WATER BUS

Kochi Metro Rail Limited

Integrated Water Transport System for Kochi



Detailed Project Report

November 2015



Urban Mass Transit Company Limited

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Abbreviations

CDIA	-	Cities Development Initiative for Asia
CIAL	-	Cochin International Airport Limited
CNG	-	Compressed Natural Gas
CoC	-	Corporation of Cochin
CRZ	-	Coastal Regulation Zone
CUSAT	-	Cochin University of Science and Technology
DPR	-	Detailed Project Report
DSCR	-	Debt Service Coverage Ratio
EA	-	Environmental Assessment
EIRR	-	Economic Internal Rate of Return
FIRR	-	Financial Internal Rate of Return
FSI	-	Floor Space Index
GCDA	-	Greater Cochin Development Authority/Area
GDP	-	Gross Domestic Product
GIDA	-	Goshree Island Development Authority
GPS	-	Global Positioning System
HASS	-	Hub and spoke system
IPT	-	Integrated Public Transport
IRC	-	Indian Road Congress
IWAI	-	Inland Waterways Authority
IWT	-	Inland Water Transport
JnNURM	-	Jawahar Lal Nehru Urban Renewal Mission
KCR	-	Kochi City Region
KfW	-	Kreditanstalt für Wiederaufbau
KMRL	-	Kochi Metro Rail Limited
KSINC	-	Kerala Shipping and Inland Navigation Corporation
KSRTC	-	Kerala State Road Transport Corporation
KSWTD	-	Kerala State Water Transport Department
KURTC	-	Kerala Urban Road Transport Corporation
kW	-	Kilo Watt
LNG	-	Liquefied Natural gas
MCS	-	Master Clock System
MTA-Kochi	-	Metropolitan Transportation Authority - Kochi
NASSCOM	-	National Association of Software and Services Companies
NH	-	National Highway
NUTP	-	National Urban Transport Policy
OCC	-	Operation Control Centre
PAS	-	Passengers Announcement System
PHPDT	-	Peak hour peak direction trips
PIDS	-	Passenger Information Display System
PIS	-	Passenger Information System
PIU	-	Project Implementation Unit

Pph	-	Persons per hectare (Unit of Density)
SA	-	Social Assessment
SH	-	State Highway
SPV	-	Special Purpose Vehicle
TAZ	-	Traffic Analysis Zone
URDPFI	-	Urban and Regional Development Plans Formulation and Implementation (guidelines)
VICT	-	Vallarpadom International Container Terminal
WPR	-	Workforce Participation Rate

Preface

With cities growing exponentially and the limited available road space getting choked with the equally increasing private vehicles, the cities across the globe are forced to adopt the more sustainable mass public transport options such as metro rail systems, bus rapid transit systems etc. Another option the cities have is to return to their traditional modes of mobility such as the waterways in the state of Kerala, especially the city of Kochi. Globally the cities with waterfronts have invested and developed with rigour and maintained their passenger water borne transport systems and are constantly upgrading the system. Kochi, with the proposed seventy eight catamaran type boat fleet and about thirty eight jetties or piers, shall only be the second largest water transport system for passengers after Venice, where ACTV is the major operator. London River Services (TfL) has prepared the River Action Plan which included better promotion of the river, better information and integration, increased coordination and partnerships and better piers. This strategy already allowed a high increase in passenger numbers (15% increase in 2014-2015) and the target of doubling passenger numbers by 2020 will most probably be reached before.

Flanked by the Arabian Sea on the west, Kochi, is a major port city on the west coast of the Indian Peninsula and also one of the most densely populated city in the state of Kerala and has witnessed substantial economic investment and growth in the last decade. To cater to the growing mobility needs of the resident population as well as the floating population which includes the workforce and tourists coming to the city, Kochi Metro project is being implemented by Kochi Metro Rail Limited (KMRL). The Metropolitan Transportation Authority (MTA-KOCHI) with the objective of developing a seamless multi-modal transportation system in the Kochi City Region is keen on developing a sustainable Integrated Water Transportation System for Kochi city, meeting the people's expectations as per international standards. The system aims to integrate with the Kochi metro network, the city buses, feeder modes as well as non-motorised modes of transport over a period of time with an integrated fare and integrated timetable. The ongoing implementation of automatic fare collection and on-board Smart Card Ticketing on the metro system is also planned to be extended to the water transport system as a common mobility card.

With waterfronts and urban and property developments being developed around embankments, waterways represent new available spaces for mobility. It is for cities on water an excellent potential to use available spaces without requiring investing in big infrastructures and many cities are developing or re-developing a waterborne public transport network to offer additional mobility services to citizens and tourists. Although generally very appreciated by travellers as it is comfortable, attractive, safe and reliable, it needs a good integration with the public transport network to be successful.

Kochi Metro Rail Limited is already undertaking studies and projects on Integrated Public Transport Solutions, Non-Motorised Transport and Bicycle Sharing Schemes and Mobility Plan and Parking Plan for the region. These studies shall ensure connecting the ferry services

with other means of public transport. One focus will be how to merge the different networks of public transport (Metro - Ferry Services - Bus Network) at the main intersections (e.g. Ernakulam Jetty – Maharaja Metro Station). The safe transfer of the passengers within the intersections (e.g. elevated walkways) should be brought into focus as well. Seamless integration of alternative means of transport without interruption on the main traffic routes would relieve the road traffic as well.

Operational sustainability is also a critical aspect of the system, with evident examples from systems in cities like Venice, Stockholm and Bordeaux. The project proposed in Kochi a total capital investment of about Rs. 820 crore, is likely to be funded by the German Development Bank, KfW, which has shown keen interest in funding about 80% of the project cost. The Detailed Project Report prepared herein aims at a seamless, sustainable and integrated water transport system. The proposed project has the strong political vision and support from the Govt. of Kerala. The feedback and suggestions from the State Planning Board and the Dept. of Finance have been duly considered and incorporated appropriately.

The integrated water transport project for Kochi progresses with the vision;

"Connecting People, Connecting Destinations, Connecting Opportunities"

Executive Summary

Kochi is a major port city on the west coast of the Indian Peninsula and also one of the most densely populated city in the state of Kerala. In the past decade, Kochi has witnessed an increased economic growth with improved investments in projects such as Vallarpadom International Container Terminal (VICT), port based Special Economic Zone and Industrial parks like Smart City, Info Park etc. All these strategic investments have given a boost to the regional economy and employment.

Project Area Profile

Flanked by the Arabian Sea on the west, the city (corporation area: 94.88 sq.km, population: 6.02 lakh) has sprawled beyond the corporation limits along the NH-47, NH-17 and NH-49 inspite of the city indicating a declining population growth rate. The Greater Cochin Development Area covering the islands spreads across an area of 630 sq.km. and a population of 21.2 lakh (Census of India, 2011). The census data of past few decades indicates that the growth rates of surrounding municipalities and villages have been higher as compared to the city core and thus the need to improve connectivity between the mainland and the adjoining municipalities, island communities and Panchayat areas. Various traffic and transportation studies have indicated increased investment focus on road connectivity including bridges that connect the islands such as Fort Kochi, Wellington, Vypeen, Bolghatty etc. The studies also highlight the growing number of automobiles in the city region whereas the much affordable public transport share has remained stagnant and inadequate, although public transport still has a 51% modal share in the city. To cater to the increasing travel demand of the city and to encourage a shift from private modes to public transit, Kochi Metro is being implemented along a 25.61 km corridor from Aluva to Petta with twenty-two (22) stations.

Kochi Metro Rail Limited (KMRL) in line with the directives of the Ministry of Urban Development, Government of India has spearheaded the task of setting up the Metropolitan Transportation Authority (MTA-KOCHI) with the objective of developing a seamless multi-modal transportation system in the Kochi City Region. As part of its initiatives, MTA-KOCHI is keen on developing a sustainable Integrated Water Transportation System for Kochi city, meeting the people's expectations as per international standards and aims to integrate the system with the other modes of transport including the metro system over a period of time with an integrated fare and integrated timetable.

Project Rationale

In the present transportation scenario, with the ferries having the average trip length of 8.9 km as compared to the average trip length of 11.3 km for public transport in general, the significance of the system for people's commute between the islands and the mainland is only further justified. Currently the State Water Transport Department is the main operator in the water transport system in Kochi besides the various private operators and the localised jangar services. Ferry services are operational between Ernakulam mainland, Fort

Kochi, Vypeen, Mattancherry, Embarkation, Bolghatty, Mulavukadu, High Court, Vytilla, Eroor and Kakkanad jetties. Other jetties such as Nettoor, Edakochi, Kumbhalam, Pizhala, Moolampilly, Thanthonithuruth etc are served by private ferry services and jangars. However, the system has been deteriorating over the last few decades owing to depleting boat numbers, low quality of boats, lack of safety measures, lack of reliability and poor access infrastructure to the jetties. The system has seen minimal investment in the system and technology upgradation.

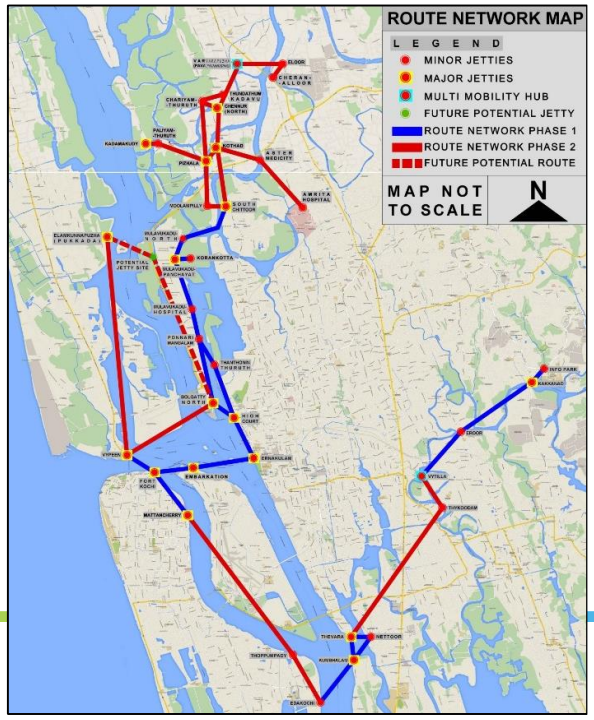
Primary surveys carried out during early 2015, indicate a daily ridership of 20,106 on the existing system. The surveys also revealed that 81.36% of the ferry passengers interviewed use the ferry services operated in Kochi on a daily basis, while 41% of the ferry passengers constituting of students, unemployed and housewives, do not own vehicles and use bus based transport as an alternative mode. These may be termed as captive users of public transport system especially ferries. Also, it was observed that majority of the ferry users (53%) access the water transport system i.e. jetties by walk thereby emphasising on the need for a good access infrastructure to the transit stops. The willingness to shift surveys indicate that 72% of the respondents are willing to shift to water transport as a mode of travel if there is an assured saving in travel time of upto 15 minutes in comparison to their current mode of travel and 75% of the respondents are willing to shift, if there is a considerable saving time. Willingness to pay surveys revealed that 54% of the respondents want the same fare as existing to be retained for the improved water based transit system. Similar response was also observed in case of ferry passengers interviewed.

Technical Description and Aspects

The Concept: One Island One Boat Hub

Based on the various stakeholders consultations, focus group discussions, numerous site visits on existing routes as well as existing and potential jetty locations, an Integrated Water Transport System for Kochi city has been proposed with a vision to connect the mainland with all the islands in the MTA-Kochi area, reviving the sustainable traditional mode of public transportation. The system is proposed to be planned on the concept of *"One Island One Boat Hub"* model thereby increasing the coverage of the water transport services. It is envisioned as a user oriented and socially inclusive transport system than being just a point to point service. It is also part of a bigger concept of seamless integration outlined for the city integrating the water

Identified Routes for Integrated Water Transport System for Kochi



transport system, metro system, city bus services, and feeder services alongwith improvised access by non-motorised transport infrastructure.

Estimated Ridership and Routes

The proposed project recommends sixteen (16) identified routes connecting thirty eight (38) jetties across ten (10) island communities across 76km route network. The identified routes and jetties are as given in the table below and represented in the figure. Of the 38 jetties, eighteen (18) are proposed to be developed as major jetties or main boat hubs while the remaining twenty (20) jetties shall be developed as minor jetties for water transit services. Part of the identified 76 km and the areas around the jetty locations shall require dredging in order to maintain a minimum desirable clearance.

Identified Routes for Integrated Water Transport System for Kochi

Route No.	Origin	Destination	Route Description	Route Length (km)
1	South Chittoor	Ernakulam	South Chittoor, Mulavukadu Panchayat, Poonarimangalam, Thanthoninthuruth	8.2
2	Edakochi	Thevara	Edakochi, Kumbhalam, Thevara	3.74
3	Ernakulam	Vypeen	Ernakulam, Embarkation Jetty, Fort Kochi, Vypeen	6.4
4	Ernakulam	Mattancherry	Ernakulam, Embarkation, Fort Kochi, Mattancherry	6.1
5	High Court	Mulavukadu	High Court, Bolgatty, Thanthoninthuruth, Poonarimangalam. Mulavukadu Panchayat, Mulavukadu Hospital, Korrankota, Mulavukadu North	11
6	Vytilla	Info Park	Vytilla, Eroor, Kakkanad & Info Park	8
7	Kumbhalam	Thevara	Kumbhalam, Nettoor, Thevara	4
8	Info Park	Edakochi	Info Park, Vytilla, Kakkanad, Thykoodam, Thevara, Kumbhalam, Edakochi	12.6
9	Mulavukadu	South Chittoor	Mulavukadu Panchayat, Moolampilly, Pizhala, Kothad, South Chittoor	8
10	Edakochi	Vypeen	Edakochi, Thoppumpady, Mattancherry, Fort Kochi Vypeen	13.6
11	South Chittoor	Cheranalloor	South Chittoor, Moolampilly, Pizhala, Kothad, Chennur, Varapuzha, Eloor & Cheranallur	6
12	Elamkunnapuzha	High Court	Elamkunnapuzha - Mulavukadu West, Bolgatty, High Court	15

Route No.	Origin	Destination	Route Description	Route Length (km)
13	Kadamakudy	Paliyamthuruth	Kadamakkudy- Paliyam Thuruth (Pizhala Island) - Korhad	6
14	Chennur	Thundathumkadavu	Chennur North-Chariyam Thuruth North-Thundathum Kadav.	3
15	Chariyamthuruth	Chennur	Chariyam Thuruth South- Pizhala Hospital - Chennur South	3
16	Kothad	Amrita Hospital	Kothad - Medicity Hospital-Amrita Hospital.	3

The routes are expected to cater to an induced demand of 34,286 daily ridership in 2016, with the introduction of new boats and an organised and reliable system of operation. The daily ridership is estimated to increase to 40,316 by 2019; 53,592 by 2025 and 86,112 by 2035 with a potential to increase upto 1,50,000 in case of optimistic scenario.

Boat Technology

Two variants of air-conditioned and wi-fi enabled glass reinforced plastic (GRP) catamaran passenger ferries with passenger capacity of 50 and 100 respectively are recommended. The boats with diesel electric hybrid based propulsion system (electric propulsion through Permanent Magnet Synchronous (PMS) Motors with VVVF technology) are recommended to operate at an optimal speed of 8 knots, with the potential to increase upto 12 knots, once the recommended dedicated water transit corridor is established. The boats shall be powered by combination of twin diesel electric generators and electric motors for propulsion.

Specification	Passenger Capacity	
	50 pax	100 pax
Length Overall	15 m	20 m
Breadth Overall	6 m	7 m
Depth	1.5 m	1.7m
Draft	0.9 m	0.9m

Fleet Estimation

The entire water transport project is proposed to be fully operationalised by 2019. Based on the demand, the identified 16 routes have been prioritised under Phase I and Phase II. During the phase I (2016-17), it is proposed to operate 7 routes with a fleet requirement of 43 boats while in Phase II (2018-19), it is proposed to operate all the identified 16 routes (7 routes of Phase I and 9 routes of Phase II) with a total fleet requirement of 78 boats. The headways shall vary between 10 minutes to 20 minutes across various routes. However, it is also expected that there is a sudden surge in the ridership demand owing to an improved system, hence it is recommended that the demand assessment be carried out every year/periodically.

Core Water Transport Infrastructure

The major and minor jetties or piers are proposed to have floating pontoons with state of the art automatic docking system technology. The floating pontoons are recommended to be covered with roof/re-traceable sheds so as to provide passenger comfort during rainy season. As part of the infratsructure for water transport project, two boatyards are proposed, one each at Thevara and Pizhala. Intelligent Navigation System and Operation Control Centre (OCC) are also proposed and are recommended to be integrated with the city's intelligent transportatation system. The Automatic Fare Collection system being implemented by the Kochi Metro is recommended to be extended to water transport system using the on-board/smart card ticketing system.

Seamless Integration and Allied/Ancillary Infrastructure

The water transport system envisaged for Kochi focuses not only on the ferry services as the mode for public transportation but also envisions a holistic development of the areas being connected by waterways as well as integrating the waterway system as a part of the entire public transport system of the city. Apart from the ferry service development, the project also recommends i) developing existing and new access roads providing increased accessibility to the jetties and also enhanced mobility within the islands; ii) infrastructure for ensuring safety and security to all its users by way of active and well lit streets, CCTV cameras; iii) promoting use of small occupancy feeder modes such as mini/midi feeder buses and electric rickshaws to access the jetties; and iv) promoting property development around the jetties and place making. Non-motorised transport infrastructure, facilities and infrastructure enabling smooth disabled friendly mobility, public bicycle sharing schemes including development of bicycle docking stations are also recommended at all the jetty locations.

Kochi Metro Rail Limited is already undertaking studies and projects on Integrated Public Transport Solutions, Non-Motorised Transport and Bicycle Sharing Schemes and Mobility Plan and Parking Plan for the region. These studies shall ensure connecting the ferry services with other means of public transport. One focus will be how to merge the different networks of public transport (Metro - Ferry Services - Bus Network) at the main intersections (e.g. Ernakulam Jetty – Maharaja Metro Station). The safe transfer of the passengers within the intersections (e.g. elevated walkways) should be brought into focus as well. Seamless integration of alternative means of transport without interruption on the main traffic routes would relieve the road traffic as well.

The major jetties or the main boat hubs shall be developed as economic centres with commercial property development upto an extent of 1 acre and developing wi-fi enabled social recreational opportunities around the jetty locations. Tourism is also proposed to be promoted as part of the project.

Proposed Fare Structure

Based on the various discussions with the stakeholders, detailed sensitivity analysis between the demand and fare, and fare comparison between the existing bus based public transport and water transport, the minimum fare proposed is Rs 6 for origin stop to first intermediate stop and thereafter the fare shall increase by Rs 2 for every stop till the final destination.

Project Investment Proposal

Capital Expenditure

The project is estimated to cost Rs. 747.28 crores (refer table below) with core water transport infrastructure estimated at Rs. 435.37 crores. In order to encourage private sector participation in the project and reduce burden on the government, it is proposed that one third of the boats are acquired and owned by the private sector participants in the project and balance two-thirds of the boats and 100% of the jetty and other infrastructure costs be funded by the Government SPV, under a suitable business model as decided by the project SPV. The funding to be provided by private sector is thus estimated at Rs. 65.47 crore. Thus the total capital outflow is expected to be RS.681 crores.

Capital Cost Estimation (₹ Crore)

Component Description	Phase I	Phase II	Total
A) Direct Infrastructure Costs			
Jetty Infrastructure Cost	62.00	40.89	102.89
Provision for Boat Yard	10.00	5.00	15.00
Dredging of Waterways	10.00	15.00	25.00
Commercial Complex	30.63	16.81	47.44
Investment on Inland Navigation System & OCC	9.70	5.60	15.30
Total Civil Infrastructure Cost	122.33	83.30	205.63
Cost of Boats	109.59	86.22	195.81
Soft Costs			
Set up/start up/development costs (2%)	4.62	3.39	8.03
Contingency 5% on Sub Total	11.83	8.65	20.47
Interest During Construction	3.23	2.20	5.44
Total	**251.61**	**183.76**	**435.37**
B) Ancillary Infrastructure			
Development of Access roads/island roads/non-motorised transport	161		161
Development of Electric Feeders, Bicycle Sharing and Walkways with travelators	130.51		130.51
Setup/start up/development cost (2%) + Contingency (5%) on B	**20.40**		**20.40**
Sub-Total	**311.91**		**311.91**
Grand Total			**747.28**
Project Cost Excluding 1/3 quantity of boats			**681**

In case of land acquisition, the project cost shall include an additional estimated Rs. 72 crore towards acquisition with the total project cost at an estimated Rs. 819.28 crore. Since the ownership of the majority of the land where existing jetties are located and the land adjacent to these jetties, is with the urban local bodies such as the corporation and the panchayats or other state departments, it is recommended that KMRL takes the required land for jetty and allied infrastructure development on lease (90 years) from the panchayats and other local bodies and invests in development of the land. In case of its inclusion in the project cost, the state government may contribute to the cost in totality.

As per the funding norms of multilateral agencies, the debt component in the project can be up to 80% of the project cost. However, no part of such funds can be used to fund land acquisition costs and taxes. Thus a sum of Rs. 589.71 crore (77%) is proposed to be obtained as soft loans from multilaterals after accounting for land acquisition costs (Rs. 72 crore) and taxes (Rs. 102.3 crore) which need to be funded by the Government.

Financial and Economic Analysis

The water transportation project has considerable potential to become a self-sustainable ecosystem while integration of all modes of transport within Kochi city is implemented along with adequate improvements in the areas pertaining to accessibility and last mile connectivity on islands, complemented with property developments at each boat jetty, and recasting them to economic centres of each island. While considering all the above characteristics along with projected ridership assessments and operation and maintenance costs, the Project IRR (pre-tax) for the water transport project per se is estimated at 1.4%. Further, without considering the civil infrastructure and ancillary costs, the pre-tax Project IRR for the capex for boats and their operation and maintenance works out to 10.4%. Hence, the project is expected to be operationally self-sustainable.

Considering the overall impact that the proposed system will have on the livelihoods on the people directly and indirectly including the savings in commuting costs and travel times, the Economic Internal Rate of Return is 26.1% with a Benefit Cost ratio of 2.06.

Impact Assessment

Kochi waterways as part of the city environment and now proposed to be catering to the new integrated water transport system, shall be prone to environmental impact on the aquatic flora and fauna. The impact is expected to be of varying degree during all the phases of the project. Hence it is important that during the pre-construction, construction as well as the operations phase, adequate mitigation measures are adopted to minimise these impacts. Despite having a much improved propulsion technology, the water transport project shall still have impact on the water and air environment. The re-development of old jetties/piers and construction of new piers is also expected to have an impact on the environment and these should be mitigated. A preliminary screening study has been conducted, while the impact of the project on the environment system is recommended to

be evaluated by conducting a detailed environmental impact assessment for the proposed system.

Besides the above impacts, the system is also expected to have social impacts on the livelihoods of the people active in the waterways for various livelihood activities as well as the economic livelihood of the island communities who rely on the mainland for various activities and purposes. Impact on the resident communities in terms of education and health facilitation is also envisaged. As the project recommends holistic all round development of the islands enhancing overall access, and economic activities, it is also expected to enhance the social quality of life of the people. Project components such as commercial development and placemaking are expected to contribute to the communities. Women currently comprise of only 27% of the water transport user group and the primary reasons for not using the system are lack of safe and secure access, lack of reliability of services etc. As the project envisions provision of these services, it is expected to contribute to opportunities for women to access a safe public transport and use to it to emancipate their social and economic rights. The project is also aimed at tourism development on the islands as well as the waterways which is likely to change the overall growth scenario of the city region.

Preliminary social aspects have been reviewed in the screening report, and it is recommended to conduct the detailed social assessment of the proposed water transportation project assessing the impact of the system on the social environments.

Project Implementation Framework

As discussed earlier, the project is proposed to be fully operationalised by end of 2019. Recognising the impact that the project would have on the livelihood of the people as well as on energy consumption and reduced emissions besides promoting integrated public transport, the project is recommended for funding by international funding agencies. It is recommended that Kochi Metro Rail Limited is appointed as the nodal agency for project implementation by establishing a vertical focussed on Water Transport Operations named “Metro Aqua”. The vertical may be headed by a General Manager (Metro Aqua) under the guidance of the Director (Systems). It is recommended that a Steering Committee be formed with the Managing Director, KMRL as the Convener and the committee shall advice and guide Kochi Metro Rail Limited on the operations and functioning of the Water Transport System as a part of the Integrated Public Transport System in Kochi. It shall coordinate with the Metropolitan Transport Authority - Kochi (MTA-KOCHI) to ensure integration.

1 Introduction

1.1 Background

Kochi is a major port city on the west coast of the Indian Peninsula and also one of the most densely populated city in the state of Kerala. In the past decade, Kochi has witnessed an increased economic growth with improved investments in projects such as Vallarpadom International Container Terminal (VICT), port based Special Economic Zone and Industrial parks like Smart City, Info Park etc. All these strategic investments have given a boost to the regional economy and employment. Many more projects have been proposed in the Kochi city and region, some of them being of national importance, with an objective of further encouraging the regional economy.

A significant share of the region's economy includes tertiary sector activities like IT industries, gold, textile, retail, export of sea food and spices, tourism and allied services, health services, banking, fishing and allied activities.

Since Kochi is flanked by Arabian Sea towards the west, the growth and development has been predominantly towards the main land along the NH-47, NH-17 and NH-49. Over the years, the urban form has extended beyond the city corporation limits and has sprawled into the immediate influence region. The census data of past few decades indicates that the growth rates of surrounding municipalities and villages have been higher as compared to the city core. The city is well connected by roads and railways to the nearby municipalities and villages, which are the main traffic generators for Kochi city and vice versa. The Development Plan-2031 for Kochi City Region highlights the inadequacies of the road infrastructure in the Kochi Region to cater to the future demand of vehicular traffic and also the related problems of emission of pollutants and noise. Various traffic and transportation studies have indicated growing number of automobiles in the city region whereas the much affordable public transport share has remained stagnant and inadequate. Hence, to cater to the increasing travel demand of the city and to encourage a shift from private modes to public transit, a rail based mass rapid transit system for the city has been envisaged. Accordingly a corridor of 25.61 km from Aluva to Petta with 22 stations was identified to be developed as "Kochi Metro". The project is under implementation currently.

However, as part of the public transport system, a mode of transport which has been ignored over the last few decades and has thereby been undergoing a steep decline in ridership and infrastructure is Inland Water Transport. Kochi being a historical port city and having an elaborate network of navigable water channels, water transport by means of traditional boats was a prime mode of movement from one island to another and to the Ernakulam mainland. However, the extensive emphasis on improving road infrastructure, depleting boat and jetty infrastructure and increased affordability of people to own private automobiles infused a vicious cycle wherein the road infrastructure increased significantly and water transport experienced a decline.

1.2 Conceptualisation and Objectives of the Study

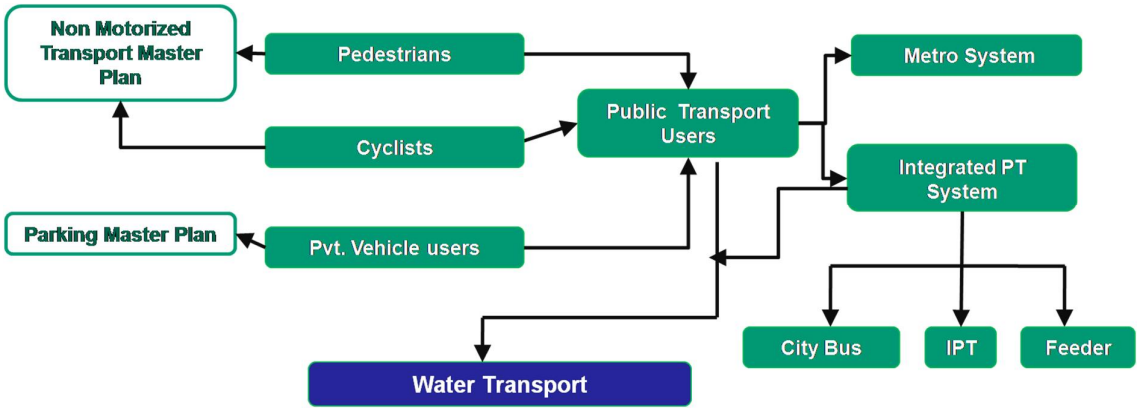
Kochi Metro Rail Limited (KMRL) in line with the directives of the Ministry of Urban Development, Government of India has spearheaded the task of setting up the Metropolitan Transportation Authority (MTA-KOCHI). The MTA-KOCHI has the objective of developing a seamless multi-modal transportation system in the Kochi City Region. MTA-KOCHI is thus focussing on developing a sustainable Integrated Water Transportation System for Kochi city as a part of the integrated approach, meeting the people's expectations as per international standards. The proposed waterways aim to integrate the system with the other modes of transport such as city buses, metro feeders, non-motorised transport etc as well as the metro system over a period of time with an integrated fare and integrated timetable.

1.3 Integrated Water Transport as part of Public Transport System

The water transport system envisaged for Kochi focuses not only on the ferry services as the mode for public transportation but also envisions a holistic development of the areas being connected by waterways as well as integrating the waterway system as a part of the entire public transport system of the city. Apart from the ferry service development, the project also looks into developing the existing and new roads providing increased access to the jetties and also within the islands, ensuring safety and security to all its users by way of active and well lit streets, promoting use of small occupancy feeder modes to access the jetties, promoting property development around the jetties and place making.

It is envisaged to be a user oriented and socially inclusive transport system than being just a point to point service. It is also part of a bigger concept of seamless integration for the city. With the metro system already under execution and consultants working on a Non-Motorized Transport Plan, an Integrated Public Transport Plan and a Comprehensive Mobility Plan and a Parking Master Plan, an inclusive transport scenario as shown in Figure 1-1 is envisioned. The three studies are envisaged to be completed by the last quarter of financial year 2015-16.

Figure 1-1 All Inclusive Transport for Kochi



All the above stated plans are proposed to be coupled with the Intelligent Transport System (ITS) and the Smart Card based Automatic Fare Collection System ensuring a smart approach to transport in Kochi.

1.4 Structure of the Report

The Detailed Project Report (DPR) for sustainable Integrated Water Transport System for Kochi City aims at identifying the best strategies/models for maximising the coverage area under water transport system which shall serve to all the islands and the mainland under Kochi City Region jurisdiction. A world class water transport system is envisaged to encourage people to shift to this sustainable mode for travel and discourage overall travel demand as well as dependency on private modes. The DPR reviews the existing scenario of public transport in Kochi, assesses the potential for a Water Transport System in Kochi and details out the proposals and recommendations on routes, modernisation and upgradation of infrastructure, and evaluates the financial viability of the project.

The Detailed Project Report presented herein is organized in the following order;

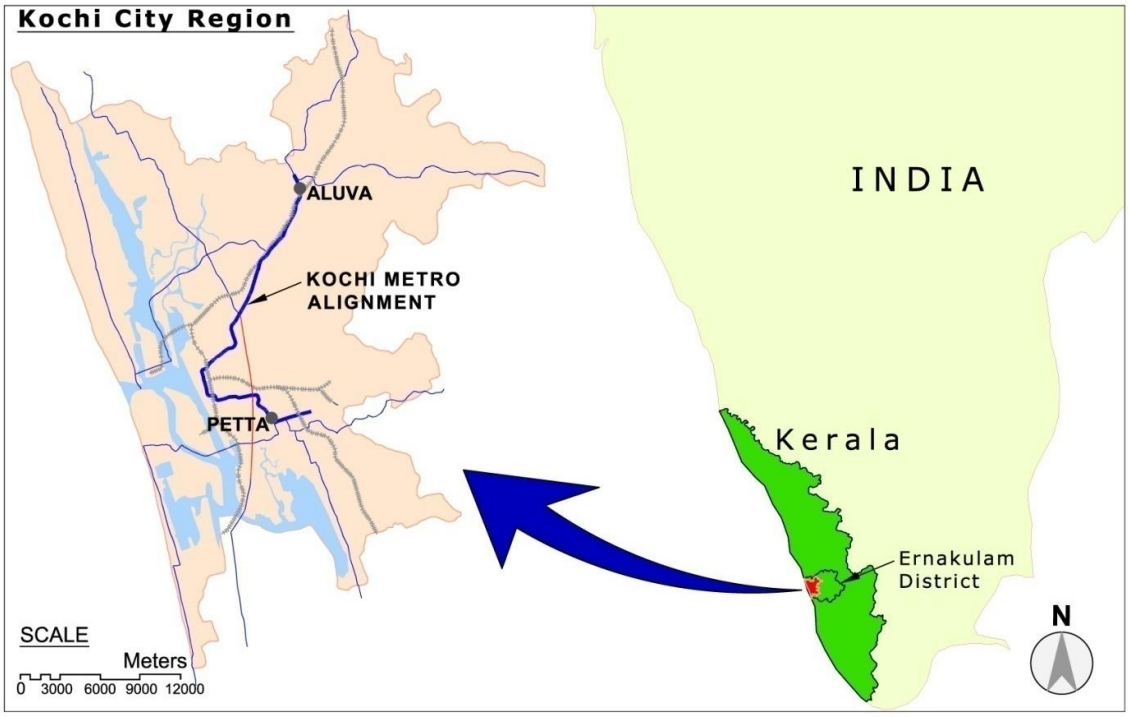
1) Introduction
2) City Profile and Travel Characteristics
3) Existing Public Transport Characteristics
4) Primary Data Analysis
5) Integrated Water Transport System
6) Infrastructure Assessment
7) Project Costing
8) Fare collection system
9) Environment and Social Impact Assessment
10) Financial and Economic Analysis
11) Implementation Framework
12) Stakeholders' Counsultation

2 City Profile and Travel Characteristics

2.1 Introduction

The City of Kochi is the nerve centre of trade and commerce of Kerala and is considered as the 'Gateway of South India'. As per Census of India, 2011, of the fifty three million plus cities in India, Kochi Urban Agglomeration (Greater Cochin Development Area) ranks seventeenth with a population of about 21.17 lakh. It is the largest urban agglomeration in the state and is widely referred to as the commercial capital of Kerala. Kochi with its wealth of historical associations and its unique setting perfectly reflects the historical blend of Kerala. Kochi is one of India's important ports and a major naval base. Kochi consists of mainland Ernakulam, the islands of Wellington, Bolghatty, Fort Kochi and Mattancherry on the southern peninsula and Vypeen Island, north of Fort Kochi. All these areas are linked by ferry services and bridges link Ernakulam to Wellington Island and to the Fort Kochi/Mattancherry. The location of the study area is indicated in Figure 2-1.

Figure 2-1: Study Area in Kochi



Source: Transit Oriented Development Action Plan for Kochi

2.2 Historical Growth of Kochi

The development of Kochi as a prime city of Kerala is closely linked with the political and administrative history of the Malabar Coast. Kerala was an important maritime region in the dawn of the Christian era and the early rulers had their capital at Tiruvanchikulam located about 18 km north of Kochi. The ancient port of Kodungallur (Cranganore) served as an international centre of trade and the main emporium of transit of goods between China and Rome. The erstwhile rulers of Kochi established their headquarters at Thripunnithura as the main land of Ernakulam was water logged in those days.

Kochi Port was formed in 1341, when the heavy floods of that year silted up the mouths of the Cranganore harbour and the surging water forced a channel past the present inlet into the sea. The old merchants of Cranganore, shifted to Kochi as soon as the new outlet became stabilized and with time the harbour gained prominence. The ruler of the region also shifted his capital to Kochi, giving impetus to the growth of the town.

From the 16th century, Kochi witnessed rapid changes through the trading and colonising attempts of European powers. The Portuguese were the first to reach Kochi and they were closely followed by the Dutch in 1663. They founded Fort Kochi, established factories and warehouses, schools and hospitals and extended their domain in the political and religious fronts. The French and the English also joined the race and by 1795, the British power took over Kochi.

Kochi port gradually became the focus of the city. A large number of business and commercial establishments linked with port activities were set up which contributed to the economic base to the city and the environs. The development of the port also coincided with the commissioning of the Pallivasal Hydro Electric Project supplying ample power, heralding a new era of industrial growth in the region.

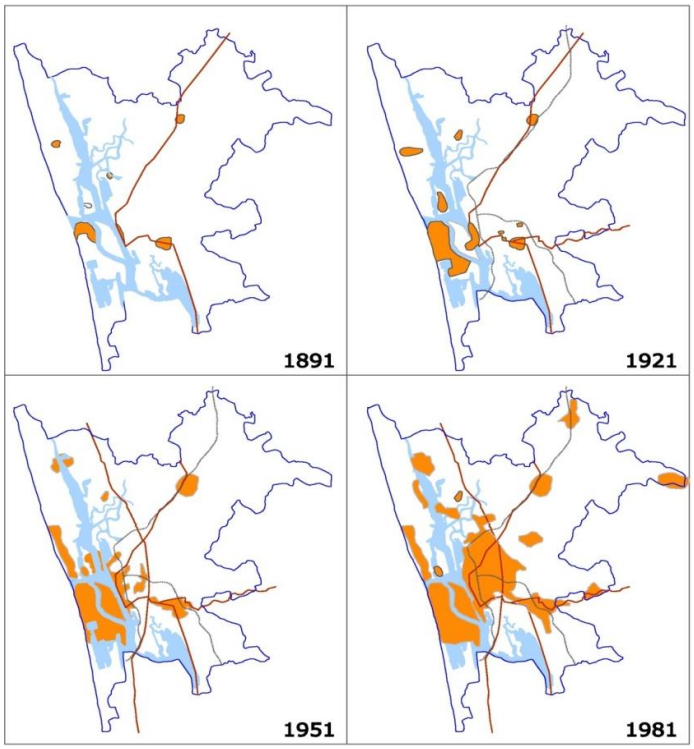
The early settlement of Kochi was at Mattancherry, facing the protected lagoons in the east, which provided safe anchorage to country crafts in all seasons. Mattancherry was linked to the entire coastal stretch of Kerala through these inland waters. Thus gradually it grew into a typical oriental market town with commercial activities distributed along the waterfronts. Agricultural produces from the vast hinterland flowed to its markets to be sold or exchanged for textiles, metals and other products of the European countries.

By 1840, Mattancherry was so much crowded that the activities spread to the eastern side of the backwaters to the Ernakulam side. Public buildings and educational institutions were setup in Ernakulam befitting the splendour of the Maharajas. Roads were laid out, markets were established and temples were renovated. Regional connectivity was improved with the commissioning of the railways in 1905. Ernakulam thus gradually started developing as an administrative town. Mattancherry rose to the status of Municipality in 1912 and was followed by Ernakulam in 1913. However it was to a large extent the Port that catapulted the importance of Kochi.

Kochi Municipal Corporation was formed in 1967, incorporating the three municipalities (Fort Kochi, Mattancherry and Ernakulam), Wellington Island and a few surrounding areas in the suburbs.

The evolution of the Kochi city region with its growth pattern is shown in Figure 2-2.

Figure 2-2: Spatial Growth Pattern of Kochi Agglomeration



Source- City Development Plan of Kochi-2006

2.3 Current Development Scenario in Kochi

Kochi is the home to Southern Naval Command of the Indian Navy and the state headquarters of the Indian Coast Guard with an attached air squadron. Commercial maritime facilities of the city include the Port of Kochi, an International Container

Transhipment Terminal, the Cochin Shipyard, offshore SPM of the Kochi Refineries, and the Kochi Marina. Kochi is also home for International Pepper Exchange, industries like HMT , Cyber City , Kinfra Hi-Tech Park major chemical industries like the FACT, TCC, IREL, HOCL and Kochi Refineries, electrical industries like TELK and industrial parks such as the Cochin Special Economic Zone and Infopark. Kochi is also home to the High Court of Kerala and Lakshadweep.

Kochi ranks first in the total number of international and domestic tourist arrivals in Kerala. Kochi has been ranked the sixth best tourist destination in India and Kochi was one of the 28 Indian cities found to be among the emerging 440 global cities that will contribute 50% of the world GDP by the year 2025, in a study done by McKinsey Global Institute.

2.4 Administrative Setting for Kochi City

There are two main administrative divisions in Kochi City, namely

(1) Corporation of Cochin (CoC)

(2) Greater Cochin Development Authority (GCDA)

- **Corporation of Cochin**

Corporation of Cochin was formed in 1967 after merging municipalities of Fort Kochi, Mattancherry and Ernakulam with an area of 94.88 Sq. Km. Kochi City had a population of 5,95,575 in 2001 which has now grown to 6,02,046 in the year 2011.

The idea for planning for a larger area beyond the municipal limits, within the immediate influence area of the city, gained momentum to develop Kochi as a Global City. An area of 330.02 Sq.km was delineated in 2006 for the preparation of City Development Plan as part of the JnNURM. Further to this a Draft Development Plan for 'Kochi City Region' was prepared in 2009 which is yet to be approved. The Kochi City Region comprises of Kochi Municipal Corporation, Thripunithura Municipality, Kalamassery Municipality and 14 Panchayats (Maradu, Thiruvankulam, Thrikakkara, Cheranellloor, Eloor, Varapuzha, Kadamakkudy, Mulavukadu, Elamkunnapuzha, Njarackal, Kumbalam, Kumbalangi,

Chellanam, Vadavukode-Puthenkurisu) with an area of 369.72 Sq.km[1] with a population of 12.11 Lakhs in 2011.

- **Greater Cochin Development Area**

Greater Cochin Development Authority (GCDA) is the statutory body which was constituted in 1976 to oversee the development of the City of Kochi and its surrounding influence area, which covers an area of 632 Sq. Km with a population of 21.2 Lakhs in 2011. GCDA consists of Kochi Corporation, 6 Municipalities (Thripunnithura, Kalamassery, Aluva, Perumbavur, Angamaly and Peravur), thirty five census towns and 12 villages in the peripheral area of the corporation. GCDA was the first agency formed to overseeing the development and planning for an urban area in Kochi. This led to the formation of many such development authorities for other urban areas of the state.

2.5 Demography and Socio-Economic Profile

2.5.1 Population growth trends in Kochi

The population growth rate of the Corporation of Cochin has been declining in the past few decades. The population had increased from 5.64 Lakh in 1991 to 5.96 Lakh in 2001 and eventually reached 6.02 Lakh in 2011 as shown in Table 2-1. The growth rate has declined from 10 % in 1981-91 to 1% in 2001-11.

Table 2-1: Population of Kochi Region

Sl. No	Name of Local body	Population 2001	Population 2011	Growth Rate 1991-01	Growth Rate 2001-11
1	Corporation of Cochin	5,95,575	6,02,046	5.5	1.1
2	Thripunnithura Municipality	59,884	69,390	17.2	15.9
3	Kalamassery Municipality	63,116	71,038	16.1	12.6
4	Other Panchayats	4,45,650	4,37,123	19.8	-1.9
	Total (Kochi Region)	11,64,225	11,79,597	11.7	1.3

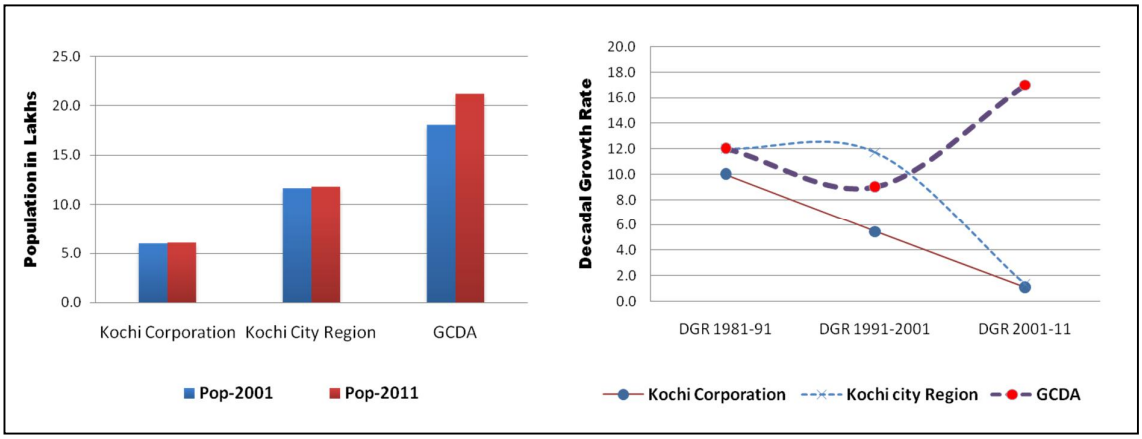
Source- Census of India -2011, Development Plan of Kochi City Region-2031 (draft)

Kochi city Region comprises of Kochi City and its immediate influence areas covering an area of 369.72 Sq.km with a population of 11.79 Lakh in 2011. The KCR was delineated in 2011 during Census enumeration and it comprises of Kochi Corporation, Thripunnithura Municipality, Kalamassery Municipality and 14 other ULB's. The population of Kochi City

[1] Development Plan for Kochi city region 2031

Region has increased from 11.64 Lakh in 2001 to 11.79 Lakh in 2011 with a very low decadal growth rate of 1.3%. Both the municipalities of Thripunnithura and Kalamassery have registered a higher growth rate of 15.9% and 12.6% respectively. With the investments in IT and port sector, it is anticipated that the growth rates would shoot up especially in the Kochi City Region. It is evident that the growth within the municipal limits is witnessing saturation and is concentrated in the suburban towns. The population growth trends within the administrative divisions of Kochi are indicated in Figure 2-3.

Figure 2-3: Growth of Population in Kochi



Source- Development Plan of Cochin Region-1976, Development Plan of Kochi CityRegion-2031 (draft), Census of India

The population of GCDA has grown from 14.8 Lakh in 1981 to 21.2 Lakh in 2011. In 1981-91 the growth rate was as 12 % which then reduced to 9% in 1991-01. The growth rate which was registered in 2001-11 is 17% as shown in Table 2-2.

Table 2-2: Growth of Population in Greater Cochin Development Authority (GCDA)

Administrative Divisions	Population (in Lakh)				Growth Rate		
	1981	1991	2001	2011	1981-91	1991-01	2001-11
GCDA	14.8	16.6	18.1	21.2	12%	9%	17%

Source- Development Plan of Cochin Region-1976, Census of India

2.5.2 Population Density in Kochi

The Corporation of Cochin has a very high density as compared to the surrounding area and it is also the most densely populated city in the state. It has a geographical area of 94.88 Sq.km, which is 1/4th of the total area of KCR, but more than 50% of the total population of the region resides here.

Table 2-3: Population Densities in Kochi Area

Administrative Divisions	Area (in Ha)	Population (in Lakh)		Density (PPHa)	
		2001	2011	2001	2011
Kochi Corporation	9488	5.95	6.02	62.8	63.5
Kochi city Region	36972	11.6	11.8	31.5	31.9
GCDA	63200	18.1	21.2	28.6	33.5

Source- Development Plan of Cochin Region-1976, Development Plan of Kochi CityRegion-2031 (draft), Census of India

The density in Cochin Corporation area is 63.5 pph which is almost double of the densities in Kochi City Region and GCDA. The density in Kochi city Region and GCDA area is almost the same. (Refer

Table 2-3 and Figure 2-5).

Figure 2-4: Distribution of Population in Greater Cochin Development Authority Area (GCDA)

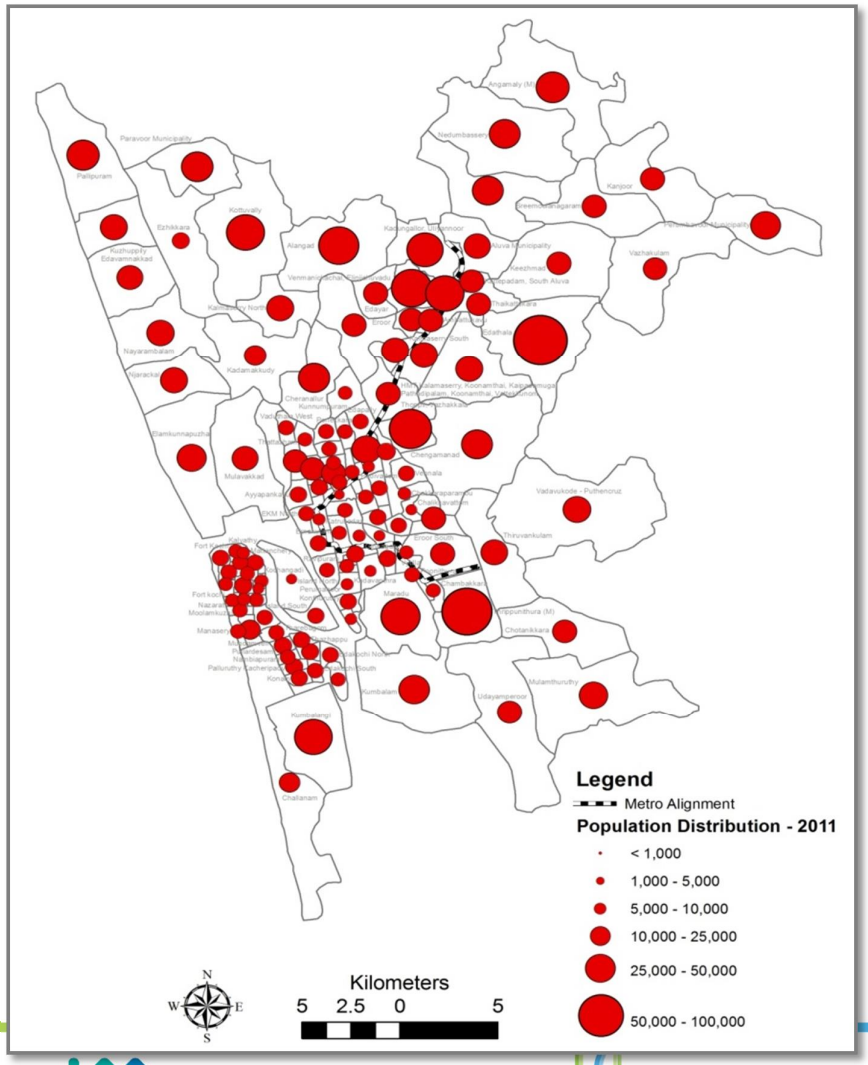
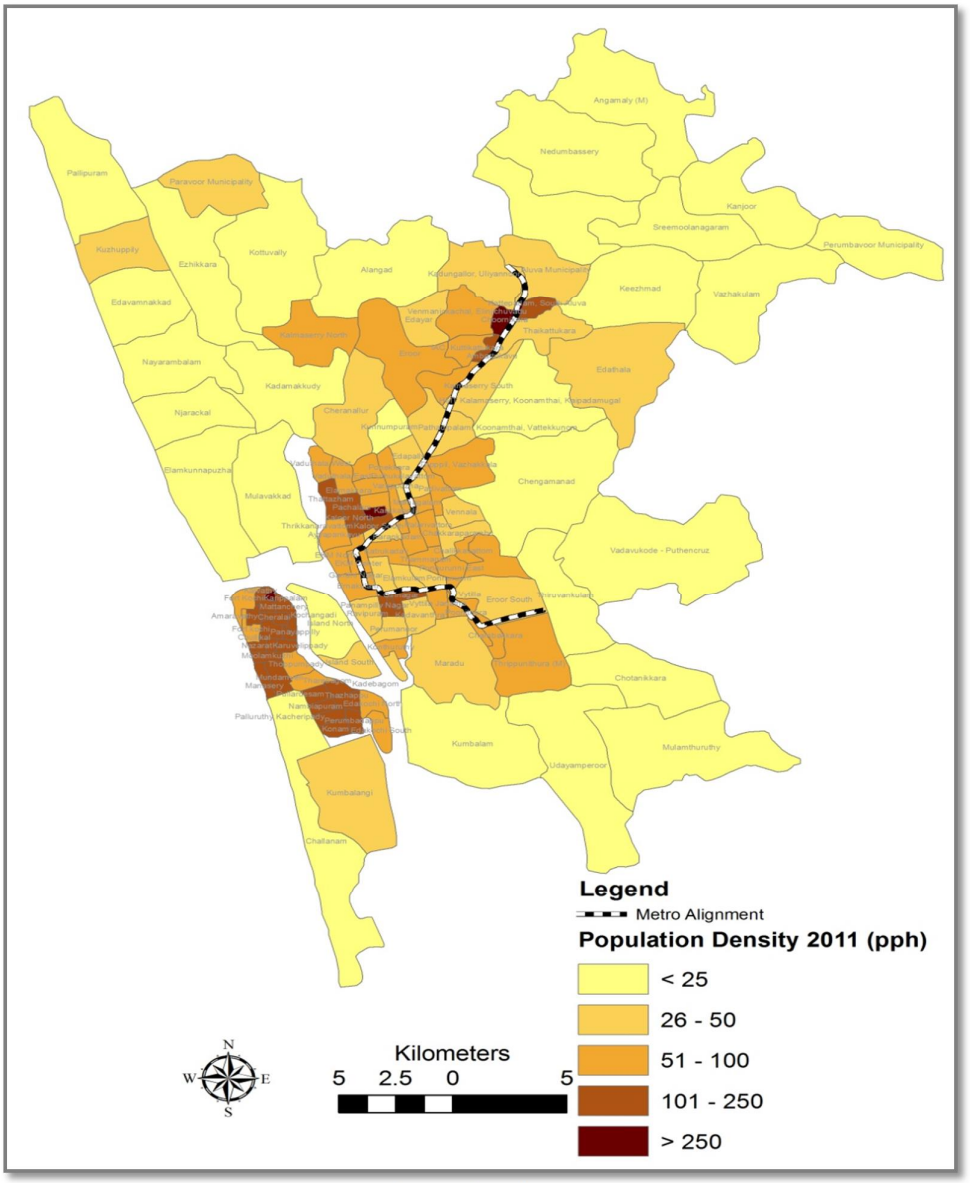


Figure 2-5: Population Density of zones in Greater Cochin Development Authority Area (GCDA)



Source: Consultants

2.5.3 Sex Ratio

In 2011, the city had a population of 6,01,574 of which male and female population was 2,96,668 and 3,04,906 respectively. The sex ratio within the Kochi Municipal area stood at 1027 females per 1000 males (2011), whereas the sex ratio in the GCDA area stood at 1034 females per 1000 males. In both cases the sex-ratio is higher than the national average of 940 in 2011.

2.5.4 Literacy Rate

The number of literates in the municipal area is 5.3 Lakh (2011), which is 88.4% of the total population of the city. The male and female literacy rates are 88.9% and 88.0% respectively.

Table 2-4: Literacy rate in Kochi

	Population	No. of Literates	Literacy Rate
Total	6,02,046	5,32,492	88.4%
Male	2,96,949	2,64,067	88.9%
Female	3,05,097	2,68,425	88.0%

Source- Census of India (2011)

2.5.5 Work Participation Rate

The total working population in the municipal area is 2.28 Lakhs, which constitutes 38.0% of the total population in 2011.

Table 2-5: Work Participation Rate in Kochi

	Population	No. of workers	WPR
Total	6,02,046	2,28,968	38.0%
Male	2,96,949	1,69,606	57.1%
Female	3,05,097	59,362	19.5%

Source- Census of India (2011)

Out of the total work force, the share of male workers is 74.1% and that of females is 25.9% as shown in Table 2-5. The male work participation rate (WPR) is 57.1%; whereas the female WPR is 19.5%.

2.5.6 Income Profile

As per the Feasibility and DPR for the Kochi Metro-Phase 2 by RITES, 2013, the distribution of households according to their monthly incomes is represented in Table 2-6.

Table 2-6: Distribution of Households by Income Group

S. No.	Income Group	No. of Households	Percentage (%)
1	Less than Rs 5000	82	1.6
2	Rs 5001- Rs 10000	488	9.8
3	Rs 10001 – Rs 15000	521	10.4
4	Rs 15001 – Rs 20000	1172	23.5
5	Rs 20001- Rs 25000	683	13.7
6	More than Rs 25000	2042	40.9
	Total	4988	100.0

Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

It can be observed that about 22% of households have a monthly income of less than or equal to Rs. 15000 and 37% have income between Rs. 15001 – 25,000 per month. The percentage of household having monthly income of more than Rs. 25,000 was observed to be about 40.9%.

Average household income per month in the study area was observed to be Rs. 29093/-.

2.6 Land use of Kochi

The Characteristic feature of Kochi's land Utilization pattern is the predominance of water bodies and wetlands. The water bodies consist of canals and backwaters. However, it has been noticed that most of the water bodies, paddy fields & farms are being converted into developable land and therefore increasing the net density of the city. The existing land use of Kochi Municipal Corporation area in 2009 is given in Table 2-7.

Table 2-7: Existing Land use in Kochi Corporation

Sl. No	Land use Category	Existing area in Ha.	% Share (Gross)	% Share (Net)
1	Residential	5,040.9	53.1%	73.1%
2	Commercial	211.6	2.2%	3.1%
3	Public & Semi Public	444.8	4.7%	6.4%
4	Industrial	173.5	1.8%	2.5%
5	Transportation	553.6	5.8%	8.0%
6	Parks and open spaces	66.7	0.7%	1.0%
7	Paddy land / Wet land	441.0	4.6%	-
8	Agriculture/ Dry cultivation	10.2	0.1%	0.1%
9	Water bodies	2,148.3	22.6%	-
10	Other (SEZ and unclassified area)	397.3	4.2%	5.8%
	Total area (Gross)	9,488.0	100%	-
	Total area (Net)	6,898.7		100%

Source- Development Plan of Kochi City Region-2031 (draft)

It was observed that out of the net area (6,898.7 Ha) of Corporation of Cochin, almost three-fourth of the area is under residential use (73.1%). The area under Transportation and Public & Semi Public uses are 8% and 6.4% respectively. The share of commercial and industrial areas within the corporation area is less than 3.5%.

The existing land use distribution of 'Kochi City Region', is given in Table 2-8. In this case as well the residential land uses have a predominant share (69.4%). The industrial land uses

occupy the second major (10.4%) share out of the total net area of Kochi city region. The share of public & semi-public uses and transportation is almost the same at 6.5%.

Table 2-8: Existing Land use in Kochi City Region

Sl. No	Land use Category	Existing area in Ha.	% Share (Gross)	% Share (Net)
1	Residential	16057.9	43.4%	69.4%
2	Commercial	367.1	1.0%	1.6%
3	Public & Semi Public	1538.37	4.2%	6.6%
4	Industrial	2404.61	6.5%	10.4%
5	Transportation	1486.35	4.0%	6.4%
6	Parks, playgrounds and open spaces	113.79	0.3%	0.5%
7	Paddy Land/ Wet land	6817.55	18.4%	
8	Area under dry cultivation (cash crops/ plantation crops)	754.06	2.0%	3.3%
9	Water Bodies	7011.43	19.0%	
10	SWM site	23.66	0.1%	0.1%
11	Port and Port related	397.3	1.1%	1.7%
	Total area (Gross)	36972.12	100.0%	
	Total area (Net)	23143.14	-	100.0%

Source- Development Plan of Kochi City Region-2031 (draft)

As per the URDPFI guidelines for Metro cities like Kochi, 35% of the total land is to be reserved for residential purposes where as the residential share is very high in both the Municipal area and in KCR area (refer Figure 2-6 &

Table 2-3) owing to low rise, plotted development throughout the region. This leads to poor efficacy of the infrastructure system and haphazard development and over dependency on private transportation systems even for short trips. The share of commercial, public & semi public areas and transportation is low and almost half of the recommended norms for the same, which is 4%, 14% and 15% respectively. This leads to poor distribution of services for all the pockets of the city and results in over usage of services.

Figure 2-6: Existing Land uses in CMC area

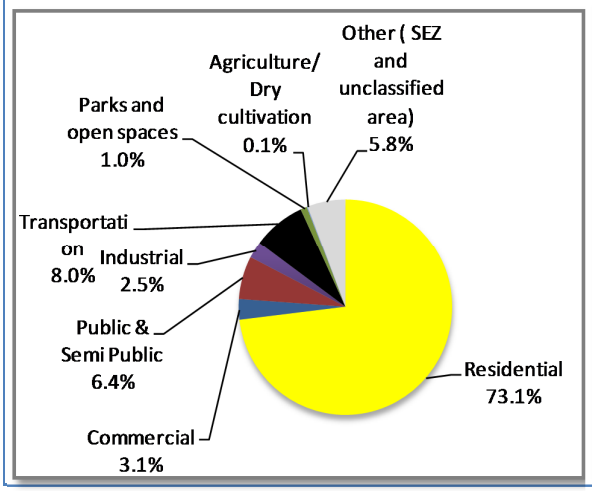
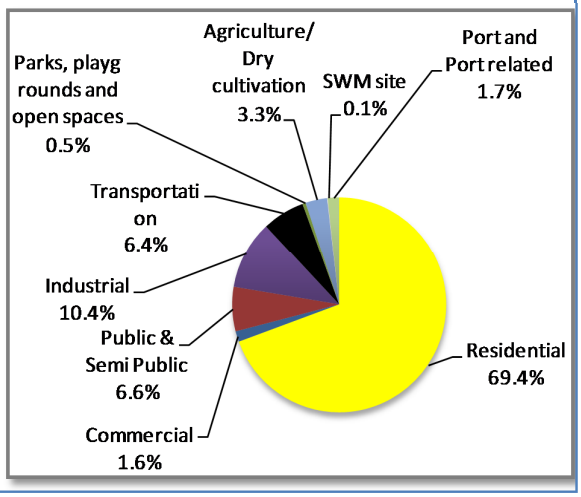


Figure 2-7: Existing Land uses in KCR (2009)



Source- Development Plan of Kochi City Region-2031 (draft)

The industrial areas are mostly located outside the corporation limits near Kalamassery and therefore the share of industries is low within the municipal area, whereas there is substantial share in KCR area, which is adequate as per the URDPFI norms (recommended 12%).

The worst effected of the lot is the share of playgrounds, parks and open spaces. As per the norms the share of these should be 20% of the city area, where as it is less that 1% in both CoC and KCR area. Some of the dearth in open spaces is compensated by the extensive water ways and back water channel running across the region.

2.7 Economic Base of Kochi

Kochi is the economic capital of Kerala by volume of trade, though, unlike other South Indian cities, Kochi has been slow in industrialization. In recent years the city has rejuvenated from its economic stagnation and has witnessed heavy investment, posting a GDP growth rate of 8.3%; thus making it one of the fastest-growing second-tier metro cities in India.

The economy of the city is predominantly classified as the tertiary sector and the important business sectors include tourism, Information Technology, ship manufacturing, exports of seafood and spices, chemical industries, health services, banking, construction etc.

Kochi is a major destination for IT and ITES companies, ranked by NASSCOM as the second-most attractive city in India for IT-based services. To contain the migration of a large

number of young working class people to IT hubs like Bangalore, Hyderabad etc. the state government has decided to set up IT and BPO establishments in Kochi to tap this opportunity. Availability of cheap bandwidth through undersea cables and lower operational costs compared to other major cities in India has been to its advantage. Various technology and industrial campuses including the government promoted Info-Park, Cochin Special Economic Zone and KINFRA Export Promotion Industrial Park operate in the outskirts of the city.

Eloor, situated 17 km north of the city, is the largest industrial belt in Kerala, with more than 250 industries manufacturing a range of products like chemical and petrochemical products, pesticides, rare earth elements, rubber processing chemicals, fertilisers, zinc and chrome compounds, and leather products. A biotechnology campus is also under construction at Kalamassery.

The Cochin Shipyard is the largest shipbuilding facility in India. The Southern Naval command is head quartered in Cochin. Developments like setting up of Vallarpadom terminal (ICT terminal) and LNG Depot will have significant impact in the overall revenue of the city. The only stock exchange in Kerala is located in Kochi. The income share through remittances from abroad by Non-resident NRI's also significant.

All of these factors have lead to a tremendous surge in the demand for office spaces and IT Parks. With the increase in demand for reality, the contribution of the real estate sector in the economy share is increasing consistently.

2.8 Traffic Network Characteristics of Kochi City

An analysis has been undertaken to establish the Traffic and Transportation Characteristics of Kochi City. This particular section discusses the road network characteristics, public transport characteristics – bus, rail and ferry, growth of registered vehicles, traffic safety and travel characteristics in Kochi City.

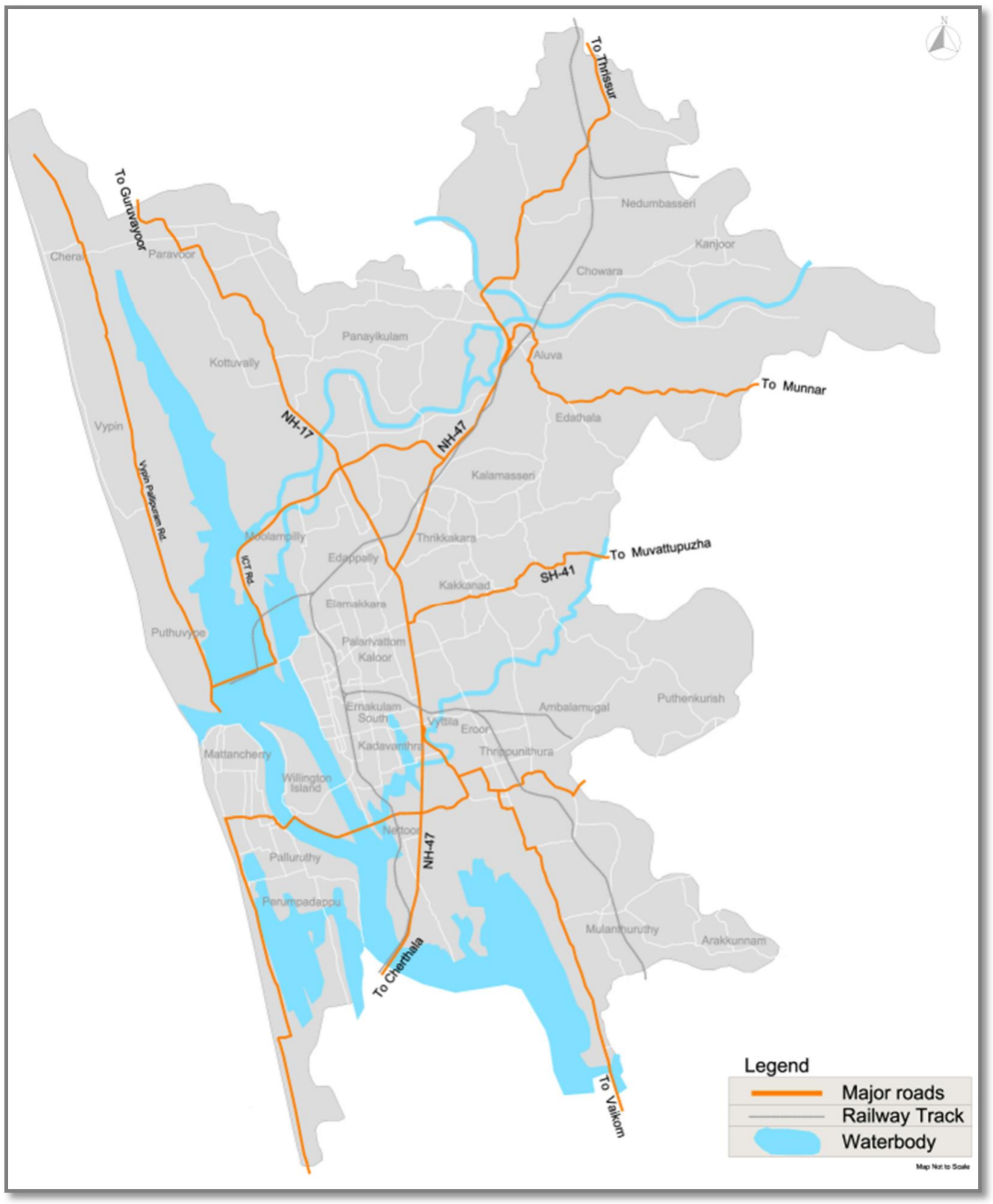
2.9 Connectivity

2.9.1 Road Connectivity

Kochi is well connected to other parts of the country and state through an extensive network of National Highways and State Highways, There are three important National

Highways NH 47, NH 17, NH 49 that pass through Kochi city and a link road which connects NH 47 and NH 49 known as 47- A. Refer Figure 2-8.

Figure 2-8: Major road and rail network in Kochi



NH 47 connects Kochi to Salem via Coimbatore, Palakkad, Thrissur and passes through Kochi and its influence region. NH 17 connects Kochi with the entire western coast and links important cities like Mangalore, Goa, Ratnagiri and Mumbai. NH 49 passes through the eastern region and connects Kochi with Madurai (Tamil Nadu) via Muvattupuzha, Munnar etc.

There are four State Highways which connect Kochi with other parts of the Kerala. Kochi is connected with Kottayam by State Highway 15 (Ettumanoor – Ernakulam Road). The State Highway 41 (Palarivattom- Thekkady Road) connects the city with eastern parts of the district. The coastal regions and settlements are served by SH 63 (Vypeen Pallipuram road) and SH-66 (Alleppey- Thoppumpady Road). There are important city roads which traverse through the city such as Mahatma Gandhi Road, Bannerji Road, Shanmugan Road etc. A 36 meter wide ring road has been proposed for Kochi city which will pass through Chatiyath-Varapuzha-Alangad-Athani-Puthencruz-Mulamthuruthy and Panangad.

2.9.2 Railway Connectivity

The Ernakulam (South) station is one of the busiest stations in South India, with more than 128 scheduled train services daily. It is the largest of the 3 major stations serving the city other being Ernakulam (North) and Aluva railway station. The older part of the city is towards the west of the rail line while all new developments are taking place in the eastern part of the city. The main rail transport system in Kochi is operated by the Southern Railway Zone of Indian Railways, and comes under Thiruvananthapuram Railway division.

The Ernakulam (North) station acts as a bypass mostly for the long distance train services from the Ernakulam South Station, which is located in congested city core. Aluva station is one of the most important railway stations in Kerala and the second busiest railway station in the state after Thrissur. This station is in close proximity of the Cochin International Airport. Edappally Railway Station is located at a distance of 6 km from Ernakulam Town and it handles few express trains and passenger trains. Other stations like Thripunnithura, Kalamassery, Nettoor, Kumbalam and Aroor serve the areas in the outskirts of the city and the surrounding metropolitan area by few express trains and passenger trains as well. The rail network in Kochi is shown in Figure 2-8.

2.9.3 Air Connectivity

Cochin International Airport (Nedumbassery Airport) is one of the largest and busiest airports in Kerala. It has a terminal area of 8.4 Lakh Sq.Ft and a daily passenger capacity of 15,000. It is also the fourth busiest airport in India in terms of international passenger traffic, and seventh busiest overall. It was the first airport to be developed in India through Public – private partnership (PPP) model.

The Cochin International Airport Limited (CIAL) is located at Nedumbassery, which is about 28 km North of Kochi city, and handles both domestic and international flights. The airport is located very close to the three National Highways which are NH-47, NH-17 and NH-49. The main railway line from Kanyakumari to Delhi is adjacent to the airport and is situated between Aluva and Angamaly Railway stations. The Cochin Port is connected to International Airport by a newly developed road link known as the Airport-Seaport road.

The Kochi airport provides direct connectivity to popular international destinations in the Middle East, Malaysia and Singapore and to most major Indian cities. The international air services are mainly concentrated in the Gulf region catering to people employed in various Gulf countries.

2.9.4 Water Transport

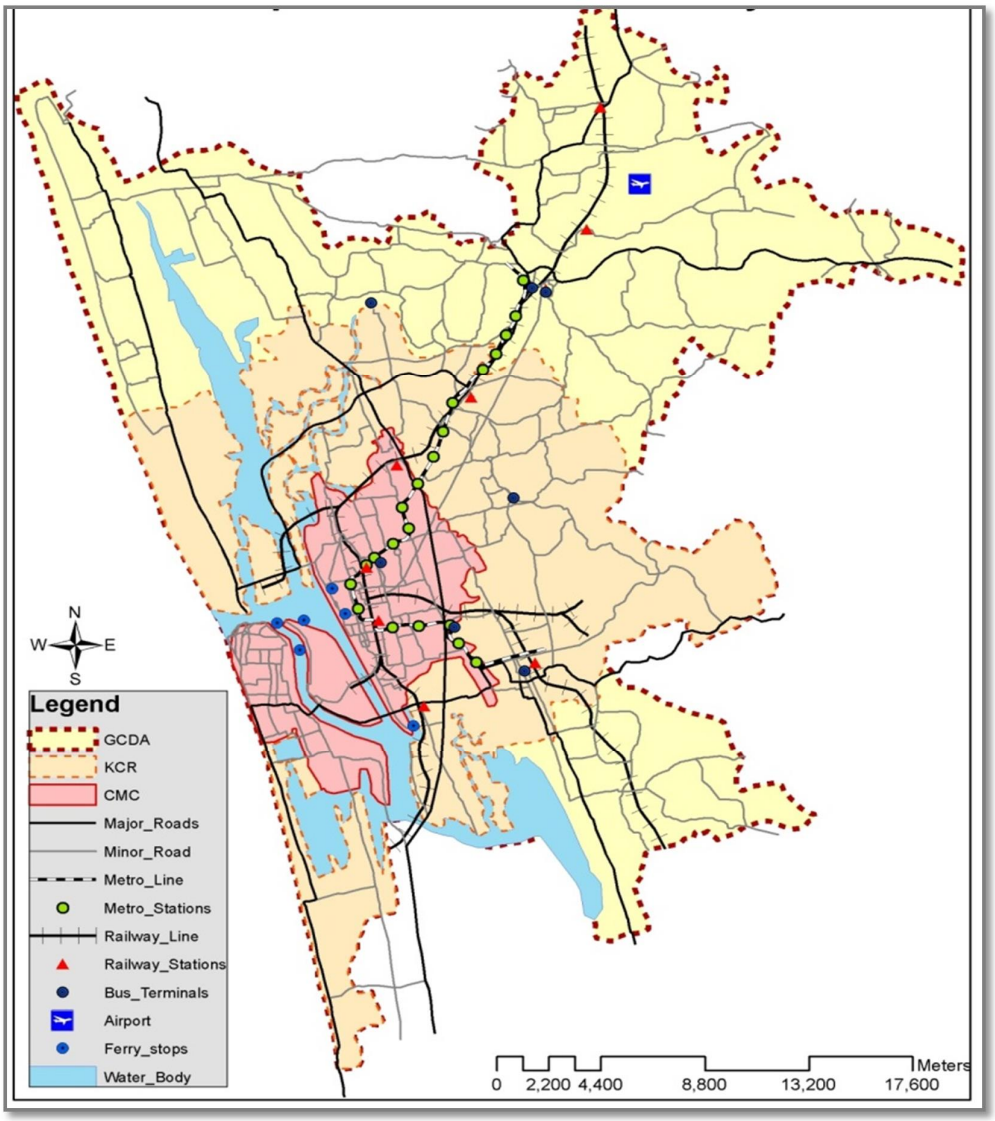
Kochi has a good network of inland waterway system consisting of backwaters, canals, lagoons and estuaries. National Waterway No.3 connecting Kollam and Kottappuram pass through the region. The State Water Transport Department (SWTD), Kerala Shipping and Inland Navigation Corporation (KSINC) and private operators are providing passenger and cargo boat services to the adjoining islands and industrial centers. Passenger ships are also operated to Lakshadweep Islands from the Kochi Port.

Over the period of time, these islands were interconnected using a network of bridges and roads(Mattancherry Bridge, Kundangaloor NH47-A link and Goshree bridges) and most of these islands are no more isolated from the city which is leading to the decline in the use of water ways as major mode of transportation to the islands.

There are very limited passenger boat services operating from Ernakulam jetty and High court jetty. The main routes served by the water transport are for transporting passengers from Ernakulam to Fort Kochi, Mulavukadu, Bolghatty, Varapuzha, Mattancherry and Vypeen. Private boats organise sightseeing trips from Ernakulam, depending on the demand from the tourists.

Kochi port offers facilities like handling cargo and passenger ships, cargo handling equipment, storage accommodation, dry dock, bunkering facilities, fisheries harbour, etc.

Figure 2-9: Transport Network in Kochi City

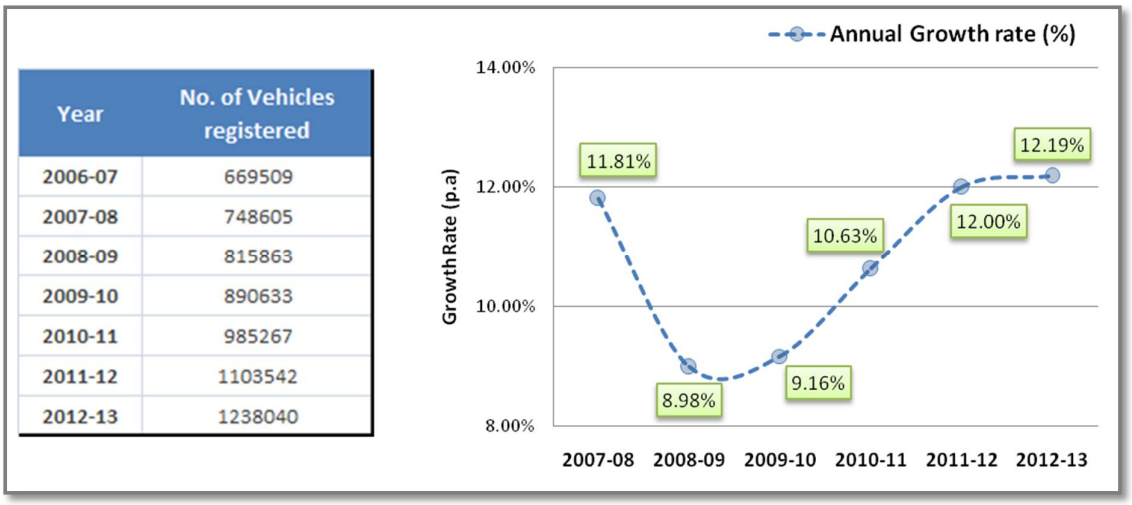


2.10 Vehicular Growth and Composition

With the rapid growth of urban population, there is an ever-increasing demand on the city's infrastructure to serve the population. The rapid motorization rates have further complicated issues and compete with the public transport systems in the cities, as mode choices for commuting. The trips per household have increased over the years, with increasing per capita incomes and increase in vehicle ownership. Considering the improving socio-economic level in the Indian cities and inadequate mass transport system, personalized motor vehicles have been growing at the rate of 6% to 15% per annum in different cities. In most of the cities, scooters/motor cycles comprise of the more than 60 per cent of the total motor vehicles.

The registered vehicles in Ernakulam have increased significantly over the years. The number has increased from 6.7 to 12.4 Lakh in seven years as shown in Table 2-4. This high density and rapid growth of vehicles have worsened the transport situation to a significant extent.

Figure 2-10: Growth of Vehicles in Ernakulam District



Source- Motor Vehicles Department, Government of Kerala (2006-2013)

The vehicular growth has been very high at approx 12% p.a. since 2006. The growth was at 11.81 % in 2007-08, which declined to almost 9% in the next two years. Since then the growth has increased and reached a high point of 12.19% and has been over 12% in the past 2-3 years. The growth of all modes of transport in Ernakulam district is shown in Table 2-9.

Table 2-9: Mode wise distribution of vehicles registered in Ernakulam District

Vehicle Type	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Scooter/Bikes	**4,22,473**	**4,71,743**	**5,11,857**	**5,53,150**	**6,16,676**	**6,81,239**	**7,77,462**
Growth Rate (p. a)		11.7%	8.5%	8.1%	11.5%	10.5%	14.1%
Cars	**1,21,503**	**1,40,549**	**1,58,516**	**1,81,805**	**1,96,039**	**2,37,108**	**2,61,417**
Growth Rate (p. a)		15.7%	12.8%	14.7%	7.8%	20.9%	10.3%
Auto Rickshaws	**41,894**	**44,679**	**48,238**	**52,307**	**56,863**	**61,859**	**61,994**
Growth Rate (p. a)		6.6%	8.0%	8.4%	8.7%	8.8%	0.2%
Buses	**21,823**	**23,292**	**24,002**	**24,544**	**26,538**	**23,180**	**24,642**
Growth Rate (p. a)		6.7%	3.0%	2.3%	8.1%	-12.7%	6.3%
Goods	**54,812**	**60,241**	**64,367**	**68,150**	**75,104**	**78,972**	**84,184**
Growth Rate (p. a)		9.9%	6.8%	5.9%	10.2%	5.2%	6.6%
Tractors	**2,436**	**2,616**	**2,732**	**2,796**	**3,063**	**2,924**	**2,944**
Growth Rate (p. a)		7.4%	4.4%	2.3%	9.5%	-4.5%	0.7%
Other	**4,568**	**5,485**	**6,151**	**7,881**	**10,984**	**17,462**	**25,397**

Vehicle Type	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Growth Rate (p. a)		20.1%	12.1%	28.1%	39.4%	59.0%	45.4%
Total	**6,69,509**	**7,48,605**	**8,15,863**	**8,90,633**	**9,85,267**	**11,02,744**	**12,38,040**
Growth Rate (p. a)		11.8%	9.0%	9.2%	10.6%	11.9%	12.3%

Source- Motor Vehicles Department, Government of Kerala (2012)

It is evident that 2 wheelers (84%) and cars (115%) have registered the highest growth rate consistently in all these years showing a trend of increased dependency on private modes of transport as shown in Table 2-10. One of the reasons is the poor supply of public transportation mode likes buses as compared to the surging demand. Unless a good mass transportation mode is in place, this trend of growing private vehicles will continue.

Table 2-10: Analysis of data of all modes of transport registered in Ernakulam District

Vehicles	Share of Vehicles		Increase in numbers	Growth Rate
	2006-07	2012-13	(in Lakhs)	(2006-13)
Scooter/Motor Cycles	63.1%	62.8%	3.55	84.0%
Cars	18.1%	21.1%	1.40	115.2%
Auto Rickshaws	6.3%	5.0%	0.20	48.0%
Buses	3.3%	2.0%	0.03	12.9%
Goods	8.2%	6.8%	0.29	53.6%
Tractors	0.4%	0.2%	0.01	20.9%
Other Vehicles	0.7%	2.1%	0.21	456.0%
Total	100.0%	100.0%	5.69	84.9%

Source- Secondary Data Analysis

It is observed that the share of two wheelers is the highest at about 63%, followed by cars at 21%, where as buses and auto rickshaws contribute only 7% put together. The sharp increase of two-wheelers and cars could be attributed to the improved economic status of people and deficient public transport supply. The phenomenal increase of cars and the resulting demand for more road-space, has resulted in dense concentration of traffic on roads. This trend has to be kept under check, in terms of the cost it imposes on users demand after a careful consideration.

2.11 Road Network Characteristics

To understand and evaluate the traffic and transportation characteristics of the GCDA area, the survey data from the DPR for the Phase II of Kochi Metro carried out by RITES, 2013 and the Ridership Updation Study by CDM Smith have been considered.

2.11.1 Right of Way (RoW)

The total length of roads in GCDA is 948.7 Km and has a road density of 4.48 km/10,000 people and 1.50 km/sq.km of surface area. It has been observed that about 75% of roads have a ROW up to 10 m and 22% has ROW between 10 to 30 m as indicated in Table 2-11. This indicates the limitation of widening for most of the roads.

Table 2-11: Distribution of Road Network by Right of Way in Kochi City

Right of Way (m)	Road Length (km)	Percentage (%)
Up to 10	707.0	74.5
10 to 20	153.7	16.2
20 to 30	55.2	5.8
Equal to or	32.8	3.5
Total	**948.7**	**100.0**

Source- Feasibility and DPR for the Phase II of Kochi Metro by RITES, 2013

2.11.2 Carriageway Width

The distribution of road network as per carriageway width is presented in Table 2-12. It can be observed that about 35% of city road network length have a carriageway width of less than 2 lane, about 55% are 2-lane and only 10% of road network is 3 lane and more.

Table 2-12: Distribution of Road Network by Carriageway Width in Kochi City

Carriageway	Road Length (Km)	Percentage (%)
Less than 2 Lane	332.7	35.1
2 Lane	518.9	54.7
3 Lane	5	0.5
4 Lane and More	92.1	9.7
Divided	91.7	
Undivided	0.4	
TOTAL	**948.7**	**100**

Source- Feasibility and DPR for the Phase II of Kochi Metro by RITES, 2013

2.11.3 Speed and Delay

The distribution of road length by peak/ off-peak journey speed of traffic is given in Table 2-13. It is observed that about 99% of the road length has peak hour journey speeds of less than 30 Kmph. During off-peak period about 81% of road length in Kochi has speeds less than 30 kmph. Average journey speed during peak period for a city is 20.4 kmph and for off-peak period it is 24.6 kmph.

Table 2-13: Distribution of Road Network by Journey Speeds in Kochi City

Journey Speed (in kmph)	Road Length (km)			
	Peak Period	Percentage (%)	Off Peak period	Percentage (%)
Less than 20	452	47.6	107.8	11.4
20-30	490.3	51.7	655.5	69.1
More than 30	6.4	0.7	185.4	19.5
Total	948.7	100.0	948.7	100.0

Source- Feasibility and DPR for the Phase II of Kochi Metro by RITES, 2013

Distribution of road length by peak / off-peak period running speed of traffic is given in Table ***2-14***. It is observed that about 98% of road length has running speed less than 30 kmph. This figure comes down to 77% for off-peak period. Average running speed for peak and off-peak period for city as a whole is found as 21.0 kmph and 25.7 kmph respectively.

Table 2-14: Distribution of Road Network by Running Speeds Kochi City

Running Speed (in kmph)	Road Length (km)			
	Peak Period	Percentage (%)	Off Peak period	Percentage (%)
Less than 20	432.4	45.6	96	10.1
20-30	494.5	52.1	630.8	66.5
30-40	21.8	2.3	206.3	21.7
More than 40	-	-	15.6	1.6
Total	948.7	100	948.7	100

Source- Feasibility and DPR for the Phase II of Kochi Metro by RITES, 2013

As seen there is no significant variation between peak and off-peak period speeds. This indicates the reasonably congested condition of the roads throughout the day.

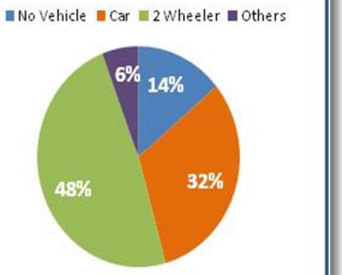
2.12 Socio-Economic and Travel Characteristics of Kochi City

2.12.1 Vehicular ownership

As per the Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013, the distribution of Households by Vehicular Ownership is as represented in Figure 2-11 and Figure 2-12. It is observed that 48% of the Households own 2 Wheelers and 32% of the households own Cars and 14% of the Households don't own any vehicles.

Figure 2-11: Distribution of Households by Vehicular Ownership

Type of Vehicles	No. of Households	Percentage (%)
No Vehicle	858	13.92%
Car	1958	31.77%
2 Wheeler	2988	48.48%
Others	359	5.83%



Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

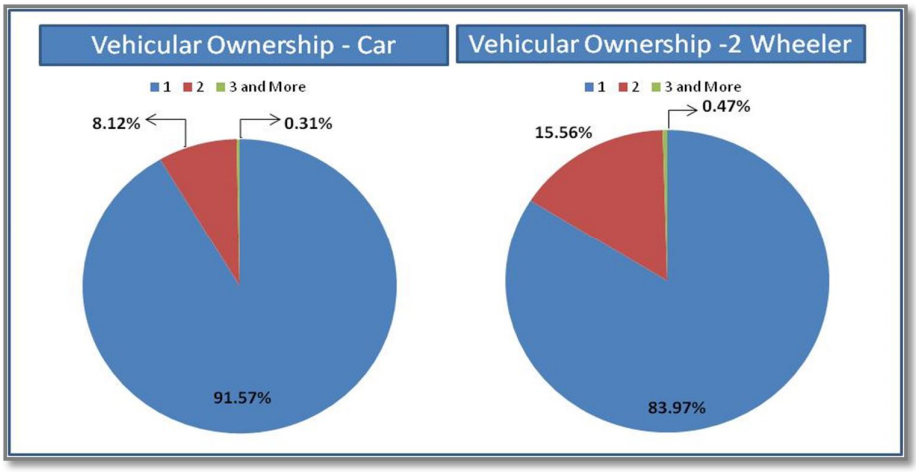
From **Figure** 2-11 , it could be observed that 31.77% of the total households own car, of which 92% of the households are single car owners.

Table 2-15: Distribution of Households by Ownership of Cars

Sl. No	No. of Cars Owned	No. of Households	Percentage (%)
1	1	1793	91.57
2	2	159	8.12
3	3 and More	6	0.31
	Total	1958	100.00

Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

Figure 2-12: Distribution of Households by Ownership of Cars and 2 Wheelers



From **Figure 2-12**, it could be observed that of the 48.48% of the Households who own a 2 Wheeler, 84% of the households own only one 2 Wheeler. However it is interesting to observe that 16% of the households own 2 two-Wheelers and 0.5% own 3 or more two-wheelers.

