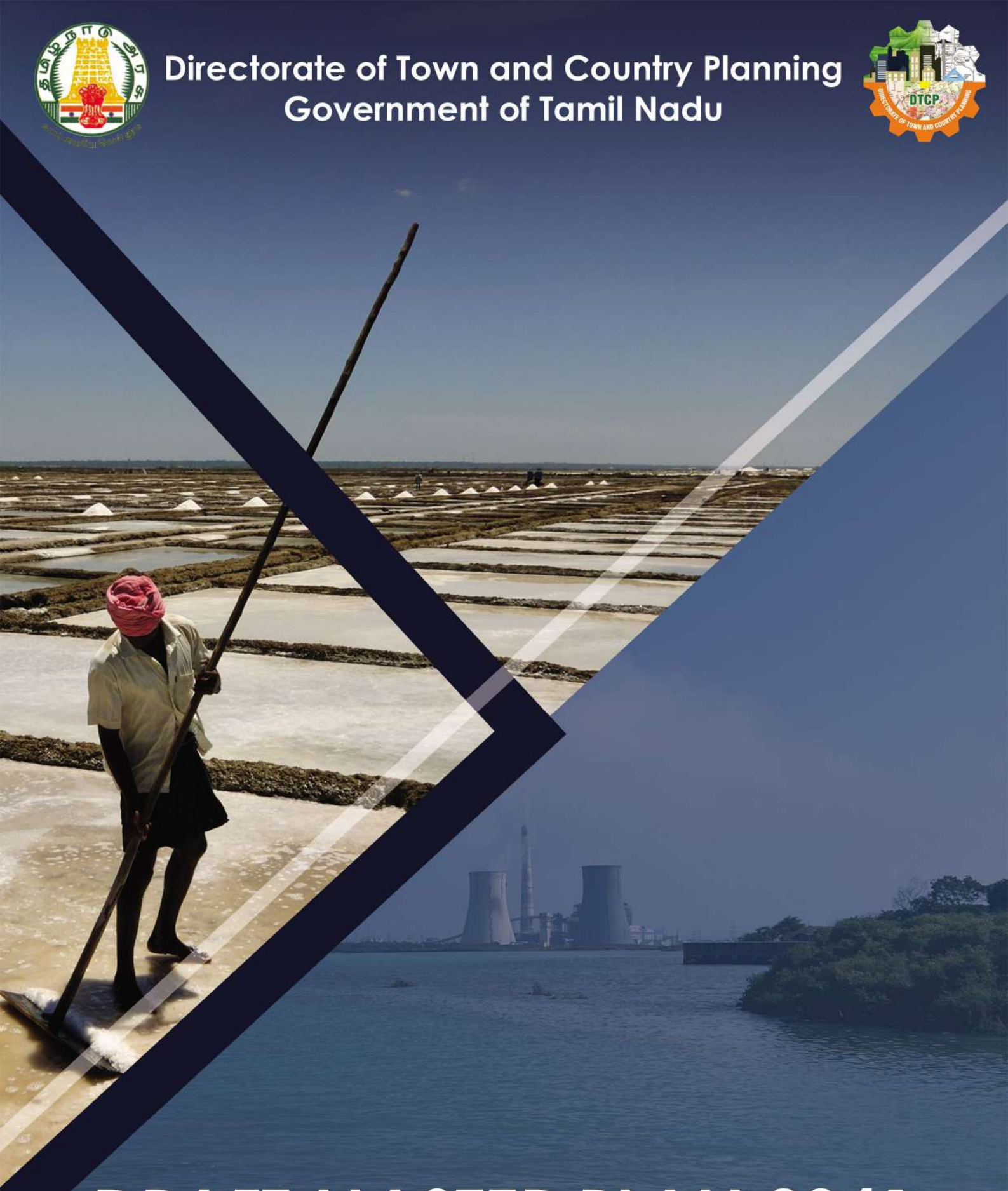
Directorate of Town and Country Planning
Government of Tamil Nadu



DRAFT MASTER PLAN 2041

THOOTHUKUDI LOCAL PLANNING AREA

VOLUME 1 / 2

MASTER PLAN FOR Thoothukudi LPA

LPA Reference No. Thoothukudi District Office	:	Roc No: 763/2016/TUTLPA
DTCP Reference No	:	
Master Plan for	:	Thoothukudi Local Planning Area
Thoothukudi Local Planning Area	:	Consented in G.O. (Ms). No. Housing & Urban Development Department Dt:

24/10/24

Member Secretary
Thoothukudi Local Planning Authority
Thoothukudi District

5/11/24

Assistant Director
Directorate of Town and Country Planning
Chennai

5/11/24

Deputy Director
Directorate of Town and Country Planning
Chennai

05/11/24

Joint Director
Directorate of Town and Country Planning
Chennai

9/11

Director
Directorate of Town and Country Planning
Chennai

13/3/25

for Addl. Chief Secretary to the Government
Housing and Urban Development Department
Government of Tamil Nadu

PROFORMA

Name of the Office : District Town and Country Planning Office, Thoothukudi District

Name of the LPA : Thoothukudi Local Planning Authority

I. PROPOSAL

1. Letter No. and date of DTCP in which proposals submitted to Government:

II. NOTIFICATION

2. The G.O details of Notification Under Section 10(1) : G.O. (Ms) No. 629 R.D. & LA Dt. 04.04.1975

3. The G.O. details which confirmation was ordered under section 10(4) : G.O. (Ms) No. 1620 H & UD Dt. 16.10.1986

4. The G.O. details of Notification Under section 10(1)(b) : G.O. (Ms) No. 149 H&UD Dt. 20.06.2013

5. The G.O. details which confirmation was ordered under section 10(4) : G.O. (Ms) No. 116 H&UD Dt. 16.06.2022

III. CONSTITUTION

6. The G.O details in which Thoothukudi appointment of members under section 11(3) : Submitted to Head Office on 05.09.2023

IV. CONSENT

7. The G.O details in which the Government accorded consent Under Section 24(2) : G.O (Ms) No. 54, H & UD Dept, Dt 11.01.1991 (For Town)
G.O (Ms) No. 71, H & UD Dept, Dt 10.02.2000 (For Villages)

V. PUBLICATION

8. Notification in form No.1 in the Tamil Nadu Government Gazette Under Section 26 :

9. Notification in form No.1 in District Gazette under Section 26(1) :

10. Letter no. and date in which Director of Town and Country Planning has given advice on O&S under Section 26(2) :

11. Resolution no. and date in which the Thoothukudi approved the Draft Master Plan :

VI. APPROVAL

12. Submission of Master Plan to Government for final approval Under Section 28 :

13. The G.O. details in which Government accorded its Approval under Section 28 :

VII. PER PUBLICATION DETAILS OF APPROVAL IN

14. The Tamil Nadu Government Gazette Under Section 30 :

15. The notice board of the Local Body :

16. One or more leading Newspaper Circulation in the Thoothukudi Local Planning :

29/10/09

Member Secretary
Thoothukudi Local Planning Authority
Thoothukudi District

Thoothukudi Local Planning Area Master Plan – 2041

CERTIFICATE

It is certified that,

- All the procedures prescribed in the Master Plan are prepared, published and sanctioned.
- The boundary of Thoothukudi Local Planning Area is reframed.
- Reports with the Master Plan are annexed and authenticated.
- The categorization in zoning map and the categorization in zoning regulation are tallied and found correct.
- The numbers found missing are duly acknowledged and verified by the concerned department.

24/12/24

Member Secretary
Thoothukudi Local Planning Authority
Thoothukudi District

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

ABBREVIATIONS

AAI	Airport Authority of India
ABD	Area Based Development
ADS	Area Development Scheme
AHIP	Affordable Housing in Partnership
AMRUT	Atal Misision for Rejuvenation and Urban Transformation
BARC	Bhabha Atomic Research Center
BWG	Bulk Waste Generator
CBD	Central Business District
CEPI	Comprehensive Ennvironemental Pollution Index
CLPA	Composite Local Planning Area
CMFRI	Central Marine Fisheries Research Insttitute
CO2	Carbon Di Oxide
CPCB	Central Pollutiion Control Board
CPHEEO	Central Public Health and Environmentak Engineering Organiation
CRZ	Coastal Regulation Zone
CT	Census Town
CWSS	Combined Water Supply Schemes
CZMP	Coastal Zone Management Plan
DC	Dead Coral
DCS	District Cooling System
DPR	Detailed Project Report
FSTP	Faecal Sludge Treatment Plant
GIS	Geographic Informations System
G.O	Government Order
GoI	Government of India
GDDP	Gross District Domestic Product
GoMBRT	Gulf of Mannar Marine Biosphere Reserve Trust
GPS	Global Positioning System
IGC	Indian Geo-informatics Centre
IOMENVIS	Institute for Ocean Management Environment Information System
ISFR	Indian State of Forest Research

ISHUP	Interest Subsidy for Housing the Urban Poor ISO
JNNURM	Jawaharlal Nehru National Urban Renewal Misision
LIDAR	Light Detection and Ranging
MCC	Micro Compost Center
MDR	Major District Road
MLD	Million Litres per Day
MNRE	Ministry of New and Renewable Energy
MOEF	Ministry of Environment and Forestry
MoHUA	Ministry of Housing and Urban Affairs
MSL	Mean Sea Level
NFC	Nuclear Fuel Complex
NH	National Highway
NHAI	National Highway Authority of India
NIWE	National Institute of Wind Energy
NMT	Non-Motorised Transport
NRSC	National Remote Sensing Center
OCC	On-site Composting Center
ODR	Other District Road
PCU	Passenger Car Unit
PMAY	Pradhan Mantri Awas Yojana
PTR	Pupil Teacher Ratio
PWD	Public Works Department
RDF	Refuse Derived Fuel
SH	State Highway
SHG	Self Help Group
SLB	Service Level Benchmarks
SIDCO	Small Industries Development Corporation
SPIC	Southern Petrochemical Industries Corporation
SIPCOT	State Industries Promotion Corporation of Tamil Nadu Limited
SRTM – DEM	Shuttle Radar Topography Mission – Digital Elevation Model
SPA	Severely Polluted Area
STP	Sewage Treatemnt Plant
SWOT	Strength Weakness Oppurtunity and Threat
TANGEDCO	Tamil Nadu Generation and Distribution Corporation
TNEB	Tamil Nadu Electricity Board
TNPCB	Tamil Nadu Pollution Control Board

TNSCZMA	Tmail Nadu State Coastal Zone Managemnet Authority
TNUHDB	Tamil Nadu Urban Habitat Development Board
TNUDP	Tamil Nadu Urbna Development Project
TTPS	Thoothukudi Thermal Power Station
TWAD	Tamil Nadu Water Supply and Drainage Board
UGSS	Under Ground Sewerage Schemes
ULB	Urban Local Body
URDPFI	Urban and Regional Development Plans Formulation and Implementation
VAMBAY	Valmiki Ambedkar Awas Yojana
WFPR	Workforce Participation Rate

1 INTRODUCTION

1.1 Project Background

The Master Plan serves as a crucial planning tool and a legal document aimed at guiding future growth by anticipating urban development, allocating land for diverse uses, projecting civic infrastructure needs, and achieving sustainable development goals.

The Directorate of Town and Country Planning (DTCP), Government of Tamil Nadu, has initiated the formulation of a GIS-based Master Plan for the Thoothukudi Composite Local Planning Area. This project is part of the centrally funded reforms for 500 Atal Mission for Rejuvenation and Urban Transformation (AMRUT) cities by the Ministry of Housing and Urban Affairs, Government of India. The GIS-based Master Plan is integral to the AMRUT mission, which aims to transform cities and enhance the quality of life for all residents. Launched by the Central Government, the mission focuses on providing basic services to households, developing city amenities, and ultimately improving the quality of life for citizens. Key project components include water supply, sewerage, storm water drainage, traffic and transportation, green spaces and parks, as well as reforms management and support, and capacity building.

This Master Plan preparation comprises the six stages/deliverables:

- Inception Report
- Spatial Attribute Collection and Vetting of Base Map
- Data Analysis Report
- Projected Requirements, Issues, and Potentials
- Draft Proposals
- Draft Master Plan

This mission involves the preparation of a master plan for the Thoothukudi Composite Local Planning Area (CLPA), for the plan period from 2021 to 2041 (20 years). The "Draft Final" report presented herein examines the current situation, analyses the findings of the evaluation, and provides recommendations for the 2041 plan period. This report is based on the outcomes of previously completed deliverables, incorporating population projections, infrastructure calculations, and proposed strategies to achieve the outlined goals.

1.2 Overview of Thoothukudi CLPA

Thoothukudi, situated in the southern part of the Tamil Nadu state, serves as both a port and industrial city. It functions as the headquarters of the Thoothukudi district and is positioned along the southern Coromandel coastal region.

The Thoothukudi Corporation underwent expansion in 2011, encompassing the Thoothukudi municipality and six adjacent villages. The Thoothukudi Composite Local Planning Area (CLPA) extends to include the Thoothukudi Corporation and 34 Neighbourhood villages with an extent of 463.61 Sq.km.

1.3 Vision of Thoothukudi Master Plan - 2041

A vision statement offers a holistic representation of the envisaged progress and prosperity in the forthcoming decades. It is essential for effectively communicating the shared goals and objectives of the community, while also guiding the direction of future planning endeavours. The primary aim of the Master Plan is to cultivate the growth of a resilient and sustainable port city. This entails creating an environment capable of overcoming potential challenges and poised to flourish amidst the ever-changing dynamics of the global landscape.

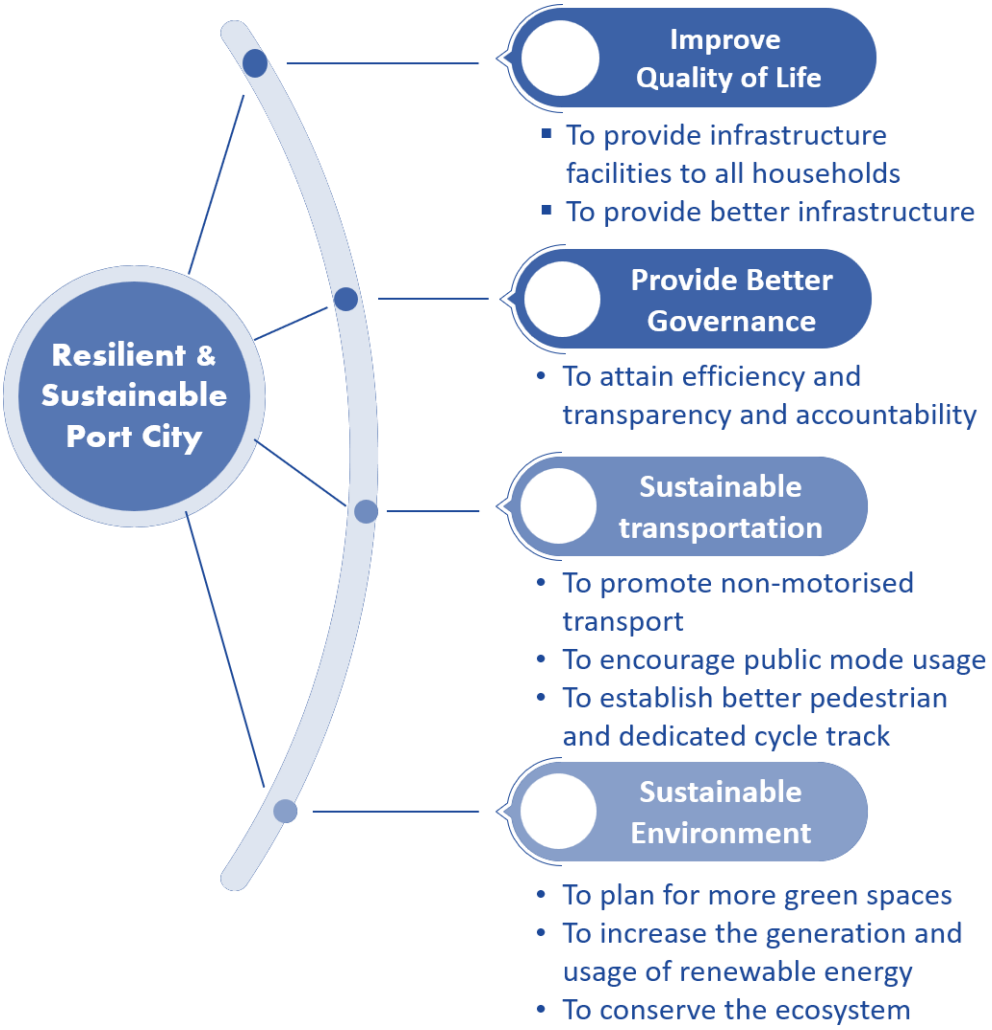
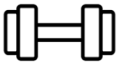


Figure 1.1: Vision of Thoothukudi Master Plan - 2041

1.4 SWOT Analysis of Thoothukudi City

The SWOT Analysis is a methodical analytical approach employed to assess the Strengths, Weaknesses, Opportunities, and Threats inherent in a situation. This structured analysis plays a crucial role in strategic planning and decision-making processes by identifying and highlighting both the positive aspects, such as opportunities and strengths, and the potential drawbacks, including weaknesses and threats. Through this comprehensive evaluation, organizations can make informed decisions and formulate strategies that capitalize on strengths and opportunities while addressing and mitigating weaknesses and threats.



Strengths

- Coastal City
- Port city
- District Headquarters
- Presence of SIPCOT industries
- Salt Production
- Potential for Fisheries
- Presence of four modes of transportation
- Well-connected to Madurai, Tirunelveli and Tiruchendur
- Existence of wind mills (Renewable resource)
- Location Advantage

Weaknesses

- Presence of eco-sensitive areas
- Pollution from industries and vehicles
- Presence of thermal power plants
- Low rail frequency
- Lack of facilities for trucks and truck drivers
- Spread of logistics industries in the planning area

Opportunities

- Proposed expansion of the port
- Establishment of furniture parks
- Desalination plant
- Sustainable fishing practices, along with awareness campaigns
- Construction of Bye-pass to VOC Port
- Production of renewable energy sources

- Proposed expansion of the airport

- Disaster vulnerability (Tsunami & Flood)
- Marine ecosystem Deteoriation
- Industrial and vehicular pollution
- Unregulated fishing practices
- Insufficient green cover

1.5 Purpose of Master Plan

A Master Plan is a dynamic long-term planning document that outlines a vision for sustainable growth and development over a period of 20 to 30 years, offering a framework to shape the future in a dynamic and structured manner. In Tamil Nadu, a Master Plan is prepared with the legislative support of the Tamil Nadu Town and Country Planning Act 1971. The Master Plan encompasses evaluations, suggestions, and plans for aspects such as a town's economic development, housing, transport systems, physical and social infrastructure. Its foundation lies in community feedback, survey results, planning efforts, current developments, and an analysis of both the physical landscape and the socio-economic backdrop.

As per the Tamil Nadu Town and Country Planning Act, of 1971, the Master plan may purpose or provide for all or any of the following matters, namely,

- The manner in which the land in the planning area shall be used;
- The allotment or reservation of land for residential, commercial, industrial, and agricultural purposes and parks, play fields, and open spaces;
- The allotment and reservation of land for public buildings, institutions and civic amenities;
- the traffic and transportation pattern and traffic circulation pattern;

- the major road and street improvements;
- the areas reserved for future development, expansion and for new housing;
- the provision for the improvement of areas of bad layout or obsolete development and slum areas and for relocation of population;
- the amenities, services and utilities;
- The provision for detailed development of specific areas for housing, shopping, industries and civic amenities and educational and cultural facilities;
- the control of architectural features, elevation and frontage of buildings and structures;
- the provision for regulating the zone, the location, height, number of storeys and size of buildings and other structures, the size of the yards and other open spaces and the use of buildings, structures and land.

The stages by which the master plan shall be carried out and such other matters as may be prescribed.

1.6 URDPFI Guidelines for Master Plan preparation

The URDPFI 2015 guideline describes the Master Plan (Development Plan) in the following manner:

- The objective of the development plan is to provide further necessary details and intended actions in the form of strategies and physical proposals for various policies given in the perspective plan and regional plan depending upon the economic and social needs and aspirations of the people, available resources, and priorities.
- Proposals of a development plan should be definite and supported by an implementation strategy and evaluation criteria.
- The time frame of these plans is generally valid over 20-30 years and should be planned in phases of 5 years, for periodic reviews.

Furthermore, the Master Plan aims to notify the areas in need of preservation and conservation, focusing on regions of ecological significance, natural beauty, and landscapes. It also includes safeguarding sites, buildings, or locations of historical, architectural, scientific interest, and environmental importance.

1.7 AMRUT Scheme

Thoothukudi Composite Local Planning Area is one of 33 towns identified in Tamil Nadu under the AMRUT scheme for preparation of Master Plan. The Government of India (GoI) launched the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) in 2015, as a Centrally Sponsored Scheme for urban development. Besides creating infrastructure for basic amenities, the Mission also focuses on reforms and capacity building of the Urban Local Bodies (ULB). Urban Planning and City-level Plan is one of the 10 identified reforms. The sub- reforms under urban planning and city-level plans are:

- Preparation of Master Plan using GIS
- Preparation of Service Level Improvement Plans (SLIP)
- Establish Urban Development Authorities
- Make an action plan to progressively increase the green cover in cities to 15% in 5 years
- Develop at least one Children's Park every year in AMRUT cities
- Establish a system for maintaining parks, playground and recreational areas relying on the Public Private Partnership (PPP) model
- Implementation of Parameters given in the National Mission for Sustainable Habitat

1.8 Need for the Master Plan

Over recent decades, urban regions in Tamil Nadu, as in other places, have expanded in both scope and complexity, becoming increasingly

difficult to manage. This growth underscores the need for a strategy to inclusively plan, regulate, and oversee urban development. More than ever, the environmental consequences of urbanization require thorough examination. The Town and Country Planning Act, 1971, facilitates the creation and execution of Master Plans for urban locales, aiming to improve conditions in these areas and promote their development in a safe, healthy, and sustainable manner.

It is essential to remember that Thoothukudi is the fast emerging industrial and port activities. So, it is important to define how this growing urban settlement can responsibly steward and co-exist with the surroundings.

1.9 Preparation of Master Plan

The Directorate of Town & Country Planning (DTCP), Government of Tamil Nadu (GoTN) has taken up the task of preparation of a Master Plan for Thoothukudi LPA along other towns in the state.

1.9.1 Inception Report

The inception report stage begins with a preliminary analysis of the LPA, leveraging secondary data and initial discussions with stakeholders. This report outlines the context, justification, scope, objectives, and strategies for the project, along with detailing the composition of the project team and the planned schedule. It offers a demographic overview of the LPA, primarily sourced from census data, and provides the area's land use patterns as depicted in the Existing Land Use Map 2021. It includes economic information at various administrative levels—municipal, block, taluk, and district—as available. The report also evaluates the LPA's road networks, connectivity, and the current state of physical and social infrastructure, alongside an overview of other relevant planning sectors like housing, infrastructure, environment, etc.

1.9.2 Spatial Attribute Collection and Base Map preparation

The DTCP (Department of Town and Country Planning) prepared the Existing Land Use Map for the Thoothukudi Local Planning Area, adhering to the AMRUT Guidelines. High-resolution satellite images from the National Remote Sensing Agency (NRSC) were utilized for this purpose. Additionally, village maps containing survey numbers, sourced from the Survey and Land Records department, were employed by the IGC (Integrated Geo-Information Consultants) to establish the cadastral framework. To enhance accuracy, Differential Global Positioning System (DGPS) surveys were conducted to collect Ground Control Points (GCPs). These GCPs facilitated the Geo-referencing of scanned paper maps, a task also undertaken by the IGC. The survey boundaries were digitized as polygon features in the GIS database, and relevant details such as village names and survey numbers were incorporated into the dataset by the IGC. The Following steps are involved to prepare the Base map for the Master Plan:

1. **Satellite data acquisition & Ground truthing -** Following the AMRUT guidelines, high-resolution satellite images were obtained from the National Remote Sensing Centre (NRSC) of ISRO. NRSC initially generated a preliminary land use map based on these satellite images. Subsequently, the Indian Geo-informatics Centre (IGC) conducted ground truthing to verify the accuracy of the land use map on behalf of the Department of Town and Country Planning (DTCP).

2. **GIS survey & Geo Referencing –** The cadastral framework was established using village maps containing survey numbers obtained from the Survey and Land Records department. To enhance Geo-referencing accuracy, Differential Global Positioning System (DGPS) surveys were conducted to collect Ground Control Points (GCPs) for scanned paper maps. Subsequently, the survey boundaries were

digitized and incorporated as polygon features in the GIS database, including details such as the village name and survey number.

3. **Quality Checking and Vetting –** The Indian Geo-informatics Centre (IGC) conducts a thorough quality assessment and verification process for the GIS data, focusing on both topological integrity and attribute accuracy. Given the diverse origins, timeframes, and scales of the map data, it is crucial to individually examine each layer and conduct cross-comparisons.
4. **Preparation of Base Map** - For the creation of the Base map, the Digital Terrain Model (DTM of SRTM) is utilized by IGC to delineate terrain features and contours. This map highlights the physical characteristics of the Local Planning Area (LPA), including topography, rivers, streams, and tanks, providing a comprehensive view of the area's natural landscape in Thoothukudi Planning Area.

1.9.3 Chapter Schema

This report has the following chapters that will provide an overall understanding of the various sectors and processes involved analysis done to streamline the Thoothukudi LPA will the overall vision of the Thoothukudi Master Plan.

Chapter 1: Introduction

This Chapter covers Introduction, project background, purpose of the master plan, AMRUT scheme, URDPFI Guidelines for the preparation of Master Plan and Need for the Master plan.

Chapter 2: Overview of the City's Profile

In this Chapter, detailed about the profile of the planning area including its location and regional setting, Historical background of the city,

administrative setup of the planning area and Natural features of the Thoothukudi District.

Chapter 3: Review of Previous Master Plan

This chapter assesses the original master plan, focusing on changes in land utilization percentages between the proposed and current conditions. Additionally, it examines the current status of implementing the proposed changes outlined in the plan.

Chapter 4: Demography

This chapter emphasizes the demographic characteristics of the Thoothukudi Local Planning Area (LPA), including population growth over decades, trends in growth differentiating between urban and rural settlements, population density, literacy rate, and sex ratio. The findings from this study will serve as a baseline for projecting the population over the next 20 years with the adoption of various projection methods.

Chapter 5: Economy

This chapter provides a comprehensive overview of the economic contributions within the Thoothukudi Planning Area. It analyses the current workforce participation across different sectors and tracks the evolution of the occupational structure over time. The aim is to formulate employment opportunities by aligning various sectoral proposals with the projected population growth over the specified horizon periods.

Chapter 6: Tourism

This chapter explores tourist attractions within the planning area and surrounding neighborhoods, aiming to evaluate the needs and demands of tourists, particularly in terms of hotels and restaurants. Furthermore, it addresses proposals for potential tourist developments over the next two decades.

Chapter 7: Housing

This chapter covers the typology of houses within the Thoothukudi Planning Area, highlighting their characteristics and available infrastructure facilities. It also examines the condition of slums and urban poor areas, as well as existing housing developments by various nodal agencies. The chapter aims to assess housing demands in relation to population projections for the next 20 years, analysing the current state and future needs for housing within the area.

Chapter 8: Physical Infrastructure

This chapter focuses on the physical infrastructure facilities within the Thoothukudi Planning Area, including the water supply system and sources, sewerage and sanitation systems, solid waste management, and power supply. It addresses existing issues and analyzes future requirements based on the projected population growth over the specified horizon period. The aim is to assess the adequacy and sustainability of current infrastructure in meeting the needs of the growing population and to identify areas for improvement and expansion.

Chapter 9: Social Infrastructure

This chapter emphasizes the existing social infrastructure facilities such as schools, colleges, training institutes, health centers, hospitals, and recreational facilities within the Thoothukudi Planning Area. These facilities are analyzed in accordance with the URDPFI guidelines and projected population growth over the specified horizon period. The goal is to assess the adequacy and suitability of current infrastructure in meeting the needs of the population both now and in the future.

Chapter 10: Traffic and Transportation

This chapter provides an overview of the major connectivity to the Thoothukudi Planning Area, encompassing various modes of transportation correlated with the current status of passenger and cargo handling performance. Through analysis of the current scenario and utilizing primary surveys and secondary data from relevant agencies, it identifies gaps and demands in connectivity. The study offers suggestions and implementations for various improvements, such as enhancing junctions, establishing a grid of roads, and other infrastructure amenities to meet the evolving needs of transportation within the area.

Chapter 11: Environment

This chapter discusses the status of the physical environment within the Thoothukudi Local Planning Area (LPA), encompassing flora and fauna. Additionally, it addresses the vulnerability of the planning area to natural hazards. The chapter likely examines the current condition of natural resources, biodiversity, and the impact of human activities on the local ecosystem. It also assesses the susceptibility of the area to natural disasters such as floods, cyclones, or earthquakes, aiming to identify areas of concern and potential mitigation strategies.

Chapter 12: Existing Land Use 2021

This chapter provides insights into the processes involved in preparing the base map and existing land use map of the Thoothukudi Local Planning Area (LPA). It details the analysis of existing situations to determine the direction of growth trends within the LPA. Additionally, the chapter proposes future land use plans for the horizon year based on this analysis. The aim is to guide the development and utilization of land resources in a manner that aligns with anticipated growth and development needs of the area.

Chapter 13: Planning proposals

This chapter identifies existing proposals and analyzes ongoing government projects, providing an update on their implementation status. Planning proposals are formulated based on the identified issues and potentials within each sector. These proposals are categorized into short-term, mid-term, and long-term initiatives, aligning with the existing demand and needs of the Thoothukudi Local Planning Area. This approach ensures a comprehensive strategy for addressing current challenges and harnessing future opportunities for sustainable development.

Chapter 14 : Proposed Land Use 2041

This chapter presents the proposed land use plan for the Thoothukudi Local Planning Area (LPA), organized according to zoning categories. The proposed land use plan is developed through analysis of areas with growth potential, taking into account factors such as planning permissions within the LPA. By delineating specific zones for different types of land use, this plan aims to guide future development in a manner that optimizes land utilization and supports sustainable growth within the area.

2 OVERVIEW OF CITY PROFILE

2.1 Profile of the Planning Area

Thoothukudi, situated in the southern region of Tamil Nadu, serves as both a vital port city and an industrial hub. It functions as the administrative headquarter for the Thoothukudi district. In 2011, the Thoothukudi Municipal Corporation underwent expansion, incorporating the pre-existing municipality and six adjacent villages. The city's planning area, designated as the Thoothukudi Composite Local Planning Area (CLPA), encompasses the Thoothukudi Municipal Corporation and 34 neighbouring revenue villages.

2.2 Historical Background of Thoothukudi City

The name 'Thoothukudi' originates from the presence of water springs (Oothu) that served as a vital source of drinking water. During the British colonial era, it was also known as "Tuticorin." Historically, Thoothukudi was primarily a fishermen's settlement, with the coastline and pearl fishing serving as the mainstays of the local economy. The present-day Thoothukudi is situated near the ancient port town of Korkai. During Pandyan dynasty in the southern Indian peninsula, the port of Korkai facilitated trade and commerce, attracting fishermen and pearl traders. However, port activities declined in the 5th Century AD with the shift of the Pandya capital to Madurai and the establishment of a port at Kayalpattinam. During the 13th and 14th centuries, Thoothukudi experienced growth in trading activities, attracting explorers from Europe and beyond with Indian spices and pearl fisheries. Marco Polo is documented to have landed in the port of Kayalpattinam in the 13th century AD. In 1532 AD, the Portuguese arrived at the port, establishing their presence mainly near Punnaikayal and setting up the first Tamil printing press in 1579.

Arrival of the British East India Company in 1782, the Dutch possessions were ceded, leading to infrastructure development in the port and railway

systems for enhanced connectivity to export goods to Europe. Thoothukudi evolved into a cargo handling port, with the area around the harbor witnessing significant development during British rule. The construction of a lighthouse in 1842 marked a milestone in harbour development, further encouraging industrial establishment.

In 1866, Thoothukudi was declared a Municipality, with Roche Victoria as its Chairman. The anchorage port with lighter age facilities facilitated traffic for over a century, with the first wooden jetty commissioned in 1864. The port handled exports such as salt, cotton yarn, senna leaves, and palmyra products, as well as imports like coal, cotton, pulses, and grains.

Thoothukudi emerged as a stronghold of the freedom struggle in the early 20th century. V.O. Chidambaram, born in Thoothukudi, established the first Swadesi Stream Navigation Company, sailing the first steamer S.S. Gealia to Thoothukudi on June 1, 1907.

On October 20, 1986, a new district was carved out of the Tirunelveli district and named after V.O. Chidambaranar. Since 1997, in alignment with the naming conventions of many other districts in Tamil Nadu, the district has been named after its headquarters town, Thoothukudi.

2.3 Geographical Location

Thoothukudi Municipal Corporation is a port town situated in the Gulf of Mannar at longitude 78.13 E and latitude 8.45 N. Thoothukudi district is geographically bounded by Virudhunagar and Ramanathapuram district in the North, by Bay of Bengal in the South and East, by Tirunelveli District in South West and Tenkasi and Tirunelveli District in the West.

Map 2.1: Regional Setting of Thoothukudi LPA

Thoothukudi is well connected by all major modes of transport. Roadways is served by four main roads which radiate to NH 32 - Madurai & NH 38 – Ramanathapuram on North, SH 176 - Tiruchendur on South and NH 138 - Tirunelveli on West. Railways has broad gauge railway line that connect Thoothukudi with Tirunelveli, Chennai, Coimbatore and Mysuru (Karnataka

State). The V.O.C. port is the third major port of Tamil Nadu State. Domestic airport terminal located in Vagaikulam at a distance of 21 kilometres from the city.

Thoothukudi City is situated at an elevation between 1 and 4 metres above Mean Sea Level (MSL), gently sloping towards the East. The figure- 3 shows the contour levels in the planning region at interval of 10m. The city mostly has a flat terrain. The planning area has loose soil with thorny shrubs in the north and salt pans in the south. Being in coastal region, the water table varies between 2 and 4 m below ground level.

2.4 Administrative Setup of Planning Area

The Thoothukudi Composite Local Planning Area, henceforth referred to as the "planning area," encompasses both the Thoothukudi Municipal Corporation area and 34 neighbourhood revenue villages.

Thoothukudi Composite Local Planning Area (CLPA) comprises Thoothukudi Single Local Planning area was originally notified vide G.O.No.629, Rural Development and Local Administration, dated 4th April, 1975 under section 10(1) of Town and Country Planning Act, 1971 and was published in Part II section 2 of Tamil Nadu Government Gazette dated 30th April, 1975. The same was confirmed vide G.O. No.1340, Rural Development Local Administration dated 6th August, 1975 under section 10(4) of Town and Country Planning Act, 1971. Subsequently, it was consented under sub-section 2 of section 24 of Town and Country Planning Act, 1971 vide G.O.Ms.No. No.54, Housing and Urban Development Department, dated 11th January, 1991.

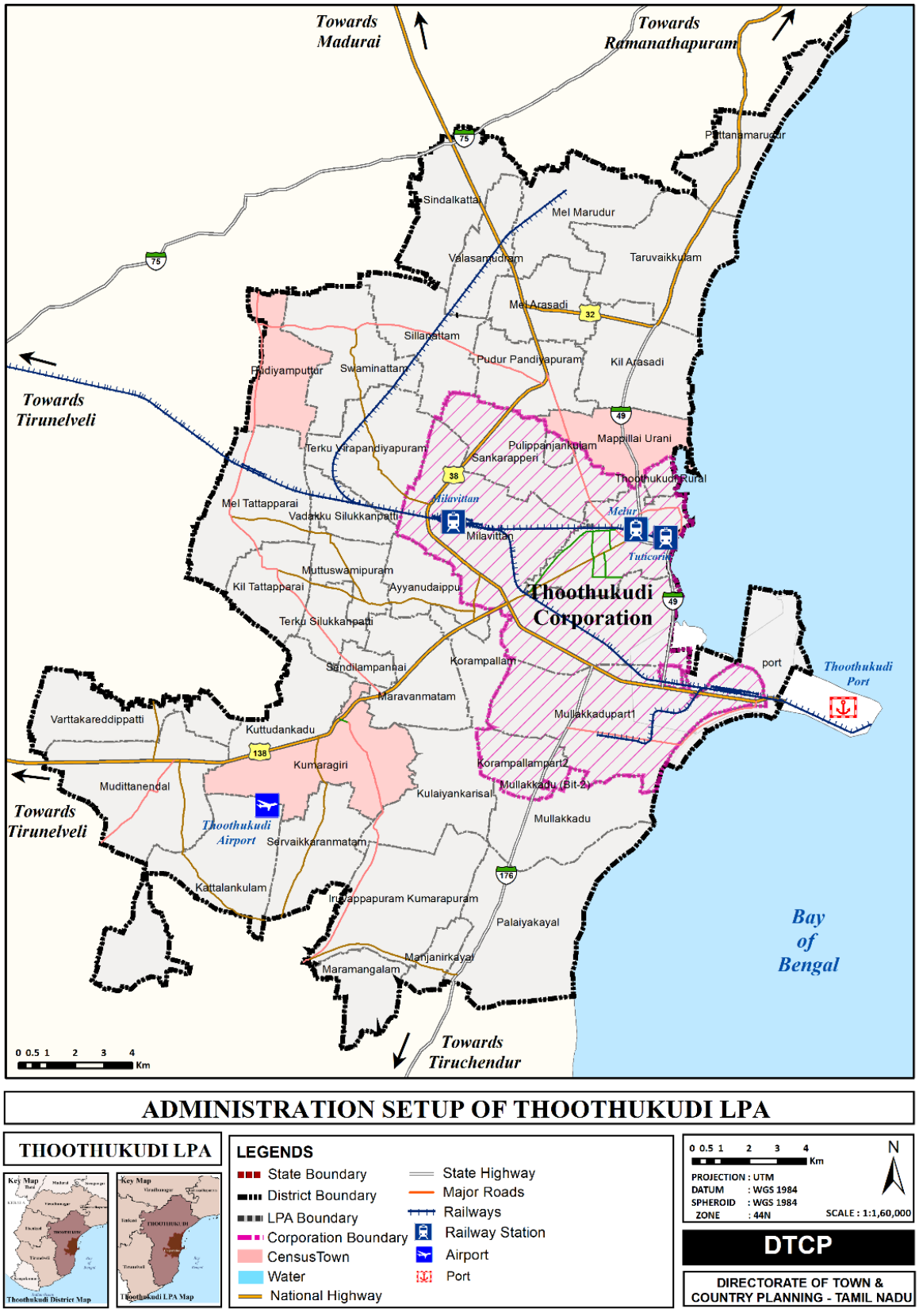
Single Local Planning Area (SLPA) of Thoothukudi was extended by adding 29 villages to form CLPA. The same was notified under section of 10 (1)(b) of the said Act vide G.O.Ms.No. No.853, Housing and Urban

Development Department, dated 1st June 1983. It was confirmed under section of 10(4) of the said Act vide G.O.Ms.No.1620, Housing and Urban Development Department, dated 16th October, 1986. The Master Plan for rural area was consented under section 24(2) of Town and Country Planning Act, 1971 vide G.O.Ms.No.71, Housing and Urban Development Department, dated 10th February, 2000.

Table 2.1: Timeline of Thoothukudi Composite Planning Area

Year	Description
1975	Notified as Thoothukudi Single Local Planning Area
1975	Confirmed as Thoothukudi Single Local Planning Area
1983	Notified as Thoothukudi Composite Local Planning Area (Rural Area)
1986	Confirmed as Thoothukudi Composite Local Planning Area (Rural Area)
1991	Master Plan consented for Urban area
2000	Master Plan consented for Rural area
2013	CLPA Notified with additional 9 villages

Additionally, 9 more revenue villages were added to the planning area and notified under section 10(1)(b) of Town and Country Planning Act, 1971 vide G.O.Ms. No.149, Housing and Urban Development Department, dated 20th June 2013. Out of those 9 villages, 5 villages namely, Koothudankadu, Mudivaithanendal, Varthagareddipatti, Kattalankulam and Servaikaranmadam falls in Thoothukudi Taluk and 4 villages namely Melamarudhur, Valasamutharam, Sinthalakattai and Pattinamarudhur falls in Ottapidaram Taluk. Table 2.1 illustrates the timeline of Composite Local Planning area of the Thoothukudi Master Plan 2041and Table 2.2 shows the extent of the Thoothukudi Master Plan 2041.



ADMINISTRATION SETUP OF THOOTHUKUDI LPA

THOOTHUKUDI LPA

LEGENDS

- State Boundary
- District Boundary
- LPA Boundary
- Corporation Boundary
- CensusTown
- Water
- National Highway
- State Highway
- Major Roads
- Railways
- Railway Station
- Airport
- Port

0 0.5 1 2 3 4 Km

N

PROJECTION : UTM
DATUM : WGS 1984
SPHEROID : WGS 1984
ZONE : 44N

SCALE : 1:1,60,000

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Map 2.2: Planning Area of Thoothukudi LPA

Table 2.2: Extent of the Thoothukudi Planning Area

S.No	Description	Area in Sq.Km
1	Thoothukudi Municipal Corporation	90.66
2	Rest of Local Planning Area	372.95
Total LPA Area		**463.61**

2.5 Thoothukudi Corporation

Thoothukudi attained municipality status in 1866, marking its initial recognition as a local governing body. Subsequently, in 1986, it was elevated to the status of a second-grade municipality. The significant milestone of Thoothukudi's municipal evolution occurred in 2008 when it was upgraded and officially declared as the Thoothukudi Municipal Corporation. Further development occurred in 2011, the Thoothukudi Municipal Corporation underwent expansion by the addition of 6 neighbourhood revenue villages of Thoothukudi District. These include Korampallam Part-II (Athimarapatti), Meelavittan, Sankaraperi, Pulipanchankulam, Thoothukudi Part-II, and Mullakadu Part-I (Muthaiyapuram).

Thoothukudi Municipal Corporation spans a total area of 90.66 Sq.KM. The corporation is divided into 60 electoral wards, distributed across four distinct zones.

- The East zone - 14-16 & 19-33 wards
- The West zone - 34-47 wards
- The North zone - 1-13 & 17-18 wards
- The South zone - 48-60 wards

This zoning facilitates effective governance and local representation throughout the municipality. The key profile of the Municipal Corporation, as outlined in Table 2.3.

Table 2.3: Profile of Thoothukudi Municipal Corporation

S.No	Description	2001	2011
1	Population	3,20,466	3,72,408
2	Population Density	36	42
3	Growth Rate	8.11	10.08
4	Literacy Rate	75,424	95,049

Source: Census of India

2.5.1 Rest of the Planning Area

The rest of the planning area comprises of 34 villages/towns from 3 taluks of Thoothukudi District. Table 2.4 shows the extent of the 34 Neighborhood villages.

Table 2.4: Profile of the Revenue Villages

S.No.	Description	Extent (in Sq.Km)
1	Ayyanadaippu	6.74
2	Kattalankulam	19.08
3	Keelathattaparai	7.99
4	Koothudankadu	8.84
5	Korampallam Part-I	6.08
6	Kulalankarisal	12.66
7	Kumaragiri	16.23
8	Mappillaiyurani	8.73
9	Maravanmatam	11.34
10	Melathattaparai	15.51
11	Mudivaithanendal	19.30
12	Mullakkadu Part-II	12.39
13	Muthusamypuram	6.12
14	Senthilampannai	2.24
15	Servaikaranmadam	10.35

S.No.	Description	Extent (in Sq.Km)
16	Therku Sillukkanpatti	4.41
17	Vadakku Sillukkanpatti	4.69
18	Varthagareddipatti	11.32
19	Iruvappapuram Part-II	17.04
20	Manjalneerkayal	2.93
21	Maramangalam	6.49
22	Palayakayal	22.6
23	Keela Arasadi.	13.41
24	Mela Arasadi	8.87
25	Melamarudhur	13.24
26	Pattinamaruthur	10.92
27	Pudurpandiapuram	9.73
28	Puthiamputhur	8.7
29	Samynatham	13.46
30	Sillanatham	11.56
31	Sinthalakattai	12.48
32	Tharuvaikulam	17.28
33	Therkuveerapandiapuram	12.88
34	Valasamutharam	7.34
Grand Total		**372.95**

Source: Census of India

2.6 Natural Features of Thoothukudi LPA

2.6.1 Geology

The Thoothukudi district features a diverse lithopackage comprising meta-sedimentary sequences intertwined with various types of rocks. These include quartzite, calc-granulite, garnet-biotite-sillimanite gneiss, and others belonging to the Khondalite Group, as well as charnockite and pyroxene

Granulite of the Charnockite Group. Additionally, there are hornblende-biotite gneiss and migmatitic complex rocks present. Basic and acid intrusive rocks, along with pegmatite and quartz veins, are also observed. Notably, there's evidence of incipient charnockite development along shear planes. These rocks, belonging to the Khondalite and Charnockite groups, and Migmatite Complex, are overlain by Tertiary and Quaternary sediments. Economic minerals in the area include gypsum, limestone, beach sand, kankar, and shell limestone.

2.6.2 Geomorphology

The Thoothukudi district is characterized by undulating terrain sloping towards the sea, featuring sand dunes and back swamps along the coast. Coastal areas exhibit recent dunes composed of white and red "teri" sand. The drainage pattern is primarily co-linear, with the Tamirabarani and Vaippar rivers and their distributaries forming the natural drainage system. Geomorphologically, the district is classified into fluvial, marine, fluvio-marine, aeolian, and erosional landforms. Notable erosional geomorphic units include the Taruvaikulam-Tuticorin surface, Kulattur surface, Vaippar surface, among others in the north, and Karamaniyar surface, Tambraparni surface, Tiruchendur-Kayalpattinam surface, and Vallanadu surface in the south. Red sandy tracts, known as Teri sand complexes, are prominent along the coast, extending 6 to 8 KM inland. Important Teri areas include Adaippanvilai Teri, Kudiraimozhi Teri, and Vaippar-Vembar Teri, with elevations ranging from 15 to 62M above Mean Sea Level (MSL).

2.6.3 Water Resources and Drainage System

The Thamirabharani River, originating in Agasthiyamalai of the Western Ghats, flows through Srivaikundam and Thiruchendur taluks before reaching its confluence with the sea at Punnakayal in Srivaikundam taluk. Pambayar and Manimuthar are its chief tributaries passing through the district. Additionally, drainage courses like Malattar and Uppodai are present in Kovilpatti taluk.

Thamirabharani and Manimutharu serve as catchment areas for river basins, originating from Pothigaimalai, with lengths of 120 km and 98 km respectively. Dams such as Pabanasam, Manimutharu, and Eppodumvernan are constructed within the district to regulate water flow.

Thoothukudi Municipal corporation limit features the Upparu River as a major river flowing through it. To manage drainage in the developed part of the city, a natural drain was channelized in the recent past by the TCMC, known as Buckle Canal. Despite its channelization, Buckle Canal has a limited carrying capacity of about 30 cu.m/sec. In the northern part of the city, three odai (smaller rivers) flow, but one of them, Kaluthapathai, lacks a water course after the Shankaraperi area. Another odai, Kalugupathai, which passes through the S.V. Kulam area, also lacks a water course after approximately 150 m from the S.V. Kulam spillway. The third odai, Kalangakari odai, follows the rail track leading to the Chidambaram port and ultimately discharges into Buckle Canal.

Additionally, within the city limits, there are three to four small creeks contributing to the local drainage system. Overall, the channelization and management of these watercourses play a crucial role in the city's drainage infrastructure.

2.6.4 Climatology

The district, located on the east coast, experiences a typical climate characterized by high humidity and relatively lower to moderate temperatures throughout the year. The annual mean minimum and maximum temperatures are 23.78°C and 33.95°C, respectively. May is the hottest month with an average temperature of 31.6°C, while January sees an average temperature of 26.5°C. The rainfall is concentrated in the months of October, November, and December, with a cooler climate from October to January. From February onwards, early summer begins, and the months of April, May, June, July, and August are hot.

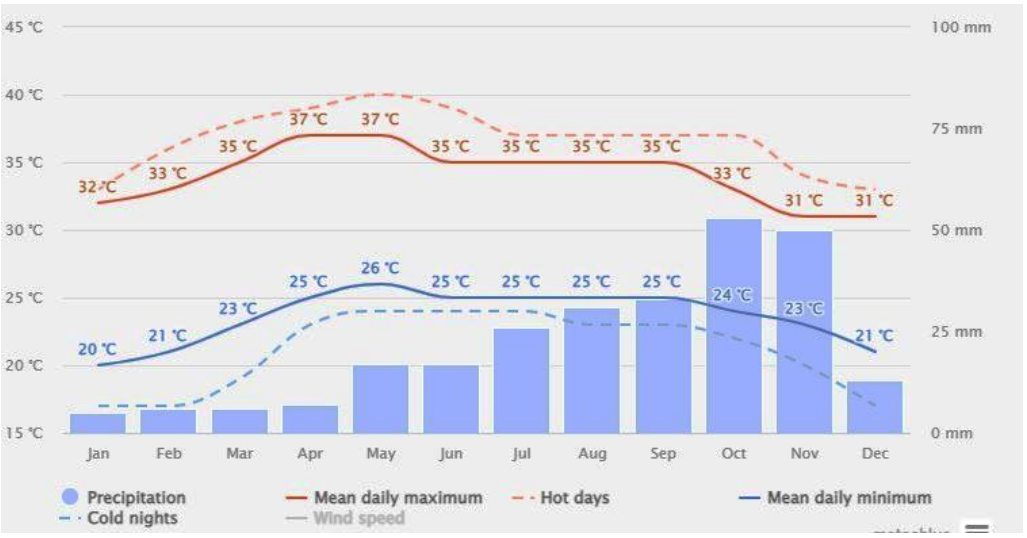


Figure 2.1: Average Temperature and Precipitation of Thoothukudi City

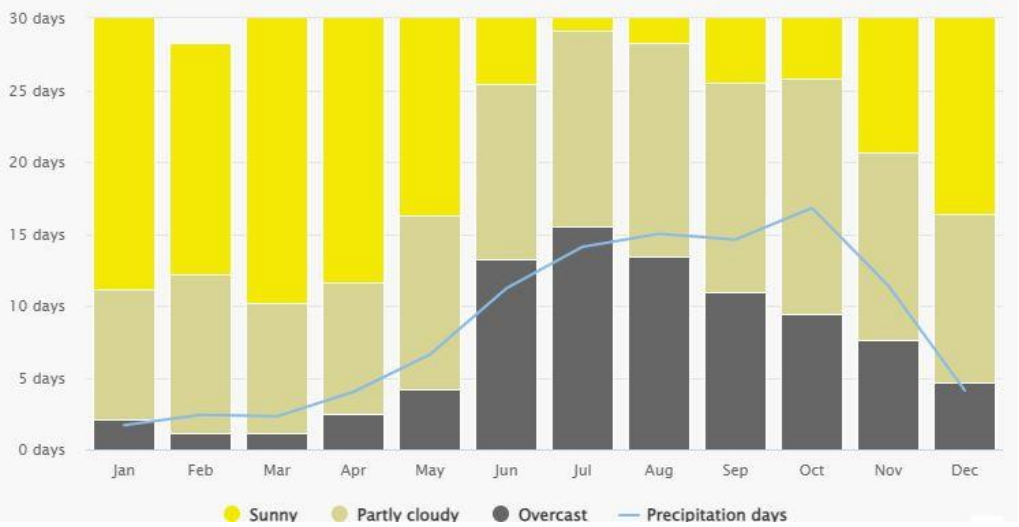


Figure 2.2: Cloud Cover and Precipitation of Thoothukudi City

2.6.5 Rainfall

The district receives rainfall from both the southwest and northeast monsoons, with the latter being the primary contributor. Cyclonic storms, often originating from depressions in the Bay of Bengal, lead to most of the precipitation. August has the lowest precipitation, averaging 3 mm, while November receives the highest rainfall, averaging 238 mm.

In December 2023, the Thoothukudi district received an annual rainfall of 70 cm from the Northeast Monsoon. However, Kayalpattinam, a locality within the district, experienced an extraordinary event when it received a remarkable 96 cm of rainfall in a single day.

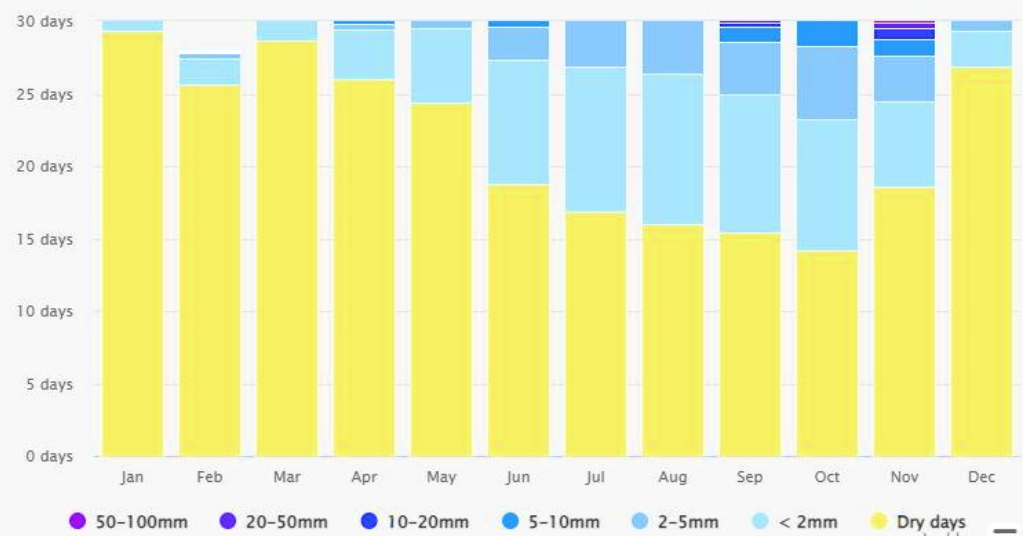


Figure 2.3: Average Rainfall of Thoothukudi City

2.6.6 Wind

In Thoothukudi, the average wind speed is 4.1 m/s, reaching a maximum of approximately 10 m/s. The average ambient temperature stands at 28.4 degrees Celsius, fluctuating between 22.4 and 35.8 degrees Celsius. Relative humidity averages around 74.6%, varying from 37.8% to 95.8%.

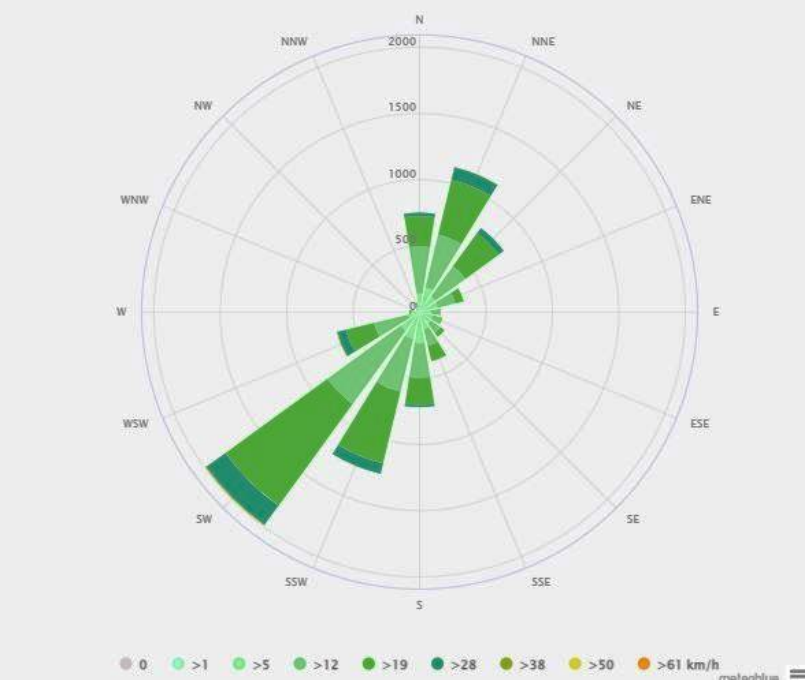


Figure 2.4: Wind rose of Thoothukudi City

According to the wind rose, the prevailing wind direction in Thoothukudi is from the WSW, accounting for about 22.42% of all wind directions.

2.6.7 Minerals

The coastal belt is abundant in valuable minerals like garnet, ilmenite, and monazite sands, particularly near the Kallar and Vaipar river mouths. Concentrations of ilmenite and garnet sands are notable in these areas, presenting economic opportunities for industrial use. These minerals, used in various sectors such as manufacturing, construction, and technology, contribute to the region's economic potential and may require careful management for sustainable extraction practices and environmental protection.

2.6.8 Seismic Zones

The Indian Tsunami Early Warning Centre (ITEWC) was established in 2007 in response to the devastating tsunami on December 26, 2004. It is located at the Indian National Centre for Ocean Information Sciences (INCOIS), an

autonomous institute under the Ministry of Earth Sciences in Hyderabad. The ITEWC plays a crucial role in monitoring and providing early warnings for potential tsunamis in the Indian Ocean region.

According to the Bureau of Indian Standards (BIS), Thoothukudi is categorized under Class 3 Seismic Zone. This classification is based on considerations such as past earthquake occurrences and the geological characteristics of the soil in the region.

2.6.9 Cyclone

Cyclones are large-scale atmospheric systems characterized by low pressure at their centre and circular wind motion, which is counter clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

In 1992, a severe cyclonic storm with wind velocities ranging from 100 to 300 Km per hour swept through the coastal villages of the Thoothukudi district. The cyclone lashed the coast for a period of 3 -4 hours, accompanied by ferocious winds, heavy rainfall, and massive tidal waves. This devastating event caused widespread destruction along its path, leaving behind a trail of devastation to both life and property in the affected areas. The combination of high winds, torrential rain, and tidal surges resulted in untold havoc, posing significant challenges for recovery and rebuilding efforts in the aftermath of the disaster.

The Vulnerability Atlas of India 2006, published by the Building Materials and Technology Promotion Council (BMTPC), indicates that the Thoothukudi District is situated in a moderate damage risk zone for winds and cyclone hazards. Over the past 115 years, the area has encountered the crossing of two to four cyclonic storms, including severe cyclone storms, across one-degree latitudes. The probable maximum wind speed in the region is estimated to reach 64 km/h. Additionally, the probable maximum storm surge varies between 6.0 meters on the eastern coast of Kanniyakumari to 4.5 meters for the northern coast of Thoothukudi. These findings underscore the

importance of preparedness and mitigation measures to minimize the impact of cyclones on the region's infrastructure and population.

2.6.10 Agriculture and Cropping Pattern

Thoothukudi district is known for the cultivation of a variety of horticulture crops. Major crops include:

1. **Fruit Crops:** Mango, banana, guava, sapota (chikoo), and aonla (Indian gooseberry).
2. **Vegetables:** Bhendi (okra), tomato, brinjal (eggplant), onion, tapioca, etc.
3. **Spices and Condiments:** Chillies, tamarind, turmeric, etc.
4. **Plantation Crops:** Betel vine and cashew.
5. **Flower Crops:** Jasmine, chrysanthemum, tube rose, marigold, rose, etc.
6. **Medicinal Plants:** Senna, coleus, aloe vera, and other medicinal herbs.

This diverse range of horticulture crops highlights the agricultural richness of the region, catering to both domestic consumption and commercial markets. The cultivation of these crops contributes significantly to the economy and agricultural landscape of Thoothukudi district.

2.6.11 Bio Diversity

The coastal stretch from Surangudi to Tuticorin features occasional coral reefs and algal patches, creating diverse marine ecosystems. Submerged rocky patches in this area support a variety of marine life, including algae, sea fans, and pearl oysters, contributing to the richness of the coastal environment. Moving towards Vilathikulam, Ottapidaram, and Srivaikundam taluks, the region boasts extensive backwater areas, adding to the ecological diversity of the coastline. These backwaters are likely to support various aquatic species and provide habitats for migratory birds and other wildlife.

The coastal area from Tuticorin to Chinnamuttam is characterized by sandy beaches, making it an ideal nesting ground for sea turtles. This stretch

of coastline is likely to play a crucial role in the conservation efforts for sea turtles, providing them with suitable habitats for nesting and breeding.

Overall, the coastal region described exhibits a rich diversity of marine and coastal ecosystems, supporting various forms of marine life and providing essential habitats for wildlife conservation.

The coastal zones of Thoothukudi District host a diverse array of shorebirds, with 80 species identified belonging to 6 orders and 15 families. The order Charadriformes stands out with 52 bird species, making it the largest contributing order. Within this order, the family Scolopacidae is particularly noteworthy, accounting for 26 bird species. Island habitats are preferred by coastal birds over the mainland in the Gulf of Mannar Biosphere Reserve (GoMBR). The feeding grounds, especially muddy flats, play a crucial role in determining bird abundance, with benthic fauna being more abundant in muddy flats compared to sandy and sediment grounds.

The Gulf of Mannar, known for its unique biological diversity, has gained attention due to both its rich wildlife and constant exploitation of its flora and fauna. It is recognized, after Point Calimere on the southeast coast of India, for attracting a large seasonal aquatic bird population of over 50,000. Additionally, pelagic birds have been sporadically recorded by residents of villages along the coastal belts in Thoothukudi district. The study sheds light on the ecological significance of the region and emphasizes the need for conservation efforts.

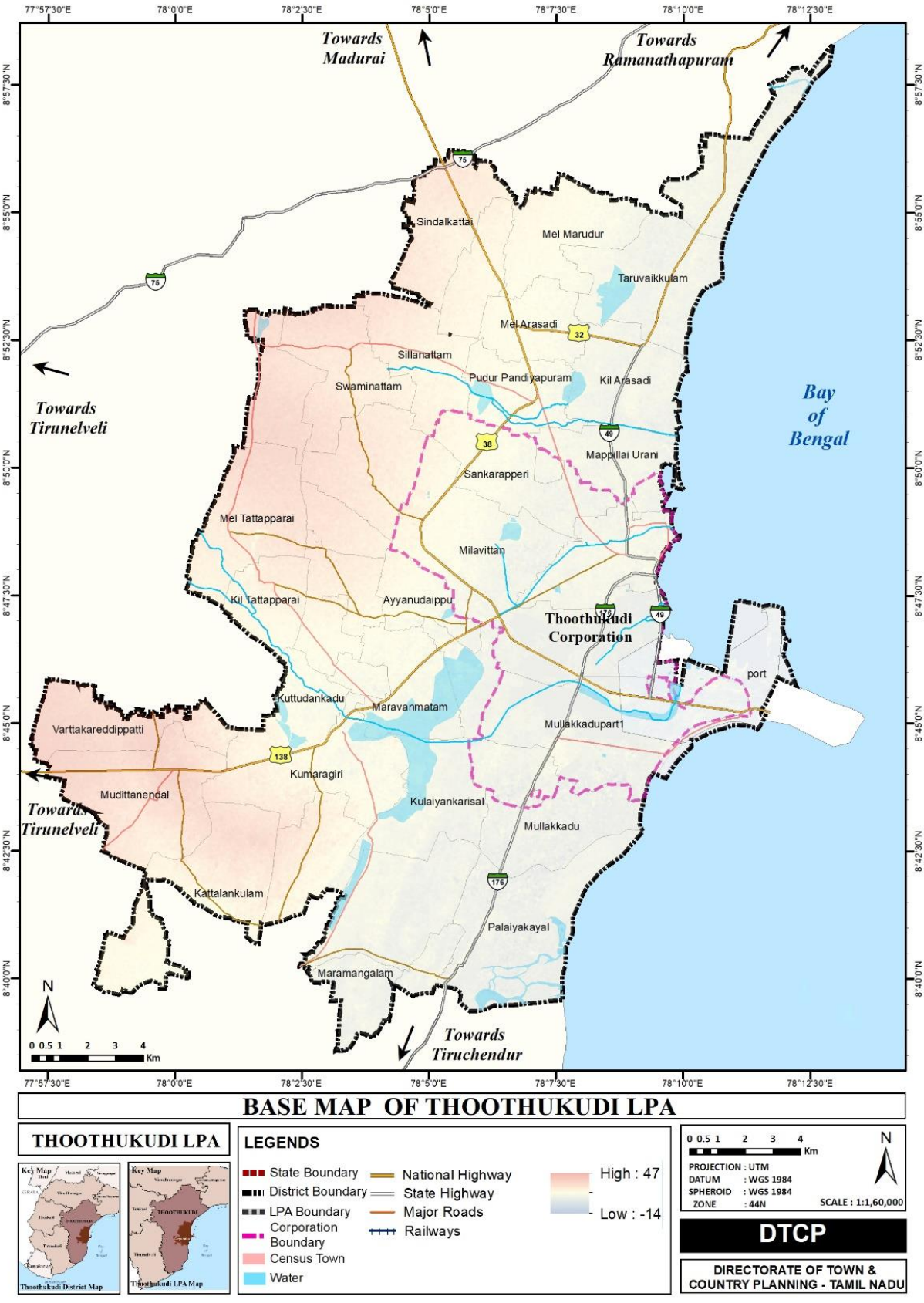
2.6.12 Coastal Regulations Zone (CRZ)

The different coastal regulation zone class of Tuticorin District coast and their areal extent are presented in the below Table 2.5.

Table 2.5: CRZ Classes and their area extent of Thoothukudi District

CRZ Categories			Tide Line		Coastal Line		
CRZ – I In Sq.KM	CRZ – II In Sq.KM	CRZ – III In Sq.KM	LTL Km	HTL Km	100 m Km	200 m Km	500 m Km
76.46	8.81	76.60	238.97	355.34	Nil	145.19	173.78

Source: Coastal Regulation Zone information of Tamil Nadu



BASE MAP OF THOOTHUKUDI LPA

THOOTHUKUDI LPA

LEGENDS

- State Boundary
- District Boundary
- LPA Boundary
- Corporation Boundary
- Census Town
- Water
- National Highway
- State Highway
- Major Roads
- Railways

High : 47

Low : -14

0 0.5 1 2 3 4 Km

N

PROJECTION : UTM
DATUM : WGS 1984
SPHEROID : WGS 1984
ZONE : 44N

SCALE : 1:1,60,000

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Map 2.3: Base Map for Thoothukudi Local Planning Area

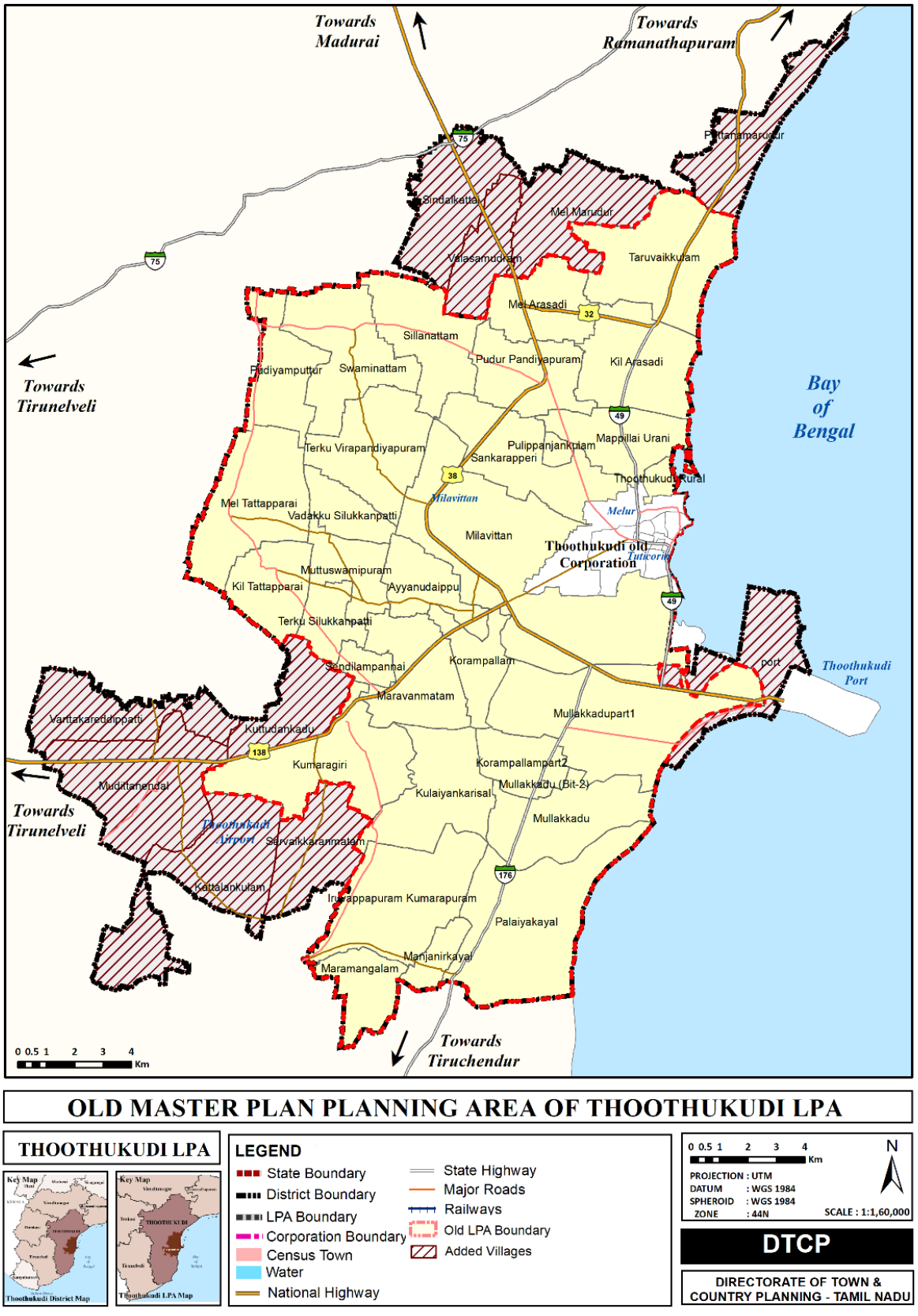
3 REVIEW OF OLD MASTER PLAN

3.1 Background

There are two master plans for Thoothukudi Local Planning Area. Initially, the master plan was done for only Thoothukudi Town which was then a Single Local Planning Area, which is 13.53 Square Kilometer. Then additional 29 Villages are added and the master plan a separate master plan is prepared for the 29 villages.

The Thoothukudi Local Planning Area in Tamil Nadu was declared under section 10(1) of the Tamil Nadu Town and Country Planning Act, 1971. This declaration was made by the Department of Rural Development and Local Administration, Government of Tamil Nadu through G.O. Ms. 629 RD & LA Department, dated 04.04.1975. Later, it was confirmed under section 10(4) of the same act in G.O Ms. 1748 RD & LA Department dated 06.08.1975. The government constituted a Single Planning Authority for the so-notified Single Local Planning Area, in G.O. Ms. 1748 RD & LA Department dated 17.10.75 under Section 11(1) of the Town and Country Planning Act 1971.

The 29 Villages situated around Thoothukudi Municipal Area were notified as additional areas to Thoothukudi Local Planning Area were declared under section 10(1b) of the Tamil Nadu Town and Country Planning Act, 1971. This declaration was made by the Department of Housing and Urban Development, Government of Tamil Nadu through G.O. Ms. No. 853 H&UD Department dated 16.10.1983. Later, it was confirmed under section 10(4) of the same act through in G.O Ms. 1620 RD & LA Department dated 16.10.1986.



Map 3.1: Old Master Plan Boundary of Thoothukudi LPA

3.2 Master Plan for Thoothukudi Single Planning Area

3.2.1 Objective of the Master Plan

The objective of the Thoothukudi LPA Master Plan is to formulate a long-term vision and strategy to make the LPA vibrant, livable, and creditworthy. It will endorse growth in desired direction, promote economic development, improving service delivery and providing amenities to its people. It ensures rational policy choices besides providing a flexible frame work based on ground realities for defined time period. Besides rationalizing the land use pattern, it will also facilitate the identification of sectorial investments and reform areas needed to transform the LPA.

3.2.2 Jurisdiction of Thoothukudi SLPA

The Total area of Thoothukudi SLPA is 13.47 Square Kilometers. The Local Planning area comprises only the town area, which comprises of 12 Wards and 260 Blocks. Later 29 villages surrounding Thoothukudi town added and master plan prepared. On the Eastern side of LPA there is Bay of Bengal.

3.2.3 Distribution of Land Use

Thoothukudi SLPA Master Plan has been prepared by considering 1985 as the base year and ultimate year of 2005. New master plan (or) Review of master plan is not taken up to the present. The population of Thoothukudi Town as on the year 1981 is 1,92,949. Table 3.1 shows the existing land use percentage within the LPA. The residential area is 52.71 % of the total area, majority of the residential area is concentrated near to the Thoothukudi old Port Trust area. The commercial uses can be seen along the major road like Victoria Road, George Road, and Beach Road. Industrial area is very minimal which is only 2.82% of the total area, the major economic activity is based only on the port allied activities hence the industrial activity is less in Thoothukudi.

Table 3.1: Existing Land Use of Thoothkudi Town 1985

Land Use	Area (In Sq. Km)	Percentage to Total Area
Residential	7.1	52.71
Commercial	0.64	4.75
Industrial	0.38	2.82
Educational	0.9	6.68
Public and Semi-Public	0.58	4.31
Agriculture (Includes Parks, Play Ground, Water Bodies, Burial)	2.27	16.85
Transportation	1.6	11.88
Total	**13.47**	**100**

Source: Thoothukudi Old Master Plan

3.2.4 Review of Thoothukudi Town Master Plan 2005

Initially, the existing land use survey for Thoothukudi Town Master Plan is done in the year 1978 and then land use is updated in year 1985. The existing land use for both years is done by the primary surveys. Table 3.2 shows the comparison of proposed land use for the year 2005 with the existing land use for 2021.

Table 3.2: Comparison of Proposed Land Use 2005 with Existing Land Use of 2021

Description	Proposed Land Use 2005		Existing Land Use 2021	
	Area (Sq. Km)	Percentage of Area	Area (Sq.km)	Percentage of Area
Residential	8.5	63.10	5.93	44.02

Description	Proposed Land Use 2005		Existing Land Use 2021	
Commercial	0.72	5.35	1.43	10.62
Industrial	0.42	3.12	0.15	1.11
Institutional	1.72	12.77	3.03	22.49
Agricultural	0.41	3.04	0.11	0.82
Transportation	1.7	12.62	2.6	19.30
Waterbody	-		0.22	1.63
Total	**13.47**	**100**	**13.47**	**100**

From Table 3.2 it is inferred that the proposed residential for Thoothukudi town is 8.5 Square kilometers but only 5.93 was achieved in 2021. There is a gap of 2.57 Sq. Km. For the Commercial it is proposed 0.72 Sq. Km but 1.43 Sq. Km is achieved, this shows the increased in the commercial activity in the Town area. For industrial 0.42 Sq. Km is proposed but only 0.15 Sq. Km is achieved majority of the industry is moved out of the town limit. In case of institutional in 2005 it is proposed 1.72 Sq. Km but 3.03% is achieved. Transportation is achieved more that the proposed land use in 2005, since the industrial activity is increased outside the planning area with proximity to the port the improvement of roads is carried out to increase the connectivity.

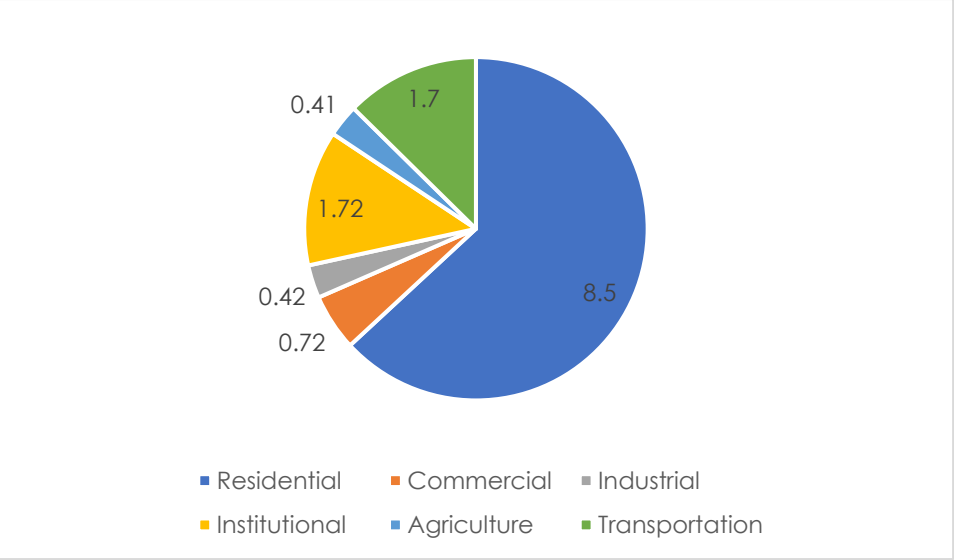


Figure 3.1: Proposed Land Use for 2005 of Thoothukudi Town

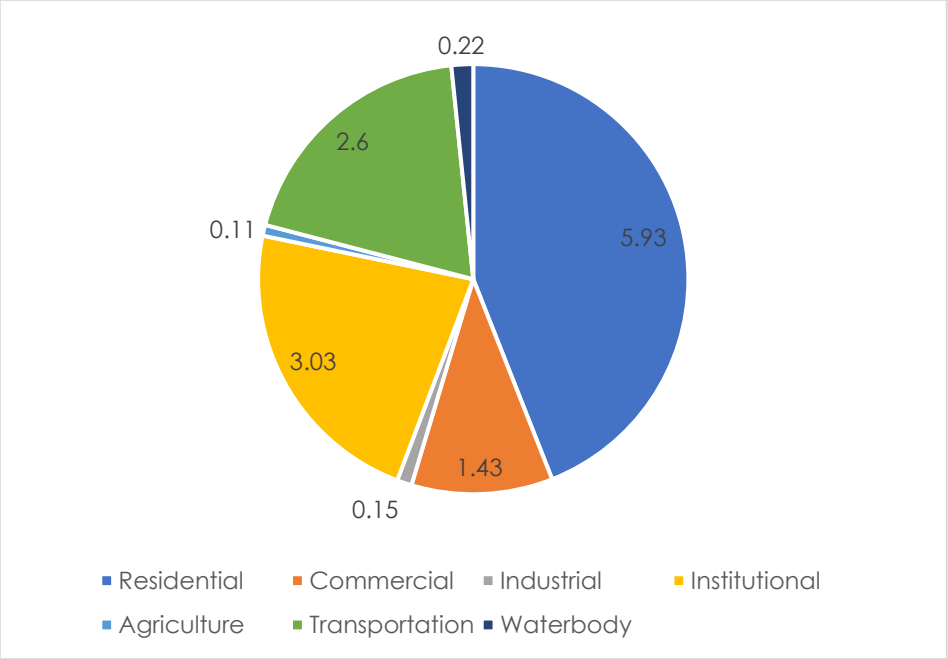


Figure 3.2: Existing Land Use of 2021 for Thoothukudi Town

3.2.5 Projected Population

The Projected population for the Thoothukudi Town for the year 2005 is 4,30,000. As per the 2011 Census population it is only 2,37,830 is achieved and

there is a gap of 1,92,170. It is observed that there is 55.30% of population gap to the projected population in comparison with 2011 population.

3.3 Master Plan for Thoothukudi Added Villages

3.3.1 Objective of the Master Plan

The objective of preparing a master plan for villages is to provide a comprehensive and strategic framework for the sustainable development of the village. This plan serves as a guiding document that outlines the goals, priorities, and actions needed to enhance the overall quality of life for the residents and promote well-planned growth.

3.3.2 Jurisdiction of Thoothukudi Added Villages

The 29 Village surrounding Thoothukudi town was added and notified by the Department of Housing and Urban Development, Government of Tamil Nadu through G.O. Ms. No. 853 H&UD Department dated 16.10.1983. The List of added 29 villages for the preparation of the master plan is shown in Annexure – I. Out of 29 Villages 17 Villages are located in Thoothukudi Panchayat Union, 8 Villages in Ottapidaram Panchayat Union and 4 Villages are present in Srivaikumdam Panchayat Union. The Total area of 29 Villages in 341.23 Square Kilometer.

3.3.3 Distribution of Land Use

Master plan for 29 added villages of Thoothukudi has been prepared by considering 1995 as the base year and the ultimate year as 2015. New master plan (or) Review of master plan is not done. The population of Thoothukudi Town as on the year 1991 is 1,31,755. Table 3.3 shows the existing land use percentage of added villages.

Table 3.3: Existing Land Use for Thoothukudi Added Villages 1995

Land Use	Area (In Sq. Km)	Percentage to Total Area
Residential	22.05	6.46
Commercial	0.92	0.27
Industrial	12.64	3.70
Educational	0.95	0.28
Public and Semi-public	9.74	2.85
Agriculture	271.67	79.61
Salt Pan	23.26	6.82
Total	**341.23**	**100**

From Figure 3.1 and Figure 3.2 it is observed that the majority of the land area comes under agricultural use which is 79.61% of the total area. The residential area is about 6.46% of the total area. Since Thoothukudi is a coastal city the production of salt is more in this area so the salt pan comprises 6.82% of the total area. Industrial use comprises 3.70% since the concentration of industries is observed in Milavittan Village. Only 3.89% of the Total area comes under developable area.

3.3.4 Review of Master Plan for Thoothukudi Added Villages

The proposed land use for the Thoothukudi Villages is done for the year 2015, Table 3.4 shows the comparison of Proposed land use for 2015 with existing land use for 2021. In case of residential 151.9 Sq. Km is proposed but only 29.75 percent is achieved. For commercial 10.95 sq. km. is proposed but

only 4.85 percent is achieved major economic activity in Thoothukudi is based on Port activity. Industrial use is proposed as 74.75 Sq. Km. but on 18.43 Sq. Km is achieved, though the Thoothukudi has potential to industrial development majority of the proposed industrial land is remains vacant. There is no separate land use classification for salt pans is not given but in the existing land use 2021it has 9.59 sq. km of area. Same as salt pans there is no separate classification for transportation and water body. For transportation in existing land use, it has 10.13 sq. km. of land and Water body has 44.62 sq. km. of land area.

Table 3.4 Comparison of Proposed Land Use 2015 and Existing Land Use 2021

Description	Proposed Land Use 2015		Existing Land Use 2021	
	Area (Sq. Km)	Percentage of Land Use	Area (Sq.km)	Percentage of Land Use
Residential	151.9	44.52	29.75	8.72
Commercial	10.95	3.21	4.85	1.42
Industrial	74.75	21.91	18.43	5.40
Institutional	17.57	5.15	9.77	2.86
Agricultural	86.06	25.22	190.94	55.96
Salt Pan	-	-	32.74	9.59
Transportation	-	-	10.13	2.97
Waterbody	-	-	44.62	13.08
Total	**341.23**	**100**	**341.23**	**100**

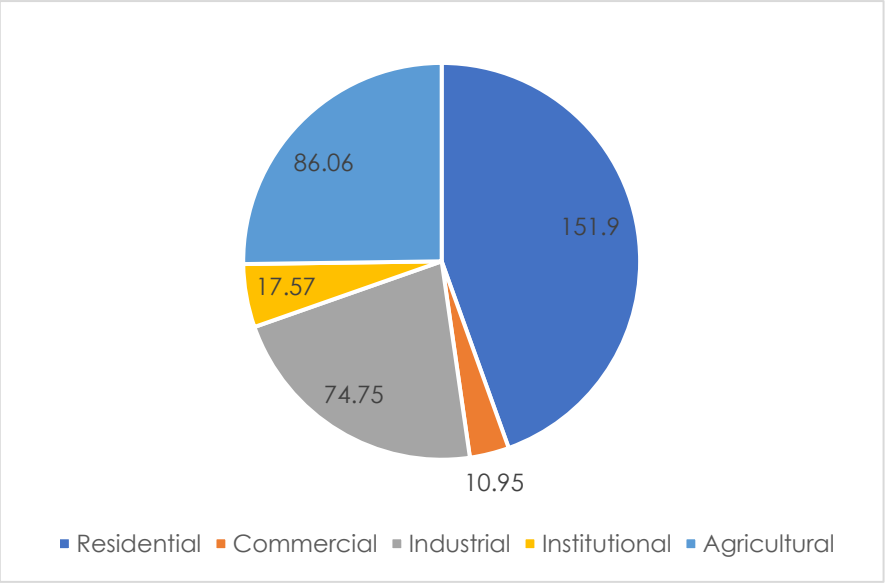


Figure 3.3: Proposed Land Use for 2015 for Thoothukudi Added Villages

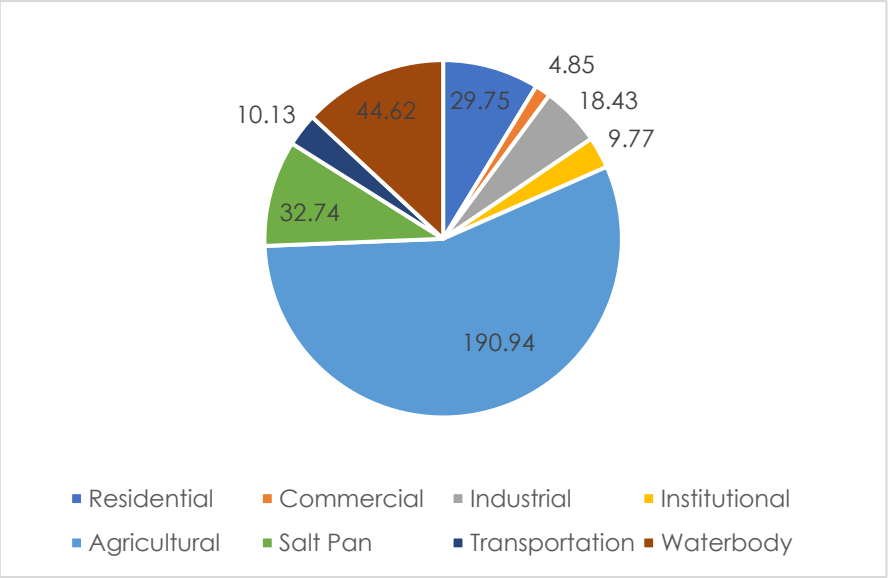


Figure 3.4: Existing Land Use of 2021 for Thoothukudi Added Villages

3.3.5 Projected Population

The Projected population for the Thoothukudi added villages for the year 2015 is 3,00,000. As per the 2011 Census population it is 2,51,498 and there is a gap of 48,502. It is observed that there is 16.16% of population gap to the projected population in comparison with 2011 population. The gap is very less when compared with previous master plan for Thoothukudi town. This shows that the growth in population is more in villages than in Thoothukudi town.

3.4 Master Plan Proposal

There is no major proposals for the development of the town in both the master plans. The two major proposals are Improvement of buckle channel and construction of new bus stand. Both the proposals are completed in Thoothukudi. There is no specific proposals for land use planning. The major issues of the town are not identified. Sector wise proposals are not included in both the master plan.

3.5 Coastal Regulation Zone

For regulating development activities, the coastal stretches within 500 M of high tide line on the landward side are classified into four categories:

Category I (CRZ I)

- Areas that are ecologically sensitive and important such as national parks / Marine parks, sanctuaries, reserve forests, wildlife habitats, corals/coral reefs, areas close to breeding and sprawling grounds of fish and other marine life, areas of outstanding natural beauty / historically heritage areas, areas rich in genetic diversity, areas likely to be inundated due to rise in sea level consequent upon global warming and such other areas as may be declared by the central government or the concerned authority at the state/union territory level from time to time.
- Areas between the low tide and the high tide line.

Category II (CRZ II)

The areas that have already been developed up to or close to the shoreline. For this purpose, "developed area" is referred to as that area within the municipal limit or in other legally designated urban areas which is already substantially built up and which has been provided with drainage and approach roads and other infrastructure facilities, such as water supply and sewage mains.

Category III (CRZ III)

Areas that are relatively undisturbed and those which do not belong to either category I or II. These will include coastal zone in the rural areas (developed or un developed) and also areas within municipal limits or in other legally designated urban areas which are not substantially build up.

Category IV (CRZ IV)

Coastal stretches in Andaman and Nicobar, Lakshadweep and Small Island, except those designated as CRZ I, CRZ II, and CRZ III.

3.6 Zoning Regulations

The proposed land use plan of the Master Plan of Thoothukudi LPA followed zoning regulations under section 49 of Town and Country Planning Act, 1971. The following are the use zones as directed by Government in G.O. Ms. No. 1730; RD & LA. Department dated 24.7.74.

- Residential Use Zone
- Commercial Use Zone
- Industrial use Zone
- Educational Use Zone
- Public and Semi-Public Use Zone
- Agriculture Use Zone

3.7 The major concerns in the Review of Master Plan -2011

Based on the development strategy and zoning regulation followed in this Thoothukudi LPA Review of Master Review 2011, the following issues are identified and that is in consideration of preparing Thoothukudi LPA Master Plan 2041.

3.7.1 Land Use

The proposed land use distribution for the Thoothukudi town for the horizon year 2005, reflect land use/ land cover analysis. There is an absence of clear policy for development of residential areas. The heritage structures, existence of mixed land use within the core area of the thoothukudi town, huge vehicular congestion, absence of parking facilities and other need regulation.

3.7.2 Population Density Pattern

The proposed population density pattern is not reflected in the proposed land use plan of Thoothukudi. The future urban areas are along the major transportation corridors. There is requirement of detailed site planning exercise with statutory provisions in these areas to prevent unplanned and unregulated future development.

3.7.3 Employment Structure

The Master Plan represents employment structure with nine categories of main worker's classification for Thoothukudi LPA. The spatial distribution and quantification of the primary, secondary and tertiary worker's/ work zones need to be identified and reflected in the Master plan.

3.7.4 Civil Amenities

Thoothukudi facing with lack of infrastructure and civil amenities to accommodate the present population needs. The urban insanitary conditions and pollution of water bodies are the major problems. To overcome these, internal sewerage system, sewage treatment plants, low-cost toilets, organized solid waste management and management of other hazardous wastes are necessary. Recycling of waste needs attention. Green concepts and solar energy utilization proposals also could have been explored.

3.7.5 Disaster Mitigation and Management

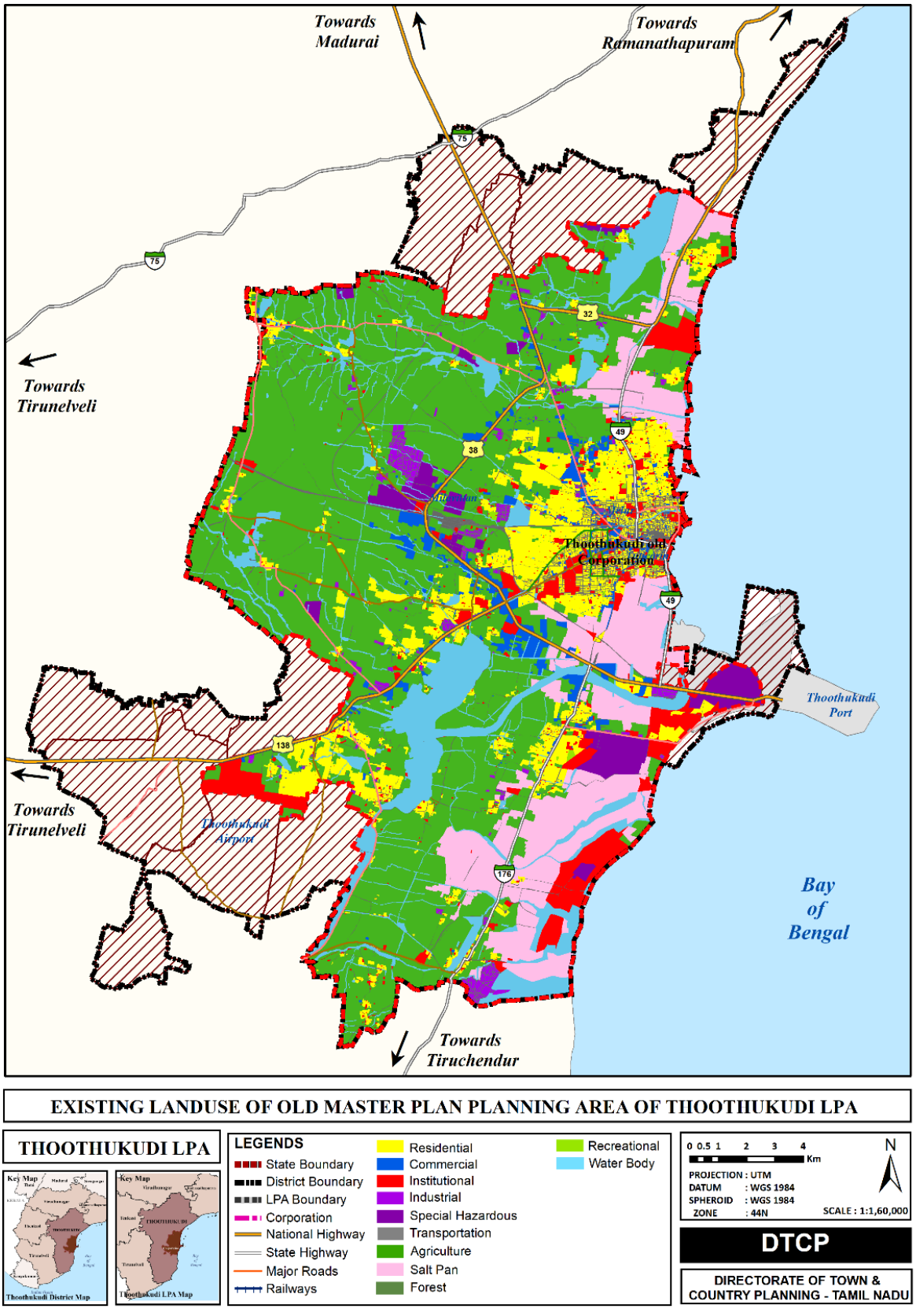
In the present Master Plan, there are no provisions for disaster management (such as earthquake, fire, flood, water logging, etc.). Provision of Disaster Mitigation and Management is mandatory in the Master Plan. All new built-up to be made earthquake resistant.

