MASTER PLAN FOR JAWAHARLAL NEHRU PORT TRUST

Master Plan for Jawaharlal Nehru Port (JNPT)

Prepared for

Ministry of Shipping
Government of India

Ministry of Shipping/ Indian Ports Association

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1.0 INTRODUCTION

1.1 Background

The Sagarmala initiative is one of the most important strategic imperatives to realize India's economic aspirations. The overall objective of the project is to evolve a model of port-led development, whereby Indian ports become a major contributor to the country's GDP.

As shown in **Figure 1.1**, the Sagarmala project envisages transforming existing ports into modern world-class ports, and developing new top notch ports based on the requirement. It also aspires to efficiently integrate ports with industrial clusters, the hinterland and the evacuation systems, through road, rail, inland and coastal waterways. This would enable ports to drive economic activity in coastal areas. Further, Sagarmala aims to develop coastal and inland shipping as a major mode of transport for the carriage of goods along the coastal and riverine economic centres.

As an outcome, it would offer efficient and seamless evacuation of cargo for both the EXIM and domestic sectors, thereby reducing logistics costs with ports becoming a larger economy.

Sagarmala aims to optimize the Logistics route for Port and Increase focus on Port led development for the country

	Details	Description
Why is Sagarmala needed?	1 Dual institutional structure at ports	▪ Due to segregation of major and minor ports, ports of India have grown as due unconnected entities and not benefitting from co-location or economics of scale
	2 Weak infrastructure at ports and beyond	▪ Weak modes of evacuation from both major and minor ports leading to sub – optimal modal mix presently ▪ Limited hinterland linkages that increases cost of transportation
	3 Limited economic benefit of location & to community	▪ Limited conscious skill development and leverage to peripheral trades (fisheries, tourism etc.) ▪ Limited development of centres of manufacturing near ports
What does Sagarmala want to achieve?	1 Ports led development	▪ Undertake development of coastal economic zones with projects like – port based industrialization, coastal tourism, Logistics parks, warehousing, fisheries etc.
	2 Port infrastructure enhancement	▪ Action points on transforming existing ports into world class ports be developing deep drafts, mechanization of existing berths, creation of new capacity and greenfield ports
	3 Efficient evacuation	▪ Expansion of rail / road network connected to ports and identification of congested routes ▪ Find optimized transport solution for bulk and container cargo

Figure 1.1 Aim of Sagarmala Development

In order to meet the objectives, Indian Port Association (IPA) appointed the consortium of McKinsey and AECOM as Consultant to prepare the National Perspective Plan as part of the Sagarmala Programme.

1.2 Scope of Work

The team of McKinsey and AECOM distilled learnings from the experience in port-led development, the major engagement challenge to develop a set of governing principles of approach is shown in **Figure 1.2** below.

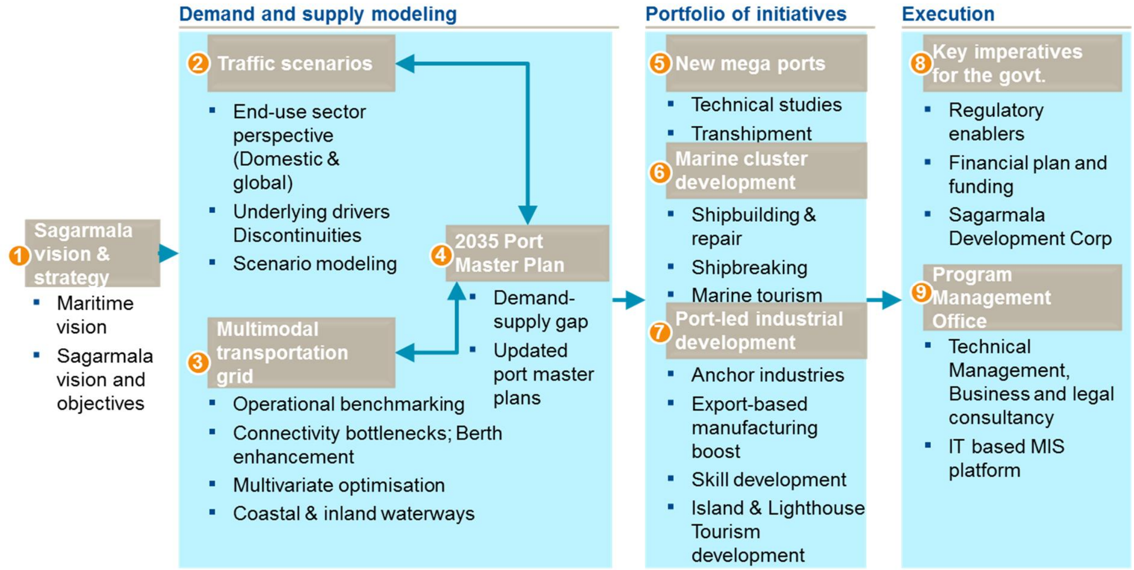


Figure 1.2 Governing Principles of Approach

As indicated above, the origin-destination of key cargo (accounting for greater than 85% of the total traffic) in Indian ports have been mapped to develop traffic scenarios for a period of next 20 years. The forces and developments that will drive change in the cargo flows shall also be identified. This would lead to the identification of regions along the coastline where the potential for expansion of existing port exists. The various activities involved in the port led developments are charted in **Figure 1.3**.

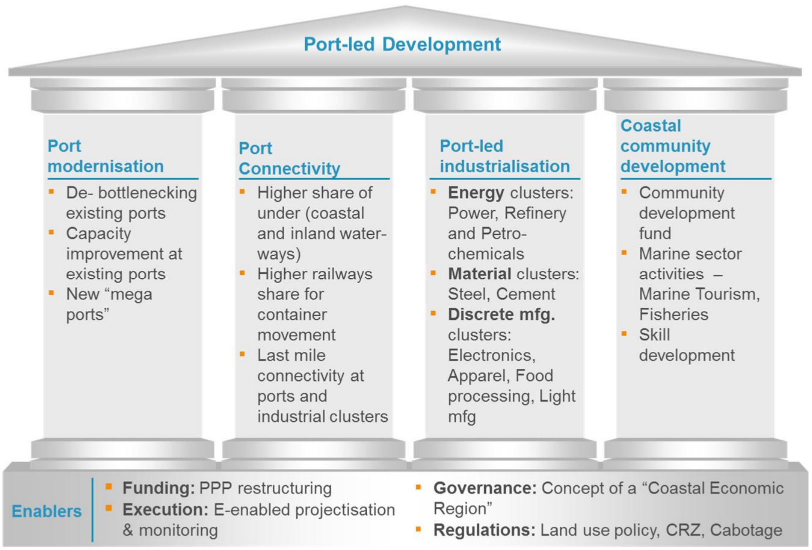


Figure 1.3 Port Led Developments

As part of the assignment, it is also expected to coordinate with the team working on “Benchmarking Operational Improvement Roadmap for Major Ports in India” study (which is being carried out simultaneously along with this assignment) and identify current and future logistic constraints (at the Major Ports) for the top 85% cargo categories based on analysis of current port capacity, productivity levels in comparison to international benchmark and evacuation bottlenecks in the logistics chain. This understanding should be an input in defining the 2035 Master Plan for each port.

Accordingly, this Master Plan Report has been prepared taking into consideration the inputs provided on the future traffic and the benchmarking and operational improvements suggested for this port.

1.3 Present Submission

The present submission is the Final Report for Development of Master Plan for Jawaharlal Nehru Port as part of SAGARMALA assignment. This report is organised in the following sections:

Section 1 : Introduction
Section 2 : The Port and Site Conditions
Section 3 : Details of Existing Facilities
Section 4 : Performance, Options for Debottlenecking & Capacity Assessment
Section 5 : Details of Ongoing Developments
Section 6 : Traffic Projections
Section 7 : Operational Improvements and Capacity Augmentation of Existing Facilities
Section 8 : Scope for Future Capacity Expansion
Section 9 : Shelf of New Projects and Phasing

2.0 THE PORT AND SITE CONDITIONS

2.1 Port Location

The location plan and a satellite image of the Jawaharlal Nehru Port is shown in **Figure 2.1** below.

Figure 2.1 Location Plan of JNPT

Jawaharlal Nehru Port was commissioned for commercial operations in the year 1989. Jawaharlal Nehru Port is run by the Jawaharlal Nehru Port Trust (JNPT), an autonomous corporation wholly owned by the Government of India under the Ministry of Shipping. The port was created to relieve pressure on Mumbai Port. It is located at the eastern end of Mumbai on the Sheva Island and is situated at latitude 18° 56' 43" N and longitude 72° 56' 24" E. JNPT accounts for more than half of total container volumes handled at India's 12 public ports and around 40% of the nation's overall containerized ocean trade.

2.2 Rail and Road Connectivity

2.2.1 Road Connectivity

The major road linkages connecting JNPT with hinterland road network are NH4B, NH4, NH17, NH 3 & 8 and a State Highway 54. The major road linkage connecting JNPT to its hinterland is as below:

National Highway 4B – This road connects JNPT with Mumbai and other important cities of Maharashtra and Gujarat. The road mainly serves the heavy traffic of containerized vehicles to and fro JNPT. It has a length of 26.43 km and branches at km 108/800 of NH4.

National Highway 4 (4 lanes) - The port is connected through National Highway number 4 through NH 4B. The linkage to NH 4 provides connectivity to Pune and southern states of India.

National Highway 17 - The state Highway number 66 links port to National Highway number 17 (2 lanes) which provide connectivity to Goa.

National Highway 3 and 8 - National Highway Number 4 (2 lanes with portion of highway being 4 lane) links port to NH 3 and NH 8 (2 lanes with portion of highway being 4 lane) which provides connectivity to Nashik and Ahmedabad region

State Highway 54 - This state Highway stretch connects Uran to Panvel. It runs more or less parallel to NH 4B. SH54 meets NH 4B at km 6/000 on Uran side and km 21/000 on Panvel side A number of container yards are located abutting SH54 and majority of traffic on this road is due to the JNPT.

Aamra Marg: It begins at km 125/800 of Sion Panvel highway (SH42) and passes through Belapur, Nerul and Ulwa and ends at km 13/900 of SH54. The road is an important link between northern and southern parts of Navi Mumbai and JNPT.

All-important destinations in India whether on the North, West or East could be accessed through any one of these three National Highways.

Figure 2.2 to **Figure 2.4** is provided to detail road connectivity around the JNPT.

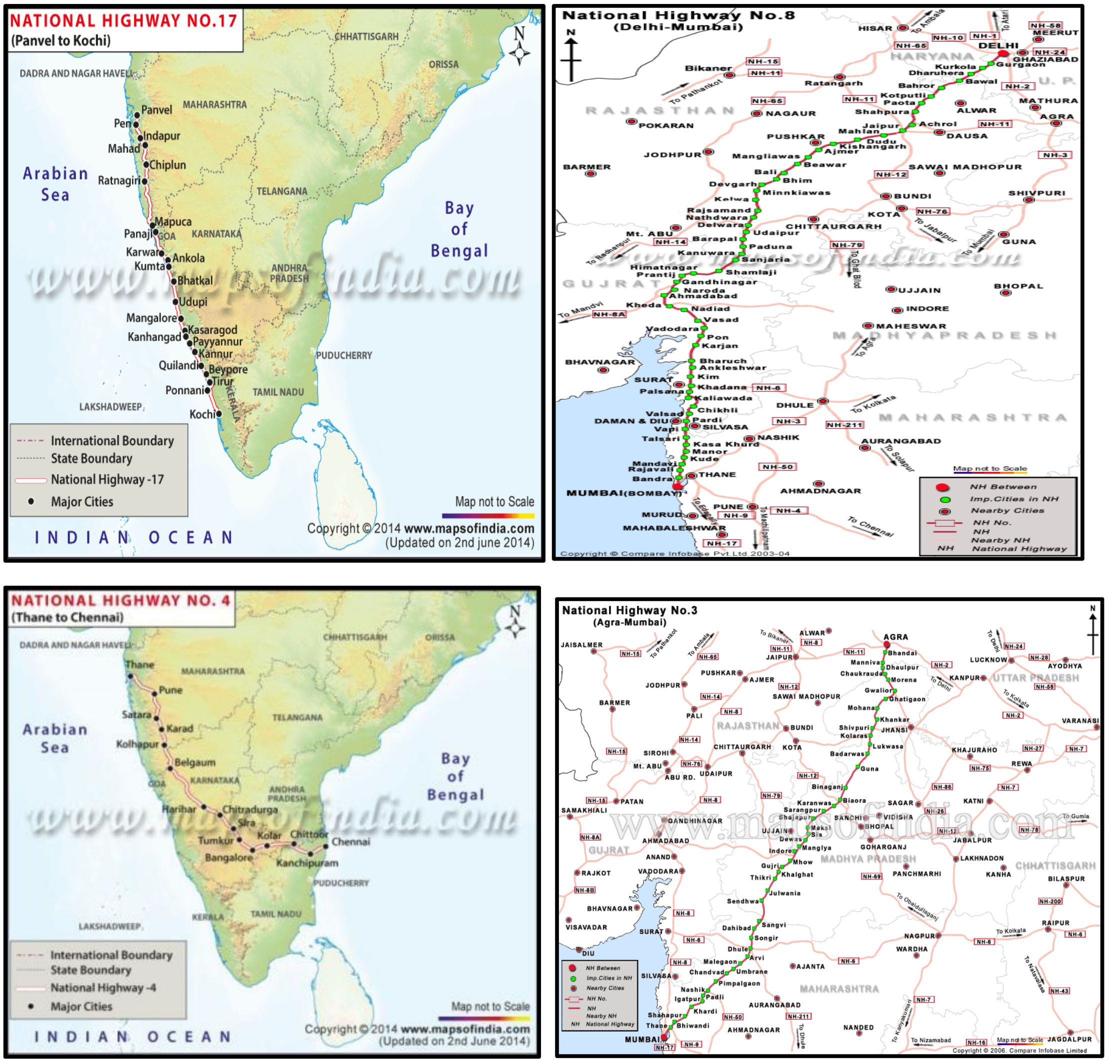


Figure 2.2 **Map Showing in Clockwise Direction NH-17 (Panvel-Kochi) , NH-8 (Mumbai-Delhi), NH-3 (Mumbai-Agra) and NH-4 (Thane-Chennai) Serving JNPT Hinterland**

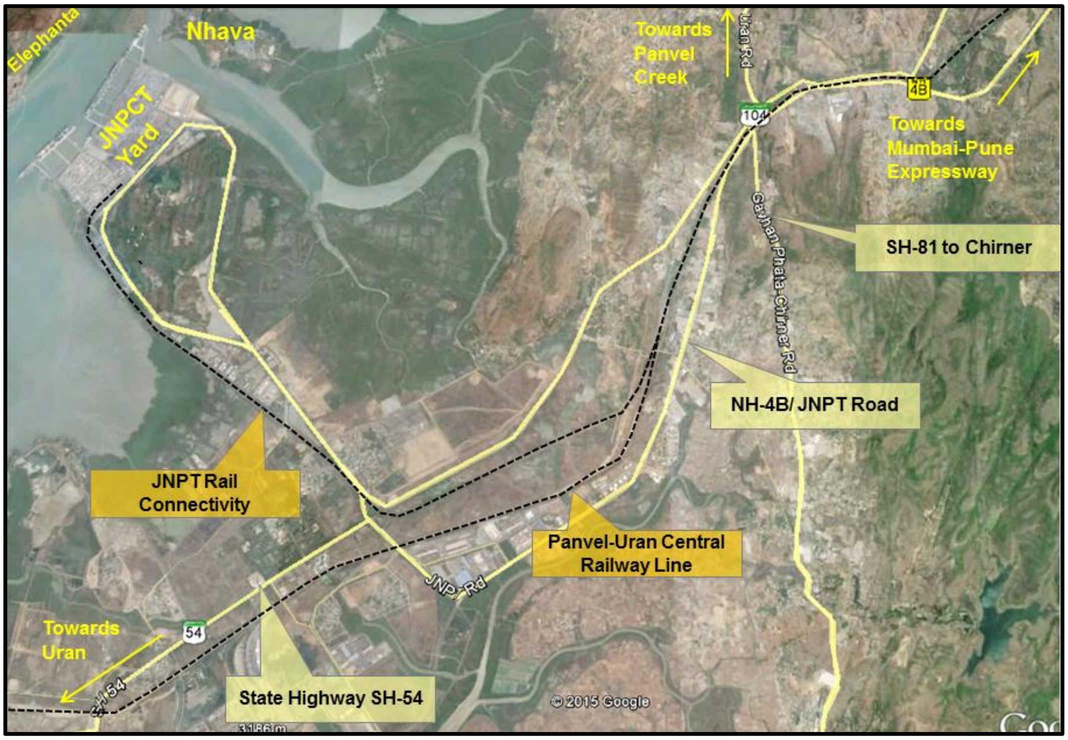


Figure 2.3 Existing JNPT Road and Rail Connectivity

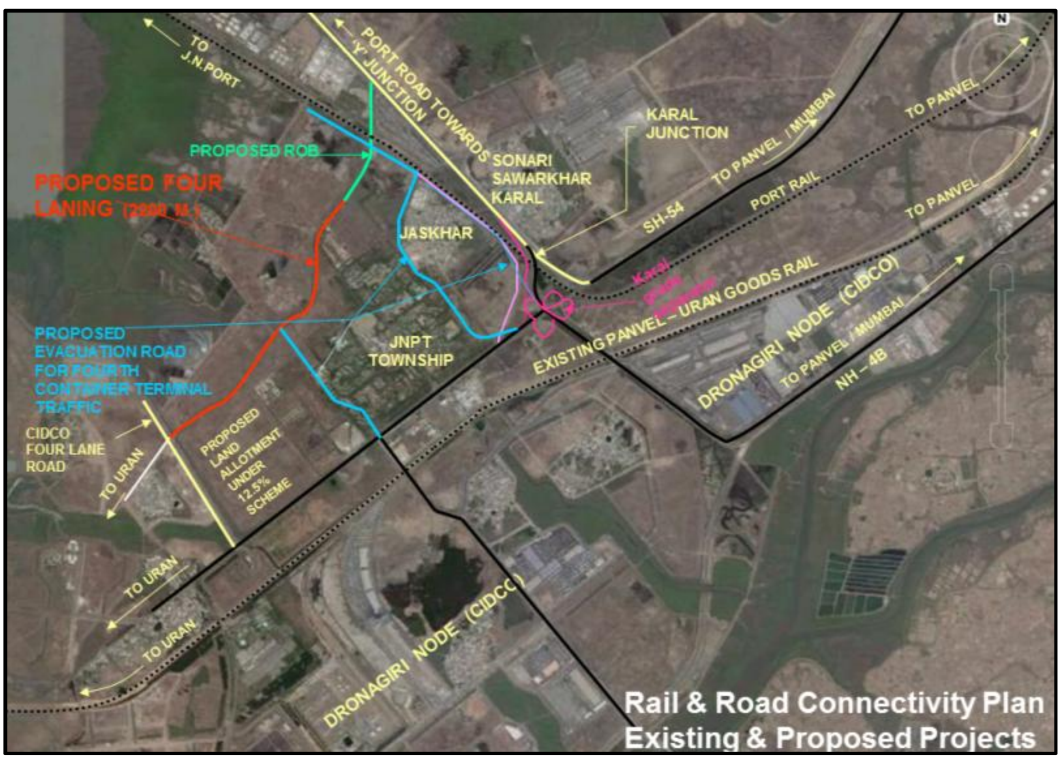


Figure 2.4 Road Connectivity at JNPT

2.2.2 Rail Connectivity

JNPT is linked with the Indian Railways through a lead line connecting the port with it serving station Jasai. Jasai is located on the Panvel – Uran branch line section of Mumbai division, Central Railway at a distance of 9 km from the port. The rail system at the port, which is operated and maintained by the Indian Railways, has 8 full length railway lines serving the three existing container terminals. Besides these, there is 4 line intermediate holding yard between Jasai and the port. The Jasai station yard deals with all traffic between JNPT and the Indian Oil Tank farm Ltd. The 4 line intermediate holding yard between Jasai and the port also serves to hold back and regulate traffic in the event of congestion at JNPT or at Jasai yard.

- Northern Corridor from JNPT up to Ludhiana via Diva, Vasai road, Vadodara, Ratlam, Kota, Bayana, Mathura junction, Tughlaqabad and Delhi.
- North Western Corridor from JNPT to Rewari via Vadodra-Ahmedabad, Sabarmati Palanpur, Marwar Jn. Jodhpur, Jaipur

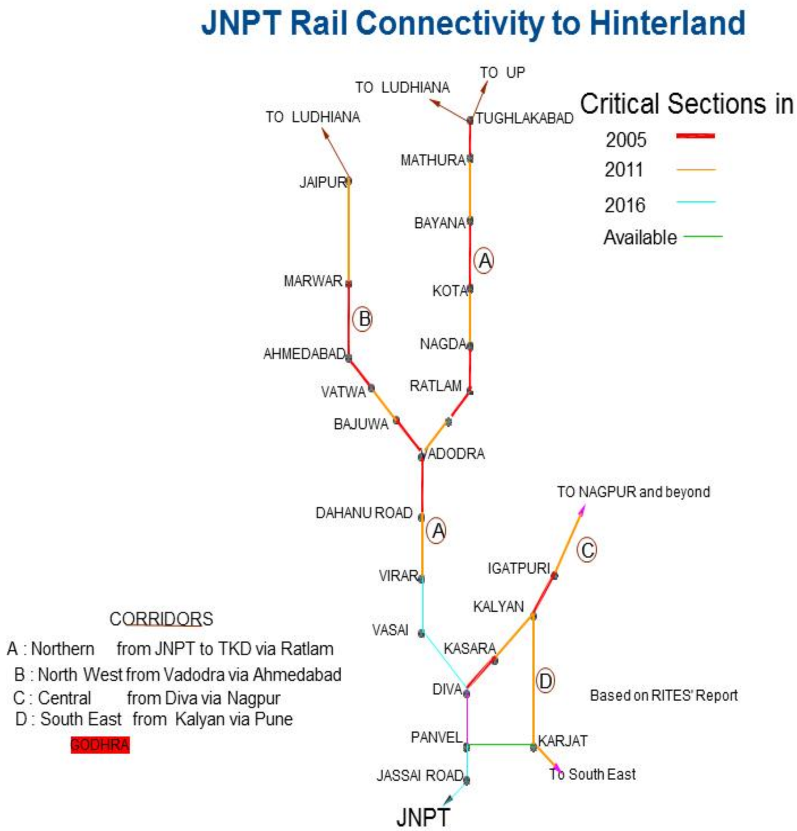


Figure 2.5 Rail Connectivity to JNPT Hinterland

2.3 Site Conditions

2.3.1 Meteorology

2.3.1.1 General

The region experiences a tropical monsoon climate with regular seasonal rains and has four distinct seasons as follows:

- Monsoon season (June to September) -This is the main rainy season with the highest number of rainy days. The main features of this season are very high humidity, low clouds and several spells of moderate to heavy rains.
- Post-monsoon season (October to November) - The frequency of severe cyclonic storms is the highest during this season.
- Winter season (December to February) - The main features of this season are fine weather and occasional morning mist or fog.
- Summer season (March to May) - This season is also referred to as the "pre-monsoon" season. During this season the sea level atmospheric pressure and wind systems gradually get disrupted prior to the setting-in of the south west monsoon. A rise in air temperature with incidence of thunderstorms and cyclonic storms during the latter part of the season are the main features.

2.3.1.2 Winds

The prevalent direction of wind is from the North West to SW direction during May to September months and that from North East to South West during October to March. The direction of occurrence of wind during various months is shown in **Table 2.1**.

Table 2.1 Occurrence of Wind - Percentage Number of Days

MONTH		WIND								
		PERCENTAGE NUMBER OF DAYS WIND FROM								
		N	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**CALM**
January	I	5	15	22	2	0	0	0	1	55
	II	18	1	0	0	0	0	12	69	0
February	I	8	15	17	3	0	0	0	2	55
	II	15	0	0	0	0	0	12	73	0
March	I	11	16	11	4	2	0	0	5	51
	II	11	0	0	0	0	2	18	69	0
April	I	9	10	7	7	8	4	3	10	42
	II	6	6	0	0	0	4	31	59	0
May	I	6	3	3	3	7	14	21	15	28
	II	2	0	0	0	8	32	48	11	1
June	I	1	1	3	9	14	22	28	8	14
	II	0	0	0	0	8	32	48	11	1
July	I	1	0	1	3	5	28	45	7	10
	II	1	0	0	0	2	30	54	10	3
August	I	1	1	1	2	3	22	49	8	13
	II	1	0	0	0	1	19	59	16	4
September	I	2	5	8	6	5	8	14	7	45
	II	4	1	0	0	1	13	38	40	3
October	I	2	15	22	6	2	1	0	1	51
	II	13	2	1	1	1	5	19	56	2
November	I	1	22	34	4	1	0	0	0	38
	II	16	3	1	0	1	1	11	65	2
December	I	1	18	35	2	0	0	0	1	43
	II	16	2	0	0	0	0	11	70	1
Annual Total or Mean	I	4	10	14	4	4	8	13	5	37
	II	9	1	0	0	1	10	30	48	1
Numbers of year	I	30								
	II									

[Source: IMD]

2.3.1.3 Cyclone

The cyclones generally occur in the period of May/June or October/November. The last serve cyclonic storm was experienced in 1982 at the port location. Occasionally, sudden high winds also occur during the fine weather period from north east.

2.3.1.4 Rainfall

The Southwest monsoon season (June-September) accounts for about 94% of the total annual rainfall in the region, which averages around 1800 mm. The onset of monsoon is generally around June, when the rainfall increases from 1% of the average annual rainfall in May to about 25% in June. On an average, there are 73 days in a year, with a rainfall of 2.5 mm or more. Out of these, about 67 days occur during the monsoon season with about 22 days in the month of July – the month of the year with the maximum rainfall (34% of the average annual rainfall).

The month-wise distribution of the average rainfall, the number of rainy days (with a precipitation of 2.5mm or more) and the heaviest rainfall recorded in 24 hours for each month of the year is provided in **Table 2.2**.

Table 2.2 JNPT Rainfall Data

Month	Average Rainfall (mm)	Average No. of Rainy Days	Heaviest Rainfall Recorded in 24 hours (mm)
January	4.1	0.3	49.3
February	2.0	0.1	41.7
March	1.5	0.1	34.3
April	1.5	0.1	37.3
May	18.3	0.8	126.2
June	464.8	14.2	408.2
July	613.4	22.2	304.8
August	328.9	18.2	287.0
September	286.0	12.6	548.1
October	64.5	3.0	148.6
November	17.5	0.8	122.7
December	2.3	0.3	24.4
Total	**1804.8**	**72.7**	**-**

[Source: IMD]

2.3.1.5 Temperature

The mean of the maximum temperature recorded is 33.3° C in the month of May while the mean Minimum is 19.4° C recorded in the month of January. Mean daily highest maximum and minimum temperature is 40.6° C and 11.7° C respectively.

The maximum and minimum mean daily air temperatures for each month along with the extremes are as follows in **Table 2.3**.

Table 2.3 Temperature Data of JNPT Area

Month	Maximum Mean Daily (°C)	Minimum Mean Daily (°C)	Highest Maximum Recorded (°C)	Lowest Minimum Recorded (°C)
January	29.1	19.4	35.6	11.7
February	29.5	20.3	38.3	11.7
March	31.0	22.7	39.7	16.7
April	32.3	25.1	40.6	20.0
May	33.3	26.9	36.2	22.8
June	31.9	26.3	37.2	21.1
July	29.8	25.1	35.6	21.7
August	29.5	24.8	32.4	21.7
September	30.1	24.7	35.0	20.0
October	31.9	24.6	36.6	20.6
November	32.3	22.8	36.2	17.8
December	30.9	20.8	35.7	12.8

[Source: IMD]

2.3.1.6 Relative Humidity

The relative humidity is moderate to high throughout the year with the mornings being more humid than the afternoons. The mean relative humidity for each month of the year measured at 0830 hrs and 1730 hrs is provided in **Table 2.4**.

Table 2.4 JNPT Area Humidity Data

Month	Mean Relative Humidity (%)	
	0830 Hr.	1730 Hr.
January	71	63
February	72	62
March	72	63
April	73	66
May	73	68

Month	Mean Relative Humidity (%)	
	0830 Hr.	1730 Hr.
June	80	78
July	85	85
August	85	84
September	85	80
October	80	74
November	73	67
December	70	64

[Source: IMD]

2.3.1.7 Visibility

From November to March smog hangs over the land around Mumbai. This happens only for short periods, most often shortly after sunrise but occasionally in the evening. The visibility in the port area is generally good throughout the year, except for a few days during the winter season and during periods of heavy rain. The number of days on which visibility is poor being negligible.

2.3.2 Oceanography

2.3.2.1 Tides

The tides in the region are semi-diurnal characterised by two high and two low waters in a period of 24 hours and 25 minutes. Duration of each tidal cycle is between 5 to 7 hours (theoretically 6 hours and 12 minutes).

The tidal levels are based on extensive data collected by the port over many years and are well established. Tidal levels are recorded at three locations in the region viz. at Apollo Bandar (Lat. 18° 55'N; Long. 72° 50'E), at Mora (Lat. 18° 55'N; Long 72° 56'E) and at Trombay (Lat. 19° 02'N; Long 72° 57'E).

From the recorded data, it is seen that the highest tidal range (both spring and neap) occur at Trombay. At Apollo Bandar the spring tidal range is greater and the neap tidal range is lesser than that at Mora. The tidal range, relative to the Chart Datum (CD), for JNPT is as follows:

Highest High Water Recorded	(HHW)	+5.38 m
Mean High Water Springs	(MHWS)	+4.42 m
Mean High Water Neaps	(MHWN)	+3.30 m
Mean Sea Level	(MSL)	+2.51 m
Mean Low Water Neaps	(MLWN)	+1.86 m
Mean Low Water Springs	(MLWS)	+0.76 m
Lowest Low Water Recorded		- 0.44 m

Statistical studies indicate that:

- All high tides exceed +2.70 m.
- About 5% of all high tides would be less than +3.20 m.
- About 5% of lower high tides (LHW) would be less than +2.85 m.

2.3.2.2 Currents

The currents in the Harbour waters are essentially caused by the tides and are not influenced to any extent by monsoon etc. The currents in the Mumbai estuary are of the order of 0.75 m/s to 1.5 m/s (1.5 to 3 knots). The current in the creeks are also affected by the freshets which results in not only increasing the strength of ebb current but also limiting the propagation of the tide upstream.

2.3.2.3 Waves

The National Institute of Oceanography (NIO) have complied and published wave data for the entire coastline of India in the form of a 'Wave Atlas' The monthly wave rose diagrams published in the 'Wave Atlas' for the area from latitude 15° N to 25° N and longitude 70° to 75° E shows that during monsoon period the predominant wave directions are from Southwest to West. During this period, waves of 4-5 m height normally occur; however, waves up to 8.0 m and period of 14 sec. have also been reported at offshore locations. October and November are transition months during which the predominant wave direction changes between North and Northeast. During December and January the waves mainly occur from North to Northeast and from February to May, waves predominantly come from the North West quadrant.

2.3.3 Geotechnical Data

The typical soil characteristics at the JN Port are silty clay or marine clay overlaying basalt rock. However, the thickness of silty/marine clay varies at different locations. While at the Nhava Creek area in shallow waters the silty clay with thickness varying from 2 m to 7 m, the same is the Uran mudflat area is much higher at about 15 to 20 m.

3.0 DETAILS OF EXISTING FACILITIES

3.1 General

The port has four container terminals:

- JNPCT operated by the JNPT port with a quay length of 680 m;
- NSICT operated on BOT basis by DP World with a quay length of 600 m and
- GTICT operated on BOT basis by a consortium of Maersk and CONCOR with a quay length of 712 m.
- NSIGT operated on BOT basis by DP World with a quay length of 330 m

Liquid bulk jetty built and operated on BOT basis by BPCL on the southern side of GTICT. It is a twin berthing jetty with a 390 m berthing face on one side and 310 m berthing face at the rear. It can handle 85,000 DWT tankers at the front side and 30,000 DWT tankers at the rear. The locations of these berths along with their back-up areas are shown in the following **Figure 3.1** and **Table 3.1** provides details of various berths. The information in this section has been obtained from JNPT.

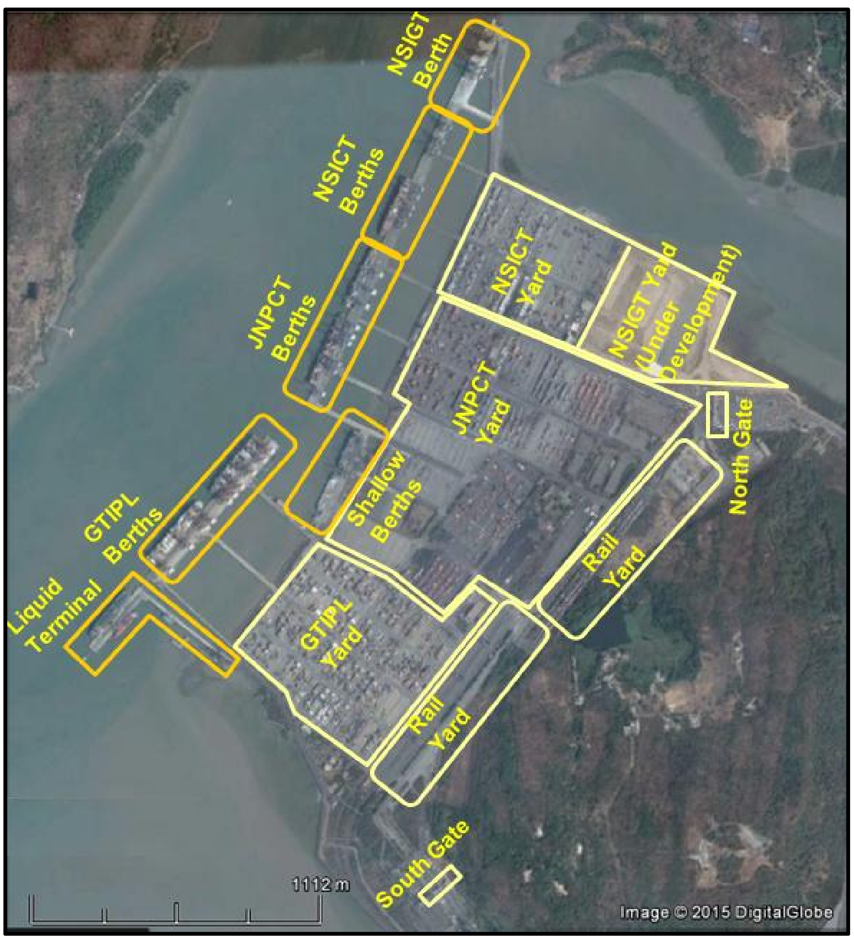


Figure 3.1 JNPT Existing Facilities

Table 3.1 JNPT Terminal Wise Details

Terminal	Operator/ Terminal	Number of Berths	Length (m)	Design Dredged Level (m)
JNP Container Terminal	JNPT	3	680	16.5
NSICT	DP World	2	600	16.5
NSIGT – 330 m	DP World	1	330	16.5
GTIPL	APM	3	712	16.5
Shallow Water Berth	JNPT	2	445	10
JNPT Liquid Terminal	BPCL	2	390 + 310	16.5 Outer Berth 12.5 Inner Berth

3.2 Nhava Sheva International Container Terminal (NSICT)

JN Port entered into a license agreement in July 1997 with M/s. Nhava Sheva International Container Terminal (NSICT) a consortium led by M/s. P & O Ports, Australia, for construction, operation and management of a new 2-berth container terminal on BOT basis for period of 30 years. The NSICT berths were commissioned in April 1999. The NSICT berths comprise of 600 m quay length; 25.84 ha. of reclaimed backup area for container yard and requisite container handling equipment along with other related facilities (**Figure 3.2**). The present capacity of the terminal is currently assessed as 1.2 MTEUs per annum.

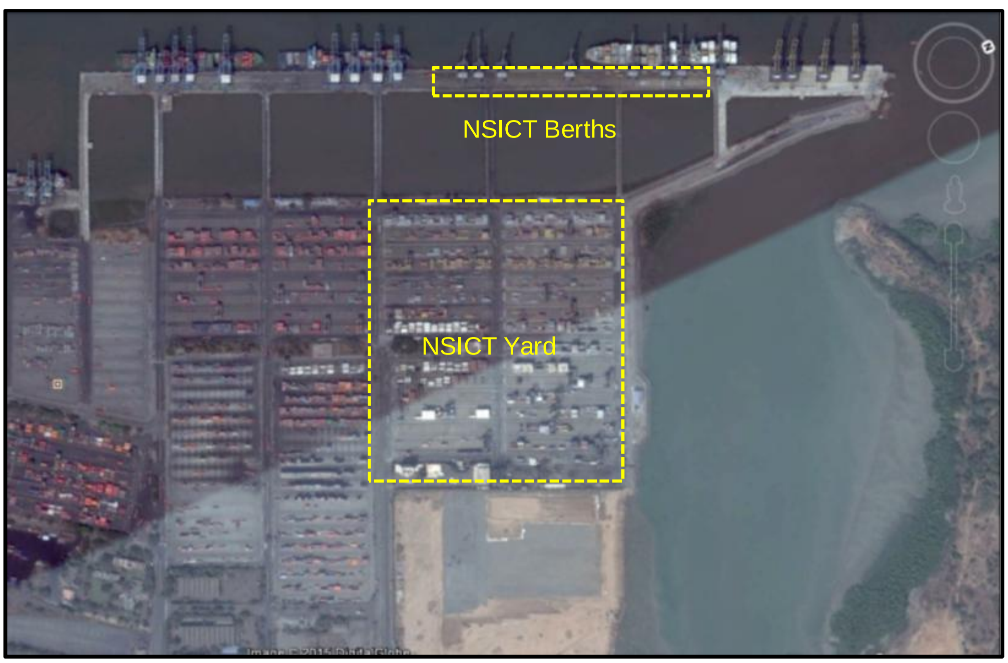


Figure 3.2 Plan View of NSICT Yard and Berth

Table 3.2 NSICT Terminal Details

Terminal	NSICT
Quay Length (m)	600
Maximum draft of vessel at Port (m)	14 (Tidal)
Design capacity • Million TEUs/ Year • MT/Year	 1.2 15
Reefer Points (No.)	772
RMQCs (No.)	8
RTGCs (No.)	29
RMGCs (No.)	3
Yard Area (In Hectares)	25.84
Max. Permissible LOA of the Vessel (m)	340

3.3 Jawaharlal Nehru Port Container Terminal (JNPCT)

JNPCT is JNPT's own Container Terminal. JNPCT has 3 berths with a total quay length of 680 m and is capable to handle vessels up to 14 m draft. The capacity of JNPCT terminal is about 1.25 M TEUs with a backup yard of approx. 61 ha. (including shallow berth area). The existing JNPCTs facilities are shown in the **Figure 3.3**.

Figure 3.3 Existing JNPCT Facilities

Recently, modernisation of container terminal were undertaken by adding three new post Panamax size Rail Mounted Quay Crane (RMQCs) at main berth totalling 9 RMQCs supported by 18 RTGCs and 5 RMGCs.

