FEASIBILITY REPORT

DEVELOPMENT OF VIZHINJAM INTERNATIONAL DEEPWATER MULTIPURPOSE PORT THROUGH PPP

April 2015

Government of Kerala

VIZHINJAM INTERNATIONAL SEAPORT LIMITED

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Abbreviation

Abbreviation	Expansion
Capex	Capital Expenditure
CD	Chart Datum
CFS	Container Freight Station
COD	Commercial Operation Date
Cr	Crores
DWT	Deadweight tonnage
ESIA	Environmental and Social Impact Assessment
GMB	Gujarat Maritime Board
GoI	Government of India
GoK	Government of Kerala
GRT	Gross Registered Tonnage
GT	Gross Tonnage
HAT	Harbor Engineering Team
ICD	Inland Container Depot
INR/Rs.	Indian Rupee
IRR	Internal Rate of Return
ITV	Internal Vehicle Transfer
NPV	Net Present Value
O&M	Operation & Maintenance
Opex	Operating Expenses
P&L	Profit and Loss
PAT	Profit After Tax
PBDIT	Profit Before Depreciation, Interest And Tax
PBIT	Profit Before Interest And Tax
PBT	Profit Before Tax
PPP	Public Private Partnership
PRECAP	Preliminary Capacity
RMG	Rail Mounted Gantry
RTG	Rubber Tyre Gantry
SEZ	Special Economic Zone
SPV	Special Purpose Vehicle
TAMP	Traffic Authority for Major Ports
TEU	Twenty-Foot Equivalent
TGS	Twenty feet ground slots
TPC	Total Project Costs
VISL	Vizhinjam International Seaport Ltd
VTMS	Vessel Traffic Management System
WACC	Weighted Average Cost of Capital
WPI	Wholesale Price Index

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Executive Summary

Introduction

Ports Department, Government of Kerala (Authority) through its special purpose government company (SPV) - Vizhinjam International Seaport Ltd (VISL), intends to develop deep water Multipurpose Greenfield Port at Vizhinjam (Project) in Thiruvananthapuram, capital city of Kerala State. The SPV is fully owned by the Government of Kerala (GoK).

The proposed project is being developed as a PPP project on a design, build, finance, operate and transfer ("DBFOT") basis in accordance with the terms and conditions to be set forth in a concession agreement to be entered into between the GoK and a concessionaire. The selection of concessionaire (private partner) will be conducted through a transparent international bidding process. The concessionaire shall design, finance, construct and operate the Port for the determined concession term. The PPP structure is based on a land lord model where the land will continue to be owned by the GoK/VISL instrumentality and the Port assets that will be developed thereon by the concessionaire shall be transferred back to the GoK/ VISL instrumentality at the end of the concession period. The GoK/VISL instrumentality shall fund a pre-determined amount to be specified, towards construction of pre identified funded works, i.e. breakwater structures and associated dredging for Phase 1 of the Project, reclamation and facilities for a new fishery harbor comprising a fish landing centre and associated infrastructure facilities.

Objective of the project

GoK is desirous of developing Vizhinjam port as a PPP project and its main objectives include:

- Development of modern deepwater port facility to improve the state's transport infrastructure.
- Facilitating trade and attracting investment in the state.
- Promoting private sector participation in port and transport sector.

Salient features of Phase 1 Port Development

The port is envisaged to be developed in phased manner. Once fully developed, the Phase-1 of the port is envisioned to have,

- Breakwater of total length 3,100m (main breakwater 2,960m with 140m extension for fish landing harbor) to be developed in Phase 1.
- Dredging and maintenance of adequate draft
- Container berth length of 800m capable of handling up to current largest 18,000 TEU container vessels.
- Container yard behind the quay length with depth of up to 500m.
- Port craft berth of 100m.
- Fish landing centre with a total berth length of 500m and associated infrastructure facilities.

The port is designed primarily to cater to the transshipment and gateway container business.

Port Location

The Site for the Port is located at Vizhinjam which is 16 (sixteen) km south of Thiruvananthapuram, Kerala. The geographical coordinates of the Site are Latitude 8° 22' N and Longitude 76° 57' E. A 2.5 km long waterfront at Vizhinjam near Thiruvananthapuram has been identified as part of the

Site for the development of the Port. The coastline is mainly oriented towards Northwest-Southeast direction (bearing of the shore line is about 155° - 304°N).

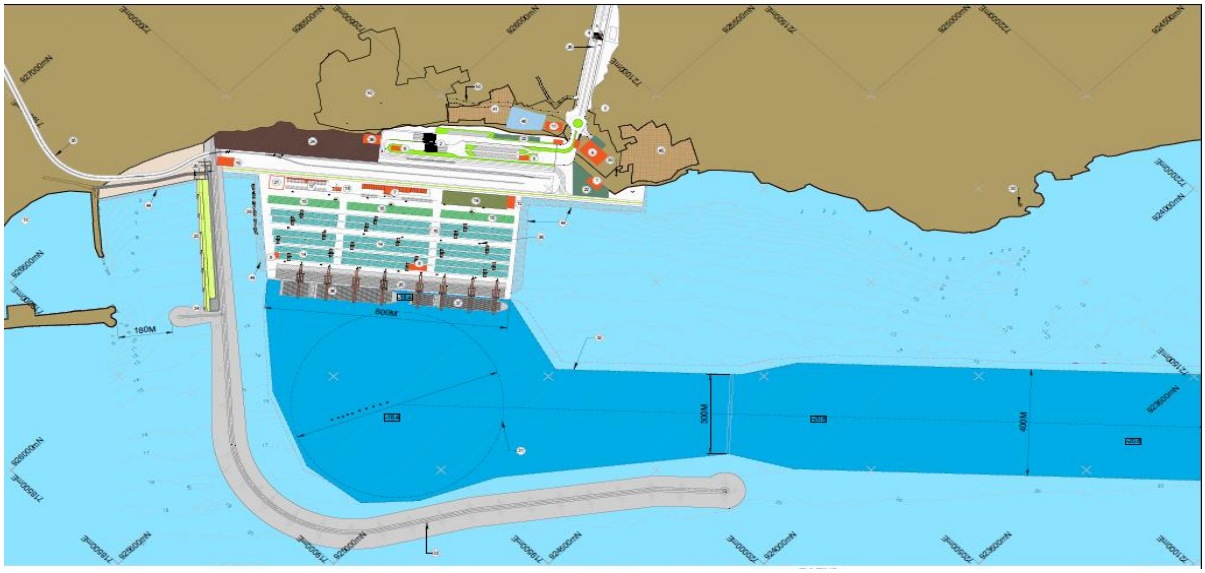
Vizhinjam Port Location Map

Vizhinjam port's immediate competition would be with Cochin (Vallarpadam) and VOC (Tuticorin) for its gateway containerized cargo; however, the port would primarily be competing with Colombo in Sri Lanka for container transshipment traffic. The port location is ideal to tap the potential of development of a deepwater international container port in India that can handle the largest container vessels serving the East-West shipping route.

Port Development Planning Overview – Phase 1

Based on the technical studies, the recommended layout for the Phase-1 development of Vizhinjam Port is as shown below. The concessionaire will be entitled to modulate the design to maximize operational efficiency, in accordance with the terms of the concession agreement.

Proposed layout for Phase-1 Port Development



The summary of the proposed port layout for Phase-1 development is provided in the table below:

S. No	Description	Unit	Value
1.	Maximum Ship Size		
	Container Vessels	TEU	18,000
2.	Breakwaters		
	Length of Breakwater	M	2,960
	Breakwater for fishery harbor extension	M	140
3.	Number of Berths (Total length of berths in meters)		
	Container Berths	No.(m)	2 (800)
	Port Craft Berths	No.(m)	1 (100)
	Fishery Berths	M	500
4.	Navigational Areas		
	Length of Outer Approach Channel	m	2,800
	Width of Outer Approach Channel	m	400
	Length of Inner Approach Channel (m)	m	1,200
	Width of Inner Approach Channel (m)	m	300
	Diameter of Turning Circle (m)	m	700

Container Handling Requirement

As equipment forms a major component under port development, the table below provides a summary of estimated requirements for various container terminal equipment for the Phase-1.

S. No	Container Terminal Equipment	Quantity	Productivity
		(no.)	(moves per hour)
1.	Rail Mounted Quay Cranes (RMQC)	8	25
2.	Rubber Tired Gantry Cranes	24	15 to 20
3.	Reach Stackers	2	12
4.	Empty Container Handlers	6	15 to 20
5.	Internal Transfer Vehicles	55	4 to 6

Traffic Potential & Forecast

Maritime consultant appointed by VISL had carried out study of the container traffic analysis and traffic trade trend of the Indian Subcontinent as basis of container traffic forecast for Vizhinjam port in 2010. In addition to the container traffic forecasted for transshipment, the Port is also expected to cater to gateway traffic which will focus on captive or hinterland market in and around Kerala. The gateway traffic is further segregated into two categories such as Loaded Containers and Empty Containers.

Based on the port components planned for Phase – 1 development, the container terminal capacity for handling the projected traffic is 10,00,000 TEU at 70% berth utilization. In such case the

terminal handling capacity would nearly get exhausted in the FY 2026 wherein the forecasted traffic would be around 9,51,467 TEU.

However, it is envisaged that the port will have state-of-art equipment to handle the projected container traffic and according to global productivity standards, such ports can achieve a maximum berth utilization rate of upto 80% at increased cost of vessel queuing. Therefore, container terminal capacity in Phase-1 development of Vizhinjam Port is expected to cater to a maximum container traffic up to 12,50,000 TEU. In such case, the projected container traffic of 12,50,025 TEU is achieved in FY 2030. Thereafter unless capacity augmentation is undertaken the container traffic remains constant.

Traffic ('000 TEUs)	2019	2023	2028	2033	2038	2043	2048	2054
Gateway-Loaded	26	92	160	194	194	194	194	194
Gateway-Empty	11	40	53	64	64	64	64	64
Gateway– Total	37	132	213	258	258	258	258	258
Transshipment	112	566	878	992	992	992	992	992
Total	149	698	1,091	1,250	1,250	1,250	1,250	1,250

Tariff Structure

In India, there are primarily two components of port tariff, namely vessel related charges (Port Dues, Berth Hire, and Pilotage) and container cargo related charges (cargo handling charges and storage charges), and miscellaneous charges. The traffic is proposed to be capped to the maximum tariff being levied by a similar Major Port in India and Colombo (specifically for transshipment traffic)

Based on the competition analysis and benchmarking with tariffs of competing ports, within a range of 750 kms from Vizhinjam Port, it is suggested that Vizhinjam offer a container transshipment tariff similar to current published tariff being levied for container operations at Colombo port and a container gateway tariff similar to current published tariff being levied for gateway container operations at the Cochin port.

Vessel Related Charges		Container Related Charges	
Coastal Vessel	Foreign Vessel	Gateway	Transshipment
Cochin	Cochin	Cochin	Cochin

Port Estate Development

- Development of the port will fuel Port estate and allied activities in and around the site area; the area being well connected through rail, road and air as well. As per the detailed project report, space for a cruise terminal is also feasible which can drive demand for hospitality services in the area thereby contributing to the overall economic growth of the state
- It is proposed that, the land used for port estate development shall not exceed 30% of the total area of the site. The total area earmarked for development of port estate development is 105 acres or 42.5 Ha..
- The area allocation has been carried out based on a preliminary demand mapping of the area. The maximum area proposed for Port estate development, is proposed to be 105 acres or 4.57 million sq.ft. of which the residential (33%), retail (42%), commercial (15%) and hospitality (10%) may ideally constitute the Port estate development
- Project proponents – The proposed Port estate development mix is envisaged to constitute one mid – market and a luxury hotel, commercial space and residential development being spread over 4.57 million sq.ft.;
- Revenue estimates are based on primary and secondary survey of the current rental rates prevailing in the market.

Financial Feasibility

- Project structure is based on Landlord model with a long term concession to the private partner with a concession period of 40 years. In case Capacity Augmentation is undertaken

by the Port developer, an additional 20 years extension in the Concession Period shall be provided. A further 20 years of concession may be granted on mutual agreement.

- Phase-1 Port Development is estimated to cost INR 4,089 Crores or USD 655.72 million of which equipment accounts for the maximum share of around 27% which is followed by dredging and reclamation cost which has a 18% share.
- The total revenue from all sources (including revenues from port estate development) is estimated to go up from Rs 93 crore in 2018-19 to Rs 7,822 crores in 2053-54.
- Tariff – With intense competition from the ports of Colombo and Vallarpadam terminal in Cochin and other ports, it was projected that Vizhinjam would need to aggressively price its container handling services to be able to attract traffic away from the competing ports
- The aims of the detailed financial analysis are to:
    - Assess the financial viability of the project;
    - In case of non-viability of the project the extent of Government support required in form of Viability Gap Funding (VGF) for making the project commercially viable;
    - Examining the financial Viability by including Port estate Development for additional revenues from commercial exploitation for implementing the project on Public Private Partnership (PPP) basis;

For implementing the project on Public Private Partnership (PPP) basis;

- The project is not financially viable (EIRR is 11.54%) on a standalone basis and offering a discount of 35% on port tariff and without VGF. However, with substantial funds in the form of VGF up to 60% and offering a discount of 35% on port tariff; the Equity IRR is 15.0%%, and accordingly, the project is viable;
- As per the (VGF) Scheme for financial support to PPPs in Infrastructure the maximum permissible (VGF) is 40% of the Total Project Cost. In this project additional revenues from Port estate Development, offering a discount of 35% on the Tariff, the project is still viable with an Equity IRR of 15% with a VGF of 40.7%;
- Revenue share of 1% (of realisable fees) to the Authority are expected to commence from the 15th anniversary of COD as per the Concession Agreement.
- Revenue share of 10% (of the gross revenues, including the proceeds of any rentals, deposits, capital receipts or insurance claims, received from the Other Business) to the Authority are expected to commence from the 7th anniversary of COD as per the Concession Agreement.

1 Introduction

1.1 Project Background

Ports are one of the most crucial links in the development of a country's trade and its economy. This is self-evident in the case of insular economies such as Hong Kong and Singapore or the United Kingdom. Even for continental economies like India, globalization of trade is key to development of the economy. Since this trade is carried primarily by sea-borne vessels, port development gains strategic importance as the key to economic development.

India has an approximately 5,423 km long peninsular coastline and is located close to major shipping routes linking East Asia, Europe and the Middle East. India therefore has the potential to significantly grow its maritime trade with other countries and as its economy grows, necessity of developing ports for international trade will also grow. Presently there are 12 Major Ports and 187 Non-Major ports in India. The Major Ports are all Government owned and handle around 64% of India's maritime trade.

The country's ports sector has witnessed strong growth over the past decade with total traffic handled by it increasing from nearly 300 million tonnes in FY01 to 883 million tonnes in FY11. The traffic-handling capacity of major ports increased at a CAGR of 7.3% during 2006–2011 to reach 645 million tonnes. During the same year, traffic handled at non-major ports grew at 8.6% year on year, largely due to the 12.4% year on year growth of Gujarat Maritime Board (GMB) ports.

The 12 major ports carry about 64% of the total maritime transport of the country. The share of non-major ports in cargo traffic has increased from less than 10 per cent in 1990 to the current levels of 36% due to congestion and inefficiencies at major ports and with development of minor ports by the respective states. There has been an impressive growth of about 11.6% per annum in container traffic during the five years ending 2010-11. The container trade went up to 10 million twenty-foot equivalent units (TEU) by 2012 from 2.47 million TEU in 2000.

Along its coastline of nearly 585 km, Kerala has one major port at Cochin and 17 non-major ports. The non-major ports are under the administration of Government of Kerala. Government of Kerala intends to provide a boost to coastal shipping with further development of ports, which will ease the burden on the heavily congested highways in the State apart from savings in transportation and social-emissions cost. Government, besides acting as a catalyst for establishment of new ship repair and ship building industries, also encourages other port based industries contributing to the development of ports. Currently, Kerala government is in the process of modernizing ports at Vizhinjam, Azhikkal, Beypore and Alappuzha.

The Government of Kerala (GoK) through its special purpose government company (SPV)-Vizhinjam International Seaport Ltd (VISL), is developing Deepwater Multipurpose Greenfield Port at Vizhinjam in Thiruvananthapuram, capital city of Kerala. The SPV is fully owned by the Government of Kerala.

The GoK through VISL had appointed a Transaction Advisor in 2010 to assist in the structuring and implementation of the Vizhinjam Port project and also to help organize a well-structured and transparent bid transaction as the port was initially proposed to be developed based on PPP model. Transaction advisor with the help of maritime consultant carried out the market assessment and technical consultant to prepare preliminary project plan for the proposed development. Maritime consultants in their studies indicated that because of a small immediate hinterland, the biggest potential for Vizhinjam project was to attract container transshipment traffic. However, because of the intense competition from the ports of Colombo and Vallarpadam terminal in Cochin and other ports, it was projected that Vizhinjam would need to aggressively price its container handling services to be able to attract traffic away from the competing ports.

The project is being developed as a PPP project on a design, build, finance, operate and transfer ("DBFOT") basis in accordance with the terms and conditions to be set forth in a concession agreement to be entered into between the GoK and a concessionaire to be selected through a transparent international bidding process. The concessionaire shall design, finance, construct and operate the Port for the concession term. The scope of facilities to be provided by the Concessionaire will include, in addition to the berths, capital dredging, reclamation, container terminal & yard development, gate complex development, installation of equipment and port connectivity road. The PPP structure is based on a landlord model where the land will continue to be owned by the GoK/VISL and the Port assets that will be developed thereon by the concessionaire shall be transferred back to the GoK/VISL at the end of the concession period. The GoK/VISL shall fund a pre-determined amount to be specified, towards construction of pre identified funded works, i.e. breakwater structures and associated dredging for Phase 1 of the Project, reclamation and facilities for a new fishery harbor comprising a fish landing centre and associated infrastructure facilities. VISL will also provide utilities to an agreed upon "hand-shake" point and the concessionaire will be providing the utilities for the rest of the container terminal and the Fisheries Harbor.

It is envisioned to develop this port incorporating the proven and cost effective Green Port initiatives in all aspects of construction and operation.

1.2 Objective Outline

The Detailed Project Report for Phase – 1 of Greenfield port at Vizhinjam Port, was prepared in May 2013 by the technical consultant appointed by VISL, to cater to the forecasted traffic which would be met by providing the harbor, berthing, storage and evacuation facilities at the port – a step forward based on the previous studies.

1.3 Salient Features of Phase 1 Port Development

The port will be developed in three phases. Once fully developed, the Phase-1 of the port is envisioned to have,

- Breakwater of total length 3,100m (main breakwater 2,960m with 140m extension for fish landing harbor) to be developed in Phase 1.
- Container berth length of 800m capable of handling up to current largest 18,000 TEU container vessels.
- Container yard behind the quay length with depth of up to 500m.
- Port craft berth of 100m.
- Fish landing centre with a total berth length of 500m and associated infrastructure facilities.

Fish Landing berths being developed as part of CSR activities as an outcome of the ESIA study to improve the fisheries and tourism sector in the project vicinity.

1.4 Amendments in Proposed Port Facilities

1.4.1 Fishing Harbor

As part of the CSR activity, VISL proposed a fishing harbor with a berth length of 500m and allied facilities of Auction hall and net mending shed for the local fishermen community in view of the congestion in the existing fishing harbor. The fishing harbor is part of the funded works. Details shall be set out in the Concession Agreement.

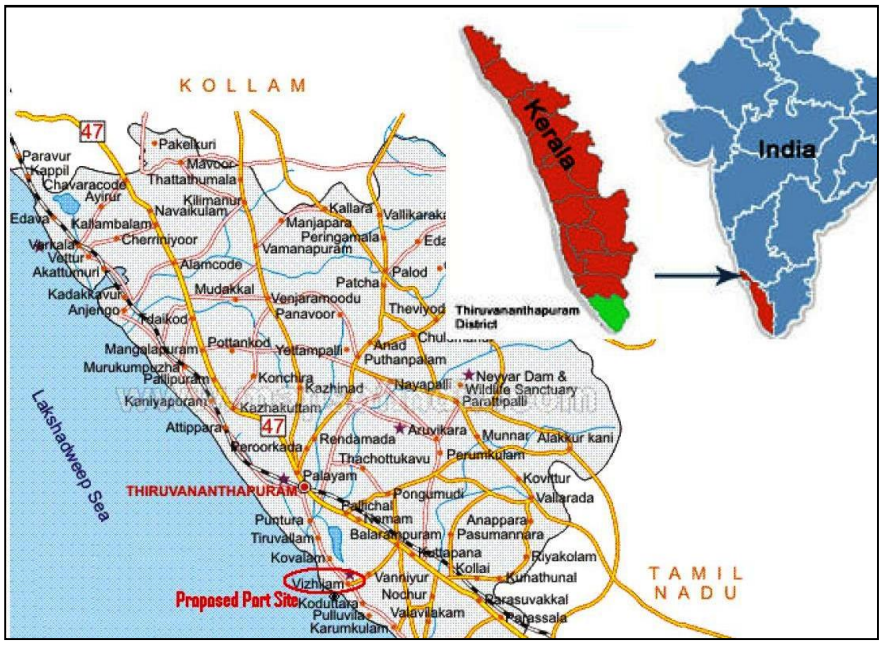
However, based on the discussions with Harbor Engineering Team (HET), it is required to provide a full-fledged facility for the proposed fishing harbor with the following facility requirements outlined below:

- 500m length of berth with differential landing facility to cater both mechanized fishing vessels as country crafts with outboard engines
- Auction hall and loading facilities to cater both type of vessels
- Administrative building
- Net mending shed
- Gear shed
- Toilet Block
- Access Road
- Utilities
- Security and fencing
- Navigational aids

1.5 Setting of Port Location

The proposed port at Vizhinjam (Latitude 8° 22' N, Long 76° 57' E) is located in India in the state of Kerala, at 16 km south of the State Capital, Thiruvananthapuram which falls in close proximity to the international East-West shipping route. The location of the port is as shown in Figure 1-1.

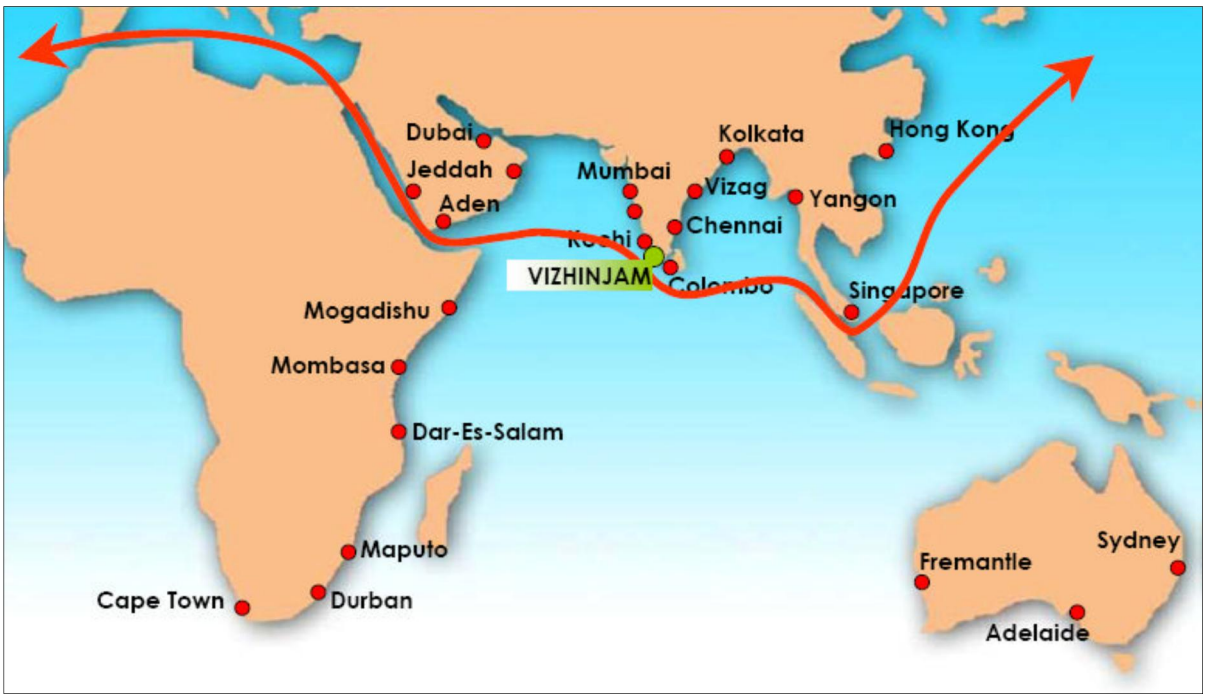
Figure 1-1: Vizhinjam Port Location Map



Vizhinjam port would be competing with Cochin and Tuticorin for its gateway containerized cargo; however, the port would primarily be competing with international ports like Colombo in Sri Lanka, Salalah in Oman, Dubai and Singapore for container transshipment traffic. The natural water depth available at proposed Vizhinjam port is more than any competing Indian port and more or equal than competing international ports. It will be able to capture the increasing trend of larger container vessels which none of the existing Indian ports can service, due to which majority of containers destined or generated from India are being transshipped or double-handled from competing international ports, resulting in higher import/export cost for Indian citizens. Vizhinjam port will further enhance India's ability to handle gateway and transshipment cargo while establishing a strong supply chain network in Kerala. Apart from catering to the needs of hinterland cargo, Vizhinjam Port will facilitate entire country's maritime trade and boost the development of a Special Economic Zones (SEZ) in the region due to opening up of new supply-chain networks.

The port location is selected to tap the potential of development of a deep water international container transshipment port that can handle the largest container vessels serving the East-West shipping route as shown in Figure 1.2. The proposed port location is just south to the existing fishery harbor of Vizhinjam.

Figure 1-2: Vizhinjam Port Location with respect to International East-West Shipping Route



1.6 Field Investigations and Studies

VISL has commissioned the required technical studies, which have become the basis of this report. The table below mentions reports related to Vizhinjam port project and work carried out by previous consultants that have been sourced and referenced in preparation of this Feasibility Report:

Table 1-1 Past Studies carried out for Vizhinjam Port

S. No.	Description of the Study/Investigations	Agency	Time (Month – Year)
Oceanographic/ Geo-Technical Investigations			
1.	Field Surveys and Investigation Report, May 2004	L&T-RAMBØLL Consulting Engineers Limited, Chennai, Rogge Marine Consulting GMBH, Germany (RMC), RAMBØLL, Hannenmann & Højlund A/S, Denmark (RAMBØLL) and L&T Capital Company Limited, India (LTC).	May 2004
2.	Geotechnical and Geophysical Survey Works	Fugro Geo-tech Pvt. Limited	May 2011
3.	Oceanographic Investigations for Tides Currents and Wave observations	EGS Survey Pvt. Ltd.	March 2013
Model Studies			
1.	Mathematical model studies by Royal Haskoning	Royal Haskoning	October 2010
2.	Updated Mathematical Model Study	L&T-RAMBØLL Consulting Engineers Limited, Chennai	May 2013
3.	Ship Simulation Study for Vizhinjam Port	BMT Consultants India	May 2013
Technical Studies			
1.	Rapid Environmental Impact Assessment Report	L&T-RAMBØLL Consulting Engineers Limited, Chennai	February 2004
2.	Detailed Techno-Economic Feasibility Study	L&T-RAMBØLL Consulting Engineers Limited, Chennai in association with Rogge Marine Consulting GMBH, Germany (RMC), RAMBØLL, Hannenmann & Højlund A/S, Denmark (RAMBØLL) and L&T Capital Company Limited, India (LTC).	May 2004, Revision June 2007
3.	Preliminary Project Plan Report	Royal Haskoning	October 2010
4.	DPR for Rail Connectivity from Neyyattinkara to Vizhinjam International Seaport	Rail Vikas Nigam Limited, Chennai	July 2011 May 2012
5.	Integrated Master Plan Report	AECOM India Private Limited	November 2012
6.	CRZ Status Report	Centre for Earth Science Studies Thiruvananthapuram	April 2013
7.	DPR for Development of Vizhinjam Port	AECOM India Private Limited	May 2013
Traffic Studies			
1.	Kerala Port PPP – Market Study	Drewry Shipping Consultants Ltd.	November 2010
Economic and Social Impact Assessment Studies			
1.	Integrated ESIA Report	L&T-RAMBØLL Consulting Engineers Limited	May 2013
2.	Estimation of Economic Internal Rate of Return of the Vizhinjam Port project-Draft Report	Deloitte Touche Tohmatsu India Private Limited	May 2013

2 Functional Requirement

2.1 Design Ship Sizes

Seaborne trade and traffic pattern have undergone tremendous changes due to technological advances. The shipping sector was more or less dormant since mid-70, when suddenly there was a movement towards bigger oil tankers due to oil crisis. After that not much happened in shipping technology for next one and half decade. But in 90's due to separation between demand and supply regions and a huge surge in commodity, demand and willingness of parties to enter into long term contracts along with the opportunity of access to cheap capital, led to the making of bigger ships which brought economies of scale.

One of the main factors that influence the layout and sizing of the port facilities and therefore the costs is the size of ships for different commodities. The design ship is the largest ship for a particular commodity that is likely to be handled at the port and based on which the dimensions and the design of the berth, the basin, the approach channel will have to be finalized. This, in turn will influence the layout and alignment of the breakwaters, if required at a particular port.

When selecting the design ship size for a particular commodity, it is essential to consider the development trends in the international maritime trade driven by the scale of economics in freight. The size of ships calling at the port will also have a bearing on the facilities available at the ports of origin/destination.

The size of ships that would call at Vizhinjam Port will be governed by the following aspects:

- The trading route and distance between Vizhinjam Port and origin/ destination ports;
- The facilities available at the loading/unloading port including the draft;
- Availability of a suitable ship in the market;
- Future availability of vessel on the market including 'trickle down' effects from mainline routes to secondary routes;
- Volume of annual traffic to be handled and the likely parcel size;
- Balance between capital costs for Vizhinjam port development and freight transport costs.

The traffic study has projected the following main cargo commodities for Vizhinjam Port:

- Containers
- General Cargo
    - Fertilizer
    - Raw Cashew
    - Timber
- Cruise

Since ocean freight is a major component of the overall logistic costs for any consignee, the operator always look for a modern port with large draft for handling big parcels and with modern handling equipment which ensures faster and loss-free turnaround of ships.

2.2 Container Ships

2.2.1 General

The success of the container ship story is unparalleled in the history of shipping. Ever since its start in the early sixties, the idea of shipping cargo in locked containers has been widely accepted, resulting in uninterrupted growth, continuing even into the beginning of this century. Consequently, the world container fleet has the fastest growth rate than any other ship type. Economy of scale effects in container shipping have led to a rapid increase in size for all types of vessels, from feeders to the large inter-continental carriers. The trend towards larger ships has accelerated in recent years and can be observed in the increasing size of the line haul as well as feeder vessels.

2.2.2 Container Vessels – World Fleet

Since its start in the early sixties, container trade has grown exponentially worldwide, resulting in significant increase in vessel numbers and sizes. The distribution of world fleet container vessel sizes is shown in the table below.

Table 2-1: World Fleet of Container Ships and Order Books

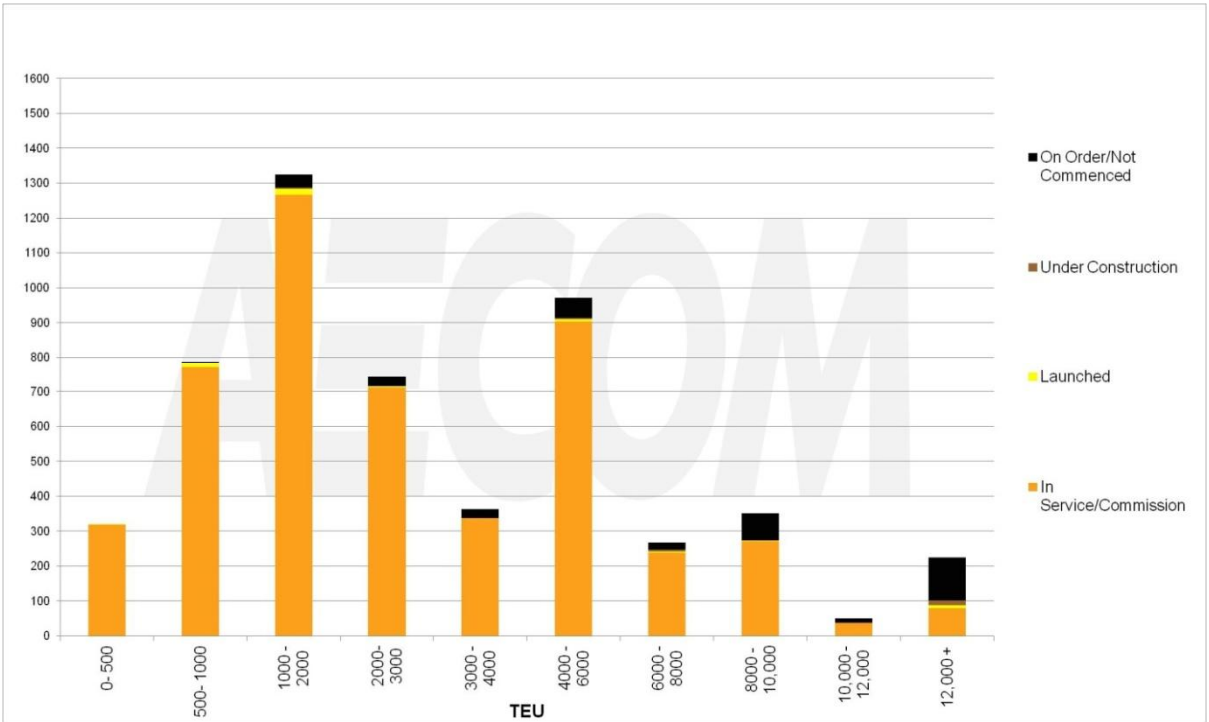
Container Ship	Year end ('000' TEU)				2011		Order Book & Delivery Schedule					
Fleet (TEUs)	2007	2008	2009	2010	No	'000' TEU	No	'000' TEU	% Fleet	2012	2013	2014
100-999	611	664	690	723	1,203	740	6	6	1%	5	1	0
1,000-1,999	1,535	1,705	1,793	1,934	1,400	1,989	22	31	2%	24	7	0
2,000-2,999	1,592	1,760	1,849	1,916	768	1,952	14	38	2%	21	16	1
3,000-7,999	5,419	6,084	6,638	7,304	1,606	7,694	94	505	7%	381	124	0
8,000+	1,228	1,664	1,999	2,685	371	3,678	98	1,117	30%	896	167	54
Total Fleet	10,385	11,877	12,969	14,562	5,348	16,053	234	1,697	11%	1327	315	55

There is a continuing trend towards larger container vessels and a number of vessels at the top end of the size range are already on order as of December 2012:

- 32 no. 12,500 TEU minimum ships ordered for delivery between 2010 and 2012.
- 8 nos. 13,100 TEU ships ordered by Hamburg based Nord Capital group on Hyundai Heavy Industries. Delivery between April 2010 and March 2011.
- A series of 16,000 TEU ships have been ordered from Samsung Heavy Industries.
- MAERSK Lines have ordered 20 new 18,000 TEU ships from Daewoo Shipbuilding.
- Other shipping lines like K-Line and United Arab Shipping Company are also looking at acquiring 18,000 TEU ships.

