Vizhinjam International Seaport Limited
(A Government of Kerala Undertaking)

YEARS OF CELEBRATING THE MAHATMA

VISL/2016-17/EE&EI-19/930

28th Nov 2019

To
Additional Principal Chief Conservator of Forests (C),
Ministry of Environment Forest and Climate Change (MoEF&CC),
Regional Office (SZ), KendriyaSadan, Koramangala II Block, Bangalore-560034 (Karnataka)

Sir,

Sub: Half yearly Compliance report of Environmental and CRZ clearance for Vizhinjam International Multipurpose Deepwater Seaport for the period of **April 2019 to September 2019** – Reg.

Ref: 1) F.No.11-122/2011-IA.III dated 3rd January 2014 of MoEF
2) No.1285/A3/13/KCZMA/S&TD dated 24th August 2013 of KCZMA

This has reference to the Environmental & CRZ Clearance (EC) issued on 3rd January 2014 (Ref 1) by the Ministry of Environment, Forest & Climate Change (MoEF&CC) to the proposed Vizhinjam International Multipurpose Deepwater Seaport at Vizhinjam in Thiruvananthapuram District of Kerala State based on the recommendation of KCZMA vide the reference cited (2).

The compliance report of the conditions stipulated in the reference cited for the half yearly period from **April 2019 to September 2019** is enclosed herewith in soft copy for record and reference.

Yours Sincerely
For Vizhinjam International Seaport Ltd

Managing Director& CEO

VIZHINJAM INTERNATIONAL SEAPORT LIMITED

Copy to: (1)**The Director (Monitoring-IA II Division)**, Ministry of Environment, Forest & Climate Change, IndraParyavaranBhavan, JorBagh, New Delhi - 110003
(2)**The Zonal Officer**, Central Pollution Control Board (CPCB), Zonal Office, Bengluru – 560 010.
(3)**The Member Secretary**, Kerala State Pollution Control Board, Pattom P.O., Thiruvananthapuram – 695 004
(4)**The Member Secretary**, KCZMA, 4th Floor, KSRTC Bus Terminal, Thampanoor, Thiruvananthapuram – 695 001
(5) **Shri. Rajesh Jha**, MD& CEO Adani Vizhinjam Port Private Ltd. (AVPPL), Vipanchika Tower, Thycaud P.O., Thiruvananthapuram- 14

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Development of Vizhinjam International Deepwater Multipurpose Seaport

Environmental Clearance F. No. 11-122/2011-IA.III dated 3rd January 2014

Compliance Report for the Period April 2019 to September 2019

Project Concessionaire

Adani Vizhinjam Port Private Ltd. (AVPPL)

Project Authority

Government of Kerala (GoK)

Implementing Agency on behalf of GoK

Vizhinjam International Seaport Limited (VISL)

(A GoK Undertaking)

November 2019

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
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.	**Complied** Consent for Establishment (CTE) had been obtained from Kerala State Pollution Control Board (KSPCB) vide Consent No. PCB/HO/TVM/ICE/08/2015 dated 15.09.2015 valid up to 31.07.2018. The CTE was renewed vide Consent No. PCB/HO/TVM/ICE-R/02/2018 dated 19.07.2018 valid up to 31.07.2023. Copy of the CTE was submitted to Ministry of Environment and Climate Change (MoEF&CC) with the compliance report for the period April 2018 to September 2018 dated 29.11.2018 (Ref No: VISL/2016-17/EE&EI-19/1132).
(ii)	Project Proponent shall carry out intensive monitoring with regulatory reporting six monthly on shoreline changes to the Regional Office, MoEF.	**Being Complied** Shoreline monitoring for a stretch of 40 km (20 km on both sides of the project site) is being done and reports are being regularly submitted to MoEF&CC as a part of the half yearly compliance report. Report for the period April 2019 to September 2019 is enclosed as **Annexure I**. L&T Infrastructure Engineering Pvt. Ltd. (L&T IEL) had prepared the Mathematical Modelling Reports based on Shoreline Monitoring data; which were vetted by National Institute of Ocean Technology (NIOT). The 1st (for the period February 2015 to February 2017) and 2nd (March 2017 to February 2018) modelling reports had been submitted with the compliance report for the period April 2017 to September 2017 and April 2018 to September 2018 respectively. These mathematical modelling reports have

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance

S. No.	Conditions	Compliance Status as on 30.09.2019
		affirmed that the shoreline change is in line with what was predicted as part of the EIA study. In continuation with the same practise Adani Vizhinjam Port Pvt. Ltd. (AVPPL) have submitted the shoreline data from March 2018 to February 2019 to LNTIEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. The Mathematical modelling report for the period March 2018 to February 2019 vetted by NIOT is given as **Annexure II**.
(iii)	The capital dredged material (7.6 Mm^3) shall be utilized for reclamation of berths.	**Being Complied** No dredging was carried out during the compliance period from April 2019 to September 2019. The dredged material till 30.09.2019 amounting to 2.90 Mm^3 has been utilized for reclamation of 36 Ha area. The dredged material has been used for reclamation. Dredging and reclamation will resume once fair weather prevails.
(iv)	Additional fish landing centre shall be developed as part of the proposed Vizhinjam port for upliftment of fisheries sector.	**Being Complied** The work for construction of the fish landing centre (Rs. 16.00 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. The EPC Contractor is finalising the design for the fishing berth and has mobilised the sub-contractor along with resources for construction of fishery harbour since March 2017. Fishing boats docked in the proposed area need to be removed before the commencement of work. GoK has initiated discussions with fishermen representatives for removal of the boats to facilitate construction

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S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		work and these discussions are ongoing.
(v)	The project shall be executed in such a manner that there is minimum disturbance to fishing activity.	**Being Complied** Following is being practiced to ensure minimum disturbance to fishing activity: • Works are planned in such a way that the movement of fishing boats is not hindered due to project construction. • Signboards have been placed for demarcation of construction area. • For mutual understanding of the developmental activities with the local fishing community an exclusive CSR team has been assigned, details are given in **Annexure III**. • Using the technological advancement the dedicated CSR team of AVPPL are in constant touch with the fishermen/fishing community members to facilitate the flow of various project related information/updates. • AVPPL CSR team also provides regular updates to the committee which has been formed by the local church representatives adjoining to the port area, who in turn pass on port project execution information to the fishermen. • Turbidity buoys at 3 locations identified by NIOT had been deployed and continuous monitoring was carried out to assess the real time turbidity till 31.05.2019. Due to change in contractor and due to rough sea conditions during the monsoon period, the turbidity buoys were not deployed from 01.06.2019 till end

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		of the compliance period; i.e. 30.09.2019. Continuous real time turbidity monitoring will be resumed after monsoon. The turbidity details for the months of April 2019 and May 2019 are given in **Annexure I** Table 13 of Reports on Oceanographic & Bathymetry Data Collection for Assessment of Shoreline Change (PSR 38 & 39). • Marine Water Quality is being monitored regularly and results are submitted as part of the compliance reports. No abnormal results were observed during the monitoring period. (**Refer Annexure IV**).
(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)	**Being Complied** As per the EIA report Rs. 7.1 crores was set apart as compensation for livelihood affected fisherman. However the amount was enhanced by GoK for the benefit of the affected fishermen. Till date an amount of Rs. 83.11 crores have been disbursed to a total number of 2621 Livelihood Affected Persons (LAPs) (including kerosene disbursal on account of breakwater construction) whose verification has been completed in all respects. This includes 2116 numbers of boat engines as well to owners of whom kerosene is supplied free of cost. Verification of the documents of balance LAPs is in progress. The status of the CSR activities envisaged in the fisheries sector is as follows: **Water supply**: Water Supply Scheme for provision to the local people has been commissioned in April 2013 by

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S. No.	Conditions	Compliance Status as on 30.09.2019
	sea food park (4crores) (iii) skill development centre (4crores) (iv) environmental sanitation (3crores) and (v) solid waste management (2crores).	VISL by expending an amount of Rs. 7.30 crores. For Operation & Maintenance (O&M) of the same an amount of Rs. 5.20 crores has been spent till date. From 04.04.2019 onwards, O&M of the scheme is being done by Kerala Water Authority (KWA). **Fish Landing centre**: The work for construction of the fish landing centre (Rs. 16.00 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. The EPC Contractor is finalising the design for the fishing berth and has mobilised the sub-contractor along with resources for construction of fishery harbour since March 2017, however AVPPL is unable to start the construction activities. Fishing boats docked in the proposed area need to be removed before the commencement of work. GoK has initiated discussions with fishermen representatives for removal of the boats to facilitate construction work and these discussions are ongoing. **Existing fishing harbour**: Tenders for modernization of the existing fishing harbour was invited by HED and work awarded. However the works could not be initiated due to sectoral protests among different fishermen groups. **Seafood park**: Procurement of land for seafood park (Rs. 26 crores) by VISL has been completed. Actions for development of seafood park are planned so as to commission the same along with the completion of the new fishing harbour.

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		Skill Development: Additional Skill Acquisition Program (ASAP) is a Government of Kerala (GoK) initiative aimed at imparting skill courses to students to improve their employability. No Objection Certificate (NoC) has been granted to ASAP to proceed with the construction of a Community Skill Park (CSP) in the 1.5 acres of land. The land has been identified with an approximate cost being Rs. 3.5 Crore. The upcoming CSP is planned to conduct various training programs which will help in providing skilled workforce for filling up the various job roles that would arise with the operation of the port. Activities carried out by Concessionaire (AVPPL) as CSR intervention for education, community health, sustainable livelihood development, community infrastructure development, etc. for the period of April 2019 to September 2019 are given in **Annexure III**.
(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.	**Will be Complied** Konkan Railway Corporation Limited (KRCL) has been engaged as a consultant for turnkey execution of the project. Out of the total rail route length of 10.7 km, 9.0 km is planned to be passing through an underground tunnel to minimize the disturbance to the local population. Detailed Project Report (DPR) has been completed and has been submitted to Southern Railway for its approval. All the required clarifications have been provided to Southern Railways and the approval is expected shortly.

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S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
(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.	**Will be Complied** Based on G.O. (Rt) No.2021/2017/RD dated 27.04.2017 and modified by G.O.(Rt) No.17/2018/F&PD dated 09.06.2018, government ordered to pay compensation for land and not for the structures since they were in violation of CRZ notification. Action in this respect is being taken and an area of 72.79 Ares is acquired up to 30.09.2019.
(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.	**Will be Complied** 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.	**Complied** All CSR activities on livelihood development health, sanitation, education etc. are being implemented after receiving formal demands from social controlled institutions; government controlled institution and recognized platforms. As indicated in EIA report during initial phase of development CSR activities will be taken for Vizhinjam & nearby village in 2 km radii, considering the same during Phase I implementation of the project, CSR activities are presently carried out in 5 wards namely; Mulloor, Kottapuram, Vizhinjam, Harbour and Venganoor. An amount of Rs. 144.68 Lakhs has been initiated (Work Orders Issued) for CSR activities mainly in the fields of education, community health,

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		sustainable livelihood development, community infrastructure development, etc. during the compliance period. Details on CSR activities carried out by AVPPL during compliance period (April 2019 to September 2019) are enclosed as **Annexure III**.
(xi)	Oil Contingency Management Plan shall be put in place.	**Will be Complied** Work has been awarded to M/s. KITCO for developing a facility Level Oil Spill Response Plan (OSRP) In line with the National Oil Spill-Disaster Contingency Plan (NOS-DCP) requirements. The Final ORSP for Vizhinjam Port was submitted to Indian Coast Guard (ICG) for approval on 24.09.2019. The submission letter is enclosed as **Annexure V**.
(xii)	All the recommendations /conditions stipulated by Kerala Coastal Zone Management Authority (KCZMA) shall be complied with.	**Complied** We are complying with all the recommendations/conditions of KCZMA. Copies of the half yearly EC/CRZ compliance reports are also being sent to KCZMA. Compliance to the recommendation/ conditions of KCZMA for the period April 2019 to September 2019 is enclosed as **Annexure VI**.
(xiii)	The responses/ commitments made during public hearing shall be complied with in letter and spirit.	**Complied** We are complying with the responses/commitments made during public hearing (as applicable). Status of the same is being submitted regularly with EC/CRZ half yearly compliance reports to all the authorities concerned. The compliance status of the commitments made during Public Hearing & actions on the same during the compliance period April 2019 to

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S. No.	Conditions	Compliance Status as on 30.09.2019
		September 2019 is enclosed as **Annexure VII**.
(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.	**Being Complied** Project is in construction stage. Out of the 5 identified EMP areas, work has started in Port Site (Building construction in back up yard), Road/Rail Corridor and in PAF (Project Annex Facility)). Recommendations of the Construction stage EMP for these areas are being implemented. Status of construction stage EMP in matrix format is enclosed as **Annexure VIII**.
(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.	**Being Complied** The final Integrated Area Development Plan prepared through CEPT university, in consultation with Town Planning, Tourism, Industry and other line departments was reviewed by the expert committee constituted by GoK. The Master Plan will be forwarded to Joint Planning Committee (JPC) for further action.
(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.	**Complied** 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	**Noted** There will not be any withdrawal of groundwater in Coastal Regulation Zone (CRZ) Area. In case of requirement of groundwater withdrawal outside CRZ area, specific

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
	from the concerned State/Central Groundwater Board shall be obtained in this regard.	prior permission will be obtained from State/Central Groundwater Board. A 3.00 MLD water supply scheme for the project had been commissioned with the source of water being Vellayani Lake whose raw water will be available for treatment. The net availability of treated water from this supply scheme is 2.49 MLD of potable water out of which 1.49 MLD of water shall be distributed to the local people as part of social welfare measures of VISL. The balance 1.0 MLD would be used for port related activities. However, at present, the entire treated water from the scheme is being utilised by the community. Due to this reason, the water for construction purposes for the port is being sourced from the open market/private suppliers. On an average about 148 KLD of water is being consumed for construction related activities.
(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.	**Complied** Presently M/s. AFCONS and M/s. B&R are the contractors working at site, under the EPC Contractor M/s. Howe Engineering Projects India Pvt. Ltd. (HEPIPL). Both the contractors have obtained separate consent from KSPCB for handling Hazardous Waste. During this compliance period (April 2019 to September 2019) 414 L of used oil is generated and it has been stored as per Hazardous Waste Rules at site and will be disposed to authorized (CPCB/KSPCB) waste oil handlers.
(xix)	No hazardous chemicals shall be stored in the	**Complied**

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S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
	Coastal Regulation Zone area.	No hazardous chemical is being stored in the CRZ area.
(xx)	The waste water generated from the activity shall be collected, treated and reused properly.	**Complied** Only batching plant wash/reject is generated from the construction activity presently. For the same a settling tank is constructed and used for collection, and recycling of all wash water generated. At present settled sludge is used for filling of low lying area.
(xxi)	Sewage Treatment facility should be provided in accordance with the CRZ Notification.	**Will be Complied** Provision for installing Sewage Treatment Plant (STP) facility of adequate capacity in phased manner is being planned and will be implemented in line to CRZ Notification along with the commissioning of the project in consultation with KSPCB. HEPIPL is in the process of finalizing of a contractor for detailed engineering and construction of the STP. AVPPL had submitted relevant documents including Location Plan, Process, Design, Capacity, Layout and other details to KSPCB seeking approval from the board as per the CTE obtained for the project. KSPCB had conducted a site visit on 21.08.2019. During the site visit additional details were sought and the same were submitted to KSPCB vide letter AVPPL/KSPCB/2019-20/878 dated 18.09.2019 given as **Annexure IX**; awaiting approval of the proposed STP scheme from KPSCB.

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S. No.	Conditions	Compliance Status as on 30.09.2019
		 **Site Visit by KSPCB**
(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.	**Being Complied** No solid waste is being disposed in the CRZ area. As mentioned in the EIA, contractors working at the site have been made responsible for management of Solid Waste during construction stage. The contractors are complying with the provisions pertaining to management of Solid Waste and it is being properly collected, segregated and disposed in line to Solid Waste Management Rules 2016, as amended.
(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.	**Complied** 14 DG sets are present at site. 10 DGs are in use and 4 DGs are not in use. These are compliant to CPCB guidelines.
(xxiv)	No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	**Being Complied** Construction of the project is being carried as per the approval obtained under Coastal Regulation Zone (CRZ) Notification.

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S. No.	Conditions	Compliance Status as on 30.09.2019
(xxv)	The approach channel shall be properly demarcated with lighted buoys for safe navigation and adequate traffic control guidelines shall be framed.	**Will be Complied** The project is in construction phase and 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.	**Will be Complied** **Greenbelt**: Although a natural greenbelt exists, the greenbelt of adequate width with suitable species in consultation with forest department as identified in the EIA will be developed in all possible areas including cargo storage areas and along the boundary of the project area. A greenbelt development plan has been considered in the Master Plan and adequate budgetary provision has been kept for this purpose. **Compensatory Afforestation**: In lieu of trees cut, AVPPL, in collaboration with Forest department, have carried out compensatory afforestation in 12.05 Ha land as identified by social Forest Department in Sainik School, Trivandrum (at an aerial distance of 24 km from project site).

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S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		**Afforestation at Sainik School**
(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** An amount of 40 Crores has been kept solely for EMP implementation as per the commitment in the EIA; and this amount is not diverted for any other purpose. The breakup of EMP fund activity wise for the compliance period April 2019 to September 2019 is enclosed as

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S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		Annexure X. An amount of Rs. 1.37 Crore has been utilized towards EMP implementation measures during compliance period April 2019 to September 2019.
(xxviii)	The project proponent shall set up an organizational 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.	**Complied** During construction phase 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 competent and qualified professional for effective implementation of EHS safeguards & CSR activities. In addition to the above, independent environment, health and safety consultants have been appointed as per concession agreement signed with AVPPL. It is also ensured that contractors executing the work also deploy qualified and competent EHS personnel for effective implementation of EMP measures. Organizational Structure for Environment, Health, and Safety & CSR for construction phase is enclosed as **Annexure XI**.
(xxix)	Staff Colony should be located beyond CRZ area.	**Will be Complied** Port facility planning is 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	**Complied** 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

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S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
	amendments. All the construction designs/drawings relating to the proposed construction activities must have approvals of the concerned Statutory Departments / Agencies.	Departments / Agencies have been obtained for the construction designs/drawings relating to the proposed construction as mentioned hereunder: • Consent to Establish (CTE) No. PCB/HO/TVM/ICE/08/2015 dated 15.09.2015 valid up to 31.07.2018 was renewed from State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE-R/02/2018, dated 19.07.2018 valid up to 31/07/2023. • Airport Authority of India NOC vide NOC no AAI/SR/NOC/RHQ dated 7.12.2015 (Submitted along with the compliance report for the period October 2015 to March 2016). • As per the exemption granted by Government of Kerala (GoK) G.O. No. 310/2015/LSGD dated 01/10/2015, AVPPL is not required to obtain any further building permits/permission to construct port related building within the port premises.
(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.	**Complied** On an average 703 Nos. of workers were engaged in the port construction activities on a daily basis during the compliance period April 2019 to September 2019. Construction workers and Labours are housed in a labour camp near to the project site as well as nearby resorts. Labours are provided with all the necessary infrastructure facilities including water, electricity, fuel, sanitation, etc. and the details of the same were submitted in the

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S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		compliance report for the period April 2018 to September 2018.
(iii)	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.	**Complied** Digging activities were undertaken during the compliance period in a limited way in the port area. Mitigation measures are being followed such as water sprinkling on roads, ensuring PUC certificate for all vehicles, etc. Marine Surface & Ground water quality is monitored on a monthly basis in line to Environment Monitoring Plan prescribed in EIA and analysis reports are enclosed as **Annexure IV**. There are no significant changes observed in the water quality during the compliance period.
(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	**Complied** Quarry material is being obtained from approved quarry sites only. The road constructed so far (Excavation/Rock Breaking, Construction of Electrical Pits, laying of Hume Pipe along with Retaining Wall are in progress from chainage 0 to 520 m and clearing of vegetation, cutting of trees and sludge removal are in progress beyond 520 m) has been made with material available on site. Earth cutting generated from road corridor construction at present are dumped in Truck terminal area. • No excavation has been carried out in private property. • No excavation or dumping has been carried out in wetlands, forest area or other ecologically valuable or sensitive locations. • No bituminous or hazardous material has been used.

