karaikal port

ISO 9001
ISO 14001
ISO 45001
ISO 50001

KPP/ENV/MoEF&CC/2022/08 Date: 01st Oct, 2022

To
The Regional Officer, Integrated Regional Office (IRO),
Ministry of Environment, Forest & Climate Change (MoEF&CC),
1st Floor, Additional Office Block for GPOA, Shastri Bhawan, Haddows Road,
Nungambakkam, Chennai - 600006

Sub: Submission of Compliance Report by end of 30th September, 2022 – Regarding

Ref: Amendment of Construction of Berth No.4 instead of Berth No.7 at Karaikal Port (Phase-II) at Puducherry by M/s. Karaikal Port Pvt Ltd - MoEF&CC Letter No. 10-42/2009-IA-III dated 20.05.2011

Sir,

As per the conditions stipulated in Environmental & CRZ Clearance letter (No.10 - 42/2009 - IA – III, dated 20.05.2011), from Govt of India, Ministry of Environment, Forest and Climate Change IA.III Section (MOEF&CC, IA.III Section), herewith we are submitting the status of compliance reports for the period of April to September 2022.

Thanking you,

Yours faithfully,

(D.Ravi Shankar)
General Manager, Environment

Cc:

- The Regional Director, CPCB Regional Directorate/Project Office, Second Floor, No.77-A, South Avenue Road, Ambattur Industrial Estate, Ambattur Taluk, Thiruvallur District, Chennai 600 058
- The Member Secretary, Puducherry Pollution Control Committee (PPCC) , Department of Science, Technology & Environment, 3rd Floor, PHB Building, Anna Nagar, Puducherry 605 005.

SIX MONTHLY EC COMPLIANCE REPORT FOR THE PERIOD OF APRIL TO SEPTEMBER 2022

DESCRIPTIVE REPORT ON STATUS OF COMPLIANCE TO THE CONDITIONS OF ENVIRONMENTAL CLEARANCE AND ENVIRONMENTAL MANAGEMENT

Subject: Amendment of Construction of Berth No.4 instead of Berth No.7 at Karaikal Port (Phase-II) at Puducherry by M/s. Karaikal Port Pvt Ltd - Reg

Reference: MoEF&CC Letter No. 10-42/2009-IA-III dated 20.05.2011

4. Specific Conditions:

Si.No	Conditions stipulated	Compliance Status
(I)	The shore line map prepared by Institute for ocean management, Chennai with regard to the stretch at Karaikal port has be examined and it is observed that on the southern side of the port, the area is shown as medium accretion while, on the northern side the area is shown as medium erosion. This is because the net littoral drift is towards the northern side and due to the breakwater at the southern port there seems to be accretion at the southern breakwater and medium erosion on the northern side. This reveals that the existing measures for beach nourishment maintenance of shore line are insufficient. Those have to be rectified by adopting suitable measures viz. sand bypass system from south breakwater to the northern side of the north breakwater. The port shall submit the details of action taken to the ministry within 2 months.	Complied. Latest copy of Shoreline Monitoring Study carried out in July 2022 and submitted in August 2022 by M/s Indomer Coastal Hydraulics Pvt. Ltd is attached as Annexure 1.
(II)	The port shall adopt suitable measures viz. sand bypass system from south breakwater to the northern side of the north breakwater. The port shall submit the details of action taken to the ministry within 2 Months.	Complied. Shoreline Monitoring Study was carried out in July 2022 by M/s Indomer Coastal Hydraulics Pvt. Ltd. Recommendations given in the said report will be strictly adhered.

SIX MONTHLY EC COMPLIANCE REPORT FOR THE PERIOD OF APRIL TO SEPTEMBER 2022

Si.No	Conditions stipulated	Compliance Status
(III)	There shall be regular monitoring on the shoreline changes and report be submitted to the ministry at regional office, Bangalore with six monthly monitoring report.	Complied. Shoreline Monitoring Study was carried out in july 2022 by M/s Indomer Coastal Hydraulics Pvt. Ltd. Copy of latest compliance report (KPPL/ENV/MoEF&CC/2022/03 dated 01.07.2022) is attached as Annexure 2.
(IV)	"Consent for Establishment" shall be obtained from Puducherry Pollution Control Committee under Air and Water Act and a copy shall be submitted to the Ministry before start of any construction work at the site.	Complied. Copy of No Objection Certificate (CTE) from Pollution Angle was issued by Puducherry Pollution Control Committee. Copy of the same is attached at Annexure 3.
(V)	Construction shall be carried out strictly as per the provisions of CRZ Notification, 1991. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in coastal regulation zone area.	Complied. Construction was carried out strictly as per the provisions of CRZ Notification.
(VI)	There shall be no disposal of solid and liquid wastes in to the coastal areas.	Complied. Waste Management Plan is in place. Solid and liquid wastes are not being disposed off in to the coastal areas.
(VII)	Dust control measures shall be installed wherever required in the coal handling areas.	Complied. Port has Mechanized Coal Handling System which includes Ship Unloaders, Conveyors, Stacker cum Reclaimers, Wagon Loading & Truck Loading Systems etc are in place and operational. This infrastructure helps in achieving efficient operations and in maintaining clean environment. Highly efficient water sprinkling/ spraying

SIX MONTHLY EC COMPLIANCE REPORT FOR THE PERIOD OF APRIL TO SEPTEMBER 2022

Si.No	Conditions stipulated	Compliance Status
		system for dust suppression have been installed to address the coal dust emission. HDPE/Corrugated sheets of various heights of wind breaking wall have been put along the Coal Stock yards, boundary & Railway sidings. Port has three tier Green Belt in all the boundaries
(VIII)	The leachate from the coal yard shall be properly collected and passed through settling tanks before reuse / recycling.	Complied. KPPL has installed a treatment plant to address the leachate from the Coal Yard
5.	All other conditions shall remain unchanged.	Noted for compliance.

Present Status of Project: Project construction has been completed and operations have started

(D.Ravi Shankar)

General Manager, Environment.

SHORELINE MONITORING STUDY FOR EROSION AND ACCRETION ASSESSMENT AT KARAIKAL PORT FOR THE YEAR 2022

PROJECT CODE: 784072223

STUDY CONDUCTED FOR

KARAIKAL PORT PRIVATE LIMITED
KEEZHA VANJORE VILLAGE, T.R. PATTINAM
KARAIKAL 609606, PUDUCHERRY U.T

REPORT PREPARED BY

INDOMER COASTAL HYDRAULICS (P) LTD.
(ISO 9001: 2015 CERTIFIED AND QCI-NABET&NABL ACCREDITED)
63, GANDHI ROAD, ALWARTHIRUNAGAR, CHENNAI 600 087.
Tel: + 91 44 2486 2482 to 84 Fax: + 91 44 2486 2484
Web site: www.indomer.com, E-mail:ocean@indomer.com

AUGUST 2022

INDOMER COASTAL HYDRAULICS (P) LTD.
(ISO 9001: 2015 CERTIFIED, NABET-QCI& NABL ACCREDITED)
63, Gandhi Road, Alwarthirunagar, Chennai 600 087.
Tel: + 91 44 2486 2482 to 84 Fax: + 91 44 2486 2484
Web site: www.indomer.com, E-mail: ocean@indomer.com

Client	Karaikal Port Private Limited (KPPL), Karaikal.
Project Title	Shoreline Monitoring Study for Erosion and Accretion Assessment at Karaikal Port for the Year 2022.
Project Code	784072223
Abstract	Karaikal Port is an all-weather Port developed under Public Private Partnership (PPP) with the Government of Puducherry. The port is in operation since the year 2009 and it handles multiple types of cargoes of which coal and fertilizer import constitute a major share. KPPL engaged Indomer Coastal Hydraulics (P) Ltd., Chennai to take up "Shoreline Monitoring Study for Erosion and Accretion Assessment" in order to understand the present status of the shoreline. This report also presents the shoreline status and the surveys carried out in October 2013, October 2016, July 2017, July 2022. All the earlier surveys and the present survey were carried out in July 2022 are compared with initial shoreline existed in June 2009.
Foreword	
Document	Controlled
References	Work order No. LOI/PROJECT/SHORELINE STUDY dated 19.07.2022.

Date	Report Type	Originator	Checked by	Approved by	Approver's Sign
01.09.2022	Final	A. Baskaran	Mr. Guru Prasath	Dr. P. Chandramohan	
	Project Code	784072223		Text pages	29
	File Location	E:/2022 Projects/July -22/KPPL		Figures	18

TEAM

Name	Qualification & Designation
Dr. P. Chandramohan	Ph. D. (Ocean Engineering) (Former Scientist, CSIR-NIO, Goa) Managing Director
Dr. J. Guru Prasath	B.E. (Marine Engineering), M.S., $\overline{Ph.D}$. (Ocean Engineering) Director
Dr. Terry Machado	Ph.D. (Marine Geology) (Former Scientist, NCESS, Trivandrum) Associate Director
Mr. A. Baskaran	B.Tech. (Civil Engineering) Senior Project Officer
Mr. R. C. Bragath	M. Tech. (Coastal Engineering) Senior Project Officer
Mr. S. Paramasivam	M.Sc., M.Phil. (Geology) Project Officer
Mr. J. Vinoth Kumar	B.E. (Civil Engineering) Project Officer
Mr. C. Mahendran	B.E. (Civil Engineering) Project Officer
Mr. M. Sharath	B. E. (Electronics and Instrumentation Engineering) Project Officer

CONTENTS

		Page
CONTENTS		**i**
LIST OF FIGURES		**i**
LIST OF ABBREVIATIONS		**ii**
1.	INTRODUCTION	1
2.	SCOPE	3
3.	VETTAR RIVER BREAKWATERS CONSTRUCTION – AN ADDITION IN THE VICINITY	4
4.	EARLIER REPORTS SUBMITTED FOR KPPL	5
5.	METHODOLOGY	6
	5.1. Reference spheroid	6
	5.2. Horizontal control	6
	5.3. Vertical Control	7
6.	TOPOGRAPHIC SURVEY	8
7.	BATHYMETRY SURVEY	10
8.	REASONS FOR EROSION AND ACCRETION	14
9.	SHORELINE MONITORING PLAN	15
10.	ESTIMATION OF EROSION / SILATION	16
11.	INFERENCES & RECOMMENDATIONS	20
GALLERY		21

LIST OF FIGURES

1	Location map	
2	The alignment of TN Fisheries breakwater in the vicinity of the Karaikal Port breakwater	
3	Topographic survey area	
4	Planned lines map for bathymetry survey	
5	Bathymetry map- 1: 2500 scale	(In Pouch)
6	Shoreline changes map from 2009 to 2022	
7	Changes in sediment volume	
8	Area of volume comparison	
9 to 13	Comparison of shoreline changes north side (NR.1 to NR.5)	
14 to 18	Comparison of shoreline changes south side (SR.1 to SR.5)	

LIST OF ABBREVIATIONS

CD	Chart Datum
HTL	High Tide Line
LTL	Low Tide Line
cm	Centimeter
dB	Decibel
DGPS	Differential Global Position System
GGA	Global Positioning System Fix Data
GLL	Geographic Lat /Long
GNSS	Global Navigational Satellite System
GPS	Global Position System
GRS	GPS Range Residuals
GSV	Detailed Satellite data
GTS	Great Trigonometrical Survey
Hz	Hertz
kHz	Kilohertz
km	Kilometer
kPa	Kilo Pascal
LAN	Local area network
LED	Light-Emitting Diode
m	Meter
mm	Millimeters
MSL	Mean Sea Level
NMEA	National Marine Electronics Association
ppm	Parts Per Million
RMC	Recommended Minimum Data for GPS
RTCM	Radio Technical Commission for Maritime Services
RTK	Real- time Kinematic
SBAS	Satellite Based Augmentation Systems
TTV	Tow Vehicle
TVG	Time varying Gain
UTM	Universal Transverse Mercator
V	Volts
VBS	Virtual base station
VDC	Direct Current Voltage
VHF	Very High Frequency communication
W	Watts
w.r.t	with respect to
WAAS	Wide Area Augmented System
WGS	World Geodetic System
ZDA	Date and Time

1. INTRODUCTION

Karaikal Port Private Limited (KPPL) is all weather port located at Karaikal region in the Union Territory of Pondicherry. It has been designed as a lagoon type all weather Deepwater port with south and north breakwaters, berthing wharfs, stacking yards, dredging of berthing areas/ harbour basin/ approach channel etc.

KPPL is located on the East Coast of India. It is located on the east coast of India in Karaikal within the Union Territory of Puducherry. The Port is in operation since the year 2009 and it has handled various types of cargoes of which the majority of the type consists of coal and fertilizer import. In addition, bagged cement and project cargo are handled including handling of offshore supply vessels (OSVs).

The breakwaters construction started in June 2008 and completed in February 2009. The port operation commenced in April 2009. In order to preserve the marine environment, KPPL has initiated the shoreline monitoring surveys since June 2009, along the northern and southern sides of the breakwaters.

The coastlines are generally subjected to quasi-steady state experiencing seasonal erosion during monsoon months and deposition in fair weather period. Over a period of one year cycle, it is expected to maintain its equilibrium without any net changes in its original form. Any changes in its annual equilibrium may be attributed due to natural causes like cyclones or manmade disturbances. However, the stability of the coastline phenomenon can be understood well only if long term data are collected, and a good monitoring program is evaluated.

Indomer Coastal Hydraulics (P) Ltd., Chennai, has been assigned with the task of monitoring of shoreline changes and identifying reasons for Erosion and Accretion in the vicinity of Karaikal Port. Indomer Coastal Hydraulics (P) Ltd., Chennai is an ISO 9001:2008 organization and QCI (NABET) accredited organization vide SI.No.81. for *Sector 27: Oil & Gas Transportation pipeline (crude and refinery/petrochemical products), passing through national parks/sanctuaries/coral reefs/ecologically sensitive areas including LNG Terminal* and *Sector 33: Ports, harbours, jetties, marine terminals, breakwaters and dredging*.

This report also presents the shoreline status and the surveys carried out in October 2013, October 2016, July 2017, July 2022. All the earlier surveys and the present survey were carried out in July 2022 are compared with initial shoreline existed in June 2009. The location map is shown in **Fig. 1.**

All calendar dates are referred in Indian style as dd.mm. yy (e.g., 20.08.22 for 20th August 2022) and the time is referred to Indian Standard Time in 24-hour clock, e.g., 3 P.M. is written as 1500 hrs. The WGS84 spheroid in Zone 44 is followed for surveys and for the presentation in this report. SI units are followed for fundamental and derived units.

2. SCOPE

i) *Shoreline Monitoring Surveys at 1 km length from either side of Northern and Southern Breakwater of Karaikal Port till 3 m water depth and at 200 m interval,*

ii) *Calculate sediment volume in comparison with baseline survey values carried out during 2009 and further monitoring values carried out during 2013 and 2016,*

iii) *To assess the causes of erosion and accretion of Karaikal Port Shoreline Area,*

iv) *To understand the Inferences drawn from the assessment and make Recommendations for mitigation of Shoreline change based on Survey, earlier survey Reports as well as present report,*

v) *To submit the Shoreline Erosion and Accretion Assessment Report.*

3. VETTAR RIVER BREAKWATERS CONSTRUCTION – AN ADDITION IN THE VICINITY

The Department of Fisheries, Government Tamil Nadu has constructed fish landing centre at Nagore to a higher degree of functionality, a project of construction of breakwaters to prevent siltation of the bar mouth at Vettar River in Nagore Fishing harbour. Breakwaters of 330 m long was constructed on Southern Bank of River Vettar Mouth and breakwater work at Northern Bank of River Mouth is under construction.

The south breakwater construction commenced on Feb 2012 and completed in September 2012. And the construction of north breakwater was commenced in September 2021 and the construction work is in with under progress and the same was expected to complete by September 2022.

The construction of TN Fisheries breakwaters at Vettar river mouth, particularly its northern breakwater has the influence on the southern part of the shoreline of the Karaikal port. This southern part of coastline is 675 m long stretching between Karaikal port and Vettar river. This segment of 675 m long shoreline has become entrapped and expected to remain stable in future. The alignment of TN Fisheries breakwater in the vicinity of the Karaikal Port breakwater is shown in **Fig. 2.**

4. EARLIER REPORTS SUBMITTED FOR KPPL

KPPL has initiated the shoreline monitoring surveys along the northern and southern sides of the breakwaters and the monitoring surveys were carried out by Indomer Coastal Hydraulics in 2008, 2009, 2010, 2013, 2014, 2016, 2017 and 2022. The chronological details of previous reports submitted to KPPL is given below:

Sl. No	Month & Year	Report Title
1	**June 2008** (Prior to Construction)	Monitoring of Shoreline survey - **Phase I**
2	**August 2008**	Monitoring of Shoreline survey - **Phase II**
3	**October 2008**	Monitoring of Shoreline survey - **Phase III**
4	**December 2008**	Monitoring of Shoreline survey - **Phase IV**
5	**February 2009**	Monitoring of Shoreline survey - **Phase V**
6	**April 2009**	Monitoring of Shoreline survey - **Phase VI**
7	**June 2009 (Post Construction)**	Monitoring of Shoreline survey - **Phase VII**
9	**September 2009 - April 2010**	Monitoring of Shoreline survey (2009 -2010)
10	**December 2010**	**Stability of Shoreline, Karaikal Port.**
11	**October 2013**	Monitoring of Shoreline survey
12	**November 2014**	Monitoring of Shoreline survey
13	**October 2016**	**Siltation study Analysis survey**
	March 2017	**Siltation study in the Navigational Channel**
14	**July 2017**	Siltation study in the Navigational Channel 1st Season: October 2016 2nd Season: February 2017 3rd Season: August 2017
15	**October 2017**	**Siltation study**
17	**July 2022**	Shoreline Monitoring Study for Erosion and Accretion Assessment at Karaikal Port for the Year 2022.

5. METHODOLOGY

5.1. Reference spheroid

World Geodetic System (WGS84) spheroid – Zone 44N was followed for entire surveys and for the presentation in the report.

5.2. Horizontal control

Reference station: The DGPS Beacon Transmitter operated at Pondicherry *by Department of Lighthouse and navigation* is taken as reference station. The transmitting frequency of this reference Beacon transmitter is 315 kHz.

Mobile station: The horizontal positioning of the mobile unit was carried out using HemisphereR100 Series DGPS Beacon Receiver. It combines high-performance GPS reception with a DGPS-capable receiver in a lightweight, durable housing and comes with a separate antenna. It gives the horizontal position to an accuracy of close to 1 m. The GPS receiver also contains technology enabling *WAAS/EGNOS*, *Omni STAR* or *Beacon* real time differential capabilities. When used with a Real- time Kinematic (RTK) Base station, the GPS receiver provides RTK positioning for high-accuracy, centimeter-level applications.

A standard GPS receiver provides the following features: •10 Hz (10 positions per second) output rate •12 GPS (C/A-code L1, C/A code L2 (for the Omni STAR XP/HP and RTK models)) tracking channels, code carrier channels •Sub meter differential accuracy (RMS), assuming at least five satellites and a PDOP (Position Dilution of Precision) of less than four (when used with Satellite Based Augmentation Systems (SBAS) correction).

The system configuration is enabled with:

- LED display and keypad
- Outputs a 1 PPS (pulse per second) strong signal on both ports. This signal enables an external instrument to synchronize its internal time with a time derived from the very accurate GPS system time.
- SBAS such as WAAS (Wide Area Augmentation System) differential correction1

- Beacon differential correction
- Omni STAR VBS capability
- Omni STAR XP/HP capability in the XP/HP and RTK models
- RTK positioning capability, In the RTK model only
- EVEREST™ multipath rejection technology
- Two connectors that support both CAN 2.0B and RS-232
- CAN: J1939 and NMEA 2000 messages
- NMEA-0183 output: GGA, GLL, GRS, GST, GSA, GSV, MSS, RMC, VTG, ZDA (the default NMEA messages are GGA, GSA, VTG, and RMC)

5.3. Vertical Control

PBM: The Naval Hydrographic Office, Dehradun has established a PBM in Berth No. 1 at Karaikal Port. The details of this PBM were provided by Karaikal Port. The bench mark is encrypted on a 6 x 6 inch square stainless steel plate of 2 mm thickness with a 1 mm dot engraved at center, embedded at the centre on top of a cemented platform with a dimension 0.34 m x 0.34 m x 0.16 m at the SE edge of Berth No.1 in 1.68 m and from first bollard at 5.64 m. 'NATIONAL HYDROGRAPHIC SURVEY', KARAIKAL PORT PVT LTD., BM,'INSDARSHAK', is engraved and painted black on the station plate. The reference level is (+) 4.250 m w.r.t. CD.

The above mentioned PBM -2 established at Karaikal Port has been used as vertical reference level for the entire bathymetry and topographic surveys.

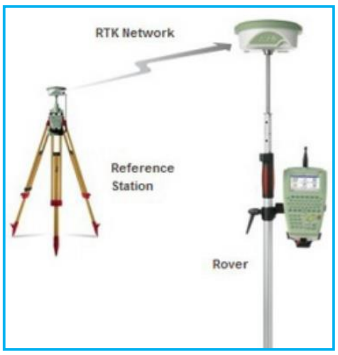
Details of Permanent Benchmark

Description	Geographical		UTM (WGS 84 - Zone 44)		Reduced Level w.r.t. CD (m)
	Latitude, N	Longitude, E	X (m)	Y (m)	
PBM Karaikal Port	10°49'54.38"	79°50'56.28"	0374178	1197616	(+) 4.250
Source: *Reference level of Benchmark given by Client (KPPL).*					

All levels reported in topography and bathymetry map are w.r.t Chart Datum (CD) Based on KPPL PBM.

6. TOPOGRAPHIC SURVEY

Area of survey: The topographical survey area is shown in **Fig. 3.** The topographical survey was carried out using RTK (Real Time Kinematic) GPS. The topography survey covers either side of the breakwaters 1000 m along the coast and 200 m into the land at 100 m grid interval.



Instruments used: Leica GS12 & GS14 GNSS RTK, Total Station and Sokkia Auto Level C320 were used for conducting the topographic survey. Leica GS09 & GS12 GNSS RTK: Leica RTK (Real Time Kinematic) satellite navigation is a technique used inland survey and in hydrographic survey based on the use of carrier phase measurements of the GPS, GLONASS and/or Galileo signals where a single reference station provides the real-time corrections, providing up to centimeter-level accuracy. When referring to GPS in particular, the system is also commonly referred to as Carrier-Phase Enhancement, GPS. RTK systems use a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. There are several ways to transmit a correction signal from base station to mobile station. The most popular way to achieve real-time, low-cost signal transmission is to use a radio modem, typically in the UHF band. This allows the units to calculate their relative position to millimeters, although their absolute position is accurate only to the same accuracy as the position of the base station.

RTK systems are available in dual-frequency and single-frequency versions. Dual-frequency systems deliver greater precision, faster and over longer baselines than single-frequency systems. Leica GS09 & GS12 GNSS RTK that used for the survey contains dual frequency requires antenna and controller to suit any surveying task with a wide range of functionality. Leica GS09 & GS12 GNSS RTK Rover is extremely light-weight and cable free rover is comfortable to use and withstand even for rough use and topple over. It uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. So, that centimeter level accuracy can be achieved from latitude, longitude and altitude. RTK technique in terms of general navigation, it is perfectly suited to roles like surveying. In this case, the base station is located at a known surveyed location, often a benchmark, and the mobile units can then produce a highly accurate map by taking fixes relative to that point. RTK has also found uses in auto drive/autopilot systems, precision farming and similar roles.