The details of JNPCT is shown as below in **Table 3.3**.

Table 3.3 JNPCT Terminal Details

Terminal	**JNPCT**
Quay Length (m)	680
Maximum draft of vessel at Port (m)	14 (Tidal)
Capacity (in million TEUs)	1.25
Reefer Plugs (No.)	320
RMQCs (No.)	9
RTGCs (No.)	18
RMGCs (No.)	5
Tractor Trailers	130
Backup Area – (ha.)	61.49 (Including Shallow Berth area)
Reach Stackers	8 (Hired)
Railway Siding Tracks for ICD	4
Maximum Permissible LOA of The Vessel	340 m

3.4 Shallow Draft Berth

Shallow Draft Berth was commissioned on 1st September 2002, has a total length of 445 m. Vessels up to 183 m LOA and up to 10 m draft is being handled at this berth (**Figure 3.4**). Container vessels, cement, general cargo and liquid cargo vessels are being handled with a capacity of about 0.15 Million TEU's Container and 0.9 MTPA other cargo totalling to 2.77 MTPA.

The details of Shallow berth are shown as below in **Table 3.4**.

Figure 3.4 JNPCT Shallow Berth and Yard

Table 3.4 Shallow Berth Details

Terminal	**Shallow Draft Terminal**
Quay Length (m)	445
Maximum draft (m)	10
Design capacity • Million TEUs Year • MT/Year	 0.15 2.77
Max. Permissible LOA of the Vessel	183 m
RMQCs (No.)	3

3.5 Gateway Terminal India Private Limited (GTIPL) Terminal

Gateway Terminals India Private Limited (GTIPL) is a joint venture between APM Terminals and the Container Corporation of India Ltd (CONCOR) and it operates the third container terminal at Jawaharlal Nehru Port on a build, operate and transfer (BOT) basis for a period of 30 years. It commenced partial operations in March 2006 and became fully operational from October 2006. **Figure 3.5** and **Figure 3.6** show GTI berths at its yard. The Quay length of the GTI berth is 712 m and is capable to handle vessels up to 14 m draft (**Table 3.5**).

Figure 3.5 Plan View of GTI Berths

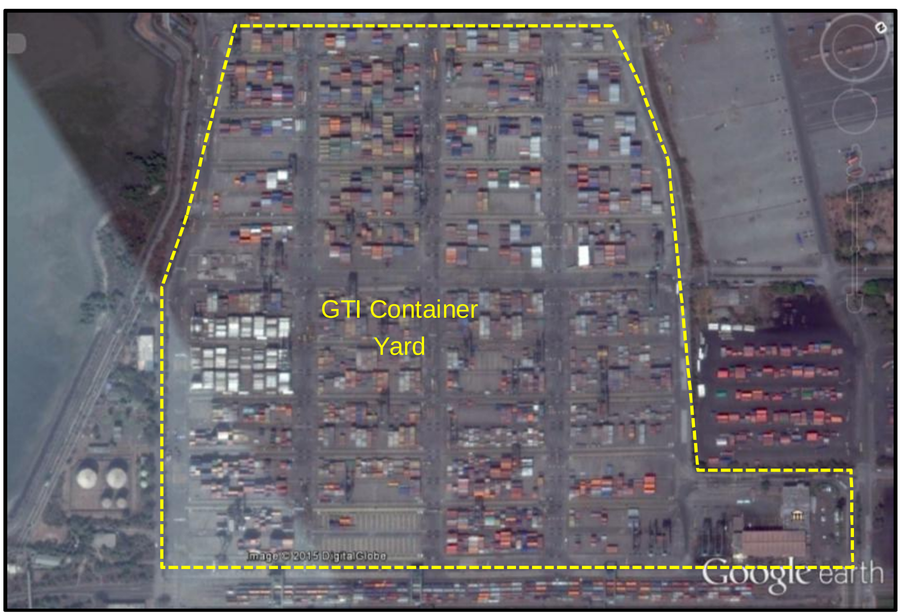


Figure 3.6 GTI Container Yard

Table 3.5 GTI Terminal Details

Terminal	GTI
Quay Length (m)	712
Maximum draft of vessel at Port (m)	14 (Tidal)
Design capacity • Million TEUs Year • MT/Year	1.8 22.5
Reefer Points (No.)	880
RMQCs (No.)	10
RTGCs (No.)	40
RMGCs (No.)	3
Yard Area (ha.)	47.24
Maximum Permissible LOA of the Vessel (m)	340
Empty Handlers (No.)	2

3.6 Liquid Terminal

A license on BOT basis was awarded to M/s. Bharat Petroleum Corporation Limited and M/s. Indian Oil Corporation Limited in August 1999 for construction of a twin-berth liquid cargo jetty. The twin-berth liquid cargo jetty has been functional since 2002. The liquid terminal is shown in **Figure 3.7**.

Figure 3.7 JNPT Liquid Terminal

The berth has twin loading/ unloading facilities which can accommodate a vessel of 120,000 DWT and 50,000 DWT on sea side and shore side respectively. The capacity of the terminal is about 6 MTPA. The jetty is provided with six 12' diameter marine loading and unloading arms and two loading arms with 16" diameter. **Table 3.6** provides details of the liquid terminal.

There are ten dedicated customers utilising the marine liquid terminal as shown in **Figure 3.7** and **Figure 3.8**.

Table 3.6 Liquid Terminal Details

Terminals	Liquid Cargo Terminal
Quay Length (m)	390-Sea 310-Shore
Berth Width (m)	40.5
Maximum draft (m)	14-Outer (Tidal) 10-Inner (Tidal)
Design capacity (MTPA)	6.5
Loading Arms (No.)	10
Storage Area Outside Port	142 Tanks Capacity: (710,619MT)
Max. Permissible LOA of The Vessel	330 m Outer Berth 185 m Inner Berth 305 m for twin Vessels

Table 3.7 JNPT Liquid Terminal Customer and Product Details

S. No	Customer	Distance to Tankage	Products
1.	BPCL	6.35 km / 15 km (LPG)	FO (Bunker); LPG
2.	Deepak Fertiliser Corporation	4.75 km	Ammonia; Phosphoric Acid; Phenol
3.	Ganesh Benzo Plast	4.75 km	Chemicals; Edible oil; Molasses
4.	Indian Molasses Company	5.00 km	Chemicals; Edible oil;; POL
5.	IOCL	6.35 km	POL
6.	Indian Oil tanking Ltd.	13.00 km	POL
7.	ONGC	15.00 km	Crude oil
8.	Reliance Industries Ltd.	5.50 km	POL; Chemicals
9.	Shell	4.75 km	Chemicals
10.	Suraj Agro Products	4.75 km	Edible oil

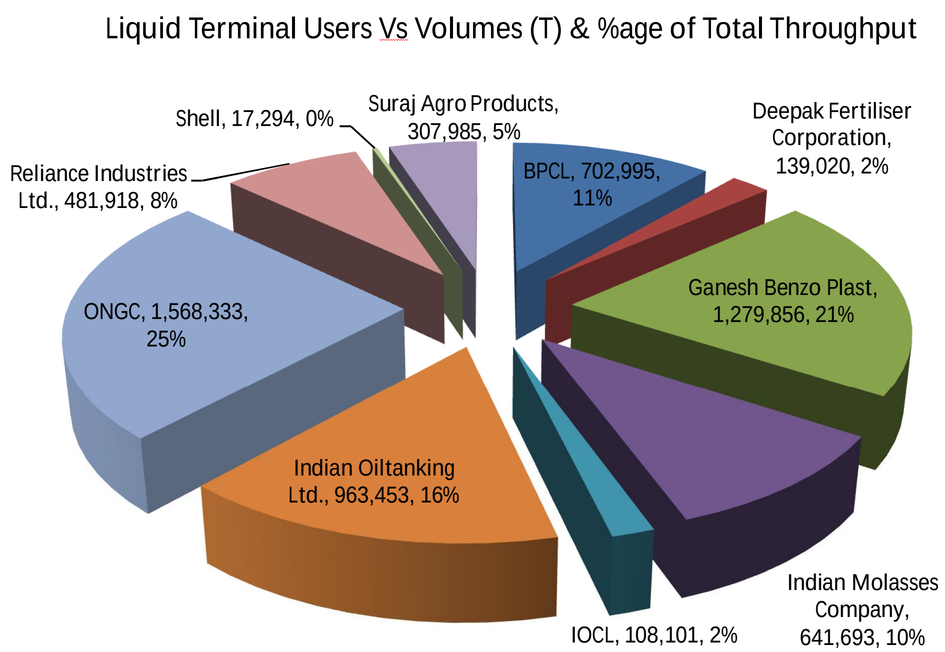


Figure 3.8 JNPT Liquid Traffic Split Customer Wise

3.7 JNPT Approach Channel

This approach channel is a Common Harbour channel for JNPT and Mumbai Port. The characteristic of the approach channel is as below:

- Channel Length of 33.54 km
- Designed Channel depth (below CD)
  - 13.1 m in JNP channel &
  - 14.2 m in outer harbour channel.
- Channel Width
  - 370 m at straight reach;
  - 460 m at the berths.
- Turning Circle/ Anchorage of 600 m diameter

The existing JNPT channel is dredged to handle 14 m draft container ship with tide advantage. **Figure 3.9** shows the layout of the existing JNPT approach channel.

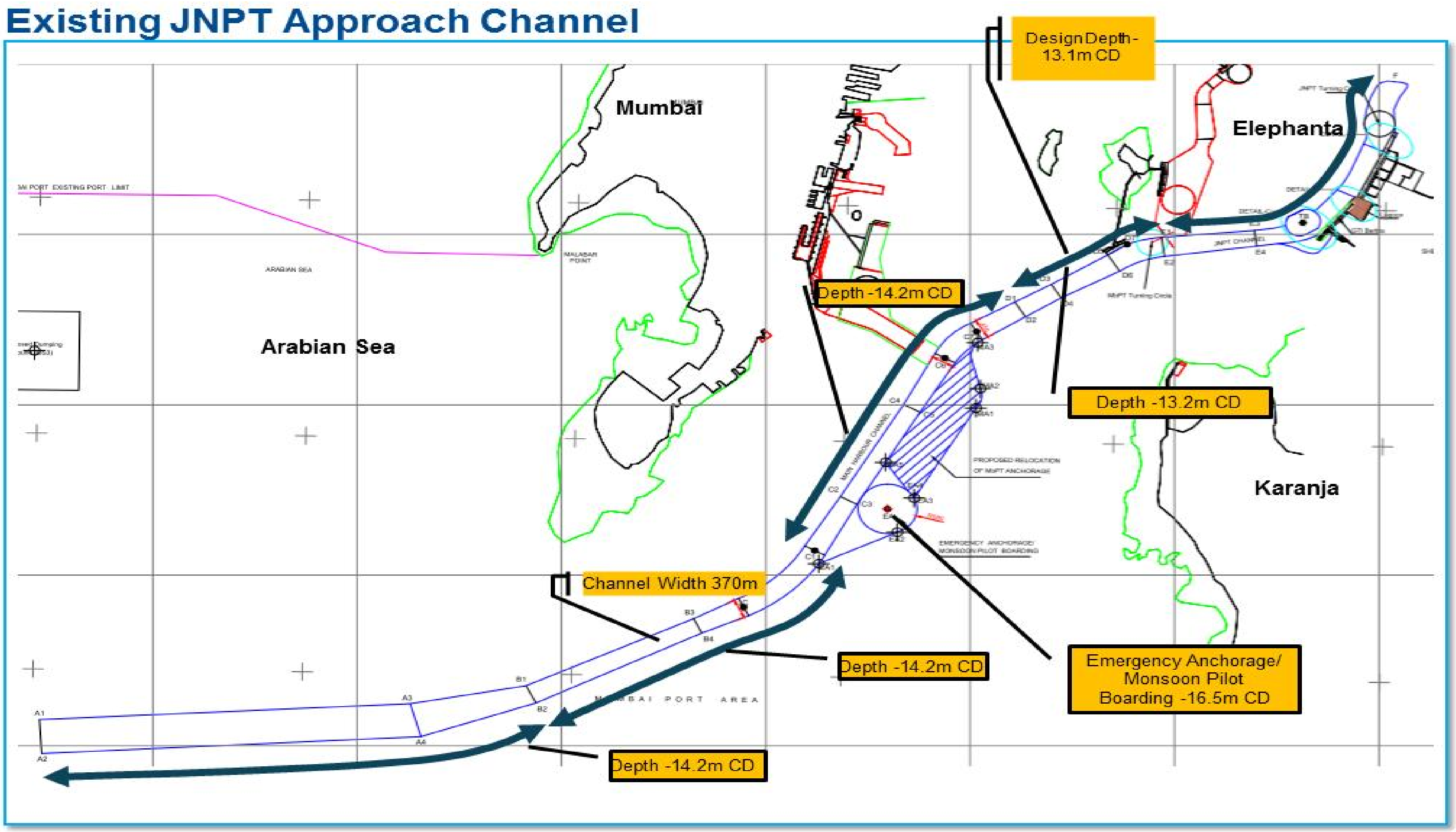


Figure 3.9 Existing JNPT Approach Channel

4.0 PERFORMANCE, OPTIONS FOR DEBOTTLENECKING & CAPACITY ASSESSMENT

4.1 General

The total cargo handled through the existing facilities, during the past 5 years is presented in the following **Table 4.1**.

Table 4.1 Cargo Handled During Past 5 Years.

Commodity	2010-11	2011-12	2012-13	2013-14	2014-15
POL+ Crude + Product	5.0	4.9	4.1	4.4	5.9
Containers					
Tonnage (MTPA)	56.4	58.2	57.9	55.2	57.6*
MTEUs	4.2	4.3	4.2	4.1	4.5
Others	2.8	2.6	2.5	2.7	0.9
Grand Total (MTPA)	**64.3**	**65.7**	**64.5**	**62.3**	**64.4**

*Conversion factor for container projections in 2014-15: 1 TEU =12.8 T

4.2 BCG Benchmarking Study Inputs for Master Plan

BCG, as part of their benchmarking study, has looked into the operation of the berths and has suggested various measures for improving the performance. The extract of report of BCG pertaining to Jawaharlal Nehru Port is given in the **Appendix-1**. The key observations are as follows:

4.2.1 Key Points of BCG Benchmarking Study

4.2.1.1 JNPT Container Terminal

- JNPT's container volume growth has been stagnated and it's loosing container traffic share to other ports in Gujarat (Mundra and Pipavav).
- JNPT's own container terminal JNPCT is lagging behind in Quay Crane productivity when it comes to its Indian terminal peers.
- As per the survey conducted by BCG with various stake holders in the port industry, JNPT's productivity, berth availability and road connectivity lags when compared to Gujarat's container terminals.
- Dual cycling, Efficient yard planning, Twin lifts Quay cranes, Quay crane operator skills and productivity enhancement through monetary incentives these are some of major points for improvement that are highlighted by the BCG study.

4.2.1.2 JNPCT Container Yard

- Current JNPCT yard storage utilization lowest among the Indian peers.
- Benchmarking shows significant gaps between JNPCT and GTI on RTGC equipment levels, utilization and productivity. High RTGC productivity gap likely driven by low utilization rather than equipment or operator skill. As a result, productivity gap between berth and yard exists today and will grow with increasing crane productivity.
- Separation of import and export yards limits opportunities for RTGC pooling and drives longer TT travel distances. Connecting IM/EX yard for RTGC sharing can increase average IM yard RTGCs and improve equipment utilization.
- BCG's yard performance diagnosis suggests improving the yard layout to facilitate RTGC sharing and reduce TT travel.

4.2.1.3 JNPCT Gate Complex

- JNPCT gate throughput is lower than average among its Indian peers and need improvement.
- JNPCT gate utilization is much lower than GTI due to longer processing time at JNPCT Gate required for CISF seal number verification.
- OCR-based gate automation can further enhance gate processing speed/accuracy and achieve manpower saving.
- Longer lead time at JNPCT for import out-gate due to EIR generation at the gate.

4.2.1.4 JNPT Rail Yard

- JNPT rail performance has declined over the past years. Rail throughput has been declining despite the overall volume growth and increasing rail turnaround time especially for JNPCT and NSICT.
- About 95% of rakes are mixed contributing to significant delay in rail turnaround time.
- Improved rail handling required given the future capacity expansion and dedicated freight corridor (DFC) project.
- BCG study considered two options to improve the rail handling for JNPT Option 1-Multi-modal logistics park (MMLP) outside port to dispatch dedicated trains for all JNPT terminals and Option 2-Common rail yard within the port for three terminals & separate station for the terminals with Single operator for ICD container handling and shared yard for ICD import & export buffer.
- Based on infrastructure availability, handling cost, turnaround time and space utilization, BCG suggested Common rail yard as preferred option.

4.3 Capacity Assessment of Existing Facilities

4.3.1 General

The cargo handling capacity of port facilities is based on many factors like the vessel size, fleet mix, equipment provided, possible handling rates, time required for peripheral activities, capacity of stackyard, number of users, grades, capacity of evacuation system etc.

4.3.2 Capacity of Berths

4.3.2.1 General

The capacity of existing berths is calculated assuming the cargo being currently handled at these berths and the corresponding parcel sizes.

Another factor that is important in arriving at the berth capacity is the allowable Berth occupancy which is expressed as the ratio of the total number of days per year that a berth is occupied by a vessel (including the time spent in peripheral activities) to the number of port operational days in a year. High levels of berth occupancy will result in bunching of ships resulting in undesirable pre-berthing detention. For limited number of berths and with random arrival of ships, the berth occupancy levels have to be kept low to reduce this detention. The norms generally followed for planning the number of berths in modern port to minimise the pre-berthing detention are given in **Table 4.2**.

Table 4.2 Recommended Berth Occupency

No. of Berths	Recommended Berth Occupancy Factor
1	60 %
2	65 %
3 & above	70 %

The available berths and the cargo handled at each of the terminal during last year are presented in **Table 4.3**.

Table 4.3 Container Cargo Handled at JNPT During 2013-2015 (in TEUs)

Container Traffic	2013-14			2014-15		
	JNPCT	NSICT	GTIPL	JNPCT	NSICT	GTIPL
Import	6,31,219	4,46,102	9,87,658	6,43,849	5,27,763	10,86,464
Export	6,31,384	5,20,816	8,78,133	6,15,413	6,20,885	9,14,625
Transhipment	50,112	2,540	13,737	34,740	11,571	11,385
Total of Terminal	13,12,715	9,69,458	18,79,528	12,94,002	11,60,219	20,12,474
JN Port Total	**41,61,701**			**44,66,695**		

[Source: JNPT Website]

4.3.2.2 JNPT Container Terminal Capacity

Based on the above considerations of berth occupancy, capacity of different container terminals have been calculated as shown in **Table 4.4**.

The berth capacity for container terminals has been estimated based on rated equipment capacity, berth occupancy of 70% which is an acceptable internal standard, 20 hours/day operations time, 350 days of total operational days, and TEU ratio of 1.3.

The capacity estimated is the optimum capacity of the terminal based of efficient levels of operations. For GTI Terminal throughput being handled in port exceeds the estimated capacity because of higher berth occupancy (in same cases as high as 90%) which has a potential to cause high pre-berthing waiting time for ships.

Table 4.4 Capacity Estimation for JNPT Container Terminals

S. No.	Particulars	JNPCT	GTICT	NSICT	NSIGT (330 m)	Shallow Berth (445 m)
1.	Berth Occupancy Proposed	70%	70%	70%	70%	70%
2.	**Annual Throughput Estimated (TEUs per annum)**	**12,22,386**	**16,38,666**	**12,04,926**	**6,84,180**	**1,88,125**
3.	Container Quay Length(m)	680	712	600	330	250
4.	Container Throughput per meter berth	1,798	2,301	2,008	2,073	753
5..	Total Quay Canes Provided	9	10	8	4	3

5.0 DETAILS OF ONGOING DEVELOPMENTS

5.1 General

The principal traffic in JN Port as of now comprises of containers and liquid bulk. With the fast growing industrial development in the hinterland, it is the intention of the port to develop facilities for handling dry bulk, break bulk, project cargo, and automobiles for export etc. Port has taken up several steps to augment the facilities in order to meet the increasing traffic. The locations of these ongoing developments are shown in the **Figure 5.1** and details are provided in subsequent section.

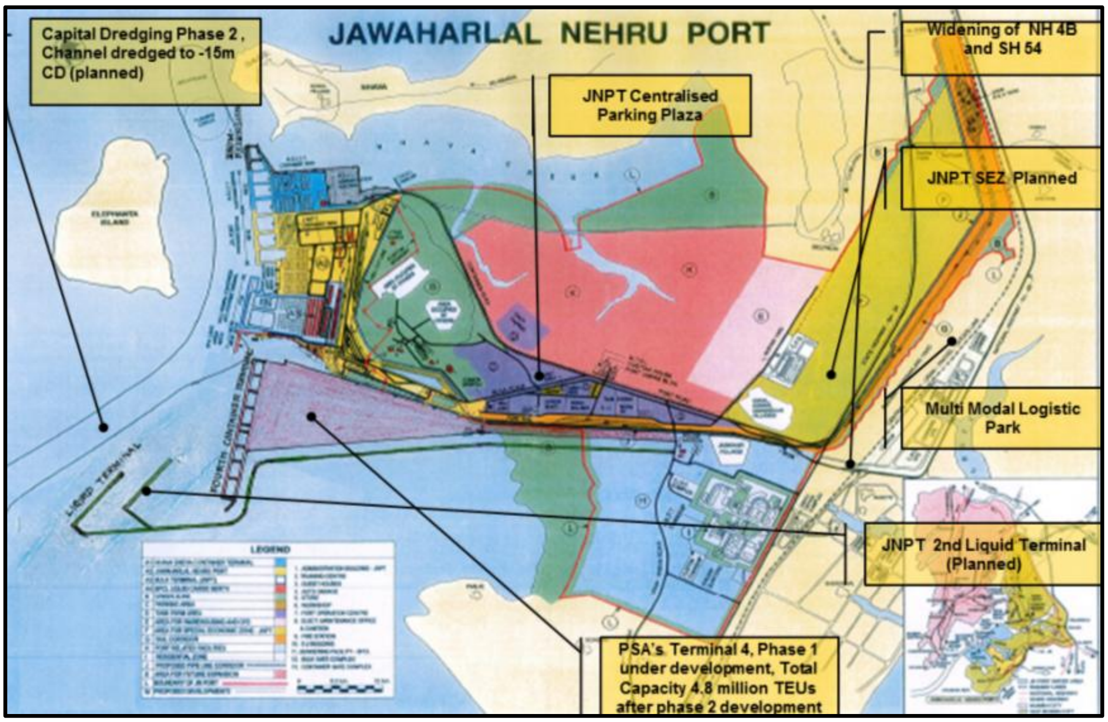


Figure 5.1 Location of Ongoing Developments

5.2 Deepening and Widening of Main Harbour Channel and JN Port Channel

The total length of the existing channel is 18.11 nautical miles (33.54 km) and it comprises five sectors named the 'Outer Sector', 'Karanja Sector', 'Uran Sector', 'S. Elephanta Sector' and the 'Elephanta Deep Sector'. The Channel is shared by the Mumbai Port Trust and the JNPT. The Channel commences at the existing west port limit of MbPT and extends up to the anchorage area north of JNPT.

Currently, the JN Port can handle container ships with draft limited to 14 m but with the need to accommodate deeper-draught Post-Panamax ships, the channel has to be deepened and extended westwards. The rocks levels in some pockets of the navigational area are at the surface or very close to the surface level. Therefore deepening of the channel and Navigational areas would involve significant quantity of rock dredging. JNPT has already prepared a detailed project report for deepening of the channel and it suggests that the dredging be carried out to handle 15 m container ships at the port. A higher draft may not be justified as the currently operating container berths are designed for a vessel draft limited to 15 m only.

5.3 NSIGT-DPW's 330 m Stand-alone Container Terminal

This project involves construction of a 330 m container berth, approach bridges, extension of guide bund, reclamation of 27 ha. area for container yard and installation of container handling equipment (**Figure 5.2** and **Figure 5.3**). The berth is already built and container yard development is in progress. The concession Agreement signed with Nhava Sheva (India) Gateway Terminal Pvt. Ltd., an SPV of DP World, on 19th June 2013.

Figure 5.2 NSIGT-DPW's 330 m Container Berth, Approach Bund and Trestle

Figure 5.3 NSIGT-DPW's 330 m Berth Container Yard Under Dvelopment

5.4 Construction of Additional Liquid Cargo Terminal

JNPT has envisaged additional 2nd liquid terminal. Feasibility studies and DPR has been completed and RFQ was invited but did not attract any bidder. Proposed JNPT 2nd Liquid Terminal Plan as shown in **Figure 5.4**.

It is understood that the currently proposed development plan is very expensive and does not commensurate with the incremental traffic. The project needs to be restructured to ensure a favourable response from the bidders.

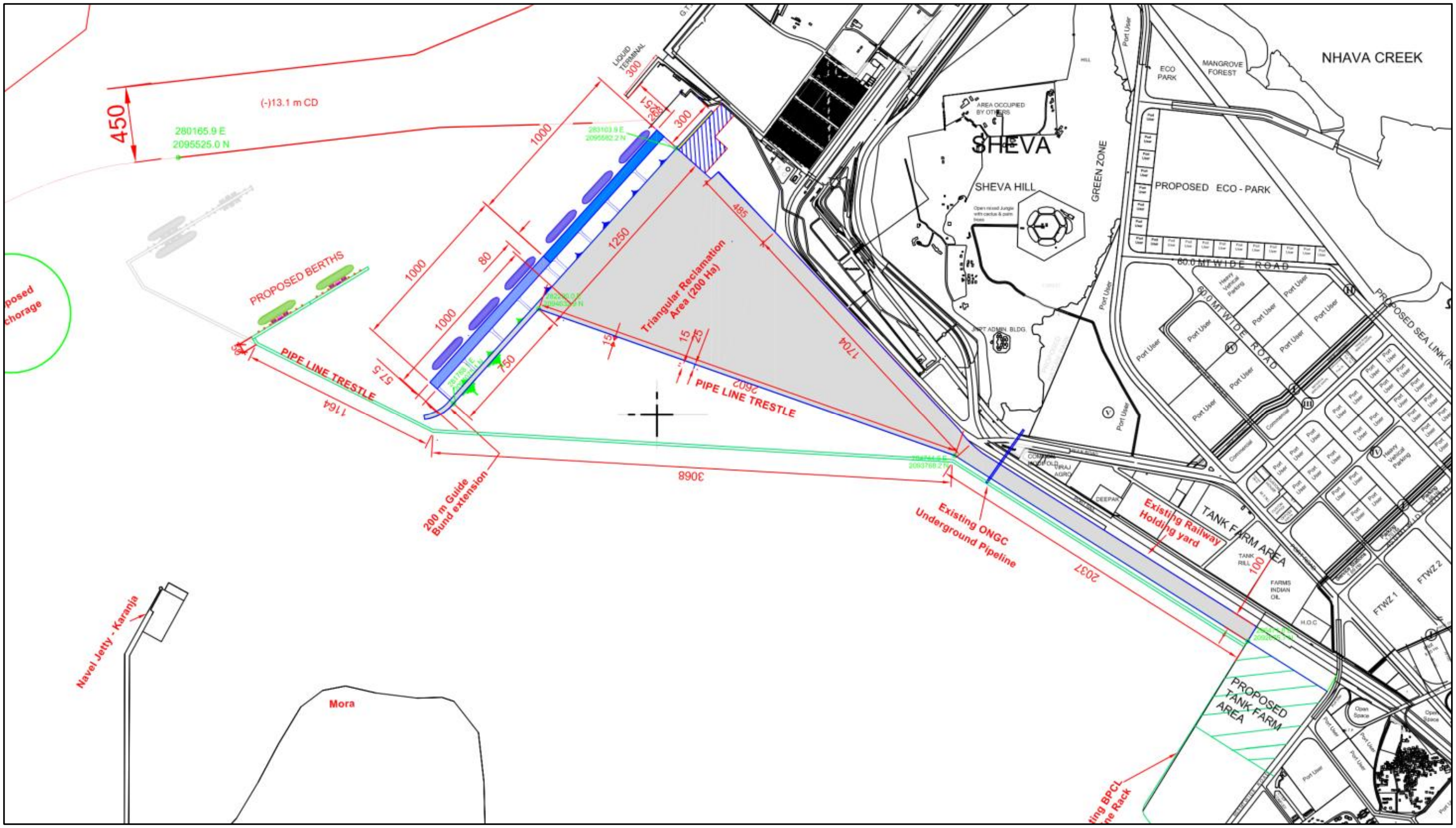


Figure 5.4 Proposed JNPT 2nd Liquid Terminal Plan

5.5 Widening of Highway Linkages to 6/8 Lanning

In order to take care of the congestion of roads, a new project has been proposed to widen 43.9 km length of NH-4B, SH-54 and Aamra Marg linkages to 6/8 lanes along with 2 lane Service Roads at an estimated cost of INR 3,220 crores, by Mumbai-JNPT Port Road Company Ltd, an SPV formed by JNPT, NHAI and CIDCO (**Figure 5.5)**.

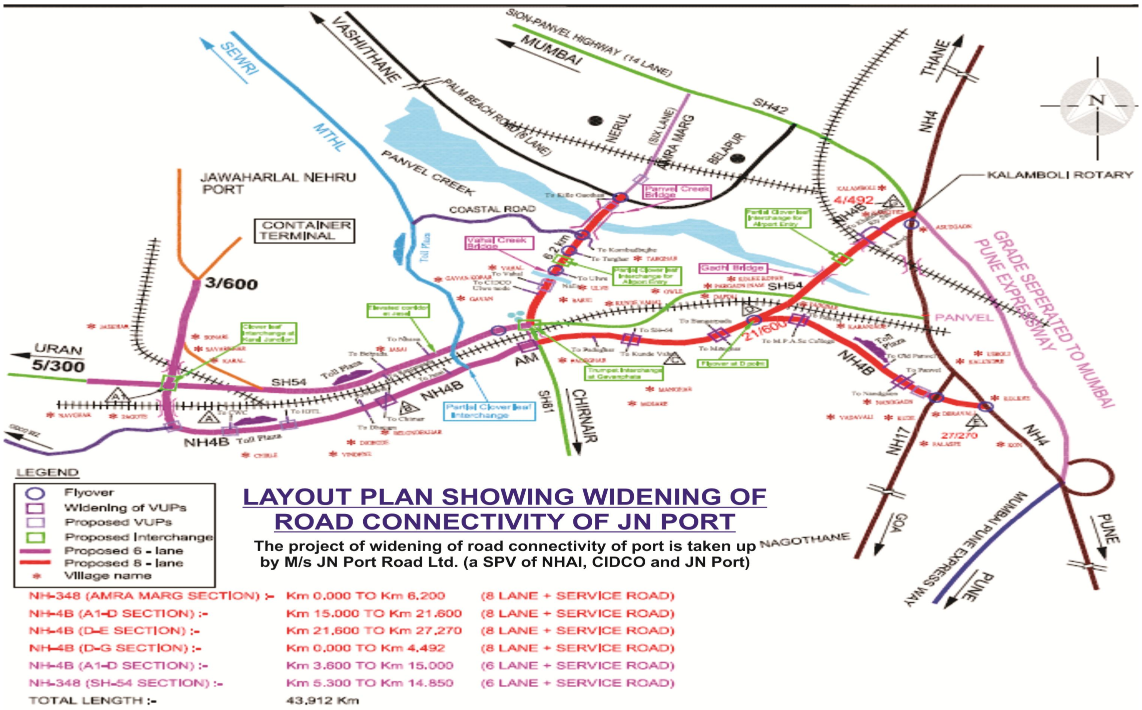


Figure 5.5 Proposed JNPT Road Connectivity Widening

5.6 Rail Connectivity Project

The Ministry of Railways has planned for Western Dedicated Freight Corridor or Western DFC to connect JN Port with the Northern hinterland, being taken up by the Dedicated Freight Corridor Corporation of India Ltd. This corridor will cover a distance of 1483 km and would be electrified with double line operation.

Figure 5.6 shows Western DFCC alignment.

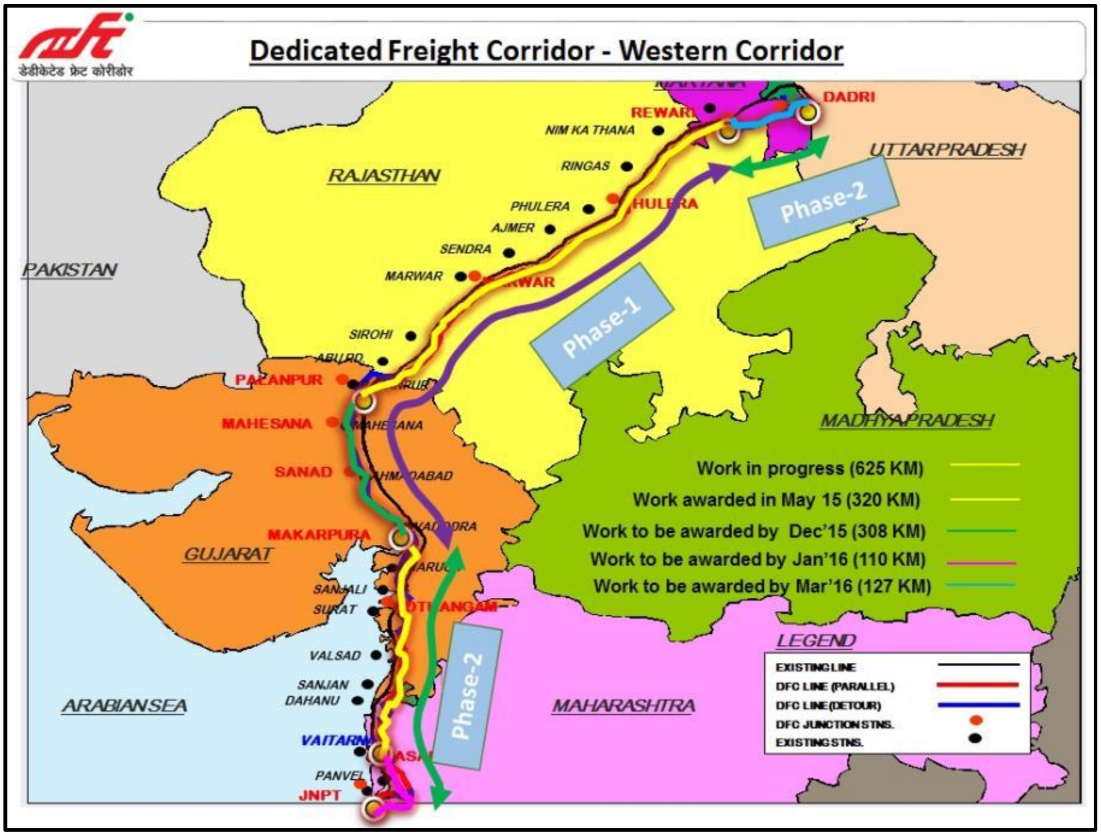


Figure 5.6 Western DFCC Alignment

5.7 Multi-Modal Logistic Park and Dry Port

JN Port had identified about 100 ha. of land near the Jasai Rail Yard (near the Port area) for developing as multi-modal logistic park and dry port (Refer **Figure 5.1)**. The logistic park was planned to have a covered warehousing, open storage, paved stacking areas, circulating areas, truck parking, repair facilities for containers, trailers/trucks and handling equipment. However, the same project has now been cancelled and instead it has been decided to develop a common rail yard inside port.

5.8 Centralized Parking Plaza

A centralised parking has also been foreseen for a 2000 TTs. A total of 45 ha area will be developed for this purpose in phases, where Phase 1 will cover 22 ha. The work has been awarded and is contemplated to complete soon. The proposed facility includes Dormitories for truck drivers, Auto Repairs Zone and Customs set-up for examining EXIM consignments. Refer **Figure 5.1** for location of proposed central parking plaza.

5.9 Development of PSA's 4th Container Terminal on DBFOT Basis

The Concession Agreement for the 4th container terminal was signed on May 6, 2014 with M/s. Bharat Mumbai Container Terminals Pvt. Ltd., an SPV of Port of Singapore Authority (PSA). The project details are given below:

- Berth Length: 2 km, Capacity: 4.8 million TEUs (60 MT).
- Area for back-up facilities: 200 ha.
- Commissioning of Phase 1: (1 km Berth) of this project having 2.4 million TEUs (30 MT) capacity will be completed by November 2017.
- The Phase 2 (1 km Berth) of the project with additional 2.4 million TEUs (30 MT) capacity will be completed by November, 2022.

5.10 Port Based Multi Product SEZ

It is proposed to develop port based multi-product SEZ at JNPT. The same shall be developed by an SPC (Special Purpose Company), a wholly owned subsidiary of JNPT under the engineering, procurement & construction (EPC) mode. An overall investment of about Rs. 4,000 crores is envisaged out of which JNPT will invest about Rs. 468 crores in developing infrastructure facilities at the SEZ.

6.0 TRAFFIC PROJECTIONS

6.1 General

JNPT handles containers, liquid cargo including POL, vegetable oil and chemicals and cement in dry and break bulk cargo. Out of these commodities, containers constitute ~90% of the cargo. JNPT currently has Maharashtra as its primary hinterland for containers with other hinterlands including Gujarat, NCR, Punjab, Rajasthan and UP which it shares with Gujarat ports- Mundra and Pipavav.

The origin-destination of key cargo (accounting for greater than 85% of the total traffic) for all Indian ports and development of traffic scenarios for a period of next 20 years has been carried out by **McKinsey & Co.** as mandated for this project. Accordingly, based on a macro level analysis the future traffic for Kandla Port upto 2035 is presented in **Table 6.2**.

6.2 Major Commodities and their Projections

6.2.1 Containers

Assessment of traffic has been done based on analysis of past traffic at JNPT, interviews with Port authorities, Maharashtra Maritime Board and Maharashtra Industrial Development Corporation (MIDC) as well as several stakeholders in the shipping and user industries.