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S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
	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.	
(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.	**Being Complied** The construction material was obtained from approved quarries only. AVPPL had obtained Environmental Clearance (EC) from the State Environmental Impact Assessment Authority (SEIAA) for the building stone quarry project in Survey No. 555/2 at Nagaroor Village, Chirayinkeezhu Taluk, Thiruvananthapuram District vide Order No. 1200/EC2/2018/SEIAA dated 01.03.2019. Subsequently Consent to Operate (CTO) has also been obtained from KSPCB vide Consent No. PCB/TVM-DO/ICO/QRY/103/2019 dated 05.03.2019 valid up to 27.02.2021. Copies of the EC and CTO were submitted along with the EC compliance report for the period October 2018 to March 2019.
(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	**Being Complied** • No solid waste is being disposed of in the CRZ area. • Solid waste is handled as per the Solid Waste Management Rules, 2016 as amended. • STP will be installed in phased manner along with the project in consultation with KSPCB. HEPIPL is in the process of finalizing of a

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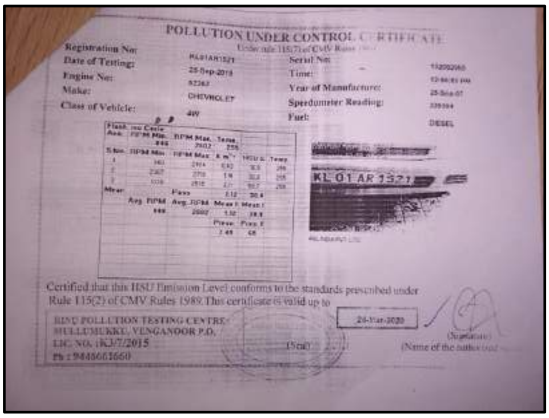
S. No.	Conditions	Compliance Status as on 30.09.2019
	etc. must conform to the standards laid down by the competent authorities including the Central/State Pollution Control Board and the Union Ministry of Environment and Forests under the Environment (Protection) Act, 1986, whichever are more stringent.	contractor for detailed engineering and construction of the STP. AVPPL had submitted relevant documents including Location Plan, Process, Design, Capacity, Layout and other details to KSPCB seeking approval from the board as per the CTE obtained for the project. KSPCB had conducted a site visit on 21.08.2019. During the site visit additional details were sought and the same were submitted to KSPCB vide letter AVPPL/KSPCB/2019-20/878 dated 18.09.2019 given as **Annexure IX**; awaiting approval of the proposed STP scheme from KPSCB. • Environment Monitoring is being carried out as per Environment Monitoring Plan prescribed in EIA by NABL and MoEF&CC accredited agency; M/s. Ashwamedh Engineers & Consultant. Summary of the Ambient Air Quality Monitoring (AAQM) for the duration from April 2019 to September 2019 at 5 monitoring locations is mentioned below.

Parameter	Unit	Max	Min	Perm. Limit
PM_{10}	μg/m³	97	33	100
$PM_{2.5}$	μg/m³	45	7	60
SO_2	μg/m³	9.79	4.03	80
NO_2	μg/m³	11	5.26	80
CO	mg/m³	BDL	BDL	4
HC	ppm	BDL	BDL	--

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		• Detailed Monitoring Reports for the period April 2019 to September 2019 is attached as **Annexure IV**). • All the monitored parameters were found within the prescribed limits.
(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.	**Will be Complied** CTO under the Water (Prevention and control of Pollution) Act, 1974 and the Air (Prevention and control of Pollution) Act, 1981 will be obtained from KSPCB before commissioning of the project and 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.	**Complied** Following precautionary measures are undertaken during transportation of the construction material as environment safeguard: • Tarpaulin cover is being used during transportation of construction material • All vehicles coming into the site are under a speed restriction of 20 km/hr • Regular Water Sprinkling is done on the approach road by water tankers. • It is ensured that all vehicles entering the Port have a valid PUC certification • The dumpers have speed governors ensuring adherence to speed limit

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance

S. No.	Conditions	Compliance Status as on 30.09.2019
		  **Water Sprinkling in Progress** **Tarpaulin Cover on Trucks**  POLLUTION UNDER CONTROL CERTIFICATE Registration No: Date of Testing: Engine No: Make: CHEVROLET Class of Vehicle: Serial No: Time: Year of Manufacture: Speedometer Reading: Fuel: DIESEL KL 01 AR 1321 Certified that this HSU Emission Level conforms to the standards prescribed under Rule 115(2) of CMV Rules 1989. This certificate is valid up to 24-Mar-2020 **PUC Certificate**
(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** During the Compliance period, NGT appointed committees reviewed the compliance conditions of EC & CRZ on 05.09.2019 and 06.09.2019, with a site visit on 05.09.2019. However there was no visit by officers of Ministry/Regional Office at Bangalore during the compliance period. All necessary support was extended to the officials during the compliance review and site visit. The same will be extended in future also to all the officials of Ministry/Regional Office.
(x)	Ministry of Environment & Forests or any other competent authority may stipulate any additional	**Noted for Compliance**

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
	conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.	
(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.	**Noted and Will be Complied** AVPPL is the concessionaire for implementing the project and operating it for the next 40 years, based on concession agreement signed between the GoK &, AVPPL on 17.08.2015. As on date, there is no change in the project profile.
(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.	**Complied** Concession agreement with AVPPL was signed on 17.08.2015. The layout of the port has been approved by GoK by letter No.308799/E1/15/F&PD dated 30.10.2015 (Submitted along with the Compliance Report of the period from October 2015 to March 2016). The preliminary construction activities commenced at site on 16.11.2015 followed by official inauguration on 05.12.2015. Financing agreement forming part of financial closure was submitted by the concessionaire on 13.05.2016.
(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.	**Noted** This condition does not pertain to project proponent. However, it is learnt that KSPCB had complied with the same.

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
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 for Compliance**
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.	**Complied** 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 (CTE) No. PCB/HO/TVM/ICE/08/2015 dated 15.09.2015 valid up to 31.07.2018 was renewed from State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE-R/02/2018, dated 19.07.2018 valid up to 31/07/2023. • Airport Authority of India NOC vide NOC no AAI/SR/NOC/RHQ dated 7.12.2015 (Submitted along with the compliance report for the period October 2015 to March 2016).

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance

S. No.	Conditions	Compliance Status as on 30.09.2019
		• As per the exemption granted by Government of Kerala (GoK) G.O. No. 310/2015/LSGD dated 01/10/2015, AVPPL is not required to obtain any further building permits/permission to construct port related building within the port premises.
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** Details regarding the advertisement published in local newspapers was intimated (with copy of advertisement) to the regional office of MoEF &CC, vide letter No. VISL/EC/MoEF/2013 dated 20.01.2014 (Submitted along with the Compliance Report of the period from October 2015 to March 2016). Copy of the Environment Clearance is available on VISL website at http://www. vizhinjamport.in/eia-30-5-13.php. The same is also uploaded on Adani Ports and Special Economic Zone (APSEZ) website at https://www.adaniports.com/Downloads
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**

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance

S. No.	Conditions	Compliance Status as on 30.09.2019
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.	**Noted** 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 02.09.2016.
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** The Environmental Clearance Letter was submitted to the concerned Panchayat, Zila Parishad / Municipal Corporation, Urban Local Body and the Local NGOs from whom representations were received vide letter No. VISL/EC/MoEF/2013 dated 29.01.2014. Copy of the Environment Clearance is available on VISL website at http://www.vizhinjamport.in/eia-30-5-13.php. The same is also uploaded on APSEZ website at https://www.adaniports.com/Downloads
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	**Complied** The copy of the latest compliance report for the period October 2018 to March 2019 including the results of six monthly monitoring data (October 2018 to March 2019) has been uploaded on VISL website http://www.vizhinjamport.in and also on APSEZ website

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance

S. No.	Conditions	Compliance Status as on 30.09.2019
	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.	https://www.adaniports.com/Downloads. Hard copies have been submitted to the MoEF & CC Regional Office (Bangalore), Zonal office of CPCB (Bangalore), KSPCB, KCZMA vide letter No. VISL/2016-17/EE&EI-19/176 dated 27.05.2019 in hard copy as well as through email on 27.05.2019 (**Annexure XII**). Environment Monitoring is being carried out as per the Environment Monitoring Plan prescribed in EIA by Ashwamedh Engineers & Consultant (NABL Accredited & MoEF&CC approved laboratory). Detailed Monitoring reports (Air, Water, Noise, Marine Water, and Sediment) are enclosed as **Annexure IV**. Additionally, summary of monthly Environment monitoring results are also uploaded on the APSEZ website https://www.adaniports.com/Downloads.
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.	**Complied** Six monthly reports on the status of compliance of the stipulated clearance conditions including results of monitored data are regularly submitted to all the concerned agencies. The Half Yearly Compliance Report for the period October 2018 to March 2019 has been submitted to the MoEF&CC, Regional Office (Bangalore), Zonal office of the CPCB (Bangalore), KSPCB & KCZMA vide letter No. VISL/2016-17/EE&EI-19/176 dated 27.05.2019 in hard copy as well as through email on 27.05.2019 (**Annexure XII**).

Half Yearly Compliance Report on Conditions Stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		As per the MoEF&CC Notification dated 26.11.2018, wherein submission of Half Yearly Compliance Reports (HYCRs) by email/soft copy is declared acceptable, henceforth, email/soft copy of HYCRs shall be submitted.
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.	**Will be Complied** The project is in construction phase. The same shall be complied post commissioning during operational phase.

Enclosures:

Annexure Number	Details of Annexure
Annexure I:	Report on Shoreline monitoring April 2019 to September 2019
Annexure II:	Shoreline Mathematical Modelling Report (March 2018 to February 2019)
Annexure III:	CSR Activities by AVPPL (April 2019 to September 2019)
Annexure IV:	Environment Monitoring Report (April 2019 to September 2019)
Annexure V:	Submission Letter of Oil Spill Response Plan to Indian Coast Guard (ICG)
Annexure VI:	Compliance of Conditions of KCZMA Recommendation for EC/CRZ Clearance
Annexure VII:	Compliance of the Response/Commitments made during Public Hearing
Annexure VIII:	Status of Environment Management Plan
Annexure IX:	Submission Letter to KSPCB regarding additional details sought post site visit of proposed STP
Annexure X:	EMP Budgetary Provision and Expenditure (April 2019 to September 2019)
Annexure XI:	Organizational Structure-EMP Implementation
Annexure XII:	Submission Letter of EC Compliance for the Period October 2018 to March 2019

Annexure I

Report on Shoreline Monitoring

April 2019 to October 2019

Report on

Oceanographic & Bathymetric Data Collection for

Assessment of Shoreline Changes

(PSR-38, April 2019)

For Adani Vizhinjam Port Pvt. Ltd.

Client

Adani Vizhinjam Port Pvt. Ltd.
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Survey Contractor

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Report no. OSaS/P21716/AVPPL/PSR-38/118 Rev 1

06th June 2019

DOCUMENT ISSUE FORM

Document Type	Periodic Survey Report (April 2019)
Prelim/Draft/Final/Other	Final
Document Title	Report on Oceanographic & Bathymetric Data Collection for Assessment of Shoreline Changes (PSR-38, April 2019) For Adani Vizhinjam Port Pvt. Ltd. OSaS Doc no. OSaS/P21716/AVPPL/PSR-38/118 Rev 1
Prepared by	Sisir K Patra
Prepared at	Ocean Science & Surveying Pvt. Ltd. Data Processing Centre, Navi Mumbai.
Submitted to	Adani Vizhinjam Port Pvt. Ltd.
No. of Copies	By email
Project No.	P21716

Revisions

Rev	Date	Description	Prepared by		Checked by	
			Name	Signature	Name	Signature
0	18.05.2019	Draft	Anoop		Sisir K Patra	
1	06.06.2019	Final	Anoop		Sisir K Patra	

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Revision Details

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Annexure IV	LEO data
Annexure V	Photographic Documentation
Annexure VI	Cross-shore Profiling
Annexure VII	Turbidity Data

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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 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 a water body moves in the ocean. The speed is denoted in cm/s
Rip Current	A relatively strong, narrow current flowing outward from the beach through the surf zone
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 in m/s
Wind Direction	Wind direction is an indicator of the direction that the wind is **blowing 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 vapour density (mass per unit volume) to the saturation water vapour density, usually expressed in percent
Turbidity	Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air.

ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
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
Mg/L	Milligram per litre
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
NTU	Nephelometric Turbidity Units

PEP	Project Execution Plan
PVD	Progressive vector diagram
PPP	Public Private Partnership
ppt	Parts per Thousand
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 a Public-Private Partnership (PPP) 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 continuation of the contract Ocean Science had with VISL earlier, which came to an end on 18th February 2016.

As part of the contract, turbidity measurements at three locations from three levels were to be monitored on a real time basis. Two turbidity buoys were installed on 19th November 2016 and the third one was installed on 9th December 2016.

This report provides the results of the data collected from 01st to 30th April 2019.

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 coastal village 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 8th Century AD.

The port is proposed to be developed in a PPP model. The investment for land, external infrastructure (rail, water and power) and breakwater will be borne by the VISL/GoK. The investments for other port infrastructure (dredging & reclamation, berths, terminals, superstructure & equipments) will be shared on PPP basis availing Viability Gap Funding (VGF) from Government of India. The PPP concessionaire, AVPPL has been given the right to operate for 40 years full port not just phase 1. 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 is located at the southern tip of India, barely 10 nautical miles from the international sea route (Suez – Far East route & Far East – Middle East route), it 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 (Mar-May), monsoon (June-Oct), and post monsoon (Nov-Feb), 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 and river crossing survey.

A Google Earth image, showing the Multibeam survey area; locations of the observations, including the wave/current, tide and AWS measurement location, is given in **Figure 1 & 2**. The cross-shore profile lines, the LEO points and photographic documentation points are shown in **Figure 3**.

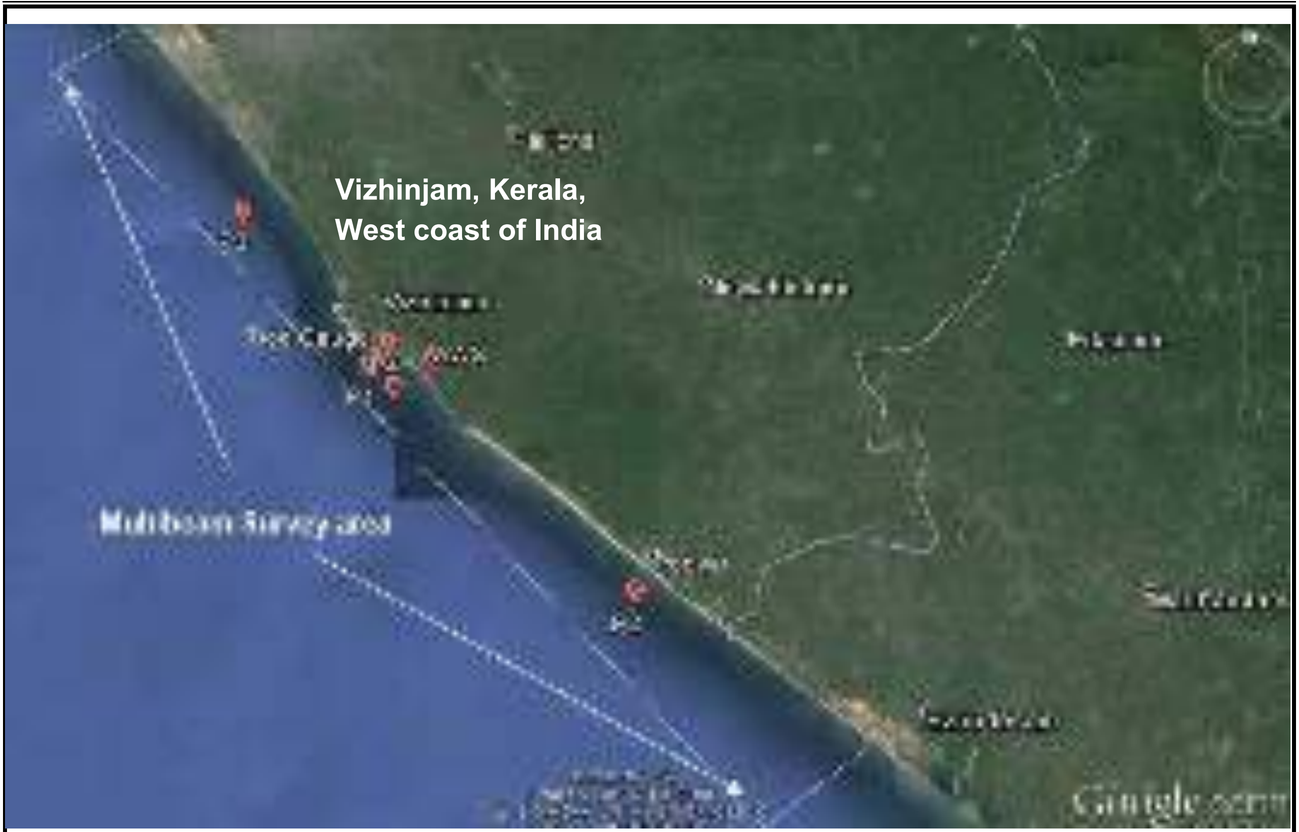


Figure 1– General survey location

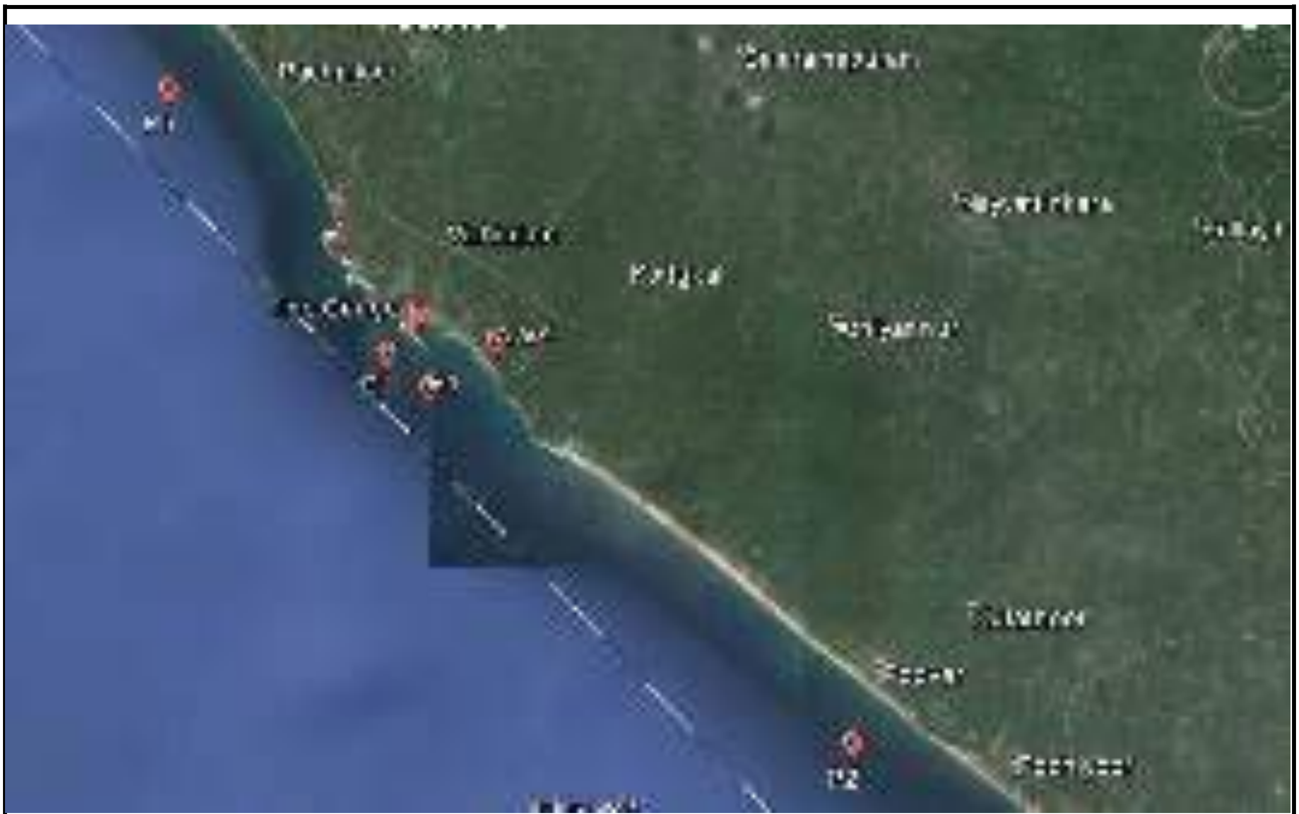


Figure 2–Location of ADCPs, Tide and Weather Station

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 and photographic documentation, 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 to the south of the existing Vizhinjam Harbour.