This will also include mitigations related to flood, water logging, fire, etc and rain water harvesting is also mandatory. The concerned local bodies should keep updating the building bye laws to safeguard against disasters and ensure effective and impartial enforcement.

3.8 Conclusion

Rapid urbanization has overtaken the planning process in Thoothukudi. Often enforcement is weak and also a lack of planning capacity, leading to loss of credibility. Land use and transport planning are conducted as separate exercises, leading to new development without integrating transport and transport infrastructure to further town's long-term visions. Responsibility for land-use and transport planning is fragmented between different agencies and different tiers of Government. In the Master Plan for the future planning process residential use near the market area (core area) is converted to commercial use in 2011.

Though majority of the area under this is presently operating as commercial, there exists residential development and will continue to coexist. Hence it is appropriate to categorize this as mixed land use. Further this is a classic case of non-integration of land use and transportation. This area developed as an organic development over the years and need to be provided adequate transport infrastructure to make it operate in a proper way. There exists room for development of transport infrastructure in this area.



Map 3.2: Comparison of Existing Land Use 2021 with Old LPA Boundary

4 DEMOGRAPHY

4.1 Background of the Planning Area

Demographic data and analysis are crucial for informing policy decisions across numerous sectors, including healthcare and education, which significantly influence population growth and development. Demography involves examining a range of population characteristics, such as growth rates, age distribution, gender ratio, literacy levels, and workforce composition. Additionally, it considers population density and spatial distribution in various regions. By projecting population trends based on historical data, policymakers can anticipate future infrastructure needs. This comprehensive approach yields valuable insights into the social and economic requirements of a population, facilitating informed planning and development strategies.

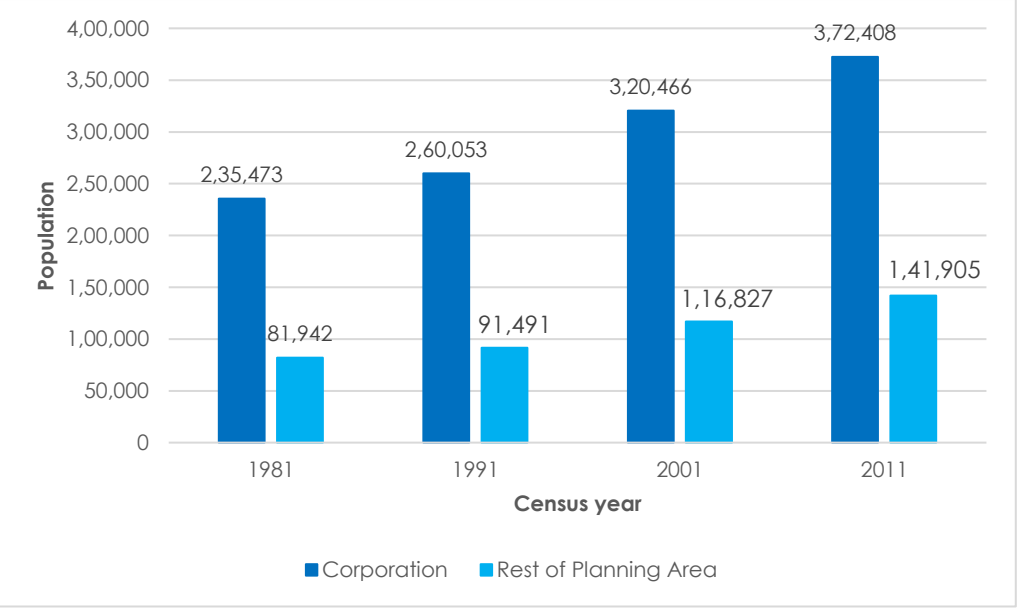


Figure 4.1: Population Growth Trend of the Planning Area

Source: Census of India (1981 – 2011)

The planning area encompasses a total population of 514,313 according to the 2011 Census. Within this, the corporation area constitutes 372,408

individuals, accounting for 72.4% of the overall planning area population. The remaining portion of the planning area is inhabited by 141,905 people, representing 27.59% of the total population within the planning area.

4.2 Growth Trend of Planning Area

4.2.1 Thoothukudi Town

Thoothukudi town witnessed its highest decadal growth rate, soaring by 43.27% between 1901 and 1911. Subsequently, the growth rate slowed to 10.79% in the following decade before surging again by 35.65%. However, over the next three decades, decadal growth rates gradually declined, reaching 24.23%.

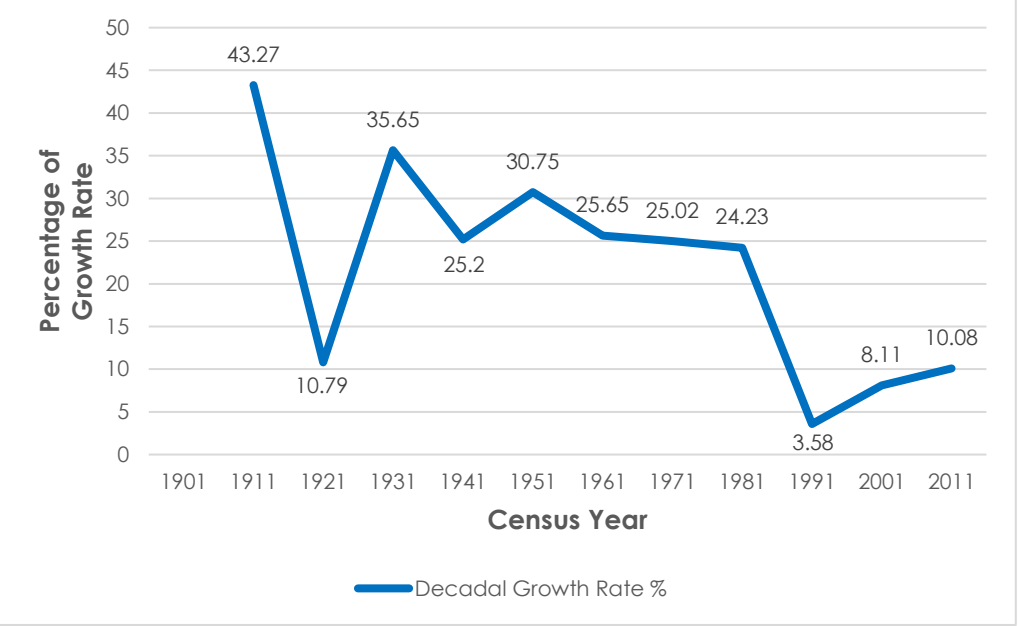


Figure 4.2: Population Growth Trend for Thoothukudi Town

Source: Census of India (1981 – 2011)

The trend took a sharp downturn in the 1991-2001 period, with growth plummeting to a mere 3.58%. Nevertheless, there was a resurgence in growth between 2001 and 2011, with a decadal growth rate of 10.08%, signifying a substantial increase compared to the previous decade. Despite fluctuations, Thoothukudi town's population has consistently trended upwards over the

years. Table 4.1 shows the growth trend of Thoothukudi town population from 1901 to 2011.

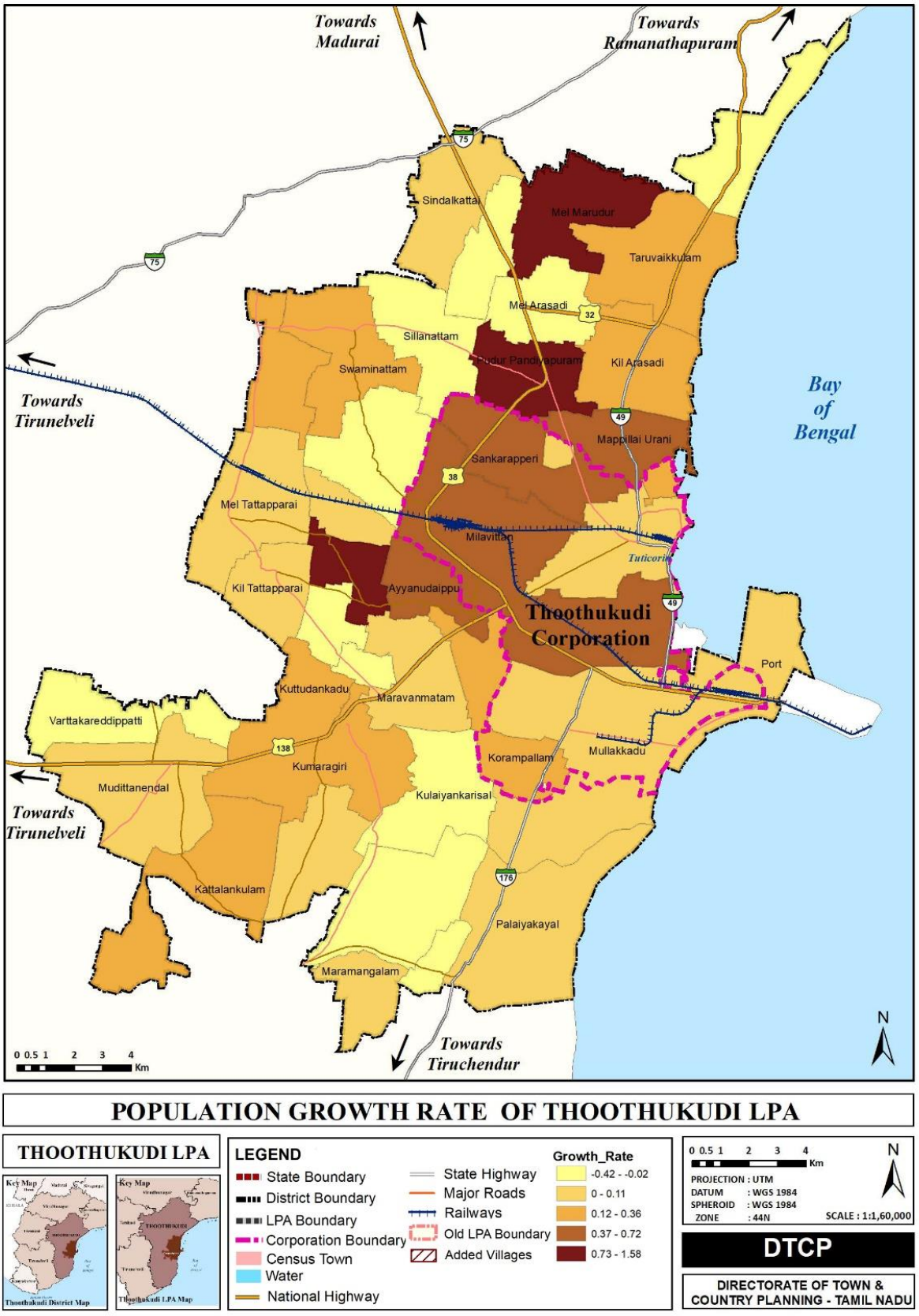
Table 4.1: Population Growth Trend in Thoothukudi Town

Census Year	Population	Change in Population	Decadal Growth Rate (%)
1901	28,048		
1911	40,185	12,137	43.27
1921	44,522	4,337	10.79
1931	60,395	15,873	35.65
1941	75,614	15,219	25.2
1951	98,866	23,252	30.75
1961	1,24,230	25,364	25.65
1971	1,55,310	31,080	25.02
1981	1,92,949	37,639	24.23
1991	1,99,854	6,905	3.58
2001	2,16,054	16,200	8.11
2011	2,37,830	21,776	10.08

Source: Census of India (1981 – 2011)

4.2.2 Rest of the Planning Area

The growth rate in 13 villages surpasses that of the corporation. Notably, villages like Muthusamypuram, Pudurpandiapuram, and Melamarudhur have experienced a population surge of over 100% in the last decade, primarily attributed to increased settlement of families in these areas. Factors contributing to this growth include proximity to the corporation, the availability of affordable residential spaces, and connectivity to other urban centers within the planning area. Conversely, 14 revenue villages exhibit a negative growth rate, likely stemming from limited employment opportunities in agriculture and soil infertility caused by salinity issues. Table 4.2 shows the growth trend of rest of the Planning Area from 1981 to 2011.



Map 4.1: Growth Rate of Thoothukudi LPA

Table 4.2:Population Growth Trend in Planning Area

S. No.	Taluk	Towns / Villages	Population				Decadal Growth Rate		
			1981	1991	2001	2011	1981 – 1991	1991 – 2001	2001 – 2011
1	Thoothukudi	Thoothukudi Municipal Corporation	1,92,949	1,99,854	2,16,054	2,37,830	3.58	8.11	10.08
2		Korampallam Part II	6,058	12,201	18,767	22,218	101.40	53.82	18.39
3		Meelavittan	5,099	10,679	30,758	45,863	109.43	188.02	49.11
4		Mullakadu Part-I	24,872	26,005	31,813	32,494	4.56	22.33	2.14
5		Pulipanchankulam	12	26	0	0	0	0	0
6		Sankaraperi	2,405	5,376	11,551	19,844	123.53	114.86	71.79
		Thoothukudi Part-II	4,078	5,912	11,523	14,159	456	22.33	2.14
SUB-TOTAL (A)			**2,35,473**	**2,60,053**	**3,20,466**	**3,72,408**	**10.44**	**23.23**	**16.2**
1	Thoothukudi	Kumaragiri (CT)	6,899	8,042	10,997	13,344	16.57	36.74	21.34
2		Mapillaiyurani (CT)	6,518	13,327	27,361	40,035	104.46	105.31	46.32
3		Ayyanadaippu	1,592	2,099	2,839	4,693	31.85	35.25	65.30
4		Kattalankulam	2,183	2,276	2,364	2,835	4.26	3.87	19.92
5	Thoothukudi	Keelathattaparai	1,359	1,396	1,248	1,382	2.72	-10.60	10.74
6		Koothudankadu	1,996	2,095	3,820	5,065	4.96	82.34	32.59
7		Korampallam Part-I	2,930	2,818	3,790	4,912	-3.82	34.49	29.60

S. No.	Taluk	Towns / Villages	Population				Decadal Growth Rate		
			1981	1991	2001	2011	1981 – 1991	1991 – 2001	2001 – 2011
8		Kulaiankarisal	4,292	4,313	4,077	3,951	0.49	-5.47	-3.09
9		Maravanmadam	1,995	2,222	2,625	2,664	11.38	18.14	1.49
10		Melathattaparai	2,292	2,025	2,007	2,154	-11.65	-0.89	7.32
11		Mudivaithanendal	5,296	5,039	5,578	5,927	-4.85	10.70	6.26
12		Mullakadu Part-II	1,917	2,271	2,346	2,191	18.47	3.30	-6.61
13		Muthusamypuram	686	331	422	886	-51.75	27.49	109.95
14		Senthilampannai	217	190	178	103	-12.44	-6.32	-42.13
15		Servaikaranmadam	4,276	4,159	4,490	4,473	-2.74	7.96	-0.38
16		Therku Sillukkanpatti	647	649	783	681	0.31	20.65	-13.03
17		Vadakku Sillukanpatti	628	543	461	473	-13.54	-15.10	2.60
18		Varthagareddipatti	1,769	1,760	2,159	1,990	-0.51	22.67	-7.83
19	Eral	Iruvappapuram Part-II	1,758	1,928	1,872	1,753	9.67	-2.90	-6.36
20		Manjalneerkayal	1,116	1,197	1,170	1,143	7.26	-2.26	-2.31
21		Maramangalam	3,470	3,886	3,882	3,819	11.99	-0.10	-1.62
22		Palayakayal	4,664	4,925	4,691	5,024	5.60	-4.75	7.10
23	Ottapidaram	Puthiamputhur (CT)	5,874	5,316	6,836	8,837	-9.50	28.59	29.27
24		Keela Arasadi	889	1,368	1,740	2,186	53.88	27.19	25.63

S. No.	Taluk	Towns / Villages	Population				Decadal Growth Rate		
			1981	1991	2001	2011	1981 – 1991	1991 – 2001	2001 – 2011
25		Mela Arasadi	2,993	3,097	3,029	1,841	3.47	-2.20	-39.22
26		Melamarudhur	541	447	390	1,005	-17.38	-12.75	157.69
27		Pattinamarudhur	790	838	842	805	6.08	0.48	-4.39
28		Pudurpandiapuram	1,362	1,045	743	1,764	-23.27	-28.90	137.42
29		Samynatham	1,815	1,929	1,905	2,598	6.28	-1.24	36.38
30		Sillanatham	1,510	1,515	1,669	1,594	0.33	10.17	-4.49
31		Sinthalakattai	1,977	2,021	2,206	2,430	2.23	9.15	10.15
32		Tharuvaikulam	3,902	4,587	6,178	7,325	17.56	34.68	18.57
33	**Ottapidaram**	Therkuveerapandiapuram	1,229	1,317	1,606	1,567	7.16	21.94	-2.43
34		Valasamutharam	560	520	523	455	-7.14	0.58	-13.00
SUB – TOTAL (B)			**81,942**	**91,491**	**1,16,827**	**1,41,905**	**11.65**	**27.69**	**21.47**
TOTAL (A+B)			**3,17,415**	**3,51,544**	**4,37,293**	**5,14,313**	**10.75**	**24.39**	**17.61**

Source - Census of India (1981 – 2011)

4.3 Population Density

Population density denotes the number of individuals residing in a specific area, usually measured in persons per square kilometre. The population density within the corporation area significantly surpasses that of the surrounding regions. Cities generally operate with greater efficiency and sustainability when residents are concentrated in densely populated urban areas.

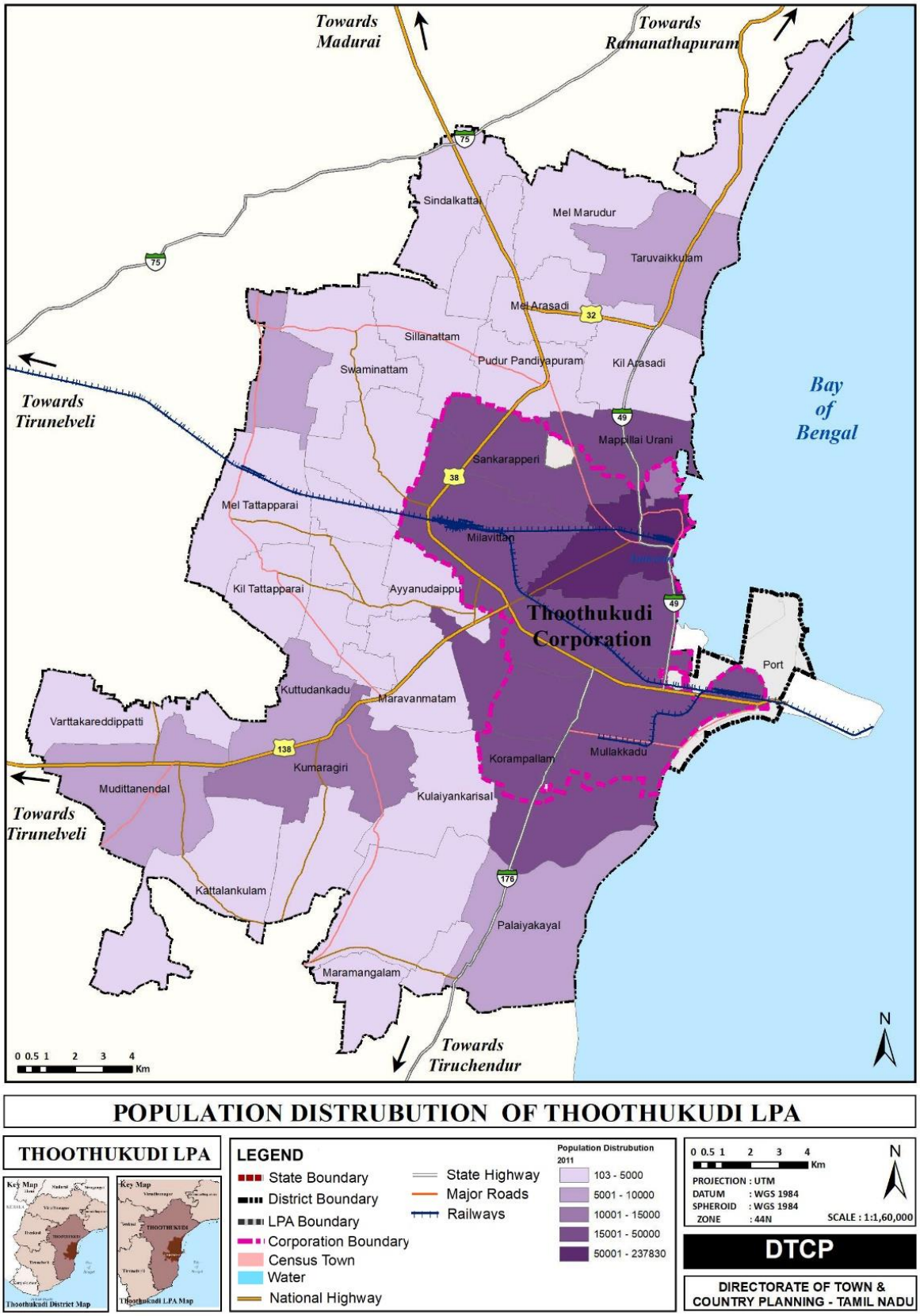
More specifically, the corporation area boasts a population density of 4,108 persons per square kilometre, whereas the density in the remaining Planning Area is 380 persons per square kilometre. Consequently, the overall population density for the planning area averages at 1,109 persons per square kilometre highlighted in Table 4.3.

Table 4.3: Population and Density for the Planning Area – 2011

Planning Area	Extent (in Sq.km)	Population (2011)	Density (persons / Sq.Km)
Corporation	90.66	3,72,408	4,108
Rest of the planning area	372.95	1,41,905	380
Total	**463.61**	**5,14,313**	**1,109**

Source - Census of India, 2011

Map 4.2 illustrates that the population distribution is highly concentrated in the Central Business District (CBD) area of the Thoothukudi Municipal Corporation. In comparison, population settlements sprawl along the transport corridor of Thoothukudi City. Within the rest of the Planning Area, the growth nodes are Kumaragiri and Tharuvaikulam, anticipated to be significant focal points for development over the next 20 years. Kumaragiri village panchayat is in close proximity to Thoothukudi Airport, while Tharuvaikulam Village panchayat is situated adjacent to the transport corridor and fishermen's hamlets.



Map 4.2:Population Distribution of Thoothukudi LPA

Table 4.4: Population and Density for Town and Village wise – 2011

S.No	Towns / Villages	Taluk	Extent in Sq.Km	Population 2011	Density (persons per Sq.Km)
1	Thoothukudi Municipal Town	Thoothukudi	90.66	2,37,830	17,656
2	Korampallam Part-II			22,218	3,831
3	Meelavittan			45,863	1,452
4	Mullakadu Part-I			32,494	1,260
5	Pulipanchankulam			0	0
6	Sankaraperi			19,844	1,693
7	Thoothukudi Rural			14,159	11,010
	SUB-TOTAL		**90.66**	**3,72,408**	**4,108**
1	Kumaragiri (CT)	Thoothukudi	16.23	13,344	673
2	Mapillaiyurani (CT)		8.73	40,035	3,142
3	Ayyanadaippu		6.74	4,693	422
4	Kattalankulam		19.08	2,835	125
5	Keelathattaparai		7.99	1,382	160
6	Koothudankadu		8.84	5,065	433
7	Korampallam Part-I		6.08	4,912	342
8	Kulaiankarisal		12.66	3,951	323
9	Maravanmadam		11.34	2,664	232
10	Melathattaparai		15.51	2,154	136
11	Mudivaithanendal		19.30	5,927	288
12	Mullakadu Part-II		12.39	2,191	190
13	Muthusamypuram		6.12	886	69
14	Senthilampannai		2.24	103	80
15	Servaikaranmadam		10.35	4,473	421
16	Therku Sillukkanpatti		4.41	681	178
17	Vadakku Sillukanpatti		4.69	473	99
18	Varthagareddipatti		11.32	1,990	191
19	Iruvappapuram Part-II	Eral	17.04	1,753	110
20	Manjalneerkayal		2.93	1,143	397
21	Maramangalam		6.49	3,819	615
22	Palayakayal		22.60	5,024	206
23	Puthiamputhur (CT)	Ottapidaram	8.70	8,837	785
24	Keela Arasadi		13.41	2,186	133
25	Mela Arasadi		8.87	1,841	342

S.No	Towns / Villages	Taluk	Extent in Sq.Km	Population 2011	Density (persons per Sq.Km)
26	Melamarudhur		13.24	1,005	30
27	Pattinamarudhur		10.92	805	79
28	Pudurpandiapuram		9.73	1,764	77
29	Samynatham		13.46	2,598	142
30	Sillanatham		11.56	1,594	145
31	Sinthalakattai		12.48	2,430	177
32	Tharuvaikulam		17.28	7,325	358
33	Therkuveerapandiapuram		12.88	1,567	125
34	Valasamutharam		7.34	455	72
	SUB-TOTAL (B)		**372.95**	**1,41,905**	**380.49**
	Total (A+B)		**463.61**	**5,14,313**	**1,109.36**

Source - Census of India, 2011

The population growth trend within the planning area exhibits a range from over 100% to negative growth trends. Notably, three villages—Muthusamypuram, Melamarudhur, and Pudurpandiapuram—demonstrate exponential growth exceeding 100%. The urbanization of Thoothukudi in the peripheral area contributes to the variability in the growth rate. Table 4.5 presents the classification of town and villages within the planning area based on population range, decadal growth rate, and density.

Table 4.5: Classification of Towns / Villages in the planning area

Population Size (2011)	No.	Decadal Growth Rate (2001 – 11)	No.	Density (person/Sq.km)	No.
More than 1,00,000	1	More than 100	3	More than 10,000	0
50,000 – 1,00,000	0	75-100	0	5,000-10,000	1
10,000 – 50,000	2	50-75	1	1,000-5,000	1
5,000 – 10,000	5	20-50	7	500-1,000	3
2,500 – 5,000	8	10-20	5	250-500	9
1,000 – 2,500	13	0-10	5	100-250	14
Less than 1,000	6	Negative	14	Less than 100	7

4.4 Child Age Population

The percentage of the child population in the range of 8 to 15% is observed. As per the 2011 census, the child population in India is reported at 10.89%, with 12.17% in the corporation and the rest of the Planning Area, respectively. This highlights a significant concern for education provision during the plan period. Additionally, as the horizon period concludes, this demographic will play a crucial role in job generation, contributing significantly to the economy. Table 4.6 provides details on the child population in 2011 for both the corporation and the rest of the Planning Area.

Table 4.6: Child Population for Planning Area - 2011

S.No	Towns / Villages	Taluk	Total Population	Child Population (0-6)			% of Child Population
				Total	Male	Female	
CORPORATION							
1	Thoothukudi Municipal Town	Thoothukudi	2,37,830	24,959	12,684	12,275	10.49
2	Korampallam Part-II		22,218	2,599	1,307	1,292	11.70
3	Meelavittan		45,863	5,273	2,691	2,582	11.50
4	Mullakadu Part-I		32,494	3,547	1,879	1,668	10.92
5	Pulipanchankulam		0	0	0	0	-
6	Sankaraperi		19,844	2,259	1,105	1,154	11.38
7	Thoothukudi Part-II		14,159	1,906	967	939	13.46
SUB-TOTAL (A)			**3,72,408**	**40,543**	**20,633**	**19,910**	**10.89**
REST OF THE PLANNING AREA							
1	Kumaragiri (CT)	Thoothukudi	13,344	1,595	795	800	11.95
2	Mapillaiyurani (CT)		40,035	5,337	2,670	2,667	13.33
3	Ayyanadaippu		4,693	634	332	302	13.51
4	Kattalankulam		2,835	306	157	149	10.79
5	Keelathattaparai		1,382	193	110	83	13.97
6	Koothudankadu		5,065	601	305	296	11.87
7	Korampallam Part-I		4,912	621	318	303	12.64
8	Kulaiankarisal		3,951	345	175	170	8.73

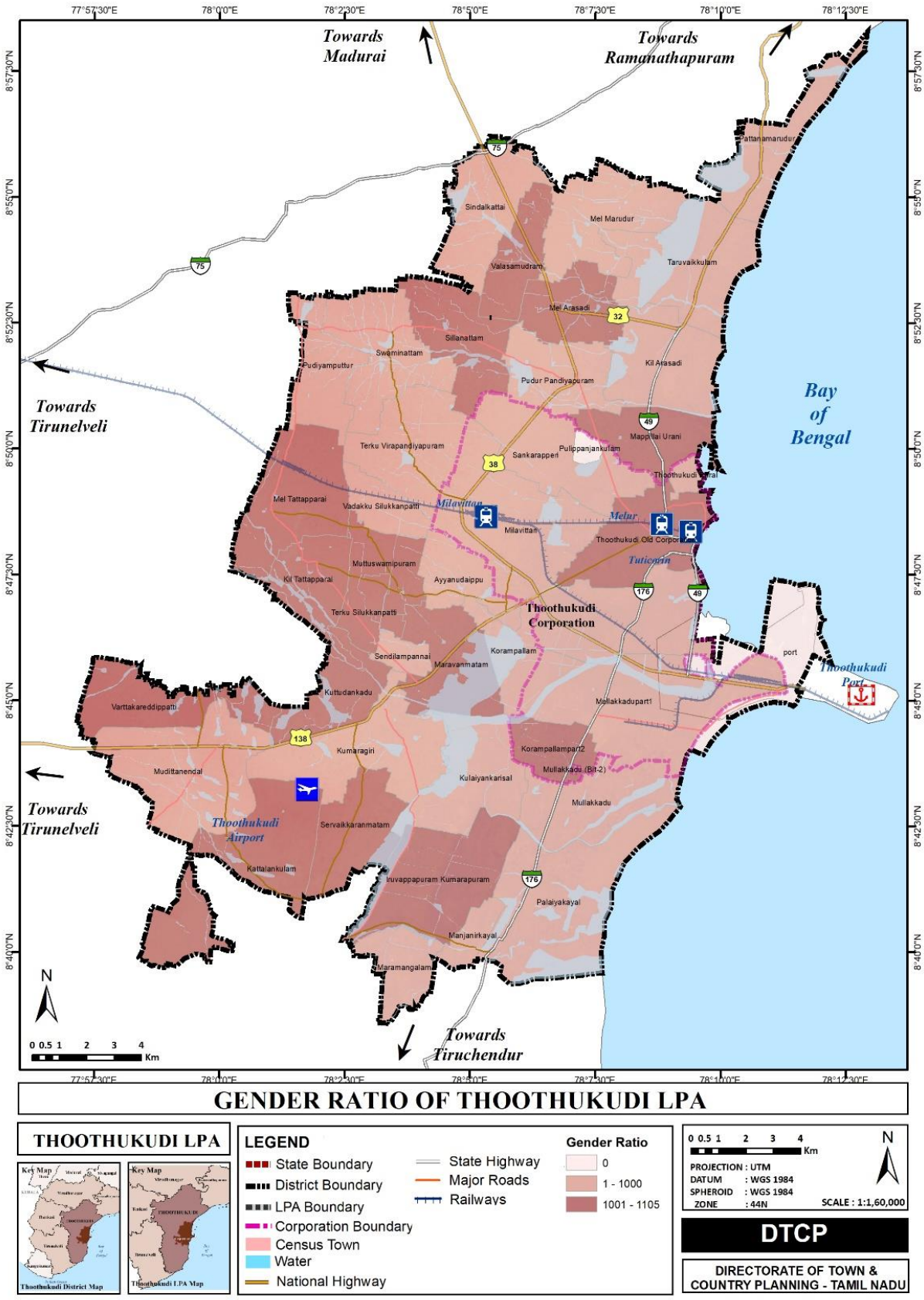
9	Maravanmadam		2,664	340	170	170	12.76
10	Melathattaparai		2,154	263	128	135	12.21
11	Mudivaithanendal		5,927	595	321	274	10.04
12	Mullakadu Part-II		2,191	226	119	107	10.31
13	Muthusamypuram		886	103	51	52	11.63
14	Senthilampannai		103	9	7	2	8.74
15	Servaikaranmadam		4,473	437	218	219	9.77
16	Therku Sillukkanpatti		681	88	41	47	12.92
17	Vadakku Sillukanpatti		473	71	40	31	15.01
18	Varthagareddipatti		1,990	197	101	96	9.90
19	Iruvappapuram Part-II	Eral	1,753	180	92	88	10.27
20	Manjalneerkayal		1,143	107	50	57	9.36
21	Maramangalam		3,819	412	221	191	10.79
22	Palayakayal		5,024	560	279	281	11.15
23	Puthiamputhur (CT)	Ottapidaram	8,837	1,068	565	503	12.09
24	Keela Arasadi		2,186	297	148	149	13.59
25	Mela Arasadi		1,841	218	110	108	11.84
26	Melamarudhur		1,005	110	59	51	10.95
27	Pattinamarudhur		805	102	53	49	12.67
28	Pudurpandiapuram		1,764	218	109	109	12.36
29	Samynatham		2,598	323	176	147	12.43

30	Sillanatham		1,594	161	77	84	10.10
31	Sinthalakattai		2,430	272	133	139	11.19
32	Tharuvaikulam		7,325	1,056	556	500	14.42
33	Therkuveerapandiapuram		1,567	182	87	95	11.61
34	Valasamutharam		455	44	20	24	9.67
	SUB-TOTAL (B)		**1,41,905**	**17,271**	**8,793**	**8,478**	**12.17**

Source - Census of India, 2011

4.5 Gender Ratio

The gender ratio, representing the number of females for every 1000 males, in the corporation is 997, closely aligning with the state ratio of 996. However, the district exhibits a higher trend with a gender ratio of 1105. Notably, Map 4.3 shows the gender ratio in 16 villages is below 1000, and in 5 villages within the Planning Area, it drops even lower, falling below 950. The reduced gender ratio in certain areas may be attributed to the out-migration of the male population in pursuit of employment opportunities. Table 4.7: provides details on the male and female population, along with the gender ratio for the year 2011 within the Planning Area, which records a gender ratio of 997.



Map 4.3: Gender Ratio of Thoothukudi LPA

Table 4.7: Gender Ratio for Planning Area - 2011

S.No,	Towns / Villages	Taluk	Population 2011			Gender Ratio
			Total	Male	Female	
CORPORATION						
1	Thoothukudi Town	Thoothukudi	2,37,830	1,18,298	1,19,532	1,010
2	Korampallam Part- II		22,218	11,081	11,137	1,005
3	Meelavittan		45,863	23,167	22,696	980
4	Mullakadu Part-I		32,494	16,823	15,671	932
5	Pulipanchankulam		0	0	0	0
6	Sankaraperi		19,844	10,001	9,843	984
7	Thoothukudi Part- II		14,159	7,145	7,014	982
		SUB-TOTAL (A)	**3,72,408**	**1,86,515**	**1,85,893**	**997**
REST OF THE PLANNING AREA						
1	Kumaragiri (CT)		13,344	6,735	6,609	981
2	Mapillaiyurani (CT)		40,035	19,853	20,182	1,017
3	Ayyanadaippu		4,693	2,380	2,313	972
4	Kattalankulam		2,835	1,403	1,432	1,021
5	Keelathattaparai		1,382	688	694	1,009
6	Koothudankadu		5,065	2,528	2,537	1,004

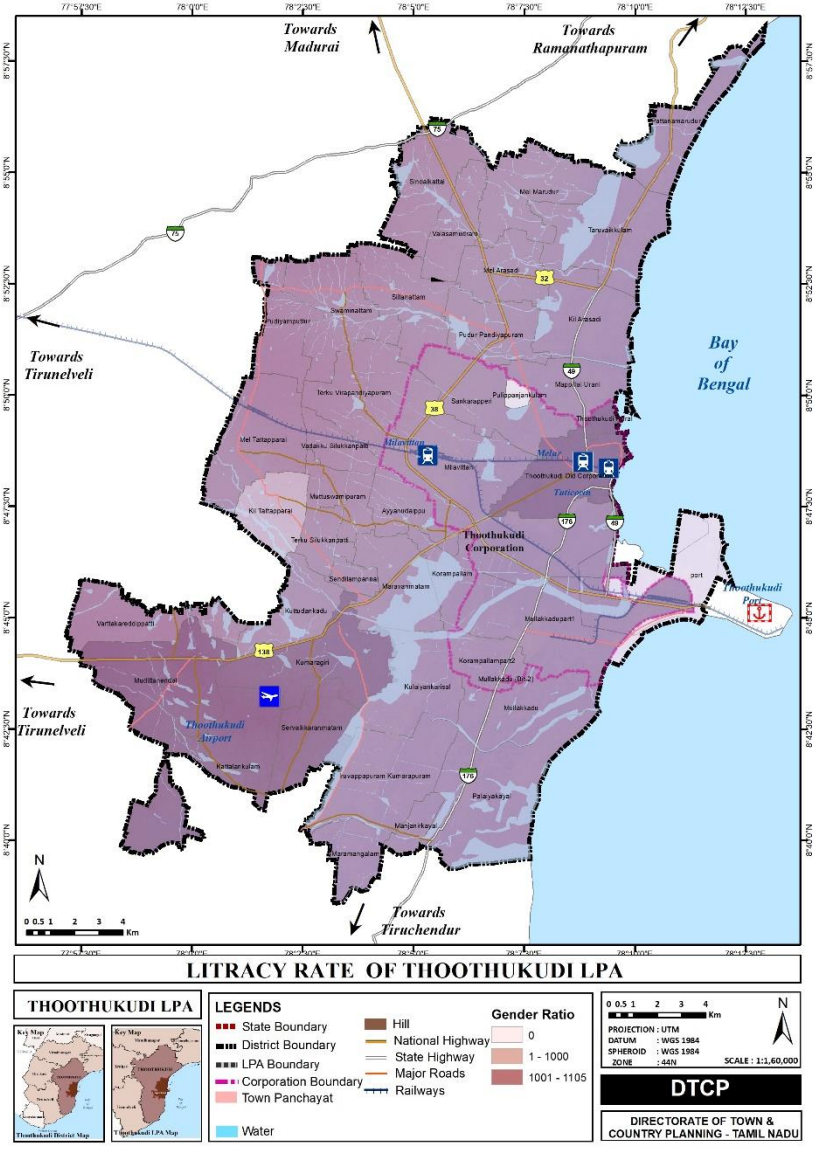
S.No,	Towns / Villages	Taluk	Population 2011			Gender Ratio
			Total	Male	Female	
7	Korampallam Part- I	Thoothukudi	4,912	2,486	2,426	976
8	Kulaiankarisal		3,951	1,984	1,967	991
9	Maravanmadam		2,664	1,312	1,352	1,030
10	Melathattaparai		2,154	1,066	1,088	1,021
11	Mudivaithanendal		5,927	2,968	2,959	997
12	Mullakadu Part-II		2,191	1,086	1,105	1,017
13	Muthusamypuram		886	421	465	1,105
14	Senthilampannai		103	53	50	943
15	Servaikaranmadam		4,473	2,221	2,252	1,014
16	Therku Sillukkanpatti		681	327	354	1,083
17	Vadakku Sillukanpatti		473	247	226	915
18	Varthagareddipatti		1,990	967	1,023	1,058
19	Iruvappapuram	Eral	1,753	863	890	1,031
20	Manjalneerkayal		1,143	575	568	988
21	Maramangalam		3,819	1,914	1,905	995
22	Palayakayal		5,024	2,519	2,505	994
23	Puthiamputhur		8,837	4,536	4,301	948

S.No,	Towns / Villages	Taluk	Population 2011			Gender Ratio
			Total	Male	Female	
24	Keela Arasadi	Ottapidaram	2,186	1,095	1,091	996
25	Mela Arasadi		1,841	908	933	1,028
26	Melamarudhur		1,005	505	500	990
27	Pattinamarudhur		805	406	399	983
28	Pudurpandiapuram		1,764	900	864	960
29	Samynatham		2,598	1,349	1,249	926
30	Sillanatham		1,594	795	799	1,005
31	Sinthalakattai		2,430	1,215	1,215	1,000
32	Tharuvaikulam		7,325	3,758	3,567	949
33	Therkuveerapandia puram		1,567	785	782	996
34	Valasamutharam		455	225	230	1,022
		SUB-TOTAL (B)	**1,41,905**	**71,073**	**70,832**	**997**
		Grand Total (A+B)	**5,14,313**	**2,57,588**	**2,56,725**	**997**

Source - Census of India, 2011

4.6 Literacy Rate

The literacy rate of the corporation matches that of the district, standing at 91.68%, surpassing the national average of 72.99%. Meanwhile, the literacy rate of the planning area is recorded at 87.01%. The effective literacy rate for the entire planning area averages at 90.40%. Table 4.8: provides detailed information on the literacy rate within the planning area.



Map 4.4: Literacy Rate of Thoothukudi LPA

Table 4.8: Literacy Rate for Planning Area - 2011

S.No	Towns / Villages	Taluk	Literates Population			Literacy Rate		
			Total	Male	Female	Total	Male	Female
CORPORATION								
1	Thoothukudi Municipal Town	Thoothukudi	1,99,432	1,01,161	98,271	93.69	95.78	91.62
2	Korampallam Part-II		16,943	8,870	8,073	86.36	90.75	82.00
3	Meelavittan		36,165	19,031	17,134	89.10	92.94	85.18
4	Mullakadu Part-I		25,210	13,760	11,450	87.09	92.08	81.77
5	Pulipanchankulam		-	-	-	-	-	-
6	Sankaraperi		16,194	8,504	7,690	84.09	86.71	81.42
7	Thoothukudi Part-II		10,303	5,357	4,946	92.09	95.59	88.50
	TOTAL (A)		3,04,247	1,56,683	1,47,564	91.68	94.45	88.90
REST OF THE PLANNING AREA								
1	Kumaragiri (CT)		10,815	5,643	5,172	92.05	95.00	89.03
2	Mapillaiyurani (CT)		30,441	15,701	14,740	87.73	91.38	84.16
3	Ayyanadaippu		3,416	1,820	1,596	84.16	88.87	79.36
4	Kattalankulam		2,353	1,192	1,161	93.04	95.67	90.49
5	Keelathattaparai		744	424	320	62.57	73.36	52.37
6	Koothudankadu		3,930	2,088	1,842	87.93	91.24	84.55

S.No	Towns / Villages	Taluk	Literates Population			Literacy Rate		
			Total	Male	Female	Total	Male	Female
7	Korampallam Part-I	Thoothukudi	3,773	1,978	1,795	92.07	94.58	89.54
8	Kulaiankarisal		3,320	1,711	1,609	88.04	93.93	82.20
9	Maravanmadam		1,985	1,021	964	85.41	89.40	81.56
10	Melathattaparai		1,595	858	737	84.35	91.47	77.33
11	Mudivaithanendal		5,070	2,585	2,485	95.09	97.66	92.55
12	Mullakadu Part-II		1,733	907	826	88.19	93.80	82.77
13	Muthusamypuram		615	325	290	78.54	87.84	70.22
14	Senthilampannai		81	45	36	86.17	97.83	75.00
15	Servaikaranmadam		3,763	1,909	1,854	93.24	95.31	91.20
16	Therku Sillukkanpatti		489	252	237	82.46	88.11	77.20
17	Vadakku Sillukanpatti		341	196	145	84.83	94.69	74.36
18	Varthagareddipatti		1,575	842	733	87.84	97.23	79.07
19	Iruvappapuram Part- II	Eral	1,345	691	654	85.51	89.62	81.55
20	Manjalneerkayal		908	479	429	87.64	91.24	83.95
21	Maramangalam		2,890	1,550	1,340	84.83	91.55	78.18
22	Palayakayal		3,910	2,061	1,849	87.59	92.01	83.14
23	Puthiamputhur (CT)		6,764	3,631	3,133	87.06	91.44	82.49
24	Keela Arasadi		1,648	846	802	87.24	89.33	85.14

S.No	Towns / Villages	Taluk	Literates Population			Literacy Rate		
			Total	Male	Female	Total	Male	Female
25	Mela Arasadi	Ottapidaram	1,289	678	611	79.42	84.96	74.06
26	Melamarudhur		676	380	296	75.53	85.20	65.92
27	Pattinamarudhur		510	295	215	72.55	83.57	61.43
28	Pudurpandiapuram		1,168	659	509	75.55	83.31	67.42
29	Samynatham		1,901	1,072	829	82.34	90.39	74.27
30	Sillanatham	Ottapidaram	1,180	649	531	81.88	89.46	74.26
31	Sinthalakattai		1,767	968	799	83.56	91.39	75.23
32	Tharuvaikulam		4,955	2,619	2,336	79.04	81.79	76.17
33	Therkuveerapandiapuram		1,176	648	528			
34	Valasamutharam		317	179	138	77.13	87.32	66.99
		SUB-TOTAL (B)	1,08,443	56,902	51,541	87.01	91.36	82.66
		TOTAL (A + B)	4,12,690	2,13,585	1,99,105	90.40	93.61	87.20

Source - Census of India, 2011

4.7 Workforce Distribution

The workforce percentage in the planning area stands at 37.18%, which is close to the national average of 39.79%. However, Tamil Nadu's workforce percentage is notably higher at 45.6%. This difference could be attributed to an increase in the dependent population and the migration of earning members for employment opportunities outside the area.

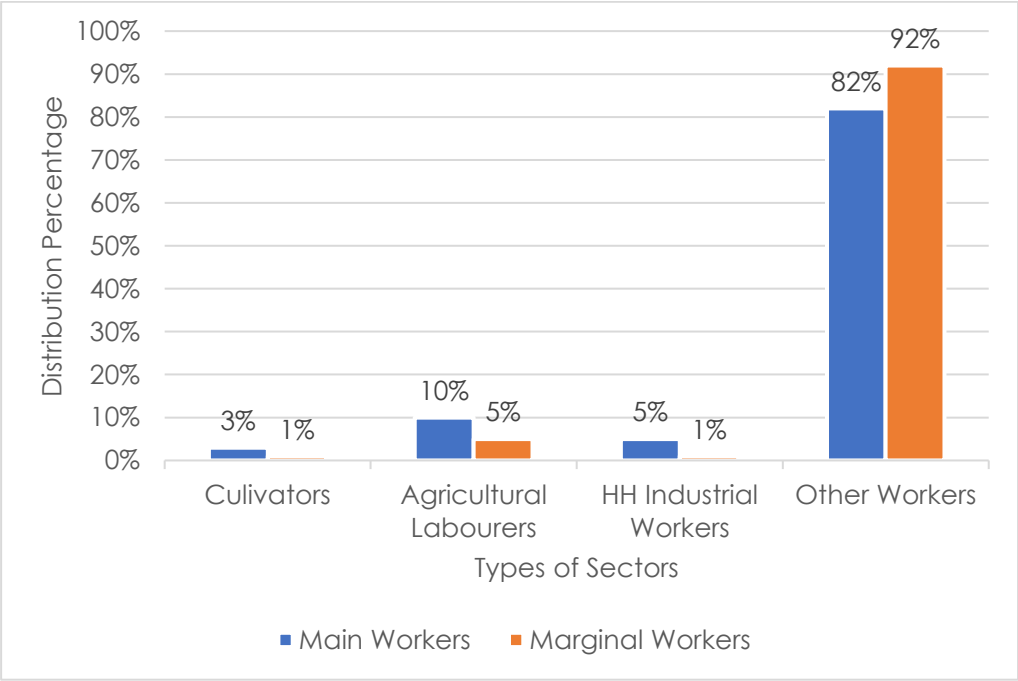


Figure 4.3: Distribution of Main and Marginal Workers

Source: Census of India, 2011

The data regarding the rate of out-migration of the workforce to other countries remains ambiguous. However, stochastic interviews conducted in the planning area suggest that the number of men working in foreign countries is higher. Additionally, the workforce participation rate shows slight variations between the corporation and the rest of the planning area.

The number of main cultivators decreased from 565 to 512 during 2001-11, while marginal cultivators witnessed a drastic decline from 4619 to 2496. Although main agricultural labourers decreased during this period, marginal agricultural labourers experienced a slight increase. These declines in agricultural activities and the increase in marginal workers may be attributed to seasonal workers engaged in specific agricultural activities. Notably, there

was an exponential increase in the "other workers" category, indicating the growth of industries in the planning area. Table 4.9: provides a classification of workers as main and marginal workers in the planning area during 2001-11.

Table 4.9: Distribution of Main and Marginal Workers (2001 & 2011)

Types of Sectors	Year	Urban	Rural	Total	Urban	Rural	Total
Cultivators	2001	228	337	565	884	3,735	4,619
	2011	120	392	512	332	2,160	2,492
Agricultural	2001	251	2,721	2,972	925	6,226	7,151
	2011	215	1,472	1,687	1,155	6,945	8,100
HH Industrial	2001	489	423	912	2,437	1,935	4,372
	2011	448	333	781	2,121	937	3,058
Other	2001	5,396	2,543	7,939	99,377	28,537	1,27,914
	2011	8,386	5,128	13,514	1,21,841	39,244	1,61,085

Source: Census of India, 2001 & 2011

4.8 Workforce Participation Rate

The proportion of total workers as percentage of total population both in rural and urban areas, termed as "workforce participation Rate" (WFPR). The planning area has a good WFPR at 37.18%. It is also observed that the Workforce Participation Rate. Figure 4.3 indicates the share of Workers and Non-Workers has increased in the past decade. This increase is mainly due to the increase in the corporation area (from 34.32% to 36.15%), as there is only a marginal increase in rest of the planning area (from 39.77% to 39.89%). The main reason for this increase in the corporation may be attributed to the decreased agricultural activities as discussed above.

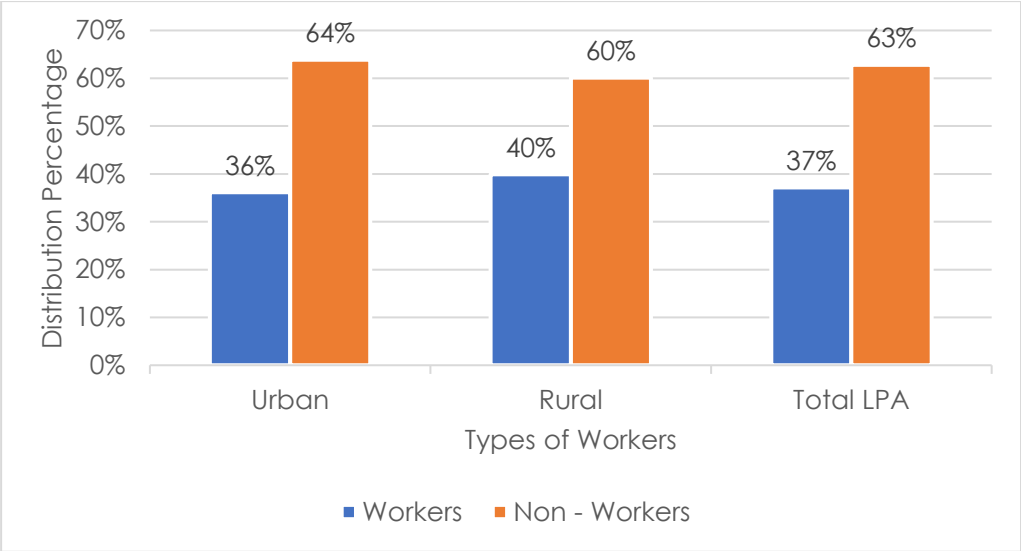


Figure 4.4: Distribution of Workers and Non-Workers - 2011

Source: Census of India, 2011

Table 4.10: Distribution of Workers and Non Workers – 2011

Area	Total Population		Total Workers		WFPR	
	2001	2011	2001	2011	2001	2011
Urban	3,20,466	3,72,408	1,09,987	1,34,618	34.32	36.15
Rural	1,16,827	1,41,905	46,457	56,611	39.77	39.89
Total	**4,37,293**	**5,14,313**	**1,56,444**	**1,91,229**	**35.83**	**37.18**

Source: Census of India, 2001 & 2011

4.9 Work Force Projection

The proportion of total workers as a percentage of the total population in both rural and urban areas is termed the "Workforce Participation Rate" (WFPR). In the planning area, a commendable WFPR of 37.18% is observed. Table 4.11 illustrates that the Workforce Participation Rate has seen an increase, with the share of both Workers and Non-Workers rising in the past decade. This surge is primarily driven by an increase in the corporation area, from 34.32% to 36.15%, while there is only a marginal increase in the rest of the planning area, from 39.77% to 39.89%. The principal reason for this increase in the corporation area may be attributed to the decreased agricultural activities discussed earlier.

Table 4.11: Workforce Projection for Planning Area

	Assumed Workforce %	2021	2031	2041
Urban	35	1,46,319	1,62,295	1,78,271
Rural	40	64,758	72,753	80,748
Total		**2,11,077**	**2,35,048**	**2,59,019**

4.10 Summary of Population Indicators

The demographic indicator of the planning area is compared with that of Tamil Nadu in Table 4.12.

Table 4.12: Demographic Indicators for Planning Area

Description	Planning Area	Thoothukudi District	Tamil Nadu
Decadal Population Growth Rate (2001- 2011) (%)	17.61	9.88	13.96
Gender Ratio	997	1023	1006
Literacy Rate (%)	90.40	86.16	78.69
Male Literacy Rate (%)	93.61	91.14	87.17
Female Literacy Rate (%)	87.20	81.33	75.25
Workforce Participation (%)	37.18	45.58	42.74

4.11 Key Findings

The level of education in the corporation surpasses that of the rest of the planning area. The Corporation is actively working towards achieving cent percent literacy by establishing more schools and professional colleges in rural areas. The increasing percentage over the years indicates that awareness-building initiatives will play a crucial role in enhancing the female literacy rate.

4.12 Population Projection - 2041

Population projection serves as a fundamental assumption for long-term planning, and the chosen projection method significantly influences the

overall planning approach by determining the magnitude of required resources. The decision to select a population projection process is a collaborative one. Planning policies delineate the role of local authorities, offering the flexibility to amend plan elements based on new population figures. This approach allows for the development of alternatives in case of major issues, such as the feasibility of providing urban services, providing a dynamic and responsive planning framework.

Table 4.13: Methods of Population projection for Planning Area

Year	Arithmetic Progression Method		Geometric increase Method		Incremental Increase Method	
	Corporation	Rest of LPA	Corporation	Rest of LPA	Corporation	Rest of LPA
2021	4,18,053	1,61,893	7,62,837	2,89,932	4,31,734	1,69,657
2031	4,63,698	1,81,880	11,53,267	4,37,959	5,04,741	2,05,174
2041	5,09,343	2,01,868	15,43,696	5,85,987	5,91,429	2,48,455

The methodology employed for projecting the population growth of the planning area is based on the growth trends observed over the past four decades. Census data from 1981 to 2011 was utilized to project the population for the year 2011. Both numerical and graphical methods were used, and the projected values were compared with the actual census population to identify the method resulting in the minimum variation. For projecting future populations from 2021 to 2041, the method resulting in less than 10 percent variation was adopted. Average decadal growth rates were estimated, and the projection of future population was conducted considering pertinent factors, potential impacts, related aspects, and applicable methods.

The projection of future population using the **"Arithmetic Progression Method"** was found to be optimal for preparing this Master Plan. This projected population will be used to evaluate the demand versus the supply

gap in urban infrastructure provision for the horizon period. The recommended projected population is provided in Table 4.14

Table 4.14: Population projection for Planning Area

Planning Area	Population 2011	Projected Population		
		2021	2031	2041
Corporation	3,72,408	4,18,058	4,63,698	5,09,343
Rest of the Planning Area	1,41,905	1,61,893	1,81,880	2,01,868
Total	**5,14,313**	**5,79,946**	**6,45,578**	**7,11,211**

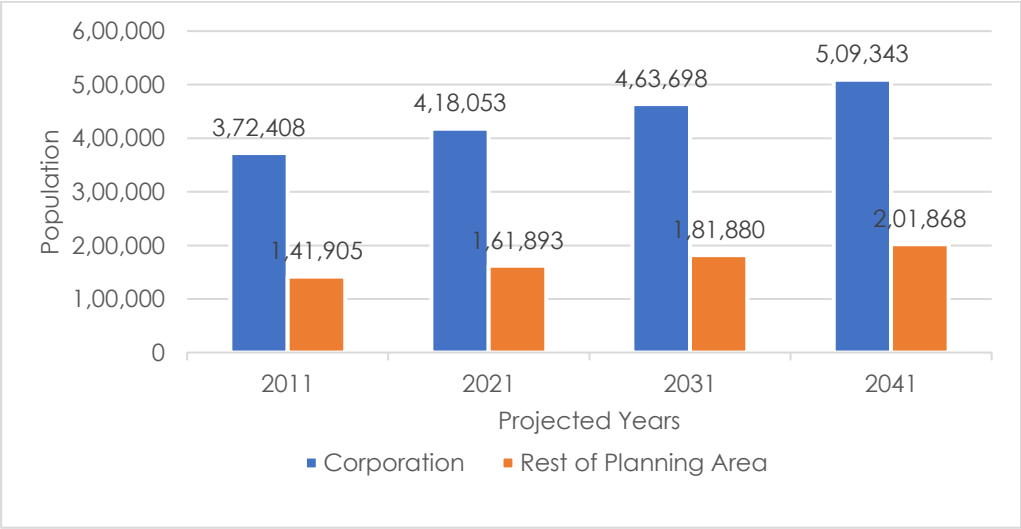
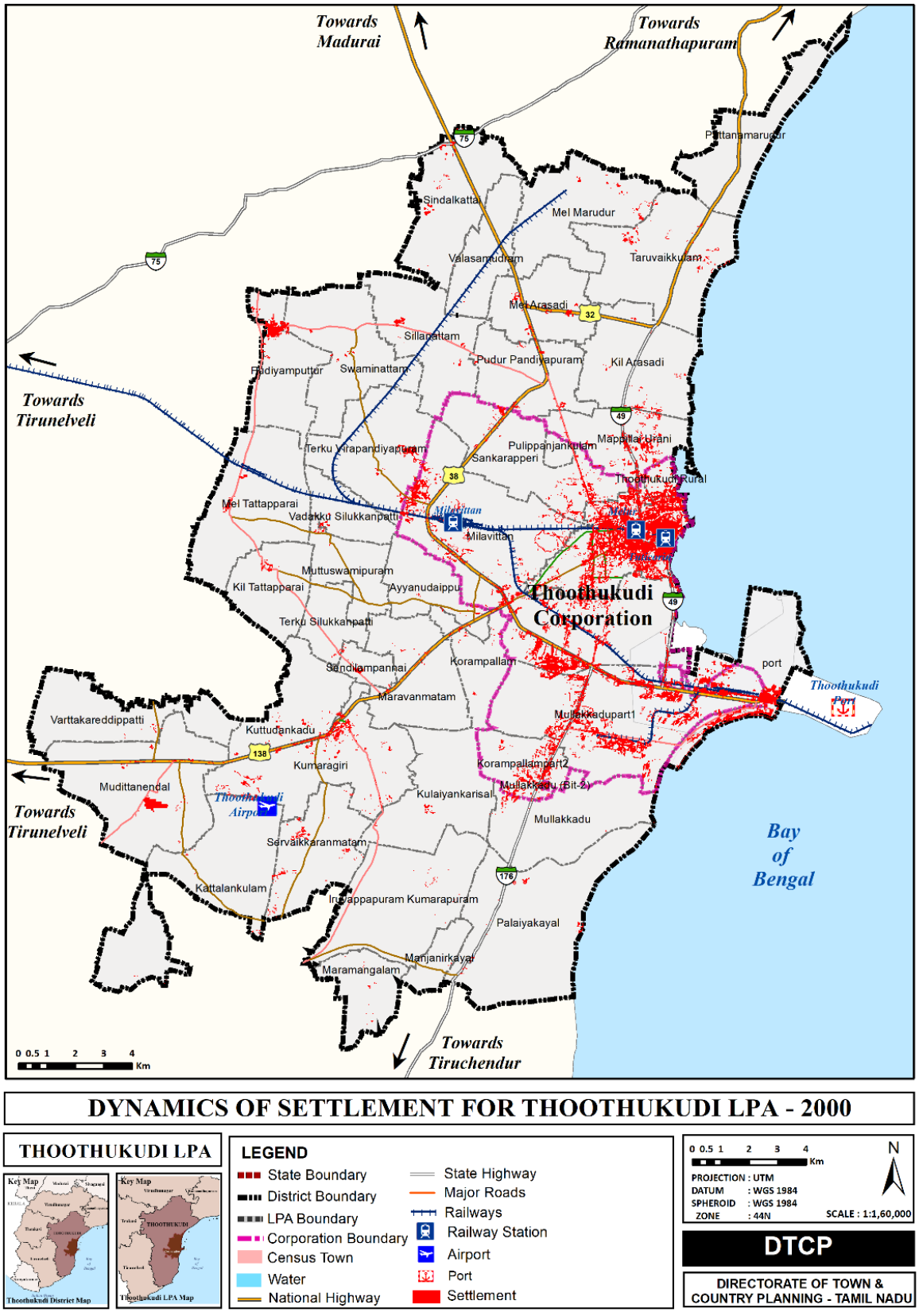
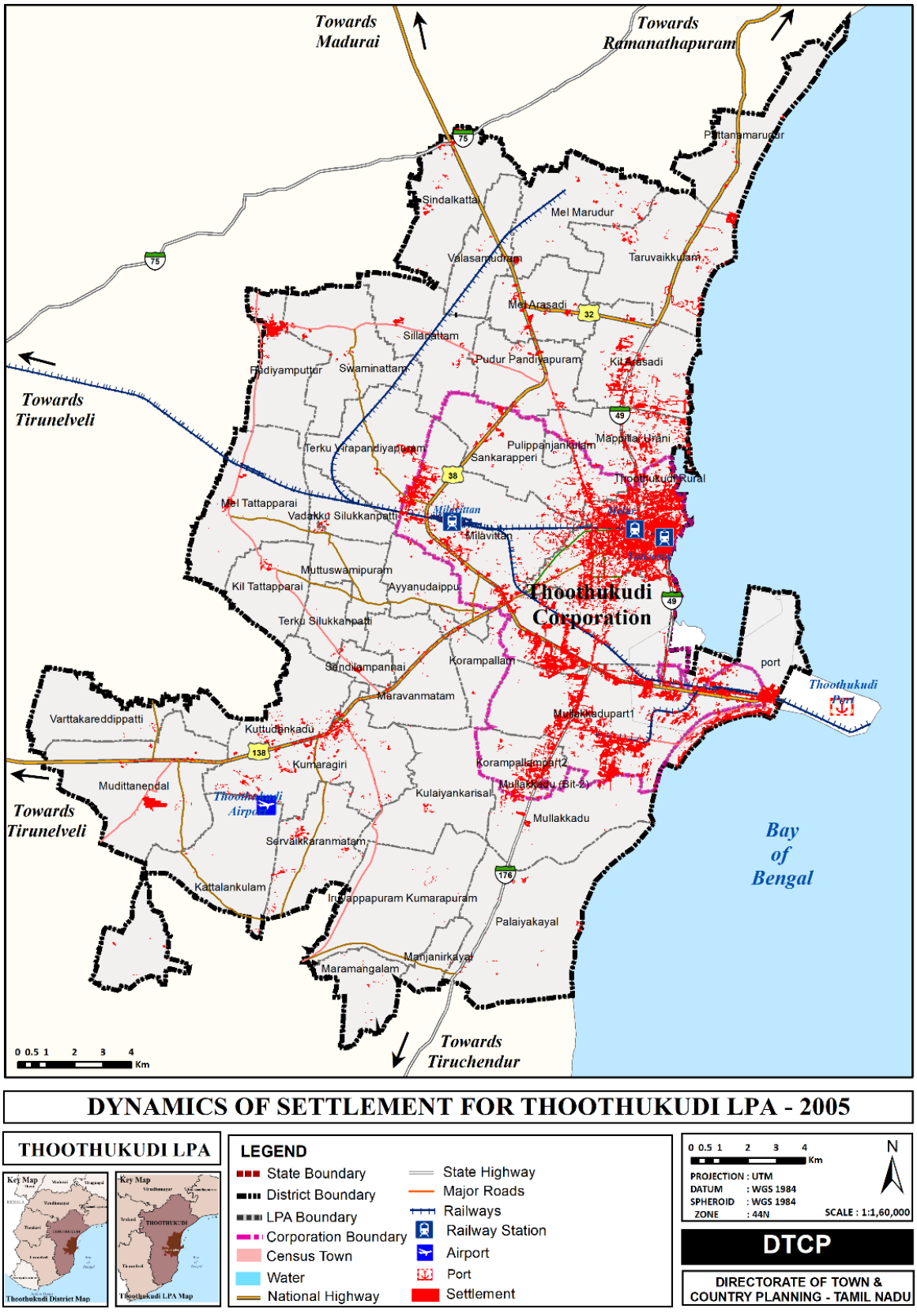


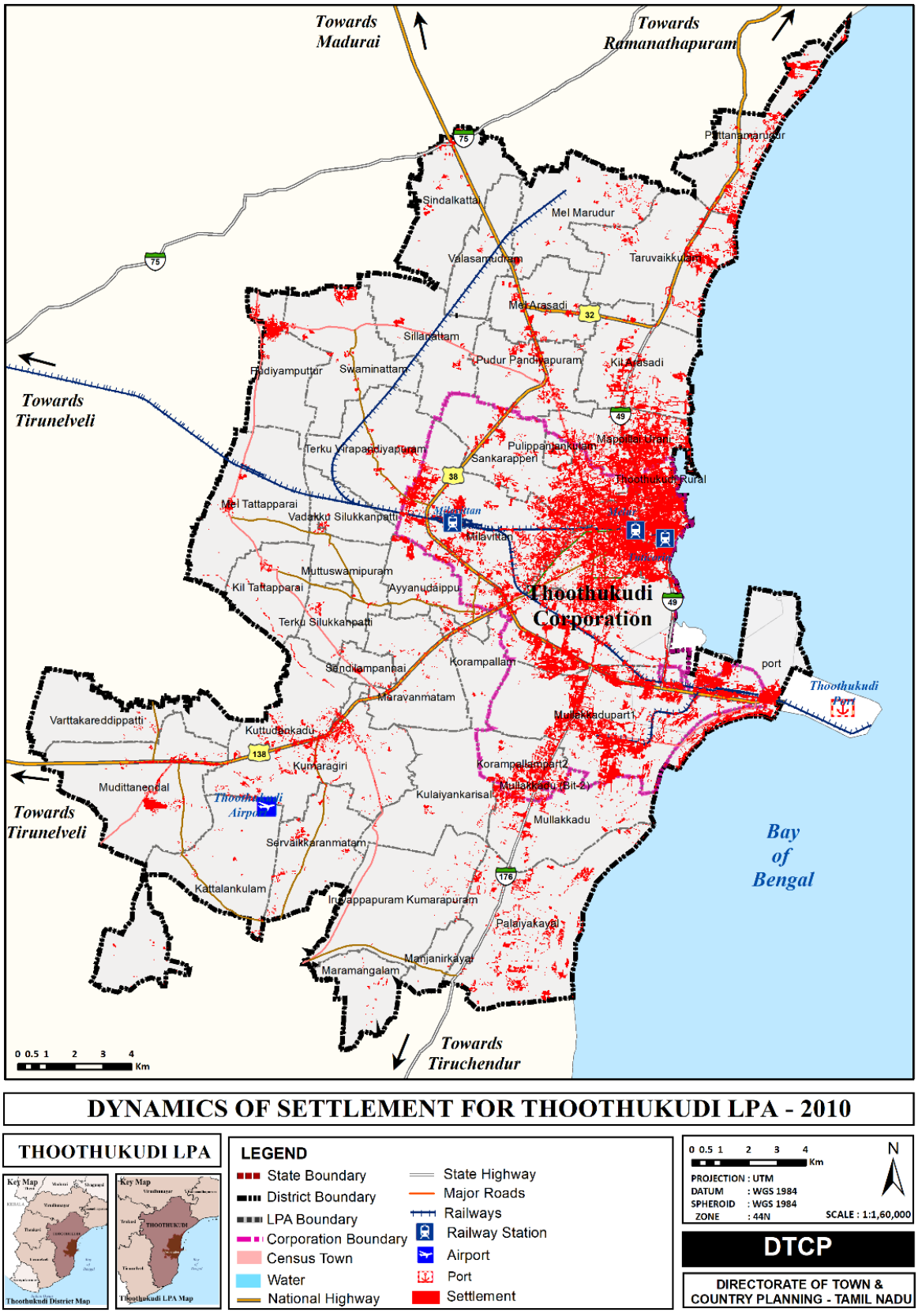
Figure 4.5: Population Projection – Arithmetic Progression Method



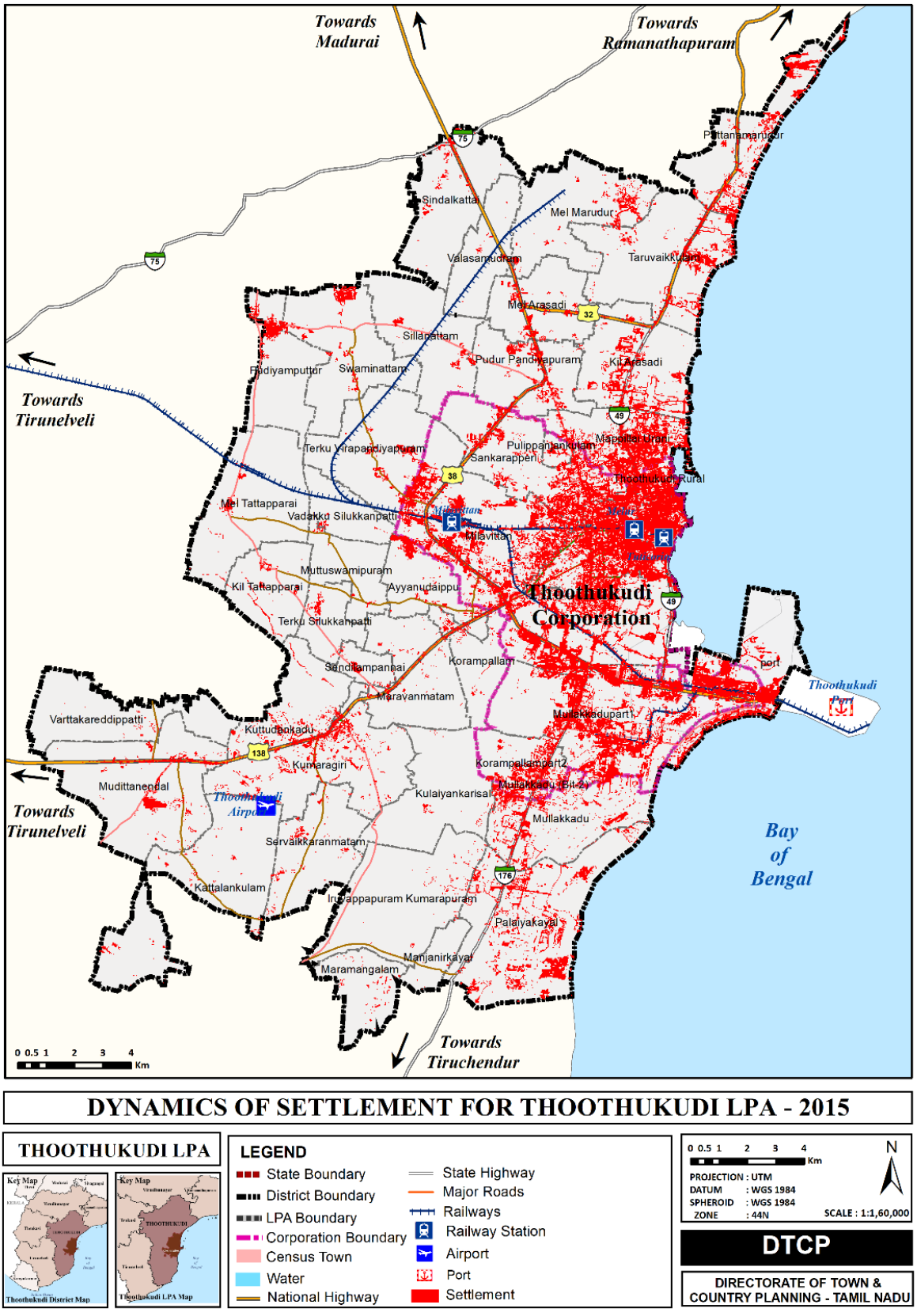
Map 4.5: Settlement Pattern of Thoothukudi LPA 2000



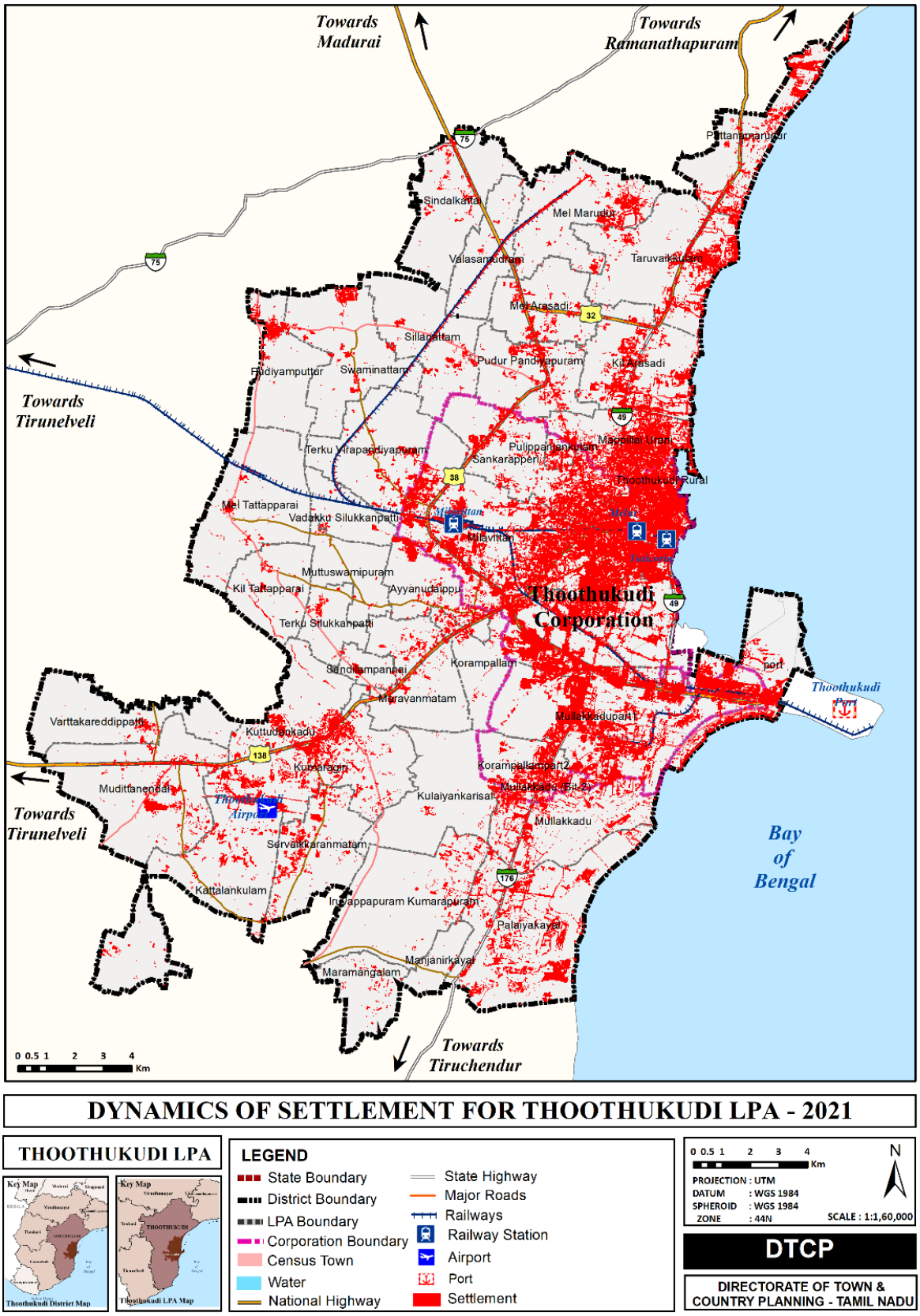
Map 4.6: Settlement Pattern of Thoothukudi LPA 2005



Map 4.7: Settlement Pattern of Thoothukudi LPA 2010



Map 4.8: Settlement Pattern of Thoothukudi LPA 2015



DYNAMICS OF SETTLEMENT FOR THOOTHUKUDI LPA - 2021

THOOTHUKUDI LPA

LEGEND

- State Boundary
- District Boundary
- LPA Boundary
- Corporation Boundary
- Census Town
- Water
- National Highway
- State Highway
- Major Roads
- Railways
- Railway Station
- Airport
- Port
- Settlement

0 0.5 1 2 3 4 Km

N

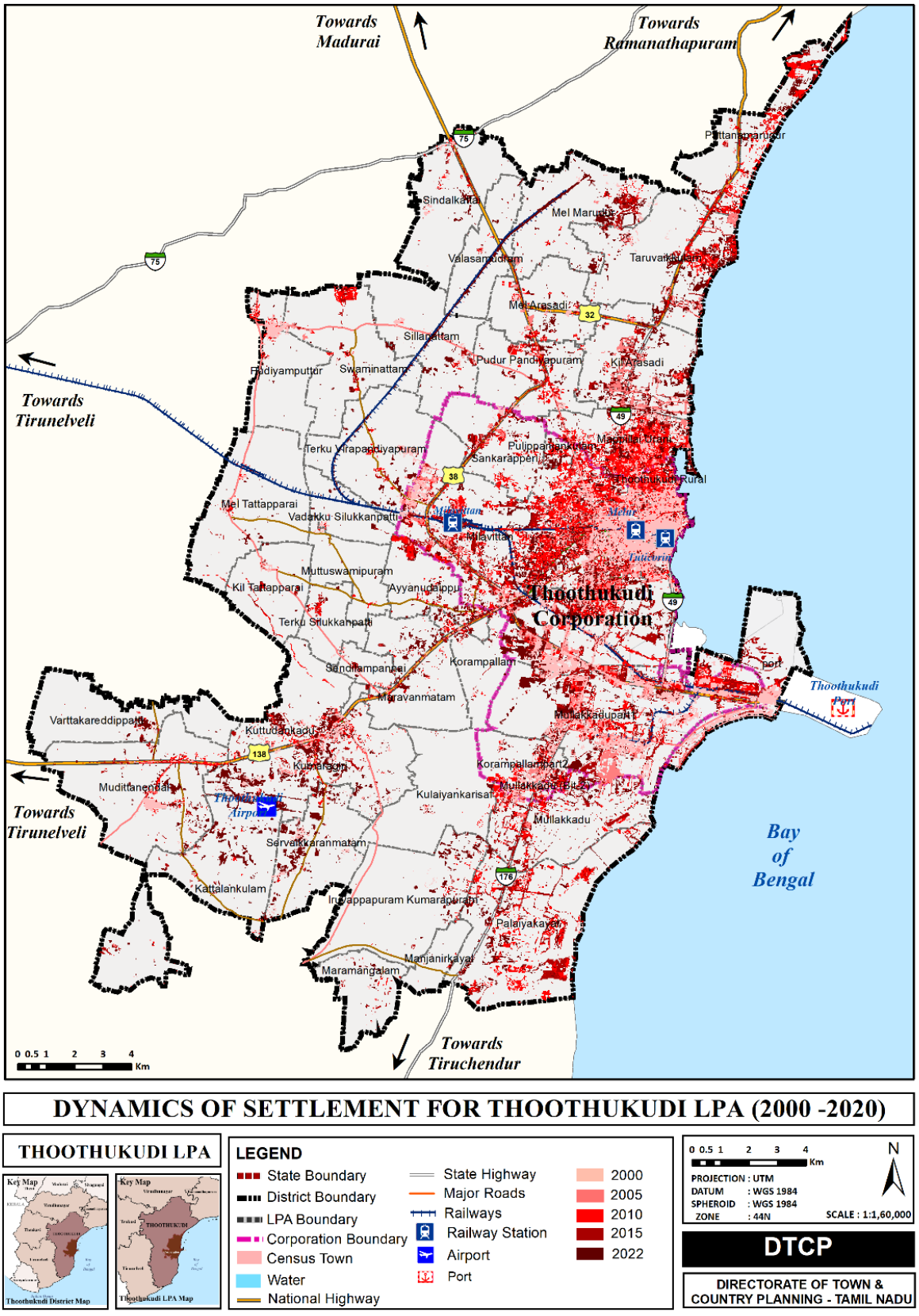
PROJECTION : UTM
DATUM : WGS 1984
SPHEROID : WGS 1984
ZONE : 44N

SCALE : 1:1,60,000

DTCP

DIRECTORATE OF TOWN & COUNTRY PLANNING - TAMIL NADU

Map 4.9: Settlement Pattern of Thoothukudi LPA 2021



DYNAMICS OF SETTLEMENT FOR THOOTHUKUDI LPA (2000 -2020)

THOOTHUKUDI LPA

LEGEND

- State Boundary
- District Boundary
- LPA Boundary
- Corporation Boundary
- Census Town
- Water
- National Highway
- State Highway
- Major Roads
- Railways
- Railway Station
- Airport
- Port
- 2000
- 2005
- 2010
- 2015
- 2022

0 0.5 1 2 3 4 Km

PROJECTION : UTM
DATUM : WGS 1984
SPHEROID : WGS 1984
ZONE : 44N

SCALE : 1:1,60,000

N

DTCP

DIRECTORATE OF TOWN & COUNTRY PLANNING - TAMIL NADU

Map 4.10: Settlement Growth Pattern of Thoothukudi LPA From 2000 to 2020

5 ECONOMY

Industrial activity serves as a cornerstone of the planning area's economy. Additionally, the Fisheries Sector holds significant economic importance, benefiting from a coastal stretch spanning 52.71 Km. The fisheries products are exported to northern parts of India and other countries, further enhancing economic prosperity. Another major contributor to the city's economy is the presence of salt pans in and around the area. These salt pans yield approximately 1.7 million tons of salt annually, making a substantial contribution to the local economy.

The economy of the planning area receives a substantial boost from thermal power production, facilitated by five generators with a capacity of 210MW each. In addition to this, the presence of chemical industries, copper industries, a heavy water plant, and other listed industries within the planning area further contributes to the overall economic elevation. These diverse industrial activities collectively enhance the economic vibrancy and sustainability of the region.

Thoothukudi boasts the presence of the State Industries Promotion Corporation of Tamil Nadu Industrial Estate (SIPCOT) and SIDCO's Industrial Estate, hosting various small and medium-scale industries. In response to the growing trade demands in Thoothukudi, the Government of India has sanctioned the construction of an all-weather port, further enhancing the area's connectivity and trade capabilities. Additionally, tourism spots in and around the planning area play a pivotal role in bolstering the local tourist economy, attracting visitors with various attractions. Furthermore, the region is home to numerous pilgrimage centres, contributing to the overall cultural and religious significance of the planning area. The subsequent sections delve into the specific contributions of each sector to the local economy.

5.1 Industrial Sector

Thoothukudi hosts a diverse range of industries, encompassing power (both thermal and wind), chemicals, and fisheries. Key industrial estates in Thoothukudi include SIPCOT, SIDCO Industrial Area, and the Co-operative Industrial Estate. Various industrial activities are dispersed across the region, such as windmills at Varthagareddipatti, Melamarudhur, and Valasamutharam, ready-made garment production at Puthiamputhur, safety match manufacturing, textile and spinning mills, traditional boat making, edible oil production, rice mills, bakery products, fish processing industry, and the Thoothukudi Port Trust.

The presence of numerous medium and small industries, including traditional ones, within the planning area significantly enriches the economic fabric of Thoothukudi and its surrounding regions. These industries not only provide employment opportunities but also contribute to the local economy through production, trade, and innovation. Additionally, they play a vital role in preserving local craftsmanship and cultural heritage while fostering economic resilience and diversification.

5.1.1 Types of Industries

Thoothukudi represents cluster development in major industries such as the salt industry, ready-made garments, and fish processing/fish-based products. These clusters serve as focal points for concentrated economic activity, fostering collaboration, innovation, and growth within their respective sectors. Table 5.1 provides a comprehensive listing of the number of industries present in the planning area, highlighting the diverse industrial landscape and the significance of cluster development in Thoothukudi's economic framework.

Table 5.1: Number of Industries in Planning Area

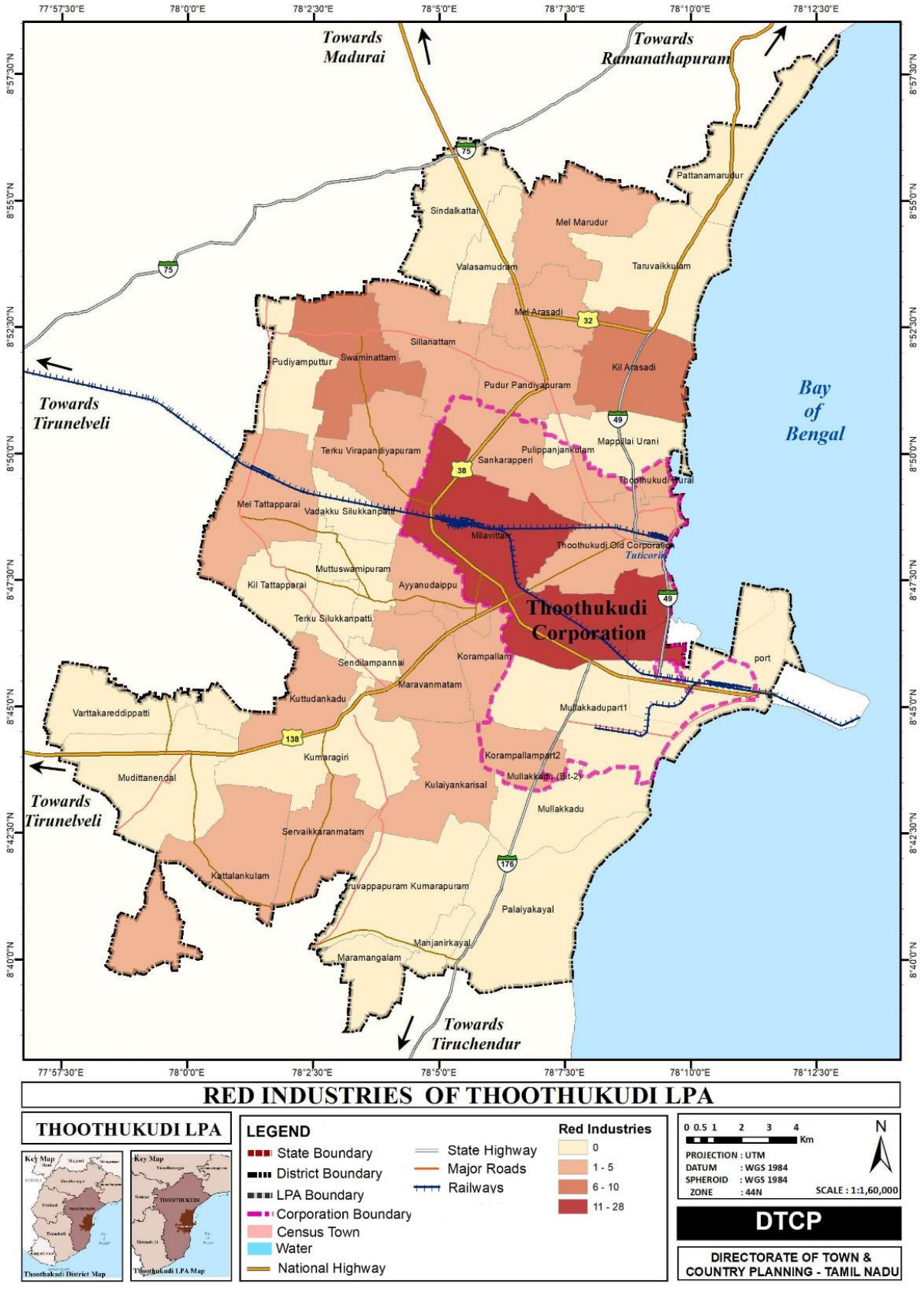
Types of Industries	Medium	Small	Micro	Total
Manufacturing	10	177	830	1,017
Service	11	327	1,651	1,989
Total	**21**	**504**	**2,481**	**3,006**

Source: District Industries Centre, Thoothukudi

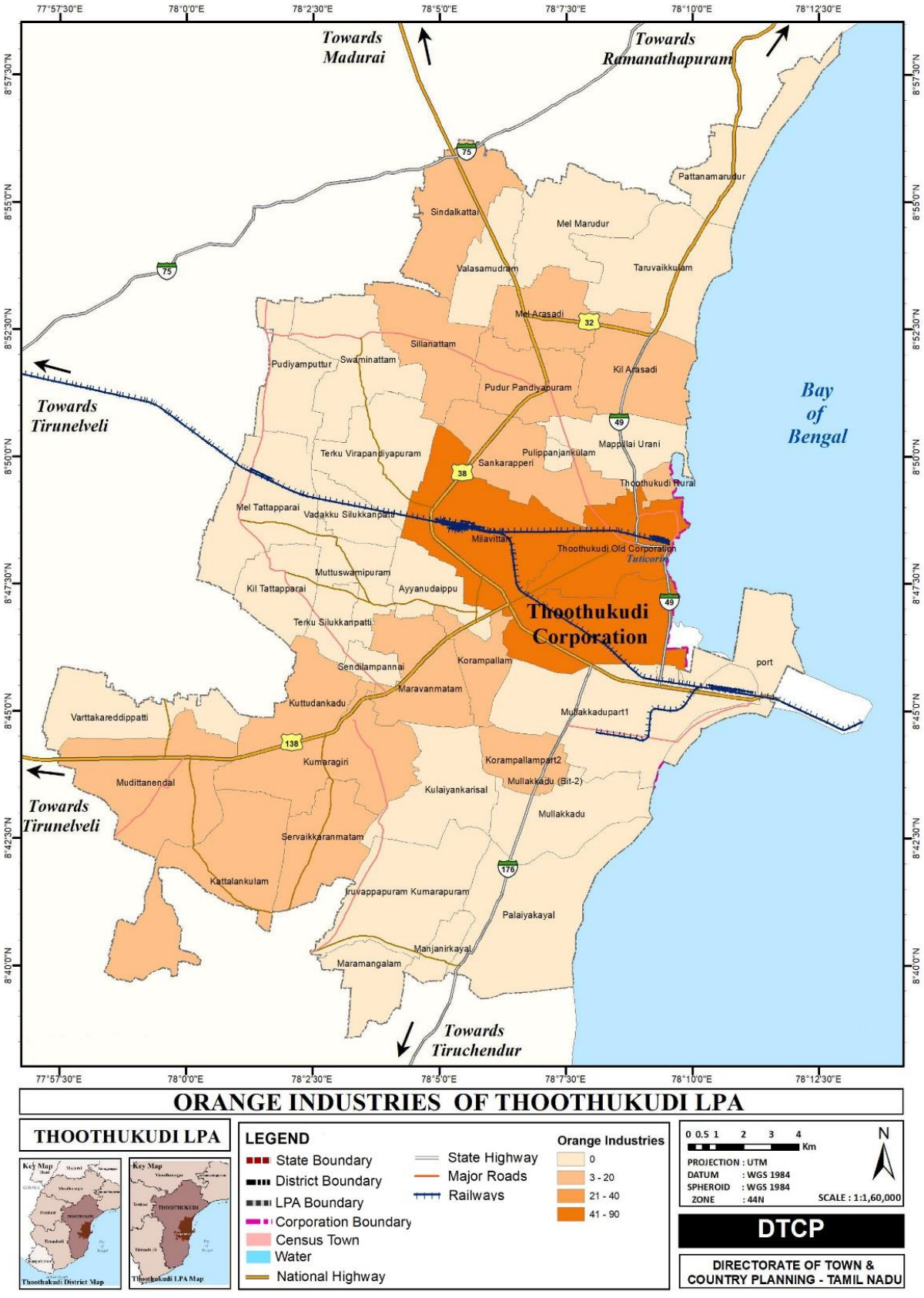
Thermal power plants and chemical industries are strategically dispersed throughout the planning area of Thoothukudi. However, in a bid to diversify the industrial sectors and foster innovation, the Government of Tamil Nadu has proposed the development of a neo-Tidel Park. This initiative aims to create a modern hub for technology and innovation, attracting companies from various sectors and promoting economic growth and employment opportunities in the region.