Table 2-16: Distribution of Households by Ownership of 2 wheelers

Sl. No.	No. of 2 Wheelers Owned	No. of Households	Percentage (%)
1	1	2509	83.97%
2	2	465	15.56%
3	3 and More	14	0.47%
	Total	2988	100.00%

Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

2.12.2 Income Profile of Households in the Kochi City

As per the Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013, the distribution of households according to monthly income is as represented in Table 2-17and in the Figure 2-13 below. It is observed that about 22% of households have monthly income less than or equal to Rs. 15000 and 37% have an income between Rs. 15001 – 25,000 per month. The percentage of household having monthly income more than Rs. 25,000 was observed to be about 40.9%. Average household income per month in the study area is observed to be Rs. 29,093/-.

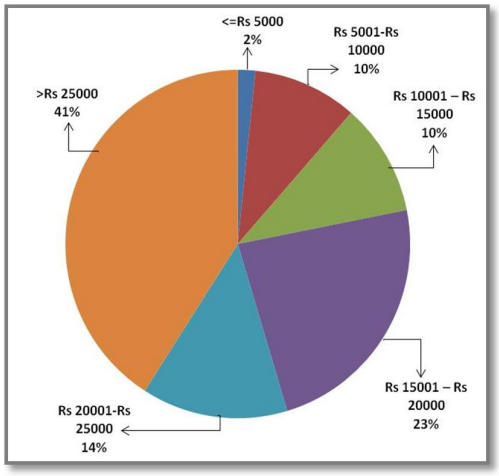


Figure 2-13: Distribution of Households by Income Group

Table 2-17: Distribution of Households by Income Group

S. No.	Income Group	No. of Households	Percentage (%)
1	<=Rs 5000	82	1.6
2	Rs 5001-Rs 10000	488	9.8
3	Rs 10001 – Rs 15000	521	10.4
4	Rs 15001 – Rs 20000	1172	23.5
5	Rs 20001-Rs 25000	683	13.7
6	>Rs 25000	2042	40.9
	Total	4988	100.0

Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

2.12.3 Expenditure on Transport

As per the Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013, the Distribution of Households by Average Monthly Expenditure on Transport is as

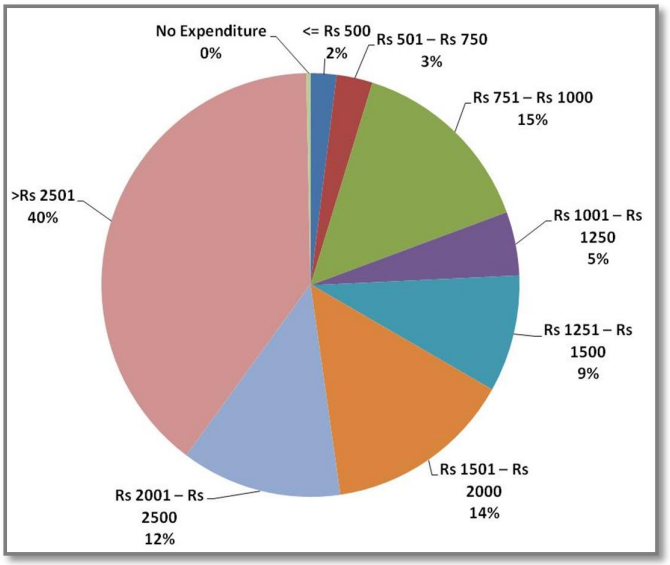
represented in Table 2-18 and Figure 2-14. The table indicates that about 19% of households spend less than or equal to Rs. 1000 per month on transport and nearly 27% have monthly expenditure on transport ranging between Rs. 1501 – 2500. Over 40% of households are having more than Rs. 2500 expenditure per month on transport. Average expenditure on transport per household is estimated as Rs 2845 per month, which is about 9.8% of average household income.

Table 2-18: Distribution of Households by Expenditure on Transport

S. No.	Expenditure on Transport	No. of Sampled Households	Percentage (%)
1	<= Rs 500	100	2.0
2	Rs 501 – Rs 750	139	2.8
3	Rs 751 – Rs 1000	729	14.6
4	Rs 1001 – Rs 1250	242	4.9
5	Rs 1251 – Rs 1500	448	9.0
6	Rs 1501 – Rs 2000	722	14.5
7	Rs 2001 – Rs 2500	619	12.4
8	>Rs 2501	1973	39.6
9	No Expenditure	16	0.3
	Total	4988	100.0

Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

Figure 2-14: Distribution of Households by expenditure on Transport



2.13 Modal Split

As per the Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013, of trips according to mode of travel is given in the Table 2-19. It is observed that about 14% of the trips made are walk trips. The trips performed by 2 wheelers are also about 14%. However, 51% trips are performed by public transport modes including bus, minibus, school bus and ferry. The trips performed by auto rickshaw are a little over 10%, whereas trips performed by cars/taxi/sumo are nearly 9%. Refer **Figure** 2-15.

Table 2-19: Existing Modal split (including Walk trips)

S. No.	Mode	No. of Trips	Percentage (%)
1	Car	179687	7.4
2	Taxi	22,591	0.9
3	Shared Taxi/Sumo/Tavera/In nova	18,461	0.8
4	2-Wheeler	339196	13.8
5	Auto Rickshaw	252875	10.4
6	Public Transport (Bus, Mini Bus, School Bus, Ferry)	1242034	51.1
7	Cycle	26,070	1.1
8	Train	9,744	0.4
9	Walk	344001	14.1
	Total	2434659	100.0

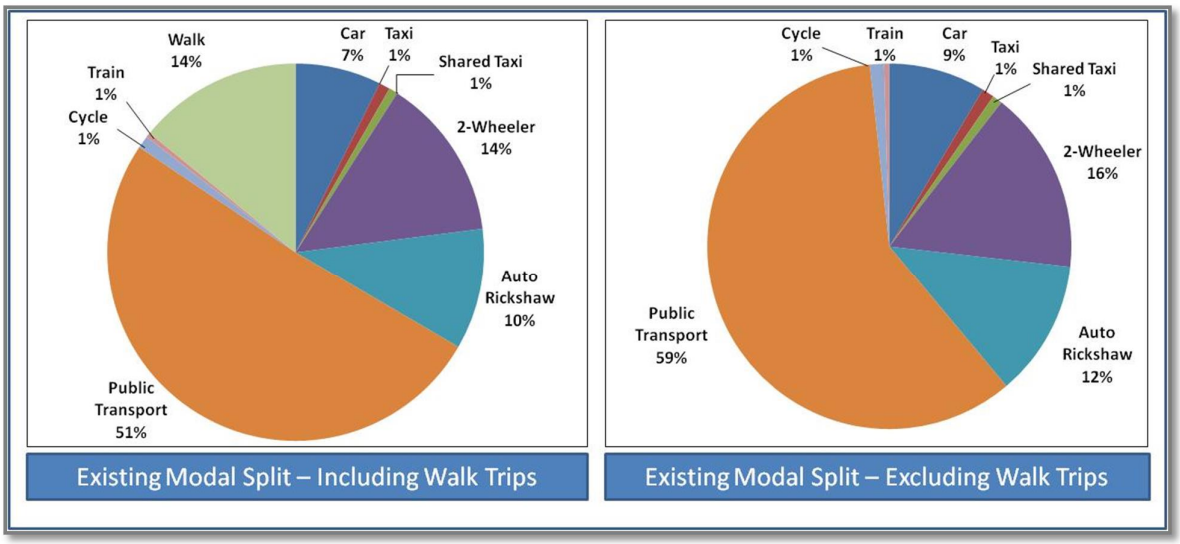
Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

Table 2-20: Existing Modal split (Excluding Walk trips)

S. No.	Mode	No. of Trips	Percentage (%)
1	Car	179687	8.59
2	Taxi	22,591	1.08
3	Shared Taxi/Sumo/Tavera/In nova	18,461	0.88
4	2-Wheeler	339196	16.22
5	Auto Rickshaw	252875	12.10
6	Public Transport (Bus, Mini Bus, School Bus, Ferry)	1242034	59.41
7	Cycle	26,070	1.25
8	Train	9,744	0.47
	Total	20,90,658	100.00

Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

Figure 2-15: Existing Modal (including walk trips/excluding walk trips)



2.14 Per Capita Trip Rate

As per the Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013, the per capita trip rate including walk is 1.17, excluding walk is 1.02.

2.15 Purpose of Journey

As per the Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013, the Table 2-21 and Figure 2-16 show the purpose wise distribution of the trips. It is observed that about 28% of the trips are performed for work and business purpose together, where as 10% trips are for education and about 15% for other trips which includes shopping, social, health and recreation. About 47% trips are return trips.

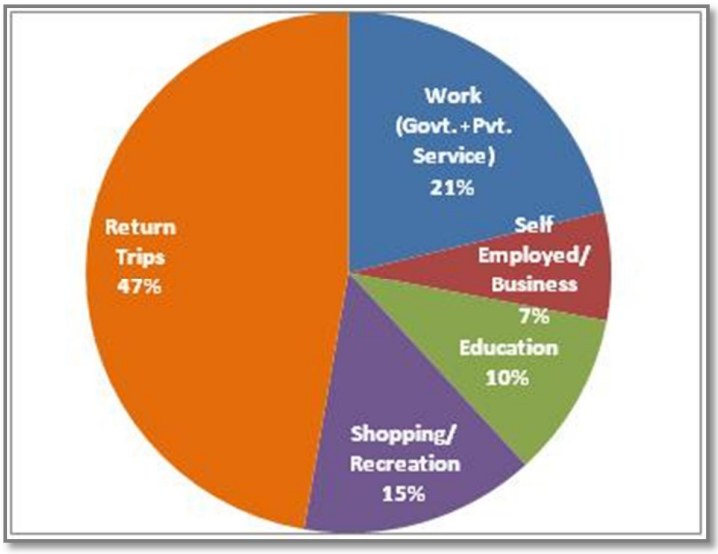


Figure 2-16: Trip Purpose

Table 2-21: Distribution of trips by Trip purpose

S. No	Purpose	No. of Trips	Percentage (%)
1	Work (Govt.+ Pvt. Service)	516,970	21.2
2	Self Employed/ Business	164,770	6.8
3	Education	248,990	10.2
4	Shopping/Recreation	352,741	14.5
5	Medical		
6	Social		
7	Others		
8	Return Trips	1,151,188	47.3
	Total	**2,434,659**	**100.0**

Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

2.16 Average Trip Length

As per the Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013, **Table 2-22** shows the Mode wise average trip lengths in Kochi City. Average trip length for walk is 1.1 Km, for 2-wheeler 9.7 km, for car and taxi is 13.6 km and 16.1 km respectively and for Bus it is about 11.3 km.

Table 2-22: Mode Wise Average Trip Lengths

Mode	Average Trip Length (Km)	Mode	Average Trip Length (Km)
Car	13.6	**Mini Bus**	7.6
Taxi	16.1	**School Bus**	7.9
Sumo/Tavera	9.7	**Ferry**	8.9
Two Wheeler	9.6	**Cycle**	4.4
Auto	7.4	**Train**	44.1
Bus	11.3	**Walk**	1.1

Source: Feasibility and Detailed Project Report for the Phase II of Kochi Metro by RITES, 2013

3 Existing Public Transport System Characteristics

3.1 Introduction

The major public transport modes existing in Kochi are the city buses, auto rickshaws and ferry boats which are operated mainly by state, but also by private operators. The bus system is an extensive network which covers the whole of the city providing fast and efficient bus transport system, mainly dominated by private operators. They offer a no-frills travel within the city, forming a major backbone of public transport, despite the issue of reliability and erratic driving behaviour. The ferry system is the predominant and in some cases the sole mode of transportation for the islanders of Kochi city region.

The mode share of the city shows a healthy 51% share of public transport modes as seen in Figure 3-1. But as the population of a city grows, share of public transport, whether road or rail-based, should increase.

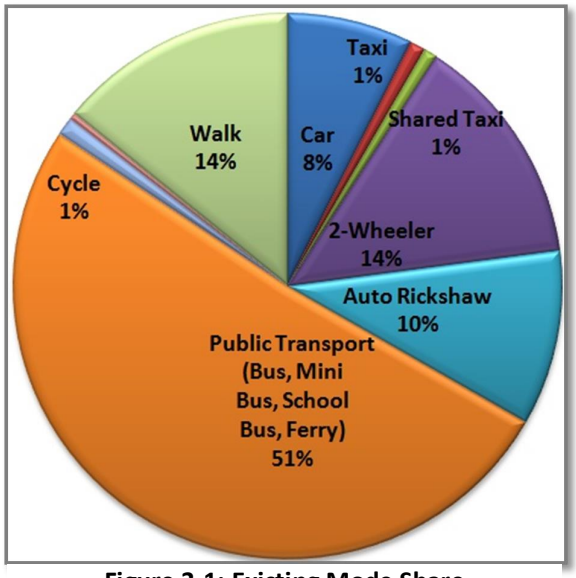


Figure 3-1: Existing Mode Share

Table 3-1 shows the average trip length by public transport to be 11.3 km while by ferries it is observed to be 8.9 km.

Table 3-1: Average Trip Length of Modes

Mode	Average Trip Length (Km)	Mode	Average Trip Length (Km)
Car	13.6	**Mini Bus**	7.6
Taxi	16.1	**School Bus**	7.9
Sumo/Tavera	9.7	**Ferry**	8.9
Two Wheeler	9.6	**Cycle**	4.4
Auto	7.4	**Train**	44.1
Bus	11.3	**Walk**	1.1

Feasibility and DPR for the Kochi Metro-Phase 2 by RITES, 2013

The National Urban Transport Policy (NUTP) recommends to "encourage and support investments in facilities that would keep people away from the use of personal vehicles rather than build facilities that would encourage greater use of personal motor vehicles" in order to promote sustainable development of the urban areas.

The present public transport system may not be able to keep its present modal share under the current scenario unless the policy changes are in favour of Kochi City Development Plan and are implemented, complimenting them with an improved public transport system infrastructure. The NUTP document also further state that the Central Govt. would therefore, recommend the adoption of measures that restrain the use of motor vehicles through market mechanism such as higher fuel taxes, higher parking fee, reduced availability of parking spaces etc.

3.2 Bus Transport System

Bus Transport System plays a vital role in meeting the travel demands of the city's population. Kochi City and the neighbouring satellite towns primarily depend on the bus transport system.

In 2010, the state public transport company, KSRTC started city services due to frequent complaints against the private buses. KSRTC operates two classes of service: a basic no-frills service known as the Thiru-Kochi which has the same fare system as the private buses. These buses are distinguishable by their blue-white livery and are JNNURM funded transport services. The JNNURM transport services operated by KSRTC also offer premium air-conditioned low-floor bus services and non-air conditioned semi low floor buses. Both

the buses connect the central business district areas of Kochi with the nearby suburbs. Currently these premium bus services are available as per the schedule published by KSRTC.

The private buses operate from different parts of the city as well as from the satellite towns and cater to the travel needs of both the intra-city and inter-city passengers. At present, 650 intra-buses are authorised to operate inside the city on 160 routes[2]. The city also caters to nearly 2100 long-distance private buses, which include 466 inter-city state buses.

The city has primarily four major bus stations:

- **Kaloor Bus station** which is a major terminus used by privately operated long-distance buses and local red-buses. It is also a major stop for private mofussil services.
- **KSRTC South Bus Station** in Ernakulam south, near the Ernakulam junction railway station which is exclusively operated by KSRTC inter-state/inter-city buses. Buses of the neighbouring state transport corporations also operate their services from this bus station.
- **KSRTC Jetty Station**, located near Ernakulam Boat Jetty in Park Avenue, is used by KSRTC city and short distance services.
- **Fort Kochi Bus Terminus**, located near Fort Kochi beach, is a major bus station for both private and KSRTC City services.

A large integrated public transport terminus at Vytilla known as Integrated Mobility Hub has been set up to ease congestion within the city limit, it acts as a converging point for various modes of public transportation like intra-city and long distance buses, metro rail and boat services. The Mobility Hub provides space for 170 buses, 2000 car bays, 50 inter-state buses parking bays, 5,000 two- and three-wheeler parking bays and a boat jetty with 3 piers for ferry transport. A shopping mall and commercial towers are planned in the second phase to sustain with additional revenues. The present bus route map is shown in the Figure 3-2.

[2] Traffic and Transportation Study Report for Kochi, Kochimetro.org

Most of the city bus services operated in Kochi City converges on MG road at some point or

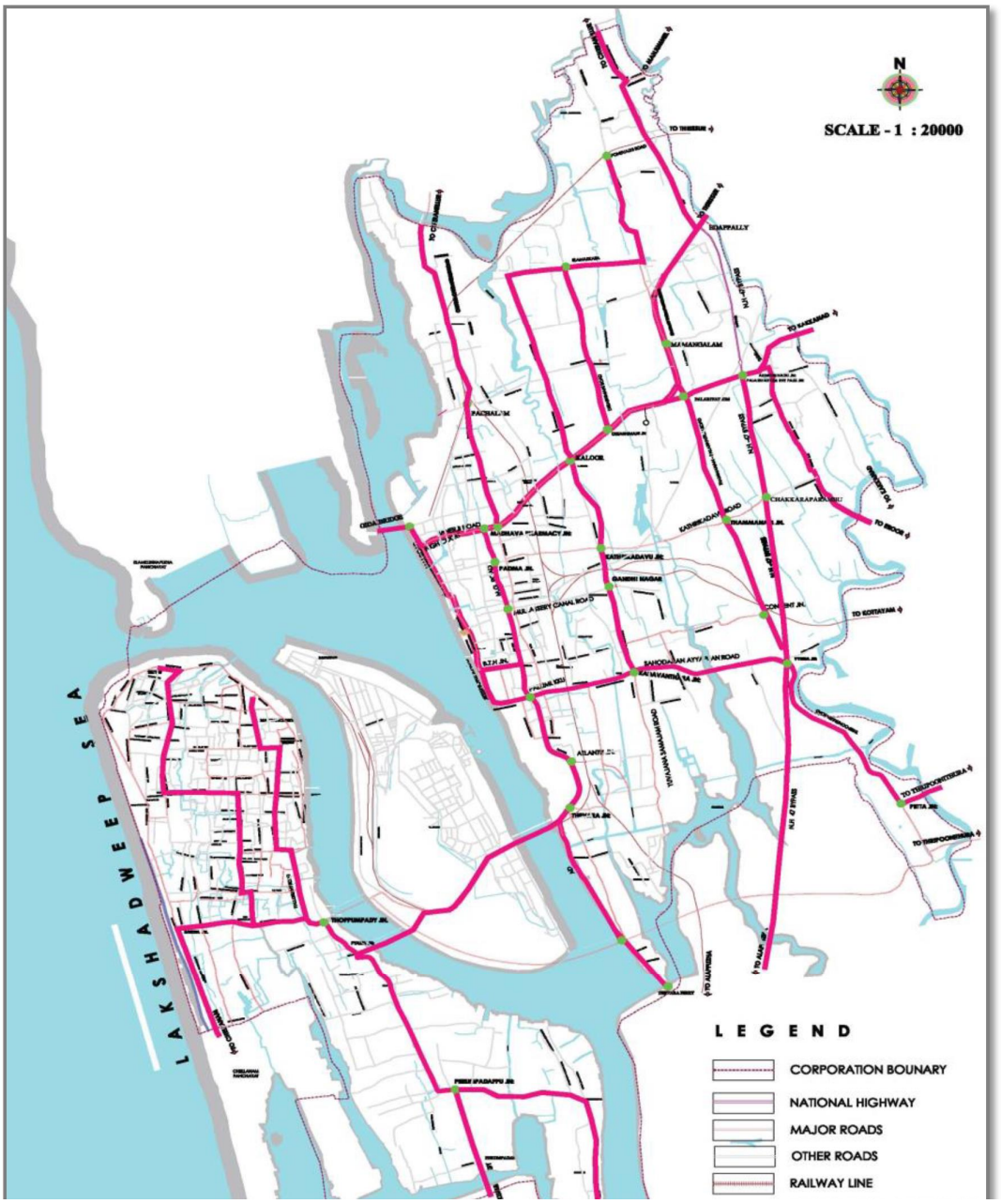


Figure 3-2 Current Bus Routes

Source: NATPAC

other making it the most congested travel corridor. Volume of buses varies along different sections of MG road from 3,000 to 6,000 buses per day. Apart from MG road there are two other important travel corridors in Kochi city, viz, Bannerji road and Sahodaran Ayyappan road, which connects the eastern and western parts of the city. Though the permitted

carrying capacity for city buses is 56, during the peak hours, the buses are found to be over crowded with more than 100 passengers in major travel corridors of the city.

The maximum boarding and alighting of bus passengers is observed at Menaka, Kaloor, Kacheripady and High Court bus stops, which indicates the concentration of office, business complexes and activity centres around these locations.

3.3 Kochi Metro Rail System

Peak hour traffic demand for the main trunk leading to the central business district of the city that is the Aluva - Petta Corridor has been assessed as 13,681 phpdt for the year 2015[3] and this is likely to increase to 21,065 phpdt by the year 2025. Road-based public transport, is therefore not envisaged to meet this demand and the need for a rapid mass transit system was identified for the city. In view of this, a metro rail system which is fast, safe, reliable, and environment-friendly has been proposed as the mass transport system for the city and is currently under construction. It is being implemented as a joint venture, with investments by the Central and State Government. A special purpose vehicle (SPV) called Kochi Metro Rail Ltd. (KMRL) was formed as per orders from the Ministry of Urban Development, Government of India for the implementation, operation and maintenance of the metro project.

The metro covers a stretch of 25.6 km from Aluva to Petta and constitutes 22 stations at the major attraction and production locations along the alignment like the CUSAT University, Lulu Mall, JLN stadium, MG Road the commercial hub, Ernakulam South Railway station and Vytilla mobility hub. Figure 3-3 shows the metro alignment with the station names.

[3] Kochi Metro project, Aluva-Petta Corridor, DMRC DPR 2011

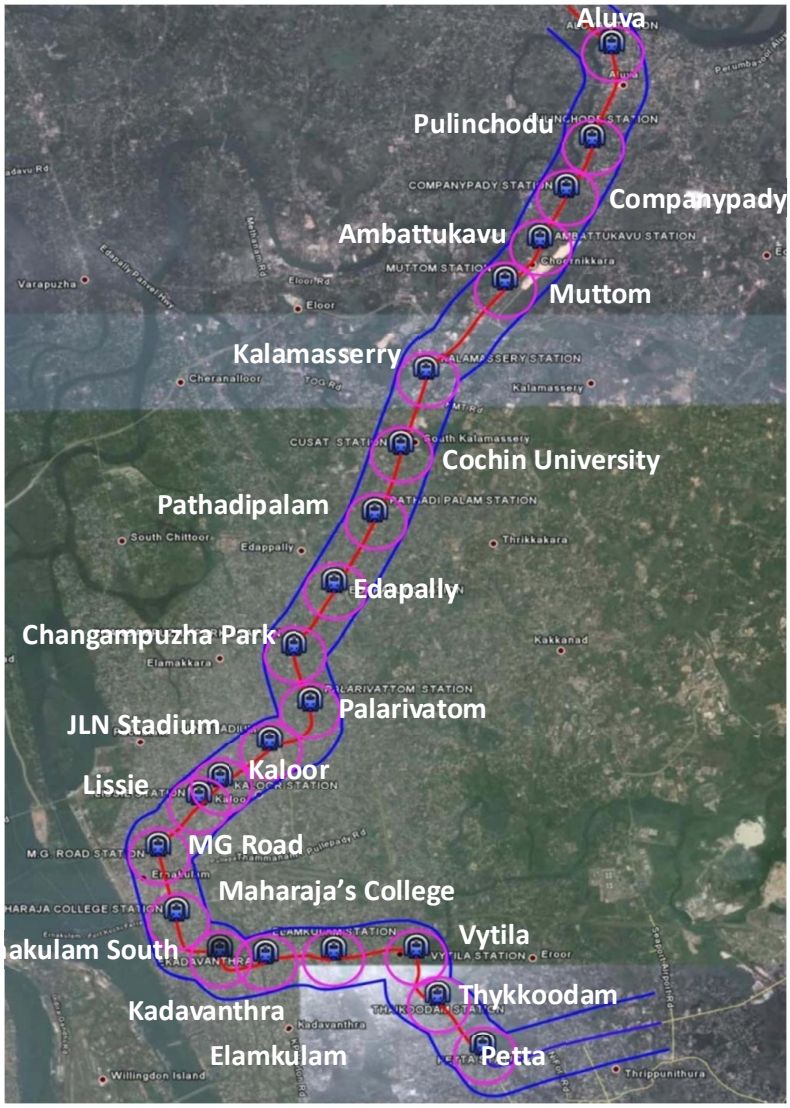


Figure 3-3: Metro Alignment with Station names

3.4 Existing Ferry System in Kochi

This section discusses the various parameters of the currently operational water transport system such as their routes, deployment of boats and its integration with the other existing modes of transport.

3.4.1 Ferry System Characteristics

State Water Transport Department (SWTD), operates the water transport in Kochi. SWTD operates services from the following 10 jetties/ferry terminals;

1. Ernakulam
2. High Court
3. Fort Kochi
4. Mattancherry
5. Embarkation (Wellington Island)
6. Vypeen
7. Mulavukadu
8. Vytilla
9. Eroor
10. Kakkanad

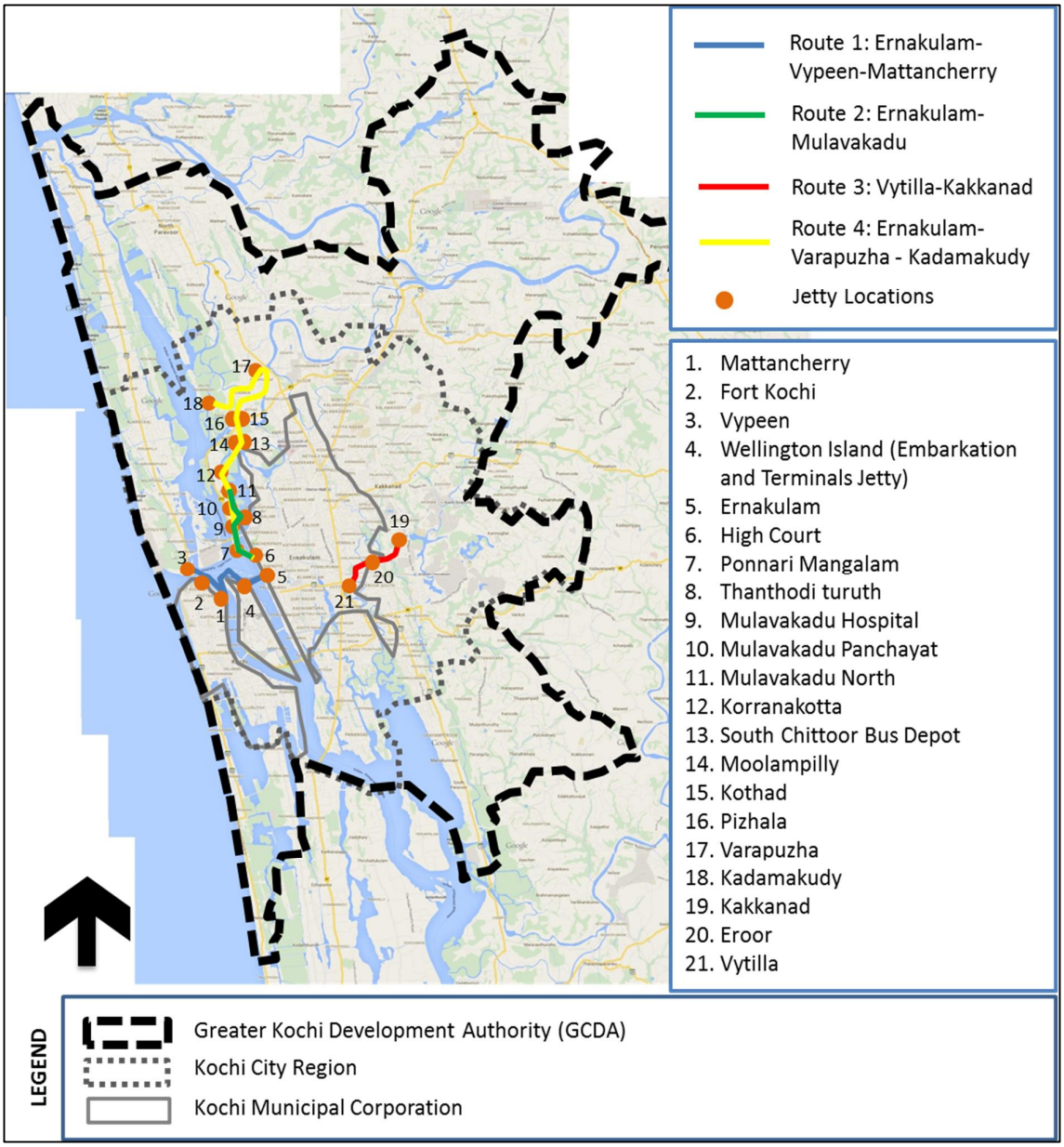
The boats/ ferries operated by the SWTD, private operators, Tourism Department and KSINC act as a principal link between the mainland and the islands. Majority of these boats are old and in a dilapidated state, due to which the water transport system is losing out on competing with the other road based motorized modes in the city. SWTD operates currently only 9 boats (source: SWTD) in the area. On these 9 boats, about 152 regular staff and 15 contractual staff are employed making it a heavily loaded system with 18.5 staff per boat.[4] Private boats operate in the area, but these are not certified by Indian Registrar for Shipping (IRS) for their design and safety aspects, which is mandatory for passenger boats. Also, these do not have a fixed schedule for operation.



As mentioned in the previous sections, there were once 60 operational jetties connecting island communities with the mainland, however only a few of those jetties are operational today. According to State Water Transport Department, currently there are 4 operational routes connecting the 21 jetties which are operational. **Figure 3-4** represents the operational routes and jetties in Kochi.

[4] Based on KMRL's discussions with SWTD representative

Figure 3-4: Existing Operational Ferry Routes and Jetty Locations in Kochi



Source: Kerala State Water Transport Department (KSWTD)

As per data from the Kerala State Water Transport Department (KSWTD), the following four routes are operated between 21 operational jetties connecting the islands to the mainland. **Table** 3-2 gives the daily ridership details along these routes

1. Section 1 – Ernakulam – Mattancherry – Vypeen – there are two routes one, via Wellington Island and the other directly to Vypeen. The first route takes about 20

minutes, and operates between 6 am and 9 pm, with headway of 30 minutes. The second route takes about 15 minutes, and operates between 7 am and 9:30 pm, with headway of 30 minutes.

2. Section 2 – Ernakulam – Mulavakadu- journey time of approximately 20 minutes, operating between 7 am and 6 pm, with headway of 30 minutes.
3. Section 3 – Vytilla – Kakkanad – this route takes approximately 30 mins and operates between 7 am and 6 pm, with headway of 1 hour.
4. Section 4 – Ernakulam – Varapuzha – Kadamakudy – this journey takes up approximately 1 hour to complete and has 6 services between 7 am and 7 pm.

Based on the route wise and jetty wise ridership data from the State Water Transport Department, the daily boarding and alighting counts are represented in the table below. It may be observed that Ernakulam Jetty, Fort Kochi, Wellington Island, Mattancherry and Vypeen have the maximum daily boarding and alighting.

Table 3-2: Jetty Wise Total Daily Boarding and Alighting

Sl. No	Jetty Names	Daily Boardings	Daily Alightings	Total
1	Ernakulam	4210	3960	8170
2	Fort Kochi	3300	3250	6550
3	Embarkation (Wellington Island)	1250	1200	2450
4	Terminals Jetty (Wellington Island)	900	1100	2000
5	Mattancherry	900	950	1850
6	Vypeen	750	850	1600
7	High Court Jetty	250	265	515
8	Pizhala	200	130	330
9	Vytilla	150	150	300
10	Kakkanad	150	150	300
11	Chittoor	110	173	283
12	Mulavakadu Panchayat	150	107	257
13	Thandonithuruth	125	100	225
14	Varapuzha	80	110	190
15	Mulavakadu North	70	40	110
16	Eroor	50	50	100
17	Kadamakudy	40	40	80
18	Poonari Mangalam	25	50	75

Sl. No	Jetty Names	Daily Boardings	Daily Alightings	Total
19	Bolgatty North	20	50	70
20	Chennur	30	15	45
21	Moolampilly	25	20	45
22	Mulavakadu Hospital	10	25	35
23	Korrankotta West	0	10	10
24	Kandanadu	10	0	10
25	Korrankotta	0	5	5
26	Kothad	0	5	5
Total		**12805**	**12805**	**25610**

Source: Kerala State Water Transport Department (KSWTD)

Figure 3-5: Desire line of the Total daily ridership of water transport (2014)



Source: Kerala State Water Transport Department (KSWTD)

Figure 3-5 represents the existing desire line diagram for the water transport system in the city region. The diagram clearly indicates that the majority of the daily trips occur between

Ernakulam, Fort Kochi, Mattancherry, Wellington Island and Vypeen jetties. This can be primarily attributed to the frequency of services available at these location/jetties.

Based on the daily ridership data on the operational routes, maximum sectional loads in the peak hour for each of the operational routes have been estimated. The estimation is based on certain assumptions and available data, which are as follows;

1. The speed of the boat is 8 knots[5] as indicated by KSWTD (however, the primary surveys indicate the boat speeds at 5-6 knots).
2. The capacity of the boat is assumed at 70 for Route 1 and 50 for Route 2, Route 3 and Route 4, with a load factor of 0.50.
3. The Peak Hour flow has been considered in the following manner, which is based on the data from the past studies on inland passenger water transport for Kochi
   a. 20% of the total daily ridership in the Route 1 and Route 2.
   b. 15% of the total daily ridership in the Route 3.
   c. 25% of the total daily ridership in the Route 4.
4. Operational hours of the ferry system is 16 hours (06:00 am to 09:00 pm)

Table 3-3: Maximum Sectional Loads for the Operational Routes

Sl No	Routes		Route Length (km)	Daily Ridership	Maximum PPHPD
1	Route 1	ERNAKULAM-VYPEEN-MATTANCHERRY	18.8	13440	840
2	Route 2	ERNAKULAM-MULAVAKADU	11	800	50
3	Route 3	VYTILLA - KAKKANAD	8	368	23
4	Route 4	ERNAKULAM-VARAPUZHA-KADAMAKUDY	13	592	37
Total			50.8	15200	950

Source: Kerala State Water Transport Corporation (KSWTC)

From the Table 3-3, it is observed that the maximum passengers in the peak hour peak direction (PHPDT) could be observed on Route 1 which is Ernakulam, Vypeen and Mattancherry. The total daily ridership in one direction is observed to be 15,200.

[5] 1 knot – 1.852 kmph

3.4.2 Ferry Passenger Characteristics based on secondary data

Various transport studies in recent years for Kochi had undertaken public transport passenger surveys at the ferry terminals. An overview of the results of these studies is presented below:

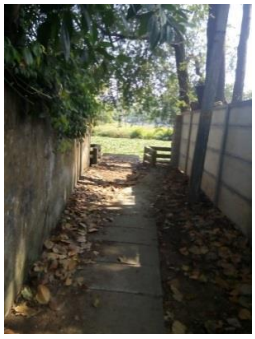
- The modal share of public transport in Kochi is 51% which includes Bus, Mini Bus and Ferry services.
- The average trip length of a ferry service is 8.9 km.
- The peak hour for each jetty is different and during the peak hour, the jetties carry approximately 25% to 35% of the daily traffic flow.
- 49% of the passengers use ferry for their work and business trips and about 16% of the passengers use it for fulfilling education trips. Around 14% of tourists are using the ferry services in the study area.
- 54% of the passengers use the ferry services for their trips on a daily basis while 20% of the passengers perform their trips weekly.
- 49% of the passengers disperse from the jetties through buses. Share of passenger dispersal by two wheelers and auto rickshaws account to about 28%, whereas walk is for 16% of the trips.
- 51% of the total passengers take less than 15 minute and about 23% passengers take 15-30 minutes to reach IWT terminals from their trip origin location.
- 44% of the passengers spend between Rs 5/- to Rs 10/- to reach the IWT terminals from their trip origin location.

3.5 Existing Jetty Infrastructure

There is limited infrastructure available at the existing boat jetty locations. Based on ground survey with the stakeholders, only Ernakulam Main Jetty, High Court Jetty, Fort Kochi and Vypeen Jetty were found to have relatively acceptable level of infrastructure. Of these, only Ernakulam and High Court Jetties are recently built with RCC structures. All other jetties, identified in the project have a simple concrete retaining wall as jetty with a dilapidated jetty shelter, which cannot house more than 6 people at a single time. The jetty areas are dark and not safe for public use in the evening. These jetty locations lack a proper transit supportive infrastructure, which has been cited by the boat users and other

people living in the influence areas, as one of the reasons for decreasing use of boats as the access is not safe, convenient and appealing.

Figure 3-6: Existing Jetty infrastructure at Varapuzha and Mulavakadu





3.6 Existing Institutional Set up for Water Transport in Kochi

There are several government and non-government agencies that have a stake in the operation of the waterway transportation in Kochi. Coordination among these agencies is, therefore, a major requirement for the smooth functioning of this sector (refer Table 3-4).

Table 3-4: Institutional bodies and their functions

Agency	Centre/State/Local	Functions
Inland Waterways Authority of India (IWAI)	Centre	• Carry out surveys and investigations for the development, maintenance of the national waterways and the appurtenant land. • Setting up of infrastructural facilities for national waterways. • Provide for the regulation of navigation and traffic. • Regulate the construction or alteration of structures on national waterways. • Ensure co-ordination of IWT on national waterways with other modes of transport. • Establish and maintain pilotage on national waterways.
Kerala State Water Transport Department (KSWTD)	State	• Operates passenger services on majority of routes. • Takes care of ticketing and maintenance of its vessels. • Operates 9 boats in Kochi waterways, with about 152 regular staff and 15 contractual staff are employees making it a heavily

Agency	Centre/State/Local	Functions
		loaded system with 18.5 staff per boat.
Kerala State Inland Navigation Corporation (KSINC)	State	• Establish, maintain and operate shipping services and to purchase, charter, hire, build ships, tankers and other vessels. • Establish, maintain and operate transportation services for the transport of goods and passengers in inland water in the state of Kerala or elsewhere. • Run, organise, conduct and manage in the state of Kerala or elsewhere workshops, repair shops, service stations for repair and maintenance of marine vessels. • Establish, provide, maintain and conduct research and training institutions and lab centres.
Cochin Port Trust (CPT)	Central	• Major portion of Ernakulam boat jetty falls under the purview of the Cochin Port, Ministry of Shipping, Government of India, clearances have to be obtained from the Cochin Port Trust (CPT) for operation of passenger or tourist boat services in this area. • Apart from the registration of the boats with the motor vehicles department, boats have also to be listed with the CPT before operating in this stretch.
Department of Irrigation	State	• Maintenance of all the water channels that do not come under the purview of IWAI. • De-silting and dredging of the channels and maintaining a steady minimum depth of 2m. • They play a major role in ensuring that all jetties are usable throughout the year.
Corporation of Cochin	Local	• Ferry services from Fort Kochi and Vypeen to Ernakulam comes under its purview. • Issue licenses to private operators to operate Jangar and boat services on the Vypeen-Fort Kochi stretch.
Greater Cochin	Local City Region	• Guiding the development in Greater Cochin region. • Preparation of structural plan for Cochin and vision documents for the region. • Identifying projects in order to attract

Agency	Centre/State/Local	Functions
Development Authority (GCDA)		development in certain parts of the region. • Maintain and collect rent from its shopping complexes at various locations.
Goshree Island Development Authority (GIDA)	Local City Region Islands	• Guide the development in the Goshree group of islands. • Help bridge the gap between the islands and the mainland, in terms of infrastructure.

3.7 Metropolitan Transport Authority - Kochi (MTA-KOCHI)

Metropolitan Transport Authority - Kochi is being established in lines with the National Urban Transport Policy with the objective to bring all activities and projects related to urban transportation under a single decision making organisation. The Authority shall consist of the following members:

- The Chairperson - officer nominated by the State Government of a rank not below that of Secretary to the State Government;
- Secretary of the Development Authority for the relevant Urban Mobility Area;
- District Collector for the relevant Urban Mobility Area;
- Secretaries of the Municipal Corporations/Municipalities in the relevant Urban Mobility Area;
- Secretary, Urban Development Department;
- Secretary, Transport Department;
- Secretary, Finance Department;
- Secretary, Public Works Department;
- City Police Commissioner;
- Managing Director of the Road Transport Corporation
- An officer nominated by the Metro Rail or Mono Rail Corporation of the relevant Urban Mobility Area (as applicable).
- An officer nominated by the National Highway Authority of India, if a National Highway connects passes through the relevant Urban Mobility Area;

- General Manager, Southern Region of the Indian Railways or an officer nominated by him not below the rank of Divisional Railway Manager, if any Indian Railways route connects passes through the relevant Urban Mobility Area;
- An officer nominated by the Inland Waterways Authority (IWAI), if a National waterways is located within the relevant Urban Mobility Area;
- Two experts nominated by the State Government who shall be from the fields of transportation engineering, corporate governance, finance, law, as the State Government may nominate.

3.7.1 Duties and Functions of the Authority

The duties and functions of the authority are as listed below:

- Preparation of a Comprehensive Mobility Plan, including but not limited to public transportation, and non-motorised transportation within the Urban Mobility Areas in conjunction with the area development plan where applicable for a horizon period of at least twenty years in each instance, and updation of such plans every five years to ensure integration of land use planning and transport planning on a regular basis.
- To achieve the goals of the approved Comprehensive Mobility Plan, preparation of a Transport Investment Programme for the Urban Mobility Area to provide guidance to the various agencies engaged in provision of the Urban Transport and the Urban Transport Ancillary Services to prepare their own investment programmes and projects in alignment with the overall Transport Investment Programme.
- Planning for financing, construction, and operation of facilities and services related to the Urban Transport and the Urban Transport Ancillary Services in the Urban Mobility Area.
- Promotion, development and regulation of integrated facilities and systems for Urban Transport within the Urban Mobility Area including developing systems for seamless transport access within the Urban Mobility Area.
- Development, construction, integration, operation and management of any integrated or stand-alone transport network facilities, services, schedules and timetables that aid and enhance the efficiency or service levels of the Urban

Transport to the consumers, in the Urban Mobility Area, either suo-moto or through agencies appointed for this purpose excluding railways.

- Creation and management of a common Command & Control Centre for integration, coordination and management of Urban Transport in the relevant Urban Mobility Area.
- Adoption of existing standards and guidelines provided by the Central and State Governments from time to time and, as necessary, development, publication, and issuance of its own standards and guidelines relating to the development and operation of Urban Transport facilities and services within the Urban Mobility Area in accordance with the requirements, taking into consideration the needs of persons with disability, elderly, women and children and establishing measures that ensure compliance of the same by various relevant public and private transport operators in the Urban Mobility Area.
- Development and dissemination of service level performance indicators for Urban Transport services within its jurisdiction.
- Regulation and enforcement of technical and performance standards on all strategic and operational matters that have a direct effect on the levels of service provided to the users of Urban Transport.
- Regulation and enforcement of environmental standards for all aspects related and/or incidental to the Urban Transport and the Urban Transport Ancillary Services.
- Administration of the Urban Transport Fund
- Setting up and operation of a control center, a web based user information system, and a helpline to provide integrated information to the users of Urban Transport in the Urban Mobility Area.
- Setting up and operation of a smart card based ticketing system for payment of user charges for Urban Transport and Urban Transport Ancillary Services.
- Promotion of technology-based solutions for traffic management, transport planning, and design of transport systems and selection of mode of transport.
- Collation of information on urban transportation within Urban Mobility Area and provision of the same to the relevant agencies with a view to contributing to the national database on urban transport.

- Publication & display of information for the users of various urban transport services within the Urban Mobility Area with a view to promote consumer awareness on the integrated urban transport system.
- Undertaking activities for the purpose of advancing the skills of persons employed by the Authority or the efficiency of the equipment of the Authority or the manner in which the equipment is operated including the provision of facilities of training, education and research.
- Enter into agreements and or make recommendations to the Railways on services, schedules and timetables to enhance the efficiency or service levels of the Urban Transport in the Urban Mobility Area.
- The Authority may appoint any person/agency to perform any activities and/ or works mentioned in relation to its function, Provided that such work or activities undertaken by any person or agency shall be subject to such restrictions, limitations, and conditions as may be laid down by the Authority, and shall also be subject to the supervision, control and revision by the Authority.
- The Authority may from time to time incur expenditure and undertake works in the Urban Mobility Area.
- The Authority shall ensure effective implementation of this Act in the Urban Mobility Area and perform such functions and duties as the State Government may prescribe.

4 Primary Surveys and Analysis

4.1 Introduction

Due to the lack of infrastructure and the irregular frequencies of the existing ferry services, the traditional water based transit has been losing its ridership to the road based motorized transit systems. Based on various levels of interactions with the local communities and reconnaissance surveys, it was observed that water transport cannot be viewed in isolation and needs to be incorporated at all levels with the other modes of transport functional within the city. With limited secondary data available to review the existing water transport system and conceptualise an integrated water transport system for the future, primary surveys were carried out in order to analyse the demand for water transport system and develop a logic based case for an improved system in the future.

This chapter discusses the results from the various primary surveys conducted to build the database to evaluate the water transport system in Kochi. The detailed primary analysis is given as annexure III.

4.2 Primary Data Analysis

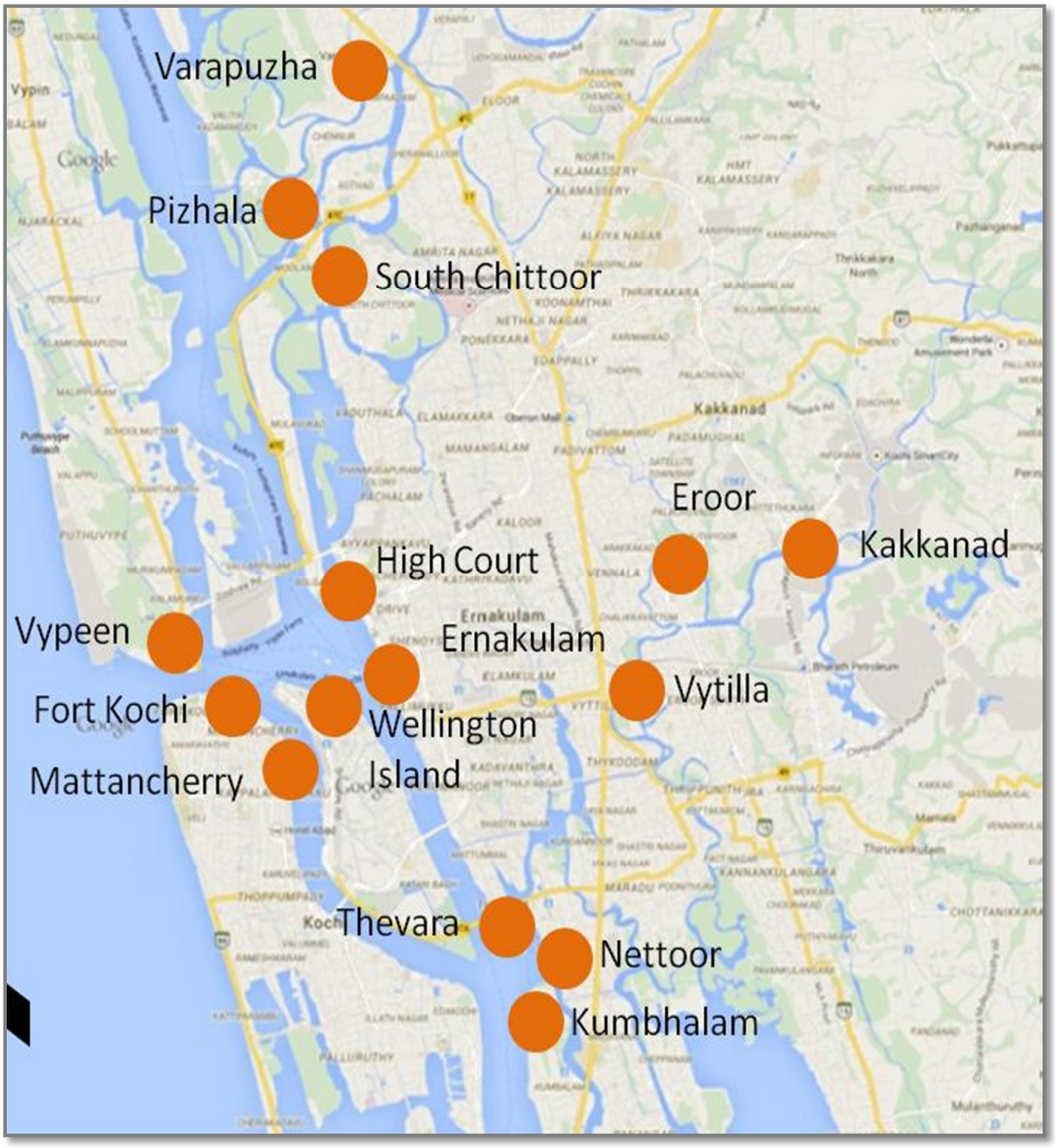
Based on the review of the secondary data and after identification of data gaps, the following primary surveys were conducted;

1. Jetty wise Boarding and Alighting Count Survey
2. Water Transport Passengers Origin and Destination cum Opinion Survey
3. Household Surveys

4.2.1 Jetty wise Boarding and Alighting Survey

The Boarding and Alighting Counts and Ferry Passenger Opinion Surveys were carried out at fifteen identified locations in the month of January, 2015. These locations were identified based on the intensive reconnaissance surveys carried out, stakeholder consultations with the various Gram Panchayats and observed passenger volumes in secondary data available from State Water Transport Department. The survey formats are attached in the Annexure II. The identified survey locations are as shown in the Figure 4-1.

Figure 4-1: Survey locations



4.2.2 Inferences from Boarding and Alighting Survey

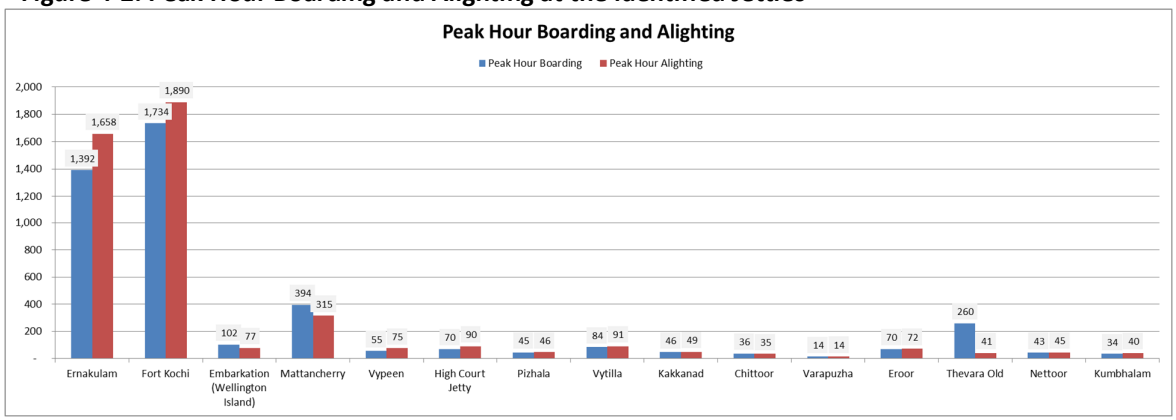
Table 4-1 summarizes the boarding and alighting counts undertaken at the 15 jetty locations. The maximum loading was recorded at Ernakulam Jetty, followed by Fort Kochi; whereas the minimum loading was recorded at Varapuzha. It was observed that the peak hour boarding and alighting approximately constitutes 34% of the daily ridership.

Table 4-1: Boarding and Alighting Counts at Jetty Locations

Sl. No	Jetty Names	Daily Boardings	Daily Alightings	Total (B+A)	Peak Time	Peak Hour Boarding	Peak Hour Alighting	Peak Hour Total (B+A)
1	Ernakulam	4,095	4,876	8,971	1600 to 1700	1,392	1,658	3,050
2	Fort Kochi	4,229	4,610	8,839	1800 to 1900	1,734	1,890	3,624
3	Embarkation (Wellington Island)	528	665	1,193	1700 to 1800	102	77	179
4	Mattancherry	692	553	1,245	1800 to 1900	394	315	710
5	Vypeen	205	277	482	1700 to 1800	55	75	130
6	High Court Jetty	278	358	637	1700 to 1800	70	90	159
7	Pizhala	263	271	533	1600 to 1700	45	46	91
8	Vytilla	161	174	335	1700 to 1800	84	91	174
9	Kakkanad	142	150	292	1800 to 1700	46	49	95
10	Chittoor	163	158	320	1800 to 1900	36	35	70
11	Varapuzha	28	29	56	1600 to 1700	14	14	28
12	Eroor	225	232	457	0900 to 1000	70	72	142
13	Thevara Old	1,237	1,028	2,265	1700 to 1800	260	41	301
14	Nettoor	201	209	410	0800 to 0900	43	45	89
15	Kumbhalam	188	222	410	1900 to 2000	34	40	75
Total		12,634	13,811	26,445		4,379	4,538	8,918

Source: Primary Surveys, UMTC

Figure 4-2: Peak Hour Boarding and Alighting at the identified Jetties



4.2.3 Origin -Destination cum Opinion Surveys: Ferry Passenger Characteristics

The Origin-Destination Surveys were also conducted at the identified 15 jetty locations to understand the Passenger information in relation to their origin and destination. The detailed analysis of the same was carried out to understand the distribution of ferry trips commuter's educational background, their occupation, household income and expenditure on transport, trip frequency and trip purpose, vehicle ownership, access and egress trip characteristics etc. The inferences drawn from this survey are discussed herein. The detailed analysis has been attached in the annexure III.

4.2.4 Inferences from Origin-Destination cum Opinion Survey

The following observations were drawn from the Origin-Destination cum Opinion Surveys conducted at the selected 15 jetty locations.

1. The average monthly income of the ferry passengers is observed to be Rs 12,500/-
2. The average monthly expenditure on transport by ferry passengers is observed to be Rs 625/-, which is 5% of their average monthly income.
3. 41% of the ferry passengers do not own vehicles, as they mainly constitute of students, unemployed, housewives, retired people and others.
4. 81.36% of the ferry passengers use the ferry services operated in Kochi on a daily basis.
5. 55.56% of the passengers use the ferry system exclusively for work and business purposes.
6. As for the access trips, it is observed that 53.05% of the ferry passengers access jetty locations on foot, followed by 37.63% who use the public transport.
7. The average length of an access trip is 4 km, the average time taken for an access trip is 17.5 minutes and the average trip cost is Rs 7.5/-.
8. As for the Line Haul trips, it was observed that the average trip length is 4 km, as majority of these trips are between opposite ends of the canal such as Pizhala and Kothad, Moolampilly and South Chittoor etc.
9. The average time taken for a Line haul trip is 25 minutes and the trip costs Rs 7.5/-
.

10. As for the egress trips, it is observed that 53.76% of the ferry passengers disperse from the jetty locations on foot, followed by 36.72% by public transport.
11. The average trip length for the egress trips is 2.5 km, the average trip time for an egress trip is 17.5 minutes, and the average trip cost is Rs 7.5/-.
12. Majority of the ferry passengers use the public transport (bus) as an alternate mode of transport. They use the alternate modes primarily due to the irregular operations of the ferry systems and lack of proper access to the jetty locations being the major reasons, followed by easily available modes for emergency purposes and personal uses.
13. It was also observed from the surveys that 60.57% of the existing passengers are willing to pay 10% more than the current fares to access a better and improved ferry transport system.
14. Major Origin-Destination Pattern: Based on the Origin Destination Survey conducted at the Jetty Locations, it was observed that the maximum movements were observed between Mattancherry – Fort Kochi, Ernakulam-Wellington, Ernakulam-Fort Kochi, Thevara-Nettor etc. Refer **Table** 4-2.

Table 4-2: Major OD Pairs in the Morning and Evening Peak Hour

Sl. No.	ORIGIN	DESTINATION
1	Mattancherry	Fort Kochi
2	Ernakulam	Wellington Island
3	Fort Kochi	Palarivattom
4	Kadavanthara	Kakkanad Info Park
5	Thevara	Nettor
6	Thevara	Kumbhalam
7	Ernakulam	Fort Kochi
8	Kaloor	Fort Kochi
9	Kakkanad	Fort Kochi
10	Mulavakadu	High Court
11	Mulavakadu	Vaduthala

Source: Primary Surveys, UMTC

4.2.5 Household Surveys

To understand the socio-economic characteristics of the users of the ferry system, household surveys were also carried out as part of the study.

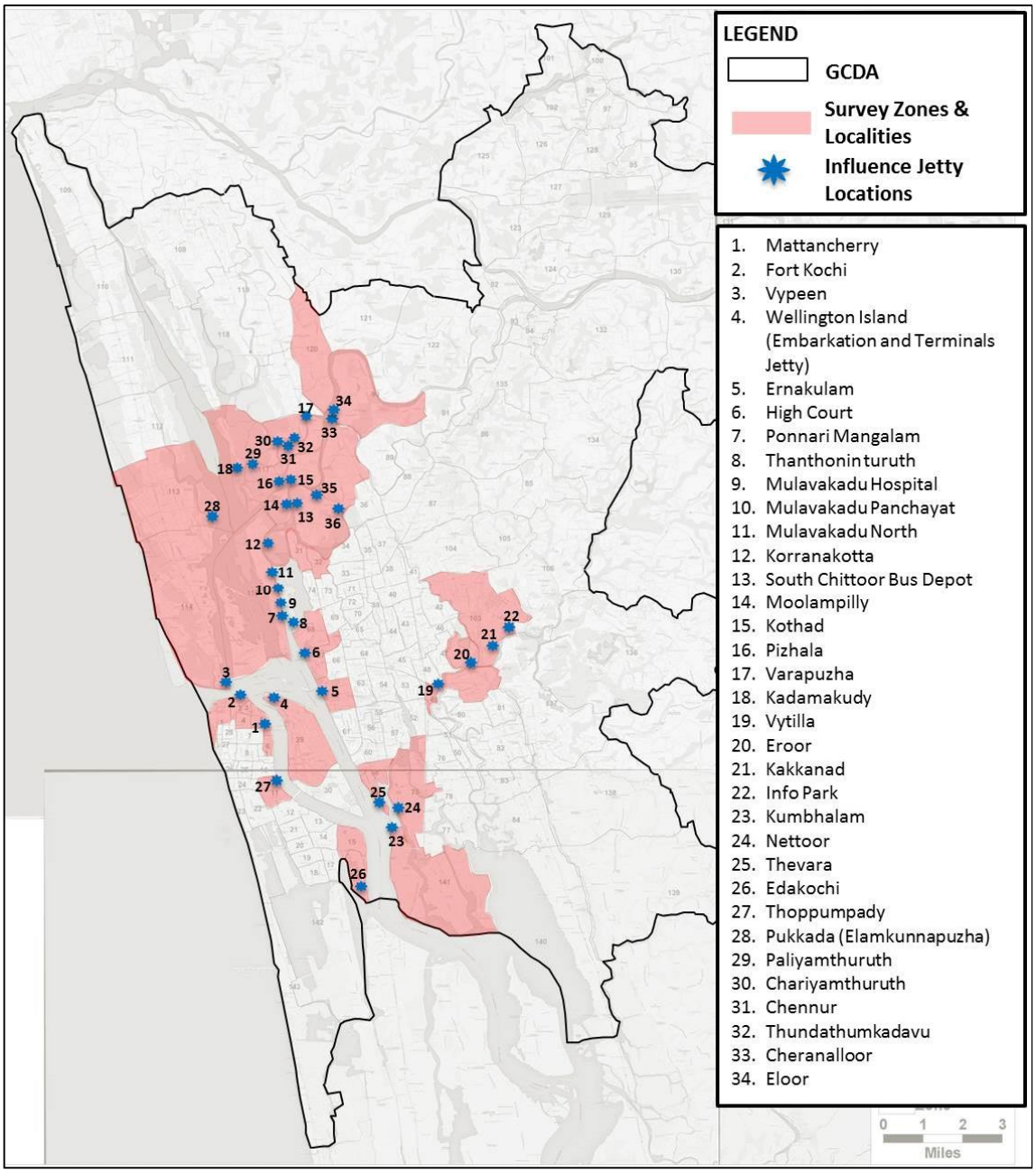
The household surveys were carried out in the influence zones of the currently operational and potential jetty locations on sample basis as part of the study. The survey covered the socio-economic profile of the households providing details like household size, education levels, monthly income and expenditure on transport, vehicle ownership etc. The individual trip information of the members of the household, which provided the details of the trips performed on the previous day by the members of the household, has also been collected. Of the total households a sample of 1% was collected as part of the household survey and the subsequent analysis. Table 4-3 and Figure 4-3 show the household zones withing the influnce of the jetties.

Table 4-3: Details of influence zones for household survey of major jetty locations

Traffic Zone No.	Name of the Zone/Locality	Population 2015	House-holds 2015	Major Boat Jetty
1	Fort Kochi	11561	3400	Fort Kochi - Govt & Fort Kochi Vypeen
2	Kalvathy	8789	2585	Fort Kochi - Govt & Fort Kochi Vypeen
3	Earavely	7226	2125	Fort Kochi - Govt & Fort Kochi Vypeen
4	Karippalam	9990	2938	Fort Kochi - Govt & Fort Kochi Vypeen
5	Mattanchery	7995	2351	Mattancherry - Govt
6	Kochangadi	7995	2351	Mattancherry - Govt
11	Thoppumpady	10421	3065	Thoppumpady
15	Edakochi North	10767	3167	Edakochi - Kumbhalam
16	Edakochi South	8781	2583	Edakochi - Kumbhalangy
29	Island North	5248	1544	Embarkation and Terminals
31	Vaduthala West	10149	2985	South Chittoor Bus Depot Jetty
32	Vaduthala East	8768	2579	South Chittoor Bus Depot Jetty
49	Vyttila	8462	2489	Vytilla Mobility Hub Jetty
58	Konthuruthy	11216	3299	Thevara
59	Thevara	5139	1511	Thevara
62	Ernakulum South	11299	3323	Ernakulam
67	Ernakulum North	10142	2983	Ernakulam & High court
68	Ayyappankavu	11442	3365	High Court
75	Maradu Ward No. 1, 2, 15, 16, 25 to 33	20350	5985	Maradu Jetty
79	Aallaprayil, Thrippunithura, Ward No. 36, 37	16279	4788	Eroor & Kakkanad
103	Vazhakkala,Thrikkakara Ward No. 17 to 26, 29 to 31	23338	6864	Eroor & Kakkanad
113	Njarackal	26723	7860	Elamkunnapuzha & Vyneen

Traffic Zone No.	Name of the Zone/Locality	Population 2015	House-holds 2015	Major Boat Jetty
114	Elamkunnapuzha (CT)	70433	20716	Vypeen
115	Mulavukadu (CT)	26804	7884	Mulavakadu (all jetties), Thanthoninthuruth Moolampilly, Bolgatty, Korrankotta)
116	Cheranallur (CT)	34407	10120	South Chittoor Bus Depot Jetty, Amrita Hospital & Medicity (potential Jetties)
117	Kadamakkudy (CT)	18327	5390	All Jetties of Kadamakudy, Pizhala,Kothad & Chennur)
118	Ezhikkara	12161	3577	Varapuzha jetties
120	Varappuzha	30085	8849	Chetibhagam Jetty (Varapuzha)
141	Kumbalam (CT)	32832	9656	Kumbhalam
Total		477129	140332	

Figure 4-3: Household Survey Zones/Localities along with the Influence Jetties



The survey formats for the same are attached in the annexure II, along with the analysis carried out on the household surveys.

4.2.6 Observations and Conclusions from Household and Opinion Survey

Based on the Household Survey, the following Inferences were drawn.

1. 66.3% of the households have 3 to 4 members; with the average household size as 3.4.
2. 54.8% of the households have a minimum of one vehicle which is predominantly a 2 wheeler.
3. 36.5% of the individuals are over 40 yrs of age followed by 20.6% of the individuals who fall within the age group of 20 to 30 yrs.
4. 60.5% of the individuals have studied upto 12th Standard.
5. The average monthly income of the households is observed to be Rs 25,500.
6. The average monthly expenditure on transport of the households is observed to Rs 625.
7. 25.9% of the total respondents are private employees, followed by 23.7% who are housewives.
8. 54% of the trips are performed for work and business purposes
9. 46% of the Line Haul Trips are performed by public transport, which are performed within the trip length range of 5 to 8 km, average trip time comes to 20 mins and more, with individuals spending more than Rs 20/- on an average.
10. As part of the Access/Dispersal trips, majority of the trips are performed on foot, with trip lengths of less than 1 km, trip time between 5 to 10 min and trip cost less than Rs 5/-
11. Based on the opinion survey, it was observed that 72% of respondents are willing to shift if there is an assured saving in travel time upto 15 mins in comparison to the current mode of travel and 75% of the respondents are willing to shift to good water transport, if there is a considerable saving time.
12. It was also observed that 54% of the respondents want the same fare to be retained for the improved water based transit system.

4.2.7 Identification of Potential User Income Groups based on primary survey

From the passenger origin-destination surveys carried out at the jetty locations, it is observed that 63% of the users have a monthly income of less than Rs 10,000/- of which 43.7% have a monthly income of less than Rs 5000/- as seen in Table 4-4 .

Table 4-4: Monthly Household Income

Sl. No.	Monthly Household Income	Percentage
1	<Rs 5,000	43.73%
2	Rs 5000-10000	19.35%
3	Rs 10000 - 15000	22.22%
4	Rs 15000 -20000	11.47%
5	Rs 20000-25000	2.15%
6	>Rs 25000	1.08%
Total		**100%**

In terms of the monthly expenditure on transport, 52% users spend less than Rs 500/- a month (refer Table 4-5). This shows that the current captive users are members of the lower income households.

Table 4-5: Monthly expenditure on transport

Sl. No.	Monthly Expenditure on Transport	Percentage
1	<=Rs 500	52.33%
2	Rs 500 -750	25.45%
3	Rs 750 - 1000	13.98%
4	Rs 1000 - 1500	3.58%
5	Rs 1500-2000	1.79%
6	Rs 2000-2500	1.79%
7	>Rs 2500	1.08%
Total		**100%**

The results of the opinion surveys conducted at the households in the jetty influence area as seen in Table 4-6 and Table 4-7 suggest that the private vehicle users as well as other public transport users are willing to shift to the ferry system if provided with a better quality and reliable system, which also ensures time savings.

Table 4-6: Willingness to shift – improved IWT

S.No.	Willingness to shift to an improved Water Transport System	Percentage
1	Yes	95.1%
2	No	4.9%
Total		100.0%

Table 4-7: Willingness to shift – time savings

S.No.	Willingness to shift in case of time savings	Percentage
1	5 to 10 mins	25.6%
2	10 to 15 mins	47.2%
3	15 to 20 mins	19.4%
4	20 to 30 mins	5.4%
5	>30 mins	2.3%
Total		100.0%

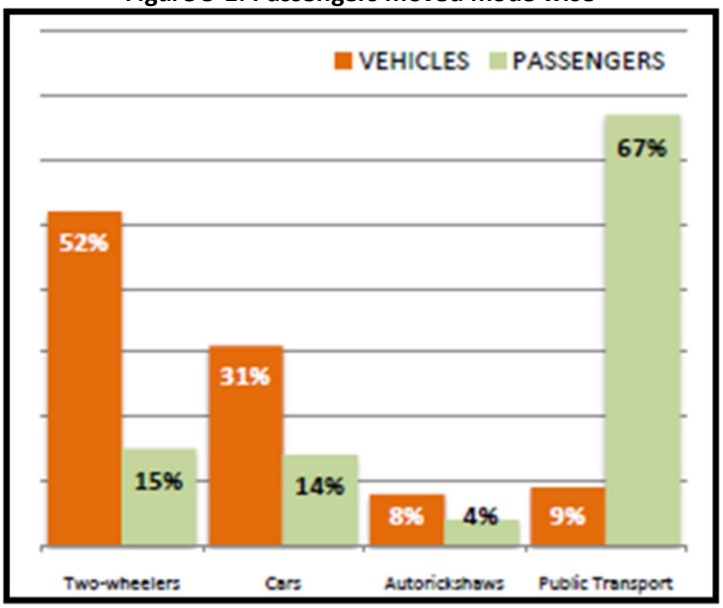
Considering the extensive presence of lower income households in the jetty influence area, it is critical to ensure that the pricing of the services remain affordable for the captive users and a good quality service be provided to attract the middle and upper middle income section of the island community.

5 Integrated Water Transport System

5.1 Need for an improved water transport system

Though the city currently has a healthy share of public transport mode share of 51%, Figure 5-1 showing the number of people moved by each mode indicates that a significant 83% of the personalized vehicles carry only 29% of the passenger traffic whereas just 9% of public transport vehicles carry 67% of the passengers. This presents a scenario of private vehicles invading the road space of Kochi and the undue pressure on the existing public transport systems.

Figure 5-1: Passengers moved mode wise



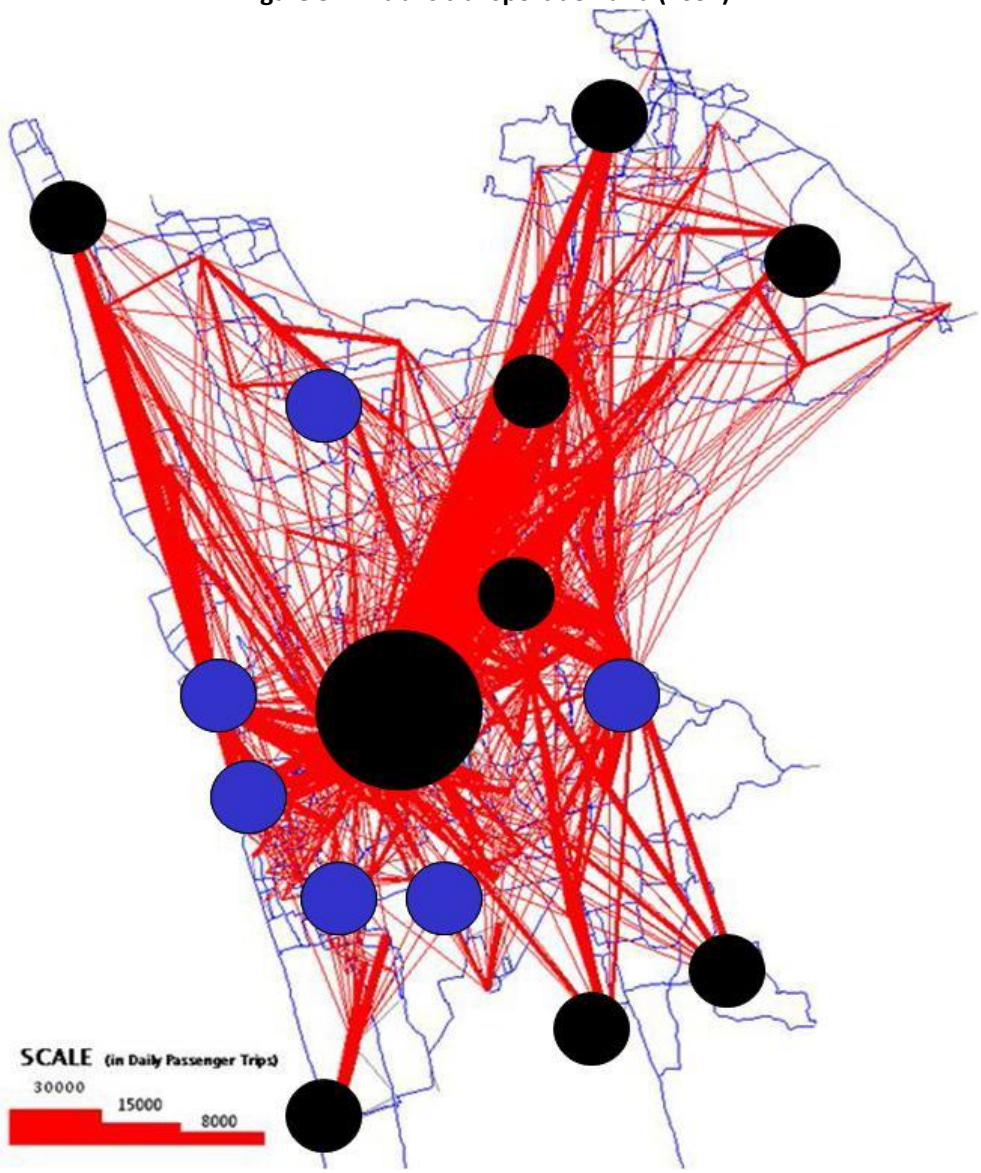
Source: A study on inland water transportation in Kochi city region, 2012

Also keeping in mind the limited road space available in Kochi, this may over a period of time lead to increased congestion, higher pollution levels, lower journey speeds and subsequently longer travel time.

The other major issue that the city faces is to retain the current public transport users and prevent them from shifting on to private modes. This would require a fast, efficient, reliable, safe and clean public transport system which attracts people on to it. The system should be inclusive and help connect all parts of the city and all classes of people.

The projected public transportation demand for 2031 is as shown in Figure 5-2. To cater to such demand, requires an integrated system which brings together all modes in the most effective way possible as no single system can provide optimum coverage in the city.

Figure 5-2: Public transport demand (2031)



With the metro being introduced in Kochi, and an already wide spread bus network (though requires route rationalizing, and increased safety requirements.) it is the island community on the west that needs attention and a sustainable public transport alternative connecting them to the mainland.

Thought the existing ferry services barely satisfy the safety norms and conditions, commuters from the island are dependent on them for their daily trips. The average trip length of ferry passengers is 8.9 km as seen from the table below.

Table 5-1: Mode wise average trip length

Mode	Average Trip Length (Km)	Mode	Average Trip Length (Km
Car	13.6	Mini Bus	7.6
Taxi	16.1	School Bus	7.9
Sumo/Tavera	9.7	**Ferry**	**8.9**
Two Wheeler	9.6	Cycle	4.4
Auto	7.4	Train	44.1
Bus	11.3	Walk	1.1

There is a potential demand for travel between the island communities and from the island to the mainland. This demand has been identified as the major outcome from stakeholder consultation meetings and the interaction with panchayat officials. With some of the islands being solely dependent on the ferry services, it becomes further important to improve the ferry services.

With an improved water transport system it would be able to retain the captive users as well as draw in people from the road based public transport system and a section of private vehicle users thereby reducing the pressure on the road network and increasing the potential user pool.

The initiative is also in lines with Kochi's transport vision of seamless transport across modes. By providing clean, affordable, fast and efficient transport services to island communities, which are primarily residential and include lower income residents it satisfies the concept of inclusiveness. It also accords with key policy drivers, by providing better island community access to mainland employment opportunities and social services; promoting public transport modes; limiting the use of private vehicles; and significantly improving western linkages. These services will also support industrial growth and sustainability on Cochin's islands, by providing better access for employees and commerce in general.

As seen in Figure 5-2 the major trip attraction and production locations are highlighted, the ones marked in blue, signify location within close proximity to currently operational jetty's or potential jetty's. This indicates that these jetties can be further developed to tap into the existing high footfalls in their vicinity, and on the other hand also connect the islanders to these core areas of the city.

5.2 Integrated Water Transport for Kochi

Sustainability can be achieved only if a set of measures are taken up to realise it. In terms of the inland water transport system, the factors which need to be considered while striving for sustainability is to assess the travel demand accurately. After assessing the demand for the system it should be utilized to develop an efficient route plan revolving around a strong time tested concept that will help develop the water transport system. All of the inputs shall be directed towards calculating the fleet requirement and also the type of boat/ferry which would best suit the requirement. It is also important to maintain a good headway and reliable services to retain and promote the water based transport system.

A sustainable transport system will also be needed to be integrated with other modes of public transport, and be provided with adequate infrastructure to make it as accessible as possible.

With an established need for a sustainable water transport system, it is also critical that the same is integrated with the other existing and proposed transportation systems in the city region. As seen in Figure 5-4, metro system (under implementation) , integrated public transport system (road based) and non-motorised transport plan are under planning and design stage alongwith an integrated intelligent transportation system (ITS) plan, hence the water transport system is essentially conceived as a part of the overall public transport system.

Figure 5-3: Integrated Water Transport and Metro System

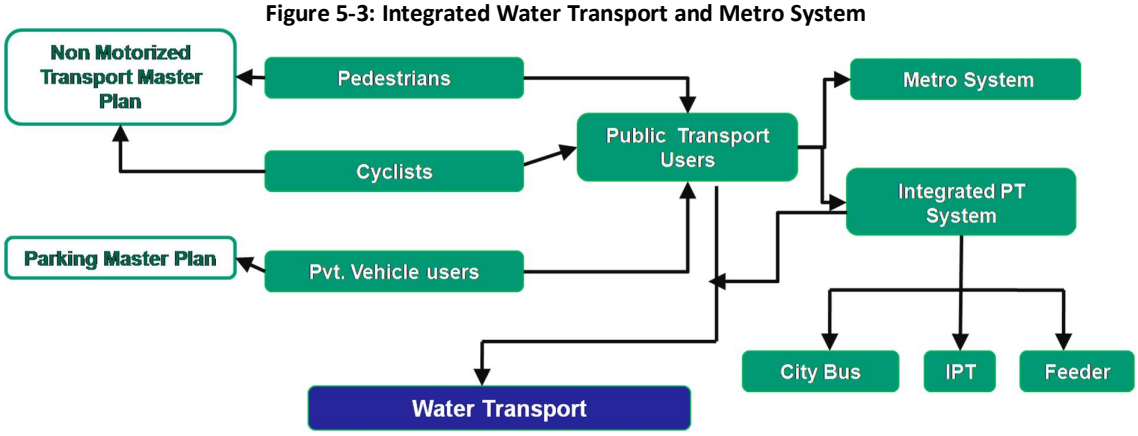


Figure 5-4: Integrated Water Transport and Metro System

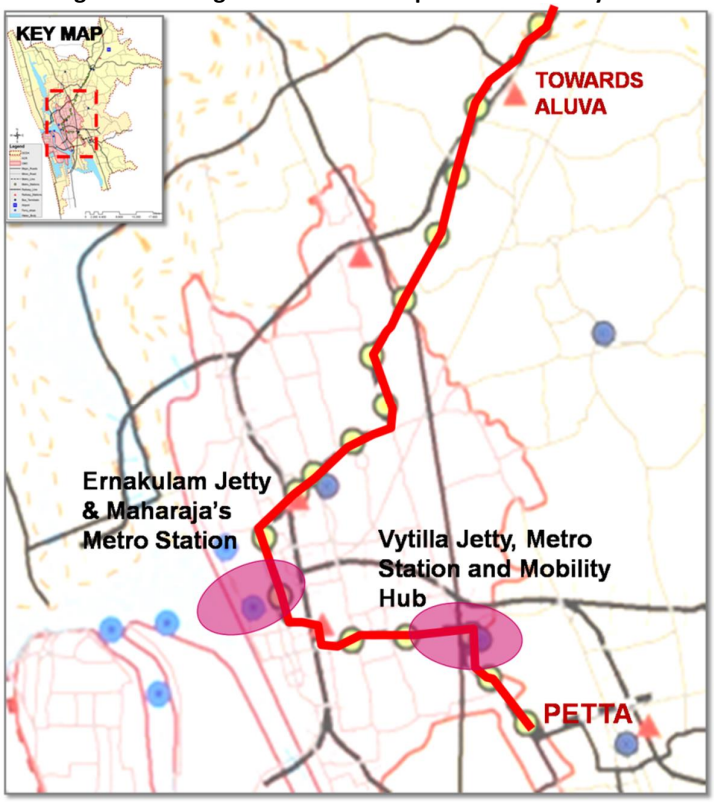


Figure 5-4 shows the metro alignment in the city along with the Jetty locations marked in blue, as seen from the figure, the Ernakulam jetty and Vytilla jetty are in close proximity to the Maharaja's metro station and the Vytilla metro station respectively. This is a case of physical integration which needs to be developed so as to provide commuters with seamless transfer from one mode to the other. A seamless, grid separated and safe transfer can be provided by means of a elevated walkways/skywalk with travellators etc.

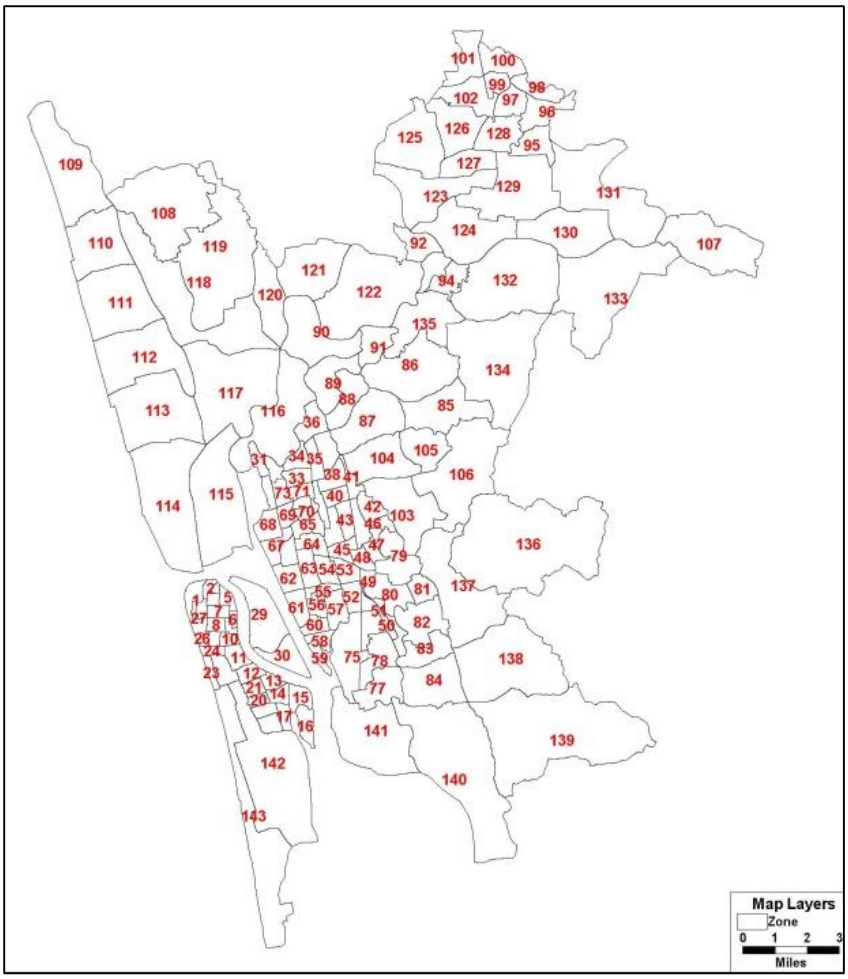
5.3 Travel Demand Assessment

This section discusses the travel demand assessment for water transport in Kochi. As discussed in the previous sections, it is well established that integration of the water transit system with the various activities on the islands is of prime importance for the sustainability of the system. Travel demand assessment aims at establishing the spatial distribution of the travel explicitly by means of an appropriate system of zones for water transport in Kochi. As discussed in the previous chapter, Boarding & Alighting, Opinion Surveys and Household surveys were conducted, in order to define the travel patterns between various origin and destination points, analysed by way of an excel based mathematical model, which assesses and evaluates the impact of the improved and modern water transport system in Kochi.

5.3.1 Zoning System

Greater Cochin Development Authority (GCDA) and Goshree Islands Development Authority (GIDA) areas have been considered as the study area as shown in the Figure 5-5. The study area comprises of Corporation of Cochin along with 9 municipalities, 20 village Panchayats spread over an area of about 632 Sq km. However the aim of the current study is to revive the traditional water transit system in Kochi, hence, for the initial assessment island communities towards the western part of the mainland have been considered.

Figure 5-5: Traffic Analysis Zones (TAZs)

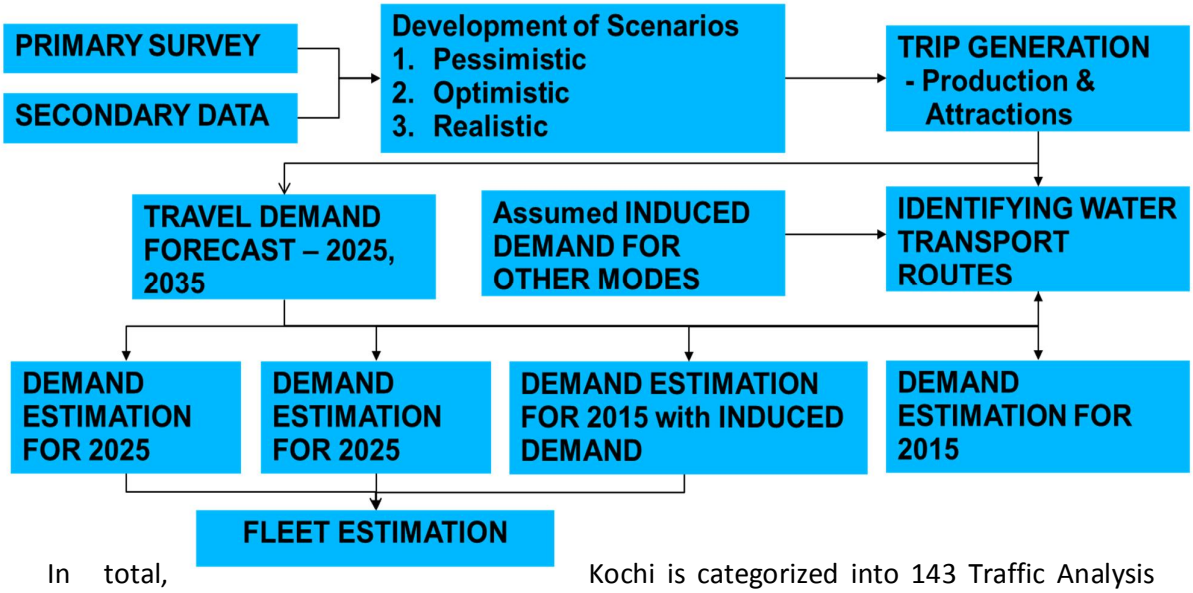


For the traffic analysis zones (TAZ's), resident population, employment and student numbers were considered for the preparation of the model. With the improved connectivity and accessibility to the island communities, it is expected that economic activities in these island communities would increase in the future years. The metro system under construction may not have immediate influence in the base year, but might play a critical role in defining the future travel patterns in the city when combined with the water transport and bus based public transport. Hence, for the assessment of modernizing the ferry transport in Kochi, various parameters have been considered to develop Water transport as an integrated system along with the development of Infrastructure.

5.3.2 Development of Transport Demand Model

With the purpose of estimating the demand for the proposed water transport in Kochi, a excel based mathematical model has been developed incorporating the existing system. The major production and attraction zones have also been identified. An overview of the methodology followed for the study is as shown in Figure 5-6

Figure 5-6: Water Transport Model Methodology



In total, Kochi is categorized into 143 Traffic Analysis Zones (TAZ). Though the zoning system has been adopted for the entire Greater Kochi Region, concentration of the assessment has been in the jurisdiction of the Municipal Corporation of Kochi and few surrounding Gram Panchayats of the Island communities. Ridership for the proposed water transit system is estimated as part of this exercise. The proposed water transit system was integrated with current and operational jetties to capture the existing and potential ridership.

5.3.3 Assumptions for the Model

Various assumptions based on the existing studies were considered to develop this model. These assumptions and estimation methods are given below:

Three scenarios have been developed in the model to facilitate the assessment of the water transport system to be undertaken for the horizon years

- In the pessimistic scenario, it is assumed that the growth rate of Kochi is 3% per annum in line with the population growth rate as observed from the past trends.
- In the optimistic scenario, it is assumed that the growth rate of Kochi would be in-line with the current vehicular growth rate at 8% per annum.
- In the realistic scenario, it is assumed that the growth rate of Kochi would be somewhere in between both the above mentioned growth rate scenarios. Hence, the growth rate is assumed to be at 5% per annum.

The trip distribution pattern of the various modes of transport is derived from the Feasibility Study and Detailed Project Report for the Kochi Metro Rail System Phase II by RITES, which has been considered for the base year.

To estimate the future demand of the water transport for Kochi, optimal shift from the existing commuters is assumed. For the current study, the induced demand is assumed to be as follows

- ✓ 1% shift from Car Users
- ✓ 4% shift from the two wheeler Users
- ✓ 7% shift from the Auto Users
- ✓ 8% shift from the Bus Users
- ✓ Peak hour passenger trips were assumed to be 30% of the total daily passengers.

It is understood from the regular consultations with the stakeholders and local bodies that there were many routes, which were operational, but had stopped operations in the recent past. As part of the study these routes were identified for the initial estimations, which were further modified according to the hub and spoke model, such that each island has one major interchange jetty and smaller intermediate jetties, which would bring people from the different parts of the island to the major jetty, for interchange to other routes.

