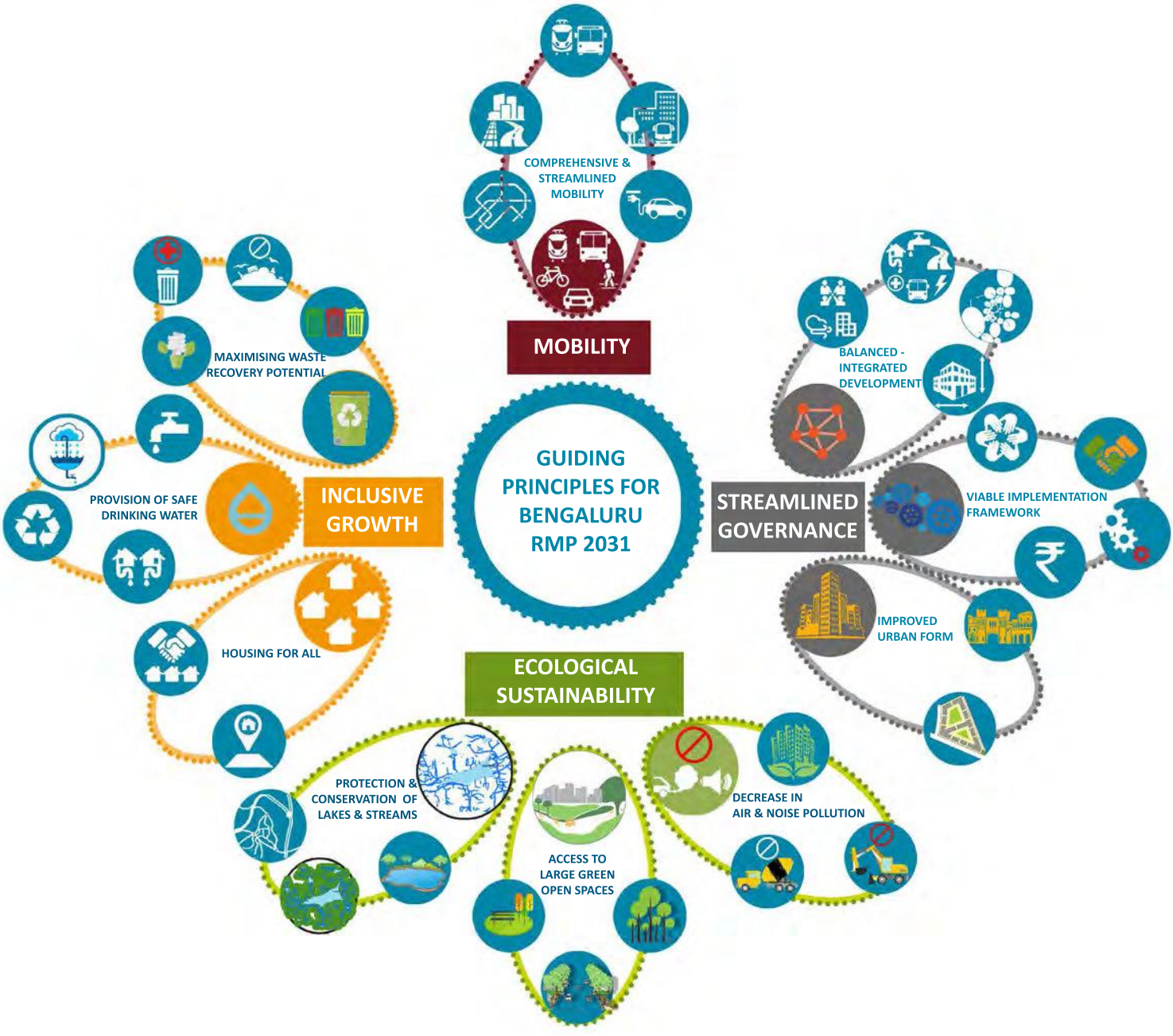
Revised Master Plan for Bengaluru-2031 (Draft)

Volume 3 - Master Plan Document



Bangalore Development Authority

RNI No. KARBIL/2001/47147

ಕರ್ನಾಟಕ ರಾಜ್ಯಪತ್ರ

ಅಧಿಕೃತವಾಗಿ ಪ್ರಕಟಿಸಲಾದುದು

ವಿಶೇಷ ರಾಜ್ಯ ಪತ್ರಿಕೆ

ಭಾಗ-I	ಬೆಂಗಳೂರು, ಗುರುವಾರ, ನವೆಂಬರ್ ೨೩, ೨೦೧೭ (ಮಾರ್ಗಶಿರಾ ೨, ಶಕ ವರ್ಷ ೧೯೩೯)	ನಂ.೧೦೫೯
Part-I	Bengaluru, Thursday, November 23, 2017 (Margashira 2, Shaka Varsha 1939)	No. 1059

ಕರ್ನಾಟಕ ಸರ್ಕಾರದ ನಡವಳಿಗಳು

ನಗರಾಭಿವೃದ್ಧಿ ಸಚಿವಾಲಯ

ವಿಷಯ: ಬೆಂಗಳೂರು ಅಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರದ ಸ್ಥಳೀಯ ಯೋಜನಾ ಪ್ರದೇಶಕ್ಕೆ ತಯಾರಿಸಿರುವ ಪರಿಷ್ಕೃತ ಮಹಾಯೋಜನೆ-2031ಕ್ಕೆ ಸರ್ಕಾರದ ತಾತ್ಕಾಲಿಕ ಅನುಮೋದನೆ ನೀಡುವ ಬಗ್ಗೆ.

ಓದಲಾಗಿದೆ: 1. ಸರ್ಕಾರದ ಆದೇಶ ಸಂಖ್ಯೆ: ನಅಇ 540 ಬೆಂಅಸೇ 2004, ದಿನಾಂಕ: 25-06-2007.

2. ಆಯುಕ್ತರು, ಬೆಂಗಳೂರು ಅಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರ, ಬೆಂಗಳೂರು ಇವರ ಪತ್ರ ಸಂಖ್ಯೆ: ಬೆಂಅಪ್ರಾ/ನಯೋಸ/RMP-2031/1312/2017-18, ದಿನಾಂಕ:12-10-2017.

3. ಮಹಾನಗರ ಆಯುಕ್ತರು, ಬೆಂಗಳೂರು ಮಹಾನಗರ ಪ್ರದೇಶಾಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರ ಇವರ ಪತ್ರ ಸಂಖ್ಯೆ: BMRDA/BDA/Master Plan/2006-07(Part-II), ದಿನಾಂಕ:03-11-2017.

ಪ್ರಸ್ತಾವನೆ:-

ಮೇಲೆ ಓದಲಾದ ಕ್ರಮಸಂಖ್ಯೆ (1) ರ ಸರ್ಕಾರದ ಆದೇಶದಲ್ಲಿ ಬೆಂಗಳೂರು ಅಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರದ ಸ್ಥಳೀಯ ಯೋಜನಾ ಪ್ರದೇಶಕ್ಕೆ ತಯಾರಿಸಲಾಗಿದ್ದ ಪರಿಷ್ಕೃತ ಮಹಾಯೋಜನೆ-2015ಕ್ಕೆ ಕರ್ನಾಟಕ ನಗರ ಮತ್ತು ಗ್ರಾಮಾಂತರ ಯೋಜನಾ ಕಾಯ್ದೆ, 1961ರ ಕಲಂ 13(3) ರಡಿಯಲ್ಲಿ ಸರ್ಕಾರದ ಅಂತಿಮ ಅನುಮೋದನೆ ನೀಡಲಾಗಿತ್ತು.

ಮೇಲೆ ಓದಲಾದ ಕ್ರಮಸಂಖ್ಯೆ (2) ರಲ್ಲಿನ ಪತ್ರದಲ್ಲಿ ಆಯುಕ್ತರು, ಬೆಂಗಳೂರು ಅಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರ, ಬೆಂಗಳೂರು ಇವರು ಬೆಂಗಳೂರು ಅಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರವು ಬೆಂಗಳೂರು ನಗರ ಸ್ಥಳೀಯ ಯೋಜನಾ ಪ್ರದೇಶಕ್ಕೆ ತಯಾರಿಸಿರುವ ಪರಿಷ್ಕೃತ ಮಹಾಯೋಜನೆ-2031ಕ್ಕೆ ಕರ್ನಾಟಕ ನಗರ ಮತ್ತು ಗ್ರಾಮಾಂತರ ಯೋಜನಾ ಕಾಯ್ದೆ, 1961ರ ಕಲಂ 13(1) ರಡಿಯಲ್ಲಿ ಸರ್ಕಾರದ ತಾತ್ಕಾಲಿಕ ಅನುಮೋದನೆಗಾಗಿ ಪ್ರಸ್ತಾವನೆಯನ್ನು ಮಹಾನಗರ ಆಯುಕ್ತರು, ಬೆಂಗಳೂರು ಮಹಾನಗರ ಪ್ರದೇಶಾಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರ ಇವರಿಗೆ ಸಲ್ಲಿಸಿರುತ್ತಾರೆ.

ಮೇಲೆ ಓದಲಾದ ಕ್ರಮಸಂಖ್ಯೆ (3) ರಲ್ಲಿನ ಪತ್ರದಲ್ಲಿ ಮಹಾನಗರ ಆಯುಕ್ತರು, ಬೆಂಗಳೂರು ಮಹಾನಗರ ಪ್ರದೇಶಾಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರ ಇವರು ಬೆಂಗಳೂರು ಅಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರದ ವತಿಯಿಂದ ತಯಾರಿಸಿ ಸಲ್ಲಿಸಿರುವ ಬೆಂಗಳೂರು ನಗರದ ಸ್ಥಳೀಯ ಯೋಜನಾ ಪ್ರದೇಶದ ತಾತ್ಕಾಲಿಕ "ಪರಿಷ್ಕೃತ ಮಹಾಯೋಜನೆ-2031"ನ್ನು ಕರ್ನಾಟಕ ನಗರ ಮತ್ತು ಗ್ರಾಮಾಂತರ ಯೋಜನಾ ಕಾಯ್ದೆ, 1961ರ ಕಲಂ 13(1) ರಡಿಯಲ್ಲಿ ಸರ್ಕಾರದ ತಾತ್ಕಾಲಿಕ ಅನುಮೋದನೆ ಕೋರಿ ಸರ್ಕಾರಕ್ಕೆ ಪ್ರಸ್ತಾವನೆ ಸಲ್ಲಿಸಿರುತ್ತಾರೆ.

ಬೆಂಗಳೂರು ಅಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರವು ಮಹಾಯೋಜನೆಯನ್ನು ತಯಾರಿಸುವ ಉದ್ದೇಶದ ಬಗ್ಗೆ ಕರ್ನಾಟಕ ನಗರ ಮತ್ತು ಗ್ರಾಮಾಂತರ ಯೋಜನಾ ಕಾಯ್ದೆ, 1961ರ ಕಲಂ 10(1) ರಡಿಯಲ್ಲಿ ದಿನಾಂಕ:07-05-2012ರ ರಾಜ್ಯ ಪತ್ರದಲ್ಲಿ ಹಾಗೂ ದಿನಾಂಕ:08-05-2012ರ ದಿನಪತ್ರಿಕೆಯಲ್ಲಿ ಪ್ರಕಟಿಸಿ ಕಾನೂನಿನನ್ವಯ ಎಲ್ಲಾ ಪ್ರಕಾರ್ಯಗಳನ್ನು ಕೈಗೊಂಡು ತಾತ್ಕಾಲಿಕ ಮಹಾಯೋಜನೆಯನ್ನು ತಯಾರಿಸಿರುತ್ತದೆ.

ಸದರಿ ತಾತ್ಕಾಲಿಕ ಮಹಾಯೋಜನೆಯಲ್ಲಿ 2031ನೇ ಇಸವಿಗೆ ಆಗಬಹುದಾದ ಸಂಭವನೀಯ ಜನಸಂಖ್ಯೆಯನ್ನು ಗಮನದಲ್ಲಿಟ್ಟಿಕೊಂಡು ಜನಸಾಂದ್ರತೆಗನುಗುಣವಾಗಿ 2015ನೇ ಮಹಾಯೋಜನೆಗಿಂತ ಕೇವಲ 80 ಚದರ ಕಿಲೋ ಮೀಟರ್ ಪ್ರದೇಶವನ್ನು ಮಾತ್ರ ಹೆಚ್ಚುವರಿ ನಗರೀಕರಣ ಪ್ರದೇಶವನ್ನಾಗಿ ಪ್ರಸ್ತಾಪಿಸಲಾಗಿದೆ.

ನಗರೀಕರಣಕ್ಕೆ ಅವಶ್ಯಕವಾಗುವ ವ್ಯವಸ್ಥೆಗಳಾದ ಸಾರಿಗೆ ಮತ್ತು ಸಂಚಾರ ವ್ಯವಸ್ಥೆ, ಸಂಪರ್ಕ ರಸ್ತೆಗಳು, ವಸತಿ ಸೌಲಭ್ಯದ ಬೇಡಿಕೆ, ನೀರು ಸರಬರಾಜು ಬೇಡಿಕೆ, ಘನ ತ್ಯಾಜ್ಯ ನಿರ್ವಹಣೆಗೆ ಬೇಕಾದ ಜಮೀನು, ಪರಿಸರ ಸಂರಕ್ಷಣೆಗೆ ಸಂಬಂಧಿಸಿದ ಬೇಡಿಕೆಗಳು, ದೊಡ್ಡ ಉದ್ಯಾನವನಗಳು(Tree Park), ವಲಯ ನಿಯಮಾವಳಿಗಳು ಮುಂತಾದ ಪ್ರಮುಖ ಅಂಶಗಳನ್ನು ಗಣನೆಗೆ ತೆಗೆದುಕೊಂಡು ಪರಿಷ್ಕೃತ ಮಹಾಯೋಜನೆ–2031ನ್ನು ತಯಾರಿಸಿರುವುದಾಗಿ ಪ್ರಸ್ತಾವನೆಯಲ್ಲಿ ವಿವರಿಸಲಾಗಿದೆ.

ಸದರಿ ಪ್ರಸ್ತಾವನೆಯನ್ನು ಸರ್ಕಾರವು ಪರಿಶೀಲಿಸಿ ಈ ಕೆಳಕಂಡಂತೆ ಆದೇಶಿಸಿದೆ.

ಸರ್ಕಾರದ ಆದೇಶ ಸಂಖ್ಯೆ: ನಅಇ 516 ಬೆಂಆಸೇ 2017, ಬೆಂಗಳೂರು ದಿನಾಂಕ: 22–11–2017

ಪ್ರಸ್ತಾವನೆಯಲ್ಲಿ ವಿವರಿಸಿರುವ ಅಂಶಗಳ ಹಿನ್ನೆಲೆಯಲ್ಲಿ, ಬೆಂಗಳೂರು ಅಭಿವೃದ್ಧಿ ಪ್ರಾಧಿಕಾರವು ತಯಾರಿಸಿ ಸಲ್ಲಿಸಿರುವ ಬೆಂಗಳೂರು ನಗರದ ಸ್ಥಳೀಯ ಯೋಜನಾ ಪ್ರದೇಶದ ಪರಿಷ್ಕೃತ ಮಹಾಯೋಜನೆ–2031ಕ್ಕೆ ಕರ್ನಾಟಕ ನಗರ ಮತ್ತು ಗ್ರಾಮಾಂತರ ಯೋಜನಾ ಕಾಯ್ದೆ, 1961ರ ಕಲಂ 13(1) ರಡಿಯಲ್ಲಿ ಈ ಕೆಳಕಂಡ ಷರತ್ತುಗಳಿಗೊಳಪಟ್ಟು ಸರ್ಕಾರದ ತಾತ್ಕಾಲಿಕ ಅನುಮೋದನೆ ನೀಡಲಾಗಿದೆ.

1. ಪ್ರಸ್ತಾಪಿತ ತಾತ್ಕಾಲಿಕ ಮಹಾಯೋಜನೆಯನ್ನು ಸಾರ್ವಜನಿಕವಾಗಿ ಪ್ರಕಟಿಸಿ 60 ದಿನಗಳ ಕಾಲಾವಕಾಶ ನೀಡಿ, ಮಹಾಯೋಜನೆ ಕುರಿತಂತೆ ಸಾರ್ವಜನಿಕರಿಂದ ಸಲಹೆ ಮತ್ತು ಆಕ್ಷೇಪಣೆಗಳನ್ನು ಸ್ವೀಕರಿಸುವುದು;
2. ಇದುವರೆಗೆ ಸರ್ಕಾರವು ಅನುಮೋದಿಸಿದ ವಲಯ ಬದಲಾವಣೆ ಮತ್ತು ಪ್ರಾಧಿಕಾರವು ಅನುಮೋದಿಸಿದ ವಿನ್ಯಾಸ ಹಾಗೂ ಇತರೆ ಅಭಿವೃದ್ಧಿ ಅನುಮೋದನೆ ಯೋಜನೆಗಳಿಗೆ ನೀಡಲಾದ ಪ್ರಕರಣಗಳನ್ನು ತಪ್ಪದೆ ಅಳವಡಿಸಿಕೊಳ್ಳತಕ್ಕದ್ದು;
3. ಪರಿಸರ ಸೂಕ್ಷ್ಮ ಪ್ರದೇಶಗಳಾದ ಕಣಿವೆಗಳು, ನದಿತೊರೆ ಪಾತ್ರಗಳು, ಕೆರೆಯ ಅಂಗಳಗಳು ಮುಂತಾದವುಗಳನ್ನು ಸೂಕ್ತವಾಗಿ ಅಳವಡಿಸಿಕೊಂಡು ಭೂ ಉಪಯೋಗ ಪ್ರಸ್ತಾಪಿಸಿರುವ ಬಗ್ಗೆ ಖಚಿತಪಡಿಸಿಕೊಳ್ಳತಕ್ಕದ್ದು;
4. ನಕ್ಷೆಗಳಲ್ಲಿ ಅಳವಡಿಸಲಾದ ಕೆಡೆಸ್ಟ್ರಿಯಲ್ ಮಾಹಿತಿಗಳು ಸರಿಯಾಗಿ ಅಳವಡಿಸಿದ ಬಗ್ಗೆ ಖಚಿತಪಡಿಸಿಕೊಳ್ಳತಕ್ಕದ್ದು;
5. ಹಾಲಿ ಅಭಿವೃದ್ಧಿಗೊಂಡ ಮತ್ತು ಅನುಮೋದಿತ ವಿನ್ಯಾಸಗಳ ಉದ್ಯಾನವನ ಮತ್ತು ನಾಗರಿಕ ಸೌಲಭ್ಯ ನಿವೇಶನಗಳನ್ನು ಪ್ರಸ್ತಾವಿತ ಭೂ ಉಪಯೋಗ ನಕ್ಷೆಗಳಲ್ಲಿ ತಪ್ಪದೇ ಅಳವಡಿಸಿಕೊಳ್ಳತಕ್ಕದ್ದು;

ಕರ್ನಾಟಕ ರಾಜ್ಯಪಾಲರ ಆದೇಶಾನುಸಾರ
ಮತ್ತು ಅವರ ಹೆಸರಿನಲ್ಲಿ,

ಎನ್. ನರಸಿಂಹಮೂರ್ತಿ
ಸರ್ಕಾರದ ಉಪ ಕಾರ್ಯದರ್ಶಿ
ನಗರಾಭಿವೃದ್ಧಿ ಇಲಾಖೆ.

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1 INTRODUCTION

1.1 An Overview

Bengaluru, a multifunctional Metropolitan and the capital city of Karnataka, is one of the fastest growing cities in India and is branded as the 'Silicon Valley of India' for spearheading the growth of Information and Communication Technology (ICT) based industries. Bangalore has become a cosmopolitan city attracting people and business alike, within India and internationally and has become a symbol of India's integration with the global economy. With the growth of IT and industries in other sectors (e.g. textiles, light engineering and defence) and the onset of economic liberalization since the early 1990s, Bangalore has taken a lead in service-based industries fuelling growth of the city both economically and spatially.

The city has grown rapidly in the past few decades from pensioner's paradise to the information technology capital of India. The presence of IT/ITES industries, large public sector undertakings like BEL, BEML and HAL, along with major hardware garment industries has led to in-migration and rapid growth of the city. Bengaluru has also emerged as the start-up hub of the nation, bringing innovation and contribution to GDP, diversity of economy and adding to employment opportunities. The city is also a major education hub with a very large number of higher educational institutions in and around the city.

Bengaluru, with its strong economic base, contributes about 1.9% to India's GDP (2013-14) and 34% to Karnataka's GSDP (2013-14). The Metropolis houses about 40% of urban population of Karnataka and has witnessed 42% growth in population during the decade 2001-2011, thus playing the role of a primate city in the State. In context of the State, the population in the city of Bengaluru accounts for nearly 14.60% of the State's population concentrated in only about 0.64% of land area.

1.2 Master Plan Preparation- Provisions under the KTCP Act

The Master Plan for any local planning area in the State of Karnataka is prepared under the provisions of Section 9 of the Karnataka Town and Country Planning Act 1961 (KTCP Act, 1961). The Master Plan is to be revised once every ten years as per the provisions of Section 13D of the KTCP Act, 1961. The Master Plan for BMA (i.e. RMP 2015), prepared and approved on June 25, 2007 is currently in force.

As per Section 81B for the KTCP Act, 1961, the Bangalore Development Authority is the Local Planning Authority and BDA is exercising the powers, perform the functions and discharging the duties under the provisions of the KTCP Act, 1961 as the Local Planning Authority for the Bengaluru Local Planning Area

1.3 Constitution of BDA

The Government of Karnataka (GoK) constituted the Bangalore Development Authority (BDA) in 1976 under separate statute, viz. the Bangalore Development Authority Act, 1976 with the functions related to planning, development, enforcement and implementation of the schemes coming under one agency to achieve coordinated development activities of the city. Under the aegis of BDA there have been continuous efforts to plan and manage the growth of city through four Plans viz. ODP-1972, Comprehensive Development Plans (CDP) 1984, CDP 1995 and Revised Master Plan 2015 for its LPA. Currently operational Revised Master Plan (RMP) 2015 was notified by Government vide G.O. No UDD 540 BEM AA SE 2004, dated 22.06.2007 for the horizon year 2015 with the LPA area of 1219.50 Sqkm.

1.4 Local Planning Area of BDA for RMP 2031

The LPA of BDA comprises of the major part of the Bruhat Bangalore Mahanagara Palike (excluding area under BMICAPA) and 251 villages in the periphery of BBMP. The city has experienced an unprecedented population growth translating into varied challenges of urbanisation and urban management in general and urban land management in particular. BDA entrusted with the responsibility of preparing and revising the Master Plan as a Planning Authority for the Local Planning Area of BDA under the KTCP Act, 1961 has undertaken the revision of the RMP-2015 for the horizon period of 2031 (herein referred as RMP-2031). The area of BMA comprising of LPA of BDA and LPA of BMICAPA as per the amended boundaries admeasures 1294 Sqkm.

The Local Planning Area (LPA) of Bangalore Development Authority (BDA) for RMP-2031 spreads over an area of about 1206.97 Sqkm with an estimated population ranging between 18-20 million for 2031.

1.5 Structure of the Master Plan Document

The Master Plan Document comprises of six volumes as given hereunder:

i. Volume-1: Vision Document
ii. Volume-2: Base Map and Existing Land Use Maps
iii. Volume-3: Master Plan Report
iv. Volume-4: Planning District Report
v. Volume-5: Proposed Land Use Maps
vi. Volume-6: Zoning Regulations

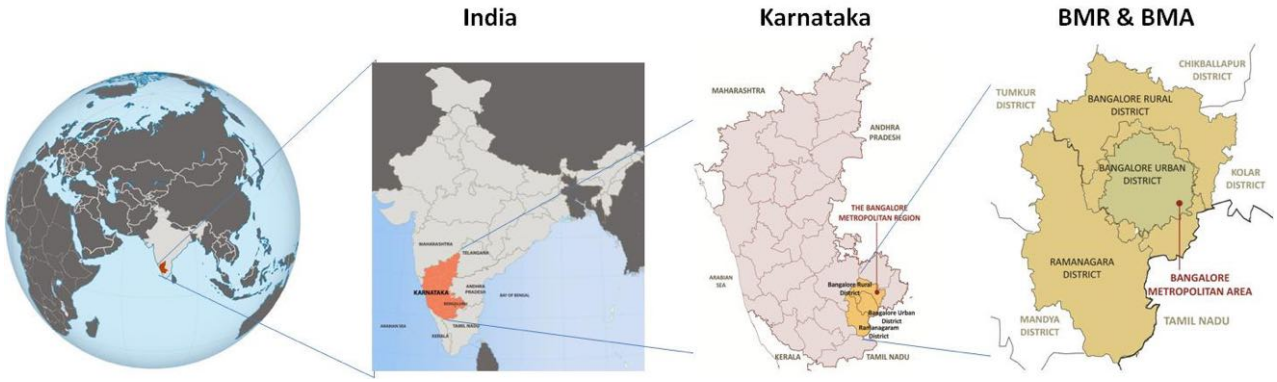
2 REGIONAL CONTEXT

2.1 Introduction

Karnataka, a vibrant, unique, multi-cultural, multi-religious state, is the seventh largest state in India by area and eight largest by population size in India (Census 2011, came into existence in the Year 1956 and was called as State of Mysore and was renamed as Karnataka in the year 1973. Karnataka is located between 11˚ 34' 59" and 18˚ 27' 20" Latitude North and 74˚5' 16" and 78˚ 35' 17" Longitude East in the south western region of India and is bordered by the Arabian Sea and the Laccadive Sea to the west, Goa to the north west, Maharashtra to the north, Telangana to the North east, Andhra Pradesh to the east, Tamil Nadu to the south east, and Kerala to the south west.

Figure 2-1 presents the location of Karnataka in the World and India and Bangalore Metropolitan Region in Karnataka. The total geographical area[1] of the state is 191,791 Sq. Km accounting for 5.83% of the total geographical area of the country.

Figure 2-1: Location of Karnataka, BMR & BMA



Note: Above figure is a graphical representation only.

The State is situated on a table land where the Western and Eastern Ghats converge into the Nilgiri Hills complex in the Deccan Plateau region of India. Karnataka has one of the highest average elevations at 1,500 feet.

Bengaluru is the largest city in Karnataka and the 5th most populous city in India. Bengaluru, is expected to become a Meta City with forward/ backward regional linkages (at Global, National, State and Metropolitan Region) which will have an impact on the growth of the city and it is thus important to understand the regional context while planning for Bengaluru. The City took shape as a fortified settlement under the ruler Kempegowda of the Vijaynagara state when he established the mud fort in year 1537.

[1] Source: www.karnataka.gov.in

2.2 Administrative Jurisdictions in BMR

Bangalore Metropolitan Region Development Authority (BMRDA) is the regional development authority that has jurisdiction over BMR, and is functioning as per the provisions of Bangalore Metropolitan Region Development Authority Act (BMRDA), 1985. Bengaluru Metropolitan Region (BMR) is defined[2] as the combined geographical extents of three districts, namely Bengaluru Urban District (BUD), Bengaluru Rural District (BUR) and Ramanagara of Bangalore Revenue Division of the Karnataka State. Total extent of BMR is 8005 sq km.

Table 2-1 presents the details of districts (Name, geographical extent, name of taluks) within BMR.

Table 2-1: Districts in BMR

Sl. No.	Name of District	Area as per DRSP 2031(sq km)	Percentage Share (%)	Name of Taluks in District
1	Bangalore Urban	2190	27.36	North, South, East, & Anekal
2	Bangalore Rural	2260	28.23	Nelamangala, Dod Ballapur, Devanahalli & Hosakote
3	Ramanagara	3555	44.41	Magadi, Ramanagara, Channapatna & Kanakapura
4	BMR (3 Districts)	**8005**	**100%**	Twelve Taluks

Source: Revised Structure Plan for BMR 2031 by BMRDA, Administrative Atlas of Karnataka 2011, Census of India, 2011

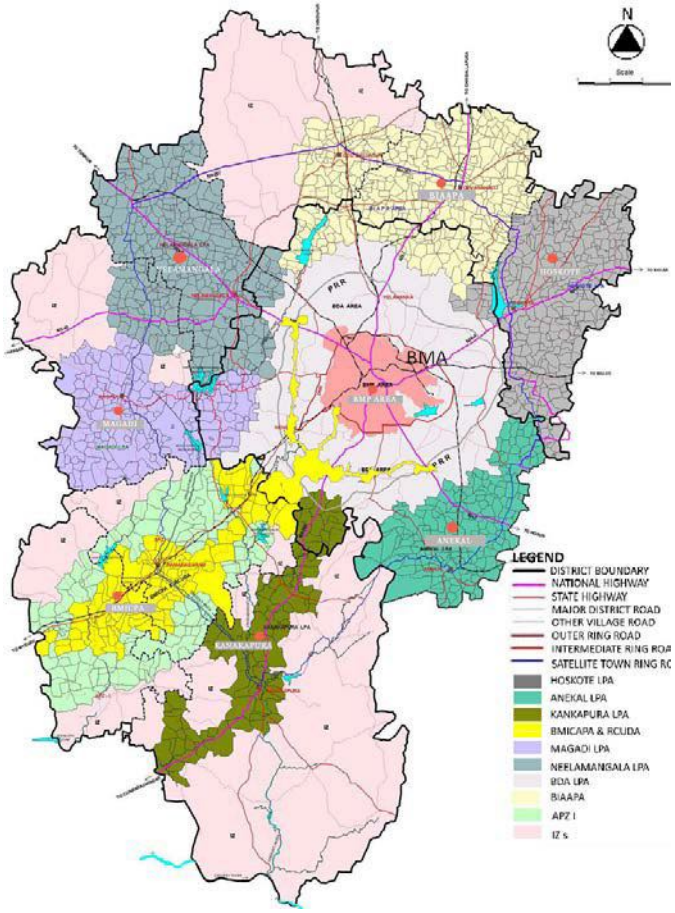
Bangalore Development Authority, constituted under Bangalore Development Authority Act (BDA), 1976, exercises its planning and development function over its local planning area under the provisions of BDA Act, 1976 and Karnataka Town and Country Planning (KTCP) Act, 1961.

In addition to the Bangalore Development Authority, the other Planning Authorities within the jurisdictions of BMRDA include Hoskote, Anekal, Kanakapura, Magadi, BIAAPA, Neelmangala, Ramanagara-Channapatna and two recently added Planning Authorities namely Satellite Town Ring

[2] As defined by sub-section c of section 2 "Definitions" of Bangalore Metropolitan Region Development Authority Act, 1985.

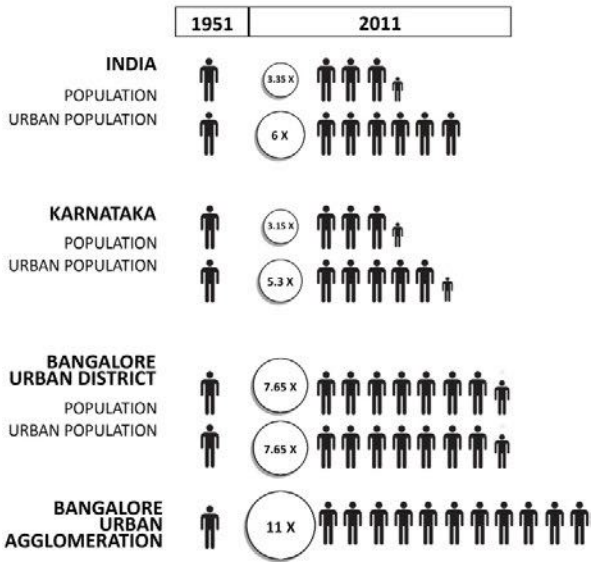
Road Planning Authority and Greater Bangalore-Bidadi Smart City Planning Authority. The part of Bangalore Mysore Infrastructure Corridor Area Planning Authority (BMICAPA) created in the year 2001 also falls within the BMR. **Figure 2-2** presents the present extent of various LPAs of Planning & Urban Development Authorities within BMR.

Figure 2-2: Planning Authorities in the BMRDA



2.3 Urbanisation in the BMR

The share of Karnataka's urban population to India's urban population is 6.27% which has broadly shown a constant trend during past 6 decades. However, within urban Karnataka, the share of Bangalore Urban agglomeration (BUA) has more than doubled, increasing from 17.66% to 35.96%, during the period 1951 to 2011. Major share of Karnataka's urban population resides in Bengaluru (38.31% of urban population), resulting in Bengaluru centric urbanisation in the state.



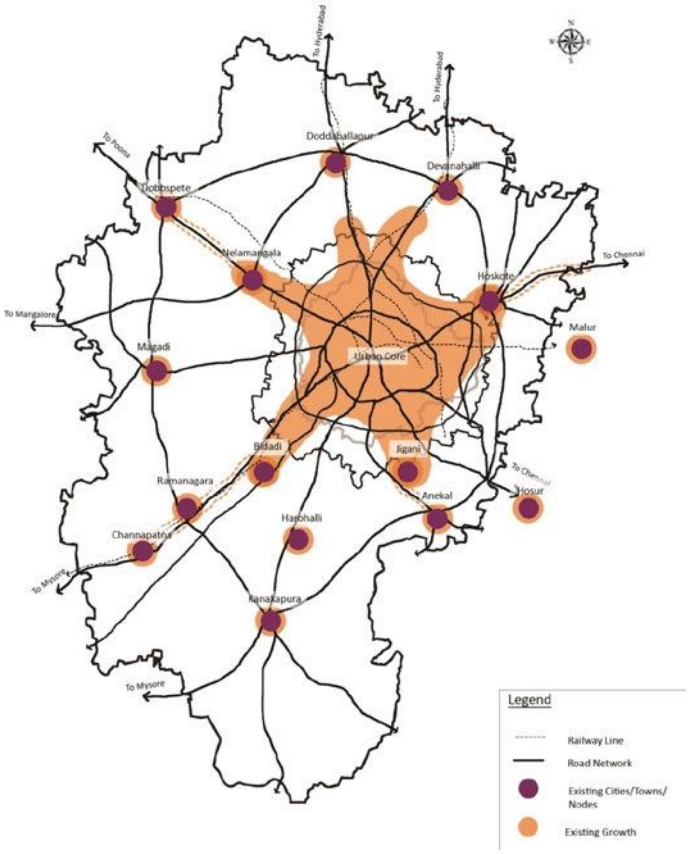
The population shows an increasing trend in BMR,

BUD, BMA primarily because of Bangalore City's stupendous population growth. Bangalore Urban Agglomeration (BUA) has increased in population by ~11 times since 1951, growing at the rate of 4.05% CAGR since 1951. This rise is reflected in the population growth for BUD and BMR. The population of Class 1 cities (25 in number) of Karnataka together accounts for 58.17% (13.74million out of 23.63 million) of Karnataka Urban Population. The next city in the urban hierarchy after Bengaluru in Karnataka is Hubballi-Dharwad, with population of 0.9 million which is 1/10th the size of Bengaluru. Out of 13.74 million population, Bengaluru alone has 8.5 million population, while balanced is distributed in 24 cities as per Census 2011.

2.4 Urban Growth Directions in the BMR

The Growth pattern in the BMR is characterised by Bengaluru City as the urban core (which has already engulfed Yelahanaka, Kengeri, Jigani, Yeswanthpur which were once satellite towns) and small urban nodes all around as satellites developed on radial road network in the region - like Anekal on Hosur Road, Hoskote on Old Madras Road, Devenahlli on Bellary Road, Neelmangala & Dobaspete on Tumukuru Road, Bidadi & Ramanagara on Mysuru Road, Kanakapura on Kanakpura Road. At present the ribbon development is seen on all major radial road and prominent ones being Tumukuru Road, Bellary Road, Old Madras Road, Mysuru Road and Hosur Road. The influence of urbanisation is beyond BMA and Karnataka state border and is evident from the fact that Mallur (in Kolar District) and Hosur in Tamil Nadu are growing because of Bengaluru. Figure 2-3 presents the urban growth pattern within BMR.

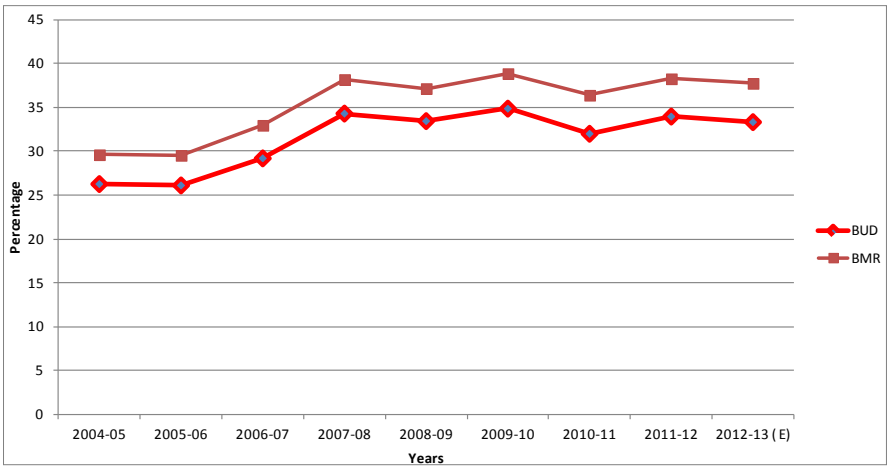
Figure 2-3: Urban Growth Pattern in BMR



2.5 Economy of BMA in the regional context

The largest share in Karnataka's GSDP comes from Bangalore Urban District. In the year 2012-13, Bangalore Urban District alone contributed 1.81% to India's GDP and 33.30% to Karnataka GSDP. As seen from **Error! Reference source not found.**, the contribution of Bangalore Urban District to the GSDP of Karnataka has increased from 26.24% (2004-05) to 33.30% (2012-13). The Bangalore Metropolitan Region, during the same period (2004-2013), due to Bangalore Urban district, has steadily increased its share.

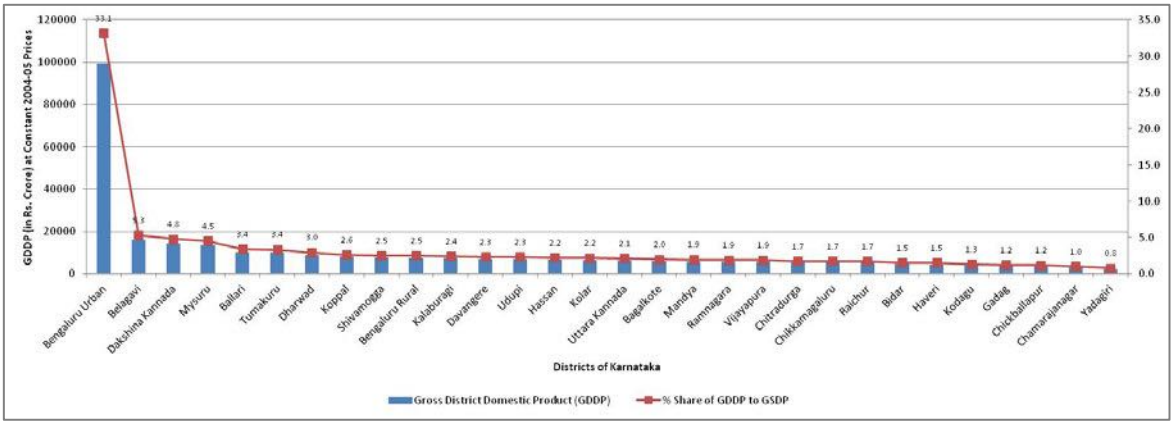
Figure 2-4: GDDP Share of BUD & BMR to Karnataka GSDP



Source: Economic Survey for 2004 to 2013, Directorate of Planning & Statistics, GoK

Figure 2-5 presents the District wise Gross District Domestic Product (GDDP) contribution to Gross State Domestic Product (GSDP) for the year 2012-13. The Gross district domestic product of Bangalore Urban has been, on higher side for most of years during 2004 to 2013. It is important to note here that the GDDP share of Bangalore Urban District is so large that it takes combined GDDP of 10 districts in hierarchy to equal the GDDP of Bangalore Urban District.

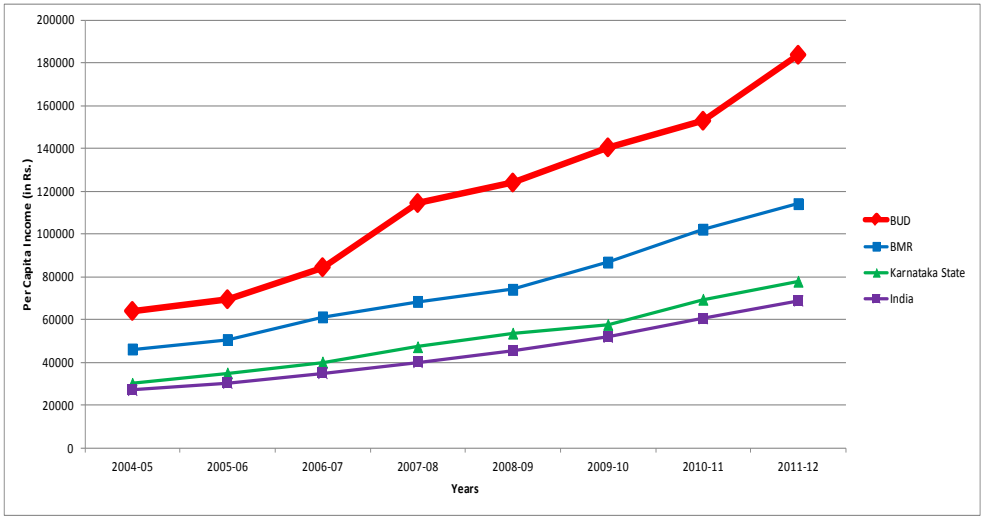
Figure 2-5: District wise GDDP & Its share to State GSDP (2012-13)



Source: Economic Survey for 2013, Directorate of Planning & Statistics, Government of Karnataka.

The annual per capita income at National, State, BMR and BUD (in 2011-12) is INR 68857, INR 77834, INR 114062 and INR 183607 respectively. The per capita income of BUD has always been higher than national, state and BMR level and so is the income growth rate. Since 2003-04 till 2011-12, the CAGR of per capita income has been 14.09%, 11.97%, 12.59% and 12.40% for BUD, BMR, State and National Level respectively. **Figure 2-6** presents the per capita income for National, State, BMR and BUD Level.

Figure 2-6: Per capita Income Growth in BUD, BMR, Karnataka and India



Source: Economic Survey of India, 2004-14, Ministry of Finance, GoI; Economic Survey of Karnataka, 2004-14 Directorate of Economics & Statistics, GoK.

2.6 Industrial Infrastructure: Industrial Estates and SEZs

KIADB is the nodal agency for acquiring, developing and allotting industrial plots in the state. As on 2013, KIADB has developed 145 industrial estates in the state. There are 34 KIADB developed industrial estates in BMR out of which 16 (47%) are in BUD. KIADB has made an effort to develop industrial estates in a balanced way in the state, unlike the population distribution or other economic development in the state, which is mostly focused on BUD and BMR. All the developed plots in industrial estates have already been allotted showing that there is high demand for industrial land in and around Bangalore (in BUD and BMR).

Table 2-2 gives the number and extent of the KIADB areas in Karnataka, BMR and BUD.

There are currently 15 Operational SEZs with 172 units in BMA, with an employment of 177520, accounting for 91% of State's share of SEZ employment. BMA also contributes 93% (Rs. 47791.7 Crores) of State's SEZ exports.

Table 2-2 Lands Acquired, Developed and Allotted by KIADB in BUD, BMR and Karnataka

Name of the District	No. of Industrial Areas	Extent (Ha)		Allotted	
		Acquired	Developed	No. of units	Extent (Ha)
KARNATAKA	145	17379.2	13299.1	16748	11351.2
BMR	**34**	**6445.5**	**5017.8**	**4968**	**4181.2**
BUD	**16**	**2711.8**	**2230.0**	**3069**	**2228.9**
BUD to BMR % Share	47	17.0	17.8	62	21.4
BUD to KAR % Share	11	6.5	6.9	18	8.1
BMR to KAR % Share	23	15.0	15.4	30	15.0

Source: KIADB Website (Status as on 31.05.2013)

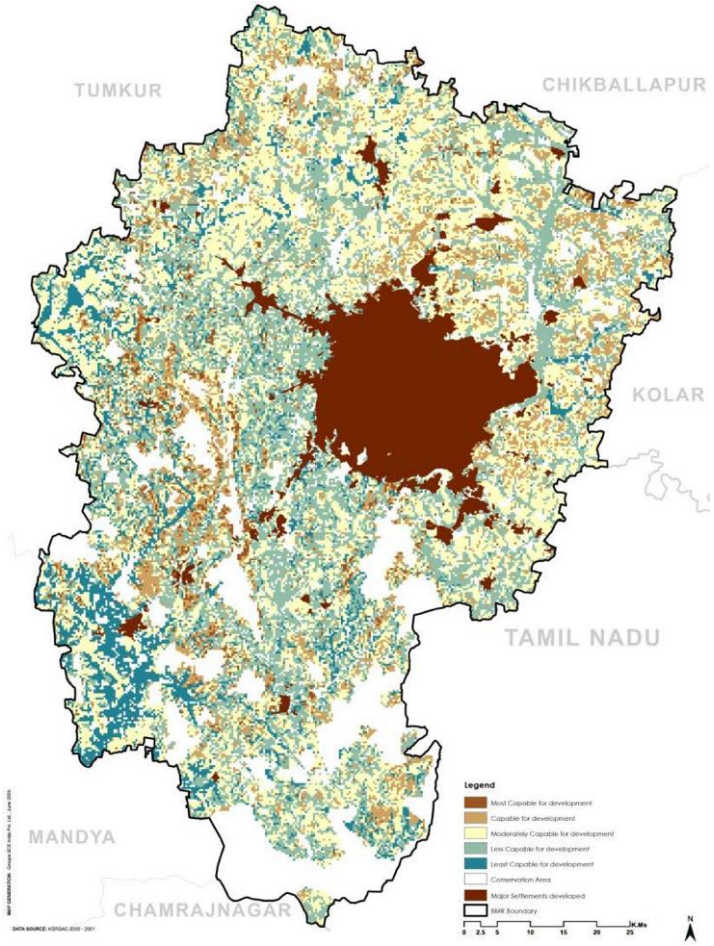
2.7 Environmental Features in the Region

Protected and reserved forests (including National Parks) and Thippgondanahalli Reservoir – Arkavati river system are eco-sensitive zones within BMR. Lakes and valley systems within BMR are equally environmentally important resources. **Figure 2-7** presents the map showing, forest areas, Thippagondanahalli reservoir sensitive area and the lakes within BMR.

Karnataka accounts for about six per cent of the country's surface water resources[3].There are seven river basins. The area under BMR & BUD is covered by three river basins namely - North Pennar, South Pennar and Palar, however the water supply requirements for Bangalore are met from Cauvery water.

[3] www.karnataka.com

Figure 2-7: Environmentally Sensitive Zones in BMR



Source: RSP- 2031. BMRDA

2.8 Regional Transportation Network

The Bengaluru metropolitan Region has well established air, road, railway connectivity, with Kempegowda International Airport (KIA) providing the air connectivity to the region. The Kempegowda International Airport (KIA) – the third busiest airport[4] in India, located at Devanahalli, Bengaluru Rural District, is 45km away from city of Bengaluru and provides air connectivity to Overseas, National, and destinations within Karnataka.

Bengaluru City, the core of BMR, is well connected through NH4 (Mumbai – Chennai via Poona, Hubli, Tumkur, Bengaluru, Kolar), NH-7 (Banaras – Kanyakumari via Nagpur, Hyderabad, Bengaluru, Hosur, Madurai), NH 48 (Bengaluru- Mangaluru via Hussan), NH 275 Bengaluru – Mysuru and NH209 (Dindegul-Coimbatore-Bengaluru). In addition to NHs, the SH-85 (Magadi Road), SH-87 (Banerghatta Road), SH-37 (Whitefield Road), SH-9 (Dodaballapur Road), SH 35 (Whitefield to Sarjapur) and SH-104 (Thanisandra Main Road) have also strengthened the regional connectivity and integrated the satellite towns in the region with Bengaluru.

[4] KIA statistics provided BIAL, 2015.

The Bengaluru division of SWR covers entire Bengaluru Metropolitan Region. Major stations within Bangalore Metropolitan Area are Bengaluru City Station Jn, Yeshwantpura Jn, Yelahanka Jn, Baiyyanpannahalli Jn. These stations are supported by second order stations like Bengaluru Cantt., Krishnarajapurama Station, Nayandahalli, Kengeri, etc. Railway network from Bangalore is extensively connected to inter-state and intra-state. It connects to Chennai (through Jolarpettai route) in the east, Chikkabellapur in the north east, Guntakal and Hyderabad (via Dharmaravam) towards the north, Tumkur in the northwest, Nelamangala in the west, Mumbai (via Goa), Mangalore & Mysore (via Ramanagara) in the south west and Coimbatore (via Salem) in the south.

Figure 2-8: Regional Transport Network of BMR

BMR RSP-2031 has proposed the regional connectivity plan to further strengthen the network within the region and minimising the through traffic crossing Bengaluru City. The major proposals of BMR RSP-2031 include STRR and ITRR that will help in easing the regional traffic in Bengaluru. The circulation network of RMP 2031 has integrated other proposals of the RSP 2031 for better regional connectivity.

3 LOCAL PLANNING AREA OF BDA

3.1 Notifications for LPA of BDA

Government of Karnataka has issued several notifications amending the extent of LPA of BDA from time to time. These notifications have been collated with Revenue Maps, Census Maps and RMP 2015 base map showing administrative boundaries of villages in LPA of BDA. The Government Notifications defining the extent of LPA of BDA are:

1. Government Notification No. S.0.3446 dated 1st November 1965, declaring the Local Planning Area (LPA) for Bengaluru City was the first notification issued by GoK after enactment of Karnataka Town and Country Planning Act, 1961. This was much before the constitution of Bangalore Development Authority.

2. Government Notification No. HUD 496 TTP 83 dated 15th March 1984 and its "Schedule –I: Statement showing the list of Villages included in the Bangalore City Planning Area" declaring the Local Planning Area for the environs of Bengaluru. This notification is after the Constitution of Bangalore Development Authority under the provisions of Bangalore Development Authority Act, 1976. This notification further expanded the extent of LPA of BDA.

3. Government Notification No. HUD 167 MNJ 87 dated 1st March 1988 specifying the areas falling within Bengaluru Development Authority.

4. Government Notification No. Na Aa Ee130 Bem Ru Pra 2001 dated 20th November 2001 declaring the Local Planning Area for the Bengaluru Mysore Infrastructure Corridor Area Planning Authority (BMICAPA). This notification reduced the extent of LPA of BDA as 62 villages (9 full and 53 in parts) were transferred to LPA of BMICAPA.

5. Government Notification No. UDD/ 118/ Bem Ru Pra 2003, dated 3rd March 2006 declaring the extent of Hoskote Local Planning Area. This notification further reduced the LPA of BDA as eight villages were transferred to LPA of Hoskote Planning Authority.

6. Government Notification No. UDD 92 MNY 2006, dated 16th January 2007 declaring extent of Bruhat Bengaluru Mahanagar Pallike (BBMP).This notification has no bearing on the extent of LPA of BDA, however, this notification provides the clarity on 110 villages that were falling within (fully or in part) the extend of LPA of BDA.

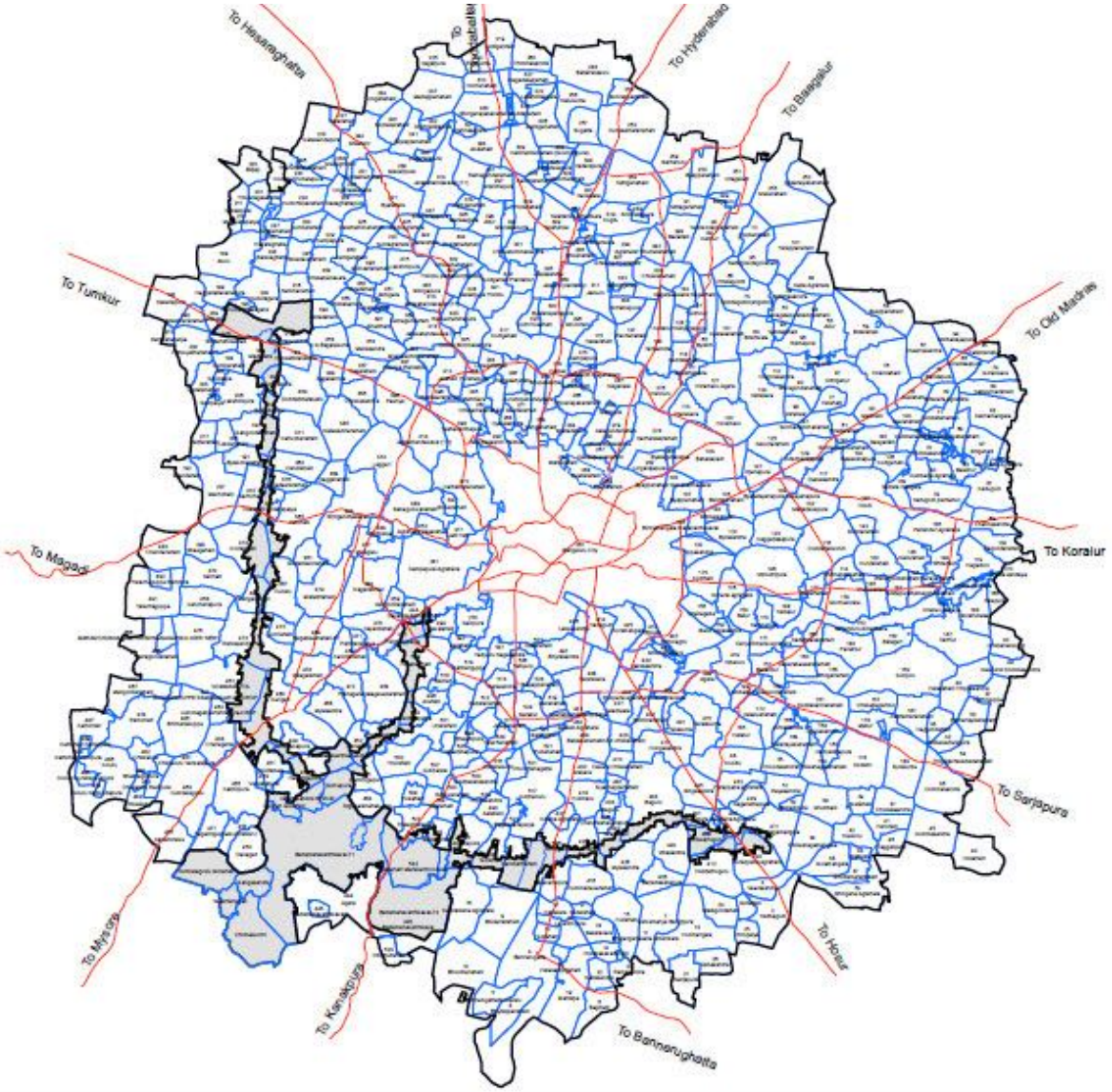
7. Government Notification No. UDD 36N BMR 2009 dated 26th September 2012 specifying exclusion of 8 villages from LPA of BDA, which was overlapping with Hoskote Local Planning Area.

3.2 Administrative Units in LPA

The corroboration of list of villages in the various notifications with Census data from previous decades (1981 to 2001) has been carried out to ascertain the locations of the villages. Mapping of BMA boundary has been done on the authenticated map of Bangalore Urban District (BUD), 1998 from the Survey Settlement and Land Records Department, GoK which locates the revenue villages within BMA.

Under the provisions of by Sub-section (1) of Section 4A and Sub-section (1) of Section 4B of the Karnataka Town & Country Planning Act, 1964 (Karnataka Act No. 11 of 1963), the area comprising villages within the boundaries of LPA of BDA is called as "Local Planning Area for BDA". **Figure 3-1** presents the map showing the extent of LPA of BDA.

Figure 3-1: Local Planning Area of Bangalore Development Authority



The LPA of BDA covers 537 revenue villages (fully or in parts) and area under city survey sheets (1 to 97) admeasuring 1206.97 Sqkm. It is important to note that several villages are partly with LPA of BDA and Partly with LPA of BMICAPA. **Figure 3-2** presents the map showing villages falling partly and fully within BMICAPA.

Figure 3-2: Villages falling Partly & Fully within LPA of BMICAPA

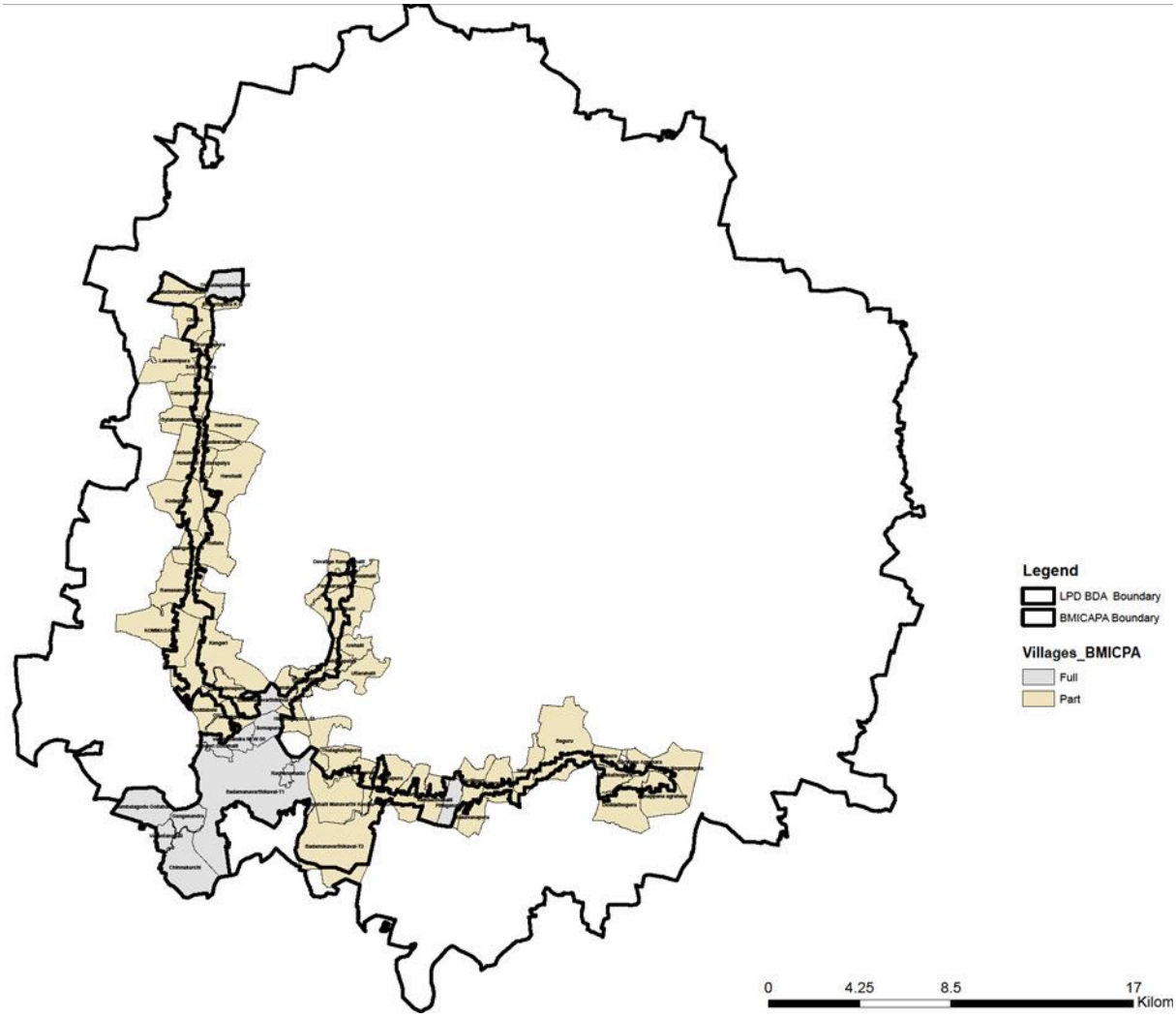
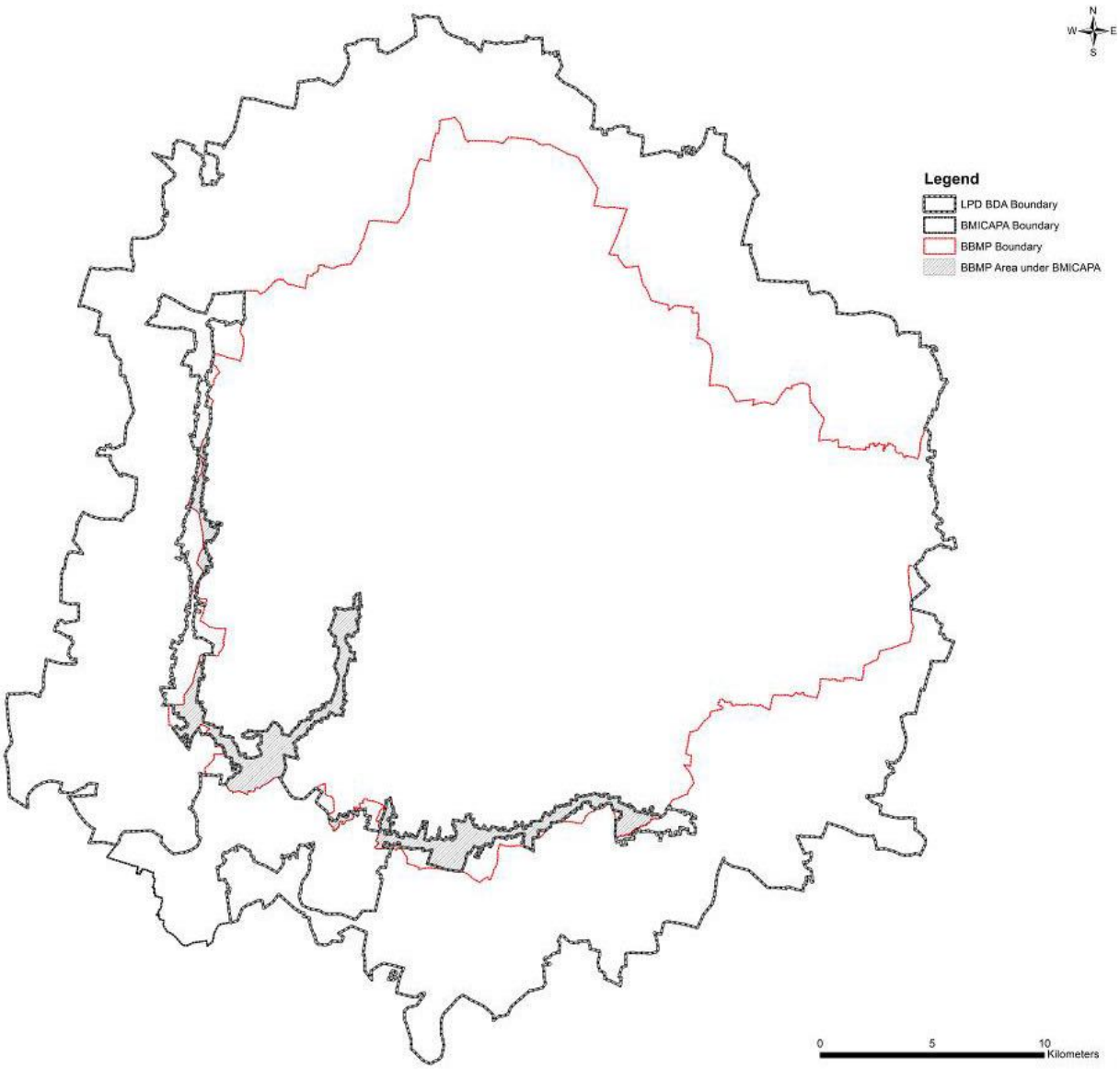


Figure 3-3 presents the overlay of extent of BBMP and extent of LPA of BDA highlighting the extents falling within BMICAPA.

Figure 3-3: Extent of BBMP within LPA of BDA and LPA of BMICAPA



The list of villages and description of running boundary for LPA of BDA for RMP-2031 is enclosed as **Annexure – 1**.

4 SURVEYS AND STUDIES

4.1 General

The preparation of Revised Master Plan for the LPA of Bengaluru required reliable and factual data regarding existing physical and socio-economic conditions such as existing land use, housing, transport, industries, employment and social services such as educational, health and recreational facilities, etc for analysing the existing situation and make projections for the future requirements. RMP-2031 made rigorous efforts for the collection of data from various sources including secondary source as well as primary surveys and studies with a clearly defined objective of minimising the variations/ discrepancies.

4.2 Data from Secondary Sources

The secondary information available with BDA as well as various agencies of the state and the central government has been collected for the preparation of RMP-2031.

1. Data with BDA:

The Planning Authority is a custodian of data base related to approved Layouts and Development Plans for Residential and Non-Residential developments and Change of Land Use (CLU) cases. As part of master plan preparation process, all these Development Plans, Layouts and CLU cases approved after the final notification of RMP 2015 have been assimilated, translated and integrated in GIS database for incorporation in the proposals.

2. Data from Government Departments (State and Central):

Large amount of data/ information has been collected from various government departments and same has been collated, complied, selected, assimilated, analysed and mapped for the preparation of RMP-2031. The following key areas have been incorporated as part of the GIS database created for RMP 2031 based on the data provided by various government departments/ agencies:

i Revenue maps procured from Department of Survey Settlement and Land Records, GoK

ii Mapping of Public Transport Infrastructure (Namma Metro, BMTC, and KSRTC) and Logistics facilities like Truck Terminals, ICD.

iii Detailed inventory of slums within BMA (notified & non-notified) and spatial Mapping of slums

iv Detailed inventory and mapping of Lakes within BMA

v Mapping of Forest Areas, Eco-Sensitive Areas and Protection Areas

vi Mapping of spread of health and education facilities within BMA

vii Mapping of Air Funnel Zones

viii Mapping of SWM Infrastructure and Facilities within BMA

4.3 Primary Surveys

The primary surveys conducted as part of preparation of RMP-2031 includes DGPS Surveys, Existing Land Use Survey, Socio-economic Survey, Traffic and Transportation Surveys, Market Tracking and Housing Supply Survey, Heritage Survey, Lake Mapping, etc aimed at preparation of base map with various layers depicting physical, natural and administrative features; existing land use survey maps and creation of analytical base for arriving at proposals supplementing the inputs from the public consultation process.

1. DGPS Surveys for Preparation of Base Map:

DGPS surveys were conducted over 1200 points across BMA to help identify survey parcels points/corners for integration of revenue maps procured from Department of Survey Settlement and Land Records, GoK in the GIS based Base Map prepared using high resolution stereo pair satellite imagery procured from National Remote Sensing Agency.

