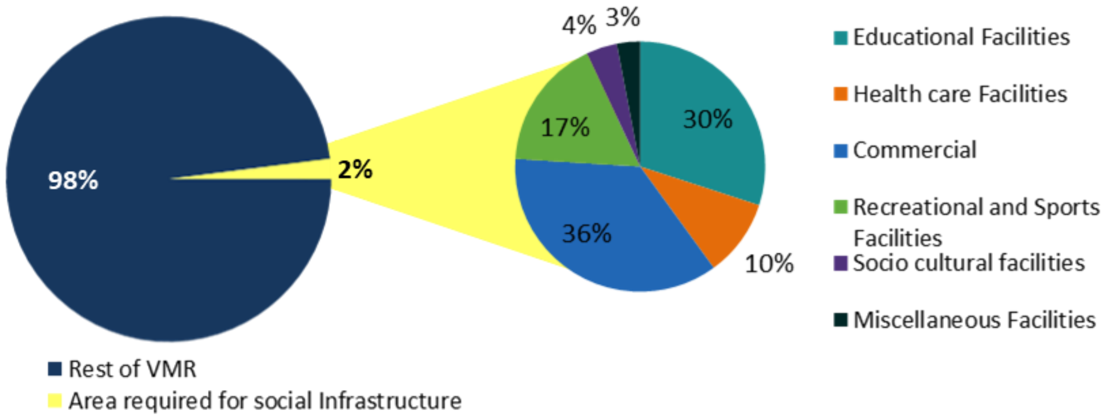


Figure 18-4: Share of Social infrastructure area requirement in VMR

The horizon year (2041) requires 12367 number of facilities covering an area of about 8944 Ha. Educational followed by Commercial facilities, are required more in number while the Recreational followed by educational demands more area. Skilled population is required for development of the region provision of educational facilities and skill development will help the local workforce grab the opportunities created by the proposed projects. Medical facilities apart from serving the local population attract the population of Chhattisgarh and Odisha. However, this is not sufficient for the horizon year. Very few recreational and sports areas including VMR Park and Swarnabharthi Stadium exists. It is mandatory to create recreational zone without neglecting Vizianagaram as well.

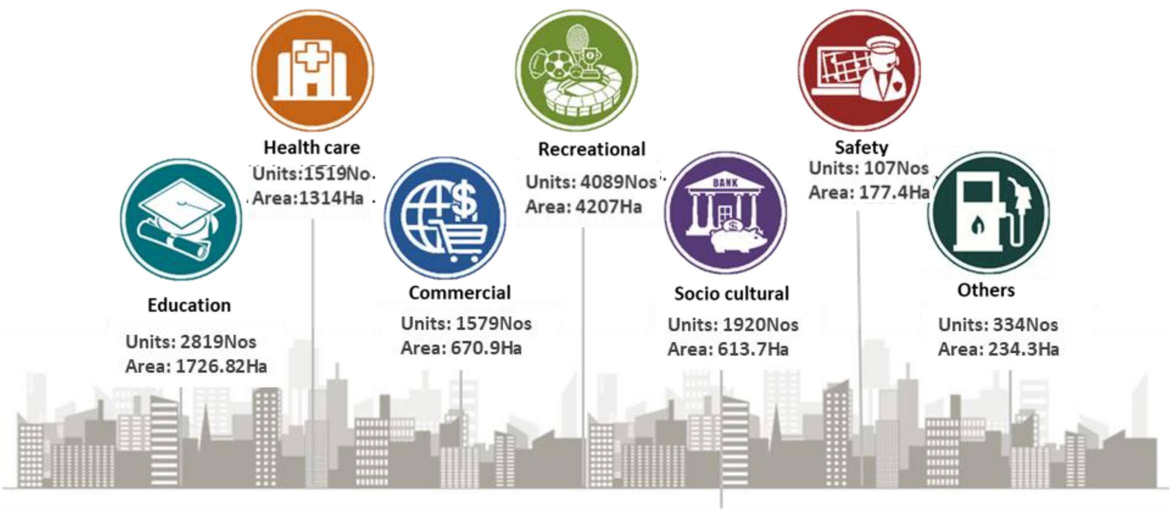


Figure 18-5: Number of Facilities and Area required for Social Infrastructure by Category

As it is not desirable to provide all social facilities at all levels, hierarchy of Planning Units as suggested in URDPFI guidelines is adopted to distribute the Social Infrastructure Facilities. The purpose of adopting this is to split the areas from small to large scale based on the population. The basic unit is considered as housing with population of about 5,000 and the highest is considered to be zone/Sub city with population 10, 00,000. The lowest will have basic facilities making it self-sustainable and as the scale moves towards higher end, the number of facilities is added on. This makes planning for infrastructure easier for different levels of planning units. The hierarchy of planning units adopted is presented in Appendix I.

The demand is calculated in zonal, center, township, sector and neighborhood level. (Table 18-3)It is distributed in suitable locations meeting the area requirement. The facilities are further assessed in a detailed level for VMR zones and are presented in Appendix I.

Table 18-3 Number of Facilities and Area required for Social Infrastructure by Planning units

	P5 - Neighborhood		P4 Sector		P3-Township		P2-City Centre		P1-Zonal Centre	
Zone	Units	Area (ha)	Units	Area (ha)	Units	Area (ha)	Units	Area (ha)	Units	Area (ha)
Educational Facilities	2316	478.72	245	611	219	362.1	23	35	16	240
Health Facilities	608	72.96	430	335.84	458	767.26	23	138	0	0
Commercial Facilities	701	105.15	826	339.8	42	126	10	100	0	0
Recreational & Sports Facilities	1465	732.5	486	486	2104	2277.5	26	335	8	376
Socio-Cultural Facilities	1612	54.42	121	24.2	130	76.1	22	82	35	377
Safety Facilities	0	0	0	0	83	105	12	24	12	48.4
Other Amenities	0	0	0	0	279	31.34	51	183	4	20

The social infrastructure demand by policy zone is estimated. GVMC will accommodate the highest proportion of population; therefore, the demand in this zone is higher both in terms of number of facilities and area. Visakhapatnam expansion area is adjoining GVMC Zone and is also envisaged as a major growth area accommodating more induced population. This will be one of the fast-urbanizing zones and have higher requirement of facilities next to GVMC Zone. The demand in other urban zones is as estimated in (Table 18-4)

The demand in rural zones is also assessed and the facilities will be allocated accordingly. The various facilities assessed by policy zone are in (Appendix I).

Table 18-4: Social infrastructure requirement by zone

Zone	Number of facilities	Area (Sq.km)
Visakhapatnam City(Part) Zone	4805	30.63
Visakhapatnam Industrial Zone	1300	9.70
Yelamanchili Zone	271	1.56
Visakhapatnam Expansion Zone	1930.00	15.92
Vizianagaram-Nellimarla Zone	1531	10.62
Bhogapuram Airport and influence Zone	481	3.03
Total	**10,318**	**71.47**

19 URBAN REGENERATION AND HERITAGE CONSERVATION AREAS

This chapter deals with urban regeneration and heritage conservation and related strategies. The main objective of the urban regeneration is to enhance economic vibrancy and livability of city core areas in VMR. While heritage conservation focuses on areas/structures listed under the draft Master Plan with a aim to provide protection and enhancement strategy and leveraging it for community and tourism development. Strategic Urban design framework and guidelines are also proposed in the chapter to enhance Livability and image of the urban centres in VMR.

19.1 URBAN REGENERATION AREAS

City core areas, which are generally low rise and high-density areas, face issues of uncoordinated urban transformation. To improve quality of life and modernize the city cores in VMR, urban regeneration of important and existing city core areas is proposed. The urban regeneration strategy is to integrate on-going efforts to improve urban infrastructure, public spaces, and other development projects in the city cores. The focus areas for urban regeneration and its components proposed are as follows.

DELINEATION AND PROFILE OF CITY/TOWN CORE AREAS

City core areas, which are older areas and generally intensely built and high-density in nature, form important parts of municipal corporation areas of GVMC, and VMC are proposed for urban regeneration. At present, these municipal areas also house majority of the urban population in VMR and faces acute issues of access to adequate basic infrastructure and uncontrolled urban transformation. Economic and functional wellbeing of these city cores is vital for future economic development of the region while enhancing their overall built environmental values.

Table 19-1: Summary of urban regeneration Municipal Wards and Population, VMR

ULB	Wards under core areas	Population 2018	% to ULB Population
Greater Visakhapatnam Municipal Corporation (GVMC)	1-3, 14-62, 64-76, 79, 81-87, 89-97	1.59 million (1,591,246)	80.5%
Vizianagaram Municipal Corporation	4-5, 7-15, 17-20, 22-23, 26, 28-39	0.19 million (189,951)	70.9%
Yelamanchili Municipality	1, 7-17, 19	0.019 million (18,971)	51.2%
Nellimarla Nagar Panchayat	3-13, 15	0.015 million (15,658)	60.2%
TOTAL		**1.95 million (1,949,489)**	**79.4%**

URBAN REGENERATION AND URBAN DESIGN STRATEGIES

Sustaining economic vibrancy with improved quality of life are the key objectives of urban regeneration in city core areas of VMR. These city cores are of very high relevance towards economic wellbeing of the region on a long-term basis hence improving urban infrastructure and strategic public spaces is of very importance. To reiterate, the development strategy for VMR equally focuses on both improvement of existing urban city core areas and development of new growth areas. The key strategies for urban regeneration of the delineated city core areas are as follows.

19.1.1.1 GVMC City Core Regeneration

It is proposed that GVMC city area, 110 Sq. km (Figure 19-1 to Figure 19-5) is delineated for urban regeneration where focus is on following project components:

- **Meeting 100% access to basic infrastructure and other municipal services:** Having access to adequate and quality basic infrastructure viz. water and power supply, urban waste collection, and drainage are one of the important indicators in improving quality of life. There are number of projects currently ongoing programmes in GVMC Area under various GoI, State Govt., and local body level to meet this objective. However, to meet this objective on a short-term basis is important to improve livability standards in the city core areas of GVMC.

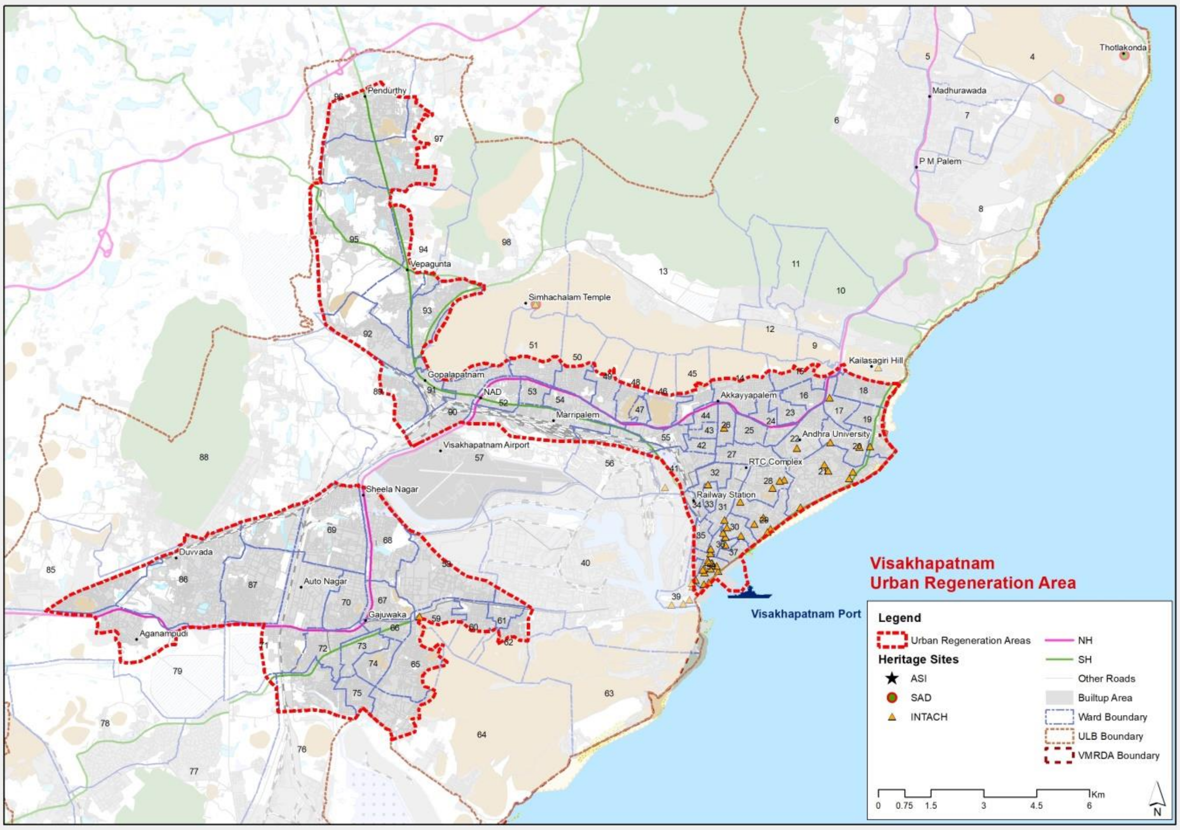


Figure 19-1: Proposed City Core Areas for urban regeneration in GVMC

- **Improved Provisioning of Public Transport:** It is desirable to make public transport accessible within walking distance i.e., 0.5 km to 1.0 km, in the city core areas so as to achieve modal share of public transport as 50% or more. Combination of metro and bus based public transport system is proposed in the city core areas of GVMC including need to improve last mile connectivity.
- **Availability of Parks and Open Spaces:** Although GVMC Area is located along 55 km of Seafront, but its core areas face shortage of parks and open spaces and quality public transport and NMT connectivity to seafront areas. Provision of parks and open spaces for children, elderly people, and rest of the residents in the city cores within a walking distance of 0.5 km is important. Converting any available government lands into public spaces along with improving existing open spaces to form priority.

Accessible and usable open spaces and parks should be in range of 5 sq. m to 10 sq. m per person as per national and international standards. Current availability of usable open spaces in GVMC is less than 3 Sq.m per person. To improve access to seafront areas treating seafront road for pedestrians/making it pedestrian friendly is one of the most important objectives towards the city core areas improvement in GVMC. Potential further expansion of open spaces can take place along the interfaces of hills and built up areas to benefits adjoining neighbourhoods in the city core areas of GVMC.

- **Streets, Public Spaces, and NMT Infrastructure Improvement:** To improve overall living and experiential quality of the city cores, improvement of streets, public spaces, and provision of safe walkways and cycle tracks is a very progressive way of looking at city cores. In this context objectives of the Smart City Mission of Visakhapatnam and National Transport Policy, 2014 needs to be extended to the core areas of GVMC. Pedestrianizing/making them pedestrian friendly of popular streets and public spaces is to be promoted in a phased manner along with improvement of public transport. Seafront road and roads leading to the seafront can be priority projects in this context.
- **Waterbodies Improvement:** There are 7 large and number of smaller water bodies located within city core areas of GVMC. Meghadri Gedda Reservoir is one of the largest water bodies adjoining the city core area next to Pendurthi. A city and regional park is proposed around this water body in the DMP to create recreational space in GVMC Area, without compromising on it as a important water source for the city. It is also recommended to improve other water bodies fronts with improved NMT access from the neighbourhood to meet requirement for quality public open spaces. It is important that water quality of these water bodies is improved and maintained as per the CPCB/SPCB standards.
- **Urban Design Projects:** To enhance economic and urban vibrancy in the core areas of GVMC, select projects for urban renewal, redevelopment, TODs, and densification needs to be identified as urban design projects. This will help improve livability standards, urban image, and economic role of the GVMC area as a whole. TODs along proposed metro corridor with focus on mixed use development to turn old highway alignment (Erstwhile NH-16) into public transit corridor, which is safe for pedestrians, is a way forward. Redevelopment/Renewal of RTC Complex, Railway Station and adjoining precincts, and other government owned and under used sites are potential areas to improve overall economic base and image of the GVMC.

Figure 19-2: TOD with focus on Mixed Land Use Development: Improving streets and public spaces, Sea and Lake fronts development as part of the urban regeneration of city core area is strategic programme for transformation of GMVC into a modern metropolis.

- **Resilient City:** Coastal area of GMVC is vulnerable to cyclones and Tsunami (as per the TERI studies on Visakhapatnam). Implementation of Disaster Management Plan for Visakhapatnam-DDMP prepared for the Visakhapatnam district is important for long term wellbeing of the city. It is recommended that more detailed assessment is carried out for GVMC Area through participation of key stakeholders and local communities at risk to prepare plan for disaster and risk management. It is also recommended that GVMC become part of the 100 Resilient Cities network to share knowledge in dealing with risk reduction and disaster management planning for the GVMC Areas.
- **Project Feasibility Studies:** GVMC in coordination with VMR carryout feasibility studies to identify urban regeneration and urban design projects in the core areas to enhance economic, functional, livability standards, and urban image of the core areas. Potential and key urban design projects are seafronts improvement with improved public transport and NMT connectivity, ToD projects along the proposed metro and BRT corridors, making key and popular streets pedestrian friendly spaces, creation of tourism and recreational spaces along the seafront and Kailasagiri, creation of public parks and open spaces along water bodies and on the interfaces of hillocks, Visakhapatnam railway station area redevelopment, and redevelopment of other under utilized government owned lands with focus on public space and assets creation. Slum areas improvement/redevelopment for basic infrastructure, additional housing, and public space creation.

19.1.1.2 Vizianagaram City Core Regeneration

The core area of VMC 20 Sq. km (Refer Figure 11.2), is proposed for for urban regeneration where focus is on the following project components:

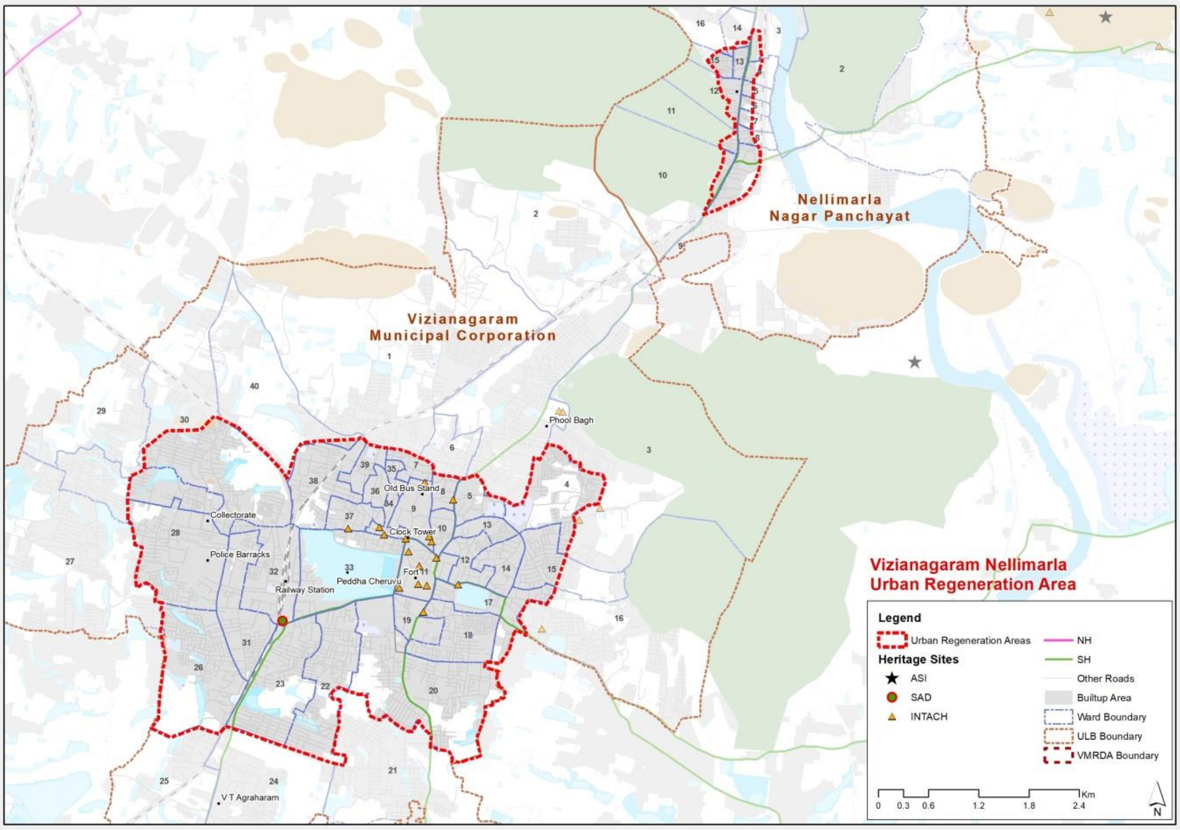


Figure 19-3: Proposed City Core Areas for urban regeneration in Vizianagaram Corporation Area.

- **Urban Heritage Areas Development:** It is proposed to carryout conservation and area improvement plan for the heritage precinct in city core area of Vizianagaram which comprises the Vizianagaram fort, Pedda Cheruvu, and adjoining urban precincts. More precise delineation is to be carried out through a detailed conservation area plan for the precinct. It is important to retain the historical significance of the heritage, carryout improvement of public spaces, improve public transport and reduced use of car, making area and streets more pedestrian friendly, induct visitor facilities, community area improvement, and remove encroachment around the fort and water tank area. Through adaptive reuse of heritage buildings in the area, an interpretation centre can be developed in the area. .

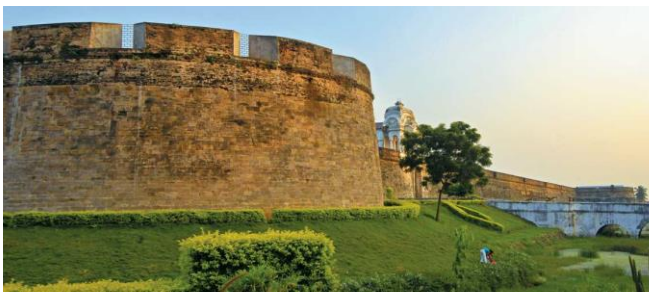


Figure 19-4: Vizianagaram Fort, Lake (Pedda Cheruvu), and adjoining urban precincts in the city core are proposed for heritage area improvement.

- **Meeting 100% access to basic infrastructure and other municipal services:** Having access to adequate and quality basic infrastructure viz. water and power supply, urban waste collection, and drainage are one of the important indicators in improving quality of life. There are number of projects currently ongoing programmes in VMC Area under various GoI, State Govt., and local body level to meet this objective. However, to meet this objective on a short-term basis is important to improve livability standards in the city core areas of VMCC.
- **Enhancing Institutional and Trade character of the City:** Vizianagaram city core is important institutional and trade centre in the region. Hence, it is desirable to carry out urban regeneration to strengthen institutional, commercial and associated infrastructure components to improve its functioning and image of the city. Here improving public transport, parking facilities, pedestrian sidewalks, parks, and overall quality of the streets are potential focus areas.
- **Improved Provisioning of Bus based Public Transport:** It desirable to make public transport accessible with walking distance i.e., 0.5 km to 1.0 km, in the city core area so as to achieve modal share of public transport 50% or more. Last mile connectivity through NMT modes is important towards use of public transport.
- **Availability of Parks and Open Spaces:** Provision of parks and open spaces for children, elderly people, and rest of the residents of the areas within a walking distance of 0.5 km. There are two large water bodies (Lakes) in the core area, and carrying lakefronts improvement can contribute significantly to augmenting open space needs in the city core area.

Figure 19-5: Development and improvement of water bodies, fort area, streets and parks are important areas for urban design projects in city core of VMC Area.

- **Streets, Public Spaces, and NMT Infrastructure Improvement:** To improve overall living and experiential quality of the city core area improvement of streets, public spaces, and provision of safe walkways and cycle tracks is a very progressive way of looking at city cores. Pedestrianizing/making them pedestrian friendly of popular streets and public spaces is to be promoted in faced along with improvement of public transport. Focus for streets improvement is be on induction of improved public transport and NMT infrastructure and generally carrying street furniture improvement, which is similar to that of smart streets and heritage areas improvement objectives.
- **Urban Design Projects:** To enhance economic and urban vibrancy in the VMC area select projects for urban regeneration/renewal, redevelopment, and densification needs to be identified as urban design projects. This will help improve image and role of the VMC area. As an example, projects on improvement of heritage area located in city core ofVizianagaram around the fort, Pedda Cheruvu, and adjoining market precincts, Railway Station area development, and traditional institutions located in VMC Areas etc. are recommended. Other potential urban design projects are water bodies and lakefront development into lakefront parks, Vizianagaram railway station developmentredevelopment of underused government lands for public institutions and open spaces. Public transport led improvement of important commercial and mixed use streets along with inducting NMT and public space, and social infrastructure provision etc.

19.1.1.3 Other City/Town Cores Regeneration

It is proposed to carryout urban regeneration in other 4 city/town cores located in municipal areas of VMR, which are having dense and mixed use environment, to improve their economic, functional, and livability standards. These other city core areas are located in municipal areas of GVMC (Anakapalli, Thagarapuvalasa, and Beemunipatnam), and in municipal council area of Yelamachili and Nillimarla. The focus areas for these city core recommended are as follows.

- 100% access to basic services for water, wastewater collection, SWM, drainage, and safe power distribution etc.
- Improved bus based public transport improvement,
- Streets enhancement from pedestrian and aesthetic perspective,
- Development of public parks and lakefront development,
- Densification of underused and unused area,
- Economic development and mixed-use encouragement.