For the fleet estimation the following assumptions were made;

- ✓ The operational speed of the boat is assumed at 8 knots (14.8 kmph)
- ✓ The capacity of the boats were assumed to be 100 PAX and 50 PAX

5.3.4 Category of Boats

Based on the extensive discussions on the category wise distribution of boats, it has been decided that the distribution of boats as shown in Table 5-2 would be required to operate the water transport system in Kochi.

Table 5-2: Fleet Distribution – category wise – Phase I, Phase II, 2025 and 2035

	Phase I (2016 - 2017)	Phase II (2018-2019)	2025	2035
Total No. of Boats (A)	**41**	**75**	**85**	**116**
50 Pax	27	53	59	76
100 Pax	14	22	26	40
Additional No. of Boats (B)	**2**	**3**	**4**	**6**
50 Pax	1	2	3	4
100 Pax	1	1	1	1
Total No. of Boats Required (A+B)	**43**	**78**	**89**	**122**

5.3.5 Speed of Boats

As part of demand assessment and fleet size analysis it is extremely important to decide on an optimal speed for the boats. The speed is considered to be 8 Knots (1 knot is equivalent to 1.85 Km/hr). With the recommendation of a dedicated water transit corridor, the boats are proposed to be designed with an operational speed enhancement upto 12 knots over a period of time.

5.4 Hub and Spoke Network Model

In the past, the transportation and distribution industry was guided by the principles of point-to-point or direct-route operations. As technology has developed, the logistics sector has found faster and more cost-effective ways of shipping freight. The hub-and-spoke model (refer Figure 5-7) was born from the industry's efforts to develop more efficient networks. Hub-and-spoke systems (HASS) are the efficient and competitive route networks and often adopted in the industries such as transportation and telecommunication- These are the network configurations by which a carrier can use larger vehicles and thus reduce costs per unit through bundling flows in a hub. It results in lower total network costs and therefore strong competitive edges. Singapore, Dubai, Frankfurt and London are some of the major cities of the world who have mastered the art of the hub and spoke model.

The hub and spoke model requires excellent operational management for it to succeed. Even today majority of the transportation systems in India; freight and passenger movement both are developed for point to point traffic.

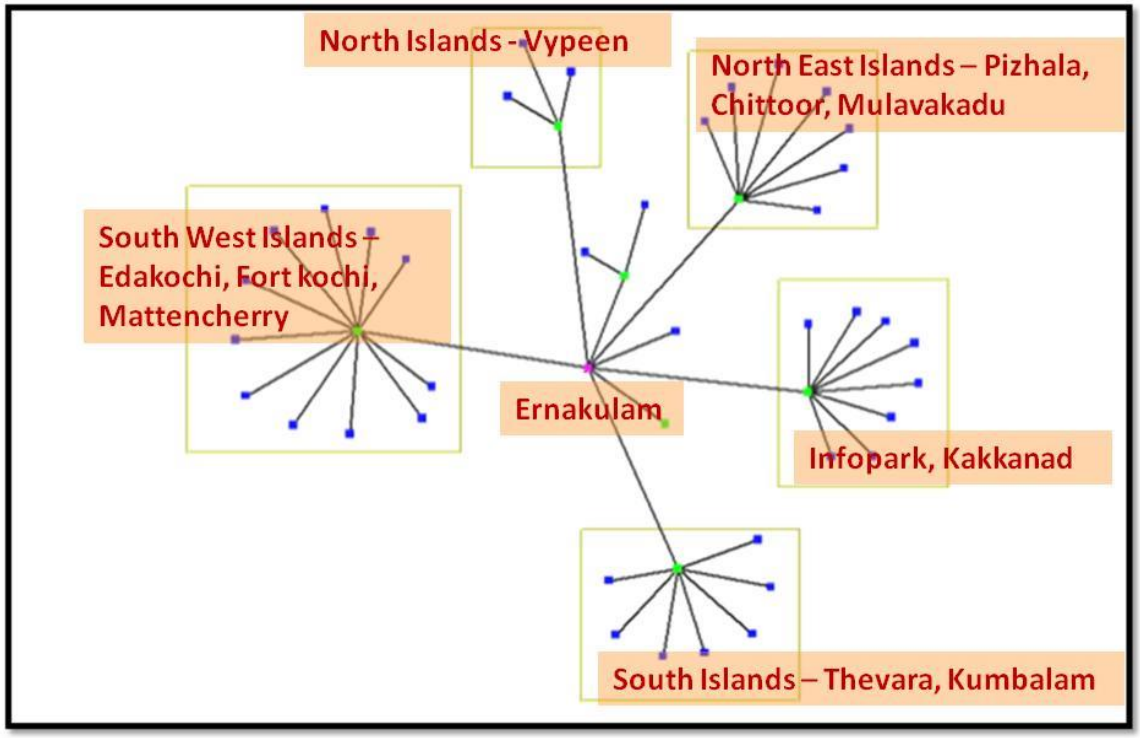
Figure 5-7: Point to Point vis a vis Hub and Spoke System



The western part of the city of Kochi is surrounded by numerous inhabited islands like Kothad, Moolampilly, Korankota, and various other smaller islands. These islands are majorly residential islands with limited economic activities and have access to the mainland of Ernakulam, only through the ferry systems. However, most of these jetties are poorly equipped or are presently non- functional.

The hub and spoke system has been proposed for the water transportation system in Kochi so as to identify certain major islands as hubs with one major boat jetty developed as a hub and the neighbouring smaller islands and jetties as the spokes which would be connected to the hub. So, in case of Kochi, the jetties in the smaller islands must be revived and with the help of ferry services, they would be connected to the Ernakulam mainland boat jetty. The Ernakulam boat jetty would be developed as a hub and ferry routing can be planned and designed in a way so as to ensure connectivity at regular intervals to the main islands. This kind of a public transportation network developed in the city of Kochi will help in providing a seamless, efficient and people-centred public transport system. This system adopted for Kochi is termed as ***"One Island One Boat Hub" concept (refer*** Figure 5-8 ***).***

Figure 5-8: Concept for Hub and Spoke System in Kochi – *One Island One Boat hub*



5.5 Principles for selection of Water Transport Routes

Kochi is greatly dependent on public transportation for its mobility needs with over 51% of passengers opting for public transport. Commissioning of the road bridges such as the Goshree Bridge, has led to a lurid encouragement to the road based transportation modes over traditional water transportation system. The level of service delivery of the ferry system has failed to keep up with the growing expectations of the general public.[6]

Currently, Kochi intends to upgrade its passenger water transport system, which is being operated by the State Water Transport Department. No other city in India has such a wide network of water bodies within the city linking the suburbs to the city center[7]. At present there are around twelve local bodies within the Kochi city region, few of these local bodies have licensed water transport/ferries to various locations. With the dominance of the motorized transport, many of the operational routes have been terminated and jetties

[6] Study on Inland Water Transportation in Kochi City Region.
[7] An Affordable & Viable Urban Transport System for the People of Kochi – A Proposal by K.J Sohan former Mayor of Kochi

abandoned. Many of the identified jetty locations have integration with road based transport systems, which needs to be upgraded with better facilities.

Based on the detailed analysis of the primary and secondary data, a step by step methodology has been adopted to identify ferry transport routes, which includes studying the travel pattern of the users, evaluation of the existing routes, study of the population and employment trends and land use distribution and physical verification.

Based on the extensive discussions with the various stakeholders and reconnaissance survey, it was decided that the ferry system would be upgraded with a concept of one island, one hub concept. For the similar purposes 16 routes were identified initially, with an objective of reviving the passenger water transport within the backwaters of Kochi.

There is a potential demand for travel between the island communities and the mainland. This was evident during stakeholder consultation meetings and the interaction with Panchayat officials. Ferry services improvement initiative clearly indicates the Kochi transport vision, of providing clean, affordable, fast and efficient transport services to island communities, which are primarily residential and include lower income residents. It also accords with the key policy drivers, by providing better island community access to mainland, employment opportunities and social services; promoting public transport modes; limiting the use of private vehicles; and significantly improving western linkages. These services shall also support industrial growth and sustainability on the islands, by providing better access for employees and commerce in general.

A maximum demand of around 1,100 to 6,500 passengers was observed for the ferry transport in the base year, which had been predominantly concentrated around Ernakulam, Fort Kochi, Mattancherry, Wellington Island, Elamkunnapuzha, Njarackal and Kumbhalam.

From the analysis it was observed that the identified routes need to be supported by the operational routes as well as increased connectivity within the islands had to be provided. The identified routes were aggregated to merge subset routes. Some of the smaller routes were grouped to form single viable route system. The aggregated routes were further analysed under various scenarios for the horizon years. To support the demand assessed for each of the identified water transport routes with an attempt to revive the traditional

waterways supply was calculated in terms of the boats required per hour in each of the sections and converted into headway.

Based on the reconnaissance surveys and the data from the previous studies, it was noted that the commuters in these small islands of Kochi look out for connectivity to their origin and destination, though not always by road. The routes were designed to provide connectivity as well as accessibility to the various destinations within the city. Based on the intensive discussions in associations with the Gram Panchayats of these island communities, the following routes have been identified as shown in Table 5-3.

The IWT sector is an investment-sensitive sector. The costs involved are cost of the vessels, fuel costs, crew salaries and maintenance costs. In order to keep the ferry services, assured patronage from the general public is pre-requisite. Keeping this in view, it is decided to introduce the identified 16 routes in a phased manner over a period of 4 years between 2016-2019, considering the high demand routes to be introduced first and low demand routes in the subsequent years. Based on the above parameter, 7 routes would be introduced in Phase I (2016 – 17) and additional 9 routes would be introduced in Phase II (2018-19).

Table 5-3: Identified Water Transport Routes

Route	Origin	Destination	Route Description	Route Length (km)
1	South Chittoor	Ernakulam	South Chittoor, Mulavukadu Panchayat, Poonarimangalam, Thanthoninthuruth	8.20
2	Edakochi	Thevara	Edakochi, Kumbhalam, Thevara	3.74
3	Ernakulam	Vypeen	Ernakulam, Embarkation Jetty, Fort Kochi, Vypeen	6.40
4	Ernakulam	Mattancherry	Ernakulam, Embarkation, Fort Kochi, Mattancherry	6.10
5	High Court	Mulavakadu	High Court, Bolgatty, Thanthoninthuruth, Poonarimangalam. Mulavukadu Panchayat, Mulavukadu Hospital, Korrankota, Mulavukadu North	11.00
6	Vytilla	Info Park	Vytilla, Eroor, Kakkanad & Info Park	8.00
7	Kumbhalam	Thevara	Kumbhalam, Nettoor, Thevara	4.00
8	Info Park	Edakochi	Info Park, Vytilla, Kakkanad, Thykoodam, Thevara, Kumbhalam, Edakochi	12.60
9	Mulavukadu	South Chittoor	Mulavukadu Panchayat, Moolampilly,	8.00

Route	Origin	Destination	Route Description	Route Length (km)
			Pizhala, Kothad, South Chittoor	
10	Edakochi	Vypeen	Edakochi, Thoppumpady, Mattancherry, Fort Kochi Vypeen	13.60
11	South Chittoor	Cheranalloor	South Chittoor, Moolampilly, Pizhala, Kothad, Chennur, Varapuzha, Eloor & Cheranallur	6.00
12	Elamkunnapuzha	High Court	Elamkunnapuzha - Mulavukadu West, Bolgatty, High Court	15.00
13	Kadamakudy	Paliyamthuruth	Kadamakkudy- Paliyam Thuruth (Pizhala Island) - Korhad	6.00
14	Chennur	Thundathumkadavu	Chennur North-Chariyam Thuruth North-Thundathum Kadav.	3.00
15	Chariyamthuruth	Chennur	Chariyam Thuruth South- Pizhala Hospital - Chennur South	3.00
16	Kothad	Amrita Hospital	Kothad - Medicity Hospital-Amrita Hospital.	3.00

The Figure 5-9, Figure 5-10 and Figure 5-11 show the proposed network and route map for the ferry services in Kochi, the detail description of the routes are described in the subsequent pages.

Figure 5-9: Identified Water Transport Network Map

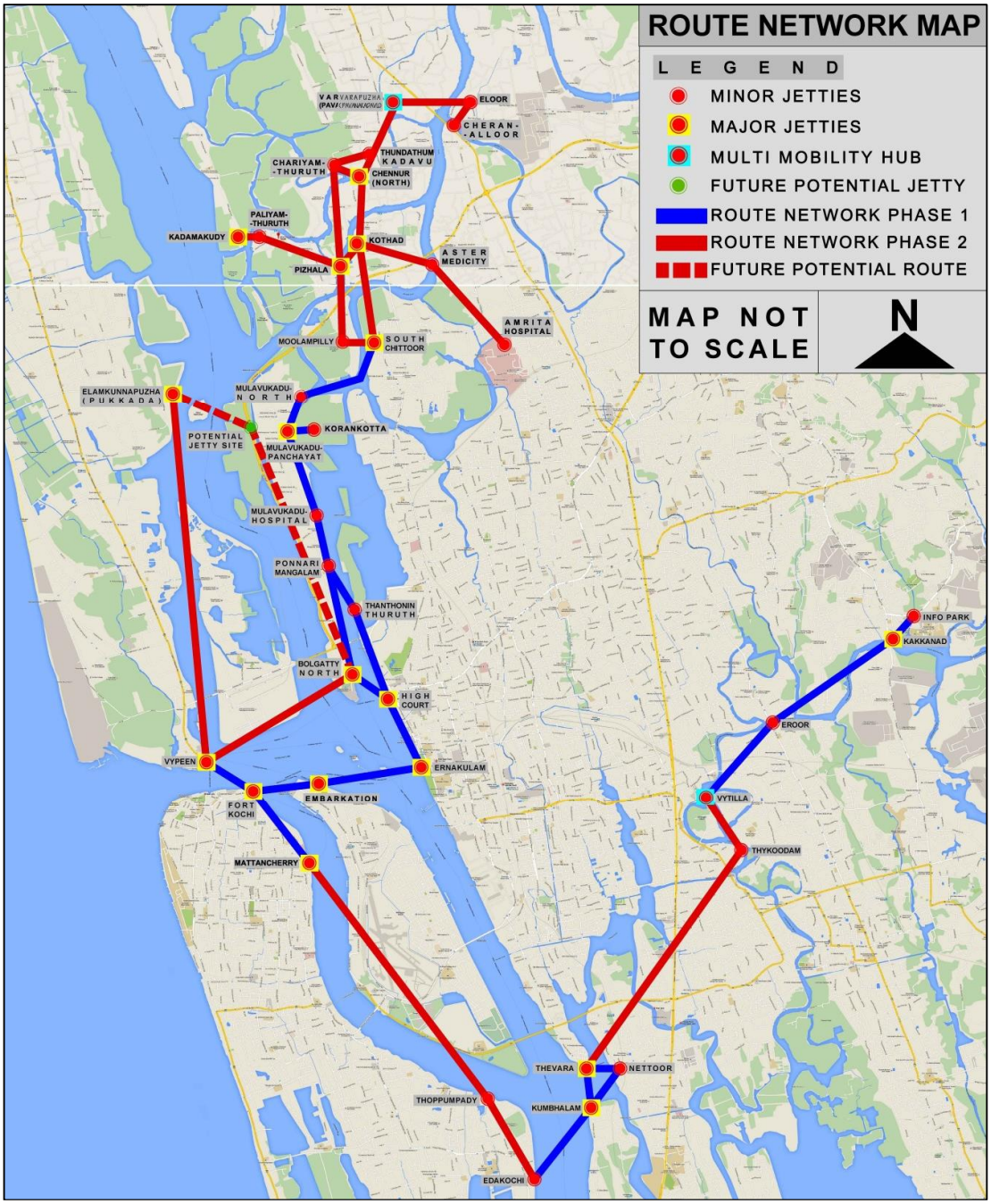


Figure 5-10: Identified Water Transport Routes – Phase I

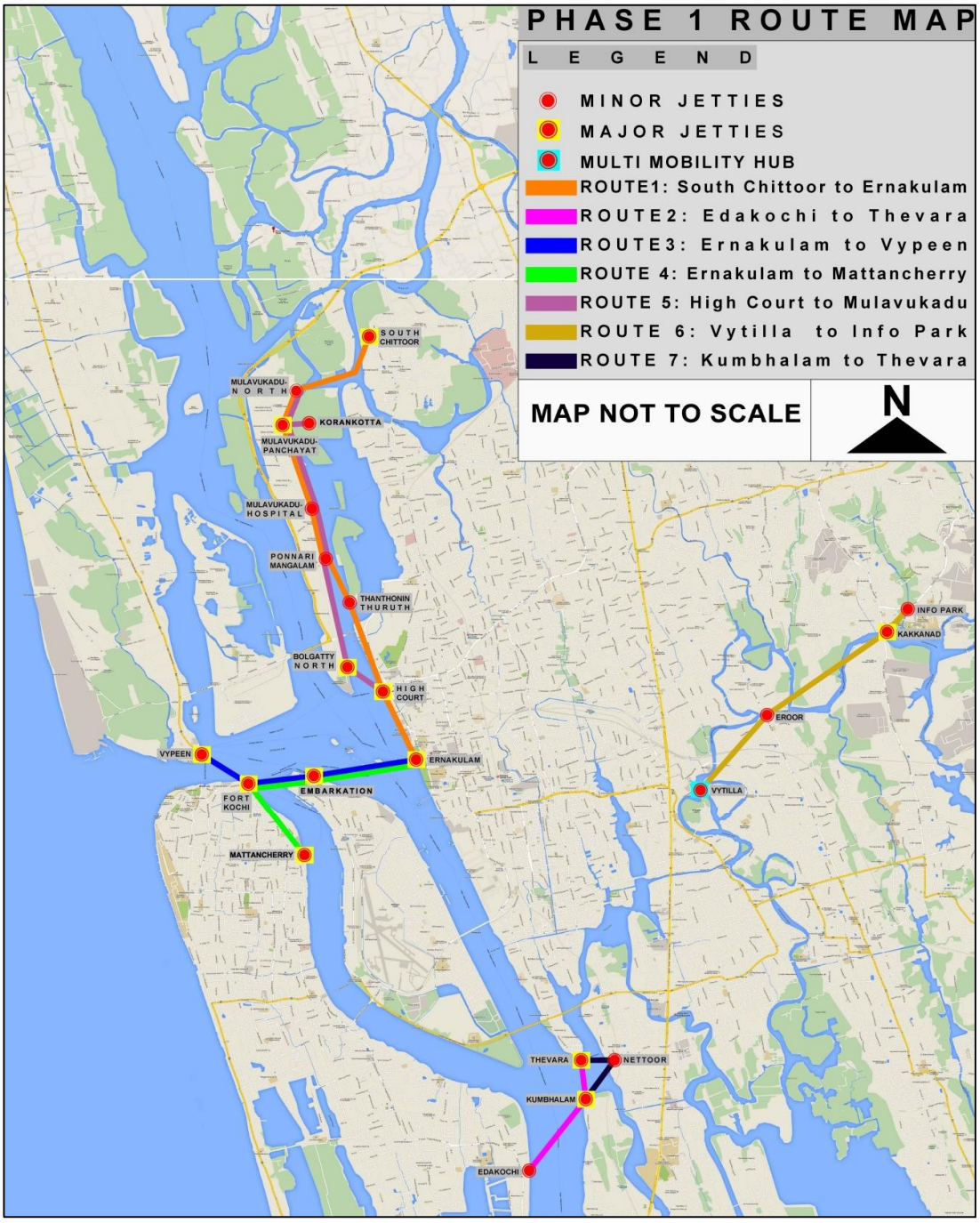
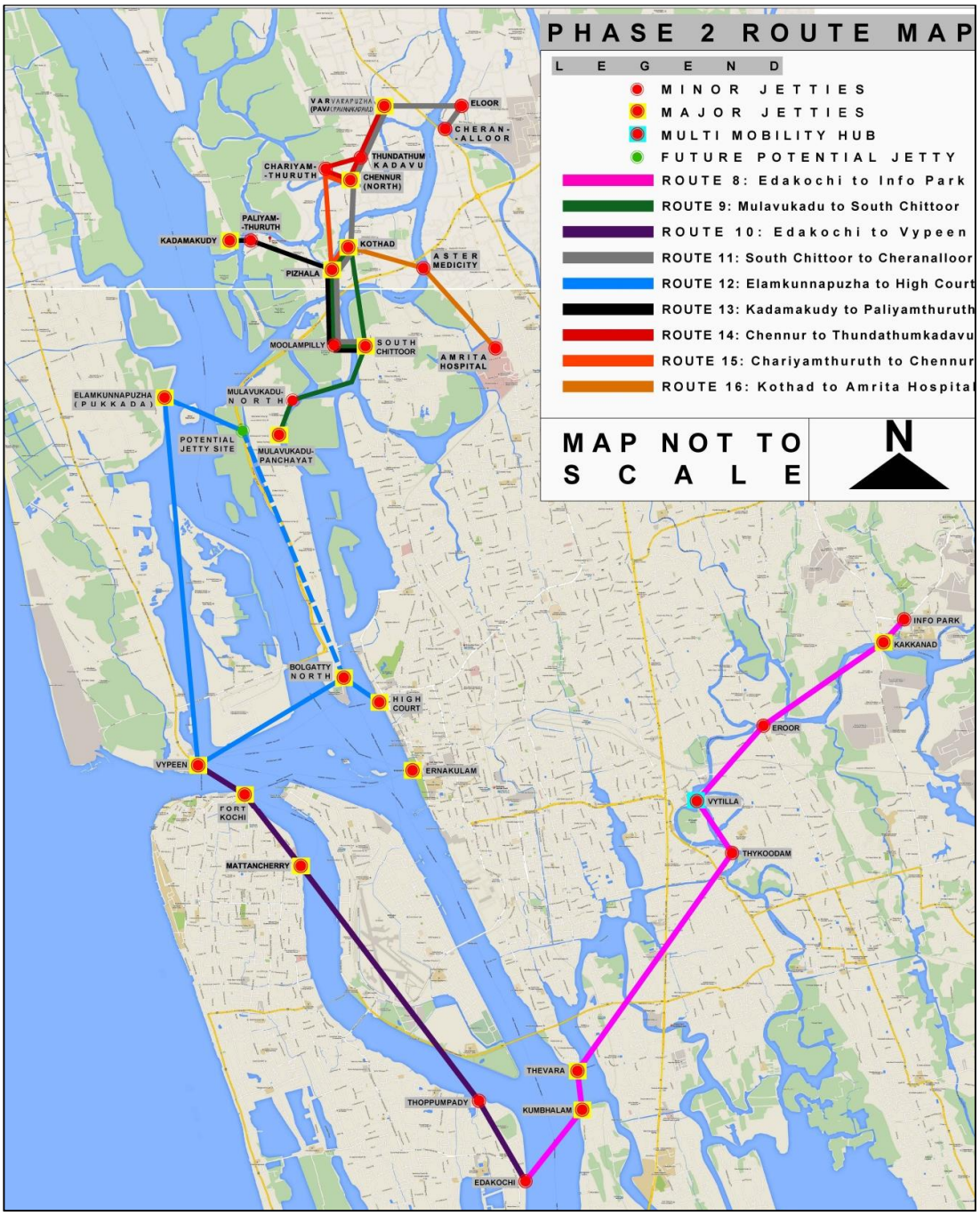


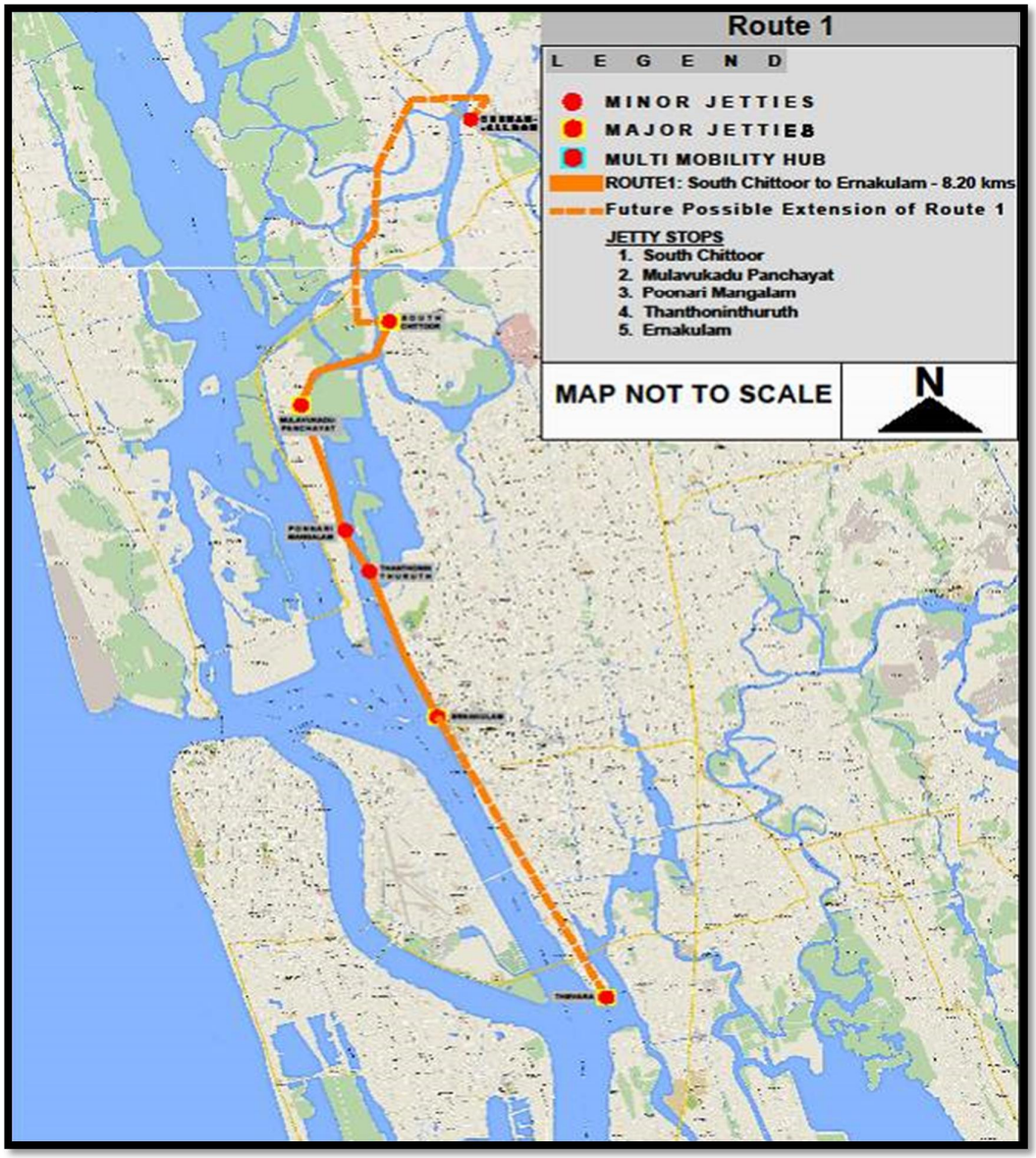
Figure 5-11: Identified Water Transport Routes – Phase II



5.5.1 ROUTE 1: South Chittoor to Ernakulam

This limited stop service will be operated by seven number of 50 PAX boats with a minimum frequency of 15 min and maximum frequency of 25 min. However, to reduce the frequency, it is essential to keep a close watch on the passenger movements and peak hours. The route can be further extended to Varapuzha in the North and Thevara in the South. It is suggested that this route will connect South Chittoor, Mulavukadu Panchayat, Ponnarimangalam and Ernakulam, covering a total route length of 8.20 km. The service requires both upgradation of vessels as well as terminal infrastructure. Future capacity on this route will be upto 5,280 passenger trips per day by 2035. The infrastructure at the jetties along the routes would be upgraded.

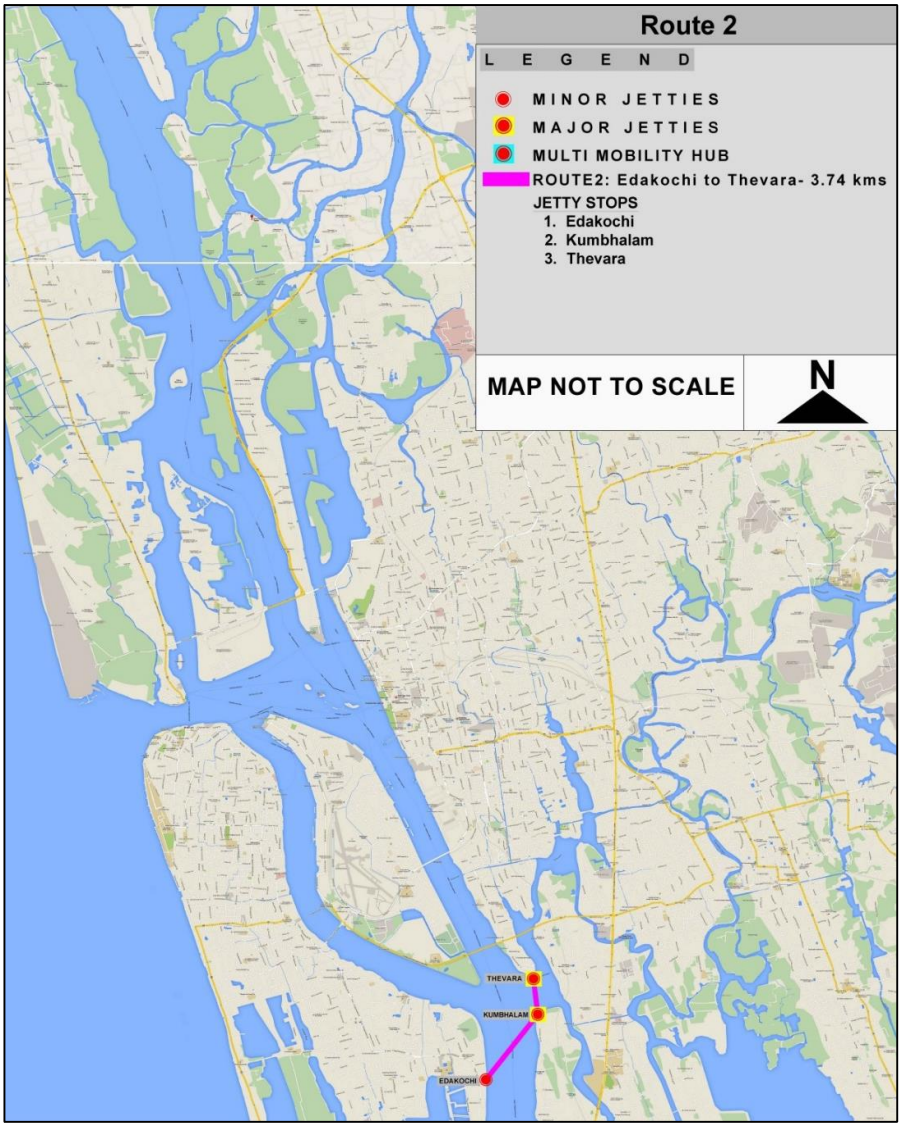
Figure 5-12: Route 1: South Chittoor to Ernakulam



5.5.2 *ROUTE 2: Edakochi to Thevara*

Based on the demand estimations, it has been observed that there is an unmet demand which could be captured by connecting Edakochi to Thevara via Kumbhalam. The route covers a route length of 3.74 kms, with an estimated daily ridership of 3,284 by 2035. The service shall operate with a minimum headway of 20 mins and maximum headway of 30 mins during the operating hours; 6:00 am to 9:00 pm on a daily basis. It was observed that there is already some level of integration at Thevara, which needs to be further upgraded for the efficient integration of routes and seamless transfer between the various modes of transport. Further to which the Jetty infrastructure at Edakochi needs to be improved. 3 50 pax boats shall be required to meet this demand in 2019. There is a possibility of locating a new jetty at the mouth of the Thevara canal, which shall require dredging. It is suggested that this new jetty be developed so as to have a common jetty with route 7 and 8.

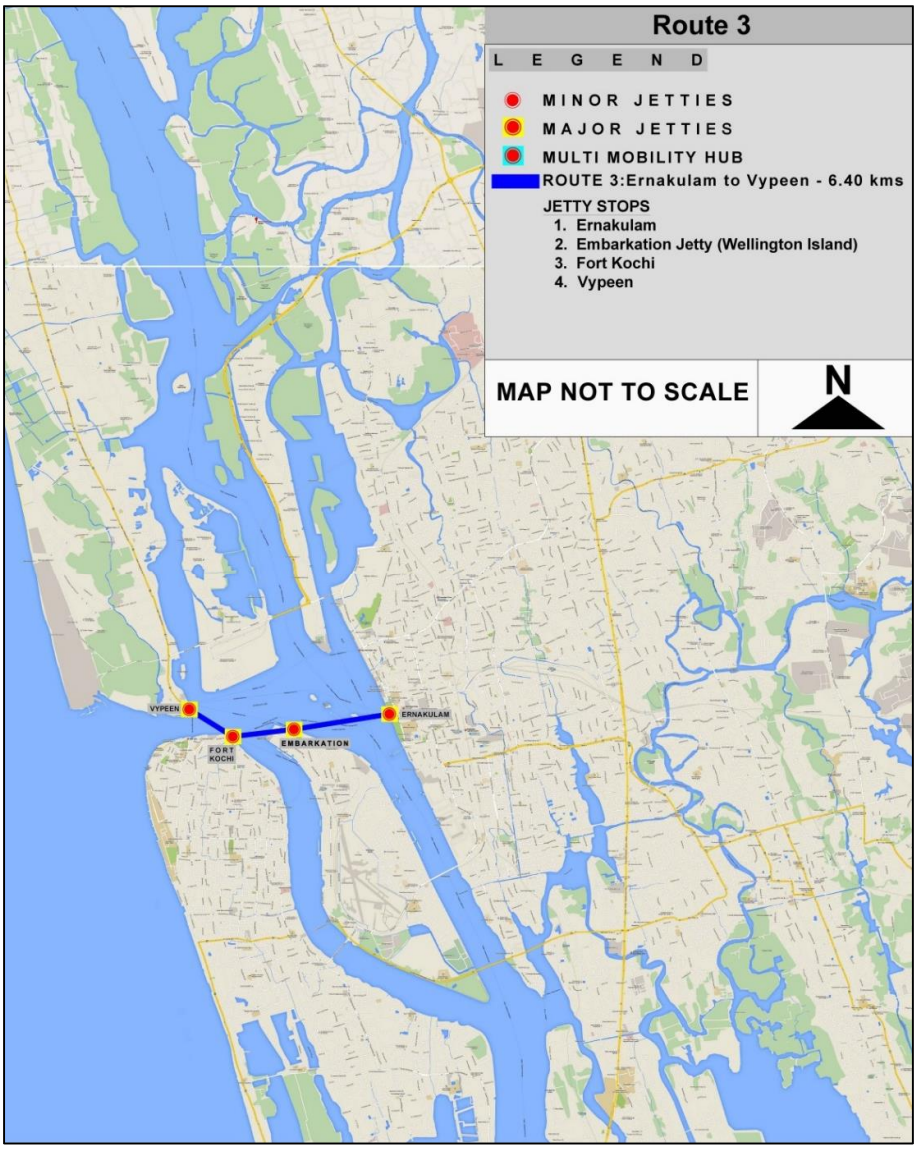
Figure 5-13: Route 2: Edakochi to Thevara



5.5.3 ROUTE 3: Ernakulam to Vypeen

Seven boats of 100 pax capacity are proposed to operate in this sector. These services shall operate with a frequency of 12 minutes during the peak hour and 18 minutes during the off peak hour. The sector will capture approximately 17, 120 passenger trips per day. Additional facilities will be necessary to impart better integration with other modes of transport.

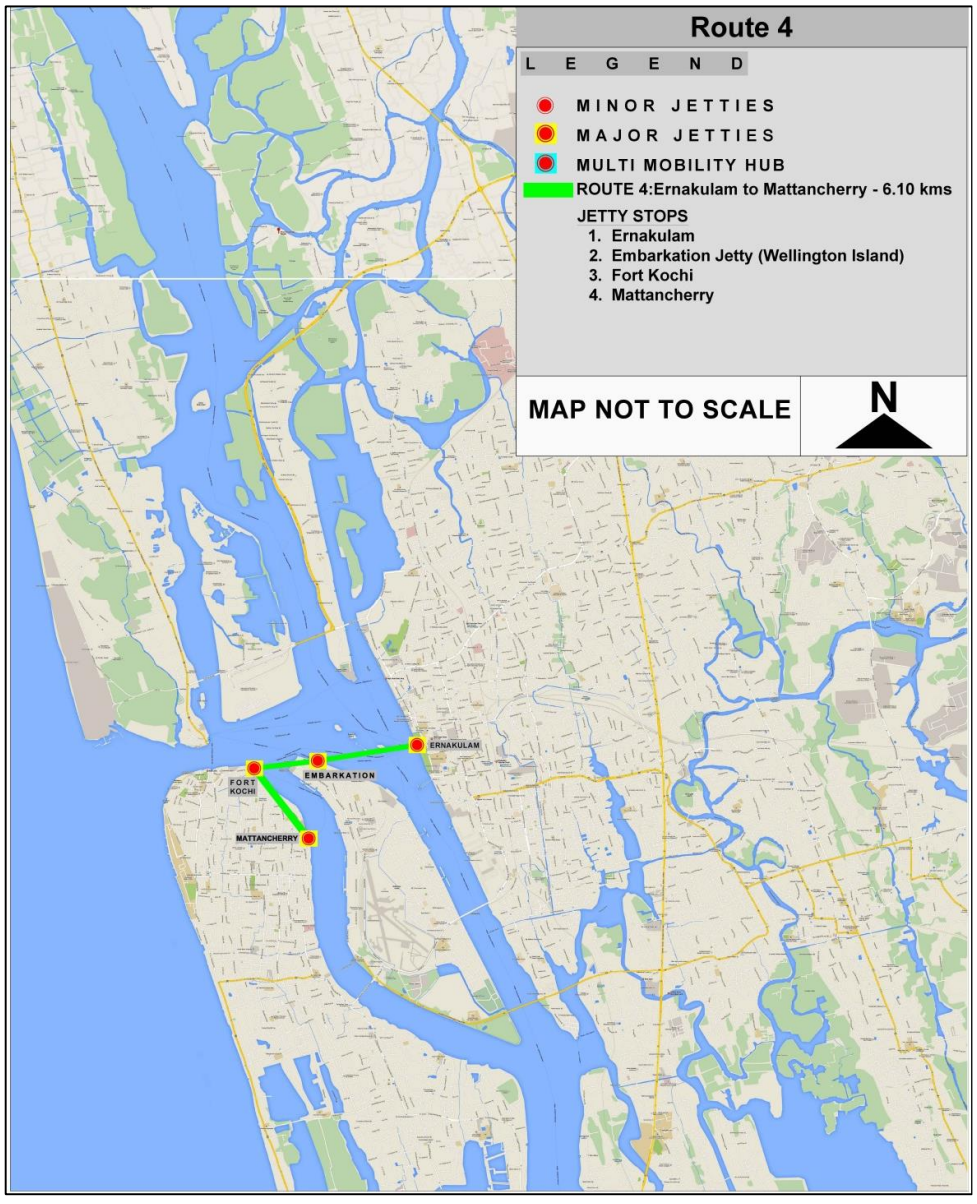
Figure 5-14: Route 3: Ernakulam to Vypeen



5.5.4 ROUTE 4: Ernakulam to Mattancherry

Seven boats of 100 pax are proposed to operate in this sector. These services shall operate with a frequency of 12 minutes during the peak hour and 18 minutes during the off peak hour. The sector will capture approximately 17, 120 passenger trips per day. Additional facilities will be necessary to impart better integration with other modes of transport.

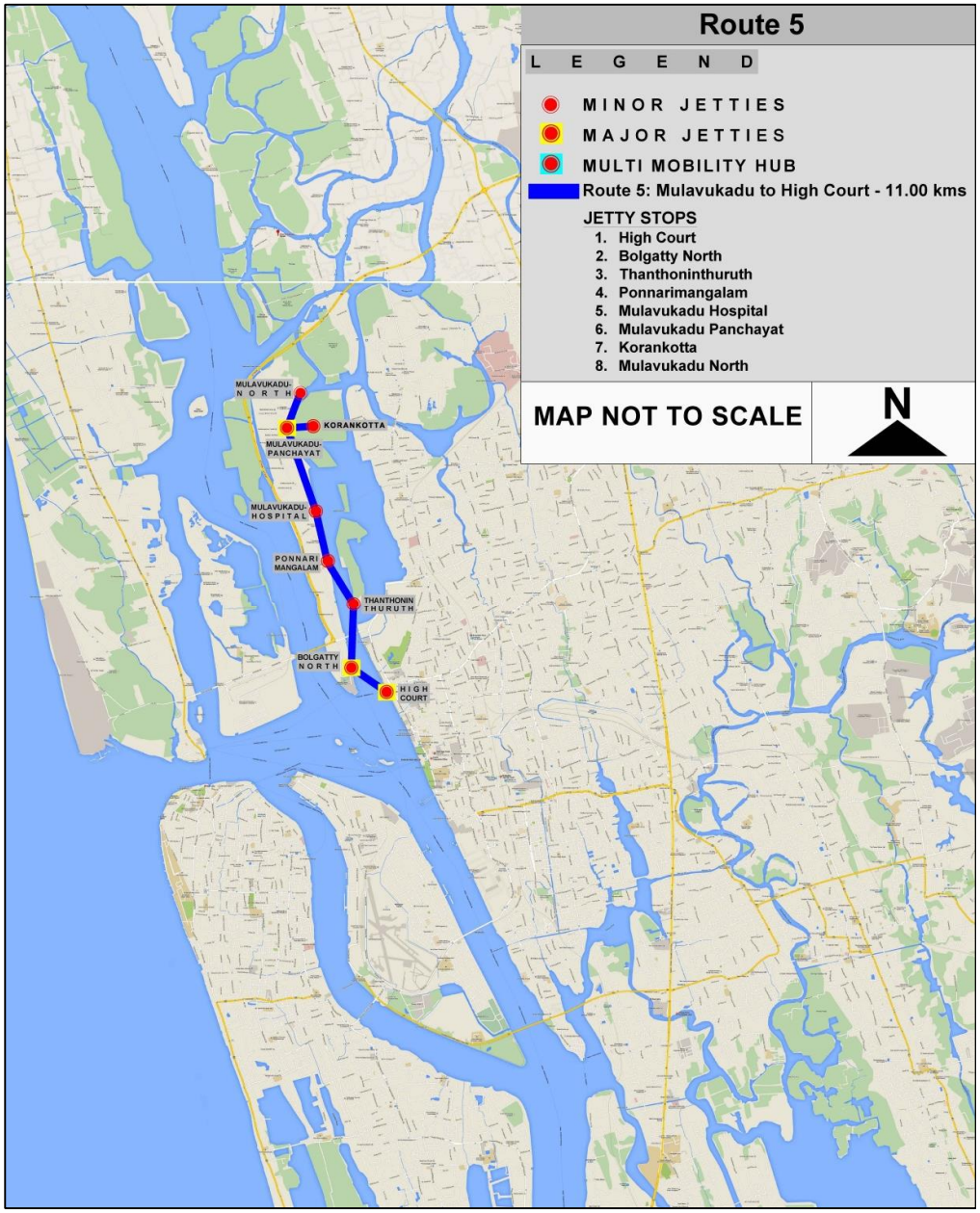
Figure 5-15: Route 4: Ernakulam to Mattancherry



5.5.5 ROUTE 5: High Court to Mulavukadu

This service is under operation currently, but is proposed to be operated by ten boats from the High Court Jetty with a frequency of 15 mins. The expected ridership on this route for the horizon year is 6,560 passengers per day. Passengers on this route will be able to link directly with the other ferry routes from High Court Jetty and Mulavukadu Panchayat.

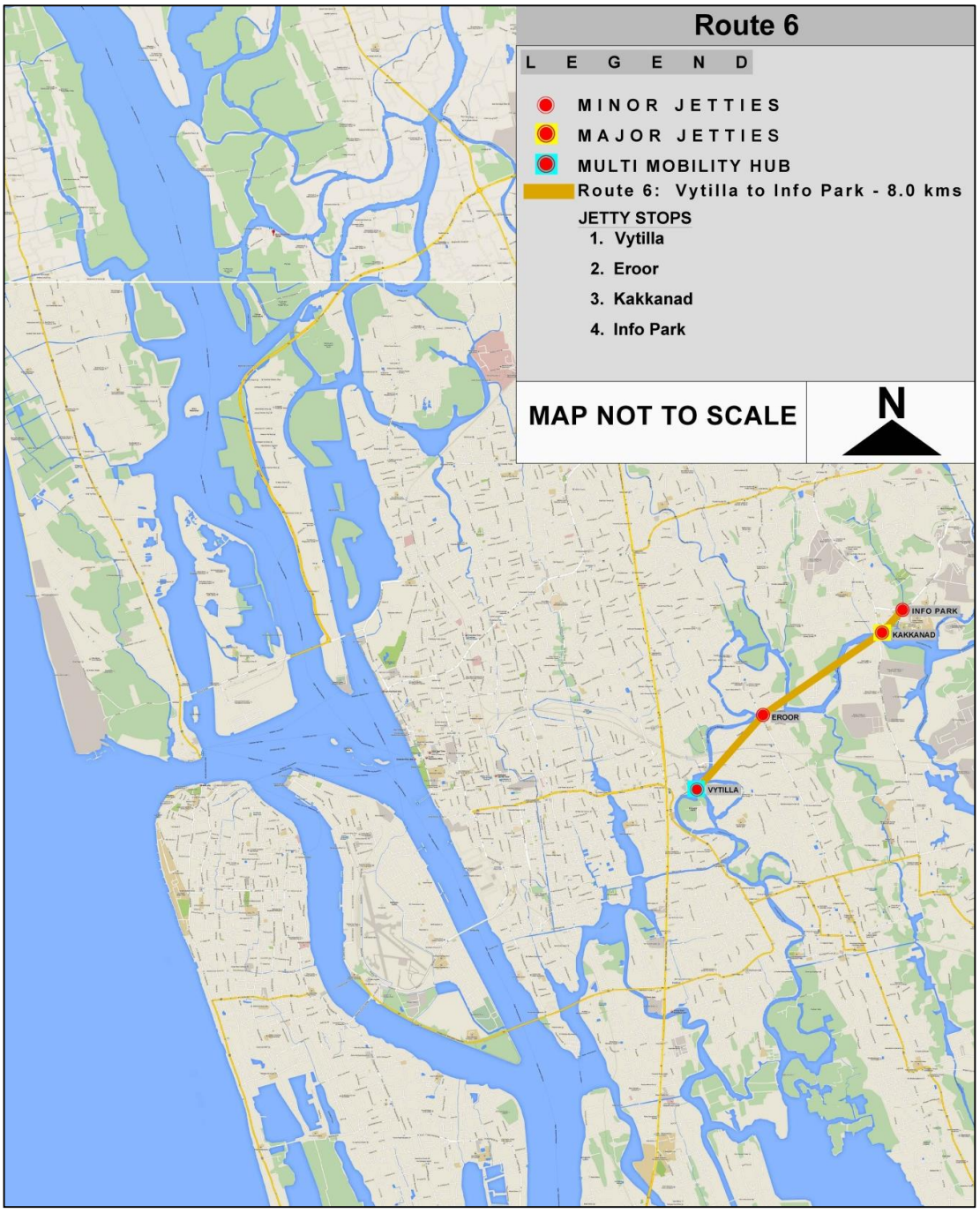
Figure 5-16: Route 5: High Court to Mulavakadu



5.5.6 ROUTE 6: Vytilla to Info Park

This service is currently under operation and is proposed to be operated by five boats from the High Court Jetty at a frequency of 20 mins. The expected ridership on this route for the horizon year is 2,800 passengers per day. Commuters on this route will be able to link directly to the other ferry routes from Vytilla.

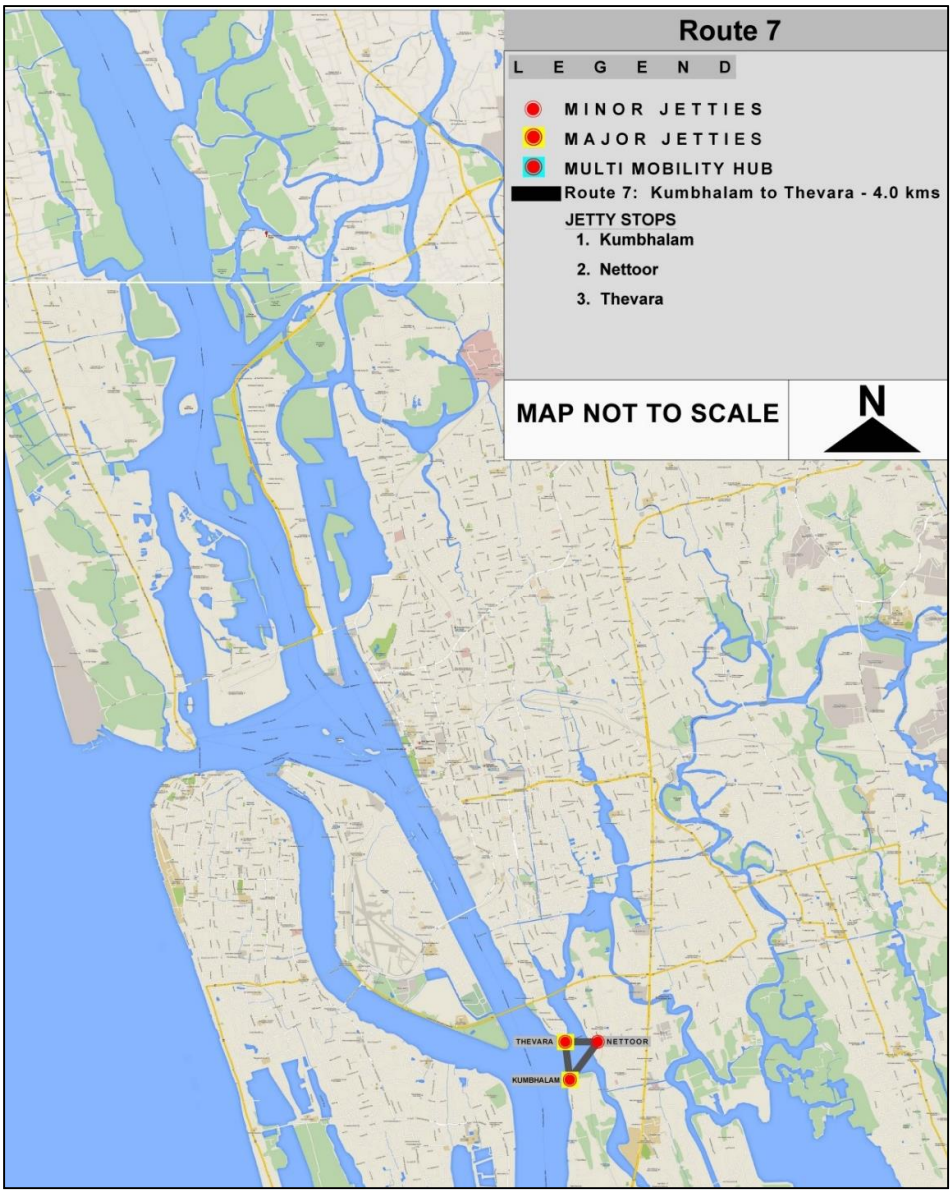
Figure 5-17: Route 6: Vytilla to Info Park



5.5.7 ROUTE 7: Kumbhalam to Thevara

This route is currently being operated partially by the Maradu Municipality connecting Thevara, Nettoor and Kumbhalam jetties. The initial leg of service would deploy three boats at a frequency of 20 mins. The expected ridership on this route for the horizon year is 3,336 passengers per day. Users of this route shall be able to link directly with the other modes of transport as well as other routes of ferry transport at Thevara and Kumbhalam to be connected with other parts of the city.

Figure 5-18: Route 7: Kumbhalam to Kumbhalam via Thevara and Nettoor

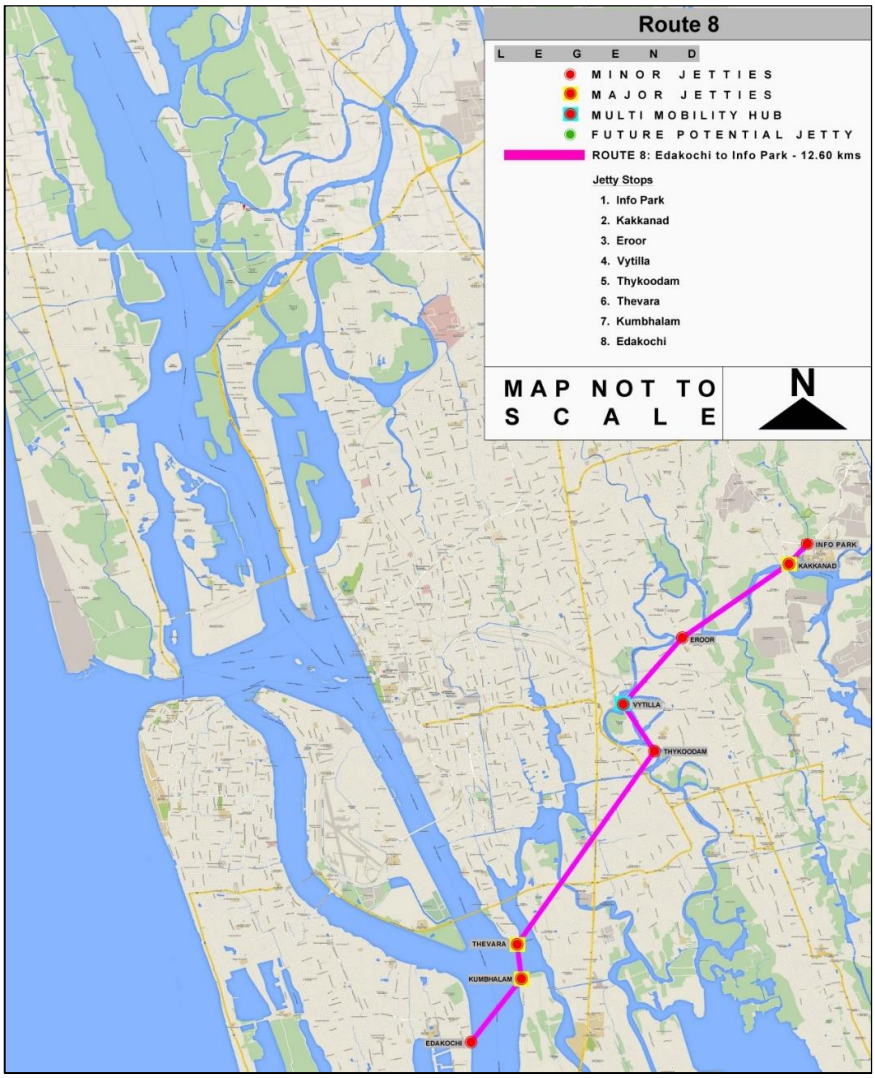


5.5.8 ROUTE 8: Edakochi to Info Park

Based on the demand estimations, it has been observed that there is a unmet demand which could be captured by extending the route and connecting Thykoodam, Thevara, Kumbhalam to Edakochi. This route covers a route length of 12.6 km with a future demand of 5,137 passengers, which would be operating with headway of 15 mins during the peak hours and 23 mins during the off peak hour. 100 pax boats are proposed to be operated on this route. It was observed that there is already some level of integration at Vytilla and Thevara, which needs to further upgraded for the efficient integration of various routes and seamless transfer between the various modes of transport. Further to which the jetty infrastructure at the Edakochi and Thykoodam needs to upgrade.

There is a possibility of locating a new jetty at the mouth of the Thevara canal, which shall require dredging. It is suggested that this new jetty be developed so as to reduce the route distance by 3 km.

Figure 5-19: Route 8: Info Park to Edakochi



5.5.9 ROUTE 9: Mulavukadu to South Chittoor

Currently, this route is partly covered in the Ernakulam-Varapuzha route which is operational at present. There is a jangar service operating between Moolampilly and South Chittoor and also between Kothad and Pizhala. Since it was observed that there is an increased demand on these routes, the services would start on the routes initially with six numbers of boats at a frequency of 20 mins. The expected ridership on this route for the horizon year is 2,759 passengers per day. Passengers on this route will be able to link directly with other modes of transport at Kothad and South Chittoor to be connected with other parts of the city.

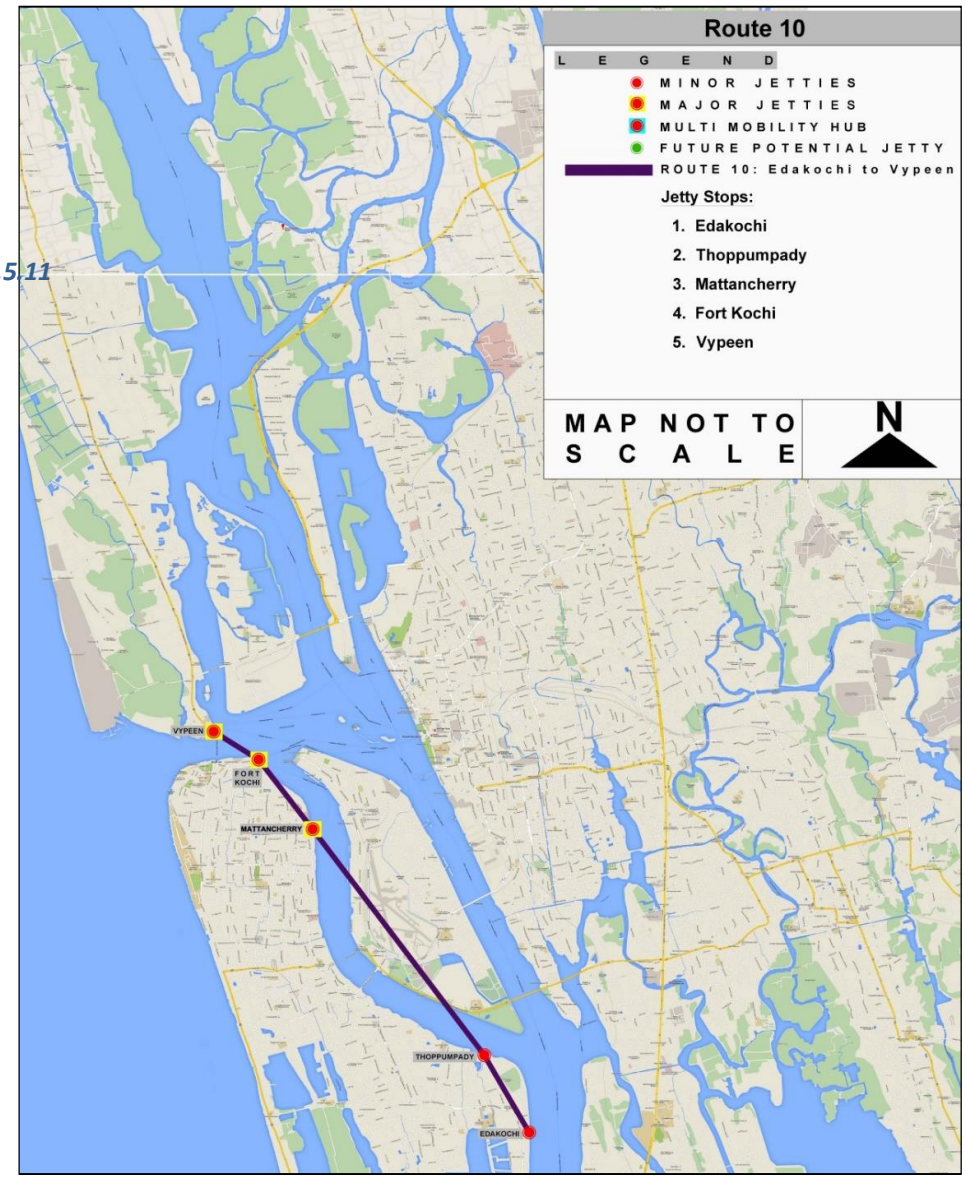
Figure 5-20: ROUTE 9: Mulavukadu to South Chittoor



5.5.10 ROUTE 10: Edakochi to Vypeen

Edakochi and Thoppumpady Jetties are also two jetties which were operational but the services have been currently terminated. At present these jetties are used to repair units of the boat vessels on a smaller scale. This route will be connected to other major and minor jetties through Route no 2, 3, 4 and 8. This route will be operating seven boats of 100 pax capacity with a frequency of 15 mins during the peak hour. The expected ridership on this route for the horizon year is 9,297 passengers per day. Along with the infrastructure upgradation of the jetties, the access and connectivity to these jetties need to be developed too.

Figure 5-21: Route 10: Edakochi to Vypeen

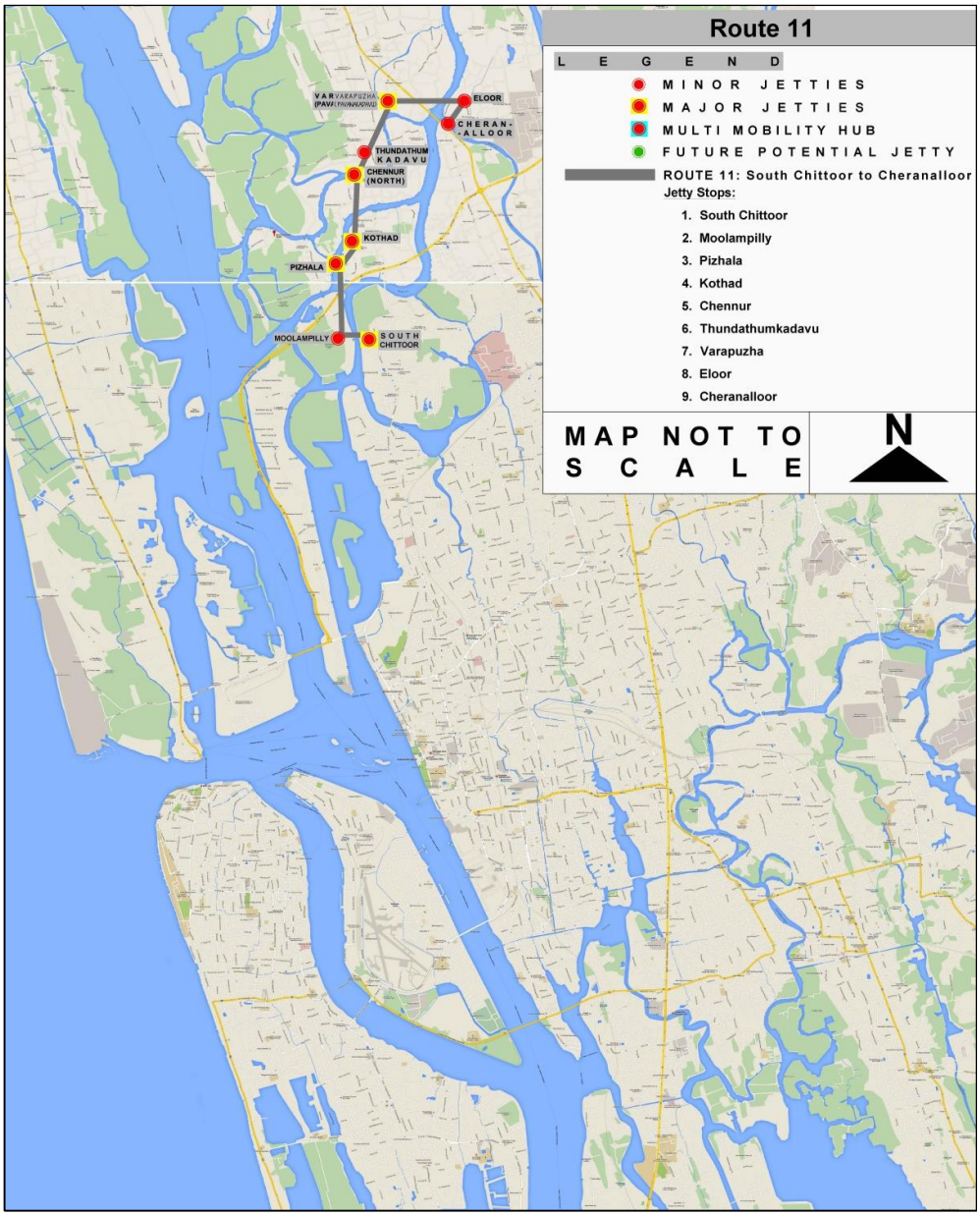


5.5.11

5.5.11 ROUTE 11: South Chittoor to Cheranallur

Currently, this route is being partly covered in the Ernakulam-Varapuzha route which is operational presently. There is a jangar service operating between Moolampilly and South Chittoor and also between Kothad and Pizhala. Since it was observed that there is an increased demand on these routes, the service would start with five boats initially at a frequency of 20 mins. The expected ridership on this route for the horizon year is 2,165 passengers per day. Passengers on this route will be able to link directly with other modes of transport at Kothad and South Chittoor to be connected with other parts of the city.

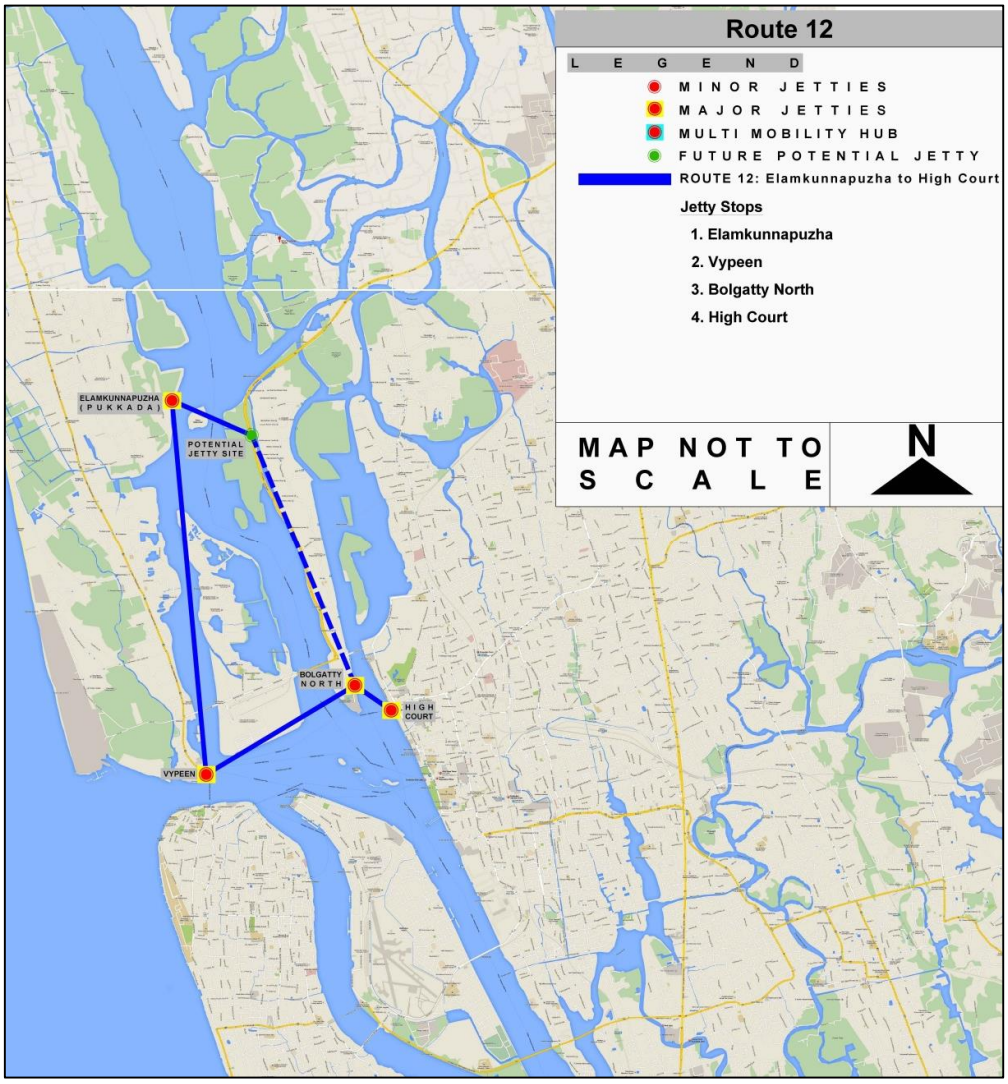
Figure 5-22: Route 11: South Chittoor to Cheranallur



5.5.12 ROUTE 12: Elamkunnapuzha to High Court

Eight boats will operate on this route. The Elamkunapuzha (Pukkada) Jetty was operational initially but the services have been terminated from this jetty over a period of time. it was realised that this is good way of reviving the jetty and capturing demand from the surrounding areas. Based on the discussions with the stakeholders, it was understood that majority of the people from Elamkunnapuzha insist on a connectivity to the ICT Road near Mulvakadu. Since there is no operational jetty on the Western side of the Mulvakadu Island, it was decided that initially this service would connect Bolgatty to High Court, further it is when the ideal location for jetty on the western side of the Mulavukadu is developed the service would get connected to ICT Road. Currently, this service will operate at a frequency of 20 minutes during the peak hour. The sector will capture approximately 6,495 passenger trips per day. Additional facilities will be required to be developed in the jetty locations for better integration with other modes of transport as well as for increased accessibility.

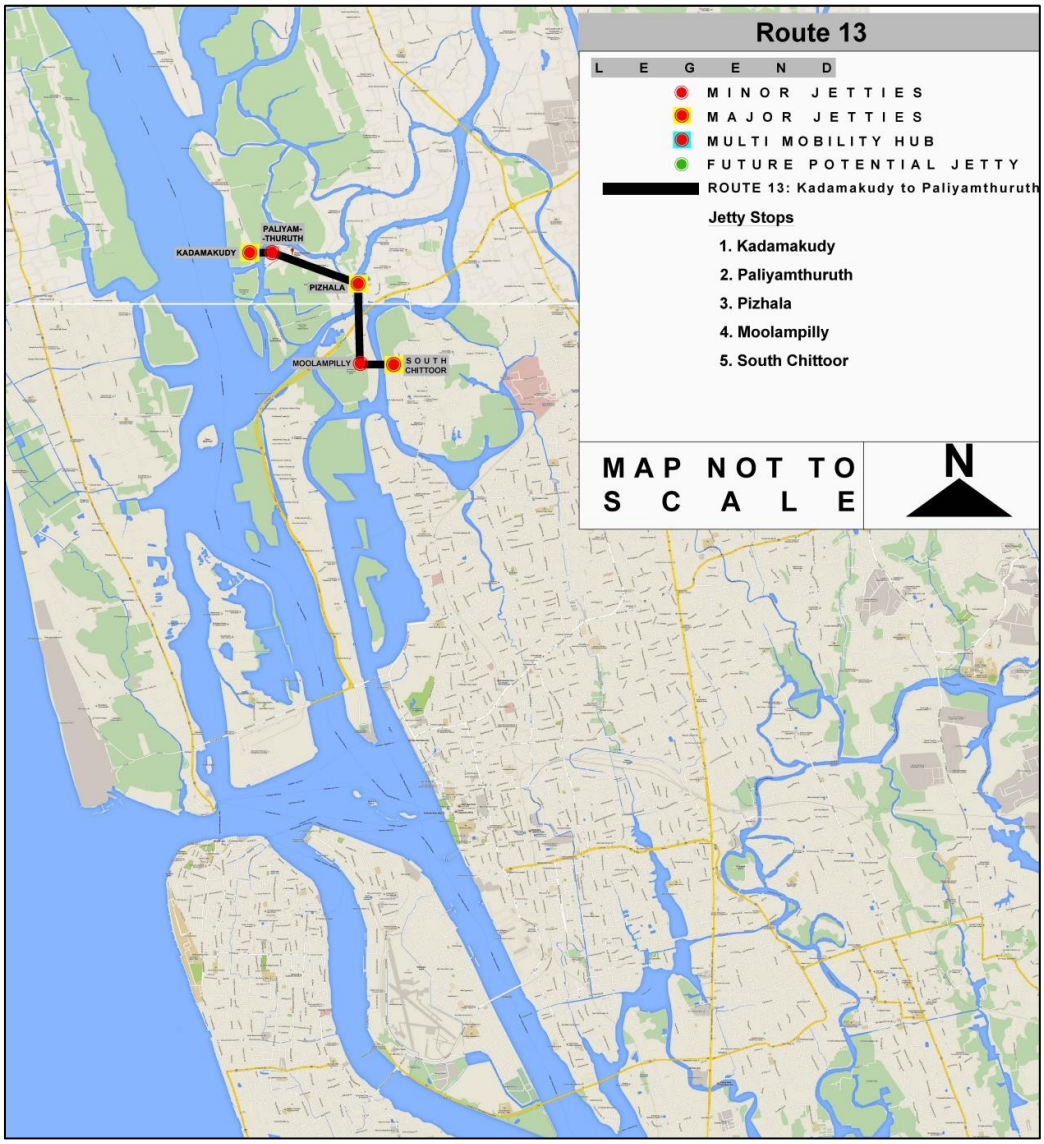
Figure 5-23: Route 12: Elamkunnapuzha to High Court


Route 12
L E G E N D
MINOR JETTIES
MAJOR JETTIES
MULTI MOBILITY HUB
FUTURE POTENTIAL JETTY
ROUTE 12: Elamkunnapuzha to High Court
Jetty Stops
1. Elamkunnapuzha
2. Vypeen
3. Bolgatty North
4. High Court
MAP NOT TO SCALE
N
ELAMKUNNAPUZHA (PUKKADA)
POTENTIAL JETTY SITE
BOLGATTY NORTH
HIGH COURT
VYPEEN

5.5.13 ROUTE 13: Kadamakudy to Kothad via Paliyamthuruth

Currently, there are minor jetties on these islands which are connected by small canopies and jangar services operated by the local bodies. This route shall be connected with a major interchange facility at Kothad. The demand during the peak hour along this route is almost 50% of the total daily ridership, Hence, it is suggested that the service on this route be started with three boats at a frequency of 20 mins.. The expected ridership on this route for the horizon year is 297 passengers per day. Passengers on this route will be able to link directly with other modes of transport as well as other routes of ferry transport at Kothad with other parts of the city.

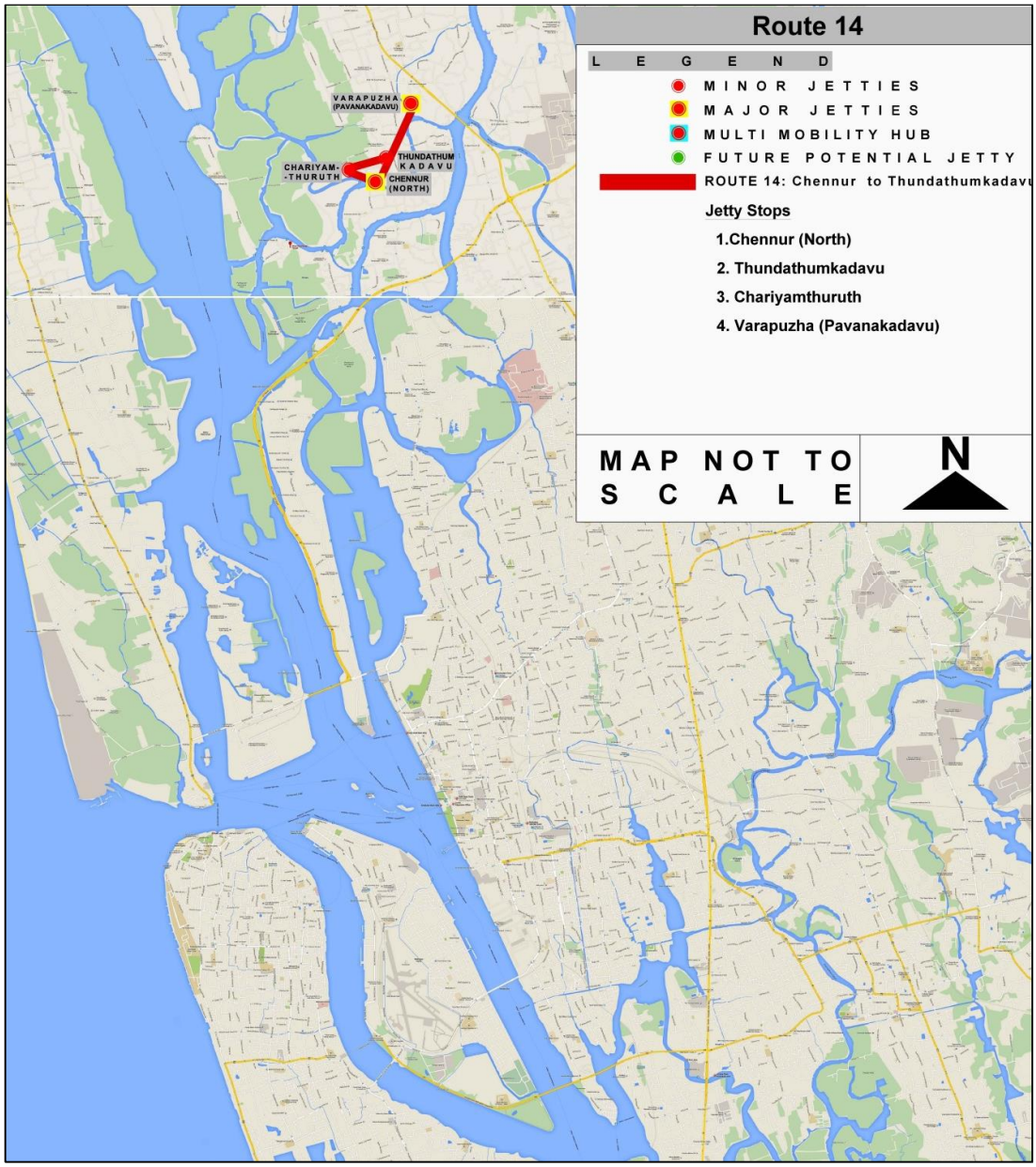
Figure 5-24: Route 13: Kadamakudy to Kothad via Paliyamthuruth



5.5.14 ROUTE 14: Chennur to Thundathumkadavu

Currently, there are minor jetties on Chennur, Varapuzha and Kadamakudy Islands and Jangar services are operational in between these jetties. The service on this route would be initiated with three boats of 50 PAX and a frequency of 20 mins The expected ridership on this route for the horizon year is 2, 802 passengers per day. This route will be able to link directly with other modes of transport as well as other ferry routes at Varapuzha with other parts of the city.

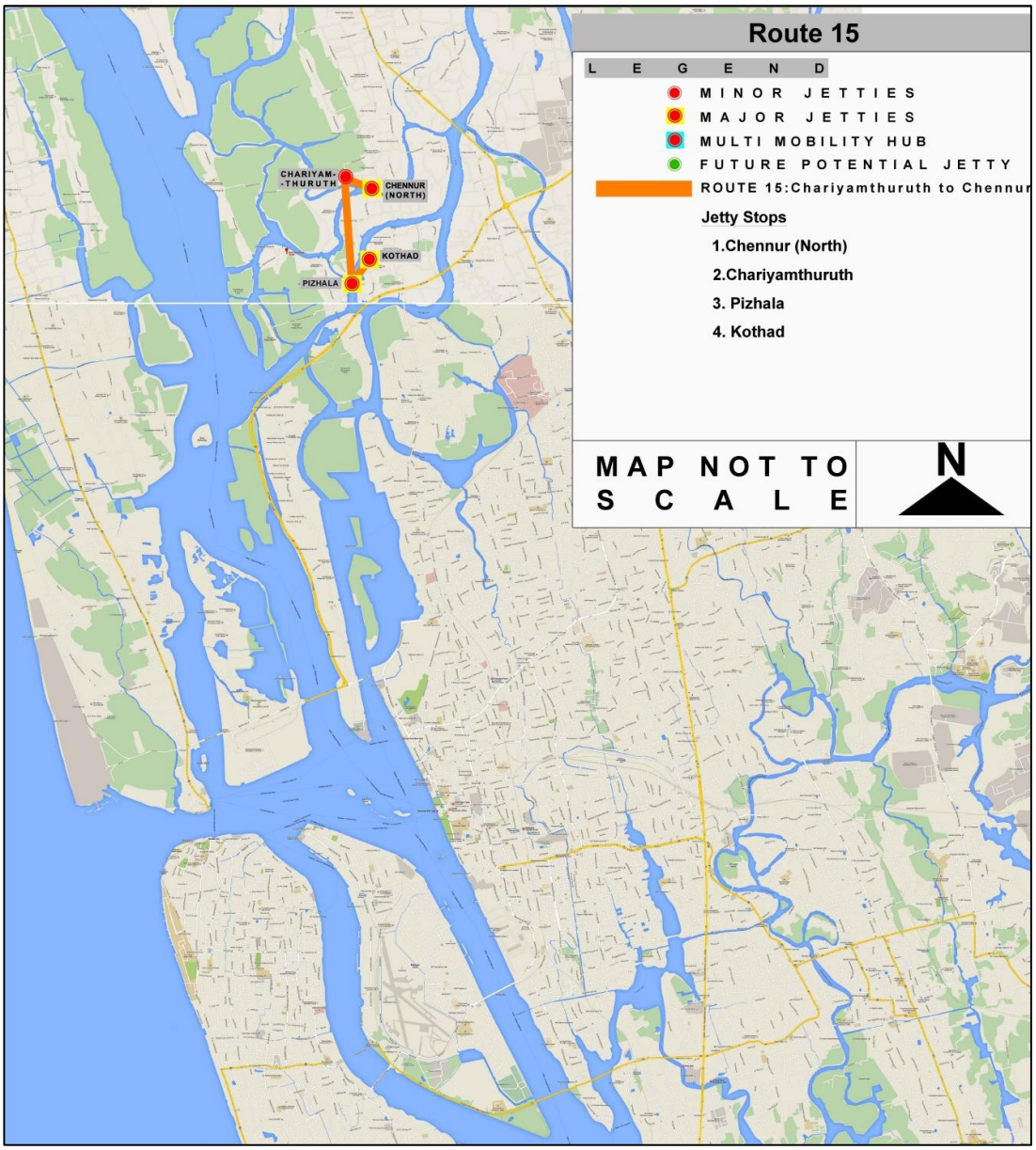
Figure 5-25: Route 14: Chennur to Thundathumkadavu



5.5.15 ROUTE 15: Chariyamthuruth to Chennur

Currently, there are minor jetties on Chennur, Varapuzha and Kadamakudy Islands, with Jangar services operating between these jetties. The service on this route shall be initiated with one boat of 50 PAX, at a frequency of 20mins. The expected ridership on this route for the horizon year is 300 passengers per day.

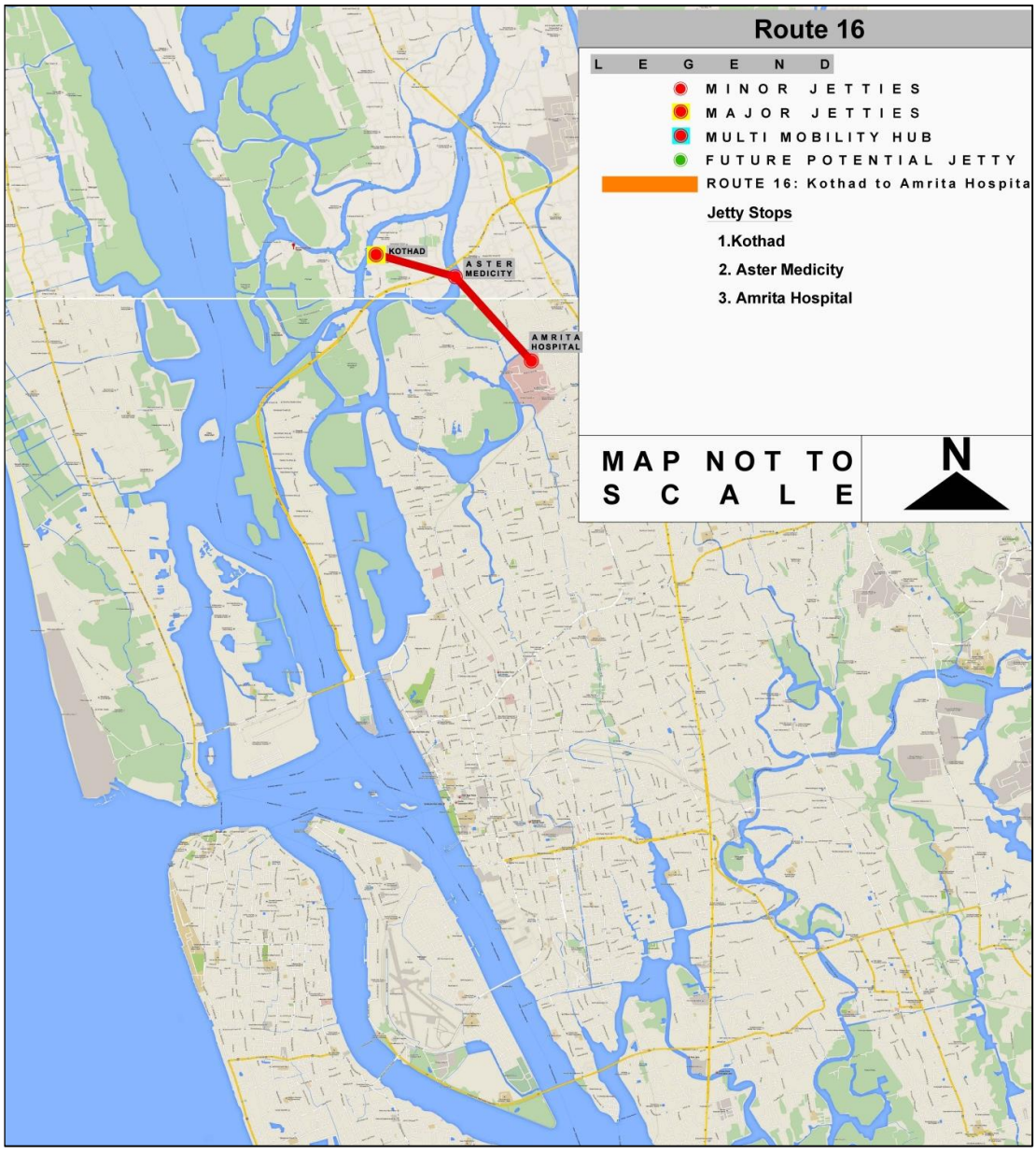
Figure 5-26: Route 15: Chariyamthuruth to Chennur



5.5.16 ROUTE 16: Kothad to Amrita Hospital

With an intension of reviving the water transport in Kochi as well as connecting the island communities with the necessary social infrastructure; this route would connect Kothad with Aster Medicity Hospital and Amrita Hospital. The service on this route would be initiated with one boat of 50 PAX at a frequency of 20 mins. The expected ridership on this route for the horizon year is 1,359 passengers per day. Commuters on this route will be able to link directly with other modes of transport as well as other ferry routes at Kothad with other parts of the city.

Figure 5-27: Route 16: Kothad to Amrita Hospital



5.6 Selection of the Identified Route Network

The prime objective of any type of urban transportation system is the development of optimum comprehensive strategy. In the current study, evaluation of the identified water transport network has been attempted from the point of view of passenger transport demand for the horizon year of 2025 and 2035 and the ability of the identified network to cater to this demand. Each of three growth scenarios has been evaluated based on the identified criteria for comparative evaluation.

a. Daily Ridership on each of the identified routes
b. Peak hour peak direction trips (PHPDT) for each of the identified routes

Comparative evaluation of each of the three growth scenarios as described above for the horizon years are represented in the tables below.

The base year daily ridership is observed to be at 20,106 passengers, whereas with the induced demand the daily ridership grew by 69% to reach 34,826 passengers. In the pessimistic scenario the daily ridership for 2019 increased to 38,056, for 2025 increased to 44,575 and for 2035 increased to 59,905 where as in the optimistic scenario the daily ridership for 2019 increased to 43,871, for year 2025 increased to 69,782 and for 2035 increased to 1, 50,464 and in the realistic scenario it was estimated to be 40,316 in 2019;53, 592 in 2025 and 86, 112 in 2035. The ridership numbers are summarised in Table 5-4.

Table 5-4: Ridership Scenarios

		Base year Ridership	20106
		Induced demand (2016)	34826
Year	**Pessimistic Scenario**	**Optimistic Scenario**	**Realistic Scenario**
2019	38056	43871	40316
2025	44575	69782	53592
2035	59905	150464	86112

On evaluation of the identified routes, it was observed that the system would have the potential to cater to the 1, 50, 000 passengers on a daily basis in the optimistic scenario for 2035, yet it was considered that the realistic scenario would be the ideal development scenario for Kochi Water Transport, which shall cater to approximately 86, 112 passengers on a daily basis in 2035. **Table** 5-5 represents the scenario wise evaluation of the maximum phpdt and Daily Ridership along the identified 16 routes.