Technical Specifications:

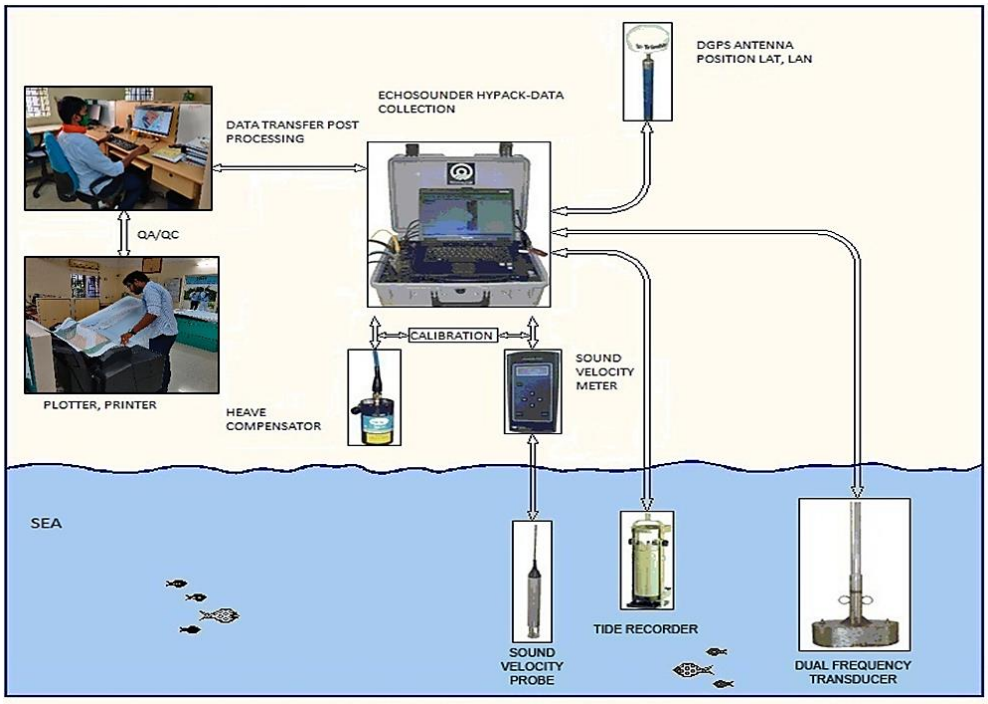
GNSS TECHNOLOGY	**MEASUREMENT ENGINE**	
	Leica patented Smart Track+ technology	• Excellent low elevation tracking technology • Very low noise GNSS carrier phase measurements with <0.5 mm precision • Minimum acquisition time
	No. of channels	• 120 channels
	Reacquisition time	• <1 sec
	GNSS Measurements	
	Satellite Reception	• Dual frequency
	Satellite signals tracking	• GPS: L1, L2, L2C (C/A, P, C Code) • GLONASS: L1, L2 (C/A, P narrow Code)
Measurement Performance	**Accuracy**	
	DGPS/RTCM	• Typically, 25 cm (rms)
	RTK Rapid static (phase)	• Horizontal: 5mm + 0.5ppm(rms) • Vertical: 10 mm +0.5ppm(rms)
	RTK Kinematic (phase)	• Horizontal: 10mm + 0.5ppm(rms) • Vertical: 20 mm +0.5ppm(rms)
	Post processing (phase) Static with long observations	• Horizontal: 3mm + 0.5ppm(rms) • Vertical: 6 mm +0.5ppm(rms)
	Post processing (phase) Rapid static mode	• Horizontal: 5mm + 0.5ppm(rms) • Vertical: 10 mm +0.5ppm(rms)
Hardware	**Physical**	
	Weight	• 1.05kg including battery
	Dimension (diameter x height)	• 186mm x 89 mm
	Power management	
	Supply Voltage	• Nominal 12 V DC, Range 10.5-28 V DC
	Power consumption	• Typically: 1.8 W, 150mA
	Internal Power supply	• Removable & rechargeable Li-ion battery, GE211 2.2Ah / 7.4 V or GE212 2.6 Ah / 7.4 V

Sokkia Auto Level C_{320}: Sokkia Auto Level C_{320} is an improved leveling instrument manufactured by Sokkia, Japan. This instrument was used for measuring the elevation and transfer of reference levels from a given Benchmark to any required points. This instrument has telescoped length of 215 mm and a minimum focusing distance of 200 m. It has the leveling accuracy of ± 1.0 mm for 1 km double run levelling.

7. BATHYMETRY SURVEY

Area of survey: The bathymetry survey covers 3300 m distance between north and south breakwaters and 1000 m distance into the sea. The survey transects were planned perpendicular to coastline at 100 m grid spacing. The planned lines map for bathymetry survey is shown in **Fig. 4.**

Instrument arrangement: The configuration of various devices and arrangements for conducting the bathymetry survey is shown below:



The fiber boat ***"FRB Raja"*** was used for the survey. The Echosounder transducer was mounted on the port side of the vessel by positioning it at 1.0 m below the sea surface. The DGPS receiver antenna was mounted on the mast vertically in line with the transducer, so that it represents the exact coordinates of the location where the depth is simultaneously measured by the transducer. The Heave Sensor was attached close to transducer stem on the boat deck in order to measure the residual vertical displacement of the boat induced by external disturbances and to carry out the correction.

The DIGIBAR-PRO sound velocity meter was used to measure the sound velocity across the vertical and entered as input for calibrating the transmitting part of the instrument. The bar check was also carried out by lowering the rigid plate at different depths and comparing with the displayed depth. The necessary inputs were given in HYPACK data collection software before the commencement of

the survey. The planned track lines were displayed on the monitor at wheel for navigation. Watch guards were positioned at bow, transducer/antenna, and heave compensator at rear end. The data were continuously collected at onboard PC along each transect. After that day data collection was made, entire data were downloaded to external hard disc and stored. The recorded data included: date, time, latitude, longitude, X coordinate, Y coordinate and heave. The depth data was recorded at 0.2 sec interval.

CEESCOPE ECHOSOUNDER: This survey echosounder is manufactured by CEE Hydro systems, Australia. It is a Single frequency echosounder with standard transducer having the frequencies of 200 kHz. It measures the depth ranging between 0 - 200 m with the accuracy of 0.01 m and a resolution of 0.01 m. It has a built in 12 channel GPS receiver with an integrated Beacon receiver. It is a dual channel Beacon receiver for collection of reference station data in both, automatic and manual mode. The system provides horizontal accuracy close to ± 0.5 m. It has the capability of giving position with WGS84 standard datum and 1 user defined datum. It has an antenna with 10 m long cable. The system works on 9 - 18 VDC or on 220 VAC. The unit has two RS232 ports and also Ethernet connection. It is equipped with internal data logger which can store 40 hours survey data and also External USB device for simultaneously log. It also has large LCD display in the front panel operating in touch screen. There is a provision for external DGPS input. It has NMEA output which can be connected to onboard PC and integrated with Hydrographic Software. The touch setting in the front panel enables to mark draught, tide input, time, date, scale shift, calibration gauge, alarm filter and fix interval.

Technical specifications:

Physical	
Dimensions	30.0 x 25.0 x 13.8 cm (L x W x D)
Display	420 x 272 touch screen colour LCD
Weight	3.65 kg (8.05 lbs.) *
Connectors	LEMO 1K & 2K series, Industrial RJ45, TNC
Environmental	
Operating temperature	0°C – 50°C (32°F – 122°F)
Humidity	95% non-condensing
Ingress protection rating	IP67

Power	
Power consumption	7.2 watts (approx. operating time 8 hours) - Eclipse L1
Internal battery	Rechargeable high-capacity NiMH battery 10Ah
Antenna voltage output	5.0 VDC (nominal)
External power supply	Nominal 12.0 VDC @ 2A (9-30 VDC range)
Connectivity	
Network Ports	1, 2
Bluetooth	0 – 50 m range
Wi-Fi	0 – 1000 m range
Internal UHF Rx modem	403 – 473 MHz (RTK only)
Transducer Options	
Standard 200 kHz	9° beam width @-3dB
Echo Sounder	
Mode	Auto Shallow, Auto or Manual
Depth range*	0.15 – 200 m (0.6 – 650 ft) @ 200 kHz
Ping rate	1 – 20 Hertz, depth dependent
Pulse length	HF (1 – 35), LF (1 – 30)
TVG	None, LOG 10, LOG 20
Acoustic Velocity Range	1350 – 1750m (4,429 – 5,741 ft)
Draft	0 – 10 m (1 cm increments)
Accuracy	1 cm ± 0.1% of depth
Resolution	1 cm
GNSS input	NMEA 0183
RTCM	RS-232 UHF or Network
Compass input	NMEA 0183, HDG or HDT

Hydrographic Survey Software: **HYPACK 2021** survey software was used for data collection and processing. It is integrated, first generation hydrographic survey software developed by Coastal Oceanographical INC., USA. It works in MS Windows operating environment. The HYPACK's design program allows to import background map in CAD's DFX or Microsoft's DGN format. It enables to quickly create planned survey lines, plotting sheets and bottom coverage grids in a graphical environment. It gives the flexibility to support multiple navigational systems (GPS, range/range, and range/azimuth), echo sounders (signal and dual frequency, multiple transducers and multibeam), magnetometers, ROV-tracking systems, telemetry tide systems and many other devices. It contains the post processing module to analyze and prepare the chart. The survey tracks were planned used this software for accurate maneuvering of the vessel and to keep the accuracy of the track. The post processing of the survey data and preparation of map were carried out using this software.

Data recording: The Echosounder, heave compensator and Beacon DGPS receiver were interfaced through HYPACK software with onboard PC. The entire system was supported by AC Power Generator installed onboard. The position and depth were recorded along the preplanned transect at 200 millisecond intervals continuously.

Calibration for Sound Velocity: ODOM DIGIPRO SVM has been used to measure the velocity of sound across the vertical and the mean value was fed in the Echosounder during calibration before the commencement of survey on each day. The bar check was carried out before the commencement of the survey and after the survey is completed using the bar mounted with a chain.

Calibration by Bar Check: Bar check was performed before starting and after completion of the survey on every day. It was done by lowering a bar plate at known depth below the transducer. The correction coefficients for known depth were noted and entered on the data collection software.

Tidal corrections: The collected data were processed in the laboratory by applying corrections for tides and immersion depth of the transducer.

8. REASONS FOR EROSION AND ACCRETION

The movement of sediments and impact on the shoreline siltation take place in the Karaikal port region due to various natural coastal processes.

Nearshore sediment movement beyond breaker zone: The pattern of nearshore sediment movement beyond the breaker is observed to move from south to north during March to September; and from north to south from October to February. The volume of sediments moving during southwest monsoon (June to September) is relatively higher compared to fair weather period (March to May) and northeast monsoon (November to February).

The nearshore region between the Vetter River northern breakwater and Karaikal port south breakwater forms a stagnant zone with a formation of a gyre in anti-clockwise direction during southwest monsoon/ fair weather period and in clockwise direction during northeast monsoon. This stagnation phenomenon causes a stable segment in recent days particularly after 2021.

Sediment characteristics: As the seabed on the southside of the port consists of finer materials like clay and silt, they are easily lifted and moved. The seabed on the northern side of the port consists relatively coarser fractions and hence their movement is slightly low.

Littoral Drift: The volume of littoral drift. i.e., annual gross volume of drift is very low. The annual net littoral drift near the project region is northerly but the volume is very low (0.03×10^6 m^3/year towards north). The littoral drift moving in surfzone from south to north during March to September takes diversion to offshore and try to bypass the Vettar groin and Port breakwaters. Such bypassing sediments which are part of the littoral drift cross the navigational channel. It is seen that about 0.63 x 10^6 m^3/year is moving across the channel due the deflection of littoral drift. The littoral drift moving across the channel is high in June, July and August amounting to 1,44,800 m^3 and it moves from south to north.

Vettar river: The sediments if any discharged from the Vettar River reach the nearshore region and get deposited on the southern side of the Karaikal port south breakwater. Other than the rainy days, the fresh water discharge from Vettar River is very low and in turn the sediment load brought by the river is very less. The influence of Vetter River appears to be not very significant for the shoreline process.

9. SHORELINE MONITORING PLAN

The neighboring coastline and the location of 10 reference stations at 200 m spacing covering on either side of the breakwaters are fixed originally in the year 2009 for monitoring the shoreline. The same reference stations are being adopted for comparison for each monitoring surveys thereafter. The monitoring stretch has been divided into two zones namely: i) South zone, 1000 m long, lying south of the southern breakwater and ii) North zone, 1000 m long, lying on the north of the northern breakwater. The reference points are spaced at 200 m interval and the details are given below:

Zones	Reference Points	UTM Coordinates (WGS84 - Zone 44N)	
		X (m)	Y (m)
North Zone	NR1	374529	1199189
	NR2	374529	1199389
	NR3	374529	1199589
	NR4	374529	1199789
	NR5	374529	1199989
South Zone	SR1	374511	1197737
	SR2	374511	1197537
	SR3	374511	1197337
	SR4	374511	1197137
	SR5	374511	1196937

10. ESTIMATION OF EROSION / SILATION

Based on the survey carried out in July 2022, the bathymetry charts are prepared in WGS84 spheroid with UTM coordinates supplemented by geographical coordinates indicating the latitude and longitude. The comprehensive chart covering the survey area is prepared in 1:2500 scale and presented in **Fig. 5.** The depths are represented in 12.5 m x 12.5 m grid with respect to Chart Datum. *The X, Y, Z data are presented in CD separately.*

To compute siltation/erosion and the volume of changes of sediments, the planar area covering 1000 m on either side of the breakwaters and 500 m distance into the sea has been considered.

The periodic shoreline changes indicating LTL (Low Tide Line) and HTL (High Tide Line) of the post project periods, i.e., October 2013, October 2016, July 2017, and July 2022 are compared with the coastline prevailed in June 2009 (period of project commencement) are shown in **Fig. 6.**

The change in sediment volume was estimated using HYPACK MAX TIN Model from the based on the bathymetry conducted in July 2009, October 2013, October 2016, July 2017 and July 2022. The changes in sediment volume with reference to the seabed level existed in June 2009 are given below in **Table 1.** The change in sediment volume over the reference area covering 1000 m on either side of the breakwater and 500 into sea is shown in **Fig. 7.** The extent of reference area used for comparison is shown in **Fig. 8.**

Table.1 Details of sediment volume changes

Region	Change in sediment volume (m^3)				
	June 2009	October 2013	October 2016	July 2017	July 2022
North	Reference	(+) 2,75,985	(+) 3,63,025	(+) 4,92,135	(+) 4,42,257
	Difference with previous survey		(+) 87,040	(+) 1,29,110	(-) 49,875
	Percentage of siltation (%)		(+) 23	(+) 26	(-) 10
South	Reference	(-) 1,30,865	(-) 1,85,300	(-) 1,84,320	(-) 2,04,060
	Difference with previous survey		(-) 54,435	(+) 980	(-) 19,740
	Percentage of siltation (%)		(-) 29%	(+) 1 %	(-) 10 %

(-) Erosion w.r.t. June 2009 seafloor; (+) Deposition w.r.t. June 2009 seafloor

North zone: The study shows that the northern side of the shoreline experienced mostly accretion compared to 2009. The accretion of sediment is (+) 87,040 m^3 (+23%) between October 2013 and October 2016. Similarly, the accretion was (+) 1,29,110 m^3 (+ 26%) between October 2016 and July 2017. The seafloor remained mostly stable between July 2009 and July 2022 showing a very marginal erosion of (-) 49,875 m^3 [(-) 10%]. In general, the northern stretch of the shoreline showed accretion trend since 2009 with mean net deposition of 15% till 2022.

South zone: The southern side of the shoreline showed net low erosion over the years compared with 2009 shoreline. The changes in sediment volume compared between October 2013 and October 2016 showed (-) 54,435 m^3 (- 29%) erosion. The sediment volume compared between October 2016 and July 2017 showed accretion of (+) 980 m^3, i.e., 1% deposition. However, volume compared from July 2017 to July 2022 showed erosion amounting to (-) 19,740 m^3, i.e. (-) 10% erosion. In general, the southern stretch of the shoreline data from July 2009 to July 2022 showed net erosion, but with very low magnitude with the mean value of 10% till 2022.

Stability of shoreline

North zone: In comparison with the survey conducted in June 2009, the survey done in October 2013 October 2016, July 2017 and July 2022 indicates that the shoreline and seabed topography has undergone changes from reference points NR 1 to NR 5 as shown in **Fig. 9 to Fig. 13.** It is seen that there is a deposition of around 30% of sediment compared to the survey done is June 2009.

Monitoring Station	Shoreline distance from monitoring stations (m)									
	June 2009		October 2013		October 2016		July 2017		July 2022	
	HTL	LTL	HTL	LTL	HTL	LTL	HTL	LTL	HTL	LTL
NR 1	34	47	75	90	90	110	86	120	134	190
NR2	42	62	65	80	75	100	77	130	120	170
NR3	30	45	45	65	65	85	70	105	80	130
NR4	18	38	20	45	45	65	58	90	43	93
NR5	-4	15	10	40	35	60	45	70	35	75

Note: (-) distance towards land

STN. NR 1: The shoreline survey indicates that the HTL in June 2009, October 2013, October 2016, July 2017 and July 2022 remained at a distance of 34 m, 75 m, 90 m, 86 m and 134 m respectively. The Low Water Line (LTL) existed at a distance of 47 m, 90 m, 110 m, 120 m and 190 m respectively. The data indicated advancement of shoreline on the northern side.

STN. NR 2: The shoreline survey indicates that HTL in June 2009, October 2013, October 2016, July 2017 and July 2022 remained at a distance 42 m, 65 m, 75 m, 77 m and 120 m respectively. The Low Water Line (LTL) existed at a distance of 62 m, 80 m, 100 m, 130 m, and 170 m respectively. The data indicated advancement of shoreline on the northern side.

STN. NR 3: The shoreline survey indicates that HTL in June 2009, October 2013, October 2016, July 2017 and July 2022 remained at a distance 30 m, 45 m, 65 m, 70 m and 80 m respectively. The Low Water Line (LTL) existed at a distance of 45 m, 65 m, 85 m, 105 m, and 130 m respectively. The data indicated advancement of shoreline on the northern side.

STN. NR 4: The shoreline survey indicates that HTL in June 2009, October 2013, October 2016, July 2017 and July 2022 remained at a distance 18 m, 20 m, 45 m, 58 m and 43 m respectively. The Low Water Line (LTL) existed at a distance of 38 m, 45 m, 65 m, 90 m, and 93 m respectively. The data indicated advancement of shoreline on the northern side.

STN. NR 5: The shoreline survey indicates that HTL in June 2009, October 2013, October 2016, July 2017 and July 2022 remained at a distance (-) 4 m, 10 m, 35 m, 45 m and 35 m respectively. The Low Water Line (LTL) existed at a distance of 15 m, 40 m, 60 m, 70 m, and 75 m respectively. The data indicated advancement of shoreline on the northern side.

South zone: In comparison with the survey conducted in June 2009, the survey done in October 2013, October 2016, July 2017 and July 2022 indicates that the seabed topography has undergone changes from reference points (SR 1 to SR 5) are shown in **Fig. 14 to Fig. 18.** It is seen that there is an Erosion of around 10 % sediment compared to the survey done is June 2009.

Monitoring Station	Shoreline distance from monitoring stations (m)									
	June 2009		October 2013		October 2016		July 2017		July 2022	
	HTL	LTL	HTL	LTL	HTL	LTL	HTL	LTL	HTL	LTL
SR 1	80	110	40	55	20	35	-5	20	10	23
SR2	43	92	15	30	-10	10	-24	-5	-25	-5
SR3	-15	68	-10	10	-50	-45	-68	-30	-60	25
SR4	Vettar River mouth									
SR5	-40	-04	-75	-50	-40	0	-95	-73	-94	-67

Note: (-) distance towards land

STN. SR 1: The shoreline survey indicates that HTL in June 2009, October 2013, October 2016, July 2017 and July 2022 remained at a distance to 80 m, 40 m, 20 m, (-) 5 m and 10 m respectively. The Low Water Line (LTL) existed at a distance of 110 m, 55 m, 35 m, 20 m and 23 m respectively. The data indicated erosion of shoreline on the southern side.

STN. SR 2: The shoreline survey indicates that HTL in June 2009, October 2013, October 2016, July 2017 and July 2022 remained at a distance 43 m, 15 m, (-) 10 m, (-) 24 m and (-) 25 m respectively. The Low Water Line (LTL) existed at a distance of 92 m, 30 m, 10 m, (-) 5 m, and 10 m respectively. The data indicated erosion of shoreline on the southern side.

STN. SR 3: The shoreline survey indicates that HTL in June 2009, October 2013, October 2016, July 2017 and July 2022 remained at a distance (-) 15 m, (-) 10 m, (-) 50 m, (-) 68 m and (-) 60 m respectively. The Low Water Line (LTL) existed at a distance of 68 m, 10 m, (-) 45 m, (-) 30 m, and 25 m respectively. The data indicated erosion of shoreline on the southern side.

STN. SR 4: The STN. SR4 falls in Vettar river mouth.

STN. SR 5: The shoreline survey indicates that HTL in June 2009, October 2013, October 2016, July 2017 and July 2022 remained at a distance (-) 40 m, (-) 75 m, (-) 40 m, (-) 95 m and (-) 94 m respectively. The Low Water Line (LTL) existed at a distance of (-) 4 m, (-) 50 m, 0 m, (-) 73 m, and (-) 67 m respectively. The data indicated erosion of shoreline on the southern side.

11. INFERENCES & RECOMMENDATIONS

- The shoreline survey carried out during July 2022 indicates that the shoreline on the northern part of the northern breakwater is an accretion trend, and the seabed has become shallower compared to June 2009 (project commencement year).

- The shoreline on the southern part of the southern breakwater has experienced slight erosion and the seabed has become deeper compared to June 2009 survey.

- The construction of TN Fisheries breakwaters at Vettar river mouth, particularly the northern breakwater built by TN Fisheries in 2021, has the influence on the stability of the southern part of the shoreline of the Karaikal port.

- The southern part of coastline is 675 m long between Karaikal port southern breakwater and Vettar river northern breakwater. Due to the presence of Karaikal port southern breakwater and the Vettar river northern breakwater, this segment of 675 m long shoreline has become sheltered from 2021 and it is expected to remain stable in future due to reduction in littoral drift.

- As the shoreline on the northern side shows accretion trend and southern side becomes stable, Karaikal port need not to take any shoreline stabilization immediately.

- The trend of the shoreline can be monitored every year preferably in April being the fair weather period. Any shoreline management plan can be taken up if needed after conducting the annual shoreline survey.

- Karaikal port has obtained EC and CRZ clearance for LNG/LPG project which has been planned on the southern side of the coastline and this segment is expected to remain stable without erosion.

- Though the southern part of the coastline is expected to be stable, it is suggested to reclaim for 100 m width from High tide line into the sea along the 675 m stretch falling between the Karaikal southern breakwater and Vettar northern breakwater.