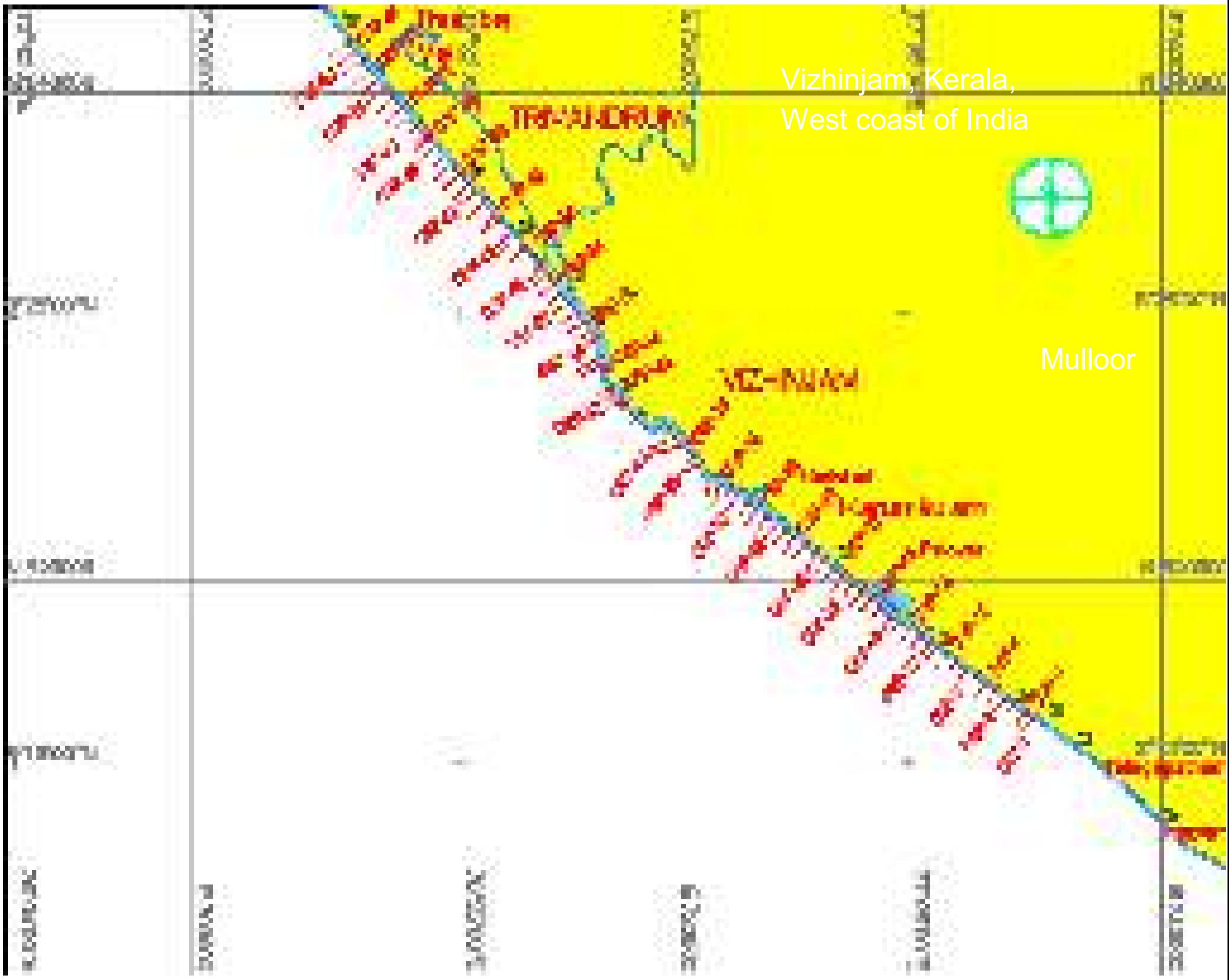


Figure 3– Cross-Shore Profile/LEO, Photographic Documentation Locations

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 20m 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 on 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.
- Continuous monitoring of turbidity at 3 location (1 upstream & 2 downstream of dredging location) - Online meter (3 levels) to be installed on buoys and data to be displayed at system in office
- Analysis and processing of the data and submission of periodic reports in soft & hard copies.

3.1 Location Co-ordinates

The location co-ordinates provided by the client forthe current and wave observations are given 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	21.4
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 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 wind speeds at 10m above MSL. The data provided is thus referenced to both the levels.

The location co-ordinates provided by the client for the turbidity observations are given below:

Location Co-ordinates WGS-84 Spheroid, UTM Projection, CM 75 East, Zone 43, North			
Name	**Latitude**	**Longitude**	**Depth w.r.t CD (m)**
Turbidity Buoy-1	08° 20' 58.6"N	77° 00' 08.1"E	21.1
Turbidity Buoy -2	08° 21' 49.9"N	76° 59' 14.3"E	21.2
Turbidity Buoy -3	08° 22' 27.6"N	76° 59' 16.1"E	15.3

Table 4: Turbidity buoy location

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 5: 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**
Sisir K Patra	Project Manager / Oceanographer	Duration of Project
Unni Krishnan	Party Chief / Surveyor	01st to 30th April 2019
Anoop V M KUMAR	Jr. Oceanographer	Duration of Project
Gaurav Sharma	Survey Engineer	01st to 30th April2019
Adani Vizhinjam Port Pvt. Ltd.		
Name	**Designation**	**Period**
Hebin C.	Manager - Environment	Duration of Project

Table 6: Survey Personnel

5. SURVEY EQUIPMENT DETAILS

5.1 General

The Wave Rider Buoy was guarded by the vessel MFB Samuel for the month. The offshore cross-shore profiling was carried out using the survey boat Bethel fitted with the multibeam echo sounder. ADCPs were deployed from a locally hired boat for the period.

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.

The consistency check of DGPS is carried out routinely. The details of the check carried out on 07th April 2019 are given below:

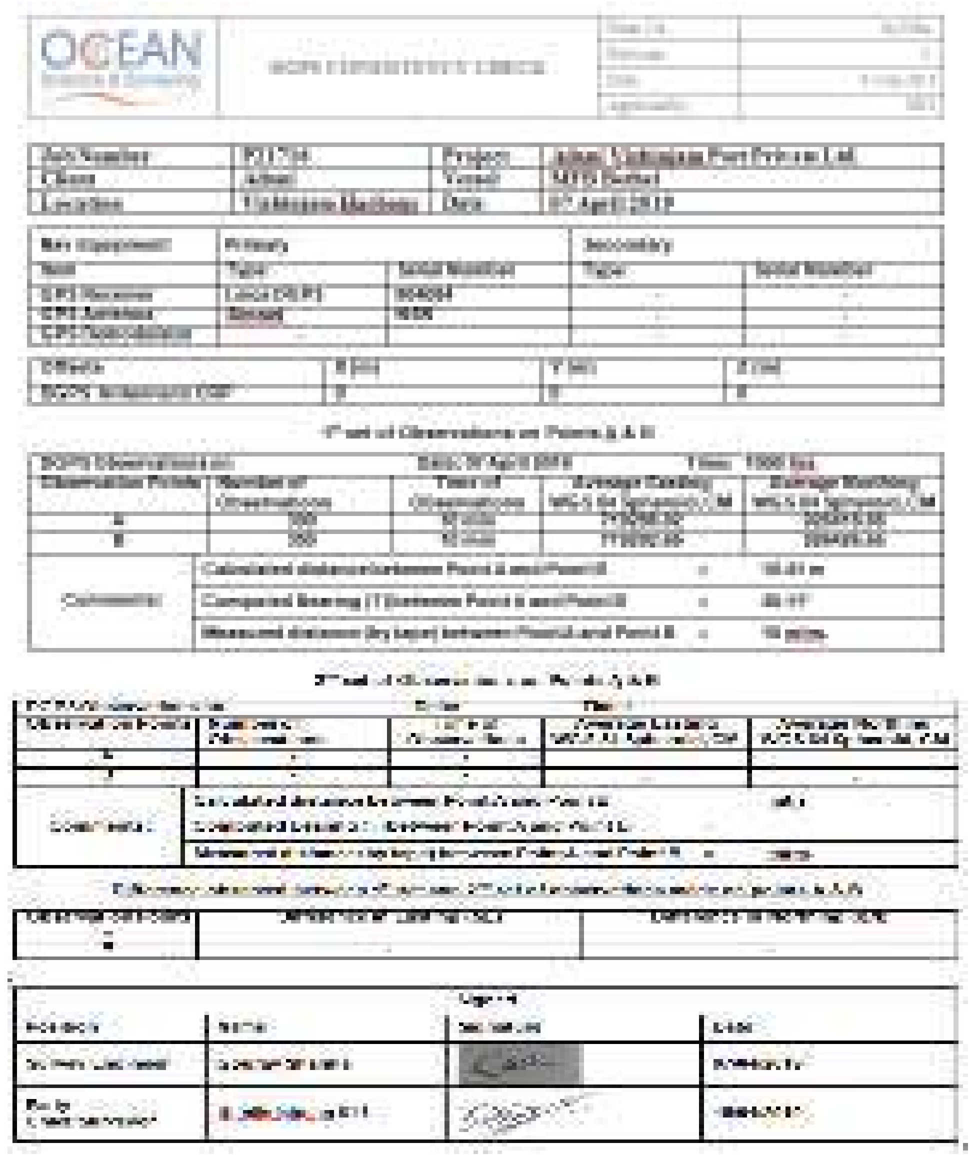


Figure 7: DGPS consistency check

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.

An Octans Gyro was used to obtain the accurate heading of the survey boat. The calibration of the gyro was carried out on 07th April 2019. The details are provided in the figure below:

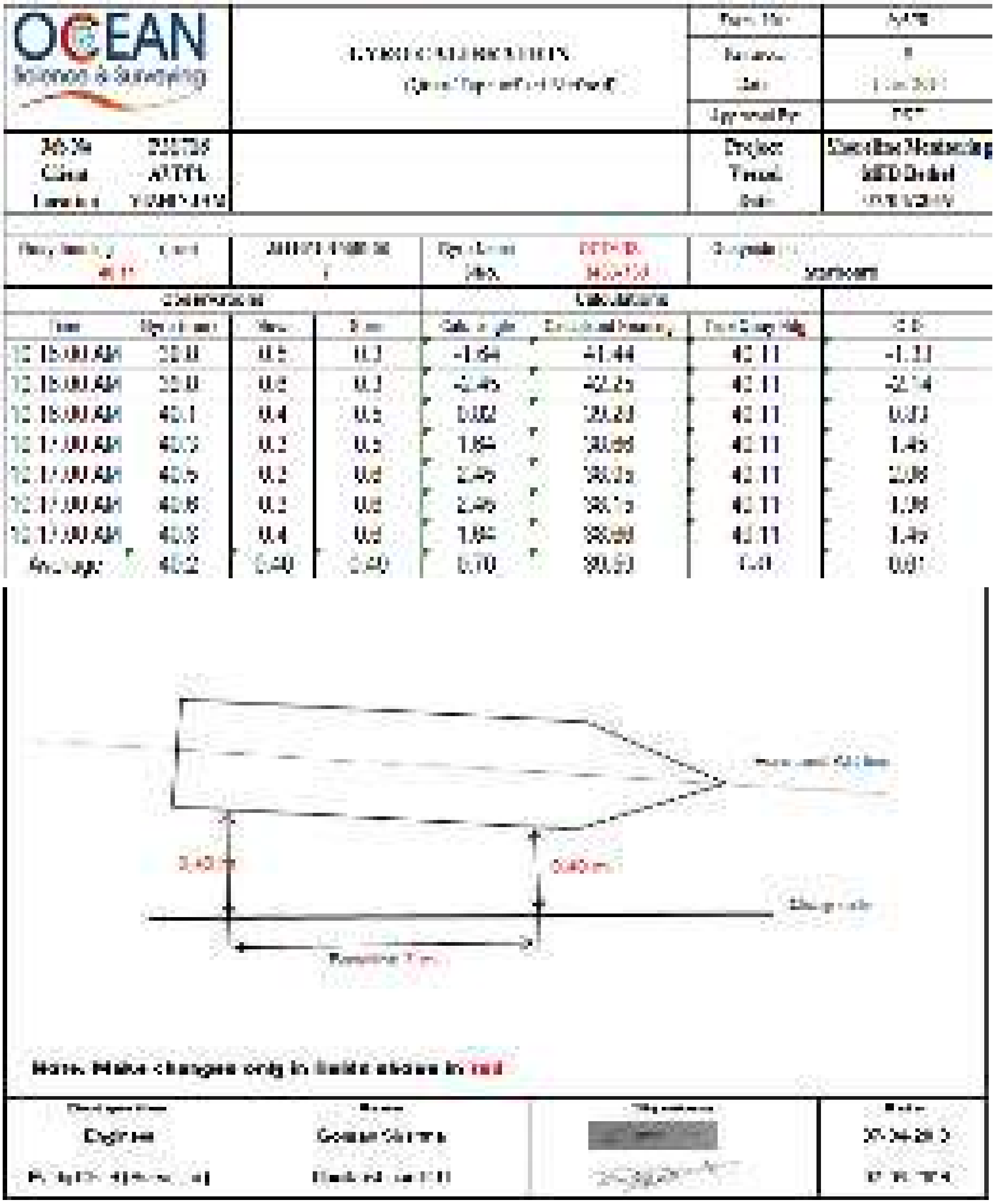


Figure 8: Gyro Calibration

5.4 Wave Rider Buoy

NIOT deployed the wave rider buoy in collaboration with VISL and AVPPL, under a tripartite agreement and is being monitored by Ocean Science. A Datawell DWR (G) wave buoy 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 setup at Ayur Bay.

The system consists of wave rider buoy (DWR G make) with HF whip/LED flasher, GPS antenna, 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 car passing nearby, 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.

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:

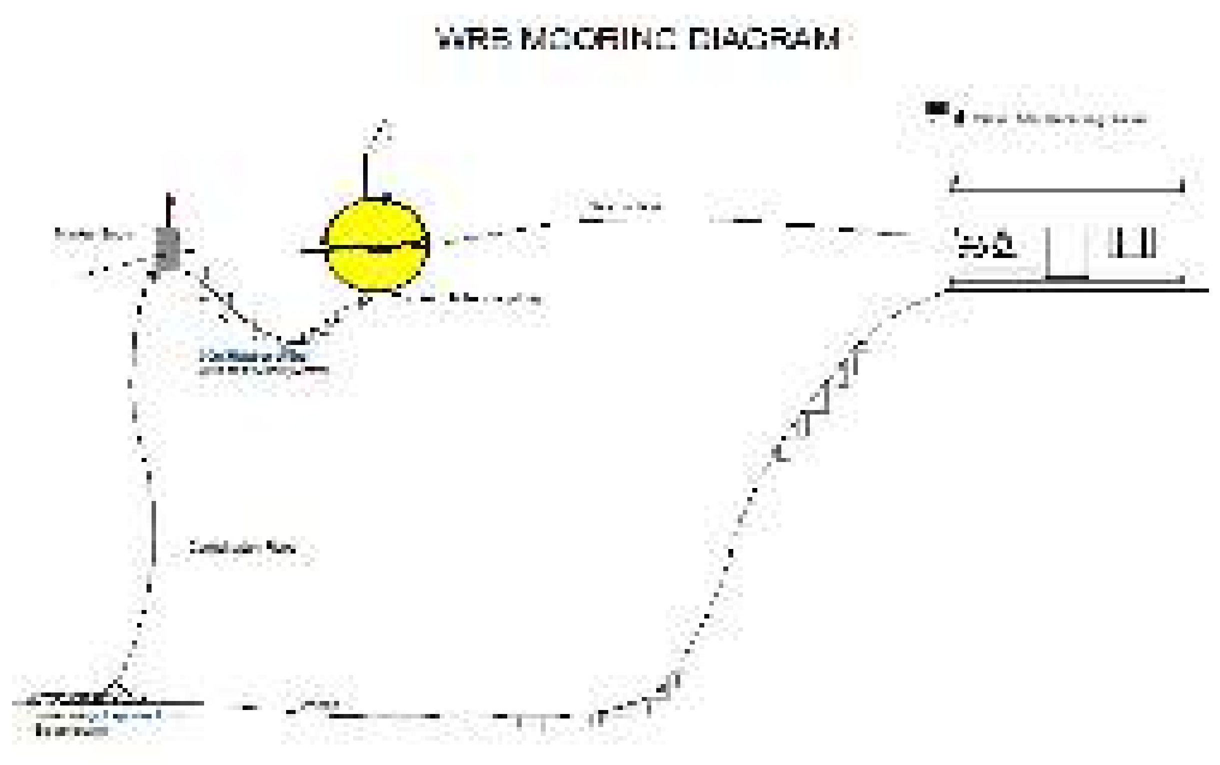


Figure 9– WRB Mooring Diagram

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.

5.5 Automatic Tide Gauge

A Valeport 740 Tide master 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
- Micro step pressure sensor
- Micro step relative humidity & temperature sensor
- Meteoservis Rain gauge
- Micro step data logger

The data is logged in a data logger installed at the receiving station at intervals of 10 minutes. The data is also transmitted from the data logger through a UHF linkto a remote PC for QC and processing.