From the table it can be observed that the maximum ridership is observed to be on the routes connecting Ernakulam with Fort Kochi and Vypeen via Wellington Island and Mattancherry.

The **Table 5-6** represents the jetty wise peak hour boarding and alighting, indicating that the maximum boarding and alighting is observed at Ernakulam, High Court, Wellington Island, Mattancherry and Fort Kochi. It is assumed that similar trends would be seen in the horizon years also. It is to be noted that based on the supply in the base year the demand from the various locations would change and the system would be required to adapt accordingly bridging the demand and supply gap on a regular basis. Refer Annexure IV for distance matrix.

Table 5-5: Scenario Wise Evaluation of the Maximum PHPDT and Daily Ridership

Route	Origin	Destination	Route Length (km)	Maximum PHPDT										Daily Ridership									
				2015	2016	Pessimistic			Optimistic			Realistic			2015	2016	Pessimistic			Optimistic			Realistic		
						2019	2025	2035	2019	2025	2035	2019	2025	2035			2019	2025	2035	2019	2025	2035	2019	2025	2035
1	South Chittoor	Ernakulam	8.2	24	137	149	179	235	172	273	590	158	205	330	384	2184	2387	2864	3760	2751	4368	9440	2528	3280	5280
2	Edakochi	Thevara	3.74	25	84	92	110	146	106	168	363	97	126	205	393	1344	1469	1760	2336	1693	2688	5808	1556	2016	3284
3	Ernakulam	Vypeen	6.4	420	441	482	570	767	556	882	1904	511	680	1070	6720	7056	7710	9120	12272	8889	14112	30464	8168	10880	17120
4	Ernakulam	Mattancherry	6.1	420	441	482	570	767	556	882	1904	511	680	1070	6720	7056	7710	9120	12272	8889	14112	30464	8168	10880	17120
5	High Court	Mulavakadu	11	53	165	180	210	282	208	330	712	191	250	410	845	2638	2882	3360	4512	3323	5280	11392	3053	4000	6560
6	Vytilla	Info Park	8	30	68	75	90	121	86	137	295	79	106	175	480	1092	1193	1440	1936	1376	2192	4720	1264	1694	2800
7	Kumbhalam	Thevara	4	65	84	92	110	148	106	168	363	97	128	208	1040	1344	1469	1760	2368	1693	2688	5808	1556	2048	3336
8	Info Park	Edakochi	12.6	25	127	139	166	224	160	254	549	147	197	321	393	2033	2221	2656	3584	2561	4064	8784	2353	3154	5137
9	Mulavukadu	South Chittoor	8	22	68	75	90	121	86	137	295	79	106	172	352	1092	1193	1440	1936	1376	2192	4720	1264	1694	2759
10	Edakochi	Vypeen	13.6	50	230	251	275	370	290	460	993	266	357	581	799	3679	4020	4400	5920	4635	7360	15888	4259	5708	9297
11	South Chittoor	Cheranalloor	6	13	54	59	70	95	67	108	232	62	83	135	208	857	936	1120	1520	1079	1728	3712	992	1329	2165
12	Elamkunnapuzha	High Court	15	70	161	176	200	269	202	322	694	186	249	406	1120	2570	2809	3200	4304	3238	5152	11104	2976	3988	6495
13	Kadamakudy	Paliyamthuruth	6	10	7	8	10	14	9	15	32	9	11	19	160	118	129	160	224	148	240	512	136	182	297
14	Chennur	Thundathumkadavu	3	15	69	76	82	111	87	139	300	80	108	175	240	1109	1212	1312	1777	1397	2224	4800	1284	1720	2802
15	Chariyamthuruth	Chennur	3	7	7	8	10	14	9	15	32	9	11	19	108	118	129	160	224	148	240	512	136	182	300
16	Kothad	Amrita Hospital	3	9	34	37	44	60	42	68	146	39	52	85	144	538	587	704	960	677	1088	2336	622	837	1359
				1,257	2,177	2,378	2,786	3,744	2,742	4,358	9,404	2,520	3,349	5,382	20,106	34,826	38,056	44,576	59,905	43,871	69,728	150,464	40,316	53,592	86,112

Table 5-6: Jetty Wise Peak Hour Boarding and Alighting in the Horizon Years

Sl. No	Jetty Names	2015			Induced 2016			Realistic Scenario 2025			Realistic Scenario 2035		
		Boarding	Alighting	Total	Boarding	Alighting	Total	Boarding	Alighting	Total	Boarding	Alighting	Total
1	Amrita Hospital	4	2	6	23	23	46	38	37	75	61	60	126
2	Bolgatty North	21	37	59	100	111	211	163	180	343	265	293	612
3	Chariyamturuth	3	4	7	19	19	38	31	31	62	50	51	107
4	Chennur	19	23	37	74	67	117	111	101	174	297	278	329
5	Cheranalloor	16	14	30	83	80	163	135	130	265	221	212	458
6	Edakochi	22	0	22	31	9	39	50	14	64	81	23	125
7	Elamkunnapuzha	42	41	83	121	120	241	198	195	392	322	317	716
8	Eloor	1	1	2	23	23	45	37	37	74	60	60	119
9	Ernakulam	993	690	1683	1099	806	1905	1836	1393	3230	3731	2981	6817
10	Eroor	11	11	22	284	282	565	462	459	922	753	748	1509
11	Fort Kochi	1007	807	1814	1250	974	2223	2036	1678	3714	3317	2734	7752
12	High Court	221	237	459	444	502	946	724	818	1543	1179	1334	2948
13	Info Park	14	15	30	59	58	116	95	94	189	156	152	335
14	Kadamakudy	1	1	3	35	35	70	57	57	114	93	93	186
15	Kakkanad	29	30	60	97	95	192	158	155	313	259	253	566

Sl. No	Jetty Names	2015			Induced 2016			Realistic Scenario 2025			Realistic Scenario 2035		
		Boarding	Alighting	Total	Boarding	Alighting	Total	Boarding	Alighting	Total	Boarding	Alighting	Total
16	Korrankotta	1	1	2	1	1	2	1	1	2	1	1	5
17	Kothad	48	46	94	125	124	245	196	195	384	435	432	723
18	Kumbhalam	80	94	175	716	730	1446	991	1010	2001	3889	3981	3621
19	Mattancherry	306	508	815	431	633	1064	703	981	1684	1146	1628	3563
20	Medicity	4	2	6	23	23	46	38	37	75	61	60	126
21	Moolampilly	8	13	20	87	81	168	141	133	274	231	217	463
22	Mulavakadu Hospital	4	3	7	7	5	12	11	8	19	18	13	38
23	Mulavakadu North	9	9	18	17	13	30	28	21	49	46	34	98
24	Mulavakadu Panchayat	27	27	54	75	60	135	122	98	220	199	160	409
25	Nettoor	5	6	10	27	27	54	43	45	88	71	73	153
26	Paliyamturuth	1	1	3	6	6	13	10	11	21	17	17	36
27	Pizhala	42	40	77	94	92	159	146	143	244	353	347	480
28	Ponnari Mangalam	9	9	18	39	36	75	48	45	93	258	265	186
29	South Chittoor	48	37	85	234	221	456	333	313	646	1189	1140	1186
30	Thanthoninturuth	25	26	51	71	60	130	101	83	184	344	327	365
31	Thevara	191	184	375	298	291	589	410	402	811	1661	1610	1776
32	Thoppumpady	6	0	6	13	7	19	21	11	32	34	17	57
33	Thundathumkadavu	2	2	3	12	12	15	19	19	24	31	31	41
34	Thykoodam	4	5	9	39	42	81	64	68	132	105	111	222
35	Varapuzha	27	24	52	256	254	510	353	351	704	1415	1408	1265
36	Vypeen	163	183	346	443	502	945	804	917	1721	1159	1291	3012
37	Vytilla	44	46	89	143	149	292	232	244	476	378	397	857
38	Wellington Island	536	742	1278	570	777	1348	477	406	883	642	517	3508
	Total	3,995	3,923	7,906	7,468	7,349	14,753	11,425	10,919	22,241	24,530	23,666	44,899

5.7 Fleet estimation for Water Transport

Estimation of the fleet size is quite essential for any public transit facility. Surplus number of fleet would often lead to the underutilization and eventually increase both the capital and operational costs. On the other hand insufficient fleet drives the users to adopt a different mode leading to reduction in the ridership values. It becomes important that an optimal fleet size be determined and such a system needs to be developed so as to ensure enough fleet size to meet the ridership demand at the same time being self-sustainable.

To estimate the fleet size for the proposed water transport system in Kochi, various parameters have been considered which were derived from primary surveys. The factors are given below;

- Average Running Speed as 8 Knots
- Route Length
- Layover Time – 10 minutes
- Headway
- Fleet Required – Length/Average Journey Speed/Headway
- Spare Boats – 5% of the Fleet Size (assumed)

Based on the extensive field surveys and discussions with the stakeholders, the following recommendations are proposed;

- The routes to be introduced in a Phase wise manner, wherein the maximum demand areas are catered in the Phase I and in the Phase II the network would be expanded to further locations w.r.t demand and connectivity.
- It has been proposed to operate 100 PAX boats on four routes (Route no. 3, 4, 8 and 10) and 50 PAX boats on rest of the routes.
- It is being proposed that the boats shall run with a speed of 8 knots.
- Along with the speed of the boats, it is necessary to consider the average operating hours of the boat, which is to be about 16 hours and the running hours per boat about 10 to 12 hrs.

5.8 Headway of Services

The total estimated ridership on the proposed water transport network is the potential demand which can be captured once the complete Public Transport system is in place. The system would start operations in a phase wise manner with respect to the availability of boats.

Based on the boarding and alighting surveys, it is observed that peak hour constituted approximately 30% of the total daily ridership. Hence, with respect to the observations from the primary surveys, peak hour and off peak hour frequency of services were decided, which is represented in **Table 5-7**.

The minimum headway of 12 minutes is proposed on the Ernakulam-Vypeen and Ernakulam-Mattancherry route and the maximum headway of 20 minutes is proposed on the route no. 2, 6, 7, 9, 11, 12, 13, 14, 15 and 16 during the peak hour (08:00 am to 09:00 am in the morning and 5:00 pm to 6:00 pm). This could be further reduced to 5 minutes and 15 minutes in the horizon year 2035. Variation in headways is proposed throughout the day along the routes depending upon the demand of commuters.

Once the routes are operational, the boarding and alighting on the respective routes need to be monitored closely so as to check the build-up of demand according to which the routes as well as the service frequencies would have to be modified.

Table 5-7: Route Wise Peak and Off Peak Hour Headways

Route No	Origin	Destination	Headways - 2019					Headways - 2025					Headways - 2035				
			Morning Slack	Morning Peak	Off Peak	Evening Peak	Slack time	Morning Slack	Morning Peak	Off Peak	Evening Peak	Slack time	Morning Slack	Morning Peak	Off Peak	Evening Peak	Slack time
			6:00 to 7:00	7:00 to 10:00	10:00 to 4:00	4:00 to 7:00	7:00 to 9:00	6:00 to 7:00	7:00 to 10:00	10:00 to 4:00	4:00 to 7:00	7:00 to 9:00	6:00 to 7:00	7:00 to 10:00	10:00 to 4:00	4:00 to 7:00	7:00 to 9:00
1	South Chittoor	Ernakulam	19.0	15.0	23.0	15.0	19.0	19.0	15.0	22.5	15.0	19.0	15.0	12.0	18.0	12.0	15.0
2	Edakochi	Thevara	25.0	20.0	30.0	20.0	25.0	19.0	15.0	22.5	15.0	19.0	15.0	12.0	18.0	12.0	15.0
3	Ernakulam	Vypeen	15.0	12.0	18.0	12.0	15.0	10.0	8.0	12.0	8.0	10.0	6.3	5.0	7.5	5.0	8.0
4	Ernakulam	Mattancherry	15.0	12.0	18.0	12.0	15.0	10.0	8.0	12.0	8.0	10.0	7.5	6.0	9.0	6.0	8.0
5	High Court	Mulavakadu	19.0	15.0	23.0	15.0	19.0	13.0	10.0	15.0	10.0	13.0	8.3	6.7	10.0	6.7	10.0
6	Vytilla	Info Park	25.0	20.0	30.0	20.0	25.0	25.0	20.0	30.0	20.0	25.0	18.8	15.0	22.5	15.0	20.0
7	Kumbhalam	Thevara	25.0	20.0	30.0	20.0	25.0	19.0	15.0	22.5	15.0	19.0	15.0	12.0	18.0	12.0	15.0
8	Info Park	Edakochi	19.0	15.0	23.0	15.0	19.0	19.0	15.0	22.5	15.0	19.0	12.5	10.0	15.0	10.0	12.5
9	Mulavukadu	South Chittoor	25.0	20.0	30.0	20.0	25.0	25.0	20.0	30.0	20.0	25.0	18.8	15.0	22.5	15.0	18.8
10	Edakochi	Vypeen	19.0	15.0	23.0	15.0	19.0	19.0	15.0	22.5	15.0	19.0	18.8	15.0	22.5	15.0	18.8
11	South Chittoor	Cheranalloor	25.0	20.0	30.0	20.0	25.0	41.0	20.0	30.0	20.0	41.0	18.8	15.0	22.5	15.0	18.8
12	Elamkunnapuzha	High Court	25.0	20.0	30.0	20.0	25.0	41.0	20.0	30.0	20.0	41.0	25.0	20.0	30.0	20.0	25.0
13	Kadamakudy	Paliyamthuruth	25.0	20.0	30.0	20.0	25.0	41.0	20.0	30.0	20.0	41.0	25.0	20.0	30.0	20.0	25.0
14	Chennur	Thundathumkadavu	25.0	20.0	30.0	20.0	25.0	41.0	20.0	30.0	20.0	41.0	25.0	20.0	30.0	20.0	25.0
15	Chariyamthuruth	Chennur	25.0	20.0	30.0	20.0	25.0	41.0	20.0	30.0	20.0	41.0	18.8	15.0	22.5	15.0	18.8
16	Kothad	Amrita Hospital	25.0	20.0	30.0	20.0	25.0	41.0	20.0	30.0	20.0	41.0	25.0	20.0	30.0	20.0	25.0

Table 5-8: Route Wise Peak and Off Peak Hour Trip Requirement

Route No	Origin	Destination	No. of Trips - 2019-2025/per boat					Total No. of Trips	No. of Trips - 2025-2035					Total No. of Trips	No. of Trips - 2025-2035					Total No. of Trips
			Morning Slack	Morning Peak	Off Peak	Evening Peak	Slack time		Morning Slack	Morning Peak	Off Peak	Evening Peak	Slack time		Morning Slack	Morning Peak	Off Peak	Evening Peak	Slack time	
			6:00 to 7:00	7:00 to 10:00	10:00 to 4:00	4:00 to 7:00	7:00 to 9:00		6:00 to 7:00	7:00 to 10:00	10:00 to 4:00	4:00 to 7:00	7:00 to 9:00		6:00 to 7:00	7:00 to 10:00	10:00 to 4:00	4:00 to 7:00	7:00 to 9:00	
1	South Chittoor	Ernakulam	0.0	2.0	2.0	2.0	0.0	6	1.0	2.0	2.0	2.0	0.0	**7**	1.0	2.0	2.0	2.0	1.0	**8**
2	Edakochi	Thevara	1.0	2.0	2.0	2.0	1.0	8	1.0	2.0	2.0	2.0	1.0	**8**	2.0	2.0	2.0	2.0	1.0	**9**
3	Ernakulam	Vypeen	1.0	3.0	2.0	2.0	1.0	9	2.0	3.0	2.0	2.0	2.0	**11**	2.0	3.0	2.0	2.0	2.0	**11**
4	Ernakulam	Mattancherry	1.0	2.0	2.0	2.0	1.0	8	2.0	3.0	2.0	2.0	2.0	**11**	2.0	3.0	2.0	2.0	2.0	**11**
5	High Court	Mulavakadu	0.0	2.0	1.0	2.0	0.0	5	0.0	2.0	2.0	2.0	0.0	**6**	1.0	2.0	2.0	2.0	0.0	**7**
6	Vytilla	Info Park	0.0	2.0	0.0	2.0	0.0	5	0.0	2.0	1.0	2.0	0.0	**5**	0.0	2.0	2.0	2.0	0.0	**6**
7	Kumbhalam	Thevara	1.0	2.0	1.0	2.0	1.0	7	1.0	2.0	1.0	2.0	1.0	**7**	2.0	2.0	2.0	2.0	1.0	**9**
8	Info Park	Edakochi	0.0	2.0	1.0	2.0	0.0	**5**	0.0	2.0	1.0	2.0	0.0	**5**	0.0	2.0	2.0	2.0	0.0	**6**
9	Mulavukadu	South Chittoor	0.0	2.0	0.0	2.0	0.0	**4**	0.0	2.0	0.0	2.0	0.0	**4**	0.0	2.0	2.0	2.0	0.0	**6**
10	Edakochi	Vypeen	0.0	2.0	2.0	2.0	0.0	**6**	0.0	2.0	1.0	2.0	0.0	**6**	0.0	2.0	2.0	2.0	0.0	**7**
11	South Chittoor	Cheranalloor	0.0	1.0	1.0	1.0	0.0	**3**	0.0	2.0	0.0	2.0	0.0	**4**	0.0	2.0	1.0	2.0	0.0	**5**
12	Elamkunnapuzha	High Court	0.0	2.0	1.0	2.0	0.0	**5**	0.0	2.0	1.0	2.0	0.0	**6**	0.0	2.0	2.0	2.0	0.0	**6**
13	Kadamakudy	Paliyamthuruth	0.0	1.0	0.0	1.0	0.0	**2**	0.0	1.0	0.0	1.0	0.0	**2**	0.0	1.0	1.0	1.0	0.0	**3**

Route No	Origin	Destination	No. of Trips - 2019-2025/per boat					Total No. of Trips	No. of Trips - 2025-2035					Total No. of Trips	No. of Trips - 2025-2035					Total No. of Trips
			Morning Slack	Morning Peak	Off Peak	Evening Peak	Slack time		Morning Slack	Morning Peak	Off Peak	Evening Peak	Slack time		Morning Slack	Morning Peak	Off Peak	Evening Peak	Slack time	
			6:00 to 7:00	7:00 to 10:00	10:00 to 4:00	4:00 to 7:00	7:00 to 9:00		6:00 to 7:00	7:00 to 10:00	10:00 to 4:00	4:00 to 7:00	7:00 to 9:00		6:00 to 7:00	7:00 to 10:00	10:00 to 4:00	4:00 to 7:00	7:00 to 9:00	
14	Chennur	Thundathumkadavu	2.0	3.0	2.0	2.0	2.0	**11**	2.0	3.0	2.0	2.0	2.0	**11**	2.0	3.0	2.0	2.0	2.0	**11**
15	Chariyamthuruth	Chennur	0.0	1.0	0.0	1.0	0.0	**2**	0.0	1.0	1.0	1.0	0.0	**3**	0.0	2.0	1.0	2.0	0.0	**5**
16	Kothad	Amrita Hospital	2.0	3.0	2.0	2.0	2.0	**11**	2.0	3.0	2.0	2.0	2.0	**11**	2.0	2.0	2.0	2.0	1.0	**9**

Based on the headways mentioned in **Table 5-7**, the no. of trip requirements has been assessed on each of the 16 routes for morning slack period, morning peak, morning off peak, evening peak and evening slack period which is as shown in Table 5-8. During the Phase I (2016-17), the total requirement of 285 boat trips per day on the 7 routes is estimated, where as there is a total requirement of about 490 boat trips per day on the 16 routes during Phase II (2018-19). The number of boat trips is estimated to increase to 630 boat trips per day by 2025 and as demand increases the boat trips would increase to 974 boat trips per day by the year 2035.

Based on the headways and the no. of boat trips, the fleet size has been estimated for Phase I and II and horizon years of 2025 and 2035. The details of the proposed routes along with the route length, proposed peak hour headway and fleet size are presented in the table below.

The entire Inland Water Transport project is proposed to be implemented over a period of four years between 2016 and 2019. Based on the demand, the identified 16 routes have been prioritised under Phase I and Phase II. The entire water transport system (with the identified 16 routes) is proposed to be operational by 2019. The phasing plan of the identified routes is given in **Table 5-9**. It is expected that the patronage of the water transport would eventually build up depending on the execution and operational features of the system. Hence depending upon the above mentioned parameters fleet estimations has been calculated for Phase I (2016-17) and Phase II (2018-19) and for the horizon years 2025 and 2035. During the phase I (2016-17), it is proposed to operate 7 routes with a fleet requirement of 43 boats, of which 14 are 100 pax boats and 27 are 50 Pax boats and 2 boats as spare. During Phase II (2018-19), it is proposed to operate all the identified 16 routes (7 routes of Phase I and 9 routes of Phase II) with a total fleet requirement of 78 boats, of which 22 boats are 100 pax and 53 boats are 50 pax and 3 boats as spare. During the horizon years 2025 and 2035, there is an additional requirement of 12 boats and 33 boats respectively to maintain the operational efficiency of the system. Refer **Table 5-10**. However, it is also expected that there is a sudden surge in the ridership demand; hence the demand may be evaluated every year.

To operate and maintain such a huge fleet, it is therefore, essential to have a continuous monitoring of the passenger volumes captured, boarding and alighting patterns and vis-à-vis the service levels offered, as the system gets implemented in phases. Subsequently, the service frequencies and routes may be needed to be modified depending on the demand.

The existing fleet of nine boats operated by SWTD is minuscule compared to the high demand and may therefore be relocated or accommodated in other areas based on policy decision.

Table 5-9: Phasing Plan of the identified 16 routes

Route No.	Origin	Destination	Route Length (km)	Phases	Year of Operation
1	South Chittoor	Ernakulam	8.2	Phase I	2017
2	Edakochi	Thevara	3.74	Phase I	2017
3	Ernakulam	Vypeen	6.4	Phase I	2016
4	Ernakulam	Mattancherry	6.1	Phase I	2016
5	High Court	Mulavakadu	11	Phase I	2017
6	Vytilla	Info Park	8	Phase I	2016
7	Kumbhalam	Thevara	4	Phase I	2017
8	Info Park	Edakochi	12.6	Phase II	2018
9	Mulavukadu	South Chittoor	8	Phase II	2018
10	Edakochi	Vypeen	13.6	Phase II	2019
11	South Chittoor	Cheranalloor	6	Phase II	2018
12	Elamkunnapuzha	High Court	15	Phase II	2019
13	Kadamakudy	Paliyamthuruth	6	Phase II	2019
14	Chennur	Thundathumkadavu	3	Phase II	2019
15	Chariyamthuruth	Chennur	3	Phase II	2018
16	Kothad	Amrita Hospital	3	Phase II	2018

Table 5-10: Fleet Estimation for Proposed Water Transport System for Kochi – Phase I, Phase II , 2025 and 2035

Route	Origin	Destination	Route Length (km)	Maximum PHPDT				Speed (kmph)	Time taken for one way journey (mins)	Lay over time (mins)	Delay at the Jetties	Total Round Trip Journey Time (mins)	Capacity of the Boats (2015 & 2025)	Headway (mins)			Fleet Required			
				2016	2019	2025	2035							2019	2025	2035	Phase I (2016-2017)	Phase II (2018-2019	2025	2035
1	South Chittoor	Ernakulam	8.2	137	158	205	330	14.8	34.0	10.0	12.0	56.0	50	15	15	12	7	7	7	10
2	Edakochi	Thevara	3.74	84	97	126	205	14.8	16.0	10.0	6.0	32.0	50	20	15	12	3	3	3	4
3	Ernakulam	Vypeen	6.4	441	511	680	1070	14.8	26.0	10.0	9.0	45.0	100	12	8	5	7	7	8	12
4	Ernakulam	Mattancherry	6.1	441	511	680	1070	14.8	25.0	10.0	9.0	44.0	100	12	8	6	7	7	7	11
5	High Court	Mulavakadu	11	165	191	250	410	14.8	45.0	10.0	18.0	73.0	50	15	10	7	9	9	10	14
6	Vytilla	Info Park	8	68	79	106	175	14.8	33.0	10.0	9.0	52.0	50	20	20	15	5	5	5	5
7	Kumbhalam	Thevara	4	84	97	128	208	14.8	17.0	10.0	9.0	36.0	50	20	15	12	3	3	3	3
8	Info Park	Edakochi	12.6	127	147	197	321	14.8	52.0	10.0	18.0	80.0	100	15	15	10	0	3	4	6
9	Mulavukadu	South Chittoor	8	68	79	106	172	14.8	33.0	10.0	12.0	55.0	50	20	20	15	0	6	7	7
10	Edakochi	Vypeen	13.6	230	266	357	581	14.8	56.0	10.0	12.0	78.0	100	15	15	15	0	5	7	11
11	South Chittoor	Cheranalloor	6	54	62	83	135	14.8	25.0	10.0	21.0	56.0	50	20	20	15	0	5	5	7
12	Elamkunnapuzha	High Court	15	161	186	249	406	14.8	61.0	10.0	9.0	80.0	50	20	20	20	0	8	12	17
13	Kadamakudy	Paliyamthuruth	6	7	9	11	19	14.8	25.0	10.0	6.0	41.0	50	20	20	20	0	2	2	2
14	Chennur	Thundathumkadavu	3	69	80	108	175	14.8	13.0	10.0	6.0	29.0	50	20	20	20	0	3	3	4
15	Chariyamthuruth	Chennur	3	7	9	11	19	14.8	13.0	10.0	6.0	29.0	50	20	20	15	0	1	1	1
16	Kothad	Amrita Hospital	3	34	39	52	85	14.8	13.0	10.0	6.0	29.0	50	20	20	20	0	1	1	2
Total No. of Boats (A)																	**41**	**75**	**85**	**116**
Additional No. of Boats (B)																	**2**	**3**	**4**	**6**
Total Fleet Requirement (A+B)																	**43**	**78**	**89**	**122**

5.9 Boat Specifications

Two variants of boats are proposed to be procured for the project. Variation shall be in the passenger capacity – 100 passengers and 50 passengers. Refer Annexure V.

The boats shall be designed and built as FRP/GRP catamaran diesel electric hybrid passenger boats. Refer Table 5-11 for comparison between FRP/GRP boats and steel boats, which indicate that the former is a preferred material for boat manufacturing. It is proposed that the boats have a flat deck, with Diesel-Electric Generator Power Pack (50% fuel savings), electric propulsion through Permanent Magnet Synchronous (PMS) Motors with VVVF technology (30% more efficient, Robust). The boats will have a passenger capacity of 50 pax and 100 pax, intended for operation in inland waters around Kochi. Catamaran type boats powered by combination of twin diesel electric generators (for 50 passenger capacity) and electric motors for propulsion are proposed to operate at an optimal speed of 8 knots, with the potential to increase upto 12 knots, once the dedicated water transit corridor is established. For 100 passenger boats, the four diesel generator composition is proposed which will facilitate operating with only two generators when the passenger load factor is 50% of the design load. The variable-speed generators shall be capable of supplying power when needed, or slowing down when demand is low. It will have auto-start/auto-shutdown technology. VVVF Air-Conditioners with on-board Li-Polymer Power Bank with shore charging /on-board solar cell charging facilities are recommended.

Table 5-11: Comparison of FRP and Steel boats

S.No	FRP/GRP Boats	Steel Boats
1	Light In Weight, lower consumption of fuel and higher speed. Higher power to weight ratio.	Heavy, consumes more fuel & lower speed. Lower Power to wight raito.
2	Stable in peace water like backwaters of Kerala	Good stability on rough water
3	Easy for visual inspection, routine maintenance and easy dry docking	Requires stringent routine inspection for monitoring corrosion. Dry docking needs comparatively heavy infrastructure
4	Factually no or least maintenance throughout the design life, being corrosion free body.	Requires heavy maintenance/overhaul schedules to up-keep the steel body, through special marine class treatments (special primers & paints).

5	single skin, multi compartment hull against impact absorption and to keep afloat even with the damaged (water submerged) multiple compartments.	Generally built as single skin hull without any pockets. Making compartments will add on weight.
6	Easy to repair the damaged compartments of the hull against cracks etc.	Repairing is possible with special welding process, painting etc.
7	Lower downtime for attending maintenance.	Requires higher downtime for maintenance or carrying out repairs
8	IACS class designs can offer 25 years of robust, least-expensive services.	Can enhance the life by expensive maintenance/overhaul schedules
9	Lower Life Cycle Cost	Has higher life cycle cost.
10	Lower manufacturing cost, as the mould facilitates mass production of hulls. The mould has one time investment cost.	Higher manufacturing cost, as each hull to be fabricated on Jigs & fixtures, requires considerable time for fabrication.
11	Speedy delivery possible as hulls are moulded	Takes longer time as the hull has to go through a number of welding cycles and heat treatments, surface treatments including paints etc.

Broad boat specifications are given in Table 5-12. All boats shall be as per the International Association of Classification Societies (IACS) classification or Indian Registrar of Shipping (IRS) classification.

Table 5-12: Broad Boat Specifications

Specification	Passenger Capacity		Remarks
	50	100	
Length Overall	15 m	20 m	
Breadth Overall	6 m	7 m	
Depth	1.5 m	1.7m	
Draft	0.9 m	0.9m	
Speed (knots)	8	8	Capacity to reach 12 knots
Power Pd (kW)	41 (full load)	55 (full load	Full load
Power Pd (kW)	35.5 (50% load)	45.9 (50% load)	50% Load
Fuel Capacity	0.25	0.25	
Average Power Pd (kW)	38.3 (load mix 1:1)	50.5 (load mix 1:1)	
Delivered power to Motor Pm (kW)	40.3	53.2	
Air-conditioning Power (kW)	17.5	25	All boats shall be air-conditioned with provisions for climate control
Auxiliary Power (kW)	3	3	

Specification	Passenger Capacity		Remarks
Total Power needed (kW)	60.3	81.2	
Propulsion Power of each motor (kW)	43	58	
Generator capacity (kW)	80	108	
Navigation/Communication Equipment :	• Radar 36NM • GPS with chart plotter • Depth sounder • VHF Radio • P A system w/intercom		

In the present time, propulsion by diesel electric generator has fuel efficiency advantages over diesel engine based propulsion. With the technological advancements, it is proposed that Kochi Metro Rail should explore more environment friendly boat technology options and make a transition towards use of electric battery banks for propulsion as well as for ancillary functions such as air-conditions.

At present, electric battery banks are available with facilities for shore changing wherein, 3km of running hours are potential advantage. This 3 hours of running operations, is equivalent to 9 hours of ancillary operations. The Electric Power Pack could be future Hybrid for CNG. On-Board LNG is being explored with 45% savings on Fuel Cost and Zero Emission. This option could be explored by KMRL in future.

Kochi is a hub for better fuel technologies such as Liquefied Natural Gas (LNG) with Compressed Natural Gas also being introduced in the city by early 2016. It is therefore suggested, that on the lines and experience of the transition of road based transport systems from diesel/petrol to CNG, and similar technology should be explored by Kochi also for boat propulsion.

Solar Energy for ancillary functions is another technological option that should be explored by Kochi for water transportation.

The wheelhouse shall have sufficient number of windows on all sides to provide all-round view during navigation. All wheelhouse windows shall be suitable for navigation and fitted with toughened glass. Surfaces forming the boundaries of the compartment shall be suitably lagged and lined to prevent conduction of outside heat into the compartment. The wheel house front glass windows shall be provided with an electric window wiper suitable for

operation in heavy rain. The wheel house shall be provided with the following furniture and equipment.

1. Helmsman's revolving chair - one
2. Cupboard - one
3. Steering wheel & accessories
4. Remote control for propulsion motors
5. Manoeuvring Desk with navigational console - one
6. Electric horn – one
7. Switches and console for Navigational Lights, search light
8. Echo Sounder - one
9. Global Positioning System – one

The boats must follow the Kerala Inland Vessel Rules 2010 for minimum standards to be fulfilled for safety standards and measures as well as fire fighting methods and equipment. Chapter VI and VII of the rules must be clearly followed. Safety standards include but not limited to sufficient number of life rafts or buoyant apparatus, life jackets, headlights or Search lights, hand torches and emergency lanterns, one pair of oars etc for Class I vessels such as passenger boats. Fire fighting equipment shall include but not limited to power driven fire pumps with motor, hand operated fire pumps, water service pipes, hydrants, fire hoses, portable dry power fire extinguishers etc.

6 Infrastructure Assessment

Based on the estimated ridership and the proposed routes as identified in Chapter 5, the infrastructure assessment for the proposed water transportation system in Kochi has been undertaken and discussed in this chapter.

6.1 Dedicated Water Transport Corridor

The Kochi City Region waterway comes under the National Waterways -3 as identified by Inland Waterways Authority of India. The waterways' and channel widths vary across the length and breadth of the city region. For the proposed routes of the water transportation system project, it is recommended to demarcate a dedicated water transport corridor with minimum 20 m width (preferably 50-60m wide wherever feasible) along the identified routes. However, the demarcation of dedicated corridor may not be feasible at stretches with existing waterway widths less than 20m such as on the Vytilla-Info park Corridor and the internal waterways around the northern islands of Pizhala, Kothad, Chennur and Moolampilly.

The corridor is proposed to be delineated by way of physical segregation using with anchored buoys with dedicated points for local fishermen to cross. The proposed speed of 8 knots as mentioned in chapter 4, has a potential to increase to 12 knots in case of a dedicated corridor. This is primarily because the waterways shall be dedicated to fleet movement under this project. The other movements i.e. of local fishermen, use of chinese nets and presence of country boats shall be controlled in the corridor.

6.2 Dredging of Waterways

There is varying level of silting across the waterways as per discussions with various departments and authorities maintaining the waterways. However, dredging is recommended on entire network to ensure a minimum vertical draft of 1.5m. Dredging may be carried out by Department of Irrigation or the Inland Waterways Authority of India, authorised to dredge the waterways. Inland Waterways Authority of India (IWAI) is reported to maintain a guaranteed depth of 1-2m[8] with a width of 32m at the bottom across the NW-3. According to IWAI, the planned routes/ traffic channels on NW-3 are dredged and the

[8] Source: Meetings with IWAI Officials and document submitted by Short Term Maritime Expert Support to KMRL by KfW

installation of navigation aids (buoys) on NW-3 is completed. Emphasis is required for dredging in the areas between the corridor/traffic channel route and the pier/jetty. The dredged silt/mud may be collected at identified locations.

It is recommended that the KMRL, which is also proposed to be the operating agency for water transport system, gets the dredging done through contract wherever and as and when required.

6.3 Jetty Stations or Piers

The existing jetties are built of cement concrete and are in a dilapidated condition. The new and renovated jetties are proposed to be developed in a phased manner. The re-development and upgradation of piers is permissible under the CRZ regulation as applicable in Kochi. It is also recommended that the "jetty" be renamed as "pier" which is a more internationally acceptable term for boat stations.

6.3.1 Major and Minor Jetties or Piers

On the lines of the Hub and Spoke model, each island has been proposed to be provided with a major jetty which would act as the Hub and the rest of the jetties would be developed as minor jetties.

It is proposed that 18 jetties would be developed as major jetties and the rest 20 as minor jetties. Of the 18 major jetties, 3 of the major jetties will be developed as part of the second phase, the three jetties being Elamkunnapuzha, Kadamakudy and Varapuzha. And the 7 minor jetties that shall be taken up as part of Phase II development are: Amrita Hospital, Chariyamthurutu, Cheranaloor, Eloor, Aster Medicity, Paliyamthuruth and Thundathukadavu. The 38 jetties proposed for development are as listed in Table 6-1.

Table 6-1: Major and Minor Jetties

Sl. No.	Jetty Names	Type of Jetty	Phase
1	South Chittoor	Major	Phase I
2	Mulavukadu Panchayat	Major	Phase I
3	Ernakulam	Major	Phase I
4	Thevara	Major	Phase I
5	Kumbhalam	Major	Phase I
6	Embarkation	Major	Phase I
7	Fort Kochi	Major	Phase I
8	Vypeen	Major	Phase I

Sl. No.	Jetty Names	Type of Jetty	Phase
9	Mattancherry	Major	Phase I
10	High Court	Major	Phase I
11	Vytilla	Major	Phase I
12	Kakkanad	Major	Phase I
13	Pizhala	Major	Phase II
14	Kothad	Major	Phase II
15	Chennur	Major	Phase II
16	Varapuzha	Major	Phase II
17	Elamkunnapuzha	Major	Phase II
18	Kadamakudy	Major	Phase II
19	PoonariMangalam	Minor	Phase I
20	Thanthoninthuruth	Minor	Phase I
21	Edakochi	Minor	Phase I
22	Bolgatty	Minor	Phase I
23	Mulavukadu Hospital	Minor	Phase I
24	Korrankota	Minor	Phase I
25	Mulavukadu North	Minor	Phase I
26	Eroor	Minor	Phase I
27	Info Park	Minor	Phase I
28	Nettoor	Minor	Phase I
29	Thykoodum	Minor	Phase II
30	Moolampilly	Minor	Phase II
31	Thoppumpady	Minor	Phase II
32	ThundathumKadavu	Minor	Phase II
33	Eloor	Minor	Phase II
34	Cheranalloor	Minor	Phase II
35	Paliyamthuruth	Minor	Phase II
36	Chariyamthuruth	Minor	Phase II
37	Aster Medicity	Minor	Phase II
38	Amrita Hospital	Minor	Phase II

6.3.2 Jetty Development

The jetties are proposed to be developed as floating pontoons with automated mechanical docking of boats, as shown in **Figure 6-1** and Figure 6-2. The floating pontoons are proposed to accommodate a maximum of two boats at major jetties with a slot system with a spacing of 1.5m. The floating pontoons are recommended to be covered with roof or re-traceable sheds so as to provide passenger comfort during rainy season roof for easy entry/exit to boats. Automated Docking Mechanism with smart jetty architecture is proposed for each jetty location.

Figure 6-1: Floating pontoons to be covered with sheds



Figure 6-2: Automated Docking Mechanism of Boats





The jetties are further proposed to be developed as per the classification of jetties as major boat hubs and minor boat jetties given in Table 6-1.

The major boat hubs are proposed to be developed as an integrated development on the lines of transit station development comprising of property development, improved non-motorised transport and feeder access to the boat jetty. For typical design of jetties refer Annexure VI.

6.4 Boatyard/Depot

The existing boatyard at Thevara is proposed to be upgraded and developed with all repair and maintenance infrastructure for periodic maintenance and upkeep of the vessels. Since the maintenance of engines and spare parts shall be covered under the Warranties and Annual Maintenance Contracts, the periodic checks may be carried out at the Thevara Boatyard. The daily fitness checks of vessels shall be undertaken at the terminal docking points of the routes. In addition to this, a new boatyard is proposed at Pizhala island which will be a floating dock with provisions for schedule annual maintenance only.

The Thevara boatyard is proposed to be equipped with the floating dock and all the state of art equipments so as to enable repair and maintenance as desired. Pizhala is recommended to be developed as a minor boatyard in phase II. The suggested programme of facilities at the boatyard is given in Figure 6-3

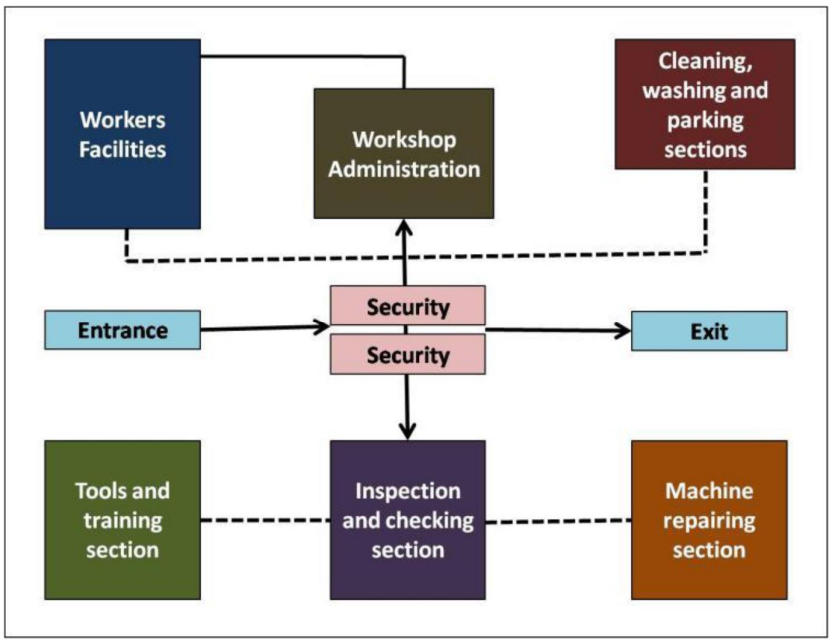


Figure 6-3: Suggested Programme of Facilities

6.5 Intelligent Transportation and Navigation System

GPRS (4G) based Intelligent Navigation & Cruise control, GPS Tracking, Passenger Address and Information Systems, dedicated 2 way voice/data communication, on-board surveillance cameras, on-board multi SIM WiFi Hot spot is recommended for the water transport project's ITS.

A cellular communication (GPRS/LTE) based intelligent transportation and navigation system is recommended for implementation and integration of boat with other mode of transportation viz Metro Rail, Bus etc.

Implementation of ITS is divided into the following categories:

- Global Positioning System (GPS) – on-board and off board.
- Passenger Information System (PIDS/PAS) – on-board and Boat jetties/Hubs.
- Master Clock.

- CCTV inside boats and at jetties/Hubs.
- Automatic Fare Collection System.
- Central Operational Control Center.

The above ITS systems are proposed along with the procurement of boats under project to be taken up as recommendations contained in this DPR. All the boats proposed in this project will be provided with 'state of art' ITS equipment and navigation systems. Boats will be capable of sending information like diesel generator status alarms, fuel amount, engine temperature, altitude, reverse geocoding, cut off fuel, turn off ignition, battery status, GSM area code/cell code decoded, GPRS/LTE status, speed, location, no of passenger on board and a lot more to the Central operational Control Center.

6.5.1 Global Positioning System (GPS)

Major constituents of the GPS based tracking are

i) GPS tracking device: The device fits into the boat and captures the GPS location information to a central server. GPS based navigation and cruise control shall be enabled and sent to the central control center.

ii) GPS tracking server: The tracking server has three responsibilities: receiving data from the GPS tracking unit, securely storing it, and serving this information on demand to the user.

iii) User interface: The UI determines how one will be able to access information, view vehicle data, and elicit important details from it. A mobile App, Web based interface is also recommended.

Seagoing Vessels calling Cochin Port are mandatorily equipped with an Automatic Identification System (AIS). Such a system is not required by any rules for inland water vessels. It is expected that it even would disturb the effective traffic control, if a lot AIS signals from small boats would appear on the control system. Thus, it is a planned traffic control system for the boats independent from AIS system is envisaged. However, a channel between the Operation Control Centre and the Port may be established to enable necessary movement of vessels in case of an emergency.

6.5.2 Passenger Information System (PIS)

- Passenger Information System (PIS) consists of Passengers Announcement System (PAS) and Passenger information Display System (PIDS). The PAS and PIDS shall be coordinated automatically to provide real time passenger audio broadcast and visual information at each jetty/boat/Central Control center in a multi-lingual format. The PAS and PIDS shall respond to special interrupt messages and also enable any PAS/PIDS operator to send special announcement or emergency messages for passengers and staff from a central/local Control center. It shall be automatically announce exact arrival information of train at boat jetties/boat.
- Four major types of messages shall be provided by the PIDS/PAS as a minimum: Fixed digital recording, Pre-formatted with data to be added, instantly recorded and Live Video/audio broadcast.
- The PIDS shall be LED screen based display, which could display the time of day and other appropriate pre-determined, fixed, pre-formatted messages, route number, fares, arrival/departure, same for the next two boats from the jetty, destination/origin information and free-entry text messages regarding safety, boat delays and emergencies etc. The PIDS shall be provided with a suitable work station with functionality of transmitting video files to the PIDS display screens for advertisement and commercial purposes.
- The PIDS/PAS shall be capable of maintaining the required intelligibility at all times regardless of the changing environment including crowd density, temperature, humidity and noise level.
- In addition, the PIS shall provide information on routes, schedules and fares on internet, Interactive Voice Response System (IVRS) and through SMS on mobile phones.

6.5.3 Master Clock

Master Clock system (MCS) is recommended which consist of following major components

i) Master Clock Unit

ii) Interface to GPS

iii) Sub-master clocks at each jetty/ hubs/Central Control Centre

iv) Slave clocks, both digital and analogue at all jetties /hubs/Central Control Centre.

v) All power and signal cables, surge protection devices etc.

vi) Man Machine Interface (MMI) at Central Control Centre for supervision

The Master Clock shall have a GPS Antenna with mounting hardware, which shall be positioned in an unobstructed area to provide a clear line of sight to no less than four of the orbiting satellites. The GPS Receiver/Decoder Unit, located adjacent to the antenna, shall continuously collect the external time information for the Master Clock Subsystem. A master clock protocol converter to deliver time-of-day and date to display clocks shall be there.

The Master Clock Subsystem (MCS) shall provide network time-of-day to all subsystems requiring time-of-day. The MSC shall be designed to provide no more than one-millisecond time difference between any MMI. The MCS shall receive time-of-day source from the Global Positioning System (GPS). The MCS shall provide time-of-day display clocks at jetties, hubs, central control center, boats etc. At major jetties and important locations, analogue and digital display clocks shall be provided for benefit of passengers and operational staff.

The MCS shall provide time-of-day with date display clocks at Central Control Centre, Jetties, hubs, inside boats etc. The MCS shall provide time-of-day display clocks at jetties, hubs, central control center, boats etc. The MCS shall provide the time-of-day and date to sub-master clocks for distribution to time-of-day and date display clocks.

A Master Clock Server shall deliver Network Time Protocol (NTP) or Precision Time Protocol (PTP) as required by other subsystems. Subsystems that are not compliant to IEEE-1588 shall receive NTP. Subsystems compliant to IEEE-1588 shall receive PTP.

6.5.4 CCTV inside boats and at jetties/Hubs

CCTV system is required to be provided to ensure effective surveillance of an area as well as to create tamper proof video recording for post event analysis.

Video surveillance system shall be end to end IP Based with Full HD IP cameras.

The CCTV subsystem shall use IP surveillance to monitor and record video over an IP Network via the Local Area Network installed locally within each site and the FOTS installed line wide for inter-site communication.

Boat jetties, Hubs, Boats, parking, specifically identified theft prone areas and other property development complexes shall be covered by camera surveillance. Also IR illuminator at the pole/wall keeping in view the lighting conditions is also recommended.

In emergencies or as required it shall be possible, without any additional resources, to view images from any/all cameras and/or record any dynamically selected location on the system at Central Control Centre.

Intelligent Video Analytics shall be implemented on the proposed cameras. Different features of the video analytics shall include but not limited to:

- Intrusion detection,
- Unattended baggage detection,
- Crowd estimation and crowd management alarms for jetties/hubs,
- Line control,
- Counter flow detection overcrowding detection,
- Camera tampering alerts and
- Any other video analytic feature relevant to boat operation.

The Video Analytics functionality shall have mechanisms to continue alarm generation in case of failure of the Server. The Video Analytics shall not be bound to the MAC address of the device and hence any video analytics feature shall be possible to be deployed on any camera.

6.5.5 Automatic Fare Collection System

Automatic fare collection system – on-board Smart card /Ticketing Solutions will be provided by financial institution led consortium (Axis bank), which will be in line with the Kochi Metro Rail model. In addition, Automated Passenger Boarding and Alighting Count (Integrated Services Control Centre) is proposed to be in place.

6.5.6 Operation Control Centre

A central control facility comprising of a LED based large video display is recommended for controlling the services. This shall act as a nerve centre of the entire system and associated services and shall provide the overall control and co-ordination of the system. It shall consist of all the necessary computing and communications hardware and software needed to fulfil this function. This shall have, at a minimum, the following:



Figure 6-4: Vessel Tracking using radar and Automatic Identification System at OCC

a) Control panels on which the location of all boats can be spotted and tracked during operating hours

b) Monitors to which visuals of the actual ground position can be transmitted by cameras located at strategic points on the corridor

c) Facilities for voice communication between the drivers and the control room as well as between hub/boat jetty supervisors and marshals and the control room

d) Facilities to receive and transmit, as needed, all data being collected by the vehicle mounted units, fare collection units, cameras and all other hardware

e) Report and alert operators to errors and faults with the Real Time Passenger Information System

f) Collect, process and store data generated by the system

6.5.7 CCTVs inside boats and at jetties/hubs

For the purpose of safety and security, CCTV surveillance systems shall be installed in each of the boats and at all appropriate locations in the minor as well major boat jetties. At the major boat jetties, these shall be appropriately installed so as to monitor the entire boat hub complex including the property development complex.



Figure 6-5: CCTV Surveillance Systems

6.6 Accessibility Infrastructure and Last Mile Connectivity

Accessibility is defined as the ease of reaching goods, services, activities and destinations, which together are called opportunities. It can be defined as the potential for interaction and exchange. In social planning, accessibility refers to people's ability to use services and opportunities.

Mobility users want door to door, smooth, seamless travel at all levels. They want to travel from A to B no matter the mode of transport as long as it is quick, reliable, well connected and informed. Water based transport has to be in line with this demand and ensure as much as possible a door-to-door journey. Services must be designed and defined taking into account connections and availability of other transport services be it buses, metros or trams, trains, shared bicycles and shared cars. Short distances between the modes and short connection times must be respected in order to make them attractive to customers. Kochi Metro Rail Limited is already undertaking studies and projects on Integrated Public Transport Solutions, Non-Motorised Transport and Bicycle Sharing Schemes and Mobility Plan and Parking Plan for the region. These studies shall ensure connecting the ferry services with other means of public transport. One focus will be how to merge the different networks of public transport (Metro - Ferry Services - Bus Network) at the main intersections (e.g. Ernakulam Jetty – Maharaja Metro Station). The safe transfer of the passengers within the intersections (e.g. elevated walkways) should be brought into focus as well. Seamless integration of alternative means of transport without interruption on the main traffic routes would relieve the road traffic as well.

As discussed in chapter 4, the Water Transport System for Kochi City is envisioned and structured in a holistic manner with passenger centric approach. Apart from being planned in a direction oriented approach to connect destinations, the system also has the objective of a spatially and socially inclusive holistic development which ensures access besides the mobility component. Major indicators of accessibility are:

- Physical Access to a location
- Accessible design (also called universal design) catering to facilities designed to accommodate people with disabilities

- Ease and comfort in reaching a location
- People's ability to use services and opportunities

Based on the above indicators and attributes influencing accessibility, the development and upgradation of boat jetty locations are recommended to be carried out along with widening of the access roads, wherever possible, disabled friendly access design, pedestrian and cycling infrastructure, place-making, provision of parking spaces for private vehicles, encouraging public bike sharing schemes etc. for overall development of the jetty area. Apart from the above, it is important to develop allied infrastructure which enhances the commuters' ability to use this infrastructure such as providing feeder modes to access the jetties/hubs, signage's, appropriate street lighting and security and safety provisions, and induced landscaping and street furniture to make the transit points attractive and interactive.

6.6.1 Development of Access Roads

There are ten (10) major islands that are covered by the water transport system proposed as part of this DPR. A total of 38 jetties have been identified to be developed in two phases as minor jetties and major boat hubs.

Access to these jetties is currently in a dilapidated shape or in a state wherein the potential users also do not use it for reasons such as poor lighting, safety and security concerns and lack of access roads as well as access modes in case of higher distances between the origin or destination point and the jetty locations. From the primary survey it is observed that the access and egress trip distance to the boat jetties for the current users of the system is about 2.5-4 km on an average, and 53% of the total access/egress trips are done by walk followed by 38% by public transport. With these figures as background, it is proposed to improve access road infrastructure to the jetties by way of widening and resurfacing so as to enable access by vehicles as well as walk and bicycles.

It is proposed that the minimum access road width to a boat jetty should be 5 m. In case of access widths more than 5m and bitumen surface, it is essential to accommodate pedestrian footpaths as per IRC 2012 standards whereas for access widths less than 5 m, it is suggested that paver block surface or other suitable surface texture is developed in order to ensure priority to pedestrian access over vehicular access.

6.6.2 Non-Motorised Transport Plan

Non-motorised transport includes walking and bicycling as modes of travel. Infrastructure with reference to the high percentage of these NMT trips in the city as well as the access trips to the jetties is inadequate and is therefore proposed to be upgraded with walkways and bicycle tracks etc. Covered walkways and footpaths are essentially to be developed to provide physical access to the jetties.

6.6.3 Disabled Friendly Access

All access roads and intersections under this project are proposed to be designed keeping in mind the provision for easy and safe access of differently-abled users. Some of the provisions made are described as under;

6.6.4 Tactile Paving – Guiding and warning tiles



Figure 6-6: Tactile paving for the blind

Tactile guidance blocks (Line-type) indicate a barrier free route for a person with visual impairment. It is recommended to install tactile guidance tiles along the entire length of the proposed access routes. Care must be taken to ensure that there are no obstacles, such as trees, poles or uneven surface, along the route traversed by the guidance block. Also there should be clear headroom of at least 2.1 m height above the tactile guidance block, free of protruding objects such as overhanging tree branches and signage, along the entire length of the walk.

Tactile warning blocks (Dot-type) indicate an approaching potential hazard or a change in direction of the walkway, and serves as a warning of the approaching danger to persons with visual impairment, preparing them to tread cautiously and expect obstacles along the travel path, traffic intersections etc. It is recommended to install tactile warning tiles at appropriate places, such as before intersections, change in direction etc. Some of the examples are shown Figure 6-6. “IRC: 37-2012 “Guidelines for the Design of Flexible

Pavements" and "Guidelines for the use of interlocking concrete block pavement IRC: SP: 63 -2004" shall be followed for design of pavements.

Audible crossing signals help visually impaired persons in crossing roads. It should be kept in mind that pedestrian traffic lights are provided with clearly audible signals to facilitate safe and independent crossing of pedestrians with low vision or vision impairments. The acoustic devices should be installed on a pole at the point of origin of crossing and not at the point of destination. A typical audible crossing signal is shown Figure 6-9..

6.6.5 Disabled Friendly Access – ramps

It is essential that ramps at all jetties and access points be provided to enable access for all the physically disabled groups.



Figure 6-7: Provision of ramps at all access points



Figure 6-8: Audible crossing signals at intersections

6.6.6 Public Bike Sharing/Rent-a bicycle scheme

As every transit trip is a multi-modal journey and everybody who rides transit is a pedestrian or cyclist on at least one end of their trip. Currently share of cycle trips in Kochi is 1% of the total trips which is quiet low. But it has been observed in case of Kochi, bicycle

infrastructure is completely missing. There are major gaps in bicycle accessibility and parking infrastructure. However, at jetty locations of Fort Kochi, Mattancherry and Kumbhalam significant bicycle usage as access mode was observed which indicates popularity of this mode.

It is proposed to introduce bicycle sharing as last mile connectivity in influence areas of major as well as minor jetties. Bicycles will act as an alternative mode to reduce load on feeder transit system. Currently public bike sharing facility has been proposed at all major and minor jetties. Bicycles will be available on rent at these jetty locations for commuting to nearby areas. In Public Bicycle Sharing scheme, the bicycles can be picked from the designated stations and dropped at any of the other designated bike stations. However, in case of rent-a-bicycle scheme, bicycles will be available on rent by depositing a copy of the

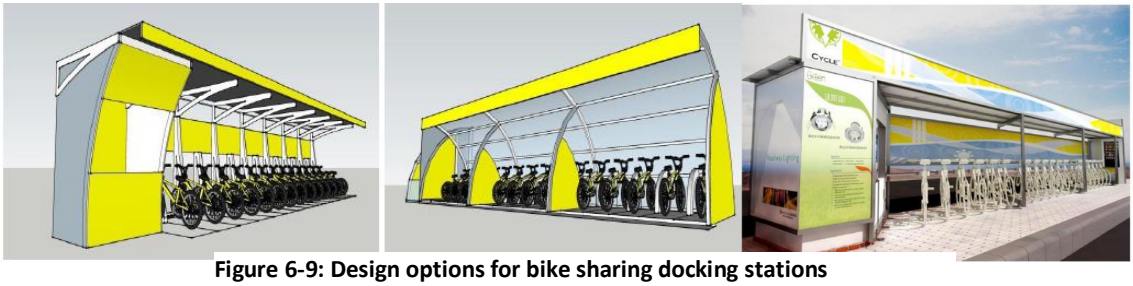


Figure 6-9: Design options for bike sharing docking stations

user's identity card and charges for time to be rented .The bicycle rented at a particular location has to be returned back at same place. Covered docking stations for bicycles will be provided. Design options can be found in Figure 6-9

6.6.7 Feeder Service Development

As discussed in Chapter 3, 38% of the access trips to the existing boat jetties are made by public transport and 53% by walk, with access trip distances upto as high as 5km. These high access trip lengths are a deterrent to people from using water transport system. Furthermore, poor connectivity to the interiors of the islands through public transport is another reason for people shifting from water transport to bus based public transport.

In order to provide connectivity and access to the boat jetties by modes other than NMT, it is proposed that feeder services be initiated to the boat jetties by introduction of small occupancy vehicles such as the mini-buses, electric rickshaws etc.



Figure 6-10: Feeder Services to boat jetties

Such modes are indicated in **Figure 6-10**.

6.6.8 Parking Provisions

Over the last few decades, due to increase in affordability, coupled with lack of public transport system, the increase in vehicle ownership has been steep with an annual growth rate of 12%. The same is also reflected even in the existing access/egress trips to the jetty by private modes i.e. 7%. It is therefore recommended that at major jetties/boat hubs, parking provisions be made for cars and two wheelers along with bicycles (privately owned) in the ratio 20:30:50 respectively. The cost of provision for parking has been included in the jetty modernisation cost.

6.6.9 Allied Infrastructure

6.6.10 Elevated Walkways for multi-modal integration

It is proposed to identify critical intersections in the island areas, especially those in the influence area of the proposed jetties, where high pedestrian-vehicular conflict is observed. It is proposed to develop elevated walkways and foot-over-bridges at such locations so as to prioritise the pedestrian movement. Two such locations have been identified which require immediate intervention in terms of grade-separated pedestrian facilities near major boat hubs proposed.

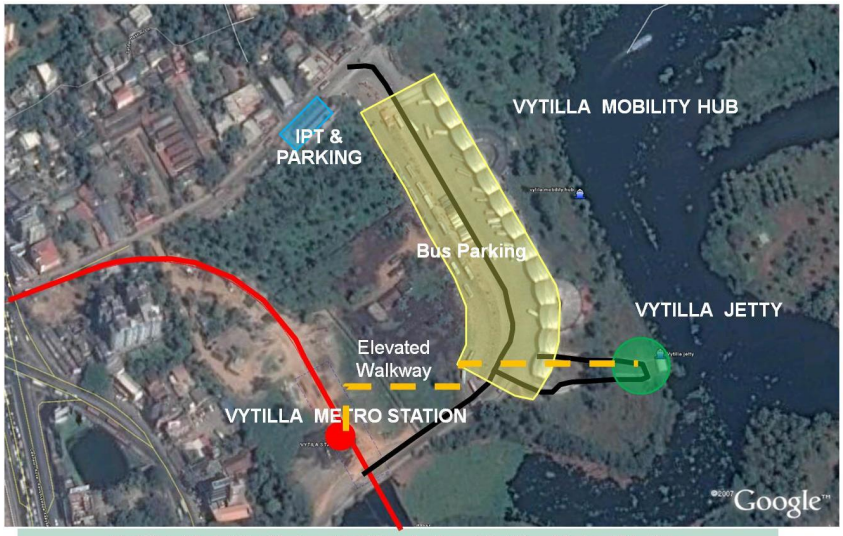


Figure 6-11: Multimodal integration at Vytilla Mobility Hub by proposed elevated walkway

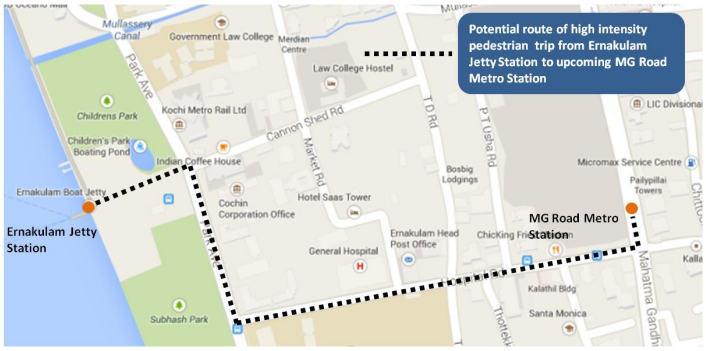


Figure 6-12: Elevated walkway from the Ernakulam Main Boat Jetty to MG Road Metro Station

6.6.11 Signages

Road signs are an important component of the traffic control system. Type, size, colour and lettering pattern of the signs are as per IRC-93-1985.



Figure 6-13: Signages

The signage system can be made more pleasing by treating entire road sections in one go instead of sporadic action at individual locations. At intersections, the signs should be planned in a logical sequence instead of haphazard placement. On the whole there should be no proliferation or clustering of signs, especially in conjunction with different utility posts, which could lead to unsightly conditions. It is

proposed to include signages as part of the investment proposal to enhance the water transport system user, invariable of the access mode used.

6.6.12 Street Safety Provisions

The user survey at the boat jetties indicated only 27% of the users to be female and the overall apprehension of both genders to use the boat jetties for access to water transportation due to isolated location of jetties, poor upkeep and lack of security at the jetties. Lack of proper lighting and hygiene were other issues indicated by the users. To overcome these constraints, it is proposed to install CCTV surveillance cameras on the access road network to the tune of covering the influence area of the jetty.

6.6.13 Street Lights

As discussed above, lack of proper street lights is a major deterrent to the potential and existing users of the water transport system. In order to improve safe access to the jetties, it is proposed to install solar powered LED lights to enable safe and active spaces around the jetties even during off-peak hours and during late hours in the day.

6.6.14 Landscaping and Street Furniture

Street furniture is an important element of each street in urban area as they are the only link between all origins and destinations and transit facilities used by pedestrians and commuters. Various on-street activities such as street vending and street markets give an appearance of vibrancy to streets. This interaction of pedestrians, motor-vehicles and varied activities on the streets needs to be resolved in a way that benefits all. Streets are being planned as pedestrian friendly. Pedestrian pathways would be designed with kiosks, benches, dustbins and street landscape elements like fountains, parks, parking and tree pits. The entire network will be studied for local need and land availability for street activities. This will enhance the pedestrian and urban experience to ensure safe and friendly pedestrian environment.

Keeping in view the climatic conditions of Kochi and enable a gender inclusive transportation system, it is proposed to provide public toilets and restrooms at regular intervals on all access roads in the islands.

Figure 6-14: Street Furniture Elements





6.6.15 Area Development Initiatives

As discussed in chapter 5, the Sustainable Water Transport Project has been proposed as a holistic project with the primary transport system components i.e. boat vessels and jetty stations/boat hubs coupled and complimented with allied infrastructure development which shall not only improve access to the jetties but also have a positive impact on the users' perception of the access areas around jetties with the installation of infrastructure for lighting, safety, disabled friendly access designs etc. In addition to the above, it is also proposed to integrate land development on the islands, tourism, water front development, urban rejuvenation and other economic activities in and around jetty locations so as to provide an economic impetus to the overall livelihoods of the people residing on the islands.

6.6.16 Property development at major boat hubs

Majority of the existing jetties which are fully functional and have high footfalls, already have an informal or at certain locations a formalised commercial retail function around the jetty. Major hub locations such as Vypeen, South Chittoor, Fort Kochi, Ernakulam, Mattancherry etc have extensive commercial development around the jetty locations.

Keeping into consideration the potential of the identified major boat hubs to be developed as modernised transit station oriented development hubs; it is proposed to develop a minimum of one acre of land around the jetty/hub with the a Floor Space Index (FSI) of 1. The property development shall include restaurants, ATMs, play-pools, retail shops, service shops such as cycle repair etc. Some of the jetties where property development can be done upfront are South Chittoor, Kumbhalam, Pizhala, Vypeen, Mulavakadu, Elamkunapuzha,

High Court, Ernakulam, Thevara, Edakochi, Nettoor, Fort Kochi, Mattancherry and Kothad. Commercial development of about 2500 sqm built up area is estimated to be developed at each of these jetties.

The property development is also proposed to contribute to the non-fare box revenue streams of the water transport project by way of commercial space rentals.



Figure 6-15: An impression of property development and water front development at boat hubs

6.6.17 Water Front Development

Kochi City Region has abundant backwaters in the region which provide scenic views and are potential areas to be developed through beautification and placemaking by introduction of social recreational areas, walkways and trailing, bicycling trails and boating areas. Islands such as Kothad, Vypeen, Bolgatty, Thanthoni Thuruth, Kadamakuddy, Mulavakadu, Moolampilly, Elamkunapuzha and Pizhala have immense potential to undertake beautification of water front and development of activities which also help in the uplifting of the livelihood of the island communities, eg, fish markets, flea markets, cultural festivals at these developed areas.

6.6.18 Tourism

Pokkalli Farming is a unique cultivation practice undertaken in Ernakulam and Allapuzha districts of Kerala which involves cultivation of a saline tolerant rice variety in an organic way in the water-logged coastal regions. Pokkalli Farming has off late developed a brand image for its way for cultivation and has generated interest in export of the products. The

quality of the paddy attracts many tourists to know more about the practice. Pizhala is one of the pioneers and is most famous for carrying out this practice on a large scale.

Similarly, other tourism practices which may attract tourists are recommended to be developed on these islands connected by the proposed water transport system. These include tourism initiatives on islands which are largely uninhabited such as Kothad, Thanthoni Thuruth and Kadamakudy. These initiatives may be undertaken under the aegis of the Cochin Tourism Development Department.

Figure 6-16: Pokkalli Farming, a tourist attraction at Pizhala



6.7 Land Acquisition

As a part of the project, 38 jetties are proposed to be developed 20 major jetties and 18 minor jetties. As discussed in the preceding sections, the major jetties shall be developed/re-developed as major boat hubs which shall be the main transit point and shall

connect various islands and as part of the property holistic development objective of the project, the hub shall also be developed as a commercial/economic centre. Also, parking is proposed to be developed at these major jetties, besides the introduction of public bicycle sharing concept at all the jetty locations. Also, placemaking is recommended as an integral part of jetty development. In accordance with the land requirement by all the jetties, a minimum of land to the extent of 1 acre is proposed to be developed for provision of the above mentioned facilities. In case of jetty locations within the Panchayat areas, the land is primarily owned by the Panchayat committees while in other cases, the ownership varies from Cochin Corporation, Port Trust, etc.

Scenario I: With the consideration that KMRL would be the implementing agency, the entire land requirement for the 18 major jetties (18 acres) and 20 minor jetties (6 acres) shall have to be acquired from various agencies/private bodies. In this case, with an average Fair Value (Revenue Department, Government of Kerala) of Rs. 3 crore per acre, the total land acquisition cost shall be Rs. 72 crores.

Scenario II: However, since the ownership of the majority of the lands where existing jetties are located and the lands adjacent to these jetties, is with the urban local bodies such as the corporation and the panchayats or other state departments, it is recommended that KMRL takes the required land for jetty and allied infrastructure development on lease (90 years) from the panchayats and other local bodies and invests in development of the land. The panchayats and the urban local bodies may lease this land free of any charge considering that KMRL is investing in the overall development of the islands as well as jetty precinct areas such as access roads, street lights, etc.

In scenario 2, it shall be a win-win situation for both the land owning agencies and the implementing agency i.e. KMRL in the interest of the project and process of land acquisition may be avoided.

7 Project Capital Cost

Estimation of capital investment is an important component of any proposed project as it provides vital inputs to economic evaluation as well as financial modelling and analyses. Cost estimates have been prepared for new infrastructure development such as jetties, boats, access road and other allied infrastructure.

Cost estimates are based on indicative designs that have been conceptualised for development as elaborated in previous chapters.

7.1 Major Components

Some of the major components covered in project cost estimates are jetties, boats, access roads and other allied infrastructure. Price contingencies are excluded but physical contingencies are included at the rate of 5% of the total construction cost because they represent real consumption of resources. Unit rates are referred from Plinth Area Rates of Delhi Schedule Rates -2012 and wherever not applicable market rates have been referred. Project development cost of 2.5% which includes the preparation of detailed design and supervision during the construction has also been included.

7.1.1 Boats

Two types of air-conditioned boats have been proposed, with a capacity of 50 and 100 passenger seating arrangement. The boats are air-conditioned, equipped with passenger information systems, restrooms and chairs. The cost of boats has been estimated as follows based on multiple discussions with local, national and global boatyards and shipyards.

Table 7-1: Cost Estimate for Boats

	2016			2017			2018			2019			Grand Total
	No.	Unit Rate (cr)	Total Cost (cr)	No.	Unit Rate (cr)	Total Cost (cr)	No.	Unit Rate (cr)	Total Cost (cr)	No.	Unit Rate (cr)	Total Cost (cr)	
100 pax boats	12	3.5	**42**	3	3.57	**10.71**	3	3.64	**10.92**	5	3.71	**18.57**	82.20
50 pax boats	6	2	**12**	22	2.04	**44.88**	14	2.08	**29.13**	13	2.12	**27.59**	113.60
Total	**18**		**54**	**25**		**55.59**	**17**		**40.05**	**24**		**46.16**	195.80

7.1.2 Jetty Stations

Out of total proposed 38 jetties, 18 are proposed to be developed as major jetties and 20 as minor jetties. The major jetties shall also have commercial space development for renting to the extent of 1 acre. For the purpose of modelling, an area of 0.62 acre per jetty has been assumed on a conservative side plus parking space of 875 sq m.

Based on the above, the total capital cost of major and minor jetties has been estimated in Table 7-2. The unit cost of the jetty development proposed does not include the cost of land.

Table 7-2: Cost Estimate for Boat Jetties

S.No	Description	2016		2017		2018		2019		Total Cost (INR) (crore)
		Unit Cost in Crore (INR)	No. of Jetties	Unit Cost in Crore (INR)	No. of Jetties	Unit Cost in Crore (INR)	No. of Jetties	Unit Cost in Crore (INR)	No. of Jetties	
1	Major Jetty	4.0	7	4.20	5	4.41	4	4.63	2	75.89
2	Minor Jetty	1.25	2	1.31	8	1.38	7	1.45	3	27
		30.5 cr		**31.48 cr**		**27.3 cr**		**13.61 cr**		**102.89**

7.1.3 Dredging

To ensure a minimum vertical draft of 1.5m, dredging is recommended for the proposed system. Dredging may be carried out by IWAI or the Department of Irrigation. Cochin Port also does regular dredging in the Ernakulam- Fort Kochi-Vypeen Link. The current rates for dredging in the region are Rs. 180-200/cum[9] (Source: IWAI). Following is the estimated cost to be incurred for dredging.

Table 7-3: Cost Estimate for Dredging

S.No	Description	Unit Cost in Crore (INR)	Length(Km)	Phase I Cost (INR) (crore)	Phase II Cost (INR) (crore)	Total Cost (INR) (crore)
	Dredging	210 / cum	41	10 cr	15 cr	25
		Total Cost (INR)				25

Dredging shall be required on routes not covered under the IWAI's NW-3 and the area around the jetty locations. Of the total kilometre length, 41 km of the waterways may be dredged.

[9] Discussions with Director and Assistant Director, IWAI, Kochi

7.1.4 Development of Boat Yard/Depot

The Thevara boatyard is proposed to be equipped with the floating dock and all the state of the art equipments so as to enable repair and maintenance as desired. The estimated cost of the development of the boatyard into a modernised functional boatyard cum depot is Rs. 10 crores while the new floating dockyard at Pizhala for Phase II is estimated to cost Rs. 5 crore.

Table 7-4: Cost Estimate for Boatyard/Depot

S.No	Description	Unit Cost in Crore (INR)	Phase	Total Cost (INR) (crore)
	Thevara Boatyard/Dockyard	10	Phase I	5
	Floating dockyard at Pizhala	5	Phase II	10
	Grand Total			15

7.1.5 Inland Navigation System & Operation and Control Centre

Total cost for implementing the inland navigation system, such as passenger information system, development of control centre and other facilities is estimated to be Rs 15 Crore.

Table 7-5: Cost Estimate for Inland Navigation (ITS)

S.No	Description	Unit Cost in Crore (INR)	No's of stations				Total Cost (INR)(crore)
			Phase I		Phase II		
			No.	Total Cost	No.	Total Cost	
	Passenger Information System	0.15	22	3.3	16	2.4	5.7
	Control Centre	2.00	1	2			2
	Installation of CCTV	0.10	22	2.2	16	1.6	3.8
	Electronic Ticket Vending Machines	0.10	2	2.2	16	1.6	3.8
	Total Cost (INR)			9.7		5.6	15.3

7.1.6 Development of Access Roads

A total of 107.71 km of road length is proposed to be developed across the influence area at a block cost rate of Rs 1.5 cr per km. The total estimated cost for developing access roads near all the jetties is Rs. 161 crore.

Table 7-6: Cost Estimate for Development of Island Roads/Access Roads and pedestrian and disabled friendly infrastructure

S.No	Name of the Station	Unit Cost in Crore (INR)	Proposed Length in Km	Total Cost (INR) (crore)
1	Major Jetty	1.5	66.74	100
2	Minor Jetty	1.25	40.97	51
	Pedestrian and Disabled Friendly street development			10
	Total Cost (INR)			161

7.1.7 Development of Electric Feeders, Bicycle Sharing, Elevated Walkways and Travelators

The total estimated cost for developing various facilities such as electric feeders, bicycle sharing, walkways and travelators is estimated to be Rs. 38.26 crore.

Table 7-7: Cost Estimate for Electric Feeders, Bicycle Sharing Stations and Elevated walkways

S.No	Description	Unit Cost in Crore (INR)	No's	Total Cost (INR) (crore)
1	Electric Rickshaws /Feeders			
a	E-Rickshaw	0.125	125	1.5
b	Feeder Bus	0.30	70	21
2	Public Bike Sharing Scheme	0.12 (Major) 0.08 (Minor)	38	3.76
3	Elevated Walkways including Travelators	4	3	12
	Total Cost (INR)			38.26

7.1.8 Installation of Signages, Street Lights and Street Landscape Furniture

The total estimated cost for installation of signages, street lights and street landscape furniture to make the access roads a well-lit and active space; cost is estimated to be Rs. 92.25 crore.

Table 7-8: Cost Estimate for installation of Signages, Street Lights and Street Landscape Furniture

S.No	Description	Unit Cost in Crore (INR)	Total Cost (INR) (crore)
1	Signages	0.055	5.92405
2	Street Lights	0.8	86.168
3	Landscaping and street furniture	0.003	0.16
	Grand Total		**92.25**

7.2 Total Cost

The total project cost in setting up the development of the Project is estimated at Rs. 747.28 INR Crores. Contingencies @ 5.0% and set up/start-up/development costs @2% over the base cost have been considered to arrive at the final project cost. The project cost abstract is detailed in **Table 7-9**.

Table 7-9: Total Project Cost Estimate (All costs in INR)

Component Description	Phase I	Phase II	Total
A) Direct Infrastructure Costs			
Jetty Infrastructure Cost	62.00	40.89	102.89
Provision for Boat Yard	10.00	5.00	15.00
Dredging of Waterways	10.00	15.00	25.00
Commercial Complex	30.63	16.81	47.44
Investment on Inland Navigation System & OCC	9.70	5.60	15.30
Total Civil Infrastructure Cost	122.33	83.30	205.63
Cost of Boats	109.59	86.22	195.81
Soft Costs			
Set up/start up/development costs (2%)	4.62	3.39	8.03
Contingency 5% on Sub Total	11.83	8.65	20.47
Interest During Construction	3.23	2.20	5.44
Total	**251.61**	**183.76**	**435.37**
B) Ancillary Infrastructure			
Development of Access roads/island roads/non-motorised transport	161		161
Development of Electric Feeders, Bicycle Sharing and Walkways with travelators	130.51		130.51
Setup/start up/development cost (2%) + Contingency (5%) on B	**20.40**		**20.40**
Sub-Total	**311.91**		**311.91**
Grand Total			**747.28**
Grand Total Including Land Acquisition Cost			**819.28**

Land acquisition cost as estimated in section 6.7 of Chapter 6, is not included as part of the project cost for funding purpose. In case of land acquisition, the project cost shall include Rs. 72 crore (including contingency and project development cost). In case of its inclusion in the project cost, the state government may contribute to the cost in totality. The total project cost including land acquisition is Rs. 819.28 crore.

8 Fare Collection System

Fare structure plays an important role in promoting the urban transport projects as it affects the demand system sustainability and contributes in reducing the congestion. The demand is highly price elastic in urban transport as observed world over. Thus high fare/tariff could shift away demand if affordability is compromised. It also impacts the financial viability/ sustainability of the system thus contributing to the system's long term sustainability. Fare structure has an impact on the mode change decisions of the commuters and thus impacts the congestion levels that the public transit seeks to reduce.

Given the vital role that the fare structure plays, essential guiding principles have been fixed for fare determination as given in **Table 8-1**.

Table 8-1: Guiding Principles for the fare determination

Principles	Description
Affordability	The fares should be within the means of middle income and lower income groups of the society. Majority of the population from these groups use cheaper modes of transportation for short and long distances. Thus price elasticity is very high.
Quality	Low fare structure should not affect the quality of services of the transportation system. Inferior service level would discourage the class of commuters who appreciate time saving and comfortable journey.
Sustainability	The fare structure should also offer the system financial sustainability during the operation period. Fare should ideally cover Operation and Maintenance (O&M) costs and capital maintenance. Ideally the system also needs to generate operating surplus (Operating Revenue -Operating cost) over a reasonable period of time to recover the investment made initially (if not fully then partially), so that funds become available for regular asset replacement.
Competitiveness	Fare structure should be competitive with other modes of transport. The principle is interconnected with Affordability. Fares should not exceed the nearest competing transportation system, meaning the system which offers similar benefits in terms of time, comfort level etc. At the same time fares should not be very low or high as they could impact sustainability and affordability.
Flexibility	The fare structure should be linked with a periodic revision method. The method should be acceptable to the public and should stand legal scrutiny. It should also be able to maintain the compatibility and integrity of the fare structure.
Equity	Fares should distribute financial and other burdens fairly among citizens and assure the availability of a suitable public transport system to all income groups.

With the above background, the modal share pattern of Kochi city and existing fare collection of the water transport system has been analysed. Analysis of the existing modal

share of the total passenger trips in Kochi city indicates that the most popular mode of transport is public transport (bus, ferry, mini/private buses - 51.1%) followed by non - motorized modes such as cycle and walk (15.2%), two - wheelers (13.8%), auto rickshaws (10.4%) and four- wheelers (8.9%). With the dominance of public transport mode share in Kochi, it is essential that the current public transport users are retained especially the ferry transport users and hence fare structure should be formulated, largely considering the affordability level of the public transport users within the ambit of guiding principles but not at the cost of quality and sustainability. This should contribute in attracting higher ridership due to the modal shift to ferry transport.

8.1 Existing Fare Collection System

It is observed that at present the ferry users pay Rs 4 for one stop to another, further with each additional stop the fare is increased by Re 1.

Example:

- Ernakulam to Vypeen; the stops along the route are Ernakulam, Wellington Island, Fort Kochi and Vypeen.

  The fare charged between

  - Ernakulam to Wellington Island – Rs 4
  - Wellington Island to Fort Kochi – Re 1
  - Fort Kochi to Vypeen – Re 1

Hence the total fare charged to a user along this route of 6.40 km is Rs 6.

According to the Kerala Government notification no 17016/B1/2012/trans. dated 20th July 2013, the fare structure of the JnNURM buses is notified as given in **Table 8-2**.

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Table 8-2: Fare structure for JnNURM buses

Type of Buses	Minimum Fare	Maximum Km for	Fare per Km	Distance of fare

	(Rs)	minimum fare	(After minimum fare)	stages after the minimum charge
Low Floor Air Conditioned	15.00	5 km	1.50	2.5 km
Low Floor Non Air conditioned	8.00	5 km	0.70	2 km

The above discussed fare structure for water based ferry and low floor AC bus services indicate that the passengers are required to pay anywhere between Rs 4-Rs 8 as base fare. It is also observed from the O-D Survey at the jetties and household surveys that majority of the people using ferry system are the people from the low income groups, who on an average spend less than Rs 625/- on their monthly travel needs and who do not own any vehicle and hence alternatively depend upon buses for their city based travel. Based on the opinion surveys at household level, it is observed that the people are ready to pay fares increased by 50% provided they get a good service which is safe and reliable.

This section discusses the fare collection processes, structures, and technologies for the proposed water transport system in Kochi.

8.2 Proposed Fare Collection System

To identify the most optimal fare collection system, the following factors were considered:

1. The present system of fare collection which is being used by State Water Transport Department
2. Number of boarding passengers
3. Availability of space at the jetties
4. Cost of the system

8.2.1 Fare Collection Process

There are two types of fare collection processes- on board and off board system. Their pros and cons are listed in Table 8-3.

Table 8-3: Types of Fare Collection Systems

Type of System*	Pros	Cons

On Board System	• Low Cost of equipment • Low manpower cost as no additional staff is required at the stations • No additional Space required at stations	• Increased dwell time of the boat therefore higher travel time. • Chances of revenue leakage
Off Board System	• Low dwell time of the boat thereby improved overall travel time and reliability	• High cost of equipment therefore only optimal where the number of passengers boarding is higher • Extra manpower required at stations for issue of tickets • Additional space required at the stations to install the equipment

Analysis of the boarding data of the jetties along the proposed routes indicates high number of boarding and alighting at the five jetties, which could have off board fare collection process. On all the other jetties on-board fare collection system could be adopted. Based on improvements with respect to the jetty infrastructure, off-board fare collection facilities are proposed to be made available at all the major and minor jetties.

8.2.2 Fare Collection technology

The technologies available for fare collection with their pros and cons have been given in Table 8-4

Table 8-4: Fare Collection Technologies

Technology		Pros	Cons
On Board System	Pay on-board system	• Low cost of equipment • Low manpower cost as no additional staff is required at the stations • No additional Space required at stations	• Increased Dwell time of the boat as single entry therefore higher travel time. • Chances of revenue leakage
	Conductor Validated	• Simple and easy to adopt • Low Cost of equipment • No additional staff is required at the stations	• High labour costs involved in visually validating all tickets. • Chances of revenue

Technology		Pros	Cons
		• No additional Space required at stations • multiple door entry possible	leakage
Off Board System	Barrier Enforced Fare Payment system	• Low Dwell time of the boat as multiple door entry possible thereby improved overall travel time and reliability	• High Cost of equipment therefore only optimal where the number of passengers boarding are higher than 75 per hour • Extra Manpower required at stations for issue of tickets • Additional space required at the stations to install the equipments
	Automated Ticket Vending Machines	• Low Dwell time of the boat as multiple door entry possible thereby improved overall travel time and reliability	• Chances of fare evasion unless combined with Barrier Enforced Fare Payment system or conductor validated system, which would then result in additional cost of equipment and manpower • High Cost of equipment
	Auxiliary Platform Personnel	• Low equipment Cost • Low Dwell time of the boat thereby improved overall travel time and reliability	• Extra Manpower required at stations for issue of tickets • Additional space required at the stations

For on-board fare collection, each boat is proposed to be provided with hand-held Electronic Ticket Vending and Verification Machine (ETVM). The machines shall be capable of verification of/charging from contact less cards, magnetic cards / smart cards and other user tariff charging instruments such as the seasonal travel passes, prepaid cards, single journey tickets, integrated tickets, etc issued earlier or off-board. These are most easy to

operate and are indigenously available, which are also being used in the JnNURM buses being operated by KURTC.

8.2.3 Fare Media

The types of fare media are given in Table 8-5.

Table 8-5: Options of Fare Media

Type of Media	Pros	Cons
Cash and Paper Media	• Simple and easy to use	• Implication on service times depending on the fare collection process. • Chances of revenue leakage • Exact change handling may be difficult and time consuming
Smart Cards or Magnetic Strips	• faster and more flexible fare collection systems • facilitate processing of differentiated fare structures • Low dwell time of the Boat thereby improved overall travel time and reliability • Reduced service time	• High cost of and card and equipment

Traditionally, in Kochi, cash and passes are being used as transaction media. Kochi Metro Rail Limited is working on the introduction of a common mobility card. It is proposed that this option be also made available for water transport. In addition smart cards are proposed to be issued from various locations for daily ferry users. To encourage the use of smart card and reduce cash transaction, incentives are proposed to be made available to the smart card users for using integrated public transportation system of water transport, bus transport and metro system.

8.3 Proposed Fare Structure

Currently, as per the fare policy of State Water Transport Department, stage based fare is being implemented. The minimum fare being charged currently is Rs 4 for origin stop to first intermediate stop and thereafter the fare increases by Re 1 for every stop till the final destination. The maximum fare being charged is Rs 17 for a route length of 22 km.

However the statistical data of SWTD suggests that the average fare being charged by SWTD is Rs 7 per person per trip.

It is therefore proposed that initially the fare structure of the water transport in Kochi be increased by 50%. To attract ridership onto the water transport system, the system needs to be promoted as a distinguished brand of public transportation.

Based on the various discussions with the stakeholders, detailed sensitivity analysis between the demand and the fare, and fare comparison between the bus transport and water transport, the fare for water transport has been increased by 50%. The minimum fare proposed is Rs 6 for origin stop to first intermediate stop and thereafter the fare shall increase by Rs 2 for every stop till the final destination. The maximum fare charged is therefore estimated to be Rs 35 for a route length of 53 km by ferry, which is 0.66 paise per km. In order to prevent revenue leakage on this account, all tickets issued by ETVMs would have the origin-destination and time of start of journey printed on it. Refer Annexure VIII for fare matrix.

8.4 Fare Revision

Fare revision is also one of the key considerations to achieve sustainability and viability of the water transport system in Kochi. Fares of the proposed water transport system are recommended to be revised from time to time based on the following formula with the due approval from the State Government, keeping in view the parameters such as increase in the fuel prices, spare parts and revision of wages.etc. The fare adjustment process is linked with the cost of the manpower and fuel cost.

1. **Increase in the diesel price from Rs XX paisa per litre to Rs XX paisa per litre**
   Diesel price adjustment fare

   F (DPA) = (F-D) + (RPD/BPD) XD

   Where

   F = Is Total Cost per Passenger km at the time of previous fare revision

   D = is Diesel Cost per passenger km at the time of previous fare revision

   RPD = is revised price of Diesel and

BPD = is Basic Price of Diesel when the last fare revision was permitted

Example;

F = CPKM/SC x LF=2091.5/(CCx0.64)=59.41 fare per passenger km.

D = CPKM (DC)/CC x LF = 845.3/ (55x0.64) =24.01 paise per passenger km.

Carrying Capacity = 55 Load Factor = 64%

CPKM = 2091.5 paise per km (Data Based on figures of June 2006)

Diesel Cost = 845.3 paise per km

BPD = Rs. 35.91 per litre

RPD = Rs. 39.27 per litre

F(DPA)=(59.41-24.01)+(3927.0/3591.0)x24.01

=35.40+ (1.09x24.01)

=35.40+26.17=61.57 paise/km

F (DPA) =61.57 paise/passenger km

Increase in Fares= F(DPA)-F=61.57-59.41=2.16 paise

2. **Increase in Dearness Allowance Rate**

F(R) =F+ (CPKM (L)/CPKM) X P/100 X F

Where

F (R) is Revised Fare paise per passenger km

F is the Present Fare in paise per passenger km

CPKM (L) is staff cost in paise per km at the time of previous fare revision

CPKM is Total cost in paise per km at the time of previous fare revision

P is % increase in Staff Cost due to increase in DA rates over the staff cost at the time of previous fare revision.

Frequency for the change in the fare should be annual with respect to the change in Wholesale Price Index (WPI) and monthly with respect to fuel prices. The fare revision should be automatic and free from any political interference.

9 Environment and Social Impact Assessment

This proposal proposes for operating 16 water transport routes (7 routes in Phase I and 9 routes in Phase II) in the waterways of Kochi city. The project suggests for procurement of new fleet, along with the upgradation and modernisation of the jetty facilities, improvement in connectivity to the jetties and other ancillary infrastructure to encourage the usage of water transport as a means of transport on a day to day basis, as a clean and affordable mode of transport in Kochi mainland and the neighbouring islands. The project intends to capture a demand of 86,000 by 2035 from 19,000 in the base year. In order to meet this demand, it requires services to be run on the 16 routes, with a total fleet size of 43 boats in the first phase (2016-17), an additional of 35 boats are to be added to the fleet in Phase II (2018-19). During the horizon years of 2025 & 2035, depending upon the demand there would be a requirement of 12 boats and 33 boats to be added to the fleet. It is proposed to have two variants of boats, one of 50 PAX and the other of 100 PAX capacities, connecting 38 jetties (18 major and 20 minor jetties) by 2019, which would be developed and introduced in a phased manner. Based on extensive discussions with the stakeholders, it is proposed that the routes, which are already operational and the routes which have substantial demand in the existing scenario shall be included in the Phase I, following which the remaining routes shall be operated.