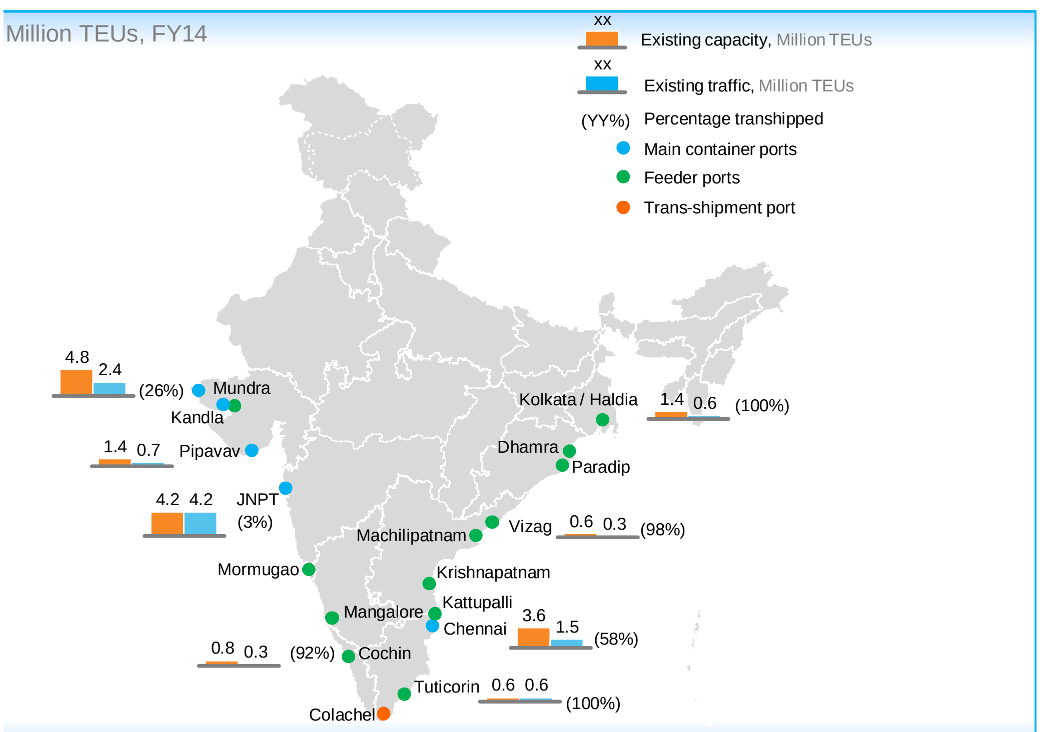


Figure 6.1 Port wise EXIM Container Movement in India

West coast container ports handled ~7.6 Mn TEUs out of the 10.7 Mn TEUs handled in India in FY14. In the same year, JNPT operated at ~100% capacity utilization handling 4.2 Mn TEUs.

The key hinterland of JNPT includes Maharashtra, NCR, Punjab, Uttar Pradesh, Uttaranchal, Rajasthan and Gujarat. Except for Maharashtra, which is almost solely served by JNPT, above hinterland is also served by the Gujarat Ports – mainly Mundra and Pipavav. Maharashtra (Mumbai, Pune, Nashik, Aurangabad and Nagpur) is the primary hinterland for JNPT generating ~45% of the total traffic (**Table 6.1**).

Table 6.1 Hinterland to Port Mapping

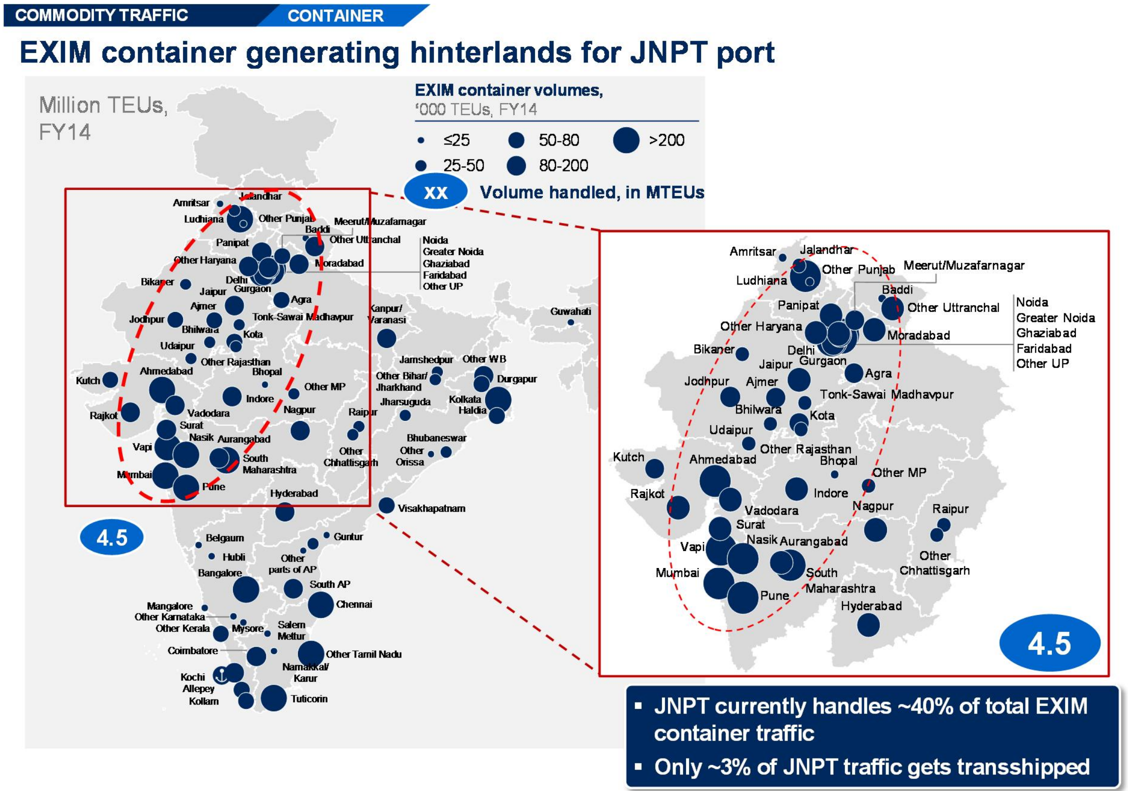
COMMODITY TRAFFIC CONTAINER

Maharashtra is the primary hinterland of JNPT followed by NCR, Punjab and Gujarat

Primary hinterland of port

EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakha-patnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	562	351	263	50

SOURCE: APMT; Expert interviews



SOURCE: APMT; IPA statistics; Stakeholder interviews

Figure 6.2 EXIM Container Generating Hiterland for JN Port

Container traffic from the North and North-western parts of India (including NCR, Uttar Pradesh, Haryana, Punjab and Rajasthan) has shifted to Mundra and Pipavav over the recent years. This trend is expected to continue going forward mainly because of the shorter distance by road and rail from this hinterland to Gujarat ports as compared to JNPT (e.g., avg. rail distance of NCR from/to Mundra and Pipavav is ~350 and 250 km lesser than JNPT).

A part of the reason for the shift is due to increasing congestion at JNPT. While the completion of the 4th container terminal and other expansions will ease this situation, the rail distance advantage of Gujarat Ports will still make them more competitive for North and North-western parts of India.

JNPT handled 4.2 Mn TEUs in FY14. Traffic projections for JNPT have been done considering

- Historical growth in container traffic at JNPT and other ports
- Historical trends in level of containerization in India
- Forecast for manufacturing GDP of different districts including increase in demand and manufacturing from initiatives like Delhi-Mumbai Industrial Corridor (DMIC), Visakhapatnam-Chennai Industrial Corridor (VCIC), Chennai-Bangalore Industrial Corridor (CBIC), Mumbai-Bangalore Economic Corridor (MBEC), "Make in India" campaign
- Proposed Dedicated Freight Corridor from Dadri till JNPT

Based on above, container traffic at JNPT is expected to be ~9-10 Mn TEUs by FY25 which will be about the same as the planned capacity at the port.

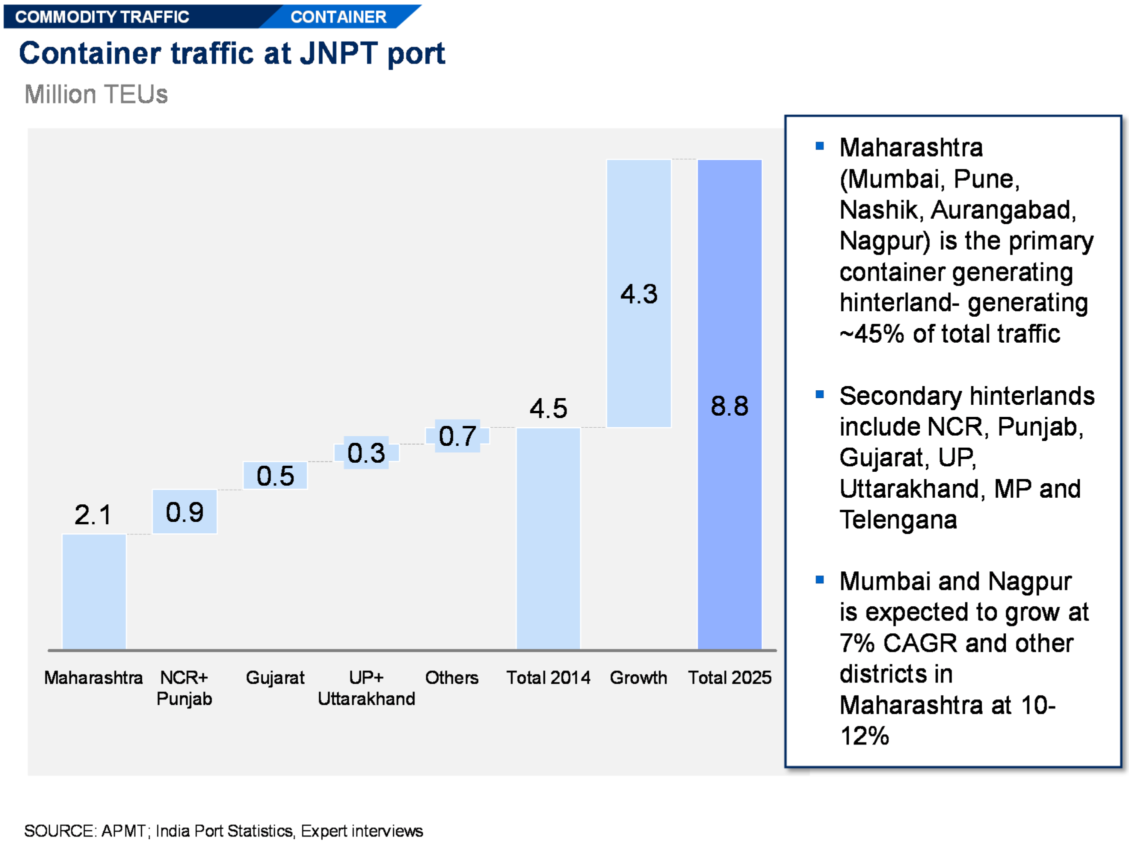


Figure 6.3 Container Traffic at JN Port

A summary of traffic projections for all commodities at JN Port is given in **Table 6.2**.

Table 6.2 Traffic Projections for all Comodities at JN Port

JNPT - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	4.1	5.5	7.0	8.1	9.1	10.3	
Vegetable Oil	1.0	1.3	1.7	1.8	2.9	3.3	
Chemicals	0.8	1.1	1.4	1.5	2.4	2.7	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	0.0	0.0	0.0	0.0	0.0	0.0	
Coking Coal	0.0	0.0	0.0	0.0	0.0	0.0	
Iron Ore	0.0	0.0	0.0	0.0	0.0	0.0	
Cement	0.7	0.9	1.2	1.3	2.0	2.3	
Fertilizers	0.0	0.0	0.0	0.0	0.0	0.0	
Containers and other Cargo							
Containers (Mn TEU)	4.5	6.8	8.8	10.2	14.6	18.3	
Others	0.2	0.3	0.4	0.4	0.6	0.7	
Total (MMTPA)	**64.4**	**96.1**	**124.5**	**143.9**	**203.9**	**253.5**	

Conversion Factor Used for Containers Projections: 1 TEU = 12.8 Tons

6.3 Coastal Shipping Potential

Apart from the above mentioned traffic, there is additional opportunity of coastal shipping of cement that can be potentially tapped. There is a potential to coastally ship ~5 MTPA of cement from Andhra Pradesh to Maharashtra via JN Port by 2025. This is contingent on the development of central AP port which will serve as the origin port for this movement (**Figure 6.4**).

COMMODITY TRAFFIC | CEMENT

Additional ~5 MTPA can be coastally shipped to JN Port from the proposed cement cluster in AP by 2025

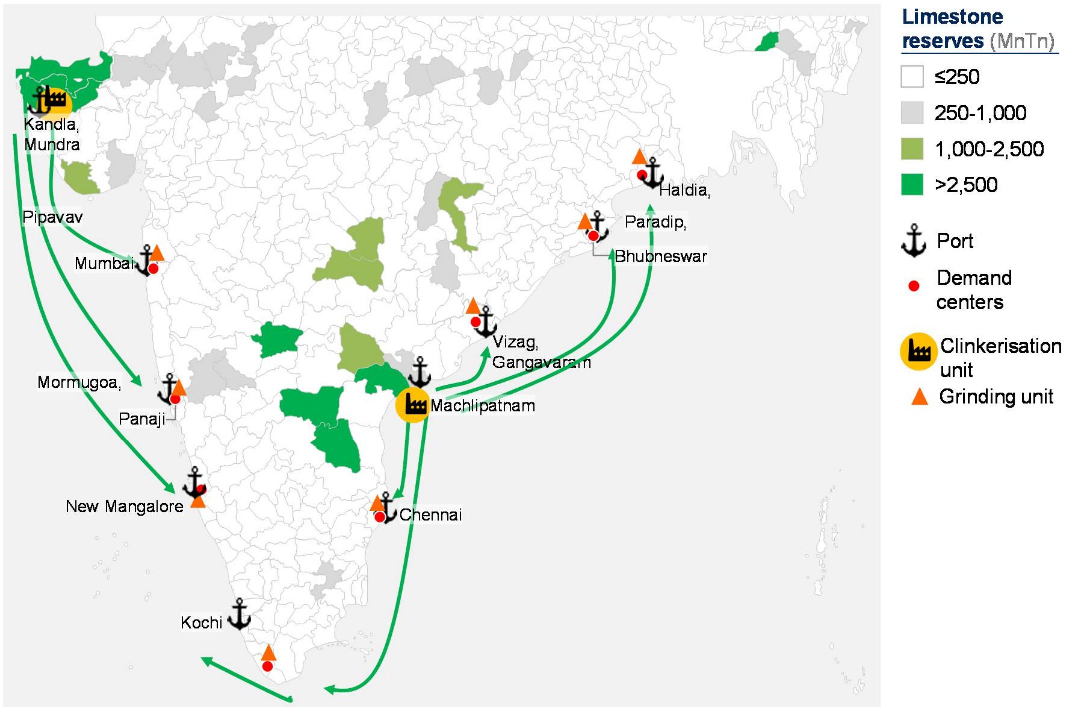


Figure 6.4 Coastal Shipping Potential of Cement

7.0 OPERATIONAL IMPROVEMENTS AND CAPACITY AUGMENTATION OF EXISTING FACILITIES

7.1 Introduction

As per the traffic projections significant cargo throughput is expected at JN Port, particularly in containers. While port has already taken action to increase the cargo handling capacity, it also needs that the current facilities operate efficiently and there should not be operational bottlenecks which would result in users drifting away from the port. The present section deals with these issues and possible remedial measures.

7.2 Operational Improvements

7.2.1 Entry Exit Gates and Approach Road Congestion

As could be seen from the **Figure 7.1** below that at the entry exist gates of NSICT and JNPCT there has been a huge congestion in front of the entry & exit traffic of both these gates which results in delays and is also an operational hazard particularly inside the gates. This is mainly due to the operational reasons in the gate processing system. At some instances, it has been observed that due to very high incoming traffic exit lanes are narrowed down to barely 2 lanes in front of the exit gates.

Figure 7.1 Entry and Exit Gates of NSICT and JNPCT

The situation is likely to worsen once the standalone 330 m long container terminal (NSIGT) becomes operational as their entry-exit gates are planned to be constructed further towards north of the existing NSICT Exit Gate. It would create three sets of interacting traffic at the Y junction. Presently, JNPT has undertaken a project of widening the road from Y-Junction to the Terminal Gates by adding another 30 m width for the new terminal.

The following two options are proposed to streamline the entry exist of the vehicles to these terminals.

Option 1 : Restructuring of the entry and exit gates of the three terminals so that all the entry gates are shifted towards south and all the exit gates are shifted towards north. This option is presented in **Figure 7.2**. This option shall create most logical traffic movement for 3 terminals at gate. However, it will require the terminal operators to exchange their present gates. This may be a difficult arrangment for operators as it is observed that the existing facilities and gate process are not exactly same between JNPCT & NSICT.

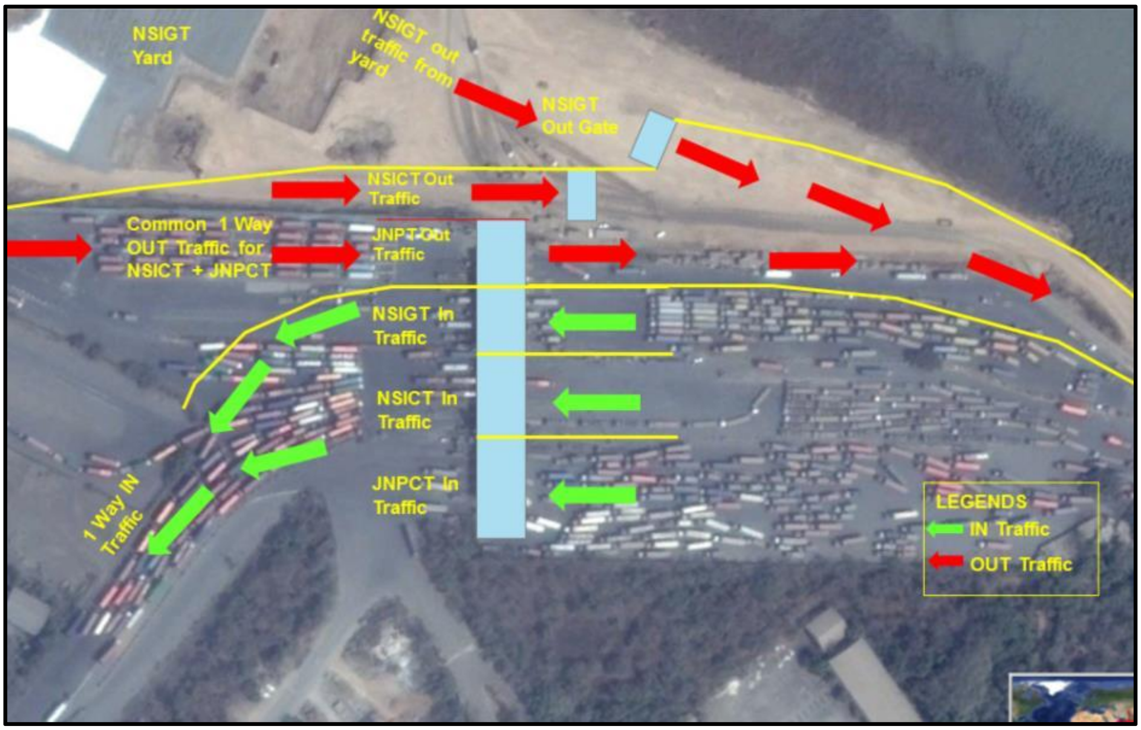


Figure 7.2 Proposed JNPT Entry-Exit Gate Restructuring

Option 2 : A segregator flyover on the approach road to the gates shall separate the approaching traffic from Y junction to the three terminals in separate lanes divided by permanent medians on the way. This is presented in **Figure 7.3**. Road from the flyover till the gates shall be 3 separate parallel roads each having it's own space for 2 way traffic movement.

Figure 7.3 Flyover Segregating Entry & Exit Traffic to & from Port

Table 7.1 Comparative Analysis of Option 1 and Option 2 to Resolve Entry-Exit Road Criss Crossing

Parameters	Option 1	Option 2
	Gate Restructuring	**Segregator Flyover**
Capital Investment	Low	High
Ease of Implementation	Moderate. Will need other terminal operators consensus	Moderate. Careful traffic planning and controlling needs to be done during construction.
Effects on Existing Operations	Will also solve intersecting traffic situations within the yard. This will facilitate traffic movement to Common ICD from all the terminals, JNPCT's Gate can be modernised while implementing the gate restructuring	Will not change existing situation within the yard
Long Term Flexibility in Planning	Since less civil infrastructure is to be created, less land is used which can provide flexibility in development	Construction of flyover will occupy existing road. Will not offer any flexibility in future

In view of the difficulties for gate exchange due to different infrastructure available in different gates and their management system implemented, it is decided to go for the segregator flyover option.

7.2.2 Traffic Flow Improvement at Y-Junction

The major problem at the Y-Junction is the interfacing of the traffic to-n-from the South & Central Gates (mainly catering to GTI Terminal) and North Gates (catering to JNPCT, NSICT & upcoming NSIGT) at the same grade. This crossing exists without any traffic control. At the very intersection there is a fuel pump located. This also adds to the traffic chaos.

To solve these issues the following measures are proposed:

a. The Fuel Pump at the crossing has to be relocated. Presently, JNPT is in the process of developing the empty land at Y-junction behind this Fuel Pump as a parking space for the incoming traffic. The fuel pump may be relocated within this developed land, somewhere inside so that the traffic leading to/coming out of the pump may not hinder the traffic flow of the main roads.
b. Of all the traffic movement possible at the Y-junction which creates the traffic interface, it is seen that the major interface is between the outbound traffic from South & Central Gate and inbound traffic to North Gate. To avoid this intersection, a flyover for the outbound traffic from South & Central Gates is proposed.

The alternatives 1 and 2 for the flyover are shown in **Figure 7.4** and **Figure 7.5** respectively.

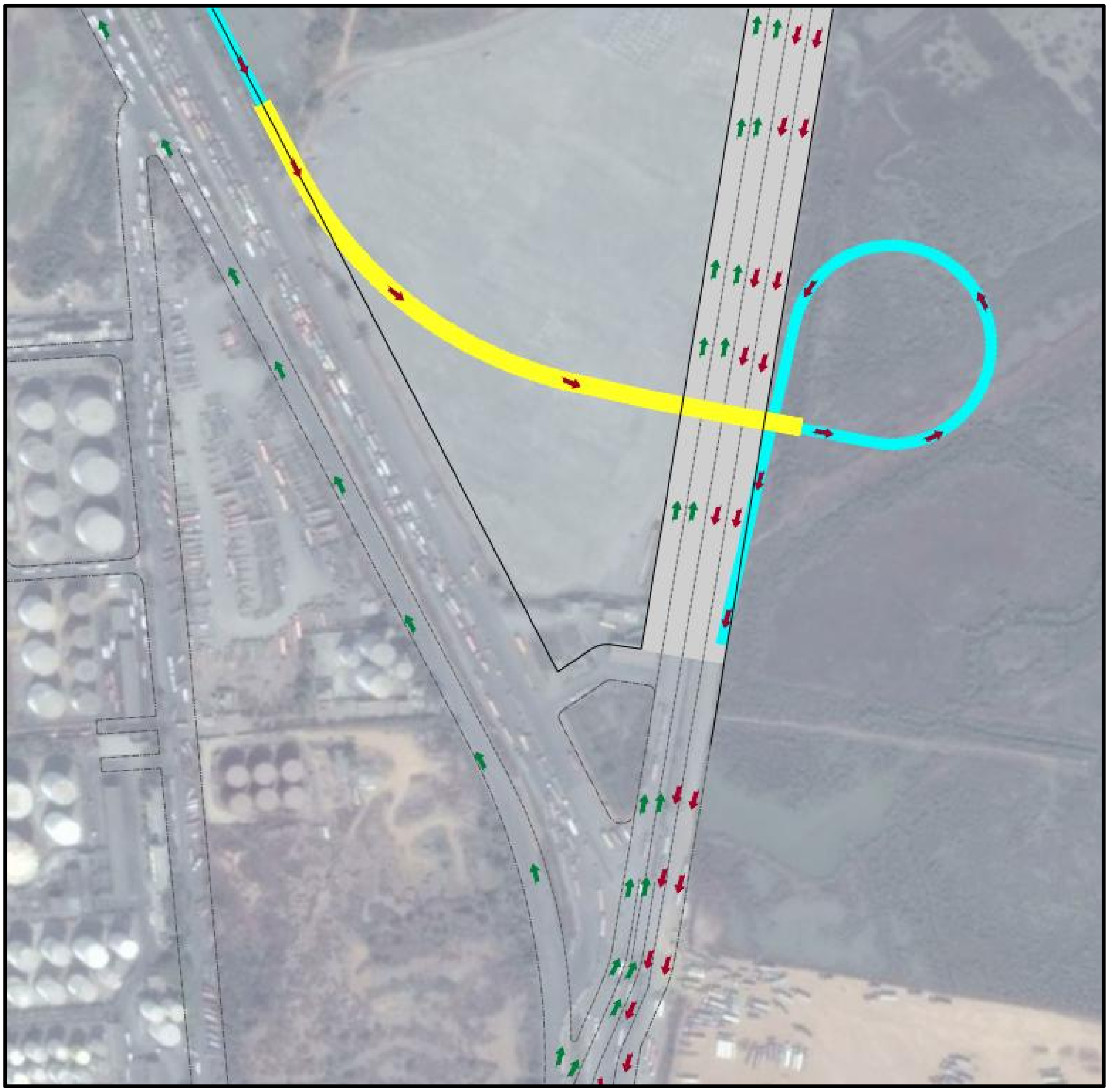


Figure 7.4 Alternative 1 - Proposed Flyover at Y Junction to Streamline Traffic

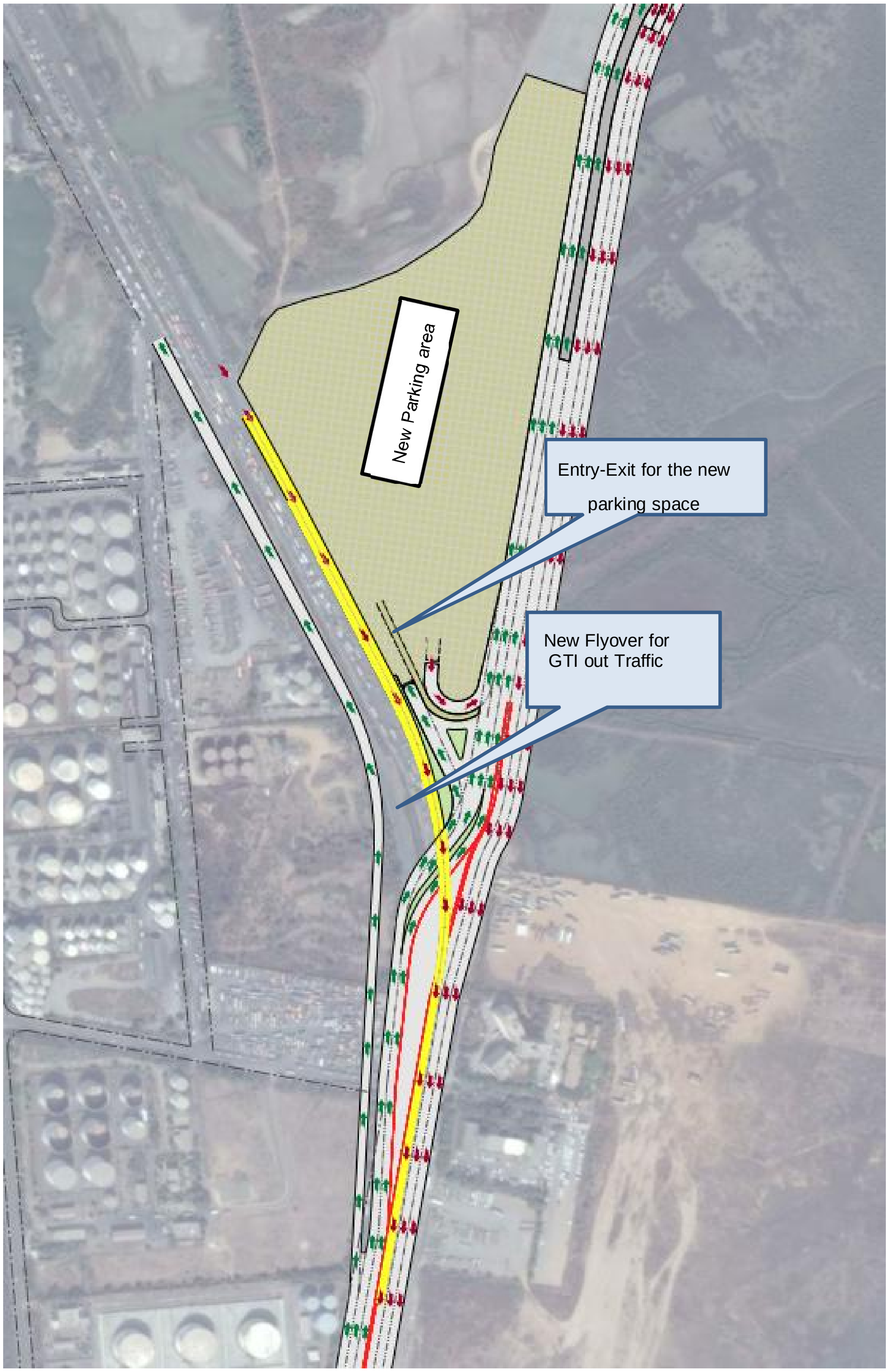


Figure 7.5 Alternative 2 - Proposed Flyover at Y Junction to Streamline Traffic

Table 7.2 Comparative Analysis of Alternative 1 and Alternative 2 of Flyover at Y-Junction

Parameters	Alternative 1	Alternative 2
	Flyover with loop over Inter-tidal zone	**Skewed Flyover aligned to existing road**
Environmental Effect	Loop over inter-tidal zone would require separate environmental clearance.	The proposed flyover shall be on the existing road space. Diverted roads shall take up existing parking spaces/developed lands. Hence, special environmental clearance may not be required.
Effect on the parking space planned	It is possible to plan the entry-exit in the way to serve all 4 terminals (GTI, JNPCT, NSICT & NSIGT)	Exit towards GTI Terminal is restricted
Traffic Movement from North Gate to Central Gate	Possible to have an escape lane remaining at the grade level for very minor traffic from North Gate to Central & South Gate	This traffic have to go back all the way to Karal junction to avail the proposed clover loop flyover to take U turn and come back to go towards central & south gate.
Future Scalability	Since the actual flyover shall be away from the junction and the total obligatory spans shall be all across the parking area planned, the road below can be easily diverted/widened in future	The flyover shall restrict the road space towards median of the outgoing traffic. Any future widening has to be done on the other side (towards Customs Building) only. Similarly the obligatory spans shall be across the road space planned below. Future widening of inward traffic lane towards north gate may not be possible.

Details of the flyover, including preferred option, shall have to be worked out in the detailed design phase.

7.2.3 Entry-Exit Flyover to GTI Terminal

The common rail yard will handle to about 9 DFCC trains per day on an average. To avoid rail crossing at grade level a flyover is proposed which will start after the GTI entry gate till GTI yard. As shown in **Figure 7.6**. This would also affect the central gate as the same is coming within the approach of the flyover. The gate shall require to be shifted further towards the Y-junction.

Figure 7.6 Proposed Flyovers for GTI Entry/Exit Traffic Over DFCC Rail Tracks

7.2.4 JNPT Yard Restructuring

The existing yard area of JN Port is discontinuous as shown in **Figure 7.7**. It is proposed that JNPCT's import-export yards are made continuous, which will lead to better RTG utilisation and provide better operational arrangement.

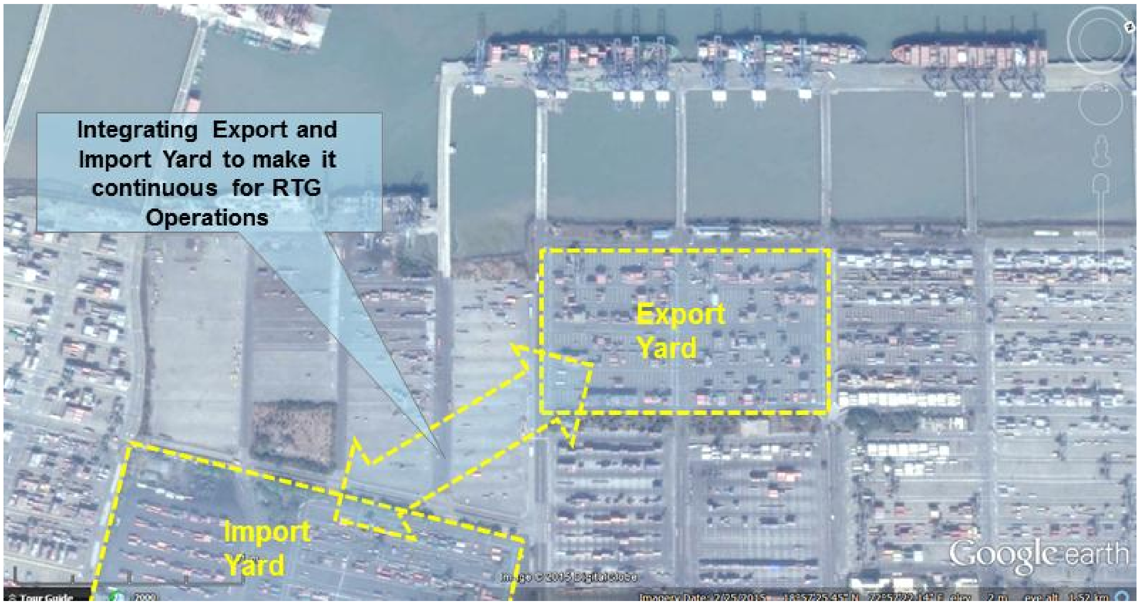


Figure 7.7 JNPCT's Existing Import-Export Yards

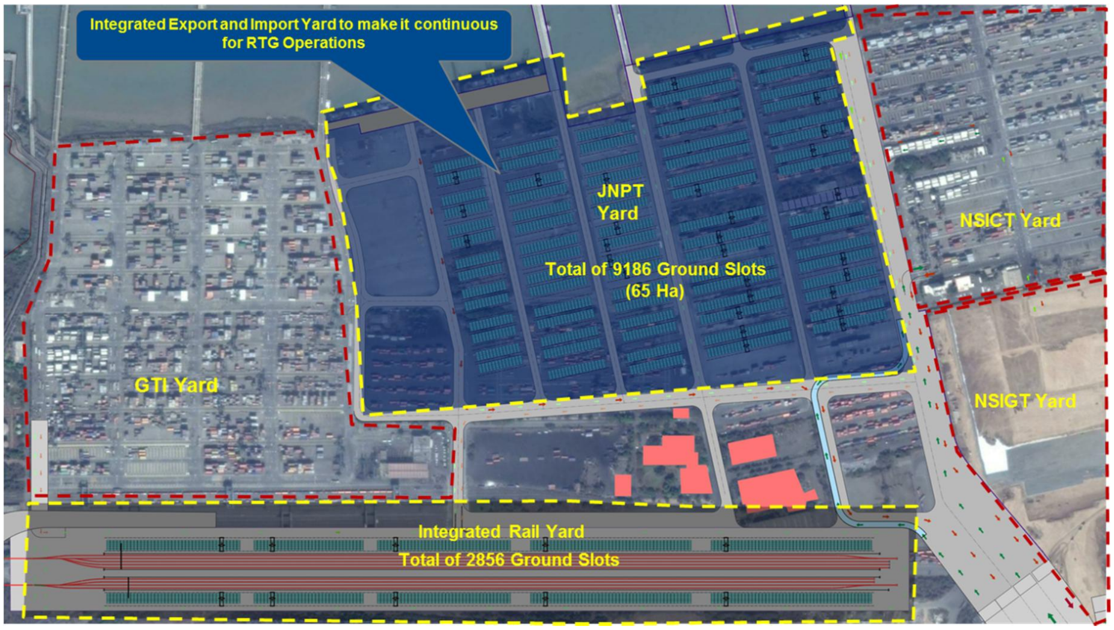


Figure 7.8 JNPT Yard Restructuring

The restructuring of the yard would allow optimum utilization of space and equipment and also free up space to develop roads of adequate width for proper circulation of traffic of all terminals to common rail yard.

Based on the current throughput to be handled at the JNPCT, it is assessed that only about 6,500 ground slots are adequate. However, provision of total 9,186 grounds slots is made to cater the increase in traffic in future. With proper arrangement for effective handling by RTGs lesser area would be needed to provide the required ground slots. This releases lot of space that could be utilised for the widening of internal roads and allow space for movement of vehicles between other terminals and common rail yard.

7.2.5 Common Rail Yard

7.2.5.1 Purpose

It is proposed to provide a common rail yard for the existing four container terminals at JNPT namely GTI, NSICT, NSIGT and Port's own JNPCT terminal. The 4th container terminal under construction shall have its own independent ICD yard.

The basic purpose of this yard is to:

- Aggregate the containers from different terminals at one location to ensure faster turnaround time of rakes.
- To allow handling of DFCC rakes which are double the length of current rakes

The location and layout of the existing yards and the proposed new yard is shown in **Figure 7.7**.

The common rail terminal shall have the following components:

1. In rail yard there shall be sidings for receipt/dispatch of DFCC rakes, assumed to be of 1400 m length.
2. Roads for movement of ITVs in the yard area and rail yard
3. Stacking space adjacent to rail yard
4. RTGs at the Yards area
5. RMGCs at rail yard
6. Terminal Buildings in the spare area in JNPT outside the rail yard
7. ITVs, other equipment, utilities

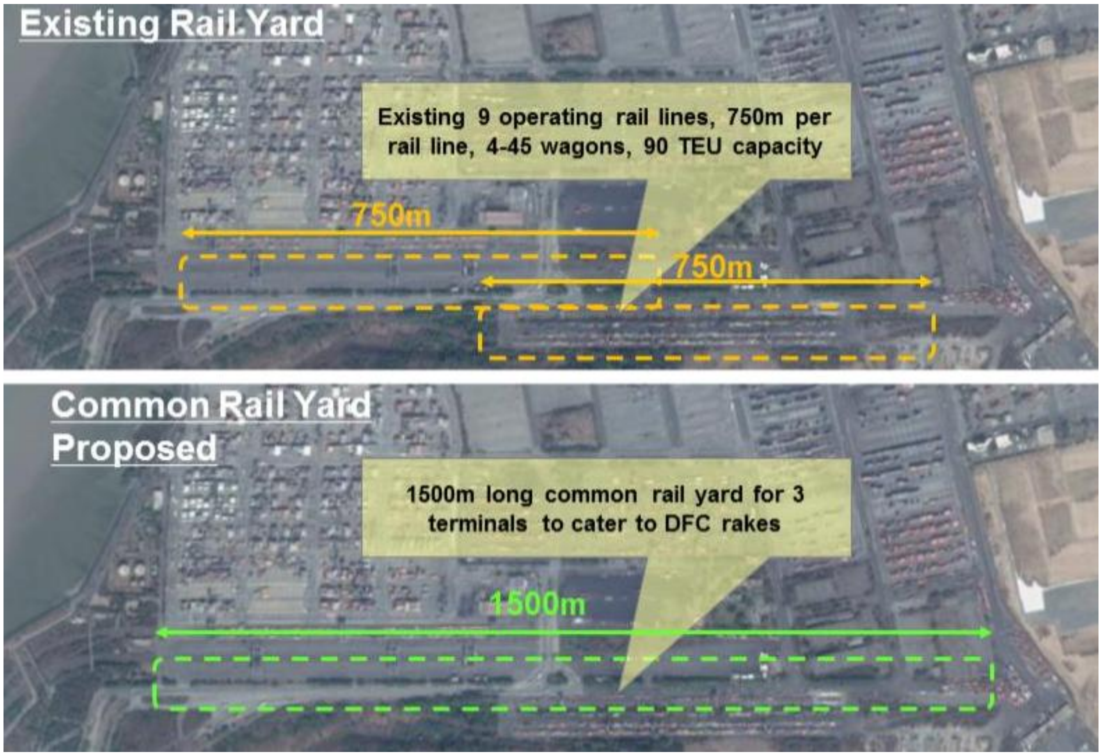


Figure 7.9 Existing and Proposed JNPT Rail Yard Plan

7.2.5.2 Facility Requirements

For arriving at the facility requirements at the rail terminal following assumptions have been made:

- The capacity of the existing terminals is taken as about 5.00 MTEUs per annum
- Maximum 5 high container stacking is assumed
- Dwell time of containers in the yard is taken as 2 days
- Total time for loading and unloading of each DFCC rake is limited to 8 hours

The facility requirements for the common rail terminal are worked out in **Table 7.3**.