An image of automatic weather station is provided below:

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

5.7 Real Time Kinematic (RTK) Survey

An 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 13 – RTK System fixed at BM-1

5.8 Bathymetric Survey

The cross-shore profiling from 10m CD to the shore was carried out using a Geoswath GS+ 500 kHz wide swath bathymetric system, which was calibrated on 07th April 2019. The calibration values obtained are given below:

Parameter	Value	Comments
Latency	0.54s	MX 420 DGPS system
Port Roll	-0.03º	Accuracy 0.05º in roll (~3.5cm at 40m)
Starboard Roll	0.25º	Accuracy 0.05º in roll (~3.5cm at 40m)
Pitch	0.00º	
Yaw	-3.60º	Accuracy better than 0.2°

Table 7: Calibration Results

5.9 Turbidity Monitoring

Optic sensors manufactured by Ponsel, France are used to measure the turbidity at all locations. The sensors are installed on a 6m buoy, in which is housed a telemetry module. The system is powered using a battery which is in turn charged with the aid of solar panels fitted on the buoy. The buoy is deployed on a two point mooring system as illustrated below:

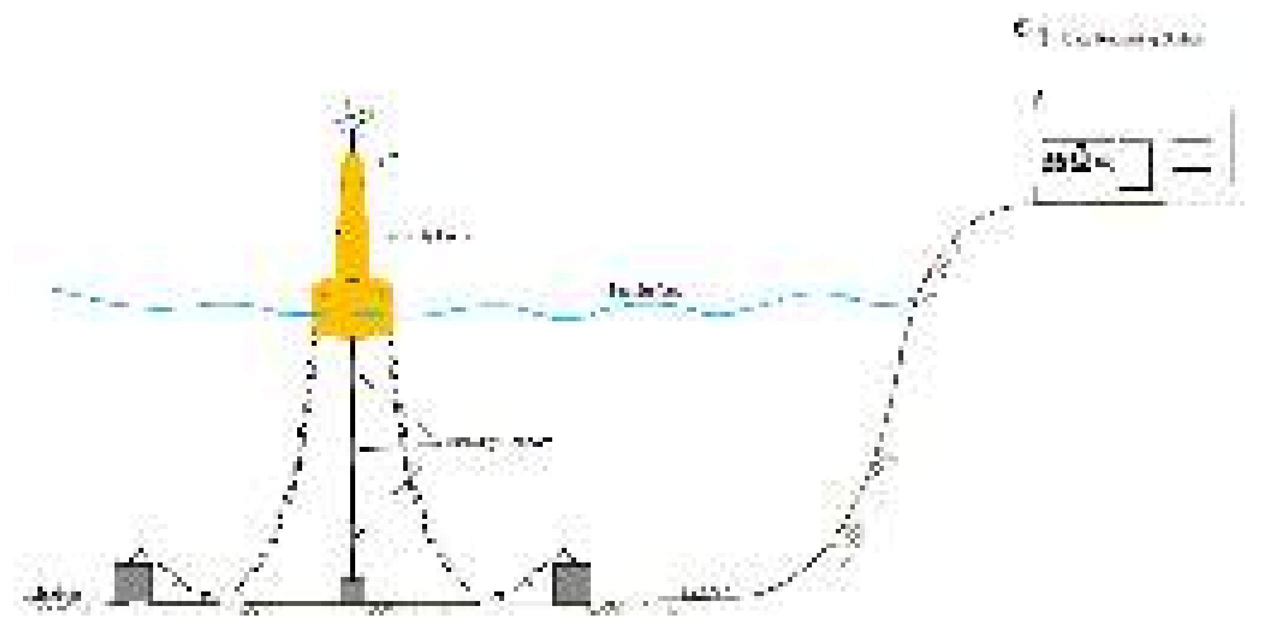


Figure 14 –Turbidity Buoy Mooring Diagram

An image of the buoy deployed at site is provided in the image below:

Figure 15 – Turbidity Buoy

The data from the buoy is received at the receiving centre at Ayur Bay resort at intervals of 10 minutes.

5.10 ADCP

The ADCP's were checked for correct pinging of each transducer heads, at site. The compass calibration was carried out for each ADCP's to check for any errors.

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 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 old VISL Project office)	8° 22’ 21”.7313 N 77° 00’ 03”.3253 E	720338.4535 mE 926061.5341 mE	44.0577

Table 8: Details of stations BM-1, BM-2& BM-3

Photographs of these stations were given in PSR-1 and hence are not repeated here.

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

Sl No.	Reference Point	Easting	Northing	Latitude	Longitude	Height above CD (m)
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
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_L EELA	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 9: 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. 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 3.251m above chart datum. An image of the TBM is provided below:

Figure 17– Location of TBM

The observed tides are mixed semi diurnal in nature. The maximum tidal 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. When the WRB became faulty, it was replaced on 29th June 2016 and is still continuing as part of the contract.

The data from the WRB was QC'ed and used to produce the time series and rose diagram, which are provided below:

Refer to the following rose plot of significant height Hs v/s direction for the period of 1st to 30th April 2019:

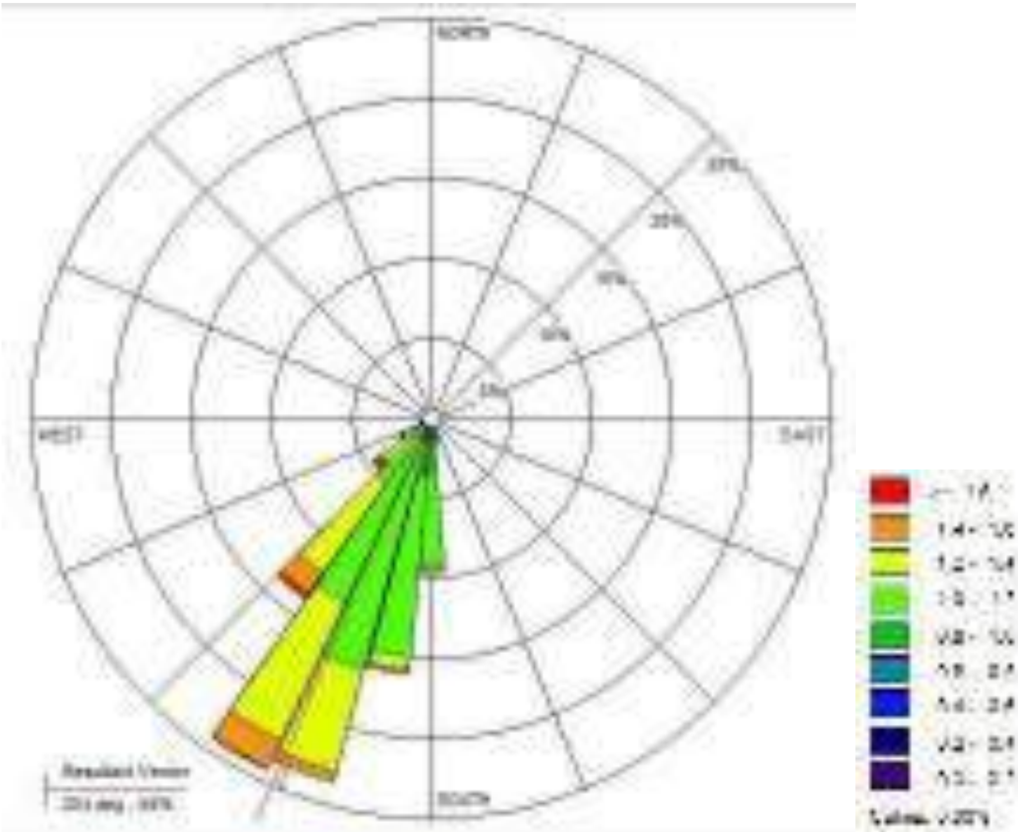


Figure 18– Wave Rose (Hs in metre v/s Direction) during 1st to 30th April 2019

The pre-dominant wave directions were South-Westerly (SW) during the period with significant wave height less than 1.6 m. As can be seen in the rose plot above, the wave heights were ranged between 0.2-1.6 m from SW directions.

The maximum significant wave height of 1.63 m was recorded on 25th April 2019 at 00:11 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 - 0.2	0	0.00	0	0.00
0.2 - 0.4	0	0.00	0	0.00
0.4 - 0.6	0	0.00	0	0.00
0.6 - 0.8	261	17.76	0	0.00
0.8 - 1.0	627	42.65	23	1.60
1.0 - 1.2	350	23.81	257	17.85
1.2- 1.4	132	8.98	396	27.50
1.4- 1.6	50	3.40	328	22.78
> 1.6	50	3.40	436	30.28
Total	1470	100	1440	100.000

Table 10: Frequency Distribution of wave height (1st to 30th April 2019)

The histogram of significant wave height during the observation period of April 2019 is given below:

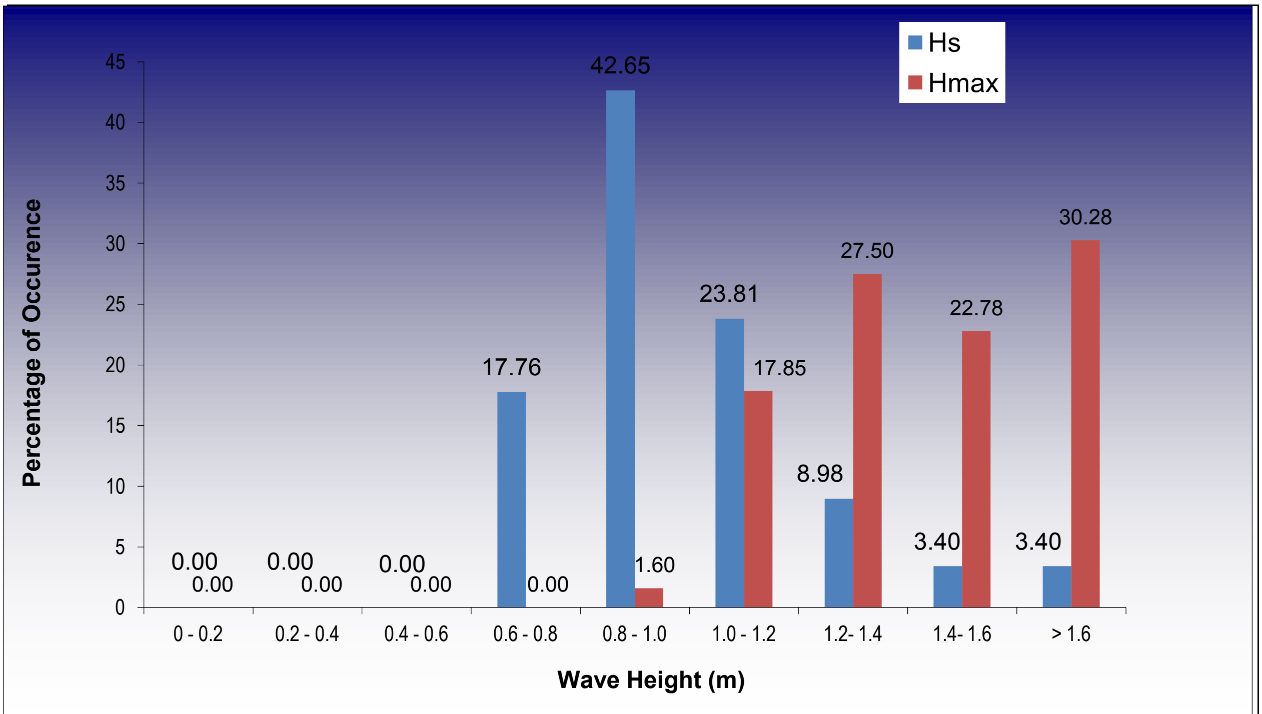


Figure 19 – Histogram of wave height (1st to 30th April 2019)

As can be observed above, about 98% of the observation the maximum wave height was more than 1m.

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

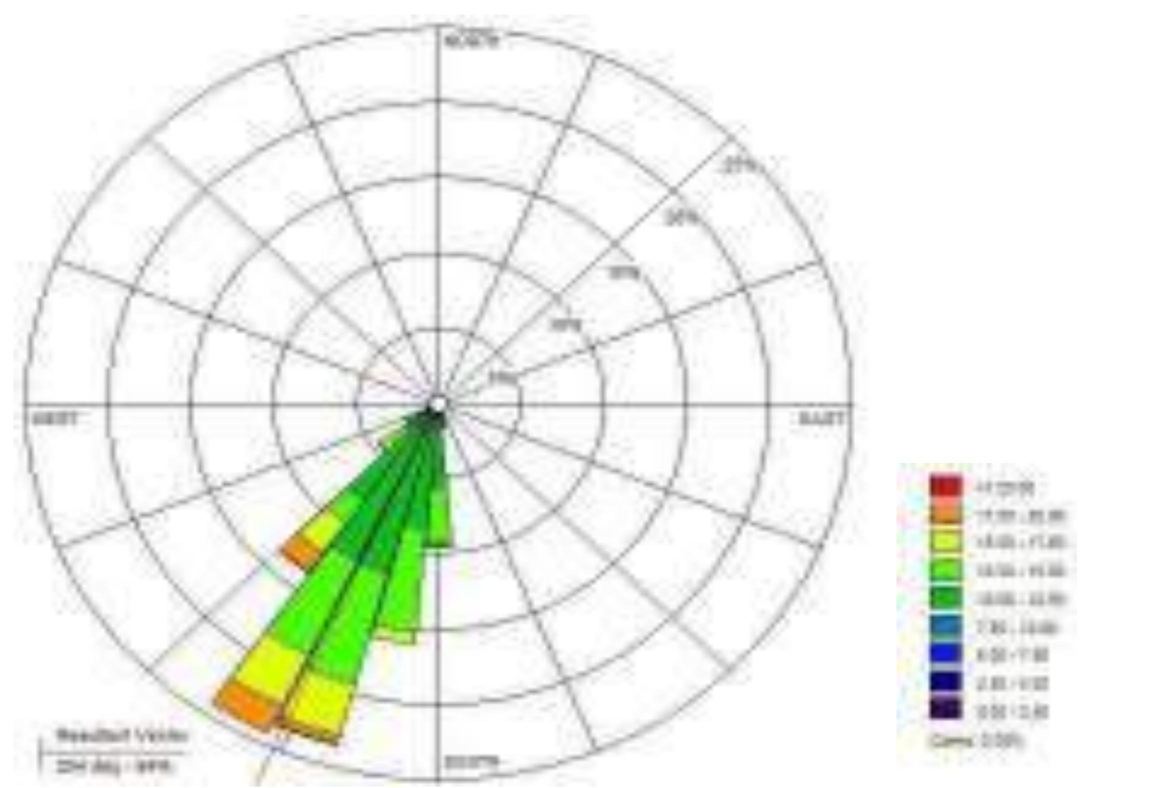


Figure 20– Wave Rose (Tp in seconds v/s Direction) during 01st to 30th April 2019

The histogram drawn for wave period for April 2019 is given below:

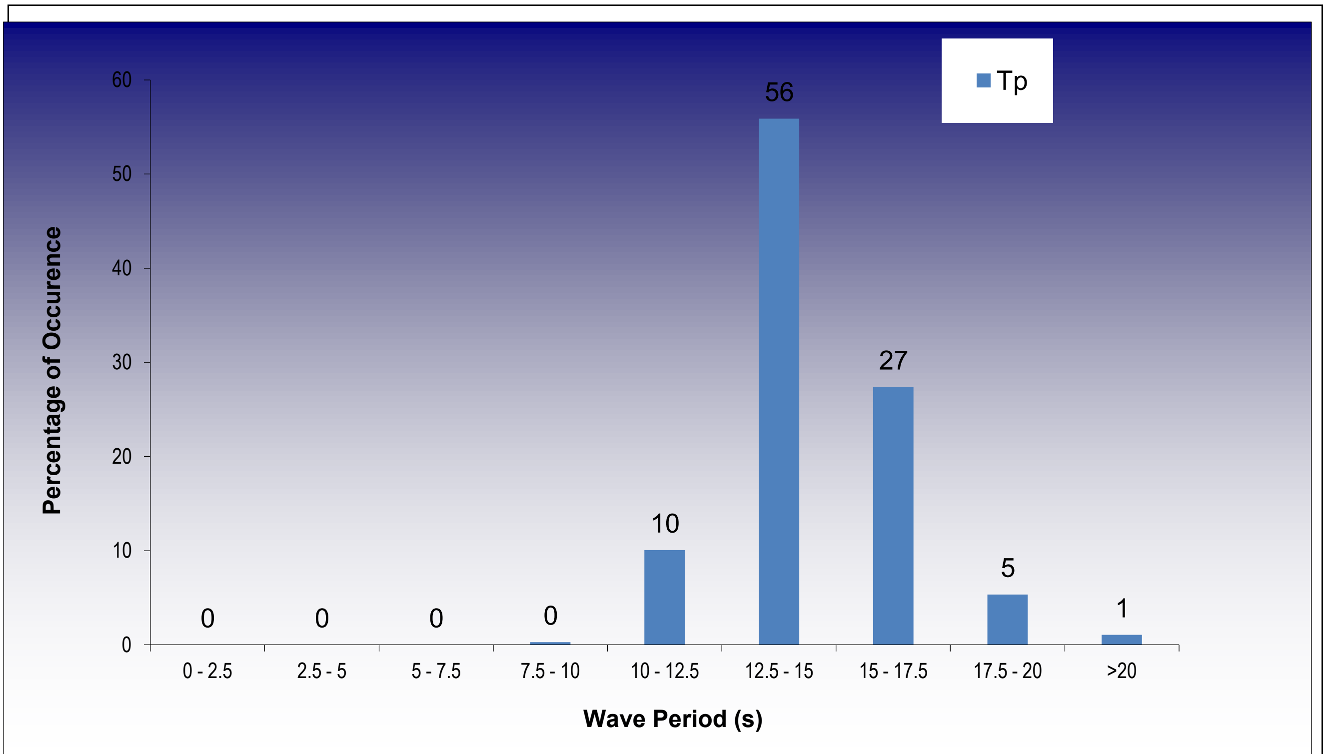


Figure 21 – Histogram of wave period (01st to 30th April 2019)

The above image indicates that during the period of observation, the wave period was in the range of 2.5 to 20 seconds, with 94% of the observations indicating long waves with a period of more than 10 seconds. The maximum period of 20 seconds was recorded on 04th April 2019 at 8:18 hours.

The time series graph for the month of April 2019 is provided in Annexure II.