Historically, as the mainline vessel sizes have increased, larger vessels operating in primary routes have 'trickled down' to the second tier routes. It is expected that vessels in the range of 8,000 TEU will 'trickle down' to serve secondary or feeder routes in the future.

Figure 2-1: Depicts the distribution of world fleet container vessel sizes



In order to establish Vizhinjam port's position as a Major Transshipment port, it will need to be able to handle ships normally in the range of 9,000 to 18,000 TEU.

2.2.3 Container Ships Dimension

Container ships are classified into six broad categories viz. Feeder, Feeder Max, Handy, Sub-Panamax, Panamax and Post-Panamax. The following table, which has been compiled through data from the Shipping Register of Lloyds Fairplay database, gives a broad outline of the principal dimensions of the ships under the different categories. The Table 2-2 gives the dimensions of the smallest and the largest ship in each category. This will help in planning the layout of the container terminal and the other facilities.

Table 2-2: Dimensions of the Smallest and Largest Ship

Category	Capacity (TEUs)	Dimensions (m)		
		LOA	Beam	Loaded Draft
Feeder	1,000	175	27	10.0
Feeder Max	2,000	210	32	12.0
Handy to Sub-Panamax	6,000	285	40	14.5
>Panamax	8,000	335	42	14.5
Post-Panamax	12,500	397	56	16.0
Super Post-Panamax	18,000	400	59	16.0

2.2.4 Selection of Design Size of Container Ships

Transshipment Containers

Container transshipment is expected to be the primary cargo for Vizhinjam Port Phase-1 development. Based on the projections, the maximum vessel size at the port is likely to be driven by the transshipment traffic. During Phase-1, the design vessel considered is 18,000 TEU.

Import/ Export Container Vessels

The projected import / export trade through the port hinterland is relatively modest in Phase 1. In this case, it is likely that the vessel sizes for import/ export trade will be driven by the use of the transshipment vessels for carrying the import/export cargo as well. For other direct vessel calls serving the import/export cargo, the design vessels considered are in the range of 1,000 TEU to 6,000 TEU.

Summary of Container Design Vessels

Based on the outcome of ship size analysis for container traffic carried out in the preceding paragraphs, the design ship sizes considered for development of VISL port have been presented in Table 2-3.

Table 2-3: Design Container Vessels over Master Plan Horizon

S. No	Commodity	Average Parcel Size	Design Ship Capacity		Overall Length	Beam	Loaded Draft
		Moves	TEU		(m)	(m)	(m)
1.	Containers (Transshipment)	2500	Min	9,000	350	46	14.5
			Max	18,000	400	59	16.0
2.	Containers (Feeder)	1200	Min	1,000	175	27	10.0
			Max	6,000	300	43	13.5

2.3 Design Ship Size

Based on the outcome of ship size analysis for major commodities carried out in the preceding paragraphs, the design ship sizes considered for Phase-1 development of Vizhinjam port is presented in Table 2-4.

Table 2-4: Summary of Design Vessels for Phase 1 Development

S. No	Commodity	Average parcel size	Design Ship Size		Overall Length	Beam	Loaded Draft
		TEU (DWT)	TEU/DWT		(m)	(m)	(m)
1.	Transshipment Containers	2,500 (23,000)	Min	9,000	350	46.0	14.5
			Max	18,000	400	59.0	16.0
2.	Import/Export Containers	1200 (11,000)	Min	1,000	175	27.0	10.0
			Max	6,000	300	43.0	13.5

2.4 Berth Requirements

The berth length needs to be sufficient to accommodate the length of the vessel plus an allowance at either end for mooring and clearances between vessels. The amount of clearance required at either end of the vessel depends upon the vessel size. Minimum single berth length for the container design vessels Is 360 to 400m, for an average design ship size of 12,500 TEU.

A spreadsheet-based capacity analysis model was used to determine Vizhinjam port's container terminal throughput capacity, which is defined as the amount of cargo a terminal can handle under given operating parameters. For containerized cargo, the capacity is calculated in TEU per year.

The total amount of cargo a terminal can handle annually depends on the capacity of four main components: ship operations, yard operations, gate operations, and rail operations. Each of these terminal-operation components were evaluated independently to identify elements limiting the

overall throughput capacity of Port facilities. If one component of the facility has a much lower throughput capacity than the others, then the entire facility must operate at the capacity of that lower-functioning component.

2.5 Container Terminal Requirements

2.5.1 Container Terminal Capacity Analysis

Technical consultant had conducted the Vizhinjam Port container terminal capacity analysis using the Preliminary Capacity (PRECAP) spreadsheet analysis model. PRECAP is a static model of terminal capacity that can be used to analyze capacity of the terminal berth, backland storage area (container yard and equipment), rail operations, and gate operations.

The primary outputs from PRECAP are annual capacity of each of these terminal elements, which can then be evaluated as independent features or as linked elements.

An important benefit of this model is its ability to identify the element that is constraining overall terminal capacity and to focus investments where the greatest capacity improvement can be achieved. For example, the model may be used to establish parameters for the container yard and for the gate to match available berth capacity so that the terminal has a balanced capacity across all elements.

The following table summarizes the key inputs to PRECAP for each terminal element.

Berth	Container Yard	Rail	Gate
► Cargo moved per vessel call ► Cranes used per vessel ► Crane productivity ► Work hours ► Non-work time at berth ► Seasonal peaking factors ► Maximum allowable berth utilization	► Mix of cargo types ► Dwell time ► Static storage capacity ► Inventory peaking factors	► Number of rail cranes in use ► Rail crane productivity ► Working hours ► Switching delay ► Static working track capacity	► Gate to vessel move ratio ► Hourly arrival pattern ► Number of gate stages ► Fraction of trucks that visit each stage ► Truck processing time at each stage

PRECAP was used to analyze a range of options, such as comparison of high/med/low capacity forecast based on specific input assumptions like crane productivity, or calculation of static density that is expected to increase as a result of a particular project, or evaluation of impacts of statistical factors – like working hours or vessel size – that are expected to change over time due to external trends.

2.5.2 Berth Requirements

Berth Capacity

Berth capacity is defined as the volume of cargo that can be handled across the berth, without concern for any backland constraints. As with all elements of capacity, berth capacity is not a single fixed number, but a range of plausible values. Higher berth capacity means higher cost (more equipment and more labor cost) and lower levels of service, because some vessels may have to queue for berth space. The potential maximum number of containers handled over the berth (measured in twenty-foot equivalent unit or TEU), is primarily dependent on following factors:

- *Design Vessel Size:* Size of vessels is increasing day by day to accommodate more number of TEU per vessel call. Considering the order-book of vessels and the vessels under construction, the typical average maximum size of the vessel for direct call at Vizhinjam port in Phase-1 is considered as 12,500 TEU (for capacity analysis).
- *Available Berth Length:* The berth length should be optimized to be able to cater to the largest design vessel along with mix of average vessels.
- *Container Moves per Vessel Call:* Based on a combination of mainline and feeder vessels, and market data relating to average number of containers handled per vessel call at peer transshipment ports, 1500 container moves per vessel call is used as the maximum average number of containers handled per vessel call. This includes a range covering small feeder vessels and large mainline container vessels.
- *Dock Cranes Assigned per Vessel:* Number of dock cranes deployed per vessel call varies based on the vessel size and number of containers to be handled per vessel call. For the vessel of size up to 12,500 TEU, up to six dock cranes are being used and for smaller feeder vessels two to three dock cranes will be deployed. On average, four dock cranes per average vessel call are considered for the capacity analysis.
- *Productivity per Dock Crane:* As per prevailing practice in India, an average productivity of 25 moves per hour is used for initial development of the Vizhinjam port. Once the operation stabilizes and core traffic achieved at the proposed port, the productivity is assumed to be reaching 30 moves per hour.
- *Maximum Practical Berth Utilization:* It is a key subjective variable in a Berth Capacity Analysis. No berth can effectively run at 100% full. Shipping lines expect a certain level of customer service when calling a terminal; they do not want to queue out at sea for too long waiting for a berth to become available. Conversely, shipping lines work on fairly rigid vessel schedules around the world and filling a berth on a given day of the week may prove difficult to accomplish by changing sailing patterns. Due to the variable nature of vessel arrivals (delays at berth, storms, etc.), and the market-driven need to service vessels in a timely manner, the maximum practical berth utilization should be limited to avoid vessel queuing. In some locations, especially in Asia where feeder vessels will in fact queue for berth space, terminals can operate at berth occupancy up to 80%. Longer contiguous berths allow for greater occupancy than shorter berths. Vessels start queuing on a two berth facility when average berth utilization goes over 70% on a transhipment terminal, whereas for a single berth, it happens at around 60%. For a transshipment terminal, the overall productivity and berth utilization can be increased without impacting the operations. At Port of Vizhinjam, the initial Phase-1 development will comprise of two berths and hence a value of 70% has been used for capacity calculations, however up to80% berth utilization will be feasible for the operator in longer run.
- *Operational Time*: Being an all-weather port, it is assumed that Vizhinjam Port will work seven days a week for 365 days. Further, it is assumed that the port will operate round the clock i.e. three shifts of eight hours each with allowance for one hour break between each shift. This result in an effective working of 21 hours a day used in the capacity analysis.
- *Unproductive Time at Berth:* It accounts for ship tie-up and untie time, which represents time where the berth is physically occupied by a vessel (i.e. no other vessel can be in that berth position) but there is no crane activity, excluding breaks which are captured by the work hours per day input. This activity includes mooring, line fastening, unlashing prior to first container move, administrative clearance, etc. These activities are assumed to take, on an average, 4 hours per vessel call.
- *Peak/mean Week Seasonal Demand:* It is assumed that a peak week demand of berth will be 20% higher than the average week demand to account for changes in seasonal demand and

adjust peak week berth capacity down to an average week berth capacity for calculation of the annual berth capacity.

Table 2-5 describes step-by-step assessment of annual berth capacity for the Port of Vizhinjam Container Transshipment Terminal. The right most columns provide formulas along with the variables description.

Table 2-5: Container Berth Capacity Analysis for Vizhinjam Port

Phase-1	Berth Capacity
12,500	Typical Max Vessel Class Size TEU
1,500	Container moves (Lifts) per vessel call [a]
4.0	Dock cranes assigned per vessel [b]
25.0	Productivity per dock crane (moves/hr.) [c]
100.0	Vessel productivity (moves/hr.) [d=b*c]
15.0	Work hours per vessel call [e=a/d]
4	Unproductive time at berth (hr.) [f]
19.0	Total vessel time at berth (hr.) [g=e+f]
21	Work hours per day [h]
1.14	Calendar hr./ work hour [i=24/h]
21.7	Total vessel hr. at berth [j=g*i]
168	Calendar hr. per week [k]
7.74	Vessel calls per week at 100% berth utilization [l=k/j]
70%	Maximum practical peak week berth utilization [m]
5.42	Maximum practical vessel calls per week [n=l*m]
8,124	Peak week berth capacity (moves) [o=n*a]
1.2	Peak/mean week seasonal demand factor [p]
6,770	Mean week throughput capacity (moves) [q=o/p]
352,000	Annual unit berth capacity (moves) [r=q*52]
1.5	TEU per container [s]
530,000	Annual unit berth capacity (TEU) [t=r*s]
2	Number of berths [u]
10,60,000	Annual total berth capacity (TEU) [v=t*u]
530,000	Capacity Per Berth (TEU)
88,000	Annual lifts per dock crane [w=r/b]
800	Total berth length (m)
1,330	Annual berth capacity per unit berth length (TEU/m)

With two berths of total quay length 800m in Phase-1 Vizhinjam Port can handle approximately 10,00,000 TEU over the berths. It is estimated that once a steady stream of bigger vessels are calling at the port (such as 18,000 TEU vessels) with higher parcel size per vessel call, additional throughput can be handled from the proposed two berth facility with potential to go up to 1.2 million TEU on two berths. This additional throughput will depend on the actual mix of different vessels calling at the port.

Another important factor in the capacity of a container terminal is the size and operation of the container yard. Ideally, the capacity of the berth and the container yard should be balanced to achieve maximum throughput from the terminal as a whole.

2.5.3 Storage Requirements

Container Yard Capacity

Container yard capacity is defined as the potential maximum throughput of containers handled inside the container yard (measured in twenty-foot equivalent units or TEU), is primarily dependent on following factors:

- *Mean Dwell Time:* The number of days a container sits inside the container terminal (dwell), which significantly varies for transshipment (usually 2 to 3 days) vs. the gateway traffic (varies from 3 to 7 days). For the gateway traffic, it varies by import vs. export vs. empty container. For the capacity calculation, an average of 5 days is used.
- *TGS Capacity:* Represents the static storage capacity in terms of total number of twenty feet ground slots (TGS) or net acres available to store those containers inside the container yard.
- *Mean Storage Height:* A mean storage height is calculated which takes into account the peak stacking height of the machine and various utilization factors than can be applied. It represents the maximum overall desired height for grounded operations. Most operators feel that 70-80% of the peak theoretical capacity is a reasonable level for planning purposes in order to account for sufficient empty slots for reshuffling and yard marshalling moves. Mean storage height used for this case is 3.5 high for capacity calculations.
- *Seasonal Peaking Factor:* It is assumed that a peak week demand of container yard will be 10% higher than the average week demand to account for changes in seasonal demand and adjust peak week container yard capacity down to an average week yard capacity for calculation of the annual container yard capacity.
- *Weekly Inventory Peaking Factor:* During a week, when a vessel arrives or departs, there is a sudden surge of inventory of containers that needs to be handled in the container yard, based on the size of the vessel and number of containers handled per vessel call. The factor applied to account for this surge is 10%.

Table 2-6 describes calculation of container yard capacity and formulas used to derive it.

Table 2-6: Container Yard Capacity Analysis for Vizhinjam Port

Phase-1	Container Yard Capacity
1000	Nominal TGS capacity available [a]
3.5	Mean storage height (containers) [b]
3,500	TEU static capacity [c=a*b]
5.0	Mean dwell time (days) [d]
73	Turnovers per year per TEU static capacity [e=365/d]
2,55,500	TEU capacity without peaking [f=c*e]
1.10	Seasonal throughput peak factor [g]
1.10	Weekly inventory peak factor [h]
2,10,000	Nominal Annual CY Capacity in TEUs [i=f/g/i]
4,286	Required TGS to meet berth capacity
5,710	Available TGS
1,199,100	Container Yard Capacity TEU/year

With available number of TGS in Phase-1 development, the Vizhinjam port will be able to handle the berth throughput from the planned container yard. The container yard capacity calculated in here is higher than the berth capacity at average five days of dwell time. However, with higher utilization of berth capacity of up to 1.4 million TEU is achieved on the berth, the additional throughput will be also possible from the container yard by reducing the average dwell time to 4 days, which is very much feasible and the current practice on existing transshipment ports.

The TGS is split into the following as indicated in Table 2-7 below to accommodate the empties and reefer storage to cater the required capacities.

Table 2-7: Container Yard Storage Split

S. No.	Container Storage	Total Ground Slots (TGS)
1.	RTG Storage	
	Non Reefer Storage	*4,270*
	Reefer Storage	*300*
2.	Empty Storage	1,140
	Total	5,710

2.5.4 Receipt and Evacuation of Cargo

Rail Throughput Capacity

This section describes the methodology that was used to determine the rail throughput capacity which is expressed as number of rail tracks required to handle the forecasted gateway container traffic that can be handled from the port.

For capacity calculations, the technical consultant has assumed 30% of the gateway traffic will be handled by rail as compared to 70% by truck. The gateway traffic estimated by Drewry is around 16% of total container traffic and hence the share of container traffic moving via rail is (30% of 16%) 5% of total container traffic.

Following factors impact rail throughput capacity:

- *Track Length:* Track length is taken as 700m clear length for each track as per the nominal length of container train operated by Indian Railways.
- *Maximum possible number of cranes working to load/discharge containers from railcars:* Based on the shortest track length available at the proposed rail yard, it is assumed that two Reach Stackers can be deployed to work simultaneously on the rail track during Phase-1 development.
- *Amount of railcar double cycling*: It is assumed that for 90% of arriving railcars that bring in a container in the port will leave with a container while departing.
- *Crane Productivity:* Reach stackers are assumed for loading/unloading of train racks over a single or double rail tracks respectively. Handling rate of 12 moves per hour is used for the cranes.
- *Work hours per day:* 8 hours per day is assumed for initial Phase 1 development. In future, with increased demand, the work hours can be increased per day for rail yard operation.
- *Peaking factors:* It is assumed that the peak month will be 20% higher than the average month and peak day throughput will be 20% higher than the average day throughput.
- *Switching time:* It is defined as time between the first set of railcars getting ready to depart from the port rail yard and going to the mainline and a second set of railcars arriving in the port rail yard through the single rail track. For the capacity analysis purpose, the switching time of trains is considered to be 4 hours. This will account for all the delays incurred in bringing the set of rail cars from the mainline to the port.

Table 2-8 describes calculations to determine the number of working tracks to handle the forecasted demand.

Table 2-8: Rail Yard Capacity Analysis for Vizhinjam Port

Phase-1	Rail Capacity
5%	% of Total Container Traffic via Rail
44,611	Total Rail Throughput Goal (TEU) [a]
1	Nominal Number of Working Tracks [b]
700	Average Length of Each Track (m) [c]

Phase-1	Rail Capacity
16	m per one well railcar [d]
45	Static capacity (railcars) [e]
2	TEU per railcar at 100% utilization [f]
100%	Rail working track utilization factor [g]
90%	Railcar utilization factor [h]
1.50	TEU per container [i]
108	Discharge + load moves possible w/o switching [j = 2*e*f*g*h/i]
2	Max Rail Yard Cranes in use [k]
12	Moves per hour per Crane [l]
4.5	Train work time (work hours) [m = j/(k*l)]
16	Work hours per day [n]
1.5	Calendar hour per work hour [o = n/24]
6.8	Train work time (hours) [p = o*m]
4.0	Switch time to replenish working tracks (hours) [q]
2.2	Max turnovers per day [r = 24/(p+q)]
241	Max rail boxes/day [s = j*r]
120%	Peak/mean week throughput [t]
120%	Peak/mean day within week for rail [u]
167	Mean rail capacity per day (moves) [v = s/(t*u)]
350	Number of working days per year [w]
60,000	Annual rail capacity per module (moves) [x = w*v]
90,000	Annual on-terminal rail capacity per module (TEU) [y = i*x]
397	Total working track length required to meet vessel capacity (m) [z = a*y/c]
1	Number of Working Tracks Required (each track of 800 m. length) [a1 = z/c]
1	Number of Working Tracks Provided [b1]
90,000	Annual Rail Capacity Provided TEU/year [c1 = y*b1]

In order to meet the traffic forecast, one working track will be required in Phase-1 development. Just one working track will provide almost twice the capacity than the overall requirement. It should be noted that if the rail yard can be operated 24/7 then additional capacity can be achieved to handle even non-containerized cargo from the rail yard area.

Container will be stacked at container yard and brought to railway siding by Internal Transfer Vehicles (ITV). Reach Stackers will load/unload them on the railway rack.

Gate Capacity

Gate capacity analysis is essential feature to get essence of seamless inward and outward traffic movement including major share of trucks having containers. Following factors impact gate throughput capacity:

- *Throughput share handled by trucks:* Share of throughput which is forecasted to be handled by truck is key factor for gate capacity planning. Amount of TEU handled by truck will determine the daily truck traffic at port and the movements at gate complex. For capacity analysis, it is assumed that 70% of the gateway traffic will be moved by trucks as compared to 30% by rail.
- *Peak Ratio:* For weekly mean moves 20% peak factor is considered. For daily traffic movement 30% peak in daily traffic is considered. For hourly traffic, 50% peak is considered for mean hourly traffic.
- *Working Hours:* Working hours of gate directly impacts the gate capacity. For Phase-1 development 8 hour gate shift is assumed. The gate working hours will be increased if additional demand for gateway traffic is experienced at the port and for future phases.

- *Moves per Truck visit:* Moves per truck visit reflect the container handling movement per truck. It reflects the number of trucks which come with a container and leave port with a container. The amount of such truck traffic is assumed 10% of total daily truck traffic.
- *RPM Capacity:* Radiation Portal Monitors (RPM) are passive radiation detection devices used for the screening of vehicles and cargo for detection of illicit sources at port gates. Number of trucks that can be screened by this device per hour determines its capacity, which is being considered as 120 trucks per hour for capacity calculation. This number can increase with reduction in screening time.

Table 2-9: Gate Capacity Analysis for Vizhinjam Port

Phase-1	Gate Capacity
706,667	Vessel moves/year [a] (from Berth Capacity calculations)
12%	% of Total Container Traffic via Truck [b]
81,732	Total throughput moved through Gate [c = a*b]
1,572	Moves per mean week [d = c/52]
1.2	Peak/mean week ratio [e]
1,886	Peak week moves [f = d*e]
7	Days per week operation [g]
269	Mean day moves [h = f/g]
1.3	Peak/mean day ratio [i]
350	Peak day moves [j = i*h]
8	Hours worked per day [k]
44	Moves per mean hour on a peak day [l = j/k]
1.5	Peak/mean hour factor [m]
66	Peak hour on a peak day moves [n = l*m]
1.1	Moves per truck visit [o]
60	Peak hour truck entries [p = n/o]
100%	Fraction of entries that have a container [q]
60	Trucks per hour at RPM [r = p*q]
30	RPM process including truck replacement (sec) [s]
120	RPM capacity per hour [t = 3600/s]
1.0	RPM lanes required [u = r/t]
180	Entry pedestal process time (sec) [v]
20	Gate capacity per hour [w = 3600/v]
3.0	Gate entry lanes required [x = p/w]
180	Exit process time (sec) [y]
20	Exit capacity per lane [z = 3600/y]
3.0	Exit lanes required [a1 = p/z]

Number of required lanes in above calculation relates to container truck traffic only. Additional two lanes are required for each entry and exit gate for the vehicles participating in port operation facilities such as port staff vehicles, vehicles of customs, vehicles for supporting services, oversize cargo etc. Therefore, total five lanes each for entry and exit gate will be required.

2.5.5 Container Terminal Summary

The container terminal has been sized to meet the market demand predicted by maritime consultant in 2010. The following Table 2-10 summarizes the development needs of berths, gate, yard and rail

elements for the Port of Vizhinjam. The Phase-1 plan has been prepared to meet this development needs.

Table 2-10: Terminal Development Summary for Vizhinjam Port

Port Components	Phase-1
Berths (400m each)	2
Container yard storage (TGS)	5,710
Rail sidings (800m each)	1
Entry/Exit Gate (lanes each)	5

Based on the port components planned for Phase-1 development, Table 2-11 shows a summary of the estimated traffic and the planned capacity for the Vizhinjam Port. As evident from the table, the Phase-1 development will provide optimum capacity for handling the projected traffic for Phase-1.

Table 2-11: Terminal Development Capacity Summary for Phase 1 Development

Description	Total	Transshipment Traffic	Gateway Traffic	
			Truck	Rail
	TEU	TEU	TEU	TEU
Phase-1: Minimum Container Capacity Planned	10,00,000	8,30,000	120,000	50,000

2.6 Dredging and Reclamation

Dredging and reclamation is one of the major costing parameter for any port project. The proposed port site is characterized by naturally available deep water depths with 20m contour located at a distance of less than 800m from the shore. This substantially reduces the dredging cost and hence enabling the port to provide berthing ability for the largest container vessels (up to 18,000 TEU). The port intends to utilize reclaimed land for most of the onshore port facilities. The dredging operations are expected to meet most of the demand for reclamation material.

Based on the navigational requirements, Table 2-12 provides the various dredge depths and the calculated dredging volumes. The volumes have been calculated based on the bathymetry information of the site and the required navigational aspects.

Table 2-12: Dredge Areas for the Vizhinjam Port

S. No.	Dredge Area	Dredge Depth	Dredge Volume
		(wrt CD)	(m^3)
1.	Approach Channel	Outer - 20.8 Inner - 18.4	3,254,953
2.	Turning Circle	18.4	904,300
3.	Berths and Harbor Basin	18.4	883,320
	Total		5,042,573

It is estimated that around 5.9 million m^3 of material will be required for reclamation. This would require total dredging to be of the order of around 6.6 million m^3. This additional dredging of around 1.6 million m3 over the required dredging may be obtained by over-dredging the navigational channel.

The suitable dredged materials will be discharged by the dredging equipment into one of the reclamation areas.

2.7 Fishery Landing Centre

The existing Vizhinjam fishing harbor has the berthing facility of 500m and is being utilized to its peak causing congestion in the utilization of the harbor. Apart from this, the harbor requires up gradation in terms of ancillary facilities.

In order to ease the congestion in the existing fishing harbor and provide additional facilities for the local population, VISL has proposed to provide fishery berths along the sea side of breakwater of the proposed Vizhinjam port as part of Corporate Social Responsibility (CSR).

The fishing landing centre is part of the funded works. Details shall be set out in the Concession Agreement.

2.8 Other Requirements

2.8.1 Port Crafts Berth

The Ship Navigation study has recommended a minimum requirement of four tugs i.e. 3 Tugs with 70T bollard pull capacity and 1 Tug with 40T bollard pull capacity to assist the navigation of ships visiting the port, 3 Mooring launches and 1 Pilot launch. It is recommended that a back-up tug be procured for the port.

A total of 100m of berth length is provided at the port for the port crafts mentioned above.

The characteristics of these support crafts are given in Table 2-13.

Table 2-13: Characteristics of Port Crafts

S. No.	Type of Craft	LOA	Beam	Draft	Freeboard
		(m)	(m)	(m)	(m)
1.	Tugs	30.0	9.0	2.5	1.5
2.	Pilot Launch	19.5	4.8	1.8	1.1
3.	Mooring Launch	10.3	3.2	1.2	0.8

2.8.2 Buildings

The Phase-1 development of port has identified the conceptual foot print and location for various terminal buildings required for the functional port operations.

Typical buildings common to a container terminal includes:

- Administration Building;
- Entry/Exit Gate Inspection Canopy;
- Security Guard Booths;
- Pre-gate and Customs Building;
- Maintenance Workshop and Repair Building;
- Quay Crane Maintenance and Marine Operations Building.

Apart from these terminal buildings, the other functional building required for the port operations include:

- VISL Port Administration Building for functioning of VISL in managing the port operations.
- Substation buildings to house the transformers and other electrical equipment as per the load requirements in the different parts of the port area.

- Fire Station building to house firefighting equipment, fire tenders, etc.
- Dispensary building to be located near the operational areas and provide minimum facilities required for the first aid.
- Other miscellaneous utility sheds as per requirements of particular terminal
- Canteen buildings to provide space for catering staff, messing facilities for the terminal personnel and for utilities.

Buildings not shown or considered in the Phase-1 development plan include those that may be needed to handle possible general/multipurpose cargo and port operator need based facilities. A provisional location for these buildings is shown on the plan but no additional details are provided to keep the flexibility for future expansion.

3 Phase 1 Port Development of Vizhinjam Port

3.1 Introduction

Based on the outcome of the model studies, the recommended layout for the Phase-1 development of Vizhinjam Port is as shown in Drawing# CA/A/II - R.

3.1.1 Breakwater

For carrying out cargo handling operations at the berths, there is a limiting wave conditions at the berths to ensure that there are no excessive movements of the ships that will hamper the loading/unloading operations. This limit varies with the handling system for the different types of cargo. Hence, the breakwater configuration and the overall port layout should ensure adequate tranquility at the berths so that cargo handling may continue even when the offshore wave climate exceeds the limit for ships' movement in and out of the harbor.

The maximum acceptable wave conditions for cargo handling operations at the berth are dependent on ship size, the type and method of cargo handling, and the direction of the wave attack. Beam waves cause the vessel to roll and affect the cargo handling operations more than head waves. The limiting wave heights (Hs) for different wave directions for cargo handling operations are summarized in Table 3-1 below. These numbers are based on IAPH guidelines and apply to the worst wave periods for each direction.

Table 3-1: Limiting Wave Heights for Cargo Handling

S. No	Type of vessels	Limiting wave height (H_s)	
		Head or stern (0°) (m)	Quadrant (45°- 90°) (m)
1.	Container Vessels	0.5	0.3

The breakwater alignment for Phase-1 development have been chosen to maximize the operations time by effectively blocking all of the bigger South-West monsoon waves and providing enough protection against rest of the year waves.

The breakwater alignment consists of breakwater that is around 3,100m (2,960 main harbor breakwater and 140m breakwater for fishery harbor extension) long. The deepest depth contour for breakwater is around -20m CD. The crest height of the breakwaters has been chosen so as to only allow industry standard overtopping discharges.

The location and details of breakwater are as shown in Drawing# CA/B/V

3.1.2 Navigational Requirements

Approach Channel

The port approach channel consists of the two parts:

- The outer approach channel which is the section of the channel outside the breakwaters area; and
- The inner approach channel, which is the section of the channel from the head of the breakwaters area to the vessel turning area.

The outer approach channel would be unprotected with vessels in transit along this section sailing under their own power without tug assistance. The inner entrance channel would be protected and should be fairly sheltered from wave attacks. Tugs will be able to meet and fasten to the vessel before it enters the turning area and starts to manoeuver towards the allocated berth.

The vessels will start slowing down after tugs are attached in the inner approach channel. As per PIANC (1997) guidelines, sheltered inner approach channel should have around 4-5 times length of the design ship. However, considering the capital cost of longer breakwater, it is expected that breakwaters will provide an effective length of 3-4 times the design vessel length overall for Phase-1 operations which is deemed adequate. The vessel navigation study has further confirmed the inner approach channel length adequacy for the vessel operations for Phase-1.

Dredged Depth at Port

The depth of the approach channel is a very important parameter in approach channel design. The Vizhinjam port location has a very favorable bathymetry and natural depth. Water depth in the channel region is around 15 to 18m depth below CD. This will minimize the initial capital dredging cost involved. The depth in the channel is determined by the vessel's loaded draught; trim or tilt due to loads within the holds; ship's motion due to waves, such as pitch, roll and heave; character of the sea-bottom, soft or hard; wind; influence of water level and tidal variations; the increase in draft of the vessel due to squat or bottom suction.

The dredged depths at the port entrance channel and maneuvering areas will be governed by the fully loaded draft of the design ship. Based on PIANC guidelines, the following dredged depths (after rounding off) are provided at different parts of the harbor for the design ships.

Vessel Size	Approach Channel outside Breakwater (Loaded draft+30%)	Inner channel and Maneuvering area (Loaded draft+15%)	Depth at Container berths (Loaded draft + 15%)
18,000 TEU (16.0m draft)	20.8	18.4	18.4

Thus the outer approach channel which will be unsheltered will have a minimum dredging depth of 20.8m CD, whereas in the inner approach channel area, turning circle and harbor basin, a water depth of 18.4m CD will be provided. Berthing pockets will have a dredged depth of 18.4m CD. These dredge depths will also be able to accommodate the 18,000 TEU ships. The vessel navigation study has further confirmed the adequacy of the depths provided at various navigational areas.

Turning Circle Diameter

As per the PIANC guidelines, diameter of the sheltered turning circle with tug assistance should be 1.75 times length of the design ship. The design ship length is taken as 400m so the turning circle diameter required would be 1.75 times 400m which is 700m. The vessel navigation study has further confirmed the adequacy of the turning circle diameter and location.

Width of Harbor Entrance

The width of the single lane approach channel has been estimated considering the design ship beam of 59m. The various factors considering the base width of the channel have been taken from PIANC guidelines. A suitable factor for each parameter is taken and it is multiplied with design ship beam to get the total base width of the channel. Channel width calculations are shown in in the table below

Table 3-2: Approach Channel Width Estimation

Factor description	Outer Approach	Inner Approach
Basic Width	1.5	1.5

Factor description	Outer Approach	Inner Approach
Vessel Speed	0	0
Prevailing Wind	0.4	0.4
Prevailing Cross Currents	0.7	0.7
Prevailing Long. Currents	0.1	0.1
Sig. Wave Height & Wavelengths	1.5	1
Aid to Navigation	0	0
Bottom Surface	0.1	0.1
Depth of Waterway	0.1	0.1
Cargo Hazard	0	0
Bank Clearance 1	0.3	0.3
Bank Clearance 2	0.3	0.3
Total Factor (One-Way Channel)	5	4.5
Beam of Design Vessel	59	59
Channel Width	295 m (=59*5)	266 m (=59*4.5)

From the above table, it can be concluded that as per PIANC guidelines outer approach channel (unsheltered) and inner approach channel (sheltered) will need approximately 295m and 266m of base width respectively.

The ship navigation simulation study has recommended that the outer approach channel be widened to 400m and inner approach channel be maintained at 300m. For Phase-1 development, outer approach channel width is sized as 400m gradually reducing at the breakwater mouth to an inner approach channel width of 300m.

The approach channel can be a single lane or a two lane channel. For busy ports which handle very large throughput and have a large number of vessel calls, it is recommended to have a two way approach channel. In order to establish the approach channel width and number of lanes, technical consultant has performed a spreadsheet analysis. Based on the operating assumptions made, Table 3-3 shows the impact of vessel traffic on the channel utilization rate for various phases.

The parameters considered for channel traffic level analysis are vessel speed (it is assumed that vessels would transit slowly in the approach channel at an average speed of 5 knots), length of the approach channel, and time for operations such as pilot boarding, tug fastening and maneuvering operations in turning circle. Traffic parameters (total ship calls) are taken from maritime consultant's report.

Table 3-3: Approach Channel Lane Requirement Estimation

Parameters	Unit	Phase-1
Assumed vessel speed (knots)	knots	5
Knots to km	km	1.852
Vessel Speed	kmph	9.26
Length of the channel	km	4
Time for transit	hr.	0.43
Time for pilot boarding	hr.	0.25
Time tug fastening	hr.	0.25
Average time from turning circle to berth	hr.	0.50
Total Channel + Turning Circle Operation Time	hr.	1.43
Average total operation time	hr.	1.50
Number of container berths	No.	2
Number of cruise berths	No.	0
Number of other berths	No.	0
Container vessels per week per berth	No.	5
Cruise vessels per week per berth	No.	0

Parameters	Unit	Phase-1
Other vessels per week per berth	No.	0
Total vessel calls per week	No.	10
Total number of vessel trips through the approach channel per week	No.	20
Number of days per week	No.	7
Total vessels trips per day	No.	2.86
Operating time per day	hr.	20
Window of availability for each vessel trip	hr.	7.0
Channel Utilization	%	21

Approach channel utilization for Phase-1 is calculated at 20% for commercial vessels. The actual usage of these berths will vary and hence these are not currently included in the utilization calculations. With these utilization figures, it can be concluded that a single lane, one way channel will be sufficient to serve the expected number of ship calls up to the final phase of development along with the naval and coast guard vessels. In addition, with the removal of south breakwater and widening of approach channel to 400m, smaller vessels may be allowed to pass each other as deemed adequate by the pilot authorities.