5.1.2 SIPCOT

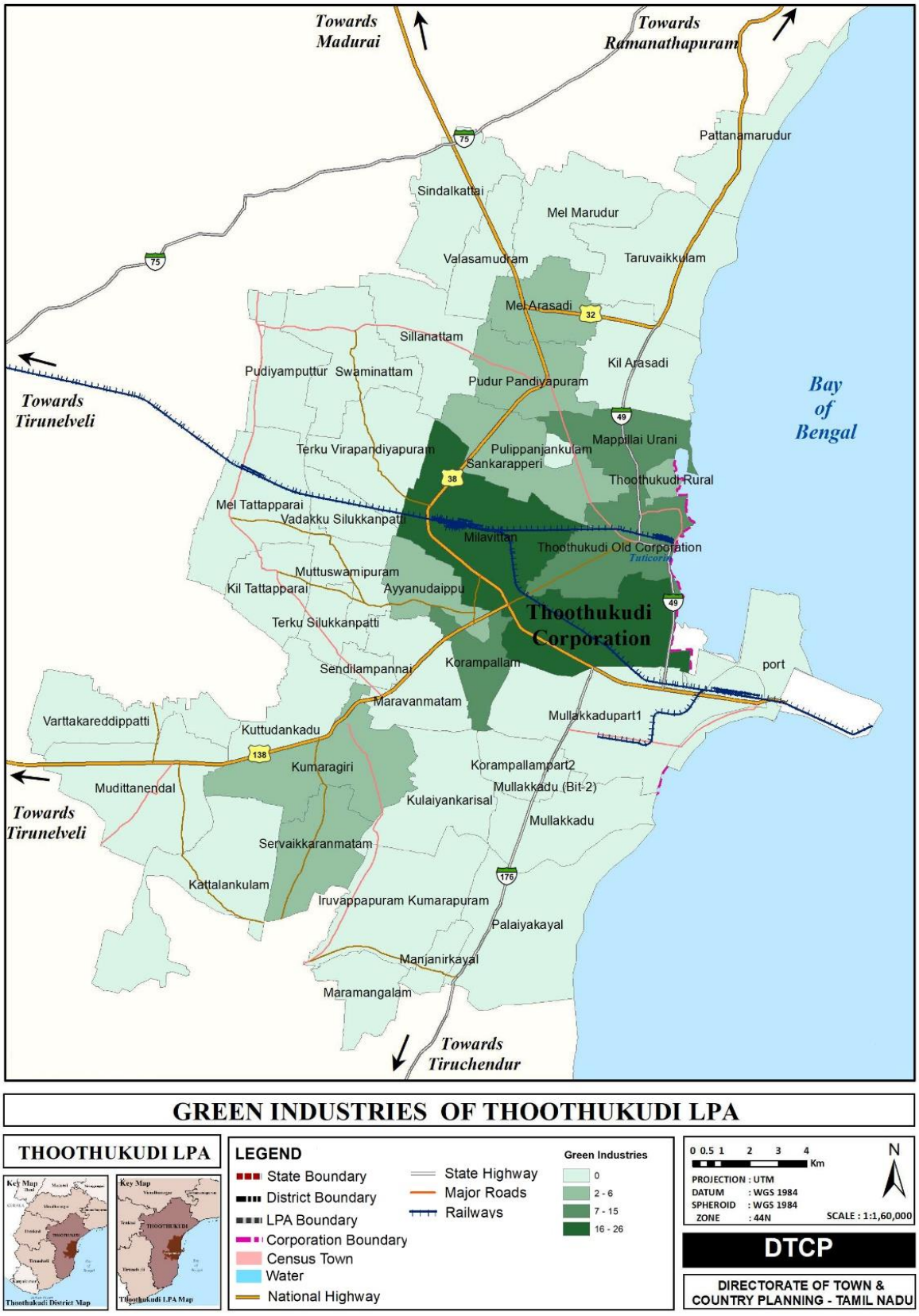
Thoothukudi Corporation is predominantly industrial-oriented, with SIPCOT playing a central role in facilitating industrial activities within the town. Table 5.3 provides detailed information on land acquisition for SIPCOT, illustrating the concerted efforts to allocate land for industrial development and support the growth of industrial activities in Thoothukudi.



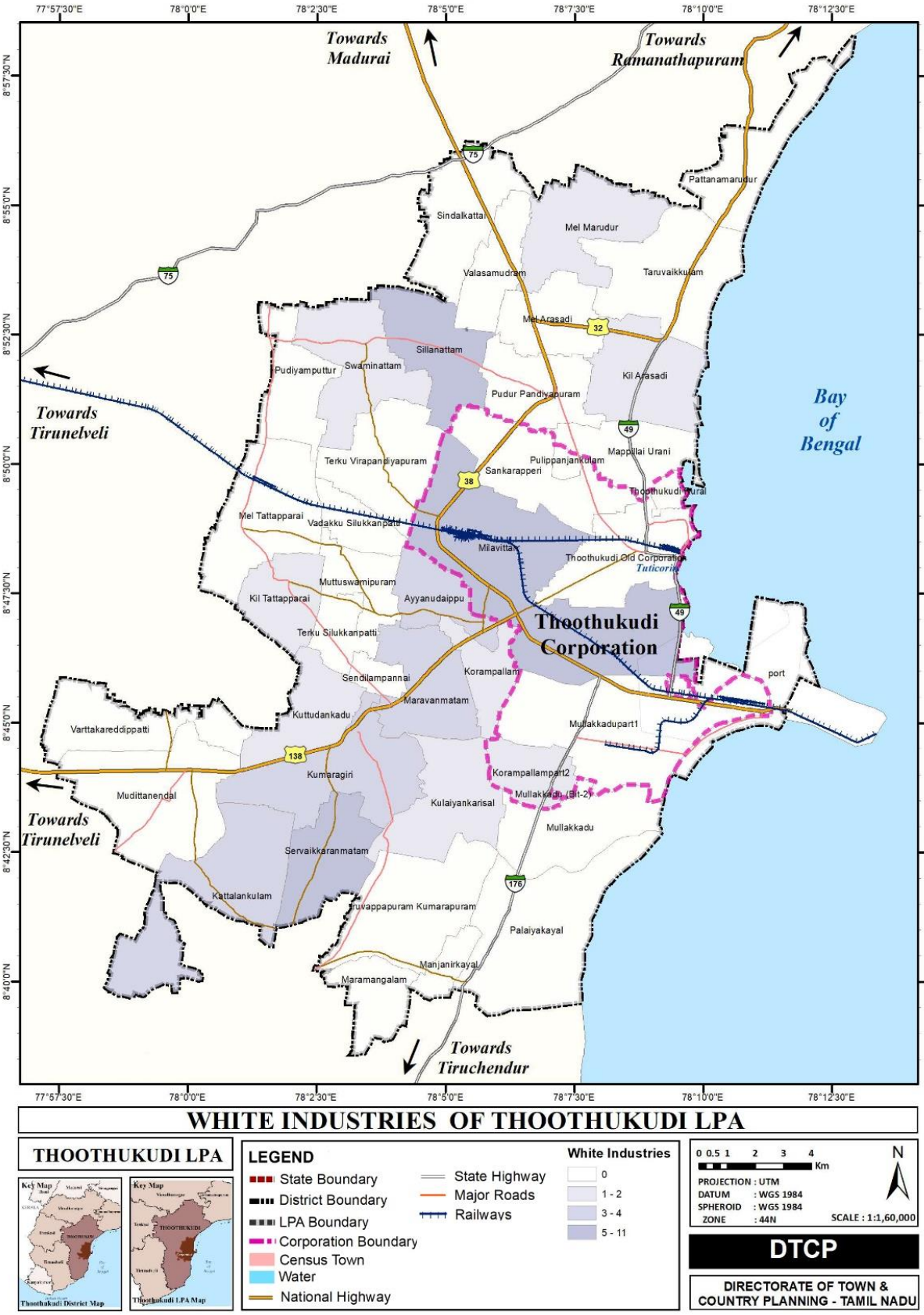
Map 5.1:Red Category Industry in Thoothukudi LPA



Map 5.2: Orange Category Industry in Thoothukudi LPA



Map 5.3: Green Category Industry in Thoothukudi LPA



Map 5.4: White Category Industry in Thoothukudi LPA

Table 5.2: Land Acquisition Details for SIPCOT Development

No.	Name of Scheme	Location	Extent (in Acre)
1	SIPCOT Industrial Estate Phase – I	Meelavittan Village Part – I	1,355.78
2	SIPCOT Industrial Estate Phase – II	Mellavittan Village Part – I & Therku Veerapandiyapuram	1,616.28
3	SIPCOT Industrial Estate Phase – II Extension	Mellavittan Village Part – II	262.46

Source: SIPCOT, Thoothukudi

The Table 5.4 outlines the existing and proposed industrial units within SIPCOT, shedding light on the current industrial landscape as well as upcoming developments. This comprehensive overview helps to understand the growth trajectory of industrial activities in SIPCOT and underscores its role as a key driver of economic development in Thoothukudi.

Table 5.3: List of Existing and Proposed Industrial Units in SIPCOT

No.	Category of Industries	Extent (in Acres)	No. of Units
	Phase – I		
	Units under production / functioning		
1	a) Private Industries	147.02	59
	b) State / Central Govt. Units	112.54	10
2	Units under installations – Private Industries	24.72	6
3	Units under closure – Private Industries	550.56	12
4	Units yet to construction – Private Industries	21.44	11
	Phase – II		
	Furniture Park	Proposed	
	Total	**856.28**	**98**

Source: SIPCOT, Thoothukudi

The following major industries are currently operational within the SIPCOT complex, as listed in Table 5.5. These industries play a significant role in driving

economic activity and employment generation in the region, contributing to the overall industrial landscape and development of Thoothukudi.

Table 5.4: List of Major Industries in SIPCOT Complex

No.	Industry	Number of Industry
1	Amulya Sea foods	300
2	Arasan Air Products (P) Ltd.	25
3	Britto Sea foods Exports (P) Ltd.	40
4	Indian Oil Corporation	20
5	KOG – KTV Food Products (India) (P). Ltd.	395
6	M.V.Subramanian HDPE bags	300
7	Maris Associates	300
8	Maris Corporation HDPE bags	300
9	Marivel Ediback (P) Ltd.	301
10	N.C.John & Sons Ltd.	190
11	Philips foods India Ltd.	146
12	Ramesh Flowers (P). Ltd.	350
13	St. John Freight System(P) Ltd.	300

Source: SIPCOT, Thoothukudi

5.1.3 SIDCO

There are two SIDCO sites located within the planning area at Meelavittan village, namely Thoothukudi Phase-I and Phase-II. Table 5.6 furnishes detailed information on developed plots, the number of workers employed in various industries, products manufactured, as well as import and export details of goods. This comprehensive data offers insights into the industrial activities and economic dynamics within these SIDCO sites, contributing to the overall industrial landscape of Thoothukudi.

Table 5.5: Details of SIDCO Industrial Sites

S.No.	Description	Phase – I Details	Phase – II Details
1	Industrial Estate land area	9.72 acre	14.46 acre
2	Developed plots provided for Micro, Small and Medium enterprises	Plot-20 Nos. Shed-10	Plot-14 Nos.

S.No.	Description	Phase – I Details	Phase – II Details
		Nos.	
3	No. of workers in different industries	200 Nos.	75 Nos.
4	Products Manufactured	Manufacturing of Plastic containers, Corrugated boxes, Rolling Shutters, Processing of Coconut appraisive, Agarpathi packing.	Manufacturing of Dhall, Melamine products, Sea food process.
5	Import and Export details of Goods and Finished products	**Import –** Popular wood **Export –** Max Boxes	**Import –** Popular Wood **Export –** Max Boxes

Source: SIPCOT, Thoothukudi

5.1.4 Thermal Power Station

Thoothukudi's strategic port connectivity has made it a preferred location for a conglomerate of thermal power plants. Table 5.7 enumerates the thermal power plants situated within the planning area, underscoring the significant role they play in meeting the region's energy needs and leveraging the port infrastructure for efficient operations.

Thoothukudi Thermal Power Station (TTPS) is equipped with five 210-megawatt generation plants, with the first plant commissioned in July 1979. Furthermore, a joint venture thermal power plant between NLC (Neyveli Lignite Corporation) and TANGEDCO (Tamil Nadu Generation and Distribution Corporation) with a capacity of 1000 MW has been completed. In addition to these, there are several private power plants, such as Ind Barath Power Limited and Mutiara Power Plant. However, it's worth noting that the Sterlite thermal power plant is not currently in operation.

Table 5.6: Details of Thermal Power Plants in Planning Area

S.No.	Thermal Power Plants	No. of Units * MW	Total MW
1	Thoothukudi Thermal Power Plant (TTPS)	5 * 210	1,050
2	(NLC Tamil Nadu Power Limited) NTPL	2 * 500	1,000
3	Ind Barath Power Gencom Limited	3 * 63	189
4	Mutiara Power Plant Limited	2 * 600	1,200
5	Ind Barath Thermal Power Limited	2 * 150	300
Total Capacity			**3,739**

Source: tnpcb.gov.in/thermalpowerunits

5.1.5 Salt Industry

The salt industry serves as the primary backbone of economic development in the district, with Tamil Nadu ranking second in salt production nationwide. Thoothukudi district alone contributes a significant 70% to the state's total salt production. Salt production spans across an extensive area of 12,850 acres, yielding a production output of 17.12 lakh metric tons. Approximately 2,208 units are actively engaged in salt production within the district.

Approximately 4,000 acres of government land are leased out to private enterprises, while the remaining 8,850 acres of land are privately owned. The concentration of salt units is primarily centered on Thoothukudi Taluk. There are approximately 2,000 small-scale salt manufacturers and traders in the area. The salt production season typically spans from February to September each year.

Around 12,000 to 15,000 labourers are involved in salt cultivation work within the planning area on a daily basis. Given that surface seawater contains lower salinity levels ranging between 2-3 Baume degrees, extensive parcels of land are required to convert it into salt. Therefore, residents in the area utilize bore well water with a depth of up to 150 feet, where the salinity ranges between 5 - 10 Baume degrees. This method, known as the Sub-Soil Brine method, yields salt with higher concentrations within 15 to 21 days. It is

crucial for salt to reach crystallizers within 21 days of being in the pan, as beyond this period, the salt pan loses its consumption quality. The crystal salt is refined by adding iodine. There are about 40 salt refining industries in the planning area. In these industries, there are 460 and 6,000 employed directly and indirectly respectively. Labour shortage is one of the key issues in this sector.

5.1.6 Fisheries

Peral Fisheries

Pearls are derived from pearl oysters, and the process of collecting them from the seabed is termed pearl fisheries. Pearl oysters are typically found attached to rocks, live or dead corals, and other molluscan shells or hard seabed's. They are commonly located at depths of 10-12 fathoms (equivalent to approximately 18.29-21.95 meters), typically around 20 Km off the shore. In India, pearl oysters are predominantly found in the Gulf of Mannar and the Gulf of Kutch. The pearl banks located in the Gulf of Mannar are referred to as "paars," as illustrated below.

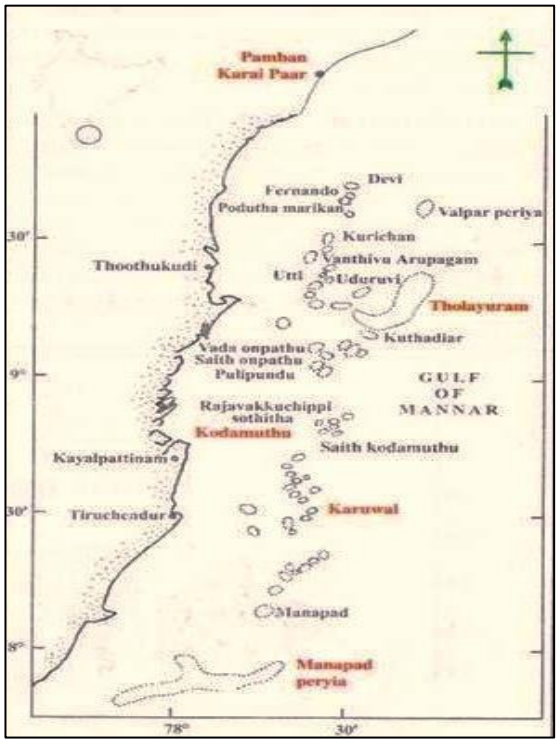


Figure 5.1: Map of Pearl Banks or "Paars" in Gulf of Mannar

The three prime species of pearl oysters, Pinctada fucata, Pinctada margaritifera, and Pinctada maxima, are renowned for producing superior quality pearls. Pinctada fucata, commonly known as the Indian pearl oyster, is typically found in intertidal areas up to a depth of 12 fathoms. It can grow up to a size of 9 cm. In India, Pinctada fucata is found in the Gulf of Kutch (off the coast of Gujarat) and in the Gulf of Mannar (off the coast of Tamil Nadu).

According to Hornell (1922), there are a total of 72 pearl banks known as "paars." A "paar" refers to a patch of hard ground with a very low profile. These paars are located in lines, parallel to and at a distance of 10-16 nautical miles from the land. This stretch extends from Pamban Karai Paar in the north (at the head of the Gulf of Mannar) to Manapad Periya Paar in the south (Figure 5.1).

Figure 5.2: Pearl Banks or "Paars" in Gulf of Mannar

Source: CMFRI, Thoothukudi

The collection of pearl oysters in the Gulf of Mannar has experienced alternating periods of increase and decline for centuries. In an effort to enhance pearl production, the CMFRI (Central Marine Fisheries Research Institute) has pioneered the technology of inducing pearl oysters to produce pearls by inserting or implanting shell bead nuclei into the interior aspect of the pearl oyster. This method, known as pearl culture, aims to increase production and results in pearls known as cultured pearls. Despite these efforts, the production of pearls through this method has been relatively low.

Occasionally, sea ranching is also practiced to boost the natural pearl oyster population. A similar attempt was made on September 15, 2022, by the District Collector near 'Tharaipaar' close to Tsunami Nagar, Thoothukudi, as depicted in Figure 15.

In addition to pearls, the collection and trade of conch, sea shells, and chanks are also common. These types of shells are found near Threspuram. The conch found in Threspuram and the surrounding areas are known for their specific qualities.

Fishing and Fish Processing

Fisheries and fish processing constitute an ancient and traditional industry in Thoothukudi. The long coastal stretch of Thoothukudi plays a significant role in marine commodities and this city has excellent market potential in the fisheries sector.

Figure 5.3: Fish Auction Centre at Threspuram

Above picture depicts the Auction Centre for Fishes in Threspuram, Thoothukudi. This facility serves as a crucial hub for the trading and auctioning of fish caught by local fishermen. The Auction Centre plays a pivotal role in the distribution and sale of fresh seafood, supporting the vibrant fishing industry of Thoothukudi and ensuring a reliable supply chain for marine products. The marine fish catch in the region includes various species such as

Leognathics, Sharks, Flying fish, Prawn, Silver fish, Rays, and other miscellaneous varieties like Praia, Salai, Valai, Guthuf, etc. Some special fish varieties found in Thoothukudi are Prawn, Cola fish, Kanavai, Vanjiram, Vela fish, and Ooli. The Table 5.7 provides a list of fishing villages in the planning area along with their occupational profiles, highlighting the diverse and integral role of the fishing industry in the region.

Table 5.7: Fishing Occupation Profile in the planning area

S.No	Fishing Villages	Taluk	Active Fishermen	Marketing of Fish	Making / Repairing Net	Curing / Processing	Peeling	Labourer	Others	Other than Fishing	Total Occupied
1	Alangarathatu	Thoothukudi	378	45	1	11	11	19	17	6	488
2	Ananda Nagar		560	47	0	22	4	10	15	10	668
3	Inico Nagar		289	12	1	12	0	17	2	8	341
4	Loorthammalpuram		425	50	2	5	4	16	2	2	506
5	Meenavar Colony		298	2	1	1	0	13	0	4	319
6	Mettupatti		595	23	0	14	31	8	12	5	688
7	Rajapalayam		200	46	1	31	4	4	1	44	331
8	Siluvaipatti		335	124	4	10	31	19	1	59	583
9	Talamuthunagar		615	214	0	63	19	57	0	240	**1,208**
10	Threspuram		2,666	206	11	77	144	24	34	113	**3,275**
11	Tuticorin F.H		4,475	935	2	21	23	126	57	67	**5,706**
12	VOC Statue		52	2	0	0	0	1	1	0	**56**
13	Pazhayakayal	Eral	237	10	1	17	2	1	2	24	**294**
14	Vellapatti	Ottapidaram	364	17	406	6	31	2	0	3	829

15	Pattinamaruthur	204	21	0	0	0	1	2	22	250
16	Tharuvaikulam	1,542	19	102	3	7	10	26	28	1,737
Total		**13,235**	**1,773**	**532**	**293**	**311**	**328**	**172**	**635**	**17,279**

Thoothukudi Fishing Harbour stands as one of the oldest fishery ports on the east coast. In addition to the main harbour, there are landing centres equipped with fuel stations located in Tharuvaikulam and Threspuram. Thoothukudi has a total of ten landing centres, namely:

- Tuticorin North (Threspuram)
- Tuticorin North (Sangumal)
- Tuticorin South (Inico Nagar)
- Pattina Maruthur
- Vellapatti
- Tuticorin Harbour Point (V.O.C Statue)
- Tuticorin Harbour Point (Meenavar Coloney)
- Pazhaya Kayal (Rachanya Puram)
- Tuticorin Fisheries Harbour
- Tharuvaikulam

These landing centres play a crucial role in facilitating the activities of the fishing industry, providing essential infrastructure and support for fishermen in the region.

The fisherwomen in Thoothukudi have organized themselves into various groups, and they undergo training in activities such as fish processing and the creation of value-added fish products. The Fisheries College and Research Institute in Thoothukudi play a crucial role by providing high-profile training to interested entrepreneurs and Women Self Help Groups (SHGs) in areas such as value-added fish products and ornamental fish culture. This training empowers them with the skills and knowledge needed to enhance their

participation in the fisheries industry, fostering entrepreneurship and economic sustainability.

Figure 5.4: Fishing Harbour at Threspuram

In Thoothukudi, mechanized boats, country boats, and fiber boats are commonly employed for fish-catching activities. Fishermen are encouraged to carry auto-identification system-enabled GPS devices for tracking purposes, particularly in cases of technical issues or other problems encountered at sea. This technology aids in ensuring the safety of the fishermen and tracking their locations during their fishing expeditions.

Furthermore, there is an annual ban period for fish-catching that spans 61 days, starting from April 15th to June 15th. This ban period is implemented to regulate and manage fish stocks, allowing for the conservation of marine resources. The peak period for fish-catching typically occurs from July to August, providing a focused timeframe for fishermen to engage in their fishing activities outside of the ban period.

Table 5.8 Details of Major Boat Landing Centres and Fish Production

Major Landing Centers	Fish Production (Tons)
Thoothukudi Fishing Harbour	150
Threspuram	50

Pattinamarudhur	28
Tharuvaikulam	311
Palayakayal	95

Note *– Fish production is approximately on daily basis with their respective landing centers*

Source: AD, Fisheries, Thoothukudi

Table 5.8 Details of Major Boat Landing Centres and Fish Production illustrates the major landing centres within the planning area along with their respective details of fish production. This visual representation provides valuable insights into the distribution of fish production across different landing centres, offering a comprehensive overview of the fishing activity in the region.

Table 5.9 Fishermen Villages with Boat Capacities in Planning Areapresents the Fishermen Hamlets within the planning area along with their corresponding Boat Capacities. This information offers a detailed breakdown of the fishing capabilities and resources available in each hamlet, providing valuable insights into the fishing infrastructure and activities within the region.

Table 5.9 Fishermen Villages with Boat Capacities in Planning Area

S.No	Hamlets	Mechanized	Outboard	Non - Motorised
1	Vellapatti	53	8	126
2	Pattinamaruthur	21	0	3
3	Tharuvaikulam	199	0	4
4	Alangarathatu	7	1	0
5	Ananda Nagar	4	0	0
6	Inico Nagar	5	74	12
7	Loorthammpalpuram	4	0	0
8	Meenavar Colony	41	25	56
9	Mettupatti	52	1	6
10	Rajapalayam	7	0	31
11	Siluvaipatti	7	0	20
12	Talamuthunagar	29	1	80
13	Threspuram	283	54	7
14	Tuticorin F.H	42	7	7
15	Voc Statue	20	1	12

S.No	Hamlets	Mechanized	Outboard	Non - Motorised
16	Pazhayakayal	4	3	60
Total		**725**	**167**	**298**

Source: Marine Fisheries Census, 2010

Cold Storage Industries

Within the planning area, there are a total of 12 fish cold storage industries. Cold industries play a critical role and there are 12 fish cold storage units in the planning area. Each cold storage facility has a capacity ranging from 1800 to 2000 metric tons.

Approximately 500 metric tons of fish are exported to Japan and various European countries, particularly Spain, every month. However, during festive seasons such as Christmas, these industries operate at full capacity to meet increased demand.

The cold storage industry is a significant employer, providing employment opportunities for around 350 direct employees and supporting approximately 12,500 indirect employees. During lean periods, when fishing activity decreases, these industries support fishermen by providing financial assistance for health and education facilities. This support is facilitated by a government grant of 18%.

Logistics

Thoothukudi, being a port town, serves as a hub for transportation and trade. Numerous trucks and containers arrive from various parts of the state, facilitating the movement of goods. The products exported from the state through Thoothukudi port encompass a diverse range, including yarn, textiles, ready-made garments, and raw materials for medicines targeting viral diseases. The port's strategic location and connectivity contribute significantly to the regional and national trade activities.

Table 5.10 Exported Goods

S.No.	Location	Exported Goods
1.	Erode and Thiruppur	Ready-made Garments, Textiles
2.	Coimbatore	Yarn, Pumps, Siddha and Ayurvedic medicines
3.	Theni	Moringa oleifera powder to Spain for preparation of Vaccine
4.	Karur	Table Cloth, Aprons
5.	Bangalore	T-shirts, nighty

The exported products from Thoothukudi are primarily destined for various parts of Europe such as France and Sweden, Hong Kong, and New Zealand. Notably, 70% of the total exports are directed towards European countries. The export process involves the engagement of 16 logistics companies responsible for packaging and exporting goods.

This export-oriented activity has a considerable economic impact, with 1850 direct employees and 9000 indirect employees contributing to the industry's workforce. On a daily basis, approximately 2100 trucks are involved in the movement of goods.

Wooden logs, essential for various industries, are imported from Myanmar (Burma), Australia, New Zealand, and Africa. These logs are transported to Sengottai for cutting and subsequent distribution to other parts of the state.

As part of future developments, SIPCOT has proposed a Furniture Park within the Planning Area. This initiative is anticipated to attract significant investments, with an expected amount of 4,000 crores per annum. The establishment of such a park can contribute to economic growth and employment opportunities within the region.

Other Industries

Thoothukudi hosts a diverse range of industries and facilities, contributing to its economic landscape. Some notable establishments in the area include:

1. SPIC (Southern Petrochemical Industries Corporation) - Fertilizers and Chemicals
2. TAC (Thoothukudi Alkali Chemicals) Fertilizer Plant
3. Dharangadhara Chemicals – Chemicals
4. Kilburn Chemicals - Titanium Dioxide
5. Heavy Water Plant (A unit of BARC - Bhabha Atomic Research Centre)
6. NFC (Nuclear Fuel Complex) - Titanium and Zirconium Sponge Plant
7. Transworld Garnet Industries
8. AVM Jumbo Bags (SIPCOT)
9. Sterlite – Copper
10. Ramesh Flowers
11. Nila Sea Foods
12. St. John Freight Systems Limited
13. Madura Coats
14. Export of Senna leaves (medicinal value)
15. Salt Industry

In addition to these industrial units, the city is home to a research institute established by the Central Marine Fisheries Research Institute and a spices laboratory set up by the Spices Board of India. This industrial diversity contributes significantly to Thoothukudi's economic vitality.

5.2 Trade and Commerce

Thoothukudi town has historically played a significant role in trade and commerce for many centuries. Various commodities, including rice, dhal, piece goods, livestock, different types of fish, salt, and macro sweets, were traded in the region. Today, the town continues to serve as a center for retail provisions and trading for the surrounding villages.

Major commercial activities are concentrated along several key roads, including Victoria Extension Road (V.O.C), West Great Cotton Road, Palayamkottai Road, Beach Road, South Raja Street, Ettayapuram Road, and East Coast Road. These areas serve as hubs for trade and commerce, contributing to the economic vibrancy of Thoothukudi. Table 5.12 provides a list of trade and commercial activities concentrated along both sides of these roads.

Table 5.11 Trade and Commerce Activities in Major Roads, Thoothukudi

S.No.	Location	Major Activities
1	(V.O.C) West Great Cotton Road	Banks, Retail trading, Health services, Textile shops, Hardware shops, Hotels, Jewellery shops, Professional consulting offices, Bakery and restaurants
2	Victoria Extension Road	Hotels and restaurants, Shopping agencies, Market (Vegetable and Fish), Banks, Furniture shops, Fruit shops, Textile and Jewellery
3	Palayamkottai road	Petty shops, Show rooms, Fruit shops, Community halls and Godowns
4	Ettayapuram road	Saw mill, Petty shops, Bus stand, Kalyana mandapam, Showrooms, Automobile service shops
5	Beach road	Banking services such as State Bank of India, Canara Bank, Bank of India and LIC head office, Shipping Agencies, Salt Pan, Roche Park etc.
6	Thiruchendur road	Fertilizer shops, Salt Pan etc.

Source: Primary Survey

Figure 5.5 Thoothukudi Private Market

Table 5.13 lists the markets within the corporation area of Thoothukudi. These markets serve as important hubs for various commercial activities, providing a platform for trading and retail provisions.

Table 5.12 Location of Markets and no. of Shops

Market Name	Location	Number of Shops
Corporation Market	S S Street, East Zone	32
Gopal Swamy Street	East Zone	30
VOC Daily Market	Victoria Extension Road, East Zone	502
Fish Market	Boobalarayarpuram, East Zone	20
Thoothukudi Vegetable Market	Private Market	-
Thoothukudi Banana Market	Private Market	-

Source: Thoothukudi Corporation

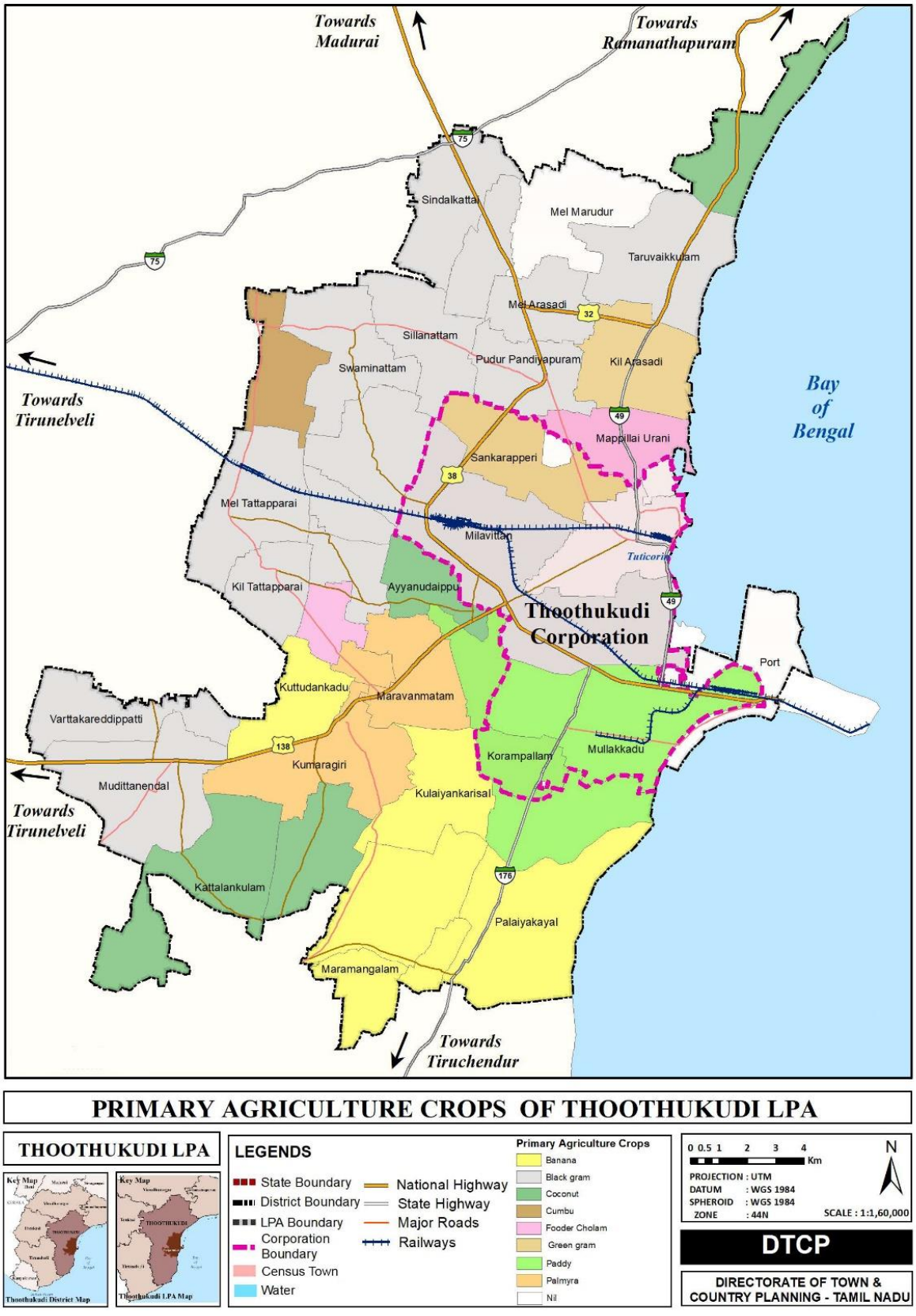
5.3 Agricultural Sector

Agriculture stands as one of the primary occupations in Thoothukudi, with around 40% of the working population relying on it for their livelihood. Major

crops cultivated in the district include chillies, black gram, green gram, and maize. Within the planning area, significant food crops include cholam, cumbu, ragi, varagu, samai, paddy, as well as commercial crops like cotton, chilli, sugarcane, and groundnut.

The sandy soils prevalent in most of the area, owing to its coastal proximity, present opportunities for development, particularly in enhancing agricultural exports via Thoothukudi port through the establishment of cold storage units. Additionally, there is significant potential to promote the adoption of new crop varieties and innovative technologies such as precision farming and the system of rice intensification. Given that farmers are increasingly educated about these advancements and willing to embrace them, leveraging these opportunities can lead to improved agricultural productivity and economic growth in the region.

The contribution of the primary sector to the Gross District Domestic Product (GDDP) was slightly lower compared to the other two sectors. Several factors contribute to this, including the fertility of the land, monsoon behaviour, rainfall patterns, irrigation facilities, application of fertilizers, climatic conditions, marketing infrastructure, pricing dynamics, and the availability of agricultural labourers. These diverse factors collectively influence the overall impact on agricultural development in the region, highlighting the multifaceted nature of challenges and opportunities within the primary sector. Addressing these factors strategically can contribute to enhancing the role of agriculture in the economic development of the district.



Map 5.5 Major and Minor Crops in Thoothukudi LPA

Figure 5.6 Palm Trees in Planning Area

Palmyra trees, prevalent in this region, contribute significantly to agricultural activities. The primary palm product derived from these trees is Neera, which serves as a key ingredient in the production of various edible palm products such as palm jaggery (Karupatti), palm candy, palm sugar, and palm halwa. Additionally, various other products like palm fibers, leaves for fans, mats, baskets, toys, and handmade items are produced from the diverse components of the palm tree. The utilization of Palmyra trees not only supports the local economy but also showcases the versatility of this resource in producing a range of products for consumption and handicrafts.

The Tamil Nadu Palm Products Development Board (TNPPDB) plays an active role in maintaining the quality of palm products in the region. Collaborating with the Horticulture Department, TNPPDB has undertaken extensive efforts, including the planting of 5 lakh seeds in the planning area. This proactive approach contributes to the sustainable development and promotion of palm-related agricultural activities, ensuring the continued production and quality of various palm products in the region.

5.4 Workforce Distribution

The workforce percentage in the planning area stands at 37.18%, which is close to the national average of 39.79%. However, Tamil Nadu's workforce percentage is notably higher at 45.6%. This difference could be attributed to an increase in the dependent population and the migration of earning members for employment opportunities outside the area.

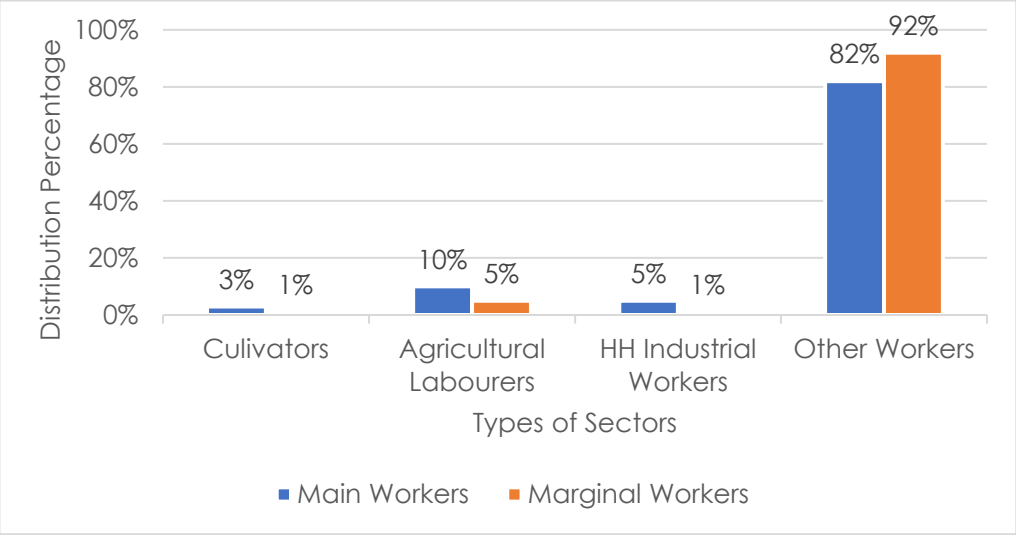


Figure 5.7 Distribution of Main and Marginal Workers

Source: Census of India, 2011

The data regarding the rate of out-migration of the workforce to other countries remains ambiguous. However, stochastic interviews conducted in the planning area suggest that the number of men working in foreign countries is higher. Additionally, the workforce participation rate shows slight variations between the corporation and the rest of the planning area.

The number of main cultivators decreased from 565 to 512 during 2001-11, while marginal cultivators witnessed a drastic decline from 4619 to 2496. Although main agricultural labourers decreased during this period, marginal agricultural labourers experienced a slight increase. These declines in agricultural activities and the increase in marginal workers may be attributed to seasonal workers engaged in specific agricultural activities. Notably, there was an exponential increase in the "other workers" category, indicating the

growth of industries in the planning area. Table 5.14 provides a classification of workers as main and marginal workers in the planning area during 2001-11.

Table 5.13 Distribution of Main and Marginal Workers (2001 & 2011)

Types of Sectors	Year	Urban	Rural	Total	Urban	Rural	Total
Cultivators	2001	228	337	565	884	3,735	4,619
	2011	120	392	512	332	2,160	2,492
Agricultural	2001	251	2,721	2,972	925	6,226	7,151
	2011	215	1,472	1,687	1,155	6,945	8,100
HH Industrial	2001	489	423	912	2,437	1,935	4,372
	2011	448	333	781	2,121	937	3,058
Other	2001	5,396	2,543	7,939	99,377	28,537	1,27,914
	2011	8,386	5,128	13,514	1,21,841	39,244	1,61,085

Source: Census of India, 2001 & 2011

5.5 Workforce Participation Rate

The proportion of total workers as percentage of total population both in rural and urban areas, termed as "workforce participation Rate" (WFPR). The planning area has a good WFPR at 37.18%. It is also observed that the Workforce Participation Rate. Figure 5.8 indicates the share of Workers and Non-Workers has increased in the past decade.

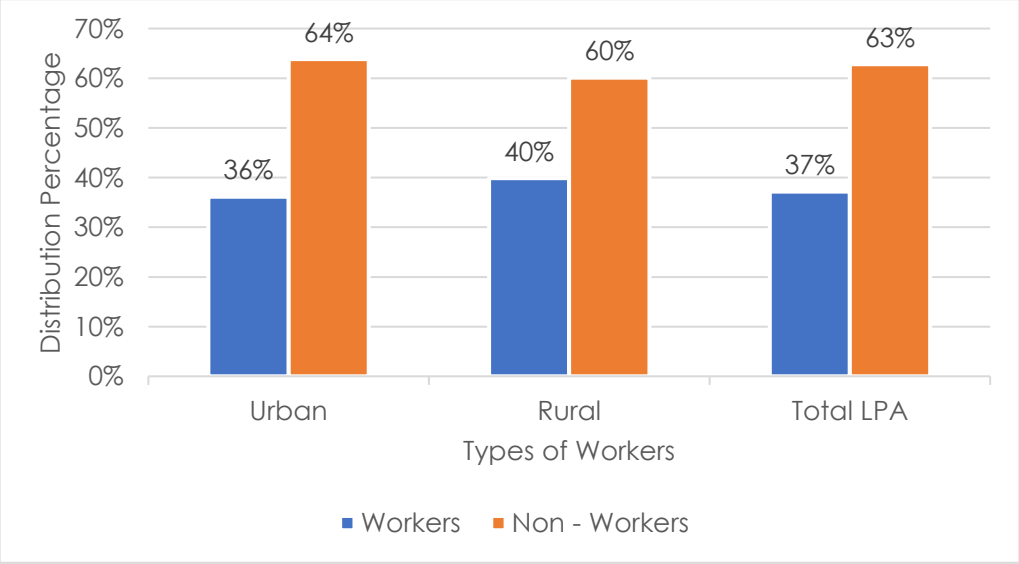


Figure 5.8 Distribution of Workers and Non-Workers - 2011

Source: Census of India, 2011

This increase is mainly due to the increase in the corporation area (from 34.32% to 36.15%), as there is only a marginal increase in rest of the planning area (from 39.77% to 39.89%). The main reason for this increase in the corporation may be attributed to the decreased agricultural activities as discussed above.

Table 5.14 Distribution of Workers and Non-Workers – 2011

Area	Total Population		Total Workers		WFPR	
	2001	2011	2001	2011	2001	2011
Urban	3,20,466	3,72,408	1,09,987	1,34,618	34.32	36.15
Rural	1,16,827	1,41,905	46,457	56,611	39.77	39.89
Total	**4,37,293**	**5,14,313**	**1,56,444**	**1,91,229**	**35.83**	**37.18**

Source: Census of India, 2001 & 2011

5.6 Work Force Projection

The employment forecast indicates the total number of jobs that are expected to be created by 2041. Table 5.16 lists the anticipated employment and labour force participation. Based on the current workforce population and the labour force participation rate, this projection has been computed. The difference in the labour force participation rates between 2001 and 2011 is included when calculating the employment prediction. The predicted total employment to be created amounts to 1,02,011 positions, with a projected population of 7,11,211 and a projected workforce participation rate of 41.23%, which is arrived at from the WPR of 2001 and 2011.

Table 5.15: Workforce Projection for Planning Area

S.No	Description	2011	2021	2031	2041
1	Total Population	5,14,313	5,79,946	6,45,578	7,11,211
2	Eligible Workers (65%)	3,34,303	3,76,965	4,19,626	4,62,287
3	Total Male Population	2,57,588	2,90,460	3,23,331	3,56,202
4	Total Female Population	2,56,725	2,89,486	3,22,247	3,55,009
5	Total workers	1,91,222	2,23,453	2,57,457	2,93,232
6	WPR	37.18%	38.53%	39.88%	41.23%
7	Additional Jobs to be created		32232	66235	102011

5.6.1 Workforce Distribution

The workforce percentage in the planning area stands at 37.18%, which is close to the national average of 39.79%. However, it is notably lower than the workforce percentage in Tamil Nadu, which is 45.6%. This disparity may be attributed to factors such as an increasing dependent population and members of earning households migrating outside the region for employment opportunities. Such trends underscore the importance of understanding local demographic dynamics and their implications for workforce participation and economic development initiatives within the planning area.

5.7 Potential and Issues

The International Furniture Park, sprawling over 1,156 acres at SIPCOT with a substantial investment of Rs 4,500 crore, is expected to generate at least 3.5 lakh jobs. This investment is set to boost the furniture market and is projected to attract an additional $750-$800 billion in investments by 2025 for the region. A port expansion study is currently underway, with plans to design the port to handle large cargo ships and crude oil, enhancing the maritime capabilities of the region.

Additionally, the Government of Tamil Nadu has announced plans for a desalination plant with a capacity of 30 MLD (million liters per day) for the SIPCOT complex in Thoothukudi. Furthermore, there are initiatives to establish food parks spread over 150 acres, showcasing a comprehensive approach to economic development and infrastructure enhancement in the region.

6 TOURISM

Tourism has emerged as a potent instrument for long-term human development, offering various benefits such as poverty alleviation, job creation, cultural preservation, and empowerment, particularly for women and marginalized communities. It is widely acknowledged for its capacity to harmonize conservation and development objectives, especially in or around protected areas.

Tourism plays a pivotal role in conserving natural regions by generating revenue, enhancing local and visitor awareness of biodiversity and conservation issues, and dissuading locals from engaging in unsustainable practices. From a developmental perspective, tourism revenue can help alleviate poverty by stimulating business growth and employment opportunities that are, in principle, compatible with biodiversity conservation efforts. Additionally, it can bolster local services and empower communities to advocate for the protection of the natural environment through enhanced education and awareness initiatives.

6.1 Place of Interest within the Planning Area

The comprehensive list of major tourist attractions mentioned in the Table 6.1 and their significance within the planning area. Further details regarding each attraction are elaborated in the following sections, highlighting their cultural, historical, and natural importance, as well as their potential contributions to tourism development and local economies.

Table 6.1 List of Interest place within the Planning Area

S.No.	Place of Interest	Location	Remarks
1	Sri Sankara Rameshwara Temple	Near Thoothukudi Melur Railway Station	Lord Shiva temple
2	Church of Lady Snow Basilica	Thoothukudi Old Town	Dedicated to St. Mary

S.No.	Place of Interest	Location	Remarks
3	Hare Island	Near Port	Excellent Picnic Spot
4	Van Theevu	Part of Keela Arasaradi	
5	Thoothukudi Beach and Roche Park	Beach	Family Fun and a tourist attraction
6	VOC Port	Thoothukudi Port	Major Port and lighthouse
7	Eco Park	Beach Road	Boating

Sri Sankara Rameshwarar Temple

Sri Sankara Rameshwarar Temple is Lord Shiva temple located near Old Bus stand. It is believed to be the place where God Shiva and Goddess Parvati rested near holy tank Vancha Pushkarani on their way to Tiruchendur. It is where Shiva explained the secrets of the pranava-mantra to the Goddess. Therefore, this place is also called "Thirumanthira Nagar".

Church of Our Lady of Snows Basilica

The church of our Lady of Snows Basilica is a spectacular church with Portuguese architecture, built in 1538 as the first Parish of St. Peter's Church. Pope John Paul II raised it to the status of Basilica. It is located in the Beach Road. Every year a procession of Saint Idol takes place as a grand festival in the month of August. This attracts lots of tourists. The shrine is dedicated to St. Mary and is inspired from the Basilica di Santa Maria Maggiore in Rome. Tales of numerous miracles have been associated with this Church. It takes influences from Rome and Italian styles.

Hare Islands

Hare Island lies adjoining the port. It is a very good picnic spot for holiday seekers and the domestic tourist. Many tourists visit here during the Pongal holidays when special buses are operated for the benefit of the tourists.

Van Theevu (Island)

The Van Theevu is locally called as Church Island. The island forms part of Keela Arasaradi village of Ottapidaram taluk. The area of the island is 0.16 Sq.km. It is situated at a distance of 6 km from the shore.

Beach and Roche Park

Thoothukudi beach, especially post sunset, is buzzing with people, both tourists and local residents. A lot of small vendors are selling different kinds of snacks, coconut water etc. The sunset at the Thoothukudi beach is as mesmerizing as any other. Roche Park is located along the eastern side of beach road which is one of the famous parks in the town. During the holidays and daily evening times children and adults with family are gathered in the park for fun.

VOC Port

V.O.Chidambaranar Port, formerly Tuticorin Port, is one of the 12 major ports in India. It was declared to be a major port on 11 July 1974. It is an artificial port. It is second-largest port in Tamil Nadu and fourth-largest container terminal in India. This is the third international port in Tamil Nadu and its second all- weather port.

Eco Park

Eco- Park is a boating club located near Beach Salt Pan road in the southern part of the corporation. It is one of the tourist attraction and local picnic spots. In order to view the coral reef in these regions, a glass bottomed boat with a capacity of 20 people is chalked out to boost the eco-tourism in Tharuvaikulam under the directive of Gulf of Mannar Marine Biosphere Reserve Trust (GoMBRT). The snorkeling and scuba diving is under proposal.

Figure 6.1 List of Places within Planning Area

6.2 Places of Interest outside Planning Area

The major tourist attractions located outside the planning area mentioned in Table 6.2, along with their respective significance. Subsequent sections will delve into the details of each attraction, highlighting their cultural, historical, and natural significance, as well as their contributions to tourism in the broader region.

Table 6.2 List of Interest place outside the Planning Area

S.No.	Place of Interest	Location	Remarks
1	Sri Subramanya Swami Temple	Tiruchendur	Second of the six abodes of Lord Murugan
2	Navathirupathi Temples	Srivaikuntam, Alwarthirunagiri, Thirukkolur, Thenthiruperai, Perungulam, Natham, Tholavillimangalami, Thirukulandhai and Thirupulingudi	Temples of Lord Perumal
3	Arulmigu Muthuramman Temple	Kulasekarapatnam	Dasara Kuzhu
4	Panchalankurichi	Panchalankurichi	Sri Jakkammadevi Temple; Kattabomman Memorial Fort

Sri Subrahmanya Swami Temple

Sri Subramanian Swami Devasthanam is located at Tiruchendur on the shore of Bay of Bengal. It is the second of the six abodes of Lord Murugan, enshrining Senthilandavar and is very popular with pilgrims.

Navathirupathy Temples

Navathirupathy temples are the nine Lord Venkatachalapathi temples. Each temple attributes different avatars. Vainava Pilgrims from northern states are gathered during September, October and December months to worship the God Perumal. The locations are Srivaikuntam, Alwarthirunagiri, Thirukkolur, Thenthiruperai, Perungulam, Natham, Tholavillimangalami, Thirukulandhai and Thirupulingudi. It is celebrated to mark the birth of Swami Namalwar, who was born in the month of Vaikasi and the star of Visakam and that had been consecrated as Vaikasi Visakam. Sri Vaikundapathy Temple is built by the Pandya King Sankara Pandiyan. It is one of the Navathirupathi temples. It is located near banks of River Tamirabarani.

Arulmigu Mutharamman Temple

Arulmigu Mutharamman Temple is a famous temple located at Kulasekarapattnam. This temple is famous for Dasara festival and it is a 10-day festival. The main thing about this festival is Dasara Kuzhu. The town is a centre for folk art and there are handicraft centres.

Panchalankurichi

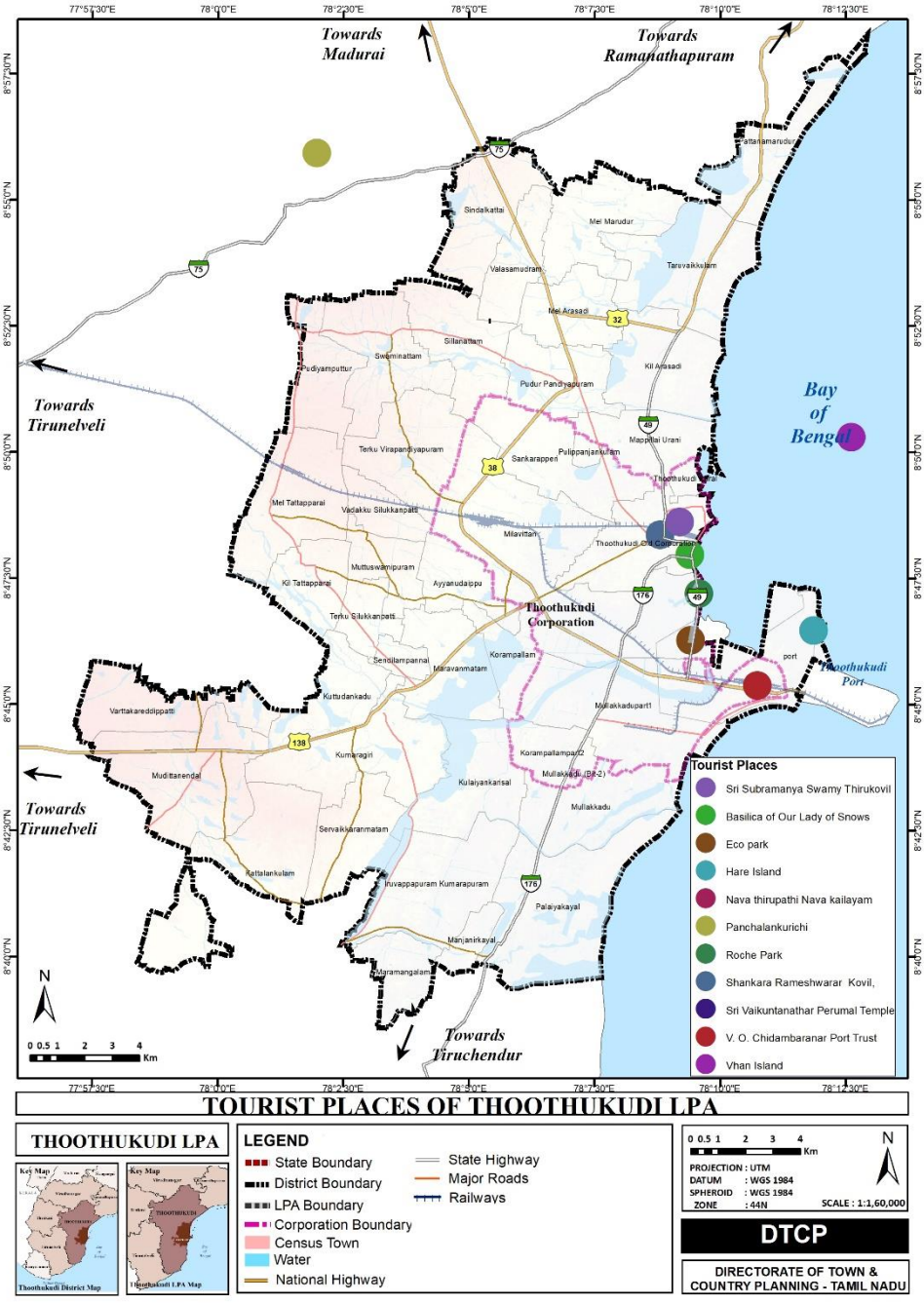
Panchalankurichi is a historical place located 25km from Thoothukudi and 55 km from Tirunelveli. The Great warrior Kattabomman is popularly known as "Veerapandiya Kattabomman" who raised his voice against the British regime in the 17th century AD. The existing memorial Fort was constructed in 1974, by the Government of Tamil Nadu. The Memorial Hall has beautiful paintings that depict the heroic deeds of the saga which give a good idea about the history of the period.

Sri Jakkammadevi Temple

Sri Jakkammadevi Temple, the hereditary Goddess of Kattabomman, is located in the fort complex. Cemetery of British soldiers can also be seen near the fort. The rest of the old fort is protected by the Department of Archaeology. During the Kattabomman festival season, small bullock cart race is conducted.

Kattabomman Memorial Fort

The Kattabomman Memorial Fort was built by the Tamil Nadu Government in memory of the Freedom fighter Veerapandiya Kattabomma Karuthayya Nayakkar (also known as Kattabomman). He waged a war against the British in Tamil Nadu and died in the fight. The fort is frequented by tourists from this region. It is beautifully made and well maintained.



Map 6.1 Tourist Place in Thoothukudi LPA

Other Pilgrimage Importance Places

Sinthalakarai near Ettayapuram is one of the famous Sakthipeedam. Kurangani Santhana Muthu Mariyamman Temple festival function is on Avani 2nd Tuesday.St. Michael and all Angels' Church in Mudalur is one of the oldest churches in Thoothukudi district. The height of the church tower is 193 feet. Meignanapuram church is one of the famous churches and its height is 196 feet. Church of Holy Cross was built 1581 and it is also one of the oldest churches in Thoothukudi district. Manapad contains the true fragments of Holy Cross. It is the first place where St. Francis Xavier landed in India, 1542. Mohiyedeen Jumma Mosque, Maqbara of Hazrat Kazi Syed Aaluddin, Kayalpattinam and Hazrat Shamsudeen Shaheed Raziyallah Dargah, Vaippa are located in Thoothukudi district.

Korkai was an archeologically significant place with excavation sites. A museum is established to exhibit the collections from the locality. One such site was located within the planning area at Maramangalam. Few coins were excavated in the site. Currently, it is a closed site.

Figure 6.1 Maramanagalam Excavation Site

6.3 Existing Tourism Infrastructure

The core tourism infrastructure within the planning area is deemed satisfactory; however, further field surveys reveal deficiencies in accommodation options and connectivity between tourist spots. During festivals, religious sites experience overcrowding, posing challenges for procession and crowd management.

The decline in foreign footfalls may be attributed to the global pandemic, but future planning efforts should aim to revitalize tourist visits to these locales. Strategic planning for a tourism circuit in the region could position Thoothukudi as a central hub, benefiting from its extensive connectivity across various modes of transport. This approach can enhance the appeal of the region and attract more visitors, both domestic and international, fostering economic growth and cultural exchange.

Table 6.3 Facilities for Tourist in Thoothukudi

Hotels / Lodges	Number of Hotels / Lodges	Number of Rooms	
Three Star Hotel	1	51	
Hotels with restaurants and lodging	22	A/C	Non-A/C
		628	414
Lodges (only)	5		
Restaurants	Large	Medium	Small
	4	10	970

Source: District Tourist Office, Thoothukudi

Table 6.3 provides a comprehensive list of accommodation facilities within the planning area, comprising 23 hotels offering both restaurant and lodge services. Among these, one hotel holds a three-star rating. Additionally, there are five lodges available for visitors. With this range of options, tourists have ample choices for dining and lodging during their stay.

6.4 Key Issues

- Ferry services from the port have been discontinued, potentially impacting transportation options for locals and tourists.
- Annually, during the month of August, the Our Lady Snows Basilica Festival spans 11 days, drawing over 250,000 pilgrims from across the state regardless of religious affiliation. This festival serves as a significant driver for the local economy, contributing to increased economic activity within the planning area.

6.5 Potentials

The planning area is situated along the coastal region, boasting a natural port and diverse marine life.

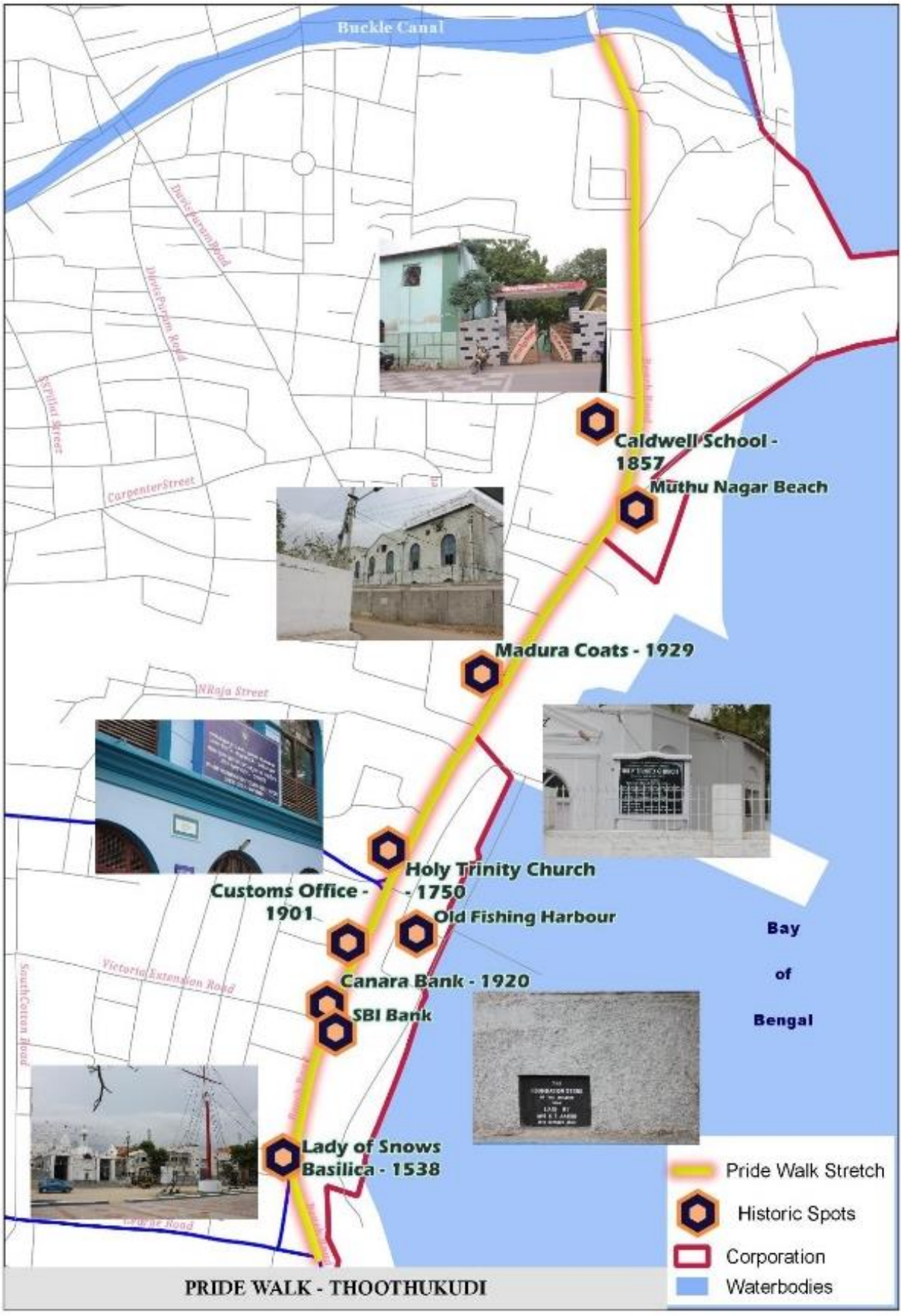
Figure 6.3 Two Lakes in Kuttadankadu

- The Eco-Park in the Gulf of Mannar forms a part of the planning area, offering opportunities for ecological exploration and conservation efforts.

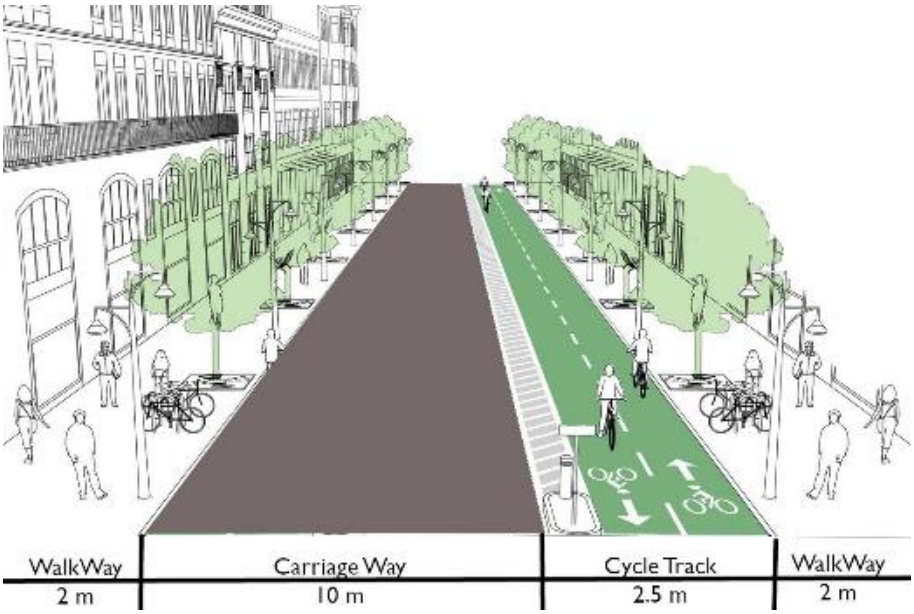
- - Mangrove forests enhance the coastal ecosystem, providing habitats for various species and contributing to environmental stability.
- - The revitalization of Buckle Canal, under the Smart City Mission, is underway, presenting the potential for aesthetic enhancements and increased recreational opportunities.
- - Lakes such as Kurinjankulam and Palamkulam Kanmoi in Kuttudankadu attract migratory birds during different seasons. Efforts to integrate these lakes can promote water retention, benefiting both local agriculture and tourism by prolonging the stay of migratory birds and enhancing the scenic beauty of the area.

6.6 Policies and Proposals

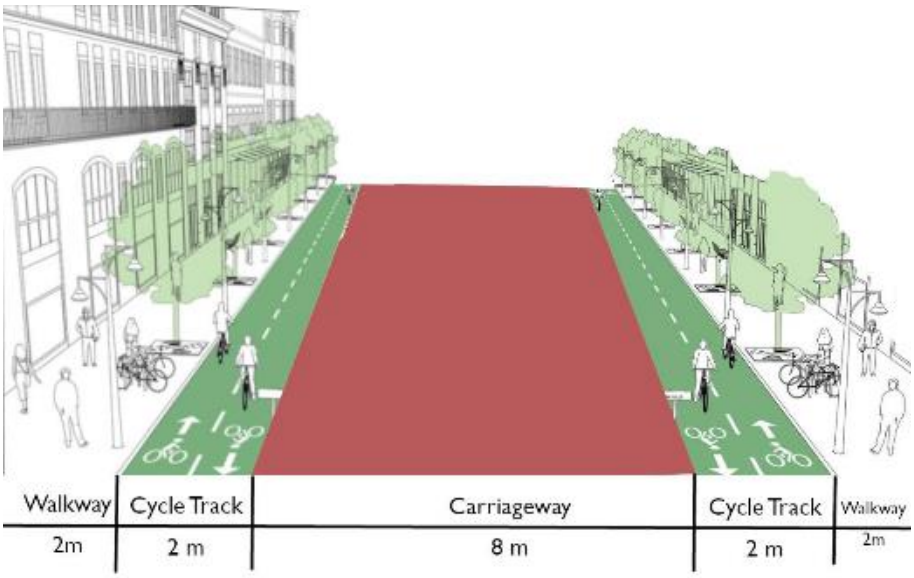
The Pride Walk is a significant stretch beginning from the George Road and Beach Road Junction (near Bell Hotel) and extending to Buckle Canal. It encompasses a collection of historic buildings that symbolize the diverse roles played by the town throughout its centuries-old history, including its prominence as a port city, industrial hub, as well as the presence of institutional and religious landmarks. To preserve its cultural significance, a development proposal for the Pride Walk with appropriate infrastructure and pedestrian amenities is suggested. The designated stretch is delineated in Map 6.2.



Map 6.2 Stretch of Pride Walk



Cycle track on One Side



Cycle track on Both Side

Figure 6.2 Recommended Street Cross Section

The current street with a 16-meter right of way can be redesigned to incorporate a cycle track and pedestrian walkway on one or both sides of the carriage way. The proposed street cross-section, accommodating these features, is illustrated in Figure 6.2.

7 HOUSING

Housing stands as a fundamental requirement in civilized society. However, population growth and escalating land values render affordable housing inaccessible to a significant portion of the populace. The shortage of housing bears numerous adverse consequences in the planning area, including the emergence of slums, substandard living conditions, and inadequate infrastructure. This master plan will factor in population growth due to natural increase and other demands to project the future number of households accurately.

7.1 Existing Status

In 2011, there were 131,507 households in the planning area. The household growth rate over the decade ranged from over 180% to negative values. The population growth rate for most towns correlates closely, with a variance of approximately +/- 10%. The household size in the planning area is 3.9, equivalent to that of Tamil Nadu. Comparatively, the household size in the vicinity area is slightly lower than in the corporation area.

Table 7.1 Comparison of Households

Area	Average Household Size
Tamil Nadu	3.9
Chennai	4.5
Thoothukudi Corporation	3.9
Planning Area	3.9

Source: Census of India (2011)

Table 7.2 Household Decadal Growth Rate

S.No.	Towns / Villages	Taluk	2001	2011	HH Decadal Growth Rate (%)	Decadal Population	Household Size (2011)
Corporation							
	Thoothukudi Municipal Town	Thoothukudi	50,182	60,714	20.99	10.73	3.9
1	Korampallam Part-II		4,575	5,613	22.69	18.39	4.0
2	Meelavittan		7,249	11,811	62.93	49.11	3.9
3	Mullakadu Part-I		8,044	8,338	3.65	2.14	3.9
4	Pulipanchankulam		0	0	0	0.00	0.0
5	Sankaraperi		2,663	5,057	89.9	71.79	3.9
6	Thoothukudi Part-II		2,711	3,516	29.69	2.14	4.0
SUB-TOTAL (A)			**75,424**	**95,049**	**26.02**	**16.80**	**3.9**
Rest of the Planning Area							
1	Kumaragiri (CT)	Thoothukudi	2,496	3,428	37.34	21.34	3.9
2	Mapillaiyurani (CT)		6,478	10,116	56.16	46.32	4.0
3	Ayyanadaippu		668	1,168	74.85	65.30	4.0
4	Kattalankulam		595	748	25.71	19.92	3.8
5	Keelathattaparai		332	368	10.84	10.74	3.8
6	Koothudankadu	Thoothukudi	947	1,334	40.87	32.59	3.8
7	Korampallam Part I		901	1,276	41.62	29.60	3.8
8	Kulaiankarisal		925	982	6.16	-3.09	4.0
9	Maravanmadam		613	661	7.83	1.49	4.0

10	Melathattaparai		495	617	24.65	7.32	3.5
11	Mudivaithanendal		1,607	1,762	9.65	6.26	3.4
12	Mullakadu Part-II		512	550	7.42	-6.61	4.0
13	Muthusamypuram		114	244	114.04	109.95	3.6
14	Senthilampannai		38	30	-21.05	-42.13	3.4
15	Servaikaranmadam		1,090	1,148	5.32	-0.38	3.9
16	Therku Sillukkanpatti		166	187	12.65	-13.03	3.6
17	Vadakku Sillukanpatti		110	123	11.82	2.60	3.8
18	Varthagareddipatti		555	567	2.16	-7.83	3.5
19	Iruvappapuram Part-II	Eral	445	453	1.80	-6.36	3.9
20	Manjalneerkayal		274	299	9.12	-2.31	3.8
21	Maramangalam		890	980	10.11	-1.62	3.9
22	Palayakayal		1,074	1,214	13.04	7.10	4.1
23	Puthiamputhur (CT)	Ottapidaram	1,579	2,266	43.51	29.27	3.9
24	Keela Arasadi	Ottapidaram	410	523	27.56	25.63	4.2
25	Mela Arasadi		758	485	-36.02	-39.22	3.8
26	Melamarudhur		93	260	179.57	157.69	3.9
27	Pattinamarudhur		183	195	6.56	-4.39	4.1
28	Pudurpandiapuram		169	431	155.03	137.42	4.1
29	Samynatham		454	651	43.39	36.38	4.0
30	Sillanatham		391	424	8.44	-4.49	3.8

31	Sinthalakattai		551	685	24.32	10.15	3.5
32	Tharuvaikulam		1,263	1,743	38.00	18.57	4.2
33	Therkuveerapandiapuram		403	406	0.74	-2.43	3.9
34	Valasamutharam		139	134	-3.60	-13.00	3.4
Sub – Total (B)			**27,718**	**36,458**	**31.53**	**21.47**	**3.9**
Total (A+B)			**1,30,142**	**1,31,507**	**27.50**	**17.61**	**3.9**

Source: Census of India (2011)

7.2 Housing Scheme

The government has implemented a range of policies and fiscal incentives to encourage housing development from both demand and supply perspectives. With a keen awareness of the needs of urban poor populations, the government has initiated numerous programs aimed at mitigating housing shortages. These efforts predominantly target the underprivileged segments of society, demonstrating a commitment to addressing the magnitude of the housing deficit.

Figure 7.1 TNUHDB Housing at Rajiv Nagar

Several programs have been initiated to address housing needs and provide essential services to the underprivileged, including the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), the Two Million Housing Programme, the Valmiki Amedkar Awas Yojana (VAMBAY), the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), the Interest Subsidy for Housing the Urban Poor (ISHUP), the Affordable Housing in Partnership (AHIP) Scheme, and various interest subvention schemes. As a comprehensive incentive, the Government of India introduced the 'National Urban Housing and Habitat Policy (NUHHP)' in 2007, with the ambitious objective of achieving 'Affordable Housing for All' and outlining the goals and areas of action to

progress toward this aim. Both the public and private sectors contribute to housing supply in India.

The Tamil Nadu Housing Board has executed numerous projects to address housing requirements over time. Table 7.3 provides a comprehensive list of the schemes implemented by the Tamil Nadu Housing Board.

Table 7.3 TNHB Schemes

S.No.	Name of the Scheme	Extent	No. of Plots	No. of Houses
1	Sankaraperi SMT scheme	70.42	909	129
2	Sankaraperi TNUDP	29.46	1,055	-
3	Sankaraperi ADS scheme	6.77	767	-
4	Meelavitan	24.43	856	-
5	Korampallam 120	19.39	-	120
6	Anna Nagar 66	2.75	-	66
7	Ganesh Nagar 114	3.85	-	114
8	Sankaraperi 198	4.5	-	198
	Total	**161.57**	**3,587**	**627**

Source: Tamil Nadu Housing Board, Tirunelveli Division

7.3 Houseless Population

Households residing outside conventional buildings or census houses, instead living in open spaces such as roadsides, pavements, within hume pipes, under flyovers and staircases, or in places like worship areas, mandaps, railway platforms, etc., are categorized as houseless households.

Table 7.4 Comparison of Houseless Households in 2011

Area	Total Population	Houseless Population	Houseless Household	% of Houseless Population
Tamil Nadu	7,21,47,030	50,929	15,299	0.071
Chennai District	46,81,087	16,682	3,730	0.356
Thoothukudi (Rural)	1,41,905	260	87	0.183
Thoothukudi (Urban)	3,72,408	475	186	0.128

A total of 273 households, encompassing a population of 735 individuals, are currently without shelter. The percentage of the houseless population in the corporation area is 0.128%, while in the rest of the Planning Area, it stands at 0.183%. Notably, this percentage is nearly half of that in Chennai District but is twice as much as the corresponding figure for Tamil Nadu as a whole.

7.4 Projected Requirements and Proposals

The household requirement for the planning period of 2041 is calculated based on the projected population and the average household size in the planning area.

Table 7.5 Housing Requirement in the Planning Area

Description	Amount
Total Population (2011)	5,14,313
Projected Population (2041)	7,11,211
Total Number of Households (2011)	1,31,507
Average Household size	3.90
Projected Number of Households (Household Size as 3.9) 2041	1,82,361
Houseless Population	273
Total Housing Requirement	50,581

Source: Census of India; Estimates

7.5 Urban Habitat or Slum

Urban habitats are characterized as contiguous settlements where residents face challenges related to inadequate housing and basic services. The swift pace of urbanization has led to the overcrowding of many Indian

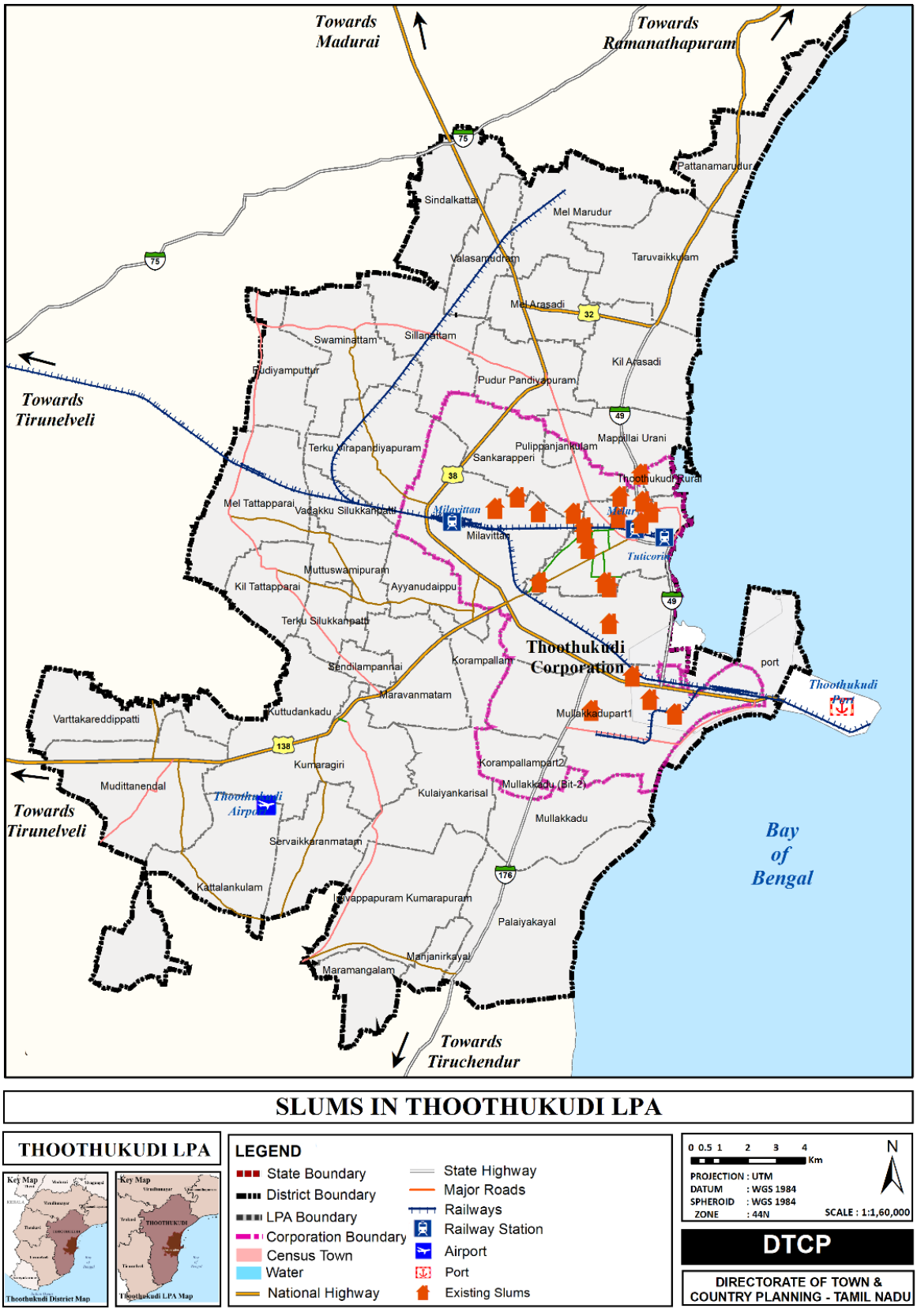
cities, primarily due to increased migration. Unutilized spaces within these cities often become occupied in unhygienic and socially fragmented ways. Notably, even in the vicinity of major city developments, these fragmented spaces tend to lack essential services, further exacerbating the challenges associated with urban living.

The government is actively proposing schemes to eliminate slums, acknowledging the pressing need for improved living conditions. As part of this effort, the Tamil Nadu Urban Habitat Development Board has been specifically designated as the Directorate for "Housing for All." The overarching vision is to transform cities into slum-free zones by the year 2023. This strategic initiative underscores the commitment to providing adequate housing and better living standards for urban residents, particularly those in vulnerable and underserved communities.

Table 7.6 Slum Details in Thoothukudi Corporation (2011)

Description	Details		
Total Population	3,72,408		
Slums Population	56,165		
% of slum Population	15		
Total Households	95,049		
Slums Households	13,736		
% of slums Households	14		
	Number	Population	Household
Notified Slums	16	47,858	11,758
Non-Notified Slums	8	8,307	1,978

The percentage of the slum population amounts to 14% of the total population. Notably, there are 16 notified slums and 8 non-notified slums. Detailed information about these slums is provided in Table 7.7.



SLUMS IN THOOTHUKUDI LPA

THOOTHUKUDI LPA

LEGEND

- State Boundary
- District Boundary
- LPA Boundary
- Corporation Boundary
- Census Town
- Water
- National Highway
- State Highway
- Major Roads
- Railways
- Railway Station
- Airport
- Port
- Existing Slums

0 0.5 1 2 3 4 Km

N

PROJECTION : UTM
DATUM : WGS 1984
SPHEROID : WGS 1984
ZONE : 44N

SCALE : 1:1,60,000

DTCP

DIRECTORATE OF TOWN & COUNTRY PLANNING - TAMIL NADU

Map 7.1Location of Slums in Thoothukudi Corporation

Table 7.7 Details of Slum

S,No	Name of the Slums	Notified / Non-Notified	Population	No. of HH's	Paved Roads (in Km)	No. of Water Taps	No. of Street Lights	Domestic Electricity Connections
1	Sundaravel Puram Ambethkar Nagar	Notified	2,940	700	2.2	47	24	630
2	Krishnarajapuram	Notified	496	118	1.3	8	4	106
3	Kandasamy Puram Sethupathai	Notified	2,173	701	1.9	47	24	631
4	K V V Nagar	Notified	3,704	882	1.6	59	30	794
5	Therespuram North Mettupatti	Notified	1,885	608	1.8	41	21	547
6	Guruspuram	Notified	1,407	335	1.9	22	11	302
7	Mangalapuram (Toovi Puram Ext)	Notified	899	214	1.2	14	7	193
8	Muthukrishnana Puram Vi Th Street	Notified	5,557	1323	3	88	44	1191
9	Madhava Nayar Colony (Theresh Puram)	Notified	2,549	607	1.6	40	20	546
10	Muthukrishnana Puram (Ponnagaram)	Notified	1,725	431	2.1	29	15	388
11	Ramarvilai	Notified	1,277	304	1.2	20	10	274
12	Toovi Puram (Anna Nagar)	Notified	11,336	2699	3.4	180	90	2429
13	Braiyant Nagar	Notified	7,081	1686	4.5	112	56	1517
14	Lokiya Nagar (Muniasamy PuramWest)	Notified	4,250	1012	3	67	34	911
15	Salt Factory Road (Near Kamaraj Salai)	Notified	62	15	0.1	1	1	0
16	Mini Sahaya Puram	Notified	517	123	0.7	8	4	111
17	Pole Pettai (T. M. C Colony)	Non-notified	470	112	1.2	7	4	101
18	Sankar Colony	Non-notified	374	89	1.2	6	3	31
19	Ceylon Colony	Non-notified	441	105	0.6	7	4	95

S,No	Name of the Slums	Notified / Non-Notified	Population	No. of HH's	Paved Roads (in Km)	No. of Water Taps	No. of Street Lights	Domestic Electricity Connections
20	Levingi Puram	Non-notified	2,793	665	1.2	44	22	599
21	George Road	Non-notified	899	214	1	14	7	193
22	Meenavar Colony	Non-notified	1,831	436	1	29	15	392
23	Annai Theresa Nagar	Non-notified	470	112	0.8	7	4	101
24	Anna Colony	Non-notified	1,029	245	1	16	8	221

Source: Thoothukudi Corporation; Census of India

7.6 Household Projection

Incorporating a housing projection within a master plan is essential to ensure the effective management of urban growth and development. This proactive approach helps to prevent issues such as housing shortages, overcrowding, and inadequate infrastructure, which can lead to social inequality, economic inefficiency, and environmental degradation. Moreover, housing projections enables tailor zoning regulations, land use policies, and investment strategies to meet diverse housing requirements, including affordable housing, mixed-use developments, and sustainable communities. Ultimately, integrating a housing projection into the master plan facilitates the creation of vibrant, resilient, and inclusive cities that provide adequate housing for all residents while promoting long-term sustainability and quality of life.

Table 7.8 Housing Projection of Thoothukudi LPA for the Year 2041

Description	Thoothukudi	Rest of LPA	Total
Population in 2011	372408	141905	514313
Projected Population 2041	509343	201049	710392
Additional Population	136935	59144	196079
Additional Households in 2041	34234	14786	49020
PMAY - Urban Sanctioned House	7758	-	7758

Description	Thoothukudi	Rest of LPA	Total
Total Household required for 2041	26476	14786	41262
Slum Households	17222	-	17222
Dilapidated Houses	265	296	560
Type of Town (in 2041) as per URDPFI	Large city	-	-
Density as per URDPFI (Hectares)	125-175	-	-
Total Additional Households in 2041	43963	15082	59044
Optimal land area per house in sq.m	320	533	-
Area requirement in Sq.km	**14.1**	**8.04**	**22.11**

From Table 7.8 the housing projection for Thoothukudi LPA is 43,963 for corporation which requires the area of 14.1 Sq. Km and Rest of LPA requires 15,082 households with area of 8.04 Sq. Km. Total area required for Thoothukudi LPA is 22.11 Sq. Km. Since the residential development in corporation is high, the projected area for corporation cannot be provided only in the corporation limits which instead can be distributed in corporation and adjacent villages.

8 PHYSICAL INFRASTRUCTURE

The foundational framework of urban systems lies in physical infrastructure, which plays a pivotal role in delivering essential services such as electricity, water supply, sewage systems, storm water drainage, waste management, energy, and telecommunications. The provision of sufficient infrastructure is indispensable for the sustainable progress of cities, as insufficient infrastructure can substantially impede the overall well-being of urban residents. It significantly influences the economic, social, and environmental conditions in urbanized cities. The increasing development and expansion exert heightened pressure on urban infrastructure, thereby necessitating strategic planning to address future requirements. This proactive approach can mitigate adverse effects, ensuring adequate service provision, environmental preservation, and fostering social equity.

8.1 Water supply

Water, being an indispensable resource, assumes a pivotal role in fostering economic growth and sustaining life. Nevertheless, the abundance of water sources is constrained, and the extant water bodies within the corporation area grapple with contamination issues.

In order to safeguard the access of the current and forthcoming populace of the corporation area to a secure and dependable water supply, a meticulous examination of the quantity and quality of available water sources becomes imperative. This scrutiny aims to pinpoint prevailing deficiencies in the water supply infrastructure, laying the groundwork for strategic planning to address current shortcomings and accommodate future demands. Additionally, it is of paramount importance to assess the efficacy of the water supply infrastructure in its entirety, encompassing treatment, storage, and distribution systems. Such a comprehensive analysis is

indispensable for informed decision-making and the sustainable management of this critical resource.

8.1.1 Existing status of water supply

Corporation Area

The main source of water is from Tamirabharani river. It is drawn from the infiltration well to the water treatment plant at ridge point at Keelavallanadu Theppam at a distance of 101.5 Km. The treated water is taken through transmission main of length 25.6 km to Rajaji park Ground level reservoir. The water is distributed to the entire planning area from this reservoir.

Figure 8.1 Korampallam Tank

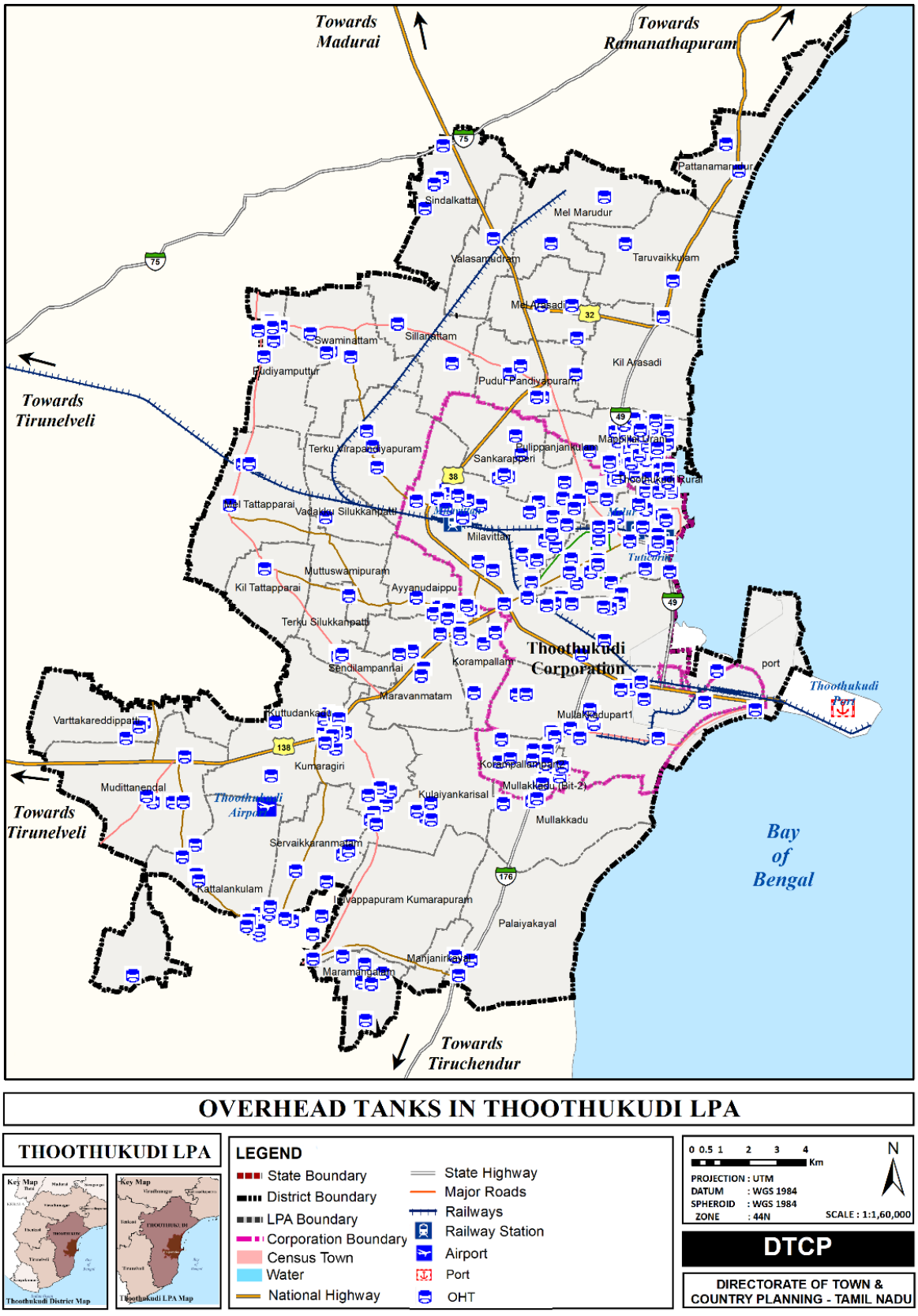
The first water supply scheme was commenced in 1938 with source from Tamirabarani river with a capacity of 9 MLD. Subsequently, two water supply schemes in 1981 and 2003 were planned with a capacity of 6 MLD and 18 MLD respectively using centrifugal pumps. In addition, the fourth water supply scheme was completed in 2012, thus making the total water supplied as 55 MLD. The depth of water level in the planning area ranges between 1-4m both during pre-monsoon and post-monsoon.

Table 8.1 Existing Water supply in Thoothukudi Corporation

Description	Details	
Source of Water Supply	Tamirabarani River	
Water supplied	55 MLD	
Design Capacity of Source	84 MLD	
Frequency of water supplied	No. of wards	Frequency
	13	Daily
	10	Alternate days
	27	Once in 3
	10	Once in 4 days
Water Supplied (litres per capita per day)	125 lpcd	
Number of Household Connections	85,469	
% of Household connections	**89.92**	

Source: TWAD board, Thoothukudi

The present population of the corporation (2021) is 3,98,869 as per Thoothukudi corporation. The water supplied for this population is calculated as 135 lpcd. with supply frequency varying from 1 to 4 days. For present population the water supply is marginally less.