GALLERY

Discussion with KPPL Officials

Commencement of bathymetry survey

Installation of Transducer

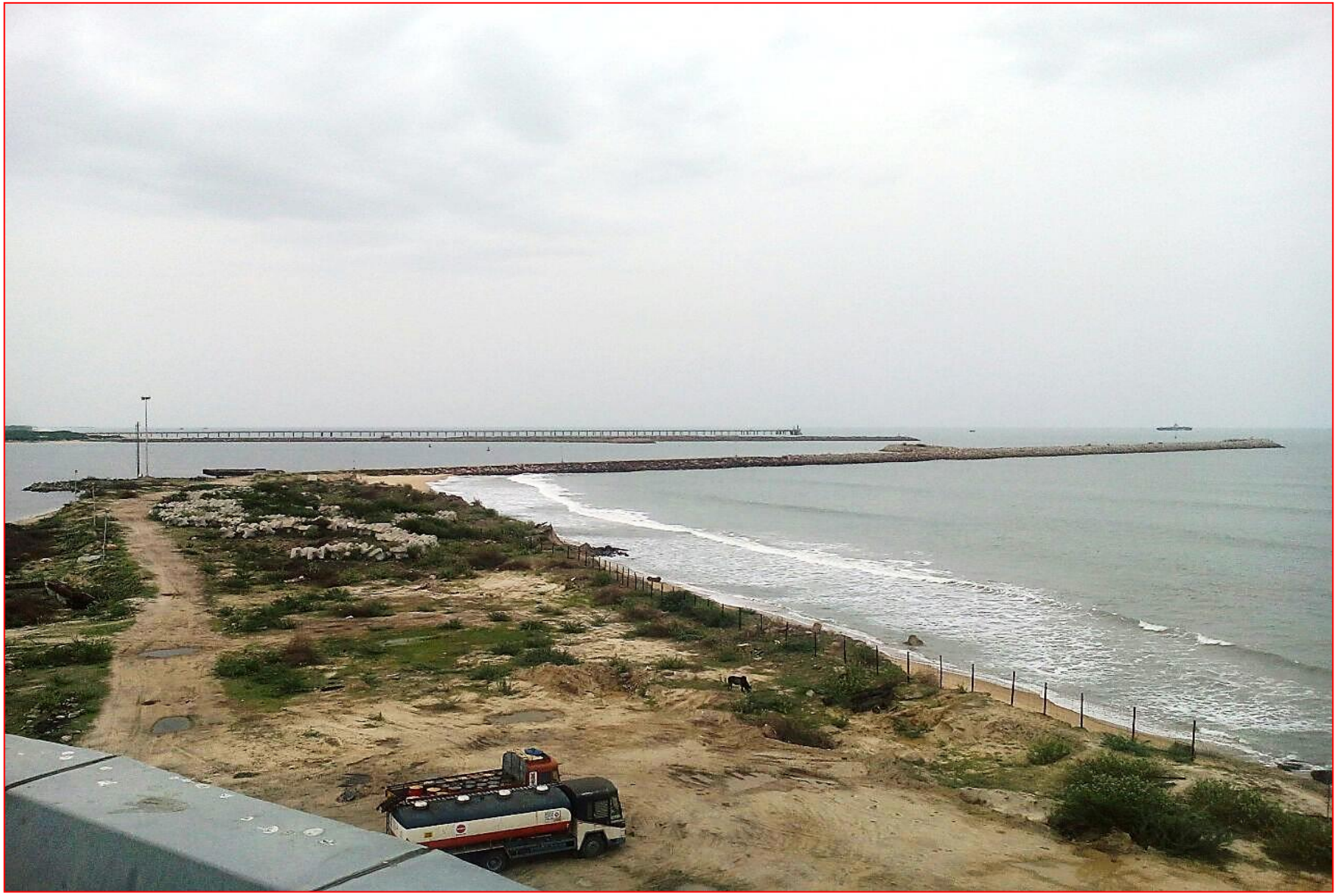
RTK Base station

Shoreline survey South side


Erosion at south of south breakwater


Shoreline survey North side


Deposition at north of north breakwater



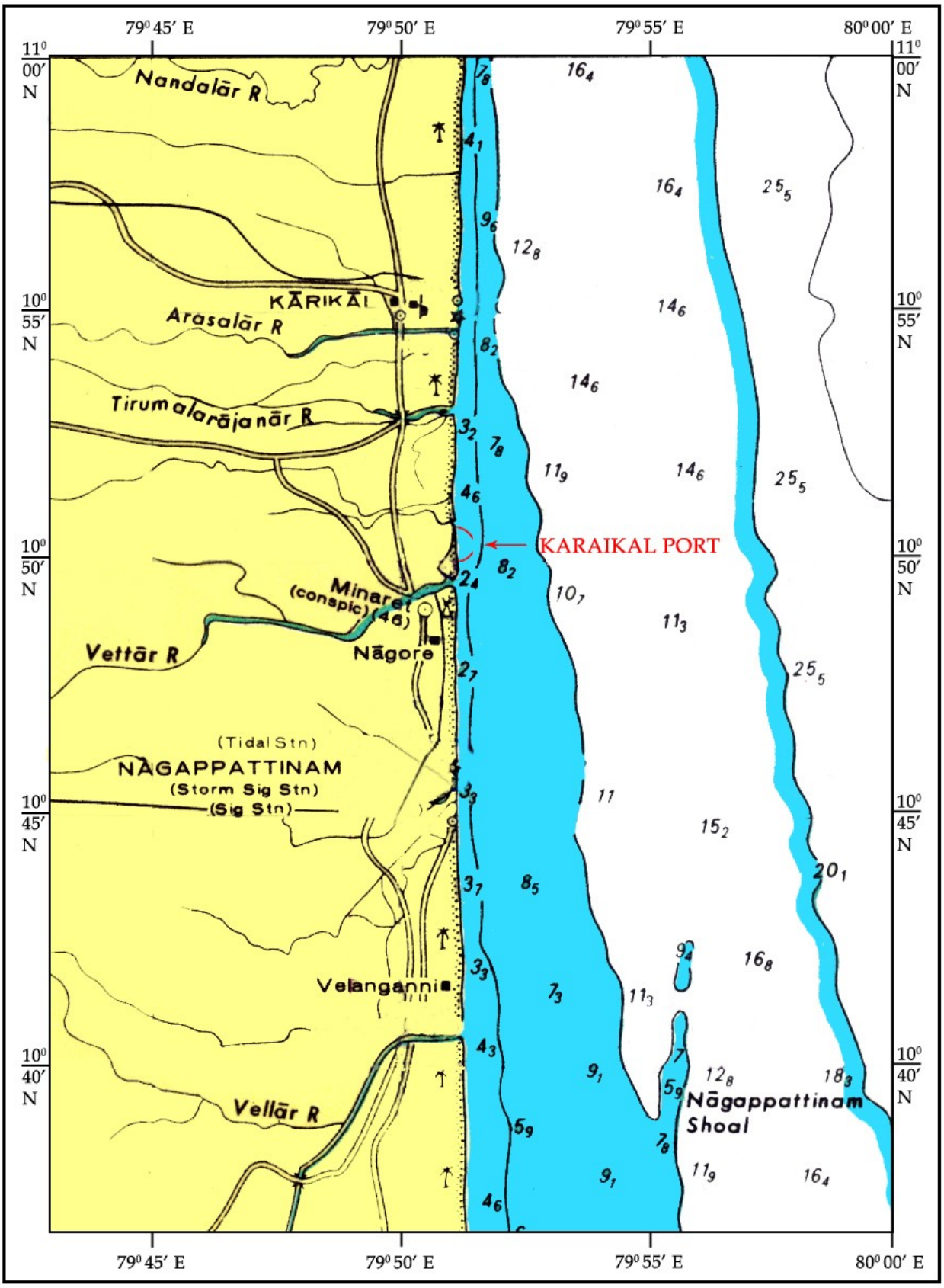


FIG. 1. LOCATION OF KARAIKAL PORT

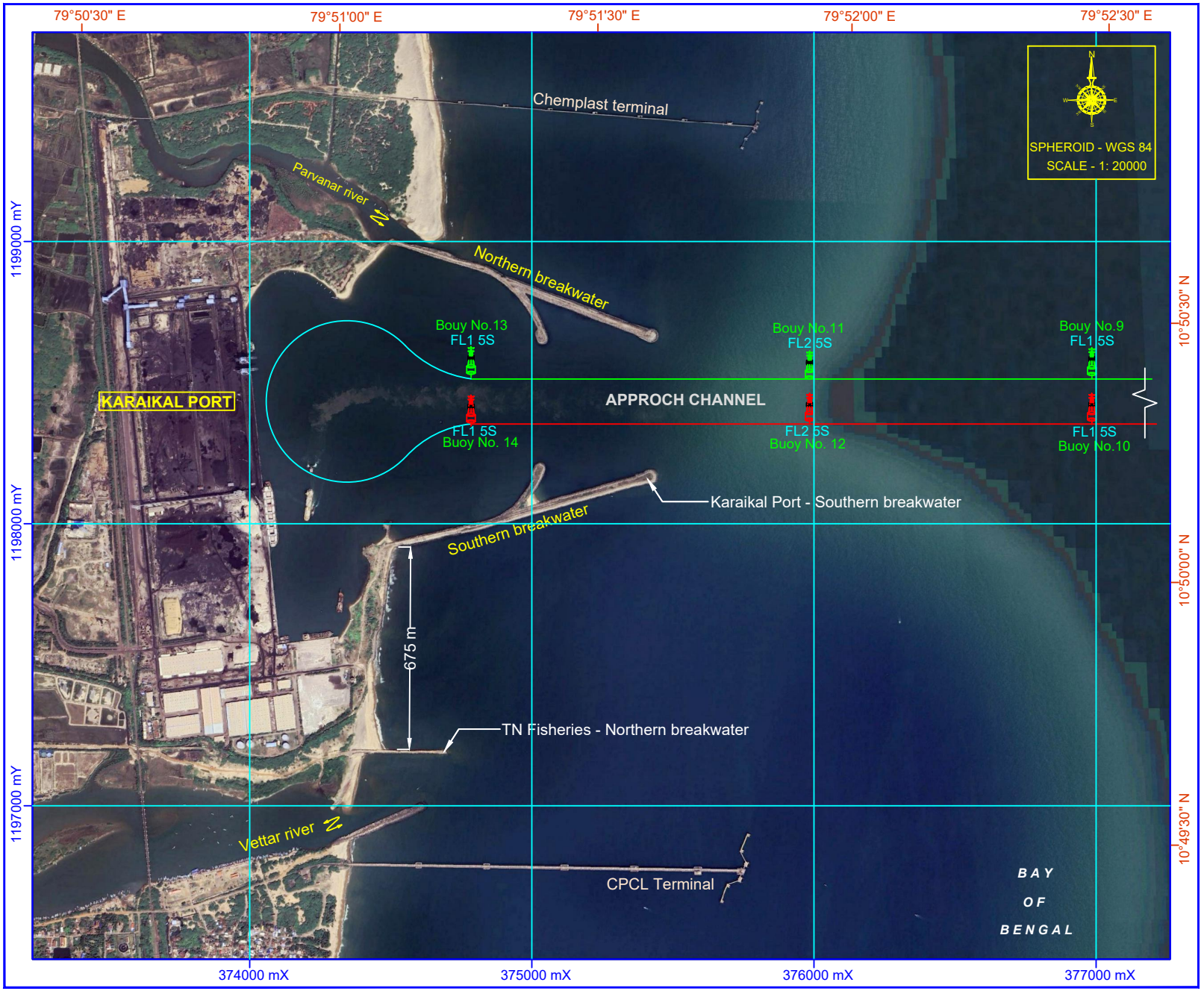


FIG. 2. ALIGNMENT OF TN FISHERIES BREAKWATER IN THE VICINITY OF THE KARAIKAL PORT BREAKWATER

FIG. 3. TOPOGRAPHIC SURVEY AREA

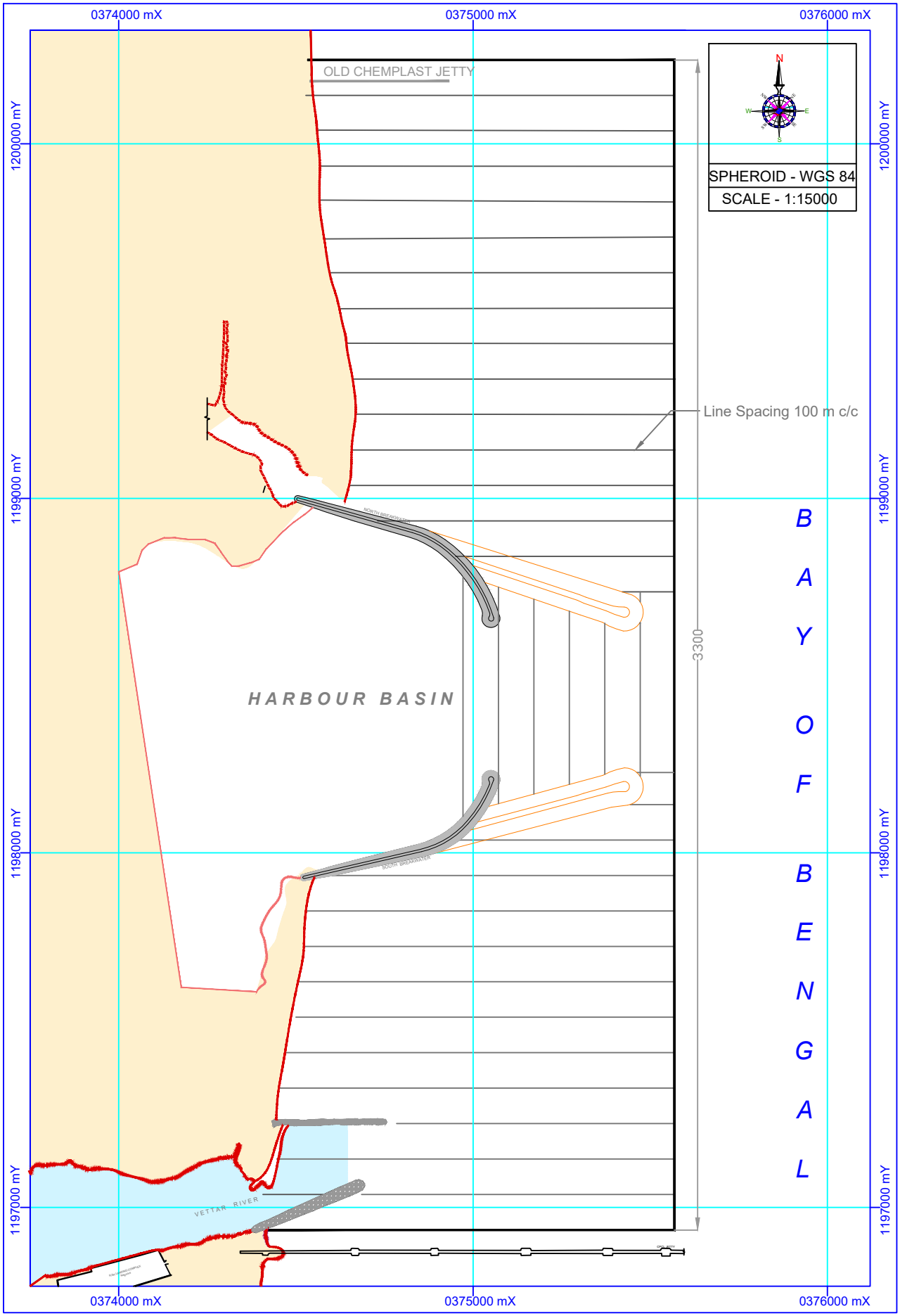


FIG. 4. PLANNED LINES MAP FOR BATHYMETRY SURVEY

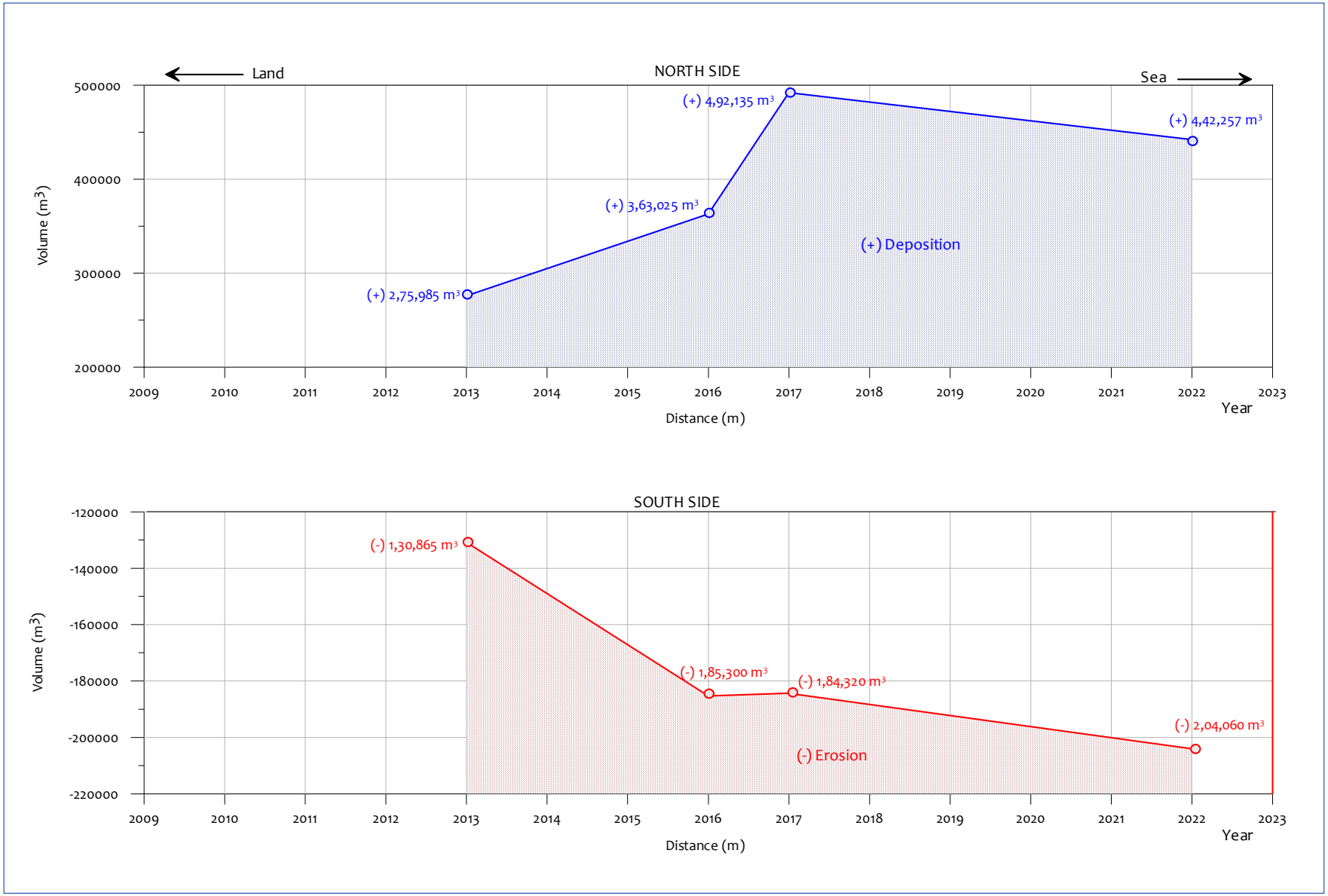


FIG. 7. CHANGES OF SEDIMENT VOLUME AT KPPL

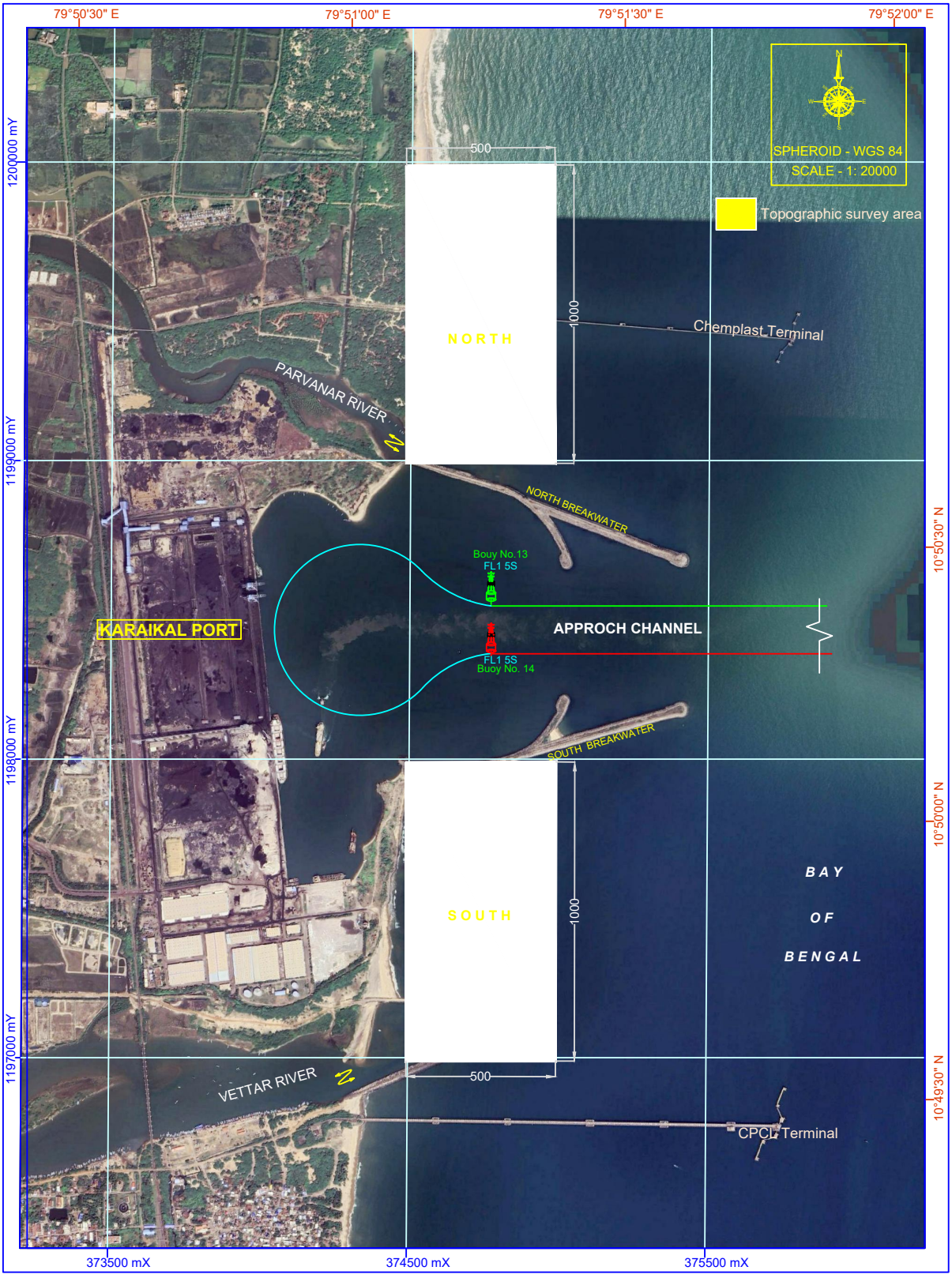


FIG. 8. AREA OF SEDIMENT VOLUME COMPARISON

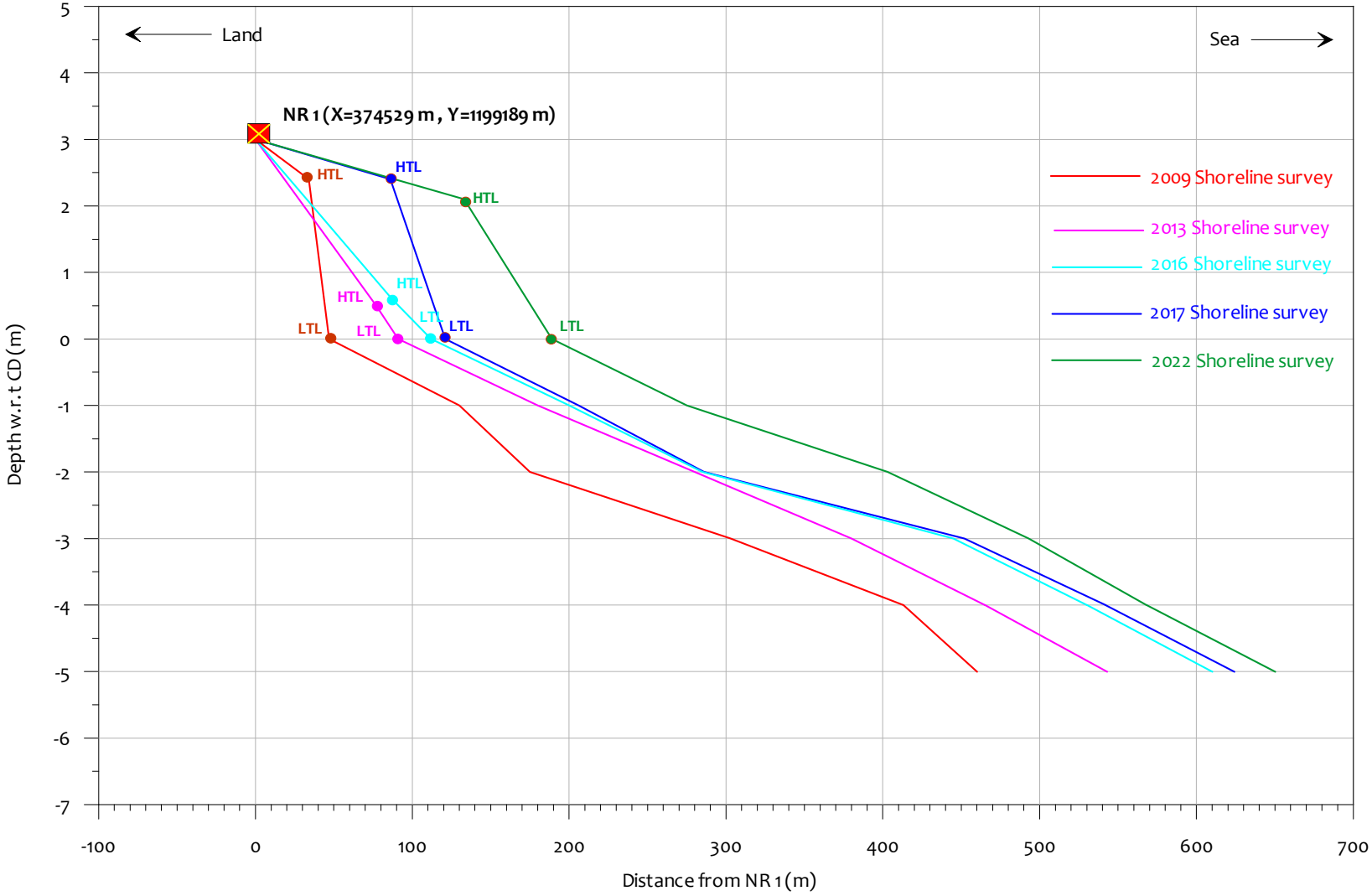


FIG. 9. CROSS SECTION PROFILE AT NR 1

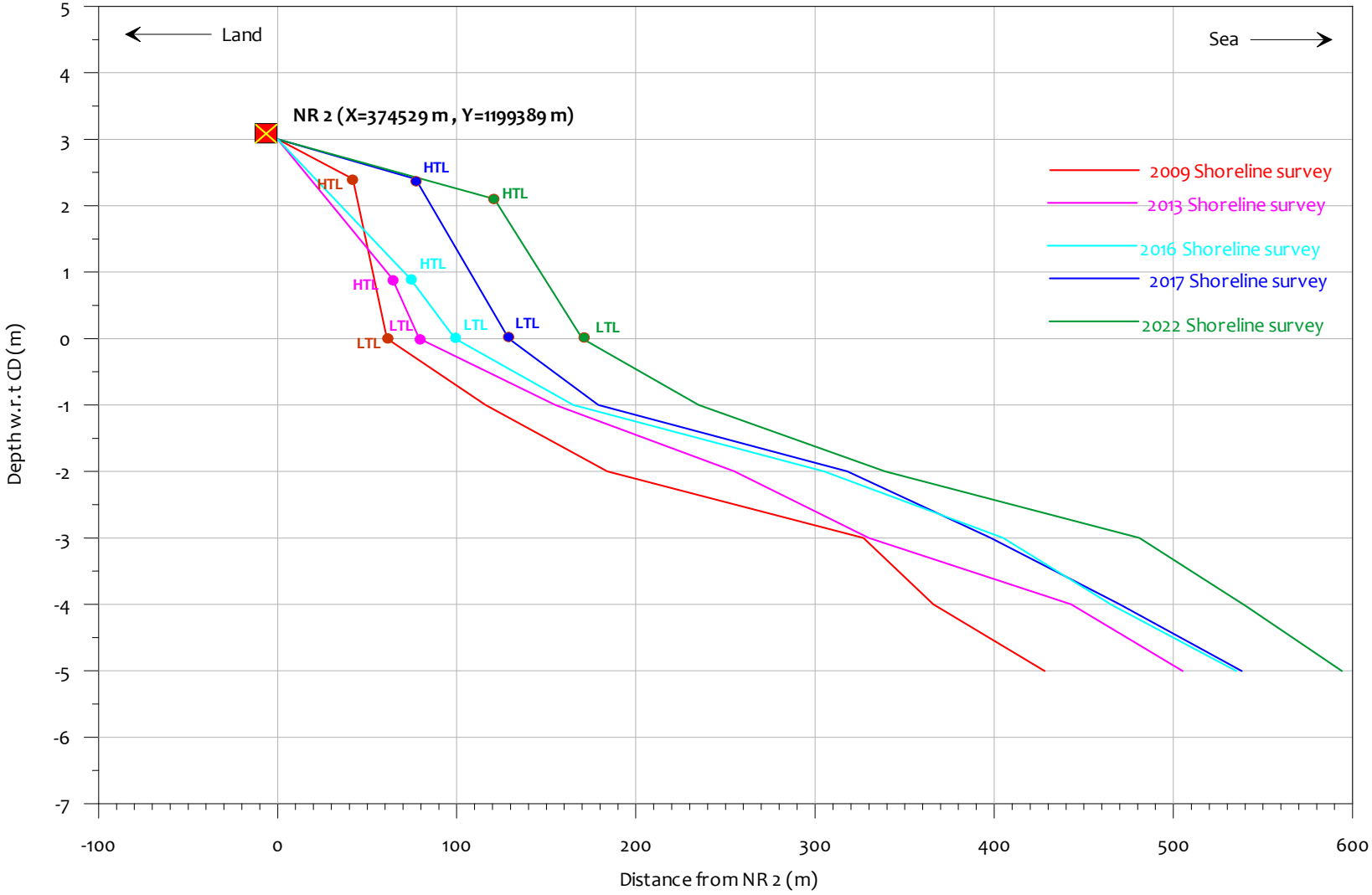


FIG. 10. CROSS SECTION PROFILE AT NR 2

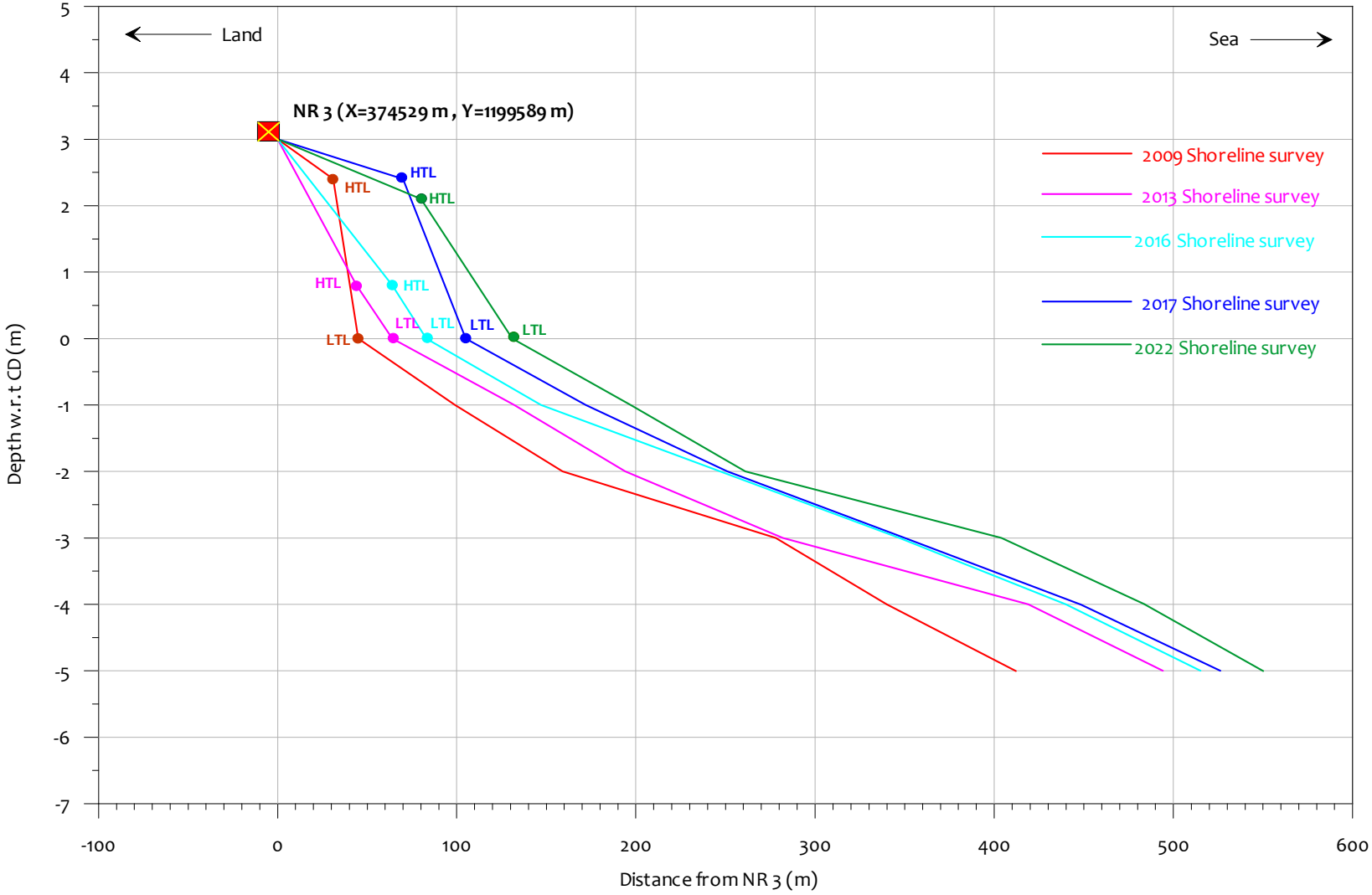


FIG. 11. CROSS SECTION PROFILE AT NR 3

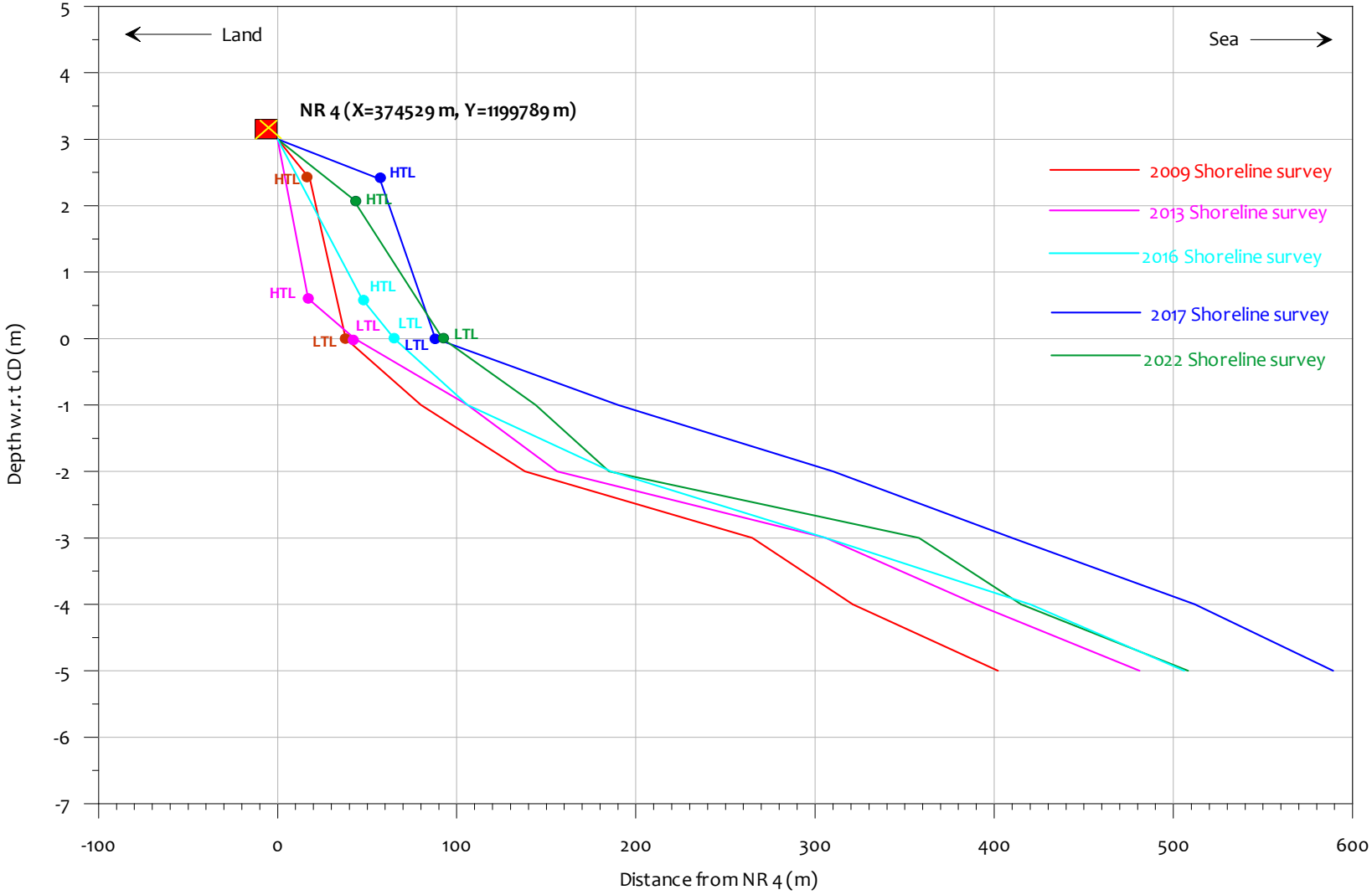


FIG. 12. CROSS SECTION PROFILE AT NR 4

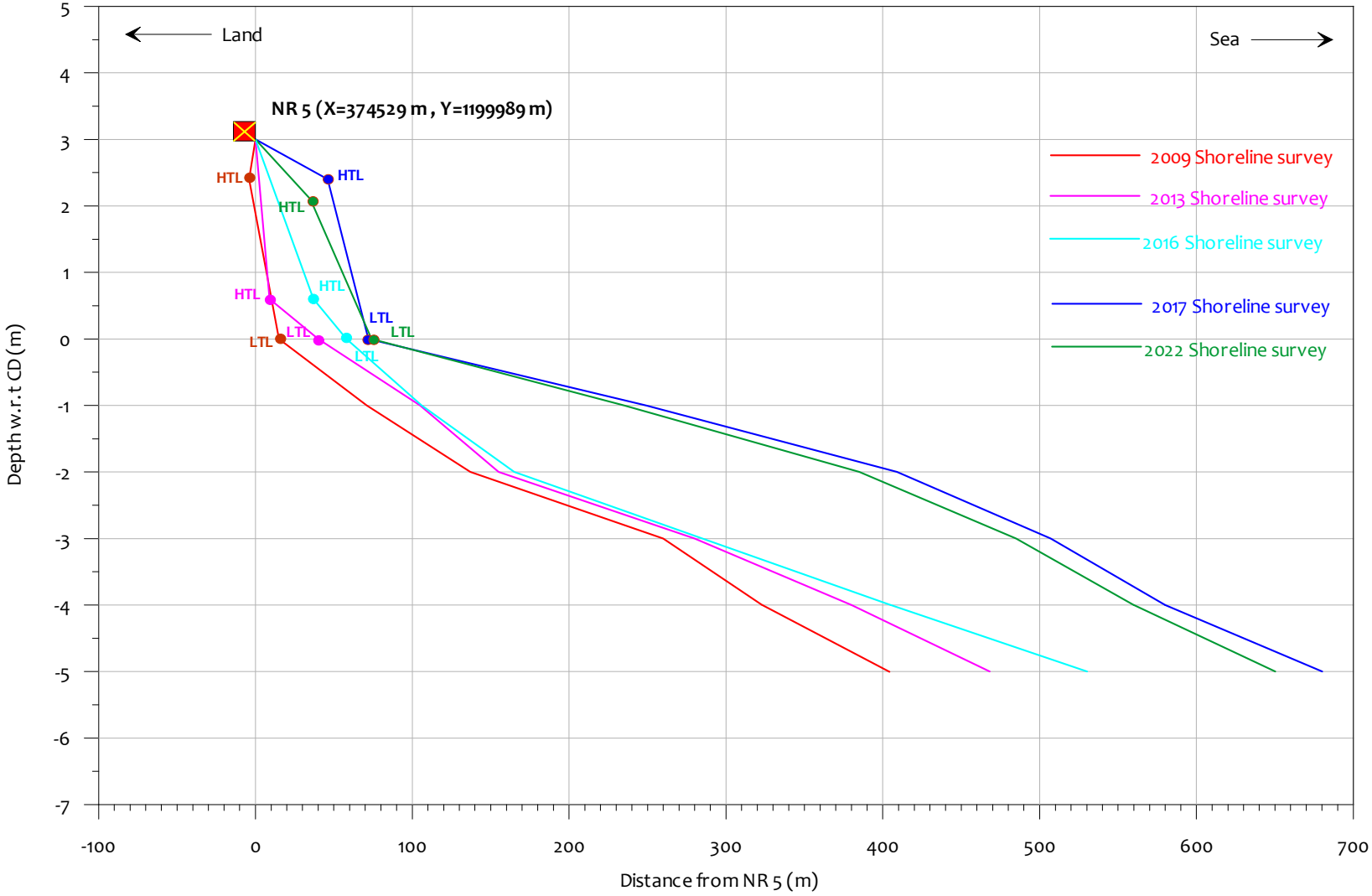


FIG. 13. CROSS SECTION PROFILE AT NR 5

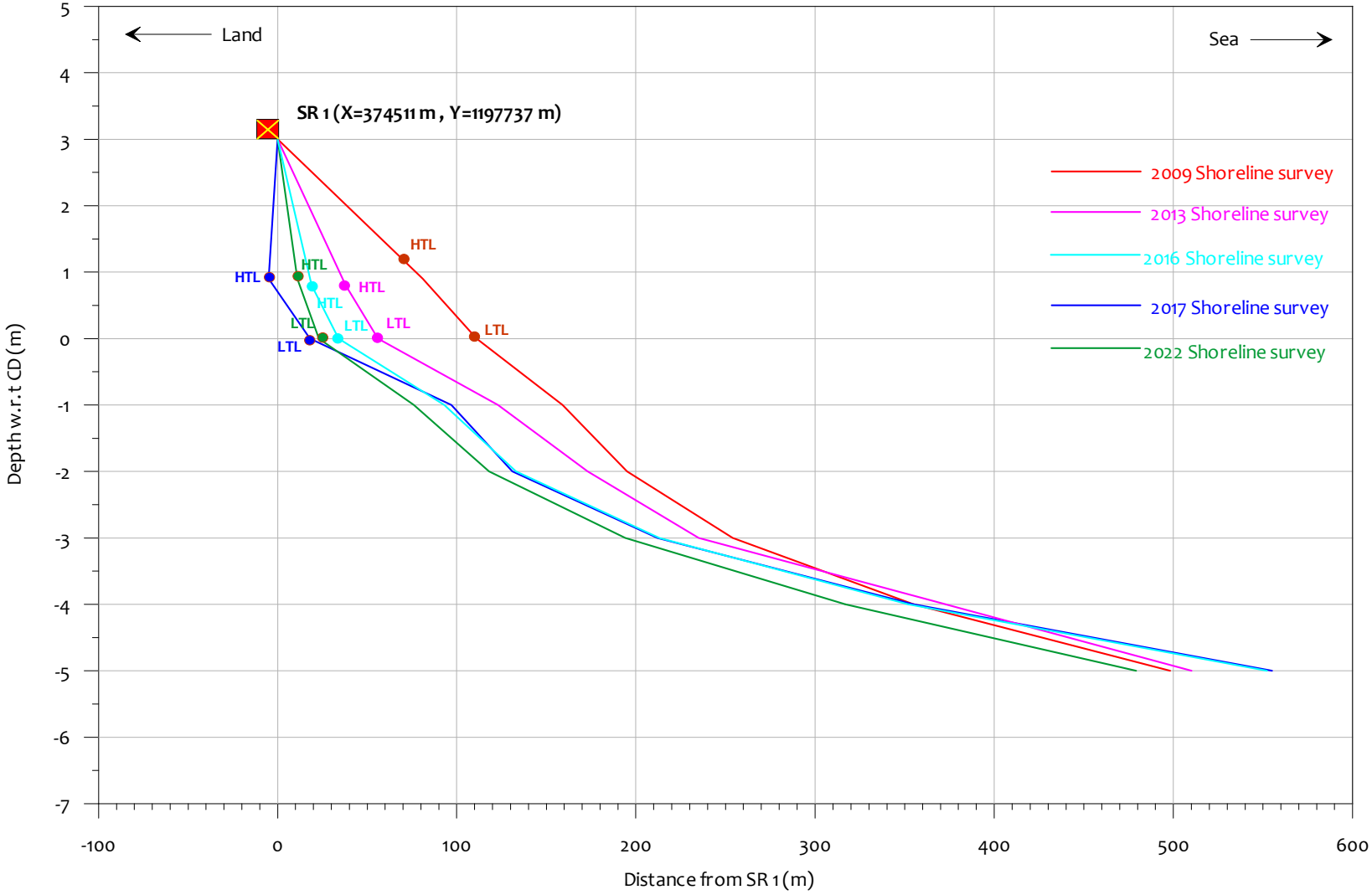


FIG. 14. CROSS SECTION PROFILE AT SR 1

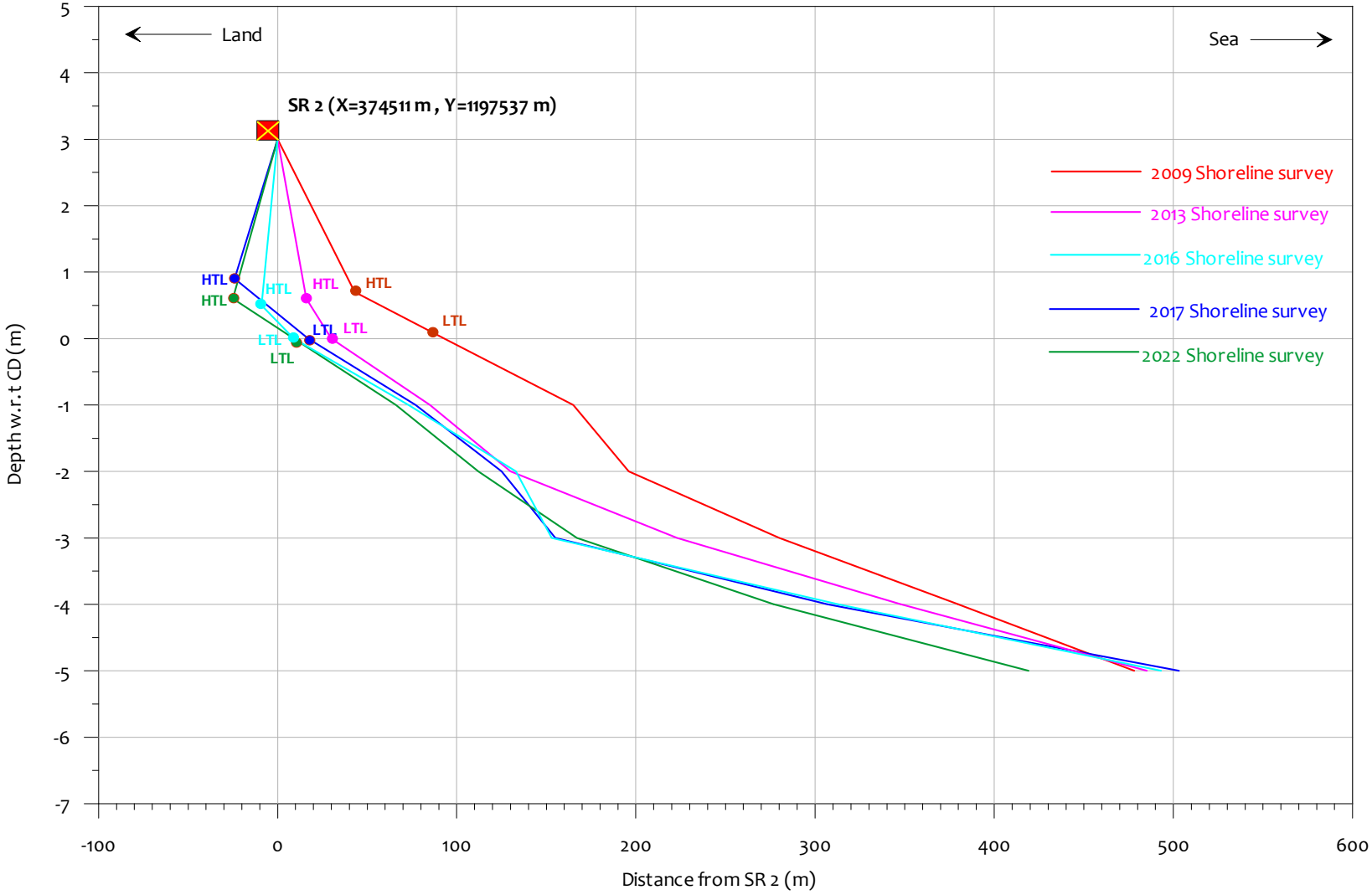


FIG. 15. CROSS SECTION PROFILE AT SR 2

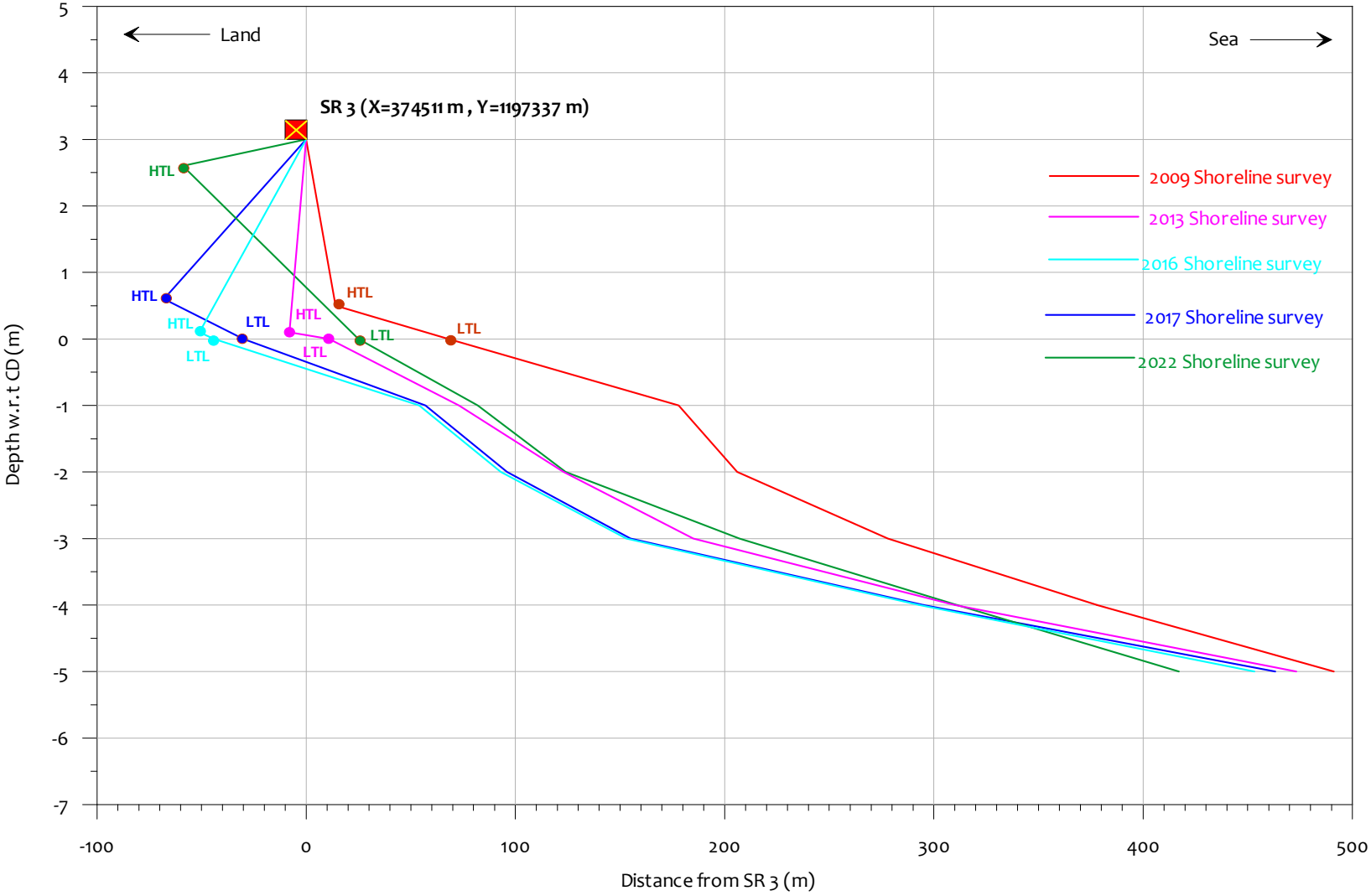


FIG. 16. CROSS SECTION PROFILE AT SR 3

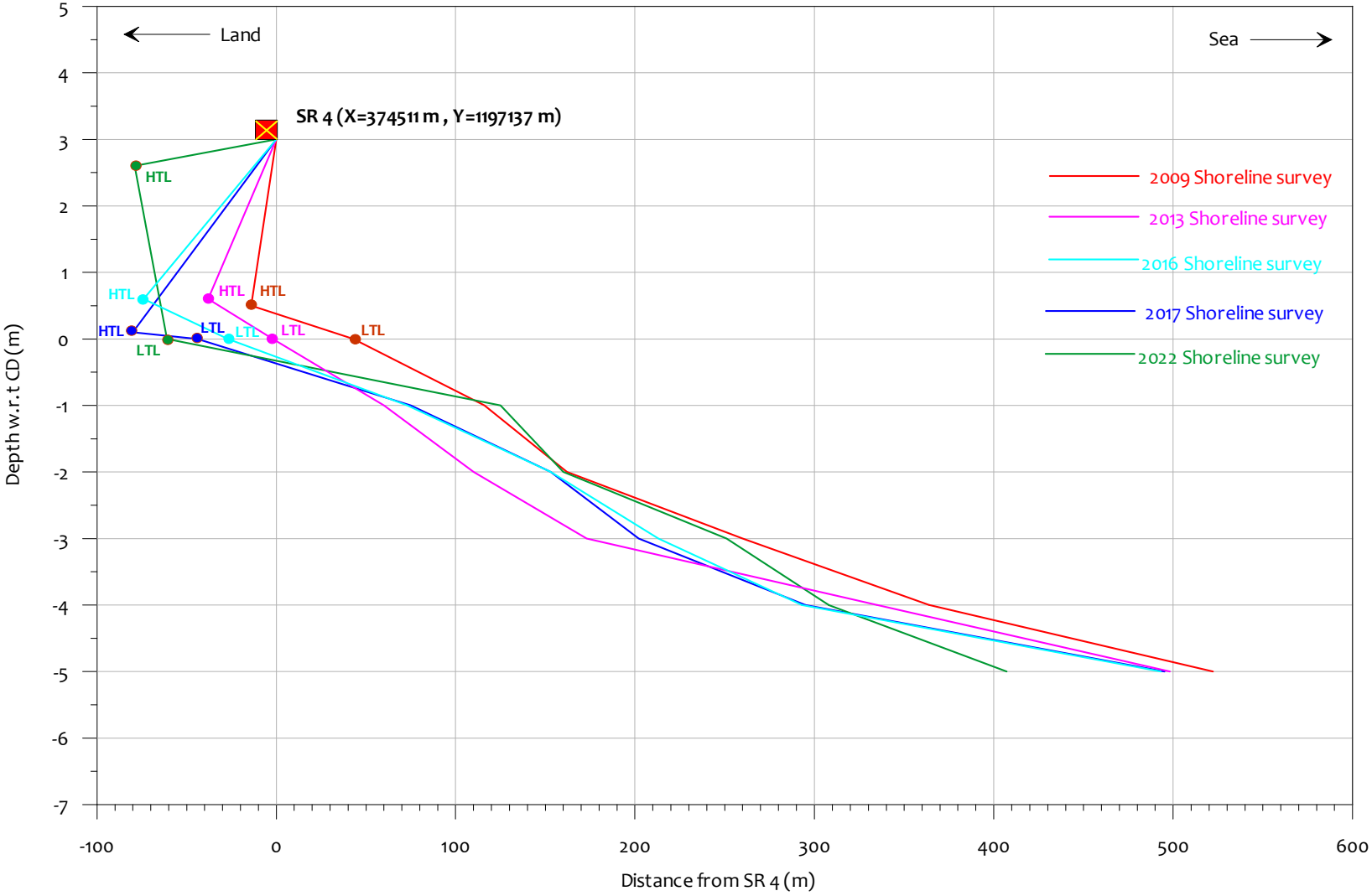


FIG. 17. CROSS SECTION PROFILE AT SR 4 (Vettar Mouth)

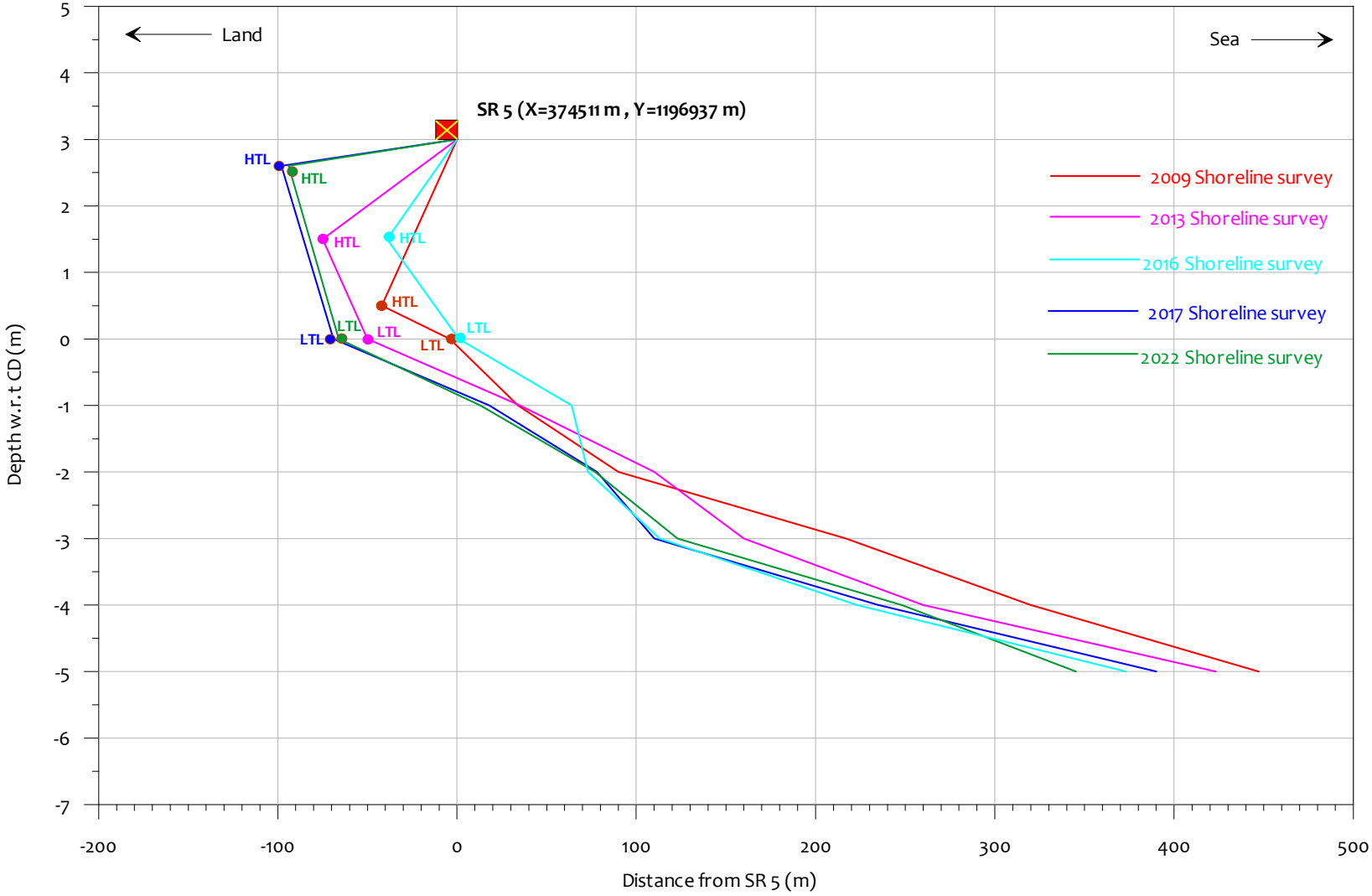


FIG. 18. CROSS SECTION PROFILE AT SR 5

karaikal port

ISO 9001
ISO 14001
ISO 45001
ISO 50001

KPPL/ ENV/ MoEF&CC/2022/03 Date: 01.07.2022

To

The Regional Officer,
Integrated Regional Office,
Ministry of Environment, Forest & Climate Change (MoEF&CC),
Ist Floor, Additional Office Block for GPOA,
Shastri Bhawan, Haddows Road, Nungambakkam –
Chennai - 600006

Sub: Amendment of Construction of Berth No. 4 instead of Berth No. 7 at Karaikal Port (Phase II0 at Puducherry by M/s. Karaikal Port Pvt. Ltd. (KPPL) - Submission of Six - Monthly Compliance Report – Regarding.

Ref: 1. Environmental & CRZ Clearance Letter (No.10 - 42/2009 - IA – III, dated 22.09.2009), and its Amendment Letter dated 20.05.2011 from Govt of India, Ministry of Environment, Forest and Climate Change

2. MoEF&CC Letter No. F. No. EP/12.1/2/2015/PY/430 dated 18th April, 2022.

Dear Sir / Madam,

With reference to the captioned subject and cited reference; we herewith submitting the status of six monthly compliance report to the conditions stipulated in the cited reference (1) above. Further, Non-compliance observed in the report (Ref 2 above) may please be treated as compliance to the requirement and accordingly records may please be updated.

Kindly acknowledge us the receipt of this letter.

Submitted for your kind information and records.

Thanking you,

Yours faithfully,

For Karaikal Port Pvt Ltd

KARAIKAL PORT PVT.LTD. KARAIKAL

(D Ravi Shankar)
Generel Manager - EHS
Encl : as above

Cc:

1. The Regional Director, CPCB Regional Directorate/Project Office at Chennai
2. The Member Secretary, Puducherry Pollution Control Committee at Puducherry

COMPLIANCE REPORT ON CONDITIONS STIPULATED IN ENVIRONMENTAL CLEARANCE

Subject: Amendment of Construction of Berth No.4 instead of Berth No.7 at Karaikal Port (Phase-II) at Puducherry by M/s. Karaikal Port Pvt Ltd - Reg

Reference: MoEF&CC EC letter of No. 10-42/2009-IA. III dated 20.05.2011

4. Specific Conditions:

Sl.No.	Conditions stipulated	Compliance verified by IRO,MoEFCC	KPPL Response
(I)	The shore line map prepared by Institute for ocean management, Chennai with regard to the stretch at Karaikal port has be examined and it is observed that on the southern side of the port, the area is shown as medium accretion while, on the northern side the area is shown as medium erosion. This is because the net littoral drift is towards the northern side and due to the breakwater at the southern port there seems to be accretion at the southern breakwater and medium	Agreed to comply. M/s Karaikal Port Pvt. Ltd., vide letter No. KPPL/ENV/MOEF/001, dated 02.08.2011 submitted that beach nourishment was carried out in the month of May 2010 and June 2010. Also shoreline stability was carried out by M/s Indomer Coastal Hydraulics Pvt Ltd and report suggests monitoring the shoreline for another two years and then to adopt suitable long term mitigating measures such as sand bypass system etc. After 2010, no report on monitoring of shoreline was submitted to this ministry. The PA assured that the monitoring of shoreline	**Complied.** M/s Karaikal Port Pvt. Ltd., (KPPL) had carried out the beach nourishment activity during May 2010 and June 2010 as per study carried out in the year 2008-2009 by M/s Indomer Coastal Hydraulics Pvt Ltd and the same was informed to Ministry of Environmental and Climate Change (MoEF & CC) vide letter No. KPPL/ENV/MOEF/001 dated 02.08.2011 and copy of the same is attached as **Annexure – 1.** M/s. Indomer Coastal Hydraulics (P) Ltd also suggested to monitor the shoreline for another two years and then adopt suitable long term mitigating measures such as sand by pass system etc and the same was also

