VIZHINJAM INTERNATIONAL SEAPORT LIMITED
(A Government of Kerala Undertaking)

Vizhinjam International Deepwater Multipurpose Seaport

Half yearly Compliance report of conditions of

Environmental and CRZ Clearance

Period: April 2016 to September 2016

December 2016

Vizhinjam International Deepwater Multipurpose Seaport

Half yearly Compliance report of conditions of

Environmental and CRZ Clearance
Period: April 2016 to September 2016

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Vizhinjam International Deepwater Multipurpose Seaport Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance

Preface

The Vizhinjam International Deepwater Multipurpose Seaport project is a flagship project of the Government of Kerala (GoK). The project site is located at Vizhinjam, 16 km south of the capital city of Thiruvananthapuram. A fully owned company of the GoK named Vizhinjam International Seaport Ltd.(VISL), was formed to oversee the activities related to the development of the project.

The Ministry of Environment, Forests 8 Climate Change (MoEF), Government of India issued Environmental & CRZ clearance to the project vides its letter F.No.11-122/2011- IA.III dated 3rd Jan 2014. This was based on the recommendations of the Expert Appraisal Committee (EAC) of the MoEF which considered (i) the Comprehensive Environmental Impact Assessment (EIA) study report, (ii) Environmental Public hearing report, (iii) other related reports and (iv)recommendations of the Kerala Coastal Zone Management Authority.

Pursuant to the Environmental Clearance, the Government of Kerala has entered into a concession agreement with M/s Adani Vizhinjam Port Private Ltd. (AVPPL),on 17th Aug 2015 for development and operation of the project for a concession period of 40 years. The preliminary works for the development of the project were initiated at the site on 16th November 2015, followed by official inauguration on 5th Dec 2015. As required under the Environmental & CRZ clearance, monitoring works were initiated by VISL and is being continued by AVPPL. This report contains the half yearly monitoring report for the period from April 2016 to Sep 2016.

Managing Director & CEO

Vizhinjam International Seaport Ltd.(VISL)

Thiruvananthapuram

25th November 2016

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance
(Period: April 2016 to September 2016)

Sr. No.	Conditions	Compliance Status as on 30-09-2016
11	**Specific Conditions**	
(i)	"Consent for Establishment" shall be obtained from Kerala State Pollution Control Board under Air and Water Act and a copy shall be submitted to the Ministry before start of any construction work at the site.	"Consent for Establishment" has been obtained from Kerala State Pollution Control Board (KSPCB) vide Consent No. PCB/HO/TVM/ICE/08/2015 dated 15.09.2015. Copy submitted to MoEF with the compliance submission for the period ending June 2016. .
(ii)	Project Proponent shall carry out intensive monitoring with regulatory reporting six monthly on shore line changes to the Regional Office, MoEF.	Shoreline monitoring of 20 Km area each side is being done. Report for the period from Nov 2015 to May 2016 is enclosed as **Annexure I** in CD.
(iii)	The capital dredged material (7.6 Mm^3) shall be utilized for reclamation of berths.	Dredged material is being used for reclamation purposes only.
(iv)	Additional fish landing centre shall be developed as part of the proposed Vizhinjam port for upliftment of fisheries sector.	The work for construction of the fish landing centre (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated as part of the funded work component of the concession agreement with AVPPL
(v)	The project shall be executed in such a manner that there is minimum disturbance to fishing activity.	Construction of the project is confined to the project area only. Regular interaction taking place between project personnel and fishermen for dissemination of information on the progress of the works..

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2016 to September 2016)

Sr. No.	Conditions	Compliance Status as on 30-09-2016
(vi)	Steps would be taken to safeguard the interests of the fisheries sector as detailed in the Resettlement Action Plan (RAP), Corporate Social Responsibility (CSR) and in the Integrated Fishing Community Management (IFCMP), namely a component of Rs.7.1 crores as part of the compensation package for the fisheries sector, as livelihood restoration measures for mussel collectors, shore seine fishermen and others. Rs.41.30 crores as part of CSR activities in the fisheries sector under (i) water supply scheme (7.3crores) (ii) new fishing landing centre (16crores) (iii) adoption of existing fishing harbor (5crores) (iv) sea food park (4crores) (iii) skill development centre (4crores) (iv) environmental sanitation (3crores) and (v) solid waste management (2crores).	In consultation with the fishermen, an enhanced livelihood compensation package amounting to Rs. 23.80 crores was sanctioned by GoK, instead of Rs.7.1 crores suggested earlier in the EIA stage. Out of this amount, Rs.11.70 crores have been disbursed till Sept 30th 2016 for a total number of 183 livelihoods affected PAP's whose verification were complete in all respects. Verification of the documents of balance PAP's is in progress. The status of the CSR activities envisaged in the fisheries sector is as follows. **Water supply**: Scheme has been commissioned in April, 2013 by VISL by expending an amount of Rs. 7.33 crores. For O&M of the same an amount of Rs.2.99 crores has been spent till date. **Fish Landing centre**: Construction of the fish landing centre (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated **Existing fishing harbour**: Action for modernization of the existing fishing harbour will be carried out in consultation with the harbour engineering department. **Seafood park**: Procurement of land for seafood park (Rs.26 crores) has been initiated by VISL **Skill development centre**: Need Assessment Study conducted in a sample size of 12,300 youth for skill development programme. . Employability, Livelihood & Construction Skill Development Programme initiated, **Environmental sanitation & Solid Waste Management:** MoU signed between Thiruvananthapuram Municipal Corporation & Adani Foundation for installation of Aerobins & Sanitation facilities in the wards, viz. Vizhinjam, Kottappuram & Harbour

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2016 to September 2016)		
Sr. No.	**Conditions**	**Compliance Status as on 30-09-2016**
(vii)	Rail connectivity shall be parallel to the harbour road on elevated structures at +4/5.00 m level without affecting the entry to the existing harbor.	The same will be taken into consideration while designing the railway line.
(viii)	Compensation packages in accordance with the Central/State Government norms shall be given to all the authorized-cum-affected (having valid clearances as applicable) resort owners.	Discussion for fixing of compensation packages for the affected resort owners have been initiated by the District level Planning Committee (DLPC) headed by the District Collector and is in progress
(ix)	The port shall ensure that all ships under operation follow the MARPOL convention regarding discharge or spillage of any toxic, hazardous or polluting material like ballast water, oily water or sludge, sewage, garbage etc. The emission of NOx&SOx shall remain within permissible limits.	Currently project is under construction. This shall be complied during operational phase.
(x)	CSR activities shall cover villages within 10 km radius of the project.	Refer to item (vi) above. In addition to the above, AVPPL as part of its CSR activities have initiated the following in the region through Adani Foundation.(i) Sanitation & Solid Waste Management (ii) Skill development (iii) Employability centre (iv) Rural infrastructure upgradation& (v) Drinking water supply. AVPPL have installed 20 water tanks in the water scarce areas in the project neighbourhood and water is being supplied on a daily basis on mobile water tanker.
(xi)	Oil Contingency Management Plan shall be put in place.	Oil Contingency Management Plan will be prepared and implemented during operation phase.
(xii)	All the recommendations/conditions stipulated by Kerala Coastal Zone Management Authority (KCZMA) shall be complied with.	Compliance report of KCZMA is enclosed as **Annexure II**
(xiii)	The responses/commitments made during public hearing shall be complied with in letter and spirit.	The status of the commitments made during Public Hearing& actions on the same is enclosed as **Annexure III**

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2016 to September 2016)

Sr. No.	Conditions	Compliance Status as on 30-09-2016
(xiv)	All the recommendation of the EMP shall be complied with in letter and spirit. All the mitigation measures submitted in the EIA report shall be prepared in a matrix format and the compliance for each mitigation plan shall be submitted to MoEF along with half yearly compliance report to MoEF-RO.	Status of EMP is enclosed as **Annexure IV**
(xv)	The project proponent shall bring out a special tourism promotion package for the area in consultation with the State Government and implement the same along with the project.	Once the first phase of port becomes operational, it would naturally attract cruise tourism. Based on the development of cruise business, dedicated cruise berths will be planned in a phased manner. Action is also being taken in consultation with the State tourism department, to design port linked tourism packages covering the Kovalam-Vizhinjam- Poovar tourism corridor
(xvi)	The project proponent shall place on its website its response to the Public Hearing, and representations as presented to the EAC in the 128th meeting held on 23rd November 2013, for information of the general public.	All the relevant details pertaining to EIA, ToR, EAC meetings, Public Hearing, etc related to the project have been placed on VISL website http://www.vizhinjamport.in/eia-30-5-13.php
(xvii)	There shall be no withdrawal of groundwater in Coastal Regulation Zone Area, for this project. In case any groundwater is proposed to be withdrawn from outside the CRZ area, specific prior permission from the concerned State/Central Groundwater Board shall be obtained in this regard.	There will not be any withdrawal of groundwater in CRZ Area.
(xviii)	The Hazardous waste generated shall be properly collected and handled as per the provision of Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008.	The project is in construction phase. The same shall be complied during operational phase.
(xix)	No hazardous chemicals shall be stored in the Coastal Regulation Zone area.	No hazardous chemical is being stored in the Coastal Regulation Zone area.
(xx)	The waste water generated from the activity shall be collected, treated and reused properly.	The project is in construction phase. The same shall be complied during operational phase

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance
(Period: April 2016 to September 2016)

Sr. No.	Conditions	Compliance Status as on 30-09-2016
(xxi)	Sewage Treatment facility should be provided in accordance with the CRZ Notification.	The detailed port facility layout planning is under progress. Provision for installing sewage treatment facility will be kept and implemented.
(xxii)	No solid waste will be disposed of in the Coastal Regulation Zone area. The solid waste shall be properly collected, segregated and disposed as per the provision of Solid Waste (Management and Handling) Rules, 2000.	No solid waste is being disposed of in the Coastal Regulation Zone area.
(xxiii)	Installation and operation of DG set if any shall comply with the guidelines of CPCB. Oil spills if any shall be properly collected and disposed as per the Rules. Project proponent shall install necessary oil spill mitigation measures.	Shall be complied
(xxiv)	No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	Construction of the project is as per the approvals obtained.
(xxv)	The approach channel shall be properly demarcated with lighted buoys for safe navigation and adequate traffic control guidelines shall be framed.	The project is in construction phase. The same shall be complied during operational phase
(xxvi)	The project proponent shall take up development of green belt in the project area, wherever possible. Adequate budget shall be provided in the Environment Management Plan for such development.	Shall be complied
(xxvii)	The fund earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.	Being complied
(xxviii)	The project proponent shall set up an organisational mechanism/institutional structure for Environment, Health & Safety & CSR under the supervision of a General Manager as outlined in the EIA Report for effective implementation of the stipulated EHS safeguards & CSR activities.	An officer of VISL has been designated as Head (EHS & CSR) for effective implementation of the stipulated EHS safeguards & CSR activities. AVPPL, the concessionaire executing the project has also appointed officers for EHS & CSR. In addition to the above, independent environment, health and safety consultants have been appointed as required in the concession agreement signed with AVPPL.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance
(Period: April 2016 to September 2016)

Sr. No.	Conditions	Compliance Status as on 30-09-2016
(xxix)	Staff Colony should be located beyond CRZ area.	Port facility planning will be done in such a way that staff Colony will be located beyond CRZ area
12.	**General Conditions**	
(i)	Construction of the proposed structures shall be undertaken meticulously conforming to the existing Central/local rules and regulations including Coastal Regulation Zone Notification, 2011 & its amendments. All the construction designs/drawings relating to the proposed construction activities must have approvals of the concerned Statutory Departments / Agencies.	All the construction activities are being carried out as per existing Central/local rules. Necessary permissions under CRZ Notification 2011 & its amendments have been obtained. Further, necessary approvals from concerned Statutory Departments / Agencies have been obtained for the construction designs/drawings relating to the proposed construction as mentioned hereunder. ❖ Consent to Establish from State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE/08/2015, dated 15.09.2015. ❖ All permits required for construction of buildings as per building by laws will be obtained. ❖ Airport Authority of India NOC vide NOC no AAI/SR/NOC/RHQ dated 7.12.2015 **(**Submitted along with the previous compliance report for the period ending June 2016**)**
(ii)	Adequate provision for infrastructure facilities including water supply, fuel and sanitation must be ensured for construction workers during the construction phase of the project to avoid any damage to the environment.	Necessary infrastructure facilities viz, water supply, fuel & sanitation are being provided to the construction workers.
(iii)	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.	Being complied.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2016 to September 2016)

Sr. No.	Conditions	Compliance Status as on 30-09-2016
(iv)	Borrow sites for each quarry sites for road construction material and dump sites must be identified keeping in view the following: (a) No excavation or dumping on private property is carried out without written consent of the owner. (b) No excavation or dumping shall be allowed on wetlands, forest areas or other ecologically valuable or sensitive locations. (c) Excavation work shall be done in close consultation with the Soil Conservation and Watershed Development Agencies working in the area, and (d) Construction spoils including bituminous material and other hazardous materials must not be allowed to contaminate water courses and the dump sites for such materials must be secured so that they shall not leach into the ground water.	Quarry material shall be obtained from approved quarry sites only. The road so far constructed (a temporary road for construction purposes) has been made with material available on site and a) No excavation has been carried out in private property b) No excavation or dumping has been carried out in wetlands, forest area etc. c) No major excavation has been undertaken d) No bituminous or hazardous material has been used
(v)	The construction material shall be obtained only from approved quarries. In case new quarries are to be opened, specific approvals from the competent authority shall be obtained in this regard.	No new quarries have been opened for construction materials. Material is being obtained from approved quarries.
(vi)	The project authorities shall make necessary arrangements for disposal of solid wastes and for the treatment of effluents by providing a proper wastewater treatment plant outside the CRZ area. The quality of treated effluents, solid wastes and noise level etc must conform to the standards laid down by the competent authorities including the Central/State Pollution Control Board and the Union Ministry of Environment and Forests under the Environment (Protection) Act, 1986, whichever are more stringent.	• No solid waste is being disposed of in the Coastal Regulation Zone area. • Solid waste will be handled as per the Solid Waste (Management and Handling) Rules, 2000. • Sewage Treatment Plant (STP) of 50 KLD will be installed in phased manner • Environment Monitoring is being carried out as per Environment Monitoring Plan prescribed in EIA

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2016 to September 2016)		
Sr. No.	**Conditions**	**Compliance Status as on 30-09-2016**
(vii)	The proponent shall obtain the requisite consents for discharge of effluents and emissions under the Water (Prevention and control of Pollution) Act, 1974 and the Air (Prevention and control of Pollution) Act, 1981 from the Kerala State Pollution Control Board before commissioning of the project and a copy of each of these shall be sent to this Ministry.	Consent To Operate (CTO) under the Water (Prevention and control of Pollution) Act, 1974 and the Air (Prevention and control of Pollution) Act, 1981 shall be obtained from Kerala State Pollution Control Board before commissioning of the project. Copy of the CTO will be sent to Ministry on receipt.
(viii)	Adequate precautions shall be taken during transportation of the construction material so that it does not affect the environment adversely.	Necessary measures are being taken
(ix)	Full support shall be extended to the officers of this Ministry/Regional Office at Bangalore by the project proponent during inspection of the project for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and other environmental protection activities.	Noted.
(x)	Ministry of Environment & Forests or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.	Noted.
(xi)	The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied to the satisfaction of the Ministry.	Noted.
(xii)	In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry of Environment & Forests.	Adani Vizhinjam Port Private Ltd (AVPPL) is the concessionaire for implementing the project and operating it for the next 40 years, based on concession agreement signed between the Government of Kerala &, AVPPL on 17th Aug 2015. Action being taken for transfer of EC to AVPPL under reference to the MoEF.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2016 to September 2016)		
Sr. No.	**Conditions**	**Compliance Status as on 30-09-2016**
(xiii)	The project proponent shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.	Concession agreement with M/s AVPPL was signed on 17th Aug 2014. The layout of the port has been approved by Govt. of Kerala by letter No.308799/E1/15/F&PD dated 30-10-15 (Submitted along with the Compliance Report of the period ending June 2016).The preliminary construction activities commenced at site on 16th November 2015 followed by official inauguration on 5th Dec 2015. Financing agreement forming part of financial closure was submitted by the concessionaire on 13th May 2016.
(xiv)	Kerala State Pollution Control Board shall display a copy of the clearance letter at the Regional Office, District Industries Center and Collector's Office/Tehsildar's office for 30 days.	This condition does not pertain to project proponent.However, it is learnt that KSPCB has complied with the same.
13.	These stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991 and EIA Notification 2006, including the amendments and rules made thereafter.	Noted
14.	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities.	All required clearances will be obtained before start of operation. However necessary approvals from concerned Statutory Departments / Agencies have been obtained for the construction designs/drawings relating to the proposed construction as mentioned below. ❖ Consent to Establish from State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE/08/2015, dated 15.09.2015. ❖ All permits required for construction of buildings as per building by laws will be obtained. ❖ Airport Authority of India NOC vide NOC no AAI/SR/NOC/RHQ dated 7.12.2015

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2016 to September 2016)		
Sr. No.	**Conditions**	**Compliance Status as on 30-09-2016**
15.	The project proponent shall advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded Environment Clearance and copies of the clearance letters are available with the Kerala State Pollution Control Board and may also be seen on the website of the Ministry of Environment & Forest at http://www.envfor.nic.in. The advertisement should be made within 10 days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional office of this Ministry at Bangalore.	Complied and intimated (with copy of advertisement) to the regional office of MoEF, vide letter No.VISL/EC/MoEF/2013 dated 20-01-2014 Copy of the environment clearance is available on VISL website at http://www.vizhinjamport.in/eia-30-5-13.php
16.	This Clearance is subject to final order of the Hon'ble Supreme Court of India in the matter of Goa Foundation Vs. Union of India in Writ Petition (Civil) No.460 of 2004 as may be applicable to this project.	Noted
17.	Any appeal against this clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.	Three appeals challenging the EC granted to the project (two appeals filed at NGT, Southern Regional Bench, Chennai and one at NGT, Principal Bench, Delhi) and one original application (OA-filed at NGT, Principal Bench Delhi) indirectly challenging the CRZ Notification,2011 were filed as per the NGT Act,2010. The appeals filed at Chennai bench were later transferred to the Delhi bench. The Delhi Bench of NGT has upheld the Environment Clearance granted to the project vide its judgment dated 2nd September 2016
18.	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, ZilaParishad/Municipal Corporation, Urban Local Body and the Local NGO, if any from whom suggestions/representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the company by the proponent.	Complied

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance
(Period: April 2016 to September 2016)

Sr. No.	Conditions	Compliance Status as on 30-09-2016
19.	The proponent shall upload the status of compliance of the stipulated Clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM, SO2, NOx (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.	The copy of the June 2016 compliance report has been uploaded in company's web site http://www.vizhinjamport.in and submitted to the Zonal office of CPCB and the SPCB. The ambient air quality level will be displayed as required
20.	The project proponent shall also submit six monthly reports on the status of compliance of the stipulated Clearance conditions including results of monitored data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB.	Compliance Report for the period Oct 2015 – March 2016 has been submitted to the MoEF, Regional Office (Bangalore) vide no. VISL/2014-15/EE&EI-9/229 dated 27.05.2016
21.	The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned Kerala State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986 as amended subsequently, shall also be put on the website of the company along with the status of compliance of Clearance conditions and shall also be sent to the respective Regional Offices of MoEF by e-mail.	The project is in construction phase. The same shall be complied post commissioning during operational phase.

Enclosures:

Annexure I: Report on Shoreline monitoring Nov 2015 to May 2016 (in CD)

Annexure II: Report on compliance of conditions of KCZMA

Annexure III: Status of the commitments made during Public Hearing

Annexure IV: Status of Environment Management Plan

Report on

Oceanographic & Bathymetric Data Collection for

Assessment of Shoreline Changes

Pre-Monsoon (February to May 2016)

For Adani Vizhinjam Port Pvt. Ltd.

Client

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Report no. OSaS/P21716/AVPPL/Pre Monsoon/118 Rev 0
5th August 2016

DOCUMENT ISSUE FORM

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Prepared by	S Philip
Prepared at	Ocean Science & Surveying Pvt. Ltd. Data Processing Centre, Navi Mumbai.
Submitted to	Adani Vizhinjam Port Pvt. Ltd.
No. of Copies	By email
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Revisions

Rev	Date	Description	Prepared by		Checked by	
			Name	Signature	Name	Signature
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Revision Details

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DEFINITIONS

Project Owner	Vizhinjam International Seaport Ltd (VISL)
Project Concessionaire	Adani Vizhinjam Port Pvt. Ltd. (AVPPL)
Advisor to VISL	National Institute of Ocean Technology, Chennai
Survey Contractor	Ocean Science & Surveying Pvt. Ltd., Navi Mumbai, India (Ocean Science)
Survey Requirement	Oceanographic & Bathymetric Survey for Shoreline Monitoring
Chart Datum	Chart datum is the level to which soundings on a published charts are reduced, and above which tidal predictions and tidal levels are given in the Tide Table. All depths on charts are referred to this datum.
Current Speed	The speed at which the water body moves in the ocean. The speed is denoted in m/s
Current Direction	The direction towards which the currents are flowing. A westerly current implies that the currents are flowing from east to west
LEO	Littoral Environmental Observations
Wave Peak period (Tp)	The peak period gives the characteristic frequency of the arriving wave energy. This gives the period at which the spectrum has its highest value.
Significant Wave Height (Hs)	Significant wave height is the average peak-to-peak amplitude of the largest one third of the waves in a given field.
Wave direction	The direction from which the waves are coming. A westerly wave implies that the waves are moving from west to east.
Wind Speed	The speed at which the air moves with respect to the surface of earth. The speed is denoted m/s
Wind Direction	Wind direction is an indicator of the direction that the wind is coming from. A northerly wind is coming from the north and blowing towards the south
Atmospheric pressure	It is defined as the force per unit area exerted against a surface by the weight of the air above that surface. Atmospheric pressure is expressed in millibars (mb)
Relative Humidity	Relative humidity is defined as the ratio of the water vapor density (mass per unit volume) to the saturation water vapor density, usually expressed in percent

ABBREVIATIONS

CES	Coastal Erosion Stone
C.M.	Central Meridian
CD	Chart Datum
cm	Centimetre
COG	Course over ground
dd mm.mmm	Degrees minutes. decimal minutes
DGPS	Differential Global Positioning System
DTM	Digital Terrain Model
EC	Environmental & CRZ Clearance
EEZ	Exclusive Economic Zone
GcGPS	Globally Corrected Global Positioning System
GoI	Government of India
GoK	Government of Kerala
GPS	Global Positioning System
HSE	Health, Safety & Environment
HWM	High Water Mark
IHO	International Hydrographic Organization
INCOIS	Indian National Centre for Ocean Information Services
kHz	Kilohertz
Km	Kilometre
kPa	Kilo Pascal
LAT	Lowest Astronomical Tide
Lat	Latitude
LEO	Littoral environmental observation
Long	Longitude
m	Metre
MBES	Multibeam Echo Sounder
MoEF	Ministry of Environment & Forests
MU	Memorandum of Understanding
MSL	Mean Sea Level
MV	Motor Vessel
NA	Not Applicable
NABL	National Accreditation Board for Testing and Calibration Laboratories
NHO	Naval Hydrographic Organization
NIOT	National Institute of Ocean Technology
nm	Nautical mile
PEP	Project Execution Plan
PVD	Progressive vector diagram
RTK	Real Time Kinematics

SBES	Single Beam Echo Sounder
SoI	Survey of India
SOG	Speed over ground
SOW	Scope of Work
TEU	Twenty Foot Equivalent Unit
UNCLOS	United Nations Convention of the Law of the Sea
UTM	Universal Transverse Mercator projection
VISL	Vizhinjam International Seaport Ltd.
w.d.	Water depth
WGS84	World Geodetic System 1984
WMO	World Meteorological Organisation

1. EXECUTIVE SUMMARY

The **Vizhinjam International Transhipment Deepwater Multipurpose Seaport** is an ambitious project taken up by the Government of Kerala. It is designed primarily to cater to container transhipment besides multi-purpose and break bulk cargo. The port is being currently developed in landlord model with a Public Private Partnership component on a design, build, finance, operate and transfer ("DBFOT") basis. The private partner, the Concessionaire **M/s Adani Vizhinjam Port Private limited** (AVPPL) has commenced construction on 5th December 2015.

Vizhinjam International Seaport Ltd (VISL) - a company fully owned by Government of Kerala is the implementing agency for the project, will be responsible for all obligations and responsibilities of the Government of Kerala in respect of the Project and the Concession Agreement.

With its numerous natural advantages and potential, the port will contribute greatly to economic development and will be an asset in terms of infrastructure development in the country.

The project obtained Environmental & CRZ Clearance ("EC") from the Ministry of Environment & Forests (MoEF), Government of India (GoI) on 3rd January 2014, wherein it has been specified to carry out intense monitoring and regulatory reporting of the shoreline changes in the project area. Accordingly VISL has entered into a memorandum of understanding (MoU) with the National Institute of Ocean Technology (NIOT), Chennai, under the Ministry of Earth Sciences, Government of India for a long term shoreline monitoring programme including the seasonal bathymetry mapping.

To that end, Ocean Science & Surveying Pvt. Ltd, (**www.oceanscience.in**), hereinafter referred to as Ocean Science, has been awarded the contract to carry out Shoreline Monitoring – Oceanographic & Bathymetric Data Collection in the vicinity of the proposed site for the development of the Vizhinjam International Deepwater Multipurpose Seaport, vide the service order; SO 5700182139 dated 14th June 2016 by AVPPL.

As part of the study, NIOT provided a wave rider buoy to be deployed off Mulloor and the data was to be monitored by Ocean Science.

This scope of work of the project is a continuation of the contract Ocean Science had with VISL earlier, which came to an end on 18th February 2016.

This report provides the results of the data collected for the pre monsoon ranging from 19th February to 31st May 2016.

All the co-ordinates in the reports and charts are referenced to WGS-84, UTM Projection, CM 75° East, Zone 43, Northern Hemisphere.

2. INTRODUCTION

Vizhinjam, (Malayalam: വിഴിഞ്ഞം) is a district of the capital city Thiruvananthapuram (Trivandrum) of the state of Kerala, India. It is located at approximately 08°22′45″N, 76°59′29″E, and 14 km south of the capital city. The city is historically known for being an important port, dating back to the 8^{th} Century AD.

The port is proposed to be developed in a landlord model having a PPP development component. The investment for land, external infrastructure (rail, water and power) and breakwater will be borne by the landlord (VISL/GoK). The investments for other port infrastructure (dredging & reclamation, berths, terminals, superstructure & equipments) will be shared on Public Private Partnership (PPP) basis availing Viability Gap Funding (VGF) from Government of India. The PPP concessionaire, AVPPL has been given the right to operate the Phase I development of the port (800 m berth length) for a specified concession period of 40 years. Traffic-linked stage-wise future development of the project with an ultimate berth length of 2000m is also envisaged.

The proposed site is endowed with a natural depth of 23 to 25m (which is by far the best compared to other ports in the world) as close as 2 km from the coast. This will enable berthing of mother vessels of 18000 TEU and higher. Since the port site located at the southern tip of India with hardly 10 nautical miles from the international sea route (Suez – Far East route & Far East – Middle East route), the port has the potential to become the future transhipment hub of the country.

The present study is to document the existing shoreline change pattern in different seasons of the year, with the aim of understanding future changes in pattern, if any, during or after the implementation of the port project.

The study comprises carrying out wave, wind and tide observations at one location for one year, as well as current for 30 days each, at four locations, during 3 different seasons; summer (Jan-May), monsoon (June-Sept), and post monsoon (Oct-Dec), bathymetric survey of up to 20m contour in two seasons, cross shore profiling from 10m CD to 100m inland from the high water line along a stretch of 40 km, water & grab sampling, littoral environmental observation, river crossing survey etc.

A Google Earth image, showing the locations of the observations, including the wave/current measurement location, is given in **Figure 1**. The cross shore profile lines, the LEOs, photographic documentation points and beach sampling locations are shown in **Figures 2** and **3**.

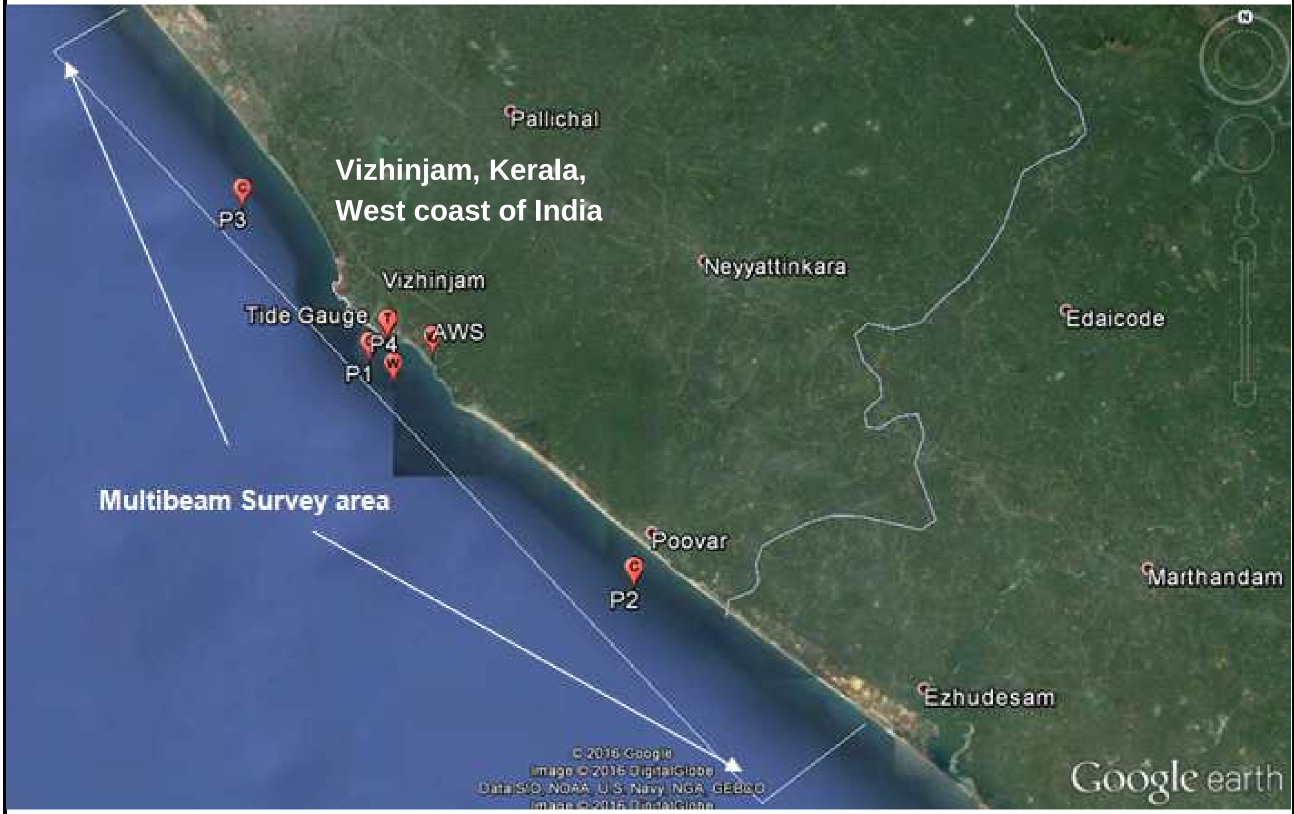


Figure 1 – General survey location

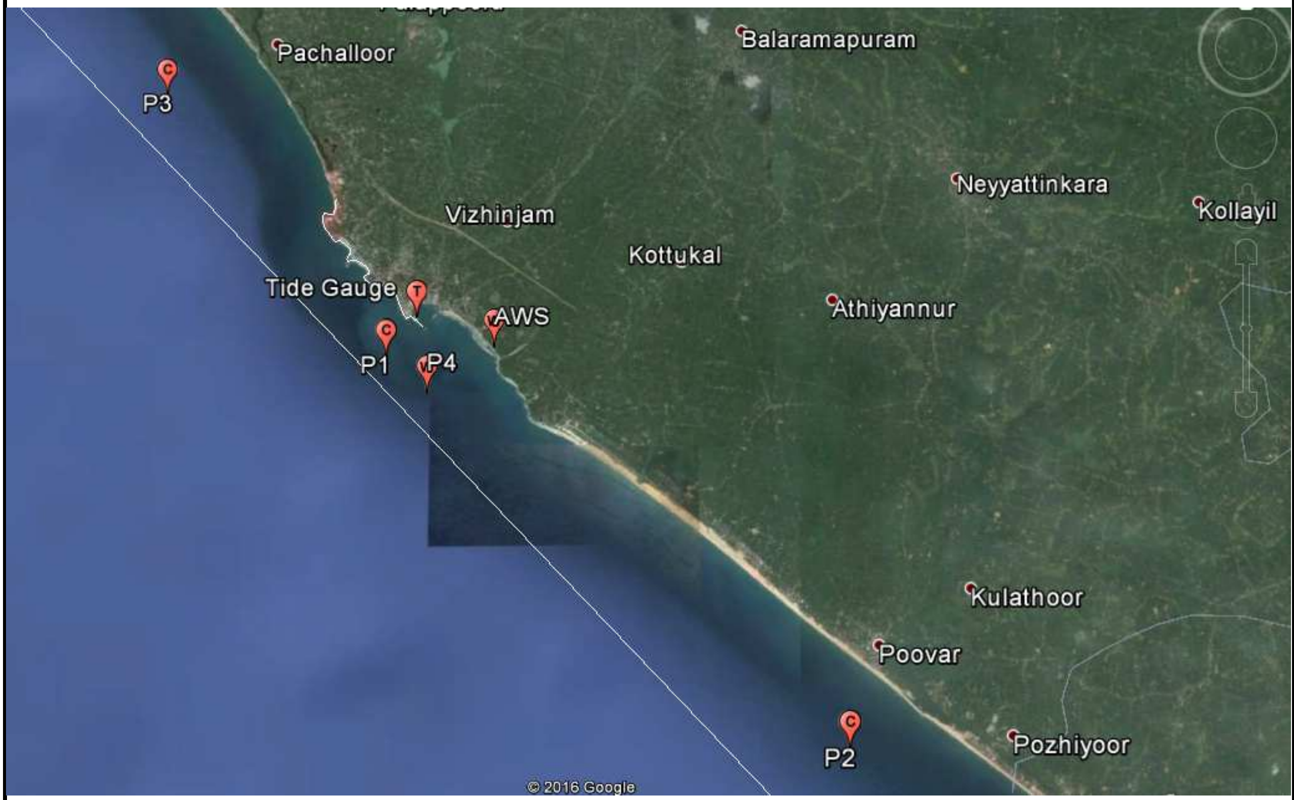


Figure 2 – Location of ADCPs, Tide and Weather Station

P1, P2 and P3 correspond to ADCP locations which are denoted as and P4 corresponds to both, ADCP and wave location which is denoted as . The tide gauge location is denoted as .

The cross shore profiling lines, which coincide with the LEO, photographic documentation points and beach sampling locations, are indicated in the image below: The cross shore profiles are named as CSP-01 to CSP-81. CSP-01 corresponds to the southernmost profile which lies south of the existing Vizhinjam Harbour.

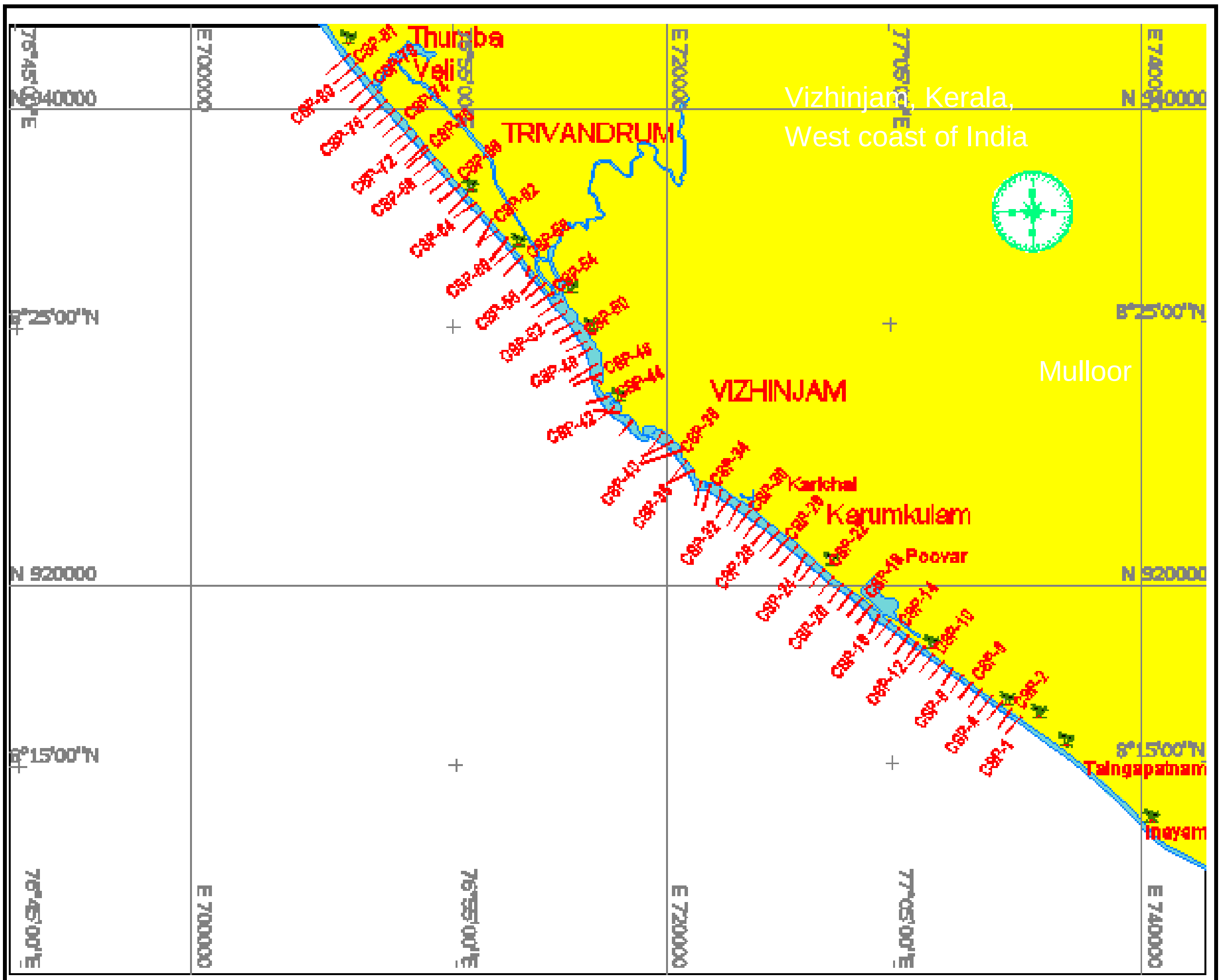


Figure 3 – Cross Shore Profile/LEO/Beach Sampling Locations

3. SCOPE OF WORK

The survey scope of work as provided in the RFQ and as per the contract included the following:

- To mobilise a suitable marine spread and a survey boat at site for carrying out the operations.
- To provide requisite personnel and equipment for undertaking of oceanographic measurements and study of shore line.
- Monthly cross shore beach profiling perpendicular to the shoreline for a 40 km stretch at intervals of 500m, using RTK or total station landward up to 100m from HTL or +2m of HTL and using shallow draft boats, sled or any other suitable techniques seaward down to 10m CD.
- Monthly monitoring of littoral zone (at the cross shore beach profiling locations) to observe the littoral transport direction and alongshore current speed by means of appropriate drogue observations and visual observations.
- Monthly photographic documentation of geomorphological changes (at the cross shore beach profiling locations).
- Seasonal beach sediment sampling and analysis (at the cross shore beach profiling locations).
- Bathymetric survey twice in a year, i.e. just after the monsoon season and just prior to the commencement of the next monsoon to generate 0.5m contours (with bathymetric survey lines spaced at 25 m interval) in areas with depths to 20m CD using multi beam echo sounder.
- Bathymetry/cross section survey for 500m length of rivers debouching in a 40 km stretch of the coast.
- Seabed sediment sampling and analysis in 80 sq km with one sample per sq km.
- Collection and analysis of water samples at specified periods (seasonal) for total suspended solids (TSS) and turbidity from four specified locations.
- Current measurements (both magnitude and direction) using Acoustic Doppler Current Profiler (ADCP) at four locations, as marked in Figure 1, for the duration of full tidal cycle/30 days each during monsoon (June-Oct), post-monsoon (Nov-Feb) and summer months (Mar-May).
- Wave observations using WRB Datawell DWG-G shall be carried out at one location as marked in the location map.
- Tide measurements using an automatic tide gauge close to the survey area to observe the tidal variations around the clock at 6 minute intervals or as specified to cover one full year. The tide gauge shall be connected to the nearest Survey of India Benchmark. The data shall be used to derive the harmonic constituents.
- Collection of wind speed & direction, atmospheric pressure, humidity, temperature at 1 location specified by the client/EIC by establishing an automatic weather station to cover a full year.
- Analysis and processing of the data and submission of periodic reports in soft & hard copies.

3.1 Location Co-ordinates

The location co-ordinates of the current and wave observations are provided below:

Location Co-ordinates WGS-84 Spheroid, UTM Projection, CM 75 East, Zone 43, North			
Name	**Latitude**	**Longitude**	**Depth w.r.t CD (m)**
ADCP - P1 (Vizhinjam)	08° 21' 55.4"N	76° 58' 51.6"E	21.1
ADCP- P2 (Poovar)	08° 17' 35.8"N	77° 04' 03.5"E	23.0
ADCP- P3 (Pachalloor)	08° 24' 08.6"N	76° 56' 16.1"E	27.4
ADCP/Wave - P4 (Mulloor)	08° 21' 42.3"N	76° 59' 33.9"E	23.2

Table 1: Current/Wave Locations

The current observations were to be carried out for 30 days in each of the seasons at the above locations. The observations commenced on 20th April till 20th May 2016. The WRB was functional till 24th May 2016, thereafter which the battery of WRB got discharged. This was then communicated to NIOT and a replacement buoy was sought.

The location co-ordinates of the tide station are provided below:

Tide Station Co-ordinates WGS-84 Spheroid, UTM Projection, CM 75 East, Zone 43, North			
Name	**Latitude**	**Longitude**	**Height above CD (m)**
Tide station	08° 22' 33.68"N	76° 59' 16.65"E	3.251

Table 2: Tide Station Location Co-ordinates

The location co-ordinates of the weather station are provided below:

Weather Station Co-ordinates WGS-84 Spheroid, UTM Projection, CM 75 East, Zone 43, North			
Name	**Latitude**	**Longitude**	**Height above CD (m)**
Weather station (on top of Ayur Bay Resort)	08° 22' 13.53"N	77° 00' 08.78"E	28.456

Table 3: Weather Station Location Co-ordinates

Since the system was installed at a height of 28.456m above CD a correction factor was applied in the wind speed to reduce the data to 10m above MSL. The corrections were obtained from WMO manual supplied by NIOT. As per section 5.2.2 in the manual, 20% of the speed was deducted to derive the current speeds at 10m above MSL. The data provided is thus referenced to both the levels.

4. SURVEY CONTROL

4.1 Geodesy

The survey operations were conducted in the WGS 84 Spheroid, Universal Transverse Mercator Projection based on the geodetic parameters presented below. All co-ordinates quoted within this document are with reference to it.

GEODETIC PARAMETERS	
Satellite Datum	
Spheroid	WGS-84
Datum	WGS 84
Semi-Major Axis	6378137.000 m
Semi Minor Axis	6356752.314 m
Inverse Flattening	298.2572
Projection Parameters	
Grid Projection	Universal Transverse Mercator
Latitude of Origin of Projection	0° (Equator)
Longitude of Origin of Projection	75° E, Zone 43
Hemisphere	North
False Easting (metres)	500000
False Northing (metres)	0
Scale Factor on CM	0.9996
Units	Metres

Table 4: Geodetic Parameters

4.2 Vessels

The following vessels were utilised for the survey operations.

Figure 4 – Survey / Watch Keeping Vessel MFB Samuel

Figure 5 – Survey Vessel MFB Bethel

Figure 6 – Survey/Transit Vessel MFB Sindhu Yatra Matha

4.3 Personnel

The following survey personnel from Ocean Science/AVPPL were assigned to the project in the capacities listed in the table below.

Ocean Science & Surveying		
Name	**Designation**	**Period**
S PHILIP	Project Manager / Oceanographer	Duration of Project
HEBIN C	Party Chief / Oceanographer	Duration of Project
J P PANDEY	Hydrographic Surveyor	26th Feb to 6th Mar 2016; 6th to 15th April 2016; 4th to 13th May 2016
UNNIKRISHNAN KU	Hydrographic Surveyor	11th to 30th April 2016
P KUMAR	Hydrographic Surveyor	11th to 31st May 2016
G SHARMA	Electronics Engineer	6th to 31st April 2016
S SRINIVASAN	Electronics Engineer	26th to 31st April 2016
P PANDA	Electronics Engineer	11th to 31st Mar 2016
S K SAHOO	Electronics Engineer	27th Feb to 31st Mar 2016; 24th to 31st May 2016
Adani Vizhinjam Port Pvt. Ltd.		
Name	**Designation**	**Period**
Vishal SHAH	Senior Manager – Health, Safety and Environment	Duration of Project
Shabdendu PATHAK	Manager - Environment	Duration of Project

Table 5: Survey Personnel

5. SURVEY EQUIPMENT DETAILS

5.1 General

The wave rider buoy was deployed from the vessel MFB Samuel. The cross shore profiling offshore, were carried out using the survey boat Bethel fitted with the multibeam echo sounder.

The equipment used for the project is described below:

5.2 DGPS Positioning System

Vessel positioning was carried out by the metric accuracy MX 420 DGPS system using MF based correction signals. Vessel track and offset positions were recorded digitally using QINSy survey data acquisition software. The system is installed permanently on board the survey vessel.

Prior to the survey, consistency check of DGPS was carried out. The details are provided below:

OCEAN Science & Surveying — DGPS CONSISTENCY CHECK

Form No.:	Sy32Ra
Revision:	0
Date:	01-Jan-2010
Approved by:	PKT

Job Number	P21716	**Project**	Shoreline Monitoring
Client	AVPPL	**Vessel**	BETHEL
Location	Vizhinjam	**Date**	18/03/2016

Nav Equipment	Primary		Secondary	
Item	**Type**	**Serial Number**	**Type**	**Serial Number**
GPS Receiver	Leica mx 420	0801351		
GPS Antenna				
GPS Demodulator				

Offsets	X (m)	Y (m)	Z (m)
DGPS Antenna to CRP	0	0	0

1st set of Observations on Points A & B

DGPS Observations on		Date:	Time:	
Observation Points	**Number of Observations**	**Time of Observations**	**Average Easting WGS 84 Spheroid, CM**	**Average Northing WGS 84 Spheroid, CM**
A	93	15	719313.937	926447.2466
B	93	15	719321.1725	926454.9499
Comments:	Calculated distance between Point A and Point B = 10.57 mtrs.			
	Computed Bearing (true) between Point A and Point B = 43.50			
	Measured distance (by tape) between Point A and Point B= 10 mtrs.			

2nd set of observations on Points A & B

DGPS Observations on		Date:	Time:	
Observation Points	**Number of Observations**	**Time of Observation**	**Average Easting WGS 84 Spheroid, CM**	**Average Northing WGS 84 Spheroid, CM**
A				
B				
Comments:	Calculated distance between Point A and Point B = mtrs.			
	Computed Bearing (true) between Point A and Point B= ° ' "			
	Measured distance (by tape) between Point A and Point B= mtrs.			

Difference observed between 1st and 2nd set of observations made on points A & B

Observation Points	Difference in Easting (δE)	Difference in Northing (δN)
A		
B		

Signed

Position	Name	Signature	Date
Surveyor	UNNIKRISHNAN K U		18/03/16
Party Chief	HEBIN C		18/03/16

Figure 7 : DGPS consistency check

5.3 Navigation & Heading System

The navigation computer running QINSy (Quality Integrated Navigation System) navigation software received the corrected GPS latitude and longitude from the DGPS system for the Multibeam survey.

The vessel's centre of gravity (COG) was defined as the central reference point (CRP) for the entire survey and deployment operations. Positioning data was logged at 1-second updates in the software.

A Standard Meridian Gyro was used to obtain the accurate heading of the survey boat. The calibration of the gyro was carried out on 18th March 2016. The details are provided in the figure below:

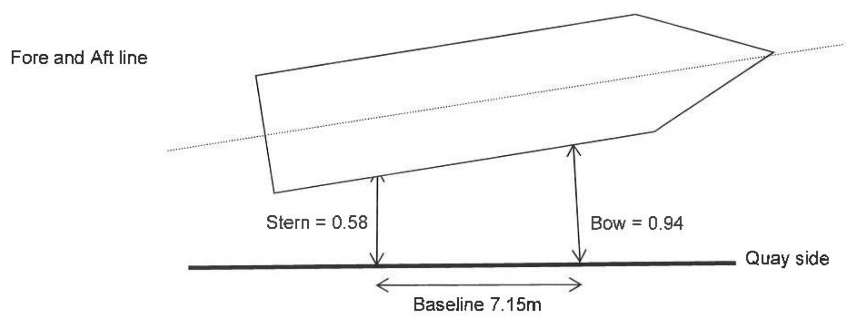
OCEAN Science & Surveying

GYRO CALIBRATION
(Quay/Tape offset Method)

Form No.:	Sy37R
Revision:	0
Date:	1-Jan-2014
Approved By:	PKT

Job No	P21716	Project	Shoreline Monitoring
Client	AVPPL	Vessel	Bethel
Location	Vizhinjam	Date	18/03/2016

Quay heading	(true)	Baseline length(m)		Gyro Name	Meridian surveyor	Quayside on:	
43.5		7.15		S/No.	5265	STBD	
Observations				Calculations			
Time	Gyro (true)	Stern	Bow	Calc. angle	Calculated Heading	True Quay hdg	C-O
13:11:02	39.5	0.69	0.8	0.88	40.38	43.5	3.12
13:11:12	39.1	0.53	0.9	2.96	42.06	43.5	1.44
13:11:22	41.7	0.4	0.65	2.00	43.70	43.5	-0.20
13:11:32	41	0.65	1.2	4.40	45.40	43.5	-1.90
13:11:42	40.6	0.53	0.95	3.36	43.96	43.5	-0.46
13:11:52	42.7	0.56	1	3.52	46.22	43.5	-2.72
13:12:02	41	0.65	1.05	3.20	44.20	43.5	-0.70
13:12:12	41.8	0.71	1.1	3.12	44.92	43.5	-1.42
13:12:22	43.6	0.43	0.75	2.56	46.16	43.5	-2.66
13:12:32	40	0.68	1	2.56	42.56	43.5	0.94
Average	41.10	0.58	0.94	2.86	43.96	**C-O**	**-0.46**



Designation	Name	Signature	Date
Surveyor	UNNIKRISHNAN K U		18/03/16
Party Chief	HEBIN C		18/03/16

Figure 8 : Gyro Calibration

5.4 Wave Rider Buoy

NIOT deployed the wave rider buoy in collaboration with VISL and it is being monitored by Ocean Science. A Datawell DWR (G) was supplied and installed for the project. The WRB was programmed to measure all the wave parameters at half-hourly intervals. The data is transmitted on a real time basis via the HF antenna to the receiver set up at Mukkola, where the Ocean Science personnel reside.

The system consists of wave rider buoy (DWR G make) with HF whip/LED flasher, GPS antennae, internal data logger, RX-D receiver with HF antenna and acquisition and post processing software w@ves21. The system has a GPS receiver mounted on a buoy along with HF radio for data transmission in real time. The system has an accuracy of 1 cm + 0.5% of vertical motion; resolution of 1cm and range of ± 30 m at the sampling rate of 1.28 Hz. The directional accuracy and resolution is 1.5° within the range of 0° to 360°.

5.4.1 Calibration of the equipment

The wave rider buoy is factory-calibrated and Datawell does not recommend recalibration of the buoy.

5.4.2 Principles of Wave measurement

The GPS wave buoy measurement principle bears a strong analogy with the Doppler-shift phenomenon of a nearby passing car blowing its horn. The GPS system calculates the velocity of the buoy from changes in the frequency of GPS signals. The velocities are integrated with time to determine buoy displacement. In practice the GPS system uses signals from multiple satellites to determine three-dimensional buoy motion. A gravity sensitive accelerometer in the buoy measures wave height by means of vertical acceleration of the platform of the buoy.

5.4.3 Mooring of the instrument

The mooring arrangement incorporates the following components between the sea bottom and the mooring eye underneath the buoy: a sinker or anchor weight, polypropylene rope, nylon covered galvanized steel cable (combination rope) and associated terminals, floats, rubber cords with associated terminals, swivels, ballast chain, anodes and shackles and cotter pins.

A schematic of the mooring of WRB is given below:

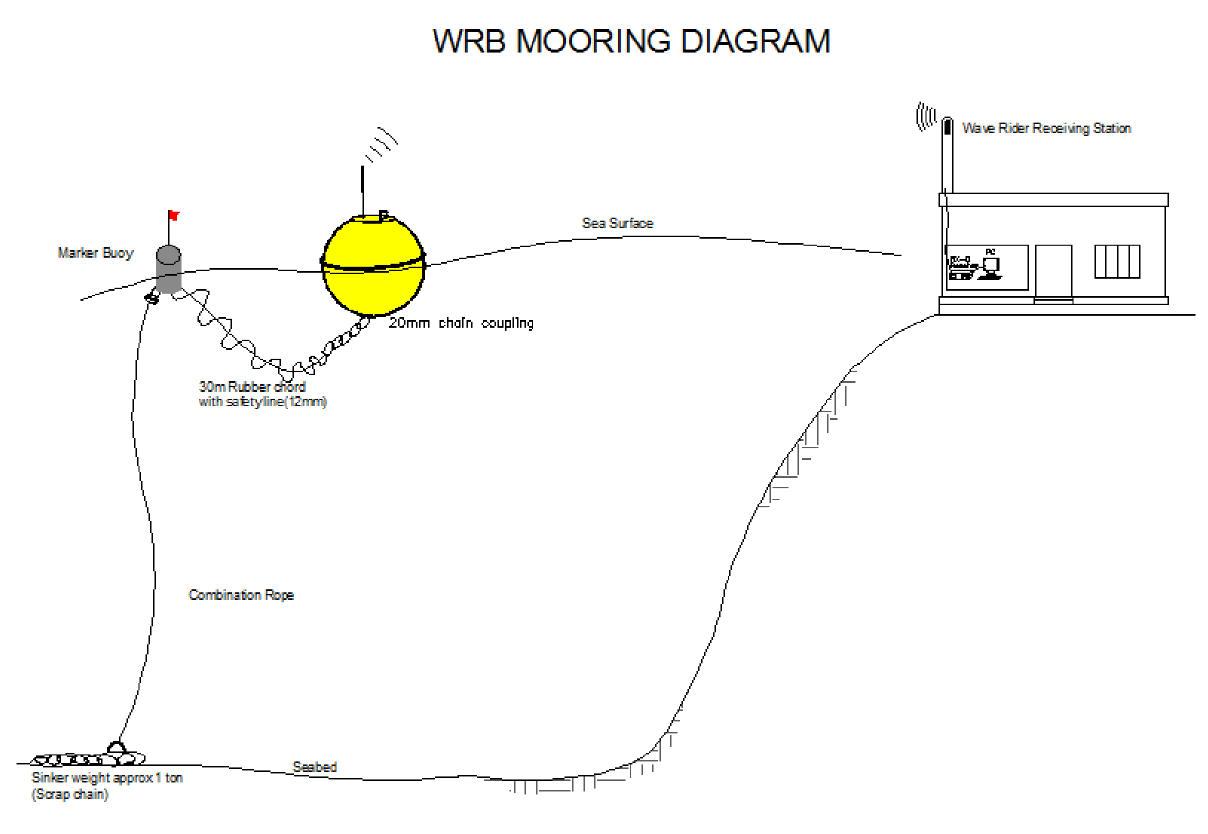


Figure 9 – WRB Mooring Diagram

A photograph of the WRB deployed at the site is provided below:

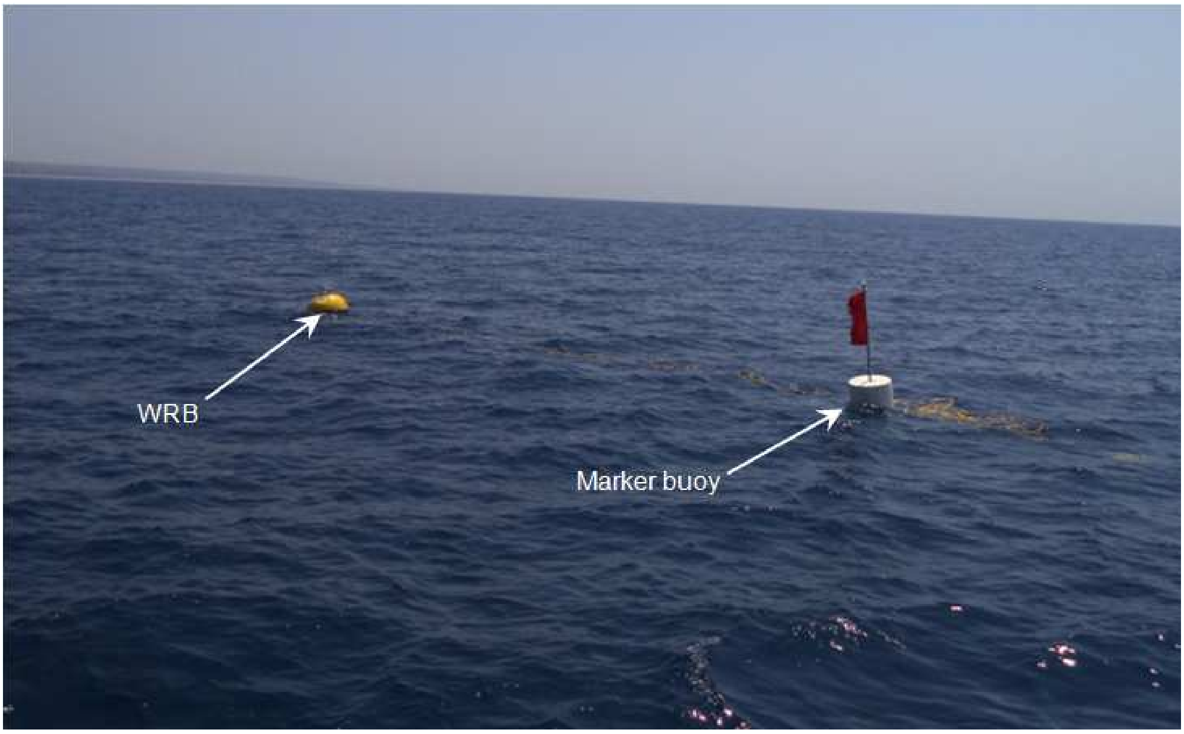


Figure 10 – WRB deployed at location P4 (Mulloor)

A highly elastic rubber cord is essential for high quality wave measurements. It allows the buoy to follow the wave motion, thus guaranteeing that the measured motion of the buoy is indeed the same as the desired motion. The buoy was deployed using single point mooring with free-floating method. The mooring design was configured as per the site conditions, followed by the mooring suggestions provided by the supplier. As frequent fishing activities were observed at the deployment location, one boat was anchored near the wave rider buoy without hindering the wave data measurements along with sufficient crew on board for around the clock watch-keeping. Another fibre boat was kept for movement of the watch-keepers to remove the fishing nets whenever required.

5.5 Automatic Tide Gauge

A Valeport 740 Tidemaster automatic tide gauge was installed near the Coast Guard jetty, inside the fishing harbour for measuring the tides. The location is close to the existing tide gauges installed by NIOT. The sensor was installed on a 5m long pipe to ensure that the sensor is always in water, irrespective of the phases of tide. This was levelled to the local bench mark, situated on top of the jetty. The tide station was programmed to measure the tide at 6-minute intervals throughout the duration of the project.

A photograph of the tide gauge location is provided below:

Figure 11 – Location of Tide Gauge

5.6 Automatic Weather Station

An automatic weather station was installed atop Ayur Bay resort at Nellikunnu. The system measures wind speed/direction, atmospheric pressure, temperature, relative humidity and rainfall.

The system consists of the following:

- Gill sonic anemometer
- Microstep pressure sensor
- Microstep relative humidity & temperature sensor
- Meteoservis Rain gauge
- Microstep datalogger

The data is logged on a PC installed at the receiving station at intervals of 10 minutes. The data is transmitted through a UHF link.

An image of the automatic weather station is provided below:

Figure 12 – Automatic Weather Station on top of Ayur Bay Resort, Nellikunnu (Mulloor)

5.7 Currentmeter

Teledyne RDI Workhorse Sentinel 600 kHz ADCP currentmeters were deployed at the 4 locations. The ADCPs were programmed to record the currents at intervals of 10 minutes. A typical ADCP deployment setup is given below:

Figure 13 – ADCP installed in a downward looking mode

A schematic representation of ADCP deployed to measure the current profile is given below:

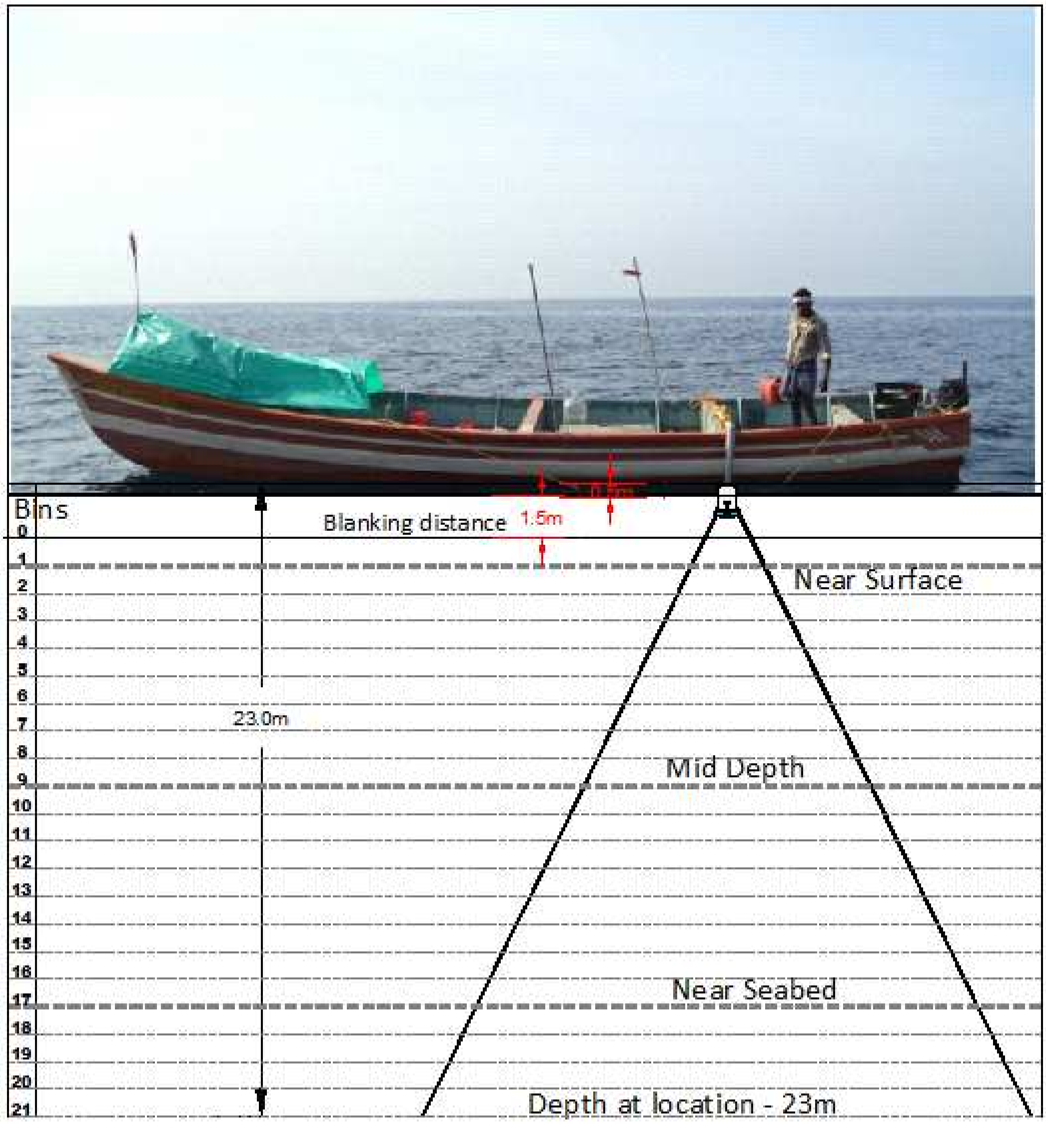


Figure 14 – Schematic diagram of surface, mid depth and near bottom measurement of ADCP

5.8 Real Time Kinematic (RTK) Survey

RTK system was mobilised at site to carry out cross shore profiling on the landward side. The system comprises the following:

- Hemisphere GPS R320 GNSS base station
- Hemisphere GPS R320 rover

A photograph of the system is provided below:

Figure 15 – RTK System fixed at BM-1

5.9 Bathymetric Survey

The cross shore profiling from 10m CD to the shore was carried out using a Geoswath GS+ 250 kHz wide swath bathymetric system, which was calibrated on 13th October 2015 and further on 9th April 2016. The calibration values obtained on 13th October are given below:

Parameter	Value	Comments
Latency	0.96s	MX 420 DGPS system
Port Roll	0.17º	DMS accuracy 0.05º in roll (~3.5cm at 40m)
Starboard Roll	0.20º	DMS accuracy 0.05º in roll (~3.5cm at 40m)
Pitch	0	
Yaw	5.5°	Accuracy better than 0.2°

The calibration values obtained on 9th April 2016 are given below:

Parameter	Value	Comments
Latency	0.30s	MX 420 DGPS system
Port Roll	0.49 º	DMS accuracy 0.05º in roll (~3.5cm at 40m)
Starboard Roll	0.04º	DMS accuracy 0.05º in roll (~3.5cm at 40m)
Pitch	0.00º	
Yaw	1.30º	Accuracy better than 0.2°

Table 6: Calibration Results

5.10 Beach and Water Sampling

A total of 72 beach samples, out of 81, were collected for grain size analysis. The remaining nine samples could not be collected due to the presence of a seawall.

The samples are to be analysed as per IS 1498.

The water samples (132 from four locations) were collected in the month of March 2016 and were analysed for TSS as per IS 3025, Part 17:1984 (reaffirmed 2012); Turbidity was analysed as per IS 3025, Part 10:1984 (reaffirmed 2012) technical specifications. The salinity was analysed as per American Public Health Association (APHA) guidelines.

5.11 Data Processing and Interpretation

The Multibeam data was processed in the GS+ software. After applying the calibration values, sound velocity and the tide, the processed data was QC-ed in the in-house software 'C-View'.

6. SURVEY RESULTS

The results obtained for the Pre Monsoon period are presented in this section.

6.1 Control Points

As per the earlier contract with VISL, 41 reference stations were fixed along the 40 km survey boundary using RTK DGPS system. This was apart from the three reference stations; BM-1, BM-2 and BM-3 which were fixed for all future references.

The co-ordinates of BM-1 and BM-2 were provided by VISL (Detailed Project Report on Rail Connectivity to Vizhinjam International Seaport: Kerala, 2011) prior to the start of the survey. BM-1 lies next to the Sri Nagar Bhagavathy Temple, Mulloor. BM-2 consists of a chiselled square on the rock adjacent to the compound wall of the Kollamkodu Sahib Dargah at Vizhinjam. BM-3 was set up on the roof of the VISL Project Office. The Survey of India Benchmark (SOI BM) which lies on a rock adjoining the basement on the western side of Vizhinjam mosque was also provided. This point is 6.945m above chart datum.

The image below depicts all the locations:

Figure 16 – Benchmark locations

The details of BM-1, BM -2 and BM-3 are given below:

Station Description	Co-ordinates in WGS 84		Height above Chart Datum (metres)
	Geographical	UTM	
BM-1 (Near Mulloor temple)	08° 21' 55".7808 N 77° 00' 13".6084 E	720657.1797 mE 925265.7437 mN	11.5576
BM-2 (Kollamkodu Sahib Dargah)	08° 22' 33".5100 N 76° 59' 12".1368 E	718770.2408 mE 926415.5205 mN	11.209 m
BM-3 (On the roof of VISL Project office)	8° 22' 21".7313 N 77° 00' 03".3253 E	720338.4535 mE 926061.5341 mE	44.0577

Table 7: Details of stations BM-1, BM-2 & BM-3

Photographs of the three stations are provided below:

Figure 17 – BM-2 adjacent to Dargah, Vizhinjam

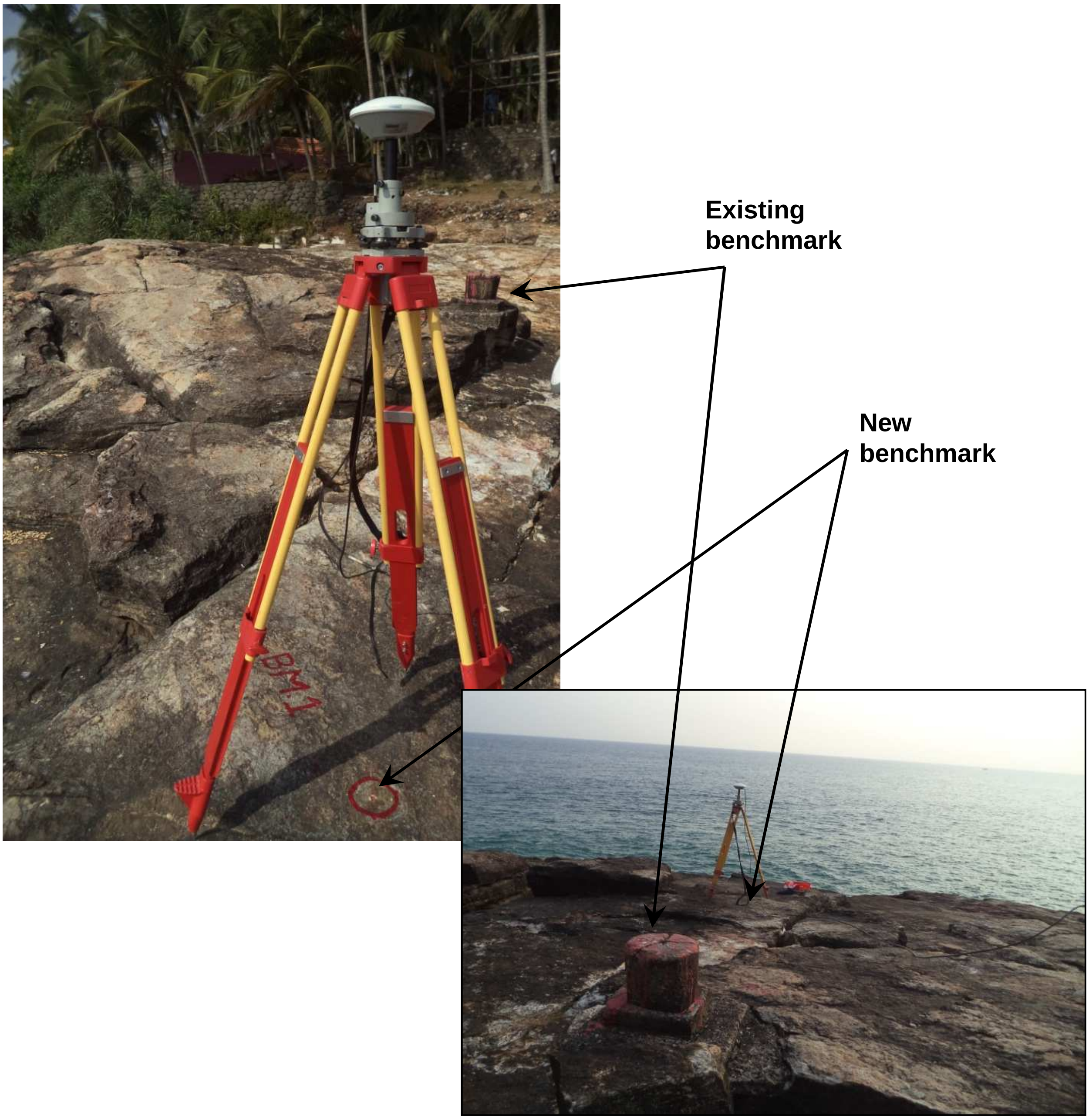


Figure 18 – BM-1 near to Sri Nagar Bhagavathy temple, Mulloor

Figure 19 – BM-3 roof top of VISL Project Office

The image below shows the SoI benchmark which is behind the Dargah at Vizhinjam.

Figure 20 – SoI Benchmark

Based on the above benchmark co-ordinates, 41 reference points were fixed along the shore during the initial phase of the survey. Most of the points were fixed on existing rocks, concrete structures and few of them were fixed on the existing CES markers. Considering BM-1 as centre, the points were named NIOT-CP-1 to NIOT-CP-19 to the south (Poovar) and NIOT-CP-A to NIOT-CP-V to the north (Shankumugham). During the course of the project, a few points had to be relocated due to damage/non-access to site.

The following table provides the updated details of the existing reference stations:

Sl No.	Reference Point	Easting	Northing	Latitude	Longitude	Height above CD (m)
1	NIOT_CP-19	734945.865	914388.234	8° 15'59".37475 N	77° 7'58".59693 E	5.052
2	NIOT_CP-18	734116.42	915024.1573	8° 16'20".21262 N	77° 7'31".61235 E	5.86
3	NIOT_CP-17	733111.267	915744.911	8° 16'43.84109 N	77° 6'58".90161 E	11.668
4	NIOT_CP-16	732485.4329	916183.7851	8° 16'58".23085 N	77° 6'38".53276 E	5.0749
5	NIOT_CP-15	731570.272	916840.7065	8° 17'19".76585 N	77° 6'8".74908 E	5.658
6	NIOT_CP-14	730843.3861	917407.4855	8° 17'38".33474 N	77° 5'45".09983 E	7.7322
7	NIOT_CP-13	730390.4197	917721.6701	8° 17'48".63657 N	77° 5'30".35551 E	7.7694
8	NIOT_CP-12	729654.9678	918329.1176	8° 18'8".52996 N	77° 5'6".43234 E	4.4221
9	NIOT_CP-11	728738.3202	919038.8737	8° 18'31".78333 N	77° 4'36".60606 E	3.9544
10	NIOT_CP-10	727993.7027	919569.1662	8° 18'49".16695 N	77° 4'12".36870 E	3.7986
11	NIOT_CP-9	729397.4389	920046.5818	8° 19'4".46345 N	77° 4'58".31359 E	4.3316
12	NIOT_CP-8	726454.8538	920766.0091	8° 19'28".37591 N	77° 3'22".29415 E	3.9366
13	NIOT_CP-7	725656.2954	921415.6312	8° 19'49".65109 N	77° 2'56".31253 E	4.2844
14	NIOT_CP-6	724768.7938	922157.4539	8° 20'13".94139 N	77° 2'27".43947 E	4.2148
15	NIOT_CP-5	724159.7014	922134.6909	8° 20'13".30291 N	77° 2'7".53371 E	3.8251
16	NIOT_CP-4	723270.1977	923410.6967	8° 20'54".97675 N	77° 1'38".68346 E	3.0972
17	NIOT_CP-3	722465.6274	923988.1456	8° 21'13".90304 N	77° 1'12".49001 E	3.1602
18	NIOT_CP-2	721481.8683	924273.9063	8° 21'23".36632 N	77° 0'40".39178 E	11.4171
19	NIOT_CP-1	721226.3295	924486.3499	8° 21'30".32234 N	77° 0'32".07696 E	14.6213
20	NIOT_CP-A	720194.5904	926065.8282	8° 22'21".89482 N	76° 59'58".62481 E	11.6288
21	NIOT_CP-B	717970.883	927172.091	8° 22'58".26291 N	76° 58'46".13906 E	22.9947
22	NIOT_CP-C	717565.394	927637.0357	8° 23'13".46045 N	76° 58'32".96422 E	4.4694
23	NIOT_CP-D	717237.5958	928806.139	8° 23'51".56131 N	76° 58'22".44381 E	3.3282
24	NIOT_CP-E	716979.2207	929552.944	8° 24'15".90758 N	76° 58'14".12252 E	4.7432
25	NIOT_CP-F	716489.6905	930413.2052	8° 24'43".98399 N	76° 57'58".26496 E	5.5908
26	NIOT_CP-G	715943.5657	931284.6071	8° 25'12".43215 N	76° 57'40".55899 E	5.2857
27	NIOT_CP-H	715577.856	931801.862	8° 25'29".32541 N	76° 57'28".9107 E	4.371
28	NIOT_CP-I	714782.774	932862.004	8° 26'03".95636 N	76° 57'2".87784 E	4.619
29	NIOT_CP-J	714171.7189	933470.9072	8° 26'23".87197 N	76° 56'43".00490 E	7.8878
30	NIOT_CP-K	713749.7645	933992.4272	8° 26'40".91294 N	76° 56'29".29807 E	7.6638
31	NIOT_CP-L	713118.6205	934741.1346	8° 27'5".38141 N	76° 56'8".79020 E	4.2566
32	NIOT_CP-M	712542.8348	935407.128	8° 27'27".14889 N	76° 55'50".07774 E	4.0076
33	NIOT_CP-N	711773.0753	935995.2397	8° 27'46".41283 N	76° 55'25".01160 E	6.3616
34	NIOT_CP-O	711328.4672	936796.413	8° 28'12".55834 N	76° 55'10".60768 E	7.6976
35	NIOT_CP-P	710540.4298	937692.2264	8° 28'41".83894 N	76° 54'44".99218 E	5.7295
36	NIOT_CP-Q	709869.231	938480.1943	8° 29'7".59078 N	76° 54'23".17776 E	5.4124
37	NIOT_CP-R	709080.5573	939351.7461	8° 29'36".08144 N	76° 53'57".53564 E	4.3292

Sl No.	Reference Point	Easting	Northing	Latitude	Longitude	Height above CD (m)
38	NIOT_CP-S	708512.7295	940019.1963	8° 29'57".89418 N	76° 53'39".07962 E	5.08
39	NIOT_CP-T	707885.2999	940760.5905	8° 30'22".12280 N	76° 53'18".68634 E	6.2363
40	NIOT_CP-U	707297.3093	941476.2951	8° 30'45".50894 N	76° 52'59".57765 E	4.7072
41	NIOT_CP-V	706563.5161	942438.4132	8° 31'16".93766 N	76° 52'35".74070 E	4.814
42	NIOT_CP_ LEELA	717068.81	928439.539	8° 23'39".65832 N	76° 58'16".86749 E	20.082
43	NIOT_BM-1	720657.1797	925265.7437	8° 21'55".78077 N	77° 0'13".60836 E	11.5576
44	NIOT_BM-3 (VISL Office)	720338.4535	926061.5341	8° 22'21".73127 N	77° 0'3".32532 E	44.0577
45	NIOT_BM-2	718770.2408	926415.5205	8° 22'33".51000 N	76° 59'12".13680 E	11.209

Table 8: Control Point Co-ordinates

All the points were engraved as per their respective names. The points NIOT_CP_19, NIOT_CP_17, NIOT_CP_H and NIOT_CP_I were relocated with respect to the earlier points. An additional point inside the Leela hotel was also fixed, which is shown in point 42 above.

6.2 Tidal Measurements

The tides were observed near the Coast Guard jetty for the first season. The tide is referenced to the chart datum, the value of which was provided by VISL. The temporary benchmark is marked on the wharf and is 3.261m above chart datum. An image of the TBM is provided below:

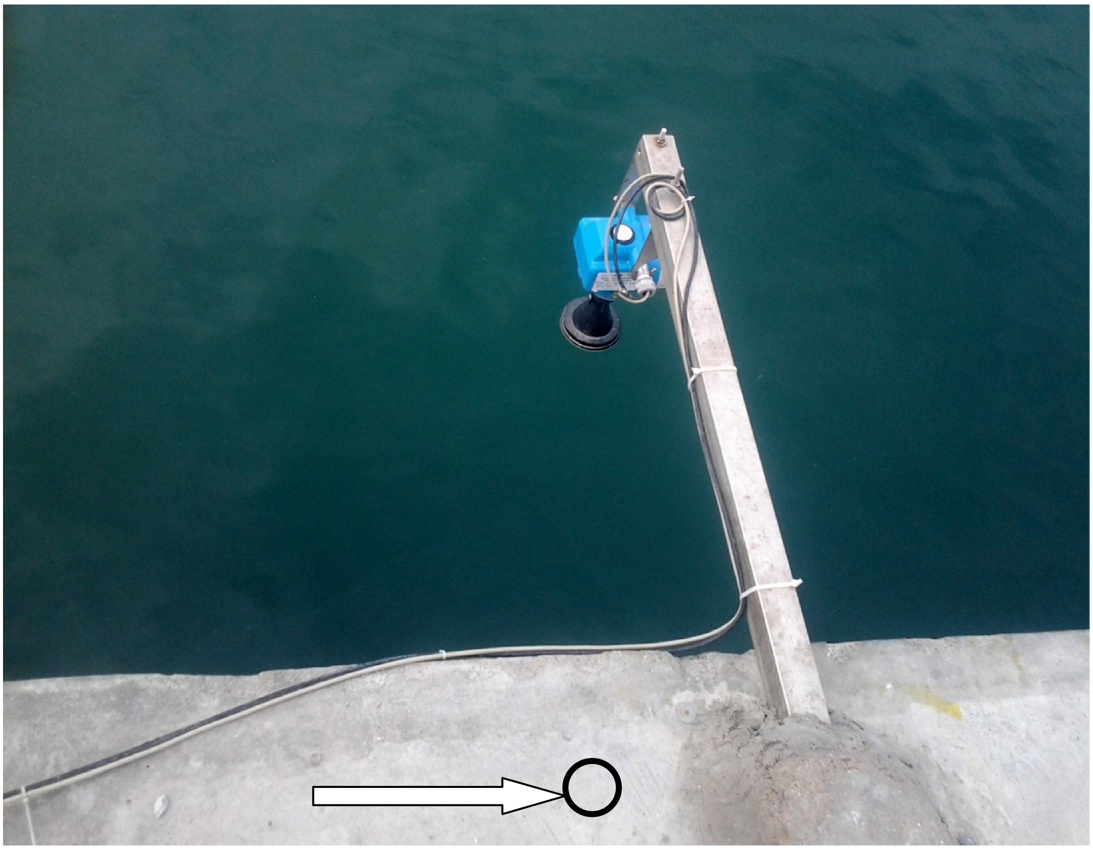


Figure 21 – Location of TBM

The observed tides are mixed semi diurnal in nature. The maximum range was observed during the springs.

The tidal data collected for the period is placed at Annexure I.

6.3 Wave Measurements

The WRB supplied by NIOT was deployed at the required location on 10th February 2015 which is still continuing as part of the contract. The processed data was then plotted for time series and rose diagram, which are provided below:

Refer to the following rose plot of Hs v/s direction for the month of February 2016:

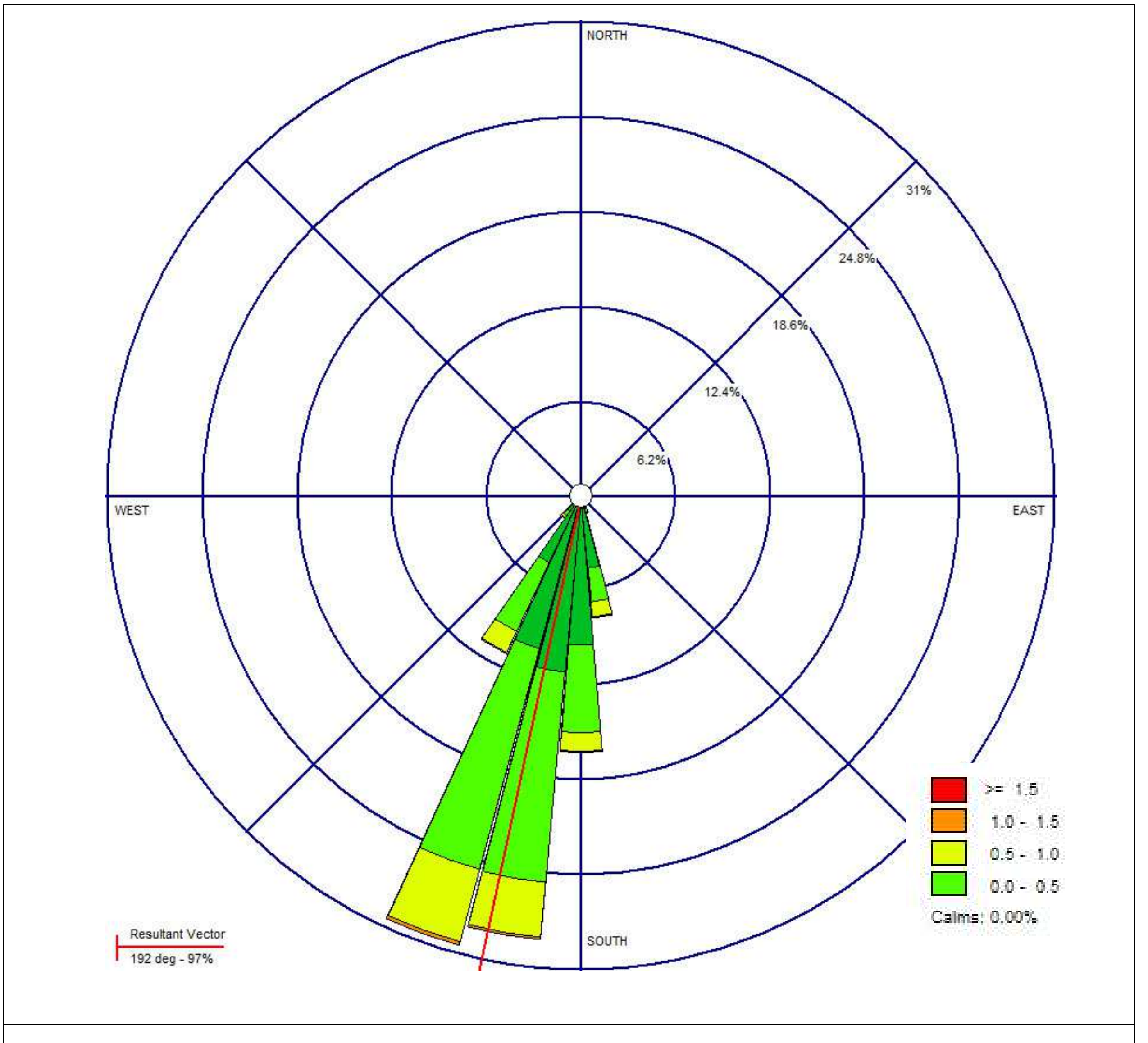


Figure 22 – Wave Rose (Hs in metre v/s Direction) during February 2016

The wave direction was south of south-westerly during the period.

The frequency distribution table and histogram for the month is provided below:

FREQUENCY DISTRIBUTION				
Significant Wave Height (m)	H_s		H_{max}	
	No. of Observations	Percentage of Occurrence	No. of Observations	Percentage of Occurrence
0 - 0.5	2	0.1	0.00	0.00
0.5 – 1.0	1244	91.1	365.00	26.62
1.0 – 1.5	118	8.6	836.00	60.98
1.5 – 2.0	2	0.1	162.00	11.82
2.0 – 2.5	0	0.0	8.00	0.58
> 1.4	0	0.0	0.00	0.00
Total	**1366**	**100**	**1488**	**100**

Table 9: Frequency Distribution of wave heights (February 2015)

The histogram of significant wave height during observation period of February 2016 is given below:

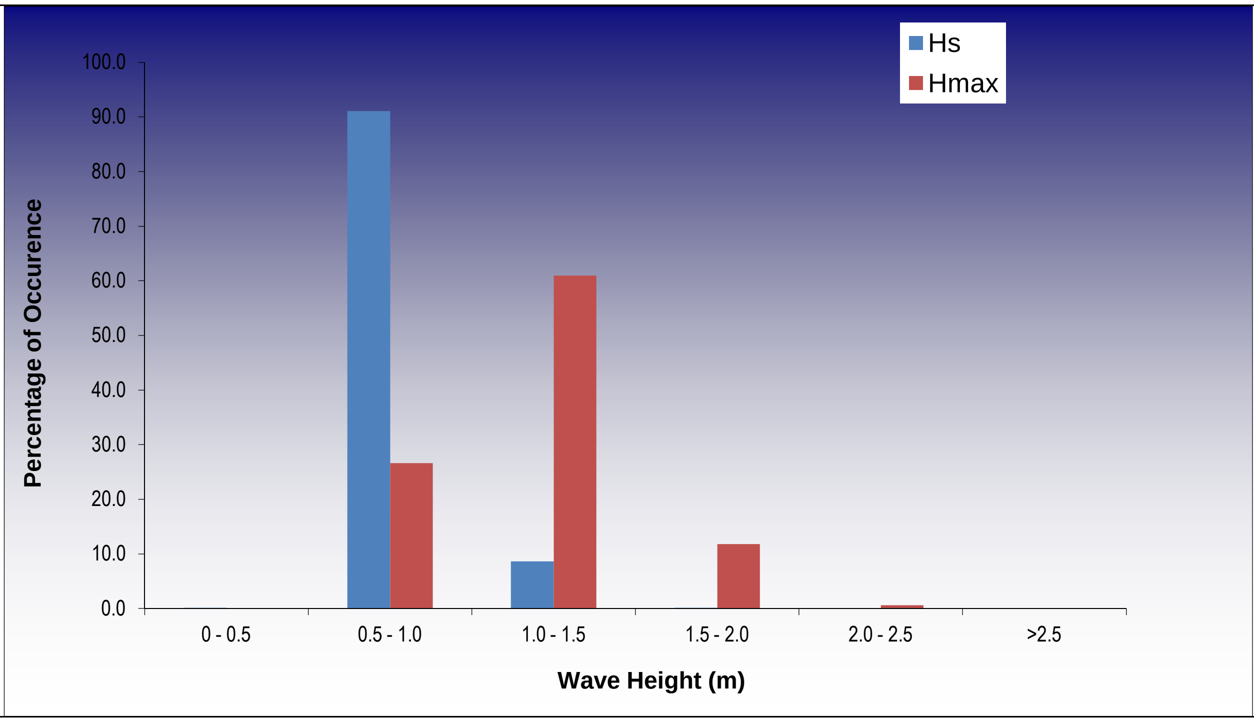


Figure 23 – Histogram of wave heights (February 2016)

As can be observed above, the significant wave height was more in the range of 0.5 to 1m in the month of February 2016.

The following image shows the wave rose drawn with respect to wave period v/s direction:

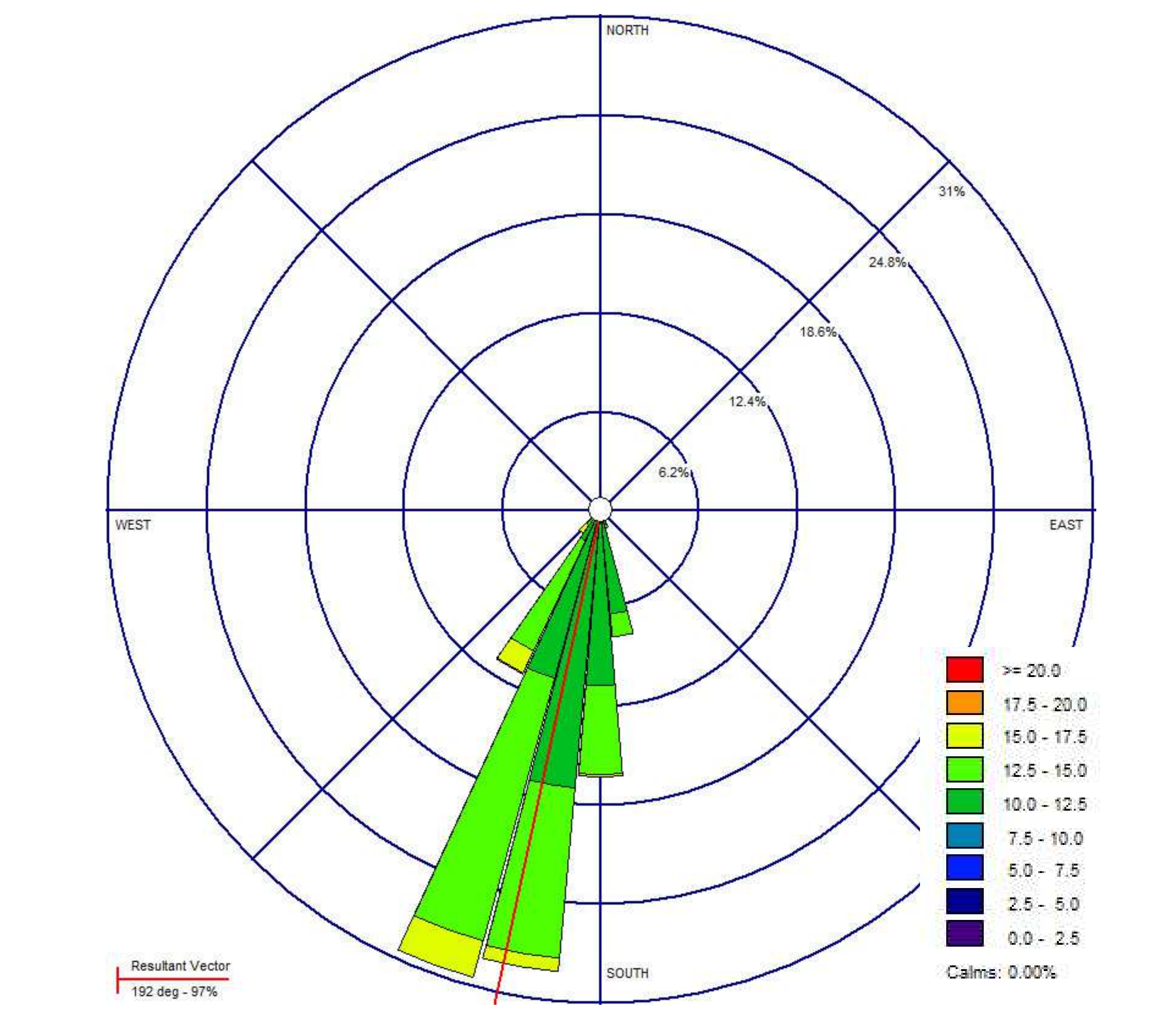


Figure 24 – Wave Rose (Tp in seconds v/s Direction) during February 2016

The histogram drawn for the wave period for February 2016 is given below:

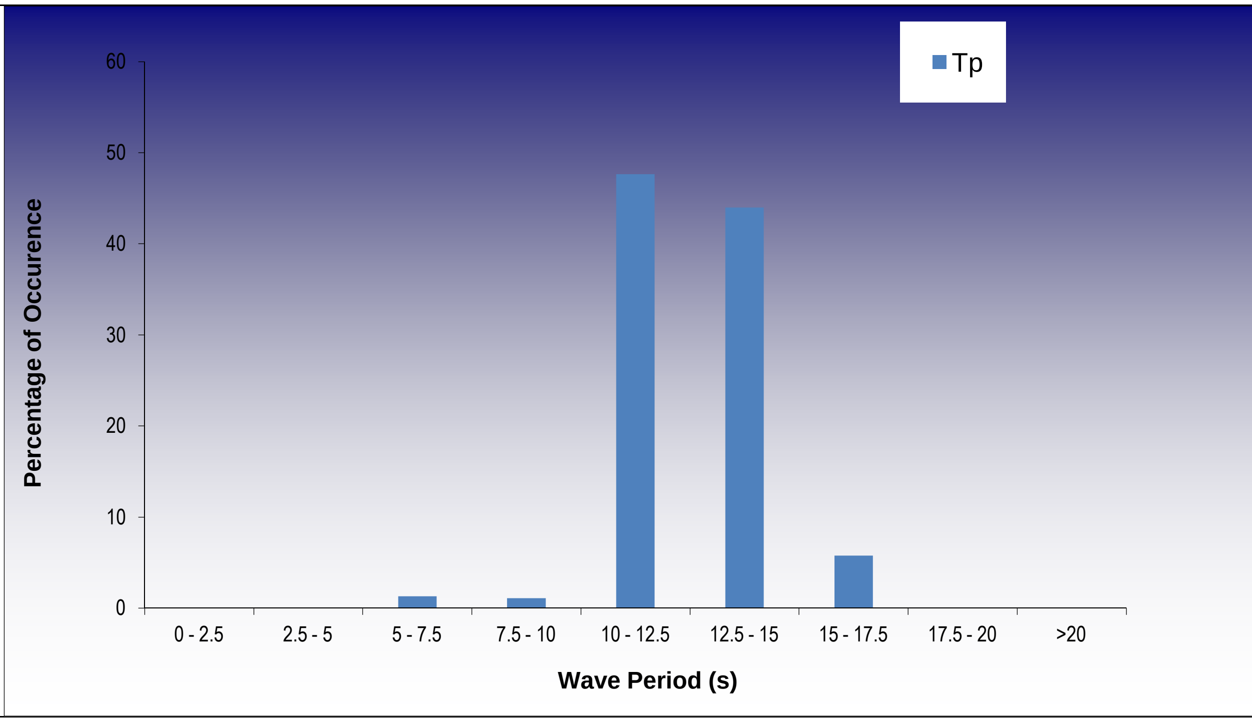


Figure 25 – Histogram of wave period (February 2016)

The above image indicates that during the month of February 2016, the wave period was in the range of 5 to 20 seconds, with bulk of wave period in the range of 10 to 15 seconds.

Refer to the following rose plot of Hs v/s direction for the month of March 2016:

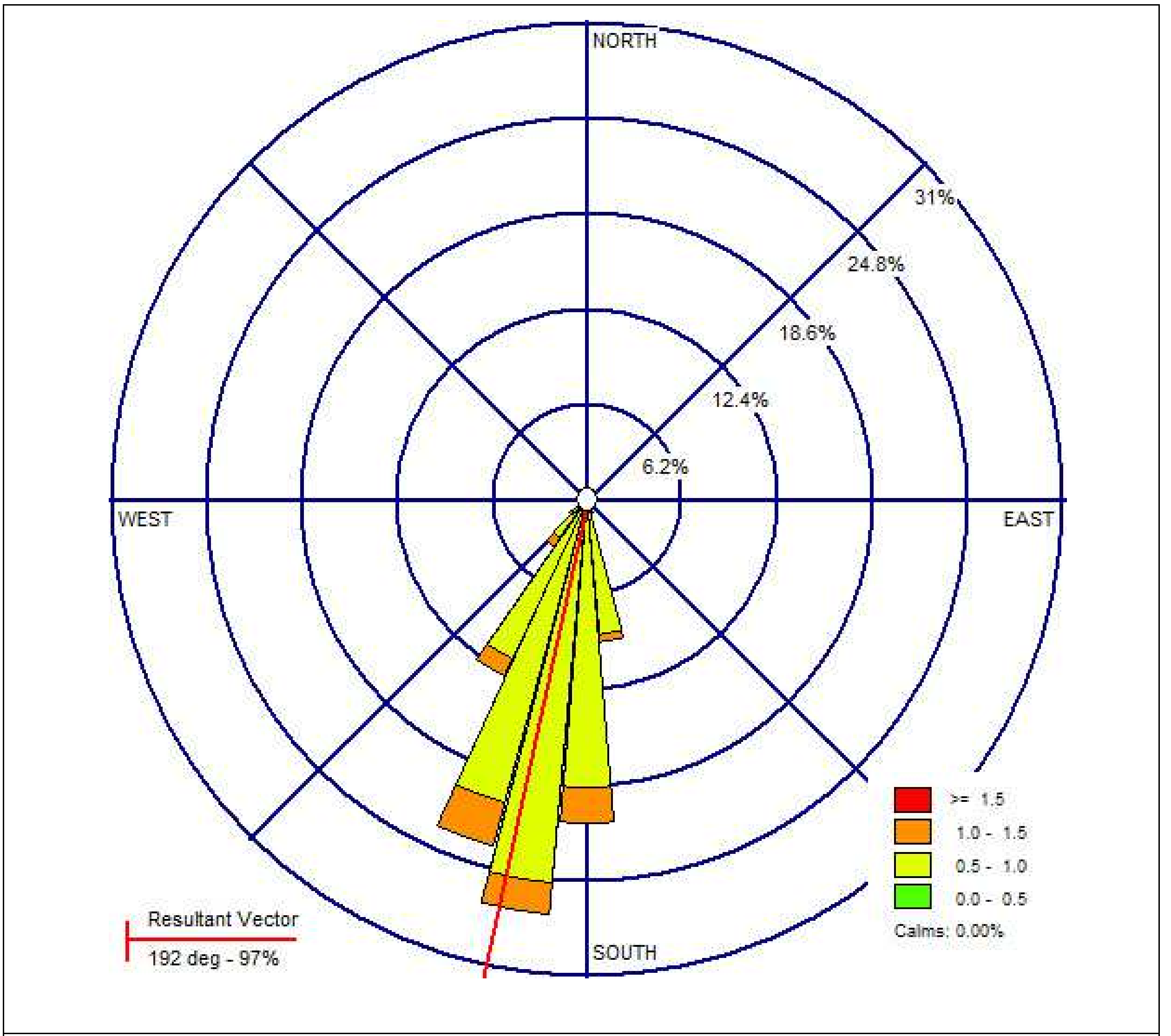


Figure 26 – Wave Rose (Hs in metre v/s Direction) during March 2016

The wave direction was south of south-westerly during the period with wave height more than 0.5m.

The frequency distribution table and histogram for the month is provided below:

FREQUENCY DISTRIBUTION				
Significant Wave Height (m)	H_s		H_{max}	
	No. of Observations	Percentage of Occurrence	No. of Observations	Percentage of Occurrence
0 - 0.5	0	0.0	0.00	0.00
0.5 – 1.0	1377	95.5	317.00	21.98
1.0 – 1.5	65	4.5	1022.00	70.87
1.5 – 2.0	0	0.0	102.00	7.07
2.0 – 2.5	0	0.0	1.00	0.07
> 1.4	0	0.0	0.00	0.00
Total	**1442**	**100**	**1442**	**100**

Table 10: Frequency Distribution of wave heights (March 2016)

The histogram of significant wave height during observation period of March 2016 is given below:

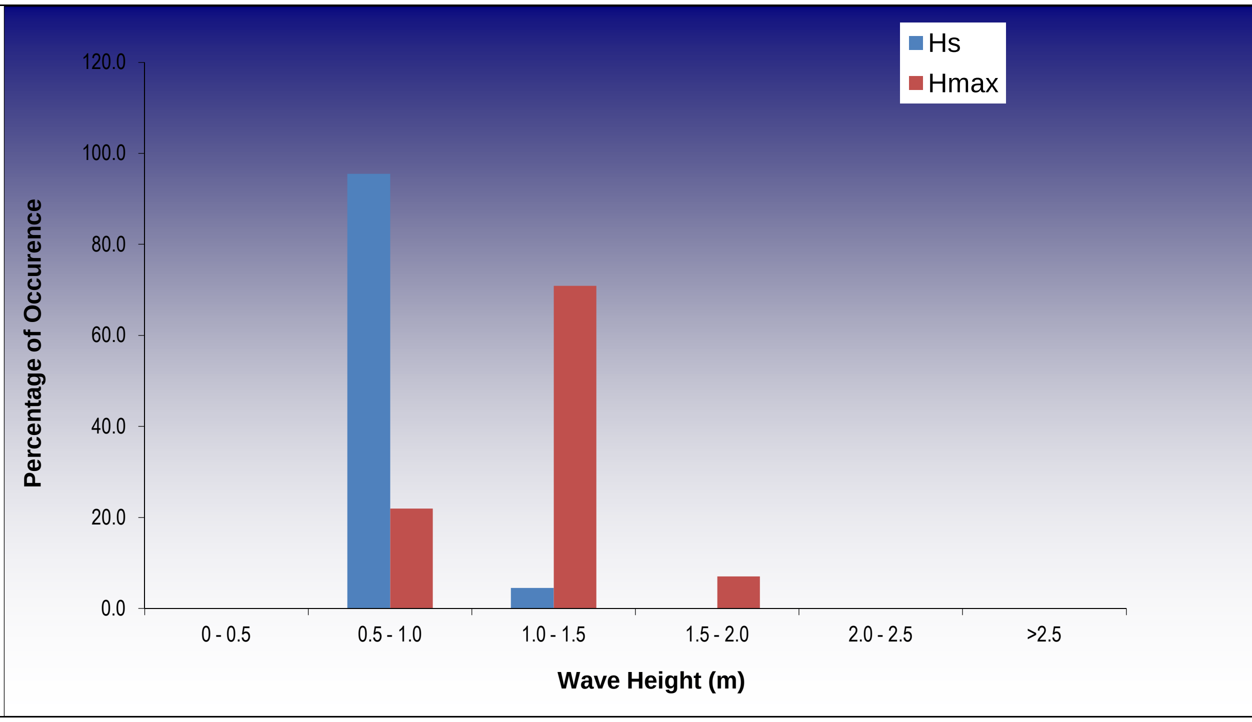


Figure 27 – Histogram of wave heights (March 2016)

As can be observed above, the significant wave height was more in the range of 0.5 to 1m in the month of March 2016.

The following image shows the wave rose drawn with respect to wave period V/s direction:

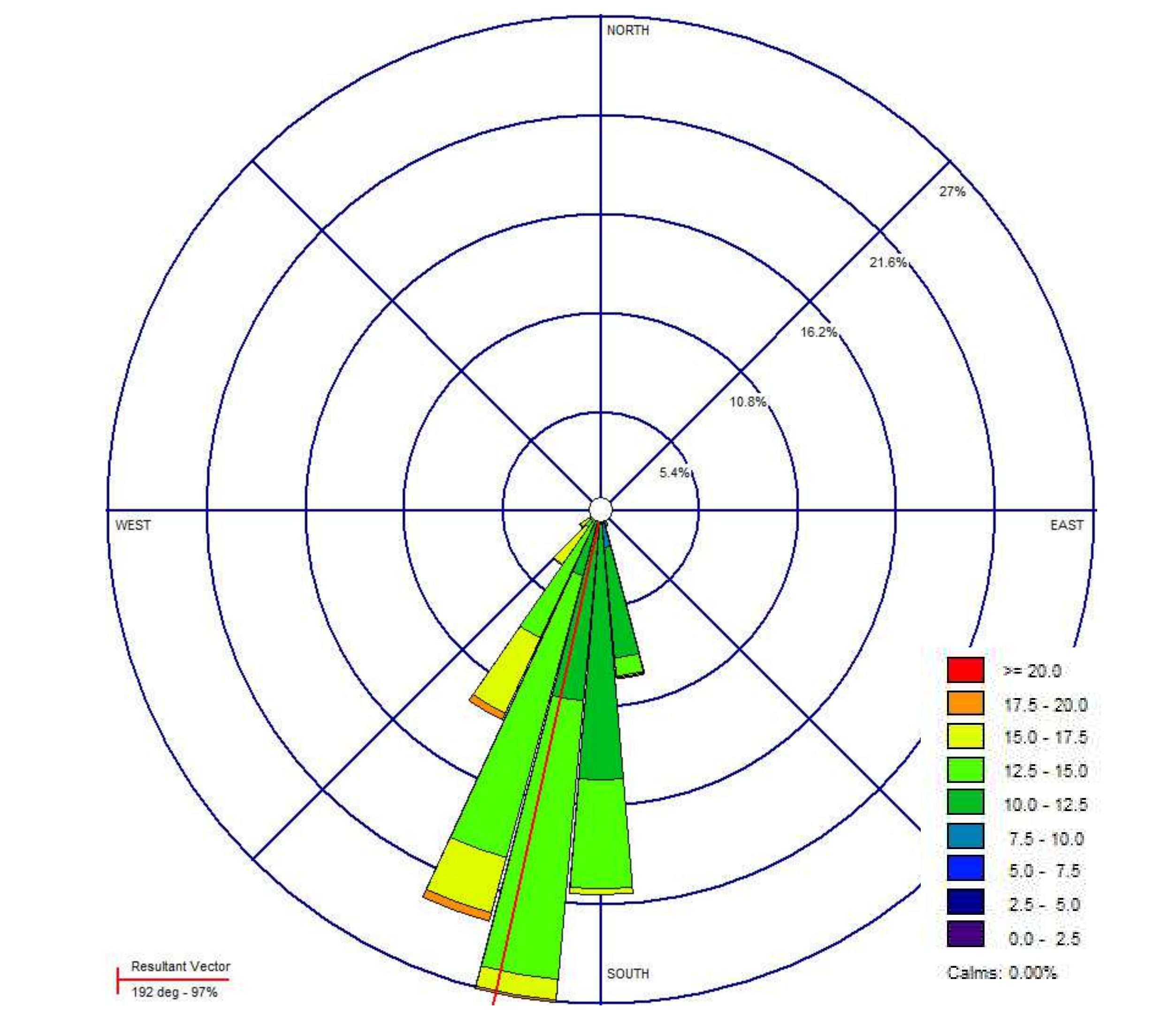


Figure 28 – Wave Rose (Tp in seconds v/s Direction) during March 2016

The histogram drawn for the wave period for March 2016 is given below:

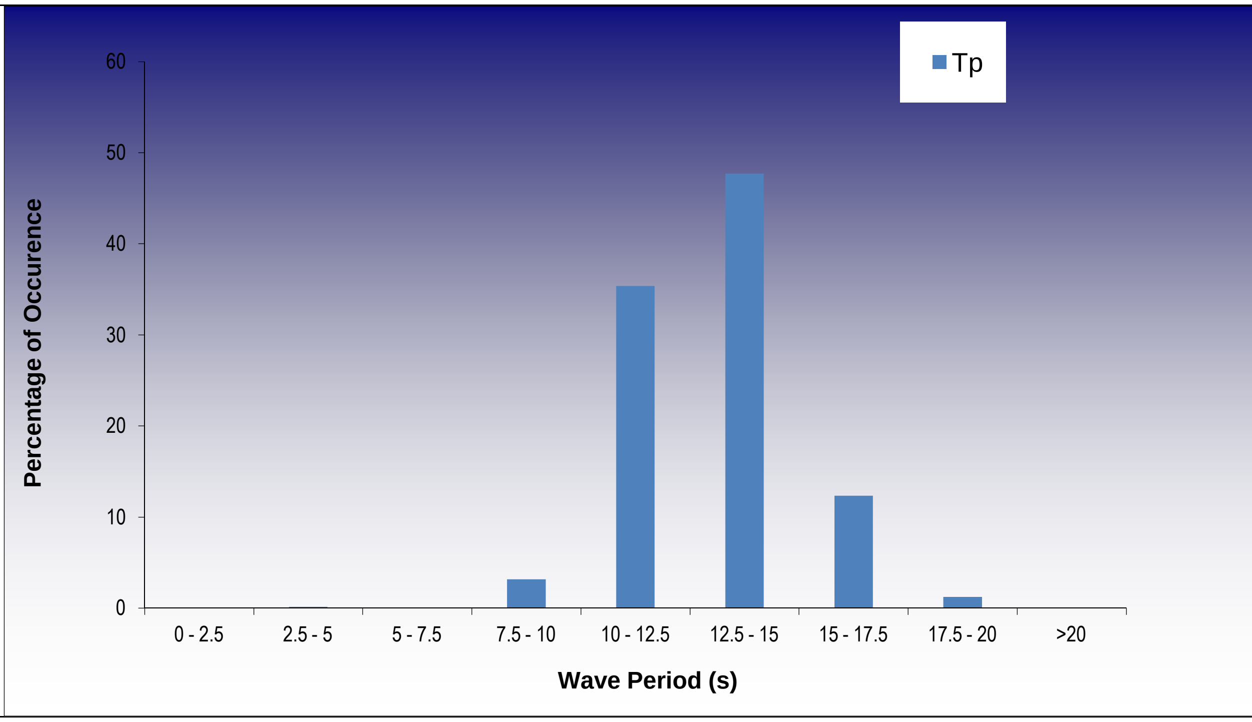


Figure 29 – Histogram of wave period (March 2016)

The above image indicates that during the month of February 2016, the wave period was in the range of 7 to 20 seconds, with the bulk of the wave periods in the range of 10 to 15 seconds.

Refer to the following rose plot of Hs v/s direction for the month of April 2016:

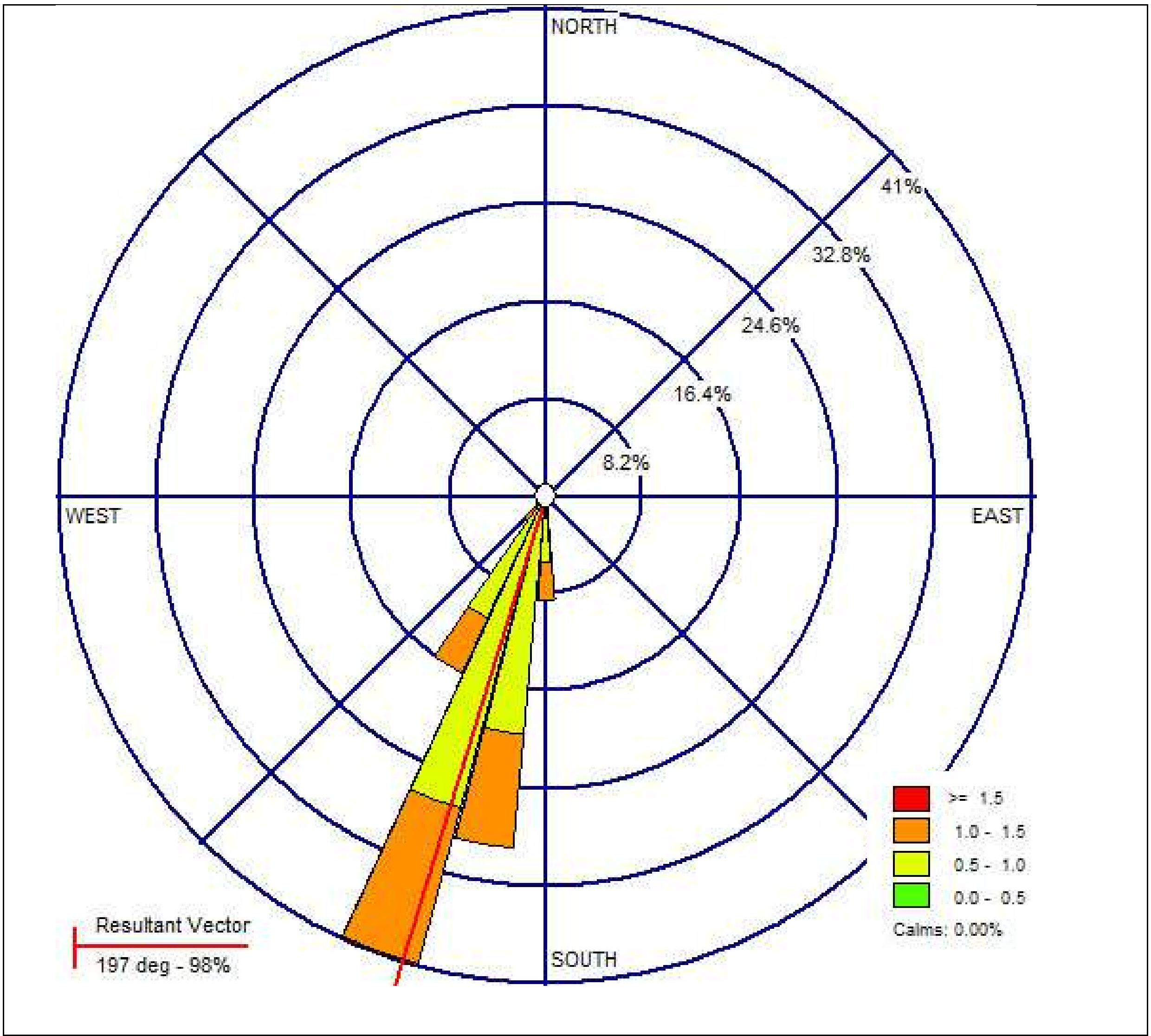


Figure 30 – Wave Rose (Hs in metre v/s Direction) during April 2016

The wave direction was south of south-westerly during the period with wave heights more than 0.5m.

The frequency distribution table and histogram for the month is provided below:

FREQUENCY DISTRIBUTION				
Significant Wave Height (m)	H_s		H_{max}	
	No. of Observations	Percentage of Occurrence	No. of Observations	Percentage of Occurrence
0 - 0.5	1	0.1	0.00	0.00
0.5 – 1.0	1065	74.2	151.00	10.49
1.0 – 1.5	367	25.6	866.00	60.14
1.5 – 2.0	2	0.1	387.00	26.88
2.0 – 2.5	0	0.0	32.00	2.22
> 1.4	0	0.0	4.00	0.28
Total	**1435**	**100**	**1440**	**100**

Table 11: Frequency Distribution of wave heights (April 2016)

The histogram of significant wave height during observation period of April 2016 is given below:

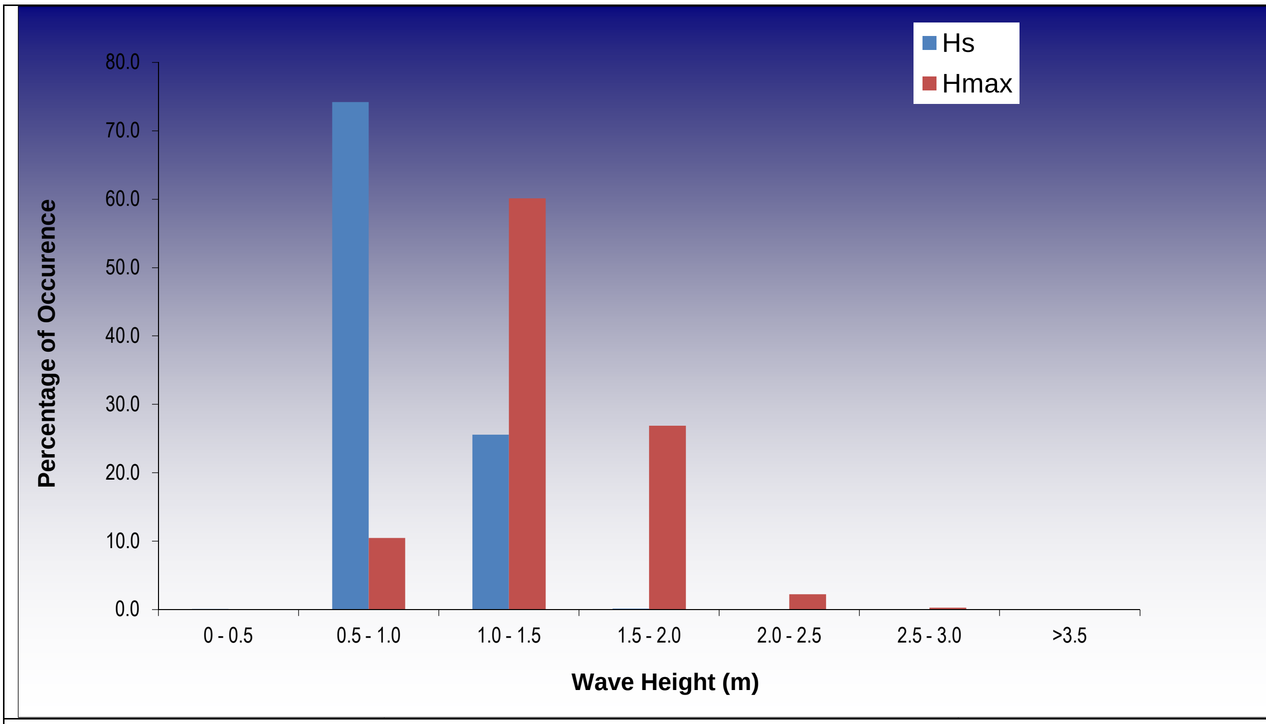


Figure 31 – Histogram of wave heights (April 2016)

As can be observed above, the significant wave height was more in the range of 0.5 to 1m in the month of April 2016.

The following image shows the wave rose drawn with respect to wave period V/s direction:

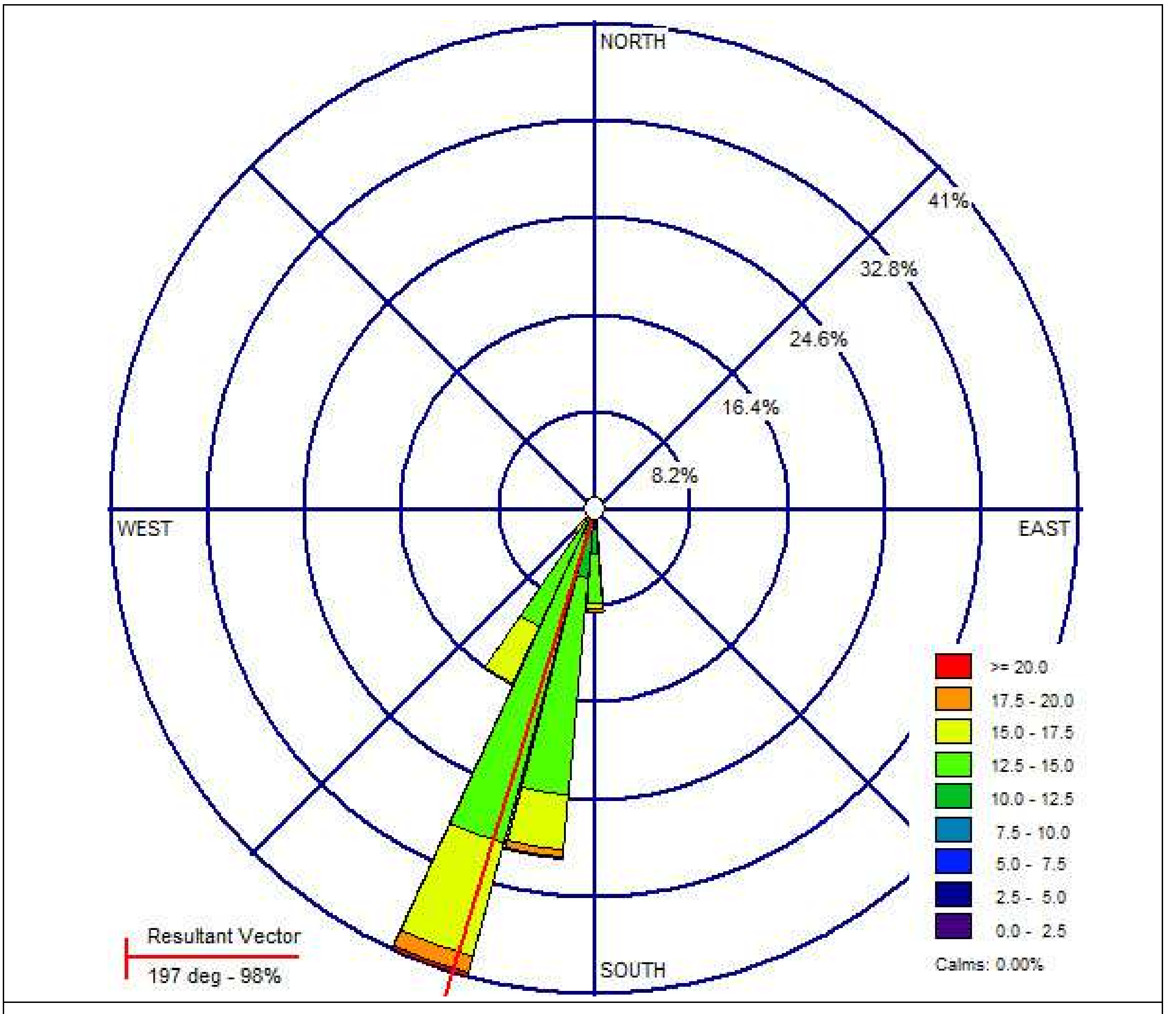


Figure 32 – Wave Rose (Tp in seconds v/s Direction) during April 2016

The histogram drawn for the wave period for April 2016 is given below:

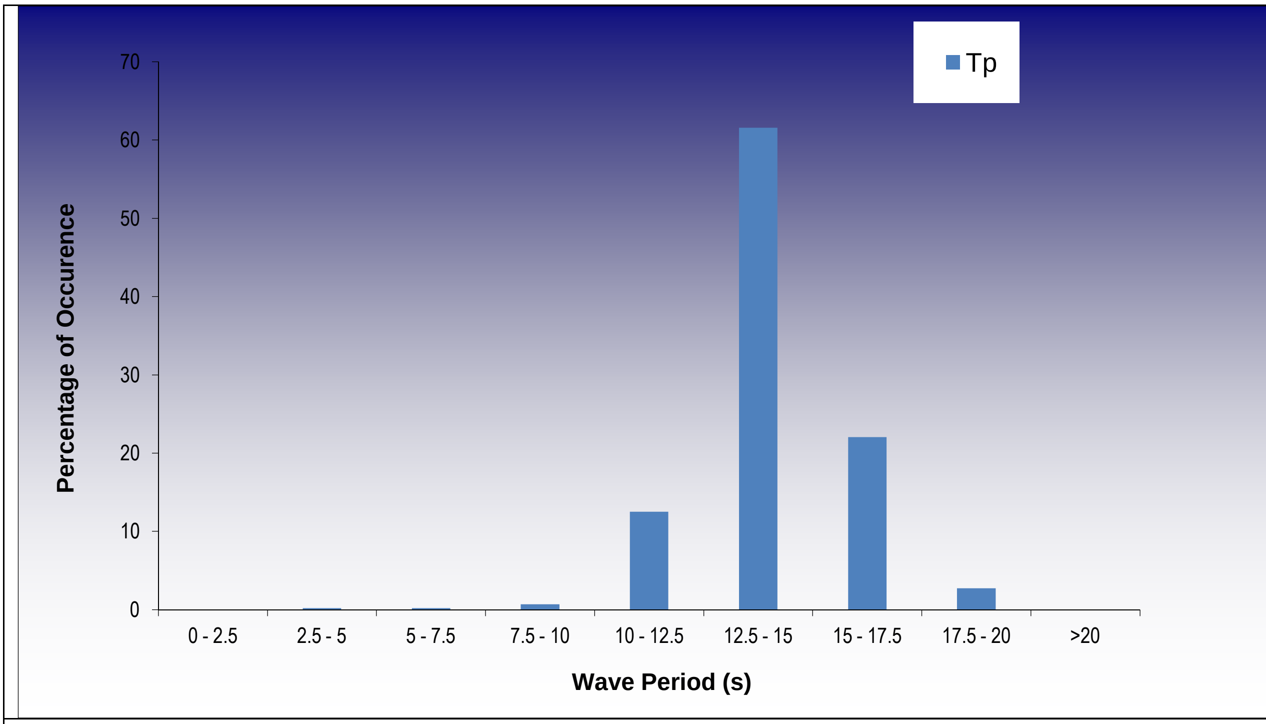


Figure 33 – Histogram of wave period (April 2016)

The above image indicates that during the month of April 2016, the wave period was in the range of 7.5 to 20 seconds, with 85% of the observations indicating long waves with a period of 12.5 to 20 seconds.

Refer to the following rose plot of Hs v/s direction for the month of May 2016:

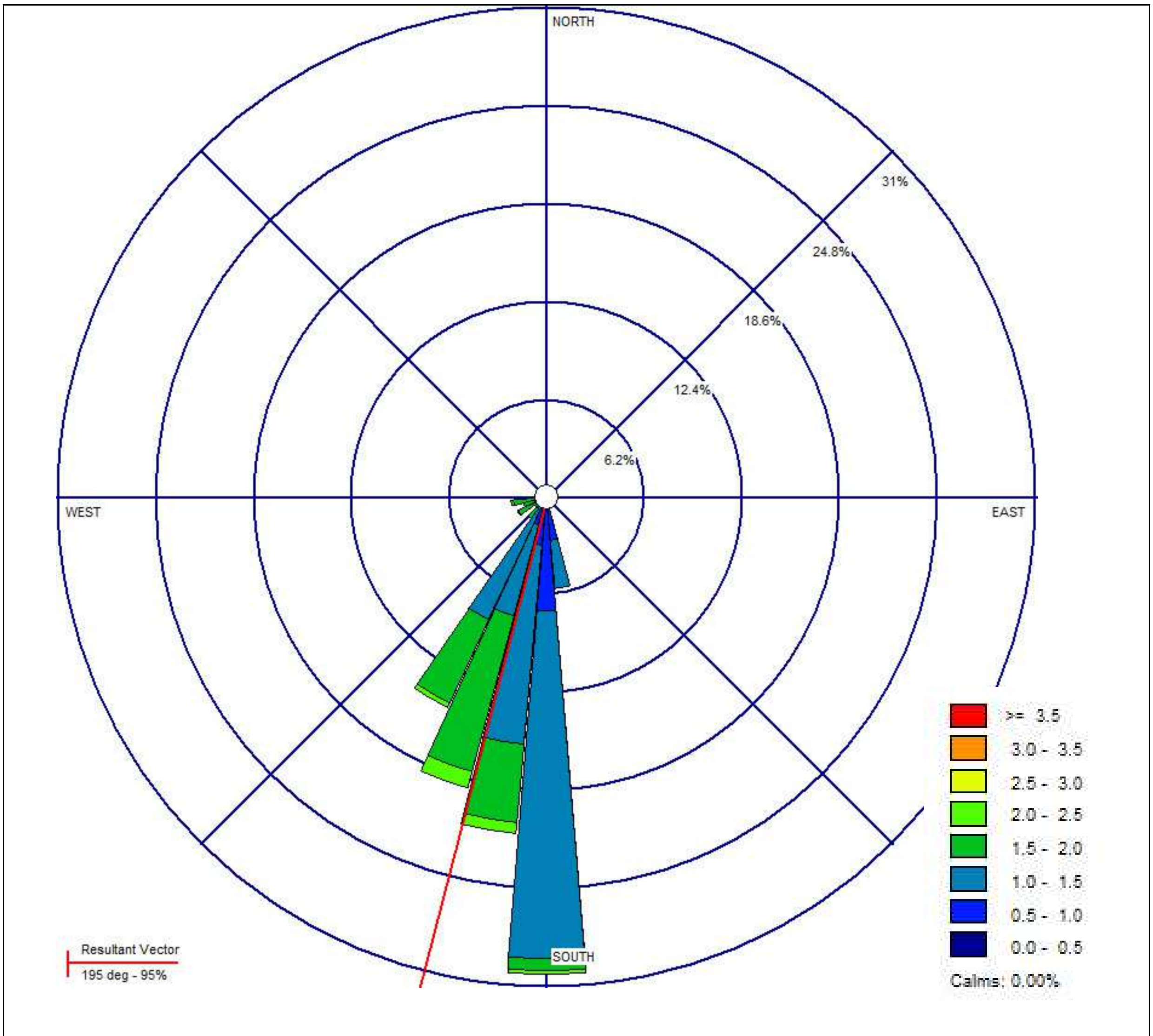


Figure 34 – Wave Rose (Hs in metre v/s Direction) during May 2016

The wave direction was southerly to south of south-westerly during the period with wave heights more than 0.5m.

A maximum significant wave height of 2.27m was measured on 20th May 2016 at 03:45 hours.

The frequency distribution table and histogram for the month is provided below:

FREQUENCY DISTRIBUTION				
Significant Wave Height (m)	H_s		H_{max}	
	No. of Observations	Percentage of Occurrence	No. of Observations	Percentage of Occurrence
0 - 0.5	0	0.00	0	0.00
0.5 - 1.0	237	22.44	3	0.28
1.0 - 1.5	493	46.69	236	21.95
1.5 - 2.0	312	29.55	414	38.51
2.0 - 2.5	14	1.33	173	16.09
2.5 - 3.0	0	0.00	202	18.79
3.0 - 3.5	0	0.00	42	3.91
> 3.5	0	0.00	5	0.47
Total	**1056**	**100**	**1075**	**100**

Table 12: Frequency Distribution of wave heights (May 2016)

The histogram of significant wave height during observation period of May 2016 is given below:

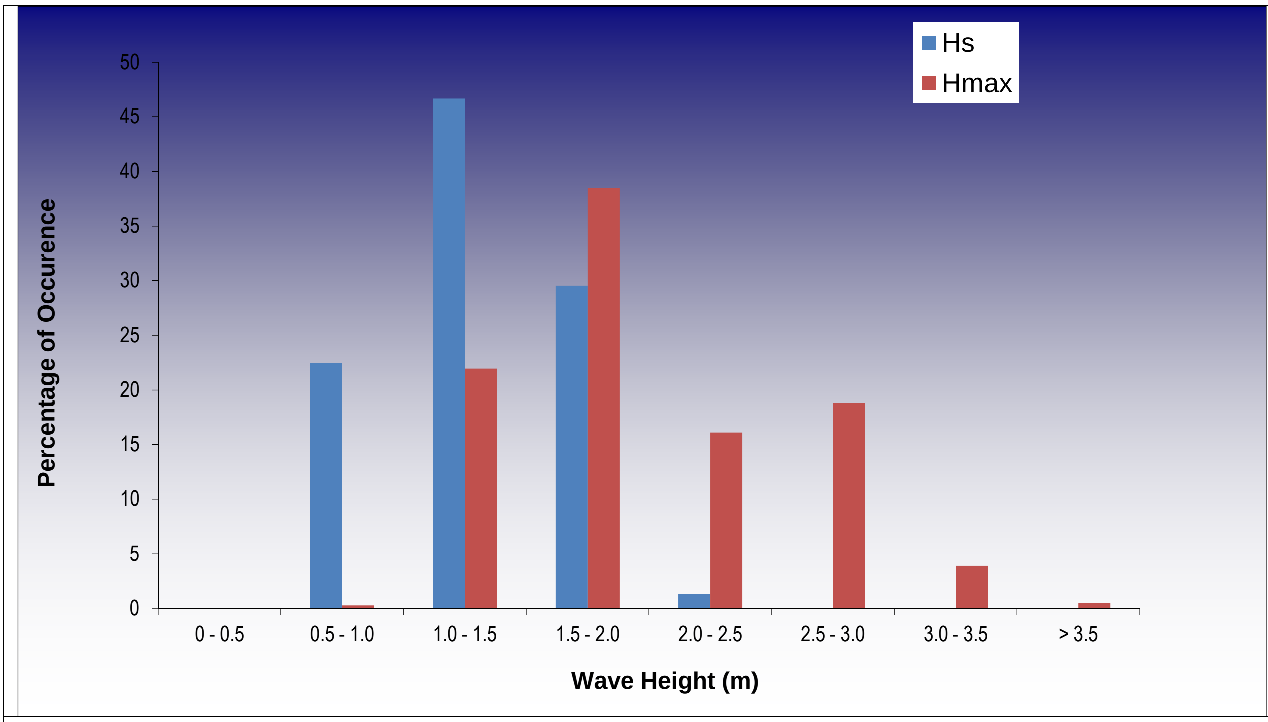


Figure 35 – Histogram of wave heights (May 2016)

As can be observed above, the significant wave height was more in the range of 0.5 to 1.5m in the month of May 2016 indicating the monsoonal waves.