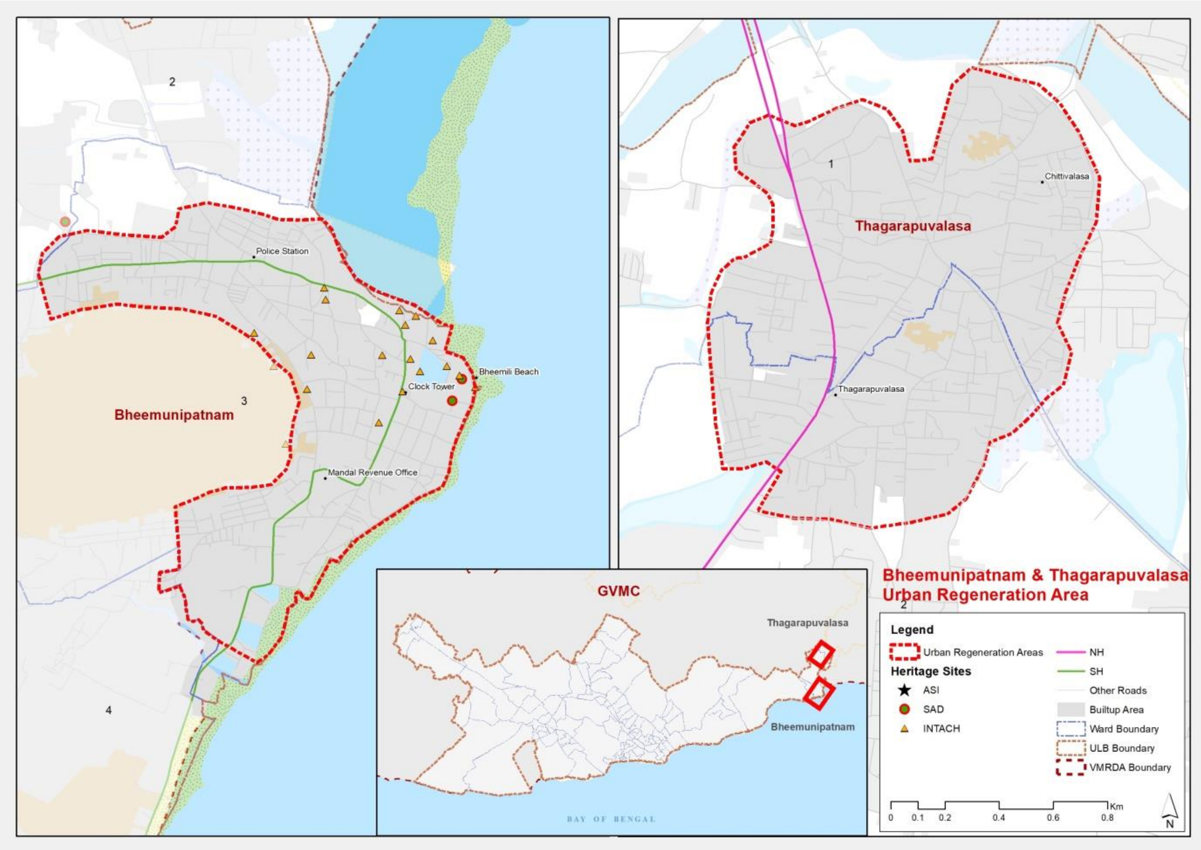


Figure 19-4: Proposed City Core Areas for urban regeneration in GVMC (Bheemunipatnam)

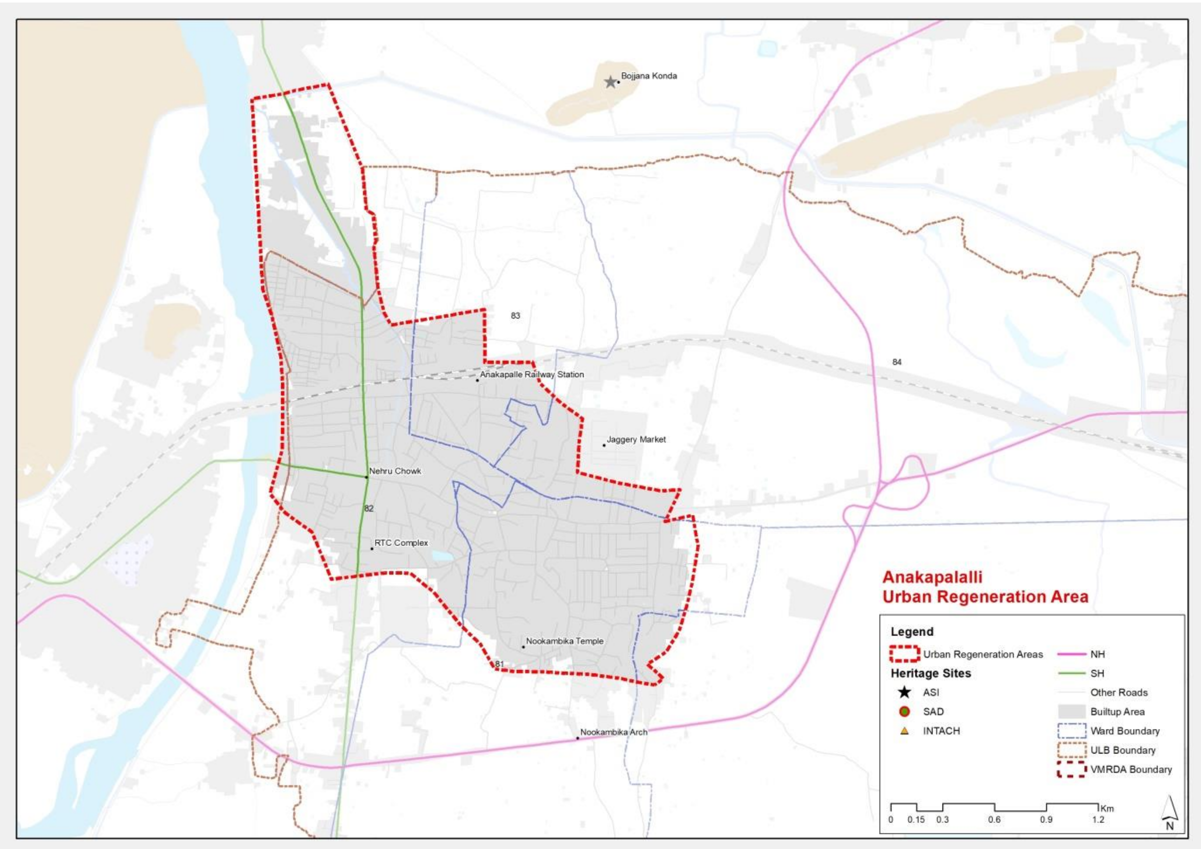


Figure 19-5: Proposed City Core Areas for urban regeneration in GVMC (Anakapalli)

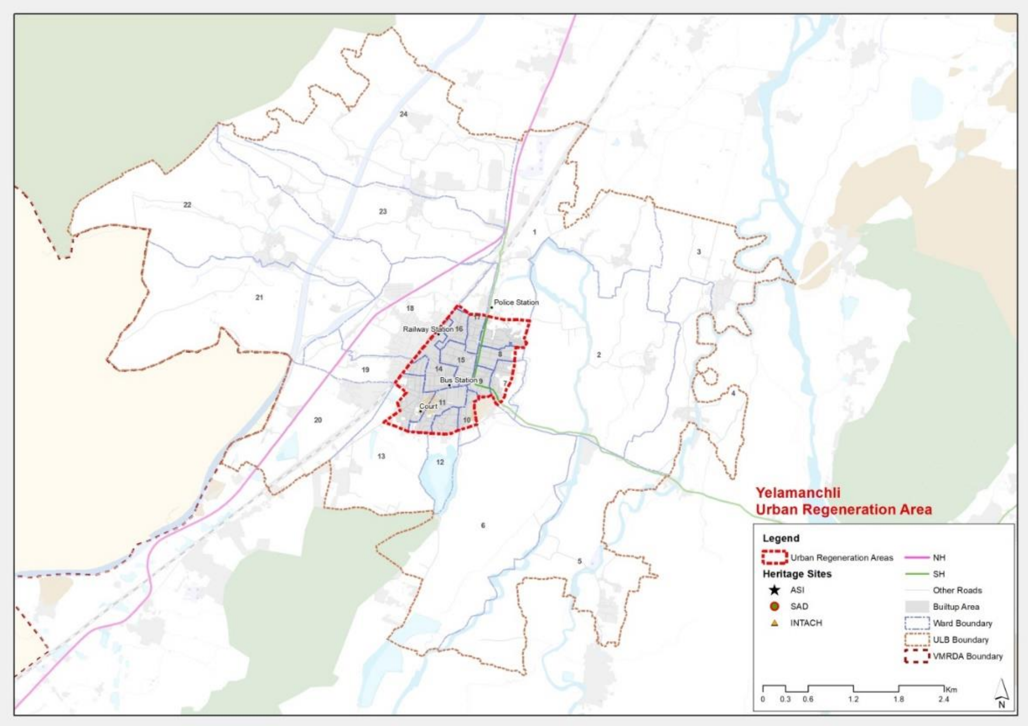


Figure 19-6: Proposed City Core Areas for urban regeneration in Yelamanchili

19.2 HERITAGE CONSERVATION AREAS

VMR region has a rich natural heritage, religious and cultural background with several layers of history. VMR is significant for cultural heritage and archaeological sites related to Buddhist sites, pilgrimage sites, and number of architecturally and cultural important places and buildings. VMR region has a rich natural heritage, religious and cultural background with several layers of history. The protection of Heritage properties is done by Archaeological Survey of India (ASI), State Archaeology Department (SAD), and listing of important heritage areas and structures are carried out by important non-government organization of INTACH (Indian National Trust for Art and Cultural Heritage). INTACH has listed heritage properties and sites that holds a historical and cultural importance in East Godavari district, which are not included for protection under ASI (or) SAD of Andhra Pradesh. The summary of heritage monuments and sites within the VMR wise is shown below in (Table 19-2) and further details of which are given in Appendix M. As a whole, VMR region has 5 monuments of national importance protected by Archaeological Survey of India, 11 monuments of regional importance protected by State Archaeology Department, and 121 important heritage areas and structures identified by INTACH. The summary of these monuments and heritage sites are given in Table 19-3. The location of Heritage sites and tourism sites is shown in figure.

Table 19-2: Institutions involved and Area wise distribution of Heritage Site

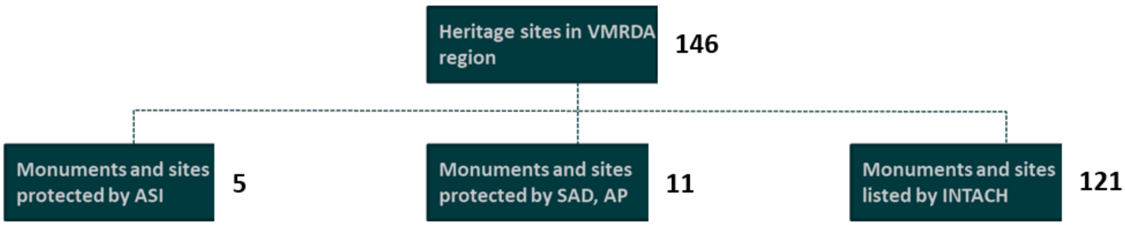


Table 19-3: Monuments and heritage sites in VMR

Districts	Vizianagaram	Visakhapatnam	Total
Heritage Properties/Areas	25	89	114

Source: List of Heritage Sites from ASI, State Archaeology Department, AP and INTACH

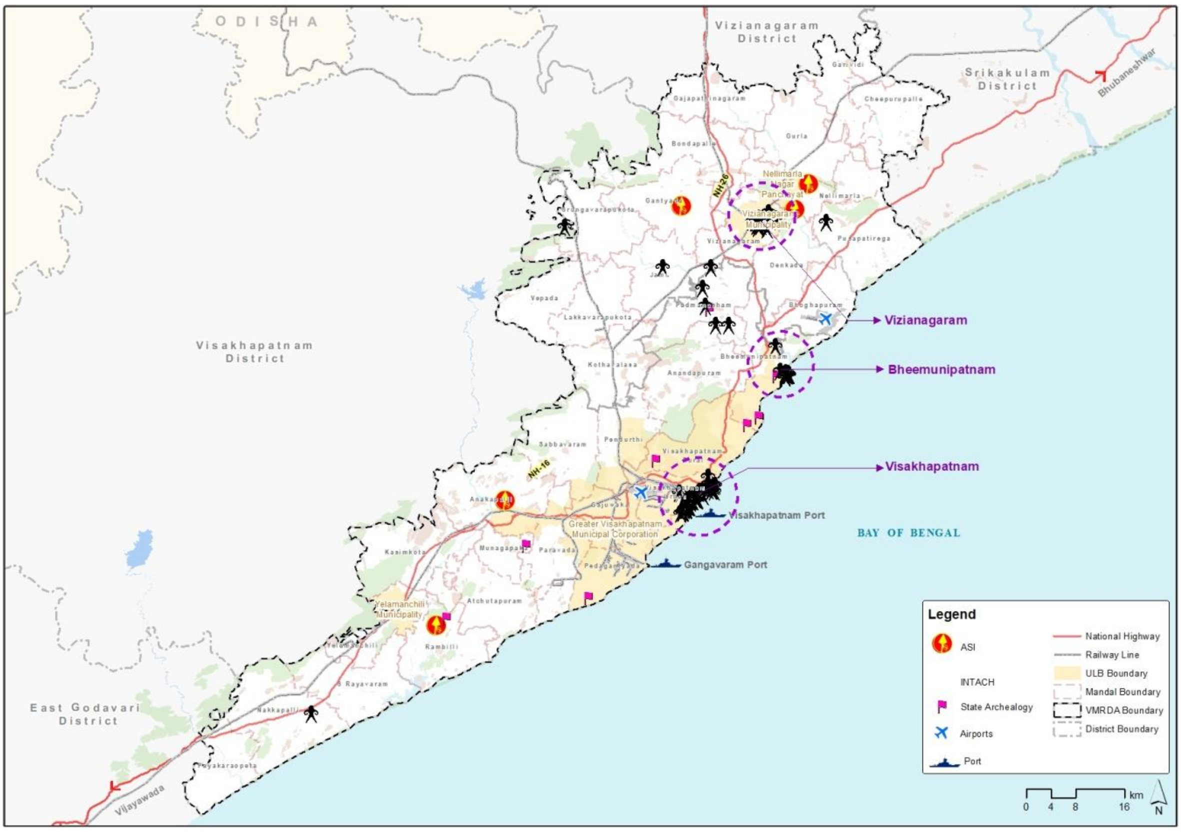


Figure 19-7: Heritage sites in VMR

Heritage is an important economic resource and has enormous tourism potential in VMR. It is important to protect and enhance these heritage areas as part of heritage protection and tourism development strategy. The strategies for heritage areas include:

- Listing and Protection of Heritage properties: An Inventory has been carried out by INTACH, to safe guard unprotected heritage in the region. The details of properties listed by INTACH were attached in Appendix M. It is proposed that these heritage resources are protection under the Master Plan and specific heritage conservation projects developed to realize their tourism and community development potential.

Figure 19-5: VMR is rich in cultural and archaeological heritage, and the heritage resource of the region can be further tapped for tourism and community development.

- **Promotion of Heritage Tourism:** Development of site-specific heritage tourism and creating infrastructure that supports tourism activity. Out of the protected and listed heritage sites, few sites can be showcased as potential heritage tourism areas. The heritage areas can be networked with other heritage and tourism properties/sites as circuits/trails.

- **Awareness:** Encouraging workshops, programs, etc. and publicity efforts at various levels.
- **Ease of Information**: social media, Websites, Apps and real time technology platform, integration with technology to be better informed.
- **Mobile app**: Navigates to near by heritage locations, displays events/programs happening, displays Heritage circuits, Heritage walks etc.
- **Urban Heritage Conservation Plan**: As part of the strategy toward urban regeneration of city core area of Vizianagaram, urban conservation plan for precincts surrounding Vizianagaram Fort, Pedda Cheruvu, traditional streets, and heritage buildings be promoted.

  - **Improving Public Space Quality**: Improving the heritage tourism in broad terms reflects improving public space quality by providing necessary infrastructure and visitor facilities like lighting, furniture, safety etc., thus contributing to community use.

19.3 URBAN DESIGN FRAMEWORK

Urban design focuses making cities/urban areas user friendly, medium to high density, public transport and pedestrian friendly, aesthetically appealing and imageable. The urban design strategies and guidelines are to focus on following aspects of existing and proposed urban built environment in VMR.

- **High Density and Transit Oriented Development (TOD):** The urban design strategy for existing and proposed new urban growth areas focuses on high density and transit-oriented development to promote an idea of compact city and encourages higher use of public transport. Potential Areas are to carry out TOD along the proposed metro corridors, dedicated bus public transit corridors, inter modal passenger mobility hubs, and Aero City at Bhogapuram. Transit oriented development while facilitating greater use of public transport will also focus on improve quality of built environment, especially from pedestrians and experiential quality standpoint.
- **Promote Mixed Use Development:** Urban design greatly emphasizes on mixed use as a way to promote flexibility in land use and development strategy in cities and create urban vibrancy in urban precincts/areas. The Master Plan for VMR focuses on promoting mixed use development at key nodal locations and as part of the overall urban structure for the VMR. As a strategy, majority of the work centres in the form of TODs, CBDs, Sub CBDs, and Neighbourhood Centres are proposed as mixed use areas to achieve vibrant, flexible, and demand based economic and socially sustainable urban built environment.
- **Walkable Streets:** In principle, the strategy is to design streets into public transport and pedestrian friendly in city cores and existing development areas. This is a central concern in context of VMR to make its exiting urban areas pedestrian/user friendly. As part of the overall and key urban design strategy, urban regeneration of city cores is proposed in the Master Plan for VMR.
- **Iconic Development:** In order to enhance image of the cities/urban areas in VMR, projects of public importance are recommended for development at strategic nodes/locations to create strong iconic and urban images for the region. These projects can include TODs, development/redevelopment of Transport nodes such as railway stations, ICBTs, and entry corridors and points to the cities/urban areas in VMR. Public parks, beachfronts development, lakefronts are some potential areas to create iconic and public friendly areas in the region.
- **Urban Development Regulations and Guidelines:** The DCR will includes urban design guidelines regulations such as FAR/FSI, building heights and setbacks with respect to RoWs, provision of NMT infrastructure in streets through Streets RoWs design treatment, heritage areas improvement, listing of important projects for urban regeneration in city cores of GVMC, VMC, and other municipal areas.
- **Key Urban Design Projects in VMR:** Followings projects are listed as potential urban design projects for which details studies before implementation are recommended.
- Seafront in GVMC Area
- 3 Sub CBDs of Anandapuram, Pendurthi, and New Gajuwaka-Kurmannapalem
- Proposed Mixed Use Corridors and ToD Nodes in Vishakhapatnam, Vizianagaram, Yelamachili, and Nellimarla.
- Urban Regeneration of City Cores of Visakhapatnam, Bheemunipatnam, Vizianagaram, Yelamachili, Nillimarla.
- Aerocity

- Enhancement and development of Meghadri Gedda Lake City Park and Edge Development, Kailashagiri hill park, Pedda Cheruvu in Vizianagaram, and other city parks proposed in VMR.
- Transit Oriented Development: Visakhapatnam Railway Station, Duvvada Railway Station, and TODs along the proposed Metro and BRT Corridors.
- Projects around concept of livable communities in greenfield expansion areas.

Figure 13-6: Urban Design Strategies and Guidelines for making Cities/Urban Areas in VMR users friendly and livable. TOD, Walkable neighbourhoods, sea and lakefronts, streets improvement from public transport and pedestrian perspective are key focus areas of the urban design strategies

19.4 WATER BODIES CONSERVATION AND SEAFRONT AREAS

VMR region has abundant water resources in the form of rivers, water tanks, rivulets, and canals passing through the region. Water Bodies are important features in ecosystem as they serve function of meeting requirements of the people for domestic, agriculture, industrial purposes and also for religious and cultural purposes. Proper conservation and restoration of water bodies will be essential to prevent water pollution, water logging and flooding in urban areas along with food security for future generation. There are approximately 20,000 water bodies (water tanks/lakes) in VMR located in rural and urban areas, which covers approximately 8.3% of VMR.

Focus needs to be given on improving water quality of the water bodies in urban and municipal areas by treating wastewater at source, such as 100% sewage and other wastewaters collection form properties, prohibiting any solid wastes and wastewaters getting into water bodies. Developing access to lakes and waterfronts is key to their utilization and making waterfronts visible and active is best way to protect waterbodies from abuse.

The major water bodies of the region are as follows.

- Lakes and other water bodies in the VMR region are mapped and their boundaries are marked as per the RVM, and wetted area as per the satellite imagery and are integrated in Proposed Land Use Plan.
- Among the above, beachfronts and surrounding tourist attractions and lakes, rivers can become important tourism and recreational facilities in the region.
- VMR, as a whole, have 170 km of coastline, over 528 Sq. km of water bodies, and number of rivers which are important part of ecological layers of the region. Protecting these environmentally sensitive layers and urban ecological system of the region is vital to retain image and ecological significance of the VMR.

Figure 19-7: Integrating seafronts, lakefronts, and riverside landscape can help further strengthen the green city image of Visakhapatnam region.

The development activities along the water bodies are primarily governed by the local and State administration through the Master Plan with the regulations enforced in AP Building Rules, 2017. Andhra Pradesh Water resource department have taken initiative in the area of sustainable water management, which focuses on promoting water conservation by interlinking of canals, construction of check dams, cleaning lakes and drains. All water bodies in VMR are protected by a buffer zone/special development zone as per the guidelines of GO. M.S. No. 119, MA & UD, GoAP (dated 28:03:2017). Best strategy to protect water bodies is to use them for recreational, tourism, and irrigation purpose. Following strategies are proposed for protection and enhancement of water bodies and seafront areas.

- Protect Urban Seafronts from encroachments and turn them into accessible and safe public space of the city, tourism and recreational uses. CRZ Regulations are guiding principles here towards protection and use of seafronts.
- Enhance lakefronts in urban areas, freeing lakes from encroachments, improving public access, and improving water quality of the lakes.
- Connect lakes and seafronts through green systems and NMT modes.
- Improve water quality of the lakes and rivers.
- Enhance biodiversity in catchment areas of the water bodies.

20 PHYSICAL INFRASTRUCTURE

20.1 INTRODUCTION

Infrastructure services act as a catalyst for development, which foster economic growth and enhance public well-being. Hence, provision of adequate infrastructure is defined as Basic Services for any developed and developing region in order to sustain its growth and development. The economic growth and urbanization in VMR will lead to congestion and urban development in new areas. Thus, the existing infrastructure facilities shall be overburdened and become inadequate. The chapter deals with the prospective demand and strategies for basic physical infrastructure required to provide satisfactory municipal services in proposed VMR.

Following basic physical infrastructure components have been discussed in this chapter:

(a) **Water Supply**

(b) **Sewerage / Waste Water System including recycling system**

(c) **Solid Waste Management**

(d) **Power Supply System**

The demand assessment for all the major components has been worked out based on the best engineering practices. The requirements for major trunk infrastructure components have also been identified for development of proposed VMR.

20.2 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 is required 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.
- 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 industrial, residential, commercial and institutional complexes has been considered. Therefore, based on the existing habitation and the developable land for various land uses the demand has been worked out.

Based upon the proximity of these entities, their demand has been clubbed together, to work out distribution zone wise / production zone wise demand of the area. So that the location of physical infrastructures viz the overhead service reservoirs, water treatment Plants, pipe lines etc., are finalized based upon area wise / zone wise water demand.

ADOPTED NORMS AND STANDARDS

Domestic Water Demand (Urban)

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, Government of India as well as URDPFI Guide line –2014 have recommended the domestic water demand for urban population as given in Table 20-1.

Table 20-1: Norms for Domestic Water Supply (Urban Population)

S No	Classification of Town / cities	Recommended water supply levels (LPCD)
1	Towns provided with piped water supply but without sewerage system	70
2	Cities provided with piped water supply where sewerage system is existing /contemplated	135
3	Metropolitan and Mega cities provided with piped water supply where sewerage system is existing /contemplated	150

Source: CPHEEO Manual

The URDPFI Guidelines-2014, issued by Ministry of Urban Development, Government of India has given classification of Urban Settlements, where in the cities having population 10 Lakh to 50 Lakh are classified as Metropolitan city class-I. Thus, the demand for urban population in VMR region has been taken as 150 LPCD for GVMC and Visakhapatnam Expansion Area and 135 LPCD for rest of the urban areas based on the recommendations in above table.

Domestic Water Demand (Rural)

The Ministry of Drinking Water and Sanitation, Government of India, under National Rural Drinking Water Program has issued Guidelines (2013) for Drinking Water Security in Rural India. These Guidelines have prescribed the Norms for providing potable drinking water in rural areas. The policy states to cover all rural households with safe piped drinking water supply @ 70 litres per capita per day. Accordingly, a service level of 70 LPCD has been adopted for all rural habitations of VMR.

Demand for floating Population & Employment

The water requirement for the floating population (without stay) and employment in secondary and tertiary sector with in VMR has been taken as 45 LPCD as per CPHEEO norms. No water demand is considered for employment in primary sector.

Industrial Water Demand

The Industrial Demand varies upon type of Industries existing / 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, steel, 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. The demand for high water intensive units goes as high as 60,000 to 1,00,000 litres per hectare in general and up to 3 to 3.25 Lakh litres per hectare for steel manufacturing units. But the demand for low water intensive units ranges between 20,000 to 50,000 litres per hectare. For assessment of water demand for industries in VMR, the type of industries existing, proposed expansion of existing industries and the industries likely to come in different zones has been assessed and the water demand calculated based on above assessment.

Horticulture Water Demand

Provision has also been kept for horticulture water demand for green parks and urban greens proposed / existing in the region. As per Table- 8.3.1.5 of URDPFI guide lines a demand of 22,500 litres per hectare has been taken for all urban greens in the region.

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)

But since VMR region covers a huge industrial area also, thus demand has been taken as 1% of the total demand, looking to the fire safety of industries in the region.

Recycling and Reuse of Water

To reduce the fresh water demand recycling of domestic and industrial wastewater is considered. The sewage and sullage generation have 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 65% of the water supplied to industries. 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 for meeting the horticulture demand for urban greens, firefighting and for industries primarily. The balance water is to be supplied in proposed new residential development for flushing use through dual piped system. It is also recommended that in group housing schemes/ commercial buildings proposed to be developed; the developer shall be bound to treat the grey water (sullage) generated and recycle it with in the property for gardening and flushing use.