Sl.No.	Conditions stipulated	Compliance verified by IRO,MoEFCC	KPPL Response
	erosion on the northern side. This reveals that the existing measures for beach nourishment maintenance of shore line are insufficient. Those have to be rectified by adopting suitable measures viz. sand bypass system from south breakwater to the northern side of the north breakwater. The port shall submit the details of action taken to the ministry within 2 months.	study will be resumed and submitted to this Ministry.	communicated to MoEF & CC in the same letter attached as Annexure- 1. As per recommendation of study report, M/s KPPL had engaged M/s Indomer Coastal Hydraulics Pvt Ltd again for conducting Shoreline monitoring study during July 2013 and copy of the same is attached as **Annexure – 2**. The study reveals that northern side of breakwater is getting accredited and southern side of breakwater is getting eroded. This shoreline study report reveals that status of shoreline condition is completely opposite compared to the shoreline condition status reported in the year 2008-2009 and hence M/s KPPL was not required to carry out neither beach nourishment on northern side of break water nor creation of sand by pass system on southern side of break water. M/s KPPL had again carried out the same study through M/s Indomer Coastal Hydraulics Pvt Ltd in the year July, 2016 to ascertain the shoreline condition and compared with the base year i.e. 2009 and

Sl.No.	Conditions stipulated	Compliance verified by IRO,MoEFCC	KPPL Response
			copy of the report is attached as **Annexure - 3**. This study also revealed that north side of breakwater is getting accredited and southern side of breakwater is getting eroded. Hence, M/s KPPL is now engaging M/s Indomer Coastal Hydraulics Pvt Ltd for carrying out the latest shoreline changes study to check and confirm the current shoreline pattern. Based on the recommendation of the study and suggested measures, if any will be implemented and the same will be informed to MoEF & CC as part of half yearly compliance submission regularly. M/s KPPL would like to also inform that reclamation is already approved in the area of southern side of break water where erosion observed during the study carried out in the year 2013 and 2016 as part of Environment and CRZ clearance of LNG terminal. Hence, this reclamation activity will stabilize the shoreline in the area of the southern side of

Sl.No.	Conditions stipulated	Compliance verified by IRO,MoEFCC	KPPL Response
			break water and the same will be monitored through shoreline change study regularly.
(II)	The port shall adopt suitable measures viz. sand bypass system from south breakwater to the northern side of the north breakwater. The port shall submit the details of action taken to the ministry within 2 Months.	Not Complied. The PA informed that the monitoring of shoreline will be resumed and submitted to this Ministry, Till then, PA assured that the nourishment of beach to suitable quantity will be carried out on the northern side to stabilize the erosion.	**Complied.** Please refer our detailed reply given for Sl.No (i).
(III)	There shall be regular monitoring on the shoreline changes and report be submitted to the ministry at regional office, Bangalore with six monthly monitoring report.	Not Complied. The PA has not submitted the six monthly compliance report in respect of specific conditions stipulated in this amendment EC.	**Complied.** M/s Karaikal Port Pvt. Ltd., (KPPL) carried out shoreline stability report through M/s. Indomer Coastal Hydraulics (P) Ltd for the period from June 2008 to June 2009 and copy of the report submitted to Ministry of Environmental and Climate Change (MoEF & CC) vide letter No. KPPL/ENV/MOEF/001 dated 02.08.2011 and copy of the same is attached as **Annexure – 1.** M/s Karaikal Port Private Limited (KPPL) had engaged M/s Indomer Coastal Hydraulics Pvt Ltd for conducting Shoreline monitoring study during

Sl.No.	Conditions stipulated	Compliance verified by IRO,MoEFCC	KPPL Response
			July 2013 and July 2016. Copy of the reports are attached as **Annexure – 2 & 3.** M/s KPPL is now engaging M/s Indomer Coastal Hydraulics Pvt Ltd for carrying out the latest shoreline changes study to check and confirm the current shoreline pattern. Based on the recommendation of the study and suggested measures, if any will be implemented and the same will be informed to MoEF & CC as part of half yearly compliance submission regularly.
(IV)	"Consent for Establishment" shall be obtained from Puducherry Pollution Control Committee under Air and Water Act and a copy shall be submitted to the Ministry before start of any construction work at the site.	Complied. The PA has obtained NOC (CTE) from Puducherry Pollution Control Committee vide proceedings No PPCC/NOC/KKL/JE/2006/303, dated 09.02.2006	**Complied.** Necessary NOC (CTE) obtained from Puducherry Pollution Control Committee.

Sl.No.	Conditions stipulated	Compliance verified by IRO,MoEFCC	KPPL Response
(V)	Construction shall be carried out strictly as per the provisions of CRZ Notification, 1991. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in coastal regulation zone area.	Complied. As per recommendations, permissible constructions were made within CRZ area.	**Complied.** Construction was carried out strictly as per the provisions of CRZ Notification, 1991.