6.4 Measurement of Meteorological Parameters

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

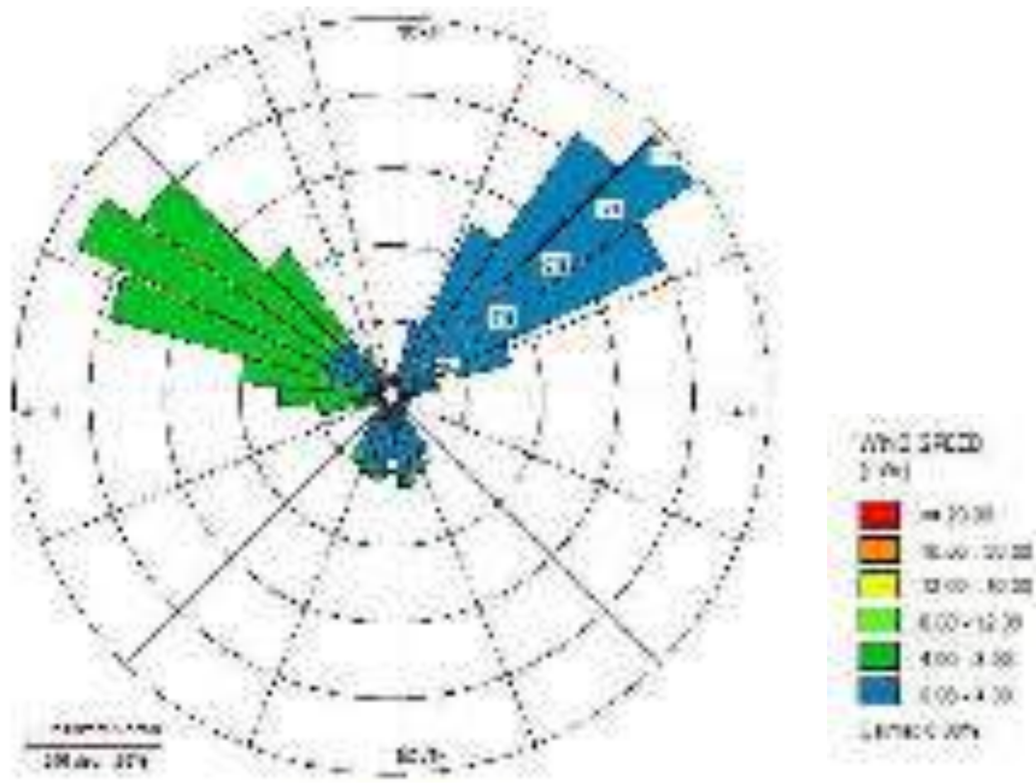


Figure 22– Wind Rose (Speed in m/s v/s Direction) during 1st to 30th April 2019

The rose plot reveals that the pre dominant wind directions are from South-westerly to Westerly and north easterly with maximum velocity magnitude up to 8 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 – 4	2900	67.69
4 – 8	1384	32.31
8 - 12	0	0.00
12 – 16	0	0.00
16 - 20	0	0.00
>20	0	0.00
Total	4284	100.0

Table 11: Frequency Distribution of wind speed (1st to 30th April 2019)

The histogram of wind speed for the period is given below:

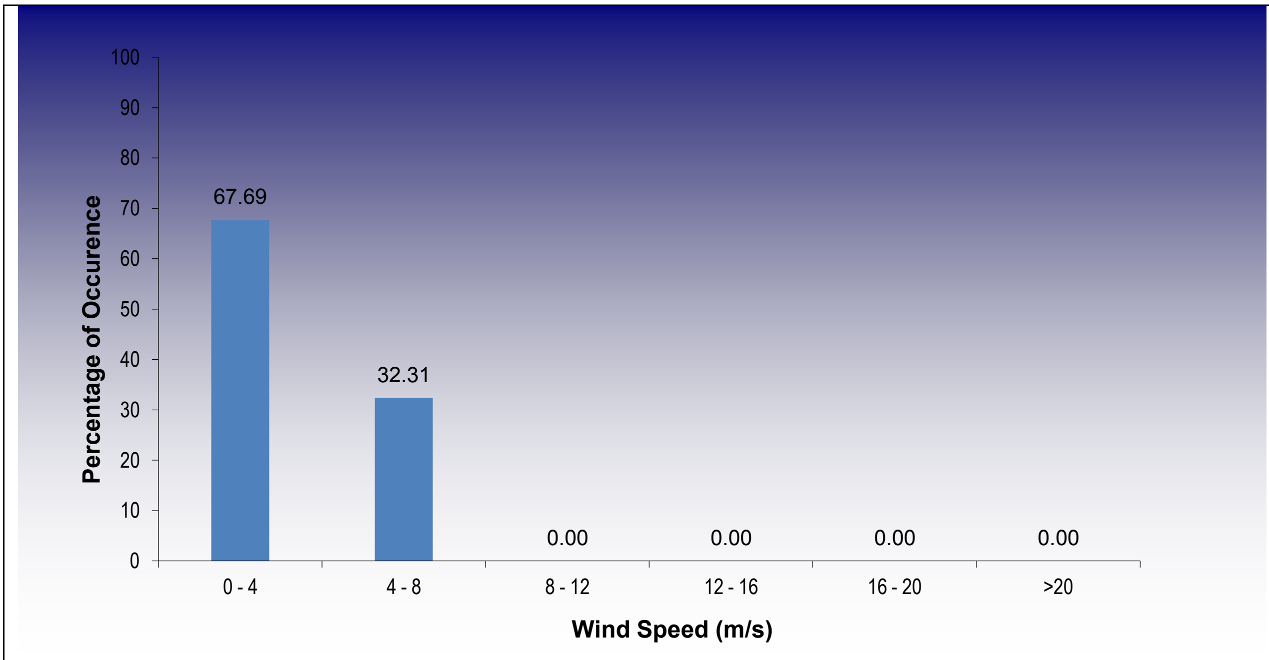


Figure 23 – Histogram of wind speed (1st to 30th April 2019)

Around 99% of winds are below 8 m/s, however the maximum wind speed in the month of April 2019 was 7.16 m/s, recorded on 25th April 2019 at 12:10 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	0.00
1000-1004	320	7.47
1004 – 1008	3656	85.34
> 1008	308	7.19
Total	4284	100.00
Temperature	No. of observations	Percentage of Occurrence
20-24	0	0.00
24-28	1322	30.86
28-32	2962	69.14
>32	0	0.00
Total	4284	100.0
RH	No. of observations	Percentage of Occurrence
50-60	0	0.00
60-70	193	4.51
70-80	1427	33.31
>80	2664	62.18
Total	4284	100

Table 12: Frequency Distribution of Met parameters (1st to 30th April 2019)

The histogram drawn for the parameters for the period (1st to 30th April 2019) is shown below:

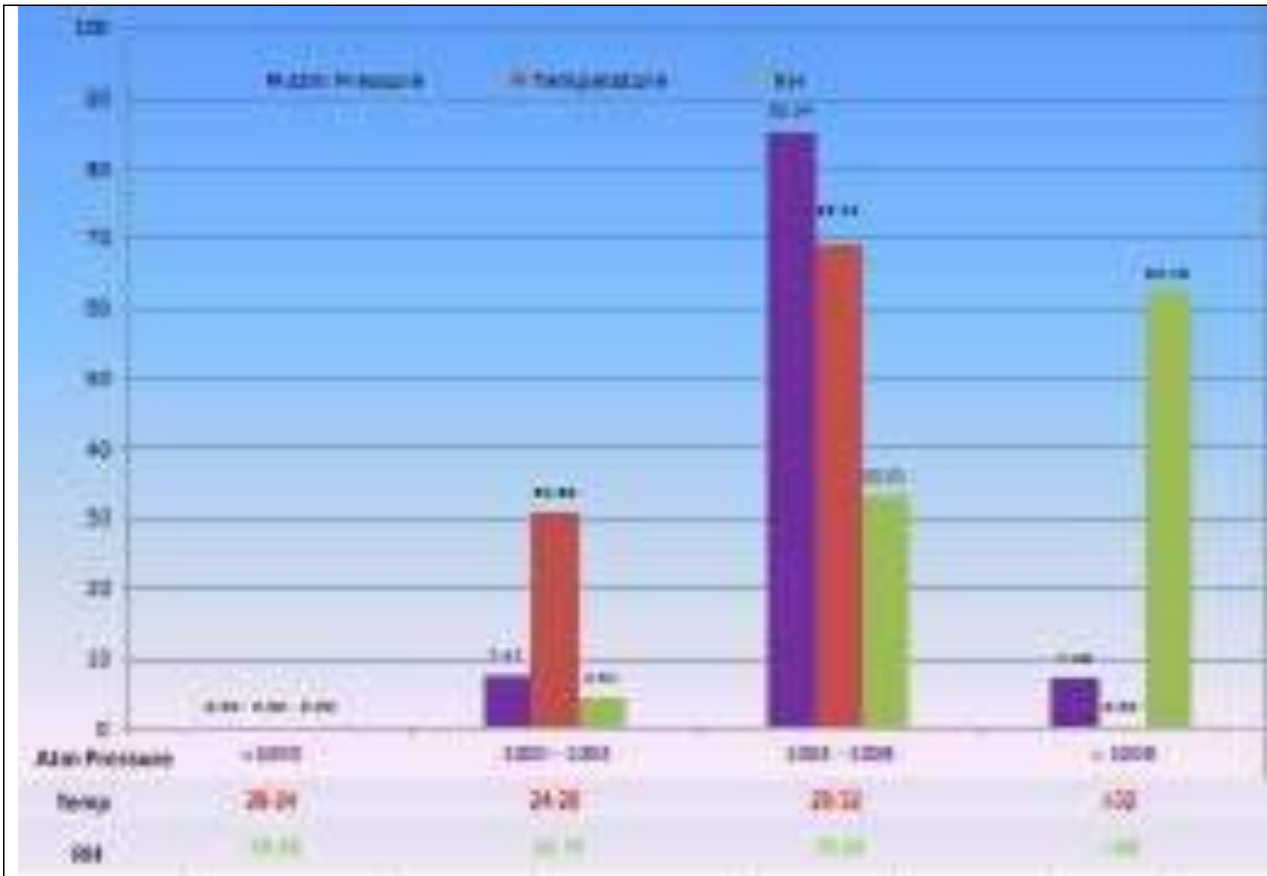


Figure 24 – Histogram of met parameters (1st to 30th April 2019)

The data represented above reveals that about 93% of the atmospheric pressure recorded for the month was above 1004 mb. The temperature hovered around 20 to 32°C during the month. The relative humidity was greater than 80% during observations indicating Pre-monsoonal conditions.

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

6.5 Littoral Environmental Observations

The LEO was carried out at 81 out of 81 locations. The LEO plate was deployed at the desired locations and the same was tracked for about five to ten minutes, as per the site conditions. The initial and final GPS positions were then used to calculate the SOG and COG. The estimated wave height, angle of wave, period and the stretch of breakers were also noted down in the log. The data sheets for all the locations are placed at Annexure IV.

The along shore current was mainly towards the North during the period of monitoring. The maximum speed of 10.16cm/s was observed at CSP-22. Rip currents were observed in the locations CSP 33, 42, 43, 44, 45 and 46.

6.6 Photographic Documentation

Photographic documentation was carried out for all the 81 locations, coinciding with the cross shore profiling. The photographs for the period are placed at Annexure V. As a common reference point, a 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.

6.7 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 wave breaker area, no data could be acquired and hence that area is shown in 'dashed line', in the enclosed AutoCAD/PDF charts.

The charts for the full period are placed in Annexure VI.

6.8 Turbidity Monitoring

Turbidity is the cloudiness or haziness of a fluid caused by suspended solids that are usually invisible to the naked eye. It is generally expressed as Nephelometric Turbidity Units (NTU).

*Nephele*isthe Greek word for "cloud" and *metric* means “measure. So, "Nephelometric, therefore, means "measuring cloudiness." All turbidity measurements detect the amount of light either transmitted through or scattered by the particles in a sample of water. Most nephelometers measure the scattered light at 90°(The light source and the detector are oriented at right angles to each other.) If more light is able to reach the detector it means that there are many small particles scattering the source beam. If less light reaches the detector it indicates less particles in the water, and hence less turbidity. The amount of light scattered is influenced by many aspects of the particles, like colour, shape, and reflectivity.

A summary of turbidity data (in NTU) recorded for the month of 01st to 30th April 2019 is given below:

Location	Surface			Mid Depth			Near Bottom		
	Max	Min	Median	Max	Min	Median	Max	Min	Median
Turbidity Buoy-1	2.5	0.0	0.6	5.7	0.1	1.9	6.3	0.1	1.0
Turbidity Buoy -2	2.9	0.0	0.9	6.0	0.0	2.2	7.6	0.8	2.8
Turbidity Buoy -3	3.0	0.0	0.4	5.8	0.1	2.6	8.0	0.4	3.6

Table 13: Summary of Turbidity values in NTU

For the period of 1st to 30th April 2019, the maximum turbidity value recorded at location 1 is 6.3 NTU (recorded at near-bottom), maximum turbidity recorded at location 2 is 7.6 NTU (recorded at near-bottom) and maximum turbidity recorded at location 3 is 8.0 NTU (recorded at near-bottom)

The entire time series curve from the three turbidity buoys are placed at Annexure VII.

7. WEATHER

During the month of April, the Pre monsoon was active in the entire Kerala state, mostly calm except long swells that hamper survey for few days.

8. CONCLUSIONS

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

1. Tide was mixed semi diurnal with a maximum range of 1.124 m during spring tide.
2. The significant wave heights ranged between 1-2 m recorded from SW directions. During same period the predominant winds of 4-8 m/s observed mostly from north-easterly directions.
3. The long-shore transport was recorded in a Southerly direction, with maximum velocity of about 10.16 cm/s recorded at CSP-22.
4. The maximum turbidity value recorded at location 1 is 6.3 NTU, at location 2 is 7.6 NTU and at location 3 is 8 NTU; all observed near seabed.

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 from February 2016 to March 2018, OSaS/P21716/AVPPL/PSR-1(to PSR-36)/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)

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.

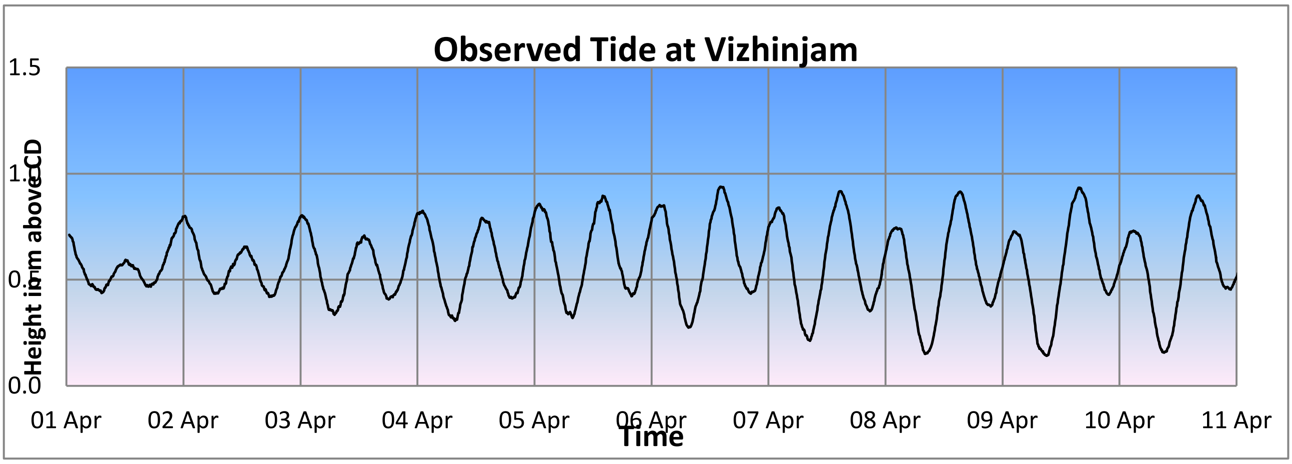
The scientists/technicians from NIOT are also acknowledged for their support and guidance during the course of the project.

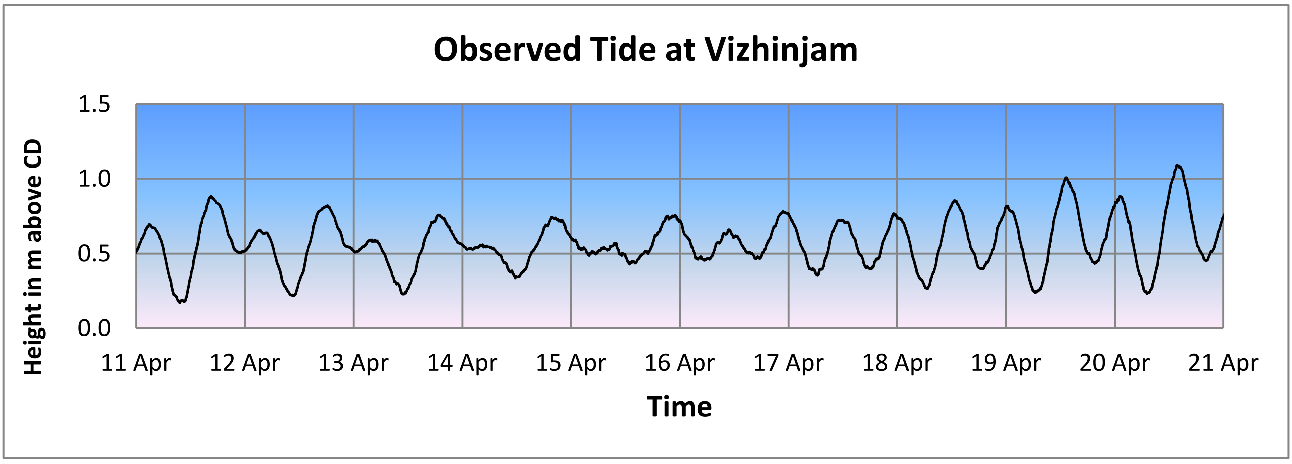
The crew of the boat and all local support obtained during the observation are also acknowledged.

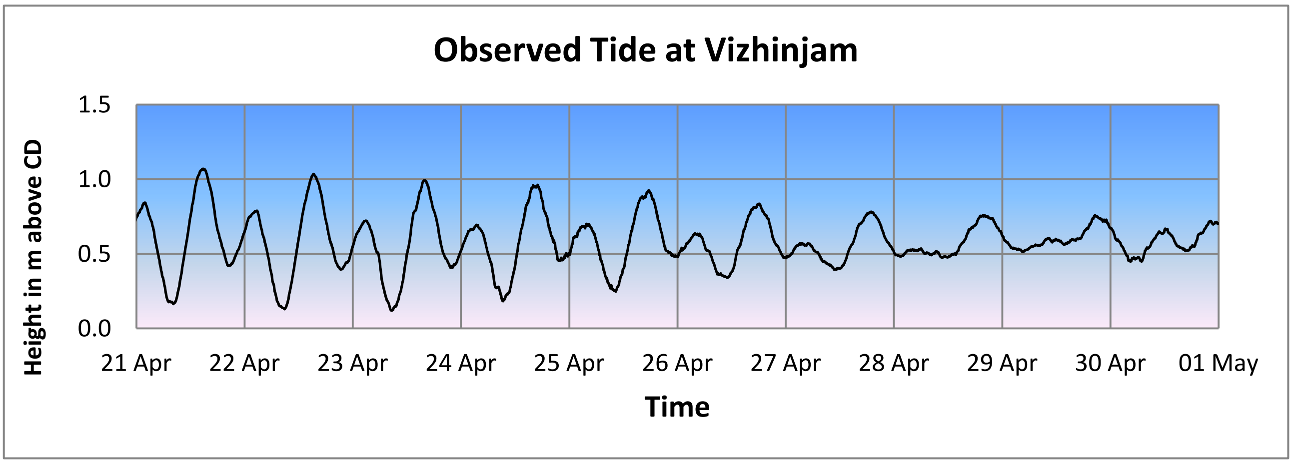
Weather forecast during the period was regularly observed at INCOIS and India Meteorological Department’s web site.