2. Existing Land Use Survey:

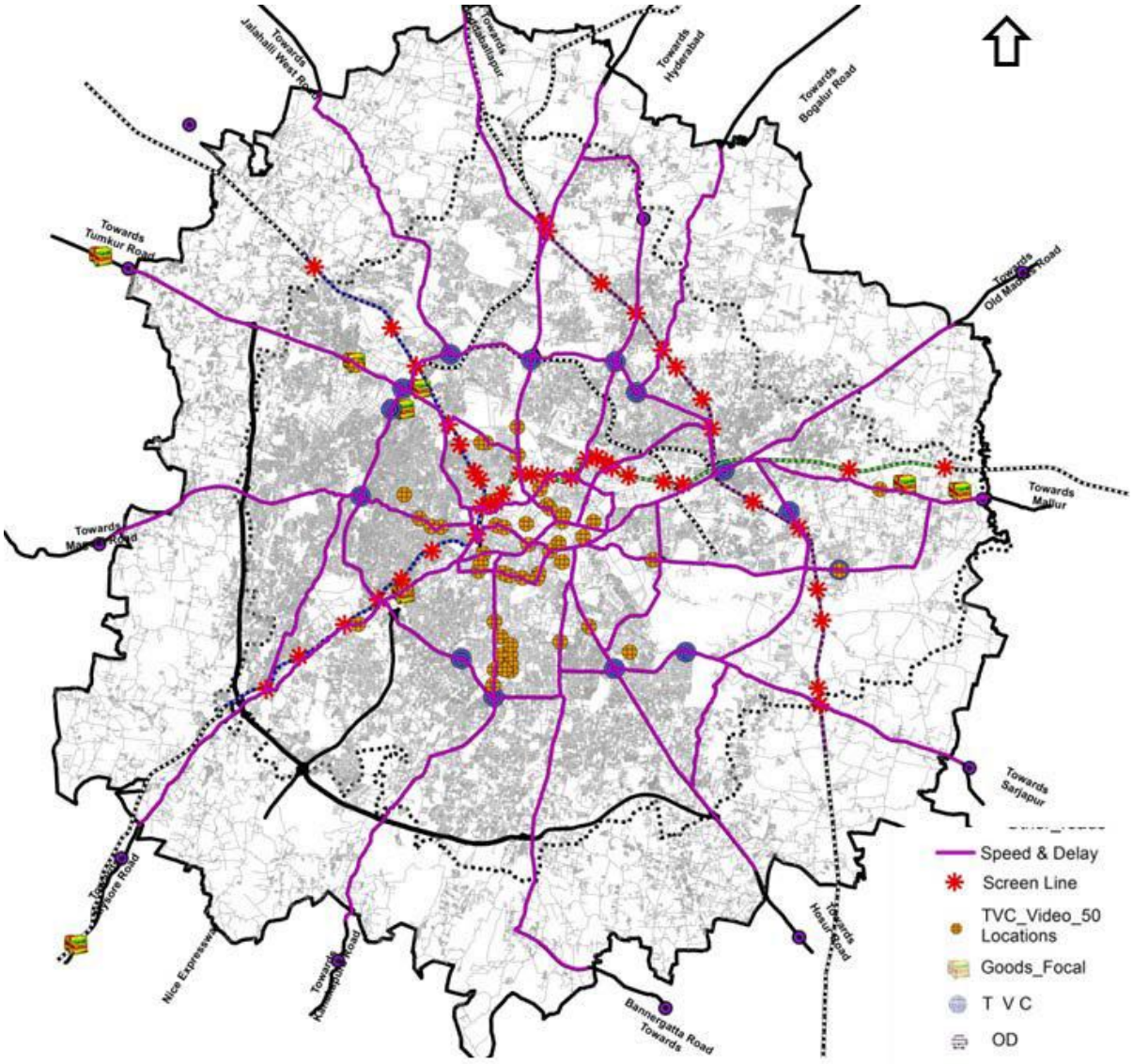
Extensive field surveys were carried out to map the existing land use and cross verification of the features extracted from satellite imagery using the base map. The ELU Survey was conducted in line with the provisions of Karnataka Planning Authority Rules, 1967 (as amended from time to time) during Nov 01, 2014 to Nov 30, 2015. The details of Existing Land Use Map 2015 for RMP 2031 are given in Chapter 5 of this report.

3. Traffic and Transportation Surveys:

Traffic & Transportation surveys were conducted to assess the traffic and transport characteristic of the study area (base line scenario) and provide inputs to developing the transport model. Focus of the surveys has been on obtaining traffic volume data on as many roads as possible. This has been done as for using a process called 'Most likely Trip estimates from traffic volume counts' to correct and update Origin Destination Matrices syntheses from earlier studies like CTTP and CTTS. Following primary surveys were carried out across BMA during December 2014 to April 2015 and there locations are presented in **Figure 4-1**.

- Screen Lines/ Classified Volume counts- 45 Locations (Video Surveys for 16 Hours)
- OD surveys- 13 Location (24hrs for one day at 13 Outer Cordon Points)
- Speed and Delay surveys – 375 km (using Floating Car Method)
- Road Network inventory – 375 km (Major arterial roads)
- Turning volume counts- 14 Locations (24 hrs for one day)
- Goods Focal /ICD/ CFS/ Transport Nagar Survey- 8 Locations (24 hrs for One day)
- Video Footage from Bengaluru City Traffic Police for 50 locations (one hr) was also used to capture volume counts at city centre.

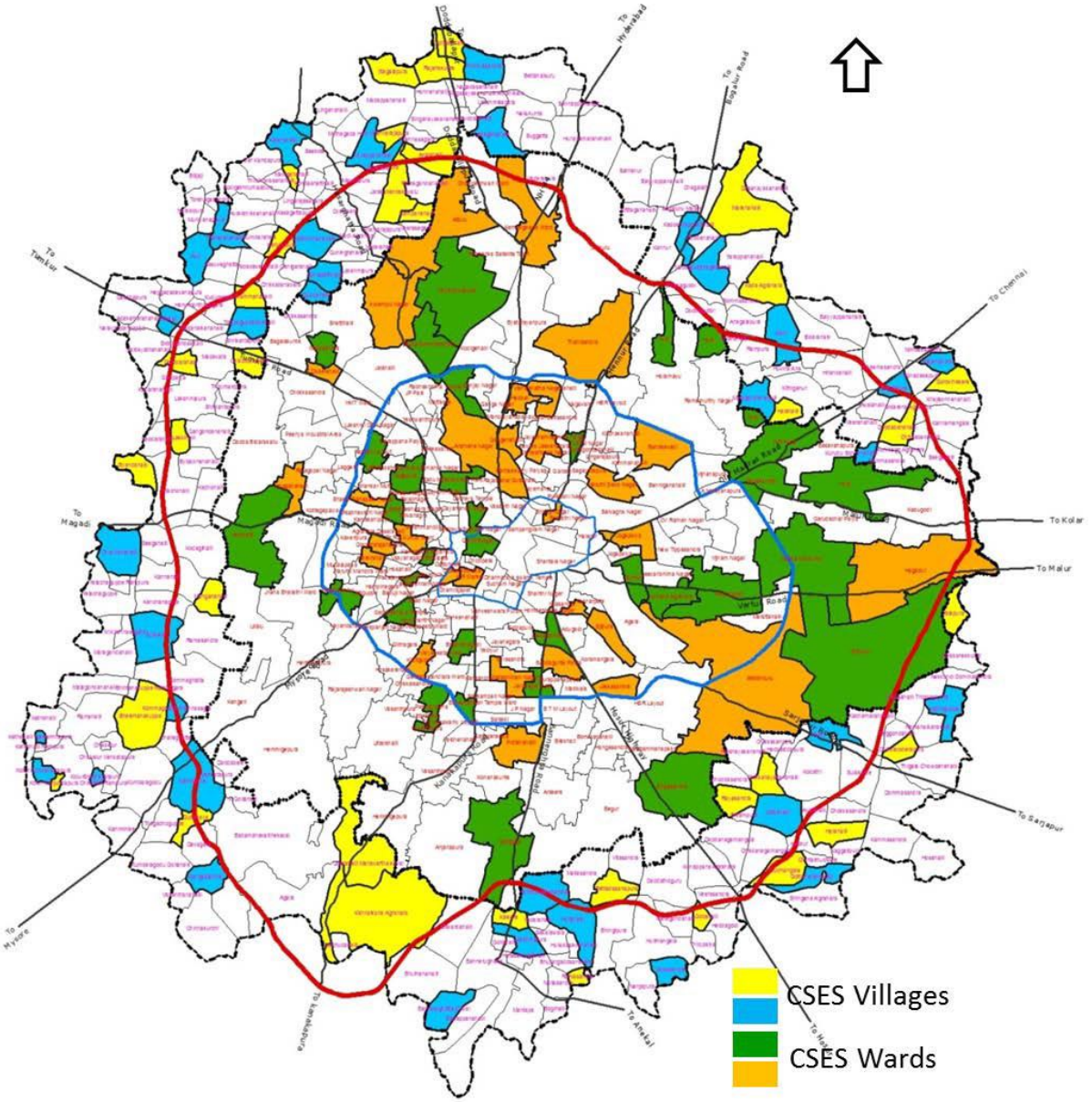
Figure 4-1: Locations of Traffic and Transportation Surveys



4. <u>Comprehensive Socio-economic Survey (CSES)</u>

Comprehensive Socio-economic survey was undertaken to understand socio-economic status, infrastructure availability and aspirations of citizens within the planning area. By using stratified random sampling technique, 30 wards and 18 villages within BMA were identified and the survey was undertaken. The survey was conducted during December 2014 to January 2015. The Stratified Socio-economic sample survey covered 10130 households, of which 90% were within BBMP and 10% in villages within BMA. Further, 7% of samples were taken from slums. The nature of survey included face to face interviews; door to door questionnaire based comprehensive socio-economic survey. **Figure 4-2** presents the locations of wards and villages wherein Comprehensive Socio-economic survey was conducted.

Figure 4-2: Comprehensive Socio-Economic Survey - Wards and Villages



5. Heritage Survey:

Bengaluru, a city with very rich cultural and built heritage, lacked the inventory of its heritage and cultural assets except for 2 ASI protected and 7 state protected heritage sites. With an objective to place the heritage conservation within the overall process of master plan preparation, a heritage survey was conducted – a first step in creating the inventory (listing) of heritage and cultural assets available in the metropolis Bengaluru. It is probably the first attempt in capturing the heritage of city since 1983 -85 efforts of erstwhile Urban Arts Commission (GoK).

The Heritage survey was conducted using pre-defined survey format which captured a) Location (address), b) Ward Number and Name, c) Use Building is put to, d) Year of establishment, e) Ownership pattern and f) photograph. Survey was conducted during April 2015 to August 2015. The

heritage buildings have been mapped in GIS platform and translated into demarcation of heritage precincts/ zones and preparation of appropriate regulations for developments in such heritage precincts/ zones.

4.4 Studies Conducted

In addition to secondary data collection and various primary surveys, the following studies have also been undertaken as part of the preparation of RMP 2031.

1. Review of RMP 2015 and BMR RSP-2031:

The review of the RMP-2015 has been carried out to derive the lessons learnt with respect to its implementation on ground and understand the emerging imperatives as a result of the envisioned provisions of RMP-2015. The BMR RSP-2031 has been reviewed with a perspective of integrating the broad spatio-policy framework for the region and aligning RMP-2031 with these provisions. The review has been discussed in Volume 1: Vision Document of Draft Revised Master Plan 2031.

2. Classification of Natural Drainage:

The Hon'ble NGT passed the judgement as part of the hearing of the PIL and issued guidelines for buffers applicable to lakes and different types of drains within the BMA during the course of preparation of the RMP-2031. The guidelines issued by the Hon'ble NGT necessitated the need for classification of natural drainage system within BMA. In this regard, a study for classification of natural drainage system based on contours and digital elevation model generated using high resolution stereo pair satellite imagery assessment and delineation natural drainage system was taken up for classification of streams into primary, secondary and tertiary. The classification has been carried using GIS software and in consultation with Karnataka State Natural Disaster Monitoring Centre. The RMP-2031 has earmarked the buffers based on the classification of the streams in the PLU Maps.

3. Urban Transport Model:

The traffic and transportation survey results and previous studies have been used to build a sophisticated urban transport model to replicate the "Bangalore Metropolitan Area" transportation system (roads, Congestion delays, transit system, etc.) with state-of-the-art software and modelling technology. The purpose of the model development is to develop a tool to help in understanding transport characteristics in the Future under changed Land use and Network conditions. A conventional 4 stage model with a combined mode choice cum distribution function has been calibrated. This model has been used to analyse the potential major future network enhancements such as introduction of an MRTS and allocating proposed land use. A very fine zoning system has been adopted (534 zones), covering Bengaluru Metropolitan Region (not only BMA). The Network was developed using the large GIS database that has been created for the RMP and hence boasts of more than 30000 links. Also all BMTC bus routes (~2500) are coded onto this Network. The Model has been developed using CUBE Voyager. The modes modelled are Car+ Taxi, Two Wheeler, Auto rickshaw, Public Transport and modes preloaded are MAV/Trucks/LCV. The Traffic Assignment is

Multi User Class, Capacity Restraint and Public Transport Assignment is True Multi path Assignment with a crowd modelling.

4. Risk & Vulnerability Assessment:

Bengaluru is vulnerable to various natural and manmade disasters. It has therefore become important to identify and assess the hazards and risks (natural & manmade) that Bengaluru is vulnerable to, and their spatial analysis (within BMA). The main objective of the Hazard and Risk Assessment is to prepare a multi-hazard map (MHM) for the planning area. The assessment has been carried out primarily based on database gathered from various government departments and includes multi-hazard assessment and a generic probabilistic assessment for future. Stakeholder consultations with Karnataka State Pollution Control Board (KSPCB), Karnataka Fire and Emergency Services (KFES) and District Disaster Management Authority (DDMA) have been carried out as part of the assessment.

5. Market Tracking (Residential, Commercial, and Industrial Developments) and Land Market Values Study:

The trends in housing, the characteristics of residential developments, characteristics of commercial (offices spaces, retails, and hospitality) development, the characteristics of industrial activities, and land values provide a sense of the current growth directions. The market tracking survey and land market value survey were undertaken with the following objectives:

a) Assess the past trends in housing supply in tracked, share of organised (tracked market) and un-organised market, definitions, affordable housing initiatives, supply demand, slums and their characteristics, slum rehabilitation and redevelopment framework, issues related to development of affordable housing, etc.

b) Understand the characteristics of Residential Developments (Typology, size and growth corridors), characteristics of Commercial Developments (Typology, size and growth corridors), Characteristics of Industrial Developments,

c) Map the market values and guidance values at various locations across BMA

The study also looked at composition of household income and housing typologies to assess the future requirement of housing including demand for affordable housing.

5 BASE MAP AND EXISTING LAND USE MAP

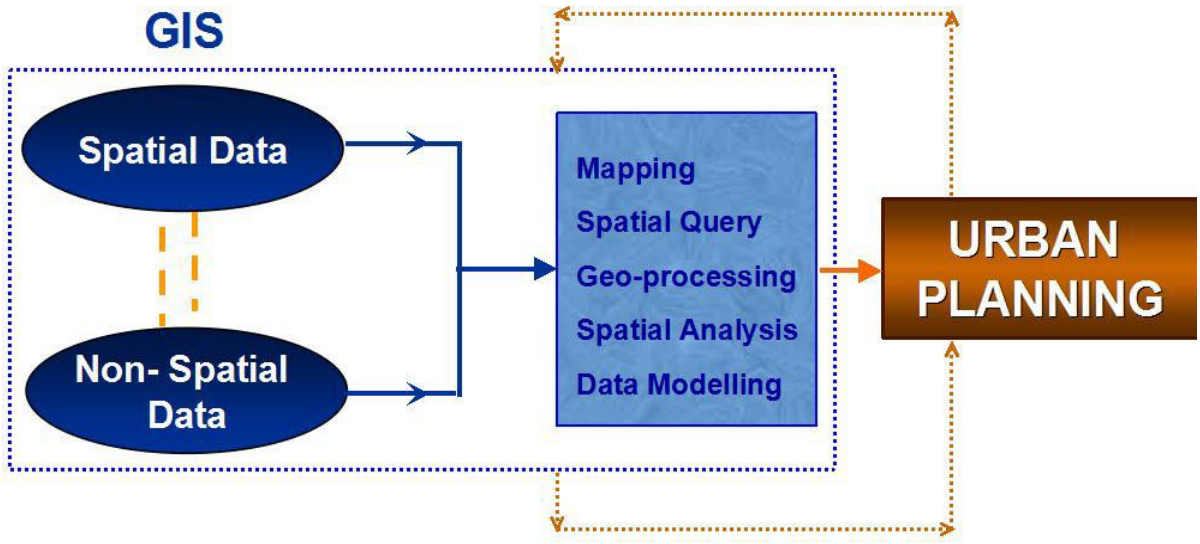
5.1 Relevance of GIS in Master Planning

Spatial data plays a key role in better decision making, planning and management of cities. In order to have sustainable planning and management it is important for planners, administrators and city managers to have access to reliable, seamless and reasonably accurate data. Satellite imagery and Geographical Information Systems (GISs) are tools that facilitate developing datasets for preparation of rapid, comprehensive, rational and implementable plans. In other words, a robust Geospatial database becomes a useful basis for making rational planning decisions for sustainable planning, development and management.

Geographical Information System (GIS) is essentially a comprehensive spatial and decision support system of computer hardware or software tools to merge spatial, preferably geo-referenced data with the non-spatial data for deriving meaningful information to be used for urban planning. The distinguishing factor that separates GIS from the other information storage and retrieval systems is the use of locational features in a co-ordinate space as the fundamental referencing principle and as important variables in quantitative analysis.

Mapping provides the most powerful visualization tool in GIS. GIS is used for preparation of land use & circulation maps, thematic maps related to socio-economic data, environmental data, infrastructure services data, revenue data and can be used for wide ranging planning applications. Planners and City Managers extract useful information from this database, containing spatial and non-spatial data.

Figure 5-1: Inter-relationship between GIS and Urban Planning



5.2 Application of GIS in RMP-2031

GIS based planning information system has been used for the preparation of RMP-2031 for the following aspects:

a) Base Map

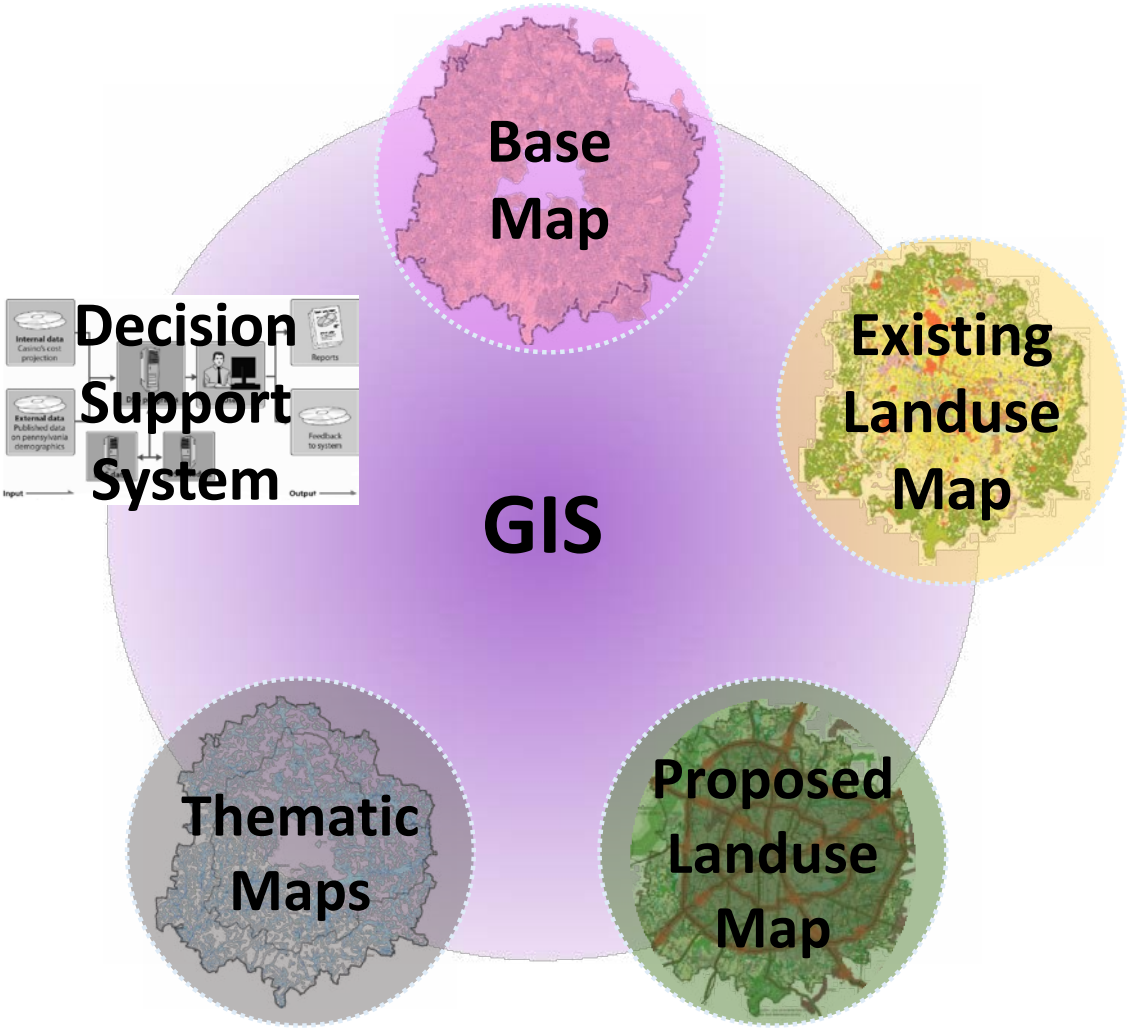
b) Existing Land Use

c) Proposed Land Use, Circulation Plans, Sectoral Plans etc.

d) Thematic Maps for analysis and use.

e) Development of a GIS to support Planning Decisions

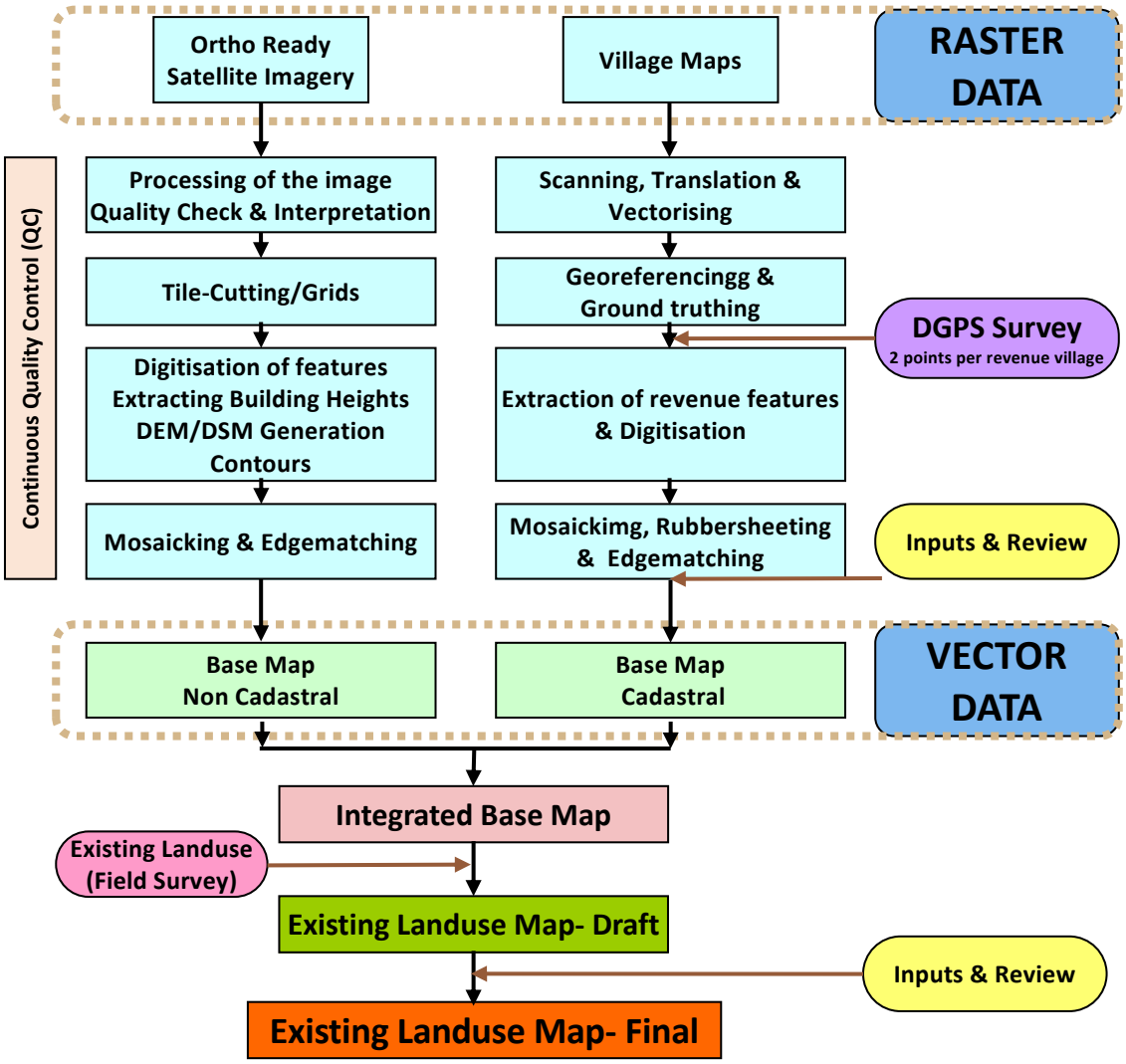
Figure 5-2: Evolution and Usefulness of a GIS for Urban Planning



5.3 Methodology for Base Map and ELU

The Base Map & Existing Land Use (ELU) Map has been prepared using High Resolution Satellite Imagery, superimposed with Cadastral information supported by extensive field surveys for the entire Bangalore Metropolitan Area (BMA) comprising of LPA of BDA and LPA of BMICAPA (in part) spread across an area of 1294 Sqkm. The base map is the foundation for developing a proper existing land use map which in turn is critical for formulating alternatives, scenarios and proposals in a Master Planning exercise. The Existing Land Use plan shows various current land uses at the specified, reasonable scale and detail indicating residential, commercial, industrial, public & semi-public uses, recreational (parks & playgrounds), open spaces, vacant land, land under agriculture, water bodies, utilities & services facilities, circulation system, conservation areas, special areas, committed land uses, etc. In addition, along with Base Map and Existing Land Use, DEM/ DSM, contours and building heights have also been captured and various thematic maps have been generated. **Figure 5-3** presents the overall methodology chart describing the process adopted for preparation of Base Map & then ELU Map for RMP 2031.

Figure 5-3: Overall Methodology for Preparation of Base Map & Existing Land Use Map



5.4 Base Map Preparation

The most crucial information for preparing any master/ spatial plan is an accurate and updated base map of the planning area. It is a necessary component, without which no spatial planning exercise can be undertaken. A base map helps the planners and administrators to prepare the existing land use, circulation pattern, road networks, spatial extent of development, natural features, and also information on the use of each land parcel including man-made and natural features on ground. It brings together in a common base the physical features, topography, drainage pattern, water bodies, power lines, road network, rail, forest area, settlement areas etc.

The Base Map for RMP 2031 has been generated by extracting spatial features visible from high resolution satellite imagery and integrating with other sources of information such as revenue/cadastral maps and relevant spatial information available including maps sourced from various other government departments. Appropriate techniques were deployed to improve the accuracy of the information and also the geo-referencing.

5.4.1 Process & Methodology

The base map preparation for RMP 2031 involved three broad stages:

a) Preparation of Base map- Non Cadastral (with the use of Satellite Imagery)

b) Preparation of Base map- Cadastral (with Revenue Village Maps)

c) Preparation of Integrated Base map (Superimposing of base map obtained from satellite imagery and cadastral maps)

A. Preparation of Base map- Non Cadastral (with the use of Satellite Imagery)

The Base Map for RMP 2031 contains features extracted from the satellite images like buildings, roads, natural features (lakes & streams/ drains), contours, railway line, metro rail line, power sub-station, High Tension Power lines, Sewage Treatment Plants etc. Secondary spatial data of other departments has also been integrated with the base map to form the overall geospatial database. Satellite imagery (GEOEYE -1, with 0.5 Meters and 2 Meters resolution for PAN and MSI respectively) was used for this purpose. Part of the BMA area which was under cloud cover in the original satellite imagery was updated using fresh satellite imagery (Archive Data, World View 01 -0.5 mtrs and PAN & Multi Spectral Ortho Image, 2015). Appropriate steps were taken to properly merge the two satellite images to extract relevant features and complete the base map.

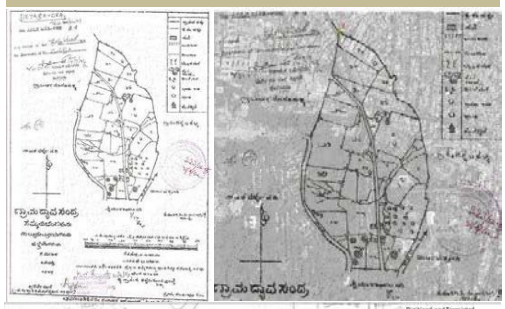
B. Preparation of Base map- Cadastral (with Revenue Village Maps)

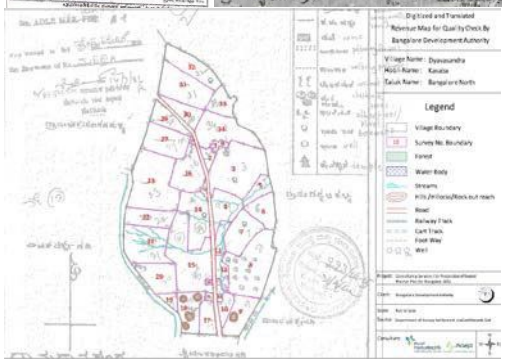
The Cadastral Maps (revenue maps) were procured (in Paper as well as jpeg/ pdf files in soft format) from the Revenue Department, GoK scanned, digitized, mosaicked, geo referenced and integrated in to the geo-spatial data. All the revenue survey numbers were translated to English. Ground truthing and validation of Base Map has been carried out through preliminary field identification (x,y coordinates) of survey points on the village maps followed by point data collection using Differential Global Positioning System (DGPS) equipment and capturing two points per revenue village. The

digital maps were then adjusted, corrected and mosaicked to form a single cadastral map. The preparation of cadastral base map involved scrutiny and validation to improve the accuracy level. **Figure 5-4** presents the Process of Preparation of Cadastral Base Map with Collection of Survey Point. **Figure 5-5** presents the process of survey point integration with cadastral base map and mosaicking.

Figure 5-4: Process of Cadastral Base Map Preparation with Survey Point Collection

Scanned Village Revenue Maps And Geo-Referenced Satellite Image Overlay





Digitised Village Map overlaid on paper

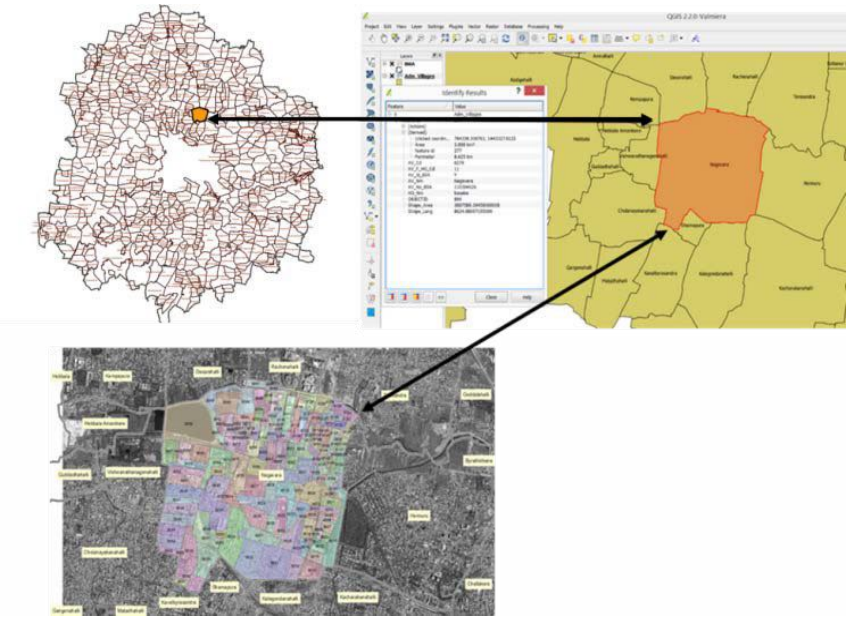
Digitized Cadastral Map (Village Revenue Map) a Revenue Village, on satellite imagery

Survey Points Identification on Map

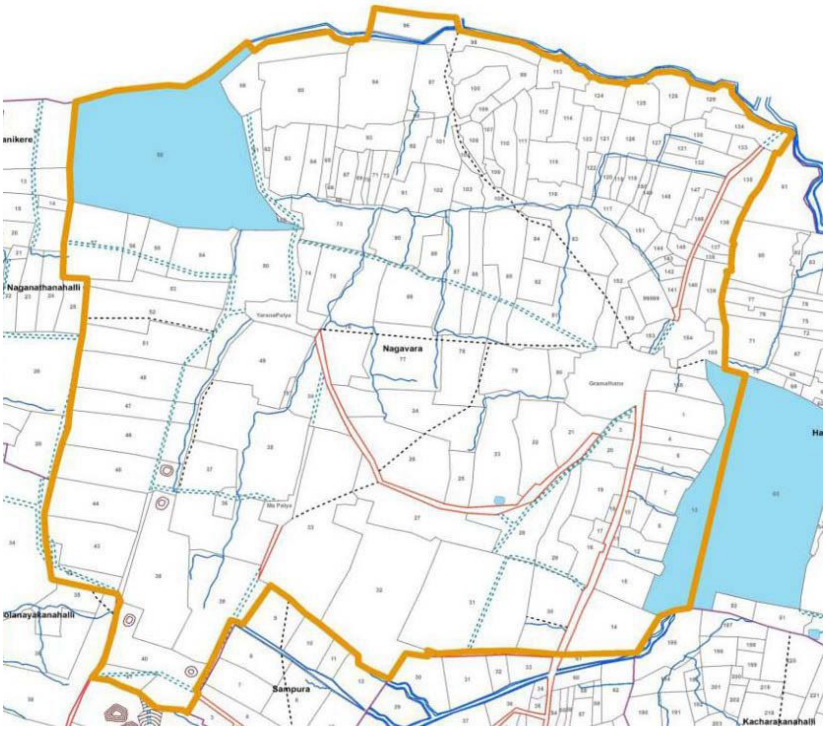
Ground Truthing & Validation of the Base Map Survey Numbers Identified on Field and Location Points for DGPS survey

Figure 5-5: Process of Survey point Integration with Cadastral Base Map & Mosaicking

Digitization, Geo-referencing and Mosaicking of Village boundaries



Village Survey Parcels & Numbers (Data Integration)



Adequate measures have been taken to improve the level of geo-referencing of the village maps, mosaicking and overlay on satellite images. It is a well-known fact that preparation of cadastral base maps, especially overlaying the cadastral information on satellite imagery is a difficult task for the fact that paper revenue maps were prepared based on field surveys surveyed many decades ago and field measurements were undertaken using chains and other field measurement techniques. These constraints have been suitably addressed by using rubber sheeting and edge-matching techniques.

An observation which has come to the fore during this exercise is the difference in extent/ alignment of water bodies (streams/ lakes) as per revenue maps and satellite imagery. This could be due to changes in natural course of streams over a period of time. The overlay of streams and lakes features extracted from the village revenue maps do not always match with the streams and lakes captured from the satellite imagery in all locations. This has an implication on the course of the streams, their widths and also the shape and extent of the water bodies and creates challenges in planning and management.

The cadastral information in the city is very old (almost five decades or so). In a city of 11 million people (2015-16), the urban fabric has drastically changed in the past five decades and the surface of the city has undergone much changes. Also the core city area does not have revenue survey numbers and it has totally urbanised and largely covered with buildings and structures.

C. Preparation of Integrated Base Map

(Superimposing base map prepared from satellite imagery with the cadastral maps)

After due process both the cadastral and non-cadastral features of the Base Map were overlaid and corrected to the maximum extent thus creating an Integrated Base Map for BMA. The Integrated Base Map so prepared was scrutinized and reviewed by Karnataka State Remote Sensing Application Centre (KSRSAC). The base map was then updated and finalized in consultation with KSRSAC.

5.4.2 Final Base Map

A fresh GIS based Base Map has been prepared for the BMA. Entire data set for Base Map has been structured and layered and is ready for further use, value addition and continuous updation in future. This base map has formed the basis for the Existing Land Use survey and mapping.

5.5 Existing Land Use Map

The Existing Land Use (ELU) is the next critical input in devising the future growth strategy of any city/town, formulating alternatives and proposals in any Master Planning exercise. The ELU maps show various current land uses at the specified and reasonable scale indicating residential, commercial, industrial, public & semi- public uses, recreational (parks & playgrounds), open spaces, vacant land, land under agriculture, water bodies, utilities & services facilities, circulation system, conservation areas, special areas, committed land uses, reservations and mixed land uses etc.

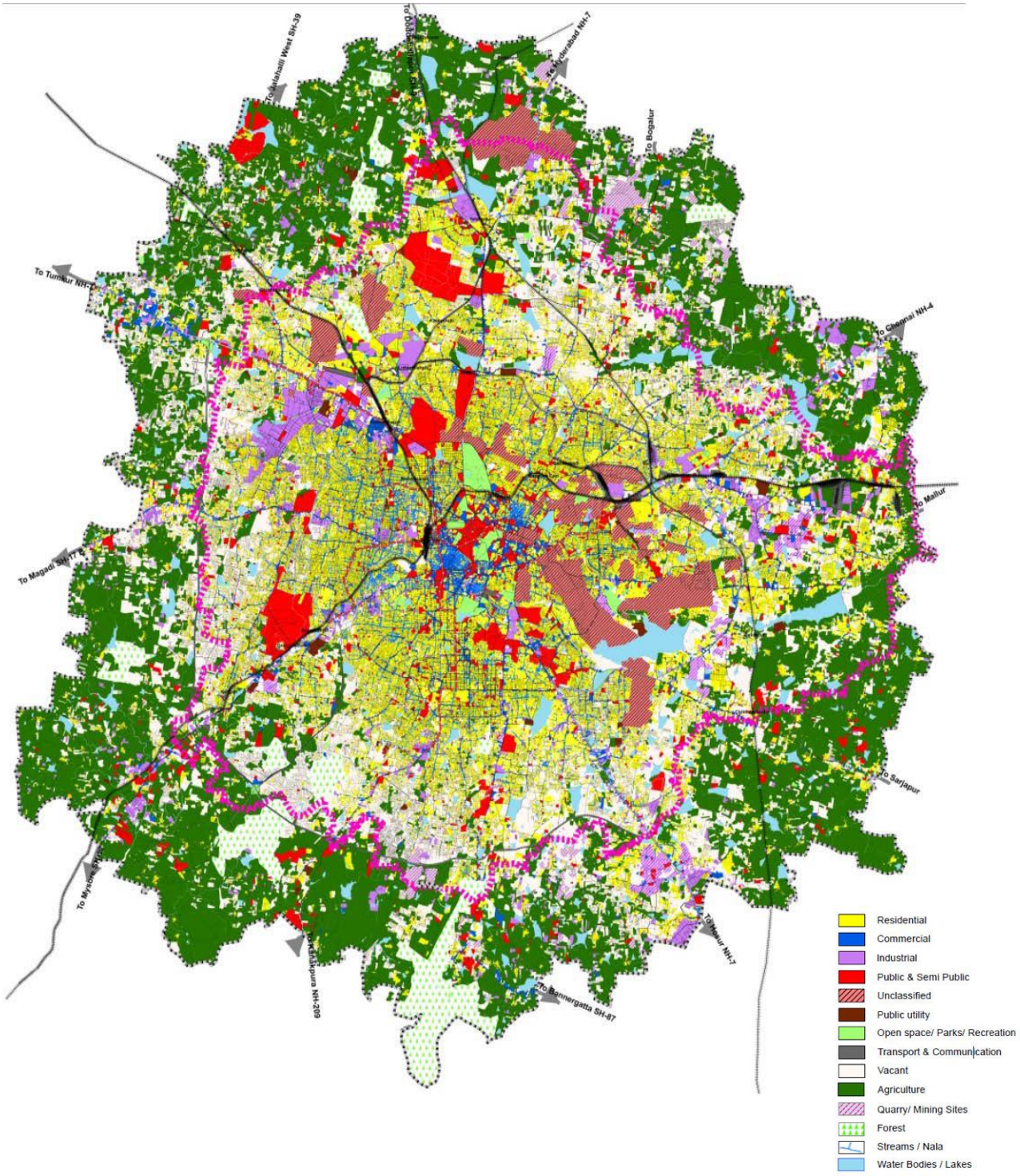
Urban land activities/ uses are numerous like residential, mixed residential, commercial, mixed commercial industrial, mixed industrial or recreational and with various combinations. Activities with similar nature have been clubbed together and Land Use classification prescribed under KTCP Act and Rule 30 of the Karnataka Planning Authority Rules have been followed for land use codification, for capturing the data on ground and preparation of Existing Land Use Map 2015. The ELU maps are based on field surveys that have been carried upto Dec 2015. To collect information and map the existing land use of the BMA a comprehensive approach and methodology was taken, wherein satellite imagery interpretation and an extensive existing land use field survey across BMA formed the basis for mapping and ELU map preparation. Since the city is a dynamically growing entity it is difficult to capture the exact land use in detail. The existing land use survey exercise is primarily aimed at capturing the overall land use pattern, general growth trends and other ground conditions. This is to assists in the preparation of the overall master plan.

The ELU maps were finalized after due scrutiny. After completing the existing land use mapping exercise the overall land use pattern has been studied. The ELU maps have been printed out at 1: 5000 in a standardized format and have been utilized for preparing the proposals. Overall composite ELU Map is presented in **Figure 5-6**, whereas the ELU Area Statement for LPA of BDA is given in **Table 5-1.**

Table 5-1: ELU Area Statement

Land Use Category	Area (Sq.km)	Share (%)
Residential	212.84	17.63%
Commercial	38.28	3.17%
Industrial	45.61	3.78%
Public Semi Public	64.78	5.37%
Unclassified	42.32	3.51%
Public Utility	4.86	0.40%
Parks & Open Spaces	20.46	1.70%
Transport Communication	88.02	7.29%
Vacant	304.82	25.25%
Agriculture	300.95	24.93%
Quarry/ Mining Sites	7.4	0.61%
Forest	27.53	2.28%
Streams	4.28	0.35%
Water Bodies	44.82	3.71%
Total LPA of BDA	1206.97	100.00%

Figure 5-6: Existing Land Use Map of BMA



6 DEMOGRAPHY

6.1 Census Data

Bengaluru has a long history, but the recording of census of population in Bengaluru began from 1871. It is notable here that since the first census, Bengaluru has been the most populous city in the State of Karnataka. Bengaluru has retained its primacy in the state for more than a century now. RMP-2031, given the available census information, has extracted population data for the unified area (BMA) for the past five decades i.e 1971 to 2011. Census information broadly coincides with the formation of BDA in 1976 and that the Jurisdiction of BMA has remained constant for all these years except for modifications due to administrative changes. However, the municipal boundaries/ urban agglomeration have changed every decade. In case of BBMP, present municipal boundaries have been used to arrive at historical data for BBMP.

BMA comprises of LPA of BDA (1206.97 sqkm) and part of LPA of BMICAPA (87.03 sqkm). Also, BMA comprises of BBMP and 251 villages around the BBMP. It is important to note here that several villages and BBMP is governed by two authorities (BDA and BMICAPA), for this reason Master Plan has considered the entire BMA, BBMP and Villages for extraction and analysis of population within BMA.

6.2 Population Trends

Population in BBMP and BMA has grown rapidly as evident from **Table 6-1**, which presents the growth of population in BBMP, BMA and villages within BMA for past five decades and **Figure 6-1** presents the details of planning area.

Table 6-1: Population Trends for BMA

Year	BBMP			Villages in BMA			BMA		
	Population	GR%	CAGR	Population	GR%	CAGR%	Population	GR%	CAGR%
1971	1897826			113879			2011705		
1981	3100811	63.4	5.03	157664	38.4	3.31	3258475	62.0	4.94
1991	4320297	39.3	3.37	209500	32.9	2.88	4529797	39.0	3.35
2001	5887853	36.3	3.14	302163	44.2	3.73	6190016	36.7	3.17
2011	8443675	43.4	3.67	600989	98.9	7.12	9044664	46.1	3.87

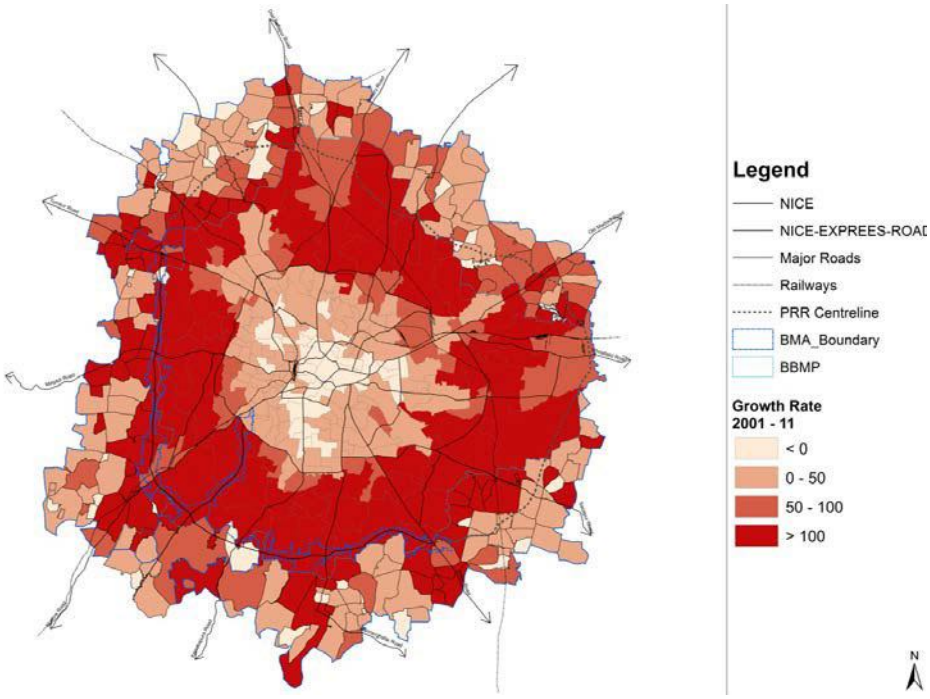
Source: Census of India Handbooks and Master Plan Analysis, 20115-16

Note: GR- Decadal Growth Rate between two Census Years, CAGR – Compounded Annual Growth Rate

BBMP has consistently experienced high growth rates though there are variations between the decades. The growth rate in villages in BMA has doubled during 2001 to 2011. Due to larger influence of BBMP in the BMA, the BMA trend line is following the BBMP and is susceptible to this pattern in future considering the large chunk of lands available for development in the surrounding villages. This requires a clear supporting policy and regulatory framework supported with measures

to make the agricultural land in the BMA as productive asset for facilitating conservation of the agricultural land.

Figure 6-1: Population Growth in BMA (2001 to 2011)



Source: Census of India Handbooks and Master Plan Analysis, 2014-15

Assessment of growth rates within BMA in the past census decade (Figure 6-1), indicates that growth rates in most of the wards of the city's core area (inside ORR) have been found to be in the ***negative***, whereas a positive and a prominent growth rate is found in most of the wards belonging to the peripheral areas.

6.3 Spatial Distribution of Population in BMA

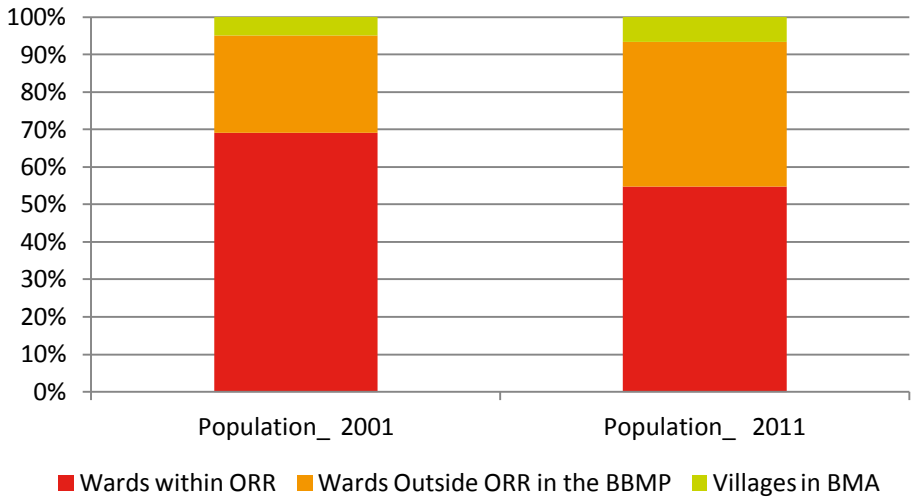
The BMA has been classified into three spatial spreads a) BBMP wards within ORR, b) BBMP wards outside ORR and up to the BBMP boundary and c) Villages in BMA to understand the spatial spread of the population. The population distribution in BMA in 2001 and 2011 is given in **Table 6-2** and **Figure 6-2**. **Figure 6-3** shows the population distribution of wards of BBMP and the villages in BMA as per population class range.

Table 6-2: Population Distribution in BMA

Spatial Spread	Population		Share of Population		Decennial Growth Rate
	2001	2011	2001	2011	
Wards within ORR	4241540	4960809	69.1	54.8	16.96%
Rest of BBMP	1598615	3482866	26.0	38.5	117.87%
Villages in BMA	302163	600989	4.9	6.6	98.90%
Total BMA	**6142318**	**9044664**	**100**	**100**	47.25%

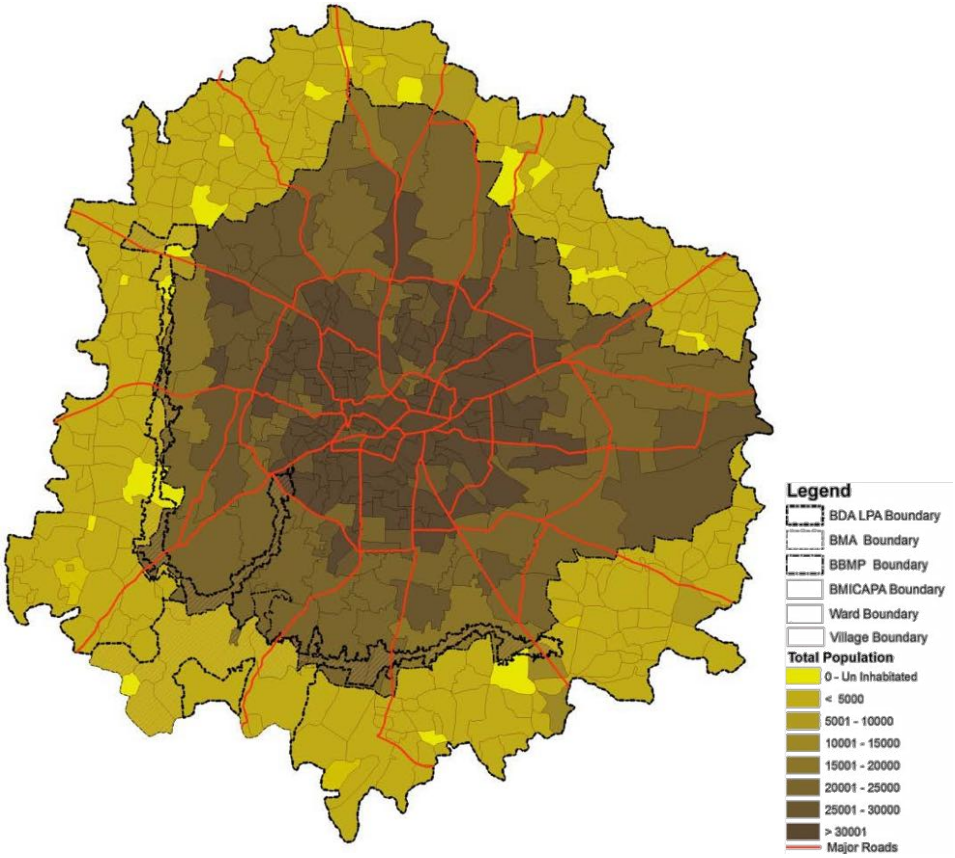
Source: Census of India Handbooks and Master Plan Analysis, 2014-15

Figure 6-2: Population Distribution within BMA



Source: Census of India Handbooks and Consultant's analysis, 2014-15

Figure 6-3: Population Distribution in BMA



Source: Census of India Handbooks and Master Plan Analysis, 2014-15

6.4 Density of Population

Population Density is defined as the number of persons per hectare (PPH). As per the census records of 2001 and 2011, the population density values for the BMA and the BBMP have gone up from 47 to 70 and 82 to 119, respectively, whereas the population density in village has doubled from 5 to 10 pph. Around 23 inhabitants were added on every hectare of BMA during the 2001-11 whereas in BBMP, 37 persons have been added for every hectare during the same period. The core areas of the city have high density; while it reduces as moving away from core to the peripheral areas (**Table 6-3**). However, with close observation the percentage change in the density is at the highest with 118% for the wards located outside ORR in the BBMP followed by the villages with 99% in the 251 Villages in BMA. The core city area which has wards inside the ORR has exhibited growth of only 17% during 2001-11. The ward wise and village wise population density for BMA for the year 2001 and 2011 is presented in **Figure 6-4** and **Figure 6-5** respectively

Table 6-3: Variation in Densities for different spatial units

Spatial Spread	Area in Ha	Population		Density (PPH)		Increase in Density (%)
		2001	2011	2001	2011	
Within ORR	21689	4241540	4960809	196	229	17%
Rest of the BBMP	49461	1598615	3482866	32	70	118%
BBMP	70829	5840155	8443675	82	119	45%
Villages in BMA	58571	302163	600989	5	10	99%
BMA	129400	6142318	9044664	47	70	47%

Source: Census of India Handbooks and Master Pan Analysis, 2014-15

Figure 6-4: Population Density of BMA 2001

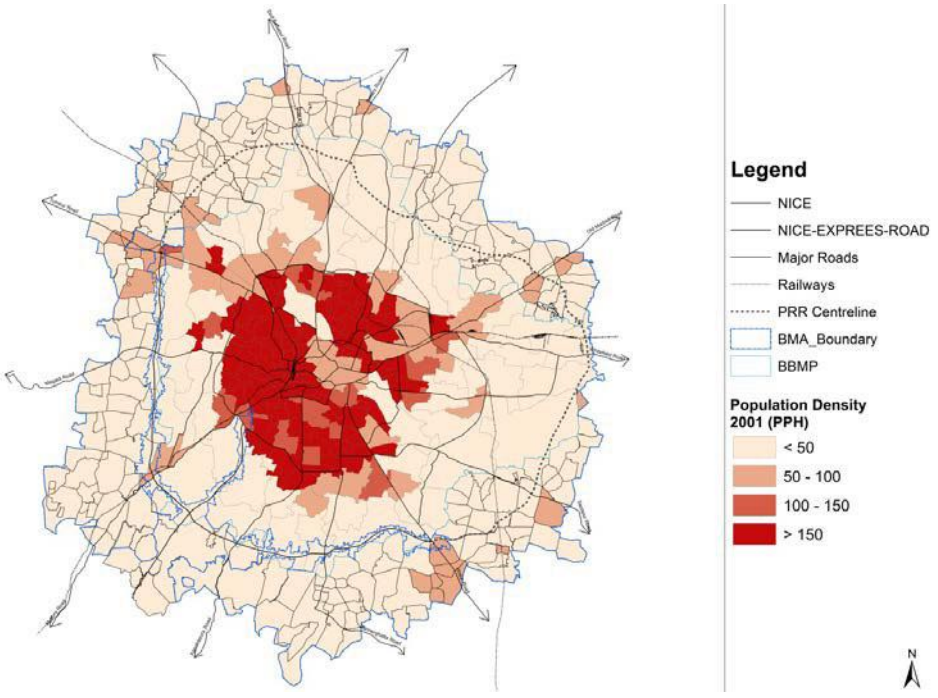
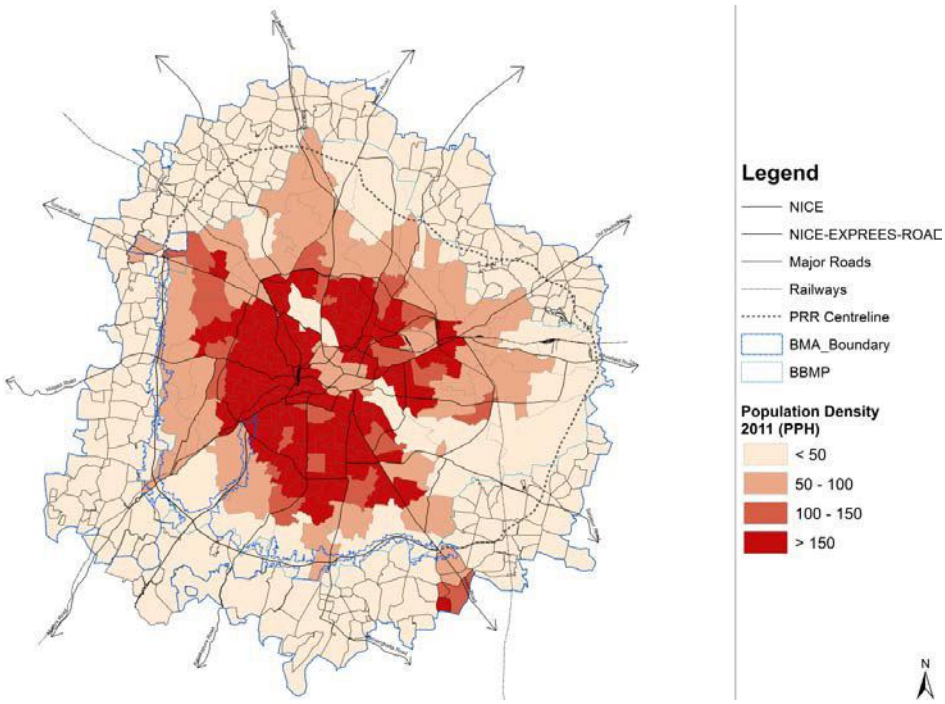


Figure 6-5: Population Density of BMA 2011



Source: Census of India Handbooks and Master Plan Analysis, 2014-15

6.5 Birth and Death Rate

Since BMA is not an administratively well-defined region hence the required demographic rates for projection are not available. Hence, the demographic rates as maintained by the Registrar of Births and Deaths for defined region such as BBMP/ BUD has been used with an assumption that the maintained rates hold good for BMA. Accordingly, the following assumptions have been made to derive the future population for the BMA. The birth rates for BBMP for 2001 and 2011 are 20.3830 and 16.4699 respectively. Similarly, the corresponding death rates are 8.3395 and 5.7309. Hence, natural increase rates for 2001 and 2011 are 12.0435 and 10.7390 respectively. The difference in natural increase rates during 2001 and 2011 is (-1.3045).

6.6 Migration

Migration is movement from one place to another during a time period. It is thus place and time specific. It has also direction; from and to. Migration is one of the most important components of population change. Whereas change is due to natural factors such as fertility, mortality, changes gradually and steadily, migration immediately responds to changes within and beyond the area under consideration. Migration changes the structure of original population and brings in its own structural patterns from different angles in the social, economic and demographic sense.

After Independence, Bengaluru, the State capital, saw an influx of population migrating to the city for better employment and livelihood opportunities. The census data from 2001 indicates that, among the total in-migrants into the state, about 19% are settled in BMR. Furthermore, 12% of the

in migrants into the state are in Bangalore Urban Agglomeration alone. The rate of in-migration to BUA has increased with a CAGR of 4.2% in an inference of the census estimates spanning from 1971 to 2001. The total number of migrants has increased from 6, 24,215 in the year 1971 to 20, 86,719 in 2001, and by 2001, about 36.5% of the city's population are in-migrants. With an exception of the decade 1981-1991, all the decades indicate a very high growth of in migrants, as indicated in the table shown hereunder.

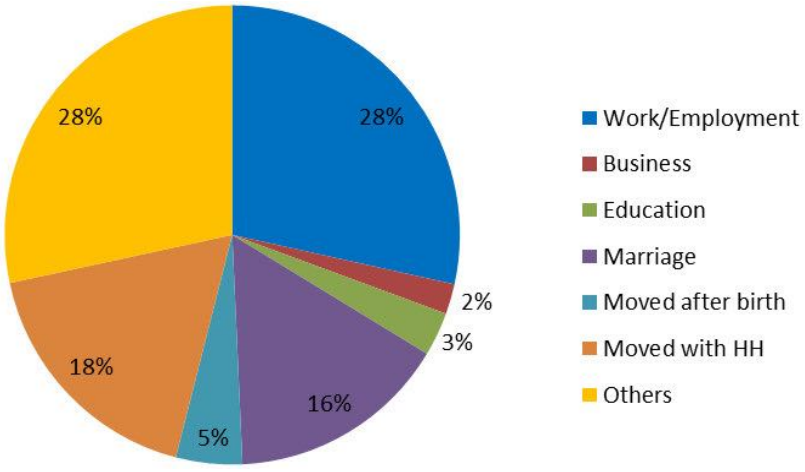
Table 6-4: Migrants in Bangalore Urban Agglomeration

Year	Population	Natural Increase	% Share	Migrants	% Share
1971	1664208	1039993	62.49	624215	37.51
1981	2921751	1822525	62.38	1099226	37.62
1991	4137314	2952146	71.35	1185168	28.65
2001	5701446	3614727	63.40	2086719	36.6

Source: Census of India Handbooks and Master Plan Analysis, 2014-15

It is important to note here that in the migration break up is that about 60% of the migrants to the Bangalore Urban Agglomeration are from within the Karnataka, while 38.7% of the migrants are from outside Karnataka. In 2001, about 28% of all the people migrated (i.e.20,86,719) to the Bangalore Urban Agglomeration, have migrated for better work and employment opportunities. However, only 11% of them are female. The percentage of female migrants is higher among the sections that have migrated for the reasons "marriage" and "moved with households/family", being 60% and 97.2% successively. Various social and economic reasons other than for work and employment, also have contributed to the migration phenomenon.

Figure 6-6: Reason for Migration - 2001



Source: Census of India Handbooks and Master Plan Analysis, 2014-15

6.7 Sex Ratio

Sex ratio is denoted by number of females per 1000 males. The sex ration in BMA has increased from 902 in 1981 to 918 in 2011. However, during the same period, in villages of BMA, the sex ratio has

decreased from 884 in 1991 to 857 in 2011. **Table 6-5** presents the sex ratio in BMA for past three decades.

Table 6-5: Sex Ratio in BMA

Area	1991	2001	2011
BMA	902	907	918
BBMP	903	909	923
251 Villages in BMA	884	878	854

Source: Census of India Handbooks and Master Plan Analysis, 2014-15

6.8 Literacy Rate

Bengaluru has always recorded a high literacy rate since its inception due to the high quality of educational infrastructure available in the city. The literacy rate in BMA has increased from 77.5% to 88.3% during the period 1991-2011. The literacy rate in 2011 is higher than Karnataka Urban (85.7%).

6.9 Population Age Pyramid

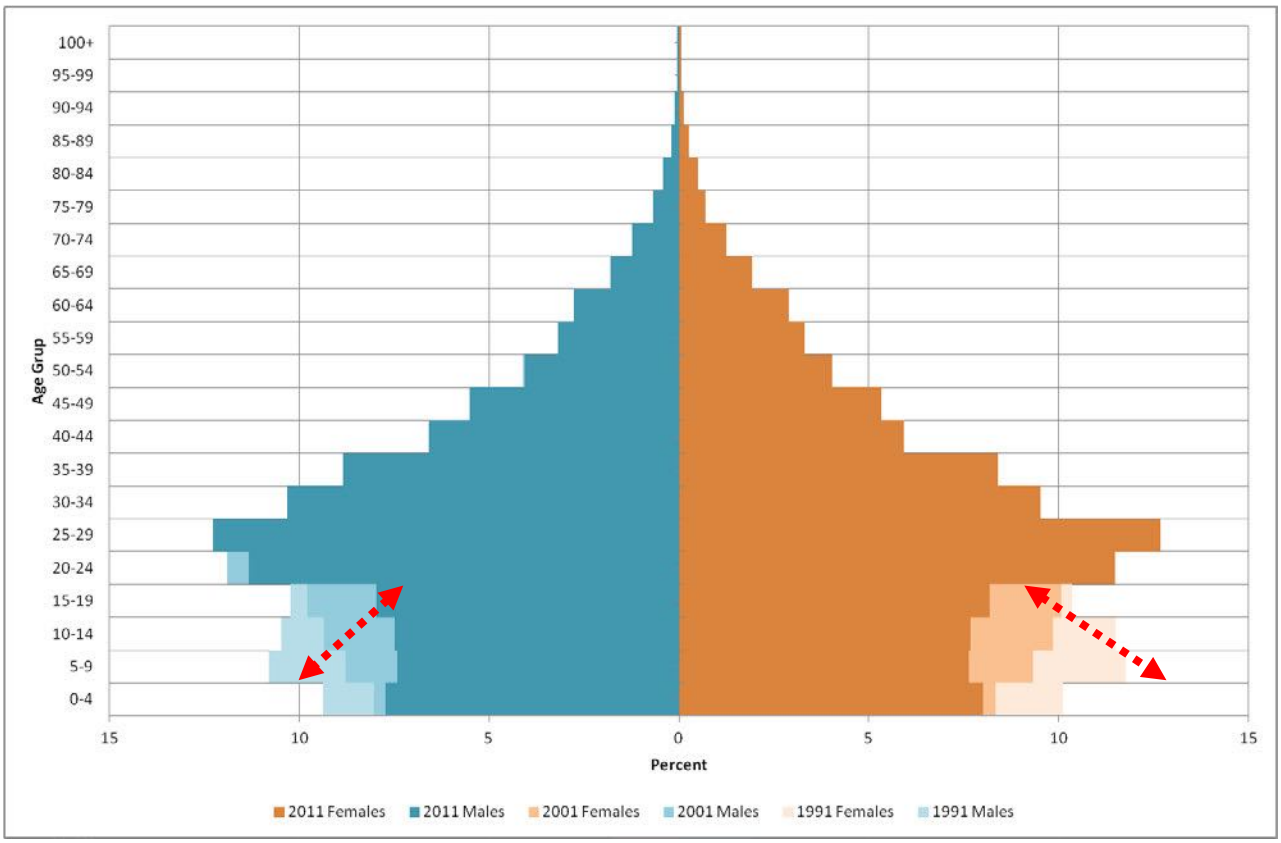
Age structure of a population in a city / metropolis plays a major role in urban planning. It gives an idea about dependent population, working population, jobs to be created, the present and future requirements of land, educational, health and other facilities and amenities. It depends on birth rate, death rate and also migration.

The Population pyramid is shown in **Figure 6-7** indicating the higher migration into the city of the age group of 20 to 60. However, the base of the pyramid which is in the age group of 0 to 14 is wider enough to reflect higher birth rate in the city (15 out of 1000 persons). The sides are not too concave reflecting the death rate is falling (6 out of 1000 persons). However, the lesser percentage of the people in peak of the pyramid indicates the life expectancy is better but still low.

The index of ageing increased rapidly from 18 elderly to 100 children in 1991 to 32 elderly to 100 children in 2011. However, the dependency ratio has decreased from 2 persons for every family to 3 persons per family. The number of persons in the age group of 15 to 60 has witnessed significant increase from 58% in 1991 to 63% in 2011. Especially the middle age group of 25 to 44 has increased tremendously from 30% in 1991 to 37% in 2011 reflecting the higher in-migration.

Further, analyzing information for the past three decades, the pyramid indicates the falling in birth and death rates from 1991 to 2011. The index of ageing indicates the shift in the balance between the child and older populations and is expressed as the number of persons above 60 years for every 100 children below the age of 15 years.

Figure 6-7: Population Pyramid of BMA for past three Decades



Source: Census of India Handbooks and Master Plan Analysis, 2014-15

6.10 Household Size

Numbers of households have increased two and half times in last two decades from 9 lakh in 1991 to 22 lakh in 2011 for BMA. However, average household size in BMA has decreased from 4.99 in 1991 to 4.01 in 2011. The interesting fact is that the household size in villages has drastically decreased from 5.21 in 1991 to 3.97 in 2011 which is less than the BMA and BBMP. **Table 6-6** presents details of households and household sizes for past three decades in BMA.

Table 6-6: Households & Household Size in BMA

Year	1991		2001		2011	
Area	**No. of HH**	**HH Size**	**No. of HH**	**HH Size**	**No. of HH**	**HH Size**
BMA	907413	4.99	1387508	4.47	2253744	4.01
BBMP	867199	4.98	1319342	4.46	2101831	4.02
251 Villages in BMA	40214	5.21	68166	4.52	151913	3.97

Source: Census of India Handbooks and Master Plan Analysis, 2014-15

6.11 Population Projections[5]

RMP-2031 has carried out projections for the spatially constant Bengaluru Metropolitan Area based on the past trends by deploying different statistical models and component method. The models and method included are:

1. Linear Model (this assumes that Population would increase steadily in a linear pattern);
2. Quadratic Model and Cubic Models (this assumes that population would experience fluctuations in growth pattern)
3. Logistic Model (this assumes that population would reach saturation at some point in the future).
4. Ration Method (this assumes that population would increase steadily in relation to Karnataka Urban Population)
5. Component Method (using birth and death rate and migration)

Population projections for BMA based on different methods (Statistical and Demographic) ranges from 11.8 million to 24.7 million for 2031. **Table 6-7** clearly shows that Linear Method and Component (demographic) method are predicting two extreme ends of the projections. Linear method has projected the lowest population for 2031. However, these estimates are likely to attain by the year 2017 in reality. Hence, these estimates can't be considered. The component method has projected population for higher end, which is almost 2.5times the 2011 population for BMA. Hence, considering this population may be inappropriate.