(VI)	There shall be no disposal of solid and liquid wastes in to the coastal areas.	Complied. During the visit, it was observed there is no discharge of liquid or disposal of solid wastes into the coastal areas.	**Complied.** Solid and liquid wastes are not being disposed off into the coastal areas.
(VII)	Dust control measures shall be installed wherever required in the coal handling areas.	Complied. Dry Fog Dust Suppression System (DFDS) has been installed in mechanized coal yard to prevent and control fugitive emissions during stacking and reclaiming operations.	**Complied.** Port has Mechanized Coal Handling System which includes Ship Unloaders, Conveyors, Stacker cum Reclaimers, Wagon Loading & Truck Loading Systems etc are in place and operational. This infrastructure helps in achieving efficient operations and in maintaining clean environment. Highly efficient water sprinkling/ spraying system

Sl.No.	Conditions stipulated	Compliance verified by IRO,MoEFCC	KPPL Response
		24*7 Online continuous monitoring stations have been installed at three locations and are linked to PPCC servers and authorized CPCB servers on real time basis	for dust suppression have been installed to address the coal dust emission. HDPE/Corrugated sheets of various heights have been put along the Coal Stock yards, boundary & Railway sidings In the Southern side of the Port. Port has three tier Green Belt in all the boundaries
(VIII)	The leachate from the coal yard shall be properly collected and passed through settling tanks before reuse / recycling.	Agreed to Comply.	**Complied.** KPPL has installed a treatment plant to address the leachate from the Coal Yard
5.	All other conditions shall remain unchanged.		Noted for compliance.

MARG

KPPL/ENV/MOEF/001

02nd August 2011

To

The Director (IA.III),
Ministry of Environment and Forests,
Paryavaran Bhavan,
CGO Complex, Lodhi Road,
New Delhi – 110 003

Subject : **Compliance Status towards Amendment of Construction of Berth No. 4 instead of Berth No. 7 at Karaikal Port (Phase II) at Puducherry by M/s. Karaikal Port Pvt Ltd – Reg.**

Reference : **Your letter No. F.No. 10 – 42/2009 – IA - III dated 20th May 2011 regarding Amendment of Construction of Berth No. 4 instead of Berth No. 7 at Karaikal Port.**

Sir,

Pursuant to our earlier communications and as per the Section 4 (I & ii) vide referred letter, Karaikal Port Pvt Ltd hereby submits the Compliance Status towards Amendment of Construction of Berth No. 4 instead of Berth No. 7.

We draw your kind attention to the following sections of the referred letter received from your Good Office.

1. Please refer enclosed shoreline stability report carried out by Indomer Coastal Hydraulics (P) Ltd for the period from June 2008 to June 2009. The report suggests monitoring the shoreline for another two years and then to adopt suitable long term mitigating measures such as sand bypass system etc.

   Beach nourishment was carried out in the month of May 2010 and June 2010. The material dredged at offshore was carried and placed on the northern side of the northern breakwater. The quantity of sediment placed for beach nourishment was 16000 m^3 in May 2010 and 24000 m^3 in June 2010. We have also enclosed a second monitoring report for the period June 2009 to July 2010. This report has suggested carrying out same amount of beach nourishment every year during May to July; accordingly we have already initiated beach nourishment on Northern side of North breakwater.

   In addition, we have initiated fresh shore line monitoring on receipt of the said clearance letter and we shall adopt suitable long term mitigating measures. Till then beach nourishment to suitable quantity will be carried out on the northern side to stabilize the erosion.

Corp. Off: Devs Ark, No.284/1136, Rajiv Gandhi Road, Kandanchavadi, Perungudi PO, Chennai 600 096. Tel : 044 - 4592 5252 / 55 Fax : 044 - 4598 5298 / 99
PB No.33, Karaikal - 609 606 Tel : 04365 - 256600 (5 lines) Fax : 04365 - 256603

2. We have already initiated fresh shore line monitoring on receipt of the said clearance letter and we shall adopt suitable long term mitigating measures viz sand by pass system. Till then beach nourishment to suitable quantity will be carried out on the northern side to stabilize the erosion.

This is for your kind information and record please.

Thanking you

Yours sincerely,
For Karaikal Port Pvt Ltd,

Capt. Prasad Rebala
Sr. Vice President - Port Operations

Enclosures : As mentioned above.

INDOMER
Coastal Hydraulics (P) Ltd.
इन्डोमर

63, Gandhi Road
Alwar Thirunagar
Chennai - 600 087, India.
Phone : + 91 44 2486 2482 to 84
Fax : +91 44 2486 2484
Email : ocean@indomer.com
Website : www.indomer.com

PAN No. AABCI5902R

MONITORING OF SHORELINE STABILITY IN THE VICINITY OF KARAIKAL PORT
(June 2008 - June 2009)

1. INTRODUCTION

Karaikal Port Private Limited (KPPL) is developing an all weather port at Karaikal, Union Territory of Pondicherry. It has been designed as a lagoon type all weather deepwater port with south and north breakwaters, berthing wharves, stacking yards, dredging of berthing areas/ harbour basin/ approach channel etc.. In order to preserve the marine environment, KPPL has taken up shoreline monitoring surveys on either side of the breakwaters and also at the mouth of Vettar River.