9.1 Existing Legal Frameworks for EIA and SIA in Kochi, Kerala

Kochi Metro Rail Limited (KMRL) are the governing and executing bodies respectively for the IWT project. KSWTD regulates and is responsible for formulation of water front development policies and plans, regulating and overseeing the management of boat jetties. KMRL will be responsible for executing the project according to its own environmental and social policies. KMRL has developed its own Resettlement and Rehabilitation Policy which is based on

- Right to Fair Compensation & Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013 and
- World Bank Operational Policies and Procedures – Involuntary Resettlement OP 4.12.

Thus the IWT project needs to comply with KMRL R&R Policy and entitlement matrix. It also needs to fulfil the requirements of KfW a German Development Bank, which is a signatory to the UNEP Statement by Financial Institutions on the Environment and Sustainable Development. KfW is committed itself to uphold the Equator Principles. Thus all nine PS of IFS, WB needs to be complied with while preparing and implementing the project. IWT needs to fulfil requirements of all state and national level environmental legal requirements which are briefly described in the Table 9-1.

Table 9-1: Applicable legislations of the Government of India

#	Law / Regulation /Guidelines	Relevance	Applicable	Reason for application	Responsible Agency
1	The Environmental (Protection) Act. 1986, and the Environmental (Protection) Rules, 1987-2002 (various amendments)	Umbrella Act. Protection and improvement of the environment. Establishes the standards for emission of noise in the atmosphere.	Yes	All environmental notifications, rules and schedules are issued under the act	Ministry of Environment, Forest and Climate Change (MoEF), State Department of Environment, Central Pollution Control Board (CPCB) and Kerala Pollution Control Board (KPCB)
2	The Forest (Conservation) Act as amended in 1988	February 1998 MOEF circular on linear plantations on road sides, canal, railway lines.	Yes	Mangalwanan Bird Sanctuary near High court jetty which is within 10 km of project area	Forest Department
3	The Coastal Regulation Zone Notification, 2011	Controls development activities in coastal, backwater channels	Yes	Required for setting up, construction or modernisation or expansion of foreshore facilities like ports, harbours, jetties, wharves, quays, slipways, bridges, sea link, road	State Coastal Zone Management Authority, Kerala
4	The Water (Prevention and Control of Pollution) Act, 1974 as amended in 1978 and 1988	Central and State Pollution Control Board to establish / enforce water quality and effluent standards, monitor water quality, prosecute offenders, and issue licenses for construction / operation of certain facilities	Yes	Consent required for not Polluting ground and Surface water during construction. The depot activity is Orange category because of automobile servicing.	KPCB
5	The Air (Prevention And Control of Pollution) Act. 1981	Empowers SPCB to set and monitor air quality standards and to prosecute	Yes	Consent required for establishing and operation of D.G. Set, plants and crushers. The depot activity is Orange category because of automobile servicing.	KPCB
6	Noise Pollution (Regulation And Control) Act, 2000	Standards for noise emission for various land uses	Yes	construction machineries and vehicles to conform to the standards for construction	KPCB
7	The motor vehicle act 1988	Empowers State Transport Authority to enforce standards for vehicular pollution.	Yes	All vehicles used for construction and buses during operation phase will need to comply with the provisions of this act.	State Motor Vehicles Department
8	The Explosives Act (&Rules)1884 (1983)	Regulations as to regards the use of explosives during both construction and operation phase	Yes	Storage of fuel in Diesel/ CNG filling stations during operation Phase	Chief Controller of Explosives
9	Public Liability And Insurance	Protection to the general public from accidents	Yes	Hazardous materials may be used for	Chief Controller of

#	Law / Regulation /Guidelines	Relevance	Applicable	Reason for application	Responsible Agency
	Act,1991	due to hazardous materials		construction	Explosives
10	Hazardous Wastes (Management and Handling) Rules, 1989	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Hazardous wastes may get generated due to activities like maintenance, repairing of boats	KPCB
11	E-waste (M&H) rules 2011	Protection against electronic waste handling & disposal	Yes	The terminals / depots will have electronic equipment's during operation phase	KPCB
12	Batteries (Management and Handling) Amendment Rules, 2010.	Protection to the general public against handling and used batteries disposal	Yes	Batteries will be used for boats during operation phase of the project	KPCB
13	Chemical Accidents (Emergency Planning, Preparedness and Response) Rules,1996	Protection against chemical accident while handling any hazardous chemicals resulting	Yes	Handling of hazardous (flammable, toxic and explosive) chemicals during construction	District & Local Crisis Group headed by the District Magistrate and Sub District Magistrate
14	Municipal Solid Wastes (Management and Handling) Rules, 2000 and amended on July 2013	Protection against MSW during construction and operation phase	Yes	Handling of Municipal solid waste	KPCB / KMRL / KSWT
15	The Building & Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996	Employing Labour / workers	Yes	Employing labours workers	District Labour Commissioner
16	Environmental Impact Assessment (EIA) notification: 2006	Proposed activity may encroach and pollute environmental resources. Hence Environmental Clearance with proper impacts and mitigations	No	Apparently the construction area will not exceed 20,000 Sq. M. but clarification should be taken from State Environment Impact Assessment Authority(SEIAA)	SEIAA Thiruvanthapuram
17	Biological Diversity Act, 2000	Prevents undertaking biodiversity related activities without approval from the Authority	Yes	Existence of rich biodiversity	National Biodiversity Authority
18	International Environmental regulation	International environmental issues such as emission of greenhouse gases	Yes	Global environmental issues	KfW
19	ECBC: Energy Conservation Act, 2001(52 of 2001)	Energy consumption increases due to the equipment required in the maintenance, waiting rooms, rest rooms, external and internal lighting	Yes	Applicable to nonresidential buildings	KMRL / KSWT
20	Persons with Disabilities Act, 2011	The existing Persons with Disabilities should get Equal Opportunities, Protection of Rights and Full Participation	Yes	Applicable for disabled persons for employment opportunities	KMRL / KSWT
21	The Wetlands (Conservation And Management) Rules, 2010	To ensure better conservation and management and to prevent degradation of existing wetlands	Yes	Wetlands are in the project area	State Wetland Regulatory Authority
22	The Inland Vessels Act.1917	Inland mechanically propelled vessel not to	Yes	Seeks NOC address extension of inland water	KMRL / KSWT

#	Law / Regulation /Guidelines	Relevance	Applicable	Reason for application	Responsible Agency
	amended in 2007	proceed on voyage or to be used for service without certificate of survey		limits, facilitating safety of vessels, controlling pollution and regulating the insurance regime	
23	Ancient Monuments & Archaeological Sites & Remains Rules, 1959	Ancient Monuments and Archaeological Sites and Remains Rules, 1959 Permission	Yes	May be applicable as many heritage structures are present in project area	Archaeological Survey of India
24	Right to Fair Compensation & Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013	Displacement of people, structures and land acquisition	Yes	May be applicable as many structures may get displaced	KMRL / KSWT
25	World Bank Operational Policies and Procedures – Involuntary Resettlement OP 4.12.	Displacement of people, structures and land acquisition	Yes	May be applicable as many structures may get displaced	KMRL / KSWT

As part of the project preparations, following clearances and No Objection Certificates will be required:

- Tree felling permission from the respective Divisional Forest Officer
- NOC and Consents under EP Acts for Air, Water, Noise, Hazardous Waste rules of SPCB for establishing and operating plants from SPCB.
- PUC certificate for use of vehicles for construction from Department of Transport
- Explosive license from Dept. of Geology and Mines & Chief controller of explosives
- NOC for water extraction for construction and allied works from Ground Water Authority if used
- Clearance for location and layout of Worker's Camp, Equipment yard and Storage yard.
- Clearance for Traffic Management Plan for each section of the route after it has been handed over for construction.
- An Emergency Action Plan should be prepared by the contractor and approved by the Engineer for accidents before the construction starts.
- NOC from ASI, Kerala
- NOC from Forest Department
- Clearance from Kerala Coastal Zone Management Authority (KCZMA)

9.2 Environment Examination and Anticipated Environmental and social Impacts

The present study is carried out through secondary data collection. Various Sources of pollution with respect to performance standards are discussed herein with details in both construction and operation phase. Given below is the list of various environmental and social impacts, which would be caused as a result of proposed project.

9.2.1 Design Phase Impacts

The planning and design of this project should be carried out by the project proponent while the construction works will be carried out by contractors and supervised by the project proponent. Design phase impacts are related to selection of sites, selection of technology and design of project. It is intended to engage consultants to undertake the environmental impact assessment (ESIA) study. Site selection and justifications, alternative site selections, technology should be studied in detailed in ESIA. The design of the system, including the exact siting of jetties, land development etc. shall take into account of local negative social (land acquisition/relocation etc.) and environmental effects. Consideration shall be given at the design stage in order to harmonize the jetty structure with the natural environment, such as floating pontoons.

9.2.2 *Pre-Construction (Site Clearing and Preparation FOR JETTY AND WATER CHANNEL) Phase Impacts*

Air and Noise Environment:

The evacuation and clearance of the project may contribute towards environmental degradation i.e. noise, water and air pollution. Land clearance for terminal construction would result in release of pollutants like NOx, SO2 gases and Particulate Matters by construction equipment. Noise pollution is another problem caused as a result of usage of construction equipment and crushers.

Land Environment:

Soil erosion may contribute towards increased sedimentation in the inland water bodies.

Terrestrial Ecology:

Primary data was not collected. Secondary data was referred for this section. Whatever was visually i.e. listed out which is meteorologically significant.

There are not many existing matured trees in all the proposed sites surveyed except for few Palm trees near the houses. The area is rich in avifauna like other parts of Kerala with many species seen in this region. There are no other species of wildlife of importance than birds in the project area. Domesticated Ducks were common at Bolghatty, Pizhala, Malavukaddu and South Chittoor. During site clearing activities vegetation and Avifauna may be disturbed. Aquatic life observed is common in nature and do not harbour any endangered species. Avifauna observed were dominated by Brahminy Kites and Cormorants are also common and no endangered species were observed. Since this area is not a significant habitat of valuable flora or fauna, adverse impacts on the ecological environment are considered to be minor. EIA consultant needs to establish presence or absence of breeding ground existing within the activity zone as this study could not eliminate the possibility of the same.

Aquatic Environment:

Pre-construction activities may have some impacts like increase on sediment loads due to dismantling of jetties the impact would be of temporary nature. EIA study should identify and quantify the impacts in ESIA.

Archaeological and Historical Monuments:

Archaeological and Historical monuments are noted near Fort Kochi, Bolagatty and High Court Jetty. There may present historical or Archaeological structures near other jetties too. The consultant needs to identify impact on it due to air, noise or vibration during ESIA.

Socio – Economic Impacts

Access to some jetties pass through small agglomeration of houses and shops at present. Capacity enhancement of the jetties and access road will result in some resettlement of houses and income

generation activities. So, consultant should consider both positive and negative impacts along with Resettlement mitigation and compensation procedures during ESIA.

9.2.3 Construction Phase Impacts

Air and Noise Environment:

This phase involves transportation of construction materials to the project site . Various raw materials used during this phase include water, steel, cement, fly-ash, wood, glass, paints, polyvinyl chloride (PVC), rubber, etc. Usage of raw materials for the construction activity release dust emissions, SO2, NOx and particulate matters. The major noise generating sources will be DG sets, crusher excavators, crane, concrete mixer / dredgers etc., which may produce noise level in the range of 70-90 dBA and may increase the background noise levels. However, since these temporary works will be confined to the project area, disturbance to local people will be minimal[10]. **The floating pontoons are proposed hence no major air and noise pollution is envisaged during jetty construction.**

EMP should presumably set rules for max noise levels and times. ESIA should highlight areas particularly affected and principles of mitigation to be applied

Land Requirement and Soil Environment:

For the construction of the 38 jetties, about 1 acre of land will be acquired for each major jetty and 0.6 acre of land for each minor jetty. Extent and details of land acquisition are not known as conveyed by KMRL during the meeting with KMRL officials on 4th July 2014. Land acquisition process will be carried out by KMRL as it is executing body. Soil contamination may take place due to movement of vehicles, leakage of fuel or lubricants and solid waste generated from the labour camp setup during construction phase. **The impact would be significant at locations of construction phase primarily due to allied activities.**

Water, Wastewater and Solid Waste Management:

Establishment of a temporary workers' colony on the site would lead to release of sewage. This may lead to chances of spread of infectious water borne diseases due to unclean surroundings in the vicinity of the site. A detailed study shall be carried out in ESIA and appropriate mitigation shall be suggested. The total water requirement for construction labours is expected to be 855 KLD and water required for construction activity is expected to be approximately 1000 KLD[11].

The quantity of construction waste is expected to be 4750 tonnes (or 6790 cu.m) for all 38 jetties. Some demolition waste will be also be generated but cannot be quantified at this state. Unplanned

[10] As per Noise Pollution (Regulation and Control) Rules, 2000
[11] Calculation based on information in DPR and use of NBC norms.

disposal of these wastes will deteriorate the water quality present in the chosen site. The impact on soil would be due to disposal of solid wastes such as construction material, rubble, composite garbage and discarded topsoil. These should be addressed in ESIA.

Construction Waste for all 38 Jetties

2500 Sq.m. area is assumed to be developed at each major jetty plus parking space for 30 cars & 100 two wheelers. Therefore, for 38 Jetties 95,000 Sq.m. area is assumed for construction waste calculations.

Table 9-2: Construction Waste Calculations[12]

Particulars	Tonnes	Cum
PCC Waste	38	54
Concrete Waste	660	943
Reinforcement steel scrap	133	190
Brick Debris	252	360
Cement bags	888	1270
Tiles Waste	2290	3270
Glass Waste	242	350
Paint Cans	190	270
Wood Waste	57	81
Total	**4750**	**6790**
30% Waste reused on site	**1425**	**2035**
Remaining will be handed over for proper disposal	**3325**	**4750**

Demolition waste will be generated but at present land acquisition is in process and in absence of primary data, it can't be quantified.

Aquatic / Marine Environment:

Removal of some the existing jetties is likely to result in the loss of some sessile marine organisms attached to the old structure, and temporary loss of habitat for crabs, fish and other small mobile marine species. However, given the low tidal range at most of the jetties except for Vypeen, Fort Kochi, Mattancherry and few other jetties at the estuary mouth, the structures are likely to have only a small population of intertidal organisms such as barnacles and oysters. Any species present are likely to be ubiquitous around the harbour and hard substrates in nearby intertidal areas. It is likely that mobile species will move away during construction and that sessile organisms will re-colonise following the completion of works. This unavoidable impact is considered to be of insignificant magnitude and no management actions may be proposed.

The location of Jetty affects aquatic fauna and flora through changes of water quality, coastal hydrology and bottom contamination. Impact on bottom biota is usually linked to a reduction in fishery resources. Deteriorations of water quality usually give rise to change in biota. The proposed

[12] Calculation based on information in DPR and TIFAC guidelines for construction waste

construction is mainly on landward side. Re-suspension of sediments in water leads to an increase in the level of suspended solid (SS) and the concentration of organic matter possibly to toxic or harmful levels. It also reduces sunlight penetration. There is a possibility of oil spills and leakage of other substances into water.

Dredging activity:

Construction work dredging disturb bottom sediments and induce re-suspension, dispersal and settlement of such sediments. Dumping of dredged material directly alters bottom configuration and biota and may disperse toxic or harmful chemicals around the disposal site. Dredging during construction might impact habitats of benthic and pelagic fauna, which gets re-colonise with time. This impact is temporary and is not significant impact. ESIA should involve detailed analysis of sites and soil quality.

Community Health, Safety & Security Aspects:

This is a big project involving many construction labours and technical staff working together on the site. The risks related to the construction activities will affect the construction labours and technical staff. Effects on communities need to be considered. Therefore proper health and safety measures should be suggested in the ESIA as per the relevant rules & regulations.

Socio-economic Aspects:

Involuntary displacement of people on landward side, loss of households and shops is probably not avoidable. As the population density along the coast is, where proposed activity are considered, is high as per site observations. Moreover, all the above environmental impacts may affect the livelihoods and life styles of those depending on them. Fishermen may be affected if there is reduction in fish yields. Also current ferry services will be affected during the construction phase. To capture this impact a detailed social study should be carried out in ESIA.

Archaeological and Cultural heritage Aspects:

The historical sites like Fort Kochi, Mattancherry, Fort Vypeen Integrated Heritage Zone, Willington Island Heritage Zone, Ernakulum Central Area Heritage Zone, Canal & Backwater Network Heritage Zone, Mangalavanam Natural Heritage, Kochi Estuary Natural Heritage Zone are within 5 to 10 km radius of project area. Pressure will be created by influx of people on the landward side. This may leads to the potential damage to the physical fabric of archaeological remains, historic buildings or historic landscapes through air pollution, change of water-table, vibration, recreation pressure and ecological damage.

9.2.4 Operation Phase Impacts

Air and Noise Environment:

In order to meet the transportation requirement, 43 boats are suggested in the first phase (2016-17). An additional of 35 boats are to be added to the fleet in Phase II (2018-19). During the horizon years of 2025 & 2035, depending upon the demand there would be a requirement of 12 boats and 33 boats to be added to the fleet. The berths are designed to have capacity of two variants of boats i.e. 50 and 100 PAX capacity. The pollutant emissions from the boats are estimated based on the emission factors for the pollutants SO2, NOx and PM10 with boats having PAX and the other of 100 PAX capacities. From the secondary sources[13 & 14] and preliminary assessment studies emissions for SO2, NOx and PM10 when 7 boats simultaneously berthed at one jetty are 28.4 µg/m^3 (Standard 80 µg/m^3), 3.0 µg /m^3 (Standard 80 µg/m^3) and 126.8 µg/m^3 (Standard 100 µg/m^3) respectively. Detailed air modelling should be carried out in ESIA.

The cumulative noise levels due to the combined operation of booster pumps, power generating units, dredgers, Boat loading/unloading and Diesel generators at the Terminals could be in the range of 70-75 dBA, which is predicted to be 50 dBA at a distance of 250 m and 44 dBA at a distance of 500 m from the sources (Standard 55 dBA for day time).

Water, Wastewater and Solid Management:

Possible discharges of waste water from boats that could be sources of water pollution are oily wastes, sewage, garbage and other residues like oil spills, lubricants and fuel may be the source of water pollution. The total water required for passengers and staff expected as 3870 KLD. Out of which, 1720 KLD will be used for domestic purpose while 2150 KLD for flushing[15]. Sewage generated is expected to be 3483 considering 10% losses. Please see Table 9-3. If left untreated it poses a threat of eutrophication of the water bodies. In ESIA mitigation/avoidance should be dealt with.

Table 9-3: Wastewater Calculations

Population		Domestic Norms	Flushing Norms	Domestic	Flushing	Total Sewage
86000		20	25	1720	2150	3483

The solid and hazardous wastes generated from boat and jetty operations will have to be disposed off properly to avoid land contamination.

These are passenger jetties and therefore solid waste will be generated from the activities of passengers & staff. The total quantity of this waste is estimated to be 21500 kg/day. Out of which dry waste will be 15050 kg/day and wet waste will be 6450 kg/day. Please see Table 9-4.

Table 9-4: Solid Waste Calculations

Population	Dry Waste	Wet Waste	Total Waste	Dry Waste	Wet	Total

[13] (SKM, 2004: Port botany upgrade EIS-Air quality impact assessment commission of inquiry)
[14] NEERI, IWT Studies, 2014
[15] Considering 15 litre/person/day

	Norms	Norms	Norms		Waste	Waste
86000	70	30	0.25	15050	6450	21500

There will be generation of e-waste resulting from scrapped/old printers, telephones, CCTV cameras, electronic ticket vending machines etc. In Phase 1, the total quantity of e-waste is expected to be 62.4 kg/annum. In Phase 2, the total quantity of e-waste is expected to be 219.2 kg/annum. If left untreated or disposed un-scientifically the waste would deteriorate soil and create unhealthy conditions.

Table 9-5: E-Waste Calculations

Phase I	**Phase II**
Equipment Proposed Passenger information system: 22 Nos. Installation of CCTV: 22 Nos. Electronic ticket vending machine: 2 Nos. Total : 47	**Equipment Proposed** Passenger information system: 16 Nos. Installation of CCTV: 16 Nos. Electronic ticket vending machine: 16 Nos. Total: 48
E-Waste Calculation Passenger information system : Weight = 22*6 Kg = 132 Kg Installation of CCTV: 22 Nos. : Weight = 22*2.5 Kg = 55 Kg Electronic ticket vending machine: Weight = 2*60 Kg = 120 Kg Master Clock, telephone etc: Weight = 5 Kg **Total Weight = 312 Kg** 312 Kg weight generated from the 22 Jetties. Therefore **62** Kg / annum waste generated in Phase I @ 20%.	**E-Waste Calculation** Passenger information system : Weight = 16*6 Kg = 96 Kg Installation of CCTV: 16 Nos. : Weight = 16*2.5 Kg = 40 Kg Electronic ticket vending machine: Weight = 16*60 Kg = 960 Kg **Total Weight = 1096 Kg** 1096 Kg weight generated from the 16 Jetties. Therefore **219 Kg** / annum waste generated in Phase II @ 20%.

Dredging Activity:

Dredging activities in the intertidal and sub-tidal areas proposed for the development of the water transport will influence the local ecology and impact on the intertidal biota of the affected areas, loss of bottom habitat, number of bacteria, phytoplankton, zooplankton, and benthic organism. Effective sediment control measures would be needed before starting work, more to prevent the entry or re-suspension of sediment in the water body. Monitor and inspect sediment control measures regularly to ensure that they are functioning properly.

Biological Environment:

- **Fisheries**

As per available literature, in Kochi backwaters, 43 species classified as resident species are available round the year, 74 species classified as migrant species while 17 species are vagrant species. About

60 no. marine fish types and molluscs including, bivalves, gastropods, cephalopods are reported from the fish landings of Kochi Fisheries Harbour (Thoppumaddy), Vypeen & one fishing zone at Fort Kochi.[16] Among these three locations, the highest catch both in terms of number of types and density with fish number with an average value of 49 was at Kochi fisheries harbour followed by Vypeen with 45 and the location at Fort Kochi with 33 no. Oil Sardines and Penaeid prawns are found in high density at all the locations.

The Kochi fishery harbour is not among the proposed location and is 3km from Mattancherry and 5 km from Fort Kochi two of the proposed major jetties. Among the actual jetty sites, in the Kochi backwaters, no significant fishing zones are reported except for the traditional Chinese net fishing practices. Not many fishermen from the proposed jetties does not engage in fishing. **As there is no significant fishing zones reported in the vicinity of the proposed jetties, and considering the low fish catch at Vypeen known to involve in fishing activity no significant impact are envisaged on the fisheries from the proposed project.** This view is presumably preliminary. Justification will be given in ESIA.

- **Mangroves**

All along the proposed project route, mangrove species occur sparsely. As such the continental shelf at Kochi being narrow and steep, this entire region does not support any significant growth of mangroves. Mangalavanam mangroves situated behind the Kerala High Court building is known for its small bird sanctuary. The impacts of the operation of jetties proposed upgradation of jetty at High Court location shall be studied for any impacts on the mangroves or the bird sanctuary during ESIA.

The fact that this project will not directly impact on the mangrove communities in the proposed jetty locations, this project will not compromise the protection of significant and/or rare species inhabitating the mangroves.

- **Dolphins**

Although the backwaters of Kochi are known to harbour Dolphins, based on the survey and the location of the project no active siting of Dolphins are reported in any of the routes proposed for the project indicated. Even considering the presence of Dolphins in the proposed project route, no significant impact is envisaged as these routes are already in operation for time a very long time.

- **Water Weeds:**

Water Weeds can grow in large quantities near the jetties where boats are berthed. These weeds are Mosquito breeding grounds, nuisance to vessel operations along waterways.

[16] CMFRIA, 2014-2015 data

- **Organic Matter and Nutrients**

The release of organic rich sediments during dredging can result in the localized removal of oxygen from the surrounding water and the re-suspension of sediments which may lead to the suffocation of marine animals and plants and Eutrophication within the localized area or may deter migratory fish or mammals from passing through. However, this removal of oxygen and turbidity from water is only temporary, therefore, in most cases if any effect on aquatic life it will be not significant.

The re-suspension of sediments in other cases may increase organic material, nutrients and algal growth may provide food for zooplankton and higher organisms, thereby increasing the productivity of the marine ecosystem.

- **Oil Spill: Due to the Jetties Operations**

Regular boat operations and remote possibility at collusion or hitting against the wharf or boat getting grounded owing to natural calamity or piloting errors can lead to oil spill in the vicinity. ESIA should consider potential effects of oil pollution which are as follows:

- Aquatic animals and plants might be tolerant to low level concentrations of oil in sediments from chronic or small discharges, however this is not always the case;
- Prolonged exposure to major or minor oil spills can lead to mass mortality of benthic communities, fish, mammals and birds;
- Contamination of sediments with oil may modify chemical, physical and biological processes.
- In sediments, as it is organic, oil will be broken down relatively quickly by microorganisms which may result in the localized removal of oxygen from the sediments and surrounding water with possible effects on aquatic life;

Community Health, Safety & Security Aspects:

Keeping the above points addressed by the people who participated in the Public Consultation (PC) conducted by BEIPL we can conclude that the Water transport is most favoured mode of transportation in terms of fare and time. The major risks & problems involved could be due to Natural Calamities & the Monsoon period, which are the major reasons which could make the water transport impractical or unsuitable for the passengers. But on contrary the Geographical & Hydro-geological records or information about this area seems to be favourable to the water based transport like, the water transport is going to be an internalized channel & it will be channelized through the 'Back Water Channels'. Also the past history records & information collected from people it can be interpreted that from last 30 years there are no records of severe Natural Calamities

like Tornadoes, Cyclones or Tsunami that could impact/ disturb the water transport & pose threat to people & livestock.[17]

However, health & safety of the passengers is of primary concern and required measures are to be taken to ensure that health and safety of people are not compromised at any end. Apart from this, for proper disposal of fuel & any chemicals at the time of construction & operation of new Jetties & upgradation of old existing Jetties there could be probable impacts on water hydrology & the people from the Fishing communities. At the time of PC it was noticed that the fishing activities are carried out by the people in the 'Back water channels' adjacent to their houses & they do their fishing activity in these water channels only.[18] Thus it needs to be verified for their impacts on the fishing activities in the dedicated project area. This information will give an idea about the impact of this project on the fisherman community as well as aquatic habitat during the construction period of the project.

Also the current jetties & the expected additional jetties will increase the load of fuel or other chemical during the construction & operational period of all these jetties. In order to minimize the load of pollution due to fuel or chemicals at present there are two Boat repair maintenance stations i.e. Jetty Depot stations are present viz; Vytilla & Pizhala. These existing maintenance depots are not highly equipped & with increasing the load of new boats due to IWTS project theses depots needs upgradation, so that the water pollution due to fuel & or chemicals will be controlled.

Socio-economic Aspects:

It is expected that due to ease of movement and extra passengers there would be a general improvement of livelihood of all people. It was noticed that the people who participated in the PC were positively willing towards this project, as it will be a fastest & cheaper way of transport. The only issues or problems are lack of provision of good safety equipment, poor services & low frequency of the ferry boats. As the project envisions provision of these services it is expected to contribute the opportunities for women to access a safe public transport & use to it emancipate their social & economic rights. Thus this project will certainly have positive impacts on the various population groups of that area.

Increase in transient population in the project area, migration of workers may cause economic, social and cultural conflicts or displacement of local populations. There are indications that sections of the society that depend on traditional resources (like coir, bamboo, fishery, cashew etc.) for livelihood and the vulnerable sections like Scheduled castes and tribes in the state were left out

[17] IMD data from net
[18] marine fish landing centre by CMFRI Kochi

from development experience. Further identification or to verify which tribes get affected & to what extend due to this IWTS project is necessary.

ESIA need to consider the impact of new / modified operations on income of existing ferry operators and look for income restoration operations if necessary.

Climate Risk Aspects:

Probable impacts of climate change on the coastal portions of the Kochi Corporation are sea level rise, accompanied by increased erosion or accretion of shorelines and incidence of water logging and flooding. Because most developed areas along the shoreline are no more than 1 meter above sea level, even a modest rise in sea level (0.3 to 0.5 meter) could bring some developed coastal areas under threat of inundation at high tide or during monsoonal storms. Additionally, saltwater intrusion into ground and surface waters would be expected to advance further inland. Hydrogeological modelling may be required. This needs to be looked into further and steps shall be taken to make the project more resilient to climate change impacts in ESIA.

Beach erosion is another concern, because it is already occurring on the sea margins of Fort Kochi / Mattancherry. The beaches along Kerala's coast, especially in the Kochi area, are of a barrier type backed by the seasonal occurrence of mud banks. Historically, erosion and accretion along the coast operated on a cyclical basis. However, in more recent times erosion has played the major role. Forecasts of more intense precipitation events as climate change occurs would appear likely to be associated with more intense wave activity, accelerating the coastal erosion rate, with all effects magnified by sea level rise.

Possible impacts of climate change, including increased variability of rainfall patterns and more intense short-duration events during the southwest monsoon—especially in combination with a rise in the water table associated with sea level rise—would be expected to cause more serious water logging, which promotes the accumulation of wastes in canals for longer durations.

This situation already contributes to disease outbreaks, and such impacts might become more frequent and severe. The combination of water stagnation, waste accumulation, and warm temperatures provide an excellent breeding ground for disease organisms and the disease vectors (mosquitoes, flies, and rodents) which can transmit the diseases to humans. The accumulation of solid wastes in water logged areas can also lead to increased leaching of pollutants from the wastes into ground water, leading to further pollution of land and water systems.

The water transport may get impacted in the event of coastal flood or floods due to extreme rains as the facilities such as jetties/ferries may get damaged. There could be reduced clearance in waterway and silt deposits which may hinder mobility.

Table 9-6: Summary of Environment and Construction Phase Impacts

Parameters	Impacts Expected
Preconstruction Phase	
Air quality	Release of SO2, NOx and other pollutants as a result of site evacuation. Fugitive emissions due to crushing; vehicular emissions
Water quality	Disposal of construction effluents at various location of sites; release of sewerage
Land environment; soil erosion	Land clearance for construction of various infrastructure facilities Soil Erosion
Noise quality	Construction equipments; Crushing of the stones
Aquatic ecology	Changes in the water quality; change in the physicochemical environment, thus affecting the various species that are dependent on the marine water
Public health water borne disease	Increased chances of occurrence of water borne disease in the workers colony, lacking the sewerage treatment
Construction Phase	
Air quality	Usage of raw materials for the construction; transportation of these materials to the project site; dust emissions from dredging materials dumping
Land Environment	Tree cutting on the project site Soil contamination due to the construction materials, wastes generation
Water quality	Effluents released from various sources like worker camps, crushers etc released into water channels
Noise level quality	Noise from the equipment used
Muck disposal and solid waste	Muck generated from the construction site and allied activities Solid waste would be released from the worker's colony
Public health safety;	Minor accidents may occur at the project site during construction phase; occurrence of diseases in the workers colony
Dredging	Influence the local ecology and impact on the intertidal biota of the affected areas, loss of bottom habitat
Operational Phase	
Maintenance Dredging	Influence the local ecology and impact on the intertidal biota of the affected areas, loss of bottom habitat dust emissions from dredging materials dumping
Aquatic ecology	Changes in physical and chemical characteristics of the water would affect the local species of plants and animals as well as those present in the waterways Breakwater quality
Oil spillage	Chances of oil spillage from boat repairing, maintenance, operation of boats
Waste generation	Generation of solid waste and waste water from the terminal operations

9.3 Suggested Mitigation Measures

9.3.1 Design Phase

Measures to mitigate possible environmental impacts shall be incorporated in the design, and appropriate contract provisions should be included to minimize the possible impacts during the construction stage.

Selection of sites should be done considering the less land acquisition and social & environmental impacts. Technology of the jetty construction should be as such to reduce the major impacts on environment like proposed floating pontoons constructions instead of concrete jetty. Design of the project components should be such that best architectural design for energy saving, sustainability.

9.3.2 Pre-Construction Phase

Air and Noise Environment:

In order to manage the impacts identified, necessary steps shall be taken. As mentioned earlier, this phase requires evacuation of site done and crushing of the stones. Risk assessment is an important step mandatory prior to any step taken for controlling pollution. Apart from this, safety precautions must be taken during construction to avoid major accidents. Provisions, like ear muffs and ear plugs, have to be supplied to the workers present in the site during the time of using the crushers to crush the stones. Periodic measurement of air quality and noise equivalent noise levels has to be monitored during daytime and night times and compare it with the standards as per National Ambient Air Quality Standards (NAAQS) as well as National Ambient Noise Quality Standards (NANQS), as specified by the CPCB.

Land Environment:

Boundaries of the construction area must be clearly marked prior to the commencement of vegetation clearance; Roads for construction access must be constructed to minimise vegetation clearance. Marine plants are only to be removed under appropriate approvals from the Administering Authority. Clearing and disposal of cleared vegetation shall be in accordance with the Administering Authority requirements. A comprehensive green belt programme is being planned which will help in improving the ecological condition of the region.

9.3.3 Construction Phase

Air and Noise Environment:

Transportation of construction materials and the process of construction of the terminals lead to air pollution. Pollutants like Particulate Matter (PM, SPM), NOx, CO2, CO may be released. Any leakages of fuels from vehicles may result in pollution of groundwater as well as soil. Dust emission from vehicles as well as from raw materials like cement also contributes to air pollution. Necessary steps,

such as regular water spray to minimise fugitive emissions and baseline ambient air monitoring given by CPCB, have to be taken to minimise the pollution generated during this phase.

Noise levels are to be checked and personal protective gears to be provided during periods of noise exposure. Maintenance of equipment and machinery are to be checked regularly. Measures have to be taken for the characterization and proper disposal of muck expected to be generated at various sites. A first-aid box needs to be provided at the construction site.

Water, Wastewater and Solid Waste Management:

The construction phase involves treating the effluents released from various sources such as worker camps, crushers, etc., before being released into the main stream, thus requiring construction of settling tank to precipitate suspended impurities. Septic tanks shall be provided thereby avoiding deterioration of water quality of the receiving water body. Solid waste disposal should be planned in a way proving harmless to the environment. Out of which 30% of waste i.e. 1425 tonnes (2035.71 cum) will be reused and remaining waste will be will be collected and kept in an identified location near to the site and then this will be handed over for proper disposal to the authorised vendor/municipality.

The waste will be generated from labour camps and presumably this will be controlled by establishing proper wastewater collection. EMP shall provide guidelines for establishment of workers camps and generation of solid waste and liquid waste. Facilities available for the hazardous waste, E-waste and solid waste management in the area should be identified and reported in the EMP.

Community Health, Safety & Security Aspects:

While constructing the jetty and terminals, safety precautions have to be taken for handling the construction materials by the workers. They should be provided with gloves while handling the paints and care should be taken while carrying the materials made up of glass. This phase has a high risk for occupational hazards and hence, mitigation measures have to be planned accordingly.

Disposal of Dredge Spoil:

The dredged material can be safely transported back to the land and used for reclamation. The offshore disposal will be totally avoided.

Socio-economic Aspects:

Land acquisition is in process. The care shall be taken to avoid or minimise the displacement of households and other structures. In such case the Rehabilitation & Resettlement which will be in sync with the Kerala State Govt. policy. This Rehabilitation and Resettlement (R&R) Policy (The Policy) is being adopted by KMRL in order to address any adverse social and economic impacts

accrued to identified families or persons in the Affected Area. This Policy has been developed generally in accordance with the requirements of the Right to Fair Compensation & Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013 (RTFCTLARRA, 2013) and the Agence Francaise de Development (AFD) social safeguard guidelines. The AFD adopts the World Bank Social Safeguard Operational Procedures to address involuntary resettlement issues under development projects globally. The RTFCTLARRA, 2013 adheres to the requirements of the World Bank Social Safeguard guidelines also and thus the Policy has adopted the RTFCTLARRA, 2013 in general. If much displacement will occur on the project site during land acquisition then alternative land parcel shall be studied. Vulnerable household e.g. Below Poverty Line / woman headed households etc. needs to be identified and dealt with specially. Also the benefits provided to SC & ST groups under the State Govt. Labour workers can be employed from local people. Fisherman shall be provided with temporary alternative facility. Details should be studied in ESIA.

Archaeological and Cultural Heritage Aspects:

Further investigations shall be undertaken on the sites identified. The Contractors shall prepare a Cultural Heritage Management Plan to manage any sites that may be encountered during construction. If a historical, cultural, or archaeological relic is encountered, all construction activities should halt and the established action plan will be implemented. Work should recommence only after appropriate measures has been taken as requested by the appropriate authorities and confirmation is received that work may resume.

9.3.4 Operation Phase

Air and Noise Environment:

Regular maintenance and cleaning of boats will restrict air and noise pollution. Also it is proposed to run the Boats on CNG to reduce air pollution. CNG stations shall be provided at major jetties / Boat Yards / Depots. Authorities should strictly monitor all operational phase activities and rules and regulations should be strictly adhered to. All environmental parameters must be checked regularly by an Environmental Safety Officer and should be maintained within permissible limits.

Wastewater and Solid Waste Management:

There will be provision of wastewater treatment at the jetties. STPs will be provided on the major jetty area while septic tanks can be provided at the minor jetties. The desired quantity and technology of STP will be estimated in detail later. The solid waste will be collected and segregated as dry and wet waste at the identified location on the site and then this will be handed over to the municipality for further processing and treatment. Dredging material generated

during maintenance will be dumped on identified sites only. Detailed studies should be carried out in ESIA.

Aquatic / Marine Environment:

Construction works have the potential to impact on aquatic fauna especially Dolphins due to noise, disturbance of the sediment bed and other construction impacts such as accidental spillages and discharges. But considering that the proposed jetties will not involve any work at the site except the establishment involving insignificant noise only for a short time, hence no impacts are envisaged. To minimize any remote possible impacts on aquatic fauna including Dolphins in the vicinity, a number of management procedures should be put in place, including: A nylon or HDPE cushion to be used between the hammer and pile to reduce hammer impact noise; Soft start procedures (i.e. commencing with reduced noise level to allow animals to move away from the area before increasing the noise levels gradually)

Biological Environment: Flora, Fauna and Ecosystems:

Careful survey of the ecological characteristics of the project area will be carried out and appropriate measures will be proposed for their conservation. Planting of appropriate plants around the jetties will be done as an effective means to mitigate adverse effects on terrestrial habitat.

Greenbelt proposal to be prepared and be implemented in the jetty premises as per the guidelines of State Pollution Control Board. Regular clearance of weeds to be carried out using weed harvesting machines to keep the waterways clear of water weeds.

Oil spill impacts to be mitigated by selection of low-emission power generators, where possible, selection of the most environmentally friendly alternatives for chemicals. With regard to accidental events, good operational practices should be adopted to avoid events that may escalate and lead to serious consequences to the environment.

Community Health, Safety & Security Aspects:

- **Passenger & staff safety:**

1. For the purpose of safety and security, CCTV surveillance systems shall be installed in each of the boats and at all appropriate locations in the minor as well major boat jetties. At the major boat jetties, these shall be appropriately installed so as to monitor the entire boat hub complex including the property development complex.

In emergencies or as required it shall be possible, without any additional resources, to view images from any/all cameras and/or record any dynamically selected location on the system at Central Control Centre. Intelligent Video Analytics shall be implemented on the proposed cameras. Different features of the video analytics shall include but not limited to:

- Intrusion detection,

- Unattended baggage detection,
- Crowd estimation and crowd management alarms for jetties/hubs,
- Line control,
- Counter flow detection overcrowding detection,
- Camera tampering alerts and
- Any other video analytic feature relevant to boat operation.
- Street lights
- Safe access to jetty

The Video Analytics functionality shall have mechanisms to continue alarm generation in case of failure of the Server. The Video Analytics shall not be bound to the MAC address of the device and hence any video analytics feature shall be possible to be deployed on any camera.

- **Transportation Safety:**

Intelligent Transportation and Navigation System a cellular communication (GPRS/LTE) based intelligent transportation and navigation system is recommended for implementation and integration of boat with other mode of transportation viz Metro Rail, Bus etc. Implementation of ITS is divided into the following categories:

- Global Positioning System (GPS) – on board and off board.
- Passenger Information System (PIDS/PAS) – on board and Boat jetties/Hubs.
- Master Clock.
- CCTV inside boats and at jetties/Hubs.
- Automatic Fare Collection System.
- Central Operational Control Centre.

All the boats proposed in this project will be provided with 'state of art' ITS equipment and navigation systems. Boats will be capable of sending information like diesel generator status alarms, fuel amount, engine temperature, altitude, reverse geocoding, cut off fuel, turn off ignition, battery status, GSM area code/cell code decoded, GPRS/LTE status, speed, location, no of passenger on board and a lot more to the Central operational Control Centre.

- **System Operational Safety:**

A central control facility comprising a LED based large video display is recommended for controlling the services. This shall act as a nerve centre of the entire system and associated services and shall provide the overall control and co-ordination of the system. It shall consist of all the necessary computing and communications hardware and software needed to fulfil this function. This shall have, at a minimum, the following:

- Control panels on which the location of all boats can be spotted and tracked during operating hours
- Monitors to which visuals of the actual ground position can be transmitted by cameras located at strategic points on the corridor
- Facilities for voice communication between the drivers and the control room as well as between hub/boat jetty supervisors and marshals and the control room
- Facilities to receive and transmit, as needed, all data being collected by the vehicle mounted units, fare collection units, cameras and all other hardware
- Report and alert operators to errors and faults with the Real Time Passenger Information System
- Collect, process and store data generated by the system

Socio-economic Aspects:

- To evaluate the ferry operators in the area so that they can be given the preference during operation of ferry
- To evaluate the socio-economic aspects of the local fishing community as well as the Tribal groups coming under the impact zone due to this project alignment.
- The results of local community survey, their current situation about livelihood, education & overall socio-economic status will guide us to plan a suitable R & R as per the local & state Govt. laws & regulations.
- Due to this project direct employment, indirect employment& other positive opportunities shall generate ancillary business to some extent for the local population.
- Also, during the construction activities some business opportunities will be available to local vendors for suppliers of materials and transportation, and for traders to cater to the employees requirements such as food, daily needs, and medical care.
- The project will have a positive effect due to improved transportation &communication and health services, which will lead to economic prosperity of individual – city – state - & eventually of Country.
- Proper displacement of PAPs in Port area will be planned with a Fair &Transparent policy.
- For the other Impacts like environment related or Social will be provided with appropriate solutions, so that the impacts of increased activity during the construction & operational period will be within acceptable limits on the locality.

Archaeological and Cultural Heritage Aspects:

The strategy to be adopted in respect of natural, manmade and historical precincts of Kochi is linked to the mechanisms for conservation without sacrificing economic productivity and harnessing the

Tourism potential. Kochi Municipal Corporation (KMC) has already setup a centre for Heritage Studies. KMC has already drawn conservation practices and listed the permissible activities. The centre for Heritage Studies can also give guidance on façade treatment and general architectural control.

Climate Risk Aspects:

- Climate risk aspects should be taken into account like
- enhancement of flood defences such as sea walls,
- protection of coastal wetlands (as buffers),
- use of more durable materials in ferries, jetties, incorporation of higher levels of flooding into future bridge design, pontoons design and
- building of more redundancy into the system – Spare ferries

As construction phase is likely to cause most impacts details of the parameters likely to be affected by each of the activities taking place during construction of the port, with their impact characteristics and level of significance with low cost EMP are summarized in Table 9-7 **and** Table 9-8for construction and operation phase**.**

Table 9-7: Preliminary Impact Assessment during Construction Phase

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
Construction material handling and transportation	Air	Generation of dust from handling and transport of fine & coarse aggregate in uncovered trucks	Short term Negative Reversible	Low, by covering the trucks with tarpaulin sheets or by using water sprays
	Noise	Vehicular noise, use of excavation equipment	Short term Negative Reversible	• Low when trucks will carry material at fixed time • Periodical maintenance and speed control
Construction activities	Air	Fugitive dust emissions and dust generation from concrete mixing, cement handling, welding, operation of construction machinery	Short term Negative Reversible	• Low, by sprinkling water and wearing masks • Installation of dust extraction unit on the crusher • Baseline ambient air monitoring as per CPCB norms
	Noise	Use of construction equipment and power tools	Short term Negative Reversible	• Low when workers are provided with ear plugs • Continuous exposure to the noise levels above 90 dB (A) has to be avoided • Regular maintenance of equipment and machineries • Baseline ambient noise monitoring as per CPCB
	Soil	Excavation of soil	Short term Negative Reversible	• Selection of proper top soil storage • Adoption of soil erosion control measures i.e. engineering measures, vegetative measures, reduction on use of fuel wood and management measures
	Water	• Water utilisation for construction • Turbid runoff from construction site washings	Short term Negative Reversible	• Low, as groundwater shall not be tapped • Turbid runoff from construction site can be minimized by construction of small bunds
	Terrestrial Ecology	Clearing of vegetation	Short term Negative Reversible	As a part of Construction EMP, Construction contractor's plan shall identify specific techniques,

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
				practices and measures that will be utilized to minimize any adverse environmental impact during construction of the facility including those specified under mitigation measures and EMP.
Road Upgradation	Land and Aesthetics	Dumping of left materials	Short term Negative Reversible	The materials left in excess during the road construction are to be collected and dumped in the designated muck disposal. After disposal operation is completed at the dump site, dump yard has to be vegetated and contoured
Labour force	Water	• Exploitation of water resources for domestic usage • Disposal of untreated waste	Short term Negative Reversible	• Low, when workers are local, current usage pattern is maintained and when groundwater is not be tapped • Low, when wastewater is disposed with basic treatment such as soak pits
	Land / Aesthetics	• Springing up of temporary buildings / dwellings • Generation of solid wastes	Short term Negative Reversible	• Low, when proper collection and disposal is practiced • Low, when hutments are within premises • Legally compulsory provisions on various factors such as health, sanitation and appropriate working conditions including accommodation must be adhered to Solid waste management – facilities for collection, conveyance and safe disposal of solid waste
	Socio Economics	Increased employment opportunities	Short term, Positive Reversible	Low, since employment is temporary
Dredging	Noise	Use of dredging equipment and power tools	Short term Negative Reversible	Low when Management of the dredging will be through a Dredge Environmental Management Plan (DEMP) to be developed by the contractor.
	Water	Sediment resuspension	Short term Negative Reversible	Medium for turbidity when the material is clay
	Sediment	Release of toxic	Short term Negative	Low for toxicity when

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
		substances and nutrients	Reversible	sediment toxicity is minimal
	Benthic Ecology	Disturbance of bottom sediments and/or destruction of spawning grounds	Short term Negative Reversible	Low, when commercially valuable species/ breeding/ spawning grounds are not present
	Land / water / Air	Dumping of dredged material	Long term Negative Reversible	Management of the dredging will be through a Dredge Environmental Management Plan (DEMP) to be developed by the contractor.
Land reclamation	Water	Sediment resuspension	Short term Negative Reversible	Medium for turbidity when the material is clay
	Sediment	Release of toxic substances and nutrients	Short term Negative Reversible	Low for toxicity when sediment toxicity is minimal
	Ecology	Loss of inter tidal area	Long term Negative Irreversible	Low since no major vegetation
	Shoreline	Material dumping	Long term Positive /Negative Irreversible	Low the dumping will be on authorised sites
	Socio-economic	Acquisition of land as well as other properties;	Long term Positive /Negative Irreversible	Increase in the employment potential Compensation as per the rehabilitation plan by the Government of Kerala, KMRL
Construction of Jetty	Noise	Floating Pontoons will be constructed hence no major noise is anticipated	Continuous for a Short period Negative Reversible	• Very low as no concrete structures will be constructed
	Water	Increased suspended solids and turbidity	Short term Negative Reversible	Low, since area of impact is localised and negligible
	Air	Floating Pontoons will be constructed hence no major noise is anticipated	Short term Negative Reversible	• Very low as no concrete structures will be constructed

Table 9-8: Preliminary Impact Assessment during Operation Phase

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
Passenger, car and small vehicles boarding and alighting activities	Air	No impacts are envisaged	--	--
	Water	Spillage into the marine environment	Short term	• Low, since quantity of accidental spill is expected to be negligible with SOP
	Sediment	Accumulation in sediments	Short term	• Low, as spills if any will be minimum and localised
Maintenance dredging	Noise	Use of dredging equipment and power tools	Short term Negative Reversible	• Low when soil is soft, silty clay • Medium when noise sensitive marine species are present
	Water	Sediment resuspension release of toxic substances and nutrients	Short term Negative Reversible	Medium for turbidity when the material is clay
	Sediment	Movement of dredge spoils	Short term Negative Reversible	Low for toxicity when sediment toxicity is minimal
	Benthic Ecology	Disturbance of bottom sediments and/or destruction of spawning grounds	Short term Negative Reversible	Low, when commercially valuable species/ breeding/ spawning grounds are not present
Jetty Operations and ferry movement	Water	Water consumption, waste water generation Discharge of Ballast water and boat residues	Short term Negative Reversible	Negligible if Proper wastewater management system like STP Low if stick to the SOP
	Oil Spills	Oil spillage into water	Short term Negative Reversible	To manage accidental Spillages and Discharges (including Hydrocarbons), jetty operators will be required to provide detailed measures to minimize the risk of spills and contingency planning for spill response.
	Solid Waste	MSW, Hazardous waste generation	Short term Negative Reversible	Low if proper SWM plan followed. Regular cleaning and handover of MSW to Municipality Follow HW management rules 2008
	Sediment	Release of toxic substances and nutrients into the upstream	Short term Negative Reversible	Low for toxicity when sediment toxicity is minimal

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
	Shoreline	Material dumping	Long term Positive /Negative Irreversible	Low proper SWM management and dumping on authorised sites

Alongside the preparation of DPR, KMRL has also conducted a preliminary screening study for the environment and social aspects of the water transport project. The screening study report is appended with the DPR. The screening study also lays out the way forward and the factors, not limited to the study which shall be covered in detail in the Detailed Environment Impact Assessment and Social Impact Assessment to be conducted.

10Financial and Economic Analysis

10.1 Financial Analysis

10.1.1 Phasing of Operations

Based on the assessment of the traffic between various jetties, a total of 16 routes have been identified as per details given in **Table 10-1**.

Table 10-1: Route details

Route no.	Origin - Destination	Route length (km)	No. of Jetties	Boat Capacity	One way Journey Time (min)
1	South Chittoor to Ernakulam	8.2	7.0	50	56
2	Edakochi to Thevara	3.7	3.0	50	26
3	Ernakulam to Vypeen	6.4	4.0	100	40
4	Ernakulam to Mattancherry	6.1	4.0	100	39
5	High Court to Mulavukadu	11.0	7.0	50	68
6	Vytilla to Info Park	8.0	4.0	50	46
7	Kumbhalam-I to Kumbhalam-II	4.0	4.0	50	30
8	Info Park to Edakochi	12.6	7.0	100	74
9	Mulavukadu to South Chittoor	8.0	5.0	50	49
10	Edakochi to Vypeen	13.6	5.0	100	72
11	South Chittoor to Cheranallur	6.0	8.0	50	50
12	Elamkunnapuzha to High Court	15.0	4.0	50	75
13	Kadamakudy to Paliyamthuruth	6.0	3.0	50	35
14	Chennur to Thundathumkadavu	3.0	3.0	50	23
15	Chariyamthuruth to Chennur	3.0	3.0	50	23
16	Kothad to Amrita Hospital	3.0	3.0	50	23

The project is proposed to be implemented in two phases to allow for sufficient time for building up of institutional as well as connecting infrastructure around the jetties. The routes 1 to 7 are proposed to be taken up in Phase I which will be started during 2016 and 2017. The remaining routes are proposed to be initiated during 2018 and 2019 (Phase II).

10.1.2 Capital Cost

The Capital Cost for the Water Transport Project can be categorised into direct costs and indirect costs related to allied infrastructure. The direct costs include the cost of boats, cost of jetty infrastructure, boat maintenance yard, dredging of waterways and cost of Inland Navigation system (ITS for navigation) and operational control centre (OCC). The ancillary infrastructure costs include

Island road improvement, provision of basic amenities like street lighting, parking and electric feeders, bicycle sharing and other non-motorised transport (NMT) which is used to ferry the potential passengers between the island areas and the jetties.

The cost of boats has been estimated at ₹ 2 crore for small boat (50 seater) and ₹ 3.5 crore for large boats (100 seater). In all 38 jetties are proposed to be developed including 18 major jetties and 20 minor jetties. The major jetties shall also have commercial space development for renting to the extent of 1 acre. For the purpose of viability assessment, 2,500 sq m per major jetty assumed to be developed at each major jetty plus parking space for 30 cars and 100 two- wheelers. Considering the same, the jetty improvement cost has been estimated @ ₹ 1.25 crore for minor jetties and ₹ 4.0 crore for major jetties. In addition, cost of property development has been provided @ ₹ 10,000/sqm.

A provision of 2% of the estimated capex is provided towards project development, supervision, training, recruitment and other overheads and start-up costs during construction period.

Phasing of Expenditure:

In each phase the routes shall be taken up sequentially. Manufacturing time of one month for small boats and 2 month for large ones is assumed. Where required, orders can be placed on multiple vendors to meet the delivery schedule of the boats as given below:

Table 10-2: Delivery Schedule of the Boats

	2016	2017	2018	2019	Total
Large Boats- 100 pax	12	3	3	5	23
Small Boats – 50 pax	6	22	14	13	55
Total	18	25	17	18	78

40% advance payment and 60% payment on delivery has been assumed for boats. Cost of other infrastructure works are phased over the 12 month construction period with major jetties taking 3 months for mobilisation and 9 months construction time whereas for smaller jetties, total time of 9 months is assumed.

Based on the above and estimated bill of quantities, the total capital cost has been estimated in Table 10-3.

Table 10-3: Capital Cost Estimation (₹ Crore)

Component Description	Phase I	Phase II	Total
Jetty Infrastructure Cost	62.00	40.89	102.89
Provision for Boat Yard	10.00	5.00	15.00
Dredging of Waterways	10.00	15.00	25.00
Commercial Complex	30.63	16.81	47.44
Investment on Inland Navigation System & OCC	9.70	5.60	15.30
Total Civil Infrastructure Cost	122.33	83.30	205.63
Cost of Boats	109.59	86.22	195.81
Soft Costs			
Set up/start up/development costs	4.64	3.39	8.03
Contingency % on Sub Total	11.83	8.65	20.47
Interest During Construction	3.09	2.10	5.19
Total	251.47	183.66	435.12
Ancillary Infrastructure			
Development of Access roads/island roads/non-motorised transport	100.08	60.92	161.00
Development of Electric Feeders, Bicycle Sharing and Walkways with travelators	81.13	49.38	130.51
Setup/start up/development cost (2%) + Contingency (5%)	12.96	7.89	20.85
Sub-Total	194.17	118.19	312.36
Grand Total	445.64	301.85	747.48

Note: Land acquisition cost estimated at Rs. 72 crore in section 6.7 of Chapter 6, is not included as part of the project cost since majority of the land belongs to the Government/local bodies. A better estimate of the land acquisition cost can be arrived at after a detailed land survey.

The year wise phasing of expenditure, considered for calculating project is given in Table 10-4. However for the purpose of calculating the project IRR, only the cost of fleet and civil infrastructure has been considered since the ancillary infrastructure shall have multiple usage and are not dedicated to the waterway project. Further, cost of cost of land is not considered in IRR calculation since most of the land is revenue land belonging to the government of Kerala or local bodies.

Table 10-4: Phasing of Expenditure (₹ Crore)

Financial year Ending	2016	2017	2018	2019	Total
Total Civil Infrastructure Cost	72.70	49.63	56.41	26.89	**205.63**
Cost of Boats	54.00	55.59	40.06	46.16	**195.8**
Soft Costs	10.83	8.72	8.27	5.87	**33.69**
Ancillary Infrastructure	97.08	97.08	80.20	37.99	**312.16**
Sub Total	**257.65**	**233.37**	**203.42**	**125.70**	**747.28**

10.1.3 Revenue Assumptions

a. **Fare Revenue:** A detailed matrix is developed for each Origin-Destination pair. The minimum fare of ₹ 7 and maximum Fare of ₹ 42 has been assumed. A reduction in fare revenue to the extent of 5% has been considered to accommodate discount to the frequent users. Based on the same, the average revenue per passenger works out to ₹ 9.83 in the first year. An annual increase of 5% of fares has been considered. Two-wheelers are expected to fetch 3 times passenger fare although they consume 2 times space. For small and large boats, 3 and 5 nos. two-wheeler spaces has been considered respectively.

b. **Demand:** The demand for the water way services has been estimated and described in detail in Chapter 5.

c. **Advertisement/Vending Revenue:** Advertisement revenue on and inside the boats and vending revenue has been assumed @ ₹ 10,000/month/boat and at the major jetties @ Rs. 100,000 per month.

d. **Commercial Rentals:** At each of the major jetties, 2,500 sq m commercial space rental has been assumed @ ₹ 500/sq m with 90% occupancy in the first year. The rentals are assumed to increase @ 5% p.a. and occupancy @ 1% up to 98%. Part of the commercial development can be considered on outright sale basis based on suitability of site location during DPR stage.

e. **Parking Revenue:** 30 car parking and 100 two-wheeler parking has been considered at each of the major jetties with average revenue of Rs. 12 for cars and ₹ 8 from Two-wheelers has been assumed.

Table 10-5: Parking Revenue

Parking Facility	Spaces	Fees	Turnover/Day
Cars	30	12.0	3.5
2- wheelers	100	8.0	4
Total			

10.1.4 Cost Assumptions

a. **Fuel Consumption:** Diesel consumption is considered on the basis of number of hours of boat operation excluding stoppages at intermediate and terminal points. The fuel

consumption for small boats is assumed @ 13.3 litres/hour whereas that for the bigger ones is assumed @ 18.0 litres/hour with increase by 0.25% p.a. The cost of diesel is assumed to increase by 5% p.a.

b. **Boat Running Maintenance:** Assumed @ ₹ 6.67/hour for small boats and ₹ 10/hour for larger boats.

c. **Boat breakdown maintenance cost** is assumed as under

Table 10-6: Breakdown Maintenance Cost

Maintenance Cost (Yr1-3)	(%age of Boat Cost)
Years 1-3	1.50%
Years 4-9	2.50%
Years 9+	4.00%

d. **Depreciation** is assumed on straight-line basis based on expected life of 28 years.

e. **Insurance cost** if assumed @ 0.5% p.a. of the depreciated value towards third party liability only.

f. **Crew Size/Salary:** Each boat is assumed to be operated by one Pilot and one customer care executive, who will also be a trained pilot. 8 hours of effective crew operating hours per shift is assumed. The Operation Control Centre will one Controller in each shift. The salary costs (Pilot/Controller ₹ 15,000, Customer Care Executive ₹ 12,000) is assumed to increase @ 6% p.a.

g. **Jetty Staff:** Each jetty (major/minor) is assumed to have one Station Master (₹ 12,000 p.m.), one cleaning staff (₹ 9,000 p.m.) in each of 2 shifts and one security guard (₹ 10,000 p.m.) at all three shifts. Salary is assumed to increase @ 6% p.a.

h. **Spare Boats: 5**% of net fleet requirement

i. **Rent, Rates and Taxes** has been assumed @ 0.5% of revenue.

j. **Financing of Operating Capex:** Whereas the initial capex is assumed to be funded by ways of equity and long term soft loans serviced by the Government of Kerala, the acquisition of boats during the operations period is assumed to be funded by medium term loans of 10 year tenor (85%) and internal accruals (15%). The rate of interest for such loans is assumed @ 11%.

10.1.5 Capital Structure and Financing

The possible financing options for the project are summarised below:

Cost Item	Financing Option	Remarks
Boats	PPP, Lease/Mortgage Financing, Viability Gap Funding, Multilateral Funding Agencies (MFA), Gross Cost/Net Cost funding	Having high collateral value, lenders will be willing to finance higher proportion of the cost. If operating lease is possible, financing cost can be minimised by utilising depreciation tax shield.
Navigation system	Grant Funding/MFA	Since there may be multiple boat operators, the operations needs to be controlled and monitored by a central authority, licenses should be under ownership of the authority. Boat operators may be charged license fees on periodic basis to meet capex/opex
Boat Yard	PPP, Viability Gap Funding from Centre/State	Boats may be operated by multiple parties, but a common maintenance yard may be operated and maintained to reduce costs.
Jetty Infrastructure	PPP, MFA, Viability Gap Funding from Centre/State	Upgradation and upkeep and maintenance of the Jetty Infrastructure can be outsourced to private parties as part of composite contract to run the waterway services or by separate contract for each jetty supported by advertisements at jetties/maintenance fee
Commercial Complexes/Parking	Loan against pledge of land/assets, Outright sale/long term lease	This constitutes the largest revenue source of the waterways project and has potential to generate surplus after meeting capex and opex.
Dredging of Water ways	Grants from Gram Panchayats, State, ULB, MFAs (Loans to State)	Since its common for all boat operators, this needs to be facilitated by implementing agency.
Development of Island Roads and basic amenities	Grants from Gram Panchayats, State, ULB, MFAs (Loans to State)	Since this is essentially a non-revenue generating activity, it needs to be funded by the state/local governments
Electric Feeders, Bicycle Sharing and Walkways, Travelators.	PPP, Viability Gap Funding from Centre/State, Tax Concessions, Grants from Panchayats	Revenue generated can partly offset the capex/opex

Considering the low profitability of the project in the initial years, the following financing structure has been considered for preparing the profitability projections:

- Since ancillary infrastructure will benefit the population of the area in general and further no revenue from such infrastructure would accrue to the waterway system, these investments are not considered for computation of IRR.
- In order to encourage private sector participation in the project and reduce burden on the government, it is proposed that one third of the boats are acquired and owned by the private sector participants in the project and balance two-thirds of the boats and 100% of

the jetty and other infrastructure costs be funded by the Government SPV, under a suitable business model as decided by the project SPV. The funding to be provided by private sector is thus estimated at Rs. 65.47 crore.

- As per the funding norms of multilateral agencies, the debt component in the project can be up to 80% of the project cost. However, no part of such funds can be used to fund land acquisition costs and taxes. Thus a sum of Rs. 589.71 crore (77%) is proposed to be obtained as soft loans from multilaterals after accounting for land acquisition costs (Rs. 72 crore) and taxes (Rs. 102.3 crore) which need to be funded by the Government.
- Thu the means of financing for the entire project is proposed as under:

Table 10-7: Debt Equity Mix* (₹ Crore)

Source	Phase I	Phase II	Total
Debt Funds	347.74	231.97	579.71
Government of Kerala	61.37	40.94	102.30
Private Sector	36.53	28.94	65.47
Total	**445.64**	**301.85**	**747.48**

The interest on loan is computed @ 1.6% pa assuming that the project will be funded by multilateral/concessional terms. The above interest cost is on rupee basis and foreign exchange variation, if any, has not been considered. A loan tenor of 20 years including 5 years moratorium has been considered.

10.1.6 Projected Profitability

Based on the above assumptions, the income statement for the boat operations is estimated as under. This does not consider the investment or maintenance costs of any ancillary infrastructure. The estimated profitability is given below:

Table 10-8: Estimated Profitability – 2017-2026 (Rs. Crore)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Revenue										
Fare revenue	4.7	7.7	10.3	14.4	15.9	17.5	19.2	21.2	23.3	25.7
Two Wheeler Revenue	0.4	0.6	0.9	1.2	1.3	1.5	1.6	1.8	1.9	2.1
Parking Revenue	0.9	1.6	2.2	2.6	2.8	2.9	3.1	3.2	3.4	3.5
Rental Revenue	8.1	14.8	20.9	24.9	26.5	28.1	29.8	31.6	33.5	35.3
Boat Advertisement	0.2	0.5	0.7	1.0	1.0	1.1	1.2	1.3	1.3	1.5
Advt Revenue at Landings	0.7	1.3	1.8	2.2	2.3	2.4	2.5	2.6	2.7	2.9
Total Revenue	15.0	26.6	36.8	46.3	49.7	53.4	57.3	61.6	66.2	71.1
Operating Costs										
Fuel Cost	3.2	7.4	10.1	16.2	17.3	19.0	21.1	22.8	24.6	29.2
Crew Salary	0.7	1.7	2.2	3.6	3.8	4.2	4.6	5.0	5.4	6.4
Jetty Staff Salary	0.5	0.9	1.3	1.5	1.6	1.6	1.7	1.8	1.9	2.0
Running Maintenance	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Boat Breakdown Maintenance	0.7	1.4	2.0	3.3	4.0	4.6	5.5	5.8	6.2	8.0
Management Cost	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5
Maintenance of Jetty etc.	-	0.1	0.3	0.4	0.5	0.6	0.6	0.6	0.7	0.7
Operating Costs	5.3	11.7	16.3	25.5	27.7	30.6	34.1	36.6	39.4	47.0
Operating Profit	9.8	14.8	20.5	20.8	22.0	22.8	23.3	25.0	26.8	24.1
Overheads										
Insurance	0.2	0.5	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Rent, rates and Taxes	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4
Maintenance of Other Infrastructure	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Depreciation/Write off	4.6	8.3	11.8	14.4	14.4	14.5	14.8	14.9	14.9	15.4
Interest	-	-	-	0.2	0.7	1.0	1.1	1.8	2.4	2.7
Total Overheads	5.1	9.2	12.9	15.9	16.4	16.9	17.3	18.0	18.8	19.6
Net Profit/Loss	4.7	5.7	7.7	4.9	5.6	5.9	6.0	7.0	8.0	4.5
Add: Depreciation	5	8	12	14	14	15	15	15	15	15
Less: Capex					(4)	(7)	(2)	(2)	(13)	(4)
Less: Net Debt	-	-	-	-	3	5	1	1	10	1
Net Cash Accrual	9.23	14.00	19.47	19.53	19.94	19.43	19.70	21.24	20.61	17.57

Table 10-9: Estimated Profitability – 2027-2035 (Rs. Crore)

Year	2027	2028	2029	2030	2031	2032	2033	2034	2035
Revenue									
Fare revenue	28.3	31.1	34.3	37.7	41.6	45.8	50.4	55.5	61.1
Two Wheeler Revenue	2.4	2.6	2.9	3.1	3.5	3.8	4.2	4.6	5.1
Parking Revenue	3.7	3.9	4.1	4.3	4.5	4.7	5.0	5.2	5.5
Rental Revenue	37.1	39.0	40.9	42.9	45.1	47.4	49.7	52.2	54.8
Boat Advertisement	1.6	1.7	1.9	2.0	2.2	2.4	2.6	2.9	3.1
Advt Revenue at Landings	3.0	3.2	3.3	3.5	3.7	3.9	4.1	4.3	4.5
Total Revenue	76.1	81.5	87.3	93.7	100.5	107.9	115.9	124.6	134.0
Operating Costs									
Fuel Cost	31.0	33.8	36.7	41.2	44.4	49.8	53.6	61.9	67.1
Crew Salary	6.7	7.4	8.0	8.9	9.6	10.7	11.5	13.4	14.4
Jetty Staff Salary	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3.1
Running Maintenance	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5
Boat Breakdown Maintenance	9.6	11.1	13.0	14.0	15.1	16.5	17.8	19.5	21.5
Management Cost	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7
Maintenance of Jetty etc.	0.7	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.1
Operating Costs	50.8	56.0	61.7	68.3	73.6	81.6	87.8	99.9	108.3
Operating Profit	25.2	25.5	25.6	25.4	26.9	26.3	28.0	24.7	25.7
Overheads									
Insurance	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9
Rent, rates and Taxes	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7
Maintenance of Other Infrastructure	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5
Depreciation/Write off	15.5	15.8	16.0	16.6	16.8	17.2	17.4	18.3	18.7
Interest	3.1	3.9	4.5	4.9	5.2	6.2	7.4	7.7	7.6
Total Overheads	20.1	21.2	22.1	23.1	23.7	25.2	26.6	28.0	28.3
Net Profit/Loss	5.1	4.4	3.5	2.3	3.2	1.2	1.5	(3.3)	(2.6)
Add: Depreciation	16	16	16	17	17	17	17	18	19
Less: Capex	(6)	(8)	(14)	(6)	(10)	(7)	(24)	(11)	(12)
Less: Net Debt	3	4	9	1	5	2	16	3	4
Net Cash Accrual	17.92	17.24	15.14	14.44	14.81	13.76	11.75	7.50	7.57

As can be seen from above, the project is expected to be not only operationally self-sustainable, but will also be able to meet the requirements of capital expenditure during the operations phase and generate net cash accruals that can partly fund the repayments of soft loan taken by Govt. of Kerala.

10.1.7 Cash flow Statement

The cash flow statement for the first 10 years of operation is given below

Table 10-10: Cash Flow Statement for Years 2016-2025 (₹ Crore)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
EBITDA		9.23	14.00	19.47	19.53	20.68	21.45	21.92	23.63	25.40
Capex	(216.6)	(192.5)	(171.6)	(101.3)	-	(3.8)	(6.8)	(2.0)	(2.0)	(13.4)
Additional Loan	184.12	163.62	145.85	86.12		3.23	5.77	1.68	1.71	11.37
Equity	32.5	28.9	25.7	15.2						
Interest		-	-	-	-	(0.2)	(0.7)	(1.0)	(1.1)	(1.8)
Loan Repaid	-	-	-	-	-	-	(0.3)	(0.9)	(0.9)	(1.0)
Surplus trans-ferred to GoK					(40.6)	(20.6)	(20.0)	(19.5)	(19.7)	(21.2)
Net Cash flow		9.2	14.0	19.5	(21.0)	(0.6)	(0.5)	0.2	1.5	(0.6)
Opening Balance		-	9.2	23.2	42.7	21.7	21.0	20.5	20.7	22.3
Closing Balance		9.2	23.2	42.7	21.7	21.0	20.5	20.7	22.3	21.7

Table 10-11: Cash Flow Statement for Years 2026-2035 (₹ Crore)

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
EBITDA	22.6	23.73	23.99	24.06	23.73	25.23	24.55	26.21	22.73	23.63
Capex	(3.7)	(6.4)	(7.6)	(14.5)	(6.2)	(10.4)	(7.1)	(24.1)	(11.1)	(11.9)
Additional Loan	3.12	5.46	6.50	12.30	5.31	8.86	6.03	20.49	9.40	10.13
Equity										
Interest	(2.4)	(2.7)	(3.1)	(3.9)	(4.5)	(4.9)	(5.2)	(6.2)	(7.4)	(7.7)
Loan Repaid	(2.1)	(2.2)	(2.5)	(2.9)	(3.8)	(4.0)	(4.5)	(4.6)	(6.2)	(6.5)
Surplus trans-ferred to GoK	(20.6)	(17.7)	(17.9)	(17.3)	(15.2)	(14.5)	(14.8)	(13.8)	(11.9)	(7.7)
Net Cash flow	(3.1)	0.2	(0.7)	(2.1)	(0.8)	0.3	(1.0)	(2.1)	(4.4)	(0.1)
Opening Balance	21.7	18.7	18.9	18.2	16.0	15.2	15.6	14.5	12.5	8.1
Closing Balance	18.7	18.9	18.2	16.0	15.2	15.6	14.5	12.5	8.1	8.0

10.1.8 Financial Viability of the Project

The Kochi water transportation project has considerable potential to become a self-sustainable ecosystem while integration of all modes of transport within Kochi city is implemented along with adequate improvements in the areas pertaining to accessibility and last mile connectivity on islands, complemented with property developments at each boat jetty, and recasting them to economic centres of each island. While considering all the above characteristics along with projected ridership assessments and operation and maintenance costs, the Project IRR (pre-tax) for the water transport project per se is estimated at 1.4%. Further, without considering the civil infrastructure and ancillary costs, the pre-tax Project IRR for the capex for boats and their operation and maintenance works out to 10.4%. Hence, the project is expected to be operationally self-sustainable.

10.1.9 Sensitivity Analysis

Sensitivity analysis is carried out on the financial IRR by varying important factors like traffic, fuel costs, rental revenue, salary costs etc. as shown in Table 10-12. Schedules of the scenarios of sensitivity analysis are given in Annexure IX.

Table 10-12: Sensitivity Analysis

Scenario	Financial IRR
Base Case	1.4%
Reduction in Fare/Traffic by 10%	-1.2%
Increase in Diesel Cost/Consumption by 10%	-1.1%
Reduction in rentals by 10%	0.4%
Increase in Salary Costs by 10%	0.8%
Reduction in annual increase in fare from 5% to 4.5%	-2.7%
Waiver of State taxes (Diesel @ 20%, Capex – 12.5%)	6.4%

We observe that the FIRR is most sensitive to reduction in the fares escalation rate. This is however relative to the increase in the prices of other inputs. If the input costs also increase at a lower rate, then the fares can be increased at a lower rate. The FIRR can be increased if the state waives of the additional revenue it will receive from the project i.e. VAT/GST on diesel and other inputs, boats and other capex.

10.2 Economic Analysis

The purpose of this section is to explore the economic feasibility of the Kochi water transportation project. In order to do that we will focus on

1. The economic benefits from the project
2. The Economic costs of the project
3. The balance of these expressed in present value terms or in terms of Economic IRR

The differences between the financial analysis of the project and the economic analysis of the project are as follows:

10.2.1 Reduction in Travel Costs

Due to the peculiar locational features of Kochi and its surrounding areas, water transport is often the best mode of travel as it does not much infrastructure. However, in the absence of any reliable services, residents are primarily using other modes like bus, 2 wheeler, auto-rickshaw and to a lesser extent cars and taxis. Many people are also forced to rely on inefficient transportation modes like walking or cycling due to absence of any alternative mode of transport. Due to introduction of the Kochi Inland Water Transportation Project, the residents are not only like to save on the total cost

paid for travelling from one place to another but also save an enormous amount of time. The project will also facilitate more frequent travels resulting in higher economic benefits. For the purpose of this analysis, the following additional economic benefits of travel by the waterway have been considered:

10.2.2 Saving in Travelling/VOC costs

For people travelling by bus at present who are expected to switch to the Waterway, the difference in existing fare for JnNURM buses and the proposed fare of the waterway has been considered. For other users the total cost of travel by those modes e.g. cars, auto-rickshaws etc. has been considered on a per kilometre basis and dividend by the average occupancy. The details of such computation for the base year are given in **Table 10-13**.

Table 10-13: Savings in Travel (VOC Costs)

	Car	Taxi	Shared Taxi	2 Wheeler	Auto Rickshaw	Bus
%age of Target Population Travelling By	2.35%	0.11%	0.11%	12.46%	3.11%	81.86%
Cost/Km (₹)	6.84	10.26	3.42	2.97	7.20	
Average Occupancy	1.5	2	3	1.25	1.5	
Total Travel Cost (₹ Crore)	2.01	0.10	0.02	5.56	2.80	13.86
Travel Cost by Boat (₹ Crore)	0.38	0.02	0.02	1.99	0.50	13.09
VOC Savings (₹ Crore)	**1.64**	**0.09**	**0.01**	**3.56**	**2.31**	**0.77**

10.2.3 Saving in Travel Time

The commuters also benefit by savings in travel/commuting time. Besides, the commuters will also save on walking/waiting time for availing these alternative modes of transport. The same has been estimated based on the average income levels with respect to commuters using different commuting modes.

Table 10-14: Savings in Travel Time

	Car	Taxi	Shared Taxi	Two-Wheeler	Auto Rickshaw	Bus	Total
Avg. Speed (Kmph)	25	22.5	22.5	25	22.5	20.4	
Total Travel Time Travelled by Road (Hours/year)	176506	9080	9080	936464	259675	7536685	
Walking time from/to taxi/auto/bus stand as compared to Jetties (min)	0	5	15	0	15	20	
Extra Walking time (Hours/Year)	0	79	11	0	1256	418	
Travel Time by Boat (Hours/Year)	184,727	8,552	8,552	980,077	244,592	6,436,354	
Difference (Hours/Year)	-8,220	606	538	-43,614	16,339	1,100,750	
Income/Month (Rs/month)	22,500	17,500	12,500	17,500	17,500	12,500	
Cost/hour (Rs/hour)	128	99	71	99	99	71	
Time Savings (Rs Crore)	**-0.11**	**0.01**	**0.00**	**-0.43**	**0.16**	**7.82**	**7.45**

10.2.4 Benefits to non-users

Due to reduction in traffic on roads, the road users who do not avail the water ways will also benefit due to less congestion, reduction in travel time and fuel costs as well as less pollution. However, these benefits have not been quantified in this report as assessing such benefits will require detailed modelling of the traffic projections and road conditions.

10.2.5 Effect of Taxes/Subsidies

10.2.6 Capital Costs :

The capex of the project, namely the costs of boats and infrastructure facilities are subject to Excise Duty (Boats @ 6%) and VAT/Sales Tax/Service Tax (Boats @ 5%, Works @ 12.5%) as well as income tax on profit margin (30% on 10% = 3%) besides other levies like octroi/entry tax, labour cess etc. Collectively, a reduction in economic costs to the extent of 20% has been assumed.

10.2.7 Operating Costs

Operating costs are mainly impacted by VAT (24%) and Excise Duty (₹ 9.96/litre) on the fuel. A reduction in fuel cost by 39% is considered for the same.

10.2.8 Economic Internal Rate of Return (EIRR)

Based on the above, the economic analysis of the project is estimated below in Table 10-5.

Table 10-15: Indicators of Economic Viability

	Including Ancillary Costs	Direct Costs Only
Present Value of Capital Costs **(₹ Crore)**	489.36	293.21
Present Value of Economic Benefits **(₹ Crore)**	601.22	603.47
Economic IRR	15.2%	26.1%
Benefit: Cost Ratio	1.23	2.06

10.2.9 Sensitivity Analysis

Table 10-16: Sensitivity Analysis for EIRR

Scenario	Economic IRR
Base Case	26.1%
Reduction in Fare/Traffic by 10%	25.4%
Increase in Diesel Cost/Consumption by 10%	25.7%
Reduction in rentals by 10%	25.2%
Reduction in annual increase in fare from 5% to 4.5%	25.2%

10.3 Financial Support Required from Government of Kerala /Local Bodies

Currently some boat operations are being managed by private operators using old and unsafe boats. Hence a part of the Kochi Inland Water Ways Project can be allocated to the private operators although adhering to the technical and operating specifications proposed in this DPR. It is proposed that 1/3rd of the total number of boats shall be procured and operated by the private concessionaire(s). The capital cost of the boats shall be borne by the concessionaire and it shall be entitled to the share of the fare, commercial, advertisement, parking revenues and operating expenses in the proportion of the capex incurred. However, since the project has a low financial IRR< the private concessionaire would need to be provided some capital or operating grants or inducement in any other form to undertake the project.

Most of the land proposed to be utilised for the project belong to the state or the panchayats. The Panchayats shall be required to transfer requisite lands for the project free of cost and/or contribute to development of Ancillary infrastructure. To that extent the contribution of Government of Kerala will stand reduced.

As mentioned above, 1/3rd of the boat costs shall be provided by the concessionaire. As such the requirement form the government to fund the equity of the project and meet the shortfalls in the debt service shall be lower than the scenario where the Government is responsible for the entire

project. Based on the above the fund requirements for the Government of Kerala is worked out below:

Table 10-17: Capital Support Required From Government of Kerala (GoK) (Rs. Crore)

		Debt Service			₹ crore
Year	Equity	Interest	Loan Repayment	Less receipt from Project	Net Outflow for GoK
2016	32.49		*	-	32.49
2017	28.87	2.95	*	-2.95	28.87
2018	25.74	5.56	*	-5.56	25.74
2019	15.20	7.90	*	-7.90	15.20
2020		9.28	*	-24.16	-14.88
2021		9.28	34.50	-20.58	23.20
2022		8.72	35.05	-19.97	23.81
2023		8.16	35.61	-19.46	24.32
2024		7.59	36.18	-19.69	24.08
2025		7.01	36.76	-21.16	22.61
2026		6.43	37.35	-20.64	23.14
2027		5.83	37.95	-17.73	26.05
2028		5.22	38.56	-17.91	25.87
2029		4.60	39.17	-17.28	26.50
2030		3.98	39.80	-15.24	28.54
2031		3.34	40.44	-14.48	29.29
2032		2.69	41.08	-14.80	28.98
2033		2.04	41.74	-13.81	29.97
2034		1.37	42.41	-11.86	31.92
2035		0.69	43.09	-7.72	36.06
Total	**102.30**	**102.63**	**579.71**	**-292.91**	**491.74**

* Moratorium period

The above projections do not assume any variation in exchange rates. It can be seen that the project is not only operationally self-sustainable, but it is expected to support the repayment of the loans taken by the Government of Kerala to the extent of 50%.

11Implementation Framework

This chapter discusses the recommended framework for implementation of Integrated Waterways Project for Kochi in an efficient manner. The roles and responsibilities of KMRL and concessionaire/ developer for executing the project during design, construction and operation are also discussed in this chapter.

11.1 Project Implementation Framework

As discussed above, it is recommended that the project shall be financed/funded by international funding agencies such as KfW recognising the impact the project would have on the livelihood of the people as well as the project's impact on energy consumption and reduced emissions by promoting integrated public transport. Some of the ancillary infrastructure may also be funded by the state government under various ongoing schemes or by the urban local bodies.

However, for the purpose of implementation, i.e. civil works as well as operations; it is recommended that Kochi Metro Rail Limited is appointed as the Nodal Agency for implementation through a vertical focussed on Water Transport Operations, namely, "Metro Aqua". The vertical may be headed by a General Manager (Metro Aqua) under the guidance of the Director (Systems). The organisation structure for the Metro Aqua vertical is given in **Figure 11-1**.

11.2 Recommended Steering Committee for Water Transport

It is recommended that a Steering Committee be formed with the existing departments and authorities having role in the functioning of the waterways system in Kochi. Managing Director, KMRL shall function as the Convener. The Committee shall advice and guide Kochi Metro Rail Limited on the operations and functioning of the Water Transport System as a part of the Integrated Public Transport System in Kochi. It shall coordinate with the Metropolitan Transport

Authority - Kochi (MTA-KOCHI) to ensure integration as envisioned above. The composition of the Steering committee is given in Figure 11-2.

Figure 11-1: Proposed Water Transport "Metro Aqua" vertical of KMRL

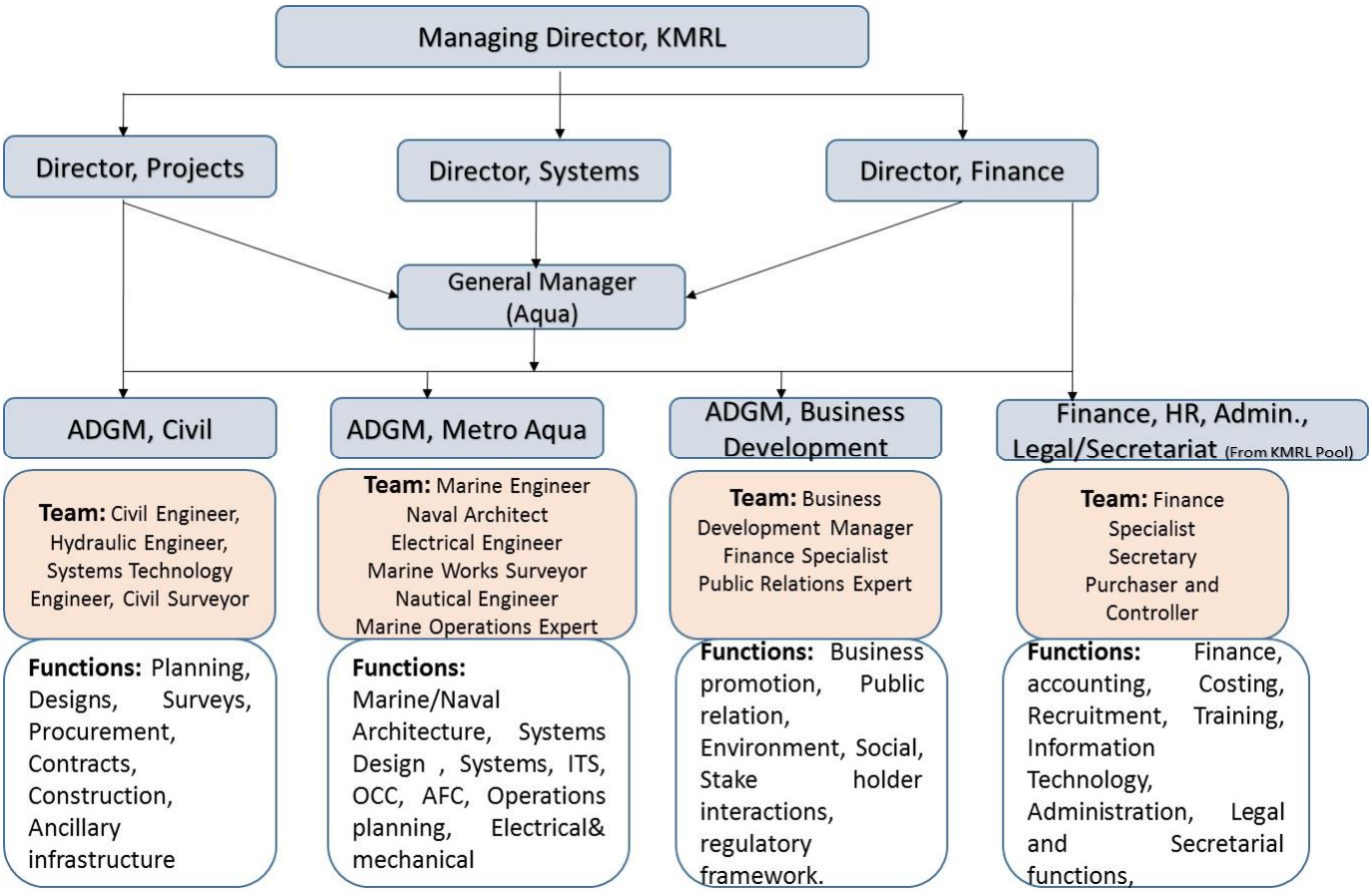
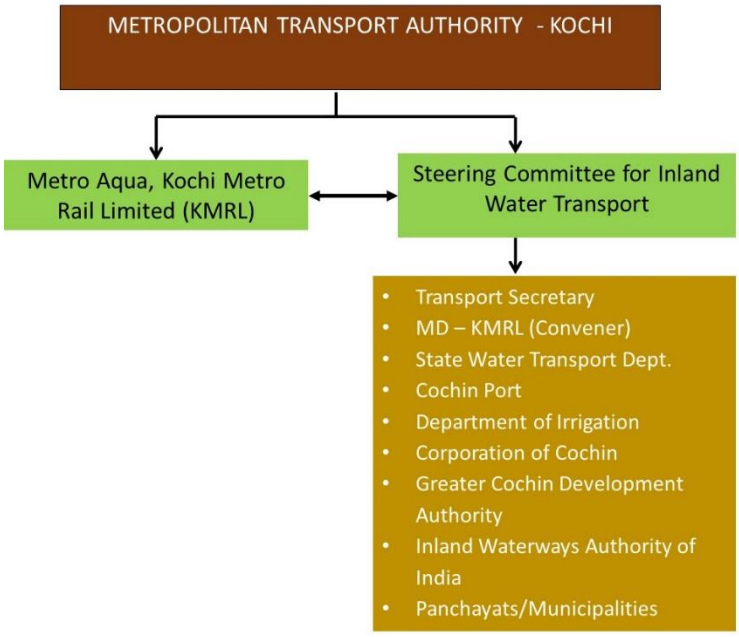


Figure 11-2-Composition of Steering Committee



11.3 Roles and Responsibilities of Kochi Metro Rail Limited (KMRL)

To oversee the construction, operation and maintenance of the infrastructure and operations of boats on the proposed routes and the related infrastructure, it is recommended that Kochi Metro Rail Limited is appointed as the Nodal Agency for implementation through a vertical focussed on Water Transport Operations, namely, “Metro Aqua”. The vertical may be headed by a General Manager (Metro Aqua) under the guidance of the Director (Systems). The organisation structure for the Metro Aqua vertical is given in Figure 11-1.

Metro Aqua, KMRL shall also ensure to

- Monitor the operation of the system against Service level performance standards
- Monitor the operation of boat as per agreed Service level performance standards

11.4 Implementation Plan and Schedule

The physical work of providing dedicated water transit corridor along with the upgradation and modernisation of the jetties along with integrated development of the area around the jetties is proposed to be completed in two phases enable operationalisation of the 16 routes as proposed. Pre-qualification and tendering process for identification of various boat

manufacturers under the design and build process shall also be included in the proposed implementation period.

The implementation schedule is presented in Table 11-1. The schedule indicates major activities required to be taken up for completion and commencement of proposed water transportation system operations for public use.