3.1.3 Container Berths

The Phase-1 development provides for a total of two, 400m container berths for a total contiguous berth length of 800m berth which will be able to accommodate two 12,500 TEU container vessels. The berths have been planned so as to meet the traffic forecast. These berths will be designed so as to be able to berth 18,000 TEU vessels. The dredged depth at these berths is -18.4m CD.

Each berth will be equipped with four quay container cranes.

Table 3-4 provides a summary of Phase-1 container terminal elements. The Quay apron area has been planned to accommodate the crane rail (35m rail gauge), circulation lanes as well as hatch cover lay-down area. The apron area has been planned for a width of 70m. However, the gauge for the crane rail is kept open which would give the flexibility to the contractor onto choosing the type of quay cranes to suit his requirements.

Table 3-4: Phase-1 Container Terminal Elements

Development Phase	Phase-1
Total Berths	2
Berth Length (m)	800
Berth Capacity (TEUs)	10,00,000

3.1.4 Fishery Berths

The Phase-1 development provides for additional fishery berths for the local fishing community. It is proposed that the fishery berth is part of the funded works and details of development for the same shall be set out in the Concession Agreement. Total berth length of around 500m is provided along the sheltered sea-ward side of the proposed port north breakwater. A 140m long breakwater provides the required tranquility for the fishing vessels. The access to the fishery berths will be provided from outside of the port and the proposed operations at the new port will not cause interference to the fishery berth access. Adequate landside facilities in terms of auction hall etc. are also planned near the berth.

3.1.5 Port Craft Berths

A total of 100m of berth length will be provided for port crafts such as tugs. The 100m berth will be able to accommodate port crafts for the Phase-1 requirements. Over the master plan horizon, additional port craft berths would be required. The location of these port craft berth has been carefully chosen so as to provide a sheltered location as well as at an optimum distance from all berthing areas, and having a provision for pilot office area adjacent to the berths.

3.1.6 Container Yard

The Phase-1 development provides for around 40 hectares of Container Yard and support facilities. The container yard is located adjacent to the berths allowing for the efficient transfer of containers from the yard to the apron. The container yard has been planned for efficient handling operations providing for dedicated areas for full, empty and reefer containers. Dedicated circulation lanes have also been provided for quay to yard as well as within yard circulation. The mode of operation for the container yard will be Rubber Tired Gantry (RTG) Cranes in the Phase-1 with provision for up gradation to Electric RTGs. Side Pick cranes will be utilized for handling empty containers. The container yard provides flexibility with adequate space provision for terminal operator to choose a different container handling operating mode such as RMG.

The numbers of ground slots have been provided so as to be able to meet the peak berth capacity. Storage for equipment and Internal Transfer Vehicle (ITV) has been provided along the northern side of the container yard. Most of the terminal roads will have two-way traffic. The truck lanes under the RTG as well as under the quay crane will have one-way traffic. The quay apron - yard movement will be anti-clockwise whereas the yard – gate/ rail yard movement will be clockwise.

In addition, the yard has been planned such that the transshipment cargo stays closer to the berths than the gateway cargo. The container yard as planned has a width of around 400m and has a total of 5,710 Twenty Foot Ground Slots (TGS) in order to match the required storage capacity. Utility routes have been planned and incorporated into the yard to allow for minimal disruption during phased development as well as easy up gradation of diesel RTGs to ERTGs. A dedicated area has been provided for reefer support operations such as Reefer Wash Down, Reefer Service and Gen-set repair Building.

3.1.7 Container Freight Stations (CFS) & Warehousing

Suitably located CFSs are the integral part of a modern container terminal. CFS provides facilities for consolidation and distribution of small consignments either exported or imported in LCL containers. Though CFS facilities are primarily conceived for handling LCL containers but in realities large volume of FCL containers also move through CFS for various reasons convenient to the exporters and importers.

Ideally the CFS should be located within a distance of 5 to 15 km from port at a place which has a direct connectivity to the port. In the present case it is proposed that the CFS is located in the land parcel at Kottukal which is about 4 Km from the Project site lying on either side of the NH47 bypass road. This land parcel will be utilized for CFS, warehouse facilities as well as housing colonies for port staff totals to 41.5 Ha. The proposed NH 47 bypass will be bi-furcating the total land area in to two. The alignment of the NH 47 bypass that is being constructed/ planned will bypass the Thiruvananthapuram capital city through the warehouse area at Punnakkulam.

3.1.8 Truck Terminal

The truck terminal for the proposed port is located close to the end chainage of proposed road alignment and is designated as Truck Terminal Area - 1 and the one located northwest is close to the proposed rail alignment and is designated as Truck Terminal Area - 2. The area for the truck terminal comprises a total of 19.94 Ha. The proposed truck terminal is located at Mukkola on either side of the road connecting Vizhinjam and Poovar, and also adjacent to the proposed NH 47 bypass. Both the road and railway alignment traverse close to the proposed vicinity of truck terminals. The road alignment for Vizhinjam port practically ends at the proposed NH 47 bypass which is just adjacent to the entry for the truck terminal-2. This gives easy access of connectivity for the container truck traffic.

3.1.9 Gate Entry/ Exit Complex

The entry/exit gate has been planned as a two-step gate. A pre-gate will be constructed at the port entrance on the main terminal road which will have parking and facilities for truckers and autos. Only authorized vehicles will be allowed to leave the pre-gate area and enter the main terminal gate. The main terminal gate has been provided at the east end of the port. It will consist of a gate canopy with three entry and three exit lanes with one bypass lane and one traffic lane in each side. The bypass lane is to be used for out of gauge container trucks. The traffic lane is to be used by port staff and other users. It is planned that, gate will consist of single shift operations in Phase-1. The proposed port is expected to be essentially a transshipment container terminal with only 16% of gateway container traffic. The split of gateway traffic coming through road trucks is assumed to be 70%. The gate lanes have been sized to accommodate this traffic. Adequate queuing space has been planned for in the gate complex. Space has been provided for customs and other regulatory processes near the gate complex. Container scanning (Radiation etc.) if needed can be accommodated within the gate complex itself.

Each container gate lane will be equipped with a weigh bridge that is used to measure and assess truck axle weights for enforcement of axle load highway rules.

3.1.10 Rail and Road Connectivity

Rail connection to the port is envisaged to be developed by the authority, from the breakwater side in the form of a coastal bridge. Electrified railway lines (with two live & one service lines, one service line for Phase-1) with container handling facilities using Reach Stackers in Phase-1 development upgradable to RTG's or Rail Mounted Gantry's (RMG's) in future phases to commensurate with the traffic. The proposed port is expected to be essentially a transshipment container terminal with around 16% of gateway container traffic. The split of gateway traffic coming through rail is assumed to be 30%. The number of rail lines has been sized to accommodate this traffic.

Space along the service line will be used for container stacking before transfer to container yard. The port will provide for switching and yard services within the railway yard.

The road entry has been planned from the Mulloor end and the main terminal access is planned along the middle of the terminal from east. The land for proposed route of the 45m road corridor is under the ownership of VISL.

3.2 Fishery/Harbor Requirements

The existing Vizhinjam fishing harbor has the berthing facility of 500m and is being utilized to its peak causing congestion in the utilization of the harbor. Apart from this, the harbor requires up gradation in terms of ancillary facilities.
In order to ease the congestion in the existing fishing harbor and provide additional facilities for the local population, VISL has proposed to provide fishery berths along the sea side of north breakwater of the proposed Vizhinjam port as part of Corporate Social Responsibility.

The fishery harbor is part of the funded works. Details shall be set out in the Concession Agreement.

The facilities to be provided are broadly divided into two categories viz.

a) Waterside facilities

- Tranquil condition for harbor operations
- Proper access to the landing area from the sea
- Landing, Outfitting Quay and berthing quay/ jetty
- Navigational Aids etc.

b) Landside facilities

- Auction hall and loading area facility
- Administrative building
- Net mending shed
- Gear Shed
- Toilet Block
- Facilities for Effluent treatment
- Vehicle parking area
- Access roads
- Security
- Electric & Water Supply etc.

It is proposed to provide 500m fishing jetty with differential landing facility for the fishing trawlers and country boats fitted with outboard engines.

3.3 Marine Layout for Implementation

The summary of the marine layout for Phase-1 development is provided in Table 3-5 below:

Table 3-5: Summary of Phase-1 Marine Layout

S. No	Description	Unit	Value
1.	Maximum Ship Size		
	Container Vessels	TEU	18,000
2.	Breakwaters		
	Length of Breakwater	m	2,960
	Breakwater for fishery harbor extension	m	140
3.	Number of Berths (Total length of berths in meters)		
	Container Berths	No.(m)	2 (800)
	Port Craft Berths	No.(m)	1 (100)
	Fishery Berths	m	500
4.	Navigational Areas		
	Length of Outer Approach Channel	m	2,800

S. No	Description	Unit	Value
	Width of Outer Approach Channel	m	400
	Length of Inner Approach Channel (m)	m	1,200
	Width of Inner Approach Channel (m)	m	300
	Diameter of Turning Circle (m)	m	700

3.4 Phase 1 Expansion

The Integrated Master Plan for the proposed port at Vizhinjam has been submitted by the technical consultant in November 2012. Considering the outcome of the ESIA and modelling studies, the master plan layout has been further optimized in May, 2013. This section provides a summary of the master plan covering the amendments in the port facilities. Please refer to the master plan report available through VISL for additional details.

The final Master Plan (also referred to as Phase-3 of development) results from identifying the infrastructure needed to achieve the projected market demand over the 30-year planning horizon for the Vizhinjam Port's two core commodities: containerized cargo and cruise. This is based on the traffic projections in the IFC/Drewry 2010 report, and considering the limited / utilizable shore length of 2.5 Km at Vizhinjam. This infrastructure will include:

- Ability to berth fully laden two 12,500 20-foot equivalent container units (TEU) vessels in Phase-1 itself with capability to handle up to 18,000 TEU vessels.
- Ability to handle 3,000 passenger capacity cruise ships cum multipurpose cargo vessels.
- Additional fish landing berths on the sea side sheltered section of breakwater.
- Liquid bunker fuel berth in Master Plan.
- Container Yard on reclaimed land.
- Rail line to port and the railway yard.
- Other support and ancillary facilities.

The technical consultant had applied the site-specific physical constraints, based on the infrastructure assessment, to identify the master plan while keeping VISL objectives in mind. These constraints include proximity to an existing fishing harbor and fishermen settlements in the north; a temple in the middle; a fishing village with long beach (Adimalathura) in the south (Phase-3 end) and steep topography of the backup area.

In summary the Master Plan addresses four main factors:

- *Market:* The master plan is based on the traffic analysis performed by IFC/Drewry (2010) and is planned to accommodate the 2044 high case scenario. In addition, expansion potential of the master plan will allow to port to expand beyond 2044. The master plan is flexible enough to accommodate various types of cargoes depending on the market situation (cruise, multi-purpose cargo). Based on the market forecast, it is recommended that Port of Vizhinjam be developed in three phases with Phase-3 bringing it up to the final master plan development.
- *Technical:* The master plan presents the most technically sound option after taking into due consideration the physical constraints at the site and providing a futuristic world class efficient facility with green design concepts.
- *Environmental:* The master plan takes into account various environmental aspects such as:
    - Provides a 300m clearance between the existing fishing harbor to avoid disturbing the existing facilities due to proposed port;
    - Minimizes the land cutting with efficient arrangement of terminal facilities;

- Minimizes tree uprooting in the back land by locating terminal facilities away from existing shoreline;
- Provides flexibility to incorporate green initiatives.

- *Social:* The Master Plan has been carefully arrived at to minimize impact on the adjoining population, some of the factors considered are:
  - Fishing community near the proposed port site;
  - Additional fish landing centre is provided for the fishing community;
  - Additional beach area developed by reclaiming into the sea for the local community
  - Rail access has been planned for minimal impact on the adjoining village;
  - Tourism industry to improve through cruise vessels and the proposed land use will match the current land use in the cruise terminal area;
  - Master plan preserves the existing Mulloor Naga temple and provides for unimpeded access to it.

3.4.1 Harbor and Breakwater Alignment

The harbor and breakwater alignment was maintained from the RH report as it was arrived at after due consideration and studies. However, some alterations were made such as maintaining the distance between the existing fishing harbor and the proposed port to be 300m (RH report had it 220m) considering the improved tranquility conditions of the fishing harbor as observed from the mathematical modelling studies.

The shape/ layout of the northern breakwater have been designed in such a way that bunkering vessels can also be berthed in future. The port design was made futuristic by considering 18,000 TEU vessels as the design vessel in Phase-1 itself with a turning circle of 700m diameter, to cater to tug assisted rotation of even futuristic vessels of 400+ m length. Considering that about 18m draft is naturally available at Vizhinjam (which will be deepened to about 21m), currently the biggest 18,000 TEU vessels (like MAERSK EEE class) will also be able to berth.

After modelling studies, it became evident that south breakwater was not needed for maintaining tranquility within the harbor and has been subsequently removed. The navigation studies have been used to further optimize and verify the navigational channel of the harbor.

The harbor and breakwater alignment for Phase-2 will be maintained as per the Phase-1 layout. LTR modelling studies have shown that a 200m extension of the breakwater will be required to achieve permissible level of tranquility for Phase-2 berths. For the Master Plan development a further breakwater extension of around 720m will be needed.

3.4.2 Container Berths

The master plan provides for a total of five, 400m each container berths. Phase-1 development will have a total of 800m berth length to accommodate two 12,500 TEU container vessels. Phase-2 development will add another 400m berth to have a total of 1200m berth length to accommodate up to three 12,500+ TEU container vessels. Phase-3 will add two additional 400m berths to have a total of 2000m berth length to accommodate up to five 12,500+ TEU container vessels. The berths have been planned so as to meet the traffic forecast. These berths will be designed to be able to berth 18,000 TEU vessels as well.

Each berth will be equipped with four quay container cranes. The Quay apron area has been planned to accommodate the crane rail (up to 35m rail gauge), circulation lanes as well as hatch cover laydown area. The apron area has been planned for a width of 70 meters.

3.4.3 Fishery Berths

The Phase-1 development plan provides for additional fishery berths for the local fishing community. A total berth length of 500m is provided for along the sheltered sea-ward side of the proposed north breakwater. The master plan report (2012), suggested that fish landing berths could also be situated on the sea side of the existing Vizhinjam harbor south breakwater. However, the modelling reports have shown that only 500m along the proposed port breakwater are feasible.

3.4.4 Cruise cum Multipurpose Berths

For the port master development, cruise berth will be constructed on the leeside along the northern breakwater, in order to optimize the container cargo handling berths and provide flexibility for phasing the cruise berths on a need basis without interrupting the cargo operations.

The master plan provides for two berths for Cruise of 500m length along the northern breakwater. The depth required for maneuvering and berthing of cruise ships is naturally available at the proposed location and will not involve any capital dredging. The berths are located on the lee-side of the breakwater so as to utilize the structure and provide a wide area behind the berths.

These berths also cater the handling for multipurpose cargo traffic which is not significant that would require a dedicated berth.

3.4.5 Liquid Berth

A provision has been provided in the master plan for a dedicated liquid berth. This berth will be used to import bunker fuel for the vessels calling at the Vizhinjam port. The berth will be connected to the storage tanks through pipelines passing along the north breakwater. A provision for 250m long berth has been provided in the Master Plan and will be able to berth a 60,000 DWT liquid bulk tanker. The berth will be located on the western side of the container terminal along the lee side of the north breakwater. This location would cause minimum interference between liquid berth operations with any other port vessel operations.

3.4.6 Container Yard

The master plan provides for around 100 hectares of Container Yard and support facilities. The container yard is located adjacent to the berths allowing for the efficient transfer of containers from the yard to the apron. The container yard has been planned for efficient handling operations providing for dedicated areas for full, empty and reefer containers. Dedicated circulation lanes have also been provided for quay to yard as well as within yard circulation. The mode of operation for the container yard will be Rubber Tired Gantry (RTG) Cranes in Phase-1 with provision for up gradation to Electric RTG's (eRTG) in later phases. Side Pick cranes are proposed for handling empty containers. Master Plan provides flexibility with adequate space provision for terminal operator to choose a different container handling operating mode such as RMG.

3.4.7 Railway Connectivity/Yard

Electrified railway lines (with two live & three service lines - one service line each in Phase 1, 2 and 3) with container handling facilities using Reach Stackers in Phase-1 and Phase-2, upgradable to RTG's or Rail Mounted Gantry's (RMG's) in Phase-3 have been planned. The proposed port is essentially a transshipment container terminal with around 30% of gateway container traffic. The

split of gateway traffic coming through rail is assumed to be 30%. The number of rail lines has been sized to accommodate this traffic.

In future, the proximity of the planned cruise berths to the rail yard can also be utilized to handle the multipurpose/ bulk cargo from the cruise berths using rail for landside transfer.

Provisional future expansion space east of rail yard and north of the gate complex can be also used for bunker fuel storage, which can also avail the proximity of rail yard, for bringing in the liquid petroleum products in the port by rail.

3.4.8 Entry/Exit Gate Complex

The main terminal gate has been provided at the east end of the port. It will consist of a gate canopy with three entry and three exit lanes with one bypass lane and one lane for port vehicles on each side. It is planned that the gate operations in Phase-1 will consist of single shift increasing to two and three shifts in Phase-2 and Phase-3 respectively. The proposed port is essentially a transshipment container terminal with around 16% of total container traffic will be Gateway traffic handled by trucks.

The gate complex is designed for handling the master plan gateway traffic to be handled by trucks. Traffic forecast by maritime consultants has been considered for designing of gate complex. In case there will be any change in market statistics and increase in gateway traffic by gate, there will be possibility to expand gate complex further in north-east direction. In case of two or more terminal operators, gate complex will remain same and secondary check gates will be provided at terminal entry points.

3.4.9 Phase 1 Expansion

The Phase-1 development is planned in such a manner that container berths can be expanded and additional berths for cruise and liquid bulk can be added at the port. This would involve extension of the breakwater and the harbor and require additional reclamation for creation of back-up land area.

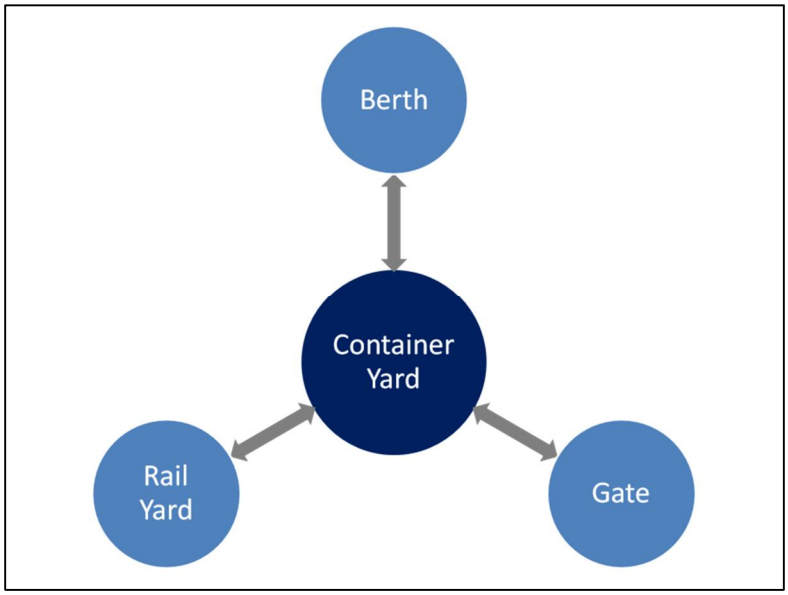
The proposed layout of the full development for Vizhinjam port (Master Plan) is shown in Drawing# CA/A/II – R and the Phase-2 development for Vizhinjam port is shown in Drawing# CA/A/II - R.

4 Container Handling System

4.1 General

It is important to note that all container moves either begin or end in the container yard. No containers move directly from vessel to rail or from gate to vessel for example. Figure 4.1 shows a schematic of each container flow at Vizhinjam Port.

Figure 4-1: Schematic Container Flow Diagram



4.2 Container Terminal Operation Strategy

The container terminal will have two container berths with total quay length of 800m, which can cater to a minimum of two container ships at any time. It is proposed to provide 8 Rail Mounted Quay Cranes (RMQCs) on these berths. There would be flexibility of moving the quay cranes to the adjacent berths so that 2 to 5 cranes can be deployed on a ship, depending upon ship size.

As per the best industry practices, it is recommended to provide RMQC: quay crane to RTGC ratio as 1:3. Based on this, it is proposed to provide 24 Rubber Tired Gantry Cranes (RTGCs) for handling in the Container Yard. Two Reach Stackers are provided to handle containers being moved by rails. For handling of Empty Containers, 6 Side Picks are proposed. For movement of containers between quay, container yard and rail yard 55 Internal Transfer Vehicles (ITVs) are provided.

It is to be noted that the actual operation strategy is to be decided by the selected operator who would be operating the terminal. However, the number of equipment is arrived at based on the terminal capacity to cater the projected forecast.

The flow diagram for the container handling system is presented in figures below.

Figure 4-2: Gate Procedure Diagram of Container Export

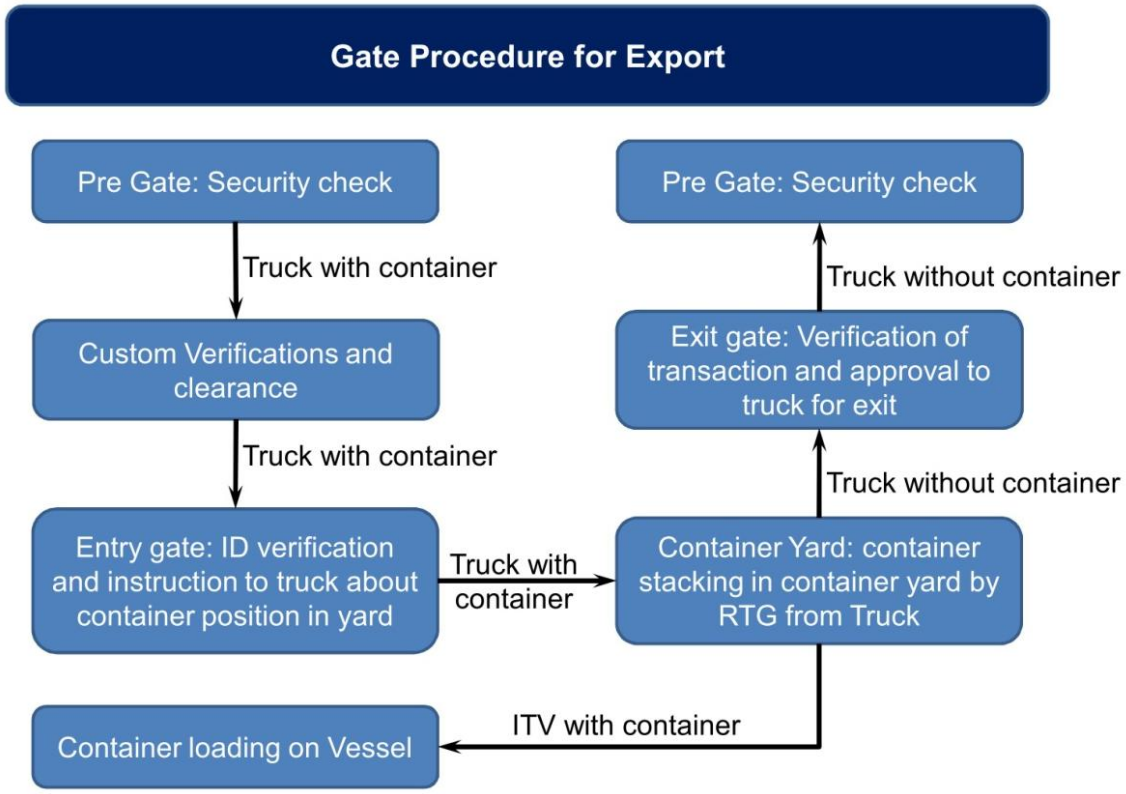
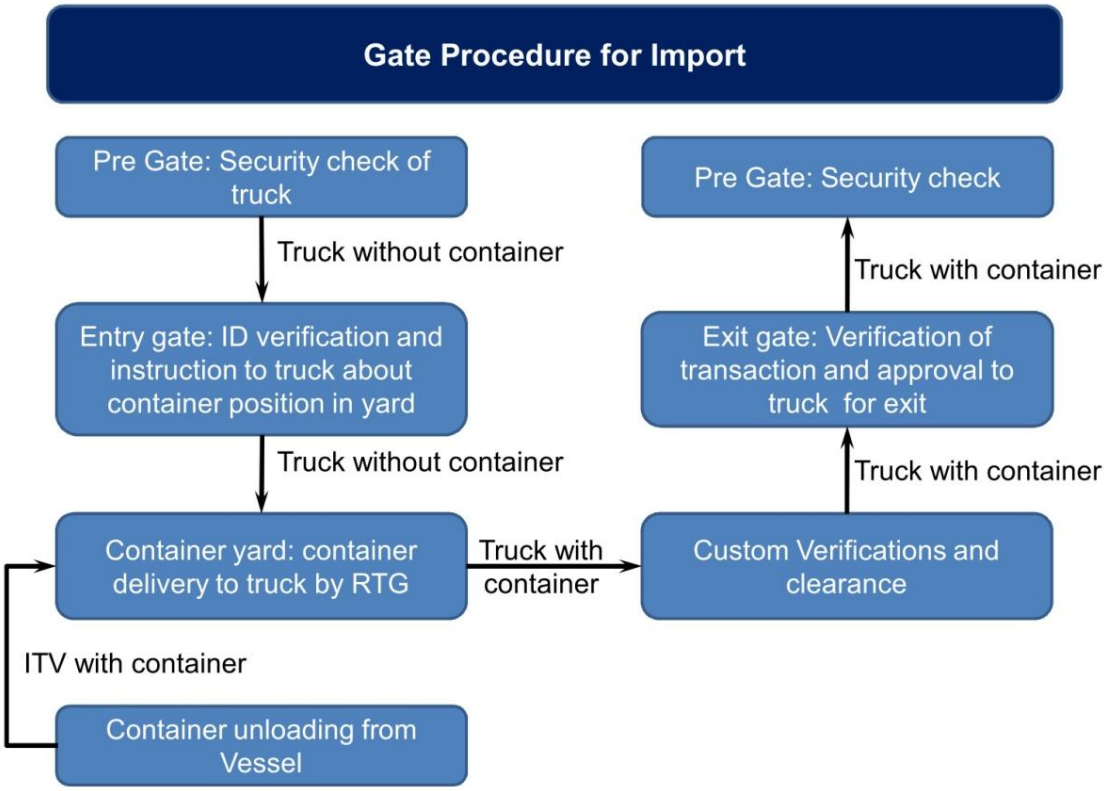


Figure 4-3: Gate Procedure Diagram of Container Export



4.3 Storage and Evacuation Strategies for Container Terminal

The container yard is planned based on the transshipment and gateway container forecast, expected dwell time at yard and the storage height of the containers. Considered dwell time for planning perspective is 5 days. As the dwell time decreases, the productivity or container handling capacity of yard increases. The actual dwell time will be based on business strategies of VISL and the Terminal Operator.

The loaded container shall be stored maximum up to four high. The Reefer containers shall have the similar stacking high but stacking arrangement will be different with provision of electricity supply. Empty container storage can go up to seven high depending upon handling equipment. Size, specifications and handling capacity of the equipment will be decided by the operator so the handling patterns may change than the pattern considered in Technical consultant's PRECAP Model for capacity analysis.

4.4 Container Yard Operation Strategy

Vizhinjam Port is being developed with a vision of green initiative, it is planned to operate the container yard with (eRTG's) i.e. RTG's run on electric power supply rather than diesel electric power, which are eco-friendly. RTGs can be operated in the yard to handle the containers up to five high and seven wide blocks and it can be moved from one block to other blocks. ITVs would be utilized for transfer of containers between yard, rail yard and the berths.

Separate blocks shall be designated for long standing containers, i.e., containers which are not lifted beyond 60 days should be moved away from the yard for subsequent auction and disposal of the cargo. If necessary these containers can be moved out to another custom bound area where the CFS operations will be undertaken. This will minimize the unproductive moves in the yard.

4.5 Handling of Inland Containers Depot (ICD) containers

It is proposed to provide one working rail siding to receive and dispatch ICD containers. Two reach stackers are provided in the rail terminal for loading and unloading the containers from the trains. The containers for dispatch will be planned and pre-stacked to turn around the train faster as per the operators' requirement and also to meet the railway requirement of engine on load concept. To augment the pre-stacking, there will also be a continuous movement of ITVs between container yard and rail yard.

4.6 Container Terminal Equipment's

Table 4-1 provides a summary of estimated requirements for various container terminal equipment for the Phase-1 associated attributes including quantity and productivity rate. This is just an estimate based on industry practice and general operating procedures. Terminal operator will finally decide on the requirements based on his operational requirements and actual container throughput.

Table 4-1: Estimated Container Terminal Equipment Requirements for Phase-1

S. No	Container Terminal Equipment	Quantity	Productivity
		(no.)	(moves per hour)
1.	Rail Mounted Quay Cranes (RMQC)	8	25
2.	Rubber Tired Gantry Cranes	24	15 to 20

S. No	Container Terminal Equipment	Quantity	Productivity
		(no.)	(moves per hour)
3.	Reach Stackers	2	12
4.	Empty Container Handlers	6	15 to 20
5.	Internal Transfer Vehicles	55	4 to 6

5 Infrastructure and Port Facility

5.1 External Rail Connectivity

Vizhinjam Port is situated on the west side of the existing railway line running from Thiruvananthapuram Central Station to Nagercoil junction Station – Kanyakumari of Thiruvananthapuram division of Southern Railway. The Division is having jurisdiction from Thiruvananthapuram to Kanyakumari, Nagercoil and Mallapalayam Halt station in the Southern direction and to Kollam, Kottayam– Ernakulam junction, Vallatol Nagar, ThrissurGuruvayur Kochi Harbor terminus and Kayamkulam junction having a route of 610km.

The main line of broad gauge that passes through Nemom, Neyyatinkara and Balaramapuram railway stations are approximately 10 Km from the Vizhinjam Port location. The broad gauge single rail line is running between Thiruvananthapuram and Kanyakumari. Beyond Thiruvananthapuram towards north, up to Kayamkulam double rail line exists.

Balaramapuram (Flag station) and Neyyatinkara (Block station) are located on the southern side of the proposed rail alignment whereas Nemom (Block station) is on the northern side. These three stations are at a distance of approximately 9km, 13km and 10km respectively from the port boundary. The 'Rail Transport Clearance' (RTC) was granted to Vizhinjam Port by the Ministry of Railways to develop private rail siding from the nearest hauling station to Vizhinjam Port on 'Engine-on-load' (EOL) concept. Subsequently, feasibility study for this rail line was undertaken by VISL for development.

For the development of the sidings for transport of cargos to the port hinterland, couple of alternatives was developed as part of the feasibility study for rail line development and to convert the hauling station to a block station with the necessary up gradation. During the initial stage of the study, RITES suggested the rail through general ground level connecting to Balaramapuram. But the Railway authorities did not approve the alignment citing technical problems for connecting to Balaramapuram.

Later, VISL entrusted to study to a rail agency to review the rail alignment and the probable block station for development. Based on their assessment, rail would be generally running through elevated structures and connecting to Neyyattinkara. Since the route displaces about four temples enroute near Neyyatttinkara, RVNL was advised to study alternate route to Nemom. Accordingly, RVNL in their study proposed that the rail would be running through elevated structures and connecting to Nemom.

The rail link to Vizhinjam Port will be a single line with automatic signaling to ensure that the trains can be moved efficiently. It is estimated that around three trains per day would be calling into the port for the forecasted hinterland traffic for Phase-1 development.

In view of the gateway traffic it is essential to develop a rail link for the project. The development details for the same shall be laid out in the concession agreement

5.1.1 Exchange Yard

Exchange/ Transit yard is the point where trains are exchanged between the main railway line and the port connected line. Facilities for reception and dispatch of trains are arranged here. Block loads of trains or point to point trains are proposed to run to and from the Nemom Station, only a Receipt & Dispatch (R&D) yard is proposed to be provided at the port. Rail line from Nemom to port will be an electrified traction line. Train operation within port boundary will also be of electric traction for arrival and departures.

RVNL has carried out detailed project report for the rail connection from Nemom station to port. Nemom is a block station having 2 main lines. 2 full length siding lines with linkage to the main line at both ends are proposed at Nemom railway station along with a station building to cater to the generated rail traffic by port.

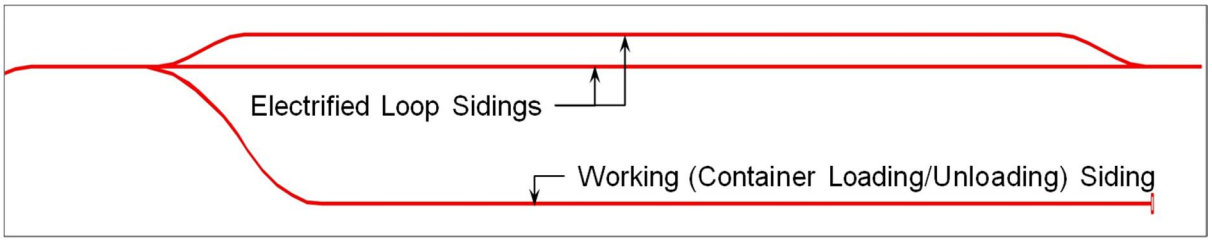
The location and details of exchange yard are as shown in Drawing 12086/DPR/261.

5.2 Internal Rail Links

5.2.1 Rail Yard

In Phase-1, it is proposed to take two electrified loop siding for pull and push operation of rake on a working siding and single working siding for loading/unloading of containers. Train coming to the port will be having locomotive with EOL (Engine on load) and the entire rail operation within port will be carried out by the same locomotive; no separate provision for dedicated locomotive has been considered for rail yard in port.