The following image shows the wave rose drawn with respect to wave period V/s direction:

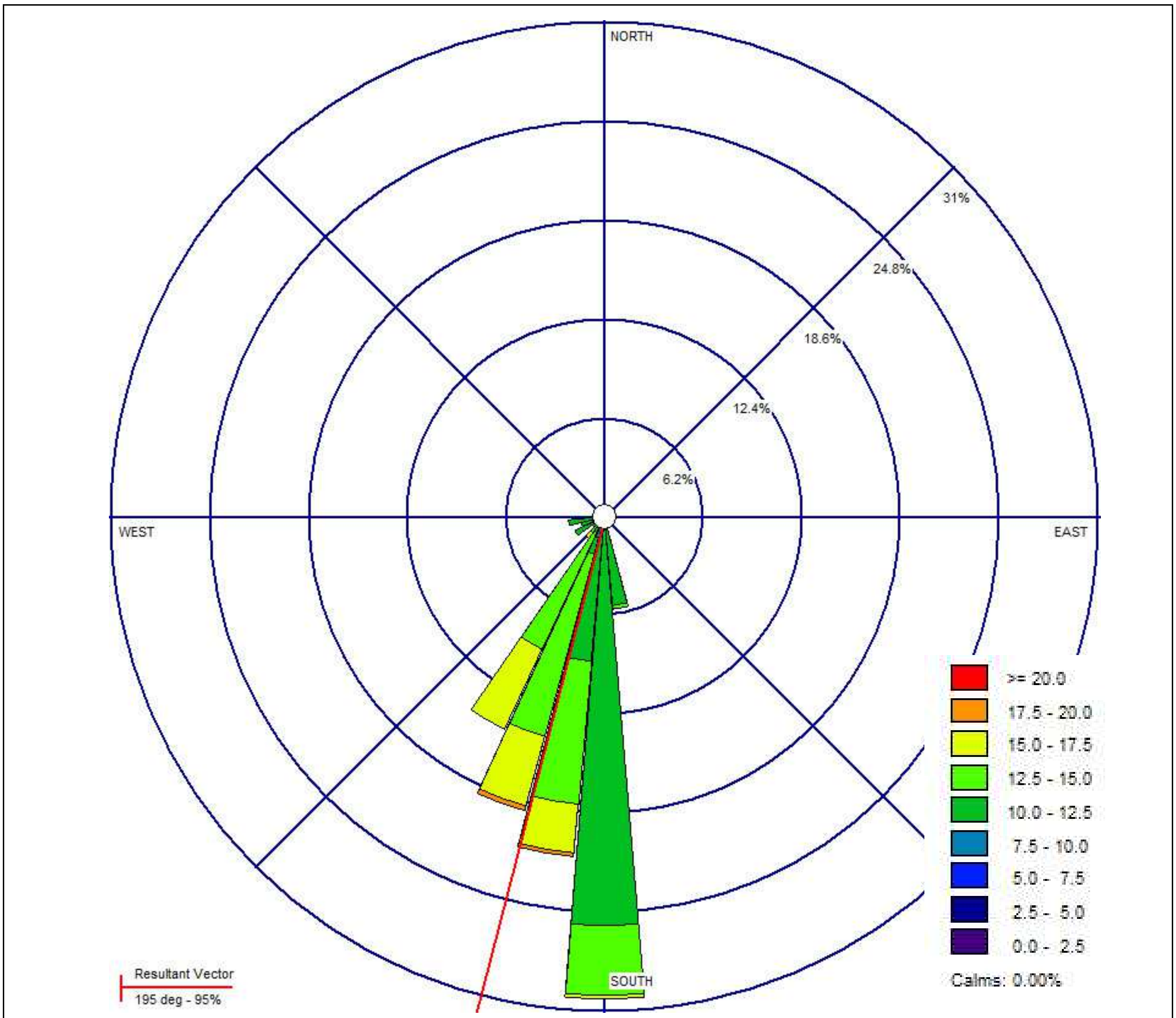


Figure 36 – Wave Rose (Tp in seconds v/s Direction) during May 2016

The histogram drawn for Wave period for May 2016 is given below:

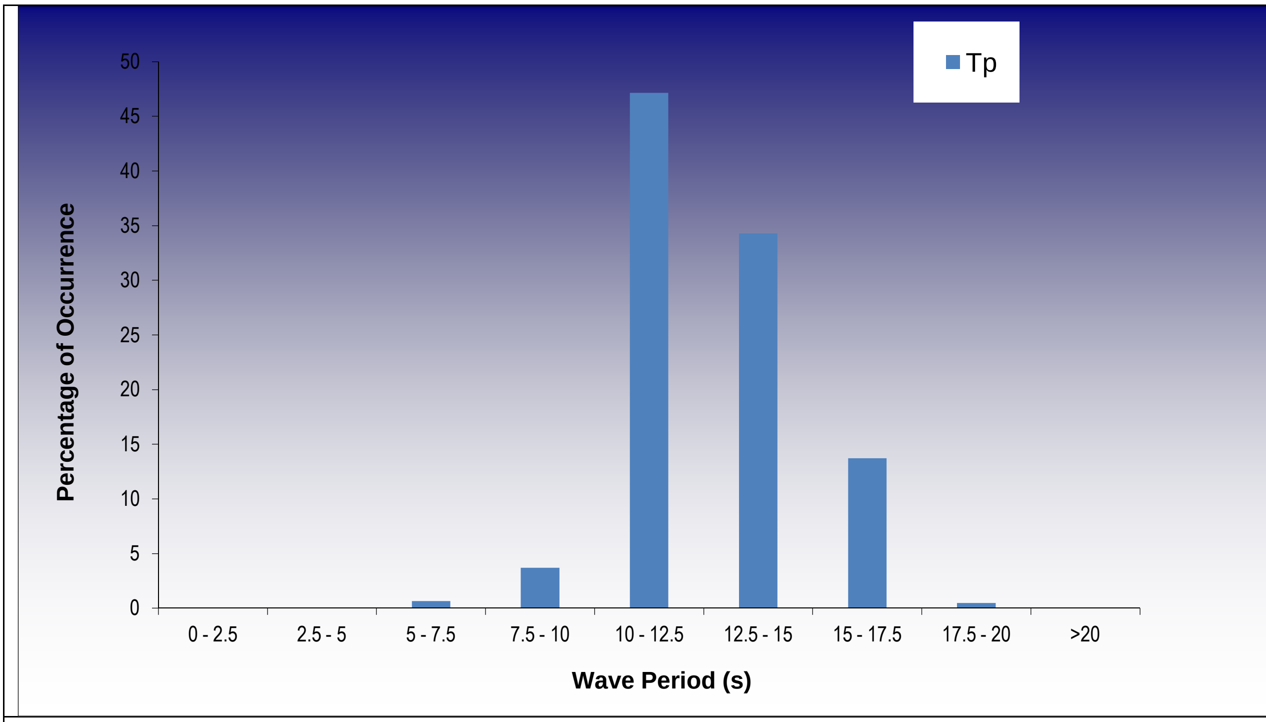


Figure 37 – Histogram of wave period (May 2016)

The above image indicates that during the month of May 2016, the wave period was in the range of 7.5 to 20 seconds, with 48% of the observations indicating long waves with a period of 12.5 to 20 seconds.

The time series graph for the month is provided in Annexure II.

6.4 Measurement of Meteorological Parameters

The data for the each month was downloaded and after quality control checks the data is presented below:

The wind rose for the month of Feb 2016 is provided below:

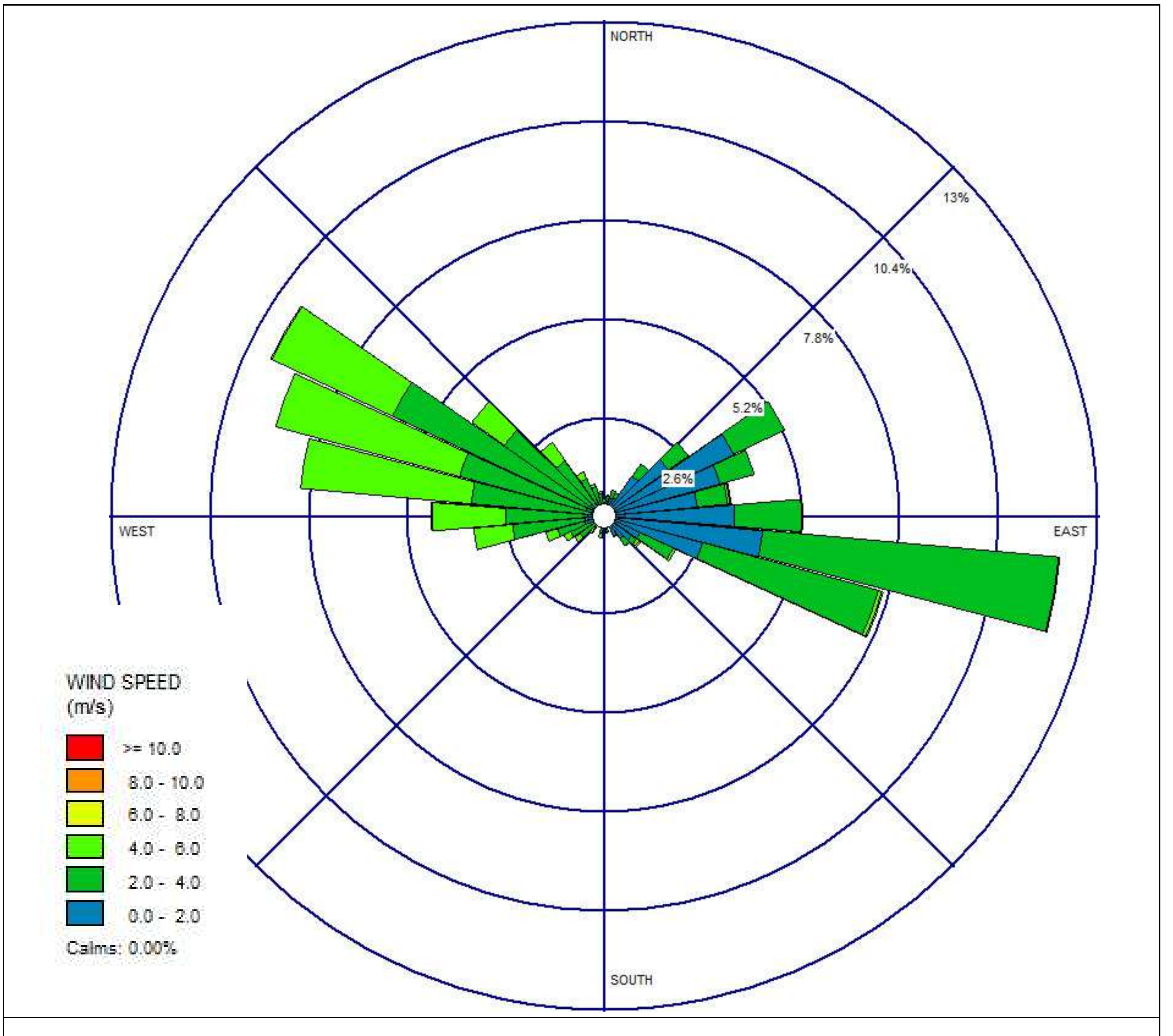


Figure 38 – Wind Rose (Speed in m/s v/s Direction) during February 2016

The rose plot reveals a westerly to north westerly winds greater than 4 m/s. The wind from easterly direction showed a less speed of less than 4 m/s.

The frequency distribution table for wind speed for the month drawn for the reduced level (10m above MSL) is given below:

Frequency Distribution		
Wind Speed (m/s)	**No. of observations**	**Percentage of Occurrence**
0 – 2	1287	34.43
2 - 4	1717	45.93
4 – 6	724	19.37
6 – 8	10	0.27
8 -10	0	0
>10	0	0
Total	**3738**	**100**

Table 13: Frequency Distribution of wind speed (February 2016)

The histogram of wind speed for the month of February 2016 is given below:

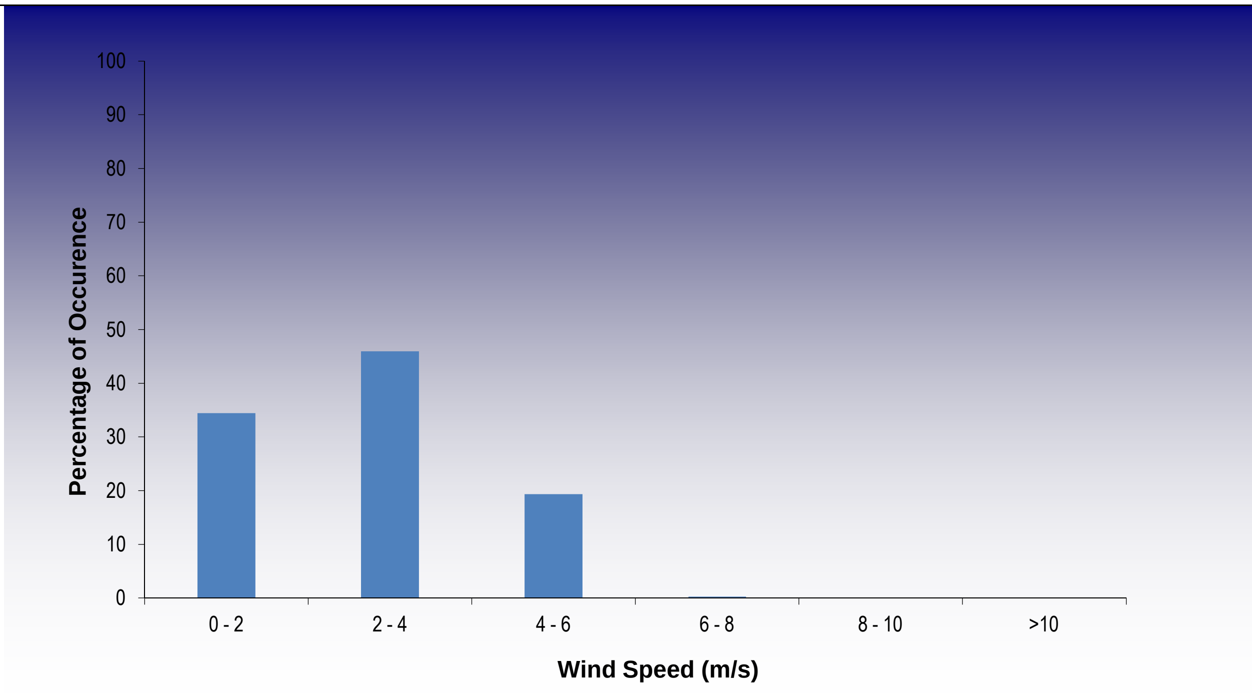


Figure 39 – Histogram of wind speed (February 2016)

As can be seen from the above images, the wind speed was from 0 to 6 m/s. The winds blowing from the sea has shown a greater magnitude than that blowing from land. The maximum wind speed attained during February 2016 period (estimated speed at 10m above ground) was 6.96 m/s on 20th February 2016.

The percentage occurrence table drawn for atmospheric pressure, temperature and relative humidity is presented below:

Frequency Distribution		
Atm Pressure	**No. of observations**	**Percentage of Occurrence**
<1000	0	0
1000-1004	0	0
1004 – 1008	1242	33.3
> 1008	2491	66.7
Total	**3733**	**100**
Temperature	**No. of observations**	**Percentage of Occurrence**
20-24	198	5.3
24-28	1614	43.2
28-32	1888	50.6
>32	33	0.88
Total	**3733**	**100**
RH	**No. of observations**	**Percentage of Occurrence**
50-60	52	1.4
60-70	163	4.4
70-80	604	1.2
>80	2914	78.1
Total	**3733**	**100**

Table 14: Frequency Distribution of met parameters (February 2016)

The histogram drawn for the parameters above for the month of February 2016 is shown below:

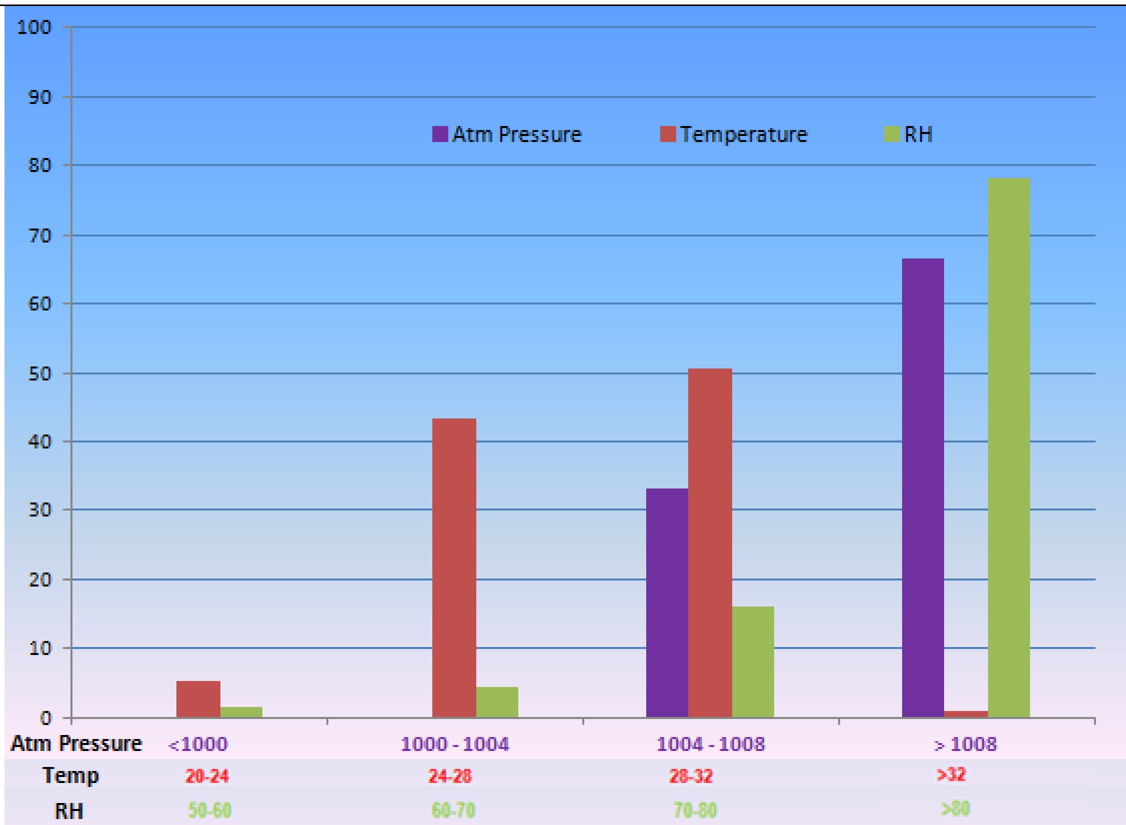


Figure 40 – Histogram of met parameters (February 2016)

The data represented above reveals that 100% of the observations, the atmospheric pressure was above 1004 mb. The temperature hovered around 20 to 32°C and the relative humidity was more than 80% during the bulk of the observations.

The wind rose for the month of March 2016 is provided below:

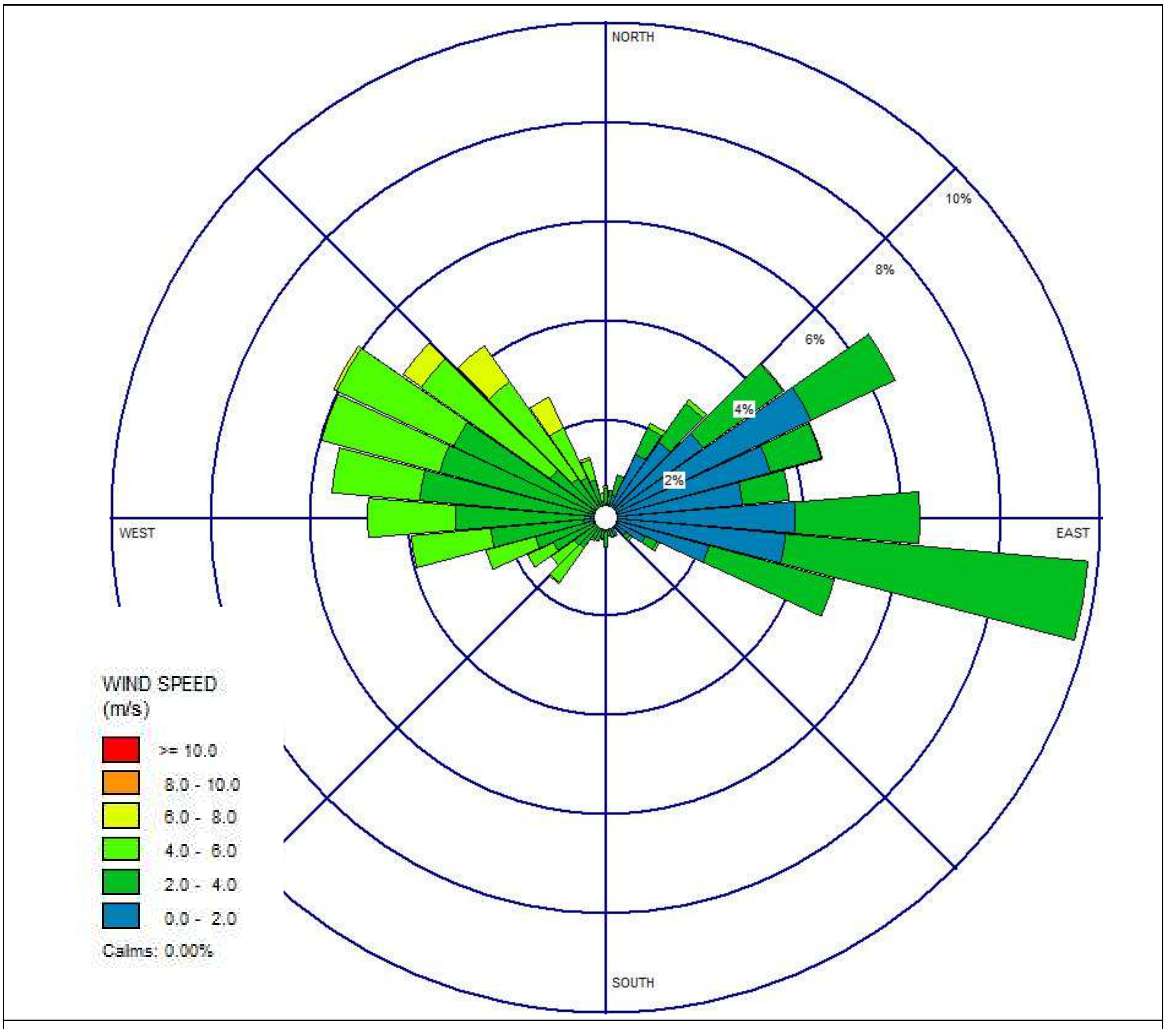


Figure 41 – Wind Rose (Speed in m/s v/s Direction) during March 2016

The rose plot reveals a strong westerly to north westerly winds compared to winds from the other quadrants.

The frequency distribution table for wind speed for the month drawn for the reduced level (10m above MSL) is given below:

Frequency Distribution		
Wind Speed (m/s)	**No. of observations**	**Percentage of Occurrence**
0 – 2	1451	32.50
2 - 4	1972	44.18
4 – 6	942	21.10
6 – 8	98	2.20
8 -10	1	0.02
>10	0	0
Total	**4464**	**100**

Table 15: Frequency Distribution of wind speed (March 2016)

The histogram of wind speed for the month of March 2016 is given below:

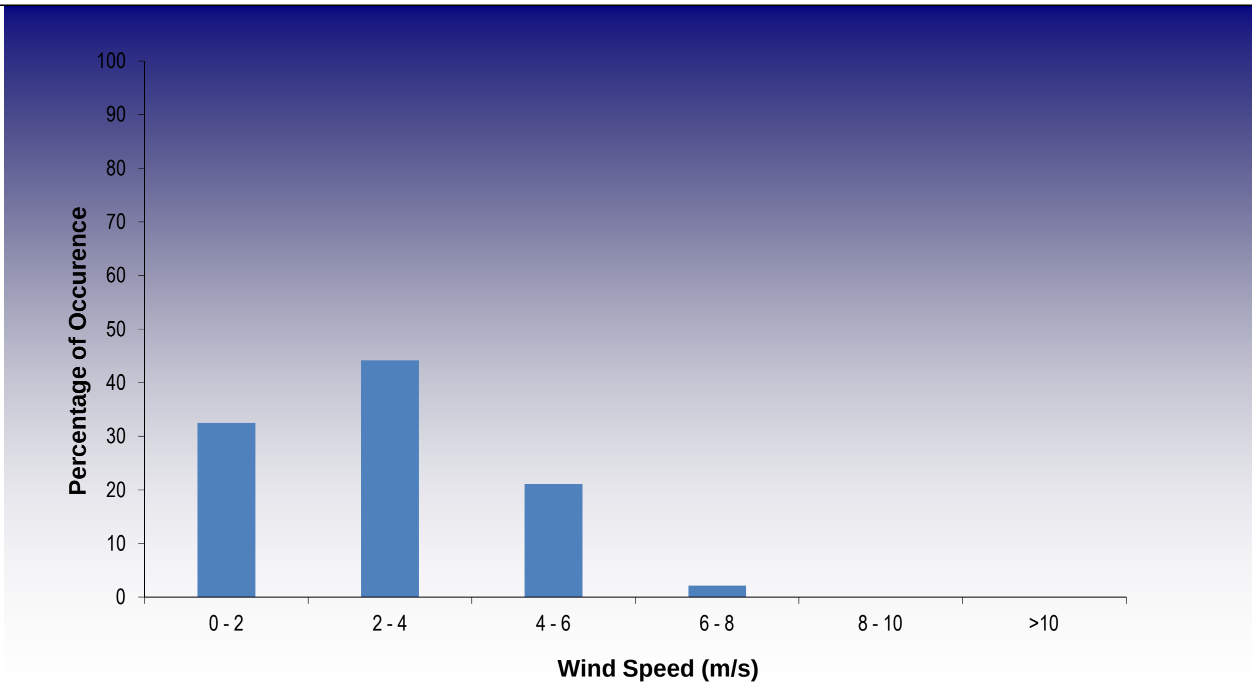


Figure 42 – Histogram of wind speed (March 2016)

As can be seen from the above images, the wind speed was from 0 to 8 m/s. The winds blowing from the sea has shown a greater magnitude than that blowing from land. The maximum wind speed attained during March 2016 period (estimated speed at 10m above ground) was 8.24 m/s on 29th March 2016.

The percentage occurrence table drawn for atmospheric pressure, temperature and relative humidity is presented below:

Frequency Distribution		
Atm Pressure	**No. of observations**	**Percentage of Occurrence**
<1000	0	0
1000-1004	0	0
1004 – 1008	2064	46.2
> 1008	2399	53.8
Total	**4463**	**100**
Temperature	**No. of observations**	**Percentage of Occurrence**
20-24	5	0.1
24-28	1538	34.5
28-32	2912	65.2
>32	8	0.18
Total	**4463**	**100**
RH	**No. of observations**	**Percentage of Occurrence**
50-60	7	0.2
60-70	11	2.6
70-80	402	9.0
>80	3938	88.2
Total	**4463**	**100**

Table 16: Frequency Distribution of met parameters (March 2016)

The histogram drawn for the parameters above for the month of March 2016 is shown below:

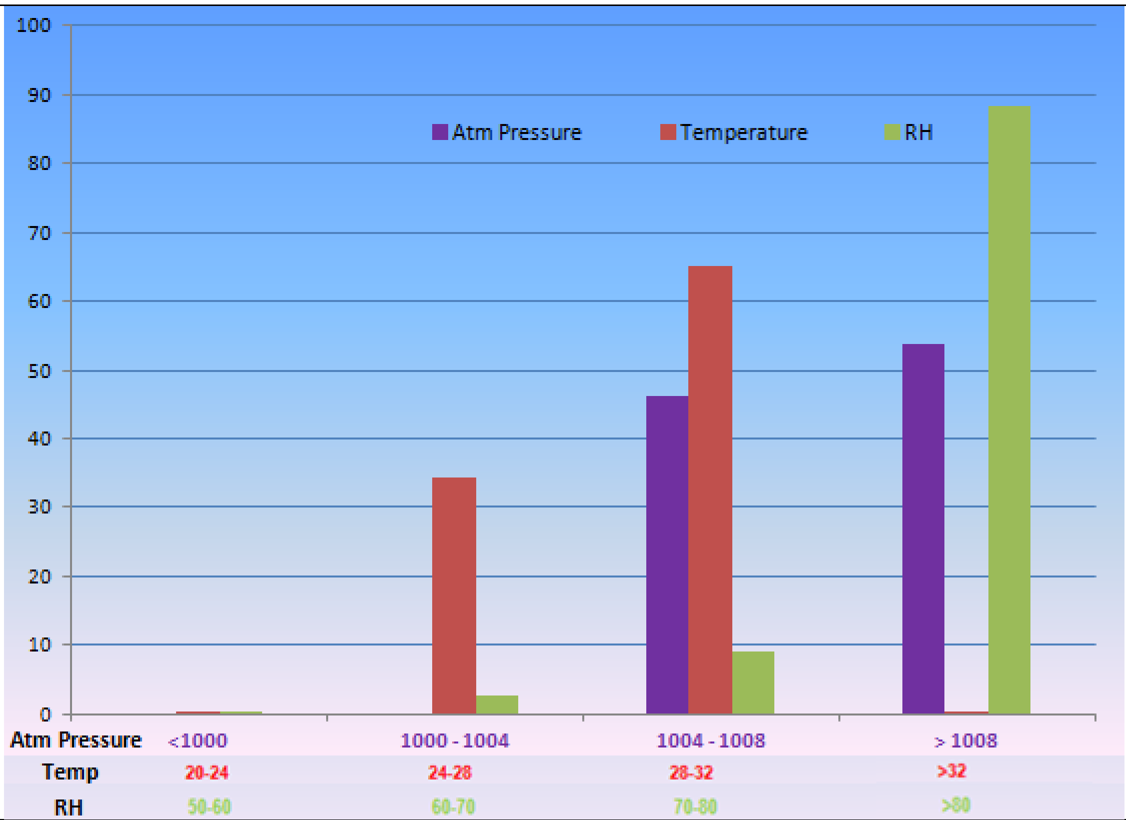


Figure 43 – Histogram of met parameters (March 2016)

The data represented above reveals that the atmospheric pressure was above 1004 mb throughout the observation period. The temperature hovered around 20 to 32°C and the relative humidity was more than 80% during the bulk of the observations.

The wind rose for the month of April 2016 is provided below:

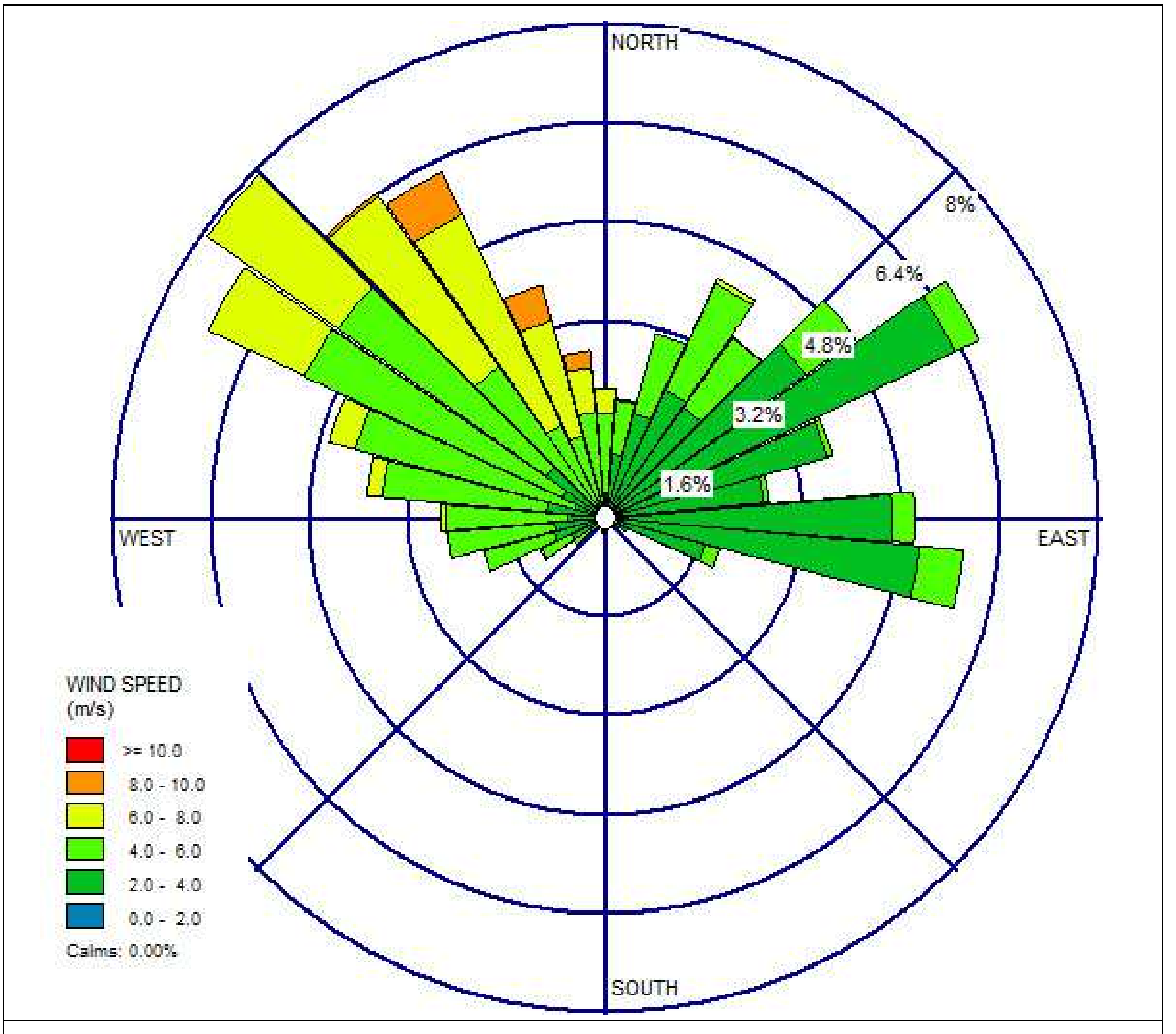


Figure 44 – Wind Rose (Speed in m/s v/s Direction) during April 2016

The rose plot reveals a westerly to north westerly winds greater than 4 m/s. The wind from easterly direction showed a speed of less than 4 m/s.

The frequency distribution table for wind speed for the month drawn for the reduced level (10m above MSL) is given below:

Frequency Distribution		
Wind Speed (m/s)	**No. of observations**	**Percentage of Occurrence**
0 – 2	1247	28.87
2 - 4	1765	40.86
4 – 6	974	22.55
6 – 8	293	6.78
8 -10	41	0.95
>10	0	0.00
Total	**4320**	**100**

Table 17: Frequency Distribution of wind speed (April 2016)

The histogram of wind speed for the month of April 2016 is given below:

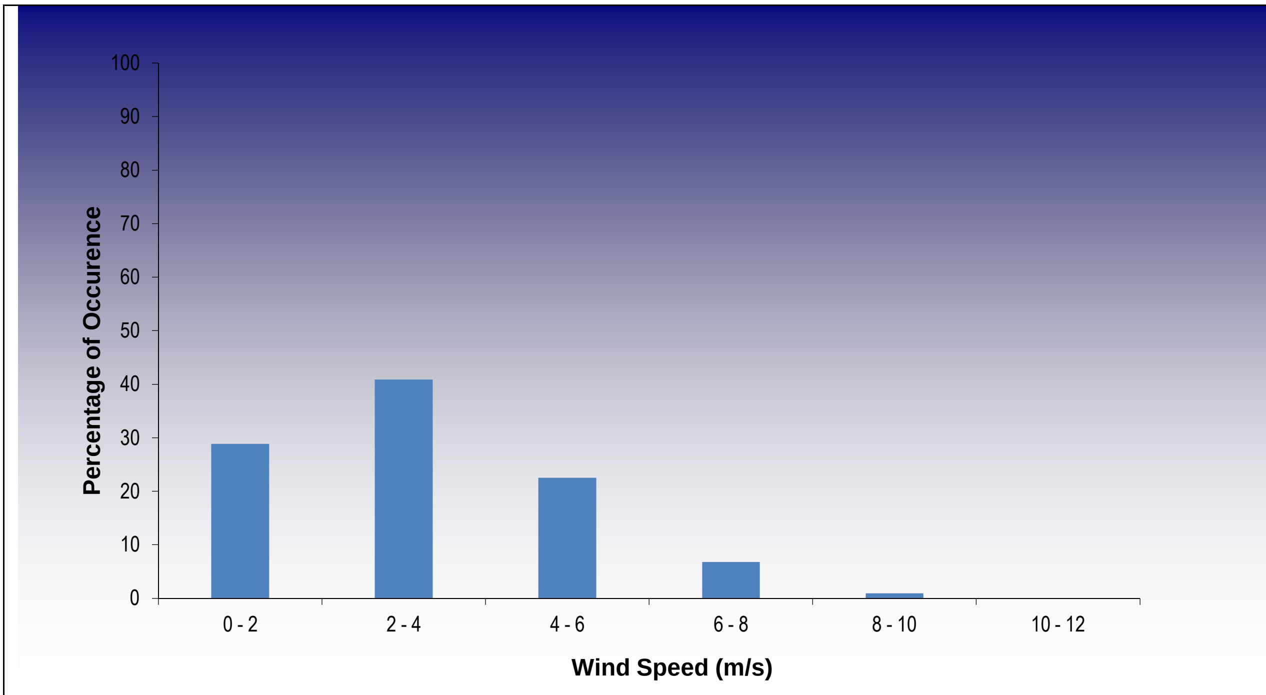


Figure 45 – Histogram of wind speed (April 2016)

As can be seen from the above images, the wind speed was from 0 to 10 m/s indicating the onset of monsoonal winds. The winds blowing from the sea has shown a greater magnitude than that blowing from land. The maximum wind speed attained during April 2016 period (estimated speed at 10m above ground) was 9.92 m/s on 22nd April 2016 at 1700 hrs.

The percentage occurrence table drawn for atmospheric pressure, temperature and relative humidity is presented below:

Frequency Distribution		
Atm Pressure	**No. of observations**	**Percentage of Occurrence**
<1000	0	0.0
1000-1004	487	11.3
1004 – 1008	3136	72.6
> 1008	697	16.1
Total	**4320**	**100**
Temperature	**No. of observations**	**Percentage of Occurrence**
20-24	0	0.0
24-28	708	16.4
28-32	3416	79.1
>32	196	4.54
Total	**4320**	**100**
RH	**No. of observations**	**Percentage of Occurrence**
50-60	0	0.0
60-70	1	0.0
70-80	271	6.3
>80	4048	93.7
Total	**4320**	**100**

Table 18: Frequency Distribution of Met parameters (April 2016)

The histogram drawn for the parameters above for the month of April 2016 is shown below:

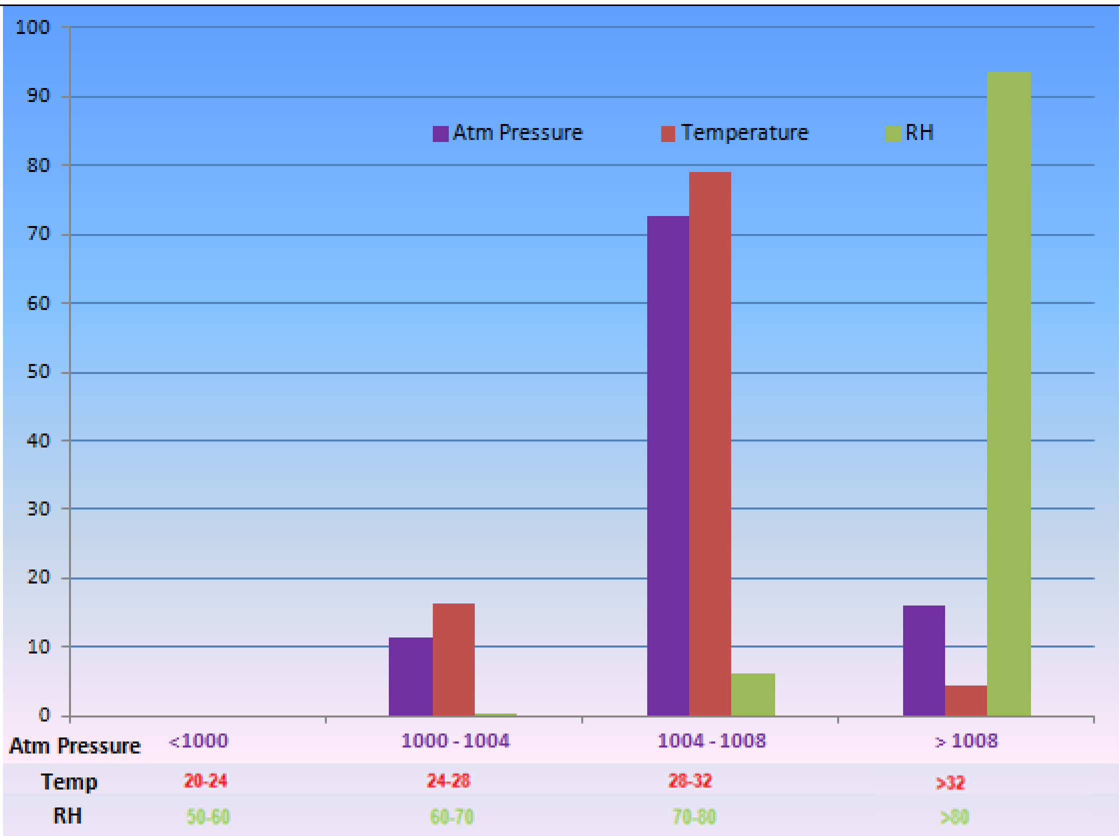


Figure 46 – Histogram of met parameters (April 2016)

The data represented above reveals that in 88.7% of the observations, the atmospheric pressure was above 1004 mb. The temperature hovered around 24 to 32°C and the relative humidity was more than 80% during the bulk of the observations.

The rainfall recorded for the period was 17.4mm.

The wind rose for the month of April 2016 is provided below:

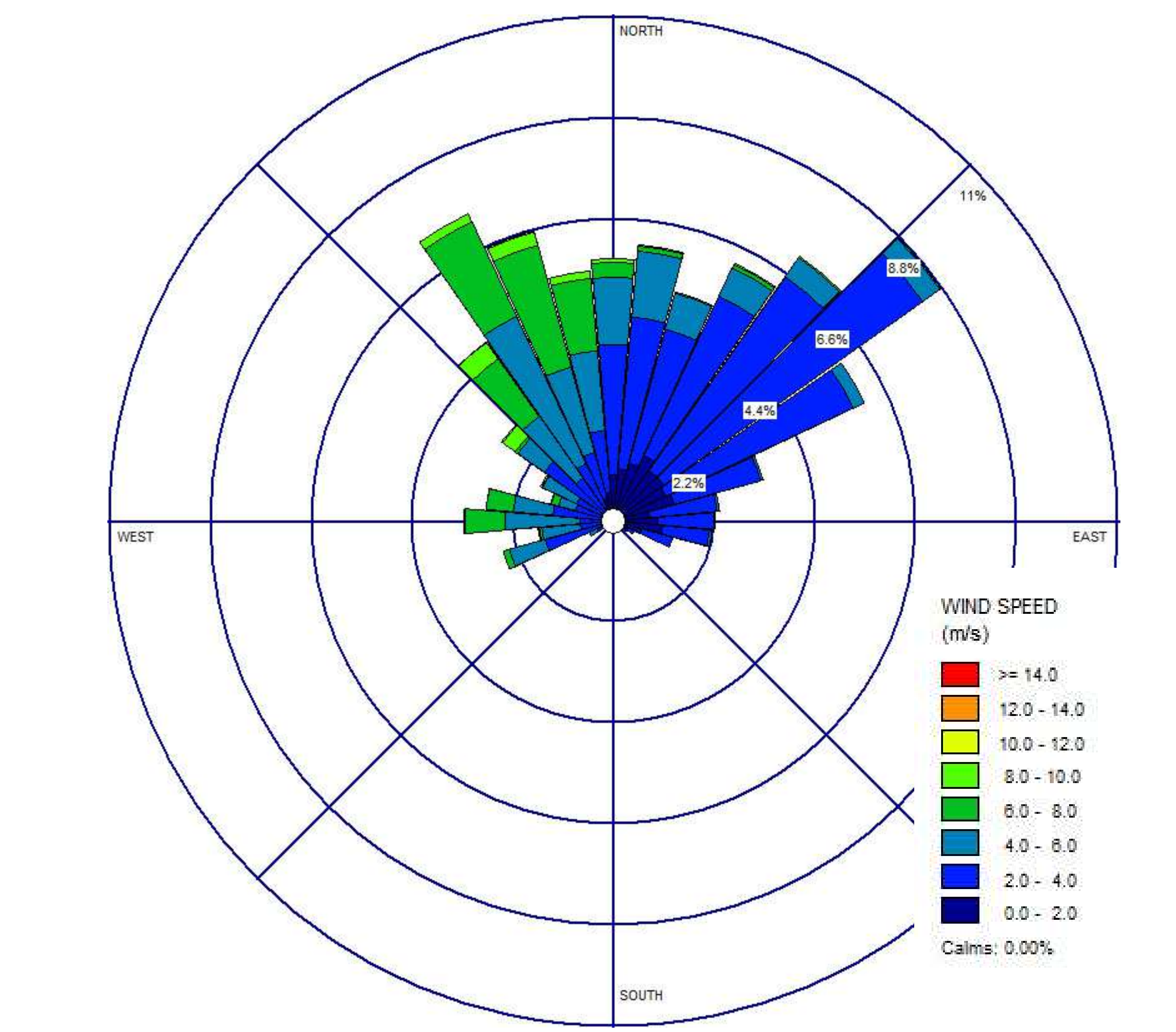


Figure 47 – Wind Rose (Speed in m/s v/s Direction) during May 2016

The rose plot reveals a westerly to north westerly winds greater than 4 m/s. The wind from north-easterly direction showed a speed of less than 4 m/s.

The frequency distribution table for wind speed for the month drawn for the reduced level (10m above MSL) is given below:

Frequency Distribution		
Wind Speed (m/s)	**No. of observations**	**Percentage of Occurrence**
0 – 2	824	18.80
2 - 4	2098	47.88
4 – 6	927	21.15
6 – 8	454	10.36
8 -10	72	1.64
>10	7	0.16
Total	**4382**	**100**

Table 19: Frequency Distribution of wind speed (May 2016)

The histogram of wind speed for the month of May 2016 is given below:

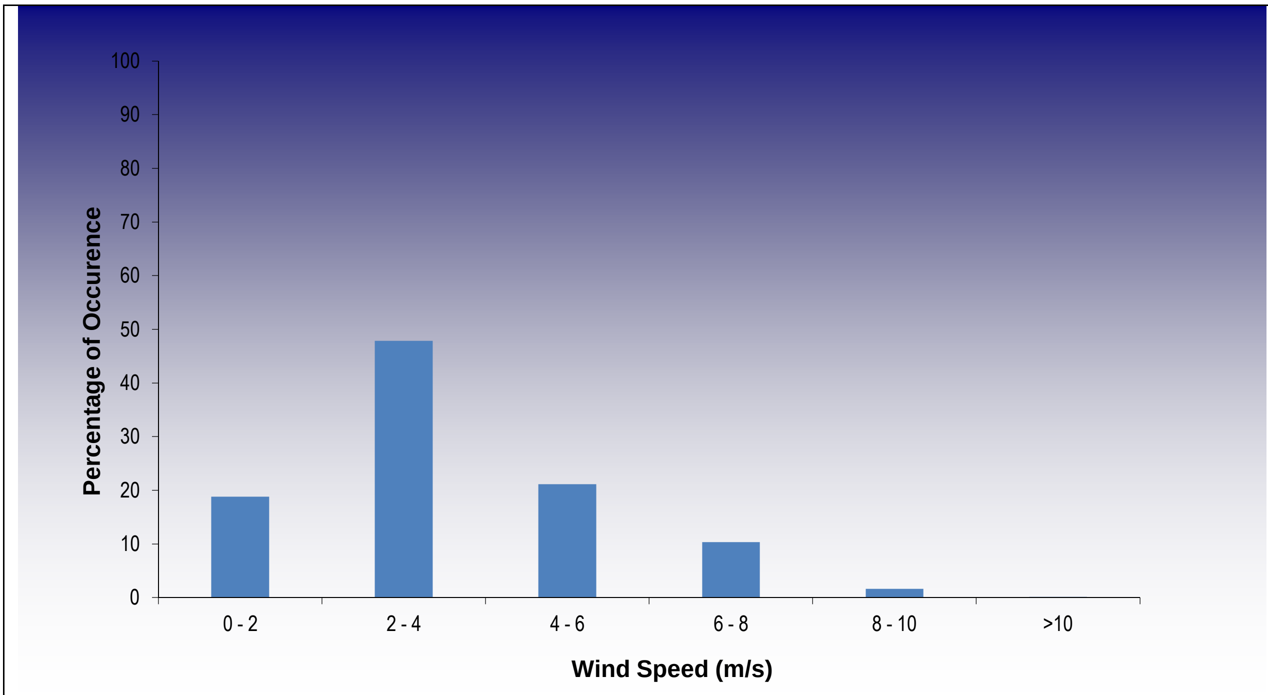


Figure 48 – Histogram of wind speed (May 2016)

As can be seen from the above images, the wind speed was from 0 to 10 m/s indicating the onset of westerly monsoonal winds. The winds blowing from the sea has shown a greater magnitude than that blowing from land. The maximum wind speed attained during May 2016 period (estimated speed at 10m above ground) was 12.93 m/s on 19th May 2016 at 22:00 hrs.

The percentage occurrence table drawn for atmospheric pressure, temperature and relative humidity is presented below:

Frequency Distribution		
Atm Pressure	**No. of observations**	**Percentage of Occurrence**
<1000	12	0.3
1000-1004	882	20.1
1004 – 1008	3297	75.2
> 1008	191	4.4
Total	**4382**	**100**
Temperature	**No. of observations**	**Percentage of Occurrence**
20-24	77	1.8
24-28	1967	44.9
28-32	2274	51.9
>32	64	1.46
Total	**4382**	**100**
RH	**No. of observations**	**Percentage of Occurrence**
50-60	0	0.0
60-70	0	0.0
70-80	112	2.6
>80	4270	97.4
Total	**4382**	**100**

Table 20: Frequency Distribution of Met parameters (May 2016)

The histogram drawn for the parameters above for the month of May 2016 is shown below:

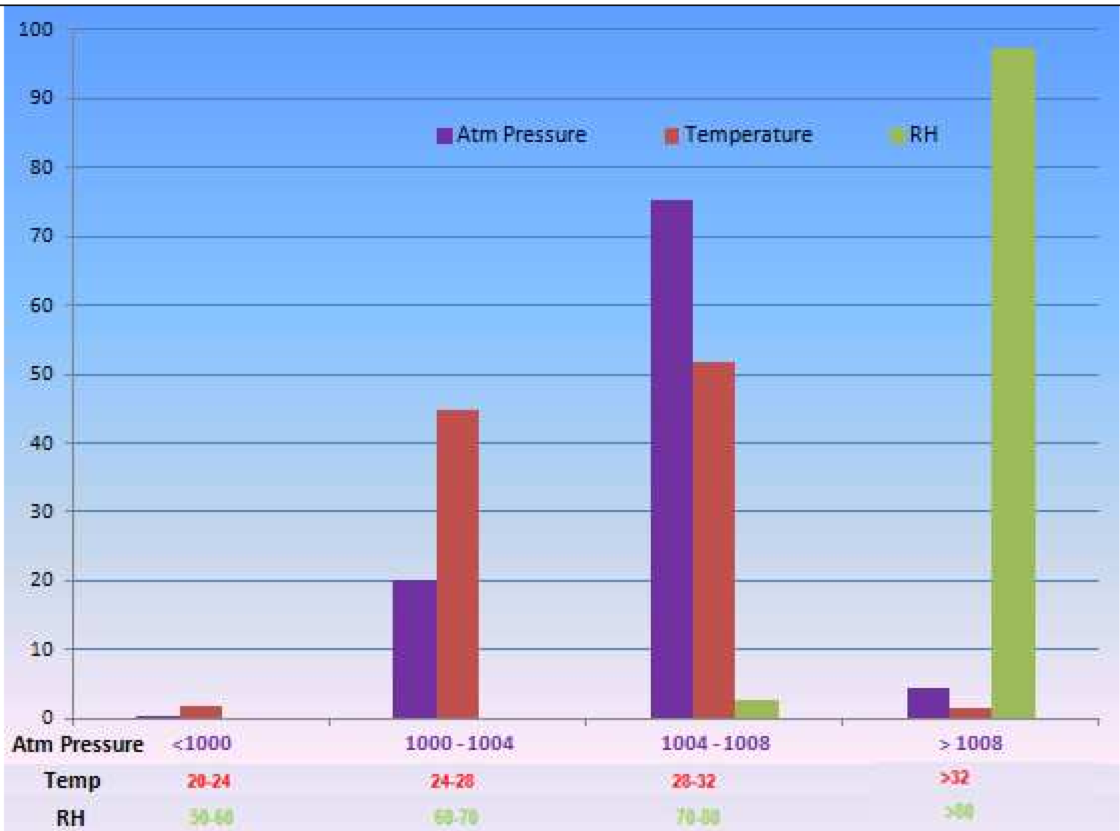


Figure 49 – Histogram of met parameters (May 2016)

The data represented above reveals that in 79.6% of the observations, the atmospheric pressure was above 1004 mb. The remaining observations (about 20.4%) were below 1004mb indicating low pressure conditions. The temperature hovered around 24 to 32°C and the relative humidity was more than 80% during the bulk of the observations.

The time series graphs for the period are placed at Annexure III.

The rainfall recorded for the month of May is 504.4 mm indicating the onset of monsoon. The histogram of rainfall for the pre monsoon period is given below:

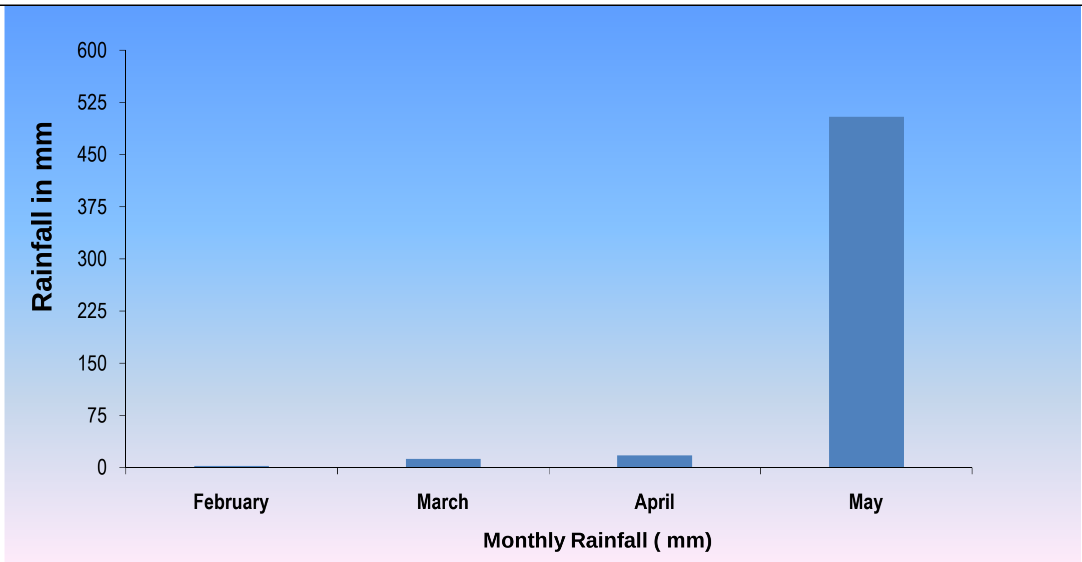


Figure 50 – Histogram of rainfall (Pre Monsoon 2016)

6.5 Current Measurements

Acoustic Doppler Current Profilers (ADCP) were mobilised for mapping the current in the survey area. One 600 kHz Rio Grande and three 600 kHz Sentinel ADCPs were deployed at the locations for measuring currents.

The following table gives the deployment details of the ADCPs in the survey area:

ADCP MOORING LOCATIONS WGS-84, UTM Projection, CM 75° East, Zone 43, North					
Location	**Water Depth (m)**	**Period of Observation**	**Easting**	**Northing**	**Frequency**
P1 (Vizhinjam)	21.1	20th April to 20th May 2016	08° 21' 55.4"N	76° 58' 51.6"E	600 kHz
P2 (Poovar)	23.0	20th April to 20th May 2016	08° 17' 35.8"N	77° 04' 03.5"E	600 kHz
P3 (Pachalloor)	27.4	20th April to 20th May 2016	08° 24' 08.6"N	76° 56' 16.1"E	600 kHz
P4 (Mulloor)	23.2	20th April to 20th May 2016	08° 21' 42.3"N	76° 59' 33.9"E	600 kHz

Table 21: ADCP Mooring Locations

The results of the data obtained by the ADCPs at the four locations are documented below, location-wise.

6.5.1 Location P1 (Vizhinjam)

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed on an ‘L’ frame installed on a boat, in a downward looking mode and was used to measure the speed and direction of the current.

The data was recovered after 30 days of observation and after quality checks, spurious data were filtered out.

A maximum current of 0.986 m/s was measured at the water surface on 20th May 2016.

Refer to the following compass plots for speed and direction of the currents for three levels, where the speed data is plotted in m/s:

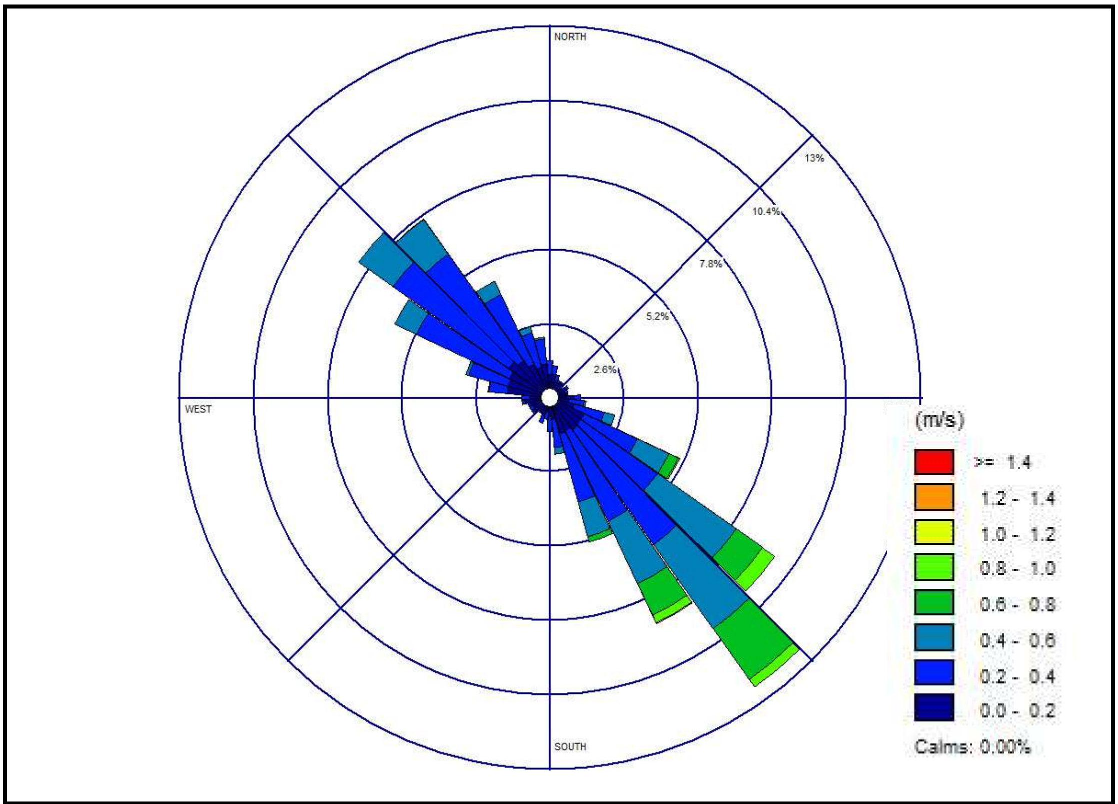


Figure 51 – Compass plot (Surface speed in m/s) – P1

The data reveals that the surface current was parallel to the coast with more currents towards south-east.

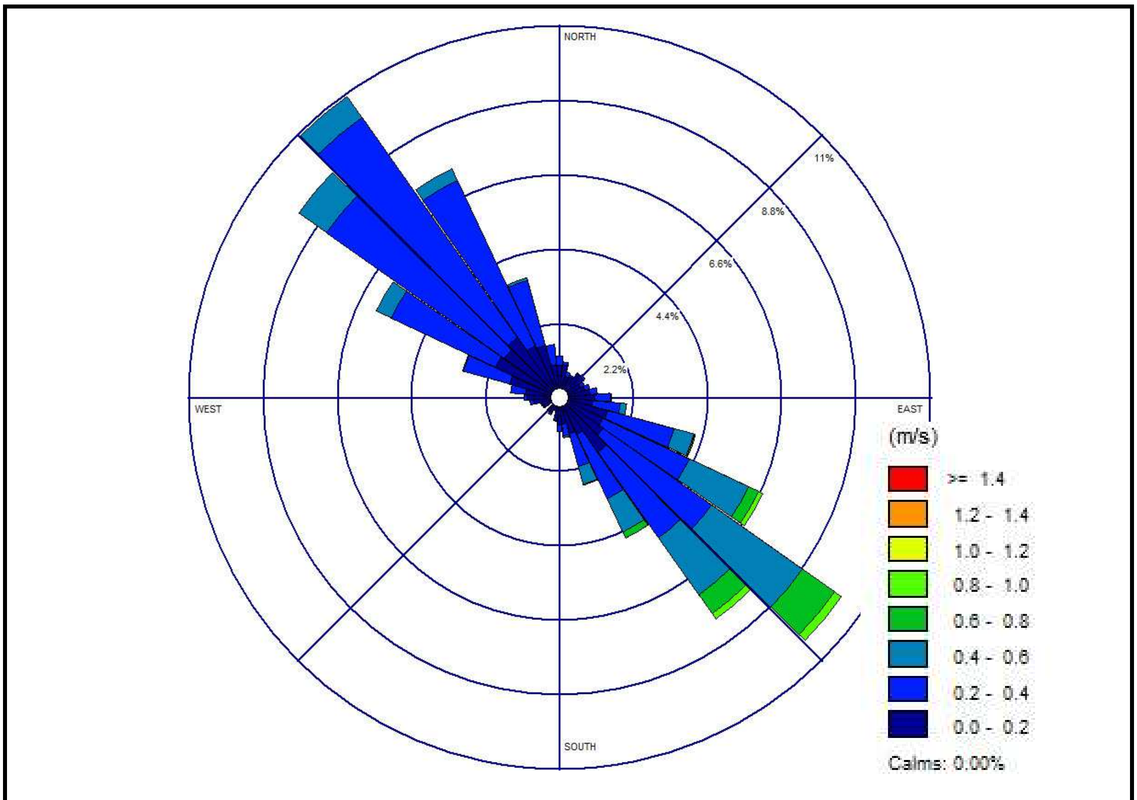


Figure 52 – Compass plot (Mid depth speed in m/s) – P1

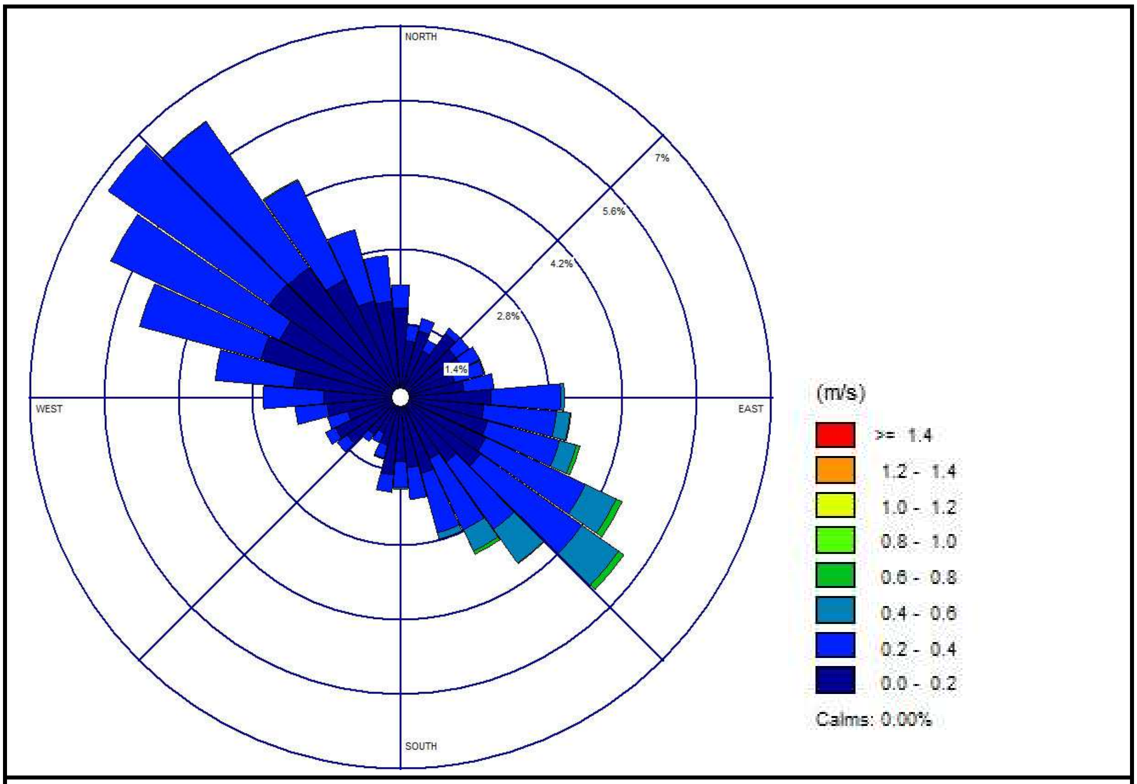


Figure 53 – Compass plot (Near Bottom speed in m/s) – P1

The currents decrease towards the seabed as compared to the surface currents.

The following table and figures give the histogram of frequency distribution & percentage exceedance curve of current speed:

Frequency Distribution			
Speed (m/s)	**Surface**	**Mid**	**Bottom**
0 - 0.2	1949	2192	3211
0.2 - 0.4	1605	1650	955
0.4 - 0.6	530	348	97
0.6 - 0.8	158	69	11
0.8 - 1.0	32	15	0
1.0 - 1.2	0	0	0
1.2 - 1.4	0	0	0
> 1.4	0	0	0
Total	**4274**	**4274**	**4274**

Table 22: Frequency Distribution of current speed - P1

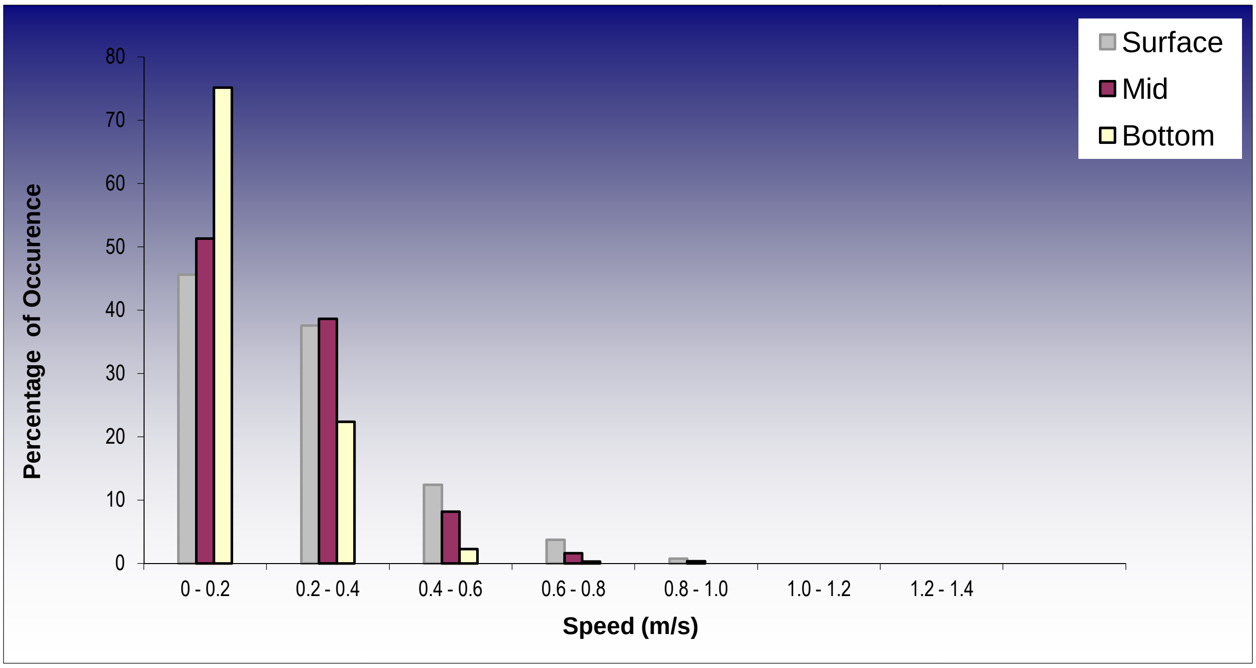


Figure 54 – Frequency Distribution of current speed – P1

Frequency Distribution			
Speed (m/s)	**% of Surface**	**% of Mid**	**% of Bottom**
0.0	100	100	100
0.2	54.40	48.71	24.87
0.4	16.85	10.11	2.53
0.6	4.45	1.97	0.26
0.8	0.75	0.35	0.00
1.0	0.00	0.00	0.00
1.2	0.00	0.00	0.00
1.4	0.00	0.00	0.00

Table 23: Percentage of Exceedance of current speed – P1

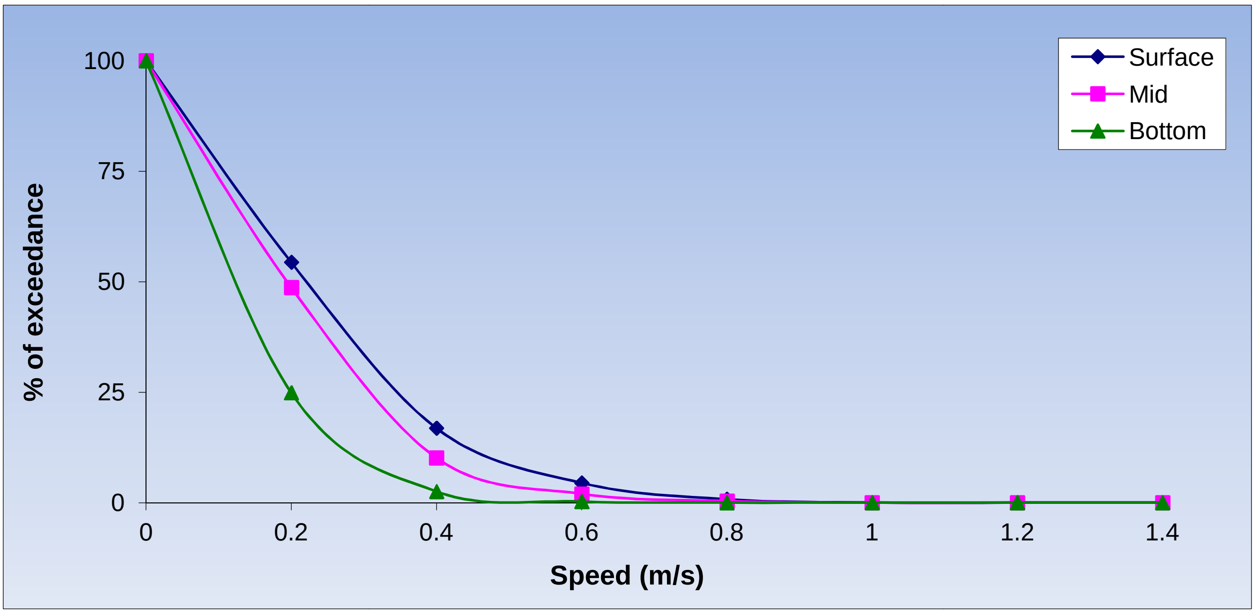


Figure 55 – Frequency Distribution of current speed – P1

The exceedance curve reveals that the current speed was mainly in the range of 0 to 0.40 m/s during the period of observation. The exceedance curves are given only for 3 levels (near surface, mid depth and near bottom obtained from the bin numbers 1, 9 and 18 respectively).

Progressive vector diagram for the full observation period is given below:

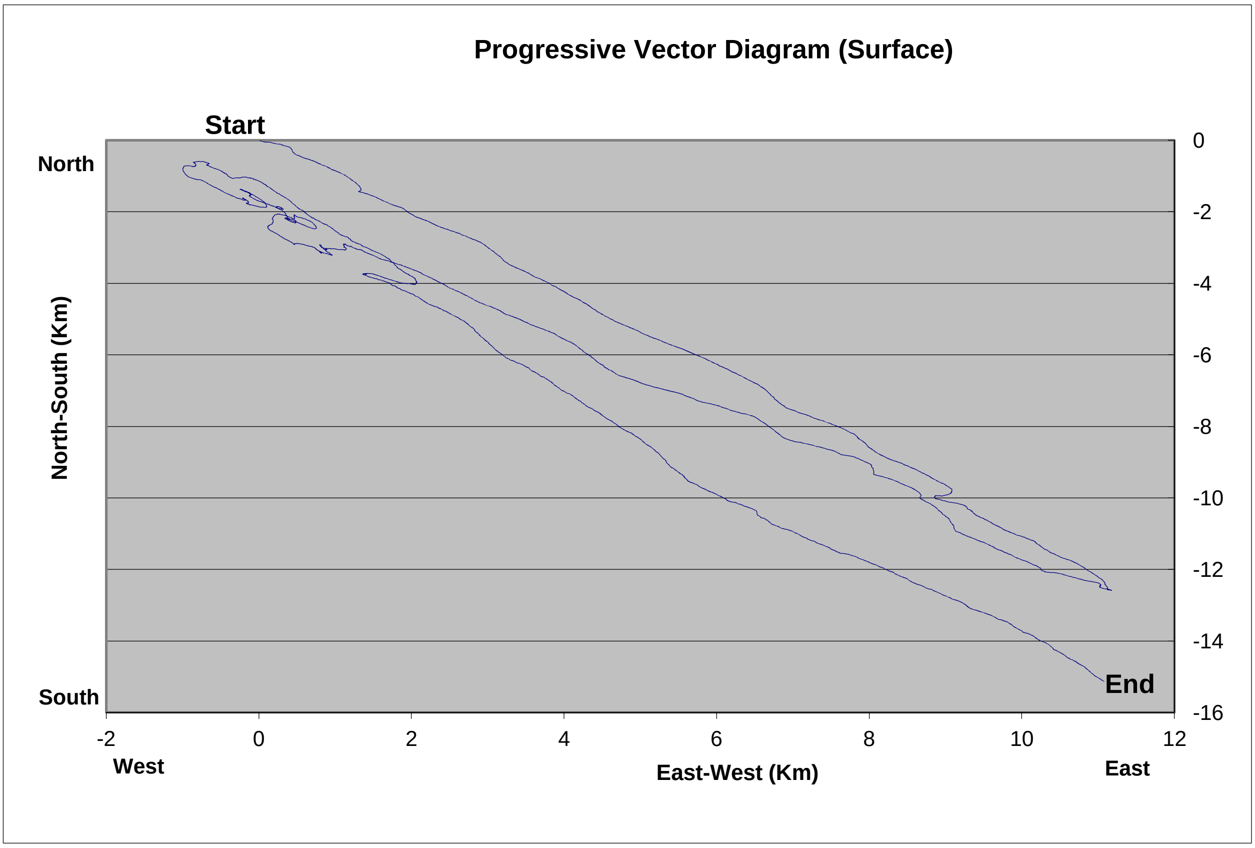


Figure 56 – Progressive Vector Diagram – P1

The progressive vector diagram is used to simulate a Lagrangian display from Eulerian measurements (a moored currentmeter). The progressive vector diagram is constructed by drawing the first current vector in a Cartesian co-ordinate grid. The second vector is then added to the first vector, its tail sitting on the head of the first vector, and so on, as shown in the above figure. The x- and y-axis, which are in velocity units (m/s), are converted to space units (km) by noting that a water parcel travelling at 1 m/s for 1 hour will have covered a distance of 1 m/s times 3600 seconds, or 3.6 km. The above figure reveals a rotary flow. During the first few days, the current flow was towards south-east followed by north-west current and again following south-easterly travelling a distance of 12 Km towards east and 16 Km towards south.

6.5.2 Location P2 (Poovar)

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed on an 'L' frame installed on a boat, in a downward looking mode and was used to measure the speed and direction of the current.

The data was recovered after 30 days of observation and after quality checks, spurious data were filtered out.

A maximum current of 1.144 m/s was measured at the water surface on 23rd April 2016.

Refer to the following compass plots for speed and direction of the currents for three levels, where the speed data is plotted in m/s:

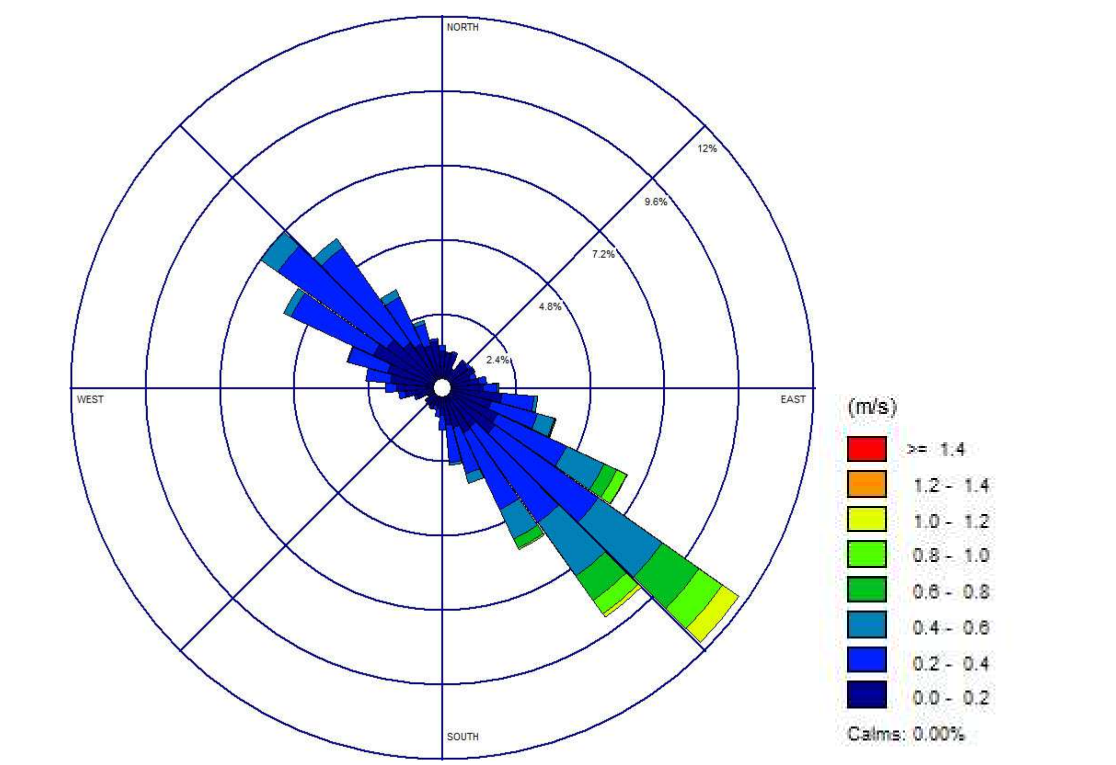


Figure 57 – Compass plot (Surface speed in m/s) – P2

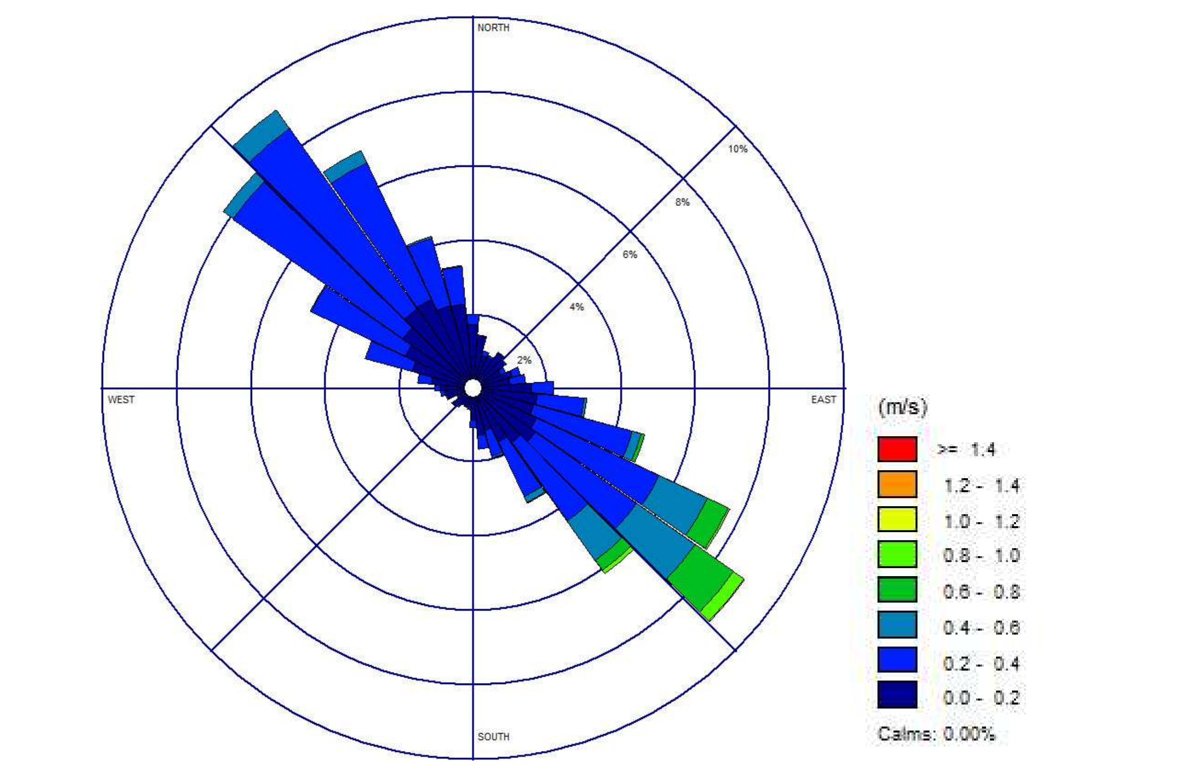


Figure 58 – Compass plot (Mid Depth speed in m/s) – P2

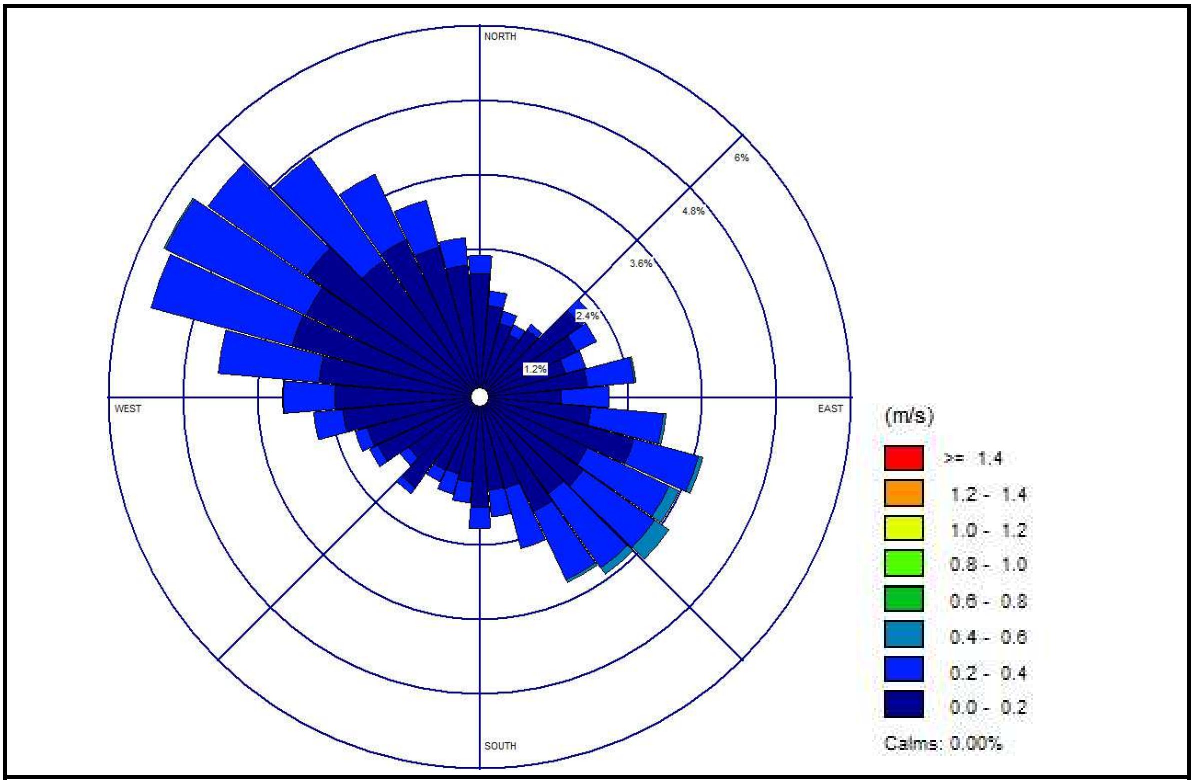


Figure 59 – Compass plot (Near Bottom speed in m/s) – P2

The data from this location follows a similar pattern as at P1.

The following table and figures give the histogram of frequency distribution & percentage exceedance curve:

Frequency Distribution			
Speed (m/s)	**Surface**	**Mid**	**Bottom**
0 - 0.2	2427	2604	3588
0.2 - 0.4	1203	1233	508
0.4 - 0.6	276	191	12
0.6 - 0.8	116	71	0
0.8 - 1.0	66	9	0
1.0 - 1.2	20	0	0
1.2 - 1.4	0	0	0
0 - 0.2	0	0	0
Total	**4108**	**4108**	**4108**

Table 24: Frequency Distribution of current speed – P2

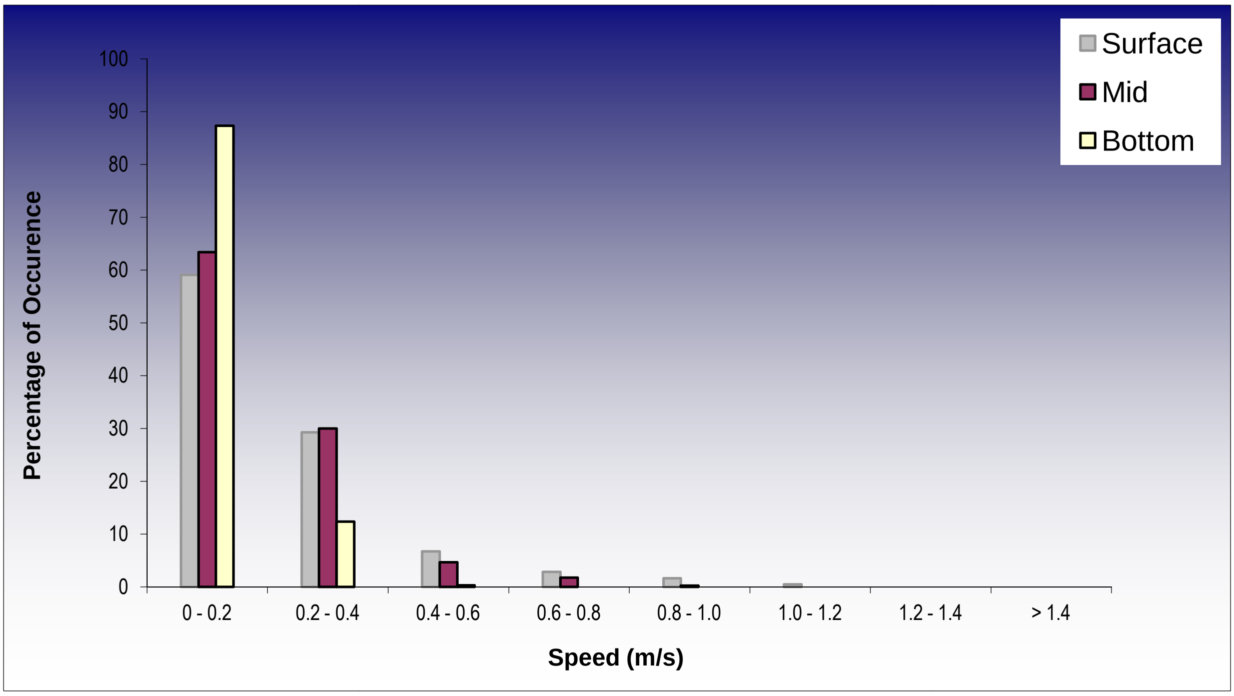


Figure 60 – Frequency Distribution of current speed – P2

Frequency Distribution			
Speed (m/s)	**% of Surface**	**% of Mid**	**% of Bottom**
0.0	100	100	100
0.2	40.92	36.61	12.66
0.4	11.64	6.60	0.29
0.6	4.92	1.95	0.00
0.8	2.09	0.22	0.00
1.0	0.49	0.00	0.00
1.2	0.00	0.00	0.00
1.4	0.00	0.00	0.00

Table 25: Percentage of Exceedance of current speed – P2

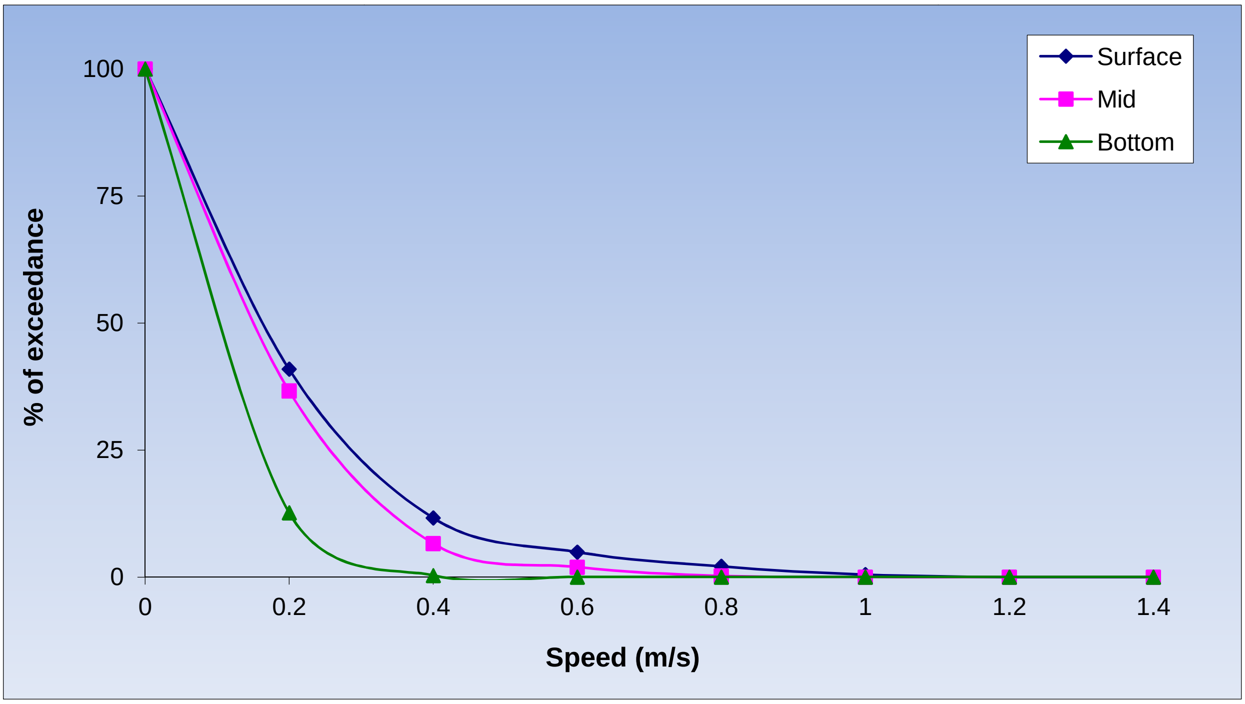


Figure 61 – Exceedance Curve of current speed – P2

The exceedance curve reveals that the speed exceeded 0.4 m/s about 2.5% of the observation period.

The progressive vector diagram for the complete lunar cycle is provided below:

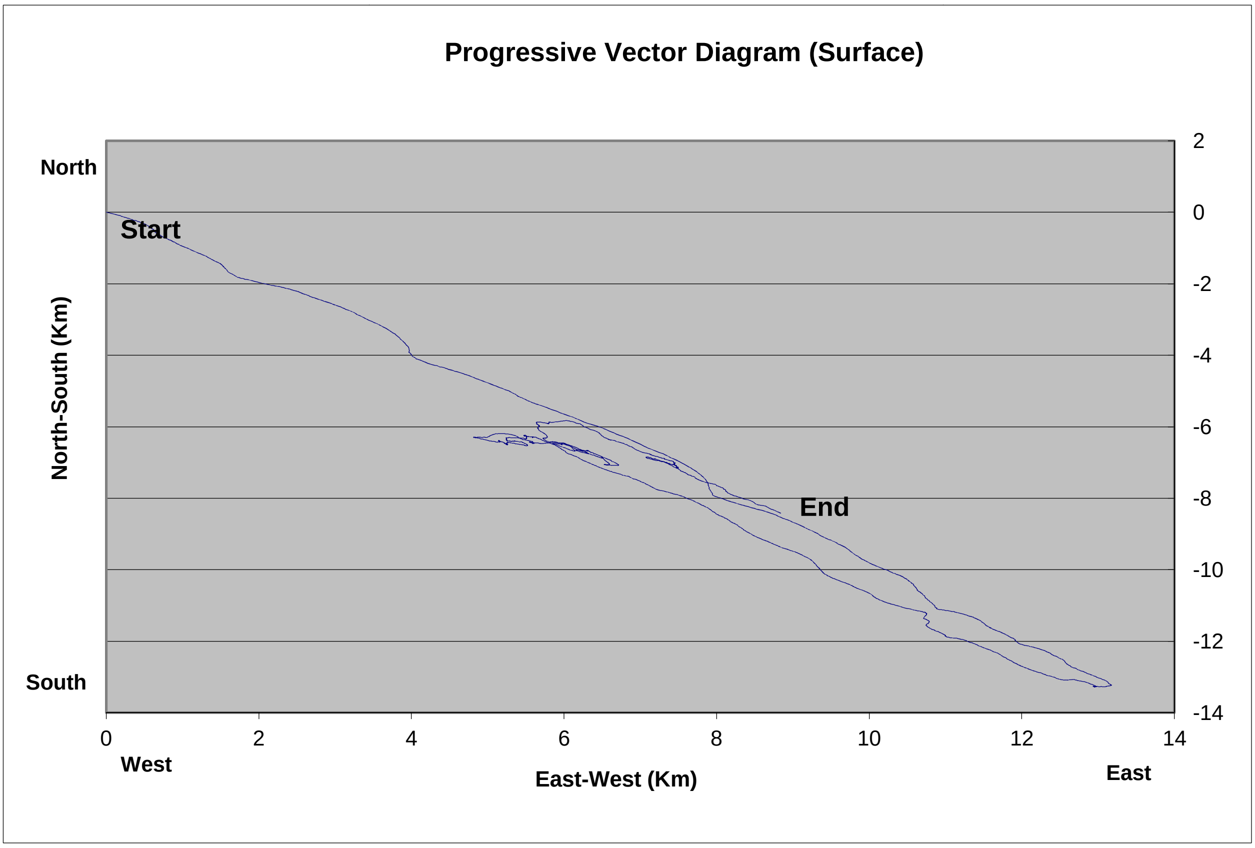


Figure 62 – Progressive Vector Diagram – P2

The above figure reveals that a parcel of water would have travelled 14 km towards south-east, then reversed its path towards north-west for about 8 km, after which it would revert to its original south-easterly trend.

6.5.3 Location P3 (Pachalloor)

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed on an 'L' frame on a downward looking mode to measure the speed and direction.

After recovery, the data was properly QC-ed for removing spurious data.

A maximum speed of 0.892 m/s was observed on 19th May 2016.

Refer to the following compass plots for speed and direction of the currents:

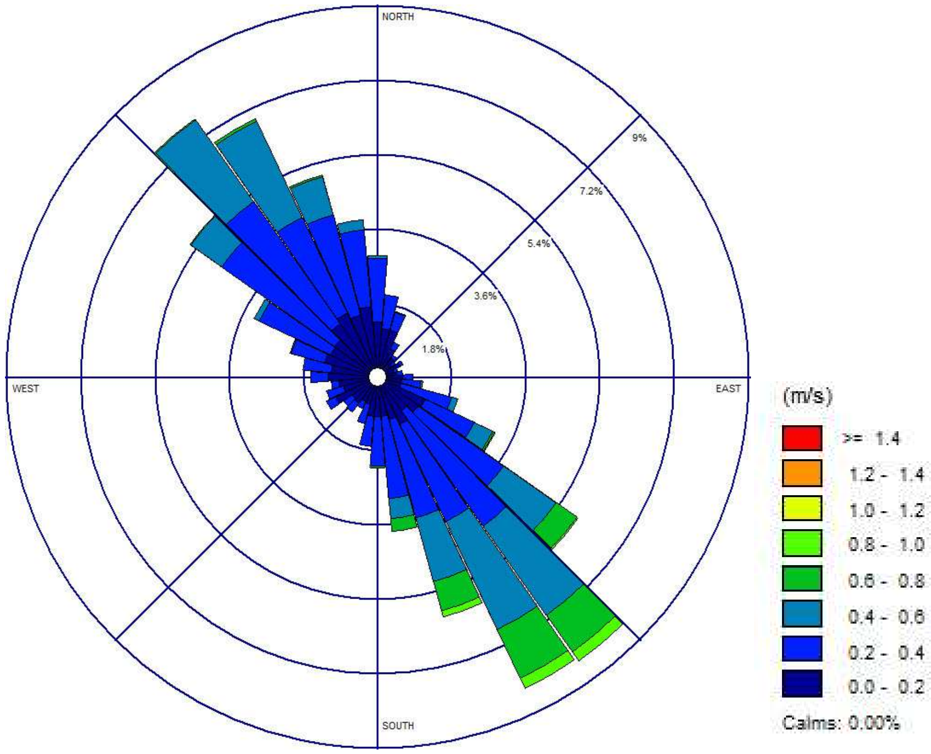


Figure 63 – Compass plot (Surface speed in m/s) – P3

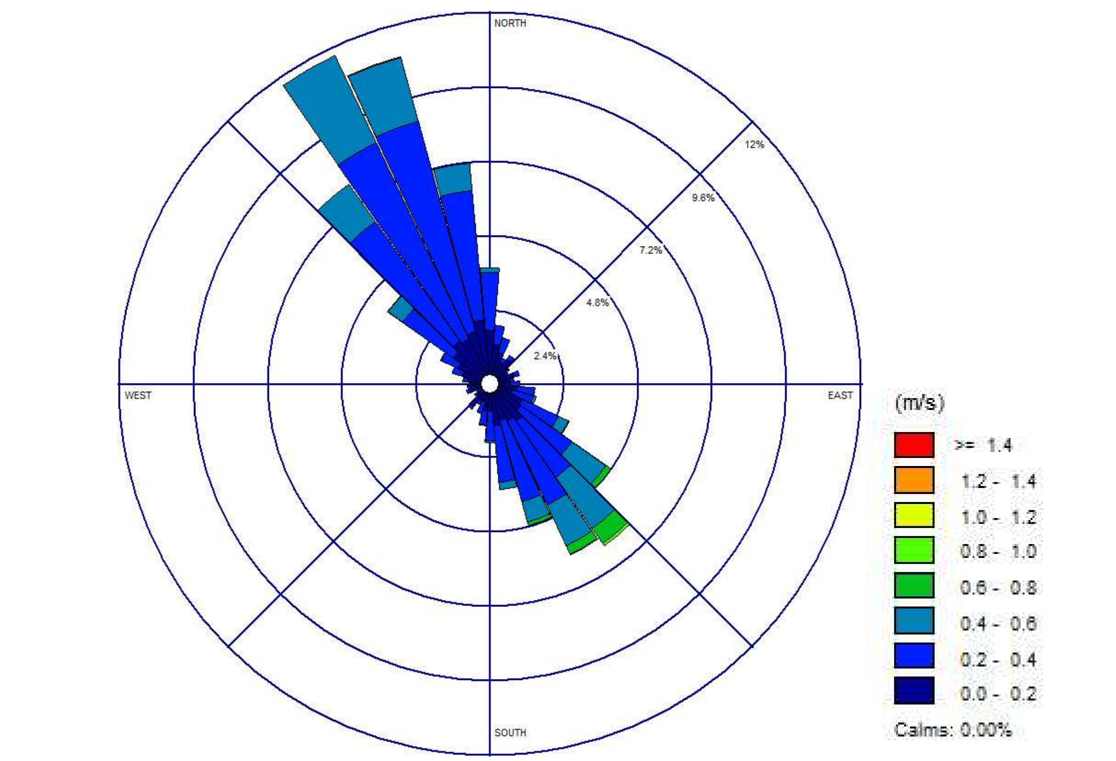


Figure 64 – Compass plot (Mid Depth speed in m/s) – P3

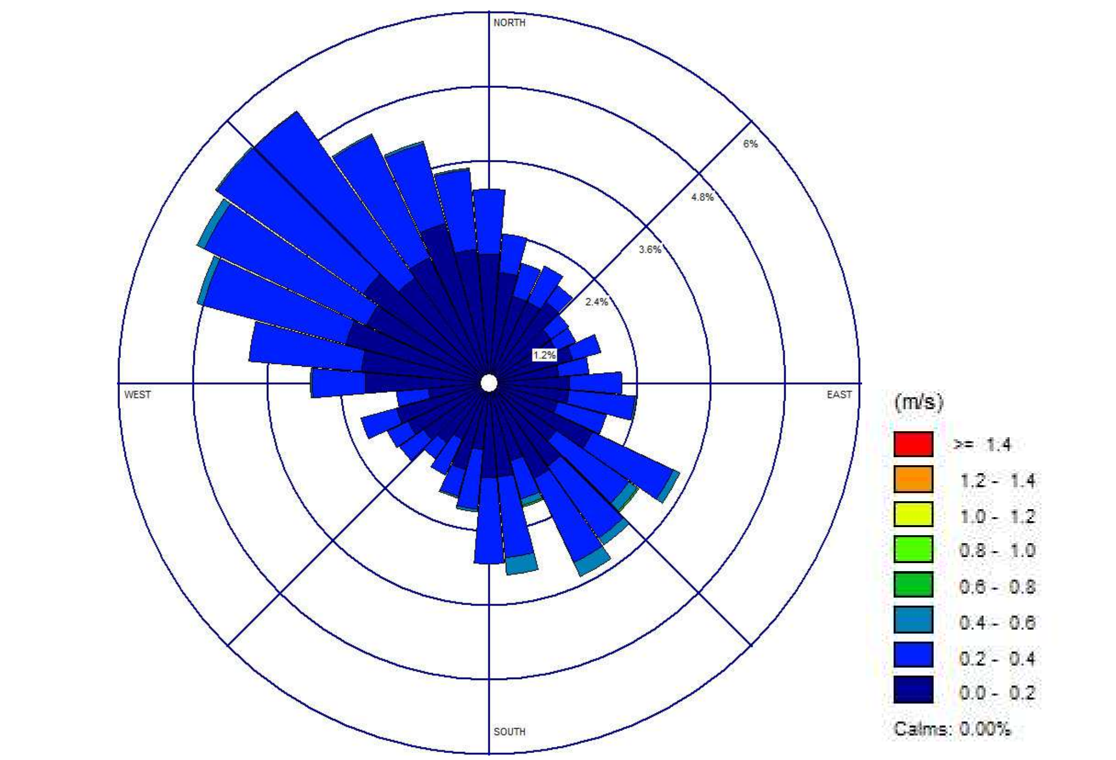


Figure 65 – Compass plot (Near Bottom speed in m/s) – P3

The data reveals a south-easterly flow with maximum readings in the range up to 0.5 m/s.

The following table and figures give the histogram of frequency distribution & percentage exceedance curve:

Frequency Distribution			
Speed (m/s)	**Surface**	**Mid**	**Bottom**
0 - 0.2	2043	2074	3173
0.2 - 0.4	1339	1594	848
0.4 - 0.6	542	355	29
0.6 - 0.8	113	25	0
0.8 - 1.0	13	2	0
1.0 - 1.2	0	0	0
1.2 - 1.4	0	0	0
> 1.4	0	0	0
Total	**4050**	**4050**	**4050**

Table 26: Frequency Distribution of current speed - P3

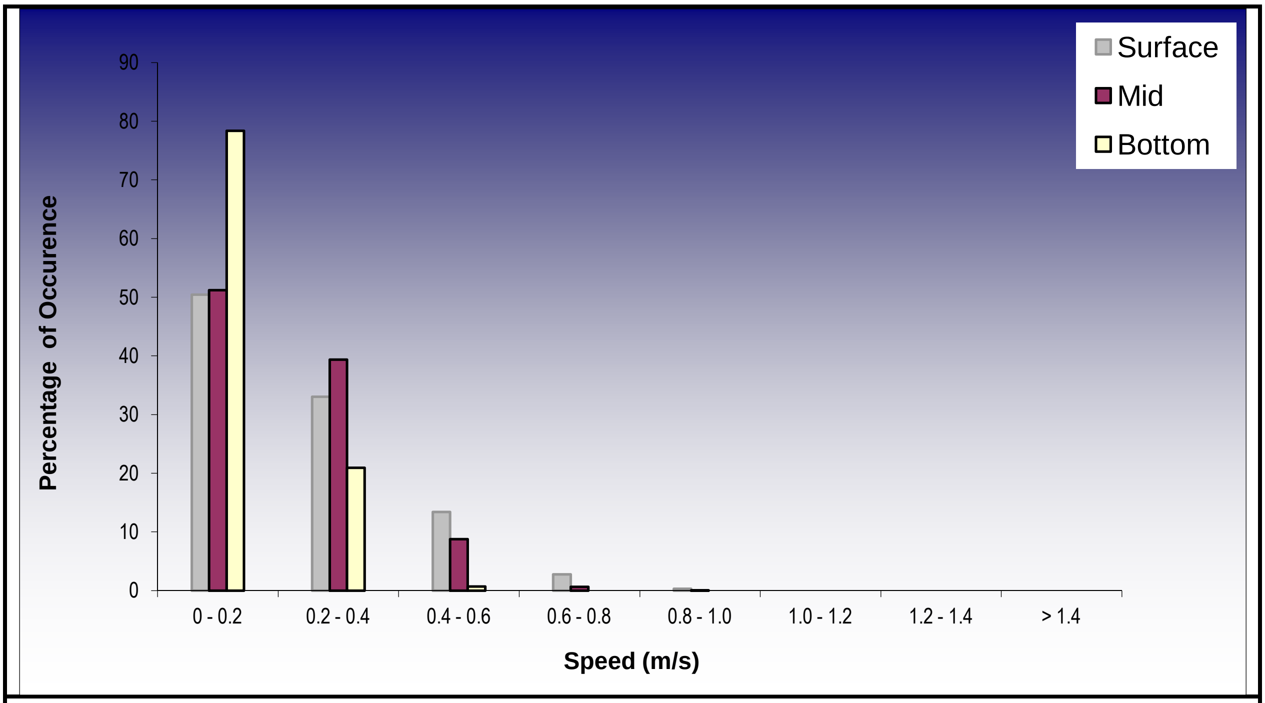


Figure 66 – Histogram of current speed – P3

Frequency Distribution			
Speed (m/s)	% of Surface	% of Mid	% of Bottom
0	100	100	100
0.2	49.56	48.79	21.65
0.4	16.49	9.43	0.72
0.6	3.11	0.67	0.00
0.8	0.32	0.05	0.00
1.0	0.00	0.00	0.00
1.2	0.00	0.00	0.00
1.4	0.00	0.00	0.00

Table 27: Percentage of Exceedance – P3

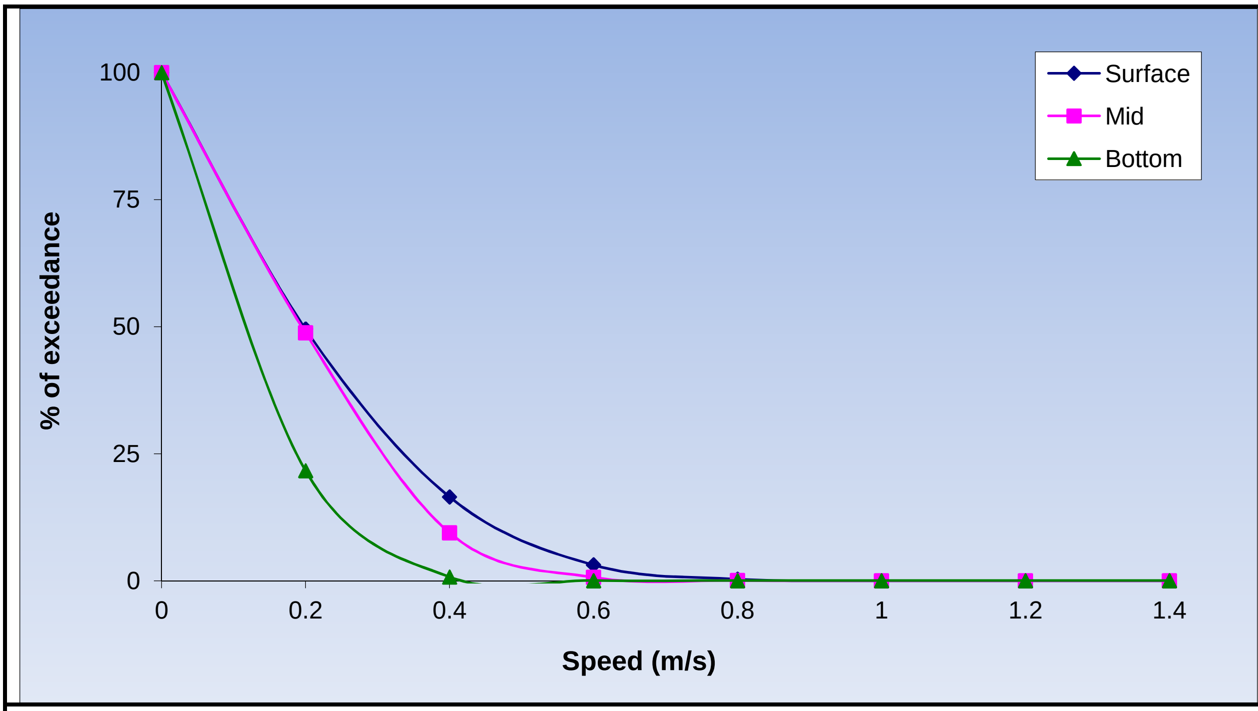


Figure 67 – Exceedance Curve – P3

The data reveals that about 3% of the observations, current speed exceeded 0.6 m/s.

The progressive vector diagram for the lunar cycle is given in the following figure:

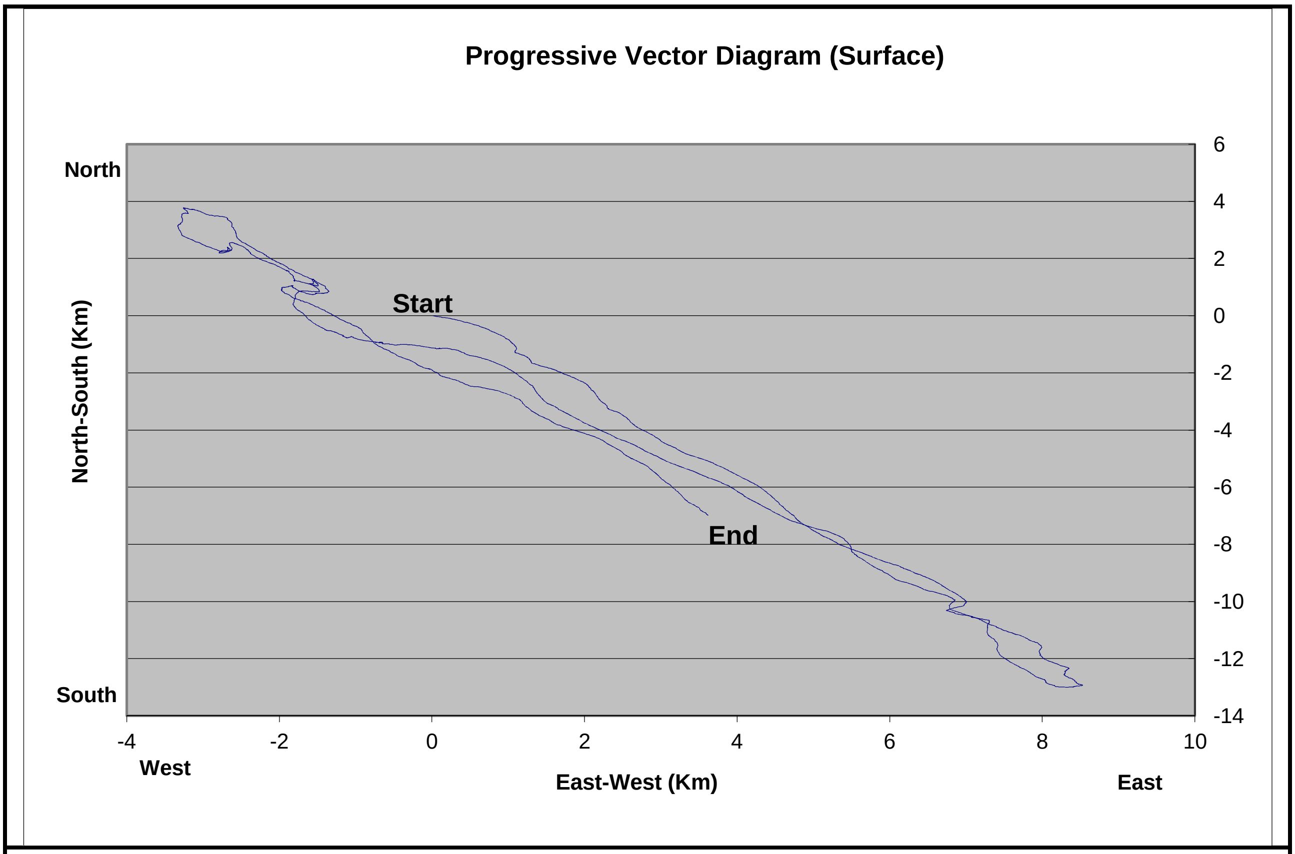


Figure 68 – Progressive Vector Diagram – P3

The above PVD shows the parcel moving about 14 km towards south-east, followed by a reverse north-westerly and again a south-easterly movement as observed in the other locations.

6.5.4 Location P4 (Mulloor)

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed on an 'L' frame on a downward looking mode to measure the speed and direction.

After recovery, the data was properly QC-ed for removing spurious data.

A maximum speed of 1.061 m/s was observed on 20th May 2016 at 02:40 hours.

Refer to the following compass plots for speed and direction of the currents:

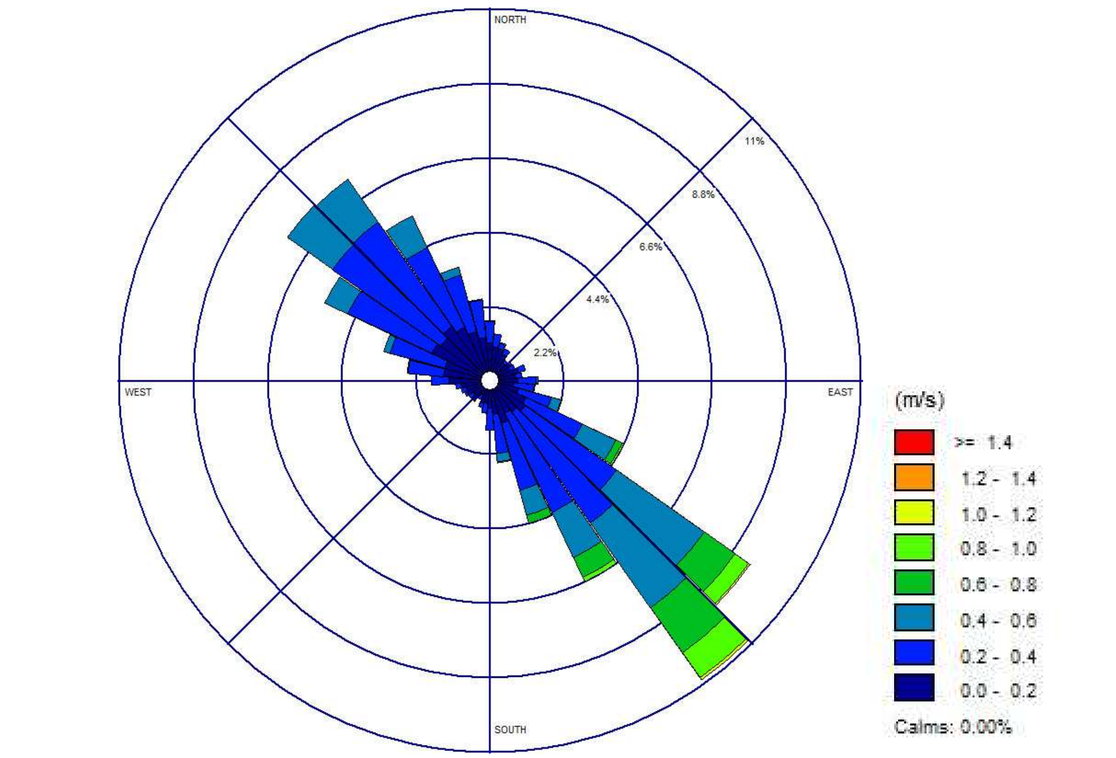


Figure 69 – Compass plot (Surface speed in m/s) – P4

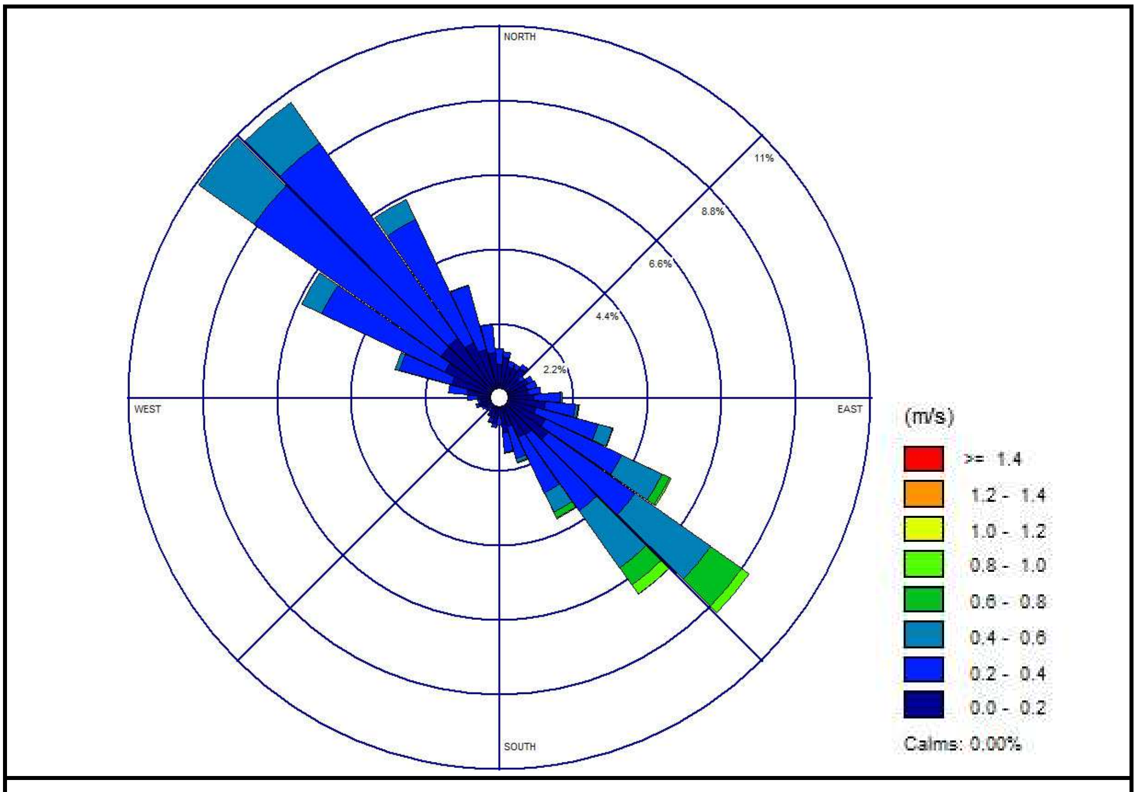


Figure 70 – Compass plot (Mid Depth speed in m/s) – P4

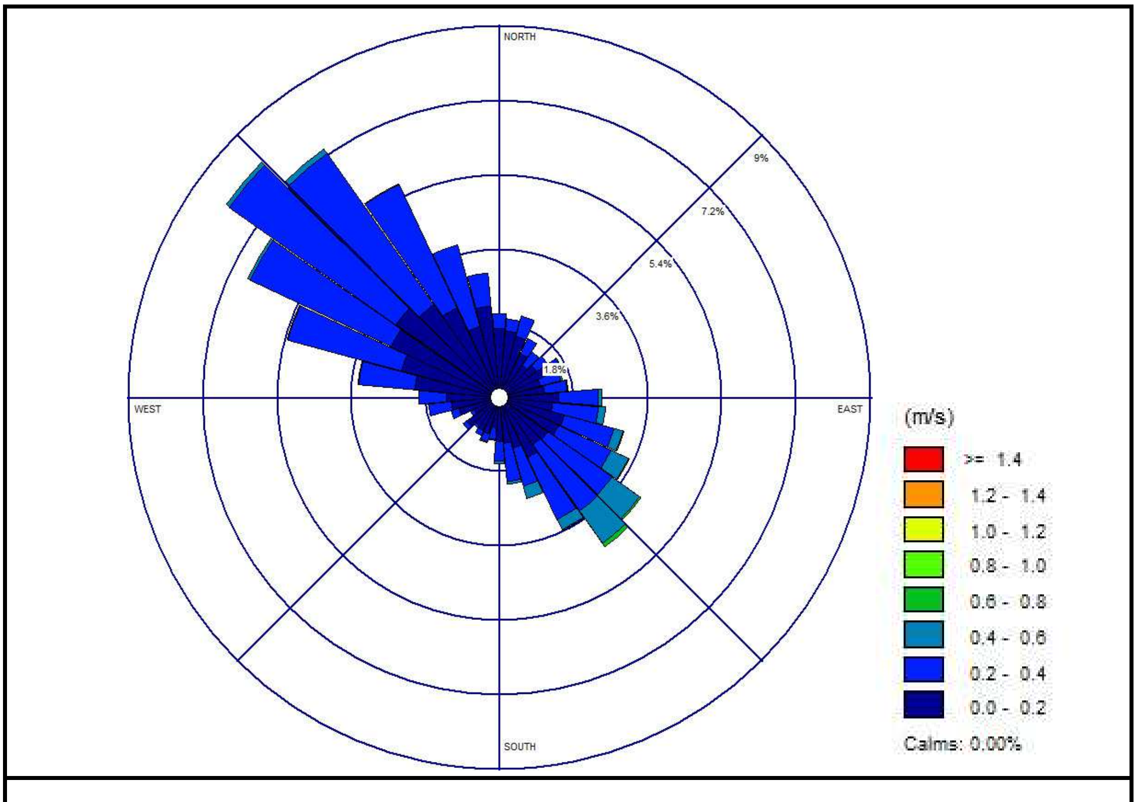


Figure 71 – Compass plot (Near Bottom speed in m/s) – P4

The currents observed at Mulloor also show the same trend as all the previous locations, with speeds up to 0.2 m/s observed 82% of the observation period.

The following table and figures give the histogram of frequency distribution & percentage exceedance curve:

Frequency Distribution			
Speed (m/s)	**Surface**	**Mid**	**Bottom**
0 - 0.2	2110	2198	2969
0.2 - 0.4	1356	1489	1029
0.4 - 0.6	454	317	92
0.6 - 0.8	125	75	4
0.8 - 1.0	47	15	0
1.0 - 1.2	2	0	0
1.2 - 1.4	0	0	0
> 1.4	0	0	0
Total	**4094**	**4094**	**4094**

Table 28: Frequency Distribution of current speed – P4

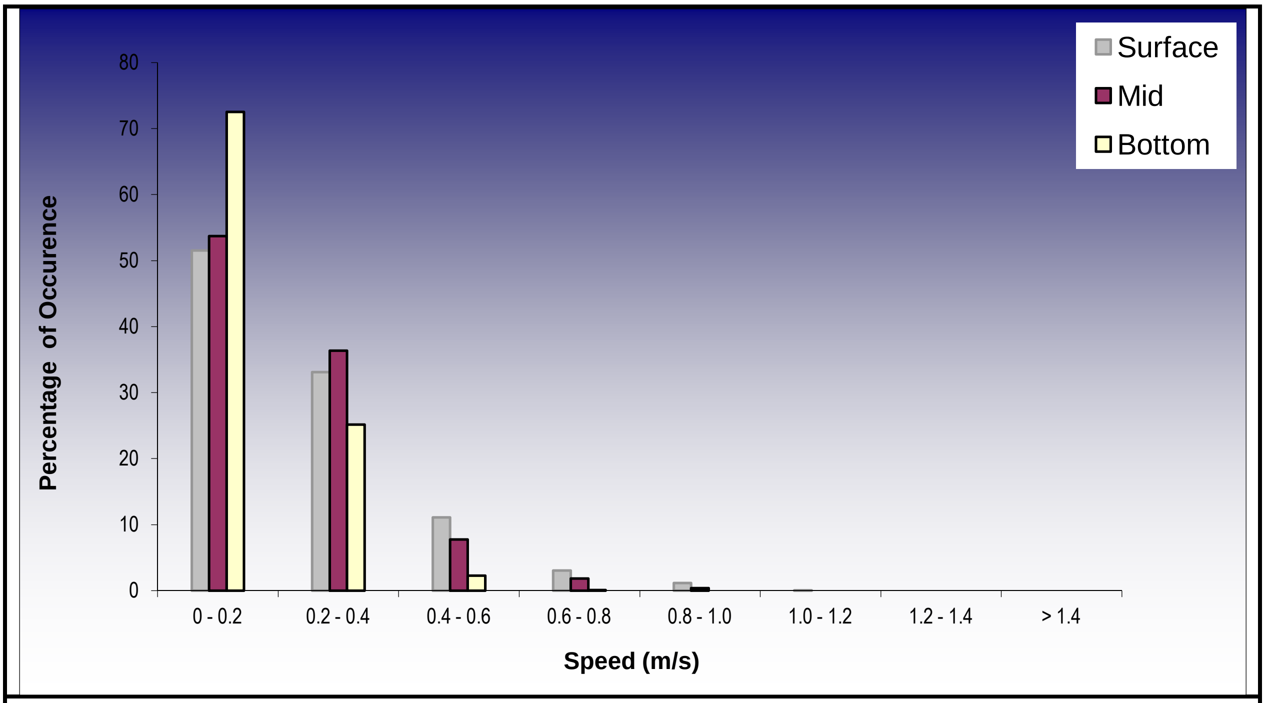


Figure 72 – Histogram of current speed – P4

Frequency Distribution			
Speed (m/s)	**% of Surface**	**% of Mid**	**% of Bottom**
0.0	100	100	100
0.2	48.46	46.31	27.48
0.4	15.34	9.94	2.34
0.6	4.25	2.20	0.10
0.8	1.20	0.37	0.00
1.0	0.05	0.00	0.00
1.2	0.00	0.00	0.00
1.4	0.00	0.00	0.00

Table 29: Percentage of Exceedance – P4

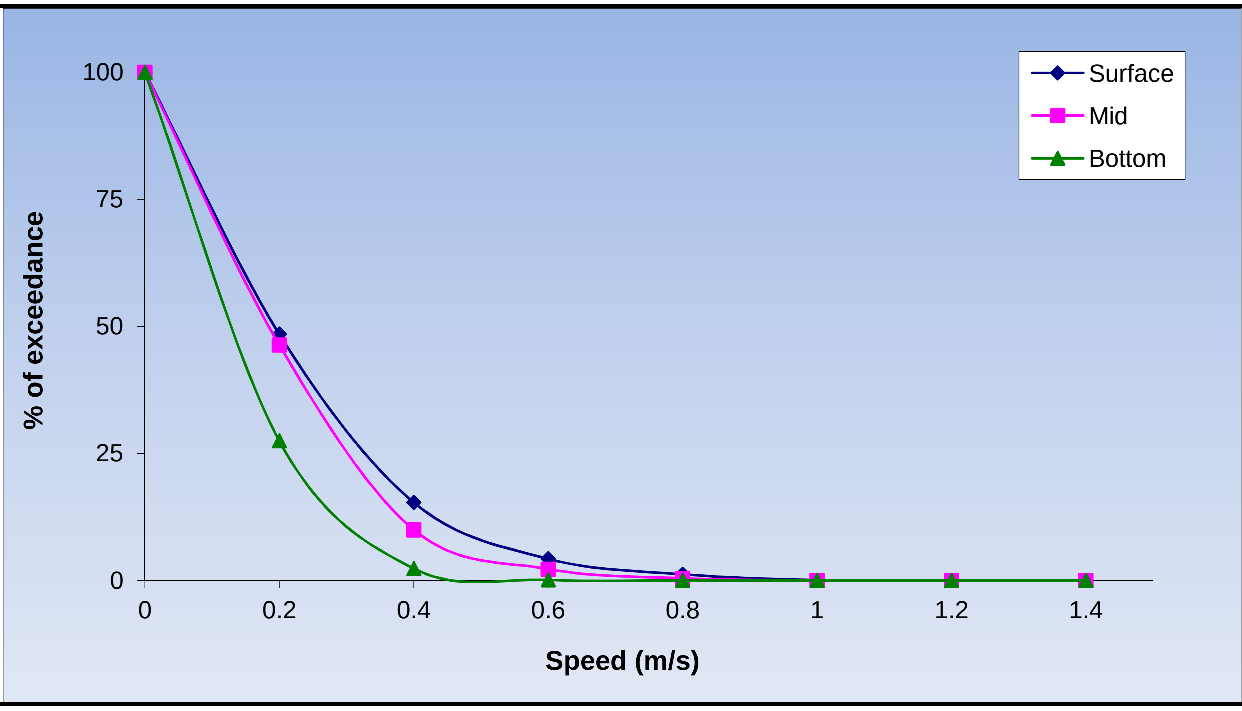


Figure 73 – Exceedance Curve – P4

The progressive vector diagram for the lunar cycle is given in the following figure:

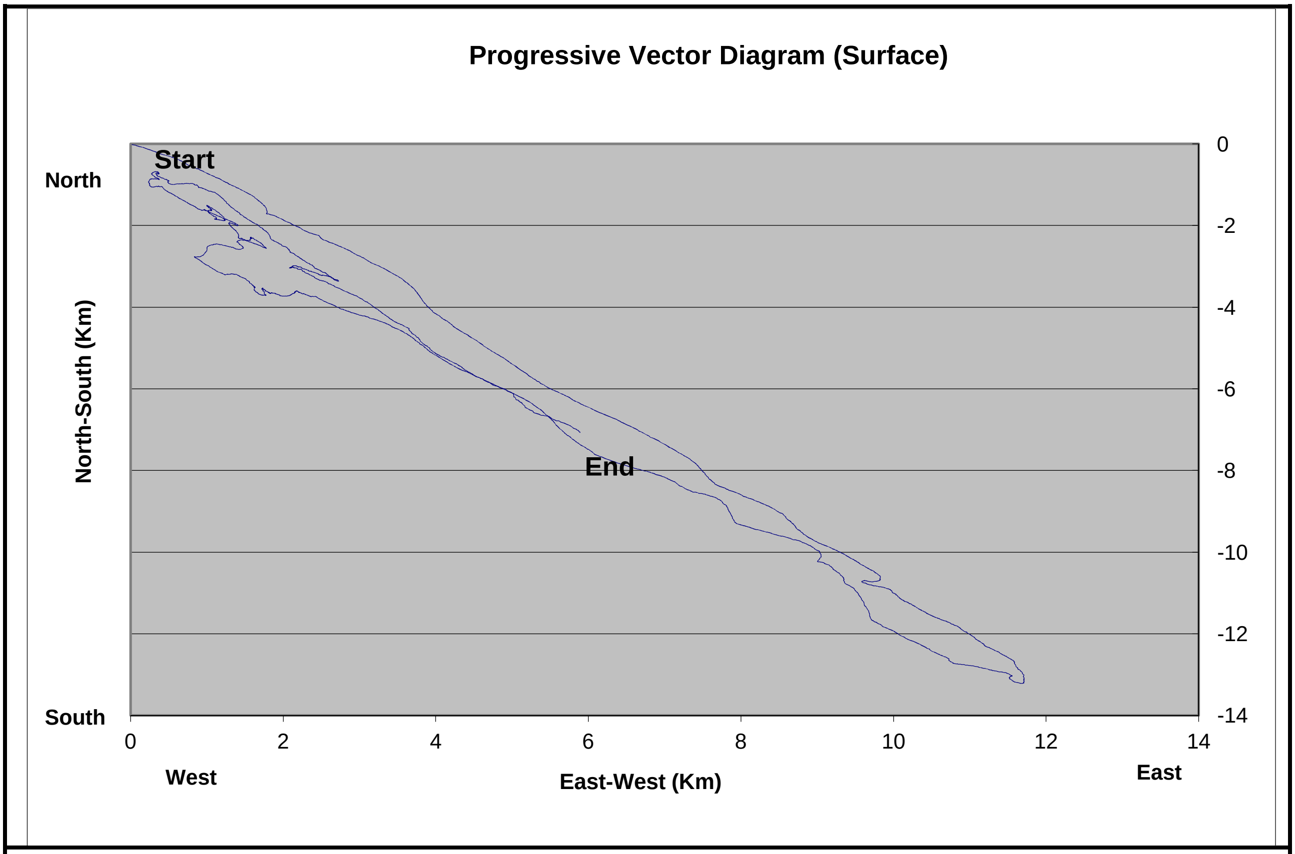


Figure 74 – Progressive Vector Diagram – P4

The above PVD shows the parcel moving towards south-east and then to north-west and back to south-east as was observed in all the locations.

The time series curves for all the locations are placed in Annexure IV.

6.6 Littoral Environmental Observations

The LEO was carried out for all the months. The LEO plate was deployed at the desired locations and the same was tracked for about ten minutes. The initial and final GPS positions were then used to calculate the speed over ground (SOG) and course over ground (COG). The estimated wave height, angle of wave, period and the stretch of breakers were also noted down in the log sheet. The data sheets for all the months are placed at Annexure V.

The along shore current always followed a northerly trend, with an average speed of up to 18 cm/s.

6.7 Photographic Documentation

The photographic documentation coinciding with the LEO was also carried out for all the months. The photographs for the period are placed at Annexure VI. As a common reference point, a red flag was fixed at each of the cross shore profiling alignments while taking the photograph. Using the RTK system, this point was staked during the photography.

6.8 Cross Shore Profiling

The cross shore profiling for the period was carried out using a combination of wide swath bathymetric system in the offshore region and with RTK in the onshore region. In the breaker area, no data could be acquired and hence that area is shown in 'dashed line', in the enclosed AutoCAD charts. As the monsoon waves progressed, the accessibility to beach was restricted in few places.

The profiles for the full period are placed in Annexure VII.

6.9 Beach and Water Sampling

The water samples were collected from the four locations from 0700 hrs to 1700 hrs from three levels; surface, mid-depth and near bottom. The samples were analysed at NABL accredited laboratory in Kochi. (Standard[s] Environmental & Analytical Laboratories, Accreditation and Approval: NABL as per ISO 17025:2005).