Map 8.1 Location of Over Head Tank in Thoothukudi LPA

Rest of the Planning Area

TWAD Board has implemented seven water supply schemes for the rest of the planning area. The seven Combined Water supply Schemes (CWSS) were implemented in the planning area. The list of CWSS and its details are listed in Table 8.2

Table 8.2 Combined Water Supply Scheme Details

Name of the Scheme	Location of Head	Villages Distributed
CWSS for 76 habitations	Agaram	Melathattaparai, Varthagareddipatti, Vadakku Sillukanpatti
CWSS for 90 habitations	Mangalakurichi	Kulaiankarisal, Maravanmadam, Therku Sillukkanpatti, Servaikaranmadam, Samynatham, Sillanatham, Keelathattaparai, Korampallam Part-I, Koothudankadu
CWSS for 248 habitations	Seevalapperi	Mela Arasadi, Keela Arasadi, Pattinamarudhur, Valasamutharam, Sinthalakattai, Pudurpandiapuram, Tharuvaikulam
CWSS for 30 habitations	Kurangani	Manjalneerkayal
CWSS for 43 & 45 habitations	Mangalakurichi	Mapillaiyurani
CWSS for 115 habitations	Ponnankurichi	Maramangalam
3 MGD water supply scheme	Valavallan	Palayakayal

Source: TWAD Board, Thoothukudi

The quantity of water supplied to the rest of the planning area as per TWAD board is 7.675 MLD. However, the estimated supply is 8.794 MLD which is greater than the actual supply. The reason for decreased supply is because of leakage in the distribution system. The actual supply for population in the rest of the planning area is calculated as 54 lpcd, whereas the standards for water supply for rest of the planning area is 70 lpcd. The breakup of estimated and actual water supplied in each revenue village is listed in the Table 8.3

Table 8.3 Water suppled in the Planning area

No	Name of the Village	Estimated Supply in MLD	Actual Supply in MLD
Thoothukudi Taluk			
1.	Kumaragiri (CT)	0.090	0.430
2.	Mappillaiyurani (CT)	3.300	1.876
3.	Ayyanadaippu	0.230	0.220
4.	Kattalankulam	-	-
5.	Keelathattaparai	0.071	0.064
6.	Korampallam Part-I	0.236	0.230
7.	Kulaiankarisal	0.220	0.150
8.	Koothudankadu	0.230	0.200
9.	Maravanmadam	0.640	0.640
10.	Melathattaparai	0.011	0.011
11.	Mudivaithanendal	0.860	0.800
12.	Mullakadu Part-II	-	-
13.	Muthusamypuram	-	-
14.	Senthilampannai	-	-
15.	Servaikaranmadam	0.218	0.210
16.	Therku Sillukanpatti	0.048	0.045
17.	Vadakku Sillukkanpatti	0.083	0.075
18.	Varthagareddipatti	0.150	0.150
Eral Taluk			
19.	Iruvappapuram Part-II	-	-
20.	Manjalneerkayal	0.038	0.040
21.	Maramangalam	0.114	0.140
22.	Palayakayal	0.1519	0.180
Ottapidaram Taluk			
23.	Puthiamputhur (CT)	0.160	0.134
24.	Keela Arasadi	0.146	0.202
25.	Mela Arasadi	0.245	0.250
26.	Melamarudhur	-	-
27.	Pattinamarudhur	0.054	0.050
28.	Pudurpandiapuram	0.036	0.030

No	Name of the Village	Estimated Supply in MLD	Actual Supply in MLD
29.	Sillanatham	0.100	0.068
30.	Sinthalakattai	-	-
31.	Samynatham	1.000	0.950
32.	Tharuvaikulam	0.260	0.220
33.	Therku Veerapandiapuram	0.037	0.250
34.	Valasamutharam	0.065	0.060
TOTAL		**8.794**	**7.675**

Source: TWAD Board, Thoothukudi

8.1.2 Standards for Water Supply

Per capita water supply for designing of various schemes as suggested in "Manual on Water Supply and Treatment" of the Central Public Health and Environmental Engineering Organisation (CPHEEO), Government of India is stated in the Table 8.4

Table 8.4 Standards for water supply

Locality	Water Supply (lpcd)
Towns provided with piped water supply but without sewerage system	70
Towns provided with piped water supply but with sewerage system & Towns adjoining the boundary of Corporation	90
Municipalities provided with piped water supply without sewerage system	90
Municipalities provided with piped water supply with sewerage system	**135**

Source: CPHEEO Guidelines

Thoothukudi with its industrial activities and populations are increasing and standards of living of local population are increasing. In view of this condition, the criteria used for fixing the water supply norms includes 100 % household shall be supplied with piped filtered water by the year 2041. Per capita gross domestic water requirement inclusive of industrial, commercial,

institutional, and firefighting works out to 135 and 70 lpcd for corporation and rest of the planning area respectively.

8.1.3 Projected Requirements

The requirement is calculated as per the CPHEEO Guidelines i.e., water should be supplied at the rate of 135 lpcd for urban and 70 lpcd for rest of the planning area. After adding the demand of total population, the total requirement for 2041 is estimated around 82.89 MLD as shown in Table 8.5

Table 8.5 Projected Water Supply for Demand for Thoothukudi Corporation

Description	Thoothukudi Corporation		
	2021	2031	2041
Population	418053	463698	509343
Domestic Demand water Supply at 135 LPCD and 55 LPCD	56.43	62.59	68.76
Demand for Public Places at 20 LPCD (Floating Population)	8.36	9.27	10.19
Sub Total (Domestic Demand + Public Places)	64.79	71.86	78.95
Fire Demand 1% of Total Water Demand	0.65	0.72	0.79
Total Demand (MLD)	65.44	72.58	79.74
Existing Water Supply (MLD)	55	55	55
Gap (MLD)	**10.44**	**17.58**	**24.74**

Table 8.6 Projected Water Supply for Demand for Thoothukudi Rest of LPA

Description	Rest of LPA		
	2021	2031	2041
Population	161083	181066	201049
Domestic Demand water Supply at 135 LPCD and 55 LPCD	21.74	24.44	27.14
Demand for Public Places at 20 LPCD (Floating Population)	3.22	3.62	4.02
Sub Total (Domestic Demand + Public Places)	24.96	28.06	31.16
Fire Demand 1% of Total Water Demand	0.25	0.28	0.31
Total Demand (MLD)	25.21	28.34	31.47
Existing Water Supply (MLD)	7.67	7.67	7.67
Gap (MLD)	**17.54**	**20.67**	**23.80**

8.1.4 Key Issues

- The water is not supplied on a daily basis to all the wards.
- The frequency of water supplied varies across various wards. The inequitable supply results in need for storage of water in each household.
- Newly developed and peripheral areas lack portable piped water supply system.
- 10% of the household in the corporation lack direct water supply.
- Unaccounted water supply attributing to the lack of metered supply.
- The distribution system in the rural area faces increased transmission loss.

8.1.5 Potentials

- The per capita supply is 125 lpcd at the present population growth.
- The estimated plan period demand is 82.89 MLD for the planning area.
- Water supply head works designed capacity of 84 MLD of the corporation is more than sufficient to the plan period. In addition, TWAD is supplying water to the rest of the planning area.
- The ground water table in most of the corporation area is 2 to 4 meters.
- Water quality and salinity varies from one area to another.

8.1.6 Policies and Proposals

Water **source augmentation** is a critical consideration for urban areas as the demand for water continues to increase. Mainly the source identification is the primarily step. Alternatively, this can be achieved through various

means, including groundwater recharge, rainwater harvesting, and the reuse of wastewater.

The **installation of water meters** provides accurate and reliable data on water usage, which can be used to identify leaks, detect abnormal consumption patterns, and improve water management. Proper planning and communication with stakeholders are crucial for the successful implementation of water metering programs. Overall, water metering is a critical tool for effective water management, helping to ensure a sustainable and reliable water supply for communities.

8.2 Sewerage and Sanitation

The Urban Local Body is responsible for providing sewerage facilities, which involves collecting wastewater from households and other built-up areas. The collected sewage is then treated in a designated treatment plant to ensure that it is safe for disposal. Proper collection and treatment of wastewater is essential for maintaining public health and hygiene in an urban area. Therefore, the provision of sewerage facilities is a critical aspect of urban infrastructure development

8.2.1 Existing Status

The sewerage system in the planning area is designed to cater to the wastewater collection and management needs of the residents. The system comprises both underground sewerage and septic tank systems. The underground sewerage system was planned in 1985 and is designed to collect wastewater from households and other built-up areas.

Figure 8.2 Open Drain in Thoothukudi Corporation

The sewerage network system in the corporation is laid over different phases. In certain areas, septic tanks are used as an alternative to underground sewerage systems.

The collected wastewater is transported to a designated Sewage Treatment Plant (STP) for treatment before disposal. The STP with an oxidation tank is located at Tharuvaikulam, approximately 10 km from the town on Mandapam Road, in an area of nearly 500 acres. The STP has recently been improved with a capacity to 28 MLD.

Figure 8.3 STP at Thuruvaikulam

Table 8.7 Details of Sewage Generation and Treatment

Description	Thoothukudi Corporation
Quantity of Water supplied (MLD)	50
Estimated Transmission Loss (MLD)	5.0
Estimated Sewage Generation (MLD)	47.71
Existing STP capacity (MLD)	28
Existing STP Coverage (%)	56.59%
Length of UGSS in km	112.36
Percentage of UGSS (%)	**18.11%**

The underground sewerage system provides an efficient and convenient means of collecting and transporting wastewater to the treatment plant, ensuring the safety of public health and the environment.

Table 8.8 Sewerage (Covered UGSS) in Corporation

No	Locality	No of Wards
1.	**North zone**	8
2.	**South zone**	1
3.	**East zone**	14
4.	**West zone**	**11**

8.2.2 Projected Requirements

Generally, 80% of water supply to be assumed to be generated as sewers. Therefore, sewers are proposed to be designed for a minimum waste water flow of 110 litres per capita per day throughout the design period. The sewage generation for the projected population for the plan period 2041 for Planning Area is tabulated in Table 8.9

Table 8.9 Projected Requirements for Thoothukudi LPA

Description	Projected Water Supply in MLD		Projected Sewage Generated in MLD		Existing Capacity of STPs in MLD	Additional Requirement 2041 in MLD
	2031	2041	2031	2041		
Thoothukudi Corporation	72.58	79.74	58.06	63.79	28	35.79
Rest of LPA	28.34	31.47	22.67	25.18	No STP	25.18

8.2.3 Key Issues

- Area without UGSS network dispose the wastewater into the Buckle canal that deteriorates the water quality and environment.
- Open Drain sewage system as shown in figure 40 disrupts the streetscape and emits bad odour in the streets.
- The sewerage network coverage is very low.

8.2.4 Potentials

- The existing facility has space for expansion in the future.
- Additional STP construction is proposed in the corporation.

8.2.5 Policies and Proposals

The **Installation of a Faecal Sludge Treatment Plant (FSTP)** to treat the waste generated from septic tanks in areas where the underground sewerage system is not feasible. The FSTP will ensure that the waste generated from septic tanks is treated safely and efficiently, preventing contamination of the environment and ensuring public health and safety.

Provision of Underground Sewerage System (UGSS) for 100% of the planning area. The UGSS will be designed to cater to the needs of the existing population and projected future growth.

The **provision of a collection and proper disposal mechanism** for the waste generated from households and other built-up areas. The collection mechanism will ensure that the waste generated is collected and transported to the designated treatment plant, preventing the contamination of the environment and ensuring public health and safety.

8.3 Storm Water Drainage

The management of storm water drainage in urban areas is essential to mitigate the risks of flooding and manage the run-off of rainwater in a systematic manner. Effective storm water drainage systems can significantly enhance the recharge of groundwater and surface water, thereby ensuring adequate water availability in the long run. Hence, a well-structured planning and implementation approach is required for storm water drainage systems. The recommendations of Storm water drainage systems Report by MoHUA and CPHEEO are considered for preparation of SWD system.

8.3.1 Existing status of Storm Water Drainage

The process of rainwater falling onto land and subsequently flowing off the surface is known as storm run-off. In the planning area, the water flows along streets and roads through both closed and open drains in order to prevent stagnation and flooding in low-lying areas. Unfortunately, many urban areas experience hindrances to the natural flow of storm water due to man-made structures and human activities, as well as the effects of climate change, such as changes in the intensity and duration of rainfall.

Table 8.10 Existing Strom Water Drain in Thoothukudi Corporation

Description	Length in Km
Drains (Closed)	48.09
Drains (Open)	142.68

Description	Length in Km
Length of Road	620.26
% of Roads with Drain	**30.76%**

In the corporation, the total length of storm water drain is 190.77 km, of which constitutes about 30% of the total roads. The natural drain order along with macro and micro drainage has been depicted in Figure 8.4, which was created using SRTM-DEM data.

Figure 8.4 Buckle Canal near Collector Office

Figure 8.5 Buckle Canal near Sundaram Arulraj Hospital

The buckle canal is the major drain facility intended to carry storm water only. Those drains and the buckle canal carry large quantity of waste water, sludge, sewage and untreated effluents from various localities/ habitations situated and from the other parts of the city. The Buckle canal near the collector office (Figure 8.4) observed to be clean. The water downstream collects all the grey water and waste in certain area, thereby it is polluted. With proper drain and prohibiting waste disposal in the canal can rejuvenate the vista of the canal and acts as a storm water drain. In Thoothukudi Corporation, there is lack a designed storm water draining arrangement except the buckle canal as shown in Figure 8.5.

Thus, the existing Storm Water drainage system is observed to be inadequate and does not effectively drain the flood water during heavy rains resulting in the stagnation of rain water in many low laying areas of the city. The effective rain water harvesting implementation with more unpaved public space with a possibility of penetration can aid the ground water recharge and control of water stagnation.

Natural Drain Analysis

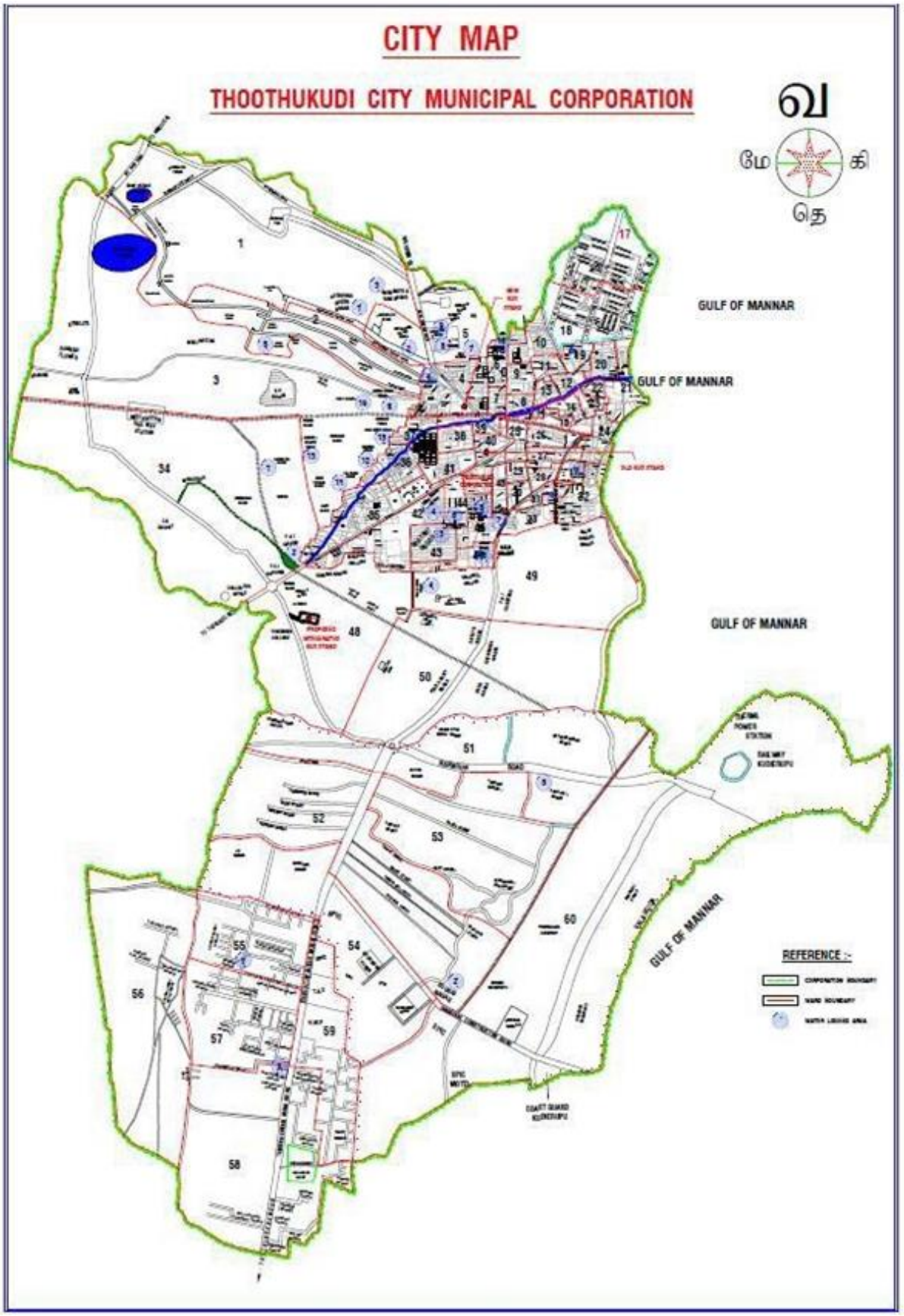
As Thoothukudi has water logging issues, the study attempted to study more detail about the drain pattern of the city and the planning area. The water logging issue is mainly due disruption in the natural drain. It is because of man- made development like rail, road, buildings, etc.

Macro Drainage

The natural drain pattern is generated using SRTM DEM (Digital Elevation Model) version (3). The stream order is generated for the planning area. It is categorised 1 to 5. The level 1 is the starting point of the drain. The multiple level 1 joins together to generate level 2. Subsequently, all the order till level 5 follows which shows major canals and rivers. The major drains in the planning area are Korampallam river or Uppar Odai, Mullakadu Odai and Tamirabarani river. The majority of the planning area falls under Kallar Basin, while the southern edge of the planning area falls in Tamirabharani river basin.

Each Drainage has its different catchment levels. Soil and Land use survey department has created watershed or catchment level to sub-catchment area. The same created for the planning area with its watershed code.

In the corporation, Tamirabarani in the south section of the planning area, Buckle canal, and Madagiri River each play important roles as a macro drain. The macro drainage clearly shows that the drainage in the north-western part of the corporation is affected leading to water-logging. The rail line and missing water body links to development leads to the disruption.



Map 8.2 Water Logging Area in Corporation

Macro Drainage

To overcome the water logging issue, the corporation is implementing storm water drain measures in four phases. Three phases are completed and the fourth phase work is in progress. The highlights of the measures carried out are listed below:

- Construction of drain from Buckle canal to Korampallam canal via Bye-pass
- Storm water drainage Basin near the railway station at Meelavittan

The southern area in the corporation has a very low water table which leads to a high likelihood of water logging.

8.3.2 Change in River Course

The course of the river tends to shift throughout time as a result of the hindrance like rocks, bunds on their banks. It is easy to realise that rivers would choose the simplest and least resistive channel in plain places. The river will follow the course that is easiest to erode and cut through. The obstacle in the river bed changes the pace of the river's flow. When river banks and beds erode, the river becomes broader and steeper.

Korampallam river runs in Keelathattaparai in the northwest to southeast direction by dividing into two streams. The bund obstructs the eastern stream of the river. The flow in the eastern streams has reduced to minimal over the past few decades. There is a change in the flow which has also widened in the western stream. However, the cadastral maps reflect the previous river course in the past decades. This change requires to be updated in the relevant maps.

8.3.3 Standards for Strom Water Drainage

The existing storm water drainage system parameters benchmarked against the normative/standard requirements or service levels as prescribed by reference guidelines/standards such as PWD/CPHEEO guidelines,

prevalent level of services in similar cities with functional (good) urban infrastructure is furnished in the Table 8.11. For rest of the planning area, proper drains are constructed to discharge storm water drained in all streets to the nearby water bodies.

Table 8.11 Normative Standards prescribed for Storm Water Drainage

No.	Service Indicator	Normative Standard
1.	Road length covered with storm water	130
2.	Pucca Drains (Open & Closed)	100
3.	Road length covered with Pucca drains	130

Description	Length (in Km)
Total Drain (Open and Closed)	190.77
Total Road Length	620.26
Minimum Length of Strom Water Drain is 100% of Length of Road	
Water Drain Coverage (120 - 150 % Ideal Condition)	930.39
Gap in Strom Water Drainage	739.62

For Strom Water drain, the total length of open and close drain is 190.77 Kilometres. The total road length in Thoothukudi LPA is 620.26 Kilometres. Minimum storm water drain length to be covered for the planning area is 100%, Ideal condition for storm water drain coverage is 120 to 150 %. But in case of Thoothukudi there is only 20% of the Local planning area is covered with storm water drain. The gap of 739.62 Kilometres is observed for storm water drain in Thoothukudi LPA.

8.3.4 Key Issues

- Natural water drain pattern has been interrupted due to man-made development. The city has more open and closed drain system. Which generates bad odour in most of the street in the corporation.
- During the rainy season water logging and locking are one of the major issues in the planning corporation.
- During the rainy season water logging and locking are one of the major issues in the planning corporation.

8.3.5 Potentials

- Buckle canal rehabilitation work is undertaken under smart city mission.
- As Thoothukudi is located on the coast, the water flows towards Bay of Bengal.
- Linkage between the buckle canal and storm water drainage network can ensure an effective storm water network.

8.3.6 Policies and Proposals

The city has only 30 percent of open and closed drains which can be increased to **100% closed drain network**. Water logging and flooding can be avoided by **linking of water bodies** and diverting overflow to the water bodies.

8.4 Solid Waste Management

Solid waste management is a crucial infrastructure provided by Urban Local Bodies (ULBs) that requires effective planning, implementation, and monitoring. In the Corporation area, approximately 180 tonnes of solid waste are generated daily. To address this issue, the segregation of waste at the source is proposed through the provision of household bins and daily clearance of waste using an adequate number of bins and vehicles.

Additionally, the construction of sanitary landfills for the storage of accumulated waste, including non-recyclable waste, has been completed. Organic waste will be converted into bio-manure, while recyclable waste will

be sent for reuse. These measures are intended to promote sustainable solid waste management practices in the Corporation area.

8.4.1 Existing Status

The daily waste generated in the region is classified into three categories, namely dry, wet, and hazardous waste. The amount of waste generated in each category is 97, 76, and 7 metric tons, respectively. The per capita waste generation rate is estimated to be 483 grams per day.

The collection of waste is carried out by a team of sanitary workers who employ a variety of transportation methods, such as pushcarts, tricycles, auto rickshaws, and bins of varying sizes. The collected waste is then transported to the dump yard by tipper Lorries and tractors. It is noteworthy that the capacity of the secondary collection vehicle is inadequate to handle the waste load.

Table 8.12 Existing status of Solid Waste Management in Corporation

Description	Details	
Existing Waste Generation (tonnes)	180	
Per capita Waste (grams)	483	
Classification	Dry	97
	Wet	76
	Inert	2
	Others	5
Method of Collection	Door-to-Door	
Method of Composting	Aerobic Method Vermicomposting	
Composting Facilities	Micro-compost Centres (MCC)– 17	
Capacity of MCC (MT)	67	

Source: Thoothukudi Corporation

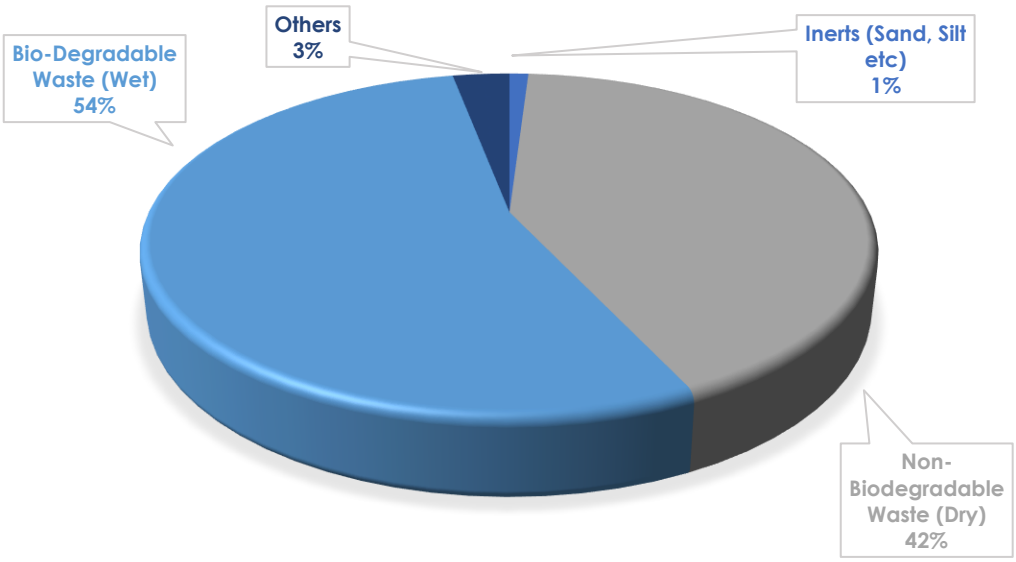


Figure 8.6: Waste Categorisation

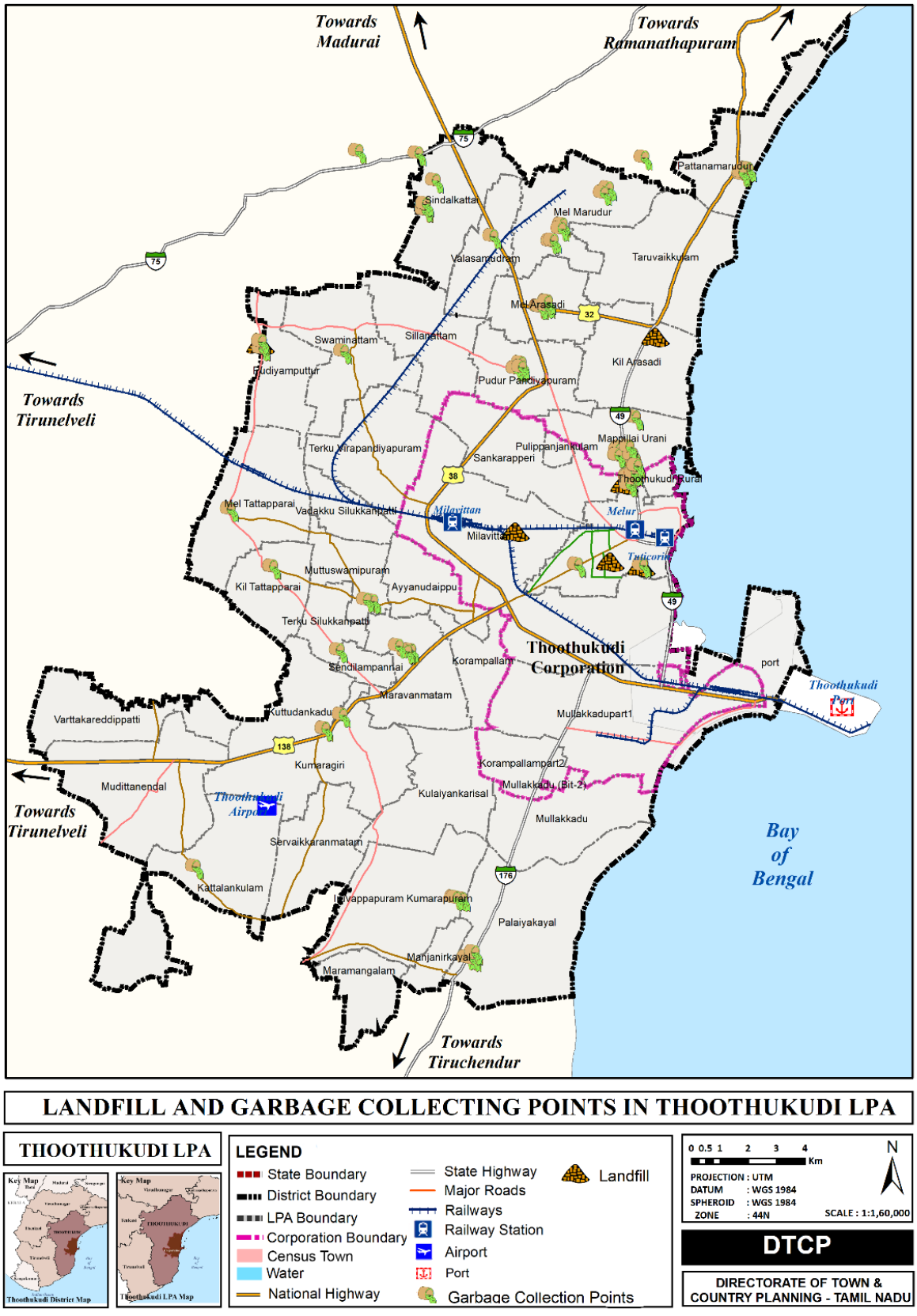
The waste collected is segregated and treatment at Micro compost Centres (MCC) in the planning area. 17 Micro level compost centres (MCC) are located in the corporation with 67 MT capacity. The details of the composting centres are listed in the Table 8.13.

Table 8.13 Compositing Centres

Plant Type	No of Plants	Total Capacity MT
Micro Composting Centres (MCC)	17	67
OCC (On-Site Composting Centre)	42	12
Bulk Waste Generator (BWG)	89	12

Source: Thoothukudi Corporation

The waste from surrounding villages is collected door-to-door through vehicles and dumped in vermicomposting yard in which the wastes are segregated as biodegradable and non-biodegradable waste.



LANDFILL AND GARBAGE COLLECTING POINTS IN THOOTHUKUDI LPA

THOOTHUKUDI LPA

LEGEND

- State Boundary
- District Boundary
- LPA Boundary
- Corporation Boundary
- Census Town
- Water
- National Highway
- State Highway
- Major Roads
- Railways
- Railway Station
- Airport
- Port
- Landfill
- Garbage Collection Points

0 0.5 1 2 3 4 Km

N

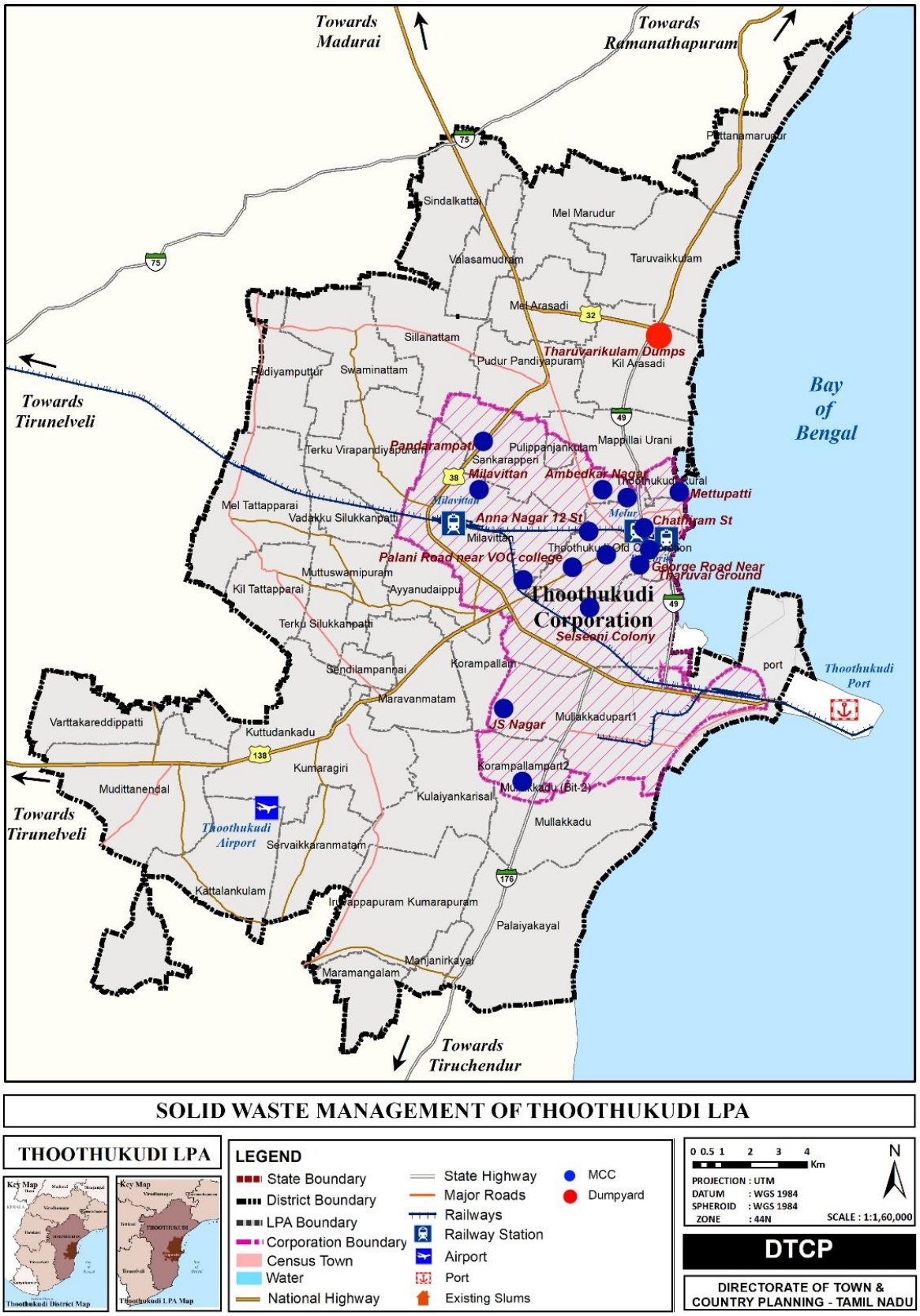
PROJECTION : UTM
DATUM : WGS 1984
SPHEROID : WGS 1984
ZONE : 44N

SCALE : 1:1,60,000

DTCP

DIRECTORATE OF TOWN & COUNTRY PLANNING - TAMIL NADU

Map 8.3 Landfill and Garbage Collection Points in Thoothukudi LPA



Map 8.4 Solid Waste Management Facilities

8.4.2 Standards for Solid Waste Management

Norms and standards for solid waste management and Service Level Benchmarks (SLBs) given by MoHUA for SWM are considered while calculating the future waste generation which include 100% households shall be covered by daily collection system and segregated at the source of households and establishment into dry and wet waste. Also 100% of the collected waste will be recycled/ processed.

8.4.3 Projected Requirements and Proposals

The per capita generated in the existing scenario is taken for the projection of waste generated in the future. The waste generation of the projected population for the plan period 2041 for the Planning Area is tabulated in Table 8.14.

Table 8.14 Projected Waste Generation in Corporation

Projected Requirement for solid Waste Generation for Thoothukudi Corporation					
Year	**Population**	**NEERI Standard (Kg/Capita/day)**	**Quantity of Waste Generated (TPD)**	**Existing Capacity of Composting Yard**	**Additional Capacity Required in 2041**
2011	372408	0.5	186	92	**94**
2021	418053	0.5	209	92	**117**
2031	463698	0.5	232	92	**140**
2041	509343	0.5	255	92	**163**

Projected Requirement for Solid Waste Generation			
Local Body	**Projected Population (2041)**	**NEERI Standards (Kg/Capita/Day)**	**Projected Quantity of Waste Generated (TPD) 2041**
Thoothukudi Corporation	509343	0.5	**255**
Villages	201049	0.2	**40**

8.4.4 Key Issues

- Disposal of waste on roadside due to lack of awareness in the collection system.
- MCC is functioning in 17 points which tends to expand. waste processing methods are usual dumping and decomposing.

8.4.5 Potentials

- Door-to-Door waste is collected effectively. It is observed that there are very minimal dustbins.
- Waste collection 100 percent is satisfactory and the dump site located in Tharuvaikulam.
- Biomining method of waste processing will help corporation to processing the waste in faster and generates revenue to the corporation which is under construction.

8.4.6 Policies and Proposals

Solid waste management in the corporation is satisfactory. **100% collection and processing the waste** is a good indicator of service. Waste collection by door to door and segregated waste are transferred to MCC and OCC and the rest transferred to Compost yard in Tharuvaikulam.

Currently **vermicomposting** method of composting is happening. Under smart city scheme Biomining process is proposed. **Biomining process** is one of the successful waste processing and also revenue making process. The main advantage of the process is that it can process large quantity of waste and minimal land requirement. The process of reuse of plastic through **RDF (Refuse Derived Fuel)** can be explored in the planning area.

8.5 Electricity

Access to electricity is a fundamental necessity for every household, and the availability of a reliable power infrastructure is crucial to sustain industrial and commercial activities within a planning area. In the planning area, TANGEDCO generates power from both renewable and non-renewable sources, which is subsequently distributed to industries and households.

To assess the adequacy of the existing power infrastructure, an evaluation was conducted to compare the capacities of the nine existing substations, which currently have a combined capacity of 363 kilovolts, with the anticipated future requirements of the corporation. It was concluded that the current substation capacities are sufficient to meet the power demands of the present population. The number of substations in the corporation is listed in Table 8.15.

Table 8.15 TNEB Sub-station in the Corporation

S.No	Substation Name	Capacity in KV
1	Auto SS Muthiapuram	110
2	Auto SS Muthiapuram	22
3	SIPCOT SS (Meelavittan)	110
4	Town SS	22
5	SIPCOT SS	22
6	Ayyanarpuram SS	22
7	Ayyanarpuram SS	11
8	Arasady SS	22
9	Beach Road SS	22
Total		**363**

Source: TNEB, Thoothukudi

The total power requirement for the projected population 5,09,343 is estimated as 374KV based on URDPFI guidelines, one substation for every 15,000 population with 11KV capacity.

Table 8.16 TNEB Substation in the Planning area

S.No	Substation Name	Capacity in KV
1	Vagaikulam SS	22
2	Vagaikulam SS	22
3	Vagaikulam SS	33
4	Manjaneerkayal SS	11
Total		**88**

Description	Current Scenario
Population 2011	514313
No. of Sub Station Existing within LPA	13
Capacity of Existing Sub-Station (In KV)	451 KV
Projected Population 2041	710392
Additional Population	196079
As per URDPFI Guidelines 11 KV Sub-Station serves for every 15000 Population	
No. of Sub-Station, Capacity (110/33-11 Kv) Required for Projected Population 2041	13
Land area required for Power Infrastructure for future population in Ha	0.65 Ha

The power production of country consists of 60.90 % of non-renewable energy, which is not sustainable. It is recommended to encourage the use of renewable energy.

9 SOCIAL INFRASTRUCTURE

Social infrastructure encompasses a diverse array of constructed facilities, services, and networks of organizations aimed at fostering community well-being. These community facilities include schools, hospitals, police/fire/ambulance stations, child-care centres, youth facilities, cultural amenities such as libraries and theatres, recreation and sporting facilities, accommodations for older individuals, public transport, pedestrian/walking trails, bike paths, and social (non-private) housing. In addition to physical structures, social infrastructure extends to community services such as health services, children's and family services, aged care services, disability services, multicultural services, youth development, welfare and support services, housing services, and employment and training services. The concept further encompasses community services networks, including inter-agency groups that collaborate to address various societal needs and challenges.

9.1 Educational Facilities

Educational facilities play a vital role not only in shaping individual personalities but also in driving the development of cities and regions. The current status of educational infrastructure is analysed to evaluate its adequacy, which is elaborated upon in the following section.

9.1.1 Existing Status

Government schools in the planning area maintain an average pupil-teacher ratio (PTR) of 24. According to the school education records for the academic year 2020-21, the total enrolment in schools (from I to XII) is 95,533, constituting approximately 18% of the total population. The School Education Department actively implements schemes and special programs to enhance student engagement in studies, with the overarching goal of increasing the literacy rate.

The planning area is home to a total of 335 schools, encompassing both public and private institutions. Among these, there are 103 government schools and 232 private schools. The distribution of schools across various categories is detailed in Table 9.1. Schools are further classified into primary, middle, high, and higher secondary categories based on the classes they teach, namely (I-V), (V-VII), (I-X), and (XI, XII), respectively.

Table 9.1 Number of Schools in the Planning Area

Description	Government School				Private School	Total
	Primary School	Middle School	Higher Secondary School	Total		
Corporation	15	15	3	33	170	203
Rest of LPA	52	13	5	70	62	132
Total	**67**	**28**	**8**	**103**	**232**	**335**

Source: District Education Office, Thoothukudi

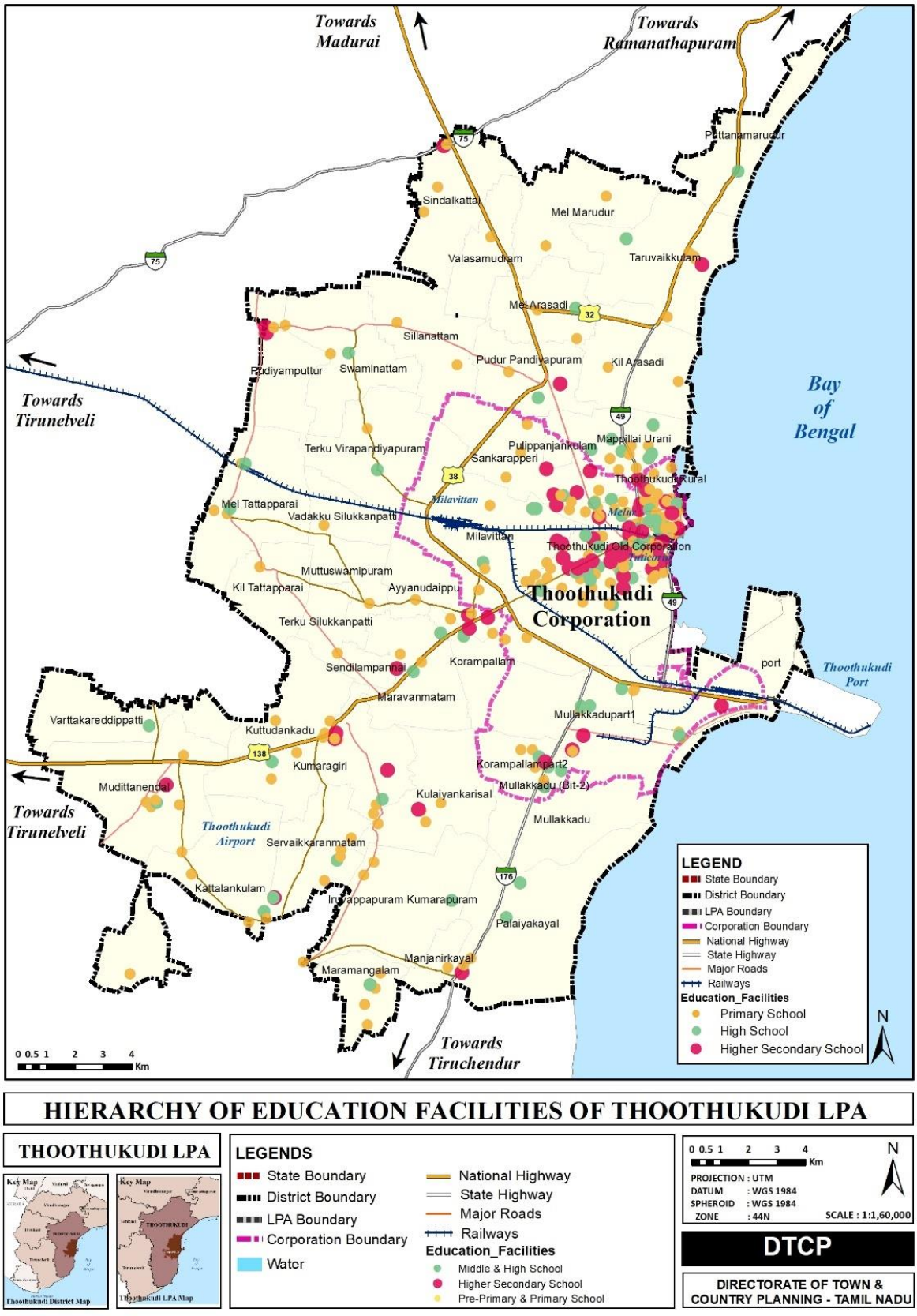
Higher education, particularly at the college and university levels, plays a pivotal role in building capacity within a population. It goes beyond mere subsistence, laying the foundation for a higher quality of life. Higher educational institutions include colleges, universities, professional training institutions, and all related centres. The presence of such educational institutions should ideally contribute to job activities by fostering the development of skilled labour in the respective area.

According to the URDPFI guidelines, it is recommended that for every 1.25 lakhs of the population, one college should be provided. The details of higher education institutions in the planning area are outlined in Table 9.2. This information likely includes the various colleges and universities contributing to the educational landscape of the region.

Table 9.2 Number of Colleges in the Planning Area

S.N0	Name of Higher Education Institutes	Typology of Education
1	University VOC College of Engineering	Engineering
2	Grace College of Engineering	Engineering

3	Fisheries and research college	Fisheries college
4	Government Medical college	Medical College
5	V.O.C College Art and Science	Arts & Science
6	Annammal College of Education	Arts & Science
7	A P C Mahalakshmi woman College	Arts & Science
8	Kamaraj college Art and Science	Arts & Science
9	St.Marys Woman College	Arts & Science
10	V.O.C. College of Education	Arts & Science
11	St.Thomas College of Education	Arts & Science
12	Chandy College of Education, Muthiahpuram.	Arts & Science
13	Holy cross Home Science College	Arts & Science
14	Rosammal Memorial Teacher Trainning Instiute.	Arts & Science
15	Ebenezer Teacher Trainning Instiute.	Arts & Science
16	BMC Teacher Trainning Instiute.	Arts & Science
17	Arignar Anna Teacher Trainning Instiute, Toovipuram	Arts & Science
18	Government Polytechnic	Polytechnic
19	Chandy Polytechnic College	Polytechnic
20	Tamil Nadu Maritime Academy	Arts & Science



HIERARCHY OF EDUCATION FACILITIES OF THOOTHUKUDI LPA

Map 9.1 Educational Institutions in Thoothukudi LPA

9.1.2 Standard for Education Facilities

The URDPFI (Urban and Regional Development Plans Formulation and Implementation) guidelines provide recommendations for educational facilities based on the population. These standards serve as a framework to maintain a hierarchy in educational facilities. The specifics of these standards and the corresponding hierarchy are detailed in Table 9.3

Table 9.3 URDPFI Standard for Educational Facilities

SNo.	Schools	Standard	Area Requirement (HA)
1	Primary School (I-V)	1 per 5000 population	0.4
2	Higher Secondary School (VI-XII)	1 per 7500 population	1.8
3	College	1 per 2.5 lakhs Population	5

Source: URDPFI Guidelines

9.1.3 Projected Requirements and Proposals

The population projected for the span of 20 years to the period of 2041, to accommodate the projected requirements for the additional primary and senior secondary schools need to be planned. This can be achieved either by establishing new schools or by enhancing existing ones to accommodate the increasing number of children in the population. Following the recommendations of the URDPFI guidelines, the projected number of schools required based on the population is tabulated in Table 9.4. This table likely outlines the estimated number of primary and senior secondary schools needed to adequately cater to the educational needs of the projected population by 2041.

Table 9.4 Projected Educational Facilities in Planning Area

Types of School	Population Served	Existing as on 20111	Projected School Required Based on the Projected population		
			2011	2021	2031
Primary School (I - V)	5,000	67	116	130	143

Types of School	Population Served	Existing as on 20111	Projected School Required Based on the Projected population		
			2011	2021	2031
Middle and Higher Secondary School (VI-XII)	7,500	36	78	87	95

9.1.4 Key Issues

Several challenges and disparities in the education sector are apparent from the given information:

Low Enrolment Rate in Government Schools:

The enrolment rate in government schools is reported to be low. This could signify issues related to accessibility, quality of education, or preferences among the population for private educational institutions.

Gender Disparities in Literacy Rates:

The data indicates that the female literacy rate is lower than the male literacy rate in both urban and rural areas. This points to gender-based disparities in educational opportunities and access, reflecting the need for targeted interventions to address this imbalance.

Insufficient Education Facilities:

The number of existing education facilities falls below the prescribed standards. This shortage of educational infrastructure may result in overcrowded classrooms, inadequate resources, and an overall compromised learning environment. Addressing this issue is crucial to providing quality education for the population.

Addressing these challenges requires a comprehensive approach, including initiatives to improve the appeal and quality of government schools, targeted measures to enhance female education, and investments in

expanding and upgrading educational facilities to meet prescribed standards.

9.1.5 Potentials

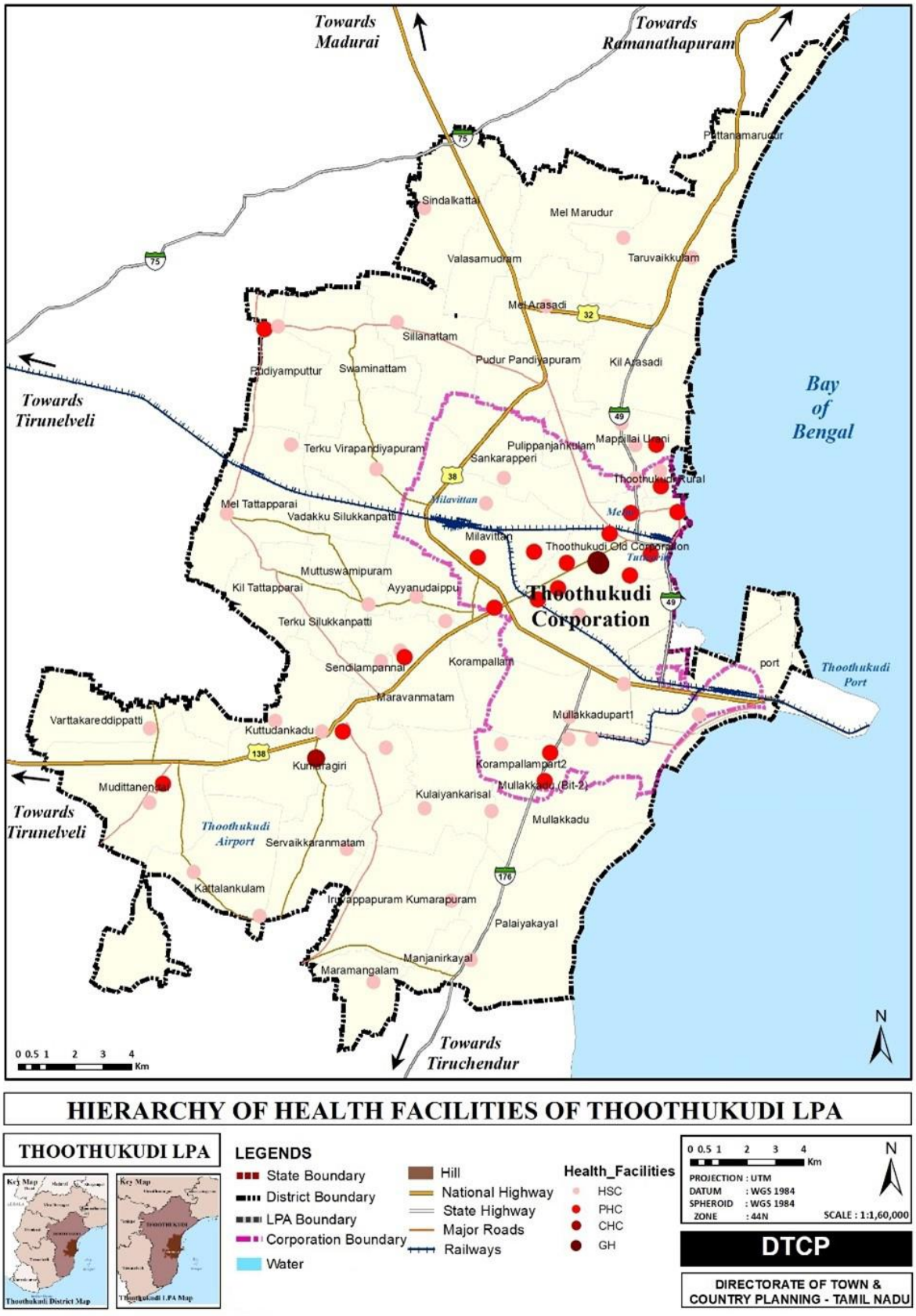
- The total number of colleges is deemed adequate, suggesting that there may not be an immediate need for additional higher education institutions.
- To address the increasing demand for education at the primary and middle school levels, it is proposed to upgrade existing primary and middle schools. This approach leverages existing infrastructure and resources while ensuring that educational facilities can accommodate the growing population and demand for education services. Upgrading these schools may involve improving facilities, enhancing teaching quality, and expanding capacity to meet the needs of students effectively.

9.2 Health Facilities

Health planning is a crucial component of overall development planning, as the health of the population serves as a key indicator of human resource development. Investments in the health sector are essential for ensuring the well-being of the population and driving socio-economic progress. Tamil Nadu, with its significant investments in healthcare, consistently ranks among the top states in India in terms of health indicators. This reflects the state's commitment to prioritizing public health and underscores the importance of ongoing investments in healthcare infrastructure, services, and programs to sustain and improve the health outcomes of its residents.

9.2.1 Existing Status

Access to healthcare is characterized by the ability to obtain healthcare services of a specified standard at reasonable cost and convenience.



Map 9.2 Existing Health care facilities in Thoothukudi LPA

In the Thoothukudi Corporation, there exist two government hospitals, along with seven primary health centers in urban areas and four in rural areas. Additionally, thirty health sub-centers are strategically located within the Planning Area. A veterinary polyclinic is situated in the New Colony of Thoothukudi, while a veterinary dispensary is located in Mapillaiyurani.

Table 9.5 Details of Existing Health Facilities in Planning Area

Type of Health Facilities	Urban	Rural	Total
Government Hospital	1	-	1
Urban Primary Health Centre (Urban)	7	-	7
Urban Primary Health Centre (Rural)	-	4	4
Health Sub-centre	-	30	30

Source: JD, Health Department, Thoothukudi

9.2.2 Standards for Health Facilities

The URDPFI guidelines and IPHS standards advocate for the establishment of one health sub-centre per 5,000 population. Similarly, in urban and rural areas, each Primary Health Centre is recommended to serve populations of 50,000 and 30,000, respectively. Furthermore, for every 250,000 population, the planning should include a hospital with more than 100 beds.

9.2.3 Projected Requirements and Proposals

Table 9.6 showcases the required number of health facilities based on the projected population.

Table 9.6 Requirements of Health Facilities for 2041

Type of Health care Facilities	Population	Existing Type of Health Facilities	Health Facility Required		
			2021	2031	2041
Government Hospital	2,50,000	1	2	3	3
Urban Primary Health Centre (Urban)	50,000	7	8	9	10
Primary Health Centre (Rural)	30,000	4	5	6	7
Health Sub-centre	5,000	30	32	36	40

Source: Joint Directorate of Health Services, Thoothukudi

9.2.4 Key Issues

The absence of infrastructure within existing health facilities poses a critical challenge to providing quality healthcare services. Without adequate infrastructure, healthcare facilities may struggle to meet the needs of patients effectively. This could include insufficient medical equipment, outdated

facilities, inadequate space, and a lack of essential resources for patient care. Addressing this issue is paramount to ensuring that healthcare facilities can deliver the necessary services to the population and improve health outcomes. Investing in infrastructure improvements and modernization efforts within existing health facilities is essential to enhance their capacity and quality of care provided.

9.2.5 Potentials

As a district, the planning area typically hosts higher-order healthcare facilities. These facilities are equipped to provide specialized medical services and advanced treatments, catering to the healthcare needs of the population at a more comprehensive level. Examples of higher-order healthcare facilities may include district hospitals, specialty hospitals, and tertiary care centers. These institutions play a crucial role in addressing complex medical conditions, conducting surgeries, and providing specialized treatments that may not be available at lower-level healthcare facilities. Their presence within the planning area ensures that residents have access to a wide range of medical services and expertise, contributing to better health outcomes for the community.

9.3 Recreational Facilities

Parks hold a significant and multifaceted role in the urban landscape. Beyond serving as spaces for traditional recreational activities, urban parks serve as havens from the hustle and bustle of city life. They provide people with a retreat where they can unwind, relax, and escape the urban environment. Additionally, parks offer opportunities for socialization, acting as communal spaces where individuals and communities can gather, connect, and foster a sense of belonging.

One of the key aspects of urban parks is their ability to bring people in contact with nature, even in the midst of urban development. These green spaces contribute to the overall well-being of city residents by providing a

connection to natural elements, enhancing mental health, and offering a respite from the concrete and steel surroundings.

In essence, urban parks play a vital role in enhancing the quality of urban life, promoting community engagement, and fostering a harmonious relationship between city dwellers and the natural world.

9.3.1 Existing Status

The planning area currently has a designated recreational area covering 0.32 sq.km. Within the corporation area, there are 82 parks, totaling 2,83,104 sq.m, as outlined in Table 9.7. On a per capita basis, the parks in the corporation area provide approximately 0.76 sq.m per person. However, this falls significantly short of the recommended standards, which suggest a range of 10 to 12 sq.m of parks and open space per person.

The existing status indicates a substantial shortfall in meeting the recommended norms for parks and open spaces. Improving the availability of green spaces is essential to enhance the quality of life for residents. Parks not only offer recreational opportunities but also serve as focal points for community activities, fostering a sense of unity and reinforcing community identity.

Noteworthy locations such as Roche Park, situated near the beach, and the sports complex at Tharuvaikulam with a swimming pool contribute to the diverse recreational offerings within the planning area. Efforts to expand and improve parks can positively impact community engagement and overall well-being.

Table 9.7 List of Parks in Thoothukudi Corporation and its surroundings

S.No	Zone	Ward	Park Name	Extent (Sq.m)
1	North	1	Subramaniapuram	1,000
2	North	1	Athiparasakthi Nagar	7,060
3	North	1	Athiparasakthi Nagar	660

S.No	Zone	Ward	Park Name	Extent (Sq.m)
4	North	1	Sankaraperi	1,790
5	North	1	Matchathu Nagar	1,500
6	North	1	Matchathu Nagar	199
7	North	1	Matchathu Nagar	8,300
8	North	1	Thirumani Nagar	6,000
9	North	1	Dhanasekaran Nagar	8,384
10	North	1	Dhanasekaran Nagar	1,055
11	North	1	Martina Nagar	2,509
12	North	1	Ganga Parameswari Colony	11,441
13	North	1	Athiparasakthi Nagar	1,160
14	North	1	Jothi Nagar	4,570
15	North	1	Matchathu Nagar	1,664
16	North	3	Nikelasen Nagar	2,803
17	North	3	Nikelasen Nagar Extn	2,710
18	North	3	Chandra Sekaran Nagar	1,982
19	North	3	V.M.S Nagar North	1,280
20	North	3	S.P.M.Nagar	1,468
21	North	3	Bharathi Nagar	1,452
22	North	3	Housing Board	75
23	North	3	Gandhi Nagar	2,419
24	North	3	V.M.S Nagar South	1,765
25	North	3	V.M.S Nagar South	1,872
26	North	4	Dhanasekar Nagar	1,715
27	North	4	Dhanasekar Nagar	180
28	North	5	Veerapagu Nagar	2,175
29	North	5	State Bank Colony M.A.C Garden	2,247
30	North	5	Rahamat Nagar	87
31	North	5	Om Shanthi Nagar	933
32	North	6	S.K.S.R Colony	850
33	North	6	Ezhil Nagar	1,010
34	North	12	Muthukrishnapuram	1,447
35	East	32	Roche Park South Cotton Road	74,866

S.No	Zone	Ward	Park Name	Extent (Sq.m)
36	West	34	Kathirvel Nagar LP/DTCP No.1366/93	1,220
37	West	34	Kathirvel Nagar LP/DTCP No.1214/93	4,150
38	West	34	Kathirvel Nagar LP/DTCP No.737/97	616
39	West	34	Kathirvel Nagar LP/DTCP No.737/97	238
40	West	34	Kathirvel Nagar LP/DTCP No.737/97	680
41	West	34	Kathirvel Nagar LP/DTCP No.737/97	945
42	West	34	Kathirvel Nagar LP/DTCP No.737/97	1,000
43	West	34	Kathirvel Nagar LP/DTCP No.737/97	670
44	West	34	Kathirvel Nagar LP/DTCP No.1/92	3,910
45	West	34	Kathirvel Nagar LP/DTCP 1367/93	3,097
46	West	34	Kathirvel Nagar LP/DTCP 1367/93	2,340
47	West	34	Kathirvel Nagar LP/DTCP 1367/93	683
48	West	34	Kathirvel Nagar LP/DTCP 1366/93	2,448
49	West	34	Kathirvel Nagar LP/DTCP 1366/93	750
50	West	34	Kathirvel Nagar LP/DTCP 1366/93	2,400
51	West	34	Murugesan Nagar LP/RCTK 4/83	1,427
52	West	34	P & T Colony Saradha Nagar LP/DTCP	144
53	West	35	P&T colony Palay Road West LP/RTK 1/74	4,830
54	West	35	Palay Road West Chinnamani Nagar	2,300
55	West	35	Palay Road West Chinnamani Nagar	2,350
56	West	35	Millerpuram Palay Road West LP/RTK	685
57	West	35	Teachers Colony Palay Road West	1,681
58	West	35	Palay Road West Ashok Nagar LP/DTCP	951
59	West	35	Palay Road West Ashok Nagar LP/DTCP	1,876
60	West	35	Palayamkottai Road Ashok Nagar LP/DTCP	444
61	West	36	Palay Road West Rajagopal Nagar LP/DTCP	1,200
62	West	36	Palay Road West Rajagopal Nagar LP/DTCP	1,649
63	West	36	Millerpuram park LP/LPA 1/2003	500
64	West	38	Toovipuram	7,985
65	West	40	Nalla Perumal Park	339
66	West	41	Palayamkottai Road Rajaji Park	18,446
67	West	44	Masilamanipuram Park 16/56	1,900

S.No	Zone	Ward	Park Name	Extent (Sq.m)
68	West	44	Kakkan Park Boldenpuram	2,741
69	West	44	Muniasamy puram park 77/55	762
70	South	48	Kirubai Nagar	2,586
71	South	49	Caldwell Colony	2,800
72	South	50	Selseeni Colony (East)	1,738
73	South	50	Selseeni Colony (West)	2,143
74	South	54	J.S.Nagar	7,050
75	East	24	Ash Memorial Park - Great Cotton Road	1,210
76	West	34	Pasumpon Nagar West Side LP/DTCP	5,077
77	West	36	Palayamkottai Road West	15,890
78	East	16	Masilamani Park	331
79	East	22	Cruzpuram Park (Roundana)	466
80	East	24	South Cotton Road,	258
81	West	47	Manikam Mahal	488
82	East	14	V.V.D Park at Muniyasamy koil street	2,300
			Total	**2,83,104**

Source: Thoothukudi Corporation

Figure 9.1 Themed Parks in Palaykottai Road
Figure 9.1 Existing status of parks

9.3.2 Standards for Parks

Parks play a pivotal role in fostering community cohesion and reinforcing identity, serving as venues for various activities such as stewardship events

and cultural fairs. Roche Park, situated near the beach, and the sports complex at Tharuvaikulam, featuring a swimming pool, contribute to the diverse recreational offerings within the planning area.

Table 9.8 highlights the green space recommendations in accordance with the URDPFI (Urban and Regional Development Plans Formulation and Implementation) guidelines. These guidelines often establish a hierarchy for organized green spaces, including parks, play fields, and other open spaces such as specified parks, amusement parks, open grounds, multi-purpose open spaces, botanical gardens, zoological parks, traffic parks, etc.

This hierarchy ensures a diverse range of green spaces catering to various recreational and community needs, contributing to a well-rounded and sustainable urban environment.

Table 9.8 URDPFI Standards for Parks

Planning Units	Number of Green Spaces	Standards
Neighbourhood	3-4 local parks/ Playgrounds	1 per 5000 population
Community	2-3 Community Level Parks	1 per 10000 population
District/ Zone	1 District Park and 1 Sport Centre	1 per District

Source: URDPFI Guidelines

9.4 Fire Station

Fire services play a crucial role in safeguarding people from various emergencies, including fire hazards and building collapses. Currently, the planning area is equipped with three fire stations strategically located to serve different areas:

1. Thoothukudi Corporation.

2. Thoothukudi thermal power plant.

3. SIPCOT industrial area.

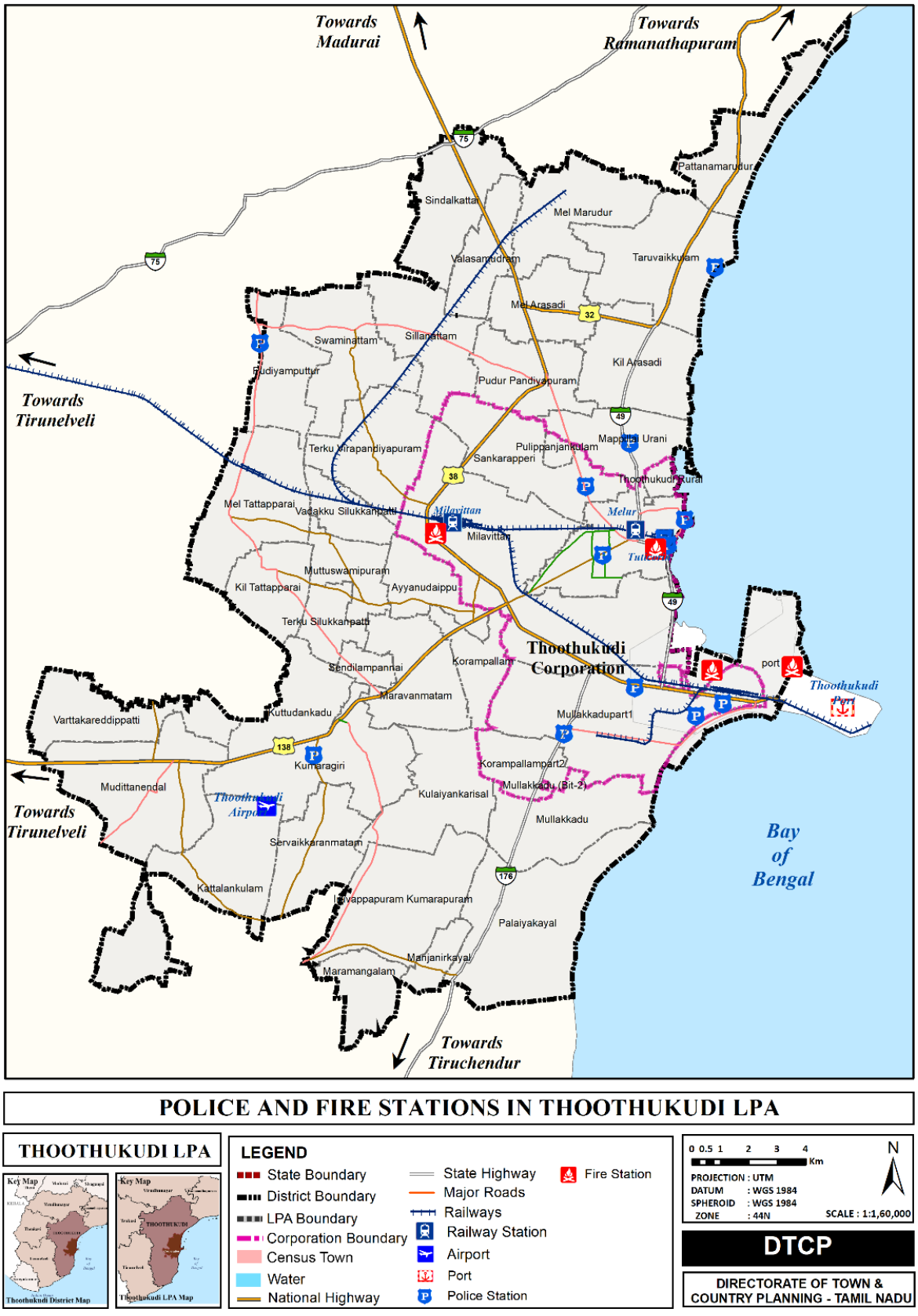
According to the URDPFI (Urban and Regional Development Plans Formulation and Implementation) guidelines on the location of fire stations, it is recommended to have a fire station for every 2 lakhs population, with a radius of 5 - 7 km. Evaluating the population density and geographic distribution of the planning area can help determine if additional fire stations are necessary to effectively cover the entire region and ensure timely response to emergencies.

Table 9.9 Standards for Fire Stations

S.No.	Description	Standard	Extent (Ha)
1.	Fire Post	Within 3-4 km radius	6.0
2.	Fire Station	1 per 2 lakhs population or 5-7 km radius	1.0

It's positive to note that the existing fire stations exceed the standard recommendation. However, the provision of additional fire stations in areas with an increased number of industries is a proactive measure. Industries often pose unique risks in terms of fire hazards and other emergencies, making it essential to have dedicated fire services nearby for prompt response and mitigation.

By strategically placing additional fire stations near industrial areas, the planning authorities demonstrate a commitment to ensuring the safety and security of both industrial workers and surrounding communities. This proactive approach can help mitigate risks associated with industrial activities and enhance overall emergency preparedness within the planning area.



POLICE AND FIRE STATIONS IN THOOTHUKUDI LPA

THOOTHUKUDI LPA

LEGEND

- State Boundary
- District Boundary
- LPA Boundary
- Corporation Boundary
- Census Town
- Water
- National Highway
- State Highway
- Major Roads
- Railways
- Railway Station
- Airport
- Port
- Police Station
- Fire Station

0 0.5 1 2 3 4 Km

PROJECTION : UTM
DATUM : WGS 1984
SPHEROID : WGS 1984
ZONE : 44N

SCALE : 1:1,60,000

N

DTCP

DIRECTORATE OF TOWN & COUNTRY PLANNING - TAMIL NADU

Map 9.3 Police Station and Fire Station in Thoothukudi LPA

10 TRANSPORTATION

Transportation is an indispensable component of urban development as it has a direct and reciprocal relationship with spatial changes. An understanding of traffic characteristics is vital to comprehending the geographical and temporal travel patterns within a study area, the association between traffic volume and network capacity, and the quality of service provided on specific network corridors.

In Thoothukudi, all modes of transportation, including road, rail, airport, and seaport, are readily available. The availability of these transportation amenities provides significant growth potential for the spatial development of the planning area.

10.1 Existing Status

The existing transportation infrastructure deals wtih the network of transportation facilities and services that are currently available in the planning area encompassing various modes of transportation, such as road, rail, air, and water transport. Understanding the existing transportation infrastructure and its limitations can aid in the identification of areas that require improvement and facilitate the development of sustainable transportation system.

10.1.1 Road Network

Thoothukudi is well connected by road network. National highway NH-138, NH-38 and State Highway SH-200 (Upgraded as NH32) and SH-176 are the major roads running from the city. NH-138 connect the city Tirunelveli and NH-38 connects Madurai. NH32 (Upgraded-SH-200) is a coastal road and SH-176 connects to Tiruchendur and the other parts of the district.

Table 10.1 Corporation Roads based on Material Used

Type pf Roads	Length in KM
Bitumen Road	342.39
Cement Concrete Road	58.72
Paver Block Road	36.21
WBM Road	1.35
Earthen Roads	181.59
Total	**620.27**

Source: Thoothukudi Corporation

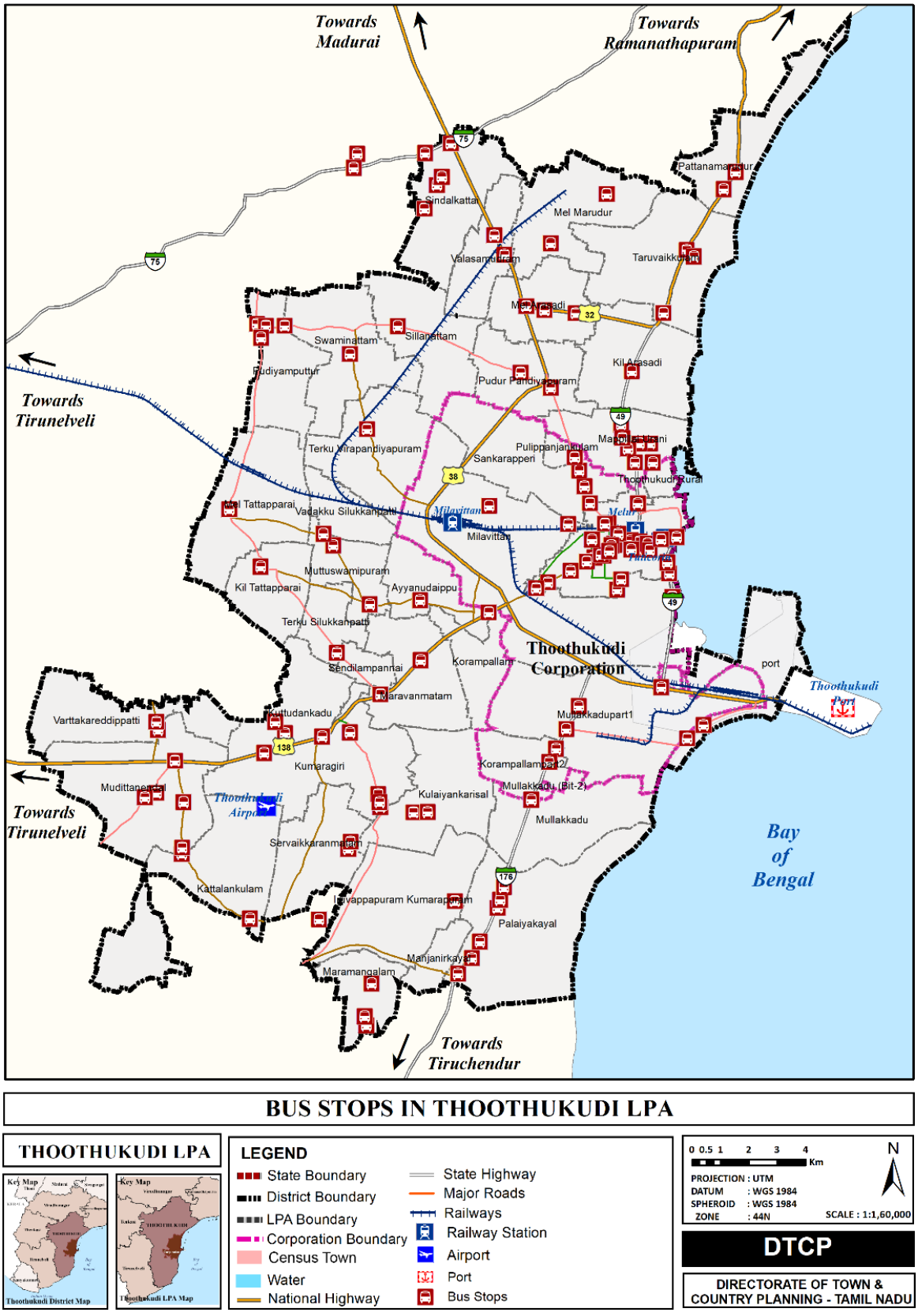
10.1.2 Bus Terminal

There are two bus stands in the corporation at Ettayapuram Road and Palayamkottai road (heart of the town). Buses are plying to all other major cities. The old bus stand in Palayamkottai road is under renovation. The details of the bus stand facilities and extent are shown in the Table 10.2.

Table 10.2 Bus stand and ancillary facilities

No	Bus stand	Bus Bayus	Extent (Acres)	Bus operation /Daily	Shop
1	New Bus Stand	51	6.88	600	80
2	Old Bus Stand	19	1.51	250	48

Source: Thoothukudi Corporation



BUS STOPS IN THOOTHUKUDI LPA

THOOTHUKUDI LPA

LEGEND

- State Boundary
- District Boundary
- LPA Boundary
- Corporation Boundary
- Census Town
- Water
- National Highway
- State Highway
- Major Roads
- Railways
- Railway Station
- Airport
- Port
- Bus Stops

0 0.5 1 2 3 4 Km

N

PROJECTION : UTM
DATUM : WGS 1984
SPHEROID : WGS 1984
ZONE : 44N

SCALE : 1:1,60,000

DTCP

DIRECTORATE OF TOWN & COUNTRY PLANNING - TAMIL NADU

Map 10.1Bus Stops in Thoothukudi LPA

10.1.3 Railway Station

Thoothukudi Railway station is one of the oldest railway junctions in Tamil Nadu. Thoothukudi railway junction railway serves connecting other parts of the state and country. Daily express services are plying to Chennai (Pearl City) and Mysore. There is a dedicated railway line service to the port for cargo handling.

Figure 10.1 Thoothukudi Railway Station

10.1.4 Harbour and Port

Figure 10.2 V.O.C port

Established in AD-124, the V.O.C Port stands as one of India's oldest ports, as attested by references in ancient Tamil literature. A significant historical milestone occurred in 1907 when V.O. Chidambaram initiated the inaugural Swadeshi Navigation Company. Operating vessels from Thoothukudi to Colombo, this enterprise played a pivotal role in India's fight for independence. Consequently, the port earned its name, V.O.C Port, in honor of V.O. Chidambaram and his contributions to the nation's struggle for freedom.

Open space for stacking bulk cargo and containers is available inside the security wall to the extent of 5,53,000 sq. m. The open areas can accommodate around 30,000 tonnes of bulk cargo either for import or export and 2,500 containers.

Figure 10.3 Performance Chart of VOC port

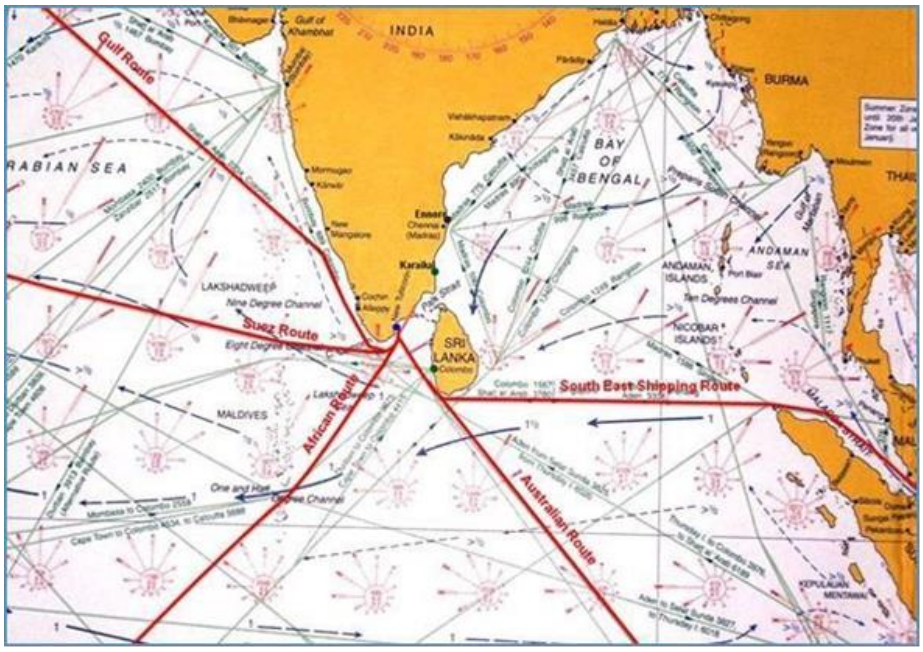


Figure 10.4 International Sea Route

The V.O. Chidambaranar Port boasts an expansive open land spanning approximately 2,158 acres outside its main gate. Within this area, the Tamil Nadu Warehousing Corporation has erected cargo godowns with a substantial stacking capacity of 36,000 tonnes. Additionally, various other agencies have been granted permission to establish godowns and warehouses, thereby enhancing import and export activities through the port. These open lands serve the dual purpose of storing timber imported through the port and stockpiling granite earmarked for export.

The passenger terminal area covers an expanse of 3,816 square meters. While a passenger ferry service once operated between Thoothukudi and Colombo, it is no longer in service. The port is equipped with a Meteorological observatory, furnishing essential data on atmospheric conditions such as pressure, temperature, humidity, rainfall, wind speed and direction, as well as tide levels.

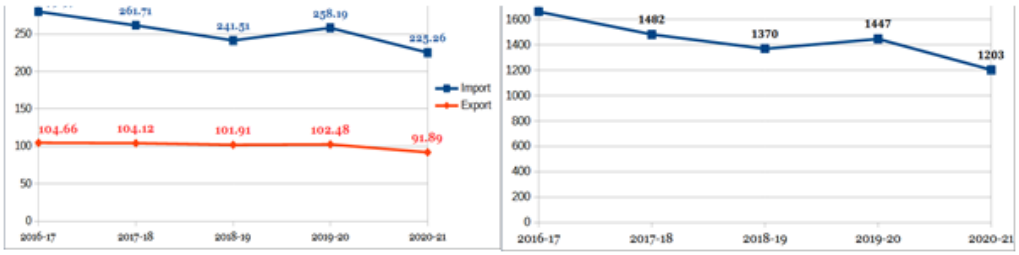


Figure 10.5 Import and Export (left) & ships Handled in VOC port (Right)

Colombo Port, located in Sri Lanka, has emerged as a pivotal transshipment hub in the Indian Ocean region. Colombo Port serves as a crucial transit point for various shipping routes connecting Europe, Asia,

Europe to Colombo:

Europe to Indian Subcontinent: Cargo from major European ports such as Rotterdam, Hamburg, and Felixstowe often travel to Colombo Port before being transhipped to destinations in the Indian subcontinent, including India, Pakistan, and Bangladesh.

Europe to Southeast Asia: European exports bound for Southeast Asian markets such as Malaysia, Indonesia, and Singapore frequently pass through Colombo Port due to its strategic location and efficient trans-shipment services.

Asia to Colombo:

South Asia to Colombo: Ports in South Asia, including Chennai, Mumbai, and Kolkata, serve as feeder ports for Colombo. Cargo from these ports is consolidated and transhipped through Colombo to reach destinations in Europe, the Middle East, and beyond.

East Asia to Colombo: Ports in East Asia, such as Shanghai, Busan, and Singapore, have established shipping routes to Colombo Port. These routes facilitate the movement of goods between East Asia and markets in the Middle East, Africa, and Europe.

Middle East to Colombo:

Middle East to South Asia: Major ports in the Middle East, such as Jebel Ali (Dubai), Doha, and Kuwait, are connected to Colombo Port through busy

shipping lanes. These routes serve as important channels for the transportation of goods between the Middle East and South Asian countries.

Middle East to East Africa: Colombo Port acts as a gateway for cargo moving between the Middle East and East African countries like Kenya, Tanzania, and Mozambique. Goods destined for these regions often transit through Colombo for efficient onward delivery.

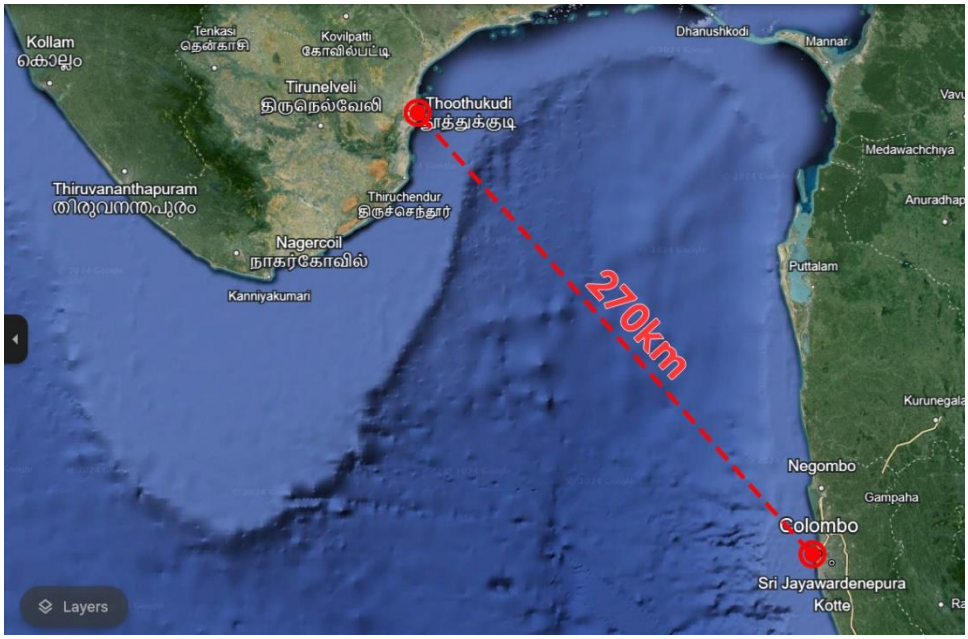


Figure 10.6 Thoottukudi connection to Colombo Sea Port

Colombo Port's strategic location, efficient operations, and continuous investments position it as a vital transshipment hub facilitating the movement of cargo across international maritime routes.

Exporting goods from Thoothukudi via Colombo seaport could pose logistical challenges due to the additional time and costs associated with transshipment, along with international logistics. Direct export from Thoothukudi port or nearby may offer a more streamlined and cost-effective solution for businesses looking to reach international markets efficiently.

Vizhinjam Port, located in Kerala, India, is being developed by the government as a key transshipment hub in the country. With its strategic location along international shipping routes and proximity to major east-west trade lanes, Vizhinjam Port aims to capitalize on its natural deep-water harbor to accommodate large container vessels. The Government of Kerala has

invested significantly in infrastructure development, including dredging operations and construction of berths and terminals, to enhance the port's capacity and efficiency.

Figure 10.7 Thoothukudi connection with Vizhinjam Port

Exporting from Thoothukudi via Vizhinjam Seaport offers a more direct and cost-effective route compared to transshipment through Colombo, it will also decrease the cost of international export logistic charges. Utilizing Vizhinjam will reduce transit time (190 km via sea from Thoothukudi, comparing 270 km from Thoothukudi to Colombo), minimize handling expenses, and avoid the logistical complexities associated with transshipment, and both the ports can be directly connected via road routes thereby enhancing efficiency and competitiveness for businesses in the region.

10.1.5 Airport

Situated 17 kilometers away from the city, Thoothukudi Airport is a domestic airport encompassing revenue villages such as Kumaragiri, Servaikaranmadam, Mudivaithanendal, and Kattalankulam in Thoothukudi Taluk. Operational since 1992, the airport currently facilitates six arrival and six departure flights operated by SpiceJet and Indigo. These flights connect the city to Chennai and Bangalore daily.

Figure 10.8 Thoothukudi Airport

Spanning an area of 188.56 acres, Thoothukudi Airport is currently undergoing expansion, with an additional 600.97 acres (243.21 ha) earmarked for development. Conveniently located on NH-138, the airport enjoys excellent road connectivity. The existing terminal building has the capacity to handle 78 passengers per hour at the Arrival Lounge and an equivalent number at the Departure Lounge.

10.1.6 Circulation Pattern

Roads serve as the primary means of connectivity, often the sole mode linking door-to-door destinations. However, as time progressed, railways emerged as the dominant mode of transportation, facilitating faster and more extensive travel within cities. The advent of high-speed rail and air travel further streamlined mobility, contributing to increased intercity traffic.

The surge in intercity mobility, driven by advancements in transportation, exerts additional pressure on urban roads. This, coupled with the expansion of transportation infrastructure, leads to urban sprawl in metropolitan areas. The burgeoning growth underscores the need for enhanced connectivity, encompassing economic zones, intercity transit, and rapid transit systems.

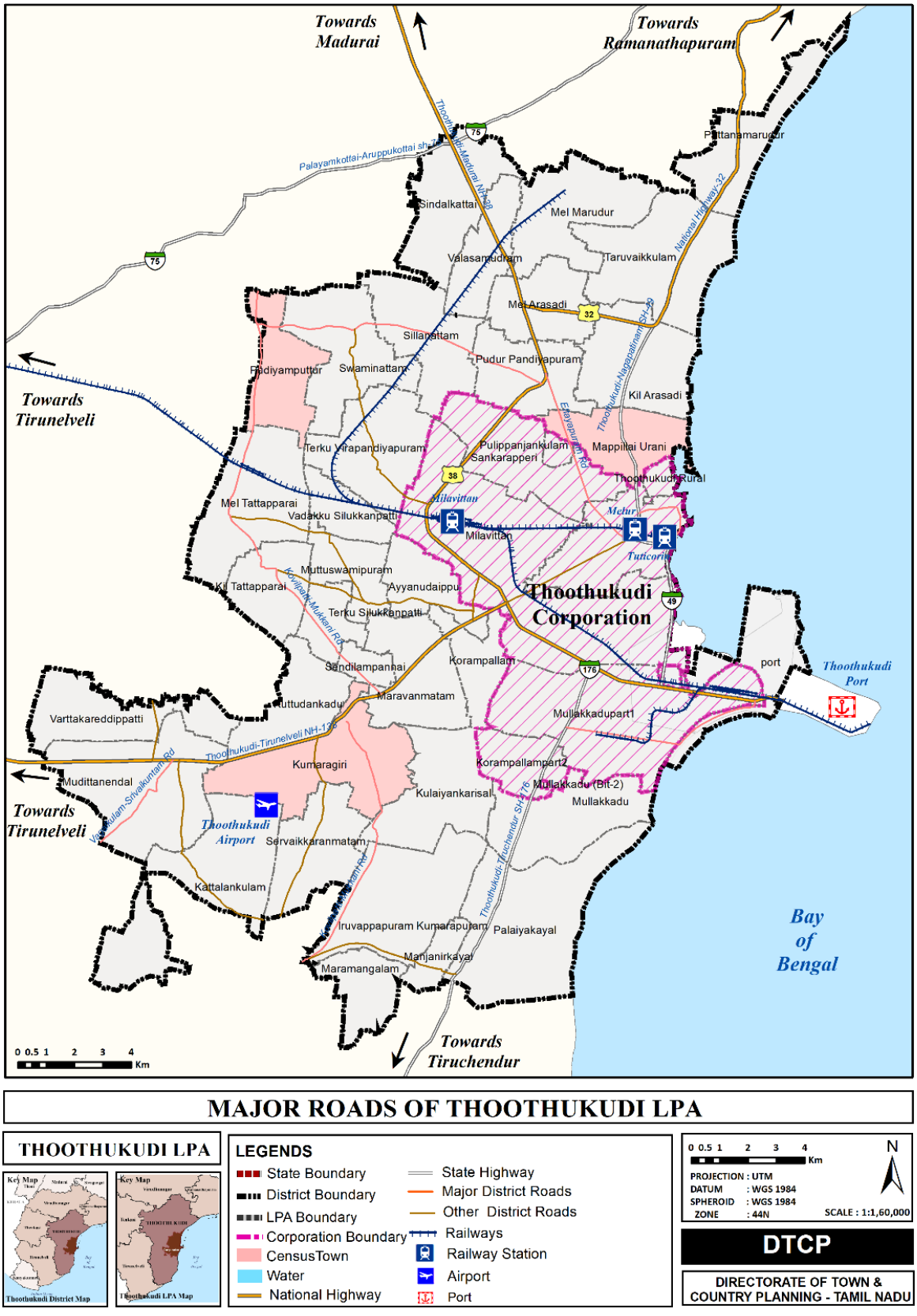
The dynamics of both inter and intra-city traffic play a crucial role in comprehending urban traffic patterns and mobility within the planning area.

10.1.7 Intra city

City's primary modes of mobility is through roads and private vehicles. As the city is historical, Great Cotton Road, Victoria Extension Road and Beach Road are the prominent road in the city core area. Even today, these roads have concentration of commercial activities. West Great Cotton Road, Palayamkottai Road, Ettayapuram Road, George Road, Thiruchendur Road, Jeyaraj Road, VVD Main Road, Azhagesapuram Road, Davispuram Road, Thalamuthu Nagar Main Road and State bank Colony main road are the major roads with the corporation.

10.1.8 Inter City

Intercity connectivity towards Ramanathapuram, Madurai, Tirunelveli and Tiruchendur forms major city roads in the city. Road pattern of the corporation is shown in the figure 59(Existing major road network). The pattern clearly shows that the city lacks hierarchy of roads. The major circulation brings mobility into the city. National Highways from Tirunelveli and Madurai stands high in the vehicle contribution over the State highway 176 from Tiruchendur and Kovilpatti.



Map 10.2 Existing Major Roads in Corporation

10.1.9 Parking

Parking is a crucial component of urban planning and plays an essential role in creating liveable, functional, and accessible in corporation area. Adequate parking provision is important to support economic development, reduce congestion and traffic, improve safety, and enhance the quality of life. Ease of parking provides better mobility inside the corporation area, whereas Irregular parking reduces the carriageway as a result affects the traffic flow.

Efficient parking management strategies, such as pricing and zoning, can help cities to regulate parking demand and encourage the use of sustainable transportation modes. This can result in reduced traffic congestion, improved air quality, and more equitable access to urban services.

Figure 10.9 On-Street Parking in West Great Cotton Road

In the core commercial streets namely Palayamkottai Road, West Great Cotton Road, the on-street parking creates numerous issues like congestion, lack of pedestrian safety and negative impact on the streetscapes in the corporation area. The aforementioned roads are already one-way street in order to handle the traffic. It can be observed in the figure 60 showing the West Great cotton road which has two-wheeler and truck parking on one

side, reducing the carriageway. It also lacks pedestrian infrastructure as well as the dedicated cycle track.

Figure 10.10 Multi-level Parking

To facilitate parking, the Thoothukudi Corporation has erected a multilevel parking facility, accommodating 74 four-wheelers and 150 two-wheelers. Refer to Figure 10.10 Multi-level Parking for the layout of the parking facility situated near the bus stand. Additionally, ongoing renovations along the Victoria Extension Road aim to create space for on-street parking.

10.2 Review of Thoothukudi Municipality City Corporate cum Business Plan

City Corporate Cum Business Plan for Thoothukudi Municipality was prepared in the year 2008 by M/s Spec Systems Limited Hyderabad. The study highlighted the three main reasons for the traffic problems in the city.

- Location of Railway station along with three major level crossings leading to traffic congestion in peak hours. Parking facilities for LCVs, trucks and other vehicles are inadequate in the town.
- City roads are having poor surface quality, absence of level crossings, Inadequate pedestrian pathways
- Absence of Parking facilities and truck terminal is another factor contributing to the congestion in the areas of the town

10.3 Review of Tuticorin Post Business Plan

The study was done by TRANSCARE in the year 2007 and covered areas such as market analysis of bulk and container cargo, Modal split analysis, capacity requirements and hinterland connectivity. The study also proposed future land use plan for the Port area. The study was done to cater to the requirements of the Port for the next 20 years (till 2027-2028).

10.3.1 Modal Share and Port Cargo Traffic Forecast

As per the information provided in the Business plan for Tuticorin Port, road has share of 80.0% fallowed by conveyor (35.9%), pipeline (62%) and rail (4.9%) in the year 2005-2006 The transfer of thermal coal by conveyor is towards the captive thermal power plant located in the district. High road share is attributed to the closeness of the hinterland to the Port and relatively better road connectivity than rail.