Figure 5-1: Gate Procedure Diagram of Container Export



The total length of the internal rail link to the Container Terminal is estimated at 2870m. The rail terminal is planned with 3 sidings (a working siding and two loop sidings) with clear length of 700 m. The track spacing for the Rail Terminal is 6m between two adjacent rail sidings to allow for maintenance access and inspection of containers and wagons. Spacing between working siding and loop siding is planned considering the future deployment of extra rail sidings to cater to the future hinterland traffic. A secondary storage area for containers is provided adjacent to working sidings.

5.3 External Road Connectivity

Thiruvananthapuram district is well developed by roads. NH-47 which connects Salem to Kanyakumari passes through Thiruvananthapuram district and at a distance 8 Km approximately from the coast line in the project region and is connected to Cochin port through NH-47A. From Cochin further north is connected by NH-17 to Mumbai. The nearest major urban centres on the NH-47 are Thiruvananthapuram in the North and Nagarcoil-Kanyakumari in the south. NH-47 also connects major towns in Kerala such as Ernakulam, Thrissur, Palakad, Kollam, Alapuzha and in Tamilnadu Salem and Chennai and the rest of the country through NH-7; NH4 etc. Thus NH-47 is well connected to the National Highway network of the country.

It has been proposed to have a road connecting Vizhinjam to NH-47 bypass.

The connectivity of the port can be further divided in three portions,

- Road towards gate and container terminal,
- Road connecting VISL Port Administration Building and

All roads will be merging with the road connecting port to the NH-47 bypass and forming rotary junction. Road from rotary junction to custom gate and container terminal will be of four lane wide road and the other roads from rotary junction to VISL Port Administration Building.

5.4 Internal Roads

Internal connectivity of the terminal will be developed by the terminal operator selected by VISL authority. Most of the terminal roads will have two-way traffic. The truck lanes under the RTG as well as under the quay crane will have one-way traffic. The quay apron - yard movement will be anti-clockwise whereas the yard – gate/ rail yard movement will be clockwise.

5.5 Container Terminal Infrastructure

5.5.1 Container Yard

Container Stack Area

Yard area of approximately 25 Ha for container stack will be designed for stacking 5.5 T/sqm (for up to 5 full container high stacks). After consolidation of reclaimed dredge material, the yard area will be leveled and fill material will be spread and compacted for base layer.

Proposed Yard Pavement

It is noted that the reclamation and ground treatments if any will need to be completed within a relatively tight timescale. Some differential settlements are therefore expected in the container stack areas, particularly during the first years of operation and it is likely that some re-levelling of the surface below the container stacks would be required during the early years of operation.

It is therefore proposed that a gravel bed solution be adopted in order to minimize the cost and time. However, it is the choice of the selected operator to adopt the type of yard pavement for the operations.

RTG Runways

For the movement of RTGCs, reinforced concrete beams of 400mm thick are provided with sub-base layer of CBM. For RTGCs, turning pads with structural plates and inserts will be provided.

In the container yard, electrical conduits and pits are to be provided for cranes, HT electrical, general lighting, communications and reefer arrangements. Also Miscellaneous works like kerbs; foundations for lighting, RTGC tie down are to be provided.

5.5.2 Reefer Gantries

Reefer containers are planned to be stacked up to 4 high. Plug in and plug out the power supply and monitoring the reefer container parameters are the operations carried out in each reefer boxes. To carry out these operations of reefer boxes which are stacked above ground level, an operation platform is required. Hence a Galvanized Iron gantry structure is planned in each slot to accommodate the power plugs as well as carry out operations. Under these platforms the compact substation and the reefer power distribution panels will be installed. From the Reefer distribution panel along the platform structure the power cable will be laid for each reefer power plugs.

300 TGS will hold on an average 700 TEUs. Each Reefer Block will have 28 plug points (7 containers * 4 stack heights) for 42 TEUs. Hence 17 Reefer Blocks are required for supporting 467 (700/TEU Factor 1.5) Reefer Points.

5.5.3 Rail Terminal

The rail yard area is planned with a total outer dimension of 1,110m length and 62m width. This area will also be on reclaimed land. After consolidation of dredged material reclaimed, the yard area will be levelled and fill material (CBR 20) will be spread and compacted for base layer. For the track portion the sub-base will be CBM and infill concrete will be provided in between sleepers and rails.

The development of the rail terminal shall be part of the rail link.

5.5.4 Gate House

The area can accommodate parking for 50 trucks. The pavement for the gate house area will be provided with a layer of GSB under CBM. 5 no. in-gates lanes and 5 no. out-gates lanes are to be provided for the container gate house area. The area of Gate house is 64,460m^2.

Container terminal fencing will be provided as per ISPS requirements. The fencing is planned along the periphery of the container and the rail yard.

5.6 Power Supply and Distribution

5.6.1 General

The required electrical system for the project will consist of

- The incoming electrical supply at 66 kV level;
- 66/11 kV substations containing transformers, switchboards, control equipment, etc. to supply the electrical power to various parts of the site at the required voltage levels of 11 & 0.415 kV;
- Control and Monitoring systems;
- 11 kV underground cabling system for medium voltage supply like for quay cranes etc.;
- Fibre optic communications from the substation to the quay cranes;
- 0.415 KV cabling system from the 11/0.415 kV substations to the reefer area. The cables should be run in cable trenches;
- Provision of underground power cabling to the buildings and gate complex shall be provided;
- Provision of underground power cabling to terminal light towers.

5.6.2 Electrical Demand

The electrical demand for the Phase-1 development for Vizhinjam Port is estimated in the table below. This information should be regarded as provisional, and it shall be a requirement of the detailed design to fully define the items within the terminal that will require electrical power and the corresponding electrical demand and diversity which must be verified / checked from the proposed manufacturer and service provider. If the terminal operator decides to use the electric RTGs, the overall electrical demand will vary and a detail planning/simulation modeling shall be conducted to provision for the electrical infrastructure at the terminal. Similarly, the need for “Cold Ironing” will change the electrical demand and shall be accounted for during the detail design of the project.

Table 5-1: Peak Demand for Vizhinjam Port

Power Demand for Container Terminal	MVA	31.5

Power Demand for Utilities and Other Misc.	MVA	1.8
Total Demand	MVA	33.3

5.7 Water Supply

5.7.1 Water Demand

The water demand for Vizhinjam Port over the Master plan horizon has been worked out in the Table 5-2 below:

Table 5-2: Estimated Water Demand over Master Plan Horizon

	Consumable	Demand (kL /day)	
		Phase-1	Master Plan
A.	Raw Water		
	Greenery and Landscape	120	264
	Reefer Wash and Misc.	24	93
	Total Raw Water (A)	144	357
B.	Potable Water		
	Port Personnel, Users & Misc.	64	113
	Township	250	500
	Cruise Terminal	-	60
	Ship Supply	-	-
	Total Potable Water (B)	314	673
	Total (A + B)	458	1,030

It can be seen from above that daily water demand for the Phase-1 development is estimated to be around 0.5 MLD (million litres per day). Out of this the potable water demand is 0.32 MLD which will accommodate the requirements for the port personnel, township with balance being the raw water. The total water demand over the master plan horizon is expected to go up to 1.0 MLD. This would comprise of 0.7 MLD of potable water with the balance being raw water. Kerala Water Authority has already sanctioned 1.0 MLD of potable water for Vizhinjam Port use.

5.8 Terminal Support Systems

5.8.1 Harbor Crafts

Tugs

The main activity of harbor tug is providing assistance to vessels entering / leaving the harbor, turning of the vessel in the harbor and the berthing / de-berthing operations.

Phase-1 development of Vizhinjam Port envisages a creation of a 1.2 km long inner channel dredged to 18.4m depth with 2 berths for handling large size container vessels. The maximum size of the ships to call at this port during initial development is fully loaded 18,000 TEU container vessels. As per the results of the ship navigation simulation studies carried out by BMT CI, for berthing / de-berthing of the design container vessels a minimum of three tugs of 70T and one tug of 40T bollard pull capacity are required.

Mooring Launches

The main activities with these small boats are the transfer of mooring ropes between vessel and quay and transfer of mooring crew.

The mooring launches with good maneuverability will be about 10m long with open deck and single screw. The propulsion power shall be delivered by an electrically starting diesel engine of approximate 75-100 kW, driving the propeller shaft via a reverse reduction gearbox. Two mooring launches will be provided at the port.

Pilot cum Survey Vessels

Pilot boats transfer pilots to and from the incoming / outgoing vessels.

It is proposed to provide one all-weather type pilot launch. The pilot launch should be a twin screw with 15 to 20m overall length and of steel construction. The speed range shall be 15-20 knots. The pilot launches will be provided with survey equipment and it can be used for hydrographic surveys and for buoy lights maintenance.

The summary of the requirements of Harbor Crafts envisaged for the Phase-1 development of Vizhinjam Port development are given in table below based on the Ship Navigation Studies.

Table 5-3: Harbor Craft Requirements for Phase 1 Development

S. No.	Harbor Craft	Phase-1
		No.
1.	Tugs	
	• 70 T bollard pull	3
	• 40 T bollard pull	1
2.	Mooring Launch	2
3.	Pilot cum Survey Vessels	1

5.8.2 Navigational Aids

Navigation aids for the port are required to ensure safe and efficient navigation of ships entering and leaving the port through the approach channel as well as berthing / un-berthing requirements inside the docks. It is envisaged that navigation will be carried out throughout the year, by day and night, except during cyclonic weather. These aids will assist the captains and pilots in determining the position of vessel while transiting the navigational channel and maneuvering inside the port.

The approach channel stretching from the breakwaters head to 21.0m contour has a width of 400m. The channel has a total length of about 2.8km. From the deep water initially the channel is oriented 343°, it takes a turn at a radius of 1200m before approaching straight into the harbor at an orientation of 317° N.

These aids as listed below are proposed to be installed on land or in water for guidance to all vessels for safe and regulated navigation in channels, basin, berths and docks.

- Fairway buoys, Port and Starboard buoys
- Leading / Transit lights
- BEACONS and
- Vessel Traffic Management Information System (VTMIS)

VTMIS will have the requisite communication, Radar system integrated into it.

5.9 Security System

Security system of the port is required to provide sufficient protection against:

- Sabotage;
- Pilferage and thefts;
- Encroachments by unauthorized persons;
- Trespassers and antisocial elements.

The security system must comply with the requirements of ISPS Code. Keeping in view the importance of various areas in the port, the following proposals are made:

- Port boundary provided with a rubble masonry wall 2.4m high with barbed wire fencing of 1m high;
- Perimeter Fence CCTV System - comprising high sensitivity colour cameras
- A security office and check post at the entrance to the terminal;
- Provision of watch towers at suitable intervals for manual monitoring;
- Adequate Container scanners are provided to scan percentage of boxes as per security plan;
- Radiation Portal Monitors (RPM) for the screening of vehicles and cargo for detection of illicit sources;
- Adequate isolated area would be allocated for storage of dangerous goods;
- The lighting in the port area shall be to the acceptable standards.

For Phase-1 development, it is proposed that the boundary wall needs to be constructed only around the actual operational areas.

The security arrangements proposed would have to be to the approval of the Director General of shipping who is the designated authority under the ISPS code.

5.10 Port Buildings

5.10.1 Administration Building

The Administration Building is located adjacent to the entrance and exit gate. It will be 3-storeyed building with a total floor area of 800sqm. The building is located on the site plan to allow visual access to the gate complex from the Customer Service Department and the second floor Control Room. Office areas on the third floor will have visual access to the container yard, container ship wharf, rail yard, and all gate areas. Building will be located on reclaimed land and will be RCC structures with piled foundations.

5.10.2 Entry/Exit Gate Inspection Canopy

Both entry and exit gate canopy will have five lanes each with five booths on each side. Each clerk booth needs to be able to house two staff and have 360° visibility of the lanes.

5.10.3 Security Guard Booth

Security guard booth will be located at the main entrance of the secured port boundary after crossing the roundabout shown on the layouts. It provides security surveillance at the main gate truck access and exit lanes.

The building is located on the site plan on either side of the road to allow visual access to the gate complex and the public roadway (Port road).

5.10.4 Maintenance and Repair Building

The building needs to be positioned near the perimeter of the container terminal so as not to interfere with terminal traffic circulation. The building has been planned in such a way that it can be easily expanded if needed. Sufficient area has been provided for additional maintenance and repair building for future phases.

The design shall include bridge cranes, floor loadings from tie-down anchors, and access platform loading in the service bays. Structural systems shall adequately support this equipment.

5.10.5 Quay Crane Maintenance and Marine Operations Building

This building is to be positioned and of sufficient height so that marine operations can have visual oversight of the wharves. Visual contact can be augmented by the use of CCTV cameras as required.

Sufficient area has been provided for additional quay crane maintenance buildings for future phases or different private operators along the berth as needed by the users.

The buildings are located on reclaimed land and will be RCC structures with piled foundations.

5.10.6 Railway Master Building

The building will be located in the planned railway yard within the terminal and will be an industrial/maintenance type building. Sufficient area has been provided for expansion for future phases.

5.10.7 Electrical Buildings

The substation and control room having a total area of 400 m2 will be located in the utility area, west of the gate complex. Smaller satellite substations and electrical rooms will be provided at various locations in the terminal areas as well. These buildings will be of RCC structures with pile or shallow foundations as needed.

5.10.8 Building Requirement Summary

Most of the port buildings are low rise buildings and it is expected that these can be safely founded on shallow foundation comprising of a combination of strip and isolated footing.

The estimated building areas required for the Phase-1 development are provided in Table 5-4.

Table 5-4: Vizhinjam Port Buildings

S. No.	Particulars	Floor Area (m^2)
1.	Administrative Buildings	
	• *VISL Administrative Building*	*800*
	• *Private Operator Administrative Building*	*800*
2.	Port Marine Operations Building	630
3.	Yard Operations Building	300
4.	Crane Maintenance Building	830

5.	Maintenance & Repair Building	3,400
6.	Trouble Kiosk & Restrooms	60
7.	Longshoremen Restrooms	60
8.	Reefer Shop w/ Genset	330
9.	Canteen	100
10.	Fire station	100
11.	Utility Building	400
12.	Electrical Sub Stations	400
13.	Security Booth - Entry Gate	30
14.	Security Booth - Exit Gate	30
15.	Other Misc. Buildings	200
16.	Rail Administration Building	200

5.11 Information and Technology Systems

5.11.1 General

State-of-the-art information technology is essential if the productivity levels and container handling efficiency of the port are to be maximized. The IT Management System will be designed to encompass port planning, operations, administration, and accounts, in addition to internal and external communications. The following minimum functions should be available:

- Ship-to-shore loading and discharge control;
- Yard planning, gate delivery and receipt control;
- Ship planning and dispatch including a vessel stowage planning module;
- Electronic Data Interchange (EDI) abilities;
- Radio Data Transfer (RDT) abilities;
- Payment status and service billing;
- Management information reports and statistics;
- Linking to shipping lines/agents.

The IT infrastructure will encompass a wide range of port functions, including planning operations and financial processing. This will allow the Licensee to optimize the management functions, respond in a timely manner to events, and readily provide shipping lines with information requested. In addition, these systems will enable the service of electronic data exchange and stowage planning to be offered to the shipping lines.

The Personal Computing (PC) network will include PC workstations for all relevant port employees, communication devices such as RDT, internet links and adequate servers, storage capacity for the operational database, and network management. Provision for data security and uninterrupted power supply will be included in the hardware, network, and communications systems.

A Vessel Traffic Management System (VTMS) will be installed at the new port with the system being built up from a family of advanced maritime information applications and sensors. It will be based on a well proven, concept of software modules and components that will make the system highly flexible and able to be augmented in both functionality and scalability.

The VTMS provided will allow it to be used as an aid to navigation (AtoN), ship reporting, Automatic Identification System (AIS) and voyage management. It will have features such as message and voice communications, multi-media logging and replay. It is intended that the system software will use a programming language that enables the software to be executed on virtually any kind of computer platform to reduce costs and ensuring a maximum system life-length.

A VTMS control centre will be designed and built to suite operational requirements. The console display units for VTS operators' workstations will provide state-of-the-art presentation and control systems. The software to be installed will permit several functions to be combined in a single workstation such as radar, AIS, AtoN management, seamless handling of voyage management information, CCTV, weather information, air situation picture, multi-fuel chart and GIS presentation etc. as applicable.

The efficiency of a port container terminal is synonymous with the information systems that practically drive and track the movement of containers as well as acting as an interface between the user, the vessel and the terminal. The container terminal with a huge amount of data being generated would naturally require sophisticated IT infrastructure with connectivity to its users. The system provided is likely to have data base servers, a large number of PCs, printers, Uninterruptible Power Supply (UPS), terminal operation/planning software (supplied by NAVIS, Cosmos or Total Softbank) etc. In particular, the Terminal Operating System should have ship planning, Electronic Data Interchange (EDI), BAPLIE, external tracking and billing modules.

A computer system for port operation takes the form of a central computer processor with hard disc storage on which information files are stored and updated. It is linked to a variety of terminals where operators can access, update or supplement this information at any time.

The operator terminals may have visual display units comprising screens and keyboards, printers for obtaining 'hard' copy or gaining access to printed information, card or tape readers, etc. depending on the specific system requirements.

A system whereby the central computer is connected with computers with Pentium processors through local area network (LAN) is required. The computers would be able to work independently as well as 'in linked' mode with the container terminal's central computer. The capital cost of this would also include developing specialized software, computerization of all operations including the management information system etc.

5.12 Fire Fighting System

The firefighting system is to be designed to be capable of both controlling and extinguishing fires. There will be two types of system i.e. Sea Water and Fresh Water. The sea water system would broadly consist of a fire water intake to draw water from the sea, pump house with pumps, nozzles for water curtains along the front side of operating platform, hydrants and distribution networks. The container and car carrier berths will also be covered under the sea water system.

A centralized fire station will be provided for attending to all calls which will house 2 mobile fire tenders. One fire tender will be provided with snorkel attachment.

Fire Alarm Bells will be located on permanent structures at strategic locations that can be heard by the terminal operators. Buildings where the hazard of fire and the occupancy are high will be provided with alarm bells (e.g. the workshop, administration building etc.). The fire alarm system will be activated by push buttons located at strategic places within the terminal areas and around the port's perimeter.

5.13 Bunkering Facility

As Vizhinjam port is developing as a container transshipment port the fuel bunkering facilities will be required for fuelling of vessels. To meet the bunkering requirements of ships (HFO and Marine Diesel), a provision for laying a 350mm dia pipeline will be made in the berths. The bunkering tank farm will also serve fuel to port crafts and port vehicles/equipment.

Fuel bunkering facility is not planned for Phase-1, but it will be a part of the master plan. It is proposed that in Phase-1, vessels are supplied bunker fuel through mobile fuel tankers/ trucks bringing the fuel from outside the terminal and directly feeding the vessels. However, the selected port operator may decide to upgrade to an automated bunkering hydrant system.

For future phases, it is estimated (based on the vessel calls for master plan) that a throughput of 1 MTPA of bunker fuel will be required. This will need space for bunker fuel storage, fuel hydrant system from tanks to berths, and unloading berth. It is estimated that approximately 100,000 tons of static storage capacity will be able to meet the annual throughput needs. These tanks may be supplied by the unloading berth or using rail. Based on various types of tanks, provision for 2 Ha land is provided in the port master plan in the future expansion area east of rail tracks and north of gate complex. It is anticipated that the provision of necessary infrastructure such as tanks, pipelines and pumps would be provided and operated by an interested oil company.

5.14 Pollution Control

5.14.1 General

One of the essential regulatory functions of a Port Authority is to ensure that the Port waters are free from pollution. To this end, pollution control assumes a significant role in any port operations. The main sources of pollution in the port are:

- Discharge of oil by ships / crafts.
- Discharge of bilge by ships / crafts.
- Discharge of dirty / contaminated ballast by ships.
- Discharge of cargo overboard.
- Spillage of cargo during unloading / loading operations.
- Discharge of garbage, sweepings, sewage, etc.
- Discharge of industrial effluents.
- Municipal sewage and drainage.
- Dust from cargo.
- Smoke from ships, vehicles.
- Noise from vehicles, machinery.

Containers being low hazardous cargo, no specific pollution control facilities are required for a container terminal. The following steps will be taken for pollution control at the port:

- For containment and cleaning of oil spillage from fuel stations, a special drainage system will be installed for the area which can separate oils from drain water. The reefer wash down area will also be provided with an oil-sediment separator unit as part of the drainage system.
- For containment and cleaning of oil spillage from vessels, a portable inflatable type oil spill containment booms and oil skimmer is proposed.
- High mast lights with shielding arrangements will be used at the terminal to minimize light pollution.

The port is envisaged as a green port and usage of eRTGs and hybrid ITVs is proposed amongst other measures to reduce the environmental impact of the port. In addition, the port is planned as a world-class facility with efficient systems that minimize processing times which reduce fuel consumption and air pollution, thus positively impacting the environment.

6 Traffic potential & forecast

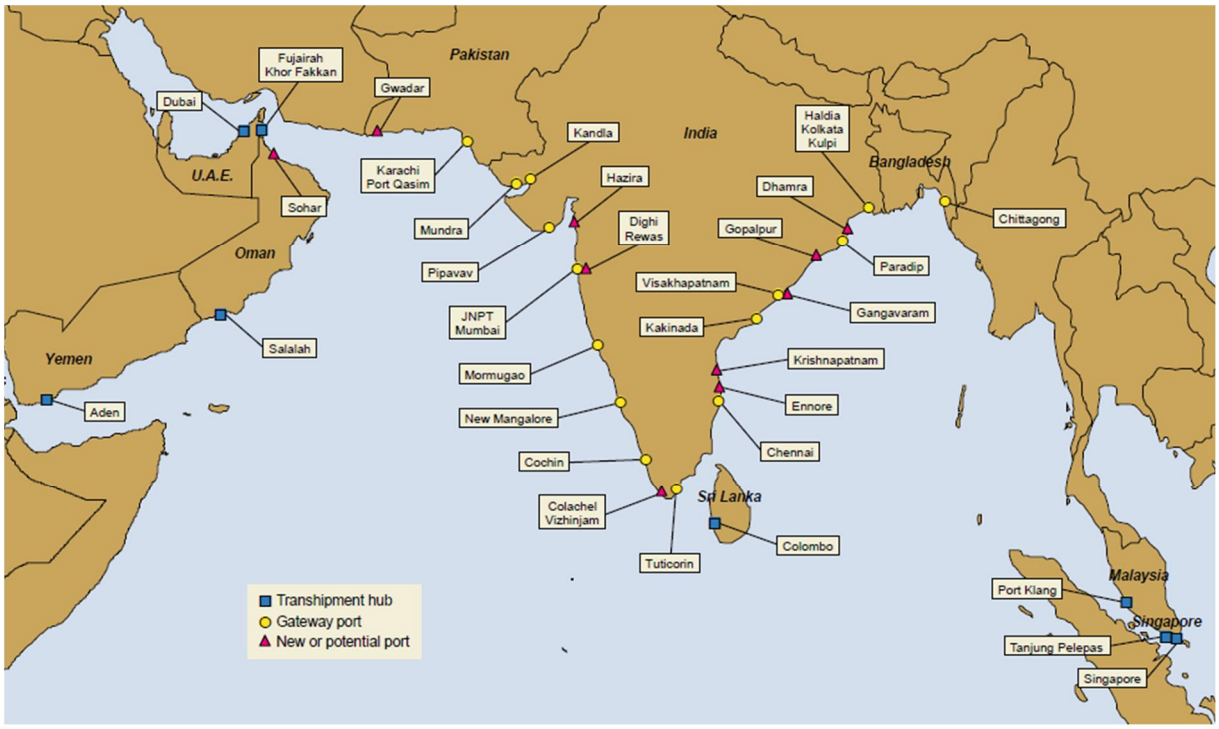
6.1 Introduction

As aforesaid, VISL appointed maritime consultants in 2010 for determining the traffic potential, for both cargo & vessel, at Vizhinjam Port after assessing and analyzing the impact of various factors influencing the maritime trade globally. The container cargo volume projections for Vizhinjam Port were forecasted under three different scenarios viz. High case, Base case and Low case scenarios. On the basis of the container cargo projections, the study forecasted the vessel traffic at Vizhinjam for Base case scenario.

6.2 Traffic rationale

The maritime consultants carried out historical traffic analysis for the Indian Sub-Continent (ISC) to understand the regional trade and commodity profiles together with a hinterland assessment to map the key consumption areas and production centers in India and traffic potential for the Vizhinjam Port. Maritime consultants concluded that providing of container handling services at the proposed port would constitute as the primary opportunity justifying the need to build the Vizhinjam Port.

Figure 6-1: Gateway and transshipment hub container ports serving the ISC region



6.2.1 Container Business

As per Maritime consultant's Report, the Indian Sub-Continent (ISC) gateway container volumes have increased from 4.3mn TEU in 1997 to 14.7mn TEU in 2008. The west coast of India contributes the largest share (50%) of container traffic in the region. Almost 2.5% of the total gateway traffic is regional ISC traffic, 66% of the gateway traffic is served through feeder services and rest 31.5% is carried on mainline vessels in the region.

In principle, container transshipment is needed to transfer the containers from a smaller feeder vessel to a much larger mainline vessels transiting along the East-West corridor and vice-versa. Larger (>10,000 TEU) container vessels tend to provide cost savings of at least 30% per TEU as compared to feeder vessels of sizes less than 4,000 TEU. Note that almost 60% of the ISC transshipment cargo is being handled by Ports outside of ISC, who are fed from ISC feeder ports mostly using smaller container vessels of less than 6,000 TEU.

Colombo is the largest transshipment hub for ISC traffic in the region and handles around 35% of the total ISC transshipment traffic, whereas 4.1% of the ISC transshipment volume is handled by ports other than Colombo within the ISC region, while it is important to note that almost 61% of the ISC transshipment traffic is handled by hub ports outside ISC, namely Singapore, Salalah, Jebel Ali, etc.

Cost of importing/exporting from India is relatively higher than in other developed countries, primarily due to inefficiencies in the logistics chain, lack of deep draft port facilities and capacity constrained hinterland cargo evacuation system.

Vizhinjam is strategically located along south of the Kerala coast and is only 10 nautical miles away from the East-West world shipping corridor. Its planned location is endowed with natural deep draft water and is estimated to have minimal maintenance dredging needs. The Greenfield location has enabled for the master plan to be developed to provide world class infrastructure for efficient services and to cater for future development potential.

6.2.2 Transshipment Business

To tap into the potential for handling ISC region's transshipment cargo, Vizhinjam port faces competition from the port of Colombo, International Container Transshipment Terminal (ICTT) at Kochi and major transshipment hubs outside the ISC region such as Aden in the west to Singapore in the east. Colombo accounted for traffic of 2.7 mn TEU, having a market share of 38% of the total ISC regional transshipment traffic. Other "hubs" within the ISC region (mainly JNPT) handled 0.24 mn TEU of transshipment. The majority of activity, representing 4.2 mn TEU in 2008, was spread amongst hub ports outside the ISC region.

Vizhinjam has a good potential to capture the transshipment cargo from Colombo and outside of ISC region ports. With these advantages and planned facilities to handle the biggest container vessels (up to 18,000 TEUs), Vizhinjam will be able to attract mainline vessels to call directly instead of transshipment at other ports outside of the country.

Container transshipment cargo has been identified as the primary cargo for the proposed Vizhinjam port, as it has a good potential to capture the transshipment cargo from Colombo and outside of ISC region ports, as it will be able to reduce the overall import/export cost.

Figure 6-2: Vizhinjam port location with respect to international East-West shipping route

6.2.3 Business Prospects for Vizhinjam

From a volume and market share point of view, Vizhinjam Port poses a very good business case. The Indian growth story will provide cargo for Vizhinjam and considerable cargo will flow through Vizhinjam, mainly due to its geographical advantage to the main cargo consuming and generating clusters in India.

As detailed in the Drewry report, currently the majority of India's container traffic is transshipped through ports outside of India. More than 60% of India's containerized import/export cargo is transshipped and handled on feeder vessels and only less than 40% of the containers are coming in directly to Indian Ports by mainline vessels, resulting in higher cost of import/export for Indian citizens and businesses. India's import/export cost per TEU is relatively much higher than many other developed countries in the West and Asia.

The Vizhinjam port has potential to become a world class transshipment hub primarily for ISC cargo servicing entire India. The port mainly faces competition from Colombo for the transshipment cargo and ICTT for gateway traffic. The gateway traffic will be limited to about 20-25% of total traffic sourced from Kollam and Trivandrum as the main hinterland of the Vizhinjam Port, resulting in overall reduction in congestion and air emissions by reducing the average travel distance through surface transport primarily by road.

6.2.4 Cabotage Law impact

The coastal trade of India is exclusively reserved for Indian ships and for this purpose a ship chartered by a citizen of India or a company which satisfied the requirements laid down in section 21 of the Merchant Shipping Act, 1958 will be deemed to be an Indian ship. A foreign ship is not allowed to ply in the coasting trade of India except under a license granted by an officer authorized to issue it.

Any party involved in coastal trade in India can employ foreign flag vessels subject to clearance by Indian National Shipowners' Association (INSA) that no suitable Indian flag vessels are available. Further it should be approved by DG Shipping.

Currently, Indian flagged container vessels cater to only less than 5% of transshipment volume. The Indian flagged container vessels have only 15,000 TEU carrying capacity vis-à-vis foreign flag, which touches Indian shores, has cumulatively close to 1 mn TEU capacity and in future, the overall capacity is going to manifold due to acquisition of bigger vessels by foreign shipping lines. Due to economy of scale & simultaneously carrying international containers help bring down cost of feeder movement by foreign flag vessels. Hence, for transshipment to be successful, cabotage has to be relaxed. In the absence of which, even if Vizhinjam is developed, shipping lines may not call at this port.

6.3 Container Traffic Forecast Estimates

6.3.1 Basic Assumptions

The Maritime consultants study considered the forecasted/horizon period for 30 years with starting period from FY 2014 to FY 2044. Post discussion with VISL, the revised horizon period for Phase 1 Port Development is commencing from FY 2018 to FY 2054 which is total 40 years. Hence, it is clear that there has been an effective extension of 6 years in the horizon period. It is therefore important to highlight the basic assumptions considered for the revision and extension in horizon period which are as follows.

As aforesaid, the Maritime consultants study determined the traffic potential at Vizhinjam Port after assessing and analyzing the impact of various factors influencing the maritime trade globally. This study was conducted in the year 2010. It is known that the global economy has shown minimal growth since 2010 and hence, marginal impact has been witnessed in the global trade. Therefore, it is safe to assume that the total container traffic potential determined for the FY 2014 still remains valid for the Phase-1 Port development and the similar traffic numbers of FY 2014 can be considered for the revised starting year i.e. FY 2018 which is assumed as the commercial operation year. Hence, in such case, there will be a shift of 4 years wherein FY 2044 traffic numbers will be taken into consideration for FY 2048. For the balance horizon period of 6 years i.e. from FY 2049-2054, which is considered as a marginal extension, the traffic growth (CAGR) for this period is assumed on a pro-rata basis as observed in the FY 2018-48.

6.3.2 Container Traffic Forecast

Drewry carried out study of the container traffic analysis and traffic trade trend/pattern of the Indian Subcontinent as bases of container traffic forecast for Vizhinjam port. It is best known that the proposed port at Vizhinjam is envisaged as a Transshipment Port for India. In addition to the container traffic forecasted for transshipment, the Port is also expected to cater to gateway traffic which will focus on captive or hinterland market in and around Kerala. The gateway traffic is further segregated into two categories such as Loaded Containers and Empty Containers.

Transshipment Traffic Forecast - ISC

Container traffic forecast for India, Pakistan, Bangladesh and Sri Lanka was estimated based on the current traffic pattern and estimated GDP growth rate and container traffic growth. Forecasted container traffic was being analyzed with the international traffic fleets of mother vessel and feeder vessels. Drewry study has estimated the traffic forecast till FY 2044 with the CAGR of 8%. As

aforesaid in the basic assumptions, it is assumed that for the period of 6 years, i.e. from FY 2049-2054, the traffic will grow at a similar growth of 8% on a pro-rata basis. The proposed CAGR also nearly matches with the transshipment traffic forecasted till FY 2025 for South East Asia region by Ocean Shipping Consultants.

Gateway Traffic Forecast – India

Gateway container traffic for Vizhinjam Port was forecasted based on linear equation considering estimated GDP growth. The average growth in import-export traffic in the region has been about 13% per annum in the last 11 years. The west coast of India has shown the strongest growth, nearing 15% per annum, whilst Sri Lanka has seen a more modest 6.7% per annum growth rate. Total gateway traffic reached 11.6 million TEU in 2008, up from 3.1 million TEU in 1997. For Gateway (Loaded & Empty) containers, Drewry study has estimated the traffic forecast till FY 2044 with a CAGR of 10% & 8% respectively. As aforesaid, it is assumed that for the period of 6 years, i.e. from FY 2049-2054, the Gateway (Loaded & Empty) containers traffic will grow at a similar growth of 10% & 8% respectively on a pro-rata basis. The proposed CAGR also nearly matches with the gateway container traffic forecasted till FY 2025 for South East Asia region by Ocean Shipping Consultants. Based on the analysis the transshipment and gateway traffic considering the base case scenario, forecasts for Vizhinjam are as below in Table 6-1.

Table 6-1: Projected Container Traffic ('000 TEU) for Vizhinjam Port 2018-2054

	2019	2023	2028	2033	2038	2043	2048	2054
Gateway-Loaded	26	92	160	266	380	493	615	778
Gateway-Empty	11	40	53	898	94	123	154	196
Gateway– Total	37	132	213	354	474	616	769	973
Transshipment	112	566	878	1,213	1,550	1,817	2,055	2,314
Total	149	698	1,091	1,567	2,204	2,433	2,824	3,287

6.3.3 Projected Container Traffic in Phase 1 Port Development

Based on the port components planned for Phase-1 development, the minimum container terminal capacity for handling the projected traffic is 10,00,000 TEU. In such case the terminal handling capacity would nearly get exhausted in the FY 2026 wherein the forecasted traffic would be around 9,51,467 TEU.

However, it is envisaged that the port will have state-of-art equipment to handle the container traffic and according the global standards, such ports can achieve a maximum utilization rate of about 125%. Therefore, container terminal capacity in Phase-1 development of Vizhinjam Port is expected to cater maximum container traffic up to 12,50,000 TEU. In such case, the projected container traffic of 12,50,025 TEU is achieved in FY 2030 which will remain constant for the rest of the horizon period till FY 2054 as capacity augmentation is not envisaged in Phase-1 Port Development.