Table 11-1: Implementation Schedule

| Sl.No | Activities | Number of Months | | |

12Stakeholder Consultations

Stakeholder Consultations and Focus Group Discussions were conducted at various stages of the project preparation. The briefs of the discussions are discussed below.

12.1 Stakeholders Discussions during site visits

Site visits were conducted as part of the study in December 2014 and January and February 2015 to understand the existing physical infrastructure conditions and experiences the existing service frequencies and condition on the functional routes. Along with the site visits focussed group discussions were also conducted with the Gram Panchayats and Urban Local bodies and the commuters from the area to understand their perception of the existing water transport service quality, in terms of infrastructure, reliability, safety, accessibility, breakdowns and accidents. The agenda was to take in the user's views and expectations and the issues faced on a daily basis so that the same can be considered and strategies to overcome those challenges incorporated in the best way possible in the project.

Figure 12-1: Snapshots from Focus Group Discussion



Figure 12-2: Snapshots from Site Visits



12.2 Stakeholders Discussions at KMRL Office

12.2.1 Stakeholders Discussions dated 23 January 2015 – Project Kick Off

To kick off the project, Kochi Metro Rail Limited organised a stakeholders meeting on 23 January 2015 with the representatives of the urban local bodies, Cochin Corporation and Department of Tourism, Cochin. The meeting was well attended by all representatives of the islands in the project area. Extensive discussions on need for water transport, the project objectives, the potential routes providing connectivity to the islands and the expectations and opinions of the stakeholders were collected. Some of the major concerns were as follows:

- Encourage commuters back to water based transport system
- Enabling the island population to access the mainland using a an efficient reliable and safe water transport system
- Shift from road based transport system to the traditional and more sustainable transport mode – boats
- Enhanced experience across user groups – children, women, old and disabled

Representatives from the following local bodies attended the stakeholders meeting:

i) Chairman Standing Committee for Town Planning Corporation, Cochin.
ii) Chairperson Public Work Standing Committee, Cochin Corporation
iii) Eloor Municipality
iv) Elamkunnapuzha G. Panchayat
v) Chairman Maradu Municipality
vi) President, Kumbalam Panchayat
vii) President, Mulavuka
viii) Mulavukad Member
ix) Kadamkudy President
x) Varapuzha Vice President
xi) Varapuzha President
xii) Varapuzha Chairman Kshemam
xiii) Convenor, Kadamkudy Panchayat Janakiya Vikasana Samiti

Figure 12-3: Snapshots from Stakeholders Meeting on 23 January 2015

12.2



olders Discussions dated 27 March 2015

With the KfW Team in presence, KMRL invited a much larger group of stakeholders for suggestions and feedback on the recommendations of the DPR. The following members attended the stakeholders' discussions chaired by Sh. Elias George, managing Director, Kochi Metro Rail Limited:

Department/Organisation	Representation

i)	Kochi Corporation	Mayor
ii)	KC-Chairman Standing Committee for Works	Sh. K.J. Sohan
iii)	Kerala State Inland Navigation Corporation (KSINC)	Managing Director
iv)	Kerala State Water Transport Department (KSWTD)	Managing Director
v)	Kerala Tourism Development Corporation (KTDC)	Managing Director
vi)	KURTC/KSRTC	Managing Director
vii)	Vytilla Mobility Hub Society	Managing Director
viii)	DTPC, Ernakulam	Secretary
ix)	Public Works Department (PWD)	Chief Engineer
x)	Major Irrigation Division, Ernakulam	Executive Engineer
xi)	Inland Waterways Authority of India (IWAI)	Chief Engineer, Ernakulam
xii)	Goshree Island Development Authority	Director
xiii)	Cochin Port Trust	
xiv)	Town and Country Planning Department	
xv)	Maradu Municipality	Chairman
xvi)	Thrikkakara Municipality	Chairman
xvii)	Chittethukara Panchayat	President
xviii)	Cheranallur Panchayat	President
xix)	Varapuzha Panchayat	President
xx)	Kadamakudy Panchayat	President
xxi)	Kumbhalam Panchayat	President
xxii)	Mulavukadu Panchayat	President
xxiii)	Elamkunnapuzha Panchayat	President
xxiv)	Njarakkal Panchayat	President
xxv)	World Bank Representatives	
xxvi)	Inland Waterways Authority of India	Director
xxvii)	KSINC	Representative
xxviii)	Kochi Metro Rail limited	
xxix)	Urban Mass Transit Company Limited (UMTC)	Mr. S. Ramakrishna, Ms. Swati Khanna

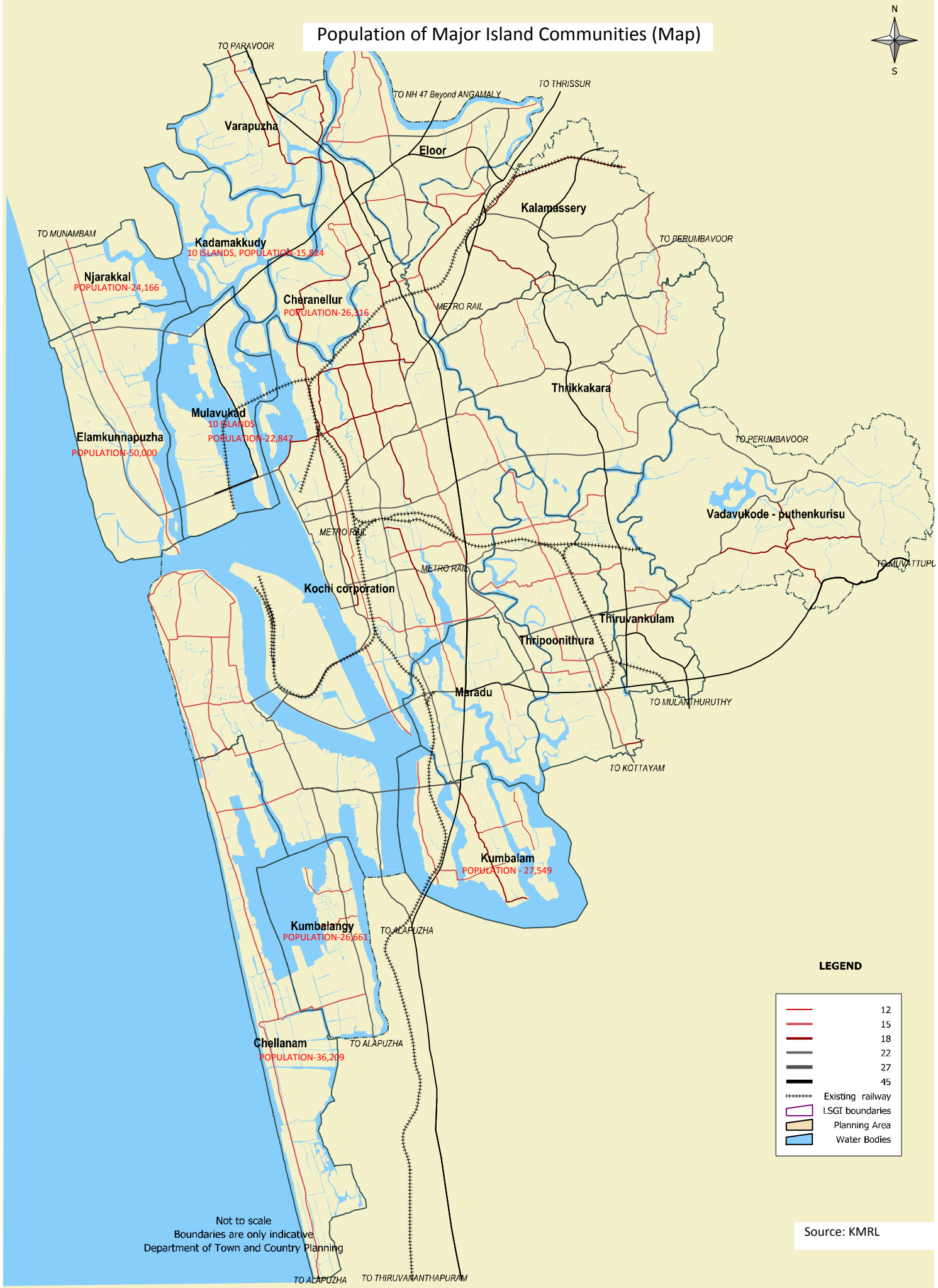
Figure 12-4: Snapshots from Stakeholders Meeting on 27 March 2015


VERITAS VOS LIBERABIT




KMRL
Kochi Metro Rail Ltd

Population of Major Island Communities (Map)



Source: KMRL

ANNEXURE

Annexure I: Existing Institutional Setup

1. The Inland Waterways Authority of India

The Inland Waterways Authority of India (IWAI) is the statutory agency in charge of the waterways in the country. It was constituted as per the Inland Waterways Authority of India Act of 1985. After the setting-up of this authority important stretches of waterways were accorded the status of national waterways, with an eye on providing much needed impetus to their development and thereby the water transportation sector. These are:

- NW-1: Ganga-Bhagirathi-Hooghly River System
- NW-2: River Brahmaputra
- NW-3: West-coast Canal along with Champakkara and Udyogmandal Canals
- NW-4: Kakinada-Puducherry Canal System integrated with Rivers Godavari and Krishna
- NW-5: East Coast Canal integrated with River Brahmani and Mahanadi delta rivers
- Proposed NW-6: Bhanga to Lakhipur in Assam.

A large portion of the waterways in KCR fall under the National Waterway-3 and therefore come under the purview of the IWAI. Much of IWAI's work in Kerala relates to maintaining the required minimum draft of 2m in the channels that are part of NW-3. IWAI also facilitates cargo movement on the water channels from Alappuzha to Cochin Port at Willingdon Island. The authority has acquired and maintained dredge-boats specifically for the purpose of maintenance of the water channels. However, the port channel near the Cochin Shipyard and the Willingdon Island are not within its scope since they are administered directly by the Ministry of Shipping, Government of India. The IWAI has provided for twenty-four hour navigation through the channels by the provision of navigational aids such as buoys, clearly marking the navigable stretches for safe operation of vessels. Besides IWAI also publishes navigational charts and river atlas's to help the vessel operators. The NW-3 is faced with the problem lack of linkage in the Alappuzha-Kollam sector and is therefore limited from Kottapuram to Alappuzha due to connectivity issues. The land acquisition process between Alappuzha and Kayankulam for completion of the NW-3 is stuck due to the non-cooperation from the local populace and their representatives. Once the process of acquisition and

dredging to the minimum requirement of 2m is completed, cashew and coir from Kollam can also be transported to the major port of Kochi.

2. Greater Cochin Development Authority

Greater Cochin Development Authority (GCDA) was formed according to the provisions of the Madras Town Planning Act, 1920 and Travancore Town Planning Act, 1932 to plan for Cochin. Its mandate was to oversee and guide the development of Cochin and its surrounding areas. GCDA has its jurisdiction spread from areas under the Municipal Corporation of Cochin, surrounding municipalities of Tripunithura, Thrikkakkara, Aluva, Kalamassery, Maradu, Eloor, North Paravur, Angamaly and Perumbavoor and twenty-five intervening panchayats. The total area under GCDA adds up to 632 square kilometres. The GCDA had through its Structural Plan for Cochin, 2001 proposed the integration of the waterways into the comprehensive transportation network of the city. It had also proposed the establishing of boat jetties at several prominent locations to facilitate the same. Other proposals included improvement of junctions, creation of grade separated foot paths and cycle lanes, allocation of parking space, two central bus stations (one for KSRTC and another for all the private buses to be located close to each other), city service stations, transit stations at interchanges road, rail and water ways wherever they are integrated, truck terminals and proposals for improvement of inland water ways and renovation of canal system. However, in the event of the implementation of the 73rd and 74th amendments of the constitution aimed at decentralization and empowerment of the planning functions of the urban local bodies, many of the powers of the GCDA, which were not well-defined in the first place have been taken away from the authority and given to the Corporation. It is another matter that these local bodies have no manpower or skill-base to undertake large-scale activities such as preparation of development plans and are therefore dependent on external agencies which are hired as consultants. As a result, a body which could have positively taken up more initiative in the field of water transportation is taken out of the picture altogether. The present debate on the role of GCDA in the larger context of planning of KCR is unclear and the authority has been relegated to an agency that prepares vision documents and tries to stay afloat by collecting rents on its properties and implementing small projects such as canal bridges and maintenance of its properties. It would be in the best interests of the city that the authority be strengthened through legislation and upgraded to the role of a Metropolitan Planning Committee (MPC).

3. Goshree Islands Development Authority

The Goshree Islands Development Authority was carved out of the GCDA in 1994 for the planning of Goshree islands including Vypeen, Vallarpadom, Mulavukadu-Bolghaty, Thannonithuruthu and several other small islands. The major achievement of this authority has been the commissioning of the Goshree bridges that provided much needed road connectivity from the mainland to the Goshree islands. It has also implemented small projects towards the beautification of the bay areas of Vypeen with the provision of paved walkways. There are plans to develop a coastal ring road in the Vypeen island. The authority also has plans to start a ferry service connecting these islands. However, these plans are still at a nascent stage.

4. Kerala State Water Transport Department

The Kerala State Water Transport Department operates passenger boats from jetties in Ernakulam to Vypeen, Fort Kochi, Mulavukadu, Willingdon Island and Mattancherry. Around fifty-nine services are operated daily from the Ernakulam jetty. Most of the boats being operated are steel boats manufactured from a private boat building company in Kannur. A few services are also operated using old wooden boats. The steel boats have a seating capacity of one hundred only. According to the KSWTD staff, more than one and half times the number jostle for space on the boat during peak hours. Each boat requires at least five staff for operations. This team of five is made up of one srank at the steering wheel, one man at the gearbox and three more to help the boat land at the jetty and allow the passengers to get on and off the boat. The average monthly collection from the operation of the boat services has been around a steady 8 lakh rupees for the past five years according to the KSWTD regional office functioning at the Ernakulam boat jetty. However, the operational costs have gone up due to increase in fuel costs and administrative costs. As a result the department has been incurring losses and continues to operate as a government service for the people with state subsidies to the tune of crores per year. The department has not yet been able to monetise the advantages of owning a prime piece of land in the heart of Ernakulam's CBD where its regional office is located. The Superintendent of the department, Mr. Joseph Xavier indicated that several proposals had been sent to the government for construction of a multi-modal hub and shopping complex in order to help bridge the losses incurred by the department towards operating the loss-making boat services.

5. Kerala Shipping and Inland Navigation Corporation

The Kerala Shipping and Inland Navigation Corporation (KSINC) was formed by merging Kerala Inland Navigation Corporation (KINCO) and Kerala Shipping Corporation (KSC) in 1974. Their objectives are:

- To establish, maintain and operate shipping services and to purchase, charter, hire, build ships, tankers and other vessels.
- To establish, maintain and operate transportation services for the transport of goods and passengers in inland water in the state of Kerala or elsewhere.
- To run, organise, conduct and manage in the state of Kerala or elsewhere workshops, repair shops, service stations for repair and maintenance of marine vessels.
- To establish, provide, maintain and conduct research and training institutions and lab centres.

Accordingly, they are involved in the transportation of bulk raw materials, petroleum products and water cargo through inland waters. They were also involved in the docking and repair of marine vessels besides construction of steel and wooden crafts. Till recently, KSINC also operated passenger ferry services in KCR and was a competitor to KSWTD operated boats. However, mounting losses prompted KSINC to withdraw from the sector and the fibre-boats were transferred on government orders to KSWTD which failed to use their services citing safety concerns. Currently, KSINC also operates cruise ferries for tourists and is in talks with Kerala Tourism Development Corporation (KTDC) to launch more packages. It is also associated with the Muziris heritage tourism project.

6. Cochin Port Trust

Since a major portion of the water sheet near the Ernakulam boat jetty falls under the purview of the Cochin Port, a major port under the aegis of the Ministry of Shipping, Government of India, clearances have to be obtained from the Cochin Port Trust (CPT) for operation of passenger or tourist boat services in this area. Apart from the registration of the boats with the motor vehicles department, boats have also to be listed with the CPT before operating in this stretch.

7. Department of Irrigation, Government of Kerala

The Department has the responsibility of maintenance of all the water channels that do not come under the purview of IWAI. De-silting and dredging of the channels and maintaining a steady minimum depth of 2m is the responsibility of the irrigation department. They play a major role in ensuring that all jetties are usable throughout the year. With the low tides, it

often becomes difficult for the boats to be brought near the jetty especially in places like Mattancherry, Thevara, Mulavukadu, Nettoor and Kumbalam. This is due to the steady deposition of silt at such locations. Dredging is required at least once in six months.

8. Municipal Corporation of Cochin

The Corporation of Cochin (CoC) has interests in operation of ferry services from Fort Kochi and Vypeen to Ernakulam as a significant area of these locations comes under its purview. In stretches such as Vypeen-Fort Kochi the CoC gives licenses to private operators to operate Jangar and boat services. With frequent requests coming from the public, the CoC also had plans to launch its own boat service on several sectors. However, owing to lack of funds and the fact that the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) does not provide for water transportation projects, such ideas were put on a backburner. The opportunity to participate in a future enterprise in this sector still stands for the Corporation.

9. Kerala State Road Transport Corporation

The Kerala State Road Transport Corporation began as the Travancore State Transport Department, constituted by the Travancore King with the intent of reorganizing the transportation services of the former state.

Following the enactment of the Road Transport Corporation Act in 1950, the Government of Kerala formulated KSRTC rules in 1965 by Section 44. The Transport Department was converted into an autonomous corporation on 1 April 1965 and the Kerala State Road Transport Corporation was formally established by the government of Kerala by the notification dated, 15 March 1965.

10. Kerala Urban Road Transport Corporation

In November 2014, Kerala Urban Road Transport Corporation (KURTC) was formed as a subsidiary of the Kerala State Road Transport Corporation to operate low-floor buses which are procured with the financial assistance from the Jawaharlal Nehru National Urban Renewal Mission (JNNURM).

11. Ernakulam District Administration

Includes the Revenue Administration, Police and the Local administration departments.

Annexure II: Survey Formats

Inland Water Transport - Kochi
Boarding and Alighting at IWT Terminals

Location :		Name of Enumerator :	
Direction :		Shift No :	
Sheet No :		Date :	

Time	Passengers In	Passengers Out	Left in Queue

Inland Water Transport - Kochi

Opinion Survey for IWT Passengers

Location :		Name of Enumerator :	
Direction :		Shift No :	
Sheet No :		Date :	

Personal Information

1	Gender	a. Male	b. Female								
2	Education Status	a. Upto 12th Standard	b. Graduate	c. Post Graduate	d. Professional	e. Illiterate					
3	Occupation	a. Govt Employee	b. Private Employee	c. Student	d. Business	e. Housewife	f. Retired	g.Unemployed	h. Others		
4	Monthly Household Income	a.<Rs 5,000	b. Rs 5000-10000	c. Rs 10000 - 15000	d. Rs 15000 -20000	e. Rs 20000-25000	f. >Rs 25000				
5	Monthly Expenditure on Transport	a. <=Rs 500	b. Rs 500 -750	c. Rs 750 - 1000	d. Rs 1000 - 1500	e. Rs 1500-2000	f. Rs 2000-2500	g. >Rs 2500			
6	Vehicle Ownership	a. Car	b. 2 Wheeler	c. Cycle	d. No Vehicle						

Trip Information

7	Trip Frequency	a. Daily	b. Weekly	c. Monthly	d. Occasionally						
8	Trip Purpose	a. Work	b. Business	c. Education	d. Social	e. Shopping	f. Others				
9	Initial Origin										
10	Initial Destination										

11	Access Trip Details	Origin	Destination	Access Mode	Access Trip Length (km)	Access Trip Time (Mins)	Access Trip Cost (Rs)				

12	Line Haul Trip Details	Origin	Destination	Access Trip Length (km)	Access Trip Time (Mins)	Access Trip Cost (Rs)					

13	Egress Trip Details	Origin	Destination	Egress Mode	Egress Trip Length (km)	Egress Trip Time (Mins)	Egress Trip Cost (Rs)				

14	Alternate Modes Used	a. Car	b. 2 Wheeler	c. Bus	d. Auto Rickshaw	e. Others					
15	Reasons for the Usage of Alternate Modes										
16	How much extra fare are you willing to pay (in relation to the existing ferry fare) for an improved ferry system?					a. Same Fare	b.Increase by 10%	d. Increase by 15%	d. Increase by 20%	e. Increase more than 25%	
17	Any Suggestion on the improvement for the Ferry Systems										

Inland Water Transport - Kochi

HOUSEHOLD INTERVIEW SURVEY

Location :		Name of Enumera	
Direction :		Shift No :	
Sheet No :		Date :	

PERSONAL INFORMATION

1. Name of the Household Head	
2. Address of the Household	
3.Telephone No:	
4. No. of Family Members	

5. Type of Vehicle Owned	Mode	Car	2 Wheelers	Cycle	Others (Please Specify)
	No.				

INDIVIDUAL FAMILY MEMBERS INFORMATION

S.No.	Member Name	Gender	Age	Education	Occupation	Monthly Income (in Rs)	Monthly Expenditure on Transport (in Rs)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

STATED PREFERENCE

1. Would you like to shift to a good Water Transport System?	Yes	No			
2. Will you shift to the proposed water transport system if, time saved in relation to your current mode of transport ?	1. 5 to 10 mins	2. 10 to 15 mins	3. 15 to 20 mins	4. 20 - 30 mins	5. >30 mins
3. How much extra fare you are Willing to Pay? (in relation to existing Bus Fare/Ferry Fare)	1. Same Fare	2.Increase by 10%	3. Increase by 15%	4. Increase by 20%	5. Increase more than
4. Will you shift to the proposed water transport system if, the waiting time is saved in relation to your current mode of transport ?	1. 1 to 2 mins	2. 2 to 5 mins	3. 5 to 7 mins	4. 7 to 10 mins	4. >10 mins

CODES

Gender	1. Male	2. Female						
Age	1. 0 to 10 yrs	2. 10 to 20 yrs	3. 20 to 30 yrs	4. 30 to 40 yrs	5. above 40 yrs			
Education	1. Upto 12th Standard	2. Graduate	3. Post Graduate	4. Professional	5. Illiterate			
Occupation	1. Govt Employee	2. Private Employee	3. Student	4. Business	5. Housewife	6. Retired	7. Unemployed	8. Others
Monthly Income	1.<Rs 5,000	2. Rs 5000-10000	3. Rs 10000 -	4. Rs 15000 -	5. Rs 20000-25000	6. >Rs 25000		
Monthly Expenditure on Transport	1. <=Rs 500	2. Rs 500 -750	3. Rs 750 - 1000	4. Rs 1000 - 1500	5. Rs 1500-2000	6. Rs 2000-2500	7. >Rs 2500	

TRIP INFORMATION																				
Sl. No.	Trip Purpose	Origin Location to Boarding point							Main Trip Details					Alighting Point to Final Destination				
		Origin	Destination	Mode	Trip Length (in kms)	Trip Time (in mins)	Trip Cost (in Rs)	Waiting Time (in Mins)	Mode	Trip Length (in kms)	Trip Time (in mins)	Trip Cost (in Rs)	Waiting Time (in Mins)	Mode	Trip Length (in kms)	Trip Time (in mins)	Trip Cost (in Rs)	Waiting Time (in Mins)
1																		
2																		
3																		
4																		
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Trip Purpose	1. Work	2. Business	3. Education	4. Social	5. Shopping	6. Others			
Mode of Travel	1. Car	2. Taxi	3. Shared Taxi	4. 2 Wheelers	5. Auto Rickshaw	6. Bus	7 Ferry	8. Cycle	9 Walk
Trip Length (in kms)	1. <=1	2. 1 to 2	3. 2 to 3	4. 3 to 5	5. 5 to 8	6. 8 to 10	7. >10		
Trip Time (in mins)	1. less than 5 mins	2. 5 to 10 mins	3. 10 to 15 mins	4. 15 to 20 mins	5. Greater than 20 mins				
Trip Cost (in Rs)	1. less than Rs 5	2. Rs 5 to Rs 10	3. Rs 10 to Rs 15	4. Rs 15 to Rs 20	5. Greater than Rs 20				
Waiting Time (in mins)	1. 1 to 2 mins	2. 2 to 5 mins	3. 5 to 10 mins	4. 10 to 15 mins	5. 15 to 20 mins	6. Greater than 20 mins			

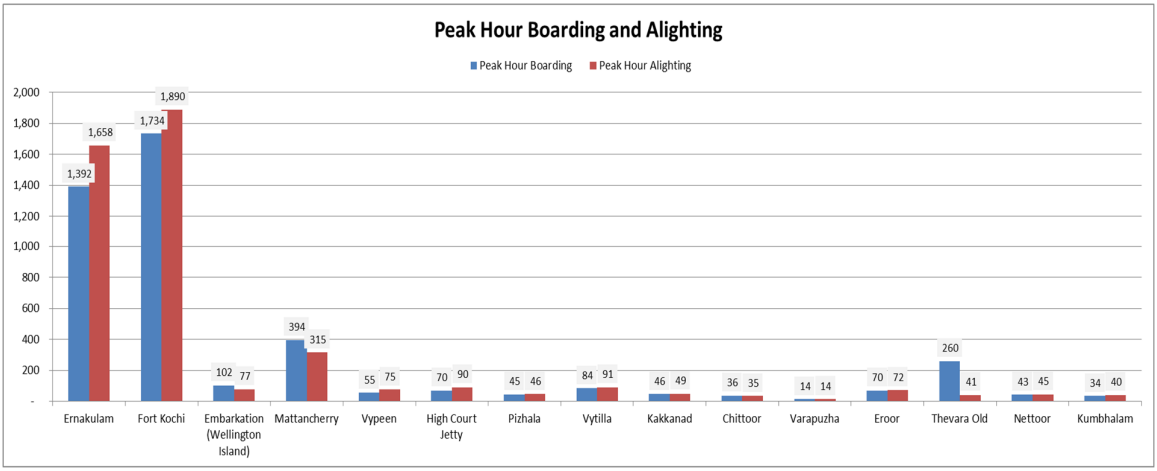
Annexure III: Primary Data Analysis

Boarding and Alighting Survey

The table below summarizes the boarding and alighting counts undertaken at the 15 jetty locations. The maximum loading was recorded at Ernakulam Jetty, followed by Fort Kochi; where as the minimum loading was recorded at Varapuzha. It was observed that the peak hour boarding and alighting constitute approximately 34% of the daily ridership.

Boarding and Alighting Counts at Jetties

Sl. No	Jetty Names	Daily Boardings	Daily Alightings	Total (B+A)	Peak Time	Peak Hour Boarding	Peak Hour Alighting	Peak Hour Total (B+A)
1	Ernakulam	4,095	4,876	8,971	1600 to 1700	1,392	1,658	3,050
2	Fort Kochi	4,229	4,610	8,839	1800 to 1900	1,734	1,890	3,624
3	Embarkation (Wellington Island)	528	665	1,193	1700 to 1800	102	77	179
4	Mattancherry	692	553	1,245	1800 to 1900	394	315	710
5	Vypeen	205	277	482	1700 to 1800	55	75	130
6	High Court Jetty	278	358	637	1700 to 1800	70	90	159
7	Pizhala	263	271	533	1600 to 1700	45	46	91
8	Vytilla	161	174	335	1700 to 1800	84	91	174
9	Kakkanad	142	150	292	1800 to 1700	46	49	95
10	Chittoor	163	158	320	1800 to 1900	36	35	70
11	Varapuzha	28	29	56	1600 to 1700	14	14	28
12	Eroor	225	232	457	0900 to 1000	70	72	142
13	Thevara Old	1,237	1,028	2,265	1700 to 1800	260	41	301
14	Nettoor	201	209	410	0800 to 0900	43	45	89
15	Kumbhalam	188	222	410	1900 to 2000	34	40	75
Total		12,634	13,811	26,445		4,379	4,538	8,918



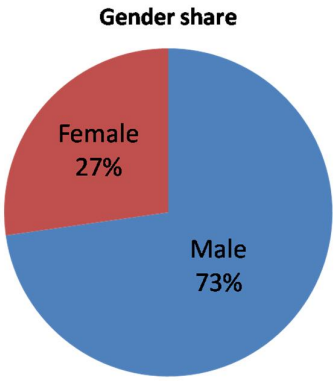
Origin and Destination Survey: Ferry Passenger Characteristics

Distribution of Trips by Gender

72.76% of the sample size of the ferry users was males while females constituted 27.24%. Table represents the distribution of ferry passenger trips by gender characteristics

Table: Distribution of Trips by Gender Characteristics

Sl. No.	Gender	No. of Samples	Percentage
1	Male	203	72.76%
2	Female	76	27.24%
Total		**279**	**100%**

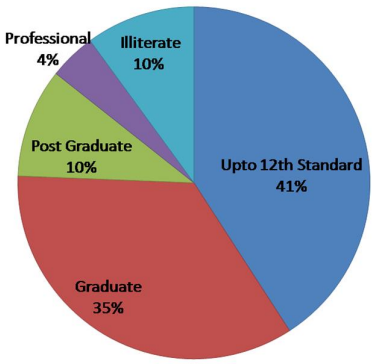


Distribution of Trips by Educational Characteristics

The Figure and Table represent the distribution of ferry passengers by their educational characteristics. It is observed that 41% of the individuals have completed schooling upto 12th, followed by graduates at 35%.

Table: Distribution of Trips by Educational Characteristics

Sl. No.	Education Status	No. of Samples	Percentage
1	Upto 12th Standard	114	40.86%
2	Graduate	97	34.77%
3	Post Graduate	28	10.04%
4	Professional	12	4.30%
5	Illiterate	28	10.04%
Total		279	**100.00%**

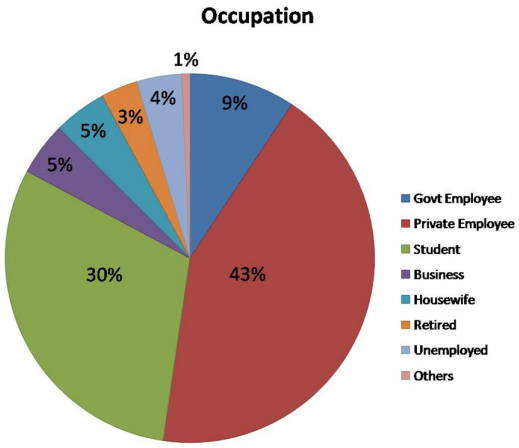


Distribution of Trips by Occupational Characteristics

Table and Figure represent the distribution of ferry passengers by their occupational characteristics. It is observed that 43% of the individuals are employed with private organisations, followed by students with 30% and Government Employees with 9%. Remaining 18% of the sampled individuals constitute of businessmen, housewives, retired, unemployed and others.

Table: Distribution of the Trips by Occupational Characteristics

Sl. No.	Occupation	Percentage
1	Govt Employee	9.32%
2	Private Employee	43.01%
3	Student	30.47%
4	Business	4.66%
5	Housewife	4.66%
6	Retired	3.23%
7	Unemployed	3.94%
8	Others	0.72%
Total		**100.00%**

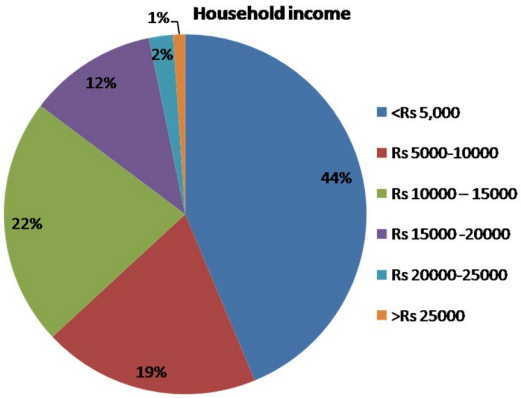


Distribution of Trips by Monthly Household Income

Distribution of trips of the ferry passengers by monthly household income is represented in the Table and Figure. It is observed that about 44% of the individuals travelling by ferry have a monthly income less than Rs 5,000 followed by individuals having a monthly income between Rs 10000 to 15000 with 22%. The Average Monthly Household income of the ferry passengers was seen to be between Rs 10,000 and Rs 15,000.

Table: Distribution of Trips by Monthly Household Income

Sl. No.	Monthly Household Income	Percentage
1	<Rs 5,000	43.73%
2	Rs 5000-10000	19.35%
3	Rs 10000 - 15000	22.22%
4	Rs 15000 -20000	11.47%
5	Rs 20000-25000	2.15%
6	>Rs 25000	1.08%
Total		**100%**

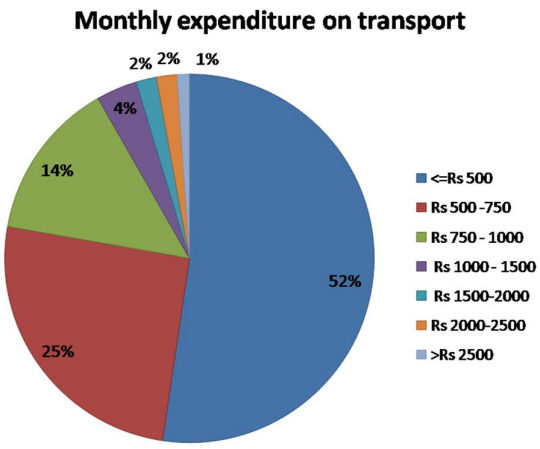


Distribution of Trips by Monthly Household Expenditure on Transport

The ferry passengers' monthly household expenditure on transport is represented in the Table and Figure below. It is seen that about 52% of the individuals travelling by ferry spend less than or equal to Rs 500/- per month on transport, followed by 25% who spend between Rs 500/- and 750/-. The Average Monthly Household expenditure on transport by ferry passengers is between Rs 500/- and Rs 750/-.

Table: Distribution of Trips by Monthly Household Expenditure on Transport

Sl. No.	Monthly Expenditure on Transport	Percentage
1	<=Rs 500	52.33%
2	Rs 500 -750	25.45%
3	Rs 750 - 1000	13.98%
4	Rs 1000 - 1500	3.58%
5	Rs 1500-2000	1.79%
6	Rs 2000-2500	1.79%
7	>Rs 2500	1.08%
Total		**100%**



Distribution of Trips by Vehicle Ownership Status

Distribution of Trips by ferry passengers based on the vehicular ownership is represented in the Table and Figure below. It is observed that 41% of the Ferry Passengers do not own a vehicle, closely followed by 39%, who own a 2-wheeler. It could also be seen that about 55% of ferry passengers have one vehicle and a mere 4% have more than 1 vehicle.

Table: Distribution of Trips by Vehicular Ownership Status

Sl. No.	Vehicle Ownership	Percentage
1	Car	10.04%
2	2 Wheeler	38.71%
3	Cycle	15.05%
4	No Vehicle	40.86%

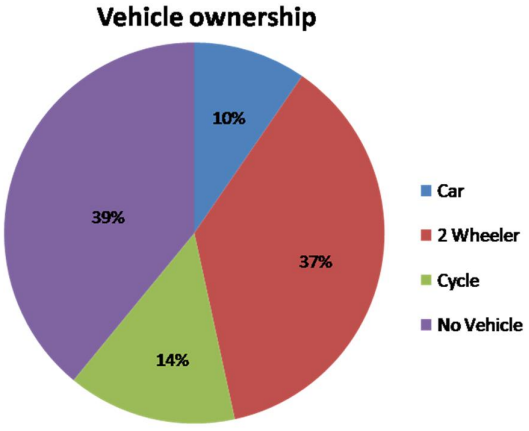
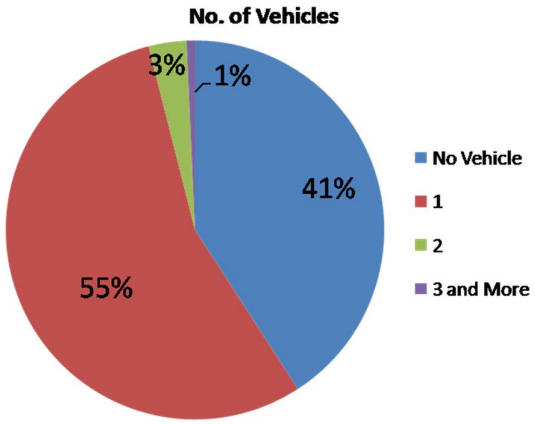


Table: Distribution of Trips by the No. of Vehicles Owned

Sl. No.	No. of Vehicles Owned	Percentage

1	No Vehicle	40.86%
2	1	55.20%
3	2	3.23%
4	3 and More	0.72%
Total		**100.00%**

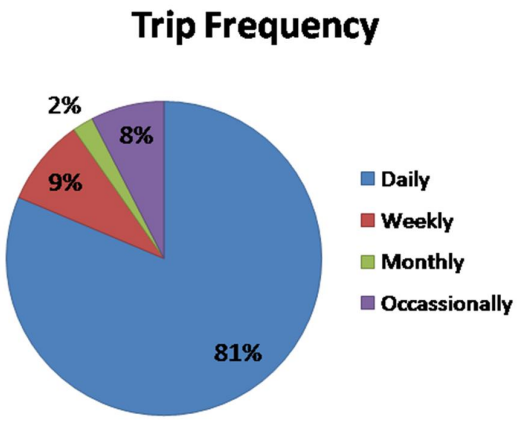


Distribution of Trips by Trip Frequency

It could be observed from the Table and Figure below that the 81% of the ferry passengers perform their trips on a daily basis followed by 9% on a weekly basis, 8% occasionally and 2% on a monthly basis.

Table: Distribution of Trips by Trip Frequency

Sl. No.	Trip Frequency	Percentage
1	Daily	81.36%
2	Weekly	8.96%
3	Monthly	2.15%
4	Occasionally	7.53%
Total		**100.00%**

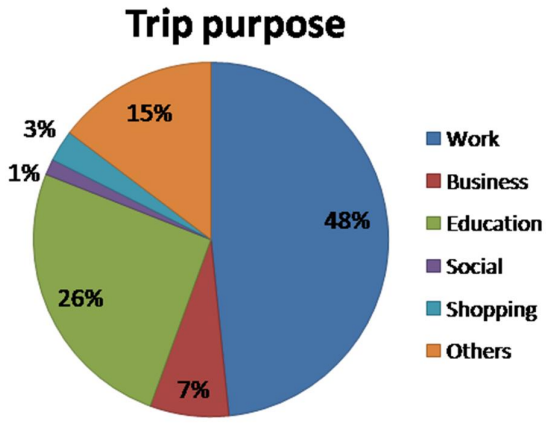


Distribution of Trips by Trip Purpose

Figure and Table below represent the purpose wise distribution of trips of the ferry passengers. It is seen from the table that about 55.56% constitutes work and business related trips taken together, whereas 25.45% trips are educational and about 19% for other trips which include social, shopping and other purposes.

Table: Distribution of Trips by Trip Purpose

Sl. No.	Trip Purpose	Percentage
1	Work	48.39%
2	Business	7.17%
3	Education	25.45%
4	Social	1.43%
5	Shopping	2.87%
6	Others	14.70%
Total		**100.00%**

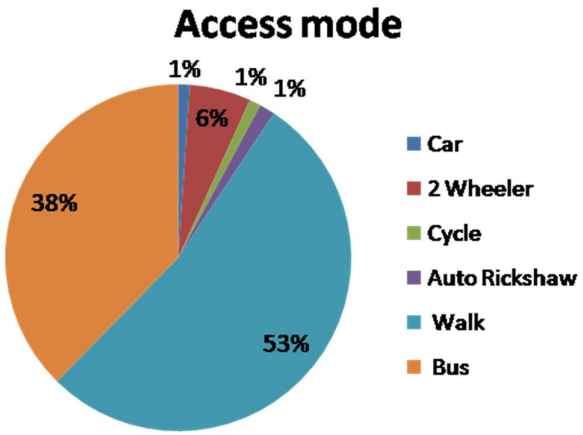


Distribution of Trips by Access Mode

From the Table and Figure it can be observed that 53.05% of the access trips to the jetties are by walk, followed by Bus with about 38% and remaining 9.% of the trips are performed by Car, 2 Wheelers, Cycles and Auto Rickshaw put together.

Table: Distribution of Trips by Access Mode

Sl. No	Access Mode	Percentage
1	Car	1.08%
2	2 Wheeler	5.73%
3	Cycle	1.08%
4	Auto Rickshaw	1.43%
5	Walk	53.05%
6	Bus	37.63%
Total		100%



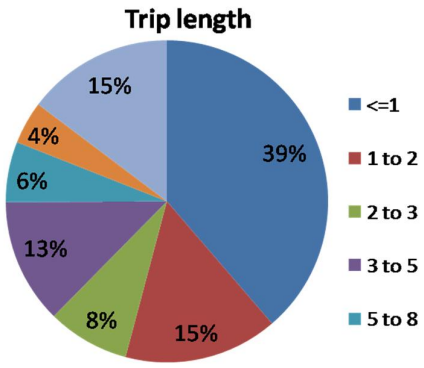
Distribution of Trips by Access Trip Length

From the Figure and Table it is seen that 39% of the access trips are less than or equal to 1km, followed by 15.41% of the trips falling between the range of 1 to 2 km, 12.54% of the trips are in the range of 3 to 5 km. Access trips ranging to greater than 10 km account for 14.70%. The average access trip length of ferry passengers is 4 km.

Table: Distribution of Trips by Access Trip Length

Sl.No.	Access Trip Length (Km)	Percentage (%)
1	<=1	38.71
2	1 to 2	15.41
3	2 to 3	8.24
4	3 to 5	12.54
5	5 to 8	6.09
6	8 to 10	4.30
7	>10	14.70
Total		**100%**

Distribution of Trips by Access Trip Time

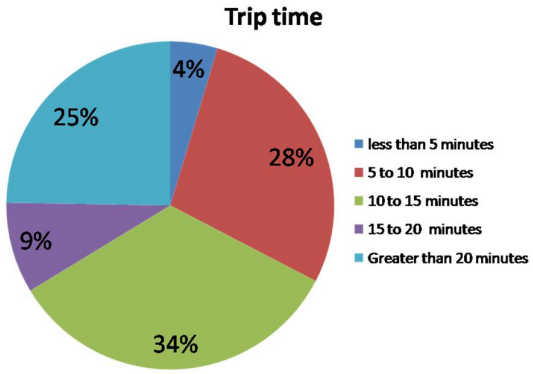


From the Table and Figure it was observed that the access trip time of the ferry passengers is between 10 to 15 minutes for about 34% of the trips, followed by 27.96% of the access trips ranging between 5 to 10 minutes, 24.73% of the trips have a access trip time of greater than 20 minutes. The average trip time for access trips of ferry passengers is 17.5 minutes.

Table: Distribution of Trips by Access Trip Time

Sl. No	Access Trip Time (minutes)	Percentage (%)
1	less than 5 minutes	4.66
2	5 to 10 minutes	27.96
3	10 to 15 minutes	33.69

4	15 to 20 minutes	8.96
5	Greater than 20 minutes	24.73
Total		**100.00**

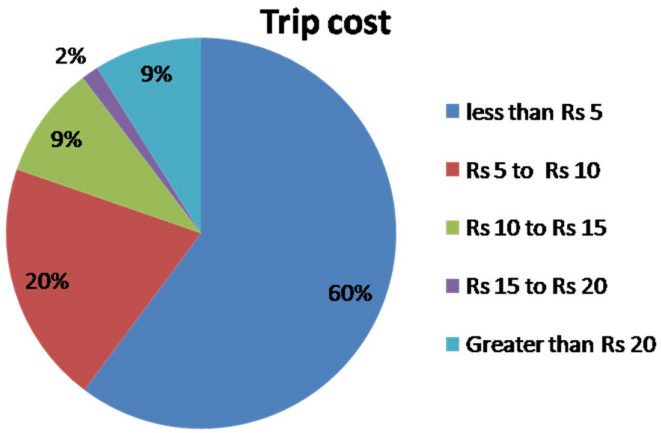


Distribution of Trips by Access Trip Cost

From the Figure and Table it could be observed that the access trip cost for the ferry passengers is less than Rs 5/- for 60.22% of the trips, followed by 20.07% of the access trips which cost between Rs 5/- to Rs 10/-. The average cost of the access trips for ferry passengers is Rs 7.5/-

Table: Distribution of Trips by Access Trip Cost

Sl. No	Access Trip Cost (Rs)	Percentage (%)
1	less than Rs 5	60.22
2	Rs 5 to Rs 10	20.07
3	Rs 10 to Rs 15	9.32
4	Rs 15 to Rs 20	1.43
5	Greater than Rs 20	8.96
Total		**100.00**

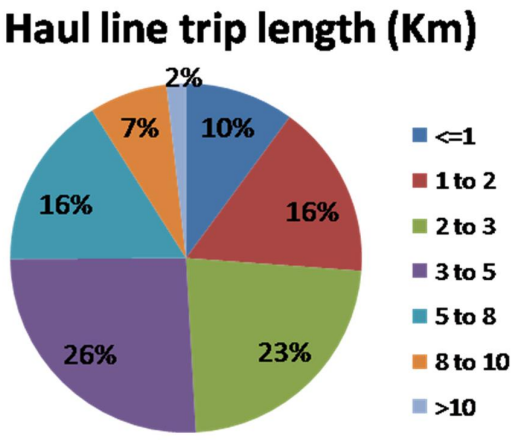


Distribution of Trips by Line Haul Trip Length (km)

From the Table and Figure it could be observed that the line haul trip length of the ferry passengers is between 3 to 5 km for 25.81% of the trips, followed by 22.94% of the trips with line haul length between 2 to 3 km, 16.13% of the trips between 1 to 2 km and rest 16.13% ranging from 5 to 8 km. The average length for line haul trips of ferry passengers is observed to be 4 km.

Table: Distribution of Trips by Line Haul Trip Length

Sl.No.	Line Haul Trip Length (Km)	Percentage (%)
1	<=1	10.04
2	1 to 2	16.13
3	2 to 3	22.94
4	3 to 5	25.81
5	5 to 8	16.13
6	8 to 10	7.17
7	>10	1.79
Total		100.00



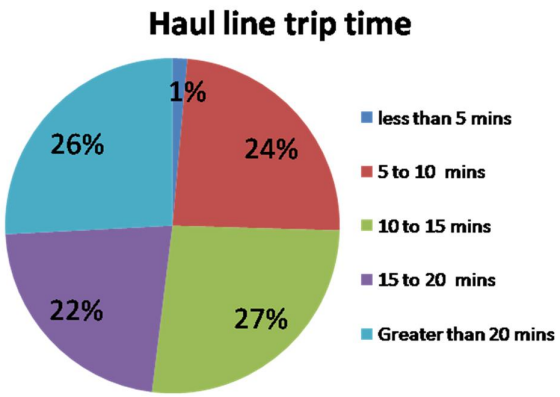
Distribution of Trips by Line Haul Trip Time (minutes)

From the Figure and Table below it is observed that the line haul trip time of the ferry passengers is majorly seen to be between 10 to 15 minutes which constituted around 26.52% of the trips, followed by 24.01% of the trips being between 5 to 10 minutes and 22.22% of the

trips between 15 to 20 minutes. The average trip time for line haul trips of ferry passengers is 25 minutes.

Table: Distribution of Trips by Line Haul Trip Time

Sl. No	Line Haul Trip Time (mins)	Percentage (%)
1	less than 5 mins	1.43
2	5 to 10 mins	24.01
3	10 to 15 mins	26.52
4	15 to 20 mins	22.22
5	Greater than 20 mins	25.81
Total		**100.00%**

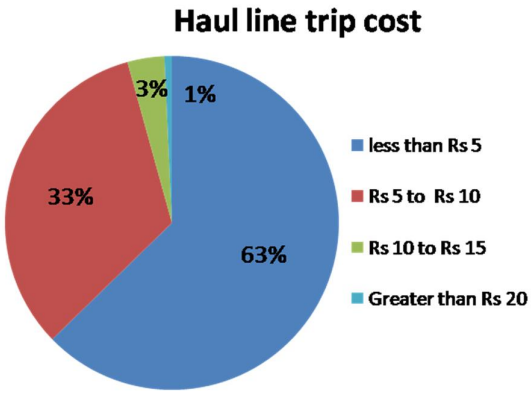


Distribution of Trips by Line Haul Trip Cost (Rs)

From Table and Figure shown below it could be observed that the line haul trip cost to the passengers is less than Rs 5/- for upto 63% of the trips, followed by 32.97% of trips between Rs 5/- to Rs 10/-. The average trip cost for line haul trips of ferry passengers is Rs 7.5/-.

Table: Distribution of Trips by Line Haul Trip Cost

Sl. No	Line Haul Trip Cost (Rs)	Percentage (%)
1	less than Rs 5	62.72
2	Rs 5 to Rs 10	32.97
3	Rs 10 to Rs 15	3.58
4	Rs 15 to Rs 20	0.00
5	Greater than Rs 20	0.72
Total		**100.00**

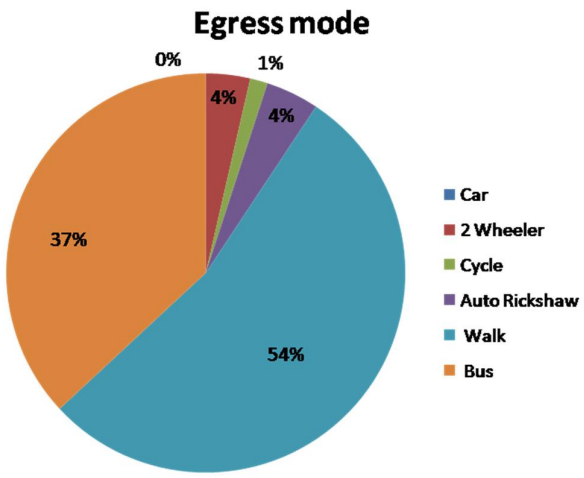


Distribution of Trips by Egress Mode

From the Figure and Table shown below it is observed that 53.76% of the trips performed by the ferry passengers is on foot, followed by Bus at 36.92% and remaining 9.18% of the trips are performed by Car, 2 Wheelers, Cycle and Auto Rickshaw together.

Table: Distribution of Trips by Egress Modes

Sl. No	Egress Mode	Percentage
1	Car	0.00%
2	2 Wheeler	3.58%
3	Cycle	1.43%
4	Auto Rickshaw	4.30%
5	Walk	53.76%
6	Bus	36.92%
Total		**100.00%**

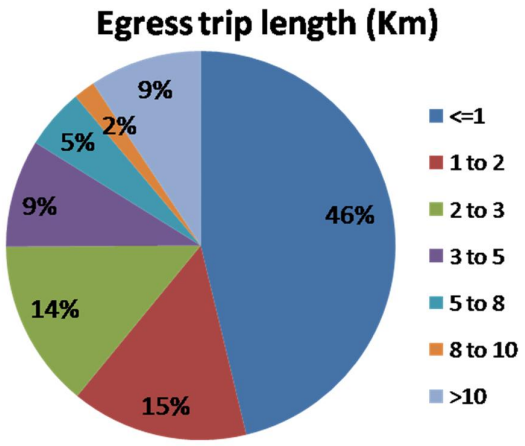


Distribution of Trips by Egress Trip Length

From Table and Figure it is realized that the egress trip length of the ferry passengers is less than or equal to 1 km in case of 46.24% of the total trips, followed by 14.70% of the trips ranging between 1 to 2 km, 13.98% of the trips between 2 to 3 km, 9.32% of the trips greater than 10 km and 8.96% of the trips between 3 to 5 km. The average trip length of egress for ferry passengers is 2.5 km.

Table: Distribution of Trips by Egress Trip Length

Sl.No.	Egress Trip Length (Km)	Percentage (%)
1	<=1	46.24
2	1 to 2	14.70
3	2 to 3	13.98
4	3 to 5	8.96
5	5 to 8	5.02
6	8 to 10	1.79
7	>10	9.32
Total		**100.00%**

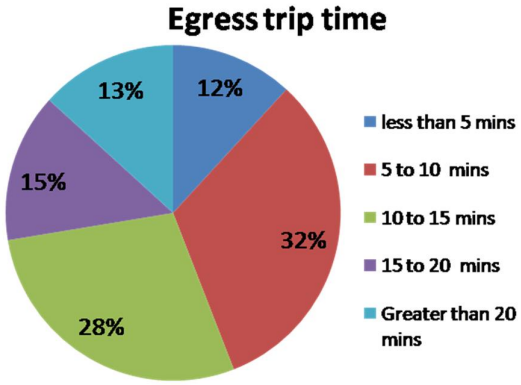


Distribution of Trips by Egress Trip Time

From the Table and Figure it could be observed that 32.26% of the trips had an egress time of 5 to 10 minutes, followed by 28.32% of the trips taking between 10 to 15 minutes, 14.34% of the trips were between 15 to 20 minutes and 13.26% of the trips greater than 20 minutes. The average time for access trips of a ferry passenger is 17.5 minutes.

Table: Distribution of Trips by Egress Trip Time

Sl. No	Egress Trip Time (mins)	Percentage (%)
1	less than 5 mins	11.83
2	5 to 10 mins	32.26
3	10 to 15 mins	28.32
4	15 to 20 mins	14.34
5	Greater than 20 mins	13.26
Total		**100.00**

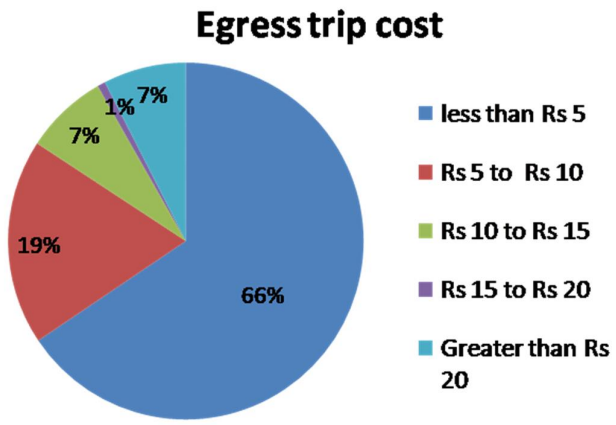


Distribution of Trips by Egress Trip Cost

From the Figure and Table it could be observed that the egress trip cost for ferry passengers is less than Rs 5/- for 65.59% of the trips, followed by 18.64% of the trips between costing between Rs 5/- to Rs 10/-. The average cost for access trips of ferry passengers is Rs 7.5/-.

Table: Distribution of Trips by Egress Trip Cost

Sl. No	Egress Trip Cost (Rs)	Percentage
1	less than Rs 5	65.59
2	Rs 5 to Rs 10	18.64
3	Rs 10 to Rs 15	7.53
4	Rs 15 to Rs 20	0.72
5	Greater than Rs 20	7.53
Total		**100.00**

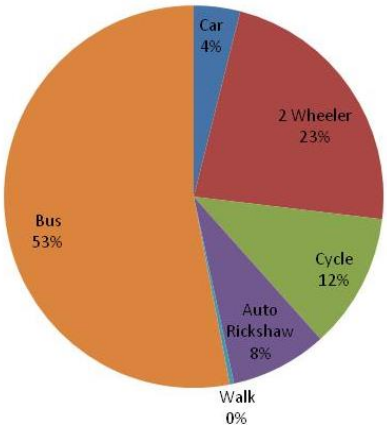


Distribution of Trips by the Alternate Modes Used

From the Table and Figure shown below, it could be observed that of all the alternate modes available, 53.05% of the ferry passengers take the bus, 22.94% use the 2 Wheelers and 11.47% take the cycle and the remaining 12.54% by Auto Rickshaw, Car and Cycle. It was observed that ferry passengers use alternate modes of transport due to the irregularity in operations of the ferry services and lack of connectivity to majority of the jetty locations except for some of which have easy access in case of emergencies and private use.

Table: Distribution of Trips by Alternate Modes Used

Sl. No	Alternate Modes	Percentage
1	Car	3.94%
2	2 Wheeler	22.94%
3	Cycle	11.47%
4	Auto Rickshaw	8.24%
5	Walk	0.36%
6	Bus	53.05%
Total		100.00

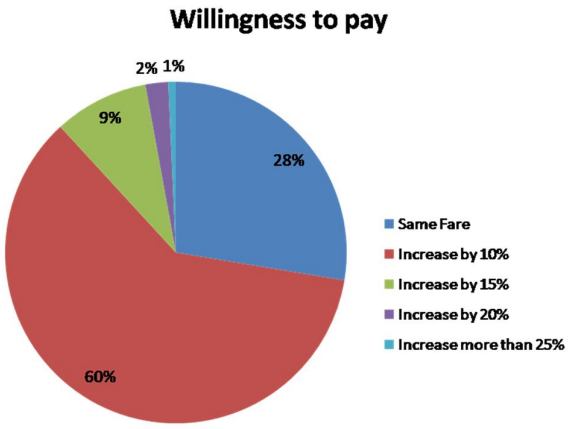


Willingness to Pay

From the Table and Figure it was observed that 60.57% of the ferry passengers are willing to pay up to a 10% increase in the current fares, followed by 27.60% who were not willing to accept any increase in the fare. But it was also inferred that even with better infrastructure provisions; passengers are not willing to pay higher fares.

Table: Distribution of Trips by Willingness to Pay

Sl. No	Willingness to Pay	Percentage
1	Same Fare	27.60%
2	Increase by 10%	60.57%
3	Increase by 15%	8.96%
4	Increase by 20%	2.15%
5	Increase more than 25%	0.72%
Total		100.00%

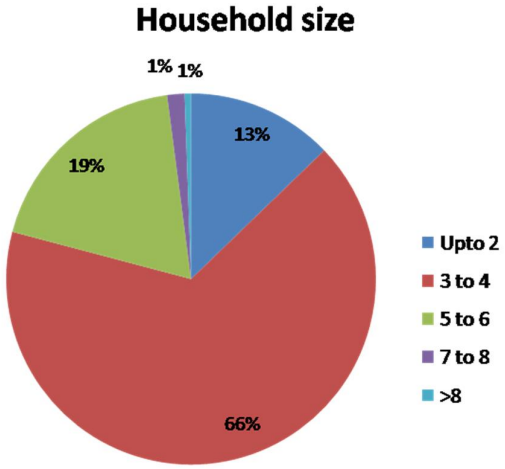


HOUSEHOLD SURVEY ANALYSIS

The Table and Figure represents the distribution of households according to the family size. The table indicates that 12% of the households have up to 2 members and about 19% of the samples belong to the category of households which have 5 to 6 members. Majority of the households (66.3%) have 3 to 4 members. The average household size is observed to 3.5.

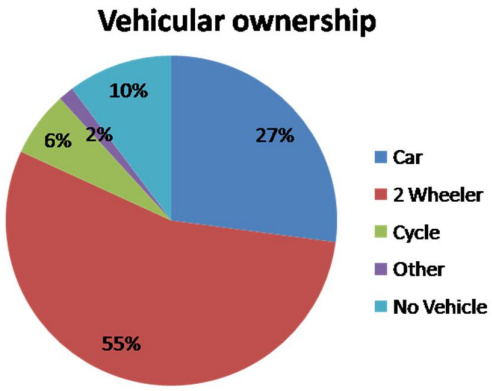
Table: Distribution of Household according to the Household Size

S. No.	Household by No. of Members	Percentage
1	Upto 2	12.8%
2	3 to 4	66.3%
3	5 to 6	18.8%
4	7 to 8	1.5%
5	>8	0.6%
Total		**100.0**



Distribution of Households by Vehicle Ownership

Distribution of households owning vehicles is represented in Tables and Figures**Error! Reference source not found.**, shows that about 54.8% of households have only 2 – wheeler.



The table indicates that about 68.2% of the household have one vehicle.

Table: Distribution of Trips by Vehicular Ownership Status

S. No.	Type of Vehicle	Percentage
1	Car	27.1%
2	2 Wheeler	54.8%
3	Cycle	6.4%
4	Other	1.5%
5	No Vehicle	10.3%
Total		100.0%

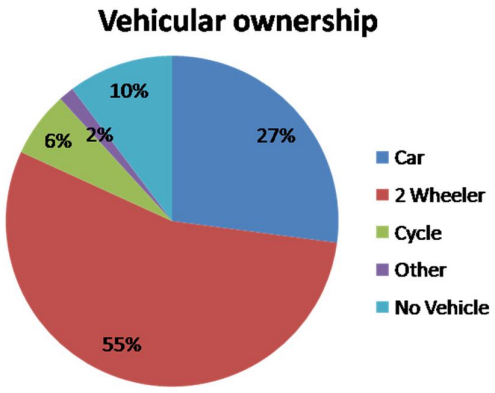
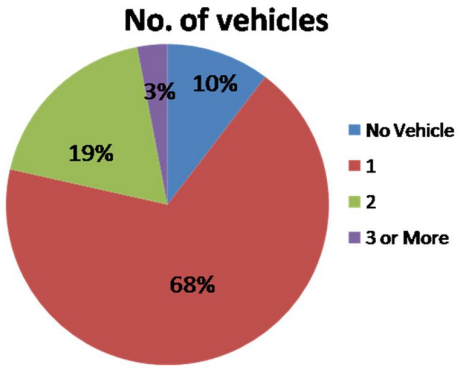


Table: Distribution of Trips by the No. of Vehicles Owned

S. No.	No. of Vehicles	Percentage
1	No Vehicle	10.4%
2	1	68.2%
3	2	18.5%
4	3 or More	3.0%
Total		100.0%

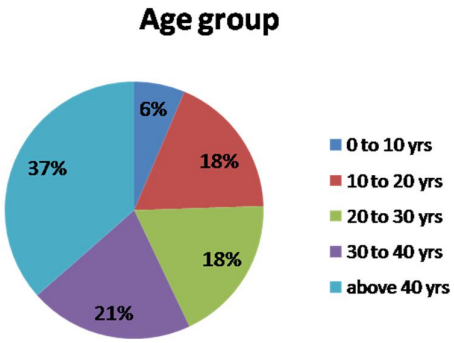


Distribution of Individuals by Age Groups

Distribution of Individuals by Age Groups is presented in the Table which shows that about 36.5% of the individuals are over the age of 40 yrs and 20.6% of the individuals are within the age group of 20 to 30 yrs.

Table: Distribution of Individuals by Age Groups

S. No.	Age Groups	Percentage
1	0 to 10 yrs	6.4%
2	10 to 20 yrs	18.1%
3	20 to 30 yrs	18.5%
4	30 to 40 yrs	20.6%
5	above 40 yrs	36.5%
Total		100.00%

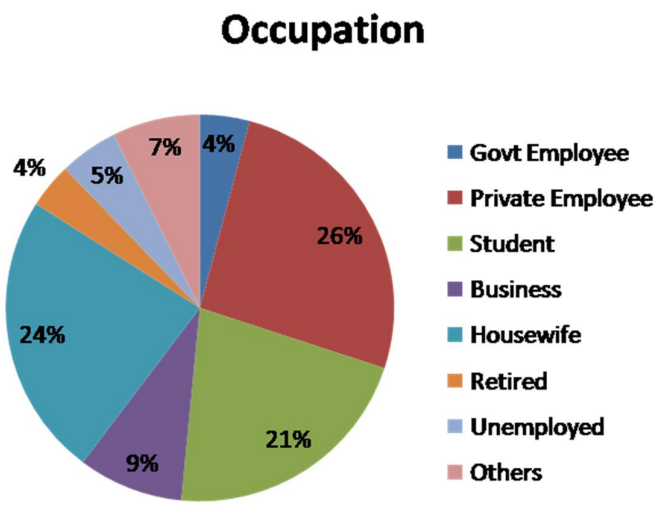


Distribution of Individual by Occupation

Distribution of Individuals on basis of their occupation is represented in the Table and Figure below, which shows that about 25.9% of the individuals are Private Employees, followed by Housewives (23.7%) and Students (21.5%).

Table: Distribution of Individuals by Occupation

S.No.	Occupation	Percentage
1	Govt Employee	4.1%
2	Private Employee	25.9%
3	Student	21.5%
4	Business	8.8%
5	Housewife	23.7%
6	Retired	3.8%
7	Unemployed	4.9%
8	Others	7.3%
Total		100.0%

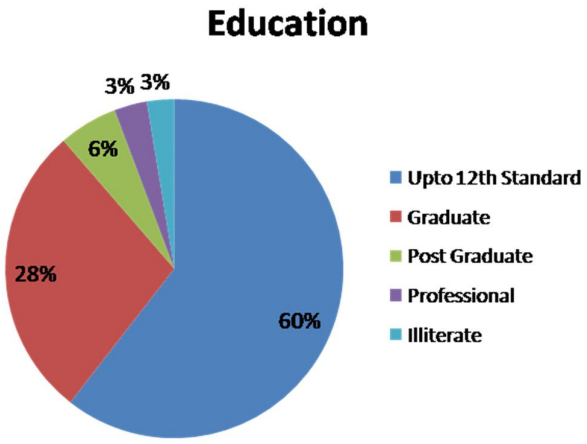


Distribution of Individual by Education

Distribution of Individuals based on their educational qualification is presented in Figure and Table below, which shows that about 60.5% of the individuals are educated upto 12th standard, followed by 28.1% who are graduates.

Table: Distribution of Individuals by Education

S.No.	Education	Percentage
1	Upto 12th Standard	60.5%
2	Graduate	28.1%
3	Post Graduate	5.6%
4	Professional	3.1%
5	Illiterate	2.6%
Total		100.0%

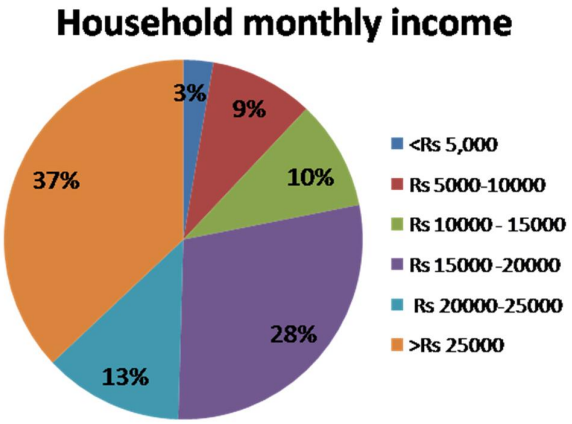


Distribution of Households by Monthly Income

Distribution of households according to their monthly income bandwidth is presented in Table and Figure as under. It is observed that nearly 21% of the households have a monthly income less than or equal to Rs 15,000/- and another 31% have income ranging between Rs 15001 to 25000 per month. The percentage of households having monthly income more than Rs 25,000 is observed to be 37.0%.

Table: Distribution of Households by Monthly Income

S.No.	Monthly Household Income	Percentage
1	<Rs 5,000	2.7%
2	Rs 5000-10000	9.3%
3	Rs 10000 - 15000	9.9%
4	Rs 15000 -20000	28.5%
5	Rs 20000-25000	12.6%
6	>Rs 25000	37.0%
Total		100.0%

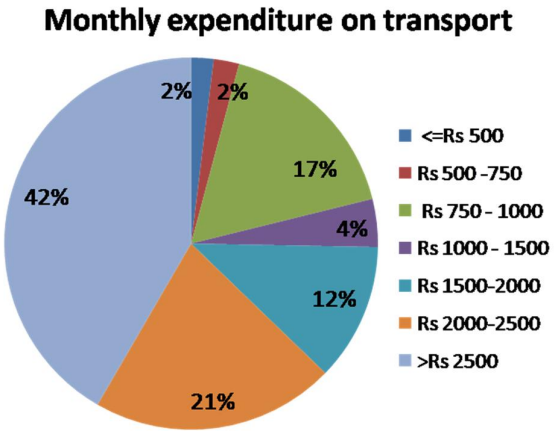


Distribution of Households according to the Average Monthly Expenditure on Transport

Distribution of households according to their average monthly expenditure on transport is presented in the Figure and Table. The table indicates that about 21% of the households spend less than or equal to Rs 1000/- per month on transport and nearly 36% of the households have a monthly expenditure on transport ranging from Rs 1501 to Rs 2500. Over 40% of households have an expenditure of more than Rs 2500 per month on transport.

Table: Distribution of Households by Average Monthly Expenditure on Transport

S.No.	Monthly Expenditure on Transport	Percentage
1	<=Rs 500	1.9%
2	Rs 500 -750	2.2%
3	Rs 750 - 1000	17.0%
4	Rs 1000 - 1500	4.2%
5	Rs 1500-2000	11.9%
6	Rs 2000-2500	21.1%
7	>Rs 2500	41.6%
Total		100.0%

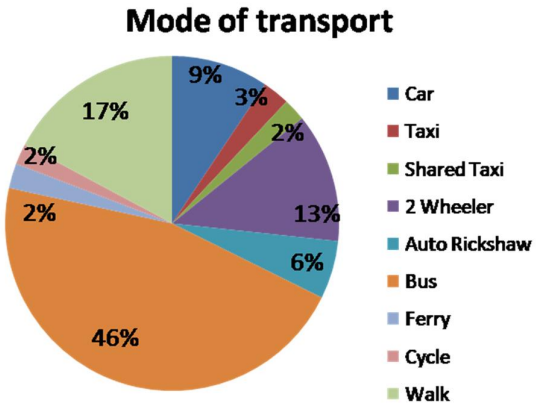


Distribution of Trips by Mode of Travel

Distribution of trips according to the mode of travel is given in the Table and Figure. It is observed that about 17% of the trips are walk trips. However, the trips performed by 2 Wheelers are about 13% and 46% trips are performed by public transport modes. The trips performed by auto rickshaw are 6%, whereas the trips performed by car, taxi, shared taxi are 14% and the trips performed by Ferry and Cycle is 2% each.

Table: Distribution of Trips by Mode of Travel

S. No.	Mode of Travel	Percentage
1	Car	9%
2	Taxi	3%
3	Shared Taxi	2%
4	2 Wheeler	13%
5	Auto Rickshaw	6%
6	Bus	46%
7	Ferry	2%
8	Cycle	2%
9	Walk	17%
Total		100%

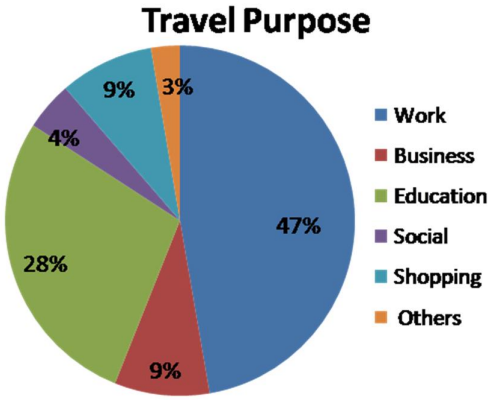


Distribution of Trips by Purpose of Travel

The Figure and Table shown below represents the purpose wise distribution of trips. It is seen from the table that about 54% of the trips are performed for work and business related purposes, where as 28.1% of the trips are for education related activities and remaining 17% of the trips are other trips which include shopping, social activities and others.

Table: Distribution of Trips by Purpose of Travel

S.No.	Trip Purpose	Percentage
1	Work	47.3%
2	Business	8.8%
3	Education	28.1%
4	Social	4.5%
5	Shopping	8.7%
6	Others	2.7%
Total		100.0%

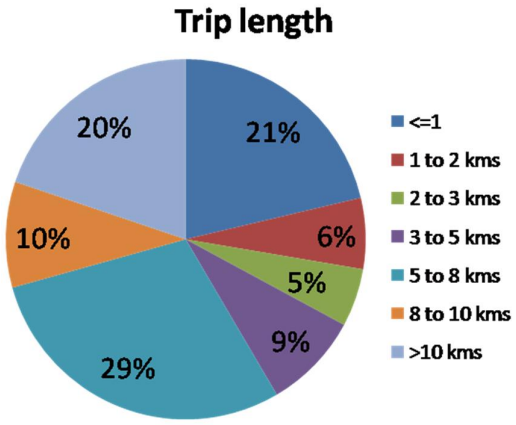


Distribution of Trips by Trip Length

Distribution of trips by trip length is presented in Table and Figure. It is observed from the table that about 29% of the trips are performed within the trip length range of 5 to 8 km, followed by 21% of trips with lengths less than 1 km, and 20% trips with trip lengths greater than 10 km. The Average trip length for walk is 0.750 km, for 2 Wheeler it is 6.5 km, Car & Taxi is 13.6 km respectively, for bus it is approximately 11.3 km, whereas for ferry it is 4km. The average trip length of ferry is less as compared to the bus based public transit systems; this might be because of the irregular frequencies of the ferry system, which has affected the reliability of the ferry system. Since the vehicular ownership is also high, people tend to depend on the road based travel options instead of water, except for the island communities, which are not directly connected by road.

Table: Distribution of Trips by Trip Length

S No.	Trip Length (km)	% of Total Trips
1	<=1	21%
2	1 to 2 km	6%
3	2 to 3 km	5%
4	3 to 5 km	9%
5	5 to 8 km	29%
6	8 to 10 km	9%
7	>10 km	20%
Total		100%

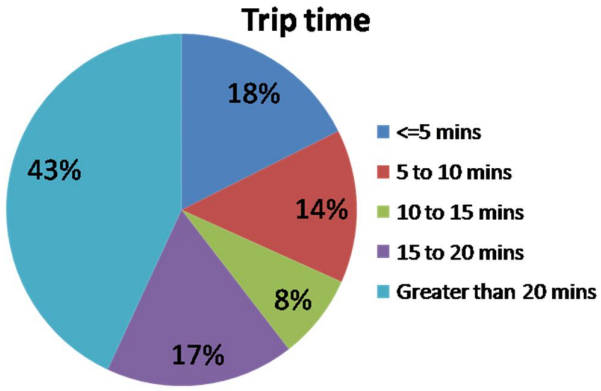


Distribution of Trips by Trip Time

The Table and Figure as under represent the distribution of trips by travel time. It is observed from the table that about 43% of the trips are performed for a period of 20 minutes and more, followed by 18% of the trips which are performed for less than 5 mins.

Table: Distribution of Trips by Trip Time

S. No.	Travel Time	Percentage
1	<=5 mins	18%
2	5 to 10 mins	14%
3	10 to 15 mins	8%
4	15 to 20 mins	17%
5	Greater than 20 mins	43%
Total		100%



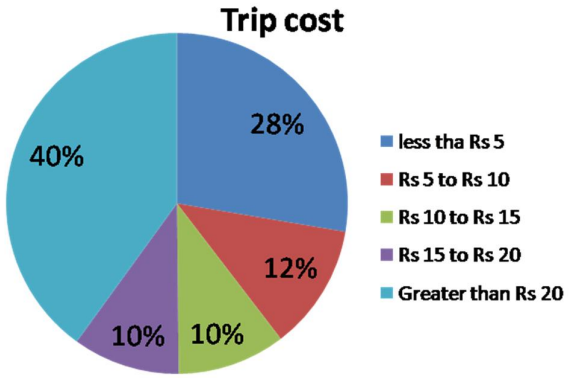
Distribution of Trips by Trip Cost

Table and Figure represent the distribution of trips by travel cost incurred. It is observed from the table that about 40% of the trips are performed by individuals spending greater than Rs 20/-, followed by 28% of the individual who spend less than Rs 5/-. This is because, majority of the individuals are performing their trips through walk, cycle and bus, and hence their travel cost is minimal.

Table: Distribution of Trips by Trip Cost

S. No.	Travel Cost	Percentage
1	less than Rs 5	28%
2	Rs 5 to Rs 10	12%
3	Rs 10 to Rs 15	10%

S. No.	Travel Cost	Percentage
4	Rs 15 to Rs 20	10%
5	Greater than Rs 20	40%
Total		100%

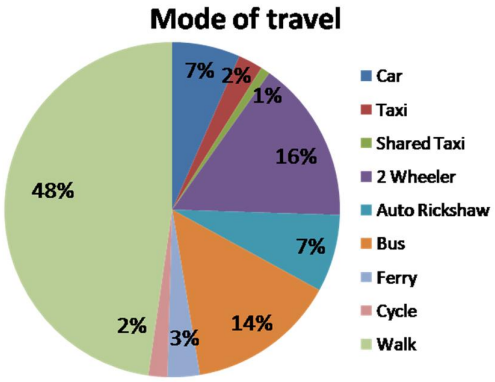


Distribution of Trips by Access/Dispersal Modes of Travel

Distribution of the trips by access/dispersal modes of travel are given in Table and Figure below. It is observed that about 48% of the trips are walk trips. However the trips performed by 2 wheelers are about 16% and 14% of the trips are performed by public transport modes. The trips performed by auto rickshaws are 7%, whereas the trips performed by car, Taxi, Shared Taxi are 10% and the trips performed by Ferry is 3% and Cycle is 2%.

Table: Distribution of Trips by Access/Dispersal Modes of Travel

S. No.	Mode of Travel	Percentage
1	Car	7%
2	Taxi	2%
3	Shared Taxi	1%
4	2 Wheeler	16%
5	Auto Rickshaw	7%
6	Bus	14%
7	Ferry	3%
8	Cycle	2%
9	Walk	48%
Total		100%

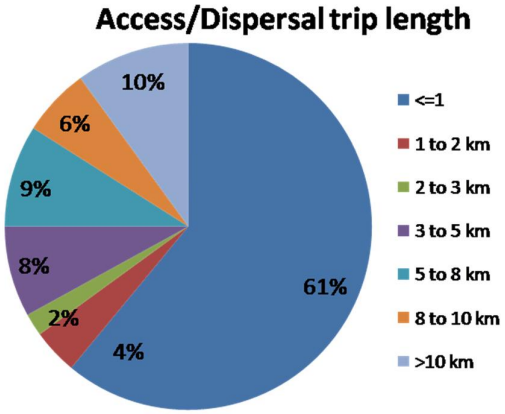


Distribution of Trips by Access/Dispersal Trip Length

Distribution of trips by trip length is represented in Figure and Table below. It is observed from the table that about 61% of the trips are performed within 1 km of the jetty followed by 10% of the trips which are performed from a distance of 10 km and more.

Table: Distribution of Trips by Access/Dispersal Trip Length

S No.	Trip Length (km)	Percentage
1	<=1	61%
2	1 to 2 km	4%
3	2 to 3 km	2%
4	3 to 5 km	8%
5	5 to 8 km	9%
6	8 to 10 km	6%
7	>10 km	10%
Total		100%

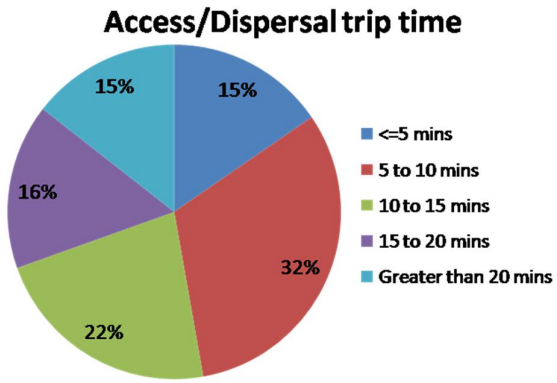


Distribution of Trips by Access/Dispersal Trip Time

From the Table and Figure it could be observed that the access/dispersal trip time of the ferry passengers is between 5 to 10 minutes for 32% of the trips, followed by 22% of the trips which take between 10 to 15 minutes, 16% of the trips are between 15 to 20 minutes and 14% represent trips which take more than 20 minutes. The average time taken for access trips by ferry passengers is 17.5 minutes.

Table: Distribution of Trips by Access/Dispersal Trip Time

S. No.	Travel Time	Percentage
1	<=5 mins	15%
2	5 to 10 mins	32%
3	10 to 15 mins	22%
4	15 to 20 mins	16%
5	Greater than 20 mins	14%
Total		100%



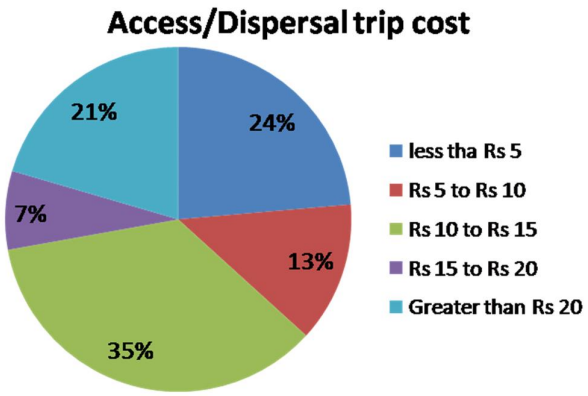
Distribution of Trips by Access/Dispersal Trip Cost

From the Table and Figure it could be observed that the access/dispersal trip cost for the ferry passengers, 35% of the access trips cost between Rs 10/- to Rs 15/- , followed by 24% of the trips which cost Rs 5/- to Rs 10/- .

Table: Distribution of Trips by Access/Dispersal Trip Cost

S. No.	Travel Cost	Percentage
1	less than Rs 5	24%
2	Rs 5 to Rs 10	13%
3	Rs 10 to Rs 15	35%

S. No.	Travel Cost	Percentage
4	Rs 15 to Rs 20	7%
5	Greater than Rs 20	20%
Total		100%

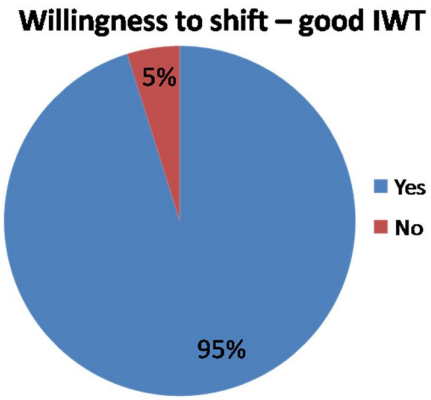


Willingness to shift to Good Water Based Transit System

The Table below shows that about 95.1% of the household respondents are willingness to shift to a good water based transit system, where as 5% of the households want to use their existing mode of travel.

Table: Willingness to Shift to Good Water Based Transit System

S.No.	Shift to Water Transport System	Percentage
1	Yes	95.1%
2	No	4.9%
Total		100.0%



Willingness to shift in case of time savings

The Table indicates that about 72% of the respondents are willing to shift to water transport system if the travel time savings on using ferries is up to 15 minutes in comparison with their current mode of travel. Around 28% of the respondents have shown their willingness to shift to new public transport if the time saving is greater than 20 minutes from their existing mode of travel.

Table: Willingness to shift in case of Time Savings

S.No.	Willingness to shift in case of time savings	Percentage
1	5 to 10 mins	25.6%
2	10 to 15 mins	47.2%
3	15 to 20 mins	19.4%
4	20 to 30 mins	5.4%
5	>30 mins	2.3%
Total		100.0%

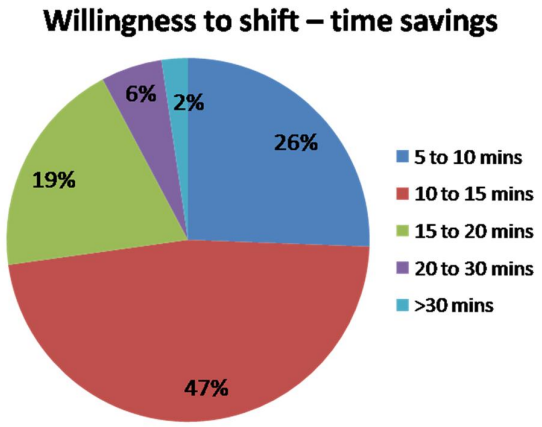
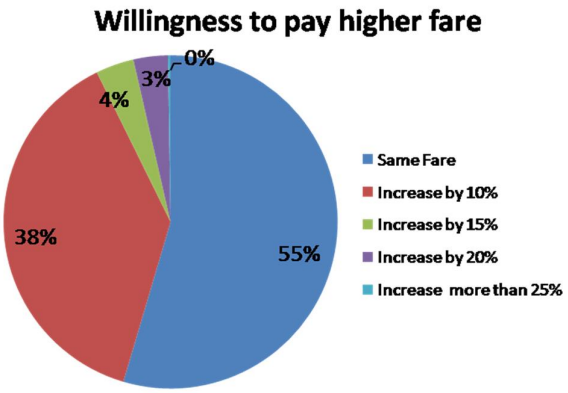


Table: Willingness to pay extra fare in relation to the existing water transit fares

S.No.	Fare willing to pay for Water Transport	Percentage
1	Same Fare	54.6%
2	Increase by 10%	38.1%
3	Increase by 15%	3.7%
4	Increase by 20%	3.3%
5	Increase more than 50%	0.2%
Total		100.0%

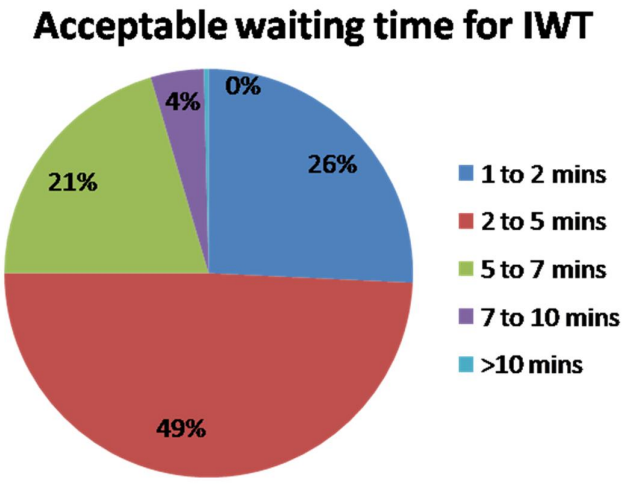


Willingness to Pay extra fare in relation to the existing water transit fares

The Table shows that about 54% respondents want the same fare for the new water transit system as per the existing bus fare and about 38.1% are showing their willingness to pay upto 10% increased fare for the improved water transit system in comparison to existing bus fare.