The projected Port Traffic is expected to reach 80 million tonnes by the year 2027-28.

Table 10.3 Traffic Forecast of Industrial areas in Thoothukudi

Traffic Forecast (Realistic Scenario)					
Commodity	**Unit (in Millions)**	**2013-14**	**2018-19**	**2023-24**	**2027-28**
Container	TEUs	1.1	1.8	2.7	3.5
	Tonnes	11.7	20.4	31.8	42.5
Thermal	Tonnes	10.1	15.1	15.1	15.1
FRM	Tonnes	1.1	1.3	1.4	1.5
Fertilizers	Tonnes	0.7	0.8	1	1.1
Copper	Tonnes	2	2	2	2
Timber	Tonnes	0.5	0.5	0.5	0.5
POL	Tonnes	1	1.1	1.3	1.5
Liquid Bulk (others)	Tonnes	0.5	0.6	0.7	0.8
Other cargo	Tonnes	5.2	6.7	8.3	9.7
Total	**Tonnes**	**34.9**	**51.5**	**66.5**	**80.8**

10.4 Review of Comprehensive Mobility Plan

In 2014, a Comprehensive Mobility Plan (CMP) was formulated for Thoothukudi, which involved a detailed analysis of survey data. The CMP put forth recommendations for the master plan, including:

1. Implementing equitable road cross-section planning.
2. Avoiding excessively wide right-of-ways.
3. Adopting a network approach over a few wide roads.
4. Providing special provisions to promote walking and non-motorized transportation (NMT).
5. Developing transit corridors and adopting transit-oriented development planning.

6. Decongesting the city center.

10.4.1 Delineation of Screen Lines and Cordon

An imaginary line circumscribing the boundary of the study area is termed as the cordon line. Similarly, imaginary lines along the physical and natural barriers, having road crossing points within the study area, are termed as screen lines. The screen lines were delineated in order to check the accuracy of the data collected and for validation of demand forecasting models for north-south and east-west travel. The following two screen lines have been identified:

1. North-South screen line along East Coast Road (Rameshwaram Road) to George Road (Tiruchendur Road)
2. East-West screen line along the existing railway line.

An imaginary line circumscribing of the study area has been identified as the Outer Cordon line. The identified screen lines along with outer cordon line have been depicted.

Figure 10.11 Defined Screen Lines for the Surveys of Comprehensive Mobility plan

10.4.2 Outer Cordon Surveys

The traffic volume counts were conducted for continuous 24 hours on a normal weekday at five outer cordon locations to note the traffic volume entering and leaving Thoothukudi.

The total traffic in Vehicles and Passenger Car Units (PCU) in each direction at the outer cordon locations have been presented in Table 10.4. Among the outer cordon (OC) locations, maximum traffic in a day was recorded near Tirunelveli Tot Plaza (004) with 14,205 vehicles (20,192 PCUs).

The lowest volume was encountered at Puthiamputur Road (OC3) with 3193 vehicles (3560 PCUS).

A total volume of 59,202 PCUs (40-416 vehicles) are encountered at the outer cordon locations in a day.

Table 10.4 Directional Distributions of Traffic Volume at Outer Cordon Locations

Locations	Incoming		Outgoing		Total	
	Veh	PCU	Veh	PCU	Veh	PCU
Near Ayyanarapuram Check Post (OC 1)	2511	3411	2378	3455	4889	6866
Madurai Toll Plaza (OC 2)	4976	8920	5013	9226	9989	18146
Pudurpandiyapuram (OC 3)	1456	1714	1737	1846	3193	3560
Near Tirunelveli Toll Plaza (OC 4)	6827	9945	7468	10247	14295	20192
Near Chandy Engg College (OC 5)	4016	5320	4033	5178	8049	10498

10.4.3 Traffic Composition

Modal composition amongst total traffic varies considerably at different locations. Amongst the total traffic crossing outer cordon, private vehicles account for 54.6 percent followed by freight vehicles (31.4 percent) and public transport (9.7 percent). Amongst all locations, maximum share of heavy truck movements is observed along Ramnathpuram Road (OC 1), and heavy car/taxi movements are observed on Madurai Road (NH 47B) (OC 2). About 56.7 percent two wheelers are observed at Puthayamputhur Road (OC 3).

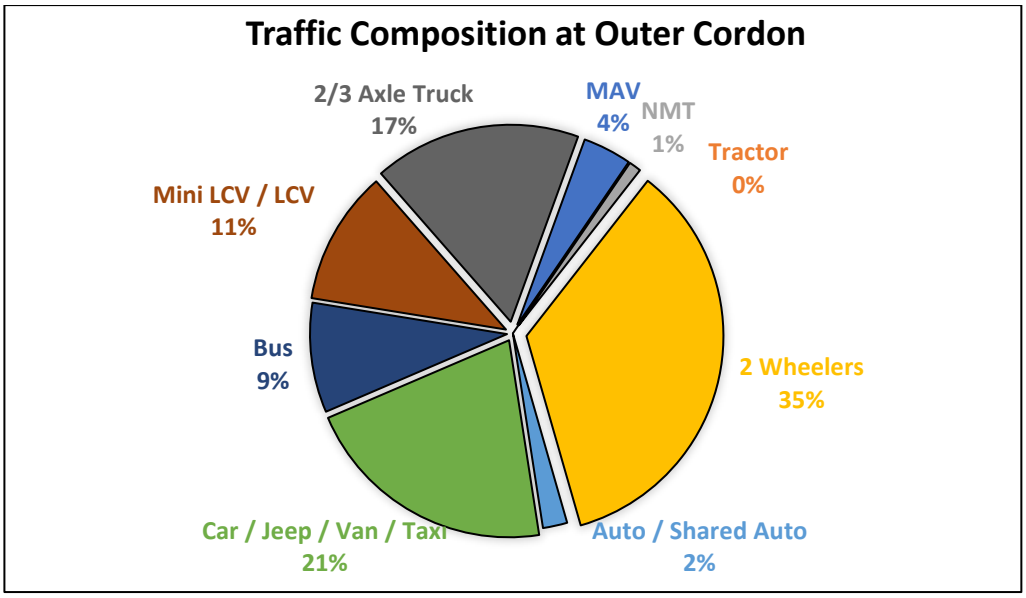


Figure 10.12 Traffic Composition of Outer Cordon Locations

Various traffic volume surveys were conducted at different locations to gather data for the preparation of the comprehensive mobility plan. The maximum Passenger Car Units (PCU) were observed at VVD junction, reaching 4282 PCU, followed by TMC (Thoothukudi Municipal Corporation) junction with 3726 PCU. Cruz Fernandes Junction and Ambedkar Statue Junction secured the third and fourth highest PCU with 3013 and 2886, respectively. Notably, the highest traffic movement occurred on Palayamkottai road, attributed to the presence of major commercial establishments, public spaces, and the bus stand. Table 10.5 provides details on the maximum vehicular volume at major junctions in each zone along with their respective PCU values.

Table 10.5 Maximum Traffic Volume Survey in Corporation

S.No	Location / Landmark	Vehicle	PCU
East West Screen Line (EW)			
1	Near Indira Gandhi statue (EW1)	1881	1251
2	Rail Gate No.1 (EW2)	1401	798
3	Rail Gate No.2 (EW3)	3612	2005
4	Rail over Bridge (EW4)	2420	1611
5	Rail Gate No.4 (EW5)	2224	1964
North South Screen Line (NS)			

S.No	Location / Landmark	Vehicle	PCU
1	Near St.Joseph Leprosy Hospital (NS-1)	475	276
2	Near St.Thomas Mat School (NS-2)	1395	792
3	Near CSI Church (NS-3)	1509	953
4	Near Melur Station (NS-4)	1193	688
5	Near Kalyan Jewellers (NS-5)	2810	1786
6	Near DSF Plaza (NS-6)	1991	1255
7	Near ICICI Bank ATM (NS-7)	972	757
8	Near 2nd Gate Market (NS-8)	1177	686
Other Locations (OL)			
1	Near Sterlite Industries (OL-1)	934	2170
2	Near Sterlite truck parking (OL-2)	338	399
3	Near V.O.C Port Check Post (CP-1)	1214	1609
Major Junction (TM)			
1	VVD Junction (TM-1)	6404	4282
2	Ambedkar Statue (TM-2)	4122	2886
3	TMC Junction (TM-3)	5504	3726
4	Cruz Fernandes Junction (TM-4)	4310	3013

Source: Comprehensive Mobility Plan, Thoothukudi

The VVD junction records the highest vehicular movement, registering a PCU of 4282, followed by the TMC (Thoothukudi Market Circle) junction with 3726. These junctions bear the brunt of significant traffic due to their close proximity to the old bus terminal. Cruz Fernandes Junction (TM-4) observes a PCU movement of 3013. Given the prevalence of higher two-wheeler movement in the corporation, PCU values tend to be lower compared to vehicle counts at most junctions.

Table 10.6 outlines the vehicular movement from other cities, with Tirunelveli junction exhibiting the maximum movement at 20,192 PCU. Notably, the PCU is considerably higher than the vehicle counts in the other cordon roads, primarily attributed to truck movements toward the port.

Table 10.6 Vehicle Movement in Outer Cordons

S.No	Location / Landmark	Vehicles	PCU
Outer Cordon (OC)			
1	Near Ayyanarpuram Check post (OC-1)	4889	6866
2	Madurai Toll Plaza (OC-2)	9989	18146
3	Pudurpandiyapuram (OC-3)	3193	3560
4	Near Tirunelveli Toll Plaza (OC-4)	14295	20192
5	Near Chandy Engg College (OC-5)	8049	10498

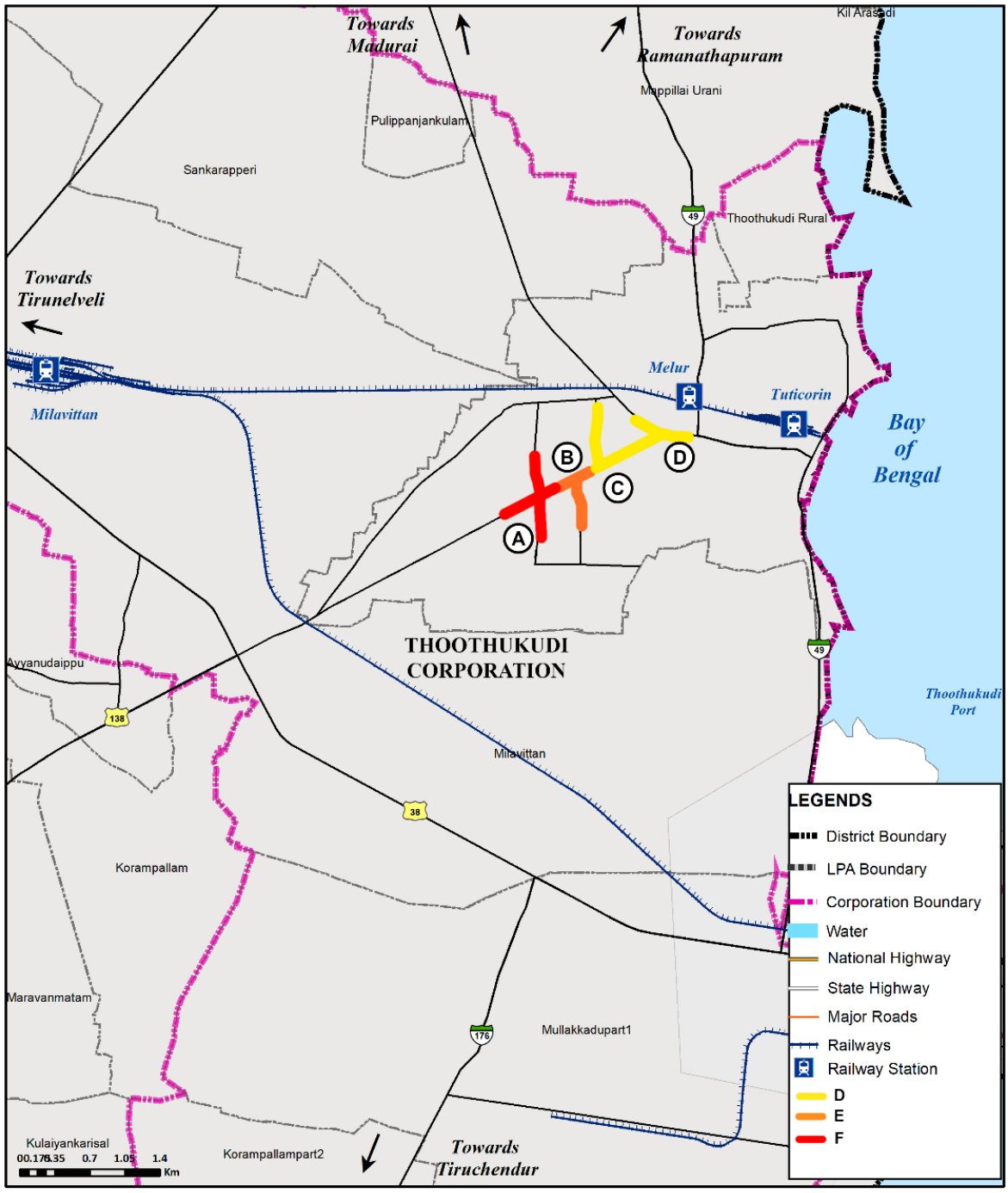
Traffic flow is higher from Madurai direction, followed by Tirunelveli and Tiruchendur. The vehicular volume increase in these plazas during the past is tabulated in the Table 10.7. This indicates the exponential increase in traffic from Madurai and Tirunelveli. The increase in traffic volume from Tirunelveli is because ease of connectivity and people prefer to commute daily, whereas from Madurai, the traffic is mainly due to the truck volume to the port and regular commute.

Table 10.7 Traffic Volume (2014-2021)

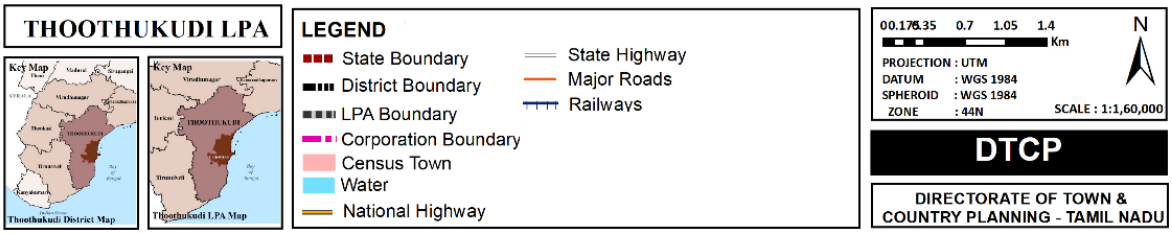
Toll Plaza	Volume Count	
	2014	2021
Pudurpandiapuram	3,193	15,310
Near Tirunelveli Toll Plaza	14,295	1,86,768

Source: CMP (2014) and National Highways

Map 10.3 Existing Major Junction



LEVEL OF SERVICE FOR THOOTHUKUDI LPA



Map 10.4 Level of Services at Major Junction

10.4.4 Modal Share

Table 10.8 Modal Share in Thoothukudi

Modes	% without walk share	% with walk share
Walk	-	47
2 Wheelers	45	24
Car	4	2
Taxi	1	0
Auto/Shared Auto	12	6
Mini Bus	9	9
Govt. bus	5	-
Pvt Bus	2	-
Cycle	21	12
Others	1	-

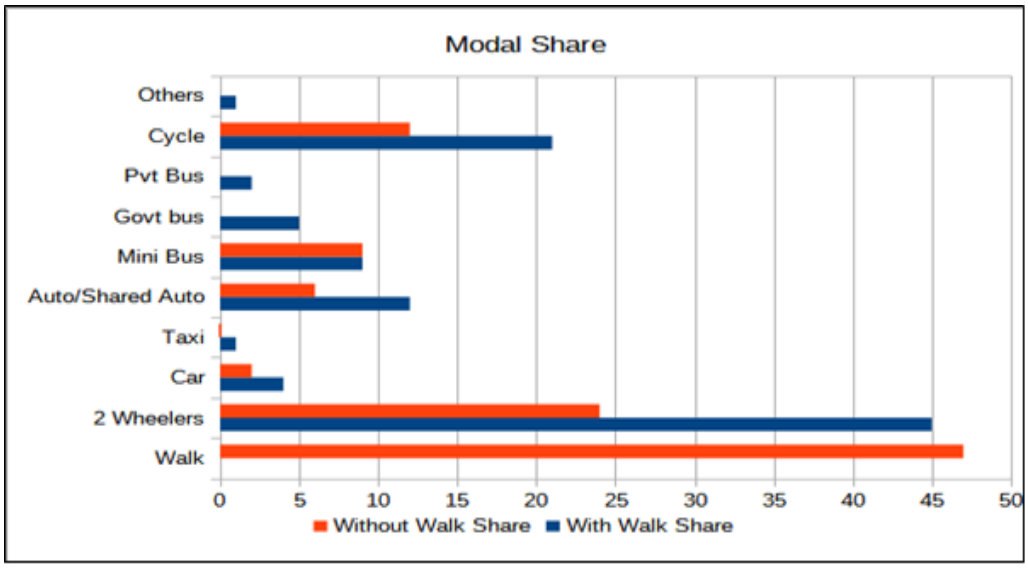


Figure 10.13 Modal Share in Thoothukudi

Modal share data is presented from the mobility plan and the modal share is compared with and without the walk share. In the Table 10.8, without walk share two- wheeler stands high with 45% followed by cycle share 21%. When it is with walk share the walk mode stand high as 47% followed by share two- wheeler with 24%. It is comparable in the second-tier cities of Tamil Nadu that share two- wheeler contribute more in their modal share. To promote

sustainable urban mobility, Non- Motorised Transport (NMT) or public modal share needs to be encouraged.

10.5 Origin Destination Survey

The survey was conducted at all five outer cordon locations (OC) as well at the VOC check post location (CP). The direction wise sample size covered for each mode is presented in the Table 10.9 below.

Average lead – Passenger Modes

Average trip lengths of predominant modes at the outer cordon and check post location. Private Buses have the maximum average trip length (254 km) followed by Govt. Bus (144.0 Km) and cars (120 km).

It is observed that nearly 56% of the total trips are made within the range of 0-20 kms. About 69% of 2-Wheeler, 54% of minibus has trip length within 20 kms. About 45% of Govt. bus has trips in the range of 20 to 70 kms. For Pvt. Bus, nearly 35% of the trips are above 150 kms. About 88% of Pvt. Car/Jeep/Van and 94% of Taxi have trips within 200 kms.

Average Occupancy – Passenger Modes

It is observed that average occupancy for 2 wheelers, Pvt. Car/jeep and Taxi is 1.8, 3.7 and 3.1 respectively. And amongst public transport buses, minibus, govt. city bus, govt. intercity bus and private bus have occupancy of 12.1, 41.6, 35.1 and 38.6 respectively.

Table 10.9 Details of sample Size for O-D Survey Conducted

Vehicle Type	OC1	OC2	OC3	OC4	OC5	CP1
Passenger Vehicles						
2-Wheeler	16.0	7.5	18.4	9.7	7.3	12.7
Pvt. Car/ Jeep	33.1	39.6	37.1	23.9	30.7	39.4
Taxi	7.6	15.8	20.8	19.0	65.6	5.1
Auto Rick	24.3	14.4	18.9	17.8	91.1	14.8
Shared Auto	5.7	48.1	30.0	65.8	53.3	43.3

Mini Bus	48.5	4.8	47.3	13.4	3.2	27.8
Govt. City Bus	76.9	70.6	28.3	50.8	66.4	73.3
Govt. Inter City Bus	90.6	42.4	41.7	36.7	58.2	23.8
Pvt. Bus	75.5	83.3	46.5	48.9	54.8	74.8
School Bus	26.7	25.0	66.7	135.7	76.9	14.3
Average	23.4	26.2	22.8	18.2	24.3	20.0
Good Vehicles						
Mini LCV	11.7	42.9	30.9	22.6	16.8	29.0
LCV	27.7	32.2	51.1	47.2	22.1	54.7
2 Axle	19.1	28.5	12.0	18.7	40.3	46.9
3 Axle	25.8	21.4	5.0	21.9	28.3	30.5
MAV	40.0	26.8	2.6	46.0	20.5	26.8
Average	21.0	27.9	19.0	26.4	25.4	31.2

Average lead – Freight Vehicles

Amongst all the vehicles, Mini LCV has the lowest trip length of 79.5 kms. 3 Axle truck has the maximum trip length of 177.6 kms. However, for all the heavy freight vehicles average trip length observed is above 125 kms.

It is observed that nearly 35% of the total trips are made within the range of 0-20 kms. About 46% of Mini LCV has trip length within 20 kms range. About 65% of 2 Axle trips are within 70 kms range and about 40% of 3 axle and MAVs have trips beyond 150 kms.

Average Load – Freight Modes

The analysis on load characterstics shows that the average payload carried by Mini LCV, LCVs, 2 Axle, 3 Axle and MAV 3.2, 2.7, 7.8, 12.8 and 14.5 tonnes respectively.

Commodities Carried

In order to understand the loading pattern and commodity movement, all the commodities have been grouped into 16 categories. The composition of the various commodities carried by at different OC and CP locations are

as presented below. It is observed that Gas, fruits and vegetables and construction materials are carried by most goods vehicles. About 34% vehicles are observed to be travelling empty.

10.6 Issues and Potentials

Figure 10.14 On-street Parking in West Car Street

- The proportion of two-wheelers are very high which is not advisable for sustainable urban mobility
- The interior roads are mostly narrow
- Lack of Streetscape design as shown in the above Figure 10.14
- The street is not pedestrian-friendly or bicycle friendly
- On-street parking is observed in most of the commercial streets namely Victoria Road, West Great Cotton Road
- City Street with open drainage system. street infrastructures are not designed
- Inadequate parking facilities
- Congestion at VVD Signal

- Only one truck terminal facility is available at the bye pass, as a result trucks parked on the bye-pass road.
- Traffic congestion at Gate 2
- Proposed Furniture Park and V.O.C Port expansion are driving increased transportation demand.
- Bypass route diverts major truck traffic away from the city, directing it to the port road with a dedicated truck terminal.
- Potential boost to the port and logistics industries in the planning area due to the new truck terminal.
- Construction of a new bus stand
- Under-construction grade-separator at Kumargiri village.
- Core area is congested with narrower road. Streetscape shall be redesigned by retaining and conserving the historical and century old building.

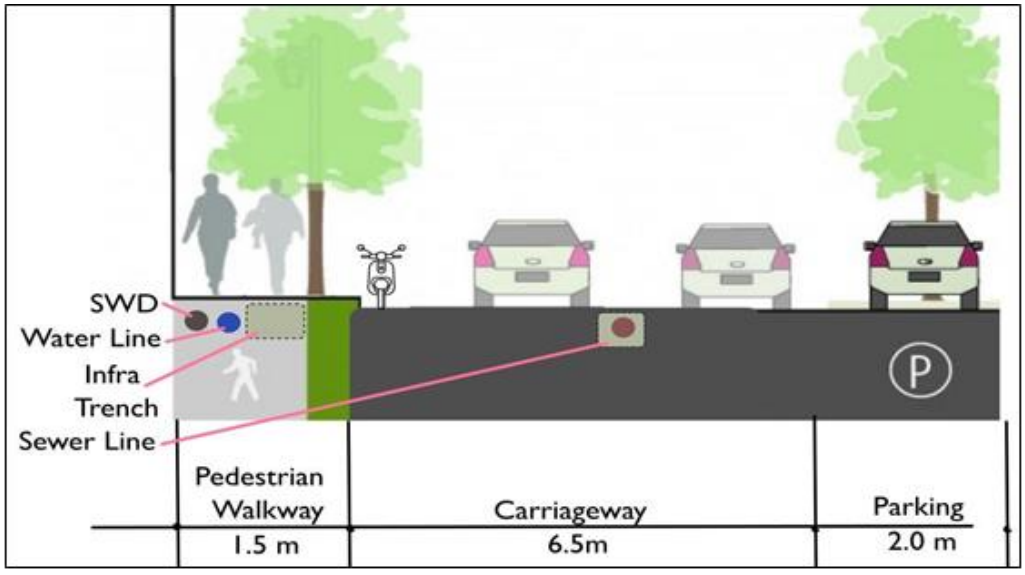


Figure 10.15 Recommendation Road Cross-section for West Car Street

- Thoothukudi railway line bisects the city into two halves. The railway level crossing within the corporation leads to congestion at first, second, third and fourth gate. This hinders movement of people during railway crossing

time which is usually during morning and evening. Currently, there is a bridge near third gate which make way to cross the rail line. However, congestion persists near the second gate whenever train crosses. If the frequency of train increases, then this will lead a big traffic congestion in the area.

- The road pattern and hierarchy of roads aid in the mode choice based on ease of mobility and accessibility to various regions in the region. Taking that into account, the planning area shall be planned with a strong public transit connecting all regions. Thereby the last mile connectivity can be achieved by better infrastructure for pedestrians and NMT in the planning area.

10.7 Freight Access Plan

Other proposed Freight management plan includes widening of major roads and junction improvements along corridors with movement of freight vehicles. To facilitate U – turn of freight vehicles along VOC port road, new links and traffic management plans have been proposed. New links have been proposed to improve turning of 40TEU trailer near the ICDs and CFSs along port road and T-junctions have been proposed with signalisations. These signals shall also be linked ITS management plan with the control centre to monitor its improvement. The main intension of this proposal is to improve safety along VOC port road by reducing conflicts with other modes during U-turning of port bound trucks.

11 ENVIRONMENTAL

11.1 Climate

Thoothukudi exhibits a semi-hot arid climate characterized by a maximum summer temperature of 39 degrees Celsius and a winter maximum of 32 degrees Celsius. The district receives rainfall from both the south-west and north-east monsoons, with the latter being the primary contributor. The precipitation is often in the form of cyclonic storms resulting from depressions in the Bay of Bengal.

Winter experiences the lowest precipitation in August, averaging 3 mm, while November sees the highest with an average of 238 mm. Throughout the year, the city receives approximately 444 mm (17.5 inches) of rainfall from the north-east monsoon, 117.7 mm (4.63 inches) in summer, 74.6 mm (2.9 inches) in winter, and 63.1 mm (2.5 inches) during the south-west monsoon season. January is the coolest month, and the hottest months span from May to June. Given its coastal location, the city maintains consistently high humidity levels.

11.2 Geography and Soil

The predominant geological composition of Thoothukudi district includes hornblende biotite gneiss and the Charnockites group of rocks in the western region. In the eastern part, there are minor representations of Cretaceous formation and granitic intrusion. The main rock types present in the planning area are garnet-biotite gneiss and rocks from the Quaternary period.

Economically significant minerals in Thoothukudi District include multi-color dimension stone and rough stone/gravel. Minor occurrences of Quartzite have also been reported. Mining activities, primarily focused on rough stone (mainly charnockite), are concentrated in Thoothukudi, Kovilpatti, Ettayapuram, Sathankulam, and Ottapidaram Taluks.

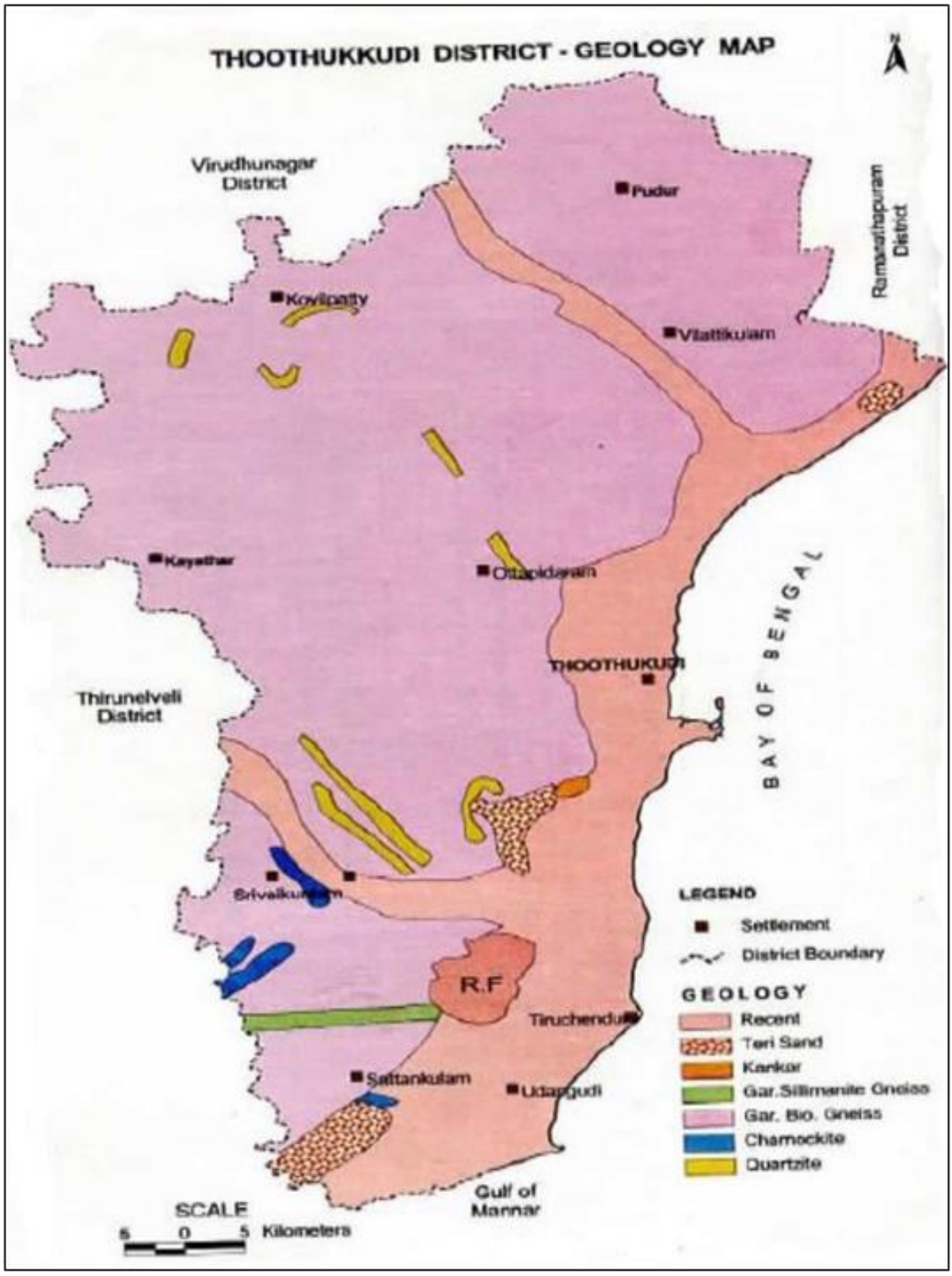


Figure 11.1 Geology Map of Thoothukudi District

The district predominantly features black cotton soil in the west and isolated soil patches in elevated areas. However, in the coastal region, sandy soil is prevalent. These sandy soils originate from sandstones, characterized by low soil moisture retention. The planning area, constituting the coastal stretch, is characterized by the abundant presence of sand and sandy clay loam soil.

Table 11.1 Rock Types in Thoothukudi District

Period	Geologic Time Scale	Formulation	lithology
Quaternary	Holocene to Recent	Alluvium Colluvium	Red Soil, Coastal Sand, Clay, River Alluvium, Laterite, Red Teri, Kankar, Tuffaceous Kankar, Shell Limestone, Calcareous Sandstone
Tertiary	Mio-Pliocene	Panamparai Sandstone	Hard, Compact calcareous sandstone, Shell Limestone
Proterozoic	Precambrian	Crystalline complex	Charnockite, Mixed and composite, Gneiss Peliticgneiss, Calc-Granulite, Quartzite

Source District Survey Report of Thoothukudi, Department of Geology and Mining

11.3 Bio-Diversity

The planning area's coastline stretches over 52.71 kilometers and encompasses crucial natural resource and sensitive zones, including mangrove forest cover, seagrass beds, and coral reef zones. These areas fall under the Gulf of Mannar Marine National Park, a protected region in India, situated along the coasts of Ramanathapuram, Thoothukudi, and Tirunelveli districts. Among the 21 small islands within the Gulf of Mannar, two—Koswari and Vaan—are situated close to the planning area.

Vaan and Koswari Islands feature ground vegetation such as halophytic herbs, creepers, and grasses. Coral reef removal has resulted in one-quarter of each island being submerged in water. Biotic interference in Vaan Island has led to biodiversity degradation. Afforestation efforts on the islands have achieved a 35-40% plant survival rate. Prosopis and Salvadora trees dominate

the terrestrial part of Koswari Island. The area surrounding Koswari Island is renowned for chank beds, attracting illegal collection by nearby fishermen.

Mangrove and coral reef ecosystems share a symbiotic relationship, with mangrove forests acting as natural shields for coastal communities and serving as vital nurseries and habitats for fish and other sea creatures. These ecosystems are crucial sources of food and livelihood for communities near mangrove forests. Mangroves also play a role in mitigating climate change by trapping carbon dioxide. Degradation of fisheries due to mangrove habitat destruction adversely impacts coral reefs.

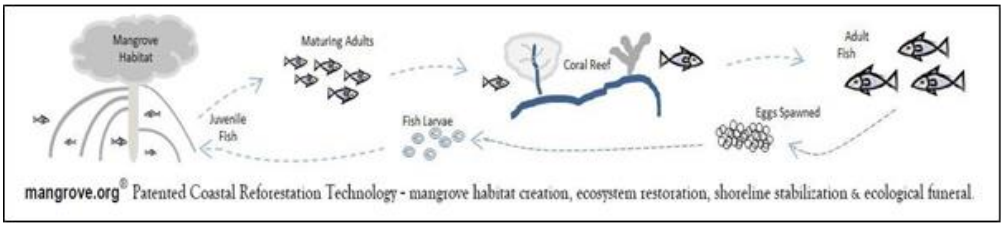


Figure 11.2 Coastal Restoration Technology

The strength of fisheries is directly linked to coral health, emphasizing their interdependence. Coral reefs and mangrove forests play critical roles in supporting biodiversity and various organisms in marine and coastal environments. Commercial and recreational fisheries, vital economic resources for indigenous populations and coastal areas, rely on the health of these ecosystems. Figure 11.2 illustrates Coastal Reforestation Technology,

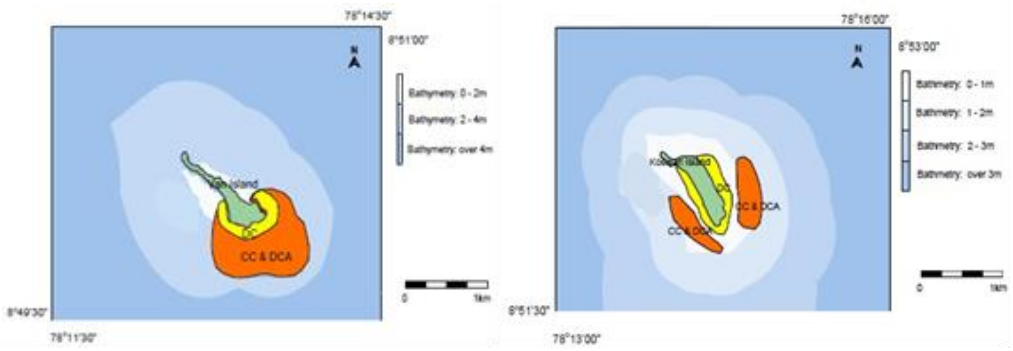


Figure 11.3 Vaan island (left) and Koswari Island (Right)

(CC- Coral Cover, DCA- Dead Coral with Algae and DC-Dead Coral)
Source: Database on Gulf of Mannar Biosphere Reserve, ENVIS Centre

The region, enveloped by mangroves, sandy shores, and sea grass beds, supports a rich biodiversity of about 36,000 species of flora and fauna. Thoothukudi shores are particularly noteworthy for being a habitat conducive to turtle nesting. This area is home to rare marine flora and fauna, boasting exotic species such as coral reefs and pearl oysters. Additionally, common marine inhabitants include algae, reef fish, holothurians, shrimps, lobsters, crabs, and Mollusca.

11.3.1 Mangrove Ecosystem

Mangroves are salt-tolerant plants of tropical and subtropical intertidal regions of the world. The specific regions where these plants occur are termed as 'mangrove ecosystem'. These are highly productive but extremely sensitive and fragile. Besides mangroves, the ecosystem also harbours other plant and animal species. Anthropological pressures and natural calamities are the enemies of the ecosystem. Growing industrial areas along the coastlines may highly impact the ecosystem.

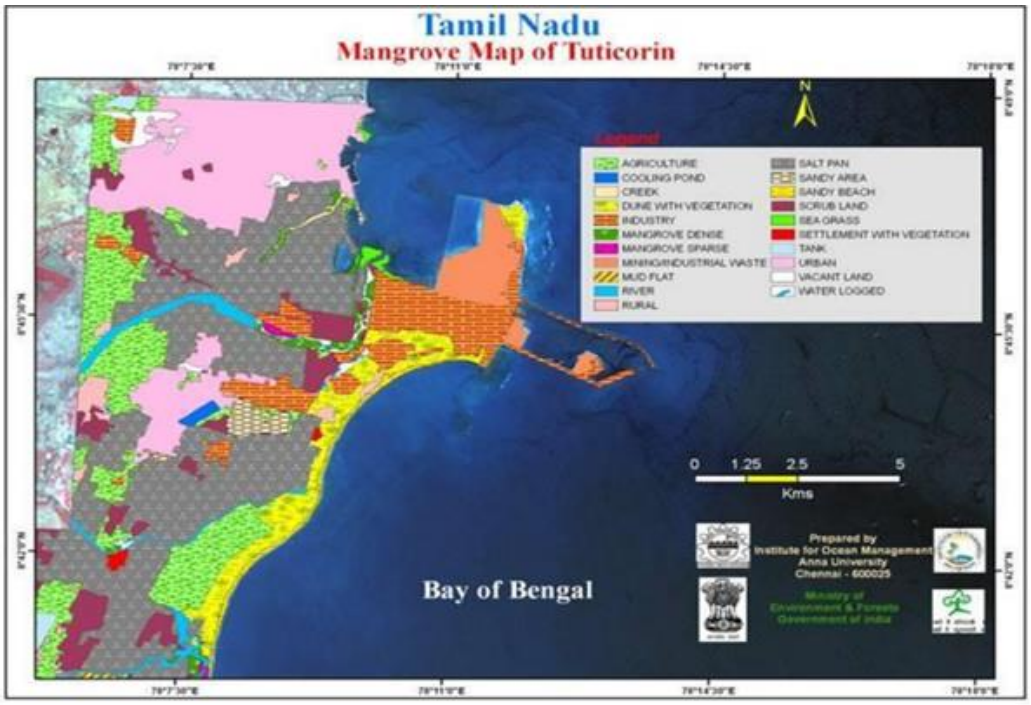


Figure 11.4 Mangrove Forest Cover

Table 11.2 District wise Mangroves Cover (As per ISFR 2019 Assessment)

Districts	Very Dense Mangrove	Moderately Dense Mangrove	Open Mangrove	Total
Thoothukudi	0	0.85	2.95	3.8
Total	**1.04**	**27.24**	**16.55**	**44.83**

Source: Forest Department, Government of Tamil Nadu

11.4 Pollution

11.4.1 Air Pollution

The escalation of industrial and commercial activities in the outskirts of major cities has led to a decline in the quality of ambient air due to emissions from industries and the ever-expanding vehicular population. Thoothukudi has been designated as a Severely Polluted Area (SPA), with a calculated Comprehensive Environmental Pollution Index (CEPI) score of 66.34, falling within the severely polluted range [CEPI score 60-70]. However, it's noteworthy

that the CEPI score assigned for the Land Environment is identified as critical rather than severe.

Flue gas desulfurization serves as the removal process for sulfur compounds from flue gases emitted by thermal power stations. The combustion of fossil fuels and various industrial materials, such as glass, steel, iron, and copper, produces sulfur dioxide (SO2). Thoothukudi, housing five thermal power plants and numerous industries, is observed to emit a monthly average sulfur concentration ranging from 5.50 to 7.40 µg/m3.

Table 11.3 CEPI score

No	CEPI Score	Categorisation of Industrial Area
1.	70 and above	Critically Polluted Areas
2.	Between 60-70	Severely Polluted Areas
3.	Between 50-60	Normally Polluted Areas
4.	Between 40-50	Other Polluted Areas

Source: TNPCB

11.4.2 Noise Pollution

Noise is characterized as any undesired, disruptive, or harmful sound that negatively impacts hearing, induces stress, disrupts concentration, diminishes work efficiency, or poses risks of accidents. Urban cities are experiencing a continual rise in noise pollution, with an increasing proportion of the population being exposed to elevated noise levels. Road traffic noise, particularly during peak hours, stands out as a significant contributor to noise pollution in the city. The construction of homes, schools, hospitals, churches, libraries, and other community buildings along main roads, often without buffer zones or adequate soundproofing, exacerbates the issue.

Currently, the noise pollution levels in different zones of the planning area remain within permissible limits. However, during festive seasons such as the Lady Snow Basilica festival and Deepavali, overall noise levels tend to escalate. To address this, regular awareness campaigns and workshops will

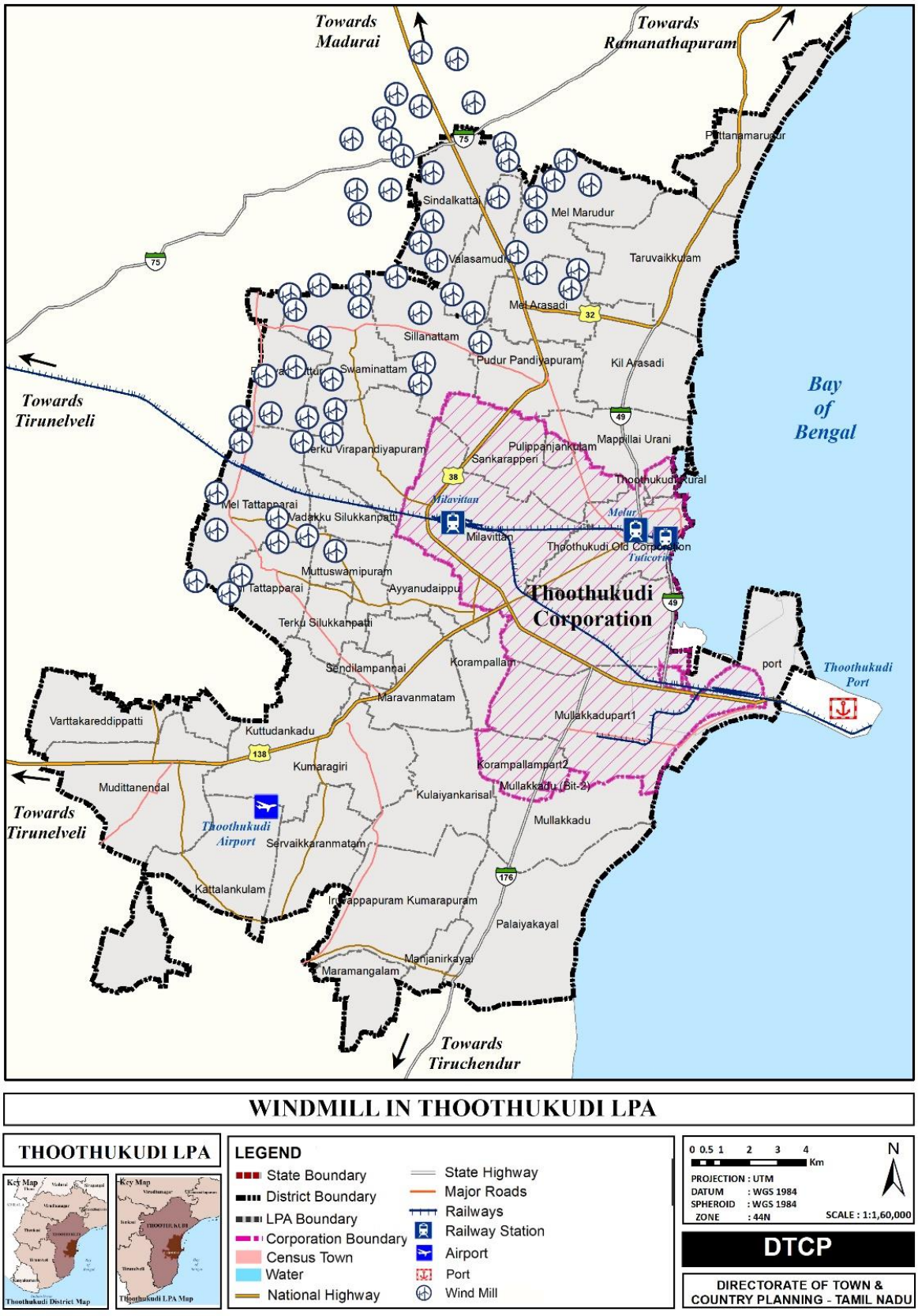
be conducted to emphasize the importance of maintaining a pollution-free environment. Specifically, during festival seasons, a targeted awareness campaign will be launched to mitigate both air and noise pollution.

11.5 Energy

Energy is an essential requirement for every household, and for sustaining industrial and commercial activities, a robust power infrastructure is indispensable in the planning area. The production and distribution of power, derived from both renewable and non-renewable sources, are managed by the Tamil Nadu Generation and Distribution Corporation (TANGEDCO).

Figure 11.5 Windmill within the Planning area

Currently, 60.90% of the country's power production comes from non-renewable sources, which is deemed unsustainable. To promote the use of renewable energy, it is recommended to harness the potential of wind energy, considering the presence of windmills in the planning area. There is further potential for generating additional wind energy through both on-land and offshore windmills. The National Institute of Wind Energy (NIWE) has plans to commission a LIDAR in the Gulf of Mannar, a part of which is located near the planning area. The locations of windmills within the planning area are highlighted in Map 11.1.



Map 11.1 Location Windmill in Planning Area

11.5.1 Offshore windmill

Harnessing renewable energy through offshore windmills is a viable approach, particularly in the planning area with its coastal stretch and optimal wind conditions. The National Institute of Wind Energy (NIWE), under the Ministry of New and Renewable Energy, in collaboration with multilateral agencies, has identified potential zones for the development of offshore wind farms in Tamil Nadu. These zones, depicted in Figure 11.6, consist of 10 sub-zones with a collective capacity for generating 150-504 MW of energy, situated at an average distance of 12.4 km from the coast.

The analysis conducted by NIWE also includes an assessment of the environmental impact and proposes mitigation measures to minimize adverse effects while enhancing energy production efficiency. The highlighted zones for offshore windmills can be observed in Figure 11.6

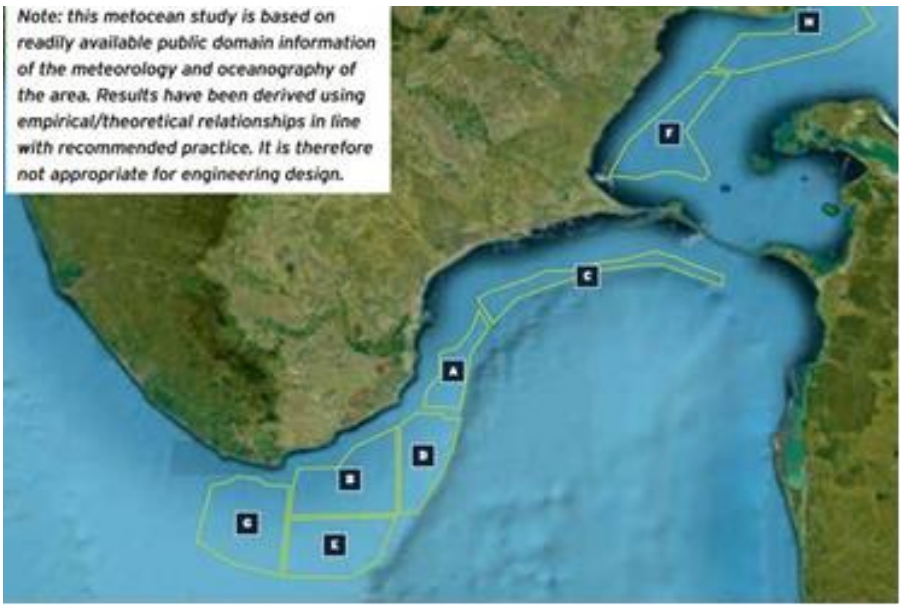


Figure 11.6 Potential offshore windmill locations

11.6 Aquifer Delineation for Thoothukudi LPA

11.6.1 Study Area

The Thoothukudi LPA covers 482 sq km and located strategically close to the east–west international sea routes on the southeast coast of India. It is a coastal town with a sea port and has been recently upgraded as corporation. Thoothukudi was established as a municipality in the year 1866 and attained the status of corporation in the year 2008.

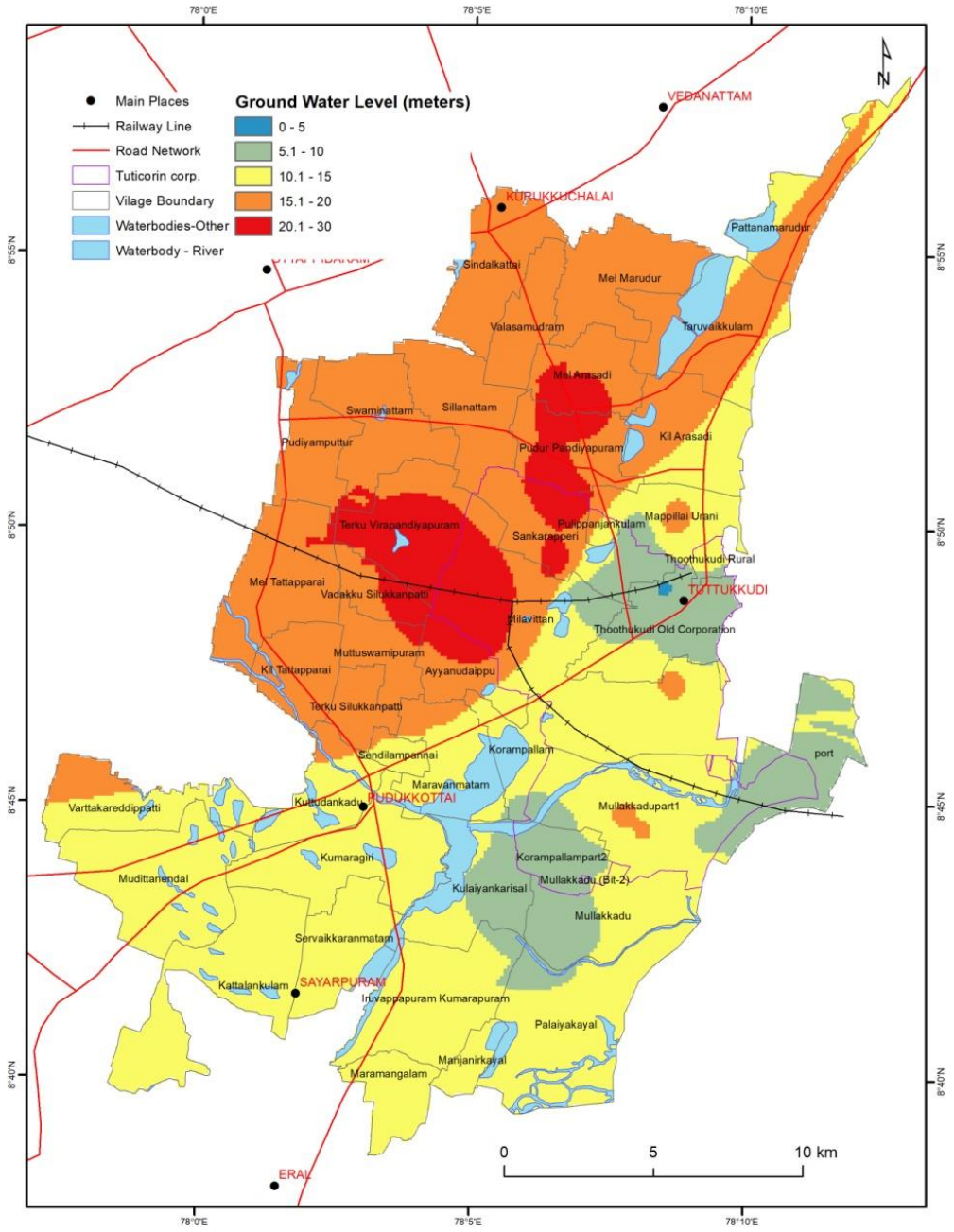
11.6.2 Secondary Data

Rainfall

Thoothukudi typically receives a relatively low amount of rainfall compared to the State average 942.8 mm of Tamil Nadu. On average, Thoothukudi receives approximately 600 to 800 millimeters of rainfall annually. The NE monsoon contributes about 65.4 % of annual rainfall and it plays as the major component of recharge into the aquifer. The contribution of the SW monsoon is only 8.06 %. The maximum and minimum rainfall was observed during November and June, respectively.

Water Level

Thoothukudi LPA water level ranges from 0 to 30 m (m.bgl).



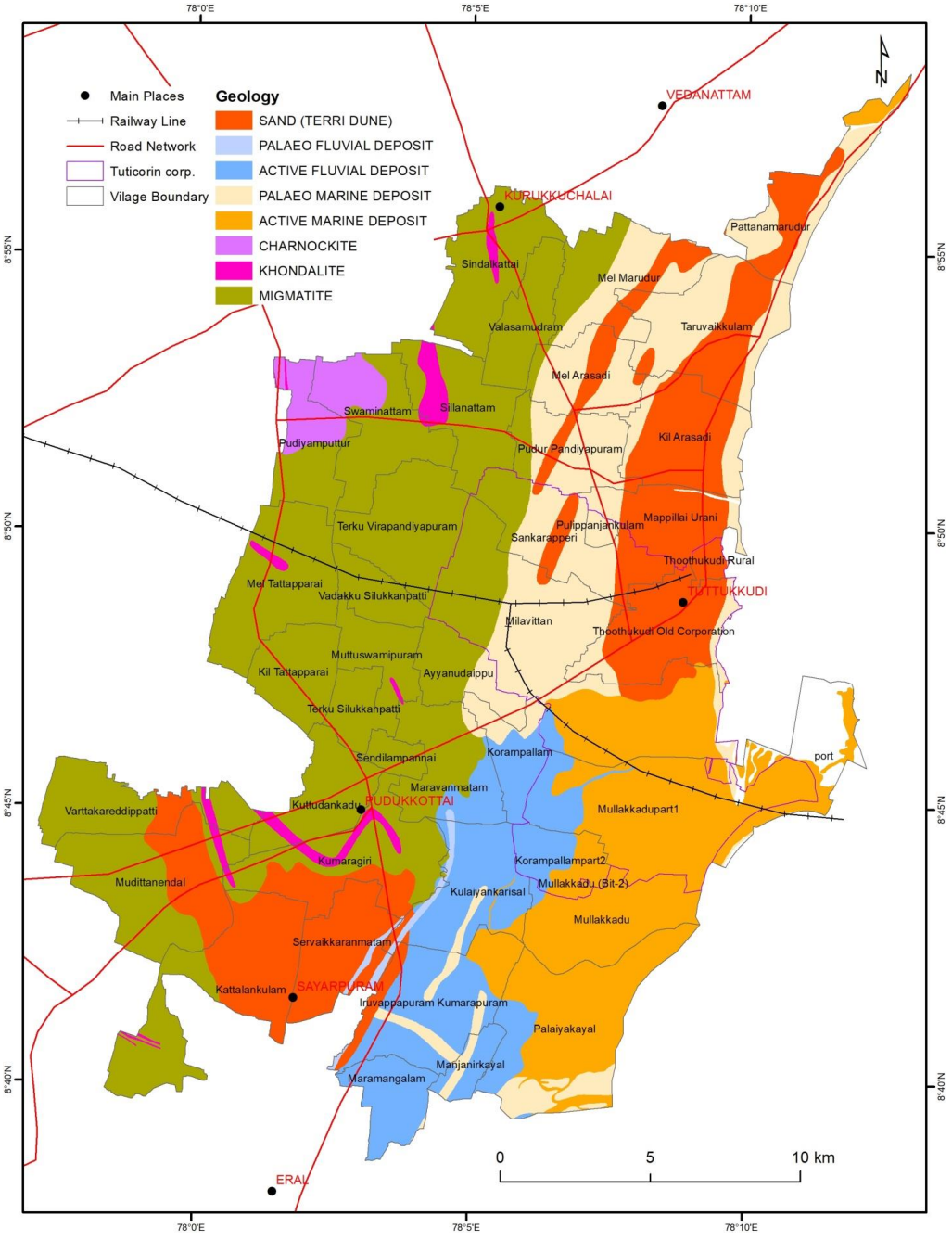
Map 11.2 Depth to water level post-monsoon

11.6.3 Thematic Layers

Geology

Northern part of the LPA, is interlaced with Sand (Terri Dune) and Paleo marine deposit along the coast line and Magmatite type of hard rock is found adjacent to Paleo marine deposit. Southern and middle part of the coastline near the Port area, Active marine deposits is found and adjacent to the Active marine deposits in the southern part Active Fluvial Deposit is found

with intrusions of Paleo Marine Deposits. Sand Terri Dune is also found along with Magmatite hard rock in the South Western part of the LPA.

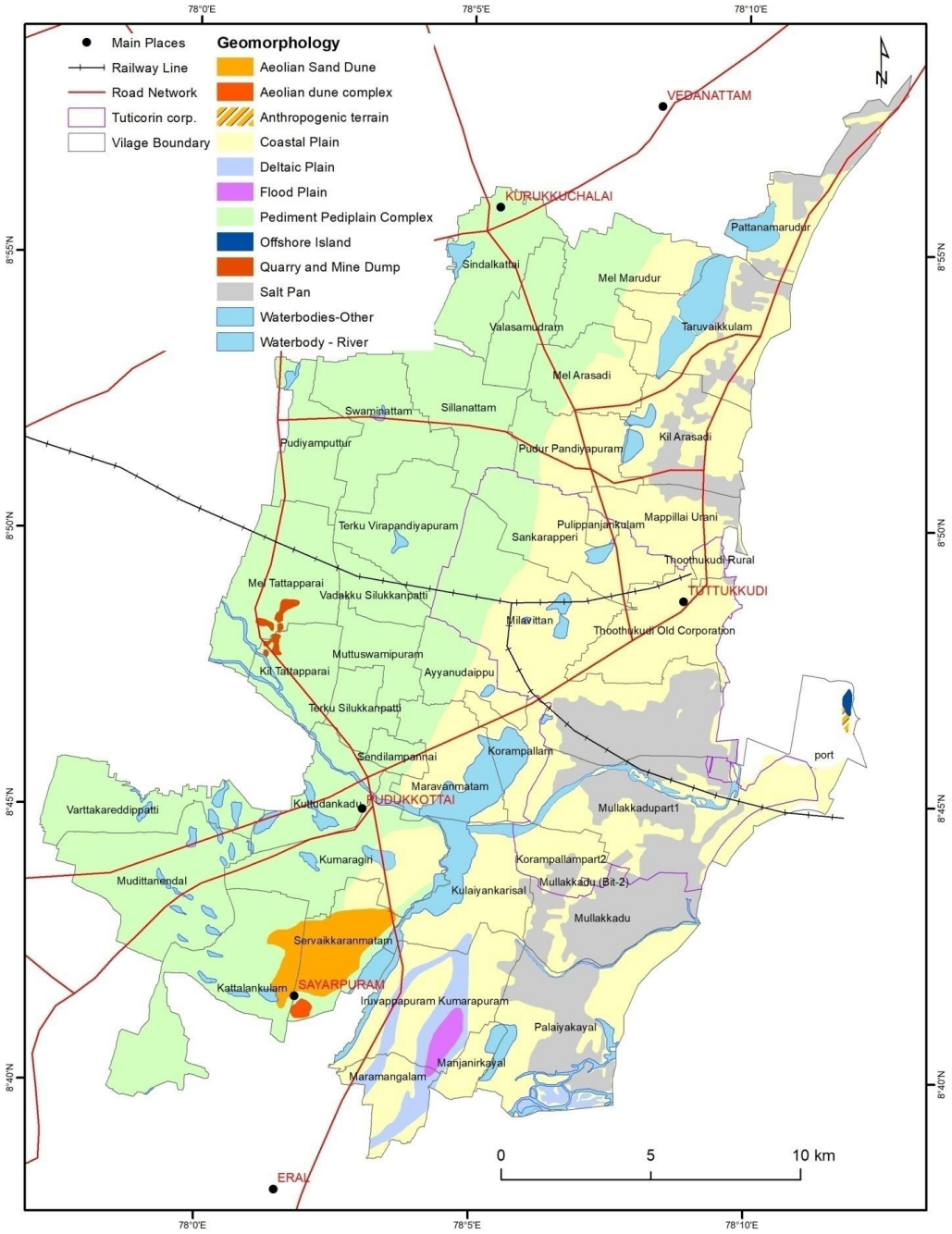


Map 11.3 Geological Map of the LPA

Geomorphology

Geomorphology of the Western half of the LPA is Pediment Pediplain Complex with mining activities in the villages of Kil Tattapparai and Mel Tattapparai. Majority of the eastern side of the LPA is covered by Coastal Plain with huge activities of Salt Pan. A small patch of offshore island is

available near the Port. Aeolian Sand Dune and Dune complex is found in Servaikkaranmatam and Kattalankulam. Deltai plain is found across the coast line whereas Flood Plain is found to occur in Iruvappapuram Kumarapuram village.



Map 11.4 Geomorphological Map of the LPA

Land Use / Land Cover

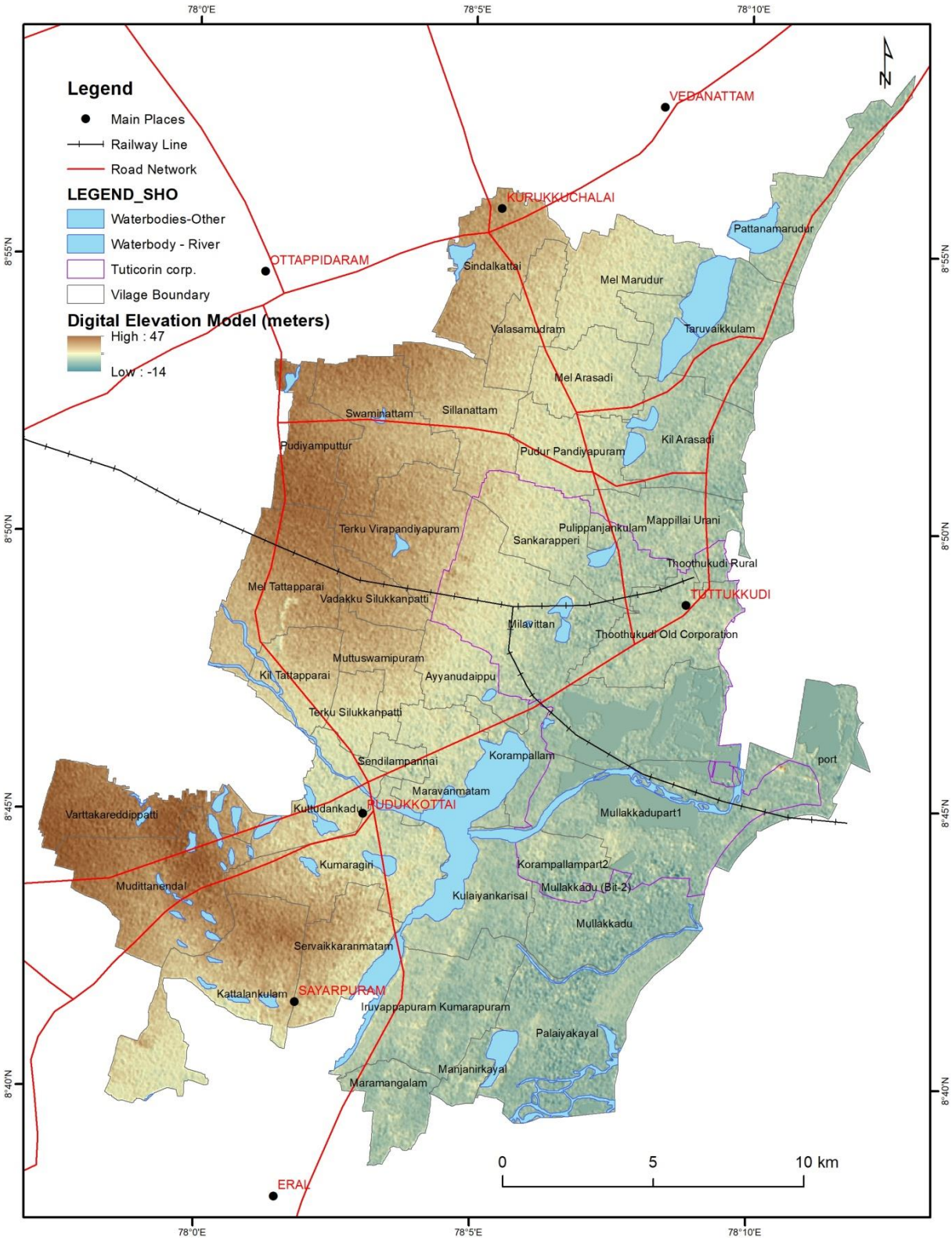
Majority of the land in the LPA is cultivable and falls under Agricultural Land followed by Built-up Land in the middle of the LPA and the northern boundary is covered Forest along the hilly terrain.

Soils

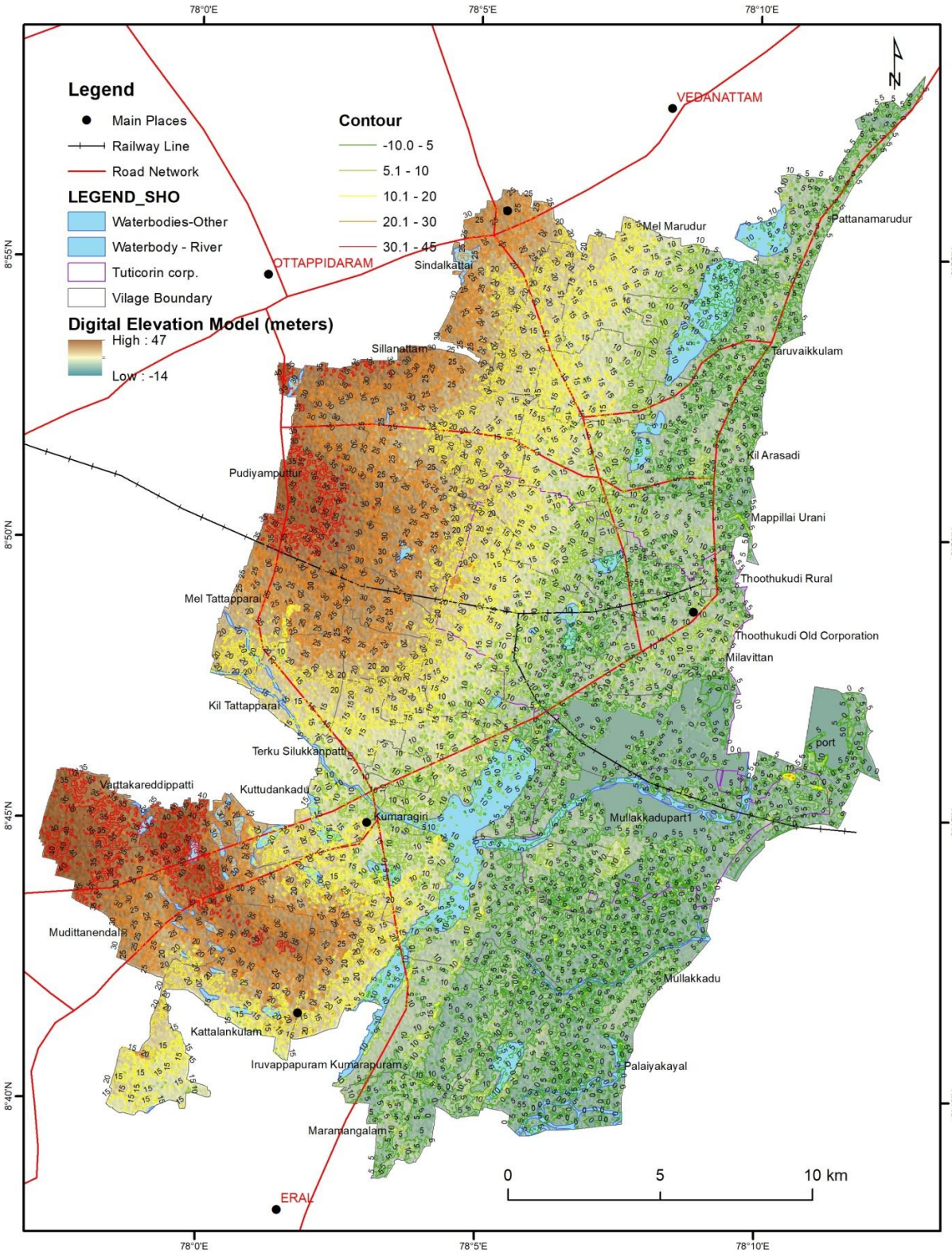
Alfisols is the variety of the Soil found majorly in the LPA including the central part of the LPA, alfisols which are moderately leached soils that have relative high fertility. Inceptisols variety of soil is found along the Coastal line, Inceptisols are soils of newer origin and are characterised by lack of clays, iron oxides,aluminium oxide or organic matter.Inceptisols can develop on young or old geologic material. Entisols occupies near coastal region of Kanyakumari.

Digital Elevation Model (DEM)

Digital Elevation Models (DEMs) play a pivotal role in crafting comprehensive master plans for urban development, environmental management, and infrastructure design. By providing detailed three-dimensional representations of terrain, DEMs offer invaluable insights into topographical variations, elevation gradients, and drainage patterns within a given area. This information is indispensable for assessing the suitability of land for different land uses, identifying flood-prone zones, planning transportation networks, and optimizing the placement of infrastructure such as roads, bridges, and utilities. Thus, integrating DEMs into master planning processes not only enhances the precision of spatial analysis but also fosters the creation of resilient and livable communities tailored to meet the needs of both present and future generations.



Map 11.5 DEM Map of the LPA



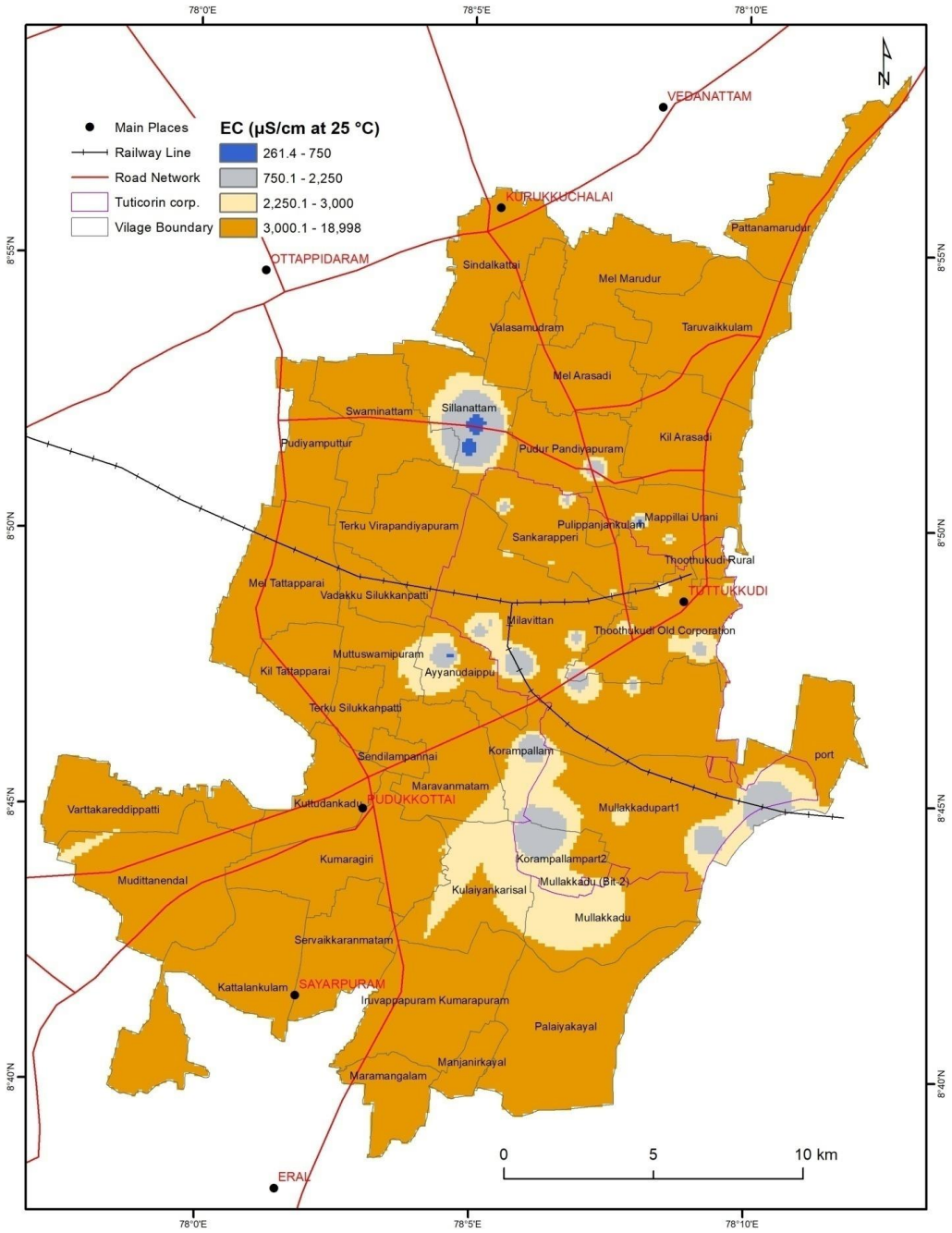
Map 11.6 DEM with Elevation Contour Map of the LPA

11.7 Water Quality

11.7.1 Electrical Conductivity (EC)

Electrical conductivity studies in groundwater play a crucial role in assessing water quality, identifying sources of pollution, understanding groundwater dynamics, and managing water resources effectively for both human consumption and agricultural use. High EC levels in groundwater can indicate the presence of saline or brackish water. Infiltration of industrial wastewater or agricultural runoff can significantly increase EC levels due to the presence of dissolved ions and pollutants.

EC value of the Thoothukudi LPA ranges from 280 to18,998 μS/cm at 25^0C, the high values of EC indicate high salinity and brackish nature of water. Only 5 to 10% LPA falls under Permissible limit as per BIS standards and rest of the entire LPA values falls beyond the permissible limit. Villages Sillanattam, Korampallam part2, Millavittan only has values less than 2,250 μS/cm which is permissible for consumption.



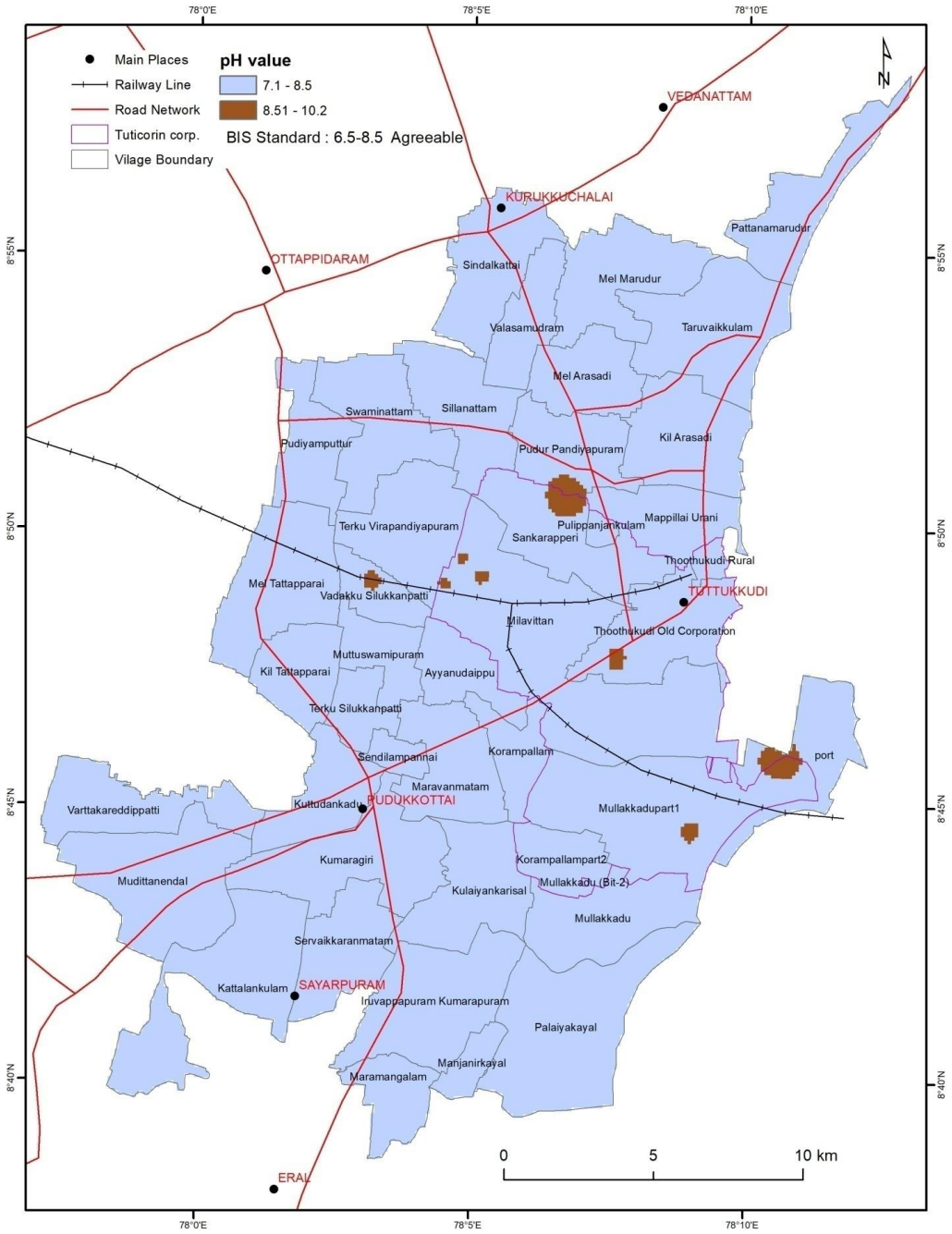
Map 11.7 Spatial representation of Electrical Conductivity map

11.7.2 Potential of Hydrogen (pH)

The pH value indicates the acidity or alkalinity of the water, water with pH values below 7 is considered acidic, while water with pH values above 7 is considered alkaline (basic). pH affects the corrosivity of water, especially for metals in contact with the water, such as pipes and plumbing fixtures. Monitoring pH helps in assessing the suitability of groundwater for irrigation and aquatic habitats. Changes in pH can indicate pollution sources in

groundwater. Assessing pH in water (even at domestic filters) protects human health and maintaining ecological balance in aquatic habitatants.

Values of the pH in the LPA falls within the BIS Standards except few places near Port, Pudur Pandiyapuram, Sankarapperi and Thoothukudi Old Corporation.



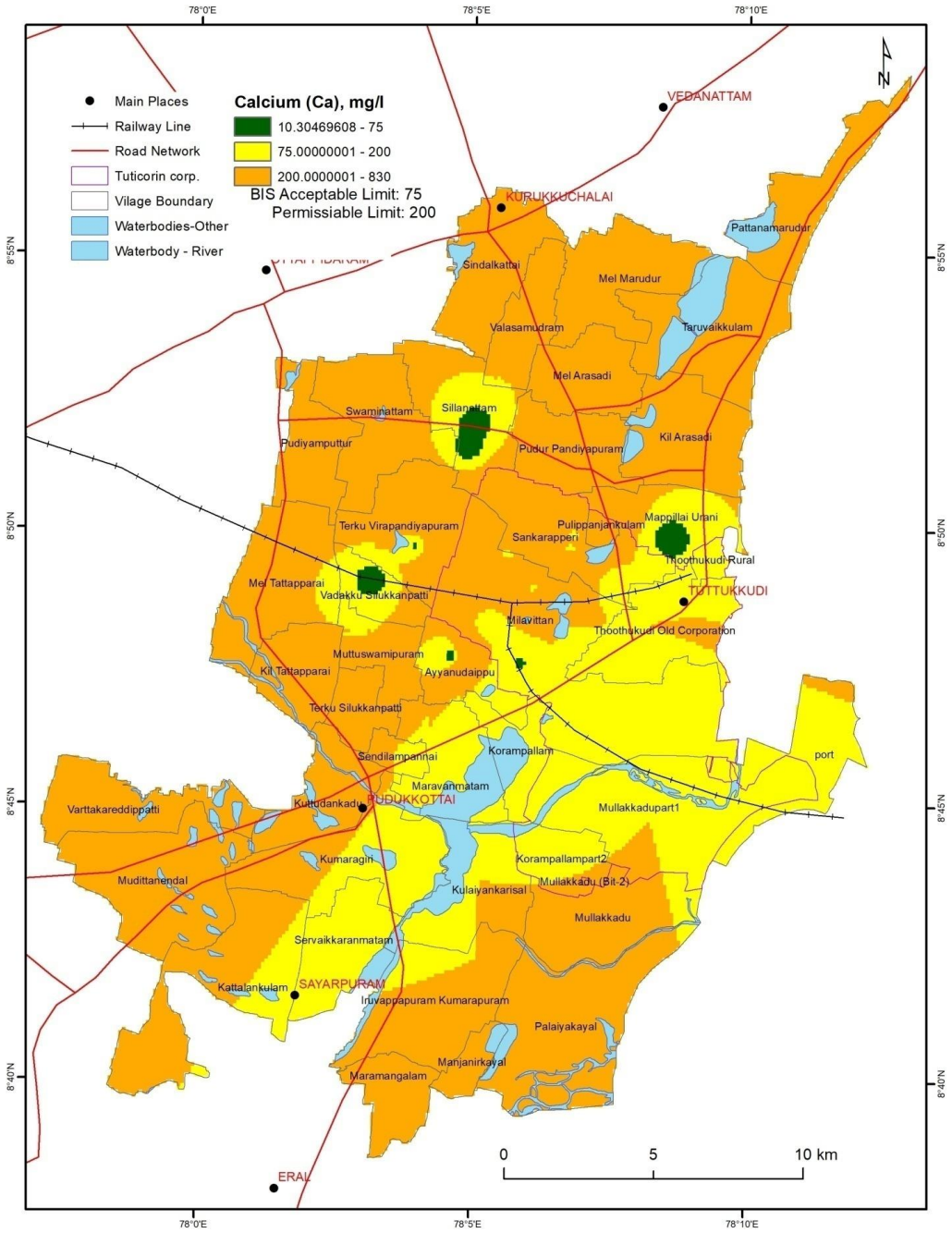
Map 11.8 Spatial representation of pH map

11.7.3 Calcium (Ca)

High calcium levels may indicate hard water, which can have implications for drinking water quality and household use. High calcium concentrations can contribute to the formation of scale deposits in plumbing systems and appliances. Monitoring calcium levels in irrigation water helps in assessing its contribution to soil fertility and crop nutrition.

Calcium is an important mineral for human health, playing a vital role in bone and teeth formation, muscle function, and nerve transmission. Groundwater with appropriate calcium levels can contribute to meeting daily calcium intake requirements. However, excessive calcium intake from drinking water may pose health risks for individuals with certain medical conditions, such as kidney stones or hypercalcemia.

In almost 80% of the LPA calcium values falls above the permissible limit of BIS Standards, where the Ca values are more than 200 mg/l. Mullakkadu Part-1, Maravanmalam, part of Kumaragiri and Servaikkaranmadam villages the Ca values falls within the permissible limit. Whereas, Sillanattam, Mappillai Urani and Vadakku Silukkanpatti has recorded less than 75 that falls under desirable limits.

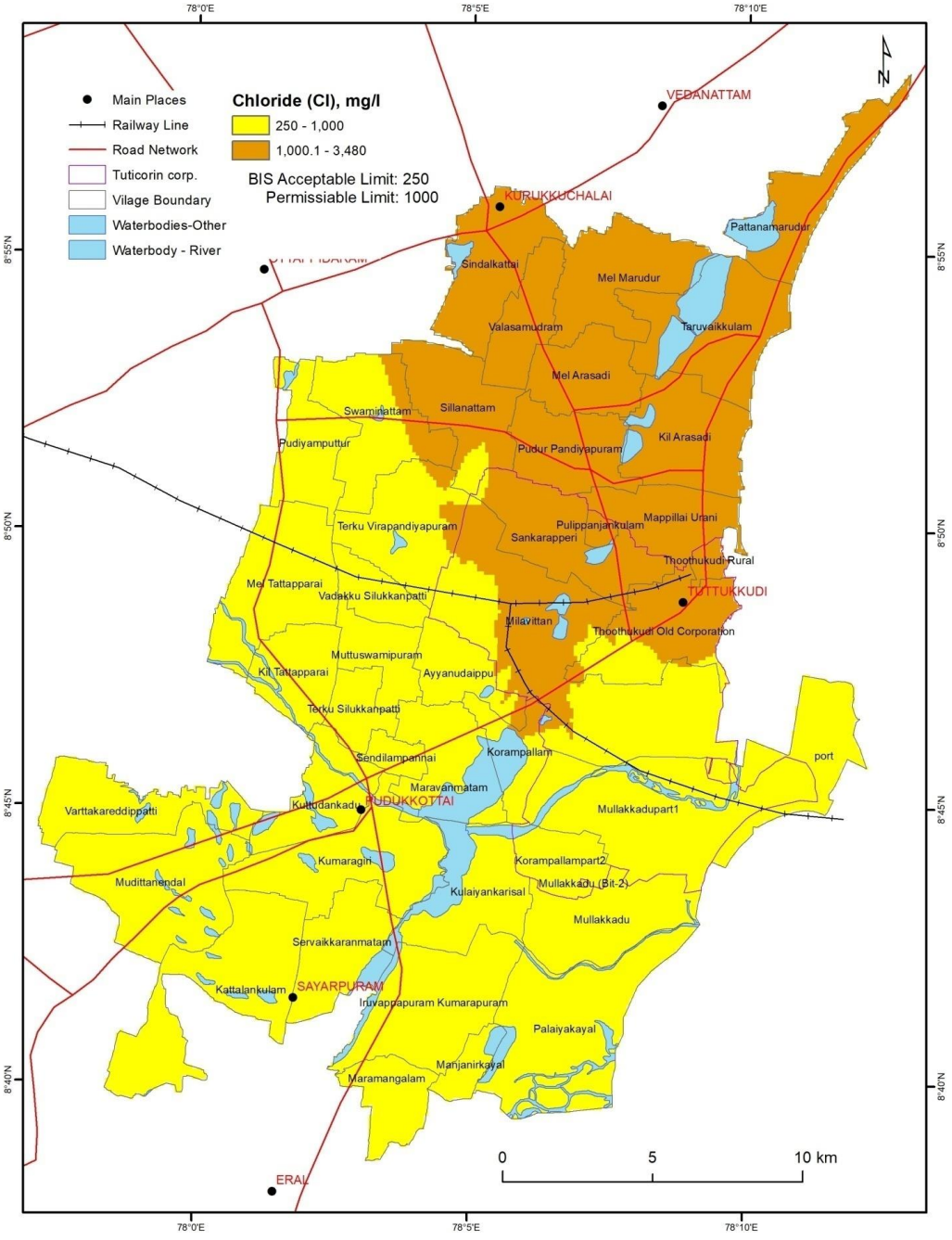


Map 11.9 Spatial representation of Ca

11.7.4 Chloride (Cl)

Assessing chloride levels helps to identify overall chemical composition of groundwater. High chloride levels may indicate contamination from sources such as road salt, wastewater discharge, or industrial activities, which can affect water suitability for drinking, irrigation, and other uses. Chloride is commonly associated with sodium in groundwater, especially in areas where seawater intrusion or saltwater intrusion from coastal aquifers occurs. Higher level of Cl affects taste and odor of the water. Elevated chloride levels in

groundwater can have adverse effects on aquatic ecosystems, particularly freshwater habitats.



Map 11.10 Spatial representation of Cl

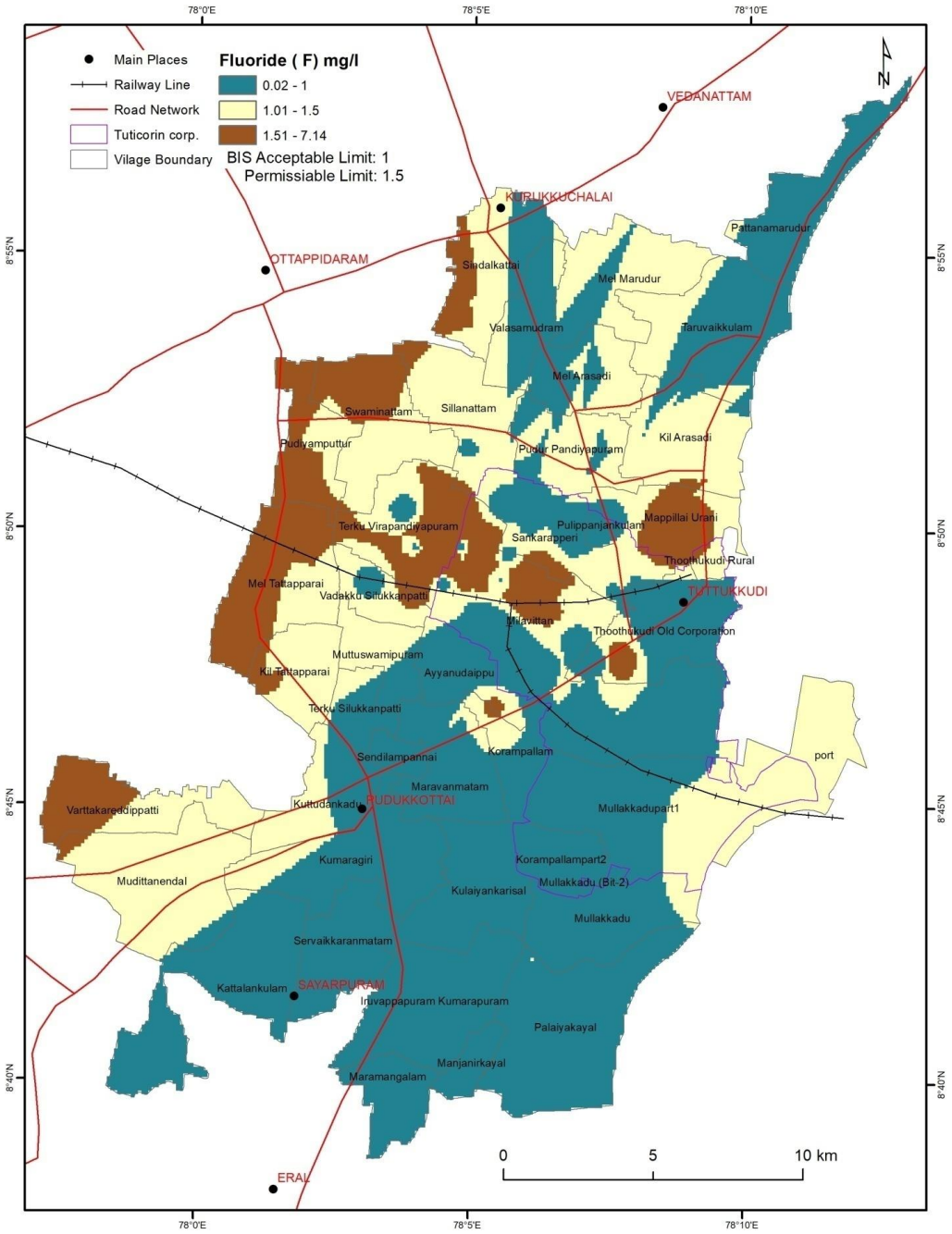
The entire LPA Cl values found to be more than the desirable limit, where the entire southern part records acceptable limit where the Cl values ranges between 250 – 1000 mg/l. Northern part of the LPA records more than the permissible limit.

Though entire coastline of the LPA has Salt Pan activities the changes in Cl level between the northern part and southern part needs to studied in detail.

11.7.5 Fluoride

Fluoride is essential for dental health, as it helps prevent tooth decay and strengthens tooth enamel, however, excessive fluoride intake can lead to dental fluorosis. Chronic exposure to high levels of fluoride in drinking water can lead to adverse health effects, such as skeletal fluorosis, which affects bone strength and causes joint pain and stiffness. High Fluoride concentration is due to geogenic and process of the rock water integration.

In the LPA the Fluoride presence is under the acceptable limit in most of the area with the value less than 1 mg/l. Middle and part of western area of the LPA falls under permissible limit with value ranging between 1.0 to 1.5 mg/l. In the following villages Varttakareddippatti, Mel Tattapparai, Terku Virapandipuram, Pudiyamputtur, Swaminattam, Milavittan and Mappillai Urani the Fluoride value is above the permissible limit, that is the value is found to be more than 1.5 mg/l.