Table 7.3 Facility Requirement for Common Rail Terminal

S. No.	Description	Proportion to be moved by Rail		
		20%	30%	40%
1.	Total Ground Slots at the Common Rail Yard	1,553	2,330	3,107
2.	Number of Rail Sidings Required	3	5	7
3.	Number of RTGs Required	16	24	32
4.	Total number of RMGCs Required	9	13	18
5.	Total Number of ITVs Required	71	105	143

It may be noted that the ground slot requirements for the common yard could be reduced by lowering the dwell time meaning the containers are transferred from this yard to the respective yards immediately on receipt or vice versa the containers are brought to this common yard just before their despatch by rakes.

7.2.5.3 Location and Layout

The common rail yard shall be located south of the existing road outside the JNPT's terminal. The overall yard length is kept as 1500 m and width as 250 m. This would enable handling of DFCC Compliant rakes at this yard. There shall be changeover points at the mid-length of the track to handle two non-DFCC compliant rakes at the same time.

The stacking areas are proposed adjacent to rail sidings with Nested RMGCs and RTGs. The storage area in this yard shall be utilised for aggregation and separation of ICD traffic. In the proposed arrangement about 2,856 Ground Slots are available for stacking. The overall layout of common rail yard is shown in **Figure 7.10**.

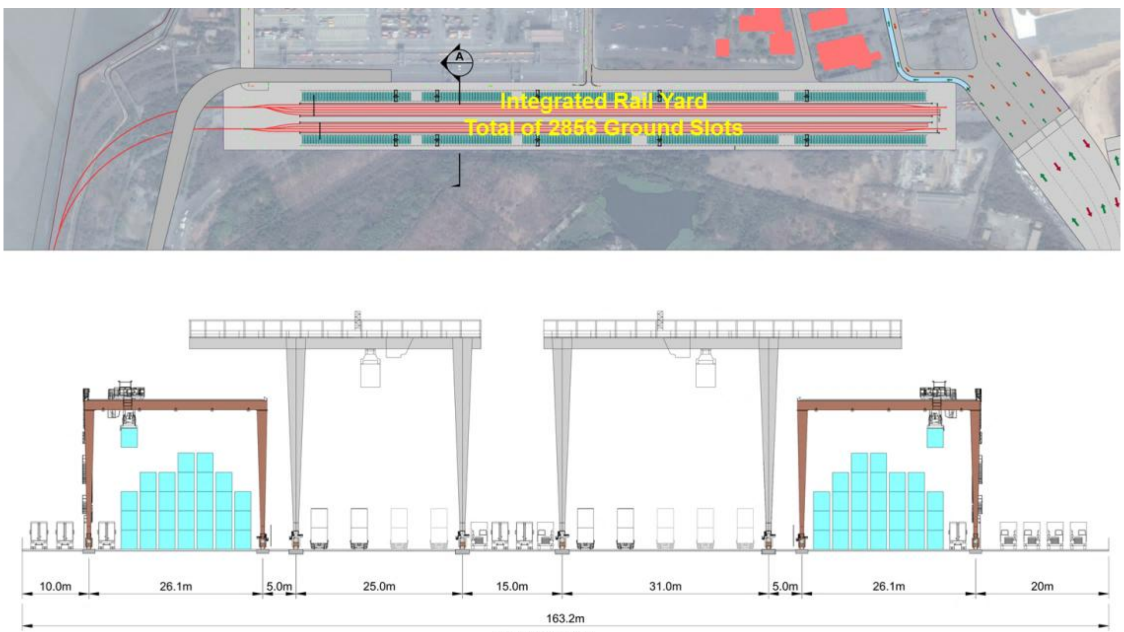


Figure 7.10 Concept Plan of Integrated Common Rail Yard

7.2.6 Traffic Circulation Plan at the Container Terminals

Major changes in the existing layout for the smooth flow of traffic at the container terminal are envisaged as below:

- A flyover is proposed for entry of external TTs to JNPCT yard to reduce criss-crossing observed at various locations.
- New 20 m wide road is proposed for movement of ITVs from terminal to Common rail yard simultaneously facilitating the inter terminal movement between GTI terminal to NSIGT/ NSICT terminal
- Existing Road as shown in the **Figure 7.11** has been widened to minimum 60m width.

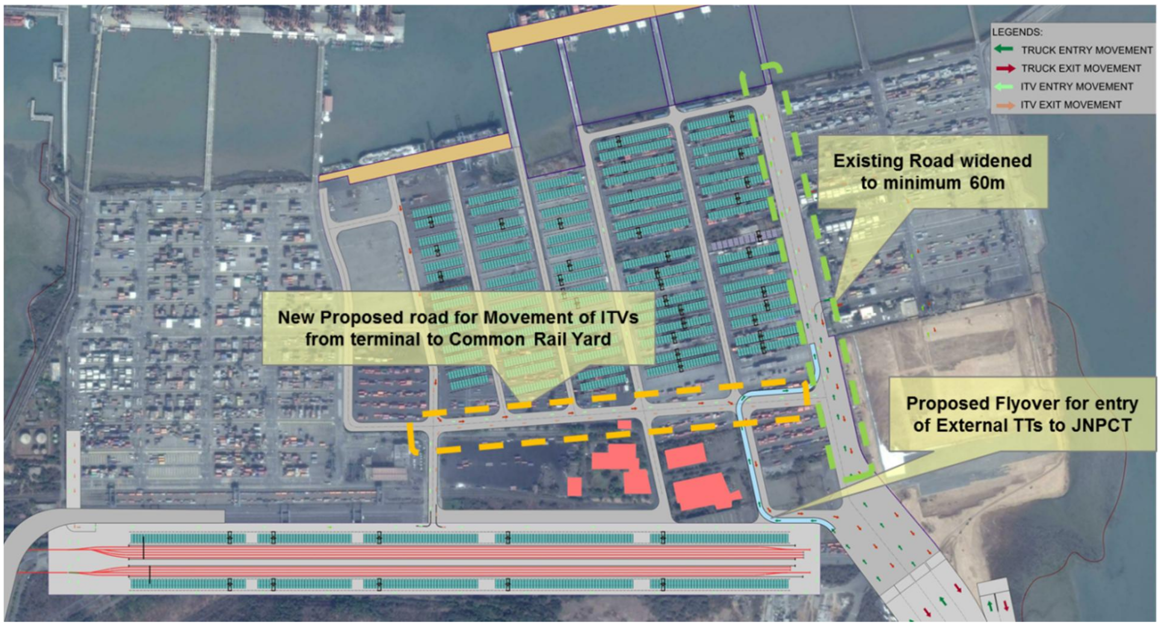


Figure 7.11 Major Changes in the Existing Layout for the Smooth Flow of Traffic at the Container Terminal

7.2.6.1 Movement of ITVs and External TTs from NSICT

The movement of ITVs from the NSICT terminal to common rail yard shall follow the designated path as shown in the **Figure 7.12**. There shall be a separate entry and exit for the movement of external TTS and ITVs in order to avoid criss-crossing.

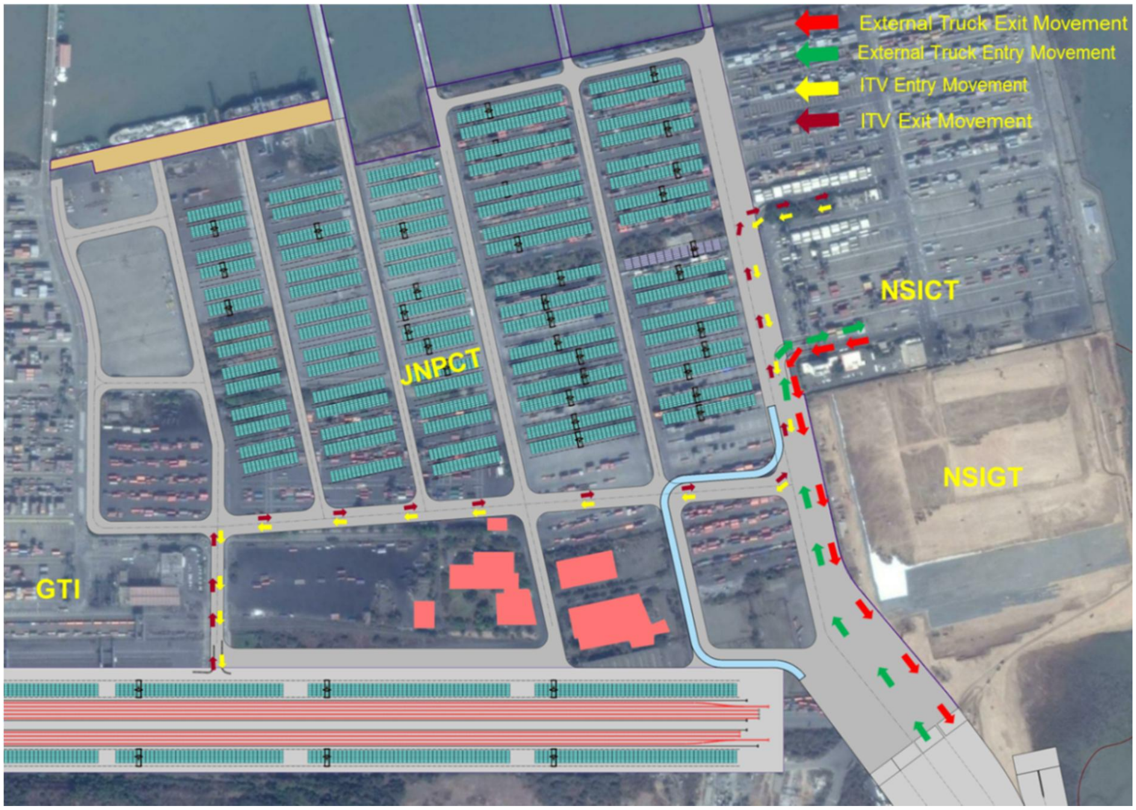


Figure 7.12 Traffic Circulation Plan for NSICT Terminal

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7.2.6.2 Movement of ITVs and External TTs from NSIGT

The movement of ITVs from the NSIGT terminal to common rail yard shall follow the same path as designated for the NSICT terminal to common railyard however the ITVs shall pass through NSICT terminal as shown in the **Figure 7.13**. The external TTs shall also follow the designated path.

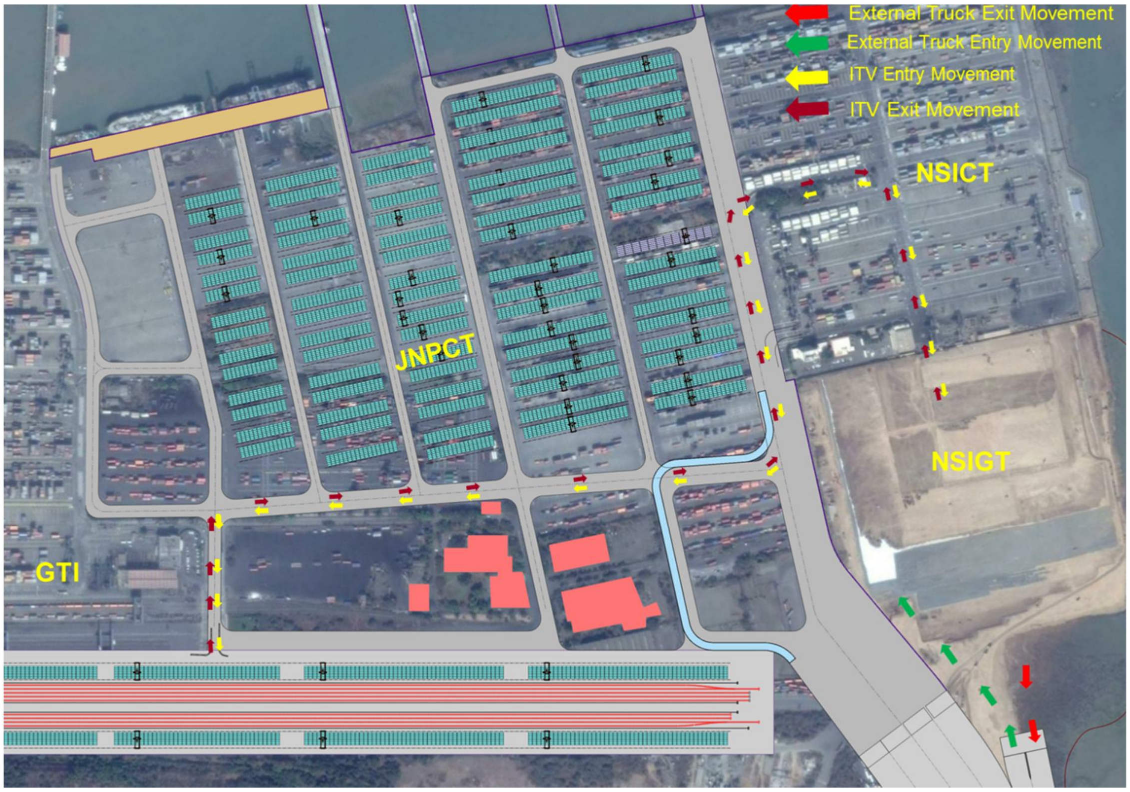


Figure 7.13 Traffic Circulation Plan for NSIGT Terminal

7.2.6.3 Movement of ITVs and External TTs from JNPCT

The movement of the ITVs from the JNPCT terminal to common rail yard shall be as per the designated path shown in the **Figure 7.14**. However for the entry of external TTs to JNPCT a flyover is proposed. This flyover allows the external trucks to enter JNPCT terminal without any criss-crossing while the exit will remain from the bottom of the proposed flyover.

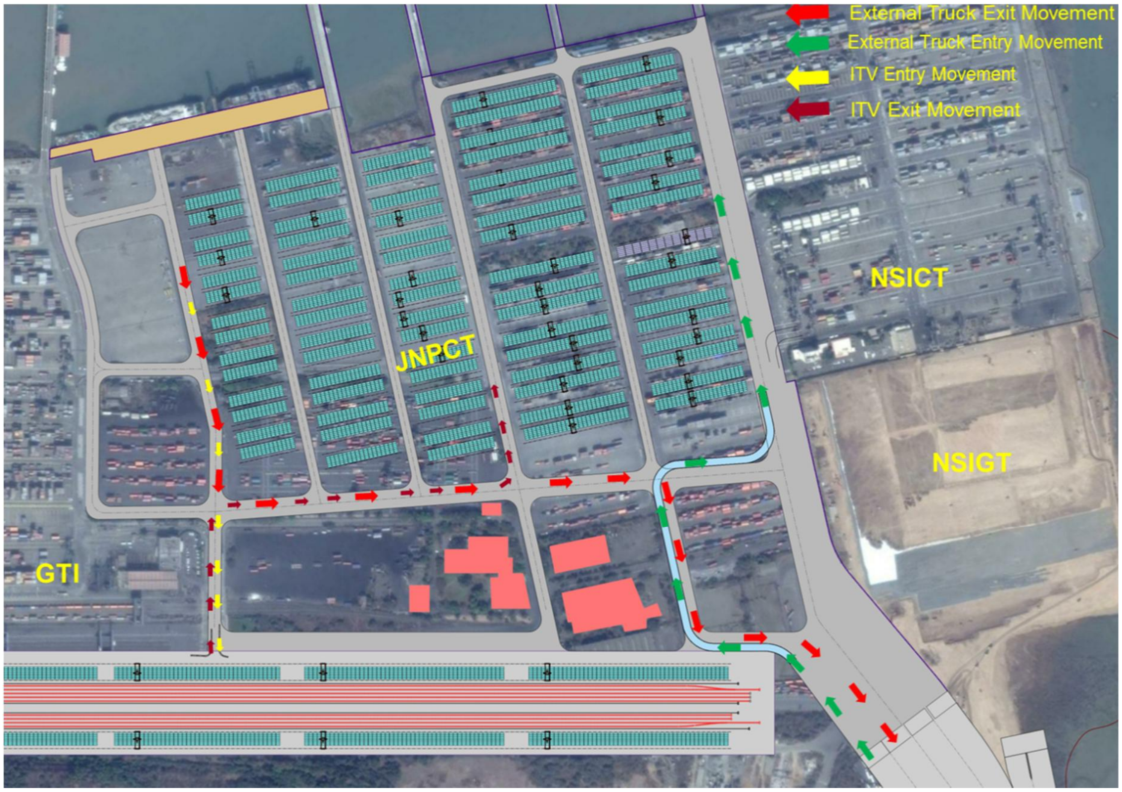


Figure 7.14 Traffic Circulation Plan for JNPCT

7.2.6.4 Movement of ITVs and External TTs from GTICT

GTICT has a separate entry and exit and shall use the flyover proposed for the to and fro movement of the external TTs. For the movement of the ITVs from GTI terminal to common rail yard the designated path shall be as shown in the **Figure 7.15**.

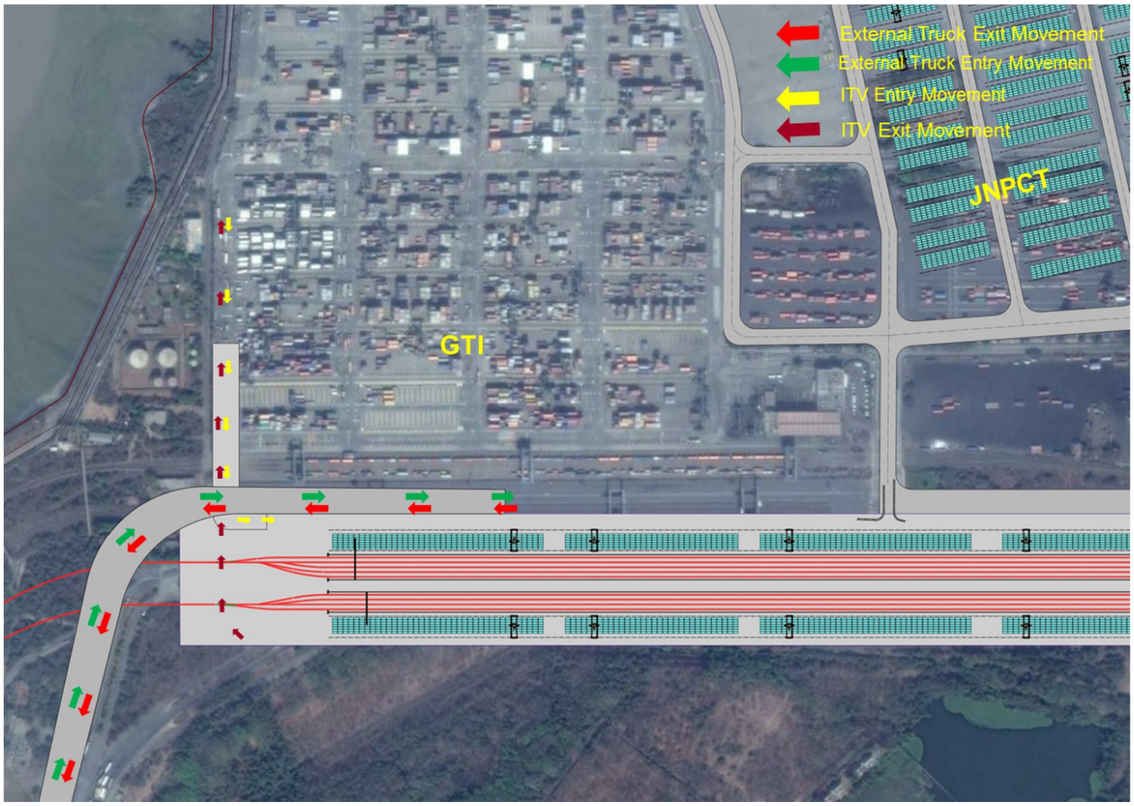


Figure 7.15 Traffic Circulation Plan for GTI

7.2.6.5 Movement of ITVs in the Common Rail Yard

One way circulation movement is proposed for the ITVs in the common rail yard as shown in the **Figure 7.16**.

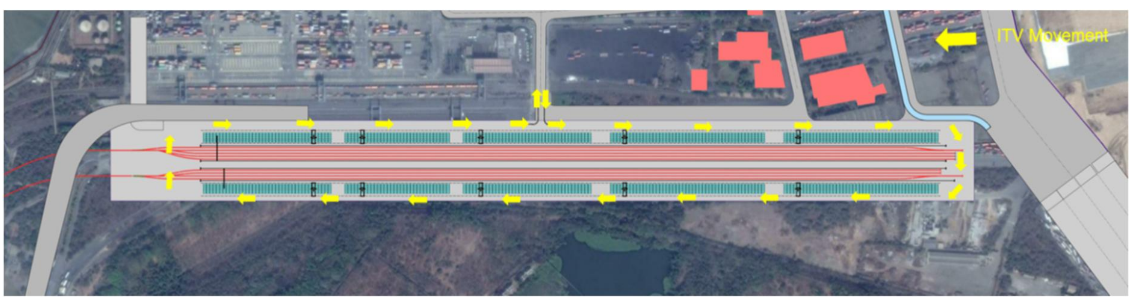


Figure 7.16 Traffic Circulation Plan for the Common Rail Yard

7.3 Capacity Augmentation

7.3.1 Liquid Cargo Handling Facility

7.3.1.1 Constraints

The existing liquid terminal faces the following constraints:

- Berth occupancy is very high at over 80% and as a result average waiting time for a vessel is around 5-6 days. Waiting period attributed due to port is 2-3 days and due to other factors in 3-5 days.
- When LPG vessel is berthed on the front side and during that time Crude/POL vessel cannot be handled at the other side but chemicals and edible oil tankers can be handled.
- Edible oil cargo volumes are showing increasing trend but due to their low parcel size and lower pumping rates they occupy the berth for significant time.

While JN Port has plans to build the second liquid terminal, it is likely to take time before it gets commissioned. It is therefore required to assess the possible schemes by way of which the waiting time of the liquid ships could be reduced and berth capacity increased.

7.3.1.2 Analysis of Data

The analysis of liquid terminal data is presented in **Table 7.4**.

Table 7.4 Analysis of JNPT's Liquid Terminal Cargo Handling

Ship Type vs. Calls Estimated			Cargo Transfer Rate (T / Hr)	Average Parcel Size (T)	Total Cargo (April14-March15)
1.	Crude Oil	22	2,167	54,912	12,08,063
2.	LPG	52	321	11,591	6,02,706
3.	POL	46	536	24,585	11,30,903
4.	Edible Oil	113	341	11,285	12,75,202
5.	Chemicals	121	260	5,394	6,52,620
Total Ship Calls		**354**		**Total Cargo**	**48,69,495**

(Liquid Terminal Raw data Source JNPT)

In order to arrive at the possible solutions the berth capacity has been assessed for the following 5 scenarios:

1. Base case scenario where berth handles all cargo
2. Berth to handle only LPG, Crude and POL
3. Berth to handle only crude and POL
4. A new berth for handling smaller tankers of Chemical and Edible oil
5. Existing berth to be augmented with an additional berth

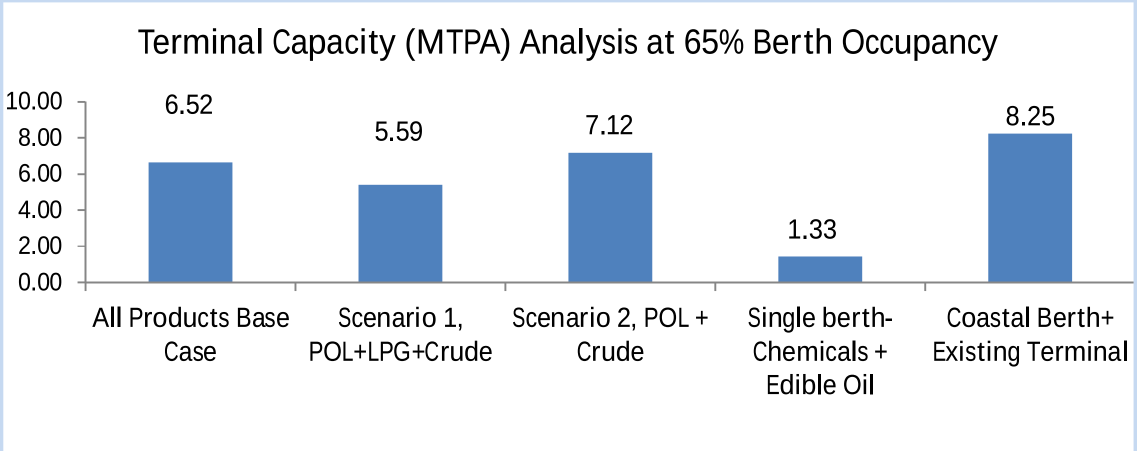


Figure 7.17 JNPT Liquid Terminal Options Capacity Analysis

The capacity for all the scenarios considered has been worked out and shown in **Figure 7.17**. It could be seen that in case an additional berth for small tankers could be made available, the total liquid handling capacity would go up to **8.25 MTPA** at optimal berth occupancy.

7.3.1.3 Possible Options to Expand Handling Facilities for Liquid Cargo

Following possible options have been considered:

- Extension of the Existing Liquid Jetty
- Utilisation of Coastal berth (under planning stage) for small tankers

These options are presented in **Figure 7.18** to **Figure 7.20**.

The extension of existing jetty would require consultation with PSA but it can offer most optimal solution by way of which significant additional liquid handling capacity would be available.

Utilisation of the coastal berth also would enhance the total capacity to **8.25 MTPA** and the only investment needed would be for laying the pipeline and providing marine hoses at berth and their connection to the existing pipelines passing nearby at a distance of about 300 m only.

7.3.1.4 Extension of Existing Liquid Terminal - Alternative 1

Existing liquid jetty can be extended by 300 m to create one side berthing facility for two small tankers as shown in **Figure 7.18**.

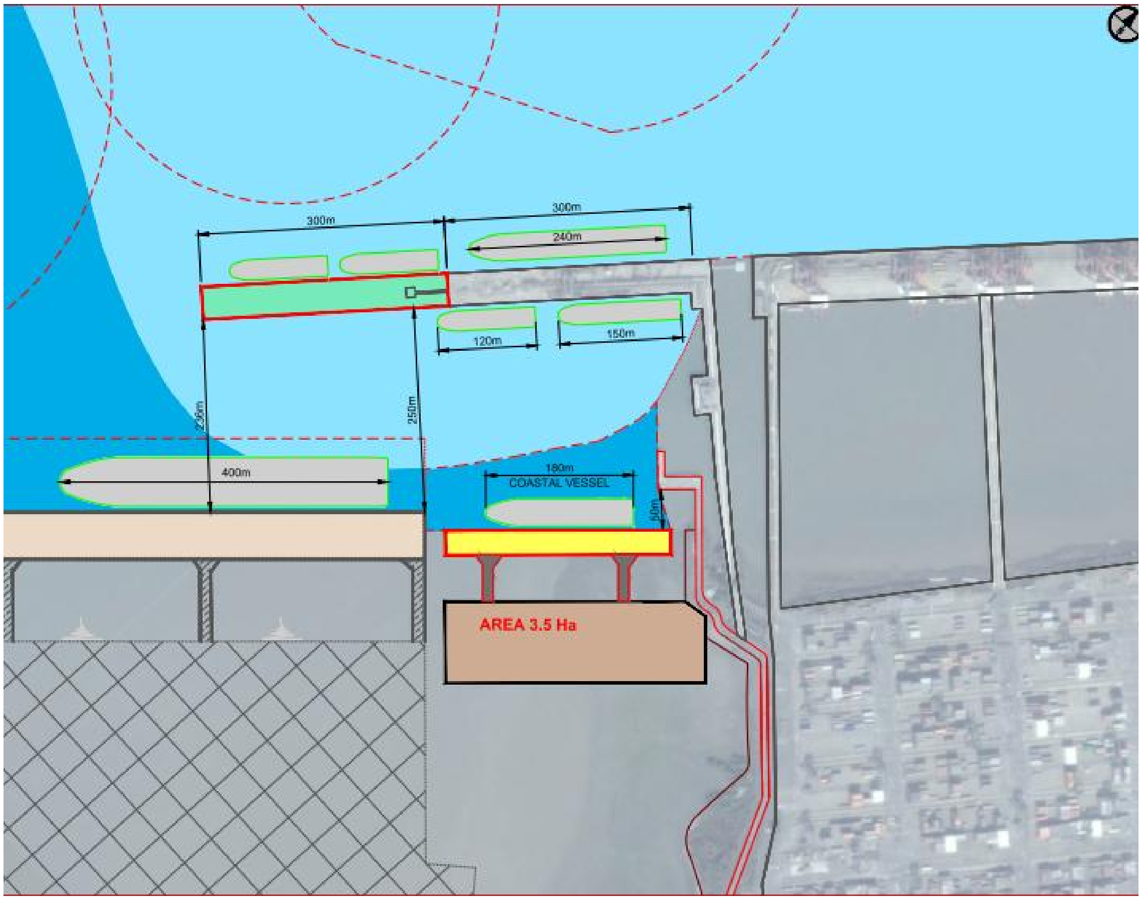


Figure 7.18 JNPT Liquid Terminal with 300 m Extension

7.3.1.5 Extension of Existing Liquid Terminal and /or Coastal Berth - Alternative 2

Existing liquid jetty can be extended by 150 m and one mooring dolphin to accommodate one small tanker on the additional berthing facility as shown in **Figure 7.19**.

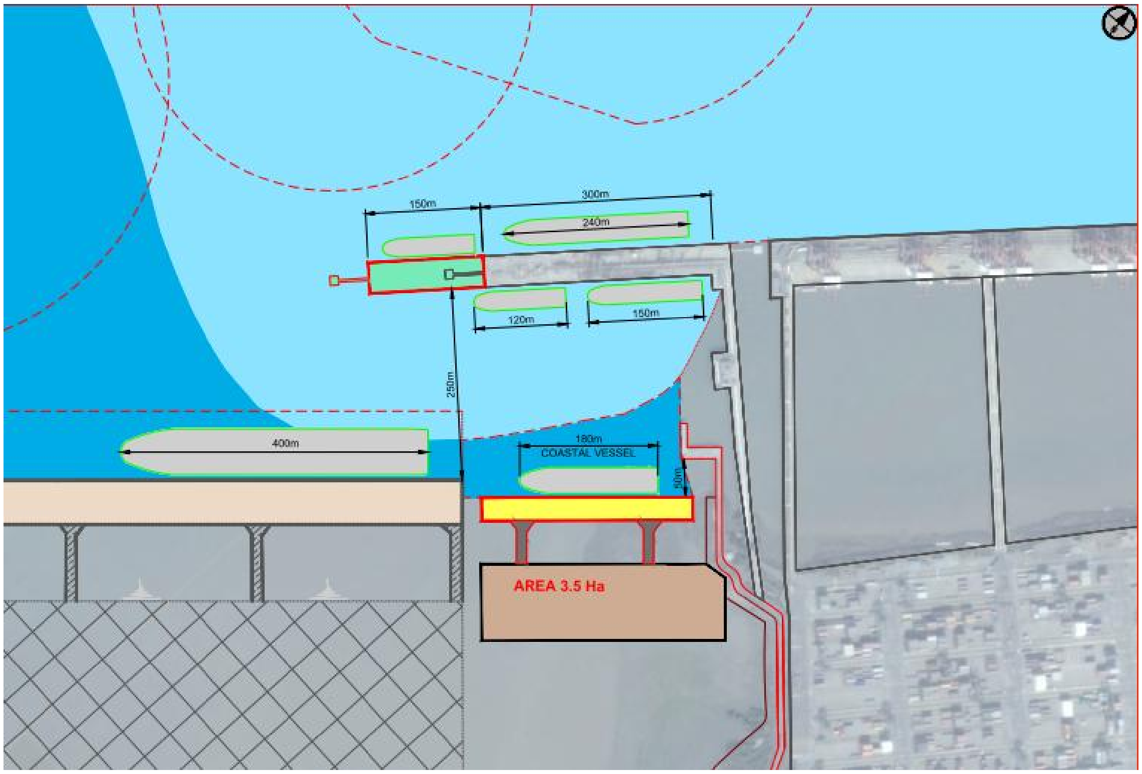


Figure 7.19 JNPT Liquid Terminal with 150 m Extension and Mooring Dolphin

7.3.1.6 Existing Liquid Terminal and /or Coastal Berth - Alternative 3

Existing liquid terminal facility can continue as it is with 300 m quay length added as a coastal terminal along the reclaimed land as shown in **Figure 7.20**. As per the capacity calculation standalone coastal berth for Edible oil and Chemicals will be able to handle about 1.3 MTPA cargoes.

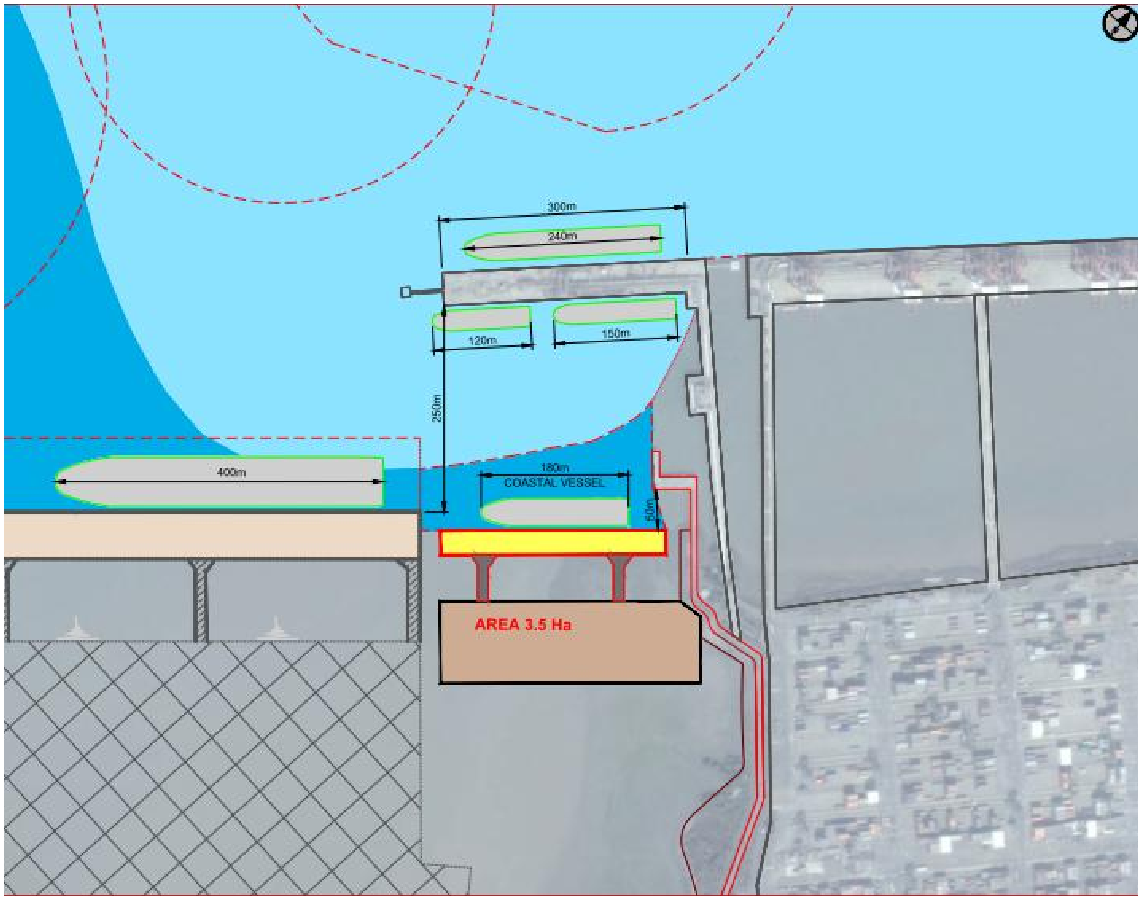


Figure 7.20 JNPT Liquid Terminal with Coastal Berths along the Reclaimed Land

7.3.1.7 JNPT Liquid Terminal Capacity Augmentation Conclusion

It may be observed from that above that Alternative 1 provides the most optimum solution, as the berth will be able to handle two small tankers. However, the clear gap of about 235 m between the 4th container terminal and the berth extension needs to be critically evaluated from the navigation point of view. Same is the case with Alternative 2. It is therefore suggested that ship manoeuvring studies be carried out to confirm the suitable scheme.

However, Alternative 3 can be independently taken up and this itself has a potential to augment the overall terminal capacity by about 1.3 MTPA.

It is also understood that port received requests from M/s. Monopoly Innovations Pvt Ltd., M/s Emami and M/s. Sumeru Bio-diesel for allotment of land for the subject purpose. They have informed that the expected throughput of these units will be about 2 to 3 MTPA. In view of the significant traffic it is suggested that shall water berth be also used along with the proposed coastal berth for handling of the edible oil and biodiesel. It would however be required that the pipelines from the coastal berth and shallow water berths are connected to the existing pipelines on the approach to BPCL jetty, for which user consent will be required. Common user manifolds will be needed at the connection point near jetty and near refineries (proposed to be located behind PUB/Custom office).

7.3.2 North Anchorage

JNPT should have an inner anchorage so sailing time can be saved thus increasing overall occupancy and throughput. Anchorage area at the north of JNPT can be used for this purpose. Two sets of Steel Mooring Buoys with Quick Release Hooks and Triple Anchor System of mooring shall be procured, which could be placed on the north western edge of the JNPT anchorage off Nhava Island. This would enable lighterage operations for transferring cargo to Mumbai port and also provide space for waiting of the ships.