Gross Water Demand & proposed source for additional demand:

Based upon the existing and proposed residential, commercial, Industrial, horticulture and firefighting demand, the gross water demand for the VMR has been estimated. 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 estimating gross water demand 15 percent losses have been considered in distribution system (as mentioned in URDPFI guide lines) and 3 percent losses in treatment plants. A transmission loss of 10% has also been considered for estimating the raw water demand at source in case if proposed source of water are open canals.

Based upon above norms and standards, the water demand for total VMR has been worked out and shown in Table 20-2 . The present water supply from existing water sources (which are minimum 90% dependable) has been deducted and additional water demand has been shown in the table. As already discussed in existing situation (part-A), the sub surface sources viz the bore wells some of the infiltration wells are not dependable during summers, thus have not been considered. Accordingly, it is seen that:

- Fresh water demand considering recycling of waste water : 1,990.6 MLD
- Yearly demand considering recycling of Waste water : 25.68 TMC
- Fresh water demand without considering recycling of waste water : 3,789.6 MLD
- Yearly demand without recycling : 48.90 TMC

Table 20-2: Gross Water Demand for VMR, 2041

Particulars of users	Water Demand (MLD)											
	GVMC	VIZ	Yelamachili	VSKP Expan.	VSKP Rural	VZM	Bhogapuram	VZM Rural	SKLM	Rajam	SKM Rural	Grand Total
Urban Population (Metro city area)	433.05	0.00	0.00	154.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	587.70
Urban Population (Below 10 Lac population)	0.00	93.69	19.71	0.00	0.00	120.02	38.07	0.00	92.75	14.45	0.00	378.68
Rural Population	0.00	0.00	0.00	0.00	30.87	0.00	0.00	67.06	0.00	0.00	61.53	159.46
Employment	50.98	9.24	2.23	9.11	0.00	19.11	11.01	0.00	17.36	1.58	0.00	120.62
Floating Population (Stay a day or 2)	8.66	2.08	0.22	7.73	0.00	2.67	4.23	0.00	2.06	0.16	0.00	27.81
Floating Population (Leaving on the same day)	6.50	1.56	0.13	2.32	0.00	0.80	2.54	0.00	0.62	0.10	0.00	14.56
Industrial demand (45 to 80 KL / Ha & 310 KL/Ha for steel plant)	832.69	717.60	1.68	6.66	8.19	9.63	9.54	119.40	17.37	0.64	46.02	1769.42
Fire fighting demand 1%	13.32	8.24	0.24	1.80	0.39	1.52	0.65	1.86	1.30	0.17	1.08	30.58
Urban Greens including Road Side Greens	85.68	74.16	6.52	113.14	0.00	33.57	26.32	0.00	23.45	4.21	0.00	367.04
Total	**1430.87**	**906.58**	**30.73**	**295.42**	**39.45**	**187.32**	**92.37**	**188.32**	**154.90**	**21.30**	**108.63**	**3455.88**
Sewage and Waste Water Generation in Urban population and industries	**940.60**	**551.70**	**18.93**	**143.38**	**5.32**	**120.34**	**50.88**	**77.61**	**101.51**	**13.44**	**29.91**	**2053.62**
Sewage from Rural Population					**24.70**			**53.65**			**49.22**	**127.57**
Recycled Water available to be used for Urban greens, fire fighting, Industries & flushing (Excluding the sewage from rural population)	659.19	386.65	13.26	100.48	3.73	84.33	35.66	54.39	71.14	9.42	20.96	1439.23
Net Fresh Water Demand at consumer end	771.68	519.93	17.47	194.94	35.72	102.98	56.71	133.93	83.75	11.88	87.66	2016.65
Transmission, Distribution & Treatment losses 25% (7+3+15)	192.92	129.98	4.37	48.73	8.93	25.75	14.18	33.48	20.94	2.97	21.92	504.16
Net demand considering recycling	**964.60**	**649.91**	**21.83**	**243.67**	**44.65**	**128.73**	**70.89**	**167.42**	**104.69**	**14.85**	**109.58**	**2520.81**
Present Water Supply including bulk supply to industries	**530.2**											**530.20**
Additional Water Demand	**434.40**	**649.91**	**21.83**	**243.67**	**44.65**	**128.73**	**70.89**	**167.42**	**104.69**	**14.85**	**109.58**	**1990.61**
Demand from Polavaram system/ BJJR Project	**1394.46**					**596.15**						**1990.61**
Yearly additional Water demand in TMC	**17.99**					**7.69**						**25.685**
Additional demand if recycling is not considered including losses												**3789.65**
Yearly demand in TMC if recycling is not considered												**48.899**
Allocation in TMC in Polavaram Dam for domestic & industrial use for Visakhapatnam area & Babu Jag Jivanram Project for Viziangram district	**23.40**					**9.80**						**33.20**

Source: Consultant's analysis

POTENTIAL WATER SOURCES

As has already been stated in Existing Situation Assessment Report, the existing sources of water in GVMC area are fully utilised and can't meet the future demand. The source of water for other urban centres are ground sources viz the infiltration wells etc, most of them go dry / yield is drastically reduced during summers. Here we are not preparing an augmentation / contingency scheme, but planning for coming 20 years, thus only dependable sources have to be considered. For any water supply project, the proposed source must have at least 90 to 95 percent dependability.

The present surface water sources within / nearby VMR, are already being used for GVMC to their full capacity / available allocation for drinking and industrial use, and the demand for VMR for plan horizon year is comparatively very high, new dependable source need to be identified. The existing impoundments in the region and possibilities of constructing new reservoirs were also explored. It is noticed that the flow from existing rivers in the region has already been captured at foot hills of their origin, and for residual flow, there is no suitable site for construction of big impoundment, since the residual flow passes through planes and no deep gorge is available to capture and impound this flow.

The available dependable sources on long term basis are:

1.	Indra Sagar Left main canal from Polavaram dam.	Available allocation for domestic and industrial use for Visakhapatnam district is 23.4 TMC
2.	Babu Jag Jeevana Ram Uttarandhra Sujala Sravanti Project.	Available allocation for domestic and industrial use for Vizianagaram district- 9.8 TMC.

Hon. Chief Minister, Andhra Pradesh has recently announced that Polavaram project shall be completed by the end of the year 2021. The work of left main canal is almost complete, and has reached within VMR region. Similarly, the work of BJR USS project along with its canals is also in progress. These projects envisage that to meet the demand for drinking and industrial use during non-operational days of these canals, the water shall be stored in proposed reservoirs and shall be transferred back to canal for domestic / industrial use. Thus, these canals have been proposed as source to draw raw water. A map showing both these canals is being shown below in Figure 20-1.

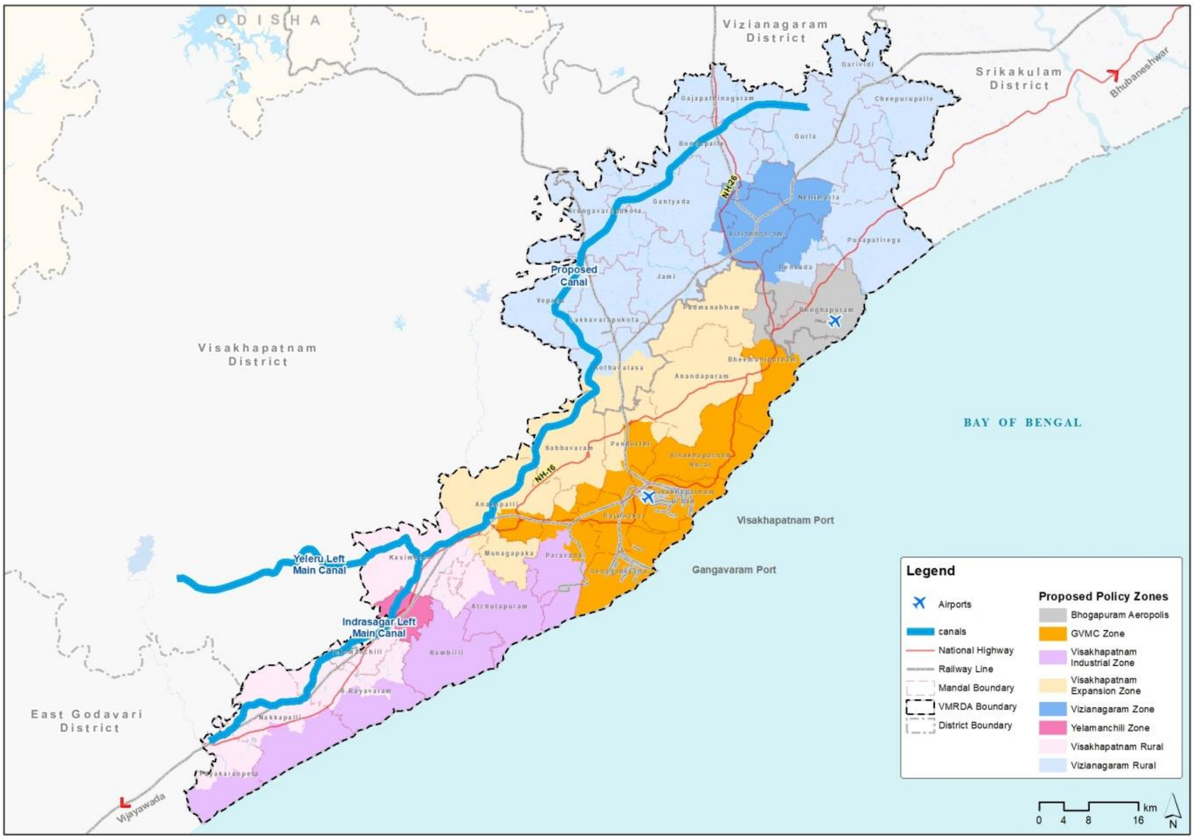


Figure 20-1: Route of Polavaram & BJR USS canals with in VMR

DESIGN CRITERIA

The design criterion adopted shall generally meet the recommendations laid down in CPHEEO manual on Water Supply and Treatment published by Ministry of Urban Development, Government of India and related specifications from Bureau of Indian Standards (BIS). Since dedicated Power feeder is proposed at each pumping station, the system has been designed for 22 hours pumping and 24 x 7 water supply in the region. The basic design considerations are being listed in Table 20-3.

Table 20-3: Water Supply System Design Criteria

Particulars	Criteria
Supply Hours	24 Hours
Pumping Hours	22 hours
Raw Water Transmission and WTP Capacity	For Available/ Allocated Water
Distribution System & Service Reservoirs	For Plan Horizon Year Demand (2035)
Economic Design of Pumping Mains	Considering capital and capitalized power expenditure for 30 Years
Pipe Material	For pumping mains – DI K-9 up to 1000 mm and MS pipe with inside cement mortar lining and outside gunnetting above1000 mm diameter. Distribution mains - DI K-7
CWR Capacity	2 Hours pumping capacity
ESR capacity	As per mass demand curve nearly 30% of Daily demand
Losses in Distribution System	15 percent

Particulars	Criteria
Losses in Treatment Plant	3 percent
Transmission Losses	10 percent, as canal being the raw water source

RAW WATER INTAKE AND PUMPING MAINS

It is proposed that Intake structures along with pumping stations shall be constructed on canals at different points in the region and water shall be pumped to different water treatment plants, through raw water transmission mains. The proposed intake arrangement and the raw water rising mains to different WTPs are shown in Figure 20-2.

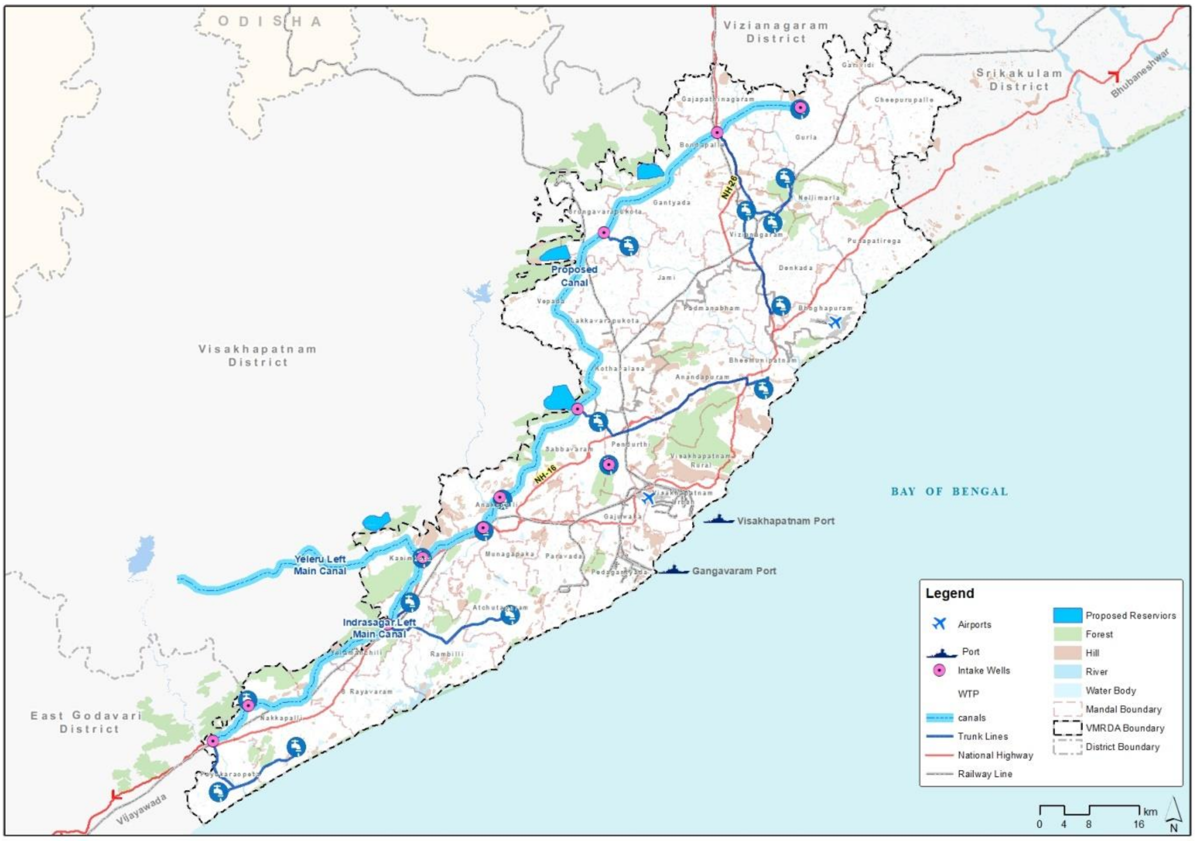


Figure 20-2: Proposed intake arrangement and the raw water rising mains to different WTPs in VMR

The size of all (raw water as well as clear water) pumping mains 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 nearby sizes of pipe has been worked out. The cost for MS pipes has been worked out considering bare cost of pipe, laying and jointing of pipe line, inside cement mortar lining and outside wrapping and coating with coal tar based epoxy / gunneting (for the length of pipe to be laid under-ground) and required saddles in case of pipes laid above ground. Thickness of MS pipe has been designed as per the provisions of Indian Water Works Association publication “Design of large diameter steel pipelines”, keeping in view the hoop stress, beam stress and localized stress at supports. Where ever economical size of pipe line is below 1000 mm diameter, ductile iron pipes with inside cement mortar lining are proposed, and the cost considered is including excavation, laying jointing, specials valves etc complete.

The design is carried out considering the present, intermediate and the ultimate demand for the project. The economical size of pipe so received has also 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. A sample design of pumping main as per CPHEEO design criteria is attached as Appendix N.

The proposed raw water mains are shown in Table 20-4 below:

Table 20-4: Proposed Raw Water Pumping Mains

S. No	Particulars	Quantity in meters
A.	Providing laying and jointing MS pipe line with inside cement mortar lining and outside CC gunneting, complete with excavation of trenches, fixing of specials and valves complete with welding testing and commissioning	
1	1829 mm diameter	43,400
2	1626 mm diameter	36,500
3	1422 mm diameter	12,330
4	1219 mm diameter	51,130
5	1067 mm diameter	2,500
B.	Providing laying and jointing Ductile Iron pipe line with inside cement mortar lining, complete with excavation of trenches, fixing of specials and valves complete with testing and commissioning.	
6	1000 mm diameter	5,800
7	900 mm diameter	33,900
8	800 mm diameter	47,365
9	600 mm diameter	46,810
10	450 mm diameter	5,850
	Total	**285,585.00**

PUMPING MACHINERY

Since water is to be pumped through wet intake well, open impeller type Vertical turbine pumps are proposed to be installed. Design discharge for the pumping sets at intake well has been arrived after taking into consideration the losses in distribution system, water treatment plant and conveyance main. Provision shall be kept for standby pumping sets minimum 50% of the working pumping sets. Where required capacity of motors is more than 500KW, 33 kV electric motors shall be installed, but for the motors below 500 KW, 440 V electric motors are proposed to be installed. The pumping sets have been designed taking the overall efficiency as 70%. The capacity of motor has been kept 10 percent higher than the input kw to pump at duty point as per CPHEEO manual, to take care of starting torque and the over load capacity of prime mover required to take care of additional power while pump is running at 25% lower head than at the duty point.

Accordingly, it is proposed to provide Turbine pumping sets of following capacities for each zone. These shall be coupled with squirrel cage induction motor complete with electric switch gears and required pipe fittings.

Table 20-5: Proposed Raw Water Pumping Sets

S. No	Particulars	Discharge in LPS	Head in M	KW Total Working	KW Total Installed
	Providing and installation of Vertical Turbine Pumps of following duty conditions, duly coupled with squirrel cage induction motor complete with riser pipes, delivery header, electric switch gears and SCADA control actuators including testing and commissioning complete job. This also includes for inlet arrangement from canal, intake well and pump house cum switch board room.				
1	Visakhapatnam Expansion & Yelamanchili	2,461.79	25	1,000	1,500
		6,019.84	50	4,800	7,200
2	Visakhapatnam Rural	374.37	40	250	500
		189.39	45	120	240
3	Visakhapatnam Expansion & GVMC	2,041.25	20	630	945
		448.93	15	105	210
		645.34	15	150	300
		1,947.25	60	2000	3,000
4	Vizianagaram Rural	2,113.85	25	820	1,230
5	Vizianagaram- Bhogapuram	5,417.55	120	10,000	15,000
	Total			**19,875.00**	**30,125.00**

WATER TREATMENT PLANTS

Based on the demand assessment for plan horizon year, the required capacity of treatment plants has been worked out. While considering additional capacity of treatment plants required, the capacity to be constructed by captive industries (RINL etc) and existing capacity of treatment plants has been deducted. The capacity of water treatment plants has been worked out taking into consideration the recycled water that can be used in the particular zone. It is proposed that recycled water is to be used primarily for horticulture, fire-fighting and to meet partial demand of industries. Remaining recycled water shall be used in newly proposed residential / commercial establishments/ group housing schemes for flushing through dual pipe line system. Existing thickly populated areas have not been considered for laying dual pipe system. The capacity of WTPs has been worked out considering 15% losses in distribution system.

Accordingly, it is proposed to construct following additional capacities of, Water Treatments Plants in each policy zone of VMR to meet the demand of plan horizon year. The zone wise capacities required are shown in Table 20-6.

Table 20-6: Proposed new Water Treatment Plants in VMR

S No	Zone	Capacity in MLD
1	Visakhapatnam Industrial Zone	586.0
2	Yelamanchili Zone	20.0

3	Visakhapatnam City(Part) Zone	143.0
4	Visakhapatnam Expansion Zone	219.3
5	Vizianagaram-Nellimarla Zone	116.0
6	Bhogapuram Airport and influence Zone	64.0
9	Visakhapatnam Rural	40.2
10	Vizianagaram Rural	151.0
	Total	**1,546.0**

Source: Consultant's analysis

It is proposed to have conventional type rapid gravity water treatment plants in all the nine zonal areas. The plants shall have following units:

(a) **Inlet chamber**

(b) **Raw water channel with flow meter**

(c) **Coagulation**

(d) **Rapid mixing device (Flash Mixer)**

(e) **Clariflocculator (Flocculator+ Clarifier)**

(f) **Granular sand beds**

(g) **Chlorine dozing mechanism**

(h) **SCADA system**

- 

The mechanical components (like, motors, pumps, etc) in the plant shall be provided for 15 years duration, and has to be replaced during the second stage augmentation.

The design parameters for calculating unit sizes of Water Treatment Plant are given in Table 20-7 below:

Table 20-7: Design Parameters for calculating the unit sizes of Water treatment plant

1	General		
	Working Hours	22	Hours

	Max losses assumed in Plant	3	Percent
	Over load capacity assumed	33	percent
	Inlet chamber detention time	45	Seconds
2	Rapid Mixing Unit (Flash Mixer)		
	Detention Time	45	Sec
	Ratio of tank height to diameter	1.5:1	
	Ratio of impeller diameter to tank diameter	0.20 to 0.40	
	Rotational speed of impeller (Paddle type)	More than 100	Rpm
3	Clariflocculator		
	Velocity of water in Influent Pipe	1	m/s
	Flocculator		
	Detention time	30	Min
	G Temporal mean velocity gradient	10 to 75	per sec
	Dimension less Parameter Gt	10,000 to 100,000	
	Depth of tank	3 to 4.5	M
	Paddle Area	10 to 25 % of X-section of tank	
	Peripheral velocity of blades	0.3 to 0.4	m / sec
	Clarifier		
	Detention time	2.0 to 2.5	Hours
	Depth of tank	2.5 to 5.0	Meters
	Inlet velocity of flow	Less than 0.3	M / min
	Surface Loading rate	30 to 40	Cum / sq m/day
	Weir loading	100 to 300	Cum / m / day
	Floor slope	1 in 12	
	Scraper Velocity	1.5 to 2	rpm
4	Rapid Sand Filter		
	Rate of Filtration	4.8 to 6	Cum / sq m / hr
	Length to width ratio	1.25 to 1.33	
	Gravel bed	45	Cm
	Sand bed	60	Cm
	Sand Effective size	0.45 to 0.70	Mm
	Sand Uniformity Coefficient	1.3 to 1.7	
	Area of perforation	0.3 % Filter area	
	Area of laterals	2.0 – 4.0 of perforation area	
	Area of manifold	1.5 - 2 times of Laterals area	
	Diameter of perforations	6 to 18	Mm
5	Backwash/Air wash		
	Duration of back wash	5	Min
	Rate of air	600 to 900	lpm / sqm
	Water wash		
	Wash water rate	400 to 600	lpm /sqm
	Duration of wash	5	Min
6	Chemical House		
	Chlorine dose	1 + 3 (Pre + Post)	Mg /l
	Alum dose	60	mg / l

Source: - Consultants Analysis

CLEAR WATER RESERVOIRS

The filtered water from above treatment plants shall be stored in RCC clear water reservoirs constructed at the site of these treatment plants. The water from WTPs shall flow under gravity to these reservoirs and stored. From these reservoirs the clear water shall be pumped to different service reservoirs in that zone. The capacity of CWRs is taken equivalent to 2 hours pumping capacity from the system to keep a margin for two hours break down and preventive maintenance of system. The proposed capacity of clear water reservoirs in each zone is being given in Table 20-8 below:

Table 20-8: Proposed Clear Water Reservoirs in VMR

S No	Zone	Capacity in ML
1	Visakhapatnam Industrial Zone	53.30
2	Yelamanchili Zone	1.80
3	Visakhapatnam City (Part) Zone	13.00
4	Visakhapatnam Expansion Zone	20.00
5	Vizianagaram-Nellimarla Zone	10.70
6	Bhogapuram Airport and influence Zone	5.80
9	Visakhapatnam Rural	3.65
10	Vizianagaram Rural	13.70
	Total	**140.80**

Source: Consultant's analysis

CLEAR WATER SUPPLY SYSTEM

The filtered water from above CWRs has to be pumped to different Service reservoirs in the zone. For which clear water pumping sets have been designed taking in to consideration the demand of particular distribution zone, difference in Ground level, staging of service reservoirs and the friction losses in transmission lines.

Clear water pumping mains have been designed for carrying treated water from CWRs to different service reservoirs in the zone. The size of all pumping mains 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 nearby sizes of pipe has been worked out. The cost has been worked out considering bare cost of pipe, laying and jointing of pipe line, inside cement mortar lining etc complete job. The design is carried out considering the present, intermediate and the ultimate demand for the project. The economical size of pipe so received has also 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.

Reinforced Cement Concrete Service Reservoirs have been proposed for each distribution zone. The staging required for the reservoir has been worked out based on the mass demand curve. The input to service reservoir is taken in 22 hours for full day demand. The peak supply is assumed both in morning and evening hours. Accordingly, the capacity of service reservoirs ranges between 29 to 30 percent of full day demand of the zone. Accordingly, it is proposed to provide following capacity of service reservoirs in each zone as shown in Table 20-9:

Table 20-9: Proposed capacity of service reservoirs in VMR

S No	Zone	Capacity in ML
1	Visakhapatnam Industrial Zone	175.80
2	Yelamanchili Zone	4.20
3	Visakhapatnam City (Part) Zone	23.90
4	Visakhapatnam Expansion Zone	65.80
5	Vizianagaram-Nellimarla Zone	20.70
6	Bhogapuram Airport and influence Zone	19.20
7	Visakhapatnam Rural	12.00
8	Vizianagaram Rural	45.30
	Total	**414.00**

Source: Consultant's analysis

The water from these service reservoirs is proposed to be supplied to consumers by gravity through properly designed distribution system. The trunk distribution system is proposed to be laid with DI pipes class K-7. Provision has also been kept for improvement of existing distribution system by sub zoning the existing zones for improvement in pressure. The distribution system shall be designed as per any popularly known program such as Water GEM/ Epanet or so.