Table 6-7: Observed & Projected Population Range for BMA: 1971-2031 (in '00000)

Year	Observed Population	Projected Population					
		Linear	Quadratic	Cubic	Logistic	Component	Ratio Method
1971	20.12	16.06	21.22	20.06	21.24	NA	NA
1981	32.58	33.08	30.50	32.83	30.60	NA	NA
1991	45.30	50.09	44.93	44.93	44.09	NA	NA
2001	61.90	67.11	64.53	62.20	63.51	NA	NA
2011	90.45	84.13	89.29	90.45	91.49	98.00	90.45
2016		92.64	103.60	110.52	109.81	116.26	108.20
2021		101.15	119.21	135.51	131.80	149.14	129.44
2026		109.65	136.10	166.17	158.19	192.20	157.93
2031		118.16	154.29	203.21	189.87	247.38	192.68
	R-square[6]	0.96436	0.99540	**0.99991**	0.99376	NA	NA

[5] *Like any other forecasts, population forecasts have their limitations. Master Plan has attempted to project the population for the BMA by as scientific an approach as possible with available data. Predicting the future course of human fertility, mortality and migration is an educated guess at best, especially when these are bound to be deeply influenced by advancements in medicine, food production and availability, climatic variability, socio-cultural setting, political and economic conditions and a host of other factors. Therefore, caution must be exercised while making or using population projections. The main limitation of this population projection exercise is that the projections have been made on the basis of a limited five decades of data considering the unavailability of earlier Census records due to change in jurisdiction. Another limitation is limited data availability for age, sex, mortality & birth and in-migration at planning area level, which is essential input to the demographic method of population projection.*

[6] R-squared = Explained variation / Total variation; R-squared is always between 0 and 1. a) 0 indicates that the model explains none of the variability of the response data around its mean and b) 1 indicates that the model explains all the variability of the response data around its mean. In general, the higher the R-squared, the better the model fits your data. However, there are important conditions for this guideline that I'll talk about both in this post and my next post.

Population projections by three methods, namely Logistics, Ratio and Cubic method are in the range of 19-20 million. The projection by logistic model (19 million) is ideal considering the fact that the population cannot grow for ever due to its natural carrying capacity limit and instead population growth will taper off and reach saturation. However, while planning for metropolitan region it would be appropriate to plan for higher range to account for sudden growth in the population – which cannot be predicted. Also, that the R-square among the statics method is close to accuracy for cubic method.

The Population Projection methodology and results were shared with Department of Economics and Statistics, GoK and Institute for Social and Economic Change for independent review and confirmation. Both have confirmed that the BMA population could be in the range of 19 to 20 million by 2031. Hence it is appropriate to consider projections by Cubic method at 20.3 million for BMA by 2031.

6.12 Future Age Distribution

The purpose of knowing demographic characteristic of future population is to understand the potential employable population, demand for social infrastructure, and social composition (age & sex).

For the purpose of assessment of Age Distribution, due to non-availability of age distribution for BMA, the age distribution pattern of urban population of BUD for 2001 and 2011 (as per census) has been considered. The percentage difference between 2001 and 2011 age distribution pattern has formed the basis for future (2021 and 2031) age distribution pattern of BMA.

Table 6-8 presents the most strategic age distributions for which future projections have been attempted based on representative description following national and international profiles.

Table 6-8: Strategic Age Distribution Pattern

Age Distribution	Description
0 – 6	Infants
7 - 15	Education Aspirant Children
16 – 24	Higher Education Aspirant Children
25 - 44	Young Job Seekers/Employed
45 - 59	Middle Aged Skills
60 - 79	Aged And Dependents
80+	Aged Dependents

The age wise population distribution ratio for the 2021 and 2031 based on 2001 - 2011 pattern is presented in the below **Table 6-9**.

Table 6-9: Projected age distribution of population for BMA for 2011, 2021 and 2031

Age	2011			2021			2031		
	Population	Male	Female	Population	Male	Female	Population	Male	Female
0-6	10.88	10.75	11.02	10.11	10.06	10.17	9.34	9.36	9.32
7-15	13.34	13.18	13.52	10.23	10.34	10.11	7.12	7.49	6.71
16- 24	17.77	17.53	18.03	15.63	15.15	16.16	13.49	12.76	14.29
25- 44	37.51	38.19	36.77	41.16	42.12	40.12	44.82	46.06	43.48
45- 59	12.86	12.9	12.82	13.91	13.56	14.3	14.97	14.23	15.78
60- 79	6.62	6.5	6.74	7.7	7.63	7.79	8.79	8.75	8.84
80+	0.89	0.8	0.98	1.11	1.01	1.22	1.33	1.21	1.46
Age not specified	0.13	0.14	0.12	0.13	0.14	0.12	0.13	0.15	0.12
Total	100	100	100	100	100	100	100	100	100

Source: Census of India and Estimates for RMP-2031

7 ECONOMY

7.1 Economy of Bengaluru- The Historical Perspective

Bengaluru's economy is diverse and has evolved from historic focus on trade and commerce centre and its shift to Public Sector Undertaking (PSU) to the recent shift to manufacturing and IT/ITES sector. Although the major drivers of the economy have changed, the sectors which have existed historically have remained as cornerstones and are significant in the present scenario. Aerospace, IT, BT and manufacturing e-commerce and transport/logistics are expected to be driving sectors in the future. Bengaluru has also emerged as the start-up hub of the nation, bringing innovation and contribution to GDP, diversity of economy and adding to employment opportunities.

Bengaluru started as trade centre in 1537 from Petta area and grew when Bengaluru was chosen as a British Cantonment and an administrative headquarters in 1800s. Binny Mills, Tata Silk Farm (Basavangudi), Indian Tobacco Company (Cox Town), United Breweries, Government Soap Factory (now Yashwanthpura), Minerva Mills, Government Porcelain Factory were the major contributors to the economy of Bengaluru before 1940. During 1940s to 1960s, the government invested heavily into large public sector units like HMT, BEL, BHEL, HAL and ITI. Industrial areas like Rajajinagar, Dyavasandra started around 1960s. In 1978, Electronic City was established for encouraging electronic industries to be set up which has now become one of the two major IT nodes of the city, catering to the world. **Table 7-1** presents the quick chronological economic timelines for Bengaluru.

Table 7-1: Key Economic Timelines OF Bengaluru

Year/Period	Key Initiations
1537	Founding of Bengaluru: Sir Kempegowda I (1513-1569), a local cheftain in the Vijayanagar Empire, builds the town of Bengaluru in the Yelahanka province. His son builds the famous four watch towers
1800 – 1900	British encourage trading in Bengaluru but discourage manufacturing
1809	South India's largest Cantonment is established at Ulsoor near Bengaluru
1831 – 81	Under direct British rule, Bengaluru becomes administrative head-quarters of the state
1850	The British revamp the administration; introduce railways, posts and telegraphs
1859	The first railway, from Bengaluru to Jolarpet, commissioned
1888	Binny Mills
1905	Fist Indian City to get electrified
1906	Tata Silk Farm established south of Basavangudi (the farm no longer exists)
1912	Indian Tobacco Company (ITC)
1915	United Breweries
1918	Government Soap Factory
1919	Minerva Mills

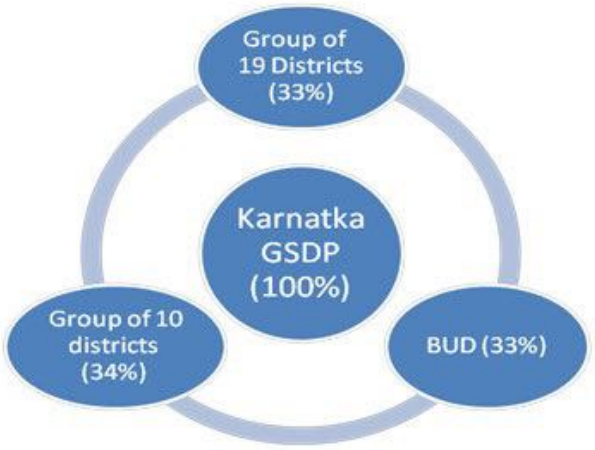
Year/Period	Key Initiations
1932	Government Porcelean Factory
1937	Bengaluru connected by air to Bombay by Indian Aviation Development Co. - Air Services
1940	HAL established
1940	Bengaluru Transport Company Ltd. commences operation with a fleet of 20 buses
1946	Indian Telephone Industries (ITI)
1946	Kirloskar Electric Company
1953	Hindustan Machine Tools (HMT)
1954	Bharat Electronics Ltd. (BEL)
1954	Bengaluru Stock Exchange opened
1960	Rajajinagar Industrial Estate formed
1962	Bengaluru Transport Company nationalised as Bengaluru Transport Service
1966	Mysore Sales International Ltd.
1940 - 60s	The government invested heavily into large public sector units like Hindustan Machine Tools (HMT), Bharat Electronics Limited (BEL), Bharat Heavy Electricals Limited (BHEL), Hindustan Aeronautics Limited (HAL) and Indian Telephone Industries (ITI)
1955	Government of India undertakings in hi-tech areas viz. aircraft, telephones, machine, tools, electronics established in Bengaluru
1961 - 71	Industrial townships of HAL, BEL, HMT and ITI built
1968	Dyavasandra Industrial Area was established by KIADB and first unit was registered
1970	High-technology industries, institutions of higher learning and favourable climate help Bengaluru become the science and technology capital of India
1970s	Peenya Industrial Estate
1978	Electronics City
1984	Wheel and Axel Plant
1980-94	Bengaluru becomes the preferred location for computer hardware and software companies, making it the “Silicon Valley of India”
1995	International Technology Park established
2008	Bengaluru International Airport constructed
(Expected)	Industrial Developments around International Airport

Sources: Census of India (2001), Bengaluru through the Ages, Provisional Population Totals, Rural Urban Distribution; Websites of the Public Sector Undertaking (PSUs) and Industrial Areas (accessed on 24th February 2015); Interactions of the Consultant with representatives of stakeholder groups.

Economic activities in the urban area has direct implications on the city fabric and structure like employment opportunities, densities, level of interaction between employment nodes, employment pattern and so on. Thus it is important to understand how city economy is connected to its region and structure of economy within the urban area.

7.2 Major Sectors of Economy

The Major share of Karnataka GSDP has been coming from Bengaluru Urban District. In the year 2014-15, Bengaluru Urban District alone has contributed 1.73% to India's GDP and 34.36% to Karnataka GSDP. The contribution of Bengaluru Urban District to GSDP of Karnataka has increased from 26.24% (2004-05) to 34.36% (2014-15). The Gross district domestic product of Bengaluru Urban has been highest during 2004 to 2015. It is important to note here that it takes combined GDDP of 10 following districts to equal to GDDP of Bengaluru Urban District. The GDDP of BUD has increased by 4.40% between 1999-00 and 2011-12 whereas at the State level it has increased by 2.94 times and at the National level 2.33 times during the same period.



- **Largest Biotechnology Hub in India**
- **Largest Software Exporter in India (Exports from IT - 1,74,418 crores (2013-14)**
  - CAGR of Exports from IT in Bengaluru 17.29% (2007-2014)
- **For 1 Job in IT/ITES sector, 2.7 other jobs are created (Direct Employment - 9,40,000; Indirect Employment - 26,00,000)**
  - CAGR of Number of IT companies in Bengaluru 3.40% (2007-2014)
- **80% of global IT companies have based their India operations and R&D centres in Bengaluru.**
- **Bengaluru is not just an IT/ITES centre but also economic leaders in Light and Heavy engineering, Automobiles, Earthmoving and Aeronautics industries.**

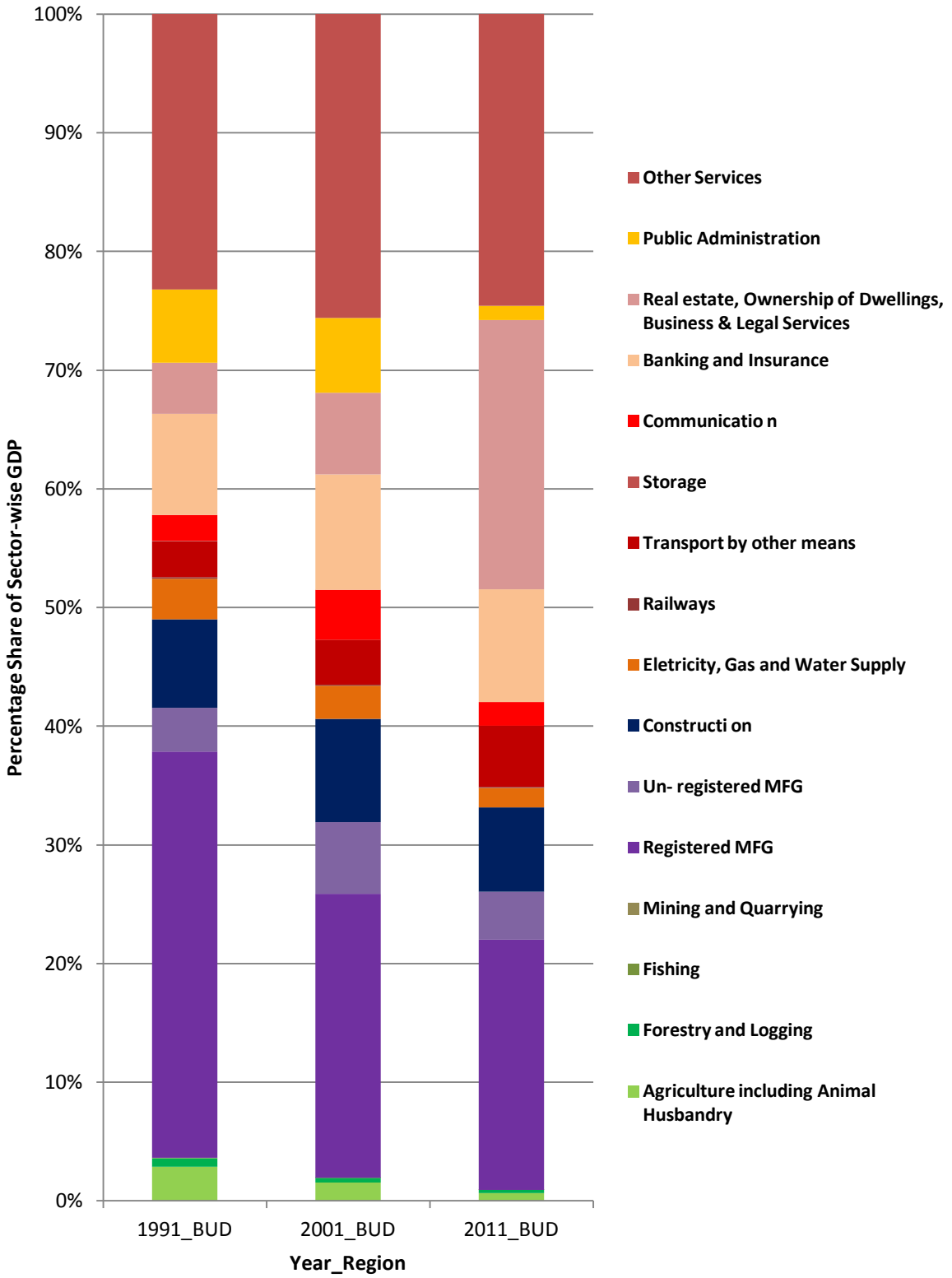
Major sectoral contribution to the economy of BUD is from manufacturing and tertiary sector, though the contribution of manufacturing has reduced steadily from 1991 to 2011. As on 2011, three sectors, 1) Others Services, 2) Real estate, Ownership of Dwellings, Business & Legal Services and 3) Manufacturing are the main pillars of economy as they constituted 24.6%, 22.7% and 21% of total GDDP (2011) respectively.

There is a steep growth in Real estate sector, Business & Legal Services from 2001 to 2011 with its sectoral share increasing from 4.3% to 22.7% during 1991 to 2011. However, the share of manufacturing has reduced from 34.2% to 21.1% during 1991 to 2011. The other important sector – public administration reduced during the same period from 6.1% to 1.2%. Further, the contribution of construction (~8%) and other services (~23% to 25%) have more or less remained constant during past three decades. **Figure 7-1** presents the sectoral GDDP share trends for BUD over 1991 to 2011. It is expected that Other Services (includes IT/ITES), Manufacturing, Real Estate, Business, and Banking and Insurance are going to retain dominant position in Bengaluru's GDDP.

7.3 Workers

The work force participation rate has increased from 34.27% in 1991 to 44.14% in 2011. This increase in the workforce can be attributed to the growth in employment opportunities and thus in-migration and also increase in the women workforce. The growth trend of WFPR over three census years is presented in Table 7-2.

Figure 7-1: Sectoral GDDP Share trends for Bengaluru Urban District (1991, 2001 and 2011)



Source: Economic Survey of Karnataka, 1993, 2001 and 2011

Table 7-2 : Workforce Participation Rate (WPR)

Year	Bengaluru Urban District[7]		
	Total Population	Total Workers	WFPR
1991	4839162	1658298	34.27
2001	6537124	2566914	39.27
2011	9621551	4246927	44.14

Source: Census of India, 1991, 2001 and 2011 and Consultants Analysis 2015

7.4 Occupational Structure

Census data on nine fold classification of occupation structure for 1991 and 2001 is presented in **Table 7-3**. There is a substantial increase in workers in other services, transport and construction, which is in line with share of sectoral contribution.

Table 7-3: Nine-Fold Classification of Census Workers 1991 and 2001

Year	1991	% share	2001	%
Cultivators	96769	5.92	78439	3.28
Agricultural labourers	75314	4.6	38091	1.59
Livestock and Allied	15894	0.97	18766	0.78
Mining & Quarrying	13099	0.8	14766	0.62
HHI	21606	1.32	57799	2.42
Non HHI	492149	30.08	640958	26.8
Construction	133070	8.13	231886	9.7
Trade and Commerce	321086	19.63	418471	17.5
Transport	124240	7.59	212327	8.88
Other Services	342760	20.95	680146	28.44
Main Workers	1635987	100	2391649	100

Source: Primary Census Abstract, Census, 1991, 2001.

7.5 Current State of Industries

1. Employment by Type of Industries:

The types of industries are classified into two categories namely manufacturing and Services. About 35000 industries are located in the Bangalore Urban District, of which about 78% manufacturing industries and the remaining 22% service industries. Total employment generated in the industries was about 13 lakhs. The service industries contributed maximum of about 62% of total employment and 38% contributed by manufacturing industries.

[7] Since the economic data is available for Bangalore Urban District, the analysis is done for Bangalore Urban District. This is also justified since 94% of population and workers of BUD is from BMA.

2. Scale of industries:

Out of 35,000 industries located in the Bangalore Urban District, the micro industries were dominated about 78% of total industries and followed by 19% small scale industries. Mega scale industries accounts for about less than 1% of total industries. The total employment generated in the sector was about 13 lakhs. The large and mega scale industries contributed maximum of about 66% of total employment, small & micro industries provided about 30% and the remaining 4% contributed by medium sale industries. Total of 7115 factories were located in the Bangalore Urban District, of which about 94 percent are non-pollution industries and the remaining 6% are polluting industries.

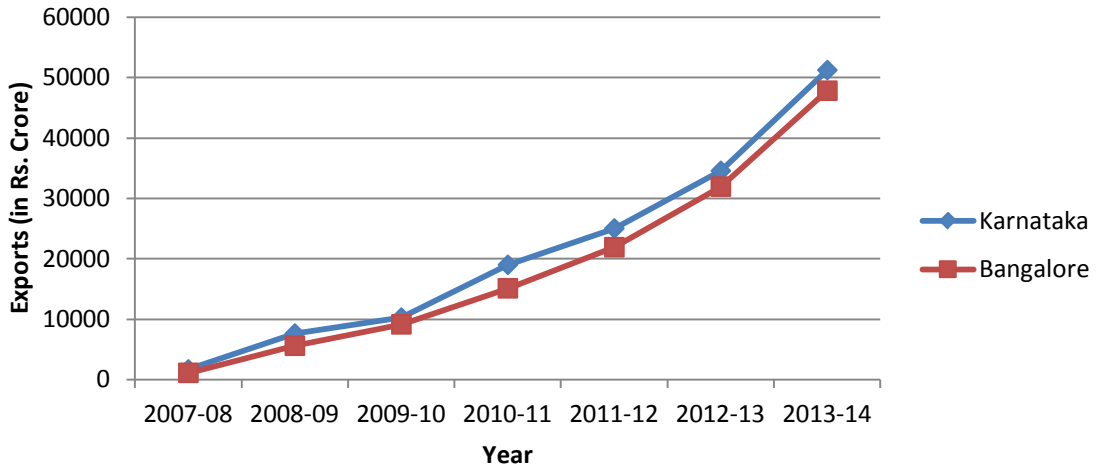
3. Classification of Industries Based on NIC 2008 Classification:

The Analysis of industrial data for 35000 industries within BUD, classified by type or investments are registered or approved by different departments has revealed that machine tool manufacturing, fabrication of metal products, manufacturing of electronic components, manufacturing of textile and its finishing, manufacturing of food products and manufacturing of motor parts and general purpose machinery are some of the major industrial sub-sectors in Bengaluru Urban District. Manufacturing of plastics, printing and related activities, and trade and commerce activities also have a significant share in the economy.

7.6 Special Economic Zones in BMA

Among the SEZs that are operational and under implementation in Bengaluru, majority of them are IT/ITES. Availability of infrastructure like power and ready markets, availability of skilled human resource and existing strong sector base with enabling policies are encouraging the SEZ growth. Exports and hence overall GDP is expected to grow exponentially even with marginal increase in the employment. Exports from SEZ have been growing steadily and most of IT/ITES export from State happens from Bengaluru.

Figure 7-2: Exports from SEZs

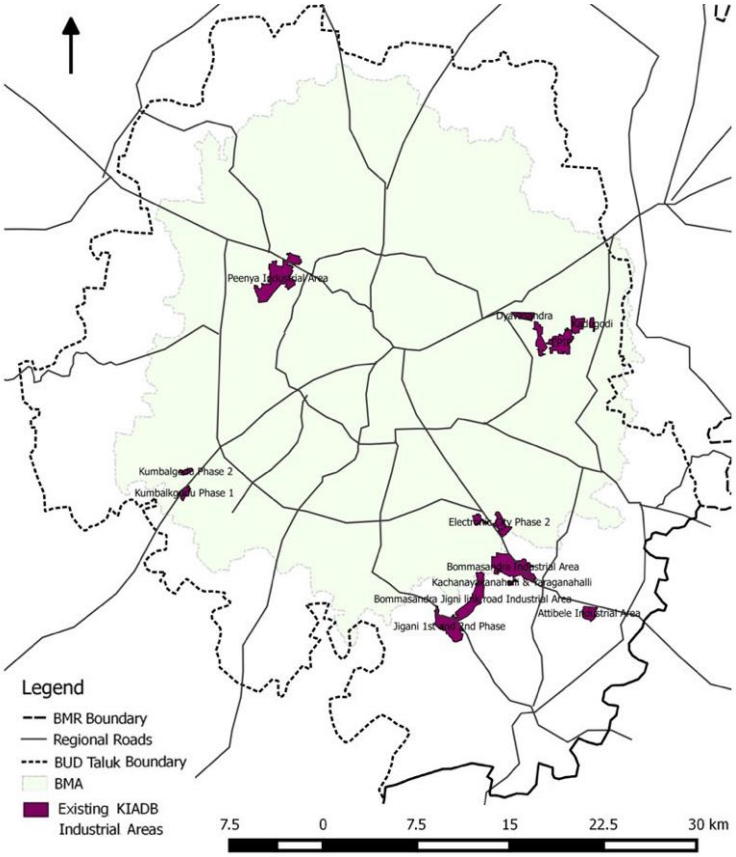


Source: Visvesvaraya Industrial Trade Centre (VITC), GOK, 2014 and Master Plan Analysis, 2015

7.7 Industrial Infrastructure within BMA

Karnataka Industrial Areas Development Board (KIADB) has several industrial estates within BMR and majority of them are in the BUD. Spatially the industrial areas are located in the North-West, East and South-East of BMA. Jigani and Bommasandra Industrial estates partly fall within BMA and Attibele is located outside BMA in Anekal Taluk. **Figure 7-3** shows the spatial spread of Industrial Areas in BUD.

Figure 7-3: KIADB Industrial Areas in and around BMA



Source: KIADB, 2014 and Consultant's Analysis, 2015

7.8 Establishments

1. Nature of Establishments

Establishments as defined by The Shops and Establishments Act, 1961[8], includes all premises where goods are sold either by retail or wholesale or where services are rendered to customers, and include an office, a store-room, godown, warehouse or workhouse or work place. Establishments are defined as shop, a commercial establishment, residential hotel, restaurant, eating-house, theatre or other places of public amusement or entertainment. Further, establishments as defined by the act may also include such other establishments as defined by the Government by notification in the

[8] The Karnataka Shops and Establishments Act, 1961 is derived from the Central Shops and Establishments Act, 1953

Official Gazette. The premises not covered under the definition of shop or commercial establishments are those registered by the Factories and Boilers Act and industries.

Directorate of Economics and Statistics, Government of Karnataka (GoK), gives the details of the Establishment Census[9] at City and District levels for the state. Of the total establishments in the state, share of Bengaluru Urban District is 14% with about 3,97,900 number of registered and unregistered establishments, of which 91.5% are urban establishments and 8.5% are rural establishments.

Out of the total establishments in Bengaluru Urban District (BUD), there are only 12.7% registered establishments in BUD. Employment in establishments in the district is 16 lakh (2013-14) contributing to 38% of the workforce of BUD. Although Bengaluru is the administrative capital and houses many administrative establishments, its share is less (2.1%) compared to 89.6% establishments that are proprietary based. The rest 8.3% of establishments are Partnerships, Companies, Self-Help Groups, Co-operatives, Non Profit Institutions or Others.

Table 7-4: Establishments by number of Workers in Bengaluru Urban District

District	Single	2 to 7	8 to 15	16 to 25	26 to 50	51 to 100	>100
Bangalore Urban	168369	202712	13157	4076	2732	1057	991
Percentage Share	42.3	50.9	3.3	1.0	0.7	0.3	0.2

Source: Establishment Census, Directorate of Economics and Statistics, GoK, 2013-14

2. Spatial Distribution of Establishments in BBMP

The total number of establishments in Bengaluru Urban District is 3,97,913, of which 3,63,933 (91%) are in BBMP. Chikpete (Petta), Dharmarayaswamy Temple Ward (Petta), Gottigere, Sampangiram Nagar (Petta and Shivajinagar), K.R.Market (Petta), Padarayanapura, Bharathi Nagar (Shivajinagar), Kaveripura, Cottonpet (Petta), Devarajeevanahalli, and Shivaji Nagar are wards with concentration of more than 3000 (up to 9000) establishments, clearly defining the Central Business District to be Petta, Shivajinagar (and MG Road – in terms of office spaces) areas.

As seen in **Figure 7-4,** number of establishments is also high in the west and north-east BBMP. The wards with least number of establishments are wards with defence areas, or with natural constraints such as lakes or reserved forests or industrial areas. Residential areas also have presence of many establishments.

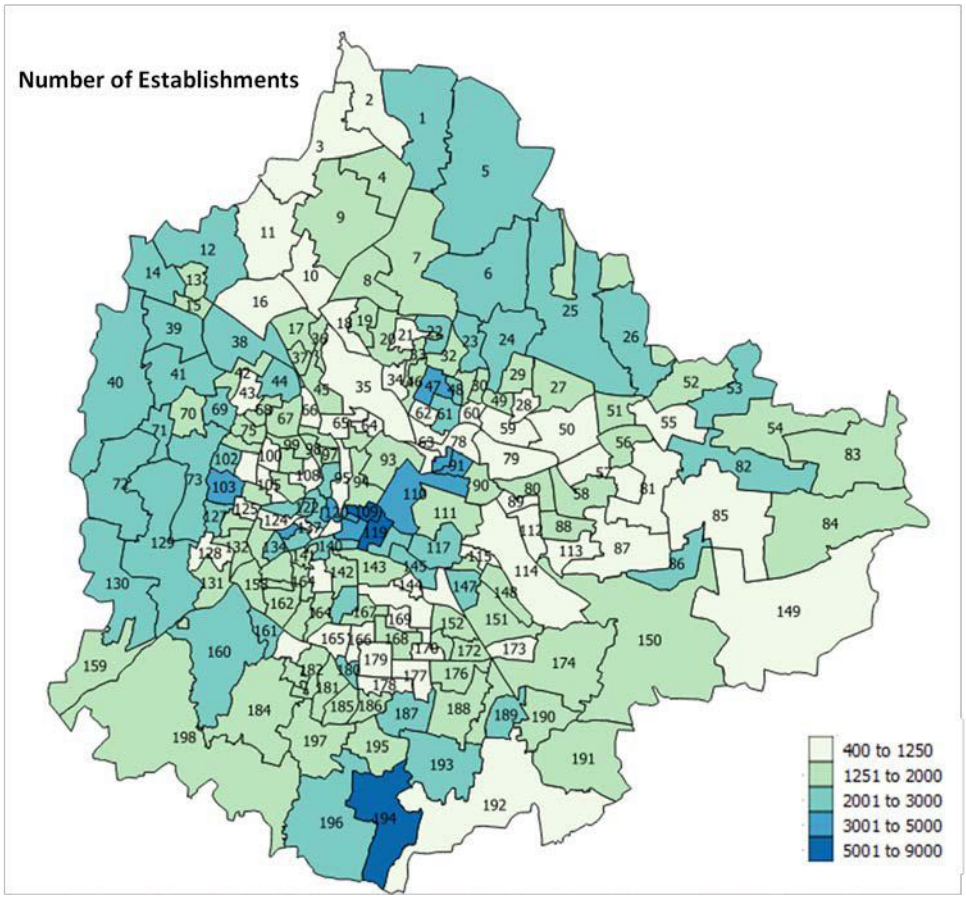
Establishments with more than 8 workers are concentrated in the areas falling under wards of CBD(Shivajinagar and in and around MG Road), Peenya Industrial area, Koramangala ward, Kottigepalya, Vrushabhavati, Deepanjali Nagar, Bapuji Nagar, Pattabhiram Nagar, BTM, Chickpet, Gandhi Nagar, Mangamanapalya, Hoysala Nagar and Hosathippasandra. These wards are major work centres and would need special focus on accessibility.

Establishments that have export units are concentrated mainly in Cottonpete and Peenya Industrial Area wards. They are also present in Devasandra, Vasanth Nagar, Hongasandra, Kavisandra,

[9] Source: http://web6.kar.nic.in/cbr/CBRHome.aspx

Yelachanahalli, Gaali Anjaneya Swamy Temple ward, Deepanjali Nagar, and Vrushabhavathi ward. These are wards with either IT/ITES companies or manufacturing units.

Figure 7-4: Ward-wise concentration of number of Establishments in BBMP



Source: Establishment Census, 2013-14, Directorate of Economics and Statistics, Government of Karnataka (GoK)

7.9 Hierarchy of Commercial Areas/ Markets

Commercial areas in Bengaluru can be grouped under three categories: commercial areas along the street, commercial areas concentrated in markets and office spaces. There are 28 major and important markets within BMA **(Figure 7-5)**. These markets have been placed under hierarchy based on following considerations:

- Population growth rate of wards – Wards with negative decadal population growth (2001 to 2011) were considered to be highly commercialised which coincides with the number or extent of the markets present in the wards
- Concentration of market places – Wards with dense commercial areas (Chickpet, Gandhi Nagar, Koramangala) were given higher weighs than the wards with lesser density of commercial areas (HSR Layout, Domalur, etc)
- Extent – Approximate extents of the markets has been used to determine the weightage

- Distance from the Core – The wards with Chickpet/Shivajinagar/MG Road were considered core and got the highest weight; the markets moving outwards got lower weight

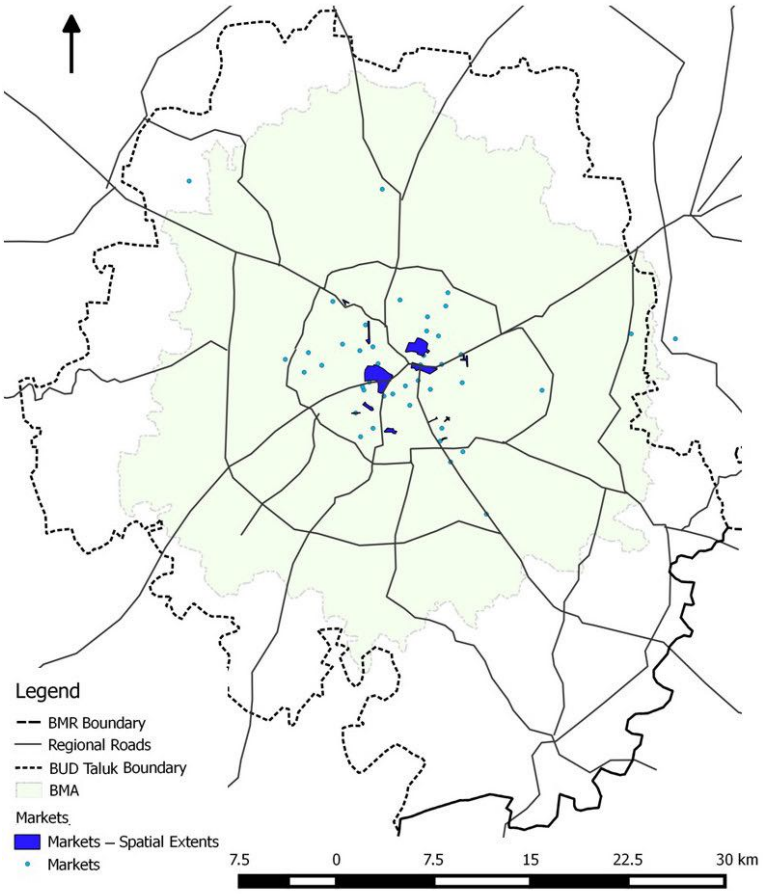
1st Order Markets: Petta, MG Road (Also Brigade Road, Commercial Street), Shivajinagar[10], Gandhi Nagar, KR Market, and Kalasipalya being within the Central Business District.

2nd Order Markets: Jayanagar Shopping Complex, Malleshwaram, Yeshwanthpur fish, fruits and vegetable markets, Madiwala market, etc. are acting as District Centres.

3rd Order Markets: Cox Town, Moore Road, and a few BDA complexes are assigned as Community Centres.

4th Order Markets: The smaller markets such as, Chikka Mavalli, L N Pura Market, Srirampura, Yadiyur, etc., are assigned as Housing Clusters.

Figure 7-5: Markets in BMA



Source: Master Plan Analysis, 2015

[10] Russell Market, Tarpaulin Market, Automobile Parts/Scrap Market, Bamboo bazaar and Furniture Market are although District Centres/Community Centres according the weights assigned, since they are located near each other and are next to core, together they form part of CBD. In other words, they are contiguous to core and hence are part of CBD, distinct only based on the specialization of goods sold.

7.10 Employment by Sector

The workers residing in the area are considered as the census workers, and employment is the workers employed at given location. Workers data as per Census has been used to derive the Work Force Participation Rate and is presented in **Table 7-5.** WFPR for BMA has increased from 33.7% to 44% during 1991 to 2011 period.

Table 7-5: Workforce Participation Rate Trend BMA, BUD and BMR

WPR Area/Year	1991	2001	2011
BMA	33.7	38.9	44.0
BUD	34.0	39.5	44.3
BMR	36.5	41.2	44.9

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

Table 7-6 presents the estimated workers and employment in BMA and BMR for 2016.

Table 7-6: Existing (2016) Population, Workers and Employment in BMA and BMR

Area/Ratio	Population 2016 (in Lakh)	Workers 2016 (in Lakh)	Employment 2016 (in Lakh)
BMA	**110**	**49**	**55**
BMR	**137**	**62**	**68**
BMA:BMR Ratio	**0.80**	**0.79**	**0.81**

Note: Population and Workers data source is Census 2011. 2016 population and Workers are estimated based on the CAGR of previous decade. Employment is estimated for 2016 based on Industrial Stakeholder Meetings, Real Estate Report and various Government Reports.

Data on workers for major sectors has been compiled from various sources:- Industries data from Karnataka Udyog Mitra and KSSIDC; IT/ITES data from Department of IT,BT and S&T; data on Establishments from Establishment Census, Directorate of Economics and Statistics[11]. The sectoral shares of workers are given in **Table 7-7** and **Figure 7-6** and it can be observed that industrial workers are about 23%, IT/ITES workers are 15% and workers in Establishments are 29%. The other sectors contribute about 33% of the total workers.

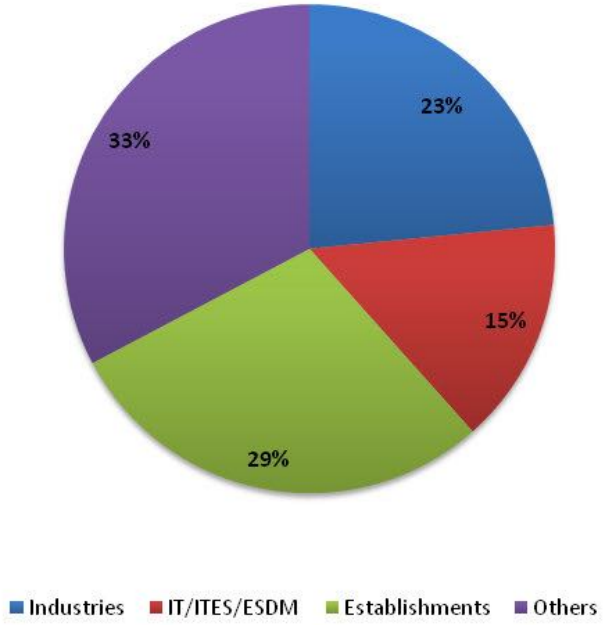
Table 7-7: Sectoral Share of Workers

Sectors	Employment	% Share Employment
Industries	1300067	23.45%
IT/ITES/ESDM	830000	14.97%
Establishments	1600323	28.86%
Others including Street Vendors	1814538	32.73%
Total	5544928	100.00%

Source: District Industries Centre (DIC), Karnataka Udyog Mitra (KUM), Karnataka State Small Industries Development Corporation (KSSIDC), Department of IT,BTandS&T(DIT),2014-15 and Master Plan Analysis, 2016

[11] http://web6.kar.nic.in/cbr/CBRHome.aspx

Figure 7-6: Share of Major Sectors of Employment for Bangalore Urban District



Source: Master Plan Analysis, 2015

Peenya, Whitefield, Electronic city and parts of Bommasandra and Jigani are the areas with major concentrations of industries. Old industrial areas like Rajajinagar are slowly being converted to residential/commercial and industries are being pushed out. Existing industrial base is expected to continue but new industries are not incentivized when compared to other districts of the State. Industries are expected to be setup in BMR (dependency on city's infrastructure). IT/ITES concentration is in Whitefield and Electronic city, but is also spreading in other parts of the city. Existing nodes with major employment are currently concentrated in BMA**.** Some of the major economic centres are: Peenya Industrial Area, Petta (Core area/Trade and Commerce), Electronic City and Whitefield (IT/ITES/ESDM), Jigani (Industrial/BT). In addition following are the areas in BMA and BMR where different industries are present.

- Hoskote – KR Pruam: BPL, Bengal lamps and several other manufacturing units are spread along the NH-7 linking to the industrial area in KR Puram, which includes ITI and the Tin factory. United Motors and Heavy Equipment's Private Limited located at KIADB industrial area is one othe major hi-tech engineering industry manufacturing spares of heavy earthmoving machineries. Bell Ceramics Limited, located in Chokkahalli village and the manufacturing unit of Volvo are also located in this area. The economy is product based manufacturing with a concentration of heavy engineering industries in the KIADB estate at Hoskote and textile, tobacco product. Oil refineries and silk manufacturing also dominate the economy of the area.

- **Bidadi – Harohalli:** The Toyota factory in Bidadi industrial area is the major generator of activities, encouraging more industries located in this area. The existing industrial area at harohalli covers almost 1000 acres. The economy is product-based with manufacturing industries located in the existing Bidadi industrial area and Harohalli industrial area.

- **Nelamangala – Peenya:** The economy is product based manufacturing with textile and other small and medium scaled manufacturing industries in the Peenya industrial estate. Other products contributing to the economy are horticulture and tobacco products.

- **Nelamangala:** The economy is product based manufacturing with textiles and manufacturing – iron & steel, plastic, bio-tech, electronic and electrical and ancillary automobile in the KIADB industrial area.

- **Dodaballapur:** The economy is product based dominated by the textile industry (silk weaving) and apparel parks. Other economics includes floriculture, wine industry and food processing.

- **Devanahalli – Yelahanka:** The economy is product based manufacturing and textile industry with the proposed Hardware park and Aerospace park. Airport related freight and logistics services and horticultural activities are also dominant.

- **Jigani – Electronic City – Bommasandra – Attibele:** The major attraction in the area that has caused industries to agglomerate in the region is the Electronic City in Bangalore. Industries along the entire stretch along NH-7 from Electronic city to Attibele, and beyond, to Hosur in Tamil Nadu from this area. Attibele located at the Tamil Nadu State border, Jigani, Bommasandra, Hebbagodi, Chandapura and Sarjapur are part of the industrial area. The industrial areas of Attibele, Jigani- Bommasandra contribute to the economy of the cluster. The industries concentrating around Sarjapur town and a few scattered ones along the Sarjapur-Attible road also form a part of the industrial cluster. Adjacent areas such as Hebbagodi, Dommasandra, Chandapur (a market town) and parts around Jigani and Anekal town serve as a residential base for the industrial area. This area has the internationally known multi-speciality hospital – Narayan Hrudalaya. The economy is product based secondary manufacturing and textile industry with the KIADB industrial area. Attibele is home for most manufacturing and textile industries. Automobile giants of India – TVS Motors and Ashok Leyand are very near to this area. Attibele, Bommansandra and the Jigani-Bommsandra industrial areas consist of manufacturing industries.

- **Ramanagara – Channapatna:** The economy of the two major areas is mainly a product-based secondary sector economy with includes agro-based industry, tobacco products, toys and wooden products and enlarged segment of the workforce.

7.11 Workforce Participation and Employment Projections

The workforce participation rate for BMA, as per Census, in 2011, is 43.9%, which has increased from 33.4% in 1991, indicating 5% increase in every decade. As per Census 2011, the male workforce participation is at 61.87%, whereas female work participation is 24.42%. The female participation rate has increase from 11.88% in 1991 to 24.42% in 2011, which is still lower that national (31.1%) and state average (34.4%). **Table 7-8** presents the workers by sex for past three decades.

Table 7-8: Comparison of Work Force in BMA

S.No	Year	Workers					
		Male	% of Male	Female	% of female	Total	% to total population
1	1991	1258609	52.8	255214	11.8	1513823	33.4
2	2001	1877261	57.7	533701	18.1	2410962	38.9
3	2011	2917774	61.8	1057196	24.4	3974970	43.9

Source: Census of India Handbooks and Master Plan Analysis, 2014-15

The employment projections for the year 2031 have been made based on the projected population in different age groups. As per the assessment, 73.05% of male and 73.55% of the female population would fall in the age category of eligible workers (16-60). Of the eligible male and female population around 65% and 35% are projected to be workers amongst males and females. The projection of demand for jobs up to 2031 has been estimated and given in **Table 7-9.**

Table 7-9: Employment Projections for BMA

Description	2011	2021(E)	2031(E)
Total Population	9044664	13551445	20320805
Eligible Workers (16-60 Group)	68.14%	70.30%	73.28%
Eligible Workers	6163034	9526666	14891086
Male Population (52%)	4715935	7046751	10566819
Female Population (48%)	4328729	6504694	9753986
Eligible Male Workers (%)	68.62%	70.83%	73.05%
Eligible Male Workers	3236075	4607274	7719061
Eligible Female Workers (%)	67.62%	70.58%	73.55%
Eligible Female Workers	2927087	4591013	7174057
Male Willing to Work (% of Male Workers)	61.87%	63.44%	65.00%
Male Willing to Work	2917774	4470125	6868432
Female Willing to Work (% of Female Workers)	24.42%	29.71%	35.00%
Female Willing to Work	1057196	1364054	2510920
Total Workers	3974970	5834179	9379352
Additional Jobs (over 2011)	0	1859209	3545173

8 ENVIRONMENT

8.1 Climatology

Climatically, the city of Bengaluru is located in the warm-humid climate zone and is considered as the most pleasant city in southern India owing to its topographical elevation. Bengaluru has a Tropical Savanna climate with distinct wet and dry seasons. Due to its high elevation, the city usually enjoys a more moderate climate throughout the year, although occasional heat waves can make summer a tad uncomfortable. There are 57 rainy days in a year on an average and that receive an average annual rainfall of 94cm. Heavy rainfall (64.5 mm in 24 hours) in Bengaluru city is mostly confined to second half of the Pre-monsoon season, Post-monsoon season[12], during break in monsoon season and also in association with weather systems like depressions/ cyclones approaching/passing through Bengaluru. Temperature ranges from 12°C to 40°C. Winds are generally light; Winds are strong during South West (SW) monsoon season and predominantly are from westerly direction. Skies are heavily clouded to overcast during SW monsoon season and to lesser extent in the post-monsoon season. During the rest of the year skies are mostly clear.[13]

8.1.1 Temperature

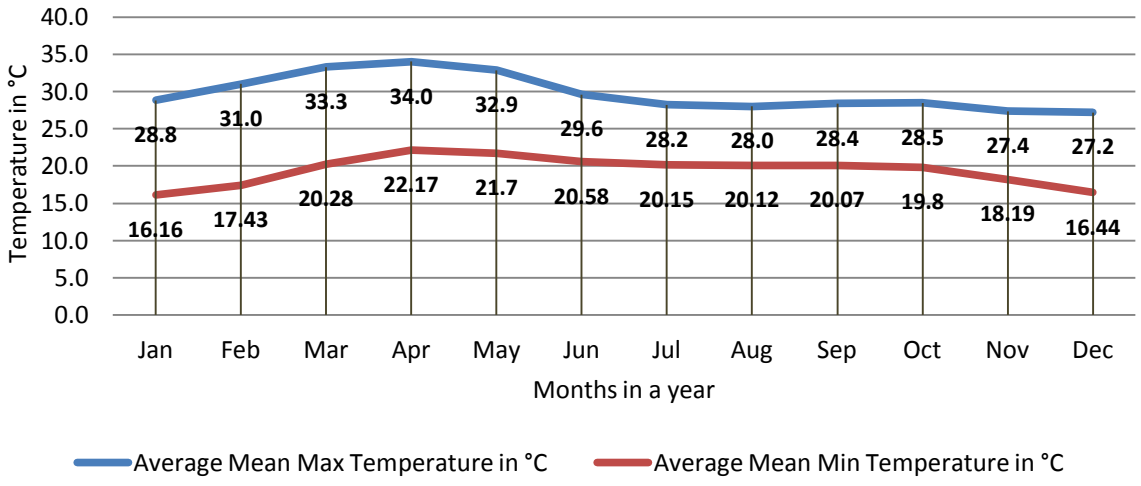
The highest temperature ever recorded in Bengaluru is 38.9 °C (recorded in May 1931). However, the suburbs of Bengaluru recorded temperatures as high as 41°C. The lowest ever recorded is 7.8 °C (recorded in January 1884). Winter temperatures rarely drop below 12 C, and summer temperatures seldom exceed 37°C. The average mean maximum temperature in the past decade varied in the range of 34 °C to 27.2 °C whilst the average mean minimum temperature varied between 16.16 °C to 20.15 °C.

Figure 8-1 presents the Average Monthly variation of temperature for the previous decade (2001-2013). It suggests that the average mean maximum temperature in the past decade varied in the range of 34 °C to 27.2 °C whilst the average mean minimum temperature varied between 16.16 °C to 20.15 °C.

It can be seen that the higher mean maximum temperatures occur in the months of April and May and the variation between the years 2004 to 2013 in the range of 32.4 °C to 35.4 °C. Also, the average of the mean maximum temperature during the same period is in the range between 29.6 °C to 29.9 °C, the variation being of 0.4 °C. Similarly cooler days occur in the months of December and January, with the lower mean minimum temperatures recorded in the range of 15.3 °C to 16.9 °C.

[12] The seasons in India as per IMD are; Winter Season (January & February); Pre-Monsoon season (March, April & May), Monsoon (June, July, August & September), and Post-Monsoon (October, November & December).
[13] Weather Services to Karnataka State Booklet of Indian Meteorological Department (IMD), Metrological Centre, Bengaluru, June 2011.

Figure 8-1: Average Monthly variation of Temperature for period 2001-2013 in BMA

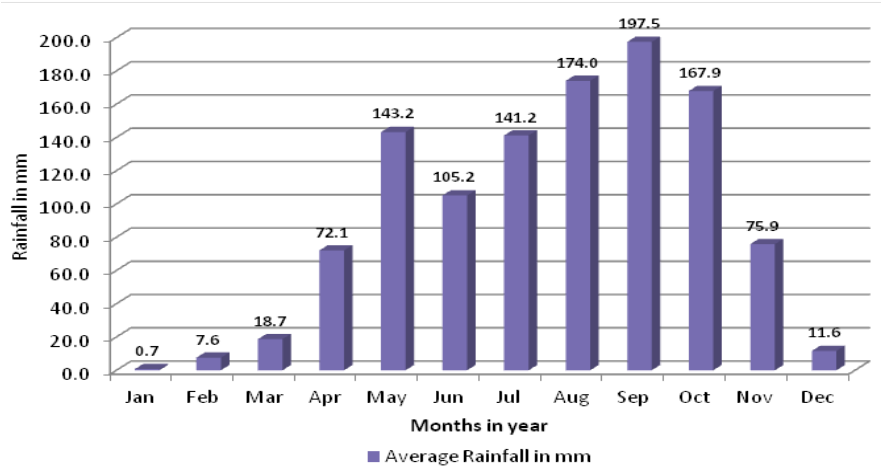


Source: IMD Database of 2004-2014

8.1.2 Rainfall

Bengaluru receives rainfall from both the North-East and the South-West monsoons and the wettest months are those of September, October and August, in that order. The summer heat is moderated by fairly frequent thunderstorms which cause power outages and local flooding. The heaviest rainfall recorded in a 24-hour period is 179 mm, recorded on 1 October 1997**.** The analysis of heaviest rainfall data for 2004-2014 over 24 hours indicates that the occurrence of heavy rainfall is very frequent for city of Bengaluru. Every year city receives heaviest rainfall during April to November period, which is wide range. The city thus needs to be prepared for heaviest rainfall any time during the year. The Bruhat Bangalore Mahanagar Palike (BBMP) area receives an annual average rainfall of 900 mm. Nearly 72% of this annual rainfall is from South-West monsoon (June- September) and rest of the rainfall is from North-East monsoon (October- December). **Figure 8-2** presents the average monthly variation of rainfall for the period of 2004-2013.

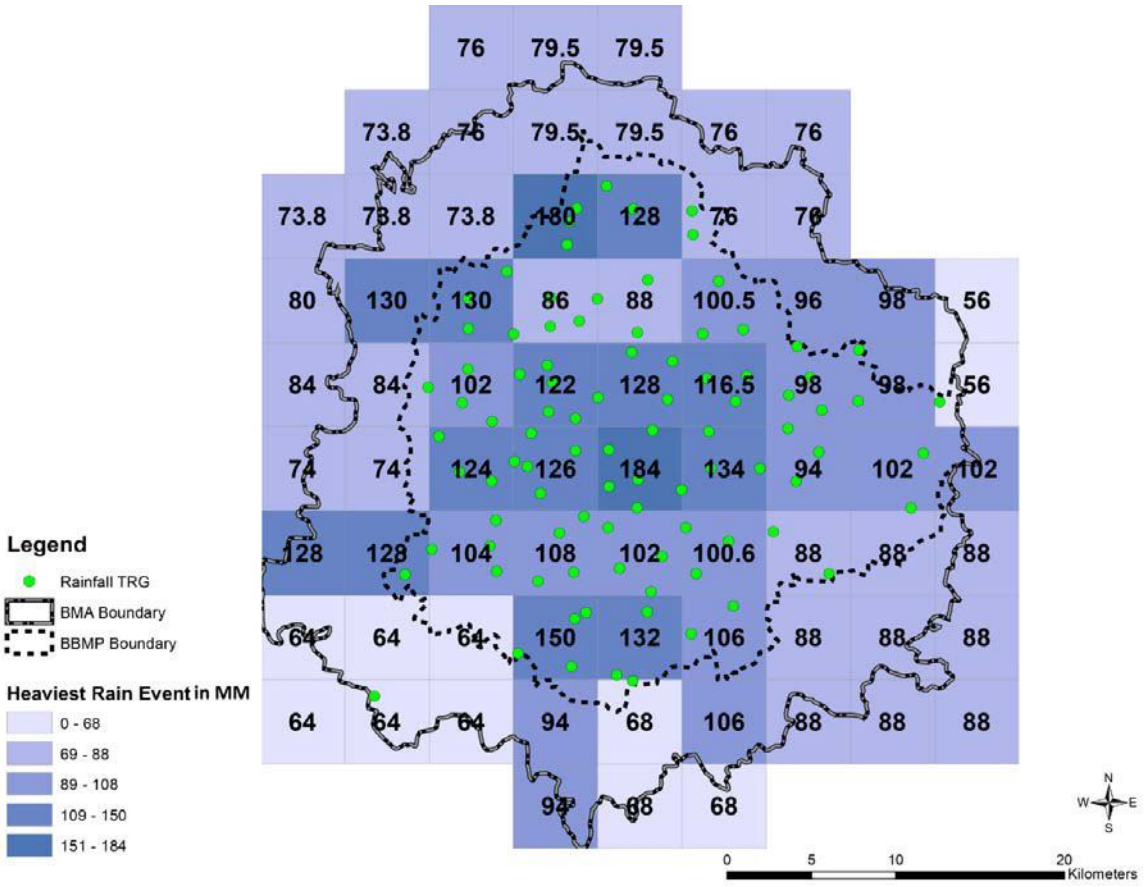
Figure 8-2: Average Monthly variation of Rainfall for period 2001-2013



Source: IMD data for the period 2004-2014

Grid density map has been prepared for the heaviest rainfall recorded at the KSNDMC telemetric rain gauges (TRGs) from 01.01.2013 to 31.03.2015, where the planning area has been divided into 5km X 5 km grids. The heavy rainfall alerts during past three years have been mapped. **Figure 8-3** presents the Grid Density map of BMA which plots the heavy rainfall calibrated in the said grids. As the TRG locations are available only within the BBMP, in the case of grids which are devoid of any TRG in rest of BMA, the heaviest rainfall has been marked by optimisation, taking into account the heaviest rainfall recorded in the nearby TRGs. As seen from the map it can be inferred that the heaviest rainfall has been recorded by the TRGs that are located in the central area of the BBMP (erstwhile BMP) than the rest of the areas.

Figure 8-3: Grid Density Map of Heavy Rainfall in BMA



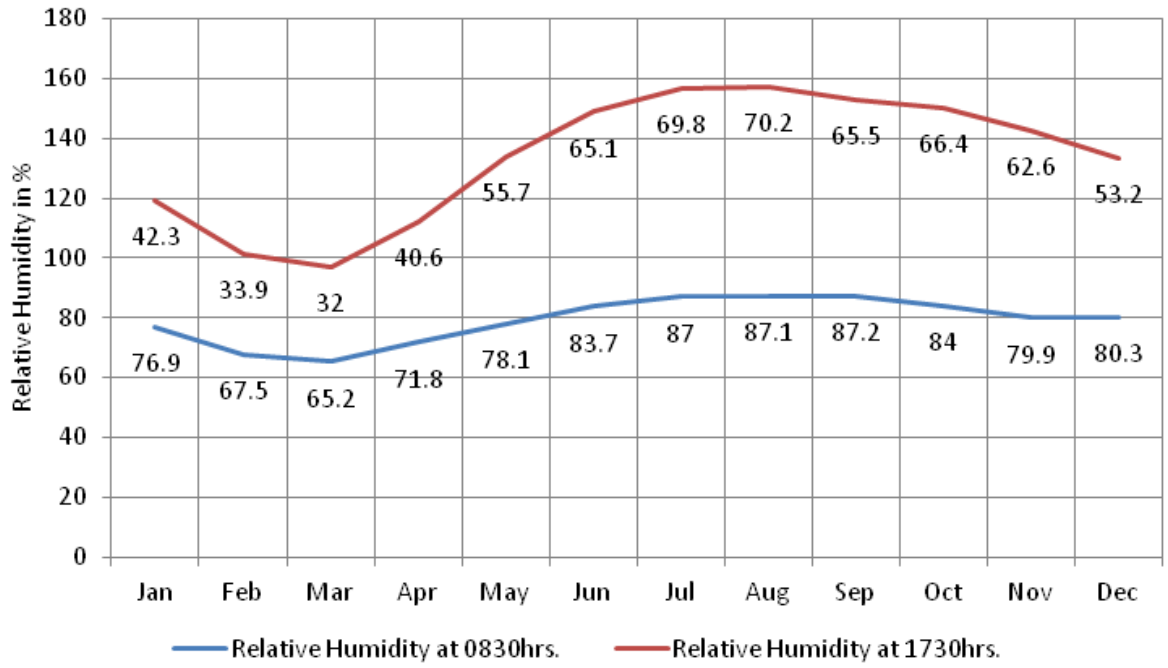
Source: KSNDMC, 2015 and Consultants Analysis 2015

It is noted that during heavy and erratic rainfall in Bengaluru, there have been instances of trees getting uprooted and their branches falling on the roads time and again. This poses a hazard to the commuters, vehicles and the overall city infrastructure (roads/street lights etc.). It is imperative that adequate planning strategies must be employed while planning city infrastructure, like road network, street design, landscape and urban design such that these instances of tree felling are avoided.

8.1.3 Relative Humidity

Relative humidity in Bengaluru varies from 32% in the month of March to 87% in August- September. The relative humidity is more than 65% during July to November months. Sunlight hours for the city range from 3.0 hours during July to 9.5 hours during March. The area experiences sunshine hours of 6.7 hours per day. **Figure 8-4** presents the variation of humidity in Bengaluru at 08:30 hrs and 17:30 hrs.

Figure 8-4: Monthly Average Relative Humidity



Source: IMD data for the period 2004-2013

8.1.4 Wind Speed and Wind Direction

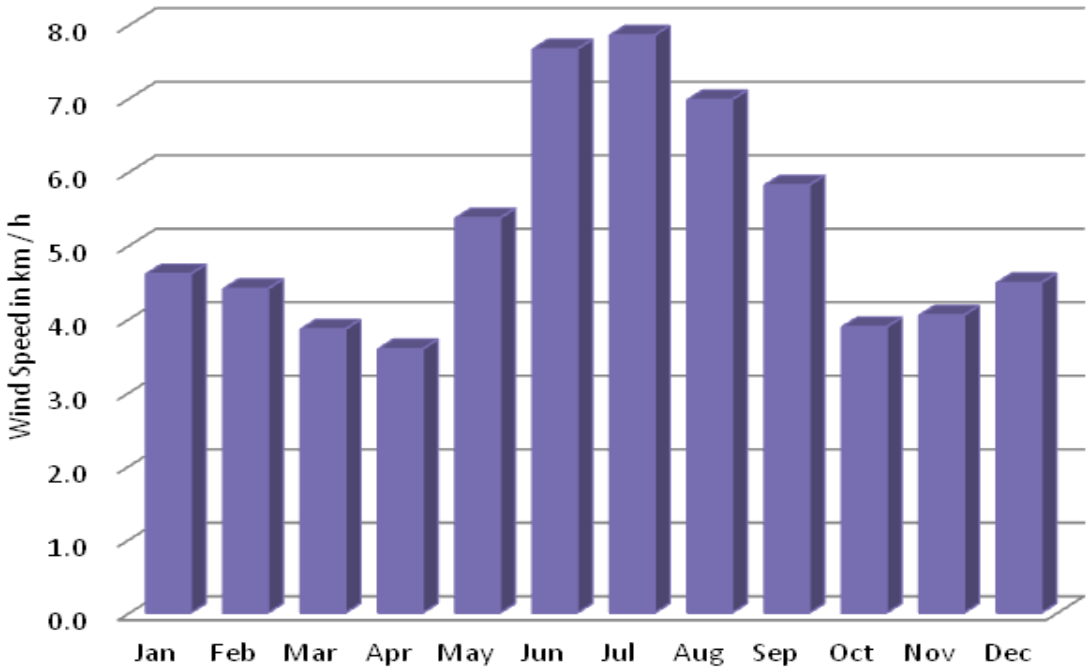
The surface winds in Bengaluru have seasonal character with the easterly components predominating during one period followed by the westerly in the other. The high wind speed averages 17 km/h during the westerly winds in the month of July and a minimum of 8-9 km/h during the months of April and October.

Figure 8-5presents the month wise average wind speed of Bengaluru for the period of 2004 to 2013. Annual wind rose diagram of Bengaluru recorded at 08:30 hr and 17:30 hr presented in **Figure 8-6**. Data has been represented as 30 years average. At 8:30 hr (morning period) annual wind speed is in the range of 1.5 - 4.5 m/s i.e 5.4 to 16.2 km/h[14].Wind direction is mostly easterly or westerly. Calm condition is only 13% cases. At 17:30 hr (evening period) wind direction is mostly easterly or westerly, like at 08:30 hr. Wind speed is mostly in the range of 1.5-4.5 m/s i.e 5.4 to 16.2 km/h. Occasionally wind speed increased to 4.5 – 7.0 m/s i.e 16.2 km/h to 25.2 km/h. Calm conditions are

[14] The unit of wind speed is in meters per second (m/s) which is equal to 3.6 km per hour(km/h)

prevalent only 12% cases at 17-30 hr. The **Table 8-1** presents the prevalent wind directions at 08:30 hrs and 17:30 hrs for 30 years average.

Figure 8-5: Month wise Average Mean of Wind Speed (in km/hr)



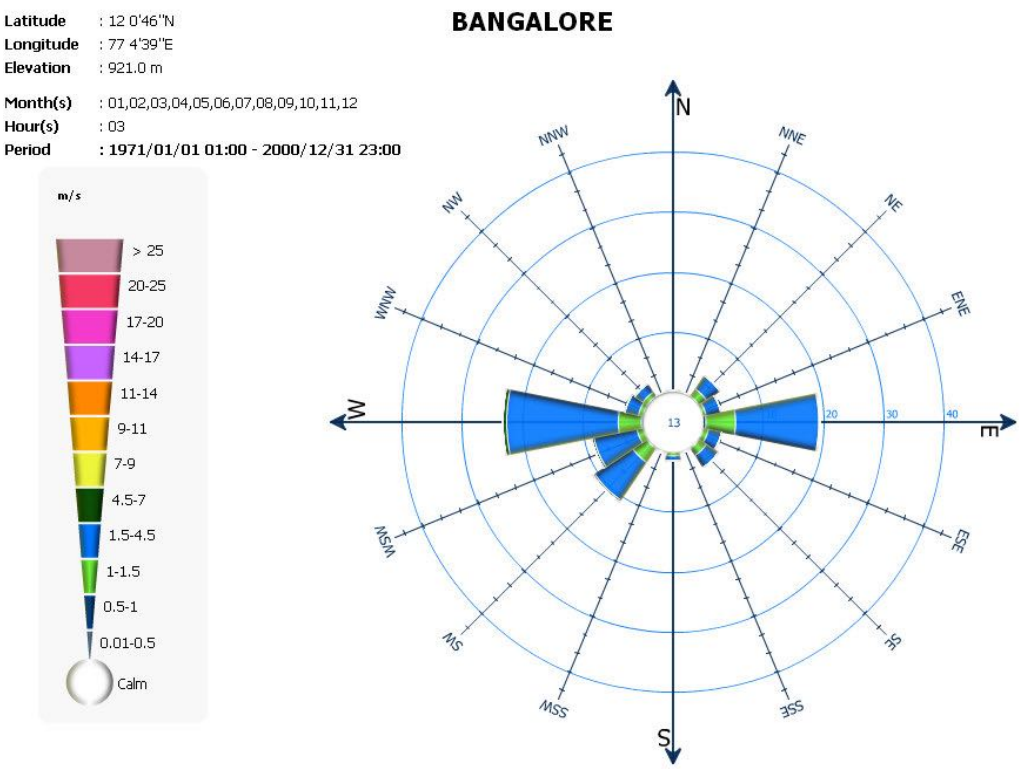
Source: IMD data

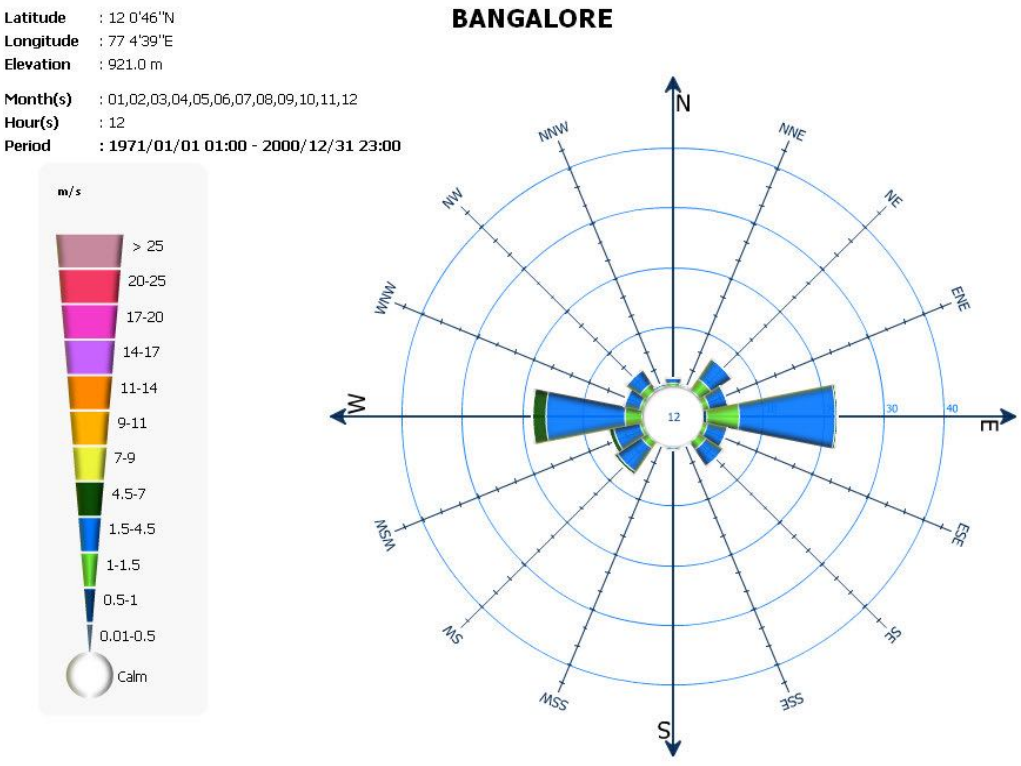
Table 8-1: Prevalent Wind Direction (period 1971-2000)

Month	Prevalent Wind Direction	
	08:30 Hrs	17:30 Hrs
January	EAST	EAST
February	EAST	EAST
March	EAST	EAST
April	SOUTH WEST	EAST
May	WEST	WEST
June	WEST	WEST
July	WEST	WEST
August	WEST	WEST
September	WEST	WEST
October	EAST	EAST
November	EAST	EAST
December	EAST	EAST

Source: IMD. Bengaluru

Figure 8-6: Annual Windrose at 08:30 hr



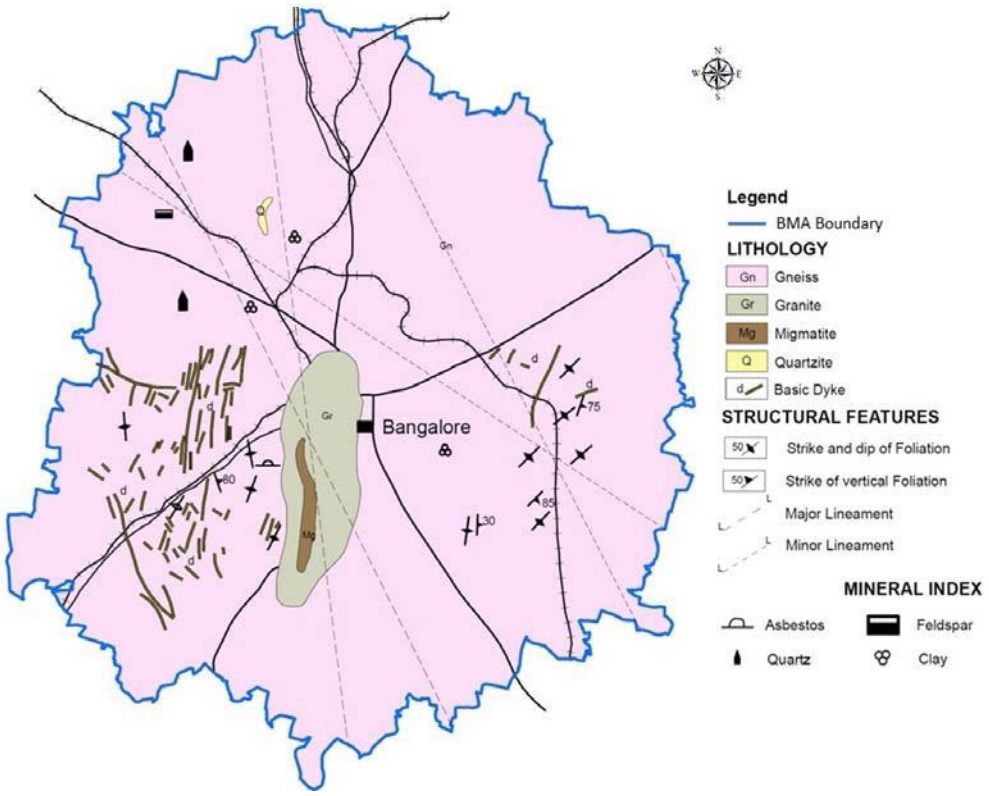


Source: IMD. Bengaluru

8.2 Geology & Topography

Bengaluru is located at latitude 12° 59' 0"N and longitude 77° 35' 0"E. It has two topological terrains, the one at the North Bangalore taluk and other being the South Bangalore taluk. The north taluk a level plateau and lies between 839-962 m above sea level. At the middle of it along the NNE to SSW runs the ridge, and the highest point at Doddabettahalli at 962 meters elevation. The topology of Bengaluru is flat except at this ridge. There are gentle slopes and valleys on either side of this ridge, forming low lying area which constitutes water tanks in varying sizes. The river Arkavathi flows through the north western part of the city. Its tributary is River Vrishabhavathi which rises at Basavanagudi. The south Bangalore terrain has uneven and undulating landscape with hills and valleys. The South Bangalore taluk has an uneven landscape with intermingling hills and valleys. The southern and western portions of the city consist of a topology of granite and gneissic masses. The eastern portion is a plane, with rare minor undulations. The BMA specifically, has the rock type that belongs to the Charkonite Group, Saugar group and the PGC. **Figure 8-7** presents the Geology and Mineral Map of BMA.