Figure 7.21 JNPT North Anchorage Location

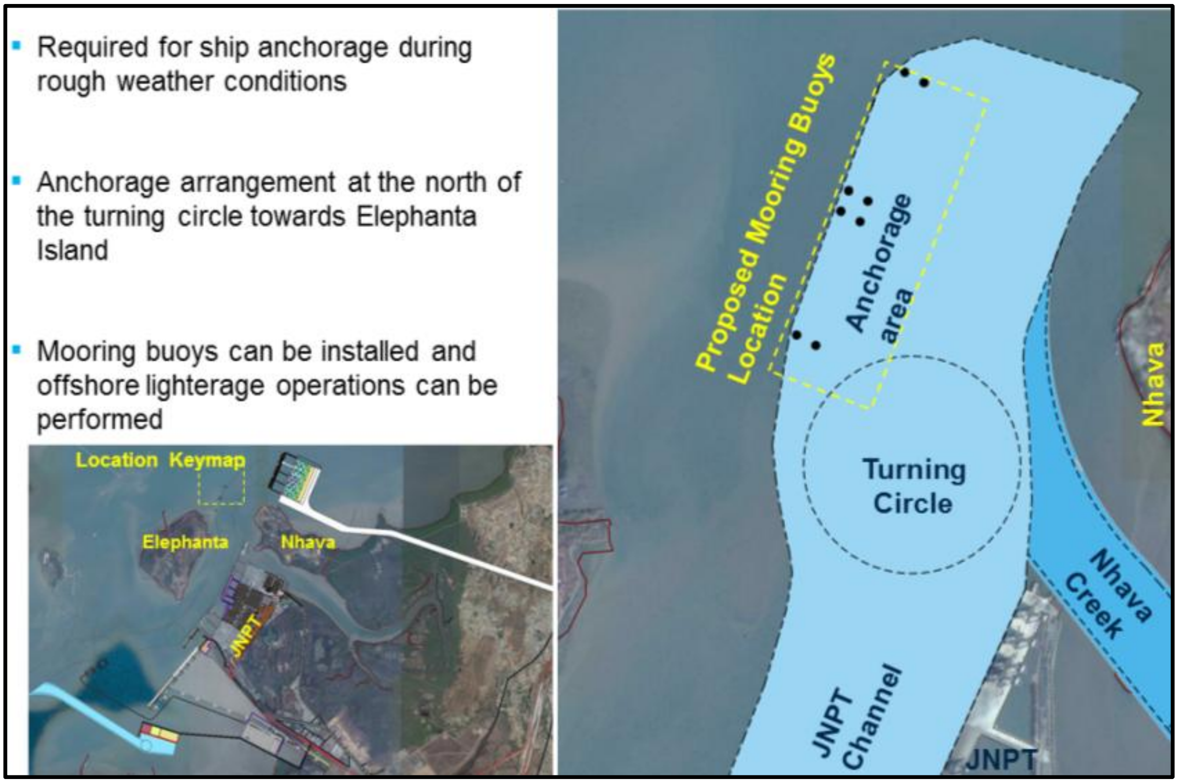


Figure 7.22 JNPT North Anchorage proposed Mooring Buoys

8.0 SCOPE FOR FUTURE CAPACITY EXPANSION

8.1 Possible Locations for Capacity Expansion

In order to create more capacity, various sites within JNPT port limits have been studied. The section presented below summarises various project which can be taken up for capacity addition. **Figure 8.1** below shows the different sites considered for new projects.

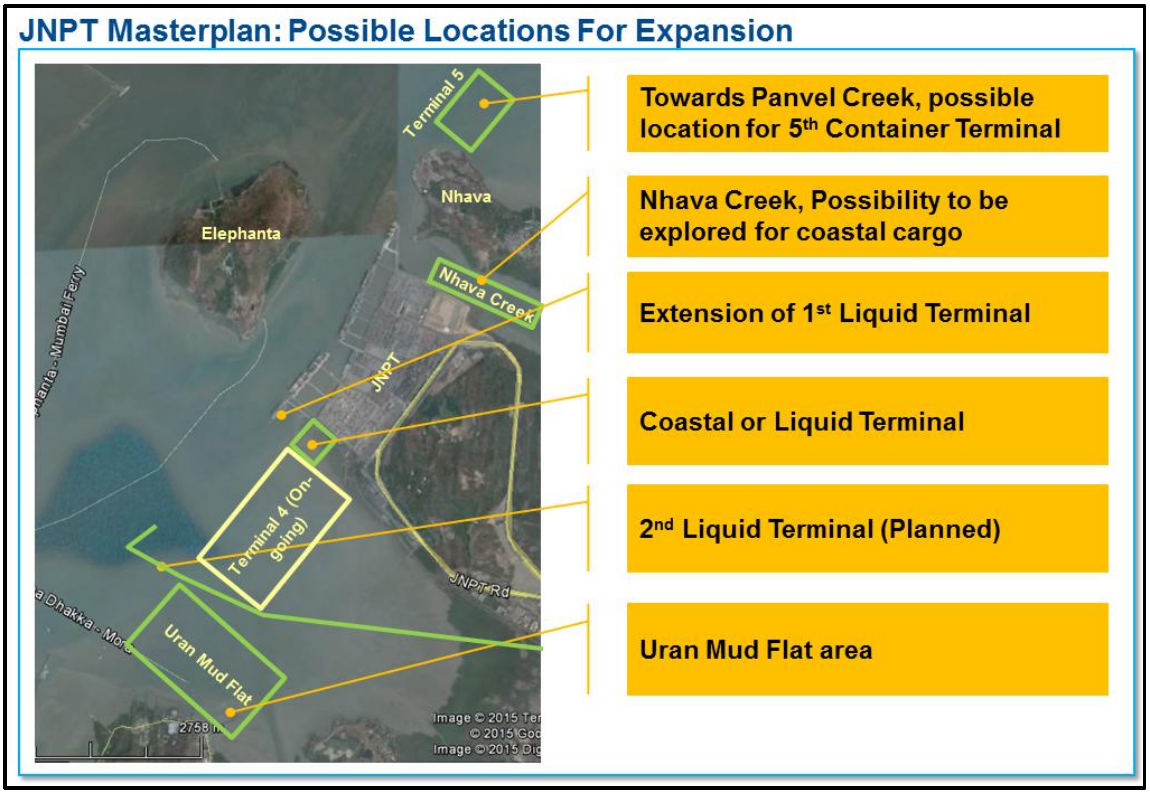


Figure 8.1 Possible Location for Expansion within JNPT Limits

8.2 5th Container Terminal at Panvel Creek

8.2.1 Site Data, Constraints & Opportunities

Figure 8.2 below shows the opportunities and constraint map of the 5th Terminal location.

5th terminal will have to be a separate terminal just like JNPT's 4th container terminal. Proposed Trans Harbour Sea Link alignment is just north of the proposed site. 5th terminal will have to be developed entirely on the reclaimed land and approach corridor will be needed for rail and road connectivity.

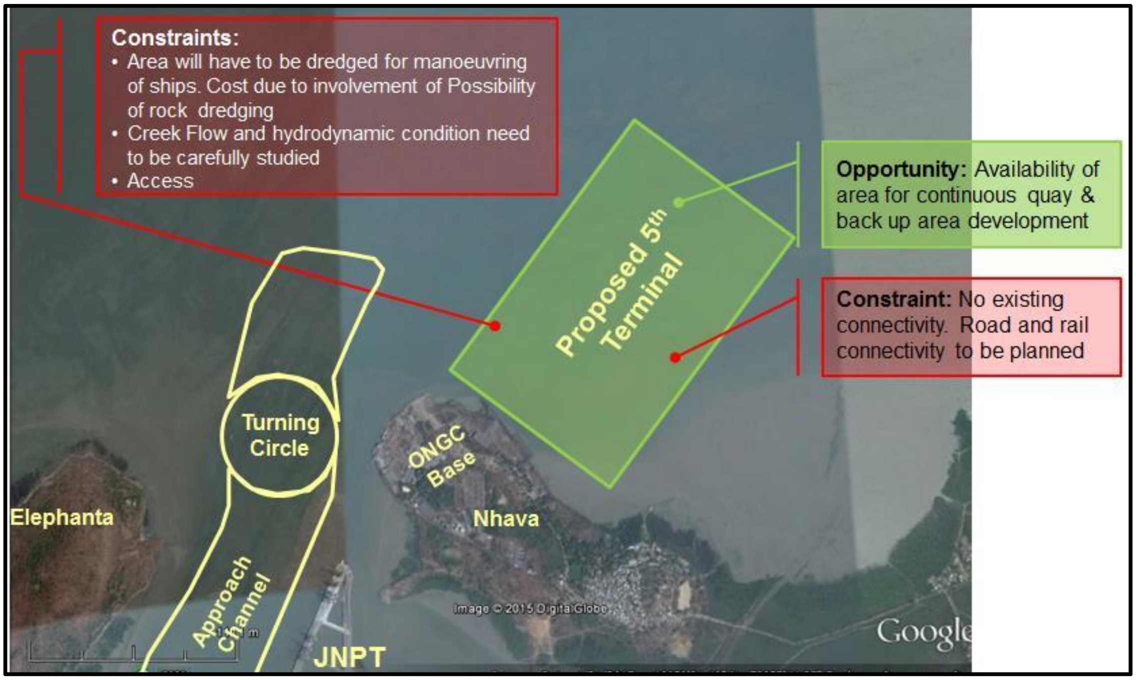


Figure 8.2 Opportunities and Constraint map of 5th Terminal Location Near Nhava

8.2.2 Salient Features & Layout of the Proposed 5th Container Terminal

- Proposed Terminal is at the North of Nhava Island in Panvel Creek
- Phase 1 facilities proposed: 1000 m long Container berth, with yard and other facilities on reclaimed land, connected to main land using approach trestle.
- 85 ha. area for Container Yard and backup area, 40 ha. area for approach corridor.
- Possible capacity addition of **2 million TEUs**

Conceptual plan of the 5th container terminal is shown in the **Figure 8.3**.

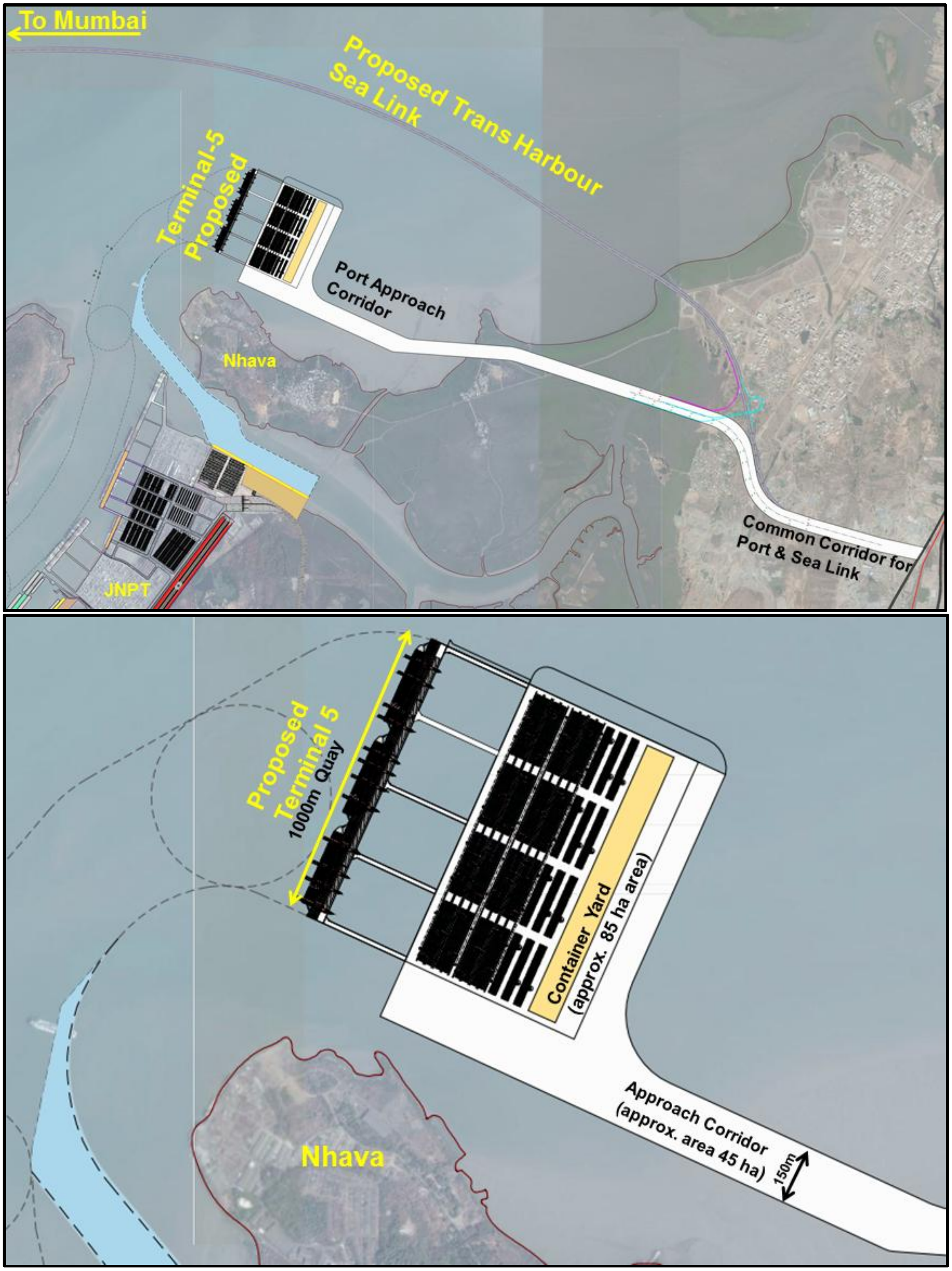


Figure 8.3 Proposed 5th Container Terminal and its Location Plan

The hydrodynamic conditions due to the proposed development need to be critically studied from sedimentation point of view

8.3 Terminals in Nhava Creek

8.3.1 Site Data, Constraints & Opportunities

Nhava Creek as shown in **Figure 8.4**, is the relatively small tidal Creek which separates Nhava Island from Sheva and flows out and meets the waters of Mumbai Harbour at the eastern edge of "Elephanta Dweep". Thus, the island of Nhava is on its north bank and Sheva on its south bank. The last (downstream) 5 or 6 km of this creek fall within the port limits of JN Port. The entrance has a restricted width of about 90 m due to the construction of the guide bund north of Sheva Island. Immediately inside the entrance the creek width is about 600 m and narrows down to about 500 m, 1 km upstream of the creek.

- POL/Edible Oil & Costal Cargo Terminal Proposed
- Road connectivity possible along the existing port road
- 16.4 ha. of storage area through reclamation.

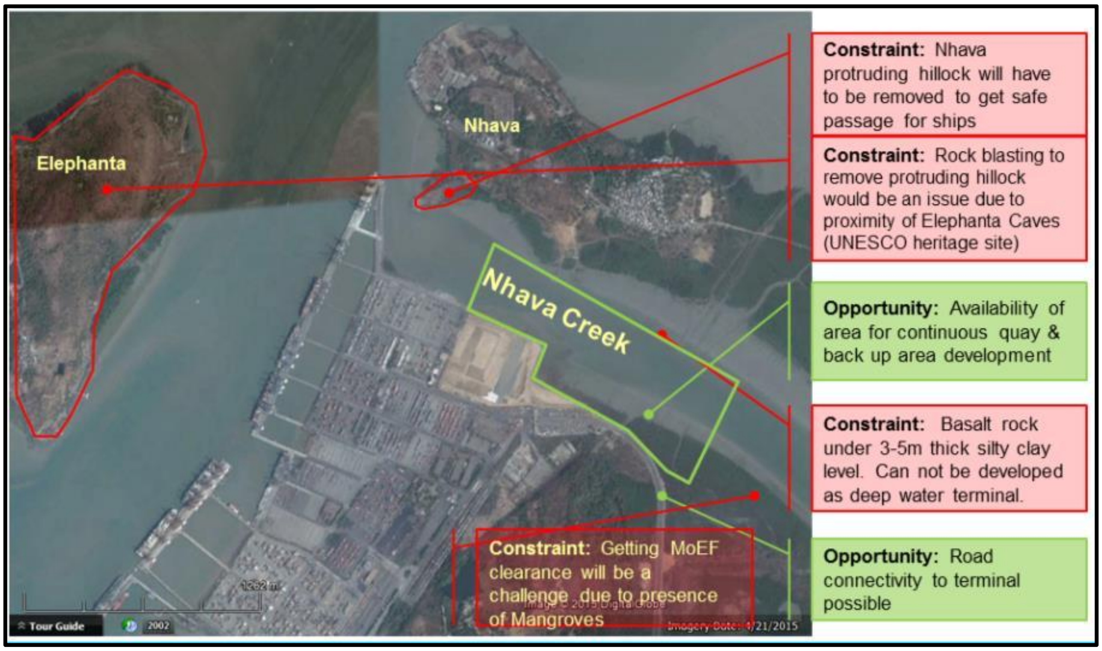


Figure 8.4 Opportunities and Constraint Map of Nhava Creek

There are many constraints for the proposed development as clearly mentioned in **Figure 8.4**. These have to be mitigated during the detailed design phase.

8.3.2 Salient Features & Layout of Nhava Creek Terminal

- Nhava creek terminal will need reclamation over the existing mangroves area in Nhava Creek.
- Approach corridor can be developed along the existing JNPT approach corridor.
- Nhava creek terminal will be developed to handle small draft coastal cargo, liquid cargo (edible oil/chemicals) and Car carriers.
- Maximum possible ship size will have to be restricted as per the Nhava creek opening and dredged depth.
- 1000 m quay length can be developed for handling various cargo handled using small parcels.

Conceptual plan of Nhava creek terminal is shown in the **Figure 8.5**.

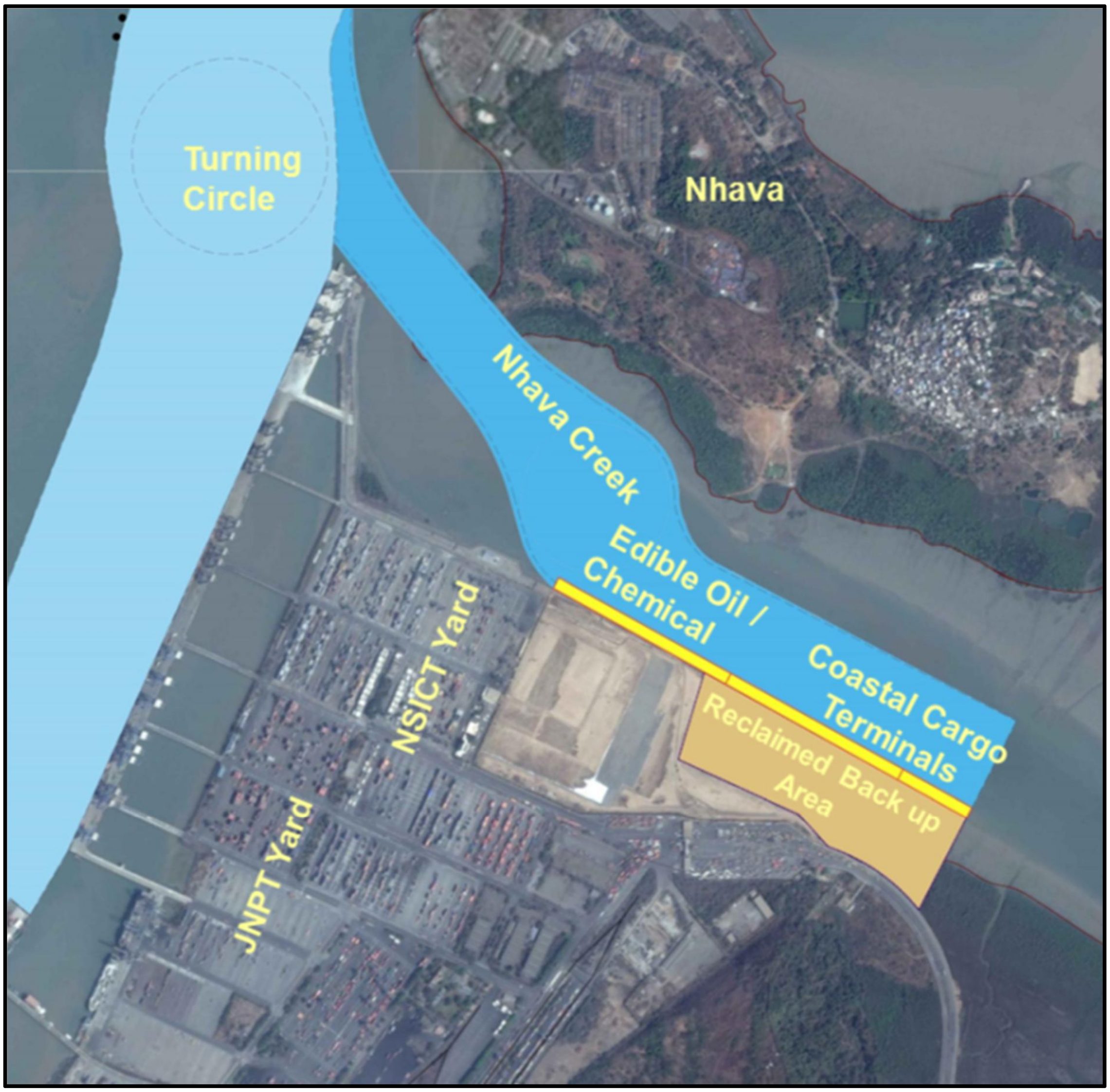


Figure 8.5 Location of Proposed Berths at Nhava Creek

8.4 Developments at Uran Mud Flat

8.4.1 Site Data, Constraints & Opportunities

Uran mud flat site is south of JNPT Terminal 4. Similar to JNPT Terminal 4, a coastal terminal can be developed on reclaimed land. The constraint could be the flow pattern that would be affected by the reclamation which can be studied using mathematical or physical modelling studies. The tidal flow pattern may cause siltation in the dredged basin. **Figure 8.6** below shows the opportunities and constraint map of Uran mud flat area.

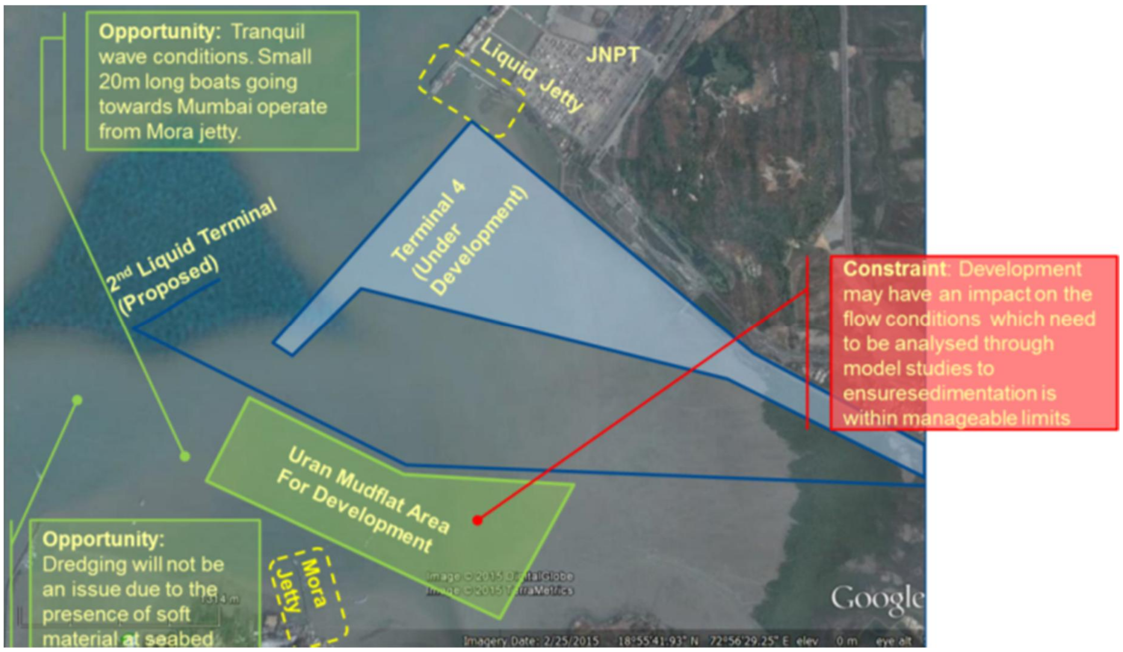


Figure 8.6 Oppotunities and Contraint Map of Uran Mudflat Area

There are many constraints for the proposed development as clearly mentioned in **Figure 8.6**. These have to be mitigated during the detailed design phase.

8.4.2 General Layout

While developing the options at Uran Mudflat, it has also been borne in mind that the independent terminal for a single commodity may not be viable financially due to likely high cost of maintenance dredging and therefore the emphasis is to provide multiple facilities, including that for liquid cargo, for which offshore berths have been planned currently.

Figure 8.7 shows various possible alternatives that could be possible at Uran Mudflats. These options would however need to be studied in model studies to arrive at the most optimal solution that can make the development in Uran Mudflats financially viable, without having an adverse impact on the existing facilities.

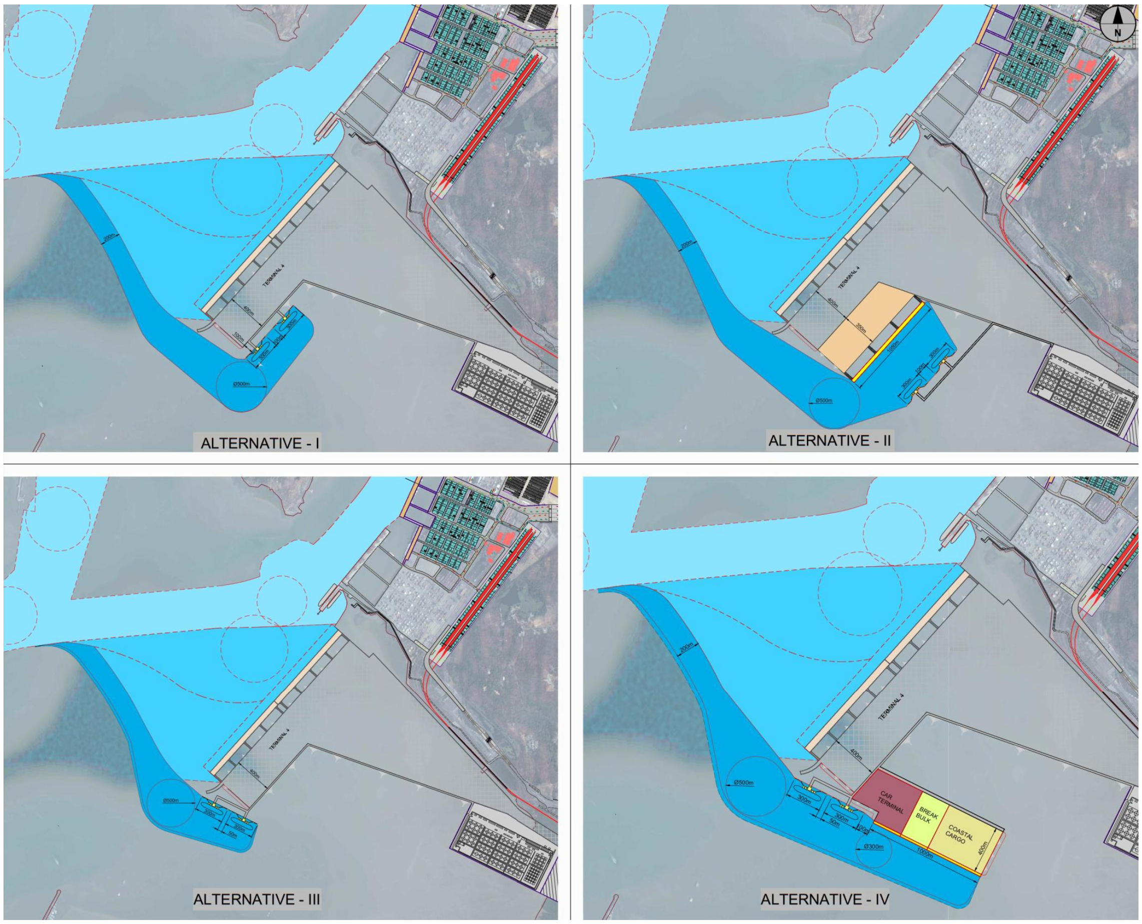


Figure 8.7 Indicative Alternative Options for Development at Uran Mudflats

9.0 SHELF OF NEW PROJECTS AND PHASING

As part of the JNPT master plan several projects have been identified which need to be taken up in phased manner with the built up in traffic. The proposed phasing, capacity addition and the likely investments are discussed in paragraphs below. Many of these projects are subject to outcome of detailed techno economic studies, which shall be conducted as part of the project development.

It may be noted that apart from these projects there could be several other projects which port would be implementing as part of the routine operations and maintenance of the port facilities. Further the phasing proposed is not cast in stone but could be reviewed periodically and revised based on the economic scenario and demand for port at that particular point of time.

9.1 Ongoing Projects

The details of the projects which have already been awarded and development is ongoing are given below in **Table 9.1**.

Table 9.1 Ongoing Projects

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (in Crores)	Mode of Implementation
1.	JNPT Container Terminal T4 - Phase 1	30.0	4,719	PPP

9.2 Projects to be completed by Year 2020

The details of the projects which are envisaged to be completed by year 2020 are given below in **Table 9.2**.

Table 9.2 Projects to be Completed by Year 2020

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (in Crores)	Mode of Implementation
1.	Restructuring of JNPT Yard for Optimal Yard Utilization	3.0	200	Port's funds
2.	Flyover at Y Junction for Decongestion of Traffic Flow	-	200	Port's funds
3.	Integrated Common Rail Yard	3.0	200	PPP
4.	North Anchorage	-	50	Port's funds
5.	Flyover for GTI Entry/Exit Over the Rail Tracks to Common Rail Yard	-	70	Port's funds
6.	Deepening and widening of JNPT and Mumbai Channel Phase 2	24.0	2,029	Port's funds
7.	Utilization of Coastal Berth for Liquid Cargo	2.5	20	Port's funds
8.	Additional liquid bulk terminal - Phase 1	3.8	570	PPP
9.	Construction of central Truck Parking Terminal	-	200	Port's funds
10.	Evacuation road for standalone Container Terminal (330 m extension to DPW terminal)	-	54	Port's Funds
11.	SEZ Phase EPC Contract for Infrastructure Development	-	468	Port's funds

The port layout after completion of projects mentioned above shall be as shown in **Figure 9.1**.

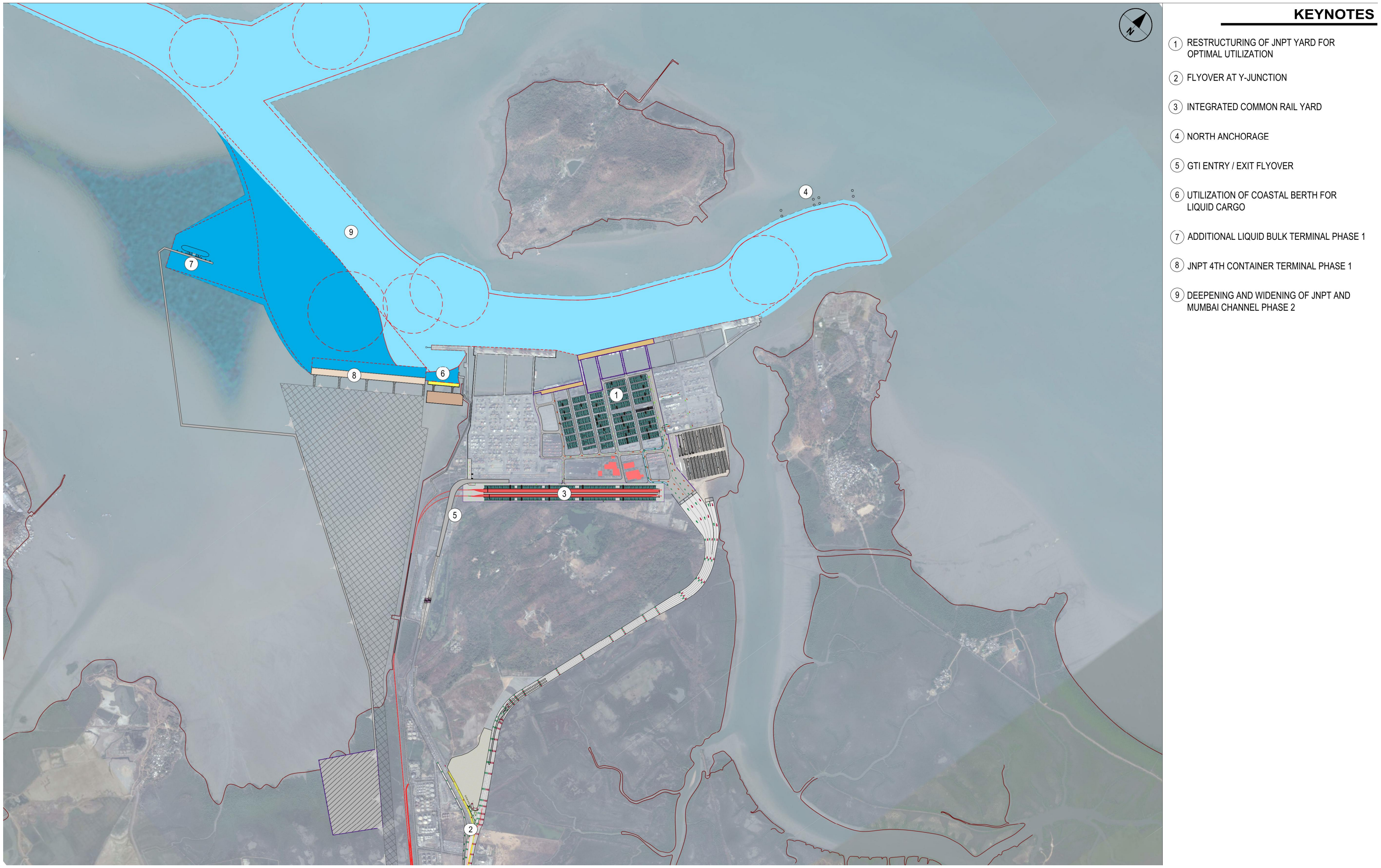


Figure 9.1 Layout Plan 2020

9.3 Projects to be completed by Year 2025

The details of the projects which are envisaged to be completed by year 2025 are given below in **Table 9.3**.

Table 9.3 Projects to be Completed by Year 2025

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (in Crores)	Mode of Implementation
1.	JNPT Container Terminal T4 - Phase 2	30.0	3,196	PPP

The port layout after completion of mentioned above shall be as shown in **Figure 9.2**.

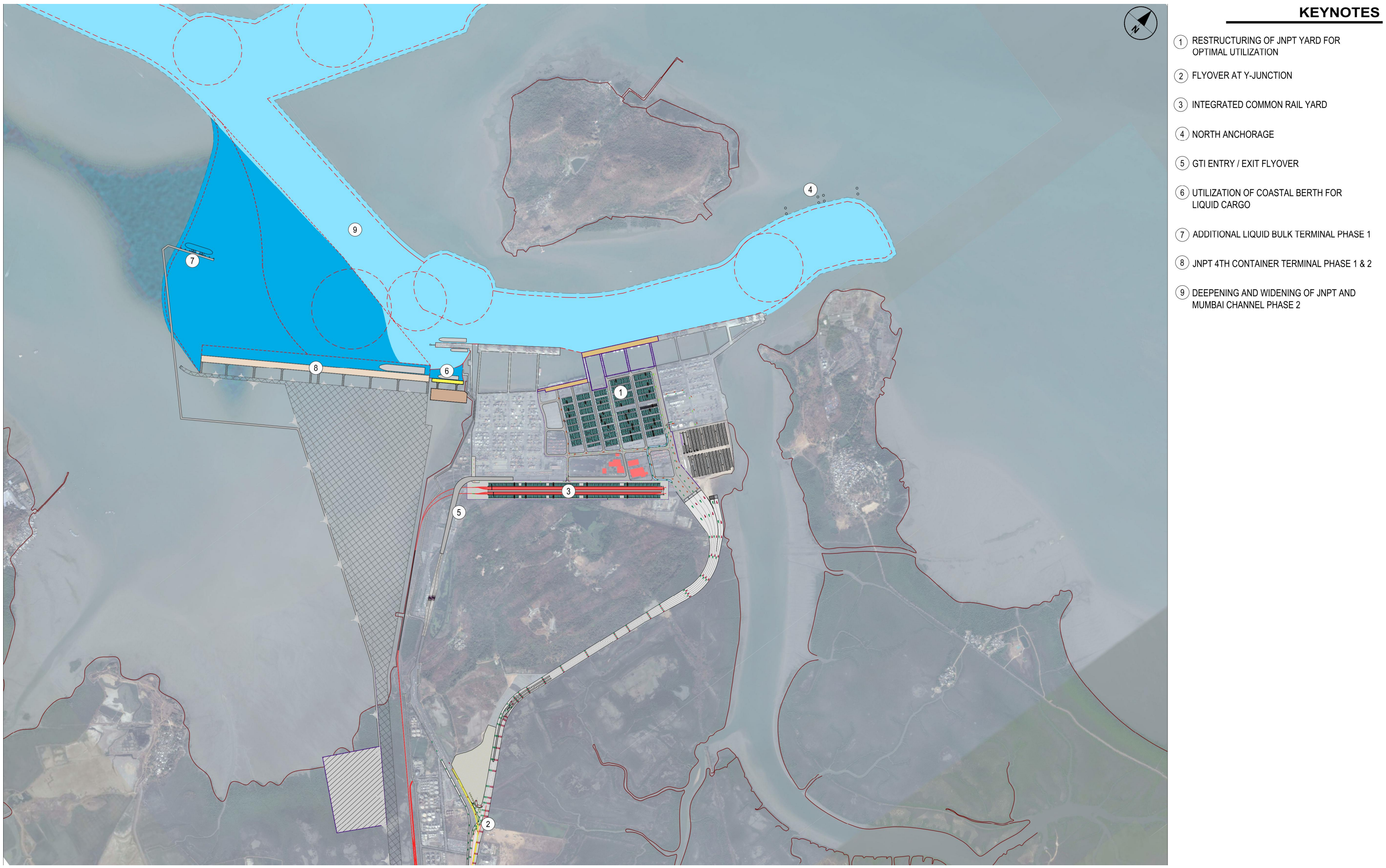


Figure 9.2 Layout Plan 2025

9.4 Projects to be completed by Year 2035

The details of the projects which are envisaged to be completed by year 2035 are given below in **Table 9.4**.

Table 9.4 Projects to be completed by Year 2035

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (In Crores)	Mode of Implementation
1.	JNPT Multipurpose Cargo Terminal in Uran Mud flats	6.0	1,000	PPP
2.	Terminals in Nhava Creek	6.0	600	PPP
3.	Additional Liquid Bulk Terminal - Phase 2	3.8	385	PPP
4.	JNPT 5th Container Terminal	30.0	5,500	PPP

The port layout after completion of mentioned above shall be as shown in **Figure 9.3**.

Figure 9.3 Layout Plan 2035

Appendix 1 - **BCG Benchmarking Study for Jawaharlal Nehru Port (JNPT)**

2 JNPT Port Deep-dive

2.1 Port overview

Jawaharlal Nehru Port Trust (JNPT) is the largest container port in India, located east of Mumbai in Maharashtra, on the western coast of India. There are three container terminals at the JNPT port—JNPCT, operated by the Port Authority, with 2 container berths, 2 shallow draught container berths, and 2 liquid berths dedicated to BPCL and IOCL; GTIPL, operated by APMT, with 2 container berths; and NSICT, operated by DP World, with 2 container berths.

In order to increase capacity, a fourth container terminal, which will be operated by PSA, is being constructed with 2km quay length. A berth extension of 330m is also being constructed for NSICT, which will be operated by DP World.

Figure 8: Container terminals at JNPT

Capacity is projected to increase by 0.8 Mn TEUs in 2015–16, with an additional berth operated by DP World. Longer-term capacity addition will largely accrue from a 4.4 Mn TEU terminal operated by PSA. Phase 1 of the fourth terminal is expected to be commissioned by 2017-18 with a capacity of 2.4 Mn TEUs. The second phase is expected to go live during 2022-23, adding a further 2 Mn TEU capacity that will take the total capacity at JNPT to 10.2 Mn TEUs. However, to bridge the gap in the medium term, more capacity needs to be unlocked from the existing terminals.