Table: Acceptable Waiting Time Savings to Shift to Good Water based transit system

S.No.	Will you shift to Water Transport, if waiting time is saved	Percentage
1	1 to 2 mins	25.7%
2	2 to 5 mins	49.3%
3	5 to 7 mins	20.4%
4	7 to 10 mins	4.2%
5	>10 mins	0.4%
Total		100.0%



Annexure IV: Distance Matrix

	Origin	Destinations																																				
		1	5	14	16	29	49	59	62	67	75	79	80	90a	90b	106a	106b	113	114	115a	115b	115c	115d	115e	115f	115g	116a	116b	116c	116d	116e	117a	117b	117c	117d	117e	117f	120	141
Fort Kochi	1	0	1	8	13	4	17	11	5	4	9	20	16	29	30	25	24	10	1	8	13	11	14	13	10	9	30	20	21	18	19	23	22	24	23	21	24	23	14
Mattancherry	5	1	0	5	10	7	14	9	6	5	8	19	15	30	31	23	22	11	3	9	14	12	15	14	11	11	31	21	22	19	20	25	23	26	25	22	25	24	15
Thoppumpady	14	8	5	0	6	7	11	6	9	10	10	14	10	35	36	19	18	16	8	14	19	17	20	19	16	15	36	22	23	21	21	25	24	25	25	23	25	25	16
Edakochi	16	13	10	6	0	11	13	12	14	15	9	8	8	41	42	13	12	22	14	20	25	23	26	25	22	21	42	21	19	20	17	18	22	21	23	24	20	21	22
Wellington Island	29	4	7	7	11	0	14	9	3	3	13	23	17	31	32	27	26	11	4	6	11	8	11	10	7	7	28	24	22	23	20	21	24	23	24	23	23	25	13
Vytilla	49	17	14	11	13	14	0	7	7	7	7	4	2	48	49	9	8	24	23	25	25	23	25	25	22	21	37	22	20	21	17	18	22	21	23	22	21	23	14
Thevara	59	11	9	6	12	9	7	0	7	8	0	10	6	41	42	12	11	13	13	15	15	13	15	15	12	11	30	20	21	18	19	23	23	23	23	23	24	23	11
Ernakulam	62	5	6	9	14	3	7	7	0	1	10	9	6	34	35	19	18	12	6	8	8	6	9	8	5	4	23	19	20	17	18	22	22	22	22	22	23	22	12
High Court	67	4	5	10	15	3	7	8	1	0	12	10	8	33	35	20	19	13	8	7	7	4	7	6	3	3	21	18	19	16	17	21	21	21	21	21	22	21	13
Nettoor	75	9	8	10	9	13	7	0	10	12	0	10	6	41	42	12	11	14	14	15	15	13	16	15	12	12	30	21	22	19	20	24	24	24	24	24	25	24	11
Eroor	79	20	19	14	8	23	4	10	9	10	10	0	4	53	54	5	4	25	25	27	27	25	28	27	24	23	42	23	22	21	22	25	25	25	26	26	27	27	13
Thykoodam	80	16	15	10	8	17	2	6	6	8	6	4	0	47	48	10	9	22	22	23	23	21	24	23	20	20	35	21	16	20	19	24	24	24	25	25	25	24	12
Cheranalloor	90a	29	30	35	41	31	48	41	34	33	41	53	47	0	6	53	51	22	16	12	8	6	9	8	5	4	5	15	15	17	17	14	13	16	16	14	15	12	26
Eloor	90b	30	31	36	42	32	49	42	35	35	42	54	48	6	0	58	57	25	18	15	11	8	11	10	7	7	7	14	26	16	16	13	12	15	15	13	14	11	25
Info Park	106a	25	23	19	13	27	9	12	19	20	12	5	10	53	58	0	1	28	28	30	30	27	30	29	26	26	51	25	25	23	24	27	27	27	27	27	29	29	15
Kakkanad	106b	24	22	18	12	26	8	11	18	19	11	4	9	51	57	1	0	27	27	29	29	26	29	28	25	25	50	24	24	22	23	26	26	26	26	26	28	28	14
Elamkunnapuzha	113	10	11	16	22	11	24	13	12	13	14	25	22	22	25	28	27	0	9	8	15	13	16	15	12	12	13	23	24	21	22	26	25	26	26	26	27	27	15
Vypeen	114	1	3	8	14	4	23	13	6	8	14	25	22	16	18	28	27	9	0	6	9	7	10	9	6	6	12	22	23	20	21	25	24	25	25	25	26	26	14
Bolgatty North	115a	8	9	14	20	6	25	15	8	7	15	27	23	12	15	30	29	8	6	0	6	3	6	5	2	2	11	17	18	15	16	20	20	20	20	18	21	21	14
Korrankotta	115b	13	14	19	25	11	25	15	8	7	15	27	23	8	11	30	29	15	9	6	0	2	2	4	3	3	3	14	15	12	13	17	16	17	17	15	18	18	19
Mulavakadu Hospital	115c	11	12	17	23	8	23	13	6	4	13	25	21	6	8	27	26	13	7	3	2	0	1	2	1	0	3	15	16	13	14	18	18	17	17	16	19	19	16
Mulavakadu North	115d	14	15	20	26	11	25	15	9	7	16	28	24	9	11	30	29	16	10	6	2	1	0	3	1	0	3	13	14	11	12	16	16	16	16	14	16	16	18
Mulavakadu Panchayat	115e	13	14	19	25	10	25	15	8	6	15	27	23	8	10	29	28	15	9	5	4	2	3	0	2	2	1	14	15	12	13	17	17	15	15	15	18	18	17
Ponnari Mangalam	115f	10	11	16	22	7	22	12	5	3	12	24	20	5	7	26	25	12	6	2	3	1	1	2	0	0	8	16	17	14	15	19	19	18	18	17	20	20	15
Thanthoninturuth	115g	9	11	15	21	7	21	11	4	3	12	23	20	4	7	26	25	12	6	2	3	0	0	2	0	0	9	17	18	15	16	20	20	19	19	18	21	21	16
Amrita Hospital	116a	30	31	36	42	28	37	30	23	21	30	42	35	5	7	51	50	13	12	11	3	3	3	1	8	9	0	12	11	14	13	15	14	15	14	13	16	16	23
Kothad	116b	20	21	22	21	24	22	20	19	18	21	23	21	15	14	25	24	23	22	17	14	15	13	14	16	17	12	0	11	12	11	14	12	13	12	11	14	14	21
Medicity	116c	21	22	23	19	22	20	21	20	19	22	22	16	15	26	25	24	24	23	18	15	16	14	15	17	18	11	11	0	12	12	13	13	14	13	12	15	15	22
Moolampilly	116d	18	19	21	20	23	21	18	17	16	19	21	20	17	16	23	22	21	20	15	12	13	11	12	14	15	14	12	12	0	11	15	15	15	14	13	16	16	19
South Chittoor	116e	19	20	21	17	20	17	19	18	17	20	22	19	17	16	24	23	22	21	16	13	14	12	13	15	16	13	11	12	11	0	14	14	14	14	12	15	15	20
Chariyamturuth	117a	23	25	25	18	21	18	23	22	21	24	25	24	14	13	27	26	26	25	20	17	18	16	17	19	20	15	14	13	15	14	0	11	14	13	11	11	11	24
Chennur	117b	22	23	24	22	24	22	23	22	21	24	25	24	13	12	27	26	25	24	20	16	18	16	17	19	20	14	12	13	15	14	11	0	12	11	12	12	12	23
Kadamakudy	117c	24	26	25	21	23	21	23	22	21	24	25	24	16	15	27	26	26	25	20	17	17	16	15	18	19	15	13	14	15	14	14	12	0	11	11	15	15	23
Paliyamturuth	117d	23	25	25	23	24	23	23	22	21	24	26	25	16	15	27	26	26	25	20	17	17	16	15	18	19	14	12	13	14	14	13	11	11	0	11	14	14	22
Pizhala	117e	21	22	23	24	23	22	23	22	21	24	26	25	14	13	27	26	26	25	18	15	16	14	15	17	18	13	11	12	13	12	11	12	11	11	0	13	13	22
Thundathumkadavu	117f	24	25	25	20	23	21	24	23	22	25	27	25	15	14	29	28	27	26	21	18	19	16	18	20	21	16	14	15	16	15	11	12	15	14	13	0	11	25
Varapuzha	120	23	24	25	21	25	23	23	22	21	24	27	24	12	11	29	28	27	26	21	18	19	16	18	20	21	16	14	15	16	15	11	12	15	14	13	11	0	24
Kumbhalam	141	14	15	16	22	13	14	11	12	13	11	13	12	26	25	15	14	15	14	14	19	16	18	17	15	16	23	21	22	19	20	24	23	23	22	22	25	24	0

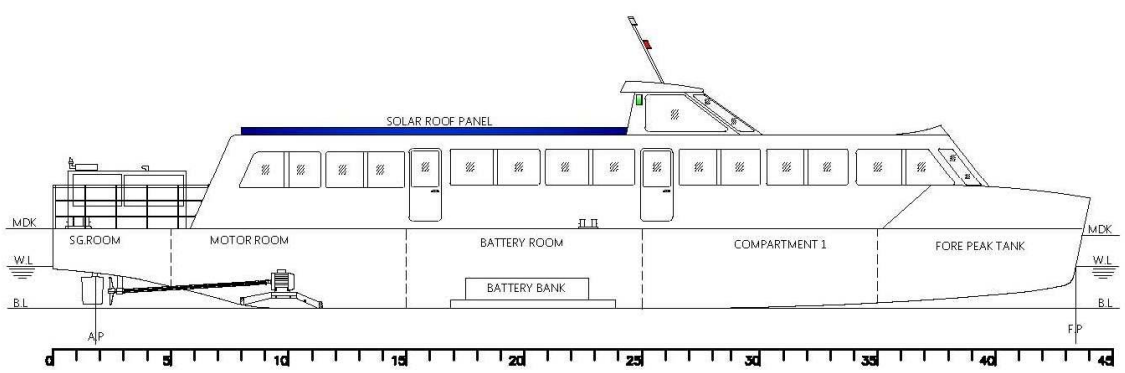
Annexure V: a) Typical Boat Design 50 Pax

MAIN PARTICULARS

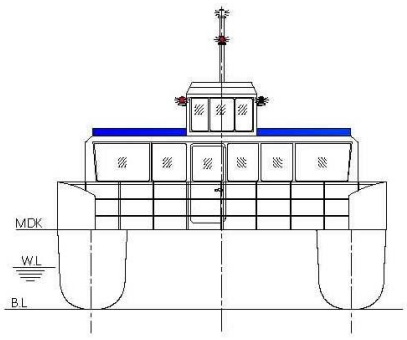
LENGTH O.A	: 15.0m
LENGTH B.P	: 13.80m
BREADTH	: 5.5m
BREADTH (DEMI HULL)	: 1.5m
DEPTH	: 1.5m
DESIGN DRAFT MAX	: 0.9 m
MATERIAL	: FRP
SERVICE SPEED	: 8 Knots
FRAME SPACING	: 500MM
PASSENGERS	: 50 no.

PRELIMINARY - GENERAL ARRANGEMENT			
DESCRIPTION			
50 PAX CAT		GENERAL ARRANGEMENT	
SCALE	1:140	DRAWING NUMBER	REV
SIZE	A3		0

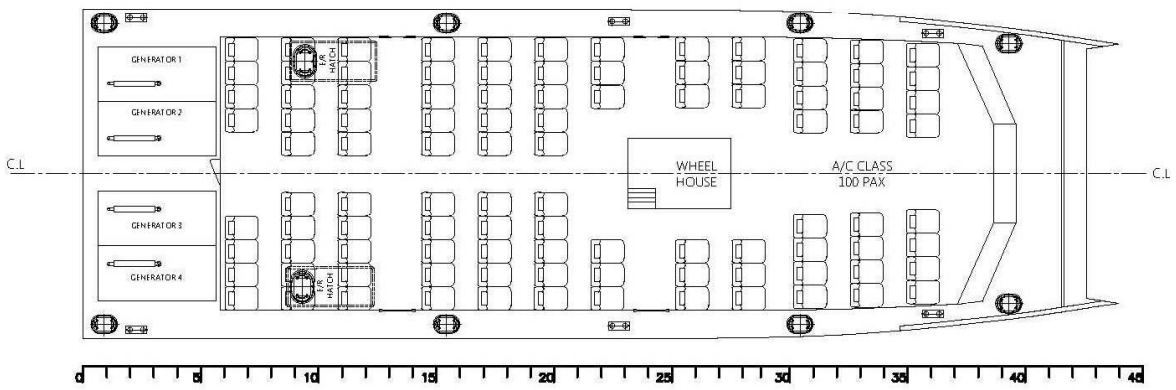
Annexure V: b) Typical Boat Design 100 Pax



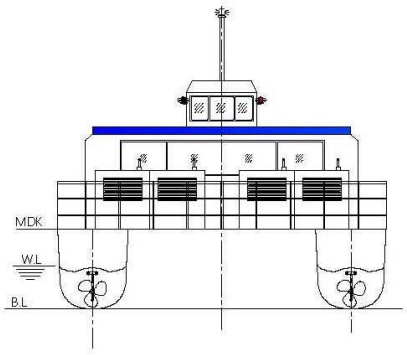
PROFILE



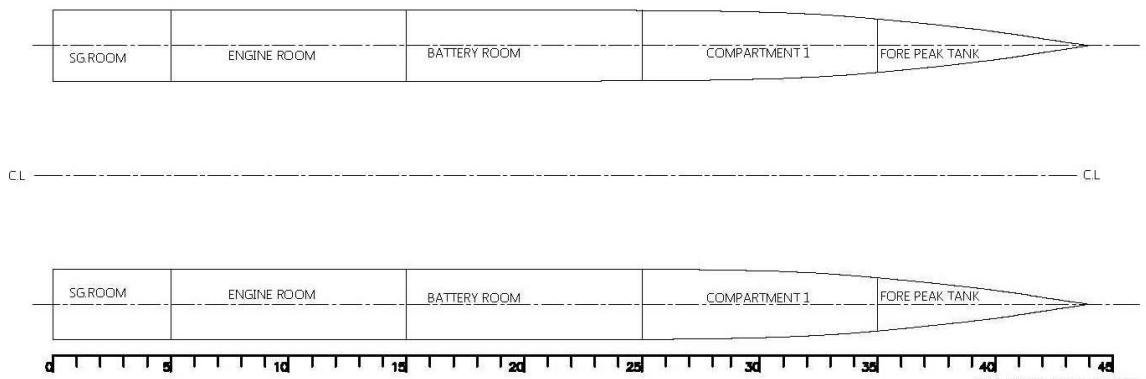
VIEW LOOKING FWD



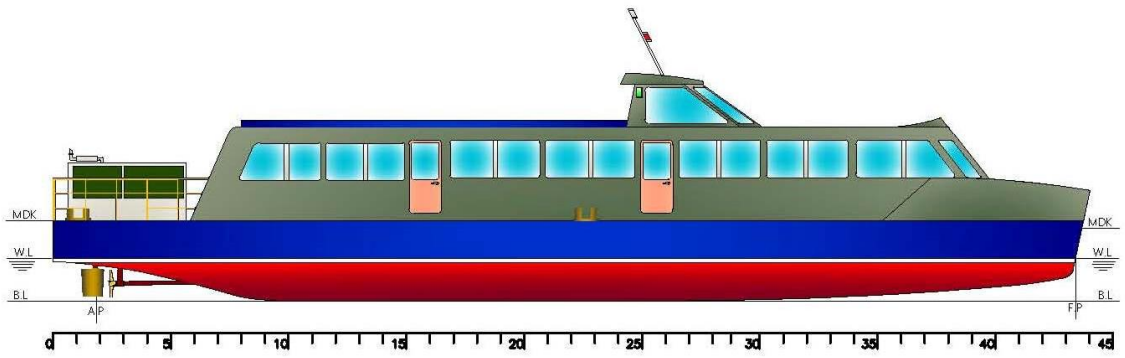
MAINDECK PLAN



VIEW LOOKING AFT



BELOW MAIN DECK



MAIN PARTICULARS

LENGTH O.A	: 22.0m
LENGTH B.P	: 20.80m
BREADTH	: 7m
BREADTH (DEMI HULL)	: 1.5m
DEPTH	: 1.7m
DESIGN DRAFT MAX	: 0.9 m
MATERIAL	: FRP
SERVICE SPEED	: 8 Knots
FRAME SPACING	: 500MM
PASSENGERS	: 100 no.

PRELIMINARY - GENERAL ARRANGEMENT			
DESCRIPTION			
100 PAX CAT		GENERAL ARRANGEMENT	
SCALE	1:140	DRAWING NUMBER	REV
SIZE	A3		0

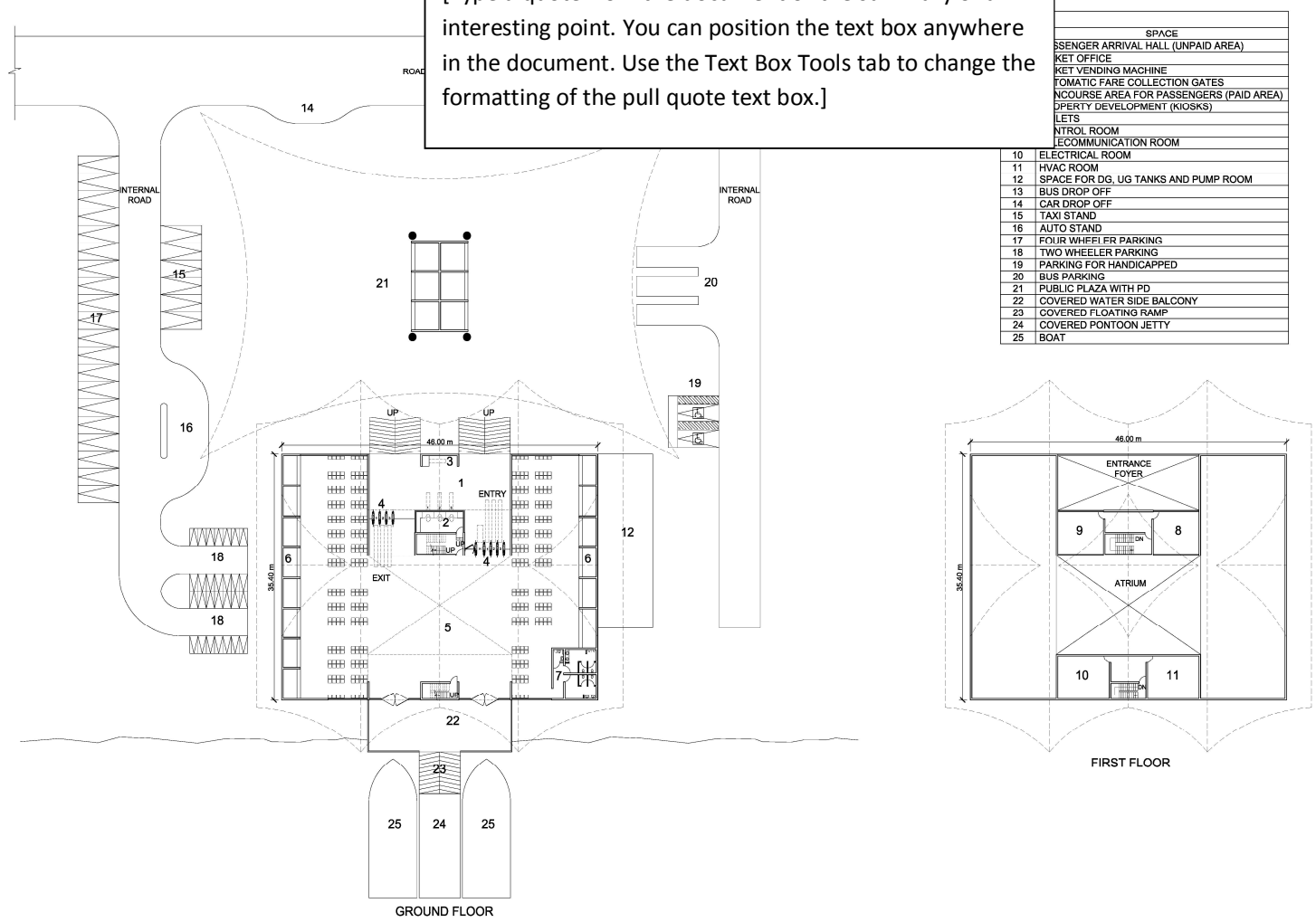
I: Jetty Design

r Jetty – Typical Design

Annexure VI: Jetty Design

Major Jetty – Typical Design

[Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Text Box Tools tab to change the formatting of the pull quote text box.]

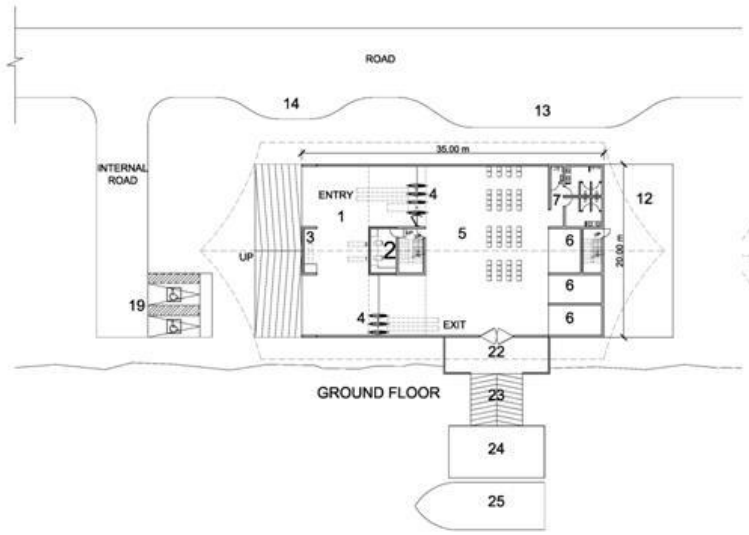


	SPACE
	SSENGER ARRIVAL HALL (UNPAID AREA)
	KET OFFICE
	KET VENDING MACHINE
	TOMATIC FARE COLLECTION GATES
	NCOURSE AREA FOR PASSENGERS (PAID AREA)
	OPERTY DEVELOPMENT (KIOSKS)
	LETS
	NTROL ROOM
	LECOMMUNICATION ROOM
10	ELECTRICAL ROOM
11	HVAC ROOM
12	SPACE FOR DG, UG TANKS AND PUMP ROOM
13	BUS DROP OFF
14	CAR DROP OFF
15	TAXI STAND
16	AUTO STAND
17	FOUR WHEELER PARKING
18	TWO WHEELER PARKING
19	PARKING FOR HANDICAPPED
20	BUS PARKING
21	PUBLIC PLAZA WITH PD
22	COVERED WATER SIDE BALCONY
23	COVERED FLOATING RAMP
24	COVERED PONTOON JETTY
25	BOAT

CONCEPT PLAN FOR MAJOR JETTY HUB AT KOCHI

Annexure VI: Jetty Design

Minor Jetty – Typical Design



CONCEPT PLAN FOR MINOR JETTY HUB

LEGEND	
S. NO.	SPACE
1	PASSENGER ARRIVAL HALL (UNPAID AREA)
2	TICKET OFFICE
3	TICKET VENDING MACHINE
4	AUTOMATIC FARE COLLECTION GATES
5	CONCOURSE AREA FOR PASSENGERS (PAID AREA)
6	PROPERTY DEVELOPMENT (KIOSKS)
7	TOILETS
8	CONTROL ROOM
9	TELECOMMUNICATION ROOM
10	ELECTRICAL ROOM
11	HVAC ROOM
12	SPACE FOR DG, UG TANKS AND PUMP ROOM
13	BUS DROP OFF
14	CAR DROP OFF
15	TAXI STAND
16	AUTO STAND
17	FOUR WHEELER PARKING
18	TWO WHEELER PARKING
19	PARKING FOR HANDICAPPED
20	BUS PARKING
21	PUBLIC PLAZA WITH PD
22	COVERED WATER SIDE BALCONY
23	COVERED FLOATING RAMP
24	COVERED PONTOON JETTY
25	BOAT

ANNEXURE VII : Block Cost Estimate

Plinth Area Rate of CPWD as on 01.10.2012

			Major Jetty			Minor Jetty		
S. No. as per PAR	**Description**	**Unit**	**Quantity**	**Rates in Rs. Per Sq.Mt. (Office / College / Hospital)**	**Amount**	**Quantity**	**Rates in Rs. Per Sq.Mt. (Office / College / Hospital)**	**Amount**
1	**2**	**3**	**4**	**5**	**11**	**4**	**5**	**11**
1	**RCC FRAMED STRUCTURE (Specifications as per Annexure-II)**							
1.1	RCC Framed structure upto six storeys							
1.1.1	Floor ht. 3.35 mtr.	Sqm.	1000	18,800.00	18800000	180	18,800.00	3384000
1.2	**EXTRA FOR**							
1.2.1	Every 0.3 mt additional height of floor above normal floor height of 3.35 mt up to 2.90 mt	Sqm.	2000	270.00	540000	360	270.00	97200
	SUB Total				19340000			3481200
	TOTAL				**19,340,000.00**			**3,481,200.00**
3	**SERVICES**							
3.1	Internal water sypply & sanitary installations			4% off/college 10% Hospital	773,600.00		4% off/college 10% Hospital	348,120.00
3.2	External service connections			5.00%	725,250.00		5.00%	174,060.00
3.3	Internal electric installations			12.50%			12.50%	435,150.00
3.4	Internal electric installations for terminal building and other allied structures in airports			15.00%	2,901,000.00		15.00%	522,180.00
5	**DEVELOPMENT OF SITE**							
5.1	Levelling	Sqm.	4500	95.00	427,500.00	180	95.00	17,100.00
5.2	Sewer	Sqm.	2250	110.00	247,500.00	180	110.00	19,800.00

			Major Jetty			Minor Jetty		
S. No. as per PAR	**Description**	**Unit**	**Quantity**	**Rates in Rs. Per Sq.Mt. (Office / College / Hospital)**	**Amount**	**Quantity**	**Rates in Rs. Per Sq.Mt. (Office / College / Hospital)**	**Amount**
5.3	**Filter Water Supply**							
5.4.3	Unfiltered water supply distribution lines	Sqm.	2250	45.00	101,250.00	180	45.00	8,100.00
5.5	**Street lighting**							
5.5.1	With HPMV Lamps	Sqm.	4500	130.00	585,000.00	180	130.00	23,400.00
5.5.2	Exit sign board i/c electric signage	Sqm.	1000	85.00	85,000.00	180	85.00	15,300.00
6	DG Set	LS			500,000.00			250,000.00
7	Floating Pontoon				9,568,125.00			5,315,625.00
	Total				**15,140,625.00**			**7,128,835.00**
	Grand Total				**34,480,625.00**			**10,610,035.00**
	Cost index for from 2012 to 2014			**1.15**	**39,652,718.75 @4.0 cr.**		**1.15**	**12,201,540.25 @1.25 cr**

Annexure VIII: Fare Matrix

	Origin	Destinations																																					
		1	5	14	16	29	49	59	62	67	75	79	80	90a	90b	106a	106b	113	114	115a	115b	115c	115d	115e	115f	115g	116a	116b	116c	116d	116e	117a	117b	117c	117d	117e	117f	120	141
Fort Kochi	1	0	6	8	9	6	14	9	8	9	12	15	12	27	26	18	17	8	6	9	17	14	17	15	12	11	23	20	21	17	18	24	23	26	24	21	26	24	11
Mattancherry	5	6	0	6	8	8	15	11	9	11	12	17	14	29	27	20	18	9	8	11	17	15	17	17	14	12	24	21	23	18	20	27	24	29	27	23	27	26	12
Thoppumpady	14	8	6	0	6	9	17	12	11	12	14	18	15	30	29	21	20	11	9	12	20	17	20	18	15	14	26	23	24	21	21	27	26	27	27	24	27	27	14
Edakochi	16	9	8	6	0	11	0	12	9	6	8	11	14	12	26	24	17	15	9	8	9	15	12	15	14	11	12	21	18	20	15	17	23	21	24	26	20	21	23
Wellington Island	29	6	8	9	11	0	11	0	8	9	11	9	6	8	29	27	9	8	15	14	12	18	15	18	17	14	15	26	23	24	20	21	26	24	26	24	24	27	9
Vytilla	49	14	15	17	0	11	0	8	9	6	8	6	9	8	27	26	12	11	12	11	9	15	12	15	14	11	12	23	20	21	15	17	23	21	24	23	21	24	11
Thevara	59	9	11	12	12	0	8	0	6	8	6	9	6	27	26	12	11	14	11	9	15	12	14	15	11	17	23	20	21	17	18	24	24	24	24	24	26	24	6
Ernakulam	62	8	9	11	9	8	9	6	0	6	8	11	8	23	24	14	12	11	9	8	14	11	12	14	9	15	21	18	20	15	17	23	23	23	23	23	24	23	8
High Court	67	9	11	12	6	9	6	8	6	0	9	12	9	21	23	15	14	12	11	6	12	9	11	12	8	14	20	17	18	14	15	21	21	21	21	23	21	23	9
Nettoor	75	12	12	14	8	11	8	6	8	9	0	8	8	29	27	14	12	14	12	11	17	14	15	17	12	18	24	21	23	18	20	26	26	26	26	26	27	26	6
Eroor	79	15	17	18	11	9	6	9	11	12	8	0	8	32	30	8	8	17	15	15	20	17	18	20	15	23	27	24	23	21	23	27	27	27	29	29	30	30	9
Thykoodam	80	12	14	15	14	6	9	6	8	9	8	8	0	29	27	11	11	14	12	12	17	14	15	17	12	20	24	21	14	20	18	26	26	26	27	27	27	26	8
Cheranalloor	90a	27	29	30	12	8	8	27	23	21	29	32	29	0	6	35	33	33	30	23	20	20	17	18	23	20	15	12	12	15	15	11	9	14	14	11	12	8	29
Eloor	90b	26	27	29	26	29	27	26	24	23	27	30	27	6	0	33	32	32	29	21	18	18	15	17	21	18	14	11	29	14	14	9	8	12	12	9	11	6	27
Info Park	106a	18	20	21	24	27	26	12	14	15	14	8	11	35	33	0	32	20	18	18	23	20	21	23	18	26	30	27	27	24	26	30	30	30	30	30	33	33	12
Kakkanad	106b	17	18	20	17	9	12	11	12	14	12	8	11	33	32	32	0	18	17	17	21	18	20	21	17	24	29	26	26	23	24	29	29	29	29	29	32	32	11
Elamkunnapuzha	113	8	9	11	15	8	11	14	11	12	14	17	14	33	32	20	18	0	6	12	20	15	17	18	14	20	27	24	26	21	23	29	27	29	29	29	30	30	12
Vypeen	114	6	8	9	9	15	12	11	9	11	12	15	12	30	29	18	17	6	0	14	18	14	15	17	12	18	26	23	24	20	21	27	26	27	27	27	29	29	11
Bolgatty North	115a	9	11	12	8	14	11	9	8	6	11	15	12	23	21	18	17	12	14	0	12	8	9	11	6	14	18	15	17	12	14	20	20	20	20	17	21	21	11
Korrankotta	115b	17	17	20	9	12	9	15	14	12	17	20	17	20	18	23	21	20	18	12	0	9	6	8	8	9	14	11	12	8	9	15	14	15	15	12	17	17	18
Mulavakadu Hospital	115c	14	15	17	15	18	15	12	11	9	14	17	14	20	18	20	18	15	14	8	9	0	6	8	12	8	15	12	14	9	11	17	17	15	15	14	18	18	14
Mulavakadu North	115d	17	17	20	12	15	12	14	12	11	15	18	15	17	15	21	20	17	15	9	6	6	0	6	11	8	12	9	11	6	8	14	14	14	14	11	14	14	17
Mulavakadu Panchayat	115e	15	17	18	15	18	15	15	14	12	17	20	17	18	17	23	21	18	17	11	8	8	6	0	8	6	14	11	12	8	9	15	15	12	12	12	17	17	15
Ponnari Mangalam	115f	12	14	15	14	17	14	11	9	8	12	15	12	23	21	18	17	14	12	6	8	12	11	8	0	6	17	14	15	11	12	18	18	17	17	15	20	20	12
Thanthoninturuth	115g	11	12	14	11	14	11	17	15	14	18	23	20	20	18	26	24	20	18	14	9	8	8	6	6	0	18	15	17	12	14	20	20	18	18	17	21	21	14
Amrita Hospital	116a	23	24	26	12	15	12	23	21	20	24	27	24	15	14	30	29	27	26	18	14	15	12	14	17	18	0	8	6	11	9	12	11	12	11	9	14	14	24
Kothad	116b	20	21	23	21	26	23	20	18	17	21	24	21	12	11	27	26	24	23	15	11	12	9	11	14	15	8	0	6	8	6	11	8	9	8	6	11	11	21
Medicity	116c	21	23	24	18	23	20	21	20	18	23	23	14	12	29	27	26	26	24	17	12	14	11	12	15	17	6	6	0	8	8	9	9	11	9	8	12	12	23
Moolampilly	116d	17	18	21	20	24	21	17	15	14	18	21	20	15	14	24	23	21	20	12	8	9	6	8	11	12	11	8	8	0	6	12	12	12	11	9	14	14	18
South Chittoor	116e	18	20	21	15	20	15	18	17	15	20	23	18	15	14	26	24	23	21	14	9	11	8	9	12	14	9	6	8	6	0	11	11	11	11	8	12	12	20
Chariyamturuth	117a	24	27	27	17	21	17	24	23	21	26	27	26	11	9	30	29	29	27	20	15	17	14	15	18	20	12	11	9	12	11	0	6	11	9	6	6	6	26
Chennur	117b	23	24	26	23	26	23	24	23	21	26	27	26	9	8	30	29	27	26	20	14	17	14	15	18	20	11	8	9	12	11	6	0	8	6	8	8	8	24
Kadamakudy	117c	26	29	27	21	24	21	24	23	21	26	27	26	14	12	30	29	29	27	20	15	15	14	12	17	18	12	9	11	12	11	11	8	0	6	6	12	12	24
Paliyamturuth	117d	24	27	27	24	26	24	24	23	21	26	29	27	14	12	30	29	29	27	20	15	15	14	12	17	18	11	8	9	11	11	9	6	6	0	6	11	11	23
Pizhala	117e	21	23	24	26	24	23	24	23	21	26	29	27	11	9	30	29	29	27	17	12	14	11	12	15	17	9	6	8	9	8	6	8	6	6	0	9	9	23
Thundathumkadavu	117f	26	27	27	20	24	21	26	24	23	27	30	27	12	11	33	32	30	29	21	17	18	14	17	20	21	14	11	12	14	12	6	8	12	11	9	0	6	27
Varapuzha	120	24	26	27	21	27	24	24	23	21	26	30	26	8	6	33	32	30	29	21	17	18	14	17	20	21	14	11	12	14	12	6	8	12	11	9	6	0	26
Kumbhalam	141	11	12	14	23	9	11	6	8	9	6	9	8	29	27	12	11	12	11	11	18	14	17	15	12	14	24	21	23	18	20	26	24	24	23	23	27	26	0

ANNEXURE IX

SCHEDULE OF LIST FOR FINANCIAL ANALYSIS

Profit and Loss Statement

Profit and Loss Statement																					
Year		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Revenue																					
Fare revenue	₹ Crore	4.7	7.7	10.3	14.4	15.9	17.5	19.2	21.2	23.3	25.7	28.3	31.1	34.3	37.7	41.6	45.8	50.4	55.5	61.1	67.2
Two Wheeler Revenue	₹ Crore	0.4	0.6	0.9	1.2	1.3	1.5	1.6	1.8	1.9	2.1	2.4	2.6	2.9	3.1	3.5	3.8	4.2	4.6	5.1	5.6
Parking Revenue	₹ Crore	0.9	1.6	2.2	2.6	2.8	2.9	3.1	3.2	3.4	3.5	3.7	3.9	4.1	4.3	4.5	4.7	5.0	5.2	5.5	5.8
Rental Revenue	₹ Crore	8.1	14.8	20.9	24.9	26.5	28.1	29.8	31.6	33.5	35.3	37.1	39.0	40.9	42.9	45.1	47.4	49.7	52.2	54.8	57.6
Boat Advertisement Revenue	₹ Crore	0.2	0.5	0.7	1.0	1.0	1.1	1.2	1.3	1.3	1.5	1.6	1.7	1.9	2.0	2.2	2.4	2.6	2.9	3.1	3.3
Advt Revenue at Landings	₹ Crore	0.7	1.3	1.8	2.2	2.3	2.4	2.5	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.7	3.9	4.1	4.3	4.5	4.7
Total Revenue		**15.0**	**26.6**	**36.8**	**46.3**	**49.7**	**53.4**	**57.3**	**61.6**	**66.2**	**71.1**	**76.1**	**81.5**	**87.3**	**93.7**	**100.5**	**107.9**	**115.9**	**124.6**	**134.0**	**144.2**
Operating Costs																					
Fuel Cost	₹ Crore	3.2	7.4	10.1	16.2	17.3	19.0	21.1	22.8	24.6	29.2	31.0	33.8	36.7	41.2	44.4	49.8	53.6	61.9	67.1	74.3
Crew Salary	₹ Crore	0.7	1.7	2.2	3.6	3.8	4.2	4.6	5.0	5.4	6.4	6.7	7.4	8.0	8.9	9.6	10.7	11.5	13.4	14.4	15.9
Jetty Staff Salary	₹ Crore	0.5	0.9	1.3	1.5	1.6	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3.1	3.2
Running Maintenance	₹ Crore	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5
Boat Breakdown Maintenance	₹ Crore	0.7	1.4	2.0	3.3	4.0	4.6	5.5	5.8	6.2	8.0	9.6	11.1	13.0	14.0	15.1	16.5	17.8	19.5	21.5	23.1
Management Cost	₹ Crore	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.8
Maintenance of Jetty etc	₹ Crore	-	0.1	0.3	0.4	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1
Operating Costs		5.3	11.7	16.3	25.5	27.7	30.6	34.1	36.6	39.4	47.0	50.8	56.0	61.7	68.3	73.6	81.6	87.8	99.9	108.3	119.0
Operating Profit		9.8	14.8	20.5	20.8	22.0	22.8	23.3	25.0	26.8	24.1	25.2	25.5	25.6	25.4	26.9	26.3	28.0	24.7	25.7	25.1
Overheads																					
Insurance	₹ Crore	0.2	0.5	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9
Rent, rates and Taxes		0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
Maintenance of Other Infrastruc	₹ Crore	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
Depreciation/Write off	₹ Crore	4.6	8.3	11.8	14.4	14.4	14.5	14.8	14.9	14.9	15.4	15.5	15.8	16.0	16.6	16.8	17.2	17.4	18.3	18.7	19.1
Interest	₹ Crore	-	-	-	-	0.2	0.7	1.0	1.1	1.8	2.4	2.7	3.1	3.9	4.5	4.9	5.2	6.2	7.4	7.7	7.6
Total Overheads	₹ Crore	**5.1**	**9.2**	**12.9**	**15.7**	**15.9**	**16.5**	**17.2**	**17.4**	**18.1**	**19.3**	**19.7**	**20.4**	**21.5**	**22.7**	**23.4**	**24.2**	**25.5**	**27.6**	**28.5**	**28.8**
Net Profit/Loss	₹ Crore	**4.7**	**5.7**	**7.7**	**5.1**	**6.1**	**6.2**	**6.1**	**7.6**	**8.7**	**4.8**	**5.5**	**5.1**	**4.2**	**2.7**	**3.6**	**2.1**	**2.6**	**(2.9)**	**(2.8)**	**(3.7)**
Add: Depreciation		5	8	12	14	14	15	15	15	15	15	16	16	16	17	17	17	17	18	19	19
Less: Capex						(4)	(7)	(2)	(2)	(13)	(4)	(6)	(8)	(14)	(6)	(10)	(7)	(24)	(11)	(12)	-
Less: Net Debt Addition/repayment		-	-	-	-	3	5	1	1	10	1	3	4	9	1	5	2	16	3	4	(7)
Net Cash Accrual		**9.23**	**14.00**	**19.47**	**19.53**	**19.94**	**19.43**	**19.70**	**21.24**	**20.61**	**17.57**	**17.92**	**17.24**	**15.14**	**14.44**	**14.81**	**13.76**	**11.75**	**7.50**	**7.57**	**8.54**

Cash Flow Statement

Cash Flow Statement

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
EBITDA		9.23	14.00	19.47	19.53	20.68	21.45	21.92	23.63	25.40	22.6	23.73	23.99	24.06	23.73	25.23	24.55	26.21	22.73	23.63	23.01
Capex	(216.6)	(192.5)	(171.6)	(101.3)	-	(3.8)	(6.8)	(2.0)	(2.0)	(13.4)	(3.7)	(6.4)	(7.6)	(14.5)	(6.2)	(10.4)	(7.1)	(24.1)	(11.1)	(11.9)	-
Additional Loan	184.12	163.62	145.85	86.12		3.23	5.77	1.68	1.71	11.37	3.12	5.46	6.50	12.30	5.31	8.86	6.03	20.49	9.40	10.13	
Equity	32.5	28.9	25.7	15.2																	
Interest		-	-	-	-	(0.2)	(0.7)	(1.0)	(1.1)	(1.8)	(2.4)	(2.7)	(3.1)	(3.9)	(4.5)	(4.9)	(5.2)	(6.2)	(7.4)	(7.7)	(7.6)
Loan Repaid	-	-	-	-	-	-	(0.3)	(0.9)	(0.9)	(1.0)	(2.1)	(2.2)	(2.5)	(2.9)	(3.8)	(4.0)	(4.5)	(4.6)	(6.2)	(6.5)	(6.9)
Surplus tranferred to GoK					(40.6)	(20.6)	(20.0)	(19.5)	(19.7)	(21.2)	(20.6)	(17.7)	(17.9)	(17.3)	(15.2)	(14.5)	(14.8)	(13.8)	(11.9)	(7.7)	(7.6)
Net Cash flow		9.2	14.0	19.5	(21.0)	(0.6)	(0.5)	0.2	1.5	(0.6)	(3.1)	0.2	(0.7)	(2.1)	(0.8)	0.3	(1.0)	(2.1)	(4.4)	(0.1)	1.0
Opening Balance		-	9.2	23.2	42.7	21.7	21.0	20.5	20.7	22.3	21.7	18.7	18.9	18.2	16.0	15.2	15.6	14.5	12.5	8.1	8.0
Closing Balance		9.2	23.2	42.7	21.7	21.0	20.5	20.7	22.3	21.7	18.7	18.9	18.2	16.0	15.2	15.6	14.5	12.5	8.1	8.0	8.9

Financial and Economic IRR (For the Whole Project)

Financial IRR																					
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Net Profit/Loss		2.9	2.5	3.6	0.2	1.8	2.7	3.2	5.4	7.6	4.0	5.5	5.8	5.7	4.9	6.7	5.7	7.5	2.6	3.4	2.5
Add: Interest		2.8	4.4	5.7	6.2	6.0	5.8	5.6	5.3	5.1	4.9	4.6	4.4	4.2	4.0	3.8	3.5	3.4	3.3	3.1	2.8
Add : Depreciation		5.2	9.6	13.6	16.6	16.6	16.7	17.0	17.1	17.2	17.7	17.9	18.2	18.5	19.1	19.3	19.8	20.1	21.1	21.5	22.0
Boat Acquisition Cost	-54.0	-55.6	-40.1	-46.2	0.0	-4.4	-7.9	-2.3	-2.3	-15.5	-4.3	-7.5	-8.9	-16.8	-7.3	-12.1	-8.2	-28.0	-12.9	-13.8	0.0
Direct Infra Cost	-81.7	-57.1	-63.3	-32.1																	
Other Infra Cost	0.0	0.0	0.0	0.0																	
Net Cash flow	**-135.7**	**-101.7**	**-86.8**	**-55.4**	**23.0**	**19.9**	**17.3**	**23.5**	**25.5**	**14.3**	**22.4**	**20.5**	**19.4**	**11.6**	**20.8**	**17.7**	**20.8**	**3.0**	**14.1**	**14.2**	**164.1**
Project IRR (pre-tax)	**1.4%**																				
Economic IRR																					
Capex	-108.6	-90.1	-82.7	-62.6	0.0	-3.5	-6.3	-1.8	-1.9	-12.4	-3.4	-6.0	-7.1	-13.5	-5.8	-9.7	-6.6	-22.4	-10.3	-11.1	0.0
VOC+Time Savings		31.6	33.2	34.9	36.6	40.3	44.4	48.9	53.8	59.3	65.2	71.8	79.1	87.1	95.9	105.6	116.2	128.0	140.9	155.1	170.8
VAT on Diesel		1.5	3.4	4.7	7.5	8.0	8.7	9.7	10.5	11.3	13.4	14.3	15.5	16.9	18.9	20.4	22.9	24.7	28.5	30.9	34.2
Net Cash Flow	0.0	11.0	16.5	22.9	23.0	24.3	25.2	25.8	27.8	29.9	26.7	28.0	28.3	28.4	28.0	29.8	29.0	31.0	27.0	28.0	27.4
Total Benefits	0.0	44.1	53.1	62.4	67.1	72.6	78.4	84.4	92.1	100.4	105.4	114.0	122.9	132.4	142.8	155.8	168.1	183.6	196.3	214.0	232.3
Total Value Flow	**-108.6**	**-46.1**	**-29.5**	**-0.2**	**67.1**	**69.1**	**72.1**	**82.5**	**90.2**	**88.0**	**101.9**	**108.1**	**115.8**	**118.9**	**137.0**	**146.1**	**161.5**	**161.2**	**186.0**	**202.9**	**232.3**
NPV @	12%																				
Costs	293.21																				
Benefits	603.72																				
Economic IRR	**26.1%**																				
Benefits/Cost	2.06																				

INTEGRATED INLAND WATER TRANSPORT PROJECT

ENVIRONMENTAL AND SOCIAL ASPECTS



PREPARED BY

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1. INTRODUCTION

Kochi Metro Rail Limited (KMRL) in line with the directives of the Ministry of Urban Development, Government of India has spearheaded the task of setting up the Kochi Unified Metropolitan Transportation Authority (MTA-KOCHI). The MTA-KOCHI has the objective of developing a seamless multi-modal transportation system in the Kochi City Region. MTAKOCHI is also focussing on developing a sustainable Integrated Water Transportation System for Kochi city, meeting the people's expectations as per international standards and aims to integrate the system with the other modes of transport including the metro system over a period of time with an integrated fare and integrated timetable.

2. PROJECT DESCRIPTION

2.1 CURRENT SCENARIO

The Inland Water Transport System in Kochi currently comprises ferries operating from about 10 jetties. The ferries operated by State Water Transport Department (SWTD), private operators, Tourism Department as well as KINCO; act as the principal link between the mainland and the islands. Majority of these boats are old and in dilapidated state, due to which the water transport system is losing out on competing with the other road based motorized modes in the city. As mentioned in the previous sections, there were once 60 operational jetties connecting island communities with the mainland, however only a few of those jetties are operational today. According to STWD, currently there are 4 operational routes connecting the 21 jetties which are operational. **Figure 1** represents the operational routes and jetties in Kochi. The route between Fort Kochi and Vypeen is the major route, with about 12,000 passengers commuting daily[1]. Fort Kochi – Vypeen carries the maximum daily vehicular traffic of 1225. Water transport is also being used as a major transport for carrying goods.

2.2 NEED FOR AN IMPROVED WATER TRANSPORT SYSTEM

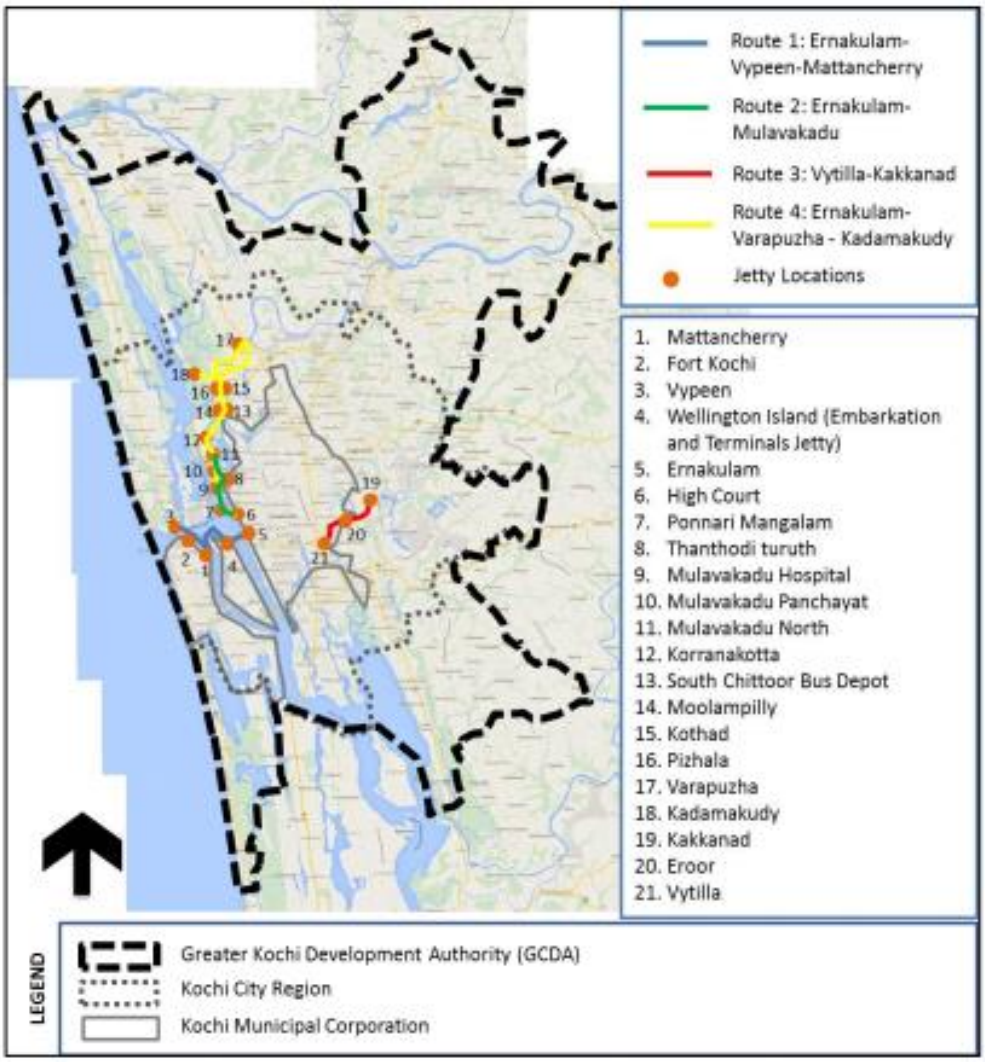
Though the city currently has a healthy share of public transport mode share of 51%, the number of people moved by each mode indicates that a significant 83% of the personalized vehicles carry only 29% of the passenger traffic whereas just 9% of public transport vehicles carry 67% of the passengers. This presents a scenario of private vehicles invading the road space of Kochi and the undue pressure on the existing public transport systems[2].

Despite the existing ferry services barely satisfy the safety norms and conditions, commuters from the island are dependent on them for their daily trips. There is a potential demand for travel between the island communities and from the island to the mainland. This demand has been identified as the major outcome from stakeholder consultation meetings and the interaction with panchayat officials. With some of the islands being solely dependent on the ferry services, it becomes further important to improve the ferry services. With an improved water transport system it would be able to retain the captive users as well as draw in people from the road based public transport system and a section of private vehicle users, thereby reducing the pressure on the road network and increasing the potential user pool.

[1] Study on Inland Water Transportation in Kochi City Region.

[2] A study on inland water transportation in Kochi city region, 2012

Figure 1 : Existing Operational Ferry Routes and Jetty Locations in Kochi



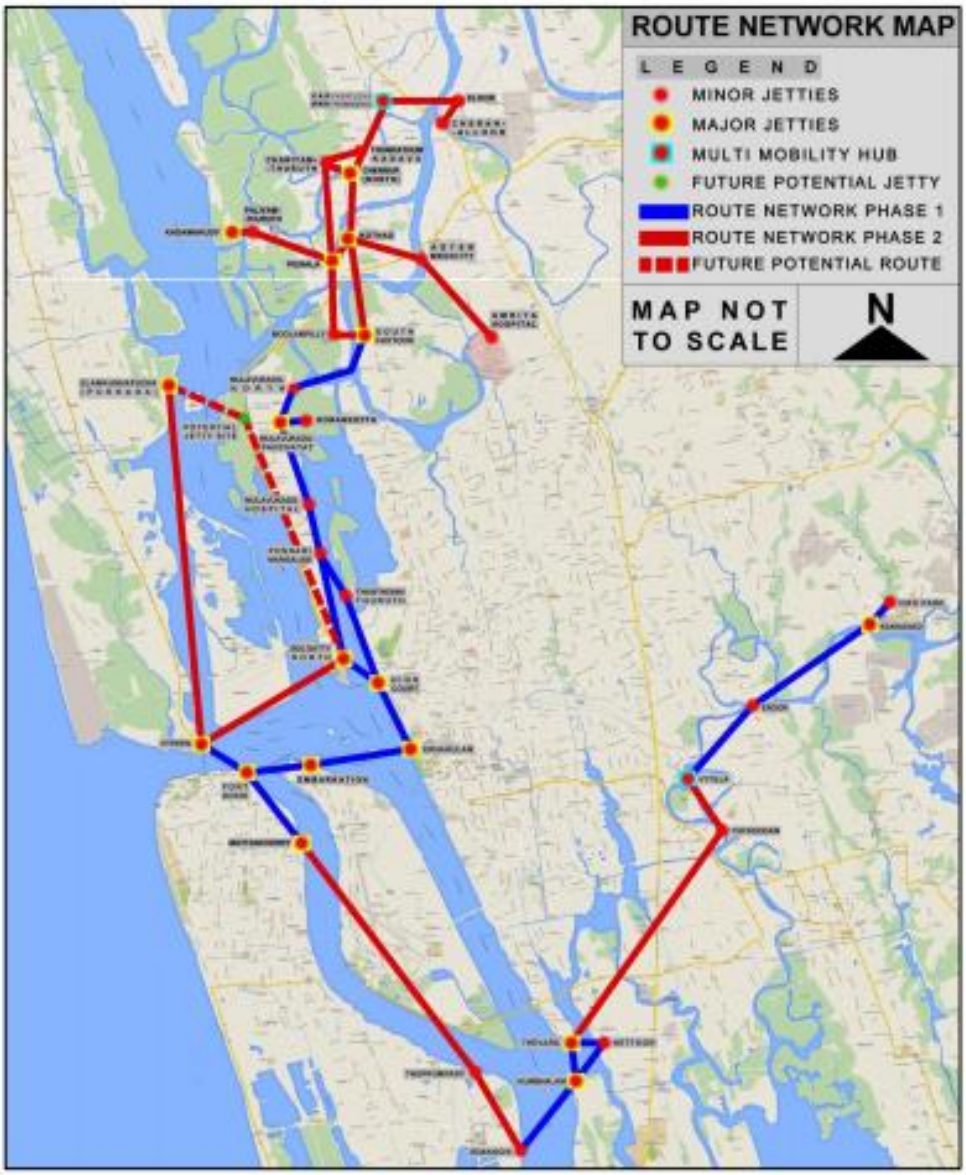
Detailed analysis of the ferry transport routes, includes the travel pattern of the users, evaluation of the existing routes, study of the population and employment trends and land use distribution and physical verification are carried out. Based on the outcomes of these studies it was decided that the ferry system would be upgraded with a concept of one island, one hub concept. For the similar purposes 16 routes are identified initially, with an objective of reviving the passenger water transport within the backwaters of Kochi[3]. The routes were assigned to provide connectivity as well as accessibility to the various destinations within the city. **Table 1** gives details about identified routes and **Figure 2** shows the identified water transport network map. On evaluation of the identified routes, it was observed that the system would have the potential to cater to the 1,50,000 passengers on a daily basis in the optimistic scenario for 2035, yet it was considered that the realistic scenario would be the ideal development scenario for Kochi Water Transport, it shall cater to approximately 86,100 passengers on a daily basis.

[3] DPR of Integrated Inland Water Transport, UMTC

Table 1 : Identified Water Transport Routs

Route	Origin	Destination	Route Description	Route Length (km)
1	South Chittoor	Ernakulam	South Chittoor, Mulavukadu Panchayat, Poonarimangalam, Thanthoninthuruth	8.20
2	Edakochi	Thevara	Edakochi, Kumbhalam, Thevara	3.74
3	Ernakulam	Vypeen	Ernakulam, Embarkation Jetty, Fort Kochi, Vypeen	6.40
4	Ernakulam	Mattancherry	Ernakulam, Embarkation, Fort Kochi, Mattancherry	6.10
5	High Court	Mulavakadu	High Court, Bolgatty, Thanthoninthuruth, Poonarimangalam. Mulavukadu Panchayat, Mulavukadu Hospital, Korrankota, Mulavukadu North	11.00
6	Vytilla	Info Park	Vytilla, Eroor, Kakkanad & Info Park	8.00
7	Kumbhalam	Thevara	Kumbhalam, Nettoor, Thevara	4.00
8	Info Park	Edakochi	Info Park, Vytilla, Kakkanad, Thykoodam, Thevara, Kumbhalam, Edakochi	12.60
9	Mulavukadu	South Chittoor	Mulavukadu Panchayat, Moolampilly, Pizhala, Kothad, South Chittoor	8.00
10	Edakochi	Vypeen	Edakochi, Thoppumpady, Mattancherry, Fort Kochi Vypeen	13.60
11	South Chittoor	Cheranalloor	South Chittoor, Moolampilly, Pizhala, Kothad, Chennur, Varapuzha, Eloor & Cheranallur	6.00
12	Elamkunnapuzha	High Court	Elamkunnapuzha - Mulavukadu West, Bolgatty, High Court	15.00
13	Kadamakudy	Paliyamthuruth	Kadamakkudy- Paliyam Thuruth (Pizhala Island) - Korhad	6.00
14	Chennur	Thundathumkadavu	Chennur North-Chariyam Thuruth North-Thundathum Kadav.	3.00
15	Chariyamthuruth	Chennur	Chariyam Thuruth South- Pizhala Hospital - Chennur South	3.00
16	Kothad	Amrita Hospital	Kothad - Medicity Hospital-Amrita Hospital.	3.00

Figure 2 : Identified Water Transport Network Map



2.3 IMPLEMENTATION PLAN OF WATER TRANSPORT SYSTEM

The entire Inland Water Transport project is proposed to be implemented over a period of four years between 2016 and 2019. Based on the demand, the identified 16 routes have been prioritised under Phase I and Phase II. The entire water transport system (with the identified 16 routes) is proposed to be operational by 2019. The phasing plan of the identified routes is given in **DPR in Chapter Number 6**. During the phase I (2016-17), it is proposed to operate 7 routes with a fleet requirement of 43 boats, of which 14 are 100 pax boats and 27 are 50 Pax boats and 2 boats as spare. In Phase II (2018-19), it is proposed to operate all the identified 16 routes (7 routes of Phase I and 9 routes of Phase II) with a total fleet requirement of 78 boats, of which 22 boats are 100 pax and 53 boats are 50 pax and 3 boats as spare. It is proposed that 18 jetties would be developed as major jetties and the rest 20 as minor jetties. Of the 18 major jetties, 3 of the major jetties will be developed as part of the second phase, the three jetties being Elamkunnapuzha, Kadamakudy and Varapuzha, and the 7 minor jetties that shall be taken up as part of Phase II development are: Amrita Hospital, Chariyamthurutu, Cheranaloor, Eloor, Aster Medicity,

Paliyamthuruth and Thundathukadavu. The detailed description is given in **DPR in Chapter Number 6**.

Along with the jetty development boatyard at Thevara, is proposed to be upgraded and developed with all repair and maintenance infrastructure for periodic maintenance and upkeep of the vessels. A new boatyard is proposed at Pizhala Island which will be a floating dock with provisions for scheduled annual maintenance only.

2.4 MAJOR ACTIVITIES

The water transport system envisaged for Kochi focuses not only on the ferry services as the mode for public transportation but also envisions a holistic development of the areas being connected by waterways as well as integrating the waterway system as a part of the entire public transport system of the city. Apart from the ferry service development, the project also looks into developing the existing and new roads providing increased access to the jetties and also within the islands, ensuring safety and security to all its users by way of active and well lit streets, promoting use of small occupancy feeder modes to access the jetties, promoting property development around the jetties and place making. It is being planned to be a user oriented and socially inclusive transport system, rather than being just a point to point service. It is also part of a bigger concept of seamless integration for the city.

The development and upgradation of boat jetty locations will also include accessibility infrastructure development like widening of the access roads, wherever possible, disabled friendly access design, pedestrian and cycling infrastructure, place-making, provision of parking spaces for private vehicles, encouraging public bike sharing schemes etc., for overall development of the jetty area. Apart from the above, it is important to develop allied infrastructure which enhances the commuters' ability to use this infrastructure such as providing feeder modes to access the jetties/hubs, signages, appropriate street lighting and security and safety provisions, and induced landscaping and street furniture to make the transit points attractive and interactive.

3. NEED AND OBJECTIVES OF ESIA

Inland passenger Water Transport (IWT) project implementation may create a diverse range of impacts on the environment and society, ranging from being temporary and short term to permanent and long term. The construction work, dredging, reclamation, landfills, discharges from boats and other Jetty related activities have potential adverse effects which encompass air pollution, noise and vibration, visual pollution, water pollution, contamination of bottom sediment, loss of bottom habitat, damage to marine ecology and fisheries, current pattern change, waste disposal, oil leakage and spillage, hazardous material emissions. The socio economic structure around the project may get affected because of loss of land, structure, income source and influx of travellers. Hence, study of potential impacts on environmental and social perspective becomes an important step, which helps in minimising the environmental and social impacts caused due to upgradation of capacity of existing jetties and construction of new jetties.

Objectives of this report are:

- Review of Legal Framework relevant to the project from Environmental and Social perspective pertaining to Indian Government and donor institution requirement.
- Basic impact and mitigation identification
- Provide TOR for further detailed Environmental and Social Impact Assessment (ESIA)

4. METHODOLOGY

Building Environment India Pvt Ltd (BEIPL) was appointed to work on Environmental and Social Aspects for this proposed Integrated Inland Water Transport project in Kochi. BEIPL carried out 4 days site survey from 30th June to 4th July 2015 to understand the project features. The study relies upon extensive review of secondary data, people's observations about the ferry system recorded through primary surveys, group discussions and observation studies to address Environmental and social issues of the project.

4.1 SITE SURVEY:

Site visit was conducted as part of the study to understand the existing physical infrastructure conditions and service frequencies and environmental and social settings of the functional routes. Total 36 jetties are covered during site visit.

The major findings of the site survey are;

- It was observed that the existing jetties are built with cement concrete and are in a dilapidated condition
- Only few ferry services are in operation with lesser capacity irrespective of demand
- Immediate habitation at most of jetty locations towards landward side and no land for appropriate development
- Access to these jetties is currently in a dilapidated shape or in a state wherein the potential users also do not use it for reasons such as poor lighting, safety and security concerns
- Lack of access roads as well as access modes in case of higher distances between the origin or destination point and the jetty locations.
- Fishing activity is observed in the navigation routs. Local fishermen use Chinese nets.

For details of the survey carried out **Please Refer Annexure I**.

4.2 SECONDARY DATA COLLECTION:

The study begins with setting the context of the project by review of data made available by KMRL. This is done with the purpose of understanding how the water transportation sector has been perceived in the past and what direction has it been offered by planners. Major list of secondary data was prepared and discussed with KMRL officials. Accordingly BEIPL team with KMRL officials approached to Central Marine Fisheries Research Institute (CMFRI), Census Department of Municipal Corporation, Inland Water Authorities of India (IWAI), Kerala Pollution Control Board (KPCB).

Many of the details from CMFRI for fish yield and marine fish landing centres collected mainly for the Fort Kochi, Vypeen and Thoppumpady. Household's details received from Municipal Corporation. Noise and vibration levels / standards related to different craft types and sizes at existing jetties details are referred from the Indian Register of Shipping, 2015 and National Environmental Engineering Research Institutes reports**.** Introductory environmental conditions are well studied from the report of Water and Air quality Directory, 2013 collected from KPCB.

BEIPL experts composed the details on biodiversity, historical monuments and cultural sites and meteorological related data along with the natural risks in the area like Floods, sea level and tidal levels from official websites of IMD, Municipal Corporation, IWT report of Kochi. Available environmental and social reports on IWT in Kerala are referred for the study.

Noise and air emissions prescribed for boats as per Indian Register for shipping are referred. For the calculations of water, wastewater, solid waste including E-waste and construction waste National Building Code (NBC), 2005 are referred.

4.3 PUBLIC CONSULTATION:

A major part of this study consisted of seeking public perception about the ferry service in Kochi. This was sought to be achieved through focus group discussion, interaction with passenger associations and primary survey. Stakeholders on the ground of water transportation consumers have been identified and their views have been recorded in order to understand their factual expectations. Total 20 individuals interviewed at three locations viz, Mulavakadu Panchayat, Pezzala and Kumbhalam Jetty.

The questionnaire had questions which enabled the collection of data regarding the age, income, occupation, origin, destination, last-mile travel modes, frequency of travel, problems, suggestions for improvement and willingness to pay for improved services among others. Based on the reconnaissance surveys and the data from the previous studies, it was noted that the commuters in these small islands of Kochi look out for connectivity to their origin and destination though not always by road. They are more concerned to the Inland transport facility with respect to the time saving, fares saving and safety. The findings have been outlined in detailed and concerns have been brought forward as a result of this exercise (**Please Refer Annexure II**).

5. EXISTING LEGAL FRAMEWORKS FOR EIA / SIA

Kochi Metro Rail Limited (KMRL) are the governing and executing bodies respectively for the IWT project. KSWTD regulates and is responsible for formulation of water front development policies and plans, regulating and overseeing the management of boat jetties. KMRL will be responsible for executing the project according to its own environmental and social policies. KMRL has developed its own Resettlement and Rehabilitation Policy which is based on

- Right to Fair Compensation & Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013 and
- World Bank Operational Policies and Procedures – Involuntary Resettlement OP 4.12.

Thus the IWT project needs to comply with KMRL R&R Policy and entitlement matrix. **Please Refer Annexure III for** KMRL R&R Policy.

It also needs to fulfil the requirements of KfW a German Development Bank, which is a signatory to the UNEP Statement by Financial Institutions on the Environment and Sustainable Development. KfW is committed itself to uphold the Equator Principles. Thus all nine PS of IFS, WB needs to be complied with while preparing and implementing the project. **Please Refer Annexure IV** for PS.

IWT needs to fulfil requirements of all state and national level environmental legal requirements which are briefly described in the **Table 2**.

Table 2 : Applicable legislations of the Government of India

#	Law / Regulation /Guidelines	Relevance	Applicable	Reason for application	Responsible Agency
1	The Environmental (Protection) Act. 1986, and the Environmental (Protection) Rules, 1987-2002 (various amendments)	Umbrella Act. Protection and improvement of the environment. Establishes the standards for emission of noise in the atmosphere.	Yes	All environmental notifications, rules and schedules are issued under the act	Ministry of Environment, Forest and Climate Change (MoEF), State Department of Environment, Central Pollution Control Board (CPCB) and Kerala Pollution Control Board (KPCB)
2	The Forest (Conservation) Act as amended in 1988	February 1998 MOEF circular on linear plantations on road sides, canal, railway lines.	Yes	Mangalwanan Bird Sanctuary near High court jetty which is within 10 km of project area	Forest Department
3	The Coastal Regulation Zone Notification, 2011	Controls development activities in coastal, backwater channels	Yes	Required for setting up, construction or modernisation or expansion of foreshore facilities like ports, harbours, jetties, wharves, quays, slipways, bridges, sea link, road	State Coastal Zone Management Authority, Kerala
4	The Water (Prevention and Control of Pollution) Act, 1974 as amended in 1978 and 1988	Central and State Pollution Control Board to establish / enforce water quality and effluent standards, monitor water quality, prosecute offenders, and issue licenses for construction / operation of certain facilities	Yes	Consent required for not Polluting ground and Surface water during construction. The depot activity is Orange category because of automobile servicing.	KPCB
5	The Air (Prevention And Control of Pollution) Act. 1981	Empowers SPCB to set and monitor air quality standards and to prosecute	Yes	Consent required for establishing and operation of D.G. Set, plants and crushers. The depot activity is Orange category because of automobile servicing.	KPCB
6	Noise Pollution (Regulation And Control) Act, 2000	Standards for noise emission for various land uses	Yes	construction machineries and vehicles to conform to the standards for construction	KPCB
7	The motor vehicle act 1988	Empowers State Transport Authority to enforce standards for vehicular pollution.	Yes	All vehicles used for construction and buses during operation phase will need to comply with the provisions of this act.	State Motor Vehicles Department
8	The Explosives Act (&Rules)1884 (1983)	Regulations as to regards the use of explosives during both construction and operation phase	Yes	Storage of fuel in Diesel/ CNG filling stations during operation Phase	Chief Controller of Explosives
9	Public Liability And Insurance	Protection to the general public from accidents	Yes	Hazardous materials may be used for	Chief Controller of

#	Law / Regulation /Guidelines	Relevance	Applicable	Reason for application	Responsible Agency
	Act,1991	due to hazardous materials		construction	Explosives
10	Hazardous Wastes (Management and Handling) Rules, 1989	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Hazardous wastes may get generated due to activities like maintenance, repairing of boats	KPCB
11	E-waste (M&H) rules 2011	Protection against electronic waste handling & disposal	Yes	The terminals / depots will have electronic equipment's during operation phase	KPCB
12	Batteries (Management and Handling) Amendment Rules, 2010.	Protection to the general public against handling and used batteries disposal	Yes	Batteries will be used for boats during operation phase of the project	KPCB
13	Chemical Accidents (Emergency Planning, Preparedness and Response) Rules,1996	Protection against chemical accident while handling any hazardous chemicals resulting	Yes	Handling of hazardous (flammable, toxic and explosive) chemicals during construction	District & Local Crisis Group headed by the District Magistrate and Sub District Magistrate
14	Municipal Solid Wastes (Management and Handling) Rules, 2000 and amended on July 2013	Protection against MSW during construction and operation phase	Yes	Handling of Municipal solid waste	KPCB / KMRL / KSWT
15	The Building & Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996	Employing Labour / workers	Yes	Employing labours workers	District Labour Commissioner
16	Environmental Impact Assessment (EIA) notification: 2006	Proposed activity may encroach and pollute environmental resources. Hence Environmental Clearance with proper impacts and mitigations	No	Apparently the construction area will not exceed 20,000 Sq. M. but clarification should be taken from State Environment Impact Assessment Authority(SEIAA)	SEIAA Thiruvanthapuram
17	Biological Diversity Act, 2000	Prevents undertaking biodiversity related activities without approval from the Authority	Yes	Existence of rich biodiversity	National Biodiversity Authority
18	International Environmental regulation	International environmental issues such as emission of greenhouse gases	Yes	Global environmental issues	KfW
19	ECBC: Energy Conservation Act, 2001(52 of 2001)	Energy consumption increases due to the equipment required in the maintenance, waiting rooms, rest rooms, external and internal lighting	Yes	Applicable to nonresidential buildings	KMRL / KSWT
20	Persons with Disabilities Act, 2011	The existing Persons with Disabilities should get Equal Opportunities, Protection of Rights and Full Participation	Yes	Applicable for disabled persons for employment opportunities	KMRL / KSWT
21	The Wetlands (Conservation And Management) Rules, 2010	To ensure better conservation and management and to prevent degradation of existing wetlands	Yes	Wetlands are in the project area	State Wetland Regulatory Authority

#	Law / Regulation /Guidelines	Relevance	Applicable	Reason for application	Responsible Agency
22	The Inland Vessels Act.1917 amended in 2007	Inland mechanically propelled vessel not to proceed on voyage or to be used for service without certificate of survey	Yes	Seeks NOC address extension of inland water limits, facilitating safety of vessels, controlling pollution and regulating the insurance regime	KMRL / KSWT
23	Ancient Monuments & Archaeological Sites & Remains Rules, 1959	Ancient Monuments and Archaeological Sites and Remains Rules, 1959 Permission	Yes	May be applicable as many heritage structures are present in project area	Archaeological Survey of India
24	Right to Fair Compensation & Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013	Displacement of people, structures and land acquisition	Yes	May be applicable as many structures may get displaced	KMRL / KSWT
25	World Bank Operational Policies and Procedures – Involuntary Resettlement OP 4.12.	Displacement of people, structures and land acquisition	Yes	May be applicable as many structures may get displaced	KMRL / KSWT

As part of the project preparations, following clearances and No Objection Certificates will be required:

- Tree felling permission from the respective Divisional Forest Officer
- NOC and Consents under EP Acts for Air, Water, Noise, Hazardous Waste rules of SPCB for establishing and operating plants from SPCB.
- PUC certificate for use of vehicles for construction from Department of Transport
- Explosive license from Dept. of Geology and Mines & Chief controller of explosives
- NOC for water extraction for construction and allied works from Ground Water Authority if used
- Clearance for location and layout of Worker's Camp, Equipment yard and Storage yard.
- Clearance for Traffic Management Plan for each section of the route after it has been handed over for construction.
- An Emergency Action Plan should be prepared by the contractor and approved by the Engineer for accidents before the construction starts.
- NOC from ASI, Kerala
- NOC from Forest Department
- Clearance from Kerala Coastal Zone Management Authority (KCZMA)

6. ENVIRONMENT EXAMINATION AND ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS

The present study is carried out through secondary data collection. Various Sources of pollution with respect to performance standards are discussed herein with details in both construction and operation phase. Given below is the list of various environmental and social impacts, which would be caused as a result of proposed project.

6.1 DESIGN PHASE IMPACTS

The planning and design of this project should be carried out by the project proponent while the construction works will be carried out by contractors and supervised by the project proponent. Design phase impacts are related to selection of sites, selection of technology and design of project. It is intended to engage consultants to undertake the environmental impact assessment (ESIA) study. Site selection and justifications, alternative site selections, technology should be studied in detailed in ESIA. The design of the system, including the exact siting of jetties, land development etc. shall take into account of local negative social (land acquisition/relocation etc.) and environmental effects. Consideration shall be given at the design stage in order to harmonize the jetty structure with the natural environment, such as floating pontoons.

6.2 PRE-CONSTRUCTION (SITE CLEARING AND PREPARATION FOR JETTY AND WATER CHANNEL) PHASE IMPACTS

Air and Noise Environment:
The evacuation and clearance of the project may contribute towards environmental degradation i.e. noise, water and air pollution. Land clearance for terminal construction would result in release of pollutants like NOx, SO2 gases and Particulate Matters by construction equipment. Noise pollution is another problem caused as a result of usage of construction equipment and crushers.

Land Environment:
Soil erosion may contribute towards increased sedimentation in the inland water bodies.

Terrestrial Ecology:
Primary data was not collected. Secondary data was referred for this section. Whatever was visually i.e. listed out which is meteorologically significant.

There are not many existing matured trees in all the proposed sites surveyed except for few Palm trees near the houses. The area is rich in avifauna like other parts of Kerala with many species seen in this region. There are no

other species of wildlife of importance than birds in the project area. Domesticated Ducks were common at Bolghatty, Pizhala, Malavukaddu and South Chittoor. During site clearing activities vegetation and Avifauna may be disturbed. Aquatic life observed is common in nature and do not harbour any endangered species. Avifauna observed were dominated by Brahminy Kites and Cormorants are also common and no endangered species were observed. Since this area is not a significant habitat of valuable flora or fauna, adverse impacts on the ecological environment are considered to be minor. EIA consultant needs to establish presence or absence of breeding ground existing within the activity zone as this study could not eliminate the possibility of the same.

Aquatic Environment:
Pre-construction activities may have some impacts like increase on sediment loads due to dismantling of jetties the impact would be of temporary nature. EIA study should identify and quantify the impacts in ESIA.

Archaeological and Historical Monuments:
Archaeological and Historical monuments are noted near Fort Kochi, Bolagatty and High Court Jetty. There may present historical or Archaeological structures near other jetties too. The consultant needs to identify impact on it due to air, noise or vibration during ESIA.

Socio – Economic Impacts
Access to some jetties pass through small agglomeration of houses and shops at present. Capacity enhancement of the jetties and access road will result in some resettlement of houses and income generation activities. So, consultant should consider both positive and negative impacts along with Resettlement mitigation and compensation procedures during ESIA.

6.3 CONSTRUCTION PHASE IMPACTS

Air and Noise Environment:
This phase involves transportation of construction materials to the project site . Various raw materials used during this phase include water, steel, cement, fly-ash, wood, glass, paints, polyvinyl chloride (PVC), rubber, etc. Usage of raw materials for the construction activity release dust emissions, SO2, NOx and particulate matters. The major noise generating sources will be DG sets, crusher excavators, crane, concrete mixer / dredgers etc., which may produce noise level in the range of 70-90 dBA and may increase the background noise levels. However, since these temporary works will be confined to the project area, disturbance to local people will be minimal[4]. **The floating pontoons are proposed hence no major air and noise pollution is envisaged during jetty construction.**

EMP should presumably set rules for max noise levels and times. ESIA should highlight areas particularly affected and principles of mitigation to be applied

Land Requirement and Soil Environment:
For the construction of the 38 jetties, about 1 acre of land will be acquired for each major jetty and 0.6 acre of land for each minor jetty. Extent and details of land acquisition are not known as conveyed by KMRL during the meeting with KMRL officials on 4th July 2014. Land acquisition process will be carried out by KMRL as it is executing body. Soil contamination may take place due to movement of vehicles, leakage of fuel or lubricants and solid waste generated from the labour camp setup during construction phase. **The impact would be significant at locations of construction phase primarily due to allied activities.**

Water, Wastewater and Solid Waste Management:
Establishment of a temporary workers' colony on the site would lead to release of sewage. This may lead to chances of spread of infectious water borne diseases due to unclean surroundings in the vicinity of the site. A detailed study shall be carried out in ESIA and appropriate mitigation shall be suggested. The total water

[4] As per Noise Pollution (Regulation and Control) Rules, 2000

requirement for construction labours is expected to be 855 KLD and water required for construction activity is expected to be approximately 1000 KLD[5].

The quantity of construction waste is expected to be 4750 tonnes (or 6790 cu.m) for all 38 jetties. Some demolition waste will be also be generated but cannot be quantified at this state. Unplanned disposal of these wastes will deteriorate the water quality present in the chosen site. The impact on soil would be due to disposal of solid wastes such as construction material, rubble, composite garbage and discarded topsoil. These should be addressed in ESIA.

Construction Waste for all 38 Jetties

As per DPR April 2015, 2500 Sq.m. area is assumed to be developed at each major jetty plus parking space for 30 cars & 100 two wheelers. Therefore, for 38 Jetties 95,000 Sq.m. area is assumed for construction waste calculations.

Table 3 : Construction Waste Calculations[6]

Particulars	Tonnes	Cum
PCC Waste	38	54
Concrete Waste	660	943
Reinforcement steel scrap	133	190
Brick Debris	252	360
Cement bags	888	1270
Tiles Waste	2290	3270
Glass Waste	242	350
Paint Cans	190	270
Wood Waste	57	81
Total	**4750**	**6790**
30% Waste reused on site	**1425**	**2035**
Remaining will be handed over for proper disposal	**3325**	**4750**

Demolition waste will be generated but at present land acquisition is in process and in absence of primary data, it can't be quantified.

Aquatic / Marine Environment:
Removal of some the existing jetties is likely to result in the loss of some sessile marine organisms attached to the old structure, and temporary loss of habitat for crabs, fish and other small mobile marine species. However, given the low tidal range at most of the jetties except for Vypeen, Fort Kochi, Mattancherry and few other jetties at the estuary mouth, the structures are likely to have only a small population of intertidal organisms such as barnacles and oysters. Any species present are likely to be ubiquitous around the harbour and hard substrates in nearby intertidal areas. It is likely that mobile species will move away during construction and that sessile organisms will re-colonise following the completion of works. This unavoidable impact is considered to be of insignificant magnitude and no management actions may be proposed.

The location of Jetty affects aquatic fauna and flora through changes of water quality, coastal hydrology and bottom contamination. Impact on bottom biota is usually linked to a reduction in fishery resources. Deteriorations of water quality usually give rise to change in biota. The proposed construction is mainly on landward side. Re-suspension of sediments in water leads to an increase in the level of suspended solid (SS) and the concentration of organic matter possibly to toxic or harmful levels. It also reduces sunlight penetration. There is a possibility of oil spills and leakage of other substances into water.

[5] Calculation based on information in DPR and use of NBC norms.

[6] Calculation based on information in DPR and TIFAC guidelines for construction waste

Dredging activity:
Construction work dredging disturb bottom sediments and induce re-suspension, dispersal and settlement of such sediments. Dumping of dredged material directly alters bottom configuration and biota and may disperse toxic or harmful chemicals around the disposal site. Dredging during construction might impact habitats of benthic and pelagic fauna, which gets recolonise with time. This impact is temporary and is not significant impact. ESIA should involve detailed analysis of sites and soil quality.

Community Health, Safety & Security Aspects:
This is a big project involving many construction labours and technical staff working together on the site. The risks related to the construction activities will affect the construction labours and technical staff. Effects on communities need to be considered. Therefore proper health and safety measures should be suggested in the ESIA as per the relevant rules & regulations.

Socio-economic Aspects:
Involuntary displacement of people on landward side, loss of households and shops is probably not avoidable. As the population density along the coast is, where proposed activity are considered, is high as per site observations. Moreover, all the above environmental impacts may affect the livelihoods and life styles of those depending on them. Fishermen may be affected if there is reduction in fish yields. Also current ferry services will be affected during the construction phase. To capture this impact a detailed social study should be carried out in ESIA.

Archaeological and Cultural heritage Aspects:
The historical sites like Fort Kochi, Mattancherry, Fort Vypeen Integrated Heritage Zone, Willingdon Island Heritage Zone, Ernakulum Central Area Heritage Zone, Canal & Backwater Network Heritage Zone, Mangalavanam Natural Heritage, Kochi Estuary Natural Heritage Zone are within 5 to 10 km radius of project area. Pressure will be created by influx of people on the landward side. This may leads to the potential damage to the physical fabric of archaeological remains, historic buildings or historic landscapes through air pollution, change of water-table, vibration, recreation pressure and ecological damage.

6.4 OPERATION PHASE IMPACTS

Air and Noise Environment:
In order to meet the transportation requirement, 43 boats are suggested in the first phase (2016-17). An additional of 35 boats are to be added to the fleet in Phase II (2018-19). During the horizon years of 2025 & 2035, depending upon the demand there would be a requirement of 12 boats and 33 boats to be added to the fleet. The berths are designed to have capacity of two variants of boats i.e. 50 and 100 PAX capacity. The pollutant emissions from the boats are estimated based on the emission factors for the pollutants SO2, NOx and PM10 with boats having PAX and the other of 100 PAX capacities. From the secondary sources[7] & [8] and preliminary assessment studies emissions for SO2, NOx and PM10 when 7 boats simultaneously berthed at one jetty are 28.4 $\mu g/m^3$ (Standard 80 $\mu g/m^3$), 3.0 $\mu g /m^3$ (Standard 80 $\mu g/m^3$) and 126.8 $\mu g/m^3$ (Standard 100 $\mu g/m^3$) respectively. Detailed air modelling should be carried out in ESIA.

The cumulative noise levels due to the combined operation of booster pumps, power generating units, dredgers, Boat loading/unloading and Diesel generators at the Terminals could be in the range of 70-75 dBA, which is predicted to be 50 dBA at a distance of 250 m and 44 dBA at a distance of 500 m from the sources (Standard 55 dBA for day time).

Water, Wastewater and Solid Management:
Possible discharges of waste water from boats that could be sources of water pollution are oily wastes, sewage, garbage and other residues like oil spills, lubricants and fuel may be the source of water pollution. As per DPR, population in the year 2035 is estimated 86,000. The total water required for passengers and staff expected

[7] (SKM, 2004: Port botany upgrade EIS-Air quality impact assessment commission of inquiry)
[8] NEERI, IWT Studies, 2014

as 3870 KLD. Out of which, 1720 KLD will be used for domestic purpose while 2150 KLD for flushing[9]. Sewage generated is expected to be 3483 considering 10% losses. Please see **Table 4**. If left untreated it poses a threat of eutrophication of the water bodies. In ESIA mitigation/avoidance should be dealt with.

Table 4 : Wastewater Calculations

Considering 86000 population in the year 2035 mentioned in the DPR Apr. 2015

Population	Domestic Norms	Flushing Norms	Domestic	Flushing	Total Sewage
86000	20	25	1720	2150	3483

The solid and hazardous wastes generated from boat and jetty operations will have to be disposed off properly to avoid land contamination.

These are passenger jetties and therefore solid waste will be generated from the activities of passengers & staff. The total quantity of this waste is estimated to be 21500 kg/day. Out of which dry waste will be 15050 kg/day and wet waste will be 6450 kg/day. Please see **Table 5**.

Table 5 : Solid Waste Calculations

Population	Dry Waste Norms	Wet Waste Norms	Total Waste Norms	Dry Waste	Wet Waste	Total Waste
86000	70	30	0.25	15050	6450	21500

There will be generation of e-waste resulting from scrapped/old printers, telephones, CCTV cameras, electronic ticket vending machines etc. In Phase 1, the total quantity of e-waste is expected to be 62.4 kg/annum. In Phase 2, the total quantity of e-waste is expected to be 219.2 kg/annum. If left untreated or disposed un-scientifically the waste would deteriorate soil and create unhealthy conditions. All the equipment details are referred from **DPR**.

Table 6 : E-Waste Calculations

Phase I	**Phase II**
Equipments Proposed Passenger information system : 22 Nos. Installation of CCTV: 22 Nos. Electronic ticket vending machine : 2 Nos. Total : 47	**Equipments Proposed** Passenger information system: 16 Nos. Installation of CCTV: 16 Nos. Electronic ticket vending machine: 16 Nos. Total: 48
E-Waste Calculation Passenger information system : Weight = 22*6 Kg = 132 Kg Installation of CCTV: 22 Nos. : Weight = 22*2.5 Kg = 55 Kg Electronic ticket vending machine: Weight = 2*60 Kg = 120 Kg Master Clock, telephone etc: Weight = 5 Kg **Total Weight = 312 Kg** 312 Kg weight generated from the 22 Jetties.	**E-Waste Calculation** Passenger information system : Weight = 16*6 Kg = 96 Kg Installation of CCTV: 16 Nos. : Weight = 16*2.5 Kg = 40 Kg Electronic ticket vending machine: Weight = 16*60 Kg = 960 Kg **Total Weight = 1096 Kg** 1096 Kg weight generated from the 16 Jetties. Therefore **219 Kg** / annum waste generated in Phase II @ 20%.

[9] Considering 15 litre/person/day

Phase I	Phase II
Therefore **62** Kg / annum waste generated in Phase I @ 20%.	

Dredging Activity:
Dredging activities in the intertidal and sub-tidal areas proposed for the development of the water transport will influence the local ecology and impact on the intertidal biota of the affected areas, loss of bottom habitat, number of bacteria, phytoplankton, zooplankton, and benthic organism. Effective sediment control measures would be needed before starting work, more to prevent the entry or re-suspension of sediment in the water body. Monitor and inspect sediment control measures regularly to ensure that they are functioning properly.

Biological Environment:

- **Fisheries**

As per available literature, in Kochi backwaters, 43 species classified as resident species are available round the year, 74 species classified as migrant species while 17 species are vagrant species. About 60 no. marine fish types and molluscs including, bivalves, gastropods, cephalopods are reported from the fish landings of Kochi Fisheries Harbour (Thoppumaddy), Vypeen & one fishing zone at Fort Kochi.[10] Among these three locations, the highest catch both in terms of number of types and density with fish number with an average value of 49 was at Kochi fisheries harbour followed by Vypeen with 45 and the location at Fort Kochi with 33 no. Oil Sardines and Penaeid prawns are found in high density at all the locations.

The Kochi fishery harbour is not among the proposed location and is 3km from Mattancherry and 5 km from Fort Kochi two of the proposed major jetties. Among the actual jetty sites, in the Kochi backwaters, no significant fishing zones are reported except for the traditional Chinese net fishing practices. Not many fishermen from the proposed jetties does not engage in fishing. **As there is no significant fishing zones reported in the vicinity of the proposed jetties, and considering the low fish catch at Vypeen known to involve in fishing activity no significant impact are envisaged on the fisheries from the proposed project.** This view is presumably preliminary. Justification will be given in ESIA.

- **Mangroves**

All along the proposed project route, mangrove species occur sparsely. As such the continental shelf at Kochi being narrow and steep, this entire region does not support any significant growth of mangroves. Mangalavanam mangroves situated behind the Kerala High Court building is known for its small bird sanctuary. The impacts of the operation of jetties proposed upgradation of jetty at High Court location shall be studied for any impacts on the mangroves or the bird sanctuary during ESIA.

The fact that this project will not directly impact on the mangrove communities in the proposed jetty locations, this project will not compromise the protection of significant and/or rare species inhabitating the mangroves.

- **Dolphins**

Although the backwaters of Kochi are known to harbour Dolphins, based on the survey and the location of the project no active siting of Dolphins are reported in any of the routes proposed for the project indicated. Even considering the presence of Dolphins in the proposed project route, no significant impact is envisaged as these routes are already in operation for time a very long time.

- **Water Weeds:**

Water Weeds can grow in large quantities near the jetties where boats are berthed. These weeds are Mosquito breeding grounds, nuisance to vessel operations along waterways.

- **Organic Matter and Nutrients**

[10] CMFRIA, 2014-2015 data

The release of organic rich sediments during dredging can result in the localized removal of oxygen from the surrounding water and the resuspension of sediments which may lead to the suffocation of marine animals and plants and Eutrophication within the localized area or may deter migratory fish or mammals from passing through. However, this removal of oxygen and turbidity from water is only temporary, therefore, in most cases if any effect on aquatic life it will be not significant.

The resuspension of sediments in other cases may increase organic material, nutrients and algal growth may provide food for zooplankton and higher organisms, thereby increasing the productivity of the marine ecosystem.

- **Oil Spill: Due to the Jetties Operations**

Regular boat operations and remote possibility at collusion or hitting against the wharf or boat getting grounded owing to natural calamity or piloting errors can lead to oil spill in the vicinity. ESIA should consider potential effects of oil pollution which are as follows:

- Aquatic animals and plants might be tolerant to low level concentrations of oil in sediments from chronic or small discharges, however this is not always the case;
- Prolonged exposure to major or minor oil spills can lead to mass mortality of benthic communities, fish, mammals and birds;
- Contamination of sediments with oil may modify chemical, physical and biological processes.
- In sediments, as it is organic, oil will be broken down relatively quickly by microorganisms which may result in the localized removal of oxygen from the sediments and surrounding water with possible effects on aquatic life;

Community Health, Safety & Security Aspects:

Keeping the above points addressed by the people who participated in the Public Consultation (PC) conducted by BEIPL we can conclude that the Water transport is most favoured mode of transportation in terms of fare and time. The major risks & problems involved could be due to Natural Calamities & the Monsoon period, which are the major reasons which could make the water transport impractical or unsuitable for the passengers. But on contrary the Geographical & Hydro-geological records or information about this area seems to be favourable to the water based transport like, the water transport is going to be an internalized channel & it will be channelized through the 'Back Water Channels'. Also the past history records & information collected from people it can be interpreted that from last 30 years there are no records of severe Natural Calamities like Tornadoes, Cyclones or Tsunami that could impact/ disturb the water transport & pose threat to people & livestock.[11]

However, health & safety of the passengers is of primary concern and required measures are to be taken to ensure that health and safety of people are not compromised at any end. Apart from this, for proper disposal of fuel & any chemicals at the time of construction & operation of new Jetties & upgradation of old existing Jetties there could be probable impacts on water hydrology & the people from the Fishing communities. At the time of PC it was noticed that the fishing activities are carried out by the people in the 'Back water channels' adjacent to their houses & they do their fishing activity in these water channels only.[12] Thus it needs to be verified for their impacts on the fishing activities in the dedicated project area. This information will give an idea about the impact of this project on the fisherman community as well as aquatic habitat during the construction period of the project.