Based on above the provisions taken for the regions pertaining to water supply system are being depicted in Table 20-10 below:

Table 20-10: Proposed Infrastructure components for Water Supply System

Particulars	Quantity	Unit
Raw Water Rising mains	285,600	Metres
Raw water Intake cum pumping station (Installed capacity)	30,125	Kw
Construction of Water Treatment Plants	1546	MLD
Construction of Clear Water Reservoirs	140.80	ML
Construction, supply and installation of clear Water pumping stations (Installed capacity)	25,836	Kw
Construction of Service Reservoirs	414	ML

Providing Laying & Jointing Clear water pumping mains	106,602	Metres
Providing Laying and Jointing Trunk Distribution system complete with fittings and accessories -DI - K7 pipes	990,993	Metres

Source: Consultant's analysis

20.3 SEWERAGE / WASTE WATER COLLECTION, TREATMENT AND RECYCLING SYSTEM

Proper sewerage system and sewage treatment plants are the basic physical infrastructure which will improve the environmental conditions in the area and also reduce the health problems of the people living in the region. The existing conditions of waste water management practices prevailing in the region, industrial waste water treatment practices / infrastructure and sewerage related infrastructure were studied in detail for identifying existing infrastructure gaps. Likely generation of waste water from proposed industrial areas and the sewage from domestic areas was also estimated. Based on the demand estimated, the waste water infrastructure requirement of the region is worked out for incorporating into the Master Plan is prepared. This section details out the waste water generated, infrastructure requirement and the design of waste water infrastructure of the region including Sewage Treatment Plants, Effluent Treatment Plants, Tertiary Treatment Plant and Recycling.

SEWAGE & WASTEWATER GENERATION

The Sewage Collection and recycling system is planned and designed to collect, treat, and recycle all the domestic sewerage generated from residential areas and Waste Water from Industrial areas. Waste water generation from the project area is estimated for domestic, commercial and industrial sources. The domestic sewage generation has been considered as per guide line given in CPHEEO Manual, ie 80% of water supplied to consumers. The waste water generated from Industries has been considered as 65% of the water supplied to Industries. Some of the industries in GVMC are captive industries, such as RNIL steel plant, HPCL steel plant, Coromandel Fertilizers etc. They will create their own infrastructure. State has only to provide water to them. Thus, CETP for such industries has not been considered.

While working out sizes of collection system and capacity of Sewage Treatment Plant, provision has been kept for 5% infiltration through sewer lines looking to rainfall in the area. The domestic sewage generation from residential areas and commercial establishments has been estimated for designing the collection system and capacity of treatment plant required. An estimate of the Sewage / Waste Water generated and capacity of Sewage Treatment Plant, Waste Water Treatment Plant (CETP) and Tertiary Treatment Plants required has been calculated separately for each zone of VMR Region and shown in Table 20-11 below. The locations of the Proposed STPs are shown in Figure 20-3.

Table 20-11: Sewage / Waste Water Generated & Capacity of STPs/ CETPs & TTPs required

Particulars	GVMC	VIZ	Yelamachili	VSKP Expan.	VSKP Rural	VZM	Bhogapuram	VZM Rural	Grand Total
Sewage generated (Sewage from Rural not considered here)	399.35	85.26	17.83	139.05	0.00	114.08	44.68	0.00	800.25
Add infiltration losses 5%	19.97	4.26	0.89	6.95	0.00	5.70	2.23	0.00	40
Capacity of Sewage Treatment Plants required	419.00	90.00	19.00	146.00	0.00	120.00	47.00	0.00	841
Capacity of existing STPs (Including under construction)	225.50								225.5
Net capacity of STPs required after sbstracting cap. of existing STPs	193.50	90.00	19.00	146.00	0.00	120.00	47.00	0.00	615.5
Proposed Capacities of STP	**195.0**	**90.0**	**19.0**	**146.0**	**0.0**	**120.0**	**47.0**	**0.0**	**617**
Waste Water Genarated		466.44	1.09	4.33	5.32	6.26	6.20	77.61	567.25
Add infilteration losses 5%	0.00	23.32	0.05	0.22	0.27	0.31	0.31	3.88	28.36
Capacity of Waste Water Treatment Plants (CETPs) required	0.00	489.76	1.15	4.55	5.59	6.57	6.51	81.49	595.62
Proposed Capacities of CETPs		**490.0**	**1.2**	**5.0**	**6.0**	**7.0**	**7.0**	**82.0**	**598.2**
Capacity of Tertiary Treatment Plants required	356.15	492.80	17.12	127.96	4.75	107.59	45.48	69.27	1221.12
Proposed Capacities of TTPs	**356.0**	**493.0**	**17.5**	**128.0**	**5.0**	**108.0**	**46.0**	**70.0**	**1223.5**

Source: - Consultants Analysis

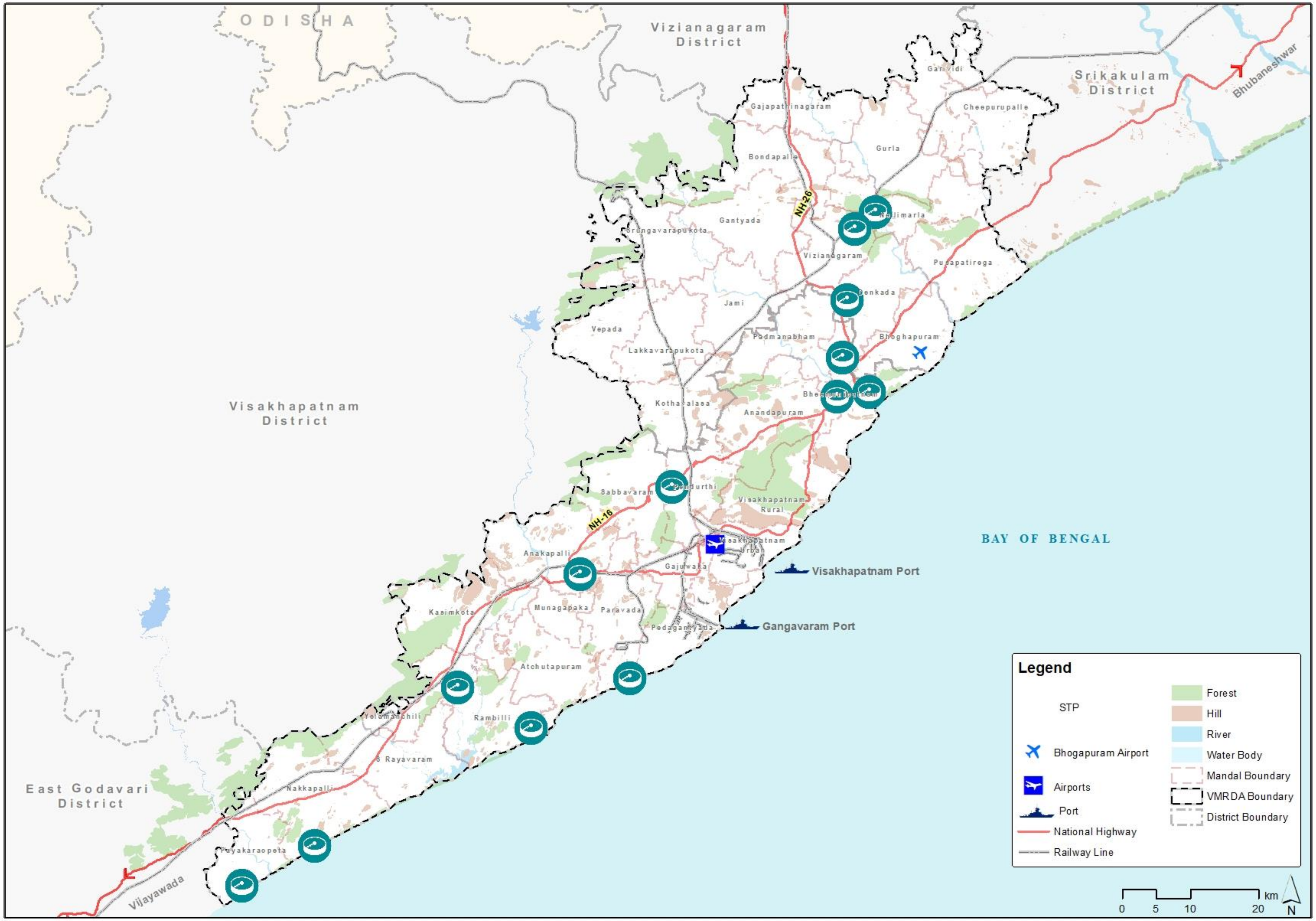


Figure 20-3: Location of Proposed STPs

COLLECTION SYSTEM

The collection system required for each zone for Sewage collection as well as for industrial Effluent is based on the design parameters shown in Table 20-12 below:

Table 20-12: Design parameters for Collection Net work

S. No.	Parameter	Design principle adopted
1	Minimum velocity at initial peak flow	0.6 m/s
2	Minimum velocity at ultimate peak flow	0.8 m/s
3	Maximum velocity	3.0 m/s
4	Maximum depth of flow at design peak flow	0.5 (up to 400 mm dia.) 0.66 (400 mm dia. to 900 mm dia) 0.8 (above 900 mm dia)
5	Minimum size of sewer in trunk system	200 mm
6	Maximum spacing of man holes	30 meters (up to 300 mm) 60 to 120 meters (above 300mm)
7	Additional man holes	At every junction, change of alignment, change of dia./gradient
8	Minimum cover	1 meter to the crown of the pipe
9	Formula adopted for designs	Manning's formula
10	Manning's coefficient	0.013 for RCC pipes
11	Per capita water supply	150/135 LPCD
12	Per capita sewage generation	80% of domestic supply & 65% for water supplied to Industries
13	Design ultimate year	Thirty Years
14	Pipe material considered	HDPE/ RCC Pipes class NP-3
15	Peak factors considered	2
16	Type of man holes	Circular

Source: CPHEEO Manual on sewerage

SEWAGE/ WASTE WATER TREATMENT AND TERTIARY TREATMENT PLANTS

The proposed Sewage/ Waste Water Treatment plants will treat the raw sewage by primary treatment such as screening and de-gritting followed by secondary treatment. After secondary treatment the sewage could be given tertiary treatment such as sand filtration followed by chlorination. The treated sewage can be reused for non-potable uses such as gardening, public parks, landscaping and flushing etc. In case of CETP, chemical treatment shall also be given prior to Biological treatment.

A comparison of various biological treatment technologies is given in Table 20-13 comparing removal of different impurities viz. BOD, COD, TSS, Area required, Capital cost required, and Power charges. It has been proposed to use MBBR/ SBR technology for treatment looking to the capital investment, Area requirement and effluent quality. The typical flow diagrams for Moving Bed Bioreactor Technology / Sequential Batch Reactor Technology along with sand filter for tertiary treatment are shown in Figure 20-4 and Figure 20-5.

Table 20-13: Comparison of different STP Technologies by MoEF

Sr. No.	Parameters	STP Technologies				
		Up flow Anaerobic Sludge Blanket (UASB)	Activated Sludge Process (ASP)	Moving Bed Bio Reactor (MBBR)	Membrane Bio Reactor (MBR)	Sequential Batch Reactor (SBR)
1	Effluent BOD, mg/l	<20	<20	<30	<5	<10
2	Effluent COD, mg/l	<250	<250	<250	<100	<100
3	Effluent TSS, mg/l	<30	<30	<30	<5	<10
4	Odour	Generates Foul Odour	Odourless	Odourless	Odourless	Odourless
5	Kinetic Reaction	Slow	Relatively Fast	Relatively Fast	Relatively Fast	Relatively Fast
6	Total Area, m2/MLD	1,000	900	450	450	450
7	Capital Cost INR Lacs/MLD	68	68	68	300	75
8	Yearly Power Cost, INR lacs pa/MLD	2.75	4.07	4.9	6.65	3.37

Source: - Recommendations and Guidelines for Sewage Treatment, Ministry of Environment and Forest

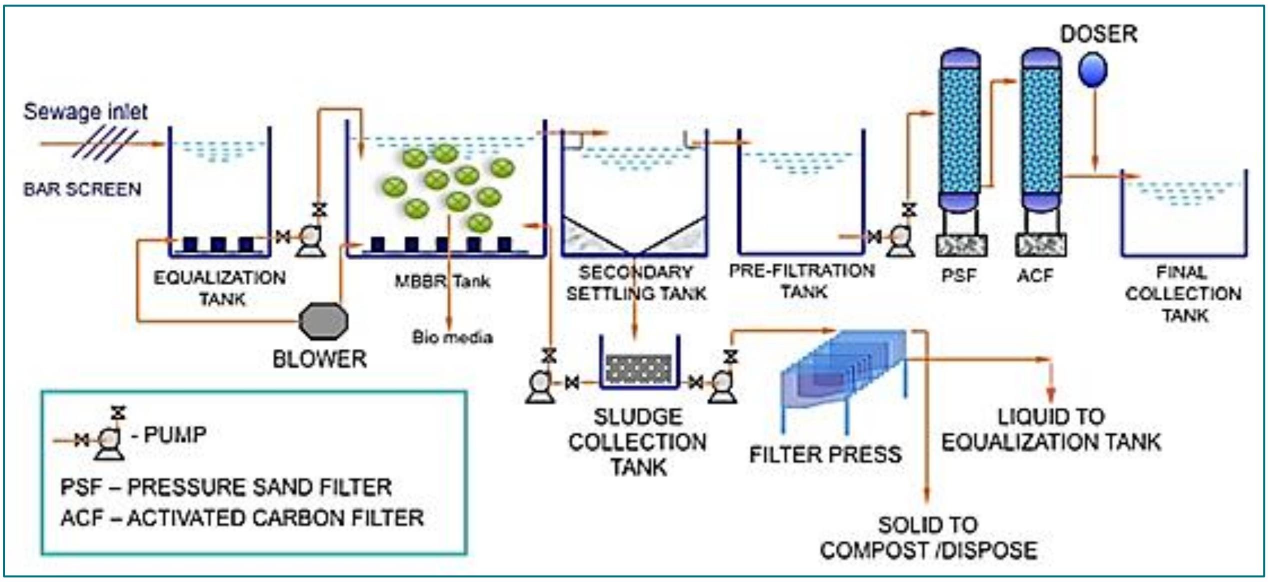


Figure 20-4: Flow diagram for MBBR Type Treatment Plant

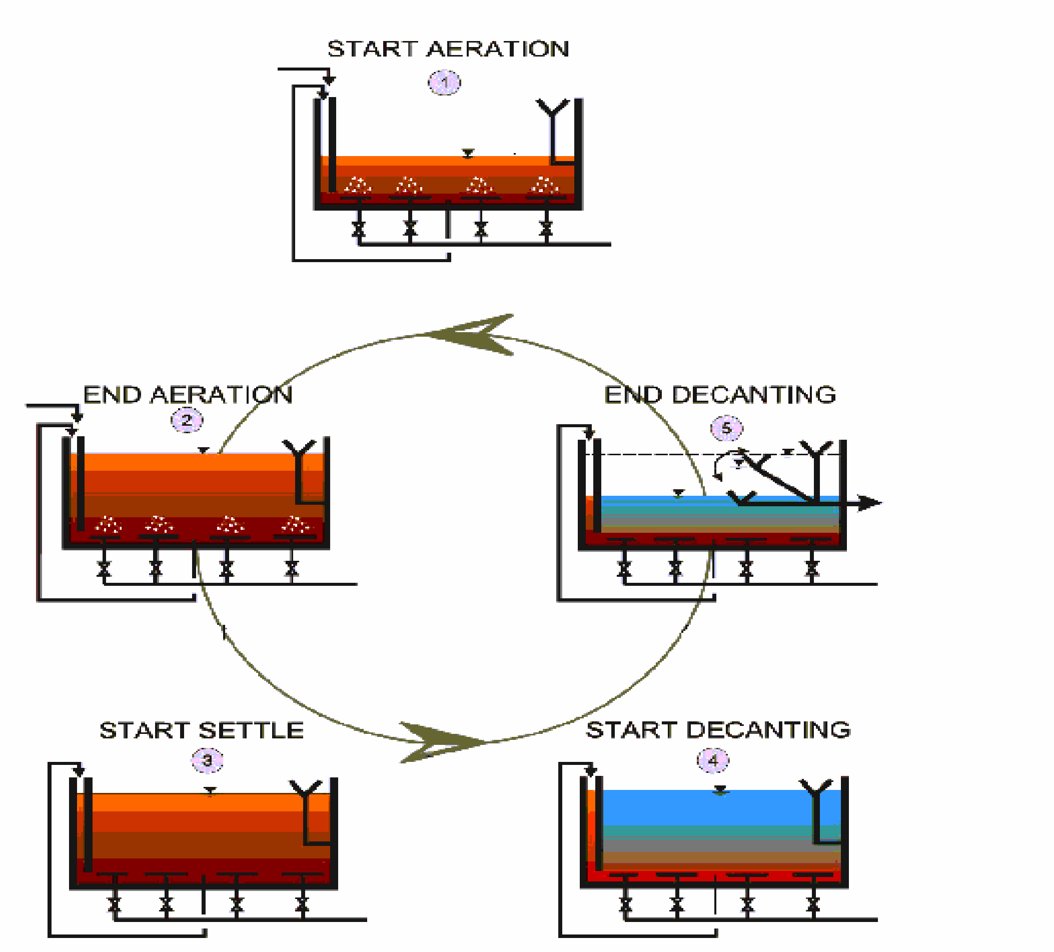


Figure 20-5: Flow diagram for SBR Type Treatment Plant

RECYCLING OF TERTIARY TREATED WATER

Given the present environmental guide lines, no land or off-shore disposal of treated sewage is proposed in the project. All treatment plants are envisaged to provide tertiary treatment to enable recycling of waste water. It is proposed that the sewage generated from the residential zones of the project area can be reused after giving proper treatment for general purposes such as gardening, public parks, washing and cleaning purposes in domestic and industrial areas etc.

The Tertiary treated water from TTPs shall be collected in an RCC storage Reservoir, where from it shall be pumped to different users through Recycled Water distribution system. The recycled water is proposed to be used for meeting the horticulture demand for urban greens, firefighting and for industries primarily. The balance water is to be supplied in proposed new residential development for flushing use through dual piped system. It is also recommended that in group housing schemes/ commercial buildings proposed to be developed, the developer shall be bound to treat the grey water (sullage) generated and recycle it with in the property for gardening and flushing use.

The recycled water distribution system is proposed with HDPE / DI pipe class K-7 pipes. Proposed Infrastructure components for Sewage/ Waste Water collection treatment and recycling system has been designed, calculated and shown in Table 20-14 below:

Table 20-14: Proposed Infrastructure components for Sewage/ Waste Water/ Recycling System

Particulars	Quantity	Unit
Providing Laying & Jointing Trunk Collection System for collection of Sewage and Waste Water with HDPE/ GRP/ RCC pipes complete with excavation, bed concrete and man holes etc.	772,733	Metres
Construction, supply and installation of Sewage Pumping Stations	3,117	Kw
Providing Laying & Jointing pumping mains ranging from 200 mm to 400 mm diameter with DI pipes class K-9 complete with all required fittings valves etc.	5,400	Metres
Construction of Sewage Treatment Plants complete with all civil and electro mechanical works	726	MLD
Construction of Effluent Treatment Plants complete with all civil and electro mechanical works	643	MLD
Construction of Tertiary Treatment Plants comprising of sand filters, activated charcoal treatment and disinfection system complete with all civil and electro mechanical works	1,354	MLD
Construction of Tertiary treated Water Reservoirs complete with pipe fittings etc	132	ML

Construction, supply and installation of pumping stations for recycling of TT water for horticulture, industrial and other non- potable usage, complete with power line staff quarters and required ancillary works	25,115	Kw
Construction of Service Reservoirs complete with all pipe fittings	265	ML
Providing Laying & Jointing clear water pumping mains ranging with DI-K-9 pipes	86,836	Metres
Providing Laying and Jointing TT Water Trunk Distribution system complete with fittings and accessories -HDPE/GRP/ DI - K7 pipes	463,640	Metres

20.4 STORM WATER DRAINAGE

Most Indian cities lack in adequate storm water drainage system, which results in flooding and inundation in habituated areas. Numerous factors account for poor drainage system in our cities. The most common of them are:

- Poor maintenance and timely cleaning/ de-silting of city drains.
- Blockage of city drainage system by solid waste.
- Changes in land use resulting in blockage of natural water ways and depletion of flood storage.
- Blockage of Natural Drainage system by agricultural wastes, silt arising from both natural erosion and construction activities, indiscriminate land filling.

These problems can be mitigated by regular maintenance of drainage system/ by clearing all blockages prior to monsoon and hundred per cent coverage by properly designed drainage system.

In addition to it the low lying, areas abutting natural drains/ rivers also face inundation and flooding. Though presently such areas were falling in rural part of VMR, but now some of such parts are proposed to be urbanised. Due to urbanisation such locations shall have built up areas with paved road surfaces. Thus, the chapter is narrated under two heads:

- Road side drainage system.
- Necessary steps to be taken to avoid inundation in urban parts falling near natural drains.

Storm water drainage is designed for the project area to collect and dispose of rain water in a manner that does not flood the surrounding areas due to increased impervious surface from the proposed habituated areas as part of the proposed developments. The design details for storm water drainage are provided below.

DESIGN CRITERIA

The drainage system has to be designed to follow the natural drainage pattern of the area to maintain the ecological balance. All care has been taken to follow natural ground slopes so as to avoid unwanted excavation during construction of drains.

The average rainfall in VMR region as per metrological data is 945 mm. Thus, drainage system has been designed with the said average rain fall. The maximum intensity of rain fall worked out based on this data.

The design of storm water drainage system is 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.

As per guide lines in IRC-SP:50, 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. It is recommended in this code that the road side drains be designed for 2 years return period, and the natural drains passing nearby for 5 years return period.

Thus the road side drains have been designed for two years return period, assuming drains on both sides of roads. 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 minutes rainfall, some 5 minutes 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 for which maximum intensity has been considered is taken equal to the time of concentration.

Based on the rainfall data, and rational analysis of the data, the Department of Hydrology, Indian Institute of Technology – Roorkee, has published a paper on Regional Rainfall intensity, Duration and Frequency relationship.

After analysing the data for 42 stations in India (Visakhapatnam being one of these 42 stations), and based on the Rambabu's empirical formula the relationship between intensity of rainfall and duration has been given as follows:

I = {K x T a}/{ t + b} n

Here I = Intensity in cm / hr

t = Storm duration in hours

K, a, b and n are the constants developed for various stations.

Values of above constants for Visakhapatnam area are;

K = 6.646

a = 0.1692

b = 0.50

n = 0.9963

So, for Visakhapatnam for 2 years return period and for one hour duration, the critical intensity of rainfall works out as 2.99754 cm per hour i.e., about 30 mm per hour. Thus, the Critical intensity of rain fall for VMR has been taken as 30 mm per hour for working out peak discharge for design of drains. 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 is prepared for adopting in the design of drain.

Table 20-15: Time of concentration & design intensity of rainfall

Time of concentration in minutes	Time of concentration in hours	Critical Design intensity of rain in cm/hr
2	0.0333	5.8065
3	0.0500	5.7143
4	0.0667	5.6250
5	0.0833	5.5385
6	0.1000	5.4545
7	0.1167	5.3731
8	0.1333	5.2941
9	0.1500	5.2174
10	0.1667	5.1429
11	0.1833	5.0704
12	0.2000	5.0000
13	0.2167	4.9315
14	0.2333	4.8649
15	0.2500	4.8000
16	0.2667	4.7368
17	0.2833	4.6753
18	0.3000	4.6154
19	0.3167	4.5570
20	0.3333	4.5000
21	0.3500	4.4444
22	0.3667	4.3902
23	0.3833	4.3373
24	0.4000	4.2857
25	0.4167	4.2353
26	0.4333	4.1860
27	0.4500	4.1379
28	0.4667	4.0909
29	0.4833	4.0449
30	0.5000	4.0000
31	0.5167	3.9560
32	0.5333	3.9130
33	0.5500	3.8710
34	0.5667	3.8298
35	0.5833	3.7895

Time of concentration in minutes	Time of concentration in hours	Critical Design intensity of rain in cm/hr
36	0.6000	3.7500
37	0.6167	3.7113
38	0.6333	3.6735
39	0.6500	3.6364
40	0.6667	3.6000
41	0.6833	3.5644
42	0.7000	3.5294
43	0.7167	3.4951
44	0.7333	3.4615
45	0.7500	3.4286
46	0.7667	3.3962
47	0.7833	3.3645
48	0.8000	3.3333
49	0.8167	3.3028
50	0.8333	3.2727
51	0.8500	3.2432
52	0.8667	3.2143
53	0.8833	3.1858
54	0.9000	3.1579
55	0.9167	3.1304
56	0.9333	3.1034
57	0.9500	3.0769
58	0.9667	3.0508
59	0.9833	3.0252
60	1.0000	3.0000

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 been adopted for the design of storm water drains in VMR:

Residential Area : 0.60

Industrial Area : 0.55

Open / Parks : 0.15

Roads : 0.90

Peak Run-off rates

The IRC – SP: 50: 1999, recommends, that for the smaller water sheds not exceeding 50 square kilo meters, the following rational formula is to be used for estimating peak run-off rates. Since in VMR individual water shed is below 50 sq. km area, so accordingly the said formula has been adopted for VMR drain design:

$$Q = 0.028 \, P \, A \, Ic$$

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 time of concentration / duration

Methodology adopted for design

Based on contours levels the water shed area for individual drainage zone was plotted on the map.

Further in each drainage zone the nearby water bodies, where drain water can be discharged was identified. Depending upon the levels of individual drainage zones the direction of flow was marked on each road, and the route to discharge point was identified in the water shed for all the drainage zones.