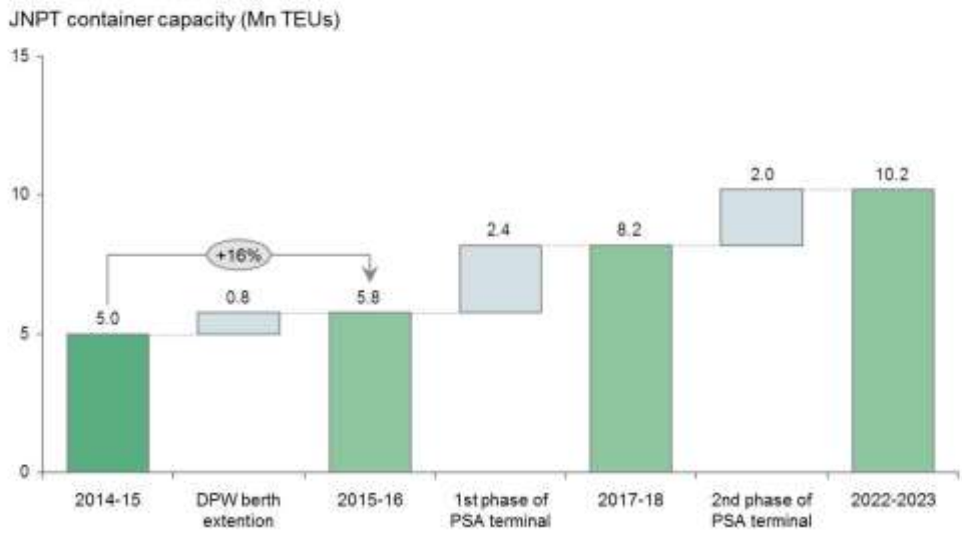


Figure 9: Projects launched to increase capacity at JNPT

Revenues for JNPT have grown at approximately 8% since 2008, with the private container terminal operators contributing to nearly 75% profits of JNPT. While JNPT has had moderate growth on operating profits, the net profit of the port sharply declined in 2015 due to fall in revenue from the GTI terminal.

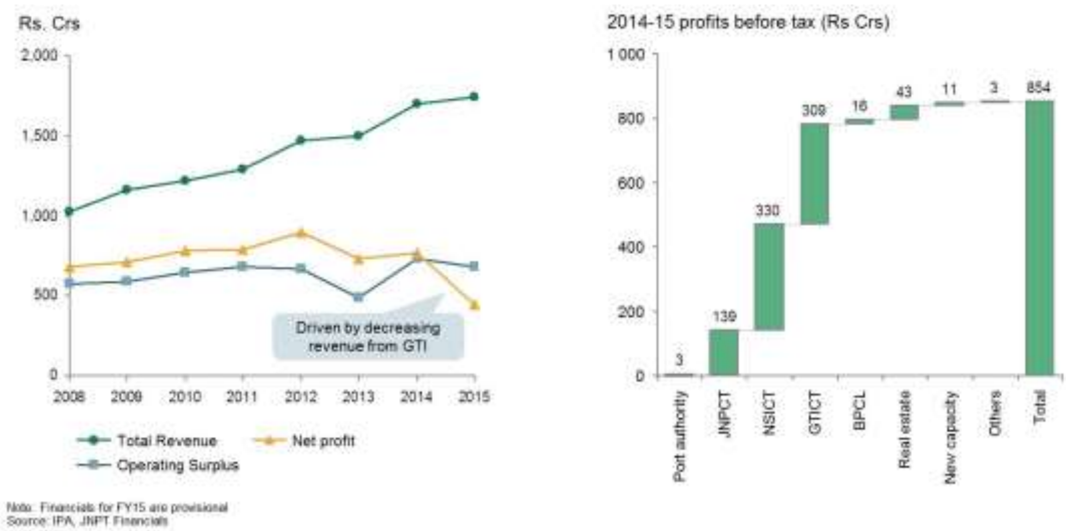


Figure 10: Revenue trends for JNPT

The capacity utilization of the two private terminals—GTI, NSICT—are greater than 90%. JNPT's own terminal has lower capacity utilization of 68%. However, when capacity utilization of JNPT is adjusted with the actual capacity instead of nominal capacity, JNPT's own terminal is seen to have a high occupancy of ~96%.

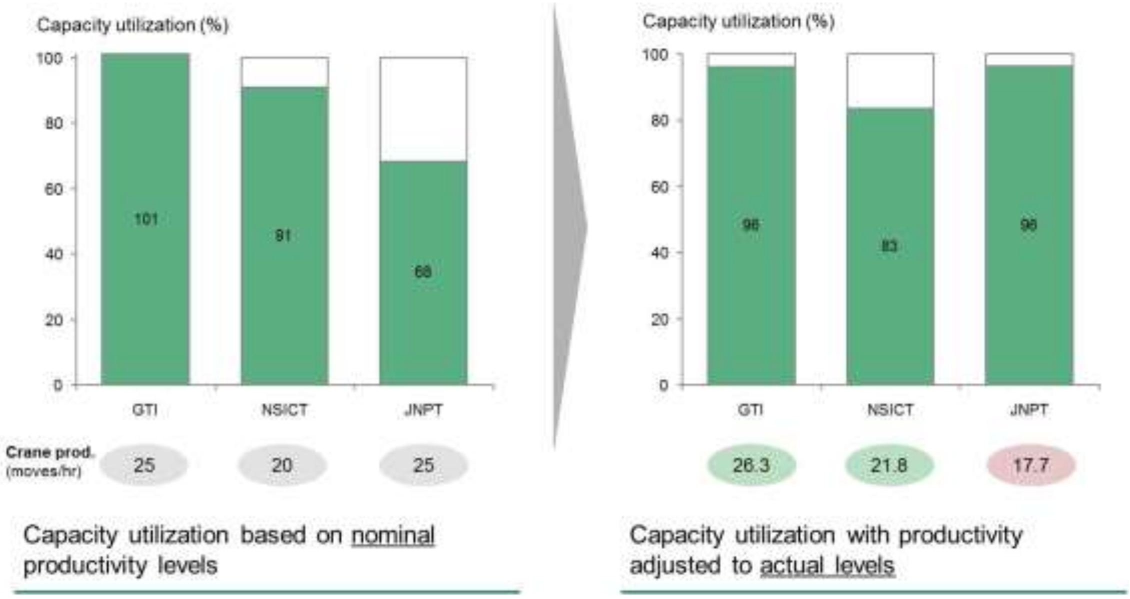


Figure 11: Terminal capacity utilization and crane productivity levels

JNPT traffic has hovered around 4-4.5Mn TEUs since 2008. JNPT has lost out on market share to the competing Gujarat ports. Mundra, the primary competitor, has grown rapidly at more than 20% rate over the last 5-7 years. Sho

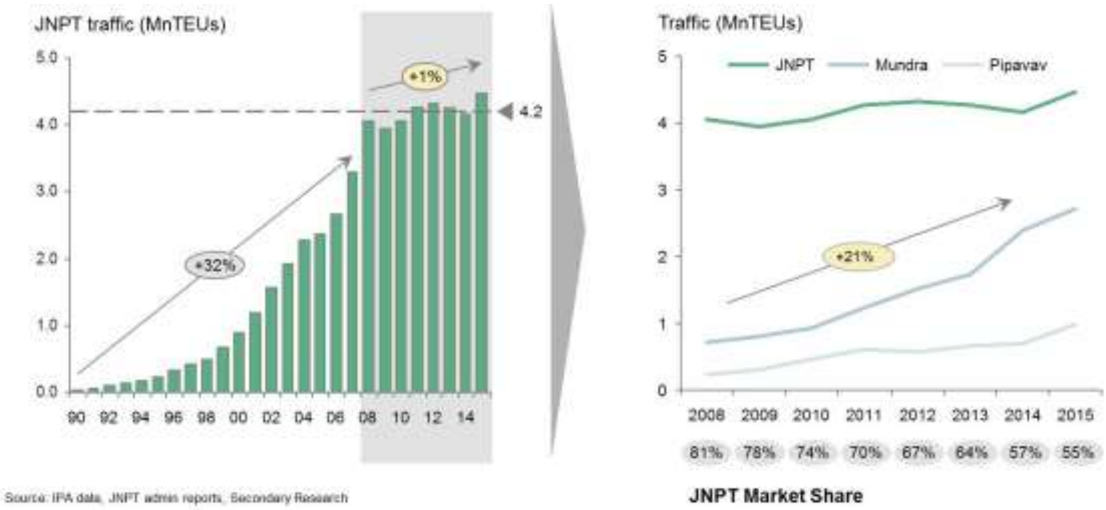


Figure 12: JNPT container traffic volumes tapering off to competition

When benchmarked against the best-in-class ports, or even other private Indian ports, JNPT's terminal clearly lags behind peers in QC productivity. With just 17 moves/hr crane productivity, JNPT is far behind the QC average of 25 moves/hour of other Indian terminals.

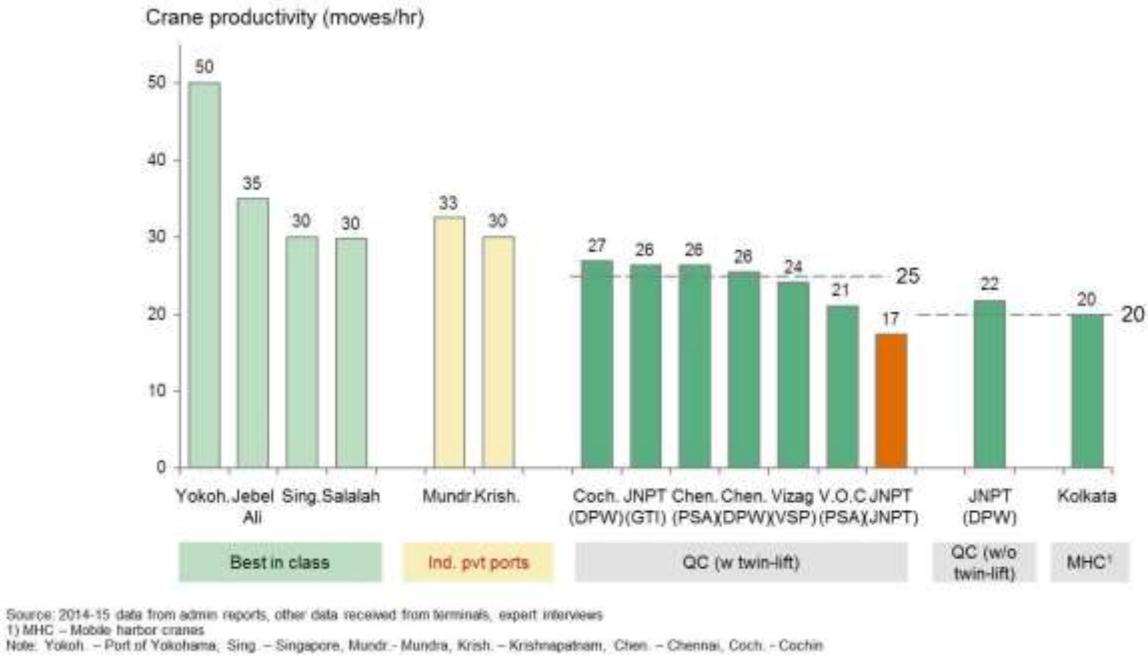
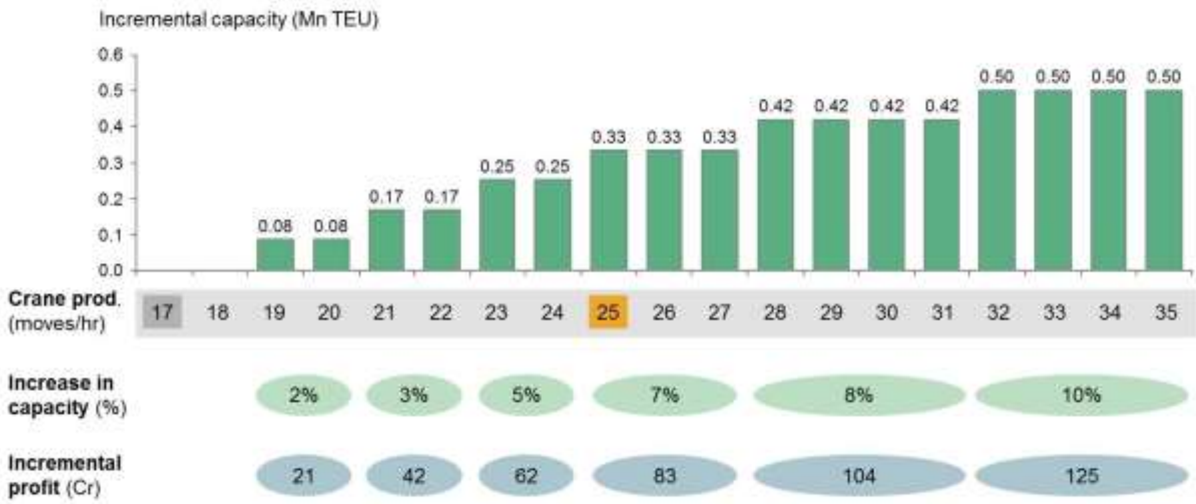


Figure 13: Terminal QC productivity comparisons

By enhancing productivity at JNPT, additional value can clearly be added. For example, moving to 25 GMPH would unlock approximately Rs. 83 Cr in value.



Note: Based on modeling of existing berth plan to unlock additional berth window of 12h with 1200 moves @ 2014-15 revenue levels and increased cost base
Source: 2014-15 financial data, current berth plan, BCG analysis

Figure 14: Benchmark levels for increased capacity and resultant increase in profits

When surveyed on the level of satisfaction on various capabilities, customers highlighted availability of berths, productivity, and road connectivity as the major shortcomings in JNPT as compared to Mundra and Pipavav.

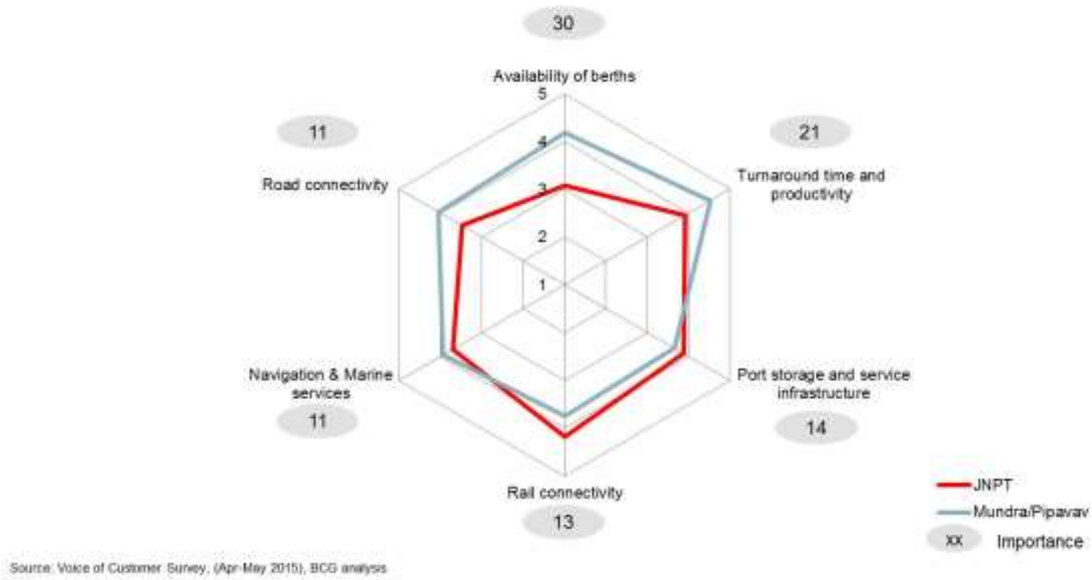


Figure 15: Survey responses on customers' level of satisfaction for JNPT and Gujarat ports

2.2 Key findings and initiatives from deep-dive

2.2.1 Berth Productivity analysis

2.2.1.1 Initiative: JNPT 1.1 Reduce shift change losses to improve QC productivity

Initiative Overview

Productivity improvement is a function of:

a) Net productivity during working time, and
b) Non-working time

In the analysis of Non-working time, the largest delay was found to be on account of work stoppage during shift changes.

Key Findings

Operations at JNPCT are designed along three shifts of eight hours each, i.e., 7:00–15:00, 15:00–23:00, 23:00–7:00. There is a significant productivity drop in the process of changing of shits due to longer than scheduled shift changes.

For example: The first shift of the day ends at 15:00 hours, however, shift wrap-up commences by 14:30 hours with tapering productivity. Operations of the first shift are halted at 14:40 hours and resumed when the second shift commences by 15:20 hours. Full-scale operations commence by 15:30 hours. Thus, a loss of 60 minutes is observed per shift-change while the same can be achieved in 30 minutes.

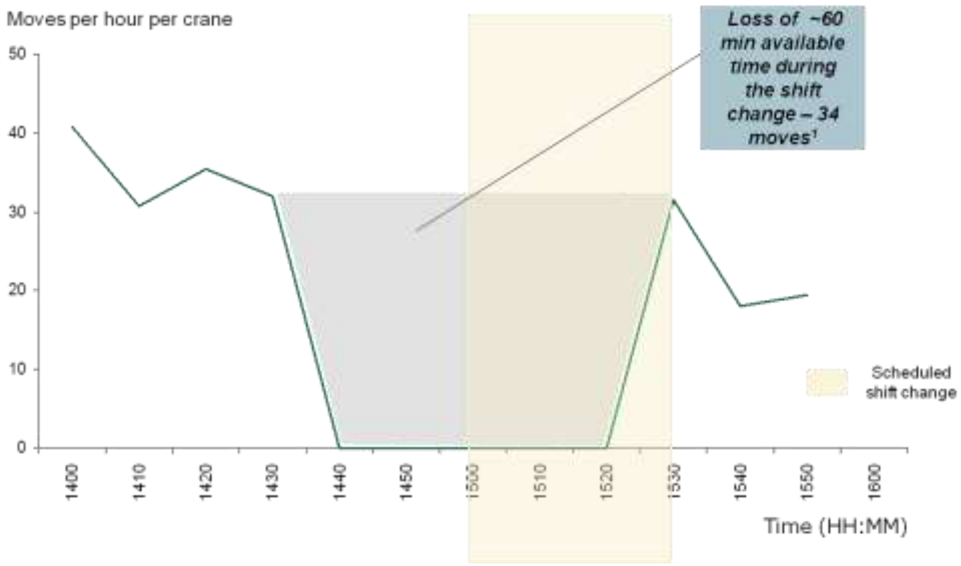


Figure 16: Crane productivity during shift changes at JNPCT

Planning of labor deployment across cranes and allocation of over-time shifts is carried out during the duration of shift changes. Shift workers arrive at the berth by 15:00 hours and record their attendance manually in a register. The shift in-charge then allocates activities to the persons who are present, and allocates an over-time shift to persons from the previous shift to fill in the activities of persons who are absent. The process of marking attendance takes approximately 20-25 minutes, with an additional 10 minutes for allocation of activities and over-time.

Recommendations

Shift time loss can be reduced by optimized planning using three main levers:

1. Advance deployment planning

- Leave of employees can be communicated to the shift in-charge in advance
- Schedule the reporting time of the second shift members at least 10 minutes before the first shift ends
- Planning and deployment of employees can be ready before the second shift starts

2. Introduce flexibility to handle delays

- QC operator continues up to 30 minutes late if next driver is delayed

3. Enforce rules for shift changes through supervision

- Enforce system log-in/log-out rules
- Track the *actual* time loss during shift change and the reasons
- Expected Impact

Potential to improve crane productivity by ~1.9 moves per hour, resulting in incremental operating surplus of ~Rs. 20 crore.

2.2.1.2 Initiative: JNPT 1.2 Increase twin-lift ratio to improve QC productivity and reduce NWT

Initiative Overview

Twin lifts, i.e., lifting two 20-foot containers simultaneously, increases the crane productivity by minimizing the total number of crane moves required for a given parcel size. Crane productivity is defined as *container moves per hour;* twin-lifts are counted as two moves when calculating crane productivity.

Figure 17: Illustration of twin-lifts

Twin lifts can boost crane productivity for terminals where 20' containers constitute a large share of traffic (60-70% in India). Maximizing twin lift of 20' containers is dependent on quay crane equipment**:**

- Cranes with high lifting capacity are required to handle the added weight
- Special spreaders compatible with twin lifting are required

All 9 quay cranes at JNPCT are equipped with twin lift capability with a maximum lifting capacity of up to 50 MT. Twin-lifts require yard planning to identify boxes that can be lifted together based on weight and POD (Port of Destination).

Key Findings

Analysis of weight profile of traffic at JNPCT shows that ~45% of containers are potentially conducive for twin lifting:

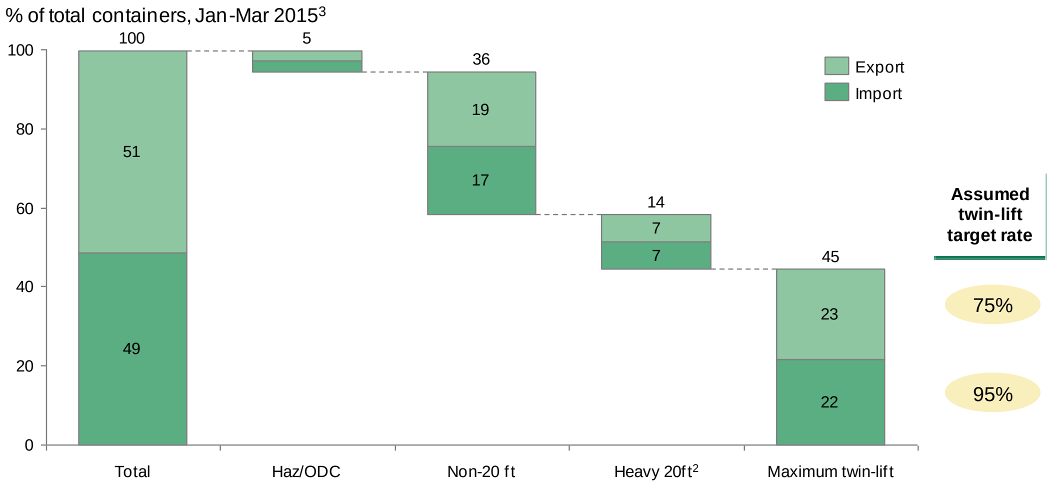


Figure 18: Container profile at JNPCT for twin-lifts

39% of total containers are not eligible for twin-lifting

- 5% of total containers are hazardous or oversized containers
- Another 35% are 40ft containers

14% of total containers are 20-foot containers that are over 25MT in weight. Therefore, two such containers would have a combined weight higher than the maximum lifting capacity of 50 MT of the quay cranes. Thus, the balance 45% of total containers fit the criteria that make twin-lifting possible, almost equally split as import and export containers. Planning is key to achieving the desired target of twin-lifts for export containers. A twin-lift target of 75% of eligible containers can be set for export containers, and 95% of eligible containers for imports.

Recommendations

Strong yard planning required to support maximization of export twin-lift ratio

1. Need to appropriately identify and segregate potential twin-lift containers

A large share of 20' containers are in the 20-25 MT weight category today, which is just within the weight limit for twin-lifts. These containers are currently being categorized as over-weight and not eligible for twin-lift. Appropriate segregation is required in the yard for containers weighing more than 25MT.

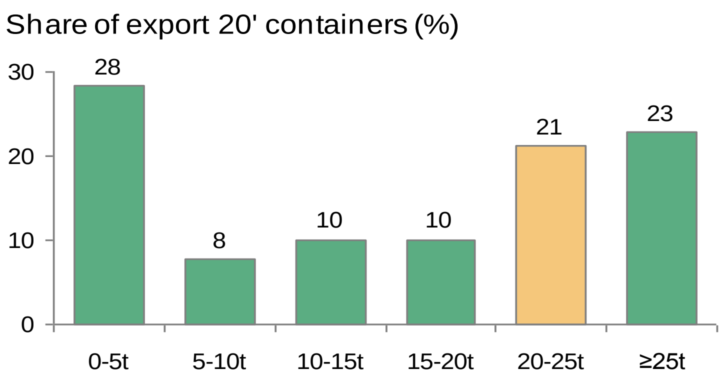


Figure 19: Weight distribution of containers handled at JNPCT

2. Ensure yard plan adherence

- Increase focus on the adherence to the yard plan, i.e., whether export containers are dropped (by truck) at the correct location
- Ensure yard inventory is correctly updated
- Measure yard planning performance by tracking the adherence vs. plan

3. Ensure stowage planning maximizes twin-lifts

4. Track/monitor the twin-lift ratio

- Track the actual twin-lifts by export/import vs. planned twin-opportunities
- Conduct leakage analysis to identify root-causes of lost twin lift opportunities
-
-
- Expected Impact
-
- Increase in crane productivity by 1.2 additional moves per hour, resulting in incremental operating surplus of ~Rs. 15 crore.

2.2.1.3 Initiative: JNPT 1.3 Redesign operator incentive scheme

Initiative Overview

A lack of focus on crane operators' individual performance and productivity has led to low crane productivity at JNPCT. High variance in skills are observed across operators, with high performers and low performers being uniformly deployed across equipment types, with no possibility of optimizing deployment based on performance.

Structurally, there is a lack of specialization among operators as operators are pooled across equipment types. ~180 operators are available today, who rotate across three equipment types viz. QC, RTGC, RMQC. Currently there are no dedicated operators for quay cranes that require a higher level of skill than other equipment.

Further, crane operators' incentive is not aligned to individual performance but to overall terminal productivity. As a result, there is limited incentive for crane operators to focus on improving their skills and target higher crane productivity rates.

Key Findings

Operator skill variance of ~30% observed based on initial observations

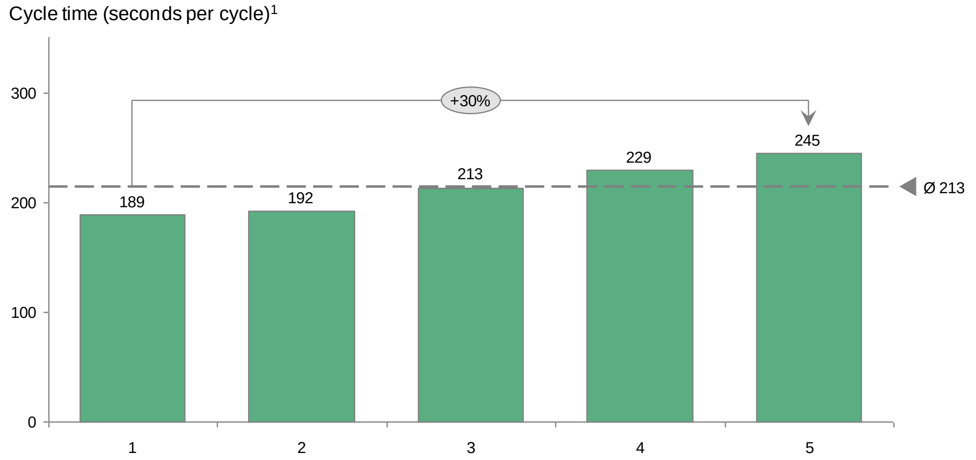


Figure 20: Variance in crane operator performance observed

Individual performance is currently not tracked for crane operators and, hence, skill-based deployment is not feasible to optimize performance. Often, new operators can get assigned to QC operations without passing the required threshold moves per hour.

To address the skill gap, measures need to be taken to have a structured assessment of operator skills, design training and mentoring programs to improve individual performance, and up-skill under-performing operators.

Case Study: Leading terminal operators approach raising operator skill levels along three key dimensions—assessment, focus and customization.

I. Assessment:

Annual or bi-annual assessments of QC operator skills are carried out, and actual cycle times are observed. New QC operators are trained and tested prior to commencing operations on the QCs. A threshold productivity level of 30 crane moves per hour is required for a QC operator to be certified to start operations.

II. Focus:

A clear focus area of the assessment program is on the improvement of the low performing operators. Lower performers are identified based on the previous month's performance record, and efforts are made to improve their cycle times.

III. Customization:

The assessment and training program is kept flexible to adjust to the learning requirements of under-performing operators based on assessment. Training can include 'ride-alongs' with best-in-class operators to facilitate learning through observation of the crane movement. Regular feedback is incorporated into the assessment and training program.

Performance-linked incentives form a low share of overall remuneration

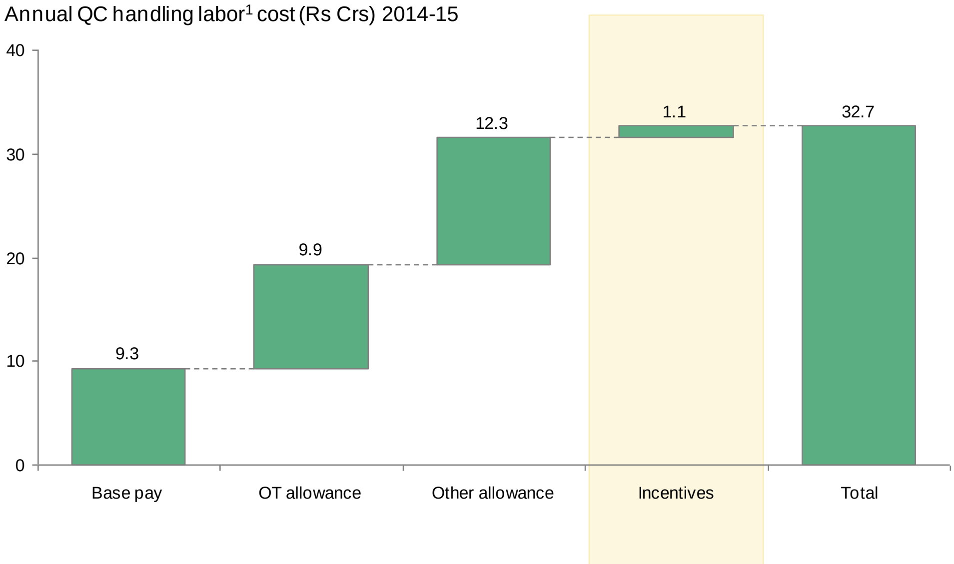


Figure 21: Break-up of components of crane operators' remuneration

Currently, performance based incentives form only ~3% of total remuneration of crane operators. Further, a large portion, ~30% of total remuneration, is driven by overtime pay. This reduces the inclination to improve individual performance and improve crane productivity.

Performance-based incentives given today are calculated on overall productivity achieved across the terminal.

Productivity slabs are defined and incentives increase based on overall achievement of a higher productivity slab. The rate (% of base pay) of incentive varies by function, i.e., quay crane operators receive higher incentive rates than RTGC operators, etc. However, amongst the operators performing the same function, there is no reward for higher performance.

Recommendations

Integrating individual performance into an incentive scheme provides a more direct link to terminal performance. Individual productivity targets should be set for different equipment types, and not just be based on quay crane productivity.

Steeper incentive structures, aligned with target productivity levels of the terminal, are required to motivate operators towards better performance.

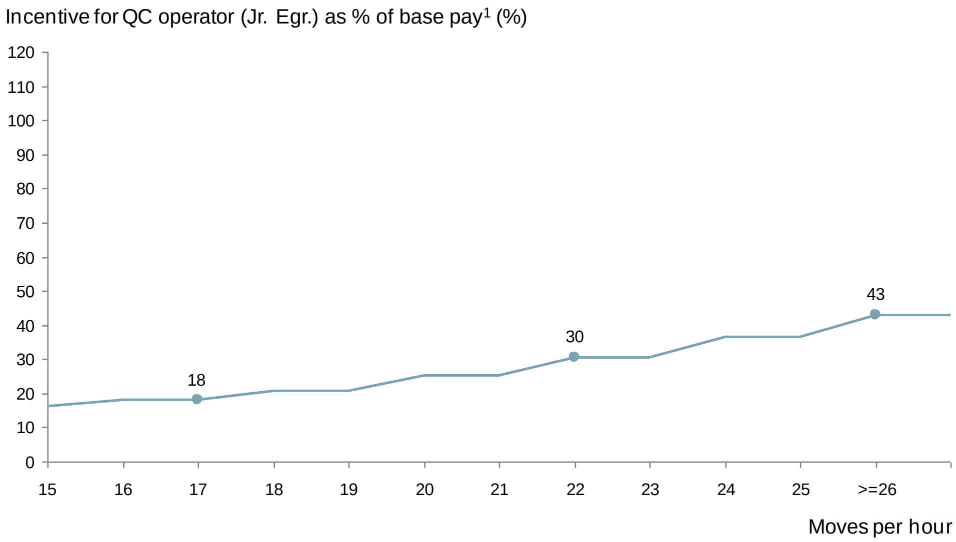


Figure 22: Incentive for QC operator (Jr. Engineer) as a % of base pay

Current incentive structure of JNPCT is relatively flat and less sensitive to improvement in crane productivity. Relatively low monetary benefits would accrue to operators even in case of significant improvement in crane productivity. At current productivity levels of ~17 crane moves per hour, performance incentive rates of 18% of base pay are provided. If productivity improves to ~26 crane moves per hour, which is among the highest productivity among the major ports, the performance incentive would remain lower than 50% of base pay.

It is imperative to provide adequate increase in incentives linked to milestones of target terminal productivity.

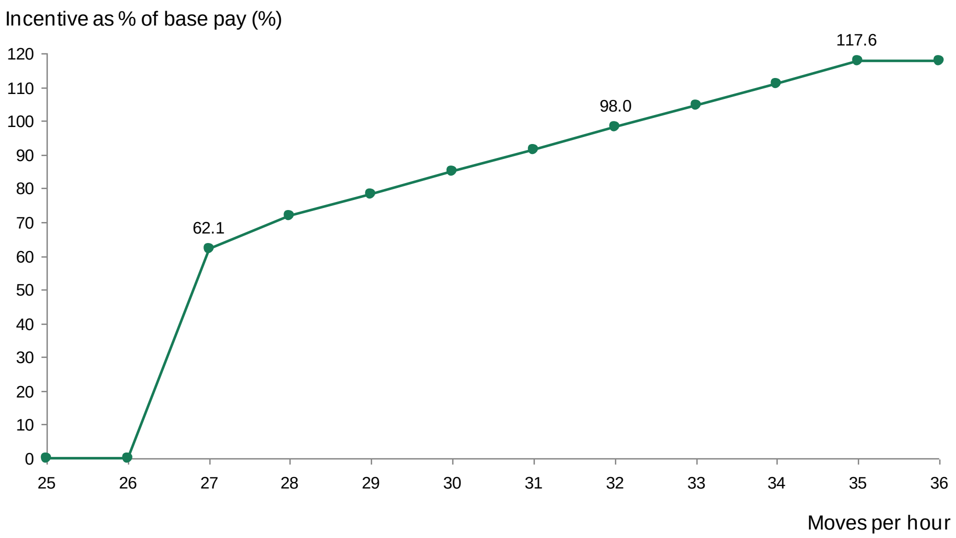


Figure 23: Case Study: Incentive scheme of leading terminal operator

Detailed recommendation provided in annexure.

Expected Impact

Improvement in crane productivity by up to ~3.5 crane moves per hour, based on improvement in operator performance; potential increase in operating surplus of ~Rs. 20 crore.

2.2.1.4 Initiative: JNPT 1.4 Improve QC productivity through dual cycling

Initiative Overview

Dual cycling is a practice of doubling crane productivity through combining load and discharge into single crane movements to avoid wasted trips. A quay crane discharges an import container from ship to shore and places it on the terminal trailer. For the return movement to the ship, the crane lifts an export box placed ready on the berth and loads it onto the ship.

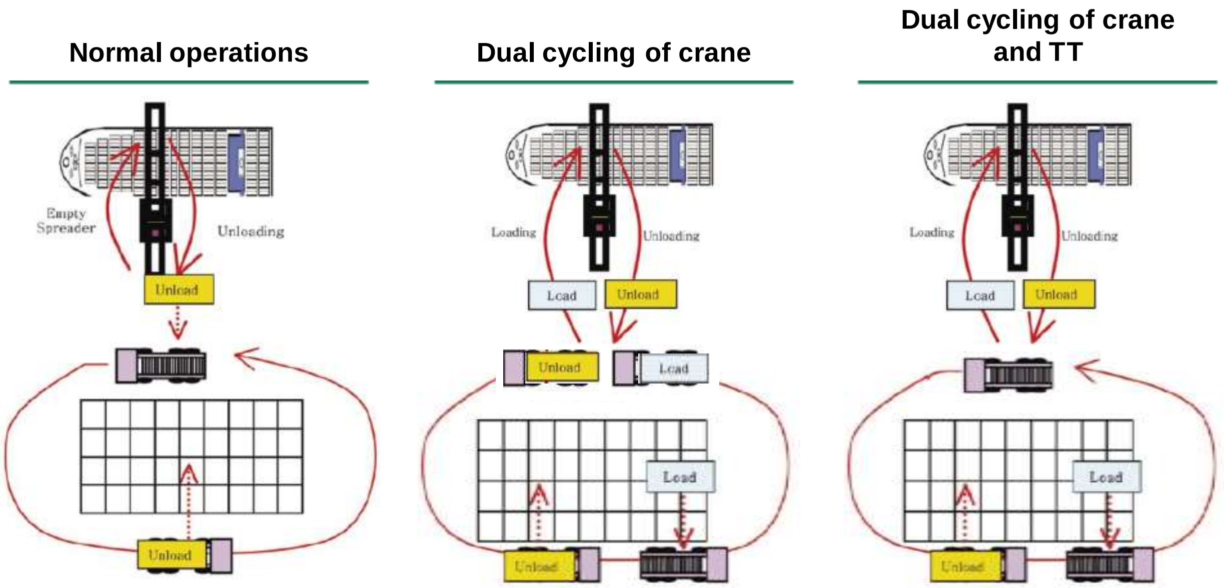


Figure 24: Dual cycling

Key Findings

Potential to improve crane productivity by ~10–40% through implementation of dual cycling

Dual cycling is used across a number of terminals globally as a practice to improve productivity. It is especially conducive to gateway terminals with large parcel sizes. Large parcel sizes are able to optimize below the deck operations, maximizing the potential for dual cycling, which is not feasible below the deck. Loading on top of the deck cannot commence simultaneously with discharge above the deck, as operations below the deck need to be carried out.

Homogenous bays of 20' or 40' containers make dual cycling more efficient as there is no time lost in adjusting the spreader width to different container sizes between two moves. Transshipment planning is less conducive to dual cycling.

The primary benefit of dual cycling is a reduction in number of cycles required for a given parcel size. Productivity improvements of 10-40% are possible with dual cycling. Further, dual cycling of TTs can provide additional benefit of reducing trips between berth and yard. Reduction in TT trips required is possible by dual cycling of the truck. Up to 15% reduction in TTs per QC have been seen in some terminals.

Recommendations

Dual cycling has been successfully deployed in a number of global ports, namely Busan (Korea), Los Angeles Long Beach (USA), Port of Shanghai (China) and Gateway Terminals India Pvt. Limited (Mumbai).