A thorough understanding on coastal processes including the wave characteristics, nearshore bathymetry, shoreline process and prevailing longshore sediment transport is essential for preserving the coastline and to design coastal protection works if required. The coastlines are generally subjected to quasi-steady state experiencing seasonal erosion during monsoon months and deposition in fair weather period. Over a period of one year cycle, it maintains its equilibrium without any net changes in its form. Any changes in its annual equilibrium may be attributed to natural causes like storms or manmade disturbances. However, the stability of the coastline phenomenon can be understood well only if long term data are collected and a good monitoring programme is evaluated.

2. SCOPE OF WORK

Indomer Coastal Hydraulics (P) Ltd., Chennai, the organization promoted by former scientists of National Institute of Oceanography, Goa, has been assigned with the task of bi-monthly monitoring surveys on shoreline changes along the neighbouring coastlines of the Karaikal Port including the Vettar river mouth. The first survey was conducted in June 2008. The following scope was kept for the monitoring survey.

i) Demarcation of HTL/LTL covering I km on either side of the breakwaters,

ii) Change in nearshore bathymetry upto 500 m distance inside the sea and 1 km along either side of the breakwater,

iii) Change in cross section along the Vettar river mouth up to 500 m upstream,

3. METHODOLOGY

Reference spheroid: The WGS84 spheroid was followed for the entire survey and for the preparation of the report.

Coastline mapping: The coastline form has been surveyed using Hemisphere R110 Series DGPS Beacon Receiver. It combines high-performance GPS reception with a DGPS-capable receiver in a lightweight, durable housing and comes with a separate antenna. It gives the horizontal position to an accuracy of close to 1 m. The GPS receiver also contains technology enabling *WAAS/EGNOS*, *OmniSTAR* or *Beacon* real time differential capabilities. When used with a Real- time Kinematic (RTK) Base station, the GPS receiver provides RTK positioning for high-accuracy, centimeter-level applications. A standard GPS receiver provides the following features: •10 Hz (10 positions per second) output rate •12 GPS (C/A-code L1,C/A code L2 (for the OmniSTAR XP/HP and RTK models)) tracking channels, code carrier channels •Sub meter differential

accuracy (RMS), assuming at least five satellites and a PDOP (Position Dilution of Precision)of less than four (when used with Satellite Based Augmentation Systems (SBAS) correction).

Depth measurements: CEEDUCER PRO Echosounder was used for depth measurements at nearshore and at river mouth. This survey echosounder is manufactured by Bruttour International, Australia. It is a dual frequency echosounder with standard transducer having the frequencies of 200 kHz and 30 kHz. It measures the depth ranging between 0 - 500 m with the accuracy of 0.01 m and a resolution of 0.01 m. It has a built in 12 channel GPS receiver with an integrated Beacon receiver. It is a dual channel Beacon receiver for collection of reference station data in both, automatic and manual mode. The system provides horizontal accuracy close to ± 1 m. It has the capability of giving position with WGS84 standard datum and 1 user defined datum. It has an antenna with 20 m long cable. The system works on 9 - 18 VDC or on 220 VAC. The unit has two RS232 ports. It is equipped with internal data logger which can store 40 hours survey data. It also has large LCD display in the front panel. There is a provision for auto scale change, external DGPS input and heave compensation input. It has NMEA output which can be connected to onboard PC and integrated with Hydrographic Software. The touch setting in the front panel enables to mark draught, tide input, time, date, scale shift, calibration gauge, alarm filter and fix interval.

Tides: The measured tides at site were used for reduction of soundings.

4. MONITORING PLAN

The port region is shown in Fig 1. The neighbouring coastline and the location of 10 reference stations covering 1 km on either side of the breakwaters are shown in Fig 2. The monitoring area has been divided into 2 zones namely: i) South zone, 1 km long, lying south of the southern breakwater covering Vettar river mouth and ii) North zone, 1km long, lying on the north of the northern breakwater. The reference points are spaced at 200 m interval and the details are:

Reference Points	UTM Coordinates (WGS84)	
	X (m)	Y (m)
NR1	374529	1199189
NR2	374529	1199389
NR3	374529	1199589
NR4	374529	1199789
NR5	374529	1199989
SR1	374511	1197737
SR2	374511	1197537
SR3	374511	1197337
SR4	374511	1197137
SR5	374511	1196937

5. RESULTS AND DISCUSSION

Shoreline in June 2008 (Prior to construction): The survey was carried out in June 2008, i.e. when the construction of southern breakwater just commenced. The coastline corresponding to LTL (Low Tide Line) and HTL (High Tide Line) is shown in Fig. 3. The bathymetry survey showed that the seabed is gradually sloping and the depth contours are nearly parallel to the coast. The Vettar river has been mapped and plotted on the bathymetric chart. The Paravanar River remained closed during the pre construction survey.

Shoreline in June 2009: The coastline corresponding to LTL (Low Tide Line) and HTL (High Tide Line) is shown in Fig. 3. The Vettar River mouth has become shallower indicating depositional tendency. The seabed south of southern breakwater has become marginally shallower, indicating a depositional trend. The seabed close to the north breakwater (off the Paravanar river mouth) has become marginally shallower, indicates depositional tendency.

The southern side coastline experienced accretion upto 30 m width compared to June 2008 coastline. Whereas, the northern side coastline experienced erosion upto 30 m width all along the 1 km stretch compared to June 2008 coastline.

6. MITIGATION MEASURES

The coastline may be monitored for another 2 years before initiating any permanent mitigation measures. Presently, the dredged sediments can partly be placed on the northern side of the northern breakwater. The volume of sediment thus placed can be around 30,000 m^3. It would help to stabilize the recession in shoreline observed over the last one year. For longterm shoreline stabilization, the following arrangement can be adopted.

- Creation of sand trap near south breakwater but without hindrance to the opening of Vettar river mouth,
- Bypassing of sediment from the sand trap to the northern side to maintain the continuity of littoral drift.

Based on the above action plans and management practices, it is anticipated that there will not be any significant alterations on the littoral drift pattern and thereby on the stability of the shoreline.

(P. Chandramohan)
Managing Director
Date: 7 December 2009

INDOMER COASTAL HYDRAULICS (I) LTD. CHENNAI

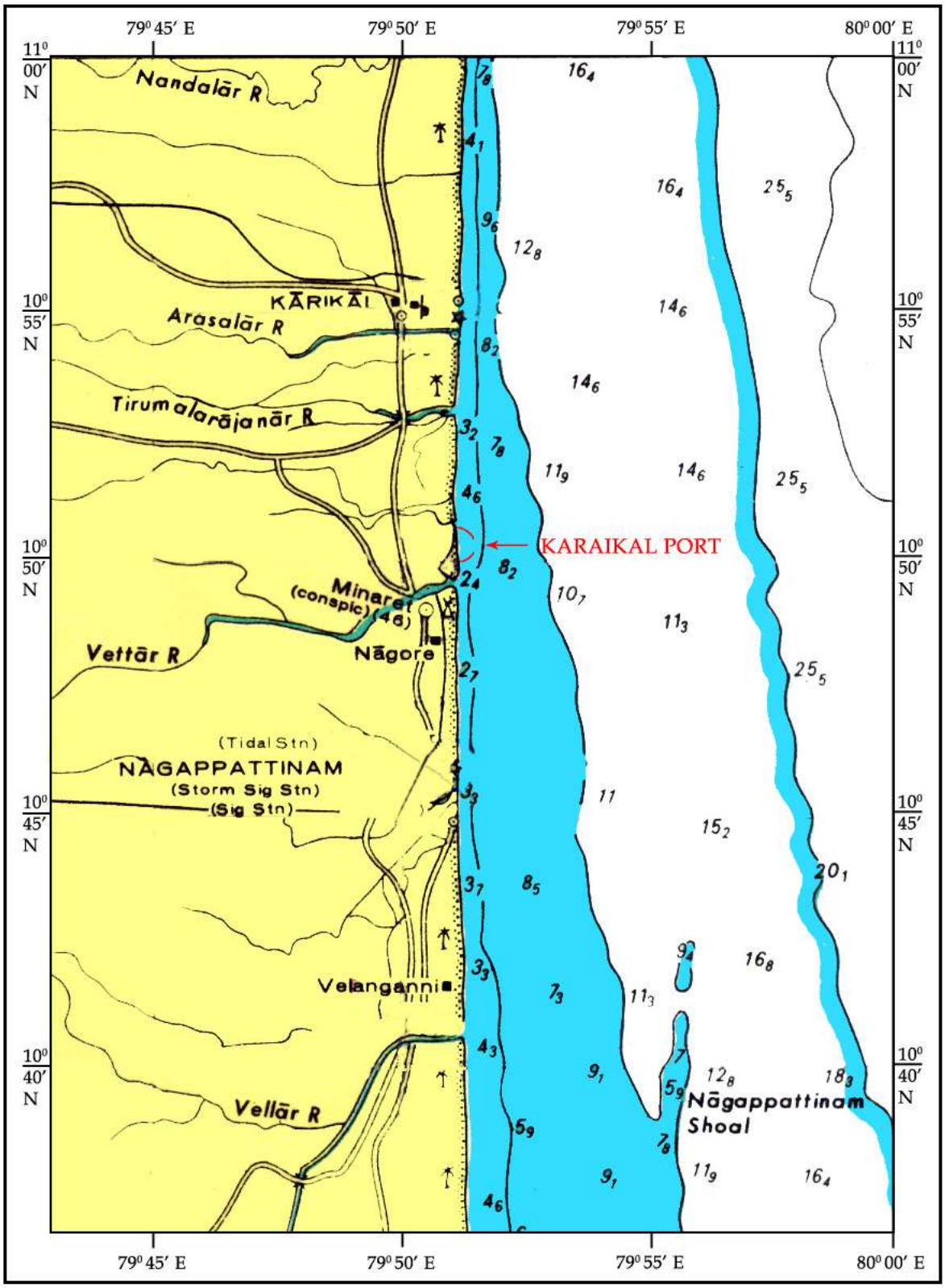


FIG. 1. LOCATION OF KARAIKAL PORT

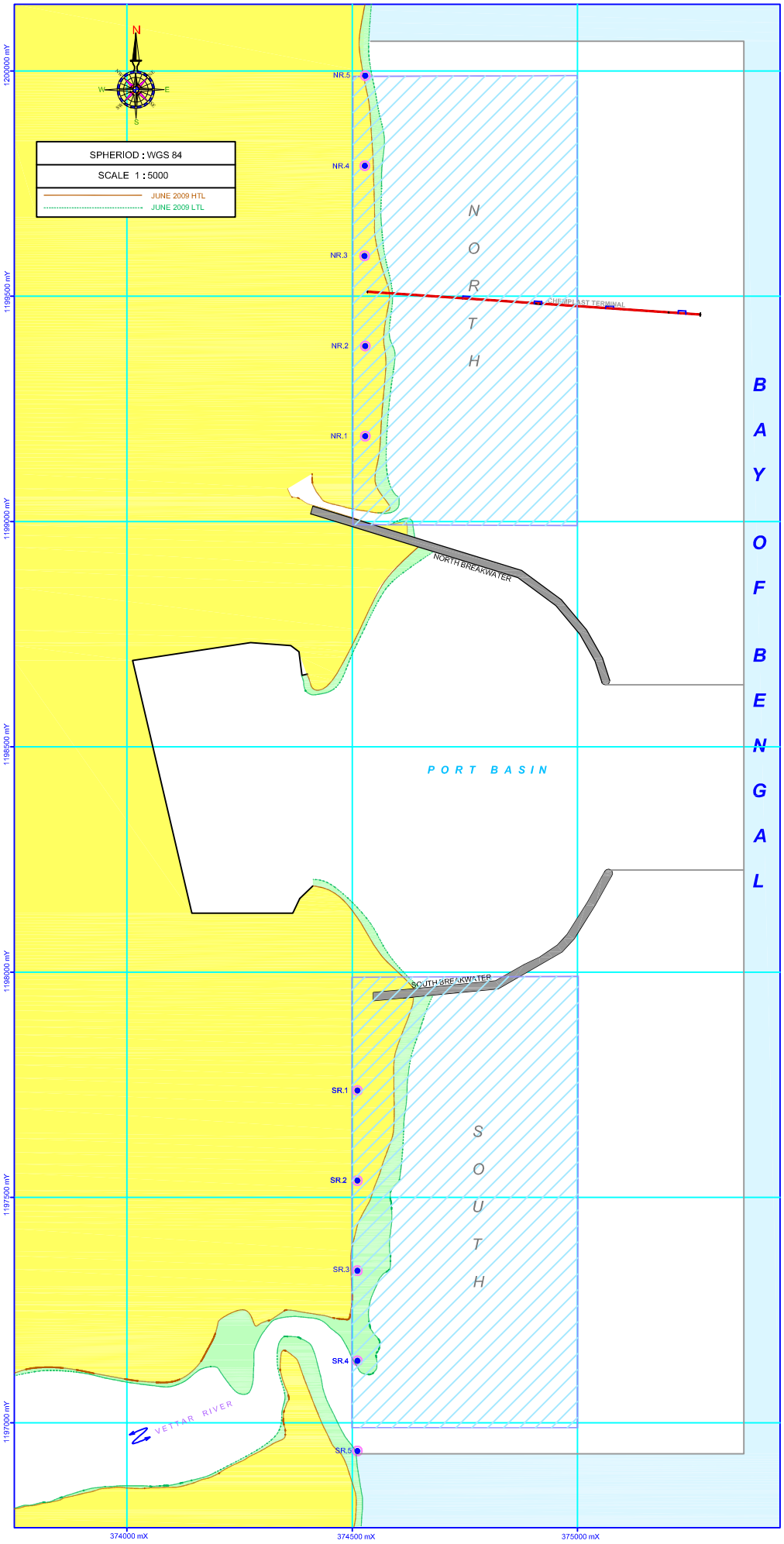


FIG. 2. SURVEY AREA

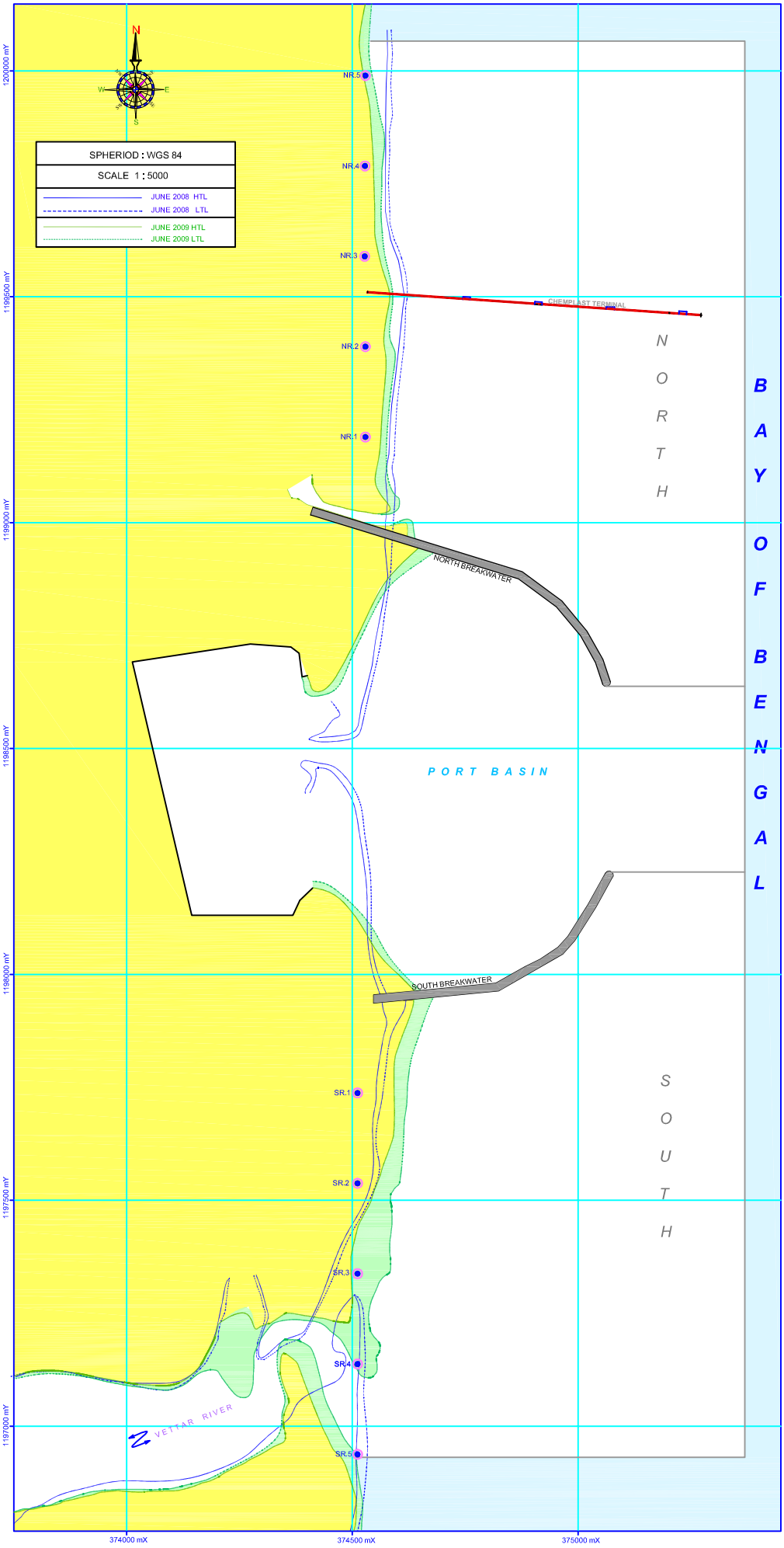


FIG. 3. CHANGES IN SHORELINE

STABILITY OF SHORELINE IN THE VICINITY OF KARAIKAL PORT
(FOR THE PERIOD FROM JUNE 2009 TO JULY 2010)

For

KARAIKAL PORT PRIVATE LIMITED
CHENNAI

DECEMBER 2010

INDOMER Coastal Hydraulics (P) Ltd.

AN ISO 9001 : 2008 CERTIFIED COMPANY
63, GANDHI ROAD, ALWAR THIRU NAGAR
CHENNAI 600 087.
Tel: (+) 91 44 2486 2482 to 84 Fax: (+) 91 44 2486 2484
Web site: www.indomer.com, E-mail: ocean@indomer.com

1. INTRODUCTION

Karaikal Port Private Limited (KPPL) is all weather port located at Karaikal region in the Union Territory of Pondicherry. It has been designed as a lagoon type all weather deepwater port with south and north breakwaters, berthing wharfs, stacking yards, dredging of berthing areas / harbour basin / approach channel etc. The breakwaters construction started in June 2008 and completed in February 2009.

The port operation commenced in April 2009. In order to preserve the marine environment, KPPL has initiated the shoreline monitoring surveys along the northern and southern sides of the breakwaters.

A thorough understanding on coastal processes including the wave characteristics, nearshore bathymetry, shoreline process and prevailing longshore sediment transport is essential for preserving the coastline and to design coastal protection works if required. *The coastlines are generally subjected to quasi-steady state experiencing seasonal erosion during monsoon months and deposition in fair weather period.* Over a period of one year cycle, it maintains its equilibrium without any net changes in its form. Any changes in its annual equilibrium may be attributed to natural causes like storms or manmade disturbances. However, the stability of the coastline phenomenon can be understood well only if long term data are collected and a good monitoring programme is evaluated.

Indomer Coastal Hydraulics (P) Ltd., Chennai, the organization promoted by former scientists of National Institute of Oceanography, Goa, has

been assigned with the task of monthly monitoring of shoreline changes in the vicinity of Karaikal Port. The first survey started in June 2009 and this report covers the form of shorelines measured till July 2010. The coastline form has been surveyed using Hemisphere R110 Series DGPS Beacon Receiver and CEEDUCER PRO Echosounder with HYPACK software.

2. BEACH NOURISHMENT

Beach nourishment was carried out in the month of May 2010 and June 2010. The material dredged at offshore was carried and placed on the northern side of the northern breakwater. The quantity of sediment placed for beach nourishment was 16000 m^3 in May 2010 and 24000 m^3 in June 2010.

Dredging offshore

North of NBW

Placement of sediments for beach nourishment

3. MONITORING PLAN

The project locations are shown in Fig. 1 and the satellite imagery is shown in Fig. 2. The neighbouring coastline and the location of 8 reference stations at 200 m spacing covering on either side of the breakwaters are shown in Fig 3. The monitoring area has been divided into 2 zones namely: i) South zone, 600 m long, lying south of the southern breakwater till Vettar River and ii) North zone, 1000 m long, lying on the north of the northern breakwater. The reference points are spaced at 200 m interval and the details are:

Zones	Reference Points	UTM Coordinates (WGS84)	
		X (m)	Y (m)
Zone I	NR1	374529	1199189
	NR2	374529	1199389
	NR3	374529	1199589
	NR4	374529	1199789
	NR5	374529	1199989
Zone II	SR1	374511	1197737
	SR2	374511	1197537
	SR3	374511	1197337

4. STABILITY OF SHORELINE

The form of shorelines prevailed in June 2009 and July 2010 is shown in Fig. 3. The shoreline changes from June 2009 to July 2010 at 8 reference stations are shown in Figs. 4 and 5.

At stn. NR1, the shoreline advanced upto 25 m throughout the year except during the month of December 2009 (eroded upto 10 m). At stn. NR2, the shoreline advanced upto 25 m except during the months of September 2009, October 2009 and May 2010. At stn. NR3, the shoreline was stable. At stn. NR4, the shoreline experienced marginal erosion during February 2010 to April 2010 a*nd the beach nourishment undertook in May 2010 and June 2010 has stabilized this segment.* At stn. NR5, the shoreline showed advancement upto 25 m.

Similarly on the southern side of the breakwater, the study was carried out at three stations (SR1 to SR3) with the equal interval of 200 m distance each. At stn. SR1, the shoreline advanced upto 40 m distance. At stn. SR2, the shoreline advanced upto 20 m. In September 2009, November 2009, December 2009 and January 2010, the shoreline remained nearly stable. At stn. SR3, the shoreline experienced marginal erosion throughout the year. During the month of December 2009, the shoreline eroded nearly 40 m.

It is important to note that the shoreline will undergo seasonal shifting i.e. about 10 m recession during monsoon and about 10 m accretion during fair weather. Taking into account of the seasonal changes of about 20 m, it is observed that the shoreline changes measured on either side of the breakwaters remain almost stable without any significant erosion or deposition. The beach nourishment carried out in May 2010 and June 2010

helped to stabilize the shoreline particularly about 600 m distance from the northern breakwater. It is suggested that the same amount of beach nourishment can be carried out from May to July on every year.