Then each junction was given a node number, and each branch in the water shed of the individual drainage zone was designed and checked for designed peak flow. The steps considered for the design of drainage system are being illustrated below:

- Each branch was designated by node numbers.
- The drain on both sides of road was designed separately.
- Length of drain worked out.
- Ground levels at start and end of drain noted.
- Based on the catchment area of the drain, the bed width and water depth at start and end of drain assumed.
- Area of proposed drain and bed slope worked out.
- The velocity and capacity of drain worked out as per Manning's formula.
- Based on the maximum length of catchment and the slope of catchment, the over land flow time was worked out.
- For the cumulative discharge the drain flow time is worked out.
- Based on these two times the time of concentration is calculated.
- Then the corresponding maximum intensity of rain fall for the time of concentration as calculated above is worked out.
- Based upon the type of catchment, the runoff coefficient is worked out.
- As per catchment area of drain and run off coefficient the sub catchment flow is calculated.
- This flow is compared with the carrying capacity of the drain proposed.

Due care is taken that the capacity of drain is slightly higher than the catchment flow, but is not enormously high. Based on above design criteria, and parameters adopted the design of road side drains (on both side of road) has been done for 2 years return period. The cost for Storm water drains have been included in the estimates prepared for Road net-work. Here the cost for training the natural streams / drains shall be included.

Natural Streams:

It is observed that some of the natural streams traverse through VMR boundary. Rivers namely Gosthani, Sarda, Varaha, Thandava, Champavati and some geddas also traverse through study area. A map showing areas observed inundation problem in previous years (up to 100 years return period) along with the related rivers is being shown below in Figure 20-6.

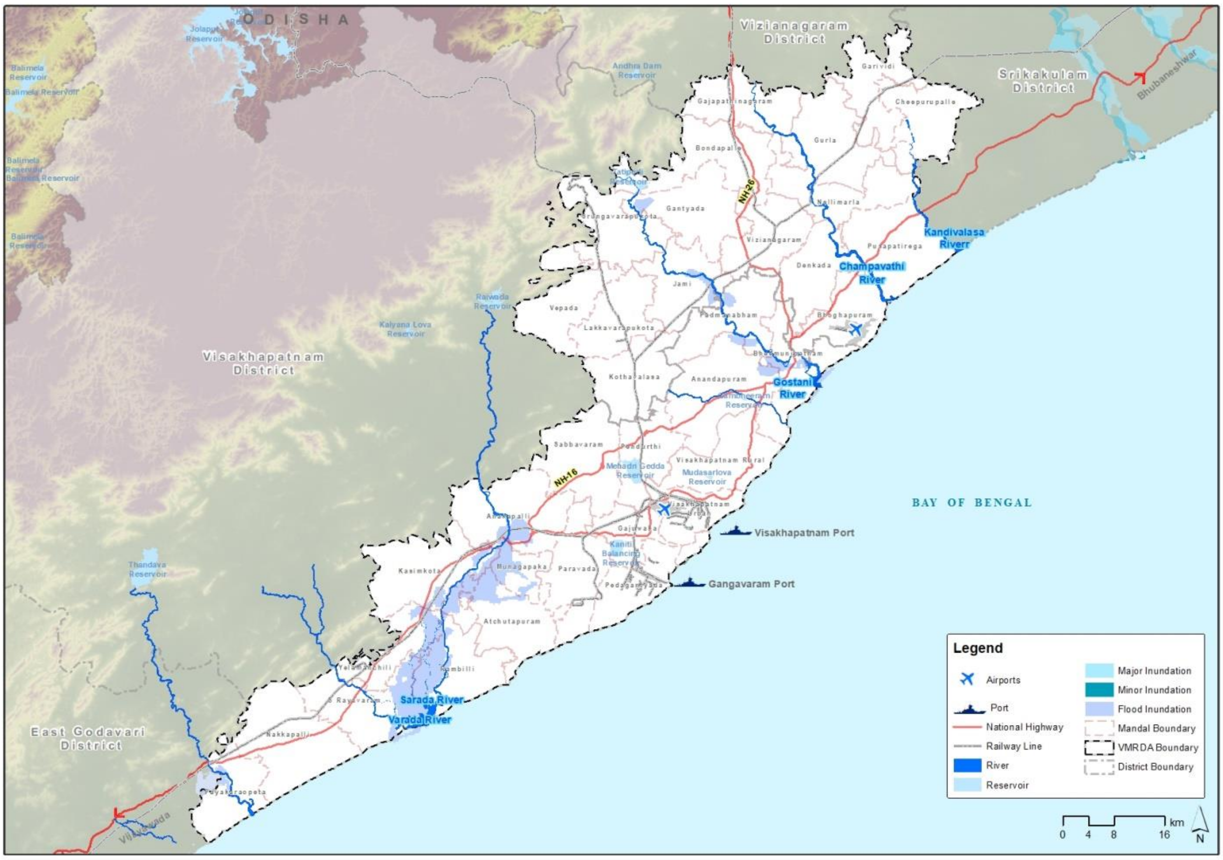


Figure 20-6: Probable areas of inundation in VMR Region

The Andhra Pradesh State Development Planning Society has also mentioned about maximum discharge for these major rivers at 2 year and 100 years return period. In general, the cause of inundation is meandering of such streams and low-lying areas nearby. The section of the stream is checked to cater the discharge for 25 years return period, and provision is being kept for straightening of such streams at meandering portions and for lining the side berms at few places to increase velocity of flow. A total of 6,900 meters long stretches has been identified for straightening the meandering portion and lining the berms with stone pitching.

20.5 SOLID WASTE MANAGEMENT

Domestic or Municipal SWM (MSWM) is the responsibility of the governing authority of any region, in this case VMR has to provide related services. Generation of solid waste has been calculated for each policy zone. This service requires an integrated approach involving the civil society and government for effective management.

Strategies for MSWM:

The strategies adopted for MSWM are highlighted as follows:

Segregation at Source: Segregating of waste at the household level reduces the quantum and increases the effectiveness of the disposal process. This includes a concerted effort of the user and the service provider.

Recycling of waste: Segregation of recyclable waste has also to be done at source. This can well be adopted by the authority with the help of NGOs to spread awareness about the same. This process can involve private participation and recycling units can be established at a small scale.

Waste to Energy: Biodegradable waste and combustible waste can be used to generate energy. This can be done through Public Private Partnership.

Scientific landfill: The MSW disposal will require a site to construct an engineered landfill site. Only the inert material should be transported to landfill site after segregation of combustible, recyclable and bio degradable waste. In general, the inert waste to go to land fill sites must be within 10 to 15% of total MSW.

The Solid waste generation has been calculated as per Solid Waste Management manual- 2000, published by the CPHEEO. Accordingly, the total waste generated in each zone has been estimated and shown in Table 20-16 below:

Table 20-16: Total MSW Generated in plan horizon year

Particulars of users	SW Generation in Gram/ Day	Total SW Generated in MT / Day								
		GVMC	VIZ	Yelamachili	VSKP Expan.	VSKP Rural	VZM	Bhogapuram	VZM Rural	Grand Total
Urban Population	450	1299.2	312.3	65.7	464	0	400.1	126.9	0	2668.2
Rural Population	250	0	0	0	0	110.3	0	0	239.5	349.8
Employment (Industrial)	800	416.2	88.5	6.7	75	5	61.9	63.2	51.7	768.2
Employment (Institutional & Commercial)	200	122.5	19	8.3	21.7	21.4	69.5	33.1	1.7	297.2
Street Sweeping (Employment + Population)	100	402	89.9	19.6	123.3	55.4	131.4	52.7	103.1	977.4
	Total	**2240**	**510**	**100**	**684**	**192**	**663**	**276**	**396**	5061

Source: Consultant's Analysis

Composition/ classification of Waste

The analysis for physical composition of waste has been carried out as per MOUD-CPHEEO Manual-2000 (P- 65). As suggested in the said manual, the following classification criteria have been adopted for VMR region:

- ***Recyclable Waste***: 15% of the total waste is considered as recyclable waste.
- ***Bio Degradable Waste:*** 50% of total MSW (as per manual, 40-60%) has been considered as Bio-degradable waste. This includes mainly Kitchen waste, Waste from Food processing industries, from fruit / vegetable market, from Fish / meat market, Garden waste and other possible organic waste.
- ***Non-Biodegradable:*** Rest of the waste (35% of total) is considered under Non-Biodegradable / hazardous / inert matter category. (Out of this 50% is taken as combustible waste (fit for Incineration) and rest 50% is proposed for landfill site.

Construction& Demolition Waste: 10% of the total Solid waste has been considered under C&D (Construction Demolition waste). Most of the item shall be recyclable in nature like metal, tiles, timber, broken glass, cardboard, plastic etc., while the rest would be having sand, masonry, broken concrete piece etc., which could be used for filling low lying area, roadside and other construction places and in landfill site.Accordingly, the zone wise classification of Solid Waste is being depicted in Table 20-17 below:

Table 20-17: Zone wise classification of Solid Waste

Type of waste	%age of Total waste	Zone wise classification								
		GVMC	VIZ	Yelamachili	VSKP Expan.	VSKP Rural	VZM	Bhogapuram	VZM Rural	Grand Total
Recyclable Waste incl. part of C & D waste	15	336	76	15	103	29	99	41	59	758
Biodegradable waste	50	1,120	255	50	342	96	331	138	198	2530
Combustable	17.5	392	89	18	120	34	116	48	69	886
Inert material for land fill site	17.5	392	89	18	120	34	116	48	69	886
Total		**2,240**	**510**	**100**	**684**	**192**	**663**	**276**	**396**	**5061**

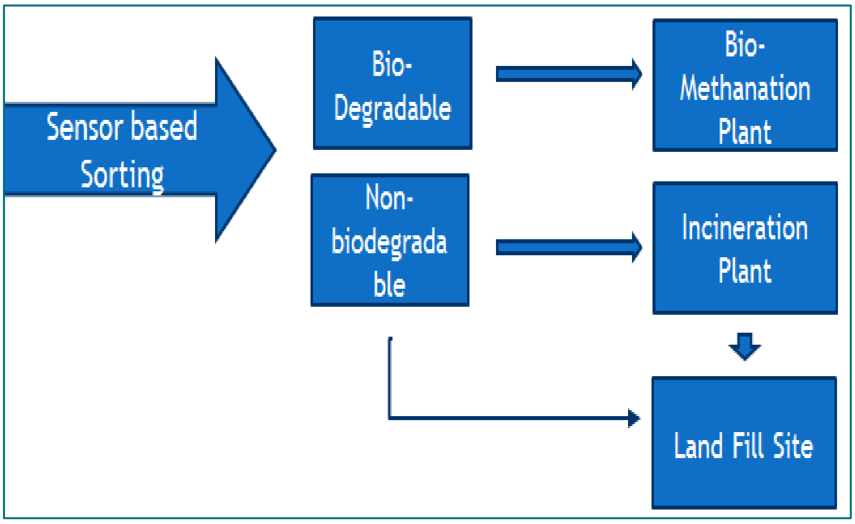
Source: Consultant's analysis

Mechanism for Solid Waste Management in VMR Region:

Solid waste management in VMR Region would take place in following steps:

- The process of collection and segregation of waste will be having dual bin system at all stages, ie from source to treatment station level. The door-to-door collection would be done at the household level and shall be collected by tricycles having dual bin system.

- As per Solid waste management rule 2016, following colour code shall be applied for collection bins



Green Bin: Bio degradable Waste (Household Waste, Commercial and institutional kitchen waste, garden waste)

Black Bin: Other waste (Industrial other inert matter)

- The tricycles/ auto tripers would carry the waste to the small community bins (separate for dry and wet) form where the waste would be transported to larger community bins (sensor based).
- From Sensor based large community bin, waste shall be further transported to waste processing depot/ centre; the trippers used for collection shall be GPS enabled vehicles.

The mechanism is being explained in following figure:

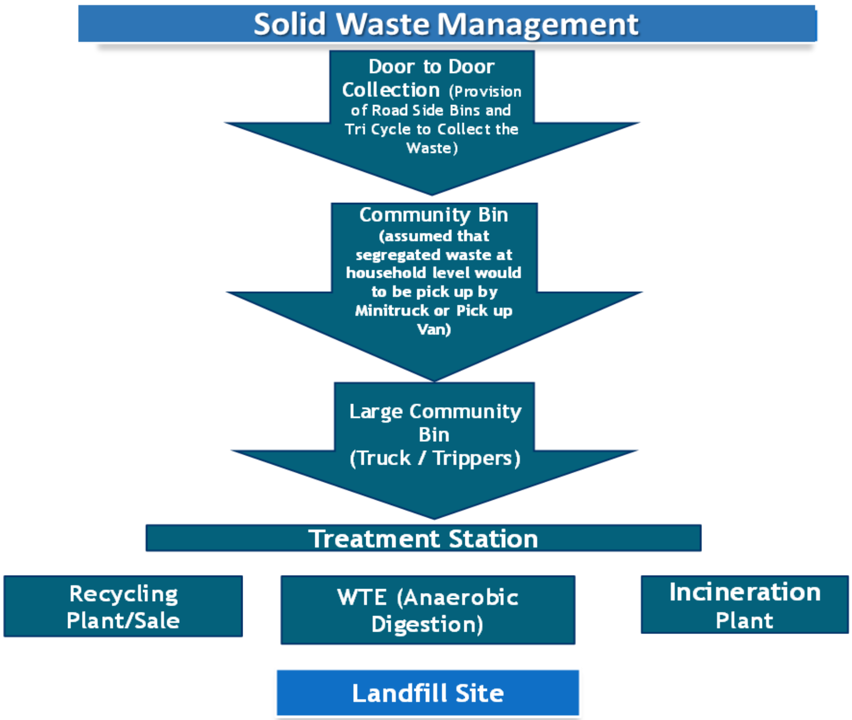


Figure 20-7: Mechanism of Solid Waste Management in VMR Region

Primary Waste Collection: These include provisions of bins (for storage of waste) and vehicles (like tri-cycles etc. that are used for transportation of waste from households/ shops/ institutes etc. to community bins). Waste would be transported to the larger community bins (by Mini-Trucks/ Pick-up Vans (Capacity -1.5 cum per vehicle). It has been assumed that the primary collection system (precisely door-to-door collection system) will be provided for the entire MSW generated. After door to door collection of waste in different packets at household level itself, the provision of double the number of Bin shall be provided at all level to collect dry and wet waste separately.

As per CPHEEO Manual, MOUD, 2000, a separate collection and transportation of Construction demolition waste shall be taken. The container for collection and pick up vehicle shall be sensor based.

Secondary Waste Collection:

Sensor based Larger Community Garbage Bin: Wastes from primary collection transferred to the specialized large community bin, it will be Sensor mounted. It will automatically send signal to GIS enabled transfer point when the bin is 90% full.

GPS devices and sensors on waste truck: GPS technology shall be used to trace the waste collection trucks to enhance the collection efficiency and ensure that contractors dump the waste at designated place. It will also give a clear picture of waste generated per ward. These vehicles would transport the waste component to the Recycling stations, Bio-Methanation plant & Incineration Plant site. Large Community bins, tripper vehicle and their frequency of collection has been estimated and included in the cost estimate.

Recycling of Waste:

Recycling reduces the use of fresh raw materials, reduce energy usage, reduce air pollution, and water pollution. The major recyclable material generated would have Paper, Glass, Electronic items, Wood, Plastic, Metallic scrap and salvaged building components of C&D waste. The mechanism of recycling will involve:

Sensor-based sorting: As per MOUD Solid waste manual, sorting of waste by an efficient mechanical sensor- based sorting technology shall be more fit to attain optimum utilization of recyclable items and save the energy and pollution instead of manual sorting. Thus, after having Segregation of Dry and Wet waste at source level and before finally sending the waste to processing units, the sensor-based sorting will be done. The sensor technology can recognize materials based on their visible spectrum or colour with Infrared/ultraviolet spectra or based on their specific and unique spectral properties of reflected light, density / conductivity / permeability or atomic characteristics.

Construction and demolition waste shall be stored separately as it has very high potential of recycling and reuse.

Land-fill Site:

The wastes which are not fit for recycling, bio-digestion and combustion shall be treated at Sanitary landfill site as per latest technology. Generally, the waste such as Incineration Ash, Dust, sand, inert matters, demolition debris etc is considered for dumping in land fill site. The land fill site shall have drainage layer in leachate collection system at bottom.

Waste to Energy

The biodegradable part of the waste will be treated in a waste to Energy Plant by technique of Bio Methaneation and energy shall be used as a fuel for electricity generation. Considering the amount of waste generated in VMR Region, feasible technology has been adopted for attaining the target of Zero Waste. Therefore bio degradable waste shall be used for generating the energy.

The feasible techniques for VMR are Bio digestion / Bio Methaneation. It is a process which involves decomposition of organic waste into an aerobic followed by anaerobic condition. A mixture of Methane and carbon dioxide (CH4 and CO2), known as biogas is produced under favourable conditions. It is an eco-friendly process, suitable for Indian climate and already practiced in India. Manure obtained from such waste shall have high nitrogen content. This would be an excellent soil conditioner. Generally, C: N ratio of this manure is 12:1 (very similar to fertile land).

A popular Bio Metheanation plant based on Nisargruna Plant technology is proposed for VMR region. This has been developed in Bhabha Atomic research Centre and as of now around 20 plants of the type are well functioning. The potential for Waste to Energy from Biodegradable waste in VMR Region is being given in Table 20-18 below:

Table 20-18: Estimate for net Energy Potential from Bio degradable waste in VMR

Particulars	Standards/Units	UNIT	Quantity
Total Organic / Volatile Solids in MSW	50%	MT	3,036
Organic Biodegradable fraction	66% of Volatile solids (VS)	MT	2,004
Typical Digestion Efficiency	60%	MT	1,202
Typical Biogas Yield Cum (B)	0.80 M^3 /kg of VS destroyed	Cum	961,706
Calorific Value	5000 Kcal /cum		
Energy recovery Potential KWh	B x 5000/860	Kwh	5,591,316
Power generation Potential KW	Kwh/24	KW	232,971
Typical Conversion efficiency	30%		
Net Power Generation Potential (KW)	KW*0.3	KW	69,891
Total Energy Generated per day kWh		**Kwh**	**1,677,395**

Source: consultant's analysis. (Ref: MOUD manual SWM 2000)

Table 20-19: Proposed Infrastructure components for Solid Waste Management

A	**Quantity for Primary Collection System**		
	Primary System for collecting total waste generated	MT/day	6,071
B	**Quantity for Secondary Collection System**		
	Secondary system needs to be designed for the waste remaining after segregation of recyclable waste at source	MT/day	5,161
C	**Requirement of Primary Collection Equipment & Vehicles**		
1	Volume of domestic wasste with density as 0.85 T/ Cum	Cum	4,229
2	Volume in litres	litres	4,229,235
3	10 litres capacity bins at house hold level One for dry & one for wet waste	Nos.	845,847
4	Volume of institutional, commercial & industrial waste	litres	1,503,245

5	25litres capacity bins at institutional level One for dry & one for wet waste	Nos.	120,260
6	Street Sweeping Refuse	Litres	1,410,318
7	50 litres capacity bins on road side	Nos.	56,424
8	Containerized Mechanized Tri-cycles with 200 litre capacity dual bin, assuming 2 trips per day & 10% standby	Nos.	5,815
9	1100 litres capacity- Mobile bins with 2 trips of each to nearby dumper placer bins	nos.	641
10	Dumper placer bins 4 cum capacity 2 nos at each site	nos.	3,929
11	Supply of Broomstick, Safety equipments, Gloves, Shoes/ Gumboots, Raincoat, Mask etc (as a set) (@ 1 set for handling street waste of 250 persons)	sets	47,956
D	**Requirement of Secondary Waste Collection Equipment & Vehicles**		
1	Hook loader mounted on Truck chasis capable of handling 16 cum containers @ 4 trips per day with 10% stanby	Nos	123
2	Tractor with 4 cum trolly assuming 4 trips per day and 10% standby	Nos	74
3	Reguse collector & compressor	Nos	62
E	**Area required for land fill site, segregation, recycling material storage and waste to energy plants**		
1	Waste for which land fill site is to be designed including inceneration waste	MT/day	1,275
2	Total Volume of Waste	Cum	1,500
3	Daily cover (on basis of 10 cm soil cover)	Cum	150
4	Volume for components of liner system and of cover system including leachate collection and gas collection layer). Assuming k=0.25	Cum	375
5	Volume likely to become available within 10 years due to settlement taking m= 0.05 for incinerated and inert waste	Cum	150
6	Landfill Capacity required/day	Cum	1,875
7	Capacity required for 15 years period	Cum	10,265,539
8	Area required for land filling for 15 mtr height	Sqm	684,369
9	Total area required after adding 15% for infrastructural facility	Sqm	787,025
10	Area for segregation & stacking	Sqm	57,142
11	Area for Bio methanation plant	Sqm	47,882
12	Area for Incineration plant	Sqm	15,961
13	Area for Compost Plant for villages	Sqm	37,040
13	Total Area required	Sqm	945,050
14	**Area in Ha**	**Ha**	**94.50**

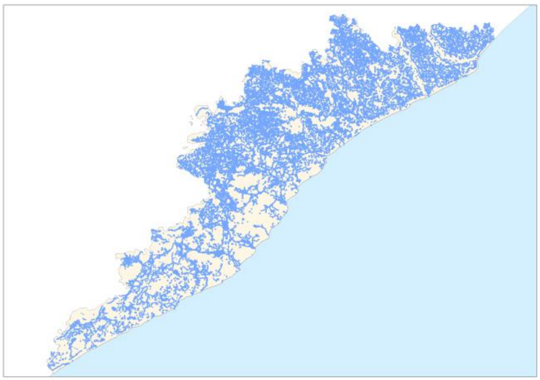
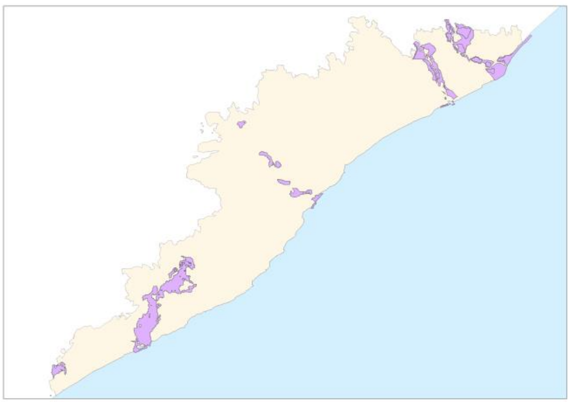
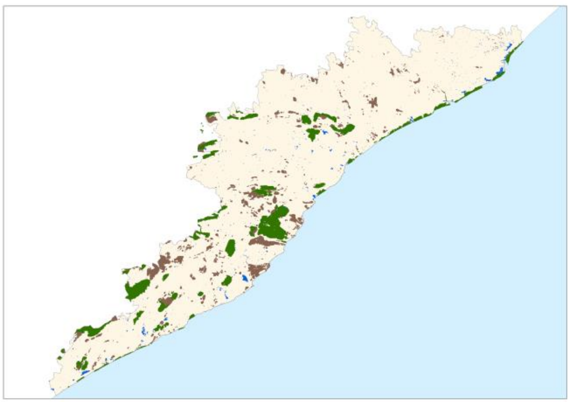
Source: Consultant's Analysis

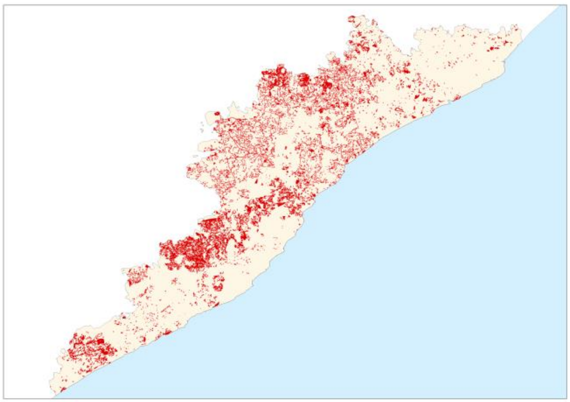
Identifying Integrated Solid Waste Management (Land fill & Treatment) site:

The existing landfill sites in urban centers are nearing their full capacity and the proposed urban growth will also engulf the areas earlier considered outside city limits and ideal for landfill sites. With the population projected till 2041 and increased urban activities there will be the need of additional landfill sites. As a part of the proposed land use allocation in the Master Plan, future landfill sites have been identified. Wastes processing facility shall be an integral part of these landfill sites.

Since, the landfill is a sensitive component of the urban development and the location has to be identified considering its impact on settlement areas as well as the environment. However, there are clear criteria for site selection given in Solid Waste Management Rules, 2016. Same guidelines along with few other planning criteria have been considered to identify the landfill site locations as per the demand in each zone of VMR. GIS based mapping has been done to map each of these criteria for allocating suitable location.

Criteria for selection of Integrated SWM site:

1. The site shall be located 100 m away from any river. 	2. The site shall be located 200 m away from pond, lake or other waterbodies. 
3. 200 m away from highway / habitations / parks / well for water supply. 	4. 20 km away from airport / airbase. 
5. Not be located under flood plains. 	6. The site should not come under CRZ / Wetlands / Eco-sensitive area. 

7. The sites are identified in government lands to reduce objections and land acquisition issues. 	8. One landfill site identified in 35km radius of all development area for daily vehicular trips 9. Buffer around landfill site to be no development zone to be decided by local body in consultation with concerned State Pollution Control Board

Based on the above criteria following 10 landfill sites have been identified for the 11 policy zones of VMR. The selected sites shall meet the demand up to plan horizon year 2041.