The location co-ordinates are provided below:

WATER SAMPLING LOCATIONS WGS-84, UTM Projection, CM 75° East, Zone 43, North				
Location	**Water Depth (m)**	**Sampling date**	**Easting**	**Northing**
Vizhinjam	21.1	7th March 2016	08° 21' 55.4"N	76° 58' 51.6"E
Poovar	23.0	8th March 2016	08° 17' 35.8"N	77° 04' 03.5"E
Pachalloor	27.4	8th March 2016	08° 24' 08.6"N	76° 56' 16.1"E
Dredge dumping / Kovalam	23.2	7th March 2016	08° 21' 42.3"N	76° 59' 33.9"E

Table 30: Water Sampling Locations

The turbidity measured never exceeded 5 NTU even though the dredging activities were going on, since all the locations were far from the dredging area.

The salinity was in the range of 35 to 40 ‰. The total suspended solids were about 10 mg/L near the Vizhinjam Harbour and less than 10 Mg/L in all other locations.

The results from the lab are placed at Annexure VIII.

6.10 Progress Report till May 2016

The following image shows the progress of the project carried out till May 2016, considering the start of work as 1st April 2016.

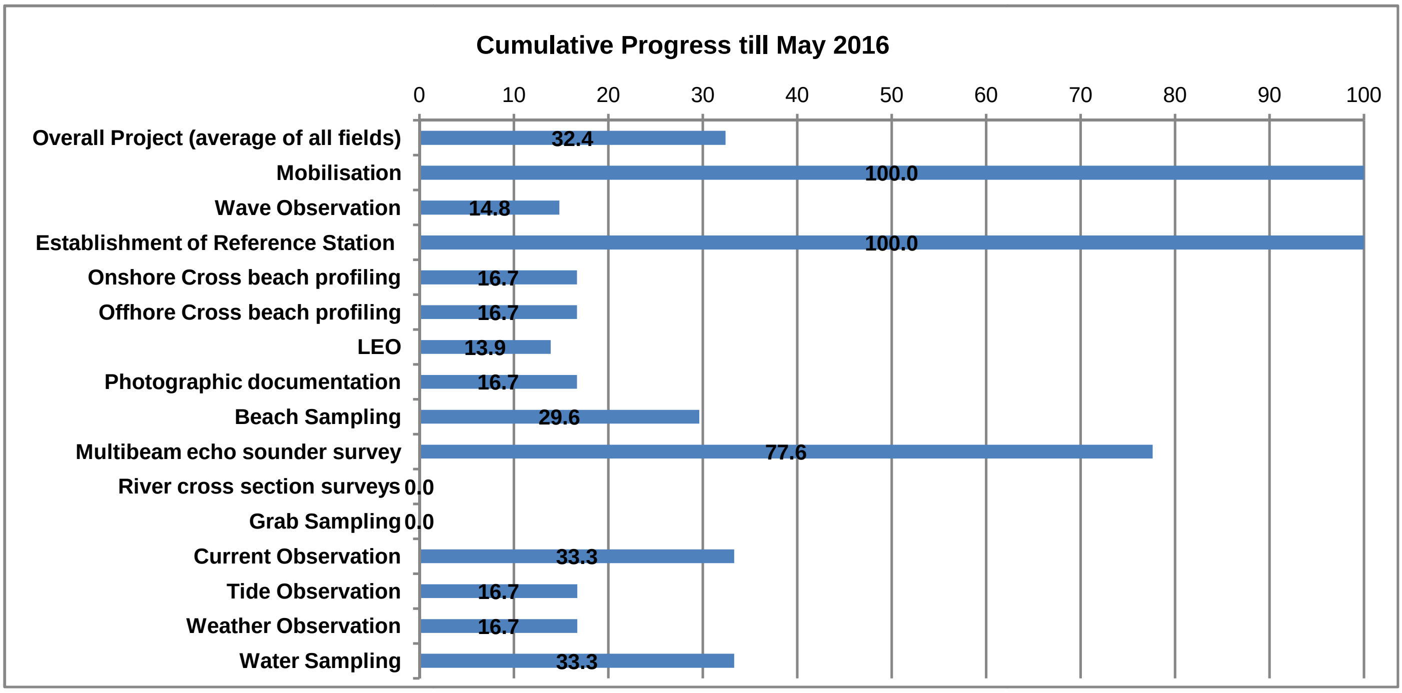


Figure 75 : Cumulative Progress Chart - till May 2016

7. WEATHER

During the survey period, the waves were greater than 1m towards end of April and in May 2016, indicating the onset of monsoon. The winds in the afternoon hampered the survey activities; hence survey was carried out mostly during the morning hours.

8. CONCLUSIONS

The following observations were made during this phase of the project.

1. Tide was mixed semi diurnal with a maximum range of 0.7m during spring tide.
2. The wave heights were greater than 1m with west to north westerly winds indicating the onset of monsoon.
3. The long-shore transport was in the northerly direction with an average velocity of 15cm/s
4. Salinity was in the range of 35 to 40 ‰.
5. The total suspended solids were about 10 mg/L near the Vizhinjam Harbour and less than 10 Mg/L in all other locations.
6. The turbidity was less than 5 NTU in all the locations.
7. The observed currents were about 1 m/s in all the 4 locations.

9. REFERENCES

Reference was made to the following in the preparation of this report.

1. Ocean Science Inception Report, OSaS/P18115/VISL/Mob Rev 0 dated 26th February 2015
2. Ocean Science Periodic Survey Reports, OSaS/P21716/AVPPL/PSR-1 to 3/118 Rev 0
3. www.vizhinjamport.in
4. Images of the survey area from Google Earth®
5. India Meteorological Department
6. WMO manual, Chapter 5 for reducing wind speed to 10m above ground (provided by NIOT)
7. IS 3025; Part 10 & 17
8. APHA Standard Methods for the Examination of Water and Wastewater, 20th Edition. (Method 2540 C and 2540 D)

10. ACKNOWLEDGEMENTS

Ocean Science gratefully acknowledges the support and co-operation received from the personnel of AVPPL and VISL, throughout the course of the survey.

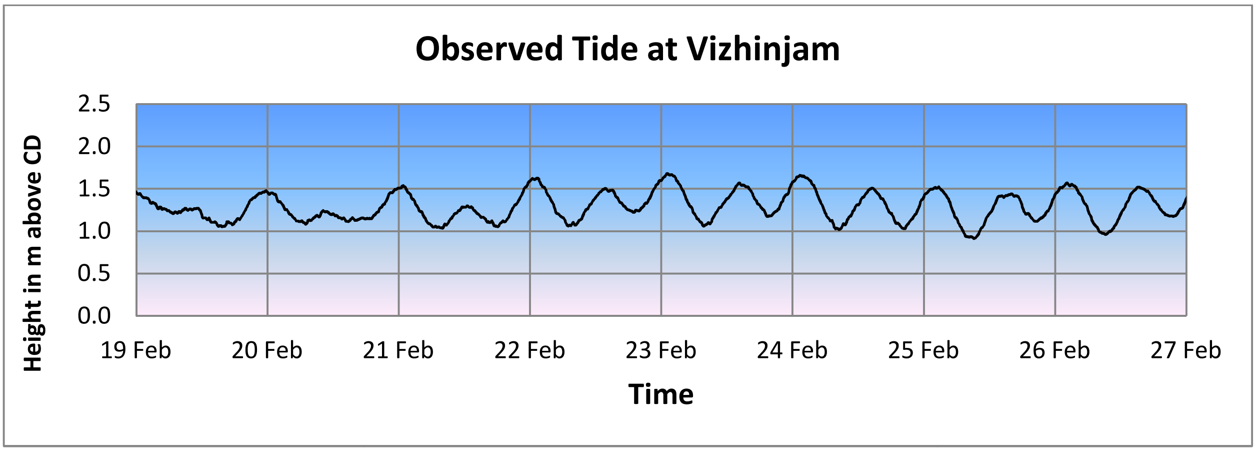
The scientists/technicians from NIOT are also acknowledged for their support and guidance during the course of the project.

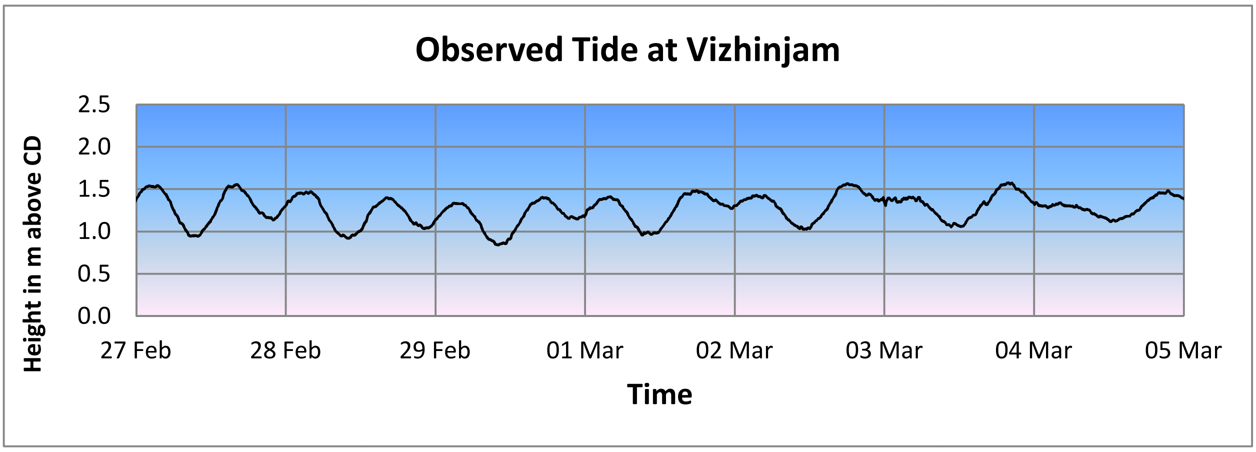
The crew of the boat and all local support obtained during the observation are also acknowledged.

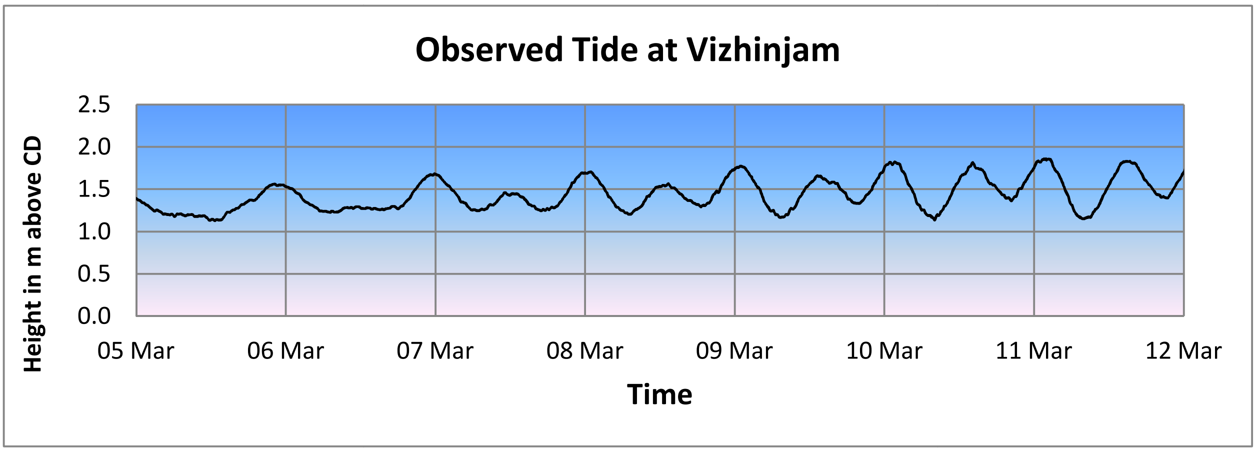
Weather forecast during the period was regularly observed at INCOIS and India Meteorological Department's web site.

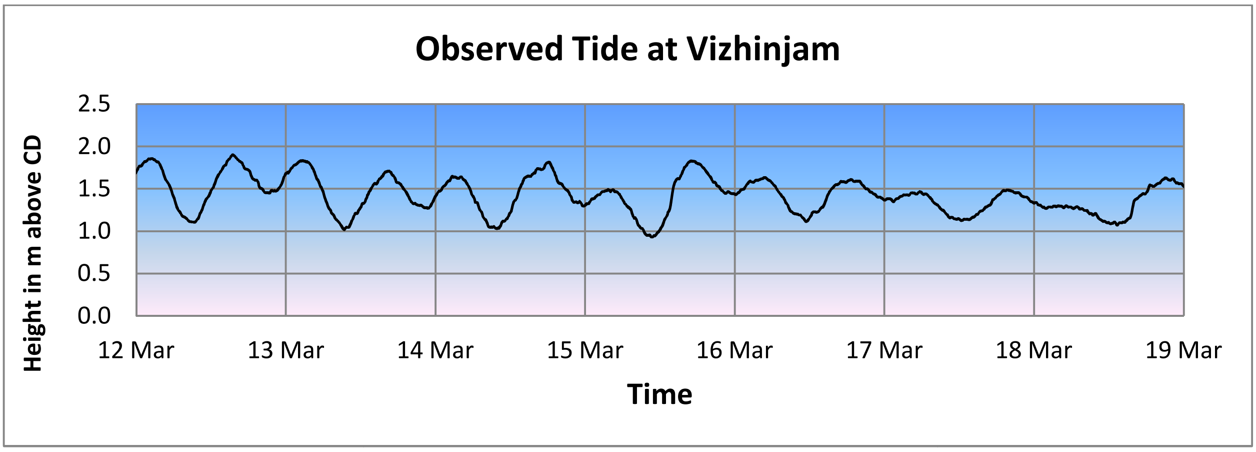
Annexure I

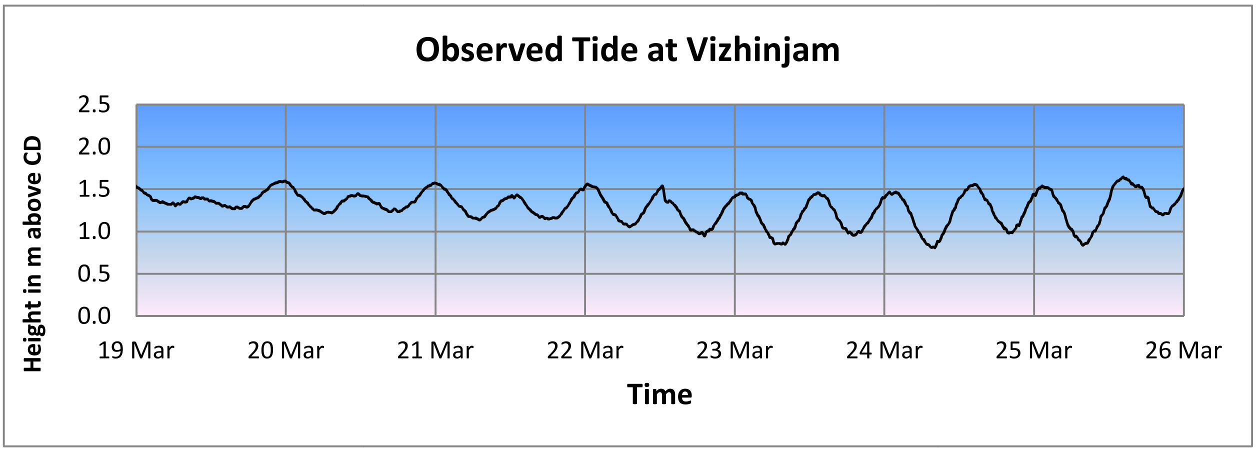
Tide Curves

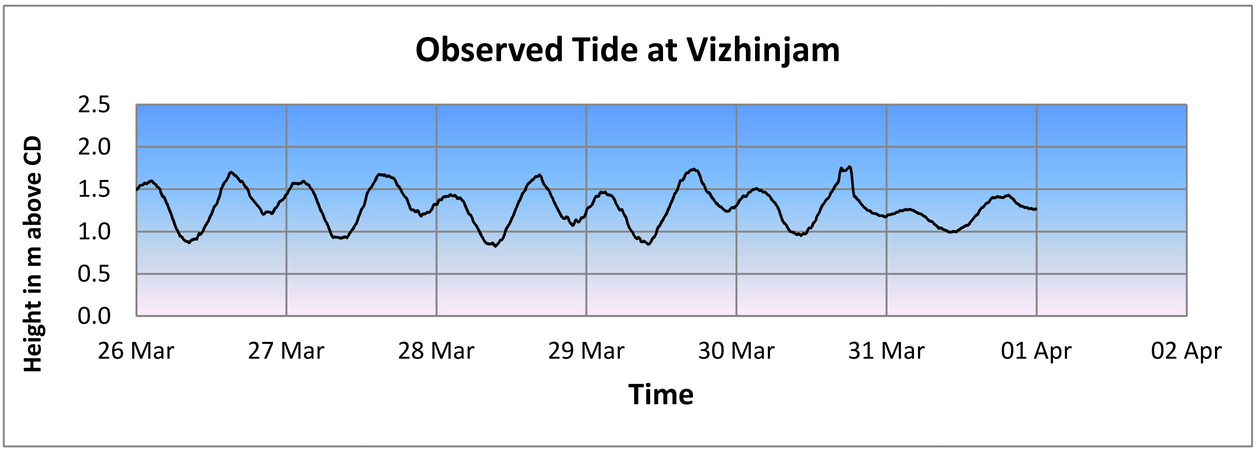

Observed Tide at Vizhinjam
2.5
2.0
1.5
1.0
0.5
0.0
Height in m above CD
19 Feb
20 Feb
21 Feb
22 Feb
23 Feb
24 Feb
25 Feb
26 Feb
27 Feb
Time

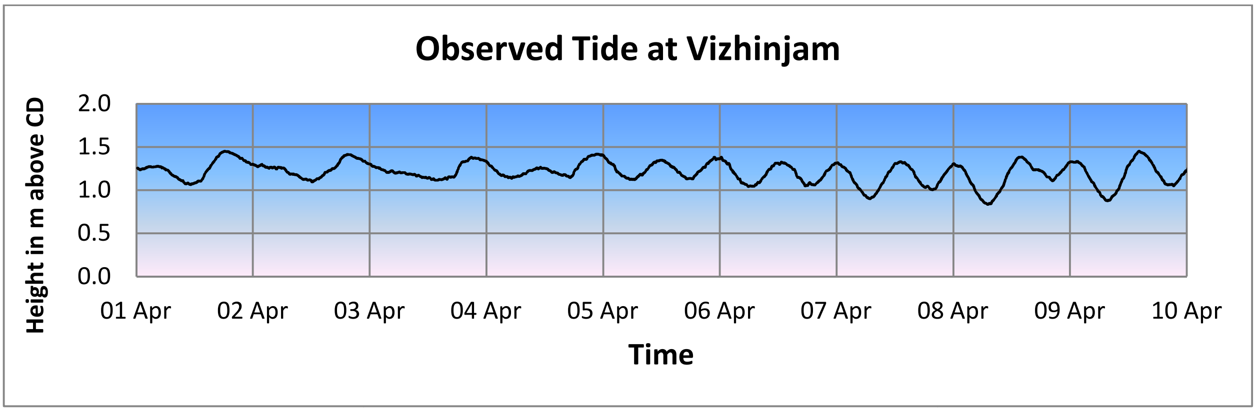

Observed Tide at Vizhinjam
2.5
2.0
1.5
1.0
0.5
0.0
Height in m above CD
27 Feb
28 Feb
29 Feb
01 Mar
02 Mar
03 Mar
04 Mar
05 Mar
Time

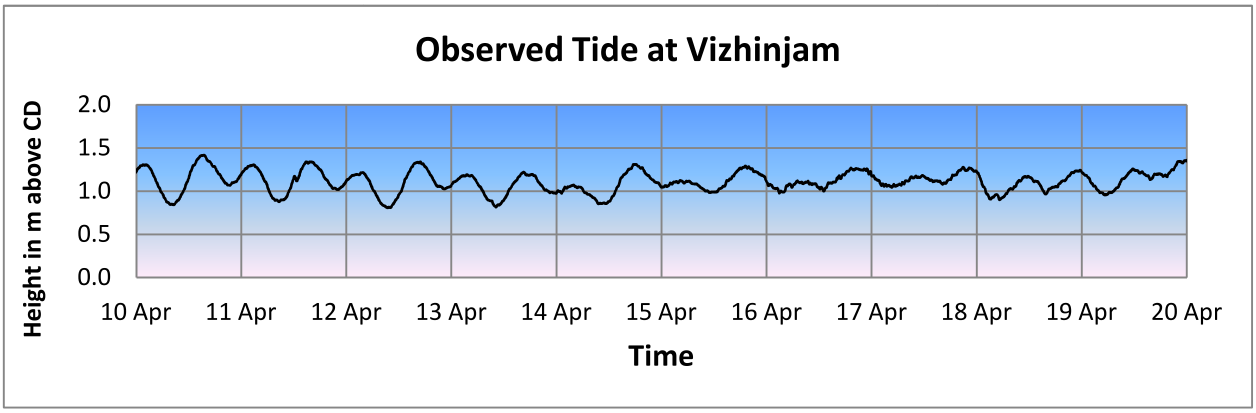

Observed Tide at Vizhinjam
2.5
2.0
1.5
1.0
0.5
0.0
Height in m above CD
05 Mar
06 Mar
07 Mar
08 Mar
09 Mar
10 Mar
11 Mar
12 Mar
Time

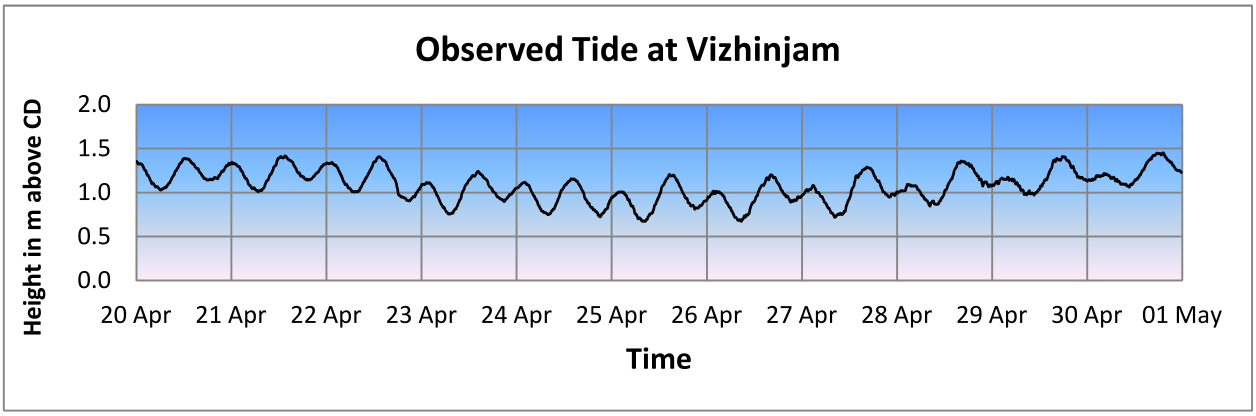

Observed Tide at Vizhinjam
Height in m above CD
2.5
2.0
1.5
1.0
0.5
0.0
12 Mar
13 Mar
14 Mar
15 Mar
16 Mar
17 Mar
18 Mar
19 Mar
Time

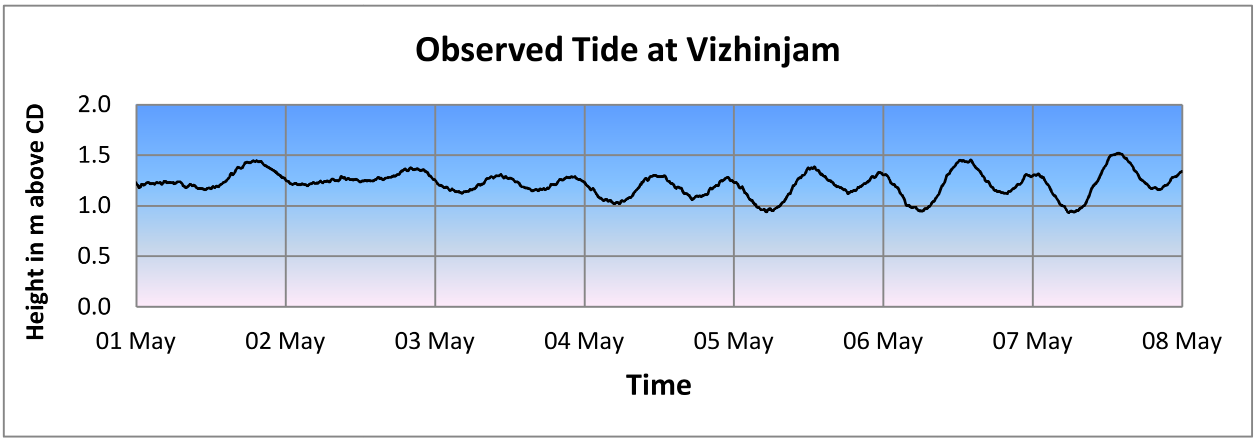

Observed Tide at Vizhinjam
Height in m above CD
2.5
2.0
1.5
1.0
0.5
0.0
19 Mar
20 Mar
21 Mar
22 Mar
23 Mar
24 Mar
25 Mar
26 Mar
Time

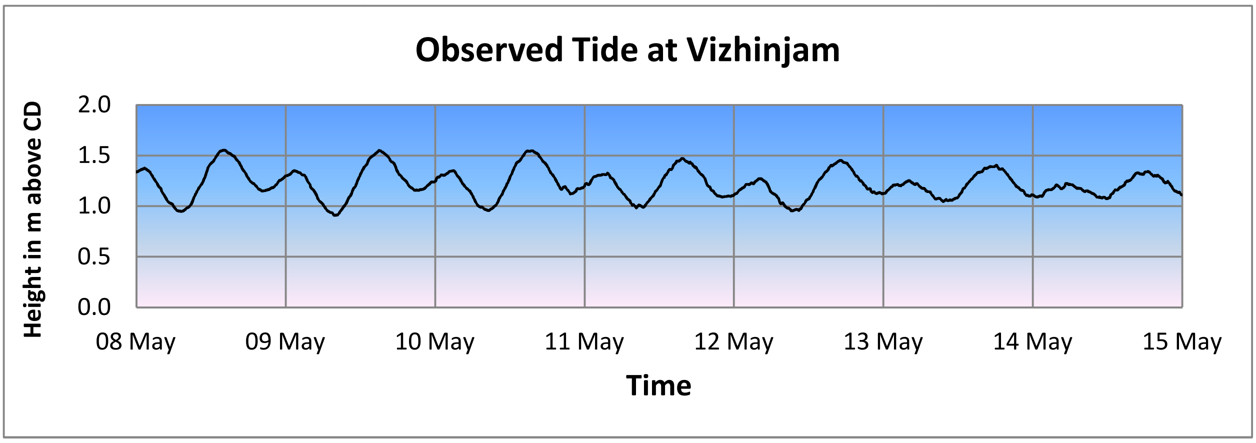

Observed Tide at Vizhinjam
Height in m above CD
2.5
2.0
1.5
1.0
0.5
0.0
26 Mar
27 Mar
28 Mar
29 Mar
30 Mar
31 Mar
01 Apr
02 Apr
Time

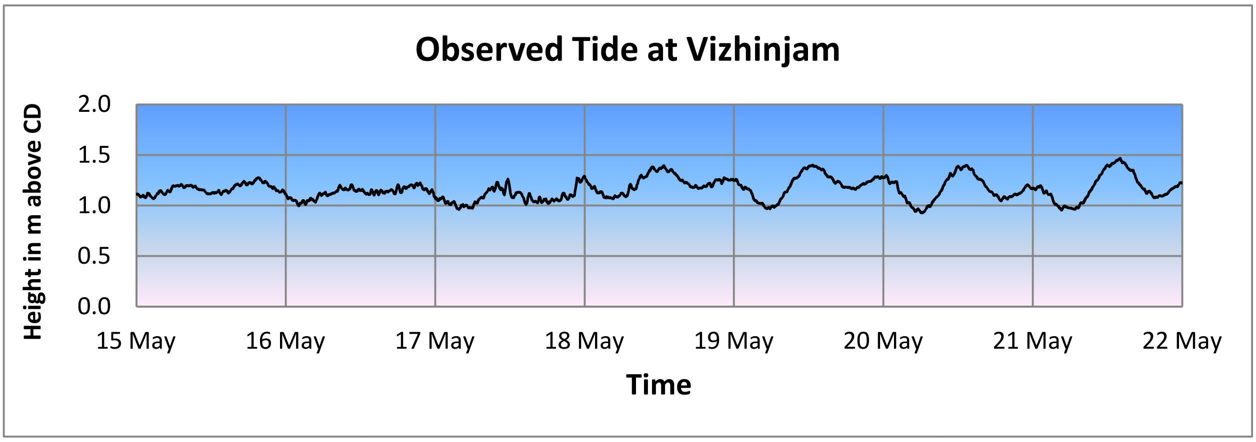

Observed Tide at Vizhinjam
Height in m above CD
2.0
1.5
1.0
0.5
0.0
01 Apr 02 Apr 03 Apr 04 Apr 05 Apr 06 Apr 07 Apr 08 Apr 09 Apr 10 Apr
Time

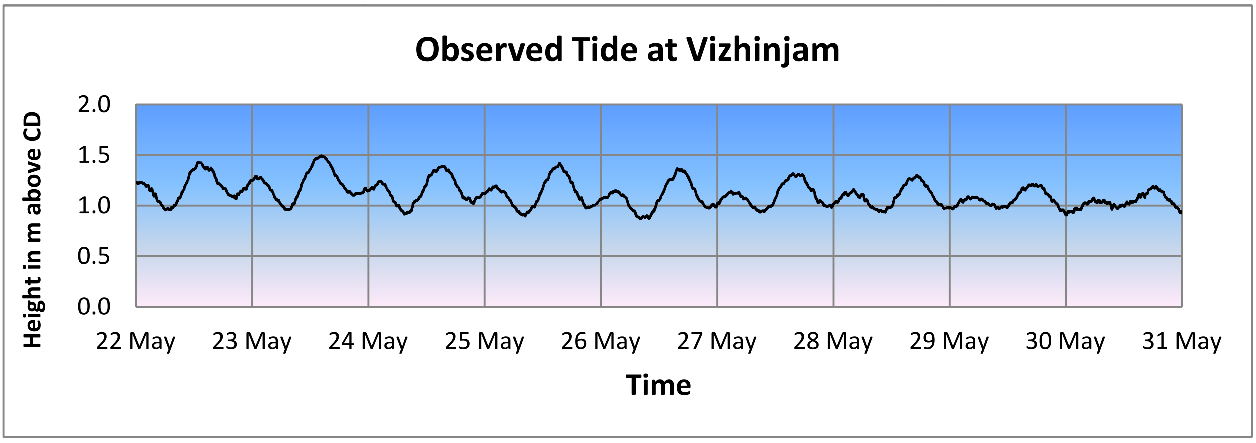

Observed Tide at Vizhinjam
Height in m above CD
2.0
1.5
1.0
0.5
0.0
10 Apr 11 Apr 12 Apr 13 Apr 14 Apr 15 Apr 16 Apr 17 Apr 18 Apr 19 Apr 20 Apr
Time


Observed Tide at Vizhinjam
Height in m above CD
2.0
1.5
1.0
0.5
0.0
20 Apr 21 Apr 22 Apr 23 Apr 24 Apr 25 Apr 26 Apr 27 Apr 28 Apr 29 Apr 30 Apr 01 May
Time


Observed Tide at Vizhinjam
Height in m above CD
2.0
1.5
1.0
0.5
0.0
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
Time

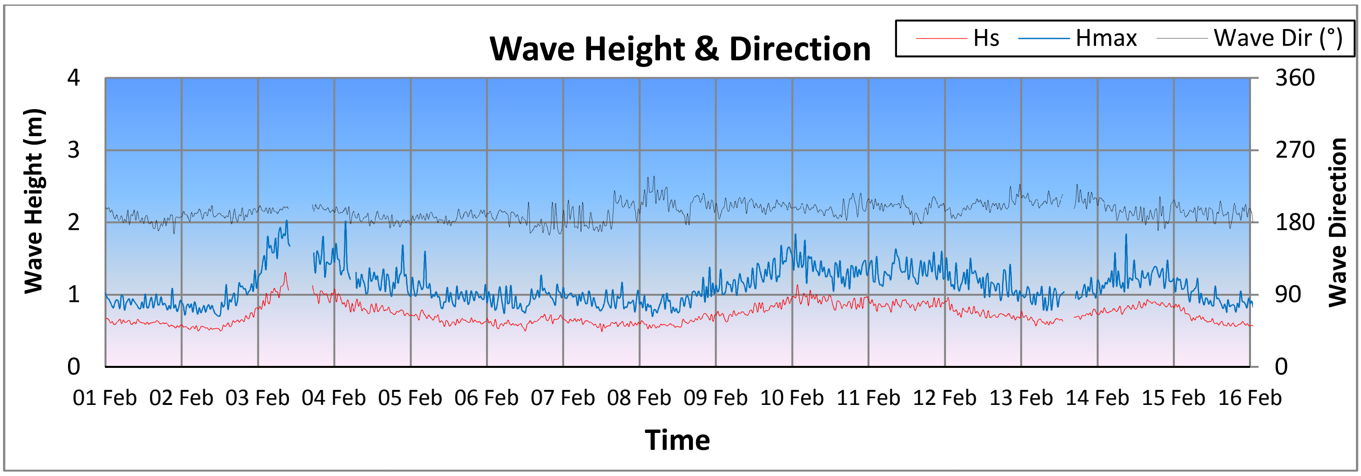

Observed Tide at Vizhinjam
Height in m above CD
2.0
1.5
1.0
0.5
0.0
08 May
09 May
10 May
11 May
12 May
13 May
14 May
15 May
Time

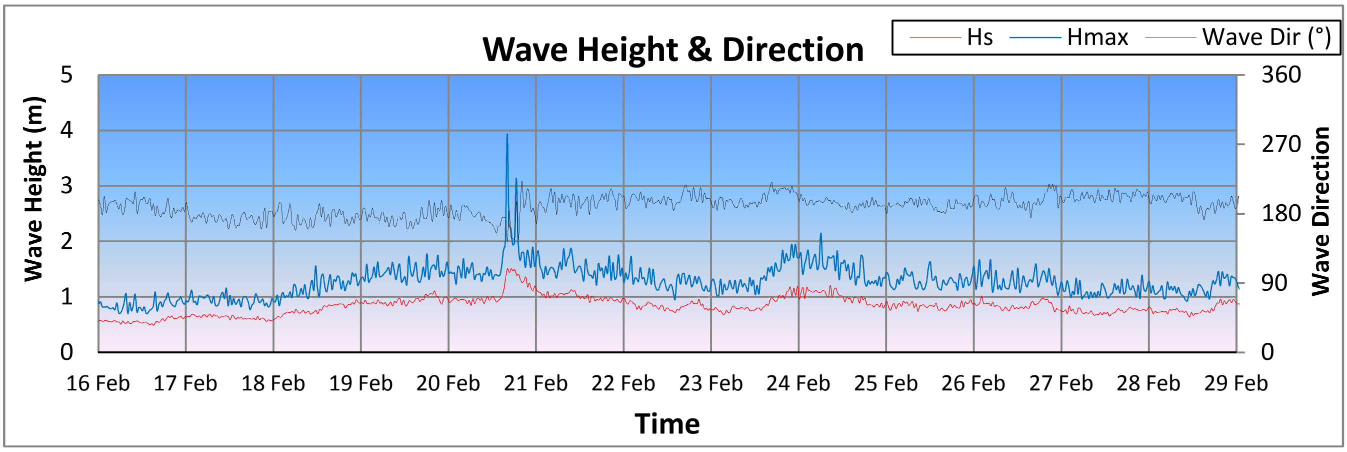

Observed Tide at Vizhinjam
Height in m above CD
2.0
1.5
1.0
0.5
0.0
15 May
16 May
17 May
18 May
19 May
20 May
21 May
22 May
Time

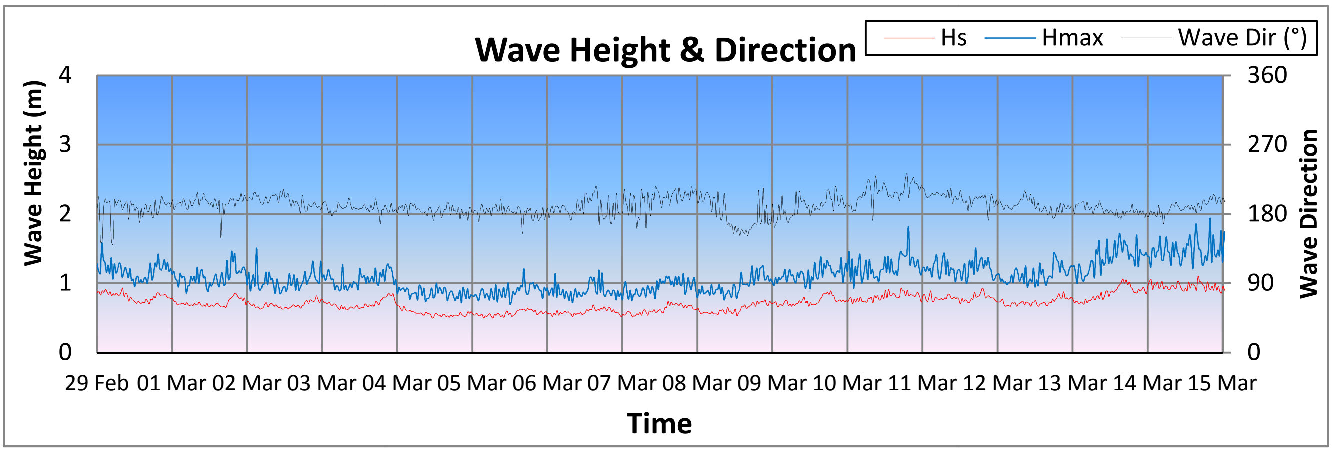

Observed Tide at Vizhinjam
Height in m above CD
2.0
1.5
1.0
0.5
0.0
22 May
23 May
24 May
25 May
26 May
27 May
28 May
29 May
30 May
31 May
Time

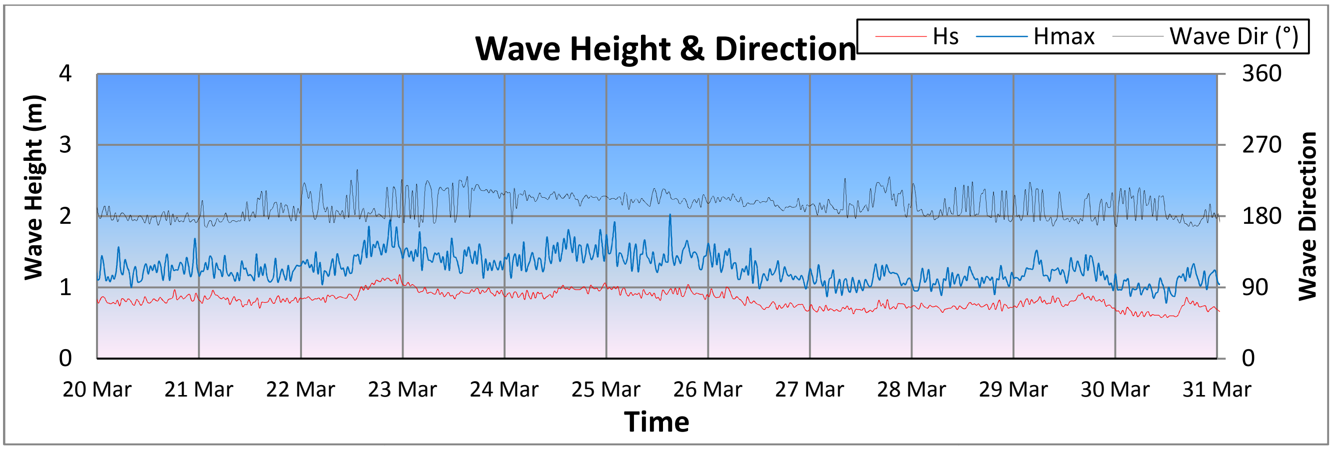
Annexure II

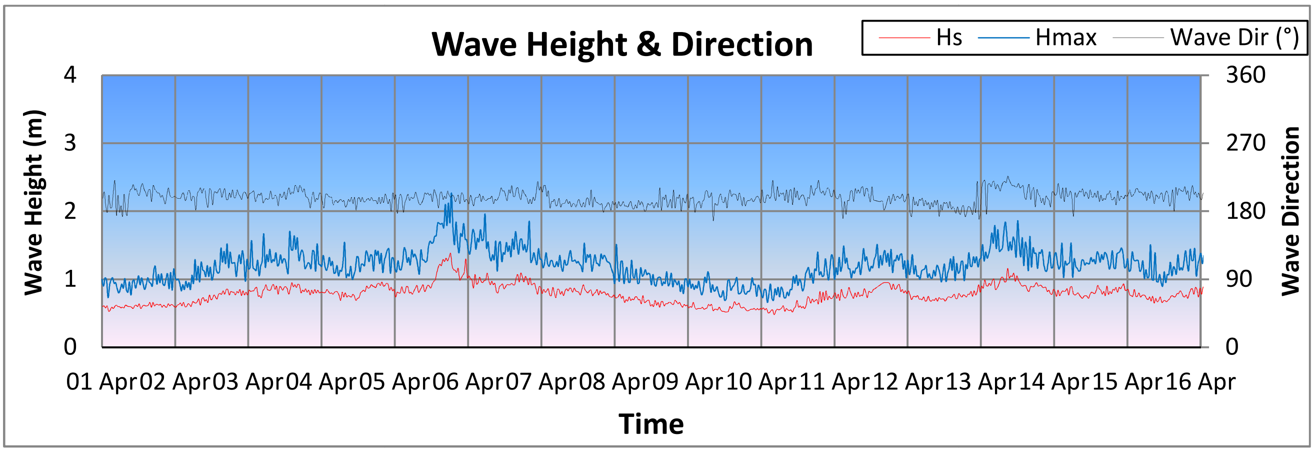
Wave Data

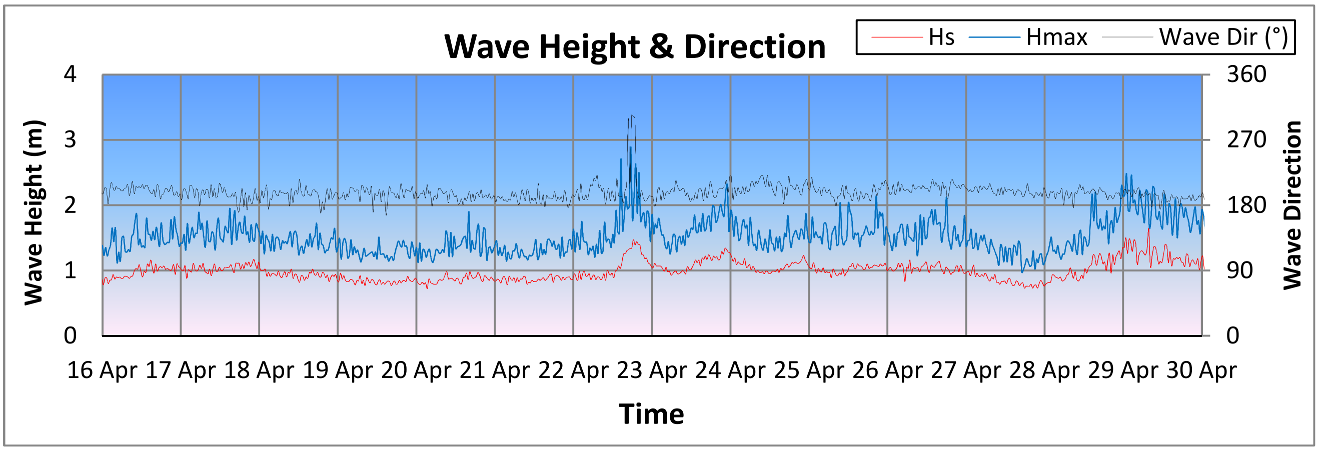

Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Wave Height (m)
Wave Direction
4
3
2
1
0
360
270
180
90
0
01 Feb 02 Feb 03 Feb 04 Feb 05 Feb 06 Feb 07 Feb 08 Feb 09 Feb 10 Feb 11 Feb 12 Feb 13 Feb 14 Feb 15 Feb 16 Feb
Time

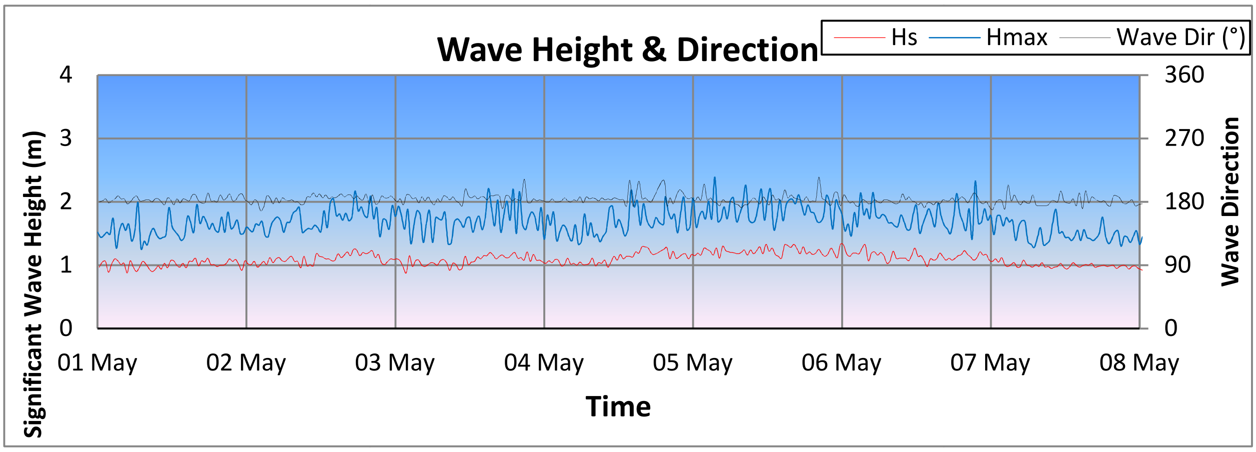

Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Wave Height (m)
Wave Direction
5
4
3
2
1
0
360
270
180
90
0
16 Feb 17 Feb 18 Feb 19 Feb 20 Feb 21 Feb 22 Feb 23 Feb 24 Feb 25 Feb 26 Feb 27 Feb 28 Feb 29 Feb
Time

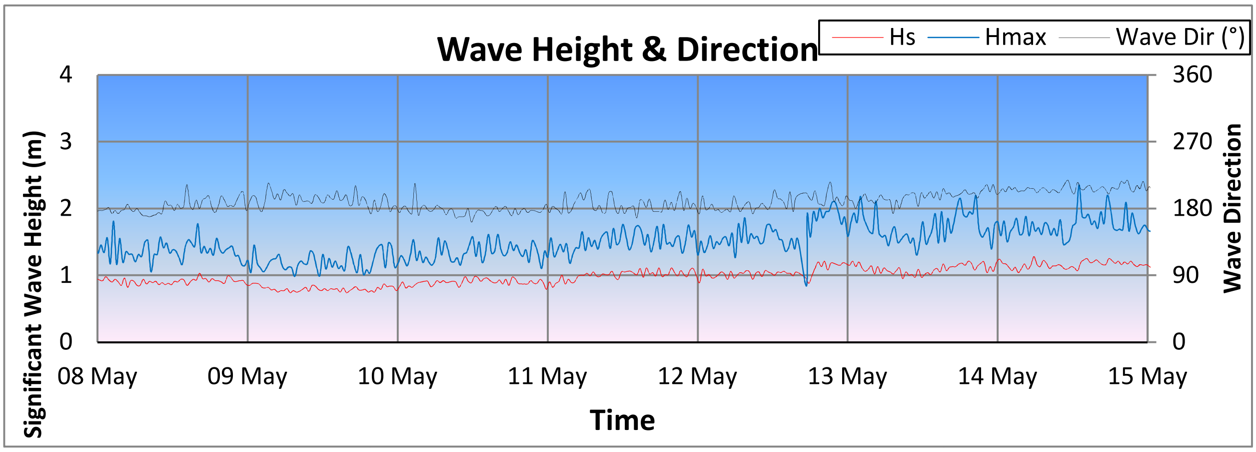

Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Wave Height (m)
Wave Direction
4
3
2
1
0
360
270
180
90
0
29 Feb 01 Mar 02 Mar 03 Mar 04 Mar 05 Mar 06 Mar 07 Mar 08 Mar 09 Mar 10 Mar 11 Mar 12 Mar 13 Mar 14 Mar 15 Mar
Time

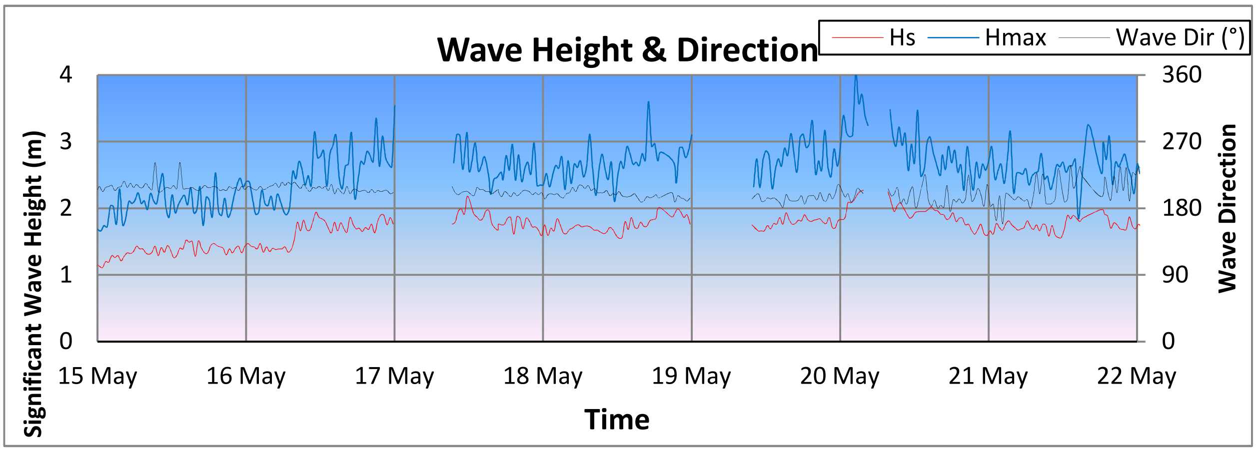

Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Wave Height (m)
Wave Direction
0
1
2
3
4
0
90
180
270
360
20 Mar
21 Mar
22 Mar
23 Mar
24 Mar
25 Mar
26 Mar
27 Mar
28 Mar
29 Mar
30 Mar
31 Mar
Time

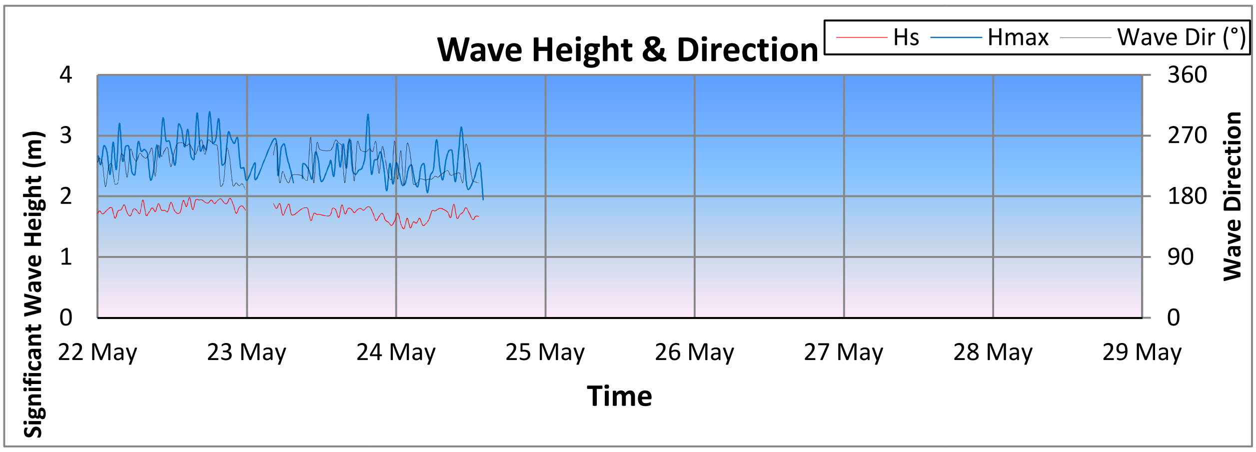

Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Wave Height (m)
Wave Direction
0
1
2
3
4
0
90
180
270
360
01 Apr
02 Apr
03 Apr
04 Apr
05 Apr
06 Apr
07 Apr
08 Apr
09 Apr
10 Apr
11 Apr
12 Apr
13 Apr
14 Apr
15 Apr
16 Apr
Time


Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Wave Height (m)
Wave Direction
0
1
2
3
4
0
90
180
270
360
16 Apr
17 Apr
18 Apr
19 Apr
20 Apr
21 Apr
22 Apr
23 Apr
24 Apr
25 Apr
26 Apr
27 Apr
28 Apr
29 Apr
30 Apr
Time


Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Significant Wave Height (m)
Wave Direction
Time
0
1
2
3
4
0
90
180
270
360
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May

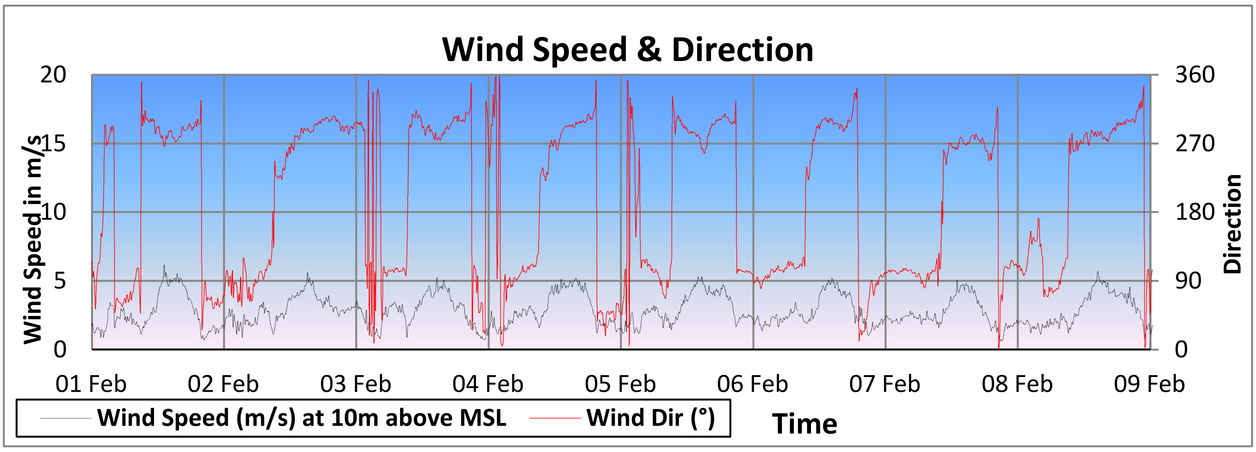

Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Significant Wave Height (m)
Wave Direction
Time
0
1
2
3
4
0
90
180
270
360
08 May
09 May
10 May
11 May
12 May
13 May
14 May
15 May


Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Significant Wave Height (m)
Wave Direction
Time
0
1
2
3
4
0
90
180
270
360
15 May
16 May
17 May
18 May
19 May
20 May
21 May
22 May


Wave Height & Direction
Hs
Hmax
Wave Dir (°)
Significant Wave Height (m)
Wave Direction
Time
0
1
2
3
4
0
90
180
270
360
22 May
23 May
24 May
25 May
26 May
27 May
28 May
29 May

Annexure III

Wind Data


Wind Speed & Direction
Wind Speed in m/s
Direction
20
15
10
5
0
360
270
180
90
0
01 Feb
02 Feb
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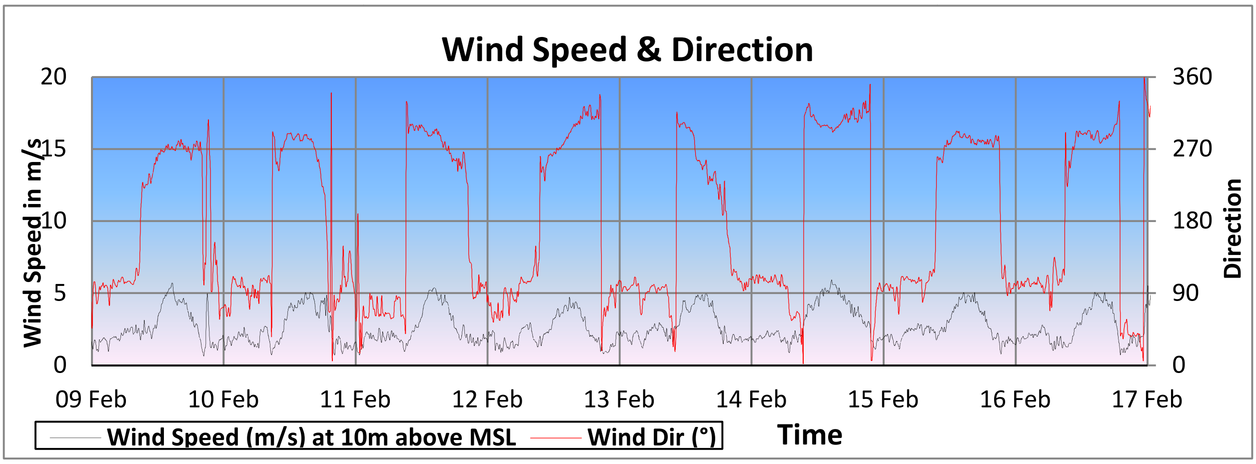
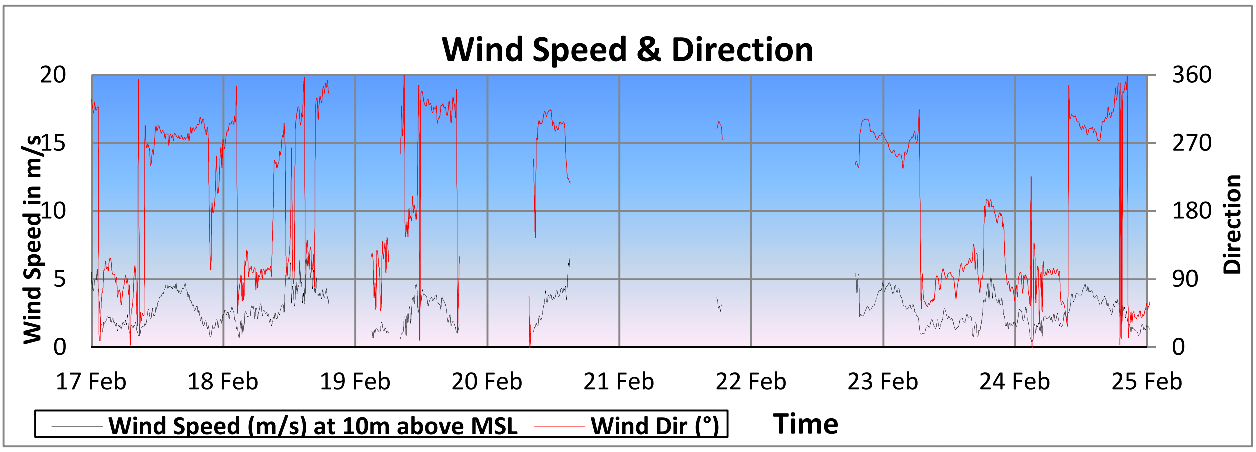
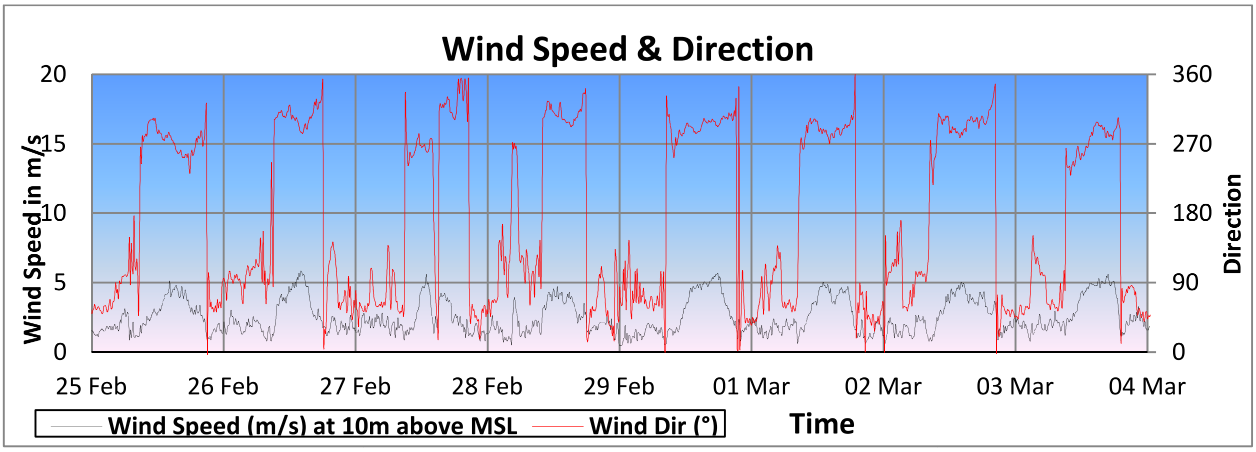
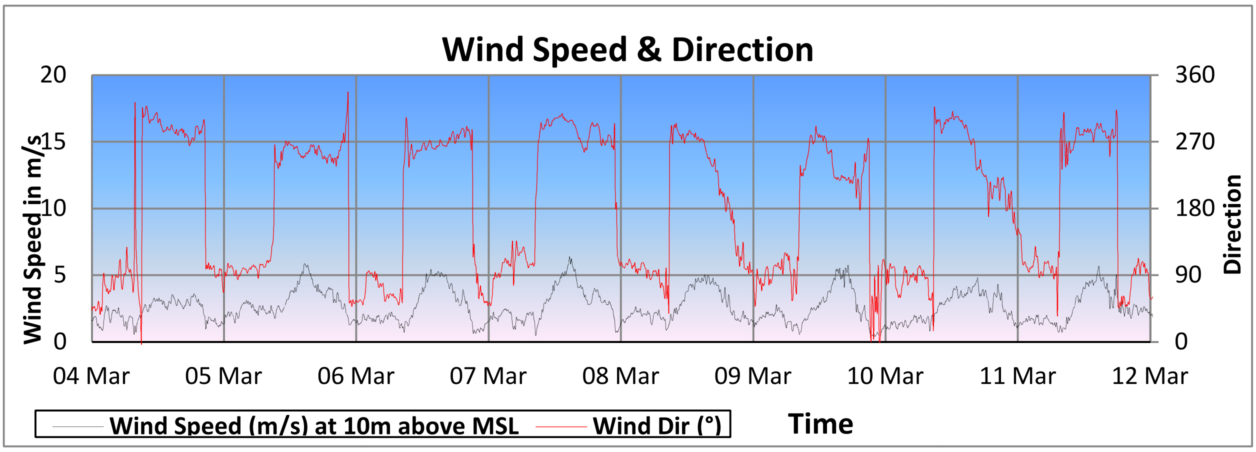
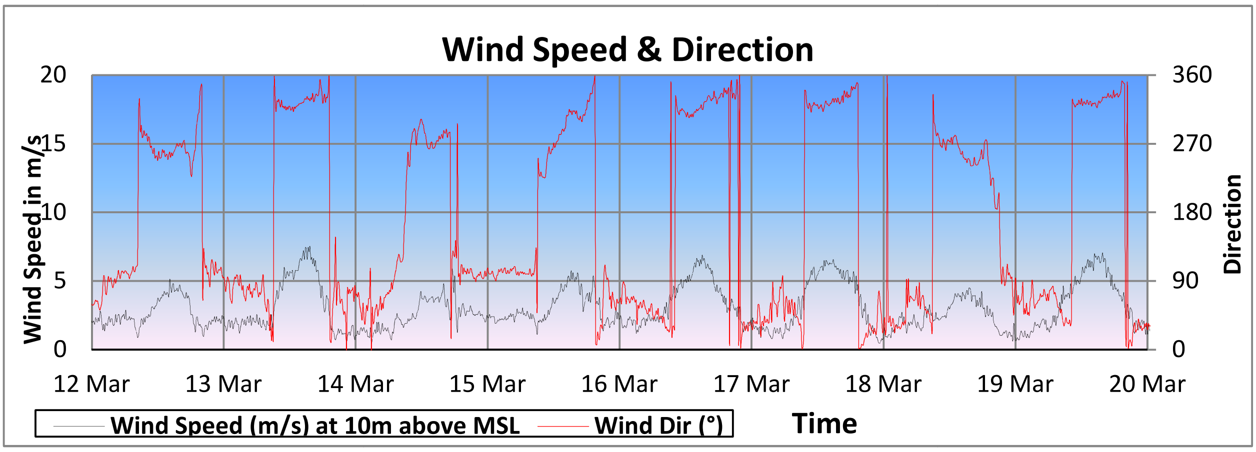
04 Feb
05 Feb
06 Feb
07 Feb
08 Feb
09 Feb
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

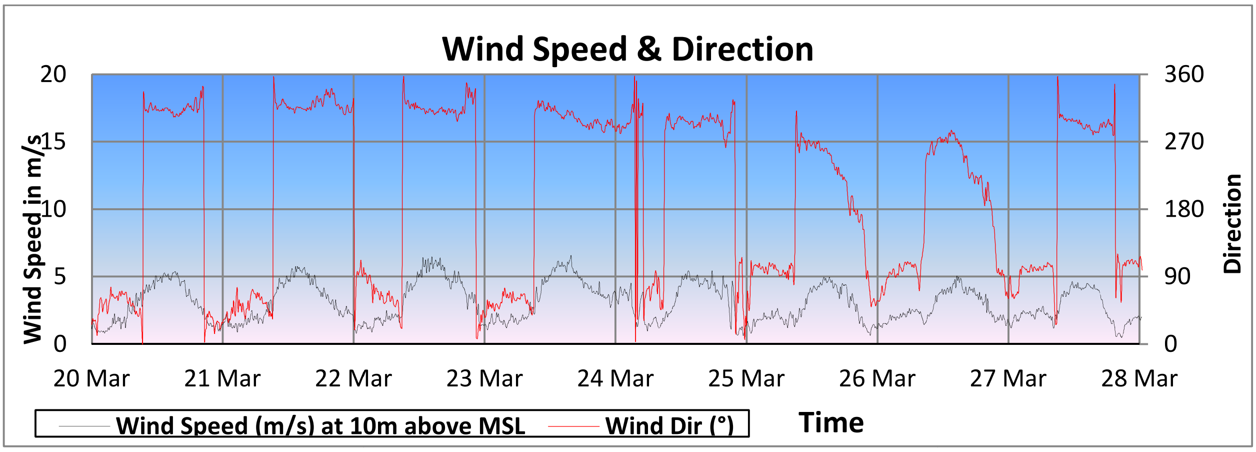

Wind Speed & Direction
Wind Speed in m/s
Direction
20
15
10
5
0
360
270
180
90
0
09 Feb
10 Feb
11 Feb
12 Feb
13 Feb
14 Feb
15 Feb
16 Feb
17 Feb
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

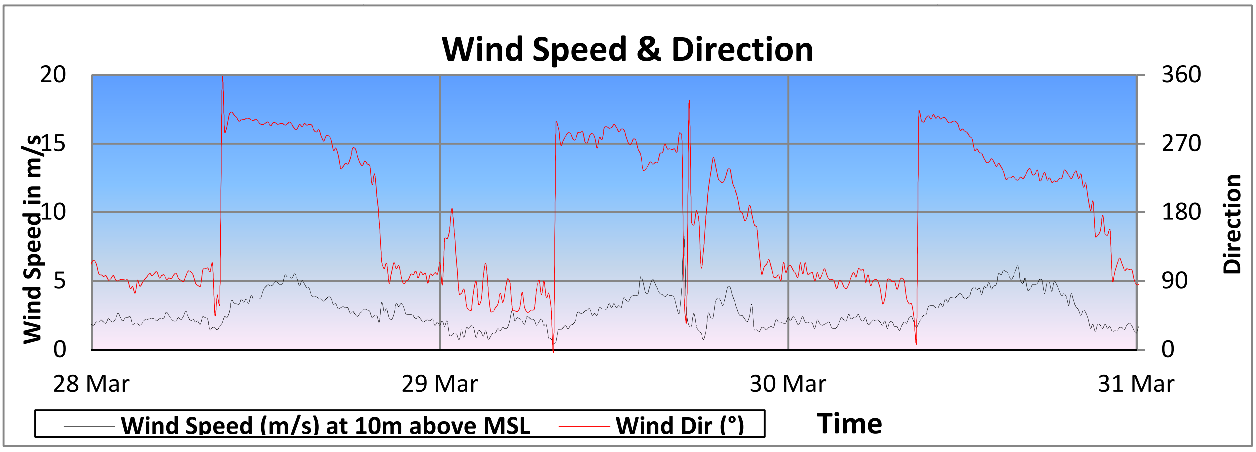

Wind Speed & Direction
Wind Speed in m/s
Direction
20
15
10
5
0
360
270
180
90
0
17 Feb
18 Feb
19 Feb
20 Feb
21 Feb
22 Feb
23 Feb
24 Feb
25 Feb
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

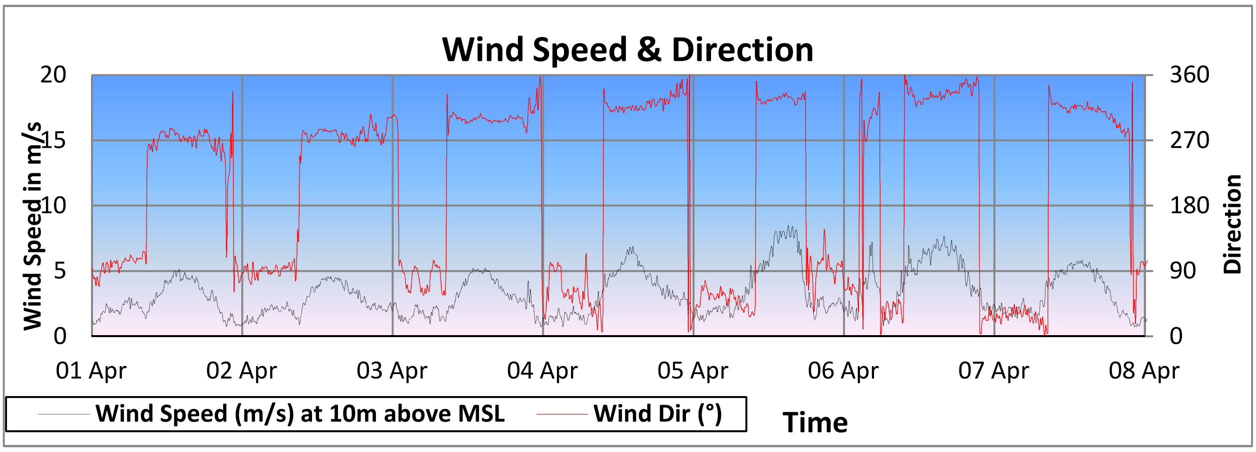

Wind Speed & Direction
20
15
10
5
0
Wind Speed in m/s
360
270
180
90
0
Direction
25 Feb
26 Feb
27 Feb
28 Feb
29 Feb
01 Mar
02 Mar
03 Mar
04 Mar
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

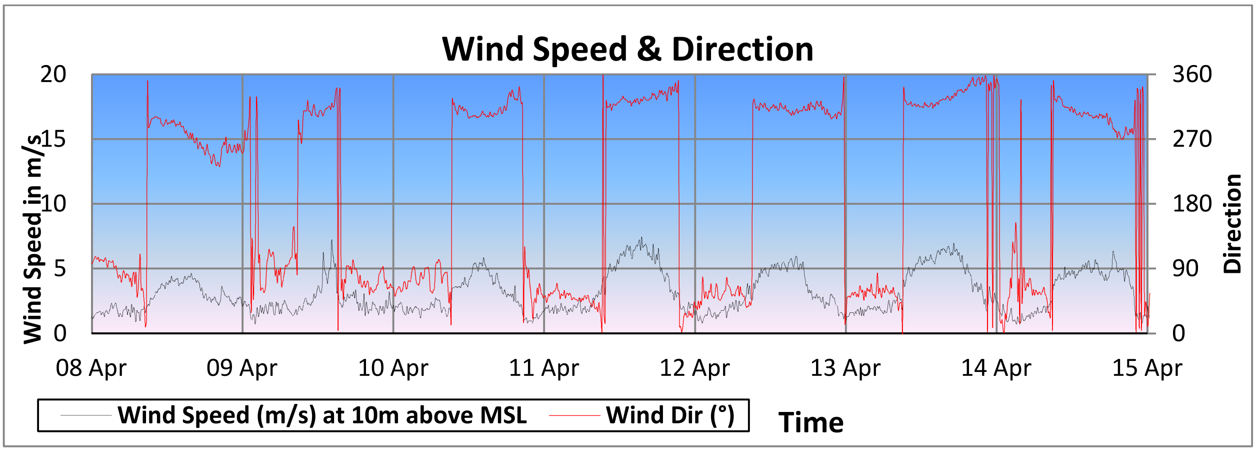

Wind Speed & Direction
20
15
10
5
0
Wind Speed in m/s
360
270
180
90
0
Direction
04 Mar
05 Mar
06 Mar
07 Mar
08 Mar
09 Mar
10 Mar
11 Mar
12 Mar
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

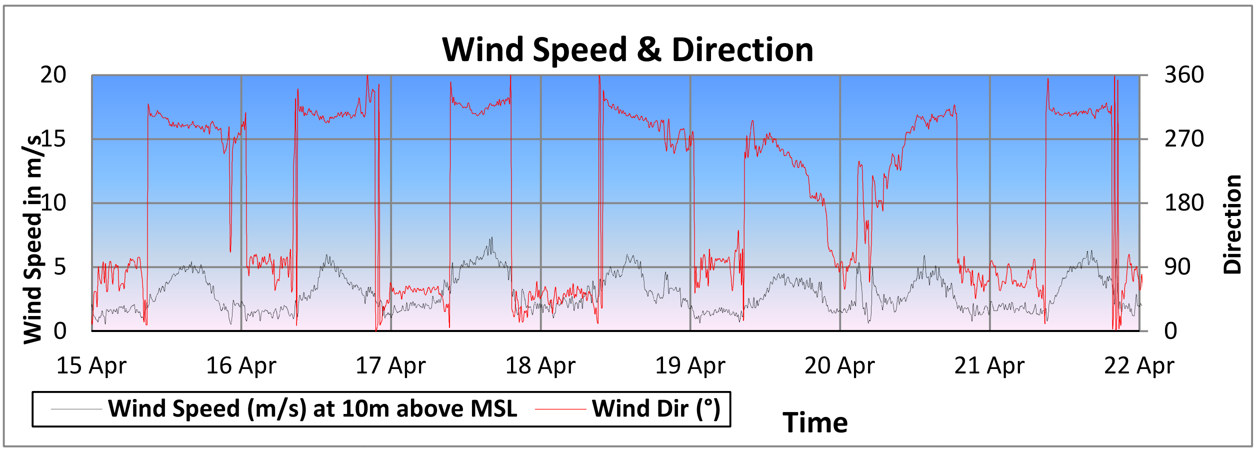

Wind Speed & Direction
20
15
10
5
0
Wind Speed in m/s
360
270
180
90
0
Direction
12 Mar
13 Mar
14 Mar
15 Mar
16 Mar
17 Mar
18 Mar
19 Mar
20 Mar
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

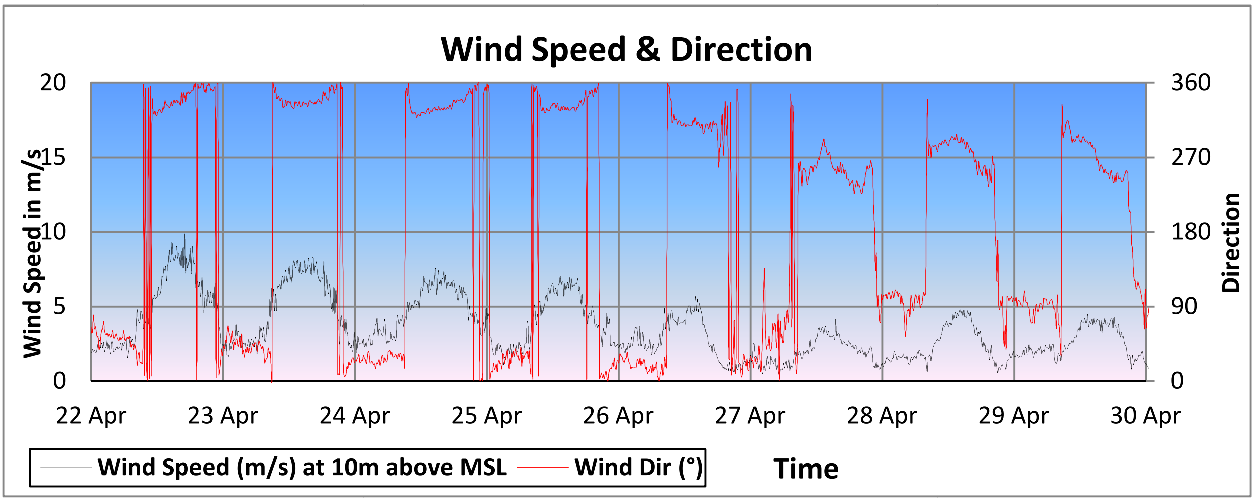

Wind Speed & Direction
20
15
10
5
0
Wind Speed in m/s
360
270
180
90
0
Direction
20 Mar
21 Mar
22 Mar
23 Mar
24 Mar
25 Mar
26 Mar
27 Mar
28 Mar
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

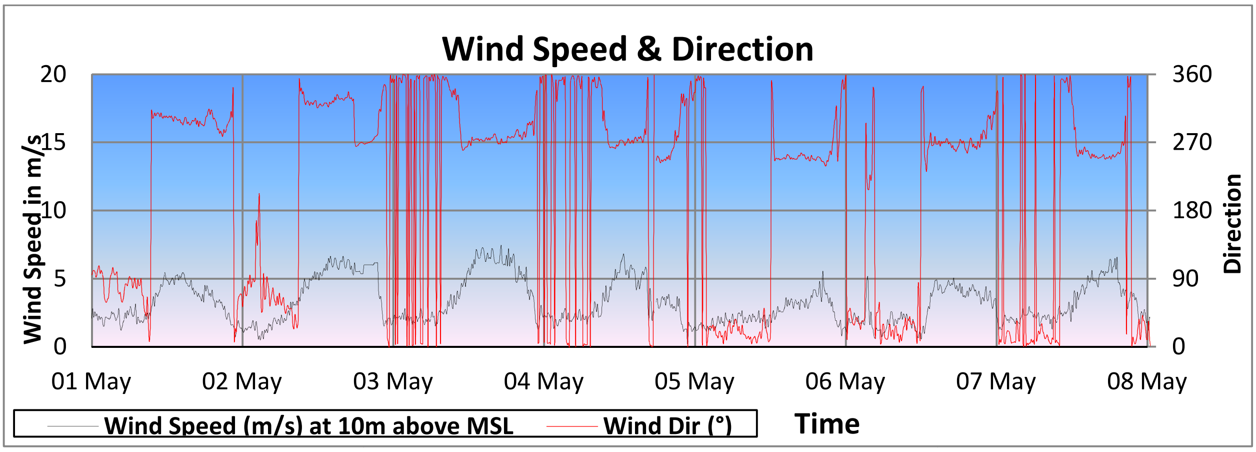

Wind Speed & Direction
20
15
10
5
0
Wind Speed in m/s
360
270
180
90
0
Direction
28 Mar
29 Mar
30 Mar
31 Mar
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

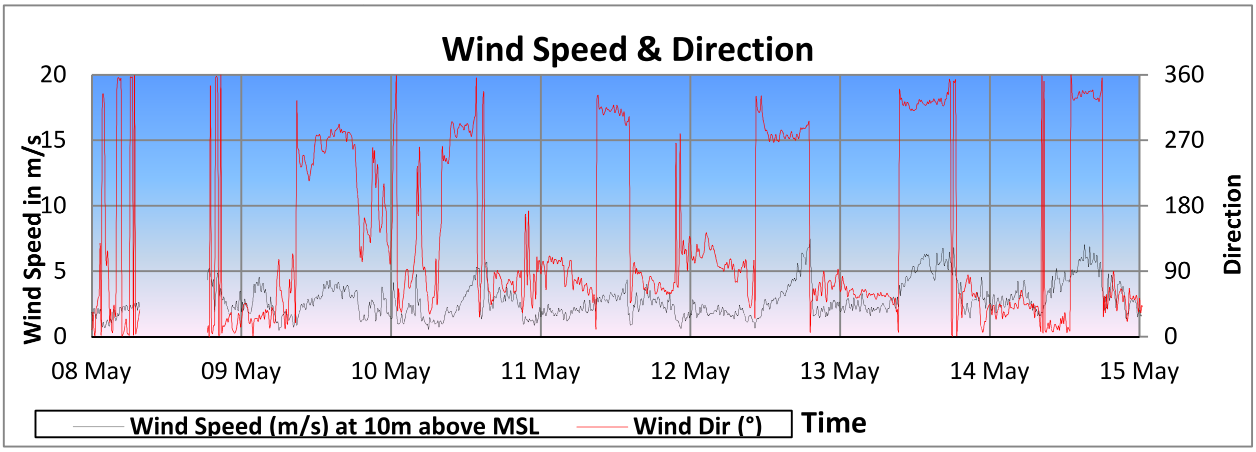

Wind Speed & Direction
20
15
10
5
0
Wind Speed in m/s
360
270
180
90
0
Direction
01 Apr
02 Apr
03 Apr
04 Apr
05 Apr
06 Apr
07 Apr
08 Apr
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

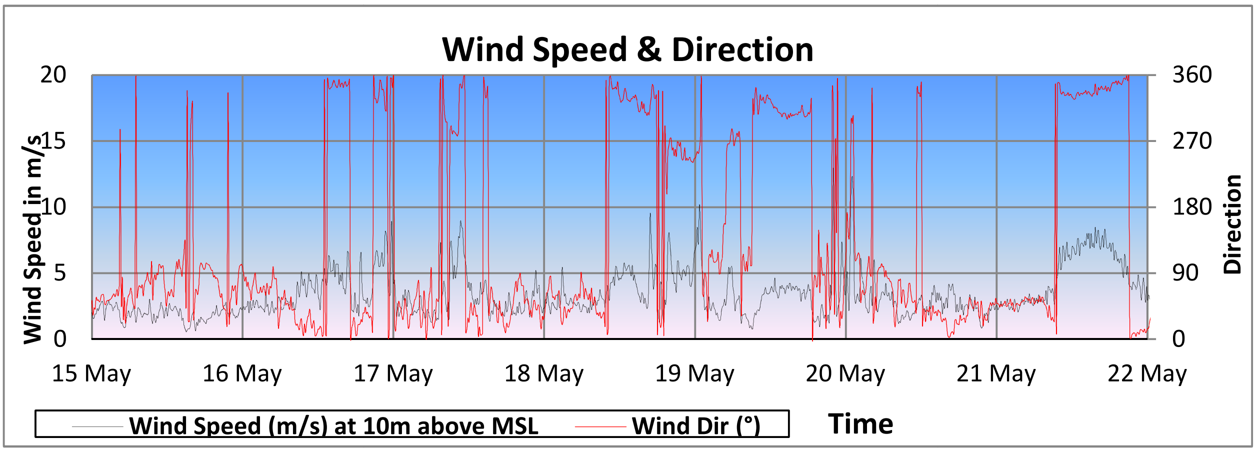

Wind Speed & Direction
Wind Speed in m/s
Direction
20
15
10
5
0
360
270
180
90
0
08 Apr
09 Apr
10 Apr
11 Apr
12 Apr
13 Apr
14 Apr
15 Apr
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

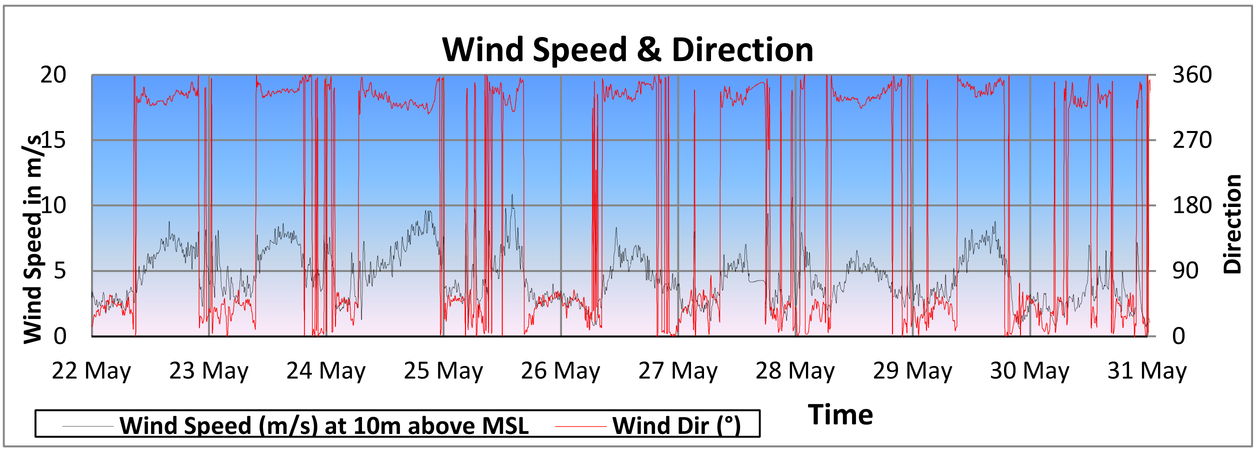

Wind Speed & Direction
Wind Speed in m/s
Direction
20
15
10
5
0
360
270
180
90
0
15 Apr
16 Apr
17 Apr
18 Apr
19 Apr
20 Apr
21 Apr
22 Apr
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time


Wind Speed & Direction
Wind Speed in m/s
Direction
20
15
10
5
0
360
270
180
90
0
22 Apr
23 Apr
24 Apr
25 Apr
26 Apr
27 Apr
28 Apr
29 Apr
30 Apr
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time


Wind Speed & Direction
Wind Speed in m/s
0
5
10
15
20
Direction
0
90
180
270
360
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time


Wind Speed & Direction
Wind Speed in m/s
0
5
10
15
20
Direction
0
90
180
270
360
08 May
09 May
10 May
11 May
12 May
13 May
14 May
15 May
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

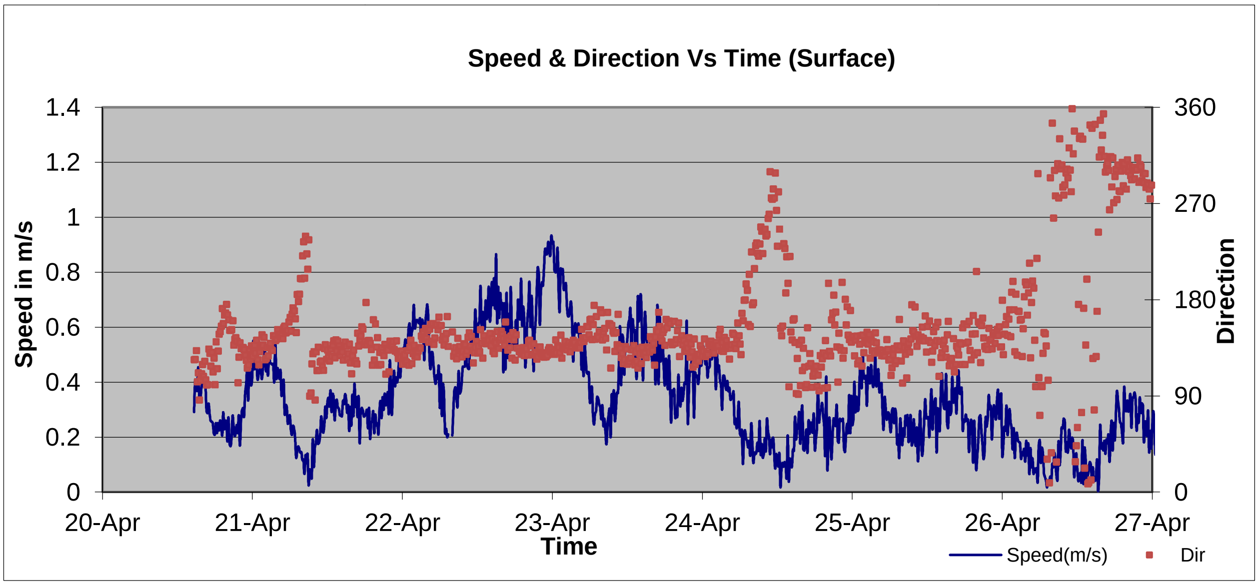

Wind Speed & Direction
Wind Speed in m/s
0
5
10
15
20
Direction
0
90
180
270
360
15 May
16 May
17 May
18 May
19 May
20 May
21 May
22 May
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

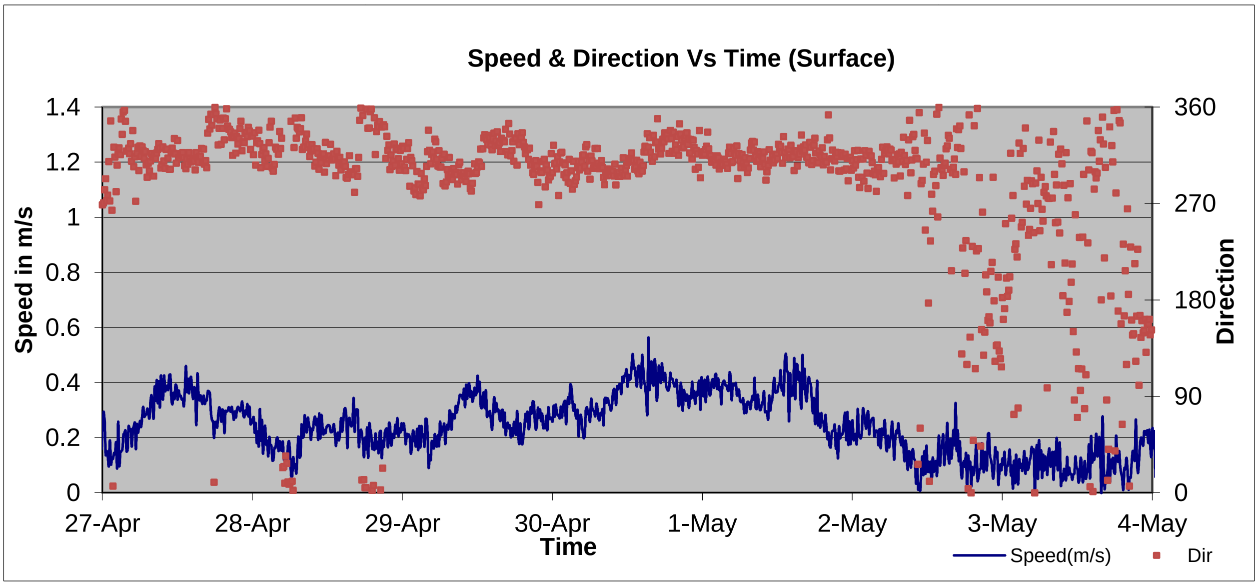

Wind Speed & Direction
Wind Speed in m/s
0
5
10
15
20
Direction
0
90
180
270
360
22 May
23 May
24 May
25 May
26 May
27 May
28 May
29 May
30 May
31 May
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

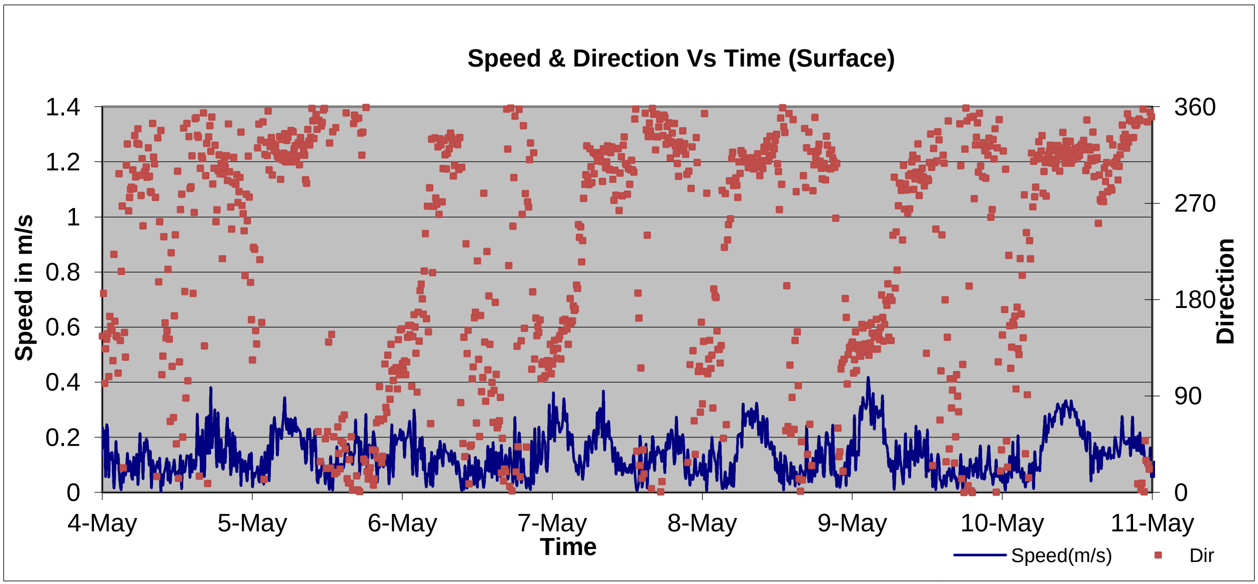
Annexure IV

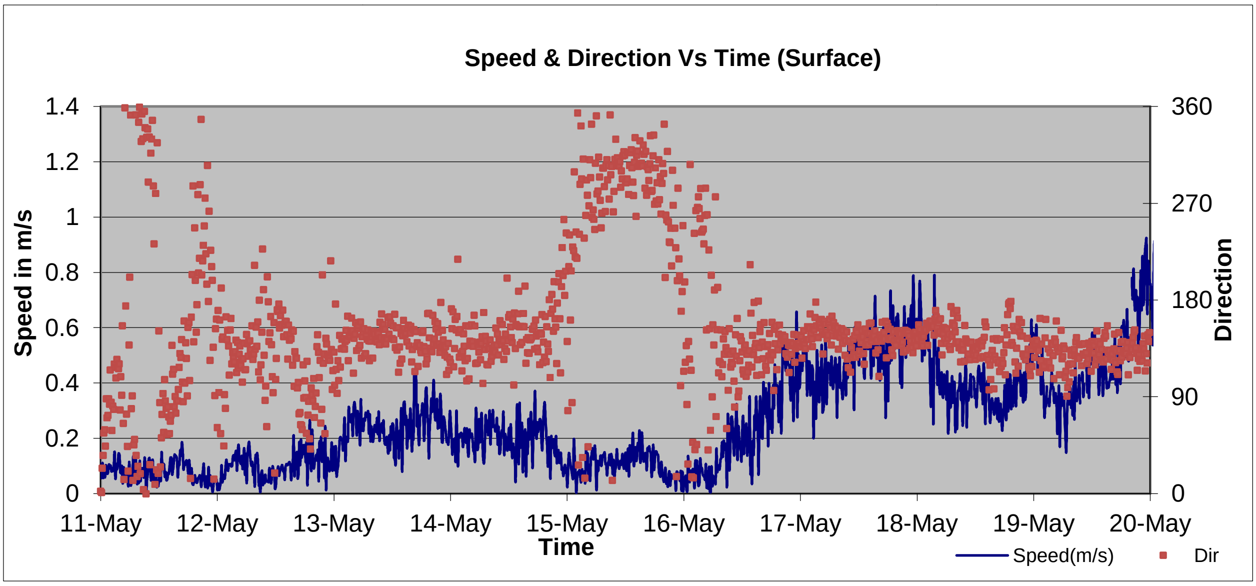
Current Data

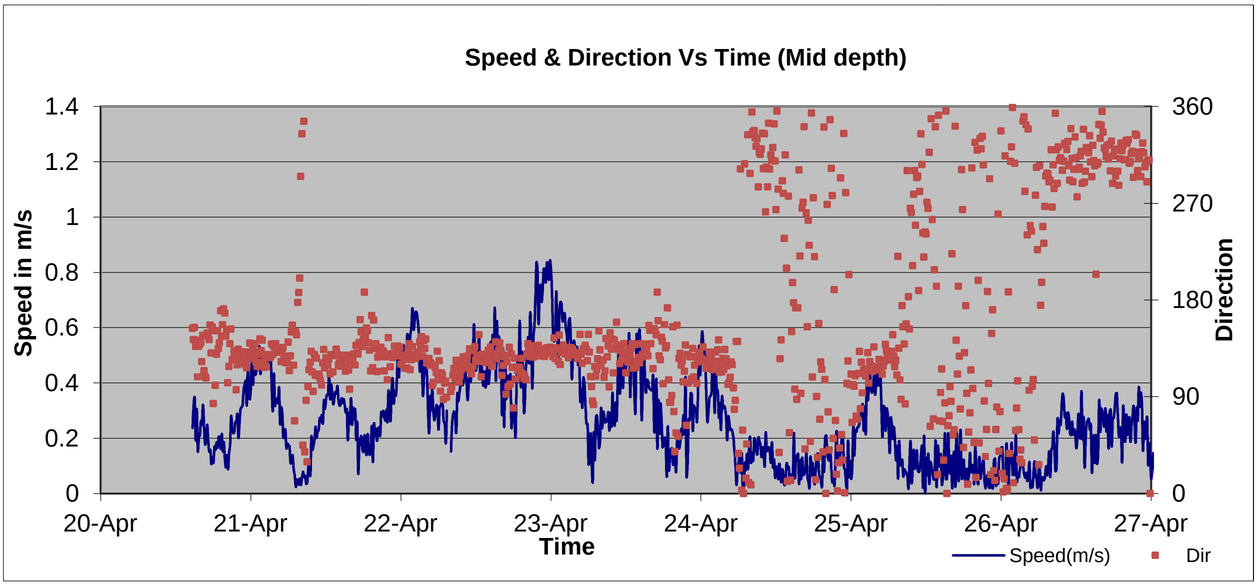
Current Data - Location P1

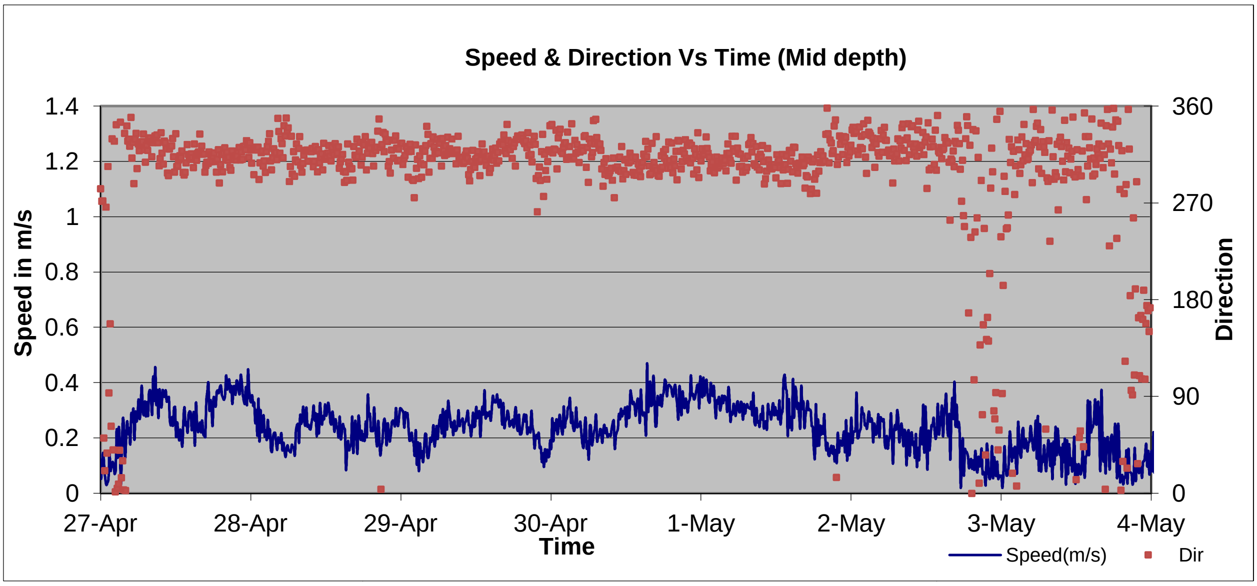

Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
Speed(m/s)
Dir
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr

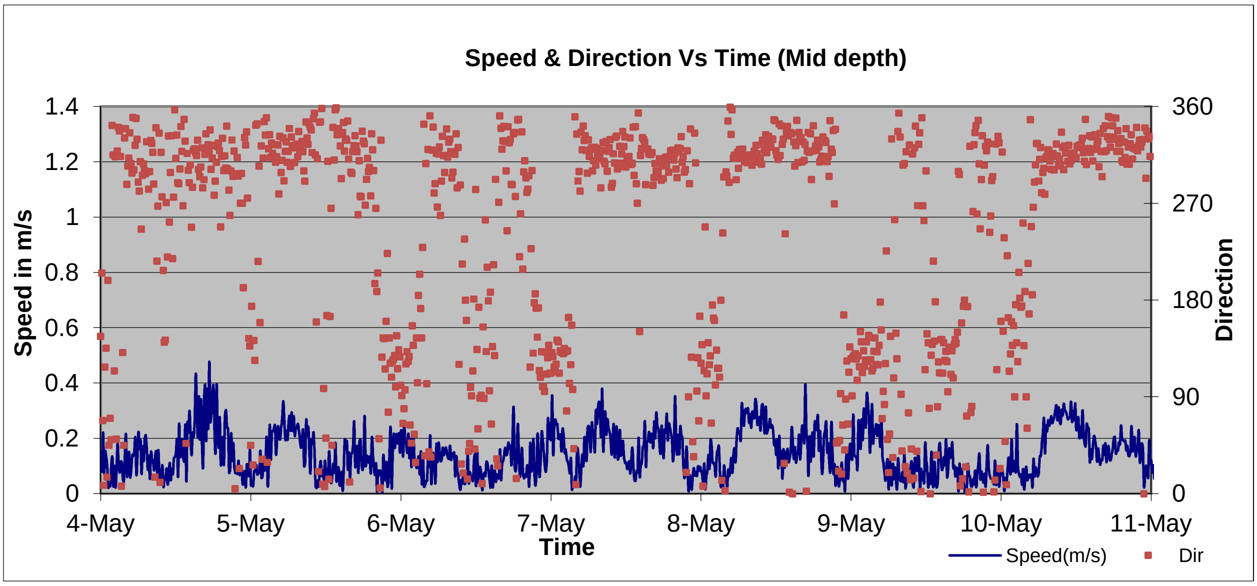

Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
Speed(m/s)
Dir
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May

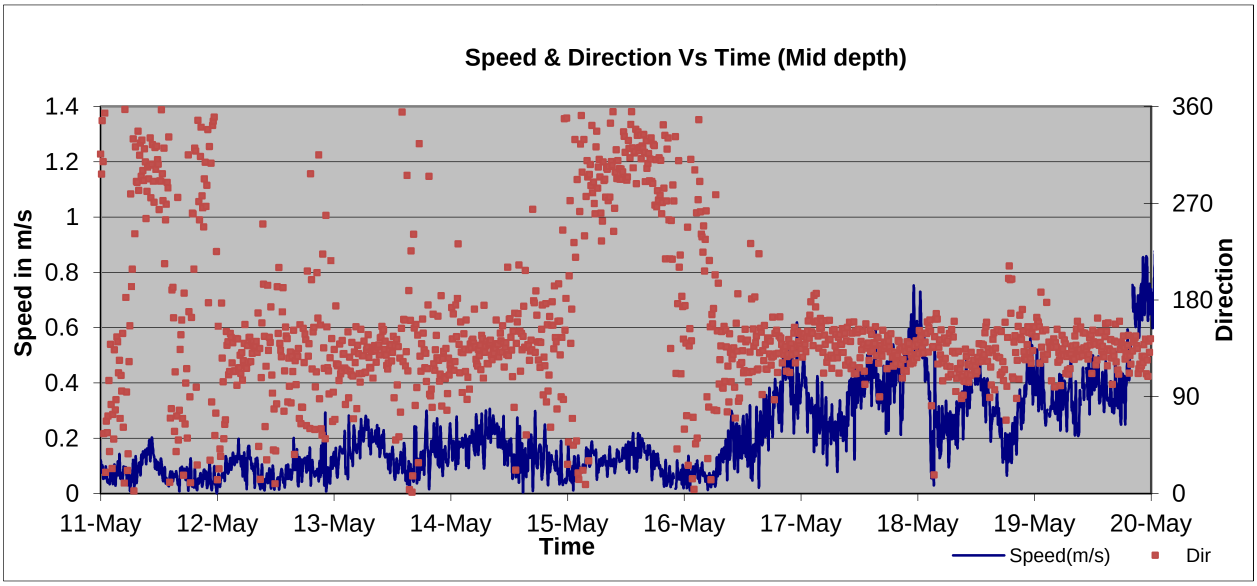

Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
Speed(m/s)
Dir
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May

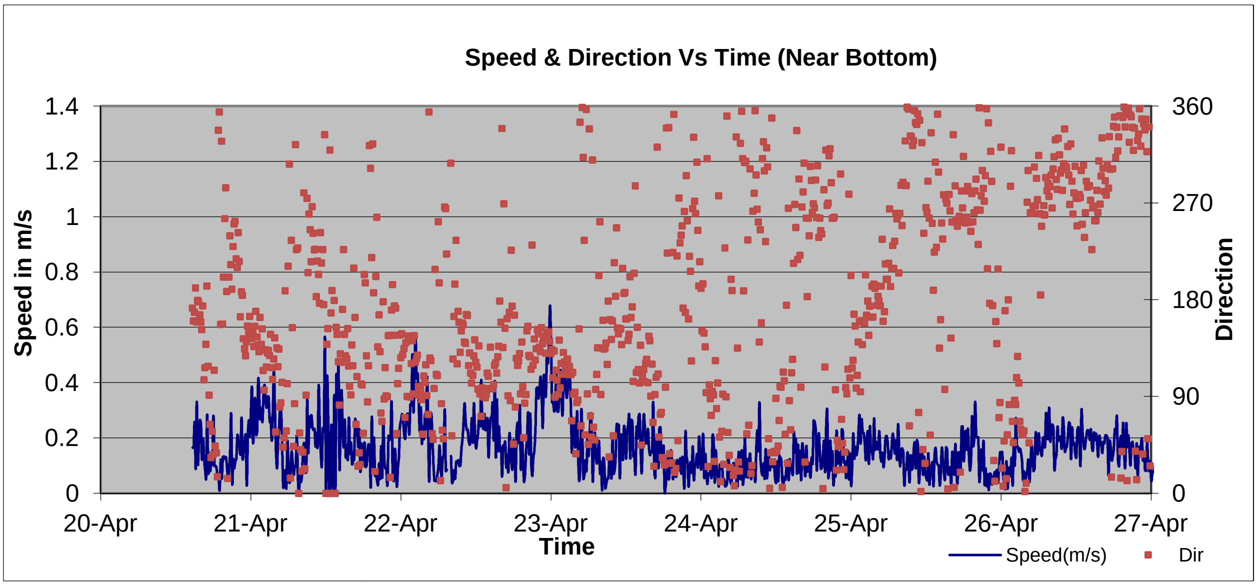

Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Speed(m/s)
Dir

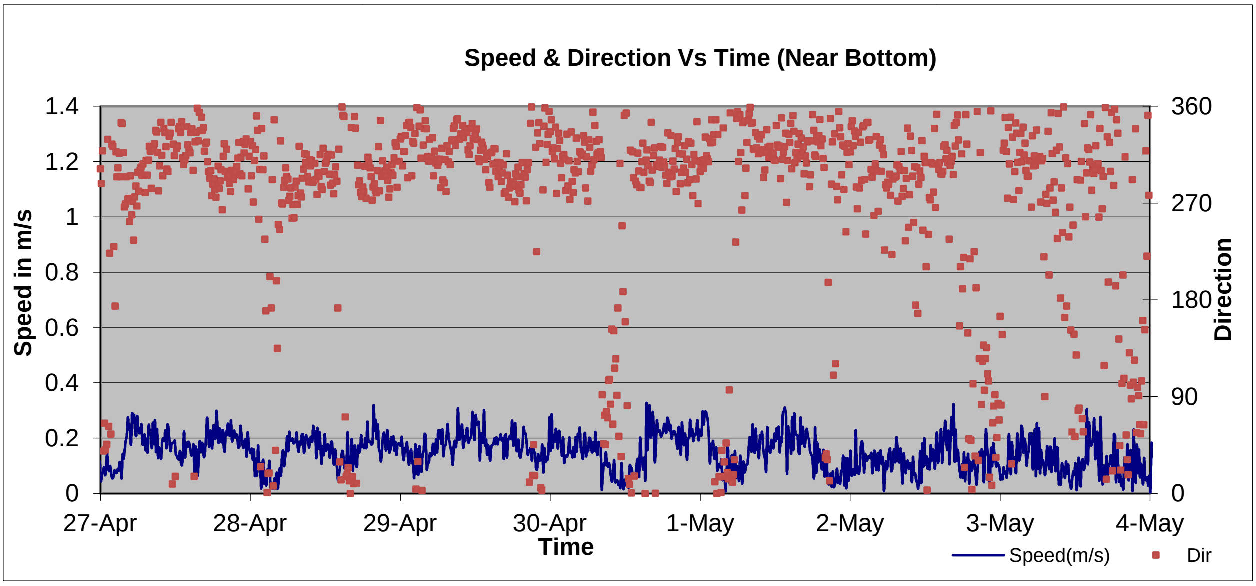

Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Speed(m/s)
Dir

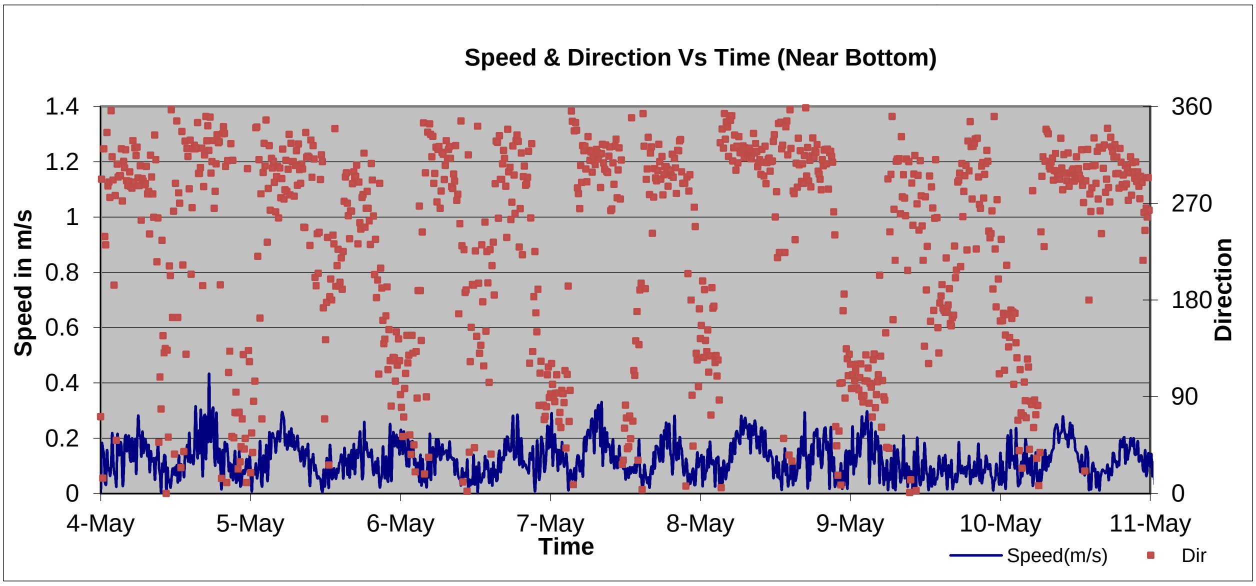

Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May
Speed(m/s)
Dir

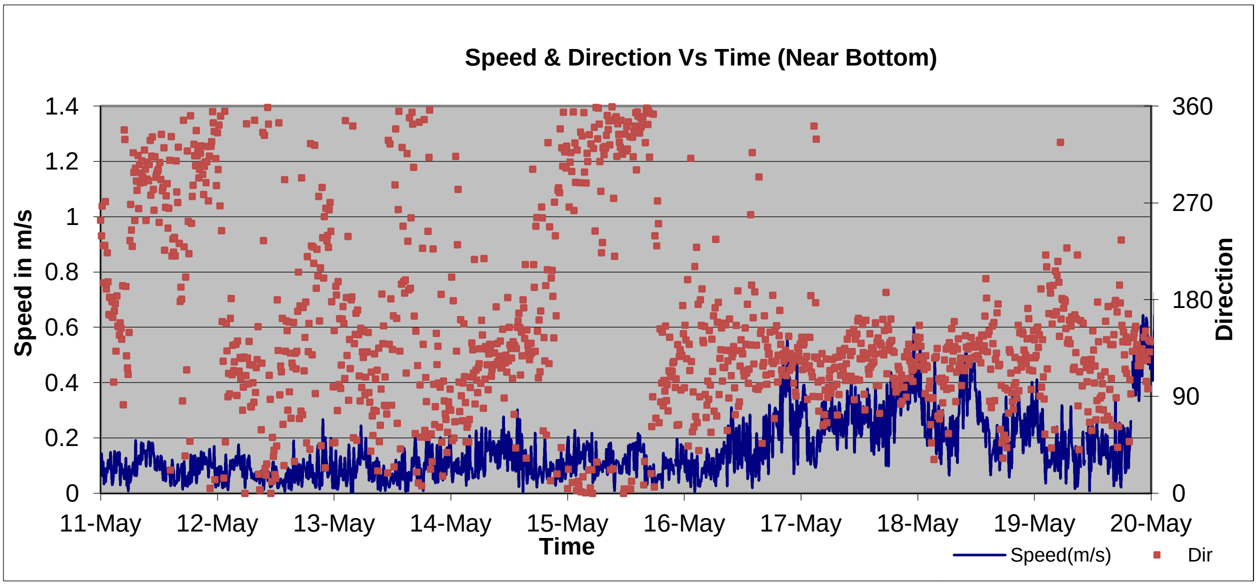

Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
Speed(m/s)
Dir


Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Speed(m/s)
Dir

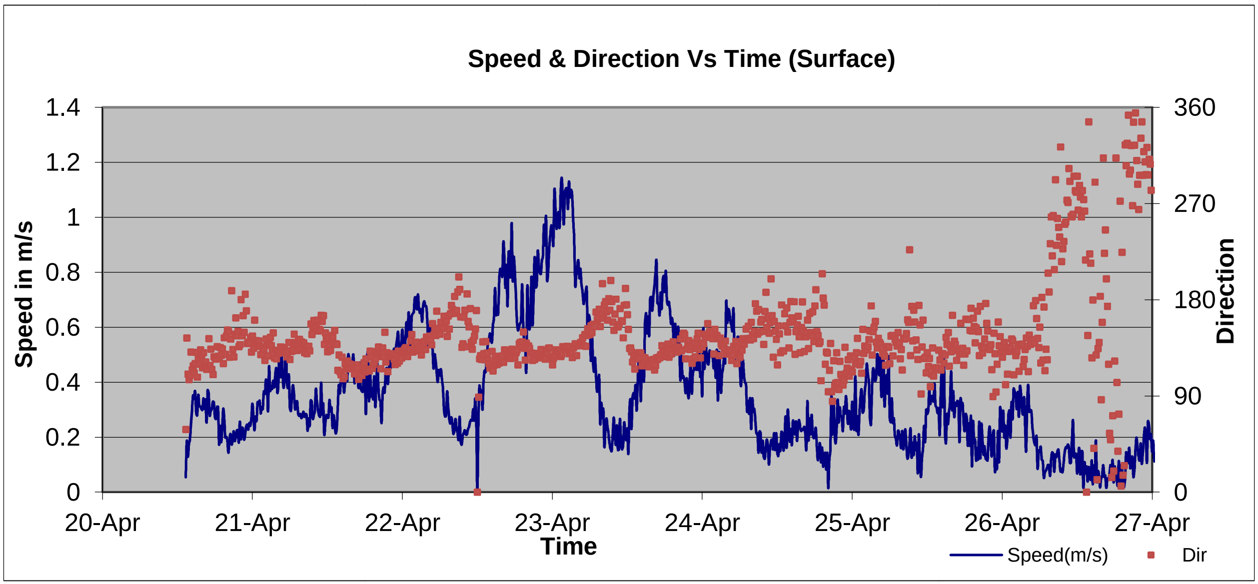

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Speed(m/s)
Dir


Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May
Time
Speed(m/s)
Dir

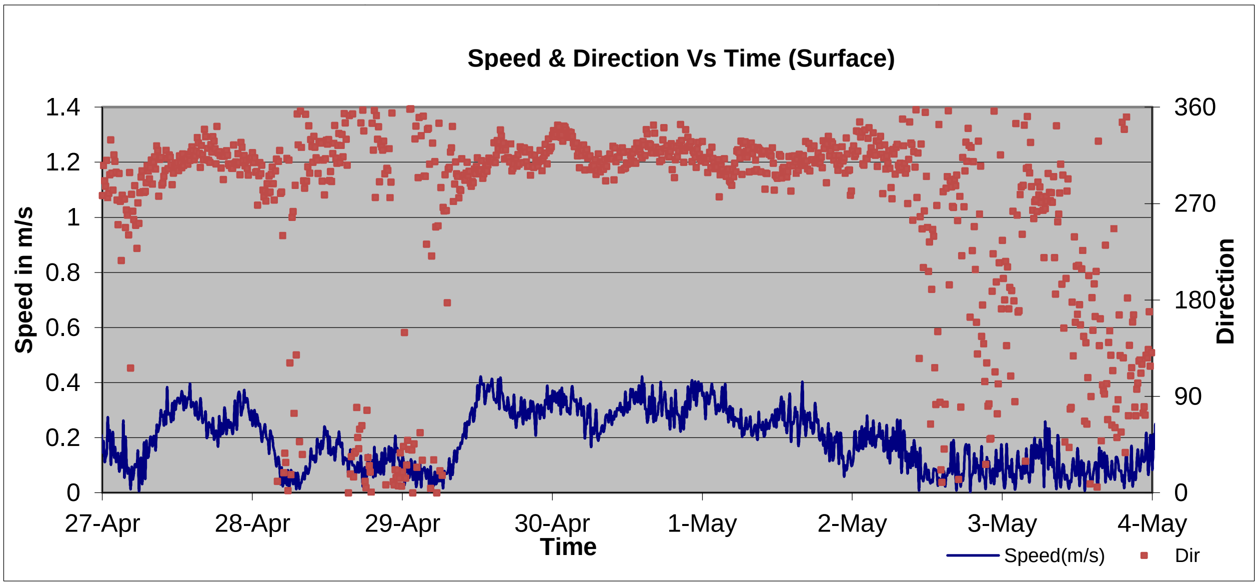

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
Time
Speed(m/s)
Dir


Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Time
Speed(m/s)
Dir

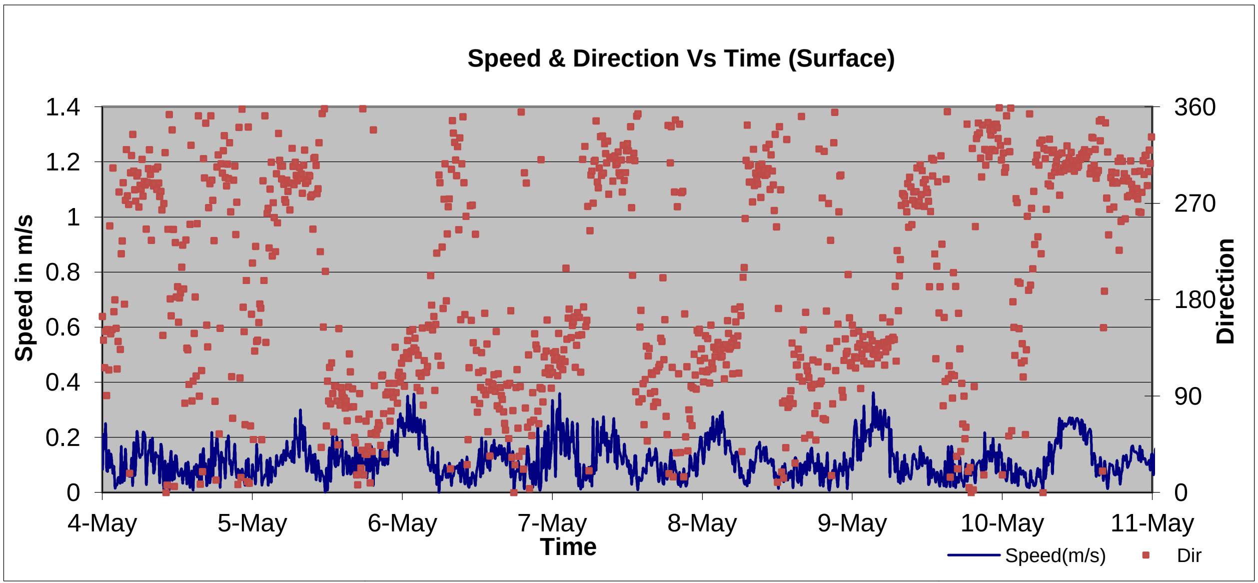
Current Data - Location P2



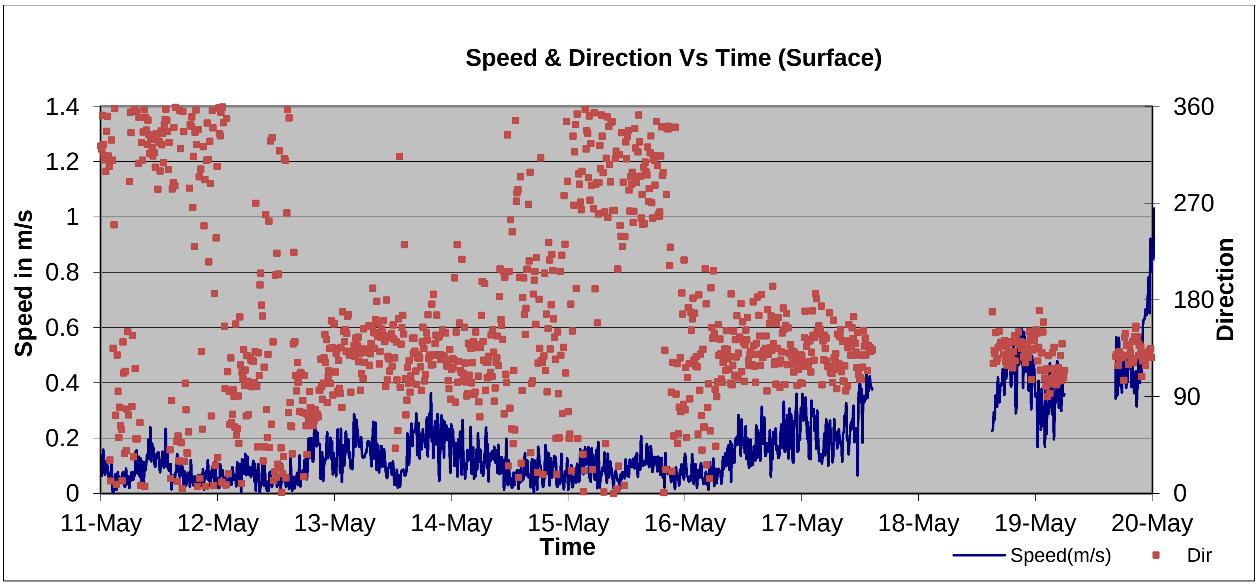
Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
Speed(m/s)
Dir
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr

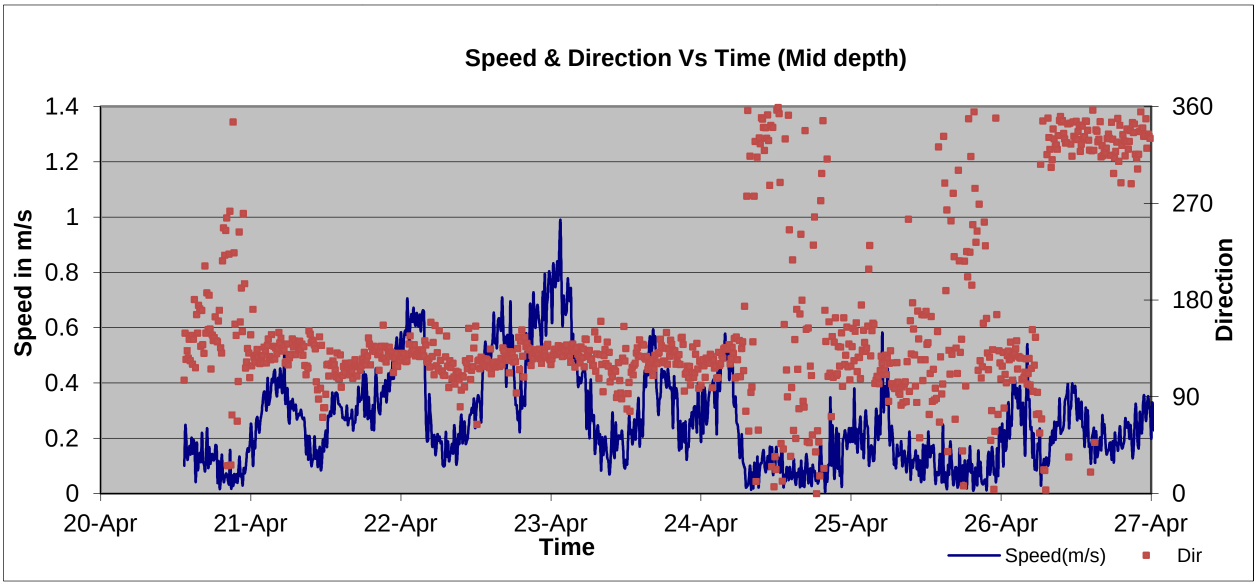


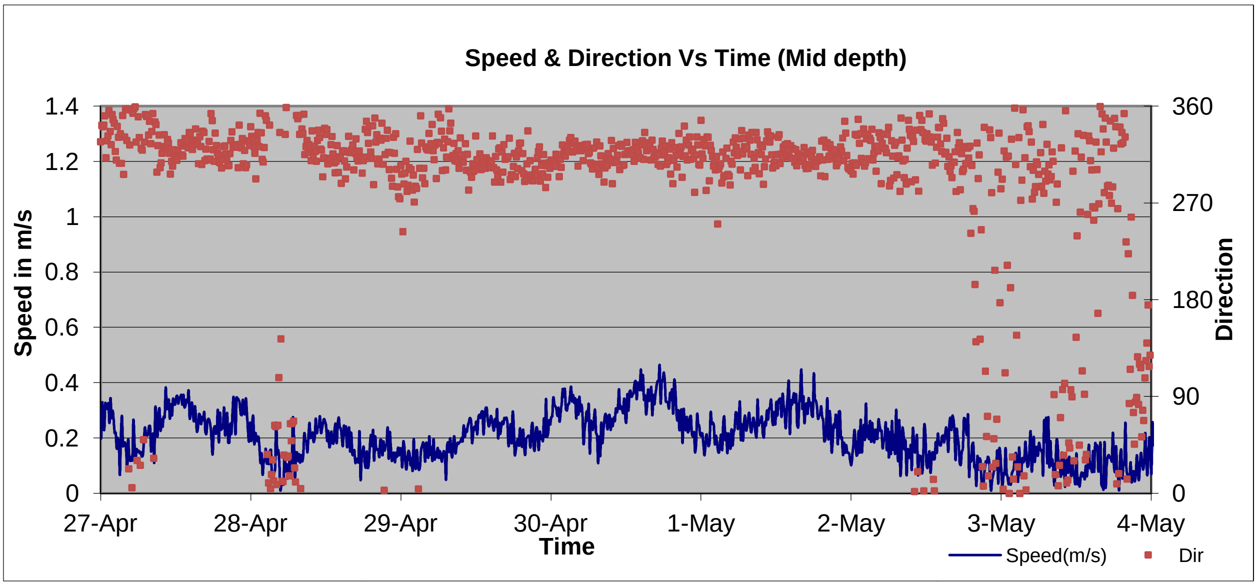
Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
Speed(m/s)
Dir
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May

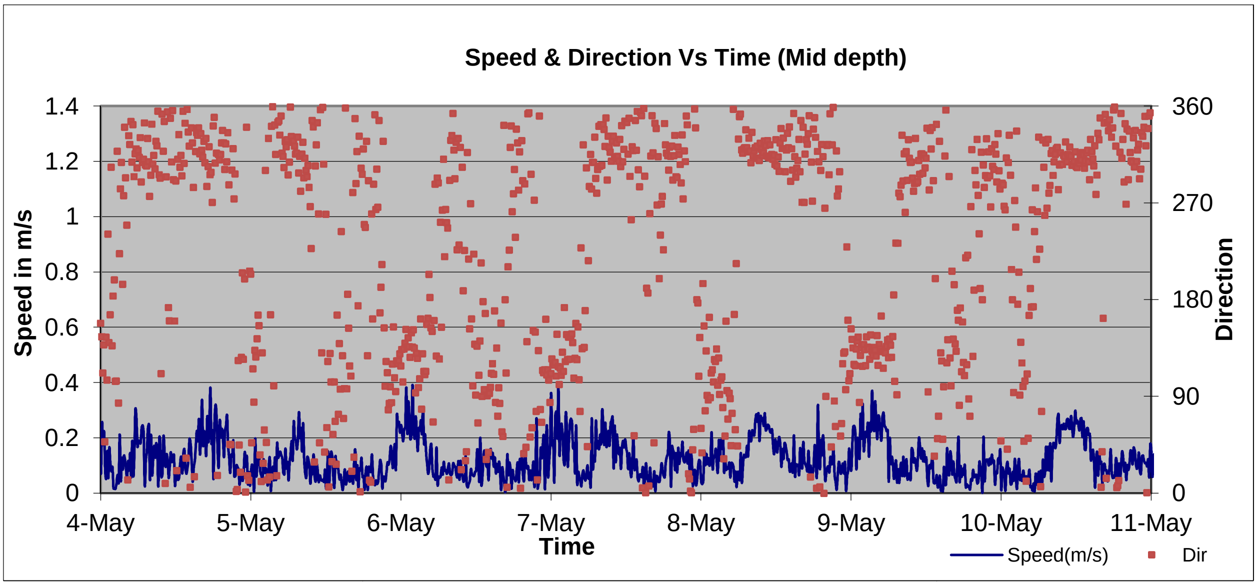


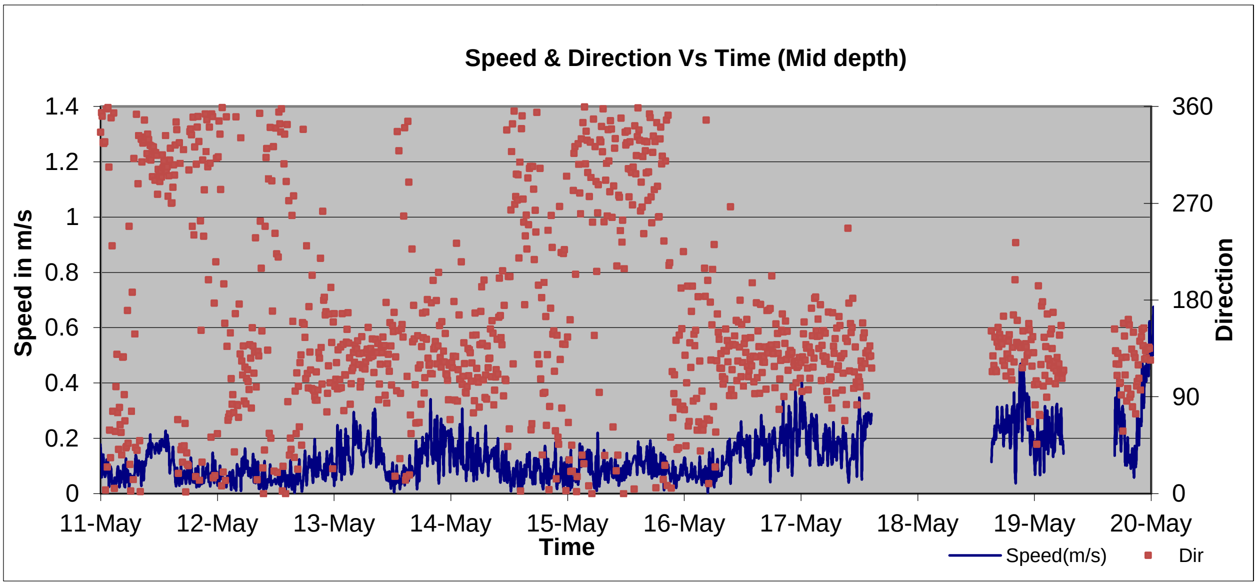
Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
Speed(m/s)
Dir
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May

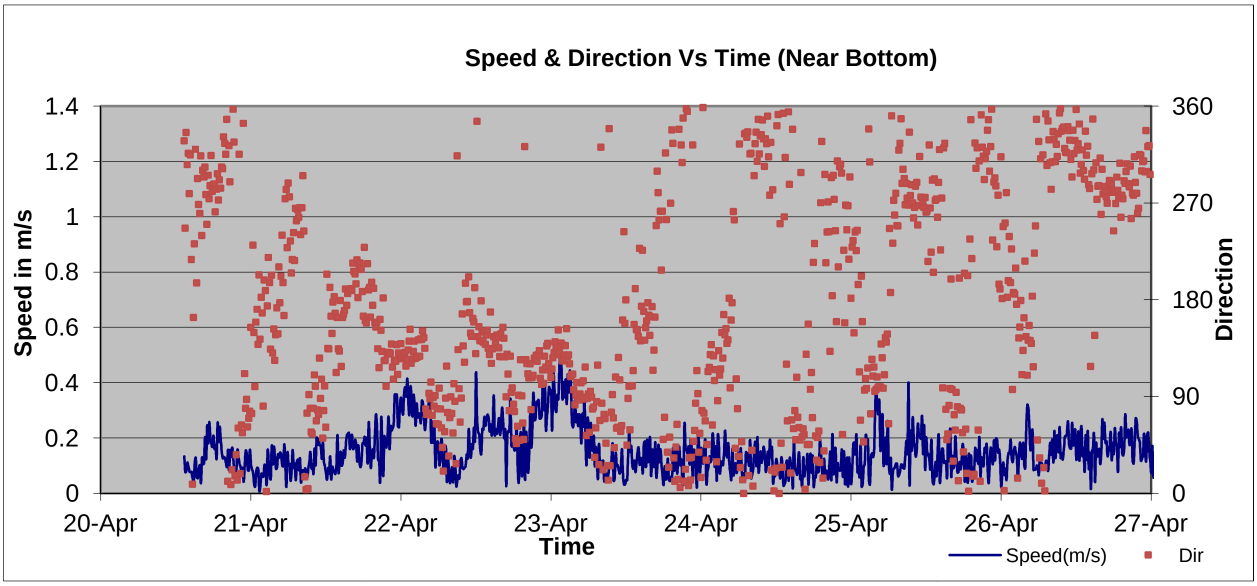

Speed & Direction Vs Time (Surface)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Time
Speed(m/s)
Dir