Figure 8-7: Geology and Mineral Map of BMA



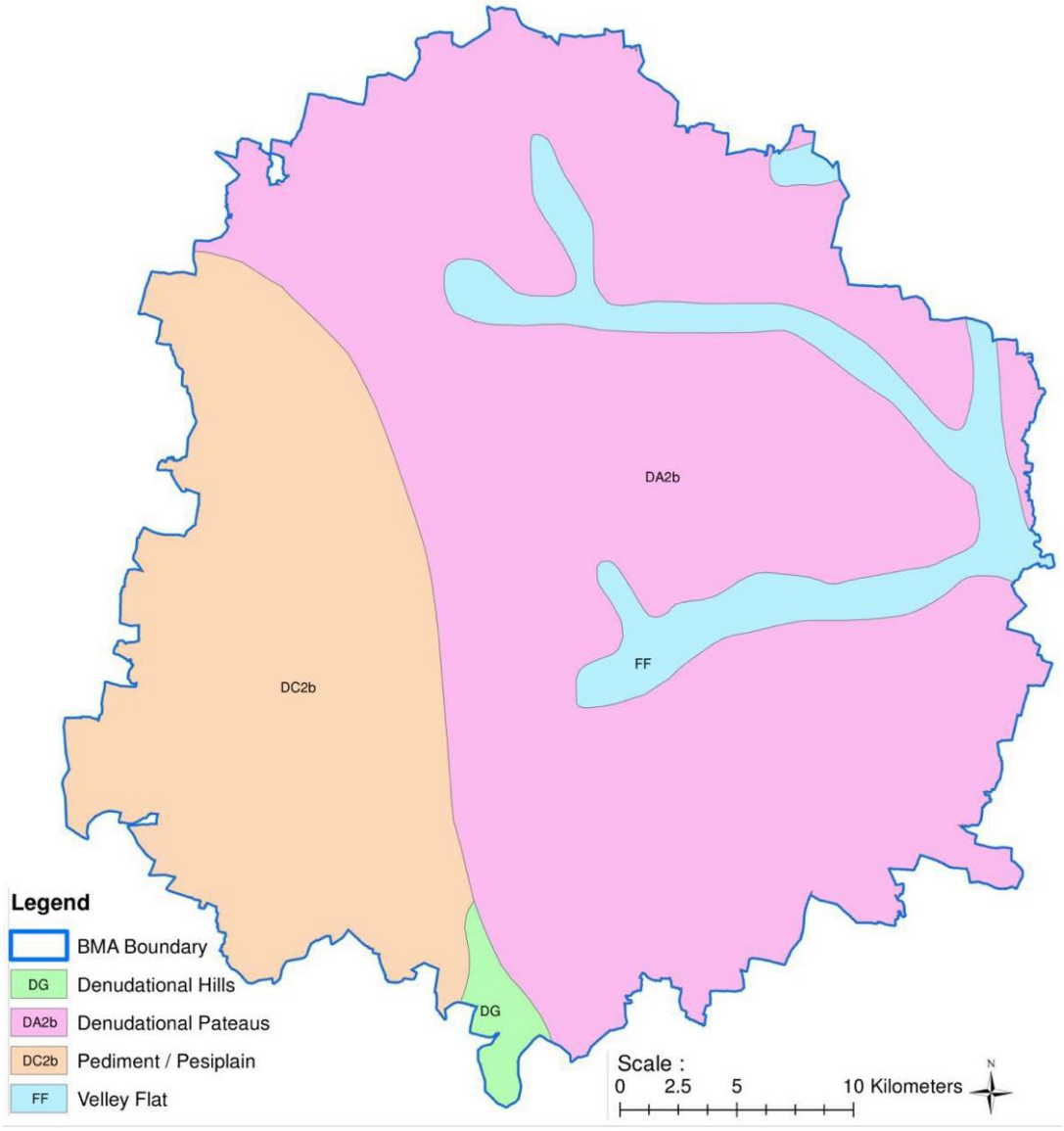
Source: District Resources Map, Geological Survey of India (2000)

Physiographic Character of BUD can be defined as plateau (as it is part of Mysore plateau) and undulating terrain. Rocky upland, plateau & flat topped hills at a general elevation of about 950 above mean sea level (amsl) defines the Geomorphology of BUD. The major part is sloping towards south and south east forming pediplains interspersed with hills all along the western part. The pediplains form the majority of BUD underlain by granites and gneisses with the highest elevation of

850 to 950 m amsl. The pediplain constitute low relief area having matured dissected rolling topography with erosional land slope covered by a layer of red loamy soil of varied thickness.

The major drainages are Cauvery and Ponniar basins. The River Cauvery flows at a distance of approximately 100 km from BUD with its tributaries of Arkavathi and Kumudavathi draining in BUD and BMA. Further, Kumudavathi, Palar and Pinakini, the tributaries of Pennar River flow in the NE part of BUD. The pediplains is dissected by streamlets flowing in southern direction. (Refer Figure 8-8)

Figure 8-8: Geomorphological Map of BMA

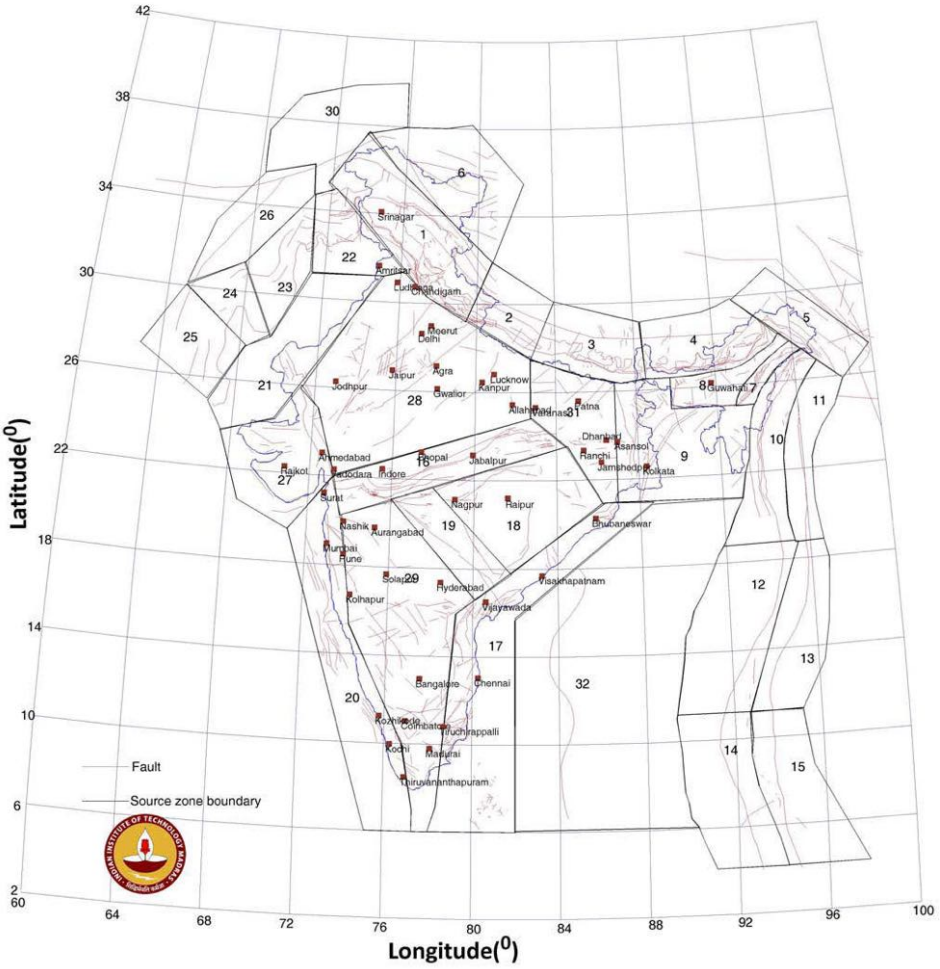


Source: District Resources Map, Geological Survey of India (2000)

8.2.1 Geo Technical Characteristics (Seismicity)

As per Final Report on Development of Probabilistic Seismic Hazard Map of India (PSHMI), by National Disaster Management Authority (NDMA), 2010, there are thirty two seismic zones of India (Refer **Figure 8-9**). Bengaluru city falls under Zone No. 29 called as Southern Craton. As per PHSMI report, Southern Craton has received 45 earthquakes and this zone has max potential of magnitude upto 6.8 Mw scale. Further, PHSMI report has carried out probabilistic analysis for 48 cities in India including Bengaluru by computing peak ground acceleration (PGA) over 500, 2500, 5000 and 10000 years. According to PHSMI report Bengaluru has relative seismic hazard at 0.02, 0.04, 0.05 and 0.06 PGA (g) respectively, which puts Bengaluru relatively the safest among the other cities.

Figure 8-9: Thirty Two Seismic Zones of India



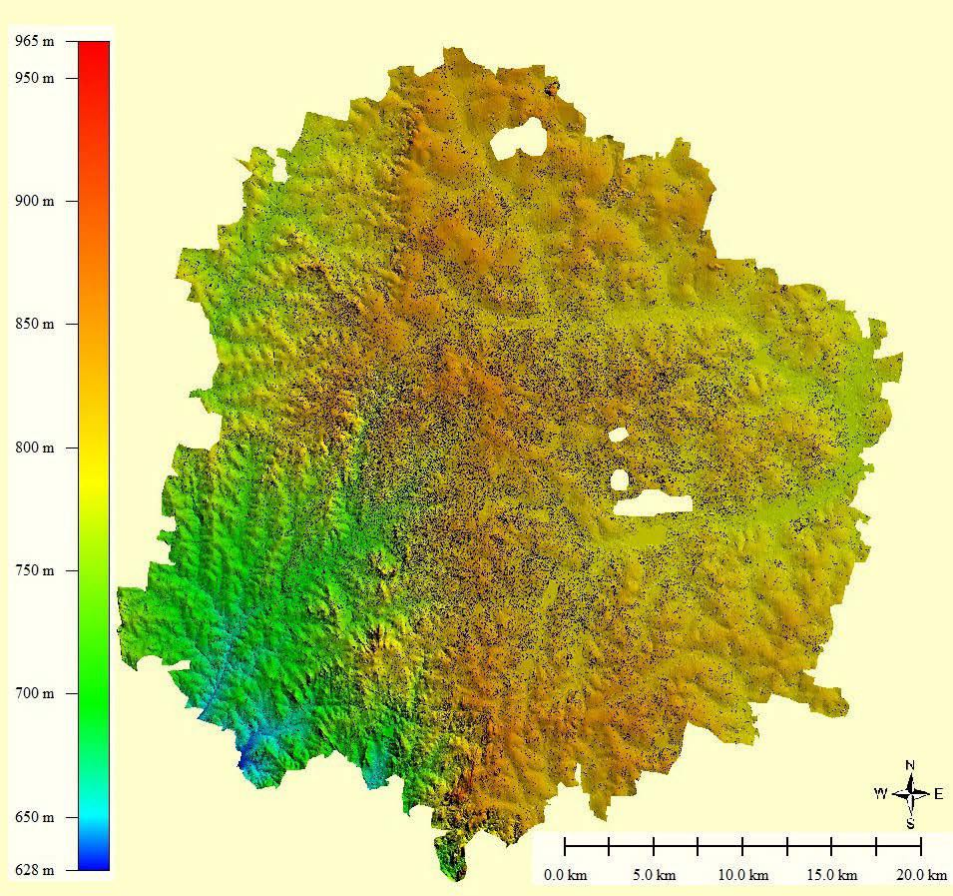
Source:
http://www.hpsdma.nic.in/Development%20of%20Probablistic%20Seismic%20Hazard%20Map%20of%20India.pdf,

The planning area is under the Seismic zone II making it least seismically active and low risk zone[15]. The geomorphological characteristics of granite and gneiss rock types along with the geotechnical characteristics of Seismic Zone II indicate that the planning area is conducive to vertical development such as high rises with adequate safety measure installed in high rise structures.

8.2.2 Topography & Contours

As part of preparation of RMP 2031, using high resolution satellite imagery, Digital Survey Model (DSM) map and Contour map of the planning area have been generated to study the topography. **Figure 8-10** presents the DSM map for BMA, which clearly depicted that the central ridge runs along North-South of BMA and the major valley is sloping towards the East and the Vrishabhavathy Valley is along the SW of BMA. **Figure 8-11** presents the Contour Map of BMA. The DSM and the Contour map can be utilised while proposing and planning infrastructure such as road and drainage system and for delineation of sensitive zones such as catchment and buffer areas of natural drainage and lakes.

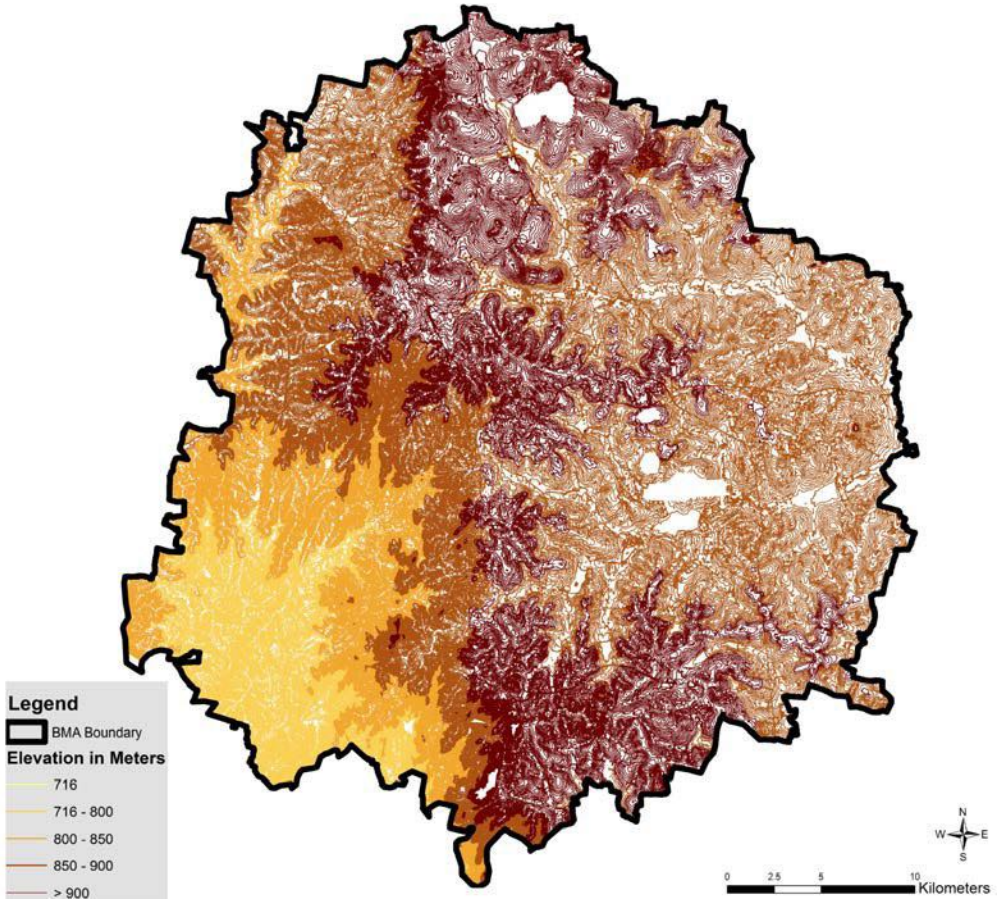
Figure 8-10: Topography (Digital Surface Model) of BMA



Source: Satellite Image (2012) and RMP 2031 Analysis, 2015

[15] More details of the geotechnical characteristics and natural hazard is included in Part VIII-Report on Hazard & Vulnerability Survey and Assessment

Figure 8-11: Contour Map of BMA



Source: Satellite Image (2012) and RMP 2031 Analysis 2015

8.3 Environmentally Sensitive Areas

8.3.1 Forests

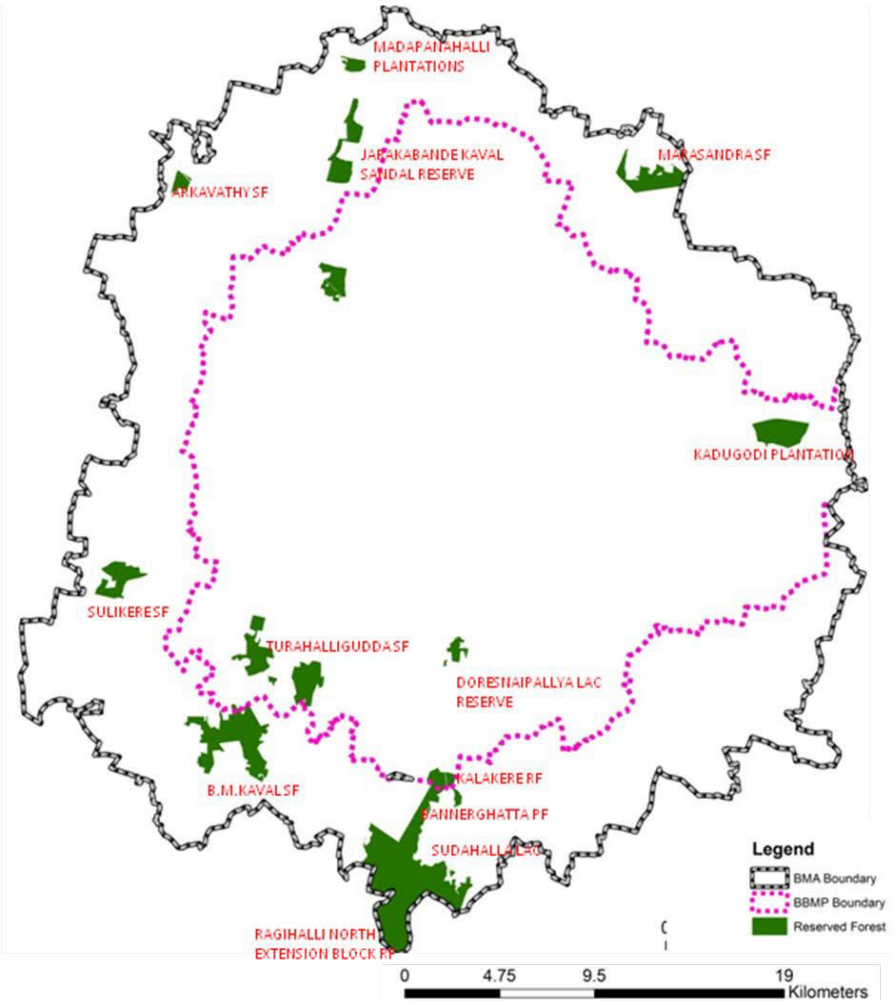
The Karnataka Forest Department (KFD) is the state department for forests in Karnataka. The total forest land in Karnataka State is 43,356.47 SqKm [16]. The BUD admeasures a geographical area of 2190 SqKm[17], out of which areas under forest is 122.26 SqKm Thus, only 5.5% of the BUD is under forests. The percentage of forest comes to only 2.28% of the BMA[18]. BMA falls under the Bangalore Urban Forest Division of the KFD which has 3 subdivisions, namely, Bangalore North Subdivision, Bangalore South Subdivision and the Lakes Subdivision.

Most of the forests in and around Bangalore now stand degraded due to biotic factors and they are classified as Dry Deciduous Scrub type (DS1). These forests are found at Govindapura, Kadugodi,

[16] Annual Report 2013-2014 of Forest Department, Gok. However, the area under forests by the the Reconstituted Expert Committee 1 of KFD reports 43356.94 sq.km.
[17] Annual Report 2013-2014 of Forest Department, Gok and the Reconstituted Expert Committee 1. However, the BUD admeasures a geographical area of 2174.1 sq.km. as per Plan for Bangalore Urban Forest Division 2002-03 to 2011-12; KFD.
[18] Existing Land Use 2015

Mandur, B.M. Kaval, Turaligudda, Jarakabande, Jarakabande Sandal Reserve, Marasandra, Kumbaranahalli, Madappanahalli and Doresanipalya. In most of these places, monoculture plantations of Eucalyptus and Acacia auriculiformes have been raised in the past. However, Bannerughatta National Park/ Forest has different characteristics.

Figure 8-12: Forests Areas within BMA



Source: KFD and RMP2031 Analysis, 2015

8.3.2 Eco –Sensitive Zone of Bannerghatta National Park (BNP)

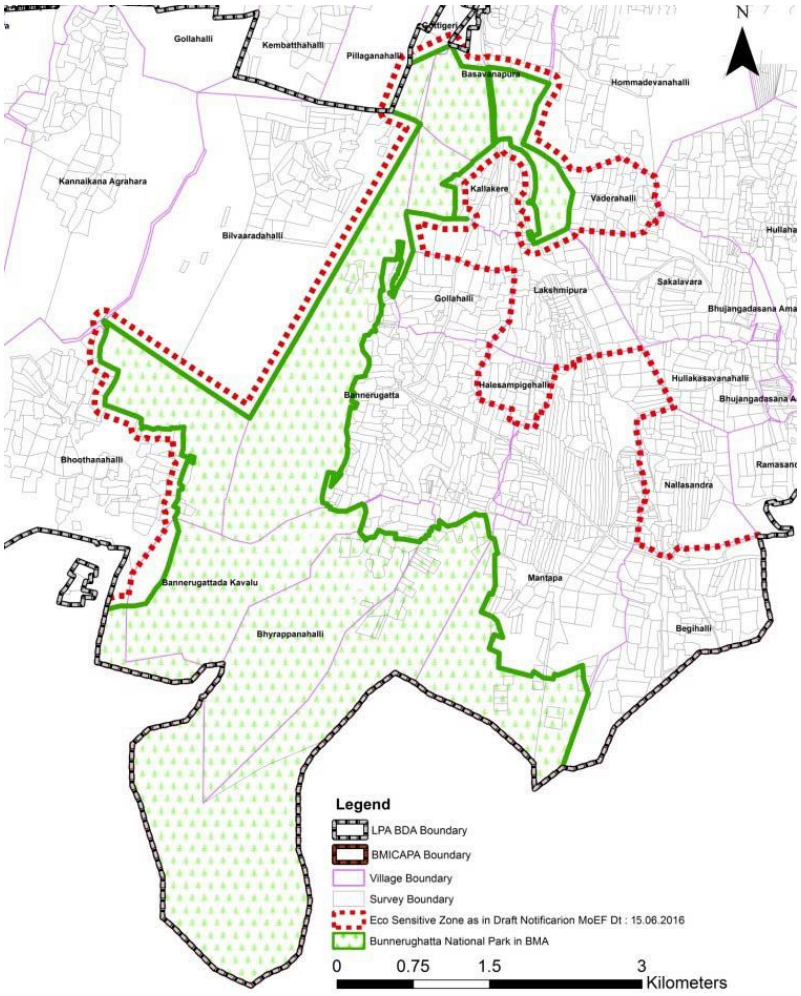
Bannergahatta National Park (BNP) and Bannerghatta Reserve Forest admeasures ~260.51 sq.km. and is spread over BUD and BRD. BNP is the northern tip of this Mysore Elephant Reserve with rich faunal and floral diversity and ~15.89 sq.km. falls within the LPA of BDA and some in the LPA of BMICAPA.

To protect the wildlife, their habitat and its environment, the provisions of Wildlife Protection Act, 1972 and The Environment (Protection) Act, 1986 and the Supreme Court Decision mandates declaration of Eco-Sensitive Zones (ESZ) around the Protected Areas. The Ministry of Environment and Forest, (MoEF) GoI, in year 2007, issued Guidelines for Declaration of Eco-Sensitive Zones National Parks and Wildlife Sanctuaries. The guidelines acknowledge the fact of various existing

developments in the vicinity/ near boundaries of protected areas and has provided the flexibility to define Eco-Sensitive Zones which can extend upto 10km looking into the ground realities.

As per the draft notification issued by the MoEF & CC dated 15.06.2016 states that BNP is an area of high floral and faunal diversity and also an important watershed area through tributaries that join the Cauvery River. Thus, it becomes imperative to protect and conserve the area as an Eco-Sensitive Zone from ecological and environmental view to protect wildlife and their habitat. It states that all activities in the Forest block areas (both within and outside Municipal Areas) shall be governed by the provisions of the Forest (Conservation) Act, 1980 (69 of 1980) and all the activities in the Protected Areas (National Park) shall be governed by the provisions of the Wild life (Protection) Act, 1972 (53 of 1972). Further, buffer extant vary from 100 meter to 4.5kms around the boundary of BNP and is declared as BNP Eco- Sensitive Zone. As per the notification the zone covers 268.96 sq kms. This zone covers 77 villages, 17hamlets and is spread across BUD and BRD. However, the extent of this Eco-sensitive zone within the LPA of BDA and extent of ESZ is such that some of the survey numbers are covered in full, and others are partly falling in the buffer zone. Figure 8-13 depicts the extents and of ESZ of BNP.

Figure 8-13: Extents of Eco-Sensitive zone of Bannerghatta National Park in BMA



Source: Draft notification MoEF & CC dated 15.06.2016 and RMP 2031

8.3.3 Historical Trees

KBB has initiated a program to identify certain trees in various districts which are unique, historical and have high significance. The same will be considered for declaring as Heritage Trees. KBB has recommended the following trees within BUD to be declared as Heritage trees under section 63 (2) (i) of the Biological Diversity Act 2002. **Table 8-2** presents trees declared as heritage trees by the board.

Table 8-2: Heritage trees by Karnataka Bio Diversity Board

S.No	Scientific Name	Location	Girth(m)	Height (m)	Age
1	Ficus Bengalensis (Doddaalada Mara) (Doddaalada Mara)	Kethohalli, in BMA	-	30	400 years
2	Araucaria cookie	Lalbagh Bangalore	7	50	140 years

Source: Annual Report 2012-13, Karnataka Biodiversity Board

8.3.4 Historical gardens in BMA

Lalbagh botanical gardens and Cubbon Park mark the two major lung spaces of the city. The central and south Bengaluru were structured around these large gardens.

Lal Bagh: Established in 1776 by Hyder Ali and further developed by his son Tippu Sultan, it was initially meant to be a private garden designed in the Moghul style. In terms of area, Lal bagh spreads across 97 Ha. It holds rare plants added by Tippu Sultan in the 18th century from Turkey, Mauratius, Persia and Afghanistan. Some trees over 100 years old still exist. Some of the exotic species introduced from different parts of the world include largest specimen of Kopak tree also called Ceiba pentandra, it is a tropical tree of the order Malvales and the family Malvaceae , native to Mexico, Central America and the Caribbean, northern South America, and to tropical west Africa. Cupressses or Cypress native to scattered localities in mainly warm temperate regions in the Northern Hemisphere, including western North America, Central America, northwest Africa, the Middle East, the Himalayas, southern China and northern Vietnam. It has rare tropical and sub tropic plants like the gymnosperms or early trees which are a group of seed-bearing plants that includes conifers, cycads, Ginkgo and Gnetales. In addition, a number of ornamental and economic plant species both of exotic and indigenous origin can be found in Lalbagh. Take a walk around the lake and you may come across herons, egrets, kingfishers, coppersmiths and even pelicans if you are lucky. These are only some of the close to 50 types of birds which are regular visitors here. Other birds in the city include Common Iora. Yellow-wattled Lapwing,B lack Kite, Ashy Prinia, Large-billed Crow, Green Bee Eater,Rose-ringed Parakeet, Different types of bulbul, Black Ibis, Spotted Dove, White-throated Kingfisher, Pied Bushchat, Black Drongo, Oriental Magpie Robin, Common Hoopoe, Greater Coucal, Red-wattled Lapwing, Plum-headed Parakeet, Asian Koel and Ashy Woodswallow. Also Lal Bagh is the most visited tourist destination in 2014 as per GoK Tourism department statistics.

Cubbon Park: The Cubbon Park has a history of over 100 years. It was established in the year 1870 by Sri John Meade, the then acting Commissioner of Mysore. The vast landscape of the park was conceived by Major General Richard Sankey, the then Chief Engineer of the State. As a mark of honour to Sri John Meade, the park was initially named as "Meade's Park" and subsequently it was called the Cubbon Park. Since the inception of the park, it was developed and improved by adding new structures and features. In the year 1927, the park was officially renamed as "Sri Chamarajendra Park" to celebrate the Silver Jubilee of Sri Krishnaraja Wodeyar's rule in Mysore State. Cubbon Park is under the control of the Department of Horticulture. The Deputy Director of Horticulture (Cubbon Park) is responsible for the administration and maintenance of the park. The park has about 68 genera and 96 species with a total of around 6000 plants / trees growing in its locale. The Gulmohar trees and massive clumps of bamboo add a distinct identity to this large lung space.

8.3.5 Conservation Zones along Arkavathi River and Thippagondanahalli Reservoir

Arkavathi River flows from the north west of the BMA to converge at the Thippagonadanahalli (T.G.Halli) Reservoir at the western side of the BMA. As per G.O. No. FEE 215 ENV 2000 dated 18.11.2003, Bangalore. Under Section 18 (I b) of the Prevention and Control of Pollution Act, 1974 and 1981, the GoK declared the catchment area of Thippagondanahalli (T.G. Halli) as a "regulated zone". This means the industries that have come up in the catchment area will not be allowed to let their waste flow into the reservoir. Future development in the catchment area is restricted. BMA falls under the regulation area of Zones 1, 3 and 4. The regulations of Conservations zones along Arakavathi are given in Table 8-3.

Table 8-3: Regulations of Zones of Arkavathy and T.G. Halli Buffer Areas

Zones	Area Covered	Nature Of Restrictions/ Regulations
Zone 1	Entire Thippagondanahalli Reservoir (TGR) Catchment	• Regulation and checking of over exploitation of ground water. • No fresh licenses for quarrying& stone crushers • No disposition of solid or liquid waste without scientific processing. • Adoption of rain water harvesting (RWH) for existing & new buildings. • Promotion of organic farming including bio-pesticide and biofertilizers
Zone 3	Area covered within 1 km distance from the river banks of Arkavathi river (only upto Hessargatta tank from TGR) and Kumudavathi.	• No person shall carry on activities other than agricultural or agricultural related activities without prior permission.

Zones	Area Covered	Nature Of Restrictions/ Regulations
Zone 4	Area covered within 1 km to 2 km distance from the river banks of Arkavathi river(only upto. Hessargatta tank from TGR) and Kumudavathi (excluding the area within Zone 2)	• Permit only those industrial activities which are listed under the Green category by the KSPCB. • Adoption of RWH & waste water treatment facilities • Consent for Establishment to be obtained by KSPCB. • Permit G - G+1 new buildings- RWH.

8.4 Natural Drainage System and Classification of Streams

8.4.1 Natural Drainage System

Watershed: Watershed is a geo-hydrological unit of all land and water within the confines of drainage divide which contributes runoff to a common point. It is a land area that captures rainfall and conveys the overland flow and runoff to an outlet in the main flow channel.

The major drainages in the BUD are the Cauvery and the South Pennar basins[19]. BMA by its N-S ridge is drained by rivers Arkavathy on the west and South Pennar or South Pinakani River to the east. Arkavathy River is a mountain river originating from Nandi hills which is further north of the BMA boundary and is a tributary of Cauvery River. Arkavathy joins Cauvery River at 34 kms south of Kanakpura outside the boundary of BMA. Additionally, Kumudavathy and Vrishabhavathy rivers are tributaries to the Arkavathy. The two catchments of Arkavathy and Pennar rivers (**Figure 8-14**) are further divided to four main watersheds in BMA which form separate and distinct drainage zones.

The Arkavathy River in the Arkavathy catchment is a tributary to the Cauvery River and flows in N-S direction. Its drainage pattern is trellis to sub-dendritic and it has high drainage density mainly due to a higher density of first order streams with lesser lengths and is dotted with number of mounds, hills and possesses only small sized tanks to the south west. The Arkavathy catchment is divided into two watersheds, namely,

- the Kumadavathy or upper Arkavathy watershed along the north west of BMA and the
- the Lower Arkavathy watershed along the south west of BMA

The two main tributary systems are flowing from North east to South east direction and the other from east to west and confluence each other at Mysore road. The eastern area of BMA comes under the Upper Pennar watershed and South Pennar watershed. The **Figure 8-15** presents the four watersheds in BMA. The lower Arkavathy watershed comprises of the Vrishavabhavathi valley. The Vrishabahavathy River originates at the Bull temple and flows further from the south of BMA where it joins the Cauvery River.

[19] The South Pennar river of Ponnaiyar basin takes its birth from Nandi hills and flows towards south.

Figure 8-14: Two Catchments in BMA

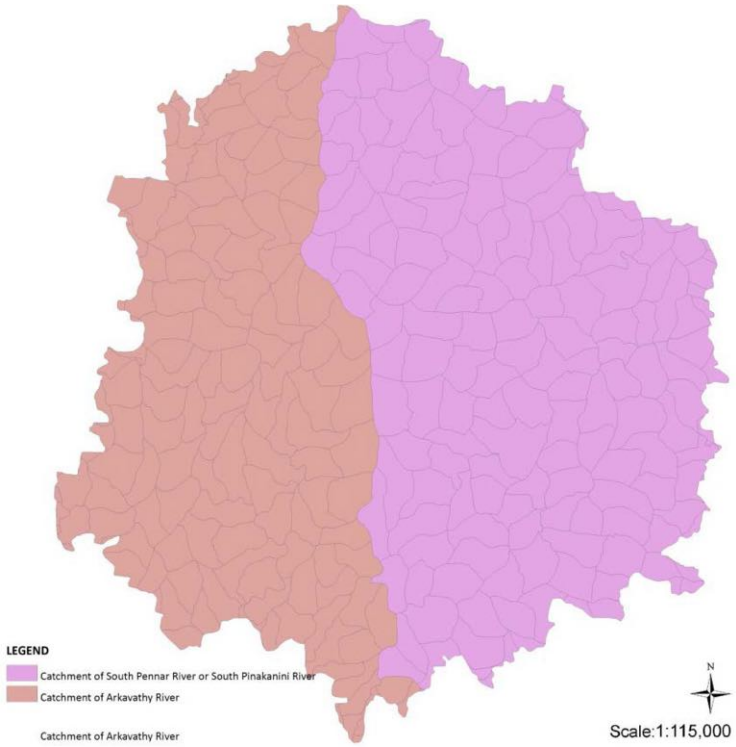
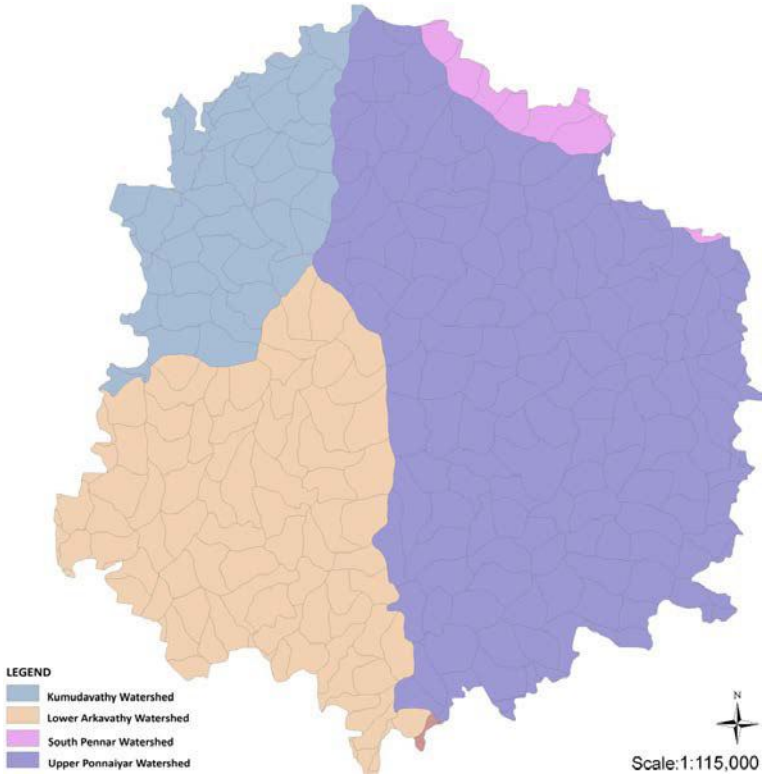


Figure 8-15: Four Major Watersheds in BMA



Source: Karnataka State Remote Sensing Application Centre, GoK, 2015

Lakes & Valley System: In the eastern part of BMA is the **Upper Pennar watershed and South Pennar watershed**, there are two major drainages, namely one is from Yelahanka flowing south easterly and the other from Sarakki area. These two watersheds constitutes the **Hebbal valley** to the north is characterized by first and second order stream, and the Bellandur valley to the south east where the streams passes on to third order. The Bellandur valley system further has the Challaghatta sub valley and Koramangala sub valley. The rainfall in BMA due to its N-S ridge gets divided and flows down to the east or west over the valleys of gentle slopes of Vrishbhavathy, Hebbal and Koramangala & Chalaghatta.

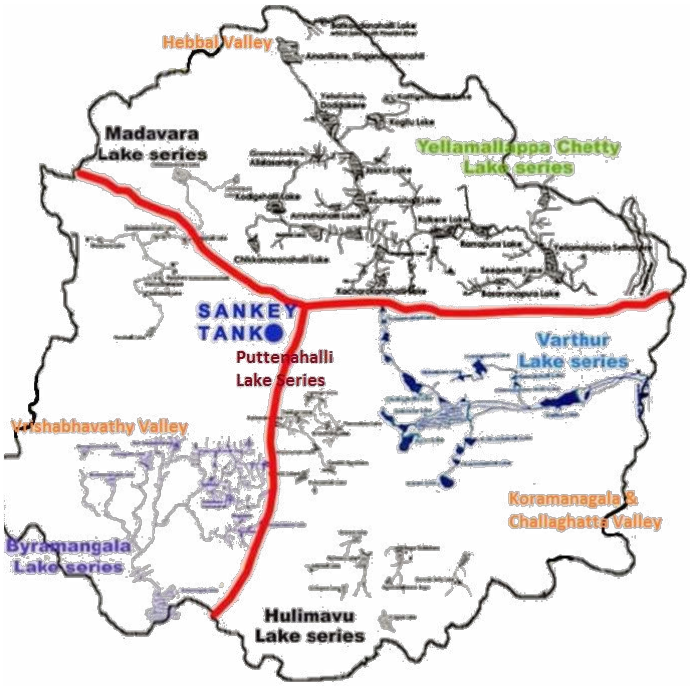
Five minor valleys, the Kathriguppa and Tavarekere to the south, the Arkavathi and Kethamaranahally to the northwest and Marathhally to the east, lie outside the tributary area of the major valleys and they drain independently to the fringe areas. The configurations of valleys in well graded side slopes of their tributary areas have provided Bangalore with a natural system of drainage without resource to pumping. Both sewage and storm water flows by gravity beyond the city. It is noteworthy that each of the valley systems, comprise of system of lake series that are essentially formed by interlinking / cascading lakes or tanks to one another through natural streams/ drains. **Figure 8-16** presents the valley system and their respective lake series in BMA. The valley systems and their respective lake series are as following:

a) Hebbal Valley: Yellamappachetty Lake Series and Madvara lake series

b) Koramangala and Challaghatta Valley: Varthur Lake Series, Puttanahalli lake series, Hulimavu Series

c) Vrishbhavathi Valley: Byramangala lake Series

Figure 8-16: Lake Series in the Valleys of BMA



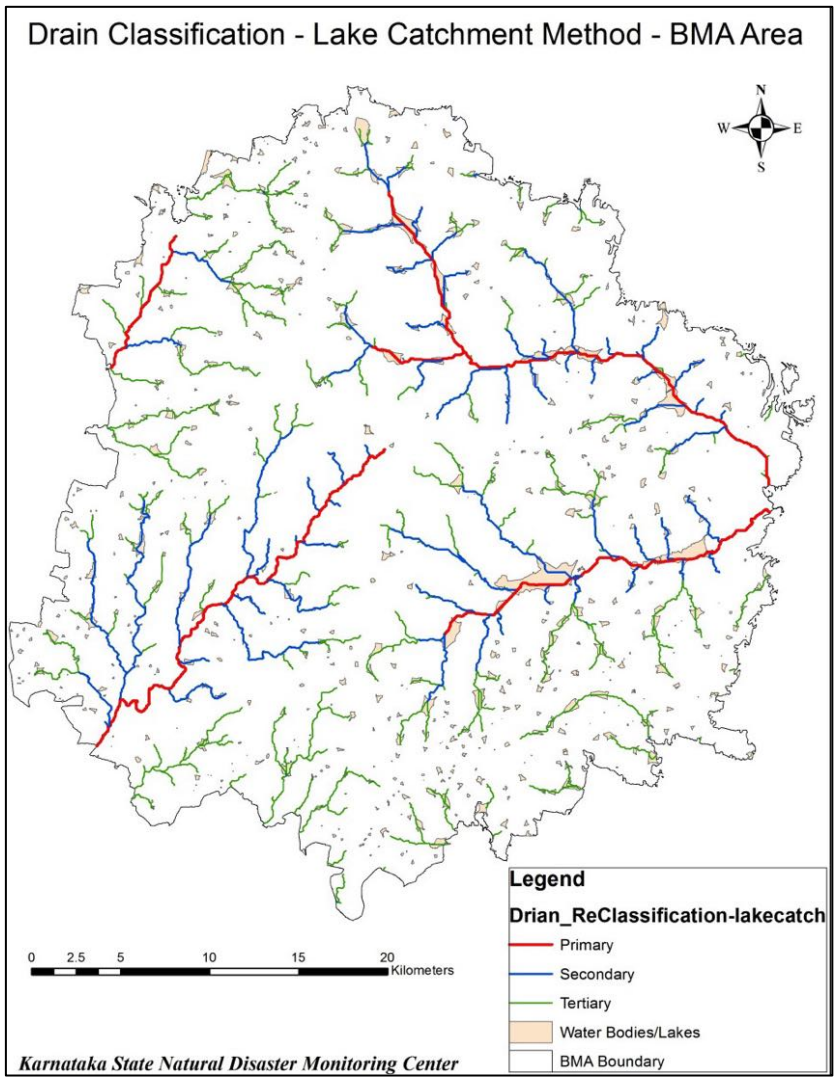
Source: KLCDA

Thippagondanahalli Reservoir: Another important physical feature relevant to the context of natural drainage in BMA is the Thippagondanahalli Reservoir[20] (TGR) is located at the confluence of the Arkavathy River and Kumudavathi River, 35 km westwards, outside the BMA boundary. This man-made reservoir built in 1933 has a catchment of 1453 sq.km and covers parts of Doddaballapur, Nelamangala, Devanahalli, Magadi and Bangalore Taluks. The water body used to act as a source of drinking water for western part of Bangalore supplying up to 117MLD, but at present the source has been abandoned due to much decreased inflow to the TGR.

8.4.2 Natural Drainage Classification

The application of buffers as prescribed by National Green Tribunal is dependent on the classification of streams/ natural drainage, namely – Primary Stream, Secondary Stream and Tertiary Stream. RMP 2031 using the DEM and GIS based software has classified the natural drainage system in consultation with KSNMDC for BMA. **Figure 8-17** presents the Drainage Classification for BMA.

Figure 8-17: Drainage Classification



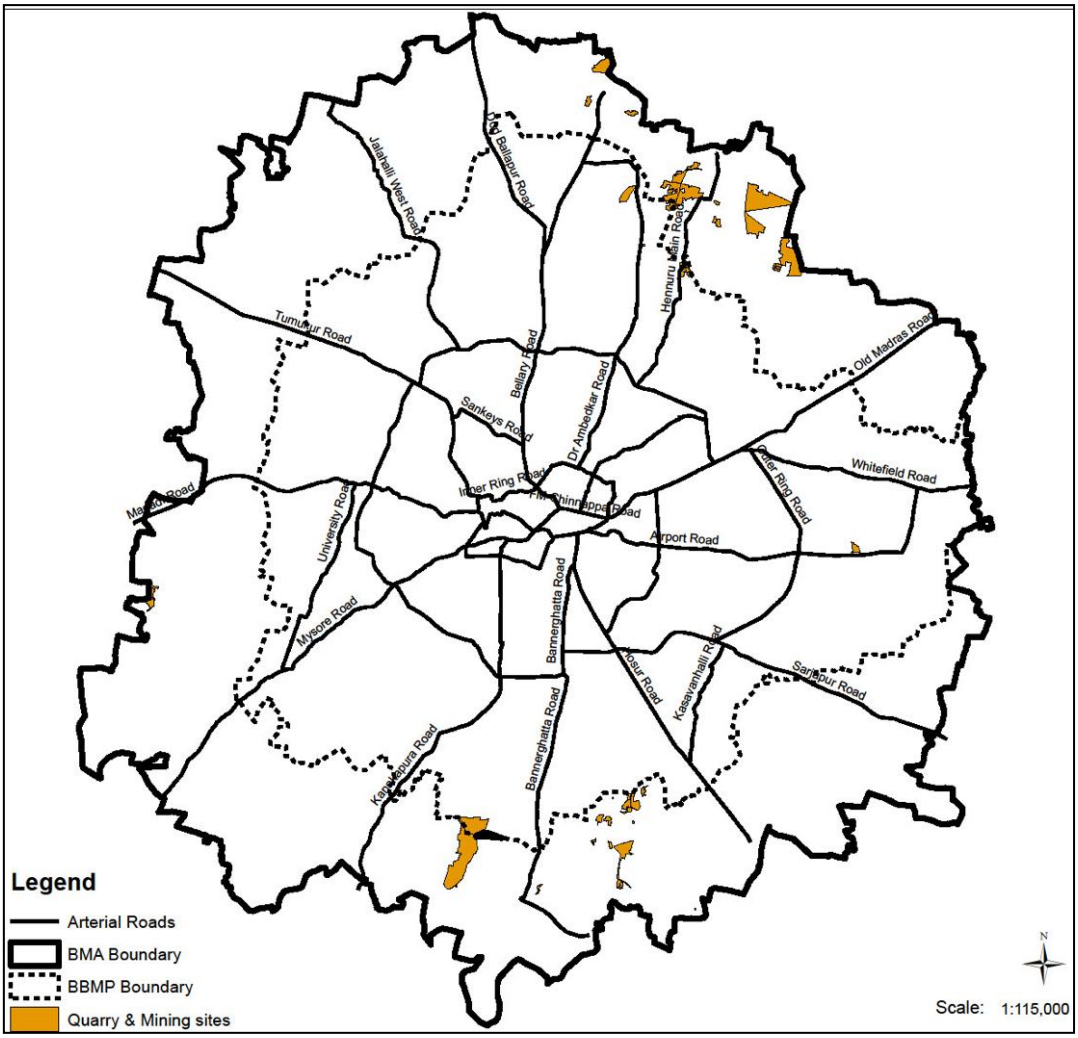
[20] Thippagondanahalli Reservoir is also known as T.G.Halli Dam and Chamaraja Sagar.

The natural drainage so classified was translated to ground situation using Base Map prepared for RMP 2031. The buffers, as prescribed by National Green Tribunal, have been applied to streams/ drainage accordingly for preparation of Proposed Land Use Map.

8.5 Mining and Quarrying Areas within BMA

BUD does not contain minerals of sufficient commercial value. Nodular concentrations of lime canker are found as secondary products in many places in the gneissic regions. Graphite is observed to occur as crystalline flakes near Chikkabanavara. Mining activities are rampant in BMA where quarrying of building stone (granite) and brick earth are active. Based on list of licensed quarrying/ mining sites, procured from the Department of Mines and Geology, GoK, and Satellite Imagery 2012 (provided by BDA), the existing stone quarrying sites/ locations within BMA have been mapped. **Figure 8-18** presents the location & extent of mining/ quarrying activities within BMA.

Figure 8-18: Map showing Location of Mining and Quarrying Sites in BMA



Source: Department of Mines and Geology, GoK.

The mining activities though scattered are predominantly concentrated in North East quadrant of BMA (areas between Bellary Road, Hennur Main Road and old madras road and along the BMA periphery) as well as in southern side (in proximity of Bennerghatta National Park and within the 2km buffer zone promoted by Forest Department, GoK). Quarrying and mining activities add to air pollution like dust, smoke, noise, etc. Airborne particulate matter is the main air pollutant associated with mining.

8.6 Environmental Pollution

Environmental Pollution refers to the contamination of the natural environment which has adverse direct effects on the physical environment like air, water, soil and also has negative impacts on health, socio-economic conditions of humans. Most of our air, water and soil resources are gradually becoming polluted due to the addition of foreign materials from the surroundings. These include organic matter of plant and animal origin, land surface washing, industrial and sewage effluents and vehicular emissions. Rapid urbanization and industrialization with improper environmental planning often has lead pollution and depletion of the environment. This section discusses on air, noise, water, and soil pollution in the context of BMA. For all forms of pollution the sources can be classified into two types:

1. **Point Source:** Contamination is introduced into the environment from a single area
2. **Non-point Source:** Contamination is introduced into the environment from multiple/ large area

8.6.1 Air Pollution

Air pollution is a major hazard that has been growing steadily in Bengaluru. The increased number of vehicles on road, industrial activity, construction activity, poor quality of roads and dust on road add to the suspended particulate matter in air. There are more than 67 lakhs vehicles registered in Bengaluru (March 2017) and there has been a consistent increase in the vehicular population at an average rate of 8% per annum. Old vehicles with worn out engines, adulterated fuels, and slow moving traffic lead to increased emissions. The total emissions in 2015 due to vehicular traffic is estimated at 196 tonnes of CO per day, 50 tonnes of HC per day, 9 tonnes of SPM per day, and 321 tonnes of NOX per day[21]. The increasing vehicles as can be seen have a direct correlation to increasing levels of air and noise pollution. Reducing the number of private vehicle trips, and increasing public transport share is expected have a positive impact in reducing the emissions due to vehicular traffic. The vulnerabilities of air pollution include people living along the major roads, travellers, pedestrians and especially children and the elderly. Mining and quarrying acitivities within BMA are also adding to air pollution.

8.6.2 Noise Pollution

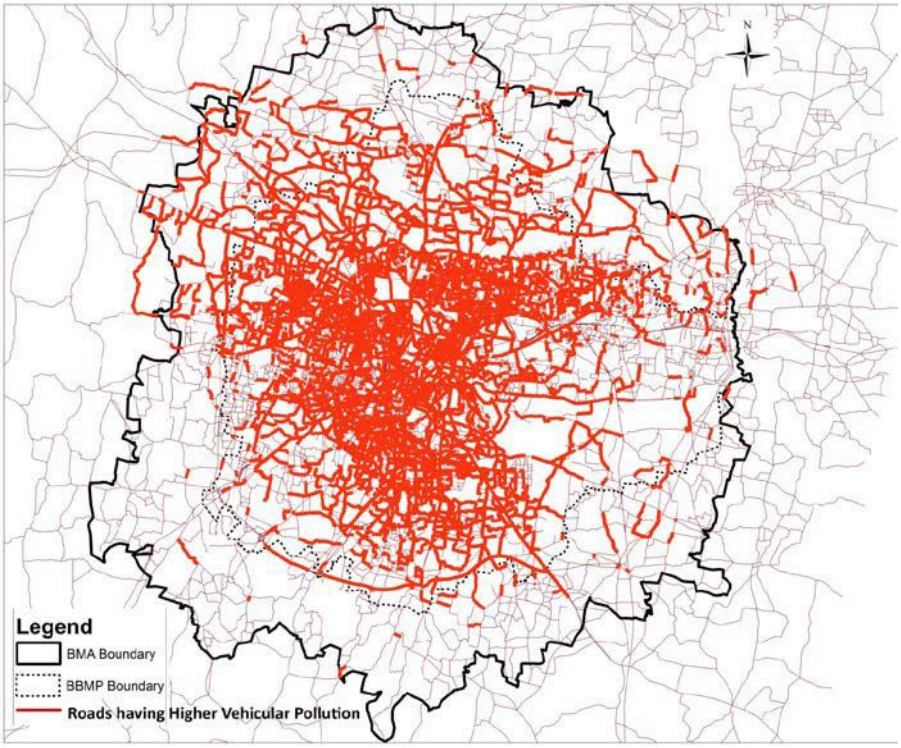
Another important source of pollution in Bangalore is of excessive noise. The sources of Noise pollution can be attributed to Vehicular traffic, Flying aircraft near airports (four air funnels are

[21] Estimation is based on Urban Transport Modal built for RMP 2031.

operational in city at present – highest in any Indian city), Drilling of bore wells, Industries, Construction activities, DG sets, Public address systems playing loud music during festivals, etc.

Noise levels and frequencies were monitored by the Central Pollution Control Board (CPCB) at important locations of the city to assess the magnitude of noise pollution. The study has revealed that noise levels in a silent zone around Victoria Hospital near City Market are far higher than permissible. The sound levels during the day (6 am to 10 pm) were as high as 64 to 79 dB (A) as against the permissible limit of 45 dB (A). At night (10 pm to 6 am) the levels ranged between 58 and 70 dB (A) as against the permissible limit of 40 dB (A). Noise levels were also recorded inside the wards where they varied from 65 to 70 dB (A). The wards are located a km away from the busy Mysuru – Bengaluru Road. As such, there is significant movement of traffic to and fro from the market creating noise. More or less the same situation exists in other sensitive zones where hospitals are located. The number of stations for monitoring Noise Levels are limited in BMA and Traffic is the major contributor of noise pollution in Bengaluru. The transportation model has given several locations with high congestion level within the BMA and is presented in **Figure 6-7**. It is perceived that some of the junctions with high congestion level are attributing to high noise levels. For example – only on outer ring road (61km stretch) there are 14 locations with high congestion level and are perceived to have high levels as well. The junctions within higher congestion level on outer ring road include a) Kundanahalli junction, b) Doddanakundi, c) Hennur junction, d) Nagavara Junction, e) BEL circle, f) Gorguntepalya, g) Subhash Chandra Bose junction, h) Sumanahalli, i) Devegowda Petrol Bunk junction, j) Sarraki Junction, k) Silk Board, l)HSR layout 27 th Main Junction, m) Tin factory and n) Hebbal. Figure 8-19 represents the roads having velocity to capacity ratio more than 1 which indicates that these roads are congested and having higher vehicular pollution.

Figure 8-19: Traffic Congestion (2015)



Source: RMP 2031 Transport Model

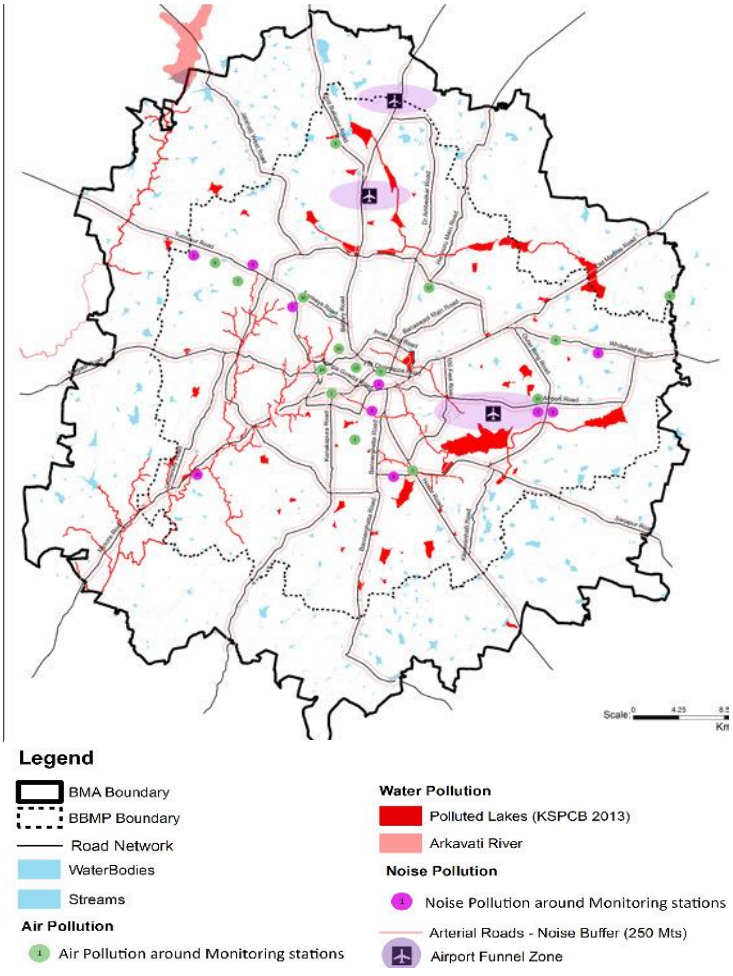
8.6.3 Water Pollution

Pollution of surface and groundwater is prevalent in Bengaluru. The rivulets Arkavathy, Vrishbhavathy, along with the lakes and the natural streams are highly polluted due to inflow of sewage, industrial effluents and municipal waste. The Dissolved oxygen (DO) level in lake waters is decreasing indicating organic pollution load leading to a phenomenon called eutrophication. Untreated Sewage flowing into lakes cause the lake to decay, and loss of aquatic life. The people living around the polluted lakes are very vulnerable as the area in the vicinity of the lake is covered in foul smell emanating from the lake. The froth and smell affects the commuters and the water pollution has led to ground water getting polluted in the area. Ground water in BMA is polluted due to sewage pollution and industrial pollution, over exploitation of ground water resources and high Nitrate concentration in ground water.

8.6.4 Mapping Pollution Hotspots in BMA

RMP 2031 based on various secondary sources, has mapped the spatial locations of various elements of environmental pollution within BMA and is shown in Figure 8-20.

Figure 8-20: Environment Pollution Hotspots (2015)



8.7 Mater Plan Proposals and Strategies

RMP 2031 has following proposals and strategies to improve the environment of BMA

1. Preparation of Ecology Master Plan for BMA: RMP 2031 proposes that Ecology Master Plan shall be prepared for entire BMA.
2. Development of Environmental Health Monitoring System: RMP 2031 proposes that a common digital data base for all environmental aspects and assets are developed and monitoring of health of lakes and streams.
3. Development of Public Transport System (discussed in Chapter on Traffic and Transportation) Transportation proposals aimed at increasing public transport share to 60-70% and development of Non-Motorised Transport. This would help in reducing air pollution and noise pollution.
4. Improving Green cover: A multipronged strategy is proposed to increase green cover within the BMA which includes
    a. Development of Large Regional Parks across BMA
    b. Block Plantation
    c. Tree Planting mandatory for every development
    d. Landscaping Plan mandatory for certain developments (as defined in Zoning Regulations)
    e. Plantation along Lakes and Streams
    f. Avenue Plantation on all Master Plan Roads
    g. Protection of Forest – clear demarcation of Forest Extents
5. Protection and Conservation of Lakes & water bodies
    a. Lakes considered in Master Plan to be marked in land use
    b. Clearly Defined Streams Network
    c. Protection of Valley System
    d. Guidelines for developments adjoining lakes and water bodies
    e. All New Layouts/ Apartment Complex's/ Commercial Spaces/ Government Buildings/ to follow zero discharge concept and implement dual pipeline system. Reuse of Grey Water mandatory.
    f. Rainwater Harvesting and Other Ground Water Recharge Techniques
    g. All red category industries to be shifted outside BMA
6. Air & Noise Pollution
    a. Banning of Mining Areas/ activities within BMA
    b. Provision of land for Truck Terminal/ Logistic Hubs. Once developed restriction on entry of heavy vehicles in to city centre to be imposed.

c. Insisting Traffic Impact Study for Large Scale Developments

d. Regulations for Installation of Recharge Points for Battery Operated Vehicles

e. Assigning land for Solid Waste Collection Centres, Transfer Stations, Treatment Plants

f. Energy Conservation:

g. Assigning land for Waste to Energy plants

h. Rooftop solar plants for public building, residential, institutional and commercial buildings as prescribed

i. Charge Points for Battery operated vehicles

9 HOUSING, REAL ESTATE ASSESSMENT AND ADDITIONAL LAND REQUIREMENTS FOR 2031

9.1 Housing

9.1.1 Existing Housing Situation

Bangalore's urban growth has spurred an overwhelming demand for housing owing to the large concentration of jobs and opportunities in the city, and this is at the centre of several of the development challenges that the city faces. Although the Bangalore Development Authority and Karnataka Housing Board have developed several layouts and townships with accompanying infrastructure in different parts of the city, there has been a gap between the supply and demand thereby opening large avenues for private sector participation in this sector.

With an estimated slum population of about 10% of the total population, Bangalore is generally not perceived as a city of slums, but skyrocketing population and economic growth in the city over the last few decades has attracted large numbers of poor migrants seeking a livelihood in the city. The slums in Bengaluru, as in other cities, tend to be located in low-lying areas that are susceptible to inundation, quarry pits, tank beds, along railway lines etc. In the context of the above, the RMP 2031 places emphasis on affordable housing, including the recognition of slums as contributors to affordable housing stock.

The key parameters considered for the assessment of existing housing situation are summarized hereunder:

a) **Existing housing stock:** The housing stock data for the BBMP and Outgrowth area as per Census 2011 shows nearly 21.04 Lakh Houses under residential uses and about an estimated 2.18 Lakh units were available in the form of vacant houses. It is important to highlight here that there were about 1.66 Lakh households without any exclusive room and an estimated about 1.40 Lakh households were living under the slums as per Census 2011 data. The housing stock for 2016 has been estimated at about 30.39 Lakh in the BMA area.

b) **Rental housing:** An increasing number of rented houses as a share of the total number of houses, a trend sharply observed in rural areas as well. Renting a house is seen as most convenient because of unaffordable land rates and long travelling distances. Nearly 60% of the households are dependent on the rental housing as per Census 2011.

c) **Decrease in household size:** Average household size in Bengaluru has decreased from 5.44 in 1961 to 5 in 1991 to 4.05 in 2011 and based on UN Headship Rate Method, it is projected to reach 3.89 by 2031.

d) **Decrease in dwelling unit size:** As there is a gap between income growth rate and real estate prices, there has been a reduction in the average dwelling unit sizes on the supply side under different categories to match affordability. The average size of a 2 BHK DU has decreased from about 122 Sqm to 108 Sqm during the period 2008-2009 to 2014-2015 and similarly the average size of DU for 3 BHK DU has shown a decline from average DU size of 183 Sqm to 143 Sqm.

e) **Economic Profile of Population and Projected Average DU Size:** Nearly 60% of the total housing demand is estimated to emerge in the affordable housing range (47% under EWS category and 13% in the LIG Category with projected average dwelling unit size of 30 sqm and 45 sqm respectively), whereas the balance 40% of the housing demand is from the middle and higher income categories (15% under MIG category and 25% in the HIG Category with projected average dwelling unit size of 80 sqm and 150 sqm respectively). It translates to an average dwelling unit size of about 70 Sqm.

f) **Slum Population:** With respect to slums in Bangalore, there is huge variation in data from different official sources. However, it can safely be said that Bengaluru's share of slum population is between 8-14% of the total population and considered at an average of 10% for the purpose of assessment. As per RAY data from DMA, there are 576 slums in the BBMP area. [Refer Figure 9-1 for spatial distribution of slums across BMA]

Figure 9-1: Spatial Distribution of Slums across BMA

g) **Existing Housing Gap:** The existing housing gap in 2015 is estimated at about 129998 houses considering the dilapidated and overstressed housing. It is important to highlight here that though the slum population is about 10%, the slums are also characterized by the access and availability of the services and not only the housing condition alone.

9.1.2 Characteristics of the Tracked Residential Market

A growing base of young professionals with rising disposable incomes and substantial global exposure, tracked market developments for a variety of uses from residential to commercial office space to retail to hospitality have become increasingly common in Bangalore. Bangalore has emerged as one of the most preferred residential locations in the country in terms of developments in the residential tracked market22. It must be noted here that supply in the tracked market is skewed towards higher income groups

With an increase in land prices over a period of time, taller buildings are being constructed in order to utilize the entire FSI and even applicable TDR. As such, apartments form 90% of the total under-construction housing supply. Considering increasing demand, land prices, construction cost and lag in the social infrastructure development in the city, the share of apartment projects in the total residential supply is expected to increase.

9.1.3 Additional Housing Demand for 2031

The additional housing stock for 2031 has been estimated considering the projected household size of 3.89 by 2031 and the estimated population of 2031. While projecting the future demand for housing stock, it has been assumed that 10% of the total housing stock would be available as vacant housing stock as per the past census trends in Bangalore. Considering the overall projection of nearly 20.30 million population in the two LPAs of the BMA (BDA and BMICAPA), the total housing demand has been estimated at about 57.00 lakh for the year 2031.

It is estimated that the total additional housing stock required for BMA would be about 26.80 lakh by the year 2031, out of which about 1.73 lakh would be provided under BMICAPA and the balance about 25.07 lakh would be within the LPA of BDA including the existing gramathan areas. It is estimated that about 5% of this demand would be met from the gramathan areas and the balance 95% would be the urban housing by the year 2031 within the LPA of BDA.

9.1.4 Additional Land Requirement for Residential Use by 2031

The following assumptions have been made for assessing the land requirement for residential use:

- Average DU size has been considered as 70 Sqm based on the assessment of real estate market trends and the economic profile of the population in Bangalore.