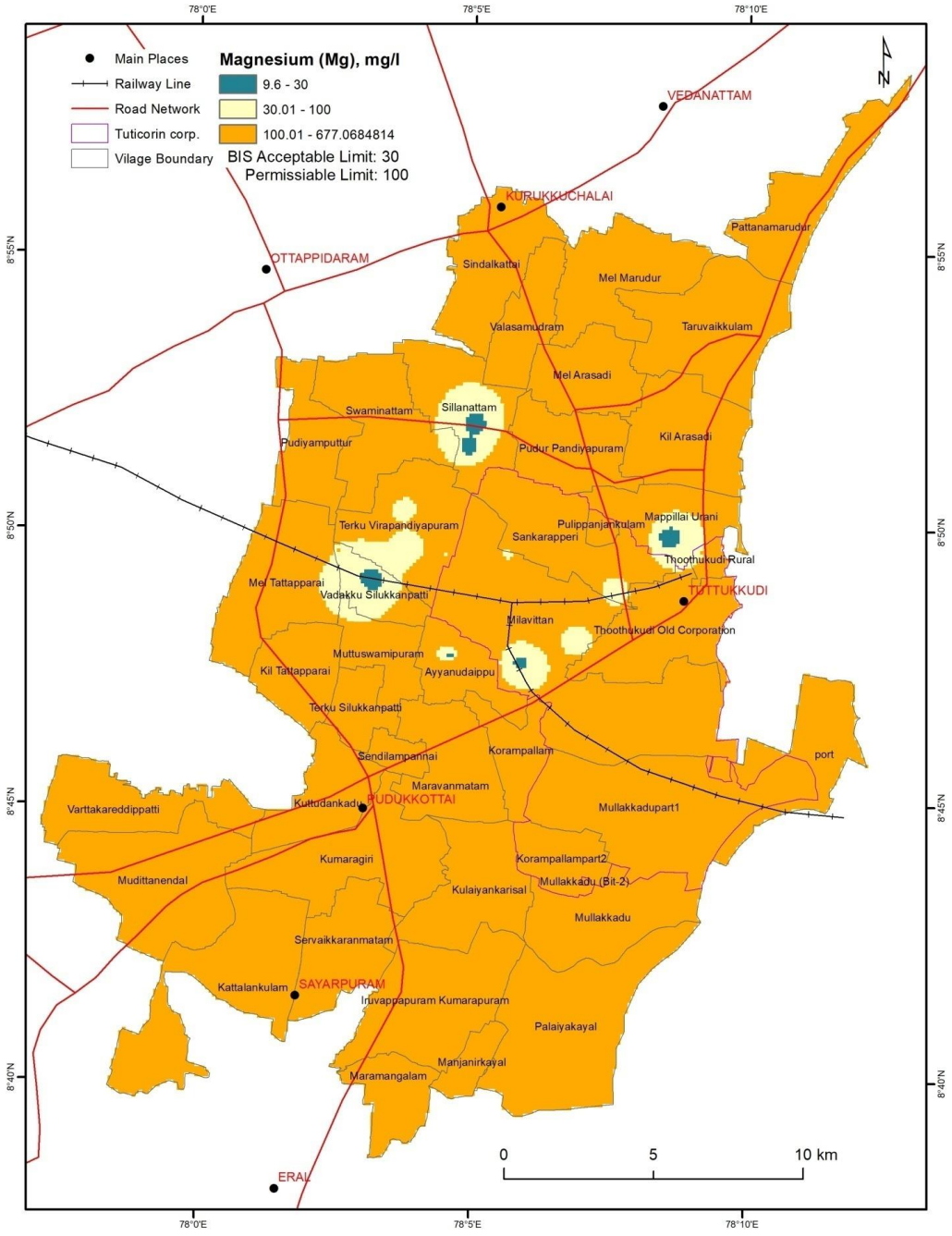


Map 11.11 Spatial representation of Fluoride

11.7.6 Magnesium (Mg)

High magnesium concentrations can affect the taste, odor, and suitability of water for various uses, such as drinking, agriculture, and industrial processes. Magnesium higher concentration intake from drinking water may have laxative effects and pose health risks for individuals with certain medical conditions, such as kidney disease or heart disease.

Monitoring magnesium levels helps water utilities and municipalities manage corrosion risks, optimize water treatment processes, and ensure the integrity of water distribution networks.



Map 11.12 Spatial representation of Magnesium

Monitoring magnesium levels in irrigation water helps ensure adequate magnesium supply for crop nutrition and soil fertility. Magnesium deficiency in soil and water can lead to decreased crop yields and poor crop quality.

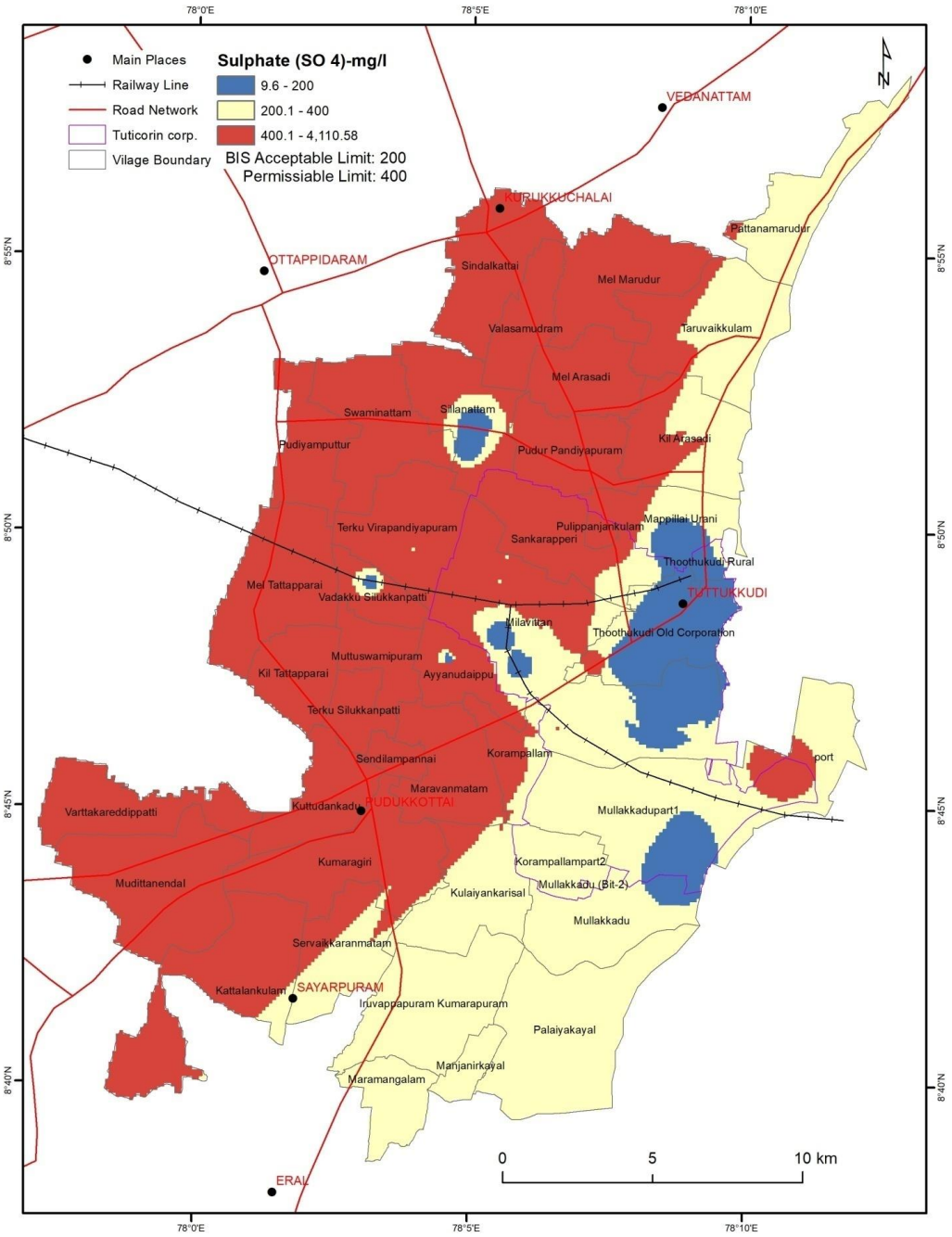
The nitrate values in the LPA mostly falls within the permissible limits of less than 45 mg/l. Agastheeswaram and Kanyakumari village records more than 45 mg/l which above the permissible limit of BIS Standards.

11.7.7 Sulphate (SO4)

Higher concentration of Sulphate levels can contribute to the formation of sulfates in the gastrointestinal tract, leading to gastrointestinal discomfort such as diarrhea or laxative effects. Additionally, sulfate can react with organic matter and disinfectants in water to form disinfection byproducts (DBPs), some of which may pose health risks. Monitoring sulfate levels helps ensure that drinking water remains within safe limits for human consumption.

Sulfate is used in various industrial processes, such as mining, pulp and paper production, and chemical manufacturing. Elevated sulfate levels in groundwater can result from industrial discharges or leaching from waste disposal sites. Monitoring sulfate levels helps identify sources of contamination and assess the environmental impact of industrial activities on groundwater quality.

Entire western part of the LPA except Silanttam village records higher concentration of Sulphate which is more than the permissible limit that is more than 400 mg/l. Concentration exceeds permissible limit near Port area. Along the eastern side Thoothukudi Old Corporation, Mullakkadu Part-1 records acceptable limit of Sulphate that is less than 200 mg/l, whereas rest of the eastern part concentration falls in acceptable limit that is between 200 to 400 mg/l.



Map 11.13 Spatial representation of Sulphate

11.7.8 Salinity

Salinity is a measure of the total dissolved salts (TDS) in water, including ions such as sodium, chloride, sulfate, and carbonate. Salinity in groundwater can vary spatially and temporally due to factors such as geological conditions, climate, irrigation practices, and groundwater extraction rates. Monitoring salinity levels helps water resource managers understand groundwater dynamics, identify areas prone to salinity intrusion or contamination, and develop sustainable management strategies to prevent further degradation of groundwater quality.

Salinity is a term used to describe the amount of salt present in a given water sample. It usually is referred to in terms of total dissolved solids measured in terms of milligrams of salts per liter(mg/L). Ground Water with a TDS concentration less than 1000 mg/L is considered as Fresh water. The somewhat arbitrary upper limit of fresh water is based on the suitability of water for human consumption. Ground water with TDS greater than 1000 mg/L is also used for domestic purpose in areas where water of lower TDS content is not available.

Generally ground water is classified as Fresh, Brackish, Saline and Brine depends on the TDS content of ground water . The Residium after fractional crystallization of NaCl (>35°Be) is called as Bitrine.

Table 11.4 Classification of Groundwater

Category of Ground water	TDS (mg/L)
Fresh	<1000
Brackish	1000 – 3000
Saline	3000 – 10000
Brine	>10000

The Brine content of Ground water is generally expressed in terms of degree Baumine (°Be) and measured with hygrometer. The chemical composition of brine water in the coastal aquifers is listed below in Table 11.4.

Table 11.5 Chemical composition of brine water in the coastal aquifers

Location	Ec	TH	Ca	Mg	Na
Mullakadu	97900	17500	1800	3162	27310

Location	K	CO3	HCO3	Cl	SO4	NO3	F
Mullakadu	782	0	342	51402	4992	1.6	0.6

Table 11.6 Concentrations of groundwater samples in the exploratory wells

Location	Depth range (mbgl)	Brine concentration (°Be)	Remarks
Mullakadu	0 - 30	5	Brine Concentration increases with depth
Mullakadu	30 - 40	7	
Mullakadu	40 - 60	10	

Table 11.7 Comparison of chemical constituents of brine and sea water

Description	Sea Water	Mullakadu
Brine ^{0}Be	1	5
Cl (mg/l)	19000	51402
Na	10500	27310
Ca	410	1800
Mg	1350	3162
SO4	2700	4992
EC µS/cm	25000	97900

11.8 Hydro physic-chemical inference

The concentrations of the samples exhibit extreme variations and high standard deviations of hydrochemical parameters. Analysis results of TDS, EC, Cl, K, SO4, Mg infer that groundwater in the coastal aquifers shows contamination of sea water and anthropogenic.

Almost all the parameters of the hyrdochemical analysis found that the concentrations were higher than the permissible limit prescribed by the BIS standards. The concentrations of EC and TDS proves the presence of sea water intrusion.

It is made clear the samples collected is not sufficient for the LPA since its highly contaminated, polluted and further evidence sea water intrusion in the LPA. Hence, it is requested to do a detailed survey with collection of water samples across all over the LPA and to be analysed for best results and planning. Based on the analysed results suitable long-term planning has to be done to restore the water quality of the LPA.

11.9 Inter Basin Transfer of Water

Water is diverted from Tamiraparani Basin through North Main Channel taking off from Srivaikundam Anicut, the last anicut across Tamiraparani river for thermal power generation etc. and thequantityof waterdivertedis10.78MCM. The water also finds use in irrigating the lower riparian stretches of the basin.

11.10Sodium Adsorption Ratio and Soil Infiltration

The sodium adsorption ratio (SAR) is a measure of the amount of sodium relative to calcium and magnesium in water. It is the ratio of the Na concentration divided by the square root of one half of the Ca+ Mg concentration. It indicates the suitability of water for use in agricultural irrigation. High levels of sodium ions in water affect the permeability of soil and can lead to water infiltration issues. Pudukottai, and Kil Thattaparai have high SAR values and thus counter to any efforts of artificial recharge to augment

the resources. Also the groundwater in these areas are unfit for irrigation purposes.

11.11AQUIFER MAPPING AND INFERENCE

11.11.1 Aquifer disposition

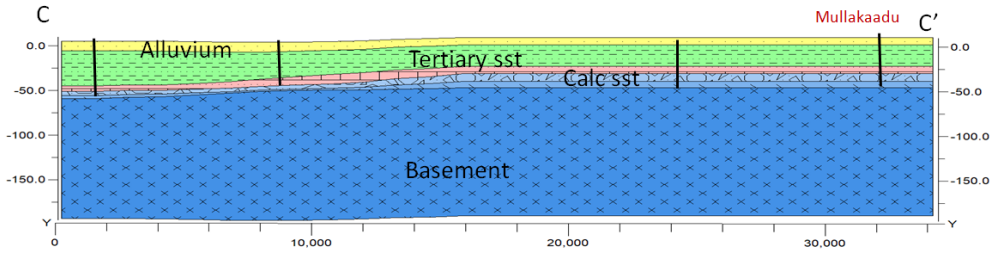


Figure 11.7 2D Aquifer Disposition

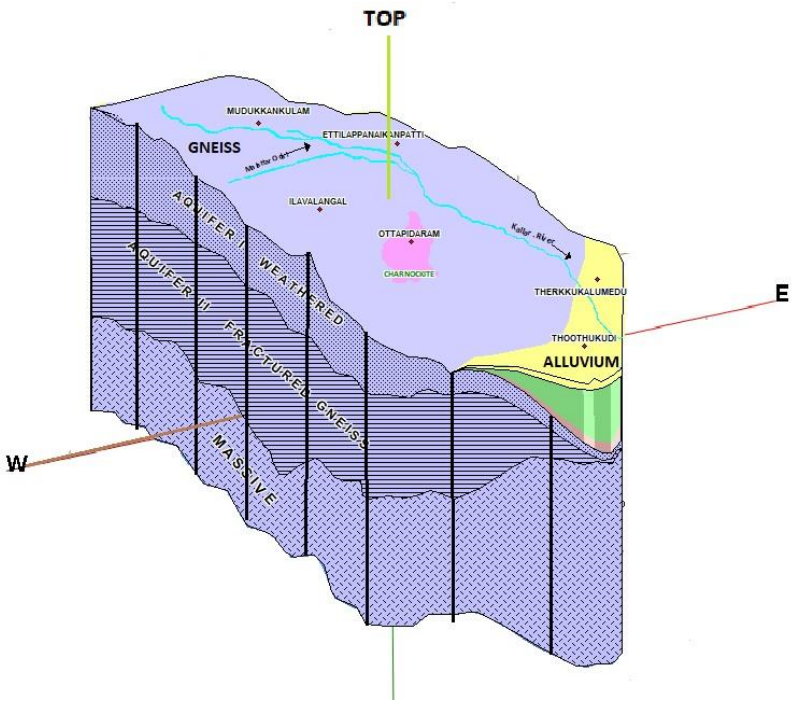


Figure 11.8 3D Aquifer Disposition

11.11.2 Annual Extractable Groundwater Resources

The annual extractable groundwater resources availability refers to the available annual recharge after allowing for natural discharge in the monsoon season in terms of base flow and subsurface inflow/outflow. This annual extractable groundwater resources includes the existing groundwater withdrawal, natural discharge due to base flow and subsurface inflow/ outflow in the monsoon season and availability for future development. As the groundwater development progresses the natural discharge gets suitably modified and comes down to negligible quantities due to interception by different groundwater structures. Hence, natural discharges in the monsoon season may not be considered and the total annual groundwater recharge may be taken as annual extractable groundwater resources. The annual extractable groundwater resources of the LPA for the year 2020 is arrived at 1313.75Ham.

11.11.3 Stage of Development and Categorization

The gross annual groundwater extraction has been assessed by using Unit draft method for irrigation draft component and by adopting formula suggested by GEC 2015 for domestic and industrial draft components. The existing annual groundwater extraction of the basin for the year 2020 is arrived at 1313.75 Ham, and the stage of groundwater extraction is worked out at 21%

Table 11.8 Annual Ground Water Extraction in Thoothukudi LPA

Assessment Unit (Firka)	Annual extractable Groundwater Recharge Ha m	Existing Groundwater Extraction for Irrigation in Ha m	Existing Grroundwater extraction for industrial Water supply in Ha m	Existing Grroundwater extraction for Domestic Water supply in Ha m	Existing Grroundwater extraction for All uses in Ha m	Stage of Groundwater extraction in %
Total in Ham	1313.75	114.2	48.6	115.03	277.83	21.15

11.12Groundwater-Related Issues

Aquifer in the LPA predominantly occupied in the Sedimentary Rocks which warrants cautious groundwater development strategy because of the below mentioned issues.

- Insitu Salinity
- Limited scope for Artificial Recharge Schemes in the saline tracts of the basin
- Limited freshwater availability in sedimentary areas occurring as floating lenses makes the coastal tract vulnerable for water quality changes

Pollution of groundwater due to industrial effluents

The aquifer system of the LPA is also stressed due to the insitu salinity observed all along the villages of the LPA which further is a major impediment to the availability of sustainable groundwater resources.

11.13Future Demand

In the LPA the groundwater is contaminated and hence the dependency on groundwater for domestic and drinking needs is decreasing and alternative surface/ river sources are being harnessed.

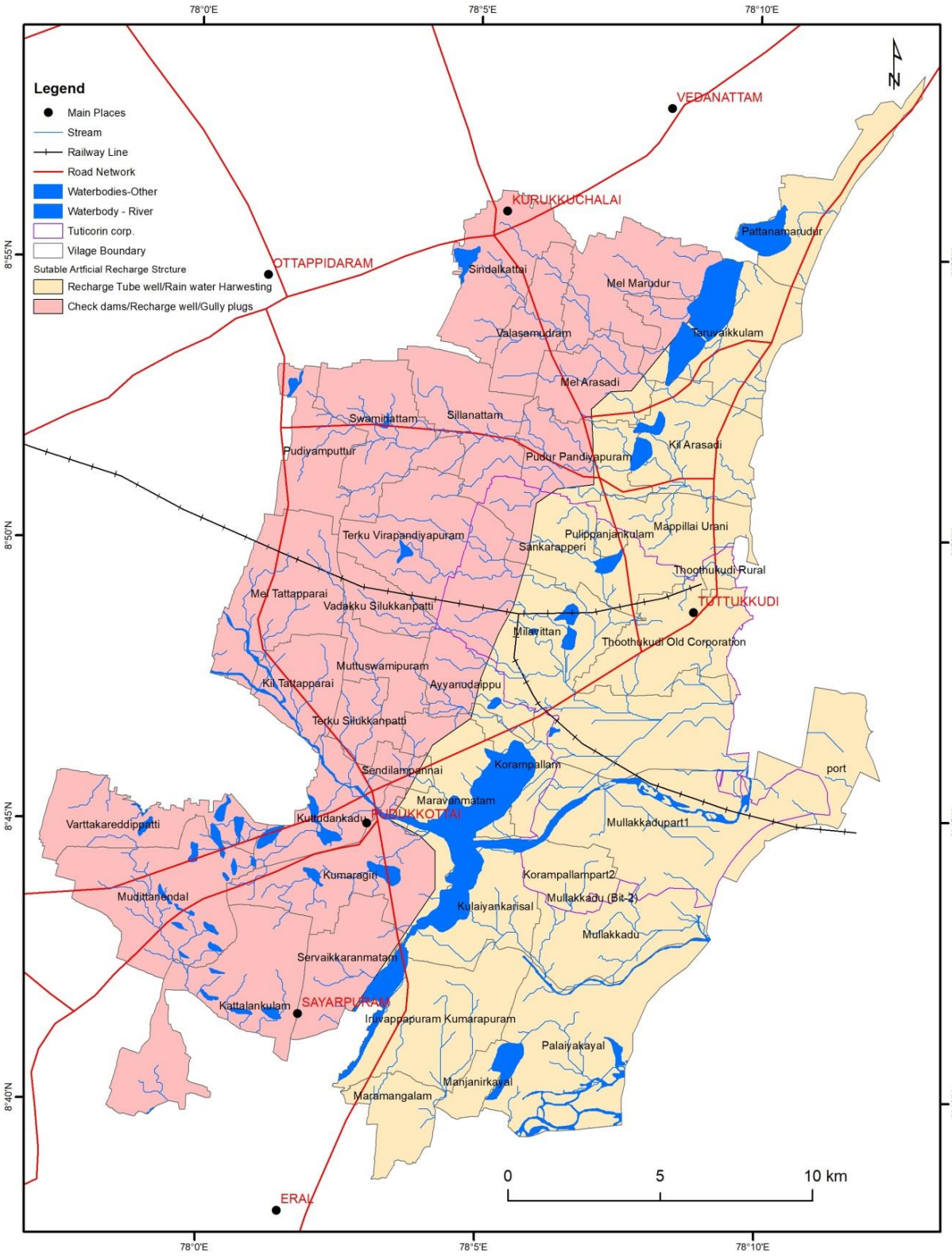
11.14Aquifer Management Plan

Aquifer of LPA needs careful management practices in view of the vulnerable sea water instruction problems and limited scope for artificial recharge schemes in saline tracts.

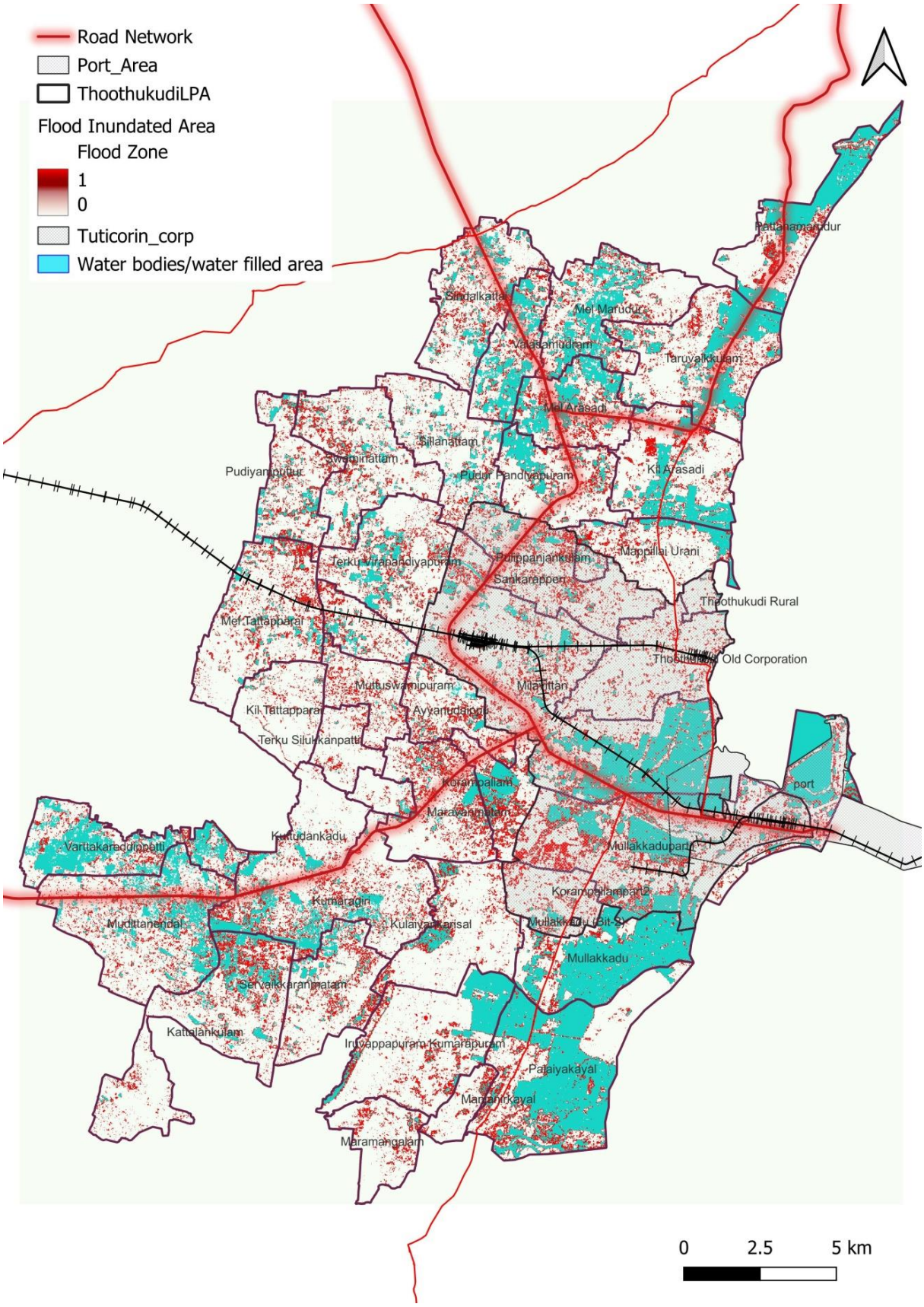
Necessary measures for regulating the exploitation of ground water may be implemented particularly in Teri sand aquifer area and fresh water bearing Tertiary sandstone areas along the coast has to be notified.

Modeling of coastal aquifers is needed for varies stress conditions in view of brine and freshwater development is very high in the region.

Intensive monitoring of ground water levels and water quality is to be taken up to monitor the movement of fresh and saline water interface.



Map 11.14 Recharge Zones of the LPA



Map 11.15 Flood Inundation Zone

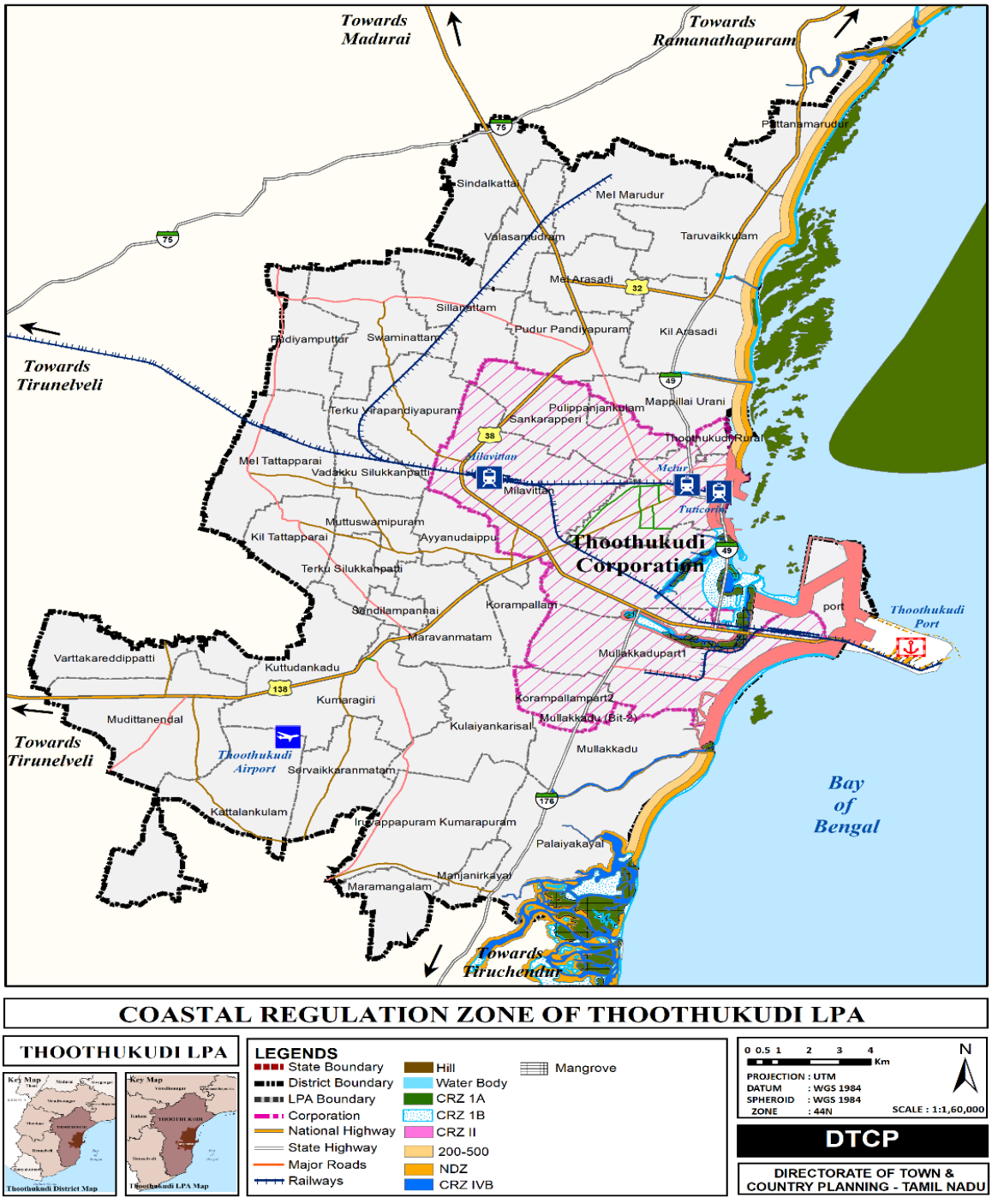
11.15Groundwater Resource of LPA

Assessment Unit (Firka)	Annual extractable Groundwater Recharge Ha m	Existing Groundwater Extraction for Irrigation in Ha m	Existing Groundwater extraction for industrial Water supply in Ha m	Existing Groundwater extraction for Domestic Water supply in Ha m	Existing Groundwater extraction for All uses in Ha m	Allocation for domestic and industrial water supply in Ha m	Net Groundwater Availability for future irrigation extraction in Ha m	Stage of Groundwater extraction in %
Pudukottai	1033.6	105.2	26	32.51	163.71	34.5	867.9	15.84
Thoothukudi	280.15	9	22.6	82.52	114.12	87.55	161	40.74
Basin total in Ham	1313.75	114.2	48.6	115.03	277.83	122.05	1028.9	21.15
Basin total in MCM	13.1375	1.142	0.486	1.1503	2.7783	1.2205	10.289	

11.16Future Demand

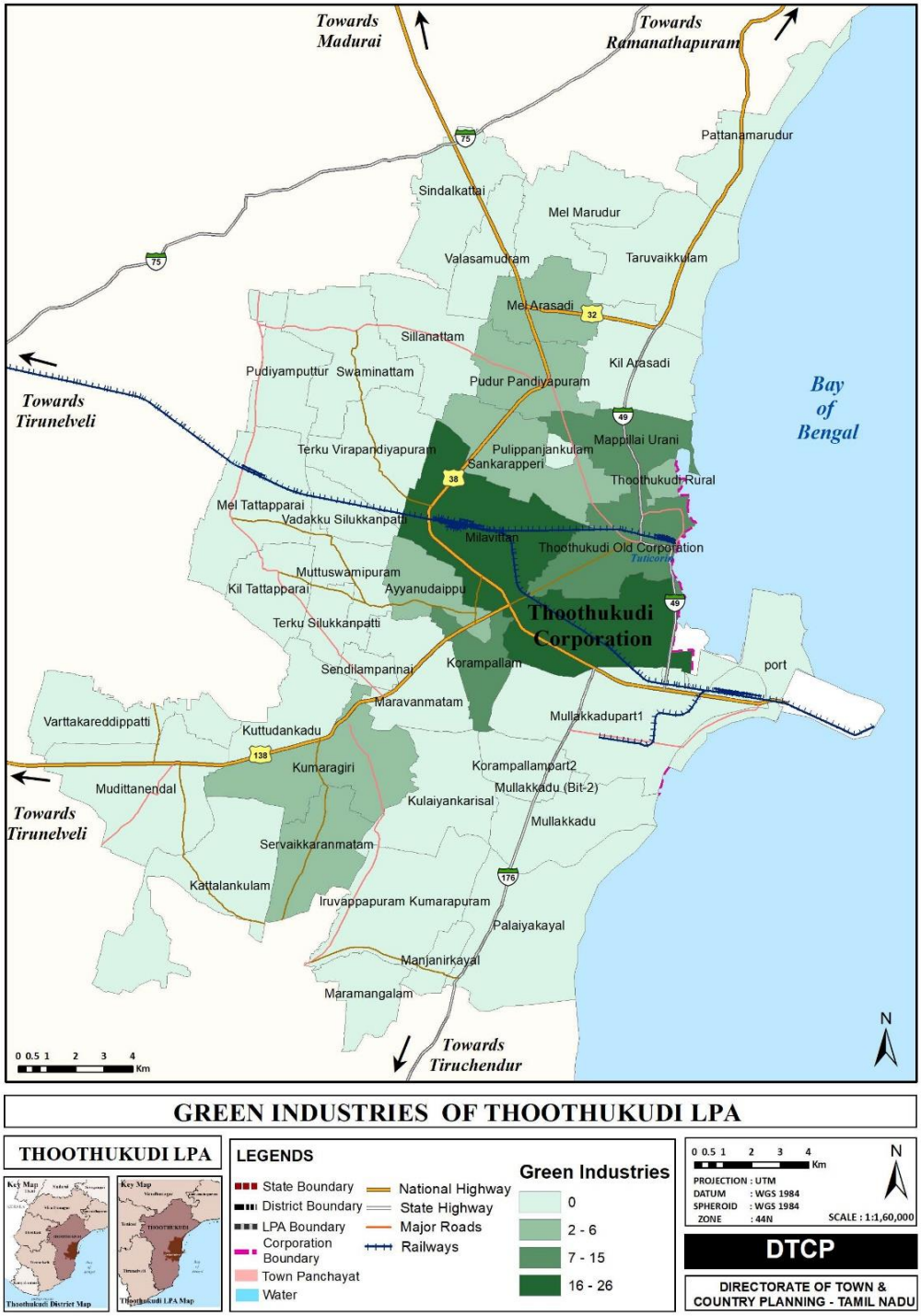
Type of industry	Average Rate of Water consumption as given in IWS m3/day	2010		2017		2020		2030		2040		2050	
		No. of industry as per IWS	Water Demand	No. of industry as per IWS	Water Demand	No. of industry as per IWS	Water Demand	No. of industry as per IWS	Water Demand	No. of industry as per IWS	Water Demand	No. of industry as per IWS	Water Demand
Small scale industry	2.5	542.00	0.49	929.00	0.85	1170.00	1.07	2526.00	2.30	5454.00	4.98	11775.00	10.74
Medium & Largescale industry	2500	24.00	21.90	41.00	37.41	52.00	47.45	112.00	102.20	242	220.83	521	475.41
Total Demand in M.Cum			**22.39**		**38.26**		**48.52**		**104.5**		**225.81**		**486.15**

11.17 Coastal Regulation Zone



Map 11.16 Costal Regulation Zone Map of Thoothukudi LPA

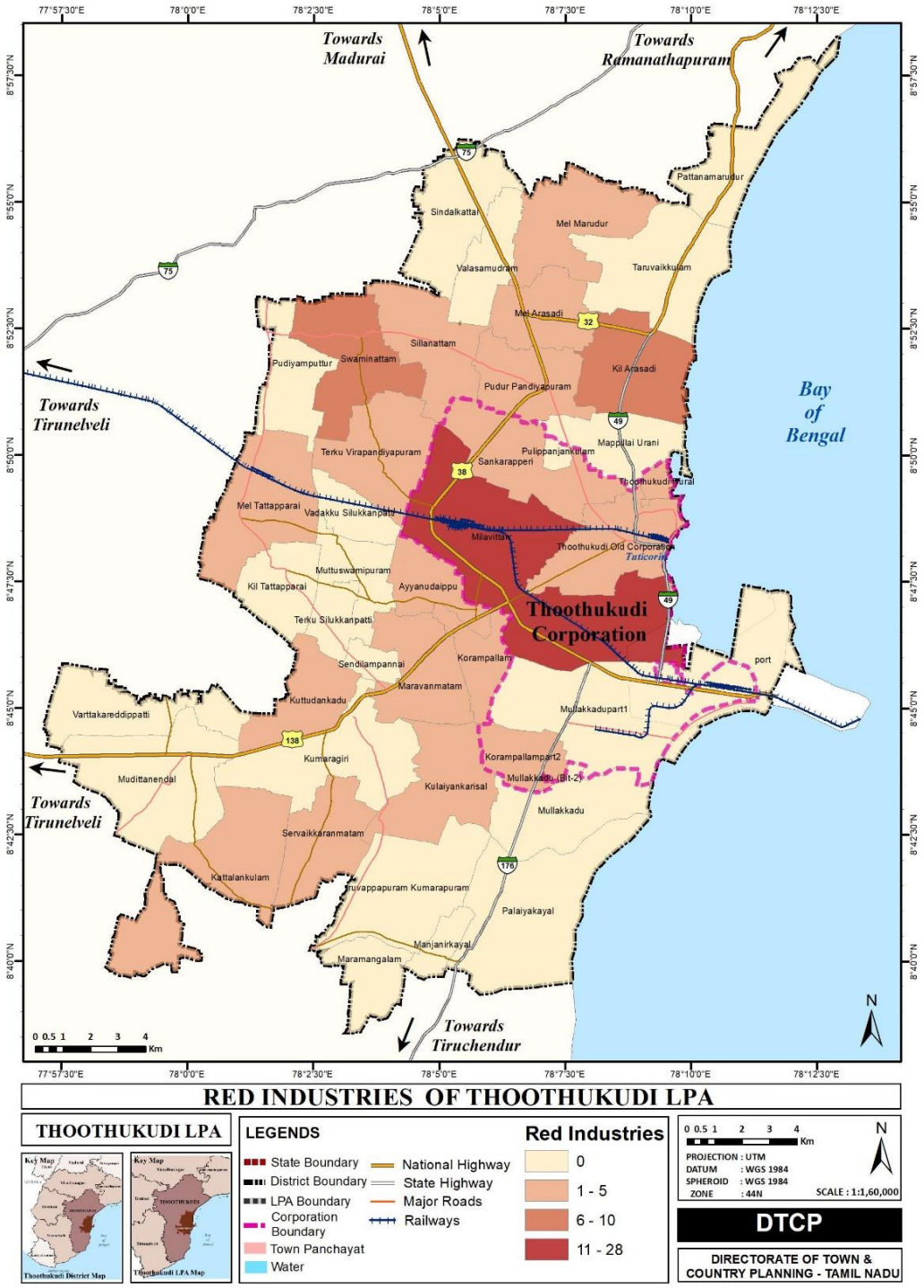
11.18 Industries Pollution Category



Map 11.17: Green industries of Thoothukudi LPA

Green Industries' are observed to be concentrated in the corporation area, as well as in the villages of Milavittan, Korampallam, Servaikkaranmatam,

Kumaragiri, Ayyanudaippu, Mappillai Urani, Pudur Pandiyapuram, Mel Arasadi, etc.



Map 11.18: Red industries of Thoothukudi LPA

Red industries' are observed to be concerntrated in the corporation area, and Milavittan village etc and and evenly distributed in along the major highways such as NH-32, NH-38 and NH-138.

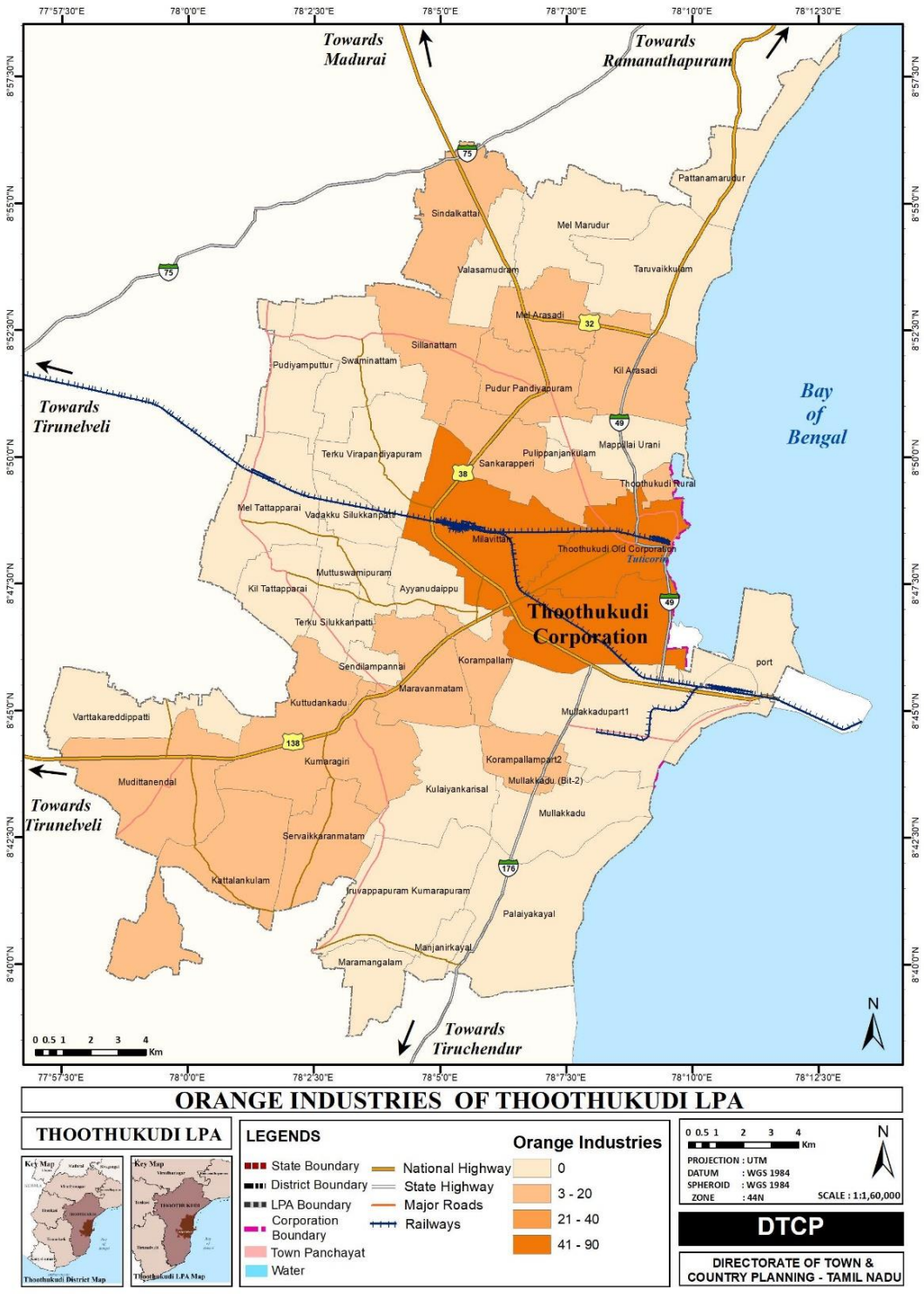


Figure 11.9: Orange industries of Thoothukudi LPA

Orange industries' are observed to be concerntrated in the corporation area, and evenly distributed in along the major highways such as NH-32, NH-38 and NH-138.

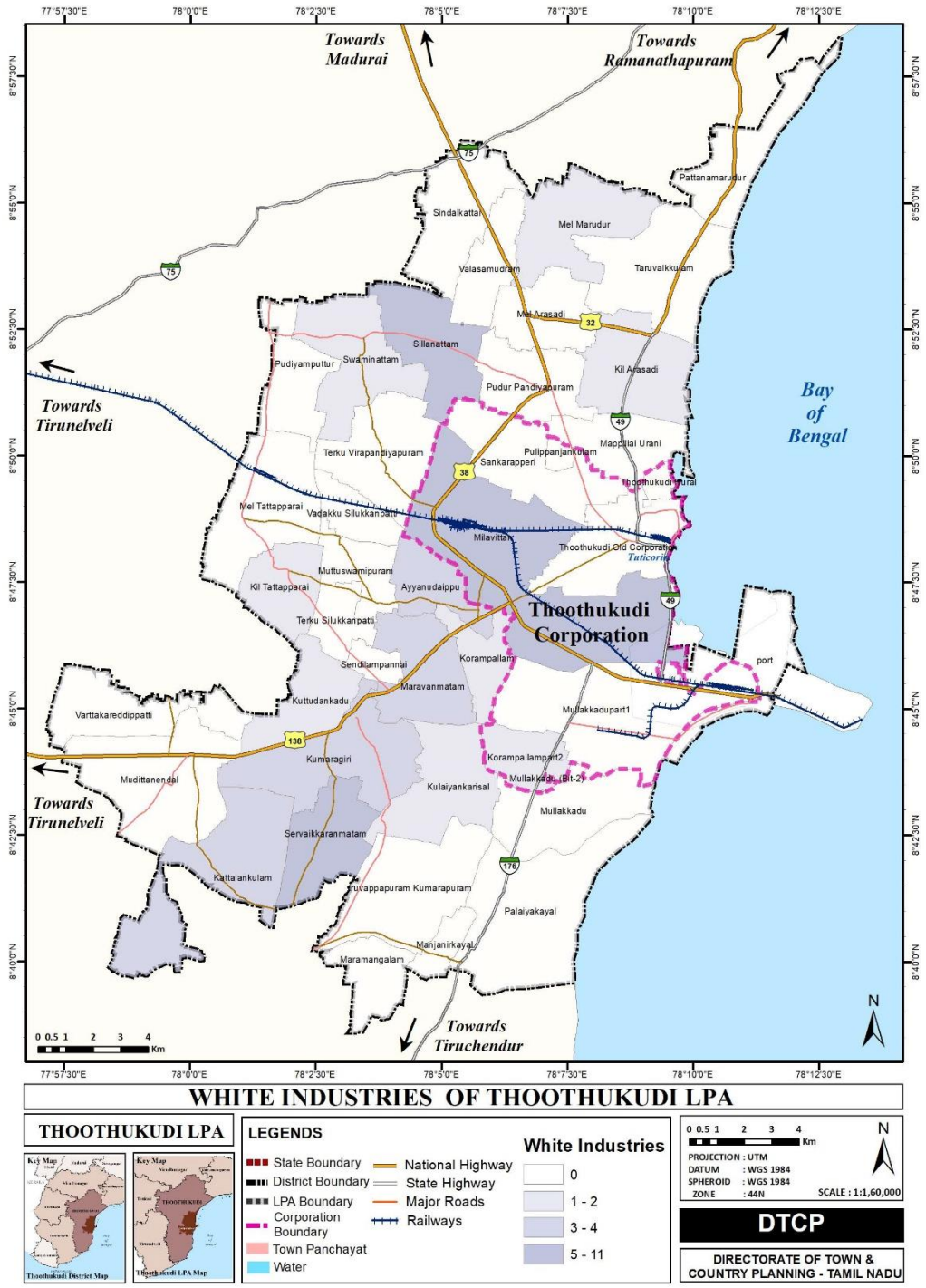


Figure 11.10: White industries of Thoothukudi LPA

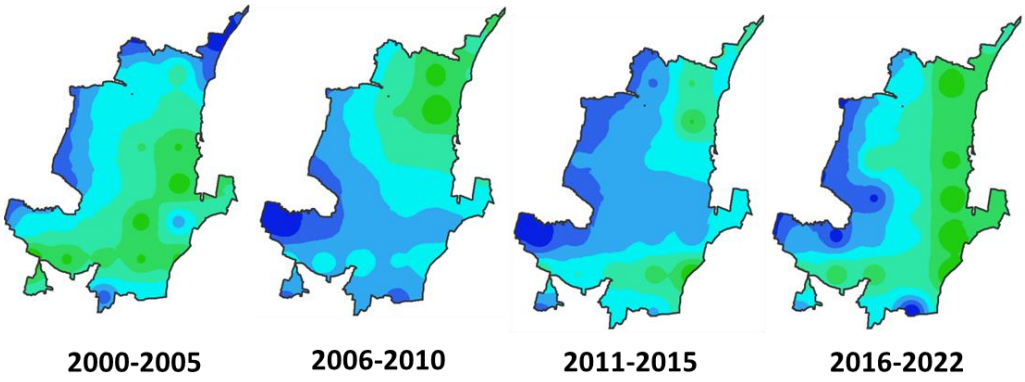
White industries' are observed to be concerntrated in the corporation area, Sillanattam, Sevaikkaranmatam and Milavittan village etc, and are distributed in along the major NH138.

12 RAINFALL AND FLOOD ANALYSIS

12.1 Rainfall Trend - Spatial Analysis and Historical Variability

The analysis of rainfall trends in Thoothukudi LPA spanning from 2000 to 2022 provides valuable insights into the spatial distribution and historical variability of precipitation in the region. Leveraging data from the CHRS data portal, rainfall patterns at rain-gauge stations within and surrounding the LPA have been scrutinized, revealing notable trends and disparities.

Historical Rainfall Trends: Over the past two decades (2000-2022), annual rainfall in Thoothukudi LPA has exhibited variability, with recorded annual precipitation ranging from 811mm to 1255mm. The average annual precipitation stands at 891mm, highlighting the dynamic nature of rainfall patterns in the region



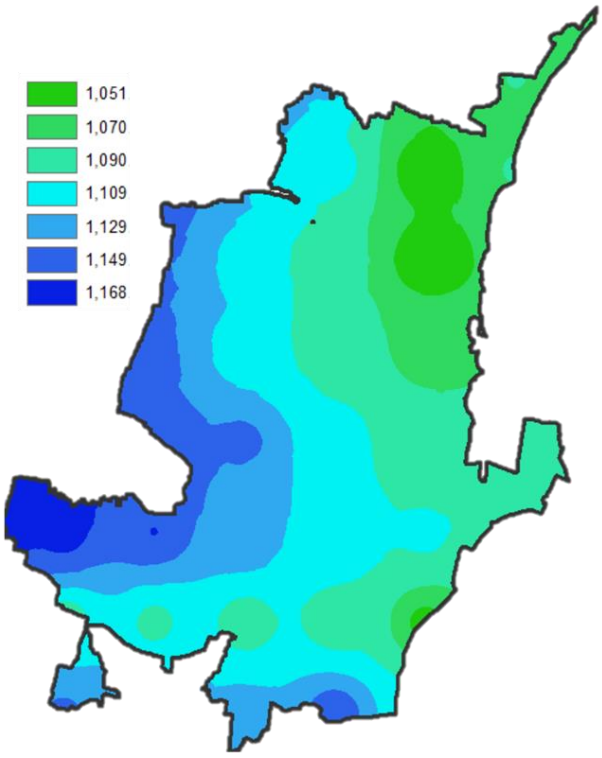
Map 12.1: 5-year interval Rainfall trend maps from 2000-2022

A key observation from the analysis is the spatial variability of rainfall across Thoothukudi LPA:

Northern Coastal Area: This area historically experiences lower levels of rainfall compared to the southern and western regions outside the LPA boundary. It ranges from 811mm to 1109mm annual precipitation over the last two decades.

Southern and Western Portions: This area notably receive higher levels of rainfall, indicating a pronounced gradient in precipitation distribution within

and around the LPA. It has a range of 1109mm to 1255mm annual precipitation over the last two decades.



Map 12.2: The 20-year Average Rainfall Map

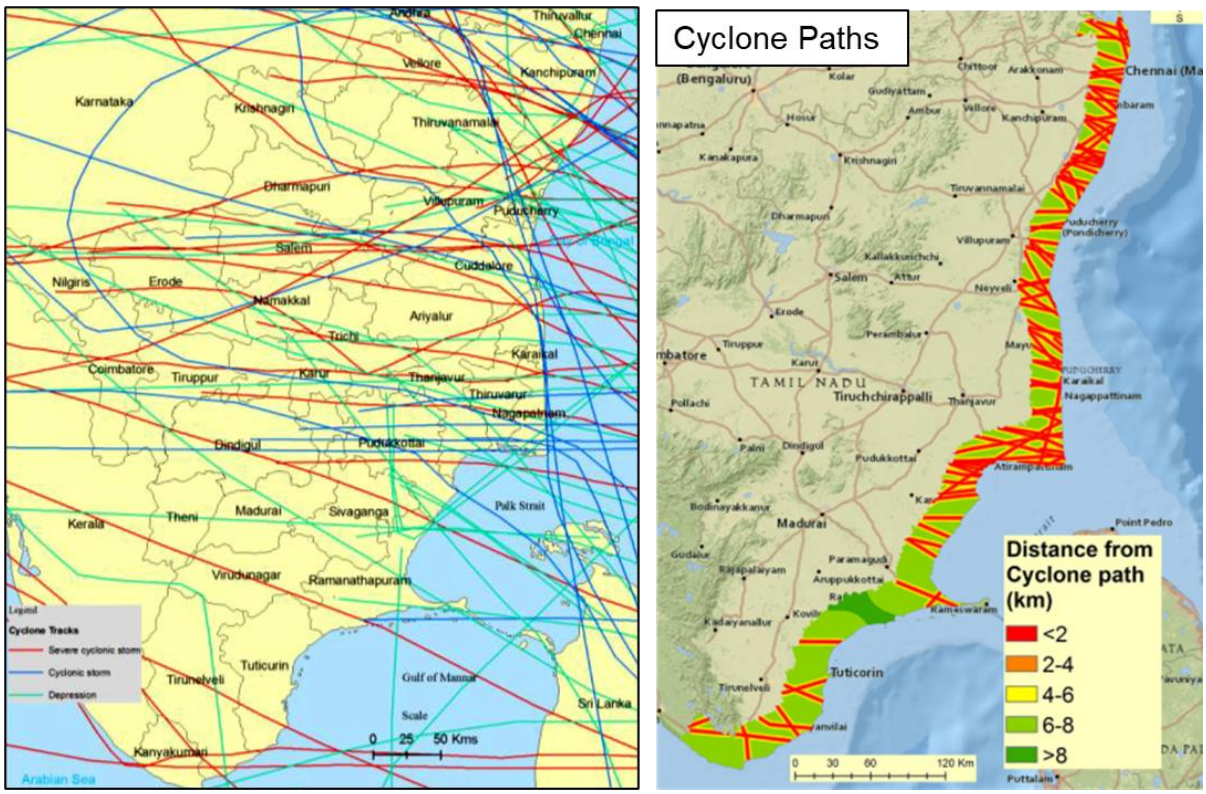
12.2 Historical Cyclone Analysis

A century-long historical analysis reveals that Thoothukudi LPA has been relatively spared from frequent cyclonic disturbances compared to other coastal areas of Tamil Nadu. While cyclonic events have occurred, their frequency in the region has been notably lower, as depicted in historical cyclone maps

However, recent events indicate a changing landscape of cyclone risks and extreme precipitation events, necessitating a comprehensive understanding of past trends and future projections.

Projected Changes in Cyclone Intensity: Global climate projections suggest a potential increase in the intensity of cyclones by 2-11% by the end of the century. While the frequency of cyclones may decrease or remain unchanged, the most intense cyclones are expected to bring about a

substantial increase in precipitation, particularly within 100 km of the storm center.



Map 12.3: 100-year Historical Cyclone Map and its Affected Paths

Recent Extreme Events:

In the past decade, Thoothukudi LPA has witnessed significant cyclone-related flood risks:

- Cyclone Gaja (2014) and Cyclone Storm Buveri (2018) brought about major flood situations, highlighting the vulnerability of the region to cyclonic impacts.

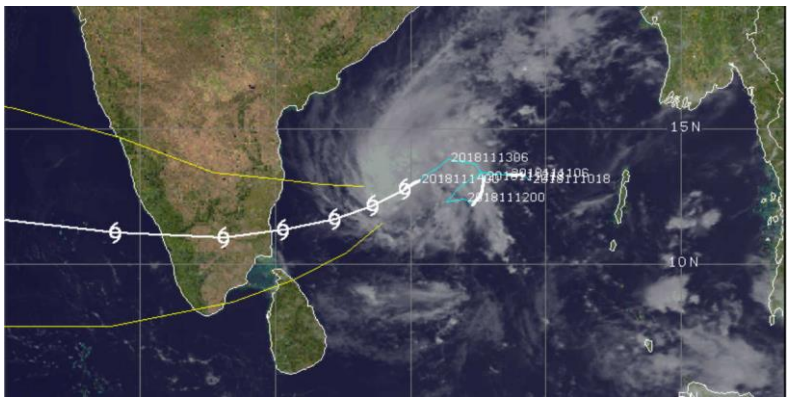


Figure 12.1: Cyclone Gaja 2014 Path

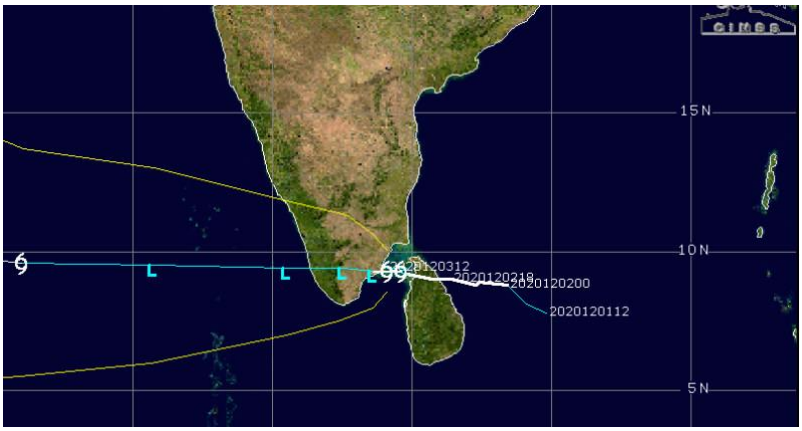


Figure 12.2: Cyclone Buveri 2018 Path

- Severe Cyclonic Michaung in December 2023 resulted in unprecedented precipitation levels, setting new records for rainfall in the district and LPA. On December 18, 2023, Thoothukudi district recorded its highest-ever precipitation of 984 mm per day, significantly exceeding the average annual rainfall of 891 mm per year. Similarly, Thoothukudi LPA experienced a record precipitation of 591.50 mm (per day) on the same day.

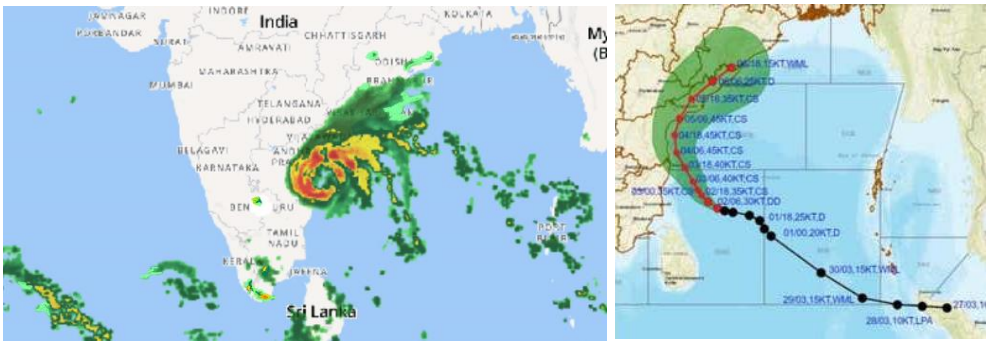
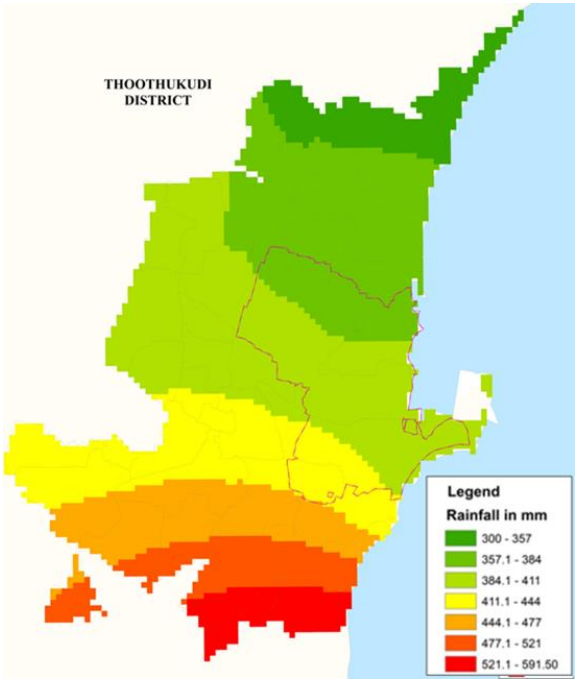


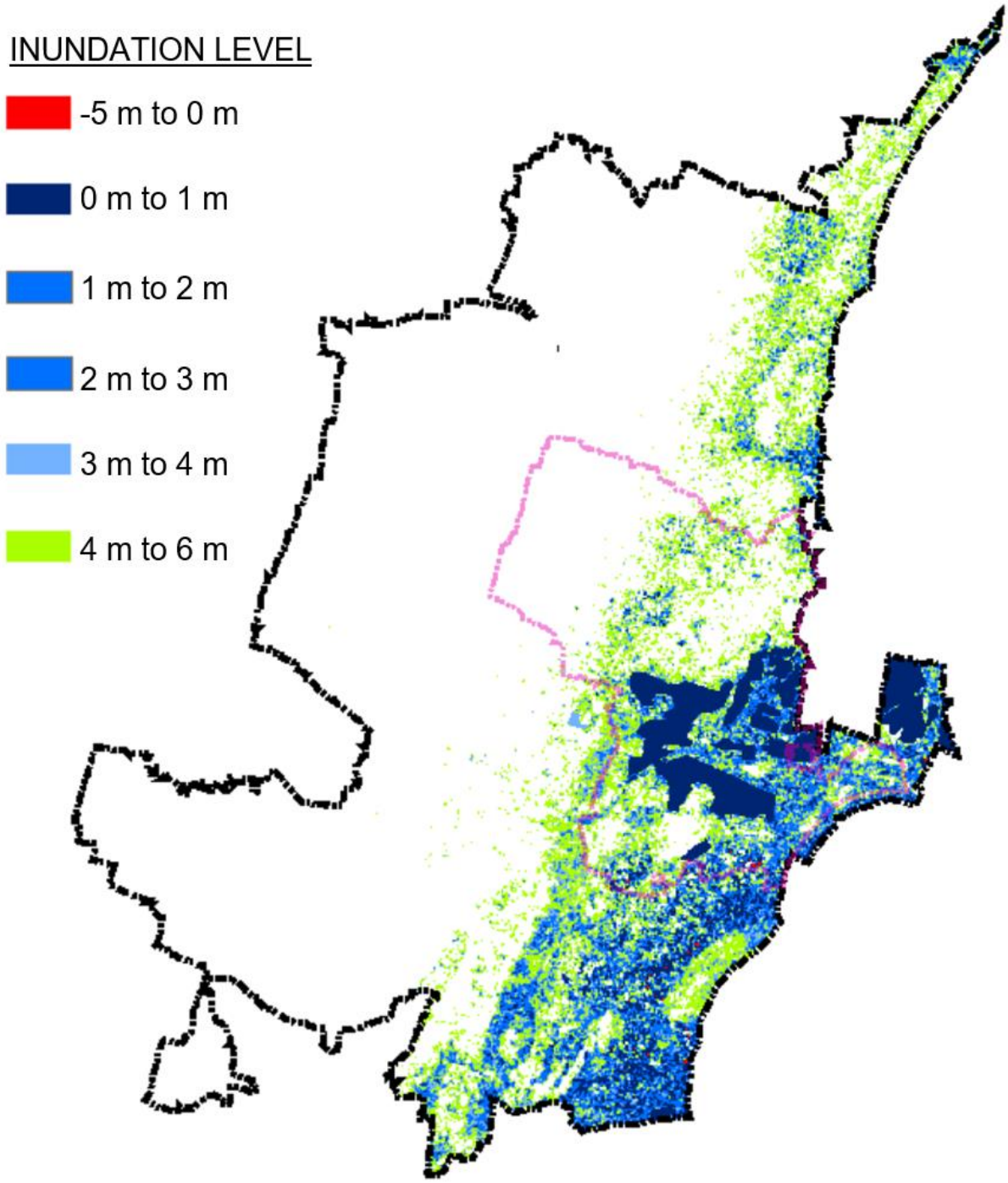
Figure 12.3: Severe Cyclonic storm Michaung 2023 (December) Path and its effects in Thoothukudi



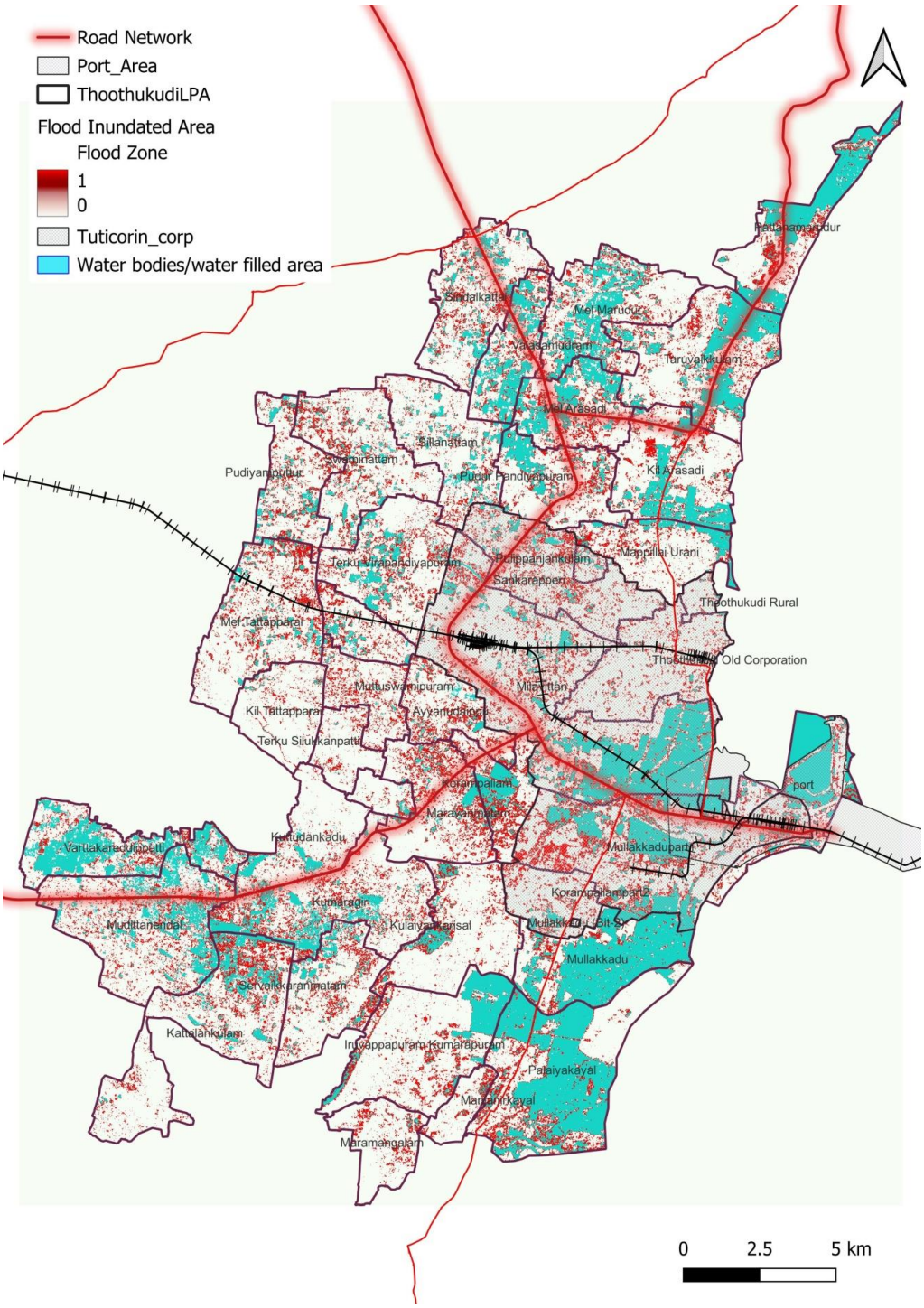
Map 12.4: Precipitation Map during Michaung Cyclone – December 2023

12.3 Flood Inundation

Thoothukudi faces significant challenges from flood inundation, particularly during monsoon seasons and extreme weather events. Understanding the extent of vulnerability and implementing timely measures are crucial to mitigate risks and protect the population and infrastructure. Understanding the vulnerability extent provides essential insights for prioritizing mitigation efforts, emergency preparedness measures, and infrastructure investments to reduce the impact of flooding and enhance resilience in Thoothukudi's LPA.



Map 12.5: Flood Inundation Map



Map 12.6 Flood Inundation Zone

Analysis of flood inundation was carried out in correlation with the elevation levels and the vulnerability extent was identified. The vulnerability extent refers to the geographical areas within Thoothukudi LPA that are most susceptible to flood inundation. In the analysed data, vulnerability is categorized based on the elevation levels at various elevation levels where flood inundation occurs, ranging from 0 to 6 meters.

- **0 to 1 Meter Level:** This category represents areas where flooding occurs at elevations between 0 to 1 meter above ground level. Approximately 6% of the LPA is observed to be inundated at this level, covering an area of 29.8 square kilometers.
- **1 to 2 Meter Level:** Flood inundation at elevations between 1 to 2 meters above the ground level, affects about 3% of the LPA, with an area of 13.5 square kilometers.
- **2 to 3 Meter Level:** Areas inundated at elevations between 2 to 3 meters above ground level, cover 4% of the LPA, accounting for 18.6 square kilometers.
- **3 to 4 Meter Level:** Flood-prone areas at elevations between 3 to 4 meters constitute 5% of the LPA, with a total area of 23.7 square kilometers.
- **4 to 6 Meter Level:** The most extensive inundation occurs in this category, with 12% of the LPA affected. The area covered by flooding at elevations between 4 to 6 meters is 54.9 square kilometers.

When considering vulnerability, it's essential to note that the most critical areas are those susceptible to flooding at lower elevations, particularly within the 0 to 4 meter range, which covers 18% of the Thoothukudi LPA area. These areas pose the highest risks during extreme weather events like cyclone surges and heavy rainfall, which can lead to widespread inundation, property damage, and threats to human safety.

Notably, the most vulnerable regions lie within the salt pans south of the corporation and there are few spots adjacent to the buckle canal, where water stagnation exacerbates the impact of flooding. 31.71% of the Thoothukudi corporation's population resides adjacent to the buckle canal, underscoring the urgency of addressing water stagnation issues to safeguard lives and livelihoods.

Addressing flood inundation challenges in Thoothukudi LPA demands a holistic approach that combines infrastructure upgradation, emergency

preparedness, community engagement, and collaboration across various sectors at various levels. By prioritizing proactive measures and mobilizing collective action, Thoothukudi can build resilience to floods and safeguard the well-being of its residents in the face of mounting climate risks.

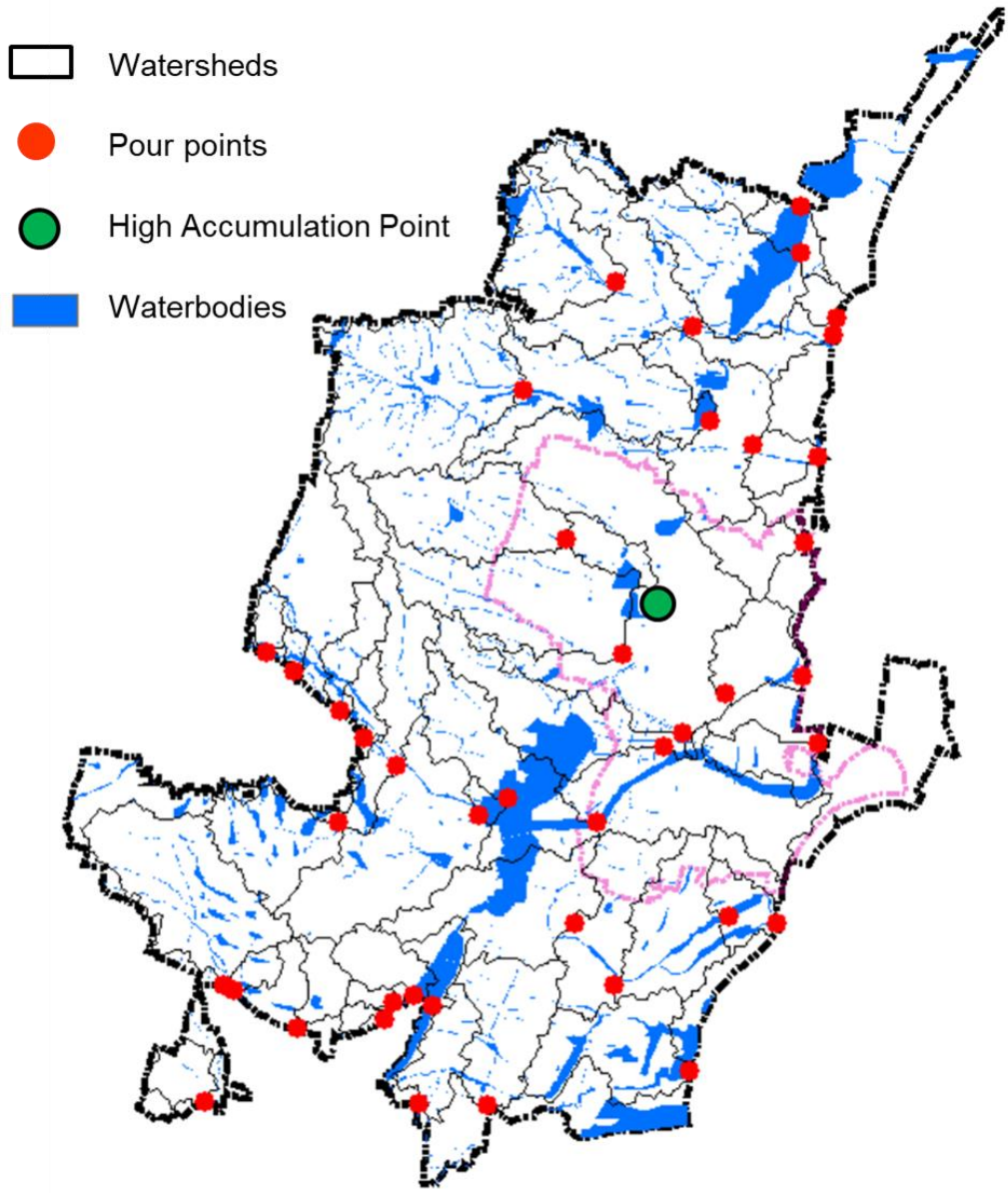
12.4 Micro-Watershed analysis

In Thoothukudi, the threat of flooding looms large, especially during extreme weather events like cyclones and cloudbursts. To better understand and address this challenge, a preliminary analysis on micro watershed using Digital Elevation Models (DEMs) in ArcGIS has been conducted. This analysis delves into water flow patterns, flow accumulation, slope aspects, and runoff stream orders within the Thoothukudi LPA, pinpointing vulnerable areas and suggesting mitigation measures.

The micro watersheds within Thoothukudi LPA have been identified, along with corresponding water accumulation pour points. While runoff streams from the northern micro watersheds feed nearby water bodies, those from the southern micro watersheds accumulate in the salt pans before draining into the Bay of Bengal.

In Thoothukudi Corporation, runoff streams converge at two critical points, notably near the origin of the buckle canal and another on the eastern side in the core area of the Thoothukudi Corporation. However, the lack of adequate water bodies for retention, coupled with urbanization and encroachments in Thoothukudi's core area, exacerbates the vulnerability of these accumulation points to extreme flood surges.

The water accumulation at the origination of the Buckle Canal can be directed and carried forward to the sea, or during the extreme weather, it can be redirected to the nearby Korampallam channel.



Map 12.7: Micro-watershed Analysis map

Recommendations for Flood Mitigation:

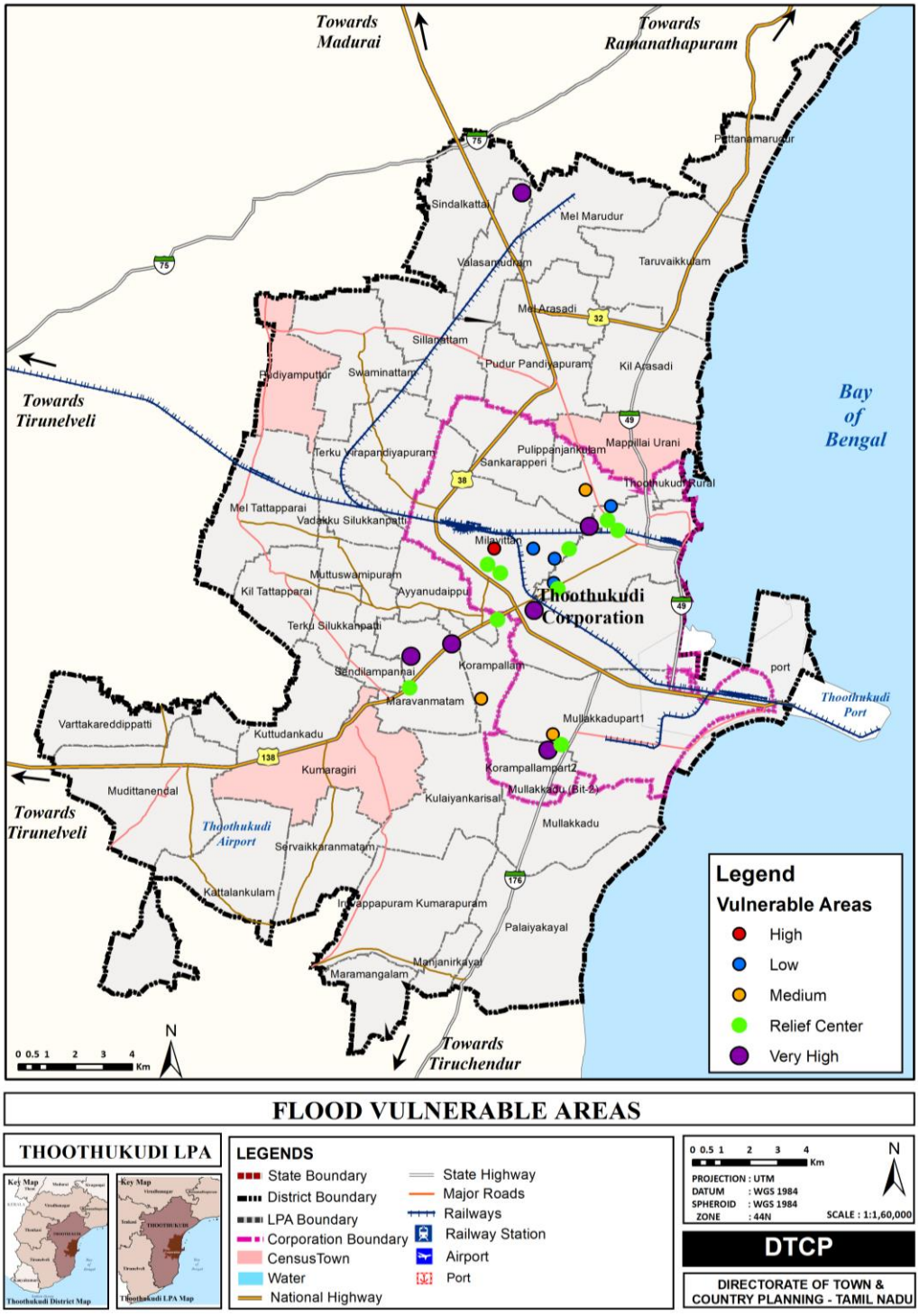
Given the looming threat of urban flooding, urgent measures are warranted to bolster flood resilience in Thoothukudi.

- **Comprehensive Flood Study**: A comprehensive flood study to further assess vulnerabilities, prioritize mitigation efforts, and inform long-term flood management strategies, needs to be undertaken.

- **Immediate Redirection of Runoff:** Redirect runoff water accumulated at critical points to nearby open spaces and underground retention water tanks, mitigating the risk of urban flooding during cloudbursts and extreme flood events.

- **Development control rules and Interventions:** Development Control Rules (DCR) to regulate urban development, discourage encroachments in flood-prone areas, and incentivize sustainable land use practices to mitigate future flood risks, needs to be undertaken.

12.5 Flood Vulnerable Areas and Disaster Relief infrastructure



Map 12.8: Flood Vulnerable Areas in the Thoothukudi LPA

Tuticorin LPA faces significant flood vulnerabilities, necessitating a comprehensive approach to disaster management. Through district offices and secondary sources, flood-prone areas have been identified, and existing disaster relief centers demarcated. However, gaps in coverage and the need

for enhanced infrastructure highlight the urgency of bolstering flood resilience efforts.

- **High Vulnerability area:** The area surrounding the junction of NH138 and NH38 as well as the Milavittan village, situated south of the railway line, emerges as a highly vulnerable area.
- **Medium Vulnerability area:** Areas surrounding the salt pans near Korampallam village and Maravanmatam village exhibit medium vulnerability.
- **Low Vulnerability area:** Few other spots in the core urban corporation area, characterized by urbanization and encroachments, demonstrates relatively lower vulnerability.

Existing Gaps in Relief Infrastructure:

Currently, Tuticorin LPA hosts nine relief centers, with eight located within the corporation area and one along NH138 near the Kumaragiri Village. However, critical gaps exist in the relief centers infrastructure in the Thoothukudi LPA.

- **Inadequate Coverage:** The absence of relief centers in flood-prone areas like Palayakayal and Manjanirkayal in the south poses a significant challenge, as these areas experiences higher rainfall and have experienced extreme flood during cyclones.

- **Emerging Urbanization:** Rapid urbanization around Tharuvaikkulam underscores the need for additional relief centers to address future flood risks.

Enhancing Existing Relief Centers:

To optimize disaster response capabilities, existing relief centers require enhancement. Few enhancement measures are suggested as follows:

- **Infrastructure Upgrades:** Infrastructure upgrades to improve the capacity and functionality of existing relief centers, including shelters, sanitation facilities, and storage provisions needs to be undertaken.
- **Accessibility Improvements:** Easy accessibility to relief centers through road improvements, signage, and public awareness campaigns, particularly in remote or vulnerable areas needs to be ensured.
- **Multi-Purpose Facilities:** Transformation of relief centers into multi-purpose facilities capable of accommodating diverse needs during emergencies, such as medical assistance, food distribution, and temporary shelter may be considered.

13 EXISTING LAND USE

13.1 Overview of the existing Land Use

The present land utilization holds significant influence over the future development growth pattern of a city within the master plan. Land usage zoning in the current plan adheres to the stipulations outlined in the master plan. Through the classification of existing land usage into categories such as residential, commercial, industrial, institutional, recreational, vacant land, agricultural reserves, forests, hills, and water bodies, the insights into the prevailing landscape of the area are gained.

In the case of Thoothukudi LPA, the existing land usage map is meticulously crafted through an extensive field survey, complemented by high-resolution satellite imagery and base maps sourced from the National Remote Sensing Centre (NRSC). Detailed analysis of existing land usage facilitates comprehension of the distribution and allocation across various categories, as well as identification of demand and surplus land utilization. Findings derived from the analysis of existing land utilization are duly considered in formulating the proposed land use plan.

13.1.1 Residential Land Use

Residential zones constitute of the areas primarily designated for housing purposes.

Based on the Existing Land use of Thoothukudi 2021 the residential land use accounts for about 47.31 Sq. Km of total area which is about 10.20%. Thoothukudi LPA falls is envisaged as an industrial, therefore according to the industry city category of URDPFI guidelines, 20-25% of the developed area is suggested for residential use.

The residential area is concentrated in the corporation area and few villages such as kumaragiri, Korampallam, Tharuvaikullam etc. The

development is observed to sprawl along the NH138 which connects Thoothukudi to Tirunelveli city, resembling a ribbon urban development.

13.1.2 Commercial Land use

Commercial Zone constitutes of the areas Zones designated for businesses and commercial activities, such as retail stores, offices, restaurants, hotels, and shopping centre

Based on the Existing Land use of 2021 in Thoothukudi LPA, the commercial land usage is predominantly situated within the corporation area, particularly along the NH-38 and in the city core area. The commercial land use accounts for about 10.78 Sq. Km of total area which is about 2.33%. According to the industry city category of URDPFI guidelines, 3-4% of the developed area is suggested for commercial use.

13.1.3 Industrial and Special Hazardous Industrial Land Use

Industrial zone constitutes of areas intended for manufacturing, processing, warehousing, and distribution activities. Industrial zones often accommodate heavy machinery, factories, storage facilities, and related infrastructure.

Based on the Existing Land use of 2021 in Thoothukudi LPA, the industrial land usage is predominantly situated in the villages of Milavittan, Servaikkaranmattam, Therku Silukkanpatti etc. The industrial land use accounts for about 8.64 Sq. Km of total area which is about 1.86% and special hazardous industrial land use accounts for 16.22 Sq.Km of total area which is about 3.50%. According to the industry city category of URDPFI guidelines, 30-35% of the developed area is suggested for industrial use.

Currently, the low concentration of industrial land use is observed in Thoothukudi LPA as the city is majorly depended on salt pans and agriculture and port related activities for its economic growth. Yet the city has high potential to be an industrial city as the Madurai-Thoothukudi industrial city

corridor and the VOC port-outer harbour are proposed and envisaged to increase the economy of the region.

13.1.4 Institutional Land Use

Institutional zone constitutes of spaces dedicated to public and semi-public use such as institutions, amenities and services, including schools, hospitals, government buildings, religious institutions, and community centres.

Based on the Existing Land use of 2021 in Thoothukudi LPA, the institutional land usage is predominantly situated along the NH-138 which connects the Thoothukudi city with Tirunelveli city. The institutional land use accounts for about 23.75 Sq.Km of total area which is about 5.12%. According to the industry city category of URDPFI guidelines, 6-8% of the developed area is suggested for institutional use.

13.1.5 Agricultural

Land primarily used for farming, cultivation, and agricultural production, including crop fields, orchards, vineyards, livestock grazing areas, and agricultural support structures are the spaces dedicated as Agricultural zone.

Based on the Existing Land use of 2021 in Thoothukudi LPA, the agricultural land usage is observed in the rest of the LPA and is less concentrated in the corporation area. The agricultural land use accounts for about 253.37 Sq.Km of total area which is about 54.65%. This indicates the current LPA region is majorly an agrarian based region and has scope to augment other land uses for the future development.

13.1.6 Transportation

Transportation zone constitutes of areas dedicated to transportation infrastructure and services, such as roads, highways, airports, railways, ports, and transit stations

Based on the Existing Land use of 2021 in Thoothukudi LPA, the transportation land use accounts for about 15.44 Sq.Km of total area which is

about 3.33%. As per URDPFI guidelines for an industrial city, 10-12% of the land use is suggested for transportation usage. The roads and well-established network of railway lines contributes to this percentage in Thoothukudi. The highways are observed to be in a radial network diverging from the Thoothukudi Corporation area.

13.1.7 Non-Urban

Non-Urban use are Salt pan areas characterized by the extraction of salt from saline water bodies, typically through evaporation methods. Salt pans are commonly found in coastal regions and cities where seawater is abundant.

Based on the Existing Land use of 2021 in Thoothukudi LPA, 9.20% (42.64 sq.km) contribute to the Forest and hillocks usage out of the total area of LPA 463.61 sq.km. Major salt pans are located in the Palayakayal belt and coastal area.

13.1.8 Waterbodies

Water Bodies Zone indicates all existing water bodies, i.e., Rivers, Streams, Lakes, Tanks, etc.

Based on the Existing Land use of 2021 in Thoothukudi LPA, 9.81% (45.47 sq.km) constitute of waterbodies of the total area of LPA 463.61 sq.km. Major waterbodies in Thoothukudi LPA are Buckle canal, Korampallam channel, Peikulam, etc.