Table 6-2: Terminal Development Capacity Summary for Phase 1 Development

Phase-1: Minimum Total Container Capacity Planned (TEU)	10,00,000	10,00,000
Phase-1 :Container Traffic Forecast (TEU)	9,51,467	12,50,025
Capacity Utilization	100%	125%
Planned terminal capacity achieved in the year	2026	2030

6.4 Vessel Traffic Forecast Estimates

To estimate the vessel traffic at Vizhinjam Port, Drewry carried out a port calls study on Colombo Ports and the key findings of this study are as follows. As per current service profile, Colombo is a wayport for most of the services on the East-West trade lane. Colombo takes wayport calls on mainline services currently serving on the Asia –Europe trade lane. This implies that although it has mainline calls at the port, it is neither starting nor ending point on a service route. Therefore, the average parcel size required for a mainline vessel is approximately 40-50% of the overall capacity.

The Drewry study has forecasted the vessel traffic at Vizhinjam Port on the basis of Base case scenario determined in container traffic projections. Furthermore, the size of the vessel and average parcel size is estimated in the study. The size of the vessels would depend upon the anticipated vessel size deployed on the East – West trade lane during the forecast period and it would also depend upon the parcel size, i.e. container traffic generated by the port. The indication of parcel size is the average container traffic available for a feeder vessel and a mainline vessel. The size of vessel deployed would determine the average number of vessels required to handle the container traffic at the port. Post studying the current vessel sizes calling schedule at ISC ports such as Colombo and JNPT, Drewry estimated the parcel size and anticipated size of vessels deployed on the East-West trade lane, the estimated size of mainline & feeder vessels deployed at Vizhinjam would be as follows.

Table 6-3: Potential future vessel sizes calling at Vizhinjam port

Type of Service	Largest Vessel(TEU)	Typical Average Sized Vessel (TEU)
Mainline vessel	12,000+	6,000-9,000
Feeder vessel	3,000	1,000-1,500

Following assumptions have been taken by the Drewry study into account to calculate the anticipated volumes available for mainline and feeder vessels.

6.4.1 Feeder – Mainline Ratio

The feeder versus mainline ratio at the proposed Vizhinjam port would be in same line as currently being witnessed at the Colombo port. Currently, with the exception of intraregional traffic, the entire gateway traffic of the Colombo port is handled on the mainline vessels. Maritime consultant estimates a similar profile of vessels calling at the proposed Vizhinjam port. As the transshipment traffic forecast has been done by double counting the container handling incidence at the Vizhinjam port, Maritime consultants assumes the share of mainline-feeder traffic at the port to be as follows:

- Transshipment traffic would be brought in by feeder vessels to the port.
- Entire gateway traffic of the port and Transshipment volume would be carried on the mainline vessels.

6.4.2 Capacity Deployed for Feeder – Mainline Vessels

- Feeder vessel capacity deployed has been taken into account considering an average capacity utilisation from 80-100% for services deployed. For example, a container vessel of 600 TEU capacities can have a parcel size of 1000 TEU with 500 TEU export moves and 500 TEU of import moves.
- As per current service profile, Colombo is a wayport for most of the services on the East-West trade lane. This implies that although it has mainline calls at the port, it is neither starting nor ending point on a service route. Therefore, the average parcel size required for a mainline vessel is approximately 40-50% of the overall capacity. For example, if a 6,000 TEU vessel calls at the Colombo port then the average parcel size expected would be close to 2,400 TEU – 3,000 TEU per call. This could be 2,000 export moves and 1,000 import moves for a 3,000 TEU parcel size.

Table 6-4 shows the expected vessel traffic anticipated at the Vizhinjam port during the forecast period in the base case scenario for Phase 1 Port Development.

Table 6-4: Potential future vessel sizes calling at Vizhinjam Port

Year	Gateway traffic	Transshipment Traffic	Traffic on Feeder Vessels	Traffic on Mainline Vessels	Parcel Size Feeder/Wk	Parcel Size Mainline/Wk	Vessel Calls Per Week					
							600 TEU	1000 TEU	1500 TEU	6000 TEU	9000+ TEU	Total
2019	37,459	1,11,687	55,843	93,303	1,074	1,794	0	1	0	1	0	2
2020	52,714	1,85,424	92,712	145,427	1,783	2,797	1	1	0	1	0	3
2021	68,990	2,71,018	135,509	204,498	2,606	3,933	2	1	0	2	0	5
2022	89,380	3,63,154	181,577	270,957	3,492	5,211	2	1	0	2	0	5
2023	1,09,787	4,60,558	230,279	340,066	4,428	6,540	2	2	0	2	0	6
2024	1,31,432	5,66,174	283,087	414,519	5,444	7,972	2	2	0	2	1	7
2025	1,38,459	6,83,798	341,899	480,357	6,575	9,238	2	3	0	2	1	8
2026	1,58,533	7,25,414	362,707	521,240	6,975	10,024	2	3	0	2	1	8
2027	1,58,533	7,75,489	387,745	563,722	7,457	10,841	2	3	0	2	1	8
2028	1,58,533	8,28,503	414,252	611,478	7,966	11,759	1	3	1	3	1	9
2029	2,13,632	8,77,433	438,716	652,348	8,437	12,545	1	3	1	3	1	9
2020	2,31,068	9,28,523	464,262	695,329	8,928	13,372	1	3	1	3	2	10
2031	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2032	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2033	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2034	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2035	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2036	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2037	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2038	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2039	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2040	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2041	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2042	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2043	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2044	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2045	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2046	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2047	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2048	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2049	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2050	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2051	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2052	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11
2053	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11

Year	Gateway traffic	Transshipment Traffic	Traffic on Feeder Vessels	Traffic on Mainline Vessels	Parcel Size Feeder/Wk	Parcel Size Mainline/Wk	Vessel Calls Per Week					
							600 TEU	1000 TEU	1500 TEU	6000 TEU	9000+ TEU	Total
2054	2,57,864	9,92,161	496,081	753,945	9,540	14,499	1	4	1	3	2	11

As per forecast in the Base case scenario, it is estimated that the total number of vessel calls would increase from 2 calls per week in 2018 to 11 calls per week in 2054 for Phase 1 Port Development. As discussed in the previous section, the port will achieve its maximum planned berth capacity by the year 2030 and hence post that the traffic forecast for the balance period would remain constant and hence, it is evident from the above table that the vessel calls per week also remains constant at 11 from F 2031 to FY2054.

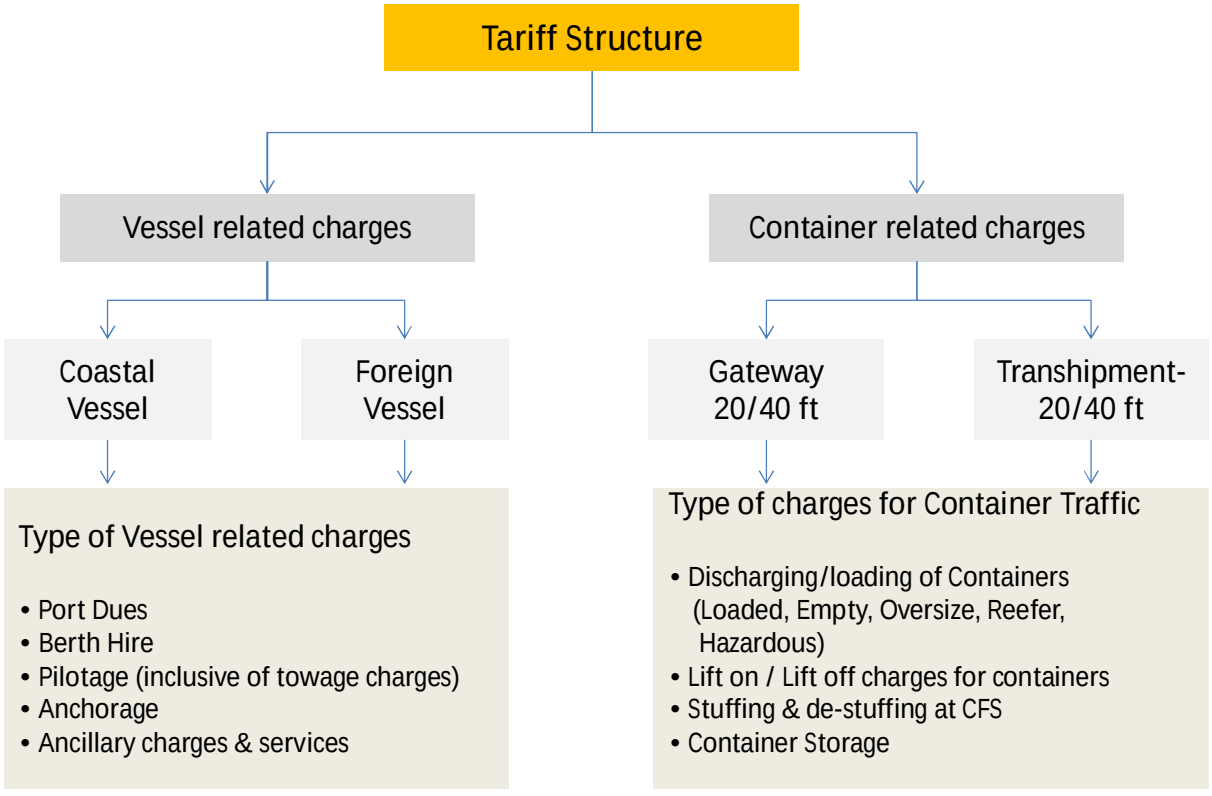
7 Tariff Structure

7.1 Introduction

Tariff levels and operating costs are an essential component in the competitiveness of a port. It is important to offer a competitive tariff that may attract potential customers. Since, competitive price provides the impetus to overcome inertia in terms of switching ports.

Generally, there are two types of charges that need to be considered, those applicable to the vessel and those relating to the cargo i.e. container itself. However, rather than simply giving a total estimated cost for calling at a facility and discharging/loading container cargo, the consultant has searched some of the components that comprise cost of a port call in India on individual tariff items. The following is a representation of the key types of vessel and container related charges that are supposed to be levied on each vessel call.

Figure 7-1: Types of vessel and container related charges



The best gauge of the level of charges that the port should levy is available by looking at what other major container handling ports in the region are currently charging. In order to draw comparison between the charges, benchmarking of tariffs applicable in various ports has been conducted for both vessel and container handling charges. Ports situated within 750 km from Vizhinjam have been studied for both vessel and container tariffs. The following indicates the name of the ports considered for both the categories and further segregated to Coastal and Foreign Vessel.

In addition to above, the cargo tariff structure study stated in the following section is limited to container cargo tariff. This is due to the reason that Phase-1 port development stage does not envisage any bulk cargo berth terminal capacity.

Table 7-1 Name of ports identified for benchmarking vessel and container related charges

Vessel Related Charges		Container Related Charges	
Coastal Vessel	Foreign Vessel	Gateway	Transshipment
Cochin, Chennai, Ennore, New Mangalore & Tuticorin	Cochin, Chennai, Ennore, New Mangalore, Tuticorin, Colombo, Dubai & Salalah	Cochin, Chennai & Tuticorin	Colombo, Cochin, Dubai & Salalah

7.2 Vessel related charges

The following is an indication of some of the type of charges that are levied to shipping lines or agents on each vessel call:

- Port Dues
- Berth Hire
- Pilotage (inclusive of towage charges)
- Anchorage
- Ancillary charges & services

Vessel related charges are applicable on various type of vessels based upon their Gross Registered Tonnage (GRT) value. According to the maritime terminology, GRT or gross tonnage (GT) represents the total internal volume of cargo vessels. Note that the GRT cannot be equated with measurements of weight such as carrying capacity – nor should it be confused with the standard displacement used to rate a warship.

In order to draw some useful comparison of rates amongst various ports, the consultant has classified the vessel size into three different categories against the number of containers (in TEU) these vessels can carry:

- Upto 30,000 GRT – Upto 2,500 TEU
- 30,001 to 60,000 GRT – 2,501 TEU to 5,000 TEU
- 60,001 GRT and above – 5,001 TEU and above

These vessel size wise classification have been based on the global estimate of containership fleet wherein container vessels upto 30,000 GRT accounts for 60% of the total containership fleet followed by vessels from 30,000 GRT to 60,000 GRT which accounts for 30% of the total containership fleet and remaining 10% share is of vessels above 60,000 GRT which can carry more than 5000 TEU. In addition to this, the vessel related tariff at Indian Ports is separately charge for Coastal Vessels (with Indian Flag) and Foreign Vessels (with Foreign Country Flag).

In this report, the tariff calculations have been based on the published port charges as mentioned in the port's website, which provide overall charges per vessel to be paid for each vessel call on these ports.

Table 7-2: Vessel related tariffs at Vizhinjam's competing Indian ports

Description/Type	Cochin	Chennai	Ennore	Tuticorin	N. Mangalore
Port dues (INR/GRT) – Any volume					
Coastal Vessel	9.59	5.41	12.37	5.25	2.32
Foreign Vessel	21.48	12.28	25.44	12.08	8.58
Berth Hire (INR/GRT/Hour) - Any volume					
Coastal Vessel	0.17	0.08	0.22	0.09	0.05
Foreign Vessel	0.33	0.17	0.60	0.20	0.10
Pilotage charges* (INR/GRT) – Coastal Vessel					
Upto 30,000 GRT	20.85	8.19	19.04	8.16	8.55

Description/Type	Cochin	Chennai	Ennore	Tuticorin	N. Mangalore
30,001 – 60,000 GRT	16.67	13.39	19.04	8.43	6.84
60,001 GRT & Above	14.59	15.50	19.04	8.43	5.99
Pilotage charges* (INR/GRT) – Foreign Vessel					
Upto 30,000 GRT	46.74	18.60	39.36	18.77	19.20
30,001 – 60,000 GRT	37.39	30.42	39.36	19.39	15.36
60,001 GRT & Above	32.72	35.22	39.36	19.39	13.44

Table 7-3: Vessel related tariffs at Vizhinjam's competing foreign ports

Description/Type	Colombo	Dubai	Salalah
Port Dues (INR/GRT)			
Upto 30,000 GRT	4.77	12.00	2.00
30,001 – 60,000 GRT	4.77	12.00	2.00
60,001 GRT & Above	4.77	12.00	2.00
Berth Hire (INR/GRT/Hour)			
Upto 30,000 GRT	0.13	1.12	0.63
30,001 – 60,000 GRT	0.13	0.55	0.46
60,001 GRT & Above	0.13	0.70	0.23
Pilotage (INR/GRT)			
Upto 30,000 GRT	4.11	27.00	21.04
30,001 – 60,000 GRT	4.11	20.00	15.70
60,001 GRT & Above	4.11	23.00	8.40

It is evident from the above tables that the vessel related charges for Foreign Vessels at Indian Ports are higher than the foreign ports. This is due to the reason that the Indian Ports are primarily governed by the TAMP rules, unlike foreign ports where charges are primarily determined by market competition where the rates are aligned with tariff published by competing ports. These rates are often a starting point for negotiation of a time/ volume agreement, a first or last port of call status agreement, or an increase in throughput from a shipping line. Foreign ports like Colombo offers huge discount (15-20%) over the published rates depending on the frequency of the calls and throughput generated by the shipping line.

In addition, it is also evident that old ports such as Chennai, Tuticorin, New Mangalore and Colombo offer lower rates in comparison to new ports such as Cochin, Ennore& Dubai. This is due to the reason of owning in-place port infrastructure (offshore and onshore) for many years and hence, can provide a better edge in the competition on pricing. However, for Vizhinjam Port, Cochin & Colombo Ports are the prime and immediate competitors which indicates that the tariff order for vessel related charges to be proposed for Vizhinjam Port could be capped on highest rates of Cochin & Colombo Ports published rates and then the discount for initial operational years could be offered on the proposed rates to attract shipping lines for port calls at Vizhinjam Port.

7.3 Container Handling Related Charges

The following represents the container handling charges levied at various ports (Indian & International) on coastal and foreign vessels for following categories:

- Gateway Traffic
- Transshipment Traffic

For this category, tariffs have primarily been mentioned for loaded and empty twenty feet equivalent units (20' TEU) and forty feet equivalent units (40' FEU). The type of container related charges levied on the shipping line or agents are as follows:

- Discharging/loading of Containers

- Loaded
- Empty
- Oversize
- Reefer
- Hazardous

- Lift on / Lift off charges for containers
- Stuffing & de-stuffing at Container Freight Station (CFS)
- Storage of Containers
  - Loaded & Empty

7.3.1 Gateway - Container Handling Charges

Table 7-4: Container handling related tariffs at Vizhinjam's competing Indian ports

Description/Type	Cochin		Chennai		Tuticorin	
TEU	20ft	40ft	20ft	40ft	20ft	40ft
Discharging/Loading of Full Containers (INR per Container)						
Coastal Vessel	1500	2300	1210	1750	750	1,130
Foreign Vessel	3300	4900	1820	2610	925	1,400
Discharging/Loading of Empty Containers (INR per Container)						
Coastal Vessel	1500	2300	760	1700	750	1,130
Foreign Vessel	3300	4900	1350	2510	925	1,400
Wharfage charges for containers of Full Containers (INR per Container)						
Coastal Vessel	500	750	35	50	270	402
Foreign Vessel	820	1250	80	120	270	402
Wharfage charges for containers of Empty Containers (INR per Container)						
Coastal Vessel	105	155	35	50	136	204
Foreign Vessel	175	260	80	120	136	204
Reefer Containers - Electricity supply & monitoring charges (INR per Container per hour)						
Coastal Vessel	35	52	25	35	27	36
Foreign Vessel	48	72	55	80	33	45

From the above table it is evident that Cochin Port container handling charges are substantially higher than other two ports in all the categories. All three ports are governed by TAMP which constraints them to price beyond the stipulated ceiling. There have been cases in Indian Ports where container terminal operated by private sector have requested TAMP for an increase in tariff for a brief period where the volumes were anticipated to go down and hence, few of those cases were accepted by TAMP for a brief period. However, though there is a tight supply/demand scenario for container handling in India, ports such as JNPT has been unable to price accordingly. It is important to note that market driven pricing is more acceptable globally by the governments and port developer particularly in case where the developer has to build an entire Greenfield port through a concession. This may be possible in the future as overall objective of the regulator is to continue to shift towards market driven competitive pricing.

7.3.2 Gateway - Container Storage Charges

All ports generally offer a period of free storage (of a varying length of time) before applying a daily rate (or part thereof) to cover storage of the container. The movement (or indeed lack of movement) of containers is a major problem at ports and terminals in many areas throughout the globe and can be a major cause of congestion (although inefficient handling operations should not be forgotten). Moreover, if a terminal is already busy then the prospect of a number of boxes lingering at the facilities can cause major operational problems for the operator and this fact is often reflected in the rent charges applied. Therefore, storage rent is not only a method of

generating revenue but also a deterrent for laggard who intends to use the precious container yard space as a warehouse. Indirectly, it also provides impetus to the movement of container by rewarding the efficient shippers.

Table 7-5: Gateway-Container storage related tariffs at Vizhinjam's competing Indian ports

Description/Type	Cochin		Chennai		Tuticorin	
TEU	20ft	40ft	20ft	40ft	20ft	40ft
Full Container on Coastal & Foreign Vessel (INR per TEU per day)						
First 7 days	Free	Free	Free	Free	Free	Free
8th to 15th day	270	375	330	660	31	47
16th to 30th day	540	745	660	1,320	124	186
Thereafter	1,080	1,490	1,320	2,640	240	360
Empty Container on Coastal & Foreign Vessel (INR per TEU per day)						
First 3 days	Free	Free	Free	Free	Free	Free
4th to 10th day	270	375	330	660	31	47
11th to 35th day	540	745	660	1,320	124	186
Thereafter	1,080	1,490	1,320	2,640	240	360

All three ports provide free storage days specifically for the purpose of customer relations. The maximum free days for Full Container are 7 days and for Empty Container it is 5 days. However, both Cochin and Chennai offers 7 free days for Full Container and 3 days for Empty Container. It is evident from the above table that Tuticorin Port offers lowest storage rates than other two ports. The reason for high storage rates at Chennai would be because of the inadequate storage capacity at terminal area and huge congestion for evacuation of cargo and hence, terminal operators have little choice other than to charge higher storage rents in order to ensure smooth facilitation of trade.

7.3.3 Transshipment - Container Handling Charges

The container handling charges for transshipment tariff by Colombo, Dubai and Salalah Ports have been taken as the benchmark rate. This is due to the reason that these ports are the major competitors of transshipment traffic for Vizhinjam.

Table 7-6: Transshipment-Container handling related tariffs at Vizhinjam's competing foreign ports

Description/Type	Colombo		Dubai		Salalah	
TEU	20 ft	40 ft	20 ft	40 ft	20 ft	40 ft
Discharging/Loading of Full containers (INR per TEU)	2,220	3,450	6,195	9,840	8,400	12,000
Discharging/Loading of Empty containers (INR per TEU)	2,220	3,450	3,825	5,220	6,000	8,400
Discharging/Loading of Oversize containers (INR per TEU)	4,260	6,000	18,000	18,000	10,500	12,900
Reefer Containers - Electricity supply & monitoring charges (INR per TEU per hour)	72	96	98	98	88	88
Re-stow	3,600	5,100	2,175	2,175	3,600	3,600

Colombo port charges equal tariff for Transshipment of loaded and empty containers and their rates are lowest primarily for all categories when compared to other two Transshipment hub ports. In addition, Colombo port offers a huge discount in the range of 15-20%, hence the effective charged rate goes even lower.

7.3.4 Transshipment- Container Storage Charges

The container storage charges for Transshipment tariff by Colombo, Dubai and Salalah Ports have been taken as the benchmark rate. This is due to the reason that these ports are the major competitors for Transshipment traffic for Vizhinjam.

Table 7-7: Transshipment-Container storage related tariffs at Vizhinjam's competing foreign ports

Description/Type	Colombo		Dubai		Salalah	
TEU	20 ft	40 ft	20 ft	40 ft	20 ft	40 ft
Loaded Container (INR per TEU per day)						
First 10 days	Free	Free	Free	Free	Free	Free
10th to 15th day	Free	Free	165	330	Free	Free
15th to 21st day	Free	Free	165	330	225	450
Thereafter	312	624	165	330	330	660
Empty Container (INR per TEU per day)						
First 10 days	Free	Free	Free	Free	Free	Free
10th to 15th day	Free	Free	165	330	Free	Free
15th to 21st day	Free	Free	165	330	225	450
Thereafter	126	250	165	330	330	660

It is evident from the table above that Colombo Port provides maximum free days for a container stored in the terminal area as compared to Dubai and Salalah Ports. However, in case a container exceeds the free day limit, the charges mentioned above shall apply to the shipper from the first day of storage itself till the date of loading on the ship.

7.4 Recommended Tariff Structure

This section provides recommended tariff structure and estimates revenue forecast from the container traffic operations at the proposed Vizhinjam port. The revenue forecast has been estimated for traffic generated in the base case scenario from FY 2018 to FY 2054.

Following are the assumptions and proposed card rates for vessel & container handling forecasts for the Vizhinjam port.

Vessel Related Charges

- It is evident and known fact that prime competitors for Vizhinjam port are Cochin and Colombo Ports for gateway and Transshipment traffic respectively. In addition, the proposed rates are capped at the highest tariffs levied by these ports. These proposed rates are expected to be further discounted by the private operator during the operation period to bring more competitiveness and attract more traffic more the compete ports. Hence, the charging rates are capped at the similar values published in the latest rate tariff order issued by Sri Lanka Ports Authority Tariff 2012 for Colombo and Scale of Rates (2013) by Vallarpadam, Cochin Port Trust, whichever is higher. The following is an indication of rates to be capped in each category.

Description/Type	Port Dues*	Berth Hire**	Pilotage*
Coastal Vessel			
Upto 30,000 GRT	Not exceeding maximum rates at Cochin Port	Not exceeding maximum rates at Cochin Port	Not exceeding maximum rates at Cochin Port
30,001 – 60,000 GRT			
60,001 GRT & Above			
Foreign Vessel			
Upto 30,000 GRT	Not exceeding maximum rates at Cochin & Colombo Ports, whichever is	Not exceeding maximum rates at Cochin & Colombo Ports, whichever is	Not exceeding maximum rates at Cochin & Colombo Ports, whichever is
30,001 – 60,000 GRT			
60,001 GRT & Above			

Description/Type	Port Dues*	Berth Hire**	Pilotage*
	higher	higher	higher

**Unit Rate (INR) / GRT, ** Unit Rate (INR) / Hour / GRT*

- Hence the following is the proposed card rate (without any discounts) for Vizhinjam Port for vessel related charges:

Description/Type	Port Dues*	Berth Hire**	Pilotage*
Coastal Vessel			
Upto 30,000 GRT	12.50	0.25	21.00
30,001 – 60,000 GRT	12.50	0.25	Rs. 625,500 plus Rs. 19.00 per GRT over 30,001 GRT
60,001 GRT & Above	12.50	0.25	Rs. 1,125,600 plus Rs. 15.00 per GRT over 60,001 GRT
Foreign Vessel			
Upto 30,000 GRT	25.00	0.60	50.00
30,001 – 60,000 GRT	25.00	0.60	Rs. 1,402,200 plus Rs. 40 per GRT over 30,001 GRT
60,001 GRT & Above	25.00	0.60	Rs. 2,550,000 plus Rs. 35.00 per GRT over 60,001 GRT

**Unit Rate (INR) / GRT, ** Unit Rate (INR) / Hour / GRT; Proposed rates have been rounded off from the original rates*

- It is assumed that the escalation factor for the tariff rate would be 100% of the Wholesale Price Index increase for each year. On an average estimated 7% y-o-y increase in WPI has been estimated over the forecast period.

Container Handling Charges - Gateway

- Container handling rates charged by Cochin port are taken as the benchmark for container handling charges for gateway tariff. This is due to the reason that Vizhinjam is competing with Indian ports for gateway traffic. The notified tariff by TAMP for the Vallarpadam container terminal has been taken a benchmark tariff for the Vizhinjam port.
- Hence the following is the proposed card rate (without any discounts) for Vizhinjam Port for gateway container handling and storage related charges:

Type	20 ft		40 ft	
	Coastal	Foreign	Coastal	Foreign
From vessel to CY or vice versa- Full Containers (Import /Export)	1500	3300	2300	4900
From vessel to CY or vice versa – Empty Containers (Import /Export)	1500	3300	2200	4900
Wharfage Charges - Full Containers	500	820	750	1250
From vessel to CY or vice versa - Over Dimensional Container (Full/Empty)	1900	4100	2800	6200

**CY: Container Yard, Proposed rates have been rounded off from the original rates*

Proposed Gateway Container (Full/Empty) Storage rates

Type	20 ft		40 ft	
	Coastal	Foreign	Coastal	Foreign
Free Days upto 7 days	Free	Free	Free	Free
From 8th to 15th day (INR/ TEU/ Day)	270	375	270	375
From 16th to 30th day (INR/ TEU/ Day)	540	745	540	745

Thereafter (INR/ TEU/ Day)	1,080	1,490	1,080	1,490

Proposed rates have been rounded off from the original rates

- It has been assumed that a large share of the traffic at the Vizhinjam port would be generated from Indian ports. As per TAMP guidelines, the coastal vessel gets a discount of approximately 40% on the both vessel and container related charges, however that guideline is binding only on major ports and doesn't cover state ports. If Vizhinjam port offers the discount to coastal vessels, then the overall cost benefit for a shipping line would further increase.
- It is assumed that Reefer and Hazardous containers will be charged as similar to normal containers and 50% of surcharge on normal containers respectively.
- It is estimated that 85% of the revenue generated by a terminal is contributed by container handling charges stated above. The other 15% revenue is generated by miscellaneous services like re-stow, hatching, internal movements of containers, washing, etc.
- It is assumed that the escalation factor for the tariff rate would be 100% of the Wholesale Price Index increase for each year. Tariff is being escalated on an average is estimated 7.6% y-o-y increase has been estimated over the forecast period.

Container Handling Charges – Transshipment

- Container handling rates charged by Colombo port has been taken as the benchmark for container handling charges for Transshipment tariff. This is due to the reason that Colombo is the prime competitor for Transshipment traffic for Vizhinjam. As observed in the earlier section, Colombo port charges equal tariff for Transshipment of loaded and empty containers.
- Hence the following is the proposed card rate (without any discounts) for Vizhinjam Port for Transshipment container handling and storage related charges:

Type	20ft	40ft
Full Containers (INR/ TEU)	2,300	3,500
Empty Containers (INR/ TEU)	2,300	3,500
Oversize Containers (INR/ TEU)	4,300	6,000

Proposed rates have been rounded off from the original rates

Proposed Transshipment Container (Full/Empty) Storage rates

Type	20 ft	40 ft
Free Days upto 21 days	Free	Free
21st to 31st Day (INR/ TEU/ Day)	130	250
32nd to 45th Day (INR/ TEU/ Day)	420	900
Thereafter* (INR/ TEU/ Day)	1,250	2,500

Proposed rates have been rounded off from the original rates

- It is assumed that the escalation factor for the tariff rate would be 100% of the Wholesale Price Index increase for each year. Tariff is being escalated at an estimated 6.7% y-o-y increase has been estimated over the forecast period.
- It is estimated that 90% of the revenue generated by a terminal is contributed by container handling charges stated above. The other 10% revenue is generated by miscellaneous services like washing, weighing, etc.
- It is assumed that Hazardous containers in both gateway and Transshipment will be charged 50% more than the normal full containers.

Assumptions on offering Discounts on proposed Tariff

- The proposed Tariff has be computed on the assumption that any cost deviation in terms of shifting transhipment hub from Colombo to Vizhinjam based on the premise that the shipping lines are being offered 20% discount on the published tariff rate for both vessel and container handling charges.
- Though the benchmarked ports are being governed by TAMP, to be competitive and generate initial traffic base, the proposed Vizhinjam port should offer a substantial discount from competition. The consultant estimates that once the traffic builds up at the Vizhinjam port, then the port can reduce the margin of discount offered vis-à-vis competing port.

8 Port estate Development

This chapter highlights the key elements of the Port estate Development proposed by GoK under the Port Development area in Vizhinjam. The study examines various real estate parameters such as site analysis, demand supply analysis and the revenue forecasts.

It is understood from the financial analysis that the Vizhinjam Port project on a standalone basis is not financially viable even after the provision of financial support from the government. Hence, to make the project attractive, Port estate Development on part of the site area shall be allowed to increase project viability.

The area around proposed Vizhinjam Port is primarily scarcely developed. It is difficult to determine the demand without having the historic or existing real estate supply information of a city. Hence, to understand the Port estate development and determine the demand effectively and logically for Vizhinjam, the Port estate development in the nearest city i.e. Thiruvananthapuram has been studied extensively. On the basis of which the following sections have been drafted.

8.1 City overview and location

Thiruvananthapuram is the capital of the Indian state of Kerala and the headquarters of the Thiruvananthapuram District. It is located on the west coast of India near the extreme south of the mainland. The city is characterized by its undulating terrain of low coastal hills and busy commercial alleys. Thiruvananthapuram contributes 80% of the state's software exports and is the major IT hub of the state.

Thiruvananthapuram, which was previously called Trivandrum, is an ancient city with tradition dating back to 1,000 B.C. Thiruvananthapuram became the capital of Travancore in 1750. The city gets its name from the word, Thiruvananthapuram, meaning the city of Anantha or "the town of Lord ANANTHA", the abode of the sacred Serpent Anantha on which Lord Vishnu, the preserver of the Hindu trinity, reclines. The town has a history of supporting fine arts and culture and as a seat of learning. During the beginning of this century, Travancore Kings made women education compulsory and free. 15 percent of the state budget was allocated to education, laying the foundation for 100% literacy, which Kerala achieved a few years ago. We can see vivid proof of the religious tolerance of this state with the location of mosque, temple, and church within yards of each other at Palayam Junction in Thiruvananthapuram City. Thiruvananthapuram, the capital of the state of Kerala is a beautiful seaside city built on seven hills. The city is characterized by its undulating terrain of low coastal hills with narrow winding lanes and busy commercial alleys. Thiruvananthapuram and its famous beaches are one of the top tourist destinations in India.

8.1.1 Geographic location

Thiruvananthapuram is located at 8.5o N 76.9o E on the west coast, near the southern tip of mainland India. The city is sandwiched between the Western Ghats and the Arabian Sea. The city is built on hills by the sea shore. The region can be divided into three geographical regions, the lowlands, the midlands and the high lands. The lowland is a narrow stretch comprising of shorelines, rivers and deltas, dotted with coconut palms. The midland region comprises of low hills and valleys adjoining the Ghats. The highlands form the eastern suburbs of the city. Ponmudi and Mukkunimala are hill-resorts near the city.

The population of Thiruvananthapuram in

2011 was 3,307,284 as per provisional reports of Census India. The male and female population constitutes about 52% and 48% of the total population respectively. The Literacy levels in the city are close to 85%.

Table 8-1: Details of demographics in the city

Census 2011 Key Highlights	
Description	2011
Actual Population	3,307,284
Male Population	1,584,200
Female Population	1,723,084
Population Growth	3.58%
Area Square Km	141.74
Average Literacy Rate	84.52%
Male Literacy Rate	86%
Female Literacy Rate	83%

8.1.2 Connectivity

Road

The NH-66, which runs from Panvel to Kanyakumari connects the city to Kochi, Kozhikode and Mangalore. The Main Central Road (MC Road) which is an arterial State Highway in Kerala and designated as SH 1 starts from Kesavadasapuram in the city.

Rail

Thiruvananthapuram comes under the Southern Railway zone of the Indian Railways. There are five railway stations within the city limits including the Thiruvananthapuram central station. Thiruvananthapuram Pettah, Kochuveli and Veli stations are located towards north direction and Thiruvananthapuram Nemom is located in south direction from the central station. The Central railway station is located at Thampanoor in the heart of the city, and is about 5 km from the new international air terminal and nearly 8 km from the domestic air terminal. It is the largest and busiest railway station in the state. Kochuveli railway station is developed to ease congestion on central station and it act as satellite station to Thiruvananthapuram Central. The city is well connected by rail to almost all major cities in India such as New Delhi, Mumbai, Chennai, Kolkata, Bangalore and Hyderabad. Thiruvananthapuram is also the first major South Indian city on the longest train route in India, Kanyakumari to Dibrugarh.

Air

Thiruvananthapuram is served by the Thiruvananthapuram International Airport, which is the first international airport in India outside the four metropolitan cities then. It has direct connectivity to the Middle East, Singapore, Maldives and Sri Lanka and is a gateway to the tourism-rich state of Kerala. The International terminal of the airport is approximately 3.7 kilometres (2.3 mi) due west and the domestic terminal is approximately 8.0 kilometres (5.0 mi) from the central business district. The importance of the airport is also due to the fact that it is the southernmost airport in India and also the closest option for neighboring countries like Maldives and Sri Lanka, and the only option to Maldives from India. Also, apart from the regular scheduled flights, charter flights, primarily carrying tourists, also serve the airport.