Advanced planning is required to maximize dual cycling

Figure 25: Stowage planning required for dual cycling

Dual cycling of quay cranes: It is imperative that the loading plan supports dual cycling by smoothing differences between loads and discharges across stacks. Further, factors like ship stability must also be taken into account for dual cycling. Advanced Navis (TOS) modules can provide planning support for dual cycling.

Dual cycling of TTs: Yard-side planning and TT dispatching must support altered truck flows. Efficient flows between import and export yard areas must be enabled so that the same TT can transport a container from the export yard to the berth and then return to the import yard with a container discharged from the vessel in the same trip. Traditional TT dispatching is based on first available cargo handling equipment (RTGC). Service-based TT dispatching is required to provide the quay crane with containers in the appropriate sequence.

Expected Impact

Improvement in crane productivity of ~1 crane move per hour, translating to an estimated increase in operating surplus of ~Rs. 12 crore per annum.

Based on initial observations, identified levers could allow QC productivity of ~27 GMPH

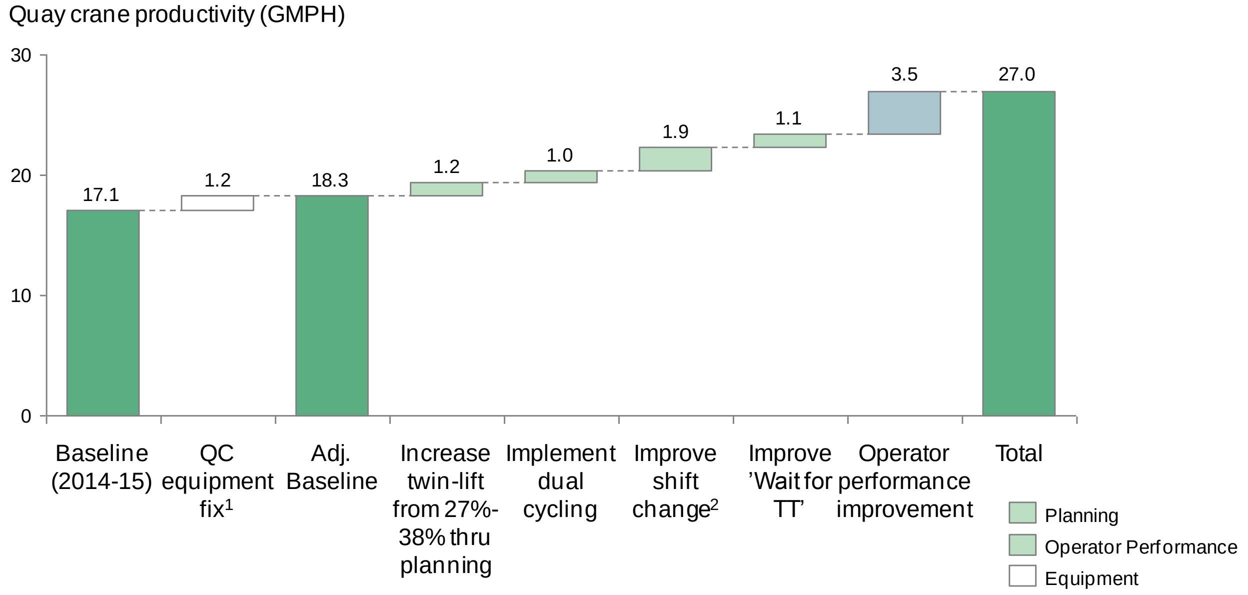


Figure 26: Projected productivity improvement at JNPCT

2.2.2 Yard Productivity analysis

Additional planned capacity through improvement of berth capacity needs to be supported by increased handling capacity at the yard. With productivity improvement up to 25 crane moves per hour, additional capacity of approximately 300,000 TEUs can be accommodated at the berth.

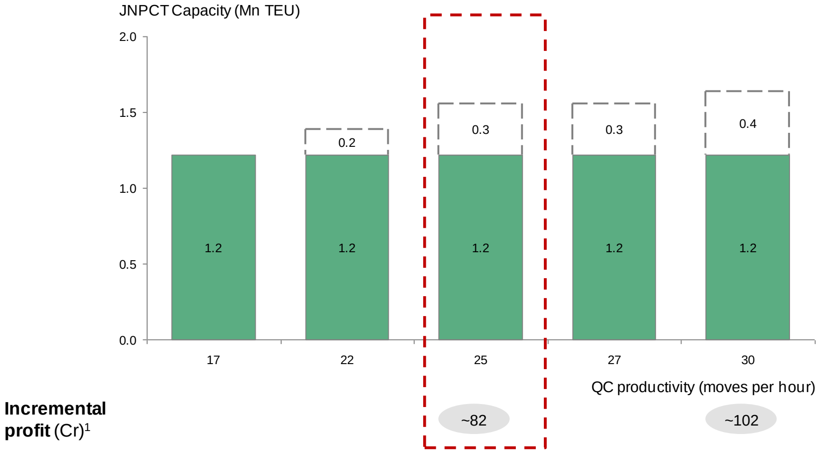


Figure 27: Incremental capacity across productivity levels

Yard and gate infrastructure is required to work in tandem with the berth, supporting a seamless flow of traffic from berth to gate. Hence, potential bottlenecks at yard and gate should be addressed to support the increased productivity at the berth.

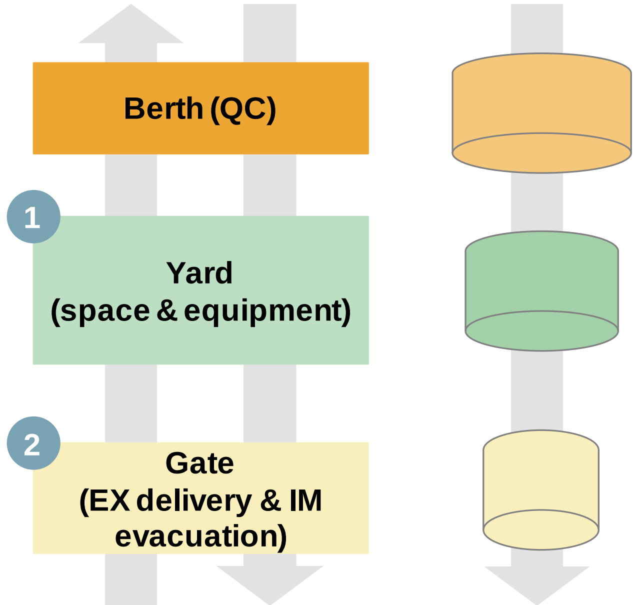


Figure 28: Linkage of Yard and Gate operations with QC productivity

A study of yard storage area was conducted to determine whether available space in hectares could potentially be a bottleneck and a cause of congestion. The analysis revealed that yard utilization, in terms of ground-slot days utilized, is lowest at JNPCT among peers. A utilization of 47% is achieved at JNPCT, vs. a median of 69% and highest utilization of ~95%. ~25% of total throughput at JNPCT is handled at private yards (paved areas), which are not included in the analysis of container yard utilization.

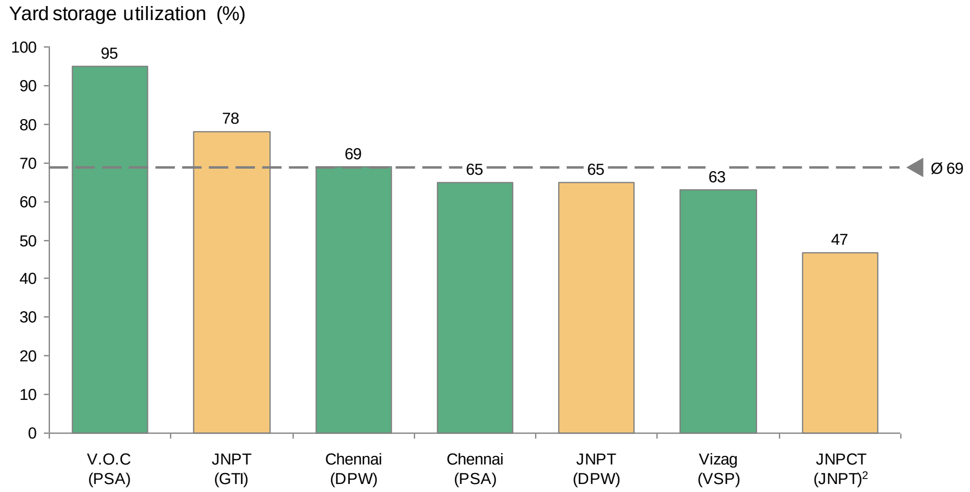


Figure 29: Yard storage utilization—JNPCT lowest among peers

Further, considering the additional traffic flowing in from unlocked capacity at the berth, the utilization in the container yard is expected to remain within an acceptable range. For quay crane productivity improvement up to 30 crane moves per hour, yard utilization would increase to ~62%. For the near-term target of 25 crane moves per hour, yard utilization would increase to 59%.

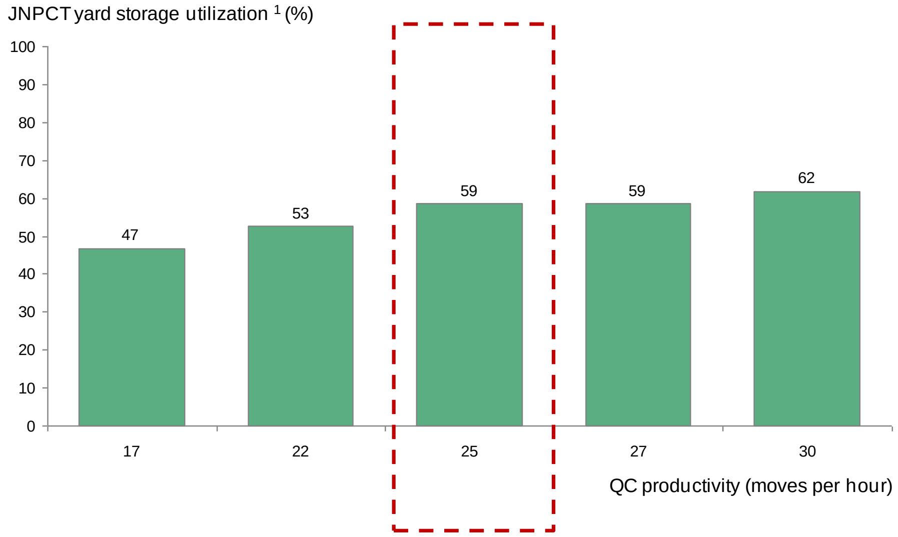


Figure 30: Increase in yard storage utilization at JNPCT across QC productivity levels

Benchmarking shows significant gaps between JNPCT and GTI on RTGC equipment levels, utilization and productivity

JNPCT has a lower RTGC:QC ratio than GTI, with 1.9 RTGCs per QC as opposed to 4 RTGCs per QC at GTI. This is primarily because export yards are served by reach stackers. Despite lower equipment levels, RTGC utilization at JNPCT is ~65% vs. 75% at GTI. Further, the RTGC productivity is approximately 50% of the productivity at GTI. While RTGCs at GTI achieve 12 moves per hour, RTGCs at JNPCT achieve only 6 moves per hour. In order to address improvement of QC performance, improvement along all three dimensions of fleet size, utilization and productivity are required. In the absence of improvement of yard productivity, the gap between hourly intake at berth and hourly intake at yard will increase with an increase in berth productivity, posing a bottleneck to achieving higher berth productivity.

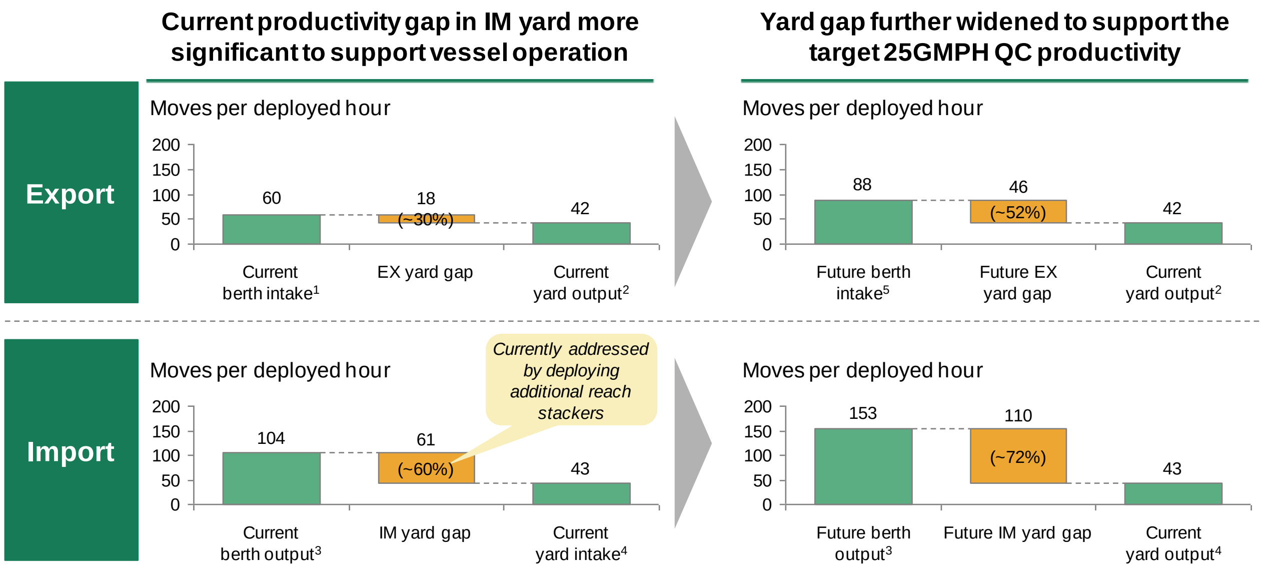


Figure 31: Productivity gap between berth and yard at JNPCT

For export containers, the productivity gap is currently 18 moves per hour. The export yard provides only 42 moves per hour while the berth can achieve up to 60 moves per hour. There would be idle time at berth on account of waiting for export boxes if the export yard is not able to keep up with productivity requirements. Hence, berth productivity would be limited by the slow supply of export boxes. The gap for import containers is significantly higher at ~61 moves per hour.

Six potential levers have been identified to improve yard performance to prevent bottlenecks to berth productivity.

		Levers	Initiatives
Utilization	1	Improve yard layout	• Use Shallow Berth yard for Import Yard (closer to berth, RTGC connectivity to EX yard) • Consolidate RFR yards closer to berth • Potentially convert the private yard to RTGC-operatable yard
Utilization	2	Improve RTGC deployment	• Deploy the RTGCs for export intake based on the in-gate volume and proximity to the container yard location • Monitor idle RTGCs and develop strategy to deploy it or turn it off
Productivity	3	Ensure yard integrity	• RTGC operator to update actual container yard location during export intake through RDTs • Deploy hand-held radio data terminals (RDTs) to checkers to perform the real-time container yard location update
Productivity	4	Optimize yard planning	• Introduce KPI for yard planning (e.g. load spread, measure execution of the plan) • Use **housekeeping** to clean up and prepare the yard for loading (consolidating minor blocks, correcting wrong container locations, etc.)
Productivity	5	Improve operator skills & deployment	• Measure operator performance and conduct structured assessment & training • Deploy high-skilled operators for RTGCs performing vessel loading / discharge and new operators for export intake / housekeeping etc.
Eqm.	6	Upgrade / add equipment	• Add additional RTGCs through leasing (incl. the manpower)

Figure 32: Six potential levers to improve yard performance

2.2.2.1 Initiative: JNPT 2.1 Dynamic deployment of RTGCs based on actual demand

Initiative Overview

RTGC utilization rate varies across RTGCs in import and export yard due to differences in peak activity for each yard. Two RTGCs are earmarked for export intake, and 6 at the export yard for loading. These are currently not re-deployed to the other process based on availability.

Key Findings

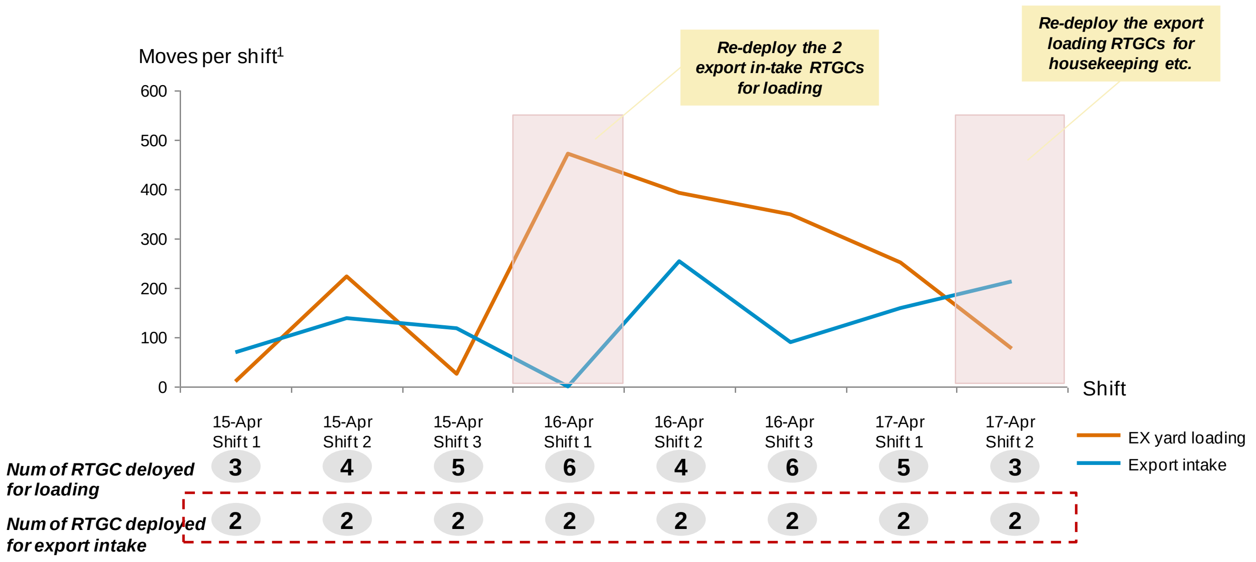


Figure 33: RTGC moves per shift across export intake and export yard loading

A high variance was observed between the moves per day at the export yard for loading, and the export intake based on study of the log book and JNPT express system. Instances of 0-100 moves per day were observed in each category (export intake and loading from yard) while the moves done on the same day in the other category were higher than 400.

Recommendations

The productivity of the RTGCs can be improved by pooling the RTGCs and re-deploying them based on peak load. As a result of deploying more RTGCs to the peak activity, loss of time due to gantry will be reduced, and productivity would increase. This in turn would reduce the waiting time for TTs at the berth, supporting higher berth productivity.

Expected Impact

Reduction in idle time at berth on account of waiting for TTs, resulting in an increase in capacity with incremental surplus of ~Rs. 6 crore.

2.2.2.2 Initiative: JNPT 2.2 Ensure 100% yard integrity through real-time update of container location

Initiative Overview

The current yard stacking norms often require more RTGC non-essential moves due to sub-optimal stacking pattern.

Key Findings

Yard stacking pattern is fragmented and export containers for the same POD on the same service are often stacked at different locations. Also, instances of minor blocks are seen with less than 5 containers for a particular POD stacked together. As a result, RTGCs are activated for a short period of time to complete the loading of a stack for a particular POD and then wait idle until the stacks for that POD from another yard location are loaded.

After completion of loading for a particular POD, the RTGC would be able to load the adjacent stack for a different POD.

For example, the export yard view for loading spread of E2586 (INDFEX service) shows fragmented stacking for each POD, instances of mixed POD stacking as well as fragmentation of empty containers over multiple columns. Corresponding to the fragmented loading spread, the gross crane productivity for the vessel is 15.3 gross crane moves per hour, which is lower than the average of 17 moves per hour.

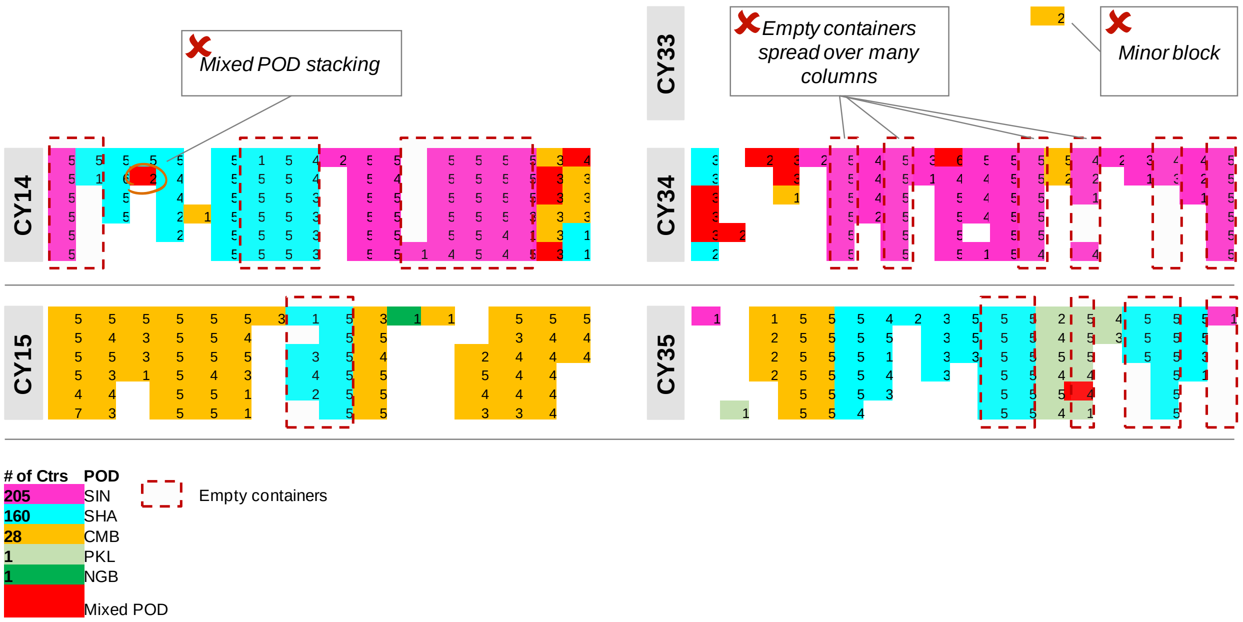


Figure 34: Current yard stacking at JNPCT

The fragmented yard stacking pattern results in multiple stacks being activated at the same time for loading of containers for the same POD, followed by long periods of idle time for a particular RTGC. The loading pattern studied for a period of four hours shows the activation of a particular stack for disjointed periods of time, and activation of multiple stacks at the same time.

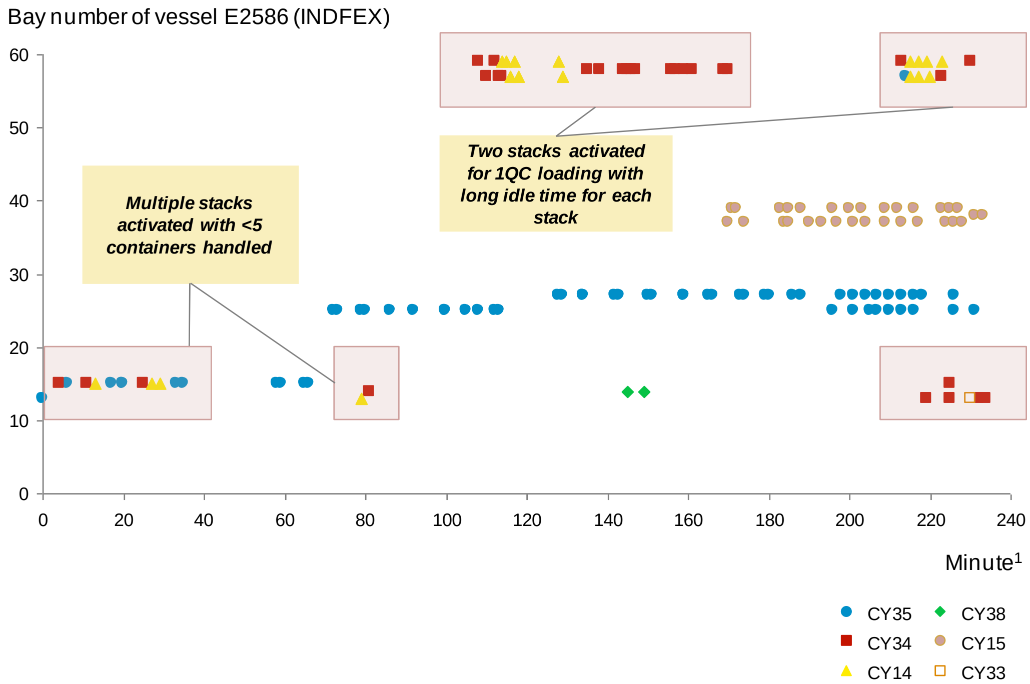


Figure 35: Current load spread at JNPCT yard

Recommendations

Ensure 100% integrity of yard locations by enforcing updating of container locations on the provided systems. From the current 30%, target reducing percentage of incorrect locations to less than 1%.

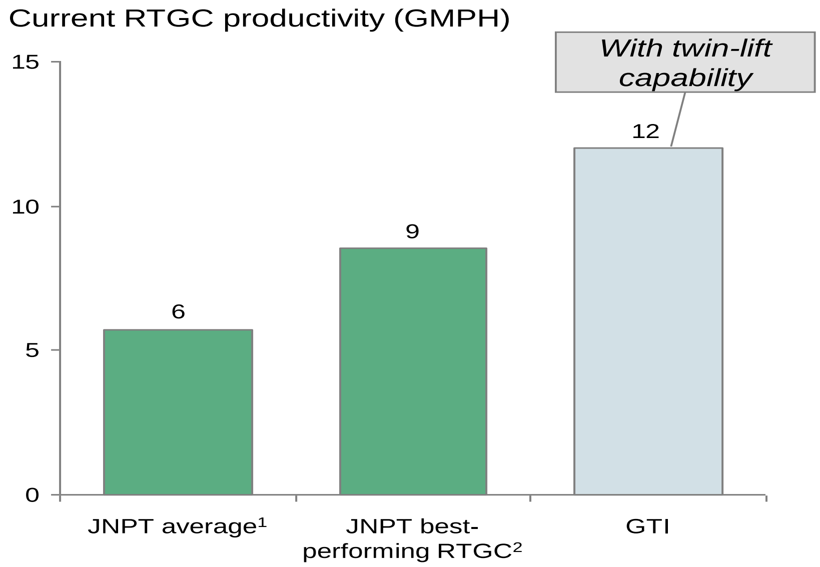
Expected Impact

Reduction in idle time at berth on account of waiting for TTs, resulting in an increase in capacity with incremental surplus of ~Rs. 4 crore.

2.2.2.3 Initiative: JNPT 2.3 Acquire 9 additional RTGCs

Initiative Overview

Average benchmark of 3 RTGCs per quay crane is required to ensure quay crane productivity is matched by yard productivity. Productivity of existing quay cranes is also required to increase from the existing 6 moves per hour to a target of ~10 moves per hour.



1. Average across 18 RTGCs for Apr-14 & Apr-15; 2. RTGC1 has the highest average RTGC productivity among the 18 RTGCs for Apr-14 & Apr-15

Figure 36: Target to improve RTGC productivity to 10GMPH

After considering an increase in productivity of RTGCs to 10 moves per hour, total yard productivity required to match quay crane productivity requires a fleet size of 27 RTGCs. Currently, 18 RTGCs are available at JNPCT, necessitating an additional requirement of 9 RTGCs.

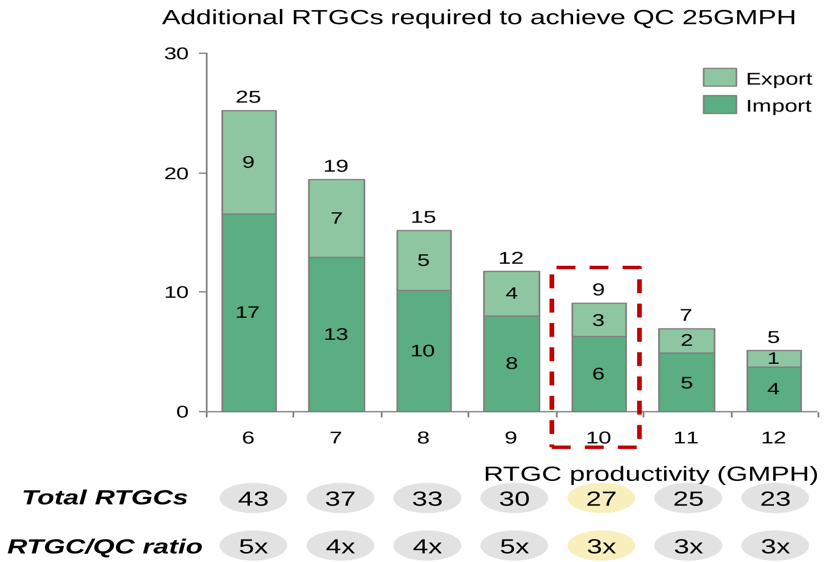


Figure 37: 9 additional RTGCs required to support QC productivity at 25GMPH

Recommendations

Acquire 9 new RTGCs to align equipment ratio with international norms.

Expected Impact

Reduction in idle time at berth on account of waiting for TTs, resulting in an increase in capacity with incremental surplus of ~Rs. 4 crore.

2.2.2.4 Initiative: JNPT 2.4 Convert shallow berth yard to RTGC-operatable IM yard

Initiative Overview

The existing yard layout has separate, fragmented import and export yards. Separation of import and export yards limits opportunities for RTGC pooling and drives longer TT travel distances. Export yards CY10-16 and CY30-36 are closest to the berth, followed by the privately operated export yards, i.e., paved areas where reach stackers operate. Import yards are organized by ICD and road evacuation. The import yards are fragmented, as well as at a distance from the export yards.

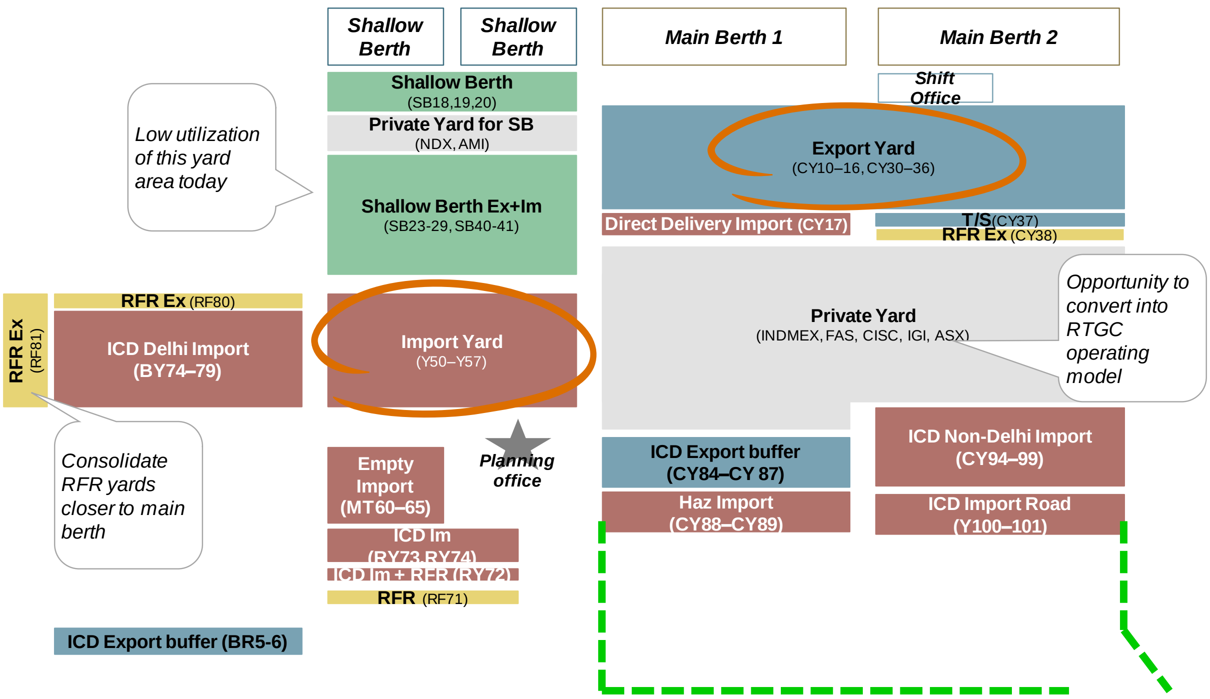


Figure 38: Separate import and export yards limit RTGC pooling opportunities

Key Findings

RTGCs in the export yard and import yard have different operating patterns with respect to the vessel arrival at berth. For ~56 hours around the arrival time of a vessel, the export yard corresponding to that service does not have any container intake, and RTGCs dedicated to the export yard are idle. At the same time, import yard RTGCs are operating, stacking the boxes that have started being discharged. At this point, RTGC pooling is not possible, as import and export yards are not contiguous and RTGCs cannot travel between the two yards. Further, re-balancing RTGC requirement between import and export yards at any point based on peak and low activity is not feasible, causing under-utilization of the RTGCs.

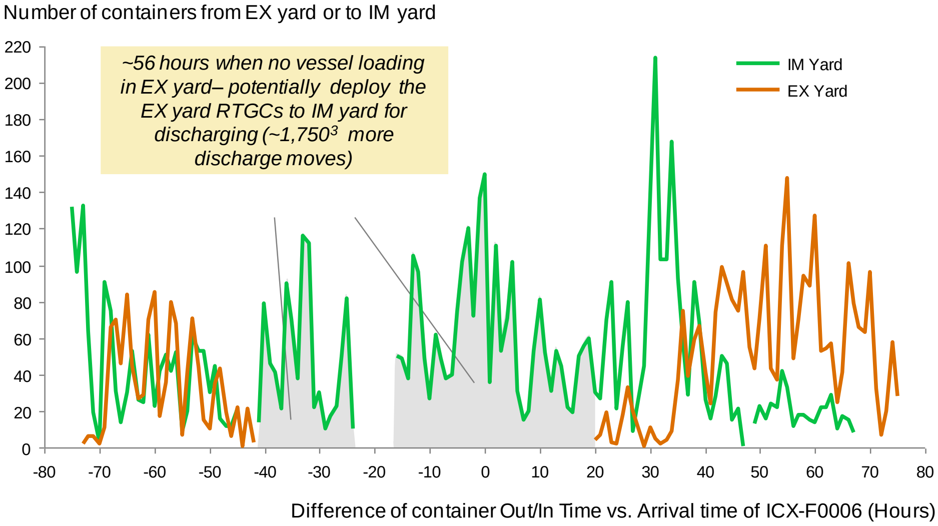


Figure 39: Container movement before and after vessel arrival time

Recommendations

In order to facilitate pooling and re-deployment of RTGCs based on peak activity requirements, the container yards require to be re-organized considering the following design principles:

- Maximize contiguous yard space with paths for RTGCs to move from one yard to another
- RTGCs need not be dedicated to an import or export yard, but be available for use based on actual volume of intake, loading and unloading

Illustrative re-design of container yard:

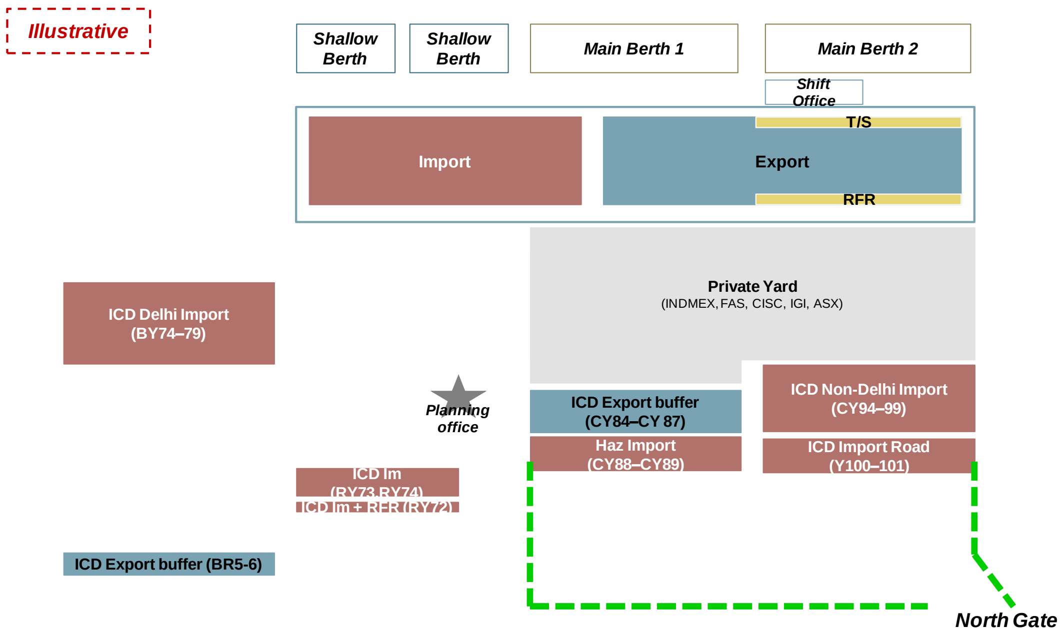


Figure 40: Illustrative yard layout to facilitate RTGC sharing

Inter-terminal road connectivity needs to be supported by traffic management in JNPCT yard to prevent congestion. Additional volume of TTs plying between GTI and NSICT would need to cross the JNPCT yard, with potential to increase congestion in the yard. The current inter-terminal road passes through JNPCT yard, crossing 32 stacks with JNPTCT TTs and RTGCs working alongside.

Yard congestion is inevitable until redesign of layout is completed. After the redesign, the yards would be consolidated on one side of the connecting road, making the road clear for yard to berth traffic.

It is essential to manage inter-terminal traffic to avoid congestion. In the absence of the same, direct inter-terminal transfers can be temporarily banned until the yard re-design is completed. Transfers between either of the terminals and JNPCT do not cross the breadth of the JNPCT yard and, hence, do not affect yard congestion. JNPCT can facilitate pooling of TTs between terminals to allow inter-terminal movement of boxes to be carried out with two TTs, via JNPCT. For example, a TT that needs to drop an export box at NSICT and then ply to GTI to pick up an import container can split the operation into two legs viz. drop an export box at NSICT and pick up an import box at JNPCT. Subsequently, a TT run by the same operator that is dropping off an export box at JNPCT can ply to GTI and pick up the import box required. As the TT operators are common across terminals, pooling can be implemented.

In the long run, traffic management inside JNPCT yard is required. Road signs and traffic rules are to be in place to manage the flow of TTs inside the yard. Traffic marshals are required within the yard to penalize drivers violating traffic regulations. Traffic regulations and monetary fines for violation of the same are currently implemented at GTI and NSICT terminals.

Expected Impact

Reduction in idle time at berth on account of waiting for TTs, resulting in an increase in capacity with incremental surplus of ~Rs. 4 crore.