The Figure 20-8 below shows the proposed sites for Integrated Solid Waste Management in VMR:

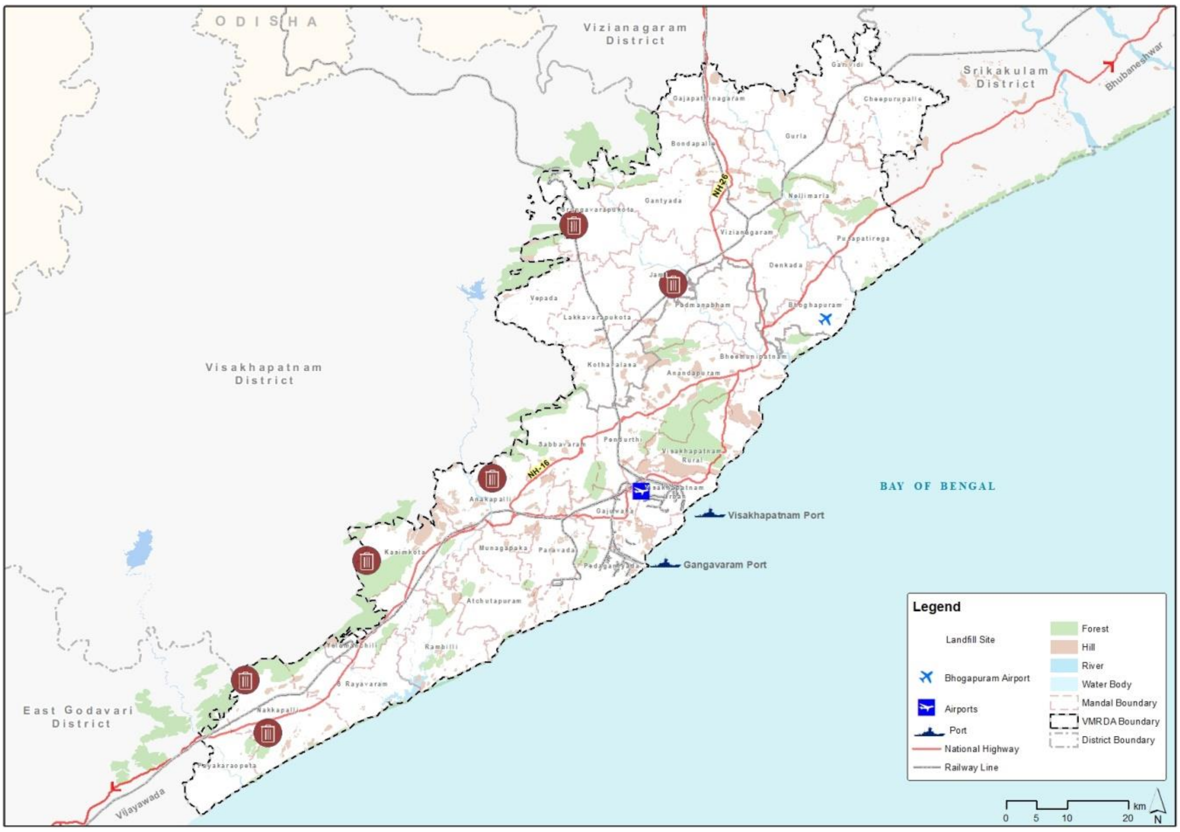


Figure 20-8: Proposed sites for Integrated Solid Waste Management

Table 20-20: Proposed Landfill sites in VMR

S No	District	Mandal	Village	Zones Serving	Area (ha)
1	Vizianagaram	Jami	Bheemasingi	Vizianagaram, Vizianagaram Rural, GVMC	21
2	Vizianagaram	Srungavarapu kota	Srungavarapukota	Vizianagaram Rural	10
3	Visakhapatnam	Kasimkota	Eswarapalle Chowduvada	Visakhapatnam Expansion, GVMC, Visakhapatnam Industrial Zone	85
4	Visakhapatnam	Nakkapalli	Nellipudi	Visakhapatnam Industrial Zone	11
5	Visakhapatnam	Nakkapalli	Cheedika	Visakhapatnam Rural	11
6	Visakhapatnam	Anakapalli	Bowluvada	Visakhapatnam Expansion, GVMC	12

20.6 POWER

Availability of uninterrupted power supply is closely associated with prospective development of a region. Master Plans shall take note of all necessary measures to ensure adequate provision for Power requirements while addressing the needs for its horizon year. In VMR Master Plan too, scope for electrical power generation, transmission and final distribution is assessed and calculated for all newly proposed development areas as well as improvement of power distribution in existing areas.

The availability of existing power and other infrastructures like EHV Sub-stations, distribution network is studied in depth and power demand for the upcoming industries and townships/population is estimated so that the proposals for plan horizon year 2041 can be formulated. The demand projection in study area is calculated based on following criteria.

FUTURE LOAD ESTIMATION

In order to estimate the likely demand for power for the horizon year, a forecast of the power demand is carried out based on the existing establishments, industries, commercial areas, projected uses in various sectors including physical infrastructure apart from projected population. Special emphasize is given to Bhogapuram International Airport, Metro rail, Visakhapatnam industrial zone and other decentralized industrial pockets located in Etcherla, Kothavalasa, Vizianagaram,and Yelamanchili. Accordingly the power demand and the required capacity of sub stations have been worked out. The loads are estimated based on the industrial and residential categories as follows;

20.6.1.1 Industrial Loads

The Estimation of power demand is prepared on the basis of number of Industrial plots and their sizes and nature of industry. Benchmarking of the industrial demand is carried out based on the consumption pattern of various types of industries in India and average demand is worked out (

Table 20-21). It is estimated that about 671.24MW of power is required by 2041 to fulfill the Industrial Power Demand. (Table 20-22)

Table 20-21: Classification of Industries based on Power Demand

S No	Sector	Representative Industries
Energy intensive manufacturing units		
1	Food	Food, beverage, tobacco product
2	Pulp and paper	Paper manufacturing, printing and related support activities
3	Basic chemicals	Inorganic chemicals, organic chemicals, resins and agriculture chemicals including chemical feed stocks
4	Refineries	Petroleum refineries and coal products manufacturing including coal and natural gas products
5	Iron and Steel	Iron and steel manufacturing including coke ovens
6	Non- ferrous metals	Primary Aluminum and other non-ferrous metals such as Copper, Zinc and Tin
7	Non-metallic minerals	Primarily Cement and other non-metallic minerals, such as Glass, Lime, Gypsum and Clay products
Non energy intensive manufacturing units		
8	Other chemicals	Pharmaceuticals (medicinal and botanical), paint and coatings, adhesives, detergents and other miscellaneous chemical products
9	Other Industrials	All other industrial manufacturing, including metal-based durables such as fabricated metal products, computer, other electronic products, transportation equipment and electrical equipment.

20.6.1.2 Residential Loads

The base year population (as per 2018) in VMR is around 53.9 lakhs and the estimates shows that the population increases to 90 Lakhs by the horizon year, 2041, with induced population of 3.6 Lakhs. As per the Draft Master Plan proposals, new residential townships are considered to be addressed with 33KV/11 KV sub-stations and distribution network with HT/LT lines and Cables. The indicated demand includes loads from residential, commercial and institutional uses as well. The per capita consumption of power is estimated based on the benchmark consumption levels of various cities in India and abroad.

Table 20-21 gives the details of the estimated loads by each land use in the study area.

It is evident from the capacity and present loading of existing sub stations that the projected load is to be accommodated by augmenting the capacity of the existing power projects and by establishing new power projects.

At present nearly 23 private power projects of different capacities are under establishment stage with some of the clearances pending from different State & Central governmental organizations with a total capacity of 17,032 MW based on Coal or Natural Gas. Four numbers coal based generating stations are already being established by APGENCO.

Two mega power projects are under consideration by central power sector agencies, one coal based of 4,000 MW thermal stations in Visakhapatnam district and another one nuclear power project with 4,000 MW capacities in Srikakulam district.

The HINDUJA coal based power project with 1,040 MW (2x520MW) and coal based KAIZEN power project with 150 MW (3x50 MW) is under execution by APSEZ. A coal based power project of 6,300 MW capacities (to be established in phased manner) is also under establishment in KSEZ, Kakinada. SPECTRUM Gas Based Power Project is under active consideration with all clearances and financial closure for enhancing the existing 226 MW to 1300 MW.

Looking to the proposed load, it is felt necessary that a 765 KV double circuit line be provided for VMR to wheel the power from the existing and future power projects and connect to the proposed power grid.

Demand forecast is worked out on the available data, addressing to the needs of various sectors and the following table gives the demand forecast for the VMR for 2041.

Table 20-22: Energy demand forecast for VMR, 2041

Land Utilisation	Present Utilisation-2018	Unit	Power Demand in KW per Ha	Total in MW	Proposed Area in Ha-2041	Unit	Power Demand in KW per Ha	Total in MW
Urban Area - Built-up	50,344.77	Ha	12.00	604.14	63,506.85	Ha	12.00	762.08
Rural Area - Built-up	29,529.46	Ha	8.00	40.00	51,165.88	Ha	8.00	409.33
Industrial Area	15,221.39	Ha	35.00	532.75	19,178.25	Ha	35.00	671.24
Commercial	1,181.84	Ha	30.00	35.46	6,719.25	Ha	30.00	201.58
Institutional	4,675.11	Ha	25.00	116.88	12,478.60	Ha	25.00	311.97
Residential	41,834.30	Ha	12.00	502.01	43,195.17	Ha	12.00	518.34
Recreational	623.63	Ha	12.00	7.48	17,278.07	Ha	12.00	207.34
Transportation	15,755.65	Ha	10.00	157.56	18,565.03	Ha	10.00	185.65
Bhogapuram Airport Area		Ha			1,425.00	Ha		25.00

Land Utilisation	Present Utilisation-2018	Unit	Power Demand in KW per Ha	Total in MW	Proposed Area in Ha-2041	Unit	Power Demand in KW per Ha	Total in MW
Total Area in Ha	**1,59,166.15**				**2,33,512.10**			
Metro Corridors		Km			140.00	Km		50.00
			Total Demand -2018	**1,996.27**			**Total Demand-2051**	**3,342.52**
TOTAL DEMAND in MVA				**2,100 MVA**				**3,500 MVA**

The power infrastructure requirement for the Horizon year based on the additional population, industries, new development areas are as in Table 20-23 and the locations of proposed substations are shown in Figure 20-9.

Table 20-23: Power Infrastructure requirement

Particulars	Nos.
Additional Consumers	9,01,066
220kv sub stations	2
132kv sub stations	13
33kv sub stations	134
33kv feeders	69
11kv feeders	828
Distribution Transformers	25,744

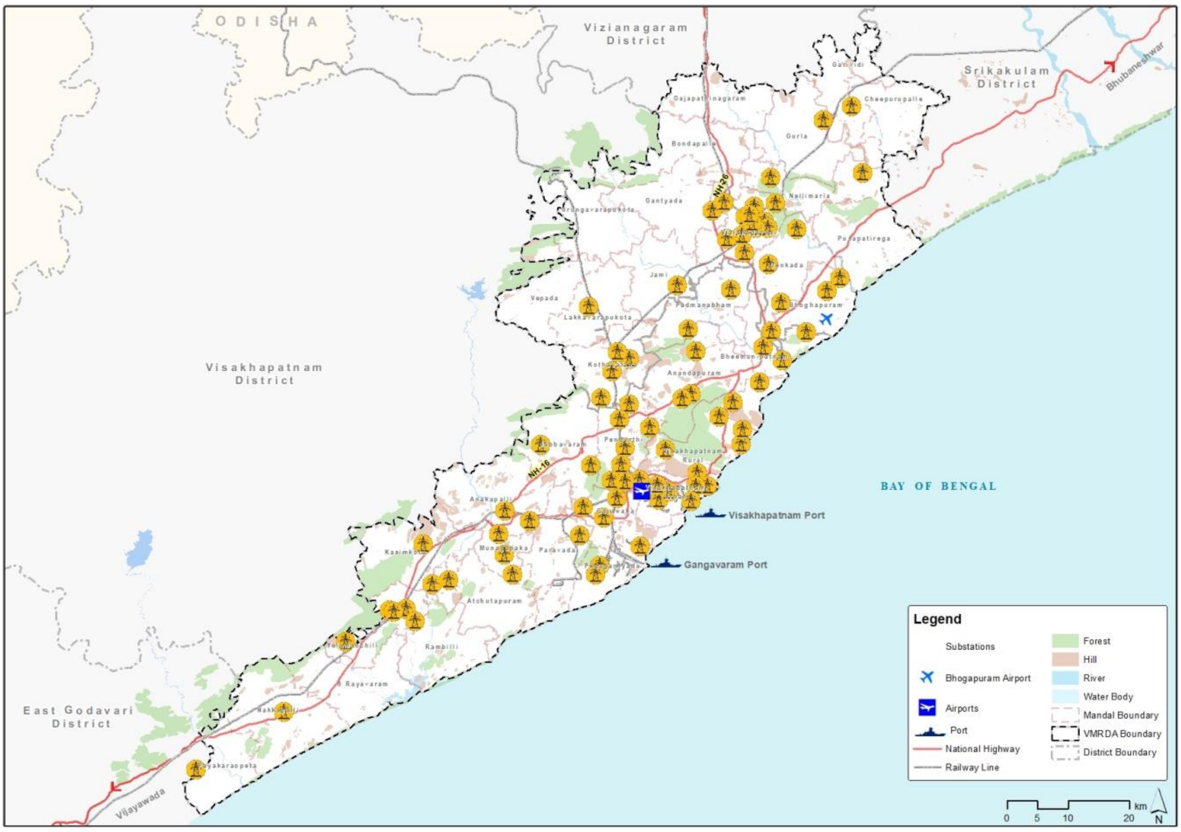


Figure 20-9: Locations of Proposed Substations in VMR

CLEAN ENERGY GENERATION:

Renewable Energy Potential in VMR

In order minimize the demand catered from the conventional sources of energy, an attempt has been made to meet the additional demand, duly addressing through the potential sources of Solar Energy as well.

As per the National Institute of Solar Energy (NISE), the scope for possible installation capacity of solar power in Andhra Pradesh is 38.44GWp. In VMR, the following areas are available for solar power Generation:

Table 20-24: Areas available for solar power Generation

Locations	Area
Reservoirs & Dams	1246.62 Ha
Public & Semi-public Areas	386.98 Ha
Land with /Without Scrub	12,335.07 Ha
Barren /Rocky Hill areas	30,043.61Ha
Total area	**44,012.28Ha**

If 20% of the Area is considered for Solar Power generation, the available area is 8,802, 45 Ha. The area required for 1MWp is around 1.5 Ha and the potential for solar power generation is 5,868MWp i.e., 5.86GW. Considering the huge potential for Solar Power, a minimum of 2GWp (2,000MWp) provision must be made in the VMR.

Therefore, the clean energy addition in the VMR will result in demand reduction on Thermal Plants and thus support clean environmental policies.

PROJECT PRIORITISATION AND PHASING:

As the power sector development is associated with huge investments, the strategy is to have short, medium and long term developmental plans.

- **Short Term Plans**: As part of immediate augmentation, existing distribution system to reduce distribution power losses and improvement on reliability and minimizing the power interruptions.
- **Medium Term Plans**: Keeping in view the proposed development areas, new sub-stations and distribution lines to be planned with proper provision RoW which enables easy vehicular movements and distribution lines space.
- **Long term plans**: The additional power requirements and demand, new power plant and transmission lines to be planned in a phased manner and implementation to be taken up simultaneously along with the major infra projects.

21 STRATEGIC ENVIRONMENTAL ACTION PLAN & CLIMATE CHANGE STRATEGY

21.1 GOALS AND OBJECTIVES

India's eastern coast offers a picturesque landscape circling the tropical teal waters of the Bay of Bengal, magnificent beaches and hilly terrain all over the Eastern Ghats. VMR fortunately has all the beauties that the region has to offer. The area covers a costal length of 250 km with almost 27% of the land covered by natural hills and forests, and 28% open agricultural spaces. The other natural features include coastal sandy areas, mangrove forests, rivers, water bodies and open spaces. The presences of environmental features also add to the sensitivity of the region towards large-scale developments.

Implementation of development strategies has to aim for sustainable development and protection of the natural features and the perspective has to be envisioned now. A holistic approach to planning environmental management in VMR, based on Strategic Environmental Goals and Objectives is required.

GOALS

As stated in Chapter 13, two Goals (4 and 5) were set for sustainability theme on "managing environment and response to climate change" in VMR. Together they align directly with 6 UN SDGs and indirectly with 7 UN SDGs.

VMR Draft Master Plan Goals	Links with UN SDGS	
	Direct Links	Indirect Links
Goal:4 - Protect and enhance the natural, cultural and marine sensitive areas and they are well integrated with the future development.	14 LIFE BELOW WATER; 15 LIFE ON LAND	3 GOOD HEALTH AND WELL-BEING; 11 SUSTAINABLE CITIES AND COMMUNITIES; 13 CLIMATE ACTION
Goal:5 - Promote sustainable use of agricultural, water and mineral resources to achieve self-sufficiency.	2 ZERO HUNGER; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION; 14 LIFE BELOW WATER; 15 LIFE ON LAND	3 GOOD HEALTH AND WELL-BEING; 11 SUSTAINABLE CITIES AND COMMUNITIES; 8 DECENT WORK AND ECONOMIC GROWTH; 13 CLIMATE ACTION

OBJECTIVES

The objectives of "managing environment and response to climate change" in VMR are:

1. To better manage the environmental resources through sustainable practices, adaptation of smart technologies, and efficient utilisation of natural resources;
2. To achieve self-sufficiency through conservation of agricultural lands, mineral, water and coastal resources; and

3. To protect and enhance cultural heritage of local communities through listing, delineating, and adaptive reuse of heritage structures/ precincts for cultural tourism development.

The objectives focus on following:

- Protection and Conservation of Environmental Resources
- Prevention and control of Environment Pollution
- Climate Change and Sustainable Development – considering SDGs for economic development and environmental protection
- Safeguards for handling hazardous wastes / discharges into the air, land or marine environment

21.2 ENVIRONMENTAL STRATEGIES

Environmental strategies fulfilling the above listed objectives for sustainable development are prepared based on innumerable environmental standards, policies and guidelines. This chapter while focussing on the environmental strategies, also puts into perspective an action plan for implementing the strategies.

FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT OF KEY SENSITIVE DESIGNATIONS

The entire VMR is broadly classified into six key designations for its environmental sustainability, protection and conservation. The areas are divided based on its characteristics, physiography, and natural resource. Each zone will have its own development and protection policy and maintaining it will facilitate a better environment and healthy surrounding around VMR. The broad zoning includes the following:

1. Designated Conservation & Protected Areas including Ecologically Sensitive Zones as designated by MoEFCC;
2. Rivers, Streams, Lakes, Reservoirs, Ponds and other water bodies;
3. Coastal Regulation Zone – all designated zones;
4. Hills as indicated in the Revenue Maps in the region;
5. Areas that are critically polluted as per designation of CPCB / SPCB such as the Visakhapatnam Bowl Area; and
6. Regulated areas outside the above designations demarcated for promoting sustainable development, environmental protection or conservation measures.

Strategies of environmental management in the VMR are applied for the identified zones to address the strategic environmental objectives and arrive at most appropriate measures that need to be taken. The management measures determined would be presented in this chapter. Since the strategic environmental objectives have also been part of the guiding principles of the Master Plan preparation, the environmental strategies discussed here have been considered as part of plan preparation process. There is full integration of communities' views on environmental and social aspects in the planning process.

Key strategies are identified for enabling the environmental protection, conservation, management and enhancement. While few of the strategies will be applicable to all the strategic environmental zones in the region, few of these strategies will be specific to the identified strategic zones. The Key Environmental Strategies are:

Environmental Strategies	
1. Conservation of Critical Environmental Resources	2. Integration of Environmental Concerns in Economic and Social Development
3. Efficiency in Environmental Resource Use	4. Environmental Governance
5. Resources for Environmental Conservation	6. Implementation Strategies
7. Preventive Environmental Actions	8. Environmental Resource Inventory and Mapping
9. Clean technological innovations	10. Climate Change and Sustainability

The Key Environmental Strategies are further elaborated in the below paragraphs with reference to the study area. The specific measures that were accordingly incorporated into the Master Plan in the form of spatial strategies as well as specific regulations in the Development Promotion Regulations associated with the Master Plan are accordingly illustrated in the subsequent sections.

1. **Conservation of Critical Environmental Resource:** The strategy aims at protection and conservation of critical ecological systems and resources, invaluable natural and man-made heritage, that are essential for life support, livelihoods, economic growth, and a broad conception of human well-being. This strategy has been integral to the preparation of the Master Plan right from the conceptualisation stage and visioning as evident in the relevant sections of the report. The Critical Environmental Resources such as the Mangroves, notified forests, hills identified as such in the revenue maps, water bodies, CRZ including the natural habitats of several marine and land-based fauna etc., have been identified and demarcated as exclusive zones as indicated in the respective guidelines for their protection and preservation in the region.

2. **Integration of Environmental Concerns in Economic and Social Development:** To integrate environmental concerns into policies, plans, programmes, and projects for economic and social development. The spatial allocation of land uses and related measures for protection and conservation have been undertaken in the Master Plan to address the environmental concerns. For integration of environmental policies into overall policy framework for the region, they have been taken into cognisance through development regulations incorporated into the DCR. The regulations mandated as per DCR are enacted in the legislations either of the state or of central government with recent amendments where appropriate. The regulations incorporated in the DCR include: (i) to avoid location of polluting industries (i.e., red and orange categories) away from habitation areas and limiting them only to designated industrial areas of VK-PCPIR and designated SEZ / Industrial Estates / Industrial Parks. (ii) to avoid location of townships and new developments away from existing Industrial Estates / SEZ / Industrial Parks and/or major polluting industries. (iii) to follow buffer zones around water bodies (iv) to follow regulations governing Eco Sensitive Zones (ESZ) and notified forests / national parks / wild life sanctuaries etc., (v) to follow CRZ regulations. The strategy will be applicable to environmental designations evident from the each of the point discussed and these have been adequately captured in the base map as well as proposed landuse map.

3. **Efficiency in Environmental Resource Use:** This strategy is aimed to ensure efficient use of environmental resources, to minimize adverse environmental impacts. Environmental resource use in the context of the Master Plan include land – in terms of land use as well as land-based resources (eg., soil, sand, mineral material), water, forest, and vegetation. While the Master Plan could optimise use of land in the plan through utilisation of brown field resources for new developments, the land-based resource use could be mandated only through development of

efficient construction techniques during implementation of the projects identified in the Master Plan. Water as resource has been proposed for tertiary recycling to enable reduction of raw water usage up to about 15 to 20 per cent of total utilisation in the region. Remaining resources are similarly proposed for recycling and usage of innovative materials for use in the region that reduce dependence on natural materials.

4. **Environmental Governance:** This strategy adopts the principles of good governance to the management and regulation of use of environmental resources. Being a coastal region and a sensitive environmental region, the environmental governance takes precedence in the economic development goals. Hence, development agenda of the region adequately captures this aspect and strict compliance to the national and state laws for environmental management and protection is expected during the development of the region.

5. **Resources for Environmental Conservation:** This strategy is adopted with a view to adopt environmental conservation measures for environmental resources that exist in the region. While measures are strategized and conceived for conservation of environment, lack of resource allocation affects the implementation of the measures conceived. This strategy is specifically targeted to assess the resource requirement for the environmental conservation measures and identify possible sources from where these can be tapped. The resources identified would not be limited to capital requirement but also technology, traditional knowledge, and social capital.

6. **Implementation Strategies:** While conceptualisation of several environmental mitigation or management measures can be undertaken as part of the Master Plan, the local authority i.e., VMRDA need to have powers vested in the organisation to implement the measures. A brief review of the implementation mechanism of various works in the region has been undertaken and the measures required for effective implementation of various measures within the ambit of the authority have been identified. The remaining measures for implementation would need to be done through the other line agencies or state level authorities.

7. **Preventive Environmental Actions:** Environmental management and conservation measures are the preventive environmental actions to ensure the development activities that would be implemented in the region do not affect the environment. While most of the preventive actions are determined by the environmental clearance for various projects, there are measures that need to be necessarily undertaken to avoid catastrophic incidents in the future. Location of industries away from habitations is one such measure. Several preventive environmental actions to accelerate the conservation efforts are built upon this strategy. It may be noted that, though care has been taken to ensure these efforts are in line with the national or state environmental acts or legislations, few measures are yet to be recognised by the respective authorities as legal.

8. **Environmental Resource Inventory and Mapping:** This strategy is most important to the Master Plan exercise that has been accomplished successfully. Mapping the environmental resources that have been inventories in the region provides an overall perspective of the region starting from the least affected to the worst affected. As identified during the review of MoEFCC legal framework for environmental management and mitigation, the Environmentally Sensitive Zones in the region should be avoided to the extent feasible. While mapping the resources provides the perspective for the region, it provides inputs into expanding the conservation efforts.

9. **Clean technological innovations:** The strategy mandates technological innovations required for addressing the environmental issues. Technological innovations would focus on reduction of wastes than treating the waste after generation. While the Master Plan provides guidance on the requirement for innovations in various fields, they would mostly be advisory in nature. The required infrastructure requirement for innovative technology introduction in the region would be provisioned for through various sources of financing and collaboration of the Authority / Stakeholders in the region with the relevant industry & institutions. All environmental

designations in the region would be affected or benefitted from this strategy and hence would need utmost priority.

10. **Climate Change and Sustainability:** The strategy on climate change and sustainability is one of the pillars of environmental management in the region. One of the foremost requirements of the region is to have a clear assessment of the effects of climate change and its effects on sustainability of various life forms as well as economic activities. In general, the effects are more pronounced on the environmental designation of coastal regions and low-lying areas. However, a detailed assessment of the climate change effects is still not in place for the region. This strategy provides an outline of the likely approach and activities to be undertaken for addressing climate change and integrating sustainability measures into the development agenda.

21.3 PROPOSALS FOR ENVIRONMENTAL STRATEGIES

Proposed strategies for environmental conservation will need to be operationalised through appropriate proposals and actions for implementation in the Master Plan and zonal development plans. This section details out the proposals that need to be implemented for this purpose. It also details out the proposed actions to be taken for incorporation into the Master Plan. While the Strategic Environmental Plan is being prepared, there have been several consultations with various agencies including VMRDA, on the concerns regarding environment in the region. Inputs received from the stakeholders and associated with experience of the consultants in the matter, the proposals have been drawn up to address these concerns.