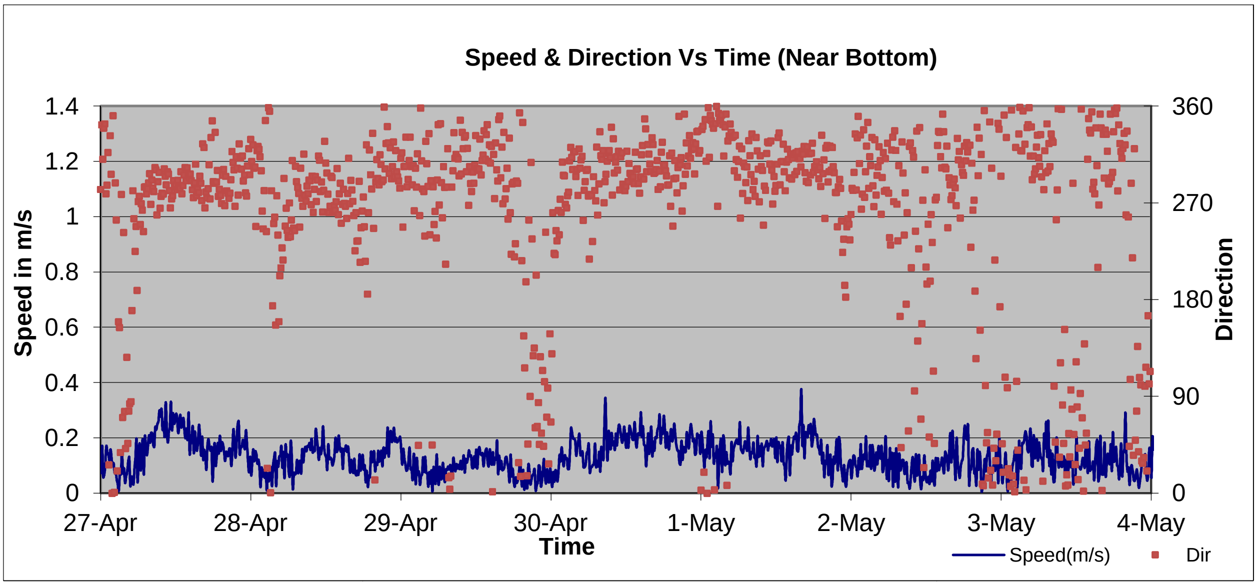

Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Time
Speed(m/s)
Dir

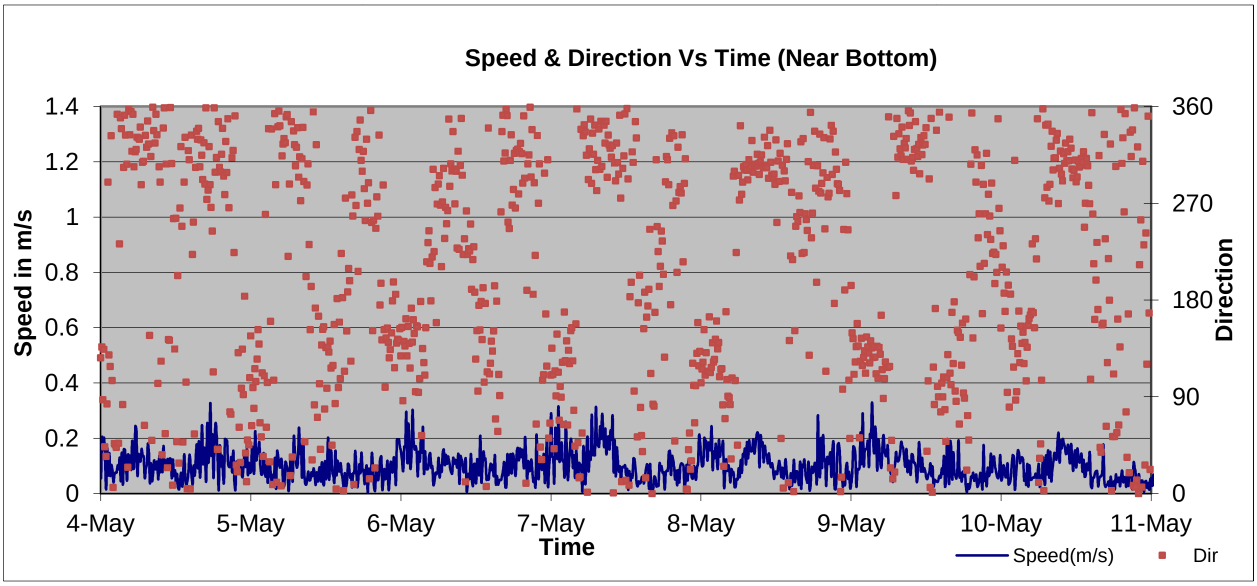

Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May
Time
Speed(m/s)
Dir

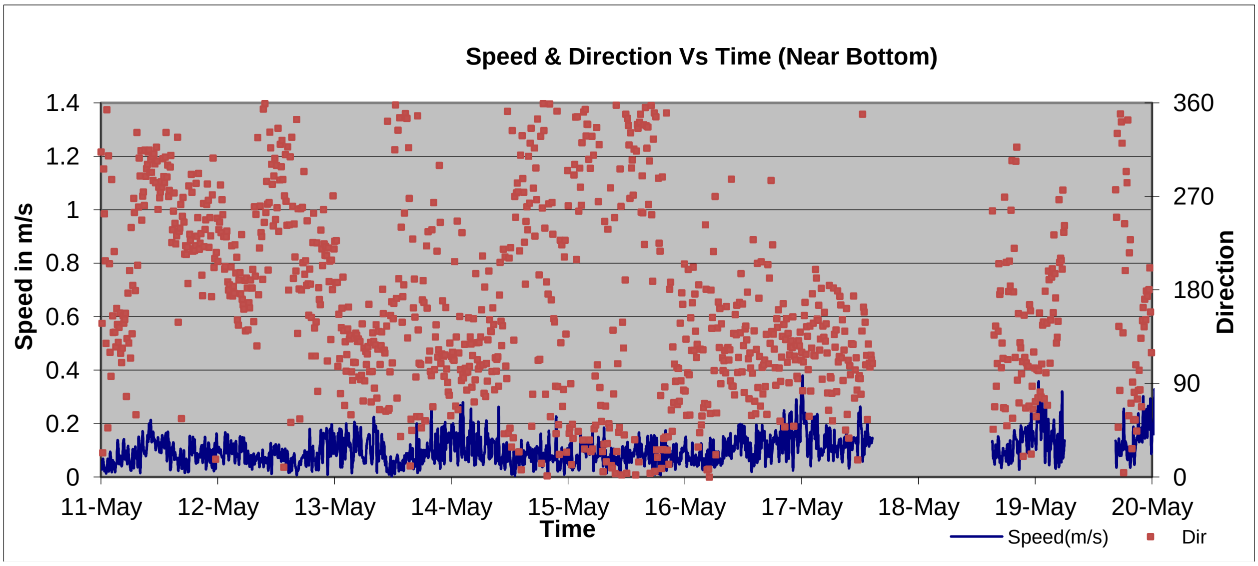

Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
Speed(m/s)
Dir


Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Speed(m/s)
Dir

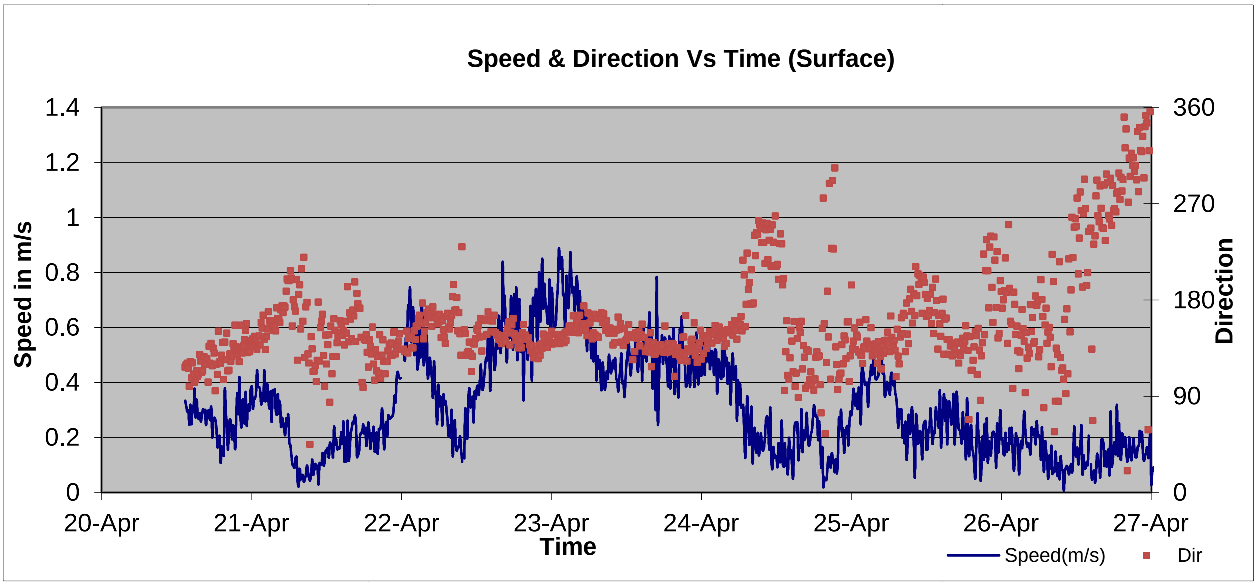

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Speed(m/s)
Dir

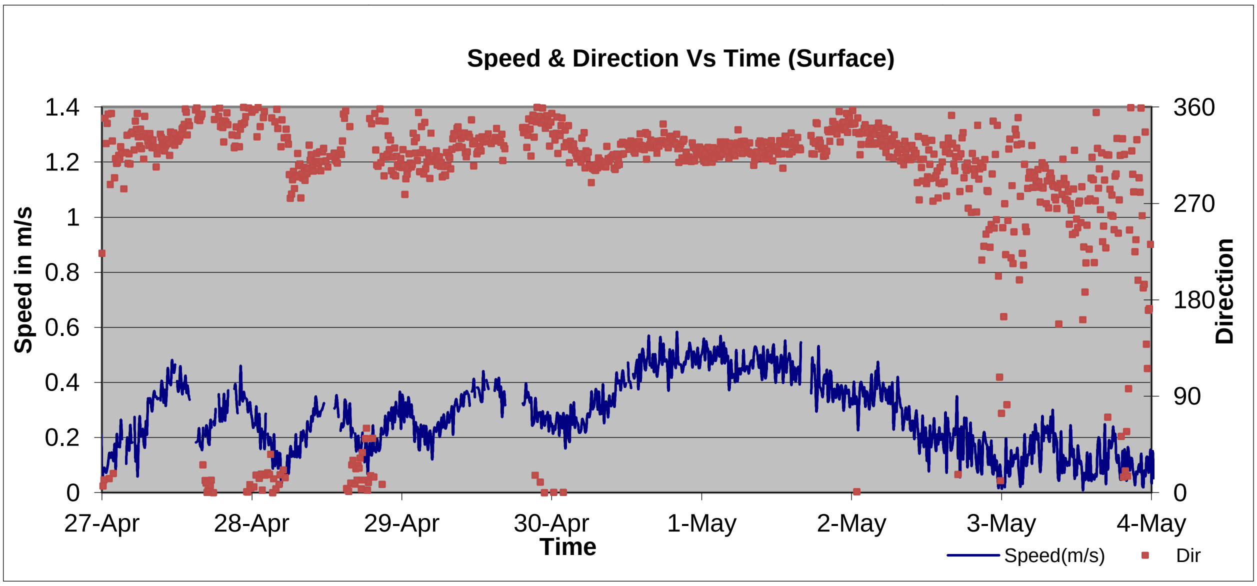

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May
Speed(m/s)
Dir

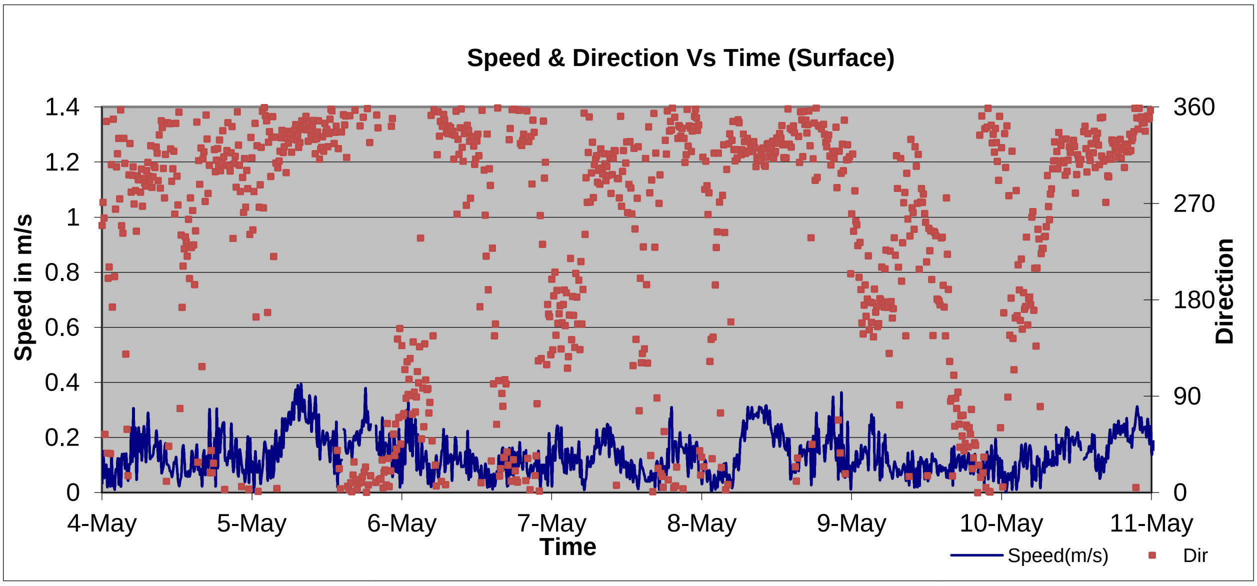

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
Speed(m/s)
Dir

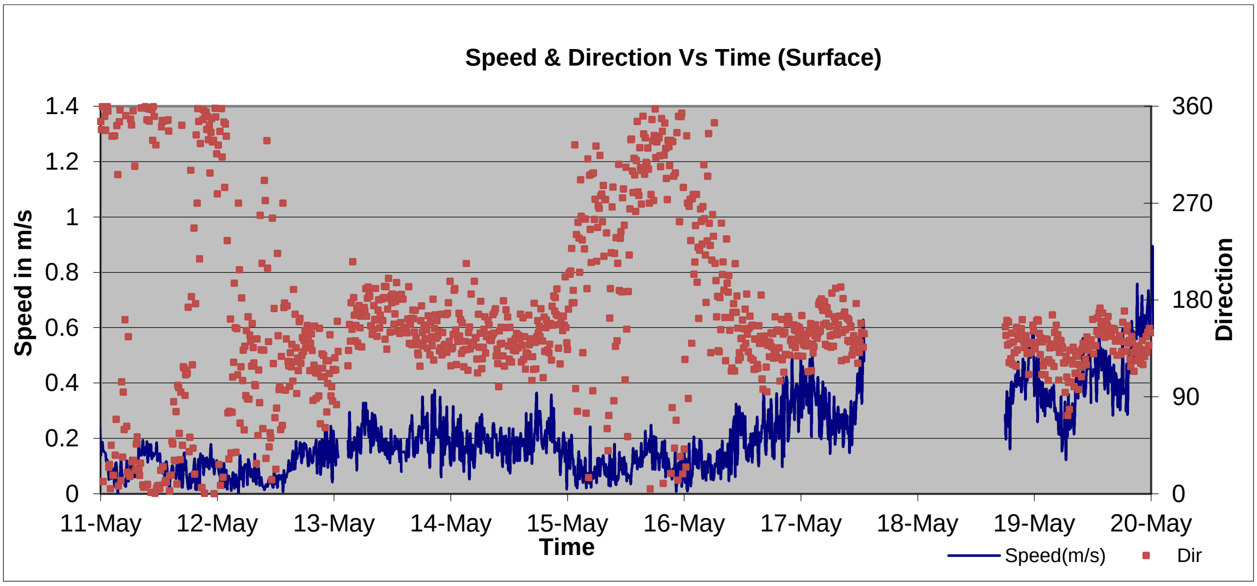

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Speed(m/s)
Dir

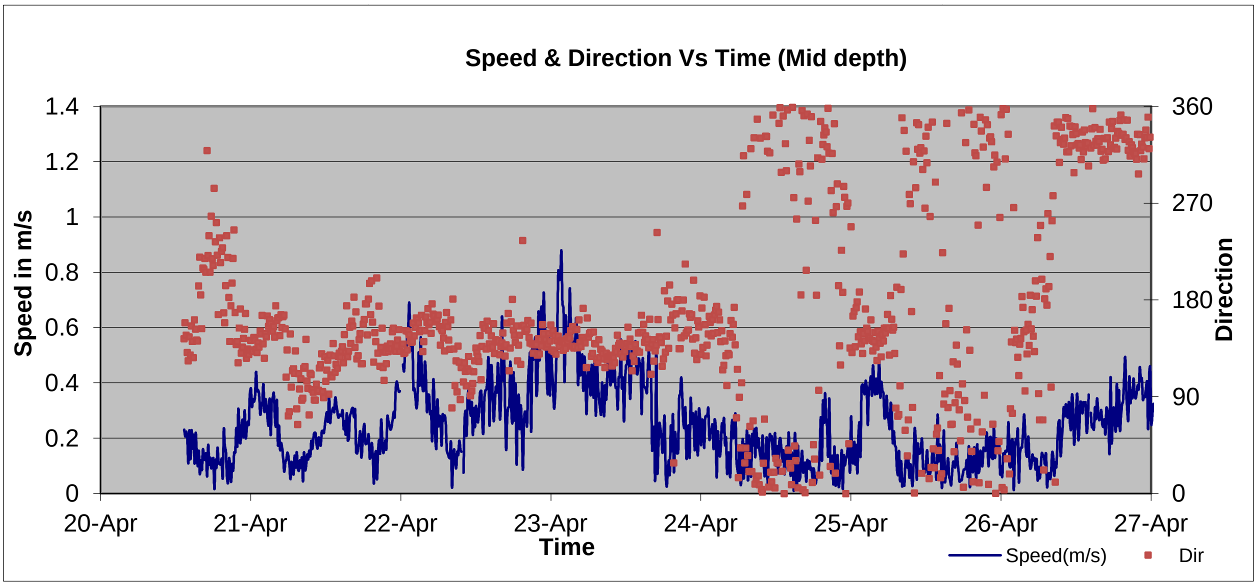
Current Data - Location P3

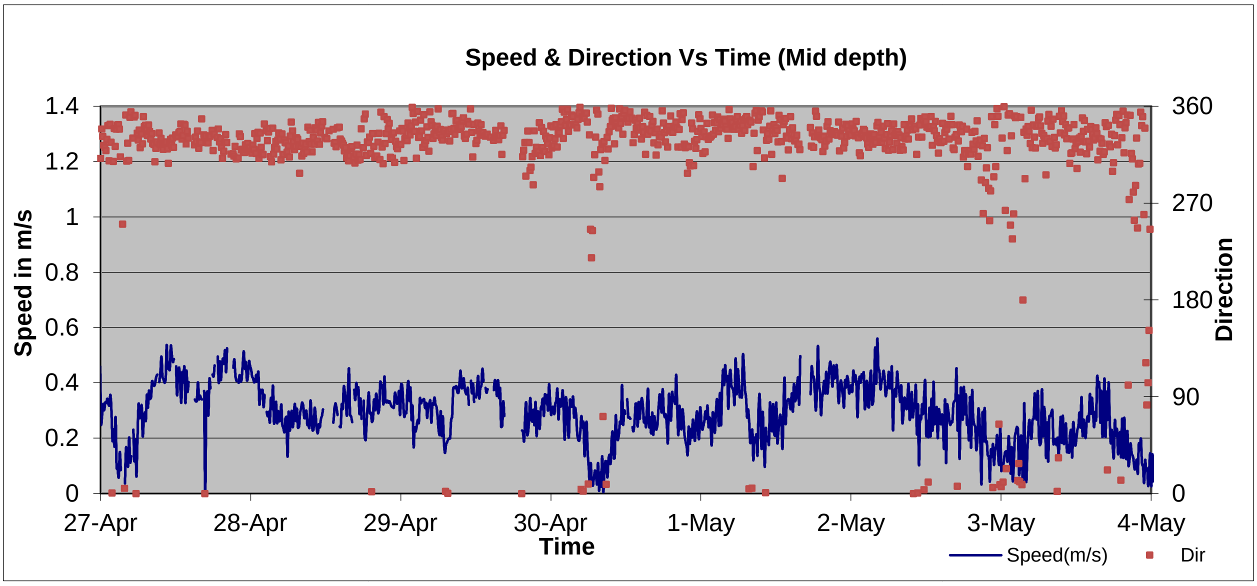

Speed & Direction Vs Time (Surface)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Time
Speed(m/s)
Dir

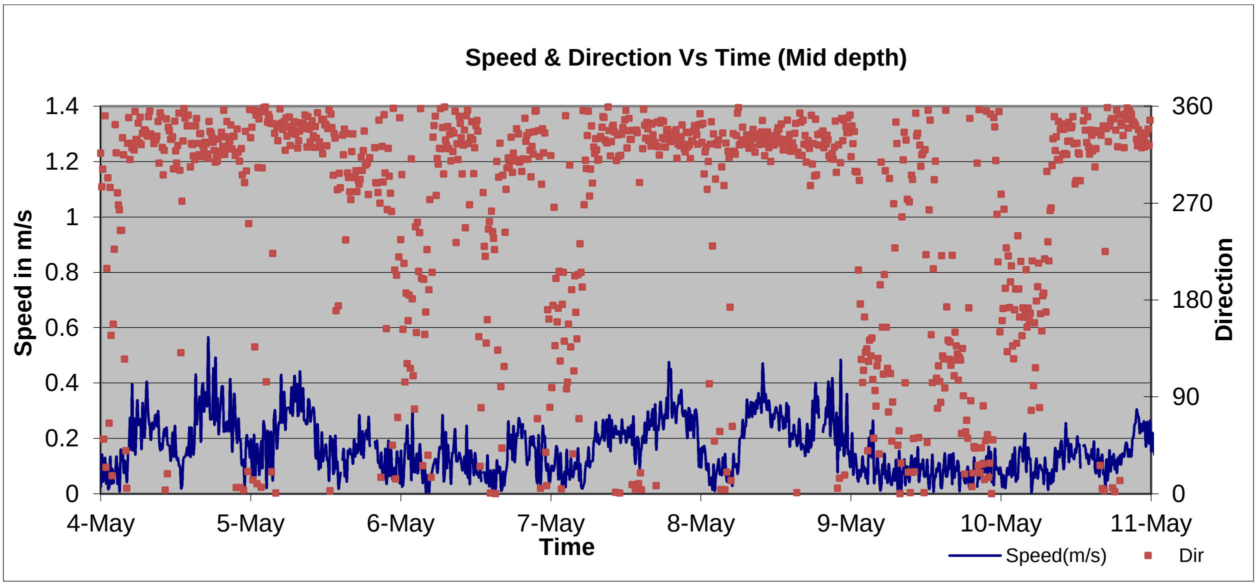

Speed & Direction Vs Time (Surface)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May
Time
Speed(m/s)
Dir

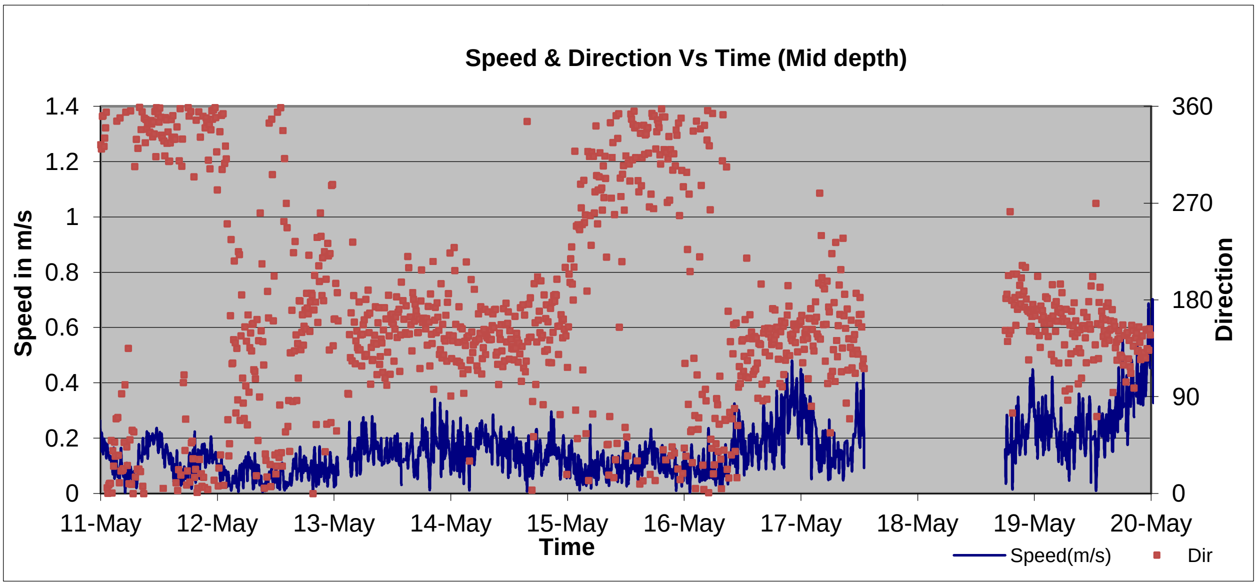

Speed & Direction Vs Time (Surface)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
Time
Speed(m/s)
Dir

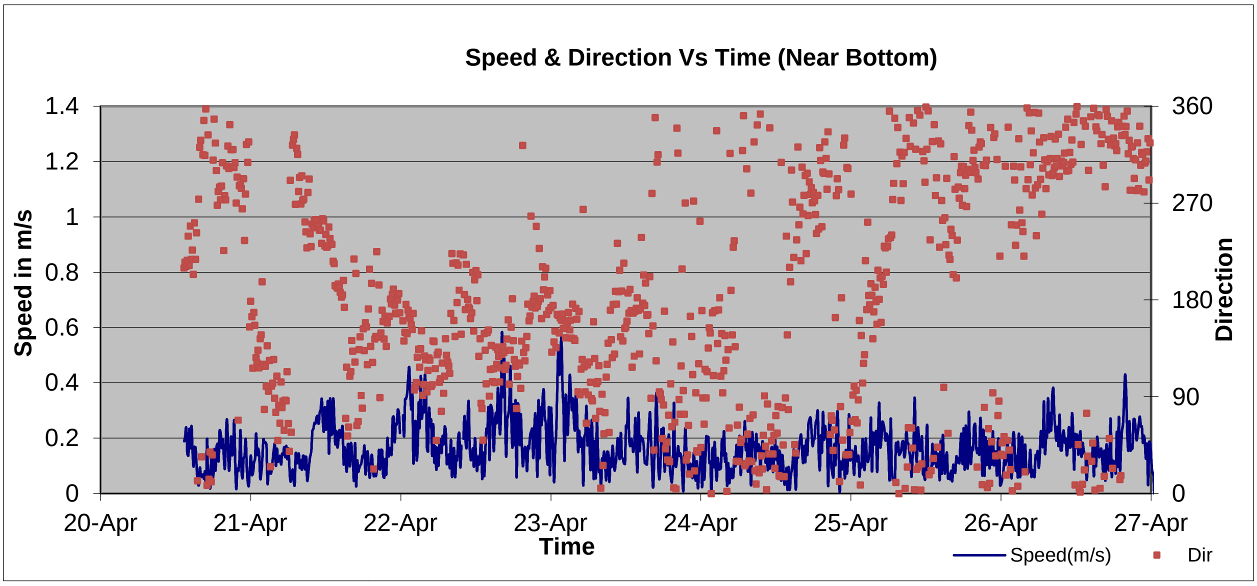

Speed & Direction Vs Time (Surface)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Time
360
270
180
90
0
Direction
Speed(m/s)
Dir

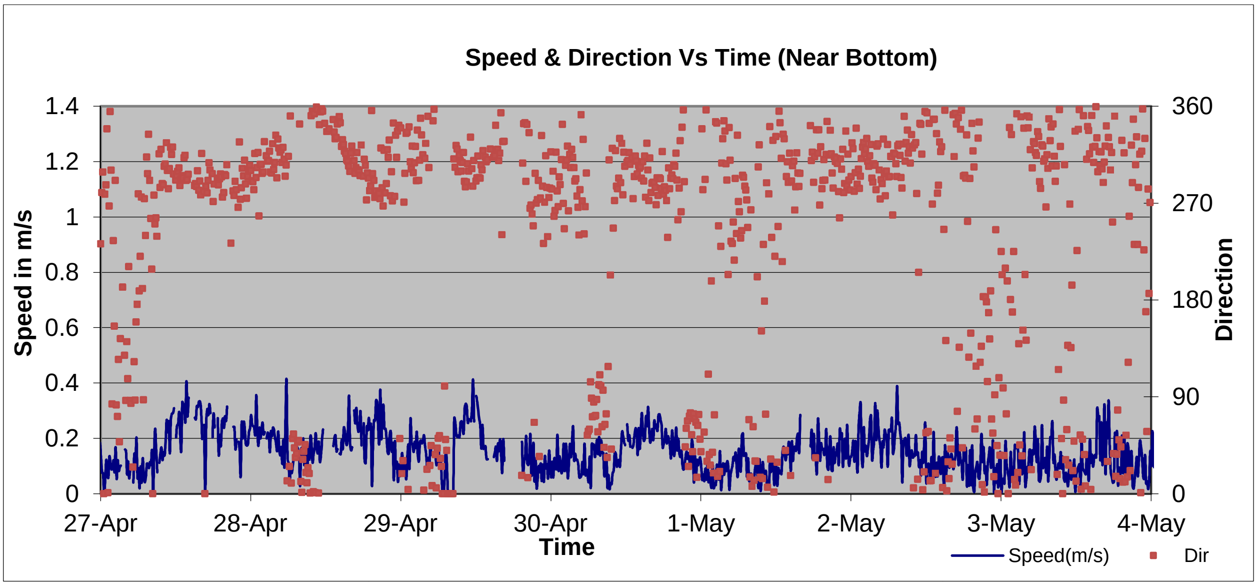

Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Time
360
270
180
90
0
Direction
Speed(m/s)
Dir

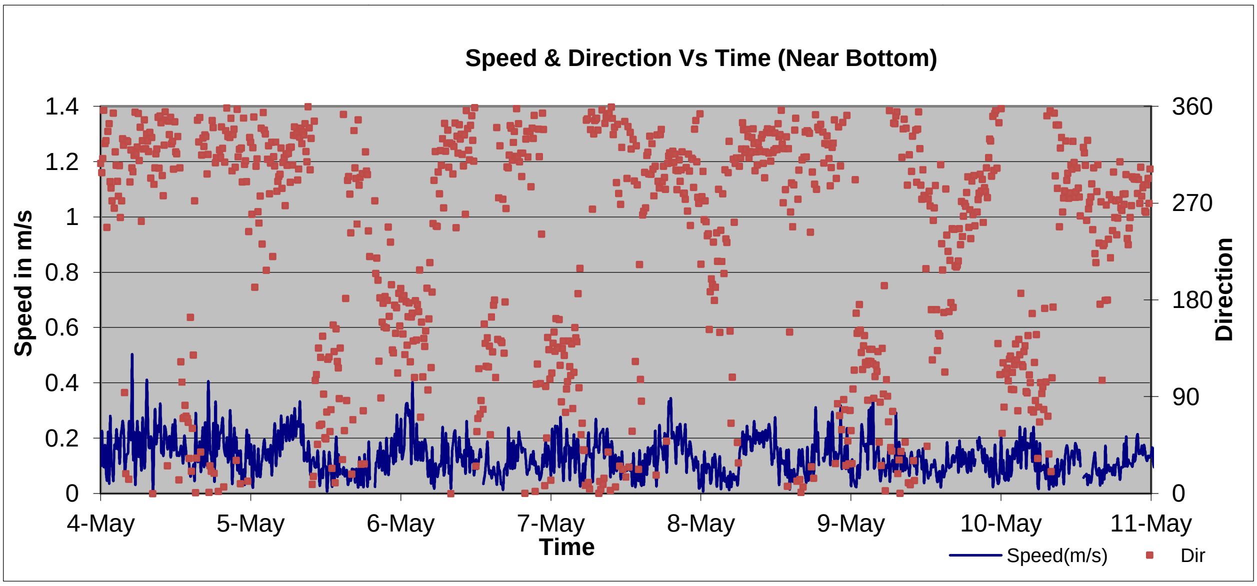

Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May
Time
360
270
180
90
0
Direction
Speed(m/s)
Dir

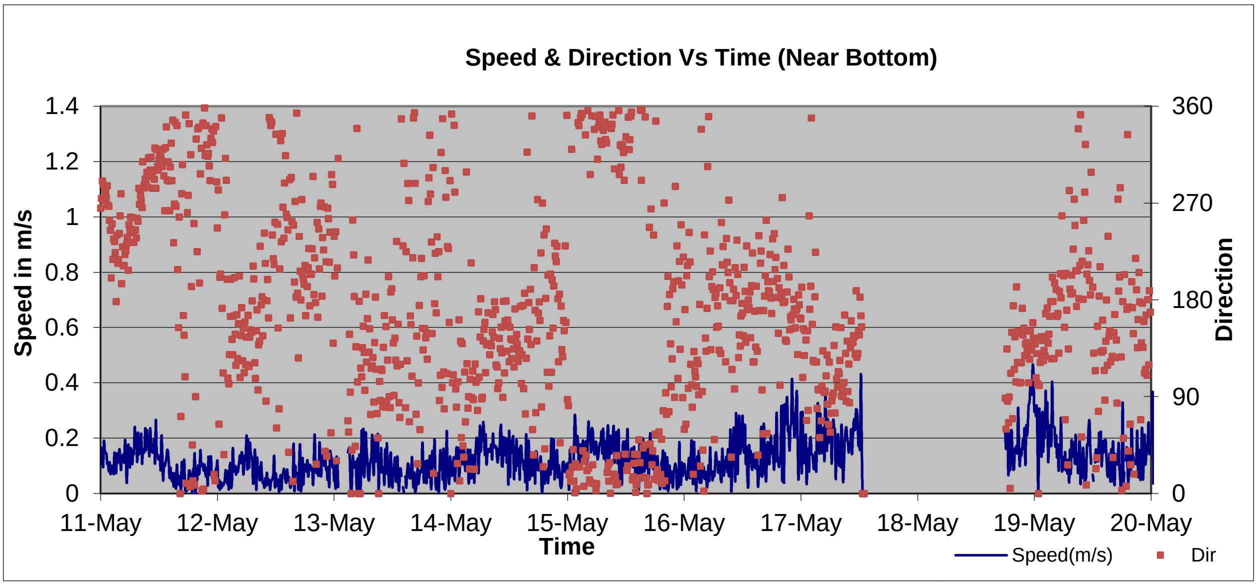

Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
Speed(m/s)
Dir


Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Speed(m/s)
Dir

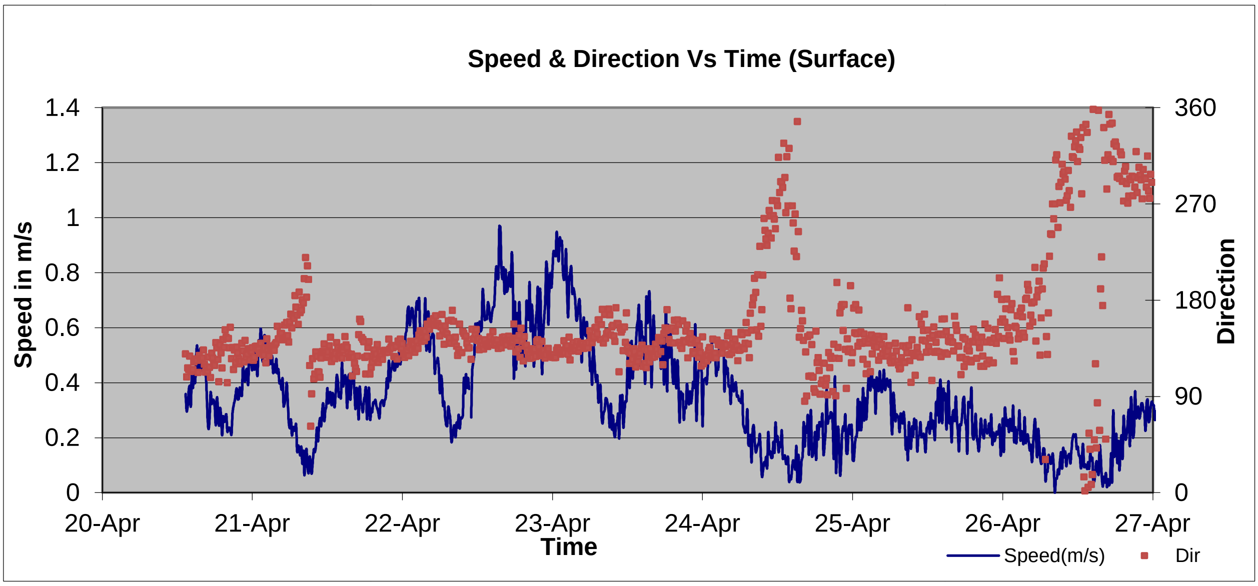

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Speed(m/s)
Dir

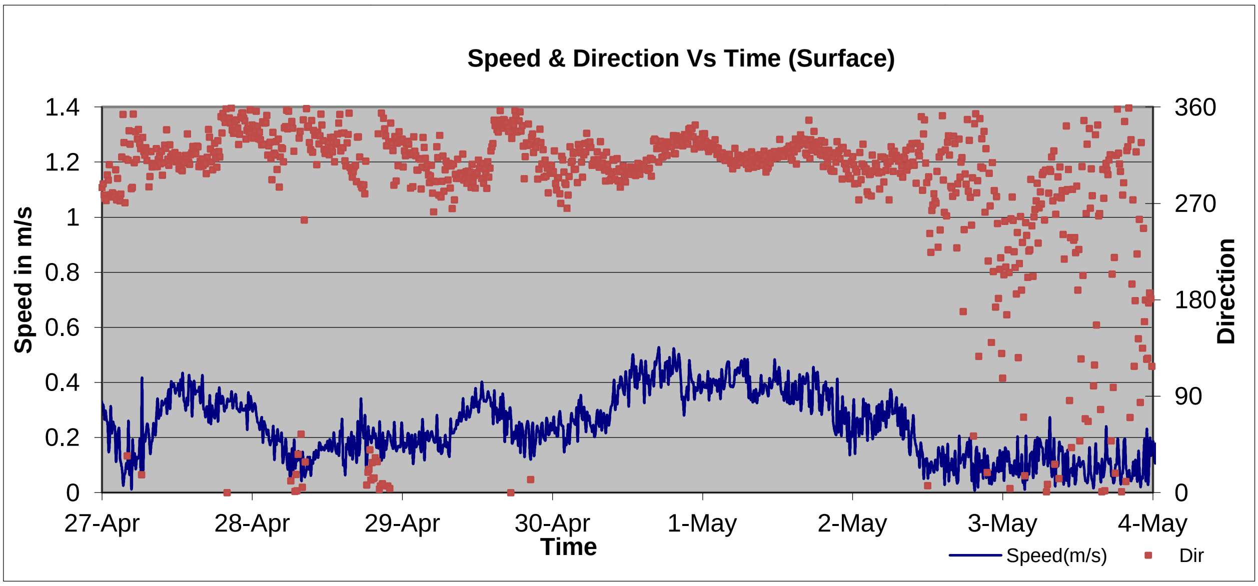

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
27-Apr 28-Apr 29-Apr 30-Apr 1-May 2-May 3-May 4-May
Speed(m/s)
Dir

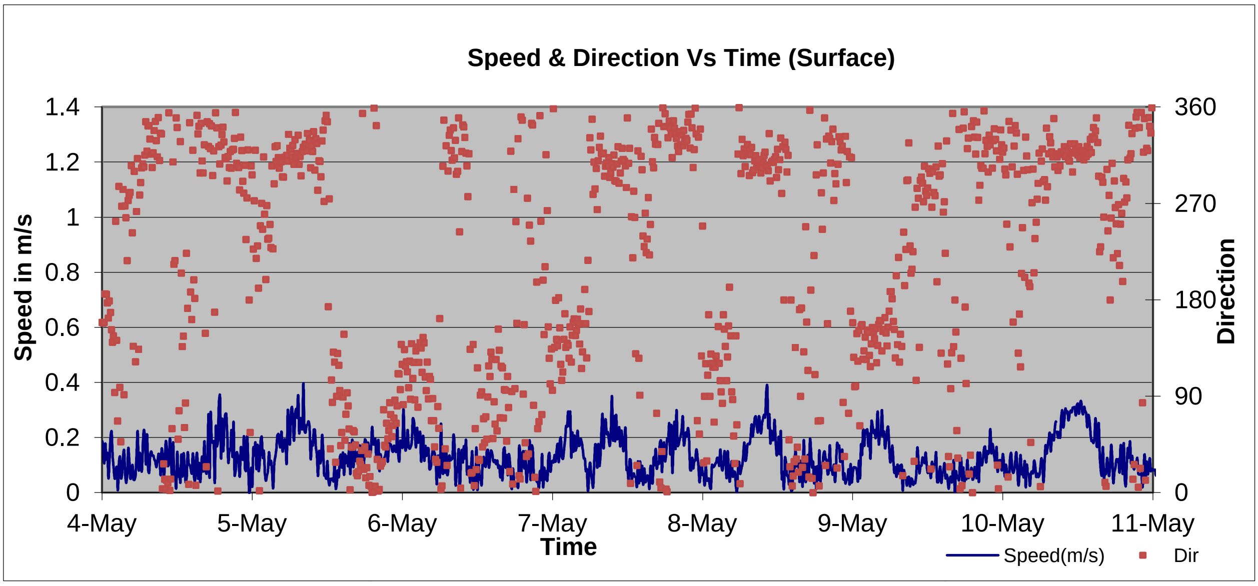

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
4-May 5-May 6-May 7-May 8-May 9-May 10-May 11-May
Speed(m/s)
Dir

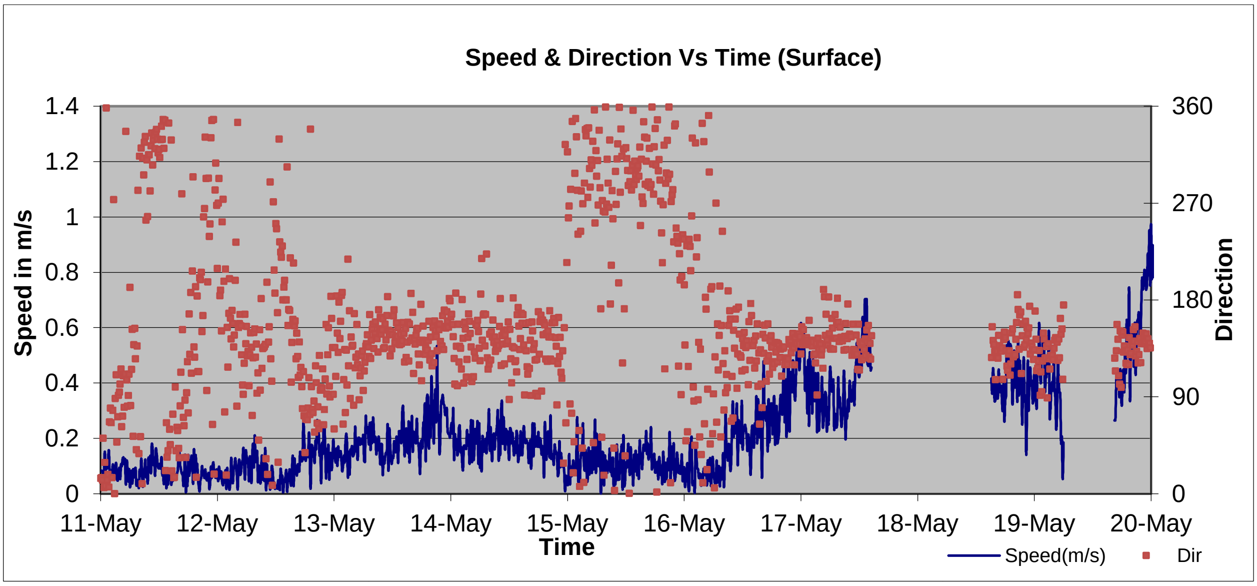

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
11-May 12-May 13-May 14-May 15-May 16-May 17-May 18-May 19-May 20-May
Speed(m/s)
Dir

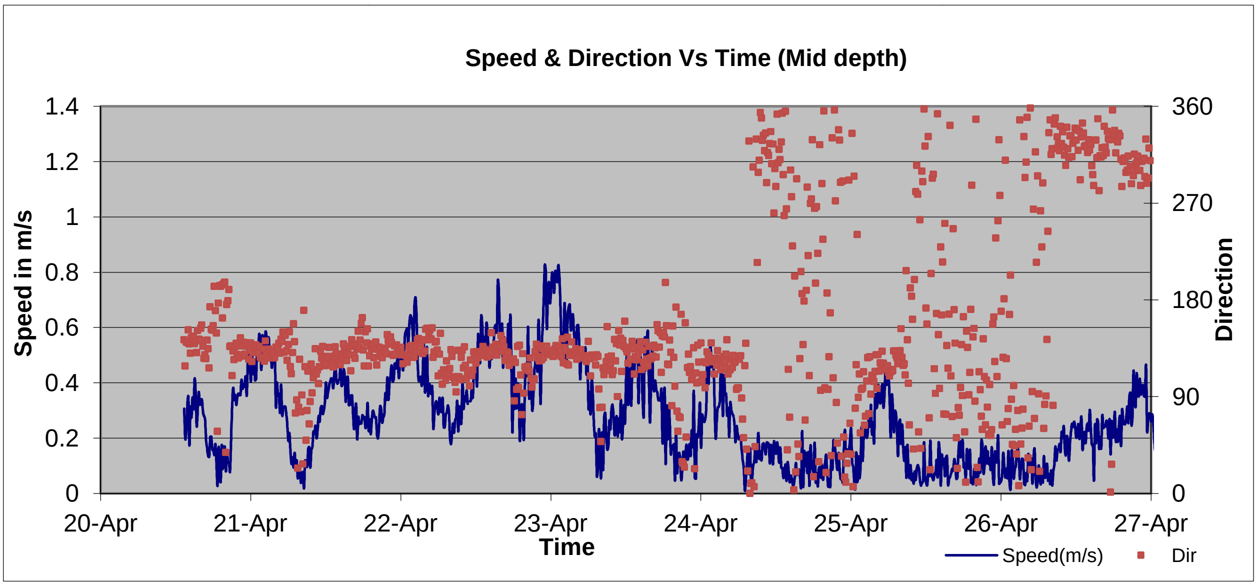
Current Data - Location P4

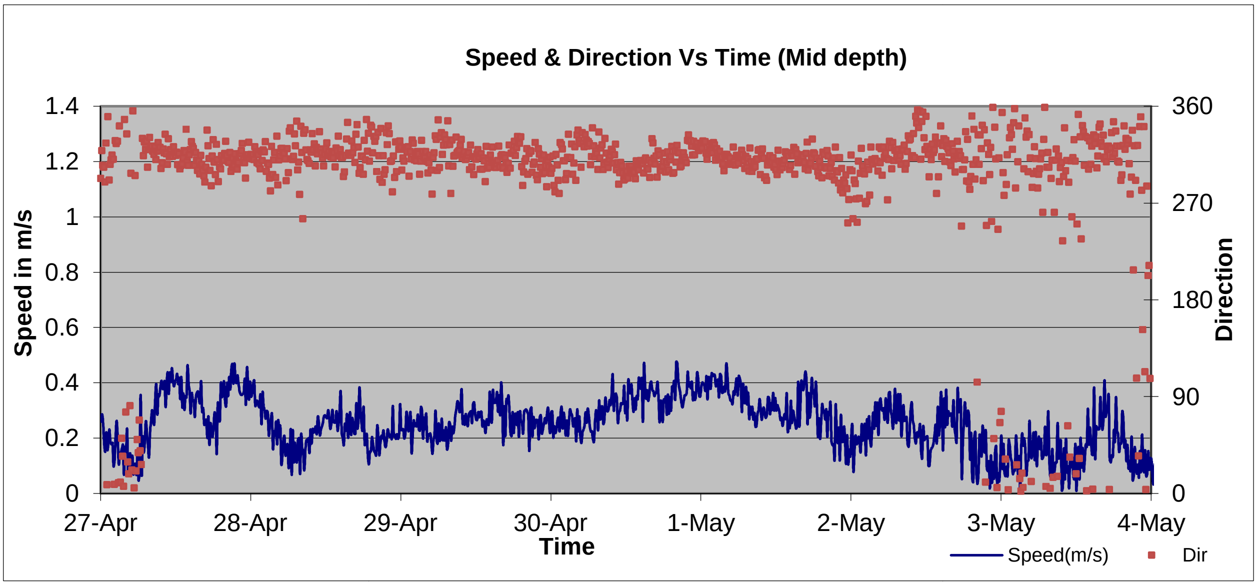

Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Time
Speed(m/s)
Dir

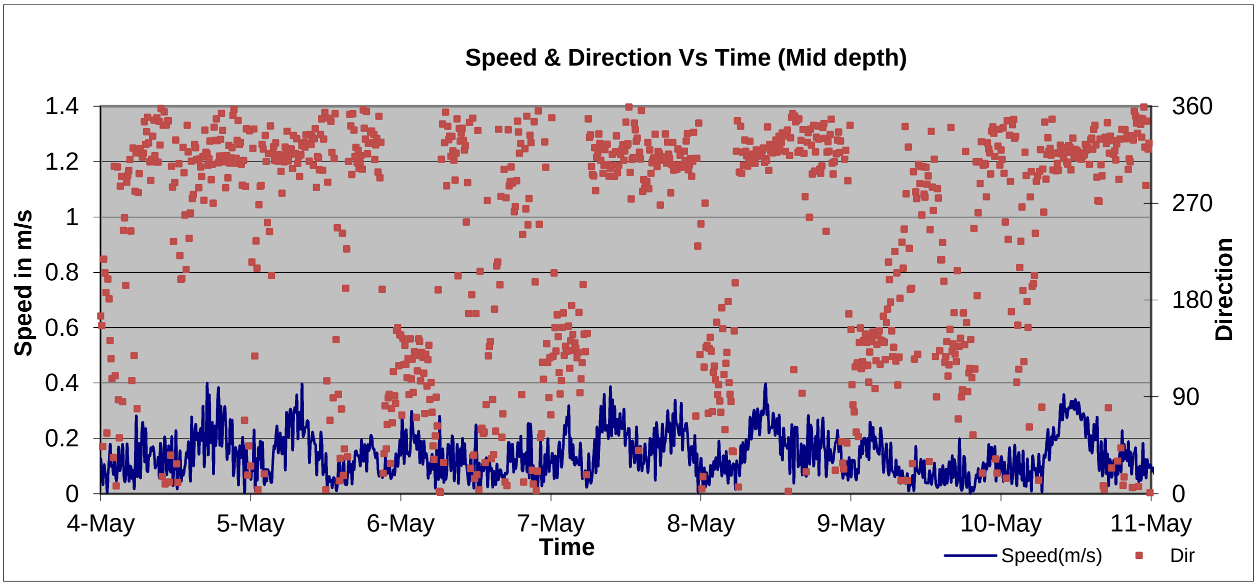

Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May
Time
Speed(m/s)
Dir


Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
Time
Speed(m/s)
Dir

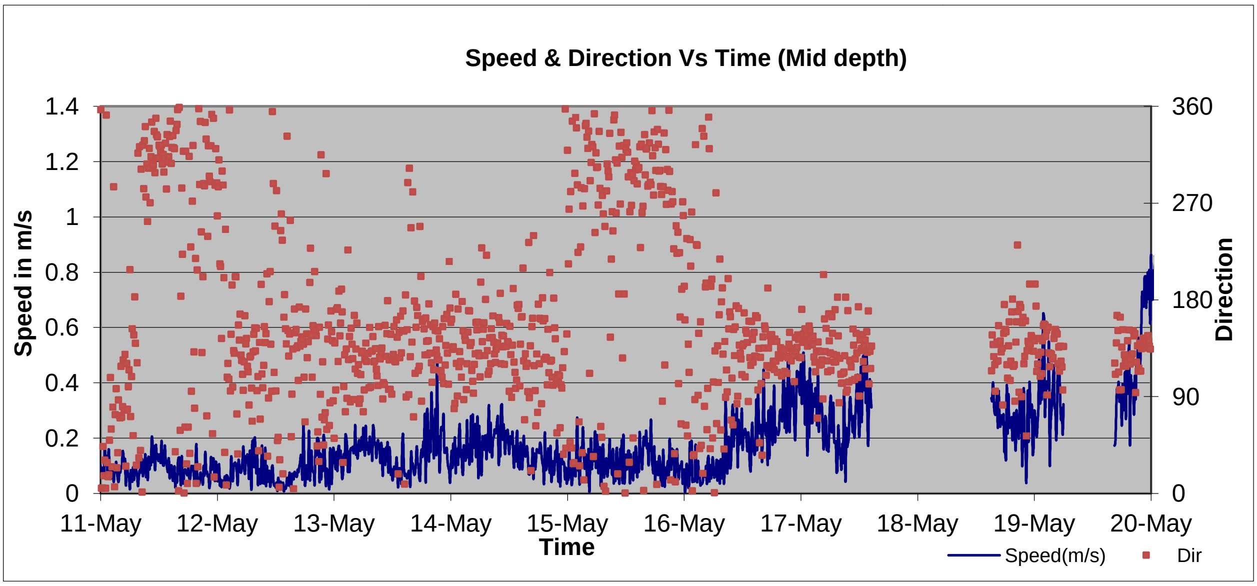

Speed & Direction Vs Time (Surface)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Time
Speed(m/s)
Dir


Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Time
Speed(m/s)
Dir

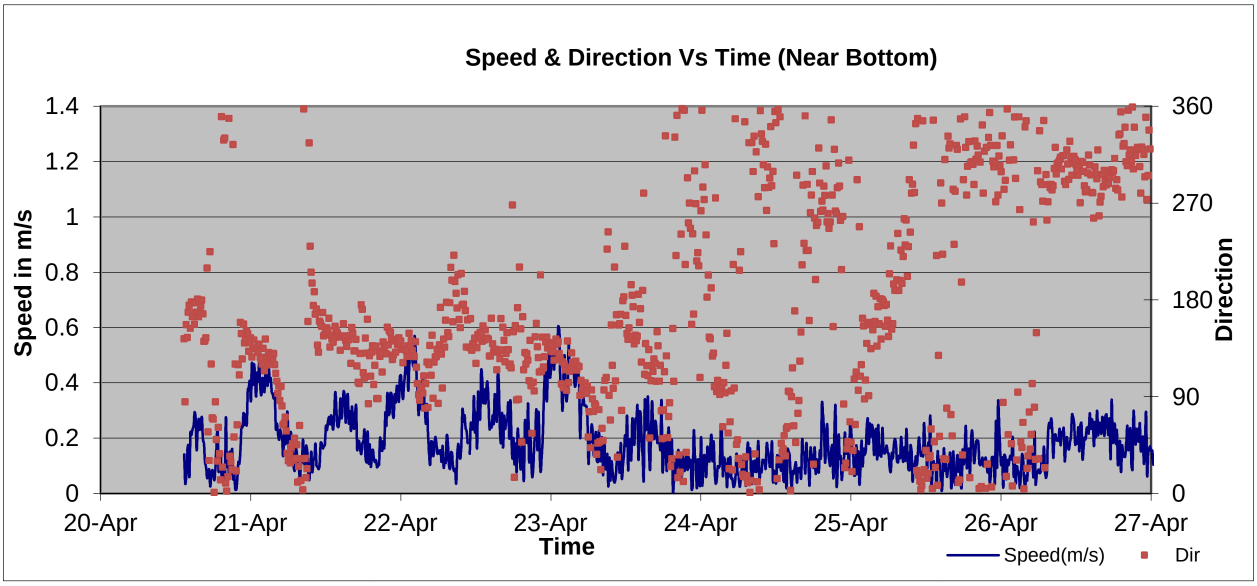

Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May
Time
Speed(m/s)
Dir



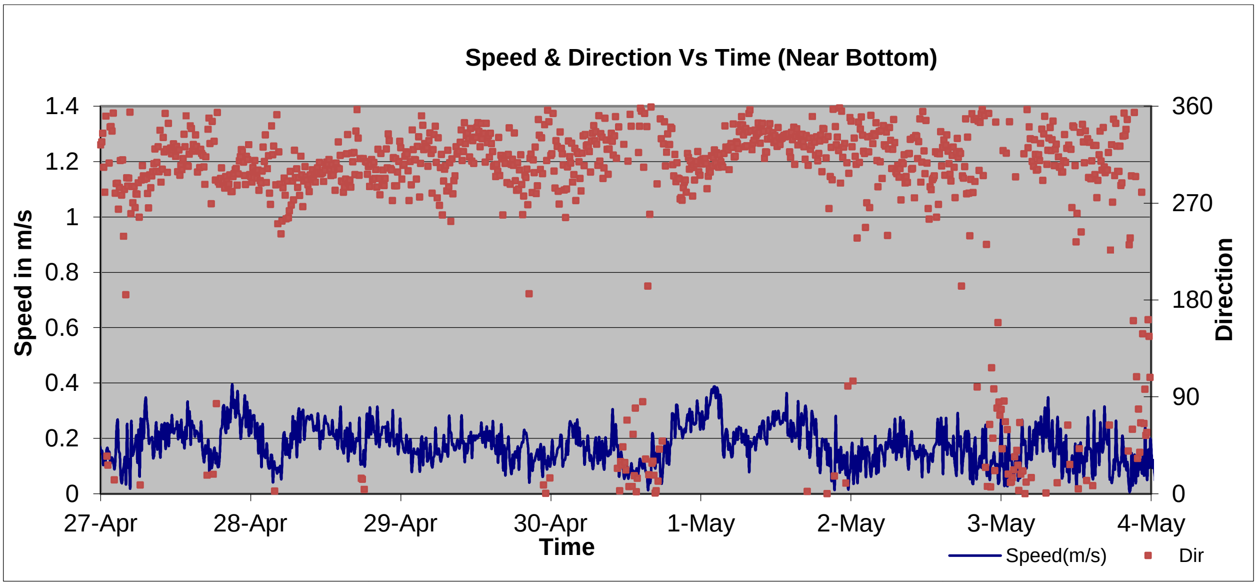
Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
Speed(m/s)
Dir

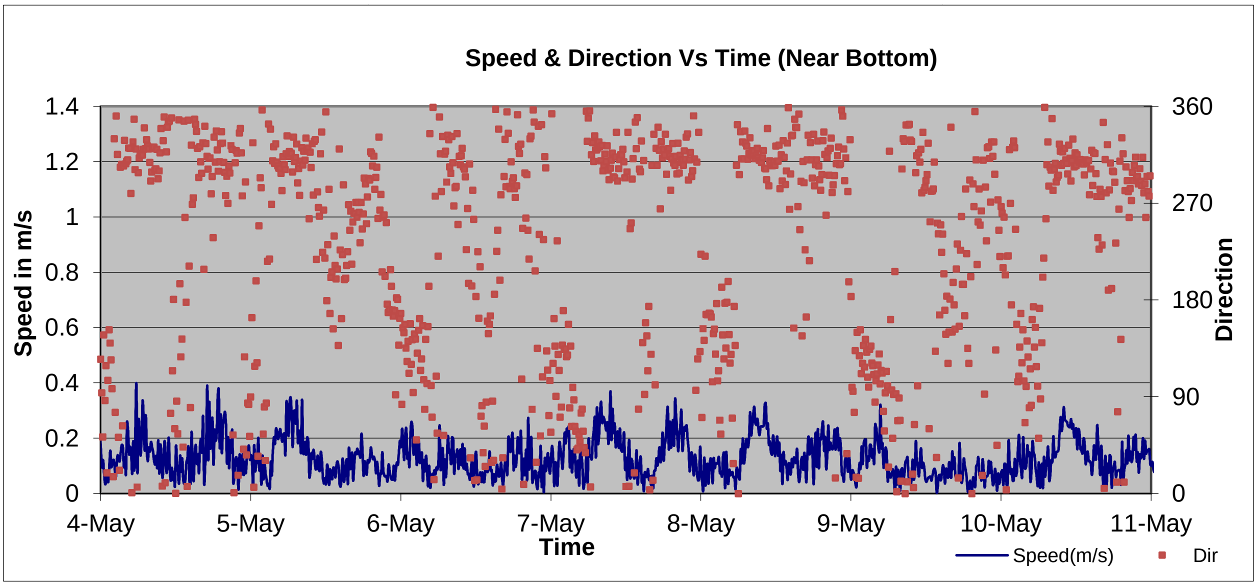


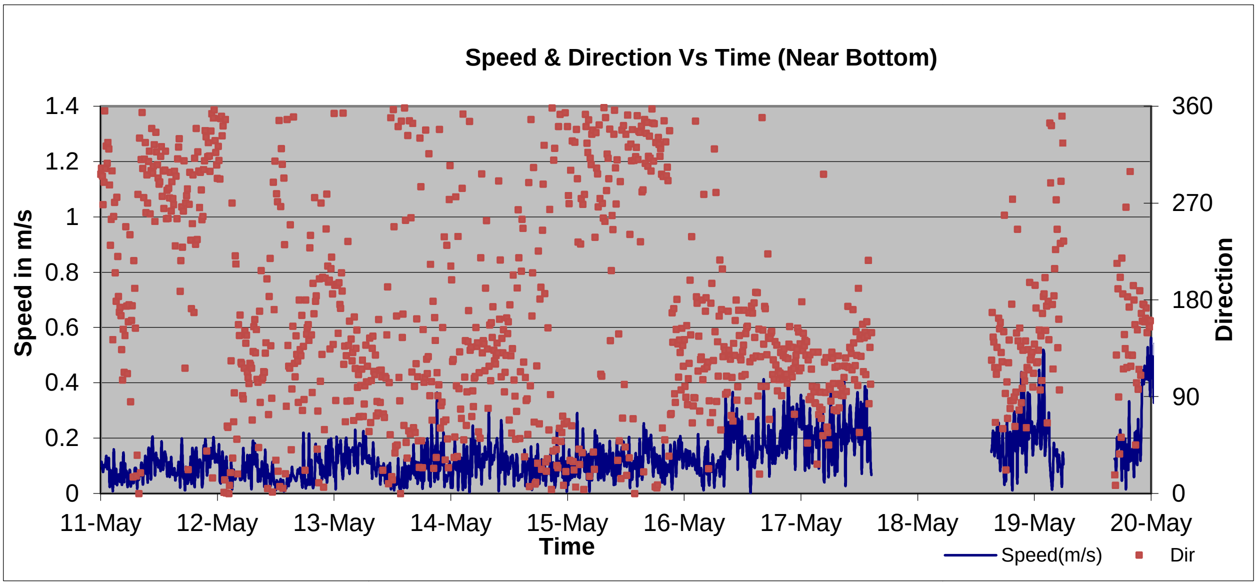
Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Speed(m/s)
Dir



Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
20-Apr
21-Apr
22-Apr
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
Speed(m/s)
Dir


Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Direction
360
270
180
90
0
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
4-May
Time
Speed(m/s)
Dir


Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Direction
360
270
180
90
0
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
Time
Speed(m/s)
Dir


Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Direction
360
270
180
90
0
11-May
12-May
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
Time
Speed(m/s)
Dir

Date	Location No	Start Time	End Time	UTM Co-ordinates				Speed Over Ground (cm/s)	Course over Ground (°)	Current direction (L/R)	Breaker angle (°)	Wave height (m)	Wave period (s)	Surf zone width (m)	Remarks
				Start Point		End point									
				Easting	Northing	Easting	Northing								
08/04/2016	CSP 01	09:08	09:13								109	0.75	9	0	Sea wall area
08/04/2016	CSP 02	09:36	09:41	734463	914728	734442	914743	8.60	306	R	108	0.75	9	15	
08/04/2016	CSP 03										103	0.75	9	0	Sea wall area
08/04/2016	CSP 04										103	0.75	9	0	Sea wall area
08/04/2016	CSP 05	10:24	10:29	733238	915602	733224	915613	5.93	308	R	104	0.75	9	15	
08/04/2016	CSP 06	11:07	11:12	732831	915884	732814	915898	7.34	309	R	106	0.75	9	15	
08/04/2016	CSP 07	11:24	11:29	732433	916185	732412	916199	8.41	304	R	108	0.75	9	15	
08/04/2016	CSP 08	11:39	11:44	732022	916477	732007	916490	6.62	311	R	108	0.75	9	15	
08/04/2016	CSP 09	11:55	12:00	731612	916768	731590	916783	8.88	304	R	109	0.75	8	15	
08/04/2016	CSP 10	12:06	12:11	731205	917055	731186	917073	8.72	313	R	109	0.75	8	15	
08/04/2016	CSP 11	12:18	12:23	730803	917352	730781	917365	8.52	301	R	108	0.75	8	15	
09/04/2016	CSP 12	08:55	09:00	730532	917546	730516	917561	7.31	313	R	105	0.75	9	15	
09/04/2016	CSP 13	09:10	09:15	730135	917836	730106	917869	14.64	319	R	100	0.75	9	15	
09/04/2016	CSP 14	09:25	09:30	729736	918142	729719	918161	8.50	318	R	105	0.75	9	15	
09/04/2016	CSP 15	09:35	09:42	729323	918446	729304	918457	5.23	300	R	100	0.75	9	15	
09/04/2016	CSP 16	11:00	11:05	728919	918706	728898	918724	9.22	311	R	105	0.75	9	15	
09/04/2016	CSP 17	11:20	11:25	728520	919051	728501	919072	9.44	318	R	100	0.75	9	15	
09/04/2016	CSP 18	11:35	11:40	728152	919375	728132	919385	7.45	297	R	112	0.75	9	15	
09/04/2016	CSP 19	11:50	11:55	727751	919678	727735	919688	6.29	302	R	110	0.75	9	15	
09/04/2016	CSP 20	12:05	12:10	727352	919962	727338	919968	5.08	293	R	113	0.7	9	15	
09/04/2016	CSP 21	12:25	12:30	726947	920278	726928	920286	6.87	293	R	110	0.8	9	15	
09/04/2016	CSP 22	12:40	12:45	726555	920582	726534	920605	10.38	318	R	112	0.75	9	15	
10/04/2016	CSP 23	08:05	08:10	726170	920906	726161	920913	3.80	308	R	110	0.8	9	15	
10/04/2016	CSP 24	08:20	08:25	725794	921216	725777	921231	7.56	311	R	115	0.7	9	15	
10/04/2016	CSP 25	08:35	08:40	725408	921534	725384	921552	10.00	307	R	110	0.75	9	15	

10/04/2016	CSP 26	08:55	09:00	725011	921855	724994	921866	6.75	303	R	112	0.75	9	15	
10/04/2016	CSP 27	09:21	09:26	724631	922156	724621	922163	4.07	305	R	110	0.75	9	15	Rip currents
10/04/2016	CSP 28	09:35	09:42	724238	922455	724219	922477	6.92	319	R	115	0.75	8	15	
10/04/2016	CSP 29	10:06	10:12	723837	922757	723819	922781	8.33	323	R	110	0.75	8	15	
10/04/2016	CSP 30	10:20	10:25	723444	923040	723436	923059	6.87	337	R	115	0.75	8	15	
10/04/2016	CSP 31	10:50	10:57	723034	923338	723009	923354	7.07	303	R	110	0.75	8	15	
10/04/2016	CSP 32	11:07	11:12	722620	923622	722599	923634	8.06	300	R	112	0.75	8	15	
10/04/2016	CSP 33	11:35	11:39	722242	923862	722225	923873	8.44	303	R	105	0.75	8	15	
10/04/2016	CSP 34	11:45	11:49	721794	924104	721772	924109	9.40	283	R	108	0.75	8	15	
10/04/2016	CSP 35	11:55	12:02	721403	924256	721386	924267	4.82	303	R	108	0.75	8		
10/04/2016	CSP 36	12:04	12:09	721086	924798	721069	924817	8.50	318	R	108	0.75	8		
10/04/2016	CSP 37	12:13	12:18	720786	925146	720773	925156	5.47	308	R	107	0.75	8		
10/04/2016	CSP 38	12:22	12:27							R	107	0.75	8		Dredging area
10/04/2016	CSP 39	12:33	12:38							R	110	0.75	8		Dredging area
10/04/2016	CSP 40	12:42	12:47	719796	926357	719782	926373	7.09	319	R	111	0.75	8		
10/04/2016	CSP 41	12:52	12:59	718517	926872	718497	926905	9.19	329	R	109	0.75	8		
11/04/2016	CSP 42	08:30	08:35	717962	927306	717967	927295	4.03	156	L	104	0.75	8	15	
11/04/2016	CSP 43	08:45	08:50	717789	927497	717774	927509	6.40	309	R	105	0.75	8	15	
11/04/2016	CSP 44	09:00	09:05	717502	927891	717485	927909	8.25	317	R	103	0.75	8	15	
11/04/2016	CSP 45	09:55	10:00	717229	928518	717237	928540	7.80	20	R	108	0.75	8	15	
11/04/2016	CSP 46	10:15	10:20	717232	928863	717225	928881	6.44	339	R	106	0.75	8	15	
11/04/2016	CSP 47	10:32	10:37							R	110	0.75	8	0	Sea wall area
11/04/2016	CSP 48	10:49	10:52							R	106	0.75	8	0	Sea wall area
11/04/2016	CSP 49	11:04	11:09							R	108	0.75	8	0	Sea wall area
11/04/2016	CSP 50	11:22	11:27							R	100	0.75	8	0	Sea wall area
11/04/2016	CSP 51	11:37	11:42							R	103	0.75	8	0	Sea wall area
11/04/2016	CSP 52	12:05	12:10							R	106	0.75	8	15	Sea wall area
12/04/2016	CSP 53	11:30	11:35	715507	931922	715486	931937	8.60	306	R	112	0.75	8	15	

12/04/2016	CSP 54	11:16	11:21	715204	932283	715191	932299	6.87	321	R	110	0.75	8	15	
12/04/2016	CSP 55	11:02	11:06	714867	932662	714853	932679	9.18	321	R	114	0.75	8	15	
12/04/2016	CSP 56	10:50	10:53	714520	933010	714496	933025	15.72	302	R	115	0.75	8	15	
12/04/2016	CSP 57	10:12	10:15	714189	933362	714173	933382	14.23	321	R	110	0.75	8	15	
12/04/2016	CSP 58	09:55	09:57	713890	933782	713882	933789	8.86	311	R	113	0.75	8	15	
12/04/2016	CSP 59	09:40	09:45	713587	934153	713574	934167	6.37	317	R	110	0.75	8	15	Sea wall area
12/04/2016	CSP 60	09:28	09:32	713264	934564	713252	934572	6.01	304	R	113	0.75	8	15	
12/04/2016	CSP 61									R	110	0.75	8	0	Sea wall area
12/04/2016	CSP 62	08:50	08:53	712611	935324	712593	935337	12.34	306	R	115	0.75	8	15	
12/04/2016	CSP 63									R	105	0.75	8	15	Sea wall area
12/04/2016	CSP 64	08:25	08:30	711939	936063	711912	936098	14.73	322	R	100	0.75	8	15	
13/04/2016	CSP 65	08:37	08:40	711601	936427	711585	936444	12.97	317	R	105	0.75	8	10	
13/04/2016	CSP 66	08:50	08:55	711269	936792	711252	936819	10.64	328	R	108	0.75	8	10	
13/04/2016	CSP 67	09:03	09:08	710928	937179	710903	937199	10.67	309	R	102	0.75	8	10	
13/04/2016	CSP 68	09:18	09:21	710597	937547	710588	937562	9.72	329	R	105	0.75	8	10	
13/04/2016	CSP 69	09:28	09:32	710262	937916	710247	937935	10.09	322	R	110	0.75	8	10	
13/04/2016	CSP 70	09:47	09:50	709930	938298	709915	938318	13.89	323	R	105	0.75	8	10	
13/04/2016	CSP 71	09:58	10:02	709790	938440	709769	938461	12.37	315	R	111	0.75	8	10	
13/04/2016	CSP 72	10:29	10:33	709463	938814	709448	938835	10.75	324	R	108	0.75	8	10	
13/04/2016	CSP 73	10:45	10:48	709135	939201	709111	939214	15.16	298	R	110	0.75	8	10	
14/04/2016	CSP 74	09:15	09:20	708812	939550	708782	939595	18.03	326	R	105	0.75	8	10	
14/04/2016	CSP 75	09:00	09:03	708472	939954	708444	939968	17.39	297	R	100	0.75	8	10	
14/04/2016	CSP 76	08:50	08:55	708163	940322	708148	940352	11.18	333	R	105	0.75	8	10	
14/04/2016	CSP 77	08:38	08:42	707847	940703	707829	940719	10.03	312	R	104	0.75	8	10	
14/04/2016	CSP 78	09:53	09:56	707516	941082	707503	941097	11.03	319	R	108	0.75	8	10	
14/04/2016	CSP 79	10:08	10:11	707216	941495	707200	941512	12.97	317	R	108	0.75	8	10	
14/04/2016	CSP 80	10:20	10:23	706903	941885	706884	941913	18.80	326	R	108	0.75	8	10	
14/04/2016	CSP 81	10:32	10:35	706602	942279	706586	942294	12.18	313	R	110	0.75	8	10	

Annexure VI

Photo Documentation at CSP Locations - April 2016

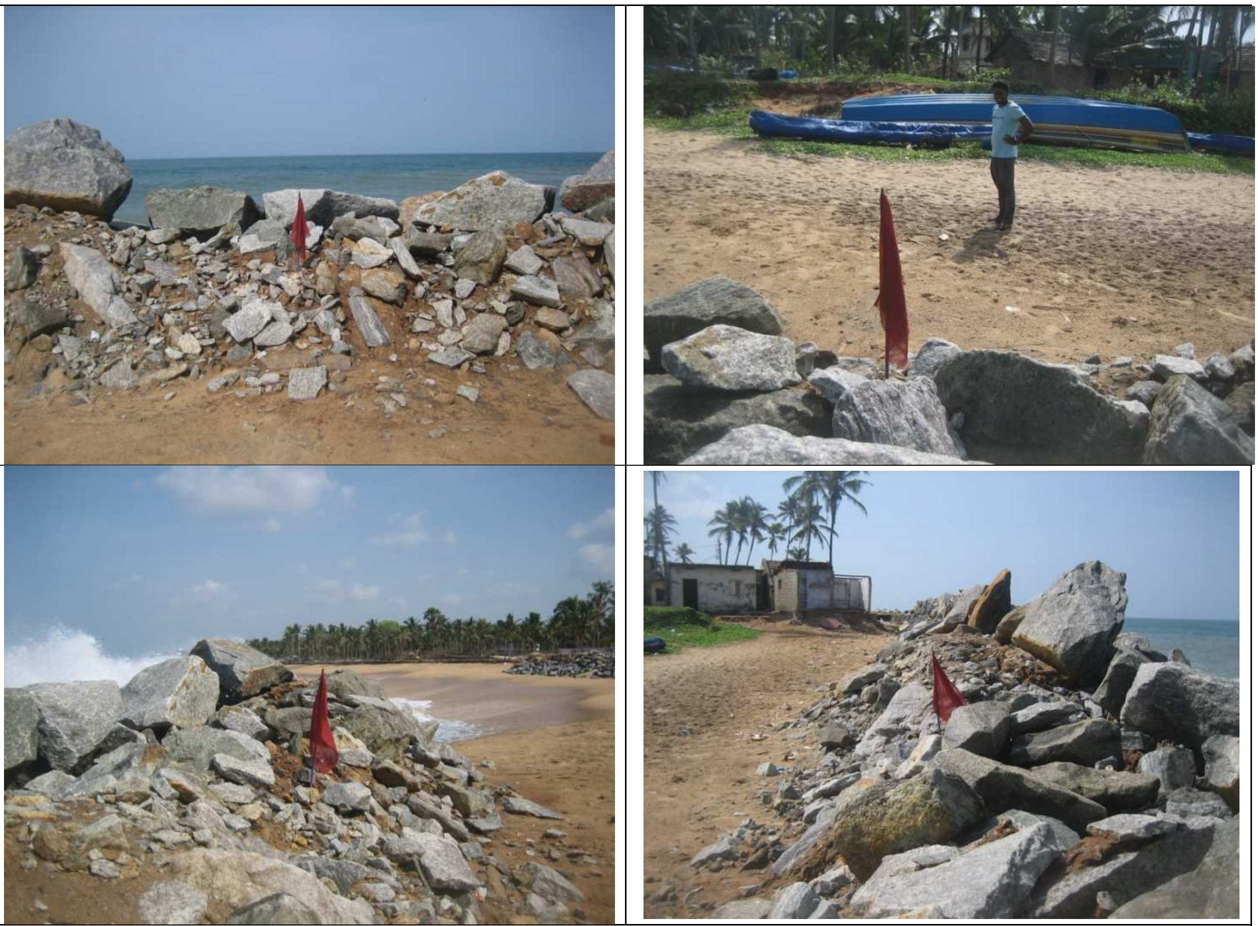


Figure 01:- April_CSP 01

Figure 02:- April_CSP 02

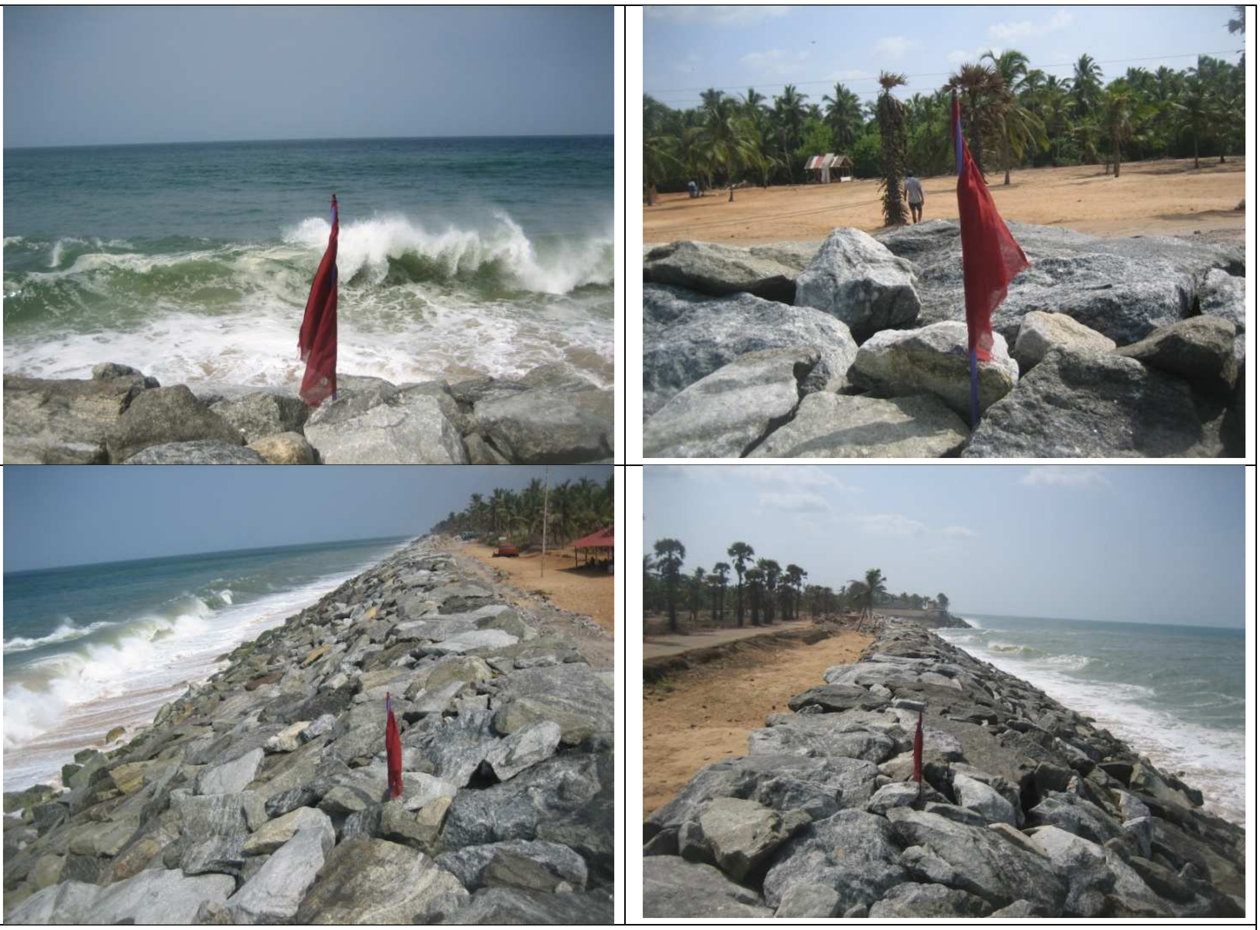


Figure 03:- April_CSP 03

Figure 04:- April_CSP 04

Figure 05:- April_CSP 05

Figure 06:- April_CSP 06

Figure 07:- April_CSP 07

Figure 08:- April_CSP 08

Figure 09:- April_CSP 09

Figure 10:- April_CSP 10

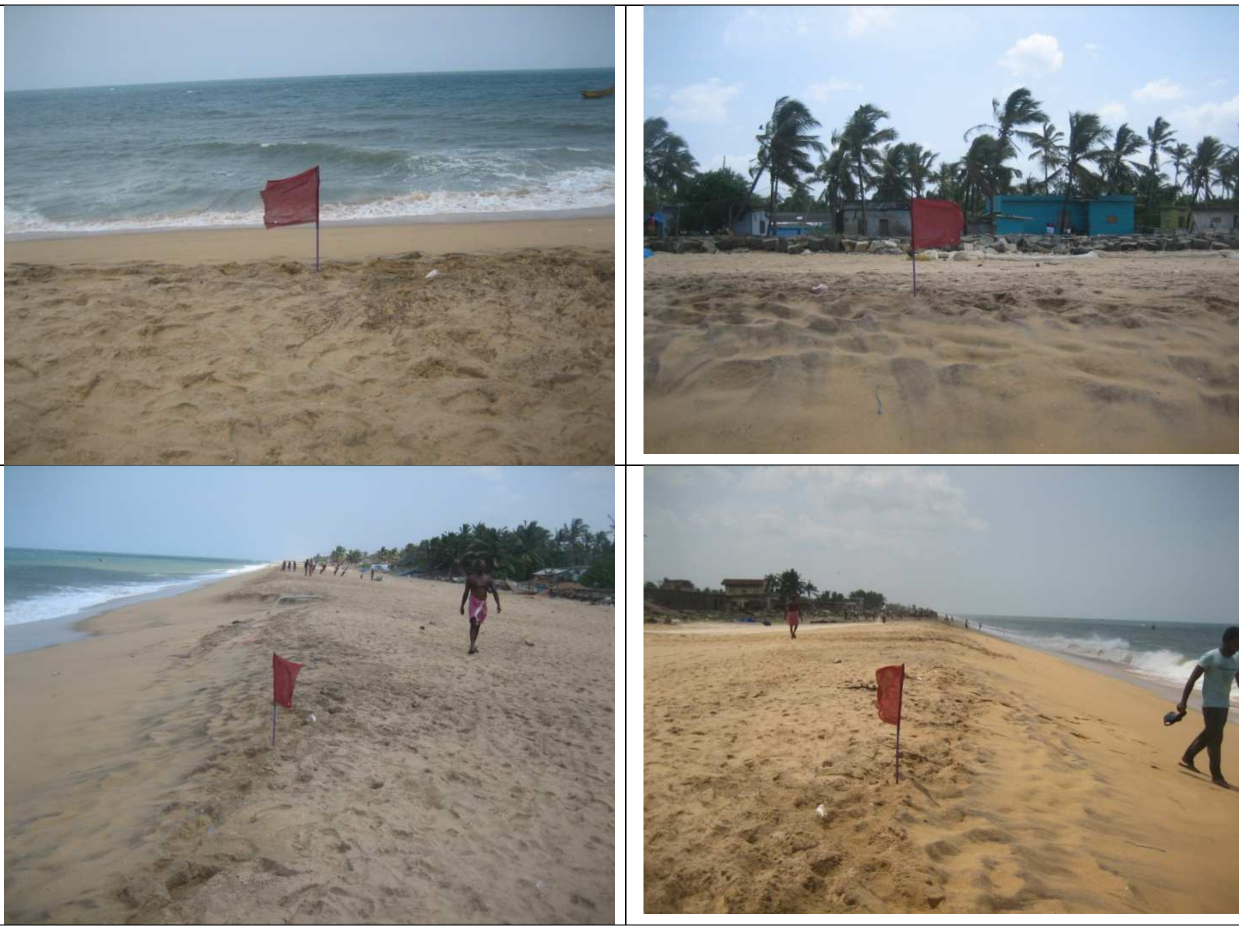


Figure 11:- April_CSP 11

Figure 12:- April_CSP 12

Figure 13:- April_CSP 13

Figure 14:- April_CSP 14

Figure 15:- April_CSP 15

Figure 16:- April_CSP 16

Figure 17:- April_CSP 17

Figure 18:- April_CSP 18

Figure 19:- April_CSP 19

Figure 20:- April_CSP 20

Figure 21:- April_CSP 21

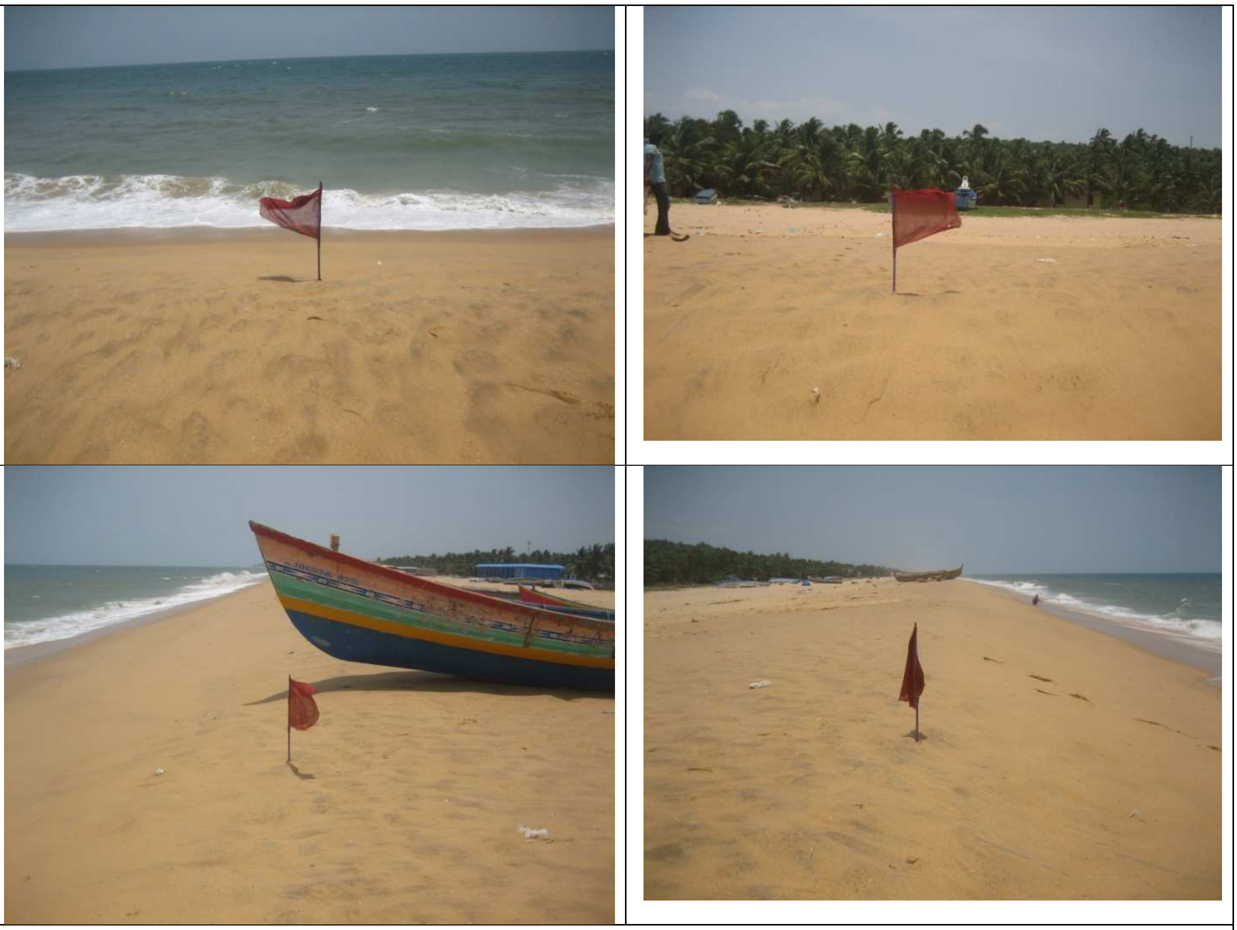


Figure 22:- April_CSP 22

Figure 23:- April_CSP 23

Figure 24:- April_CSP 24

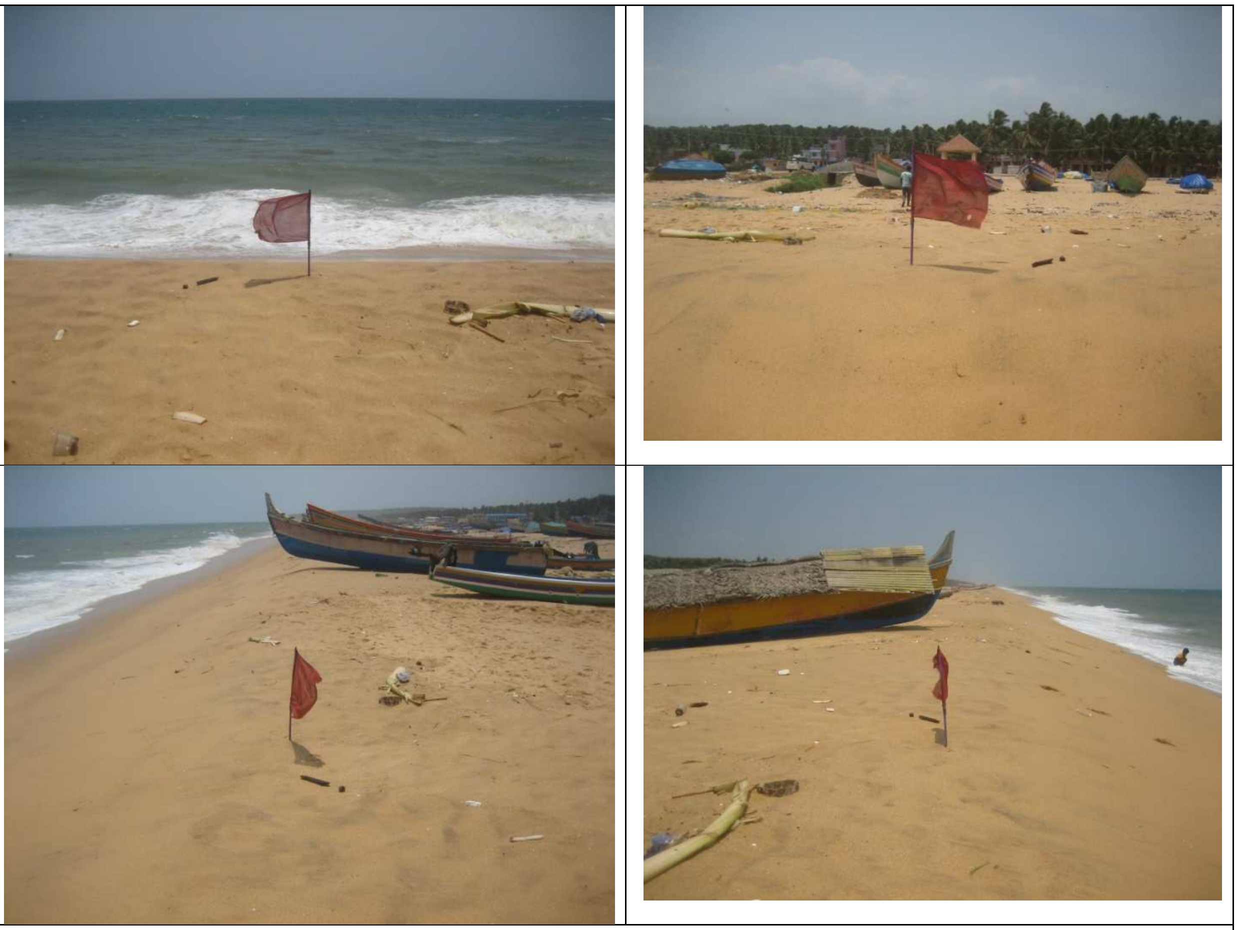
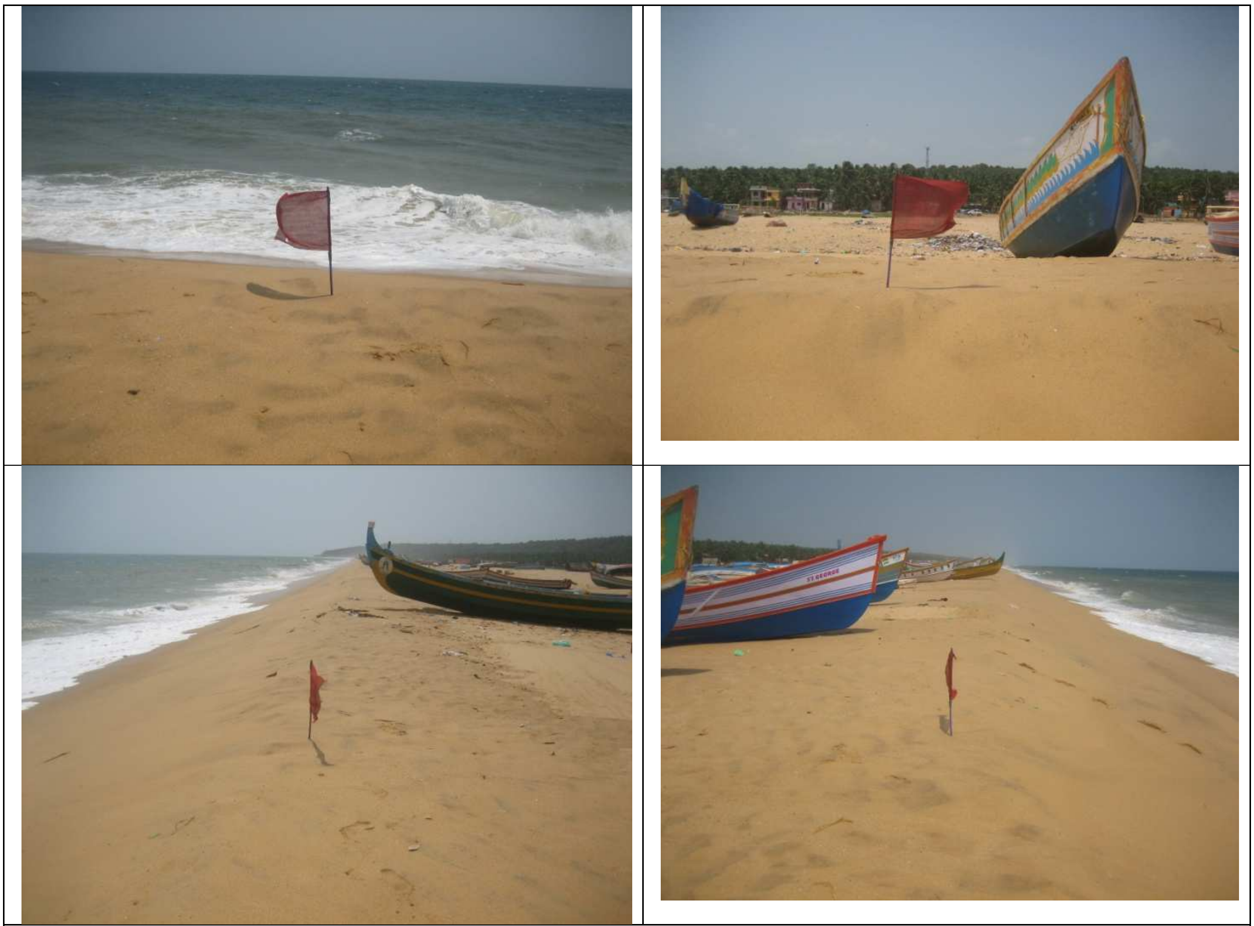


Figure 25:- April_CSP 25

Figure 26:- April_CSP 26

Figure 27:- April_CSP 27

Figure 28:- April_CSP 28



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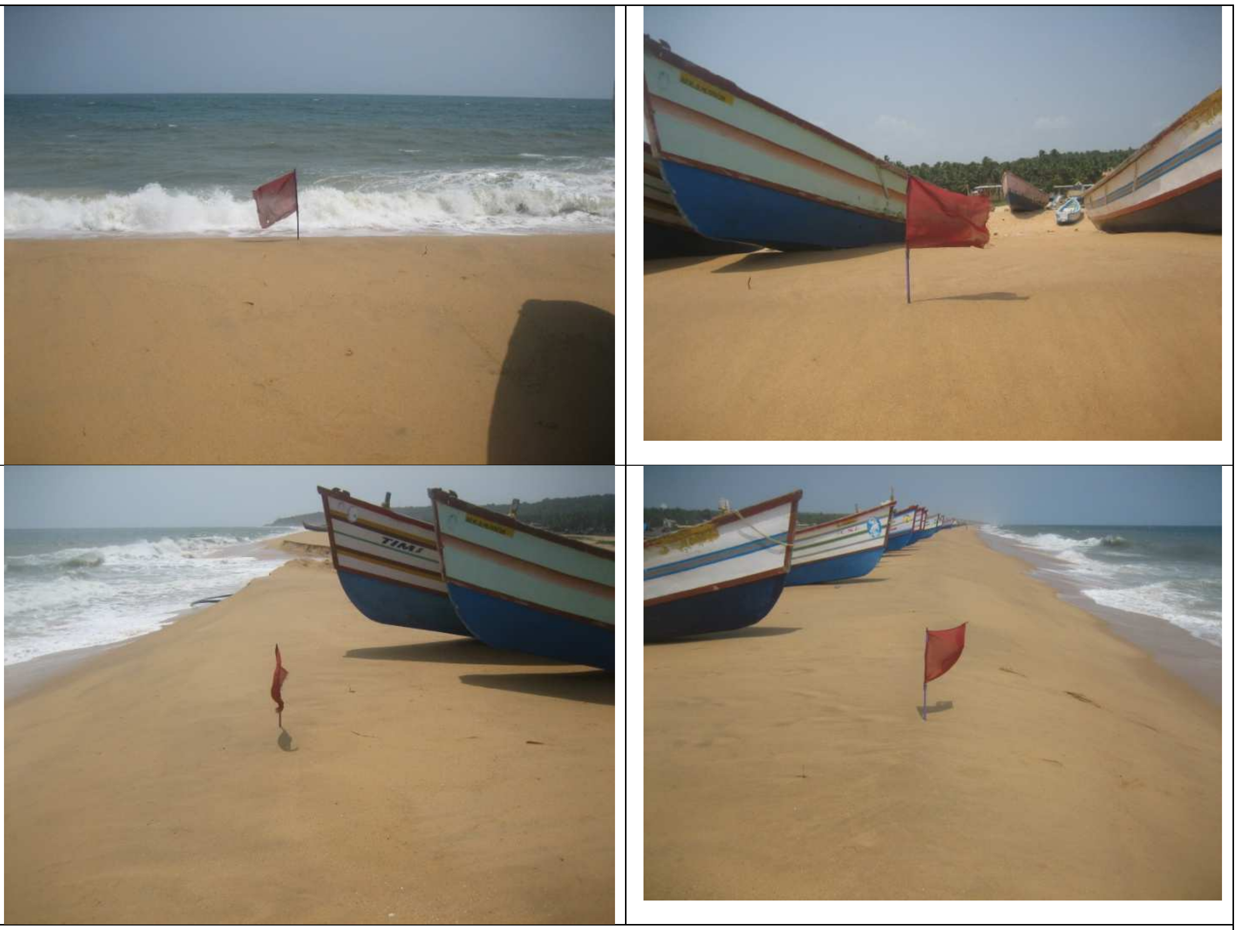

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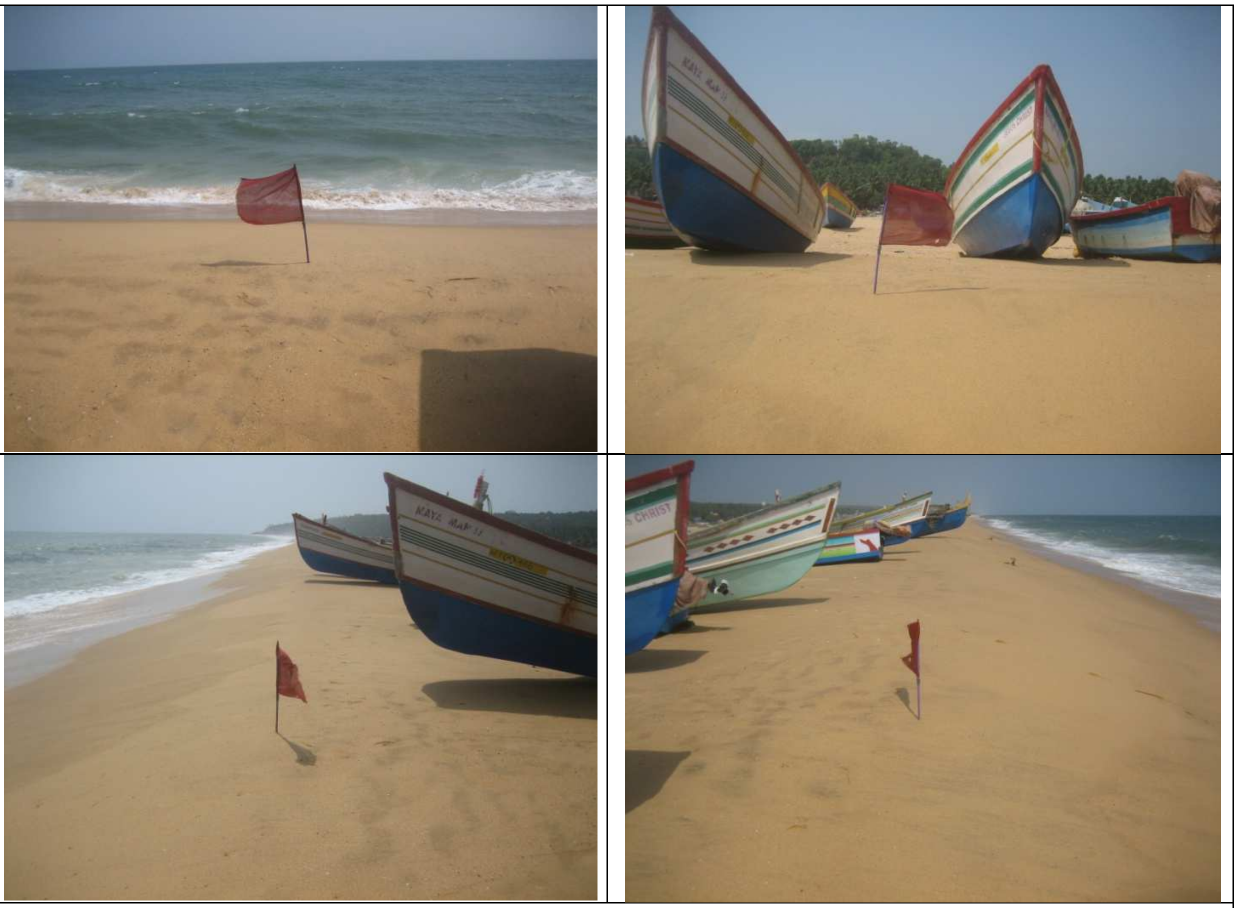


Figure 31:- April_CSP 31

Figure 32:- April_CSP 32

Figure 33:- April_CSP 33

Figure 34:- April_CSP 34

Figure 35:- April_CSP 35

Figure 36:- April_CSP 36

Figure 37:- April_CSP 37

Figure 38:- April_CSP 38

Figure 39:- April_CSP 39

Figure 40:- April_CSP 40

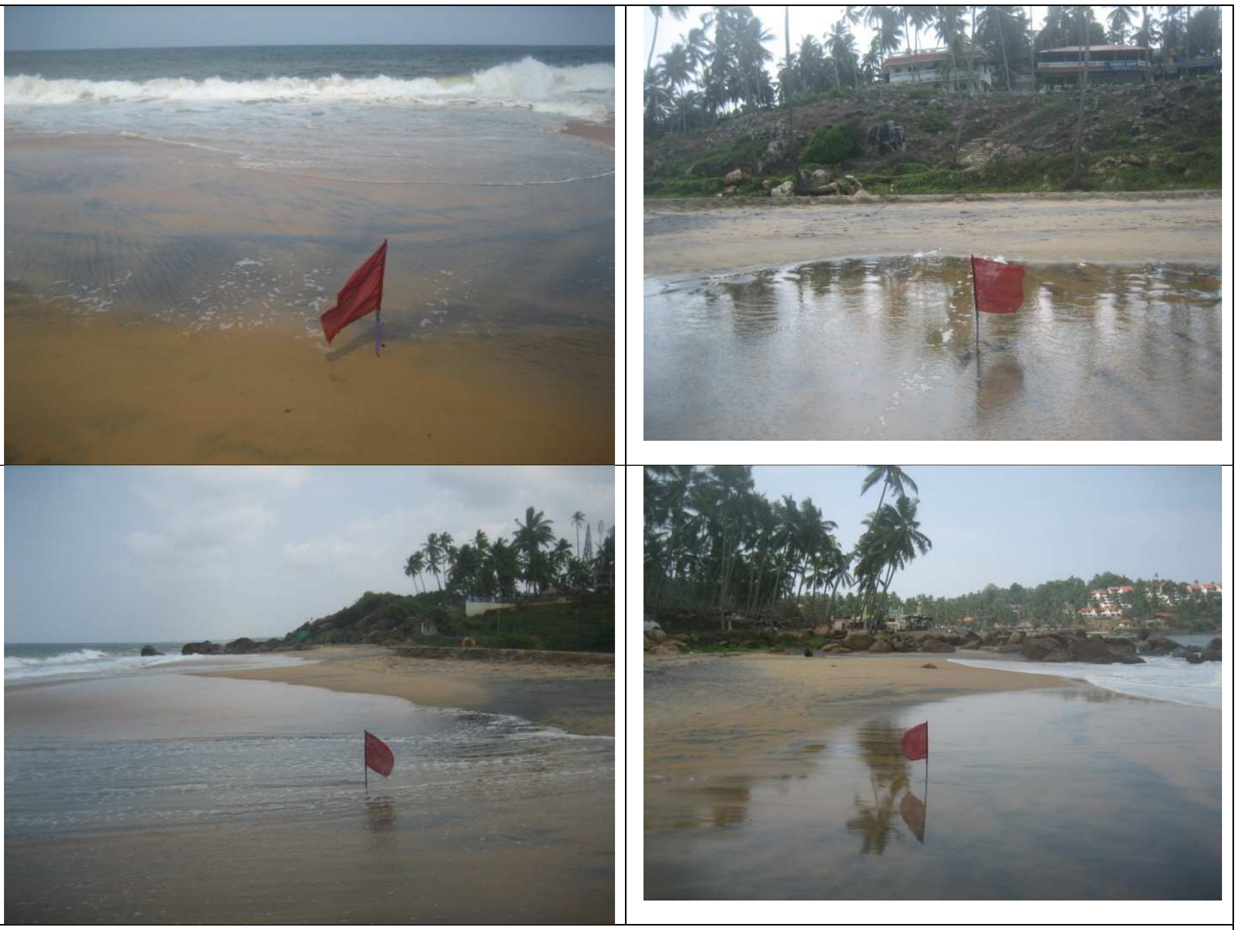
Figure 41:- April_CSP 41

Figure 42:- April_CSP 42

Figure 43:- April_CSP 43

Figure 44:- April_CSP 44

Figure 45:- April_CSP 45



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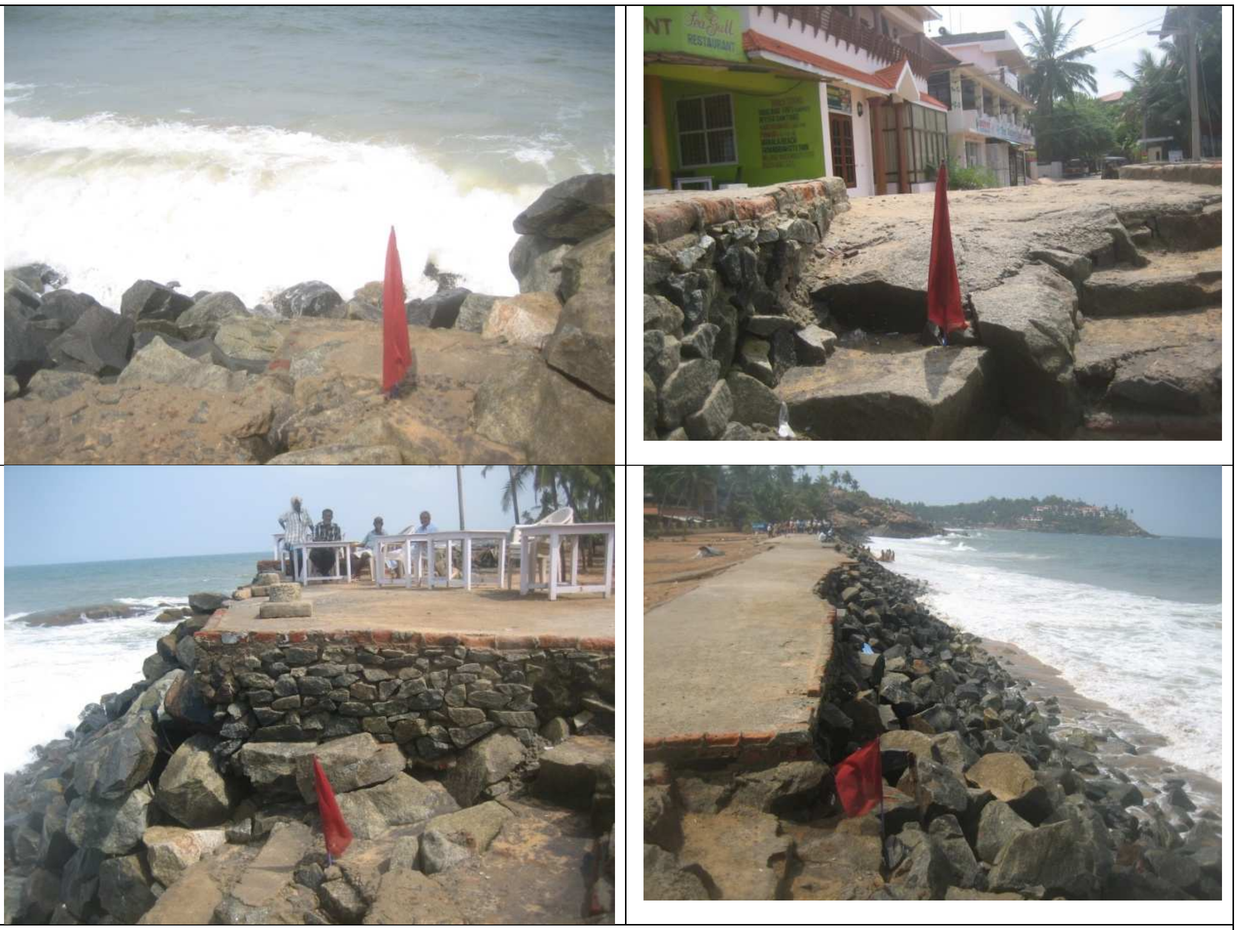
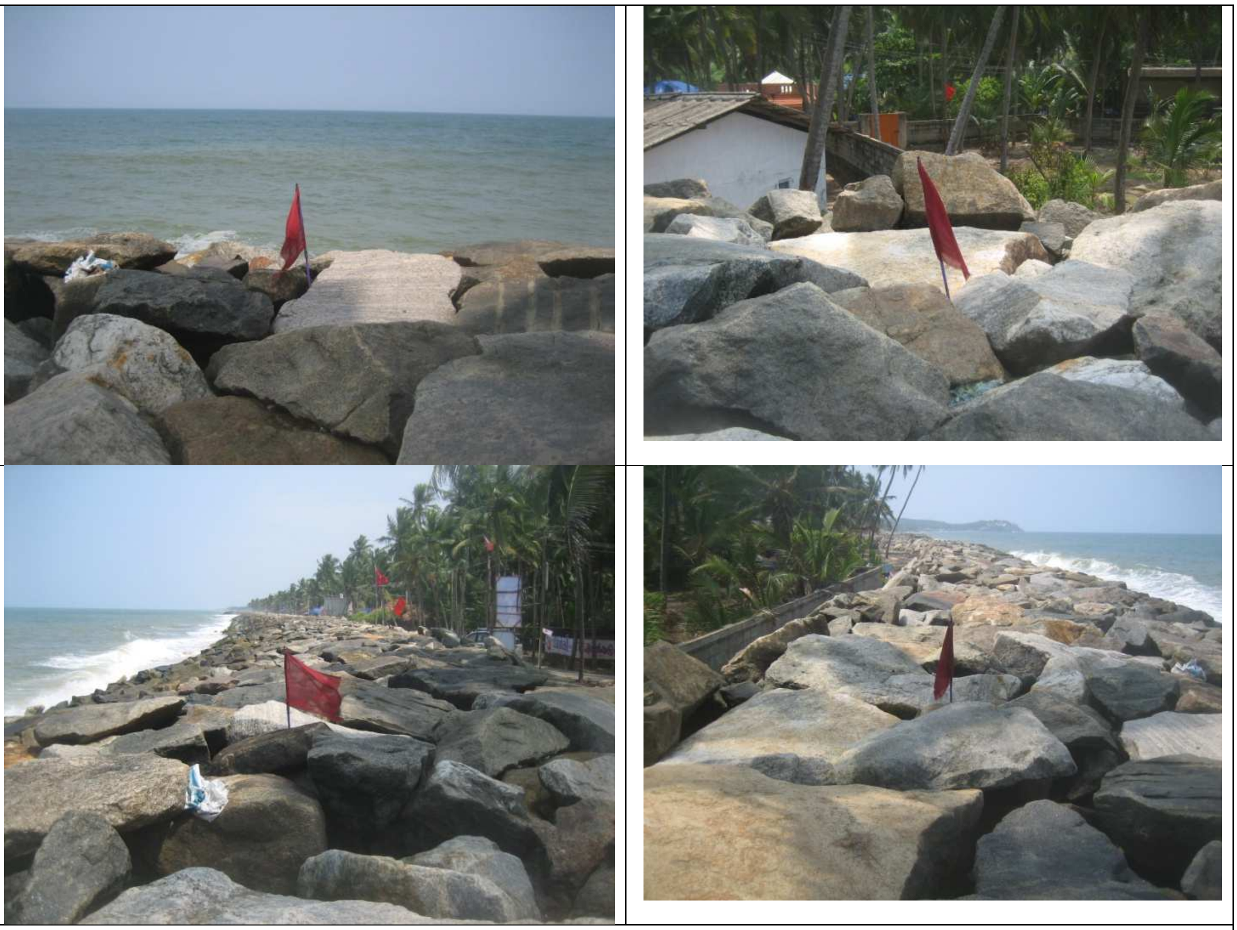


Figure 47:- April_CSP 47

Figure 48:- April_CSP 48

Figure 49:- April_CSP 49

Figure 50:- April_CSP 50



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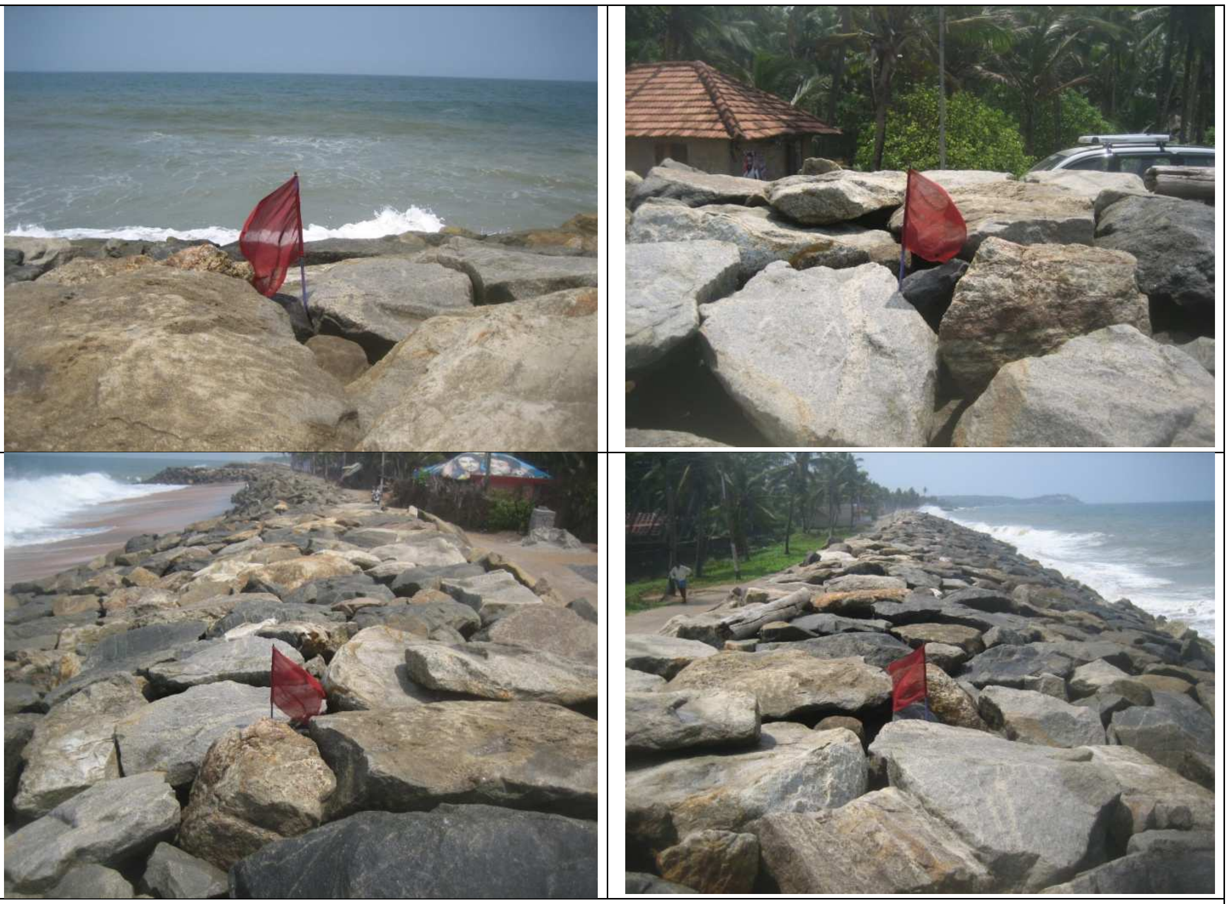


Figure 52:- April_CSP 52

Figure 53:- April_CSP 53

Figure 54:- April_CSP 54

Figure 55:- April_CSP 55

Figure 56:- April_CSP 56

Figure 57:- April_CSP 57

Figure 58:- April_CSP 58

Figure 59:- April_CSP 59

Figure 60:- April_CSP 60

Figure 61:- April_CSP 61

Figure 62:- April_CSP 62

Figure 63:- April_CSP 63

Figure 64:- April_CSP 64

Figure 65:- April_CSP 65

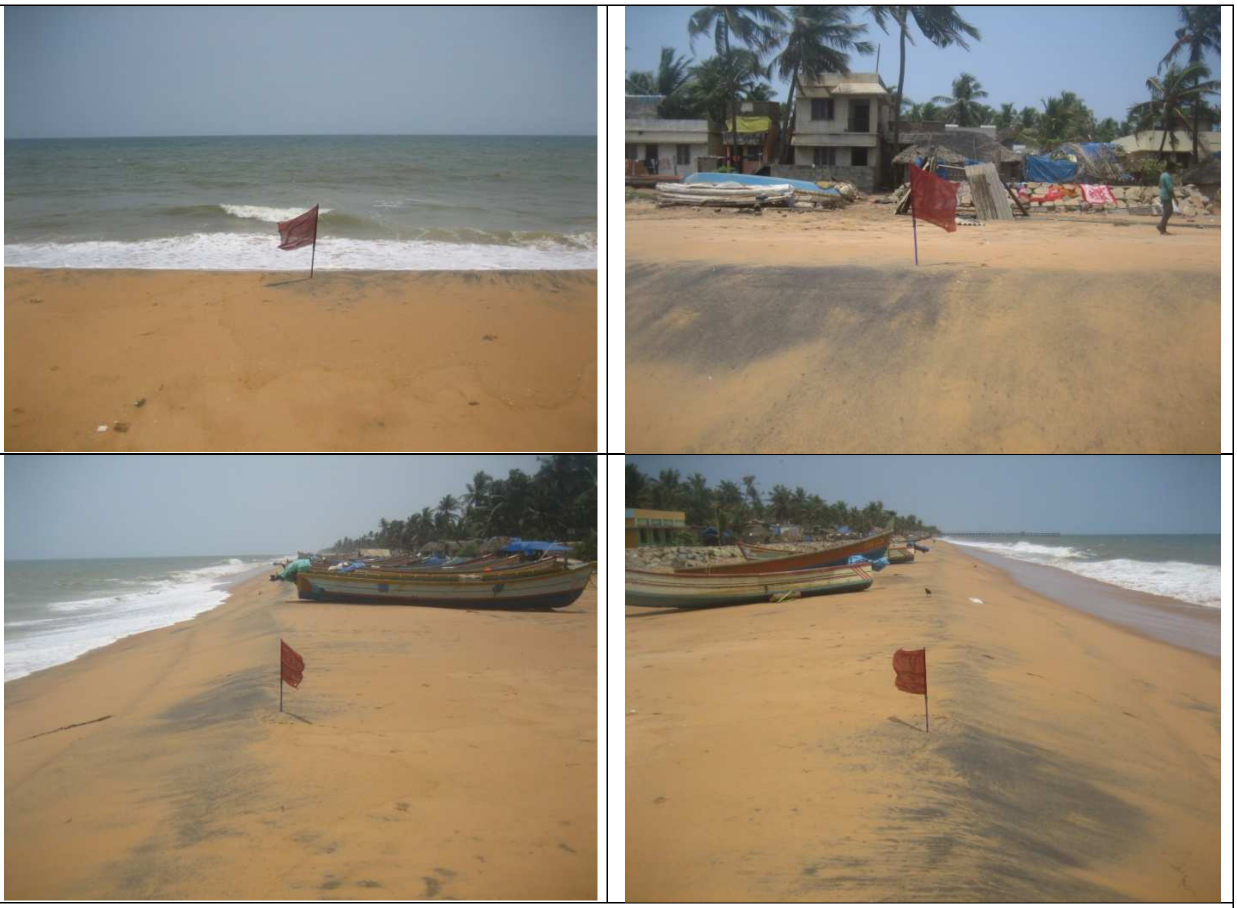


Figure 66:- April_CSP 66

Figure 67:- April_CSP 67

Figure 68:- April_CSP 68

Figure 69:- April_CSP 69

Figure 70:- April_CSP 70

Figure 71:- April_CSP 71

Figure 72:- April_CSP 72

Figure 73:- April_CSP 73

Figure 74:- April_CSP 74

Figure 75:- April_CSP 75

Figure 76:- April_CSP 76

Figure 77:- April_CSP 77

Figure 78:- April_CSP 78

Figure 79:- April_CSP 79

Figure 80:- April_CSP 80

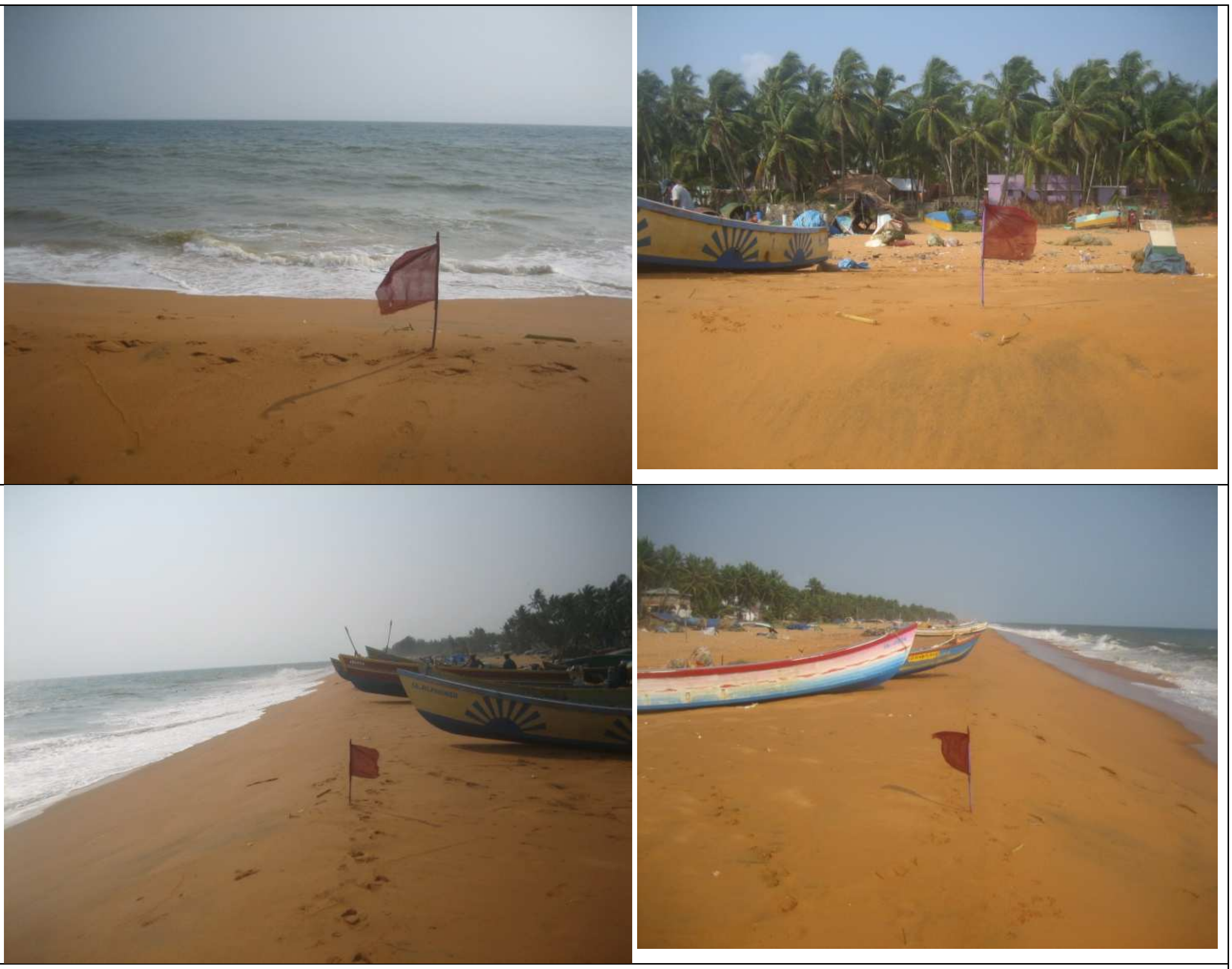


Figure 81:- April_CSP 81

Annexure VI

Photo Documentation at CSP Locations – February 2016

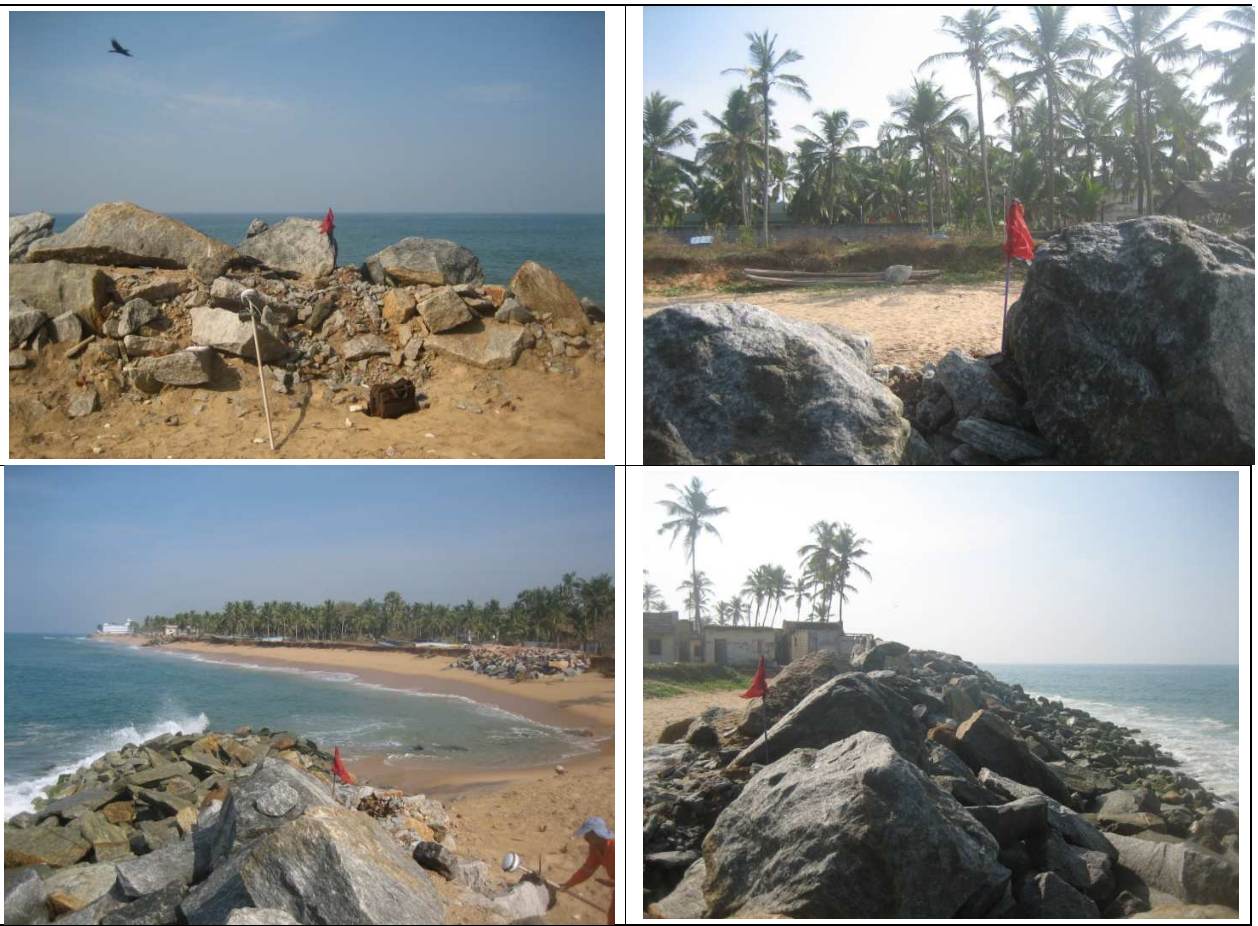
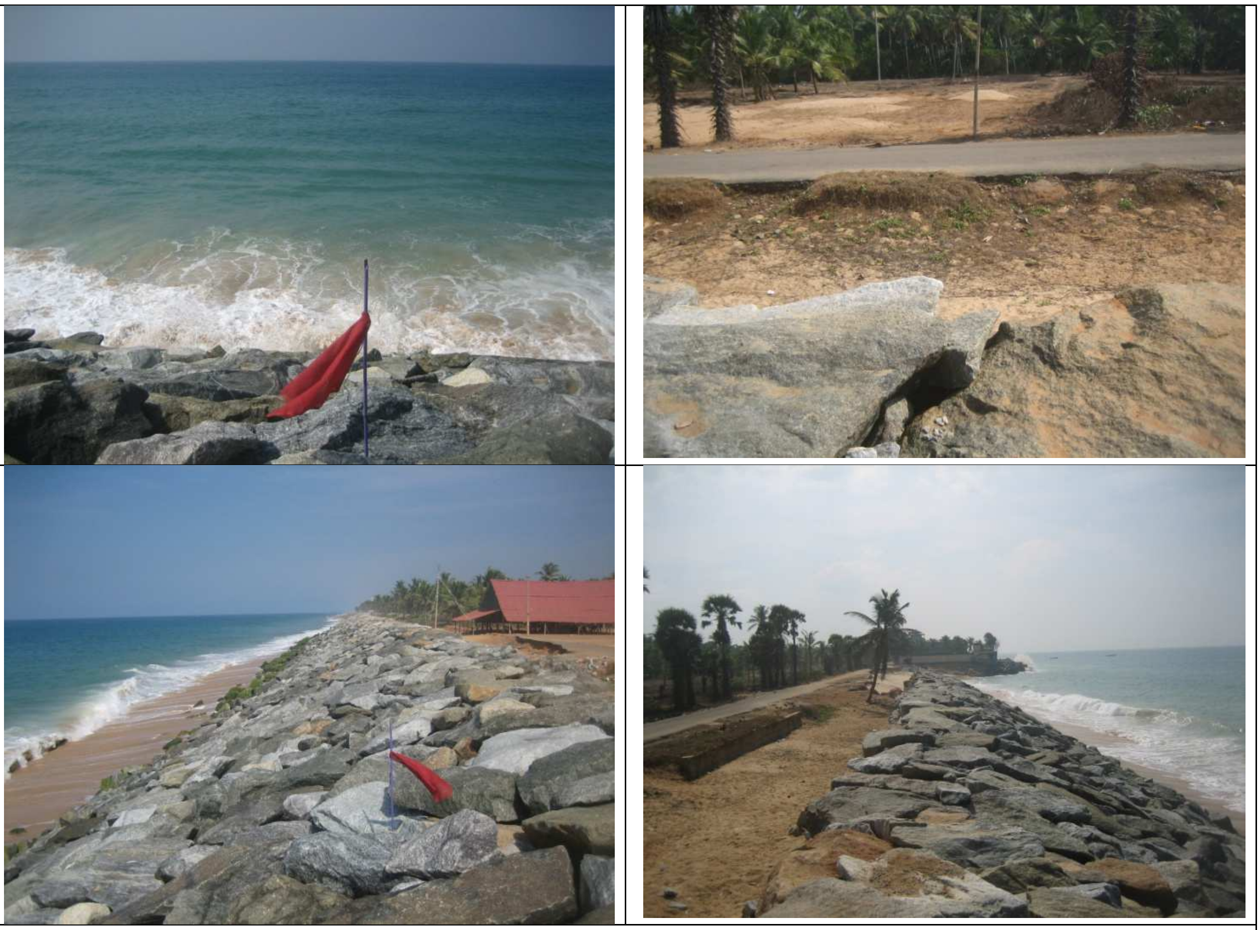