[22] For the purposes of this analysis, the "residential tracked market" refers to multi-dwelling apartment and villa projects with more than 10 units which are sold in the primary market. It does not include government housing projects and small scale independent developments

- Average FAR of 2 has been considered for the purpose of calculation of net residential land for the housing in the urbanisable area for RMP 2031 considering the pattern of existing development, which is predominantly in the form of plotted development, utilising an average FAR of 1.5 and the developments in vacant/undeveloped areas within the conurbation limits would potentially absorb higher FARs estimated at 2.5 in context of provisions defined in the zoning regulations for promoting high density compact development in the special development zones and integrated townships in other undeveloped lands within the existing conurbation.
- The gross land area requirement has been worked out considering 40% of the total land would be under the net residential land and balance 60% of the land would accommodate the circulation patterns for these areas including the Master Plan Level Roads, the neighbourhood and sector level greens and recreational areas, the local retail level commercial and the land requirements for social amenities (educational/ Health/ other Community facilities) and utilities at neighbourhood and sector levels.
- It is assumed that about 5-10% of the residential land will be used for Industrial and Commercial activities of higher order as per the provisions of Integrated Development Plans, Integrated Townships and permissible uses in residential areas as per space standards and road widths in the Zoning Regulations.
- No separate land provisions have been made for the existing backlog in the housing stock as certain amount of densification through redevelopment and extension of additional floors creating additional housing stock has been considered to cover-up for the backlog.
- The major share of slum population (75%) can be provided the housing through redevelopment of the existing land to cover up for the existing slum population and the balance about 25% of the total slum population would require relocation/ rehabilitation at alternate locations due to unsuitability of land for residential purposes.
- About 5% of the land earmarked for residential use will be undevelopable as a result of NGT buffer considering 50% of the NGT buffer could be utilised for mandatory greens within the layouts/ Development Plans.

Based on the above assumptions, the total additional land requirement under the residential land use has been assessed at about 220-230 Sq Km.

The existing net residential density in the core area (inside ORR) has been estimated at about 515 PPH, whereas the density in the remaining urbanised areas of RMP-2015 is estimated at about 355 PPH. This translates to a city level net residential density of about 435.

With the average assigned net residential density of 450 PPH for the urbanisable area, the requirement for additional land works out to about 220 Sqkm (after deducting the existing residential area). Accounting for non-residential uses in the residential land use in the range of 5% to 10%, the total demand for additional land under residential land use is estimated at 230-240 Sqkm using the density method.

9.1.5 Housing Strategy of RMP 2031- Focus on Affordable Housing

The RMP 2031 recognizes affordable housing as one of the key components as part of the Inclusive Growth, one of the 4 major pillars around which entire Plan has been envisioned. The Housing Strategy as part of RMP 2031 has been proposed with supporting provisions in the ZR to ensure that a substantial share of the new housing stock is developed in the affordable housing category especially targeted towards the EWS housing. The RMP 2031 has taken a cognizance of the Karnataka Affordable Housing Policy, 2016, that has advocated various strategies for enhancing the supply of affordable housing supply including the role of public agencies, private developers and public-private partnerships as well as laid advocated supporting regulatory and fiscal mechanisms for encouraging the development of rental housing stock and night shelters. In line with the strategies and the actions suggested under the Karnataka Affordable Housing Policy 2016, the RMP 2031has made the following specific provisions.

1. **Government Land Parcels for Affordable Housing:**

All the government land parcels earmarked for residential land use shall be mandatorily developed through public agencies exclusively for meeting the demand for affordable housing especially targeted towards the EWS sections with atleast 60% of the share of dwelling units with size of upto 30 Sqm.

2. **Special Provisions for EWS Housing and Redevelopment of Slums:**

The zoning regulations have introduced special regulations for EWS Housing in the ZR including use of maximum allowable FAR as the base FAR free of cost by the public agencies. The provision related to permissibility of maximum allowable FAR as base FAR free of cost shall also be applicable for slum redevelopment/ affordable housing schemes on PPP basis taken up as part of any government scheme/ program if atleast 60% of the total built-up area is proposed for EWS/ affordable housing.

3. **Creation of Land Bank for Affordable Housing through Mandatory Provisions in the Layouts/ Development Plan Approval:**

The Zoning Regulations for RMP-2031 has made a provision for mandatory relinquishment of 2.5% of the land under the layouts in favour of the Authority for construction of EWS Housing by the public agencies under the government schemes/ programs. In addition, for all the DPs, provision of 15% of the total number of units or 5% of the built-up area counted towards FAR, whichever is higher has been made mandatory. An alternative has been provided for the Developers to relinquish 5% of the total land area in favour of the Authority in case they do not intend to develop the EWS housing on their own. The incentives in FAR for mandatory provision for EWS housing has been introduced in the ZR. The provisions for EWS housing as part of the integrated townships or integrated DPs have also been made mandatory in line with the provisions under Development Plans.

9.2 Assessment of Industrial and Service Sector Offices

9.2.1 Nature of Demand

The additional industrial land for large manufacturing sector industries has not been envisaged for BMA given the past trends and the Master Plans for adjoining LPAs. The demand for future would be on the non-polluting and service sector soft industries with land character similar to that of commercial land use. The household industries are permissible under the residential use for which necessary provisions have been defined in the Zoning Regulations as part of permissible activities.

9.2.2 Built Space Assessment

The total requirement for the built space has been assessed at about 300 Million Sqft or 2788 Ha of built space during the period 2016-2031 derived based on the assessment of market absorption trends of these spaces during the period 2008-2014. Based on historical information on supply and demand of office space from the same market tracking survey, it is observed that only 90% of office space supplied is absorbed, i.e. actually used. Thus, it is anticipated that about 3100 Ha of office space will actually be built.

9.2.3 Additional Land Requirement

The following assumptions have been made for assessing the land requirement for industrial and office space use:

- The total built-up space requirement would be about 31 Sqkm
- The average FAR for these developments would be of the order of 2.50
- The retail commercial development requirement shall be met through the residential land use in light of the provisions for permitting commercial activities as part of the layouts/ DPs to ensure development of planned commercial activities rather than informal street side commercialisation of residential sites.

At an average FSI of 2.5, the total net land requirement works out to about 1239 Ha or 12.39 Sqkm. It is assumed that 10% of this land requirement would be met through the areas falling under the jurisdiction of BMICAPA that makes the requirement for land pegged at about 11 Sqkm within the LPA of BDA. Considering 60% of the total land earmarked for these uses will be available as net land after making provisions for master plan and access roads, public utilities at zonal/ sector level, the greens and open spaces, parking areas etc, the gross land required for these activities is estimated at about 18 Sq Km. It is also important to highlight here that these demands would be predominantly met through the land use earmarked for industrial and commercial land use including the redevelopment of existing industrial areas.

In addition the provisions have been made under the Zoning Regulations for promoting walk to work concepts for which Integrated Townships and Integrated DPs have been promoted through incentives in FAR which are permissible even in the residential land use. Similarly, the provisions

related to permissible activities within residential use zone subject to fulfilment of space standards and road width would also encourage such activities to promote mixed use developments in planned manner in the new developments.

9.3 Assessment of Land for Other Major Uses

The net land requirement for additional city level infrastructure facilities, utilities and amenities comprising of water supply, power, solid waste management, city level greens and recreational, higher level educational and health facilities, burial and cremation grounds and the road network has been estimated at about 25-30 Sqkm. Considering 50% of the land would only be available as net land, the total land requirement for other major uses has been assessed as 50-60 Sqkm.

In addition, the requirement for certain major road networks and traffic and transportation facilities, planned as part of RMP 2031 has been assessed at about 20-30 Sqkm.

9.4 Additional Land Requirement for RMP 2031

The total additional land requirement for accommodating the additional population and the supporting activities has been estimated to be between 318-348 Sq Km for RMP 2031. The analysis of the existing land use clearly indicates that about 304 Sqkm of vacant land is available under the existing conurbation limits of RMP 2015, out of which nearly 46 Sqkm falls under the purview of NGT buffer that leaves about 258 Sqkm available for development.

Thus, the total additional land requirement for accommodating the future population with a perspective of compact city development is estimated to be between 60-90 SqKm for RMP 2031 considering that entire additional land is available as developable land. However, considering the requirements of NGT buffer (estimated at 15-20% in the peripheral areas), the total additional land requirement has been assessed to range between 72-108 Sqkm.

The URDPFI Guidelines issued by the Ministry of Urban Development, Government of India have recommended a gross density of more than 200 PPH for the metropolitan cities.

The gross density of 200 PPH translates to the gross urbanisable area of nearly 932 Sqkm for accommodating about 18.60 million population residing in urban part of BMA. Similarly, the density of 210 PPH and 220 PPH translate to gross urbanisable area requirements of about 888 Sqkm and 847 Sqkm respectively targeted towards the objectives of compact city development.

10 CONURBATION LIMIT 2031 AND PROPOSED LAND USE

10.1 Considerations for Extension of Conurbation Limits

The Differential Strategy Scenario was approved by the Bangalore Development Authority for detailing of the RMP-2031 in a Board meeting held on June 9, 2017. Summary of the directions/ decisions by the Authority are given hereunder:

- While delineating the additional land requirements for the extension of conurbation limits of RMP 2015 for RMP 2031, the aspects related to circulation pattern, buffer zones, affordable housing and economic nodes should be considered as per the outcomes of the public consultation meetings.
- The indicative identified economic nodes should be located near to the junctions of the major roads to the extent possible and the activities should be suitable for such locations and balance with the regional context. The proposals of the Master Plans of adjacent LPAs should be considered while formulating the proposals for RMP 2031 to achieve the balanced regional development. Separate regulations should be considered for these nodes.

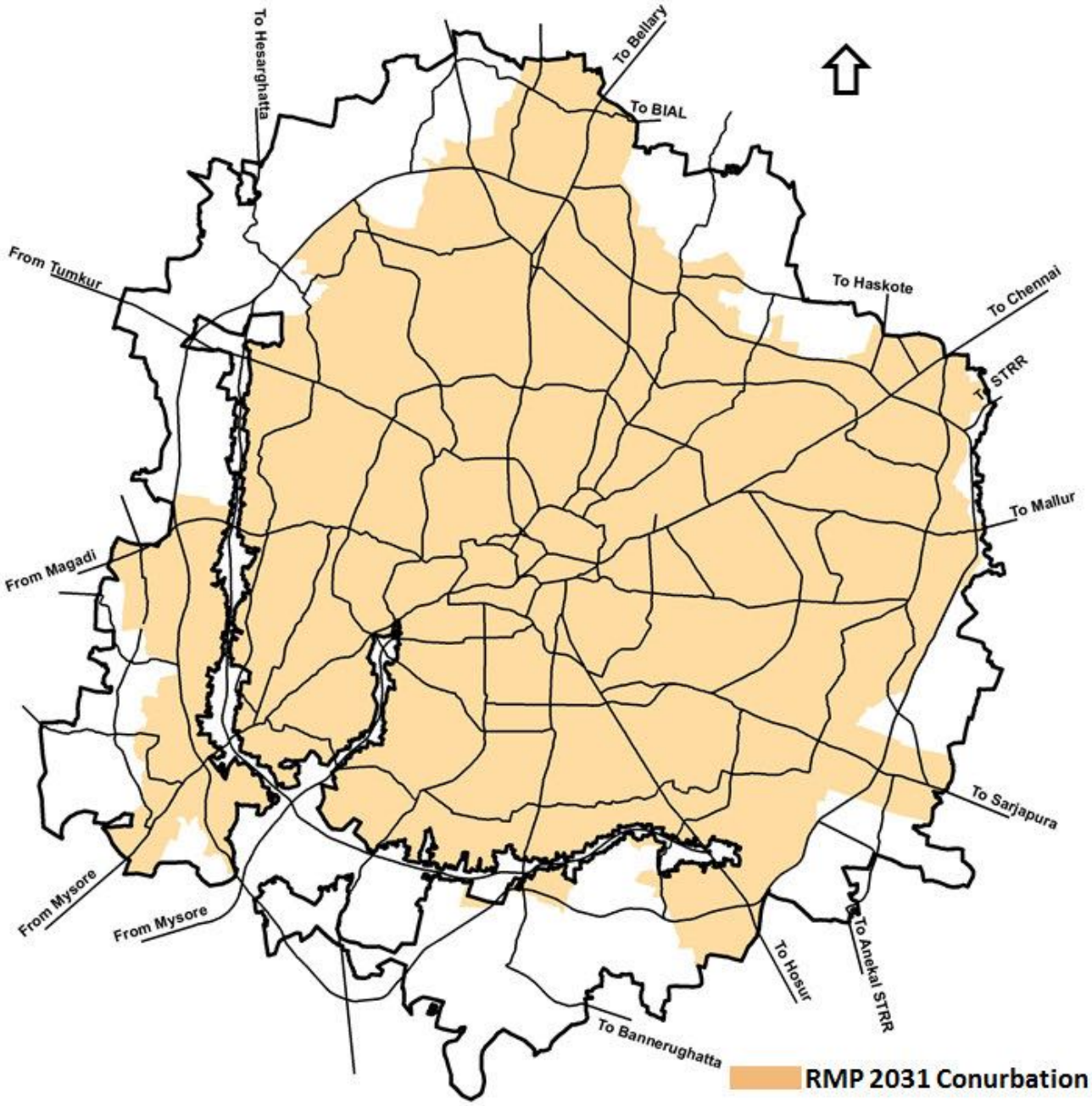
Based on the decision and guidelines given by the Authority, the conurbation limits have been extended with the following considerations:

- The Major road corridors considered for extension of conurbation considering the existing directions of growth and the capacity of the major road network, the five Special Development Zones (SDZ)/ Economic Nodes proposed are (1) SDZ Bellary Road, (2) SDZ Old Madras Road, (3) SDZ Sarjapur Road, (4) SDZ Hosur Road and (5) SDZ Mysuru Road.
- The emergence of economic activities is highly governed as per the backward-forward linkage, however, it is a very dynamic phenomenon guided by the market demand. Considering the existing pattern of growth in these zones and in the adjoining region, SDZ Bellary Road, Hosur Road and Sarjapur Road would act as hubs of IT and other related Hi-Tech industries and supporting service sector Offices. SDZ Mysore road is envisaged as a hub for Knowledge Driven Economy. SDZ Old Madras road is envisioned to create opportunities through light and service sector industries.
- The delineation of Special Development Zones as an extension of the conurbation limits of RMP 2015 has also taken cognisance of the existing level of development in these zones in order to plan for compact high density developments as per the availability of vacant land.
- The Special Development Zones have been envisaged as High Density Integrated Developments providing employment opportunities (Economic Nodes) supported with the necessary residential and amenity requirements. The road network in these special development zones have accordingly been proposed to accommodate the high density developments.

- The outgrowths of the conurbation limits of RMP-2015 where the intensity of development has been observed high with regard to the economic opportunities especially along the proposed PRR alignment.

Figure 10-1 depicts the proposed conurbation limit for RMP 2031.

Figure 10-1: Proposed Conurbation Limit for RMP 2031



10.2 Land Use Strategy for RMP 2031

The Land Use for RMP-2031has been proposed with the following considerations:

- The Land Use Zoning is as per the provisions of the Rule Number 30 of the KPA Rules.
- For the purpose of detaining of RMP-2031, the entire LPA of BDA has been divided into 42 Planning Districts for which the Planning District Level Proposed Land Use Maps and proposed major development proposals are given in Volume-5 and Volume-4 respectively.
- The commercial strip model including commercial axis, mutation corridor in the RMP 2031 has been relooked at and a multi-pronged strategy of planned commercial areas in the new areas of development and strip model on selected corridors/ roads of width 15 m and above has been provided based on the existing commercialisation in the existing developed areas.
- The economic centres/ industrial areas and the amenity areas have been spatial distributed across different Planning Districts for balancing the growth at the LPA Level.
- The Development Constraints such as Air Funnel Zones, regulations related to eco-sensitive zones, quarry and mining sites, defense areas etc have been given due cognisance while delineating the conurbation limits as well as formulating the land use proposals.
- Except for the developments proposed along the five major corridors and the existing conurbation limits of RMP 2015, the agricultural belt admeasuring nearly 323 Sqkm has been retained along the periphery of the entre LPA to act as a buffer between the LPA of BDA and the developments in the adjoining LPAs.
- The Proposed Land Use for RMP 2031 has considered and incorporated the planning permissions and change of land use accorded by the Authority/ Government. The Proposed Land Use of RMP 2015 has been suitably amended in several zones based on the predominant existing land use and the development pattern.
- The entire LPA has been divided into three planning zone i.e.
  - **Planning Zone A** (Ring 1+Ring 2 of the RMP 2015) comprises of the core of the City area falling within the outer ring road (erstwhile BMP). Owing to limited availability of land and high densities, there is very little scope for further growth in this zone. This is also the zone that – owing to its high densities – is crippled by traffic congestion and environmental pollution. This zone requires, strategies to stabilise the growth in this zone and interventions that discourage further commercialisation in the residential areas as well as densification process.
  - **Planning Zone B** (Part of Ring 3 of the RMP 2015), the areas between the outer ring road and the proposed Conurbation limit of RMP-2031 form part of this zone. The infrastructure is poor in several areas in this zone, in spite of being major part falling under the jurisdiction of BBMP. Numerous lakes and water bodies present an opportunity to conserving the overall valley and tank network in the BMA. This zone is characterised by narrow roads and absence of a good network hierarchy. Improvement of infrastructure will lead to increased capacity to hold higher densities and more population in Zone B. The zone envisaged as zone of

consolidation – one where development can be further encouraged through strengthened infrastructure.

- **Planning Zone C** (Part of Ring 3 of the RMP 2015) is the outermost zone that extends from the conurbation limits till the boundary of the BMA. This area consists of agricultural land use and has sparse developments. RMP 2031 views this zone as a preservation zone, one where the agriculture land-use, to the extent possible, will be retained, although it requires certain additional interventions beyond zoning regulations in order to facilitate better economic utilisation of the agricultural lands. This may be conceptualised as productive landscapes.

- The road hierarchy has been given special attention by way of identifying major activities and the importance of the area with regard to the envisaged density patterns.
- The proposed circulation pattern has been evolved on the concept of rings and radials whereby necessary missing links or widening proposals have been included to create a network comprising of 5 rings and 26 radials. The land has been earmarked for the critical junctions for easing the free flow of traffic by construction of grade separators/ flyovers. Truck terminals and ISBTs have been proposed along the major corridors and land has been accordingly allocated.
- The proposals of BMRDA for regional level network including Intermediate Town Ring Road (ITRR) of Hoskote and other roads have been integrated as part of the RMP 2031 based on the ground situation and utilising the alignment of the proposed PRR with 100 m RoW under RMP 2031.
- The RMP 2031 has also integrated the road network of BMICAPA.
- The RMP 2031 has also taken cognizance of the road network proposed under RMP 2015 and amended several roads especially the lower hierarchy roads in the form of reduction of the proposed road widths and/ or removal of certain roads due to lack of feasibility of achieving such RoWs on ground due to high intensity of development.
- RMP 2031 has identified Regional Parks/ City Level Parks in different zones utilising the abandoned quarry sites, wherever suitable, and the areas having high intensity of streams and water bodies where NGT buffers have been integrated as part of such large open spaces.
- The land for Public and Semi-public and the public utilities has been earmarked across different Planning Districts to cater to the zonal level requirements. Efforts have been made to allocate the government land parcels to the extent possible for demarcation of land for such facilities.
- The Eco-sensitive zones along with their extent of regulation boundaries like Arkavati, TG Halli and Bannergatta National Park has been demarcated on the PLU Map.
- RMP-2031 for the first time has classified the streams into primary, secondary and tertiary based on the Flood Modelling carried out in association with KSNMDC, GoK and earmarked on the PLU maps along with demarcation of buffers as per the orders of the Hon'ble NGT. This measure will help in keeping a close check on the encroachments in the buffer zones and also address a major issue for the city in the form of urban flooding. It will also contribute towards enhancement in

the green area for the city acting as lung space. This buffer will also help in revival of the river valley system.

- For Planning Zone C i.e the Agricultural Zone, the existing Gramathan have been provided limits for the natural growth of the rural population and the area of natural expansion has been demarcated as part of the PLU Map in the respective Planning Districts.
- Heritage zones/ precincts and heritage buildings have been identified and earmarked in the PLU Maps.

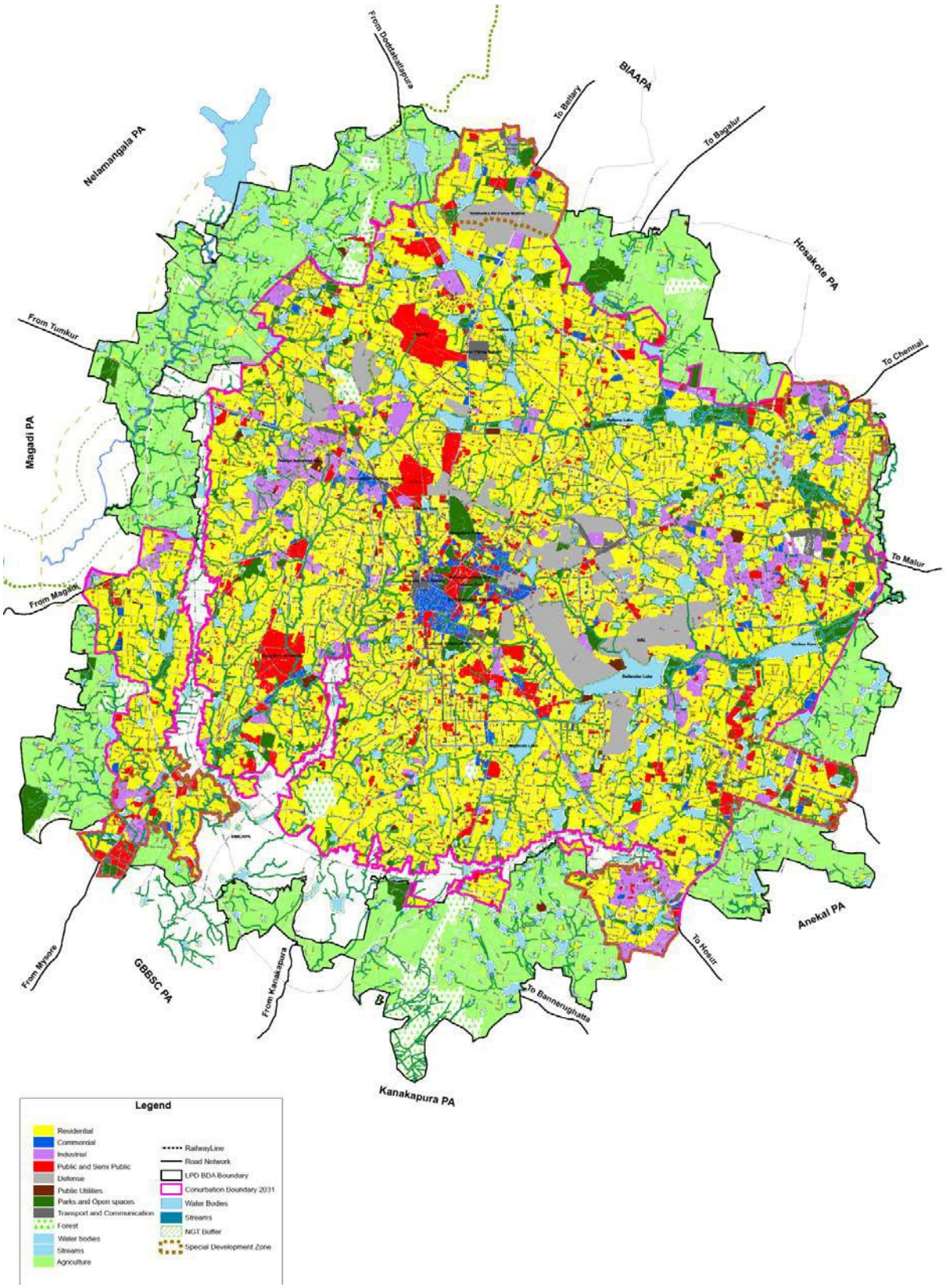
10.3 Proposed Land Use 2031

The **Figure 10-2** presents the proposed land use plan for RMP-2031 for the entire LPA of BDA, whereas .proposed land use break-up for conurbation limit of RMP 2031 is given in **Table 10-1.**

Table 10-1: Proposed Land Use Area Statement

Landuse Category	Area (Ha)	% To Total Developable Area
Residential	42477.08	48.03
Commercial	2473.74	2.80
Industrial	4256.47	4.81
Public & Semi Public	6007.85	6.79
Public & Semi Public - Defence	4356.28	4.93
Public Utility	471.15	0.53
Parks / open spaces	3734.55	4.22
Transport & Communication	11834.34	13.38
Forest	577.15	0.65
Water Bodies and Streams	3393.56	3.84
NGT Buffer	8848.90	10.01
Total Developable Area	**88431.06**	**100.00**
Agriculture Zone	32266.00	-
Total Conurbation Area	**120697.00**	**-**

Figure 10-2: Proposed Land Use for RMP 2031 (draft)



11 TRAFFIC AND TRANSPORTATION

11.1 Traffic and Transport Scenario in Bengaluru

Bengaluru is spatially characterized by a ring-radial system of roads formed by five big axes, which converge towards the centre of the city. Bengaluru Metropolitan Area with more than 11 million people, travelling is getting more and more difficult as the city witnesses nearly 10 million trips a day. Traffic in Bangalore has become a scourge and is only becoming worse. Network speeds are dropping at an alarming rate as overcapacity of its junctions and links are being reached and traffic jams have become the order of the day. Being a victim of its own success, Bangalore's traffic infrastructure has just not been able to keep pace with the fast growing IT industry to which Bangalore is associated with.

Today, home to more than 11 million people the strained network is loaded with more than 100 lakh trips per day. BMTC operates more than 6000 buses and carry more than half these trips, but this is hardly enough, the rest of the traffic has simply overwhelmed the network.

The paucity of public transport services, lack of road network, over dependence of private vehicles and a high growth rate with the city (in the past decade, the city has nearly doubled), has resulted in:

- Traffic Jams/ Extreme congestion
- Decline in journey speeds from 18kmph (2008) to 11kmph (2015) leading to severely overburdened Road Network and long commute times.
- Present trip rate 0.9 per capita per day – approximately 90 lakh trips per day
- Mode share 52% trips on vehicular traffic and 48% on Public Transport (includes private buses)
- Absence of clearly defined road network hierarchy
- Network congestion hampers bus operations significantly - Share of Public Transport dropping further
- Growing use of personalized vehicles
- Intensification of existing economic nodes leading to traffic congestion
- Deficient multimodal integration
- Movement of Freight/ Goods inside the city area
- Intercity Bus Travel Movements disorganized and is scattered all over the city
- Non-Motorized Transport is inadequate with respect to provisions of footpaths and cycling facilities.
- Parking is disorganized in most parts of the city.
- A high car dependency has also added to high air and noise pollution levels

To address the growing concerns of the prevailing and anticipated traffic demands, it is imperative to understand the traffic related issues both at a macro level and a micro level. Hence, to respond to transport requirements of future more appropriately, for the first time in a master planning exercise in India, a transport model has been developed with a focus on integrating land use and transport planning. The model has more than 500 zones and includes 15000 road links and 2300 bus routes.

11.2 Model Development for the Revision of Master Plan

A state of the art transportation modelling suite (CUBE VOYAGER) has been employed for the modelling purpose. A detailed circulation network was drawn taking into cognizance the spatial growth of the city and the road proposals of RSP 2031 and RMP 2015. On this circulation network BMTC bus routes where meticulously coded. All the wards in the BBMP zones and the Villages up to the BDA limit were considered as individual zones. The model was extended to include the BMR as many transport solutions may include the BMR region as well. The Origin and destination data was estimated from the earlier Comprehensive Traffic and Transport Study (CTTS) calibrated functions and further refined and brought up to date through a process called "Matrix estimation from Counts".

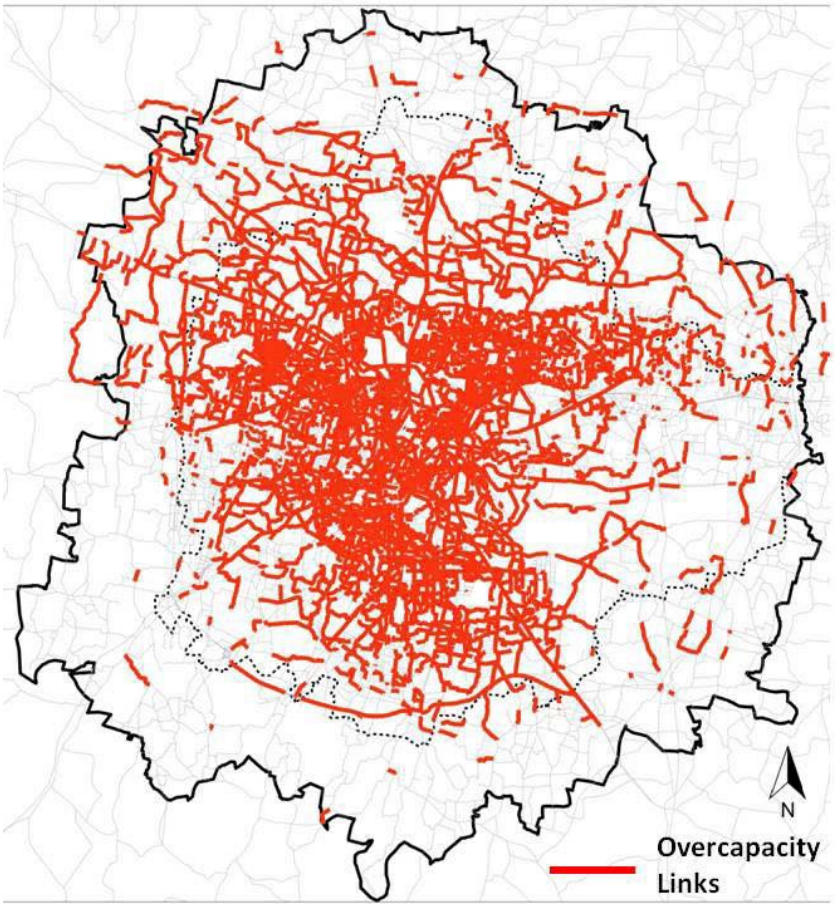
A conventional four stage model was calibrated for Bangalore afresh, and validated across screen lines to prove that the input data is satisfactorily representing city travel. The model was calibrated over 4 modes, Cars and Taxis, Two Wheelers, Auto rickshaws and Public Transport. Trucks, Multi Axial Vehicle's (MAV's), Light Commercial Vehicle's (LCV's) and Bicycles where separately considered for the assignment. The model has been calibrated to represent the morning peak period – the journey to work period (the period used for network capacity analysis)

11.3 Forecast Scenario

The model was run for 2031 assuming spatial growth in line with the growth trends observed today. The metro phase 1 and phase 2 were included in the model. The peripheral ring road was included. The existing network was also improved to a limited extent – example the outer ring road was fully completed and buses have been doubled. The forecast Business As Usual (BAU) scenario shows very high congestion, the followings are the key observations. Refer **Figure 11-1**.

- The Vehicular trips increase more than 3 times and the network is severely congested
- Public Transport share reduces substantially
- Bus frequency would reduce to less than half even with double the fleet
- Almost all roads will be operating at higher than Capacity
- Network speed drops to 8kmph. In the peak direction its < 5kmph. A clearly non sustainable situation.
- The pollution levels from vehicular emission would increase 3 times
- Doing nothing but believing that the Metro phase-II will solve Bengaluru's problem is not a solution

Figure 11-1: Map showing Over-capacity links as per Business as Usual or Do Nothing scenario for BMA 2031



Source: RMP 2031 Analysis

11.4 Approach to Traffic and Transport Planning of the BMA

Conceptually, the larger mobility strategy has been to move people through rings and radials of higher order mass transit systems and a well formed road network that exhibits a strong hierarchy of roads. The main intent has been towards integration of land use with the overall transport network to significantly enhance public transport use. The circulation network establishes strong grid patterns which represent the spatial organization of an orbital and radial form. Also integration of intermodal hubs are being proposed at locations where different mass transit corridors meet, independent of the selected system to help in efficient interchanging. The accessibility is not being addressed in detail within the ambit of the Master Plan study but the essential base network is being setup to ensure that good end mile connectivity to the mobility corridors are easily achievable.

- A major mass transit station is within 3 to 4 kms of any part of Bangalore which can be fitted with an end mile connectivity solution.
- Cross sectional elements of the road networks are set with proper footpaths and segregated cycle tracks.
- Minor bus terminals are being provided in all areas to ensure that a feeder system can be operated. These can be fitted with charging ports to facilitate Electric Vehicle's (EV's).

- The Multi Utility Zones proposed in the larger road network have been conceived to include Intermediate Public Transport (IPT) stands or Taxi Stands which can be included adjacent to mass transit stations to enable efficient end mile connectivity.
- Also, the Multi Utility Zones proposed as part of the road cross sections can also house Public Bicycle docking stations. Given that all major roads will compulsorily have a cycle track dedicated), it should be easy to put in place a Public Bicycle Sharing System to help improve end mile connectivity

11.5 Transport Strategy

Considering the current challenges that Bangalore is facing and the Business as Usual forecasts which shows a totally unsustainable situation, a set of key priorities or principles are devised that underpin the development of the transport strategy. The strategy seeks to address the concerns of all segments of commuting population by emphasizing the pre-eminence of public transport and non-motorized modes of travel; adopting various elements of Travel Demand Management and integrating with the land use development scenarios. This is in line with the National Urban Transport Policy. The following measures have to be considered while implementing the master plan:

- Improve the existing road network by developing a network structure and define the road hierarchy. Provide additional rings/radials wherever possible and consider urban road design as an important element.
- Focus on providing more public transport targeting to carry 70% of trips of the city from the present 50%. Seriously consider more transport spends on provision of Metro/BRT/Monorails etc. Push for the Commuter rail system.
- Establish a street network model design which intrinsically has provisions for pedestrians and cyclists. Consider that the Pedestrian is also a road user – provide comfortable/safe facilities for pedestrians. Re-establish the role of bicycles in Bangalore and encourage/provide for them.
- To bring 20-25% of Planning Area under Transit Oriented Development
- Provide a freight movement plan with logistic hubs and warehouses interconnected with dedicated freight corridors
- Reorganize interstate bus and rail hubs and integrate the same with the local public transit systems for seamless intermodal transfers.

Other critical transport elements that need to be considered but is not explicitly spelt out in the master plan are as follows:

- Traffic management is assumed to be efficiently handled through state of the art ITS. The BTRAC programme that is already part implemented in Bangalore should be continued to bring in the best technologies in the market to ensure that traffic management is at its efficient best.
- It is assumed that BMTC buses have to be increased to 15,000 by 2031.

- The shift to public transport can never be achieved if some form of demand management is applied. One of the best forms of demand management that is already in an advanced stage of thinking is parking charges. While this would push private mode users away from cars and two wheelers the city authorities can also be assured of a regular source of income.
- Other demand management measures such as increasing restriction; corridor pricing etc must be pursued after the implementation of the Public Transport Network.

11.6 Traffic and Transportation Proposals

11.6.1 Circulation Plan

The circulation network has identified radial and ring roads to create more opportunities for mobility within the metropolitan area and the larger region. The proposed circulation network will have about 800 Kms (including existing 375 kms) of Primary Arterial which has 26 radials and 5 rings. The primary circulation network embraces completely new ring road (Inner Peripheral Ring Road) apart from the completion of the Intermediate Ring Road and the Peripheral Ring Road. A detailed Primary Circulation Network Plan along with an inventory is shown in Figure 11-2 and a summary of the inventory is given in Table 11-1.

Figure 11-2: Map showing Proposed Primary Circulation Network- RMP 2031

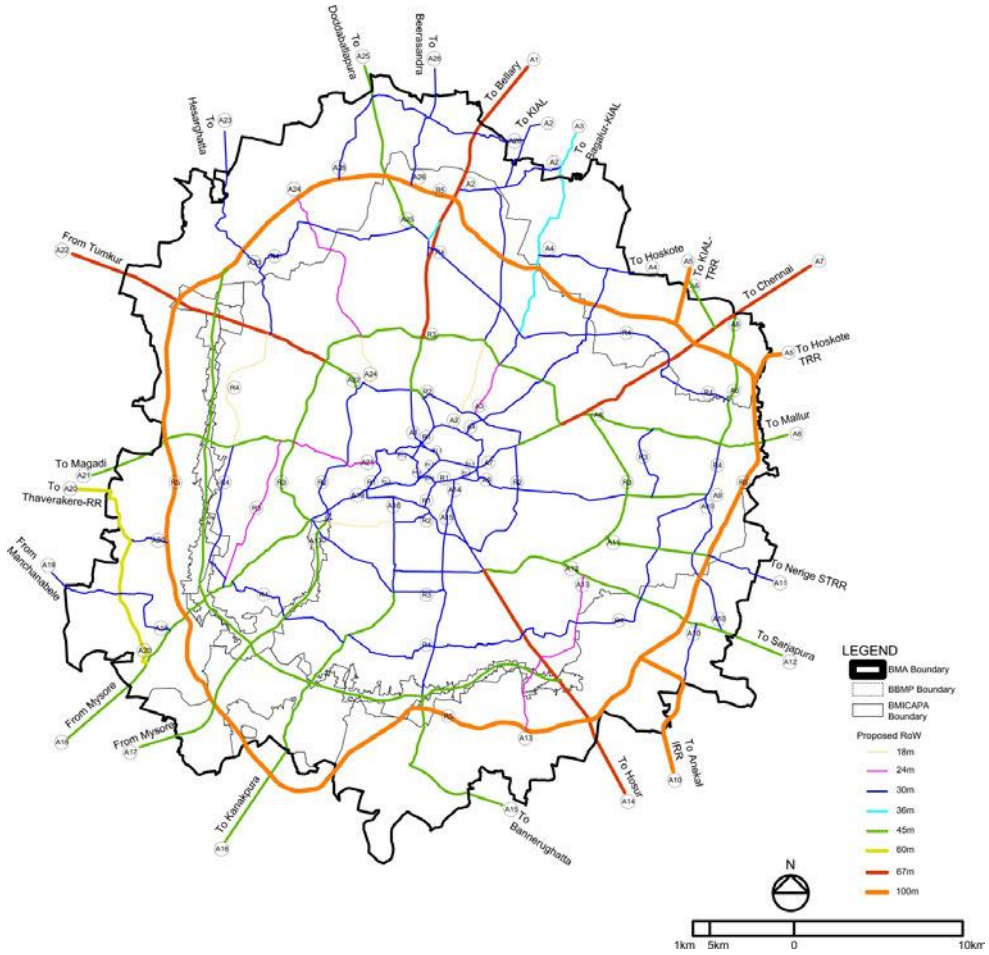


Table 11-1: Inventory of Existing and Proposed Primary Circulation Network (Category-1 Projects)

Sl. No.	Road Code	Road Name	Road Type	Approximate Length (kms)	Alignment Status	
					Existing	Proposed
1	R1	Inner Ring Road	Arterial	40		
2	R2	Intermediate Ring Road	Arterial	40		
3	R3	Outer Ring Road	Major Arterial	60		
	R3	Old Outer Ring Road	Arterial	9		
	R3	Hoodi/ Graphite India Main Road	Arterial	5		
4	R4	Inner Peripheral Ring Road	Arterial	105		
5	R5	Peripheral Ring Road	Major Arterial	118		
	R5	NICE Ring Road	Major Arterial	44		
6	A1	Bellary Road (AH43)	Major Arterial	20		
7	A2	Nagawara Main Road	Major Arterial	26		
8	A3	Hennur Main Road	Major Arterial	16		
9	A4	Banaswadi Main Road	Major Arterial	12		
10	A5	Hoskote TRR Road	Major Arterial	6		
11	A6	SH 35/ Sivas Road	Major Arterial	7		
12	A7	Old Madras Road (NH4)	Major Arterial	18		
13	A8	Whitefield Main Road	Major Arterial	11		
14	A9	Old Airport Road	Arterial	14		

Sl. No.	Road Code	Road Name	Road Type	Approximate Length (kms)	Alignment Status	
					Existing	Proposed
15	A10	SH 35/ Chandapura-Domasandra Main Road/ Anekal IRR Road	Major Arterial	13		
16	A11	Kadabessanahalli Main Road	Arterial	9		
17	A12	Sarjapur Main Road	Major Arterial	13		
18	A13	Haralur Main Road	Arterial	11		
19	A14	Hosur Main Road (AH45)	Major Arterial	18		
20	A15	Bannerughatta Main Road (SH87)	Major Arterial	20		
21	A16	Kanakpura Main Road (NH 209)	Major Arterial	18		
22	A17	Mysore Express Way	Arterial	17		
23	A18	Mysore Main Road (SH17)	Major Arterial	19		
24	A19	Dodda Almara Main Road	Arterial	9		
25	A20	Thaverakere Ring Road	Arterial	18		
26	A21	Magadi Main Road (SH85)	Major Arterial	14		
27	A22	Tumkur Main Road (AH47)	Major Arterial	16		
28	A23	Hessaraghatta Main Road (SH39)	Major Arterial	6		
29	A24	Jallahalli West Main Road	Arterial	10		

Sl. No.	Road Code	Road Name	Road Type	Approximate Length (kms)	Alignment Status	
					Existing	Proposed
30	A25	Dodda Ballapur Main Road (SH9)	Major Arterial	12		
31	A26	Sir MVIT College Road/ Beerasandra Road	Arterial	21		
Total				**795**		

Some of the important new alignments identified are:

- Completing missing links within the Intermediate Ring Road which include connecting CIL Main Road and Pottery Main Road, connecting Byapanahalli Main Road and Pottery Main Road and augmentation of Banashankari 50 feet road which connects to BMIC Expressway
- Inner Peripheral Ring Road, which is a newly identified ring in between ORR and PRR. The alignment is a combination of existing and new roads. It connects suburbs such as Yelahanka, Jakkur, RK Hegde Nagar, Horamavu, Kithaganur, Sonnenahalli, Kadugodi, Varthur, Chikka Begur, Hulimavu, Kengeri, Ullal, Nagasandra and Chikbanavara. This is a critical link as it constitutes areas which will further densify in the coming years.
- As mentioned earlier the PRR is critical to BMA, the master plan also proposes that the PRR connects to NICE corridor at Tumkur road portion.
- Two new links are proposed to BIAL other than the existing Bellary Road and Hennur Road. One is an extension of existing Nagawara Main Road and the other is extension of SH-35 at Old Madras Road via Sivas Road.
- Extension of Banaswadi Main Road via Panathur Main Road towards Hoskote LPA
- Developing a 30m road between Dodda Ballapur Main Road and Bellary Road towards Beerasandra (SH 104) in BIAPPA LPA
- Integration of Regional connections with STRR at Nelamangala, Hoskote and Anekal LPA's respectively.

11.6.2 Public Transport Systems

As discussed a complex grid of radial and ring systems have been proposed complimenting the metro phase 1 and 2. The mass rapid transit systems proposed is as per the **Table 11-2** and as shown in **Figure 11-3**. The selection of mass transit system is based on the section load (passenger per hour per direction) for selected systems.

Table 11-2: Existing and Proposed Public Transport Systems under RMP 2031

Sl.No	Corridor	Length (kms)	System
1.	Metro Phase 1	42.4	Metro (Implemented)
2.	Metro Phase 2	81.4	Metro (Under Implementation)
3.	Metro Phase 3 (Airport Link)	29.5	Metro (18.3 km within BMA)
4.	Commuter Rail Network	106	Commuter Rail System
5.	Intermediate Ring Road (R2)	37	LRT/ Monorail/ BRTS (Medium Level)
6.	Outer Ring Road (R3)	62.6	Metro
7.	Inner Peripheral Ring Road (R4)	81.8	LRT/ Monorail/ BRTS (Medium Level)
8.	Peripheral Ring Road (R5)	106	Metro
9.	Bellary Road (A1)	13.5	LRT/ Monorail/ BRTS (Medium Level)
10.	Hennur -Bagalur Main Road (A3)	21.6	BRTS
11.	Sarjapura Road (A10)	26.3	LRT/ Monorail/ BRTS (Medium Level)
12.	Old Airport Road (A8)	26	LRT/ Monorail/ BRTS (Medium Level)
13.	Magadi Road (A20)	9.2	LRT/ Monorail/ BRTS (Medium Level)
14.	Jalahalli West Main Road (A24)	10.4	LRT/ Monorail/ BRTS (Medium Level)
Total		653.7	

11.6.3 Bus Augmentation

BMTC, at present is operating 6249 buses on 2500 routes. There are 10 TTMC's (Traffic and Transit Management Centre's) and 40 depots, new depots and TTMC/ Bus Terminals have been identified within the newly planned areas of BMA. It is assumed that the bus fleet size will be in the range of 15,000.

11.6.4 Interstate Bus Terminal

BMTC along with KSRTC provides the regional/ interstate connectivity from Bangalore to other parts of the cities and vice versa. A total of six interstate bus terminals are proposed on Tumkur Road, Mysore Road, Old Madras Road, Hosur Road, Bellary Road and Magadi Road so that intercity traffic will not get mixed with the city traffic.

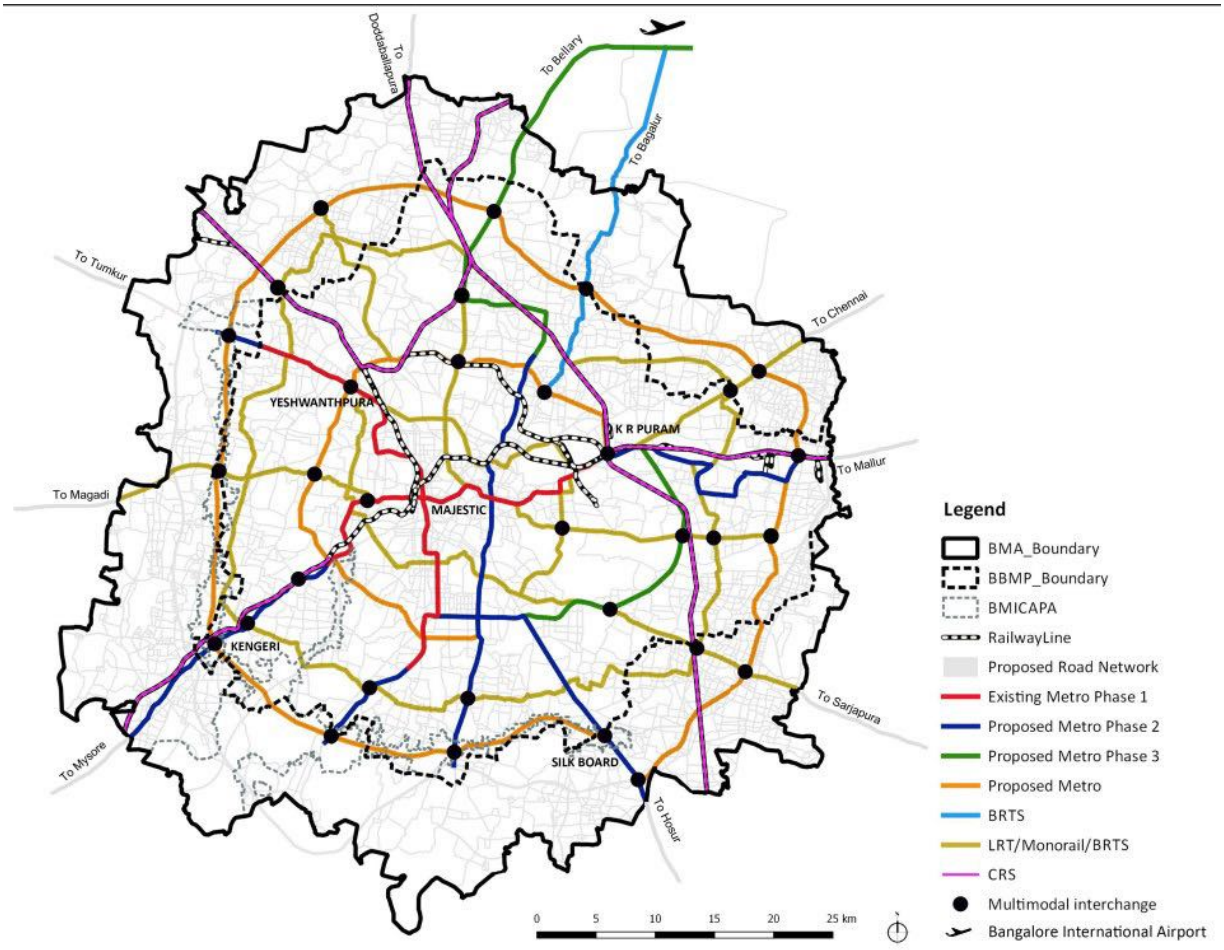
11.6.5 Intermodal Interchange

RMP 2031 has proposed 36 intermodal interchange stations intersections of two or more public transit corridors.

11.6.6 Freight/ Goods Infrastructure

In order to restrict the freight movement inside the city, eight logistic hubs of 100 acres each is proposed at the periphery of major highways. Logistic Hubs are proposed on Bannerughatta Road, Tumkuru Road (outside BMA), Mysore Road, Mallur Road, Bellary Road, Old Madras Road, Hosur Road and Sarjapura Road.

Figure 11-3: Map showing Proposed Public Transport Network of RMP 2031



12 PHYSICAL AND SOCIAL INFRASTRUCTURE

12.1 Water and Waste Water

The water availability for meeting the future demands of Bengaluru for the master plan period and beyond was one of the concerns expressed by some citizens during the public consultations. By all accounts, the availability of surface water (synonym as Cauvery water) has not affected the growth of city (in terms of population and spatial). Having said that Bengaluru is at the situation where the only surface water source available to city (River Cauvery) is legally getting exhausted and dependency on ground water is growing. Will the city continue to grow? probably yes – for the fact that Bengaluru has become self-sustaining economic growth centre in entire state of Karnataka. Even if the policy decision is taken to reduce the pressure on Bengaluru by developing counter magnets, the real impact would only be visible after decade or two, provided all policy initiatives are implemented in time bound manner.

Water would be required for future population in Bengaluru – during the master plan period (2031) and beyond. It is indeed a fact that city is to face water shortage in future even after having exhausted the only surface water source, thereby increasing the dependency on ground water much more than today. The situation is likely to persist in future, the only difference being the spatial impact. The water is likely to be available and supplied to entire of BBMP by master plan period, it is the adjoining villages with Bengaluru Metropolitan Area, that are likely to get urbanised over next 15 years. How we reduce the water demand and manage the water demand is going to be most important aspect in utilising existing resources to providing safe drinking water to fellow city residents. The implementation of dual pipeline system and use of recycled water for non-potable activities for all future developments is likely bring substantial reduction in potable water demand, thereby dependency on resources. Further, social acceptability of use of recycled yet potable water would completely change the water dynamics in the city. However, this is possible only if the of water supply and sewage system covers the entire planning area.

Located at 950 Mean Sea Level Bengaluru is only metropolitan city which is not abutting to any major surface water source (River). Bangalore Water Supply and Sewerage Board (BWSSB) formed in 1964 under BWSSB Act, 1964 is mandated to provide water supply and sewage systems primarily within the BBMP (708.5 sqkm). However in the Bengaluru Metropolitan Area (admeasuring 1294 sqkm), in addition to BBMP, there are 51 Gram Panchayat's (with 251 villages having spatial extent of 583 sqkm) served by Panachayath Raj Engineering Department (RDPR/ PRED). At present BWSSB is extending the water supply and sewage network to entire BBMP area and is expected to complete the works by 2021. However, there is no coverage of water supply and sewage network in many areas already urbanised and under process of urbanisation outside the BBMP Limits. These areas are expected to get further urbanised by 2031 with planned development as envisaged under Revised Master Plan - 2031. It is therefore recommended that BWSSSB provide support to RDPR in planning for water supply and sewerage network for entire BMA, for the fact that existing/ planned systems

within BBMP will have to be integrated/ extended to villages outside BBMP. This is to help in designing and implementing the integrated networks across BMA.

As per Census, BBMP has a population of 8.4 Million (93% of BMA) whereas the rest of 251 villages together hold 0.7 million persons, thus a total of ~9.1 million in BMA. The population projections for RMP 2031 suggests that population within BMA is expected to reach ~20 million by 2031, thereby, making Bengaluru the third most populous city in the country.

At present BWSSB is withdrawing about 19 TMC of water (1470 MLD) from Cauvery to meet city's water demand. The Plan/ work is on for getting additional 10 TMC (775 MLD) of water as accorded by the Cauvery Tribunal to meet the water demand for BBMP area alone. Thus, altogether about 29 TMC (2250 MLD) of water is available for Bengaluru from Cauvery. Though Unaccounted for Water amounts to 46%, the actual water losses (transmission, leaks, treatment and distribution) are around 15-18%. Also, network coverage (both water supply and sewage) in the city is limited and work is in progress to get entire BBMP covered by 2021.

The water demand has been established considering 135 LPCD supply to the population. Non-domestic water demand for potable purposes has been established considering 45 lpcd for estimated work force. Equal amount of non-potable water has been considered for non-domestic sector to establish the total non-domestic demand. The net water demand including water demand for non-domestic activities has been estimated at 3639MLD for the projected population of 20.3 million for BMA by 2031. The net demand of 3639MLD translates to the total gross water requirement for BMA at 4282 MLD considering 15% losses towards transmission & distribution.

As mentioned earlier, dual pipeline system for use of recycled water would reduce the overall water demand for potable water. If the water supply is split (within plot/ site) into two – potable (@90 lpcd) and non-potable (45lpcd) then the water demand for potable water can be reduced by 865 MLD. However, still there will be water shortage of about 862MLD [refer table 2]. This water shortage likely to be met through Ground Water, thereby increasing the dependency on ground water from present level 677 MLD to 862 MLD (about 27% (185MLD) higher than present levels). It may be noted that due to change of land use from Agriculture to urban activities within BMA, the water withdrawal for current agriculture activities to the tune of 100-150 MLD would be available for urban activities. This is with the assumption that present over draft will continue. Thus, the status of ground water dependence in 2031 would be of the similar scale as it is at present.

To meet the future water demand following are the master plan suggestions:

- **Providing Infrastructure across the Planning Area:** Being a public utility, providing water to the public has a vital interest in its functioning and wellness of the society. More than 27% of water supplied by BWSSB is among the BPL and EWS of the society and is provided free of charge. BWSSB has coverage of 575 sq.km area out of 710 sq.kms of BBMP. The rest 135 Sq.km under 110 villages is expected to be covered by 2021. However, rest of the planning are outside BBMP are not covered by BWSSB, and it is imperative to improve the coverage to not only within BBMP but also in villages outside BBMP falling within BMA. It is therefore recommended to institutionalise the planned water supply and sewage network out BBMP as well to reduce the dependency on ground water.

- **Dual pipe line for drinking and other purposes** for the newly planned areas and additional population. On implementation of Dual pipeline, Government has to take measures to supply Cauvery water for all the purposes for population expected to be living in the BBMP in existing establishments and for only potable purposes for the population residing in any new developments in BBMP area which need to be developed on the basis of zero liquid discharge policy. Similarly, dual pipeline system shall cater to additional population expected to be residing in 251 villages of BMA with only potable water demand being supplied by Government infrastructure. This initiative could minimize additional water requirement significantly but it is difficult to make an assessment of the same at master plan level. As per IS 1172, out of a total per capita demand of 135-200 lpcd, a flushing water requirement of 45 lpcd may be taken for flushing requirements and the remaining quantity for other domestic purposes. However, other non-potable water uses may include gardening, washing etc. Recycled water has to be made available for non-domestic purposes and non-drinking purposes in the 251 villages where the new supply network is planned. Even after realising 865mld of treated recycled water and additional about 2000mld recycled water would be available, which can be utilised for revival of lakes and valley system. Using innovative systems like artificial aquifer recharge would help in improve the ground water levels.
- **Water Conservation:** Over 50% of the population of the project population of 2031 has been assumed to be supplied potable water @135lpcd; however there is a strong potential for reducing this demand of 135lpcd through promoting awareness for water conservation, implementation of decentralised sewerage treatment plants for the local area, which can be utilised for gardening, horticulture purposes and other activities like car washing. This would lead to reduction in potable water demand to 120lpcd, which translate to saving of about 166MLD. Thereby bringing down the dependence on ground water below the present level.
- **Treating Recycled Water to Potable Level:** The fact that Cauvery will not be adequate for city and relishing water from other sources is still to determined, it is proposed to recycle the sewage water with tertiary treatment technologies available in the market and supply to the city for all the purposes.
- **Evaluation of Proposals of Thyagaraja Committee:** For long term purposes some of the major interventions proposed by the Thyagaraja Committee to explore new sources have to be considered by the state government on priority basis.
- **Rejuvenation of Lake and Valley System:** The lake and valley system has been historically water supply source, however due to limited sewage network coverage; most of the lakes are filled with sewage. The improved coverage of sewage network is expected to improve the quality of water flowing into lakes. In addition to that recycled water shall be used to rejuvenate the lakes along with dredging of some of large lake to improve the holding capacities and aid ground water percolation. Adequate sewage network and infrastructure shall be developed to contain the sewage flow into lakes and streams.

Towards provision of land for water and sewage infrastructure, the Master Plan has incorporated the proposals provided by BWSSB for BBMP area and are appropriated depicted in proposed land use maps.

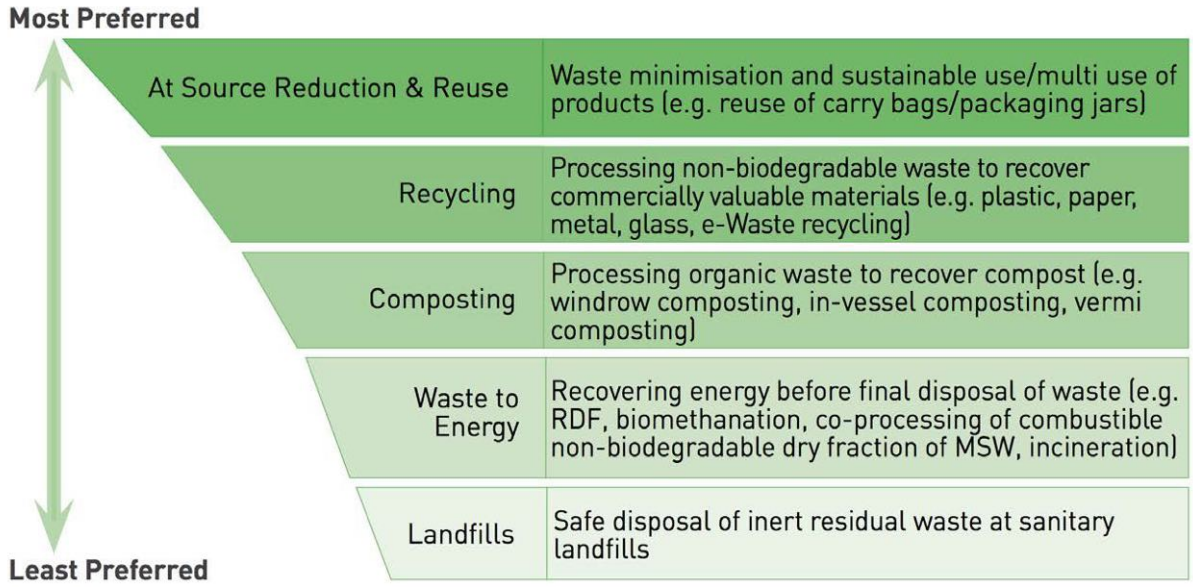
12.2 Municipal Solid Waste

Solid Waste Management (SWM) is an obligatory function of the BBMP and is governed by the Solid Waste Management Rules, 2016 ("SWM Rules") and several court directives. In BMA, which comprises of BBMP and around 50 Gram Panchayats, there is no single unified authority for the waste management. BBMP is looking after the waste management within its jurisdiction, while the rest of the area, which is administered by different Gram Panchayath's, concerned Gram Panchayath is responsible for waste management in their respective jurisdictions.

BBMP is in the midst of transforming its waste management system from centralised to a decentralised one. Going forward with the decentralized approach, in BBMP area, SWM facilities have been substantially provisioned at the ward, zone and city level. BBMP looks after the collection, transportation, segregation, processing, treatment and disposal of solid waste in the city of Bengaluru. BBMP has established dry waste collection centres, enhanced solid waste collection and transportation activity, mechanical sweeping, bulk waste management and waste processing units using modern technologies like bio-methanation waste to energy plants and vermi-composting facilities.

Essentially, BBMP is aiming at The Integrated Solid Waste Management (ISWM) System – a waste management hierarchy (refer Figure 12-1), to ensure reduction in the amount of waste being disposed (Landfill waste) and maximise resource recovery and efficiency.

Figure 12-1: Integrated Solid Waste Management System Hierarchy



Source: BBMP

In Panchayath areas within BMA, reliable information about the management of waste is not readly available. However, the comprehensive socio-economic household survey suggests that 14% of the households in these villages have access to waste collection system. Hence, the existing Status on Solid Waste is limited to BBMP. However, forecasts and demand estimates are for the entire BMA

(including part of BMICAPA). In view of the above, to attain a sustainable solid waste management system in Bengaluru, BBMP has adopted the following Approach and Strategies within its jurisdiction.

a) The Approach:

Reduce – Reuse – Recycle (3R approach): The 3R Approach is aimed at optimising SWM management from all the waste-generating sectors and involving all the stakeholders (waste generators, service providers, informal sector, regulators, government, and community or neighbourhoods). The adoption of 3R minimizes the waste being handled by the local bodies (BBMP/GPs), minimizing public health and environment risk associated with it.

b) Strategies:

- Decentralised SWM Systems: In order to reduce the burden of unscientific handling of large volumes of MSW, the city has opted to shift its focus from a centralised 'single stream' collection and 'Landfill disposal' system to a decentralised 'multiple stream' collection and scientific 'Processing' system.

- Separating Bulk Generators: Bulk Generators contribute to 25% of the city's waste and have been separated from the regular collection cycle. They include domestic generators - apartment complexes with more than 50 units and Commercial bulk generators viz. hotel/ restaurant, clubs, factory, choultry, mall, shopping complex, marriage halls, convention hall, place of worship, institution, office establishment, railway stations, bus stand or any other commercial or public entity which accumulates MSW of a quantity not less than 10 kg per day. These generators are being mandated to set up in-situ systems or link with BBMP empanelled vendors to manage their waste.

- Micro plan: A Micro Plan is a process of creating a solid waste management plan for the smallest unit of management, by splitting the ward into blocks (750 Households + shops). City-wide implementation of the micro SWM plan is already being rolled out in the BBMP area.

The master plan proposes that similar approach and strategies be followed by respective Gram Panchayats in consultation with various stakeholders including ward committees and SWM experts within LPA of BDA for better synchronisation synergies and optimisation of resources. With this background, the RMP 2031 has analysed the existing status of SWM within BMA and has formulated the proposals for allocation of land for SWM facilities in consultation with BBMP.

12.2.1 Municipal Solid Waste Generation

As per the assessment and quantification of municipal solid waste generation carried out by BBMP in the year 2016, the waste generation rate in BBMP area is approximately 564 grams/capita/day (gcpd). In addition, the villages administered by the Gram Panchayath's are expected to get further urbanised/ populated by 2031 with planned development as envisaged by RMP-2031 and therefore, similar estimates have been made for areas outside BBMP.

RMP 2031 has considered waste generation growth rate at 1.3% per annum on the base of 564 gcpd to estimate per capita waste generation by 2031. RMP 2031 estimates that about 13911 tonnes per day of Municipal Solid Waste (MSW) will be generated in BMA by the year 2031 (**Table 12-1)**.

Table 12-1 Waste Generation Estimates for BMA

Year	MSW gpcd @ 1.3% growth p.a.	BBMP Area (8 zones; 198 wards)		Outside BBMP Area (50 Gram Panchayath's; 251 Villages)		BMA (BBMP area + Villages)	
		Projected Population	MSW generation (TPD)	Projected Population	MSW generation (TPD)	Projected Population	MSW generation (TPD)
2016	564	10207062	5757	844837	476	11051899	6233
2021E	602	12164520	7318	1386925	834	13551445	8153
2026E	642	14026694	9002	2590119	1662	16616813	10664
2031E	685	15480378	10597	4840427	3314	**20320805**	**13911**

Source: BBMP

-gpcd: gram per capita per day (as per 2016 waste assessment carried out by BBMP)
-gpcd for BMA is calculated as per gpcd considered for BBMP area
-TPD: Tonnes per day
-Municipal Solid Waste (MSW) comprises of: Residential HH; Small commercial establishments, Bulk generators; Street Sweeping
-MSW excludes Construction & Demolition Waste [estimated to be around 1500 to 2000 TPD (2016 assessment)
E-estimates

12.2.2 Waste Streams & Composition – BMA

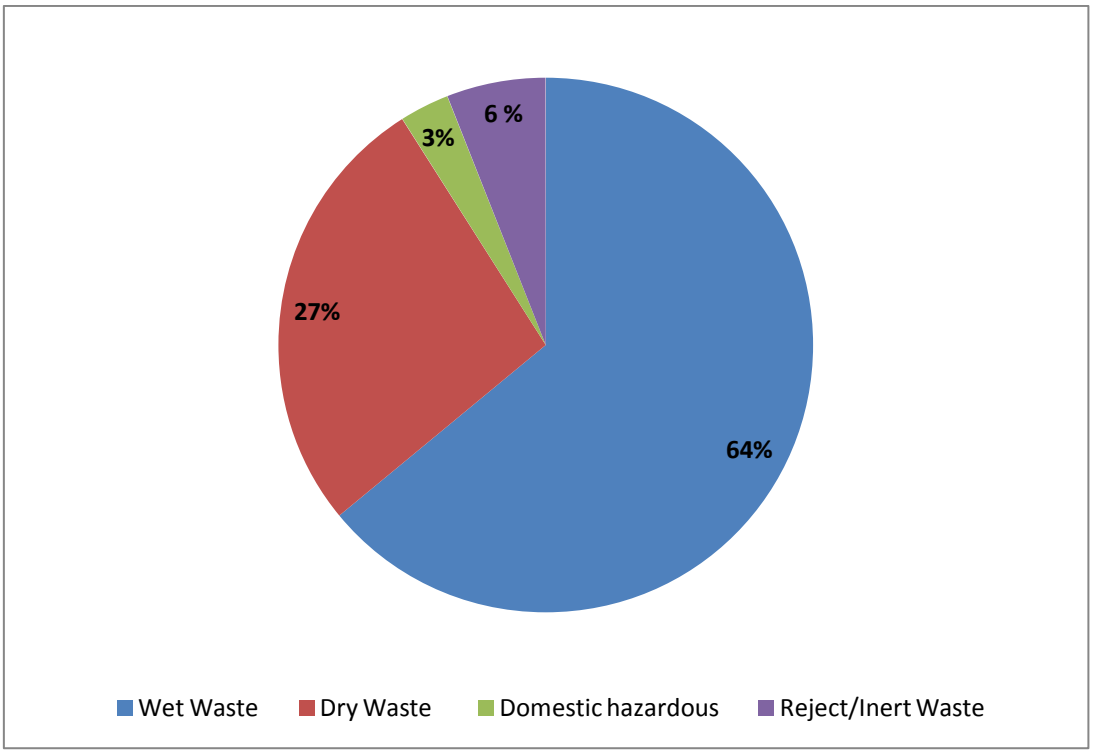
In line with the SWM Rules 2016 and micro assessment carried out by BBMP, the 4 basic streams of waste identified are as follows. Subsequently, the waste composition for BMA (assuming same for outside BBMP area) is depicted in Figure 12-2.

- Wet Waste: Any organic material that can be degraded by micro-organisms into simpler stable compounds. It includes household kitchen waste, food waste from small hotels and bakeries and garden waste.
- Dry Waste: Waste other than food waste and inert and includes recyclable waste, non-recyclable waste, combustible waste and sanitary waste
- Domestic Hazardous Waste: comprises sanitary and bio-medical waste. This includes hygiene products like sanitary napkins and baby or adult diapers contaminated with blood, urine and faeces; and bandages and sharp objects like syringes and needles
- Inert/Reject Waste: includes street sweeping inert (like silt from drains) and post processing rejects from the wet waste processing units or dry waste collection centres. It does not refer to mixed waste or construction and debris waste.

In addition, other waste streams that are being addressed in terms of segregating, collecting and processing are:

- Coconut Waste: This includes the exterior shell of tender coconut left over after the water is consumed
- Leaf/Garden Waste: This is all horticulture waste and includes leaf litter, garden pruning, and branch cuttings.

Figure 12-2: Waste Composition - BMA



The waste composition is the basis of projections-stream wise projections for entire BMA. Table 12-2 provides the estimated quantum of wet, dry, domestic hazardous and reject waste generation in the year 2031.