Strategies such as Environmental Governance, Resources for Environmental Conservation, Implementation Strategies, Environmental Resource Inventory and Mapping are mainstreamed in the plan preparation and described adequately in the conservation strategies themselves. In context of the environmental inventory and resource mapping, the basemap and existing landuse map of the VMR provides extensive details on the environmental resources. The Capital Investment Plan worked out as part of the Master Plan details the sources of funding for implementation of various proposals, of which the Environmental Conservation is also an integral part of the proposals.

Several regulations already exist for protection of the environment; these have been appropriately adopted to ensure incorporation of environmental considerations in the plan preparation. Some of the important conservation strategies where appropriate actions were required to be included are detailed in the below sections.

CONSERVATION OF CRITICAL ENVIRONMENTAL RESOURCES

Critical environmental resources in the region as listed in the strategy include protection of natural and manmade resources in the region. The proposals included in the Master Plan for conservation of these resources are presented in the following paragraphs. While some of the measures suggested are specific to the region, these are also mandated as per various regulations in force across the state and the country i.e., as per the national acts or state acts with amendments as appropriate. Since these measures are having, the legal instruments for implementation, it may be construed that the measures are mandatory to be followed in the region and accordingly they will be strictly implemented.

21.3.1.1 Forests & Sanctuaries

One of the key advantages VMR has is its location on the coast along with having magnificent natural and environmentally sensitive resources in the form of forest, rivers and water bodies, hills, and wild life sanctuaries. Close to 20% of VMR (1,230 Sq. km) are natural and sensitive areas, which require protection and integration into the human landscape to retain its environment significance.

Around 12.5% of the region is covered under hills and forest, which acts as the backbone for the ecological footprint of the region. The consultation with the stakeholders has resulted in suggestions such as making these ecological forests and buffer zones not permissible for construction, considering new techniques of afforestation along with identifying tourist ecological zones for camping, trekking, etc.

Ecological Sensitive Areas or Ecologically Sensitive Zones refer to those areas, which have been notified by the Ministry of Environment, Forests and Climate Change as areas around the Wildlife Sanctuaries, National Parks and Protected Areas as requiring more protection due to their sensitiveness.

Protection of forests and hills will help local communities preserve forests in critical areas through community forestry and management plans; improve agricultural practices through irrigation and mixed cropping; and better manage livestock to reduce overgrazing.

The strategies involved in protection of forest as given by the AP GO MS No. 119 are as follows.

The vegetation cover of the forest areas in India are classified into 6 types. They are,

a) VDF – HL: Very Dense Forest in Hill Areas
b) PF – HL/WB: Other than very dense forest in hilly areas or 20m buffer around streams or water bodies
c) VDF – PL: Very dense forest in Plain areas
d) MDF – PL: Moderate dense forest in plain areas
e) OF/SF – PL: Open/Scrub forest in plain areas
f) NF – PL: Non-forest in plain areas

Table 21-1: Vegetation cover in the forest of VMR by circles

Division/ Circle	VDF-HL	PF-HL/WB	MDF-PL	OF/SF-PL	NF-PL	Total (Ha)
Visakhapatnam	1.12	24,048.73	2,778.99	8,222.35	3,404.43	38,455.62
Vizianagaram	0	11,303.35	1,731.48	2,407.58	406.16	15,848.57
Total VMR	1.12	35352.08	4510.47	10629.93	3810.59	54304.19

Source: Forest Department

Study area has highest area of its Forest vegetation cover as (PF HL/WB) Other than very dense forest in hilly areas or 20m buffer around streams or water bodies.

VMRhas 1.12 Ha of its area as VDF-HLin Nakkapalli mandal; 36794. 91 Ha PF-HL/WBwith highest area in Srungavarapukota mandal (4471.81 ha) and smallest in Anakapalle (1.06 ha); 14900.24 ha of OF/SF – PL, highest in Anandapuam (1639.13 ha) and lowest in Bhogapuram mandal (2.17 ha); 5578.74 ha in NF - PL highest in Gara mandal (591.39 ha) and lowest in Gantyadamnadal (0.18 ha).

STRATEGIES TO PROTECT FOREST

a) Maintain order in forests and protected areas.

b) Increase revenue returns from authorized activities.

c) Prevent damage to forest resources resulting from unwanted resource violations.

d) Meet sustainable yield targets.

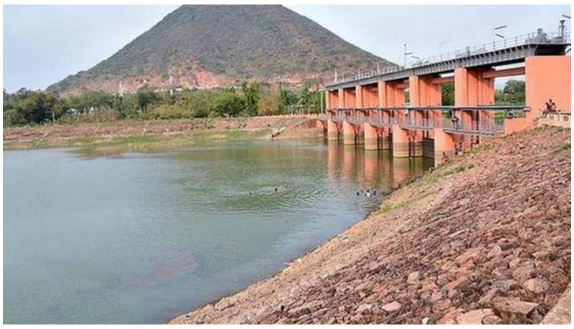
e) Involve the public through information and education programs to prevent violations and damage to forests and protected areas.

f) Increase skill levels of forest technicians and forest managers in prevention, detection and monitoring programs.

g) Reduce susceptibility or vulnerabilities that can create opportunities for unwanted activities to occur.

21.3.1.2 Water bodies Conservation Proposals

In Andhra Pradesh, the number of water bodies is not increasing. The reason is due to not taking up the formation of new water bodies. Due to continuous drought and deficit rainfall prevailing in last few years, along with continuous development on the catchment area blocking the inflows to the water bodies decreased considerably, as such some of the water bodies located very adjacent to the habitations were being encroached which leads to decrease in water bodies.



Protect all lakes and lakefronts under G.O.Ms.No.119, Dt. 28-03-2017 by MA&UD, AP Provide additional protection buffers around key lakes, which can be used as open and recreational spaces under the Master Plan. Protect all critical drainage channels of the lakes through mandatory open and green buffers under this perspective plan along with Improve water quality of lakes and lakefronts through well-defined projects. Develop important lakes, lakefronts located within GVMC area for recreational, and tourism without compromising their ecological aspects.

Buffer around Water bodies according to GO MS No. 119, AP.

a) No building / development activity shall be allowed in the bed of water bodies like river or nala and in the Full Tank Level (FTL) of any lake, pond, cheruvu or kunta / shikam lands. Unless and otherwise stated, the area and the Full Tank Level (FTL) of a Lake / Kunta shall be reckoned as measured and as certified by the Irrigation Department and Revenue Department.

b) The above water bodies and courses shall be maintained as Recreational/Green Buffer Zone and no building activity shall be carried out within:

   i. 100m from the boundary of the River outside the limits of Local Authorities and 50m within the limits of the Local Authorities. The boundary of the river shall be as fixed and certified by the Irrigation Department and Revenue Department.

   ii. 30m from the FTL boundary of Lakes / Tanks / Kuntas of area 10Ha and above.

   iii. 9m from the FTL boundary of Lakes / Tanks / Kuntas of area less than 10Ha / shikam lands;

   iv. 9m from the defined boundary of Canal, Vagu, Nala, Storm Water Drain of width more than 10m.

   v. 2m from the defined boundary of Canal, Vagu, Nala, Storm Water Drain of width up to 10m.

c) Unless and otherwise specified in the Master Plan/Zonal Development Plan.

   i. In case of (b) (i) & (ii) above, the buffer zone may be utilised for road of minimum 12m RoW, wherever feasible.

   ii. In case of (b) (ii) above, in addition to development of recreational / green belt along the foreshores, a ring road or promenade of minimum 12 m may be developed, wherever feasible 3.6 m walking / cycle track within the 30 m buffer strip may be provided. (iii)

   iii. The above buffer zone to may be reckoned as part of tot lot or organized open space and not for setback requirements.

d) In case of areas along the seacoast, the Coastal Regulation Zone Regulations shall be followed.

Type	Area (ha)	Buffer strip	Permitted Activities
Water Body	Less than 10 ha	Green Buffer area 9 m	Seasonal plantations, recreation, and Fishing activity
	More than 10 ha	Green Buffer area 30 m	
Rivers and Canals	Less than 10 ha	Buffer area 2 m	Seasonal plantations, waterfront development and recreation and Fishing activity
	More than 10 ha	Buffer area 9 m	

21.3.1.3 Hills

As evident from the terrain of the region, the Eastern Ghats with Anantagiri Hills in the backdrop is a major topographical feature. Being a terrain at the foothills, the terrain as it approaches the coast varies from Rolling to Plain. VMR has several isolated hills / hillocks but are low in elevation. Most of these hills are in the southern portions of the region from Rushikonda and down south.


While some of these hills are declared forests, the rest are having thick vegetation but not declared as forests. These hills are vulnerable as a resource, which requires protection from several real estate dealers operating in the region. The hills are also home to a number of heritage monuments right from small shrines to more than two centuries old Buddhist Monasteries though now stand abandoned.

Land area in which the hills are located was denoted as a separate parcel and a parcel number has been assigned in the Revenue Maps. These have been accordingly identified in the base map and marked as such. All developmental proposals considered as part of the Master Plan in the region considered such area to be 'No Go' areas. Some of the hills along the coast were having economic activities like a software park and high-end residential accommodation already in place. These have been considered as such in the proposed Master Plan. With the avoidance of intensive landuses in the hill areas and keeping the development away from such locations, the hill areas in the region stand protected from developmental proposals of the Master Plan.

21.3.1.4 Coastal Areas

Coastal areas in the region are subject to intense developmental pressures in the region by way of tourism, marine fishing activity, industrial infrastructure such as sea water pumping and marine outfalls apart from real estate pressures. The coastal areas being a rich ecosystem of marine and land-based flora and fauna, the region needs protection and conservation. In a bid to implement such a strategy, apart from following the legal provisions of protection and conservation such as the Coastal Regulation Zone Notification 2011 and subsequent amendments, the Master Plan doesn't propose intensive landuses along the coast.


The fishing villages along the coastline are dependent traditionally on the sea for their livelihood. The villages are however away from the coast and in the backwaters of the streams joining seas in most cases. These villages are to be sustained in the future for generation of fishing revenues as well. Developmental efforts are proposed in the Master Plan at such locations adhering to the legal provisions and proposing only the permitted activities in CRZ. No other activity, not ancillary to the fishing activity or any conservation activity has been proposed as part of the coastal areas.

Proposals for protection of the coastal vegetation such as Mangroves and habitats of sea turtles that nest in this region are being protected by active NGOs with the assistance of Forest Department. Hence, no specific measures for conservation for this aspect has been envisaged but no hard landscaping or high intensity landuses were proposed as part of the Master Plan in these areas, thus carrying out this strategy effectively in the Master Plan.

21.3.1.5 Heritage Area Conservation

The conservation of built heritage is a complex process, dealing with an extremely heterogeneous range of elements and different substrates with a large variety of conservation conditions. In recent years, its sustainability has become a relevant issue, due to the general limitation of resources and unique features of cultural heritage assets.

Visakhapatnam region has rich cultural and religious traditions that defined its socio-cultural landscape. Religious and spiritual growth in Hinduism, Islam, Christianity and Buddhism took place through its socio-cultural history with significant magnitude, leaving behind heritage in the form of Temples, Dargah, Masjids, Churches and Buddhist sites.

In order to conduct the heritage survey, the list of various heritage properties and precincts have been prepared by compiling the list of heritage sites from 3 organizations instrumental in keeping record of the heritage properties which are:

Along with Listed Heritage Buildings or Listed Heritage Precincts, it will also include; those natural feature areas of environmental significance or of scenic beauty, sacred groves, hills, hillocks, water bodies (and the areas adjoining the same), open areas, wooded areas, points, walks, rides, bridle paths (hereinafter referred to as 'listed natural feature areas'). The strategies to be adopted for Heritage Management are as follows;

- The buildings owned by private party should be maintained and restricted from development; reconstruction etc. and the property belonging to the government shall be taken care. Penalty should be imposed on violation the norms.
- Road widening and improvements and any changes in Master Plan should consider heritage precincts be it natural or structural, in the first case to be protected from development/destruction.
- Proposal of incentive usage of heritage can generate revenue for protection of the property and increase its historic importance.
- Management of regulation in a heritage area by maintaining the skyline and keeping an architectural harmony in the area can enhance the value of the heritage and view of the historic area.

- Grading of historic buildings and precincts of national importance, state importance and aesthetic importance can help to strategize the tourism potential of heritage structures.
- Improvement of infrastructure including access, signage, and street furniture can accentuate the heritage area.
- Corporate sponsorship in heritage buildings can bring significant impact in maintenance as well as popularity of a heritage site.
- Heritage Conservation Committee (HCC) to be formed by VMRDA

INTEGRATION OF ENVIRONMENTAL CONCERNS IN ECONOMIC & SOCIAL DEVELOPMENT

While the project appreciates and proposes to incorporate the environmental concerns in the Master Plan preparation process, one needs also to devise methods for integrating the solutions to such concerns, not only in the Master Plan, but also for the economic and social development of the region.

The region being located very close to the coast in a region of moderate to high rainfall, it is expected to have high bio-diversity. True to the nature, the region embodies its essential quality in terms of bio-diversity and richness of the species. It is thus essential to integrate the proposals of economic and social development with the measures to be undertaken for environmental conservation.

The project area being on a fast growth trajectory due to various economic activities already being implemented through various schemes and projects such as VCIC, Sagarmala, SEZ policy and more recently requires sustainable solutions for environmental conservation. They will also need to cater to the economic development of the region. Accordingly, the Master Plan while providing flexible landuses for unhindered growth of the region, underpins the conservation efforts by integrating them into the Development Promotion Regulations for implementation. The major provisions of the DCR that enable conservation of environment are listed below:

- Recognition of critical environmental resources in the region for protection and conservation wherein change of any such critical landuses will require approval from the Authority.
- Integration of CRZ provisions into DCR and accordingly approval from CZMA needed for undertaking any development activity in the CRZ
- Integration of EIA Notification 2011 with subsequent amendments into the DCR mandating the Environmental Clearance for further moving ahead on any developments
- Integration of provisions of Draft Industrial Policy, Aug 2020 with the DCR as appropriate in order to reduce the impacts from Industrial Park / Industries locations

EFFICIENCY IN ENVIRONMENT RESOURCE USE

Whilst critical environmental resources are being conserved and protected under the conservation strategy of the Master Plan, there are several instances where these resources are to be used for development; this is where the strategy of efficiency in resource use finds a foothold. Efficient use of resources is also one of the key elements of environmental conservation strategies. Resources that are identified in this section are the most critical elements that have been adopted in the Master Plan preparation. Other critical elements most appropriately pertaining to the sustainability of the resources in the region in conjunction with the climate change are appropriately discussed in the subsequent sections. The overall objective of this strategy is achieved through the following aspects:

- Reduction in use of agriculture land for development proposals including real estate and industrial areas
- Retaining vegetated areas such as hills and unclassified forests for development proposals
- Improving green cover in the region through extensive network of parks strictly following as per the layout regulations as well as afforestation at incidental spaces
- Proposals for conservation of resources through use of manufactured materials in construction activities such as encouraging use of fly ash, blast furnace slag, other disposable material as fill material etc.,
- Active proposals for recycling of water from wastewater and industrial effluents by undertaking tertiary treatment

21.3.1.6 Agriculture Conservation Proposals

The fear of losing right, title and ownership over one's own land by leasing out discourages the landowners, even when they are themselves unable to cultivate, to lease out their parcels of land. This is the cause behind substantive extent of land remaining fallow or being developed to buildings or other landuses. It is further known that a lot of land remains fallow for many do not opt to offer their piece of land on oral lease. It is, therefore, necessary that lease is legally recognised by enacting a suitable law. However, it should explicitly and emphatically protect the interests of the landowner, in supersession of any other provision of law that may be in force. The Model Land Lease Act, 2016 prepared and approved by the NITI Aayog offers an appropriate template for the States and UTs to draft their own piece of legislations, in consonance with the local requirements and adopt an enabling Act. Legalised land helps to promote agricultural efficiency, equity and power reduction. This will also help in much needed productivity improvement in agriculture as well as occupational mobility of the people and rapid rural change.

Providing a buffer limit of village expansion area around villages and hamlets will stop uncertain landuse change in future with protected agricultural land. Providing better facilities like go downs, cold storage, shades, machine storage areas and Kisan Vikas Kendras will encourage the villagers to continue agriculture instead of shifting to other occupation.

In determining the areas that could be urbanised, preference will be given to the areas under single crop and scrub / vegetation lands than double-cropped areas. With the strategy of preserving rich agriculture lands, large amount of area is indicated as agricultural.

One of the main causes of change in agricultural land is no proper guidelines on approval of LRS on layouts in agricultural lands that has already started developing. People sell the land and start development on them to get permission in future but leading to destruction of good agricultural lands. Stringent guidelines need to be developed and passed under the competent authority on approval of LRS on agricultural land. This will lead to less conversion of land and encouragement of better agriculture produce.

Provisions in the zonal regulations for conversion of the agriculture use to other desirable land uses by the landowner for justified reasons of self-use and / or community use will be made.

21.3.1.7 Green Cover & Landscape Conservation

State of Forest Report 2017 released by the Forest Survey of India reveals that the forest cover of the country is 21.54% of the total geographical area showing a marginal increase from the assessment in 2015 at 21.34%. The bulk of the increase has come from the improvement in forest covers in three states, one of which is Andhra Pradesh along with Karnataka and Kerala.

At present, the total land use covered by recreation, forest and hills makes a total green coverage of 12% of VMR and if the plantation around lakes and rivers is considered it becomes a green cover of 17% which is much lower than the state and national average.

The strategies that can be incorporated to increase the green cover are as follows

1. Development of green belt spanning the core area
2. Embark open spaces in residential area
3. Afforestation in open spaces like around lakes waterbodies canals etc
4. Avenue plantation

At present VMR has a stretch of 220 km National Highway, 490 km State Highway, 1,700 of Major District Roads and other district roads. At present only 11% of the total road length having medians has plantation. Considering plantation along the road to about 50% can improve the greenery and green cover to a huge extent.


Greening of abundant quarrying sites, which are left barren, can be used for public green spaces or man-made landscapes or green cover by afforestation.

Provisions in the zonal regulations for conversion of green covers and landscapes to other desirable land uses by the landowner for self-use and / or community use, compensatory tree plantations should be carried out to maintain the green cover.

CLIMATE CHANGE AND SUSTAINABILITY

Increased dependency on the coastal regions for food, energy, international trade, tourism, recreation, etc., in turn, these valuable ecosystems are susceptible to immense threats. The coastal areas in India are critically prone to the adverse effects of climate change. Frequent natural disasters and the rise of sea levels push back the coastline displacing millions of communities from the coastal regions. It can affect coastal cropland and impact biological productivity and diversity. The effects are so vast; it can change the ocean circulation pattern, vertical mixing of waters, and wave patterns, etc. due to these corresponding effects cooler areas get warmer resulting geographical shifts in biodiversity.

Changes in plankton activity due to an increase in temperature will affect the ocean's ability to absorb or store carbon. This could go back into the system and boost climate change. Therefore, the sustainability approach has been adopted to cope with the changing climate and man-made change in the land use pattern. Further, there will be profound impacts of climate change and sea level rise on several critical infrastructures in the region.

21.3.1.8 Addressing Landuse Related aspects of Climate Change Impacts

While the landuse related impacts are addressed through the strict implementation of CRZ Regulations, there still needs to be specific studies on localised impacts of climate change on the coastline of Visakhapatnam City and the VMR in the overall context of the Master Plan. Any intensive or active proposals to combat climate change at this stage if made would only be speculative in nature and wouldn't stand the scrutiny, given the magnitude of investments required for such measures. As an interim measure, sensitive landuses that may be impacted from sea level rise were avoided within the CRZ following the relevant regulations.

21.3.1.9 Critical Infrastructure

Critical Infrastructures are exposed to several potentially damaging physical events or Hazards. They may cause the loss of life or injury, property damage, social and economic disruption, and environmental degradation. The impacts of these hazards on infrastructure assets and urban settlements are to be assessed based on the below mentioned aspects and appropriate measures should be taken after the assessment.

- **Disruption of Service Network:** are critical which are likely to be affected due to flooding, exposure to seawater, and seawater intrusion caused by Sea Level Rise (SLR) and extreme events like storm surges. Predominantly all the infrastructures like communication systems, power, internet, etc., lying in the areas defined as 'vulnerable' in the natural hazards
- **Damage of Transportation Network:** which are critical for relief / response in case of extreme events like cyclones— These include rail; road; and aviation networks, hospitals/clinics, schools, open areas/public spaces/parks, emergency response stations, administrative headquarters, etc.
- **Damage of health units:** Devastating cyclones and corresponding inundation severely damage to the hospitals, health clinics, blood banks, emergency response stations, administrative headquarters, etc.

- **Damage of Other Utility Services**: Cyclones and storm surges create huge damage in the potable water and wastewater treatment services, drainage system, animal husbandry, etc.
- **Damage of Natural Ecosystems**: The area lying in the CRZ-IV zone or ecologically sensitive/vulnerable zone is also critical. Once the area disturbed ecologically, never returns to their original form. Also, all infrastructure assets lying in these sensitive or vulnerable zones are considered to be critical'.

21.3.1.10 Proposals for Sustainable Environment

The climate change and the vulnerability effects on both the living and non-living substances, which causes irreversible damages to the natural habitat, lives, and physical structures. These damages are very prominent in the coastal regions, where these are accounted to be many folds than the damages that occur in inland regions. Therefore, strong actions to be needed to offset those vulnerabilities during the effects of climate change. To cope up with the climate change and vulnerabilities, climate-resilient infrastructure in a sustainable development manner to improvise in the coastal region. The following actions should be taken up;

MANGROVE PLANTATION TO ARREST CYCLONES AND TIDAL WAVES

Mangroves play a crucial role in arresting tidal waves and tsunamis besides of supporting the ecological balance, protect from soil losses, also support in shrimp seed production, crocodile breeding, turtle nesting site, etc.,. There has been a decline or degradation of mangrove forests in the VMR over the past two decades.

This has been a serious concern when it was estimated the losses are about to 80% (i.e. 265 ha) of total mangroves area (i.e. 320 ha) in Vishakhapatnam coastal region since 1988, due to human interference and indiscriminate deforestation of the mangroves cover for industrial development and urbanization.

According to AP-SAPCC, about 500 ha coastal area was allocated for the mangrove plantation over the 7 years in Andhra Pradesh. Therefore, mangrove plantation and protection is one of the major interventions against climate change vulnerability. Shelterbelt tree plantation in the coastal region would reduce damage caused by cyclones and needs to be actively taken up along the coast. While Master Plan demarcates the coastline, the specific areas of plantation will be identified by the AP-SAPCC and implemented.

CONSTRUCTION OF SEAWALLS / CUT-OFF WALLS AT THE SEACOAST TO PREVENT SOIL EROSION & FLOODING IN LOW-LYING AREAS

Seawater rising, Tidal waves, storm surges, are threats to the coastal population. These result in flooding over the region, which predominantly causes potable water scarcity, water-borne diseases, disrupt the transportation system, loss of productive agriculture land. Moreover, the coastal erosion result in severe marine pollution due to setting of thermal power plants, pharmaceutical plants ports, ship breaking units, sand mining activities, etc. along the coast in case of Visakhapatnam

While measures for control of soil erosion are being taken up along the coast in Visakhapatnam, these are capital intensive and need detailed studies to locate exactly where these are needed. Presently, soil erosion is being prevented by the construction of physical barriers in the coast or sea walls by using stone, concrete cubes or tetrapods.

With the Visakhapatnam coast experiencing severe to very severe cyclonic storms in the recent past and possibility of affect from Tsunami, multiple lines of defence utilising the measures suggested such as sea walls, dykes, breakwaters and also measures such as plantation, improving mangrove plantations are needed to be implemented. Further detailed design reports are needed for several locations along the VMR Coast, which the Authority may take us as needed.

PROMOTE RENEWABLE ENERGY LIKE WIND AND SOLAR

Urbanization and industrialization demand an uninterrupted supply of energy, which generally comes from thermal power, which is the burden for the environment as they release a huge amount of carbon to the atmosphere. Therefore, to balance adequate demand and supply of energy, there solar & wind power energy should be encouraged.

Wind energy is having vast potential (100-200 W/m2), whereas solar power energy generation potential (150-250 W/m2) relatively higher than the wind energy in the northern coastal region of Visakhapatnam. This energy could be used in the power backup for reverse osmosis plant, hydraulic pressure barrier, cold storage, streetlights, water supply, etc. These proposals have accordingly been examined as part of the power infrastructure and accordingly incorporated into the Master Plan.

GROUND WATER RESOURCE

VMR region has an abundant source of water in the form of rivers, rivulets and canals passing through the area and in the end draining into the Bay of Bengal of the East Coast. Because of its location of the area on the downhill of the Eastern Ghats surface, ground water and drains have a natural gravitational line of flow. Because of the abundance of the waterbodies, there is a generous supply of water throughout year by means of surface and ground water. Surface water in the area is mainly utilized for irrigational purposes, industrial purposes and treated drinking water supply for population of ULBs. Municipal administrations of the VMR region utilize water from major rivers, and reservoirs in the area to cater to the water demand of the people. Ground water in the area is majorly utilized for the domestic water necessities of the people in rural and semi urban areas, irrigational and industrial purposes.

SURFACE WATER

The minor rivers from south to the north of the VMRare Yeleru reservoir, Pampa river, Thandava river, Varaha river, Sarada river, Meghadri gedda reservoir, Peddagedda, Gosthani river, Champavathi, Kandivalasa gedda, Pedda gedda (Figure 6 2).

The Other principal water sources in this region are Suvarnamukhi, Vegavati, Champavati, Gosthani, Kandivalasa, Mahendratanaya, Bahuda, and Kumbikotagedda.