Figure 01:- February_CSP 01

Figure 02:- February _CSP 02



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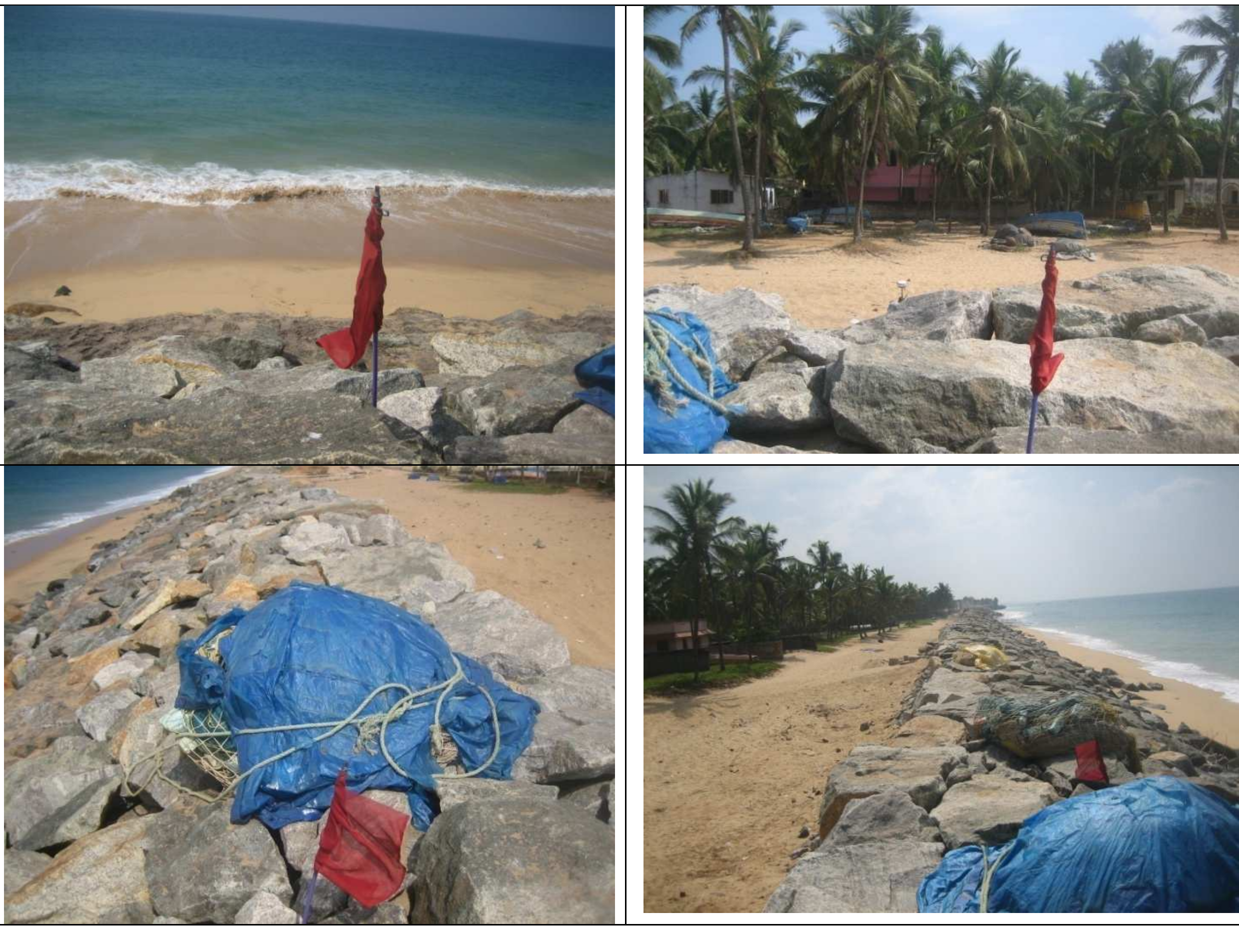

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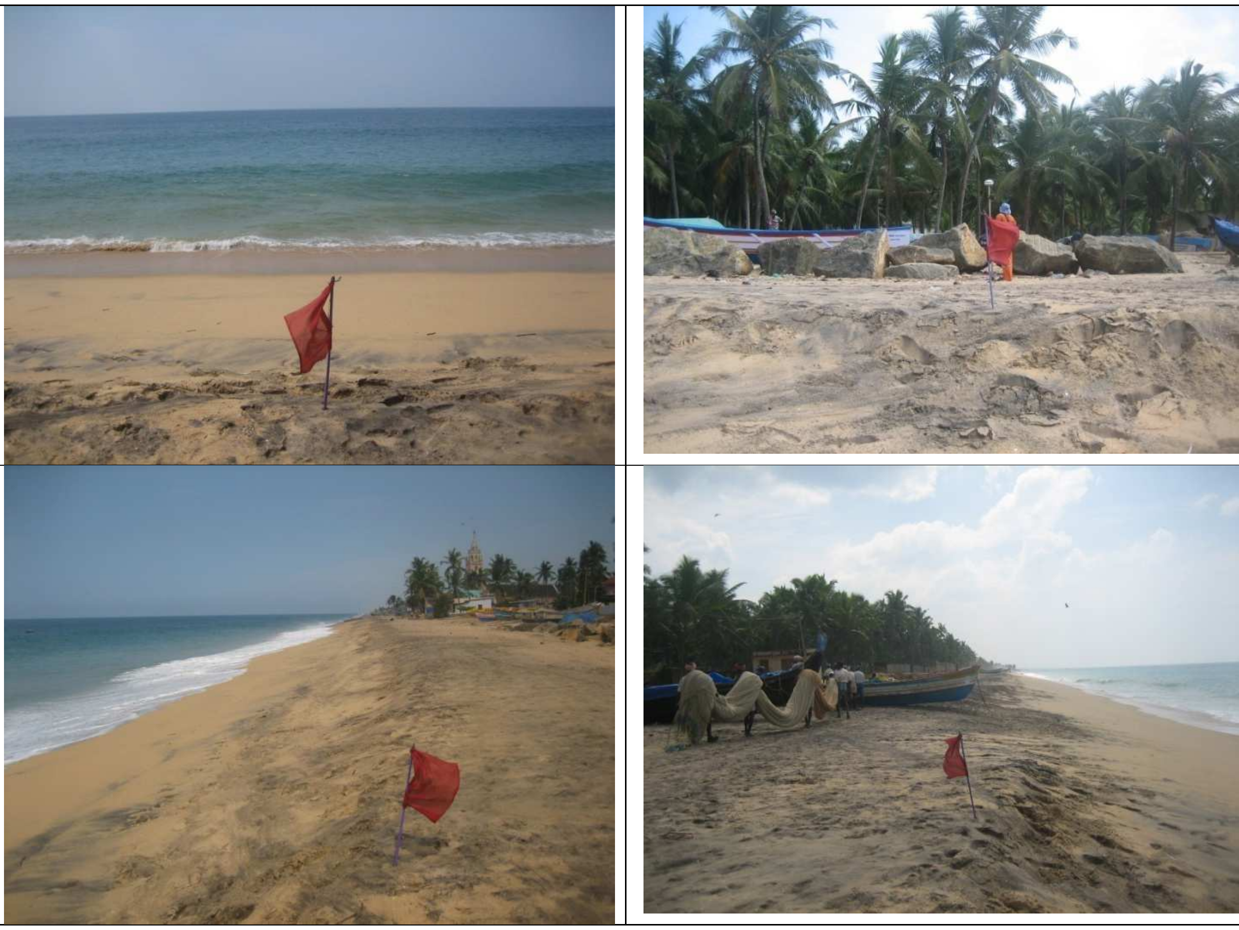

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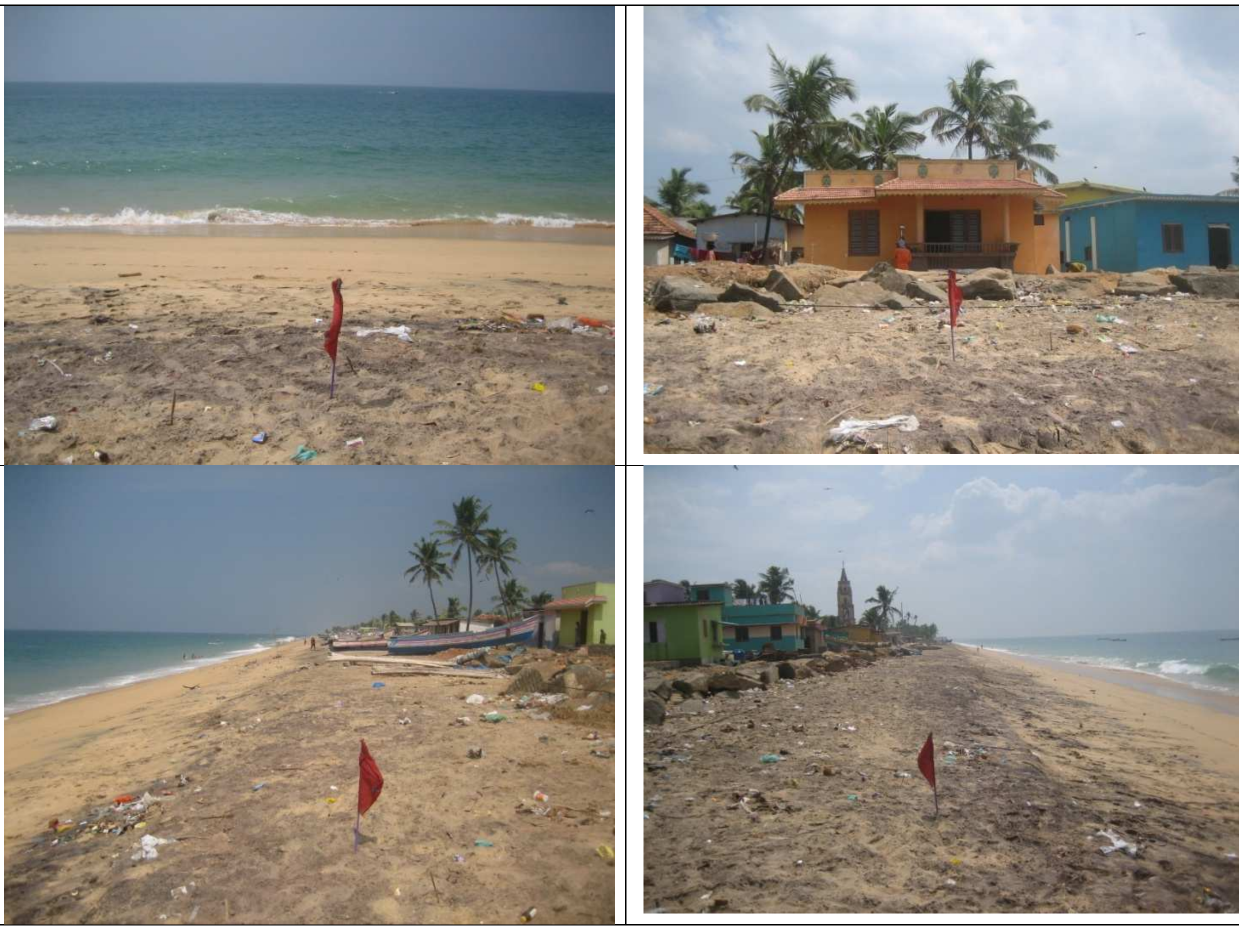


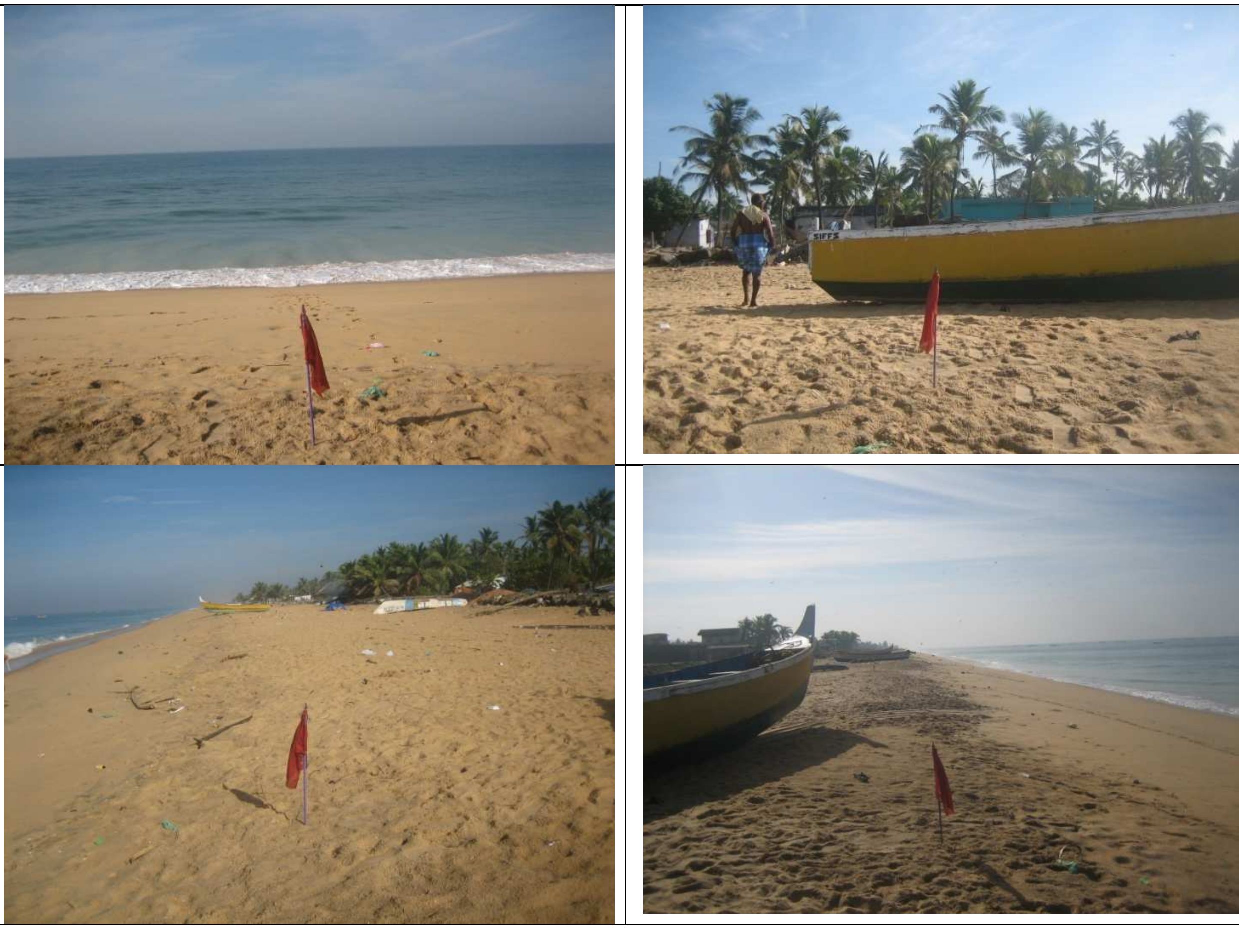
Figure 06:- February _CSP 06

Figure 07:- February_CSP 07

Figure 08:- February_CSP 08

Figure 09:- February_CSP 09

Figure 10:- February_CSP 10



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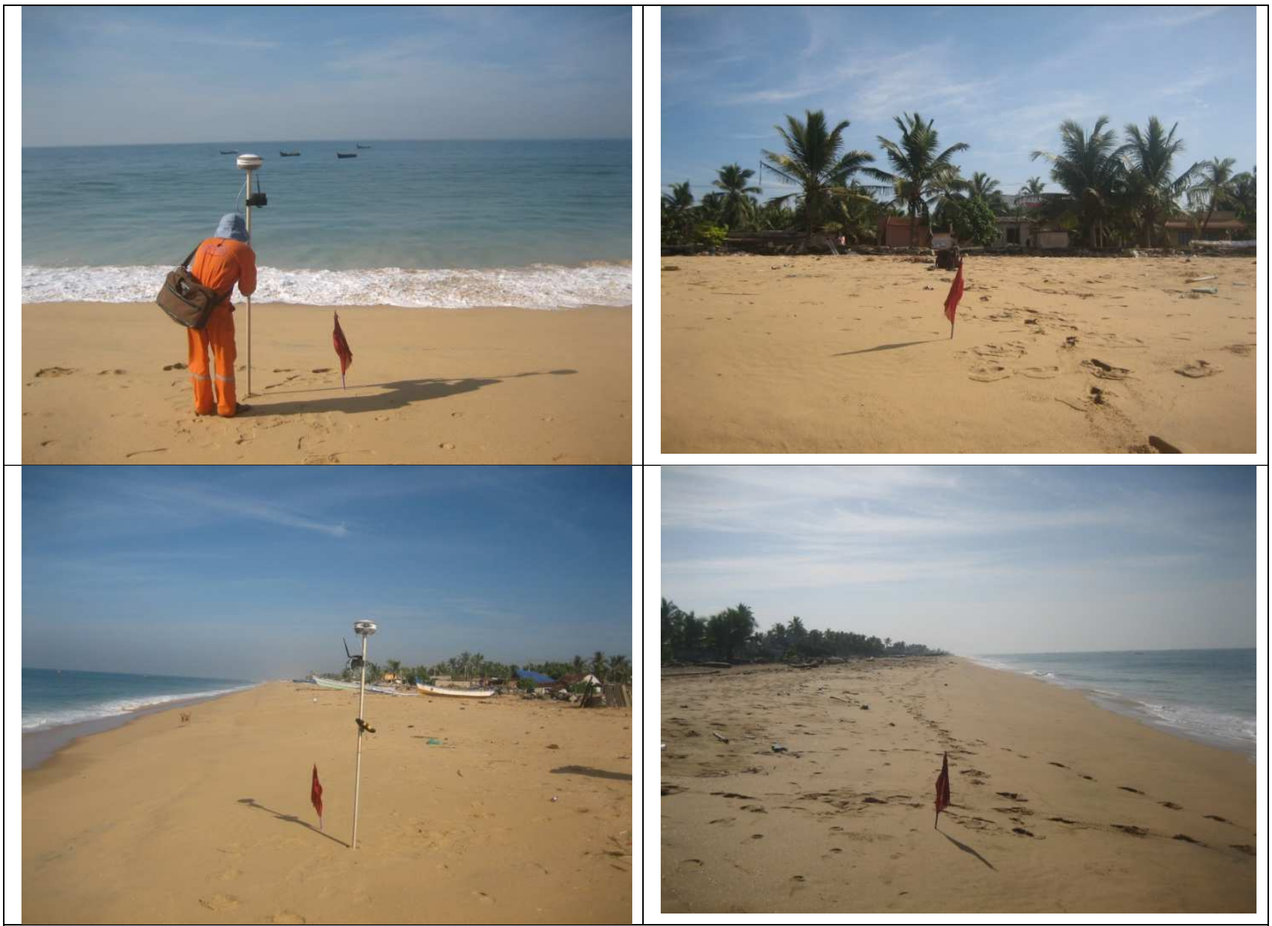


Figure 12:- February_CSP 12

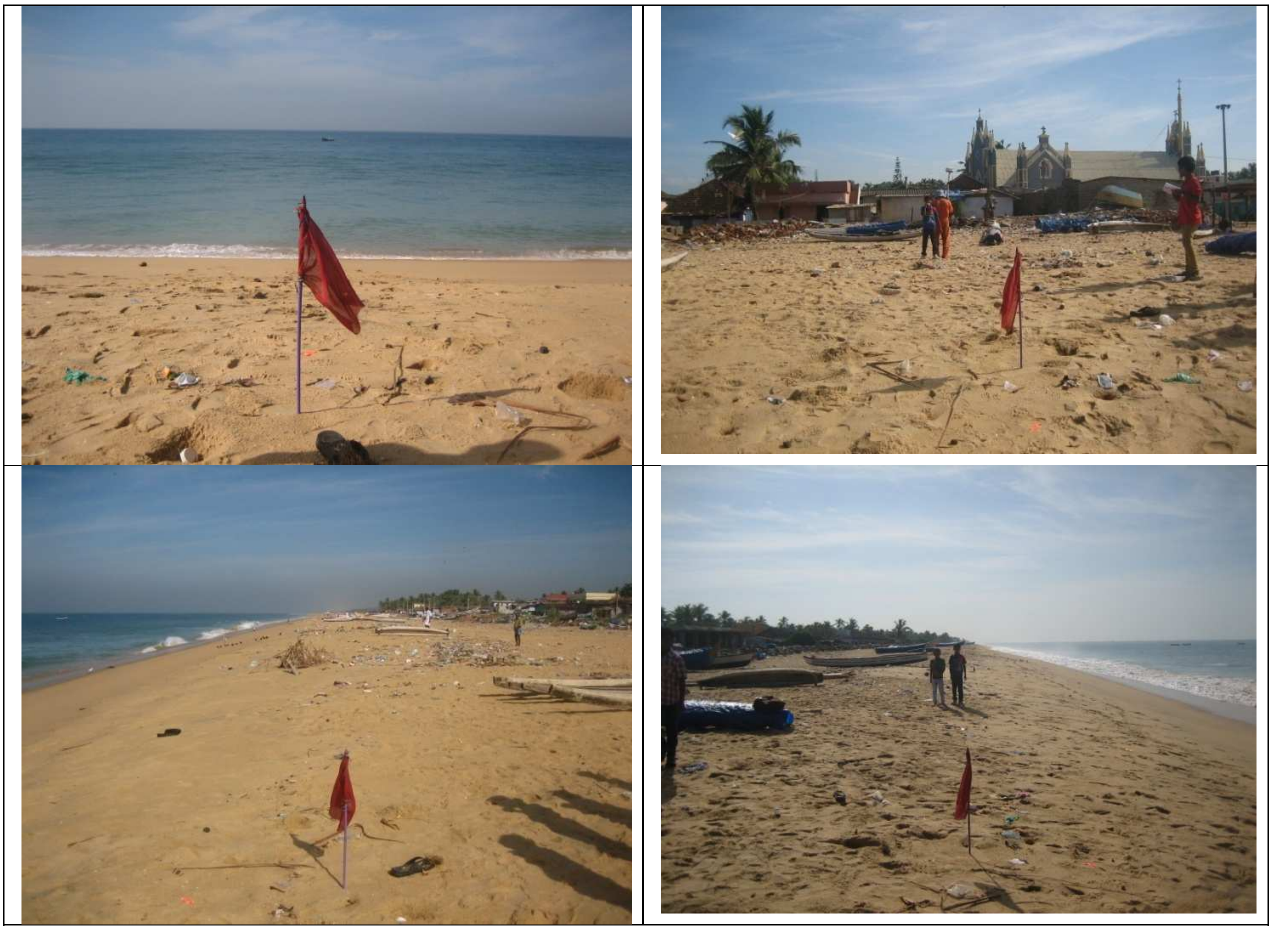


Figure 13:- February _CSP 13

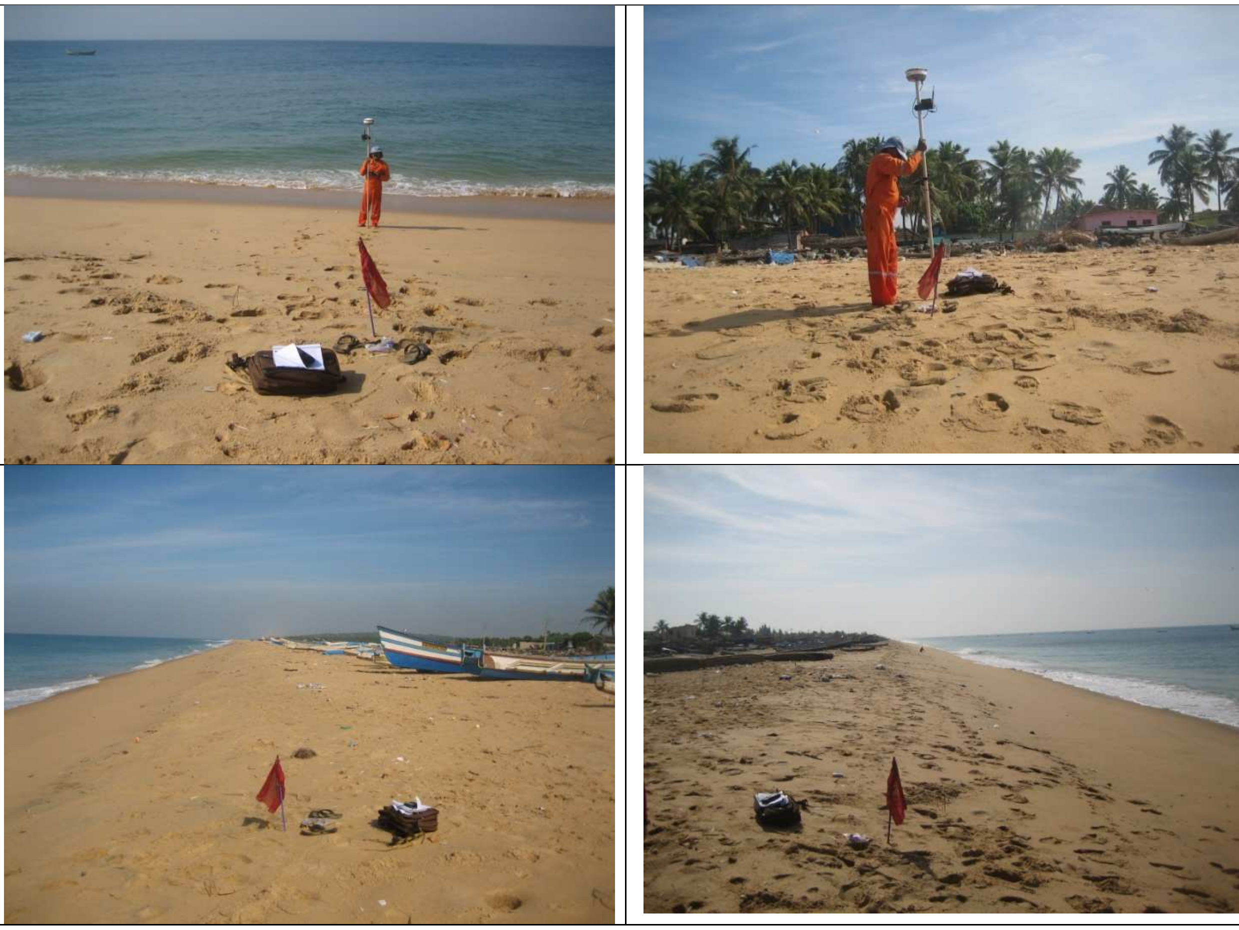
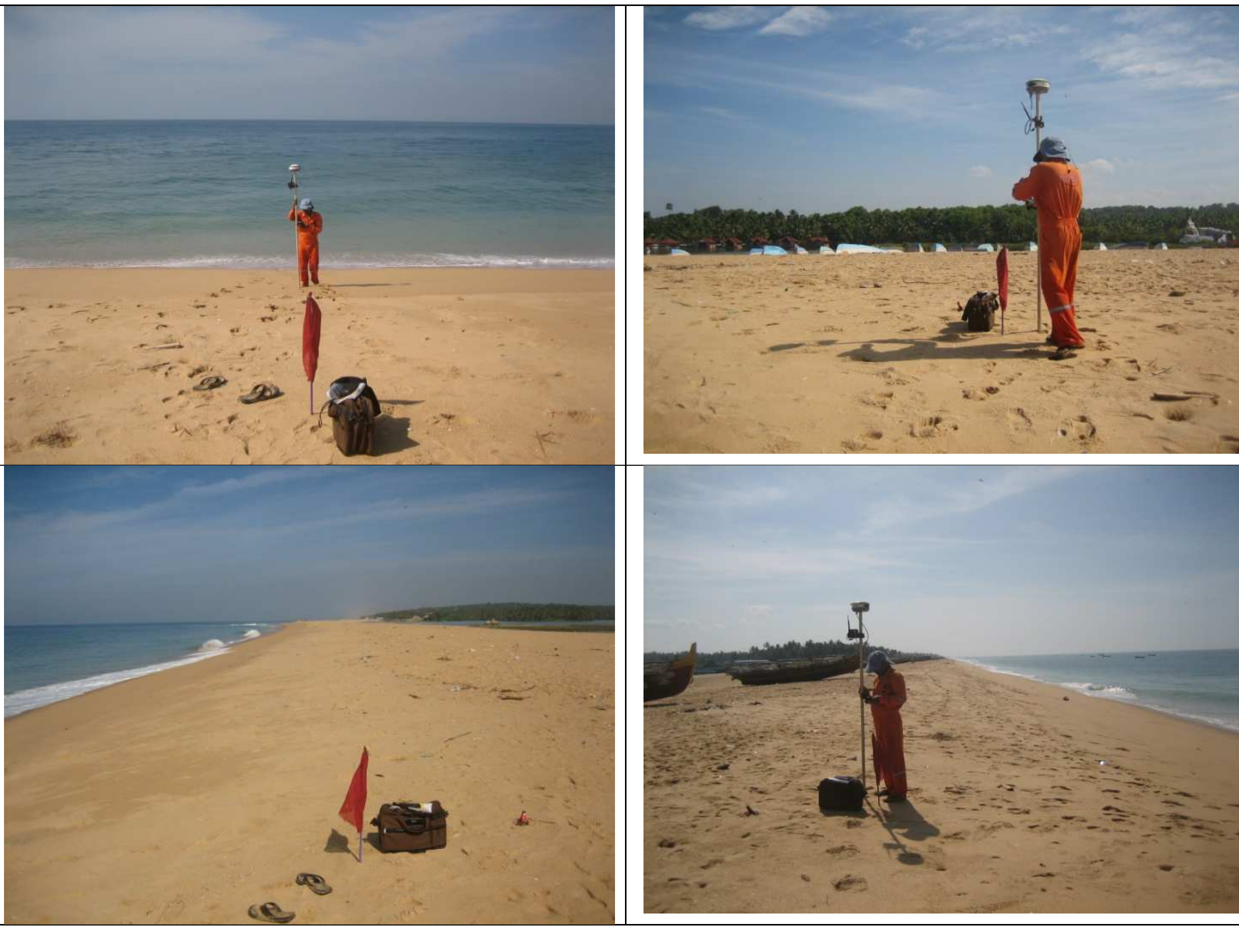


Figure 14:- February _CSP 14



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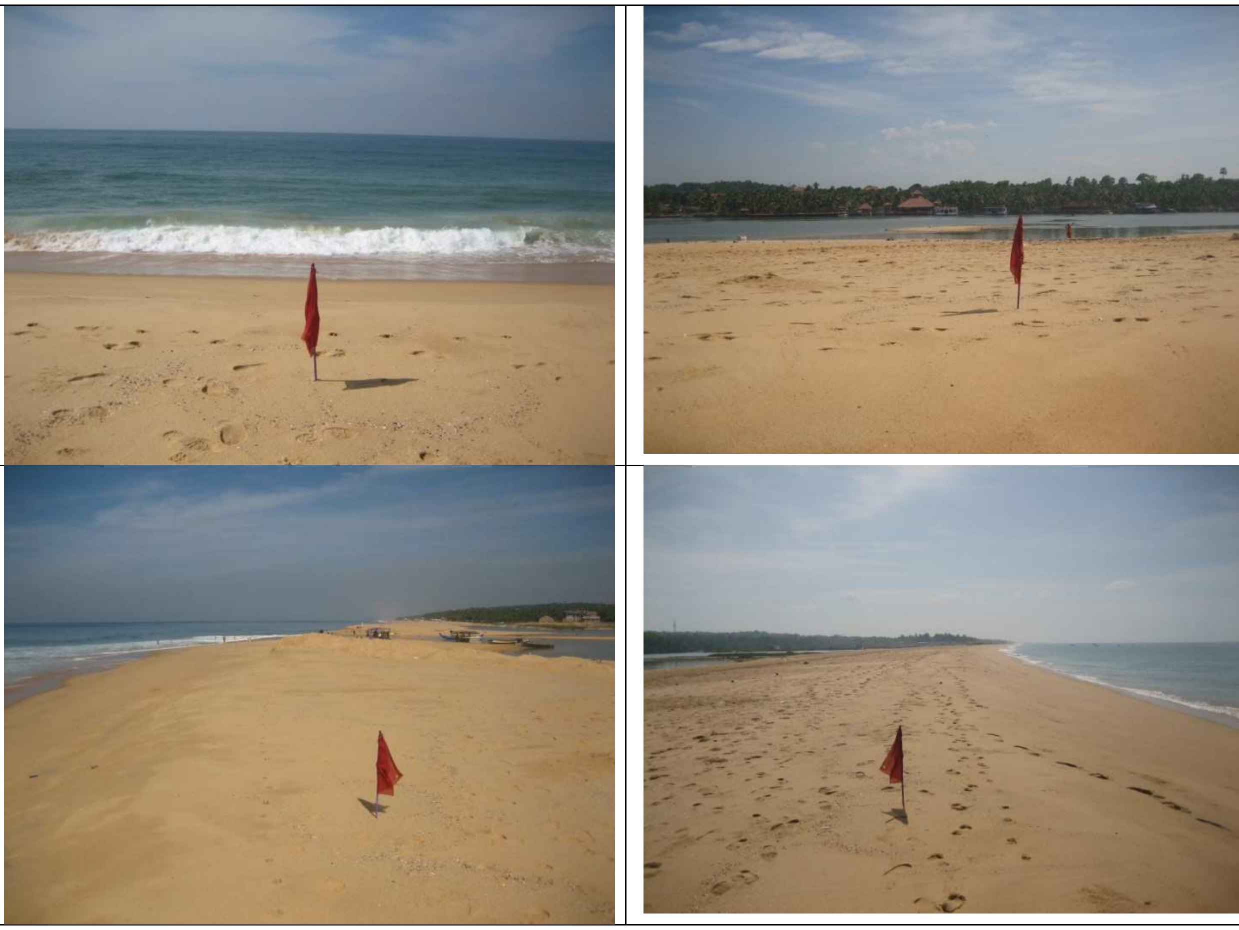

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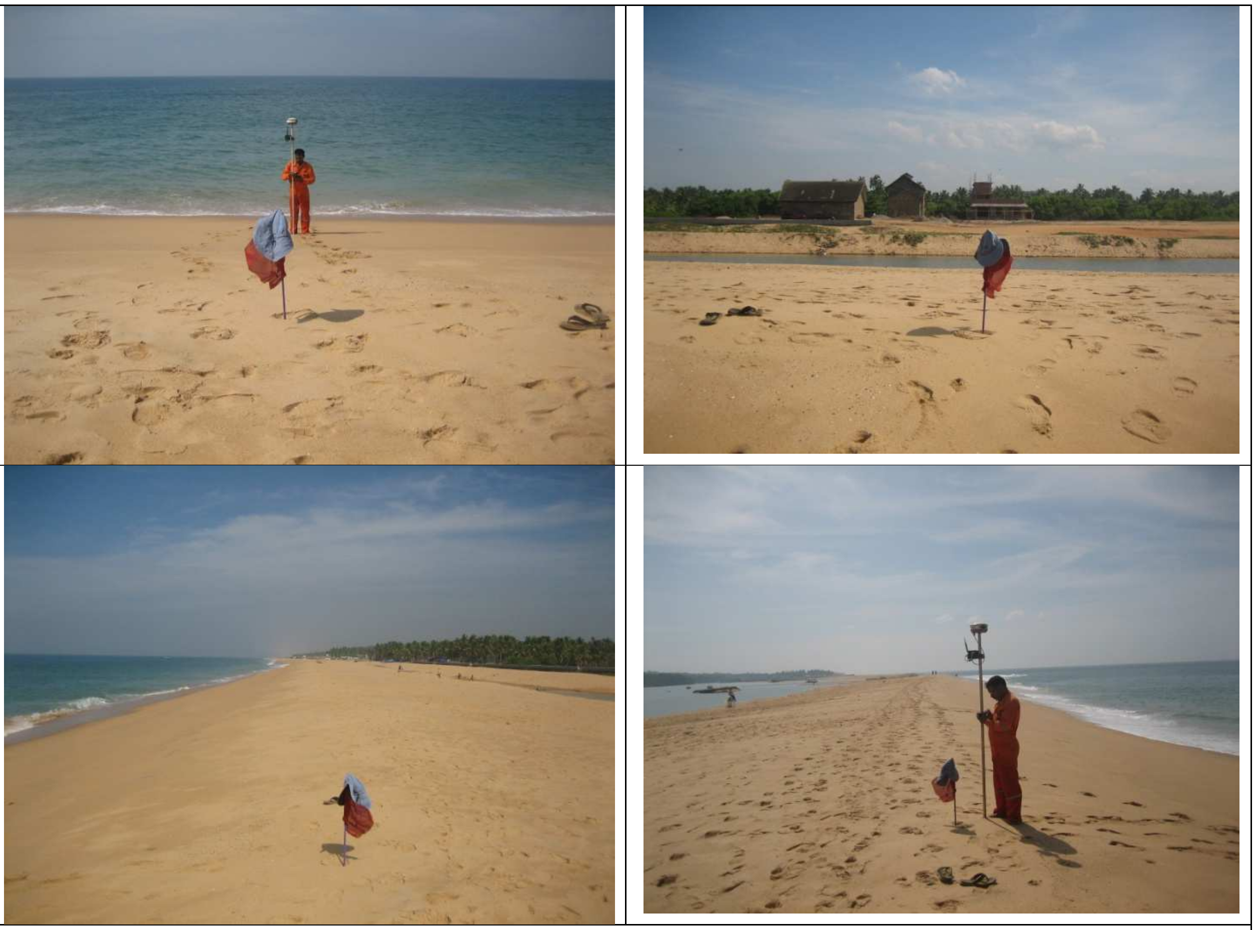
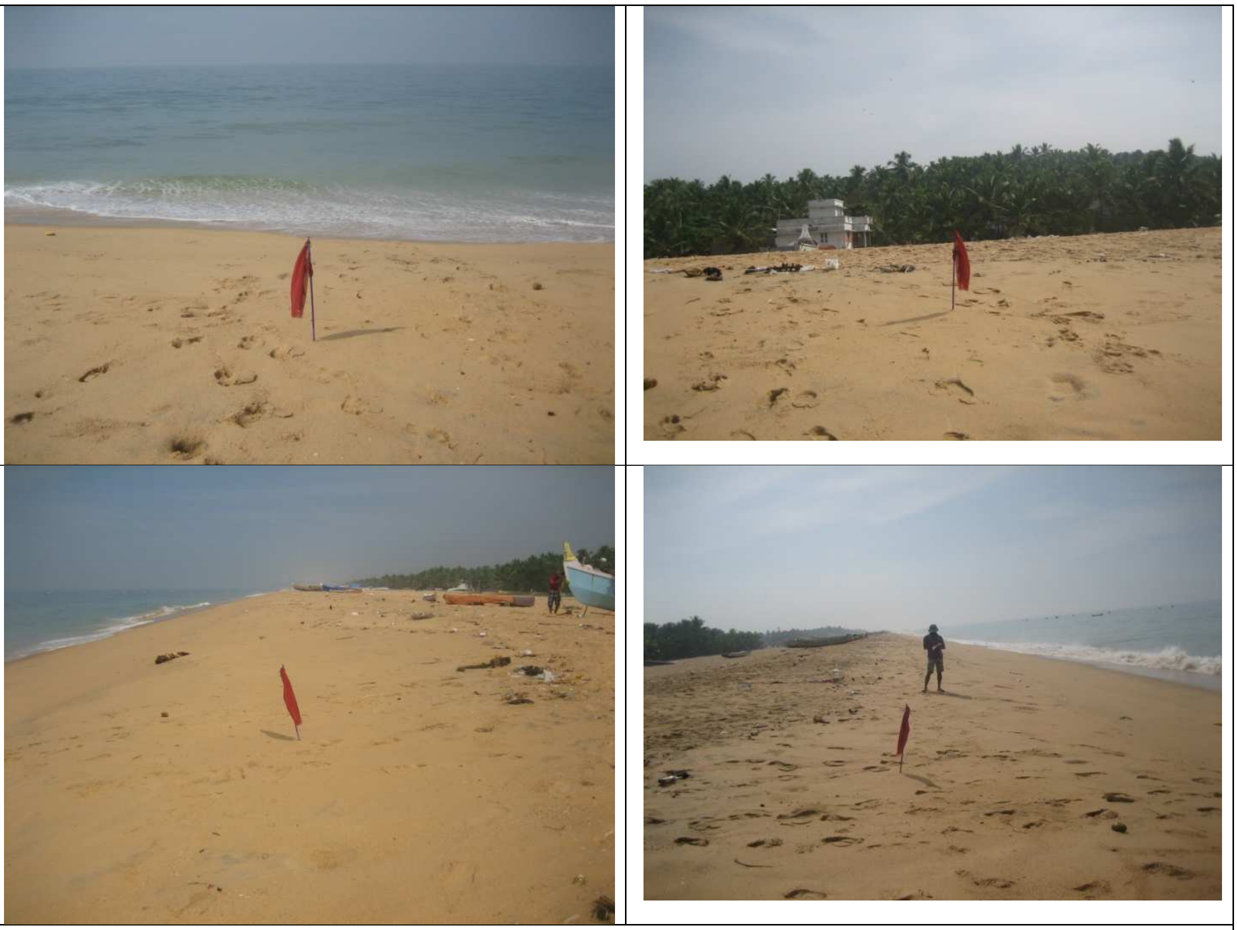


Figure 17:- February _CSP 17

Figure 18:- February_CSP 18

Figure 19:- February_CSP 19

Figure 20:- February _CSP 20



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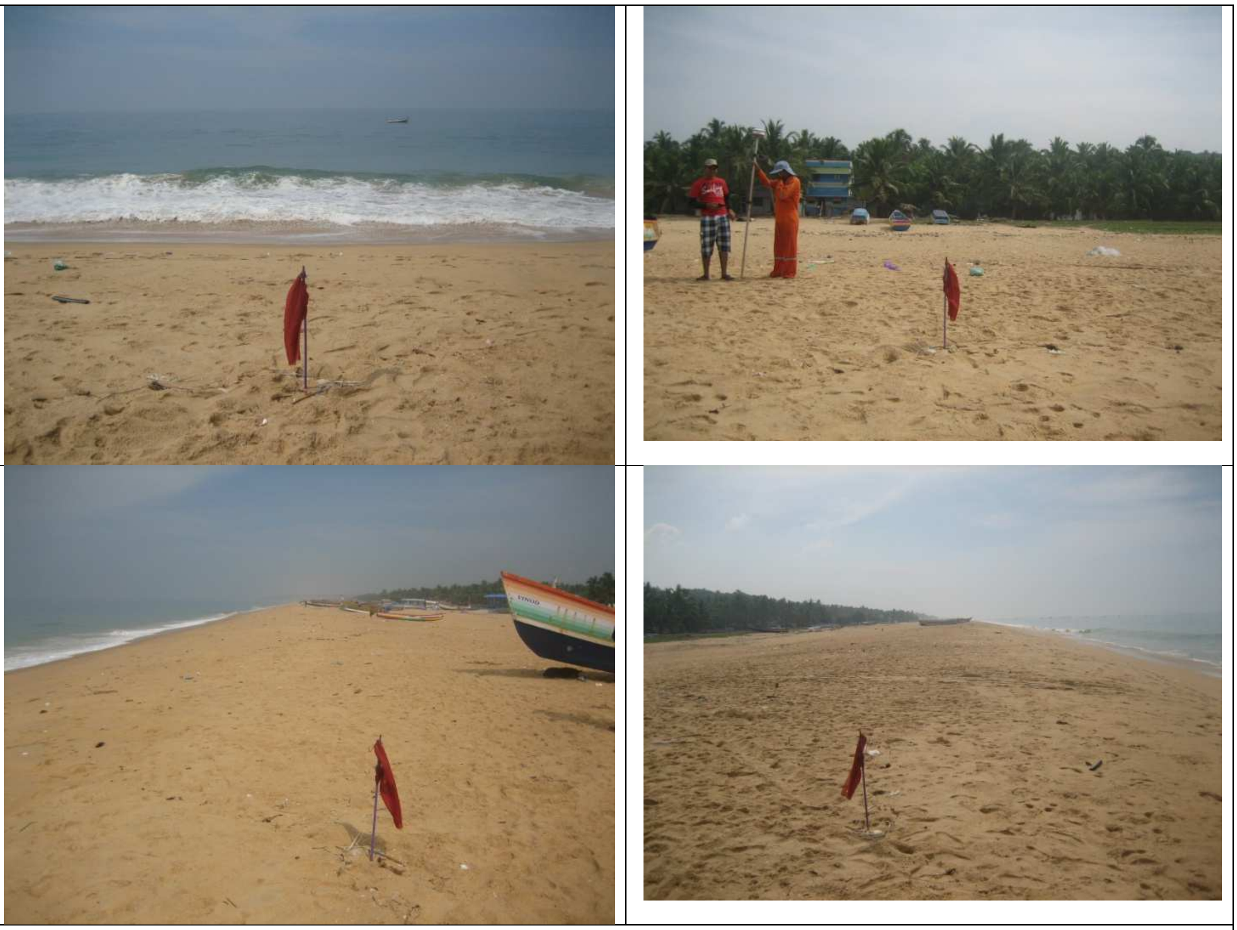


Figure 22:- February _CSP 22

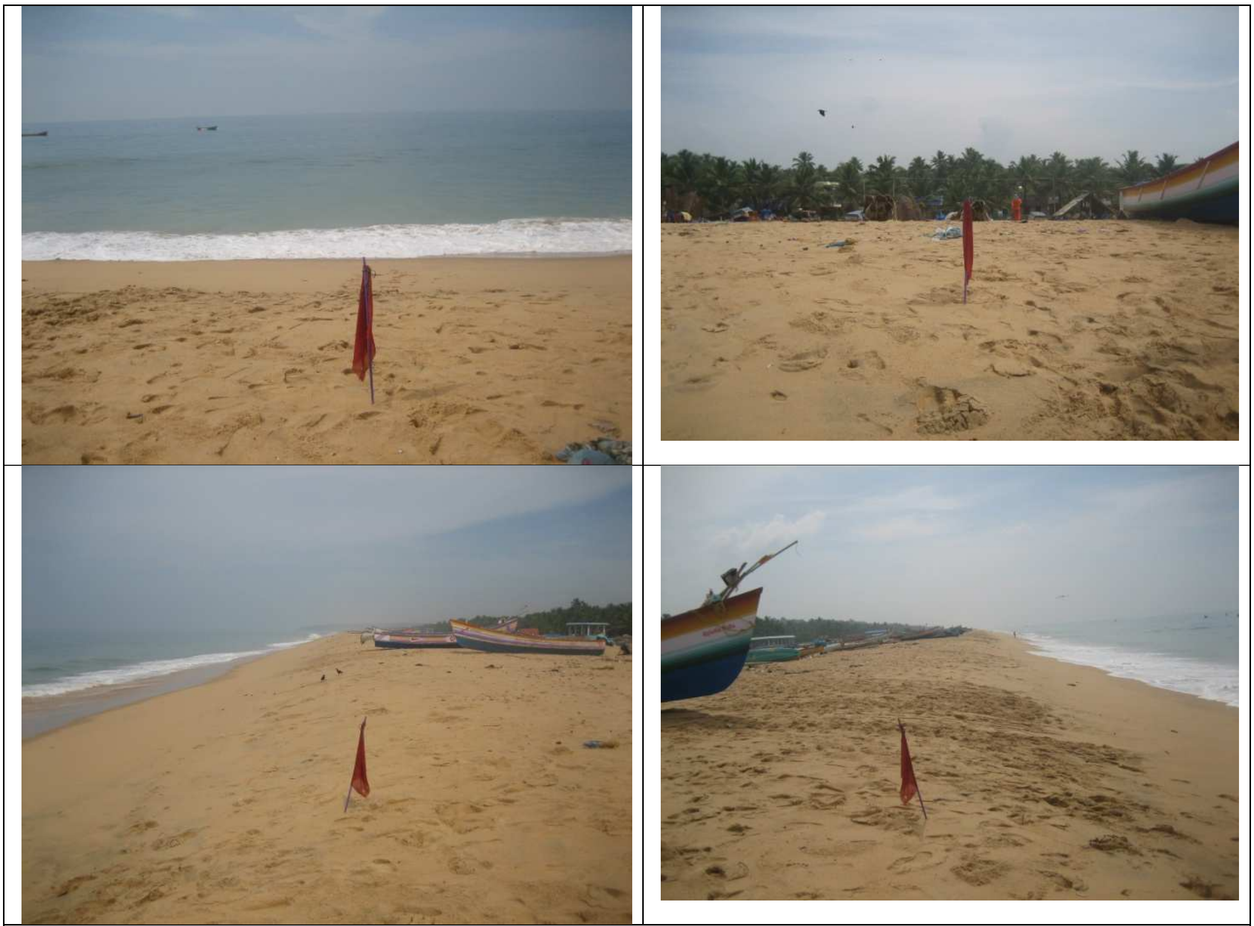
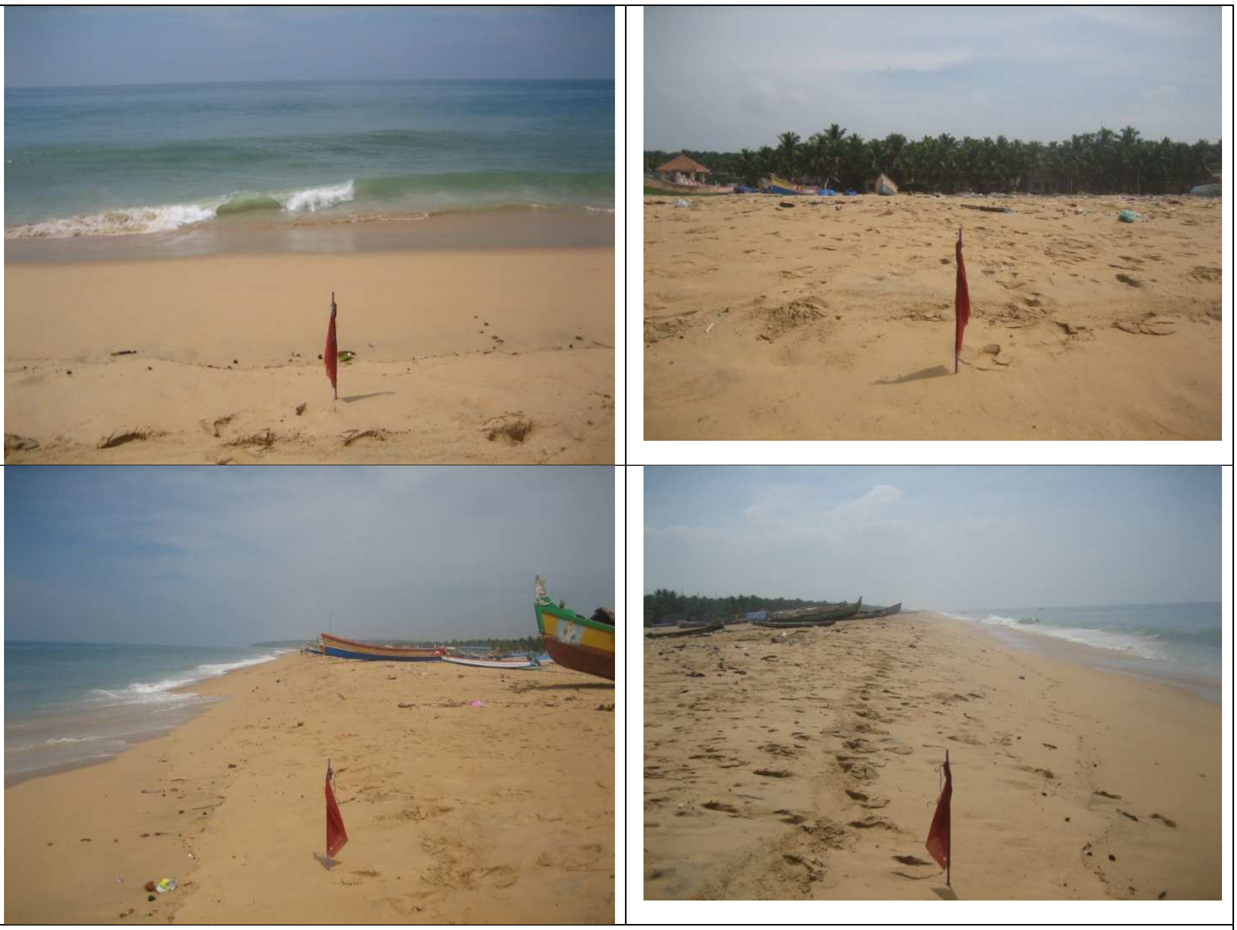


Figure 23:- February _CSP 23

Figure 24:- February _CSP 24



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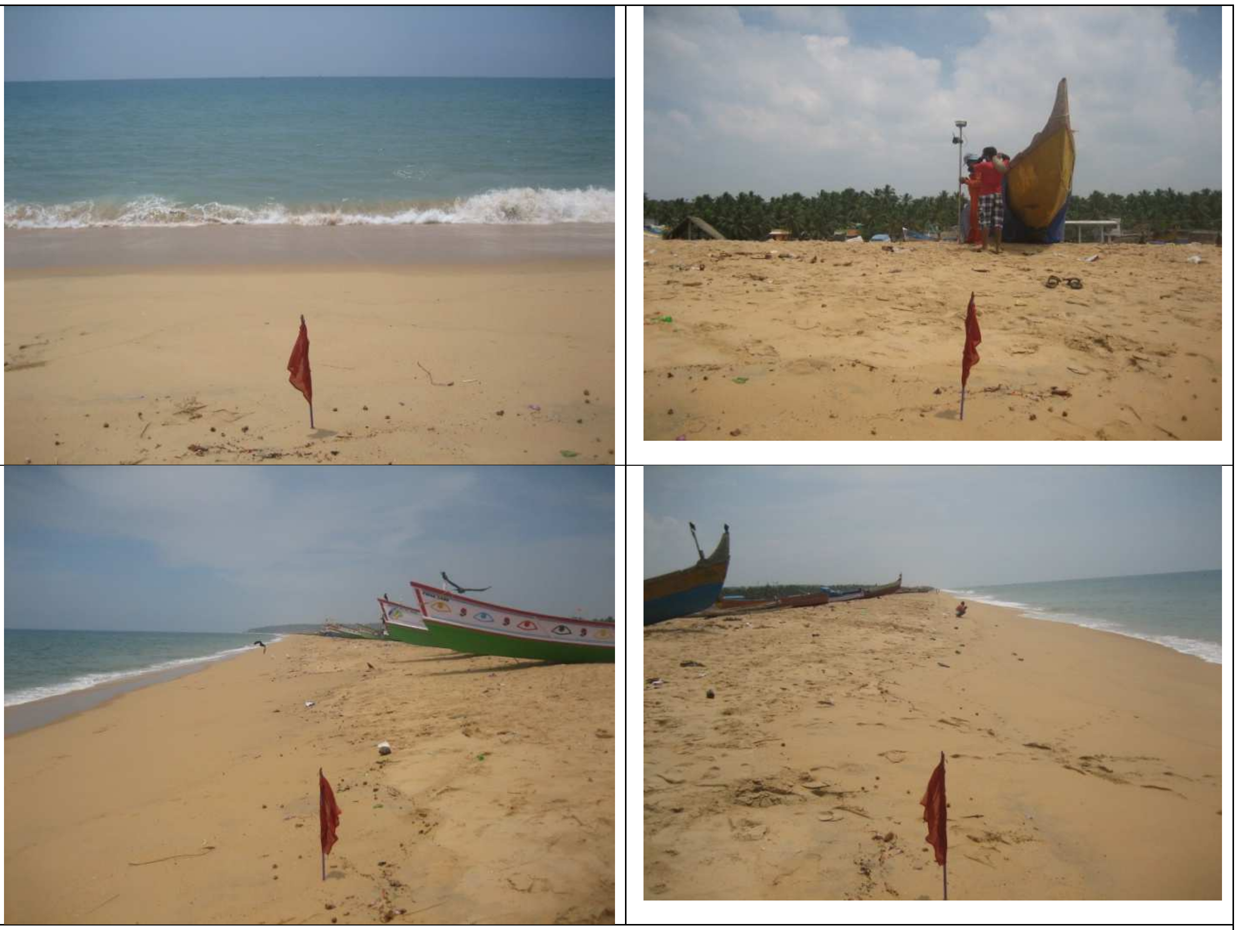

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Figure 27:- February _CSP 27

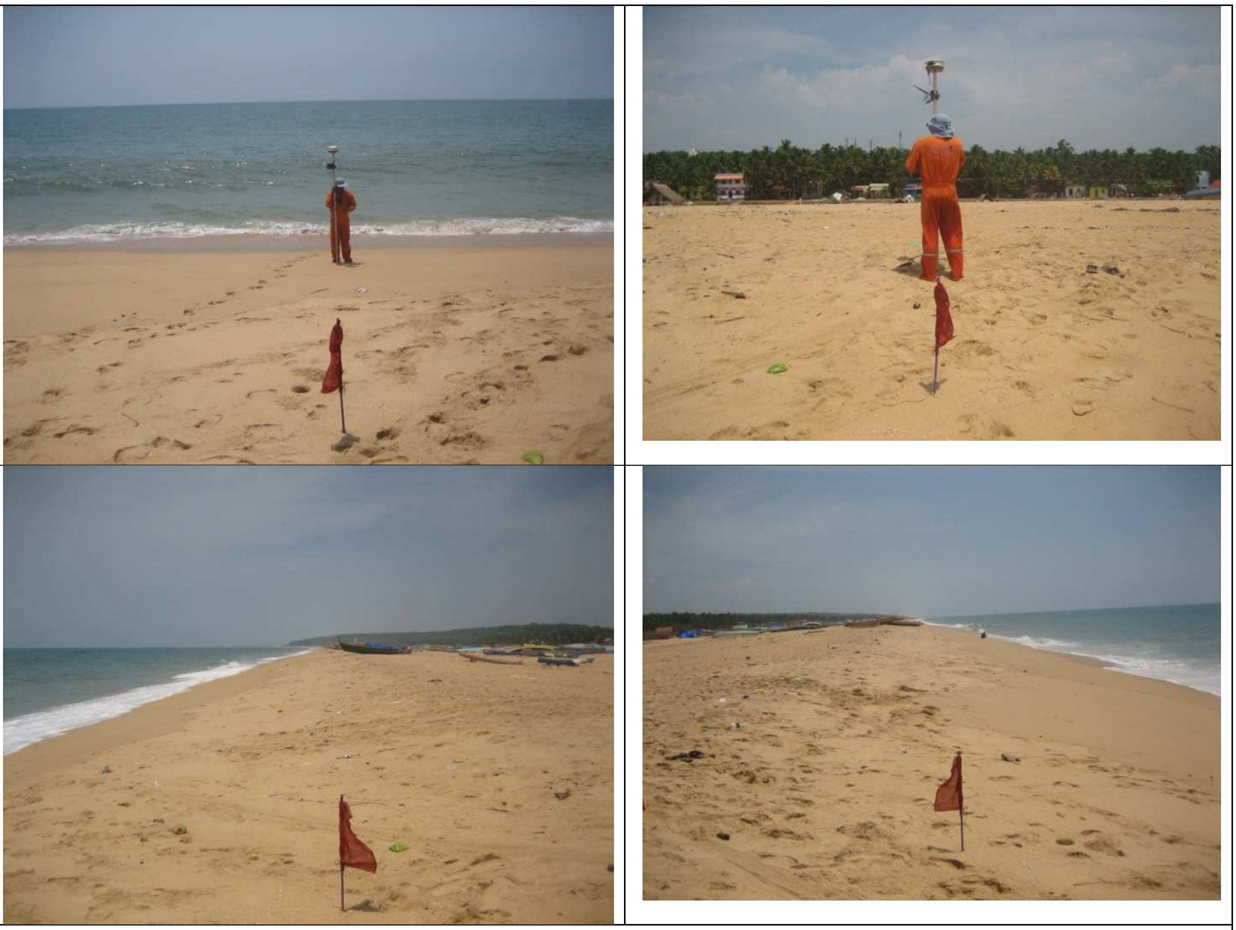


Figure 28:- February _CSP 28

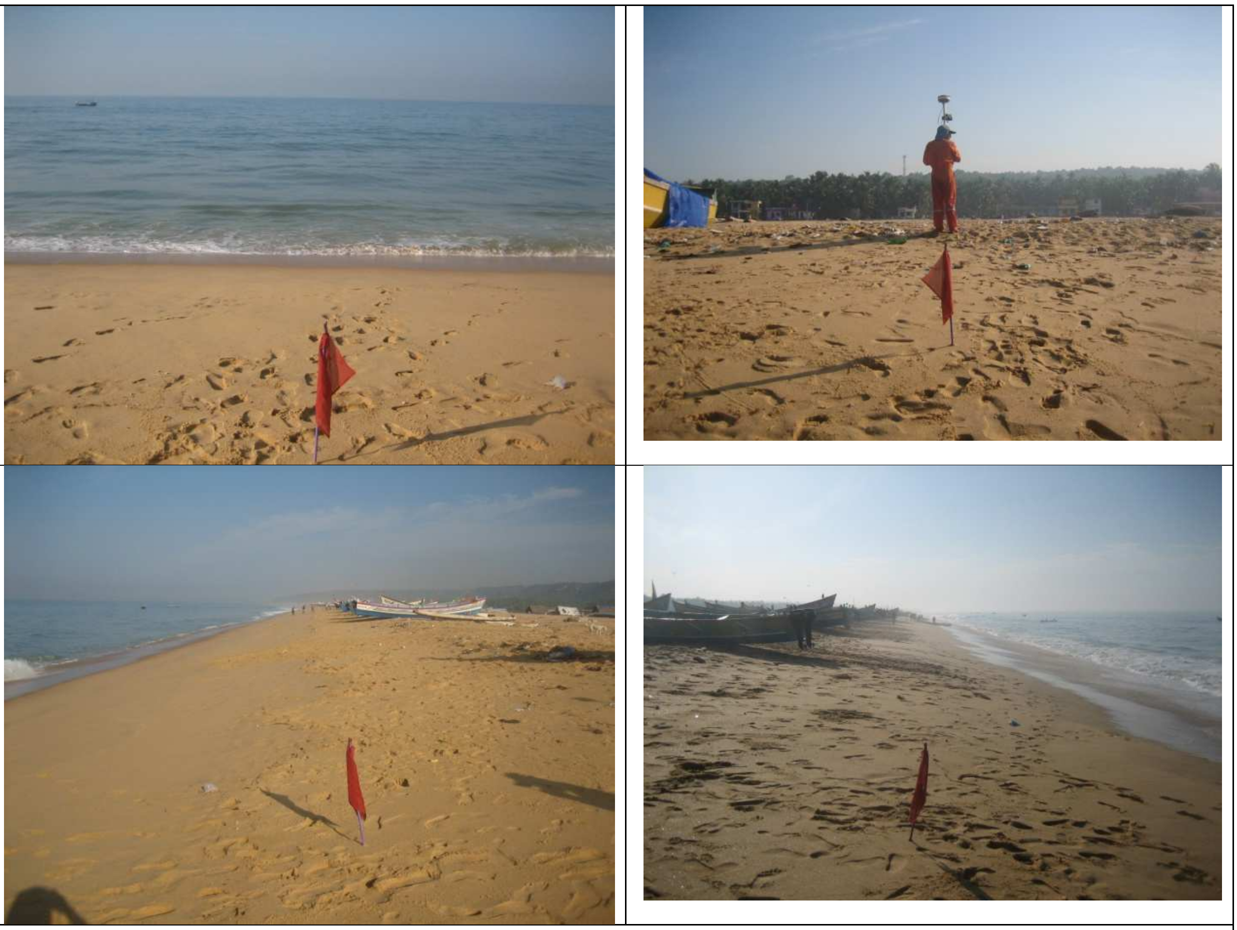


Figure 29:- February_ CSP 29

Figure 30:- February _CSP 30

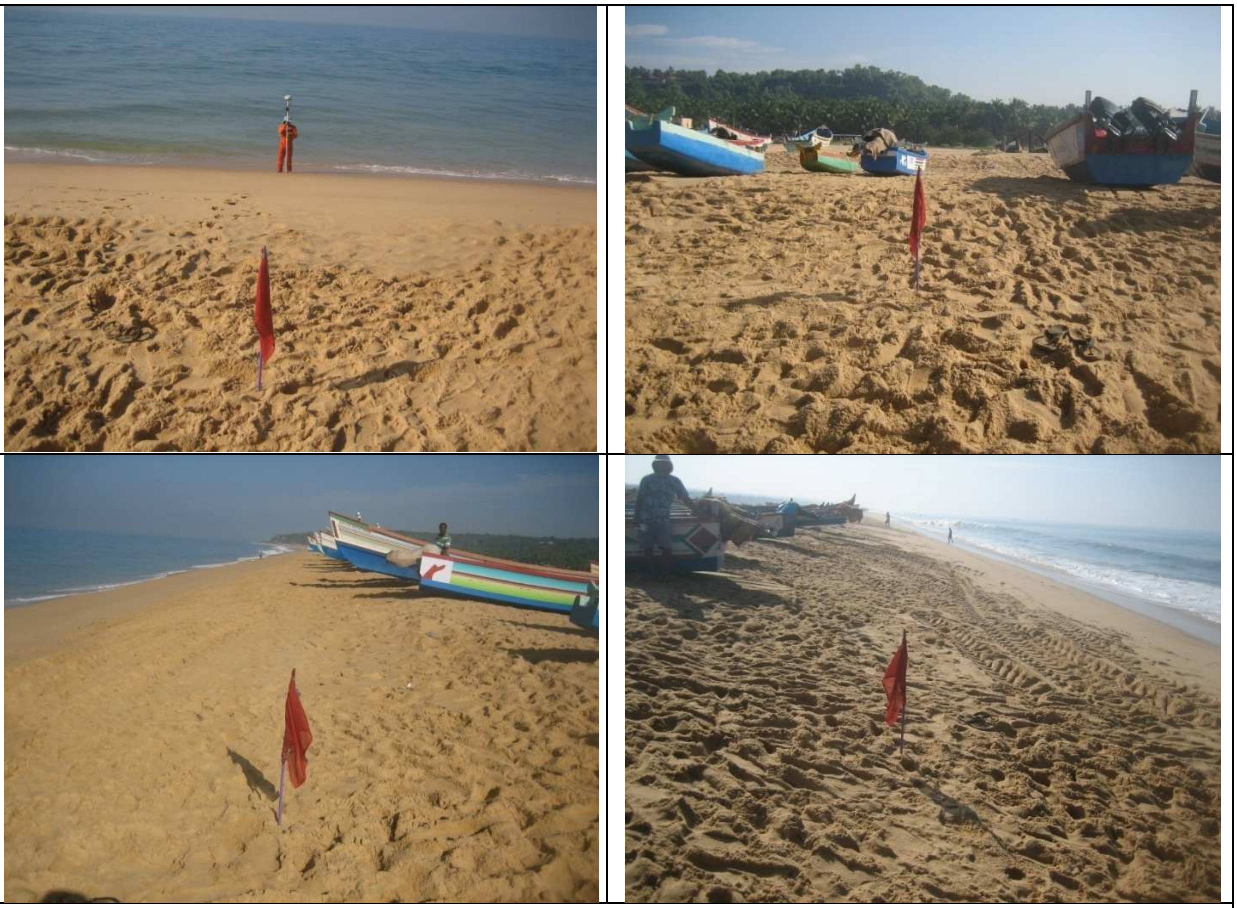


Figure 31:- February_CSP 31

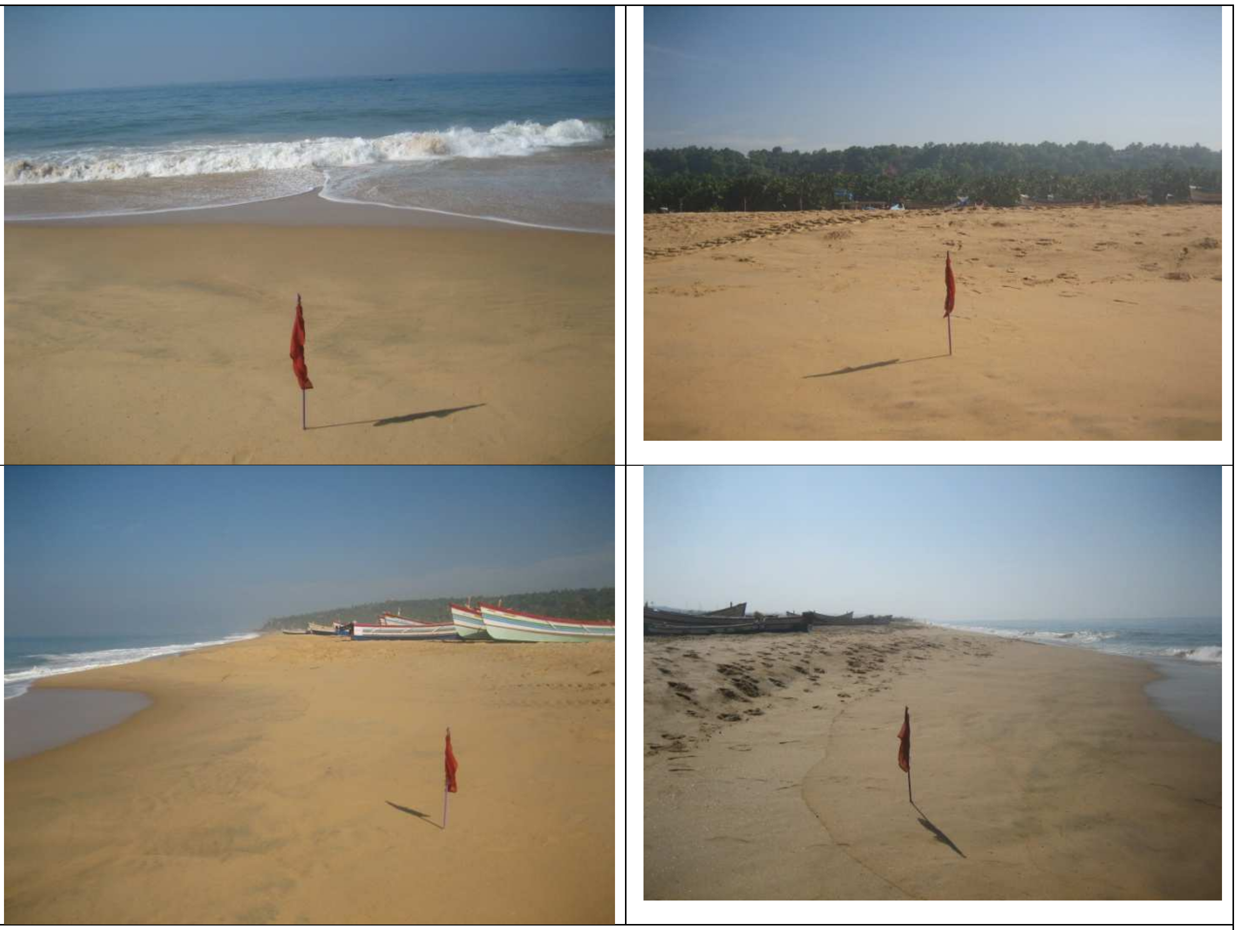


Figure 32:- February _CSP 32

Figure 33:- February _CSP 33

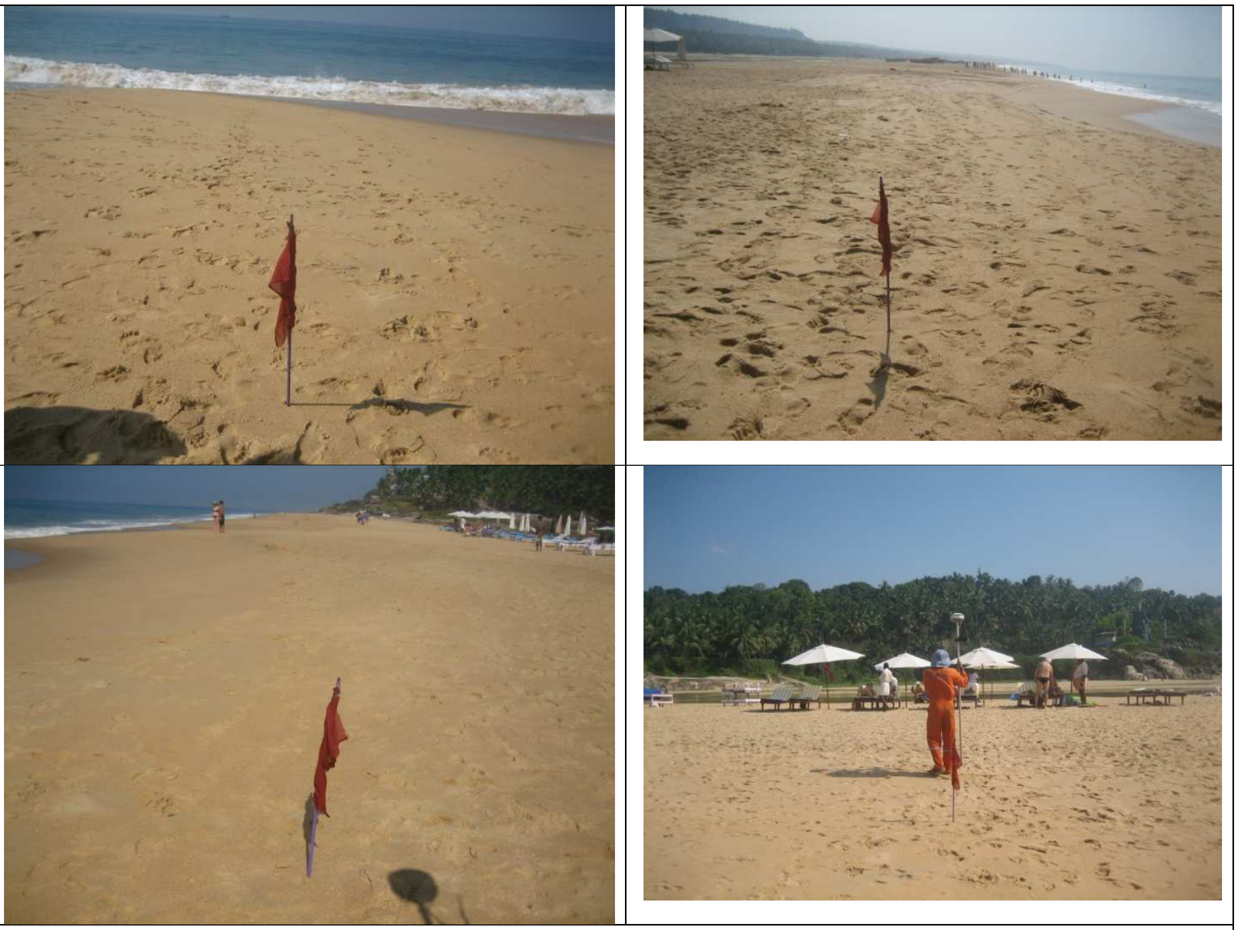


Figure 34:- February _CSP 34

Figure 35:- February _CSP 35

Figure 36:- February _CSP 36




Figure 37:- February _CSP 37

Figure 38:- February _CSP 38

Figure 39:- February _CSP 39

Figure 40:- February _CSP 40

Figure 41:- February _CSP 41

Figure 42:- February _CSP 42

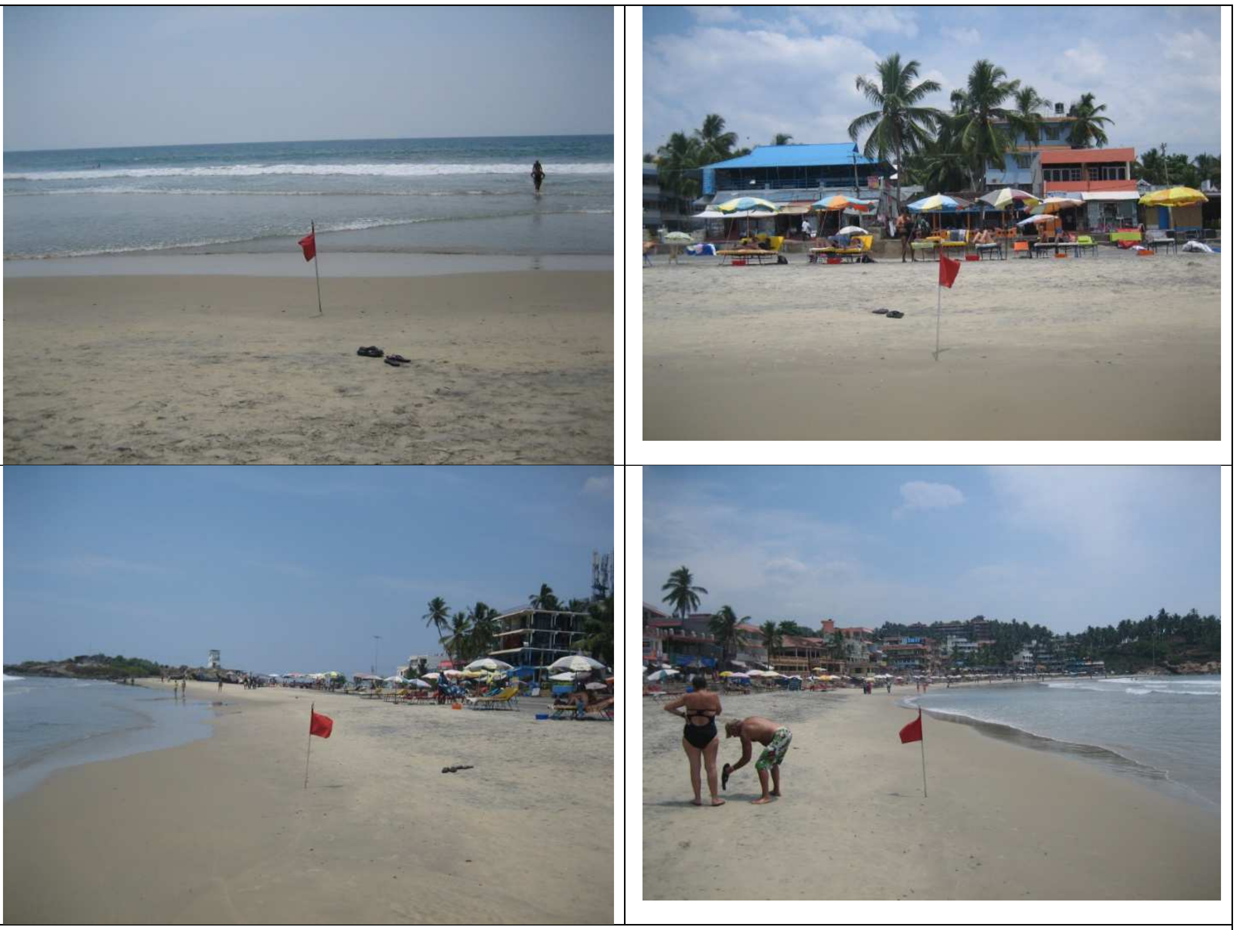


Figure 43:- February _CSP 43

Figure 44:- February _CSP 44

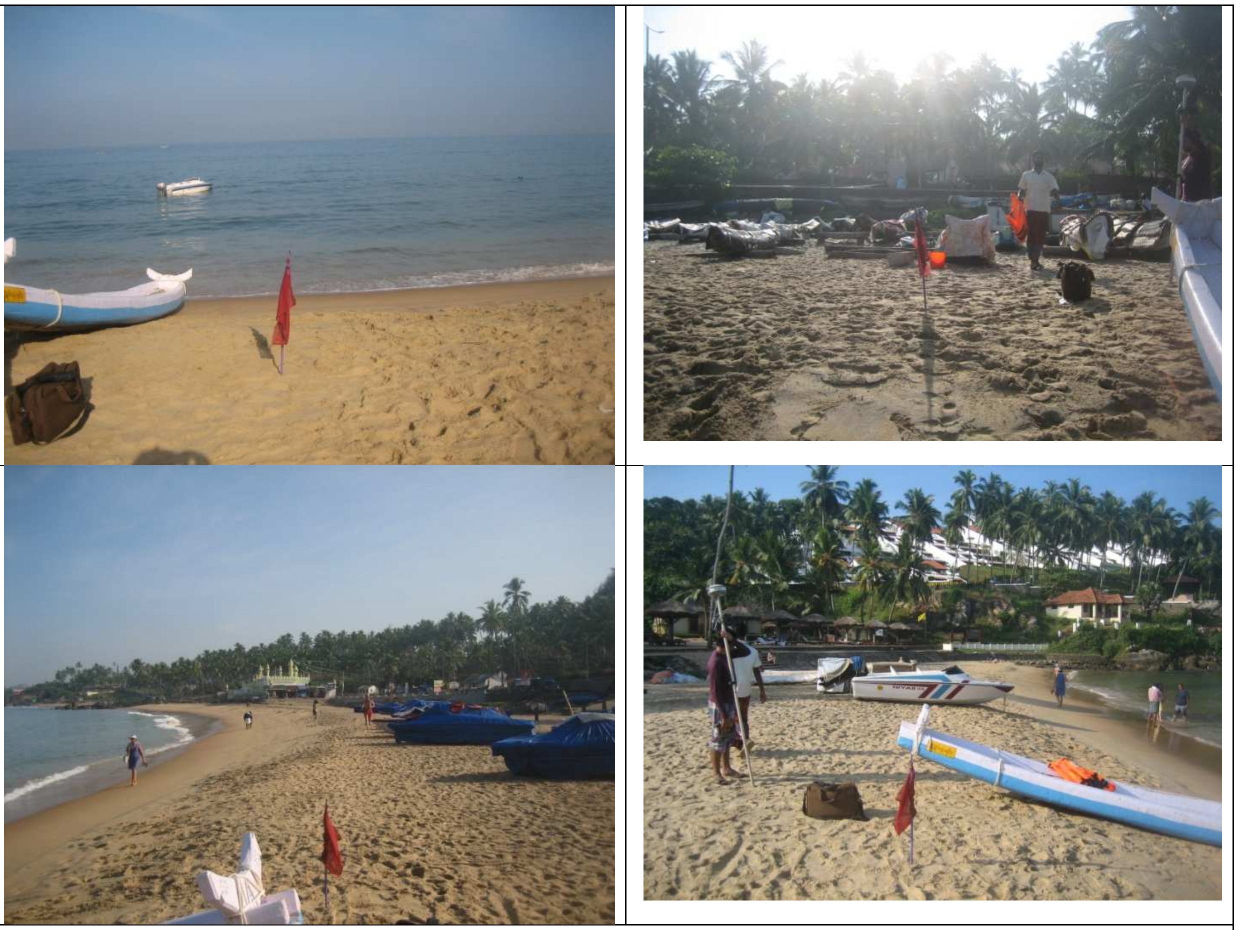


Figure 45:- February _CSP 45

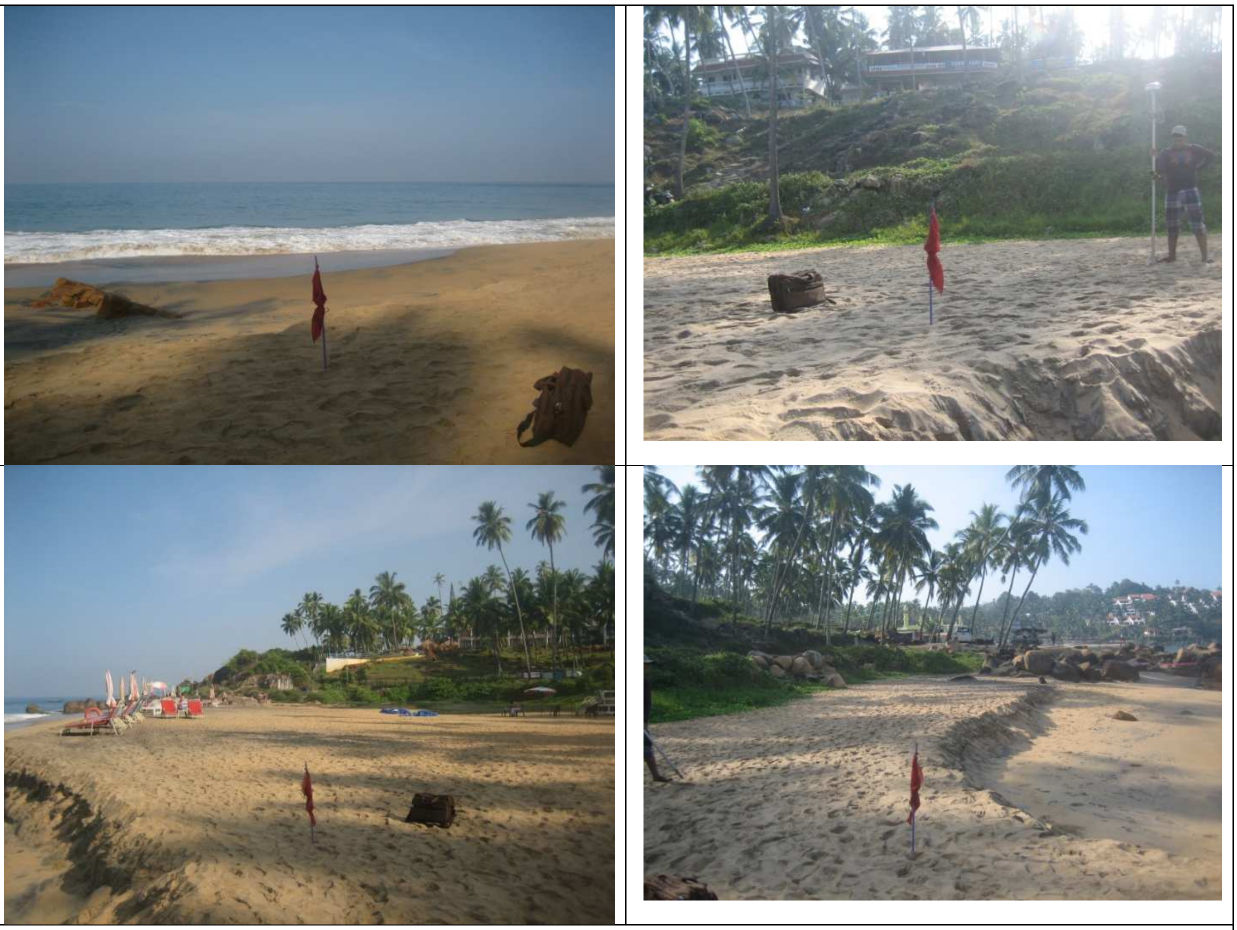


Figure 46:- February _CSP 46

Figure 47:- February _CSP 47

Figure 48:- February _CSP 48

Figure 49:- February _CSP 49

Figure 50:- February _CSP 50

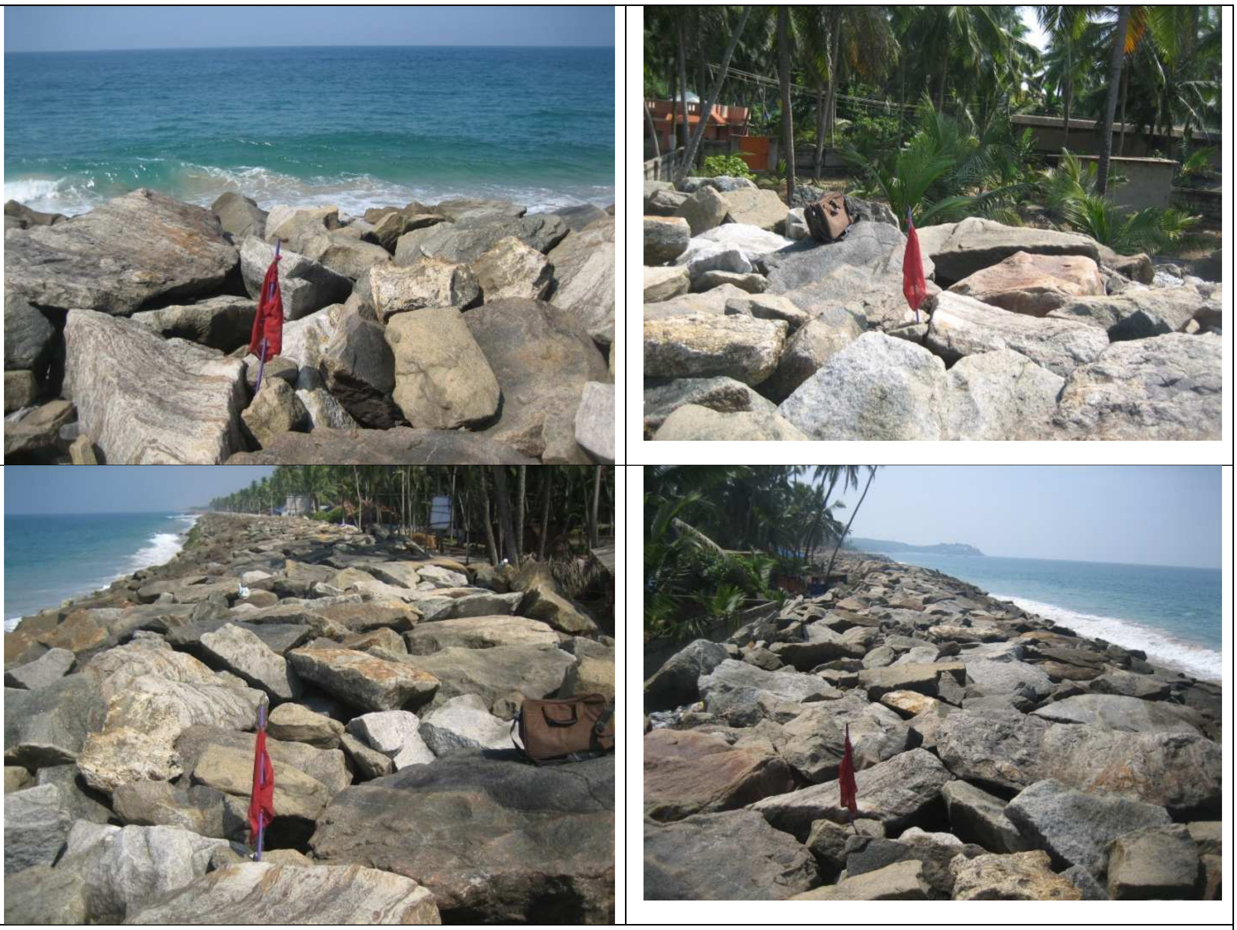


Figure 51:- February _CSP 51

Figure 52:- February _CSP 52

Figure 53:- February _CSP 53

Figure 54:- February _CSP 54

Figure 55:- February _CSP 55

Figure 56:- February _CSP 56

Figure 57:- February _CSP 57

Figure 58:- February _CSP 58

Figure 59:- February _CSP 59

Figure 60:- February _CSP 60

Figure 61:- February _CSP 61

Figure 62:- February _CSP 62

Figure 63:- February _CSP 63

Figure 64:- February _CSP 64

Figure 65:- February _CSP 65

Figure 66:- February _CSP 66

Figure 67:- February _CSP 67

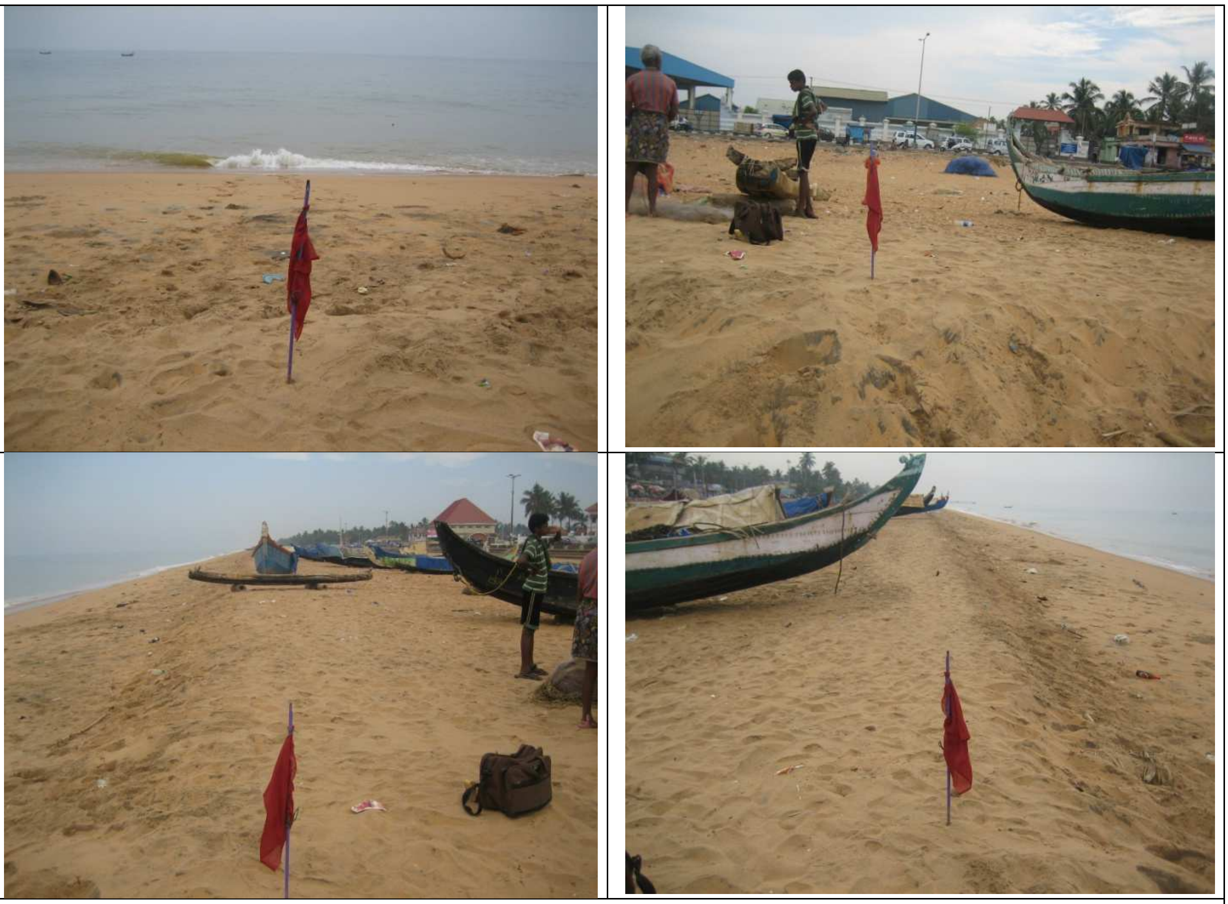


Figure 68:- February _CSP 68

Figure 69:- February _CSP 69




Figure 70:- February _CSP 70

Figure 71:- February _CSP 71

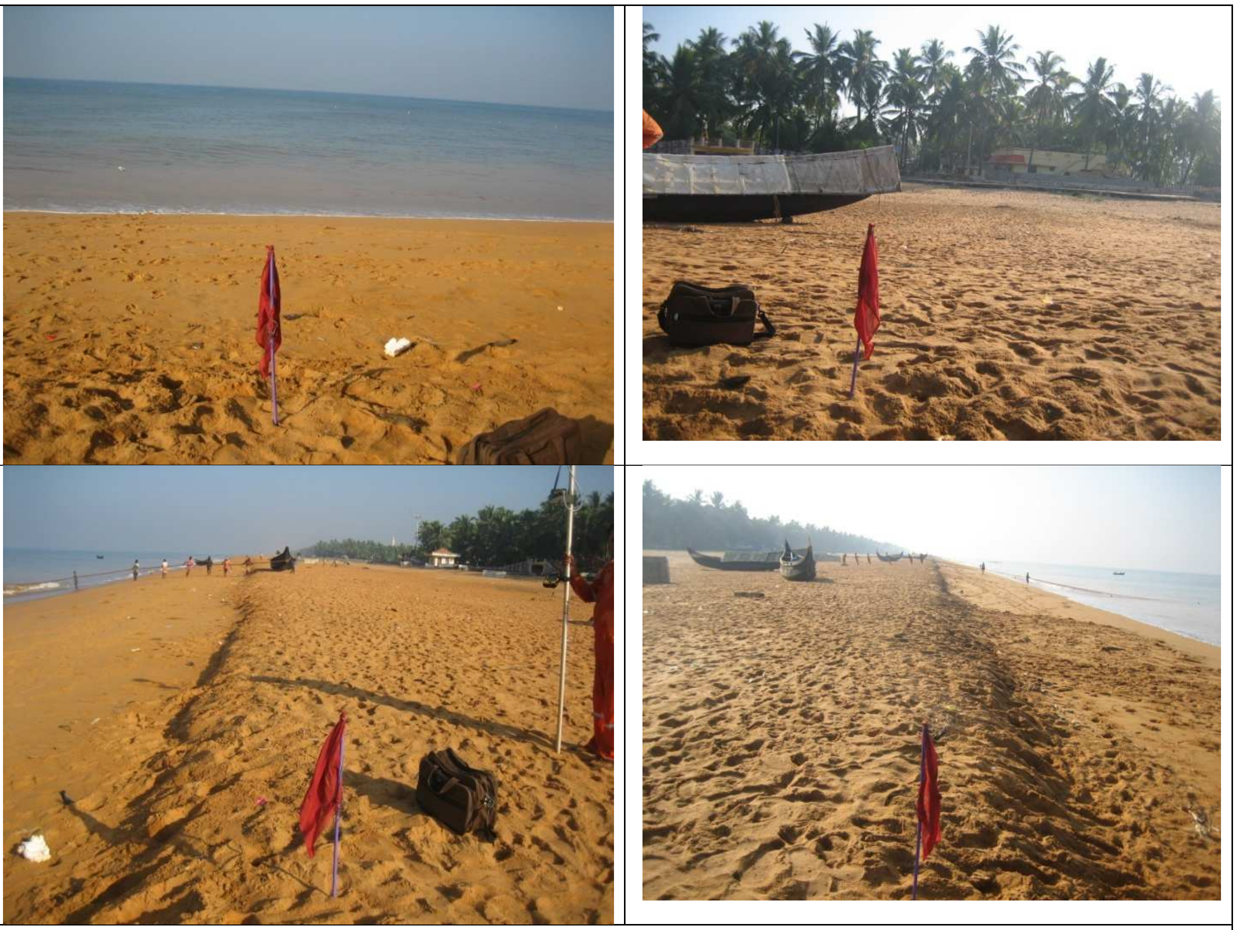
Figure 72:- February _CSP 72

Figure 73:- February _CSP 73

Figure 74:- February _CSP 74

Figure 75:- February _CSP 75

Figure 76:- February _CSP 76



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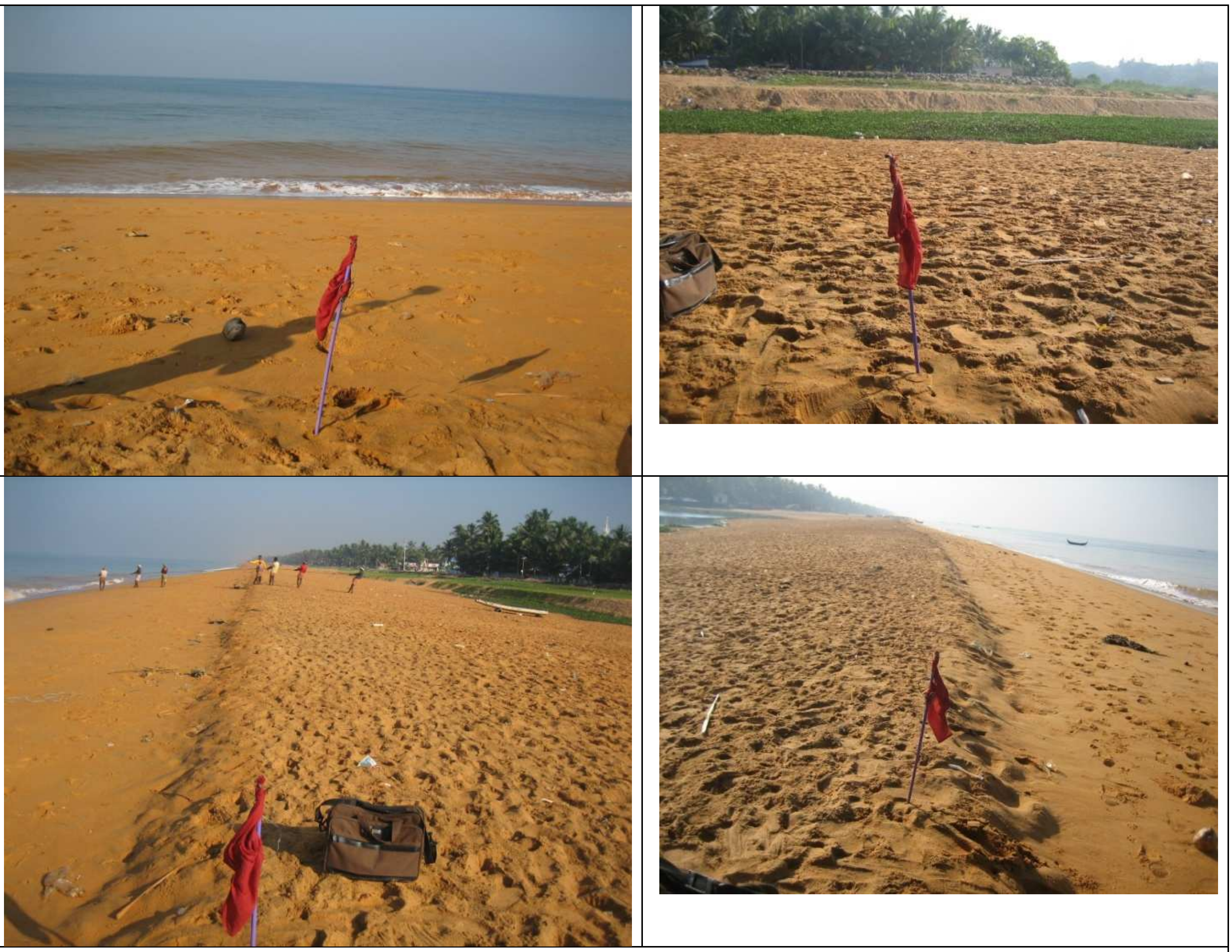


Figure 78:- February _CSP 78

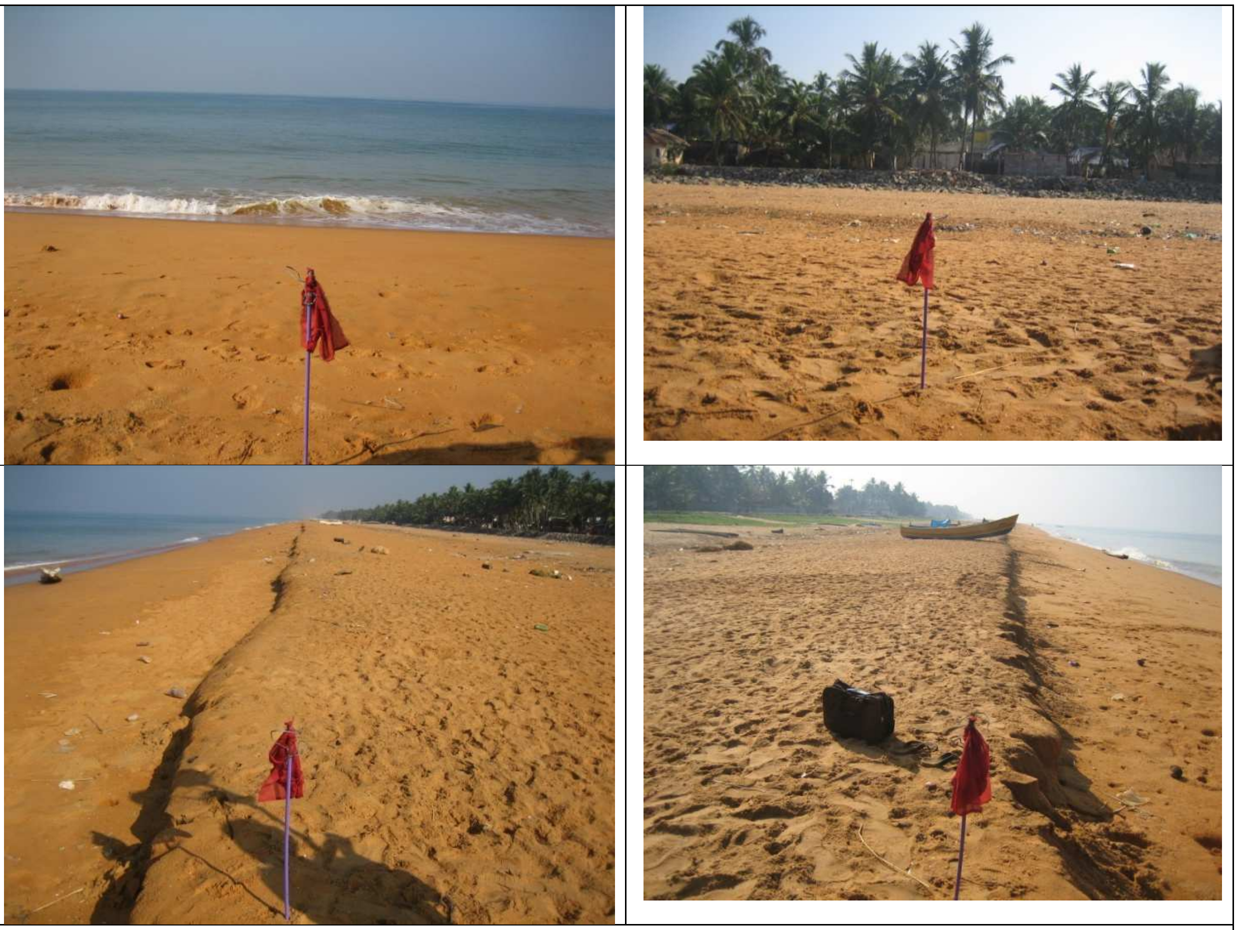
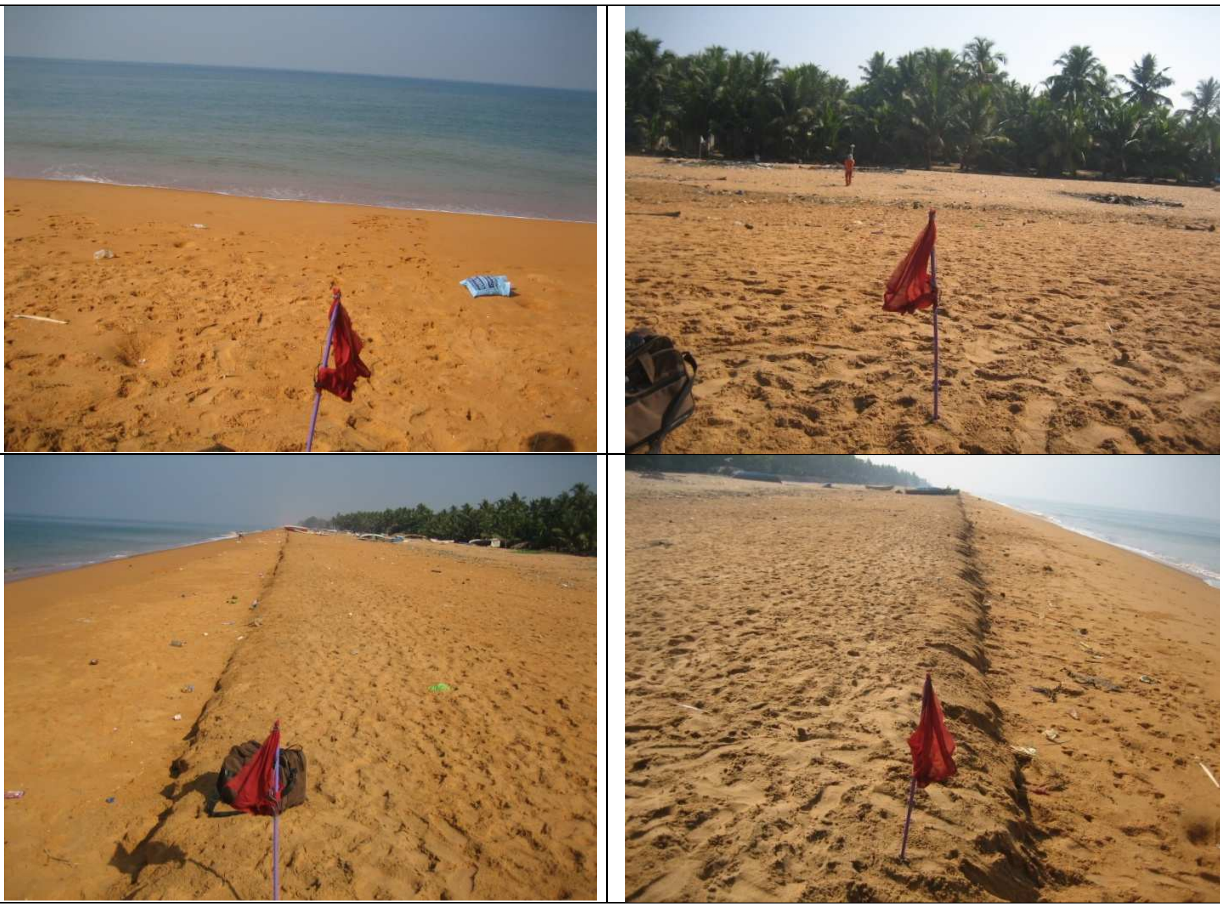


Figure 79:- February _CSP 79



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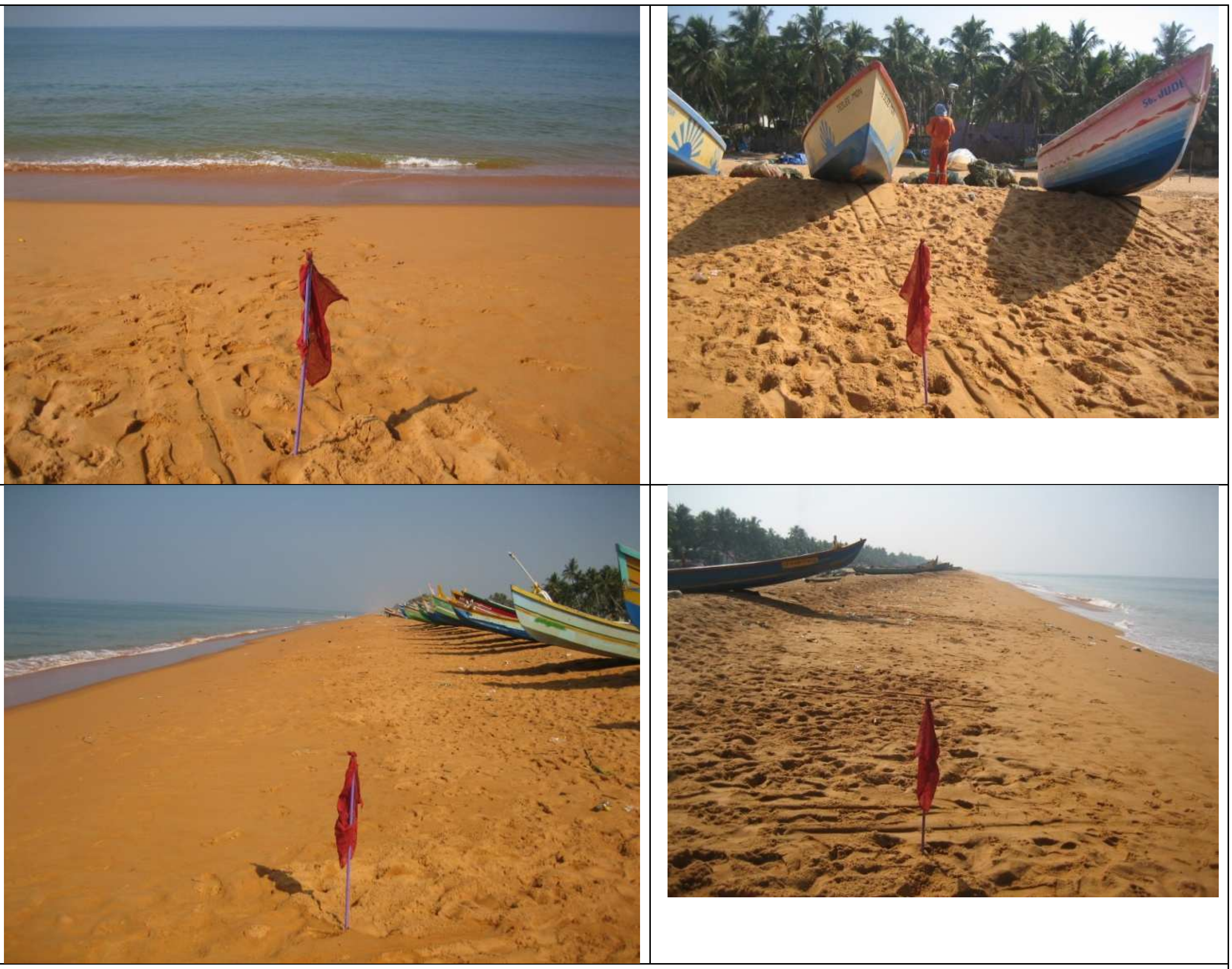


Figure 81:- February _CSP 81

Annexure VI

Photo Documentation at CSP Locations – March 2016

Figure 01:- March_CSP 01

Figure 02:- March_CSP 02

Figure 03:- March_CSP 03

Figure 04:- March_CSP 04

Figure 05:- March_CSP 05

Figure 06:- March_CSP 06

Figure 07:- March_CSP 07

Figure 08:- March_CSP 08

Figure 09:- March_CSP 09

Figure 10:- March_CSP 10

Figure 11:- March_CSP 11

Figure 12:- March_CSP 12

Figure 13:- March_CSP 13

Figure 14:- March_CSP 14

Figure 15:- March_CSP 15

Figure 16:- March_CSP 16

Figure 17:- March_CSP 17

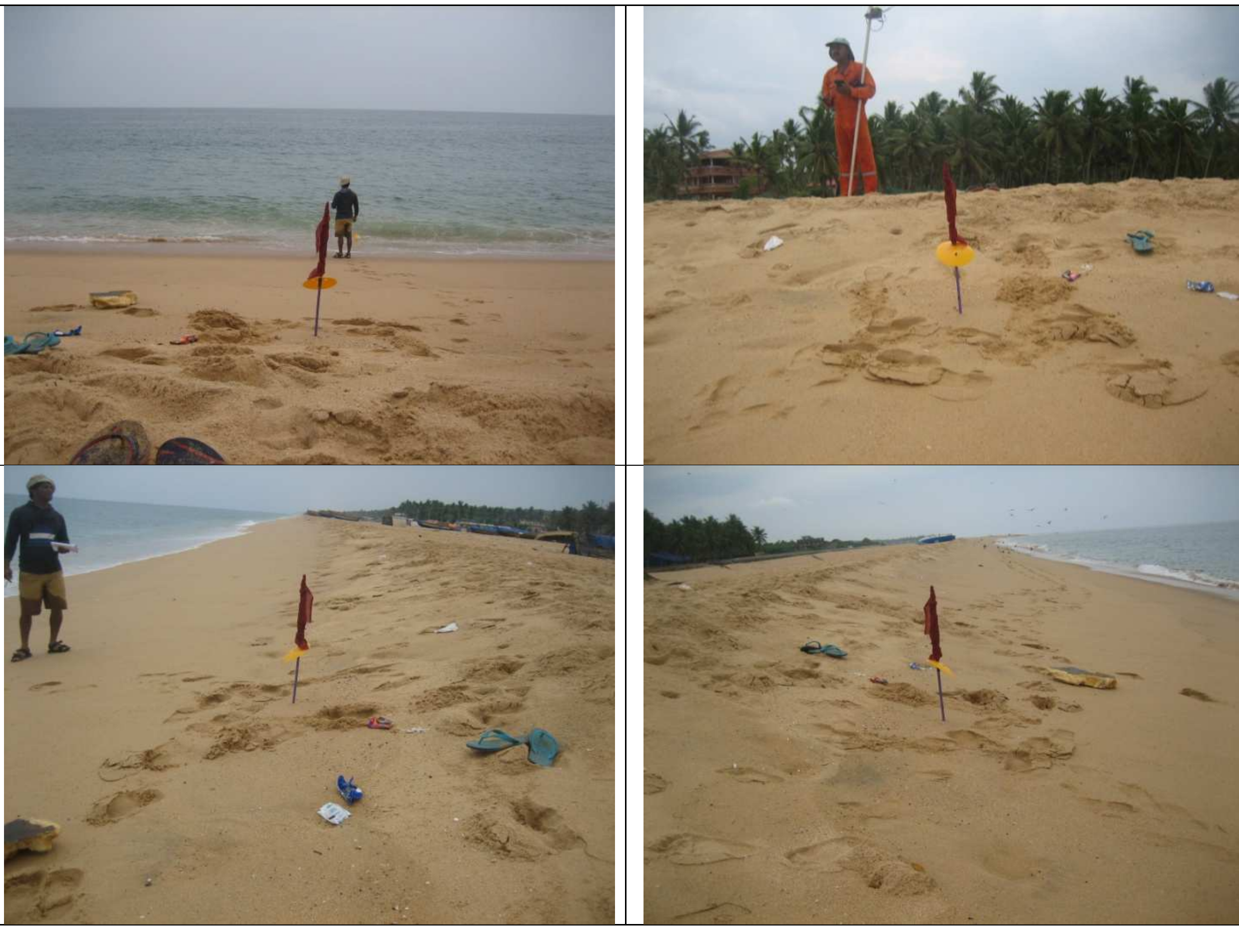


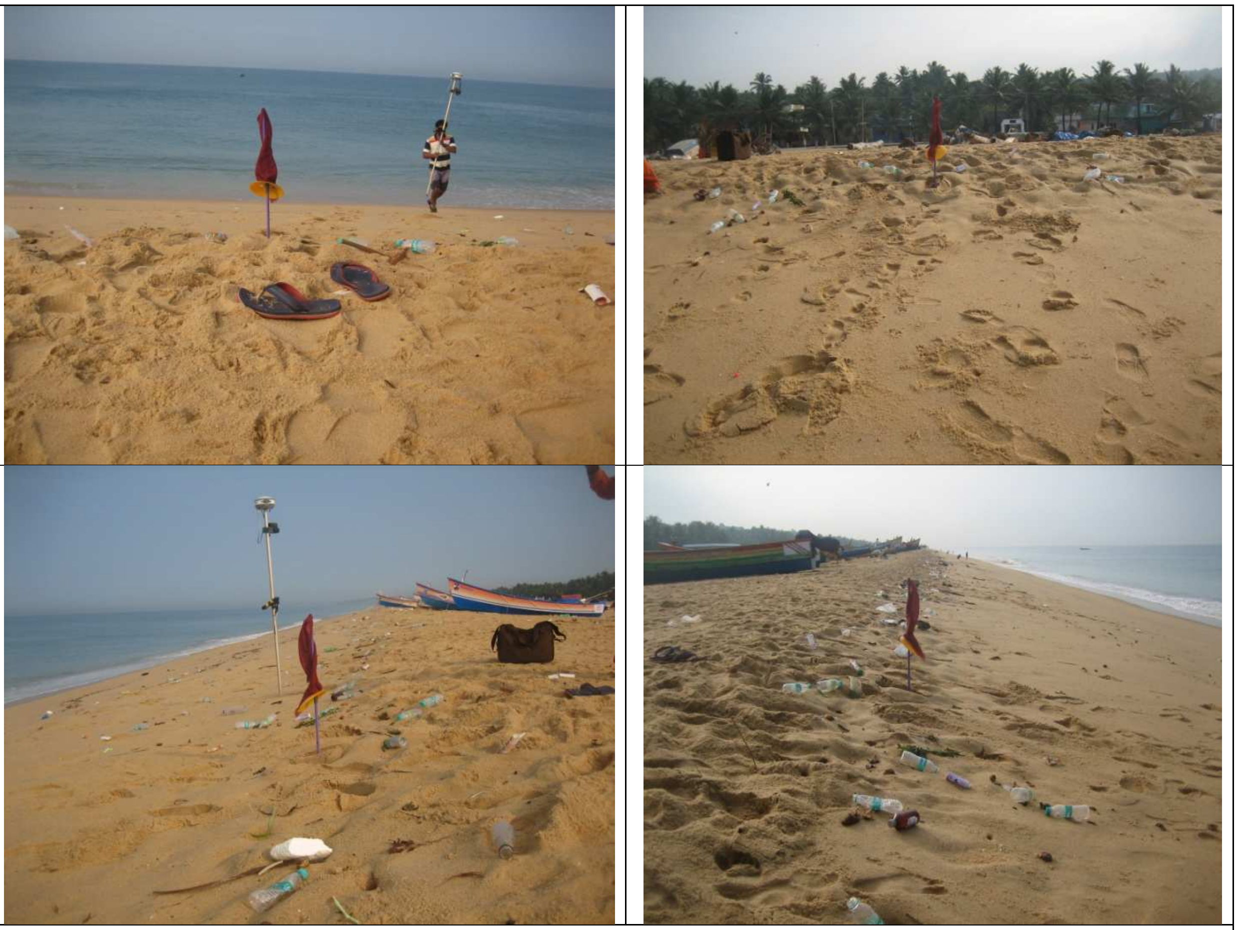
Figure 18:- March_CSP 18

Figure 19:- March_CSP 19

Figure 20:- March_CSP 20

Figure 21:- March_CSP 21

Figure 22:- March_CSP 22



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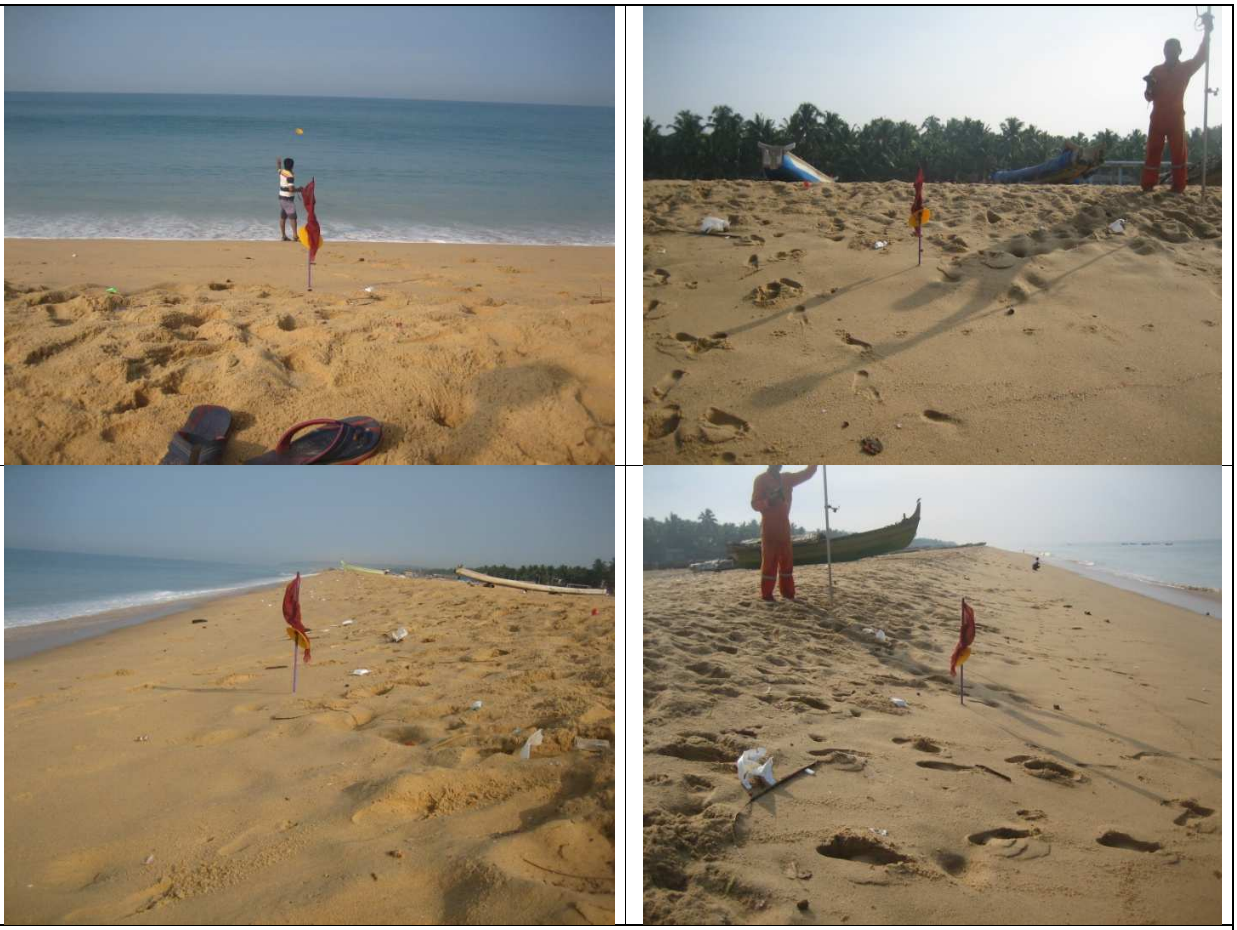

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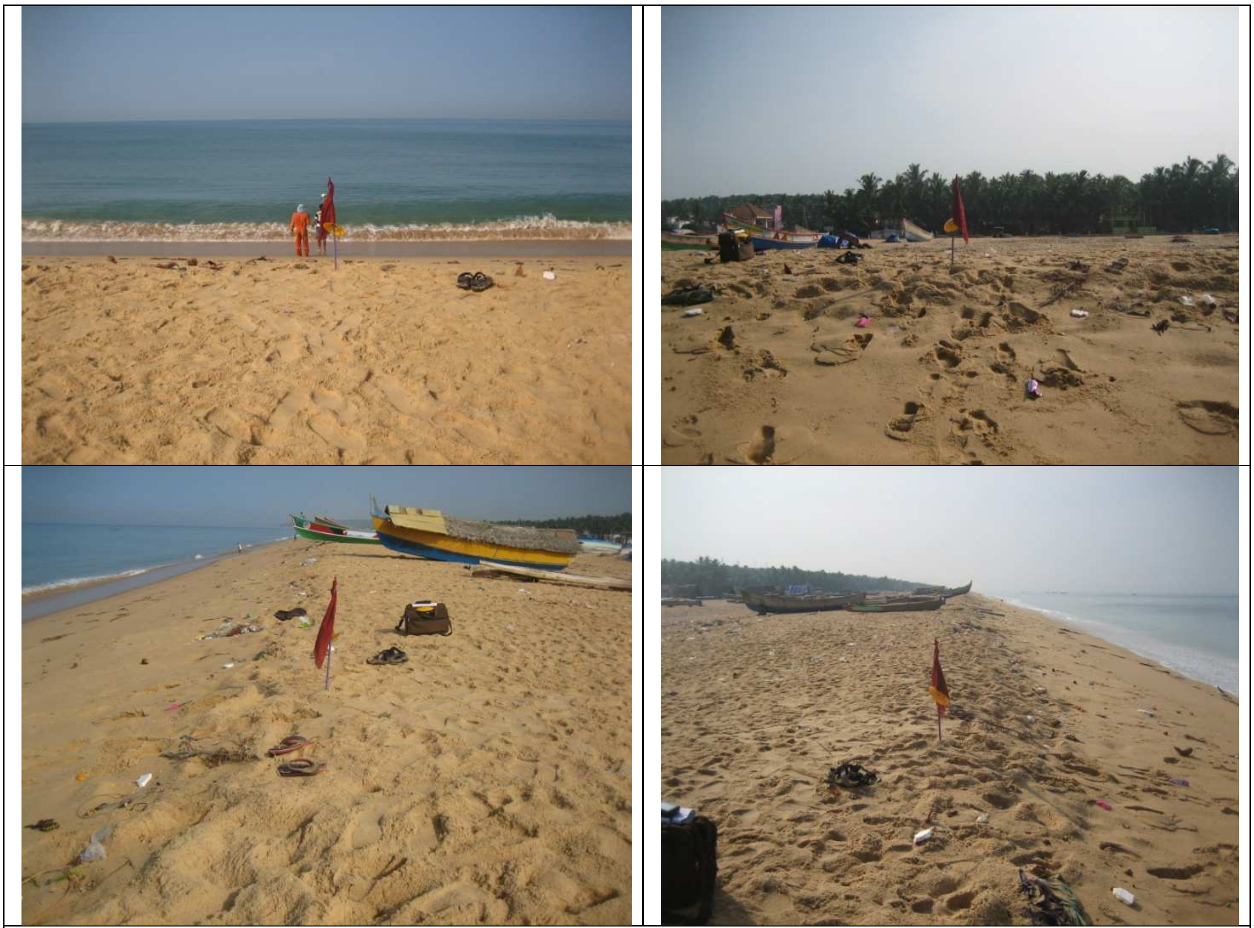


Figure 25:- March_CSP 25

Figure 26:- March_CSP 26

Figure 27:- March_CSP 27

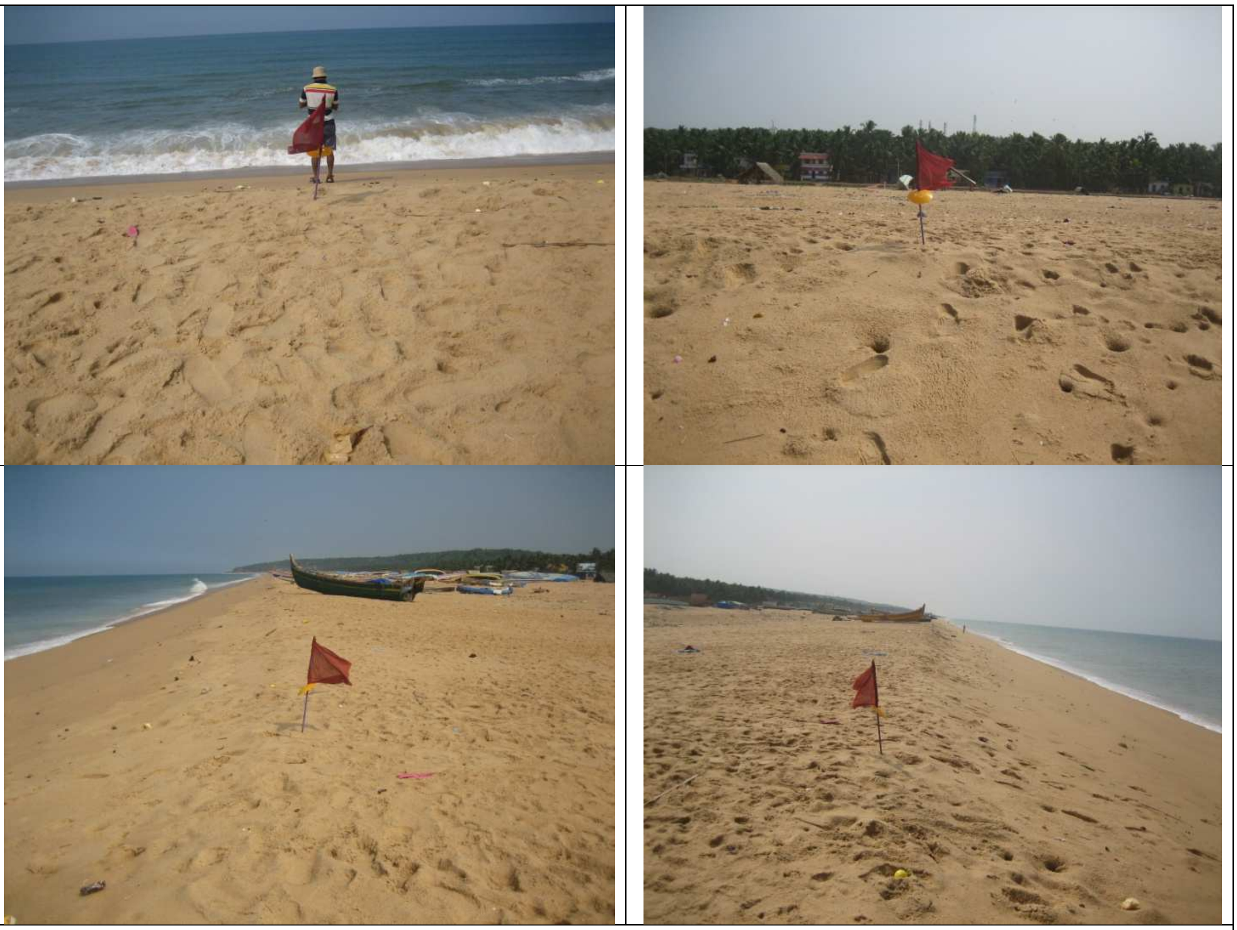
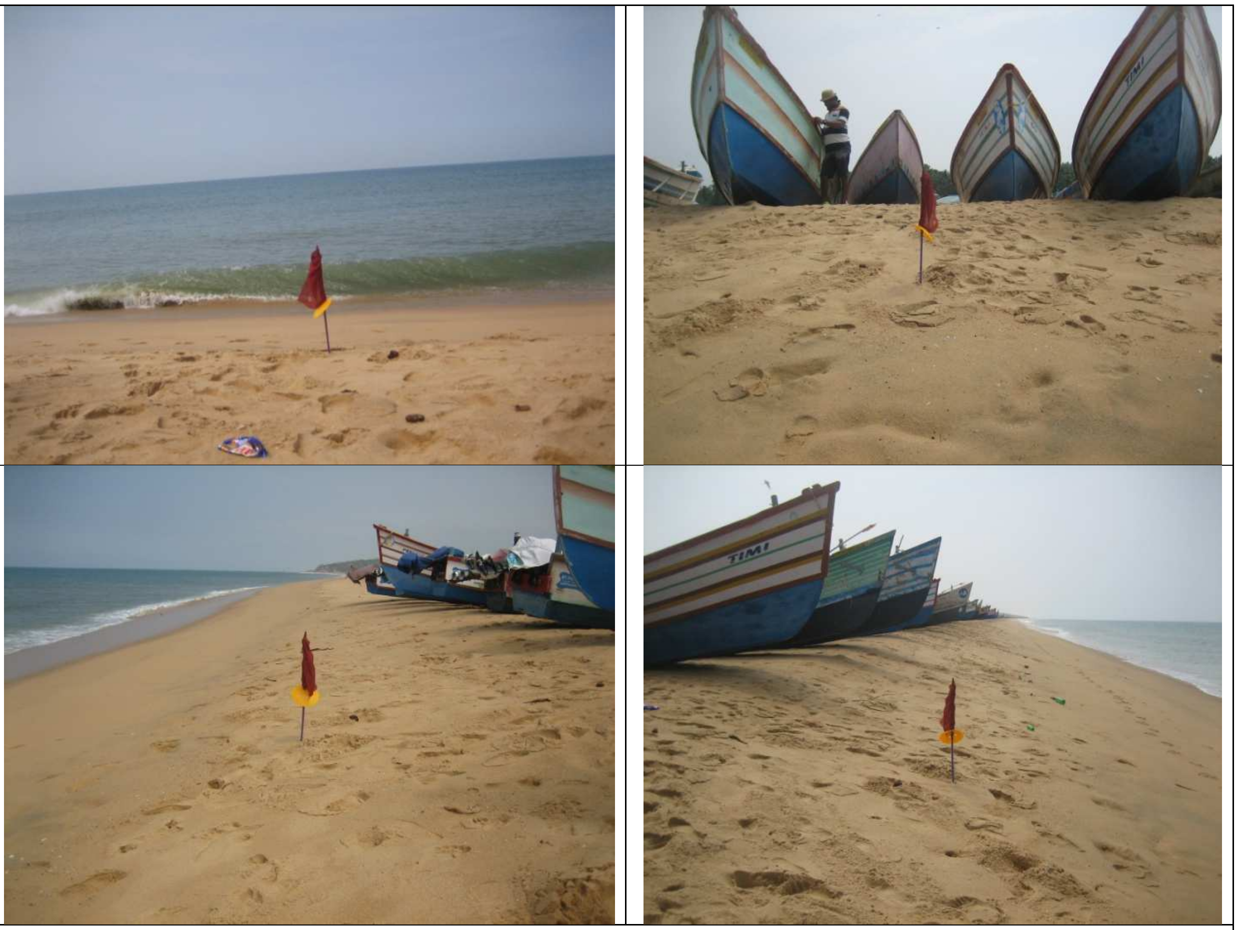