Annexure I

Tide Curves

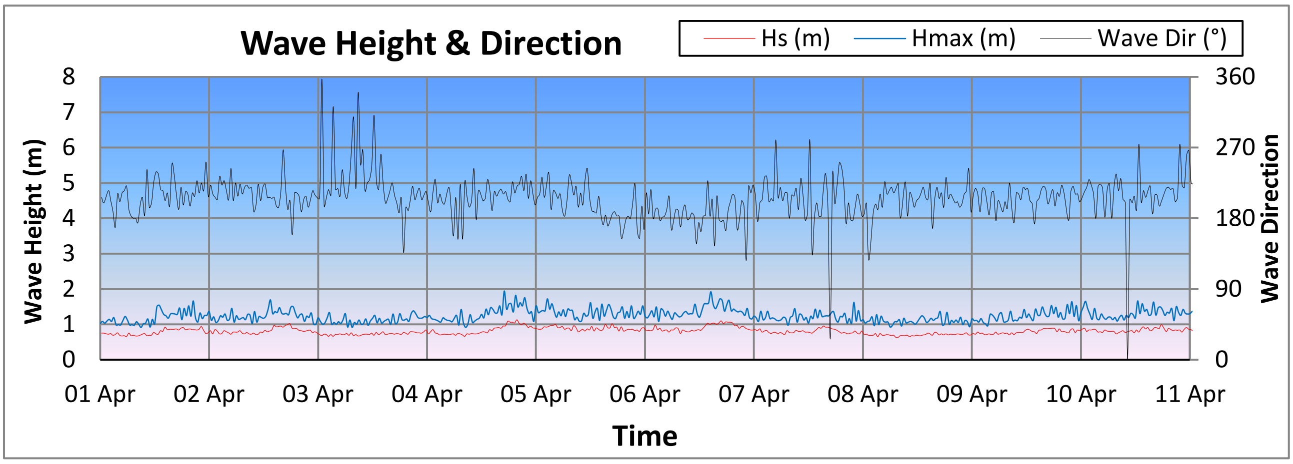

Observed Tide at Vizhinjam
Height in m above CD
1.5
1.0
0.5
0.0
01 Apr
02 Apr
03 Apr
04 Apr
05 Apr
06 Apr
07 Apr
08 Apr
09 Apr
10 Apr
11 Apr
Time

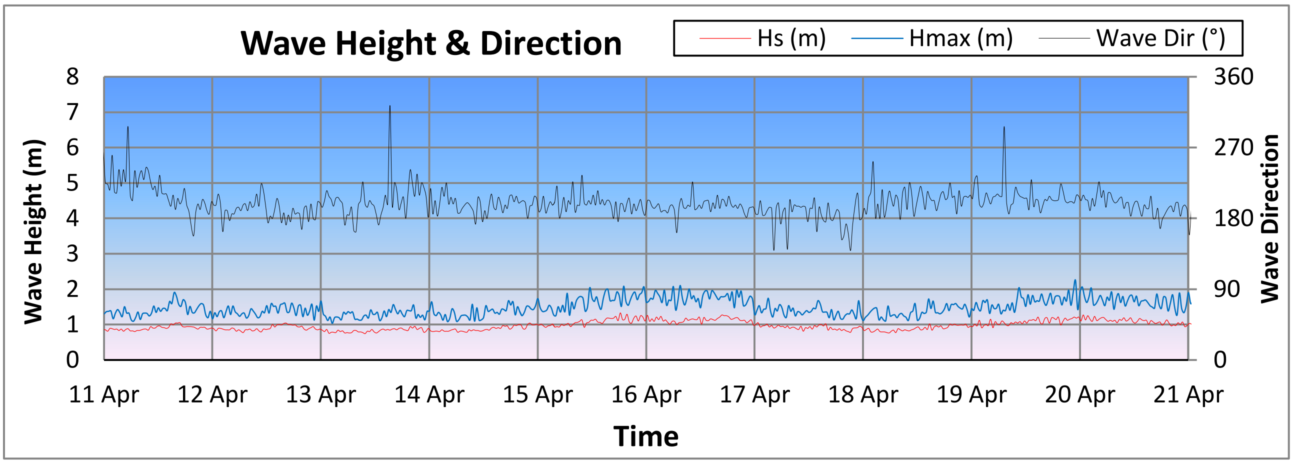

Observed Tide at Vizhinjam
Height in m above CD
1.5
1.0
0.5
0.0
11 Apr
12 Apr
13 Apr
14 Apr
15 Apr
16 Apr
17 Apr
18 Apr
19 Apr
20 Apr
21 Apr
Time

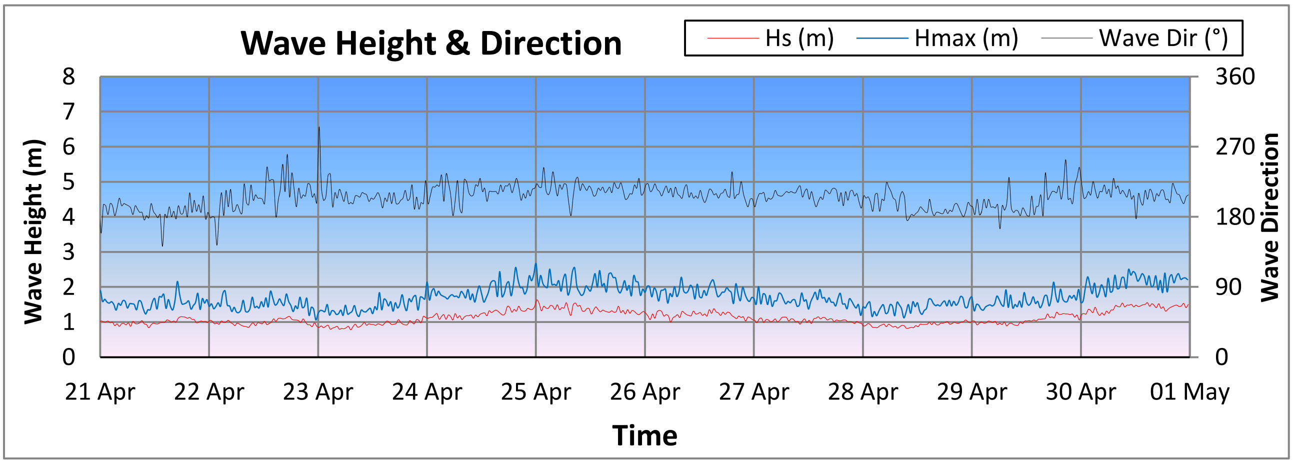

Observed Tide at Vizhinjam
Height in m above CD
1.5
1.0
0.5
0.0
21 Apr
22 Apr
23 Apr
24 Apr
25 Apr
26 Apr
27 Apr
28 Apr
29 Apr
30 Apr
01 May
Time

Annexure II

Wave Data

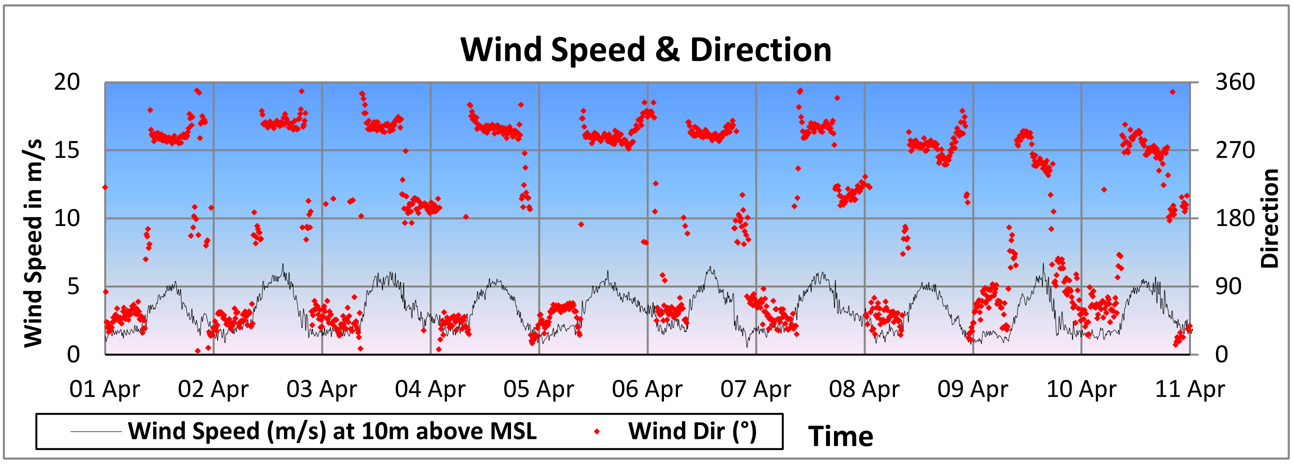

Wave Height & Direction
Hs (m)
Hmax (m)
Wave Dir (°)
Wave Height (m)
0
1
2
3
4
5
6
7
8
Wave Direction
0
90
180
270
360
01 Apr
02 Apr
03 Apr
04 Apr
05 Apr
06 Apr
07 Apr
08 Apr
09 Apr
10 Apr
11 Apr
Time

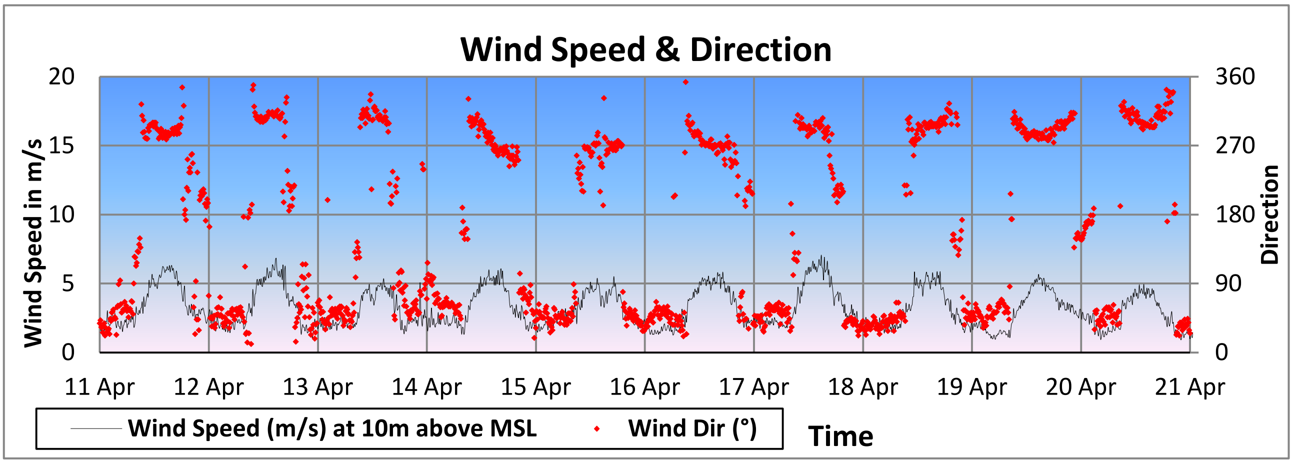

Wave Height & Direction
Hs (m)
Hmax (m)
Wave Dir (°)
Wave Height (m)
0
1
2
3
4
5
6
7
8
Wave Direction
0
90
180
270
360
11 Apr
12 Apr
13 Apr
14 Apr
15 Apr
16 Apr
17 Apr
18 Apr
19 Apr
20 Apr
21 Apr
Time

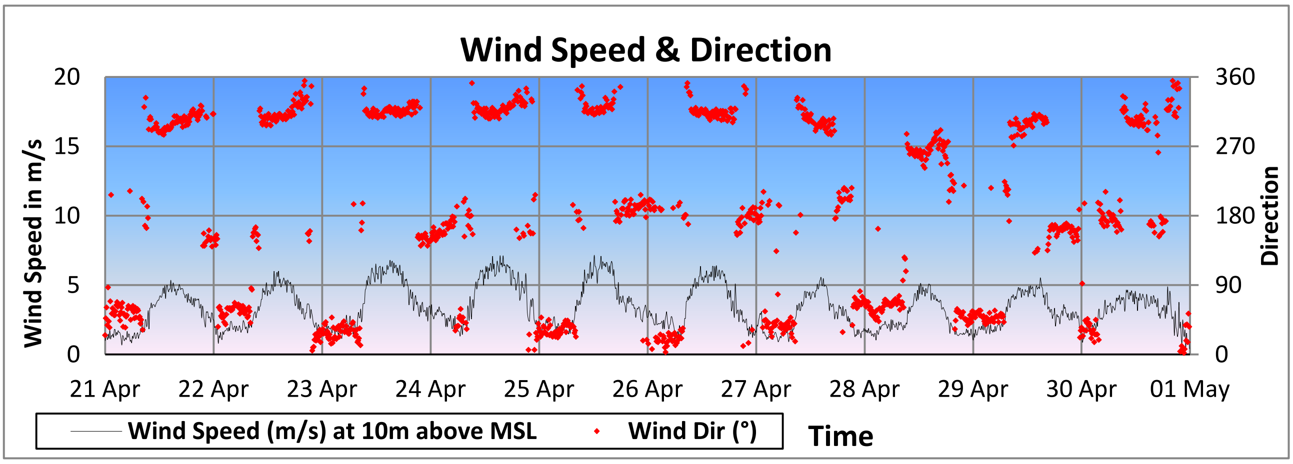

Wave Height & Direction
Hs (m)
Hmax (m)
Wave Dir (°)
Wave Height (m)
0
1
2
3
4
5
6
7
8
Wave Direction
0
90
180
270
360
21 Apr
22 Apr
23 Apr
24 Apr
25 Apr
26 Apr
27 Apr
28 Apr
29 Apr
30 Apr
01 May
Time

Annexure III

Wind Data


Wind Speed & Direction
Wind Speed in m/s
Direction
20
15
10
5
0
360
270
180
90
0
01 Apr
02 Apr
03 Apr
04 Apr
05 Apr
06 Apr
07 Apr
08 Apr
09 Apr
10 Apr
11 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
11 Apr
12 Apr
13 Apr
14 Apr
15 Apr
16 Apr
17 Apr
18 Apr
19 Apr
20 Apr
21 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
21 Apr
22 Apr
23 Apr
24 Apr
25 Apr
26 Apr
27 Apr
28 Apr
29 Apr
30 Apr
01 May
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

adani

OCEAN Science & Surveying

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									
				Northing	Easting	Northing	Easting								
03/04/2019	CSP-1	16:30	16:36	914460.8306	734908.15	914469.036	734903.3759	2.64	120	R	85	1.5	10	5	
03/04/2019	CSP-2	16:42	16:47	914742.1642	734480.96	914750.455	734467.5274	5.26	148	R	85	1.5	10	5	
03/04/2019	CSP-3	16:49	16:54	915038.3259	734087.68	915043.414	734080.1087	3.04	146	R	85	1.5	10	25	
03/04/2019	CSP-4	16:57	17:03	915326.4525	733672.72	915331.36	733666.5513	2.19	142	R	85	1.5	10	5	
03/04/2019	CSP-5	17:06	17:11	915620.3205	733258.54	915624.324	733253.3242	2.19	142	R	85	1.5	10	25	
03/04/2019	CSP-6	17:15	17:20	915917.1344	732852.08	915922.837	732842.5268	3.71	149	R	85	1.5	10	25	
03/04/2019	CSP-7	17:22	17:27	916209.1704	732452.08	916212.722	732446.8008	2.12	146	R	90	1.5	10	25	
03/04/2019	CSP-8	17:30	17:36	916494.227	732041.17	916499.057	732035.2887	2.11	141	R	90	1.5	10	20	
03/04/2019	CSP-9	17:40	17:45	916784.7634	731630.61	916798.719	731612.6113	7.59	142	R	90	1.5	10	20	
03/04/2019	CSP-10	17:52	17:57	917083.4355	731230.93	917099.403	731209.1073	9.01	144	R	90	1.5	10	20	
04/04/2019	CSP-11	15:05	15:11	917373.0616	730821.01	917387.834	730798.698	7.43	146	R	90	1.5	10	20	
04/04/2019	CSP-12	15:16	15:22	917564.0775	730556.36	917580.917	730535.662	7.41	141	R	90	1.5	10	20	
04/04/2019	CSP-13	15:28	15:34	917864.636	730149.96	917881.951	730126.9456	8.00	143	R	90	1.5	10	20	
04/04/2019	CSP-14	15:40	15:46	918161.5818	729746.11	918180.825	729720.8918	8.81	143	R	90	1.5	10	20	
04/04/2019	CSP-15	15:52	15:59	918448.4963	729337.23	918463.329	729318.0825	5.77	142	R	90	1.5	10	20	
04/04/2019	CSP-16	16:03	16:09	918721.7588	728934.76	918737.554	728916.6879	6.67	139	R	90	1.5	10	20	
04/04/2019	CSP-17	16:12	16:17	919058.661	728544.44	919078.173	728524.2057	9.37	136	R	90	1.5	10	20	
04/04/2019	CSP-18	17:00	17:06	919378.9889	728163.79	919396.425	728142.0008	7.75	141	R	90	1.5	10	20	
04/04/2019	CSP-19	17:14	17:20	919680.8046	727764.04	919699.242	727738.573	8.73	144	R	90	1.5	10	20	
04/04/2019	CSP-20	17:28	17:34	919979.3392	727364.63	919995.685	727341.9134	7.77	144	R	90	1	10	20	
04/04/2019	CSP-21	17:40	17:46	920279.4499	726960.94	920293.15	726943.3579	6.19	142	R	90	1	10	20	
04/04/2019	CSP-22	17:50	17:55	920590.749	726564.44	920610.648	726541.3406	10.16	139	R	90	1	10	20	
08/04/2019	CSP-23	17:19	17:25	920907.7128	726177.23	920920.495	726162.1802	5.49	140	R	85	1	9	20	
08/04/2019	CSP-24	17:04	17:09	921228.8735	725800.94	921238.353	725788.1057	5.32	144	R	85	1	9	10	Rocky area
08/04/2019	CSP-25	16:54	16:59	921551.4889	725409.27	921556.561	725403.4863	2.56	139	R	85	1	9	20	
08/04/2019	CSP-26	16:45	16:50	921862.0295	725016.71	921876.086	725004.0511	6.31	132	R	85	1	9	20	
08/04/2019	CSP-27	16:34	16:39	922174.717	724621.89	922183.467	724611.8724	4.43	139	R	85	1	11	20	
08/04/2019	CSP-28	16:19	16:25	922478.2795	724230.26	922491.933	724212.251	6.28	143	R	85	1	11	20	
08/04/2019	CSP-29	16:05	16:11	922766.0932	723837.54	922782.768	723821.8213	6.37	133	R	85	1	11	20	
08/04/2019	CSP-30	15:53	15:59	923047.177	723448.08	923058.493	723432.2738	5.40	144	R	85	1	11	20	
08/04/2019	CSP-31	09:15	09:20	923350.4853	723043.27	923338.961	723055.0779	5.50	316	L	85	1	11	25	

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									
				Northing	Easting	Northing	Easting								
08/04/2019	CSP-32	09:00	09:06	923637.6413	722621.18	923628.88	722634.408	4.41	326	L	85	1	11	25	
08/04/2019	CSP-33	08:44	08:50	923881.2452	722246.85	923877.296	722252.9541	2.02	327	L	85	1	11	15	Rip Current
08/04/2019	CSP-34	08:28	08:34	924116.9194	721797.33	924109.579	721808.9504	3.82	328	L	85	1	11	15	
09/04/2019	CSP-35	16:08	16:14	924297.7139	721415.99	924293.591	721426.2645	3.08	338	L	85	1	11	10	Rocky area
09/04/2019	CSP-36	16:33	16:38	924803.3427	721110.51	924791.339	721119.8607	5.07	308	L	85	1.5	11	15	
09/04/2019	CSP-37	16:47	16:52	925156.9082	720773.05	925146.536	720782.7774	4.74	313	L	85	1.5	11	20	
09/04/2019	CSP-38	17:08	17:12	925556.3006	720317.33	925552.926	720323.2938	2.85	330	L	85	1.5	11	20	
09/04/2019	CSP-39	11:35	11:40	925884.0351	719934.23	925871.28	719946.7909	5.97	315	L	85	1.5	11	15	
09/04/2019	CSP-40	11:49	11:55	926064.6914	719562.82	926063.299	719565.9179	0.94	336	L	85	1.5	11	5	Rotary motion due to seawall
09/04/2019	CSP-41	17:36	17:42	926874.5739	718515.7	926872.01	718520.158	1.43	330	L	85	1.5	11	15	
06/04/2019	CSP-42	09:35	09:41	927281.2447	717986.66	927288.534	717987.1231	2.03	86	R	85	1.5	11	15	Rip Current
06/04/2019	CSP-43	09:45	09:51	927524.2066	717769.97	927530.905	717768.9526	1.88	99	R	85	1.5	11	15	Rip Current
06/04/2019	CSP-44	09:53	09:59	927903.2067	717481.23	927907.768	717478.9249	1.42	117	R	85	1.5	11	15	Rip Current
06/04/2019	CSP-45	10:28	10:34	928528.6044	717227.55	928525.129	717226.4876	1.01	253	L	85	1.5	11	15	Rip Current
06/04/2019	CSP-46	10:36	10:42	928867.771	717225.4	928871.646	717225.5543	1.08	88	R	85	1.5	11	15	Rip Current
06/04/2019	CSP-47	10:57	11:03	929300.5633	717057.78	929297.898	717060.2611	1.01	313	L	85	1.5	11	15	
06/04/2019	CSP-48	11:11	11:17	929942.9967	716786.91	929939.15	716790.0353	1.38	309	L	85	1.5	11	5	Seawall area
06/04/2019	CSP-49	11:20	11:26	930239.9636	716610.97	930236.877	716612.8491	1.00	301	L	85	1.5	11	5	Seawall area
06/04/2019	CSP-50	11:36	11:42	930659.1917	716353.72	930654.858	716356.3187	1.40	301	L	85	1.5	11	5	Seawall area
06/04/2019	CSP-51	11:49	11:55	931105.1021	716073.97	931100.997	716075.4561	1.21	290	L	85	1.5	11	5	Seawall area
06/04/2019	CSP-52	12:00	12:06	931495.94	715785.81	931491.208	715786.3965	1.32	277	L	85	1.5	11	5	Seawall area
10/04/2019	CSP-53	10:04	10:10	931927.1343	715512.37	931943.72	715495.7145	6.53	135	R	85	1.5	11	15	
10/04/2019	CSP-54	09:53	09:59	932281.508	715202.16	932302.823	715183.2674	7.91	132	R	85	1	11	15	
10/04/2019	CSP-55	09:40	09:46	932674.5448	714873.91	932694.717	714852.8203	8.11	136	R	85	1	11	15	
07/04/2019	CSP-56	10:49	10:55	933018.4249	714525.83	933009.136	714535.8426	3.79	317	L	85	1	11	15	
07/04/2019	CSP-57	10:38	10:44	933381.726	714198.84	933374.819	714204.134	2.42	307	L	85	1	11	15	
07/04/2019	CSP-58	10:29	10:35	933791.3817	713894.14	933800.406	713886.6522	3.26	130	R	85	1	11	15	
07/04/2019	CSP-59	10:18	10:24	934166.7981	713593.43	934160.762	713599.3723	2.35	315	L	85	1	11	15	Between seawall
07/04/2019	CSP-60	10:04	10:10	934572.3664	713265.47	934563.395	713274.1154	3.46	314	L	85	1	11	15	
07/04/2019	CSP-61	09:53	09:59	934941.821	712929.41	934938.349	712932.3651	1.27	310	L	90	1	11	5	Seawall area
07/04/2019	CSP-62	09:43	09:49	935316.2788	712607.79	935333.365	712598.4799	5.40	119	R	90	1	11	20	
07/04/2019	CSP-63	09:31	09:37	935709.1279	712288.73	935703.452	712293.1511	2.00	308	L	90	1	11	5	Seawall area