Main canals passing along VMR are Yeluru and Polavaram canalsIn Visakhapatnam District, Visakhapatnam rural, Visakhapatnam urban, Sabbavaram, Pendurthi, Pedagantyada, Parawada, Padmanabham, Nakkapalli, Gajuwaka, Bheemili, and Anandapuram mandals are solely dependent on surface water supplied from ULBs. In Vizianagaram district, Vepada, Vizianagaram, Lakkavarapukota, Kothavalasa, Garividi, and Cheepurupalli are not using ground water.

PROPOSALS FOR SURFACE WATER USES

- As a rule, the quality will be poorer than that of rainwater or groundwater, the water is often unclear because of the presence of algae or other pollutants. Most surface water can therefore only be used for low-grade purposes such as flushing toilets and watering the garden.
- The benefit of using surface water as opposed to using rainwater is that no reservoir needs to be installed. To ensure a closed water balance, the rainwater can be drained from the site and the roof surfaces and into the surface water.
- Encourage infiltration is another way of protecting water resources, as this can potentially contribute to recharging aquifers and support groundwater. Ground coverage needs to be reduced with more natural and perforated ground cover to increase infiltration.
- Usage of surface water for industrial use, urban use or other uses by storing and supplying water at accessible locations like summer storage tanks, or underground storage tanks in industries.
- Recycling and reuse of treated effluent by industries in house or in their own premises.
- Localised usage of treated water at community level for non-domestic purposes.
- Replacement of ground water with surface water by using water from canals and other surface water bodies for irrigation purposes.

The effluents from the households end up as untreated and into the sea causing harm to seawater as well as marine life in the coastal region. Due to lack of treatment plants, most of the untreated water ends up in rivers, streams and finally in the ocean. The various ways to treat this water are as follows

- Improvement of sewerage system by treating household and industrial effluent at treatment plants.
- Utilization of rainwater through rainwater harvesting: Storage of rainwater in earthen tanks for domestic and agricultural uses is common. Rainwater harvesting can be done at individual household level and at community level in both urban as well as rural areas. At household level, harvesting can be done through roof catchments, and at community level through ground catchments. Depending on the quantity, location and the intended use, harvested rainwater, it can be utilized immediately or after storage.
- Infiltration systems should not be used in areas where the land use contributing pollutants with chemical storage, high levels of pesticides, the washing and maintenance of vehicles or equipment, or where wastes are handled.

PREVENTIVE ENVIRONMENTAL ACTIONS

Preventive Environmental Actions are required to protect the environment from pollution and degradation. While most of the measures suggested are preventive in nature but planning action for this strategy to be more effective towards air and noise pollution is critical in nature for its success in operationally reducing the pollution levels. Therefore, the air and noise pollution actions are discussed in this section. Other measures for preventive pollution such as for combating climate change are discussed in the previous sections, preventive action such as climate resilience is discussed in this section.

21.3.1.11 Air & Noise Pollution control

The monthly Average of Ambient Air quality monitoring at NAMP monitoring stations in Visakhapatnam, and Vizianagaram, and districts, SO2, NOx, RSPM and Ammonia, levels that are monitored by APPCB are analysed. As per the study of the air quality in the region for last seven consecutive years it is observed that, the RSPM concentrations are higher than standard in the whole region and highest Concentration is observed in year 2016. SO2, NOx, and NH3 concentrations are less than standards and in a fluctuating trend.

The higher RSPM concentrations in the region are due to higher concentration of industries such as HNPCL, Port activities, Visakhapatnam steel plant and others. Mitigatory measures need to be adopted for reducing the RSPM levels with augmenting green covers and better filtering of effluents before release to atmosphere.

Buffer spaces or green covers around the polluting industries is a way to reduce the pollution. Apart from this, plantation and buffer towards the wind direction can reduce the pollution to a certain level.

To understand the pollution levels in the other non - NAMP monitored areas of the VMR region a rigorous exercise of is done to extract ten ambient air quality sample locations from the air quality monitoring study conducted samples in various EIA reports submitted to AP Pollution Control Board.

The sample locations identified are either near SEZ's, near Reserve forest, ports, or near coast. The PM 2.5, PM10, SO2, NOx concentrations of ambient air monitored in these locations is taken as reference for air quality in the project area. SO2 concentrations have been found higher in some areas due to use of automobile like autos and buses, which do not use LPG. With the increasing number of autos and vehicles using incomplete combustion of fuel, the problem will rise further.

In order to prevent further escalation of air pollution levels in the Visakhapatnam City in particular and rest of the VMR, network of public transportation is proposed for improvement. This shift to public transport for more than 40% of travel demand would reduce the air and noise pollution levels. Location of industries away from potential habitation areas, provision of buffer areas, reduces the effects of air pollution and noise from proposed industrial areas. These measures have accordingly been incorporated into the Master Plan.

21.3.1.12 Climate Resilient Infrastructure and Disaster Relief

A Disaster Management Plan prepared by the respective districts while address the basic challenges of a disaster, the preventive actions should ensure the infrastructure created as part of the Master Plan is robust enough to withstand the vagaries of nature. Climate change induced events are usually aggressive in nature right from increased intensity of rainfall to high intensity winds from Cyclones, high temperatures, reduced crop productive and another unseen phenomenon. The design standards that need to be adopted for infrastructure like buildings, roads, drainage systems, bridges, power lines etc., should be adopting highest risk levels and high factor of safety. Further, existing infrastructure may also be on individual basis be recommended for retrofitting to be climate resilient as a preventive action.

22 RURAL DEVELOPMENT

This chapter presents the development strategies for the rural settlements in VMR. Measures have been taken to integrate the villages in the overall development in order to have a synergy with the urban development. Since VMR has a large area and population which is rural in nature it is important to have focus on the particular aspect to and nurture the growth of the region as a whole.

22.1 INTRODUCTION

Currently close to 45% population of VMR is living in rural areas with agriculture and fisheries as the main source of employment. To carry out the comprehensive economic and infrastructure development in VMR development of the rural areas is integral to planning of VMR. Under this strategy improvement of connectivity to mandal headquarters, villages, and major resource centre to rural areas is proposed. Besides protecting the current economy of the rural areas, development of transport connectivity, employment, and improved social infrastructure areas near the nodal villages and mandal headquarters is key to comprehensive rural community's development of VMR.

22.2 HIERARCHICAL DEVELOPMENT

The development in the rural areas can be achieved fostering infrastructure facilities at the villages based on their hierarchy. The provision of economic and infrastructure facilities has financial constraints which can be addressed by providing these facilities at central villages which are placed at advantageous locations for connectivity and centrality etc. The smaller villages will have less population which is not sufficient for proper and full utilization of services. Thus, the location of facilities should be in view of minimum threshold population. In this way, the central villages which provide the economic and infrastructural facilities can generate growth in the adjoining villages. However, for an integrated development, spatial and functional integration is necessary between the central and basic villages. The local economies should also be taken into consideration for a holistic approach to improve quality of living with provision of basic infrastructure facilities like safe drinking water, road connectivity, health facilities and education along with employment programmes for the poor. The list of Central villages is given in Appendix O.

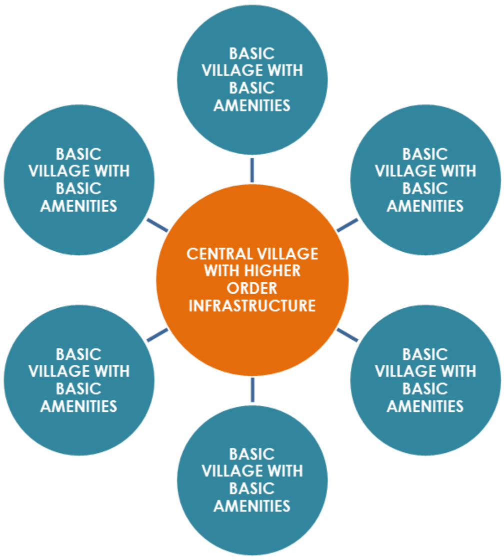


Figure 22-1: Rural Development structure

22.3 DEVELOPMENT PARAMETERS

The rural areas are connected to the overall network of VMR. However, there are differences in the levels at which each of the settlements are envisaged to grow. Parameters have been identified to measure the function of the settlements where they will act as a central village or a basic village. The parameters considered are:

- Connectivity through transportation network
- Accessibility to higher order facilities
- Availability of Physical Infrastructure
- Availability of Social Infrastructure
- Significant Economic Base

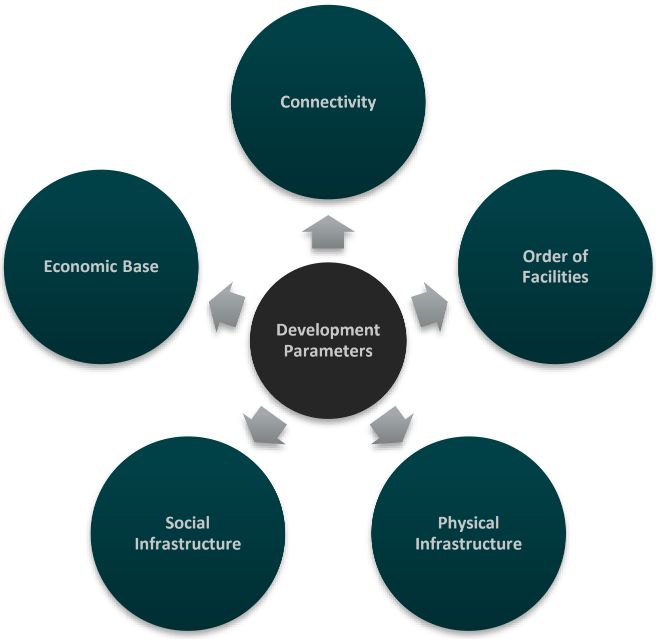


Figure 22-2: Rural Development Parameters

Connectivity

The Master Plan keeps provision of a minimum of 18 m wide road connecting every village of VMR. A robust network for the region has been designed providing width of roads based on the significance and functionality of each settlement. The higher order settlements with more population and facilities are ought to have better connectivity to the urban areas considering the higher traffic movements as compared to the basic villages which are well connected to the central villages. This ensures better allocation of resources and optimum usage of the network.

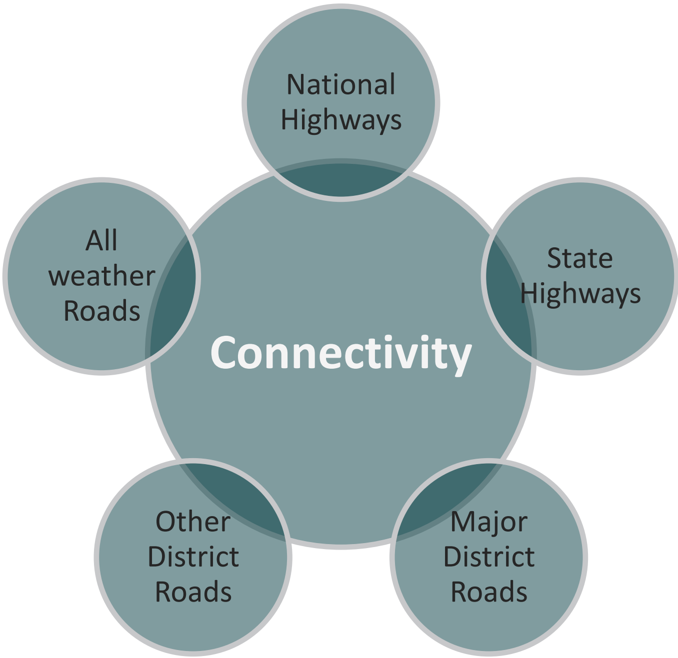


Figure 22-3: Hierarchy of Rural Connectivity

Order of Facilities

Each rural settlement will be having the order of facilities based on the population they are catering to. The basic villages will be housing basic amenities to provide for the needs of their own population while the central villages will be serving for the whole cluster of the central and the surrounding basic villages. People residing the in the basic villages will be able to avail the next order of facilities at the nearby central village. The facilities considered for these criteria are:

- Educational Facilities
- Healthcare Facilities
- Commercial Facilities
- Socio-Cultural Facilities
- Recreational Facilities
- Miscellaneous Facilities

Figure 22-4 and Figure 22-5 shows the order of facilities available at central and basic villages respectively.

Educational Facilities	Healthcare Facilities	Commercial Facilities	Socio-Cultural Facilities	Recreational Facilities	Miscellaneous Facilities
Total Area: 15 Ha	Total Area: 0.5 Ha	Total Area: 2 Ha	Total Area: 1.5 Ha	Total Area : 11 Ha	Total Area: 0.5 Ha
• Pre Primary, Nursery Schools	• Dispensary	• Convenience Shopping	• Anganwadi - Housing area/ cluster	• Housing Area Park	• Milk Distribution
• Primary School	• Family Welfare Centre	• Local shopping including service centre	• Community Room	• Residential unit play area	• Post office counter without delivery (Floor area to be provided in local shopping centre)
• Senior Secondary School (VI to XII)	• Diagnostic centre	• Bank with extension counters with ATM facility	• Religious facilities At neighbourhood / housing cluster level	• Neighbourhood Park	• LPG Godown/ Gas godown
• School for Physically Challenged		• Weekly Markets	• Community hall, mangalkaryalaya, baraat ghar	• Neighbourhood Play area	• Police Post
			• Library		• Petrol/ Diesel filling cum Service Station cum workshop

Total Area: 31 Ha

Figure 22-4: Order of facilities available at central villages

Educational Facilities	Healthcare Facilities	Commercial Facilities	Socio-Cultural Facilities	Recreational Facilities	Miscellaneous Facilities
Total Area: 4.5 Ha	Total Area: 0.1 Ha	Total Area: 1.0 Ha	Total Area: 0.5 Ha	Total Area : 4.5 Ha	Total Area: 0.05 Ha
• Pre Primary, Nursery Schools	• Dispensary	• Convenience Shopping	• Anganwadi - Housing area/ cluster	• Housing Area Park	• Milk Distribution
• Primary School		• Local shopping including service centre	• Community Room	• Residential unit play area	• Post office counter without delivery (Floor area to be provided in local shopping centre)
• Senior Secondary School (VI to XII)		• Bank with extension counters with ATM facility	• Religious facilities At neighbourhood / housing cluster level	• NeighbourhoodPark	
			• Community hall, mangalkaryalaya, baraat ghar	• Neighbourhood Play area	
			• Library		

Total Area: 11 Ha

Figure 22-5: Order of facilities available at basic villages

Economy

The primary livelihood of rural population is based on agricultural and fisheries activities. It is important to make the rural areas more self-reliant to strengthen their economy. Facilitating growth in economy of the region through encouraging small scale agro-based industries using local produce can improve the livelihood of the rural communities. The agro based industries not only boost the economy of the region, but also create employment opportunities for the local communities.

Agricultural land Protection: With the rapid and uncontrolled urbanization in the region many agricultural lands are being converted for other purposes. Most of the agricultural lands in the region are very fertile and produce two to three crops per annum. Regulatory measures need to be taken to preserve these high productive agriculture lands from being converted to other uses. Agriculture land conversion may be permitted only to low crop yielding lands for Agro-based and allied industries and cities are developed in a compact manner.

Household / Cottage Industries: Household based industries or cottage industries are an integral part of rural areas. These small-scale village industries which are primarily agro based or artisanal entrepreneurships are key economic remedies for landless farmers and wage labour. With proper connectivity to the central villages and regional centres in the region, these industries tend to reach a wider marketplace and boost the local economies of the region, alleviating poverty in the villages through employment of non-skilled labour.

Employment generating activities has been identified for the hierarchy of rural settlements which will work in sync with the rural economy and also play an active role in the overall supply chain of VMR. Figure 22-6 shows the order of employment generating activities proposed in the villages.

Figure 22-6: Employment generating activities in rural settlements

22.4 CONCLUSION

The region has a rich rural resource. The rivers and canals meandering the region, makes the land more fertile and creates great potential for Agriculture. The stakeholders' consultations also revealed that people preferred to conserve the agricultural lands. Observing the potential of the region and taking into account the interest of Stakeholders, measures has been taken to conserve the agriculture land and at the same time boost the economy of rural region by adopting techniques in agriculture to increase cropping and increase higher household wages. Harmony of the rural area is not disturbed by urbanization but provisions for better infrastructure facilities like skill development centres, agricultural markets, connectivity to central villages, access to basic amenities are done to improve the quality of life in the rural region and as proposed in the Master Plan.

23 CAPITAL INVESTMENT PLAN

23.1 SUMMARY OF CAPITAL INVESTMENT PLAN

This chapter presents preliminary capital cost of key infrastructure projects by 2041 in VMR. An estimated Rs. 1,49,202 crores are needed to meet the transportation and infrastructure demand for VMR by 2041. The abstract of the cost estimation for the future development is shown in Table 23-1

Table 23-1: Abstract of the development cost estimation

Sl. No.	Component	Estimated Cost (INR crores)
1	Transport Infrastructure	95,992.00
2	Water Supply System	45,62.6
3	Sewerage / Waste Water System with Recycling System	59,35.0
4	Solid Waste Management including Treatment and Waste to Energy Plant	439.6
5	Flood Control System	6,62.3
6	Power Infrastructure	52,500
	Total	**149,201.5**

Source: Consultant's Estimation

23.2 CAPITAL INVESTMENT PLAN FOR TRANSPORT SECTOR

The cost of horizon year transport network (road widening, missing/ new links, bus system, BRTS, Suburban Rail system, Metro/ LRT system, Inter City Bus Terminals, Truck Terminals, traffic management measures have been estimated based on the unit rates, compiled from the Consultants own experience on similar projects, DPR studies on BRTS projects, Feasibility/ DPR studies on suburban lines, metro lines, etc.

The details of broad cost estimate for the total transport network for the horizon year 2041 are presented in Table 23-2.The total cost of horizon transport network for the horizon period up to 2041 is INR 0.95 lakh crores @ 2019-20 prices. Approximate cost of proposed public transport network proposals under Metro/ Metro lite/ LRT system, BRTS and Bus system, is INR 47,671 crores, INR 1,623 crores and INR 1,136 crores respectively, with the individual share of total cost being 49.7%, 1.7% and 1.2% respectively. Approximate cost of proposed Roads/ Highways, Bus Terminals, Truck Terminals and Traffic Management Measures is INR 40,972 crore, INR 478 crores, 537 crores and 3,575 crores respectively with individual share of total cost being 42.7%, 0.5%, 0.6% and 3.7% respectively. Similarly, broad cost estimates for the total transport network for the horizon period upto 2051 is worked out and presented in Table 23.2

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Table 23-2: Summary of Preliminary Broad Cost Estimates (in INR crores @ 2019-20) for Proposed Transport Infrastructure for Horizon period upto 2051

System	Upto 2041			Upto 2051		
	Length (km)	Broad Cost in INR Crore @ 2019-20	%	Length	Broad Cost in INR Crore @ 2019-20	%
Metro	175	47,671	49.7%	175	47,671	39.5%
Suburban Train				236	11,697	9.7%
BRTS	127	1,623	1.7%	127	1,623	1.3%
Bus System		1,136	1.2%		1,677	1.4%
Roads/ Highways		40,972	42.7%		51,215	42.4%
Inter City Bus Terminals		478	0.5%		478	0.4%
Truck Terminals: Major and Mini		537	0.6%		537	0.4%
Traffic Management Measures		3,575	3.7%		5,900	4.9%
Total		**95,992**	**100%**		**120,797**	**100%**

** For cost assessment purpose, components required for construction of dedicated lanes for BRTS, bus stops, bus fleet, bus depot/ terminal, bus fleet, etc. are only considered. Cost of other carriageway portion, NMT facilities along the corridor are included as part of Road/ Highways category already.*

*** Traffic Management Measures include intersection improvements, installation of traffic signals, flyovers/ elevated roads, RoBs/ RuBs, Pedestrian FoBs/ Subways/ Skywalks, Off-street Parking/ MLCP facilities, etc.*

23.3 CAPITAL INVETSMENT PLAN BY KEY INFRASTRUCTURE SECTOR

Based on the designs and quantities for infrastructure components worked out, Block cost estimates have been framed for all the sectors on prevailing rates in the region. The sector wise and component wise block cost so worked out is being depicted below in Table 23-3 to Table 23-7.

WATER SUPPLY SYSTEM

Table 23-3: Block Cost Estimate for Water Supply System

S No.	Particulars	Amount Rs in Millions
1	Providing Laying & Jointing MS spiral welded pipes with inside cement mortar lining and outside gunnetting/ protective coating for Raw water mains 1067 mm to 1829 mm diameter complete with excavation, fixing of specials and valves and saddles where required.	9,473.07
2	Providing Laying & Jointing Ductile Iron pipes with inside cement mortar lining for Raw water mains 450 to 1000 mm diameter complete with excavation, fixing of specials and valves complete	3,757.46
3	Construction, supply and installation of raw water lift stations from canal including power feeder, switch gears, transformer etc complete as required.	1,084.50
4	Construction of Water Treatment Plants complete including all electro- mechanical equipment & SKADA system	1,004.93
5	Construction of Clear Water Reserviors complete with pipe fittings	1,406.63
6	Construction, supply and installation of clear Water pumping stations complete with power line staff quarters and required ancillary works	807.38
7	Construction of Service Reservoirs complete with all pipe fittings	7,453.17
8	Providing Laying & Jointing clearwater pumping mains with DI -K-9 pipes	645.9
9	Providing Laying and Jointing Trunk Distribution system complete with fittings and acessories with DI pipes class K-7.	15,732.37
	Total	**41,365.41**
	Add for Contingencies supervision and DPRs 10.3%	4,260.64
	Grand Total	**45,626.04**
		Say INR 4,563 Crore

SEWERAGE / WASTE WATER SYSTEM

Table 23-4: Block Cost Estimate for Sewerage / Waste Water System with Recycling System

S No.	Particulars	Amount Rs in Millions
1	Providing Laying & Jointing Trunk Collection System for collection of Sewage and Waste Water with HDPE/ GRP/ RCC pipes complete with excavation, bed concrete and man holes etc.	20,050.19
2	Construction, supply and installation of Sewage Pumping Stations	93.52
3	Providing Laying & Jointing Sewage pumping mains with DI pipes class K-9 complete with all required fittings valves etc.	76.18
4	Construction of Sewage/ Effluent Treatment Plants complete with all civil and electro mechanical works	14,984.40

5	Construction of Tertiary Treatment Plants comprising of sand filters, Activated charcoal treatment and disinfection system complete with all civil and electro mechanical works	5,008.00
6	Construction of Tertiary treated Water Reserviors complete with pipe fittings etc	1,321.56
7	Construction, supply and installation of pumping stations for recycling of TT water for horticulture, industrial and other non potable usage, complete with power line staff quarters and required ancillary works	952.20
8	Construction of Service Reservoirs complete with all pipe fittings	5,286.22
9	Providing Laying & Jointing Treated effluent pumping mains with DI pipes class K-9, for recycling.	952.20
10	Providing Laying and Jointing TT Water Trunk Distribution system complete with fittings and acessories -HDPE/GRP/ DI - K7 pipes	5,084.05
	Total	**53,808.50**
	Add for Contingencies supervision and DPRs 10.3%	5,542.28
	Grand Total	**59,350.78**
	Say INR 5,935 Crore	

SOLID WASTE MANAGEMENT

Table 23-5: Block Cost Estimate Solid Waste Management including Treatment and Waste to Energy Plant

Primary Handling & Transportation Equipment		
S No	**Particulars**	**Amount Rs in Millions**
1	10 litres capacity bins	112
2	25 litres capacity bins	40
3	50 litres capacity bins on road side	63
4	Containerized Tri-cycles/ auto tripper with 200 and 600 litre capacity dual bin	455
5	1100 litres capacity- Dual Mobile bins	15
6	Dumper placer bins 4 cum capacity 2 Nos at each site	587
7	Supply of Broomstick, Safety equipment, Gloves, Shoes/ Gumboots, Raincoat, Mask etc	33
	Sub Total	**1,304.66**
Secondary Handling & Transportation Equipment		
1	Hook loader mounted on Truck chassis capable of handling 16 cum containers @ 2 trips per day with 10% standby	845.94
2	Tractor with 4 cum trolly assuming 2 trips per day and 10% standby	34.84
3	Reguse collector & compressor	321.27
	Sub Total	**1,202.05**
Integrated Waste Management and Treatment Facelity		
1	Land Development for Landfill Site	1.87
2	Civil Works	513.18
3	Mechanical Works	307.91
4	Electrical Works	114.37

5	Cost of Biomethanation Plant	468.05
6	Cost of incineration Plant each unit of 50MTD capacity	73.31
7	Cost of Compost Plant for villages	327.46
	Sub Total	**1,478.69**
Total with cost of Integrated Waste Managemant		**3,985.40**
Add Contingencies & Non Core components 10.3%		**410.50**
Grand Total		**4,395.90**
Say Rs. 439.6 Crores		

INUNDATION/ FLOODING MANAGEMENT

Table 23-6: Block Cost Estimate to check Inundation/ flooding due to Natural drains

S No	Particulars	Amount in INR millions
1	Provision for straightening the meandering parts causing scouring of side berms of natural drains in VMR Region, including excavation, required masonry work and stone pitching etc.	4,031.60
2	Provision for excavation / earth filling for maintaining required gradient and for stone pitching work on side berms for increasing velocity of flow in the sections where stagnant water / inundation is observed on the sides of streams.	1,973.30
	Sub Total	**6,004.90**
Add Contingencies & Non-Core components 10.3%		**618.50**
Grand Total		**6,623.40**
Say Rs. 662 Crores		

POWER

Assuming the cost of Power Generation is at INR 5 Crores for Mega Watt, the additional power demand estimated for the region of 3,500MW will account at INR17, 500 Crores of investment for Generation and around INR 35,000 Crores for transmission and distribution. A total investment of INR 52,500 is estimated for the region.

Table 23-7: Block Cost Estimate for Power generation and transmission

S No	Particulars	Amount in INR Crores
1	Generation of 3,500 MW Additional Power Demand	17,500
2	Transmission and Distribution	35,000
	Sub Total	**52,500**

Accordingly, it is recommended that respective organizations need to make necessary provisions [in their budget allocations to meet the power sector requirement in the region.

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