13.2 Existing Land Use (2021) Composition

13.2.1 Existing Land Use (2021) composition of Thoothukudi LPA

Table 13.1: Composition of Existing Land use of Thoothukudi LPA

Landuse	Existing Land Use of Thoothukudi LPA 2021	
	Area (In Sq. Km)	% of Area
Residential	47.31	10.20 %
Commercial	10.78	2.33 %
Industrial	8.64	1.86 %
Special Hazardous Industries	16.22	3.50 %
Institutional	22.91	4.94 %
Open Space Recreation	0.84	0.18 %
Agricultural	253.37	54.65 %
Transportation	15.44	3.33 %
Non-Urban	42.64	9.20 %
Waterbody	45.47	9.81%
Total	**463.61**	**100 %**

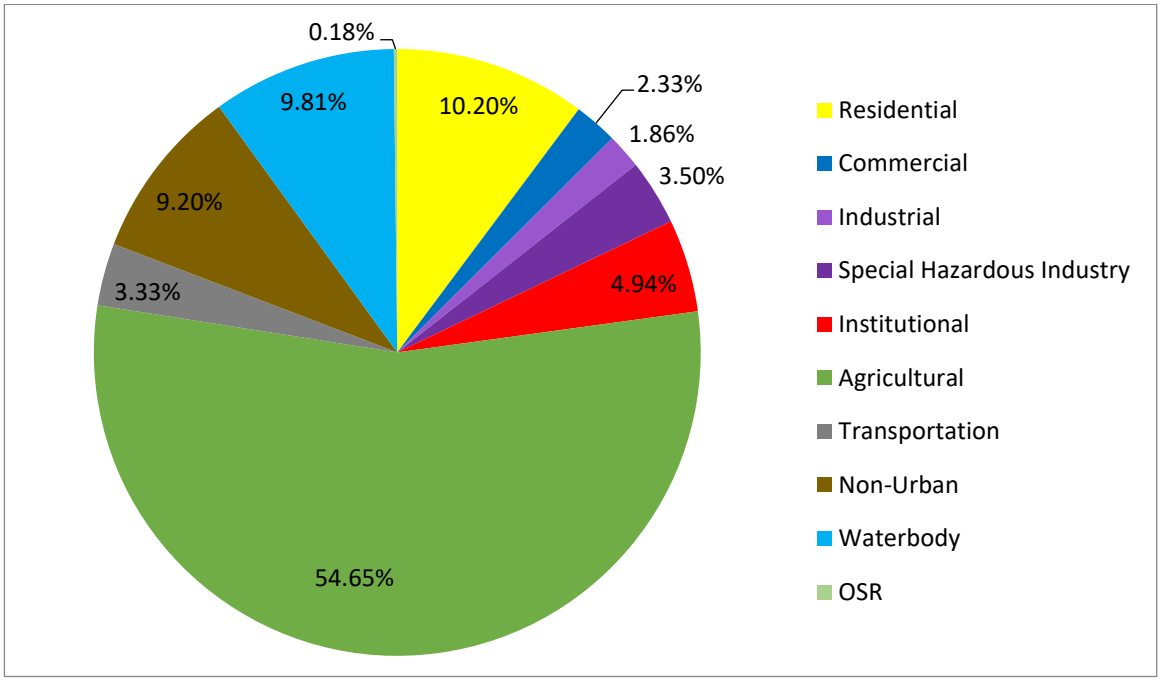
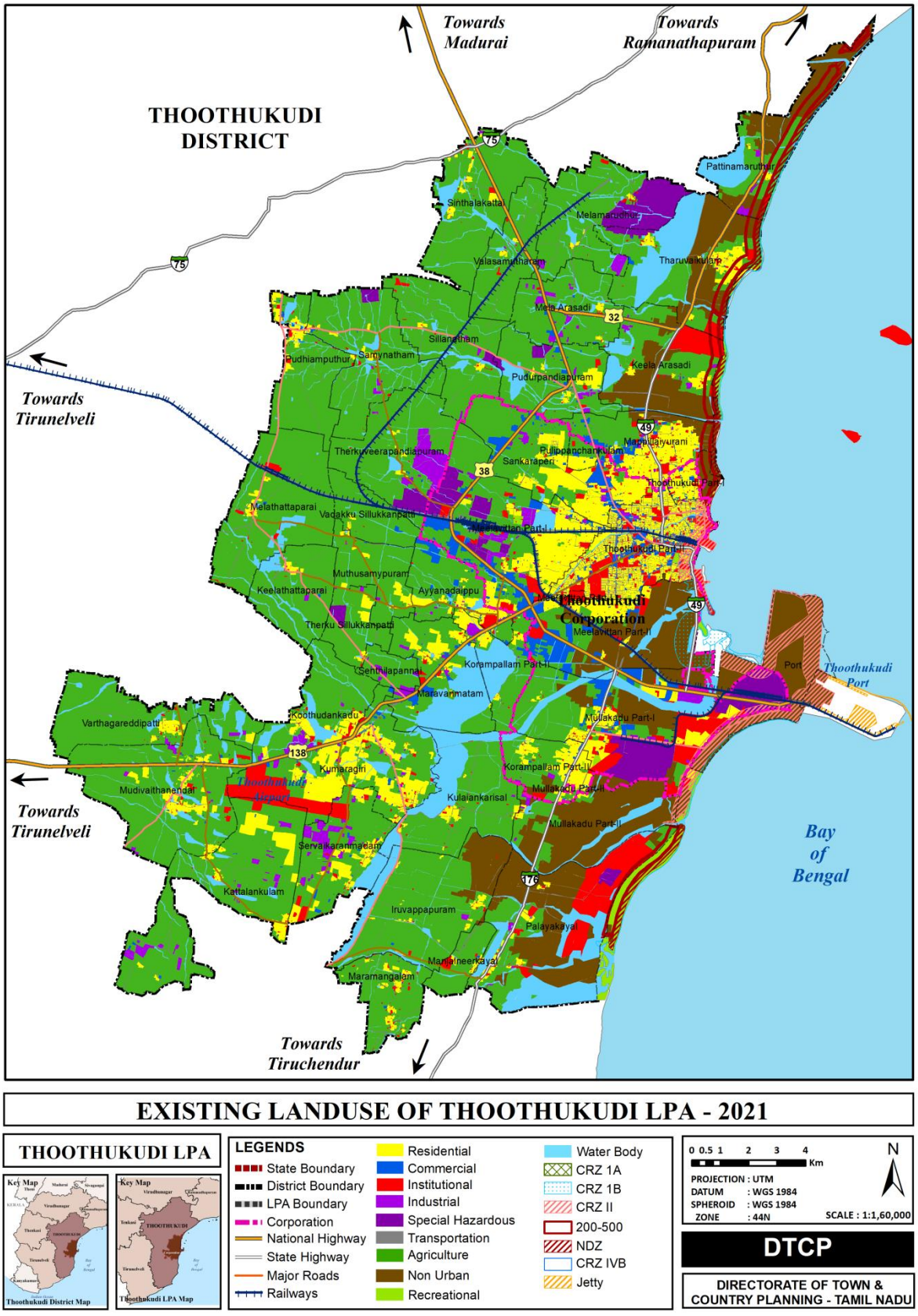


Figure 13.1 Existing Land use Percentage of Thoothukudi LPA



Map.13.1: Existing Land use of Thoothukudi LPA, 2021

13.2.2 Existing Land Use (2021) Composition of Thoothukudi Corporation

Table 13.2: Composition of Existing Land Use of Thoothukudi Corporation, 2021

Land Use Composition of Thoothukudi Corporation		
Landuse	**Existing Land Use 2021**	
	Area (In Sq. Km)	**% of Area**
Residential	22.94	25.30 %
Commercial	7.93	8.75 %
Industrial	1.89	2.08 %
Special Hazardous Industries	10.67	11.77 %
Institutional	8.43	9.30 %
Open Space Recreation	0.8	0.88 %
Agricultural	21.70	23.94 %
Transportation	6.22	6.86 %
Non-Urban	6.01	6.63 %
Waterbody	4.07	4.49 %
Total	**90.66**	**100 %**

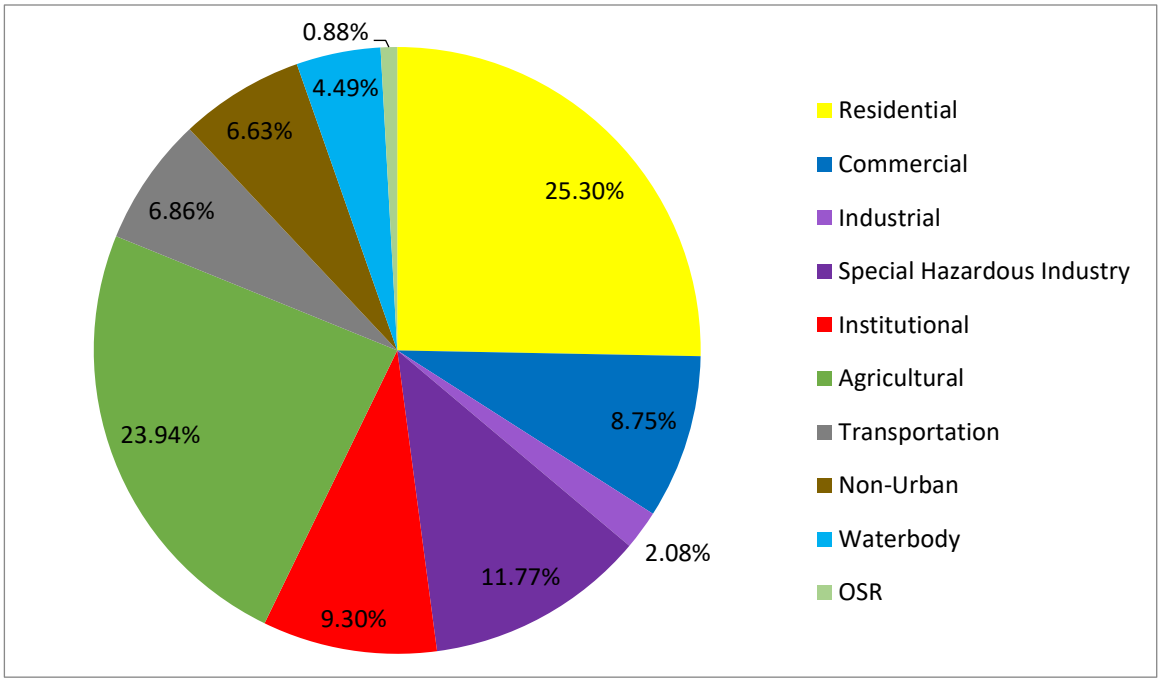
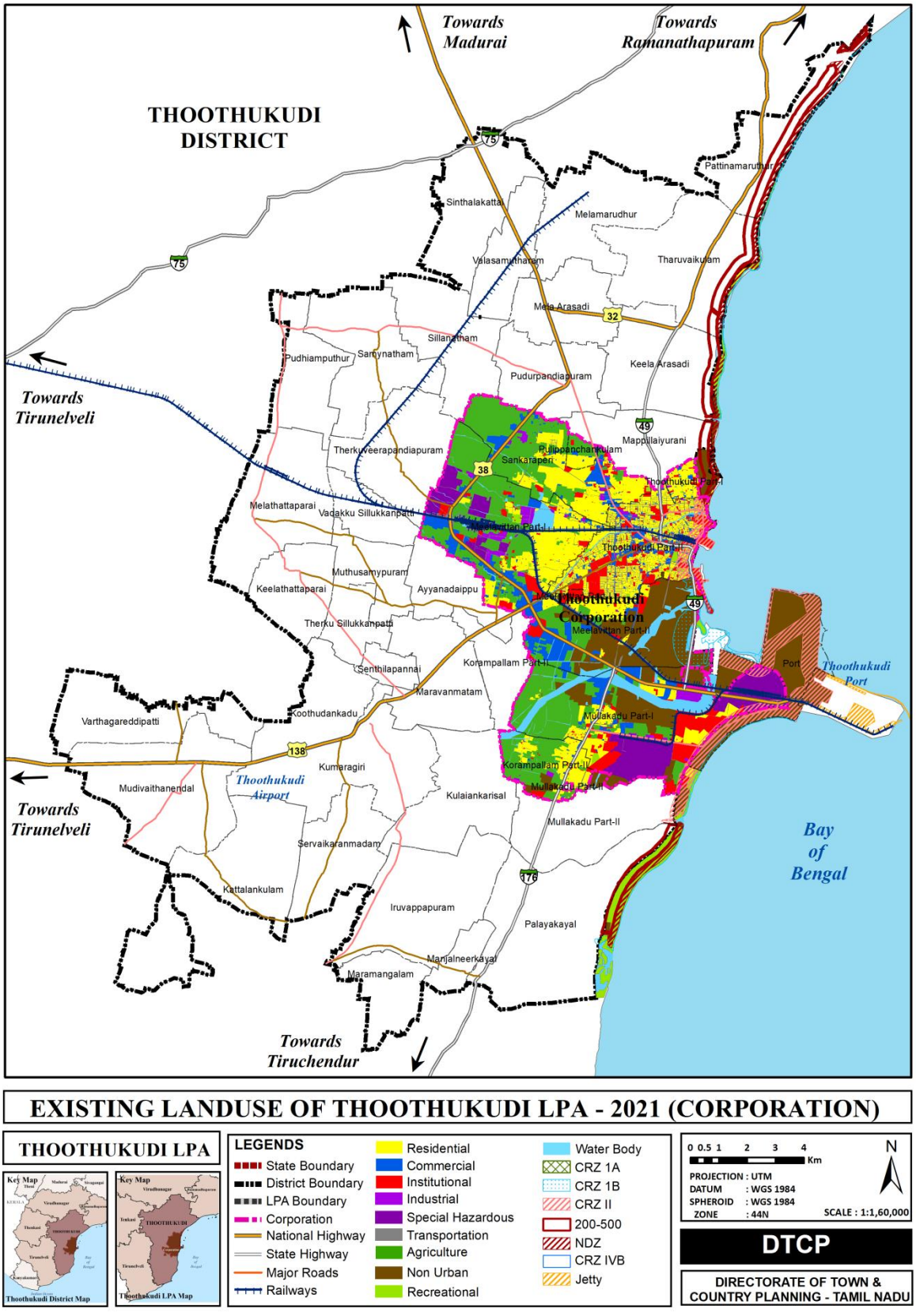


Figure 13.2 Existing Land use Percentage of Thoothukudi Corporation



Map.13.2: Existing Land use of Thoothukudi Corporation, 2021

13.2.3 Existing Land Use (2021) Composition - Rest of Thoothukudi LPA

Table 13.3: Composition of Existing Land Use of Rest of Thoothukudi LPA, 2021

Land Use Composition of Rest of Thoothukudi LPA		
Landuse	**Existing Land Use 2021**	
	Area (In Sq. Km)	**% of Area**
Residential	24.37	6.53 %
Commercial	2.85	0.76 %
Industrial	6.75	1.81 %
Special Hazardous Industries	5.55	1.49 %
Institutional	14.48	3.88 %
Open Space Recreation	0.04	0.01 %
Agricultural	231.67	62.12 %
Transportation	9.22	2.47 %
Non-Urban	36.63	9.82 %
Waterbody	41.40	11.10 %
Total	**372.96**	**100 %**

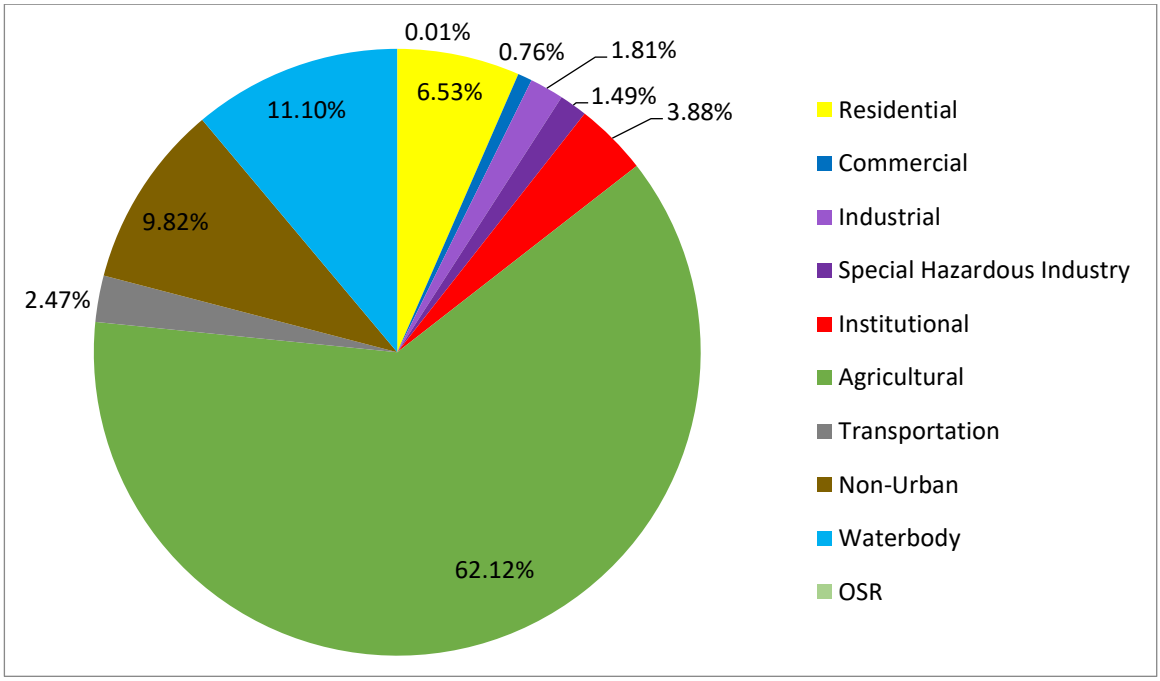
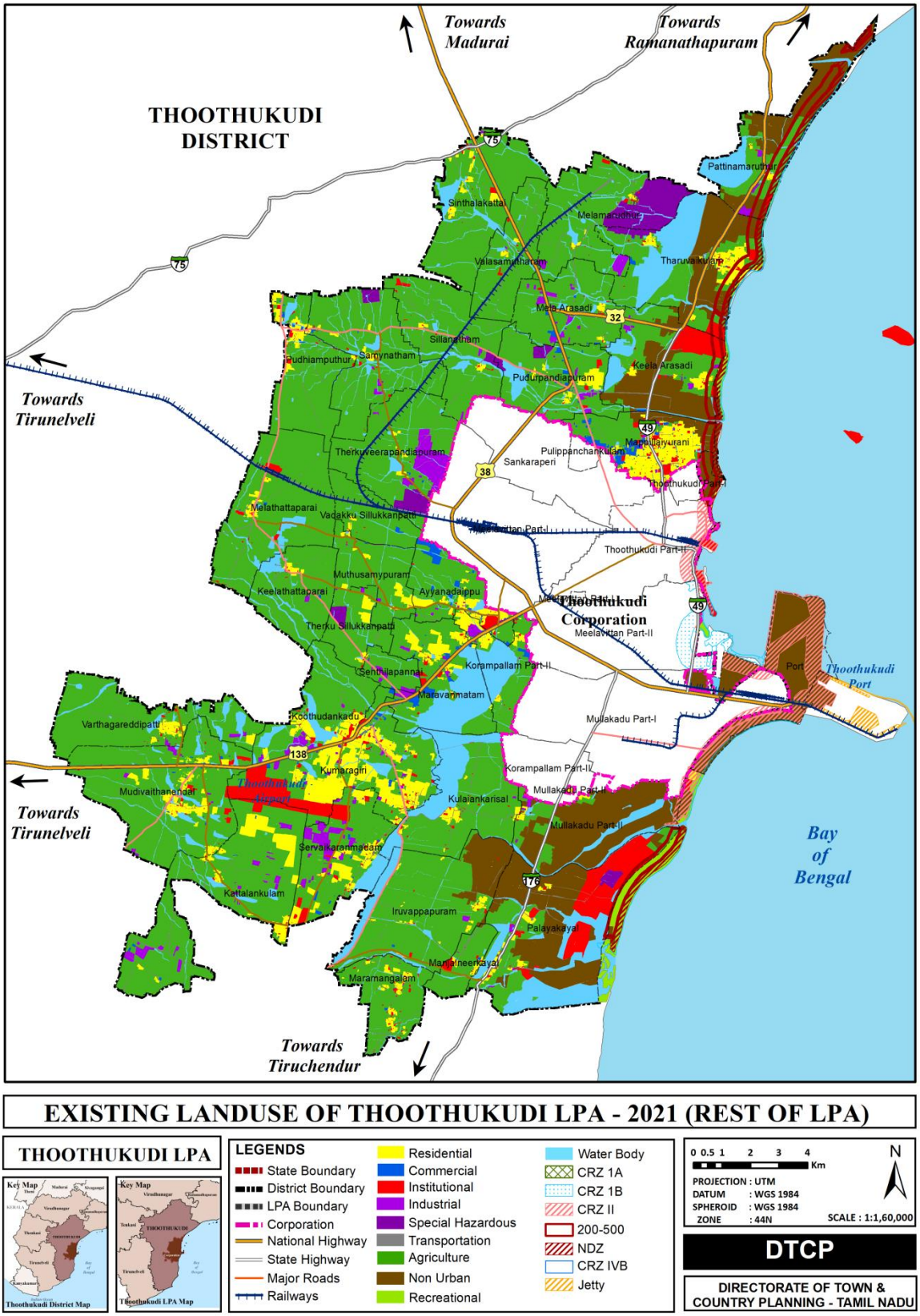


Figure 13.3 Existing Land use Percentage of Thoothukudi (Rest of LPA)



Map.13.3: Existing Land use of Rest of Thoothukudi LPA, 2021

13.3 Comparison of Land Use with URDPFI Guidelines

Table 13.4: Comparison table of Existing Land Use 2021 of Thoothukudi LPA with URDPFI guidelines for an industrial city

Land use category	% of Land use Composition in Existing Land use 2021	% of Landuse Suggested as per URDPFI Guidelines
Residential	10.20	20-25%
Commercial	2.33	3-4%
Industrial	5.36	30-35%
Institutional	4.94	6-8%
Transportation	3.33	10-12%
Agricultural	54.65	Balance % for Agriculture, Water bodies & Special areas
Non-Urban	9.20	
Waterbody	9.81	
Total	**100 %**	**100 %**

The Table 13.4 illustrates the percentage of land use recommended for an industrial city by the URDPFI guidelines of 2014, alongside a comparison with the existing land use distribution within the Thoothukudi LPA. This analysis serves to determine the additional land area available for future development, which can guide the conversion of vacant or agricultural land to meet the evolving developmental needs of the population.

Within the existing land use classification of the Thoothukudi LPA, the following are the land use categories observed: Residential, Commercial, Industrial, Institutional, Agricultural, Transportation, Recreational, Salt pan, Waterbodies, and CRZ. In accordance with URDPFI guidelines: Agriculture, Waterbodies, and salt pans are combined into category 7 to balance, earmarked for future development in alignment with proposed land use plans.

Analysis of the Table 13.4 indicates a need to augment more industrial, and transportation area in addition to provision of more housing options by balancing the agricultural area with other land usages, in order to meet the recommendations of land use composition of an industrial city as per URDPFI

guidelines. Hence, there's a recommendation to propose more service-based industries to meet the future developmental demands of the area.

In addition, from the Table 13.4, it can be seen that the recreational area has to be increased, which indicates the need for establishment of parks, open spaces etc. to cater the population needs.

14 DEVELOPMENT CONCEPT

This chapter outlines the development concept for Thoothukudi Corporation and its surrounding villages, serving as a structured framework to guide future growth and strategic planning in the region. The concept is essential for organizing spatial proposals within the master plan, considering the distinct dynamics of urban and rural areas. Historically, Thoothukudi has evolved around its coastal port, a significant economic driver that has influenced its spatial development. Initial expansion was primarily confined to the corporation limits, while growth in the surrounding villages progressed along major transportation corridors and industrial zones.

The development concept emphasizes sustainable urban growth, focusing on enhancing infrastructure and improving transportation networks to facilitate movement and trade. It aims to promote economic diversification beyond the port by fostering industries like tourism, fisheries, and manufacturing, while also ensuring access to essential services such as healthcare and education. Additionally, community engagement is crucial in the planning process to meet local needs and enhance the overall quality of life. As Thoothukudi continues to evolve, the goal is to create a thriving community with improved infrastructure, economic opportunities, and a high quality of life for all residents.

14.1 Methodology for Development Concept

The development status of the Thoothukudi Local Planning Area (LPA) was assessed using a weighted scoring system that evaluated the infrastructure and population density across village panchayats. The system considered several key indicators, including population density, road infrastructure, public transportation, education, healthcare, water supply, electricity, housing, employment, social facilities, digital connectivity, and environmental factors. Each indicator was assigned a weight based on its significance, providing a comprehensive evaluation of development. The

results help classify panchayats into categories like well-developed, moderately developed, or underdeveloped, aiding in targeted planning and investment decisions.

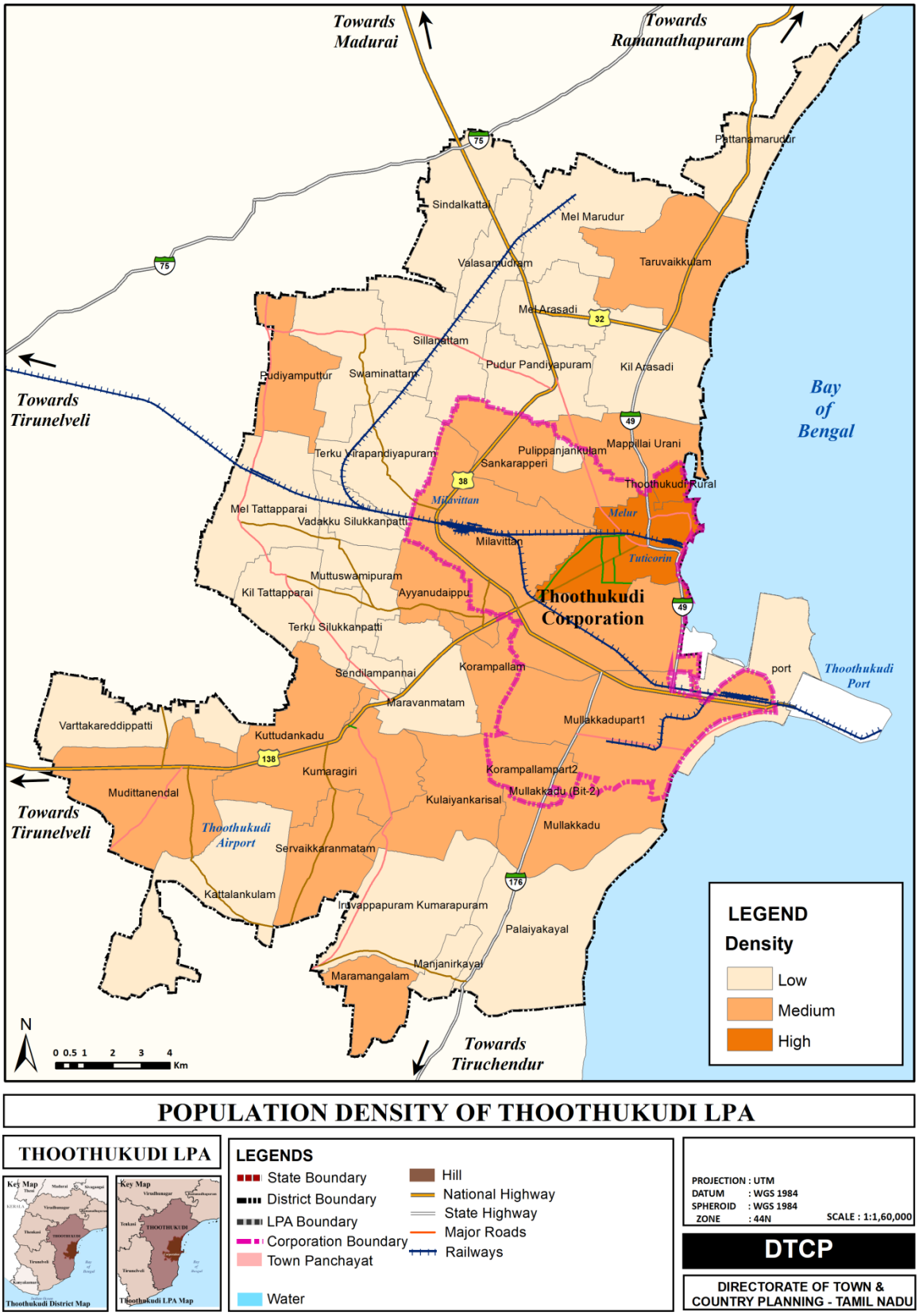
Factors considered with respect to existing development trend

1. Population Density
2. Settlement pattern
3. Land Development trend
4. Economic
5. Social
6. Ecological

14.1.1 Population Density

The map categorizes villages within the Thoothukudi Local Planning Area (LPA) into low, medium, and high population density zones. High-density areas include Thoothukudi Corporation, Mappillaiyurani, Mullakkadu, and Korampallam, which are primarily urban centers. Medium-density villages encompass Servaikaranmadam, Paalayakayal, Kumaragiri, Maravanmadam, Muditтanendal, and several others. In contrast, low-density villages such as Taruvaikullam, Palayakayal reflect more rural characteristics.

The map clearly demarcates these density zones, showcasing a concentration of urban development in the core areas while revealing a decrease in density in peripheral villages. This distribution highlights the urban-rural divide, with Thoothukudi Corporation serving as the primary hub of activity and population. Apart from the core area, the area around the core of the city and the villages falling along the transit corridor shows a medium density growth which emphasis the distribution of settelement from the core.



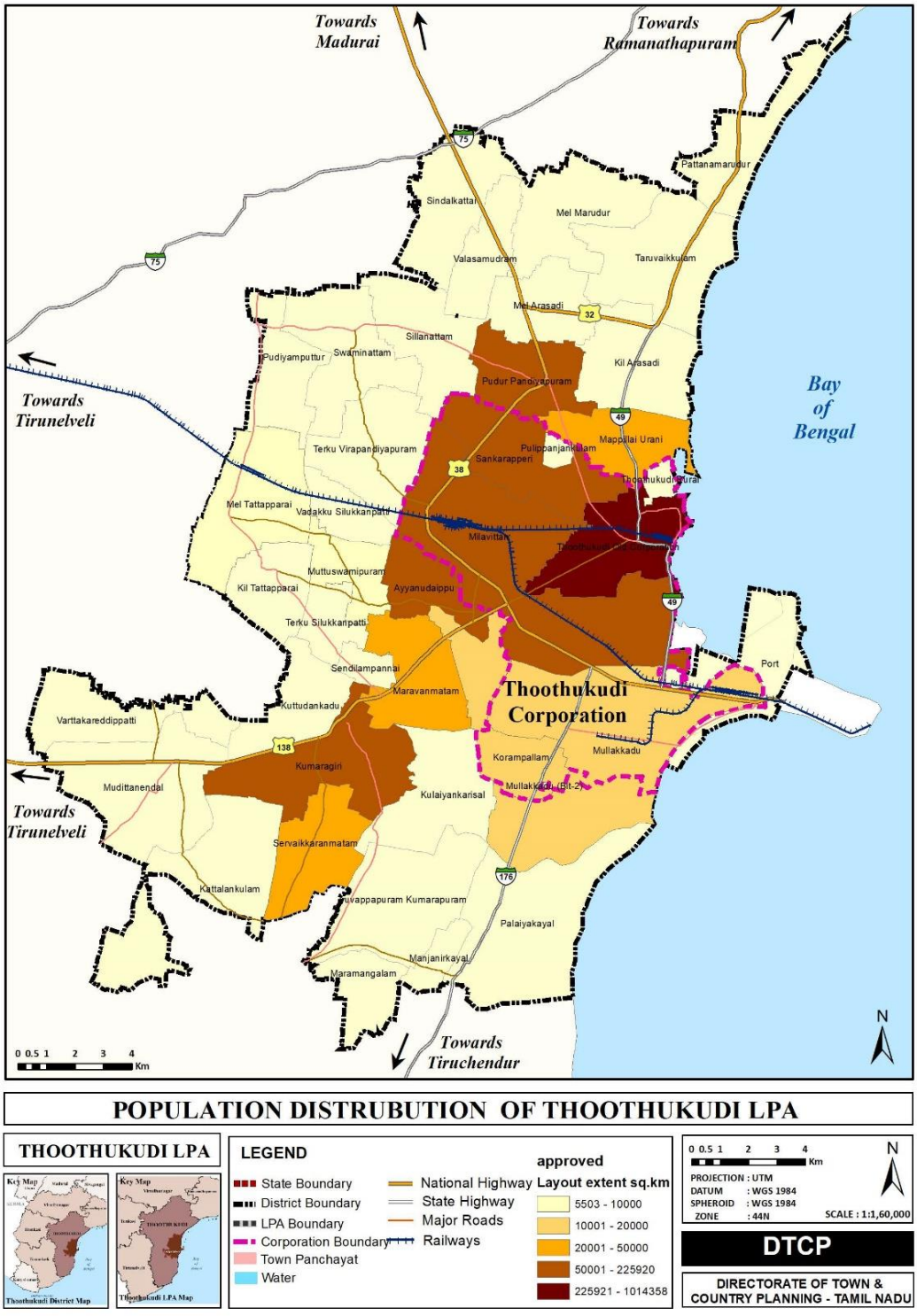
POPULATION DENSITY OF THOOTHUKUDI LPA

Map 14.1 Population Density of Thoothukudi LPA

14.1.2 Land Development Trend

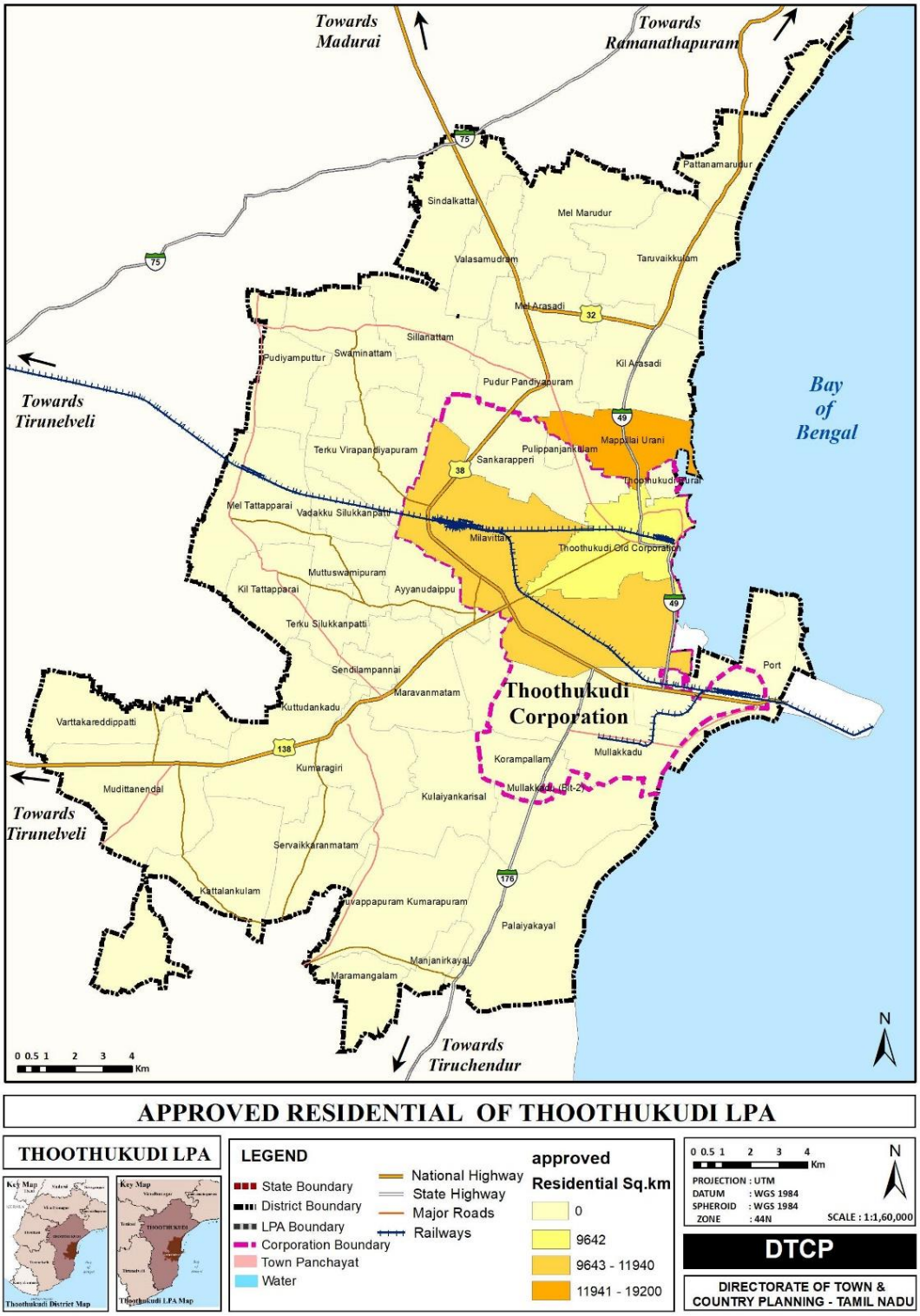
An examination of land use patterns spanning from 2011 to 2023 involved analysing the areas designated for residential, commercial, institutional, and industrial purposes as well as industrial sub-categories such as green industries, orange industries, red industries and white industries etc.

These analyses were based on construction proposals submitted for approval by the Local Planning Authority and other relevant local bodies. Additionally, the study assessed the approval of residential layouts in acres and one industrial layout sanctioned by the Local Planning Authority. This investigation served to discern the prevailing trends in development, including the proliferation of commercial, institutional, and industrial structures, as well as the direction of residential development driven by market forces. It also offered insights into potential factors influencing these trends, such as land prices and market speculation regarding future growth, given that residential land ownership is often viewed as an investment. However, relying solely on these trends for future land use decisions carries inherent risks, particularly if they are founded on flawed growth projections driven solely by land values. Such reliance may inadvertently contribute to uncontrolled urban expansion.



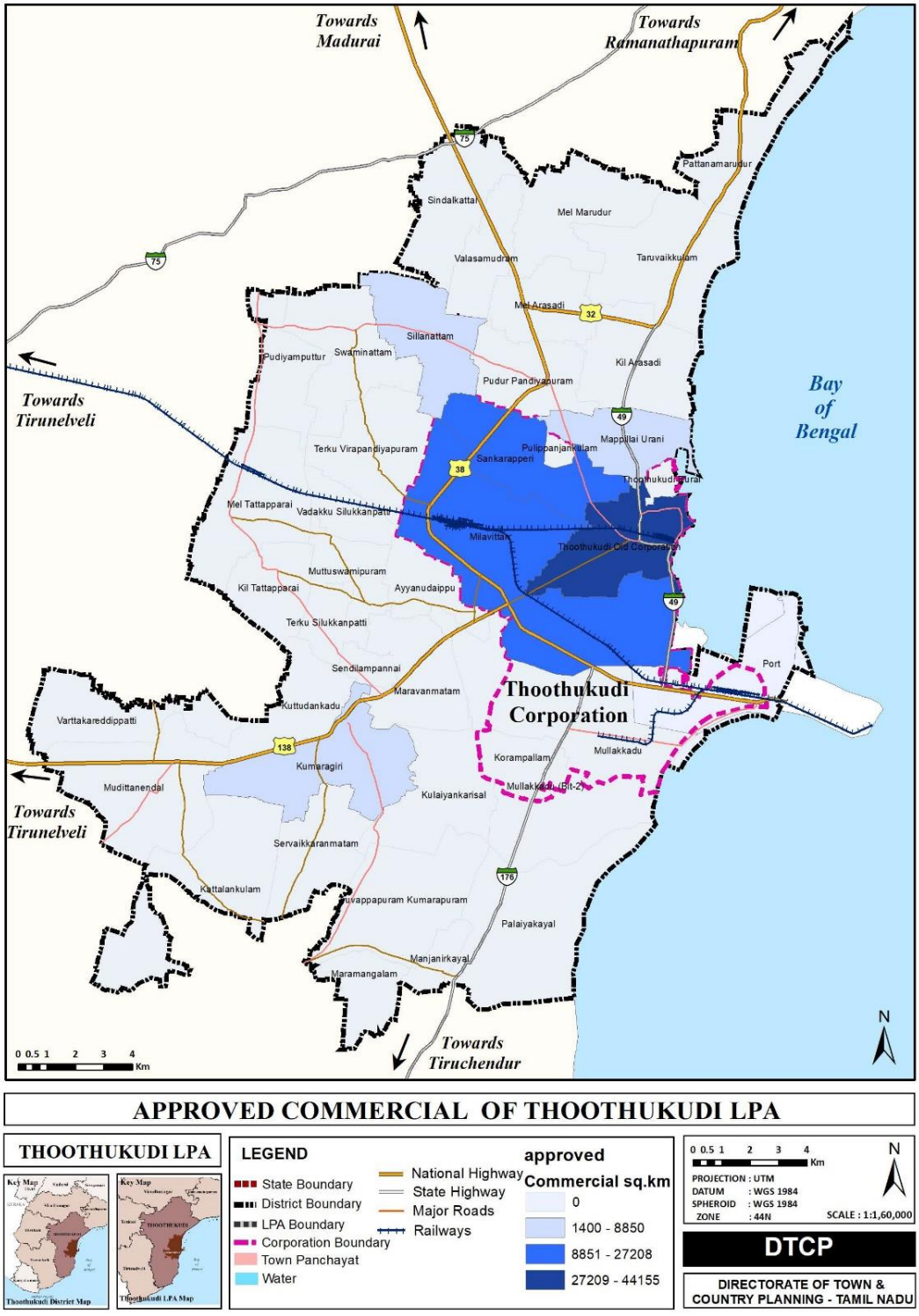
Map 14.2: Residential Layout approval decadal trend 2011-2023

Residential Layout trends are observed to be concentrated in the old Thoothukudi Corporation, Milavittan, Sankarapperi, Pudur pandiyapuram, Ayyanudaippu, Kumaragiri.



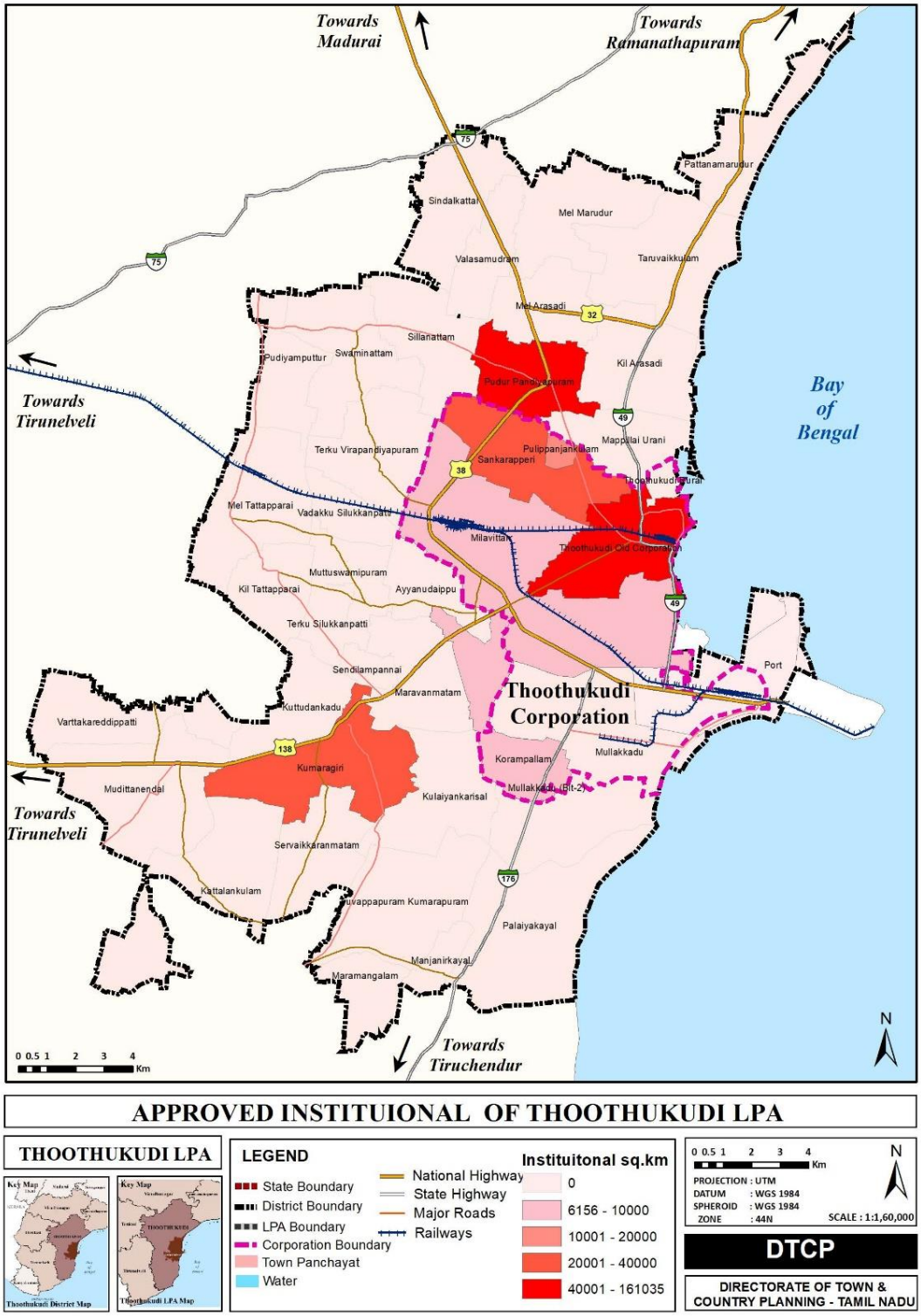
Map 14.3: Residential Building approval decadal trend 2011-2023

Residential building approval trends are observed to be in high concentration in the Thoothukudi Old corporation and in the villages of Milavittan and Mappillai Urani for approvals of building area above 9,000 sq.m.



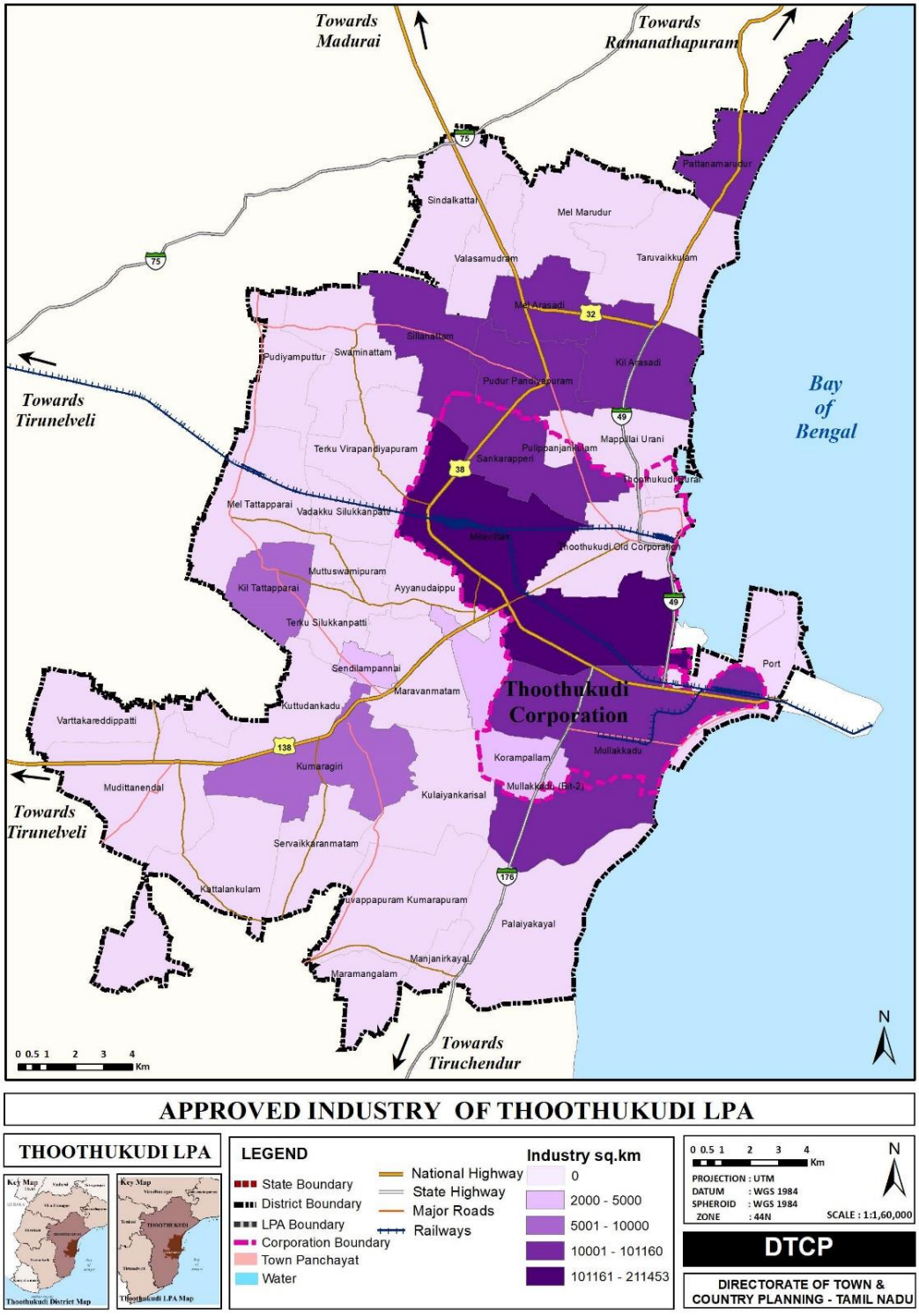
Map 14.4: Commercial Building approval decadal trend 2011-2023

Commercial Building approval trends are observed to be concentrated in the old Thoothukudi Corporation area, Sankarapperi and Milavittan villages.



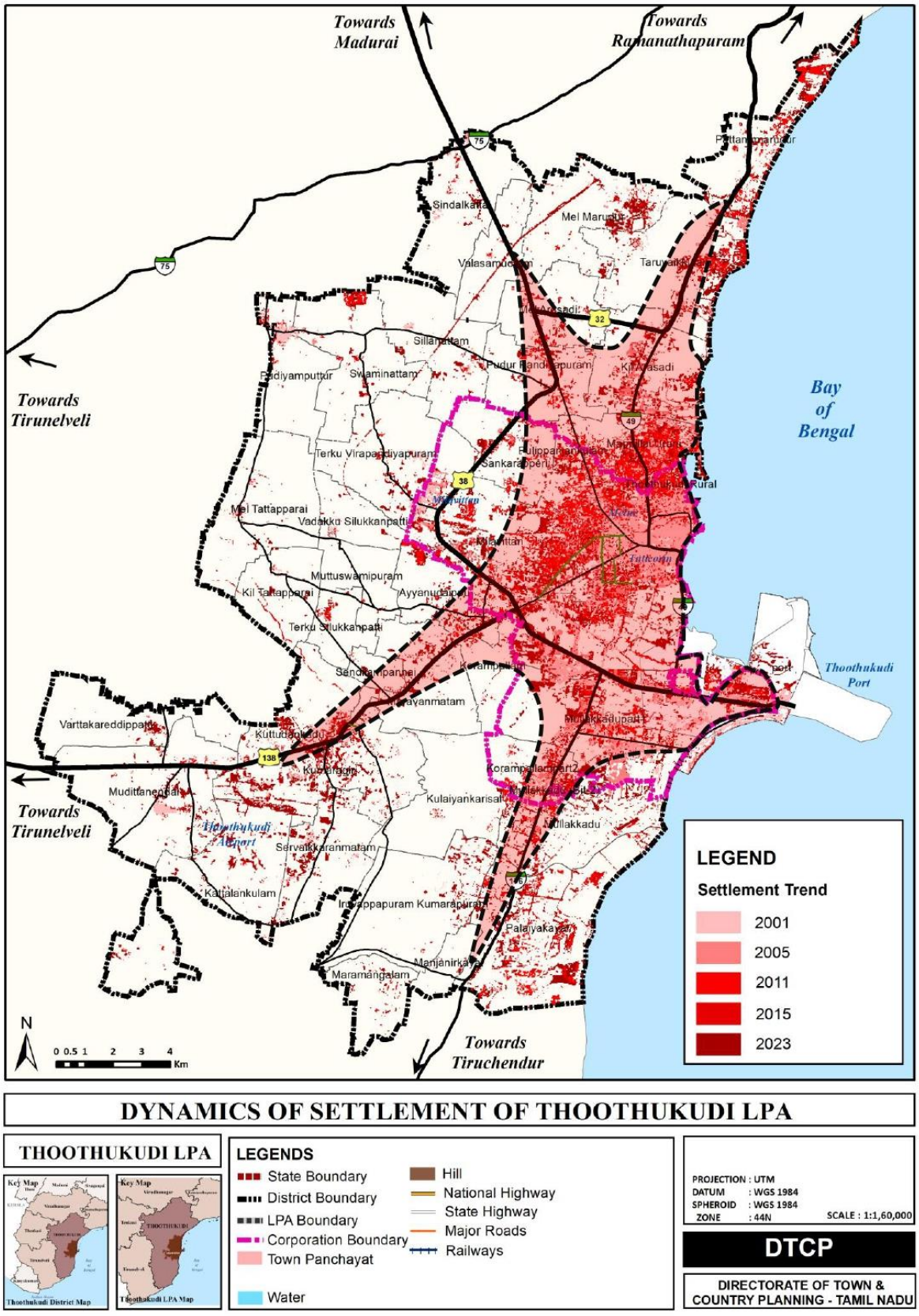
Map 14.5: Institutional Building approval decadal trend 2011-2023

Institutional building approval trends are clustered in Thoothukudi Old corporation, Sankarapperi, Pudur Pandiyapuram and Kumaragiri for the building area ranging between 20,000 to 40,000 sq.m

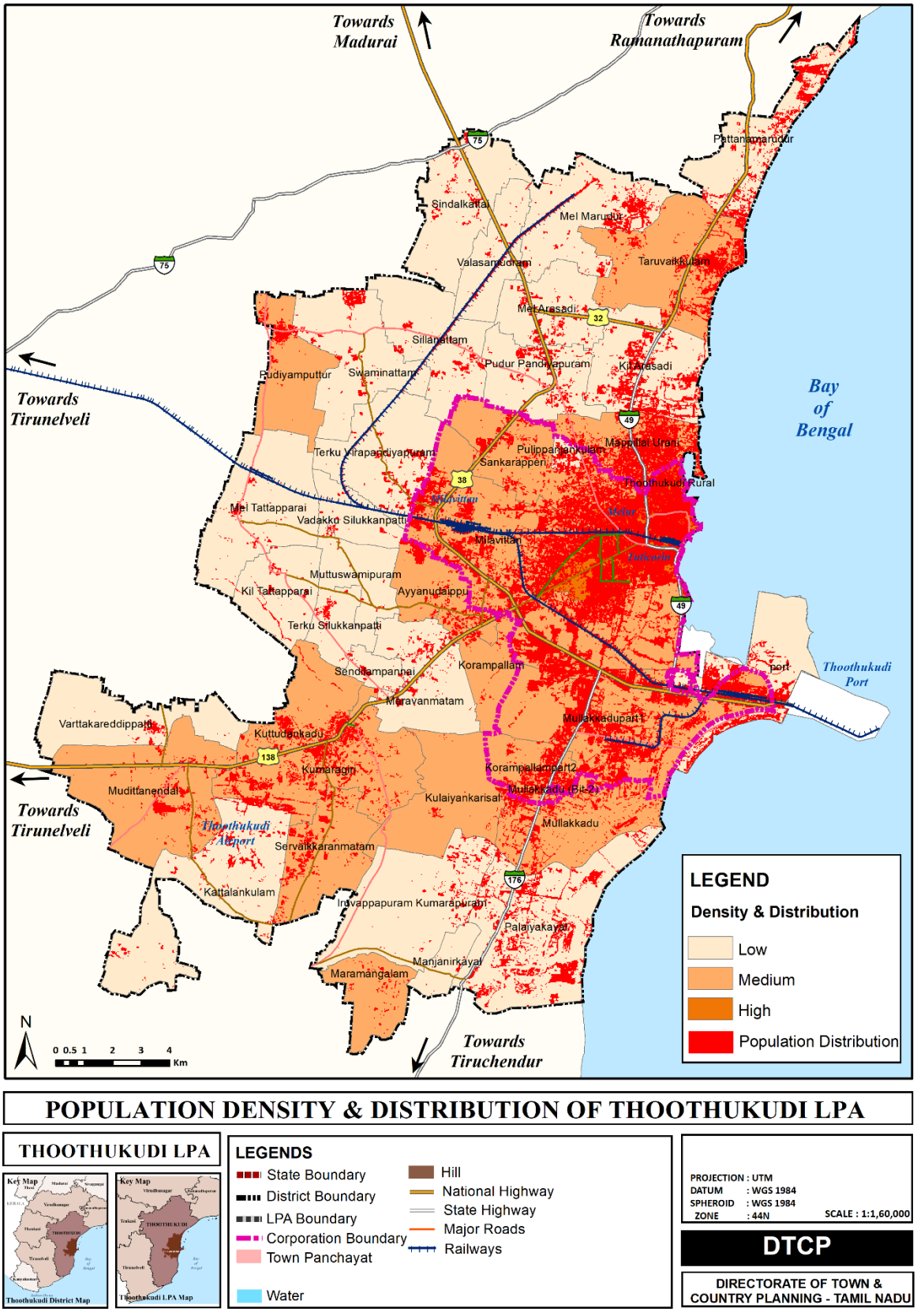


Map 14.6: Industrial approval decadal trend 2011-2023

Industrial approval trends are observed to be concentrated in the corporation area, as well as in the villages of Kumaragiri, Kil Tattapparai, Pudur Pandiyapuram, Mel Arasadi, Sillanallam, Kil Arasadi etc. for the approval of industries above 10,000 sq.m.



Map 14.7 Dynamics of Settlement of Thoothukudi LPA



Map 14.8 Settlement Development Trend

Thoothukudi has evolved around its coastal port, a significant economic driver that has influenced its spatial development. Initial expansion was primarily confined to the old corporation limits, while growth in the surrounding villages progressed along major transportation corridors and industrial zones.

14.1.3 Existing Development Sectors

The development trend also depends on the infrastructure facilities, public amenities etc, which determines the needs of the people. Thus a set of indicators under various sectors is considered and a weighted analysis is carried out.

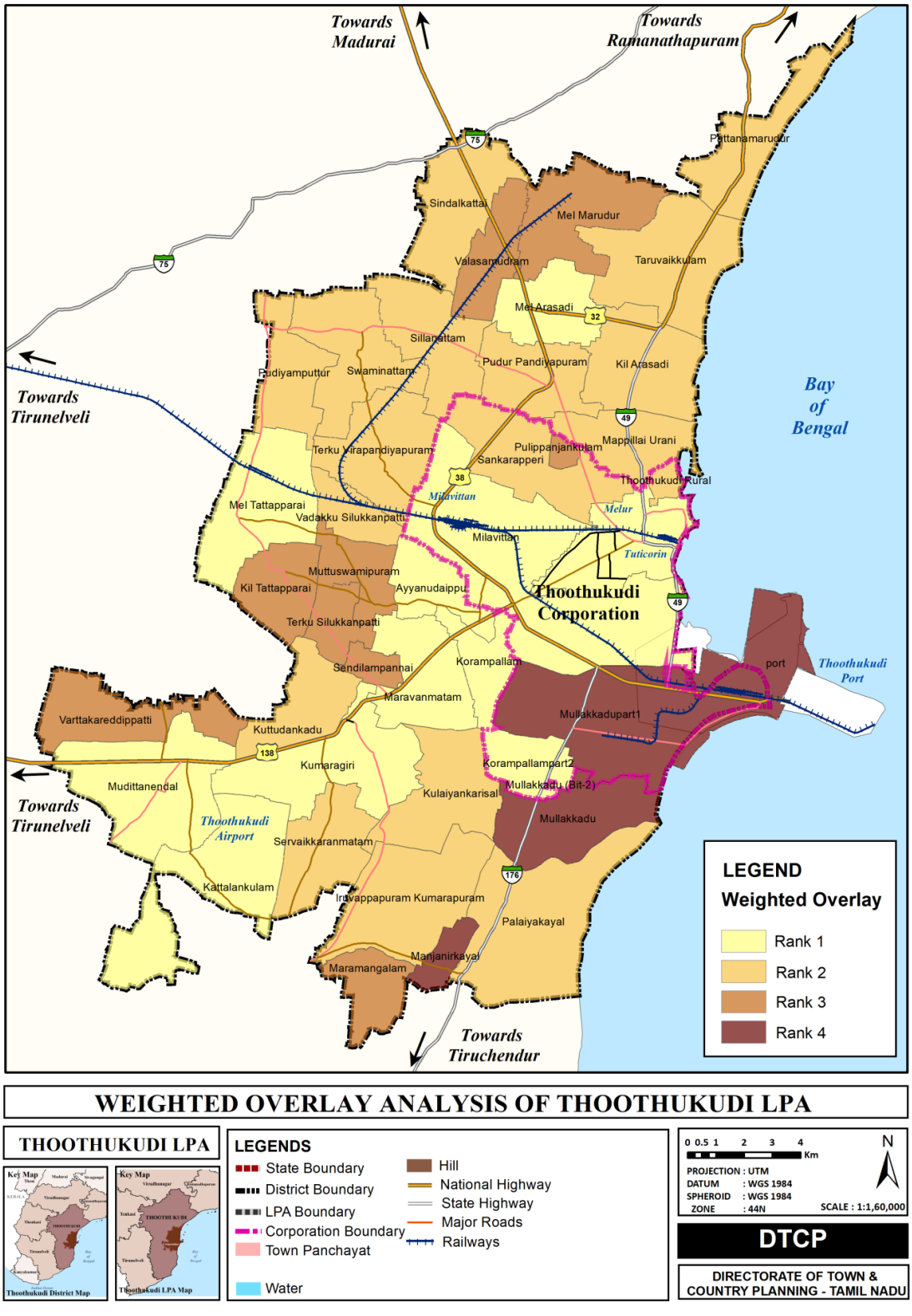
Scoring and Categorization

To evaluate the development levels among various villages in the LPA, a weighted scoring method was utilized. Each indicator was evaluated as follows:

- **Presence of an Indicator**: Given a score of 1.
- **Absence of an Indicator**: Given a score of 0.

The final score for each village was obtained by adding up the scores of all individual indicators. Based on these cumulative scores, the villages were divided into three distinct development categories:

- **Low Development Zone**: Villages with a score of 0, indicating minimal infrastructure and services.
- **Medium Development Zone**: Villages scoring between 1 and 3, indicating a moderate level of development with partial availability of key amenities.
- **High Development Zone**: Villages with a score above 3, representing well-developed areas equipped with more comprehensive infrastructure and services.



WEIGHTED OVERLAY ANALYSIS OF THOOTHUKUDI LPA

THOOTHUKUDI LPA

LEGENDS

- State Boundary
- District Boundary
- LPA Boundary
- Corporation Boundary
- Town Panchayat
- Water
- Hill
- National Highway
- State Highway
- Major Roads
- Railways

0 0.5 1 2 3 4 Km

N

PROJECTION : UTM
DATUM : WGS 1984
SPHEROID : WGS 1984
ZONE : 44N

SCALE : 1:1,60,000

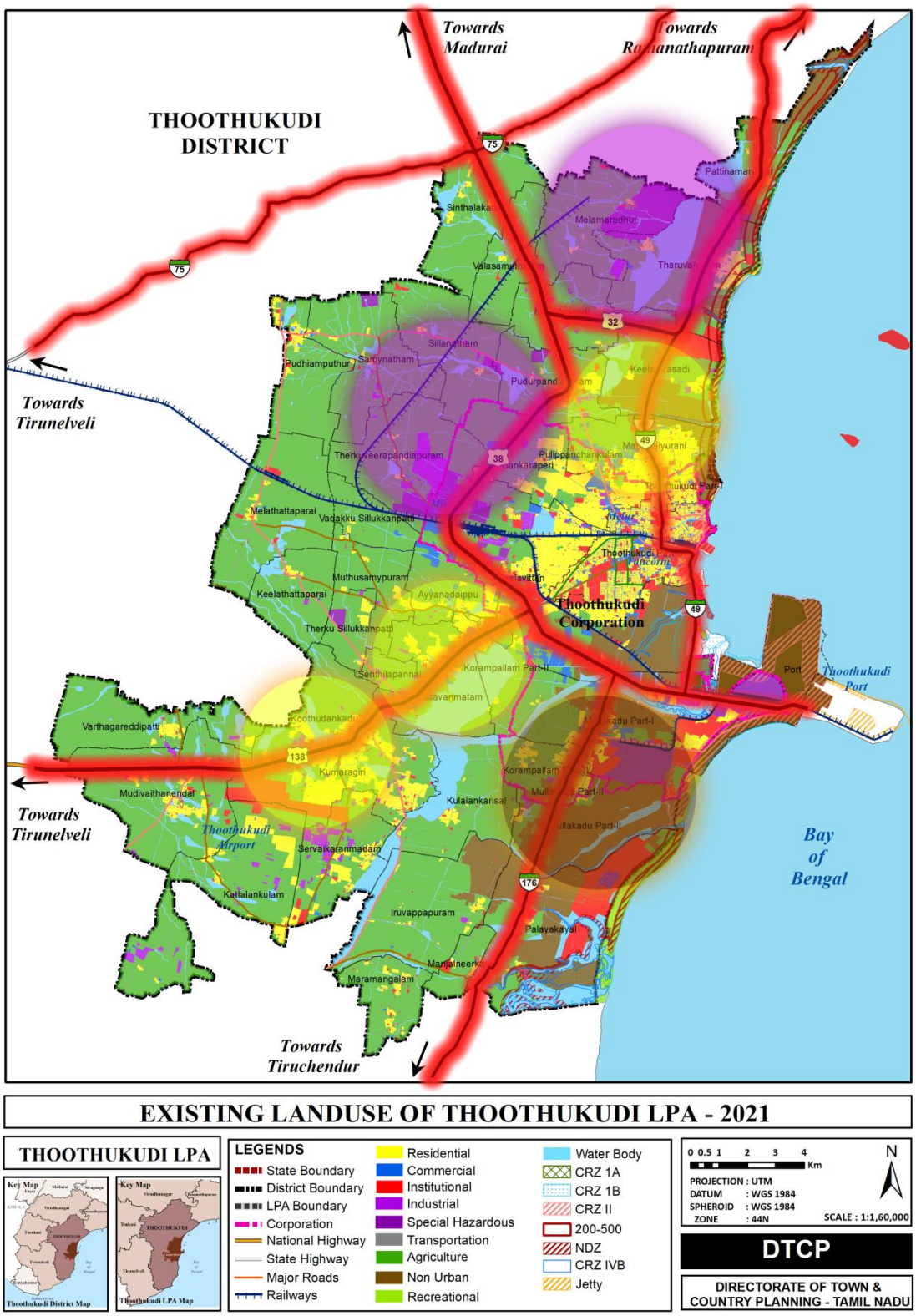
DTCP

DIRECTORATE OF TOWN & COUNTRY PLANNING - TAMIL NADU

Map 14.9 Existing Infrastructure Development Trend

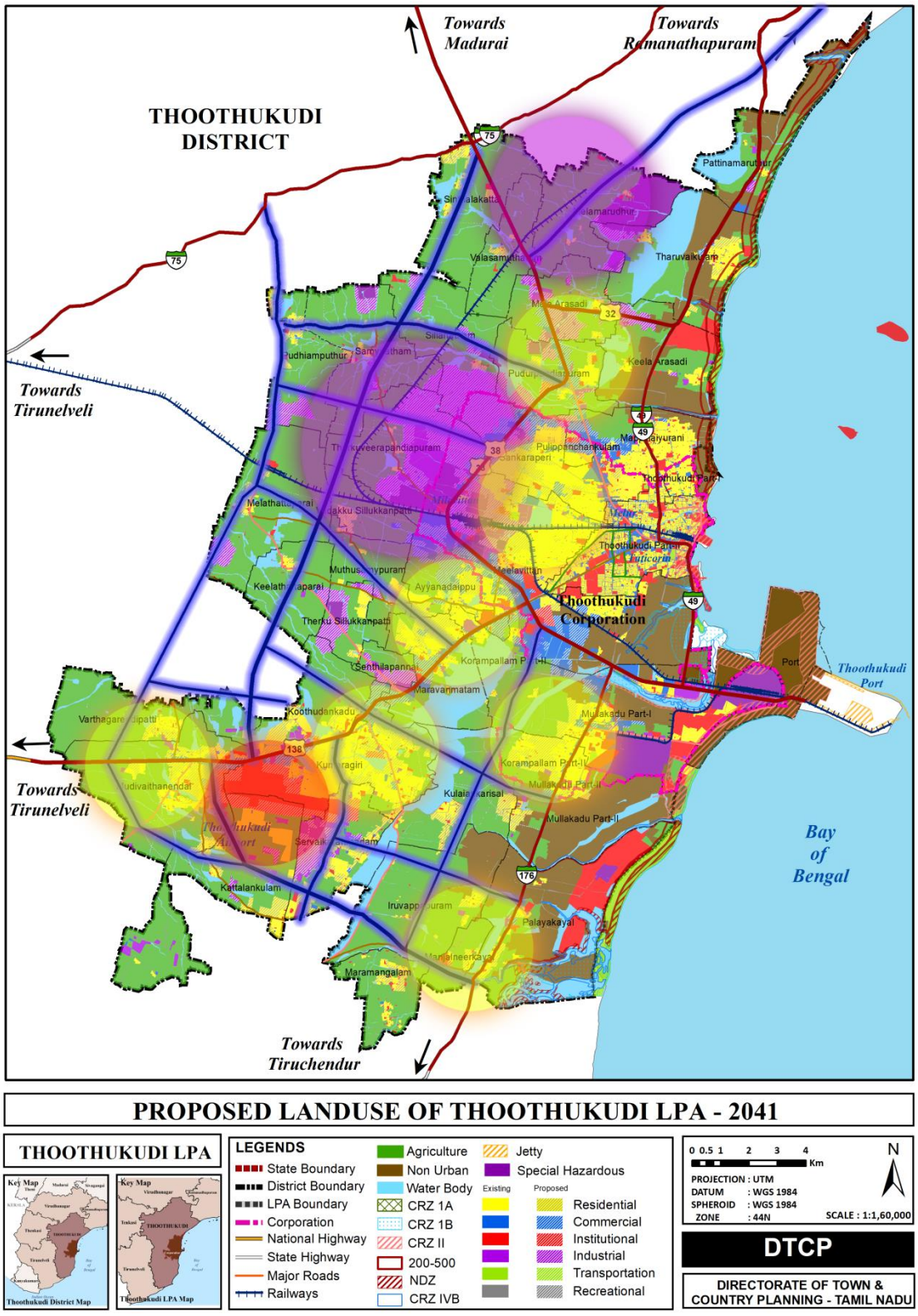
14.2 Development Concept

14.2.1 Existing Development Concept



Map 14.10 Existing Development Trend

14.2.2 Proposed Development Concept



Map 14.11 Proposed Development Concept

The existing development trend is detailed in Map 14.10. This map shows that the residential use is most concentrated in the core of the corporation and along the transit lines. The industrial use is concentrated towards the north-west side of Thoothukudi LPA. The Transportation lines runs radially from the core city. With this development trend, the concept is developed. The Map 14.11 depicts the development concept. The residential use is proposed in villages along the transit lines, industrial use is propsed slong the existing industrial area as it falls under dry agriculture area and it causes less effect on thee environement as well the residential settlement. The transporattaion connectivity is improved by connecting the main spines with ring road proposals. This helps in diverting the vrhicular traffic from passing through the core city. Also the ring road mainly helps in deverting the freight movement from accesing the major highways with easy.

15 PLANNING PROPOSALS

PROPOSALS TO BOOST ECONOMY AND TOURISM

15.1 SIDCO Industrial Layout at Sendilampannai-Puthiyamputhur Village

Figure 15.1: SIDCO Industrial Layout proposal at Puthiyamputhur Village

In line with the government's vision for fostering small-scale industries and promoting economic development, a Small Industries Development Corporation (SIDCO) Industrial Layout is proposed in the vibrant Puthiyamputhur Village as an integral part of the Thoothukudi master plan.

Spanning across a sprawling 52 acres, this initiative exemplifies SIDCO's commitment to stimulating entrepreneurship and creating potential growth centres in Tamil Nadu.

The proposed SIDCO Industrial Layout in Thoothukudi is poised to contribute significantly to the region's economic landscape, providing a conducive environment for the establishment and expansion of Micro, Small, and Medium Enterprises (MSMEs). This strategic move underscores the government's unwavering dedication to promoting industrial development, job creation, and overall economic prosperity in the region.

The site details of the proposed SIPCOT industries:

- Village: Sendilapannai, Puthiyamputhur
- Survey number 10
- Site area 52 acres

The suitability and feasibility of the site for the proposal shall be studied.

15.2 Integrated Salt Processing Centre and Museum

An integrated salt processing centre and museum in Thoothukudi is proposed to celebrate the city's cultural heritage and practices, boost economy, foster educational engagement, drive tourism, and stimulate community development. Thoothukudi, historically known as Tuticorin, boasts a rich salt production legacy dating back centuries. This proposal outlines the establishment of a Salt Processing Center and a Museum, aiming to:

- Preserve and celebrate the cultural heritage of salt production in Thoothukudi.
- Boost economic development by creating jobs and attracting tourism.
- Promote sustainable salt production practices through education and research.

15.2.1 Location of the Project:

Figure 15.2: Map showing the location of proposed Salt processing centre and museum.

The Salt Processing Center and Museum is strategically proposed to be located at Tharuvaikulam village, considering factors like:

- Proximity to existing salt production areas: This ensures efficient operation and collaboration with local stakeholders.
- Accessibility for visitors: This proposal enables easy access by public transport. This location integration with nearby existing and proposed tourist attractions can potentially maximize its reach and impact.

15.2.2 Site Details for the Salt Processing Centre and Museum

The area and survey number details for the Salt processing center and museum are:

- Village: Tharuvaikulanm
- Survey number: 351,349, 353;
- Site area ~46 acres

15.2.3 Components of the Proposal:

1.1.1.1 Salt Processing Center:

The Salt processing center is proposed to utilise and demonstrate the sustainable technology for efficient salt processing, potentially including:

- **Solar evaporation ponds:** Sustainable and energy-saving method for salt production.
- **Crystallization tanks:** Enhance salt quality and consistency.
- **Packaging and storage facilities:** Maintain product quality and facilitate distribution.

This can also be done by partnering with existing salt producers and local communities to ensure fair trade practices and community development.

1.1.1.2 Salt Museum:

Salt Museum is proposed to:

- Showcase the history and evolution of salt production in Thoothukudi through interactive exhibits, artifacts, and multimedia presentations.

- Highlight the significance of salt in various aspects of life, including food preservation, cultural practices, and health.
- Feature educational programs for students and visitors to learn about the science and technology behind salt production, its ecological impact, and its importance in human history.

15.2.4 Potential Benefits of the proposal:

- **Job creation:** The center may require personnel for operation, maintenance, and administration, generating employment opportunities.
- **Tourism:** The museum will attract visitors interested in learning about Thoothukudi's heritage, potentially increasing tourism revenue and promoting local businesses.
- **Education and research:** The center can collaborate with academic institutions for research on sustainable salt production methods and the environmental implications of the industry.
- **Cultural preservation:** The museum shall document and showcase traditional salt-making practices, preserving this vital aspect of Thoothukudi's cultural identity.

15.3 Neo-Tidal Park at Milavittan

The establishment of NEO-TIDEL Park in Thoothukudi, as part of the Tamil Nadu government's initiative to promote IT infrastructure in tier 2/3 locations, was proposed by the government and this proposal is in the implementation stage and construction.

With a focus on creating job opportunities for educated youth, the NEO-TIDEL Park aims to contribute significantly to socio-economic development in the region. As part of the larger plan to set up seven mini Tidel Parks across the state, the NEO-TIDEL Park in Thoothukudi signifies the government's commitment to expanding IT infrastructure beyond major urban centers. This regional expansion ensures equitable distribution of economic opportunities.

Figure 15.3: Proposed NEO-TIDEL park in Milavittan

15.3.1 Key components of the Neo- Tidal Park project

1.1.1.3 Customizable Workspaces:

NEO-TIDEL Park may offer customizable workspaces at affordable costs, catering specifically to the service sector, including IT companies and startups. This flexibility encourages diverse businesses and Entrepreneurs to thrive within the region.

1.1.1.4 Employment Opportunities

The establishment of NEO-TIDEL Park in Thoothukudi will generate numerous employment opportunities for educated youth in the district and neighbouring towns. This is particularly significant for women seeking employment in the IT sector, contributing to increased gender inclusivity.

By promoting IT jobs, the initiative also aims to uplift the community and enhance the overall economic landscape.

15.4 Ferry Services between Tharuvaikulam and Vhan Island

Figure 15.4: Satellite Map showing the Proposed Ferry service from Tharuvaikulam to Vhan Island

Thoothukudi district, with its scenic coastline, historical sites, and cultural heritage, holds immense potential for tourism development. A ferry service between Tharuvaikulam and Vhan Island was in service previously and was discontinued.

This proposal outlines the establishment of a Tourism Development Center with ferry service from Tharuvaikulam to Vhan Island, aiming to:

- **Enhance tourism opportunities** in Thoothukudi by providing a gateway to the unique ecosystem and cultural significance of Vhan Island.

- **Support economic growth** through job creation, attracting visitors, and stimulating local businesses.
- **Promote sustainable tourism practices** by ensuring responsible development and environmental protection.

15.4.1 Components of the Project

1.1.1.5 Ferry Service

The establishment of a reliable and efficient ferry service operating between Tharuvaikulam and Vhan Island, is proposed ensuring:

- Safe and comfortable transportation for visitors and passengers.
- Regular and convenient scheduling to cater to tourist needs.
- Environmentally friendly and cost-effective vessels that minimize impact on the marine ecosystem.

1.1.1.6 Tourism Development Centre

The tourism development centre with the following facilities maybe proposed to support the ferry service:

- **Ticketing and information hub:** Providing details about ferry services, island attractions, and local tourism offerings.
- **Visitor orientation area:** Showcasing the cultural significance and ecological value of Vhan Island through exhibits, multimedia presentations, and cultural performances.
- **Retail space:** Featuring local handicrafts, souvenirs, and F&B options to support local businesses and enhance the visitor experience.
- **Adventure Water sports facilities:** partnering with local business to provide services for adventure sports such as snorkelling, scuba diving, surfing, etc, may be provided.

15.4.2 Benefits of the Proposal

- **Job creation:** The proposal can create employment opportunities in various sectors, including tourism services, hospitality, retail, and transportation.

- **Economic growth:** Increased tourist influx can benefit local businesses like hotels, restaurants, and souvenir shops, stimulating the district's economy.
- **Sustainable tourism:** The centre can promote responsible tourism practices by educating visitors about the island's fragile ecosystem and encouraging eco-friendly activities.
- **Community development:** The proposal can empower local communities by involving them in tourism operations, creating income-generating opportunities, and fostering cultural exchange with visitors.

15.5 Truck Terminals in Milavittan and Kumaragiri

The establishment of two truck Terminals and way side amenities in Milavittan and Kumaragiri are proposed strategically near the National highways including NH38 and NH138. This proposal aims to:

- **Address the growing need** for safe and efficient rest areas for truck drivers traversing national highways.
- **Enhance overall traffic flow and safety** by reducing congestion and driver fatigue.
- **Support the thriving industrial sector** of Thoothukudi by providing essential facilities for the trucking industry

Figure 15.5: Map showing the location of proposed Truck Terminal

15.5.1 Site Details for the Truck Terminals

The area and survey number details for the Truck terminal proposals are:

1) Proposed Truck Terminal (1) at Milavittan near Puthur Pandiyapuram:
    - Village: Puthur Pandiyapuram
    - Survey number: 261 and 262

- Site area ~11 acres

2) Proposed Truck Terminal (2) at Kumaragiri near Sendilampannai:
   - Village: Kumaragiri
   - Survey number: 312-1
   - Site area ~4 acres

15.5.2 Need for the Truck Terminal Proposals

National highways, including NH83, and NH138, serve as vital lifelines for transporting goods across Thoothukudi and surrounding regions including Madurai, Tirunelveli, Kanyakumari etc. However, the lack of designated rest areas for truck drivers poses several challenges, such as:

- **Unregulated parking** alongside highways creates congestion and safety hazards.
- **Lack of basic amenities** for drivers leading to potential discomfort and health risks
- **Driver Fatigue and accidents:** Long driving hours without adequate rest periods lead to driver fatigue, increasing the risk of accidents along the Highways.

15.5.3 Components for the Truck Terminals

Figure 15.6: Truck terminal and Way side amenities
Source: Typical Layout of Truck terminal with wayside amenities, (as suggested by NHAI WSA Brochure)

1.1.1.7 Truck Terminal Infrastructure:

i. The infrastructure may be developed with a well-designed parking facilities, loading/unloading zones, and administrative offices.
ii. May implement advanced technologies for tracking and managing truck movements within the terminal.

1.1.1.8 Way side Amenities

i. **Rest Areas and Motels:** Established rest areas with facilities for drivers, including restrooms, sleeping quarters, and dining options may be designed and proposed.
ii. **Fuel Stations:** Fuel stations for the convenience of trucks, promoting fuel efficiency and reducing downtime may be proposed.
iii. **Restaurants, Dhaba and Food courts:** F&B outlets including restaurants, Dhaba and Food courts may be designed and proposed in the truck terminal.
iv. **Vehicle Maintenance Services:** Provision of on-site maintenance services to ensure the optimal functioning of trucks passing through the terminal may be proposed
v. **Security and Surveillance system:** Advanced security measures, including surveillance systems and adequate lighting, to ensure the safety of goods, vehicles, and personnel within the Truck Terminal shall be implemented.

It is crucial to conduct public consultations and engage with local stakeholders to address any concerns and gather input before the design and implementation of the truck terminal.

Collaboration with local businesses and organizations to ensure that the Truck Terminal aligns with the community's needs and expectations is encouraged.

15.6 Bird Observatory Deck Opposite to Roche Park

The establishment of a Bird Observatory Deck located along the water channel leading from the salt pans to the sea, opposite Roche Park is proposed. This initiative aims to enhance tourism in the area by providing a unique and enriching experience for nature enthusiasts, particularly those interested in observing migrating birds. The deck is proposed to be strategically placed within the mangrove-surrounded water channel, ensuring a pristine natural setting for visitors.

Figure 15.7: Location of Bird Observatory Deck- Proposal

The proposal's key components include:

- The development of an architecturally pleasing and environmentally sensitive observatory deck, strategically positioned for unobstructed views of the water channel and mangroves.
- Bird-watching facilities, including telescopes and live-streaming cameras, aiming to enhance the visitor experience.
- An interpretive center near the deck providing insights into local avian species and the significance of mangrove ecosystems.

- Ancillary facilities support the project, encouraging local businesses, guided tours, and visitor centres with amenities.

Figure 15.8: Reference image showing the proposed Bird Observatory deck

15.6.1 Benefits of the project

- **Tourist Attraction:** The proposed Bird Observatory Deck is strategically positioned to attract tourists, especially nature lovers, birdwatchers, and photographers seeking an immersive experience with the diverse avian species frequenting the region. This complements the existing commercial shops near Roche Park, providing an opportunity for economic growth by drawing more tourists to the area.
- **Biodiversity Conservation:** The project contributes to biodiversity conservation by raising awareness about the importance of these ecosystems.
- **Educational Value:** The Bird Observatory Deck will serve as an educational platform, offering insights into the migratory patterns and behaviour of birds.

15.7 Satellite Towns proposals at Valasamuthiram and Kumaragiri

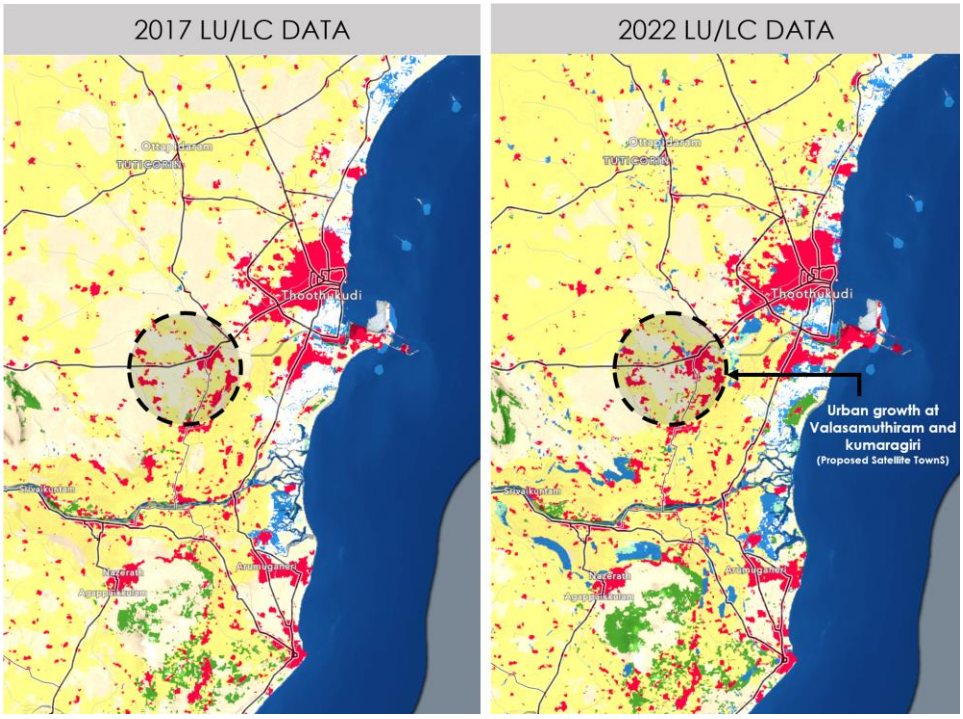


Figure 15.9: LU/LC map showing Proposed Satellite towns - Valasamuthiram and Kumaragiri (Urban growth is depicted by Red in the map)

The satellite towns at Valasamuthiram and kumaragiri are proposed to leverage its strategic location as the villages are recognised as the next potential urban growth area. This proposal envisions villages' transformation into a thriving satellite town, fostering sustainable development, economic prosperity, and an enhanced quality of life for its residents.

15.7.1 Key Components of the proposal

1.1.1.9 Strategic Location

- Towns' positions along NH138 ensures excellent connectivity between Thoothukudi and Tirunelveli, facilitating seamless transportation and accessibility.
- Proximity to the airport enhances the town's accessibility for residents and potential businesses, fostering economic growth.

1.1.1.10 Infrastructure Development

- It is essential to implement state-of-the-art infrastructure, including well-designed roads, utilities, and public spaces, to facilitate the future growth.
- The prioritization of the development of modern amenities such as schools, hospitals, and recreational facilities, as per the requirements is significant, to enhance the quality of life for residents.

1.1.1.11 Mixed Use Zone

- It is imperative to plan the satellite town with mixed-use zoning to promote a balanced community that has residential, commercial, and recreational spaces.
- This fosters a vibrant urban environment by encouraging diverse businesses, creating job opportunities, and supporting local entrepreneurship.

1.1.1.12 Green Spaces and parks

- The integrated green spaces and parks within the town provides the residents with recreational areas, thus promoting environmental sustainability, and also enhances overall well-being.
- Implement landscaping and tree planting initiatives to create a green and aesthetically pleasing environment.

1.1.1.13 Housing

- Provide a range of housing options, including affordable housing, to accommodate diverse socio-economic groups and promote inclusivity.
- Encourage sustainable and energy-efficient building practices to contribute to environmental conservation.

1.1.1.14 Employment Hubs

- It is significant to identify and develop areas within the satellite town suitable for employment hubs, attracting businesses and industries that align with the region's economic potential.
- This fosters a conducive environment for job creation and economic development.

15.8 VOC Port as a Transhipment Hub

V.O. Chidambaranar Port Trust (VOC Port) in Thoothukudi, Tamil Nadu, India, presents a compelling case for becoming a major transhipment hub in Asia. Its strategic location, ongoing development initiatives, and government support position it for significant growth in cargo handling.

15.8.1 Strategic Advantages and Benefits

- **Favorable Location:** VOC Port's position on the east coast of India offers a geographically advantageous route for cargo movement between Southeast Asia, the Middle East, Europe, and Africa. This bypasses the congested Malacca Strait, a critical chokepoint for global shipping.

- **Growing Importance**: The port has witnessed a steady rise in container traffic, indicating its increasing prominence in regional trade. This existing foundation positions it well to handle the higher volumes associated with a transhipment hub.

- **Planned Expansion**: The ambitious Outer Harbour Project aims to significantly expand VOC Port's capacity to handle up to 4 million TEUs. This substantial increase in cargo handling capabilities will make it highly competitive with established transhipment hubs.

- **Infrastructure Developments:** With the government actively supporting development of VOC Port, for infrastructure upgradation and improved connectivity, the potential for VOC port as transhipment hub has a strong impetus for the project's success.

- **Reduced Costs and Diversification:** Currently, Indian businesses heavily rely on Colombo Port in Sri Lanka for transhipment, leading to significant additional expenses. Developing VOC Port as a domestic transhipment hub can significantly reduce these costs, enhancing the competitiveness of Indian exports and imports. The establishment of other ports as transhipment hubs in India need not diminish VOC Port's potential. In fact, a diversified network of transhipment hubs can better serve the growing cargo volumes in India, offering businesses more options and potentially fostering healthy competition within the country.

- **Improved Efficiency:** Transhipment via a domestic hub allows for greater control over cargo movement and potentially faster turnaround times compared to relying on external ports.

- **Strategic Significance:** A robust transhipment hub strengthens India's position in the global maritime trade network, reducing dependence on foreign infrastructure and fostering economic growth.

PROPOSALS TO CONSERVE ECOSYSTEM AND TO PROMOTE BLUE-GREEN INFRASTRUCTURE PLANNING

15.9 Restoration of Abandoned Quarries to Quarry lakes with Floating Solar Plants

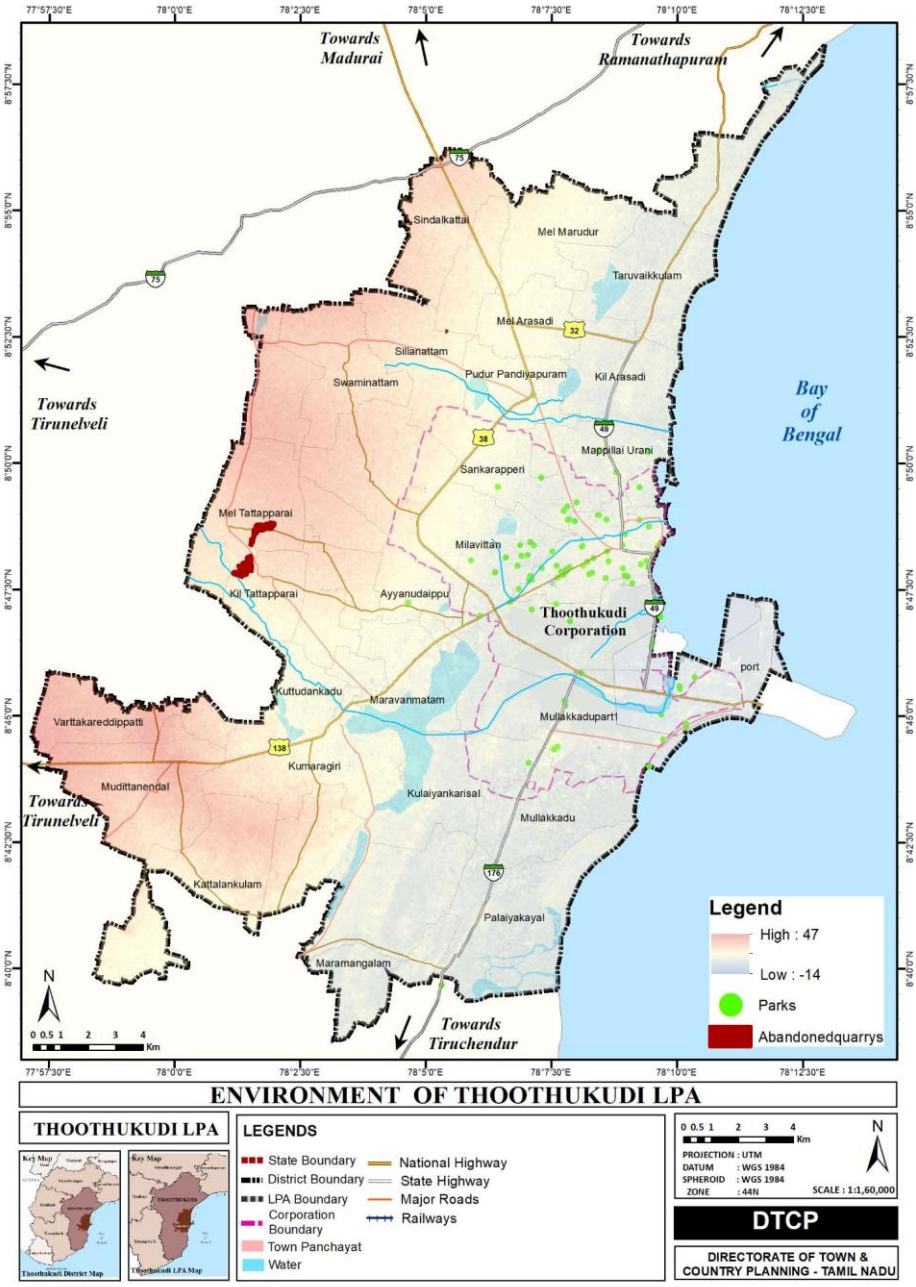


Figure 15.10: Map showing abandoned quarries

Thoothukudi's landscape presents both challenges and opportunities due to the presence of several identified abandoned quarries as given in the Figure 15.10. This **restoration of abandoned quarries to quarry lakes** is proposed transform these spaces into vibrant tourism attraction spaces

suitable for water sports and recreation. Simultaneously, the initiative aims to harness solar energy by exploring the feasibility of accommodating **floating solar plants** to minimize water evaporation.

15.9.1 Suitablity of the Quarry Lake proposal in Thoothukudi

The several factors making repurposing abandoned quarries into lakes the most suitable option are:

- **Climate and water availability:** Thoothukudi experiences a hot and dry climate with limited freshwater resources. Quarry lakes can serve as valuable water storage facilities, potentially providing- irrigation for nearby agricultural land, reducing dependence on groundwater. Installing floating solar plants on a section of the quarry lake is a strategic measure to reduce water evaporation, thereby preserving water availability and ensuring its sustainability throughout the entire year.
- **Feasibility:** Depending on the depth and size of the quarries, creating lakes might require minimal intervention compared to other repurposing options, making it a more cost-effective solution.
- **Multi-functionality:** Quarry lakes offer diverse benefits beyond water storage, including:
    - **Recreation:** They can be developed for various water sports like kayaking, canoeing, and paddleboarding, promoting leisure activities and attracting tourists.
    - **Habitat restoration:** With proper management, the lakes can become habitats for native flora and fauna, fostering biodiversity and enriching the ecosystem.
    - **Scenic appeal and aesthetics:** Creating scenic water bodies can significantly enhance the visual appeal of the area, transforming the landscape from an eyesore into a valuable asset for tourism.
    - **Water Retention:** Leverages the quarry lakes as natural reservoirs to retain water by installing the floating solar plants and mitigate the effects of evaporation.

15.9.2 Facilities and services required for the Quarry Lakes with Floating Solar Panels

To ensure the success and sustainability of the quarry lake project, the following ancillary facilities are proposed to be present adjacent.

1. **Water Treatment and Management Plant:**
   - A filtration system prop may be proposed to maintain water quality suitable for recreational activities.
   - A water level management system may be proposed to control water levels and prevent flooding or water scarcity.
2. **Floating Solar Plant and facilities:**
   - It is essential to explore the extent and the feasibility of integrating floating solar plants within the quarry lakes to harness solar energy.
   - The ancillary facilities to Floating solar plant include:
     - Specialized floating platforms designed to accommodate solar panels,
     - Robust anchor systems to secure the platforms,
     - Electrical infrastructure connecting the solar panels and inverters for efficient energy conversion
     - Monitoring and control systems are integral for remote oversight and performance tracking.
     - Buoyancy and ballast systems maintain stability of the solar plants amidst changing water levels.
     - Additional facilities encompass weather monitoring stations, environmental impact mitigation measures, and emergency response equipment.
3. **Support Infrastructures:**
   - The roads and parking areas within the layout may be developed for easy access.
   - The restaurant, shops, fishing equipment rental shops, changing rooms and restroom facilities may be developed.

- The designated areas for picnics and recreation around the lake may be developed.

4. **Eco-Tourism development support:**
   - Partnership with local businesses to offer kayak and paddleboard rentals may be proposed to promote the tourism and boost economy.
   - The guided tours and nature walk around the lake to promote ecotourism and raise awareness about the local environment may be framed and proposed.
5. **Security stations and services:**
   - The security and lifeguard stations may be provided adjacent to the quarry lakes along with provision of safety equipment like life jackets for the tourists using the recreational lake.
   - Strict security measures to be implemented to prevent unauthorized access and ensure visitor safety.

15.10 Integrated Flood Resilience, Urban Revitalisation and Pollution Mitigation Proposal of Buckle Canal

Integrated Flood Resilience, Urban Revitalisation and Pollution Mitigation of Buckle Canal is proposed to instigate a transformative urban and environmental revitalization.

15.10.1 Key strategic initiatives of the proposal

1. **Canal Resilience and Urban Revitalization:**

   a. **Enhancing Canal Capacity:** Deepening the lower canal section to augment its overall capacity;

   b. **Creating an Extended Upper Canal Segment:** Deepening the adjacent walkway to serve as an extended upper canal segment during emergencies.

c. **Cloud Burst management:** Establishing emergency outlets for redirecting excess stormwater to designated open spaces and/or underground reservoirs during cloudbursts.

d. **Connecting with Korampallam Channel via NH138:** Expanding the Buckle canal in a south-eastern direction along NH138 to connect with the Korampallam canal aims to address and alleviate flood-related issues.

e. **Canal Urban Revitalisation:** Installing placemaking spots along these sunken walkways for community interaction.