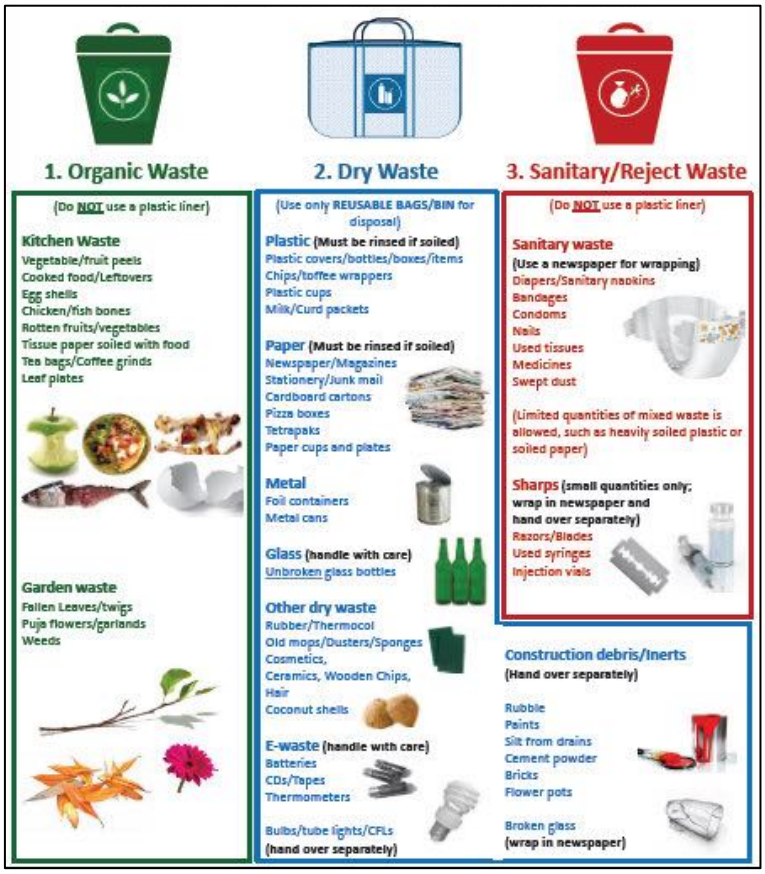
Table 12-2: Projected Composition of Total solid waste for 2031 - BMA

Waste Streams	Waste Composition	Quantum of Waste Generated (TPD)
Wet Waste	64%	8903
Dry Waste	27%	3756
Domestic Hazardous Waste	3%	417
Rejects/Inert waste	6%	835
Total	100%	**13911**

12.2.3 Waste Segregation, Collection & Transportation

As per the High court directive dated 17 December 2015, 3-way segregation at source (wet, domestic hazardous & dry) for domestic generators and 2-way segregation for commercial generators was mandated and is being implemented.

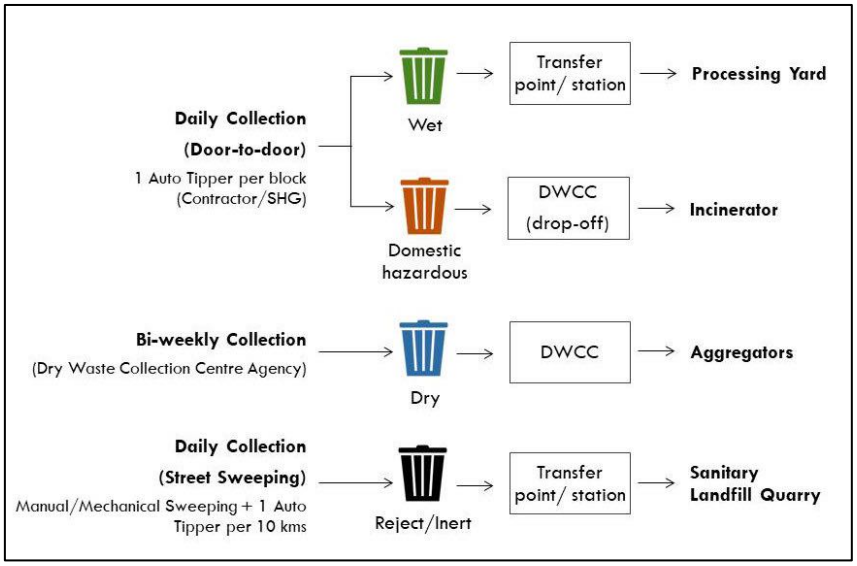
Figure 12-3: Waste Segregation Guidelines



Source: BBMP

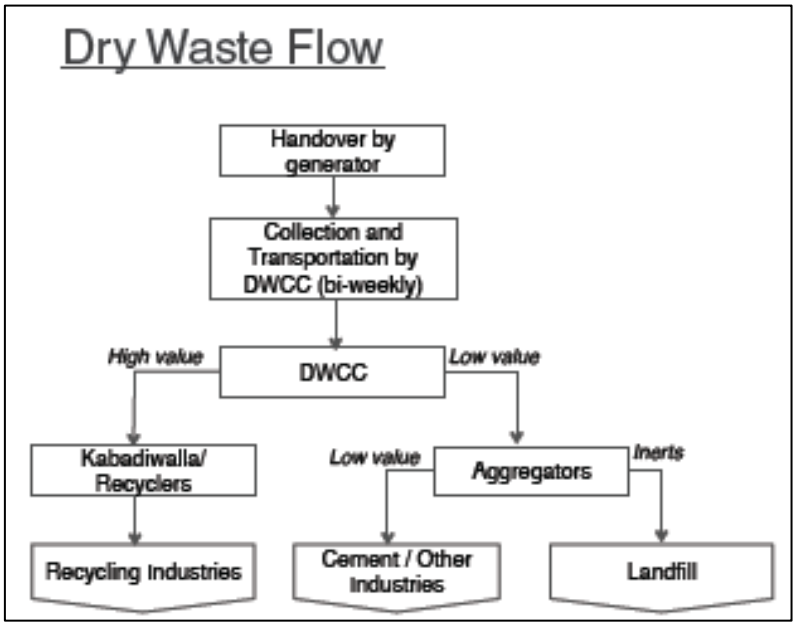
Primary collection & transportation involves three activities - wet and domestic hazardous waste collection (daily), dry waste collection (bi-weekly) and street sweeping (frequency based on road width)

Figure 12-4: Waste Collection & Transportation Process



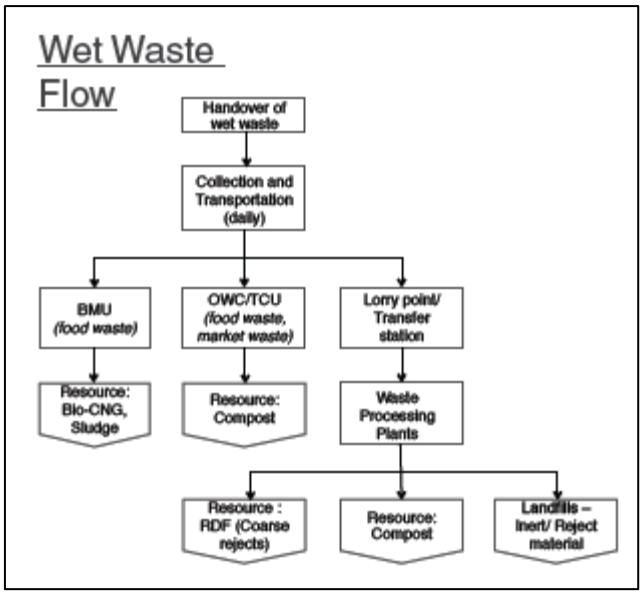
- **Dry Waste:** For recycling of Dry waste in the city, at present there are 196 Dry Waste Collection Centers (DWCC), 1 per ward and large aggregators as per zonal requirement. Out of 27% of dry waste generated in the city, only 36% of it is currently processed**. Figure 12-5** presents the Dry waste flow.

Figure 12-5: Dry Waste Flow



- **Wet Waste:** For city level processing of wet waste, at present there are 11 bio-methanation units (BMU), 7 organic waste converters (OWC) as per ward requirement – small hotels and markets and windrow composting in 9 integrated waste processing plants (IWPP) at the zone level. At present, out of 64% of the total wet waste generated in the city 92.5% is processed in IWPP, 7% in BMU and 0.25% in OWC's.

Figure 12-6: Wet Waste Flow



- **Domestic Hazardous Waste:** At present, out of 3% of the total domestic hazardous waste generated in the city, only 1% of the waste is processed by existing biomedical waste processing agencies.
- **Inert/Reject Waste:** At present, 6% of the total waste generated in the city is inert waste, meaning waste that cannot be further processed or utilized in any other form. This waste is usually termed as Landfill waste as it is disposed of in a sanitary landfill.
- **Facilities required by 2031: Table 12-3** presents the facilities required with BMA for Waste Segregation, Collection & Transportation.

Table 12-3: Proposed Units for processing of Dry waste generated

Particulars	No.s
DWCC (3 TPD to 5TPD) @240 to 480 sqm	470
Aggregators (50 TPD @ 1200 sq.m)	19
BMU (5 TPD @ 600 sq.m)	12
OWC (1 TPD @ 220 sq.m)	85
IWPP (500 TPD @ 97125 sq.m)	8

Source: BBMP and RMP 2031

12.2.4 Waste Disposal

Although Inert waste comprise 6% of the total waste generated at present and the waste to be landfilled should be approx. 10-12% of the total waste however, taking into account post-processing rejects from the wet waste processing units or dry waste collection centres including unprocessed dry waste (~17%) along with construction and debris waste altogether, make up to over 25-30% of the waste going to Landfill.

(a) Processing of Domestic Hazardous Waste generated:

The segregated domestic hazardous Waste (including sanitary waste) will be collected from drop-off locations/points (DWCCs) and further processed by existing biomedical waste processing agencies. The facilities include incinerators, Autoclaves, Shredders and Effluent Treatment Plants to scientifically dispose this waste. There are 3 units to manage bio-medical waste in Bengaluru: 1) SembRamky Environmental Management Pvt. Ltd. 2) Maridi Eco Industries Pvt. Ltd. 3) Anu Autoclave

(b) Lorry Point/Transfer Stations:

A Lorry Point is a point where the transfer of waste takes place from the Primary to the Secondary vehicle, within a ward. These are usually located by the side of the road, vacant sites and in front of decentralised waste facilities. At present, there are 340 lorry points throughout the city. As these Lorry points are informally located within wards, they result in several issues such as garbage on

ground, creation of black spots, resident opposition, etc. Therefore, the city aims to move from multiple informal points to a single built transfer station per ward.

(c) Disposal of Inert/Rejects (Landfill Waste):

BBMP has identified 3 abandoned quarries, which are currently been designed as Sanitary Landfills. It will receive only the following types of waste:

- Comingled waste (mixed waste) not found suitable for waste processing
- Pre-processing and post-processing rejects from waste processing sites
- Non-hazardous waste not being processed or recycled

As per BBMP, the three Landfills available have a total capacity of approx. 1460 TPD. Significantly, this capacity can address the quantum of waste to be landfilled upto 2031. However, this is a far-fetched assumption as this is only feasible if the rejects/inerts to be landfilled are 10-12% of the total waste generated, which in its entirety is dependent on factors such as:

- 100% Segregation of waste
- Waste processing/treatment achieved as per ISWM hierarchy, SWM rules 2016
- High recycling and waste diversion rate
- Processing and disposal of Construction & Debris Waste as per C&D rules, 2016

Moreover, keeping in view the fact that finding new sanitary landfill sites in Bengaluru is becoming extremely difficult, there is no option, but to resort to the strategy (decentralized) as developed by BBMP at the micro-level. This in turn, has led to the need for a new approach in Solid Waste Management as the city plans its shift towards 'A Future with No Landfills'.

Landfill area requirement: Considering active period of the Landfill as 20 years, it is estimated that about 220 ha of land (25% additional services) will be required to landfill the rejects generated in BBMP area. These estimates have been made by taking into consideration the waste being landfilled at 25% of the total waste during (2011-2018) after which computations have been made keeping in view the ongoing interventions (decentralized approach), if successful will yield only 12% of rejects from the total quantum of waste generated.

12.3 Construction & Demolition (C&D) Waste

Wastes generated from building materials, debris and rubble resulting from construction, re-modelling, repair and demolition operation is termed as C&D waste. It excludes steel, aluminium, wood and other components currently being salvaged for reuse or recycling. In exercise of the powers vested under section 256 of Karnataka Municipal Corporations Act , 1976 (Karnataka Act, 14 of 1977) and enabling provisions U /s 257 and 260 of the said Act, a public notification regarding separate collection and disposal of Construction and Demolition Waste or Debris within the BBMP area , w.e.f. 01-03-2016 along with the guidelines have been issued.

As per BBMP and other studies it is estimated that around 1500-2000 TPD of C&D waste is generated daily in Bengaluru as of 2016. To manage the C&D waste BBMP has identified seven C&D waste management site for BBMP zones.

Table 12-4: Approved C&D waste management sites designated by BBMP for each zone

Sl No.	Name of the location	Address	Extent of area in acres	Nearby zone
01.	Mallasandra	Sy. No. 33, Mallasandra grama, Yeshwanthpura hobli Bangalore, North Taluk	30	R.R. Nagar/West
02.	Kadu Agrahara	Sy. No. 34, Kadu Agrahara grama, Bidhrahalli hobli, Bangalore East Taluk	18	Mahadevpura
03.	Srinivasapura & Kogilu	Sy No. 15, Srinivasapura & Kogilu grama, Yelahanka Hobli, Bangalore North Taluk	10	Yelahanka
04.	Gollahalli	Sy No. 58, Gollahalli grama, Uttarahalli Hobli, Bangalore South Taluk	60	Bommanahalli & South
05.	Kannur	Sy. No. 50, Kannur grama, Bidhrahalli hobli, Bangalore East Taluk	50	East
06.	Guddadahalli	Sy.No. 43, Guddadahalli grama, Hesaraghatta hobli, Bangalore North Taluk	46.31	Dasarahalli
07.	Mittaganahalli	Sy.No. 02, Mittaganahalli grama, Bidhrahalli hobli, Bangalore East Taluk	10	East/Mahadevpura

Source: BBMP

12.4 Power Infrastructure

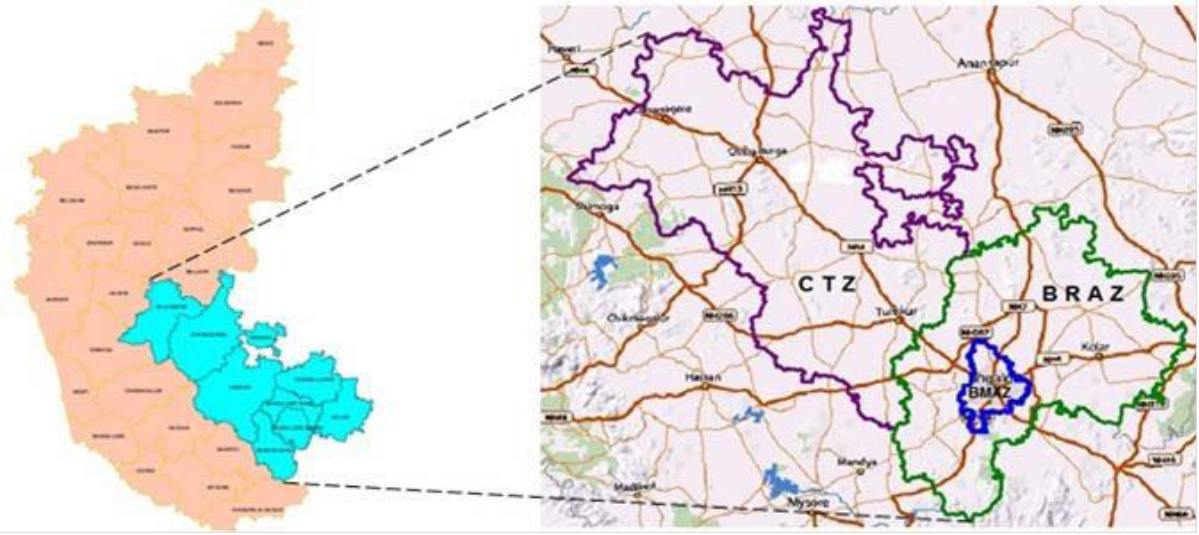
12.4.1 Existing Situation and Trends

Bengaluru, with almost one third of state's demand/ consumption is the largest power consumption centre in Karnataka. With the rapid change and growth in Bengaluru the demand for power supply is also ever growing. Karnataka Power Transmission Corporation Limited (KPTCL) and Bangalore Electricity Supply Company Limited (BESCOM) are responsible for powering Bengaluru city. While KPTCL is responsible for transmission (upto and including 66kv lines), BESCOM is responsible for distribution and supply (below 66kv lines).

BESCOM has 3 operating Zones – Bengaluru Metropolitan Area Zone (BMAZ), Bengaluru Rural Area Zone and Chitradurga Zone. BMA is covered by BESCOM BMAZ and BRAZ. BMAZ of BESCOM is divided into twelve divisions which includes – i) Indiranagar, ii) Shivajinagar, iii) Vidhanasoudha, iv) Hebbal, v) Malleshwaram, vi) Peenya, vii) H.S.R. Layout, viii) Jayanagar, ix) Koramangala, x) Kengeri, xi) Rajajinagar and xii) Rajajeshwarinagar.

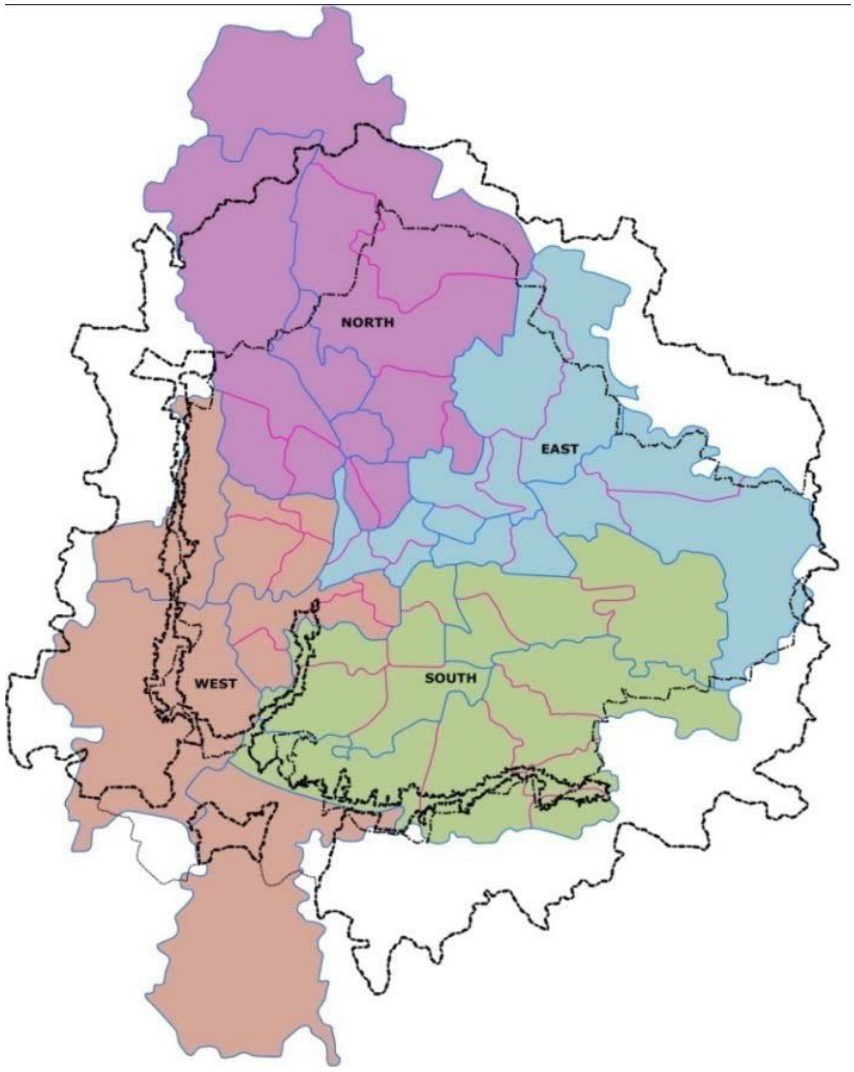
Figure 12-7 presents the BESCOM administrative zones, whereas **Figure 12-8** presents overlay of the BESCOM BMAZ and BMA.

Figure 12-7: BESCOM Zones



Source: BESCOM

Figure 12-8: BESCOM BMAZ and Bengaluru Metropolitan Area Overlay



Bengaluru is powered by the same southern grid that supplies to the entire state. The sources include hydel, thermal and non-conventional sources like wind and solar. Karnataka state gets power from Central Generating Stations (CGS), Hydel Power Stations and Thermal Power Stations within the state. There are no dedicated power plants/ generation centres for Bengaluru.

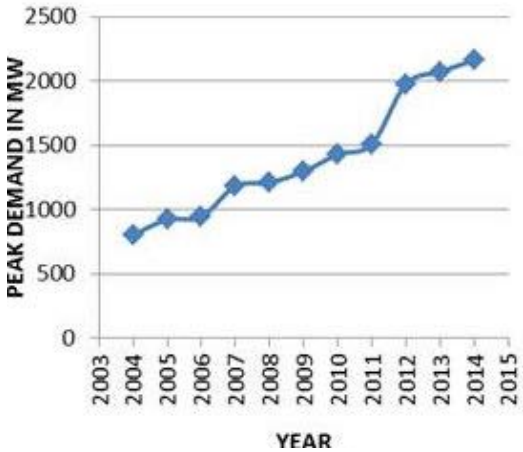
The total peak power demand for Bengaluru (BMAZ) stood at 2579 MW (2015-16) and the energy consumption is at 13885 MU. The average growth in peak demand during 2004 to 2015 has been 11.6% per annum (CAGR), while the Energy Demand has increased by 9.5%. The Per capita energy consumption has increased from 827 units in 2005 to 1219 units in 2014 with CAGR of 4.4%.

Table 12-5: Summary of Power Consumption Trend for BMAZ

DESCRIPTION	Growth Rate (2004 TO 2015)
Peak Demand	11.6%
Energy Demand	9.5%
Per Capita Consumption	4.9%

Source: 19th EPS, KPTCL

Figure 12-9: BMAZ Peak Demand (2004-2015)



YEAR	BESCOM Peak Demand in MW	BMAZ Peak Demand in MW
2004	1608	804
2005	1843	921
2006	1888	944
2007	2364	1182
2008	2418	1209
2009	2592	1296
2010	2856	1428
2011	3019	1510
2012	3953	1977
2013	4144	2072
2014	4321	2161

Source: 19th EPS, KPTCL

BESCOM BMAZ has over 45.26 lakhs consumers (as on March 2014) of which domestic and commercial constitutes 92% (80.2% and 11.8% respectively) whereas industrial and agricultural consumers are negligible. Consumers of electricity in BMA include low-tension (LT) consumers – domestic, commercial, agriculture, industries and miscellaneous categories and high tension (HT) consumers – residential apartments, industries, commercial, irrigation, water supply.

The power supply to Bengaluru is made through four 400/220kV power stations located at Hoody, Nelmangala, Bidadi and Somanahalli. Further, electric supply to different parts of the city is made through 220/66kV sub stations, which are equally distributed to all parts of the city. The power

supply to consumer is supplied after being stepped down voltage through substations; primarily at 11kV, however 33kV power is also supplied to bulk consumers/industries. BMAZ has 4 of 400/220kV Substations, 25 of 220/66kV Substations and 52 of 66/11kV Substations having total installed capacity of 13245 MVA. There are 2801 numbers of Distribution Transformers within BMAZ. Further, KPTCL has planned 18 sub-stations of different capacities (400kV, 220kV, 66kV sub-stations) in BMA Zone of BESCOM.

In general, the present transmission and distribution infrastructure is inadequate to meet the un-restricted peak hour demand given the fact that around 25 out of 62 substations would require immediate augmentation along with associated distribution network.

12.4.2 Power Demand/ Forecast and Land Demand

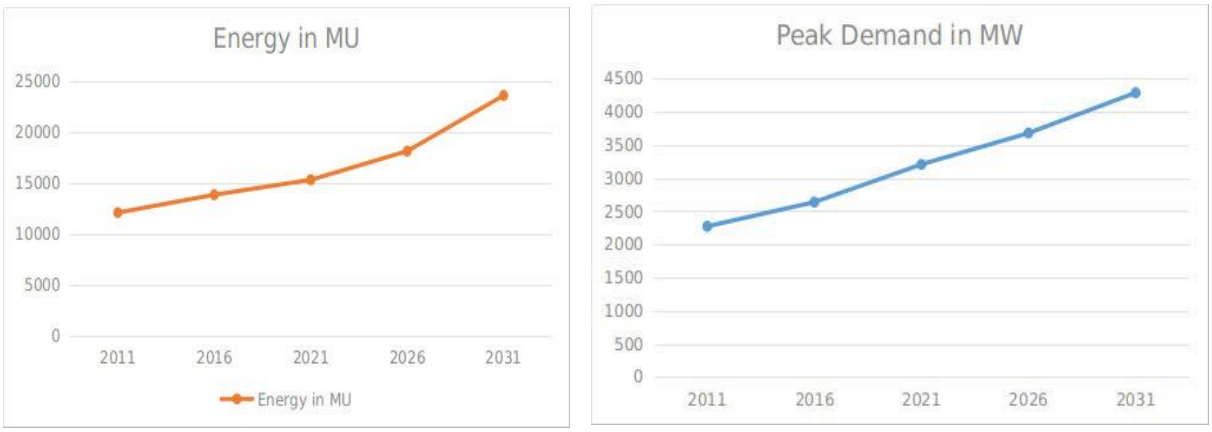
Based on the 19th Electricity Power Survey, Central Electricity Authority (CEA), requirement of power for Bengaluru in the year 2026 as projected by the KPTCL is 3680 MW, the estimated peak demand for 2031 is 4288 MW (say 4300MW). To meet the additional requirement of 1720MW, the KPTCL & BESCOM need to augment the power supply and improve the transmission and distribution system. The additional power requirement is expected to be met from allocated share from the grid system and generation at state level.

Table 12-6: 19th Electric Power Survey Forecast for Energy and Peak Demand for BMAZ

YEAR	2011	2016	2021	2026	2031 (extended forecasts)
Energy in MU	12129	13885	15349	18174	23638
Peak Demand in MW	2273	2639	3207	3680	4288

Source: KPTCL

Figure 12-10: 19th Electric Power Survey Forecasts for BMAZ



Source: KPTCL

In order to meet the future power demand, it is recommended that The Government of Karnataka enter into power purchase agreements with power generating companies and/ or establish power generation plant for effectively meeting Bengaluru's long term power demand. The power

infrastructure and land required for power infrastructure has been planned based on CEA planning norms recommending planning for 200% of peak demand. Accordingly, it is estimated that in addition to existing infrastructure, 2 of 400/220 KV, 39 of 220/66KV and 68 of 66/11KV substations are required. It may be noted that some of the additional requirement are already in the process of being implemented. **Table 12-7** provides the summary of required sub-stations.

Table 12-7: Details of Existing and Additionally Required Sub-Stations

Description	No. of Substation Existing in 2016-2017	No. of additional Substation Required by 2031
400/220kV	4	2
220/66kV	14	39
66/11kV	80	68

Note: Additional substation required also includes substation proposed by KPTCL

It is estimated that about 7.2 hectares of land is required for 400/220kV substation, 13.5 hectares of land is required for 220/66kV substation and 12.34 hectares of land is required for 66/11kV substation. The land estimates has been done with the assumption that all future sub-stations would be GIS based, thus reducing the land requirement. **Table 12-8** presents the land requirement considered for each substation.

Table 12-8: Land Requirement of Sub-stations

Substation	Land required for GIS (ha)	Land required for AIS (ha)
400/220kV Substation(GIS)	3.64	16
220/66kV Substation(GIS)	0.48	4
66/11kV Substation(AIS)	0.202	0.25

It is proposed that major transmission network would be developed within the Right Of Way of proposed master plan roads and would follow short route method in agriculture zone. The grid sub-stations has been identified and land has been allocated in the master plan and shown at Planning District level proposals. The safe distance for developments along the transmission lines should adhere to Indian Electrical Rules, 1956. The vertical & horizontal clearances from buildings along transmissions lines shall be as given in Table below.

Table 12-9: Indian Electric Rules, 1956 prescribed Safe Distance for Buildings

BUILDING CLEARANCE	66kV	230kV	400kV
Vertical Clearance	3.969(13')	5.488(18')	7.318(24')
Horizontal Clearance	2.14(7')	3.66(12')	5.489(18')

Source: Indian Electric Rules, 1956

In addition to existing 4 and 2 planned 400/220kV substations, 2 more such sub-stations are required for BMA and some of them are required to be established outside BMA and within other local planning area of Bengaluru Metropolitan Region (BMR). Potential Locations for establishing

these sub-stations are Devanahalli and Jiganii. It is therefore required that BMRDA and KPTCL coordinate for allocation of Land in other LPAs within BMR for establishing 400/200kV sub-stations.

12.4.3 Use of Renewal Energy

In order to reduce the dependency on fossil fuels and attend energy efficiency it is critical to attend the following:

- Non-conventional energy sources like recovering energy from municipal waste, sewerage, solar energy, etc. should be used for street lighting, lighting at public spaces, open areas, traffic signals, hoardings, etc.
- To supplement part of the estimated growing power requirement, nonconventional sources / solar energy and other actions proposed are as follows:
    - Solar energy should be encouraged for all establishments with floor area of more than 300 sq.mt.
    - All public buildings to install roof top solar panels and use CFL blubs.
    - Solar Panels for public advertising, lighting in open areas, public utilities, streets, etc.
    - As alternate mandatory arrangement during power cuts to replace generators/inverters etc.
    - Interim solutions of single point connection in unauthorized developments and slums.
    - Incentivizing energy savings and use of energy efficient gadgets.
    - Promotion of Battery Operated Vehicles and Non-motorized Transport.

It is proposed that a Government of Karnataka prepares a detailed Renewal Energy Master Plan for Bengaluru and implements the same for long term energy savings.

12.5 Social Infrastructure

RMP 2031 envisages good quality of life in the city with accessible social infrastructure for all citizens. As the city grows rapidly, there will be need to expand the number of social infrastructure facilities like educational infrastructure, healthcare infrastructure, recreational infrastructure, safety and security infrastructure, and other necessities like neighbourhood amenities, opens spaces etc.

12.5.1 Educational Infrastructure

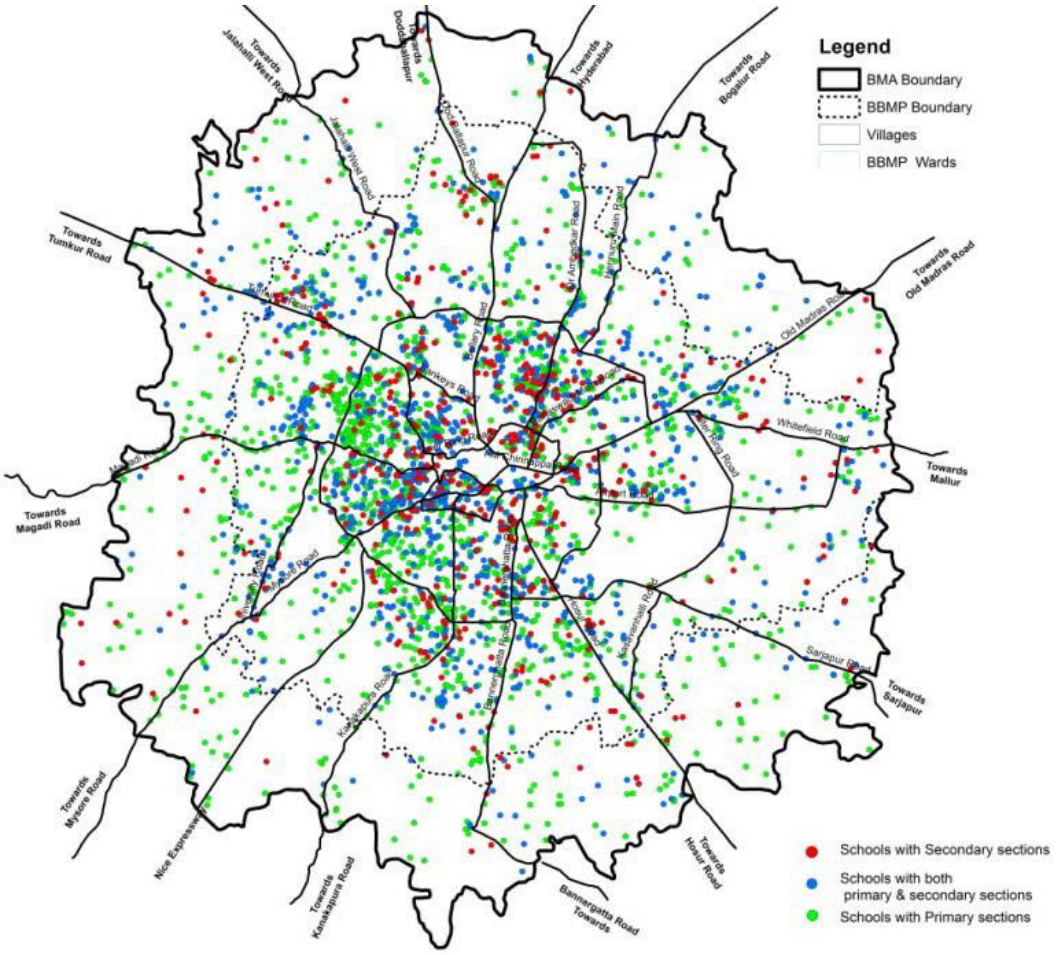
Primary and Secondary Educational Infrastructure: Bengaluru has very good educational infrastructure in comparison to the rest of the state. For the purpose of administration, the education department categorises schools under various educational districts. Table 12-10 shows the number of government and private schools across various categories in Bengaluru Urban District, whereas Figure 12-11 presents the spatial spread.

Table 12-10: Number of existing government and private schools in each category

Sl. no.	Category of School	Classes	No. of Gov. Schools	No. of Private Schools/ Others	Total No. of Schools
1	Primary , Upper primary and secondary	*1 to 10*	15	894	909
2	Primary , Upper primary, Secondary, Higher Secondary	*1 to 12*	9	777	786
3	Primary	*1 to 5*	670	493	1163
4	Primary , Upper Primary	*1 to 7/ 8*	712	1116	1828
5	Secondary	*9,10*	146	448	594
6	Secondary and Higher Secondary	*9 to 12*	14	18	32
7	Upper primary, Secondary, Higher Secondary	*6 to 12*	1	6	7
8	Upper primary, Secondary	*6 to 10*	4	11	15
9	Upper Primary	*6 to 7 / 8.*	0	8	8
	Total		**1571**	**3771**	**5342**

Source: E-Governance Unit, Department of Public Instruction (2014-2015) and Consultants Analysis, 2015

Figure 12-11 Spatial spread of schools within Bengaluru Metropolitan Area



A gap analysis study shows that most inhabited areas in BMA have access to a primary school within 1 km radius. The schools also face challenges like traffic safety and congestion during the schools hours.

The RMP 2031 envisages development of new schools in the transitional periphery zone of BMA. The educational infrastructure in the inner and outer core may be reinforced by provision of playground spaces wherever possible. Presently there are no gaps, and all areas are adequately covered by schools. There is less concentration of schools outside the outer ring road presently. However the city needs more government schools to be more inclusive. It is expected that land areas of government schools is met by the land ceded to the BDA under C.A site.

Higher Education Infrastructure: Bengaluru plays a role of primacy in the state of Karnataka, in the education sector. Bengaluru Metropolitan Area (BMA) has a fair share of institutes of higher education and professional institutions. Bengaluru is a hub of higher education in the country with a high number of colleges and professional institutes.

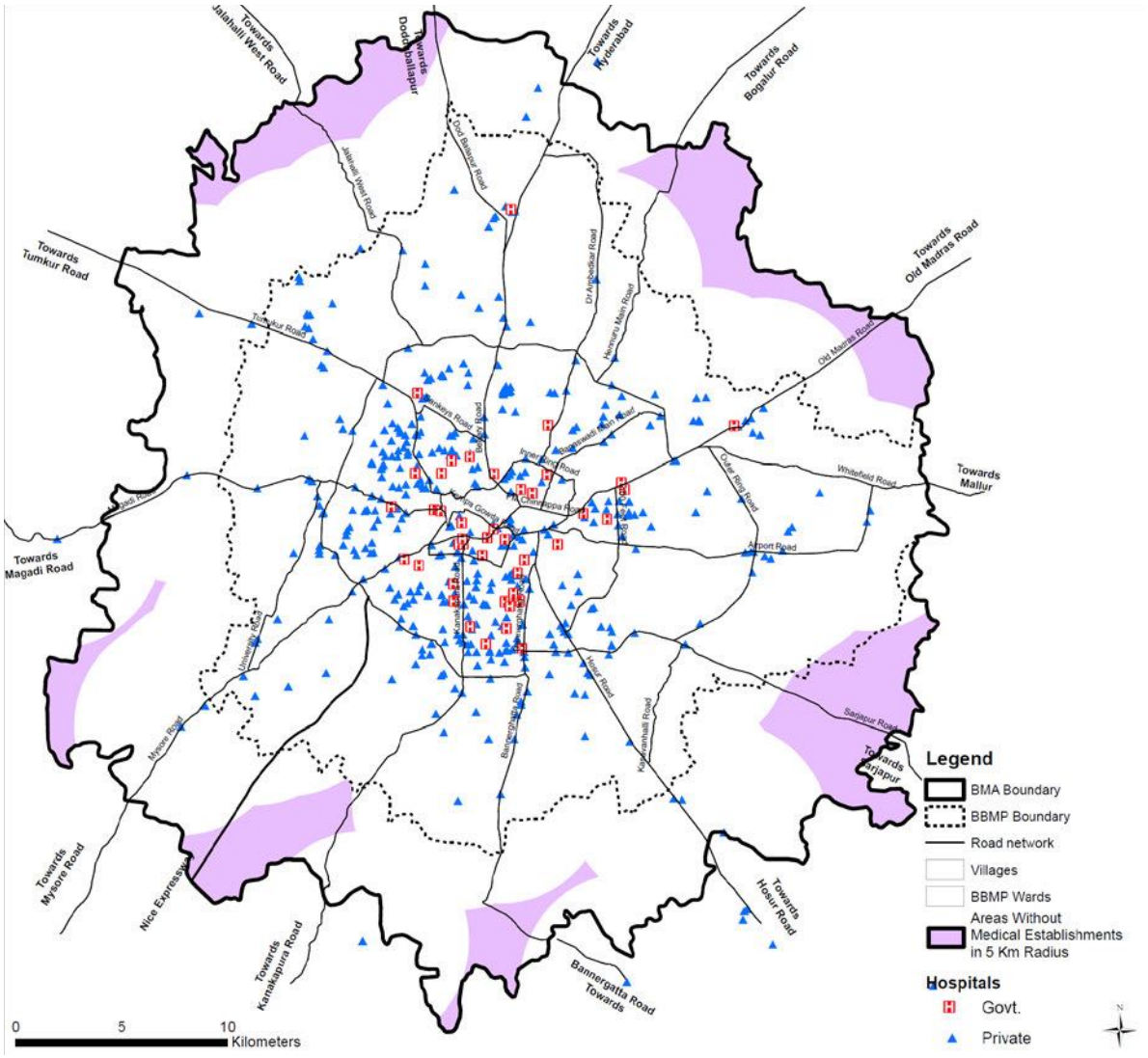
12.5.2 Healthcare Infrastructure:

Accessible health infrastructure is a necessity for welfare of the residents. The city of Bengaluru has a high concentration of healthcare facilities in the BBMP area. Bengaluru serves as a tertiary healthcare centre for the surrounding region with several tertiary and referral hospitals in the city. Bengaluru has many super speciality and multispecialty facilities which also make it a healthcare tourism destination. The BBMP runs several government hospitals, maternity centres, and healthcare centres within the erstwhile BBMP areas. The rest of the BMA is served by healthcare infrastructure run by the department of health and Family Welfare. Private healthcare facilities are spread around the city. Most of the large referral and tertiary care hospitals are located within BBMP and concentrated in the core areas within the outer ring road

Gaps: There are several pockets in the peripheral areas of BMA, which are more than 5kms away from a healthcare facility. With the increasing traffic congestion, and reducing vehicle speeds in the city, the accessibility to medical facilities has reduced even in some of the core areas in Bengaluru, especially for people living far away from healthcare centres. The access to tertiary healthcare is a major gap in the peripheral areas of BMA.

RMP 2031 proposes that government run public healthcare facilities be opened in some of peripheral areas of the city outside the BBMP so that no area is more than 3 Kms away from a government healthcare unit.

Figure 12-12: Healthcare Facility Accessibility



Source: RMP 2031, District Health Officer, BBMP,

12.5.3 Public Open Spaces

Bengaluru has public open spaces like Cubbon Park, Lalbagh, several city level and neighbourhood level parks, as well as other accessible open spaces. The loss of green cover in the city in the last decade is a major cause of concern. While there are large city level parks and neighbourhood parks in the core areas of the city, there is a lack of playgrounds in the city. The peripheral areas which lack large parks or playgrounds, give an opportunity for the same to be developed in a systematic way, owing to availability of vacant lands and buffer areas along the lakes and streams. RMP-2031 proposes regional parks and city level public open spaces. These open spaces shall conserve the greenery, lake buffers and eco-sensitive areas, while also providing recreational benefits to the residents of the city. The RMP 2031 also envisages development of playgrounds and sports centres in the city, in the peripheral areas, which are easily accessible to the public. The need of playgrounds

in the neighbourhood is stressed upon, and neighbourhood level parks along with playgrounds are to be developed in all proposed residential areas.

Table 12-11 outlines the various categories of Parks and Open spaces and the nature of each type of open space.

Table 12-11 Categories of Parks and Open spaces

S.No.	Park Categories	Approx Area	Examples in Bangalore	Broad nature of the environment	Active Recreation spaces	Passive Recreation Spaces
1	Regional Parks	200 – 400 Acres	Cubbon Park ~ 300 acres Lalbagh ~ 240 acres	Largely natural, in eco sensitive areas, with riparian buffers.	Very limited, in areas other than no development zones.	Prominently more
2	City Parks – Planning District Park	50 – 150 Acres	Freedom Park ~ 21 Acres	A combination of natural areas and activity areas like playground, running tracks.	Several active recreation spaces available	Passive recreation spaces available.
3	Sporting Facilities	10 to 50 Acres	Kanteerava stadium	Mostly intense activity areas with some amount of natural landscaping and lawns.	Prominently more	Very limited passive recreation facilities
4	Multipurpose Grounds / Play grounds	5 to 10 Acres5 acres and above	Several local level grounds present	Mostly intense activity areas with some amount of natural landscaping and lawns.	Should facilitate active recreation when necessary	Should facilitate passive recreation like jogging and walking etc.

Regional Parks: 8 Regional/ Large Parks and are proposed to be developed as natural areas to provide recreational space and also safeguard the fragile lake and stream system.

12.5.4 Sports Complex (city level sports facilities)

Sports facilities proposed in the revised RMP 2031 would be public spaces supporting active recreation and catering to a range of activities and games including badminton, tennis, cricket, football, basketball, table tennis, fitness, gymnastics etc. These facilities may be provided as standalone sporting facilities or as additional sporting facilities to larger parks open spaces and multipurpose grounds. RMP 2031 proposes development of 4 large sports complexes across BMA.

12.5.5 Fire Stations

Fire stations are critical infrastructure that needs to be present in every planning district. An optimum distance for fire station is 10.5 sq km radius, but the frequency of fire stations need to be more in high density areas due to increase of risks. Bengaluru has 19 fire stations, mostly located in the core areas.

As per the requirement of Karnataka Emergency and Fire Services Department 16 new fire stations have been incorporated in RMP 2031. In addition, RMP 2031 has identified additional fire stations and defined in Proposed land Use map as Public and Semi-public use.

12.5.6 Art and Cultural Infrastructure

Bengaluru is an important centre of art and culture with several prominent art schools, performance spaces and cultural hubs. Bengaluru is the capital of the Kannada cinema industry, and an important theatre and drama hub in the country. The city has several art installations, and hosts street art festivals along with formal events like art exhibitions, book fairs etc. Formal and informal spaces must be provided for art and culture to thrive city. Informal spaces include street pavements, plazas, open spaces, parks and open spaces etc. Formal spaces like art galleries, museums, performance spaces, outdoor spaces like open air theatres, cinema halls etc must be provided in all planning districts.

12.5.7 Markets

Markets, both formal and informal, are needed at accessible distance. While the core areas of the city have very good market facilities, such facilities must be provided in the outer areas. Each market must also have space for informal vendors and vendors who sell occasionally or seasonally. It is proposed to develop markets along with logistic hubs and in the planning districts which are devoid of markets.

12.5.8 Cemetry and Graveyard

Bengaluru has limited number of cemeteries and graveyards. Most of the graveyards in the city have reached the threshold. More number of graveyards is required in the city and the outer areas. RMP2031 proposes development of burial grounds, cremation ground/ cemetery in each planning district.

12.5.9 Night Shelters

RMP 2031 proposes that adequate number of night shelters be developed based across BBMP depending on the requirement by BBMP for the urban poor.

12.5.10 Women's Hostels

Bengaluru attracts many people from other parts of the state and the country who come here to study and work. Women, especially from poorer families find it very difficult to find a safe place to stay while they work or study in the city. RMP 2031 proposes development women's hostels for working women and female students in each planning district that would provide affordable and safe accommodation to women.

13 DISASTER AND HAZARD MANAGEMENT

13.1 Introduction

Bengaluru has been experiencing very high rates of urbanisation and population growth. Parts of the city are vulnerable to several natural and manmade disasters in varied degrees. Urban flooding, wide spread pollution and scarcity of water are some of the challenges the city faces presently. Certain hazards like droughts, earthquakes etc in other parts of Karnataka also have impact on the city. Hazard and Disaster Management as part of the revised master plan is an attempt to understand the hazards, reduce their impact and decrease the vulnerability of the city to these hazards.

13.2 Hazard Risk Assessment

Hazard Risk Assessment includes identification of the major hazards (natural & manmade) affecting the Bengaluru metropolitan area, understanding the risk the city faces from the hazard, and profiling the hazard and its vulnerabilities. Identification of the major hazards in BMA has been done through past occurrences, frequency and impact levels. The physical, social, economic and environmental vulnerabilities of the hazards have been assessed to prepare strategies to reduce vulnerabilities.

13.3 Hazards Affecting Bengaluru

Bengaluru, owing to its location, is not affected by hazards like volcanoes, tsunami and coastal cyclones. The climate in Bengaluru is favourable and it is not affected by extreme temperatures. However, the city is affected by several natural and manmade hazards in varying degrees. Some hazards like earthquake, floods and drought outside BMA/planning area but primarily limited to Karnataka may also affect the city in various ways like in migration from other parts of the state, water scarcity, agricultural scarcity, energy deficit, water deficit and loss of critical supplies to the city. The Hazards affecting the city may be classified into natural and man-made hazards.

13.3.1 Earthquake

Earthquake is a major natural hazard with severe impact and high vulnerability. Bureau of Indian Standards [IS 1893 (Part I):2002], has grouped the country into four seismic zones, viz. Zone II, III, IV and V with zone V being the most seismically active region while zone II is the least. Bengaluru region is located in low seismicity zone (Seismic zone 2). The intervention of the Master Plan is restricted to guidelines that may help reduce vulnerability to an earthquake.

Vulnerability: Since Bengaluru is in a region, prone to low and moderate earthquakes earthquake related environmental vulnerability is less significant. In the event of a medium intensity earthquake in the region, there will be some physical damage to buildings and infrastructures. Economic activities in the city are expected to be disrupted for a short while. There may be loss to life and property depending on the intensity of the earthquake.

Mitigation: To reduce the physical damage, buildings, communication towers and public utility centres, and other critical infrastructure need to withstand damage during an earthquake. Construction rules need to be followed to resist vulnerable condition. All multi-storey buildings must be designed and constructed adopting the norms prescribed in the National Building Code.

13.3.2 Urban Floods in Bengaluru

Urban flooding is a natural hazard triggered by climatic events, and aggravated by human activities and urbanisation. Flooding of major roads, hinder the functioning of smooth traffic in the city, leads to congestion. In the recent past, incidences of flooding have been reported in 2005, 2007, 2010 and 2013 and very prominently in 2017.

The areas which are particularly prone to flooding include parts of the city which lie within the natural floodplains of the river and drainage channels. Several slums and unauthorised developments in low lying flood prone areas make a large population of the city directly vulnerable to urban flooding. Urban flooding occurs due to natural and manmade factors. Some of the major reasons identified for flooding in BMA are as following.

a. **Heavy and incessant rains:** Heavy rainfall event leads to urban flooding. As per the Karnataka State Action Plan for Climate Change, the climate change is expected to affect the rainfall pattern and may lead to several heavy rain events in the future.

b. **Increased urbanisation:** Increased urbanisation has led to significant changes in the hydrologic flow of storm water runoff from developed areas. Effects of urbanisation like increased peak flow; reduced ground water infiltration and diminishing base flow of streams have impacted urban flooding.

c. **Breached water bodies:** The loss of retention basins such as lakes and reservoirs has led to increase in the urban flooding. The breached network of natural water bodies and tanks, which play a major role in storm water drainage and runoff within the city, is leading areas getting flooded during heavy rainfall events. It may be noted here that many of the low lying areas are the locations where slums have developed, leaving a large group vulnerable to floods and epidemics. The loss of lakes and streams this also increased the vulnerability of these areas to urban flooding Also, at several locations, storm water drainage system have been broken/ lost due to developmental activities, which is also contributing to urban floods.

13.3.3 Environmental Pollution

Environmental Pollution includes pollution of air, water and noise within the Planning Area.

Air Pollution: Air pollution is a major hazard that has been growing steadily in Bengaluru. The increased number of vehicles on road, industrial activity, construction activity, poor quality of roads and dust on road add to the suspended particulate matter in air. There are more than 67 lakhs vehicles registered in Bengaluru (March 2017). Old vehicles with worn out engines, adulterated fuels, and slow moving traffic lead to increased emissions. The total emissions in 2015 due to vehicular traffic is estimated at 196 tonnes of CO per day, 50 tonnes of HC per day, 9 tonnes of SPM

per day, and 321 tonnes of NOX per day[23]. Reducing the number of private vehicle trips, and increasing public transport share is expected have a positive impact in reducing the emissions due to vehicular traffic. The vulnerabilities of air pollution include people living along the major roads, travellers, pedestrians and especially children and the elderly.

Water Pollution: Pollution of surface and groundwater is prevalent in Bengaluru. The rivulets Arkavathy, Vrishbhavathy, along with the lakes and the natural streams are highly polluted due to inflow of sewage, industrial effluents and municipal waste. The Dissolved oxygen (DO) level in lake waters is decreasing indicating organic pollution load leading to a phenomenon called eutrophication. Untreated Sewage flowing into lakes cause the lake to decay, and loss of aquatic life. The people living around the polluted lakes are very vulnerable as the area in the vicinity of the lake is covered in foul smell emanating from the lake. The froth and smell affects the commuters and the water pollution has led to ground water getting polluted in the area. Ground water in BMA is polluted due to sewage pollution and industrial pollution, over exploitation of ground water resources and high Nitrate concentration in ground water.

Noise pollution: The sources of noise pollution in BMA are a) vehicular traffic, b) flying aircrafts near airports, c) drilling of bore wells, d) industrial sound, e) construction activities, f) DG sets, g) public address systems, etc. Noise sensitive areas like hospital area, schools and also residential neighbourhoods are witnessing heavy noise pollution due to traffic and unnecessary honking.

13.3.4 Water Scarcity

Bengaluru faces a major challenge in the availability and access to reliable good quality water supply. Water is supplied in the BMA from Cauvery River catchment pipeline systems linked with water storage and replenish-able groundwater resources, all of which are rain fed. The Karnataka State Action Plan on Climate Change[24] has estimated change in rainfall patterns in the future that may have an impact on water availability. Further detailed studies are required in regards to the impact on climate change on the water availability in BMA to fully comprehend this future challenge.

Drinking Water: Peripheral areas in BMA, where Cauvery water is not supplied, is facing acute shortage of good quality drinking water. Considering the demand in BMA and the requirements of Non-Domestic and industrial supplies, total water shortage at present in BMA could be established as 876 MLD. However, with envisaged tapping of additional 10 TMC of Cauvery water, the current demand could be met. Unaccounted flow of water (UFW) has been observed as 46% which is predominantly due to leakages in the old system of the core city area. UFW needs to be moderated to 15 – 20 % on priority. Availability of water in the future shall depend on the population distribution, and reducing losses.

Ground Water: Ground water table in BMA is depleting, increasing the risk of unavailability of drinking water in the future. Urbanisation has increased in the last two decades leading to wiping out of many tanks and lakes that were helpful in maintaining the ground water level. Increased

[23] Estimation is based on Urban Transport Modal built for RMP 2031.

[24] Karnataka State action plan on climate change: by Department of Forest Ecology and Environment-Government of Karnataka.

dependency on water tankers as well as bore wells especially in areas where BWSSB supply is not present. Groundwater levels have fallen steadily as a result of withdrawal for private self-supply and supply through private water tankers. Over exploitation of ground water has led to decrease in water tables and reduction in ground water quality.

As per CGWB net annual groundwater availability in Bangalore Urban district is 11723 ham, total ground water draft for irrigation, domestic and industrial uses is 3794 ham and existing gross ground water draft for all uses is 16,703 ham. Thus, draft exceeds the total available ground water resources leaving absolutely nil ground water resources for future use. In view of the stage of the ground water development to the tune of 128- 176% and over exploitation of ground water resources water level has gone deeper thereby leaving the only solution of building up of ground water resource through artificial recharge and rainwater harvesting. The stage of ground water development in all the four Taluks of the district is above 100% and are in the over exploited category as per the Central Ground Water Authority. Increase in paved areas due to urbanisation and encroachment of catchment areas has led to drying of aquifers.

Drought: Bengaluru is prone to droughts and several years in the past few decades have been declared as drought years for the Bangalore urban district. Droughts occur at approximately fixed intervals, the phenomenon referred to as 'stationarity' in hydrology. Due to changing climate and varied rainfall patterns, it has become difficult to predict a drought by stationarity and hence it is difficult to be prepared for drought. Bengaluru has been declared drought hit several times. Bengaluru is dependent on Cauvery River for drinking water, which is a rain fed, and drought in other regions is likely to have an impact on Bengaluru. Drought in BMA will deplete the ground water resources and lakes, reservoirs, leading to shortage of drinking water. In the outer areas of BMA, drought may affect the availability of water for irrigation, and cattle fodder may also be affected. The people, whose livelihood is based on agriculture and other allied activities in BMA, would be worst hit during a drought. Due to depletion of water resources, there would be shortage of drinking water, which may turn into a health hazard.

13.3.5 Hazards Associated with Waste

Municipal Waste: Solid waste disposal is a challenge in BMA. It is difficult to manage the quantum of waste that is produced in Bengaluru. As per the BBMP, the total waste generated in the BBMP area is about 6233MT, with wet waste contributing upto 64% and 27% of dry waste. Waste mixed with rain water, is a hub of diseases. Stray animals often feed on the waste, further resulting in the spread of diseases. Improper disposal of waste in the landfills leads to Leachate seeping into the soil, which may enter the human food chain and lead to diseases.

Electronic waste: Bengaluru is the IT Capital of India and employs over 8,30,000 people in IT industry with more than 1300 IT/ ITES companies (as per ENVIS news letter dated June 2011) working from Bengaluru. The number of computers and consumption of electronic goods is directly linked to software professionals and rising income which mostly leading to higher generation of e-waste in the city than perhaps any other city in the country. It is estimated that Bengaluru generates close to

199768 MT/ annum (547 MT/ day) of e-waste, which is huge. Of which 45438.5MT/ annum (less than quarter of e-waste generated), is recycled through organised / authorised e-waste recyclers[25].

The majority of e-waste management/ handling and recycling is through informal sector and hence un-regulated. The informal sector handling of e-waste is not always environmentally safe and is leading to environmental pollution and health hazards.

13.3.6 Hazards due to Traffic Congestion

Traffic congestion may be defined as a hazard, considering the impact on human health, productivity, and economy. Traffic congestion gives rise to several other hazards like accidents, road rage, air pollution and also financial losses due to loss of productive time. The average speed of vehicles in the city has decreased due to increased congestion. Reasons of traffic congestion are increased number of vehicles, inadequate or non-uniform road width, poorly designed junctions, poor road surface, and improper traffic management. Rash driving without concern for others on the road leads to traffic grid locks and ultimately congestion. Sometimes, vehicle breakdowns, festivals or rallies etc are responsible for congestion. Congested corridors are also hubs of air pollution due to suspended particulate matter, leading to several health hazards. There is a huge economic loss on account of congestion in BMA.

13.3.7 Fire Hazards

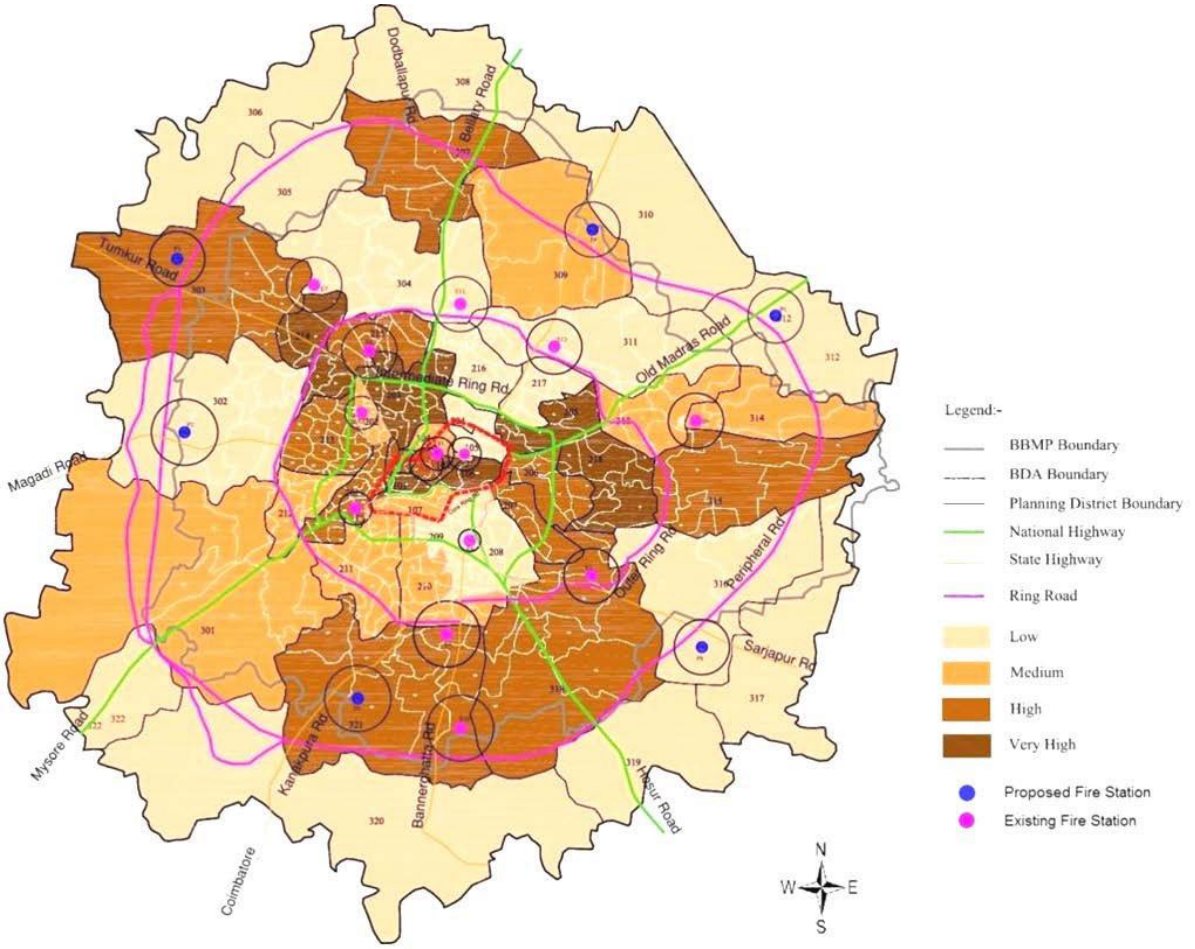
Fire Hazard: The Karnataka Fire and Emergency Services Department (KFES) has carried out an fire risk assessment for entire planning area of Bengaluru, classifying BMA in four fire risk zones – Very High Risk, High Risk, Medium Risk and Low Risk zones, formulated considering factors like population density, concentration of commercial, public assembly, industrial areas and high rise buildings, and major accident hazard units as well as Planning District boundaries of RMP 2015. **Figure 12-1** shows the Fire Hazard risk zones within BMA as per KFES. It can be seen that seven zones are classified under “Very High Risk (Petta, Richmond Town, Malleshwaram, Baiyyappanahalli, Peenya, CV Raman Nagar, Byatarayanapura), 12 as “High Risk”, 10 “Medium” and remaining 9 as “Low Risk” zones. Overall 14 percent of total area is classified as Very High Risk. Thus, many areas in Bengaluru are vulnerable to fire hazards. Fire can easily spread in highly congested areas. Narrow and congested roads also make accessibility for fire tenders difficult in the area. The central market area in Bengaluru, namely the Petta area is susceptible to fire hazards. Markets selling easily inflammable goods are more vulnerable than others. People living or working in high rise buildings, or enclosed spaces, are more vulnerable to fire hazards

Hazards from Electricity: In several places in the city, safety norms as prescribed by Karnataka Power Transmission Corporation Limited (KTCPL) guidelines on safety buffer zones along the HT corridors have not been enforced and developments have been within safety buffer zones of the HT Line. Many buildings have been constructed not only in close proximity but beneath the HT lines, posing a great risk to human life and property. As may be observed, HT lines run over buildings and

[25] http://www.cpcb.nic.in/Ewaste_Registration_List.pdf

unauthorised development under HT lines needs to be checked. Exposed electric wires in several areas pose a high risk in several areas.

Figure 13-1: Areas of High Fire Risk within BMA



Source: Fire Hazard Response and Mitigation Plan for Bengaluru City, KFES

13.3.8 Industrial and Chemical Hazards

Industrial Hazard may be defined as any incident connected with an uncontrolled development (such as leak, fire and / or explosion) of an industrial activity involving a serious immediate or delayed hazard to man and / or the environment. A chemical disaster may take place due to accidental leakage from a facility, accident during transportation of hazardous material through population centres or due to indiscriminate use of chemical agents. Industrial and chemical accidents mostly are a result of human activity and error, though there are several possibilities of Industrial hazards occurring as a result of natural phenomena, such as earthquakes.

a. **Hazardous Industries**: Some of the clusters of hazardous industries are also accident prone. Peenya has a high concentration of Hazardous factories, and major accident hazards. It is noteworthy that Peenya also has several hazardous waste recyclers. The areas, with risk of industrial hazards, have also been considered in the risk assessment for fire safety by the KFES.

b. **Quarrying in urban limits:** Several stone quarry sites are located in BMA which are in close proximity to forest areas such as the Bannerghatta National Park and residential areas. Quarrying activities add to air and noise pollution. Fine solid particles from drilling, blasting and mining are scattered across wide areas and habitations by the wind. Transportation of ore by road adds to the problem significantly. Activities like drilling, blasting, loading and transportation, results in significant noise. Human habitations located adjacent to quarries are especially subjected to high levels of noise. Abandoned quarries are safety hazards for humans. Several unauthorised sites are left abandoned without any precaution, causing risk to humans.

c. **Hazardous Material transportation/ Oil and Gas Installations:** Transportation of Hazardous materials like Oil and gas through pipelines or by tankers on road is a risk and may lead to industrial accidents. Spur lines carrying gas are being laid in Bengaluru that will distribute gas in the BMA. Oil and Gas installations are hazardous in nature and may pose risk to traffic, properties and economic activities in case of burst/ fire in pipelines. Further, highly inflammable liquids and gas storage is done at Devanagonthi, outside BMA. Several oil and gas tankers use roads within BMA, to transport the oil from Devanagonthi depot. Quality of road surface and narrow road widths pose great danger on these roads leading to Devanagonthi from BMA.

13.4 Probabilistic Hazard Assessment

A probabilistic assessment of hazard occurrence for BMA over next 25 to 50 years has been done for natural hazards only as it is not possible to assess the possibilities of occurrence for manmade hazards. The assessment is the compilation of assessment done by various government agencies.

a. Earthquake: Bengaluru lies in a low intensity seismic zone (Seismic Zone II) and is at minimal risk of an earthquake. However, there have been a few incidents of low to medium intensity earthquakes in the region that have affected Bengaluru. There may be a possibility of an earthquake in the Bengaluru region in the next 100 years. Such earthquake may lead to a damage to physical infrastructure, and lead to economic loss. Strict adherence to codes will help reduce vulnerability to earthquakes in the future.

b. Heavy Rainfall Events leading to Urban Flooding: Urban flooding may take place in the future due to heavy rain events in BMA. The clearing of blockage in the rainwater drainage system shall help mitigate some of the urban flooding events. The present infrastructure need to be upgraded to handing very heavy rain events, as such events may cause extensive flooding especially in the identified low lying areas in BMA.

c. Drought: Drought conditions may affect Bengaluru, and will have some impact on availability of water. The change in rainfall pattern in the future shall affect the occurrence of drought. The areas with limited access to the water supply network will have a higher impact from the drought.

Table 13-1 gives a probability matrix of the major hazards that BMA may face in the future. Some events like Earthquakes cannot be predicted. With change of climate and rainfall patterns, it has become difficult to predict droughts too. The probability matrix, gives the risk from each hazard. A general probability analysis for the various natural hazards is given for 25 years, 50 years and 100

years horizon. It may be noted that it is difficult to predict other man made / technological hazards due to the dynamic nature of the associated risks. With newer technology, it is expected that some of the technological hazards may have lower impact in the future.

Table 13-1 Probabilistic Hazard Risk Assessment

	Hazard Identification	Probability				
	Hazard	**Risk to BMA**	**Level of Impact**	**25 years**	**50 years**	**100 years**
1	**Urban Floods**	High	Moderate to High	High Possibility	High Possibility	High Possibility
2	**Earthquake**	Low	Low to moderate	Low to moderate possibility	Low to moderate possibility	Low to moderate possibility
3	**Drought**	Low	Low	Low to moderate possibility	Low to moderate possibility	Low to moderate possibility

Source: Consultant's Analysis.

13.5 Institutional Framework for Disaster Management in BMA

Disaster monitoring Centre: Karnataka State Natural Disaster Monitoring Centre (KSNDMC), an autonomous Body affiliated to Department of Science & Technology, Govt. of Karnataka, monitors natural Hazards and disasters and issues early warnings in BMA as well as for the whole state. KSNDMC issues alerts for heavy rain events, heavy wind etc and monitors rainfall patterns in the state as well as BMA.

Disaster Management Cell: The Disaster Management Act 2005 mandates every district to establish a District Disaster Management Authority under the chairmanship of the deputy chairman or collector and to be co-chaired by the elected representative of the local body.

Bangalore Urban District has a Disaster Management Cell overseen by the Deputy Commissioner of the district. The cell coordinates between various government agencies, organisations, stakeholders and hospitals, in the event of any disaster and manages available resources and manpower to tackle emergencies. Some of the agencies with which coordination is involved during emergency situations are the Karnataka Fire and Emergency Services (KFES), BESCOM, BBMP, and the Bengaluru City Police. In addition, several organisations and service providers have their own disaster management cells that manage the disasters in their respective sectors and services.

13.6 Hazard Mitigation and Disaster Management

The Masterplan recommends the following actions to mitigate the hazards and to reduce vulnerabilities in BMA.

- Effective implementation of National Building Codes for fire safety of buildings.

- Rejuvenating the lake and stream system to their intended volume and flow.
- Using open spaces, parks and playground as a flood protection strategy.
- Strengthening of the public transportation system which will address congestion and air pollution.

To understand the Hazards in detail, the masterplan recommends an in-depth study that shall establish the mitigation measures for all the hazards and disaster that are likely to affect BMA in near future.

As part of strengthening the institutional capacity, the masterplan recommends the District Disaster Management cell to be upgraded to a District Disaster Management Authority and it shall be responsible for preparation of the 'District Disaster Management Plan' and upgrade it regularly in coordination with all the stakeholders, subject experts, government bodies, elected representatives, and citizen groups.

14 HERITAGE CONSERVATION AND PROTECTION

Bengaluru has a rich cultural and built heritage dating back from the Western Ganga civilization (860 A.D.) to the Vijaynagara dynasty (1343 A.D.) to Hyder Ali-Tippu Sultan period (1753 A.D.) and later the during British period (1806 A.D.). It is noteworthy that the settlement of Bengaluru has been in existence for almost four and half centuries. Bengaluru also has a unique landform, as it is located at the ridge that separates the two river basins of the Arkavathi and S.Pinakini rivers. The city since historical times has a well-established system of cascading lakes and tanks developed over centuries. The natural heritage of lakes, heritage buildings/sites, and cultural ethos of the city exhibited through its festivals and cuisine stands testimony to its glorious past.