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									
				Northing	Easting	Northing	Easting								
07/04/2019	CSP-64	09:23	09:29	936091.829	711961.37	936088.906	711963.6642	1.03	308	L	90	1	11	20	
07/04/2019	CSP-65	11:08	11:14	936422.5571	711650.97	936419.55	711655.3348	1.47	325	L	90	1.5	11	20	
07/04/2019	CSP-66	11:17	11:23	936818.9386	711280.72	936800.758	711298.8966	7.14	315	L	90	1.5	10	20	
07/04/2019	CSP-67	11:27	11:33	937190.2655	710940.18	937170.146	710959.7753	7.80	314	L	90	1.5	10	20	
07/04/2019	CSP-68	11:34	11:40	937555.03	710604.06	937540.301	710622.3997	6.53	321	L	90	1.5	10	20	
07/04/2019	CSP-69	11:42	11:48	937928.53	710269.49	937907.501	710293.1668	8.80	318	L	90	1.5	10	20	
07/04/2019	CSP-70	11:55	12:01	938305.315	709936.46	938292.702	709949.2121	4.98	315	L	90	1.5	10	20	
07/04/2019	CSP-71	12:03	12:09	938442.5456	709809.97	938425.794	709827.2316	6.68	316	L	90	1.5	10	20	
07/04/2019	CSP-72	12:12	12:18	938816.4059	709478.83	938805.047	709496.8191	5.91	328	L	85	1.5	10	20	
05/04/2018	CSP-73	17:20	17:26	939192.6148	709150.45	939206.587	709139.7391	4.89	127	R	85	1	10	20	
05/04/2018	CSP-74	17:08	17:14	939567.9199	708824.98	939588.256	708808.1353	7.34	130	R	85	1	10	20	
05/04/2018	CSP-75	16:55	17:01	939943.6988	708493.68	939964.746	708478.3948	7.23	126	R	85	1	10	20	
05/04/2018	CSP-76	16:41	16:47	940329.2553	708171.75	940350.513	708155.2816	7.47	128	R	85	1	10	20	
05/04/2018	CSP-77	16:27	16:33	940713.2073	707855.11	940730.068	707838.9857	6.48	134	R	85	1	10	20	
05/04/2018	CSP-78	16:01	16:07	941090.5528	707525.93	941113.597	707511.1545	7.60	123	R	85	1	10	20	
05/04/2018	CSP-79	15:51	15:57	941492.8124	707229.26	941513.851	707214.193	7.19	126	R	85	1	10	20	
05/04/2018	CSP-80	15:38	15:44	941885.0445	706918.32	941908.321	706902.4515	7.83	124	R	85	1	10	20	
05/04/2018	CSP-81	15:25	15:31	942282.1726	706609.04	942308.337	706588.3095	9.27	128	R	85	1	10	20	

Annexure V

Photo Documentation at CSP Locations - April 2019

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:- July_CSP 25

Figure 26:- April_CSP 26




Figure 27:- April_CSP 27

Figure 28:- April_CSP 28

Figure 29:- April_CSP 29

Figure 30:- April_CSP 30

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

Figure 46:- April_CSP 46

Figure 47:- April_CSP 47

Figure 48:- April_CSP 48

Figure 49:- April_CSP 49

Figure 50:- April_CSP 50

Figure 51:- April_CSP 51

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

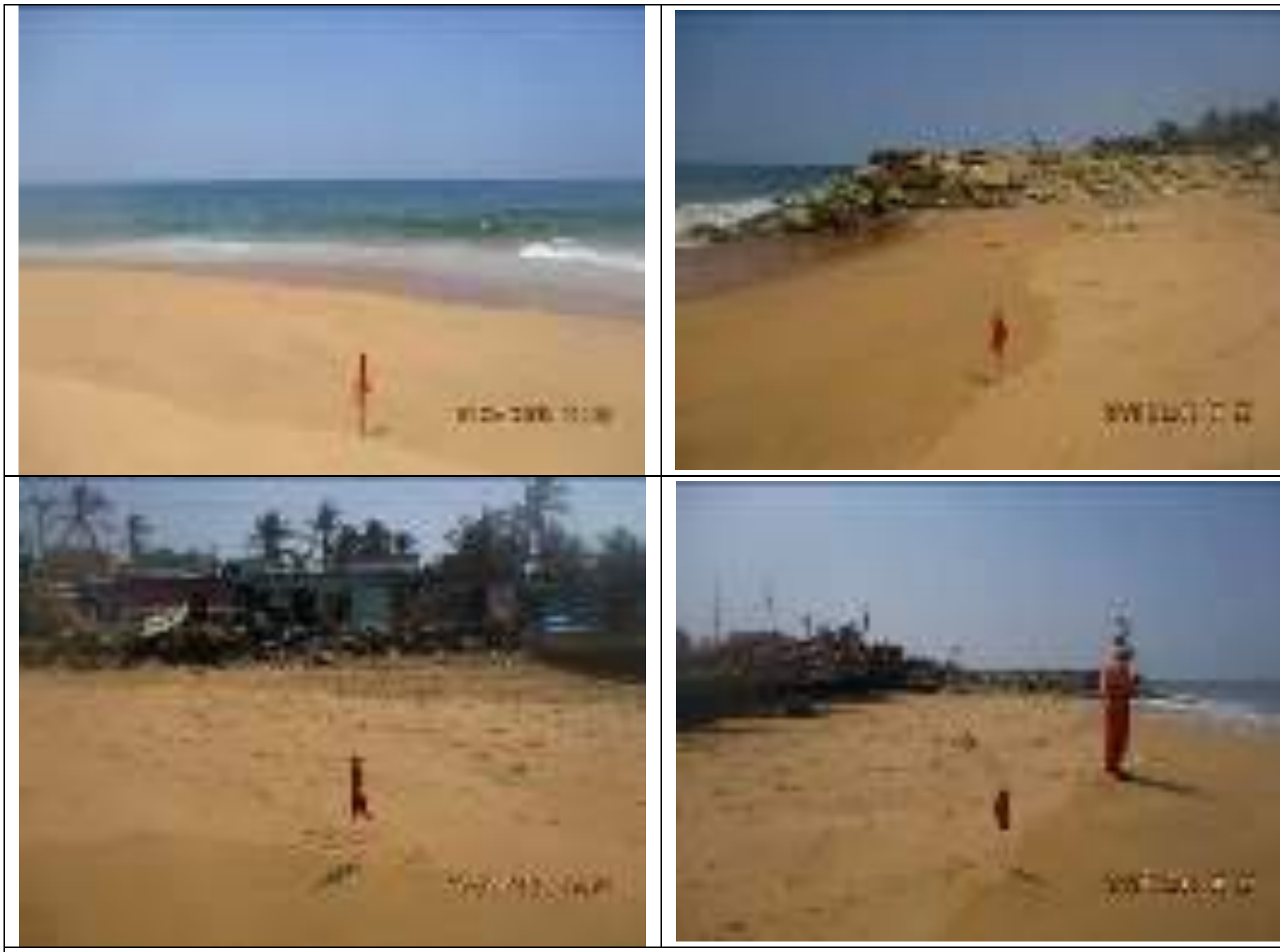


Figure 58:- April_CSP 58

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

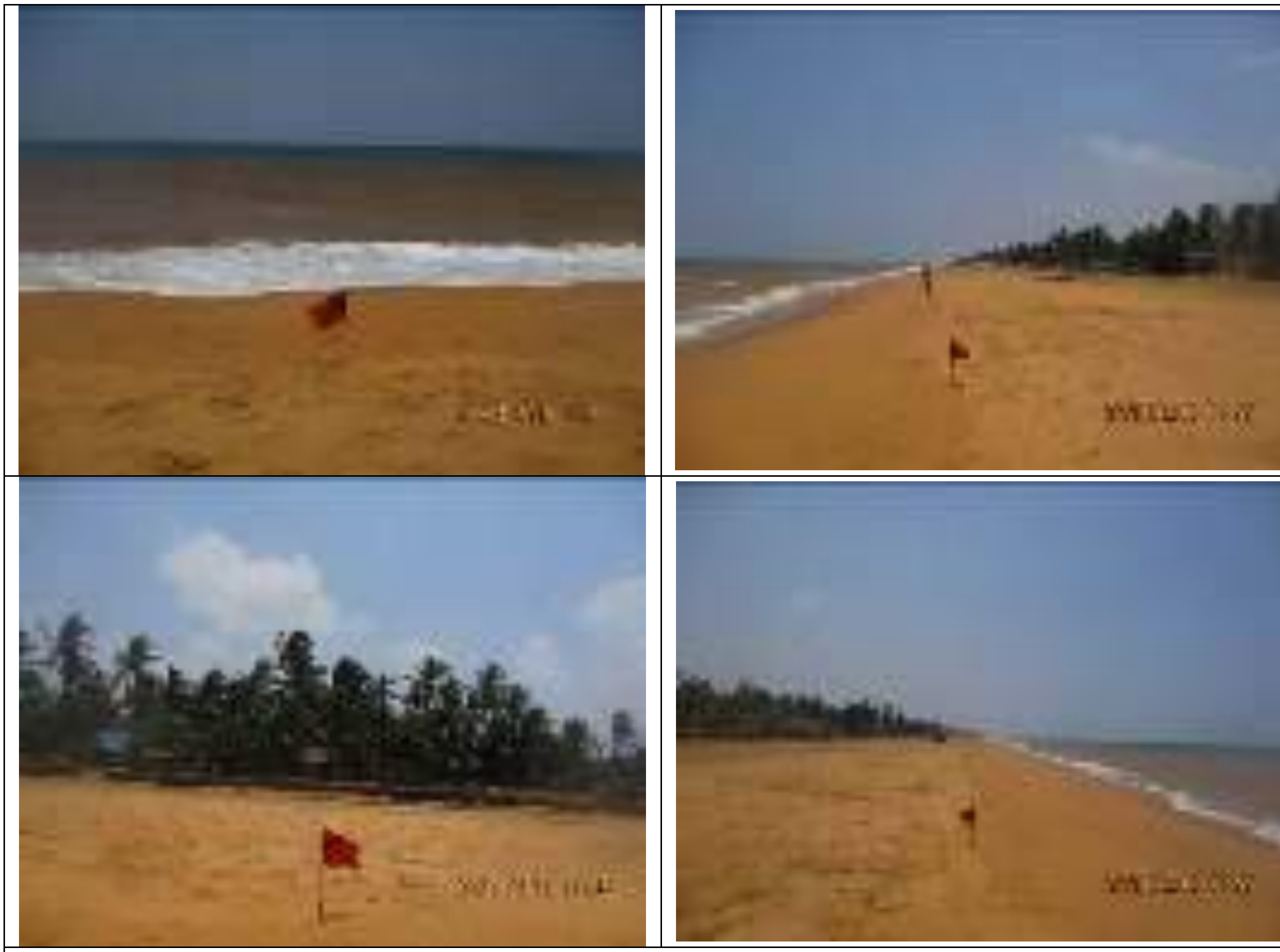


Figure 70:- April_CSP 70

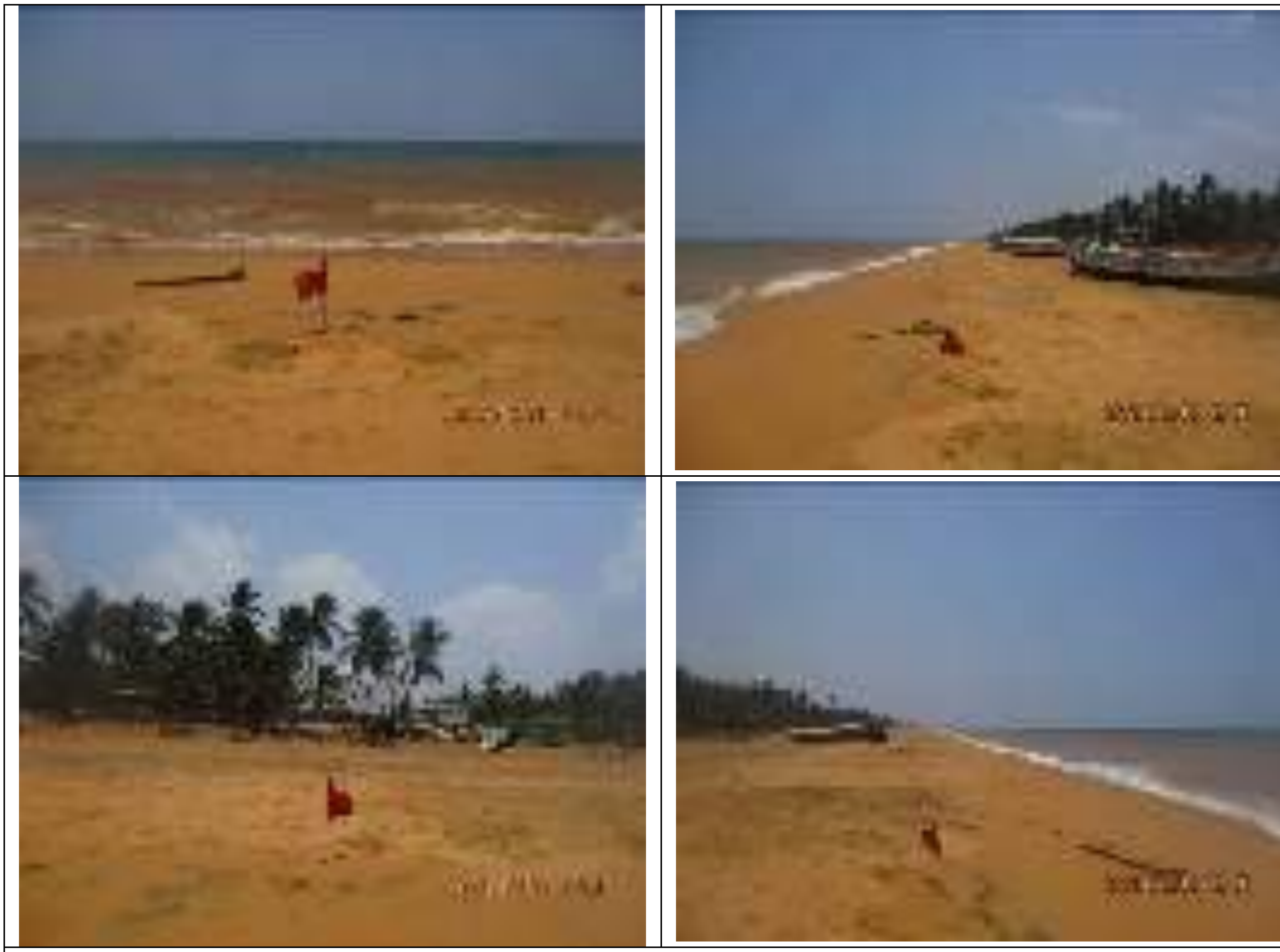


Figure 71:- April_CSP 71

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

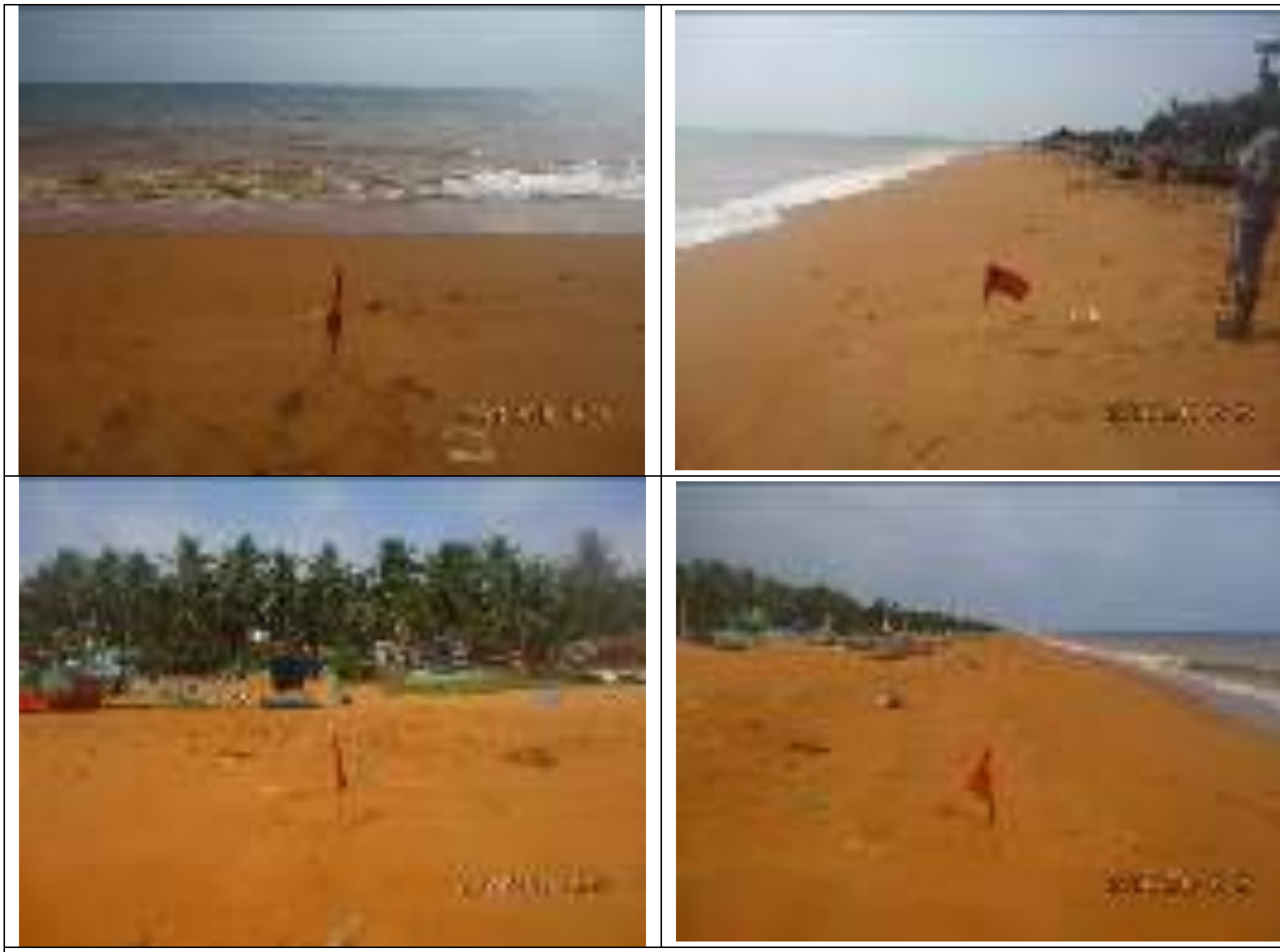
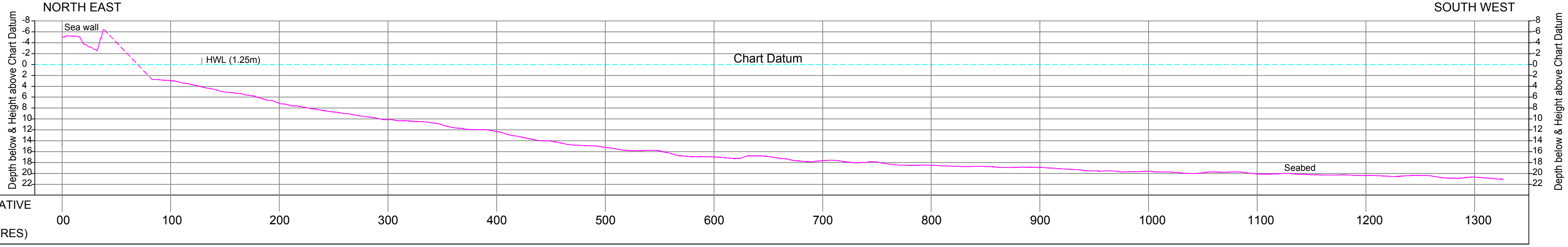