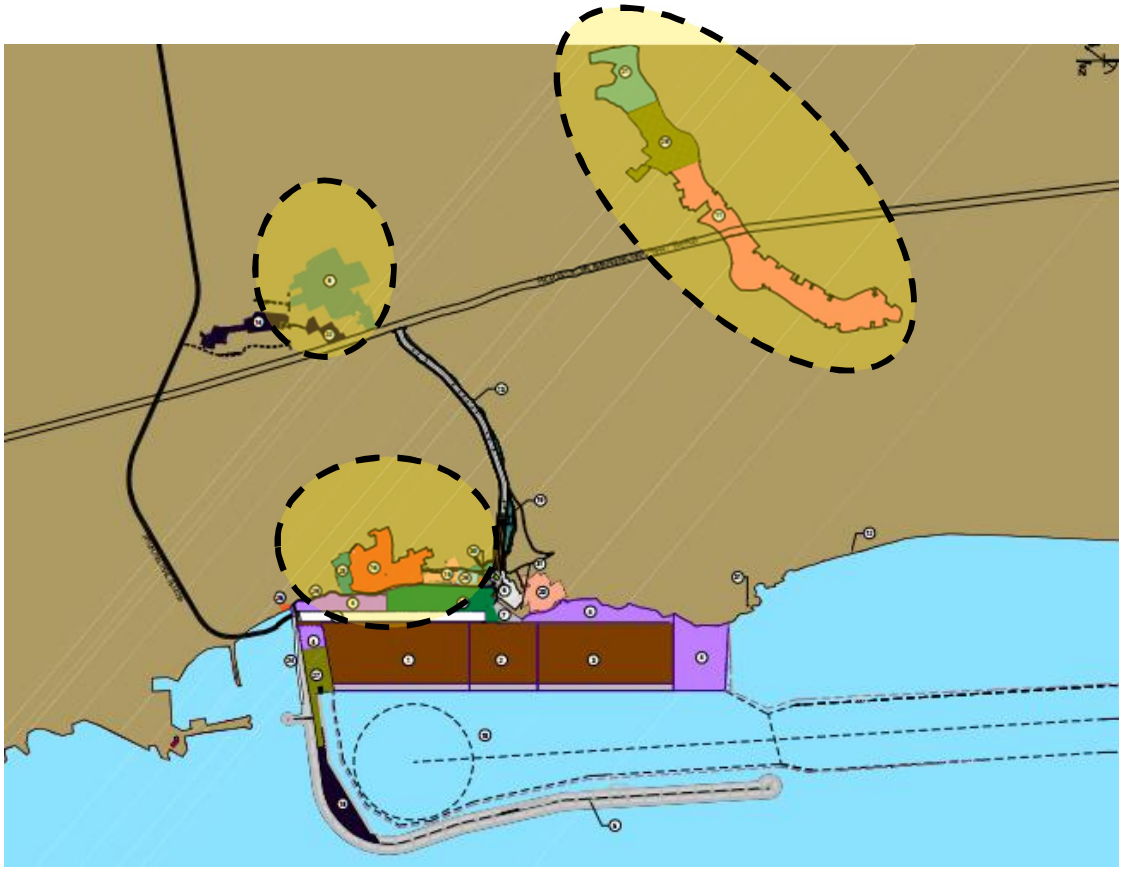
8.2 Site analysis

8.2.1 Site for Port estate Development

As part of the Port Development, several infrastructure facilities are envisaged to be developed and Port estate Development is one such activity. This development is expected to be implemented by the private partner or port developer which will be chosen through open competitive process. Under the PPP concession, GoK will allow the private developer to develop some portion of the site as Port estate Development with a cap of maximum 30% of the total site area. The total site area without reclaimed land i.e. on the landward side is 350 acres; hence the land area allotted for the Port estate Development is about 105 acres.

According to the master plan, there is a huge land parcel on the east side of the port area and the total site area of this land parcel 103 acres. It is proposed that the stated land parcel on the master plan could be allocated for Port estate Development due to its contiguous nature and its strategic location. The proposed NH 47 bypass will be bi-furcating the total land parcel in to two. The alignment of the NH 47bypass that is being constructed/ planned will bypass the Thiruvananthapuram capital city through the warehouse area at Punnakkulam. The figure below shows the location of the site proposed for Port estate development, encircled in yellow.

Figure 8-1: Location of Site proposed for Port estate Development



All the port facilities are proposed to be developed entirely on reclaimed land whereas all the infrastructure facilities are planned to be developed on the landward side in area of 237 Ha, about 87.6%% of which has been acquired by GoK till date.

Figure 8-2: Land and road in Port estate land parcel

8.2.2 Existing transport linkages

The figure below shows the existing transport linkages to the site. The existing road and rail connectivity is further described in the sections below.

NH 47 and NH 47 Bypass are in close proximity (NH at 10 km & Bypass at 3 km). NH 47 connects Salem to Kanyakumari and is connected to Cochin Port through NH 47A. From Cochin to further north it is connected to Mumbai through NH 17. NH 47 is connected to Chennai and the rest of the country through NH 7 and NH 4. The alignment of the NH 47bypass that is being constructed/ planned will bypass the Thiruvananthapuram capital city through the warehouse area at Punnakkulam. New alignment connecting Thiruvananthapuram to Kanyakumari is also proposed by National Highway Authority of India (NHAI).

A railway line runs parallel to the NH 47 and connects to Thrissur, Palakkad, Kollam and Alappuzha. The existing railway line runs North-South and connects to Mumbai through Konkan Railway. Neyyatinkara and Balaramapuram railway stations are about 10 Km (aerial distance) from the project site. It is a broad gauge single line running between Thiruvananthapuram and Kanyakumari. Rail connection to the port has been planned for electrified lines with container handling facilities. Due to the port development, transport linkages are expected to be better in the future.

8.3 Market Assessment

8.3.1 Demand Drivers:

- Economy
  Kerala is a leading agricultural state in the country, specializing in rubber, spice and coir production. It has also been promoting knowledge – based industries such as IT/ITeS, computer hardware and bio-technology. Thiruvananthapuram accounts for 70% of the State's IT Exports and 70% of the IT Workforce. Thiruvananthapuram houses India's largest IT Park in terms of built up area (BUA). As of 2012, it is spread over 300 acres with 4 million square feet of BUA and houses over 285 companies. Technopark is currently on an expansion mode by adding another 37 hectares as part of Phase III expansion and 450 acres (1.8 km^2) as Technocity–an integrated

IT township near Pallippuram. In future, the figure of directly employed professionals is expected to be much higher, which in turn will boost the Port estate demand.

- Facilitating infrastructure
  The Government has approved various projects in the field of IT, textiles, commercial space etc. under Emerging Kerala 2012 summit and specifically the expansion of IT infrastructure in IT Technopark. Most of the Port estate growth is happening in the heart of the Thiruvananthapuram city.
- Tourism
  Thiruvananthapuram has been a tourist hub since the 1970s; today it attracts 30% of all foreign tourist arrivals in Kerala and 20% of domestic tourists. Tourism is the most potential sector which has the ability to grow in respect to economic aspects by which the quality of life of the local community as well as the entire region could be elevated. Thiruvananthapuram has immense potential in all the different types of tourism including natural, heritage, religious, cultural, health – care and educational tourism. Thiruvananthapuram is well linked with all modes to travel, there are many hotels, restaurants and home stays in and around the city but lacks toilets and basic amenities along the corridor and near tourist spots. Also the quality assurance of food from restaurants and hotels is necessary.
- Connectivity
  The site is well connected through rail, road and air (the nearest airport being 15 kms away from the proposed site) and is seen as a catalyst for growth and a major economic boost to the area.

8.3.2 Upcoming Infrastructure Projects

The development of International Sea Port will fuel economic growth in Thiruvananthapuram. It will lead to generation of employment and attract investments in overall infrastructure sector (residential, commercial, hospitality).List of upcoming infrastructure projects approved during the Kerala Summit 2012 has been elucidated in the table below:

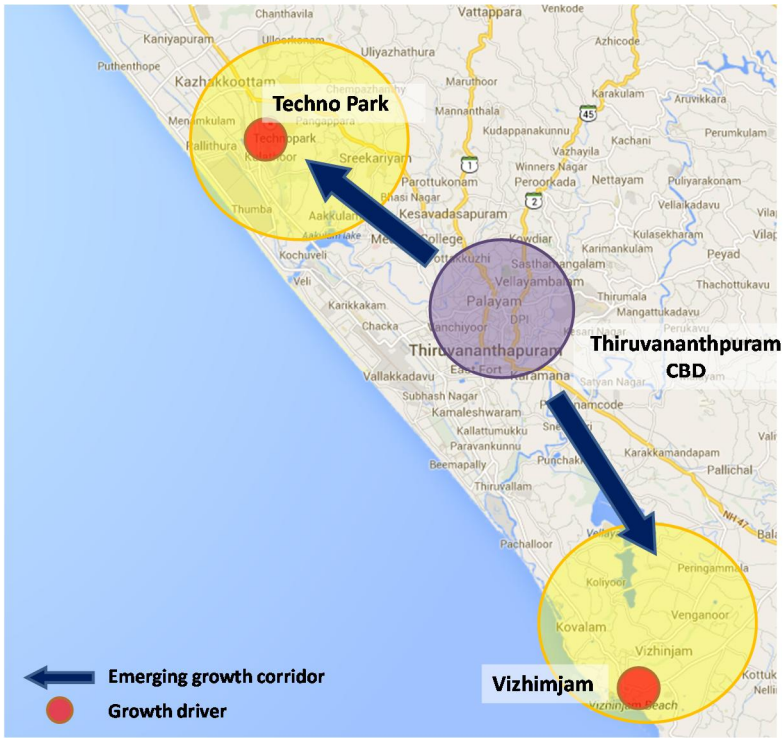
Table 8-2: List of upcoming infrastructure projects in Kerala

Project name	Agency/ Developer	Location
Adventure Sports Zone and Backwater Resort	Tourist Resorts (Kerala) Limited	Kappil
Ropeway connecting Akkulam and Veli	Tourist Resorts (Kerala) Limited	
Seaplanes	Tourist Resorts (Kerala) Limited	
Plastic Waste Pyrolysis - CFSC, Industries Department	Industries Department	
Commercial space		Thampanoor, Inkel
Food Park	Directorate of Industries and Commerce	Vithura
Jackfruit and Date Processing	Directorate of Industries and Commerce	
Renovation of Kerala State Coconut Development Corporation plant	Kerfed	Attingal
Ship repair yard and Marina		Poovar
New generation holographic tax stamp production facility	KELTRON	
Tool and dye making	Education Department	
Advanced Mechatronics Training Centre	Education Department	
Commercial production of Spirulina Algae	KSIDC	
Promoting Chackai-Kovalam bypass as	Directorate of Industries	

Project name	Agency/ Developer	Location
tourism-commercial corridor	and Commerce	
Aerospace Park	Directorate of Industries and Commerce	Kadinamkulam
Solid Waste Treatment Plant	Directorate of Industries and Commerce	
Centre for Applied Mathematics, Education Department		
Centre for non-destructive testing	Education Department	
Centre for textile technology	Education Department	
Cooperative Institute of Management Technology	CMIT	
11 projects in IT Technopark phase 3		Technopark
Mono rail		
M-square Mall		TVM – Kanyakumari highway
Hanza Plaza		Pappanmcode
Nikunjam Mall		MG Road, Paramount Jn
Big I Mall		Opp. Technopark NH Bypass, Kazhakkuttam
Alfa Mall		Enchakkal
Plaza Center		Akkulam

Most of the Port estate development is being done in and around the city area, same being approx. 18 kms away from the proposed site (Vizhinjam Sea Port).

Figure 8-3: Growth drivers



8.4 Demand & Supply

8.4.1 Hospitality

Thiruvananthapuram, the capital city of Kerala, is fairly dissimilar to other cities in the state in that Leisure travel is not the main demand segment for hotels in the area. Room night demand in the city primarily emanates from the Commercial and Government segments. Kovalam, which is located approximately 16 kms south of the city, is the only area that generates Leisure demand by way of its quality hotels with private beach access. A lack of any significant new commercial development has resulted in declining occupancy and average rates for Thiruvananthapuram. Although the government is trying to encourage growth of the IT and ITeS sector with the expansion of the Technopark campus, these developments have been slow in taking shape and are not helping generate new demand for the city hotels. As this trend is expected to continue in the short to medium term coupled with a limited addition to future supply, the hotel market in the city is expected to see limited growth for the next few years.

Snapshot of the existing room rental, per night, at Kovalam (nearest to the site) has been elucidated in the table below:

Table 8-3: Hotel room tariffs in Kovalam region

Hotel room rentals (Kovalam)	Rs. Per night
The LeelaKovalam Beach	13,000 – 15,000
Vivata by Taj, Kovalam	24,000 – 26,000
Swagath Holiday Resort	3700 – 4,500
Soma Palmshore Beach Resort	4,400 – 4,650
Thapovan Heritage Hotel	3,300 – 3,500
Hotel Sea Rock	2,750 – 3,000
Sagara Beach Resort	2,900 – 3,100
Park International Kovalam	2500 – 2,600

For the purpose of financial analysis, we have assumed Rs. 4,500 per night and Rs 8,000 per night for a mid – market and a luxury hotel respectively, the location being ~ 6 kms away from Kovalam.

Demand – supply analysis

Table 8-4: Hotel rooms – demand supply gap

Particulars	Figure
Average room penetration (per 1,000 people)	0.63
Total population of Thiruvananthapuram	35,33,512
Demand for rooms	2,226
Existing rooms (As per FHRAI)	1,562
Gap	664

Figure 8-4: Hotel room analysis

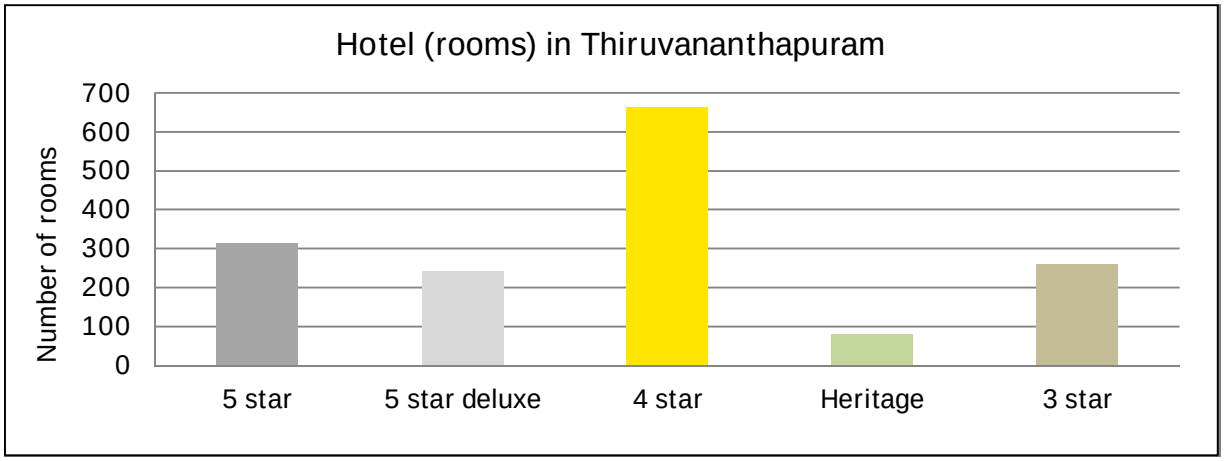
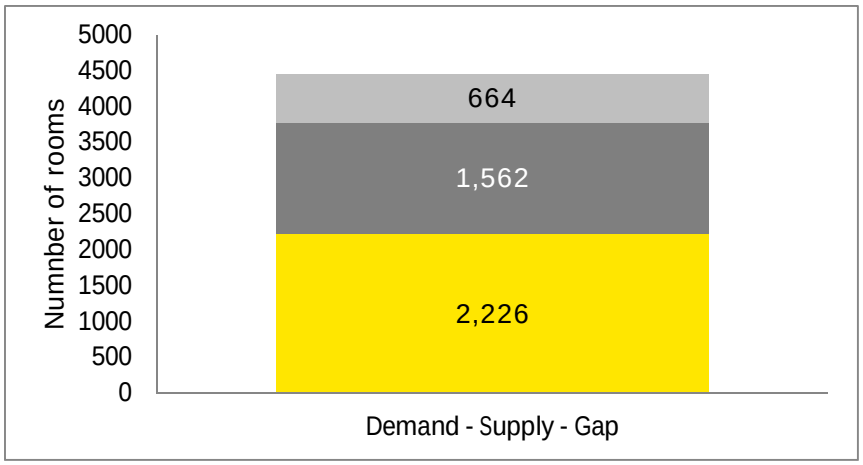


Figure 8-5: Demand – supply gap: Hotels in Thiruvananthapuram



As per the above analysis, the average room penetration has been arrived at based on the report/ white paper published by HVS – Hotel room supply, capital, investment and manpower requirement by 2021. The demand has been calculated based on the population and the factor (as per HVS report) for Thiruvananthapuram. The record of the Federation of Hotel and Restaurant Association of India suggests the number of rooms currently in Thiruvananthapuram is ~1,562 and as per analysis a gap of 664 rooms persists.

8.4.2 Residential

The current rates for a 2, 3 BHK flat is Rs 10 – 14sq.ft. per month and Rs 14 per sq.ft. per month based on interactions with local property dealers. For the purpose of financial analysis we have considered Rs 10 per sq.ft. per month.

Table 8-5: Capital & Rental values in residential segment

Place	Sale value (Rs per sq.ft. per month	Rentals per (Rs per sq.ft. per month)
Apartment in Pattor		13 – 15
Apartment in Chackai		7 – 10
Apartment in Sasthamangalam		9 – 12
Apartment in Pettah		8 – 10

Place	Sale value (Rs per sq.ft. per month	Rentals per (Rs per sq.ft. per month)
Apartment in Kowdiar		10 – 12
Apartment in Peroorkada		8 - 10
Confident Avior (Technopark)	2,850	
Sreekariyam	3,392	
Coral Sanrock Heritage	3,000	
SriremaVillaments	4,700	
Si Tana	4,200	
Appartment at Kovalam	11,666	

Residential Demand in the city is expected to be high owing to large scale commercial activities in the region. The demand for residential spaces is also increasing due to expansion of IT Park. The site is easily accessible and well connected to various parts of the city via road and Rail. Moreover, its proximity to Airport is one of the most important advantages in its future outlook.

8.4.3 Commercial - Retail

Commercial activity is low mainly due to the underdevelopment of ports. The demand for retail space in Thiruvananthapuram has been estimated based on population in the region and the per capita income of the people. Firstly, the per capita disposable income of people of Thiruvananthapuram has been estimated depending on the past trend. Then, the portion of that income available to organized retail has been calculated based on information available in Industry reports. Based on survey conducted, average revenue expectation of a mall per annum per square feet was assessed. Given this value and the annual spending of the population of region on organized retail, the area of retail space required in the region for that spending was estimated. For financial analysis we have considered Rs 35 per sq.ft per month for commercial and Rs 60 per sq.ft., per month for retail units.

Table 8-6: Rental values in commercial segment

Retail	
Place	Lease Rental (Rs per sq.ft.per month)
Kowdiar	70
Vazhuthacaud	55
Sasthamangalam	50 to 55
Palayam	50-80
Poojapurra	35-40
M G Road	50-55

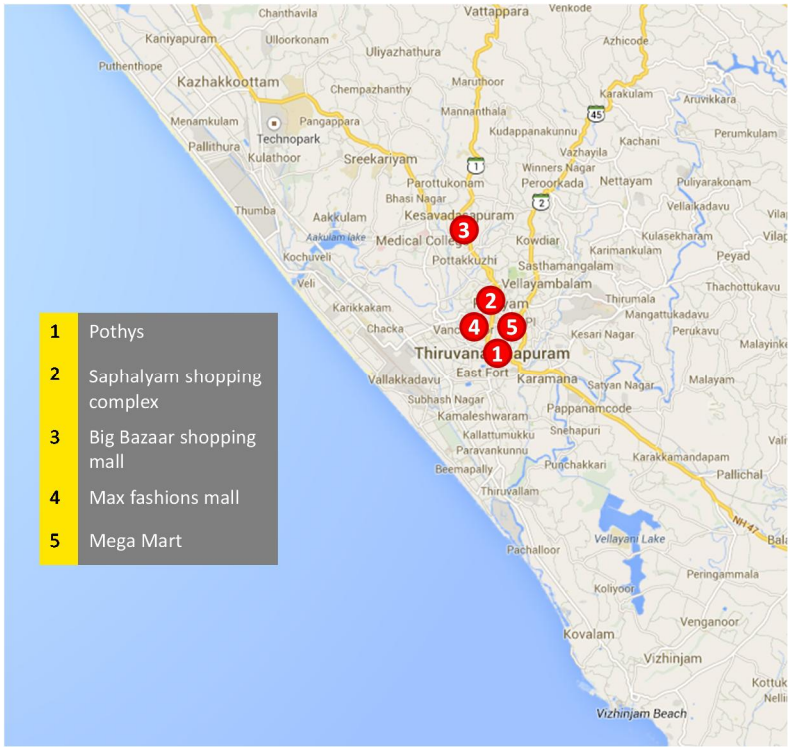
Table 8-7: Demand Assessment of Retail Space

Demand Assessment of Retail Space						
Formula	Particulars	2011	2012	2013E	2014E	2015E
A (Increased 1.92% y-o-y)	Population	33,07,284	33,81,036	34,56,434	35,33,512	36,12,309
B (increases 5% y-o-y)	Per Capita Income (in INR.)	1,02,000	1,07,100	1,12,455	1,18,078	1,23,982
C =50% of B	Per Capita Savings (50% of Per Capita Income)	51,000	53,550	56,228	59,039	61,991
D = B - C	Per Capita Disposable Income (in INR)	51,000	53,550	56,228	59,039	61,991

Demand Assessment of Retail Space						
Formula	Particulars	2011	2012	2013E	2014E	2015E
E = D x A	Total Disposable Income Available in INR. millions	1,68,671	1,81,055	1,94,347	2,08,615	2,23,930
F = E x 40% (% of disposable income is on retail)	Total Spend Capture Potential by Organized Retail in Rs. Millions	67,469	72,422	77,739	83,446	89,572
G	Average Revenue Expectations of the Mall (Rs/sqft/Annum)	8,000	8,400	8,820	9,261	9,724
H = F/G	Retail Space Requirement in Thiruvananthapuram in million sq. ft.		8.62	8.81	9.01	9.21

The estimated supply of mall space is expected to be around 2.42 million square feet in Thiruvananthapuram in 2014 and about 2.66 million square feet in 2015. Based on demand analysis, the total demand for retail would be around 9.21 million square feet in 2015 which would mean a supply gap of about 6.55 million square feet.

Figure 8-6: Shopping complexes concentration



8.4.4 Commercial -Office Space

As per the report published by Jones Lang Lasalle, the IT sector in Thiruvananthapuram has been experiencing strong growth among the top 30 tier -2/ 3 cities in India. The city contributes 80% of software exports from the state, and was selected as the fourth hottest IT destination in India. Since the establishment of Technopark in 1995, Thiruvananthapuram has steadily grown into a competitive IT centre. The city was rated as the best 2nd tier metro with IT/ITES infrastructure, and second in terms of availability of human talent. Technopark houses global majors like Oracle Corporation, Accenture, Infosys, ITC Infotech, TCS, Capgemini, Visual Graphics Computing Services,

Ernst & Young Global Shared Services Center, Allianz Cornhill, RR Donnelley, UST Global, Tata Elxsi, IBS Software Services, NeST Software, SunTec Business Solutions etc.

8.5 Project Components

On the basis of the Port estate sector market assessment study, four project components are proposed for Port estate Development.

- Hospitality
- Commercial – Retail
- Commercial – Office
- Residential

Hospitality: Hospitality specifies hotels under various starred categories. Revenue from hotels would come from room rents, restaurants, banquets halls and other recreational facilities.

Retail: A mall space includes retail outlets for various international and domestic brands of apparel, food and beverages, electronic items, jewellery and other accessories etc. Apart from these, most common tenants in a mall would be hypermarkets/supermarkets, foods chains at the food courts, gaming zones, multiplexes etc.

Office Space: Office space refers to Grade A office complexes:

Residential Space: These include high end luxury apartment complexes with facilities such as parking, swimming pool, gymnasium, park/playground etc.

8.6 Port estate Development Forecast

As stated earlier that the total area available for Port estate Development is 105 acres. It is assumed in the financial analysis that 100% of this area will be developed.

As per the current trend in Thiruvananthapuram, the Port estate development is being witnessed in the northern side, i.e. towards the city and the Technopark area. Kovalam is the nearest area where some development is being witnessed, due to increase in tourist footfall. Industry reports and papers suggest the development of the international deepwater sea port; will fuel growth in and around the site area (Vizhinjam Port) and in turn give way for companies to setup new manufacturing units and offices. Another factor to fuel growth is the fact; the site is well connected by road, rail and air.

Keeping the current commercial scenarios in view, snapshot of the product mix has been elucidated in the table below along with the phasing schedule (100% development is being proposed in 6 years).

In the financial analysis development of one mid – market and luxury (each) spread over 1,82,952 sq.ft., and 2,59,182 sq.ft., respectively is proposed. 13,72,140 sq.ft. area is being proposed for commercial units (shopping malls etc.) and the balance being for residential and retail space development. A snapshot of the on area distribution has been elucidated in the table below.

Table 8-8: Area distribution of Port estate components (Built up area)

Project Components	Area Distribution (Sq ft)	% share of development
Residential	45,73,800	33%
Retail	38,41,992	42%
Commercial	13,72,140	15%
Mid-market Hotel	1,82,952	4%
Luxury Hotel	2,59,182	6%
Total	1,02,30,066	100%

The total construction time is assumed as 5 years for Port estate. The project phasing schedule is given below:

Table 8-9: Port estate Development phasing schedule

Particulars	2015	2016	2017	2018	2019	2020
Residential	-	-	91,476	9,14,760	20,58,210	15,09,354
Retail	-	-	76,840	7,68,398	17,28,896	12,67,857
Commercial	-	-	27,443	2,74,428	6,17,463	4,52,806
Mid-market Hotel	-	-	3,659	36,590	82,328	60,374
Luxury Hotel	-	-	5,184	51,836	1,16,632	85,530
Total (in sqft.)	-	-	2,04,601	20,46,013	46,03,530	33,75,922
Total (%)	0%	0%	2%	20%	45%	33%

Construction phasing forms one of the key assumptions in any Port estate project. The phasing in this sector depends upon various factors which are very dynamic in nature and may have to be reviewed from time to time. Commercial Port estate projects generally comprise of retail mall space, Grade A and Grade B office spaces, different categories of hotels and service apartments, residential complexes etc. The decision on phasing depends majorly on the demand-supply scenario in each of these type of projects listed above. The phasing has to take into account the financial viability by estimating the expected dynamics between absorption rates and capital/rental values. Six year construction phasing has been proposed keeping in view the large area of 105 acres available for port estate development and the overall growth in the port traffic which as per estimates is >3 lakh. Majority of the construction activity has been proposed from 4th year onwards and from 6th year, from the appointed date, the revenues starts to accrue from the project.

9 Financial Feasibility

In this chapter financial viability of the project is analyzed and determined. This analysis conducted to justify the (large) initial investments for construction of the port and to investigate whether the port will become profitable in the course of time. The financial analysis includes profitability indicators like Internal Rate of Return (IRR), Net Present Value (NPV) and a sensitivity analysis. Before the financial analysis, a brief snapshot of the recommended structure of the project is discussed to understand the modality of the structure.

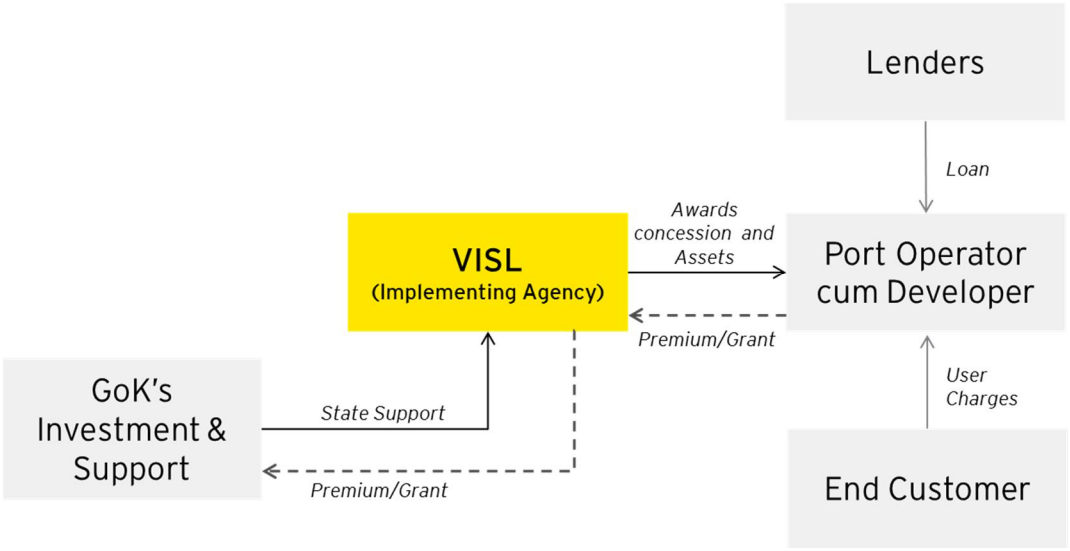
9.1 Structuring of the Project

The GoK intends to develop this port on a "Landlord Port Model". Though there have been few variations in the terms of the structure drafted in the present model from the previous one, the overall concept and principles of the proposed model remains the same. The following section highlights the key elements of the recommended project structure model for Vizhinjam Port.

The project structure is based on the Landlord Port Model and the role of GoK/VISL and Concessionaire is as follows:

- GoK will grant a concession on a DBFOT basis for developing, operating, maintaining and managing the entire Port including the civil infrastructure and supra-structure (terminal) and to provide cargo handling services and other ancillary services to Users at the Port. However, the funding of pre identified civil infrastructure works (breakwater and fishing harbor) will be borne by GoK/VISL. The Concessionaire will be required to undertake provide these services to the Users at specified performance levels.
- Concessionaire will be entitled to set, levy and collect tariff from Users for the use of all infrastructure at the Port and the provision of cargo handling services and other ancillary services to Users. The GoK will notify the tariff set for vessel and container handling related services in accordance to the concession agreement, which will be the ceiling. The Concessionaire will also be entitled to generate revenues from the Port estate Development for the entire concession period.

Figure 9-1: Types of vessel and container related charges



- Project assets will be owned by the GoK, the Concessionaire will be entitled to create security over its leasehold rights in assets, its concession rights, the Project assets and

Project revenues earned by the Concessionaire. These assets will be transferred to the GoK on expiration or early termination of the concession.

- During the bid process, the bidders will be required to bid for the extent of government financial support required (in form of capital grant) from the GoI/GoK for developing and operating the supra-structure (terminal). Alternatively, in case bidders find the construction and operation of the supra-structure (terminals) to be very profitable, they will be free to bid for a premium to GoK.

9.2 Financial Analysis

- Elements of financial viability: The concession period is envisaged to be granted by the Government for construction and development of ports is 40 year or more. This time frame normally enable a robust project structure and any further extension would improve financial viability only marginally as the present value of projected revenues thereafter would be comparatively low from the Concessionaire's perspective.
- A price cap tariff structure would also lead to greater predictability of the revenue streams of Concessionaires, besides incentivizing efficiency and cost reduction. In the medium term, tariffs should find their own levels through competition, the same can happen only after adequate capacity has been created.
- Capital cost determines the financial viability of a port DBFOT project
- Concession period: The guiding principle for determining project specific concession period should normally be the capacity of the respective port to handle the expected cargo at the end of the proposed concession period. However, capacity constraints would normally be addressed by augmentation of facilities. As such, it would be advantageous to allow a longer concession period both from the perspective of the concessionaire as well as the Government.
- Port tariff: A balanced mechanism for determination of tariffs has been specified for a part of the concession period since this would be of fundamental importance in estimating the revenue streams of the project, and therefore, its viability. The tariffs shall be capped by the rates to be specified by the GoK prior to invitation of bids. While this will ensure that users are not exploited in a situation of congestion in port capacity, there will be sufficient freedom for the Concessionaire to levy and collect competitive and economic charges at all times. These notified tariffs will be subject to escalation over the term of the concession as per a predetermined mechanism, linked with WPI.

9.2.1 Key Assumptions

This section highlights the key assumptions made on main items based on which the financial model is prepared.

Concession & Construction Period

The Concession Period considered is 40 years which is inclusive of 4 years of construction period for port development and 6 years for Port estate Development; however the revenues shall commence from the 6th year of the appointed date. Only Phase-1 Port development is envisaged to be constructed in this period as per the draft Concession Agreement.

Project Phasing

The project construction start year would be 2014-15 and concludes during 2017-18 for Port Development and for Port estate Development the end year would be 2019-20.

Table 9-1: Project phasing

	2015	2016	2017	2018	2019	2020
Phase 1 Port Development						
Project Preliminaries and Site Development	100.0%	0.0%	0.0%	0.0%		
Dredging and Reclamation	0.0%	40.0%	30.0%	30.0%		
Berths	10.0%	40.0%	30.0%	20.0%		
Buildings	30.0%	40.0%	30.0%	0.0%		
Container Yard	0.0%	40.0%	40.0%	20.0%		
Equipment	0.0%	0.0%	10.0%	90.0%		
Utilities and Others	10.0%	10.0%	50.0%	30.0%		
Port crafts and Aids to Navigation	0.0%	20.0%	30.0%	50.0%		
Gates Complex & Road Development	0.0%	0.0%	60.0%	40.0%		
Port estate Development						
Residential	0%	0%	2%	20%	45%	33%
Retail	0%	0%	2%	20%	45%	33%
Commercial	0%	0%	2%	20%	45%	33%
Mid-market Hotel	0%	0%	2%	20%	45%	33%
Luxury Hotel	0%	0%	2%	20%	45%	33%

Traffic & Throughput

Traffic section is presented in the Chapter 6. The traffic for both vessel and container cargo has been evaluated on the base case scenario for the period of FY2019-2054. Hazardous & Reefer containers are assumed at 5% of the total gateway container traffic and Res-stow at 10% of the total transshipment traffic. Out of the total vessels, it is assumed that 10% vessels will account for foreign flags and 10% Indian flags under Gateway and 60% vessels will account for foreign flags and 20% Indian flags under vessels for Transshipment.

Tariff

Tariff structure is presented in the Chapter 7 & Revenue Estimates section in this Chapter.

WACC

WACC sets the minimum targeted result expected by the private party in the Port project and is used to calculate respective project Net Present Values. It is assumed at 10.6%.

Depreciation

The depreciation rate is in accordance to the latest Companies Act on SLM basis.