Conserving this ancient heritage (natural, built and cultural) is imperative as it serves as identity to the city and its origin. Yet, heritage and culture of the city needs to be more than a record of the past that creates urban identities for not only the past and present but also for the future.It is noteworthy that Bengaluru, till date, lacked the formal inventory of its heritage and cultural assets and therefore the RMP 2031 has placed heritage protection and conservation within the overall process of urban development and in course of its preparation.

The city has seen unprecedented growth demographically and spatially since the past two decades, evolving the city into a vibrant cosmopolitan. Under this context it is additionally important to protect its Built-Cultural Heritage. The heritage narrative of Bengaluru has mostly revolved around the four Kempe Gowda's watch towers, Tippu Sultan's Palace precinct, the traditional markets, British era buildings of MG road, Cleveland town / Richards town, Vidhana Soudha and High Court administrative amongst many other buildings, which evoke a sense of pride and ownership among all Kannadigas and residents of Bengaluru.

14.1 Need for addressing Heritage Conservation in BMA

It is essential that the heritage in Bengaluru is safeguarded, conserved and maintained in to order to mitigate and cope with impacts of rapid and fast paced urbanisation. The narrative around Heritage conservation has usually focused at improvements to build form of Heritage Site. It is important to understand that the heritage and cultural preservation/ conservation of heritage precincts do have positive impact on economy, social aspects and environment of the city, though these impacts are long term in nature. Heritage and cultural conservation may lead to boost tourism and helps in educating ourselves about our rich cultural history. Heritage conservation and designation increases property values, both of the restored building and surrounding properties. Thus Heritage preservation & conservation should be an integral part of urban development. However, it is important to note that the objective of the assignment is to prepare the Revised Master Plan 2031 and therefore the assessment of Heritage & Cultural Heritage has been done to evolve guidelines for heritage conservation in line with the provisions of Karnataka Town & Country Planning Act, 1961 (KTCP Act, 1961).

To achieve this, first most it calls for a detailed identification of all types of heritage and listing of the heritage sites/buildings, identification of the heritage listing to heritage zones by specific classifying criteria. This is followed consequently by framing of regulations and guidelines for contextual interventions (inclusive of but not limited to, conservation, restoration related activities) and at the same time regulating the development activities around these heritage sites. Finally, an institutional and enforcement mechanism that will aid in implementation of the various heritage related aspects.

These heritage related aspects needs be addressed and complemented by a comprehensive Heritage Master Plan that requires to be prepared for the entire Bangalore Metropolitan Area (BMA), the purpose of which will be to ensure heritage resources are identified, graded, protected, conserved and the heritage regulations and proposals implemented through an appropriate institutional mechanism. The master plan therefore proposes recommended that the Heritage Master Plan for Bengaluru shall be prepared.

14.2 Identification and Listing of Heritage Sites

It is important to understand Bengaluru's chronology of historical events in order to appreciate the heritage of the city. It also helps in deriving the appropriate approach to assessment of heritage and cultural aspects. **Figure 14-1** presents the Chronology of history and evolution of the heritage of Bengaluru City.

14.2.1 Brief Historical Context of Bengaluru

Initial Settlement of Bengaluru: The earliest reference to Bengaluru as a settlement has reference in the 8th century (890 AD) Pancha Linga Nageshwara Temple complex that was established by the Ganga dynasty where it locates the 1100 years old stone inscription that refers to a 'Bengaluru War'.


Kempe Gowda's Tower at Lal Bagh

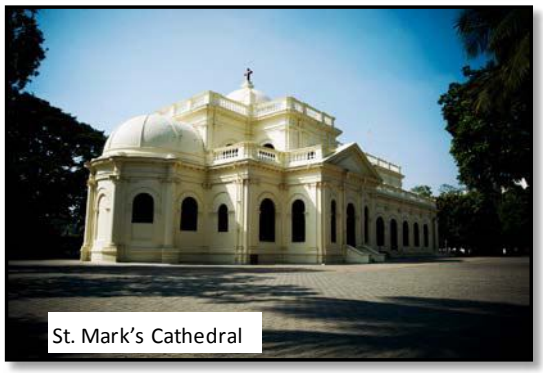
Bengaluru under Chola and Vijayanagara period: The city took shape as a fortified settlement under Kempegowda of the Vijaynagara state when he established the mud fort in year 1537. The region relied heavily on lakes & tanks which were constructed right across this territory as the principal source of water for agricultural and domestic needs. It is likely that Kempegowda's rule coincided with the development of a new urban form: a fortified settlement linked to a network of temples and tanks, later attracting many merchants and artisans who took up residence there[26]. This network of tanks supported mixed farming and market gardening activities. The well-known markets in the Petta where the *Tharagupete*–market for grains, the *Balepete* – for Bangles and musical instruments, the *Chikkapete* and the *Nagarthpete* for textile trade, the *Ballapurpete* and *Ganigarapete* market where oil is extracted by people of the Ganiga community, the *Tigalarapete*–flower market of gardeners, the *Cubbonpete* – textile manufacture by

[26] Janaki Nair in her book title Bangalore's Twentieth Century: The promise of a Metropolis(Oxford University Press 2005)

people of the Devanga community. Kempegowda established 4 towers (at present day Lal Bagh, Gavi puram, Ulsoor lake and Mekeri Circle) to ascertain the extent of the city and the high grounds with the city. **Figure 14-1** presents the historical time lines along with the heritage mapping of Bengaluru.

17th Century: saw the influence of itinerant Sufis who redrew the sacred space of the city with *dargahs* and shrines. Mysore was the then capital of Hyder Ali's kingdom and later on his son Tippu Sultan took over. Mysore was Tippu Sultan's administrative capital while Bangalore was the commercial capital. Tippu Sultan re-built the mud fort using granite and also a summer place, located in present day KR market area. The gardens of Lal Bagh took its present shape during his rule.


Tippu Sultan's Summer Palace

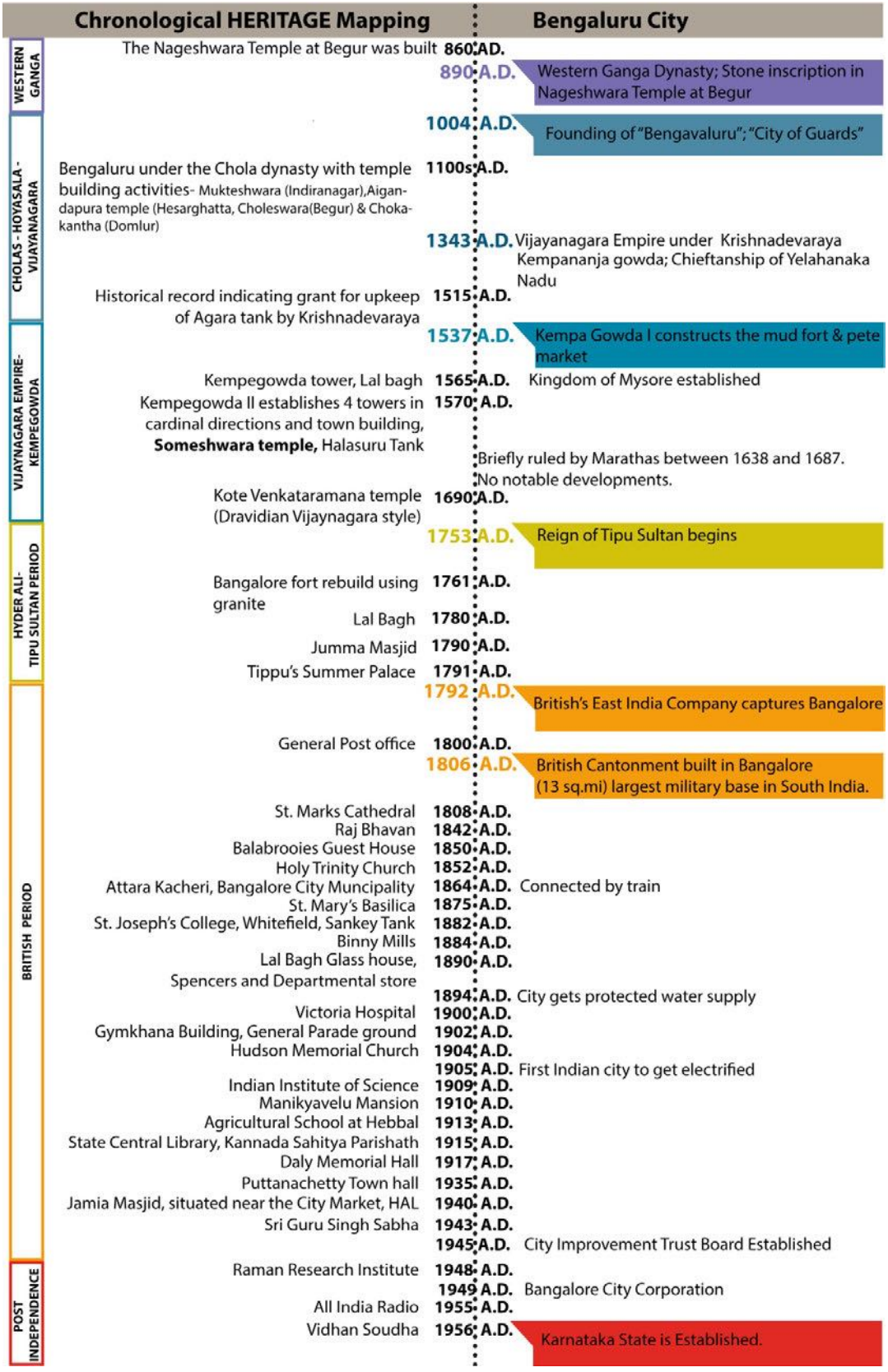

St. Mark's Cathedral

18th Century: marked the entry of the British. At that point of time there were 3 major distinct aspects of medieval life in the region: the grants to the Brahman Agraharas(residential areas), large temple complexes and construction of tanks. British developed Bangalore as a Cantonment around the Ulsoor tank in 1806 A.D. Creating the Cantonment on the high ground and the Pettap was located in the valley showing their dominance over the natives. The British setup places for recreation like South Parade (MG Road), Brigade Road and Church Street and Parks like Cubbon Park and Coles Park, Markets like Russel Market. The Christian missionaries established churches and schools like Trinity church, St. Mark's Cathedral etc. There was a clear divide in the city, one was The Pettah (Old City) and The Cantonment. **Figure 14-2** shows a mapping of the Pete and the Cantonment in the 18th century clearly divided by green spaces like Cubbon park, Lal bagh etc.

19th Century: The 19th century saw the British further establish their rule over the region. The city was the first to be electrified in the country way back in 1905 AD. The important built form interventions in this period were mainly educational typologies like Indian Institute of Science, Agricultural school at Hebbal, Bishop Cotton's School and the State Central Library. Also religious and cultural typologies like Hudson Memorial church, Daly Memorial Hall and Puttanachetty Town Hall came up during this time.

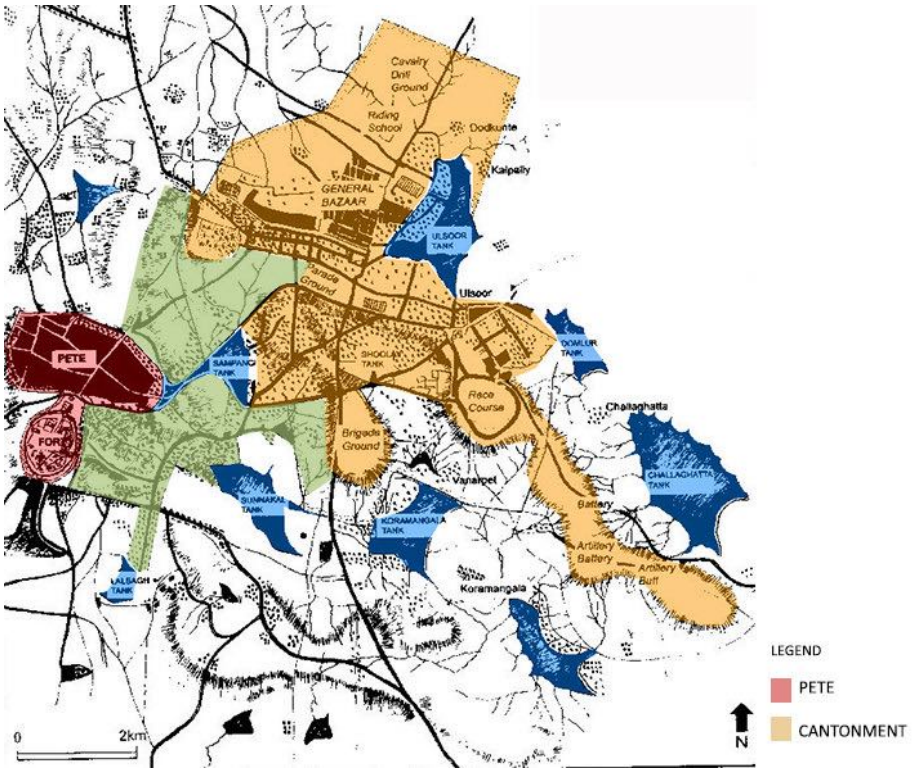
Post Independence the British had left a distinctive mark on the cities development. The Bangalore city corporation was established in 1945. On November 1, 1956, State of Karnataka was born out of the merging of the erstwhile Mysore state along with the Kannada speaking areas of Bombay and Madras states. Bengaluru was made the capital of the state and Vidhana Soudha was built as a seat of state legislature in Karnataka. Built in the Neo Dravidian/ Indo Sarcenic style of architecture by Kengal Hanumanthaiah, the Vidhan Soudha is an imposing architectural statement of the states aspirations.

Figure 14-1: Chronological Heritage mapping



Note: The historical events have been compiled based on information from various published secondary sources and web resources. It was observed that in different sources there were variations in dates for some of the historical events. RMP 2031 has considered its best judgement while compiling the historical account as presented above.

Figure 14-2: Map showing Bangalore 1850, distinctly showing the Petta and the Cantonment



Source: Janaki Nair (2005), RMP 2031

Architectural Style: Bangalore has a distinctive vernacular architectural styles spanning over 5 centuries. The earliest being the influence from the Western Ganga dynasty, who built the Nageshwara temple at Begur in 860 A.D. The temple has distinctive stone carvings, which follows anthropometrics and planning styles of Chola dynasty. The Vijanagara Empire under Kempe Gowda founded Bengaluru with the formation of the mud fort and also established various temples and


Sri Dharmaraaya Swamy temple

lakes. The earliest temples being Bull temple and Someshwara temple. At this point Mysore was established as the capital of the empire and Bengaluru was the commercial hub. Thus a lot of markets came up during this time. During the 17th century under Tipu Sultan's reign, Bengaluru saw development in the form of rebuilding of the existing fort using stone. Also Mughal typologies like Mosques and Gardens were built, most notably the Lal Bagh gardens. Stone(Saddarahalli granite) being a local material was extensively used. This period saw buildings in the Indo-Islamic style, domes, arches and minarets was the basic character buildings had. The Tipu Sulthan's summer palace is a classic example of this style of architecture. The palace is built completely out of teak with pillars, arches and balconies. The walls and arches are engraved with beautiful floral motifs.

Majority of the developments outside the Petta happened under the British rule. The British established Bengaluru as their Cantonment in 1806 A.D around the Halasuru tank. The British built various parks, shopping centres, military infrastructure, churches, schools and bungalows. The bungalow typology was an influence of colonial architecture. It was a sign of control over the natives. The major architectural feature of the British bungalow was the monkey top. The monkey top was ideal for the Bangalore's climate. Other building features include lancet arches, rose windows and Mangalore tiles (clay). The bungalows are majorly found in the Cantonment area, Basvangudi and also in Malleshwaram.

Colonial Bungalow on Kenchappa Road

14.2.2 Identification and Listing of Heritage Sites in Bengaluru.

The city of Bengaluru currently has 9 protected heritage sites, of which 2 sites are Archaeological Survey of India (ASI) (centrally) protected and 7 heritage sites by the Department of Archaeology, Museums and Heritage (state) protected. **Table 14-1** shows List of Protected Monuments in BMA and **Figure 14-3** shows spatial mapping of Protected Heritage sites in BMA.

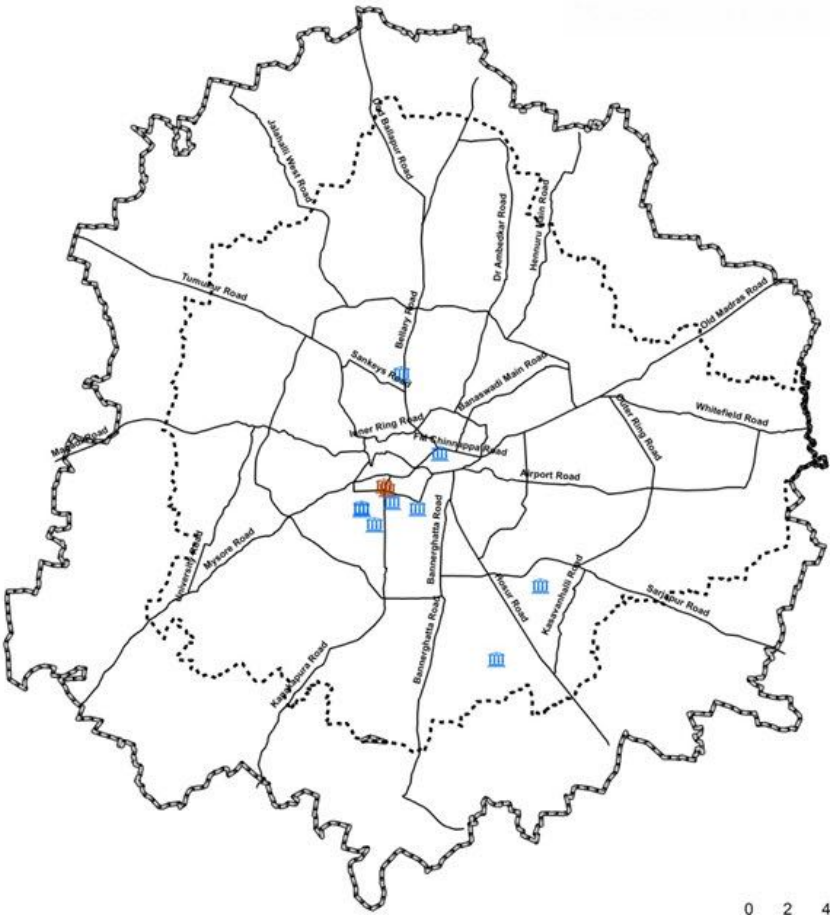
Table 14-1: List of Protected Monuments in BMA

Sl. No	Archaeology Survey of India (Central Protected)	Department of Archaeology, Museums and Heritage, GoK (State Protected)
1.	Banaglore Old Dungeon Fort and Gate	Basavesvara Temple
2.	Tippu Sultan's Summer Palace	Bowring Institute
3.		Gavi -Gangadhareswara Temple at Gavipuram
4.		4 no.s of Kempe Gowda's Watch Towers (Lal Bagh, Gavi puram, along Bellary Road)
5.		Mallikarjuna Temple and Boulder Inscription at

Sl. No	Archaeology Survey of India (Central Protected)	Department of Archaeology, Museums and Heritage, GoK (State Protected)
		Basavanagudi
6.		Sri Nagareshwara Group of Temples at Begur
7.		Venkataramanaswami Temple at V.V. Puram

Source: ASI, GoI, and Department of Archaeology, Museums and Heritage, GoK

Figure 14-3: Protected Monuments in Bengaluru



This is against the listing of 747 heritage buildings prepared by INTACH for the erstwhile Bangalore Urban Arts Commission (BUAC) (constituted in 1983 and disbanded since 2002). This clearly indicated the urgent need for greater heritage awareness and sensitiveness amongst governing agencies and citizens alike. As mentioned above, city does not have inventory of its heritage assets. RMP 2031 has created the listing of heritage and cultural assets available in the Bengaluru.

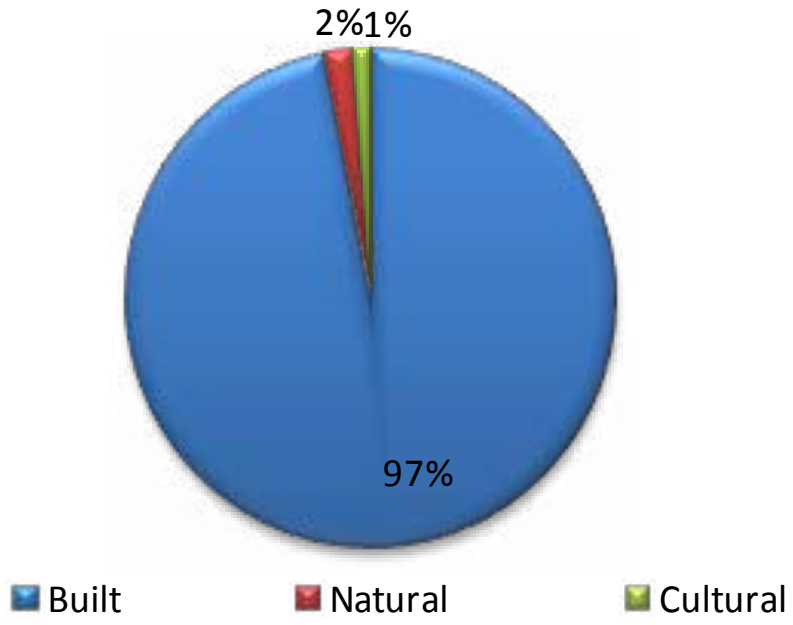
The Revised Master Plan 2031 (RMP 2031) carried out the physical survey for identification of heritage sites and has documented the heritage sites based on various parameters like spatial location and extent, age of the building, building use, ownership, classification of heritage and their respective heritage value.

In all 558 sites have been listed, which include Heritage sites of Built, Natural and Cultural importance. 533 heritage sites are of built heritage value, while 16 heritage sites are of natural heritage value and 9 heritage sites of cultural heritage value It is noteworthy that majority of them are located within the core of the city.

14.3 Classification of Heritage Sites

The identified heritage sites have been classified into three main categories, a) Architectural and Built heritage, b) Natural and Environment heritage and c) Cultural and Intangible heritage. The majority of the sites identified come under built-heritage.

Figure 14-4: Classification of Heritage Sites in BMA



Source: Heritage Survey for RMP 2031, 2015

14.3.1 Architectural and Built heritage

Built Heritage is the part of our tangible cultural heritage which can be physically touched and stored. This would include structures following a specific Architectural style and having elements and characteristics pertaining to that style. It should have 'historical, aesthetic, archaeological, architectural, scientific, ethnological or anthropological value'. The following shall be considered as Built Heritage. For example this would include Vidhana soudha, Attara Kacheri, State Central Library-Sheshadri Iyer Memorial hall, Bangalore Fort, all located in the central part of Bengaluru.

- **Monuments:** architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science.

- **Groups of buildings:** groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science.
- **Sites:** works of man or the combined works of nature and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view. [27]

14.3.2 Natural Heritage

Natural heritage includes physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view.[28] Geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation. Natural Heritage in the context of BMA would include historically established natural landscapes- parks, forests, lakes like Cubbon park, Lal bagh, Ulsoor lake, Sankey tank, Big Banyan tree etc.

14.3.3 Cultural and Intangible heritage

“Cultural Heritage" designates a monument, group of buildings or site of historical, aesthetic, archaeological, scientific, ethnological or anthropological value. (UNESCO). The cultural heritage may be defined as the entire corpus of material signs - either artistic or symbolic - handed on by the past to each culture and, therefore, to the whole of humankind. As a constituent part of the affirmation and enrichment of cultural identities, as a legacy belonging to all humankind, the cultural heritage gives each particular place its recognizable features and is the storehouse of human experience. The preservation and the presentation of the cultural heritage are therefore a corner-stone of any cultural policy (Definition Of Cultural Heritage, ICCROM Working Group 'Heritage and Society)29. This would include heritage precincts having political, religious and residential development which are inhabited and carries an inherent cultural-associational value. This would include areas like Karaga festival, Bull temple and Kadlekai Parishe, Someshwara temple in Halasuru and its processional path, Shivajinagar(areas around St. Mary’s basilica, during St. Mary’s feast) when the

[27] Note: The 1972 Convention of UNESCO concerning, ‘The Protection of the World Cultural and Natural Heritage’ defines cultural heritage as above referred exclusively to the monumental remains of cultures, heritage as a concept has gradually come to include new categories such as the intangible, ethnographic or industrial heritage. A noteworthy effort was subsequently made to extend the conceptualization and description of the intangible heritage. So, for better understanding the earlier definition of cultural heritage is included in Built Heritage here.

[28] http://whc.unesco.org/archive/convention-en.pdf

[29] http://cif.icomos.org/pdf_docs/Documents%20on%20line/Heritage%20definitions.pdf

streets are pedestrian-only streets during these festival. In addition, there are several fairs and festivals that are organized/ celebrated in the City of Bengaluru having scale ranging from local to international.

14.4 Delineation of Heritage Zones and Heritage Precincts

The RMP 2031 based on the identification, listing and spatial mapping of heritage sites, has delineated Heritage Zones and identified Heritage Precincts for Bengaluru. A Heritage Zone is the zone delineated in the Master Plan that requires special attention in terms of heritage conservation and a Heritage Precinct means and includes spaces that require conservation or preservation for historical or architectural or aesthetic or cultural or environmental or ecological purpose and walls or other boundaries of a particular area or place or building which may enclose such space by an imaginary line drawn around it. [30]

As defined above, the heritage zones are to be treated as special areas around which the heritage sites / buildings are retained/conserved/restored in best possible manner along with guiding and regulating the proximal new development and or redevelopment as the same may be, by adopting approaches that protects, conserves and enhance the heritage value of these heritage sites.

Proposals such as upgrading infrastructure, facilitating public transportation, providing for its better access transportation are few of the aspects in a heritage zone that are required to be promoted.

It is envisaged that the heritage zones and precincts will engage the public and seek participation in the process of development and conservation of these zones. The identified zones can be developed based on their potentials such as administrative, tourism or residential heritage zones.

For the purpose of identifying and delineating Heritage Zones and precincts, the RMP 2031, considered the following criteria:

1. Historicity of the Heritage area / building / monument
2. Urban Character and Nature of activities
3. Architectural Character and style
4. Spatial contiguity and congruence

Based on the above listed criteria of historicity, urban character and nature of activities, architectural style, spatial congruity, the RMP 2031 has delineated 12 heritage zones in the LPA of BDA. They are as following:

1. Central Administrative Heritage Zone
2. Petta and Bangalore Fort Heritage Zone
3. Gavipuram, Basavanagudi and VV Puram Heritage Zone
4. M.G.Road Heritage Zone

[30] Model Heritage Guidelines, 2011; Town and Country Planning Office, Ministry of Urban Development, GoI.

5. Shivajinagar Heritage Zone
6. Cleveland Town Heritage Zone
7. Richards Town Heritage Zone
8. Malleshwaram Heritage Zone
9. Ulsoor Heritage Zone
10. Whitefield Inner Circle Heritage Zone
11. Begur Temple Heritage Zone
12. Bangalore Palace Heritage Zone

15 URBAN DESIGN

The urbanscape of a city constitutes the built man made environment of buildings, the streets along which they are located, modelled to provide access to & fro places of living to work places and public services through transport, communication interfaces that connect with places of natural environment for leisure and recreation. In other words, cities are concentrated points for flows of socio-cultural and economic exchange over space. These exchanges and flows happen between buildings, streets, system of communication and utilities, places of work, along transportation networks, leisure and meeting places of the city. Urban Design encompasses the design and integration of the built form (i.e. urban structure and morphology or the relationship between buildings and their form, in accordance with their typology) with the public realm (i.e. streets, transport corridors, markets, parks & open spaces, lakes etc) into the city.

It is in this context that urban design is envisaged as a tool to realise sustainable planned urban development and interventions to give the city a modern urban character, establish a strong public realm that lends from its past and yet ushers into the future with a world view of a Global City.

15.1 Urban Design Strategies for RMP 2031

Urban Design helps in shaping the physical setting for life in cities, creating places where people want to live, work and play. Urban Design guidelines aim to preserve and enhance the urban character of different existing and future physical areas in the BMA. These guidelines will help to ensure that developments integrate well with their surrounding urban environments. The following are the urban design strategies that are proposed in RMP 2031.

1. Urban Design aspects for Certain Areas that require special and intended treatment
2. Providing for well-designed public realm
    - Promoting Lake front and treatment to Buffer Areas for water bodies
    - Providing Streetscape and Avenue Plantation
    - Parks and Open Spaces
    - Promoting and regulating Street Vending
3. Landscaping Plan for BMA.
4. Accessibility Improvement Plans for transportation modes and educational institutes
5. Conservation of Heritage Zones and Heritage Precincts
6. Providing for Universal Accessibility such that the city is accessible and made user friendly.
7. Regulating Signages and hoardings such that the visual character of the city is not marred.

15.2 Urban Design Scheme

Master Plan proposes that Urban Design shall be embedded in all area development, redevelopment, linear projects etc in consideration to physical features, providing improvements in the physical layout, making infrastructure and amenities accessible and their upgradation, conservation of heritage zones and precincts, managing the area to enhance health and safety of the occupants, to support economic development as well as to enhance the quality of living, environment, and preparation of area specific regulatory parameters for the area covered[31]. Urban design guidelines need to be formulated for specifications of plot frontage, building line regulations, landscaping features and architectural elements, for specific particular plots/area. Local Area Plans can be used on peri-urban areas for providing plot layouts, laying of infrastructure and providing social amenities while respecting the traditional and prevalent culture of the people. This aids in achieving structured development and densities along with visual integration.

15.3 Providing for Well-Designed Public Realm

15.3.1 Promoting Lake front and treatment to Buffer Areas for water bodies

Bengaluru requires urban places for recreation for its people. The lakes and water bodies can serve as the public realm, but with careful consideration to the sensitive wetland ecosystem. Specific guidelines are recommended, that regulates activities and other landscaped interventions.

15.3.2 Providing Streetscape and Avenue Plantation

The streetscape and visual character of any city is not resplendent without designed and well thought out interventions in streetscape. Streetscape includes street furniture, road side planting, street lighting, pedestrian and non-motorised lanes, spaces and pockets for street vending, public interaction with surrounding land uses such as commercial, markets, institutions etc. the streetscape is envisaged to enliven the spaces for vibrant and safe public interaction.

15.3.3 Parks and Open Spaces

RMP-2031 proposes Parks and Open spaces that are envisaged to provide public recreation, conserve the ecology, and also provide for flood protection and ground water recharge. The following are the guidelines;

- Parks and Open spaces are natural habitats of rich and varied flora and fauna. The habitats must be conserved, and the open spaces must protect the ecology.
- Emphasis has to be given on native plants species, and only limited use of ornamental and decorative plant species shall be allowed.
- The parks also have a role to play in flood control. All regional parks and zonal level parks to be designed based on the gradient. Low lying areas in the park must not be paved.

[31] Draft URDPFI Guidelines 2014

- Rain Gardens and bio swales may be designed in zones identified as flood prone, in smaller parks where the pervious area is less.

15.4 Universal Accessibility

Any public open space needs to be accessible to everyone, irrespective of their disabilities and shortcomings. Most areas in the open space should be accessible for the differently-abled. Elderly need passive recreation and some amount of active recreation. Frequent seating needs to be provided along the walkways for resting. Sufficient lighting along the walking tracks. Activities for adults may include passive recreation as well as active recreation like outdoor Gym, jogging track, and sports. Play areas for children of school going age (shall involve a lot of running and active recreation) is necessary in suitable areas within the parks. Safety of Toddlers shall be taken care of. Smaller level plays spaces within the parks, which can be easily monitored. The Universal Accessibility and Urban design Guidelines for Public Spaces are as following:

Guidelines for Footpaths, Paving and Street Furniture:

1. Public walkways, footpaths must be minimum 1.2 m wide with a maximum gradient of 1 in 20 and must have ramps at all the entrances for entry and exit.
2. The footpaths should be well lit, with proper marking.
3. Tactile paving should be used for lead persons with vision impairments to the lifts, crossings, toilets, bus stops etc, and away from the flowing traffic.
4. Obstructions: A 1500 – 2000mm pathway (depending on pedestrian volumes) clear from any obstruction must be dedicated to pedestrian use. Trees, planters, street furniture etc must be placed beyond this 1500 m.
5. Bollards: A minimum width of 815 mm between bollards is required for the passage of wheelchairs.
6. Seats: All public walk ways must preferably be provided with seating facilities, and the seats should be easily accessible to the differently abled.

Universal Accessibility for Transportation

1. At least one accessible route should be provided from the alighting and boarding point of the bus stand to the walkway that leads to the accessible building entrance.
2. Public transport system must be barrier free with easy entry from bus stop/rail station, into the vehicle, for all groups of users using person using wheelchairs.
3. Bus stops with designated spaces to wait and relax (Urban Mobility India)
4. Alighting and Boarding Areas:
5. Directional signs should be installed to direct the differently abled to an accessible entrance.
6. Guiding blocks should be provided along the accessible walkway from the bus stand to the building entrance to aid persons with visual impairments.

7. The bus stand shall have optimum illumination levels (minimum 35 to 40 lux) for ease of visibility.
8. Accessible car parking to be provided in the parking areas, with 1200 metres access for wheelchair. Where there are two accessible parking bays adjoining each other, then the 1200mm side transfer bay may be shared by the two parking bays. The transfer zones, both on the side and the rear should have yellow or white cross-hatch road markings.
9. Accessible parking lots that serve a building should be located nearest to an accessible entrance and / or lift lobby within 30 meters. In case the access is through lift, the parking shall be located within 30 meters. The accessible route of 1200 mm width is required for wheelchair users to pass behind vehicle that may be backing out.
10. International symbol of accessibility (wheelchair sign) should be displayed at approaches and entrances to car parks to indicate the provision of accessible parking lot for Persons with Disabilities within the vicinity.
11. Appropriate signage including directional signs must be installed at suitable location.
12. Accessible parking lots that serve a building should be located nearest to an accessible entrance and / or lift lobby within 30 meters. In case the access is through lift, the parking shall be located within 30 meters. The accessible route of 1200 mm width is required for wheelchair users to pass behind vehicle that may be backing out.
13. Foot over bridge, pedestrian underpass: Any pedestrian foot-over bridge or pedestrian underpass must be installed with Elevators and ramps for differently-abled persons. The entry to the underpass/ foot over bridge must have ramps if there is any difference in level.

Universal Accessibility for Public buildings

1. All public buildings must comply with accessibility requirements for differently abled persons, including government institutions, office buildings, residential buildings, commercial buildings, health facilities, restaurants, recreational and sports facilities, religious buildings and all other building types used by the general public.
2. *Entrance:* At least one entrance per facility should be accessible to a wheelchair user. For new buildings, the accessible entrance(s) should be the main entrance(s), and not side or back entry, intended for use by the public.
3. *Facilities:* Wherever waiting areas, coffee shops, display areas, merchandising departments, service areas, ticket counters, refreshment stands, etc. are provided for public use, these facilities should be accessible to all Persons with Disabilities and not just wheelchair users only.
4. *Washroom:* In all buildings at least one unisex accessible washroom/toilet should be provided. In multi-level buildings all floors should have one such facility near the general washrooms.
5. Vertical Transportation (Ramps, Elevators and escalators): Ramps must be installed in all public buildings to the plinth level. All public buildings should be accessible by lift / ramp on the upper floors.
6. *Lighting:* All pathways must be lit properly.

7. *Signage:* All areas in public building should have proper signage for entry, exits, and fire escape.

Universal Accessibility for Recreation- Parks and Open Spaces

1. There should not be any difference in level around an approach to a park and/or park roads. If a level difference is unavoidable, a ramp must be provided for every level change, in addition to steps if any.
2. Benches, dustbins and drinking fountains should be installed with adequate space around them for wheelchair users to manoeuvre.
3. A level landing should be provided before and after the change in level, and the level changes must be negotiable in wheelchair.

16 MASTER PLAN PROJECTS AND PHASING

16.1 Project Listing

To ensure the implementation of Master Plan proposals, the proposals have been projectised. The clear definition of projects, responsible agencies and time schedule shall help line departments visualise long term requirements and prioritise their actions in their budgets and financial resources taking into account the projects identified by Master Plan. Projectisation would also help in better coordination among various line agencies and concerned stakeholders. Broadly following are the Projects and Programmes identified by Master Plan for implementation:

A. Road Development Plan: This includes following components

1. Demarcation of Master Plan Roads (18m above only) on Ground
2. Upgradation/ Widening of Existing Roads
3. Development of New Links
4. Junction Improvement Programme and Development of Flyovers/ Railway Bridges
5. Preparation of Parking plans for Streets/ Areas

B. Public Transport Network Development: This includes following components

1. Development of Commuter Rail Service
2. Development of Metro Network
3. Development of LRT/Mono Rail/ BRTS
4. Development of Intermodal Interchanges
5. Development ISBTs
6. Development of Bus Stations/ Terminals

C. Development of Logistic Facilities: This includes following components

1. Demarcation of Land for Logistic Facilities
2. Development of Logistic Hubs/ Truck Terminals

D. Rejuvenation of Lakes and Streams: This includes following components

1. Prioritise Lakes for Rejuvenation
2. Demarcation of Lakes Extent

3. Demarcation of Primary, Secondary & Tertiary Drains (which are not existing on ground, missing links only)
4. Preparation of Lake Rejuvenation Plans and Lake Area Development Plan
5. Preparation of Stream Development Plans
6. Implementation of Plans and Project for Lake & Stream Rejuvenation

E. Green Development Plan: This includes following components

1. Demarcation of Regional Parks
2. Demarcation of Other Parks
3. Land Acquisition of Regional & Other Parks
4. Development of Parks and Open Spaces (Regional Parks & Other Parks)
5. Avenue Plantation (Master Plan Roads)
6. NGT Buffer Area Development
7. Block Plantation in Villages / Forest Areas
8. Development of Sports Complex's

F. Redevelopment/ Upgradation/ Development Plans: This includes following components

1. Preparation of Industrial Area/ Estates Redevelopment Plans
2. Preparation of Area Redevelopment Plans/ Upgradation of Urban Villages
3. Preparation of Slum Redevelopment Plans
4. Preparation of Village Development Plans

G. Heritage Area Protection and Conservation Scheme: This includes following components

1. Grading and Listing of Heritage Buildings
2. Preparation of Heritage Master Plan for Bengaluru

H. Development of Social Infrastructure: This includes following components

1. Development of Crematoriums/ Graveyards
    a. Land Identification and Demarcation of Land
    b. Development of Facility
2. Development of Fire Stations
    a. Land Identification and Demarcation of Land

b. Development of Facility

3. Development Night Shelters
    a. Land Identification and Demarcation of Land
    b. Development of Facility
4. Street Vending
    a. Preparation of Street Vending Plan
    b. Declaration of Street Vending Zones and Streets

I. Development of Physical Infrastructure: This includes following components

Water Supply & Sewerage

1. Finalisation of Water Source and development of Trunk Pipeline to BMA
2. Development of Water Supply and Sewerage Network for BBMP
3. Preparation of Water Supply and Sewage Network Plan for areas outside BBMP
4. Development of Water Supply and Sewerage Network for Areas outside BBMP

Solid Waste Management

5. Demarcation of Land and Development of SWM facilities
    a. Dry Waste Collection Centre
    b. Organic Waste Collection Center (OWCC)
    c. Aggregators (AGGR)
    d. Bio-Methanation Units (BMU)
    e. Coconut waste Processing Unit (CPU)
    f. Integrated Waste Processing unit (IWPU)
    g. Central processing unit
    h. Leaf litter
    i. Landfill

Power Supply

6. Demarcation of Land and Development of Sub-station (220kv only)

J. Disaster & Hazard Management: This includes following components

1. Preparation of Disaster & Hazard Mitigation Plan
2. Implementation of Components and Projects of Disaster & Hazard Mitigation Plan

K. Town Planning Scheme / Development Schemes: This includes following components

1. Prioritise Area for TPS / DS/ SDZ
2. Identity extent and declare intention of prepare TPS / DS (2/3 Schemes)
3. Planning & Implementation of Scheme

16.2 Phasing and Responsible Agencies

Table 16-1 lists the projects/ actions proposed by Master Plan, the responsible agencies and phasing of projects (time schedule).

Table 16-1: Phasing of Master Plan Programme and Projects

Phasing of Master Plan Programme & Projects			
Main Programme/ Project/ Action	Agency Responsible	Phase 1 [2018-24]	Phase 2 [2025-31]
Road Development Plan			
Land Demaoncation of Master Plan Roads (18m & above roads)	BDA & BBMP		
Land Acquisition for Master Plan Roads	BDA & BBMP		
Development of PRR (Northern Stretch)	BDA		
Development of ORR (Part Stretch)	BDA		
Development of Intermediate Ring Road	BBMP		
Development of BMR Regional Links	BDA		
Upgradation of NH/ SH	NHAI/ PWD/ KSRDCL		
Development of Missing Links and upgradation of Existing Links of Inner PRR	BBMP/ BDA		
Development of Other Master Plan Roads	BBMP/ BDA/ PWD/ KSRDCL/NHAI		
Upgradation/ Widening of Existing Roads (within BBMP)	BBMP		
Upgradation/ Widening of Existing Roads (outside BBMP)	BDA		
Upgradation of Village Roads	Gram Panchayath		
Development of Railway Bridge/ Underpass	BDA/ BBMP/ PWD		
Improvement of Major Junctions & Development of Flyovers/ Cloverleafs, Grade Seperators	BDA/ BBMP/ PWD/ KSRDCL		
Preparation of Parking Plans and Implementation	BBMP		
Public Transport Infrastructture			
Namma Metro			
• Metro Electronic City	BMRCL		

Phasing of Master Plan Programme & Projects			
Main Programme/ Project/ Action	Agency Responsible	Phase 1 [2018-24]	Phase 2 [2025-31]
• Metro Bannerughatta (extension till Basvanpura)	BMRCL		
• Metro Mysore Road extension (till Kanmanike)	BMRCL		
• Metro ORR (Hebbal to KR Puram to Silk Board	BMRCL		
• Metro ORR (Rest Ring)	BMRCL		
• Metro to Bengaluru International Airport	BMRCL		
• Metro PRR (Phase-1 OMR to Varthur)	BMRCL		
• Metro PRR (Phase -2 Rest)	BMRCL		
LRT/ Mono/ BRT			
• Intermediate Ring Road	Agency to be decided by GoK		
• Bellary Road	Agency to be decided by GoK		
• Old Airport Road	Agency to be decided by GoK		
• Magadi Road	Agency to be decided by GoK		
• Hessarghatta Road	Agency to be decided by GoK		
• Inner PRR	Agency to be decided by GoK		
Commuter Rail Service			
• Byapanahalli - Whitefield	Railways + GoK		
• Yeshwanthpura - Devanahalli	Railways + GoK		
• Yeshwanthpura - Tumukuru	Railways + GoK		
• Yeshwanthpura - Doddaballapur	Railways + GoK		
• Yelahanka - Byapanahalli - -Anekal - Hosur	Railways + GoK		
• Nayandanahalli - Mysuru	Railways + GoK		

Phasing of Master Plan Programme & Projects							
Main Programme/ Project/ Action	Agency Responsible	Phase 1 [2018-24]			Phase 2 [2025-31]		
Inter State Bus Terminus							
- Tumkur Road	BMTC + KSRTC	■	■	■			
- Mysuru Road	BMTC + KSRTC	■	■	■			
- Old Madras Road	BMTC + KSRTC	■	■	■			
- Hosuru Road	BMTC + KSRTC	■	■	■			
- Bellary Road	BMTC + KSRTC	■	■	■			
- Magadi Road	BMTC + KSRTC	■	■	■			
Bus Stations / Depots / Stands	BMTC	■	■	■	■	■	■
BRTS							
Hennur Bagalur Road	BDA	■	■	■			
Logistic Facilities							
Demarcation & Acquisition of Land	D. Deveraj Urs Ltd	■	■	■			
Development of Logistics Facility / Truck Terminals							
- Bannerghatta - road	DDU	■	■	■	■	■	■
- Tumkuru Road - (outside BMA)	DDU	■	■	■			
- Mysuru Road	DDU	■	■	■			
- Mallur Road	DDU	■	■	■	■	■	■
- Bellary Road	DDU	■	■	■			
- Old Madras Road	DDU	■	■	■			
- Hosur Road (outside BMA)	DDU	■	■	■			
- Sarjapura Road	DDU	■	■	■	■	■	■

Phasing of Master Plan Programme & Projects								
Main Programme/ Project/ Action	Agency Responsible	Phase 1 [2018-24]			Phase 2 [2025-31]			
Lake & Stream Rejuvenation Plan								
Prioritise Lakes for Rejuvenation	BDA/ BBMP/ KLCDA	■	■	■				
Demarcation of Lakes Extent	Revenue/ BDA/ BBMP/ Forest/ Irrigation Department	■	■	■				
Demarcation of Primary, Secondary & Tertiary Drains (which are not existing on ground, missing links only)	Revenue/ BDA/ BBMP	■	■	■				
Preparation of Lake Rejuvenation Plans and Lake Area Development Plan	BBMP/ BDA/ KLCDA/ Gram Panchayath / Forest / Irrigation Department	■	■	■	■	■	■	
Preparation of Stream Development Plans	BBMP/ BDA/ KLCDA/ Gram Panchayath / Forest / Irrigation Department	■	■	■	■	■	■	
Implementation of Plans and Project for Lake & Stream Rejuvenation	BBMP/ BDA/ KLCDA/ Gram Panchayath / Forest / Irrigation Department/ Line Dept.	■	■	■	■	■	■	
Green Development Plan								
Demarcation of Regional Parks & Other Parks	BDA / Revenue	■	■	■				
Development of Parks	BDA / BBMP	■	■	■	■	■	■	
NGT Buffer Area Development	BDA/ BBMP	■	■	■	■	■	■	
Block Plantation in Villages / Forest Areas	Forest	■	■	■	■	■	■	
Play Ground and Sports Complex Development								
Development of Playgrounds	BBMP/ Dept of Youth & Sports	■	■	■	■	■	■	
Development of Sports Complexes	BDA/ BBMP/ Dept of Youth & Sports	■	■	■	■	■	■	

Phasing of Master Plan Programme & Projects							
Main Programme/ Project/ Action	Agency Responsible	Phase 1 [2018-24]			Phase 2 [2025-31]		
Heritage Area Protection & Conservation Scheme							
• Preparation of Heritage Master Plan	Heritage Committee						
• Heritage Zone Area Development Plan	BDA/ BBMP						
Development of Social Infrastructure							
Development of 'Crematoriums / Burial Grounds	BDA/ BBMP/ Gram Panchayat						
Development of 'Fire Stations	KEFS						
Development of Night Shelters	BBMP						
Declaration of Street Vending / Zones	BBMP/ BDA						
Area Redevelopment							
Preparation of Area Development Plans	BBMP/ Gram Panchayath						
Preparation of Slum Redevelopment Plans	KSDB + BBMP						
Preparation of Village Upradation / Development Plan	Gram Panchayat + BDA						
Preparation of Industrial Area Redevelopment	KIADB						
Implementation Plan Components / Projects	BBMP / BDA / G.P / PRED / PWD / BESCOM / BWSSB & Line Dept.						
Disaster & Hazard Management							
Preparation of Disaster & Hazard Mitigation Plan (covering various Disasters & Hazards)	District Administration (Bengaluru Urban)+ BBMP + District Disaster Management Cell + BDA						
Implementation of Disaster & Hazard Mitigation Plan (Continous process)	BDA+BBMP+Line Departments						
Town Planning Scheme / Development Schemes							

Phasing of Master Plan Programme & Projects								
Main Programme/ Project/ Action	Agency Responsible	Phase 1 [2018-24]			Phase 2 [2025-31]			
• Pritotise Area for TPS / DS/ SDZ	BDA	■	■	■				
• Identity extent and declare intention of prepare TPS / DS (2/3 Schemes)	BDA	■	■	■				
• Planning & Implementation of Scheme	BDA	■	■	■	■	■	■	
Physical Infrastructure								
Water Supply & Sewerage								
• Source Finalisation and Trunk Line Development	GoK+BWSSB	■	■	■				
• Water Supply and Sewerage Infrastructure Development (within BBMP)	BWSSB	■	■	■				
• Preparation of Water & Sewerage Network Plan & Outside BBMP	BWSSB PRED	■	■	■				
• Water Supply & Sewerage Network Development in outside BBMP area	PRED (with support from BWSSB)	■	■	■	■	■	■	
Power Supply Network (220 KV submission)								
• Development of substation	KPTCL	■	■	■				
Solid Waste Management								
• Land Identifications	BBMP Grama Panchayath	■	■	■				
• Land Acquisition/ Transfer	BBMP Grama Panchayath	■	■	■				
• Development of DWCC	BBMP Grama Panchayath	■	■	■				
• Development of OWCC	BBMP Grama Panchayath	■	■	■	■	■	■	
• Development of Integrated Waste Processing Unit	BBMP	■	■	■	■	■	■	
• Development of Central Processing Unit	BBMP	■	■	■	■	■	■	

Phasing of Master Plan Programme & Projects			
Main Programme/ Project/ Action	Agency Responsible	Phase 1 [2018-24]	Phase 2 [2025-31]
• Development of Bio Methanation Unit	BBMP		
• Development of Coconut Processing Unit	BBMP		
• Development of Land Fill sites	BBMP		

17 IMPLEMENTATION AND FINANCIAL FRAMEWORK

The RMP-2031 has evolved a spatial plan and identified various project proposals with regard to the different components of infrastructure and urban development. The responsibility for implementation of projects across different sectors along with the phasing plan and the agencies responsible for the implementation of these projects has been illustrated in the previous section. The RMP 2031 has taken cognizance of the major hurdles including (i) gaps in the existing institutional framework and the areas of strengthening the Institutional Arrangements with regard to the enforcement and implementation of the Plan; (ii) Access to Land and Land Procurement; and (iii) Financial Resources for Plan Implementation.

17.1 Institutional Framework

Considering the complexities of administrative and spatial jurisdictional for BMA, RMP-2031 has envisioned the streamlining of the institutional framework for effective implementation and enforcement of the Plan. The key components of the Institutional framework are defined in the following sections.

17.1.1 Role of Metropolitan Planning Committee

RMP 2031 for the LPA of BDA covers the areas under the jurisdictions of BBMP as well as 251 Gram Panchayats (in full or part). In addition, the LPA of BMICAPA also integrated symbiotically with LPA of BDA as part of the BMA. For effective implementation of RMP 2031, large number of projects and developments would involve issues related to (i) translating the RMP 2031 into development plan (5 year plan and annual plans) for implementation in phased manner; (ii) coordination between multiple institutions of local self-government with regard to the matters of common interest; (iii) sharing of resources, financial, physical and natural, available with different sectoral departments. RMP 2031 strongly recognizes and envisages the critical role of Metropolitan Planning Committee (MPC) in context of the provisions of the 74th Constitution Amendment Act. RMP 2031 envisages that MPC being an institution with jurisdictions across municipal and panchayats shall be able address the issue mentioned above for successful implementation of RMP 2031.

17.1.2 Strengthening the Master Plan Implementation Process within BDA

BDA endeavours to take the following actions targeted towards strengthening of the Master Plan Implementation Process and making it citizen friendly through improved governance measures.

A. Setting-up the Spatial Data Management Cell (SDMC)

BDA will set-up this cell under the ambit of the Town Planning Section which shall be responsible for managing the GIS data base created under the RMP-2031. The Cell shall be responsible for updation of the planning permissions granted in GIS data base and make the information related to permissions granted accessible to general public. The Cell shall manage the uploading and

availability of RMP-2031 on-line in a user friendly interactive mode for citizens to access the information related to their land with regard to the Proposals under RMP-2031.

SDMC shall also maintain the database of the land assets of the Authority including the CA/ open space/ EWS housing/roads land parcels relinquished in favour of the Authority as part of the planning permissions as well as the government lands transferred to the Authority for different projects like affordable housing, commercial exploitation for project financing etc.

SDMC shall also be responsible for linking the database on Development Rights issued by the BDA and BBMP and its online updation of information on the availability of TDR.

BDA also intends to set-up a system for on-line applications for Planning Permission, change of land use.

B. Special Development Zone Cell (SDZC)

The RMP 2031 has proposed five Special Development Zones envisaged as high density zones and are envisioned to be implemented through Development Scheme or and Town Planning Scheme Model by the Authority. The SDZC shall be responsible for formulation, notification, implementation, resource mobilisation and regulation of the developments in these zones.

The SDZC shall also be responsible for assisting the Authority and the GoK for the development of policy, legislative and regulatory framework for land pooling and land assemblage through alternate mechanisms.

17.1.3 Coordination with Adjoining LPAs

The proposals of BMRSP 2031 with regard to the regional road network have been integrated as part of RMP-2031 based on the ground situation and utilizing the alignment of proposed PRR (100 m RoW). The institution of BMRDA is already in place for coordination of these projects.

17.1.4 BDA and BBMP Coordination

BBMP is the key agency for enforcement of RMP-2031 within the BBMP limits, the coordination between the BDA and the BBMP is a pre-requisite for effective implementation and enforcement of the plan. The Spatial Data Management Cell proposed as part of the BDA will be responsible for the coordination with the IT Cell of the BBMP. All building permissions within the BBMP area are envisaged to be aligned with the database of planning permissions inclusive of change of land use managed by SDMC.

17.1.5 Municipalisation of Conurbation Limit

RMP 2031 also recognises the importance of municipalisation of the rural areas incorporated as part of the conurbation limit of RMP-2031 and envisages that by the end of the plan period as the areas under conurbation transforms from rural to urban character, the areas would be brought under the Municipal Umbrella from the perspective of management of urban services.

17.2 Financial Framework for RMP-2031

The financing of infrastructure and Urban Development projects can be broadly classified into two major components i.e. (i) Land Procurement and (ii) Development Cost, for majority of the city level infrastructure/ urban development projects. The operation and maintenance of these projects, a very critical component for the sustenance of the capital investments, has been considered to be financed through the existing institutional mechanisms in place under different agencies including the levy of statutory taxes, user charges/ user fee/ service charges by the service providing agencies and budgetary allocations from state governments in the form of grants to various agencies.

17.2.1 Land Procurement

RMP 2031 has also recognized the provisions of the Section 69(2) of the KTCP Act, 1961 with regard to the validity of the designated land use for a period of five years and subsequent lapse of the assigned land use for the purposes defined under Section 12 other than the land earmarked for roads and traffic circulation. RMP 2031 has identified the location for regional parks/city parks and public utilities. An effort has been made to earmark the land for regional parks/city parks and public utilities in the government land to the extent possible and it is envisaged that the concerned agencies shall initiate the process for transfer/ allotment of government land or acquisition of the land within the period of five years.

The land earmarked for roads is envisaged to be mobilized/ procured through the following mechanisms:

(i) Relinquishment of land for Master Plan Roads in favour of the Authority as part of layout/ sub-division and development plan approvals.

(ii) Acquisition of land as per the provisions of Karnataka Town and Country Planning (Benefit of Development Rights) Rules, 2016

(iii) Transfer of Government Land parcels in the road alignment to the agency responsible for a particular road project

(iv) Transferring Developed Land in lieu of Acquired Land based on the guidance values of land in the two areas

17.2.2 Development Cost

The financing of infrastructure and urban development projects for a large metropolitan city like Bengaluru cannot be managed through resources generated by the local authorities/ agencies of the state government alone and large share of financing comes through budgetary allocations from the state or central government under various programs.

In addition, RMP 2031 also recognizes the important role that the private sector would need to play in supplementing the efforts made by the local authorities/ state through their participation in the implementation of projects either directly or through the Public Private Partnership models.

The infrastructure projects identified under the RMP-2031 for agencies other than BDA are envisaged to be aligned with the budgets of the respective agencies.

The BDA which shall have major role in the development of the major master plan roads especially in the undeveloped areas within the proposed conurbation limit outside the BBMP limits or certain sections/ links of major roads within the BBMP limits, affordable housing and Regional Parks shall endeavour to mobilise resources through financing instruments including:

i. levy of betterment taxes by notifying SDZs as Development Schemes under Section 20 of the BDA Act

ii. land monetisation from the CA sites relinquished in favour of the Authority

iii. private sector participation in development of roads as part of the layout/ DP approval provisions in the ZR for access roads as well as Master Plan Roads

iv. mobilise project financing for major master plan/ regional level roads from NHAI/ budgetary allocations with the state road agencies through MPC

v. resources available under housing programs of the central and state government in collaboration with BBMP for affordable housing especially focussing on the EWS section

In addition, the Authority also intends to initiate the process of exploring new avenues with the approval of the GoK through legislative enactments and policy directions. The potential areas identified by the Authority for generating additional resources for the implementation of RMP-2031 include:

i. Introduction of Premium FAR and External Development Charges through amendment in KTCP Act

ii. Assignment of share of state revenues from Stamp Duty and Registration Fees collected from within BMA area to the Authority which shall be exclusively used for the development of road infrastructure

iii. Levy of environmental cess on state taxes on petrol for the petrol pumps within the BMA which shall be exclusively used for development of the regional parks and implementation of other environmental measures related to lake rejuvenation and streams development

iv. Redefining the role of the Authority in terms of facilitator for availability of developed bulk land through land pooling mechanisms and development of trunk infrastructure directly or through joint venture models

v. Commercial exploitation of government land parcels allotted to BDA free of cost for project financing of major road projects and commercial component in affordable housing projects

17.3 RMP Implementation Monitoring Mechanism

The proposed Master Plan Coordination and Monitoring Committee shall be responsible for regular review of the Master Plan Implementation process and facilitate coordination between different agencies responsible for implementation of the Master Plan. The structure of the proposed Committee is as following:

1.	Additional Chief Secretary/ Principal Secretary, Urban Development Department, Government of Karnataka	Chairman
2.	MD, BMRCL	Member
3.	Chairman, BWSSB	Member
4.	Metropolitan Commissioner, BMRDA	Member
5.	Commissioner, BBMP	Member
6.	Commissioner, Slum Clearance Board	Member
7.	Director Town and Country Planning	Member
8	Secretary, RDPR Department	Member
9.	Commissioner, BDA	Member Secretary

In this regard, the necessary Government order would be required for the constitution of the Committee and defining the functioning and powers of the Committee.