Figure 28:- March_CSP 28

Figure 29:- March_ CSP 29



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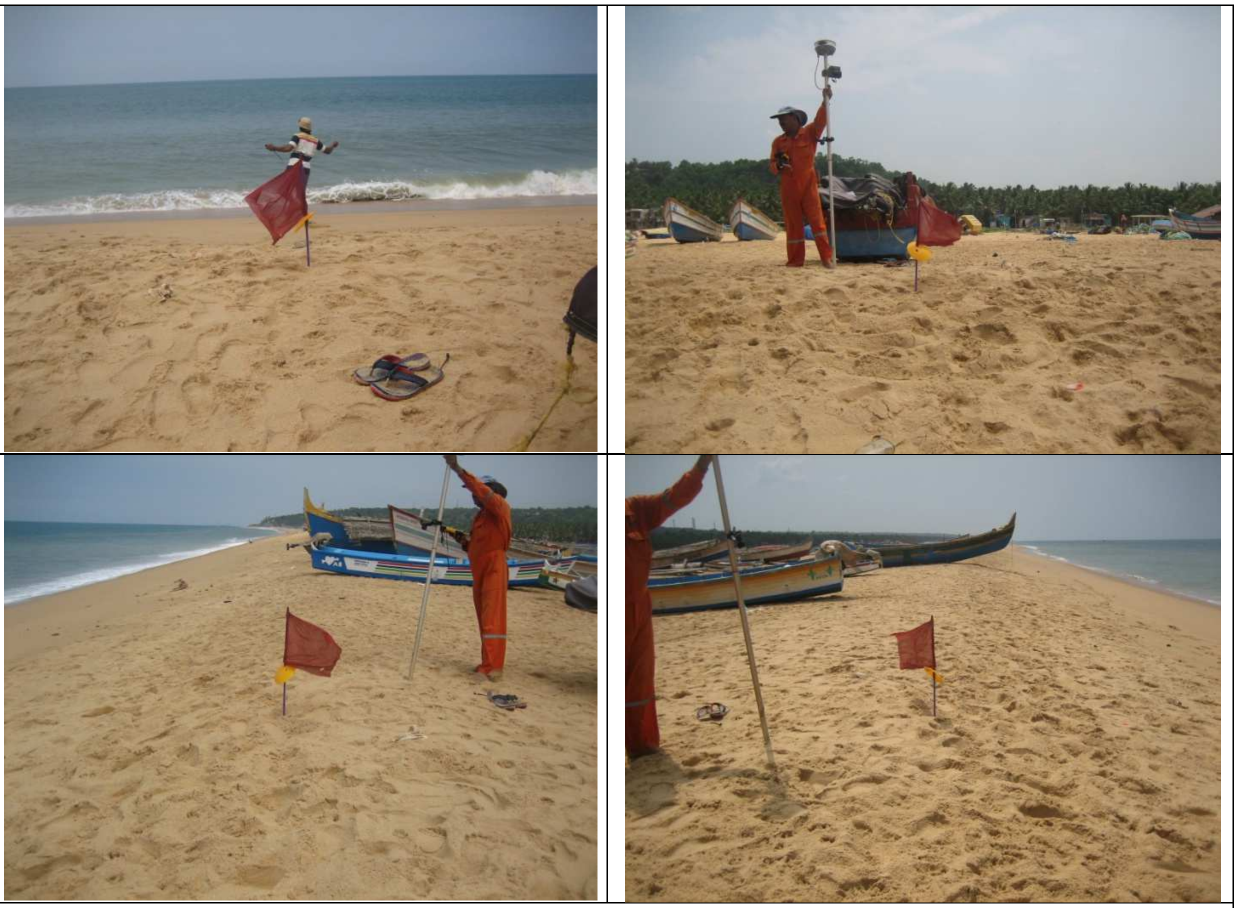

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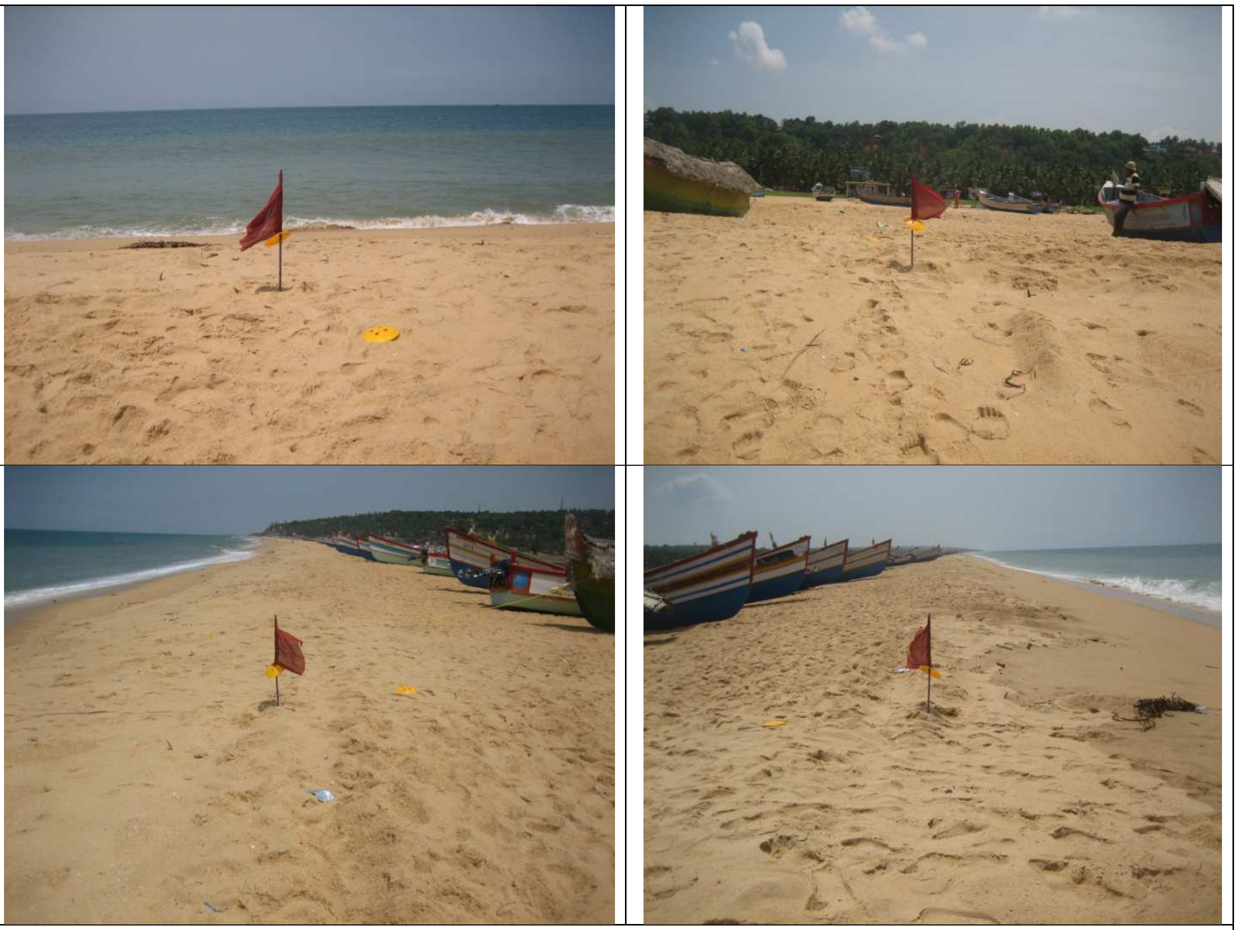


Figure 32:- March_CSP 32

Figure 33:- March_CSP 33

Figure 34:- March_CSP 34

Figure 35:- March_CSP 35

Figure 36:- March_CSP 36

Figure 37:- March_CSP 37

Figure 38:- March_CSP 38

Figure 39:- March_CSP 39

Figure 40:- March_CSP 40

Figure 41:- March_CSP 41

Figure 42:- March_CSP 42

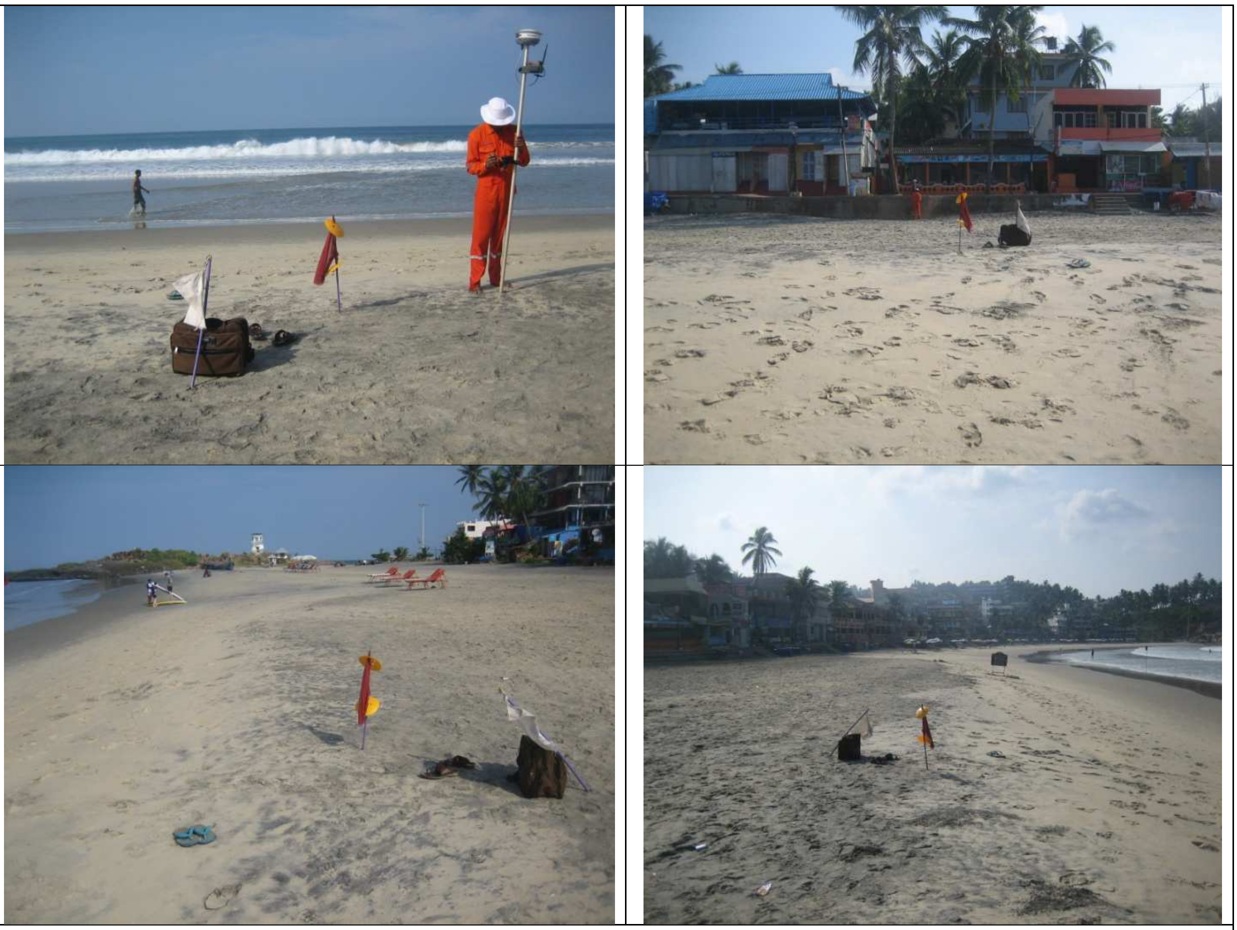


Figure 43:- March_CSP 43

Figure 44:- March_CSP 44

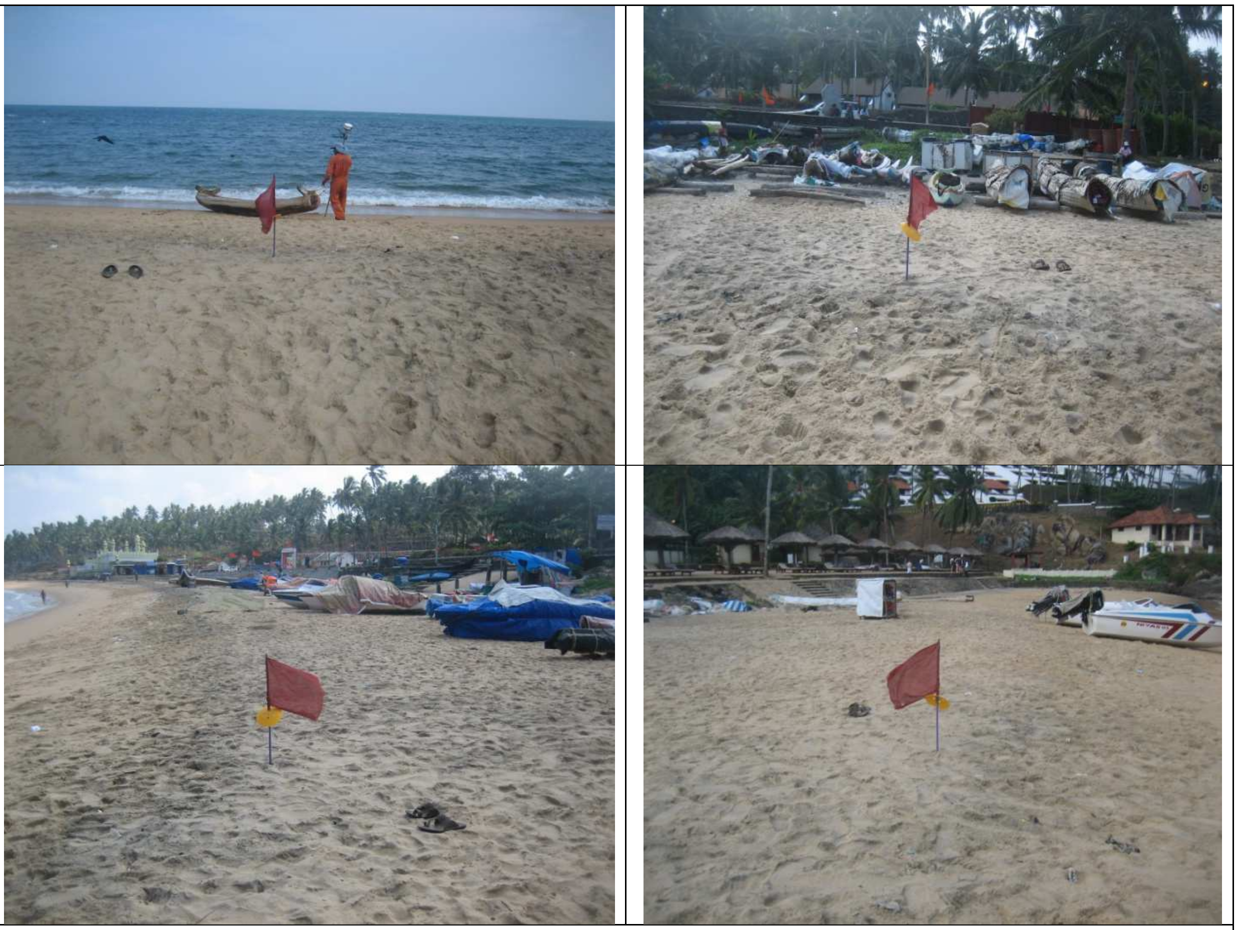


Figure 45:- March_CSP 45

Figure 46:- March_CSP 46

Figure 47:- March_CSP 47

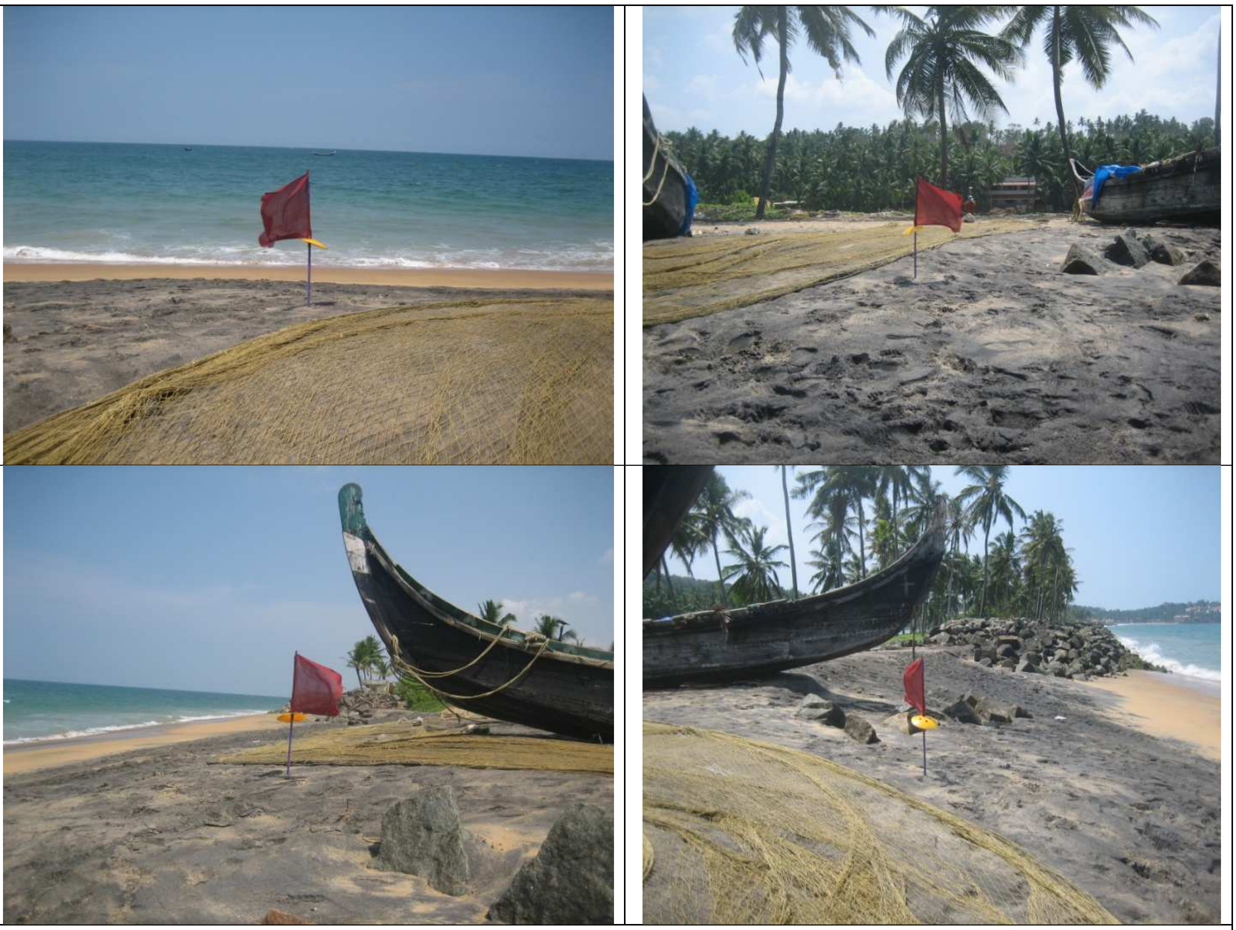


Figure 48:- March_CSP 48



Figure 49:- March_CSP 49

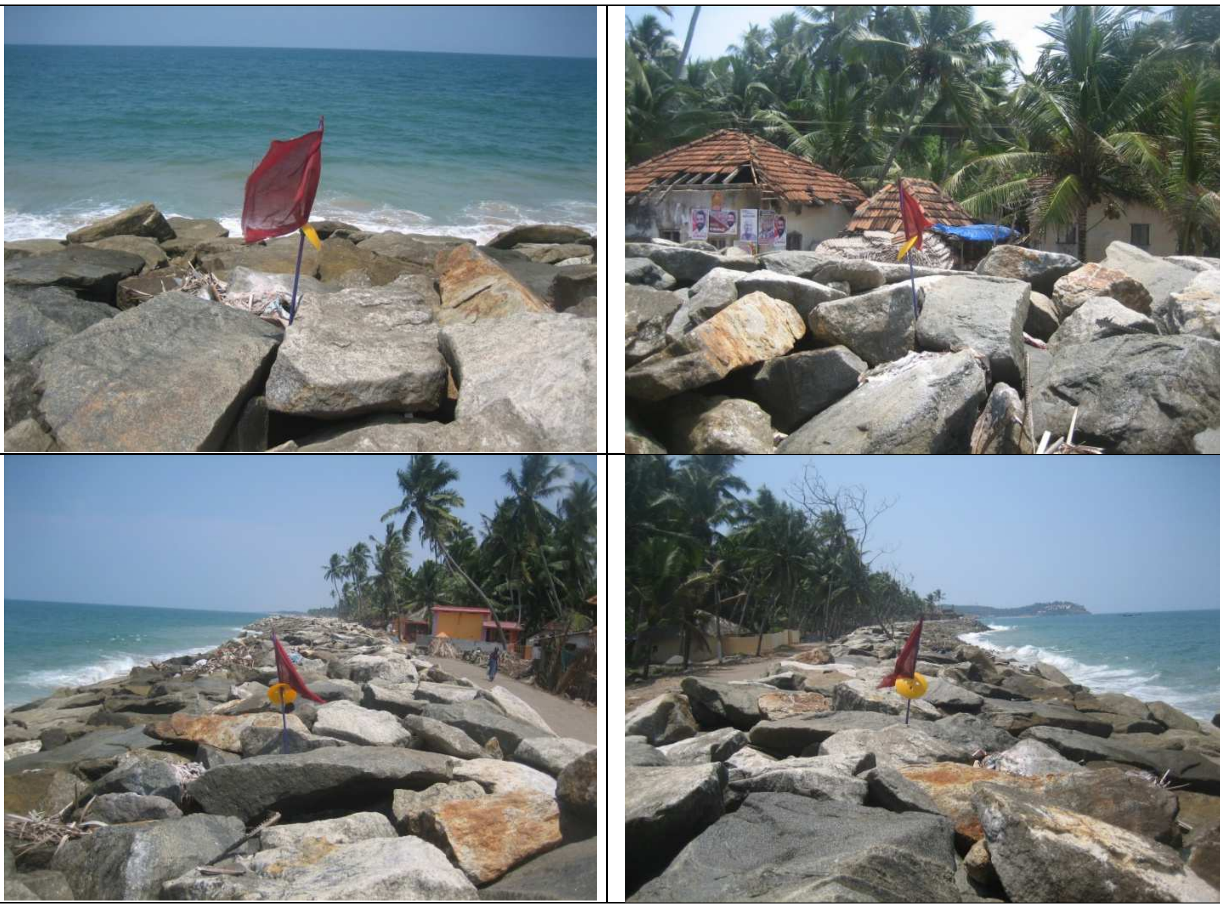


Figure 50:- March_CSP 50

Figure 51:- March_CSP 51

Figure 52:- March_CSP 52

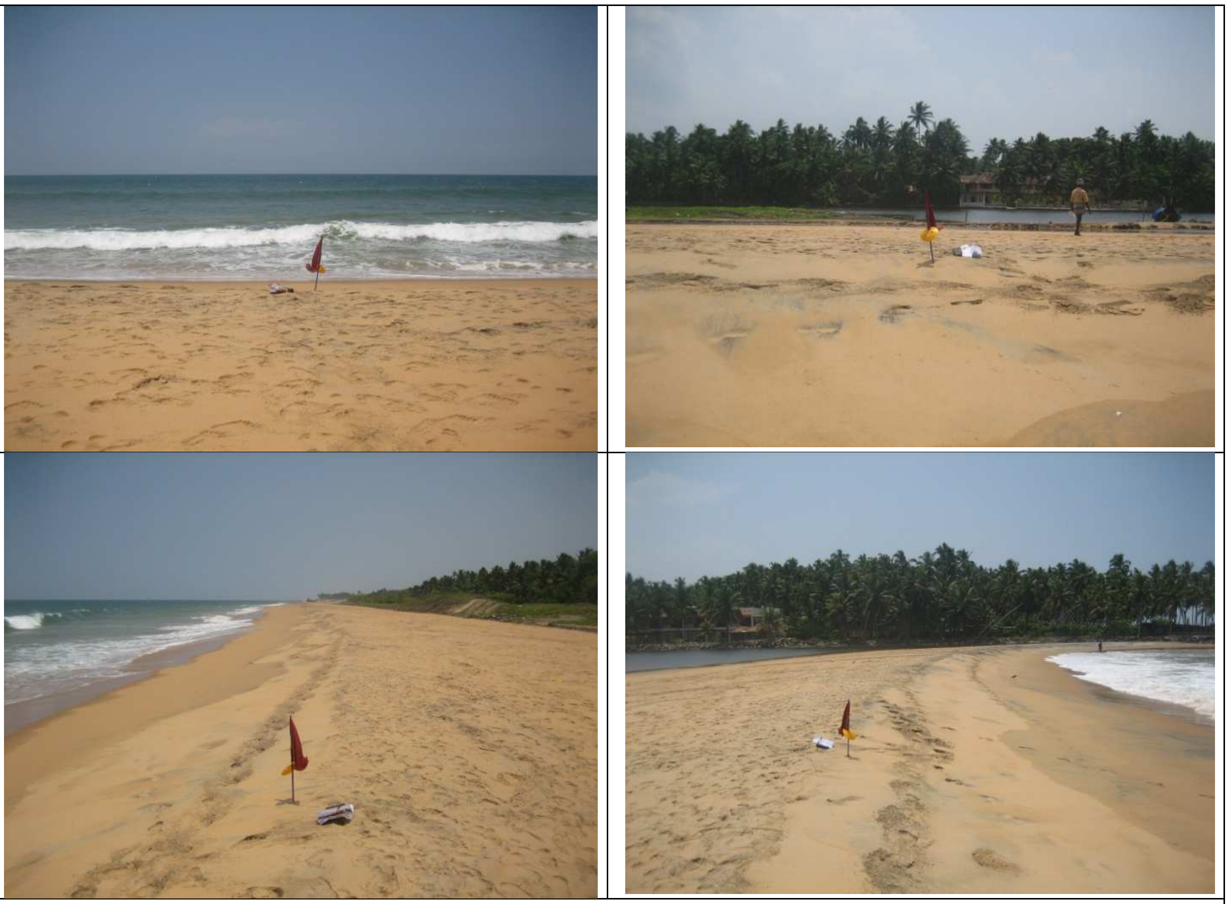


Figure 53:- March_CSP 53

Figure 54:- March_CSP 54

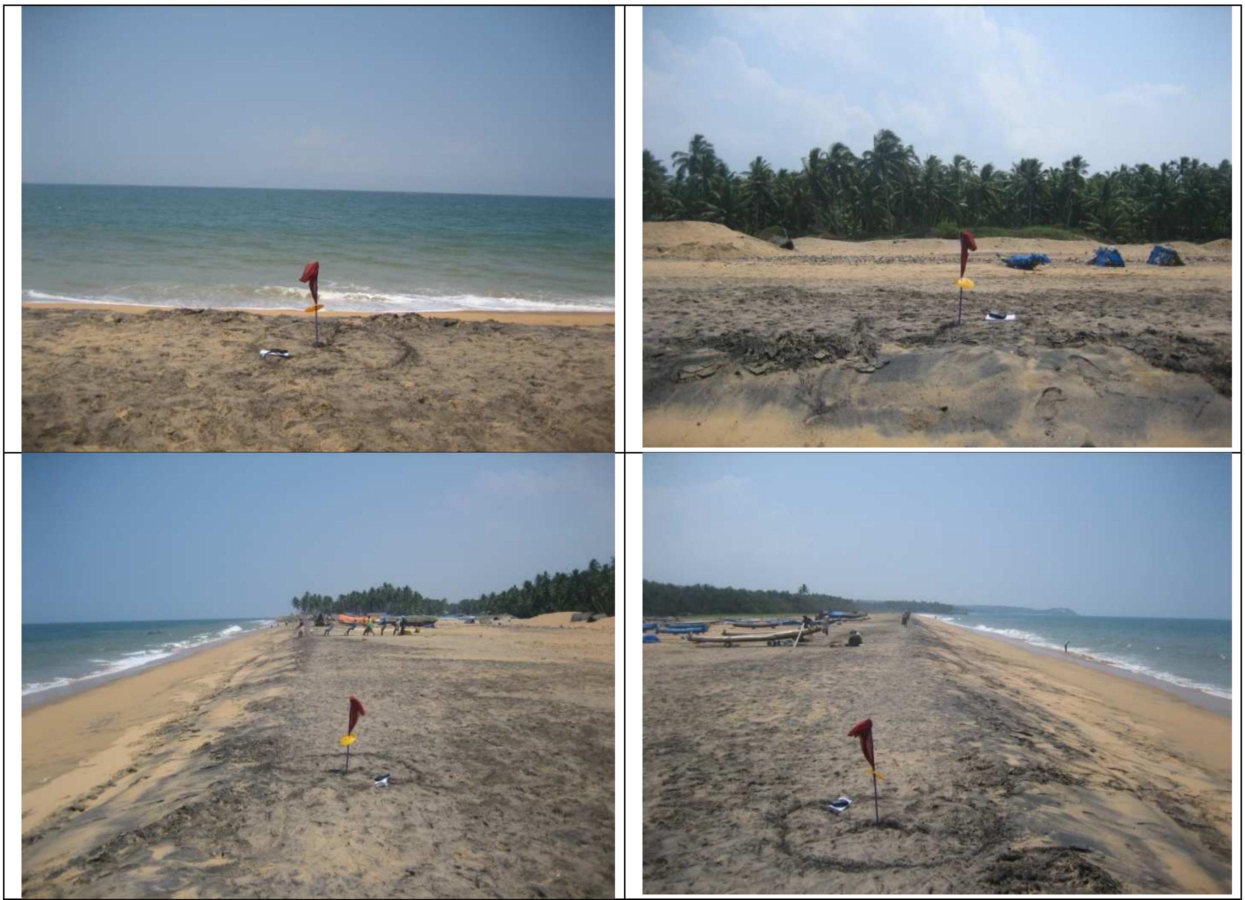


Figure 55:- March_CSP 55

Figure 56:- March_CSP 56

Figure 57:- March_CSP 57

Figure 58:- March_CSP 58

Figure 59:- March_CSP 59

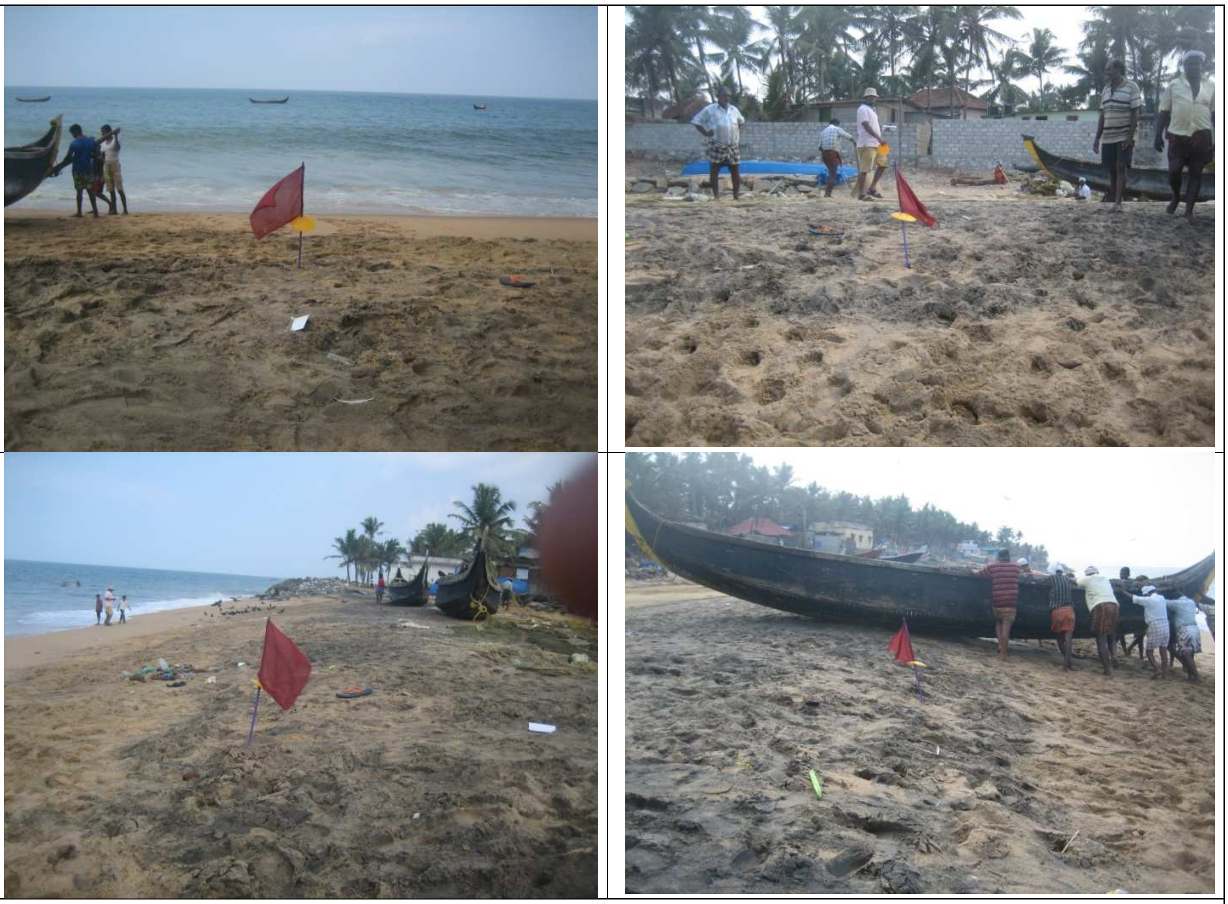


Figure 60:- March_CSP 60

Figure 61:- March_CSP 61

Figure 62:- March_CSP 62

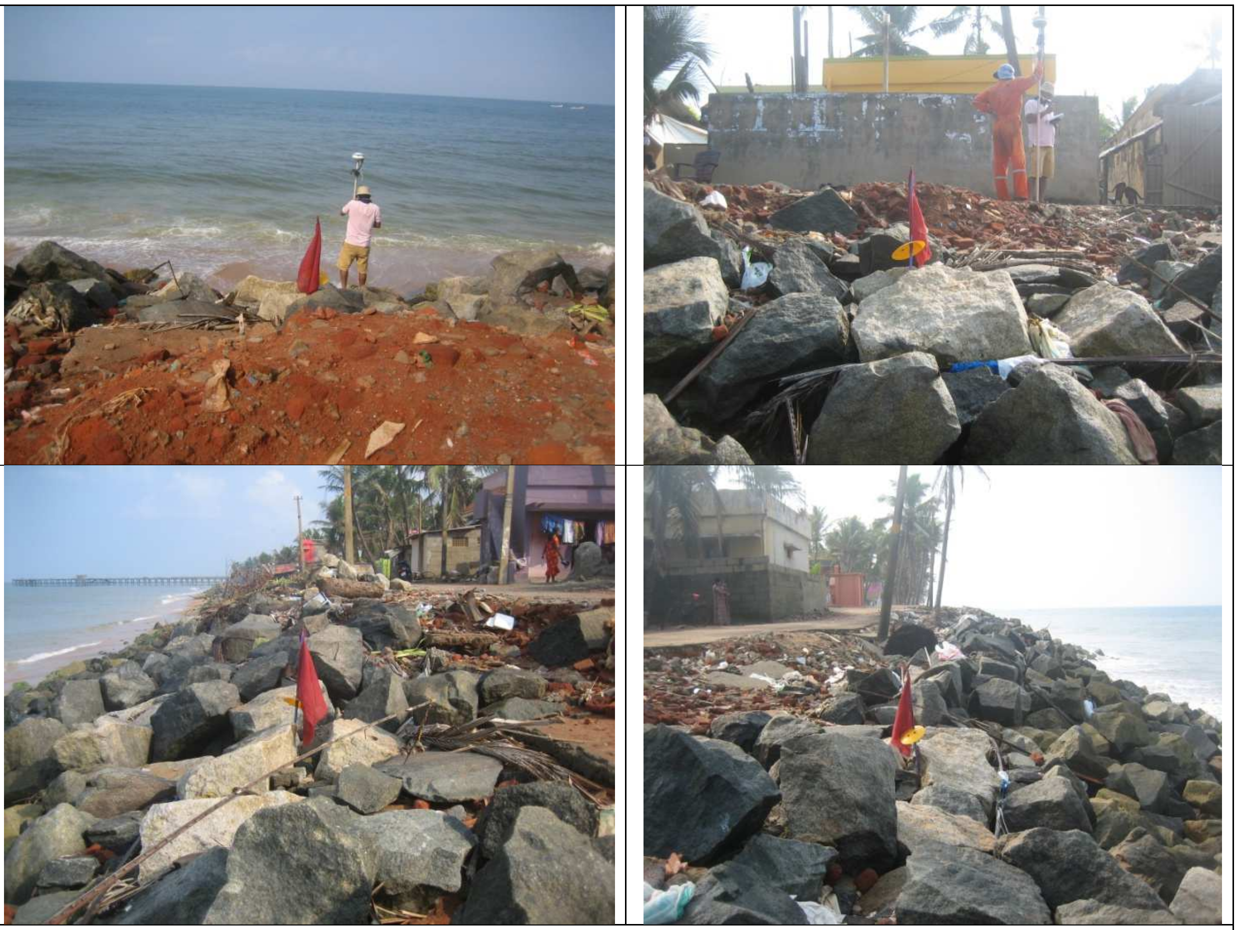


Figure 63:- March_CSP 63

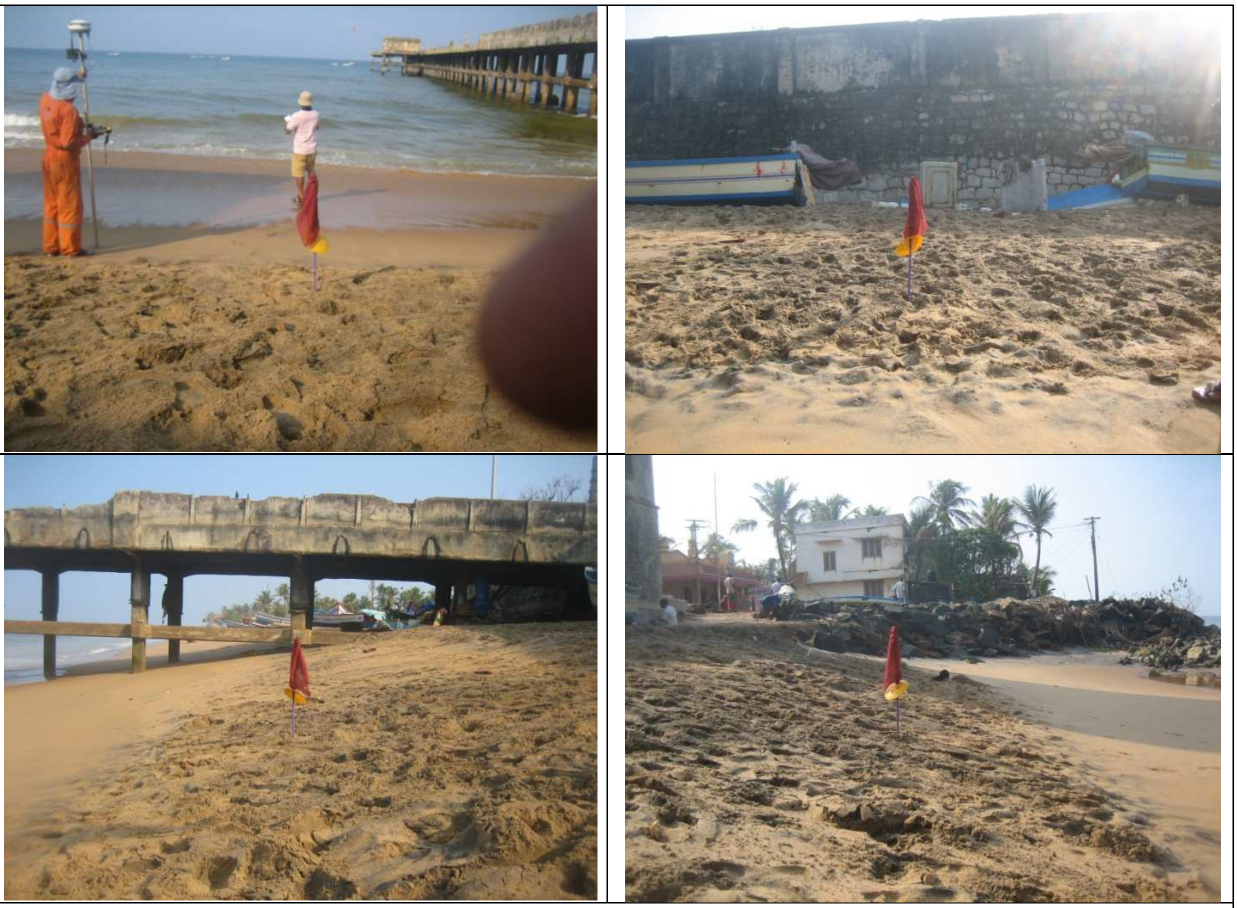


Figure 64:- March_CSP 64

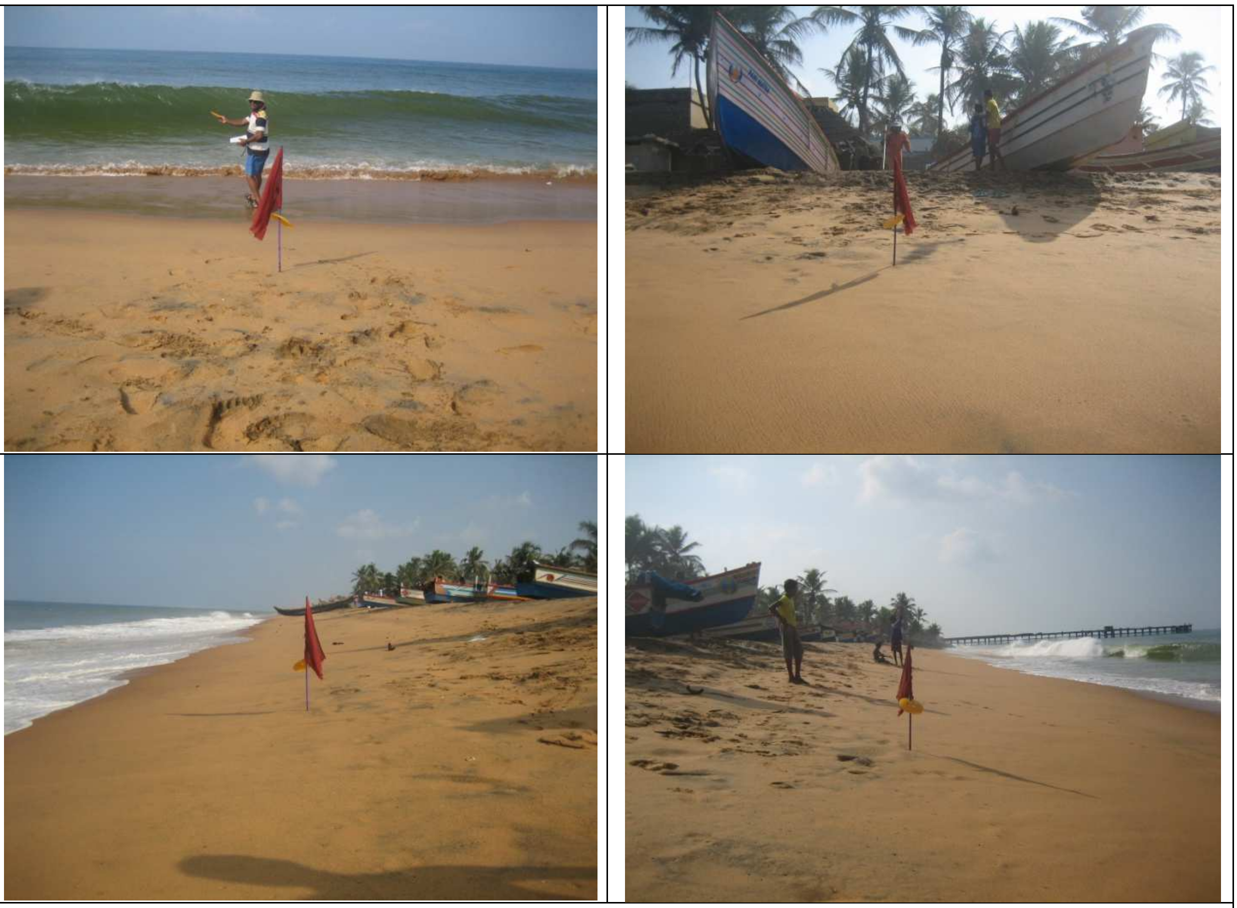


Figure 65:- March_CSP 65

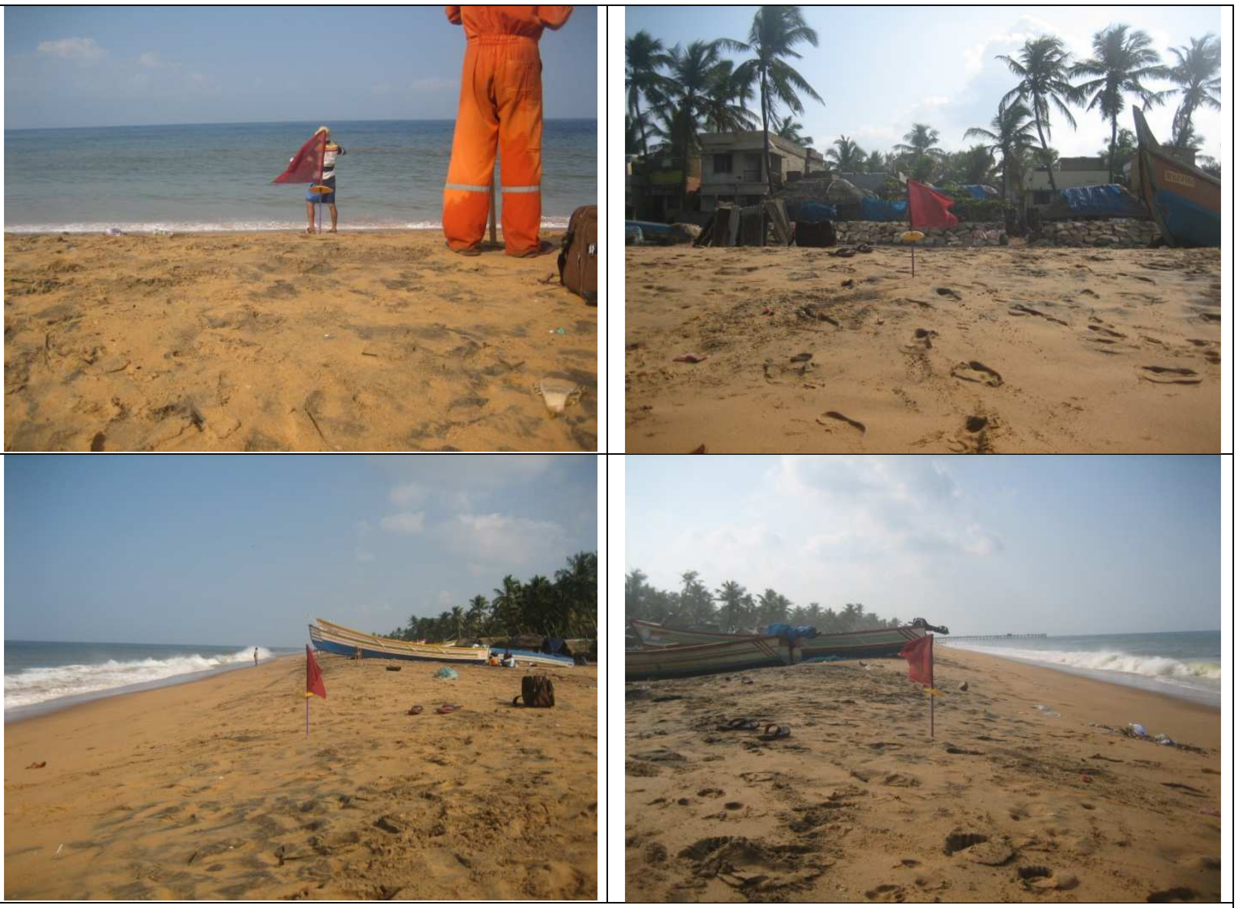


Figure 66:- March_CSP 66

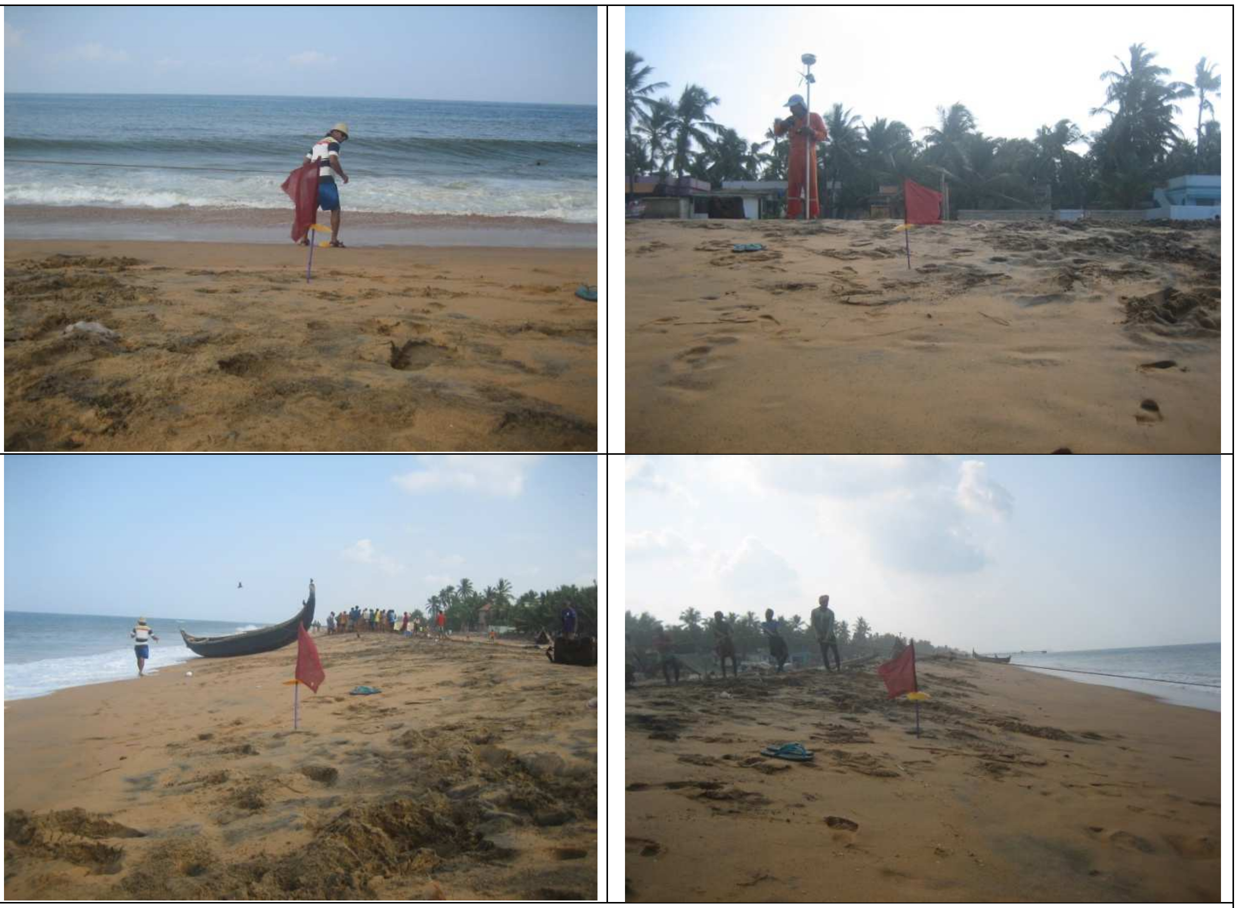


Figure 67:- March_CSP 67

Figure 68:- March_CSP 68

Figure 69:- March_CSP 69

Figure 70:- March_CSP 70

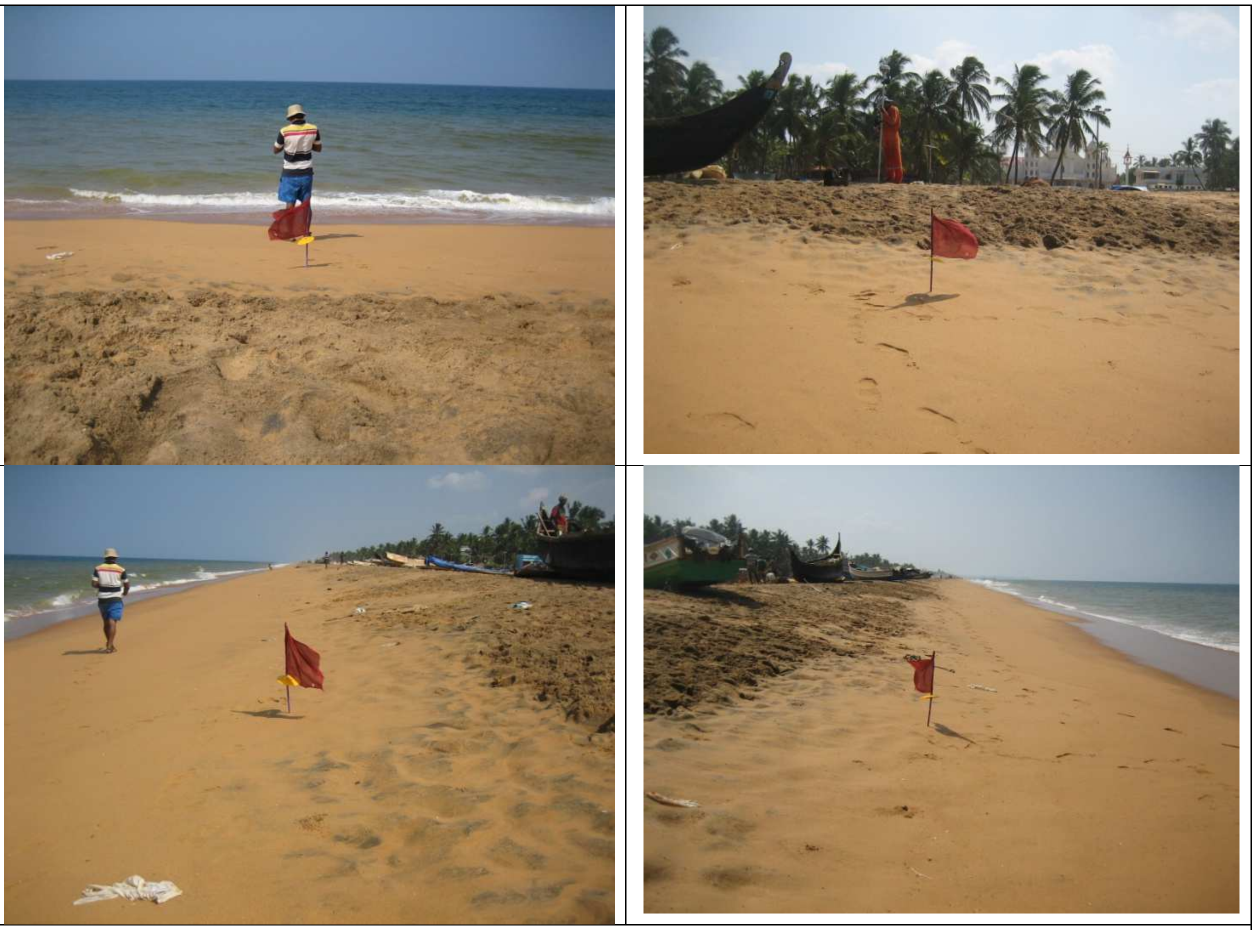


Figure 71:- March_CSP 71

Figure 72:- March_CSP 72

Figure 73:- March_CSP 73

Figure 74:- March_CSP 74

Figure 75:- March_CSP 75

Figure 76:- March_CSP 76

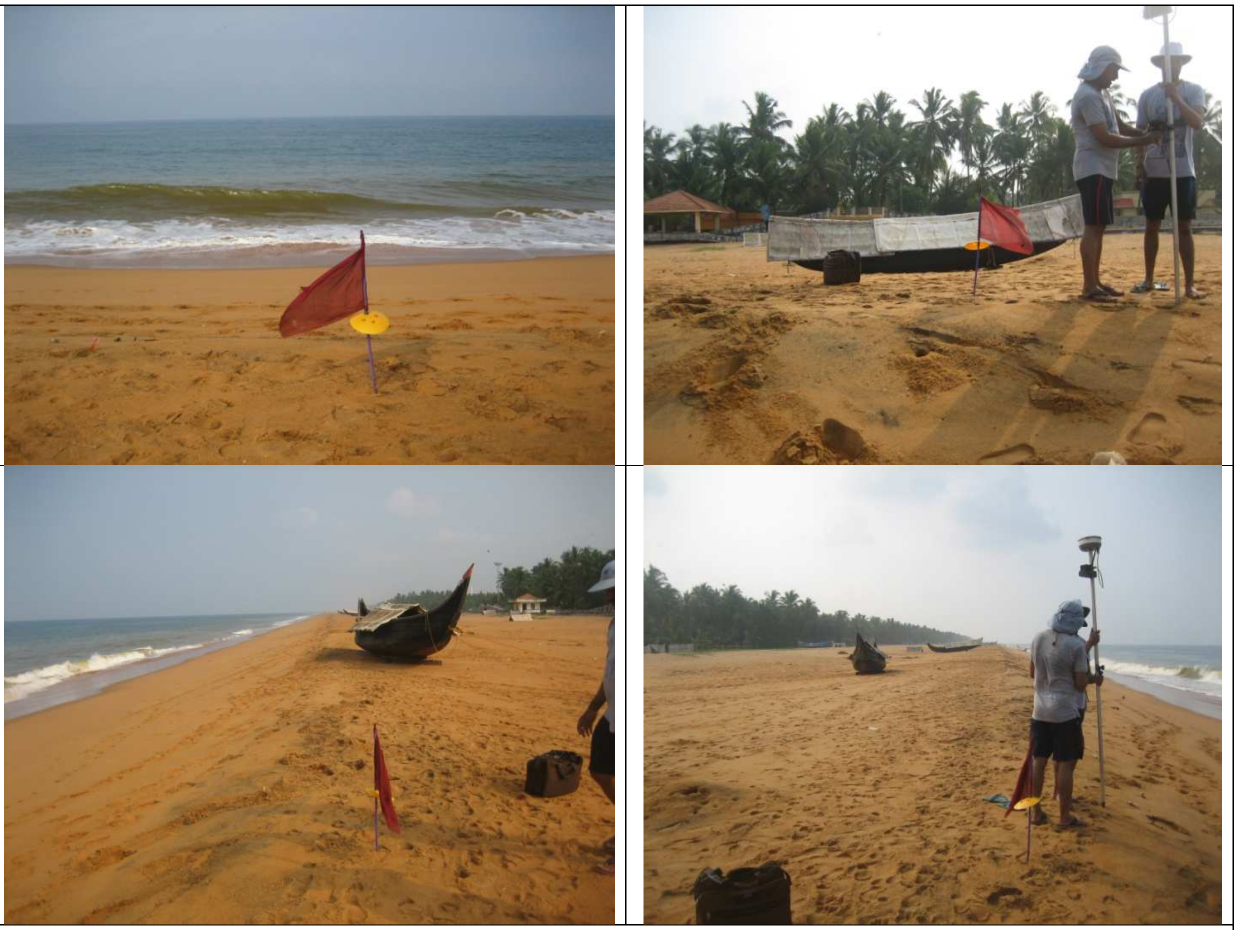


Figure 77:- March_CSP 77

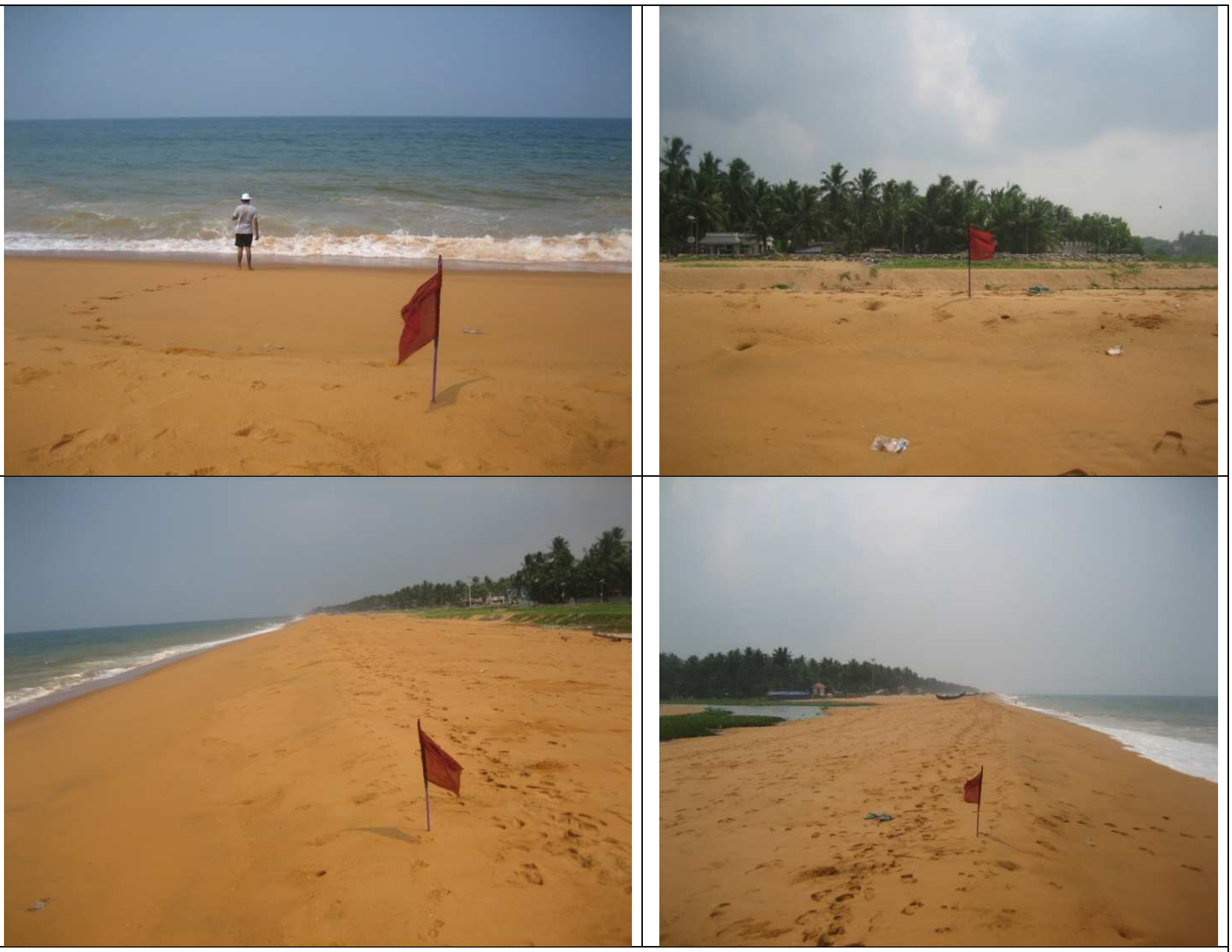


Figure 78:- March_CSP 78

Figure 79:- March_CSP 79

Figure 80:- March_CSP 80

Figure 81:- March_CSP 81

Annexure VI

Photo Documentation at CSP Locations - May 2016

Figure 01:- May_CSP 01

Figure 02:- May_CSP 02

Figure 03:- May_CSP 03

Figure 04:- May_CSP 04

Figure 05:- May_CSP 05

Figure 06:- May_CSP 06

Figure 07:- May_CSP 07

Figure 08:- May_CSP 08

Figure 09:- May_CSP 09

Figure 10:- May_CSP 10

Figure 11:- May_CSP 11

Figure 12:- May_CSP 12

Figure 13:- May_CSP 13

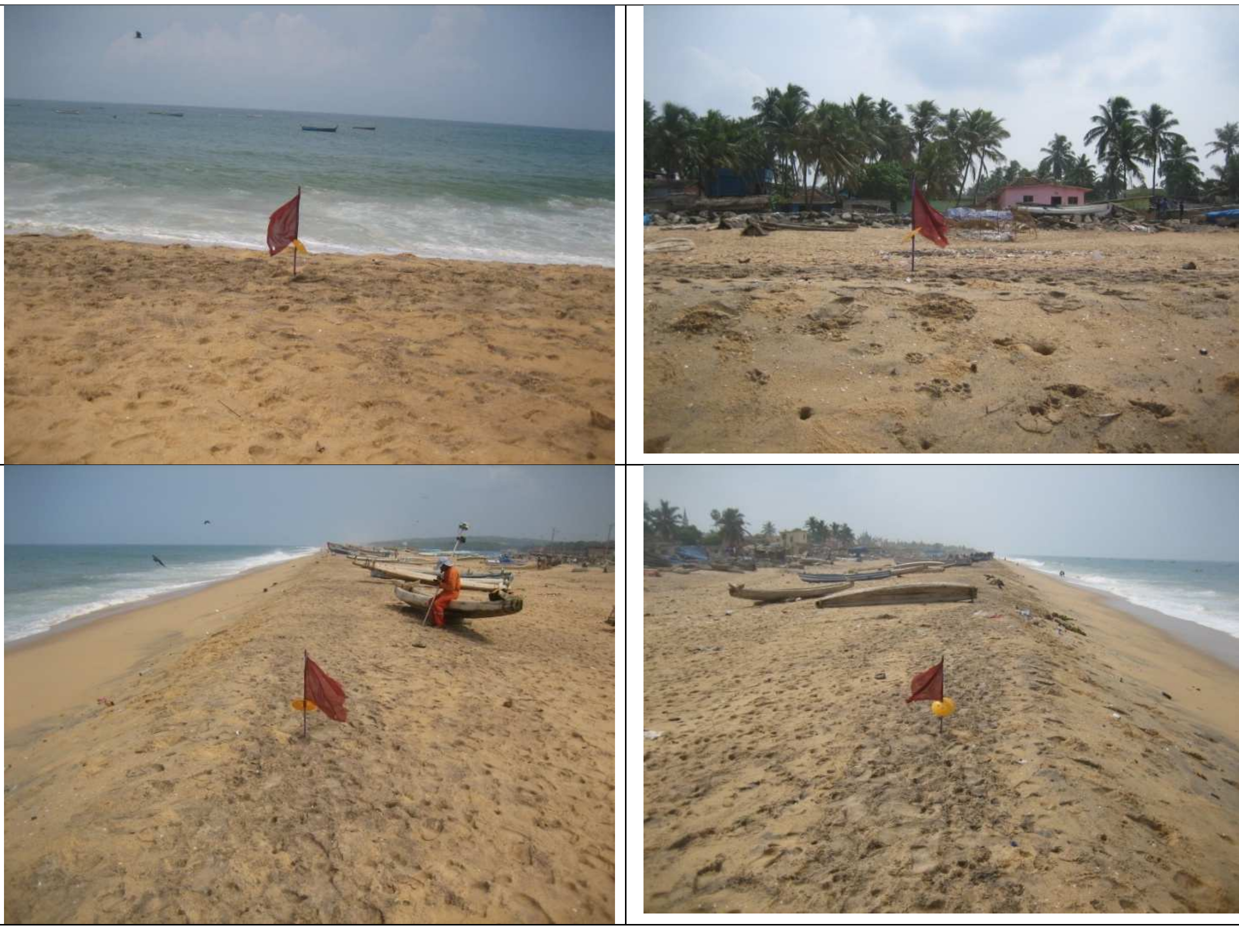


Figure 14:- May_CSP 14

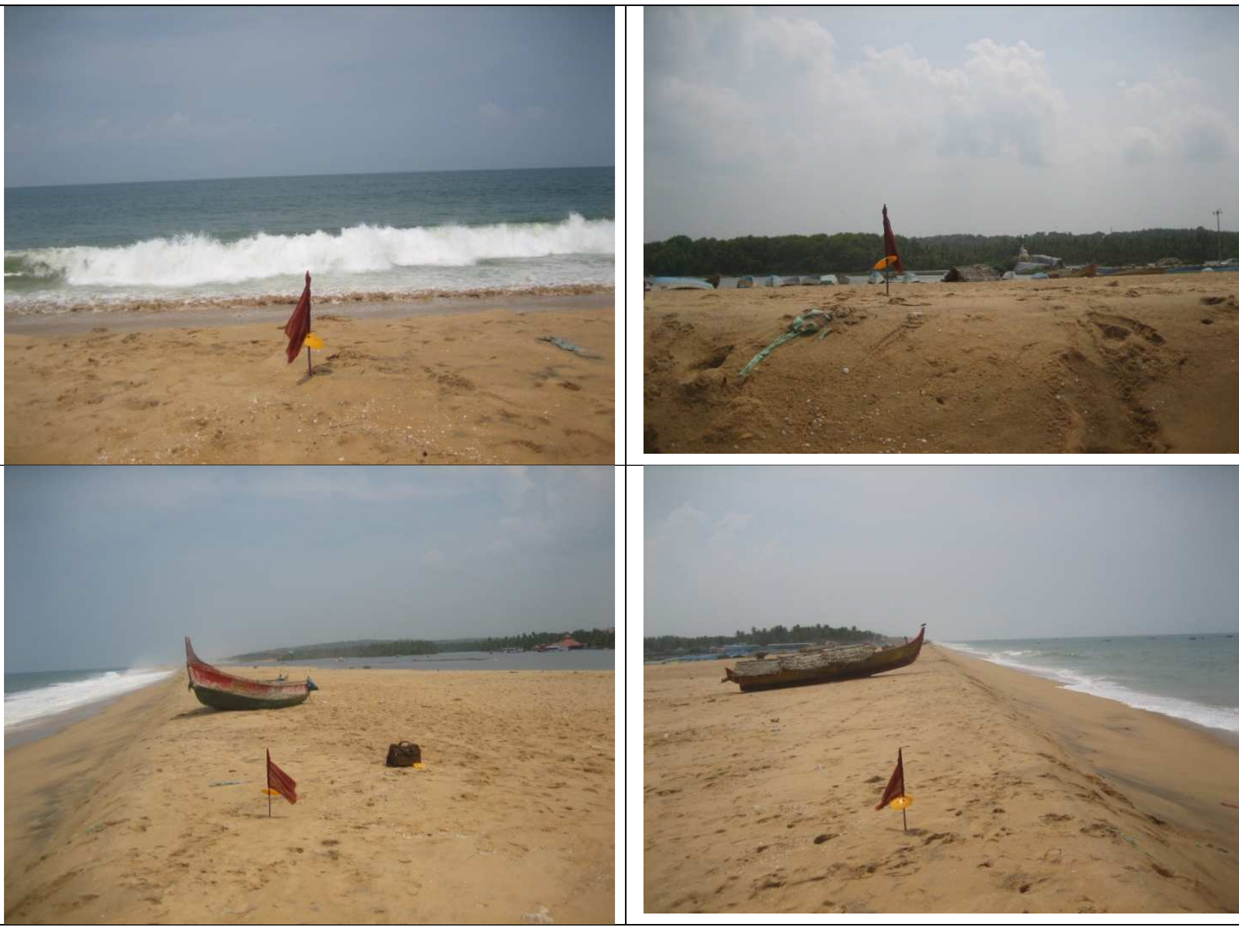


Figure 15:- May_CSP 15

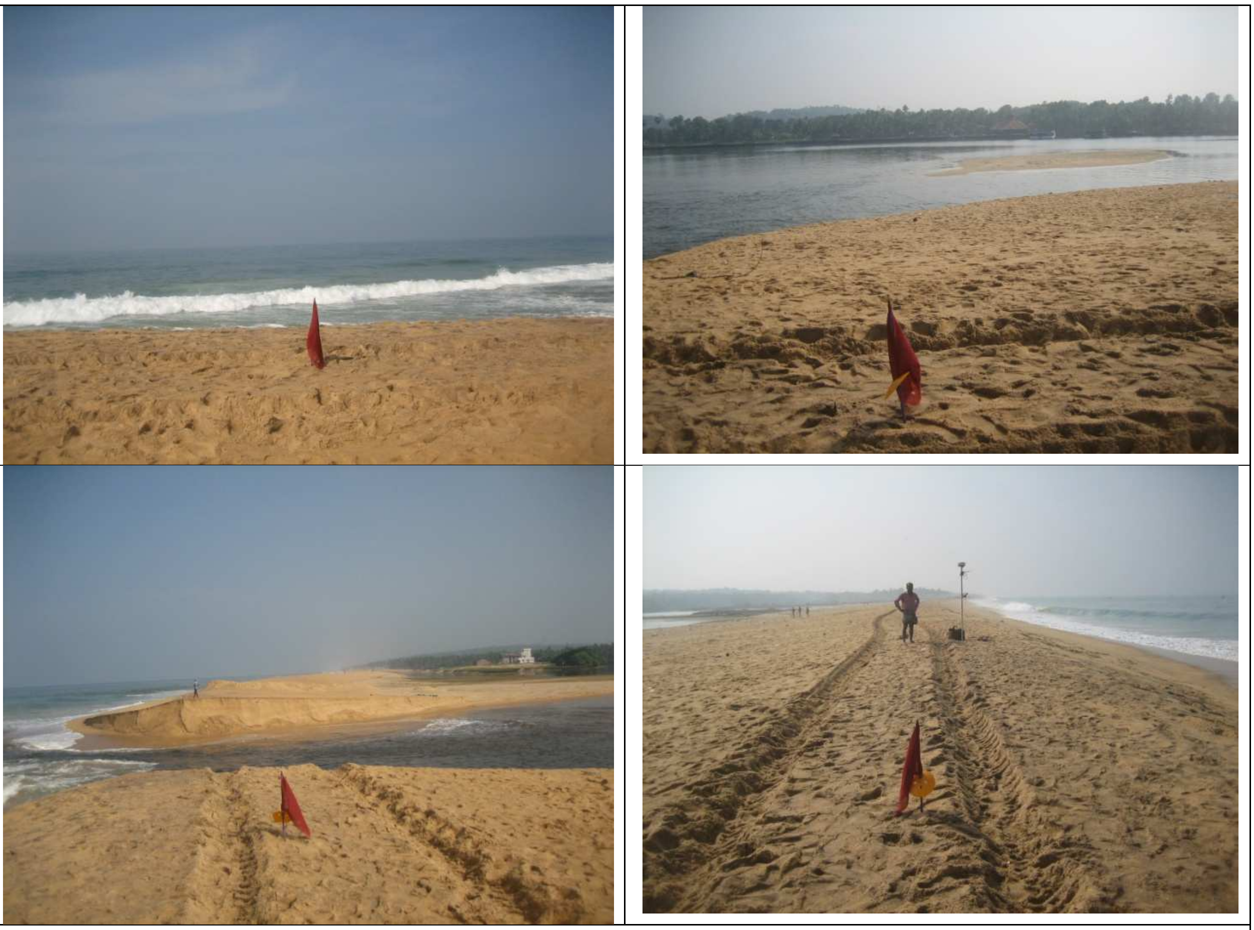


Figure 16:- May_CSP 16

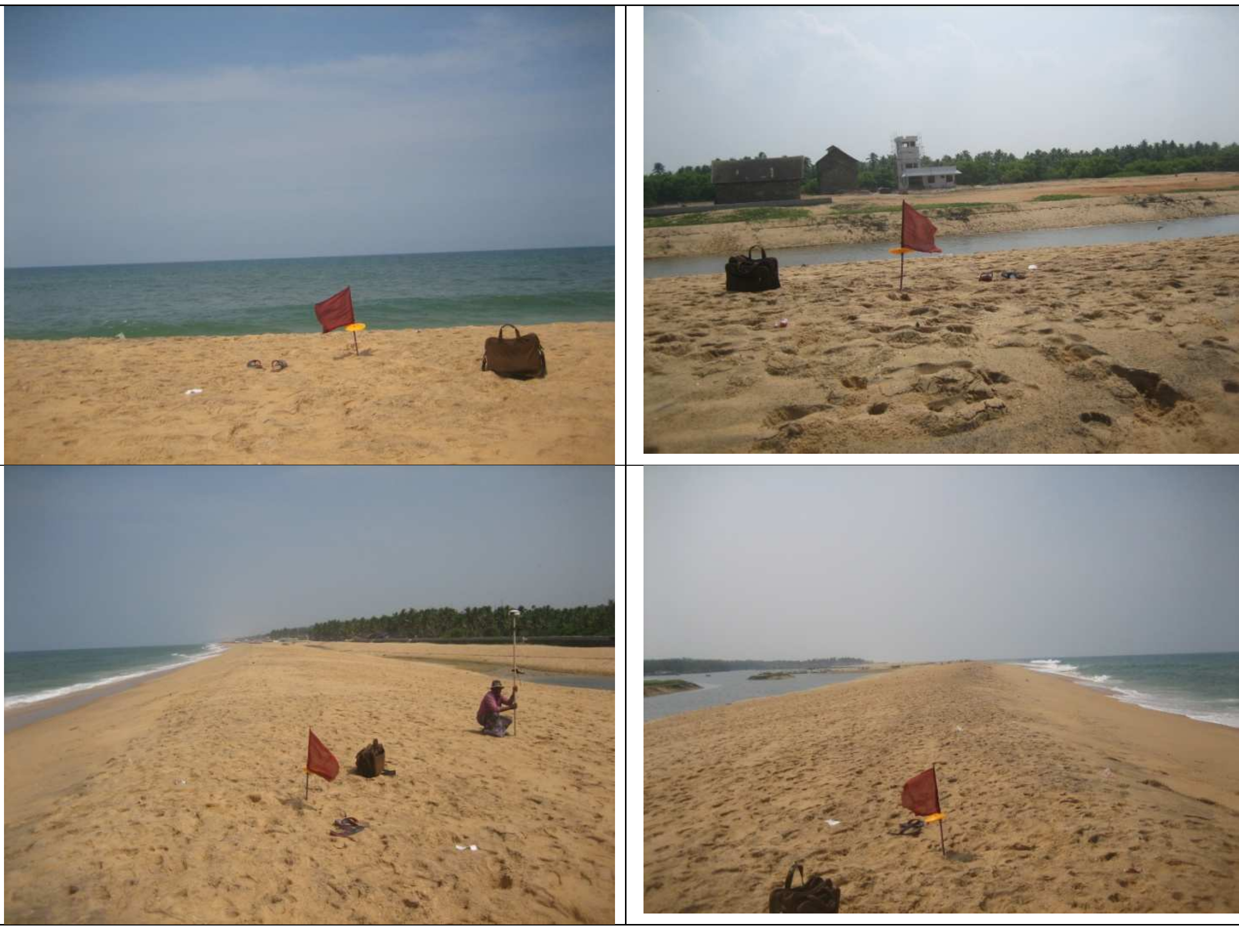


Figure 17:- May_CSP 17

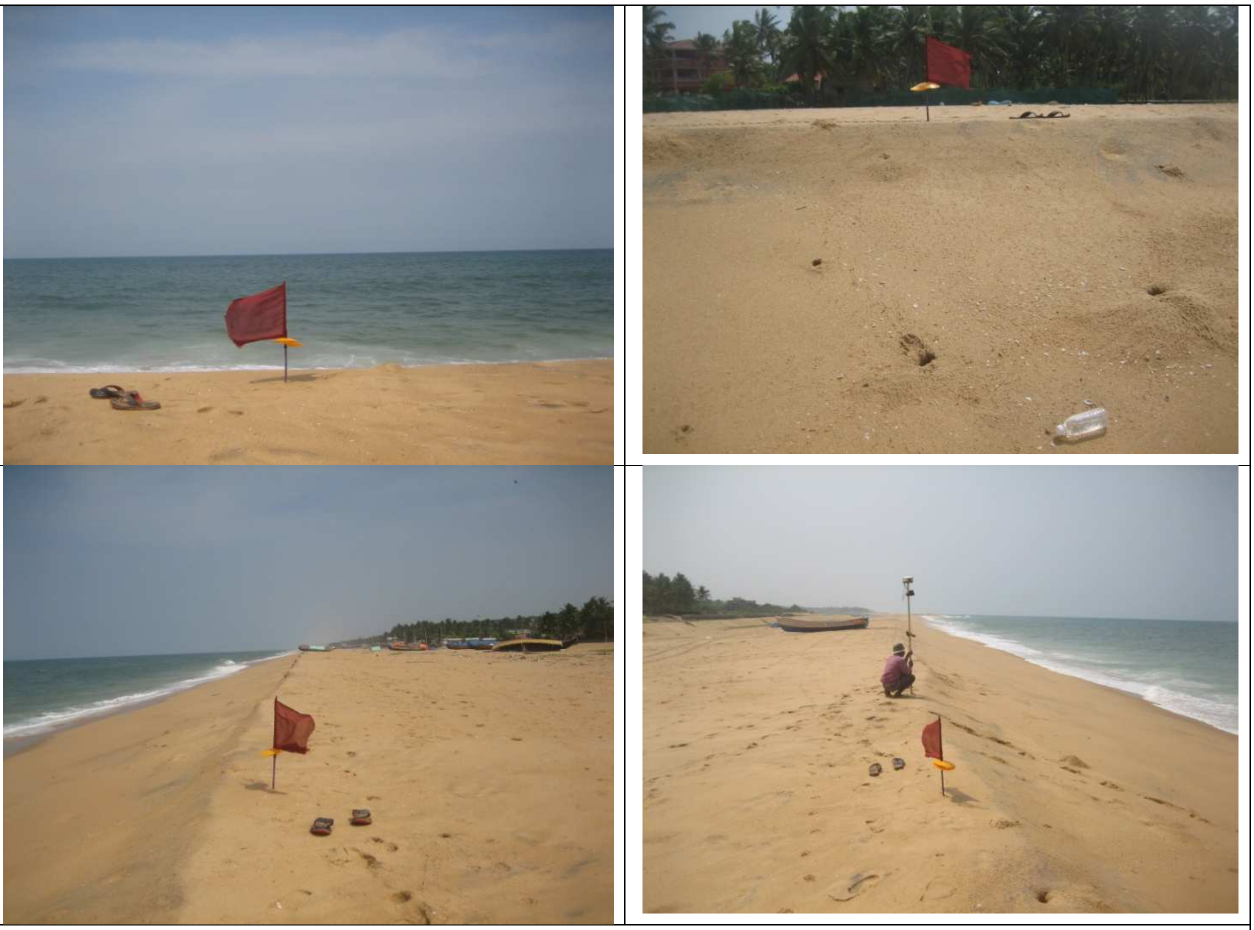


Figure 18:- May_CSP 18

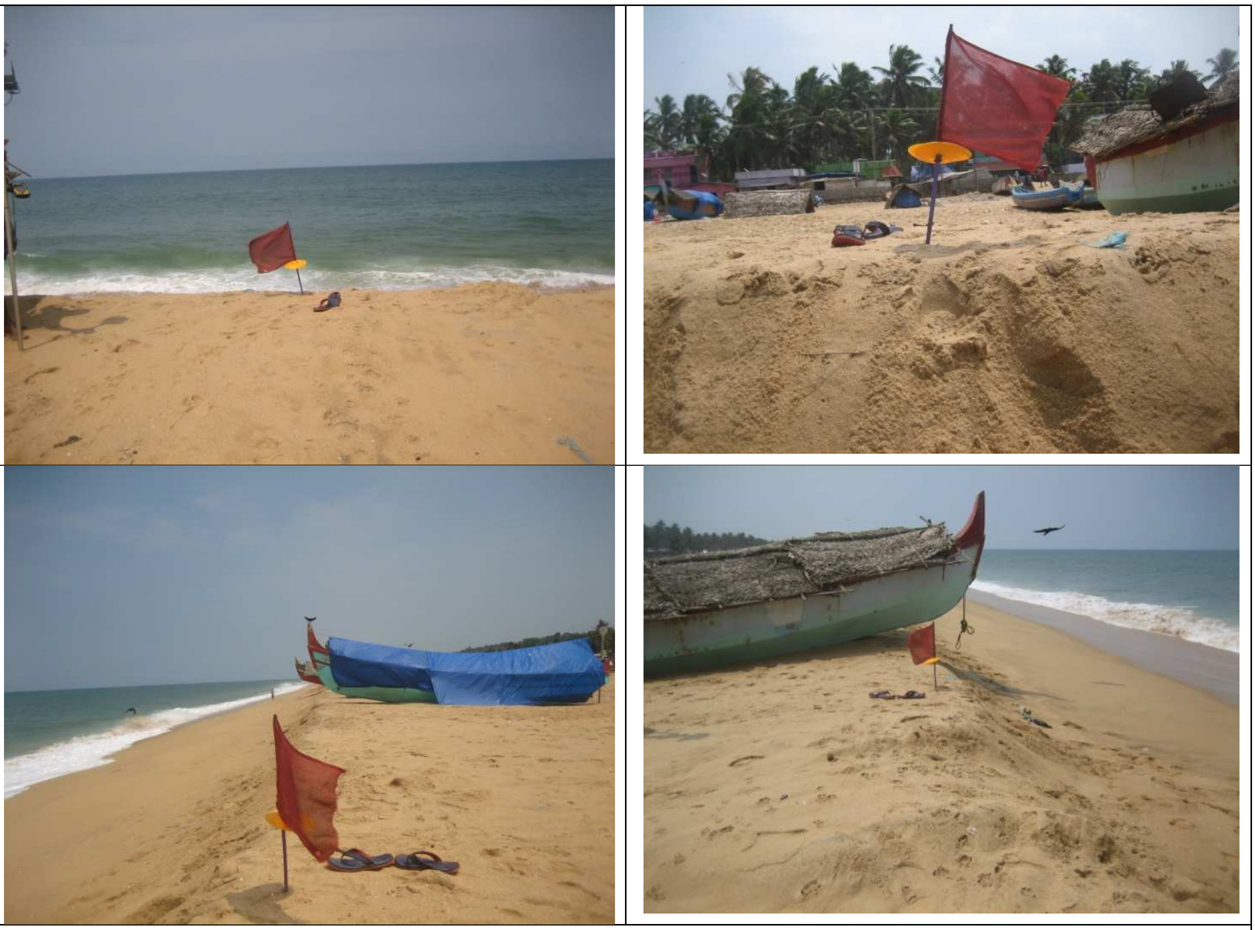


Figure 19:- May_CSP 19

Figure 20:- May_CSP 20

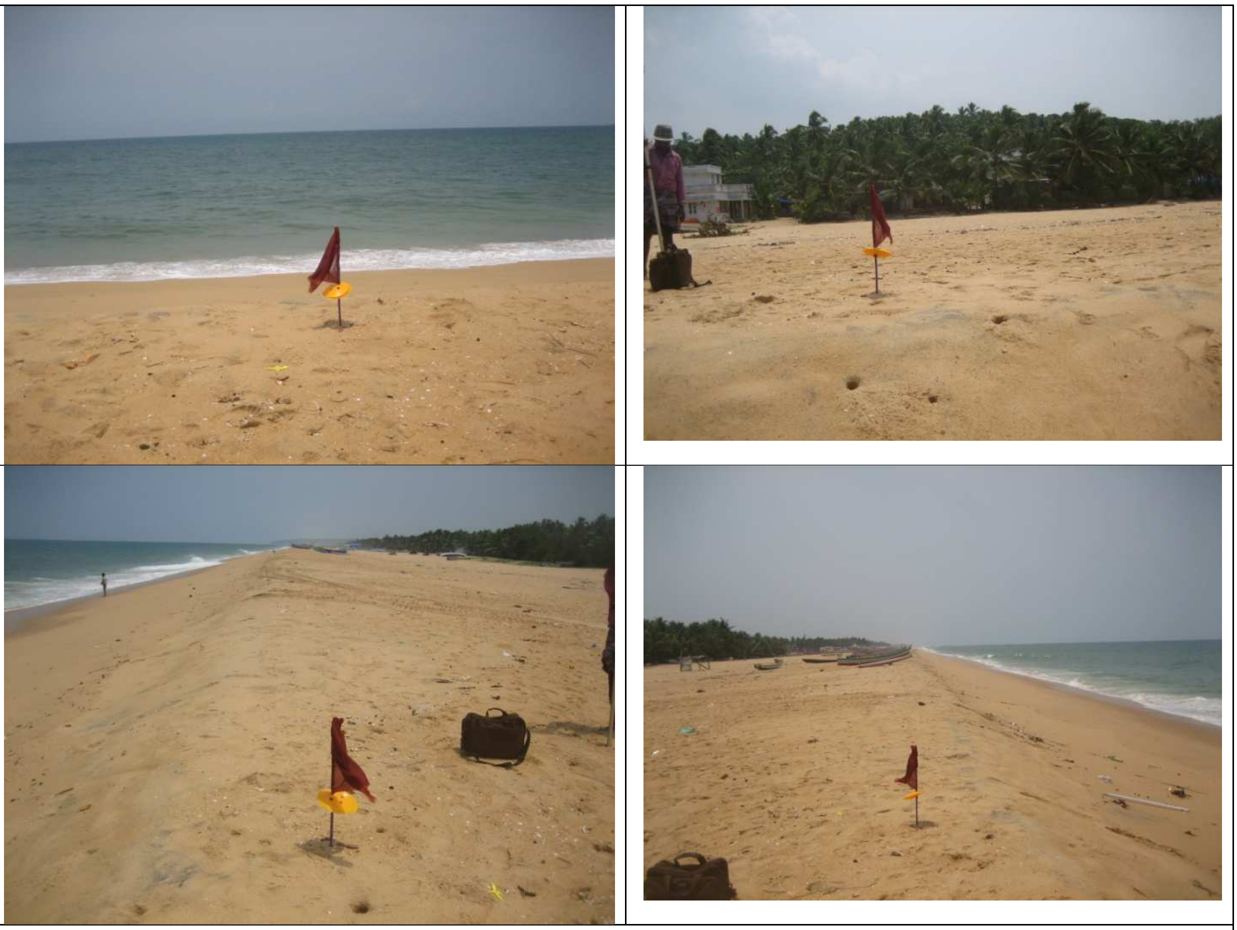


Figure 21:- May_CSP 21

Figure 22:- May_CSP 22

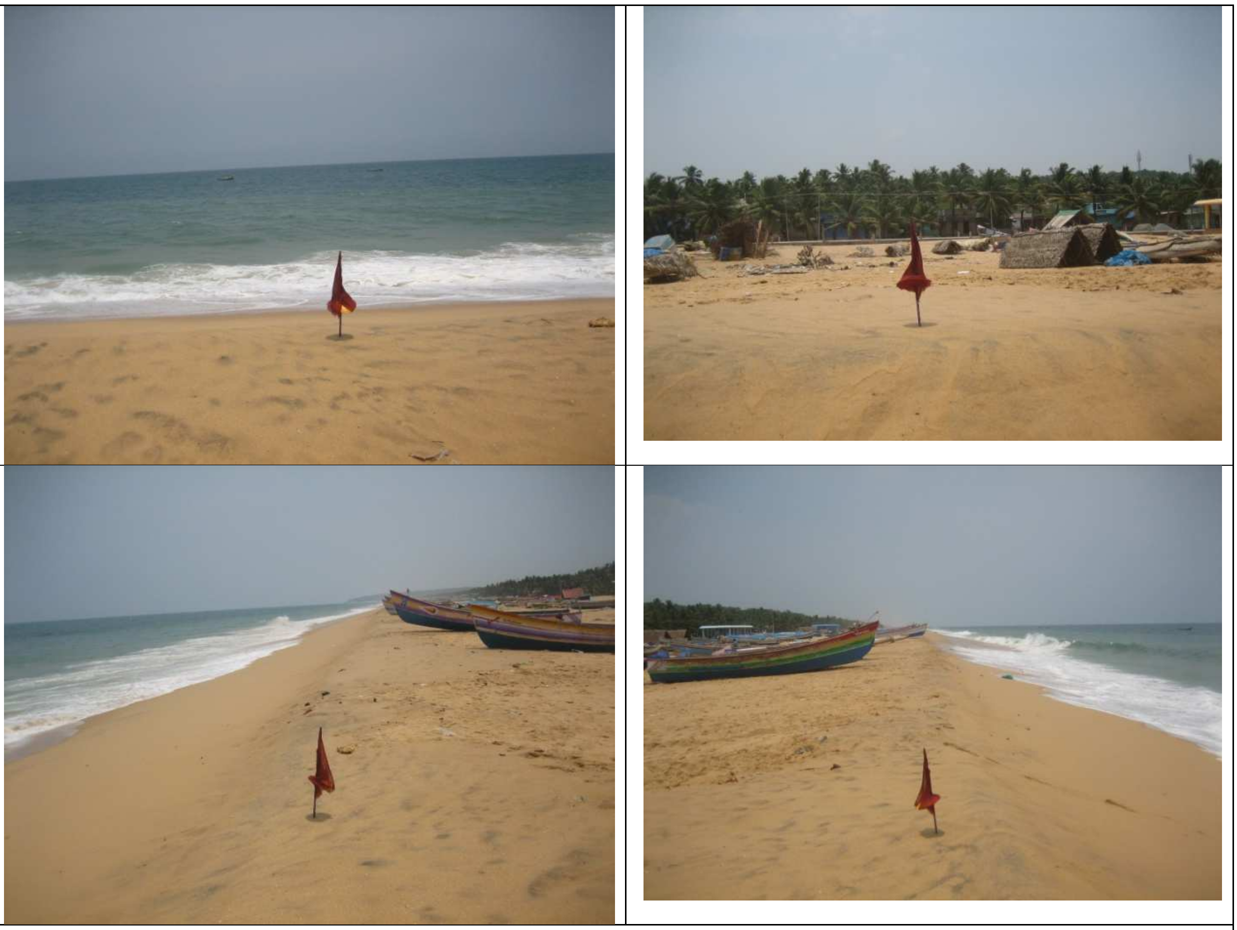


Figure 23:- May_CSP 23

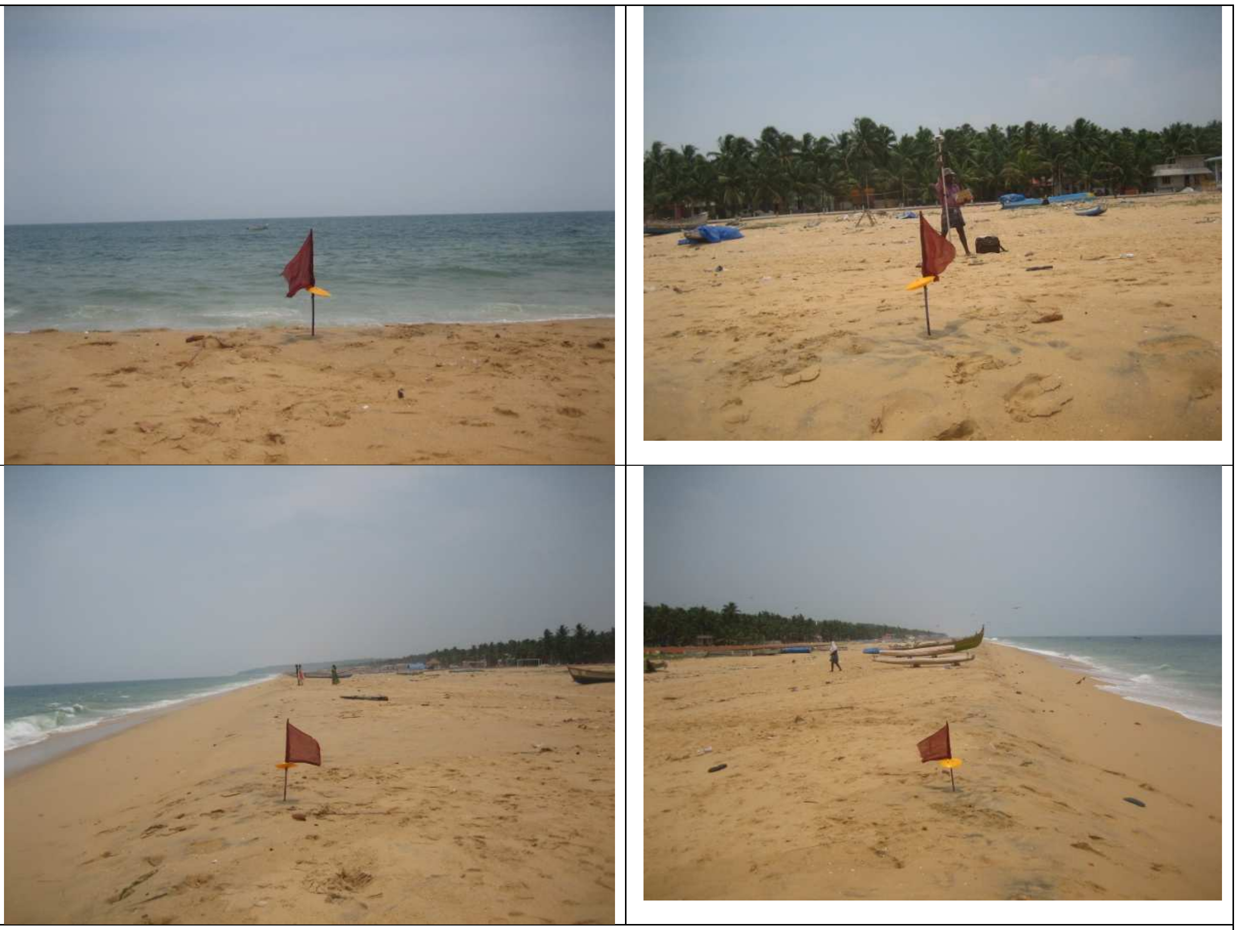


Figure 24:- May_CSP 24

Figure 25:- May_CSP 25

Figure 26:- May_CSP 26

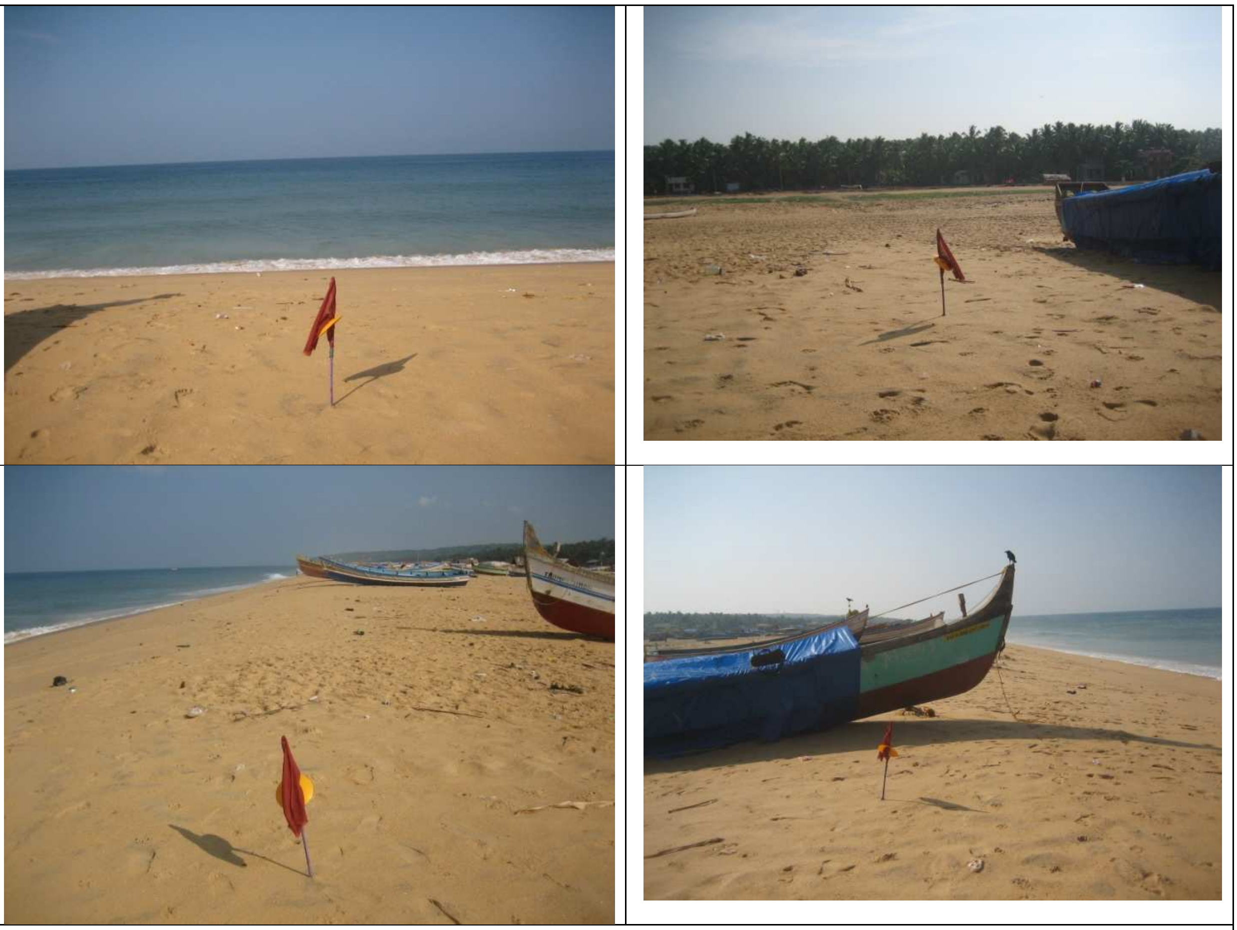


Figure 27:- May_CSP 27

Figure 28:- May_CSP 28

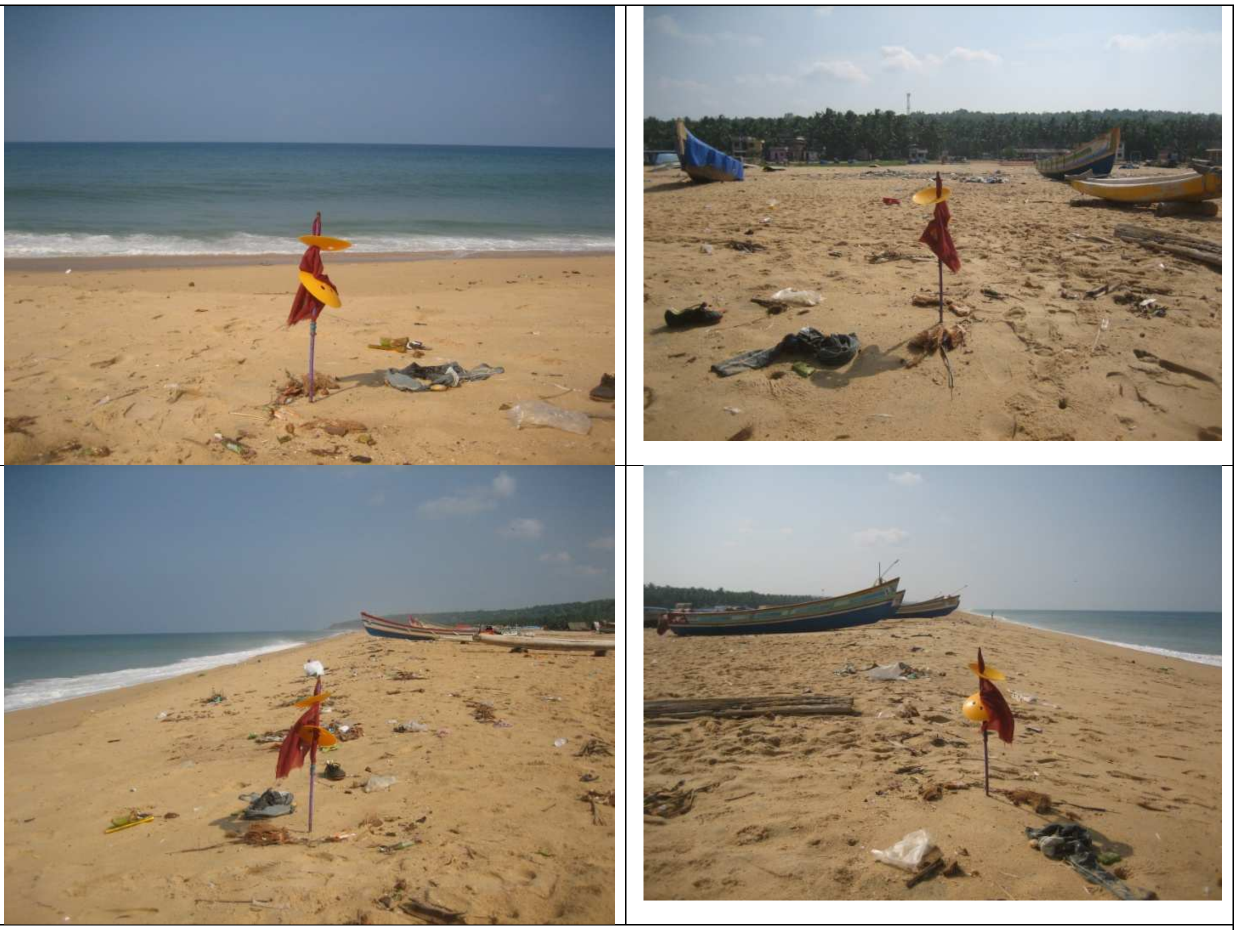


Figure 29:- May_ CSP 29

Figure 30:- May_CSP 30

Figure 31:- May_CSP 31

Figure 32:- May_CSP 32

Figure 33:- May_CSP 33

Figure 34:- May_CSP 34

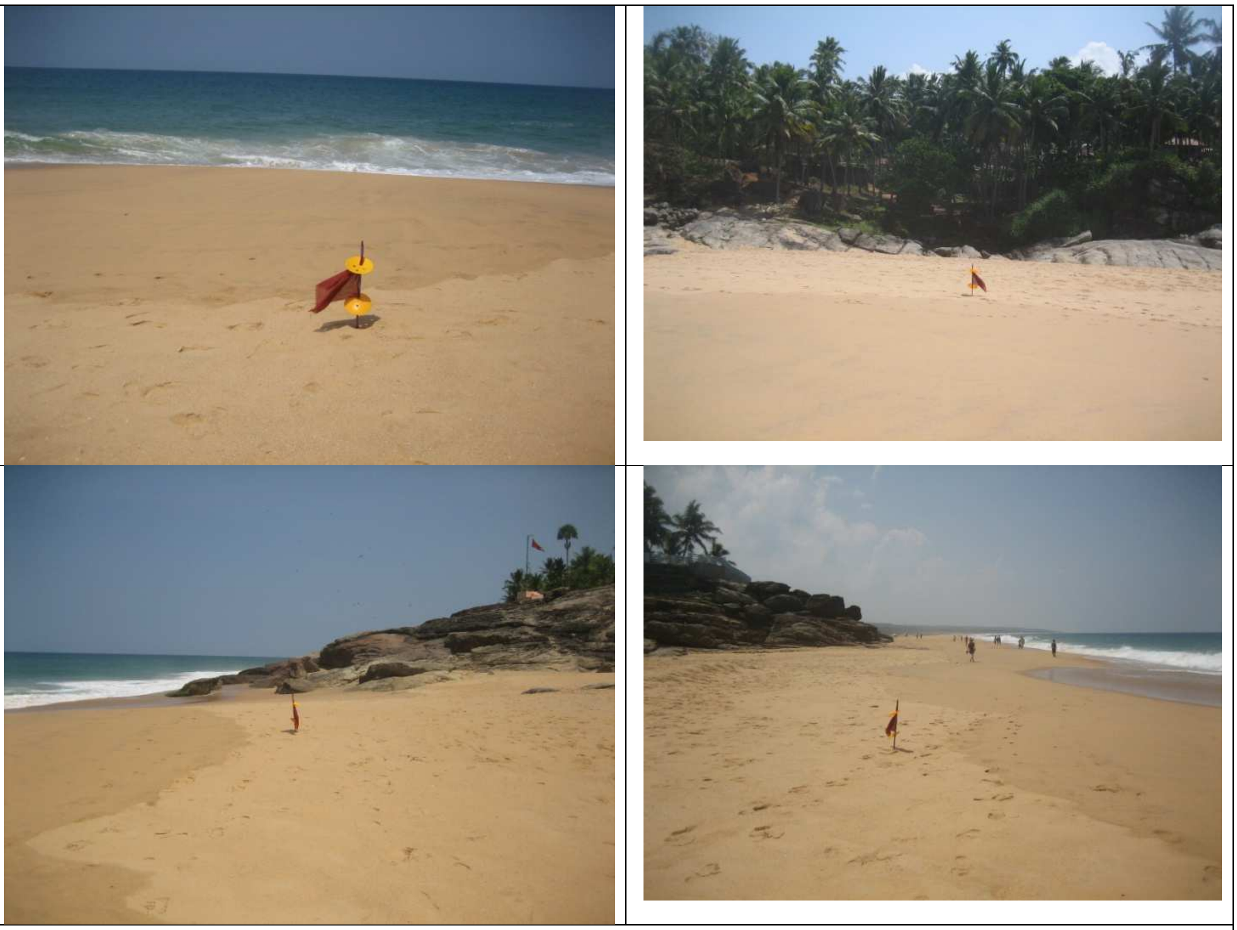


Figure 35:- May_CSP 35

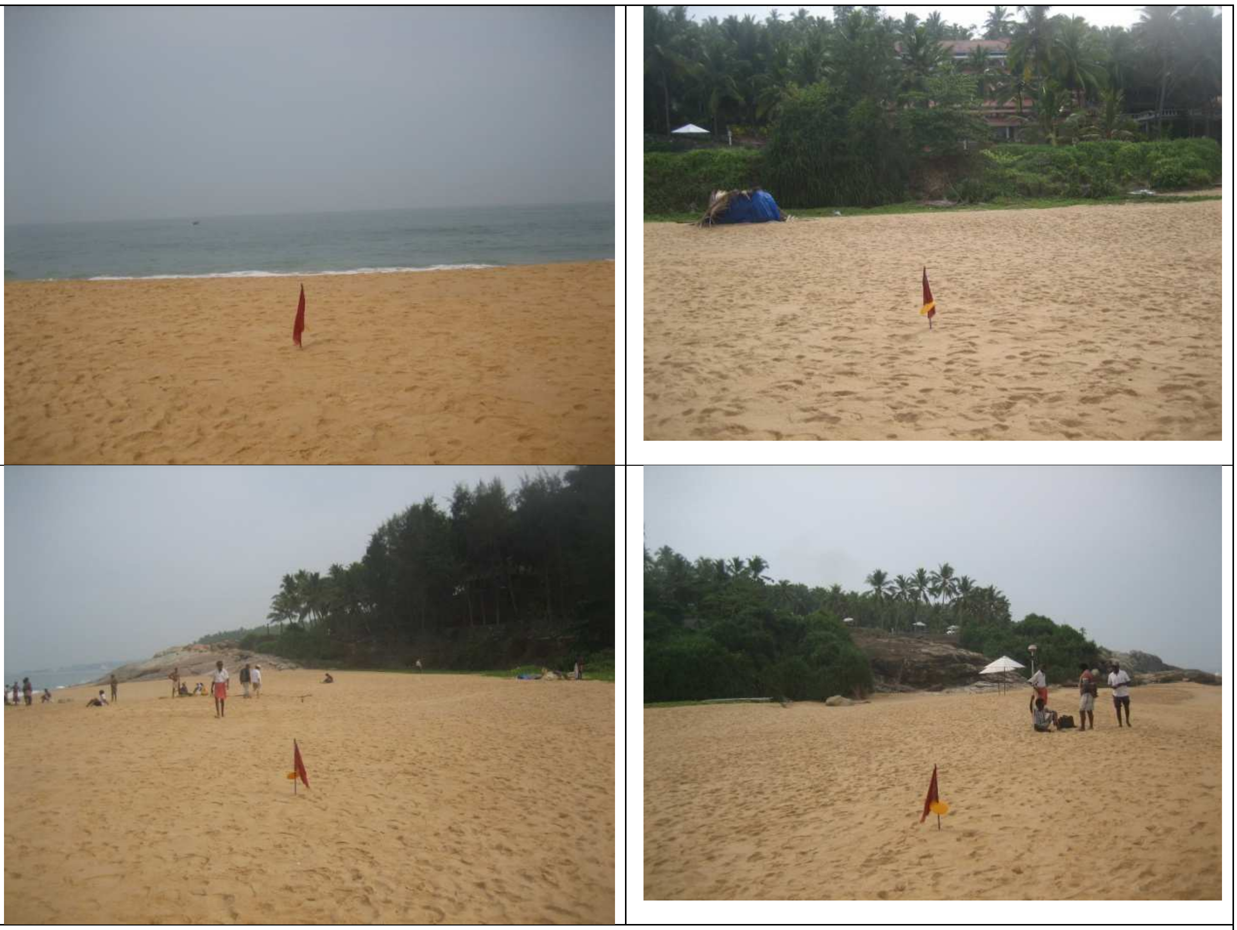


Figure 36:- May_CSP 36

Figure 37:- May_CSP 37

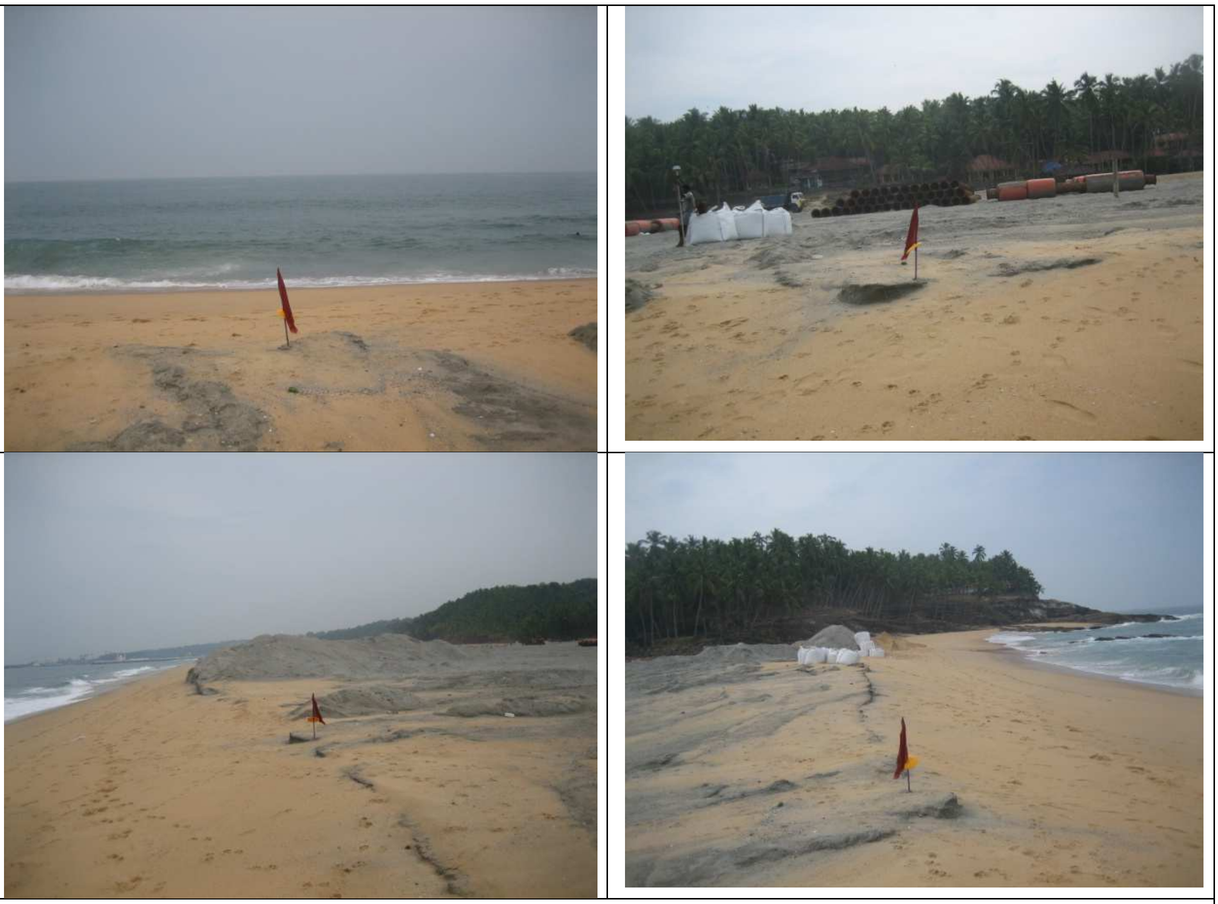


Figure 38:- May_CSP 38

Figure 39:- May_CSP 39

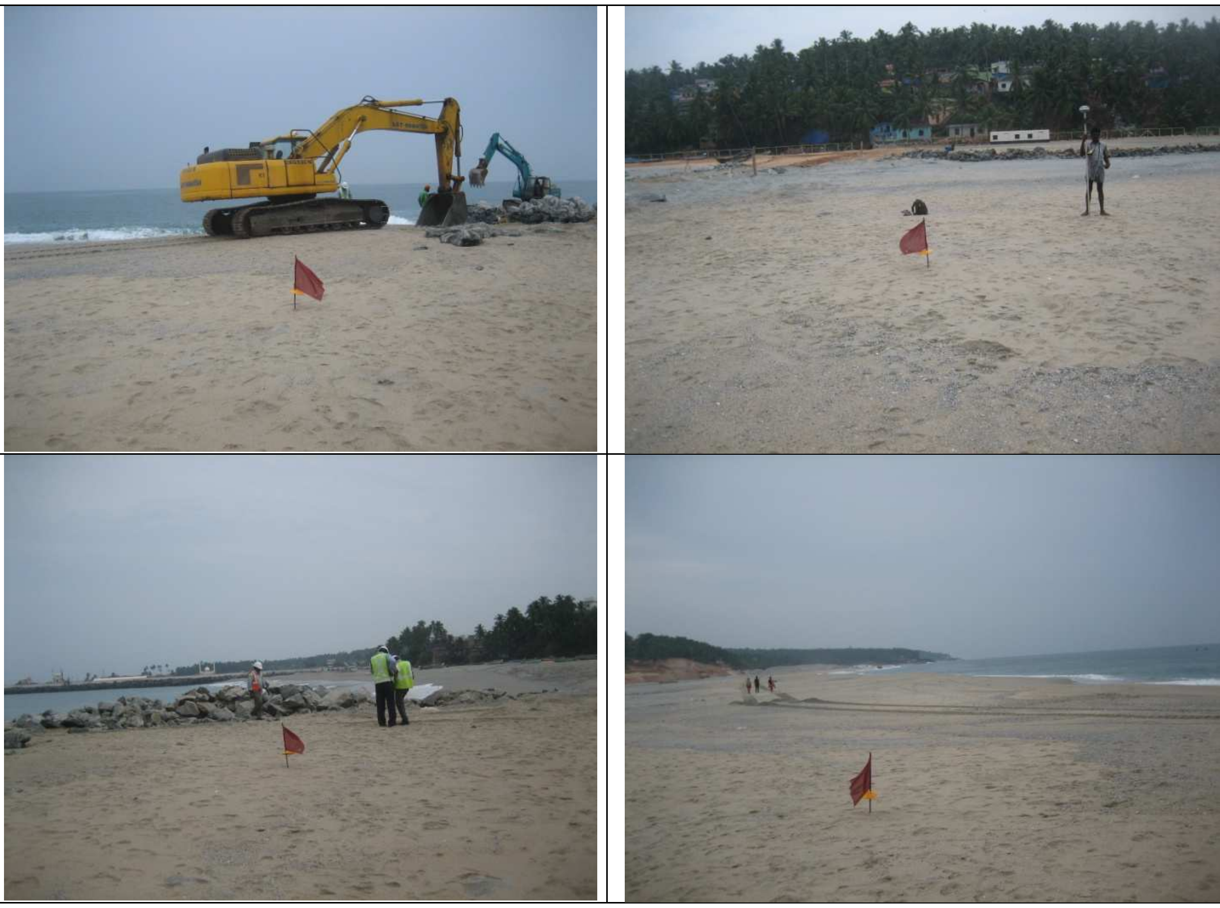


Figure 40:- May_CSP 40

Figure 41:- May_CSP 41

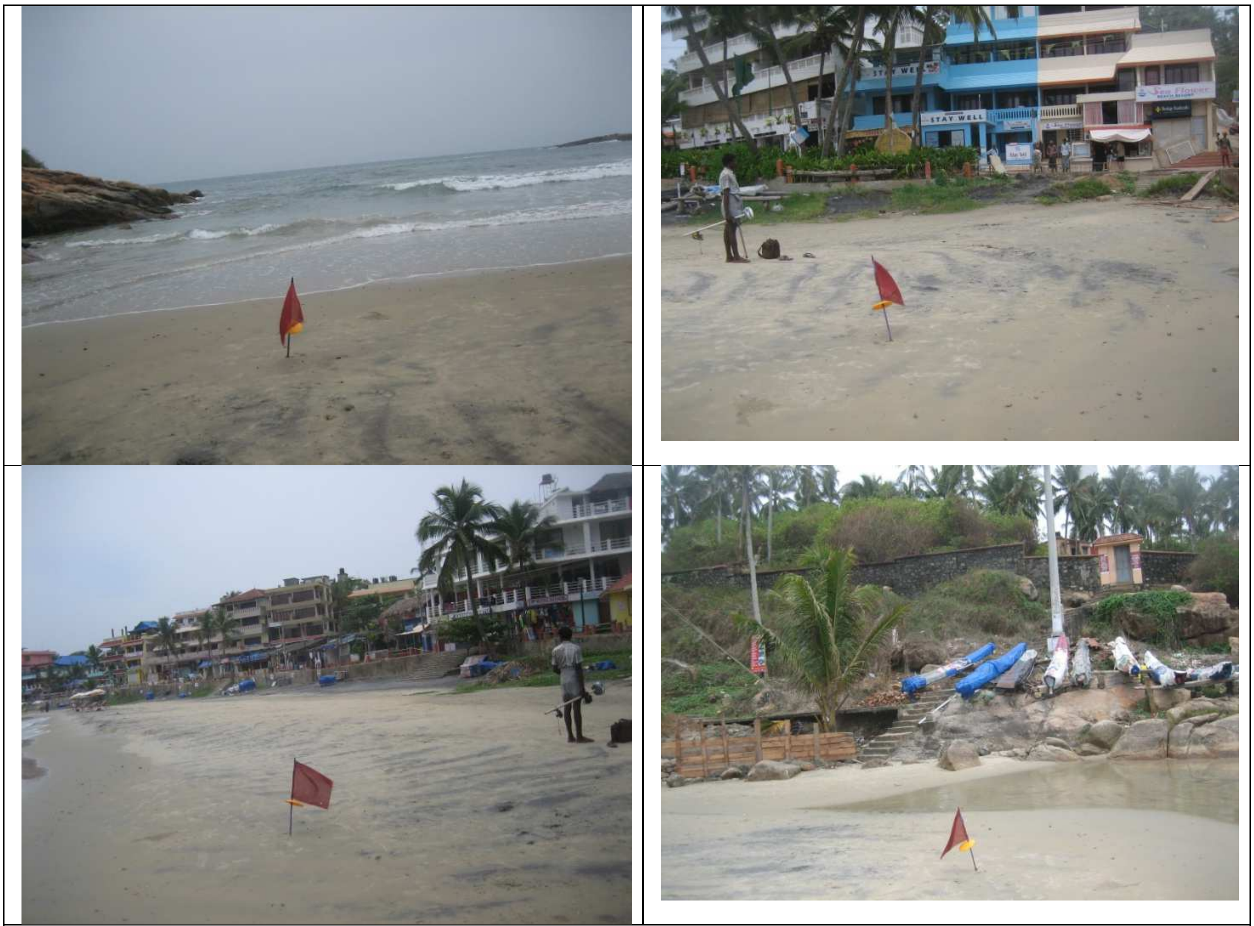


Figure 42:- May_CSP 42

Figure 43:- May_CSP 43

Figure 44:- May_CSP 44

Figure 45:- May_CSP 45

Figure 46:- May_CSP 46

Figure 47:- May_CSP 47

Figure 48:- May_CSP 48

Figure 49:- May_CSP 49

Figure 50:- May_CSP 50

Figure 51:- May_CSP 51

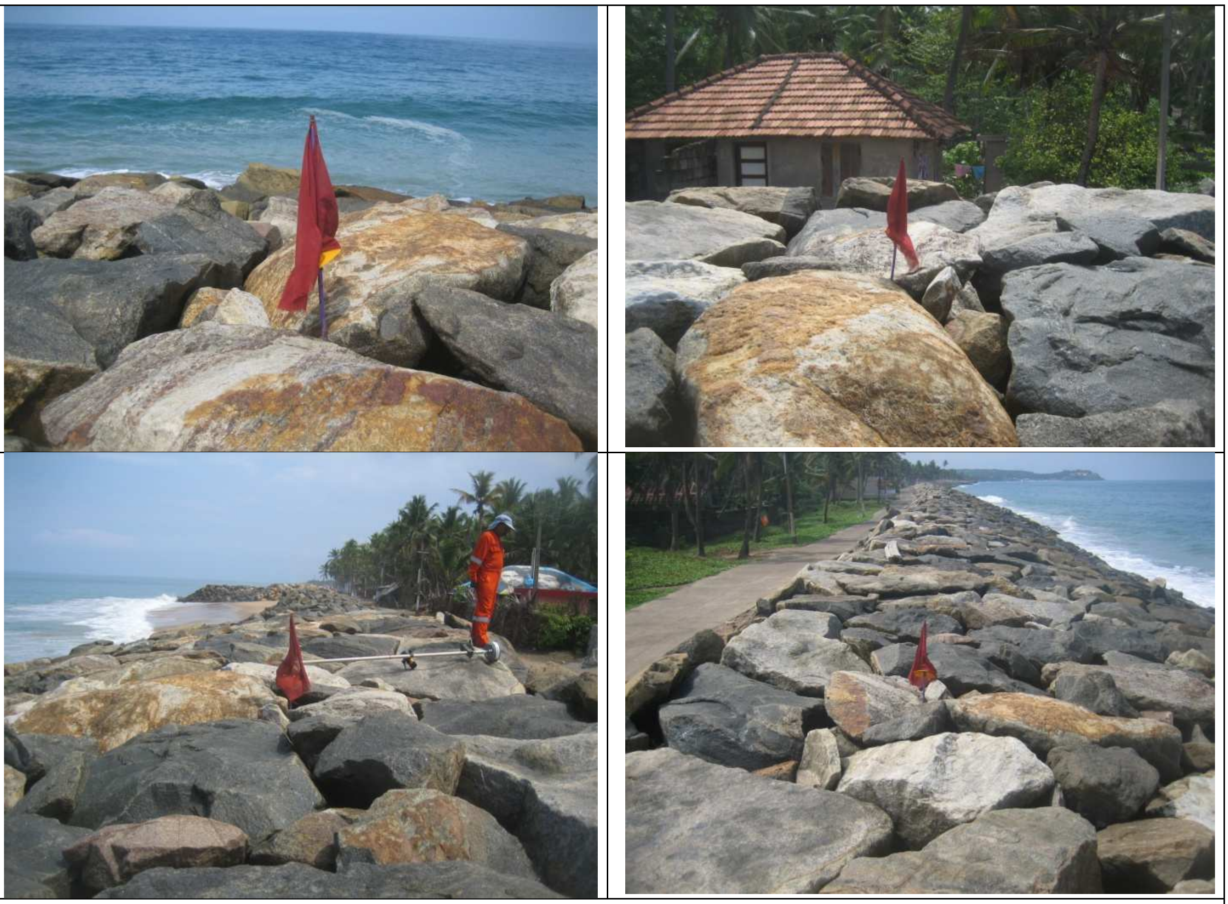


Figure 52:- May_CSP 52

Figure 53:- May_CSP 53

Figure 54:- May_CSP 54

Figure 55:- May_CSP 55

Figure 56:- May_CSP 56

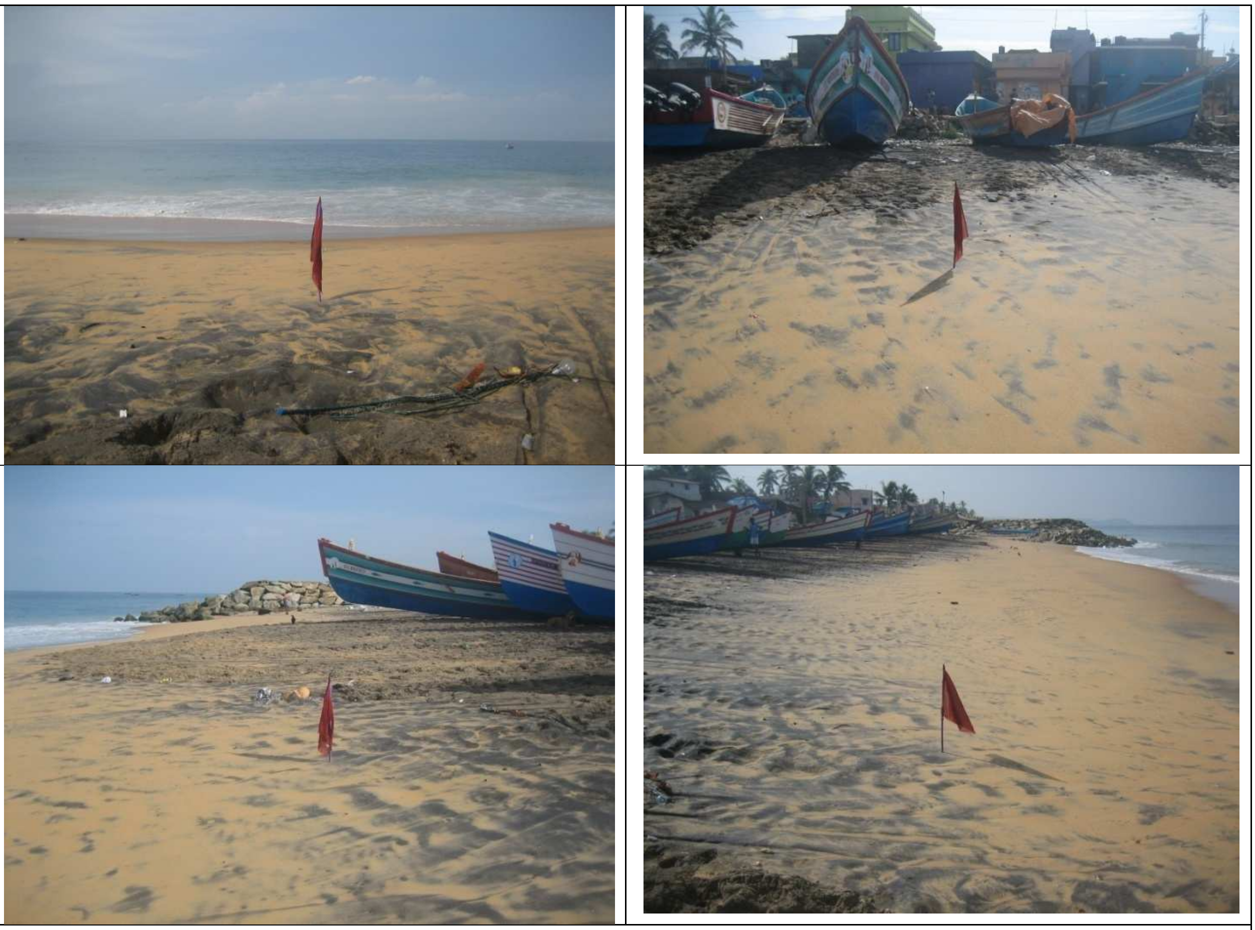


Figure 57:- May_CSP 57

Figure 58:- May_CSP 58

Figure 59:- May_CSP 59

Figure 60:- May_CSP 60

Figure 61:- May_CSP 61

Figure 62:- May_CSP 62

Figure 63:- May_CSP 63

Figure 64:- May_CSP 64

Figure 65:- May_CSP 65

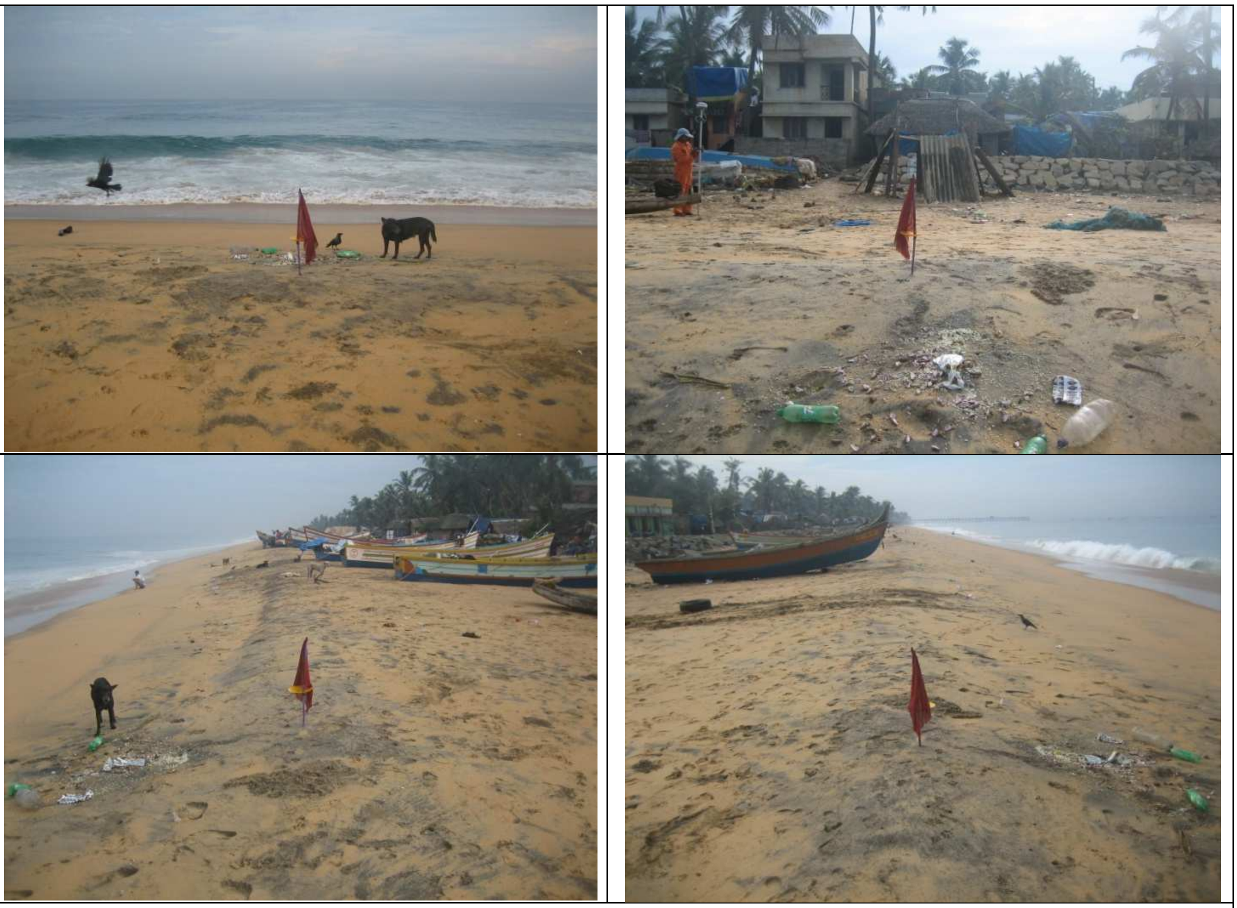


Figure 66:- May_CSP 66


Figure 67:- May_CSP 67

Figure 68:- May_CSP 68

Figure 69:- May_CSP 69

Figure 70:- May_CSP 70

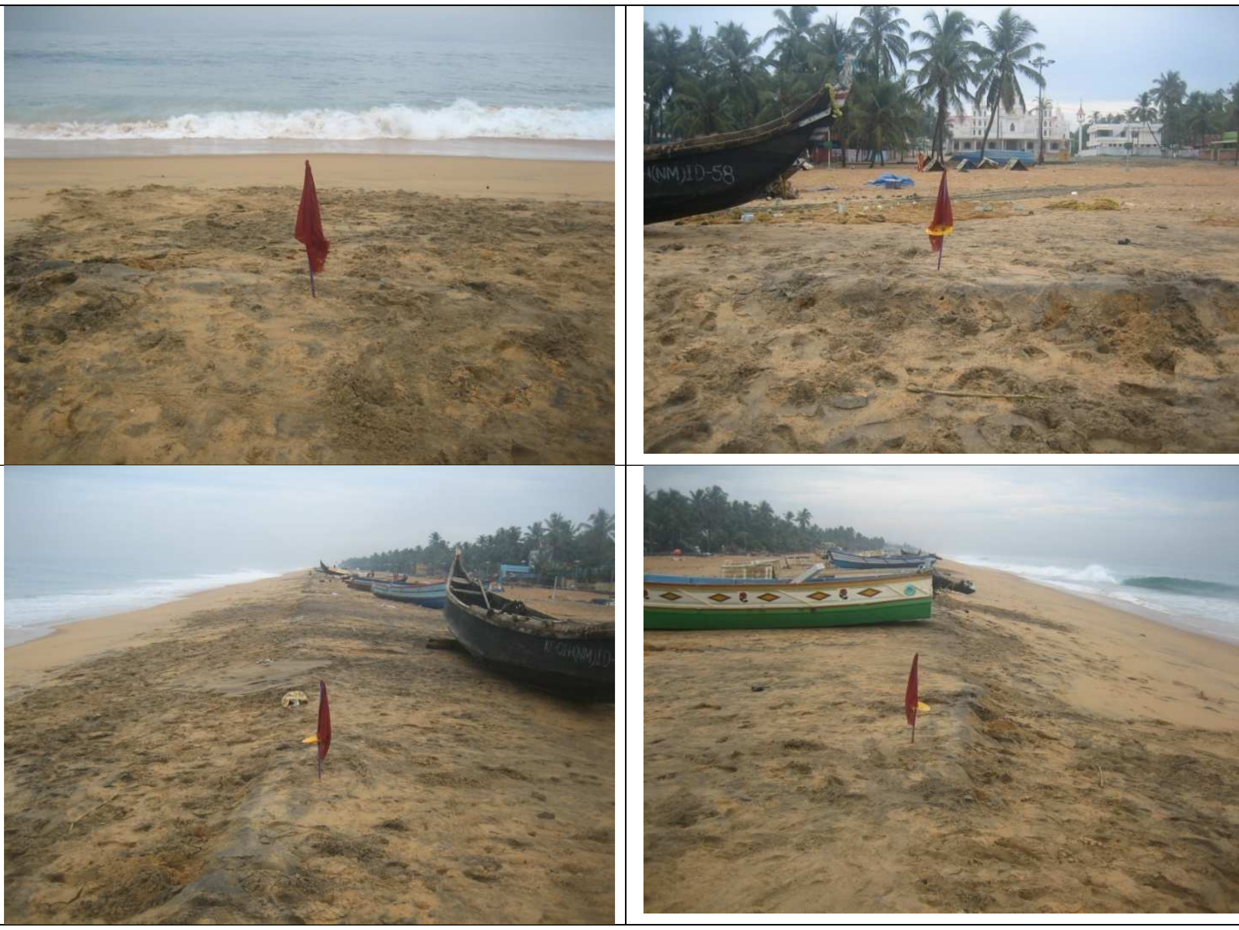


Figure 71:- May_CSP 71

Figure 72:- May_CSP 72

Figure 73:- May_CSP 73

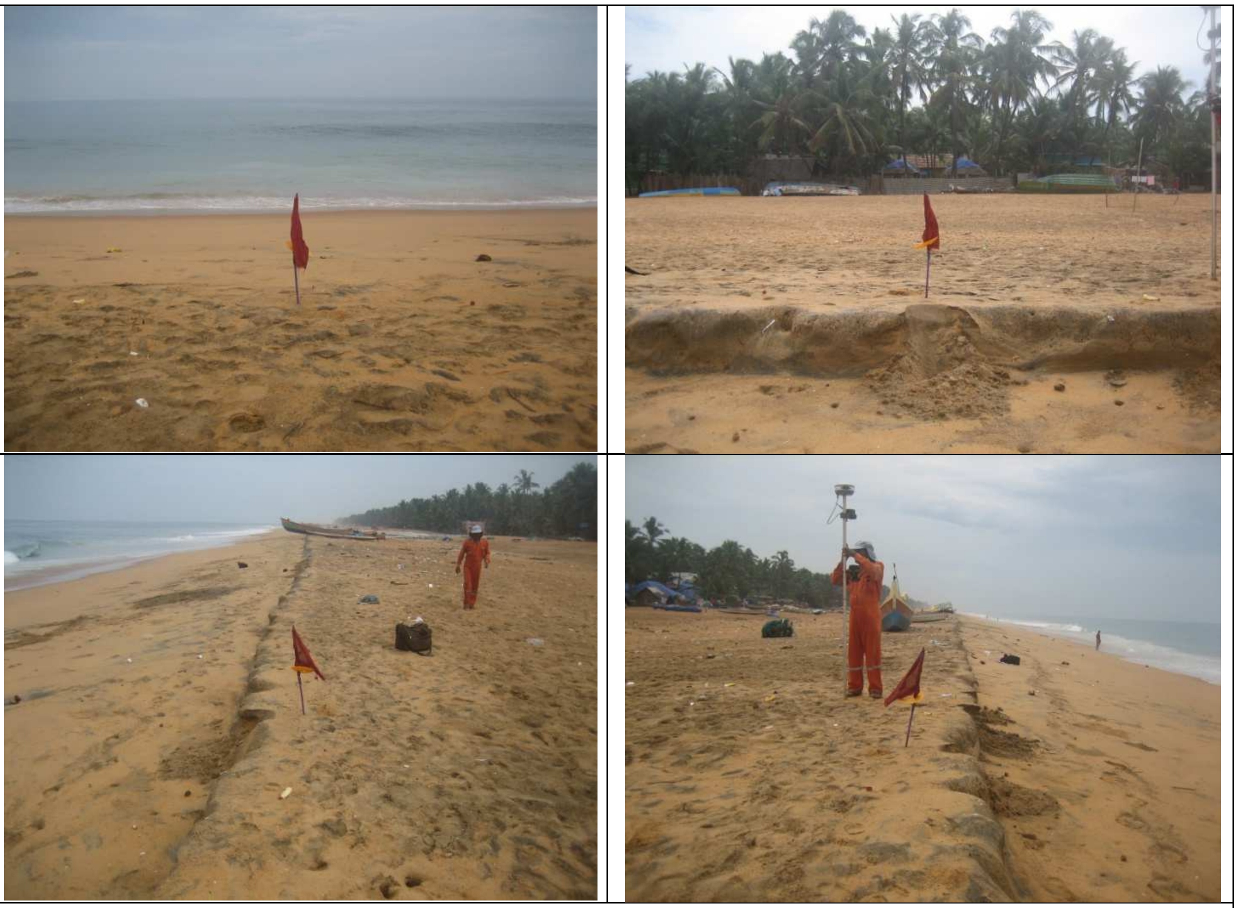


Figure 74:- May_CSP 74

Figure 75:- May_CSP 75

Figure 76:- May_CSP 76

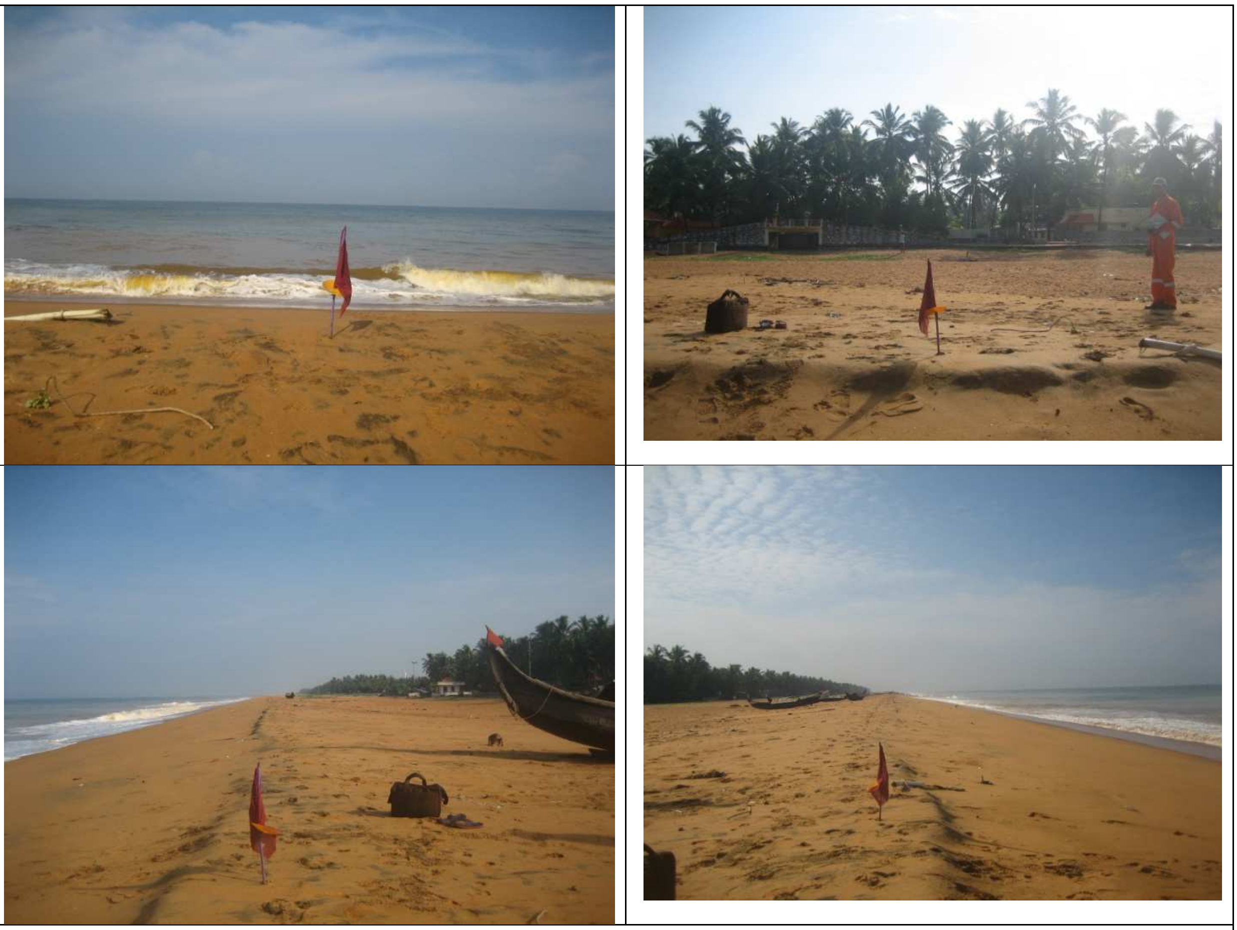


Figure 77:- May_CSP 77

Figure 78:- May_CSP 78

Figure 79:- May_CSP 79

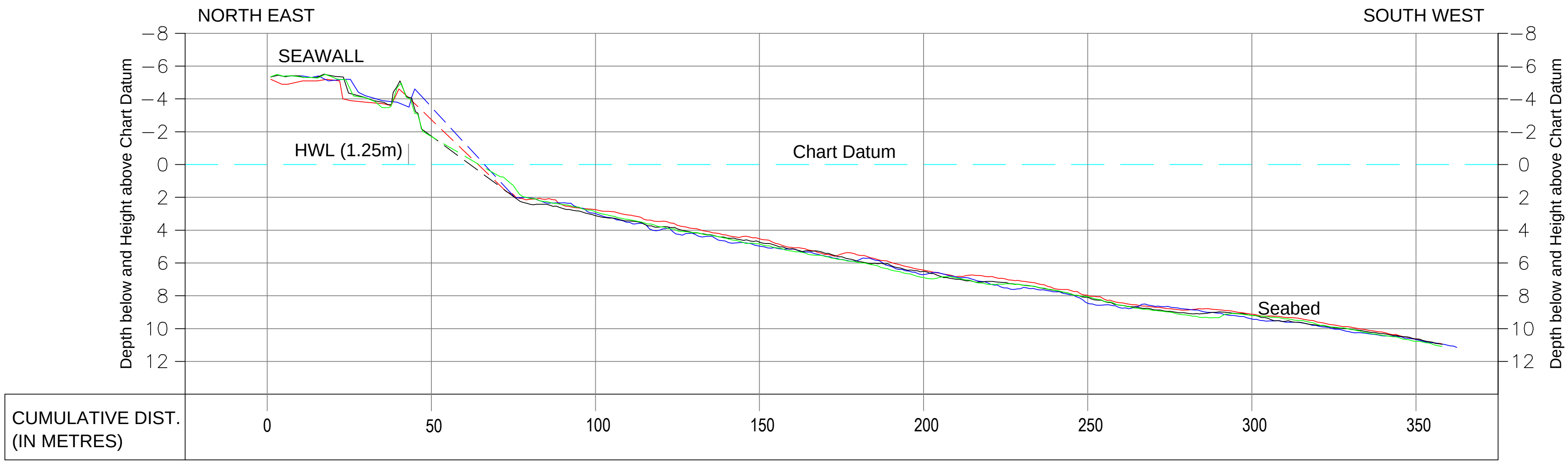
Figure 80:- May_CSP 80

Figure 81:- May_CSP 81

Annexure VII

Cross Section Profiles

Cross Section Line No.CSP-01
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