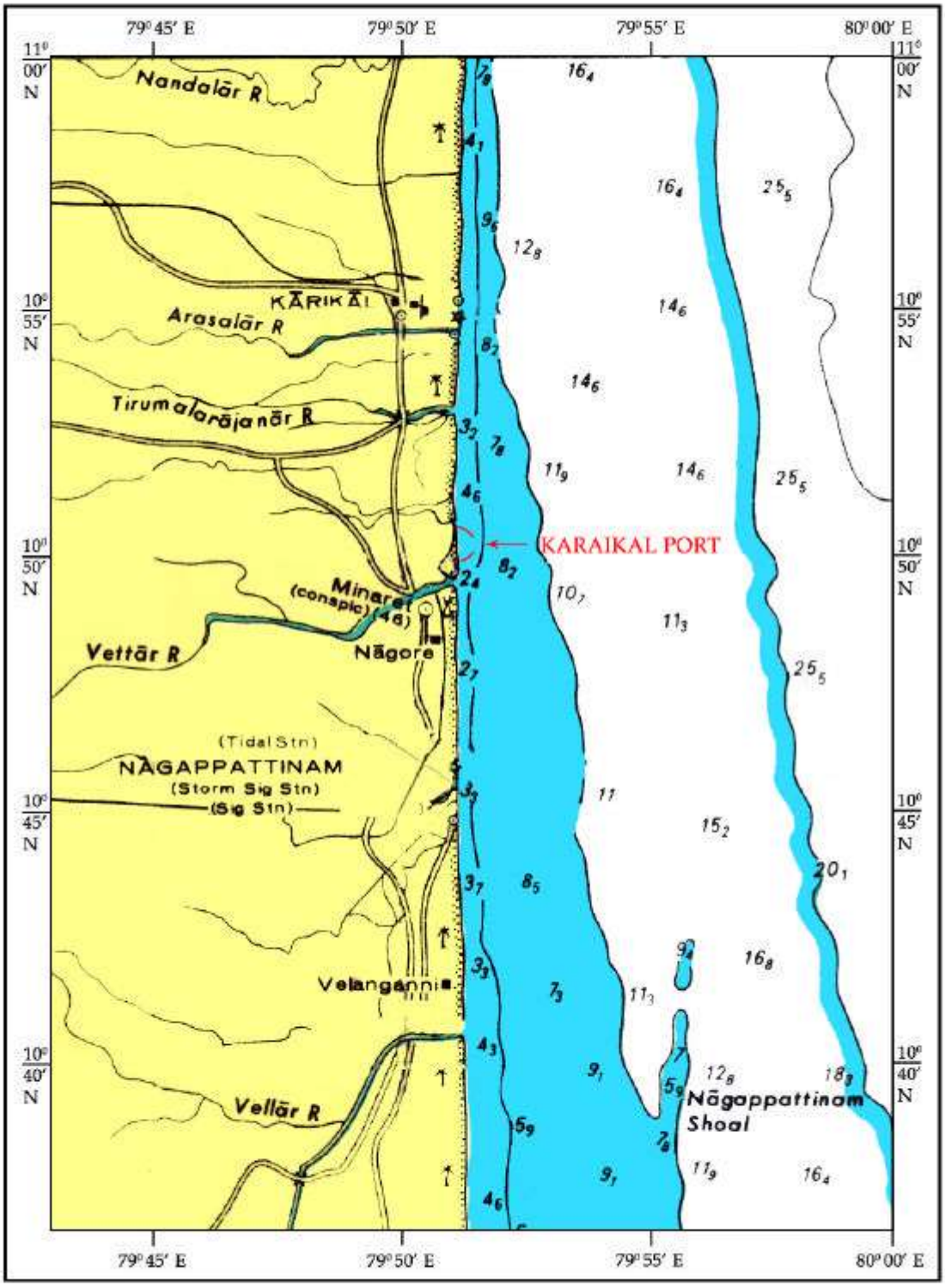


FIG. 1. LOCATION OF KARAIKAL PORT

FIG. 2. SATELLITE IMAGERY OF PORT AND COASTLINE IN THE VICINITY

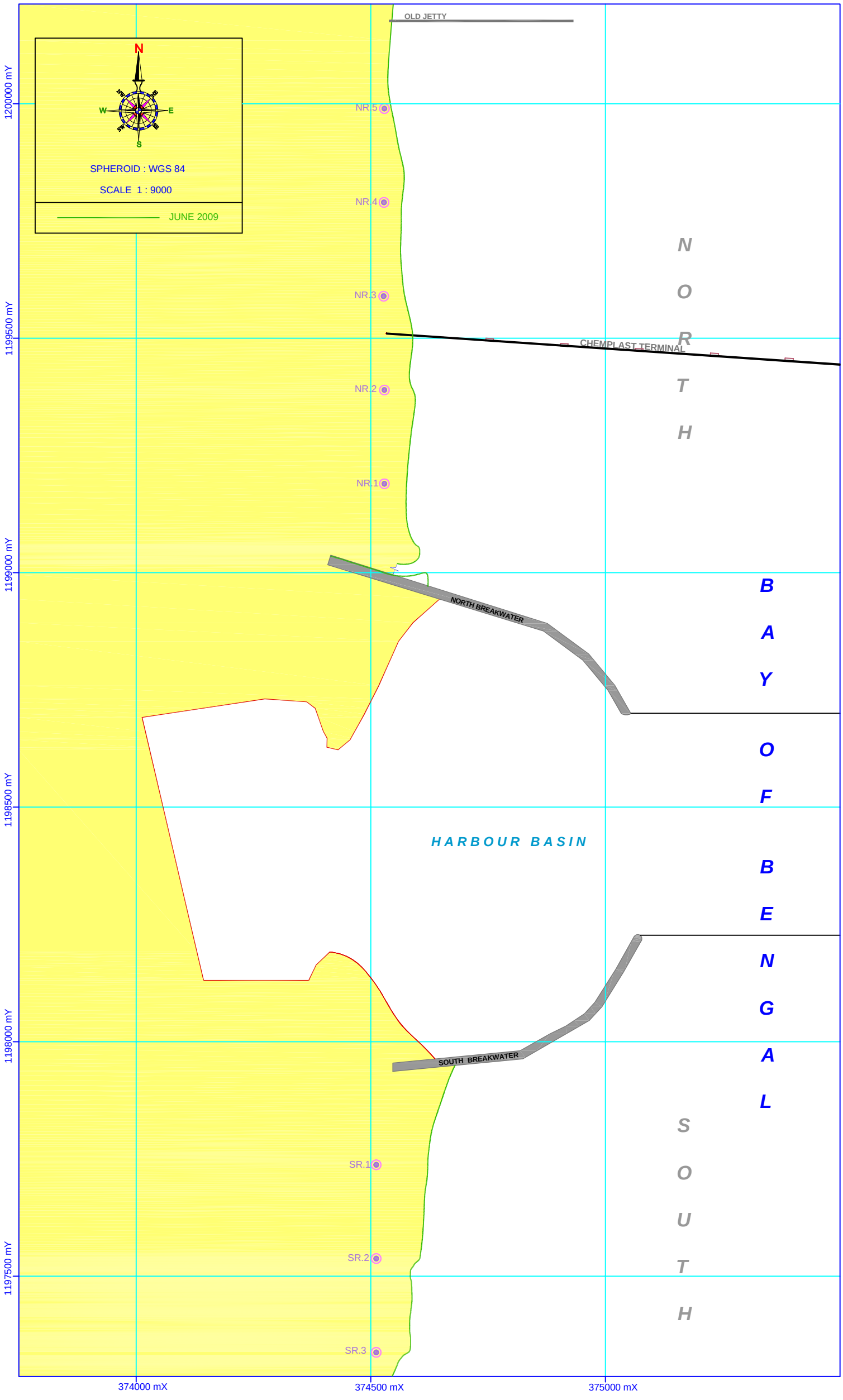


FIG. 3. LOCATIONS OF REFERENCE STATIONS

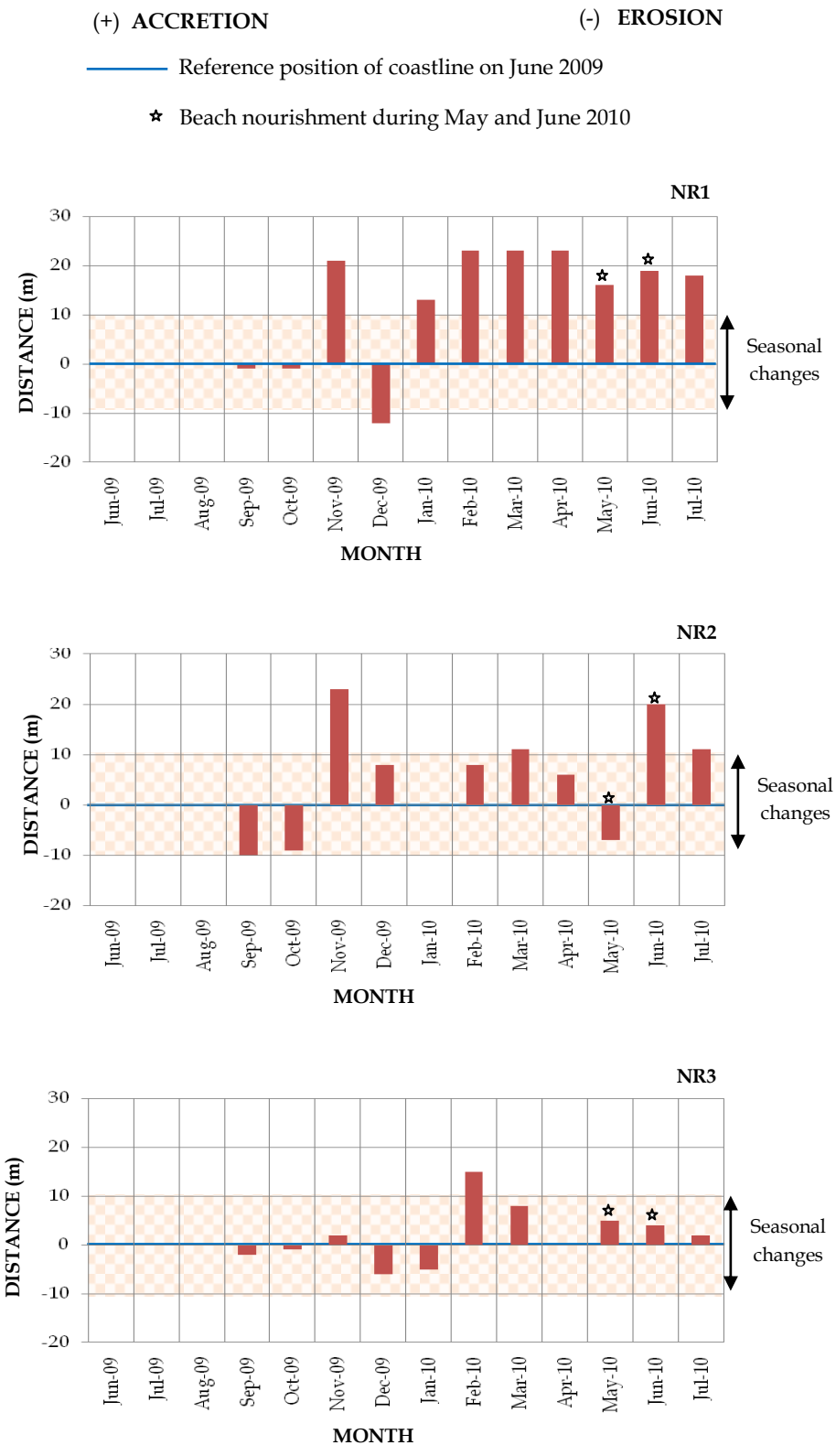


Fig. 4. Shoreline changes from June 2009 to July 2010 (NR1 to NR5)

Contd.....

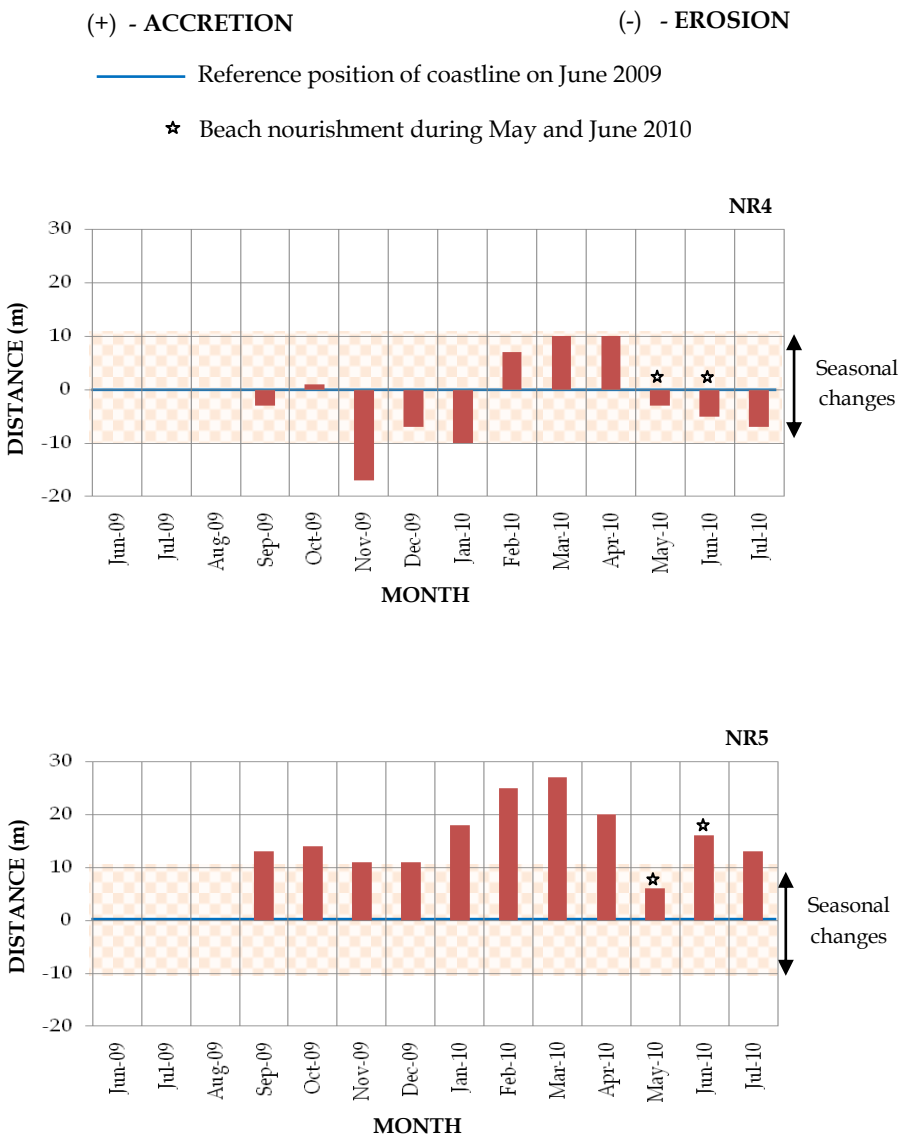


Fig. 4. Shoreline changes from June 2009 to July 2010 (NR1 to NR5)

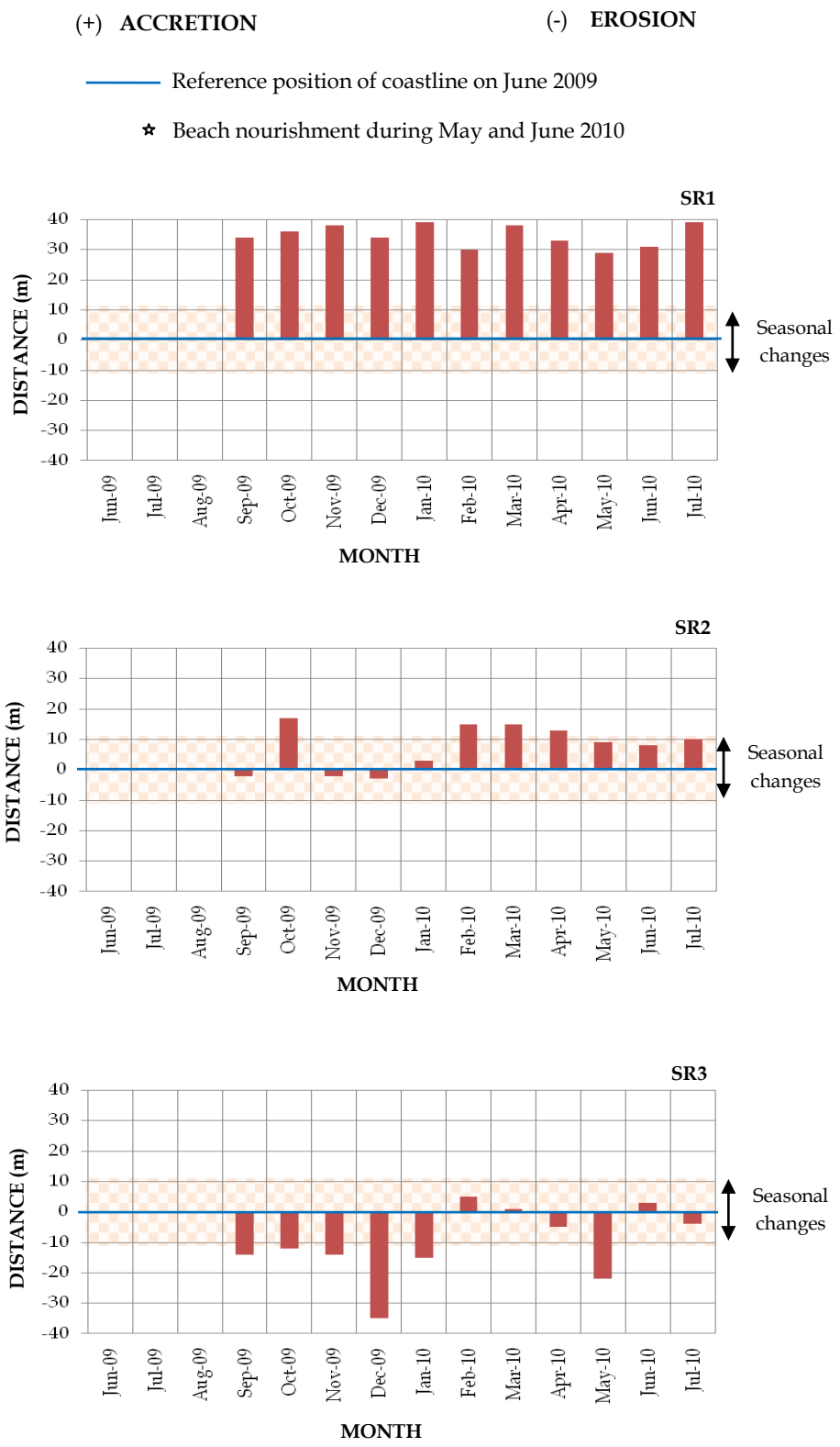


Fig. 5. Shoreline changes from June 2009 to July 2010 (SR1 to SR3)

1. INTRODUCTION

Karaikal Port Private Limited (KPPL) is all weather port located at Karaikal region in the Union Territory of Pondicherry. It has been designed as a lagoon type all weather deepwater port with south and north breakwaters, berthing wharfs, stacking yards, dredging of berthing areas/ harbour basin/ approach channel etc. The breakwaters construction started in June 2008 and completed in February 2009.

The port operation commenced in April 2009. In order to preserve the marine environment, KPPL has initiated the shoreline monitoring surveys along the northern and southern sides of the breakwaters.

A thorough understanding on coastal processes including the wave characteristics, nearshore bathymetry, and shoreline process and prevailing longshore sediment transport is essential for preserving the coastline and to design coastal protection works if required. *The coastlines are generally subjected to quasi-steady state experiencing seasonal erosion during monsoon months and deposition in fair weather period.* Over a period of one year cycle, it maintains its equilibrium without any net changes in its form. Any changes in its annual equilibrium may be attributed to natural causes like storms or manmade disturbances. However, the stability of the coastline phenomenon can be understood well only if long term data are collected and a good monitoring programme is evaluated.

Indomer Coastal Hydraulics (P) Ltd., Chennai, has been assigned with the task of monitoring of shoreline changes in the vicinity of Karaikal Port. This report covers the shoreline survey carried out in July 2013 and compared with June 2009.

2. SCOPE

i) to carry out shoreline monitoring survey on either side of the breakwaters till 3 m water depth at 200 m interval,

ii) to calculate volume computations,

iii) to prepare and submit a report.

3. METHODOLOGY

Reference spheroid

The WGS84 spheroid was followed for the entire survey and for the preparation of the report.

Coastline mapping

The coastline form has been surveyed using **Hemisphere R100** Series DGPS Beacon Receiver. It combines high-performance GPS reception with a DGPS-capable receiver in a lightweight, durable housing and comes with a separate antenna. It gives the horizontal position to an accuracy of close to 1 m. The GPS receiver also contains technology enabling *WAAS/EGNOS*, *OmniSTAR* or *Beacon* real time differential capabilities. When used with a Real- time Kinematic (RTK) Base station, the GPS receiver provides RTK positioning for high-accuracy, centimeter-level applications. A standard GPS receiver provides the following features: •10 Hz (10 positions per second) output rate •12 GPS (C/A-code L1,C/A code L2 (for the OmniSTAR XP/HP and RTK models)) tracking channels, code carrier channels •Sub meter differential accuracy (RMS), assuming at least five satellites and a PDOP (Position Dilution of Precision)of less than four (when used with Satellite Based Augmentation Systems (SBAS) correction).

Depth measurements: ***Garmin Echosounder:*** **GARMIN 420s** Survey Echosounder is manufactured by Garmin International, Inc., USA and is used for carrying out the

bathymetry measurement. This unit uses 12 satellites simultaneously for fast accurate positioning, adding GBR 420s beacon receiver for accuracy. The superior features are *dual frequency of 50 and 200* kHz, operation for maximum coverage with good bottom detail, continuous display of digital depth. It measures the depth ranges from 0-500 m with accuracy of 0.01 m. The system works on 10-40V DC and maximum usage of 10W. The unit has a single RS232 port for interfacing with personal computer. It has flat big screen for larger digital display. It has NMEA output which can be connected to onboard PC and integrated with Hydrographic Software.

Hydrographic Survey Software: HYPACK survey software was used for data collection and processing. It is integrated, first generation hydrographic survey software developed by Coastal Oceanographical INC., USA. It works in MS Windows operating environment. The HYPACK's design program allows to import background map in CAD's DFX or Microsoft's DGN format. It enables to quickly create planned survey lines, plotting sheets and bottom coverage grids in a graphical environment. It gives the flexibility to support multiple navigational systems (GPS, range/range, and range/azimuth), echo sounders (single and dual frequency, multiple transducers and multibeam), magnetometers, ROV-tracking systems, telemetry tide systems and many other devices. It contains the post processing module to analyze and prepare the chart. *The survey tracks were planned using this software for accurate maneuvering of the vessel and to keep the accuracy of the track. The post processing of the survey data and preparation of map were carried out using this software.*

Data recording: The Echosounder and Beacon DGPS receiver were interfaced through HYPACK software with onboard PC. The entire system was supported by AC Power Generator installed onboard. The position and depth were recorded along the preplanned transect at 500 millisecond interval continuously.

4. MONITORING PLAN

The neighbouring coastline and the location of 10 reference stations at 200 m spacing covering on either side of the breakwaters are shown in Figs. 1 and 2. The monitoring area has been divided into 2 zones namely: i) South zone, 1000 m long, lying south of the southern breakwater and ii) North zone, 1000 m long, lying on the north of the northern breakwater. The reference points are spaced at 200 m interval and the details are:

Zones	Reference Points	UTM Coordinates (WGS84)	
		X (m)	Y (m)
Zone I	NR1	374529	1199189
	NR2	374529	1199389
	NR3	374529	1199589
	NR4	374529	1199789
	NR5	374529	1199989
Zone II	SR1	374511	1197737
	SR2	374511	1197537
	SR3	374511	1197337
	SR4	374511	1197137
	SR5	374511	1196937

5. STABILITY OF SHORELINE

Based on the survey conducted in July 2013 the bathymetry chart prepared in a scale of 1:2500 is shown in Fig. 1. The coastline corresponding to LTL (Low Tide Line) and HTL (High Tide Line) in July 2013 compared with the coastline in June 2009 is shown in Fig. 2.

The change in sediment volume was estimated using HYPACK-DREDGE package based on the bathymetry conducted in July 2013. The change in sediment volume with reference to the seabed level in June 2009 is shown below.

Region	Change in sediment volume (m^3)	
	June 2009	July 2013
North	Reference	(+) 256347
South	Reference	(-) 182257

(-) Erosion w.r.t. June 2009 seafloor; (+) Deposition w.r.t. June 2009 seafloor

North zone: In comparison with the survey conducted in June 2009, the survey done in July 2013 indicates that the seabed topography has undergone changes are shown in Fig. 1. The area considered for volume calculation is shown Fig. 1. It is seen that there is a deposition of around 256347 m^3 of sediment compared to the survey done is June 2009.