ANNEXURE – 1: SCHEDULE OF LPA OF BDA

Statement showing the list of Villages/ City Survey Sheet Limit included in the Local Planning Area of Bengaluru Development Authority

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
1	Anekal Taluk	Attibele	Gollahalli	Full Village
2	Anekal Taluk	Attibele	Hebbagodi	Full Village
3	Anekal Taluk	Attibele	Veerasandra	Full Village
4	Anekal Taluk	Jigani	Bannerugatta	Full Village
5	Anekal Taluk	Jigani	Bannerugattada Kavalu	Full Village
6	Anekal Taluk	Jigani	Begihalli	Full Village
7	Anekal Taluk	Jigani	Sarvamanya Bingipura	Full Village
8	Anekal Taluk	Jigani	Bhyrappanahalli	Full Village
9	Anekal Taluk	Jigani	Bilvaaradahalli	Full Village
10	Anekal Taluk	Jigani	Bhoothanahalli	Full Village
11	Anekal Taluk	Jigani	Bhujangadasana Amanikere	Full Village
12	Anekal Taluk	Jigani	Gollahalli	Full Village
13	Anekal Taluk	Jigani	Hulimangala	Full Village
14	Anekal Taluk	Jigani	Hullakasavanahalli	Full Village
15	Anekal Taluk	Jigani	Hullahalli	Full Village
16	Anekal Taluk	Jigani	Kannaikana Agrahara	Full Village
17	Anekal Taluk	Jigani	Kallakere	Full Village
18	Anekal Taluk	Jigani	Lakshmipura	Full Village
19	Anekal Taluk	Jigani	Mantapa	Full Village
20	Anekal Taluk	Jigani	Maragondahalli	Full Village
21	Anekal Taluk	Jigani	Nanjapura	Full Village
22	Anekal Taluk	Jigani	Nallasandra	Full Village
23	Anekal Taluk	Jigani	Ramasandra	Full Village
24	Anekal Taluk	Jigani	Sakalavara	Full Village
25	Anekal Taluk	Jigani	Thirupalya	Full Village
26	Anekal Taluk	Jigani	Vabasandra	Full Village
27	Anekal Taluk	Jigani	Vaderahalli	Full Village
28	Anekal Taluk	Jigani	Halesampigehalli	Full Village
29	Anekal Taluk	Sarjapura	Avalahalli	Full Village
30	Anekal Taluk	Sarjapura	Chikkanekkundi	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
31	Anekal Taluk	Sarjapura	Chokkasandra	Full Village
32	Anekal Taluk	Sarjapura	Chikkavaderapura	Full Village
33	Anekal Taluk	Sarjapura	Madivala	Full Village
34	Anekal Taluk	Sarjapura	Chikkanagamangala	Full Village
35	Anekal Taluk	Sarjapura	Choodasandra	Full Village
36	Anekal Taluk	Sarjapura	Dommasandra	Full Village
37	Anekal Taluk	Sarjapura	Ghottamaranahalli	Full Village
38	Anekal Taluk	Sarjapura	Gulamangala	Full Village
39	Anekal Taluk	Sarjapura	Ghattihalli	Full Village
40	Anekal Taluk	Sarjapura	Hosahalli	Full Village
41	Anekal Taluk	Sarjapura	Harohalli	Full Village
42	Anekal Taluk	Sarjapura	Huskuru	Full Village
43	Anekal Taluk	Sarjapura	Heggondahalli	Full Village
44	Anekal Taluk	Sarjapura	Halasahalli Thippasandra	Full Village
45	Anekal Taluk	Sarjapura	Kommasandra	Full Village
46	Anekal Taluk	Sarjapura	Kaggalipura	Full Village
47	Anekal Taluk	Sarjapura	Kathriguppe	Full Village
48	Anekal Taluk	Sarjapura	Koodlu	Full Village
49	Anekal Taluk	Sarjapura	Nekkundi Dommasandra	Full Village
50	Anekal Taluk	Sarjapura	Ramanayikanahalli	Full Village
51	Anekal Taluk	Sarjapura	Rayasandra	Full Village
52	Anekal Taluk	Sarjapura	Shrirampura	Full Village
53	Anekal Taluk	Sarjapura	Shingena Agrahara	Full Village
54	Anekal Taluk	Sarjapura	Thigalachoudadenahalli	Full Village
55	Bengaluru East	Bidarahalli	Anagalapura	Full Village
56	Bengaluru East	Bidarahalli	Adooru	Full Village
57	Bengaluru East	Bidarahalli	Aavalahalli	Full Village
58	Bengaluru East	Bidarahalli	Byappanahalli	Full Village
59	Bengaluru East	Bidarahalli	Bidarahalli	Full Village
60	Bengaluru East	Bidarahalli	Bilashivale	Full Village
61	Bengaluru East	Bidarahalli	Bhattarahalli	Full Village
62	Bengaluru East	Bidarahalli	Bidare Agrahara urf Chikkanagenahalli	Full Village
63	Bengaluru East	Bidarahalli	Belathuru	Full Village
64	Bengaluru East	Bidarahalli	Bommasandra	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
65	Bengaluru East	Bidarahalli	Bhyrathi	Full Village
66	Bengaluru East	Bidarahalli	Chikkagubbi	Full Village
67	Bengaluru East	Bidarahalli	Cheemasandra	Full Village
68	Bengaluru East	Bidarahalli	Chikkabanahalli	Full Village
69	Bengaluru East	Bidarahalli	Channasandra	Full Village
70	Bengaluru East	Bidarahalli	Dommasandra	Full Village
71	Bengaluru East	Bidarahalli	Doddabanahalli	Full Village
72	Bengaluru East	Bidarahalli	Doddenahalli	Full Village
73	Bengaluru East	Bidarahalli	Doddagubbi	Full Village
74	Bengaluru East	Bidarahalli	Goravigeri	Full Village
75	Bengaluru East	Bidarahalli	Huvina Ane	Full Village
76	Bengaluru East	Bidarahalli	Hirandahalli	Full Village
77	Bengaluru East	Bidarahalli	Halehalli	Full Village
78	Bengaluru East	Bidarahalli	Bhandapura	Full Village
79	Bengaluru East	Bidarahalli	Kadagodi Plantation	Full Village
80	Bengaluru East	Bidarahalli	Kumbena Agrahara	Full Village
81	Bengaluru East	Bidarahalli	Kadugodi	Full Village
82	Bengaluru East	Bidarahalli	Kurudasonnenahalli	Full Village
83	Bengaluru East	Bidarahalli	Kannamangala	Full Village
84	Bengaluru East	Bidarahalli	Khajisonnenahalli	Full Village
85	Bengaluru East	Bidarahalli	Katamnalluru	Full Village
86	Bengaluru East	Bidarahalli	Konadasapura	Full Village
87	Bengaluru East	Bidarahalli	Kitthaganooru	Full Village
88	Bengaluru East	Bidarahalli	Kada Agrahara	Full Village
89	Bengaluru East	Bidarahalli	Kannuru	Full Village
90	Bengaluru East	Bidarahalli	Kadasonnappanahalli	Full Village
91	Bengaluru East	Bidarahalli	Mittaganahalli	Full Village
92	Bengaluru East	Bidarahalli	Maragondanahalli	Full Village
93	Bengaluru East	Bidarahalli	Medahalli	Full Village
94	Bengaluru East	Bidarahalli	Nimbekayipura	Full Village
95	Bengaluru East	Bidarahalli	Nadagoudagollahalli	Full Village
96	Bengaluru East	Bidarahalli	Ramapura	Full Village
97	Bengaluru East	Bidarahalli	Sheegihalli	Full Village
98	Bengaluru East	Bidarahalli	Vaddarahalli	Full Village
99	Bengaluru East	Bidarahalli	Varanashi	Full Village
100	Bengaluru East	Bidarahalli	Veerenahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
101	Bengaluru East	Bidarahalli	Yarappanahalli	Full Village
102	Bengaluru East	Krishnarajapura	Thippasandra	Full Village
103	Bengaluru East	Krishnarajapura	Banasawadi	Full Village
104	Bengaluru East	Krishnarajapura	Basavanapura	Full Village
105	Bengaluru East	Krishnarajapura	Bendiganahalli	Full Village
106	Bengaluru East	Krishnarajapura	Binnamangala Manavarthe Kavalu	Full Village
107	Bengaluru East	Krishnarajapura	Byappanahalli	Full Village
108	Bengaluru East	Krishnarajapura	Byappanahalli Manavartha Kavalu	Full Village
109	Bengaluru East	Krishnarajapura	Byatarayanapura (Narayanapura)	Full Village
110	Bengaluru East	Krishnarajapura	Byrasandra	Full Village
111	Bengaluru East	Krishnarajapura	Byrathikane	Full Village
112	Bengaluru East	Krishnarajapura	Channasandra	Full Village
113	Bengaluru East	Krishnarajapura	Chelakere	Full Village
114	Bengaluru East	Krishnarajapura	Chinnappanahalli	Full Village
115	Bengaluru East	Krishnarajapura	Dasarahalli	Full Village
116	Bengaluru East	Krishnarajapura	Doddanekkundi	Full Village
117	Bengaluru East	Krishnarajapura	Dyavasandra	Full Village
118	Bengaluru East	Krishnarajapura	Gedlahalli	Full Village
119	Bengaluru East	Krishnarajapura	Hagadooru	Full Village
120	Bengaluru East	Krishnarajapura	Horamavu	Full Village
121	Bengaluru East	Krishnarajapura	Horamavu Agara	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
122	Bengaluru East	Krishnarajapura	Hudi	Full Village
123	Bengaluru East	Krishnarajapura	Kaggadasapura	Full Village
124	Bengaluru East	Krishnarajapura	Kalkere	Full Village
125	Bengaluru East	Krishnarajapura	Kavudenahalli	Full Village
126	Bengaluru East	Krishnarajapura	Kodagehalli	Full Village
127	Bengaluru East	Krishnarajapura	Kotthanooru	Full Village
128	Bengaluru East	Krishnarajapura	Kotthanuru Narayanapura	Full Village
129	Bengaluru East	Krishnarajapura	Krishnarajapura	Full Village
130	Bengaluru East	Krishnarajapura	Kundarahalli	Full Village
131	Bengaluru East	Krishnarajapura	Kyalasanahalli	Full Village
132	Bengaluru East	Krishnarajapura	Mahadevapura	Full Village
133	Bengaluru East	Krishnarajapura	Nagareshwaranaganahalli	Full Village
134	Bengaluru East	Krishnarajapura	Nagondanahalli	Full Village
135	Bengaluru East	Krishnarajapura	Nallurahalli	Full Village
136	Bengaluru East	Krishnarajapura	Pattanduru Agrahara	Full Village
137	Bengaluru East	Krishnarajapura	Rachenahalli	Full Village
138	Bengaluru East	Krishnarajapura	Ramagondahalli Narayanapura	Full Village
139	Bengaluru East	Krishnarajapura	Sadaramangala	Full Village
140	Bengaluru East	Krishnarajapura	Sheegehalli	Full Village
141	Bengaluru East	Krishnarajapura	Sonathammanahalli	Full Village
142	Bengaluru East	Krishnarajapura	Sonnenahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
143	Bengaluru East	Krishnarajapura	Srinivasapura	Full Village
144	Bengaluru East	Krishnarajapura	Thannasandra	Full Village
145	Bengaluru East	Krishnarajapura	Thippasandra Manavarthe Kavalu	Full Village
146	Bengaluru East	Krishnarajapura	Vibhuthipura	Full Village
147	Bengaluru East	Krishnarajapura	Vijanapura	Full Village
148	Bengaluru East	Krishnarajapura	Whitefield	Full Village
149	Bengaluru East	Varthur	Ambalipura	Full Village
150	Bengaluru East	Varthur	Balageri	Full Village
151	Bengaluru East	Varthur	Bellandur	Full Village
152	Bengaluru East	Varthur	Bellandur Amanikane	Full Village
153	Bengaluru East	Varthur	Beluru	Full Village
154	Bengaluru East	Varthur	Beluru Nagasandra	Full Village
155	Bengaluru East	Varthur	Bhoganahalli	Full Village
156	Bengaluru East	Varthur	Challaghatta	Full Village
157	Bengaluru East	Varthur	Chikkabellanduru	Full Village
158	Bengaluru East	Varthur	Chikkakannelli	Full Village
159	Bengaluru East	Varthur	Chikkanayikanahalli	Full Village
160	Bengaluru East	Varthur	Devarabisanahalli	Full Village
161	Bengaluru East	Varthur	Doddakannelli	Full Village
162	Bengaluru East	Varthur	Gunjuru	Full Village
163	Bengaluru East	Varthur	Hadoshiddapura	Full Village
164	Bengaluru East	Varthur	Halanayikanahalli	Full Village
165	Bengaluru East	Varthur	Haraluru	Full Village
166	Bengaluru East	Varthur	Junnasandra	Full Village
167	Bengaluru East	Varthur	Kachamaranahalli	Full Village
168	Bengaluru East	Varthur	Kadabeesanahalli	Full Village
169	Bengaluru East	Varthur	Kaikodahalli	Full Village
170	Bengaluru East	Varthur	Kanekandaya	Full Village
171	Bengaluru East	Varthur	Kariammana Agrahara	Full Village
172	Bengaluru East	Varthur	Kasavanahalli	Full Village
173	Bengaluru East	Varthur	Kempapura	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
174	Bengaluru East	Varthur	Kodathi	Full Village
175	Bengaluru East	Varthur	Kodihalli	Full Village
176	Bengaluru East	Varthur	Konena Agrahara	Full Village
177	Bengaluru East	Varthur	Marutthahalli	Full Village
178	Bengaluru East	Varthur	Mulluru	Full Village
179	Bengaluru East	Varthur	Munnekolala	Full Village
180	Bengaluru East	Varthur	Panathuru	Full Village
181	Bengaluru East	Varthur	Ramagondanahalli	Full Village
182	Bengaluru East	Varthur	Shiddapura	Full Village
183	Bengaluru East	Varthur	Shorahunashi	Full Village
184	Bengaluru East	Varthur	Soolakunte	Full Village
185	Bengaluru East	Varthur	Thubarahalli	Full Village
186	Bengaluru East	Varthur	Valepura	Full Village
187	Bengaluru East	Varthur	Varthuru	Full Village
188	Bengaluru East	Varthur	Yamaluru	Full Village
189	Bengaluru North	Dasanapura	Aluru	Full Village
190	Bengaluru North	Dasanapura	Adakimaranahalli	Full Village
191	Bengaluru North	Dasanapura	Bylakonenahalli	Part Village [Sy. No. 1 to 23, 25 to 58, Gramathana]
192	Bengaluru North	Dasanapura	Byandahalli	Full Village
193	Bengaluru North	Dasanapura	Chikkabidarakallu	Part Village [Sy. No. 1 to 21, 23 to 51, Gramathana]
194	Bengaluru North	Dasanapura	Dombarahalli	Full Village
195	Bengaluru North	Dasanapura	Dasanapura	Full Village
196	Bengaluru North	Dasanapura	Gavipalya	Full Village
197	Bengaluru North	Dasanapura	Gangondanahalli	Part Village [Sy no.1 to 15, 22 to 40, 45 to 97, 102 to 104, 106 to 110, 113 to 115, and Gramathana]
198	Bengaluru North	Dasanapura	Hanumanthasagara	Full Village
199	Bengaluru North	Dasanapura	Heggadadevanapura	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
200	Bengaluru North	Dasanapura	Harokyathanahalli	Full Village
201	Bengaluru North	Dasanapura	Thore Nagasandra	Full Village
202	Bengaluru North	Dasanapura	Kachohalli	Part Village [Sy No. 1 to 13, 17, 18, 20 to 26, 28 to 75, and Gramathana, Gollarapalya
203	Bengaluru North	Dasanapura	Kadaranahalli	Full Village
204	Bengaluru North	Dasanapura	Kuduragere	Full Village
205	Bengaluru North	Dasanapura	Lakkenahalli	Full Village
206	Bengaluru North	Dasanapura	Lakshmipura	Part Village [Sy. No. 1 to 14, 16 to 63, Gramathana, Thigalarapalya, Koliganahalli
207	Bengaluru North	Dasanapura	Machohalli	Full Village
208	Bengaluru North	Dasanapura	Madavara	Part Village [Sy. No. 1, 2, 16, 18 to 23, 63 to 65, 69 to 123, 125, and Gramathana, Majare]
209	Bengaluru North	Dasanapura	Makali	Full Village
210	Bengaluru North	Dasanapura	Muniyanapalya	Full Village
211	Bengaluru North	Dasanapura	Narasipura	Full Village
212	Bengaluru North	Dasanapura	Narayanapalya	Full Village
213	Bengaluru North	Dasanapura	Kayamguttha Srikantapura	Part Village [Sy. No. 1 to 32, 39 to 48, and Gramathana]
214	Bengaluru North	Dasanapura	Srikantapura	Part Village [Sy. No. 1, 2, 3, 6, 7, 8, 21 to 24, 28 to 31, and Gramathana]
215	Bengaluru North	Dasanapura	Siddanahosahalli	Full Village
216	Bengaluru North	Dasanapura	Thammenahalli	Full Village
217	Bengaluru North	Dasanapura	Vaddarahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
218	Bengaluru North	Hesaraghatta	Ivarakandapura	Full Village
219	Bengaluru North	Hesaraghatta	Addiganahalli	Full Village
220	Bengaluru North	Hesaraghatta	Bilajaji	Full Village
221	Bengaluru North	Hesaraghatta	Bylakere	Full Village
222	Bengaluru North	Hesaraghatta	Guni Agrahara	Full Village
223	Bengaluru North	Hesaraghatta	Hesaraghatta	Part Village [Sy. No. 159 to 165, 193 to 210]
224	Bengaluru North	Hesaraghatta	Hurlichikkanahalli	Full Village
225	Bengaluru North	Hesaraghatta	Ittagalpura	Full Village
226	Bengaluru North	Hesaraghatta	Kalathammanahalli	Full Village
227	Bengaluru North	Hesaraghatta	Kalenahalli	Full Village
228	Bengaluru North	Hesaraghatta	Kasagattapura	Full Village
229	Bengaluru North	Hesaraghatta	Kempapura	Full Village
230	Bengaluru North	Hesaraghatta	Kodagithirumalapura	Full Village
231	Bengaluru North	Hesaraghatta	Kondashettihalli	Full Village
232	Bengaluru North	Hesaraghatta	Krishnarajapura	Full Village
233	Bengaluru North	Hesaraghatta	Kumbarahalli	Full Village
234	Bengaluru North	Hesaraghatta	Linganahalli	Full Village
235	Bengaluru North	Hesaraghatta	Lingarajapura	Full Village
236	Bengaluru North	Hesaraghatta	Lingarajasagara	Full Village
237	Bengaluru North	Hesaraghatta	Madappanahalli	Full Village
238	Bengaluru North	Hesaraghatta	Maddagirihalli	Full Village
239	Bengaluru North	Hesaraghatta	Mavalipura	Full Village
240	Bengaluru	Hesaraghatta	Muthakarahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
	North			
241	Bengaluru North	Hesaraghatta	Mylappanahalli	Full Village
242	Bengaluru North	Hesaraghatta	Rajanakunte	Full Village
243	Bengaluru North	Hesaraghatta	Sasiveghatta	Full Village
244	Bengaluru North	Hesaraghatta	Sheekoti	Full Village
245	Bengaluru North	Hesaraghatta	Soladevanahalli	Full Village
246	Bengaluru North	Hesaraghatta	Thammarasanahalli	Full Village
247	Bengaluru North	Hesaraghatta	Tharabanahalli	Full Village
248	Bengaluru North	Jala	Bettahalasuru	Full Village
249	Bengaluru North	Jala	Bagaluru	Part Village [Sy. No.260 to 271, 376 to 379]
250	Bengaluru North	Jala	Byappanahalli	Full Village
251	Bengaluru North	Jala	Chagalatti	Full Village
252	Bengaluru North	Jala	Dasanayakanahalli	Full Village
253	Bengaluru North	Jala	Hunasamaranahalli	Full Village
254	Bengaluru North	Jala	Kattigenahalli	Full Village
255	Bengaluru North	Jala	Marenahalli	Full Village
256	Bengaluru North	Jala	Nallakunti	Full Village
257	Bengaluru North	Jala	Sugatta	Full Village
258	Bengaluru North	Jala	Sonnappanahalli	Full Village
259	Bengaluru North	Jala	Sathanuru	Full Village
260	Bengaluru North	Jala	Thimmasandra	Full Village
261	Bengaluru North	Kasaba (Bengaluru)	City Survey Sheets [from N0. 1 to No.97]	Full City Survey Sheet

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
262	Bengaluru North	Kasaba (Bengaluru)	Chikkamaranahalli	Full Village
263	Bengaluru North	Kasaba (Bengaluru)	Bupasandra	Full Village
264	Bengaluru North	Kasaba (Bengaluru)	Byadarahalli	Full Village
265	Bengaluru North	Kasaba (Bengaluru)	Byataguttapalya	Full Village
266	Bengaluru North	Kasaba (Bengaluru)	Cholanayakanahalli	Full Village
267	Bengaluru North	Kasaba (Bengaluru)	Devarajeebanahalli	Full Village
268	Bengaluru North	Kasaba (Bengaluru)	Dyavasandra	Full Village
269	Bengaluru North	Kasaba (Bengaluru)	Gangenahalli	Full Village
270	Bengaluru North	Kasaba (Bengaluru)	Gavipura	Full Village
271	Bengaluru North	Kasaba (Bengaluru)	Geddalahalli	Full Village
272	Bengaluru North	Kasaba (Bengaluru)	Guddadahalli	Full Village
273	Bengaluru North	Kasaba (Bengaluru)	Gurihodeyuvamaidana	Full Village
274	Bengaluru North	Kasaba (Bengaluru)	Hebbala	Full Village
275	Bengaluru North	Kasaba (Bengaluru)	Hebbala Amanikere	Full Village
276	Bengaluru North	Kasaba (Bengaluru)	Hennuru	Full Village
277	Bengaluru North	Kasaba (Bengaluru)	Jedihalli	Full Village
278	Bengaluru North	Kasaba (Bengaluru)	Kacharakanahalli	Full Village
279	Bengaluru North	Kasaba (Bengaluru)	Kalagondanahalli	Full Village
280	Bengaluru North	Kasaba (Bengaluru)	Kaval Byrasandra	Full Village
281	Bengaluru North	Kasaba (Bengaluru)	Kempapura Agrahara	Full Village
282	Bengaluru North	Kasaba (Bengaluru)	Lingarajapura	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
283	Bengaluru North	Kasaba (Bengaluru)	Lottigollahalli	Full Village
284	Bengaluru North	Kasaba (Bengaluru)	Matadahalli	Full Village
285	Bengaluru North	Kasaba (Bengaluru)	Matthikere	Full Village
286	Bengaluru North	Kasaba (Bengaluru)	Nagashettihalli	Full Village
287	Bengaluru North	Kasaba (Bengaluru)	Nagavara	Full Village
288	Bengaluru North	Kasaba (Bengaluru)	Poornapura	Full Village
289	Bengaluru North	Kasaba (Bengaluru)	Shyamapura	Full Village
290	Bengaluru North	Kasaba (Bengaluru)	Tata Research Institute	Full Village
291	Bengaluru North	Kasaba (Bengaluru)	Vishwanathanagenahalli	Full Village
292	Bengaluru North	Kasaba (Bengaluru)	Gerahalli	Full Village
293	Bengaluru North	Yelahanka	Aavalahalli	Full Village
294	Bengaluru North	Yelahanka	Agrahara	Full Village
295	Bengaluru North	Yelahanka	Allalasandra	Full Village
296	Bengaluru North	Yelahanka	Amruthahalli	Full Village
297	Bengaluru North	Yelahanka	Ananthapura	Full Village
298	Bengaluru North	Yelahanka	Atturu	Full Village
299	Bengaluru North	Yelahanka	Bellahalli	Full Village
300	Bengaluru North	Yelahanka	Byatarayapura	Full Village
301	Bengaluru North	Yelahanka	Chikkabammasandra	Full Village
302	Bengaluru North	Yelahanka	Chikkabettahalli	Full Village
303	Bengaluru North	Yelahanka	Chokkanahalli	Full Village
304	Bengaluru North	Yelahanka	Doddabettahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
305	Bengaluru North	Yelahanka	Doddabommasandra	Full Village
306	Bengaluru North	Yelahanka	Gantigenahalli	Full Village
307	Bengaluru North	Yelahanka	Gasthikempanahalli	Full Village
308	Bengaluru North	Yelahanka	Govindapura	Full Village
309	Bengaluru North	Yelahanka	Harohalli	Full Village
310	Bengaluru North	Yelahanka	Honnenahalli	Full Village
311	Bengaluru North	Yelahanka	Jakkuru	Full Village
312	Bengaluru North	Yelahanka	Jakkuru Plantation	Full Village
313	Bengaluru North	Yelahanka	Jyarakabandekavalu	Full Village
314	Bengaluru North	Yelahanka	Kempanahalli	Full Village
315	Bengaluru North	Yelahanka	Kempapura	Full Village
316	Bengaluru North	Yelahanka	Kenchenahalli	Full Village
317	Bengaluru North	Yelahanka	Kodagihalli	Full Village
318	Bengaluru North	Yelahanka	Kodagihalli Plantation	Full Village
319	Bengaluru North	Yelahanka	Kogilu	Full Village
320	Bengaluru North	Yelahanka	Kothihosahalli	Full Village
321	Bengaluru North	Yelahanka	Krishnasagara	Full Village
322	Bengaluru North	Yelahanka	Lakshmisagara	Full Village
323	Bengaluru North	Yelahanka	Manchenahalli	Full Village
324	Bengaluru North	Yelahanka	Mandalakunte	Full Village
325	Bengaluru North	Yelahanka	Medi Agrahara	Full Village
326	Bengaluru North	Yelahanka	Muddanahalli	Full Village
327	Bengaluru	Yelahanka	Nagadasanahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
	North			
328	Bengaluru North	Yelahanka	Narashipura	Full Village
329	Bengaluru North	Yelahanka	Puttenahalli	Full Village
330	Bengaluru North	Yelahanka	Ramachandrapura	Full Village
331	Bengaluru North	Yelahanka	Ramagondahalli	Full Village
332	Bengaluru North	Yelahanka	Sampigehalli	Full Village
333	Bengaluru North	Yelahanka	Shinganayakanahalli	Full Village
334	Bengaluru North	Yelahanka	Shinganayakanahalli Amanikere	Full Village
335	Bengaluru North	Yelahanka	Shingapura	Full Village
336	Bengaluru North	Yelahanka	Shivanahalli	Full Village
337	Bengaluru North	Yelahanka	Shyamarajapura	Full Village
338	Bengaluru North	Yelahanka	Sreerampura	Full Village
339	Bengaluru North	Yelahanka	Srinivasapura	Full Village
340	Bengaluru North	Yelahanka	Thindalu Plantation	Full Village
341	Bengaluru North	Yelahanka	Thindlu	Full Village
342	Bengaluru North	Yelahanka	Thirumalenahalli	Full Village
343	Bengaluru North	Yelahanka	Vaderahalli	Full Village
344	Bengaluru North	Yelahanka	Vaderapura	Full Village
345	Bengaluru North	Yelahanka	Vasudevapura	Full Village
346	Bengaluru North	Yelahanka	Veerasagara	Full Village
347	Bengaluru North	Yelahanka	Vengatala	Full Village
348	Bengaluru North	Yelahanka	Venkateshapura	Full Village
349	Bengaluru North	Yelahanka	Yelahanka	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
350	Bengaluru North	Yelahanka	Yelahanka Amanikere	Full Village
351	Bengaluru North	Yeshwanthapura	Abbigere	Full Village
352	Bengaluru North	Yeshwanthapura	Agrahara Dasarahalli	Full Village
353	Bengaluru North	Yeshwanthapura	Bagalagunti	Full Village
354	Bengaluru North	Yeshwanthapura	Chikkabanavara	Full Village
355	Bengaluru North	Yeshwanthapura	Chikkasandra	Full Village
356	Bengaluru North	Yeshwanthapura	Chokkasandra	Full Village
357	Bengaluru North	Yeshwanthapura	Dasarahalli	Full Village
358	Bengaluru North	Yeshwanthapura	Doddabidarakallu	Full Village
359	Bengaluru North	Yeshwanthapura	Gangondanahalli	Full Village
360	Bengaluru North	Yeshwanthapura	Ganigerahalli	Full Village
361	Bengaluru North	Yeshwanthapura	Giddadakonehalli	Full Village
362	Bengaluru North	Yeshwanthapura	Guladahalli	Full Village
363	Bengaluru North	Yeshwanthapura	Handrahalli	Part Village [Sy. No. 1 to 86, 93 to 96, 103 to 119, and Gramathana]
364	Bengaluru North	Yeshwanthapura	Hegganahalli	Full Village
365	Bengaluru North	Yeshwanthapura	Herohalli	Part Village [Sy. No. 1 to 66, 68 to 74, 76 to 169, 171 to 175, 177, 182 to 194, Gramathana,and Majare Byadarahalli]
366	Bengaluru North	Yeshwanthapura	Hosahalli Gollarapalya	Part Village [Sy. No. 1 to 12, 21, 30, 34, 35, 42 to 44, and Gramathana]

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
367	Bengaluru North	Yeshwanthapura	Hullalu	Part Village [Sy. No. 1 to 28, 31 to 185, 189 to 193, 197, 198, 200to 208, Gramathana, Majare(South of Sy no.39), Majare(East of Sy no.5), Majare(South of Sy no.97), and Majare(South of Sy no. 168)
368	Bengaluru North	Yeshwanthapura	Jyalahalli	Full Village
369	Bengaluru North	Yeshwanthapura	Kamagondanahalli	Full Village
370	Bengaluru North	Yeshwanthapura	Kannelli	Full Village
371	Bengaluru North	Yeshwanthapura	Karivobanahalli	Full Village
372	Bengaluru North	Yeshwanthapura	Kethamaranahalli	Full Village
373	Bengaluru North	Yeshwanthapura	Kodagihalli	Part Village [Sy. No. 1 to 29, 35, 39 to 72, 77 to 82, 94, 105 to 111, 120, 135 to 139, Gramathana, and Gongadipura]
374	Bengaluru North	Yeshwanthapura	Laggeri	Full Village
375	Bengaluru North	Yeshwanthapura	Lakshmipura	Full Village
376	Bengaluru North	Yeshwanthapura	Lingadeeranahalli	Part Village [Sy. No. 1 to 36, 40, 42 to 54, and Gramathana
377	Bengaluru North	Yeshwanthapura	Malagala	Full Village
378	Bengaluru North	Yeshwanthapura	Mallasandra	Full Village
379	Bengaluru North	Yeshwanthapura	Mallatthahalli	Full Village
380	Bengaluru North	Yeshwanthapura	Manganahalli	Part Village [Sy. No. 1 to 29, 46, 49, 63 to 65, 74 to 77, and Gramathana]
381	Bengaluru North	Yeshwanthapura	Medarahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
382	Bengaluru North	Yeshwanthapura	Myakalachinnenahalli	Full Village
383	Bengaluru North	Yeshwanthapura	Nagarabhavi	Full Village
384	Bengaluru North	Yeshwanthapura	Nagasandra	Full Village
385	Bengaluru North	Yeshwanthapura	Nallakadirenahalli	Full Village
386	Bengaluru North	Yeshwanthapura	Peenya	Full Village
387	Bengaluru North	Yeshwanthapura	Peenyada Plantation	Full Village
388	Bengaluru North	Yeshwanthapura	Sajjipalya	Full Village
389	Bengaluru North	Yeshwanthapura	Saneguruvanahalli	Full Village
390	Bengaluru North	Yeshwanthapura	Sheegehalli	Full Village
391	Bengaluru North	Yeshwanthapura	Shettihalli	Full Village
392	Bengaluru North	Yeshwanthapura	Shivanahalli	Full Village
393	Bengaluru North	Yeshwanthapura	Shrigandhakavalu	Full Village
394	Bengaluru North	Yeshwanthapura	Sidedahalli	Full Village
395	Bengaluru North	Yeshwanthapura	Somashettahalli	Full Village
396	Bengaluru North	Yeshwanthapura	Thanneeranahalli	Full Village
397	Bengaluru North	Yeshwanthapura	Thirumalapura	Part Village [Sy. No. 1 to 9, 11, 12, 17, 18, 36, 37, 38, 40 to 42, and Gramathana
398	Bengaluru North	Yeshwanthapura	Yeshavanthapura	Full Village
399	Bengaluru South	Beguru	Agara	Full Village
400	Bengaluru South	Beguru	Arakere	Full Village
401	Bengaluru South	Beguru	Basapura	Part Village [Sy. No. 1 to 27, 30 to 33, 43, 49 to 70, and Gramathana]

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
402	Bengaluru South	Beguru	Basavanapura	Part Village [Sy. No. 1 to 39, 47 to 52, and Gramathana]
403	Bengaluru South	Beguru	Beguru	Part Village [Sy. No. 1 to 30, 35 to 38, 52 to 62, 65 to 78, 84, 91 to 93, 94 (P), 97 to 106, 109, 130 to 142, 144 to 395, 397 to 403, Gramathana, and Kodihalli]
404	Bengaluru South	Beguru	Bellakkanahalli	Full Village
405	Bengaluru South	Beguru	Beratena Agrahara	Part Village [Sy. No. 1 to 39, Gramathana, and Majare]
406	Bengaluru South	Beguru	Bettadasanapura	Full Village
407	Bengaluru South	Beguru	Bommanahalli	Full Village
408	Bengaluru South	Beguru	Chandrashekarapura	Full Village
409	Bengaluru South	Beguru	Chikkathoguru	Part Village [Sy. No. 24 to 27, 36 to 45]
410	Bengaluru South	Beguru	Devarachikkanahalli	Full Village
411	Bengaluru South	Beguru	Doddanagamangala	Part Village [Sy. No. [1 to 17, 19 to 23, 25, 26, 29 to 95, and Gramathana]
412	Bengaluru South	Beguru	Doddathoguru	Part Village [Sy. No. 40 to 111, 117 to 121, 126 to 129, 133 to 135, 149 to 168, and Gramathana]
413	Bengaluru South	Beguru	Ejipura	Full Village
414	Bengaluru South	Beguru	Haadagodi	Full Village
415	Bengaluru South	Beguru	Haralakunti	Full Village
416	Bengaluru South	Beguru	Hommadevanahalli	Full Village
417	Bengaluru South	Beguru	Hongasandra	Full Village
418	Bengaluru South	Beguru	Hulimavu	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
419	Bengaluru South	Beguru	Ibbaluru	Full Village
420	Bengaluru South	Beguru	Jakkasandra	Full Village
421	Bengaluru South	Beguru	Kalena Agrahara	Full Village
422	Bengaluru South	Beguru	Kammanahalli	Part Village [Sy. No. 1 to 19, 20(P), 21 to 36, 39 to 41, 48 to 53, 58 to 70, 75 to 81, 82(P), 86, 87, 88(P), 91 to 135, Chikkamana Halli and Gramathana]
423	Bengaluru South	Beguru	Kodichikkanahalli	Full Village
424	Bengaluru South	Beguru	Konappana Agrahara	Part Village [Sy. No. 2 to 46, 48, 54, 56, 58, 59, 93, 94, 96, 97, Palya and Gramathana]
425	Bengaluru South	Beguru	Koramangala	Full Village
426	Bengaluru South	Beguru	Lakkasandra	Full Village
427	Bengaluru South	Beguru	Madivala	Full Village
428	Bengaluru South	Beguru	Mylasandra	Full Village
429	Bengaluru South	Beguru	Naganathapura	Full Village
430	Bengaluru South	Beguru	Nyanappanahalli	Full Village
431	Bengaluru South	Beguru	Nynappashettipalya	Full Village
432	Bengaluru South	Beguru	Parappana Agrahara	Full Village
433	Bengaluru South	Beguru	Rupena Agrahara	Full Village
434	Bengaluru South	Beguru	Sarakki Agrahara	Full Village
435	Bengaluru South	Beguru	Shingasandra	Full Village
436	Bengaluru South	Beguru	Shinivagala Kere	Full Village
437	Bengaluru South	Beguru	Shinivagalu	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
438	Bengaluru South	Beguru	Tavarekere	Full Village
439	Bengaluru South	Beguru	Venkaji Rao Kere	Full Village
440	Bengaluru South	Beguru	Vittasandra	Full Village
441	Bengaluru South	Beguru	Yalakunte	Full Village
442	Bengaluru South	Beguru	Yelenahalli	Part Village [Sy. No. 1 to 37, 44, 50 to 60, 63, 65, 67, 68 and Gramathana]
443	Bengaluru South	Kengeri	Devatigeramanahalli	Part Village [Sy. No. 1 to 4, 10 to 57, Radio and Electrical Manufacturing Company and Central Industrial Workshop]
444	Bengaluru South	Kengeri	Agara	Full Village
445	Bengaluru South	Kengeri	Badamanevarthikavalu	Part Village [Sy. No. 45, 76 to 82, 133 (part), 134 (Part), 135 (part) 146 to 160, 162, 188 to 189
446	Bengaluru South	Kengeri	Bheemanakuppe	Full Village
447	Bengaluru South	Kengeri	Bheemanakuppe Ramasagara	Full Village
448	Bengaluru South	Kengeri	Challaghatta	Full Village
449	Bengaluru South	Kengeri	Choodenapura	Part Village [Sy. No. 1 to 14, 20 to 38, Gramathana, and Palya]
450	Bengaluru South	Kengeri	Devageri	Full Village
451	Bengaluru South	Kengeri	Doddabele	Part Village [Sy. No. 1 to 7, 9 to 40,and Gramathana]
452	Bengaluru South	Kengeri	Ganakullu	Part Village [Sy. No. 1 to 3, 13 to 22, and Gramathana]
453	Bengaluru South	Kengeri	Gudamava	Full Village
454	Bengaluru South	Kengeri	Halagevaderahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
455	Bengaluru South	Kengeri	Hemmigepura	Part Village [Sy. No. 9 to 50, 52, 56, 60, 62 to 72, 78 to 85, 87 to 106, 108 to 113, 115, Gramathana (2), Majare (2)]
456	Bengaluru South	Kengeri	Kambipura	Full Village
457	Bengaluru South	Kengeri	Kanaminake	Full Village
458	Bengaluru South	Kengeri	Kenchanapura	Full Village
459	Bengaluru South	Kengeri	Kenchenahalli	Full Village
460	Bengaluru South	Kengeri	Kengeri	Part Village [Sy. No. 1 to 93, 95 to 111, 113 to 117, 129 to 136, 156 to 163, 170 to 201, 203, 206 to 211, 213 to 236, 238 to 240, 256 to 268,and Gramathana]
461	Bengaluru South	Kengeri	Kommagatta	Part Village [Sy. No. 28, 29, 31 to 37, 39 to 93, 95, 100 to 111, 115 to 124, 142 to 158, 168, 169, and Byrappana Palya]
462	Bengaluru South	Kengeri	Kommagatta Krishnasagara	Full Village
463	Bengaluru South	Kengeri	Kumbalagodu	Full Village
464	Bengaluru South	Kengeri	Lingadheeranahalli	Full Village
465	Bengaluru South	Kengeri	Maaragondanahalli	Full Village
466	Bengaluru South	Kengeri	Maaragondanahalli Krishnasagara	Full Village
467	Bengaluru South	Kengeri	Maligowdanahalli	Full Village
468	Bengaluru South	Kengeri	Mylasandra	Full Village
469	Bengaluru South	Kengeri	Nagadevanahalli	Full Village
470	Bengaluru South	Kengeri	Nayandahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
471	Bengaluru South	Kengeri	Pantharapalya	Part Village [Sy. No. 1 to 8, 24, 25, 75 to 131, and Gramthana]
472	Bengaluru South	Kengeri	Patnagere	Full Village
473	Bengaluru South	Kengeri	Ramasandra	Part Village [Sy. No. 1 to 3, 11, 12, 14, 15, 20 to 32, 34 to 37, 50, 61, 62(P), 63, 64, 81 to 167, 170 to 175, Gramthana, Majare Dannaikanapalya, Majare Doddabasthi, Majare, Majare Chikkabasthi, and Palya]
474	Bengaluru South	Kengeri	Ramohalli	Full Village
475	Bengaluru South	Kengeri	Sonnenahalli	Full Village
476	Bengaluru South	Kengeri	Sulikeri	Full Village
477	Bengaluru South	Kengeri	Thagachikuppi	Full Village
478	Bengaluru South	Kengeri	Valagerehalli	Full Village
479	Bengaluru South	Kengeri	Venkatapura	Full Village
480	Bengaluru South	Thavarekere	Chikkeluru Rampura	Full Village
481	Bengaluru South	Thavarekere	Chikkeluru Venkatapura	Full Village
482	Bengaluru South	Thavarekere	Chikkeluru	Full Village
483	Bengaluru South	Thavarekere	Channenahalli	Full Village
484	Bengaluru South	Thavarekere	Koluru Nanjundapura	Full Village
485	Bengaluru South	Thavarekere	Koluru Gurarayanapura	Full Village
486	Bengaluru South	Thavarekere	Koluru	Full Village
487	Bengaluru South	Thavarekere	Kethohalli	Full Village
488	Bengaluru South	Thavarekere	Kethohalli Rampura	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
489	Bengaluru South	Thavarekere	Kethohalli Narasipura	Full Village
490	Bengaluru South	Thavarekere	Sheshagiripura	Full Village
491	Bengaluru South	Thavarekere	Yalachaguppe	Full Village
492	Bengaluru South	Thavarekere	Yalachaguppe Rampura	Full Village
493	Bengaluru South	Uttarahalli	Aalahalli	Full Village
494	Bengaluru South	Uttarahalli	Aavalahalli	Part Village [Sy. No. 1 to 16, 18 to 26, 28, 29, 31 to 45, and Gramthana]
495	Bengaluru South	Uttarahalli	Anjanapura	Part Village [Sy. No. 1 to 12, 17 to 21, 29 to 48, 50 to 77, 82 to 92, 94, 98, 108, 115 to 120, Gramthana, and Majare
496	Bengaluru South	Uttarahalli	Arehalli	Part Village [Sy. No. 1 to 23, 28(P), 29 to 40, 42 to 46, and Gramthana]
497	Bengaluru South	Uttarahalli	Bhyrasandra	Full Village
498	Bengaluru South	Uttarahalli	Bikashipura	Full Village
499	Bengaluru South	Uttarahalli	Channasandra	Part Village [Sy. No. 3 to 7, 10 to 12, 13(P), 14, 20 to 26, 35 to 38]
500	Bengaluru South	Uttarahalli	Chikkallasandra	Full Village
501	Bengaluru South	Uttarahalli	Chunchanagatta	Full Village
502	Bengaluru South	Uttarahalli	Dasarahalli	Full Village
503	Bengaluru South	Uttarahalli	Doddakallasandra	Full Village
504	Bengaluru South	Uttarahalli	Gollahalli	Part Village [Sy. No. 1 to 34, 39, 47 to 56, 59 to 65, Gramthana and Majare]
505	Bengaluru South	Uttarahalli	Gopinayakanahalli	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
506	Bengaluru South	Uttarahalli	Gottigeri	Part Village [Sy. No. 1 to 9, 11 to 62, 72 to 96, 105 to 111, 125 to 132, and Gramthana]
507	Bengaluru South	Uttarahalli	Gubbalala	Full Village
508	Bengaluru South	Uttarahalli	Hosahalli	Full Village
509	Bengaluru South	Uttarahalli	Hosakerihalli	Part Village [Sy. No. 1 to 6, 7(Part), 8, 16 to 24, 44 to 68, 84 to 86, 88 to 123, 125, 129, 131 to 135, and Gramthana]
510	Bengaluru South	Uttarahalli	Ittamadu	Full Village
511	Bengaluru South	Uttarahalli	Jeraganahalli	Full Village
512	Bengaluru South	Uttarahalli	Kadarenahalli	Full Village
513	Bengaluru South	Uttarahalli	Karesandra	Full Village
514	Bengaluru South	Uttarahalli	Katthariguppe	Full Village
515	Bengaluru South	Uttarahalli	Kembatthahalli	Part Village [Sy. No. 14 to 22, 51, 52, 57 to 100, Gramthana]
516	Bengaluru South	Uttarahalli	Konanakunti	Full Village
517	Bengaluru South	Uttarahalli	Kotthanuru	Full Village
518	Bengaluru South	Uttarahalli	Mallasandra	Part Village [Sy. No. 1 to 6, 8 to 18, 21, 25, 36 to 41
519	Bengaluru South	Uttarahalli	Marenahalli	Full Village
520	Bengaluru South	Uttarahalli	Obichudahalli	Full Village
521	Bengaluru South	Uttarahalli	Puttenahalli	Full Village
522	Bengaluru South	Uttarahalli	Raghavanapalya	Full Village
523	Bengaluru South	Uttarahalli	Raguvanahalli	Full Village
524	Bengaluru South	Uttarahalli	Sarakki	Full Village

Sl.No	Taluk	Name of Hobli	Village Name	Village / Survey No's (Coverage)
525	Bengaluru South	Uttarahalli	Sarakkikeri	Full Village
526	Bengaluru South	Uttarahalli	Marasandra (Subramanyapura)	Full Village
527	Bengaluru South	Uttarahalli	Thalaghattapura	Part Village [Sy. No. 1 to 23, 30, 31, 40, 42 to 88, Gramthana]
528	Bengaluru South	Uttarahalli	Thayappanahalli	Full Village
529	Bengaluru South	Uttarahalli	Thippasandra	Full Village
530	Bengaluru South	Uttarahalli	Thurahalli	Full Village
531	Bengaluru South	Uttarahalli	Uttarahalli	Part Village [Sy. No. 1 to 87, 89 to 120, Gramthana, and Majare
532	Bengaluru South	Uttarahalli	Uttarahalli Manavarthi Kavalu	Part Village [Sy. No. 1 to 7, 23, 25, 26]
533	Bengaluru South	Uttarahalli	Vaddarapalya	Part Village [Sy. No. 1 to 6, 14 to 31 and Gramthana]
534	Bengaluru South	Uttarahalli	Vajarahalli	Full Village
535	Bengaluru South	Uttarahalli	Vasanthapura	Full Village
536	Bengaluru South	Uttarahalli	Yadiyuru	Full Village
537	Bengaluru South	Uttarahalli	Yadiyuru Nagasandra	Full Village
538	Bengaluru South	Uttarahalli	Yalachenahalli	Full Village

Note: For survey number 133,134 and 134 of Badamanevarthe Kaval Village which are falling in part in LPA of BDA, the podi survey boundary shall define the LPA of BDA. The podi survey numbers whos area is falling majorly in LPA of BDA shall be considered as part of LPA of BDA or shall be part of LPA of BMICAPA.

SCHEDULE II

Running boundary of the proposed Local Planning for the "Environs of Bengaluru"

The boundary starts from the north eastern corner of Adigananahalli runs south – east along the eastern boundary of Adigananahalli until it meets the north – western corner of Thimmasandra Village turns east and runs along the northern boundary of Thimmasandra Bettahalsur till it meets the north eastern corner of Bettahalsur turns south and runs along the eastern boundary of Bettahalsur till it meets the south eastern corner of the Nellukunte village, turns south east and runs along the north – eastern boundary of Sonnappanahalli crosses Bellary road (NHto7) and runs further south – east and runs along the northern boundary of Sonnappanahalli and Hunasamaranahalli upto the north – eastern corner of Hunasamaranahalli turns south and runs along the eastern boundary of Hunasamaranahalli till it meets the north – western boundary of Sathanoor village upto the north – eastern corner of the same village turns south and runs along the eastern boundaries of Santhanoor and Bayappanahalli villages until it meets the north – western corner of Chagalatti turns east and runs along the northern boundary of Chagalatti until it meets the north – eastern corner of Chagalatti turns north and runs along the western boundary of Marenahalli upto the north – western corner of the village turns east and runs along the eastern boundary of Marenahalli until it meets the Northern tip of Dasanayakanahalli turns south – east and runs along the eastern boundary of Dasanayakanahalli until it meets the south – eastern corner of the same village turns south and runs along the eastern boundary of Dasanayakanahalli, Marenahalli, Yarappanahalli and Kada Agrahara until it meets the south – eastern corner of Kada Agrahara village turns east and runs along the northern boundary of Bayyappanahalli until it meets the north – eastern tip of Bayyappanahalli turns south – east and runs along the north and eastern boundary of the same village until it meats the north western corner of Cheemasandra turns east and runs along the northern boundary of Cheemasandra and Nimbekayipura until it meets the north – eastern corner of Nimbekayipura turns south and runs along the eastern – boundary of Nimbekayipura until it meets the north – western corner of Katamnallur village turns east and runs along the northern boundary of the same village crosses Bengaluru – Madras Road (NHto 4) and runs further east along the northern boundary of Katamnallur until it meet the north – eastern corner of the village turns south and runs along the eastern boundary of the village upto the south eastern corner of the village turns east and runs along the northern boundary of Goravigere upto its north – eastern corner turns south and runs along the eastern boundary of Goravigere and Kaji Sonnenahalli till it meets the eastern tip of Kaji Sonnenahalli turns south and meets the North Eastern boundary corner of Kannamangala turns South and runs along the eastern boundary of the same village and turns West and runs along the Eastern boundary until it meets the North Eastern corner of Seegehalli turns South and runs along the Eastern boundary of Seegehalli till it reaches the North – West corner of Kadugodi turns East and runs along the Eastern boundary of same village and turns South and runs along the Eastern boundary of same village until it needs the North Eastern corner of Channasandra turns South and runs along with the Eastern boundary of Channasandra till it reaches the North Eastern corner of Nagondanahalli turns East and runs along Eastern boundary of Nagondanahalli till it meets the South Eastern tip of the same village turns West and South and runs Western boundary till it meets the North – East corner of Hagadur turns South and Eastern boundary till it meets the North – Eastern corner of Vali Pura and turns South and Eastern boundary of tip of the same village, turns South – West it reaches the North Eastern corner of and Nekkundi Dommasandra village turns south – west and runs along the Eastern boundary of Nekkundi Dommasandra Katriguppe till it meets the sourthern tip of Katriguppe village turns west and runs along the sourthern boundary of Katriguppe village till it meets the south eastern tip of

Romanaikanahalli turns south and runs along the Eastern boundary of Thigala Chavadadenahalli crosses Bengaluru – Sarjapur Road runs further south along the Eastern boundary of Thigala Chavadadenahalli, Dommasandra, Kammasandra, until it meets the north western tip of Hosahalli Village turns east and runes along the northern boundary of Hosahalli Village till it meets the north eastern boundary corner of Hosahalli turns south and runs along the Eastern boundary of the same village till it meets the Southto Eastern corner of the village turns west and runs along the southern boundary of Hosahalli , Kammasandra and Kaggalipura till it meets the south eastern corner of Huskuru village turns south and runs along the Eastern Boundary of Shingena Agrahara until it meets the south eastern corner of the same village turner west and runs along the southern boundary of Shingena Agrahara till it meets the western tip of Shingena Agrahara turns south and runs along the eastern boundary of Gulimangala village areas BengalurutoHosur road and runs further south – west along the eastern boundary of Hebbagodi Village till it meets the southto eastern tip of Hebbagodi village turns west and runs along the southern boundary of Hebbagodi and Thirupalya until it meets the south – western comer of Thirupalya village turns south and runs along the Eastern boundary of Hulimangala and Vabasandra village till it meets the southto eastern corner of Vabasandra village turns south and runs along the eastern boundary of Nanjapura till it meets the southern tip of Nanjapura village turns in the north – west direction and run s along the western boundary of Nanjapura village until it meets the southern tip of Hulimangala village turns west and runs along the southern boundary of S. Bingipura and Ramasandra till it meets the southtowestern corner of the same village turns south and runs along the eastern boundary of Bogihalli , crosses Bengaluru – Anekal Road and rune further south along the Eastern boundary of Bogihalli until it meets the southto eastern corner of the village turns south west and runs along the southern boundary of the same village until it meets the southern boundary turn corner of Mantapa village turns north west run along the southern boundary of Mantapa Village till it meets the south – western corner of Mantapa turn west and south along the south eastern boundary of Bannerghatta village till it meets the southern tip of Bannerghatta village turns north and runs along the western boundary Bannerghatta village and Bannerghatta Kaval till it meets the boundary of Bhuthanahalli turns west and runs along the southern boundary of Bhuthanahalli until it meets the south western corner of Bhuthanahalli turns north and runs along the Western boundary of Bhuthanahalli until it meets the south – eastern tip of Badamanavarthikaval and turns west and runs along the southern boundary of Badamanavarthikaval and Obichudahalli crosses Bengaluru – Kanakapura road and runs further west along the southern boundary of Agara until it meets the southern tip of Badamanavarthikaval village turns north and runs along the western boundary of Agara (Sy No's 76 to 82 of Badamanavarthikaval village are included) till it meets the norttowestern corner of Sy no. 153 of same village, crosses stream and runs along the western boundary of Agara and western side of stream turns southtoeast and runs along the northern boundary of Agara till it meets northern tip of Sy no. 192 of Agara and turns towards northtoeast and runs along the boundary of Agara till it meets the northtoeast corner of Sy no. 37 of Agara and turns east and runs along the northern boundary of Agara till it meets the northtoeast corner of Sy no. 48 and turns south and runs along the eastern boundary of Agara till it meets the northtoeast corner of Sy no. 49 and continues along north boundary of same sy.no. to meet north corner of Sy.no.126 of Badamenvarthe Kaval village and follows the village boundary of Agara Village along the boundary of Sy. No.49, MajreHosa Thathagun, 50, 51,and 53 till it meets southern corner of sy.no.53 of Agara Village and turns south running along the boundary of Agara Villlage to meet southern corner of sy.no of 57 of same village and truns south east to meet north east corner of sy.no. 130 of Badamanevarthe Kaval and turns south running along the Sy.no. 130, 131 and 132 till its meest the north east corner of Sy.No. 64 of Agara Villages and truns east to meet north west coner of same sy.no. and truns south to meet south east corner of sy.no 64 and turns west to south west corner of same sy.no. and turns south following the boundary of sy.no. 132 and 133 of Badamanevarthe Kaval village till it meets the western corner of Sy.No. 133 and turns east in straight line cutting through Sy.no. 133, 134 and 135 to meet northwest corner of Sy. No.189 follows

northern boundary to reach north east corner of same sy.no. then turns south east cutting through sy.no. 135 to meet north eastern corner of sy. No. 146 then follows the boundary of Sy. No. 146, 156, 160 and 151 till it meets the eastern corner of Sy. No. 151 and turns north folliwng boundary of Sy. No. 162 to meeth the northern corner of Sy. No. 162 amd truns east to mmeet south east corner of Sy. No. 163 ammd turns north following the eastern boundry of Badamanevarthe Kaval village along sy. No. 163, 164, Amal Majare, 166, 274, 273, 167, 168, 169 till it meets north east corner of Sy. No. 169 of Badamanavarthikaval village and truns west and runs along the western boundary of Sy no's 89 and 98 of Anjanapura and meets northern tip of Sy no. 98 and turns east and runs along the northern boundary of Sy no's 98, 75, 21, 18 and 17 till it meets the southtoeast corner of Sy no. 19 of Anjanapura village and turns east and runs on northern boundary of Sy no. 39 of Gollahalli till it meets the northtoeastern corner and turns south and runs along the eastern boundary of same Sy no till it meets the northern boundary of Bilwaradahalli and turns east and runs along the northern boundary of same village till it meets the southtowestern corner of Sy no. 109 of Gottigere and turns north and runs along the western boundary of Sy no's 109, 111, 107, 106 and turns east and runs along the northern boundary of Sy no's 106 and 105 and turns south and runs along the eastern boundary of Sy no's 105 and 107 of same village till it meets the northtowestern corner of Sy no. 7 of Basavanapura and turns east and then turns north and runs along the western boundary of Sy no's 7, 9, 10 crosses Bannerughatta Road and turns north and runs along western boundary of Sy no's 30, 39, 37, 36 and turns east and runs along the northern boundary of Sy no's 36, 35, 34, 21, 50, 49, 47 till it meets the southtowestern corner of Sy no. 88 of Kammanahalli and cuts diagonally through the Sy no. 88 till it touches northtoeast corner of same Sy no. and turns east and runs along northern boundary of Sy no's 86 crosses stream and continues along 70, 68, 67, 58, 61, 53, 49, 48, 35, 36 and turns south and runs along the eastern boundary of Sy no's 36, 29, 28, 22, 21 till it meets the northern boundary of Hommadevanahalli and turns east and runs along northern boundary of Hommadevanahalli till it meets the southtowestern corner of Mylasandra and turns north and runs along the western boundary of Mylasandra till it meets the southtowestern corner of Sy no. 44 of Yelenahalli and turns north and runs along the western boundary of same Sy no. turns east and runs along the northern boundary of Sy no's 44, 68 till it meets the western boundary of Mylasandra and turns north and runs along the northern boundary of same village till it meets the southtowestern corner of Sy no. 52 of Begur and turns northtoeast and runs along the boundaries of Sy no's 52, 57, 59, 61, 62, 71, 66, 65, 78, 101, 100, 99, 98, 97, 106, 105 and turns south and runs along eastern boundary of Sy no's 105, 104 of same village till it meets the northern boundary of Vittasandra and turns east and runs till it meets the southtowest corner of Sy no. 109 of Begur and runs along northern boundary of Sy no. 109 till it touches the western boundary of vittasandra and turns north and runs along northern boundary of vittasandra and turns south and runs along the eastern boundary of vittasandra till it meets the northtowest corner of Sy no. 27 of Chikkathoguru and turns east and runs along eastern boundary of Sy no's 27, 26, 25, 24 of same village till it touches the village boundary of Vittasandra and turns south and runs along the eastern boundary of Vittasandra till it meets the northtowest corner of Sy no. 110 of Doddathoguru and turns east and runs along northern bounday of Sy no's 110, 111, 117, 118 and turns north and runs along western boundary of Sy no's 119, 120, 121, 126, 127, 128 and turns east and runs along northern boundary of Sy no's 128, 129, 51, Gramthana, 41, 40 and turns south and runs along eastern boundary of Sy no. 40, 44 of Doddathoguru till it meets the northtowest corner of Sy no. 8 of Konappana Agrahara and turns east and runs along northern bounday of Sy no's 8, 93, 94, Gramthana boundary, 2, 3, 28, crosses Bengaluru to Hosur road, 59, 58, 54, Palya boundary, 48, 44 and turns north till it meets the northtowest corner of Sy no. 46 of Konnappana Agrahara further continues north along with western boundary of Dodda Nagamangala till it meets the southtowest corner of Sy no. 16 of Dodda Nagamangala and turns northtoeast and runs along northtowestern boundary of Sy no's 16, 17, 16 and turns west and runs along southern boundary of Sy no's 19, 22, 23, 25, 26, 29, 36, 37, 38, 39 till it meets the Baretena Agrahara boundary and turns south and runs along eastern boundary of same

village till it crosses the hosur road and turns northtowest and runs along hosur road till it meets the southtoeast corner of Sy no. 2 and turns west and runs along southern boundary of Sy no's 2, gramthana boundary, 1 and turns north and runs along western boundary of Sy no's 1, 2 till it touches hosur road and runs along hosur road till it meets the southtoeast corner of majare boundary and turns west and runs along majare boundary till it touches chikkathoguru boundary and turns south and runs along southern boundary of Sy no. 45 of Chikkathoguru till it touches the southtoeast corner of Sy no. 135 of Doddathoguru and turns west and runs along southern boundary of Doddathoguru till it meets the Chikkathoguru and turns south and runs along eastern boundary of Sy no's 38, 37 and turns west and runs along southern boundary of Sy no's 37, 36 of Chikkathoguru, till it meets Basapaura boundary and runs along southern boundary of Sy no's 27, 30, 33, 32, 70, 69, 67, 43, 66, 56, 54, 53, 52, 51, 49 of Basapura and turns north and runs along the western boundary of Basapura till it meets the southtoeast corner of Sy no. 144 of Begur and turns west and runs along southern boundary of Sy no's 144, 142, 141, 140, 130, 132 cuts through Sy no. 94 till it touches the eastern boundary of Sy no. 93 and continues west along southern boundary of Sy no's 93, 92, 18, 84, 22, 37, 38, 36, 35, 30 of Begur till it meets boundary of Yelenahalli and turns south and runs along eastern boundary of Yelenahalli till it meets the southtoeast corner of Sy no. 36 and turns west and runs along southern boundary of Sy no's 36, 37, 51, 60, 59, 58, 57, 63, 50, 67 and turns north and runs along western boundary of yelenahalli till it touches the southtoeast corner of Sy no. 112 of Kammanahalli and turns south and runs along eastern boundary of Sy no's 112, 113, 19, 11, 9 and turns west and runs along southern boundary of Sy no's 9, 8, 7, 5, 39, 41, 75, cuts through part of Sy no. 82, and runs along southern boundary of Sy no. 91, till it meets the boundary of Gottigere and runs along southern boundary of Sy no's 62, 83, 77, 76, 75, 72, 88, 92, 93, 94, 95, 96, crosses Bannerughatta Road, gramthana boundary, 127, 125, 7, 8, 9, 11 of Gottigere till it meets the boundary of Kothanuru and turns south and runs along eastern boundary of Kothanuru and turns west and runs along southern boundary of Kothanuru till it meets the northtoeast corner of Sy no. 98 of Kembathanahalli and turns south and runs along eastern boundary of Sy no's 98, crosses stream, 99, 64, Gramthana boundary, 17, 16, 15, 14, 15, 16, 17, 18, 19, 22, 57, 58, 59, 60, 61, 62, 71, 74, 52, 51 till it meets the boundary of Gollahalli and further continues west along southern boundary of Sy no's 34, 33, 32, 31, 30, 26, 63, 61, 59, 55, 56, 65, 56, 49, 47 till it meets the boundary of Anjanapura and turns west and runs along southern boundary of Sy no's 12, 10, 32, 31, 30, 29, 92, 115 and turns north and runs along western boundary of Sy no's 115, 108, 92, 94, 118, 83, 84, 82, 86, 119, 120, 87, 76, 77, 88, 74, 72 and turns south and runs along the eastern boundary of Sy no's 67, 85, 91, 90, 50, 51, crosses stream and meets northtoeast corner of Sy no 17 of Mallasandra and further continues south along eastern boundary of Sy no's 17, 18 and turns west and runs along southtowestern boundary of Sy no's 18, 25, 15, 9, 8, 7 till it touches the northtowest corner of Sy no. 7 and turns west and runs along the southern boundary of Sy no's 5, 39, 38, 37, 36 till it touches the boundary of Talaghattapura and further continues west along southern boundaries of Sy no's 23, 22, 30, 31 crosses kanakapura road, 46, 40, 42 turns northtowest and runs along western boundary of Talaghattapura till it touches the southtowest corner of Sy no. 23 and further continues along western boundary of Sy no's 23, 26, 25, 7, 6 of Uttarahalli Manavarthe Kaval till it meets the northtoeast corner of Sy no. 6 of Lingadeeranahalli and turns south and runs along the southern boundary of lingadeeranahalli till it meets the southtowest corner of same village and turns north and runs along the same village boundary till it meets the southtowest corner of Hemmigepura and further continues north along western boundary of same village till it meets the northtowest corner of Sy no. 82 and turns east and runs along northern boundary of Sy no's 82, 85 and turns north and runs along western boundary of Sy no's 98, 99, 100, 89 and continues along west side of stream (west of Sy no. 88) and turns east along the stream and continues untill it touches southtowest corner of Sy no. 13 of Channasandra and continues along western boundary of Sy no. 13 cuts through northern portion of Sy no. 13 and turns northtoeast and runs along western boundary of Sy no's 12, 10, 7, 5, 4, 3 till it meets the boundary of Channasandra and continues along eastern

boundary of Channasandra till it meets the northtowest corner of Sy no. 85 of Uttarahalli and turns east and runs along northern boundary of Sy no's 85, 86, 87, 90, 89 till it meets the boundary of Vaddarapalya further continues north along the southtowestern boundary of Sy no's 19, 18, 16, 14, 15, 6 till it meets the southtowest corner of Sy no. 28 of Arehalli and runs along western boundary of Sy no. 28, cuts through Sy no. 28 till it meets the boundary of Hosakerahalli, cuts through Sy no. 7 till it touches the southtowest corner of Sy no. 8 of Hosakerahalli and runs along western boundary of same Sy no. Till it meets the northtowest corner of Sy no. 8 and turns east and runs along northern boundary of Sy no's 8, 7 till it touches the southtowest corner of Sy no. 3 and turns north and runs along southtowestern boundary of Sy no's 3, 16, 17, 19, 24, 83 till it touches the northtowest corner of Sy no.83and turns east till it meets the western corner of Sy no. 85 and turns north runs along western boundary of 86, 90, 91, 89, 88 till it meets the boundary of Avalahalli and further continues north along western boundary of Sy no's 16, 18, 26, 28, 29, 33 and turns west and runs along southern boundary of Sy no 31 of Avalahalli till it touches the southtoeast corner of Sy no. 41 of Byatarayapura and turns north and runs along eastern boundary of Sy no's 41, 40, 6 till it touches the Bengaluru to Mysuru Road and turns southtowest and continues along the same road till it meets the north corner of Sy no. 4 of Devatige Ramanahalli and turns south and runs along eastern boundary of Sy no's 4, 11, 10 crosses stream and continues along south and eastern side of stream till it meets the southtowest corner of Sy no. 128 of Hosakerahalli and turns east and runs along northern side of the stream till it meets the northtowest corner of Sy no. 44 of Hosakerahalli and turns south and runs along north east of Sy no's 44, 45, 47, 48, 49, 50, 52 till it meets the boundary of Halagevaderahalli and runs along eastern boundary of Halagevaderahalli till it meets the northtoeast corner of Sy no. 25 of Channasandra and turns south and runs along eastern boundary of Sy no's 25, 26, 24, 22, 20 and turns east and runs along southern boundary of Sy no's 20, 21, 22, 35 till it meets the east corner of Sy no. 3 of Ganakallu and continues along the southern boundary of Sy no's 3, 2, 13 of Ganakallu till it meets the boundary of Badamanevarthekavalu and turns south follows eastern boundary of Sy. No. 68 of Badamanavarthikaval village and runs along the southern boundary of Sy.69 of Badamanavarthikaval village till it meets the boundary of Chudenapura village till it meets norther corner of Sy. No. 63 of Badamanavarthikaval and truns east along the northern side of Sy. No. 66, 69, 68 till it meets the corner of Sy. No. 172 of Badamanavarthikaval and turns south along western side of Sy. No. 172 and turns west along boundary of Sy. No. 68, 69 and meets east corner of Sy. No. 104 of Badamanavarthikaval and follows eastern boundary of Sy. No. 103, 101 and runs along southtowestern boundaries of Sy no's 71, 72, 105, 106, 64, 62, 60, till it meets the boundary of Chudenapura further continues and runs along southtowestern boundaries of Sy no's 30, 29, 10, 9, 8, 20 crosses stream and continues along west side of the stream till it meets the southtoeast corner of the Sy No. 117 of Kengeri and runs along southtowestern boundaries of Sy no's 117, 113, 111, 129, crosses Bengaluru to Mysuru Road, 134, 136, crosses Bengaluru to Mysuru railway line, 170, 201, 203, 193, 268, 260, 261, 211, 213 till it meets the boundary of Ramasandra and turns east and runs along Ramsandra boundary till it meets the southtowest corner of Sy no. 32 and turns north and runs along western boundary of Sy no's 32, 31 and turns northtowest and runs along the southtowestern boundary of Sy no's 34, 35, 37, cuts through 62, 61, 63 and continues along west side of stream till it touches southtowest corner of Sy no. 76 and runs along the south boundary of Sy no. 76 and western boundary of Sy no's 20, 21, majare chikkabasthi boundary, 15, 167, majare, 14, 12, 11 till it meets the boundary of Hullalu and continues north and runs along the southtowestern boundary of Sy no's 185, west of road, 198, 203, 202, 200, 6, 8, 9, 11, 21, 25, 26, 28, 31 till it meets the boundary of Herohalli, and continues north and runs along the southtowestern boundary of Sy no's 182, 183, 184, 186, 188, 66, 164, 169, 63, 62, 69, 68, 73, 74, 76 till it meets the boundary of Hosahalli Gollarapalya and continues north and runs along the southtowestern boundary of Sy no's 12, crosses magadi road, 8, 6, 5, 34, 35, 44, 43, 42 till it meets the boundary of Lingadeeranahalli further continues north and runs along the southtowestern boundary of Sy no's 36, 35, 34, 40, 43, 42 till it meets the boundary of Handrahalli further continues north and runs along

the southtowestern boundary of Sy no's 86, 93, 95, 96, 105, 104, 103 till it meets the boundary of Karivobanahalli further continues north and runs along the western boundary of Karivobanahalli till it touches the southtoeast corner of Sy no. 24 of Srikantapura and turns west and runs along the southern boundary of Sy no's 24, 23, 22, 21 and turn north and run along the western boundary of Sy no. 21till it touches the boundary of Doddabidarakallu and runs towards north along the boundary of the same village till it touches the boundary of Thirumalapura and continues north and runs along the southtowestern boundary of Sy no's 8, 9, 11, 12, 17, 18, 40, 41, 38, 36 and continues along the eastern boundary of Thirumalapura till it meets the southtowest corner of Chikkabidarakallu boundary and continues north along the boundary of same village crosses Bengaluru to Tumkur road and runs further till it meets the boundary of Srikantapura K. G. and continues along the western boundary of Sy no's 32, Gramthana boundary, 48, 47, 39, 41 of same village and crosses stream and turns east and runs along the north side of stream and boundary of Srikantapura K. G. till it meets the boundary of K.G. Bagalakunte and turns north and runs along western boundary of K.G. Bagalakunte further continues along western boundary of Sidedahalli till it meets the southtoeast boundary of Thammenahalli and turns west and runs along southern boundary of Thammenahalli till it touches the boundary of Kuduragere and turns south and runs along eastern boundary of Kuduragere and turns west and runs along the boundary of Kuduragere further continues along the southern boundary of Hanumanthasagara till it touches the stream and turns south and runs along east side of the stream till it touches the boundary of Siddanahosahalli and turns east and runs along northern boundary of Siddanahosahalli further continues along northern boundary of Madavara crosses stream (above Sy no. 21) and turns south and runs along eastern boundary of Sy no's 16, 2, gramthana boundary, 64, 63, 65, 75, 74, 70, 69 till it meets the boundary of Lakshmipura and turns east and runs along the boundary of same village till it touches the northtoeast corner of Sy no. 14 and turns south and runs along east and northern boundary of Sy no's 14, 16 till it touches the boundary of Srikantapura and turns south and runs along the eastern boundary of Sy no's 8, 7, 6, 3, 2, 1, gramthana boundary, 28 of Srikantapura till it meets the boundary of Gangondanahalli further continues south and runs along eastern boundary of Sy no's 102, 103, 15, 10, 23, 22, 24, 29, 30, 35, 40, 45, 104 of Gangondanahalli till it touches the northtoeast corner of Sy no. 27 of Bylakonenahalli and continues south and runs along eastern boundary of Sy no's 27, 26, 46, 48, 49, 23 till it touches the boundary of Kachohalli further continues south and runs along eastern boundary of Sy no's 13, 17, 18, 20, 25, 26, 54, 34 till it touches the northtowest boundary of Sy no. 30 of Hosahalli Gollarapalya and runs along the eastern boundary of Sy no. 30 and runs along the western boundary of Hosahalli Gollarapalya crosses Bengaluru to Magadi Road and runs along the eastern boundary of Sy no. 21 till it touches the boundary of Kodigehalli runs along the north, west boundary of Sy no. 38 of Kodigehalli and turns south and runs along north and eastern boundaries of Sy no's 39, 40, 42, 35, 28, 29, 94, 3, 72, 71, 77, 79, 80, 81, 82 of Kodigehalli till it touches the northtowestern corner of Sy no. 6 of Kanneli and runs along eastern boundary of Kanneli till it touches Manganahalli boundary and continues south along the north, eastern boundaries of Sy no's 25, 26, 29, 28, 46, 19, 49, gramthana boundary, 63, 65, runs along road (east of Sy no. 75) till it meets the boundary of Ramsandra and continues south and runs along the eastern boundary of Sy no's 162, 163, 164, gramthana boundary, 3, 81, Majare Dannaikanapalya, 50, 106, road connecting palya, palya boundary, 109 till it meets the boundary of Kommaghatta and runs west and runs along the Kommaghatta boundary till it touches the northtoeast corner of Sy no. 110 and turns south and runs along north eastern boundary of Sy no's 110, 111, 108, 107, 100, 95, 101, 93, 40 continues along stream, 39, 37, 158, 123, 115 and turns west and runs along southern boundary of Sy no's 115, 116 till it meets the boundary of Kommaghatta Krishnasagara and turns south and runs along boundary of Kommaghatta Krishnasagara till it touches the northtowest corner of Sy no. 29 of Kommaghatta and runs south along eastern boundary of Sy no's 29, 28 of Kommaghatta till it touches the boundary of Chellaghatta and turns east and runs along the northern boundary of Chellaghatta further continues along the northern boundary of Kengeri till it

touches the northtoeast corner of Sy no. 162 and turn south and runs along the eastern boundary of Sy no's 162, crosses Bengaluru to Mysuru Railway line, 159, 156, Bengaluru to Mysuru road, 235, 234, 233, 231 and turns north and runs along western boundary of Sy no. 231 till it touches the Bengaluru to Mysuru road and turns southtowest and runs along Bengaluru to Mysuru road till it touches the Kambipura boundary and turns southtoeast and runs along Kambipura boundary till it touches the northtowest boundary of Sy no. 240 and runs along northern boundary of Sy no's 240, 238 and turns south and runs along eastern boundary of Sy no's 238, 239, 240 till it touches the Kambipura boundary and turns southtoeast and runs along Kambipura boundary till it touches the southtowest corner of Sy no. 5 of Doddabele and turn northtoeast and runs along the western boundary of Doddabele till it touches the north corner of Sy no. 7 and turns southtoeast and runs along the eastern boundary of Sy no. 7, 9 crosses stream and continues along east side of stream till it touches the northtowest corner of Sy no. 56 of Hemmigepura and runs along eastern boundary of Sy no's 56, 96, 50, 52, gramthana boundary, 34, 16, 15, 11, 10, 9 till it touches the boundary of Varahasandra and turns southtowest and runs along southern boundary of Hemmigepura south side of stream (northern boundary of Kengeri Gollahalli) till it touches the northtoeast corner of Sy no. 110 of Kambipura and turn south and runs along eastern boundary of Kambipura further continues along eastern boundary of Gudimavu and Devageri and turns southtowest and runs along southern boundary of Devageri further continues west along southern boundary of Gudimavu and Tagachiguppe till it meets the stream (east of Kanaminike) and runs east side of stream until it meets south eastern corner of Kanaminake turns west and runs along the sourthern boundary of Kanaminake till it meets the south western corner of the same village turns north and north west and runs along the western boundary of Kanaminake village crosses Bengaluru Mysore road and Bengaluru – Mysore railway line runs further north west till it meets the southern boundary of Sheshagiripura turns west and runs along the southern boundary of Sheshagiripura and southern tip of Koluru village till it meets the south western corner of Koluru turns north and runs along the western boundary of Koluru, Koluru Gurarayanapura, Kethohalli Ramapura and Kethohalli till it meets the North – Western corner of Kethohalli village turns east and runs along northern boundary of Kethohalli till it meets the boundary of Ramohalli turns north and runs along the western boundary of Ramohalli and Maligowdanahalli until it meets the north – western corner of Maligowdanahalli turns east and runs along the northern boundary of Maligowdanahalli until it meets the north – western corner of Maragondanahalli and turns north and runs along the western boundary of Maragondanahalli and Yelachaguppe and Channenahalli crosses Bengaluru – Magadi road and runs further north until it meets the north western corner of Channenahalli turns east and runs along the northern boundary of Channenahalli village until it meets the boundary of Seegehalli turns north and runs along the western boundary of Seegehalli and Machohalli along the western boundary of Byandhalli till it meets the north – western corner Byandahalli turns east and runs along the northern boundary of Byandahalli till it meets the northtowestern corner of Byandahalli turns north and runs along the Western boundary of Vaddarahalli Kadarenahalli, Harokyathanahalli, Narayanappan palya until it meets the southern tip of Dasanapura village turns north west and run along the southern boundary of Dasanapura village until it meets the south western corner of Dasanapura turns in north and runs along the western boundary of Dasanapura crosses BengalurutoPoona Road (NHto4) and runs further north until it is meets the NorthtoWestern corner of Dasanapura village turns east and runs along the northern boundary of Dasanapura village until it meets the NorthtoEastern corner of the same village turns north and runs along the western boundary of Heggadadevanapura Aluru and Narasipura crosses BengalurutoPoona Railway line and runs further north until it meets the western tip of Bilajaji turns east and north and runs along the western boundary of Bilajaji until it meets the northern west tip or Bilajaji village turns east and runs along the northern boundary of the same village until it meets the northtoeastern corner of the village turns south and runs along the eastern boundary of Bilajaji village and Thore Nagasandra until it meets the northern boundary of Kodagi Thirumalapura (B) village turns east and runs along the

northern boundary of Kodagi Thirumalapura (B) village turns east and runs along the northern boundary of Kodagi Thirumalapura (B) village until it meets the western boundary of Huralichikkanahalli turns north and runs along the western boundary of Huralichikkanahalli turns north and urns along the western boundary of Huralichikkanahalli and Kodagi Thirumalapura until it meets the northtowestern corner of Kodagi Thirumalapura village until it meets the boundary of Ivarakandapura village turns north east and runs along the western boundary of Ivarakandapura village until it meets the north western corner of Kalenahalli turns east part runs along the northern boundary of Kalenahalli and Seekote until it meets Linganahalli village boundary turns north and runs along the western boundary of Linganahalli until it meets the north – western corner of Linganahalli turns east and runs along the northern boundary of Linganahalli until it meets the western boundary of Madappanahalli turns north and runs along the western boundary of Madappanahalli and Ittagalapura until it meets the north – western corner of Ittagalapura turns east and runs along the northern boundary of Ittagalapura till it meets the western tip of Rajanakunte village turns north – east and runs along the north – western tip of Rajanakunte village turns north – east and runs along the north – western boundary of Rajanakunte village till it meets the south – western corner of Adiganahalli turns north and along the western boundary of Adiganahalli until it meets the north – western corner of Adiganahalli turns east and runs along the northern boundary of Adiganahalli crosses the Bengaluru – Doddaballapur road and Bengaluru – Guntakal Railway line and runs further east until it meets the north – eastern corner of Adiganahalli village, the starting point.

Town Planner Member BDA	Commissioner BDA	Chairman BDA

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