2. **Plastic Pollution Mitigation:**

Implementing the innovative **Bubble Barrier System** in five strategic locations along the canal infrastructure.

3. **Blue-green infrastructure Integration:**

a. Introducing **Floating Treatment Wetlands (FTW)** and aquatic vegetation to enhance ecological diversity.

b. Constructing **geotextile dikes** along the canal banks for stabilization.

c. Recreating a **biofiltration zone** with elements, including bioswales and permeable surfaces, around the canal, and along the sunken walkways for natural water filtration.

15.10.2 Canal Resilience and Urban Revitalization

The five interventions are proposed for Buckle canal to increase flood resilience and to facelift the water front as depicted in the Figure 15.11 and Figure 15.15.

1.1.1.15 Enhancing Canal Capacity:

One of the primary initiatives outlined in this comprehensive proposal for Buckle Canal involves the deepening of its lower section. This strategic intervention aims to significantly enhance the canal's overall capacity and functionality.

The existing canal has a width of 7.5m to 12m wide and can be widened based on site feasibility. By excavating and widening the lower canal segment, it is intended to increase its depth and width, thereby allowing for greater water retention and carrying capacity.

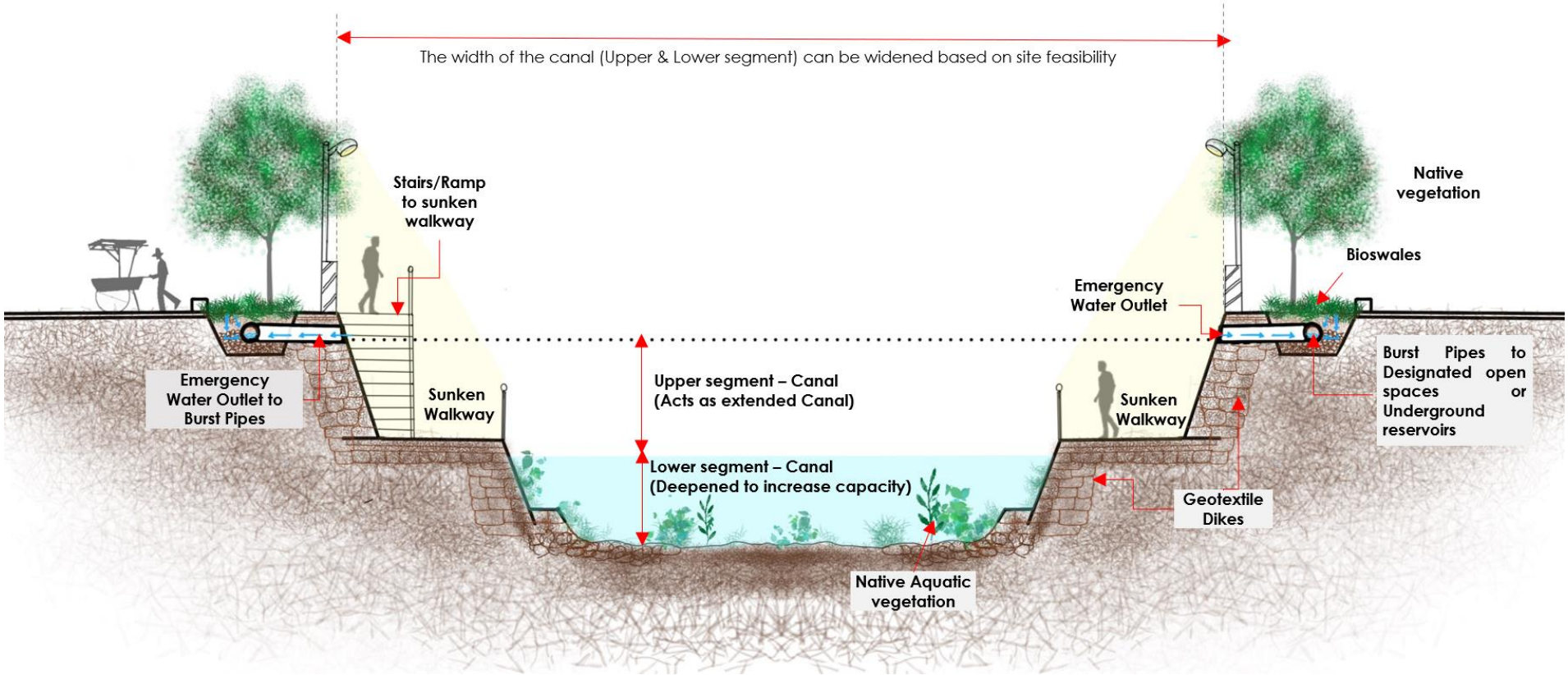


Figure 15.11: Sectional Detail of Buckle Canal

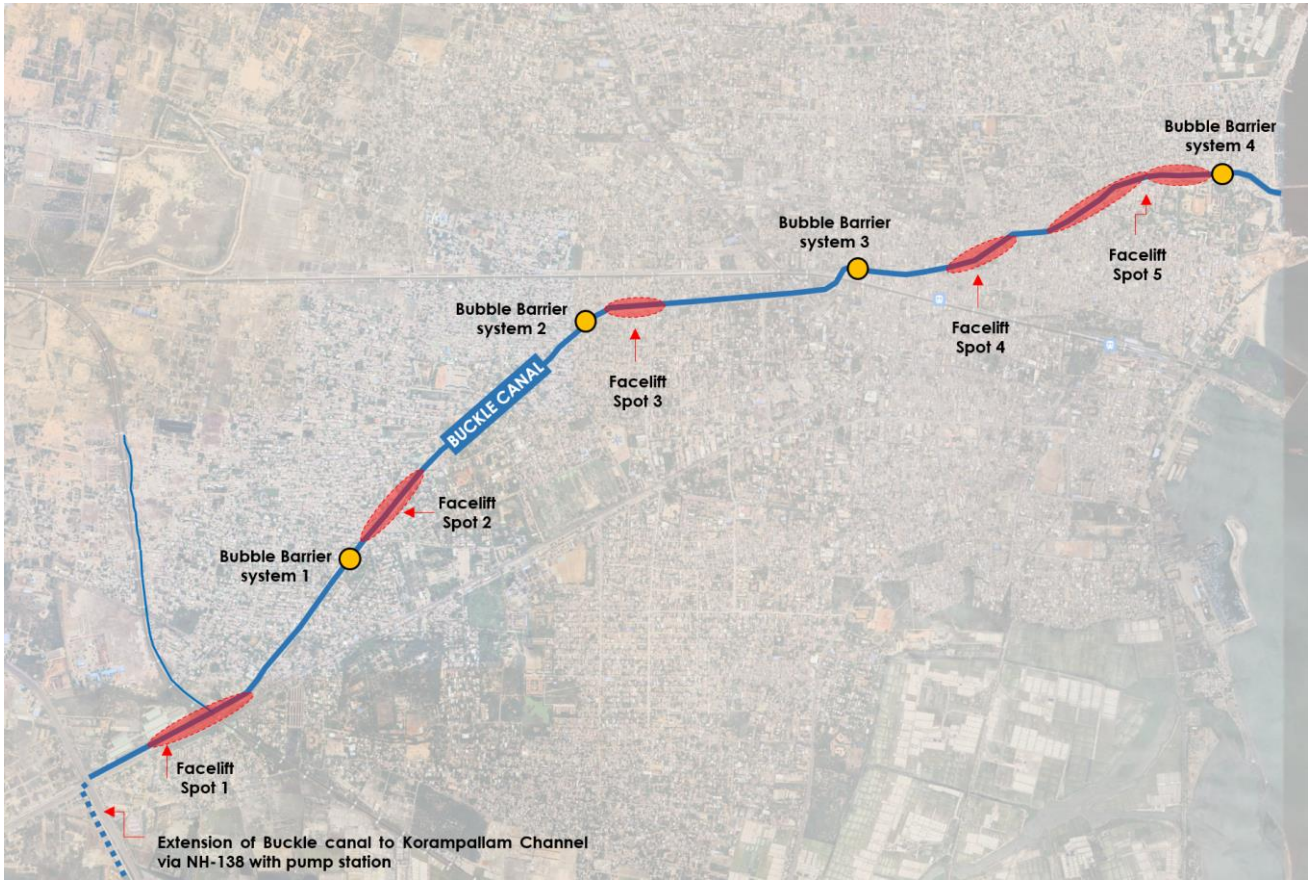


Figure 15.12: Satellite image showing- the location of proposed Urban Facelift spots and Bubbles barrier systems along Buckle canal

1.1.1.16 Creating an Extended Upper Canal Segment

Proposing an innovative strategy, we aim to establish an extended upper canal segment by deepening the adjacent walkway, as depicted in the Figure 15.11.

This initiative involves enhancing the depth of the walkway to mimic the characteristics of the upper canal. This versatile design ensures that, during unforeseen circumstances like emergencies or cloudbursts, the walkway seamlessly transforms into an integral extension of the upper canal. By strategically implementing this adaptation, this helps not only bolster the canal's capacity to handle excess stormwater but also create a dynamic and responsive urban space that can effectively mitigate potential challenges posed by extreme weather events.

1.1.1.17 Cloud Burst Management:

For the cloudburst management, an initiative involves the establishment of dedicated emergency outlets along the upper segment of the canal. These outlets are strategically positioned along the canal infrastructure to efficiently redirect surplus stormwater to specifically designated open spaces and/or underground reservoirs during cloudbursts. The emergency outlets placed strategically along the canal shall be designed with reference to Figure 15.11.

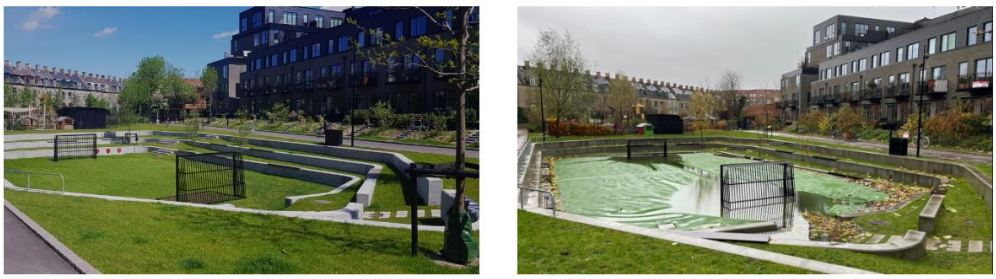


Figure 15.13: Example-A Park in Copenhagen has been adapted to store excess water at ground level
source: https://constructionnews.ie/copenhagen-cloudburst-plan/

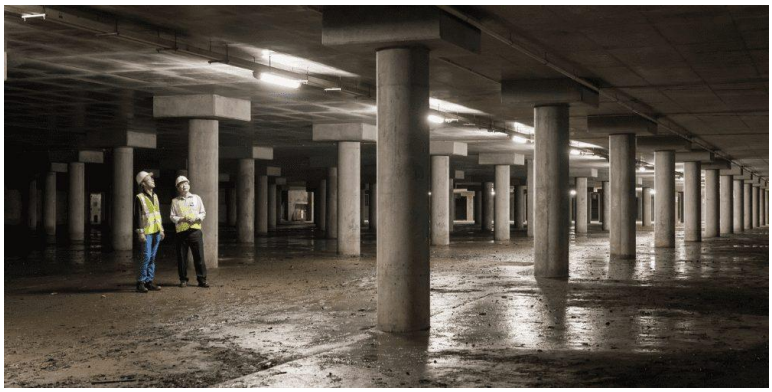


Figure 15.14: Example- Underground reservoir provided in Hong Kong
source: https://binnies.com/innovative-rainwater-storage-system-goes-down-a-storm/

The designated open spaces and underground reservoirs for emergency water retention during cloudbursts may be provided. The following table showing the list of selected area for water retention tanks.

Table 15.1 Location of Water Rentention Tanks

Sl. No	Area Identified for Flood Retention Tanks
1	Thoothukudi Corporation Park, Asirvatham Nagar
2	CMN Childrens Park
3	Children's Park Sinnamani Nagar
4	Thoovaipuram Park
5	VVD Park, Therespuram
6	Fisheries Department, Threspuram

This multifaceted approach is designed to mitigate the impact of sudden and intense rainfall events. By creating a network of strategically located emergency outlets along the canal connecting to open spaces or underground water reservoirs for emergency water retention, it ensures a systematic and controlled discharge of excess water, preventing potential flooding and minimizing the risk of damage to urban areas and also facilitates lesser dependency on other water supply sources during dry climate and drought conditions.

Thus, this proactive measure aims to enhance the canal's resilience, safeguard surrounding communities, and contribute to effective urban water management.

1.1.1.1 Connecting with Korampallam Channel along NH138:

The extension of Buckle canal till Korampallam Channel running adjacent to NH138, along with a pumping station, is proposed to facilitate faster discharge of Buckle canal water especially during extreme weathers.

Need for extension of the canal:

The necessity for extending the Buckle Canal in Thoothukudi arises from a critical examination of the prevailing flood-related challenges and the unique soil conditions in the region. The urban coastal area of Thoothukudi faces a significant issue with slow infiltration, primarily due to soil salination. This characteristic impedes the natural drainage of rainwater, exacerbating flood risks during extreme weather events.

Figure 15.15: Extension of Buckle Canal to Korampallam Channel along NH-138

Components of the Extended Canal Proposal:

To counteract these challenges, proposing the extension of the Buckle Canal along with a pumping station- becomes a strategic solution.

- By **stretching the canal along NH138 till the Korampallam channel**, which ultimately connects to the sea, the excess water can be efficiently channelled away from the city.
- This strategic connection, when complemented by a well-designed **pumping station** near the intersection of 'Madurai-Thoothukudi highway' and 'Palayamkottai road,' ensures effective flood mitigation

This greatly caters to the welfare of the 31.71% of Thoothukudi's population residing in close proximity to the Buckle Canal, as identified in the survey conducted by the NIUA- Thoothukudi smart city report. The proposal promotes the long-term resilience of Thoothukudi against climatic uncertainties.

1.1.1.2 Canal Urban Revitalisation:

This initiative involves revitalisation of 5 face-lift spots along the sunken walkways as depicted in the Figure 15.11. These 5 spots are designed to foster community interaction and engagement. Recognizing the profound impact of connecting people with nature, specifically the canal, these sunken walkways serve as community spaces that promote a sense of ownership and care for the canal environment.

To further facilitate this initiative, these 5 urban placemaking spots may intricately linked with nearby green corridors. This thoughtful integration not only enhances the overall aesthetic appeal but also creates a comprehensive and interconnected circuit for pedestrians. Specifically, these corridors extend to nearby open spaces, such as parks and grounds within 1km radius from these identified 5 face-lift spots, establishing a seamless network that encourages community members to engage with and appreciate the canal within a broader, nature-centric context.

15.10.3 Plastic Pollution Mitigation

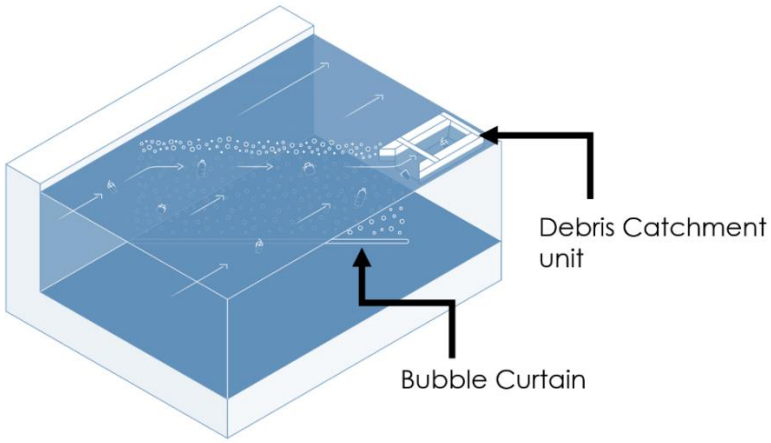


Figure 15.16: Bubble Barrier System
Source: https://thegreatbubblebarrier.com

Plastic pollution in waterways poses a critical environmental challenge worldwide. This proposal introduces an innovative solution **– the Bubble Barrier System –** designed to effectively mitigate plastic waste in water bodies. 4 spots are identified suitable for the bubble barrier system in alignment with the other proposals along the canal, as depicted in the Figure 15.11. This innovation was successfully practised in Amsterdam, Netherlands and many other cities. The system employs a bubble curtain, an air supply mechanism, and a catchment system, collectively working to guide, collect, and retain plastic debris.

1.1.1.3 Components of Bubble Barrier System:

A. Bubble Curtain:

- The bubble curtain utilizes a perforated tube on the waterway's bottom, diagonally covering the entire depth and width.
- It generates a screen of bubbles that blocks and directs suspended plastics to the surface.
- Its diagonal placement guides plastic waste to the side and into the Debris catchment system.

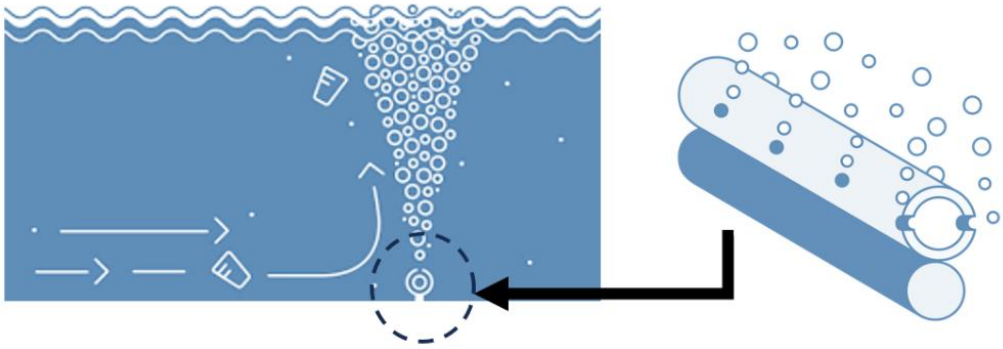


Figure 15.17: Bubble Curtain with a perforated tube
Source: https://thegreatbubblebarrier.com

B. Air Supply:

- It employs electric compressors optimized for continuous operation 24/7.
- It can be tailored to specific location characteristics and can be powered by renewable energy where feasible.

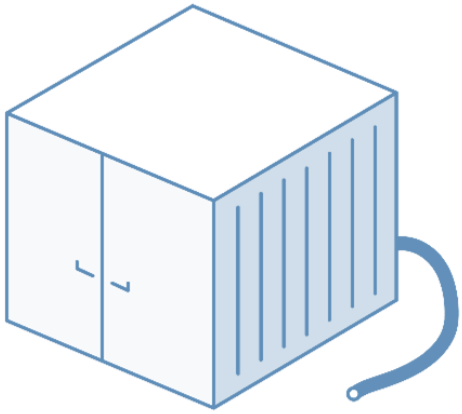


Figure 15.18: Electric Compressor for Air Supply
Source: https://thegreatbubblebarrier.com

C. Debris Catchment System:

- This debris catchment system works harmoniously with the bubble curtain to collect and retain plastics in a unit along the canal's bank at the designated spits of Bubble Barrier system.
- It is adaptable to local infrastructure and designed for easy emptying by local authorities.

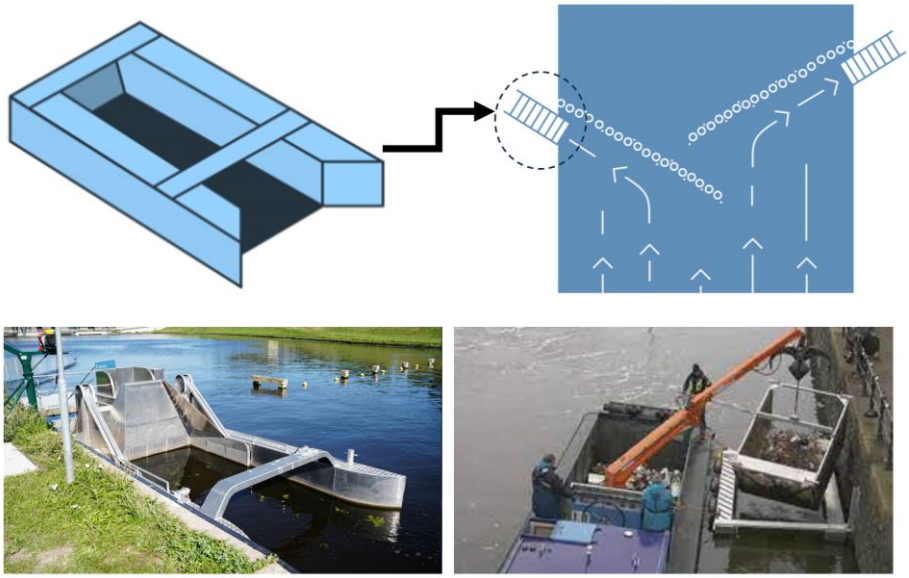


Figure 15.19: Debris Catchment System
Source: https://thegreatbubblebarrier.com

1.1.1.4 Benefits of the Bubble Barrier:

- **Increased Dissolved Oxygen**: It enhances dissolved oxygen at the site, benefiting the aquatic ecosystem.
- **Aquatic livings to pass safely:** This bubble curtain allows migrating fish and other living beings to pass through the bubble curtain safely.
- **Versatility:** It is suitable for various locations without requiring changes to existing local infrastructure.
- **24/7 Operation:** it functions round the clock without the need for constant operator supervision.
- **Cost effective:** This innovation is cost effective when compared with grey infrastructures meant for waterbodies' plastic pollution mitigation.
- **Extensive Reach:** Covers the full width and depth of the waterway, ensuring a comprehensive cleaning effect.

1.1.1.5 Success Stories of the Bubble Barrier:

The Bubble Barrier System has undergone successful pilot projects in Amsterdam, Netherlands, Harlingen, Vila do Conde, Katwijk, and

Wervershoof. **Amsterdam**, in particular, has demonstrated an **85% catch rate** for debris collection based on pilot data.

Therefore, the Bubble Barrier System stands as a revolutionary solution to combat plastic pollution in waterways. With proven success in various pilot projects, its integration promises not only a significant reduction in plastic debris but also a positive impact on the overall health of aquatic ecosystems.

15.10.4 Blue-green infrastructure Integration

1.1.1.6 Floating Treatment Wetlands (FTW):

This proposal is to introduce Floating Treatment Wetlands (FTW) as an effective and sustainable solution for water purification in Buckle Canal. FTWs are designed as artificial islands to support the growth of aquatic plants in deep water. They act as purification islands.

It can be made comprising of four layers, including:

1. Floatable bamboo at the bottom,
2. Styrofoam cubicles,
3. Floatable bamboo at the top, and
4. A top layer of cleansing plants. FTWs utilize a soil-less hydroponics method. Vegetables, cattalis, canna, bulrush, citronella, hibiscus, fountain grass, floral herbs, tulsi, and ashvagandha are among the cleaning agents planted on FTW.

Figure 15.20: A successful example of Floating Treatment Wetland (FTW) in Hyderabad's Neknampur Lake.
Source: *Floating Treatment Wetlands in Neknampur Hyderabad*

Mechanism:

The FTW mechanism utilizes sunlight and water. Small pores at the base enable nutrient transfer to plants via biological uptake. Microbial decomposition, facilitated by plant root systems, filters sediments and contaminants, contributing to a reduction in the chemical content of the water.

FTW in Wetland Conservation:

- **Biofilm Formation:** Plant roots create a biofilm layer, promoting nutrient intake and decomposition.
- **Floating Mat:** Acts as a mat, absorbing sediments and reducing turbulence caused by wind and waves.

- **Nutrient Capture:** Serves as a nutrient sink, collecting and converting contaminants into harmless byproducts.

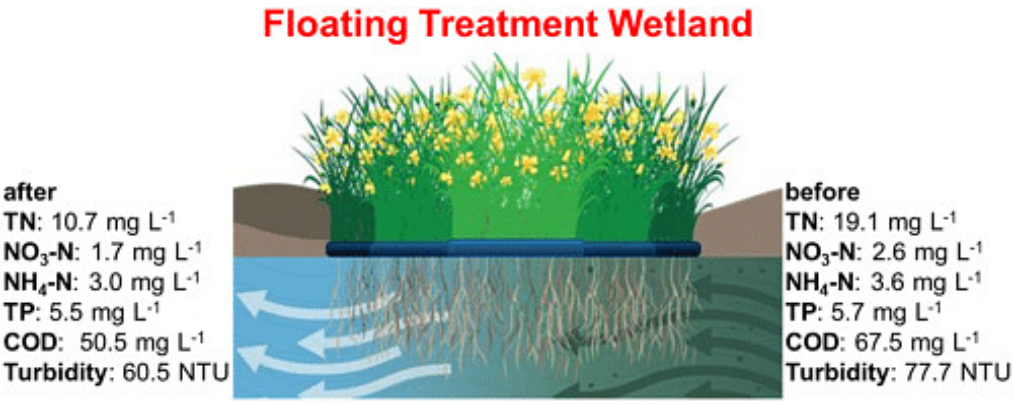


Figure 15.21: Floating Treatment Wetland- Nutrient Capture
Source: *Floating Treatment Wetlands in Neknampur Hyderabad*

Advantages:

FTWs exhibit proficiency in removing suspended particles, treating contaminants like heavy metals and nutrients, and enhancing the removal of dissolved contaminants. Their adaptability to changing water levels and prevention of suffocation from settled sediments make them suitable for retrofitting retention ponds and preventing further contamination.

Beyond functionality, they enhance canal aesthetics and engage communities in environmental stewardship. Their adaptability and scalability make them flexible solutions for different canal sizes and conditions. When thoughtfully implemented, floating wetlands contribute significantly to sustainable canal management, fostering cleaner water and healthier ecosystems.

1.1.1.7 Geotextile Dikes with aquatic vegetation:

The introduction of native aquatic vegetation along the canal edges, strategically complemented by the integration of geotextile dikes approach aims to stabilize banks, mitigate erosion, sediment filtration, stabilization and create natural barriers.

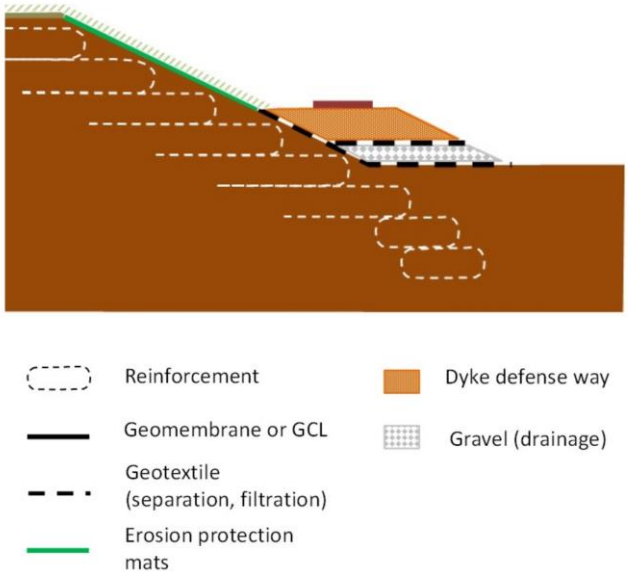


Figure 15.22: Geotextile Dikes

By synergizing these interventions, we enhance the aesthetic appeal of the canal while fortifying its resilience against environmental challenges, promoting long-term stability and a healthier ecosystem.

1.1.1.8 Bio-filtration Zone

A bio-filtration zone is created by installation for bioswales and permeable surfaces in the buffer space of ~1km radius from the face-lift spots. The bio-filtration zones align with modern urban design principles, fostering an environmentally conscious and resilient landscape. This recommendation not only enhances water quality but also supports groundwater recharge, contributes to temperature regulation, and ensures the long-term vitality of Buckle Canal and neighbourhood community.

Bio-swales:

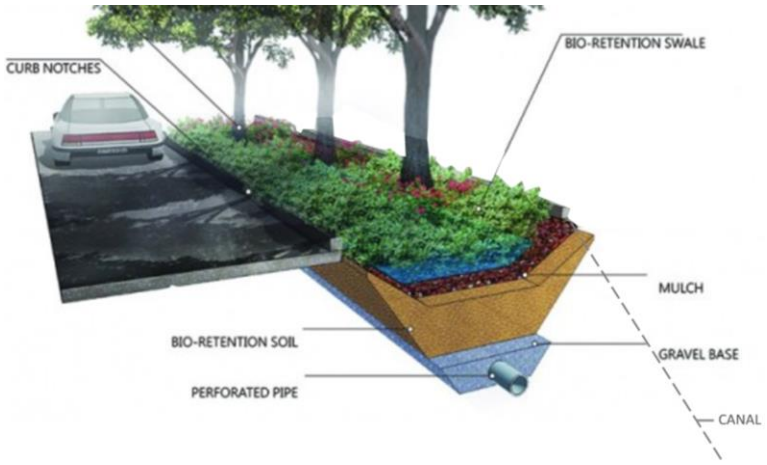


Figure 15.23: Detail of Bioswales- installed adjacent to the canal bank
Source: https://jpalandscapeblog.wordpress.com/2018/05/08/bio-swales/

- This proposal of bioswales advocates for the integration of bioswales alongside Buckle Canal ***to effectively manage stormwater, mitigate pollutants, and enhance water quality*** within the watershed.
- Bioswales, in this context, refer to purposefully designed vegetated features such as swales, ditches, or depressions along Buckle Canal.
- Serving as natural stormwater conveyors, bioswales mimic ecosystems to filter pollutants and debris from stormwater, ultimately improving the quality of water entering the canal and surrounding watershed.

- **Placement of Bioswales:** Bioswales should be strategically positioned near roadways and parking lots adjoining Buckle Canal. This deliberate placement addresses the significant issue of automotive pollution settling on paved surfaces in common interest developments.

- **Slope Optimization:** Bioswales will feature a carefully calibrated slope to ensure controlled water flow in the desired direction without inducing rapid runoff.

- **Maximized Retention Time:** The design philosophy focuses on maximizing the time water spends within the bioswale. This extended duration allows

plant material and soil to effectively absorb pollutants and capture debris, thereby slowing and filtering stormwater.

Permeable surfaces:

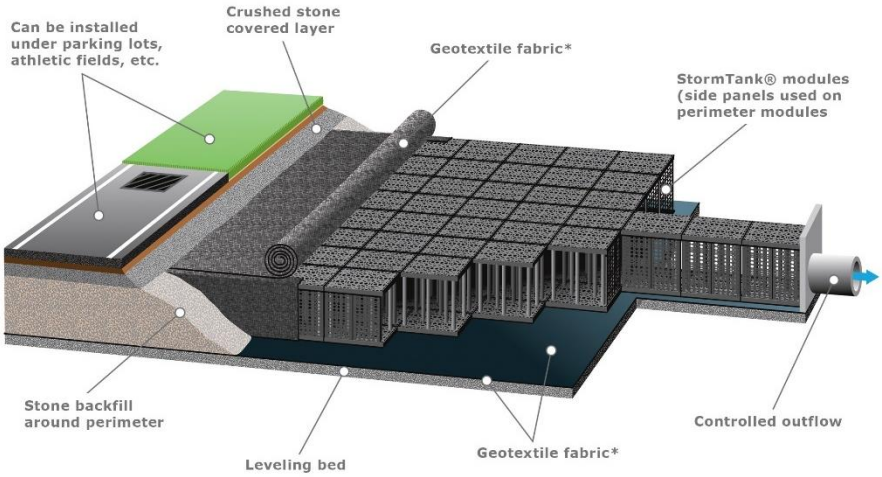


Figure 15.24: Permeable surfaces with outflow pipes connected to Underground water reservoirs
Source: stormwater.brentwoodindustries.com/knowledge-center/detention-tank

Permeable pavement, a porous urban surface, stands as a promising solution for enhancing bio-filtration of Buckle Canal and its surrounding areas. Beyond functionality, these surfaces primarily contributing to sustainable stormwater management, actively promote bio-filtration, allowing soil and vegetation to absorb and neutralize pollutants before entering the canal.

Figure 15.25: Types of Permeable surfaces
Source: USGS- evaluating potential benefits permeable pavement

- Comprising open pore pavers, concrete, or asphalt with an underlying stone reservoir, as given in the Figure 15.25, this innovative approach catches precipitation and surface runoff, thus preventing flooding.

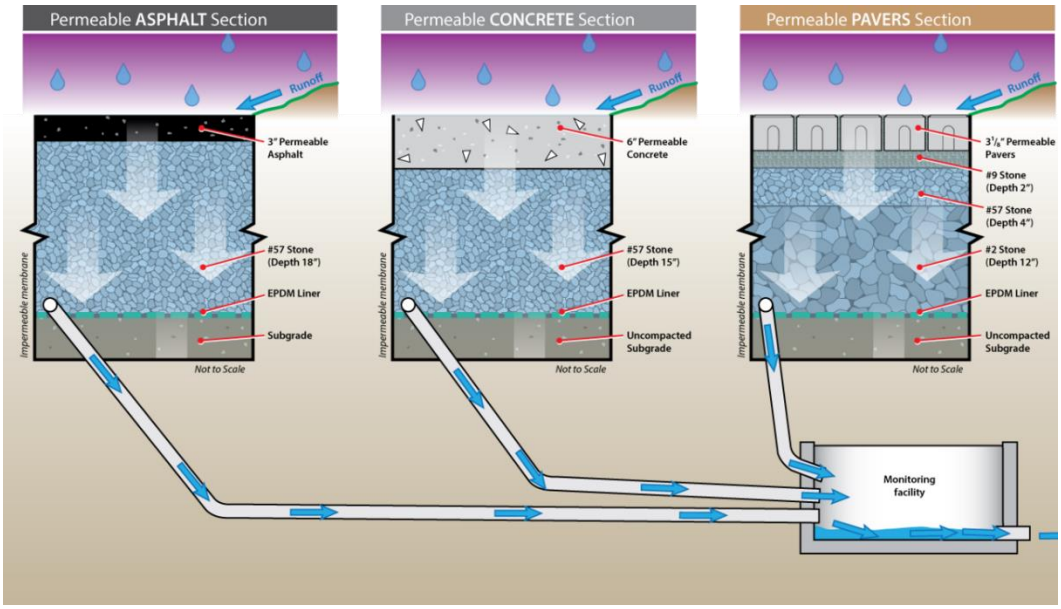


Figure 15.26: Detail section of bio-filtration in various types of permeable surfaces
Source: USGS- evaluating potential benefits permeable pavement

- As given in the Figure 15.26, by storing water in the underlying stone reservoir, it gradually infiltrates into the soil or discharges via a drain pipe into the canal in case of cloudburst,

15.11 Urban Forest

Figure 15.27: Location maps showing the proposed Urban Forest in Tharuvaikulam village

As Tharuvaikulam is the upcoming urban development area in Thoothukudi district, an urban Forest in Tharuvaikulam is proposed to envisage a balance between development and environmental conservation.

The Urban Forestry initiative in Tharuvaikulam Village will focus on planting and maintaining a diverse range of native trees and vegetation within designated areas. The project will incorporate the following key components:

- **Species Selection:** A thorough analysis of native tree species is to be conducted to ensure compatibility with the local climate, soil conditions, and ecosystem. Emphasis shall be placed on selecting trees that provide ecological benefits, such as improved air quality, biodiversity support, and carbon sequestration.
- **Green Corridors:** Strategic placement of green corridors may be established to connect different parts of the development. These corridors will not only enhance the aesthetic appeal of the area but also promote biodiversity and provide a pleasant environment for residents.
- **Community Engagement:** Public awareness campaigns, workshops, and educational programs will be conducted to encourage community participation in tree planting, maintenance, and overall environmental stewardship.
- **Infrastructure Integration:** Urban forestry may also be seamlessly integrated into existing and future infrastructure plans. Consideration shall be given to factors such as road design, recreational spaces, and stormwater management to ensure a harmonious coexistence of urban development and green spaces.

15.12 Proposal – Mangrove Conservation by Students Engagement Programme

The region of Thoothukudi LPA, with its rich mangrove ecosystems facing the threat of degradation, has the opportunity to pioneer a comprehensive Mangrove conservation initiative. This intervention for Thoothukudi LPA,

proposed for the **Mangrove Conservation through Student Engagement Programme**, leveraging the potential of underprivileged students to actively participate in safeguarding these crucial coastal habitats.

The initiative aims to provide financial opportunities to students through active participation and trainings, empowering them to contribute to mangrove conservation efforts coordinated by Community Benefit Organizations (CBOs).

15.12.1 Objectives

a. **Student Empowerment:** To provide stipends and scholarships to underprivileged students through CBOs, equipping them with the skills and resources needed for the conservation programme, thus enabling a sustainable economic development among the youth population.
b. **Mangrove Conservation**: To establish a CBO in every coastal village adjacent to mangrove lagoons in Thoothukudi. And to engage students in mangrove conservation activities to protect and enhance these vital ecosystems.
c. **Community Resilience:** To promote improved fishing and agriculture practices to enhance community livelihoods, making them more resilient to shocks and stresses. Foster sustainable development that aligns with mangrove conservation goals.

15.12.2 Benefits and Environmental Impact of Mangroves:

Mangrove forests, situated at the interface of fresh and saltwater in the tropical belt, play a crucial ecological role locally and globally. They provide a habitat for various birds, crustaceans, reptiles, and mammals, thriving at the intersection of land and sea. Mangroves strengthen interconnected marine ecosystems, such as coral reefs, and serve as vital nursery grounds for fish.

Seagrass beds often act as spawning grounds for reef fish, and post-hatching, juvenile fish move to mangroves, where abundant food and shelter from predators are available. In the absence of mangroves, juvenile fish move directly to reefs, exposing them to increased predation. The United

States National Oceanic and Atmospheric Administration estimates that the livelihoods of 30 million people globally are entirely reliant on coral reefs, which, in turn, are supported by mangroves. This shows the significance of Mangrove conservation for any region

15.13 Proposed Desalination plant at Tharuvaikulam

Following the successful Global Investors Meet, where investments totalling Rs 6.6 lakh crore were secured, the industries department in Tamil Nadu has proposed strategic initiatives including **Desalination plants and greywater treating facilities across the State**, to address water scarcity for industrial needs and also to reduce the dependency on freshwater reservoirs and groundwater.

The State Industries Promotion Corporation of Tamil Nadu Limited (SIPCOT) is actively considering the establishment of five treatment facilities plants to ensure a sustainable water supply for industries.

Desalination Plant in Tharuvaikulam, Thoothukudi: One of the key locations identified for such a crucial initiative is Tharuvaikulam in Thoothukudi, where a 15 million litres per day (MLD) desalination plant is proposed. This facility aims to cater to the increasing water demands of industries in the region and mitigate the strain on traditional freshwater sources.

PROPOSALS TO PROMOTE EFFECIENCY IN MOBILITY

15.14 Mobility – Grid of Roads

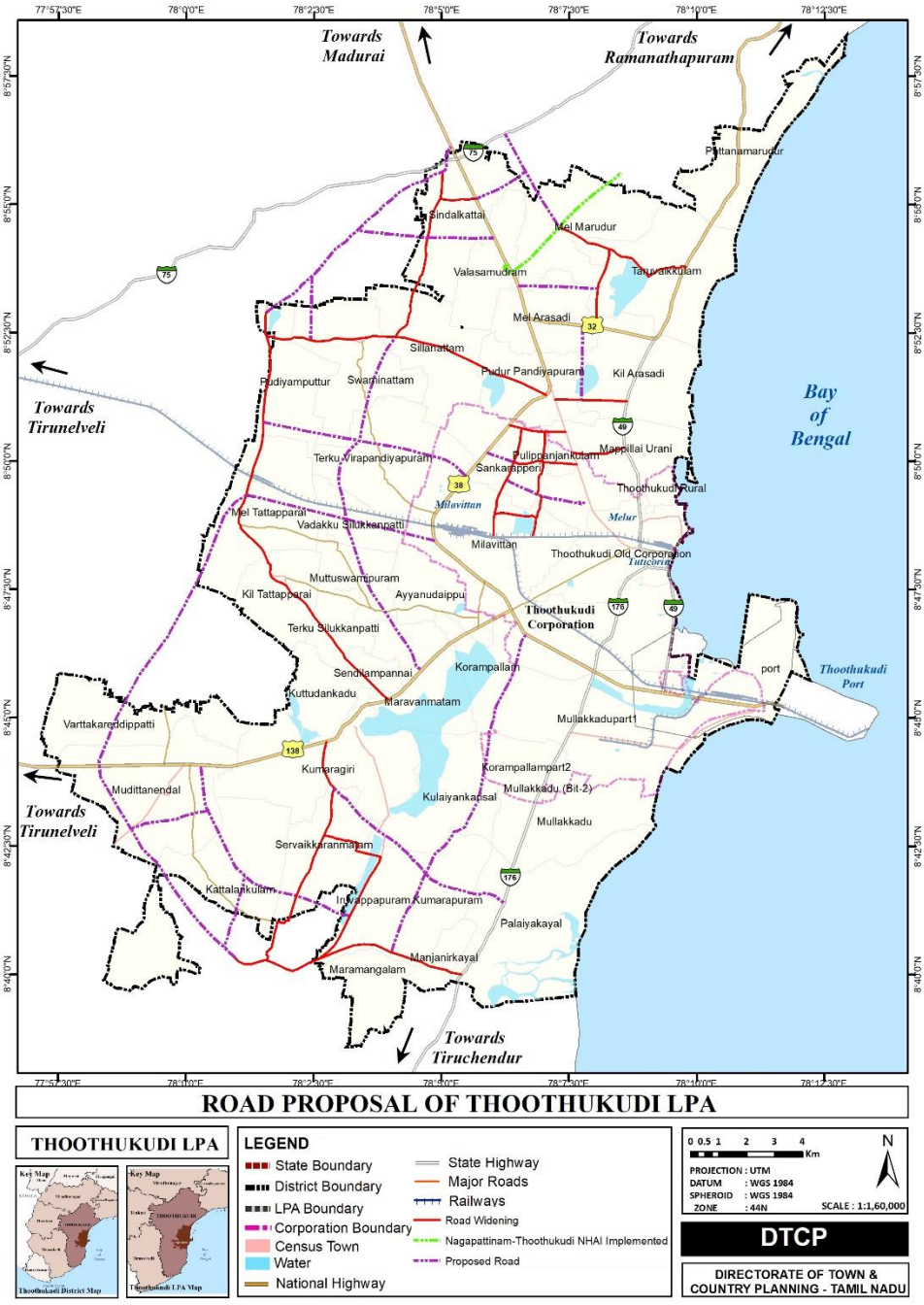


Figure 15.28: Thoothukudi -Grid of Roads

The widening and improvement of existing roads while identifying and constructing missing links to establish a well-connected grid of roads in Thoothukudi is proposed to enhance urban connectivity, ensuring a seamless transportation network that aligns with feasible urban planning principles.

The list of roads identified to connect the missing links and to form a well-connected grid of roads are:

- A1- Palayakayal to Milavitan
- A2- Pazhayakayal to Pudukottai (Kumaragiri)
- A3- Thoothukudi (Madurai Thiruchendur Highway to Manjakkalai
- A4-Vagaikulam to Kadodipannai
- A5- Pudhiyamputhur to Kurukkuchalai
- A6- Swaminatham to Maravanmadam
- A7- Pudhiyamputhur to Therku Veerapandiyapuram

The list of Roads under improvisation and widening are:

- Bl- Kovilpatti - Ottapidaram - Pudukottai - Eral - Mukkani Rd
- B2- Kovilpatti - Ottapidaram - Pudukottai - Eral - Mukkani Rd
- B3- Pudhiyamputhur to Pudur Pandiyapuram

The list of roads under implemnetation are:

- Cl- Nagapattinam - Thoothukudi NH

15.14.1 Need and Benefits of the proposal

Traffic Efficiency:

- A well-connected road network established with widening existing roads and constructing missing links, will alleviate traffic congestion, and enables optimized routes reducing travel times and fuel consumption.

Accessibility:

- Improved and expanded roadways enhance accessibility to various neighbourhoods, public services, and commercial areas.
- Establishing missing links addresses gaps in the current road network, ensuring a comprehensive reach across the urban landscape.

Economic Development:

- A well-connected road network stimulates economic growth by improving accessibility for businesses, attracts investors and fosters local entrepreneurship, contributing to a vibrant economic environment.

Public Safety:

- Widened roads and new links contribute to enhanced emergency response times, ensuring prompt assistance during unforeseen events.
- Improved road infrastructure reduces the risk of accidents and enhances overall road safety for both pedestrians and motorists.

Environmental Impact:

- A well-planned road network minimizes congestion-related emissions, promoting environmental sustainability.
- Encouraging public transportation through improved connectivity reduces individual reliance on private vehicles, contributing to a greener urban environment.

15.15New Ring Road proposal from Palayakayal via Airport Road to Milavittan

The inclusion of new ring road connecting Palayakayal, via Airport Road to Milavittan via various villages including Kadodipannai, Kootapali, and Pudukottai in the Thoothukudi Master Plan, is proposed. This not only enhances overall local connectivity but also establishes the easiest and most direct route to Tiruchendur which is a vibrant tourist hub. The Figure 15.28 shows the proposed road alignment (A1).

The proposed road would contribute significantly to the city's infrastructure, promoting efficient transportation and fostering economic development. Additionally, this new road alignment aligns with the broader goal of creating a well-connected network, catering to the needs of residents, businesses, and facilitating smoother travel to key destinations. The inclusion of this proposal in the master plan is essential for optimizing the urban

landscape, promoting accessibility, and ensuring the seamless flow of traffic in and around Thoothukudi.

15.16 Promenade along Palayamkottai Road

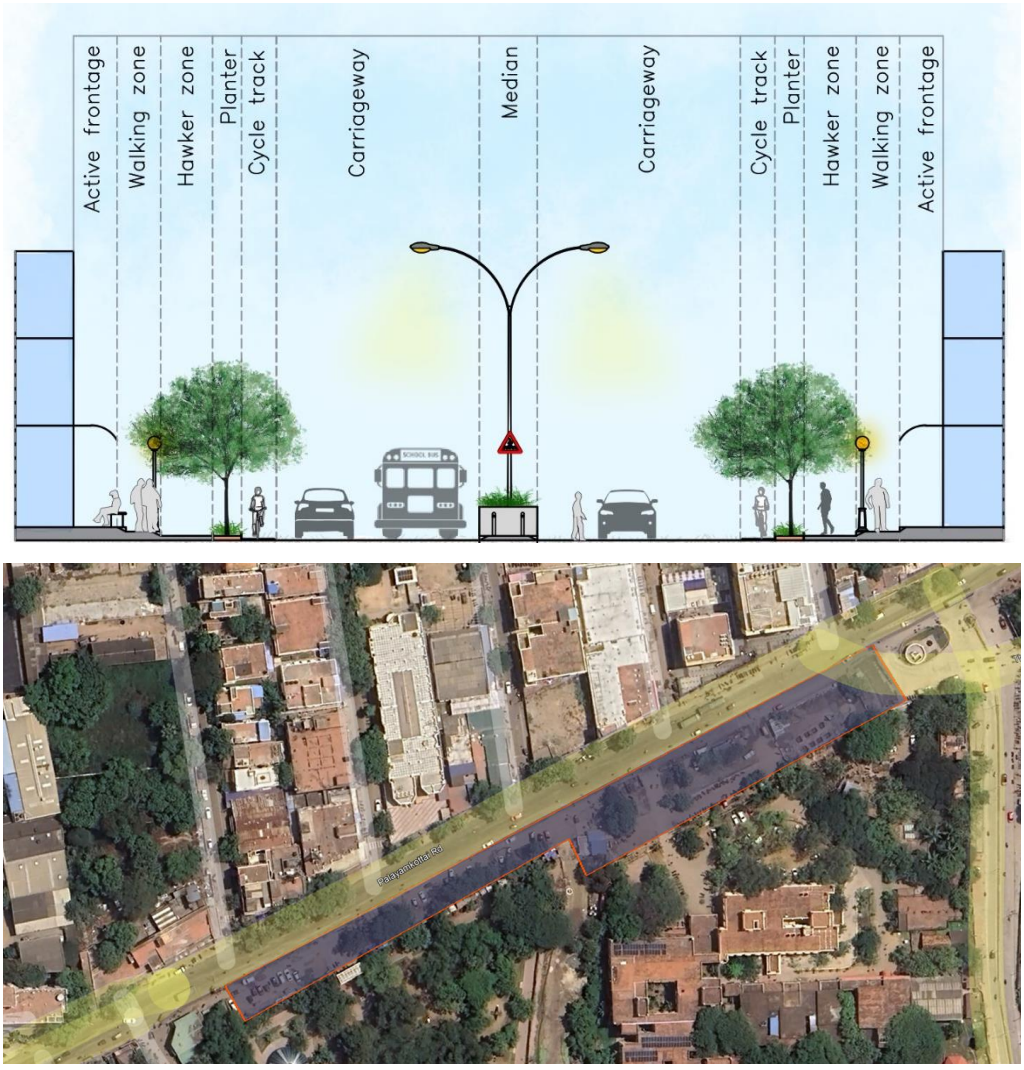


Figure 15.29: Proposed Promenade along Palayamkottai Road - Location and Road Section (Conceptual)

The Promenade along Palayamkottai Road is proposed to enhance the urban fabric of Thoothukudi by integrating dedicated commercial spaces, food streets for hawkers, and green amenities within a carefully planned promenade. The project envisions a vibrant and sustainable urban environment that prioritizes both functionality and aesthetics.

15.16.1 Key components of the Promenade

1.1.1.9 Dedicated Commercial Spaces

To foster economic growth in Thoothukudi, introduction of new commercial zones along Palayamkottai road is proposed and shall be carefully planned in the layout based on feasibility of the site. This aims to create a vibrant business district, attracting diverse enterprises and enhancing the city's economic profile.

1.1.1.10 Dedicated Hawkers' Space for Food Streets:

The designated specific areas for hawkers within the promenade are proposed to create a lively food street atmosphere and to support the needs of street vendors, ensuring a safe and hygienic environment.

1.1.1.11 Promenade Development:

Integrated bioswales and green planters with native vegetation along the promenade is proposed to manage stormwater runoff and promote sustainable urban drainage, to enhance the aesthetic appeal and contribute to environmental conservation.

1.1.1.12 Cycle Track:

The proposal suggests creating a designated cycle track that is not physically separated from the roadway. This initiative aims to promote sustainable transportation, encourage a healthier lifestyle, and support efforts toward non-motorized modes of travel.

1.1.1.13 Pedestrian Spaces:

The proposal shall include designated pedestrian-friendly zones and footpaths along the promenade, fostering a safe and enjoyable environment for residents and visitors.

Theses pedestrian spaces shall incorporate street furniture, lighting, and landscaping to create an inviting atmosphere for leisure and social interactions.

15.17 Railway Gate 4- Flyover

The construction of a flyover at Gate-4 to address the persistent traffic congestion caused by the railway line crossing is proposed, to mitigate traffic-related issues, reduce delays, and enhance overall transportation efficiency in the area.

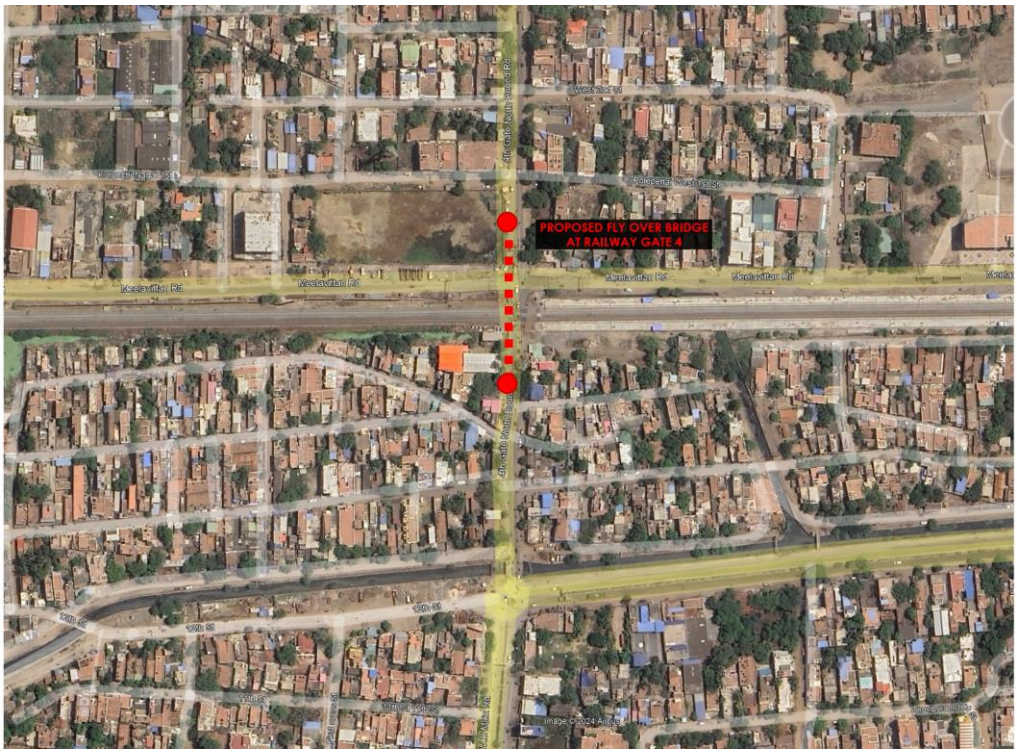


Figure 15.30: Map showing the location of proposed Flyover bridge at Railway Gate 4

15.17.1 Need for the construction of Flyover at Gate-4

- **Traffic Congestion:** Gate-4 regularly faces congestion due to the railway crossing, causing delays and frustration for commuters.
- **Safety Concerns:** The crowded conditions at Gate-4 pose safety risks, especially during peak hours, making a flyover essential for improved traffic flow and road safety.
- **Economic Impact**: Traffic jams lead to economic losses through wasted fuel and increased operational costs for businesses, affecting local commerce negatively.

- **Public Transport Efficiency:** A flyover not only benefits private vehicles but also enhances the efficiency of public transportation, reducing travel time for buses and improving the overall reliability of the transportation network.
- **Emergency Services Access:** Quick access for emergency services is critical during critical situations, and a flyover would facilitate faster response times, ensuring public safety.
- **Enhanced Connectivity:** The flyover improves citywide connectivity by providing a seamless route across the railway line, fostering economic development and regional integration.

16 PROPOSED LAND USE PLAN

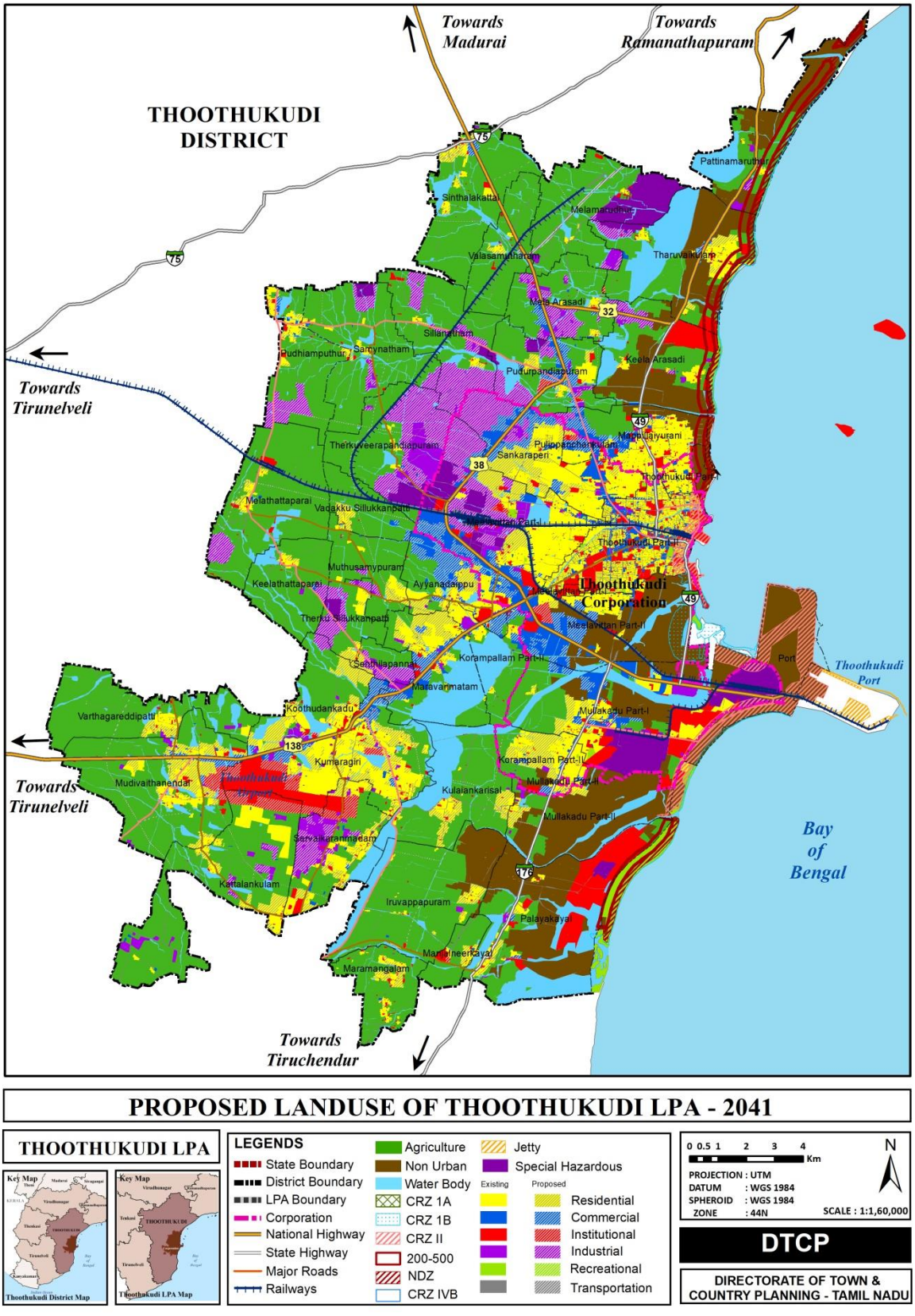
To ensure the systematic growth and sustainable management of local planning, as well as to maintain its economic feasibility, social cohesion, and effective governance both presently and in the foreseeable future, the implementation of a Master Plan accompanied by zoning regulations and development controls is imperative. Zoning serves the purpose of segregating specific land uses from others, thereby minimizing the adverse impacts that certain activities may have on surrounding areas.

The Thoothukudi Local Planning Authority (LPA) has a total area of 463.61 Sq. Km in the existing master plan 2021, out of which, around 64.46% (298.84 sq.km) is non-developable area coming under Agriculture use and Water bodies. Only the remaining 35.54% (164.78 sq.km) is available for development.

Based on the Project Proposals formulated in the previous sections, **the proposed land use plan for Thoothukudi LPA for the horizon year 2041**. The Thoothukudi Local Planning Authority (LPA) has a total area of 463.61 Sq. Km in the proposed master plan 2041, out of which, around 50.20% (232.72 sq.km) is non-developable area coming under Agriculture use and Water bodies. Only the remaining 49.80% (230.9 sq.km) is available for development.

Map 16.1 shows the land use composition of both existing land use structure of 2021 and the Proposed Land structure of 2041 for Thoothukudi LPA. Table 16.1shows the land use breakup of the existing land use of 2021 and proposed land use of 2041 for the Thoothukudi LPA.

16.1 Land use plan of Thoothukudi LPA



Map 16.1: Proposed Landuse Map of Thoothukudi LPA Master plan 2041

Table 16.1: Composition of existing and Proposed Land use plan -Thoothukudi LPA

Land Use Composition of Thoothukudi LPA				
Landuse	**Existing Land Use 2021**		**Proposed Land Use 2041**	
	Area (In Sq. Km)	**% of Area**	**Area (In Sq. Km)**	**% of Area**
Residential	47.31	10.20 %	70.67	15.24 %
Commercial	10.78	2.33 %	21.83	4.71 %
Industrial	8.64	1.86 %	32.56	7.02 %
Special Hazardous Industries	16.22	3.50 %	16.22	3.50 %
Institutional	22.91	4.94 %	28.13	6.07 %
Open Space Recreation	0.84	0.18 %	1.33	0.29 %
Agricultural	253.37	54.65 %	187.25	40.39 %
Transportation	15.44	3.33 %	17.52	3.78 %
Non-Urban	42.64	9.20 %	42.64	9.20 %
Waterbody	45.47	9.81%	45.47	9.81%
Total	463.61	100 %	463.61	100%

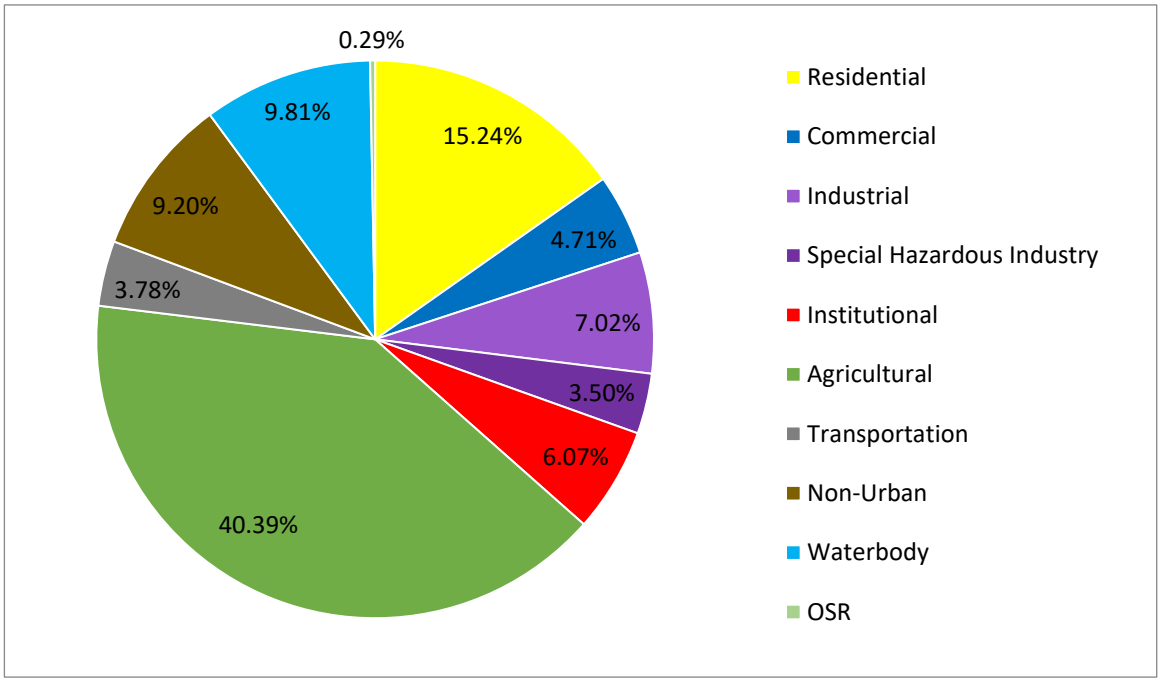
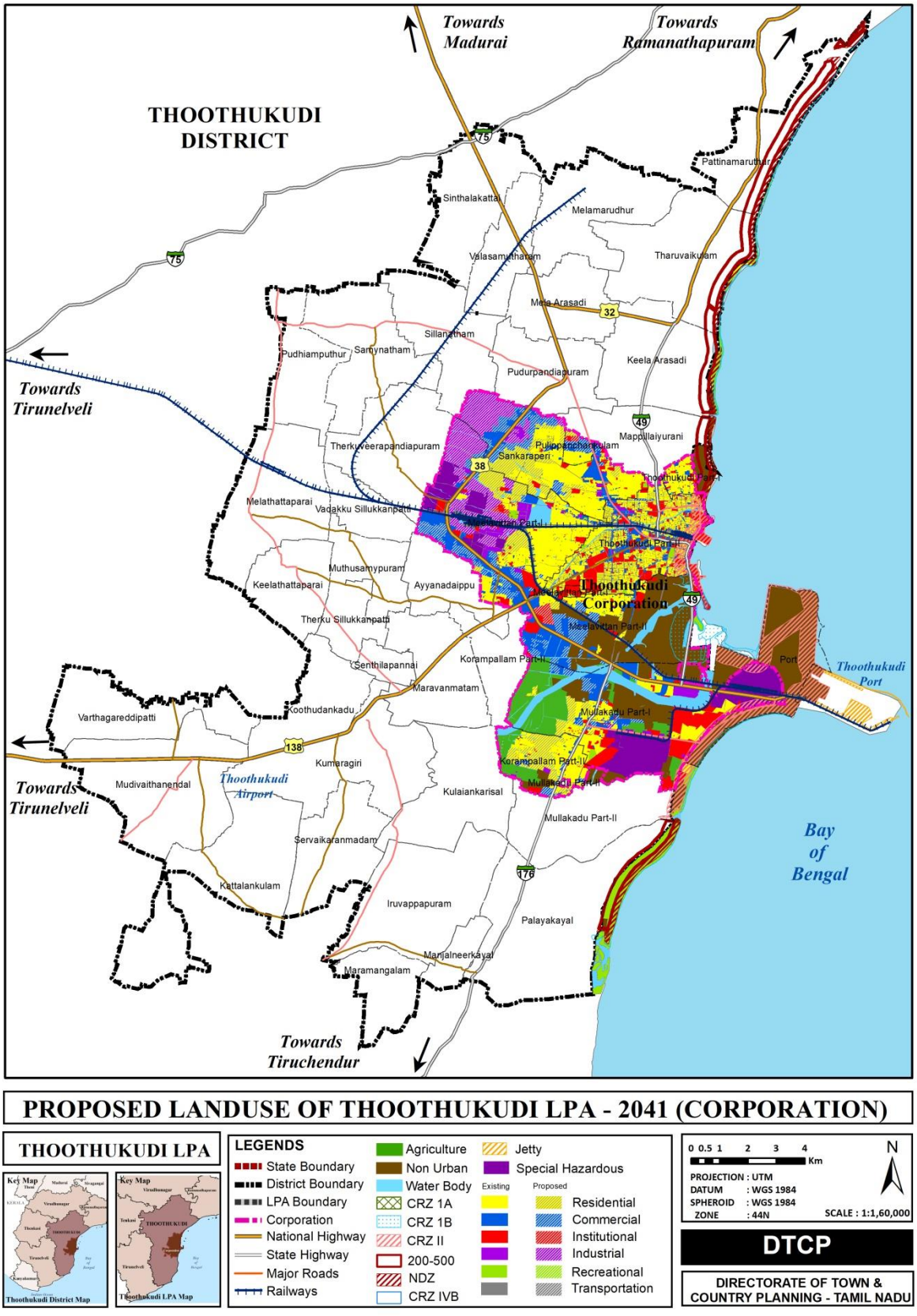


Figure 16.1 Proposed Land use Percentage of Thoothukudi LPA

16.2 Land use plan of Thoothukudi Corporation



Map 16.2: Proposed Landuse Map of Thoothukudi Corporation Master plan 2041

Table 16.2: Composition of existing and Proposed Landuse plan- Thoothukudi Corporation

Land Use Composition of Thoothukudi Corporation				
Landuse	**Existing Land Use 2021**		**Proposed Land Use 2041**	
	Area (In Sq. Km)	**% of Area**	**Area (In Sq. Km)**	**% of Area**
Residential	22.94	25.30 %	29.18	32.19 %
Commercial	7.93	8.75 %	11.58	12.77 %
Industrial	1.89	2.08 %	6.90	7.61 %
Special Hazardous Industries	10.67	11.77 %	10.67	11.77 %
Institutional	8.43	9.30 %	10.17	11.22 %
Open Space Recreation	0.8	0.88 %	1.20	1.32 %
Agricultural	21.70	23.94 %	4.56	5.03 %
Transportation	6.22	6.86 %	6.32	6.97 %
Non-Urban	6.01	6.63 %	6.01	6.63 %
Waterbody	4.07	4.49 %	4.07	4.49 %
Total	90.66	100 %	90.66	100%

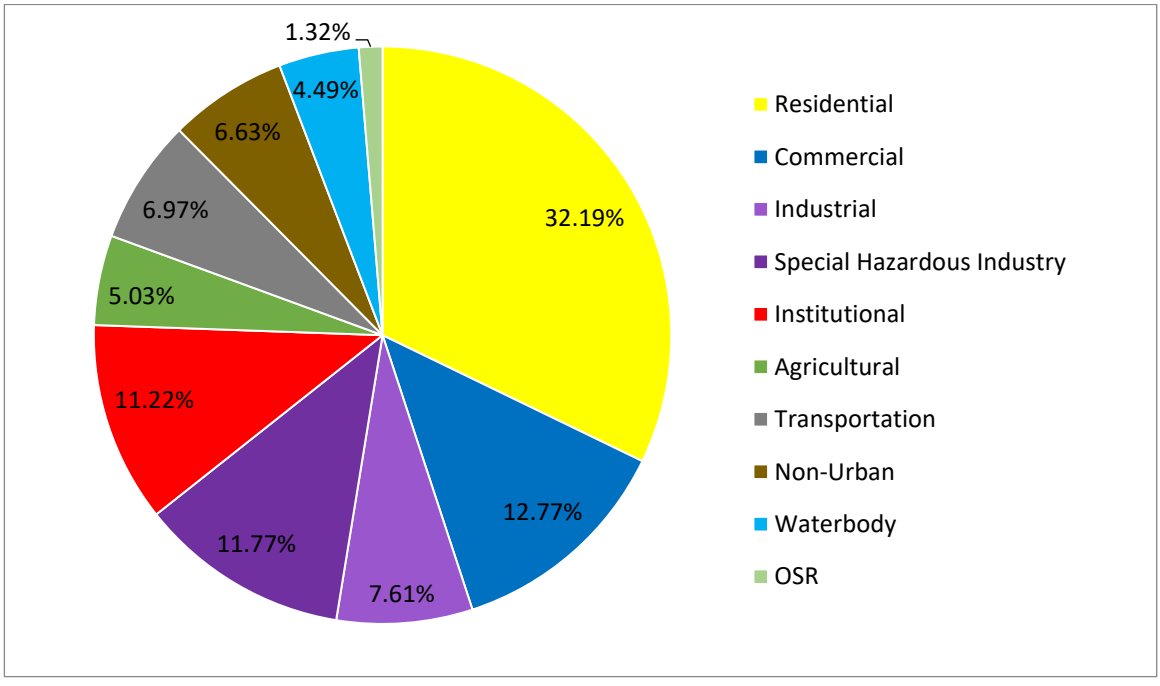
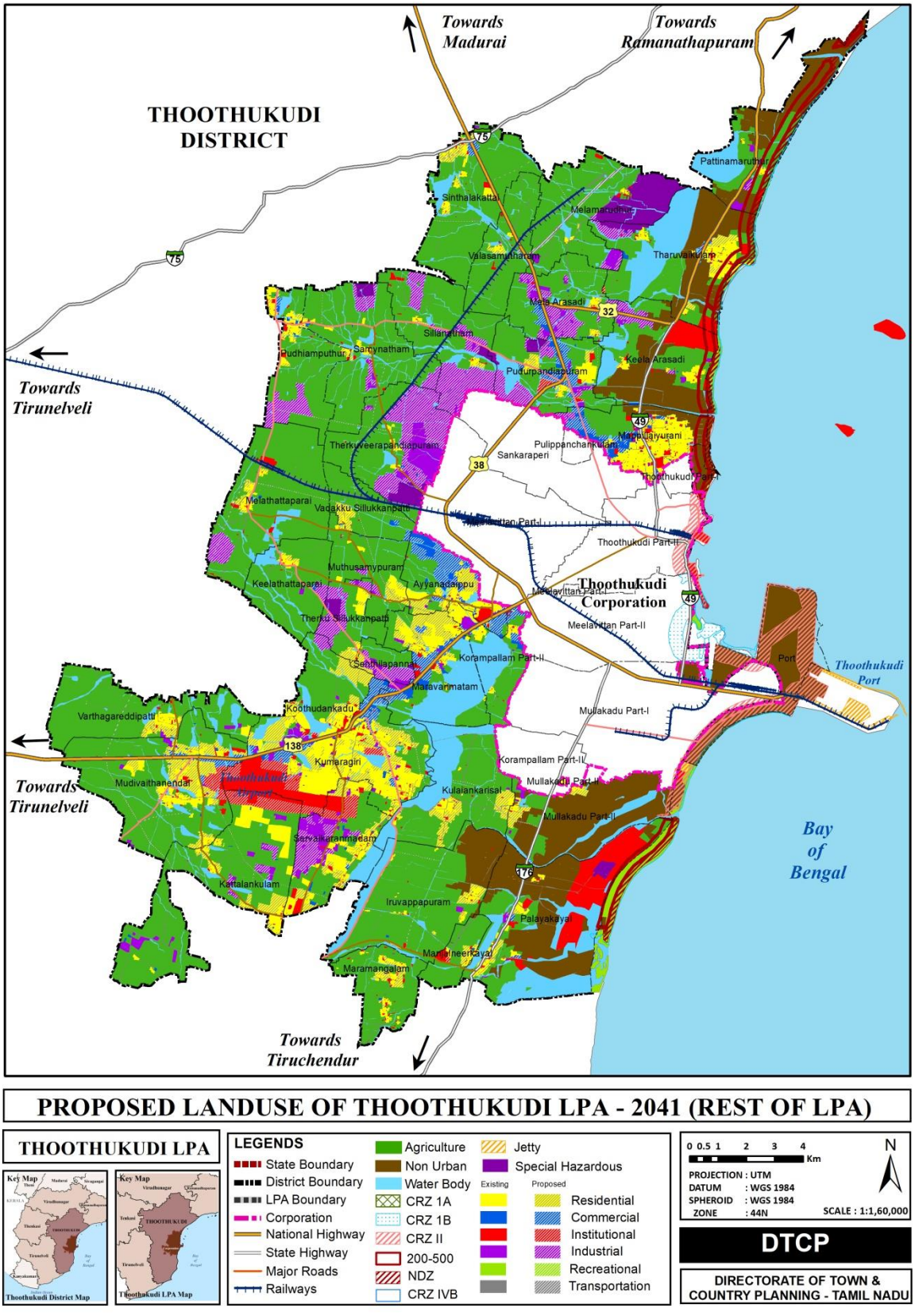


Figure 16.2 Proposed Land use Percentage of Thoothukudi Corporation

16.3 Land use plan of Rest of Thoothukudi LPA



Map 16.3: Proposed Landuse Map of Rest of Thoothukudi LPA- Master plan 2041

Table 16.3: Composition of existing and Proposed land plan- -Rest of Thoothukudi LPA

Land Use Composition of Thoothukudi -Rest of LPA				
Landuse	Existing Land Use 2021		Proposed Land Use 2041	
	Area (In Sq. Km)	% of Area	Area (In Sq. Km)	% of Area
Residential	24.37	6.53 %	41.49	11.12 %
Commercial	2.85	0.76 %	10.25	2.75 %
Industrial	6.75	1.81%	25.66	6.88 %
Special Hazardous Industries	5.55	1.49 %	5.55	1.49 %
Institutional	14.48	3.88 %	17.96	4.82 %
Open Space Recreation	0.04	0.01 %	0.13	0.03 %
Agricultural	231.67	62.12 %	182.69	48.98 %
Transportation	9.22	2.47 %	11.20	3.00 %
Non-Urban	36.63	9.82 %	36.63	9.82 %
Waterbody	41.40	11.10 %	41.40	11.10 %
Total	372.96	100 %	90.66	100%

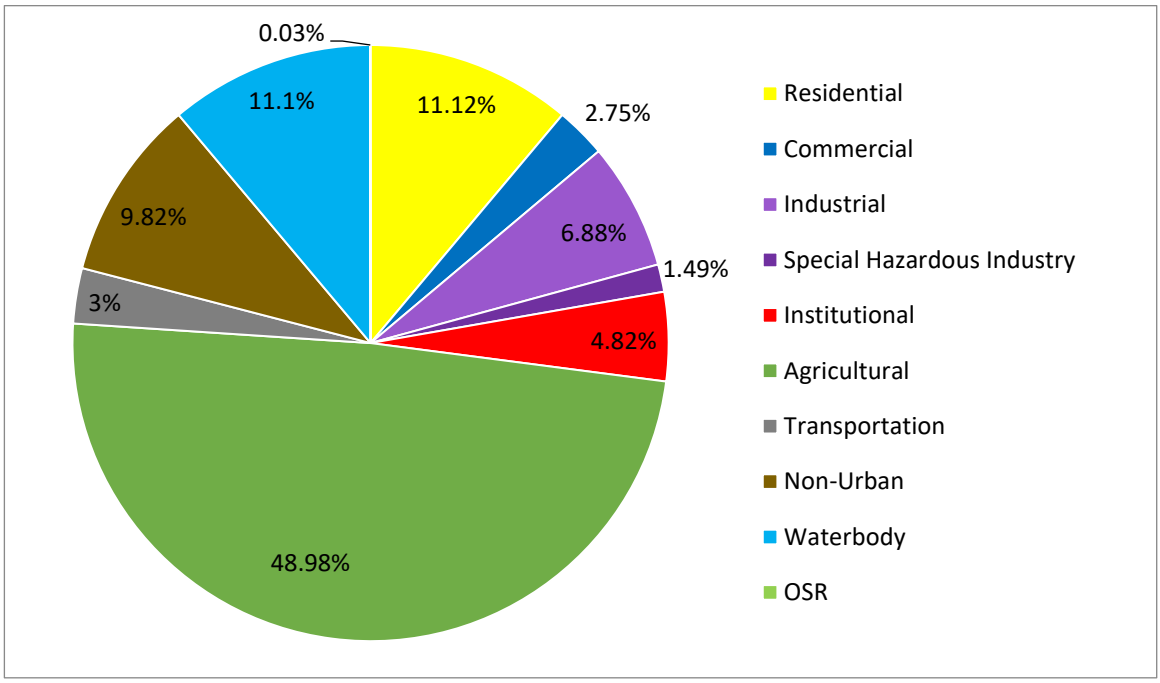


Figure 16.3 Proposed Land use Percentage of Thoothukudi (Rest of LPA)

16.4 Overview of Proposed Landuse plan of Thoothukudi LPA 2041

The overall objective of this proposed land use is to improve the economy of Thoothukudi and to cater to the future population of the LPA with its potential identified through the analysis of ground realities and based on the vision statement drawn at the project inception stage. Proposed land use zoning for Thoothukudi LPA has been prepared based on the TNCDBR, 2019. In the proposed land use 2041 of Thoothukudi LPA, land use zones are classified as Residential, Commercial, Industrial, Special Hazardous Industries, Institutional, Recreational, Agricultural, Transportation, Salt Pan, Waterbodies, and CRZ zones. Roads have also been demarcated.

16.4.1 Land Use Zone Classification

The various land use classifications given in the proposed landuse plan of Thoothukudi LPA 2041 shall be as follows:

16.4.1.1 Residential Zone

Residential zones constitute of the areas primarily designated for housing purposes, including single-family homes, apartment buildings, condominiums, and other forms of residential development

Areas earmarked as Residential Lane Use in the proposed Land Use Plan shall be considered for Residential spaces only.

16.4.1.2 Commercial Zone

Commercial Zone constitutes of the areas Zones designated for businesses and commercial activities, such as retail stores, offices, restaurants, hotels, and shopping centre.

Areas earmarked as Commercial Lane Use in the proposed Land Use Plan shall be considered for Commercial spaces only.

16.4.1.3 Industrial Zone

Industrial zone constitutes of areas intended for manufacturing, processing, warehousing, and distribution activities. Industrial zones often

accommodate heavy machinery, factories, storage facilities, and related infrastructure.

Areas earmarked as Industrial Use Zone in the proposed Land Use Plan shall be considered for Industries only.

16.4.1.4 Special Hazardous Industries:

Special Hazardous Industries zone constitutes of Specific areas designated for industries that involve hazardous materials, processes, or activities, such as chemical plants, refineries, nuclear facilities, and other high-risk industrial operations.

Areas earmarked as Special Hazardous Industrial Use Zone in the proposed Land Use Plan shall be considered for Special Hazardous Industries only.

16.4.1.5 Institutional Zone

Institutional zone constitutes of spaces dedicated to public and semi-public use such as institutions, amenities and services, including schools, hospitals, government buildings, religious institutions, and community centers.

Areas earmarked as Institutional Use Zone in the proposed Land Use Plan shall be considered for Institutions only.

16.4.1.6 Open Spaces and Recreation

Recreational spaces constitute of areas set aside for recreational activities and leisure purposes, including parks, playgrounds, open spaces, sports facilities, golf courses, beaches, and other outdoor recreational spaces etc.

Open space and recreational areas are the breathing spaces for the environment. Making sure these areas are provided adequately will ensure various benefits such as Ground water recharge, reduce carbon footprint, protect eco-system to an extent and increases the quality of life of the residents.

16.4.1.7 Agriculture Zone

Land primarily used for farming, cultivation, and agricultural production, including crop fields, orchards, vineyards, livestock grazing areas, and agricultural support structures are the spaces dedicated as Agricultural zone.

Areas earmarked as Agriculture Zone in the proposed Land Use Plan shall be considered for agriculture only.

16.4.1.8 Transportation Zone

Transportation zone constitutes of areas dedicated to transportation infrastructure and services, such as roads, highways, airports, railways, ports, and transit stations

All the roads and spaces as earmarked in the proposed Land Use Plan for Transportation shall be considered specifically for transport related facilities only.

16.4.1.9 Non-Urban

Non-urban use are Salt pan areas characterized by the extraction of salt from saline water bodies, typically through evaporation methods. Salt pans are commonly found in coastal regions and cities where seawater is abundant.

All the areas as earmarked in the proposed Land Use Plan for Salt pan shall be considered specifically for salt pan and salt manufacturing facilities only

16.4.1.10 Waterbodies Zone

Water Bodies Zone indicates all existing water bodies, i.e., Rivers, Streams, Lakes, Tanks, as indicated in the topographical sheets published by the Survey of India, the State Irrigation Department or Revenue Department or other competent authorities. The boundary of the water bodies relates to the Full Tank Level as indicated in relevant maps, covering both perennial and non-perennial parts when such distinction exists.

All the areas as earmarked in the proposed Land Use Plan for waterbodies shall be considered waterbodies and related facilities only.

16.4.2 Landuse Composition Overview for an Industrial city

Residential use: The proposed land use of Thoothukudi LPA 2041 has residential land use of 15.24% (70.67 Sq.km) of the total land area of the LPA (463.61 Sq.km). This is **less than the recommended** residential land use composition of 20%-25% for an industrial city, as per URDPFI Guidelines of 2014. This residential area proposal is based on the projected requirement for the projected population of 2041 and based on the decadal trend analysis of residential layouts and residential building approvals in the LPA.

Commercial Use: The proposed land use of Thoothukudi LPA 2041 has Commercial land use of 4.71% (21.83Sq.km) of the total land area of the LPA (463.61 Sq.km). This is ***satisfying the recommended*** commercial land use composition of 3-4% for an industrial city, as per URDPFI Guidelines of 2014.

Industrial and Special Hazardous Industrial use: The proposed land use of Thoothukudi LPA 2041 has industrial land use of 7.02% (which is around 41.32.56 Sq.km and special hazardous industrial land use of 3.50 (32.56sq.m) of the total land area of the LPA (463.61 Sq.km). This ***is way less than the recommended*** Industrial land use composition of 30-35% for an industrial city, as per URDPFI Guidelines of 2014. Industrial land use has been proposed along the NH-138 and NH-38.

Institutional use: The proposed land use of Thoothukudi LPA 2041 has institutional land use of 6.35% (29.46 sq.km) of the total land area of the LPA (463.61 Sq.km). This slightly ***satisfies the recommended*** institutional land use composition of 6-8% for an industrial city, as per URDPFI Guidelines of 2014.

Transportational use: The proposed land use of Thoothukudi LPA 2041 has transportation land use of 3.78% (17.52 sq.km) only, out of the total land area of the LPA (463.61 Sq.km). This ***does not satisfy the recommended*** recreational land use composition of 10-12% for an industrial city, as per URDPFI Guidelines

of 2014. New proposals of transportation and related facilities are proposed along the National hights of NH-138 and NH-38

16.5 Land use recommendations

To develop Thoothukudi as envisioned for 2041, the proposals in the previous sections along with few further recommendations must be considered as outlines in the following section:

i. **Industries near Waterbodies**: It has been determined that industrial activities situated in proximity to existing water bodies may pose a threat to the natural ecology if precautionary measures are not implemented. Reforms 7 and 8 of the Supplementary Guidelines, issued by the Ministry of Finance, Department of Environment, Government of India, dated June 19, 2023, explicitly emphasize the significance of conserving urban ecosystems through effective urban planning. Therefore, only environmentally supportive industries that contribute to ecological enhancement and are non-polluting should be authorized within industrial zones adjacent to waterways.

   Consistent with this objective, there is a necessity to further categorize industrial land use into special hazardous industrial utilization and industrial (general) utilization as proposed in the Landuse plan of Thoothukudi LPA 2041. This classification aids in safeguarding the current natural ecosystem.

   All industries are required to adhere to CPCB regulations regarding the treatment of effluent they produce. For small and medium-sized industries, the development of Common Effluent Treatment Plants (CETP) infrastructure should be carefully planned. Extra attention should be given in cases where treated effluent is discharged into water bodies.

ii. **Flood Resilience:** In the context of flood resilience recommendations in Thoothukudi, especially for the Buckle Canal area and Korampalla channel, the vulnerability analysis for the region should be undertaken and high to medium vulnerability regions along the waterbodies necessitate strategic planning measures. It is recommended to designate high vulnerability areas for agricultural zones, public open spaces, and recreational uses to mitigate potential flood impacts.

Furthermore, detailed development plans should prioritize high-sensitive locations to minimize damage during calamities. Preserving existing water bodies, restoring drainage networks, and implementing diligent solid waste management practices are essential. These measures not only prevent waterway blockages but also harness the traditional irrigation system for flood prevention and agricultural development. Careful consideration must be given to transport network planning to avoid bifurcation of water bodies, and contingency mechanisms should be established to maintain natural drainage integrity even in unavoidable circumstances.

iii. **Recreational pockets:** Given the severe lack of recreational areas and parks in Thoothukudi, it is imperative to incentivize upcoming residential developments to allocate more open spaces in accordance with regulations. Utilizing existing water bodies for recreational purposes not only preserves them but also offers city residents much-needed opportunities for relaxation, thereby enhancing overall quality of life within the LPA.

iv. **Integrated planning:** To foster social cohesion within the community, residential sectors comprising informal settlements, low-income groups, managerial staff, and pockets of high-income residents shall be strategically integrated. This planning aims to minimize conflicts and promote social and economic interaction among residents. Specifically, areas designated for low-income housing shall be situated

near industrial and commercial zones to facilitate convenient mobility and alleviate strain on public transportation systems.

Public transportation shall primarily target integration of residential area s with industrial zone

v. **Greenfield Industries:** In the case of new industrial sites / Greenfield industries, expansion plans for existing hamlets and small settlements shall be subject to buffer zones overseen by the respective authorities. These buffers, to be delineated on the development plan following an assessment of induced growth rates, shall be designated for recreational, livestock support, and social infrastructure purposes for the benefit of the hamlets. Similarly, buffers along rivers in industrial areas shall be safeguarded against water pollution by permitting riverfront developments with recreational activities, while prohibiting permanent structures.

17 BLOCK COSTING

Block costing is a method used in preparing cost estimates for proposals, in master plans or urban development projects. It involves breaking down the overall project into smaller "blocks" or segments, each representing a distinct category or phase of work—such as infrastructure development, transportation, housing, utilities, and public amenities.

It helps to understand the financial implications of various development strategies, allocate budgets effectively, and prioritize investments. Its goal is to provide a comprehensive cost framework that aligns with the town's development goals.

17.1 Sector wise Block Costing

The proposals have been arrived as a result of the analysis from various sectors in the Chapters 5 to Chapter 14. The block cost for the proposals following under the sectors

- Economy
- Transportation
- Physical Infrastructure
- Social Infrastructure
- Environment have been worked out and the summary of the block cost is phased for the span of 20 years in the upcoming sections of this chapter.

17.1.1 Block Cost for Economic Proposal

Table 17.1 Block Cost – Economic Proposal

S No	Proposal	Quantity	Cost of Private Land (INR Crores)	Development Cost (INR Crores)	Total Cost (INR Crores)
Economic Proposals					
1.	SIDCO Industrial Layout (in ha)	21	Government Land	38	38
2.	Integrated Salt Processing Centre and Museum (in ha)	18.6	Government Land	45	45
3.	Ferry Service – Tharuvaikulam and Vhan Island (in ha)	4.85	0.2	40	40.2
	Total		0.2	123	123.2

17.1.2 Block Cost for Transportation Proposal

Table 17.2 Block Cost – Transportation Proposals

S No	Proposal	Quantity	Cost of Private Land (INR Crores)	Development Cost (INR Crores)	Total Cost (INR Crores)
Mobility Proposals					
1.	A1- Palayakayal to Milavitan (in Km)	35.39Km(60ft) 0.65 sq.km	0.2	0.72	0.92
2.	A2- Palayakayal to Pudukottai (Kumaragiri) (in Km)	8.4 Km(60ft) 0.15 sq.km	0.2	0.17	0.37
3.	A3- Thoothukudi (NH38) to Manjanirkayal (in Km)	12.72 km (40ft) 0.16	0.2	0.17	0.37
4.	A4- Vagaikulam to Kadodipannai (in Km)	8.45 km (40ft) 0.10 sq.km	0.2	0.11	0.31
5.	A5- Pudhiyamputhur to Kurukkuchalai (in Km)	9.2 km (60ft) 0.17 sq.km	0.2	0.19	0.39

6.	A6- Swaminatham to Maravanmadam (in Km)	13.24km (60 ft) 0.24 sq.km	0.2	0.27	0.47
7.	A7- Pudhiyamputhur to Therku Veerapandiyapuram (in Km)	7.6 km (60ft) 0.14 sq.km	0.2	0.15	0.35
8.	Junction Improvements (in Nos)	4	Government Land	2	2
9.	Truck Terminal (in Ha)	11 Acres	0.2	15	15.2
	Truck Terminal (in Ha)	75 Acres	Private	102	102
10.	Railway Gate-4 Flyover (in Nos)	1	0.2	50	50.2
	Total		1.6	170.78	172.58

17.1.3 Block Cost for Physical Infrastructure Proposal

Table 17.3 Block Cost – Physical Infrastucture Proposal

S No	Proposal	Quantity	Cost of Private Land (INR Crores)	Development Cost (INR Crores)	Total Cost (INR Crores)
Physical Infrastructure Proposals					
1.	Over Head Tank (OHT) (in ML)	17.42	Government Land	5.22	5.22
2.	Sewage Treatment Plant (STP) (in ML)	60.97	Government Land	105.47	105.47
3.	MCC (in MT)	164	Government Land	3.15	3.15
4.	Storm water Drain (30.76%) (in m)	429	0.85	364.65	365.5
5.	Electricity - Sub-Station (13 Nos) (in Ha)	0.65	0.2	12	12.2
	Total		1.05	490.49	491.54

17.1.4 Block Cost for Social Infrastructure Proposal

Table 17.4 Block Costing - Social Infrastructure Proposal

S No	Proposal	Quantity	Cost of Private Land (INR Crores)	Development Cost (INR Crores)	Total Cost (INR Crores)
Social Infrastructure Proposals					
1.	Higher Secondary School (6 Nos) (Area in Ha)	10.64	Government Land	20	20
2.	Primary Health Centre (5 Nos) (Area in Ha)	2.15	Government Land	2.5	2.5
3.	Fire Station (1 No) (Area in Ha)	1	Government Land	1	1
	Total			23.50	23.50

17.1.5 Block Cost for Environmental – Blue-Green Infrastructure Proposal

Table 17.5 Block Cost – Environmental Proposal

S No	Proposal	Quantity	Cost of Private Land (INR Crores)	Development Cost (INR Crores)	Total Cost (INR Crores)
Environmental Proposals					
1.	Restoration of Abandoned Quarries to Quarry Lakes with Floating Solar Plants (in Ha)	91 Ha	Government	6.5	6.5
2.	Bird Observatory Deck (in Ha)	9.4 Ha	0.2	1.2	1.4
3.	Urban Forestry (in Ha)	1	Government	0.1	0.1
	Total		0.2	7.8	8.0

17.2 Summary of Block Costing

Table 17.6 Block Costing

S No	Proposal	Cost of Private Land (INR Crores)	Development Cost (INR Crores)	Total Cost (INR Crores)
1.	Economic Proposal	0.2	123	123.2
2.	Mobility & Transportation	1.6	170.78	172.58
3.	Physical Infrastructure	1.05	490.49	491.54
4.	Social Infrastructure	-	23.50	23.50
5.	Environment	0.2	7.8	8.0
	Total	3.05	815.57	818.82

17.3 Phasing Cost Summary – 5 Years

Table 17.7Phasing of Block Cost

S.No	Phasing Year	Cost INR (Crores)
1.	FY 2023-2028	327.52
2.	FY 2028-2033	204.70
3.	FY 2033-2038	204.70
4.	FY 2038-2041	81.88
	Total	818.82

Directorate of Town and Country Planning
Government of Tamil Nadu

THOOTHUKUDI LOCAL PLANNING AREA