Monitoring Station	Shoreline distance from monitoring stations (m)			
	June 2009 (reference)		July 2013	
	HTL	LTL	HTL	LTL
NR 1	34	47	60	90
NR2	42	62	57	84

NR3	30	45	50	76
NR4	18	38	34	56
NR5	-4	15	18	46

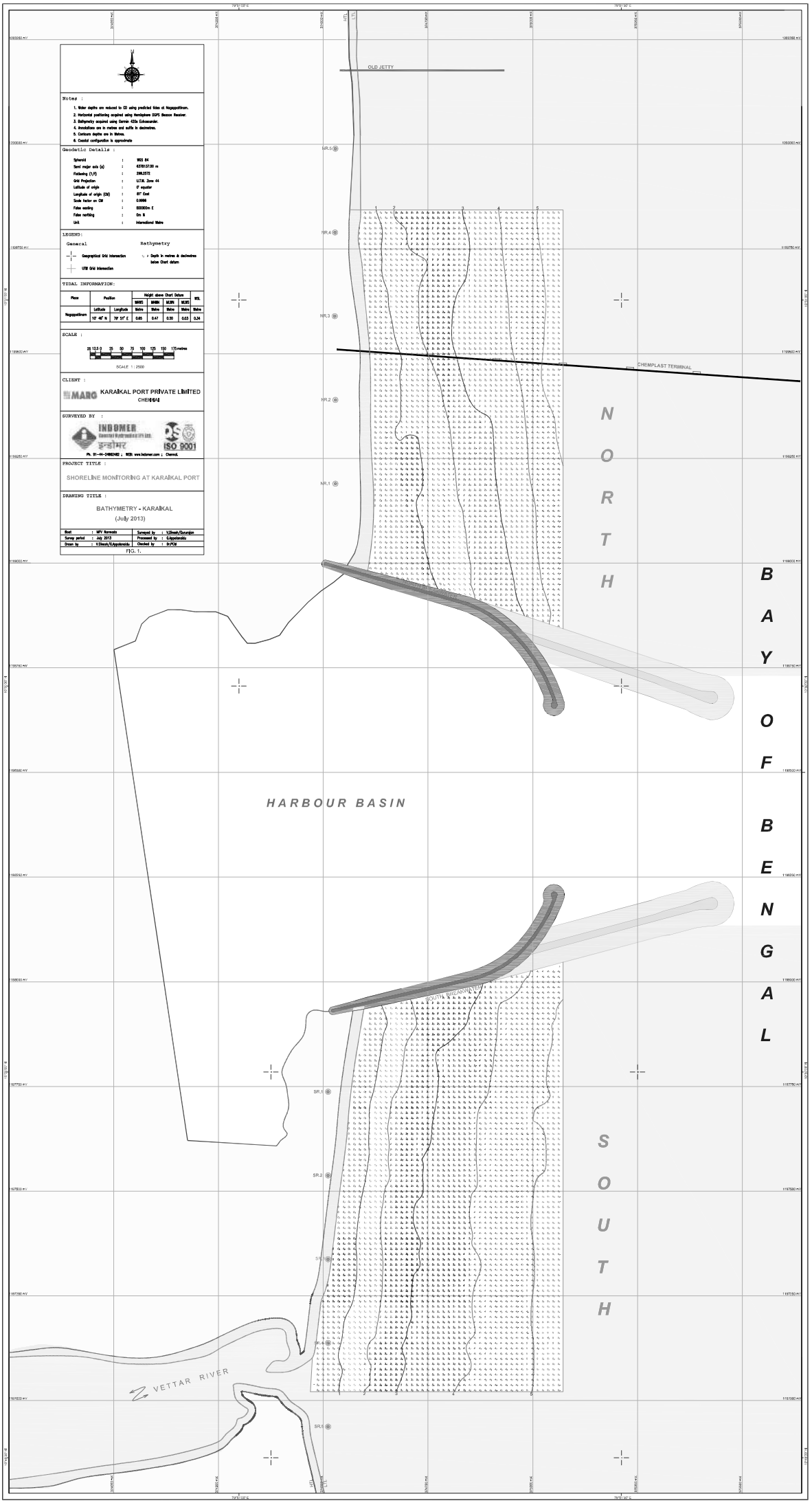
Note: (-) distance towards land

South zone: In comparison with the survey conducted in June 2009, the survey done in July 2013 indicates that the seabed topography has undergone changes are shown in Fig. 1. The area considered for volume calculation is shown Fig. 1. It is seen that there is an Erosion of around (-) 182257 m^3 of sediment compared to the survey done is June 2009.

Monitoring Station	Shoreline distance from monitoring stations (m)			
	June 2009 (reference)		July 2013	
	HTL	LTL	HTL	LTL
SR 1	80	110	30	54
SR2	43	92	07	33
SR3	-15	68	-18	08
SR4	Mouth of Vettar river			
SR5	-40	-04	-30	-18

Note: (-) distance towards land

Inference: The shoreline observation done during July 2013 indicates that the seabed, north of port area has become marginally shallower, indicating a depositional trend compared to June 2009 survey. The region south of port area has become deeper indicating erosional trend compared to June 2009 survey.


OLD JETTY
CHEMPLAST TERMINAL
NR.5
NR.4
NR.3
NR.2
NR.1
SR.1
SR.2
SR.3
SR.4
SR.5
SR.6
1
2
3
4
5
NORTH BAY OF BENGAL
HARBOUR BASIN
SOUTH BREAKWATER
SOUTH
VETTAR RIVER
Notes :
1. Water depths are reduced to CD using predicted tides at Nagapattinam.
2. Horizontal positioning acquired using Hemisphere DGPS Beacon Receiver.
3. Bathymetry acquired using Garmin 420s Echosounder.
4. Annotations are in metres and suffix is decimetres.
5. Contours depths are in Metres.
6. Coastal configuration is approximate
Geodetic Details :
Spheroid : WGS 84
Semi major axis (a) : 6378137.00 m
Flattening (1/f) : 298.2572
Grid Projection : U.T.M. Zone 44
Latitude of origin : 0° equator
Longitude of origin (CM) : 81° East
Scale factor on CM : 0.9996
False easting : 500000m E
False northing : On N
Unit : International Metre
LEGEND:
General
Geographical Grid intersection
UTM Grid intersection
Bathymetry
Depth in metres & decimetres below Chart datum
TIDAL INFORMATION:
Place | Position | Height above Chart Datum | WRS
Latitude | Longitude | MHWS | MHWN | MLWN | MLWS
Nagapattinam | 10° 46' N | 79° 51' E | 0.85 | 0.47 | 0.20 | 0.03 | 0.24
SCALE :
SCALE : 2500
CLIENT :
MARG
KARAIKAL PORT PRIVATE LIMITED
CHENNAI
SURVEYED BY :
INDOMER
Ph. 91-44-24862482 ; WEB: www.indomer.com ; Chennai.
PROJECT TITLE :
SHORELINE MONITORING AT KARAIKAL PORT
DRAWING TITLE :
BATHYMETRY - KARAIKAL
(July 2013)
Boat : MFV Nanmathi
Surveyed by : V.Umesh/Gurunajan
Survey period : July 2013
Processed by : S.Appalanaidu
Drawn by : V.Umesh/S.Appalanaidu
Checked by : R.PCH
FIG. 1.

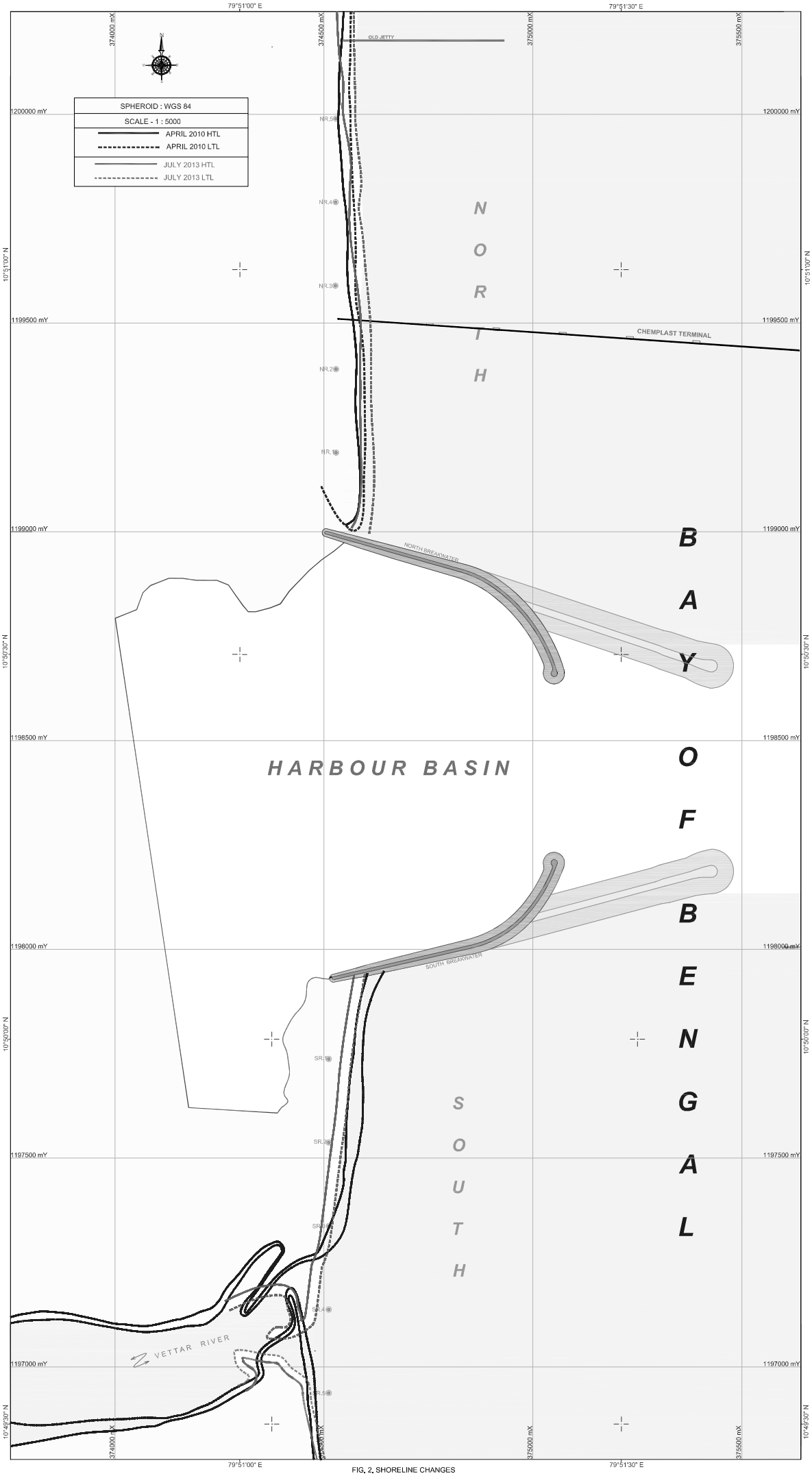


FIG. 2. SHORELINE CHANGES

SHORELINE MONITORING SURVEY

AT KARAIKAL PORT

(JULY 2016)

PROJECT CODE: 320090910

For

KARAIKAL PORT PRIVATE LIMITED
KARAIKAL

JULY 2016

INDOMER COASTAL HYDRAULICS (P) LTD.
(ISO 9001 : 2008 CERTIFIED AND NABET-QCI ACCREDITED)
63, GANDHI ROAD, ALWAR THIRUNAGAR, CHENNAI 600 087.
Tel: + 91 44 2486 2482 to 84 Fax: + 91 44 2486 2484
Web site:www.indomer.com, E-mail:ocean@indomer.com

INDOMER COASTAL HYDRAULICS (P) LTD.
(ISO 9001 : 2008 CERTIFIED AND NABET-QCI ACCREDITED)
63, Gandhi Road, AlwarThirunagar, Chennai 600 087.
Tel: + 91 44 2486 2482 to 84 Fax: + 91 44 2486 2484
Web site: www.indomer.com , E-mail: ocean@indomer.com

Client	:	Karaikal Port Private Limited, Karaikal.
Project Title	:	Shoreline Monitoring Survey at Karaikal Port. – July 2016.
Project Code	:	320090910
Abstract	:	Karaikal Port Private Limited (KPPL) is all weather port located at Karaikal region in the Union Territory of Pondicherry. In order to preserve the marine environment, KPPL has initiated the shoreline monitoring survey along the northern and southern sides of the breakwaters since from 2009. In this connection KPPL asked Indomer Coastal Hydraulics (P) Ltd., Chennai, to carry out necessary survey for monitoring of shoreline changes in the vicinity of Karaikal Port. This report covers the shoreline survey carried out in July 2016.
Foreword	:	
References	:	-

Date	Report Type	Originator(s)	Checked by	Approved by	Approved
25.07.16	Final	N & S .Karthikeyan	Dr. Terry Machado	Dr .P.Chandramohan	

	Project Code	:	320090910	Text pages	:	10
	File Location	:	F:/2016 Projects/July 16/320. KPPL	Figures	:	2

TEAM

Name	Qualification	Task
Dr. P. Chandramohan	Ph.D. (Ocean Engineering) (Former scientist, CSIR-NIO, Goa)	Project Coordinator
K. Dharmalingam	B.E. (Civil), M.Tech. (DIIT Dock and Harbour Engineering) (Former UN expert, Ports & Harbours)	Data analysis & interpretation
Dr. Terry Machado	Ph.D. (Marine Geology)	Seabed and coastline Surveys
S. Karthikeyan	D.C.E. (Civil)	
N. Karthikeyan	D.C.E. (Civil)	
J. Vinoth Kumar	B.E. (Civil)	

CONTENTS

Page

Contents i
Figures ii
1 INTRODUCTION 1
2 SCOPE 2
3 METHODOLOGY 3
3.1 Reference spheroid 3
3.2 Coastline Mapping 3
3.3 Vertical Control 4
3.4 Depth measurements 5
4 MONOTORING PLAN 7
5 STABILITY OF SHORELINE 8
6 INFERENCE 10

LIST OF FIGURES

Figures

1. Bathymetry Map (In pouch)

2. Coastline comparison Map (In pouch)

1. INTRODUCTION

Karaikal Port Private Limited (KPPL) is all weather port located at Karaikal region in the Union Territory of Pondicherry. It has been designed as a lagoon type all weather deepwater port with south and north breakwaters, berthing wharfs, stacking yards, dredging of berthing areas/ harbour basin/ approach channel etc. The breakwater construction started in June 2008 and completed in February 2009.

The port operation has been commenced in April 2009. In order to preserve the marine environment and understand the shoreline stability, KPPL has initiated the shoreline monitoring surveys along the northern and southern sides of the breakwaters since 2009. Indomer Coastal Hydraulics (P) Ltd., Chennai has been involved in shoreline mapping/monitoring since 2009 till 2013. Thereafter it has conducted the shoreline survey now in July 2016.

A thorough understanding on coastal processes including the wave characteristics, nearshore bathymetry, and shoreline process and prevailing longshore sediment transport is essential for preserving the coastline and to design coastal protection works if required. The coastlines are generally subjected to quasi-steady state experiencing seasonal erosion during monsoon season and deposition in fair weather period. Over a period of one year cycle, it maintains its equilibrium without any net changes in its form. Any changes in its annual equilibrium may be attributed to natural causes like storms or manmade disturbances. However, the stability of the coastline phenomenon can be understood well only if longterm data are collected and a good monitoring programme is evaluated.

2. SCOPE

i) to carry out shoreline monitoring surveys 1 km on either side of the breakwaters till 3 m water depth 200 m interval,

ii) to calculate sediment volume based on first survey conducted in June 2009,

iii) to prepare and submit a report.

3. METHODOLOGY

3.1. Reference spheroid

WGS 84 spheroid was followed for entire surveys and for the presentation in the report.

3.2. Coastline mapping

The coastline form has been surveyed using Leica Real Time Kinematic (RTK). Leica RTK (Real Time Kinematic) satellite navigation is a technique used in land survey and in hydrographic survey based on the use of carrier phase measurements of the GPS, GLONASS and / or Galileo signals where a single reference station provides the real-time corrections, providing up to centimeter-level accuracy. When referring to GPS in particular, the system is also commonly referred to as Carrier-Phase Enhancement, CPGPS. RTK systems use a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. There are several ways to transmit a correction signal from base station to mobile station. The most popular way to achieve real-time, low-cost signal transmission is to use a radio modem, typically in the UHF band. This allows the units to calculate their relative position to millimeters, although their absolute position is accurate only to the same accuracy as the position of the base station.

RTK systems are available in dual-frequency and single-frequency versions. Dual-frequency systems deliver greater precision, faster and over longer baselines than single-frequency systems. Leica GS09 & GS12 GNSS RTK that used for the survey contains dual-frequency requires antenna and controller to suit any surveying task

with a wide range of functionality. Leica GS09 & GS12 GNSS RTK Rover is extremely light-weight and cable free rover is comfortable to use and withstand even for rough use and topple over. It uses a single base station receiver and a number of mobile units.

The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. So, that centimeter level accuracy can be achieved from latitude, longitude and altitude. RTK technique in terms of general navigation, it is perfectly suited to roles like surveying. In this case, the base station is located at a known surveyed location, often a benchmark, and the mobile units can then produce a highly accurate map by taking fixes relative to that point. RTK has also found uses in auto drive/autopilot systems, precision farming and similar roles.

3.3. Vertical control

PBM: The Permanent Bench Mark (PBM) fixed by Naval Hydrographic Office at Karaikal Port is taken as the vertical reference for the topographic survey and bathymetric survey. The Bench mark details are given below

Description	Geographical Coordinates (WGS 84)		UTM Coordinates (Zone 44)		Reference Level w.r.t. MSL (m)	Reduced Level * w.r.t. CD (m)
	Latitude, N	Longitude, E	X (m)	Y (m)		
PBM Karaikal Port - Berth 1	10˚49′ 54.38″	79˚50′ 56.28″	0374178	1197616	(+) 3.910	(+) 4.250

**MSL = (+) 0.34 m w.r.t. CD as per the records of Indian Tide Table.*

Reference Bench Mark at Karaikal Port Limited

3.4. Depth measurements: *Garmin Echosounder:* GARMIN 420s Survey Echosounder is manufactured by Garmin International, Inc., USA and is used for carrying out the bathymetry measurement. This unit uses 12 satellites simultaneously for fast accurate positioning, adding GBR 420s beacon receiver for accuracy. The superior features are *dual frequency of 50 and 200* kHz, operation for maximum coverage with good bottom detail, continuous display of digital depth. It measures the depth ranges from 0-500 m with accuracy of 0.01 m. The system works on 10-40V DC and maximum usage of 10W. The unit has a single RS232 port for interfacing with personal computer. It has flat big screen for larger digital display. It has NMEA output which can be connected to onboard PC and integrated with Hydrographic Software.

Hydrographic Survey Software: HYPACK survey software was used for data collection and processing. It is integrated, first generation hydrographic survey software developed by Coastal Oceanographical INC., USA. It works in MS Windows operating environment. The HYPACK' s design program allows to import background map in CAD' s DFX or Microsoft' s DGN format. It enables to quickly create planned

survey lines, plotting sheets and bottom coverage grids in a graphical environment. It gives the flexibility to support multiple navigational systems (GPS, range/range, and range/azimuth), echo sounders (single and dual frequency, multiple transducers and multibeam), magnetometers, ROV-tracking systems, telemetry tide systems and many other devices. It contains the post processing module to analyze and prepare the chart. *The survey tracks were planned using this software for accurate maneuvering of the vessel and to keep the accuracy of the track. The post processing of the survey data and preparation of map were carried out using this software.*

Data recording: The Echosounder and Beacon DGPS receiver were interfaced through HYPACK software with onboard PC. The entire system was supported by AC Power Generator installed onboard. The position and depth were recorded along the preplanned transect at 500 millisecond interval continuously.

4. MONITORING PLAN

The neighbouring coastline and the location of 10 reference stations at 200 m spacing covering on either side of the breakwaters are shown in Fig. .1. The monitoring area has been divided into 2 zones namely: i) South zone, 1000 m long, lying south of the southern breakwater and ii) North zone, 1000 m long, lying on the north of the northern breakwater. The reference points are spaced at 200 m interval and the details are:

Zones	Reference Points	UTM Coordinates (WGS84)	
		X (m)	Y (m)
Zone I	NR1	374529	1199189
	NR2	374529	1199389
	NR3	374529	1199589
	NR4	374529	1199789
	NR5	374529	1199989
Zone II	SR1	374511	1197737
	SR2	374511	1197537
	SR3	374511	1197337
	SR4	374511	1197137
	SR5	374511	1196937

5. STABILITY OF SHORELINE

Based on the survey conducted in July 2016 the bathymetry chart prepared in a scale of 1:2500 is shown in Fig. 1. The coastline corresponding to LTL (Low Tide Line) and HTL (High Tide Line) in June 2016 compared with the coastline in June 2009 is shown in Fig. 2.

The change in volume was estimated using HYPACK software based on the bathymetry conducted in July 2016. The change in volume with reference to the seabed level in June 2009 is shown below.

Region	Change in sediment volume (m^3)		
	July 2009	June 2016	
North	Reference	(+)6,51,841	-
South	Reference	(+)9,419	(-)1,66,410

(-) Erosion w.r.t. June 2009 seafloor; (+) Deposition w.r.t. June 2009 seafloor

North zone: In comparison with the survey conducted in June 2009, the survey done in July 2016 indicates that the seabed topography has undergone changes are shown in Fig. 1. The area considered for volume calculation is shown Fig. 1. It is seen that there is a deposition of around (+) 6, 51,841 m^3 of sediment compared to the survey done is June 2009.

Monitoring Station	Shoreline distance from monitoring stations (m)			
	July 2009 (reference)		July 2016	
	HTL	LTL	HTL	LTL
NR 1	34	47	115	126
NR2	42	62	106	118
NR3	30	45	75	90
NR4	18	38	50	72
NR5	-4	15	31	51

Note: (-) distance towards land

South zone: In comparison with the survey conducted in June 2013, the survey done in July 2016 indicates that the seabed topography has undergone changes are shown in Fig. 1. The area considered for volume calculation is shown Fig. 1. It is seen that there is an erosion of around (-) 1, 66,410 m^3 and deposition of (+) 9,419 m^3 of sediment compared to the survey done is June 2009.

Monitoring Station	Shoreline distance from monitoring stations (m)			
	July 2009 (reference)		July 2016	
	HTL	LTL	HTL	LTL
SR 1	80	110	10	38
SR2	43	92	-6	8
SR3	-15	68	-34	-10
SR4	Mouth of Vettar river			
SR5	-40	-04	-78	-34

Note: (-) distance towards land

6. INFERENCE

The shoreline observation done during July 2016 indicates that the seabed, north of port area has become marginally shallower, indicating considerable depositional trend compared to June 2009 survey. The region south of port area has become deeper indicating erosional trend compared to June 2009 survey.

Recd 27.6.11

GOVERNMENT OF PUDUCHERRY
DEPARTMENT OF SCIENCE, TECHNOLOGY AND ENVIRONMENT
PUDUCHERRY POLLUTION CONTROL COMMITTEE
3rd Floor, PHB Building, Anna Nagar
Puducherry – 605 005.
***

Phone : (0413) 2201256
Telefax : (0413) 2203494

NO OBJECTION CERTIFICATE FROM POLLUTION ANGLE

No.PPCC/NOC/KKL/JLA/2011/731 Puducherry, the 23 JUN 2011

Sub : PPCC – Issue of NOC for amendment in construction of Berth No. 4 instead of Berth No. 7 – Issued – Reg.

Ref : 116th Meeting of PPCC held on 16.06.2011.
***

With reference to the above, it is informed that the proposal for issue of No Objection Certificate from Pollution Angle (NOC) for amendment in construction of Berth No. 4 instead of Berth No. 7 was discussed in the 116th Meeting of Puducherry Pollution Control Committee held on 16.06.2011. The Puducherry Pollution Control Committee has no objection in according clearance to **Construct Berth No. 4 instead of Berth No. 7** subject to the **following conditions:**

1. All the conditions stipulated in the clearance issued by Ministry of Environment and Forests, Government of India vide F. No. 10-42/2009-IA.III dated 20.05.2011 shall be strictly adhered.

2. All the measures adopted in Environmental Impact Assessment (EIA) studies shall be strictly adhered.

3. The applicant shall not undertake any expansion, modernization, diversification, change of location etc., without the prior approval / clearance from this authority.

4. M/s. Karaikal Port (P) Ltd., shall take all possible measures to create pollution free surroundings during construction activities.

5. The applicant shall apply to this Committee in prescribed form for Air and Water Consent Order (To Operate) thirty (30) days before the commencement of activities.

6. This No Objection Certificate (NOC) from Pollution Angle shall be exhibited in the office room and must be made available to the inspecting officers of this Committee.

For & on behalf of PPCC

(Dr. S. SUNDARAVADIVELU)
MEMBER SECRETARY
PUDUCHERRY POLLUTION CONTROL COMMITTEE

To
M/s. Karaikal Port Pvt. Ltd., Post Box No. 33, Karaikal – 609 602.