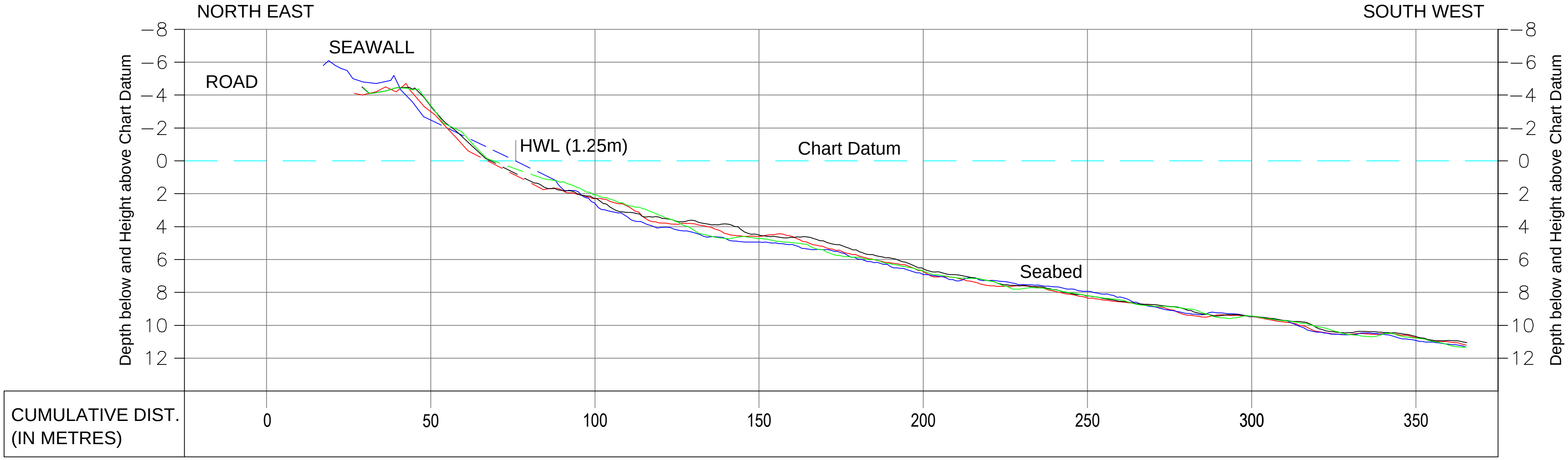
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-02

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

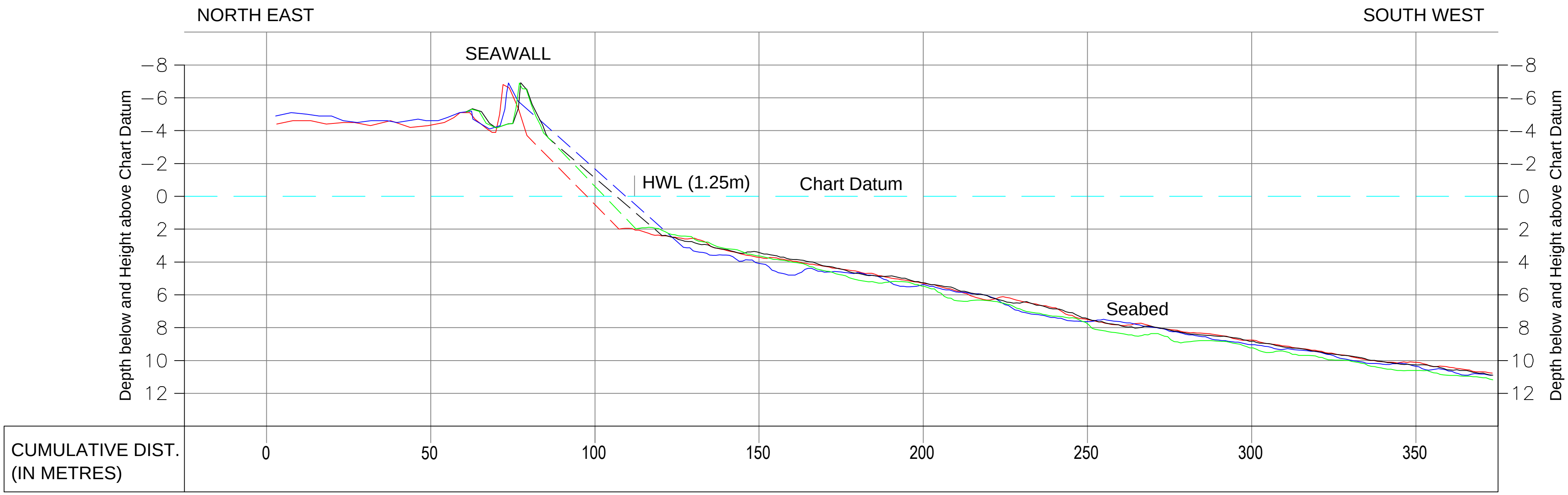
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-03

(February, March, April, May 2016)



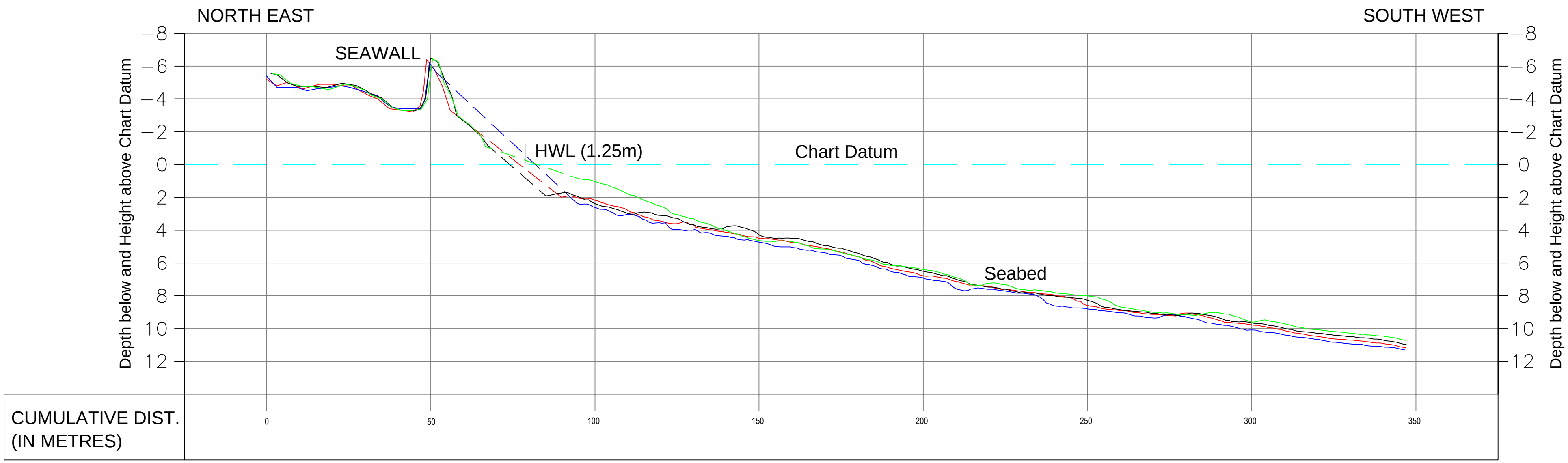
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-04
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

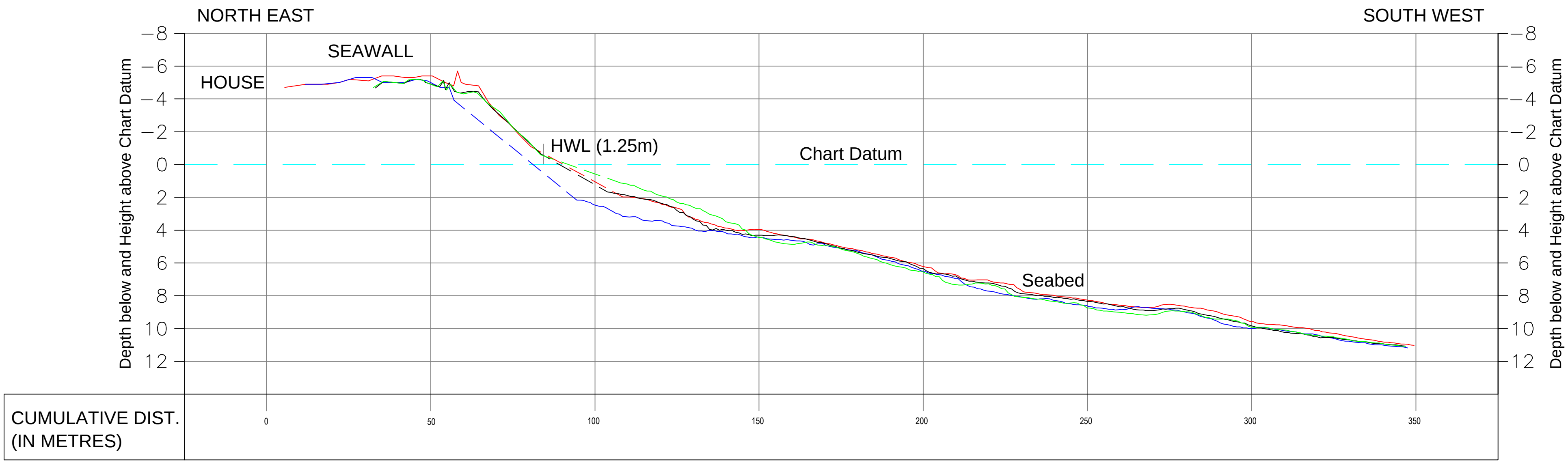
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-05

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

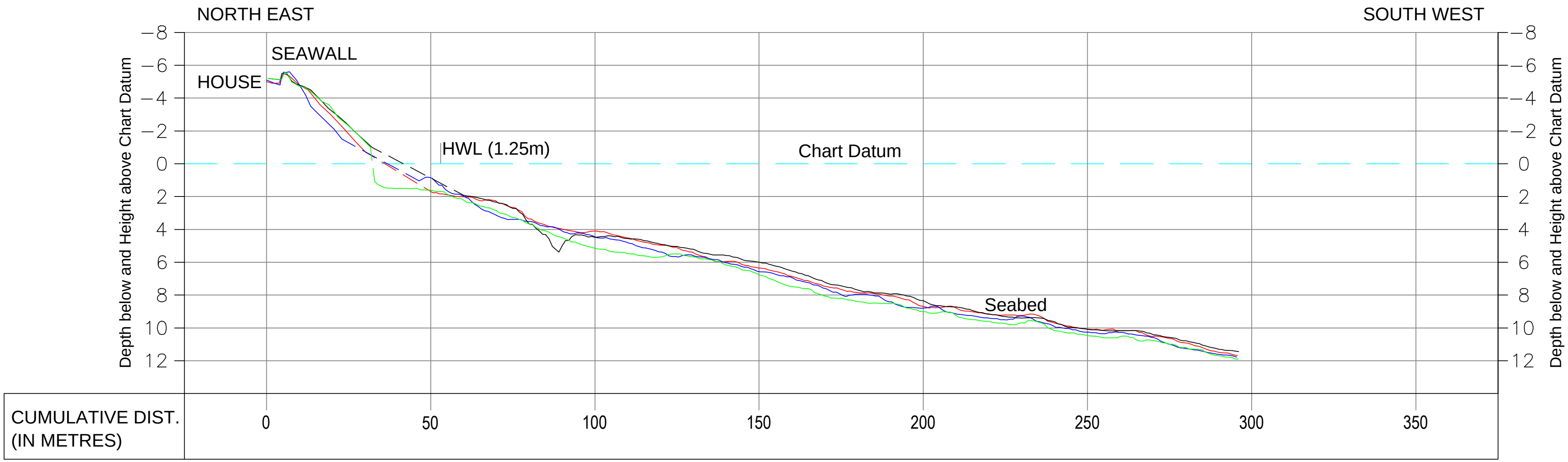
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-06

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

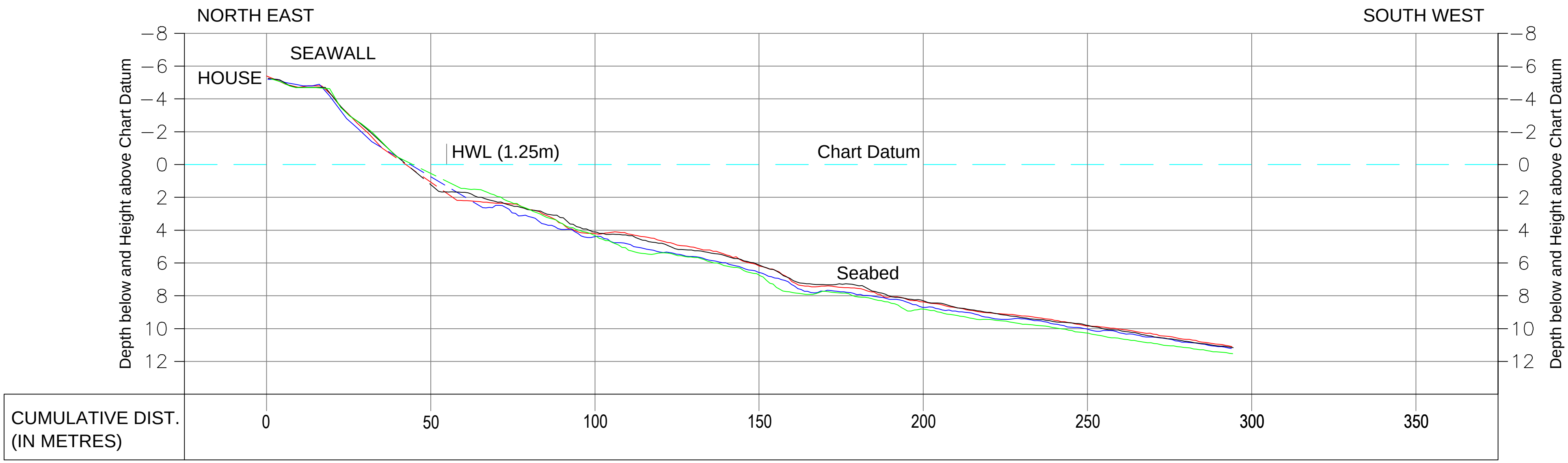
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-07
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

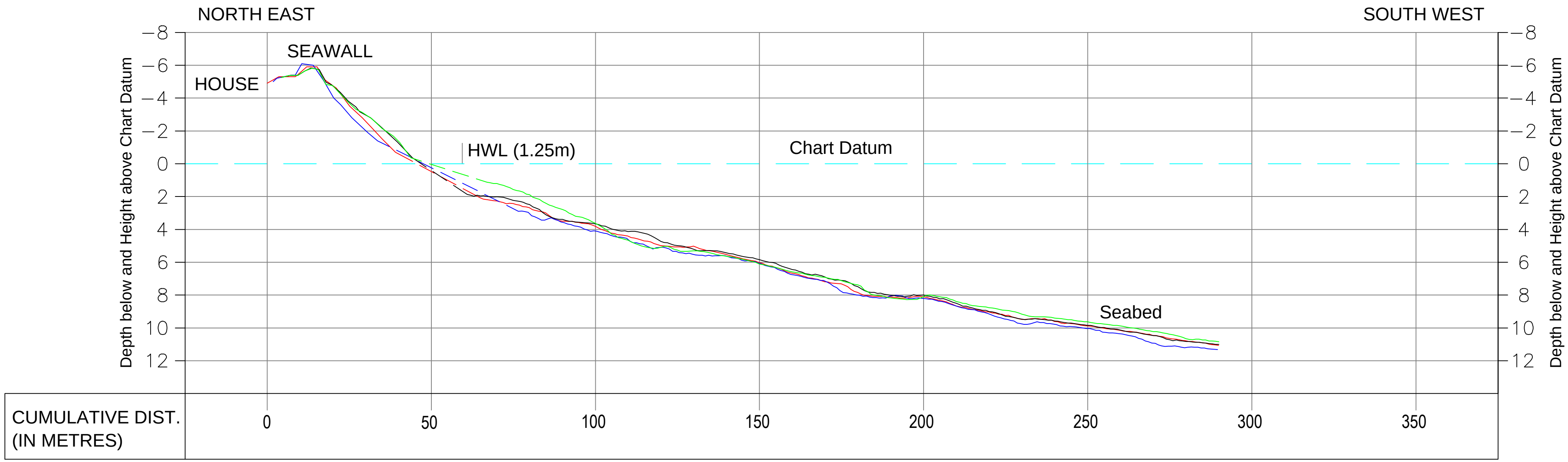
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-08
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

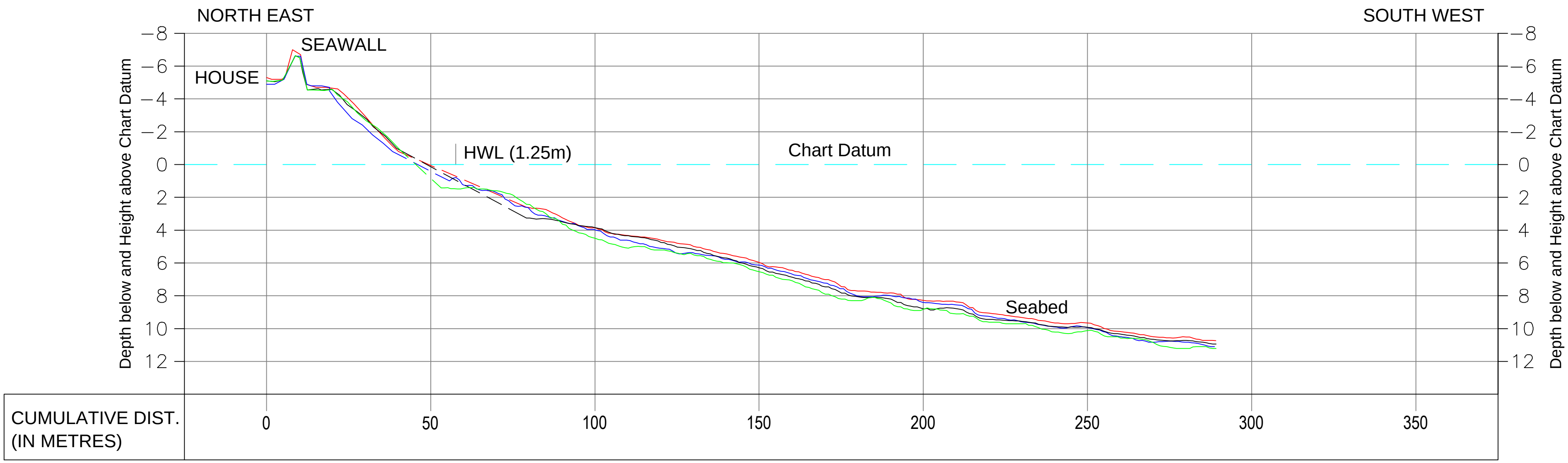
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-09
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

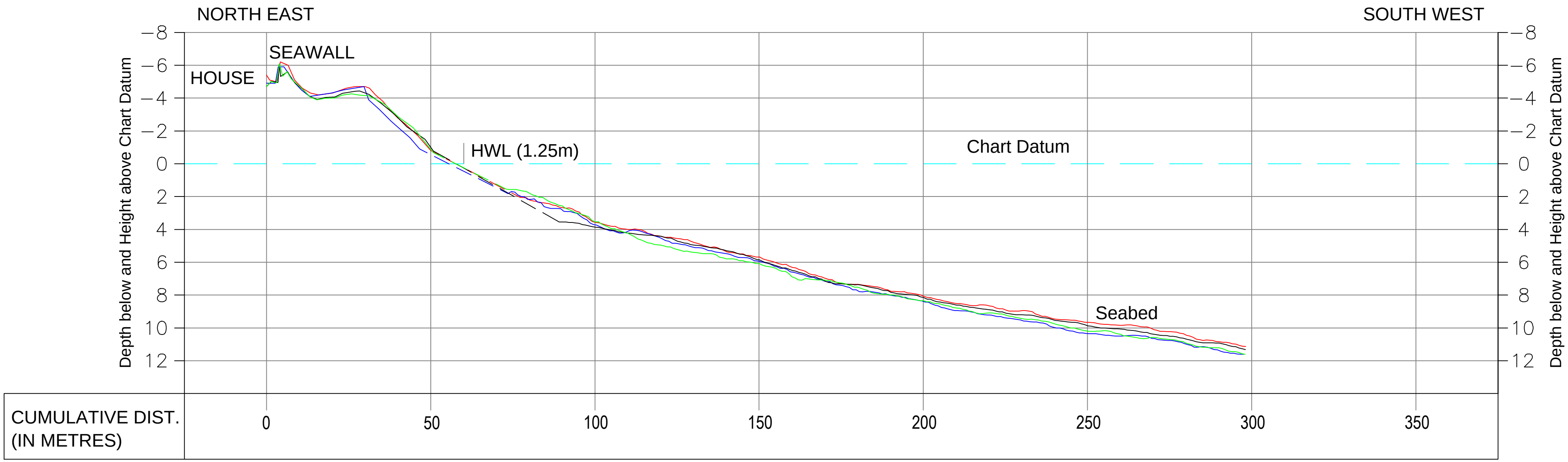
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-10
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

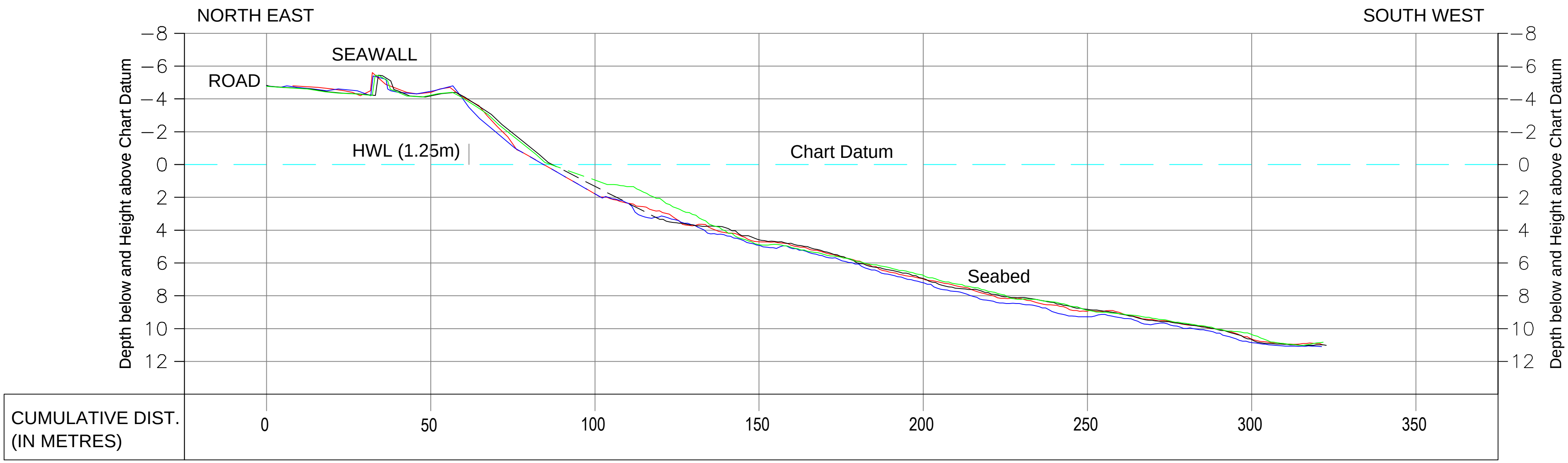
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-11

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

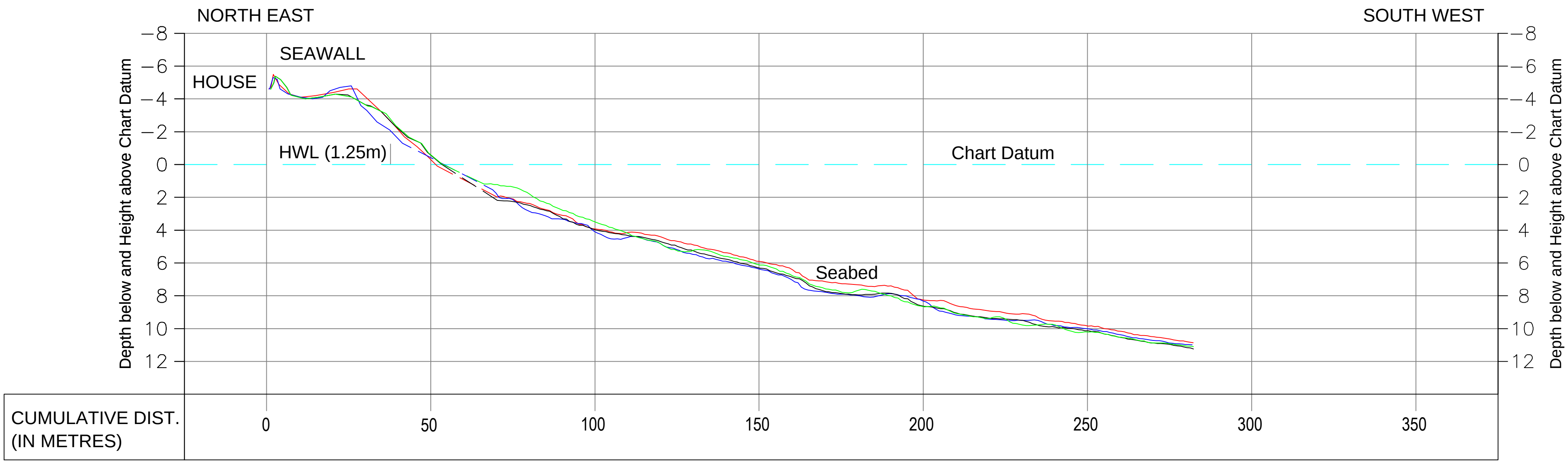
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-12

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

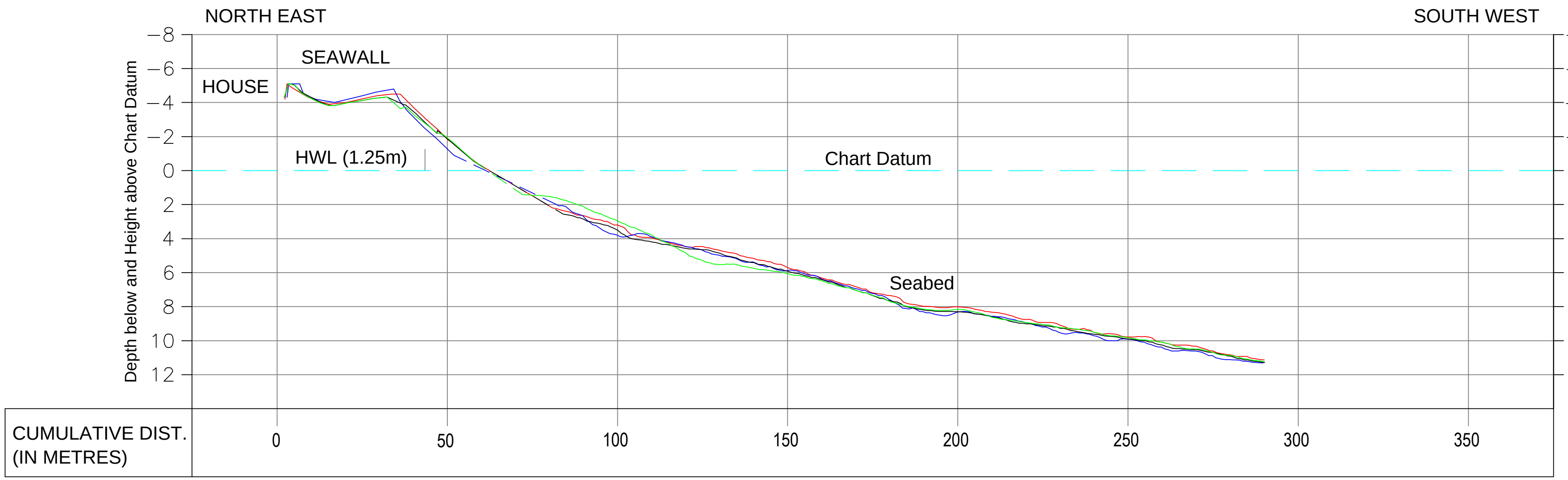
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-13

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

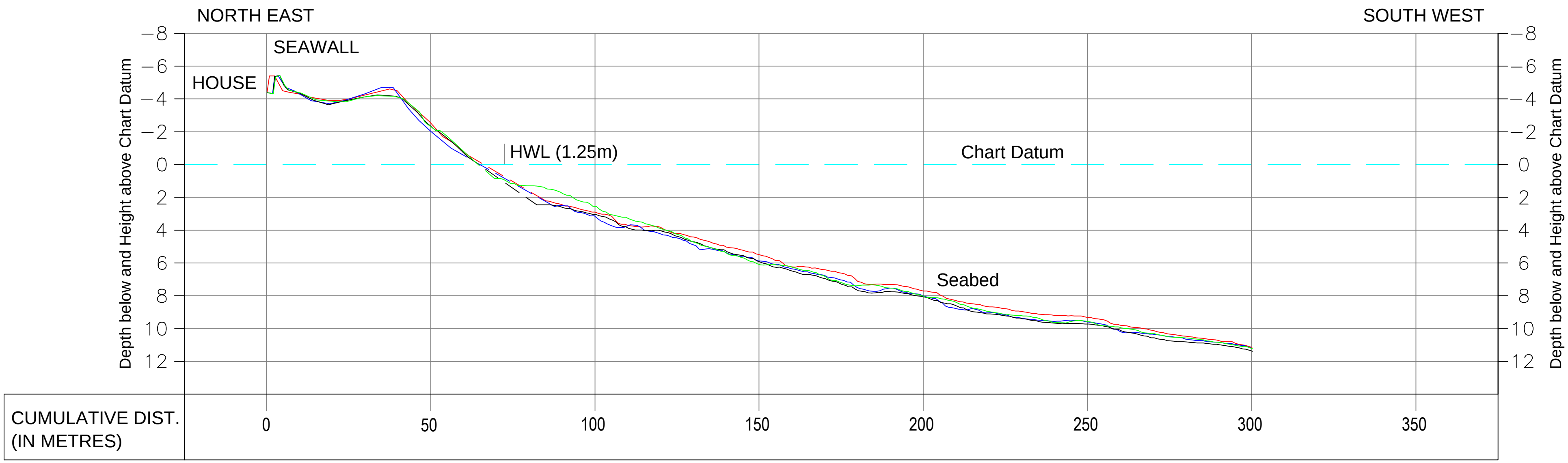
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-14

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

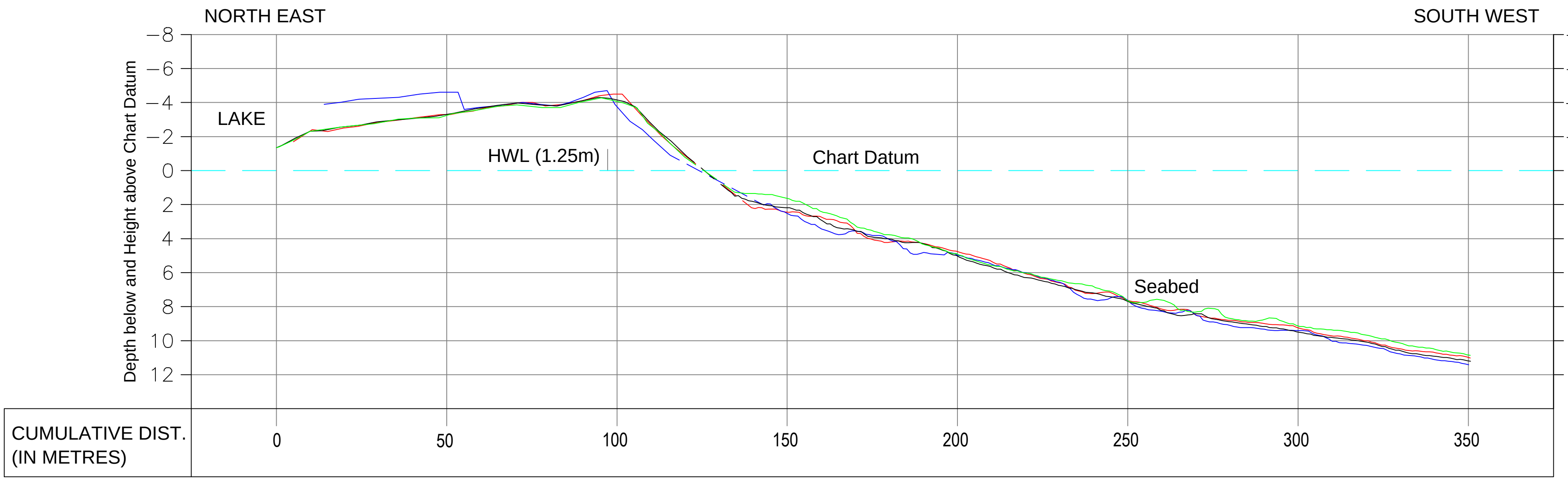
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-15

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

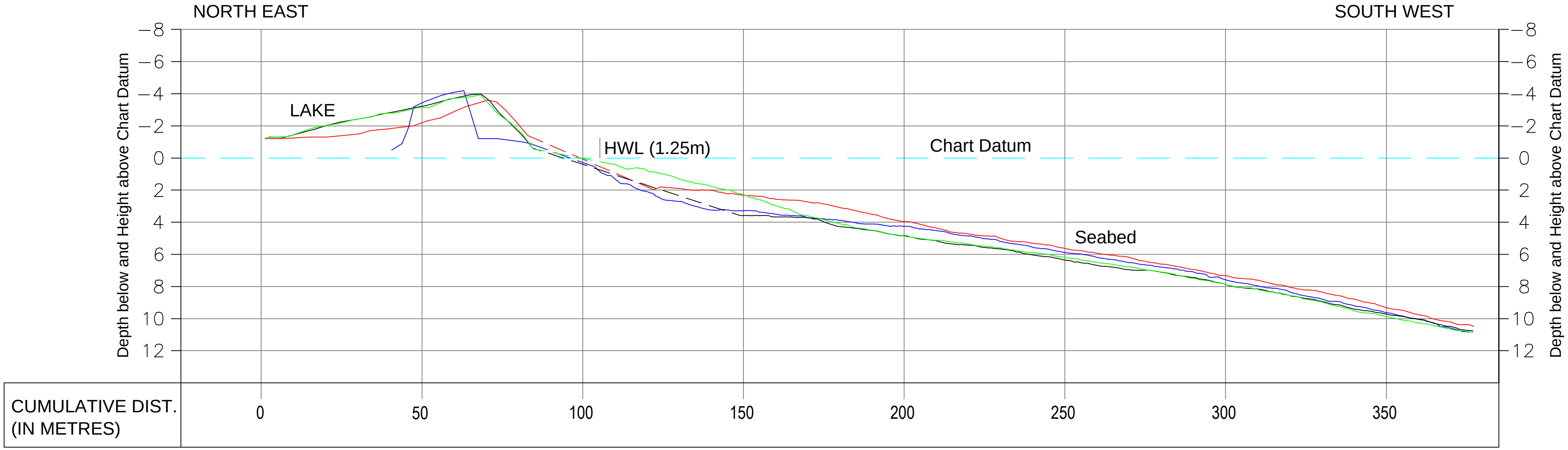
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-16

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

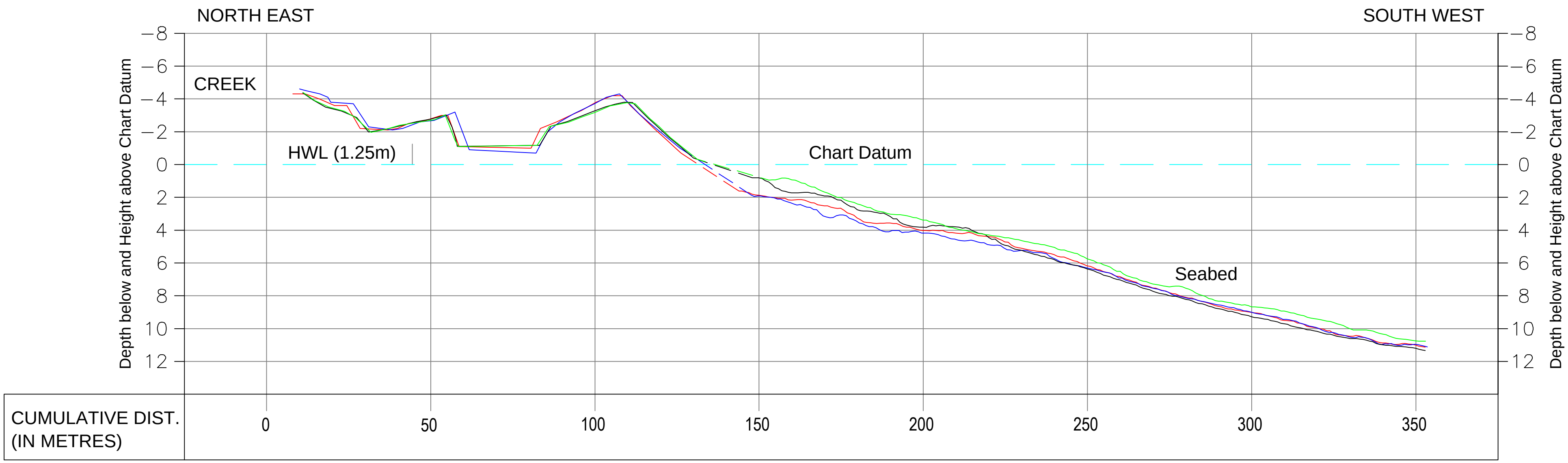
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-17

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

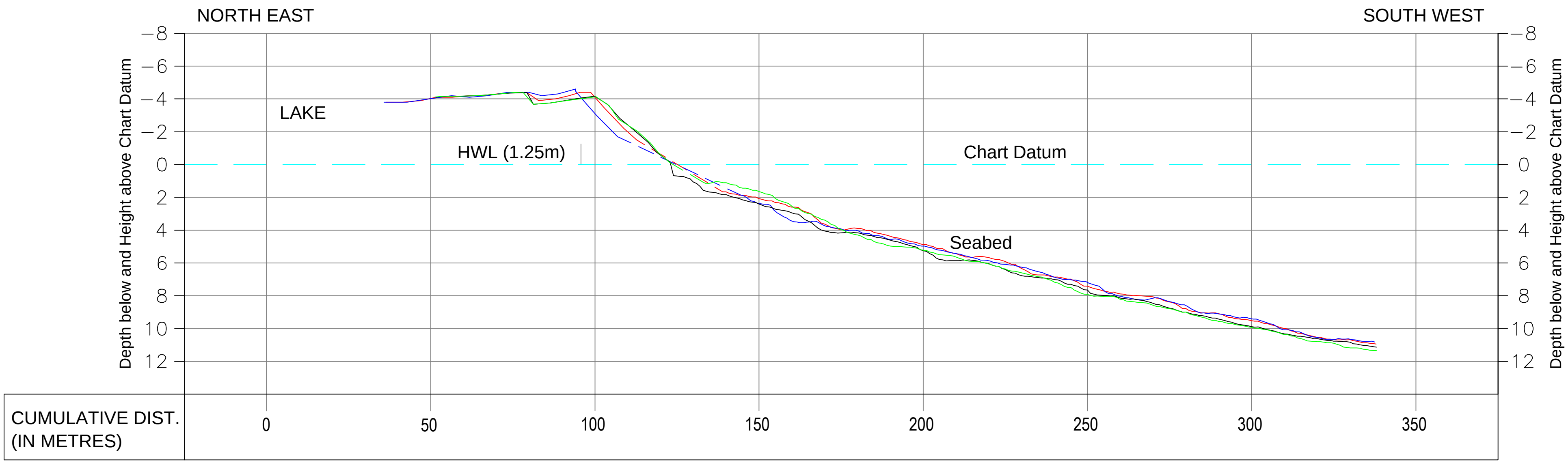
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-18

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

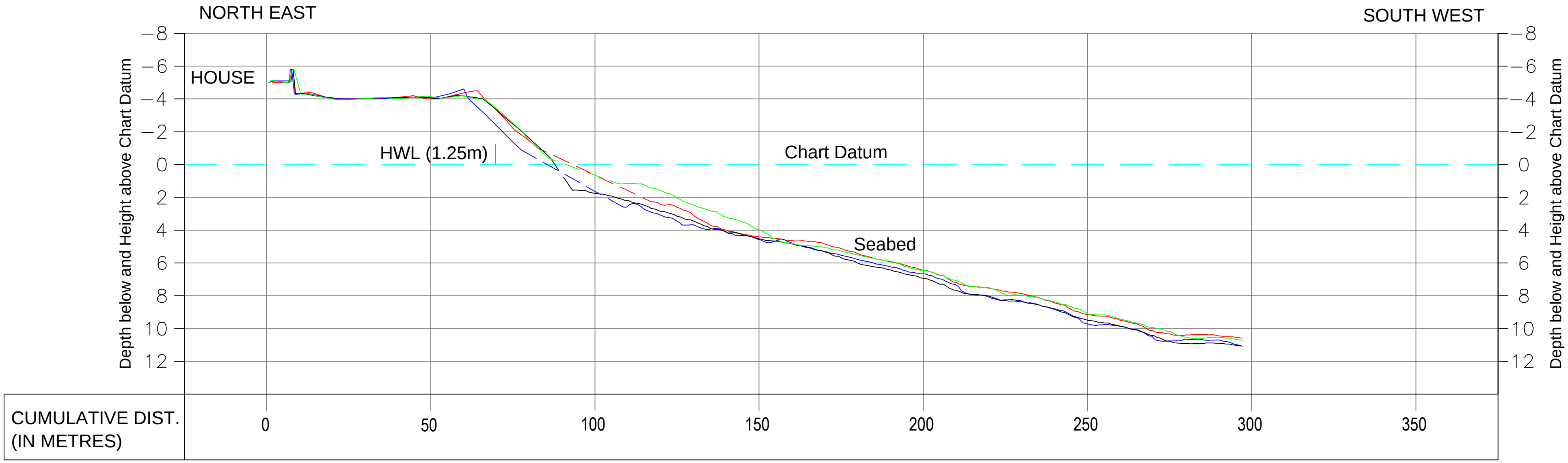
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-19

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

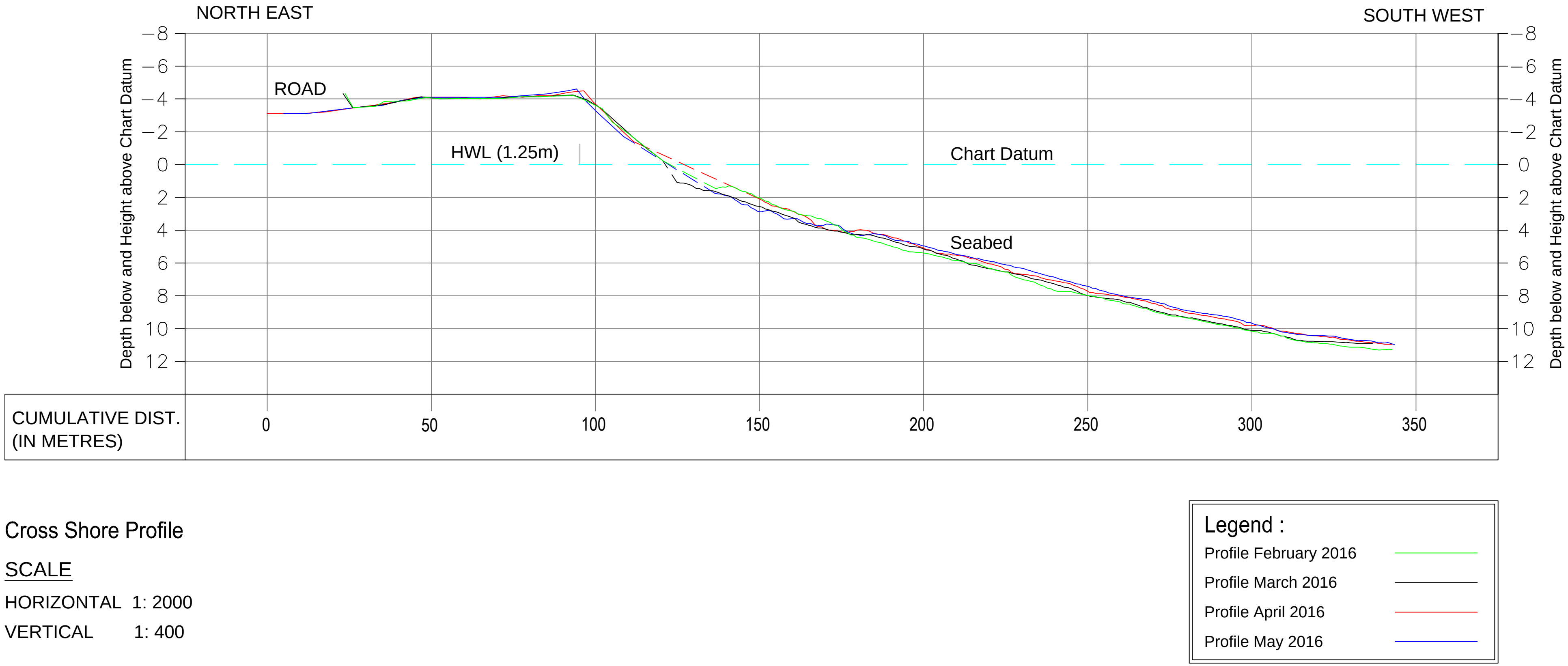
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-20

(February, March, April, May 2016)



Cross Shore Profile

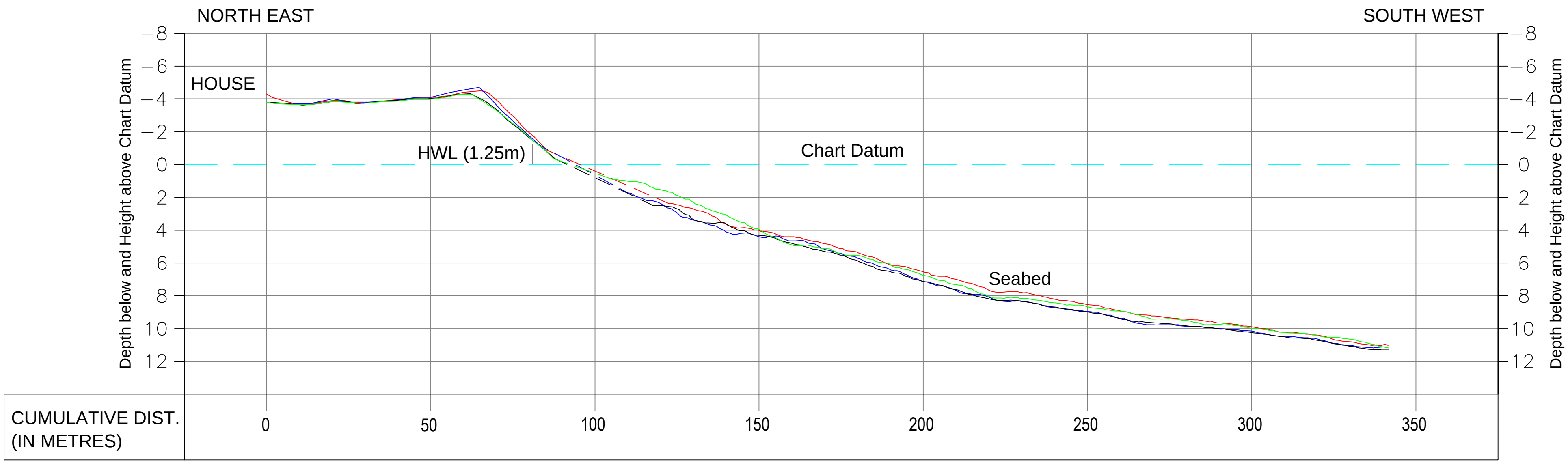
SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-21

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

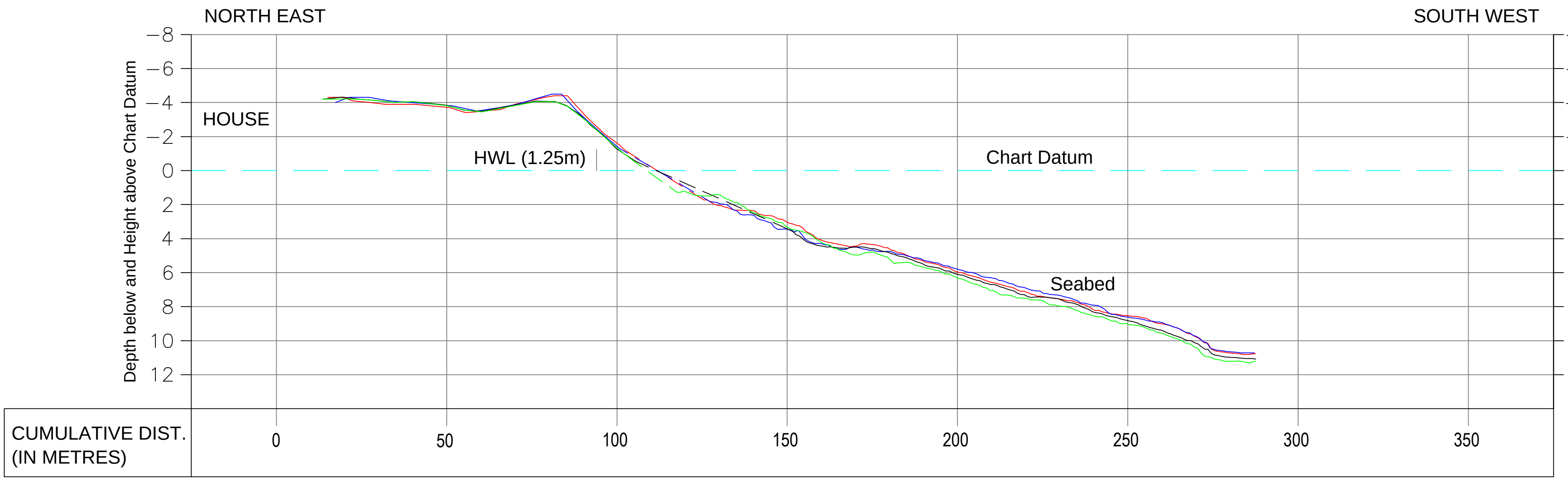
VERTICAL 1: 400

Legend :

- Profile February 2016
- Profile March 2016
- Profile April 2016
- Profile May 2016

Cross Section Line No.CSP-22

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

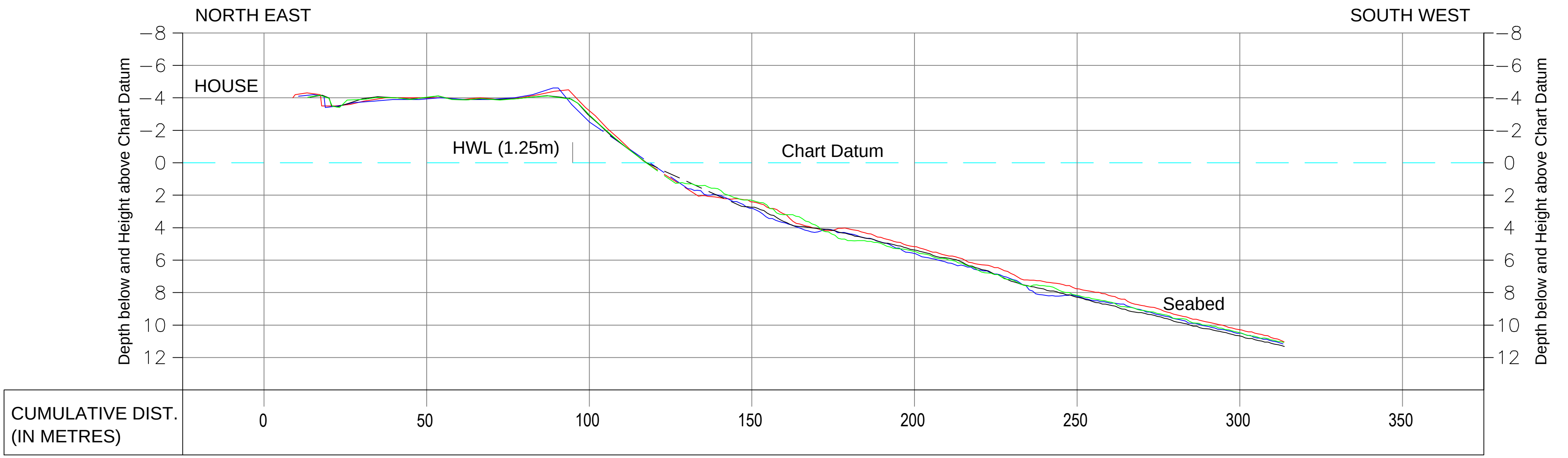
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-23

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

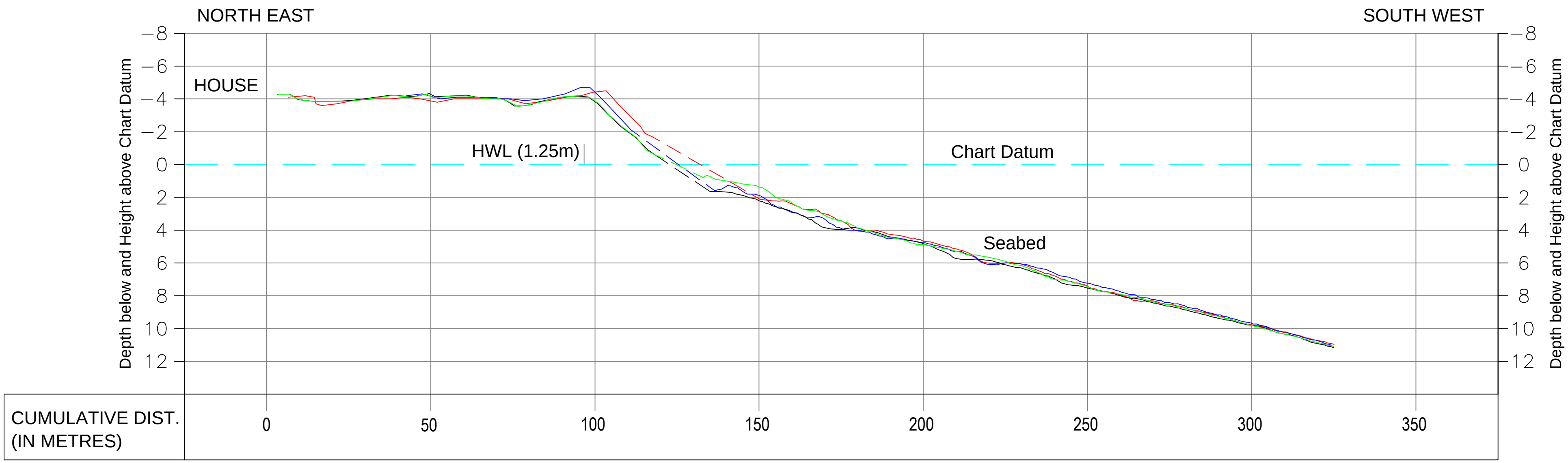
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-24

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

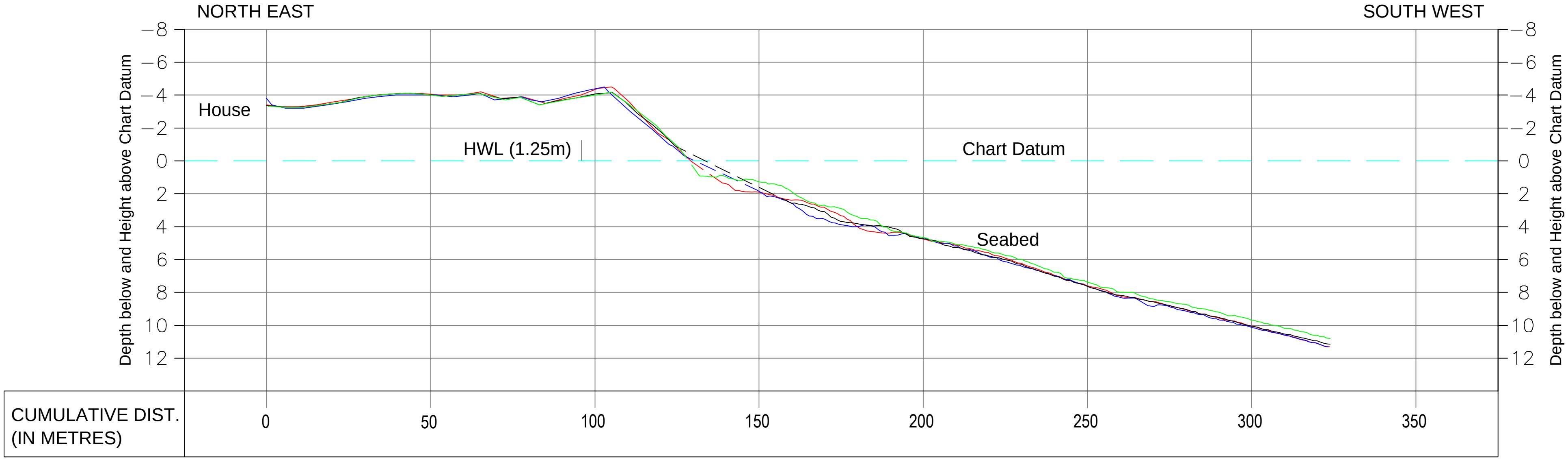
VERTICAL 1: 400

Legend :

- Profile February 2016
- Profile March 2016
- Profile April 2016
- Profile May 2016

Cross Section Line No.CSP-25

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

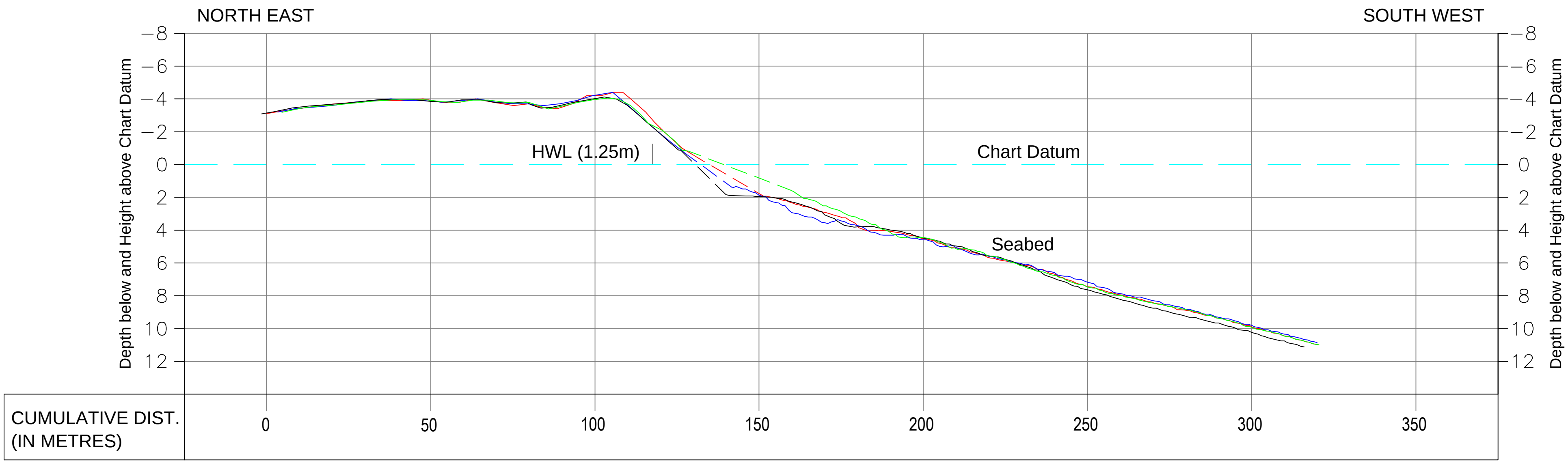
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-26

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

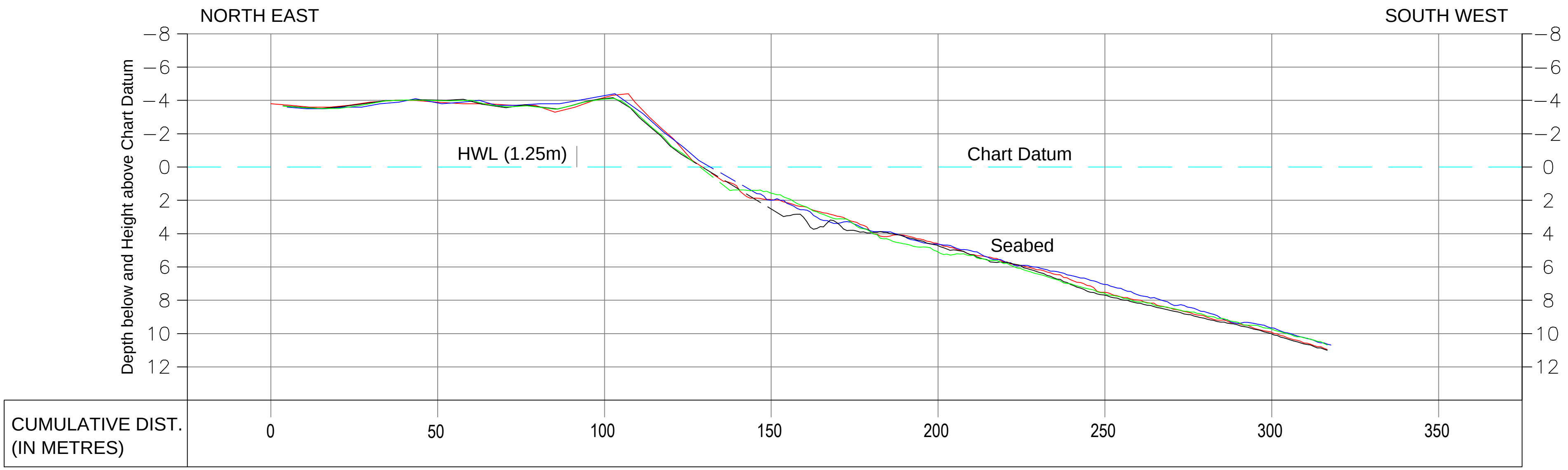
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-27
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

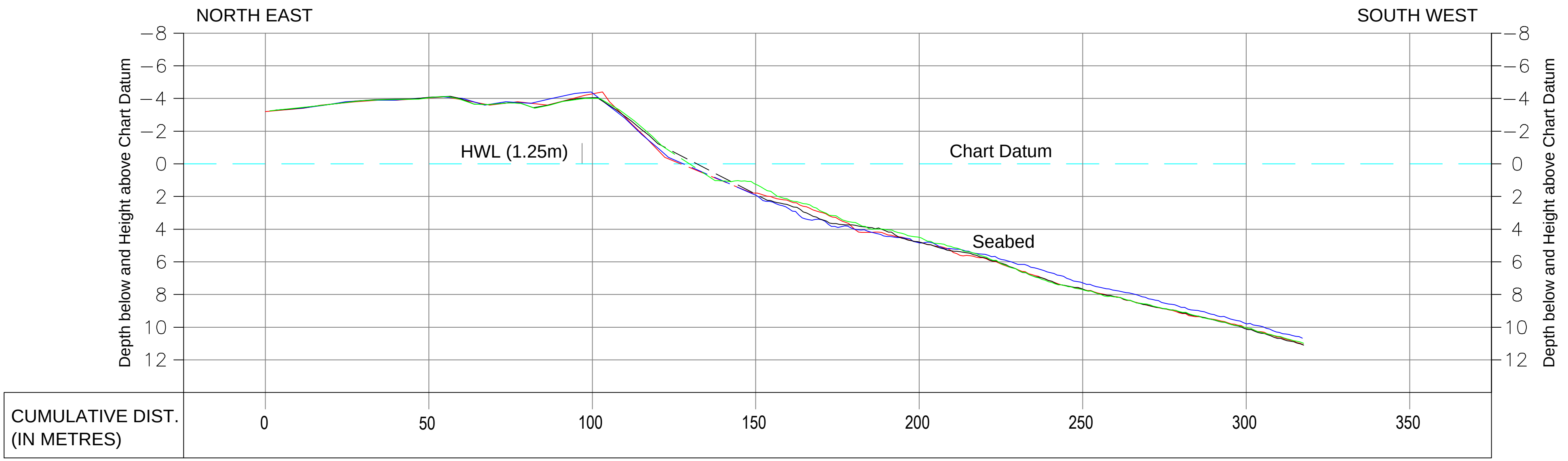
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-28

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

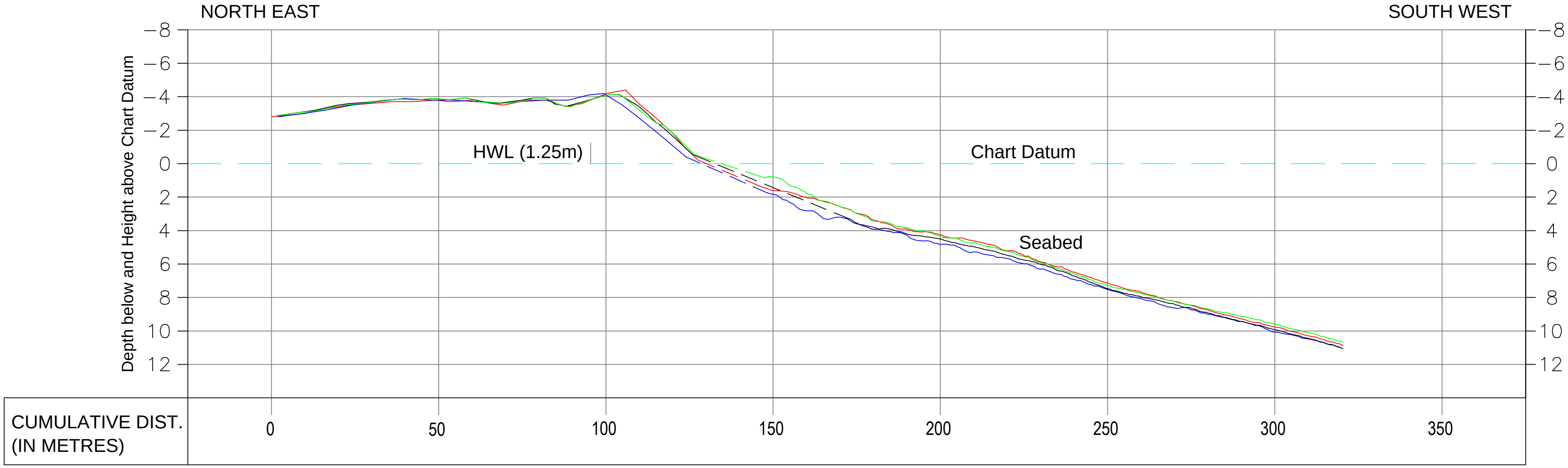
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-29

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

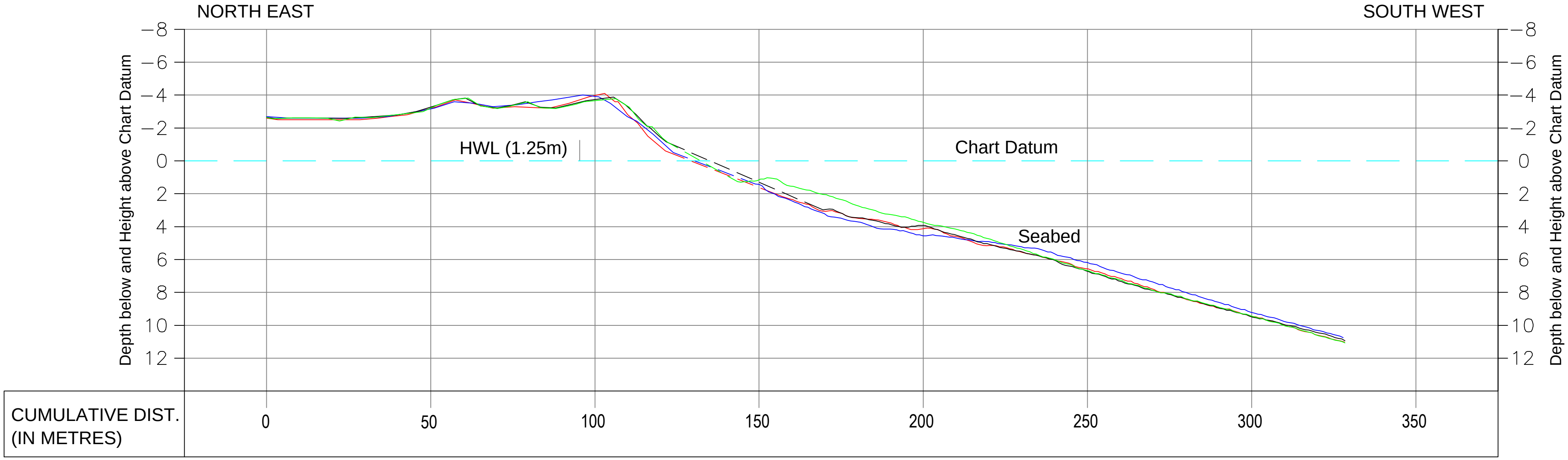
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-30

(February, March, April, May 2016)



Cross Shore Profile

SCALE

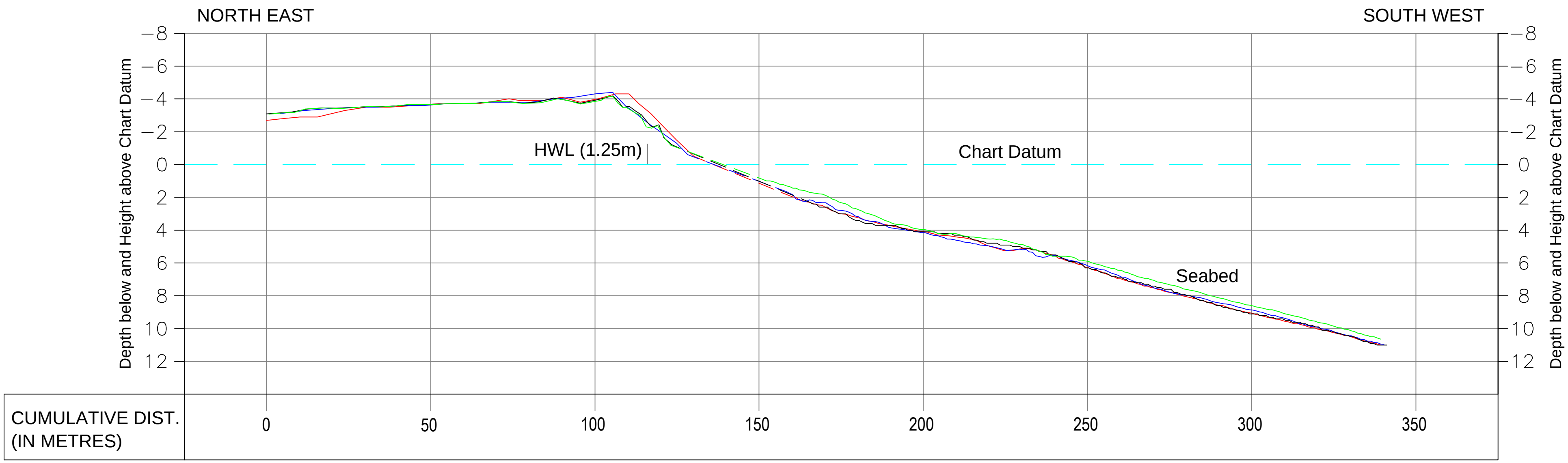
HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :	
Profile February 2016	
Profile March 2016	
Profile April 2016	
Profile May 2016	

Cross Section Line No.CSP-31

(February, March, April, May 2016)



Cross Shore Profile

SCALE

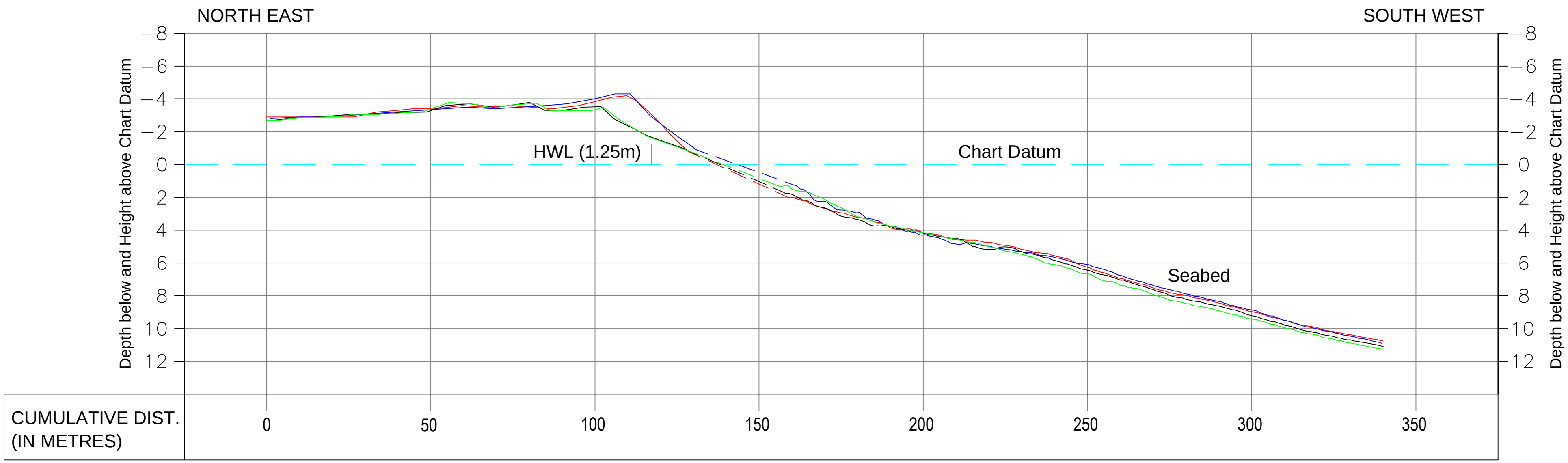
HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :	
Profile February 2016	green
Profile March 2016	black
Profile April 2016	red
Profile May 2016	blue

Cross Section Line No.CSP-32

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

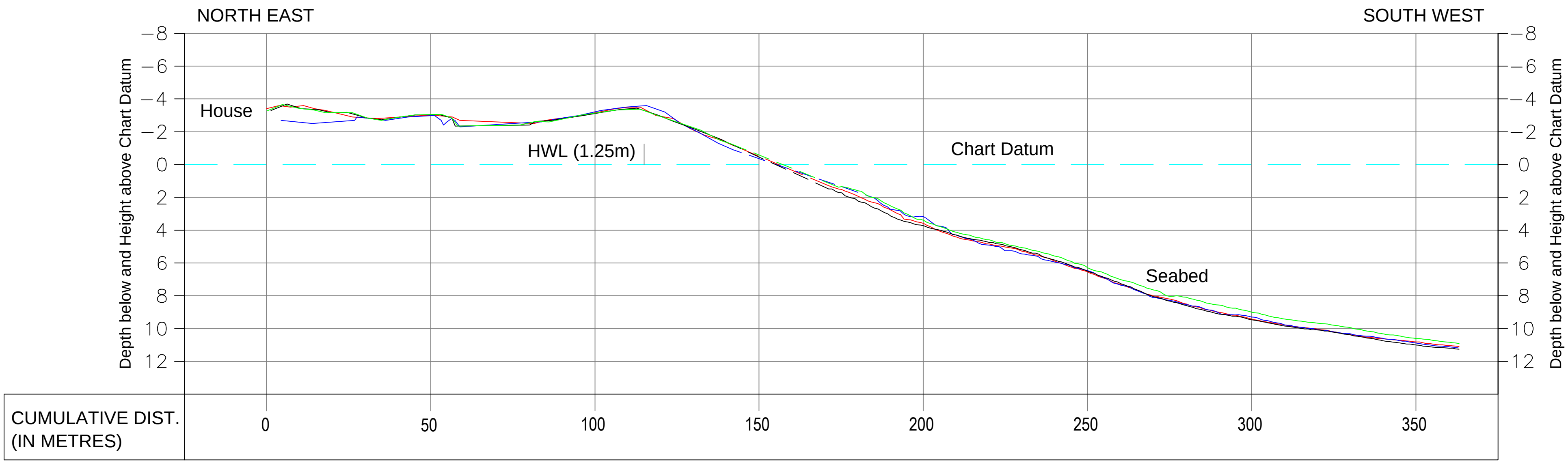
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-33

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

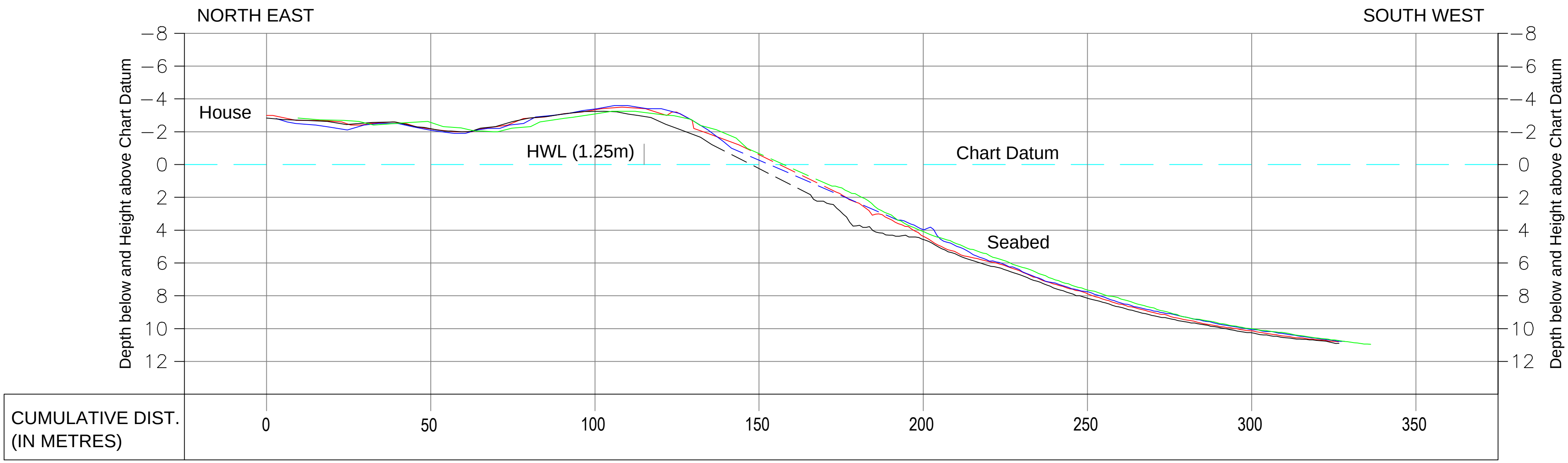
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-34

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

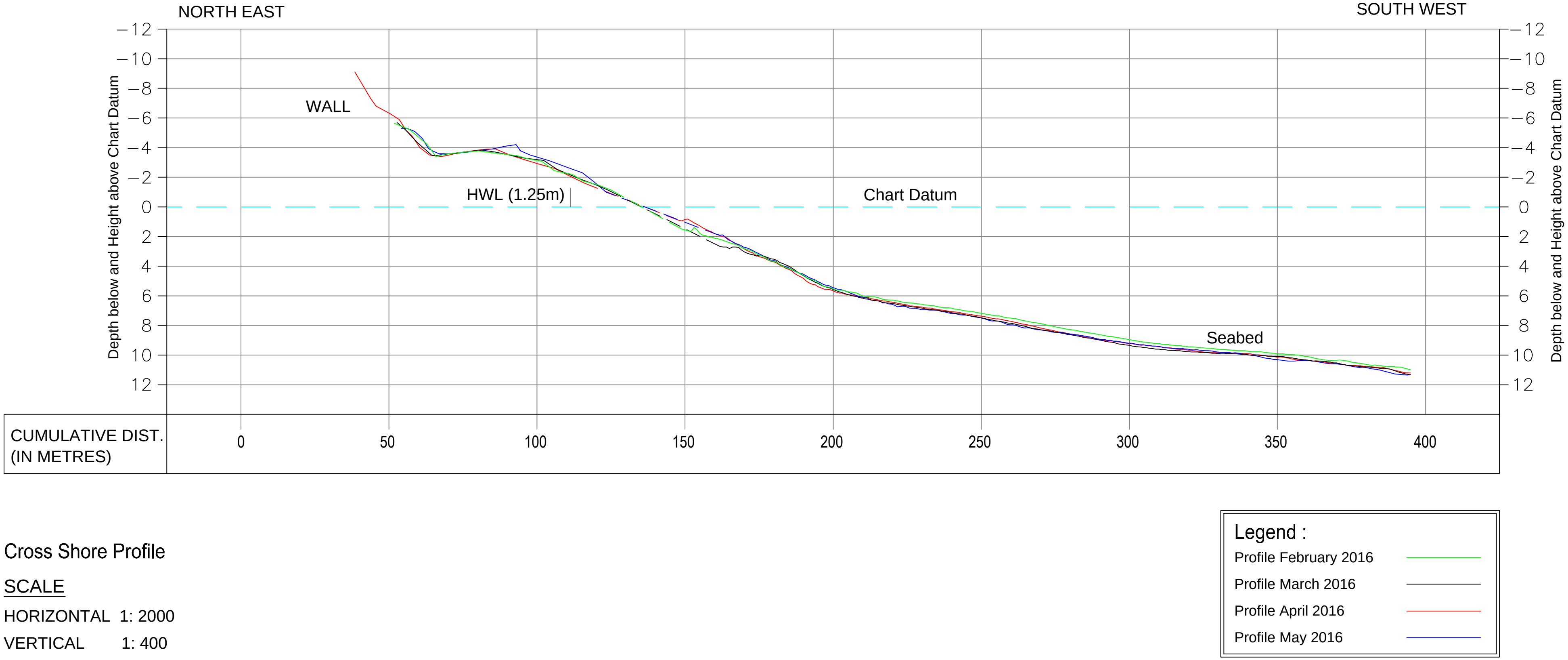
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-35
(February, March, April, May 2016)



Cross Shore Profile

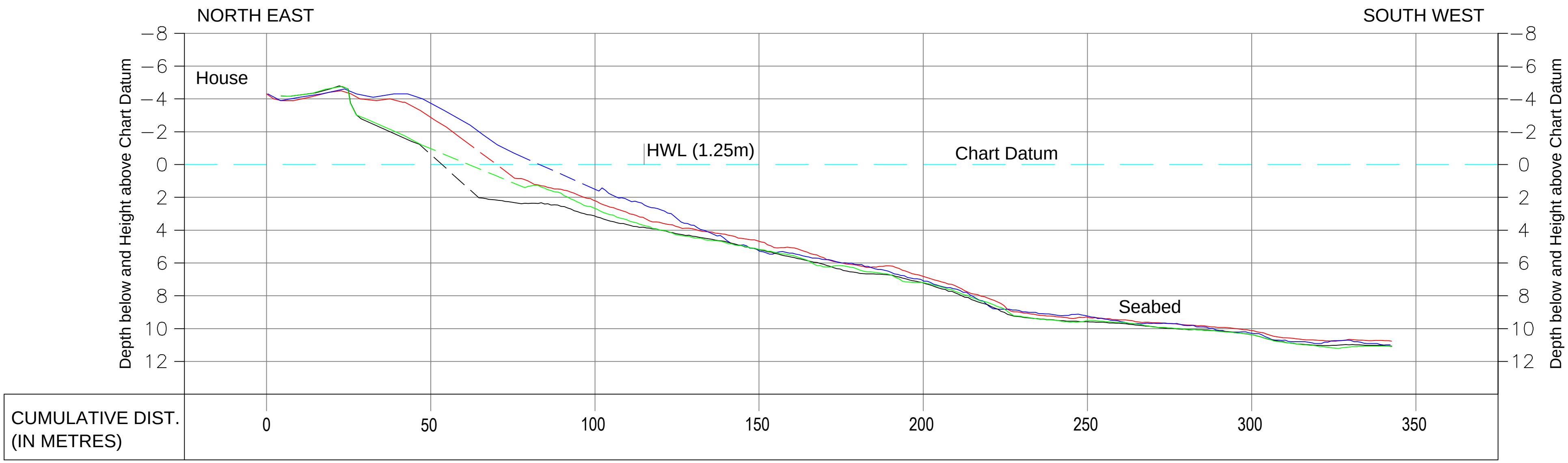
SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-36

(February, March, April, May 2016)



Cross Shore Profile

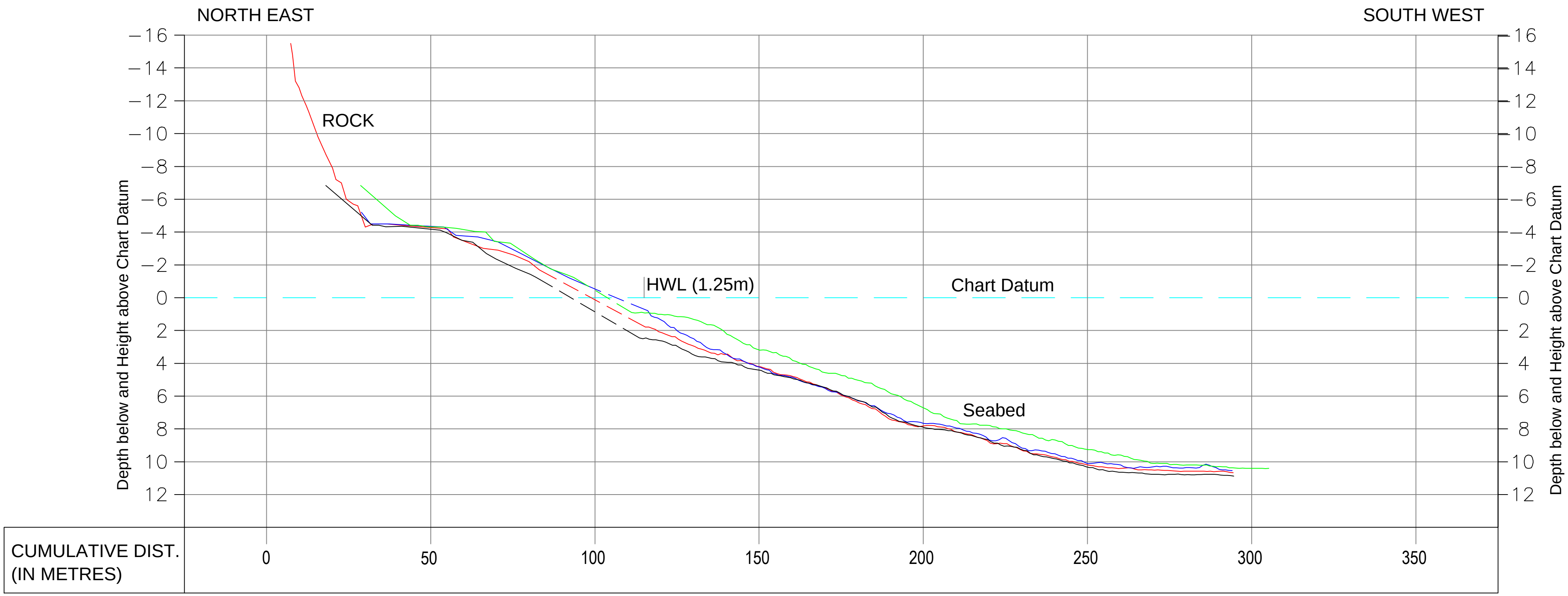
SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :	
Profile February 2016	green
Profile March 2016	black
Profile April 2016	red
Profile May 2016	blue

Cross Section Line No.CSP-37
(February, March, April, May 2016)



Legend :

- Profile February 2016
- Profile March 2016
- Profile April 2016
- Profile May 2016

Cross Shore Profile

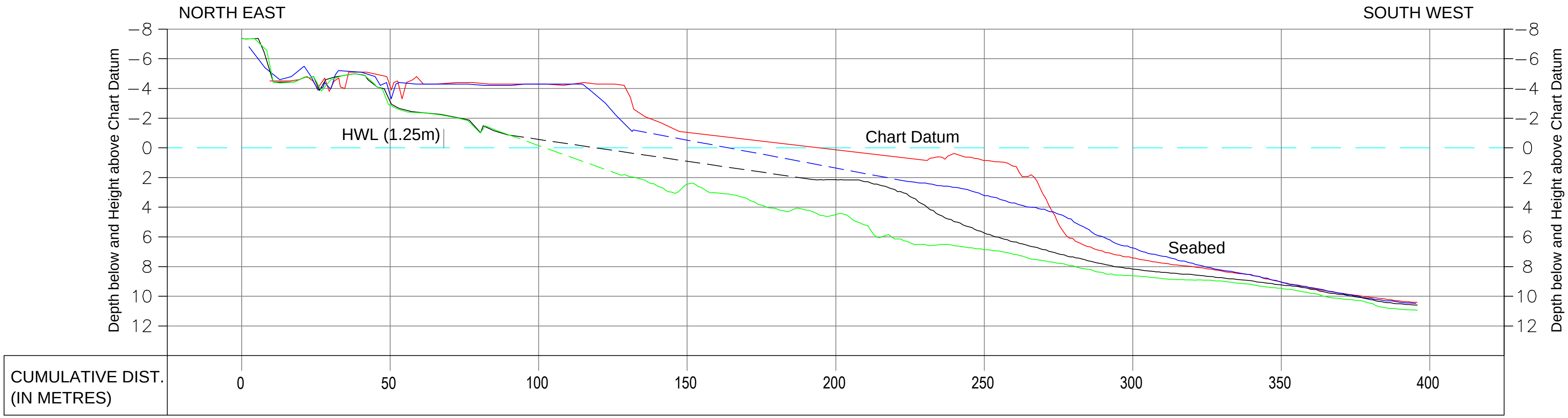
SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-38

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

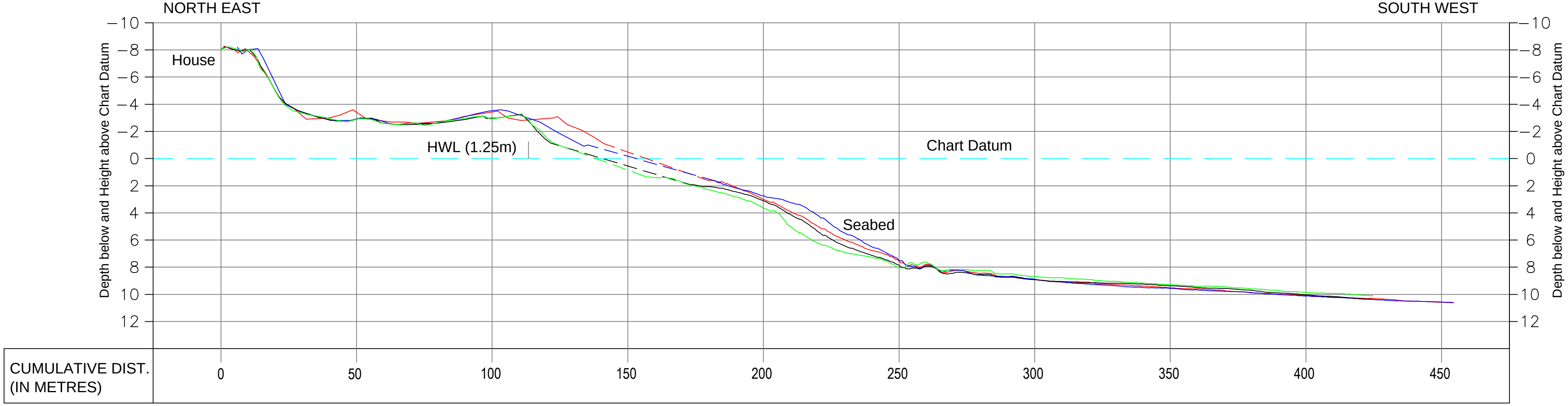
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-39

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

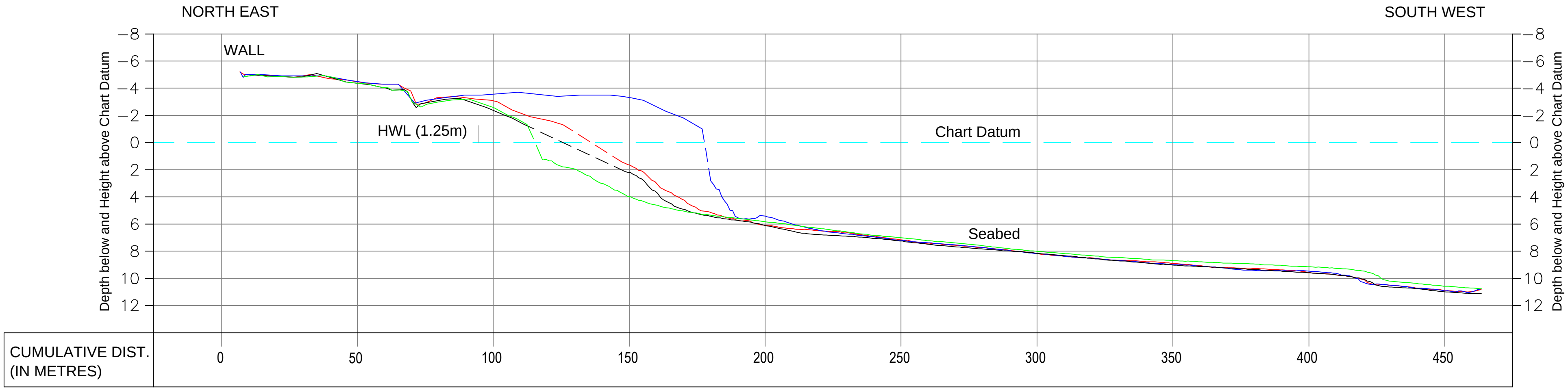
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-40

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

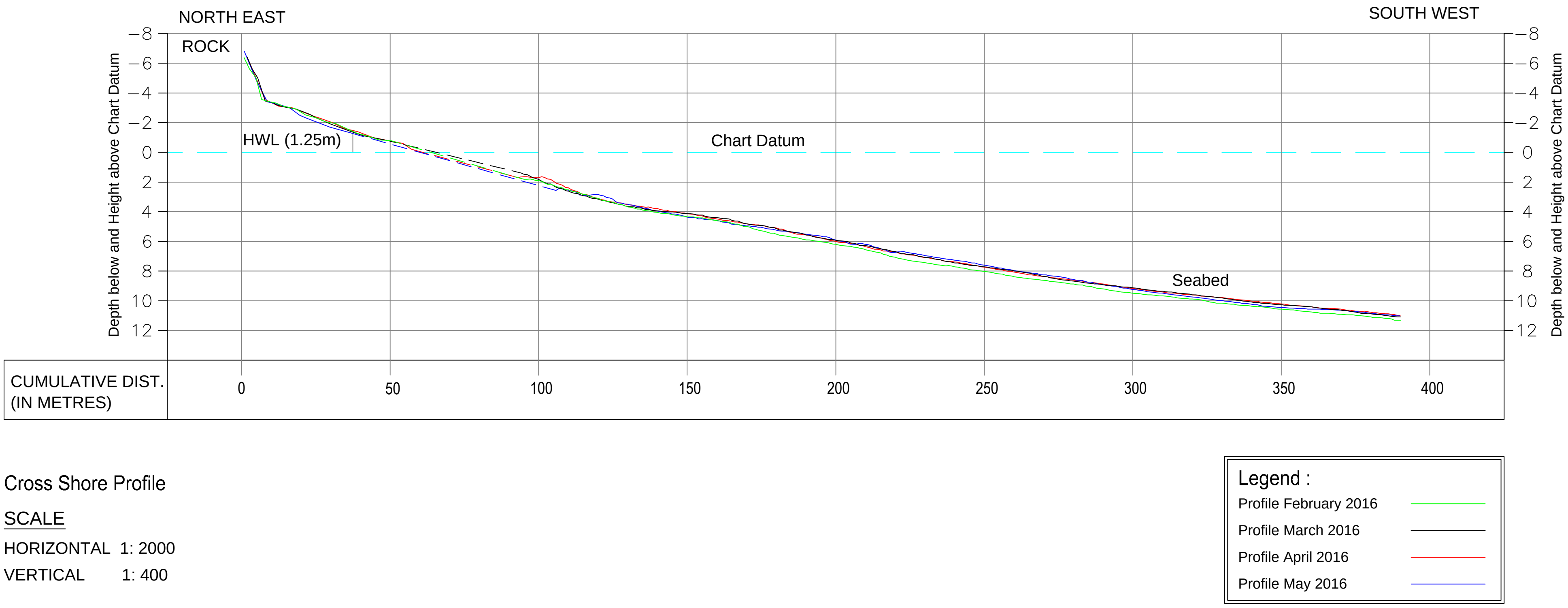
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-41

(February, March, April, May 2016)



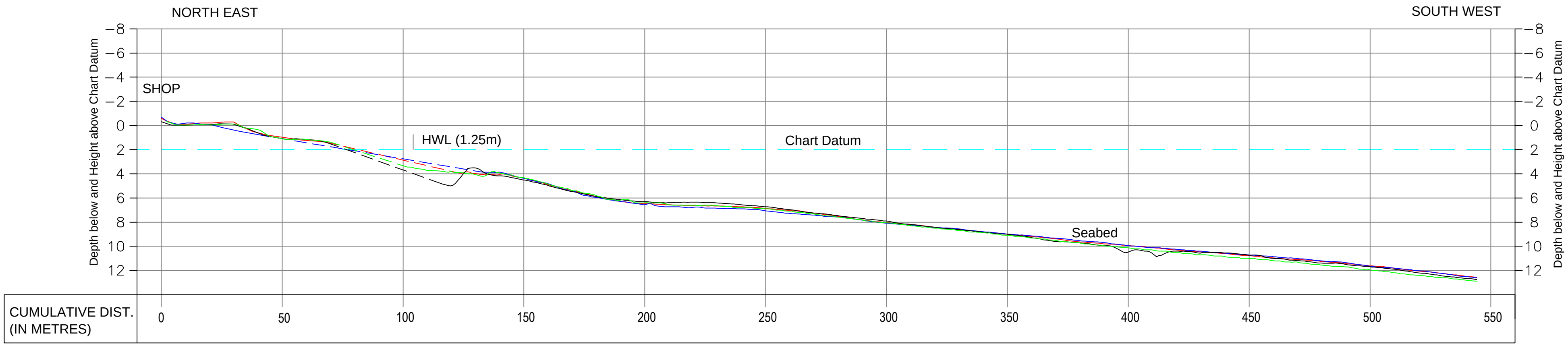
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-42
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

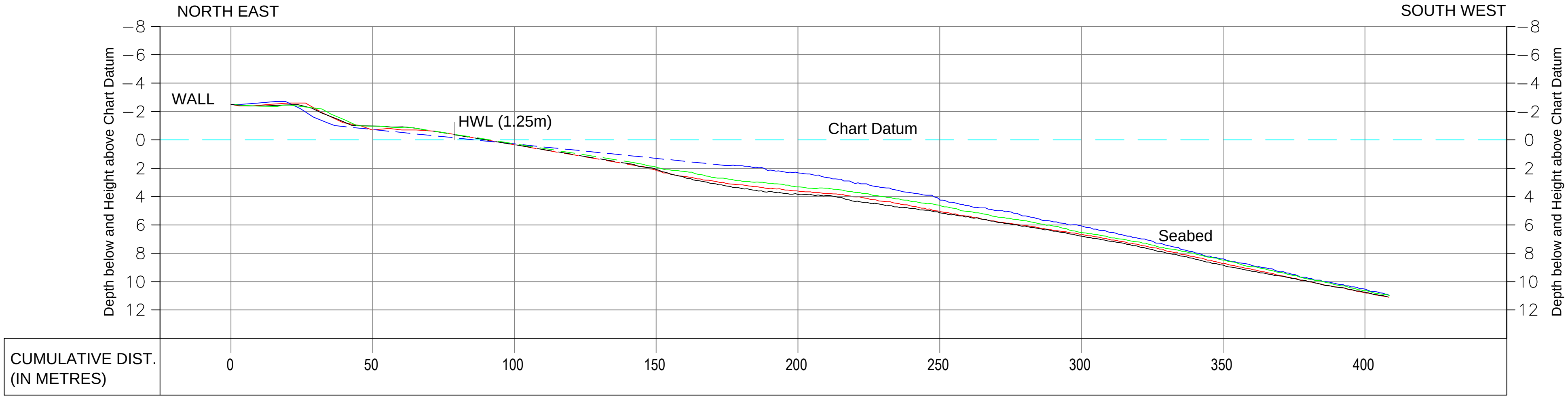
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-43

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

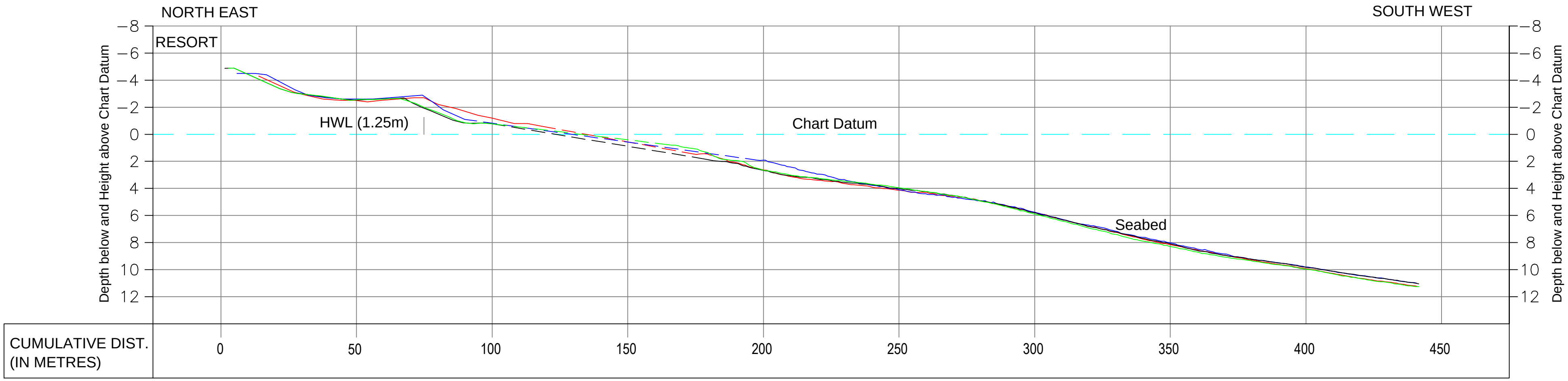
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-44
(February, March, April, May 2016)



Cross Shore Profile

SCALE

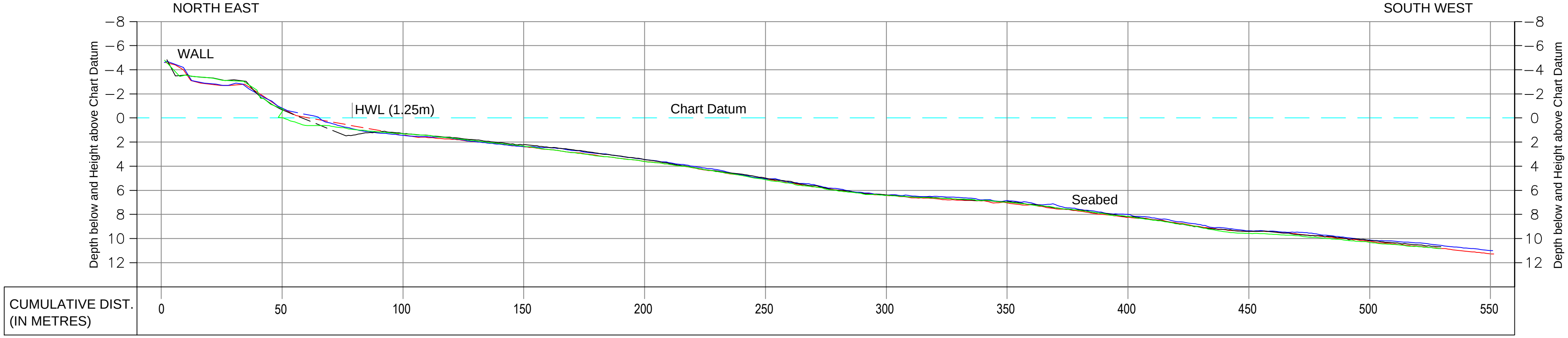
HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :
- Profile February 2016
- Profile March 2016
- Profile April 2016
- Profile May 2016

Cross Section Line No.CSP-45

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

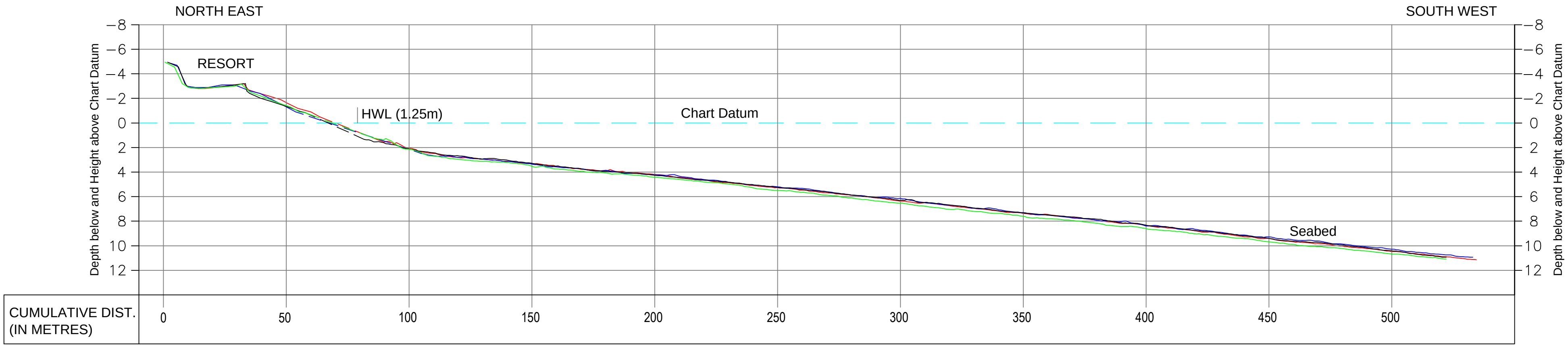
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-46
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Shore Profile

SCALE

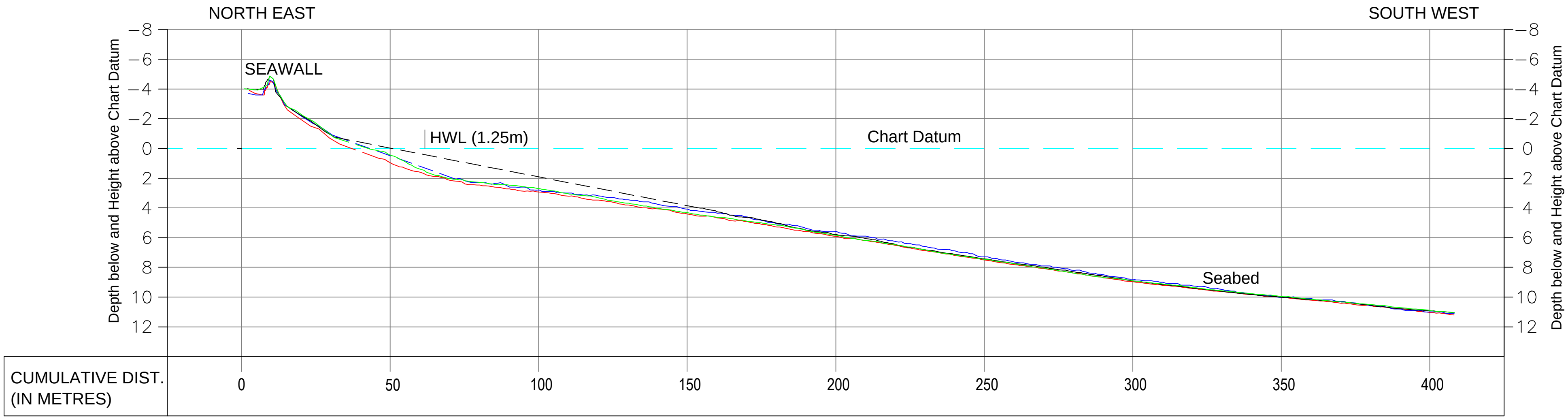
HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016	green
Profile March 2016	black
Profile April 2016	red
Profile May 2016	blue

Cross Section Line No.CSP-47
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

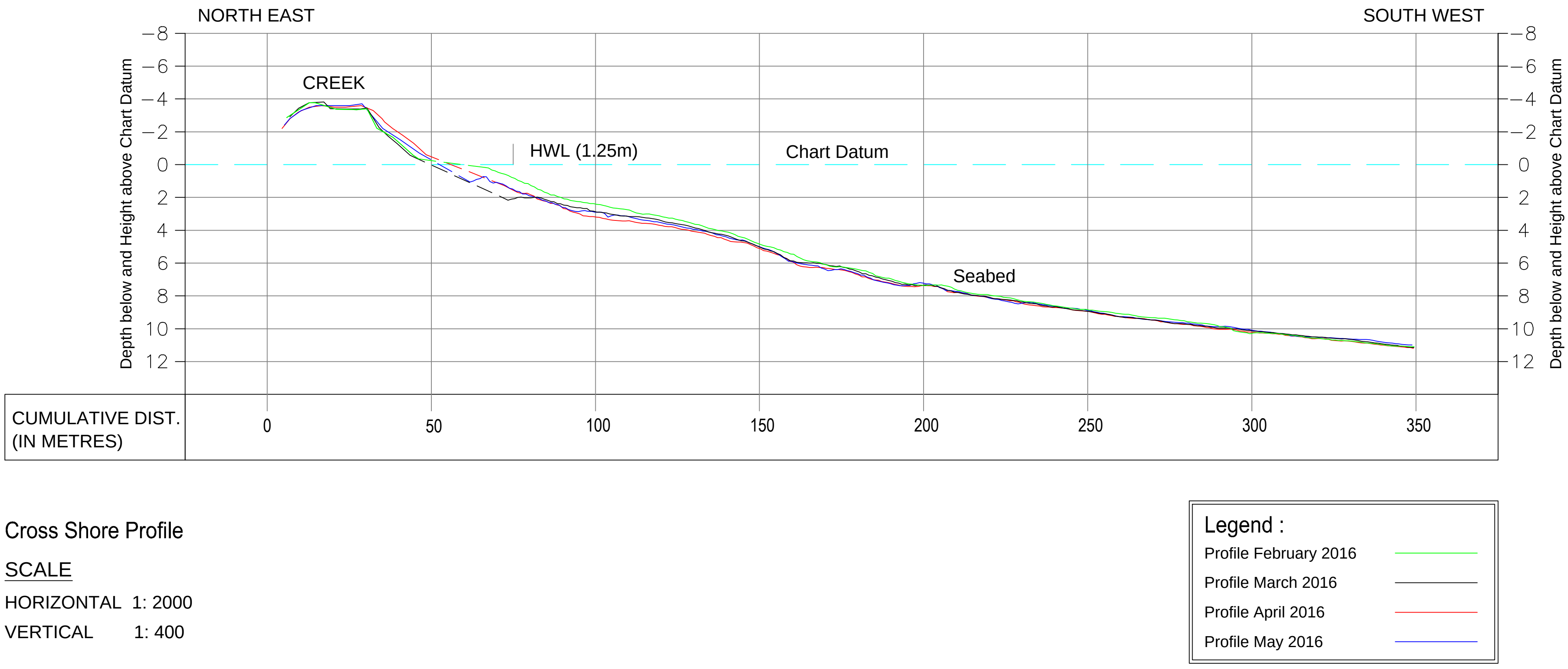
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-48
(February, March, April, May 2016)



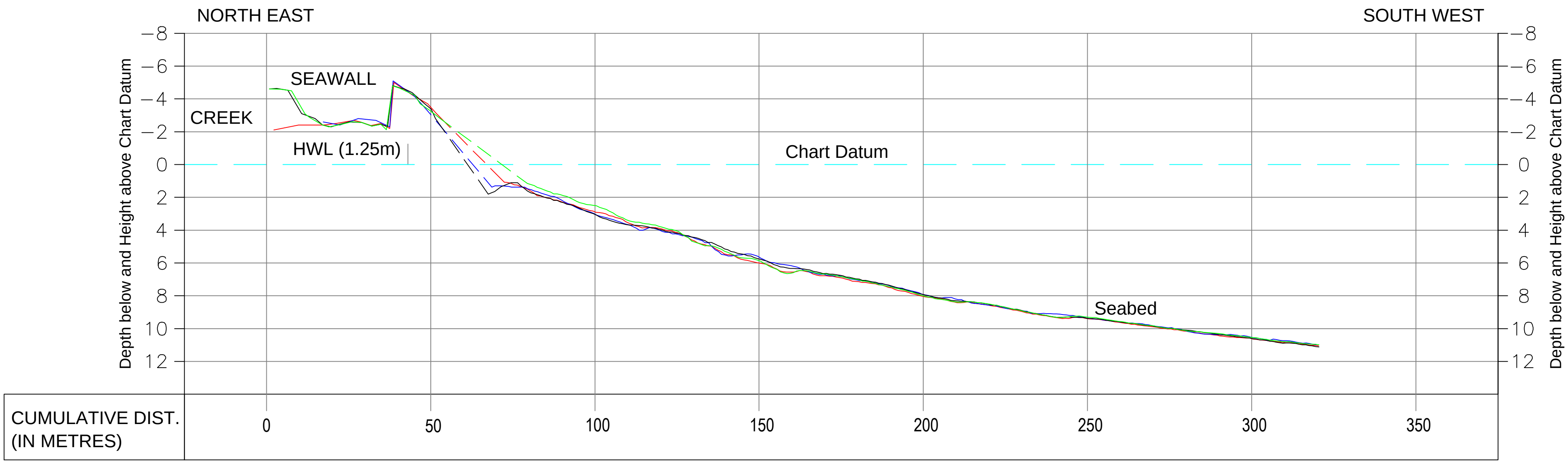
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-49
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

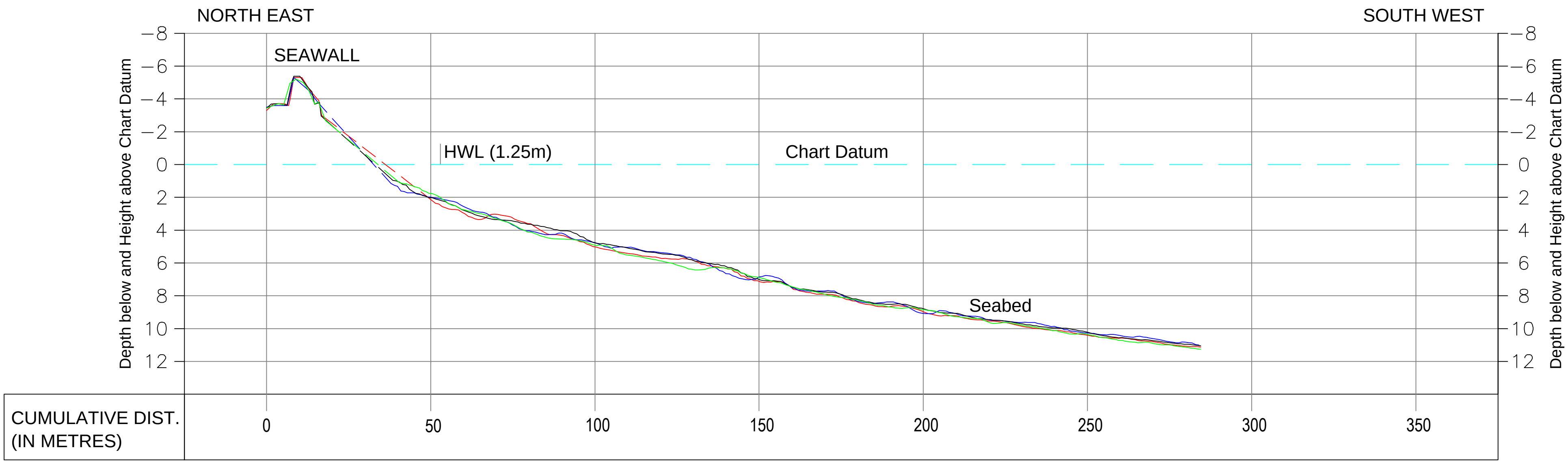
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-50

(February, March, April, May 2016)



Cross Shore Profile

SCALE

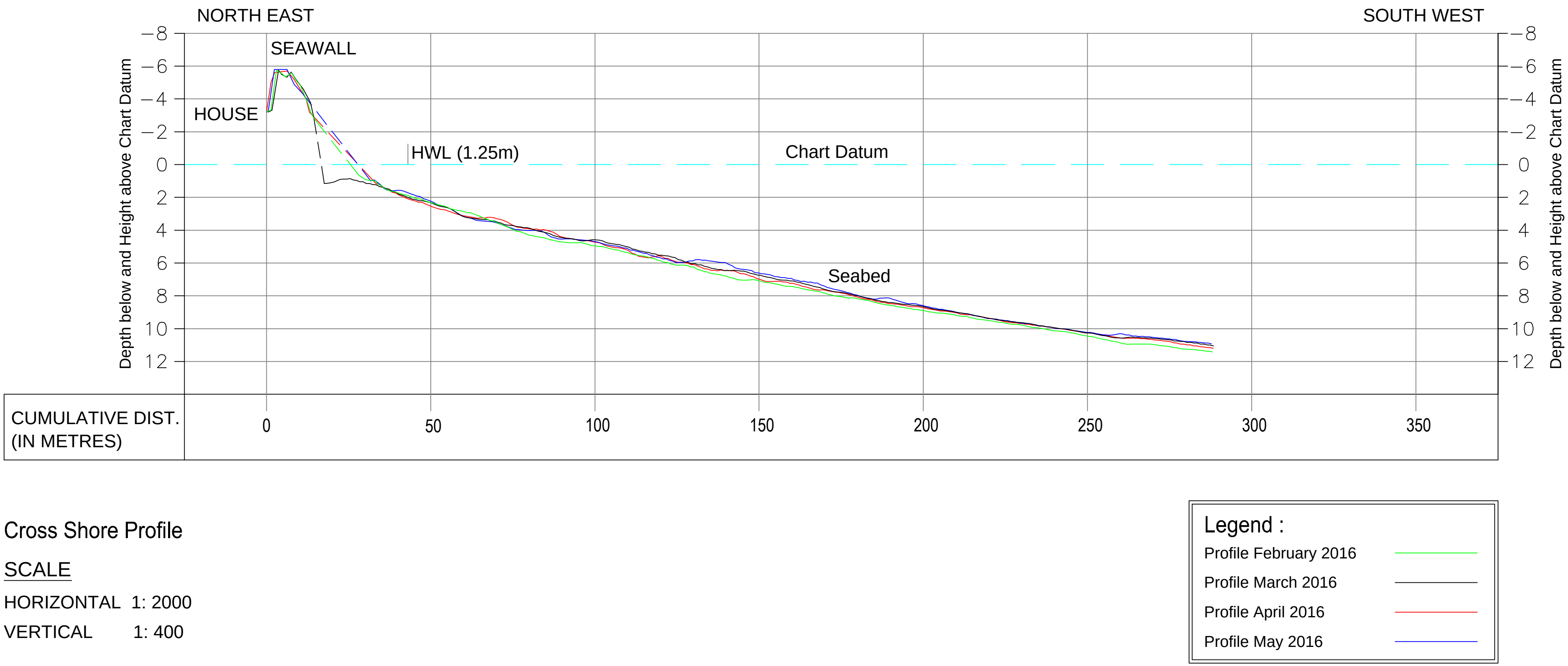
HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

- Profile February 2016
- Profile March 2016
- Profile April 2016
- Profile May 2016

Cross Section Line No.CSP-51
(February, March, April, May 2016)



Cross Shore Profile

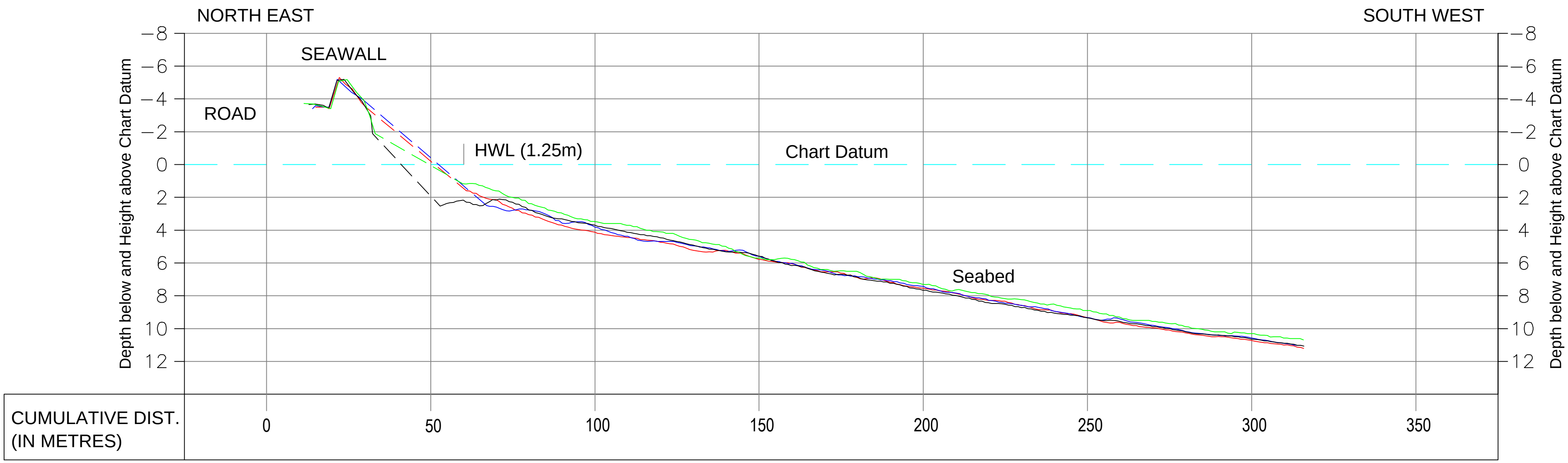
SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-52