Building : 1.67%

Plant & Machinery : 12.50%%

Pre-operative expenses: 10.00%

The depreciation rate is in accordance to the Income Tax Act on WDM basis.

Building : 1O.00%

Plant & Machinery : 15.00%

Pre-operative expenses : 20.00%

Taxation

Corporate Tax Rate: 33.99%

Minimum Alternative Tax (MAT): 20.96%

Section 80-IA Deduction: Granted for infrastructure projects – can deduct 100% of operating profits for ten consecutive years, starting on or after COD and ending on or before 15 years after COD. Sponsor still pays MAT when applicable during years of 80-IA exemption.

Debt terms

Port Development - Assumed at 70% of the total fund required and at 12.50% interest rate. The start year of disbursement is 2015 and the start year of repayment is assumed by 2019. Capital grant if sought by the Concessionaire would be released only after entire equity has been invested.

Port estate Development - It is assumed at 50% of the total fund required and at 12.50% interest rate. The start year of disbursement is 2015 and the start year of repayment is assumed by 2019.

Other Port estate Development Assumptions

Port estate Development assumptions are presented in the Chapter 8 and under Cost & Revenue Estimates sections in this Chapter.

9.2.2 Cost Estimates

In this section, capital expenditures (CAPEX) for both Phase 1 Port Development and Port estate Development are examined.

Phase 1 Port Development

The capital cost estimates prepared for the Phase-1 development of the project have been arrived by technical consultant at based upon site information, appropriate assumptions, wherever required, quotes and discussion from various suppliers and the database available with the technical consultant for the similar projects.

The cost is divided into major components such as Project Preliminaries & Site Development, Dredging & Reclamation, Breakwaters, Berthing Structures, Buildings, Container Yard, Equipment, Utilities, Port Crafts & Aids to Navigation and Gate Complex etc. For each major component, based on its functional requirements, cost has been estimated as per the proposed development. For berthing structures, dredging & reclamation, breakwaters the cost estimation has been done by considering the preliminary engineering as per the Vizhinjam Port site and environmental conditions. The unit rates have been taken based on the past projects carried out by technical consultant in India and current market rates obtained from ongoing projects and vendors.

The calculations used to create the estimates reflect current construction costs (2014 base year), as well as estimated allocation of funds for construction contingencies and planning/design costs.

The following assumptions were used during the development of these estimates:

- The capital cost estimates are based on the project descriptions and drawings which were prepared after carrying out basic engineering of various components of the project. These will need to be developed, revised, and refined during the detailed design phase, and, therefore, quantities shown in the cost estimates may undergo revision.
- A four year construction period has been assumed;
- As per Draft Concession Agreement (DCA), Phase – I capacity ((mandatory) is 1.0 million TEU;
- Contingency cost, at 20%, has been proposed and included in the base project cost for civil items and not included equipment and port craft & aid to navigation components;
- A year on year escalation on the base cost has been assumed at 5% p.a., as per Planning Commission guidelines, for various infrastructure projects;
- Further, an escalation of 25% has been added to the total hard cost which primarily includes provision for interest during construction and other contingencies. All mobilization costs are included in respective entities.
- A construction methodology has been assumed based on experience of similar structures and utilized for costing provided in this section.

- The components of the port such as Breakwaters & associated berths, VISL Building, Rail Yard and External connectivity, land etc. are VISL's responsibility and the costs of these components will become part of Funded Works, hence are not mentioned in the total project cost summary. Costs for environmental studies and potential mitigation have been estimated by LTR as part of the EIA studies.

The following exclusions were used during the development of these estimates:

- No taxes such as Service Tax, VAT etc. are included.
- The costs to furnish buildings and to operate the facility are not included.
- General administrative supplies are not included.

1. Project Preliminaries and Site Development

This includes the cost involved in site preparation & development for construction activities, pre-operative expenses, initial surveys & project studies.

2. Dredging and Reclamation

Dredging and reclamation is one of the major cost parameter for any port project. Based on the bathymetry contours provided by VISL and as per the proposed phase wise development plan, the dredging and reclamation quantities have been estimated.

It is estimated that reclamation quantity required for Phase-1 development will be met by dredging. The initial reclamation bund and shore protection revetment costs have also been included. The ground improvement costs are estimated over the complete gross reclaimed area of the port.

3. Berths

Cost estimated for the berthing structures includes container terminal berths and Port craft berths (8m apron width). The cost estimates are done considering the basic design of an open pile berthing structure with stone pitching underneath the berth. These include costs for piles, diaphragm wall crane rails where applicable, fenders, bollards, in-situ and pre-cast concrete works.

4. Container Yard

Major items included in the cost estimate for container yard development are site grading, pavement and RTG beams.

5. Equipment

Costs for required equipment as discussed in Section 11 have been considered for Phase-1 development. Major equipment are Rail Mounted Quay Cranes (RMQC), Rubber Tire Gantry (RTG for container yard), Reach Stackers, Empty Handlers and Internal Transfer Vehicles (ITV).

6. Buildings

Major buildings included in the cost estimate include

- Administrative Building including Port Users
- Port Marine Operations Building
- Yard Operations Building
- Crane Maintenance Building
- Maintenance & Repair Building
- Trouble Kiosk & Restrooms
- Quay Workers Restrooms
- Railway Master Building
- Reefer Shop & Genset
- Gate Canopy

- Canteen
- Fire Station
- Utilities Building
- Electric Substation
- Guard booth (Entry & Exit Gate)
- Fuel Station
- Fish Landing Centre Buildings
    - Auction Hall
    - Administration Office
    - Net Mending Shed
    - Gear shed
    - Cold Storage
    - Toilet Block
    - Security Block
- Other Miscellaneous Buildings

7. Utilities

The following within the terminal utilities have been included in the cost estimate:

- Electric supply & distribution including high mast lighting for container yard
- Fire fighting
- Lighting & Earthing
- Water supply
- Drainage & Sewerage
- Communication & IT (including Terminal Operating System)
- Compound wall for land side port area
- Workshop equipment
- Security infrastructure

8. Port Crafts & Aid to Navigation

The terminal will need tug boats for berthing, stopping & turning manoeuvers for the container & other vessels. The other port crafts include mooring launch and pilot cum survey launch. Aids to Navigation requirements have been assessed as per the IALA guidelines.

9. Gate Complex & Terminal Road

The gate complex, customs processing area and main terminal road (4 lane road along the container yard) costs have been included.

Total Project Cost (TPC) Estimation Summary – Tabulated below is the breakup of component wise project cost as per the project phasing estimated after escalations.

Table 9-2: Phase-1 Port Development Cost Estimate Summary

Financial year	Total project cost (in Cr)
Civil costs	
Project preliminaries and Site Development	*11*
Dredging & reclamation	*720*
Berths	*426*
Buildings	*28*
Container Yard	*218*
Equipment	
RMQC	*723*

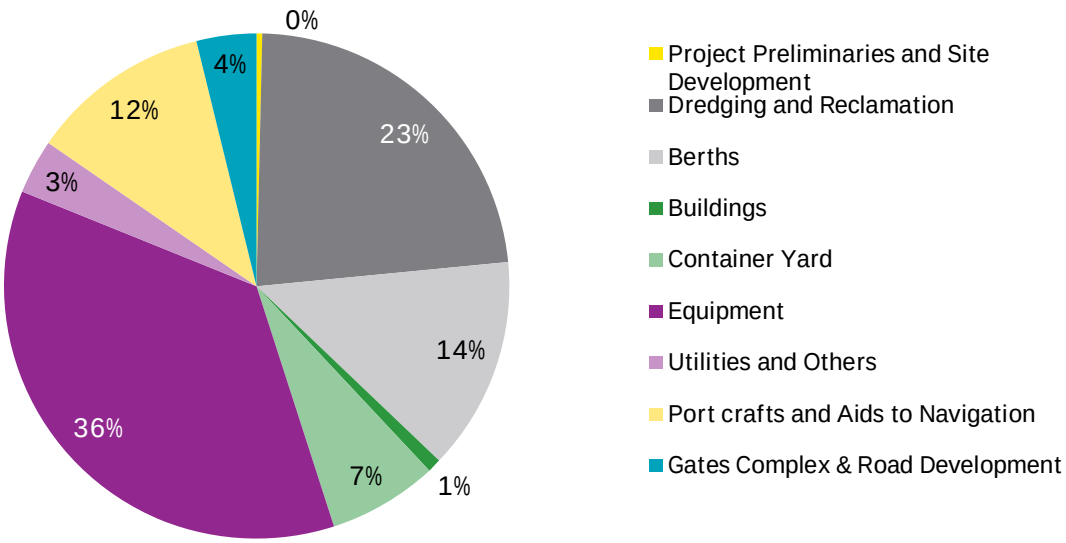
Financial year	Total project cost (in Cr)
Reach Stackers	*7*
RTG (Yard)	*270*
Empty Container Handler	*17*
ITVs	*46*
Maintenance Vehicles	*0*
Workshop Equipment	*6*
Spares	*54*
Utilities and Others	110
Port crafts and Aids to Navigation	360
Gates Complex & Road Development	120
Engineering and project management fee at 5%	156
Total Base (Civil and Equipment) Cost	3,272
Escalation for Interest during construction and other financing cost @ 25% as per Planning Commission	818
Total Project Cost	4,089

The estimated project for the project is Rs 4,089 crores; the base cost as provided by the technical consultant, i.e., Rs. 2,806 crores. Cost provided by the technical consultant does not include the financing cost & Interest during construction and the escalation in the base cost due to the project's phasing schedule. The same has been highlighted in the table below.

Table 9-3: Total project cost (port development) % wise bifurcation

Particulars	Rs in crores	% of total project cost
Base Cost (technical consultant)	2,806	69.0
Escalation	467	11.0
Escalation for Interest during construction & other financing cost	818	20.0
Total	4,089	100

Figure 9-2: Percentage share of the Main cost items



Cost Inflation

In order to determine cost escalation relating to price inflation over the project term, Whole Price Index, as reported by Office of Economic Advisor, for long term and medium term has been

analysed. For long term 15 years WPI from 1995 to 2010 (post liberalization period) was considered and has been elucidated in the table below:

Table 9-4: Capex cost Escalation for Port Development

Base	2015	2026	2037	2048
	2025	2036	2047	2054
5.5%	5.8%	6.1%	6.4%	6.7%

The cost estimates have been summarized in Table 9.2. The Phase-1 development is estimated to cost INR 4.089 Crores or USD 655.72 million. As it is evident from the Figure 9-2, equipment accounts for the maximum share of the total civil cost i.e. around 36% which is followed by dredging and reclamation cost which has a 23% share.

Assets (equipment) Replacement / Refurbishment

Asset replacement and/ or refurbishment have been proposed at regular intervals; the same are elucidated in the table below:

Table 9-5: Asset refurbishment/ replacement

Equipment	Quantity	Unit price	Purchase Cost (in INR)	Replacement / Refurbishment year
RMQC	8	75,44,00,000	6,03,52,00,000	20
Reach Stackers	2	3,31,20,000	6,62,40,000	8
RTG (Yard)	24	9,30,00,000	2,23,20,00,000	20
Empty Container Handler	6	2,30,00,000	13,80,00,000	20
ITVs	55	69,00,000	37,95,00,000	10
Maintenance Vehicles	2	15,00,000	30,00,000	20
Workshop Equipment	LS		5,00,00,000	20
Spares			44,51,97,000	10

Port estate Development

Details on assumptions and the capital cost pertaining to Port estate development have been elucidated in the table below:

The Port estate Development cost for residential is assumed at Rs 2,100 per sq.ft. Rs 2,250 per sq.ft., for retail, Rs. 2,750 per sq.ft., for commercial, Rs. 3,750 per sq.ft., for mid – market hotel and Rs 5,750 per sq.ft., for a luxury hotel.

The pre – operative expenditure has been assumed at 4% of the Port estate Development cost, contingencies has been assumed at 6% of commercial development cost and the financing fee of 1% of the total debt amount has been assumed in the financial analysis; the escalation rate are used similar to what has been proposed in port development.

Table 9-6: Assumptions for Port estate Development

Particulars	Unit	Assumption
Total site area	Ha	142
Total site area	Acres	350
Land for Port estate Development	Acres	105
Other Assumptions		
Ground coverage - Residential	%	65%
Ground coverage - Retail/ commercial	%	40%
Ground coverage - Hotels	%	40%
Start date of construction	Year	2015

Particulars	Unit	Assumption
Start date of operations	Year	2019
Start date of operations - Luxury hotel	Year	2020
Total Construction period	Nos	6
Hotel FAR	No	1
Residential FAR	No	3
Financing Assumptions		
Debt	%	50%
Equity	%	50%
Rate of interest	%	12.50%
No. of years for repayment	No	5
Moratorium (yrs)	No	4
Start year of disbursement	Year	2015
Start year of repayment	Year	2019

CAPEX escalation

The cost has been escalated by 5% y.o.y.

Total Project Cost Summary for Port estate Development

As can be seen from the table below, major portion of the Port estate development is being proposed under commercial and residential use (combined ~48% of the total area) and the total BUA envisaged is 5.95 million sq.ft. , the snapshot of the area proposed for each component under Port estate development and the phasing schedule, has been given in the tables below.

The phasing for the entire Port estate development is proposed to be carried out in 6 years.

Table 9-7: CAPEX – Port estate Development Distribution

Particulars	Rs (in crores)	% of total
Residential	1,172.0	35%
Retail	1,055.0	31%
Commercial	459.0	14%
Mid-market Hotel	81.0	2%
Luxury Hotel	180.0	5%
Total base cost	2,947.0	88%
Preliminary expenses	116.0	3%
Contingencies	175.0	5%
Financing fees	11.2	0%
IDC	111	3%
Total Capex	3,360.2	100%

9.2.3 Revenue Estimates

In this section, revenue estimates for both Phase 1 Port Development and Port estate Development are examined and determined.

Phase 1 Port Development

As stated in the Chapter 7, major revenue of the port is from tariffs for vessel and container cargo handling. Determination of the tariffs is explained in detail in the Chapter 7. The tariffs for Vizhinjam port will need to be benchmarked with the competing ports like Cochin and Colombo for Gateway and Transshipment traffic respectively. A recommendation of the tariff structure is made in this chapter.

Port charges consist of a list of tariffs for all services in the port. They are divided in two categories; vessel related and container cargo related charges. Container cargo related charges are further

segregated in two categories such as Gateway &Transshipment charges. For financial analysis we have discounted the port tariff by 35%.

Recommended Tariff Structure for Phase 1 Port Development

1. Vessel related charges

Vessel related charges are port dues, berth hire and (un)berthing charges, pilotage fees, tug and ancillary charges. These charges are generally based on the type and size of the vessels measured in the maximum amount of TEU of the container vessels or in gross registered tonnage (GRT) of other cargo vessels. For the purpose of this study, EY has considered GRT as a unit to measure the vessels for levying the charges.

Table 9-8: Vessel related charges (A)

Description/Type	Port Dues*	Berth Hire**
Coastal Vessel	12.50	0.25
Foreign Vessel	25.00	0.60

Table 9-9: Vessel related charges (B)

Description/Type	Pilotage*
Coastal Vessel	
Upto 30,000 GRT	21.00
30,001 – 60,000 GRT	19.00
60,001 GRT & Above	19.00
Foreign Vessel	
Upto 30,000 GRT	50.00
30,001 – 60,000 GRT	40.00
60,001 GRT & Above	40.00

2. Cargo related charges

a. Gateway

Cargo related charges are discharging / loading of containers, (de)stuffing and storage charges. Throughput of the vessels in TEU is the measurement for these charges.

Table 9-10: Cargo related charges – Gateway

Type	20 ft		40 ft	
	Coastal	Foreign	Coastal	Foreign
From vessel to CY or vice versa- Full Containers (Import /Export)	1,300	2,900	1,900	4,350
From vessel to CY or vice versa – Empty Containers (Import /Export)	1,300	2,900	1,900	4,350
Wharfage Charges - Full Containers	2,550	5,800	2,550	5,800
From vessel to CY or vice versa - Over Dimensional Container (Full/Empty)	1,300	2,900	1,900	4,350

b. Transshipment

Transshipment charges are cargo charges including the double crane service, terminal handling and the storage at the terminal. Because of these extra services the transshipment charges are higher than the cargo related charges.

Table 9-11: Transshipment charges

Type	20ft	40ft
Full Containers (INR/ TEU)	2,300	3,500
Empty Containers (INR/ TEU)	2,300	3,500
Oversize Containers (INR/ TEU)	4,300	6,000
Reefer Containers (INR/ TEU /Hour)	75	100
Re-stow (INR/ TEU)	3,600	5,100

It is assumed that Hazardous containers in both the categories will be charged 50% more than the normal full containers.

Revenue Estimates for Phase 1 Port Development

On the basis of the assumptions and recommended tariff structure in Chapter 7, revenues have been estimated for the horizon period of FY2018 TO 2054 for various tariff items as shown below.

Table 9-12: Revenue forecast for Vessel Related Charges

	2019	2023	2028	2033	2038	2043	2048	2054
Port Dues (INR Crores)								
Foreign Vessels	14	40	66	105	135	175	225	306
Coastal Vessels	2	7	12	18	23	30	39	53
Berth Hire (INR Crores)								
Foreign Vessels	9	24	40	63	81	105	135	183
Coastal Vessels	1	4	6	9	12	15	19	26
Pilotage (INR Crores)								
Foreign Vessels	23	64	106	169	218	281	362	492
Coastal Vessels	4	11	18	28	36	46	59	81
Total (INR Crores)	53	150	248	392	505	652	839	1,141

Table 9-13: Total Revenue Forecast for Vessel & Container related charges (INR Crores)

	2019	2023	2028	2033	2038	2043	2048	2054
Vessel Charges	53	150	248	392	505	652	839	1,141
Gateway	9	56	84	176	232	303	386	523
Transshipment	27	179	297	521	672	867	1,118	1,517
Miscellaneous*	4	27	44	82	106	138	177	240
Total (INR Crores)	93	412	673	1,171	1,515	1,960	2,520	3,421

Escalation

In order to determine cost escalation relating to price inflation over the project term, Whole Price Index, as reported by Office of Economic Advisor, for long term and medium term has been analyzed. For long term 15 years WPI from 1995 to 2010 (post liberalization period) was considered and has been elucidated in the table below:

Table 9-14: Revenue escalation assumptions

Base	2015	2026	2037	2048
	2025	2036	2047	2054
5.5%	5.8%	6.1%	6.4%	6.7%

Port estate Development

Estimated revenue

Revenue streams for city side development have been considered for retail, commercial and hospitality sectors. The hotel industry forms a major portion of the revenue from city side development. The major assumptions and projected revenues have been mentioned in subsequent parts.

Revenue assumptions

The rentals rates for retail and commercial have been mentioned below: The rates have been taken on the conservative side taking in to account the present developments near the site. These rates are expected to increase in the near future.

Table 9-15: Revenue / Rent Assumptions

Retail (per sqft per month)	60
Commercial (per sqft per month)	35
Residential (per sqft per month)	10

Escalation in lease rentals y.o.y. has been on the similar lines for revenues from port development activities

Occupancy

The occupancy rates have been studied for the last few years. Though the occupancy levels have been found to be slightly on the lower side, the absorption is expected to increase significantly in the region in the next few years. Though in short term, the vacancies are expected to be high but the absorption is envisaged to increase in medium and long term. The occupancy rates assumed have been mentioned below:

Table 9-16: Assumptions for Occupancy

Occupancy	MIN	MAX
Retail/Commercial/Residential	30%	90%
Hotels	30%	85%

Assumptions for Hotel Industry

Hospitality is a dynamic industry with numerous revenue streams. Generally, a hotel has various other sources of revenue apart from the room rent that a guest pays. Often food and beverages, banquet halls, meetings and conferences together contribute a significant amount to the share of revenues. The various assumptions related to the hotel revenue have been mentioned below:

Table 9-17: Revenue/Rent from Hotel

Particulars	Unit	Hotel type	
		Mid – market	Luxury
Number of hotels	Nos.	1	1
Hotel Room Rate	INR per day	4,500	8,000
No. of Rooms	#	457	288
F&B revenue	% of Annual Revenue	45%	60%
Other revenue	% of Annual Revenue	13%	15%
Average area of the room	sqft	400	900
Total Area of hotel	sqft	1,82,952	2,59,182

Projected revenue

The revenue for city side development in Vizhinjam has been estimated till the year 2054 (i.e. for 40 year concession period). The revenue predictions for retail, commercial and hospitality have been done considering the above mentioned assumptions.

Table 9-18: Projected revenue: Port estate Development

Particulars	2020	2023	2028	2033	2038	2043	2048	2054
Rentals								
Residential	*29*	*51*	*101*	*165*	*209*	*264*	*331*	*431*
Retail	*140*	*245*	*488*	*800*	*1,014*	*1,277*	*1,605*	*2,087*
Commercial	*29*	*51*	*102*	*168*	*213*	*268*	*336*	*437*
Total	199	347	692	1,131	1,437	1,809	2,272	2,956
Hotels								
Mid – market	*46*	*80*	*160*	*247*	*314*	*395*	*498*	*645*
Luxury	*57*	*100*	*199*	*307*	*389*	*490*	*617*	*800*
Total	103	180	359	554	703	885	1,114	1,446
Grand total	302	527	1,051	1,687	2,139	2,693	3,387	4,401

9.2.4 O&M Estimates

O&M Estimates for Phase 1 Port Development

As per the proposed project contours, private developer, under the concession agreement will have to incur mandatory works and maintain the facility.

For the purpose of estimation, O&M cost has been bifurcated into six broad components and the power and fuel charges assumptions are based on technical consultant's study. These are explained in the following paras:

- Power charges
- Fuel charges
- Repair & maintenance
  - Civil
  - Equipment
- Insurance expenses
- Labour cost
- Administrative Cost/Overhead/Salaries/General Management

The table below elucidates the assumption details for each of the O&M component:

Table 9-19: O&M Cost Assumptions for Port Development

Particulars	Unit	Value
Power charges		
KwHr requirement per hour per TEU	Kw	8
Per hour unit rate	Rs	4.4
Fuel charges		
Fuel requirement	Litres per TEU	4
Fuel price per litre	Rs	59.56
Repair & maintenance		
Civil	% of all civil cost	1.00
Equipment	% of cost of mechanical and electrical equipment	2.00
Insurance	% of Gross fixed asset	1.00
Labor cost	Rs. / TEU	300
Administrative Cost/ Overhead/ Salaries/General Management	Rs. / TEU	400

The cost per TEU for labour and administrative/overheads/salaries/general management has been provided by the technical consultant.

Cost Inflation

In order to determine cost escalation relating to price inflation over the project term, Whole Price Index, as reported by Office of Economic Advisor, for long term and medium term has been analysed. For long term 15 years WPI from 1995 to 2010 (post liberalization period) was considered and has been elucidated in the table below:

Table 9-20: O&M Cost Escalation for Port Development

Base	2015	2026	2037	2048
	2025	2036	2047	2054
5.5%	5.8%	6.1%	6.4%	6.7%

Snapshot of the operating expenditure has been elucidated in the table below:

Table 9-21: O&M Cost Summary for Port Development

Particulars	2019	2023	2028	2033	2038	2043	2048	2054
Power	1	4	7	13	17	22	30	42
Fuel	5	28	46	87	115	152	201	281
Repair and maintenance – Civil	19	23	31	41	54	71	95	133
Repair and maintenance - Equipment	30	37	49	65	86	114	152	212
Insurance	41	52	68	91	120	159	210	294
Labour cost	6	35	58	109	144	191	253	354
Salaries/Overhead/Admin and General Expenses	8	46	78	145	192	255	337	472
Total	110	225	337	551	728	964	1,278	1,788

O&M Estimates for Port estate Development

In Port estate, most of the operating costs of building are borne by tenants/end users, but there are certain expenses, a developer has to incur to manage the property. Marketing expenses are critical in Port estate and incurred throughout, in order to maintain occupancy.

- Administration expense head comprises of the expenses incurred for various administration related work, stationary, postal expense, conveyance, etc. The administration expense has been estimated to be 3% of the total revenue.
- Maintenance expense includes the maintenance and repair expenses assumed to be 2% of the total revenue.
- Marketing and advertising expense comprise of expenses towards publicity of the project done through the print, media, through hoardings and sales promotional activities to reach out to wider strata of populace. This expense is assumed to be 3% of the revenues for residential and others (retail, residential, office) respectively.

In case of hotels, there are various other operating costs. The expenses incurred under the hotel component primarily consists of salaries and wages, food and beverages consumed other operating expenses, power & fuel cost, general and administration expenses and the marketing expenses. Other than the above listed operational expenditure heads, the hotel component has to incur an additional revenue related expenses which is assumed to be 70% of revenue. These have been assumed based on the trends observed in hotels across India. The assumptions towards the expenses by the various components are as follows:

Table 9-22: Operating Cost Assumptions: Port Estate Development

Commercial, residential	
Administrative expenses	3% of revenue
Maintenance	2% of construction cost
Marketing Expense	3% of revenue
Hotel	
Housekeeping expenses	12.5% of room revenue
F&B expenses	55% of F&B revenue
Other revenue related expenses	65% of other revenue
Administrative expenses	10% of revenue
Maintenance	5% of capital costs
Marketing Expense	3% of revenue
Power expenses	7.5% of revenue

Cost escalation

In order to determine cost escalation relating to price inflation over the project term, Whole Price Index, as reported by Office of Economic Advisor, for long term and medium term has been analysed. For long term 15 years WPI from 1995 to 2010 (post liberalization period) was considered and has been elucidated in the table below:

Table 9-23: O&M Cost Escalation for Port Development

Base	2015	2026	2037	2048
	2025	2036	2047	2054
5.5%	5.8%	6.1%	6.4%	6.7%

Projected O&M Cost (Consolidated – with Port estate)

On the basis of the assumptions mentioned, the total O&M expenses during the project term are summarized as under:

Table 9-24: Operating Cost Assumptions: Port Estate Development

	2020	2023	2028	2033	2038	2043	2048	2054
Hotel								
Housekeeping expenses	*8*	*13*	*27*	*41*	*53*	*66*	*83*	*108*
F&B expenses	*18*	*31*	*63*	*97*	*122*	*154*	*194*	*252*
Other expenses	*6*	*10*	*20*	*30*	*38*	*48*	*61*	*79*
Administrative expenses	*10*	*18*	*36*	*55*	*70*	*88*	*111*	*145*
Maintenance	*14*	*16*	*20*	*27*	*36*	*50*	*68*	*100*
Marketing Expense	*3*	*4*	*9*	*14*	*18*	*22*	*28*	*36*
Power expenses	*8*	*13*	*27*	*42*	*53*	*66*	*84*	*108*
Admin expense	6	10	21	34	43	54	68	89
Maintenance	32	36	47	63	84	115	157	231
Marketing Expense	5	9	17	28	36	45	57	74
Total	108	161	286	431	554	710	911	1,222

9.2.5 Project Profitability Indicators

This chapter presents the summary of results of the financial analysis after running the financial model using projected traffic figures and industry benchmarks for port projects. The financial

analysis identifies and estimates various revenue streams, project costs, phasing or implementation schedule, cash flows and the financial viability of the project along with analysis for Commercial Exploitation for the Greenfield Vizhinjam Port. The financial analysis of the Vizhinjam Port is based on set of assumptions and inputs based on the industry benchmarks and from analysis & experience in the Port sector in India and globally.

A detailed financial model has been developed for a Concession period of 40 years; the financial viability of the project has been assessed on the Discounted Cash Flow (DCF) and Internal Rate of Returns (IRR) method. IRR is the annualized effective compounded return rate which can be earned on the invested capital, i.e., the yield on the investment. If IRR is higher than the Weighted Average Cost of Capital (WACC) for the project, it means that project is generating net positive value.

The financial analysis shows that the project is not viable on a standalone basis; the key profitability metrics for the base case are tabulated below:

Table 9-25: Base Case - Key Profitability Metrics

Base Case	Key Profitability Metrics
Project IRR	8.70%
Equity IRR	11.54%
NPV Revenue share	INR 276
Project Cost	INR 4,089 crores

Please refer to annexure for detailed financial projections. The Project is not financially viable because of long gestation periods and limited financial returns, and that financial viability may be improved through Government support and the port tariffs have been discounted by 35% in line with Colombo tariff structure.

9.2.6 Sensitivity Analysis

In order to evaluate the change in financial viability of the Project, following scenarios have been explored:

- Scenario 1: Government support as Viability Gap Funding 60% of the Total Project Cost is offered; EIRR restricted to 15.0% with a 35% discount in port tariff;
- Scenario 2: Viability Gap Funding 40.7% of the Total Project Cost is offered along with land for commercial exploitation; EIRR restricted to 15.0% with a 35% discount in port tariff;

The Model Concession Agreement for State - Ports provisions for payment of Concession Fee to the Authority from the 15th (Fifteenth) anniversary of the Commercial Operation Date (COD). The Concession Fee as % of revenue share to the Authority to start from 15th (Fifteenth) anniversary of COD and shall start at 1% to be increased by 1% year on year till the end of Concession Period. Further, the concessionaire shall pay to the authority commencing from 7th anniversary from CoD 10% of gross revenues, including the proceeds of any rentals, deposits, capital receipts or insurance claims, received from the Other Business).

Keeping all this in mind, a financial analysis has been undertaken to arrive at the maximum concession fee payable to VISL, considering an Equity IRR of 15.0% to the concessionaire. An equity rate of return has been proposed due to the development of Port estate infrastructure as well as the post facilities and ancillaries.

- Scenario 1

Government Support is required for improving the financial viability as the Vizhinjam International Deepwater Multipurpose Port is found to be unviable on a standalone basis. The profitability metrics under this scenario are discussed below:

Table 9-26: Scenario 1 - Key Profitability Metrics

Scenario 1	Key Profitability Metrics
Project IRR	8.75%
Equity IRR	15.0%
VGF (In %)	60%
VGF (in INR Crore)	INR 2,454 crores
Total Project Cost	INR 4,089 crores

Please refer to annexures for detailed financial projections of Scenario 1. With 60% VGF, the Project is financially viable. In order to attract investor's interest, Port estate development may be being offered as a sweetener to the PPP Port developer to make the project financially viable.

- Scenario 2

The possibility of allowing Port estate development on 30% of Site area acquired by VISL for the purpose of developing Truck Terminal, CFS Yard and Cruise Terminal has been explored in the previous sections so that sweetener is being offered to the potential concessionaires for developing the Port on PPP mode.

An assessment of revenues from Port estate Development has been carried out to make the project financially viable and accrues a higher rate of return to the concessionaire. The quantum for both Investments and revenues from Port estate has been assessed as per current market estimates. Along with the VGF, the profitability metrics under this scenario with Port estate Development are discussed below:

Table 9-27: Scenario 2 - Key Profitability Metrics

Scenario 2	Key Profitability Metrics
Project IRR	10.57%
Equity IRR	15.0%
VGF (In %)	40.7%
VGF (in INR Crore)	INR 1,664 crores
Total Project Cost	INR 4,089

Quantification of investments and revenues for Residential, Retail, Commercial and Hospitality assets under Port estate have been undertaken to increase the project's financial viability after provision of VGF. Along with VGF, with additional revenues from Port estate Development, the project is financial viable with Equity IRR of 15.0%.

9.2.7 Key Findings

As witnessed in the previous financial analysis section, the project is not financially viable, and even with substantial funds in the form of VGF, the financial viability does not improve. Hence, the project, apart from the VGF, will need additional revenues from Port estate development.

Considering, the expected low traffic at Vizhinjam port particularly in the initial years of operations, coupled with intense competition from Colombo and other Indian Competing Ports, the government is required for providing subsidies and viability gap funding to cover part of the capital expenditure and operating costs and Port estate development on 30% of the total site area.

It is evident from the financial analysis that the project is not viable. Hence, to make it attractive for the investors, it is important to view this project as not a stand-alone project but as a larger development, whereby landward area near the port can be used for other infrastructure development such as Port estate. Through this the port developer will get opportunity to cross subsidize its revenue with non-core infrastructure and operate the core infrastructure i.e. port in an effective manner.

10 Conclusion

Phase 1 Port Development Planning- Overview

- Breakwater of total length 3,100m (main breakwater 2,960m with 140m extension for fish landing harbor) to be developed in Phase 1.
- Container berth length of 800m capable of handling up to current largest 18,000 TEU container vessels.
- Container yard behind the quay length with depth of up to 500m.
- Port craft berth of 100m.
- Fish landing centre with a total berth length of 500m and associated infrastructure facilities.
- Summary of the port layout and container handling requirement for Phase-1 development is provided in the table below:

S. No	Description	Unit	Value
Port Layout			
1	Length of Outer Approach Channel	m	2,800
2	Width of Outer Approach Channel	m	400
3	Length of Inner Approach Channel	m	1,200
4	Width of Inner Approach Channel	m	300
5	Diameter of Turning Circle	m	700
6	Length of Breakwater	m	2,960
7	Breakwater for fishery harbor extension	m	140
Container Berth			
8	Maximum Vessel Size	TEU	18,000
9	Total Container Berths	No.	2
10	Dredged Depth	m	18.4
11	Quay Crane	No.	8
12	Quay Crane (Moves)	Moves / hour	25
13	Berth Length	M	800
14	Average Container Berth Length	m/berth	400
15	Estimated Throughput	'000TEU	900
16	Estimated Throughput (Maximum)	'000TEU	1,200
Other Berths			
17	Port Craft Berths	No.(m)	1 (100)
18	Fishery Berths	m	500

Traffic Potential

- The total container traffic is estimated to increase from 0.15 mn TEUs to 1.250 mn TEUs in FY 2054.
- Container terminal capacity in Phase-1 development of Vizhinjam Port is expected to cater maximum container traffic upto 12,50,000 TEU. In such case, the projected container traffic of 12,50,025 TEU is achieved in FY 2030 which will remain constant for the rest of the horizon period till FY 2054.
- As per forecast in the Base case scenario, it is estimated that the total number of gateway traffic would increase from 37,459 TEUs in FY 2019 to 2,57,864 TEUs in FY 2054 for Phase 1 Port Development. In the same period, it is also estimated that the total number of Transshipment traffic would increase from 1,11,687 TEUs in FY 2019 to 9,92,161 TEUs in FY 2054.

- As per forecast in the Base case scenario, it is estimated that the total number of vessel calls would increase from 2 calls per week in FY 2019 to 11 calls per week in FY 2054 for Phase 1 Port Development.
- The Gateway to Transshipment traffic ratio is in the range of 20-25% to 75-80% respectively

Tariff Structure

- Vizhinjam Port is located between two established gateway and transshipment ports such as Cochin and Colombo respectively. Once developed, Vizhinjam port will face intense competition from these ports. Hence, the tariff structure is capped at the highest rates of tariff charged at these competing ports.