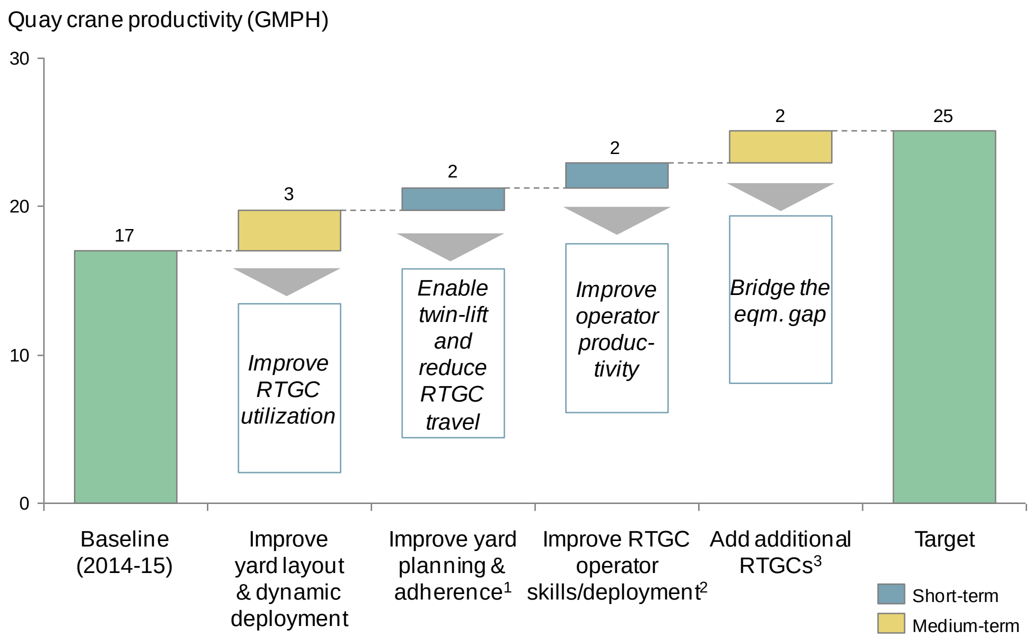


Figure 41: Yard improvement levers to support the target QC productivity at 25GMPH

2.2.3 Gate Productivity Analysis

Along with an increase in berth productivity and corresponding input in throughput, there is an increase in average road throughput per day. Accordingly, productivity of the gate, measured in throughput per lane per day, needs to be increased commensurate to increase in berth handling capacity to handle the additional traffic. For an increase in QC productivity from 17 GMPH to 25 GMPH, the average road throughput would increase from ~2,800 TEUs to ~3600 TEUs per day.

JNPT has 5 export gates and 6 import gates, including one gate for empties (in and out). In order to accommodate additional traffic with the same gate infrastructure, ~26% increase in gate productivity is required.

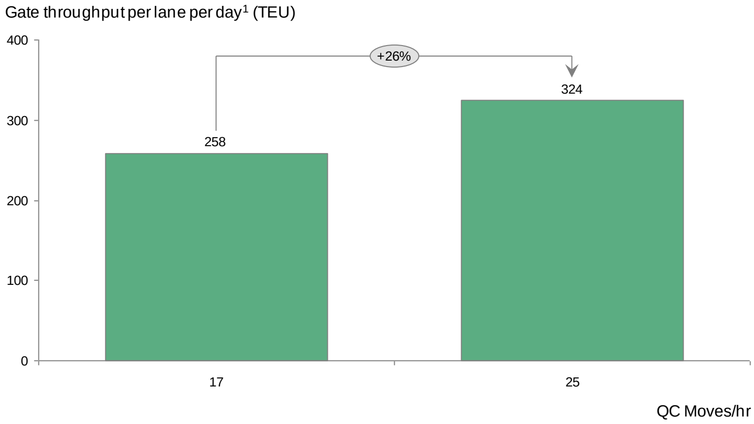


Figure 42: Gate throughput will need to increase to match capacity increase

Currently, the gate throughput (per lane per day) is lower than the average of major ports in India. The highest productivity is observed at the GTI Terminal at JNPT, with throughput of ~440 TEUs per lane per day. Average gate throughput per lane per day across the major ports is ~275 TEUs. Corresponding to this, JNPCT gate throughput is only ~258 TEUs per lane per day.

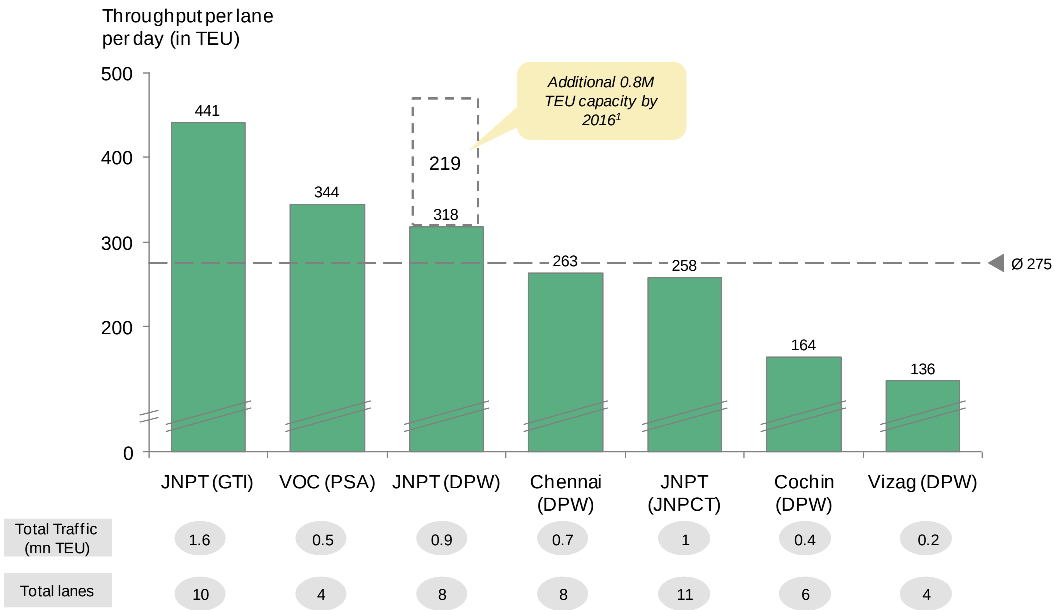


Figure 43: JNPCT has lower than average gate throughput among peers

Process description

Truck movement at the gate can be of three types, as follows:

1. Receive exports only

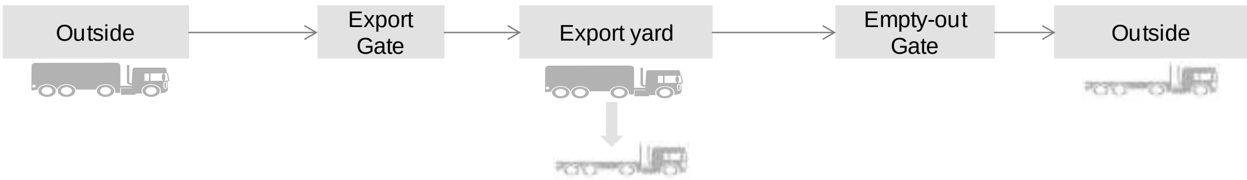


Figure 44: Gate process for receiving exports only

2. Deliver imports only

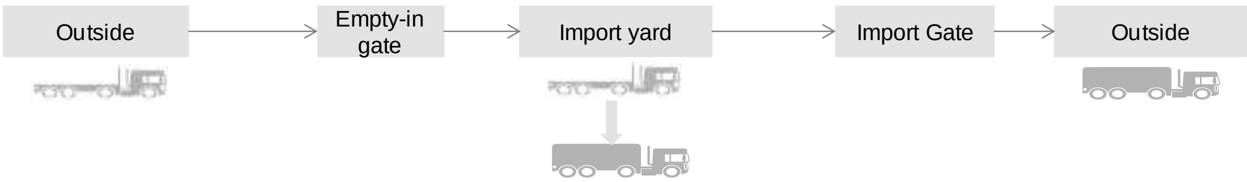


Figure 45: Gate process for delivering imports only

3. Receive Export + deliver Import

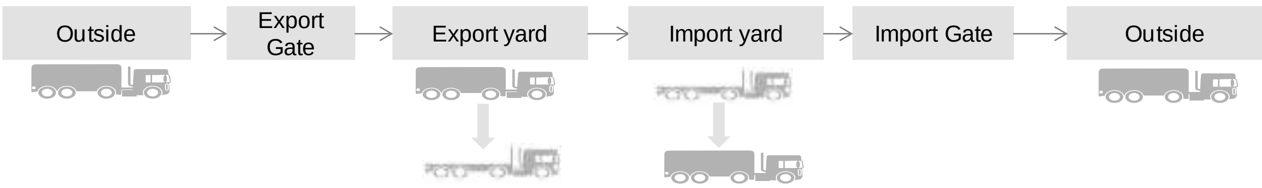


Figure 46: Gate process for receiving exports as well as delivering imports

Export (in-gate) process consists of two stages

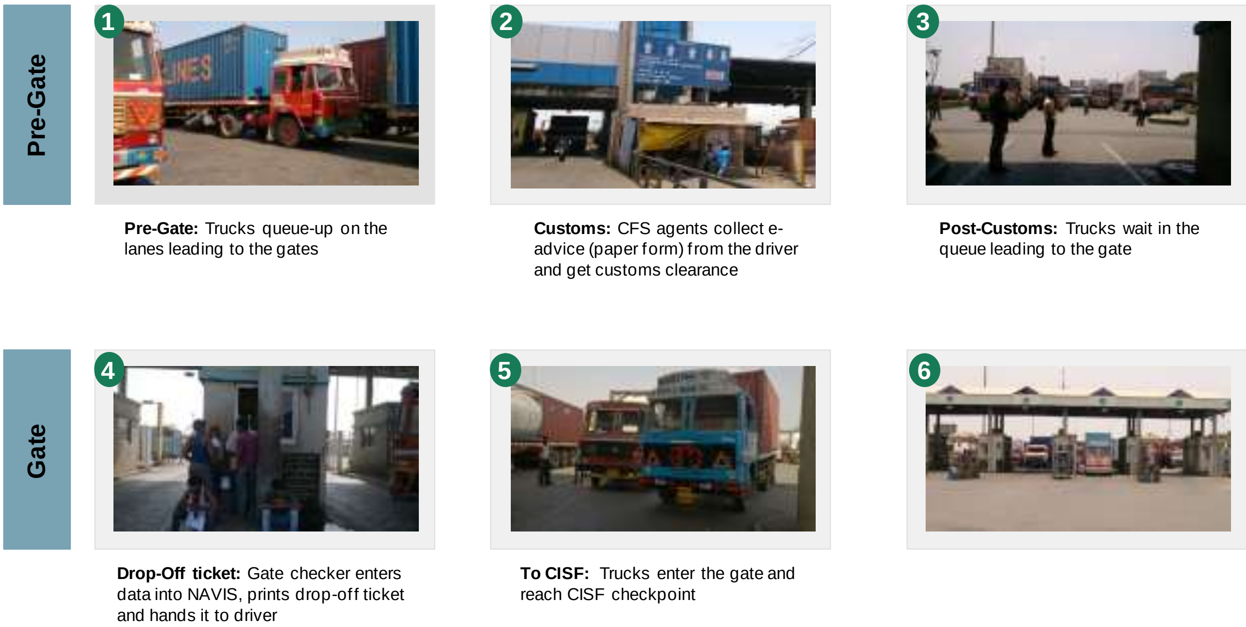


Figure 47: Two stages of Export (in-gate)

Five levers have been identified to improve export gate performance:

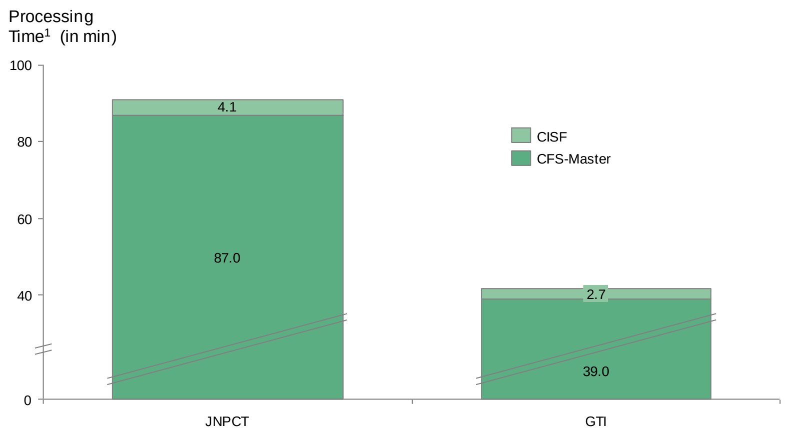
Levers	Initiatives
Traffic Management	• Additional manpower at gates to organize traffic flow • Create mechanisms to prevent the driver from leaving the trucks unattended • Increase clearance between gate and start of truck lane • Create an evacuation plan for trucks that don't have necessary approvals at gate
CISF Improvements	• Identify physical space to carry out seal number checks much before the gate • Hire contractors/surveyors to carry out the seal check; joint liability to ensure compliance
Gate Automation through OCR	• Install OCR portals to automate the gate check-in process; additionally OCR systems to perform container, seal number and vehicle verification
Appointment System	• Provide arrival windows to TTs to control their inflow into port ecosystem
Minimize shift change losses	• Next gate checker to be available before the departure of the current gate checker • Synchronize shift changes between CISF and gate checkers

Figure 48: Five levers to improve export gate performance

2.2.3.1 Initiative: JNPT 3.1 Improve pre-gate traffic management

Initiative Overview

JNPCT's export gate utilization is ~24%, which is significantly lower than the ~40% gate utilization of GTI. The primary driver of low gate utilization is high cycle time for customs processing by CFS masters and CISF.



*1. Time per truck at export gate checker=1.6 min. Based on time study observations (18 hours) at JNPT export gates; Based on time study observations at JNPT (18 hours) and JNPT traffic data and driver's survey (N=23). Processing time per truck per export-lane = (24*60)/(Total TEU export traffic per day per lane/average TEU per truck). Average TEU per truck=1.37. Export traffic per day (in TEU)=1388. No. of export lanes=5*

Figure 49: Lower gate utilization at JNPCT due to pre-gate and CISF inspection delays

Key Findings

Pre-gate delay is largely driven by late arrival of CFS masters causing high waiting time and blocked traffic. Based on truck-driver survey where 31 truck drivers were polled, average waiting time for CFS masters is approximately 87 minutes at JNPCT, compared to only 39 minutes at GTI. It has been observed that CFS' prioritize deployment of masters at GTI and NSICT gates over the JNPCT gate. This is because the GTI and NSICT terminals often shut their gates to prevent congestion inside the yard.

Recommendations

Two key levers have been identified to ensure timely servicing of trucks by CFS masters at JNPCT gates:

i. Implementation of a penalty system

A process should be implemented under which a truck is penalized by being detained for 24 hours in case it is found blocking traffic due to non-availability of documents, etc. Such detention policies are currently in place at the GTI and NSICT terminals. A monetary penalty can also be imposed whereby a truck is fined for obstruction of traffic or violation of lane discipline. The NSICT terminal already imposes a fine of Rs. 2,000 for obstructing traffic.

ii. Build a mechanism for evacuation of trucks

Infrastructure is required to be put in place for physical evacuation of un-cleared trucks so that they do not obstruct the path of trucks behind them in the queue. It is also necessary to ensure that the lanes are manned to enforce evacuation.

At the NSICT terminal, trucks are required to stop 100 meters before the gate complex and, in case a truck has un-cleared documents, it can vacate the export lane via the adjacent out-lane for empty containers. This leads the truck back to the common parking area where the trucker can wait for complete documents. This is the preferred mode of pre-gate evacuation to be followed at JNPCT.

At the GTI terminal, the trucks go up to the CISF check-post at the gate complex before being identified as un-cleared by customs. Un-cleared trucks are flagged by CISF at the gate and asked to evacuate via the adjacent out-gate for empty containers. It is then taken ~1.5km away to the marshaling yard to await completion of documentation. Under this model, un-cleared trucks also utilize the gate processing capacity, which can be avoided via a pre-gate check.

Expected Impact

Improvement of gate utilization to a target of ~40%, from the current ~24%.

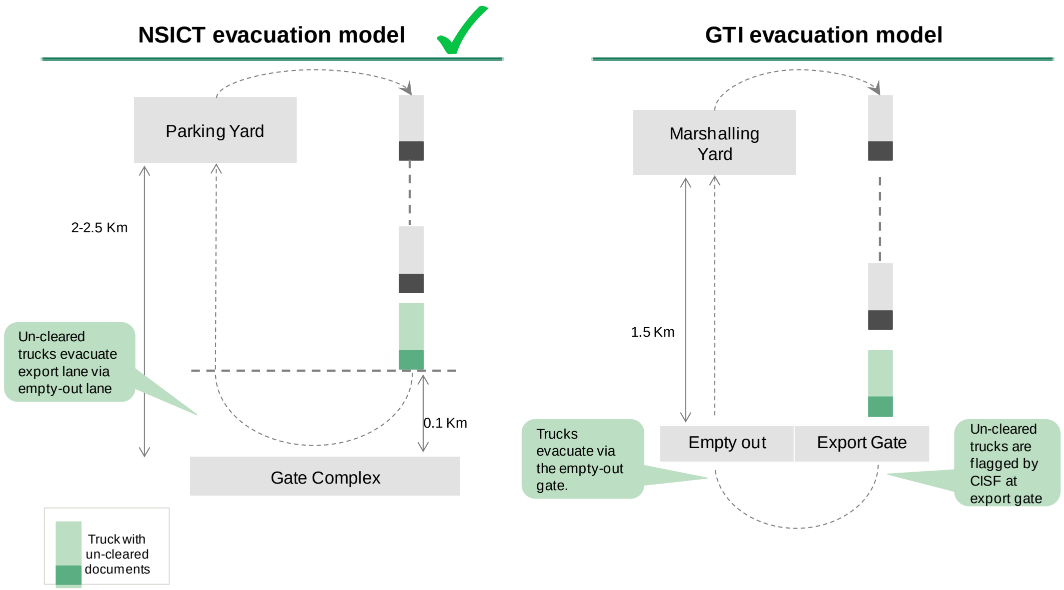


Figure 50: Truck evacuation mechanism at GTI and NSICT

2.2.3.2 Initiative: JNPT 3.2 Install OCR portals at 3 import and export gates

Key Findings

Longer processing time observed at the JNPCT gate for seal number verification by the CISF. The total gate processing time by CISF is ~4.1 minutes at JNPCT vs. 3 minutes at the GTI gate complex. The CISF performs four checks at the gate, i.e., seal check, container verification, license check and drop-off ticket check.

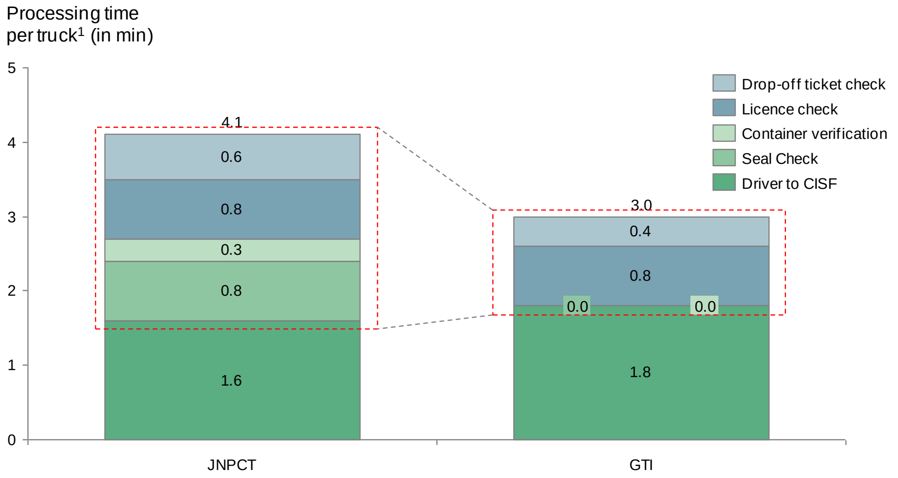


Figure 51: Break-up of truck processing time at gate

Recommendations

The process of CISF seal verification can be improved through two potential levers:

i. Frontloading of the seal verification process:

The GTI terminal currently front-loads the seal and container check and carries them out in the marshaling yard. Only after checking of seals and containers is the truck allowed to enter the queue at the terminal gate. In order for JNPCT to implement a similar process, physical space needs to be identified to carry out the verification. A contractor can be hired to carry out the seal check and container check at such a location prior to joining the gate queue. The risk involved can be shared between the port and the contractor through joint-liability clauses in the agreement, which has been implemented by GTI currently.

E.g.: GTI has reduced the processing time by front-loading seal and container verification in marshaling yard

Figure 52: GTI's front-loading seal and container verification reduces processing time

However, this system would still not be able to solve the problem of road congestion outside the gate and long queues before the gate complex. Further enablers are required to ease the road congestion along with pre-gate checks.

The truck queue outside GTI gate complex can, at times, be as long as 5 km. One of the reasons is the increased movement of dumpers in connection with construction of the fourth container terminal. There are fewer truck lanes allocated to containers on the approach road (for ~2km between the Y-junction and gate)—only two export lanes are available, with one lane allocated to dumpers transporting construction material.

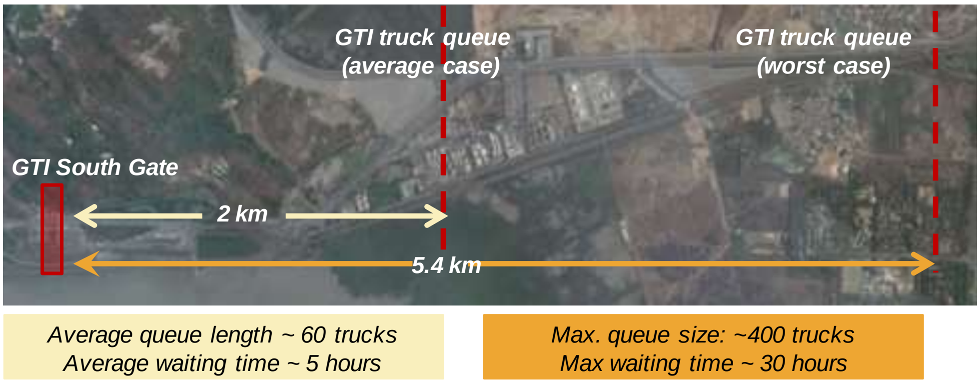


Figure 53: Longer truck queue at GTI gate

Additionally, due to shortage of yard space, the terminals frequently close their gates to prevent congestion inside the gate, or when yard space is full. RTGCs are prioritized for vessel operation, hence truck TAT inside the terminal increases when fewer RTGCs are allocated for gate moves. JNPT may allocate more yard space to GTI after re-arranging own yard layout.

An appointment system would help segregating RTGC time for the gate and vessel moves in the yard, and reduce the gate-in volume spikes. Peak activity spikes in traffic may cause long trucking queues at the in-gate. Appointment systems would help smoothen traffic at the export gate and reduce truck waiting time.

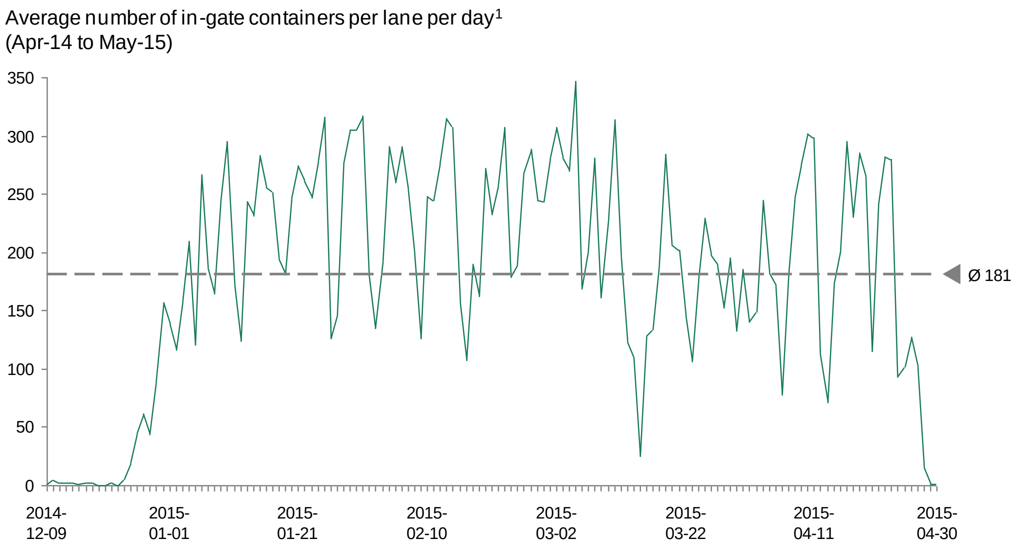


Figure 54: Peak in-gate volume may cause long truck queueing

Fixed window appointment can be implemented through which a pick-up window is assigned for cargo. Web/ SMS-based pre-gate systems can be utilized to assign trucks to windows.

Selected customer groups can be given a priority window. Top CFS accounts with highest volume can have dedicated appointment express lanes.

Open appointments would be available for all to make upfront, either at pre-gate or on the Internet. Trucks are assigned non-express lanes for such appointments.

ii. Implement OCR driven gate automation system:

An optical character recognition (OCR) portal installed at the gate can identify and verify the container number and seal number while trucks are in motion, passing through the gate. This can automate the collection and verification of other information such as vehicle details that could potentially eliminate manual verification at CISF.

Installation of OCR portals can potentially handle 20 times the throughput at the gate, with reduced manpower. A camera is installed to capture container number, seal number and vehicle details when trucks travel through the portal at 20 kmph. Thus, only 1 gate checker is required to monitor the camera and handle exceptions for ~5 lanes. CISF personnel can also be reduced.

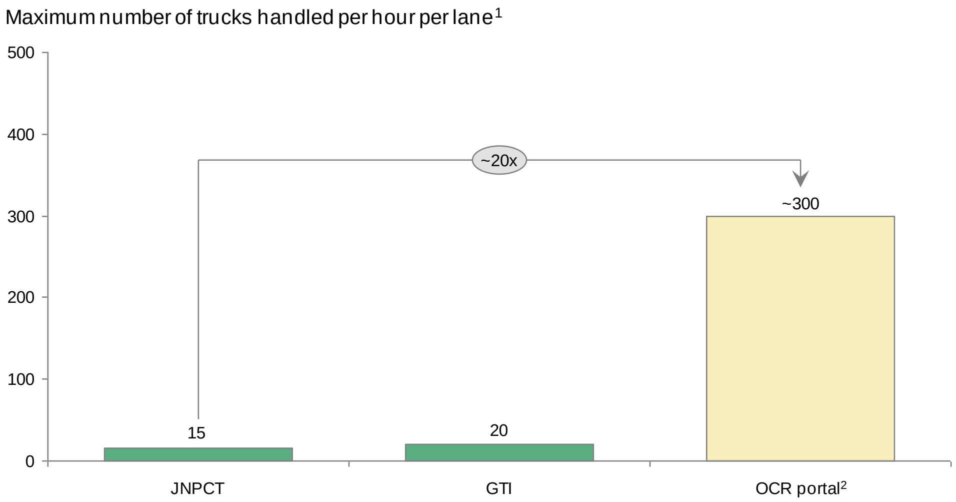


Figure 55: OCR portal can increase potential to handle throughput by ~20X

OCR has been widely deployed in international container terminals such as Port of Rotterdam and Port of Shenzen. The NSICT terminal at JN Port is also in the process of implementing OCR systems, currently in the test phase. The process is expected to be rolled out in the next few months.

Expected Impact

Reduction in processing time per truck from 6 minutes to 1 minute, resulting in reduction in congestion outside the gate.

2.2.3.3 Initiative: JNPT 3.3 Frontload import EIR generation to import yard

Initiative Overview

The import out-gate process consists of two steps, i.e., pre-gate and gate processing. For trucks performing an import box pick-up function, a pick up ticket is first issued to the truck at the export/empty in-gate, after which they are allowed into the import yard to pick up the container. This is followed by an equipment interchange receipt, which is generated at the import out-gate. The container is taken through customs processing and CISF checks only after EIR generation.

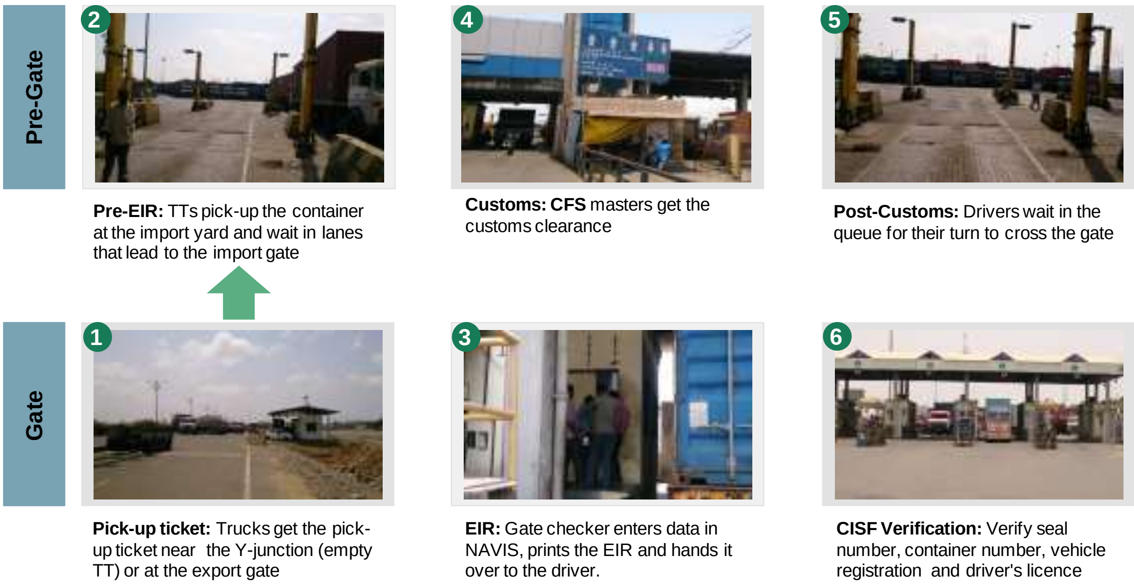


Figure 56: Import (out-gate) processes

Key Findings

Lead time at JNPCT for the import out-gate processing is ~3 times the time taken at the GTI terminal, primarily due to the generation of EIR (equipment interchange receipt) at the gate itself.

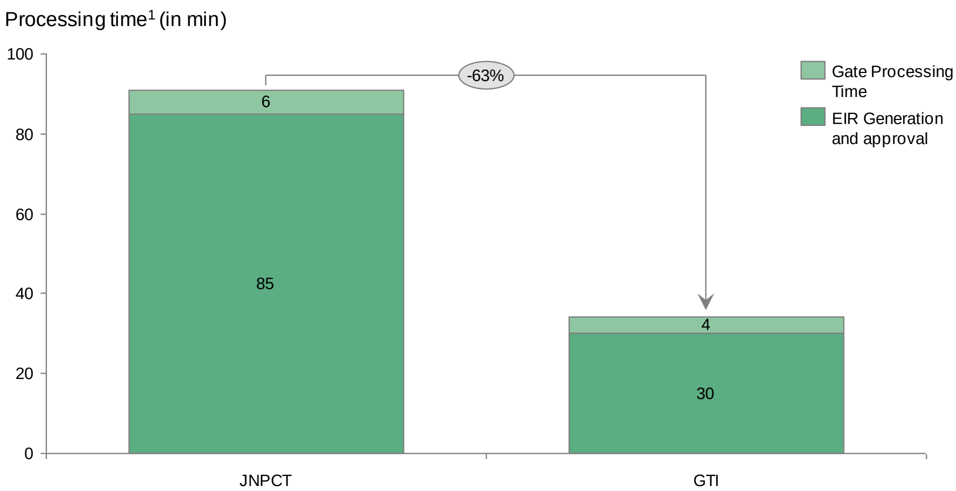


Figure 57: High waiting time at JNPCT import gate due to EIR approval

Recommendations

The EIR generation process can be front-loaded and carried out prior to the truck queuing at the gate, similar to the NSICT and GTI terminals.

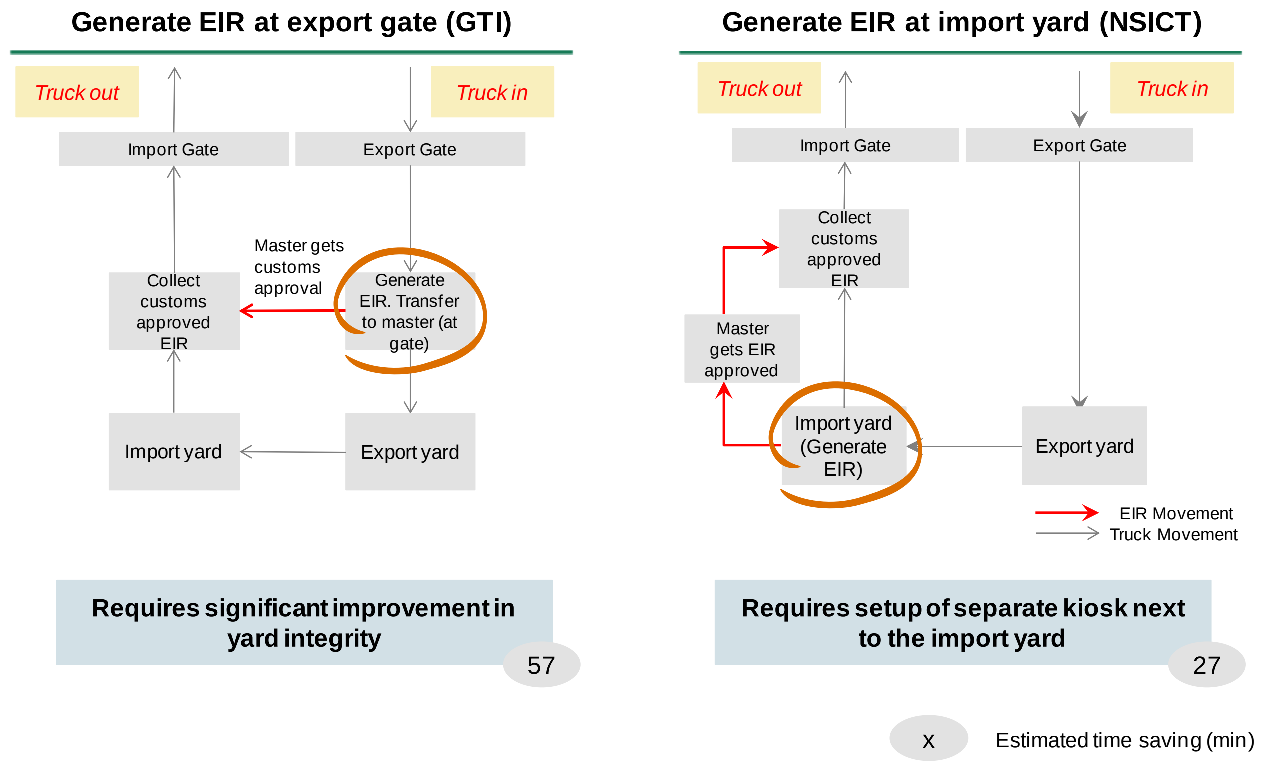


Figure 58: GTI and NSICT front-load EIR generation before the import gate

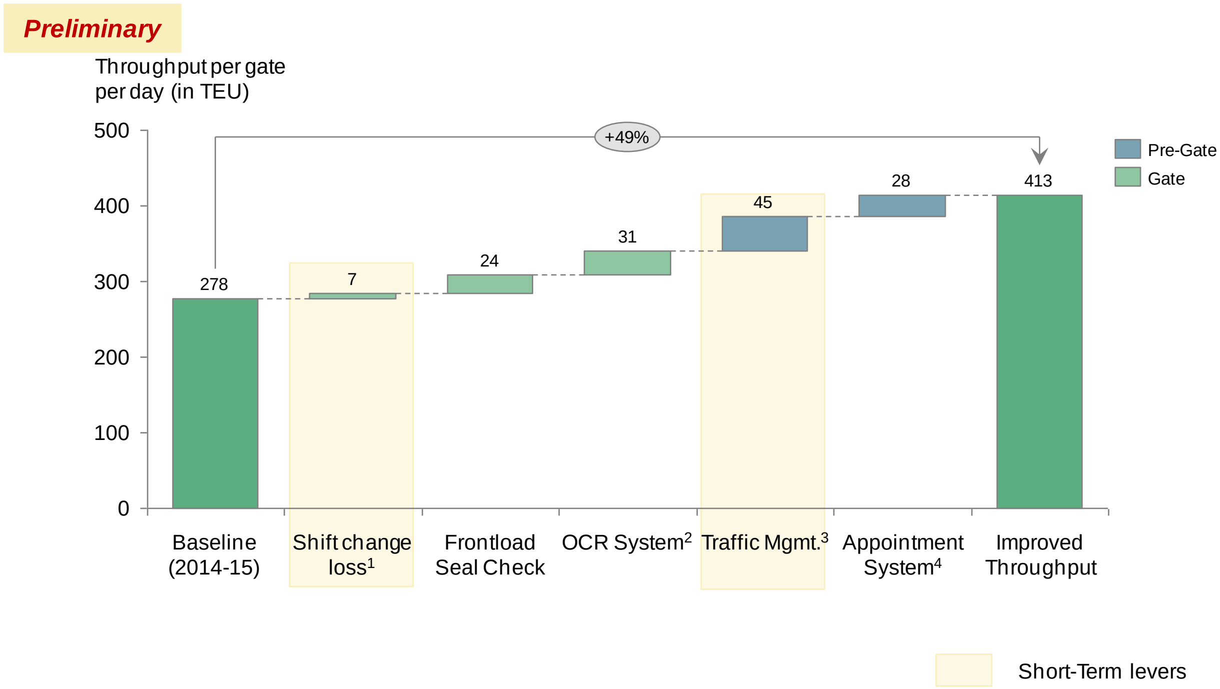
At the JNPCT terminal, however, the yard integrity may pose a challenge in front-loading the process of EIR generation in the import yard itself.

EIR requires actual container details for customs approval, however, containers picked in the JNPCT import yard are often different from the assigned ones on the pick-up ticket at the export gate. This is primarily due to the fact that the actual container location is not reflected correctly in the system. While the system shows container X available for pick up at a specified yard slot and the same is mentioned in the pick-up ticket, in reality, container Y would be stored in that specified slot. CFS agents in the Import yard often decide on the actual pickup container on-the-spot. In such a case, the trucker picks up container Y and proceeds to the gate for the EIR generation that would contain the details of container Y.

Expected Impact

Reduction in import gate lead time from current levels of ~90 minutes to less than 60 minutes.

Summary of gate productivity analysis



1. An average of 10 minutes are lost at the gate during every shift change; 3 shift changes per day
2. OCR system would help eliminate the checking of container number and vehicle details that take approx 30s per truck. Assumed that customs verification would still be done near the gate.
3. Post-customs waiting time to go down by 40% from current levels; estimate based on drivers' survey
4. Estimated based on the deviation of peak traffic from average traffic levels

Source: BCG Analysis

Figure 59: Gate productivity analysis summary