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

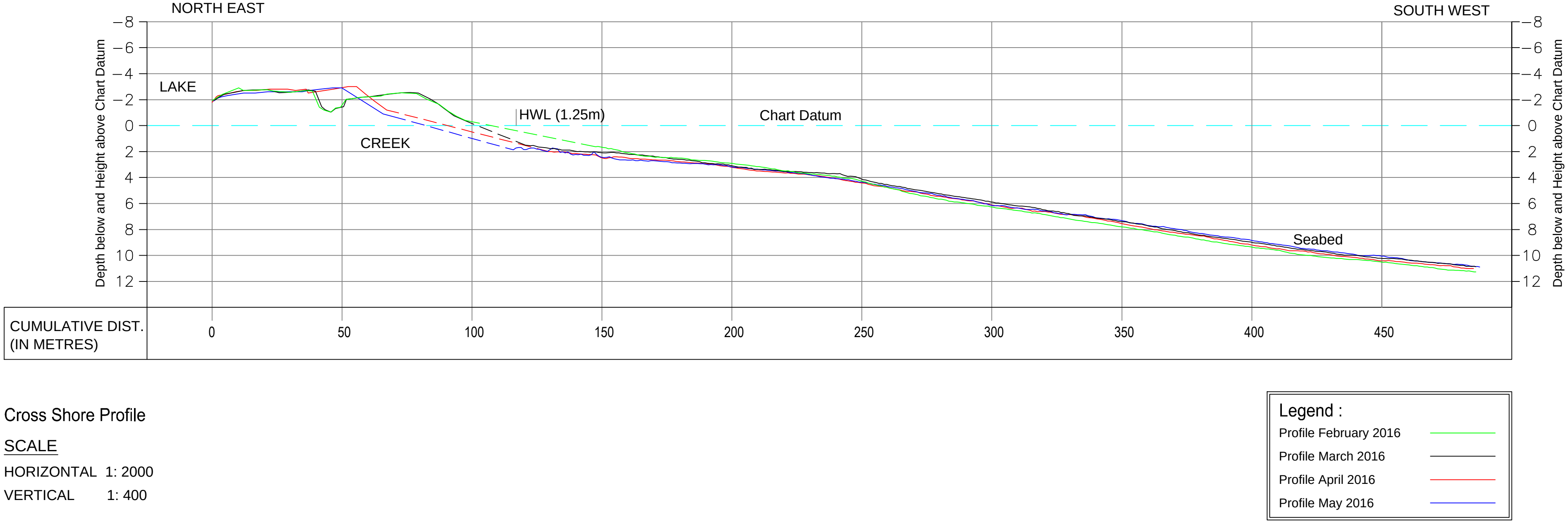
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-53
(February, March, April, May 2016)



Cross Shore Profile

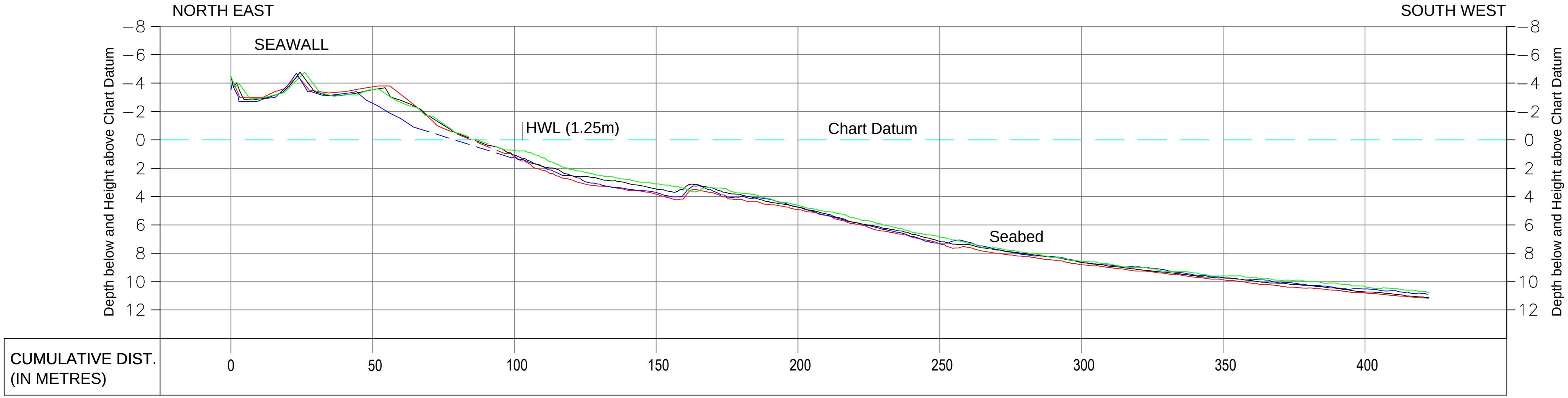
SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-54

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

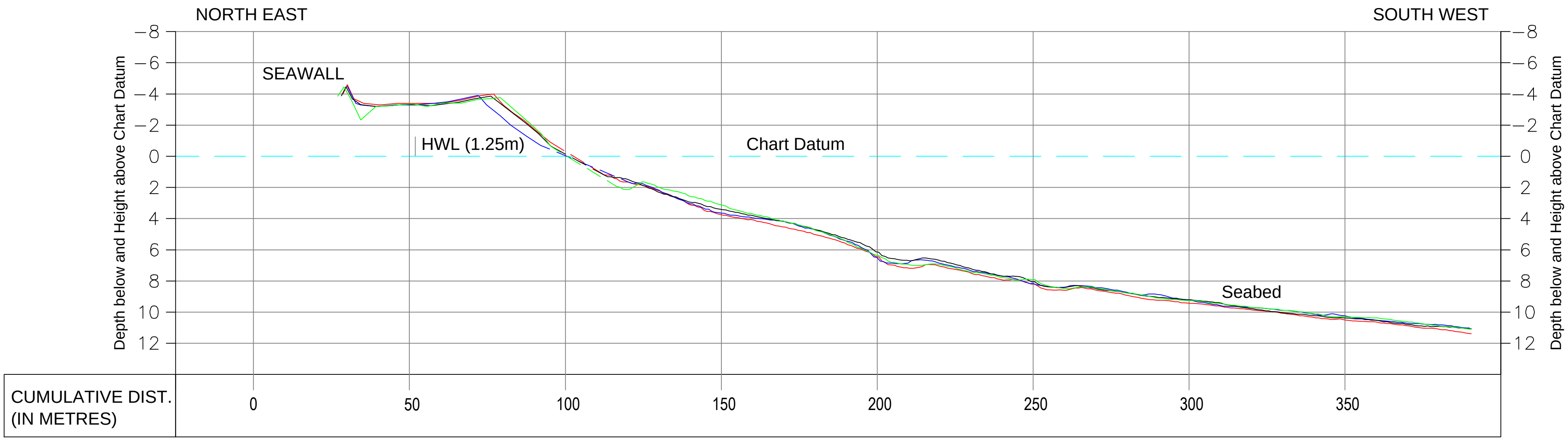
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-55

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

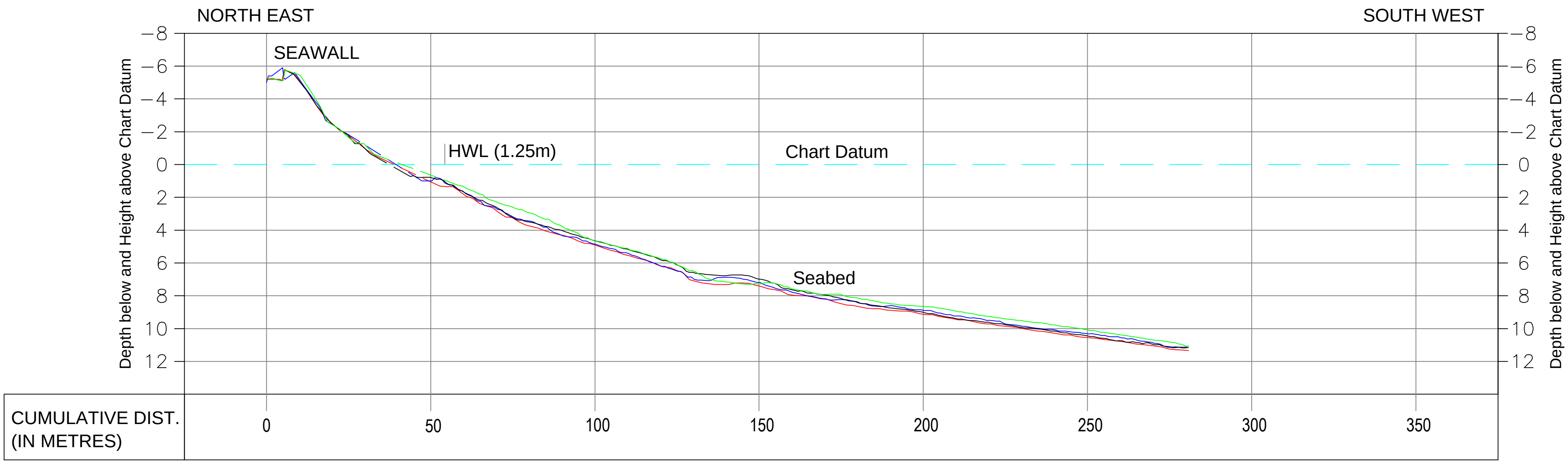
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-56

(February, March, April, May 2016)



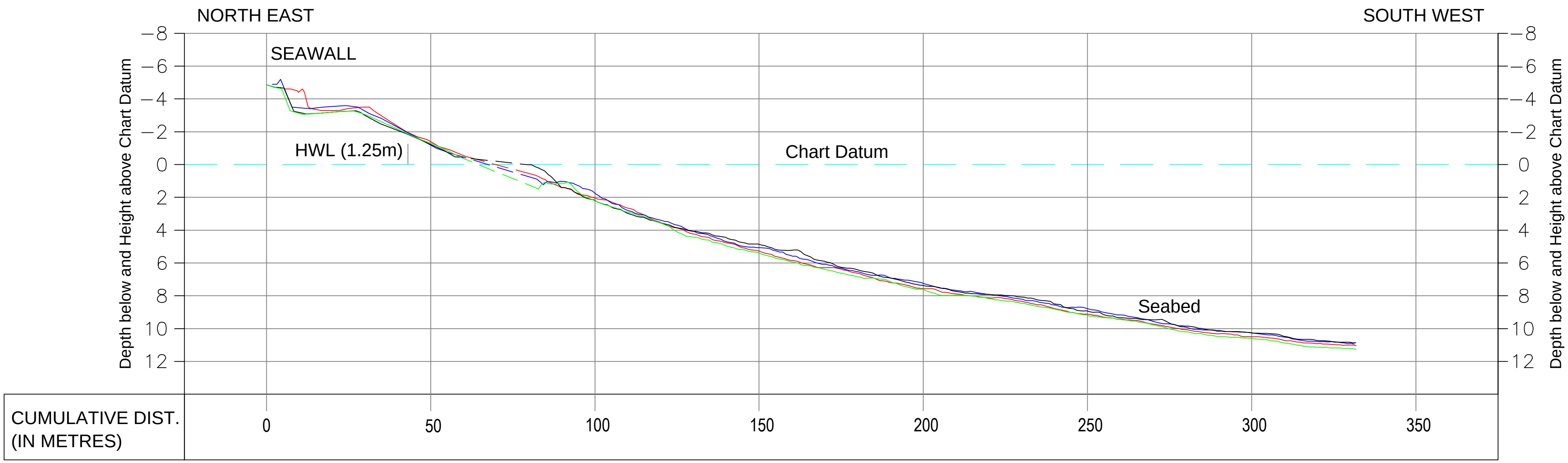
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-57
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

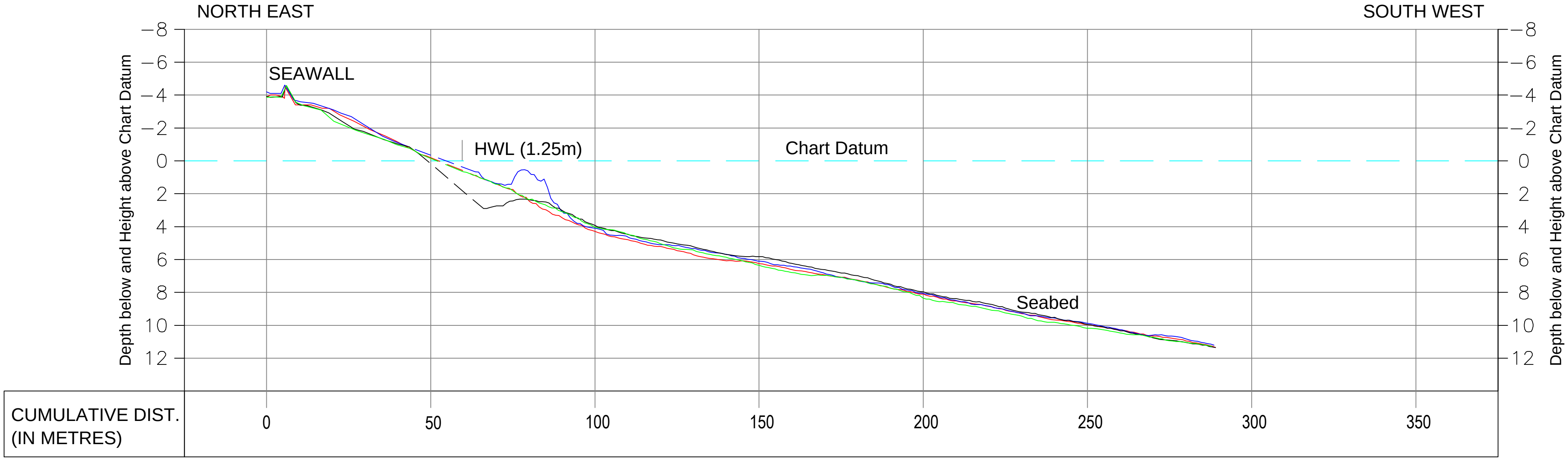
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-58

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

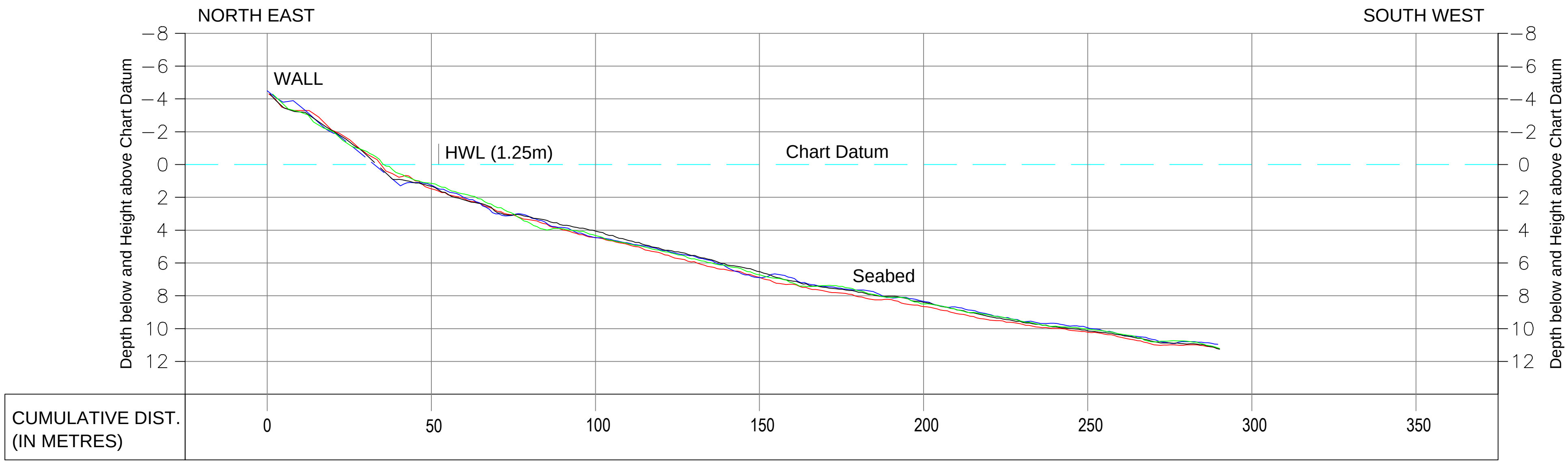
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-59

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

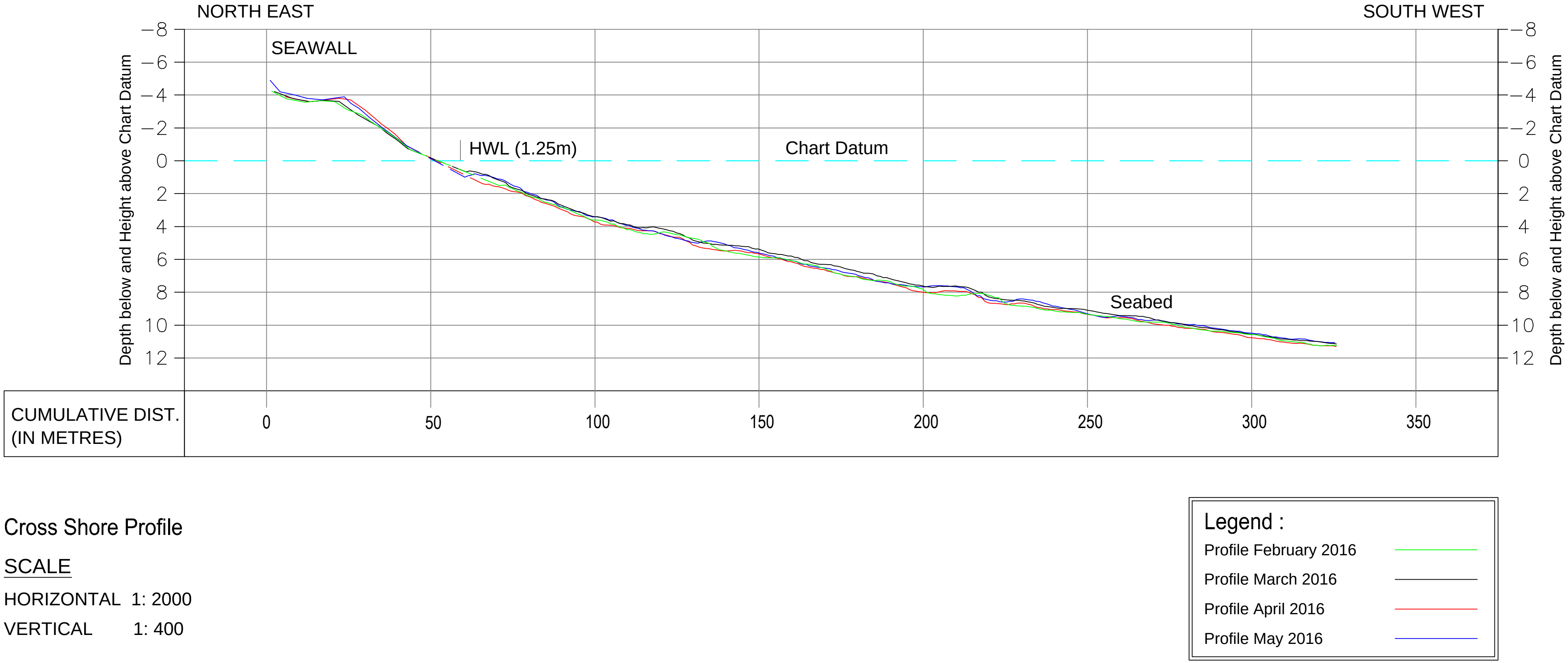
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-60

(February, March, April, May 2016)



Cross Shore Profile

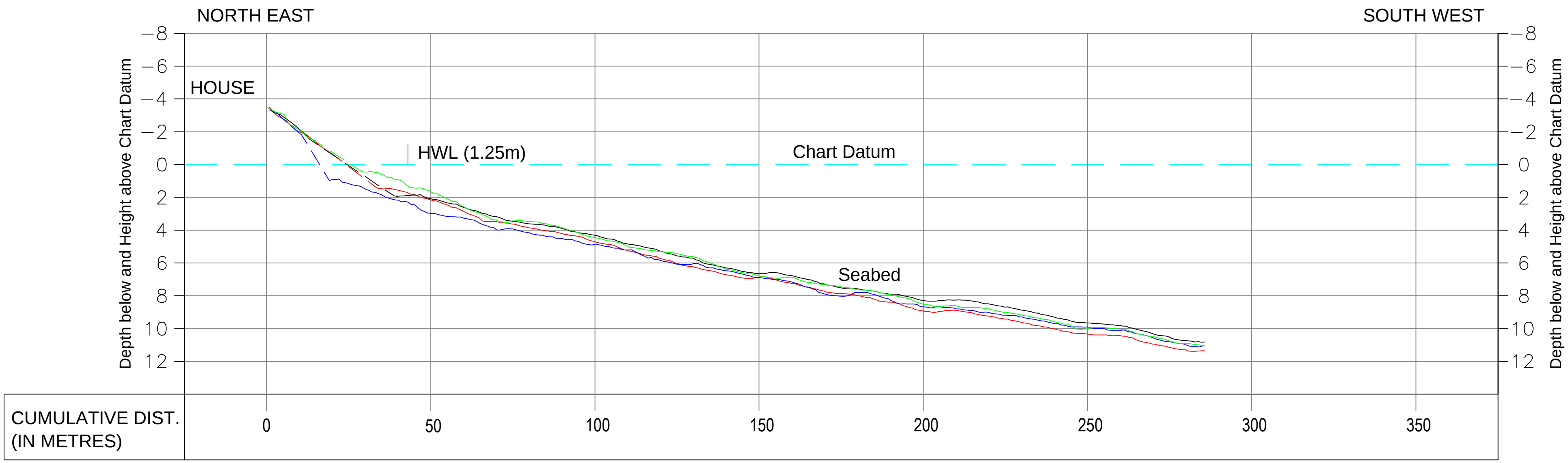
SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-61

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

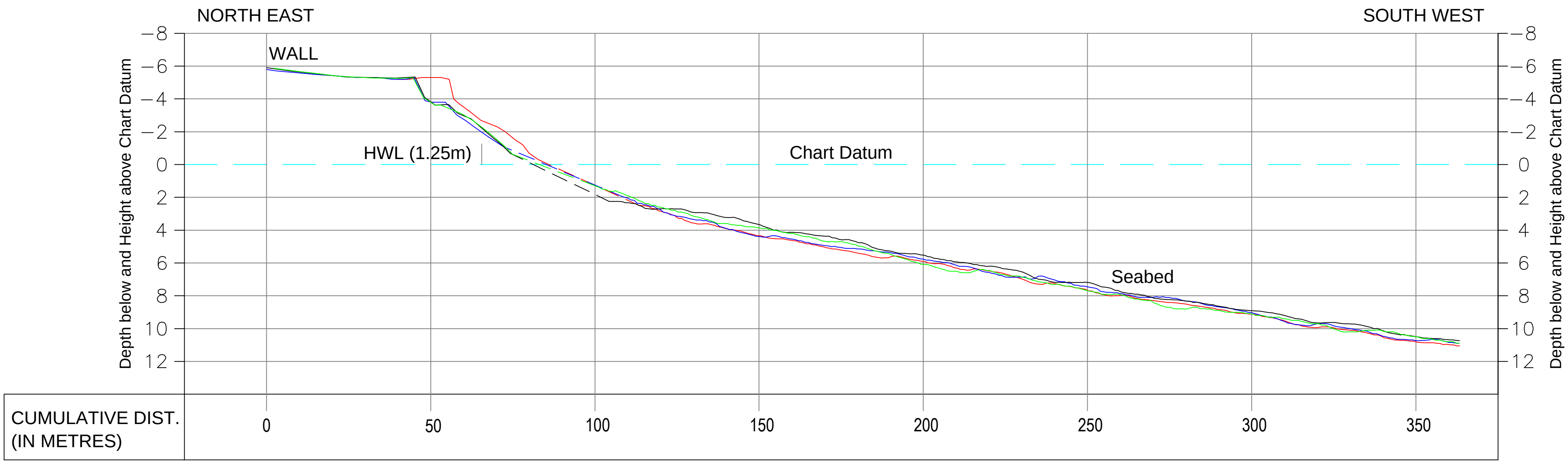
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-62

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

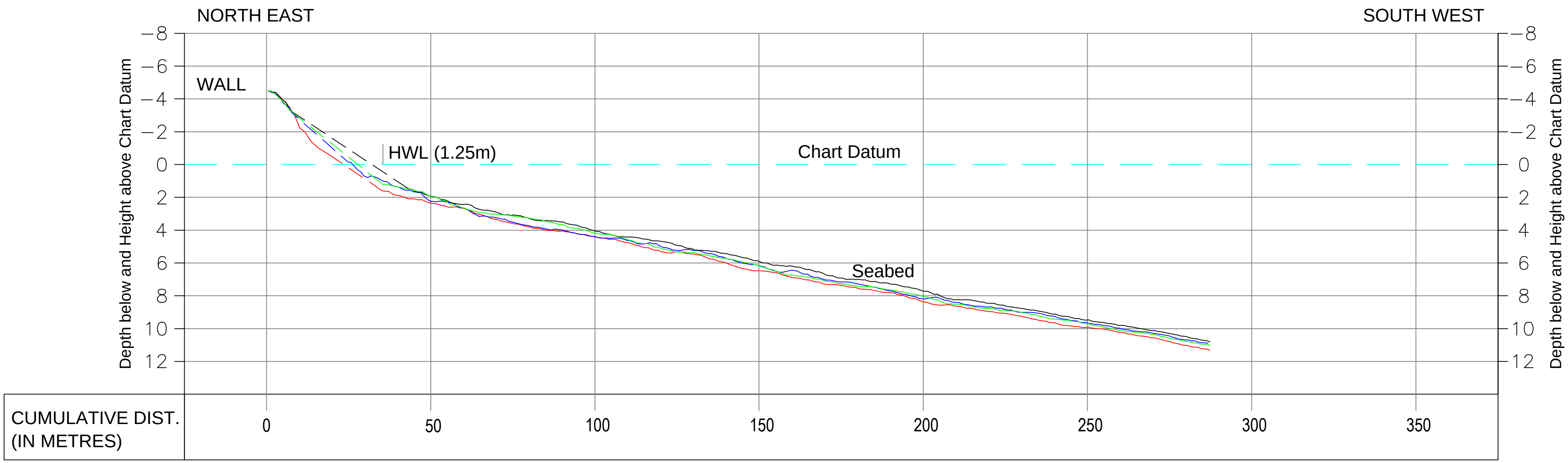
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-63

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

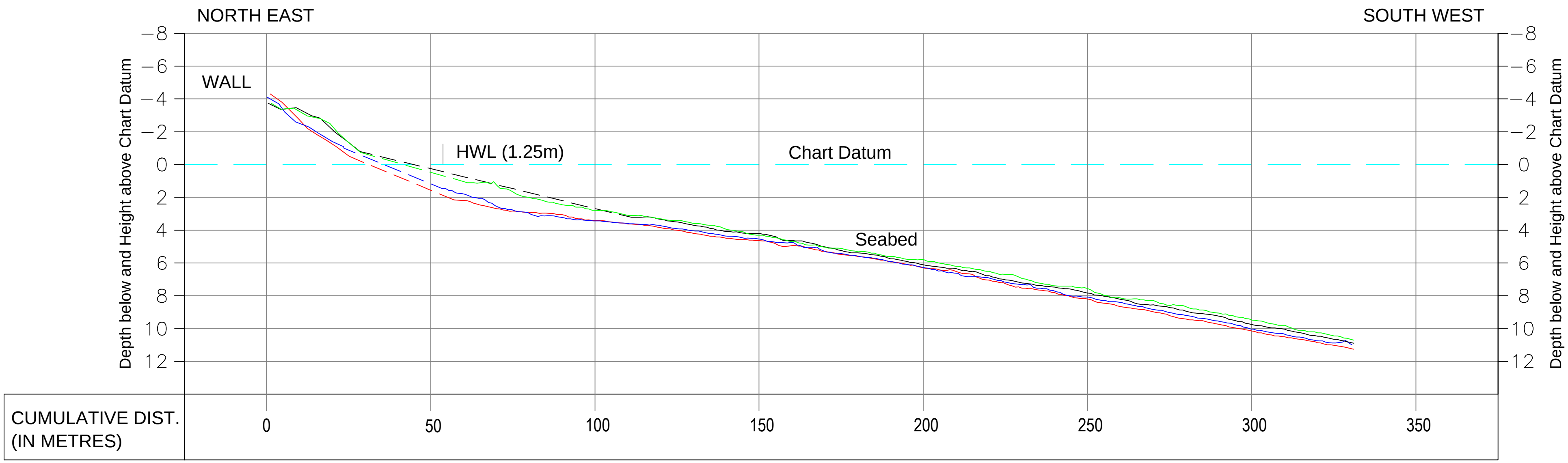
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-64
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

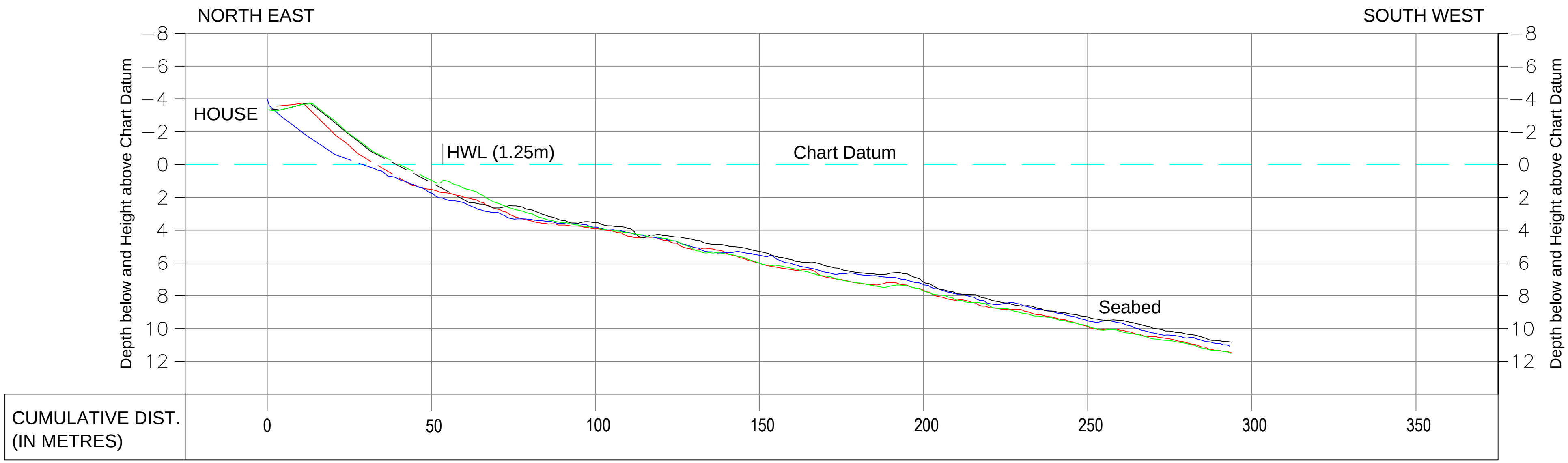
VERTICAL 1: 400

Legend :

- Profile February 2016
- Profile March 2016
- Profile April 2016
- Profile May 2016

Cross Section Line No.CSP-65

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

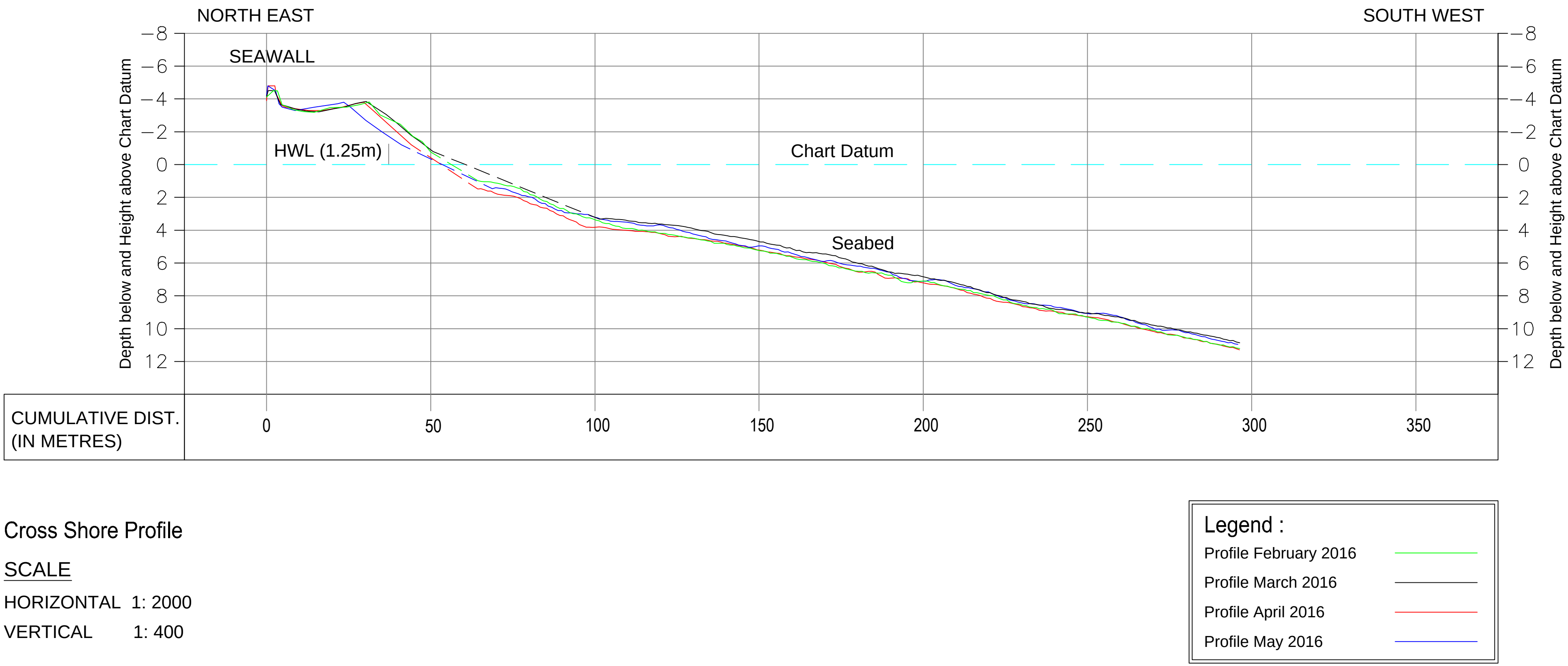
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-66
(February, March, April, May 2016)



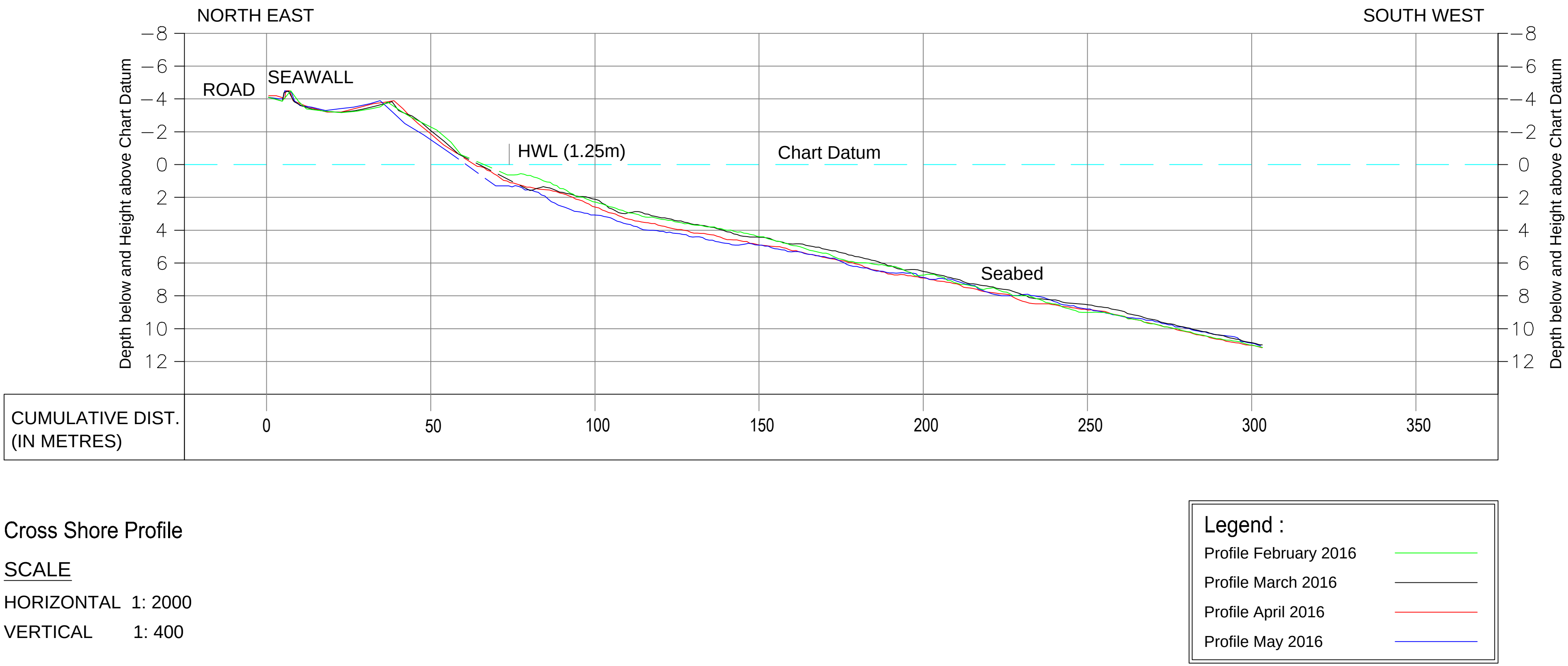
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-67
(February, March, April, May 2016)



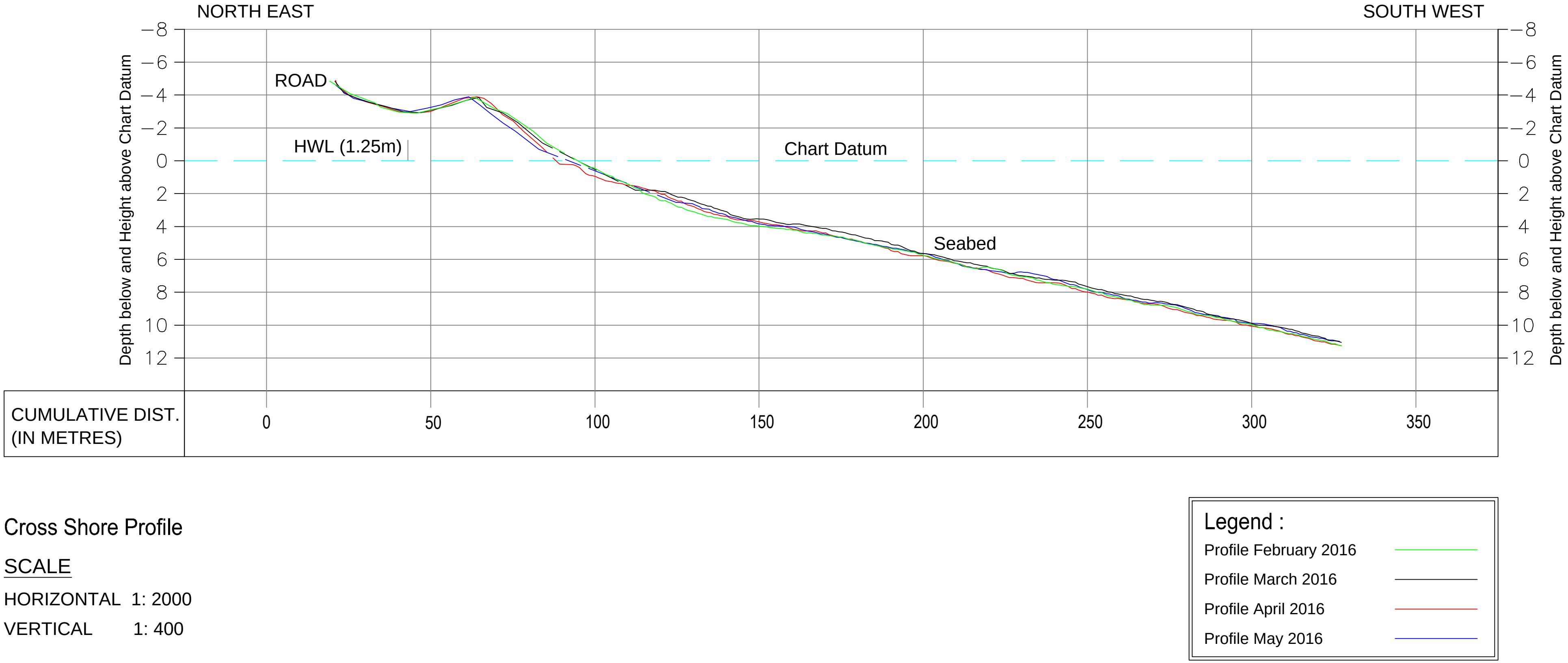
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-68
(February, March, April, May 2016)



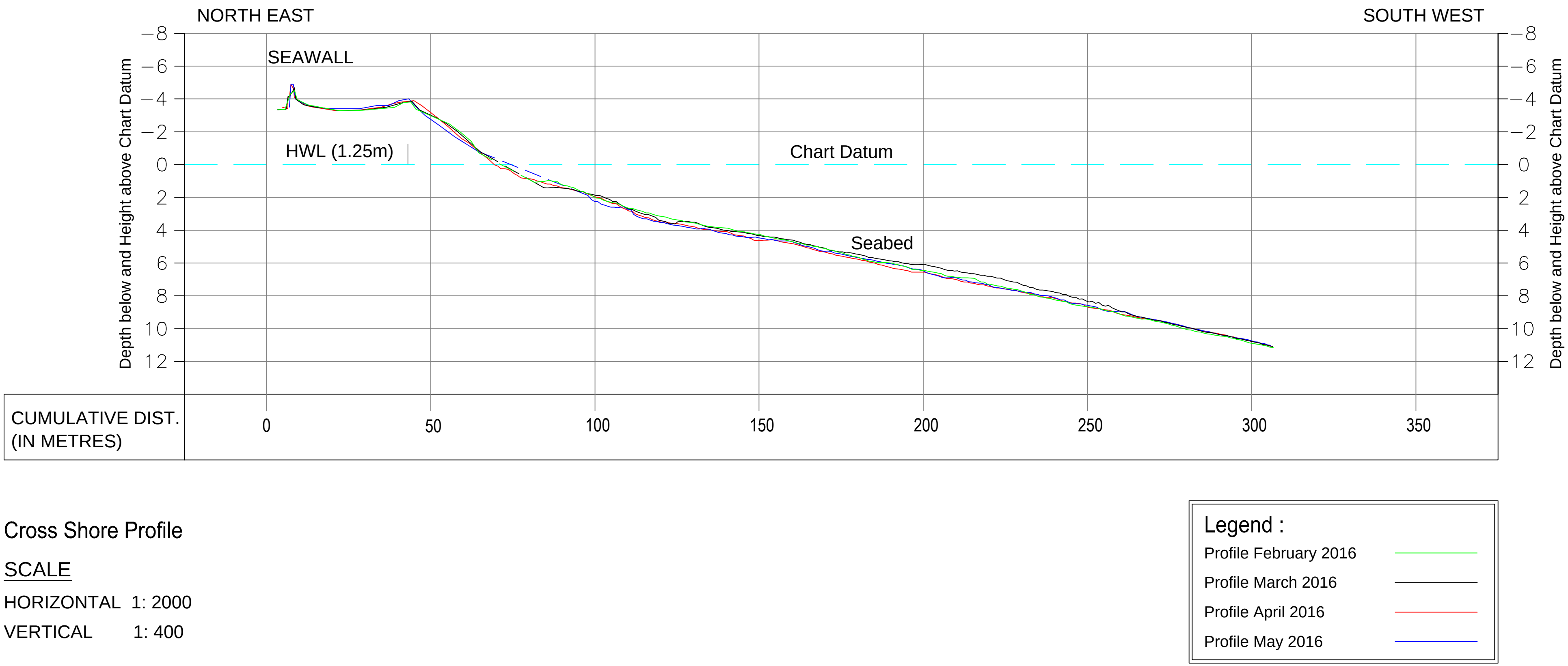
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-69
(February, March, April, May 2016)



Cross Shore Profile

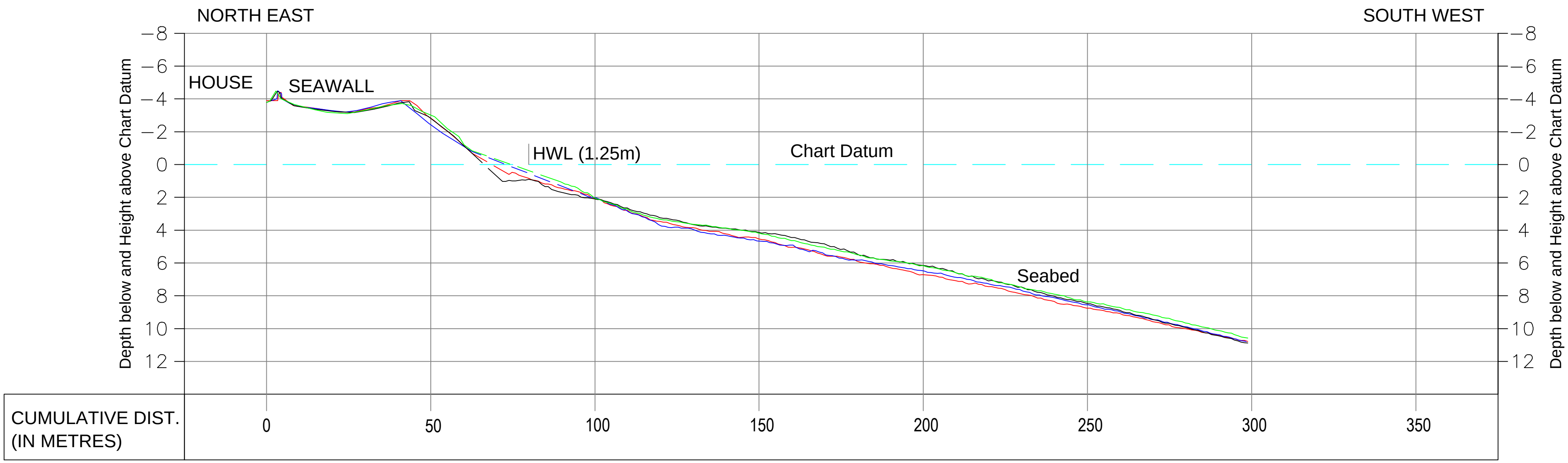
SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-70

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

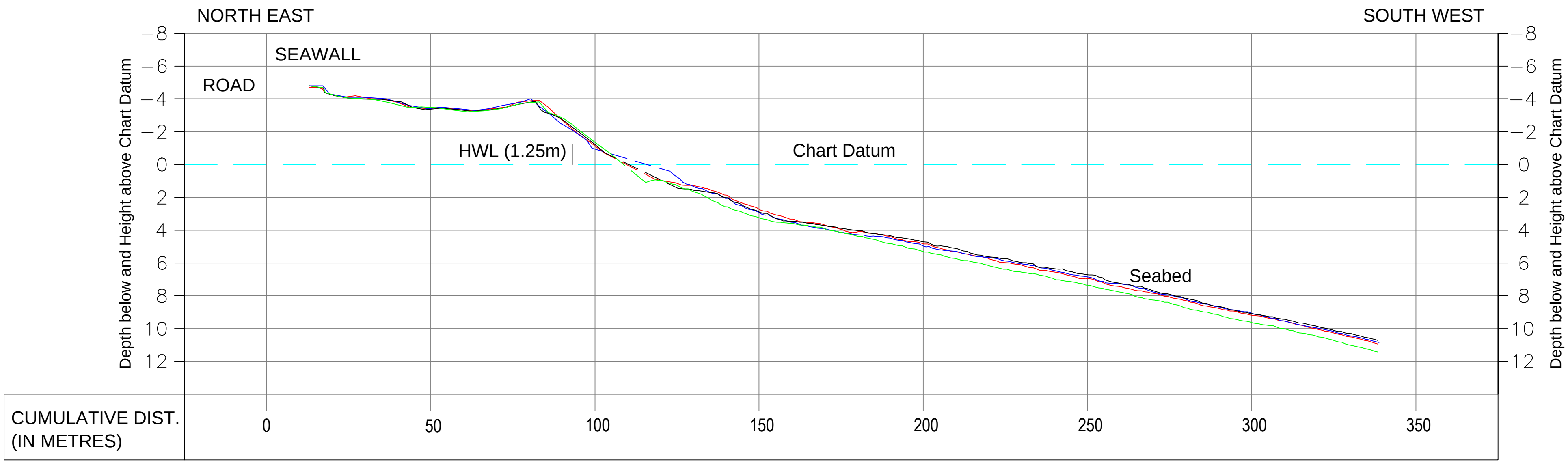
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-71

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

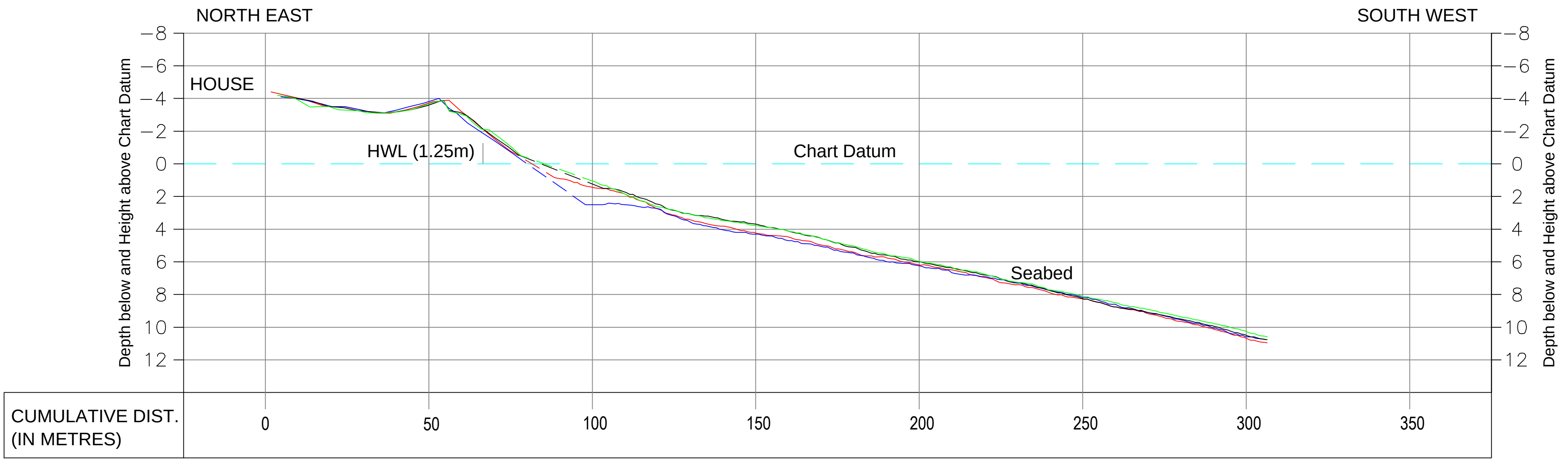
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-72

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

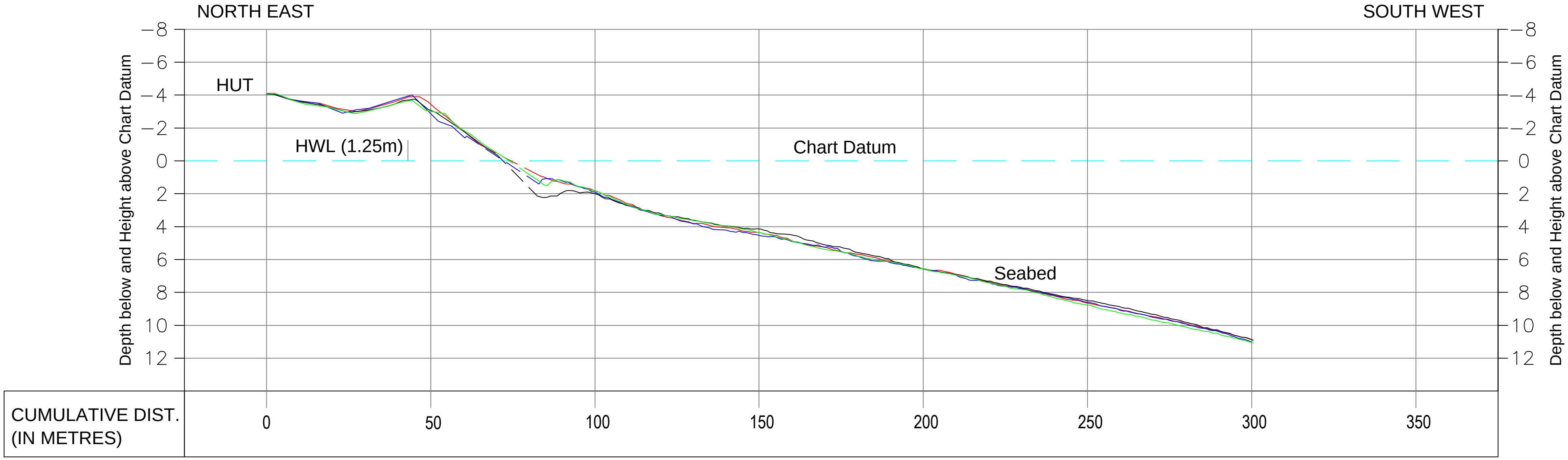
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-73

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

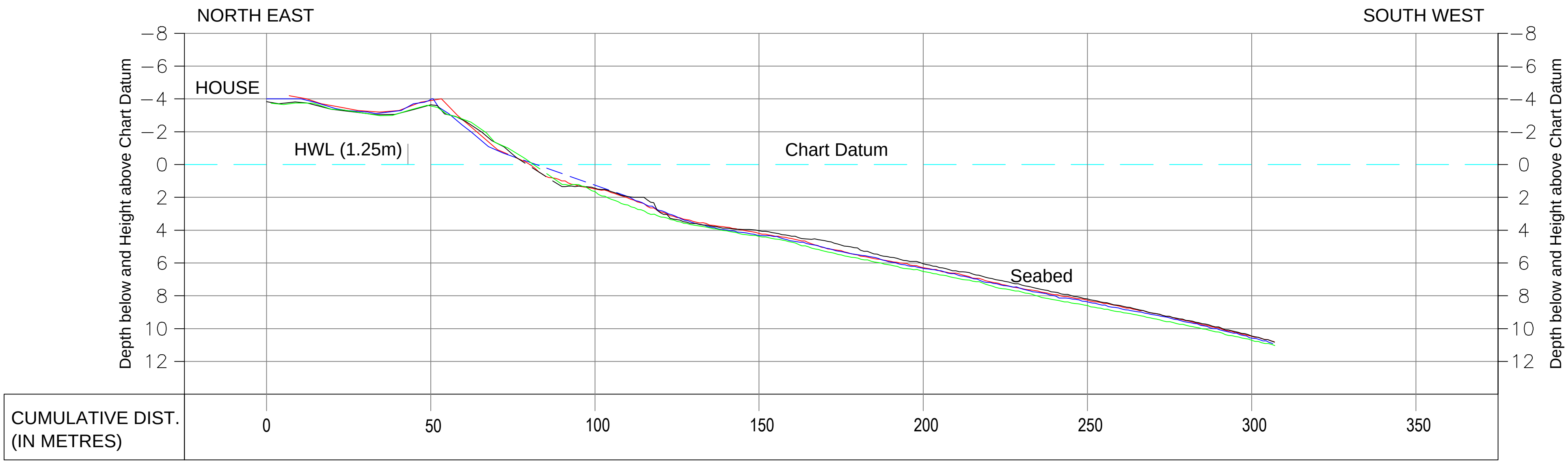
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-74
(February, March, April, May 2016)



Cross Shore Profile

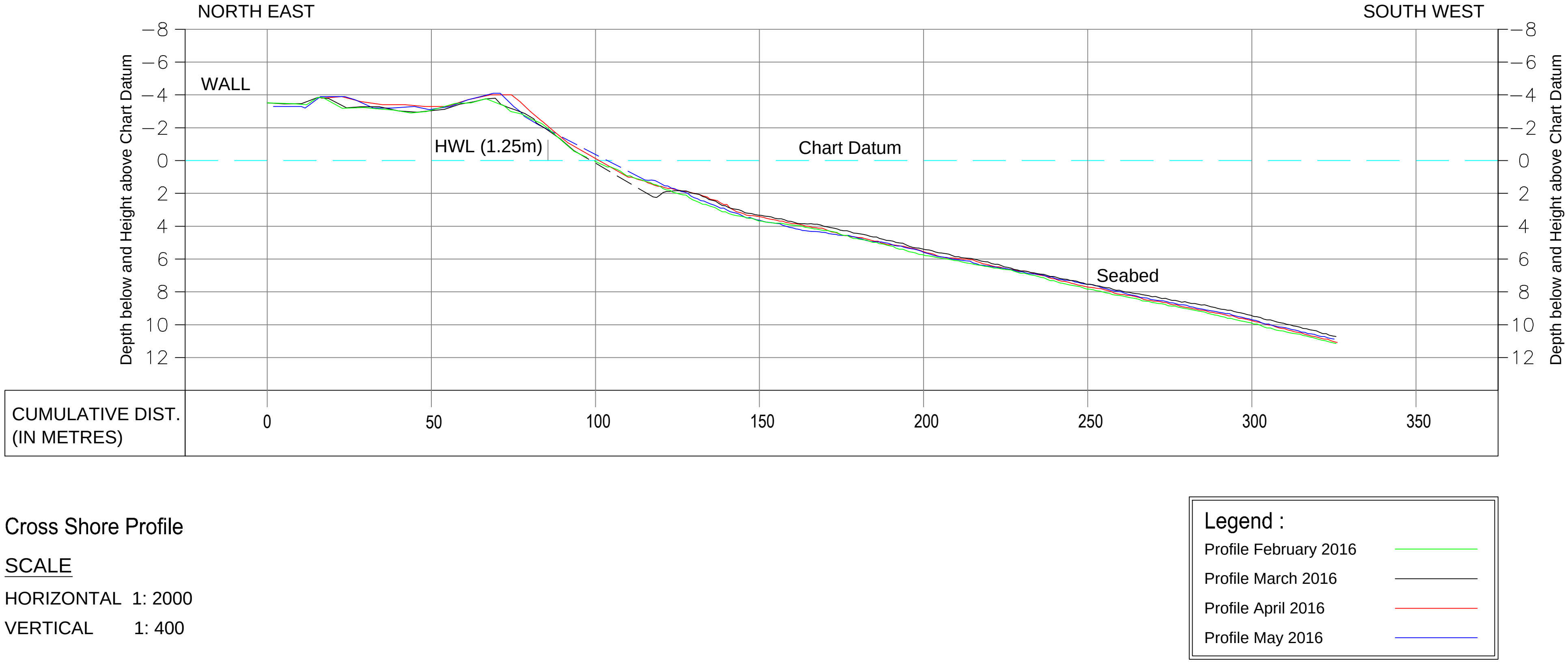
SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :
Profile February 2016
Profile March 2016
Profile April 2016
Profile May 2016

Cross Section Line No.CSP-75
(February, March, April, May 2016)



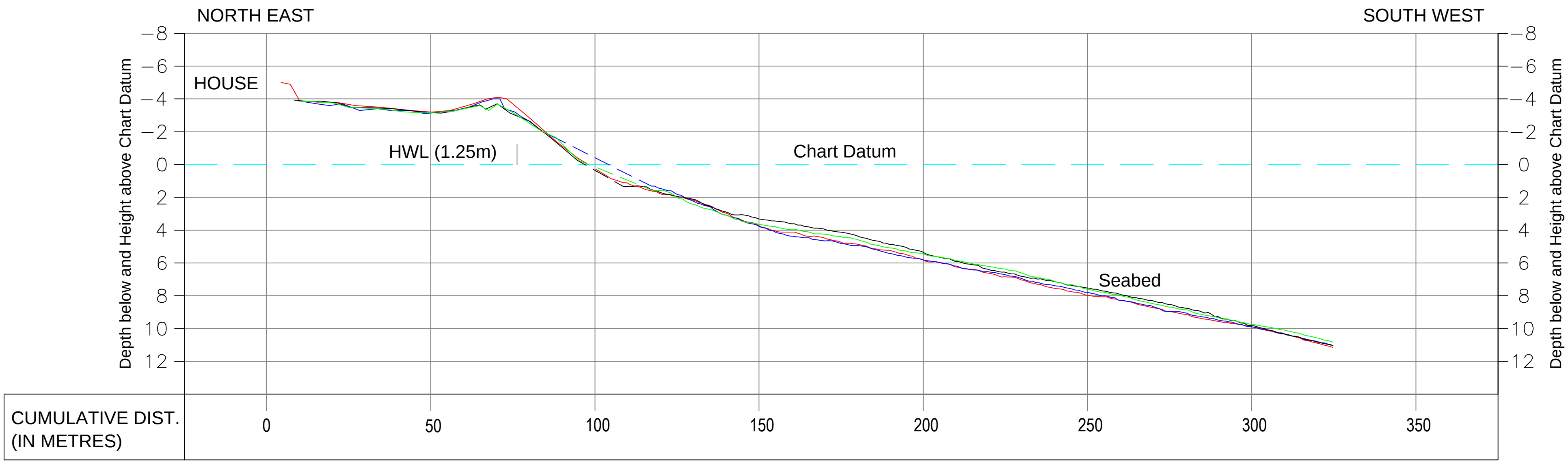
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-76
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

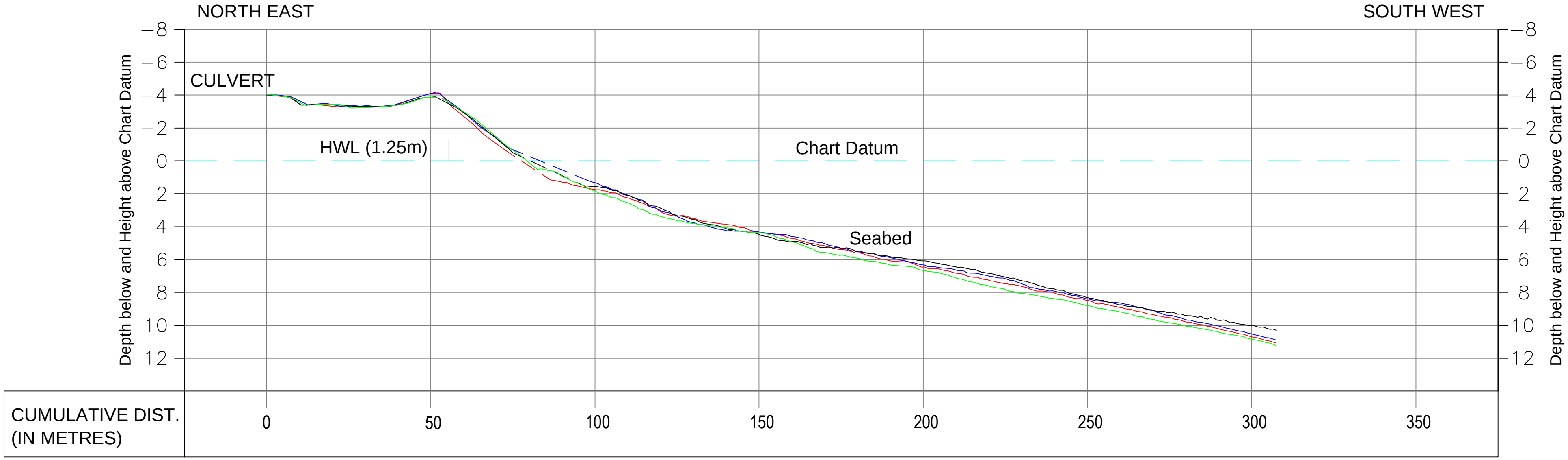
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-77
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

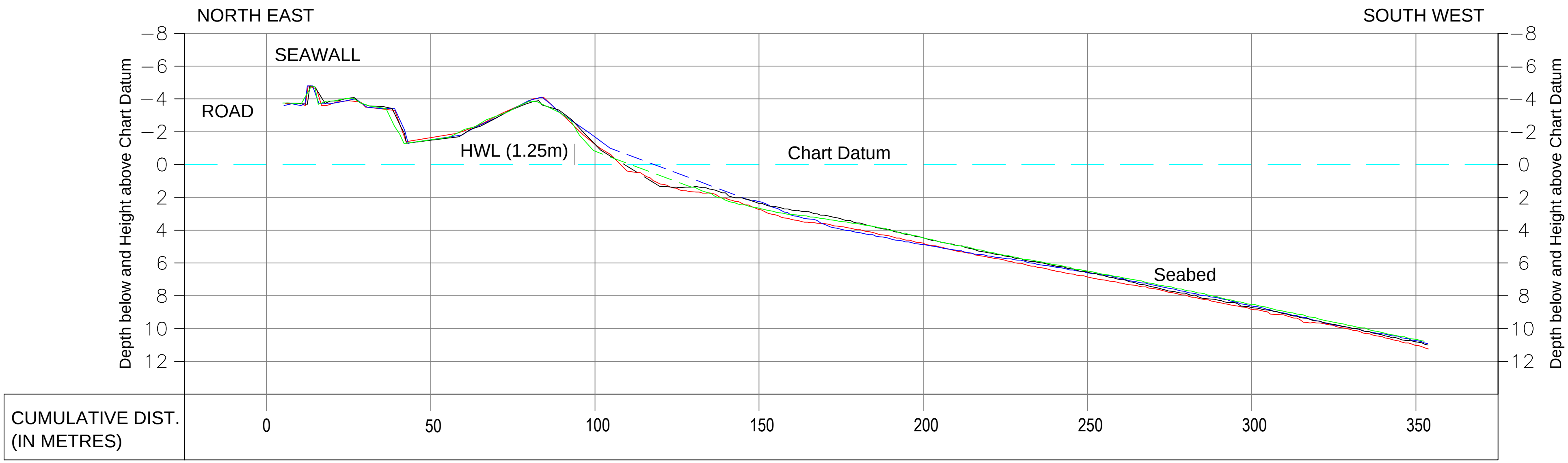
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-78
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

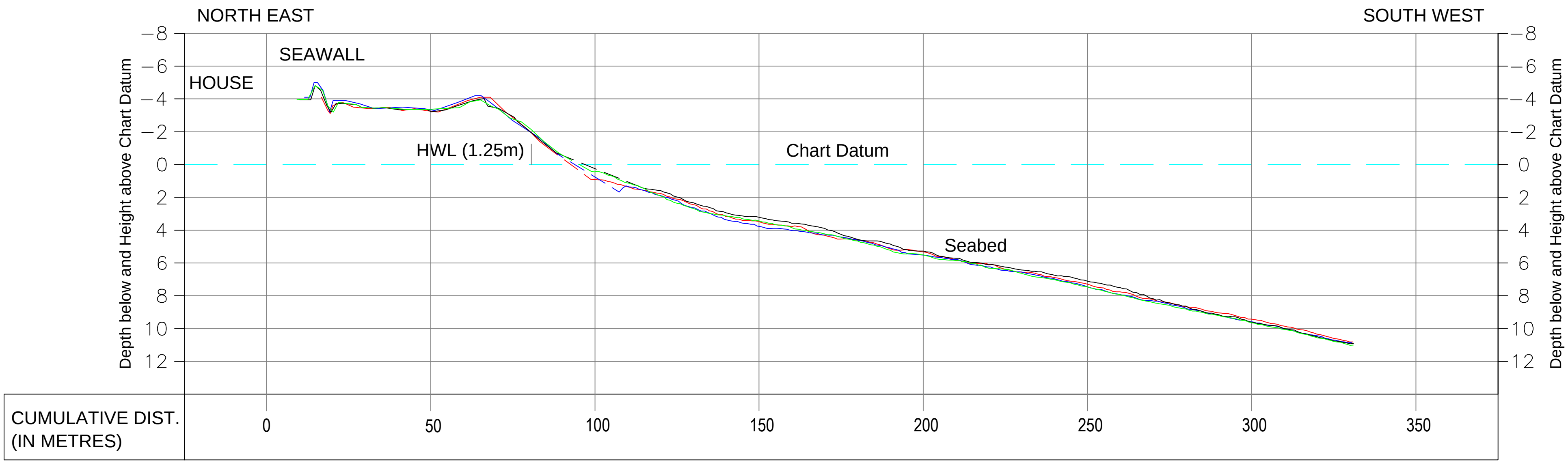
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-79

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

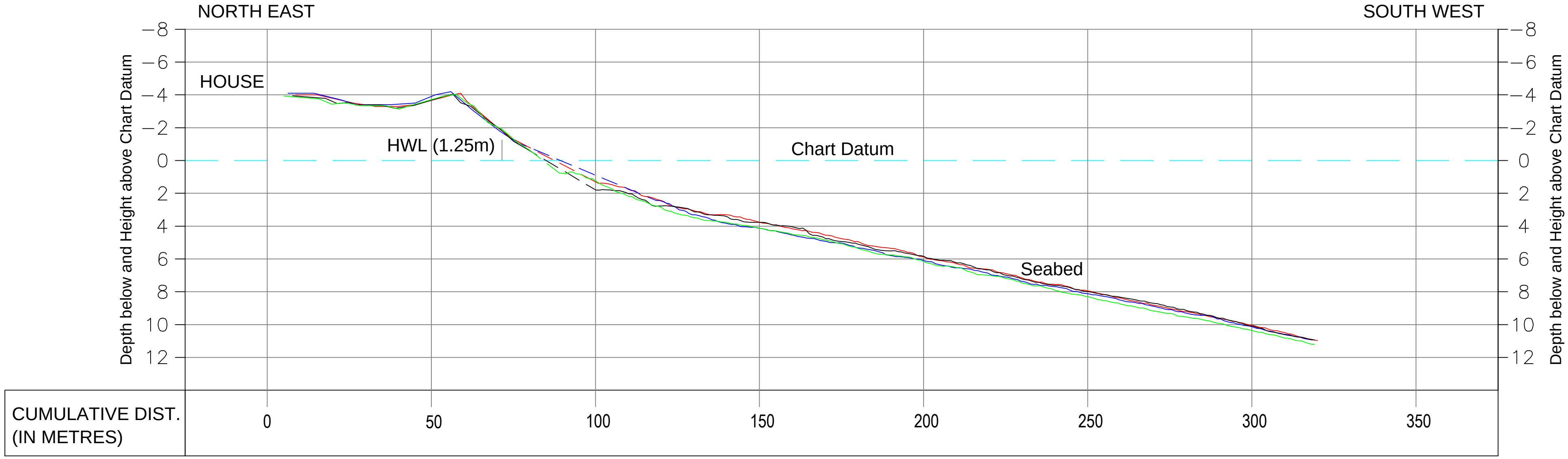
Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-80
(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

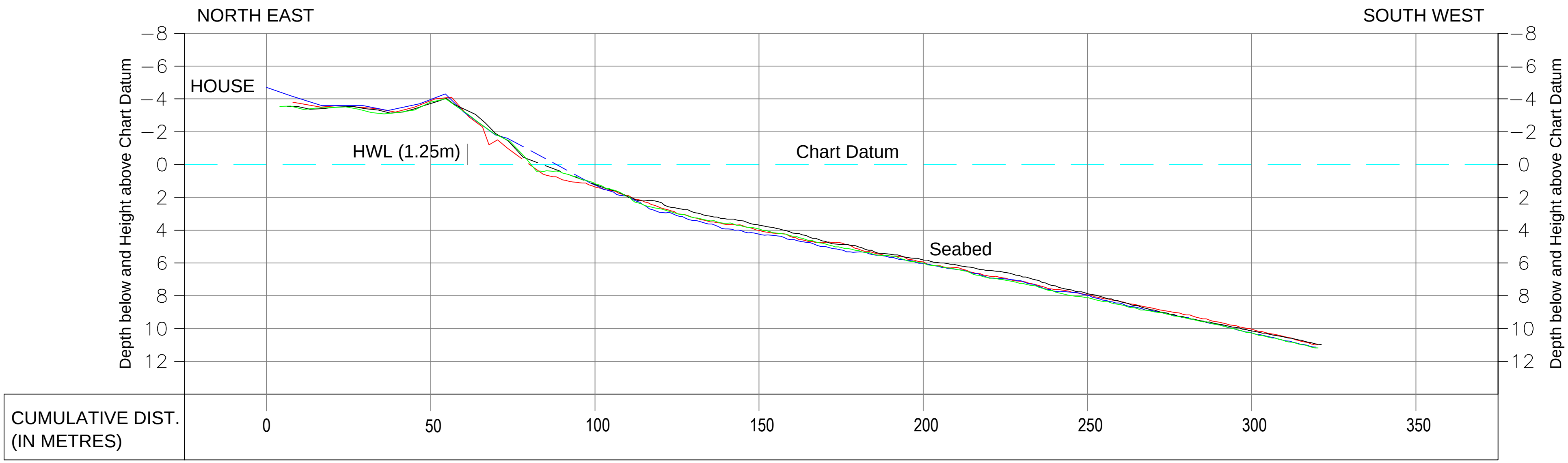
Profile March 2016

Profile April 2016

Profile May 2016

Cross Section Line No.CSP-81

(February, March, April, May 2016)



Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

Legend :

Profile February 2016

Profile March 2016

Profile April 2016

Profile May 2016

Annexure VIII

WATER SAMPLE REPORT

Standard[S] Environmental Monitoring

TEST REPORT

Test Report No: SEANN/1603/R218	Date: 19.03.2016	Page 1 of 2

CUSTOMER DETAILS	
Customer Name & Address	M/s Ocean Science & Surveying (P) Ltd Railway Station Complex, CBD Belapur, Navi Mumbai.
Customer Reference	Test Request Form Dated 14.03.2016

SAMPLE DETAILS			
Sampling Site	Proposed Vizhinjam Port	Sample Received On	12.03.2016
Sample Name	Water	Sample Condition	Good
Sampled On	07.03.2016	Test Started On	12.03.2016
Sampled By	By Customer	Test Completed On	18.03.2016

Location	Sample Name	Sampling Time	Parameters		
			Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)
			IS 3025 Part 10 (Reaff. 2012)	IS 3025 Part 17 (Reaff. 2009)	SEAAL/SOP/06
Dredge dumping/ Kovalam	WS_DD_Sur_001	7:00	0.8	3.2	37.70
Dredge dumping/ Kovalam	WS_DD_MID_002	7:00	1.1	2.8	39.45
Dredge dumping/ Kovalam	WS_DD_BOT_003	7:00	0.7	< 1.0	38.58
Dredge dumping/ Kovalam	WS_DD_Sur_004	8:00	0.3	< 1.0	39.45
Dredge dumping/ Kovalam	WS_DD_MID_005	8:00	< 0.1	< 1.0	37.70
Dredge dumping/ Kovalam	WS_DD_BOT_006	8:00	0.5	< 1.0	39.45
Dredge dumping/ Kovalam	WS_DD_Sur_007	9.00	0.9	< 1.0	37.70
Dredge dumping/ Kovalam	WS_DD_MID_008	9.00	1.5	4.1	35.07
Dredge dumping/ Kovalam	WS_DD_BOT_009	9.00	0.6	< 1.0	39.45
Dredge dumping/ Kovalam	WS_DD_Sur_010	10.00	0.4	< 1.0	37.70
Dredge dumping/ Kovalam	WS_DD_MID_011	10.00	0.5	< 1.0	35.05
Dredge dumping/ Kovalam	WS_DD_BOT_012	10.00	1.2	< 1.0	38.58
Dredge dumping/ Kovalam	WS_DD_Sur_013	11.00	0.6	< 1.0	39.45
Dredge dumping/ Kovalam	WS_DD_MID_014	11.00	< 0.1	< 1.0	35.07
Dredge dumping/ Kovalam	WS_DD_BOT_015	11.00	0.7	3.3	38.58
Dredge dumping/ Kovalam	WS_DD_Sur_016	12.00	1.0	< 1.0	37.70
Dredge dumping/ Kovalam	WS_DD_MID_017	12.00	< 0.1	< 1.0	38.58
Dredge dumping/ Kovalam	WS_DD_BOT_018	12.00	< 0.1	< 1.0	39.45
Dredge dumping/ Kovalam	WS_DD_Sur_019	13.00	0.9	2.4	37.70
Dredge dumping/ Kovalam	WS_DD_MID_020	13.00	1.2	< 1.0	38.58
Dredge dumping/ Kovalam	WS_DD_BOT_021	13.00	1.0	< 1.0	37.70

Standard[S] Environmental & Analytical Laboratories
Accreditation and Approval: NABL as per ISO 17025: 2005 & "A" Grade laboratory of KSPCB
K.J. Tower, Pathalam, Udyogamandal P.O., Ernakulam-683 501, Tel. 0484-2546660, 93 87 27 24 02, 90 20 67 24 02
Web: www.sealabs.in, E-mail: seaalab@gmail.com, info@sealabs.in

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Environmental Monitoring

TEST REPORT

Test Report No: SEANN/1603/R218	Date: 19.03.2016	Page 2 of 2

Location	Sample Name	Sampling Time	Parameters		
			Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)
			IS 3025 Part 10 (Reaff. 2012)	IS 3025 Part 17 (Reaff. 2009)	SEAAL/SOP/06
Dredge dumping/ Kovalam	WS_DD_Sur_022	14.00	< 0.1	< 1.0	39.45
Dredge dumping/ Kovalam	WS_DD_MID_023	14.00	< 0.1	< 1.0	38.58
Dredge dumping/ Kovalam	WS_DD_BOT_024	14.00	1.2	3.4	35.07
Dredge dumping/ Kovalam	WS_DD_Sur_025	15.00	< 0.1	< 1.0	38.58
Dredge dumping/ Kovalam	WS_DD_MID_026	15.00	0.5	< 1.0	37.70
Dredge dumping/ Kovalam	WS_DD_BOT_027	15.00	0.7	< 1.0	39.45
Dredge dumping/ Kovalam	WS_DD_Sur_028	16.00	2.1	3.9	38.58
Dredge dumping/ Kovalam	WS_DD_MID_029	16.00	0.8	< 1.0	38.58
Dredge dumping/ Kovalam	WS_DD_BOT_030	16.00	0.6	< 1.0	37.70
Dredge dumping/ Kovalam	WS_DD_Sur_031	17.00	< 0.1	< 1.0	35.07
Dredge dumping/ Kovalam	WS_DD_MID_032	17.00	< 0.1	< 1.0	39.45
Dredge dumping/ Kovalam	WS_DD_BOT_033	17.00	0.9	3.4	35.07

End of Report

For and on behalf of
Standard[s] Environmental & Analytical Laboratories

Authorized Signatory

Laiju P. N.
Laboratory Head

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Environmental Monitoring

TEST REPORT

Test Report No: SEANN/1603/R219	Date: 19.03.2016	Page 1 of 2

CUSTOMER DETAILS			
Customer Name & Address		M/s Ocean Science & Surveying (P) Ltd Railway Station Complex, CBD Belapur, Navi Mumbai.	
Customer Reference		---	
SAMPLE DETAILS			
Sampling Site	Proposed Vizhinjam Port	Sample Received On	12.03.2016
Sample Name	Water	Sample Condition	Good
Sampled On	07.03.2016	Test Started On	12.03.2016
Sampled By	By Customer	Test Completed On	18.03.2016

Location	Sample Name	Sampling Time	Parameters		
			Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)
			IS 3025 Part 10 (Reaff. 2012)	IS 3025 Part 17 (Reaff. 2009)	SEAAL/SOP/06
Vizhinjam Harbour	WS_DD_Sur_034	7:00	1.6	3.2	39.45
Vizhinjam Harbour	WS_DD_MID_035	7:00	0.3	< 1.0	35.95
Vizhinjam Harbour	WS_DD_BOT_036	7:00	4.4	8.3	38.58
Vizhinjam Harbour	WS_DD_Sur_037	8:00	0.6	< 1.0	36.82
Vizhinjam Harbour	WS_DD_MID_038	8:00	< 0.1	< 1.0	38.58
Vizhinjam Harbour	WS_DD_BOT_039	8:00	< 0.1	< 1.0	39.45
Vizhinjam Harbour	WS_DD_Sur_040	9.00	< 0.1	< 1.0	37.70
Vizhinjam Harbour	WS_DD_MID_041	9.00	0.4	< 1.0	38.58
Vizhinjam Harbour	WS_DD_BOT_042	9.00	0.6	< 1.0	36.82
Vizhinjam Harbour	WS_DD_Sur_043	10.00	1.0	< 1.0	37.70
Vizhinjam Harbour	WS_DD_MID_044	10.00	1.4	5.3	38.58
Vizhinjam Harbour	WS_DD_BOT_045	10.00	3.8	10.2	37.70
Vizhinjam Harbour	WS_DD_Sur_046	11.00	1.0	< 1.0	36.82
Vizhinjam Harbour	WS_DD_MID_047	11.00	2.1	4.1	35.95
Vizhinjam Harbour	WS_DD_BOT_048	11.00	1.9	3.3	38.58
Vizhinjam Harbour	WS_DD_Sur_049	12.00	0.8	3.4	36.82
Vizhinjam Harbour	WS_DD_MID_050	12.00	4.0	9.2	39.45
Vizhinjam Harbour	WS_DD_BOT_051	12.00	1.8	4.9	38.58
Vizhinjam Harbour	WS_DD_Sur_052	13.00	1.1	< 1.0	37.70
Vizhinjam Harbour	WS_DD_MID_053	13.00	2.2	3.9	35.95
Vizhinjam Harbour	WS_DD_BOT_054	13.00	3.6	6.8	36.82

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Standard[S] Environmental Monitoring

TEST REPORT

Test Report No: SEANN/1603/R219	Date: 19.03.2016	Page 2 of 2

Location	Sample Name	Sampling Time	Parameters		
			Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)
			IS 3025 Part 10 (Reaff. 2012)	IS 3025 Part 17 (Reaff. 2009)	SEAAL/SOP/06
Vizhinjam Harbour	WS_DD_Sur_055	14.00	0.7	< 1.0	37.70
Vizhinjam Harbour	WS_DD_MID_056	14.00	1.4	3.4	36.82
Vizhinjam Harbour	WS_DD_BOT_057	14.00	0.6	< 1.0	36.82
Vizhinjam Harbour	WS_DD_Sur_058	15.00	< 0.1	< 1.0	38.58
Vizhinjam Harbour	WS_DD_MID_059	15.00	< 0.1	< 1.0	39.45
Vizhinjam Harbour	WS_DD_BOT_060	15.00	0.9	< 1.0	38.58
Vizhinjam Harbour	WS_DD_Sur_061	16.00	< 0.1	< 1.0	36.82
Vizhinjam Harbour	WS_DD_MID_062	16.00	0.5	< 1.0	38.58
Vizhinjam Harbour	WS_DD_BOT_063	16.00	0.8	< 1.0	36.82
Vizhinjam Harbour	WS_DD_Sur_064	17.00	0.7	< 1.0	37.70
Vizhinjam Harbour	WS_DD_MID_065	17.00	0.6	< 1.0	36.82
Vizhinjam Harbour	WS_DD_BOT_066	17.00	0.8	< 1.0	38.58

End of Report

For and on behalf of
Standard[s] Environmental & Analytical Laboratories

Authorized Signatory

Laiju P. N.
Laboratory Head

Standard[S] Environmental & Analytical Laboratories
Accreditation and Approval: NABL as per ISO 17025: 2005 & "A" Grade laboratory of KSPCB
K.J. Tower, Pathalam, Udyogamandal P.O., Ernakulam-683 501, Tel. 0484-2546660, 93 87 27 24 02, 90 20 67 21 02
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Standard^S Environmental Monitoring

TEST REPORT

Test Report No: SEANN/1603/R221	Date: 19.03.2016	Page 1 of 2

CUSTOMER DETAILS			
Customer Name & Address	M/s Ocean Science & Surveying (P) Ltd Railway Station Complex, CBD Belapur, Navi Mumbai.		
Customer Reference	Test Request Form Dated 14.03.2016		
SAMPLE DETAILS			
Sampling Site	Proposed Vizhinjam Port	Sample Received On	12.03.2016
Sample Name	Water	Sample Condition	Good
Sampled On	07.03.2016	Test Started On	12.03.2016
Sampled By	By Customer	Test Completed On	18.03.2016

Location	Sample Name	Sampling Time	Parameters		
			Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)
			IS 3025 Part 10 (Reaff. 2012)	IS 3025 Part 17 (Reaff. 2009)	SEAAL/SOP/06
Pachallor	WS_DD_Sur_067	7:00	0.4	< 1.0	38.36
Pachallor	WS_DD_MID_068	7:00	0.5	< 1.0	35.80
Pachallor	WS_DD_BOT_069	7:00	0.7	< 1.0	39.21
Pachallor	WS_DD_Sur_070	8:00	0.4	< 1.0	38.36
Pachallor	WS_DD_MID_071	8:00	0.8	< 1.0	39.21
Pachallor	WS_DD_BOT_072	8:00	0.6	< 1.0	35.80
Pachallor	WS_DD_Sur_073	9.00	0.3	< 1.0	38.36
Pachallor	WS_DD_MID_074	9.00	0.5	< 1.0	40.06
Pachallor	WS_DD_BOT_075	9.00	1.1	< 1.0	38.36
Pachallor	WS_DD_Sur_076	10.00	0.5	< 1.0	36.65
Pachallor	WS_DD_MID_077	10.00	0.4	< 1.0	40.92
Pachallor	WS_DD_BOT_078	10.00	0.6	< 1.0	38.36
Pachallor	WS_DD_Sur_079	11.00	1.0	< 1.0	36.65
Pachallor	WS_DD_MID_080	11.00	0.7	< 1.0	37.51
Pachallor	WS_DD_BOT_081	11.00	0.9	< 1.0	39.21
Pachallor	WS_DD_Sur_082	12.00	0.3	< 1.0	37.51
Pachallor	WS_DD_MID_083	12.00	0.5	< 1.0	39.21
Pachallor	WS_DD_BOT_084	12.00	0.7	< 1.0	40.06
Pachallor	WS_DD_Sur_085	13.00	0.8	< 1.0	39.21
Pachallor	WS_DD_MID_086	13.00	0.9	< 1.0	38.36
Pachallor	WS_DD_BOT_087	13.00	0.1	< 1.0	39.21

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TEST REPORT

Test Report No: SEANN/1603/R221	Date: 19.03.2016	Page 2 of 2

Location	Sample Name	Sampling Time	Parameters		
			Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)
			IS 3025 Part 10 (Reaff. 2012)	IS 3025 Part 17 (Reaff. 2009)	SEAAL/SOP/06
Pachallor	WS_DD_Sur_088	14.00	0.9	< 1.0	37.51
Pachallor	WS_DD_MID_089	14.00	1.1	< 1.0	39.21
Pachallor	WS_DD_BOT_090	14.00	0.7	< 1.0	35.80
Pachallor	WS_DD_Sur_091	15.00	1.0	< 1.0	37.51
Pachallor	WS_DD_MID_092	15.00	0.5	< 1.0	38.36
Pachallor	WS_DD_BOT_093	15.00	0.9	< 1.0	37.51
Pachallor	WS_DD_Sur_094	16.00	0.8	< 1.0	39.21
Pachallor	WS_DD_MID_095	16.00	0.9	< 1.0	38.36
Pachallor	WS_DD_BOT_096	16.00	0.8	< 1.0	37.51
Pachallor	WS_DD_Sur_097	17.00	0.6	< 1.0	36.65
Pachallor	WS_DD_MID_098	17.00	0.7	< 1.0	37.51
Pachallor	WS_DD_BOT_099	17.00	0.5	< 1.0	39.21

End of Report

For and on behalf of
Standard^S Environmental & Analytical Laboratories

Authorized Signatory

Laiju P. N.
Laboratory Head

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Standard^S Environmental Monitoring

TEST REPORT

Test Report No: SEANN/1603/R222	Date: 19.03.2016	Page 1 of 2

CUSTOMER DETAILS	
Customer Name & Address	M/s Ocean Science & Surveying (P) Ltd Railway Station Complex, CBD Belapur, Navi Mumbai.
Customer Reference	---

SAMPLE DETAILS			
Sampling Site	Proposed Vizhinjam Port	Sample Received On	12.03.2016
Sample Name	Water	Sample Condition	Good
Sampled On	07.03.2016	Test Started On	12.03.2016
Sampled By	By Customer	Test Completed On	18.03.2016

Location	Sample Name	Sampling Time	Parameters		
			Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)
			IS 3025 Part 10 (Reaff. 2012)	IS 3025 Part 17 (Reaff. 2009)	SEAAL/SOP/06
Poovar	WS_DD_Sur_100	7:00	0.7	< 1.0	39.21
Poovar	WS_DD_MID_101	7:00	0.5	< 1.0	36.65
Poovar	WS_DD_BOT_102	7:00	0.8	< 1.0	37.51
Poovar	WS_DD_Sur_103	8:00	0.9	< 1.0	40.92
Poovar	WS_DD_MID_104	8:00	1.0	< 1.0	39.21
Poovar	WS_DD_BOT_105	8:00	0.6	< 1.0	38.36
Poovar	WS_DD_Sur_106	9.00	0.5	< 1.0	37.51
Poovar	WS_DD_MID_107	9.00	0.8	< 1.0	38.36
Poovar	WS_DD_BOT_108	9.00	1.2	< 1.0	39.21
Poovar	WS_DD_Sur_109	10.00	1.6	< 1.0	35.80
Poovar	WS_DD_MID_110	10.00	0.5	< 1.0	38.36
Poovar	WS_DD_BOT_11	10.00	1.0	< 1.0	39.21
Poovar	WS_DD_Sur_112	11.00	1.3	< 1.0	36.65
Poovar	WS_DD_MID_113	11.00	1.1	< 1.0	38.36
Poovar	WS_DD_BOT_114	11.00	0.9	< 1.0	40.92
Poovar	WS_DD_Sur_115	12.00	1.2	< 1.0	38.36
Poovar	WS_DD_MID_116	12.00	0.3	< 1.0	37.51
Poovar	WS_DD_BOT_117	12.00	0.9	< 1.0	38.36
Poovar	WS_DD_Sur_118	13.00	0.7	< 1.0	39.21
Poovar	WS_DD_MID_119	13.00	1.1	< 1.0	39.21
Poovar	WS_DD_BOT_120	13.00	0.9	< 1.0	39.21

Standard^S Environmental & Analytical Laboratories
Accreditation and Approval: NABL as per ISO 17025: 2005 & "A" Grade laboratory of KSPCB
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Web: www.sealabs.in, E-mail: seaalab@gmail.com, info@sealabs.in

Standard[S]
Environmental Monitoring

TEST REPORT

Test Report No: SEANN/1603/R222	Date: 19.03.2016	Page 2 of 2

Location	Sample Name	Sampling Time	Parameters		
			Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)
			IS 3025 Part 10 (Reaff. 2012)	IS 3025 Part 17 (Reaff. 2009)	SEAAL/SOP/06
Poovar	WS_DD_Sur_121	14.00	1.6	< 1.0	35.80
Poovar	WS_DD_MID_122	14.00	1.0	< 1.0	39.21
Poovar	WS_DD_BOT_123	14.00	1.5	< 1.0	37.51
Poovar	WS_DD_Sur_124	15.00	1.1	< 1.0	38.36
Poovar	WS_DD_MID_125	15.00	0.5	< 1.0	40.06
Poovar	WS_DD_BOT_126	15.00	0.5	< 1.0	34.95
Poovar	WS_DD_Sur_127	16.00	0.8	< 1.0	37.51
Poovar	WS_DD_MID_128	16.00	0.9	< 1.0	38.36
Poovar	WS_DD_BOT_129	16.00	0.6	< 1.0	37.51
Poovar	WS_DD_Sur_130	17.00	0.8	< 1.0	39.21
Poovar	WS_DD_MID_131	17.00	1.3	< 1.0	35.8
Poovar	WS_DD_BOT_132	17.00	0.9	< 1.0	40.92

End of Report

For and on behalf of
Standard[s] Environmental & Analytical Laboratories

Authorized Signatory

Laiju P. N.
Laboratory Head

Standard[S] Environmental & Analytical Laboratories
Accreditation and Approval: NABL as per ISO 17025: 2005 & "A" Grade laboratory of KSPCB
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Annexure II

Half yearly compliance report of conditions stipulated in KCZMA recommendation for Environment and CRZ Clearance

Sr. No.	Conditions	Compliance Status as on 31-03-2016
(i)	The developmental works and the construction of the structures may be undertaken as per the plans approved by the concerned local Authorities, local administration, conforming to the existing local and central rules and regulations including the existing provisions of CRZ Notification.	Necessary approvals from concerned Statutory Departments / Agencies have been obtained ❖ Consent to Establish from State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE/08/2015, dated 15.09.2015. ❖ All permits required for construction of buildings as per building by laws will be obtained as and when required. ❖ Airport Authority of India NOC vide NOC no AAI/SR/NOC/RHQ dated 7.12.2015
(ii)	Since the project envisages development of roads, infrastructural facilities, dredging of the lake and kayals proper environmental safety measures must be ensured.	All safety measures are being adopted. It is also brought to notice that dredging of lakes or kayals are not envisaged as part of this project
(iii)	The project proponent must obtain necessary clearance separately from the Kerala State Pollution Control Board, Health Department and other appropriate Authorities when such implementation programmes are undertaken.	"Consent for Establishment" has been obtained from Kerala State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE/08/2015, dated 15.09.2015.
(iv)	The construction should be undertaken, if any with least damages to the existing mangroves. A buffer zone of 50m shall be provided for mangroves present in the area.	There is no mangrove in the vicinity of the project area.
(v)	The project proponent must take necessary arrangements for disposal of solid wastes and for the treatment of effluents / wastes. It must be ensured that the effluents/solid wastes are not discharged into the backwater area/sea.	• No solid waste is being disposed of in the Coastal Regulation Zone area. • Currently no effluent is generated
(vi)	The project proponent should provide necessary facilities for official of the Kerala Coastal Zone Management Authority (KCZMA) for inspection of the project site and its premises at any time.	Noted

Half yearly compliance report of conditions stipulated in KCZMA recommendation for Environment and CRZ Clearance

Sr. No.	Conditions	Compliance Status as on 31-03-2016
(vii)	The KCZMA may be duly informed of any construction/ developmental works/ major activities undertaken in the CRZ area of the project	Following construction activities are in progress: • Temporary approach road of 1.2 KM • Reclamation of 10 Ha has been completed as of 30th Sept 2016
(viii)	Environmental clearance must be obtained from the Ministry of Environment & Forests.	Environment & CRZ Clearance has been obtained from Ministry of Environment & Forest vide MoEF letter dated 03rd January, 2014 (F.No.11-122/2011-IA.III)
(ix)	Adequate financial provisions has to be made for environmental protection measures.	A total of Rs 40 Crore has been set aside for environmental protection measures as per the EIA report
(x)	Scrutiny fee of Rs. 10,00,000/- (Rupees Ten lakh only) to be remitted under the head account 1425-800-97 applications for scrutiny fee etc. for CRZ clearance, in the district/Sub Treasury concerned, if private parties are involved in the project and the chalan receipt in original be forwarded to the Science & Technology Department quoting this letter.	Not applicable since the application for CRZ/Environmental clearance was submitted by Vizhinjam International Seaport Ltd.(VISL), a Government of Kerala undertaking

Annexure III

Compliance Status of Public Hearing Responses/Commitments

Sl No	Responses/Commitments	Status
1	Good compensation package for all livelihood issues have been included for all related PAPs for all affected sectors including the fisheries sector. Strict adherence to EMP compliance with all relevant rules and regulations will be done	In consultation with the fishermen, an enhanced livelihood compensation package amounting to Rs. 23.80 crores was sanctioned by GoK, instead of Rs.7.1 crores suggested earlier in the EIA stage. Out of this amount, Rs.11.70 crores have been disbursed till 30th Sept 2016 for a total number of 183 livelihood affected PAP's whose verification were complete in all respects. Verification of the documents of balance PAP's is in progress.
2	Land under the Jamaath which includes Karimppaly, Magham, Varuthari Pally, etc. need to be protected and should not be acquired.	Complied
3	Compensation for the land acquired (rail/road connectivity and back up areas) are paid promptly and any for additional land required also will be paid in the same way.	Compensation for all the procured land has been disbursed along with R&R package. Compensation for balance land to be acquired will also be disbursed promptly.
4	Additional fish landing centre will be constructed	The work for construction of the fish landing centre (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated as part of the funded work component of the concession agreement with AVPPL.
5	Existing harbour will be improved under the CSR provisions of the project	Action for modernization of the existing fishing harbour will be initiated through the harbour engineering department.
6	Fisherman will get first preference to cross the ship channel	Will be complied as per the applicable laws
7	GoK/VISL will monitor the shore line changes during construction and operational phases. If necessary, intervention to arrest erosion will be carried out.	Baseline year round status of the shoreline has been mapped from Feb 2014 to Jan 2015 for a stretch of 40km. Change monitoring is being continued for

		the construction phase.
8	Water supply provision to the Vizhinjam fishing village	Scheme has been commissioned in April, 2013 by VISL by expending an amount of Rs. 7.33 crores. For O&M of the same an amount of Rs.2.99crores has been spent till date by VISL. AVPPL have installed 20 water tanks in the water scarce areas in the project neighbourhood and water is being supplied on a daily basis on mobile water tankers. An amount of Rs13.54 lakhs has been spent by AVPPL on this account till date.
9	Construction of the new fishing harbour will be simultaneously completed with the port project	The work for construction of the fish landing centre (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated as part of the funded work component of the concession agreement with AVPPL
10	Railway work will be initiated after Environment Clearance (EC)	Action being taken through M/s Rail Vikas Nigam Ltd (RVNL)
11	Job Opportunity - Preference will be given to local people during construction stage	Being complied
12	Rehabilitation measures ensures employment opportunities for fishermen	R&R package for fishermen has been finalised in consultation with the affected PAP's & is being disbursed
13	Take all possible measures for judicial use of lighting system as part of the Green Port concept to reduce the carbon footprint	Will be considered with appropriate planning.
14	Appropriate action like providing compensation or alternate employment etc to fishermen will be implemented wherever applicable after the Environment Clearance	R&R package for fishermen has been finalised in consultation with the affected PAP's & is being disbursed
15	Compensation, Resettlement and Rehabilitation benefits to all the livelihood affected and displaced fisherman will be implemented after the Environment Clearance	R&R package for fishermen has been finalised in consultation with the affected PAP's & is being disbursed
16	Waste management is included in the EMP and E&E waste management is part of the SWMP.	A budgetary provision has been included for waste management. MoU signed between Thiruvananthapuram Municipal Corporation & Adani Foundation for

		installation of Aerobins & Sanitation facilities in the wards, viz.Vizhinjam, Kottappuram& Harbour
17	Upgradation of PHC at Vizhinjam will be carried out	Revised Plan for upgrading Community Health Centre (CHC) –Vizhinjam was presented to the Department of Health, Government of Kerala by Adani Foundation. As per the revised plan Adani Foundation would construct the second floor in the upcoming building at CHC with necessary equipment support, whereas the basement and first floor would be constructed by harbour department
18	New fishing harbour with all the infrastructural facilities will be constructed with reserved rights to mooring/berthing the boats	The work for construction of the fish landing centre (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated as part of the funded work component of the concession agreement with AVPPL
19	Appropriate compensation will be given to the resort owners as per the regulatory advice of KCZMA and MoEF since the resorts are seen to be located in No Development Zone (NDZ) as per CRZ Notification 2011	Discussion for fixing of compensation packages for the affected resort owners have been initiated by the District level Planning Committee (DLPC) headed by the District Collector and is in progress
20	Rail, Road, Coastal and Inland Waterways connectivity will be ensured to the rest of Kerala and other Indian Peninsula Ports	This is one of the objectives of the project and this will be fully materialised once all phases of the project are implemented.
21	Waste Management, Water Treatment plants, etc. will be part of an operational EMP	Decentralized waste water management techniques as per EMP will be carried out.
22	Shoreline monitoring on 15 km both sides on regular basis during construction and operation as suggested in EIA report will be carried out	Baseline year round status of the shoreline has been mapped from Feb 2014 to Jan 2015 for a stretch of 40km. Change monitoring is being continued for the construction phase.
23	VISL will ensure that appropriate dredging and reclamation methodology as suggested in EIA report will be adopted to contain the turbidity within applicable limits.	Being complied
24	Appropriate measures relating to maintenance of health, hygiene, safety and security will be implemented as per EIA	Being complied. An officer of VISL has been designated as Head (EHS & CSR) for effective implementation of the

	report	stipulated EHS safeguards & CSR activities. AVPPL, the concessionaire executing the project has also appointed officers for EHS & CSR. In addition to the above, independent environment, health and safety consultants have been appointed as required in the concession agreement signed with AVPPL.
25	VISL will ensure that livelihood issues of Mussel collectors are addressed as per the EIA report	R&R package for fishermen has been finalised in consultation with the affected PAP's & disbursed
26	VISL will ensure all the project components i.e., including road/rail connectivity are implemented in time. In addition the planned CSR and EMP measures will also be implemented and monitored to ensure the socio-economic development of the region.	Being complied
27	The implementation of the EMP/RAP/CSR will be ensured through the institutional and regulatory mechanism with regular monitoring and periodic compliance reports to the MoEF	Being complied
28	Special care will be taken to minimise the tree felling in the backup area and to plan the development in tune with the topography.	Being complied to the extent possible, but in line with the technical requirements of the project
29	The livelihood restoration measures for fisherman affected during construction phase as reported in the EIA has to be implemented	R&R package for fishermen has been finalised in consultation with the affected PAP's & disbursed
30	Dredging materials will be used for reclaiming (filling) the sea and additional materials are not required	Being complied
31	The number of fisherman who will be temporarily affected in the Adimalathura stretch have been assessed and livelihood restoration measures have been framed for the construction period	As and when the works in this stretch is initiated, appropriate compensation will be disbursed during the affected period
32	There will be no erosion on the shoreline on account of dredging the deep sea at (-) 18m to (-) 20m	Baseline year round status of the shoreline has been mapped from Feb 2015 to Jan 2016 for a stretch of 40km. Change monitoring is being continued for

		the construction phase.
33	An Area Development Plan is being prepared by CEPT University (Ahmedabad) for planned development of the region to avoid haphazard development.	Being followed up for finalisation, including the inputs from AVPPL, the concessionaire for the project.
34	Maximum 3 ships are expected per day in phase I. Appropriate traffic mechanism to cross the ship channel for fisherman with first priority will be practised as is happening in Cochin Port where fishing harbour, container berth, navy, shipyard, inland water transport etc are co-existing	Will be complied in the operation phase
35	An additional fish landing centre has been suggested at Vizhinjam to decongest the existing harbour, and to cater to the needs of the fisherman in the 15 km vicinity including Pozhiyur & Poovar, considering the suitability of the site having natural bay, increased tranquillity and operational / infrastructural convenience than location like Pozhiyur–Poovar estuary	The work for construction of the fish landing centre (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated as part of the funded work component of the concession agreement with AVPPL
36	Implementation of CSR measures and planned development of the region through well designed area development plan will arrest the formation of slums and the like.	Refer point 33 above
37	"Inconvenience Allowances" during construction period of three years to the fisherman (As per EIA Report)	Inconvenience allowance in the form of kerosene for outboard engines for circumventing the construction site will be provided to affected boats during the construction period.
38	As per the Entitlement Framework, Hardship Allowance is suggested in the EIA/EMP for resort workers who lost their job due to acquisition of the resort	Compensation for livelihood loss; Rs 6.06 Crores out of allocated 6.11 Crores has been disbursed to 209 out 211 number of resort workers.
39	During the construction period of three years livelihood assistance to the shore seine fisherman in the 2km ship channel foot print beach has been suggested although they can move further southward and continue with their activity.	As and when the works in this stretch is initiated, appropriate compensation will be disbursed during the affected period
40	Ensure that all EMP related aspects are	Will be complied

	properly implemented during construction and operational phase	
41	A dedicated port road directly connecting to NH-47 bypass is envisaged.	This is part of the concession agreement signed with AVPPL
42	Rail connectivity is proposed along the outer side of the stream running parallel to the harbour road and that too on elevated structures without affecting the entry to the fishing harbour	Will be complied
43	The port project will not affect the inflow of Neyyar river and AVM canal	This is a fact, since both are away from the project site
44	The port road will be access controlled for the exclusive use of container and related port movements. The suggestion for a new approach road can be considered on technical feasibility and subject to surrendering of adequate land by the beneficiaries	Scope of providing connectivity for the local residents to the nearest Vizhinjam-Poovar road will be considered subject to surrendering of adequate land by the beneficiaries
45	The Master Plan has already included a reservoir/ground water recharge facility adjoining the road for water-shed management	Will be complied
46	Where ever possible and based on eligibility, local people will be employed	Will be complied
47	Reconstruction of Roads in the nearby area- Adequate provisions have been made for the old fishing harbour and its linkage roads as it will be adopted as a part of best practice and beautification process	Will be complied
48	The development of the warehouse area will be taken up	This is part of the proposed port estate development
49	Livelihood Compensation considered for those who were affected at Adimalathura during construction phase and those affected in the project foot print area at Mulloor and Valiyakadappuram during construction/ operation phase	R&R package for fishermen has been finalised in consultation with the affected PAP's & is being disbursed. As and when the works in Adimalathura stretch is initiated, appropriate compensation will be disbursed during the affected period
50	CSR activity suggested a skill development centre to equip the local people to adapt to the industrial needs of port/tourism and fisheries so that they can be appropriately	Need Assessment Study conducted in a sample size of 12,300 youth for skill development programme. . Employability, Livelihood & Construction

	employed based on their merit. However during construction period the EIA study has suggested to adequately employ local population to the maximum extent possible	Skill Development Programme initiated through Adani Foundation.
51	Loss of livelihood to the traditional fisherman who do shell fishing in the Mulloor beach area is a real issue/impact. All necessary provisions for livelihood assistance have been considered in the EIA Report.	R&R package for fishermen has been finalised in consultation with the affected PAP's & disbursed
52	Only prohibited area for fishing is inside the breakwater. However fishing will be restricted along ship channel and port limits subject to safety norms and operational requirements.	Will be complied during operation phase
53	The existing notification of the Vizhinjam Port includes the Vizhinjam Fishing harbour. The revised Notification will include the Vizhinjam Deep Water Port based on revised Port limit provided in the EIA report. Except inside the breakwater of the Deep Water Port in all other areas of the port limit fishing is allowed with all safety and operational restrictions.	Revised port limits for (i) fishing harbour/minor port and (ii) Vizhinjam seaport will be notified. Restrictions on fishing will be as per the applicable laws.
54	There will only be a movement of 8 barges per day during the construction period of 3 years and the same will not be a hindrance for the fisherman to cross since this is far less than the number of ships being crossed by them daily in the international ship channel.	Inconvenience, if any, to fishing will be monitored during the construction phase.
55	The maximum rate of accretion at southern side of the harbour will be 21.6 m/year in the 1st year and by the end of tenth year it reduces to 0.5 m/year. The shoreline evolution along the south side of the port will get stabilized in the initial years. On stabilization, the maximum net increase in the shoreline accretion would be around 27m immediately south of the port which reduces to negligible levels within 2.3km alongshore. There will not be any impact on the shoreline along Poovar-Pozhiyar sector which is about 7km away from the proposed port.	Baseline year round status of the shoreline has been mapped from Feb 2015 to Jan 2016 for a stretch of 40km. Change monitoring is being continued for the construction phase.

56	The 8 resorts affected will be compensated in line with R&R package in place but subject to the advice of the KCZMA/MoEF considering that all these resorts are in NDZ as per CRZ Notification, 2011	Discussion for fixing of compensation packages for the affected resort owners have been initiated by the District level Planning Committee (DLPC) headed by the District Collector and is in progress
57	The cruise terminal proposed in the project, will promote tourism in the Kovalam-Poovar belt and the region may become the cruise hub/tourism gate way of India in future	Once the first phase of port becomes operational, it would naturally attract cruise tourism. Based on the development of cruise business, dedicated cruise berths will be planned in a phased manner. Action is also being taken in consultation with the State tourism department, to design port linked tourism packages covering the Kovalam-Vizhinjam- Poovar tourism corridor
58	CSR activity considers training the local people to adapt to the new economic development of the area	Need Assessment Study conducted in a sample size of 12,300 youth for skill development programme. . Employability, Livelihood & Construction Skill Development Programme initiated through Adani Foundation
59	The Coast Guard & Navy Berth are as per the needs of the Ministry of Defense on national security	Specific conditions have been included in the concession agreement relating to use of berths by Navy/Coast Guard

Annexure IV

Status of Environment Management Plan- Port site- Construction Stage

Potential Impacts and Mitigation Measures of Various Project Activities

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30th Sept2016
Construction Phase					
1	Capital dredging	Marine water quality	○ Increase in turbidity ○ Change in marine water quality due to aqueous discharges (oily waste, sanitary wastes) from dredgers, barges and workboats	○ Check turbidity levels with baseline levels as reference during entire monitoring programme ○ Preparation of Dredge/reclamation Management plan ○ Discharge of waste into sea will be prohibited ○ Oil Spill control measures will be adopted ○ Ensure that slop tanks will be provided to barges/ workboats for collection of liquid/ solid waste ○ Marine environmental monitoring as per environmental monitoring programme	○ Capital dredging has started in a limited way since Dec 2015 with the use of a cutter suction dredger. Turbidity level during the dredging was monitored at three locations and found to be within the permissible limits
		Marine ecology	○ Decrease in DO levels ○ Increase in noise levels ○ Removal of benthic communities ○ Increase in species diversity and density in areas adjoining dredging site ○ Smothering or blanketing of sub-tidal communities		○ Marine Environmental Monitoring has commenced since August 2016 and the parameters are within permissible limits.
2	Material transport and construction activities	Air Quality	○ Exhaust emissions from vehicles ○ Windblown dust during material movement ○ Fugitive dust during material unloading ○ Dust suspension during site preparation, construction	○ Most of the Breakwater stones will be transported from the quarries to the nearest harbour. From there through Barges it will be transported to project site. This is will avoid substantiate flow of Heavy Vehicles during construction	○ Rejected rocks being cleared as part of quarry closure plan is being used for Breakwater Construction. Fugitive emission during transportation is contained by water sprinkling on approach roads and tarpaulin covering

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30th Sept2016
				Phase thereby minimizing impact on Air and Noise Quality in the project region. ○ To reduce impacts from exhausts, emission control norms will be enforced / adhered. ○ All the vehicles and construction machinery will be periodically checked to ensure compliance to the emission standards ○ Construction equipment and transport vehicles will be periodically washed to remove accumulated dirt ○ Providing adequately sized construction yard for storage of construction materials, equipment tools, earthmoving equipment etc ○ Provide enclosures on all sides of construction site ○ Movement of material will be mostly during non-peak hours. ○ On-site vehicle speeds will be controlled to reduce excessive dust suspension in air and dispersion by traffic ○ Water sprinkling will be carried out to suppress fugitive dust	of the transport trucks

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30th Sept2016
				○ Environmental awareness program will be provided to the personnel involved in developmental works ○ Use of tarpaulin covers and speed regulations for vehicles engaged in transportation	
		Noise	Noise from following activities ○ Vehicles transporting construction material ○ Diesel run engines of construction machinery and dredgers ○ Pile driving activities during construction of cargo berths	○ Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB ○ Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A) ○ Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used ○ Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors ○ Noise attenuation will be practiced for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers	○ Noise levels are being monitored every fortnight and are found to be well within the permissible limits within the project area .

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30th Sept2016
				○ High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am to 10pm) to minimise noise impacts ○ Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. ○ Ambient noise levels will be monitored at regular intervals	
		Disturbance to Natural Drainage pattern	○ Impact to natural flow of runoff due to blockage and change of drainage course	○ Port development is mostly on reclamation ○ Rainwater/surface water harvesting pond included in design ○ Existing drainage near port boundary (backup area) will be integrated with port storm water drainage & management plan ○ Existing drains / Streams that are passing in ware house area will not be closed/ diverted. And these streams will be de-silted and enhanced to improve their carrying capacities	○ Measures have been taken for maintaining the natural flow of the streams debouching in the construction site, by laying drain pipes beneath the temporary road. A mix of water harvesting pond with appropriate drains are planned for the operational phase
		Vegetation and Strain on existing infrastructure	○ Loss of vegetation and strain on existing infrastructure.	○ Port development is planned mostly on reclaimed land; ○ Land use at backup area, PAF Zone and warehouse area will be mostly coconut	○ Care is taken to limit the felling of trees to the bare minimum. Plantation of saplings along the road margins and port boundary are planned as part of the

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30th Sept2016
				plantation and low mixed plantation ○ Adequate green belt will be developed in port and its associated (backup area, PAF, warehouse and road & rail connectivity). ○ Temporary workers camp with self-sufficient infrastructure facilities.	master plan development
		Existing Traffic	○ Traffic addition	○ NH-47 bypass under construction around 2.0 km from the proposed Port site and the Transportation of construction materials will be carried out during non- peak hours. Hence a dedicated road of 45 M RoW is proposed to connect site with NH Bypass ○ Regularization of truck movement ○ Majority of rock for breakwater construction will be transported through sea route via barges from nearby quarry sites ○ A dedicated rail network of approximately 15 km is proposed from port to Nemom railway station	Traffic monitoring & regularization is being carried out for maximum efficiency
3.	Land Reclamation	Existing Water Resources like Groundwater	○ The surface water drainage system may get affected	○ Land to be reclaimed will be separated from adjoining land by creating containment bund. ○ Return sea water will be sent back to sea	○ The existing drains are maintained for unhindered disposal of surface drainage water.

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30th Sept2016
		and surface water		through appropriate channels.	
4.	Solid Waste Management	Soil quality	○ Impacts due to disposal of solid waste on ground without treatment	○ Construction waste will be used within port site for filling of low lying areas. ○ Composted bio-degradable waste will be used as manure in greenbelt. ○ Other recyclable wastes will be sold. ○ Excavated soil at backup, PAF Zone and ware house area will be stockpiled in a corner of the site in bunded area to avoid run off with storm water. ○ General refuse generated on-site will be collected in waste skips and separated from construction waste. ○ Burning of refuse at construction sites will be prohibited. ○ All control measure will be taken to avoid the contamination of groundwater during construction phase	○ Construction waste will be used within port site for filling of low lying areas. ○ Burning of refuse at construction sites is prohibited. ○ There is no disposal of waste in the project area which may lead to groundwater contamination ○
5.	Handling of hazardous wastes	Human safety and property loss	○ Fire accidents due to hazardous material handling	○ Adequate safety measures as per OSHA standards will be adopted ○ Construction site will be secured by fencing with controlled/limited entry points. ○ Hazardous materials such as lubricants, paints, compressed gases, and varnishes	Presently no hazardous waste is being handled as the present construction activities are of preliminary nature., a. Adequate safety measures as per OSHA standards will be adopted as and when necessary. b. Construction site is secured by

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30th Sept2016
				etc., will be stored as per the prescribed/approved safety norms. ○ Construction site will be secured by fencing with controlled/ limited entry points ○ Medical facilities including first aid will be available for attending to injured workers. ○ Handling and storage as per statutory guidelines. ○ Positive isolation procedures will be adhered ○ Hazardous wastes will be disposed through approved KSPCB/CPCB vendors.	fencing with controlled/limited entry points c. Medical facilities including first aid are available for attending to injured workers. d. Handling and storage as per statutory guidelines. e. Hazardous wastes will be disposed through approved KSPCB/CPCB vendors.
6.	Water Resources	Water scarcity / Pollution	○ Impacts to the surface water body	○ Water requirement during the construction is expected to be around 0.10 MLD ○ Water will be sourced from Vellayani lake ○ Avoid/minimise the loss during conveyance ○ Optimized utilization of the water ○ Care will be taken to prevent the runoff from the construction site to the nearby natural streams, if any	○ A water treatment plant of 3mld capacity is already commissioned. Source of the water is Vellayani lake.
7.	Fishing	Fisherme	○ Impact on fishing due to Construction	○ Signboards will be placed at the	○ Signboards have been placed for

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30th Sept2016
		n and fishing villages	works	construction activities in order to make fishermen aware of the ongoing construction activities ○ Necessary marker buoys will be installed ○ Interactions will be initiated with the fishing community before commencement of construction works	demarcation of construction area. ○ Continuous interaction being done with fishing community for mutual understanding of construction activity.
8.	Tourism	Effect on tourism	Loss of Pocket beach/access/expose to beach / loss of resorts and other tourist facilities in the acquired area	○ Tourism activity is observed at Kovalam located about 2.0 km towards the North of Proposed Port. Mathematical Modelling studies on shoreline changes show the insignificant impact due to the port development on the existing coastline. However, the Shoreline monitoring during construction as well as operation Phases were proposed and given as Appendix 5.4. ○ A cruise terminal and related facilities is part and parcel of the project. This is to largely compensate the losses made ○ For all acquired properties and land adequate compensation will be provided based on legally valid documents	○ The tourism activity in the nearby Kovalam area is not impacted by the construction of the port. ○ Once the first phase of port becomes operational, it would naturally attract cruise tourism. Based on the development of cruise business, dedicated cruise berths will be planned in a phased manner. Action is also being taken in consultation with the State tourism department, to design port linked tourism packages covering the Kovalam-Vizhinjam- Poovar tourism corridor ○ Discussion for fixing of compensation packages for the affected resort owners have been initiated by the District level Planning Committee

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30th Sept2016
					(DLPC) headed by the District Collector and is in progress
9	Breakwater	Change in shoreline	Erosion and accretion along the coast	○ Shoreline monitoring shall be carried out ○ Suitable Shoreline protection measures will be implemented based on the observations	○ Shoreline monitoring of 40 km area along the shore (20 km each on either side of project area) is being done. No need has arisen so far for any mitigation measures.
10	Effect on existing fishing harbour	Movement of fishing boats	○ Restriction on free movement of fishing boats to/ from fishing harbour ○ Tranquillity in fishing harbour ○ Loss of livelihood	○ Detailed modelling studies have been carried out on tranquillity conditions in the fishing harbour with port development. The studies reveal that the tranquillity conditions will be improved in fishing harbour with construction of the port. Further minor accretion happening within the fishing harbour will be arrested ○ Traffic of Marine vessel/ fishing boats will be planned without affecting each other ○ Adoption of fishing harbour to manage it to perform as per International standard ○ A new fishing harbour provided under CSR initiatives because of additional tranquillity creator. ○ Loss of livelihood will be either taken care of in the new port	○ Wave, current and tide data are being monitored along with the shoreline monitoring of 40 km stretch. Based on the above, the modelling studies done at the EIA stage will be further evaluated and related to the shoreline evolution. ○ Traffic of Marine vessel/ fishing boats will be planned without affecting each other ○ The work for construction of the fish landing centre (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated as part of the funded work component of the concession agreement with AVPPL ○ In consultation with the fishermen, an enhanced livelihood compensation package amounting to Rs. 23.80 crores was sanctioned by GoK,

Sl .No	Activity	Relevant Environmental Components likely to be impacted	Likely Impacts in the absence of Mitigation Measures	Proposed Mitigation Measures	Status as on 30thSept2016
				premises or adequately compensated mostly in the form of employment	instead of Rs.7.1 crores suggested earlier in the EIA stage. Out of this amount, Rs.11.70 crores have been disbursed till 30th Sept 2016 for a total number of 183 livelihood affected PAP's whose verification were complete in all respects. Verification of the documents of balance PAP's is in progress.
11	Shoreline changes	erosion/accretion	Loosing of beach area Impact on houses/ structures along the coast	Final shoreline Impact management plan will be prepared in consultation with agencies like CESS/INCOIS, NGO and local bodies and will implemented. The draft shoreline impact management plan is given in Appendix 6.6.	○ Shoreline monitoring of 40 km length is being done under the technical guidance of National Institute of Ocean Technology (NIOT), Chennai.

Environmental Management Plan - Road/Rail Corridors*

***Construction work has not commenced in this area**

Sl.No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Current Status
1	EnvironmentalManagementand MonitoringFacilityEquipmentfor EMP(Meters,VehiclesandBuilding s)	This will include institutional requirements, training, environmental management and monitoring. Provision for purchasing required equipment.	During and after construction (Five Years)	As a Project specific action this will have to be incorporated	○ An Environment Management Cell has been established to look after day to day affairs like Monitoring, Training ○ An officer of VISL has been designated as Head (EHS & CSR) for effective implementation of the stipulated EHS safeguards & CSR activities. AVPPL, the concessionaire executing the project has also appointed officers for EHS & CSR. In addition to the above, independent environment, health and safety consultants have been being appointed as required in the concession agreement signed with AVPPL. ○ Necessary equipment will be purchased. ○ Third party environmental monitoring has commenced since August and the monitoring results are satisfactory
2	Altered Road embankments	Retaining walls and gabions should be provided	During construction	Design standard requirement	Will be complied as and when required
3	Dust	○ Water should be sprayed during the construction phase, at mixing sites, and temporary roads. ○ In laying sub-base, water	During the Construction phase	Design standard requirement	Being Complied

Sl.No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Current Status
		spraying is needed to aid compaction of the material. After the compaction, water spraying should be carried out at regular intervals to prevent dust. o Vehicles delivering materials should be covered to reduce spills and dust blowing off the load.			
4	Air Pollution	o Vehicles and machinery are to be maintained so that emissions conform to National and State standards. o All vehicles and machineries should obtain Pollution Under Control Certificates (PUC).	Beginning with and continuing throughout construction phase	MORTH's Specifications	Being Complied
5	Noise	o Machinery and vehicles will be maintained to keep their noise to a minimum. o Construction of noise barriers of an average length of 100m and eight feet height where ever necessary. o Proper maintenance of the rail track and rail wagon, by frequent lubrication to avoid frictional noise. o Regular monitoring shall be	Beginning and throughout construction phase	MORTH's Specifications	Being Complied

Sl.No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Current Status
		carried out as per the Environmental Monitoring Plan.			
6	Loss of low lying land and ponds	○ Impacted ponds can be enhanced by constructing bridged structures like Gabions to avoid plugging of springs. ○ Mitigation/Compensation shall be affected for the completely impacted ponds. ○ At Chainage km 6.500 the Railway alignment goes below the Existing NH and then at km 6.600 it will hit pond. The pond will be excavated partially and the soil material shall be used to fill in the western part and an equivalent area lost may be excavated to compensate the loss of effective pond area.	During Construction phase	MORTH's Specifications	Will be complied
7	Flood Impacts and Cross Drainage Structures	Formation level should be raised according to the design and the cross drainage structures suitably planned for the flood events.	During construction phase	MORTH's Specifications	Will be complied
8	Alteration of drainage	○ In sections along watercourses, earth and stone will be properly disposed of so as not to block rivers and streams, thereby preventing any adverse impact	During construction phase	MORTH's Specifications	Will be complied

Sl.No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Current Status
		on water quality. o All necessary measures shall be taken to prevent earthworks and stone works from impeding cross drainage at streams and canals or existing irrigation and drainage systems in conformity to the Contractors visual integration and management plan and EMP.			
9	Contamination from Wastes	All justifiable measures will be taken to prevent the wastewater produced during construction from entering directly into rivers and irrigation systems	Throughout construction phase	MORTH's Specifications	Will be complied
10	Borrow pits	Borrow pits are to be identified, opened and closed after consultations and proper documentation	During construction phase	MORTH's Specifications	Will be complied as and when required
11	Quarrying and Material sources	o Quarrying will be carried out at approved and licensed quarries only. o Details of Quarrying material sources are given in Chapter 4.	During construction phase	MORTH's Specifications	Construction material is being procured from approved quarries belonging to third party contractors
12	Soil Erosion and Soil Conservation	o On slopes and other suitable places along the two proposed corridors, trees and grass should be planted.	During construction and upon completion of construction	MORTH's Specifications	Will be complied

Sl.No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Current Status
		○ On sections with filling and deep cutting their slopes should be covered by sod, or planted with grass, etc. ○ If existing irrigation and drainage system, ponds are damaged, they will be suitably repaired. ○ Retaining walls and gabions shall be suitably provided.	activities at these sites.		
13	Loss of agricultural topsoil	○ Arable land should not be used for topsoil borrowing. ○ Topsoil will be kept and reused after excavation is over. ○ Any surplus to be used on productive agricultural land.	During construction phase	MORTH's Specifications	Arable land has not been used
14	Compaction of Soil and Damage to Vegetation	Construction vehicles should operate within the Corridor of Impact avoiding damage to soil and vegetation.	During construction	MORTH's Specifications	Being Complied
15	Loss of trees and Avenue Planting	○ Areas of trees cleared will be replaced according to Compensatory Afforestation Policy under the Forest Conservation Act - 1980. ○ Landscaping shall be done at major junctions.	After completion of construction activities	MORTH's Specifications	Will be complied alongside the road and port boundaries
16	Vegetation clearance	Tree clearing within the ROW should be avoided beyond that which is	During cleaning operations	MORTH's Specifications	Being complied

Sl.No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Current Status
		directly required for construction activities and/ or to reduce accidents. Especially in plantation and house garden areas both along road and rail alignment.			
17	Fauna	Construction workers should protect natural resources and animals. Hunting of birds and other local animals is prohibited.	During construction phase	MORTH's Specifications	Being complied
1 8	Traffic Jams and congestion	If there is traffic congestion during construction, measures should be taken to relieve it as far as possible with the co-operation of the traffic police.	During construction phase	MORTH's Specifications	Being complied
19	Health and Safety	All contractors' staff and workers must wear high visibility purpose made overalls or trousers/a waist coat at all times All operators working with any materials above head height (even in trenches) must wear hard hats all at times on the worksite.	Health and Safety	MORTH's Specifications	Complied
20	Pollution of Streams parallel or along the alignments	Construction material /waste should be disposed of properly so as not to block or pollute streams or ponds with special attention to confining concrete work.	During construction phase	MORTH's Specifications	Being Complied
21	Cultural Remains	Construction should be stopped until	Throughout	ASI Acts	Being complied

Sl.No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Current Status
		authorised department assess the remains to preserve Archaeological relics and cultural structures like Temples, mosques and churches. Archaeologists will supervise the excavation to avoid any damage in the relics.	Construction phase		

Environment Management Plan – Warehouse Area* (Construction Phase)

***Construction work has not commenced in this area**

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
	WAREHOUSE AREA				
	Construction Phase				
1	Material transport and construction activities	Air Quality/Dust	○ Exhaust emissions from vehicles ○ Windblown dust during material movement ○ Fugitive dust during material unloading ○ Dust suspension during site preparation, construction and trenching	○ To reduce impacts from exhausts, emission control norms will be enforced / adhered. ○ All the vehicles and construction machinery will be periodically checked to ensure compliance to the emission standards. ○ Construction equipment and transport vehicles will be periodically	Being complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				washed to remove accumulated dirt. ○ Providing adequately sized construction yard for storage of construction materials, equipment, tools, earthmoving equipment, etc. ○ Provide enclosures on all sides of construction site ○ Movement of material will be mostly during non-peak hours. ○ On-site vehicle speeds will be controlled to reduce excessive dust suspension in air and dispersion by traffic ○ Water should be sprayed during the construction phase, at mixing sites, and temporary roads. ○ In laying sub-base, water spraying is needed to aid compaction of the material. After the compaction, water spraying should be carried out at regular intervals to prevent dust. ○ Vehicles delivering materials should be covered to reduce spills and dust blowing off the load. ○ Environmental awareness program will be provided to the personnel involved in developmental works. ○ Use of tarpaulin covers and speed	

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				regulations for vehicles engaged in transportation.	
		Noise	Noise from following activities ○ Vehicles transporting construction material ○ Diesel run engines of construction machinery	○ Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB. ○ Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A). ○ Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used ○ Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors. ○ Noise attenuation will be practiced for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers. ○ High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am to 10 pm) to minimize noise impacts.	Being complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				○ Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. ○ Ambient noise levels will be monitored at regular intervals	
2	Construction of Buildings, Roads, Sheds, etc.	Vegetation and Strain on existing infrastructure	Loss of vegetation and strain on existing infrastructure	Most of the land is covered withcoconut trees and few other trees. Trees that are cut down will be accounted for and the same no. of trees of the same or some other species will be replanted at another location to compensate for the loss of greenery.	Will be complied alongside the road and port boundaries
		Water Environment	There are several streams that pass through the warehouse area and will be affected with the construction of new infrastructure on the land	○ The streams 1 and 2 will be made to avoid entering the warehouse area by diverging them into the Karichal River. ○ A tunnel like arrangement with RCC structures will be used so as to not affect the streams (3 and 4) that will go through the warehouse area. The streams will be made to go under the warehouse areas through the tunnel. Another option is to divert through the boundary wall- an application was filed with the irrigation dept. ○ Another option is to divert the stream through the boundary	Will be appropriately planned in consultation with the concerned departments

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				○ An application has been filed with the irrigation department for permission.	
			○ Loss of low lying area	○ The low lying area in the region is already made use by the local people, and has been degraded. There are no active ecological systems in the area. As far as possible, during operation phase the network of streams that add to the low lying area of the region will be diverted or channeled under the constructed buildings to avoid impact to the low lying area. ○ Filling of low lying areas (if required) shall be done	Will be appropriately planned in consultation with the concerned departments
			○ Impact to the downstream due to pollution of the streams	○ Construction waste such as cement, paint, and other construction waste will flow into the downstream parts of the streams and Karichal River. Construction will be avoided during rainy season. Good housekeeping practices, such as cement being stored in dry areas will be taken care of. Labour camps will be provided with proper support services.	Being complied
		Disturbance toNaturalDrainage pattern	○ Impact to natural flow of runoff due to blockage and change ofdrainage course	○ As mentioned above, formidable measures will be taken to avoid the disturbance to the natural flow of water. If some structure or building	Being complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				comes in the way of the existing flow of water, the flow will be redirected to the closest stream in the drainage pattern. ○ In sections along watercourses, earth and stone will be properly disposed of so as not to block rivers and streams,thereby preventing any adverse impact on water quality. ○ All necessary measures shall be taken to prevent earthworks and stone works from impeding cross drainageat streams and canals or existing irrigation and drainage systems in conformity EMP.	
		Existing Traffic	Traffic addition	○ Transportation of construction materials will be carried out during non- peak hours. ○ Regularization of truck movement. ○ Existing roads shall be strengthened and shall be used for the construction material transportation.	Being complied
3	Solid Waste Management	Soil quality	○ Impacts due to disposal of solid waste on ground without treatment	○ Construction waste will be used within warehouse site for filling of low lying areas. ○ Composted bio-degradable waste will be used as manure in greenbelt. Other recyclable wastes will be sold.	Will be complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				○ Excavated soil will be stockpiled in a corner of the site in bunded area to avoid run off with storm water. ○ General refuse generated on-site will be collected in waste skips and separated from construction waste. ○ Burning of refuse at construction sites will be prohibited.	
	Project Auxiliary Facility (PAF)* ZONE ***Construction work has not commenced in this area**				
	Construction Phase				
1	Material transport and construction activities	Air Quality/Dust	○ Exhaust emissions from vehicles ○ Windblown dust during material movement ○ Fugitive dust during material unloading ○ Dust suspension during site preparation, construction and trenching	○ To reduce impacts from exhausts, emission control norms will be enforced / adhered. ○ All the vehicles and construction machinery will be periodically checked to ensure compliance to the emission standards. ○ Construction equipment and transport vehicles will be periodically washed to remove accumulated dirt. ○ Providing adequately sized construction yard for storage of construction materials, equipment tools, earthmoving equipment, etc. ○ Provide enclosures on all sides of construction site	Will be complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				○ Movement of material will be mostly during non-peak hours. ○ On-site vehicle speeds will be controlled to reduce excessive dust suspension in air and dispersion by traffic ○ Water should be sprayed during the construction phase, at mixing sites, and temporary roads ○ In laying sub-base, water spraying is needed to aid compaction of the material. After the compaction, water spraying should be carried out at regular intervals to prevent dust. ○ Vehicles delivering materials should be covered to reduce spills and dust blowing off the load. ○ Environmental awareness program will be provided to the personnel involved in developmental works. ○ Use of tarpaulin covers and speed regulations for vehicles engaged in transportation.	
		Noise	Noise from following activities ○ Vehicles transporting construction material ○ Diesel run engines of construction machinery	○ Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB. ○ Procurement of machinery /	Will be complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A). o Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used o Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors. o Noise attenuation will be practised for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers. o High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am to 10 pm) to minimise noise impacts. o Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. o Ambient noise levels will be monitored at regular intervals	

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
	Construction of Buildings, Roads, Parking features, etc.	Vegetation and Strain on existing infrastructure	Loss of vegetation and strain on existing infrastructure.	○ Most of the land is covered with coconut trees and few other trees. Trees that are cut down will be accounted for and the same no. of trees of the same or some other species will be replanted at another location to compensate for the loss of greenery. ○ There are very few existing buildings and infrastructure on the PAF zone area land which will be acquired and people in that area will be rehabilitated.	Will be complied alongside the road and port boundaries
		Existing Traffic	Traffic addition	○ Transportation of construction materials will be carried out during non- peak hours. ○ Regularization of truck movement. ○ The existing roads shall be strengthened and shall be used for the construction material transportation.	Will be complied
		Solid Waste Management	Impacts to Soil quality due to disposal of solid waste on ground without treatment	○ Construction waste will be used within port site for filling of low lying areas. ○ Composted bio-degradable waste will be used as manure in greenbelt. Other recyclable wastes will be sold. ○ Excavated soil will be stockpiled in a	Will be complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				corner of the site in bunded area to avoid run off with storm water. ○ General refuse generated on-site will be collected in waste skips and separated from construction waste. ○ Burning of refuse at construction sites will be prohibited.	
	BACK UP AREA* – Construction Phase				
	***Construction work has not commenced in this area**				
1	Material transport and construction activities	Air Quality	○ Exhaust emissions from vehicles ○ Windblown dust during material movement ○ Fugitive dust during material unloading ○ Dust suspension during site preparation, construction and trenching	○ To reduce impacts from exhausts, emission control norms will be enforced / adhered. ○ All the vehicles and construction machinery will be periodically checked to ensure compliance to the emission standards ○ Construction equipment and transport vehicles will be periodically washed to remove accumulated dirt ○ Providing adequately sized construction yard for storage of construction materials, equipment tools, earthmoving equipment, etc. ○ Provide enclosures on all sides of construction site ○ Movement of material will be mostly during non-peak hours.	Will be complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				○ On-site vehicle speeds will be controlled to reduce excessive dust suspension in air and dispersion by traffic ○ Water sprinkling will be carried out to suppress fugitive dust ○ Environmental awareness program will be provided to the personnel involved in developmental works ○ Use of tarpaulin covers and speed regulations for vehicles engaged in transportation	
		Noise	Noise from following activities ○ Vehicles transporting construction material ○ Diesel run engines of construction machinery	○ Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB ○ Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A) ○ Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used ○ Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from	Will be complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				sensitive receptors o Noise attenuation will be practised for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers o High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am to 10 pm) to minimise noise impacts o Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. o Ambient noise levels will be monitored at regular intervals	
2	Construction Activities	Water Environment	Flood Impacts and Cross Drainage Structures	Formation level should be raised according to the design and the cross drainage structures suitably planned for the flood events.	Will be complied
			Contamination from Wastes	All justifiable measures will be taken to prevent the wastewater produced during construction from entering directly into the water bodies.	
		Land Environment	Soil Erosion and Soil Conservation	o On slopes and other suitable places along the two proposed corridors, trees and grass should be planted.	Will be complied

Sl.No.	Activity	Relevant Environmental & Social Components likely to be impacted	Likely Impacts and their Significance in the absence of Mitigation Measures	Proposed Mitigation Measures	Current Status
				o On sections with filling and deep cutting their slopes should be covered by sod, or planted with grass, etc. o If existing irrigation and drainage system, ponds are damaged, they will be suitably repaired. o Retaining walls and gabions shall be suitably provided.	
			Loss of agricultural topsoil	o Arable land should not be used for topsoil borrowing. o Topsoil will be kept and reused after excavation is over. o Any surplus to be used on productive agricultural land.	Will be complied
			Compaction of Soil and Damage to Vegetation	o Construction vehicles should operate within the Backup Areas avoiding damage to soil and vegetation.	Will be complied
			Loss of trees and Avenue Planting	Areas of trees cleared will be replaced according to Compensatory Afforestation Policy under the Forest Conservation Act - 1980. Landscaping shall be done at major junctions.	Will be complied alongside the road and port boundaries
			Vegetation clearance	Tree clearing within the backup areas should be avoided beyond that which is directly required for construction activities and / or to reduce accidents.	Will be complied to the extent possible considering the technical requirements