Port estate Development

- Development of the port will fuel Port estate and allied activities in and around the site area; the area being well connected through rail, road and air as well. As per the detailed project report, space for a cruise terminal is also feasible which can drive demand for hospitality services in the area thereby contributing to the overall economic growth of the state
- It is proposed that 30% of the land acquired for development of the Project (say 105 Acres) would be the maximum permissible area proposed to be utilized for commercial exploitation.
- The area allocation has been carried out based on a preliminary demand mapping of the area. The maximum area proposed for Port estate development, is proposed to be 105 acres or 10.25 million sq.ft. of which the residential (33%), retail (42%), commercial (15%) and hospitality (10%) may ideally constitute the Port estate development
- Project proponents – The proposed Port estate development mix is envisaged to constitute one mid – market, a luxury hotel and commercial space development being spread over 11.28 million sq.ft.;
- Revenue estimates are based on primary and secondary survey of the current rental rates prevailing in the market.

Financial Feasibility

- Project structure is based on Landlord model with a long term concession to the private partner with a concession period of 40 years. In case Capacity Augmentation is undertaken by the Port developer, an additional 20 years extension in the Concession Period shall be provided. A further 20 years of concession may be granted on mutual agreement.
- Phase-1 Port Development is estimated to cost INR 4,089 or USD 655.72 million out of which equipment accounts for the maximum share of around 36% which is followed by dredging and reclamation cost which has a 23% share.
- The total revenue from all sources is estimated to go up from Rs 93 crore in 2018-19 to Rs 7,822 crores in 2053-54.
- Tariff – With intense competition from the ports of Colombo and Vallarpadam terminal in Cochin and other ports, it was projected that Vizhinjam would need to aggressively price its container handling services to be able to attract traffic away from the competing ports
- The aims of the detailed financial analysis are to:
    - Assess the financial viability of the project;
    - In case of non-viability of the project the extent of Government support required in form of Viability Gap Funding (VGF) for making the project commercially viable;
    - Examining the financial Viability by including Port estate Development for additional revenues from commercial exploitation for implementing the project on Public Private Partnership (PPP) basis;

For implementing the project on Public Private Partnership (PPP) basis;

- The project is not financially viable (EIRR is 11.54%) on a standalone basis, i.e. without VGF. However, with substantial funds in the form of VGF up to 60% and offering a discount of 35% on port tariff; the Equity IRR is 15.0%, and accordingly, the project is viable;
- As per the Viability Gap Funding (VGF) Scheme for financial support to PPPs in Infrastructure the maximum permissible (VGF) is 40% of the Total Project Cost. In our case additional revenues from Port estate Development, offering a discount of 35% on the Tariff, the project is still viable with an Equity IRR of 15.0% with a VGF of 40.7%;
- Revenue share of 1% to the Authority are expected to commence from the 15th anniversary of COD as per the Concession Agreement.
- Revenue share of 10% (of the gross revenues, including the proceeds of any rentals, deposits, capital receipts or insurance claims, received from the Other Business) to the Authority are expected to commence from the 7th anniversary of COD as per the Concession Agreement.

Essential points to make Vizhinjam a successful port

- Transshipment faces regulatory issues related to Cabotage law in India. Hence, for Transshipment to be successful, cabotage has to be relaxed for Vizhinjam Port. Government should give a firm commitment to provide exemptions to Cabotage Rules, similar to those at Vallarpadam can be obtained, with greater certainty. In the absence of which, even if Vizhinjam is developed, shipping lines may not call at this port.
- Construction of a world class greenfield port at Vizhinjam requires heavy investment in civil works such as breakwater, dredging, reclamation and quay walls that does not generate any direct revenues. International experience also indicates that there are very few green-field projects where costs of breakwater, dredging, reclamation and quay walls have been fully financed and developed by a private investor. Hence, substantial financial support from Government will be required for the project to make it financially viable.
- It is evident from the financial analysis that the project is not viable. Hence, to make it attractive for the investors, it is important to view this project as not a stand-alone project but as a larger development, whereby landward area near the port can be used for other infrastructure development such as Port estate. Through this the port developer will get opportunity to cross subsidize its revenue with non-core infrastructure and operate the core infrastructure i.e. port in an effective manner.

Annexures - Financials

Base case: No VGF and No Port estate Development

Profit & loss statement (Rs in crores)

Financial yr	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Total Revenue	93	199	244	327	412	497	553	603	640	673	880	1,010	1,062	1,115	1,171	1,233	1,299	1,366
Operational expenses	110	141	165	193	225	259	286	301	319	337	419	465	490	521	551	583	616	650
Concession fee																12	26	41
EBITDA	-17	58	79	134	187	238	267	302	321	336	461	545	572	594	620	638	657	675
Interest	336	291	246	201	157	112	67	22		6	6					1	1	
Depreciation	271	271	271	271	271	271	271	271	141	131	185	33	33	33	33	33	51	33
PBT	-624	-504	-438	-339	-241	-145	-71	9	180	200	270	512	538	561	587	604	605	642
Tax							103	66	39	45	69	91	99	107	114	120	125	130
PAT	-624	-504	-438	-339	-241	-145	-175	-57	140	155	202	421	439	454	472	484	481	511

Financial yr	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054
Total Revenue	1,438	1,515	1,592	1,675	1,765	1,860	1,960	2,060	2,168	2,278	2,393	2,520	2,656	2,791	2,937	3,094	3,251	3,421
Operational expenses	688	728	770	814	863	912	964	1,020	1,080	1,142	1,207	1,278	1,350	1,429	1,511	1,598	1,691	1,788
Concession fee	58	76	95	117	141	167	196	227	260	296	335	378	425	474	529	588	650	718
EBITDA	692	712	726	744	760	780	800	813	828	840	851	864	881	888	898	909	910	915
Interest		43	43			1	1					21	21	2	2			
Depreciation	33	33	331	331	331	219	61	33	33	33	33	33	398	178	80	33	33	33
PBT	659	635	352	413	429	560	737	780	795	807	818	810	462	708	816	875	877	881
Tax	135	131	102	162	209	222	234	244	254	262	269	269	251	266	272	281	286	291
PAT	524	504	251	251	220	337	504	536	541	545	549	541	210	442	544	594	591	591

Cashflow statement (Rs in crores)

Particulars	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Cash flow from operations																				
PAT				-	(624)	(504)	(438)	(339)	(241)	(145)	(175)	(57)	140	155	202	421	439	454	472	484
Depreciation				-	271	271	271	271	271	271	271	271	141	131	185	33	33	33	33	33
Changes in WC				-	(3)	(8)	(3)	(6)	(6)	(6)	(4)	(4)	(3)	(2)	(15)	(10)	(4)	(3)	(4)	(4)
Total				-	(356)	(241)	(170)	(74)	24	120	92	210	279	284	371	444	469	484	502	513
Cash flow from investments																				
Civil costs	-68	-613	-777	1,657	-	-	-	-	-	-	-	(11)	-	-151	-	-	-	-	-	(17)
Preliminary & other expenses	-21	-192	-243	(518)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-89	-805	-1,020	-2,175	-	-	-	-	-	-	-	(11)	-	-151	-	-	-	-	-	(17)
Cash flow from financing																				
Equity	27	241	306	652	714	599	528	431	334	238	265	150	-	45	-	-	-	-	-	5
Debt	62	564	714	1,523	-	-	-	-	-	-	-	8	-	106	-	-	-	-	-	12
VGF				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repayment of debt				-	(358)	(358)	(358)	(358)	(358)	(358)	(358)	(358)	(8)	-	(106)	-	-	-	-	-
Total	89	805	1,020	2,175	356	241	170	74	(24)	(120)	(92)	(200)	(8)	151	(106)	-	-	-	-	17
Net cash flow					-	-	-	-	-	-	-	-	271	284	265	444	469	484	502	513
Ending cash balance													271	555	819	1,264	1,732	2,216	2,718	3,232

Particulars	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054
Cash flow from operations																				
PAT	481	511	524	504	251	293	234	337	504	536	541	545	549	541	210	442	544	594	591	591
Depreciation	51	33	33	33	331	331	331	219	61	33	33	33	33	33	398	178	80	33	33	33
Changes in WC	(4)	(5)	(5)	(5)	(5)	(6)	(6)	(6)	(7)	(6)	(7)	(7)	(8)	(8)	(9)	(9)	(10)	(11)	(10)	(11)
Total	527	540	552	532	577	618	559	550	558	563	567	571	574	566	599	611	614	617	614	613
Cash flow from investments																				
Civil structure	-	-	-	-1079	-	-	-	(28)	-	-	-	-	-	(510)	-	(47)	-	-	-	-
Preliminary & other expenses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-1079	-	-	-	(28)	-	-	-	-	-	(510)	-	(47)	-	-	-	-
Cash flow from financing																				
Equity	-	-	-	323	-	-	-	8	-	-	-	-	-	153	-	14	-	-	-	-
Debt	-	-	-	756	-	-	-	20	-	-	-	-	-	357	-	33	-	-	-	-
VGF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repayment of debt	(12)	-	-	-	(756)	-	-	-	(20)	-	-	-	-	-	(357)	-	(33)	-	-	-
Total	(12)	-	-	1,079	(756)	-	-	28	(20)	-	-	-	-	510	(357)	47	(33)	-	-	-
Net cash flow	515	540	552	532	(179)	618	559	550	538	563	567	571	574	566	242	611	581	617	614	613
Ending cash balance	3,746	4,287	4,839	5,371	5,191	5,809	6,369	6,919	7,457	8,020	8,587	9,158	9,733	10,298	10,541	11,152	11,732	12,349	12,963	13,576

Capex statement (Rs in crores)

Financial year	Total project cost (in Cr)
Civil costs	
Project preliminaries and Site Development	*11*
Dredging & reclamation	*720*
Berths	*426*
Buildings	*28*
Container Yard	*218*
Equipment	
RMQC	*723*
Reach Stackers	*7*
RTG (Yard)	*270*
Empty Container Handler	*17*
ITVs	*46*
Maintenance Vehicles	*0*
Workshop Equipment	*6*
Spares	*54*
Utilities and Others	110
Port crafts and Aids to Navigation	360
Gates Complex & Road Development	120
Engineering and project management fee at 5%	156
Total Base (Civil and Equipment) Cost	3,272
Escalation for Interest during construction and other financing cost @ 25% as per Planning Commission	818
Total Project Cost	4,089

Scenario 1: VGF (at 60%) + No Port Estate development (EIRR fixed at 15.0%)

Profit & loss statement (Rs in crores)

Financial yr	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Total Revenue	93	199	244	327	412	497	553	603	640	673	880	1,010	1,062	1,115	1,171	1,233	1,299	1,366
Operational expenses	110	141	165	193	225	259	286	301	319	337	419	465	490	521	551	595	642	691
EBITDA	-17	58	79	134	187	238	267	302	321	336	461	545	572	594	620	638	657	675
Interest	134	116	98	81	63	45	27	9		6	6					1	1	
Depreciation	271	271	271	271	271	271	271	271	141	131	185	33	33	33	33	33	51	33
PBT	-422	-329	-290	-219	-147	-78	-31	22	180	200	270	512	538	561	587	604	605	642
Tax							15	30	39	45	69	91	99	107	114	120	125	130
PAT	-422	-329	-290	-219	-147	-78	-46	-8	140	155	202	421	439	454	472	484	481	511

Financial yr	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054
Total Revenue	1,438	1,515	1,592	1,675	1,765	1,860	1,960	2,060	2,168	2,278	2,393	2,520	2,656	2,791	2,937	3,094	3,251	3,421
Operational expenses	746	804	865	931	1,004	1,079	1,160	1,247	1,340	1,438	1,542	1,656	1,775	1,903	2,040	2,186	2,341	2,506
EBITDA	692	712	726	744	760	780	800	813	828	840	851	864	881	888	898	909	910	915
Interest		43	43			1	1					21	21	2	2			
Depreciation	33	33	331	331	331	219	61	33	33	33	33	33	398	178	80	33	33	33
PBT	659	635	352	413	429	560	737	780	795	807	818	810	462	708	816	875	877	881
Tax	135	181	165	195	209	222	234	244	254	262	269	269	251	266	272	281	286	291
PAT	524	455	187	218	220	337	504	536	541	545	549	541	210	442	544	594	591	591

Cashflow statement (Rs. in crores)

Particulars	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Cash flow from operations																				
PAT				-	(422)	(329)	(290)	(219)	(147)	(78)	(46)	(8)	140	155	202	421	439	454	472	484
Depreciation				-	271	271	271	271	271	271	271	271	141	131	185	33	33	33	33	33
Changes in WC				-	(3)	(8)	(3)	(6)	(6)	(6)	(4)	(4)	(3)	(2)	(15)	(10)	(4)	(3)	(4)	(4)
Total				-	(154)	(66)	(22)	46	118	187	221	259	279	284	371	444	469	484	502	513
Cash flow from investments																				
Civil costs	-68	-613	-777	(1,657)	-	-	-	-	-	-	-	(11)	-	-151	-	-	-	-	-	(17)
Preliminary & other expenses	-21	-192	-243	(518)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-89	-805	-1,020	(2,175)	-	-	-	-	-	-	-	(11)	-	-151	-	-	-	-	-	(17)
Cash flow from financing																				
Equity	10	96	123	261	297	209	165	97	25	-	-	3	-	45	-	-	-	-	-	5
Debt	25	226	285	609	-	-	-	-	-	-	-	8	-	106	-	-	-	-	-	12
VGF	54	483	612	1,305	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repayment of debt				-	-143	-143	-143	-143	-143	-143	-143	-143	(8)	-	(106)	-	-	-	-	-
Total	89	805	1,020	2,175	154	66	22	(46)	(118)	-143	-143	(132)	(8)	151	(106)	-	-	-	-	17
Net cash flow					-	-	-	-	-	44	78	116	271	284	265	444	469	484	502	513
Ending cash balance										44	122	238	509	792	1057	1501	1,970	2,454	2956	3,469

Particulars	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054
Cash flow from operations																				
PAT	481	511	524	455	187	218	220	337	504	536	541	545	549	541	210	442	544	594	591	591
Depreciation	51	33	33	33	331	331	331	219	61	33	33	33	33	33	398	178	80	33	33	33
Changes in WC	(4)	(5)	(5)	(5)	(5)	(6)	(6)	(6)	(7)	(6)	(7)	(7)	(8)	(8)	(9)	(9)	(10)	(11)	(10)	(11)
Total	527	540	552	483	513	543	546	550	558	563	567	571	574	566	599	611	614	617	614	613
Cash flow from investments																				
Civil structure	-	-	-	(1,079)	-	-	-	(28)	-	-	-	-	-	(510)	-	(47)	-	-	-	-
Preliminary & other expenses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	(1,079)	-	-	-	(28)	-	-	-	-	-	(510)	-	(47)	-	-	-	-
Cash flow from financing																				
Equity	-	-	-	323	-	-	-	8	-	-	-	-	-	153	-	14	-	-	-	-
Debt	-	-	-	756	-	-	-	20	-	-	-	-	-	357	-	33	-	-	-	-
VGF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repayment of debt	(12)	-	-	-	(756)	-	-	-	(20)	-	-	-	-	-	(357)	-	(33)	-	-	-
Total	(12)	-	-	1,079	(756)	-	-	28	(20)	-	-	-	-	510	(357)	47	(33)	-	-	-
Net cash flow	515	540	552	483	(243)	543	546	550	538	563	567	571	574	566	242	611	581	617	614	613
Ending cash balance	3,984	4524	5077	5,559	5,317	5,860	6,405	6,956	7,494	8,057	8,624	9,195	9,769	10,335	10,578	11,188	11,769	12,386	13,000	13,613

Scenario 2: VGF + PED; EIRR fixed at 15.0% with 40.7%

Profit & loss statement (Rs in crores)

Financial yr	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Total Revenue	93	501	615	772	939	1,114	1,266	1,419	1,569	1,724	2,061	2,332	2,536	2,724	2,858	3,004	3,158	3,318
Operational expenses	110	249	289	335	386	442	491	530	575	623	817	908	981	1,049	1,114	1,196	1,280	1,362
EBITDA	-17	252	325	437	553	672	775	889	994	1,101	1,243	1,424	1,554	1,674	1,744	1,808	1,878	1,956
Interest	199	333	333	298	246	182	123	62	16	6	6					1	1	
Depreciation	310	334	341	348	355	362	368	375	253	249	268	82	82	82	82	82	100	82
PBT	-526	-415	-349	-209	-48	129	284	452	725	846	969	1,341	1,472	1,592	1,661	1,725	1,777	1,874
Tax							27	75	117	151	184	231	266	298	318	336	355	375
PAT	-526	-415	-349	-209	-48	129	257	376	608	696	785	1,110	1,206	1,294	1,343	1,388	1,422	1,498

Financial yr	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054
Total Revenue	3,481	3,655	3,832	4,023	4,221	4,432	4,653	4,883	5,122	5,371	5,631	5,907	6,191	6,485	6,796	7,130	7,464	7,822
Operational expenses	1,450	1,543	1,643	1,748	1,861	1,979	2,104	2,239	2,381	2,531	2,690	2,862	3,039	3,231	3,432	3,648	3,874	4,114
EBITDA	2,031	2,111	2,189	2,275	2,360	2,453	2,549	2,643	2,740	2,839	2,941	3,044	3,151	3,254	3,364	3,481	3,590	3,708
Interest		43	43			1	1					21	21	2	2			
Depreciation	82	82	380	380	380	269	111	82	82	82	82	82	447	227	129	82	82	82
PBT	1,948	1,986	1,766	1,895	1,980	2,183	2,437	2,561	2,658	2,757	2,859	2,941	2,683	3,025	3,233	3,399	3,508	3,625
Tax	544	658	634	691	730	771	810	850	889	928	967	999	1,013	1,062	1,103	1,149	1,190	1,235
PAT	1,404	1,327	1,131	1,204	1,250	1,412	1,627	1,711	1,769	1,829	1,891	1,941	1,670	1,963	2,130	2,250	2,317	2,391

Cashflow statement (Rs in crores)

Particulars	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Cash flow from operations																				
PAT				-	(526)	(415)	(349)	(209)	(48)	129	257	376	608	696	785	1,110	1,206	1,294	1,343	1,388
Depreciation				-	310	334	341	348	355	362	368	375	253	249	268	82	82	82	82	82
Changes in WC				-	(3)	(8)	(3)	(6)	(6)	(6)	(4)	(4)	(3)	(2)	(15)	(10)	(4)	(3)	(4)	(4)
Total				-	(219)	(89)	(11)	133	301	484	621	748	858	942	1,038	1,183	1,285	1,373	1,422	1,467
Cash flow from investments																				
Civil costs	-68	-613	-829	(2,215)	(1,321)	(1,016)	-	-	-	-	-	(11)	-	-151	-	-	-	-	-	(17)
Preliminary & other expenses	-21	-192	-249	(599)	(226)	(100)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-89	-805	-1,078	(2,814)	(1,547)	(1,116)	-	-	-	-	-	(11)	-	-151	-	-	-	-	-	(17)
Cash flow from financing																				
Equity	16	143	211	707	1,204	892	282	204	124	46	-	3	-	45	-	-	-	-	-	5
Debt	37	334	452	1,223	773	558	-	-	-	-	-	8	-	106	-	-	-	-	-	12
VGF	36	328	415	885	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repayment of debt				-	(282)	(282)	(282)	(282)	(548)	(478)	(478)	(478)	-274	-	(106)	-	-	-	-	-
Total	89	805	1,078	2,814	1,696	1,168		(78)	(424)	(432)	(478)	(468)	-274	151	(106)	-	-	-	-	17
Net cash flow				-	(70)	(37)	(11)	54	(123)	52	143	270	584	942	932	1,183	1,285	1,373	1,422	1,467
Ending cash balance					(70)	(107)	(118)	(63)	(187)	(135)	8	278	862	1,804	2,736	3,919	5,203	6,577	7,999	9,466

Particulars	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054
Cash flow from operations																				
PAT	1,422	1,498	1,404	1,327	1,131	1,204	1,250	1,412	1,627	1,711	1,769	1,829	1,891	1,941	1,670	1,963	2,130	2,250	2,317	2,391
Depreciation	100	82	82	82	380	380	380	269	111	82	82	82	82	82	447	227	129	82	82	82
Changes in WC	(4)	(5)	(5)	(5)	(5)	(6)	(6)	(6)	(7)	(6)	(7)	(7)	(8)	(8)	(9)	(9)	(10)	(11)	(10)	(11)
Total	1,518	1,576	1,482	1,405	1,507	1,579	1,624	1,675	1,731	1,787	1,844	1,904	1,966	2,015	2,108	2,181	2,250	2,322	2,389	2,462
Cash flow from investments																				
Civil structure	-	-	-	-1,079	-	-	-	(28)	-	-	-	-	-	(510)	-	(47)	-	-	-	-
Preliminary & other expenses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-1,079	-	-	-	(28)	-	-	-	-	-	(510)	-	(47)	-	-	-	-
Cash flow from financing																				
Equity	-	-	-	323	-	-	-	8	-	-	-	-	-	153	-	14	-	-	-	-
Debt	-	-	-	756	-	-	-	20	-	-	-	-	-	357	-	33	-	-	-	-
VGF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repayment of debt	(12)	-	-	-	(756)	-	-	-	(20)	-	-	-	-	-	(357)	-	(33)	-	-	-
Total	(12)	-	-	1,079	(756)	-	-	28	(20)	-	-	-	-	510	(357)	47	(33)	-	-	-
Net cash flow	1,506	1,576	1,482	1,405	751	1,579	1,624	1,675	1,711	1,787	1,844	1,904	1,966	2,015	1,751	2,181	2,217	2,322	2,389	2,462
Ending cash balance	10971	12,547	14,029	15,434	16,184	17,763	19,387	21,061	22,772	24,559	26,403	28,307	30,273	32,289	34,039	36,221	38,437	40,760	43,149	45,611

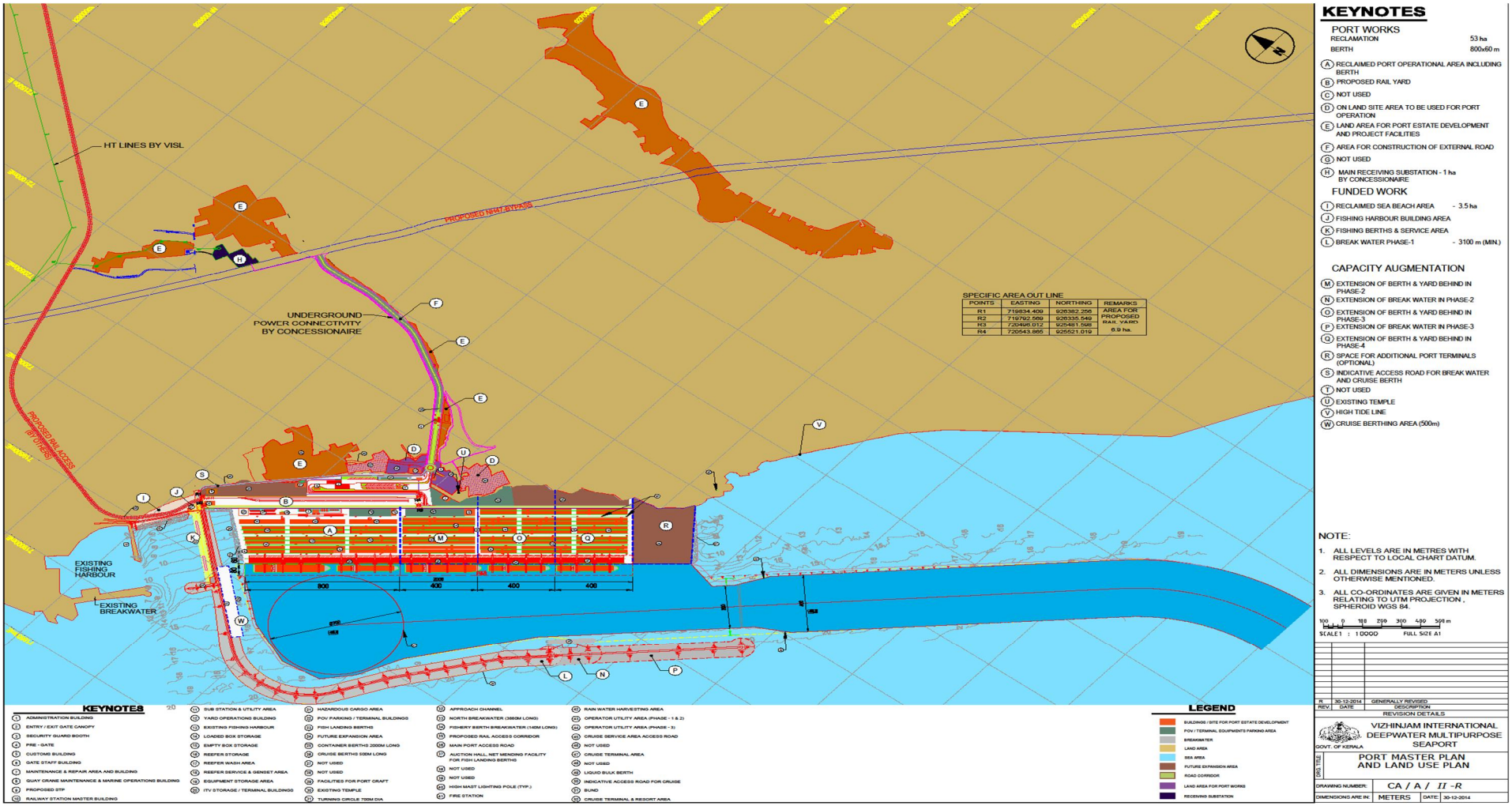
Capex statement (Rs in crores)

Financial year	Total project cost (in Cr)
Civil costs	
Project preliminaries and Site Development	*11*
Dredging & reclamation	*720*
Berths	*426*
Buildings	*28*
Container Yard	*218*
Equipment	
RMQC	*723*
Reach Stackers	*7*
RTG (Yard)	*270*
Empty Container Handler	*17*
ITVs	*46*
Maintenance Vehicles	*0*
Workshop Equipment	*6*
Spares	*54*
Utilities and Others	110
Port crafts and Aids to Navigation	360
Gates Complex & Road Development	120
Engineering and project management fee at 5%	156
Total Base (Civil and Equipment) Cost	3,272
Escalation for Interest during construction and other financing cost @ 25% as per Planning Commission	818
Total Project Cost	4,089

Particulars	Rs (in crores)
Residential	1,172.0
Retail	1,055.0
Commercial	459.0
Mid-market Hotel	81.0
Luxury Hotel	180.0
Total base cost	2,947.0
Preliminary expenses	116.0
Contingencies	175.0
Financing fees	11.2
IDC	111
Total Capex	3,360.2

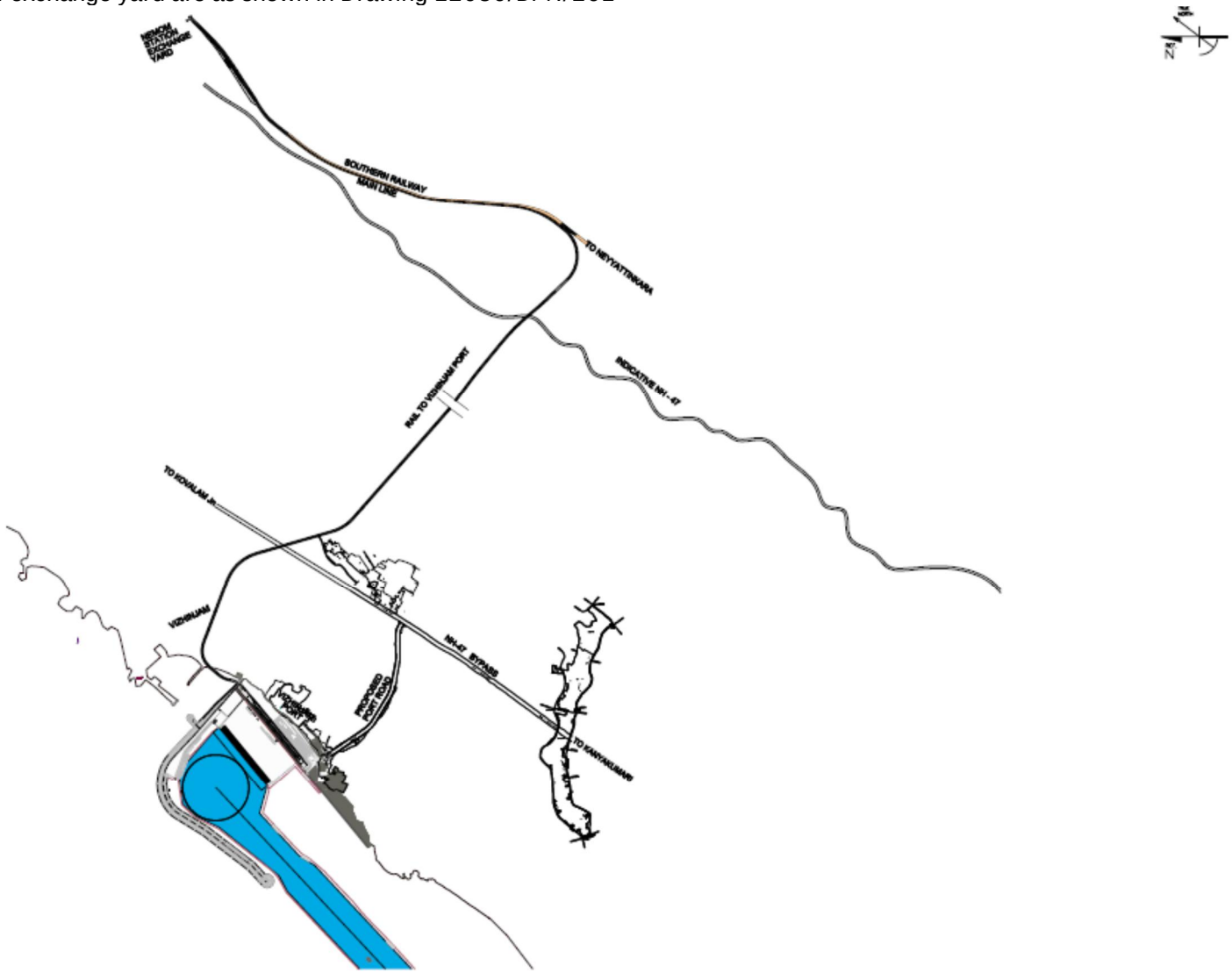
Annexure – Drawings

Recommended layout for development of Vizhinjam Port[1] (Port Master Plan) – Drawing# CA/A/II - R

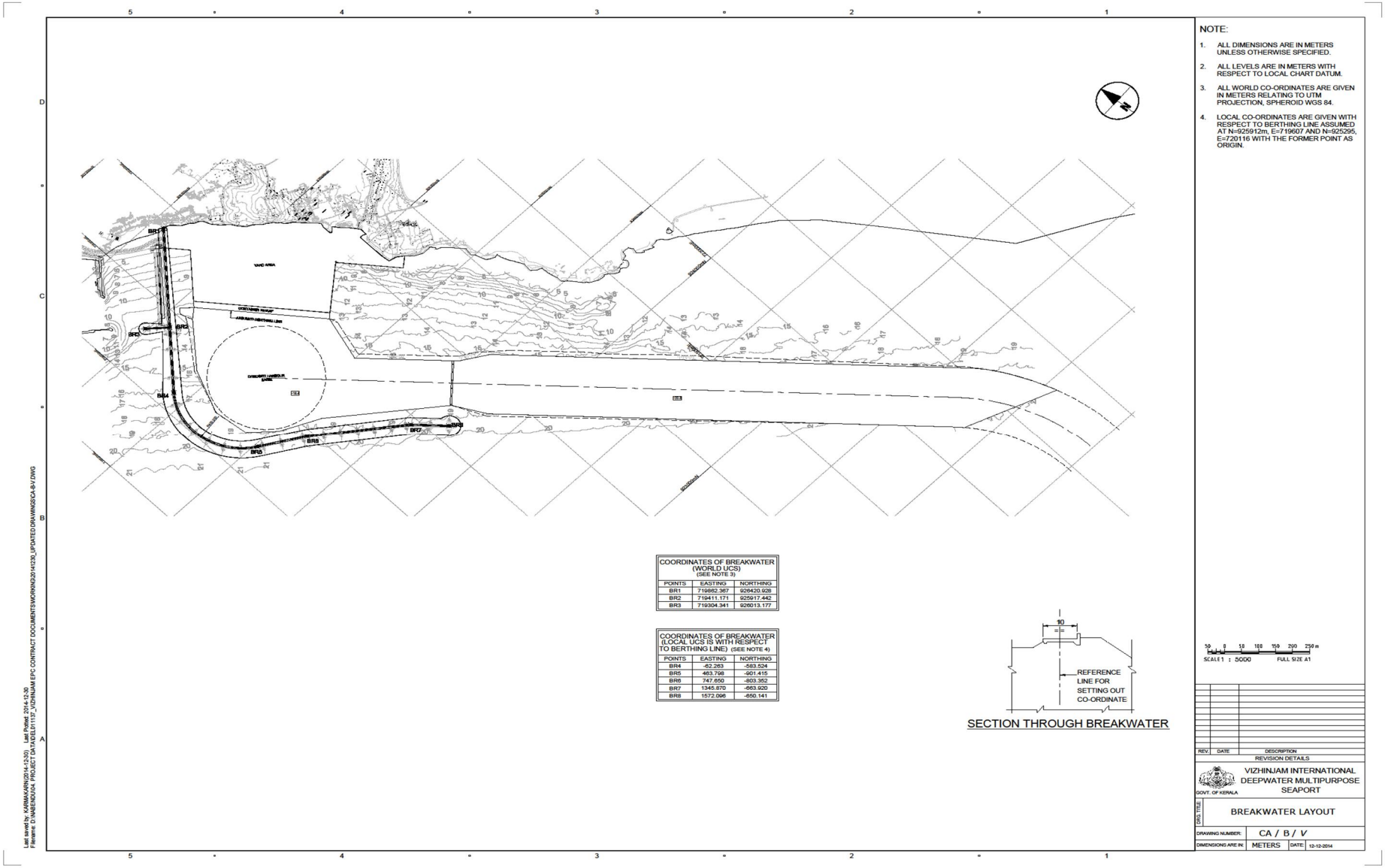


[1] The feasibility report has been prepared for Phase – I development of Vizhinjam Port, however the developer has the options to augment the port capacity based on the terms and conditions mentioned in the Draft Concession Agreement for Phases II, III & IV.

Location and details of exchange yard are as shown in Drawing 12086/DPR/261



The location and details of breakwater are as shown in Drawing# CA/B/V



This feasibility report has been collectively prepared by Ernst & Young LLP, AECOM and HSA Advocates, for and on behalf of Vizhinjam International Seaport Ltd. / Ports Department, Government of Kerala