Also the current jetties & the expected additional jetties will increase the load of fuel or other chemical during the construction & operational period of all these jetties. In order to minimize the load of pollution due to fuel or chemicals at present there are two Boat repair maintenance stations i.e. Jetty Depot stations are present viz; Vytilla & Pizhala. These existing maintenance depots are not highly equipped & with increasing the load of new Boats due to IWTS project theses depots needs upgradation, so that the water pollution due to fuel & or chemicals will be controlled.

[11] IMD data from net

[12] marine fish landing centre by CMFRI Kochi

Socio-economic Aspects:
It is expected that due to ease of movement and extra passengers there would be a general improvement of livelihood of all people. It was noticed that the people who participated in the PC were positively willing towards this project, as it will be a fastest & cheaper way of transport **(Please Refer Annexure II)**. The only issues or problems are lack of provision of good safety equipment, poor services & low frequency of the ferry boats. As the project envisions provision of these services it is expected to contribute the opportunities for women to access a safe public transport & use to it emancipate their social & economic rights. Thus this project will certainly have positive impacts on the various population groups of that area.

Increase in transient population in the project area, migration of workers may cause economic, social and cultural conflicts or displacement of local populations. There are indications that sections of the society that depend on traditional resources (like coir, bamboo, fishery, cashew etc.) for livelihood and the vulnerable sections like Scheduled castes and tribes in the state were left out from development experience. Further identification or to verify which tribes get affected & to what extend due to this IWTS project is necessary.

ESIA need to consider the impact of new / modified operations on income of existing ferry operators and look for income restoration operations if necessary.

Climate Risk Aspects:
Probable impacts of climate change on the coastal portions of the Kochi Corporation are sea level rise, accompanied by increased erosion or accretion of shorelines and incidence of water logging and flooding. Because most developed areas along the shoreline are no more than 1 meter above sea level, even a modest rise in sea level (0.3 to 0.5 meter) could bring some developed coastal areas under threat of inundation at high tide or during monsoonal storms. Additionally, saltwater intrusion into ground and surface waters would be expected to advance further inland. Hydrogeological modelling may be required. This needs to be looked into further and steps shall be taken to make the project more resilient to climate change impacts in ESIA.

Beach erosion is another concern, because it is already occurring on the sea margins of Fort Kochi / Mattancherry. The beaches along Kerala's coast, especially in the Kochi area, are of a barrier type backed by the seasonal occurrence of mud banks. Historically, erosion and accretion along the coast operated on a cyclical basis. However, in more recent times erosion has played the major role. Forecasts of more intense precipitation events as climate change occurs would appear likely to be associated with more intense wave activity, accelerating the coastal erosion rate, with all effects magnified by sea level rise.

Possible impacts of climate change, including increased variability of rainfall patterns and more intense short-duration events during the southwest monsoon—especially in combination with a rise in the water table associated with sea level rise—would be expected to cause more serious water logging, which promotes the accumulation of wastes in canals for longer durations.

This situation already contributes to disease outbreaks, and such impacts might become more frequent and severe. The combination of water stagnation, waste accumulation, and warm temperatures provide an excellent breeding ground for disease organisms and the disease vectors (mosquitoes, flies, and rodents) which can transmit the diseases to humans. The accumulation of solid wastes in water logged areas can also lead to increased leaching of pollutants from the wastes into ground water, leading to further pollution of land and water systems.

The water transport may get impacted in the event of coastal flood or floods due to extreme rains as the facilities such as jetties/ferries may get damaged. There could be reduced clearance in waterway and silt deposits which may hinder mobility.

Table 7 : Summary of Environment and Construction Phase Impacts

Parameters	Impacts Expected
Preconstruction Phase	
Air quality	Release of SO2, NOx and other pollutants as a result of site evacuation. Fugitive emissions due to crushing; vehicular emissions
Water quality	Disposal of construction effluents at various location of sites; release of sewerage
Land environment; soil erosion	Land clearance for construction of various infrastructure facilities Soil Erosion
Noise quality	Construction equipments; Crushing of the stones
Aquatic ecology	Changes in the water quality; change in the physicochemical environment, thus affecting the various species that are dependent on the marine water
Public health water borne disease	Increased chances of occurrence of water borne disease in the workers colony, lacking the sewerage treatment
Construction Phase	
Air quality	Usage of raw materials for the construction; transportation of these materials to the project site; dust emissions from dredging materials dumping
Land Environment	Tree cutting on the project site Soil contamination due to the construction materials, wastes generation
Water quality	Effluents released from various sources like worker camps, crushers etc released into water channels
Noise level quality	Noise from the equipments used
Muck disposal and solid waste	Muck generated from the construction site and allied activities Solid waste would be released from the worker's colony
Public health safety;	Minor accidents may occur at the project site during construction phase; occurrence of diseases in the workers colony
Dredging	Influence the local ecology and impact on the intertidal biota of the affected areas, loss of bottom habitat
Operational Phase	
Maintenance Dredging	Influence the local ecology and impact on the intertidal biota of the affected areas, loss of bottom habitat dust emissions from dredging materials dumping
Aquatic ecology	Changes in physical and chemical characteristics of the water would affect the local species of plants and animals as well as those present in the waterways Breakwater quality
Oil spillage	Chances of oil spillage from boat repairing, maintenance, operation of boats
Waste generation	Generation of solid waste and waste water from the terminal operations

7. SUGGESTED MITIGATION MEASURES

7.1 DESIGN PHASE

Measures to mitigate possible environmental impacts shall be incorporated in the design, and appropriate contract provisions should be included to minimize the possible impacts during the construction stage.

Selection of sites should be done considering the less land acquisition and social & environmental impacts. Technology of the jetty construction should be as such to reduce the major impacts on environment like proposed floating pontoons constructions instead of concrete jetty. Design of the project components should be such that best architectural design for energy saving, sustainability.

7.2 PRE-CONSTRUCTION PHASE

Air and Noise Environment:
In order to manage the impacts identified, necessary steps shall be taken. As mentioned earlier, this phase requires evacuation of site done and crushing of the stones. Risk assessment is an important step mandatory prior to any step taken for controlling pollution. Apart from this, safety precautions must be taken during construction to avoid major accidents. Provisions, like ear muffs and ear plugs, have to be supplied to the workers present in the site during the time of using the crushers to crush the stones. Periodic measurement of air quality and noise equivalent noise levels has to be monitored during daytime and night times and compare it with the standards as per National Ambient Air Quality Standards (NAAQS) as well as National Ambient Noise Quality Standards (NANQS), as specified by the CPCB.

Land Environment:
Boundaries of the construction area must be clearly marked prior to the commencement of vegetation clearance; Roads for construction access must be constructed to minimise vegetation clearance. Marine plants are only to be removed under appropriate approvals from the Administering Authority. Clearing and disposal of cleared vegetation shall be in accordance with the Administering Authority requirements. A comprehensive green belt programme is being planned which will help in improving the ecological condition of the region.

7.3 CONSTRUCTION PHASE

Air and Noise Environment:
Transportation of construction materials and the process of construction of the terminals lead to air pollution. Pollutants like Particulate Matter (PM, SPM), NOx, CO2, CO may be released. Any leakages of fuels from vehicles may result in pollution of groundwater as well as soil. Dust emission from vehicles as well as from raw materials like cement also contributes to air pollution. Necessary steps, such as regular water spray to minimise fugitive emissions and baseline ambient air monitoring given by CPCB, have to be taken to minimise the pollution generated during this phase.

Noise levels are to be checked and personal protective gears to be provided during periods of noise exposure. Maintenance of equipment and machinery are to be checked regularly. Measures have to be taken for the characterization and proper disposal of muck expected to be generated at various sites. A first-aid box needs to be provided at the construction site.

Water, Wastewater and Solid Waste Management:
The construction phase involves treating the effluents released from various sources such as worker camps, crushers, etc., before being released into the main stream, thus requiring construction of settling tank to precipitate suspended impurities. Septic tanks shall be provided thereby avoiding deterioration of water quality of the receiving water body. Solid waste disposal should be planned in a way proving harmless to the environment. Out of which 30% of waste i.e. 1425 tonnes (2035.71 cum) will be reused and remaining waste will be will be collected and kept in an identified location near to the site and then this will be handed over for proper disposal to the authorised vendor/municipality.

The waste will be generated from labour camps and presumably this will be controlled by establishing proper wastewater collection. EMP shall provide guidelines for establishment of workers camps and generation of solid waste and liquid waste. Facilities available for the hazardous waste, E-waste and solid waste management in the area should be identified and reported in the EMP.

Community Health, Safety & Security Aspects:
While constructing the jetty and terminals, safety precautions have to be taken for handling the construction materials by the workers. They should be provided with gloves while handling the paints and care should be taken

while carrying the materials made up of glass. This phase has a high risk for occupational hazards and hence, mitigation measures have to be planned accordingly.

Disposal of Dredge Spoil:
The dredged material can be safely transported back to the land and used for reclamation. The offshore disposal will be totally avoided.

Socio-economic Aspects:
Land acquisition is in process. The care shall be taken to avoid or minimise the displacement of households and other structures. In such case the Rehabilitation & Resettlement which will be in sink with the Kerala State Govt. policy. This Rehabilitation and Resettlement (R&R) Policy (The Policy) is being adopted by KMRL in order to address any adverse social and economic impacts accrued to identified families or persons in the Affected Area. This Policy has been developed generally in accordance with the requirements of the Right to Fair Compensation & Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013 (RTFCTLARRA, 2013) and the Agence Francaise de Developpement (AFD) social safeguard guidelines. The AFD adopts the World Bank Social Safeguard Operational Procedures to address involuntary resettlement issues under development projects globally (**Please Refer Annexure III**). The RTFCTLARRA, 2013 adheres to the requirements of the World Bank Social Safeguard guidelines also and thus the Policy has adopted the RTFCTLARRA, 2013 in general. If much displacement will occur on the project site during land acquisition then alternative land parcel shall be studied. Vulnerable household e.g. Below Poverty Line / woman headed households etc. needs to be identified and dealt with specially. Also the benefits provided to SC & ST groups under the State Govt. Labor workers can be employed from local people. Fisherman shall be provided with temporary alternative facility. Details should be studied in ESIA.

Archaeological and Cultural Heritage Aspects:
Further investigations shall be undertaken on the sites identified. The Contractors shall prepare a Cultural Heritage Management Plan to manage any sites that may be encountered during construction. If a historical, cultural, or archaeological relic is encountered, all construction activities should halt and the established action plan will be implemented. Work should recommence only after appropriate measures has been taken as requested by the appropriate authorities and confirmation is received that work may resume.

7.4 OPERATION PHASE

Air and Noise Environment:
Regular maintenance and cleaning of boats will restrict air and noise pollution. Also it is proposed to run the Boats on CNG to reduce air pollution. CNG stations shall be provided at major jetties / Boat Yards / Depots. Authorities should strictly monitor all operational phase activities and rules and regulations should be strictly adhered to. All environmental parameters must be checked regularly by an Environmental Safety Officer and should be maintained within permissible limits.

Wastewater and Solid Waste Management:
There will be provision of wastewater treatment at the jetties. STPs will be provided on the major jetty area while septic tanks can be provided at the minor jetties. The desired quantity and technology of STP will be estimated in detail later. The solid waste will be collected and segregated as dry and wet waste at the identified location on the site and then this will be handed over to the municipality for further processing and treatment. Dredging material generated during maintenance will be dumped on identified sites only. Detailed studies should be carried out in ESIA.

Aquatic / Marine Environment:
Construction works have the potential to impact on aquatic fauna especially Dolphins due to noise, disturbance of the sediment bed and other construction impacts such as accidental spillages and discharges. But considering that the proposed jetties will not involve any work at the site except the establishment involving insignificant noise only for a short time, hence no impacts are envisaged. To minimize any remote possible impacts on aquatic fauna including Dolphins in the vicinity, a number of management procedures should be put in place, including:

A nylon or HDPE cushion to be used between the hammer and pile to reduce hammer impact noise; Soft start procedures (i.e. commencing with reduced noise level to allow animals to move away from the area before increasing the noise levels gradually)

Biological Environment: Flora, Fauna and Ecosystems:
Careful survey of the ecological characteristics of the project area will be carried out and appropriate measures will be proposed for their conservation. Planting of appropriate plants around the jetties will be done as an effective means to mitigate adverse effects on terrestrial habitat.

Greenbelt proposal to be prepared and be implemented in the jetty premises as per the guidelines of State Pollution Control Board. Regular clearance of weeds to be carried out using weed harvesting machines to keep the waterways clear of water weeds.

Oil spill impacts to be mitigated by selection of low-emission power generators, where possible, selection of the most environmentally friendly alternatives for chemicals. With regard to accidental events, good operational practices should be adopted to avoid events that may escalate and lead to serious consequences to the environment.

Community Health, Safety & Security Aspects:

- **Passenger & staff safety:**

1. For the purpose of safety and security, CCTV surveillance systems shall be installed in each of the boats and at all appropriate locations in the minor as well major boat jetties. At the major boat jetties, these shall be appropriately installed so as to monitor the entire boat hub complex including the property development complex.
In emergencies or as required it shall be possible, without any additional resources, to view images from any/all cameras and/or record any dynamically selected location on the system at Central Control Centre. Intelligent Video Analytics shall be implemented on the proposed cameras. Different features of the video analytics shall include but not limited to:

- Intrusion detection,
- Unattended baggage detection,
- Crowd estimation and crowd management alarms for jetties/hubs,
- Line control,
- Counter flow detection overcrowding detection,
- Camera tampering alerts and
- Any other video analytic feature relevant to boat operation.
- Street lights
- Safe access to jetty

The Video Analytics functionality shall have mechanisms to continue alarm generation in case of failure of the Server. The Video Analytics shall not be bound to the MAC address of the device and hence any video analytics feature shall be possible to be deployed on any camera.

- **Transportation Safety:**

Intelligent Transportation and Navigation System a cellular communication (GPRS/LTE) based intelligent transportation and navigation system is recommended for implementation and integration of boat with other mode of transportation viz Metro Rail, Bus etc. Implementation of ITS is divided into the following categories:

- Global Positioning System (GPS) – on board and off board.
- Passenger Information System (PIDS/PAS) – on board and Boat jetties/Hubs.
- Master Clock.
- CCTV inside boats and at jetties/Hubs.
- Automatic Fare Collection System.
- Central Operational Control Centre.

All the boats proposed in this project will be provided with 'state of art' ITS equipment and navigation systems. Boats will be capable of sending information like diesel generator status alarms, fuel amount, engine temperature, altitude, reverse geocoding, cut off fuel, turn off ignition, battery status, GSM area code/cell code decoded, GPRS/LTE status, speed, location, no of passenger on board and a lot more to the Central operational Control Centre.

- **System Operational Safety:**

A central control facility comprising a LED based large video display is recommended for controlling the services. This shall act as a nerve centre of the entire system and associated services and shall provide the overall control and co-ordination of the system. It shall consist of all the necessary computing and communications hardware and software needed to fulfil this function. This shall have, at a minimum, the following:

- Control panels on which the location of all boats can be spotted and tracked during operating hours
- Monitors to which visuals of the actual ground position can be transmitted by cameras located at strategic points on the corridor
- Facilities for voice communication between the drivers and the control room as well as between hub/boat jetty supervisors and marshals and the control room
- Facilities to receive and transmit, as needed, all data being collected by the vehicle mounted units, fare collection units, cameras and all other hardware
- Report and alert operators to errors and faults with the Real Time Passenger Information System
- Collect, process and store data generated by the system

Socio-economic Aspects:

- To evaluate the ferry operators in the area so that they can be given the preference during operation of ferry
- To evaluate the socio-economic aspects of the local fishing community as well as the Tribal groups coming under the impact zone due to this project alignment.
- The results of local community survey, their current situation about livelihood, education & overall socio-economic status will guide us to plan a suitable R & R as per the local & state Govt. laws & regulations.
- Due to this project direct employment, indirect employment& other positive opportunities shall generate ancillary business to some extent for the local population.
- Also, during the construction activities some business opportunities will be available to local vendors for suppliers of materials and transportation, and for traders to cater to the employees requirements such as food, daily needs, and medical care.
- The project will have a positive effect due to improved transportation &communication and health services, which will lead to economic prosperity of individual – city – state - & eventually of Country.
- Proper displacement of PAPs in Port area will be planned with a Fair &Transparent policy.
- For the other Impacts like environment related or Social will be provided with appropriate solutions, so that the impacts of increased activity during the construction & operational period will be within acceptable limits on the locality.

Archaeological and Cultural Heritage Aspects:

The strategy to be adopted in respect of natural, manmade and historical precincts of Kochi is linked to the mechanisms for conservation without sacrificing economic productivity and harnessing the Tourism potential. Kochi Municipal Corporation (KMC) has already setup a centre for Heritage Studies. KMC has already drawn conservation practices and listed the permissible activities. The centre for Heritage Studies can also give guidance on façade treatment and general architectural control.

Climate Risk Aspects:

- Climate risk aspects should be taken into account like
- enhancement of flood defences such as sea walls,
- protection of coastal wetlands (as buffers),
- use of more durable materials in ferries, jetties, incorporation of higher levels of flooding into future bridge design, pontoons design and

- building of more redundancy into the system – Spare ferries

As construction phase is likely to cause most impacts details of the parameters likely to be affected by each of the activities taking place during construction of the port, with their impact characteristics and level of significance with low cost EMP are summarized in **Tables 8 and 9** for construction and operation phase**.**

Table 8 : Preliminary Impact Assessment during Construction Phase

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
Construction material handling and transportation	Air	Generation of dust from handling and transport of fine & coarse aggregate in uncovered trucks	Short term Negative Reversible	Low, by covering the trucks with tarpaulin sheets or by using water sprays
	Noise	Vehicular noise, use of excavation equipment	Short term Negative Reversible	• Low when trucks will carry material at fixed time • Periodical maintenance and speed control
Construction activities	Air	Fugitive dust emissions and dust generation from concrete mixing, cement handling, welding, operation of construction machinery	Short term Negative Reversible	• Low, by sprinkling water and wearing masks • Installation of dust extraction unit on the crusher • Baseline ambient air monitoring as per CPCB norms
	Noise	Use of construction equipment and power tools	Short term Negative Reversible	• Low when workers are provided with ear plugs • Continuous exposure to the noise levels above 90 dB (A) has to be avoided • Regular maintenance of equipments and machineries • Baseline ambient noise monitoring as per CPCB
	Soil	Excavation of soil	Short term Negative Reversible	• Selection of proper top soil storage • Adoption of soil erosion control measures i.e. engineering measures, vegetative measures, reduction on use of fuel wood and management measures
	Water	• Water utilisation for construction • Turbid runoff from construction site washings	Short term Negative Reversible	• Low, as groundwater shall not be tapped • Turbid runoff from construction site can be minimized by construction of small bunds
	Terrestrial Ecology	Clearing of vegetation	Short term Negative Reversible	As a part of Construction EMP, Construction contractor's plan shall identify specific techniques, practices and measures that will be utilized to minimize any adverse environmental impact during construction of the facility including those specified under mitigation measures and EMP.
Road Upgradation	Land and Aesthetics	Dumping of left materials	Short term Negative Reversible	The materials left in excess during the road construction are to be collected and dumped in the

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
				designated muck disposal. After disposal operation is completed at the dump site, dump yard has to be vegetated and contoured
Labour force	Water	• Exploitation of water resources for domestic usage • Disposal of untreated waste	Short term Negative Reversible	• Low, when workers are local, current usage pattern is maintained and when groundwater is not be tapped • Low, when wastewater is disposed with basic treatment such as soak pits
	Land / Aesthetics	• Springing up of temporary buildings / dwellings • Generation of solid wastes	Short term Negative Reversible	• Low, when proper collection and disposal is practised • Low, when hutments are within premises • Legally compulsory provisions on various factors such as health, sanitation and appropriate working conditions including accommodation must be adhered to Solid waste management – facilities for collection, conveyance and safe disposal of solid waste
	Socio Economics	Increased employment opportunities	Short term, Positive Reversible	Low, since employment is temporary
Dredging	Noise	Use of dredging equipment and power tools	Short term Negative Reversible	Low when Management of the dredging will be through a Dredge Environmental Management Plan (DEMP) to be developed by the contractor.
	Water	Sediment resuspension	Short term Negative Reversible	Medium for turbidity when the material is clay
	Sediment	Release of toxic substances and nutrients	Short term Negative Reversible	Low for toxicity when sediment toxicity is minimal
	Benthic Ecology	Disturbance of bottom sediments and/or destruction of spawning grounds	Short term Negative Reversible	Low, when commercially valuable species/ breeding/ spawning grounds are not present
	Land / water / Air	Dumping of dredged material	Long term Negative Reversible	Management of the dredging will be through a Dredge Environmental Management Plan (DEMP) to be developed by the contractor.
Land reclamation	Water	Sediment resuspension	Short term Negative Reversible	Medium for turbidity when the material is clay
	Sediment	Release of toxic substances and nutrients	Short term Negative Reversible	Low for toxicity when sediment toxicity is minimal
	Ecology	Loss of inter tidal area	Long term Negative Irreversible	Low since no major vegetation
	Shoreline	Material dumping	Long term Positive /Negative Irreversible	Low the dumping will be on authorised sites

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
	Socio-economic	Acquisition of land as well as other properties;	Long term Positive /Negative Irreversible	Increase in the employment potential Compensation as per the rehabilitation plan by the Government of Kerala, KMRL
Construction of Jetty	Noise	Floating Pontoons will be constructed hence no major noise is anticipated	Continuous for a Short period Negative Reversible	• Very low as no concrete structures will be constructed
	Water	Increased suspended solids and turbidity	Short term Negative Reversible	Low, since area of impact is localised and negligible
	Air	Floating Pontoons will be constructed hence no major noise is anticipated	Short term Negative Reversible	• Very low as no concrete structures will be constructed

Table 9 : Preliminary Impact Assessment during Operation Phase

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
Passenger, car and small vehicles boarding and alighting activities	Air	No impacts are envisaged	--	--
	Water	Spillage into the marine environment	Short term	• Low, since quantity of accidental spill is expected to be negligible with SOP
	Sediment	Accumulation in sediments	Short term	• Low, as spills if any will be minimum and localised
Maintenance dredging	Noise	Use of dredging equipment and power tools	Short term Negative Reversible	• Low when soil is soft, silty clay • Medium when noise sensitive marine species are present
	Water	Sediment resuspension release of toxic substances and nutrients	Short term Negative Reversible	Medium for turbidity when the material is clay
	Sediment	Movement of dredge spoils	Short term Negative Reversible	Low for toxicity when sediment toxicity is minimal
	Benthic Ecology	Disturbance of bottom sediments and/or destruction of spawning grounds	Short term Negative Reversible	Low, when commercially valuable species/ breeding/ spawning grounds are not present
Jetty Operations and ferry movement	Water	Water consumption, waste water generation Discharge of Ballast water and boat residues	Short term Negative Reversible	Negligible if Proper wastewater management system like STP Low if stick to the SOP
	Oil Spills	Oil spillage into water	Short term Negative Reversible	To manage accidental Spillages and Discharges (including Hydrocarbons), jetty operators will be required to provide detailed measures to minimize the risk of spills and contingency planning for spill response.
	Solid Waste	MSW, Hazardous waste generation	Short term Negative Reversible	Low if proper SWM plan followed. Regular cleaning and handover of MSW to Municipality Follow HW management rules 2008

Activity	Impacts		Impact Characteristic	Significance Level with EMP
	Parameter	Cause	Duration / Nature / Reversibility	
	Sediment	Release of toxic substances and nutrients into the upstream	Short term Negative Reversible	Low for toxicity when sediment toxicity is minimal
	Shoreline	Material dumping	Long term Positive /Negative Irreversible	Low proper SWM management and dumping on authorised sites

Please refer Annexure V for Proposed TOR.

ANNEXURE I:

All the surrounding details of the Proposed Jetties as seen during the Site Visit on 2nd and 3rd July 2014.

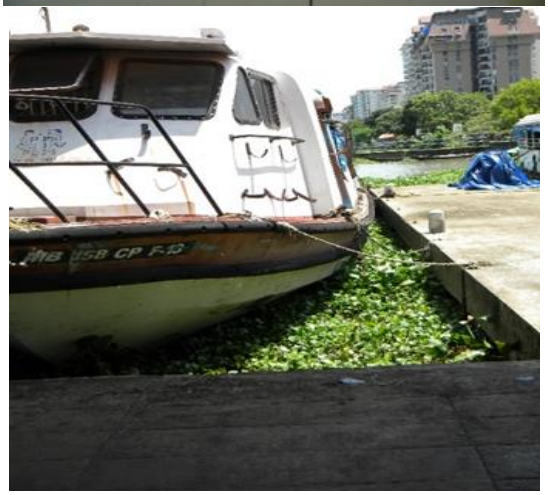
1. Ernakulam Jetty:

- There is some tree vegetation on the landward side of Ernakulam
- Small patches of luxuriant growth of water weed Echornia sps. is seen on both sides of the jetty where boats are anchored. Also in the immediate vicinity small amount of **Echornia** weed was observed.
- On the opposite side of the jetty are seen various boats anchored along with lot of oil tanks and containers. Also at much further distance there is a freight loading unloading area.









2. High Court Jetty:

- Being already operated jetty, boats are seen anchored at the jetty
- There are few trees on the landward side with large buildings in the vicinity
- The jetty is within a small distance from Ernakulam jetty





3. Bolgatty Jetty

- Bolgatty jetty is on the famous Bolgatty island known for its historic Bolgatty palace.
- There is a good amount of land vegetation on the landward side with few large matured trees on the Resort side of the island but near the Jetty it is the typical palm trees and the Thespesia populnae
- Many tourist boats are seen operated and anchored at this jetty.

4. Thuruth Jetty:









- This jetty is in the very close vicinity of some small houses and new construction in the background.
- Behind the houses some trees are present and further away from the jetty point a small grove of palm trees is visible.

- Most important thing in this area was the presence of many Chinese fishing nets and the presence of Brahminy Kites in and around these nets.









5. Mullavakadu Jetty:

- This jetty is in the midst of houses on all sides with a very narrow access road from the village.

- In the close surrounding of the jetty the water is quite turbid and is mostly covered with water weeds.
- In this area, a small traditional water raft is used for fishing who are immigrants from Andra Pradesh
- All along the route in this area many groves of palm trees were observed.









6. Mohambally Jetty:

- There is a good amount of land vegetation on the right hand side of the jetty
- On the Left hand side there is a shed and some small structures.

- The water in this area is very clean with no sign of any weeds









7. Pizhala Jetty:

- There is a good wide access road to this jetty and also large area leading to the jetty.

- Though there are small small houses/structures in the area close to jetty no much vegetation is present except for few palm trees.
- Towards the landward side, it is a thickly populated village.









8. South Chittoor Jetty:

- This is already well developed jetty with sheds for waiting passengers.

- Just behind the jetty is a large vacant area available with 2 carts selling fishes.
- This area was literally devoid of any tree vegetation in the jetty area and









9. Ellure Jetty:

- This is already an operational jetty.

- On the landward side there few small trees but slifghtly further away from the jetty point there is a luxuriant growth of water weeds
- On the landward side away fromm the jetty point are thickly grown palm trees.









10. Varvakuzha Jetty:

- This is a very small jetty crammed with hoses on both side.

- All along the edge of this jetty are palm trees.









11. Elampunnaakuzha Jetty:

- There is a bunded water body next to the existing jetty on the left side which is used for prawn/fish culture and on its edge there are quite a good amount of mangroves (major *Rhizophora* species) is observed. Further up towards the landward side is a dense patch of vegetation of mangroves with associated flora including palm trees.
- On the right side of the Jetty a large area was seen covered by *Eichornia* sps. and other weed (looks like sweet potato plant)
- People were seen fishing by boat and hand using lines.
- Only one traditional Chinese net was seen in the immediate vicinity
- There is a temple at a distance of about 50 m towards the landward side









12. Vypeen Jetty:

- The approach road to this jetty is very narrow with many closely situated houses on all sides
- Not much vegetation is there near the jetty except for the planted trees in the compounds of the houses.
- Lot of eichornia was observed in the near vicinity.









13. Fort Kochi:

The Jetty's entrance starts from the main road and has a passage with bicycles kept on both sides inside the passage.

- On the outside there are building structures on either side
- Some trees are seen alongside the passage
- A small patch of luxuriant growth of eichornia is seen where the boats are anchored









14. Mattancherry Jetty:

- The entrance to this jetty is from the road but there is a large area where presently vehicles are parked
- Few trees are present in the parking area
- There are immediate building structures to the parking area.
- On the opposite side of the jetty are seen various boats anchored along with lot of oil tanks and containers.









15. Kumballam Jetty:

- The Jetty point has alarge vacant area with no structures and any vegetation but few small trees are seen growing along the edge of the waterfront.
- A large patch of luxuriant growth of eichornia is seen on the right hand side of the jetty









16. Eroor Jetty:

- This is a small operational jetty
- Near the jetty a narrow strip of land presently used as a pathway seperates the village hoses from the jetty
- In the background a good amount of vegetation mostly of Thespia plant is seen





17. Kakkanad Jetty:

- Kakkanad is in a vacant area with well developed road
- Few palm trees are seen growing in the jetty area









18. Toodoor Jetty:

- This jetty is on the banks of a small creek and is not operational now.
- The waters in this area are clean
- All along the edges there are houses in the area









19. Vythylla Jetty:

- This is the only well developed jetty with an adjacent bus depot and police post already existing.
- The access road is well developed with a large vacant area in the surrounding
- Not many trees are seen in the vicinity of the jetty













20. Thevara Jetty:

- This small jetty with a very wide and well developed access road.
- There is a large vacant area in the surrounding which is conreted and n vegetation is visible in this area.









21. Thevara Boat Yard:

- The entrance to this jetty is a large undeveloped pathway
- The whole area is barren with some grass growing. Bordering this area are few well grown mature trees.









ANNEXURE - II

STAKEHOLDERS MEETING: OUTCOMES

1. VILLAGE NAME: MALAVUKADDU PANCHAYAT – MAJOR JETTY

Date: 2th July 2015
Stakeholders Present: Mr. V. S. Anzar (Sarpanch President from Jan 2015), Mr. Thomas (Assistant to Sarpanch President from Jan 2000)
BEIPL Team Members: Dr. Prajakta Kulkarni, Dr. Sandhya Clemente, Mr. Amol Kulkarni
KMRL Team Members: Mr. Nitin, Mr. Paul

Meeting Points:

Sr. No.	Discussion Points	Outcomes / Findings
1.	Population of the village	15,000 population of the village.
2.	Households	3000 to 4000 households.
3.	Major religions / communities / indigenous / tribal	60% Hindu, 30% Cristian and 10% SC population. No indigenous / tribal are recorded.
4.	Literacy / Education institutes / colleges	100% literacy. Schools are only upto 10th standard. For further education students need to go Ernakulum and court area.
5.	PHC, Clinics, Hospitals and other facilities	Only PHC is available in the village. For better treatment and serious health issues they have to go to Court jetty and Ernakulum jetty.
6.	Major Workers / source of income	Amongst 75% about 50% are manual workers 40% are government / private workers and 10% are fisherman.
7.	Fishing Activity / Major Fish Catch / permanent or Temporary	Traditional Chinese fishing i.e. artisanal fishing is in practice. Fishing is almost for commercial purpose.
		Prawns fishing is maximum
		No obstruction due to the boat operations. Fisherman doing fishing in dedicated areas.
		Fisherman are not permanently doing fishing as source of livelihood. Alternatively they are manual workers, labours especially during rainy season.
		Educated people / working people are also doing part time traditional fishing activity.
8.	Agricultural Activity / land	No agricultural land.
9.	Woman Workers	Amongst 50% manual workers 20% ladies are workers as housekeeping, construction labours and amongst 40% are government / private workers 15% ladies are working as sales girls.
10.	Skilled labours	Skilled labours are mostly Masson, shuttering workers. They get Rs. 800 /day.
11.	Alternative Source of income	Alternatively some people are having boats. Altogether there are 250 boats owned by some village persons amongst which only 50 are in operation for fishing.
		Amongst these 50 boats 25 boats are only used as tourist's boats

Sr. No.	Discussion Points	Outcomes / Findings
		About 80 persons are auto drivers and 100 persons are boat drivers.
12.	Boat repairing units / workshops	4 Boat workshops are existing. Tourist's boats come here for maintenance.
13.	Industrial units	No industrial units existing in the entire village
14.	Highest crowd on jetty	Highest influx or use of jetty during the Hindu festivals.
15.	Dependency on Boat Jetty	As boats are very less i.e. 2 boats only hence at present dependent on bus service, which is expensive and time consuming as compared boat services. It this jetty will upgraded then dependency on jetty will be more
16.	Major routs / area where people travel from this jetty	People from this village travel to Ernakulum, Malavukaddu hospital and Punnari Mangalam for work and education. From Punnari Mangalam to high court demand is very high.
17.	Fares and time required for water transport and road transport	From Malavukaddu to high court it takes half an hour to travel which is at 10 km distance and 10 rupees fare by bus. By boat the distance is 3 kms which takes 15 minutes to reach and fares are 5 rupees only. Special concession for handicapped.
18.	Other services like auto	Share auto from Punnari Mangalam to high court takes 10 rupees. No auto services from Punnari Mangalam to Malavukaddu.
19.	How many boats currently running through this jetty	Before 13 boats were running on this route. Now only 2 boats and hence people are suffering travelling problems
20.	Time of boats services	6:00 am to 9:00 pm
21.	Access Road to the jetty	Width of road to jetty is very narrow constructed under JNNRUM scheme. It will be upgraded under this IWT project. For parking no space is available. Hence want proper parking facility.
22.	Overall observation	Displacement of houses, shops may be happened. People are strongly in favour of this project. They want better services, more boats and upgradation of jetty. They find this service as safe transportation for all age-group people, economically feasible and time saving. Hence eagerly waiting for more number of boats and frequent schedule.

STAKEHOLDERS MEETING: PHOTOS









STAKEHOLDERS MEETING: OUTCOMES

2. VILLAGE NAME: PEZZALA – MAJOR JETTY

Date: 2th July 2015
Stakeholders Present: Mr. Unnikrishnan (Local Villager), Mrs. Uma (Shopkeeper at Jetty), Mr. Gopala (Common Villager, Student)
BEIPL Team Members: Dr. Prajakta Kulkarni, Dr. Sandhya Clemente, Mr. Amol Kulkarni
KMRL Team Members: Mr. Nitin, Mr. Paul

Meeting Points:

Sr. No.	Discussion Points	Outcomes / Findings
1.	Population of the village	5,000 population of the village.
2.	Households	1,500 households.
3.	Major religions / communities / indigenous / tribal	60% Hindu, 35% Cristian and 5% SC population. No indigenous / tribal are recorded.
4.	Literacy / Education institutes / colleges	100% literacy. Schools are only upto 7th standard. For further education students need to go Ernakulum and court area.
5.	PHC, Clinics, Hospitals other facilities	Only PHC is available in the village. For better treatment and serious health issues they have to go to Court jetty and Ernakulum jetty. Mobile boat PHC is available which comes once in a week.
6.	Major Workers / source of income	Amongst 80% about 50% are manual workers 40% are government / private workers and 10% are fisherman.
7.	Fishing Activity / Major Fish Catch / permanent or Temporary	Traditional Chinese fishing i.e. artisanal fishing is in practise. Fishing is almost for commercial purpose.
		Tiger Prawns, crabs, tilapia fishing is maximum
		No obstruction due to the boat operations. Fisherman doing fishing in dedicated areas.
		Fisherman are not permanently doing fishing as livelihood. Alternatively they are manual workers, labours especially during rainy season.
		Educated people / working people are also doing part time traditional fishing activity.
8.	Agricultural Activity / land	Paddy fields wetlands. Agriculture Activity only during rainy season. This also known as pokkadi farm. After rainy season fishing in coming backwater fishes.
9.	Woman Workers	Amongst 50% manual workers 20% ladies are workers as housekeeping, construction labours and amongst 40% are government / private workers 15% ladies are working as sales girls.
10.	Skilled labours	Skilled labours are mostly Masson, shuttering workers. They get Rs. 800 /day.
11.	Alternative Source of income	Alternatively some people are having boats. Altogether there are 100 boats owned by some village persons amongst which only 50 are in operation for fishing.

Sr. No.	Discussion Points	Outcomes / Findings
		About 80 persons are auto drivers and 100 persons are boat drivers with licence.
12.	Boat repairing units / workshops	No Boat workshops are existing.
13.	Industrial units	No industrial units existing in the entire village
14.	Highest crowd on jetty	Highest influx or use of jetty during the Hindu festivals.
15.	Dependency on Boat Jetty	At every 10 minuits boats are running on this route. As boats are very less i.e. 3 boats only at present. No bus service is existing. Hence very much dependency is on boat services.
16.	Major routs / area where people travel from this jetty	People from this village travel to Ernakulum, Kodad via Chittoor and High Court area for work and education. From Punnari Mangalam to high court demand is very high.
17.	Fares and time required for water transport and road transport	From Pizzala to high court and Ernakulum it takes 15 minuits and half an hour to travel respectively which is very time saving and less expensive. No other source of services. Special concession for handicapped.
18.	Other services like auto	No Share auto from high court or Ernakulum. If took individually then its fare will be Rs. 75 to 80 and takes 45 mints to reach.
19.	How many boats currently running through this jetty	Before 13 boats were running on this route. Now only 2 boats and hence people are suffering travelling problems
20.	Time of boats services	6:00 am to 9:00 pm
21.	Access Road to the jetty	Access Road width is good enough to sustain the coming load to the jetty. For parking no space is available. Hence want proper parking facility.
22.	Overall observation	Displacement of houses, shops may be happened. People are strongly in favour of this project. They want better services, more boats and upgradation of jetty. They find this service as safe transportation for all age-group people, economically feasible and time saving. Hence eagerly waiting for more number of boats and frequent schedule.

STAKEHOLDERS MEETING: PHOTOS









STAKEHOLDERS MEETING: OUTCOMES

3. VILLAGE NAME: KUMBHALAM – MAJOR JETTY

Date: 3rd July 2015
Stakeholders Present: Mr. Pilley (Local Villager), Mr. Thomas (Local Villager), Mr. Binu Kepi (Local Villager), Mr. Sabo T. M. (Local Villager), Mr. Subran K.K. (Local Villager), Mr. Sanu V. K. (Local Villager), Mr. V. A. Pundappan (Local Villager), Mrs. Shaylaja (Shopkeeper at Jetty), Mr. Sham (local Villager), Mr. Sijesh (Local Villager)
BEIPL Team Members: Dr. Prajakta Kulkarni, Dr. Sandhya Clemente, Mr. Amol Kulkarni
KMRL Team Members: Mr. Nitin, Mr. Paul

Meeting Points:

Sr. No.	Discussion Points	Outcomes / Findings
1.	Population of the village	20,000 population of the village.
2.	Households	5000 households.
3.	Major religions / communities / indigenous / tribal	60% Hindu, 35% Cristian and 5% SC population. No indigenous / tribal are recorded.
4.	Literacy / Education institutes / colleges	25% literacy. Amongst 25% only 100 people are teacher, doctors and engineers. Females are less literate. Schools are only upto 7th standard. For further education students need to go Ernakulum and court area. About 1000 students need to go outside of the village for education. About 50 school buses come for students. It consumes much time to go to school and come back.
5.	PHC, Clinics, Hospitals other facilities	Only one PHC is available in the village. For better treatment and serious health issues they have to go to Court jetty and Ernakulum jetty. No Mobile boat PHC is available.
6.	Major Workers / source of income	Amongst 80% about 75% are manual workers 15% are government / private workers and 10% are fisherman.
7.	Fishing Activity / Major Fish Catch / permanent or Temporary	Traditional Chinese fishing i.e. artisanal fishing is in practise. Fishing is almost for commercial purpose.
		Chiala, Aila, Tiger Prawns, crabs, tilapia fishing is maximum
		No obstruction due to the boat operations. Fisherman doing fishing in dedicated areas.
		Fisherman are not permanently doing fishing as livelihood. Alternatively they are manual workers, labours especially during rainy season.
		Educated people / working people are also doing part time traditional fishing activity.
8.	Agricultural Activity / land	Only 2-3% agricultural land are but no cultivation.
9.	Woman Workers	About 5% ladies are working in textile shop and as sales girls.
10.	Skilled labours	Skilled labours are mostly Masson, shuttering workers. They get Rs. 800 /day.

Sr. No.	Discussion Points	Outcomes / Findings
11.	Alternative Source of income	No such alternative source of income. No ship mechanics or boat drivers are recorded.
12.	Boat repairing units / workshops	No Boat workshops are existing.
13.	Industrial units	No industrial units existing in the entire village
14.	Highest crowd on jetty	Highest influx or use of jetty during the Hindu festivals.
15.	Dependency on Boat Jetty	At every 10 minuits boats are running on this route. As boats are very less i.e. 3 boats only at present. Only 2 buses run in the area. Hence very much dependency is on boat services.
16.	Major routs / area where people travel from this jetty	People from this village travel to Ernakulum and High Court area for work and education.
17.	Fares and time required for water transport and road transport	By road From Kumbhalam to Ernakulum the distance is 20Kms it takes 45 minuits. By boat it takes only 10 mins and distance is 5kms. No other source of services. Special concession for handicapped.
18.	Other services like auto	No Share auto from high court or Ernakulum. If took individually then its fare will be Rs. 75 to 80 and takes 45 mints to reach.
19.	How many boats currently running through this jetty	Before 13 boats were running on this route. Now only 1 boat and hence people are suffering travelling problems
20.	Time of boats services	6:00 am to 9:00 pm only 20 trips
21.	Access Road to the jetty	Access Road width is good enough to sustain the coming load to the jetty. For parking no space is available. Hence want proper parking facility.
22.	Overall observation	Displacement of houses, shops may be happened. People are strongly in favour of this project. They want better services, more boats and upgradation of jetty. They find this service as safe transportation for all age-group people, economically feasible and time saving. Hence eagerly waiting for more number of boats and frequent schedule. Janguar service is mostly in demand.

STAKEHOLDERS MEETING: PHOTOS

















KOCHI METRO RAIL LIMITED

A joint venture of Govt. of India & Govt. of Kerala

Rehabilitation & Resettlement (R&R) Policy for Kochi Metro Rail Project

March – 2015

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Kochi Metro Rail Project

Rehabilitation and Resettlement Policy and Entitlement Framework

1.0 DEFINITIONS

The definitions of various terms utilized in this policy are:

a) **Acquired land** means the land acquired under Land Acquisition Act 1894 or the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 for the Kochi Metro Rail Project or any other prevailing GOs.

b) **Agricultural Land** means lands being used for the purpose of (i) Agriculture or horticulture; (ii) Dairy farming, poultry farming, pisciculture, sericulture, seed farming breeding of livestock or nursery growing medicinal herbs; (iii) Raising of crops, trees, grass or garden produce; and (iv) Land used for the grazing of cattle;

c) **Affected Area** means such area as may be notified by the Government of Kerala under the relevant land acquisition acts for the purposes of land acquisition for the Project;

d) **Affected family** means:

i. A family whose land or other immovable property has been acquired for the Kochi Metro Rail Project;

ii. A family which does not own any land but a member or members of such family may be agricultural labourers, tenants including any form of tenancy or holding of usufruct right, share-croppers or artisans or who may be running a commercial establishment in the Affected Area, whose primary source of livelihood stand affected by the acquisition of the land;

iii. The Scheduled Tribes and other traditional forest dwellers who have lost any of their forest rights recognized under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 due to acquisition of land;

iv. Family whose primary source of livelihood for three years prior to the acquisition of the land is dependent on forests or water bodies and includes gatherers of forest produce, hunters, fisher folk and boatmen and such livelihood is affected due to acquisition of land;

v. A member of the family who has been assigned land by the State Government or the Central Government under any of its schemes and such land is under acquisition;

vi. A family residing on any land in the affected area for preceding three years or more prior to the acquisition of the land or whose primary source of livelihood for three years prior to the acquisition of the land is affected by the acquisition of such land;

e) **Family** means a person, his or her spouse, children, brothers and sisters dependent on him:

i. Provided that Widows/divorcees and women deserted by families shall be considered as separate families.

f) **Below poverty line or BPL Family** means below poverty line families as defined by the Planning Commission of India, from time to time, and those included in the State BPL list in force.

g) **Compensation** refers to the amount paid as compensation under various provisions of the Land Acquisition Act 1894 or RTFCTLARRA 2013, for private property, structures and other assets acquired for the project, excluding rehabilitation and resettlement entitlements as per this policy.

h) **Cutoff Date** is the date of Notification under Section 4(1) of Land Acquisition Act 1894 or Section 11(1) of the RTFCTLARRA, 2013.

i) **Displaced Family** means any Affected Family, (i) who on account of acquisition of land has to be relocated from the affected area; (ii) a family whose primary place of residence or other property or source of livelihood is adversely affected by the acquisition of land for the Project (iii) any tenure holder, tenant, lessee or owner of other property, who on account of acquisition of land in the affected area, has been involuntarily displaced from such land or other property; (iv) any agricultural or non-agricultural laborer, landless person (not having homestead land or agricultural land) rural artisan, small trader or self-employed person; who has been residing or engaged in any trade, business, occupation or vocation in the acquired land, and who has been deprived of earning his livelihood or alienated wholly or substantially from the main source of his trade, business, occupation or vocation because of the acquisition of land in the affected area

j) **Employee** means an individual engaged by a displaced commercial establishment in the Acquired Land, for compensation under a contract for employment whether oral or written, express or implied.

k) **Encroachers** are those persons who have extended their building, business premises or work places or agriculture activities into government lands.

l) **Land acquisition** means acquisition of land under Land Acquisition Act 1894 or under the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 or any other prevailing Government Orders.

m) **Minimum Wages** means the minimum wage of a person for his/her services/labour per day as per notification published by Department of Labour, Government of Kerala.

n) **Non-Perennial Crop:** means any plant species, either grown naturally or through cultivation that lives for a particular harvest season and perishes with harvesting of its yields.

o) **Notification** means a notification published in the Gazette of India, or as the case may be, the Gazette of State;

p) **Perennial Crop:** means any plant species that live for years and yields its products after a certain age of maturity.

q) **Project** means the Kochi Metro Rail Project covering 25.612 KM in the first phase from Aluva to Petta including the Muttom Depot.

r) **Rehabilitation and Resettlement** means carrying out rehabilitation and resettlement as per KMRL Policy on rehabilitation and resettlement or under Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 or as

per any other law in force as may be applicable for rehabilitation and resettlement benefits to be provided to the affected families.

s) **R & R Entitlements** means the benefits awarded as per the R & R Framework given in the KMRL Policy on Rehabilitation & Resettlement and as subsequently approved by the Government.

t) **Severance of Land** means a land holding divided into two or more pieces due to acquisition of land mainly for laying new project alignment or a re-alignment.

u) **Squatter** means those persons who have illegally occupied government lands for residential, business and or other purposes for a minimum of 3 years prior to 4(1) notification or 11(1) notification.

v) **State Government/Government** refers to the Government of Kerala**;**

w) **Tenants** are those persons having ***bonafide*** tenancy agreements for three years prior to the acquisition of the land, with a property owner with clear property titles, to occupy a structure or land for residence, business or other purposes.

x) **Vulnerable groups**: persons such as differently abled, widows, and women headed household, persons above sixty years of age, Scheduled Caste and Scheduled Tribes and other groups as may be specified by the State Government.

y) **Women Headed Household** means a family headed by a woman and does not have a male earning member. This woman may be a widowed, separated or deserted person.

2.0 INTRODUCTION

This Rehabilitation and Resettlement (R&R) Policy (The Policy) is being adopted by Kochi Metro Rail Limited in order to address any adverse social and economic impacts accrued to identified families or persons in the Affected Area. This Policy has been developed generally in accordance with the requirements of the Right to Fair Compensation & Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013 (RTFCTLARRA, 2013) and the Agence Francaise de Developpement (AFD) social safeguard guidelines. The AFD adopts the World Bank Social Safeguard Operational Procedures to address involuntary resettlement issues under development projects globally (given as **Annexure I**). The RTFCTLARRA, 2013 adheres to the requirements of the World Bank Social Safeguard guidelines also and thus the Policy has adopted the RTFCTLARRA, 2013 in general.

The Policy provides appropriate monetary entitlements to the Affected Families under each category of loss identified.

3.0 BASIC PRINCIPLES

The basic principles of the Policy are:

a) Transparency

b) Just and fair provisions to ensure rehabilitation and resettlement measures, commensurate with the hardships faced by the Affected Families, for mitigating the impacts of the acquisition or displacement.

c) Provide for improvement in the social and economic status of the Affected Families, post-acquisition.

d) Any amendments to RTFCTLARRA, 2013 or the rules thereunder that may be adopted/modified or amended by the Appropriate Government will be adopted by Kochi Metro Rail Limited from time to time, if such amendments casts an obligatory compliance requirement on the part of KMRL or in any manner increases the benefits available as per the Policy to any of the Affected Families.

4.0 OBJECTIVES OF THE POLICY

The main objective of the Policy is to appropriately identify, address and mitigate all adverse socio-economic impacts accrued to the communities, families or people due to the implementation of the Project.

5.0 GUIDELINES AND APPLICABLE ACTS

These include

a) World Bank Operational Policies and Procedures – Involuntary Resettlement OP 4.12 (at **Annexure I**)

b) The Right To Fair Compensation And Transparency In Land Acquisition, Rehabilitation And Resettlement Act, 2013 (RTFCTLARRA 2013) (at **Annexure II**)

c) Interim Resettlement and Rehabilitation Policy and Package for the Kochi Metro Rail Project, 2011 (at **Annexure III**) ; and

d) Rehabilitation and Resettlement Policy of Government of Kerala, 2011 (at **Annexure IV**)

Since the guidelines and principles of the international funding agencies (like the AFD – [which primarily adopts the World Bank Policies], World Bank, ADB, etc.) has been considered in the RTFCTLARRA 2013 hence the same has been taken as the guiding document for the preparation of the Policy. A brief description of RTFCTLARRA 2013 and World Bank Guidelines is given in **Appendix 1.**

6.0 METHODOLOGY

All the Affected Families along the metro corridor were identified based on the data available with the Revenue Department. A 100% survey was conducted for collecting relevant information directly from the Affected Families. Based on the survey, duly considering the relevant Guidelines and Acts, the impact of the project on each Affected Families were categorised and accordingly the R & R Policy is framed which also includes the R & R Entitlement Framework. In order to implement the R & R Policy and Entitlement Framework, an R & R Action Plan (RAP) report is also formulated.

The different categories of impacts that were identified has been classified under three categories, viz., loss of land, loss of structures and loss of livelihood. The quantification of the Rehabilitation and Resettlement entitlements for these losses has been done based on the provisions of schedule II of RTFCTLARRA 2013. The category of losses is tabulated in **Table 1**.

Table 1 : Category of loss under the project

Sl. No.	Category of loss	Description of the loss
1.	Land	▪ Agriculture

		▪ Non-Agriculture.
2.	Structures	▪ Owners and tenants (commercial and residential)
3.	Livelihood	▪ Due to direct loss of commercial property

In accordance with the above, the entitlements and provisions have been made in the Rehabilitation and Resettlement Action Plan that is being formulated for the Project. The entitlement framework that has been designed is based on the RTFCTLARRA 2013. The categories mentioned in Table 1 are in accordance with the categories provided in the entitlement framework (Section 8) of the Policy. Each category of losses for purpose of R&R entitlements are classified under two major categories, which include the titleholders (owners) and non-titleholders (Tenants in the commercial/residential properties, Encroachers and Squatters).

7.0 CORRELATION OF FUNDING AGENCY GUIDELINES WITH RTFCTLARRA 2013

In order to have an understanding of the correlation of provisions of RTFCTLARRA 2013 with the guidelines and principles of the international funding agencies (like the AFD – [which primarily adopts the World Bank Policies], World Bank, ADB, etc.), on the basis of which the Policy is framed, a comparative study of various guiding principles of these enactments were carried out as detailed in Appendix 2. The RTFCTLARRA 2013 incorporates all the guiding principles of the World Bank and hence the Policy is ultimately aligned with the RTFCTLARRA 2013. A brief on the RTFCTLARRA 2013 provisions is provided in Appendix 3 of the Policy.

8.0 RESETTLEMENT AND REHABILITATION

The Policy provides appropriate monetary entitlements to the Affected Families under various categories of loss detailed in the Policy based on the applicable guidelines and Acts. The adverse impact due to displacement caused by land acquisition for the Project on the various categories of PAPs has been identified and quantified. The provisions of Second Schedule of RTFCTLARRA 2013 have been adopted for quantifying the entitlements. The R&R Entitlement Framework covers all the categories of PAPs along with the R&R benefits for each such categories of Affected Families.

9.0 R&R ENTITLEMENT FRAMEWORK

The R&R entitlement framework has been formulated based on the guiding principles outlined in the Policy. This R&R framework will be adopted to formulate the Resettlement Action Plan. The R&R entitlement matrix includes various components of R&R benefits as provided in **Appendix 4**. This matrix addresses all categories of people being affected and all categories of impacts accrued to the affected families due to the Project.

Appendix 4 indicates the entitlements for all categories of impact as per the RTFCTLARRA 2013 and the AFD guidelines that are applicable for the Project. The same can be classified under three major categories of impact, viz, loss of land, loss of structures and loss of livelihood, which covers the entire gamut of the affected population.

The Compensation is provided as per the relevant laws of the land and hence is not covered in the policy. However the basic principles governing present Compensation structure for the Project is indicated in **Appendix 5**

10.0 RESETTLEMENT PLANNING

To achieve the objectives of this policy, the planning instruments used are:

a) The Resettlement Policy, which is required for providing basic policy guidelines for all Project operations that may entail involuntary displacement.

b) The Resettlement Action Plan which is required implementing the Policy

The full costs of resettlement and rehabilitation activities necessary to achieve the objectives of the project are included in the total costs of the project. The costs of resettlement, like the costs of other project activities, are treated as a charge against the economic benefits of the project; and any net benefits to resettlers (as compared to the "without-project" circumstances) are added to the benefits stream of the project. Resettlement components or free-standing resettlement projects need not be economically viable on their own, but they should be cost-effective.

11.0 IMPLEMENTATION AND MONITORING OF THE POLICY

In accordance with this Rehabilitation and Resettlement Policy, the Rehabilitation and Resettlement Action Plan (RAP) for the affected families will be devised. The RAP will provide the strategy for implementation of the Policy along with the institutional arrangements and the budgetary estimates for rehabilitation and resettlement packages, monitoring and evaluation as may be necessary for effective implementation of the policy. The monitoring of the implementation will be done by an appropriate authority/committee of KMRL. The external monitoring and evaluation of the RAP will be done third party agency as appointed by KMRL.

This Policy would ensure a fair and transparent rehabilitation and resettlement to all the affected families or persons as applicable. This Policy is adopted by Kochi Metro Rail Limited to provide rehabilitation and resettlement benefits as defined under the entitlement framework of this Policy.

APPENDIX- 1

BRIEF DESCRIPTION OF RTFCTLARRA 2013 AND WORLD BANK GUIDELINES

A) The Right To Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (RTFCTLARRA)

This Central Act ensures, in consultation with institutions of Local Self-Government and Gram Panchayats established under the Constitution, a humane, participative, informed and transparent process of land acquisition for industrialization, development of essential infrastructural facilities and urbanization. It also ensures that the same is achieved with the least disturbance to the owners of the land and other affected families and provide just and fair compensation to the affected families whose land has been acquired or proposed to be acquired or are affected by such acquisition. The Act also makes adequate provisions for such affected persons for their rehabilitation and resettlement and ensures that the cumulative outcome of compulsory acquisition should be such that the affected persons become partners in development leading to an improvement in their post-acquisition social and economic status and for matters connected therewith or incidental thereto.

The provisions of this Act Under Section 2(1) relating to land acquisition, compensation, rehabilitation and resettlement, shall apply, when the appropriate government acquires land for its own use, hold and control, including for Public Sector Undertakings and for public purpose. Under RTFCTLARRA, 2013 for land acquisition for various types of project, provisions of consent has been inbuilt to secure the interest of the stakeholders. The details of the consent are given in **Table 2** as follows:

Table 2 : Consent Requirements across Project Types and Sites

Project Type + Area	Consent	
	Land Owners and Tenants	Gram Sabha/ Panchayat/ Autonomous District Council
Public + Non-Scheduled Area	Not required	Not required
Public + Scheduled Area	Not required	Required
PPP + Non-Scheduled Area	Required (70%)	Not required
PPP + Scheduled Area	Required (70%)	Required
Private + Non-Scheduled Area	Required (80%)	Not Required
Private + Scheduled Area	Required (80%)	Required

i. "**Scheduled Areas**" means the Scheduled Areas as referred to in Clause (1) of Article 244 of the Constitution. The Act extended the provisions of Panchayats to the tribal areas of nine states that have Fifth Schedule Areas.

ii. **Panchayats (Extension to Scheduled Areas) Act, 1996 or PESA** is a law enacted by the Government of India to cover the "Scheduled areas", which are not covered in the 73rd amendment or Panchayati Raj Act of the Indian Constitution. It was enacted on 24 December 1996 to enable Gram Sabhas to self-govern their natural resources.[1] It is an Act to provide for the extension of the provisions of Part IX of the Constitution relating to the Panchayats to the Scheduled Areas.

Since the project type is public and the area wherein the project is being implemented is an urban area which is non-scheduled, consent is not required for this project.

B).World Bank Social Safeguard Policies—Policy Objectives and Operational Principles

The Operational Procedures (OP) is the Involuntary Resettlement OP 4.12. Description (as given in **Table 3**) of the operational principles includes:

Table 3 : Policy objectives and Operational Principles of the World Bank 4.12

Objectives	*Operational Principles*
Involuntary Resettlement OP 4.12	
To avoid or minimize involuntary resettlement and, where this is not feasible, to assist displaced persons in improving or at least restoring their livelihoods and standards of living in real terms relative to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.	1. Assess all viable alternative project designs to avoid, where feasible, or minimize involuntary resettlement.
	2. Through census and socio-economic surveys of the affected population, identify, assess, and address the potential economic and social impacts of the project that are caused by involuntary taking of land (e.g., relocation or loss of shelter, loss of assets or access to assets, loss of income sources or means of livelihood, whether or not the affected person must move to another location) or involuntary restriction of access to legally designated parks and protected areas.
	3. Identify and address impacts also if they result from other activities that are (a) directly and significantly related to the proposed project, (b) necessary to achieve its objectives, and (c) carried out or planned to be carried out contemporaneously with the project.
	4. Consult project-affected persons, host communities and local nongovernmental organizations, as appropriate. Provide them opportunities to participate in the planning, implementation, and monitoring of the resettlement program, especially in the process of developing and implementing the procedures for determining eligibility for compensation benefits and development assistance (as documented in a resettlement plan), and for establishing appropriate and accessible grievance mechanisms. Pay particular attention to the needs of Vulnerable Groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, Indigenous Peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation.
	5. Give preference to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
	6. For those without formal legal rights to lands or claims to such land that could be recognized under the laws of the country, provide resettlement assistance in lieu of compensation for land to help improve or at least restore their livelihoods.
	7. Disclose draft resettlement plans, including documentation of the consultation process, in a timely manner, before appraisal formally begins, in an accessible place and in a form and language that are understandable to key stakeholders.

Table 3 : Policy objectives and Operational Principles of the World Bank 4.12

Objectives	*Operational Principles*
Involuntary Resettlement OP 4.12	
	8. Apply the principles described in the involuntary resettlement section of this Table, as applicable and relevant, to subprojects requiring land acquisition.
	9. Design, document, and disclose before appraisal of projects involving involuntary restriction of access to legally designated parks and protected areas, a participatory process for: (a) preparing and implementing project components; (b) establishing eligibility criteria; (c) agreeing on mitigation measures that help improve or restore livelihoods in a manner that maintains the sustainability of the park or protected area; (d) resolving conflicts; and (e) monitoring implementation.

APPENDIX 2

Correlation of funding agency guidelines with RTFCTLARRA 2013

Objectives	AFD/ World Bank	RTFCTLARRA, 2013
i. Avoid involuntary resettlement	Involuntary resettlement should be avoided wherever feasible	Yes
ii. Minimize involuntary resettlement	Minimize involuntary resettlement by exploring all viable alternative project designs	Yes
iii. Mitigate adverse social impacts	Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits.	Yes
iv. Identify, assess and address the potential social and economic impacts	Through census and socio-economic surveys of the affected population, identify, assess, and address the potential economic and social impacts of the project that are caused by involuntary taking of land (e.g. relocation or loss of shelter, loss of assets or access to assets, loss of income sources or means of livelihood, whether or not the affected person must move to another location) or involuntary restriction of access to legally designated parks and protected areas.	Yes
v. Prepare mitigation plans for affected persons	To address the Project impacts, prepare resettlement plan or a resettlement policy framework prior to Project appraisal, estimating to the extent possible the total population to be affected and the overall resettlement costs.	Yes
vi. Consider alternative project design	Assess all viable alternative project designs to avoid, where feasible, or minimize involuntary resettlement.	Yes
vii. Involve and consult with stakeholders	Consult project-affected persons, host communities and local nongovernmental organizations, as appropriate. Provide them opportunities to participate in the planning, implementation, and monitoring of the resettlement program, especially in the process of developing and implementing the procedures for determining eligibility for compensation benefits and development assistance (as documented in a resettlement	Yes

Correlation of funding agency guidelines with RTFCTLARRA 2013		
Objectives	**AFD/ World Bank**	**RTFCTLARRA, 2013**
	plan), and for establishing appropriate and accessible grievance mechanisms. Pay particular attention to the needs of Vulnerable Groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, Indigenous Peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation.	
viii. Disclose and inform APs of RP and mitigation measures	Disclose draft resettlement plans, including documentation of the consultation process, in a timely manner, before appraisal formally begins, in an accessible place and in a form and language that are understandable to key stakeholders.	Yes
ix. Support existing social and cultural institutions of the affected persons	To the extent possible, the existing social and cultural institutions of resettlers and any host communities are preserved and resettlers' preferences with respect to relocating in pre-existing communities and groups are honored.	Yes
x. Build capacity of the borrower(s) in IR implementation	Financing of technical assistance to strengthen the capacities of agencies responsible for resettlement, or of affected people to participate more effectively in resettlement operations.	Yes
xi. Categorization	Categorization of the affected families is defined as titleholders, non-titleholders – including encroachers, Squatters, tenants, etc.	Yes
xii. Resettlement Plan	To cover the direct social and economic impacts that that are caused by the involuntary taking of land and/or the involuntary restriction of access to legally designated parks and protected areas, the borrower will prepare a Resettlement plan or resettlement policy framework . The RP or framework will include measures to ensure that the displaced persons are provided assistance during relocation; provided with residential housing, or housing sites, or as required agricultural sites; offered transitional support; provided with development assistance in addition to compensation.	Yes

Correlation of funding agency guidelines with RTFCTLARRA 2013		
Objectives	**AFD/ World Bank**	**RTFCTLARRA, 2013**
xiii. Supervision	The Bank regularly supervises resettlement implementation to determine compliance with the resettlement instrument.	Yes. Provision for R&R committee provided.
xiv. Monitoring Evaluation	The borrower is responsible for adequate monitoring & evaluation of the activities set forth in the resettlement instrument. Assess whether the objectives of the resettlement instrument have been achieved, upon completion of the project, taking account of the baseline conditions and the results of resettlement monitoring.	Yes
xv. Timeline for every process	World bank does not give any time schedule for activities	Under new LARRP, 2013 the act sets timeline for each activity and its process i.e. SIA, RAP, Compensation etc.

APPENDIX- 3

Summary of the RTFCTLARRA Sections as applicable		
Sl. No.	**Section**	**Description of the section**
1.	Section 4(1) – SIA notification	▪ Social Impact Assessment Study ▪ Total duration 6 months
2	Section 5	▪ Public Hearing for SIA
3	Section 6 (1)	▪ Publication of SIA
4.	Section 7(1) – SIA evaluation and approval	▪ Independent SIA Evaluation by Expert Group – 2 non official social scientist – 2 representatives of Panchayat, Gram Sabha, Municipality or Corporation – 2 experts on rehabilitation – 1 technical expert in subject area – Publication of recommendation

Summary of the RTFCTLARRA Sections as applicable

Sl. No.	Section	Description of the section
		– Total duration 2 months
8.	Section 8	▪ Examination of proposals for land acquisition and Social Impact Assessment report by appropriate Government
9.	Section 11(1) – Notice to acquire land	▪ Publication of Preliminary Notification for acquisition
10.	Section 11(5) – Land record Updation	▪ Updating Land records ▪ Total duration 2 months
11.	Section 14 – SIA lapse period	▪ If Section 11(1) not published within 12 months (18 months from the date of 4(1) notification) after the submission of SIA report under section 7, such report will lapse . Then fresh SIA to be done before acquisition under section 11. ▪ Appropriate government shall have the power to extend the period of 12 months
12.	Section 15(1) – Hearing of objections	▪ Within 60 days from the date of 11(1) notification
13.	Section 16(1) – Preparation of R&R Scheme by Administrator (by state notification not below the rank of Joint Collector or Additional Collector or Dy. Collector or equivalent official of Revenue Department to be the Administrator for R&R)	▪ After the publication of 11(1) notification by collector, Administrator for R&R shall conduct census survey of affected families.
14.	Section 16(5)	▪ Public hearing of R&R Scheme
15.	Section 16(6)	▪ Submission of draft R&R scheme to collector
16.	Section 17(1)	▪ Review of R&R scheme by Collector with R&R committee
18.	Section 18 – Approval of R&R scheme by Commissioner	▪ Officer off the rank of Commissioner or Secretary of that Government
19.	Section 19(1) – Publication of declaration and summary of R&R	▪ To be published within a period of 12 months from the notification under section 11(1) excluding stay or court order
20.	Section 19(7) – Lapse of notification under section 11(1)	▪ If no declaration is made within 12 months from the notification under section 11(1) excluding stay or court order
21.	Section 21(1)	▪ Notice to person interested for taking possession.
22.	Section 23	▪ Land Acquisition Award by collector
23.	Section 25 – Lapse of entire proceeding for acquisition	▪ Award to be made within 12 months from the date of declaration under section 19. (Appropriate government shall have the power to extend the period with justification).
24.	Section 31(1)	▪ R&R award by collector ▪ Collector shall take possession after ensuring 100% compensation payment and R&R entitlement or ▪ Tendered within a period of 3 months for compensation and 6 months for R&R entitlements.

Summary of the RTFCTLARRA Sections as applicable

Sl. No.	Section	Description of the section
25.	Section 38(1)	▪ Power to take possession of land to be acquired by Collector
26.	Section 38(2)	▪ R&R process to be completed in all respect before displacing the AFs
27.	Section 43(3)	▪ Formulation, Execution and monitoring of R&R scheme shall vest in the Administrator under the direction and control of Government and Commissioner R&R.
28.	Section 44(1)	▪ Appointment of R&R Commissioner
29.	Section 44(2)	▪ Commissioner will be responsible for supervising the formulation of R&R schemes or plans and proper implementation of such schemes or plans.
30.	Section 44(3)	▪ Commissioner shall be responsible for post implementation social audit in consultation with Gram Sabha in Rural areas and municipality in urban areas.
31.	Section 45(1) Composition of R&R committee: (acquisition of equal to or more than 100 acres of land)	▪ Chairman (Collector) ▪ Women representative residing in affected area ▪ Representative of ST &SC residing in the affected area ▪ Representative of NGO working in the area ▪ Representative of Nationalized bank ▪ Land Acquisition officer of the project. ▪ Chairpersons of the Panchayats or municipalities located in the affected area or their nominees. ▪ Chairperson of the District Planning Committee or his nominee. ▪ MP and MLA of the concerned area or their nominees. ▪ Representative of the requiring body. ▪ Administrator for R&R as member-convenor.

APPENDIX- 4

Entitlement Matrix					
Sr. No	**Category of Impact**	**Eligibility for Entitlement**	**Relevant RTFCTLARRA 2013 Provisions**		**KMRL Adopted Policy/Entitlements**
			Entitlement	**Provisions**	
1	**2**	**3**	**4**	**5**	**6**
Rehabilitation Package					
1.	Loss of Residential Structure	Title-holder of a Displaced Family whose residential structure is lost due to acquistion)	Provision of Housing unit in case of displacement.	▪ If a house is lost in ***urban areas***, a constructed house shall be provided, which will be not less than 50 sq. mtrs. in plinth area. ▪ Provided also that no family affected by acquisition shall be given more than one house under the provisions of this Act. ▪ Provided that any such family in urban areas which opts not to take the house offered, shall get a one-time financial assistance for house construction, which shall not be less than one lakh fifty thousand rupees. (Rs. 1,50,000) ▪ Explanation: The houses in urban areas may, if necessary, be provided in multi-story building complexes.	▪ **Rs. 1,50,000** will be given to all residential owners who are displaced due to lose of their housing units.
2.	Loss of Livelihood	Affected Family	Annuity or Employment (a) Job OR (b) 5 lakh one-time payment OR (c) Rs. 2000.00 per month for 20	a. Where jobs are created through the project, affected families will get after providing suitable training and skill development in the required field, make provision for employment at a rate not lower than the minimum wages provided for in	The head of the household of all Affected Families losing primary source of livelihood due to land acquisition will be provided with **Rs. 5,00,000** (per Affected Family as defined under the Policy).

			years (with increment) (the option of availing a, b, or c shall be that of the affected family)	any other law for the time being in force, to at least one member per affected family in the project or arrange for a job in such other project as may be required; or b. onetime payment of five lakhs rupees (**Rs. 5,00,000**) per affected family; or c. Annuity policies that shall pay not less than two thousand rupees per month per family for twenty years, with appropriate indexation to the Consumer Price Index for Agricultural Labourers (Refer: http://labourbureau.nic.in).	
3.	Loss of Livelihood	Displaced Family	Subsistence grant for displaced families for a period of one year (for the families displaced due to land acquisition)	Each affected family which is displaced from the land acquired shall be given a monthly subsistence allowance equivalent ***to Rs. 3000.00 per month for a period of one year*** from the date of award. **(3000 x 12months= Rs. 36000)** In addition to this amount, the Scheduled Castes and the Scheduled Tribes displaced from Scheduled Areas shall receive an amount equivalent to Rs. 50000. In cases of displacement from the Scheduled Areas, as far as possible, the affected families shall be relocated in a similar ecological zone, so as to Preserve the economic opportunities' language, culture and community life of the tribal communities.	Each Displaced Family will be provided with Rs. **36,000.** **a.** All Displaced Family belonging to the Scheduled Castes or the Scheduled Tribes shall receive an amount equivalent to fifty thousand rupees. **(Rs. 50,000).** b. This amount is additional to other rehabilitation measures being provided to all displaced families.
4.	Loss of Structure	Displaced Family	Transportation cost	Each affected family which is displaced	One time financial assistance of Rs.

			for displaced families.	shall get a one-time financial assistance of Rs. 50,000.00 as transportation cost for shifting of the family, building materials, belongings and cattle.	**50,000.00** for shifting family, building material, belongings and cattle shall be given to each Displaced Family.
5.	Loss of Structure	Affected Family	Cattle shed / petty shops	Each affected family having cattle or having a petty shop shall get one-time financial assistance of such amount as the appropriate Government may, by notification, specify subject to a minimum of twenty-five thousand rupees for construction of cattle shed or petty shop as the case may be.	Each Affected Family having cattle or having a petty shop in the Acquired Land shall get one time financial assistance of **Rs. 25,000.00** for re construction of cattle shed or petty shop as the case may be.
6.	Loss of Livelihood	Affected Family	One time grant to artisan, small traders and certain others	Each affected family of an artisan, small trader or self-employed person or an affected family which owned non-agricultural land or commercial, industrial or institutional structure in the affected area, and which has been involuntarily displaced from the affected area due to land acquisition, shall get one-time financial assistance of such amount as the appropriate Government may, by notification. specify subject to a minimum of Rs. 25,000.00	Each Affected Family of an artisan, small trader **o**r self-employed person or a Displaced Family which owned non-agricultural land or commercial, industrial or institutional structure in the Affected Area, shall get one-time financial assistance of **Rs. 25,000.**
7.	Loss of Land/Structure/Livelihood	Affected Family	One time resettlement allowance.	Each affected family shall be given a one-time "Resettlement Allowance" of Rs. 50000 only.	Each Affected Family will be given a one-time “Resettlement Allowance” of **Rs. 50000.**
8.	Loss of Livelihood	Employees	Not Covered	Not Covered	A onetime subsistence allowance of **Rs. 36000** to each Employee, who has been working for a minimum period of three years prior to the date of acquisition of the land, in a commercial establishment other than banks, financial institutions,

					companies incorporated under the Companies Act, shopping malls, cooperative societies, Public sector undertakings, Government organisations/ departments, Urban Local Bodies or an establishment which shifted its operations to another location.
9	Loss of Commercial Establishment(small)	Displaced Affected Family, being a small merchant or having a small Commercial establishment, in the acquired land.	Nil	Nil	The right of first refusal on allotments of commercial space being planned as part of the project in the Metro stations or in the adjoining area or being developed by KMRL for commercial purposes, provided the Affected Family had participated in the bidding process for allotment of such spaces and are willing to match the highest accepted financial offer. This entitlement will be limited to one commercial space per affected establishment, irrespective of the number of affected persons.
10	Land/Structure/Livelihood	Affected Family	Nil	Nil	Affected Family shall be given preference in employment opportunities in KMRL. This is subject to the availability of vacancies, suitability of the affected person for the employment and other requirement for employment being at par with other candidates. This entitlement is limited to only one person per Affected Family, within a period of 15 years from the date of

					the commercial operations in the first reach. The recruitment will be governed by the HR policies of KMRL on recruitment and the reservation policy of Government of India.

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APPENDIX 5 - Basic Principles Governing Compensation Structure

Sr. No.	Category of Impact	Eligibility for Entitlement	Relevant RTFCTLARRA 2013 Provisions	
			Entitlement	Provisions
1	2	3	4	5
1.	Loss of Land	Titleholder	1. Market value of land. This will be determined as per Sections 26 to 29 of LARR Act 2013 by Collector. 2. Amount equivalent to current stamp duty and registration charges on compensation amount for replacement of lost assets.	▪ Applicable as per RTFCTLARRA 2013. ▪ PAPs that have received the compensation on or before 31st December 2013 will be provided additional compensation as per RTFCTLARRA 2013. ▪ This is as per Section 24 of RTFCTLARRA 2013 wherein it is mentioned: *… Provided that where an awarded has been made and compensation in respect of majority of land holdings has not been deposited in the account of the beneficiaries, then, all beneficiaries specified in the notification for acquisition under section 4 of the said Land Acquisition Act, shall be entitled to compensation in accordance with the provisions of this Act.*
			Land Value factor	▪ Scale 1 to 2 based on the distance of project from urban area, as may be notified by appropriate government. Illustrative scale (0-10 km=1), (10-20=1.20), (20-30 km=1.40), (30-40 km=1.80), and (40-50 km=2).
		Affected Family/Person	Land for land	▪ Not applicable
2.	Loss of other Immovable Assets	Titleholder	Value of Assets attached to land or building	▪ This will be provided to affected families as per the RTFCTLARRA 2013 (provision under First Schedule Sl.No.2 (ref. Section 29 of the said Act). ▪ This will be provided along with the loss of land and/or the structure which will be finalised by the Collector (revenue department).
3.	Loss of Land, Structure and other immovable assets (1+2)	Titleholder	Solatium	▪ As per RTFCTLARRA 2013 – Under section 30(1) of the said Act. ▪ The compensation is calculated for land, structures

Sr. No.	Category of Impact	Eligibility for Entitlement	Relevant RTFCTLARRA 2013 Provisions	
			Entitlement	Provisions
1	2	3	4	5
				and such assets attached to the building or land as applicable and the total of all considered before considering the solatium.
4.	Loss of Land and other assets	Titleholder	Additional 12% on market value of land.	▪ In addition to the market value of land, additional **12% per annum** to be paid on such market value commencing on and from the date of publication of notification of SIA u/s (2) of section 4 in respect of land, till award or date of taking possession of land whichever is earlier.
5.	Land/Structure	Titleholder	**Stamp duty and registration fee.**	The stamp duty and other fees payable for registration of the land or house allotted to the affected families shall be borne by the Requiring Body.

ANNEXURE IV

Performance Standards for Environmental Screening Report

A screening study is required to initially determine the project's potential environmental and social impacts, identifying areas requiring further analysis, based on key Performance Standards (PS) and relevant national rules and regulations, in order to ensure the project compliance.

PS1: Assessment and Management of Environmental and Social Risks and Impacts

- Is the Project area adjacent to or within any of the following environmentally sensitive areas; (i) Cultural heritage site, (ii) Legally protected Area (core zone or buffer zone), (iii) wetland, (iv) mangrove, (v) Estuarine, and (vi) Special area for protecting biodiversity
- Are there social concerns relating to local inconveniences associated with ferry operation (e.g. increased volume of port traffic, greater risk of accidents, communicable disease transmission)?
- Will there be impacts on existing workers or industries that will be effected or displaced by project activities, or future operation.

PS2: Labor and Working Conditions

Will the project cause:

- Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STI's and HIV/AIDS) from workers to local populations?
- Creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents?
- Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?

PS3: Resource Efficiency and Pollution Prevention

Will the project cause:

- Increased air pollution due to project construction and operation
- Noise and vibration due to project construction or operation?
- Short-term air quality degradation due to dredging-related operations?
- Increased noise and air pollution resulting from airborne emissions (e.g. gas, smoke, fumes) from maneuvering and berthing ferries and the waterfront facilities?
- Deterioration of water quality due to ferry (e.g. ballast water, oil waste, lubricant and fuel spills, and sewage) and waterfront facility discharges?

PS4: Community Health, Safety, and Security

Will the project cause:

- Disproportionate impacts on the poor, women and children or other vulnerable groups?
- Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?

PS5: Land Acquisition and Involuntary Resettlement

- Will there be land acquisition and is the site for land acquisition known?
- Is the ownership status and current usage of land to be acquired known?
- Will there be loss due to land acquisition of (i) shelter and residential land, (ii) agricultural and other productive assets, (iii) crops, trees, and fixed assets, (iv) loss of businesses or enterprises, and (v) loss of income sources and means of livelihoods
- Is there dislocation or involuntary resettlement of people? (physical displacement and/or economic displacement)
- Will access to land and resources owned communally or by the state be restricted

PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Will the project cause:

- disturbance to precious ecology (e.g. sensitive or protected areas)?
- alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site?
- encroachment on precious ecology resulting in loss or damage to fisheries and fragile coastal habitats such as coral reefs, mangroves, and seagrass beds?
- short-term increase in turbidity and sunlight penetration as well as changes in sediment pattern and flows at dredging site?
- removal and disturbance of aquatic flora and fauna at dredging site?
- alteration of bottom surface and modifications to bathymetry, causing changes in tidal bore, river circulation, species diversity, and salinity?
- modification of terrestrial habitat by upland disposal of dredged material or covering of potential archaeological sites with dredge spoil?
- social conflicts if construction depletes local fishery resources on which communities depend for subsistence?

PS7: Indigenous Peoples

- Are there socio-cultural groups present in or use the project area who may be considered as "tribes", "minorities" (ethnic or national minorities), or "indigenous communities" in the project area?
- Will the project directly or indirectly benefit or target Indigenous Peoples or their traditional socio-cultural and belief practices?

PS8: Cultural Heritage

Will the project cause:

- impairment of historical/cultural areas; disfiguration of landscape or potential loss/damage to physical cultural resources.

(PS9) Climate risk screening

- Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?
- Would the project design need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?

- Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?
- Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s)?
- Would weather/climate conditions, and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?

ANNEXURE V

Environmental and Social Impact Assessment (ESIA)
Terms of Reference (TOR) For Inland Water Transport Project, Kochi

1.0. Background

The Environmental and Social Impact Assessment study report for the development of Integrated Inland Water Transport facilities is to be prepared as per guidelines of Ministry of Environment, Forests and Climate Change (MoEFCC) and Coastal Regulation Zone as applicable with state and central government, Government of India, Performance Standards (PS) of International Finance Corporation (IFC), World Bank (WB) and applicable regulations and standards of the state Governments. The ESIA report would address relevant aspects including but not limited to the following.

2.0. Project Background

Kochi Metro Rail Limited (KMRL) in line with the directives of the Ministry of Urban Development, Government of India has spearheaded the task of setting up the Kochi Unified Metropolitan Transportation Authority (MTA-KOCHI). MTAKOCHI is focussing on developing a sustainable Integrated Water Transportation (IWT) System for Kochi city, meeting the people's expectations as per international standards and aims to integrate the system with the other modes of transport including the metro system over a period of time with an integrated fare and integrated timetable.

3.0. Need for ESIA

Development of IWT facilities can make a significant contribution to the economic development and growth of maritime transport. At the same time, it may also create adverse impacts on the surrounding environment. Jetty and allied facility development may create a wide range of impacts on the environment through activities such as construction work, dredging, reclamation of the required land, landfills, discharges from boats / ferries and operations, and other terminal activities.

IWT development and operation should, therefore, be planned with careful consideration of the environmental impacts. Thus, the preparation of an ESIA report and implementation of EMP is essential for effectively managing these adverse effects.

The ESIA studies and reporting requirements to be undertaken under these ToR must conform to the Government of India (GoI) and PS of IFC, WB and Government of Kerala regulations.

3.1 Project Description

This section should cover the broader details of the basic activities, such as

- Location, layout and implementation schedule of the project
- Type of the project—new, expansion, modernization,
- Relevance of the project in light of the existing development plans of the region
- Project coverage, master plan, phasing and scope
- Description of a project site, geology, topography, transport and connectivity, demographic aspects, socio-cultural and economic aspects, villages and settlements
- Capacity of the Jetty, parking details
- Technologies involved in design, construction, equipment and operation
- Use of existing public infrastructure—road, railway and inland waterway networks, water supply, electrical power, etc.

- Estimated water balance for the proposed project during construction/operation stages
- Estimated cost of development of the project, environmental cost, funding agencies, and whether the project is being implemented through government/international funding
- Details of land acquisition, rehabilitation of communities/villages and present status of such activities
- Resources, manpower and time frame required for project implementation

Essential Maps to be provided with the Project Description

- A map specifying locations of the state, district and project
- A map of project and the area within 10km of the boundary of the proposed/existing project area, delineating (i) protected areas notified under the Wildlife (Protection) Act, 1972, (ii) critically polluted areas as notified by the CPCB from time to time, (iii) notified eco-sensitive areas
- Land-use map of the study area on recent satellite imagery of the proposed project boundary, delineating the cropping pattern, wastelands, forest area and built-up areas, water bodies, human habitation and other surface features such as railway tracks, roads, national highways and major industries
- Site layout plan of the proposed development clearly marking the layout of breakwaters, navigation channels, berths, workshops, roads, effluent disposal points, administrative and operational buildings, utilities, townships, green belts, dredged material disposal, etc.
- Boundaries of the proposed project shall be shown therein with latitude and longitude.
- Area drainage contour map of the project and area within 2-5km of the proposed project area
- Hydrographic data
- The Costal Regulation Zone (CRZ) maps indicating the high tide level (HTL) low tide level (LTL), demarcated by one of the seven authorized agencies and the project layout superimposed on the map submitted on a 1:4000 scale map, which is reviewed and recommended by the Coastal Zone Management Authority (CZMA) of the state

3.2. Environmental Legislations

Discussion of the policy, legal and administrative framework within which the project is set, major stakeholder departments of the local, state, central government and international with their specific roles, aspects and clearance requirements at various levels and their current status

3.3. Description of the Natural, Environmental and Social Baseline Conditions

a) Collection of information from secondary sources that are necessary for understanding the baseline pertaining to physical, biological and socio-economic environments project and influence area like
   - IMD,
   - Cultural heritage areas and monuments,
   - Eco-sensitive/protected areas if any,
   - hydrography data in the proposed project area
   - Fishery details,
   - Census,
   - Existing communicable diseases if any
   - Climate conditions including extreme weather related events such as floods, droughts, storms, landslides

b) Carrying out site visits and investigations of all the environmentally sensitive locations and document them on the base maps to identify conflict points with preliminary design

c) Collection of primary baseline data within project boundary for
   - Air and Noise Environment
   - Land Environment

- Water environment with specific focus on those within the corridor of impacts
- Study of existing and proposed drainage patterns
- Ecology and Biodiversity
- Bathymetry
- Traffic study for Water traffic, road and railways

Following components of the environment shall be studied and incorporated in ESIA;

- Land Environment for micrometeorology, topography, geology and soil
- Water Environment for groundwater and surface water
- Marine Environment for Coastal hydrology/geomorphology, Details of mangroves, marshes and other coastal vegetation, bottom sediments
- Biological Environment for Marine/Coastal ecology and Terrestrial ecology
- Air and Noise Environment
- Existing Solid Waste Disposal facilities
- Socio-economic and Occupational Health Environments

3.4. Analysis of Alternatives (Technology & Sites)

- Description of various alternatives like locations or layouts or technologies studied
- Description of each alternative
- Summary of adverse impacts of each alternative
- Selection of alternative sites and technologies

3.5. Anticipated Environmental Impacts and Mitigation Measures

This section should describe the likely impact of the project on each of the environmental parameters and the methods adopted for assessing the impact such as model studies, empirical methods, reference to existing similar situations, reference to previous studies, details of mitigation methods proposed to reduce adverse effects of the project, best environmental practices and conservation of natural resources. The identification of specific impacts followed with mitigation measures should be done for different stages i.e., location of the project, construction including dredging, boat traffic including discharges from vessels and jetty operations.

- Land Environment
- Water Environment
- Marine Environment
- Biological Environment
- Air and Noise Environment
- Solid Waste Management
- Socio-Economic and Occupational Health Environment

3.6. Environmental Management Plan (EMP)

- Recommendation of feasible and cost-effective measures to prevent or reduce significant negative impacts to acceptable levels
- Identification of opportunities for enhancement of environmental quality (of specific locations, water bodies, scenic areas etc.) in the project area
- Detailed specification of environmental mitigation and enhancement measures suggested, separate for pre-construction, construction and operation stages
- Suggestion of good practices for construction and upkeep of plant and machinery, responsibilities for execution and supervision of each of the mitigation
- Description of implementation arrangement needed for the project
- Description of environmental supervision, monitoring and auditing requirements, including the technical aspects of monitoring the effectiveness of mitigation measures (including

measurement methodologies, data analysis, reporting schedules, emergency procedures, cost estimates, detailed budget and procurement schedules)

- Summary matrix of environmental monitoring, during construction and operation stages, along with the requirement of monitoring facilities, frequency, location, parameters of monitoring , compilation and analysis of data, comparison with baseline data, compliance to accepted norms and reporting system, and plantation monitoring programme
- Listing of all the mandatory government clearance conditions and the status of procuring clearances
- Inclusion of separate attachment, if applicable, Natural Habitat Plan and /or Cultural Properties Plan to satisfy the requirements of the KfW safeguard policies
- Details of green belt development indicating the area along with an implementation plan
- Details of Post project environmental quality monitoring programme

3.7. Socio-Economic Assessment

- Public Consultation
  - As per the KMRL and KFW standards & guidelines which stipulates to conduct the Public consultation during the ESIA stage with Project Affected Peoples, Government staff, NGO & etc.

- Social Impact Assessment
  - To study about details of poor, women & children, vulnerable groups, Indigenous peoples
  - To first identify positive & negative impacts on these groups due to this project & to what extent.
  - Study of R & R policy as per the KMRL and KFW guidelines
  - Health & safety of the passengers, storage & disposal of materials like fuel & other chemicals to ensure the preventive methodology for the safe water transport system during construction as well as operation period.

3.8. Additional studies

Studies on the following need to be conducted:

- Risk Analysis and Disaster Management Plan (DMP)
  - Disaster Management Plan including emergency evacuation during natural and man-made disaster like floods, cyclone, tsunami and earth quakes etc.
  - Details of the contingency plan for accident scenarios, natural disaster and accidental oil spills Management
- Safety measures for handling liquid waste
- Personal protection equipment
- Oil-spill contingency plan
- Emergency response procedures, natural resource conservation and optimization, plan of action for conservation of natural resources
- Dredged material utilization and disposal plan
- Detailed R&R plan with data on the existing socio-economic status of the population in the study area and broad plan for resettlement of the displaced population, site for the resettlement
- Issues identified by the public and other stake holders during public hearings along with the issues raised by the public and the responses of the project proponents should also be studied.

3.9. Executive Summary (Summary ESIA)

Summary of the ESIA report necessarily covering in brief the following chapters of the full ESIA report: Introduction, Project Description, Description of the Environment, Anticipated Environmental Impacts & Mitigation Measures, Additional Studies, Environmental Monitoring Programme, Project Benefits and Environmental Management Plan (EMP)



Kochi Metro Rail Limited