Figure 81:- April_CSP 81

Annexure VI

Cross Section Profiles

Cross Section Line No.CSP-01
(April 2019)



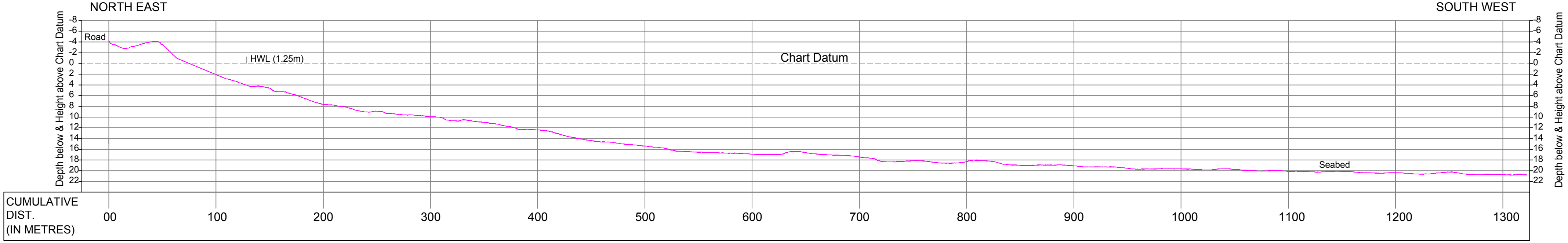
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-02
(April 2019)



Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

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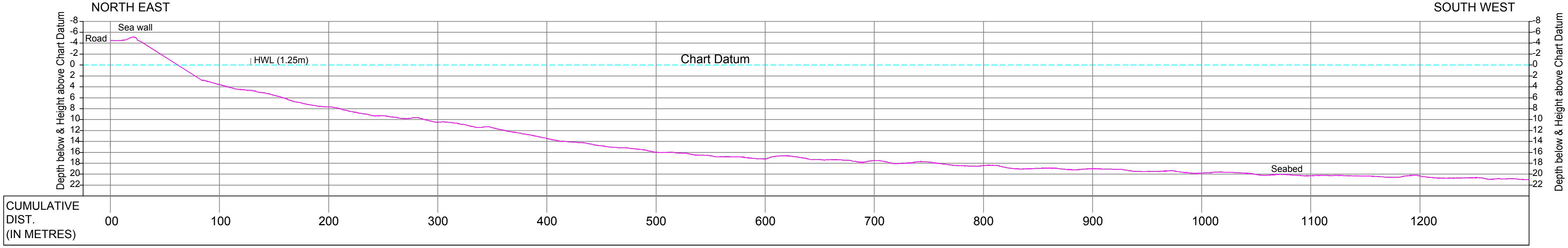
Cross Section Line No.CSP-03
(April 2019)



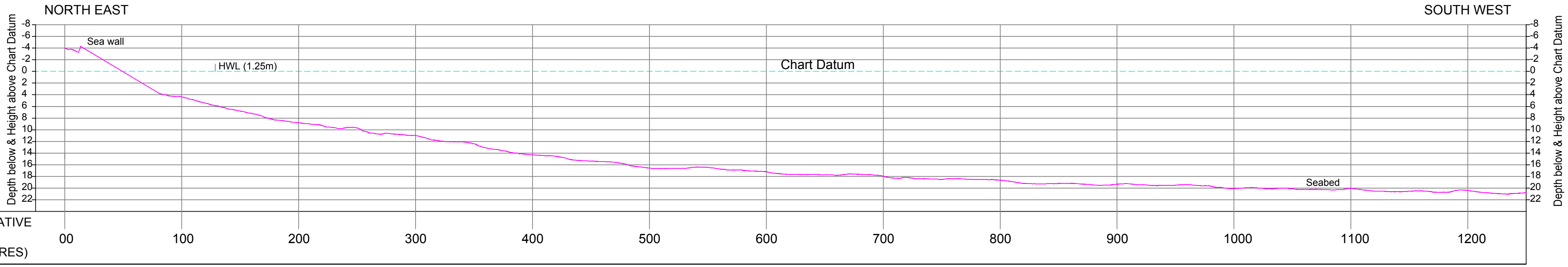
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-04
(April 2019)



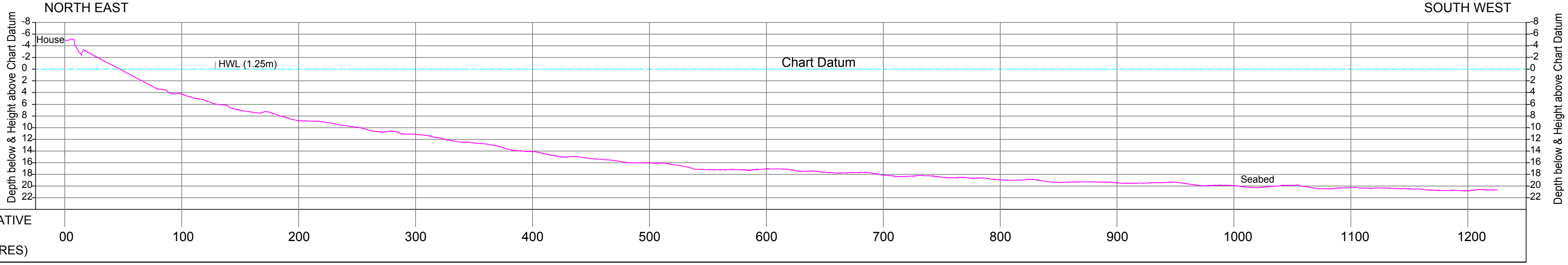
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-05
(April 2019)



Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

adani

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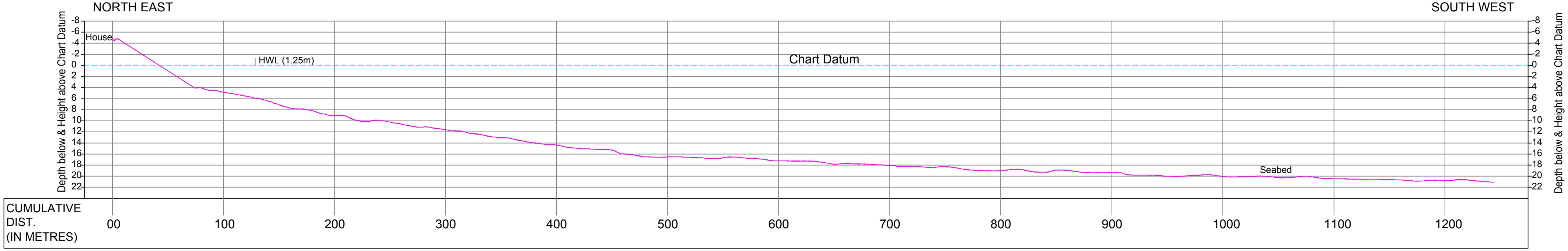
Cross Section Line No.CSP-06
(April 2019)



Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

adani

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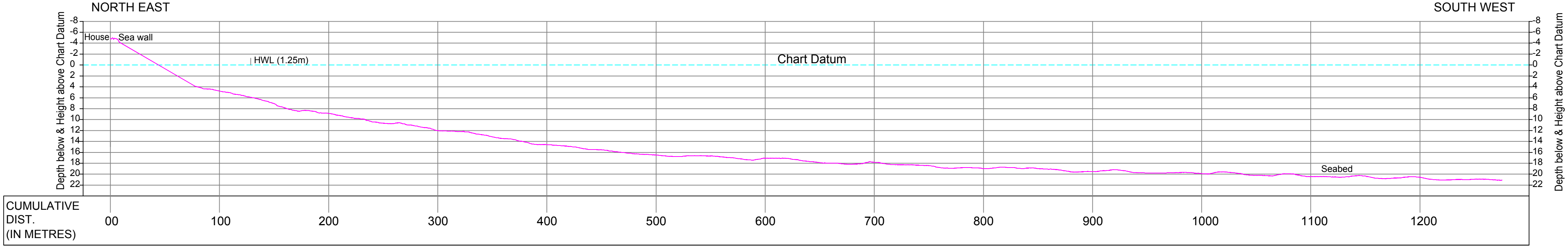
Cross Section Line No.CSP-07
(April 2019)



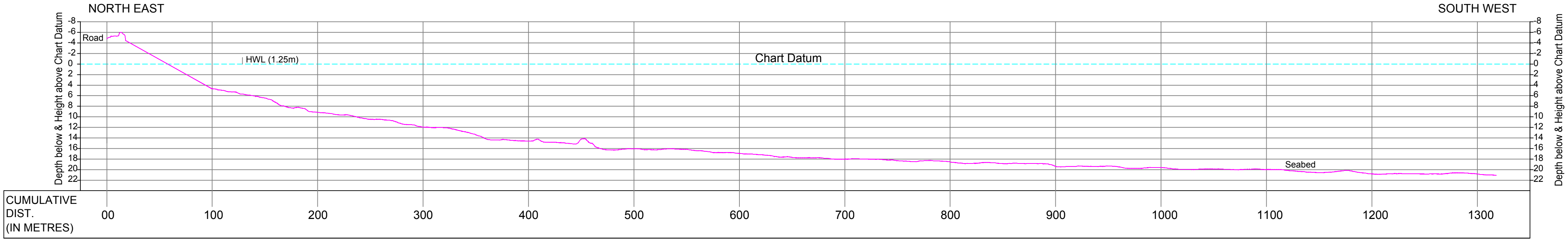
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

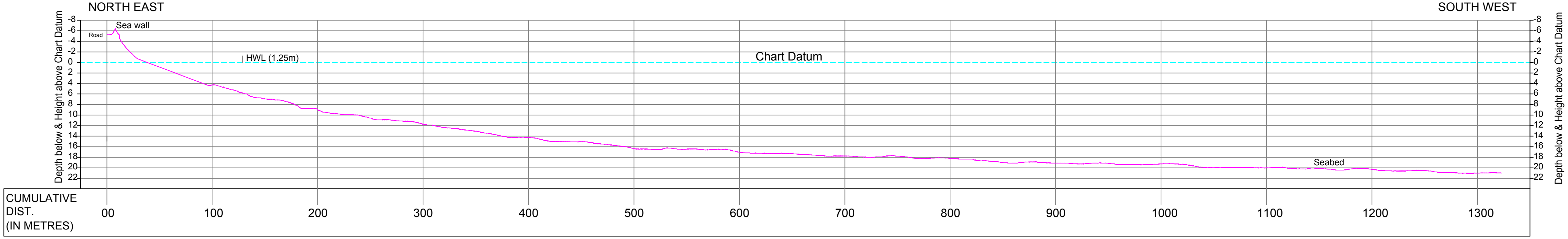
VERTICAL 1: 400

Cross Section Line No.CSP-08
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-09
(April 2019)



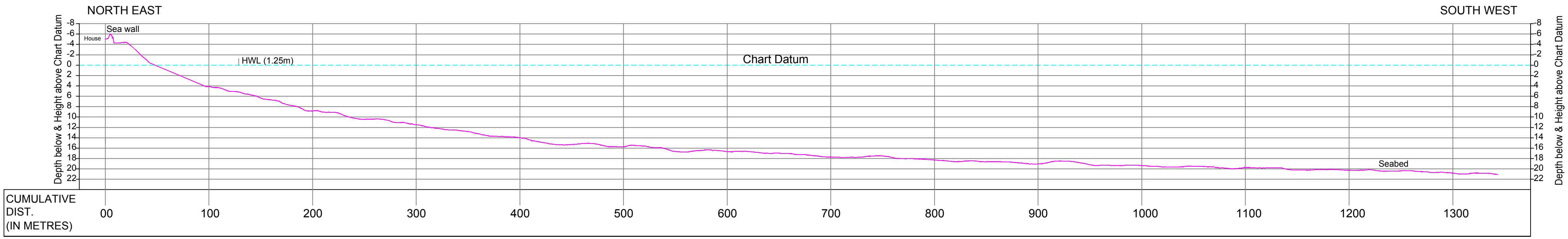
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-10
(April 2019)



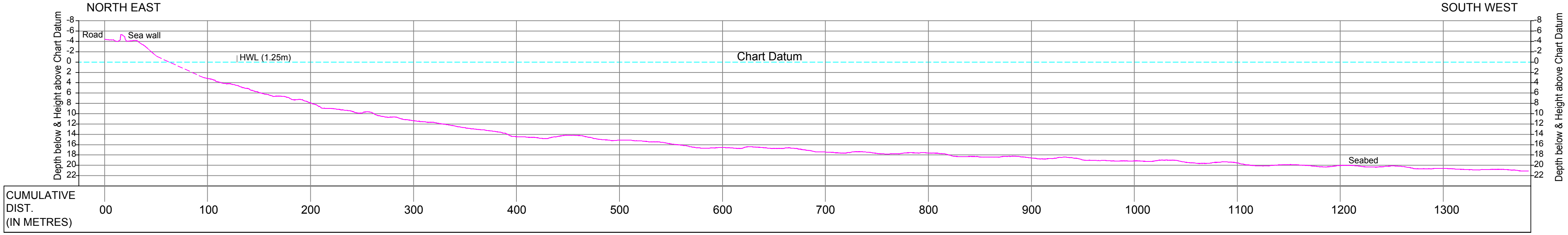
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-11
(April 2019)



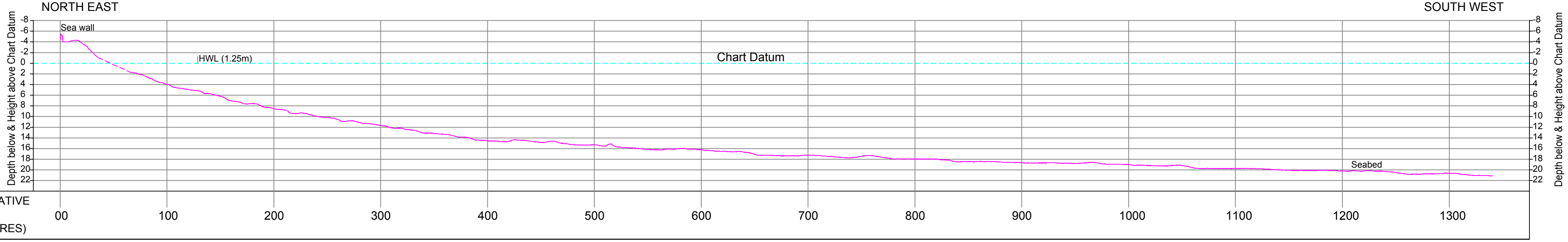
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

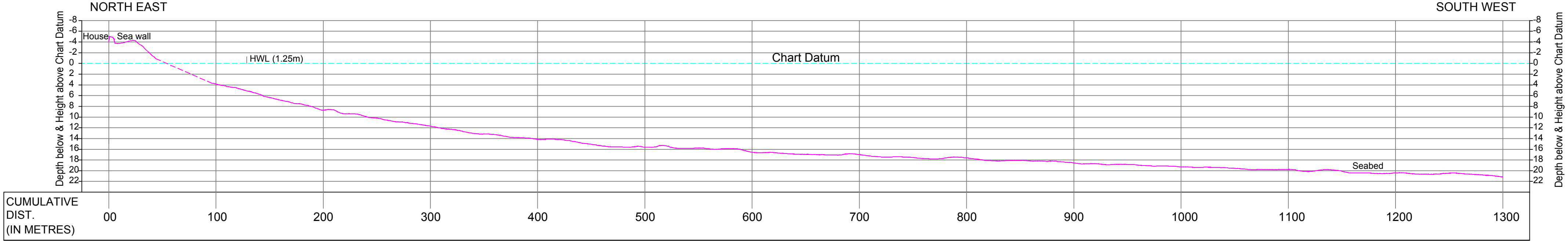
VERTICAL 1: 400

Cross Section Line No.CSP-12
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-13
(April 2019)



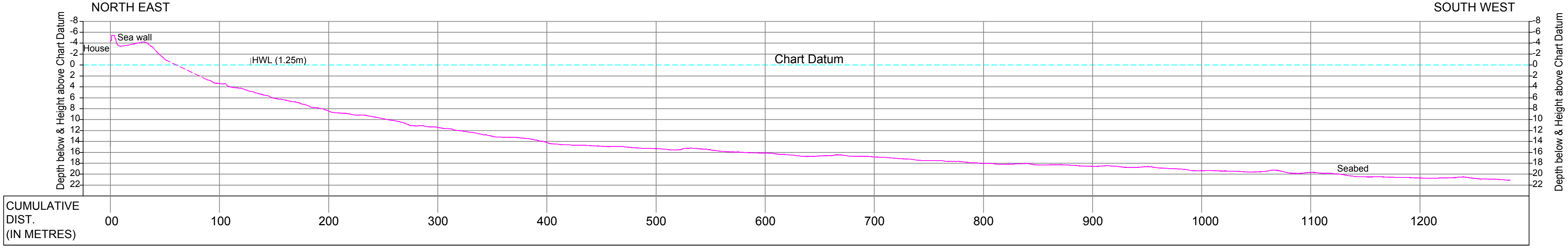
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

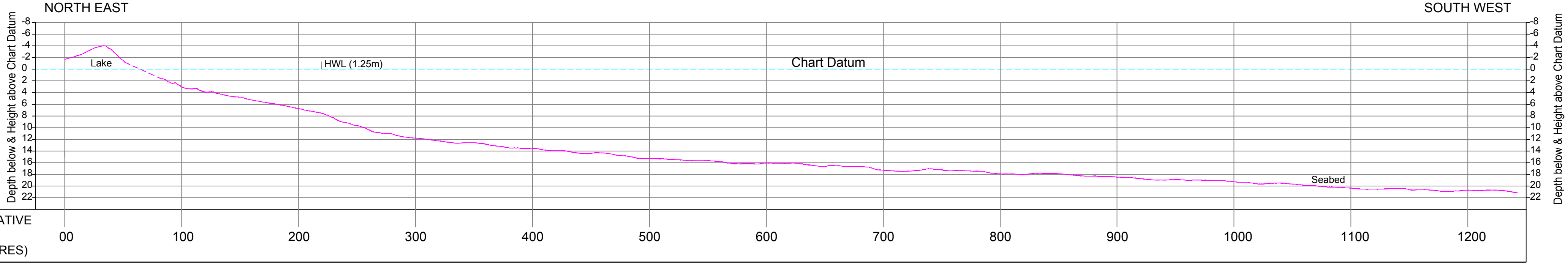
VERTICAL 1: 400

Cross Section Line No.CSP-14
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

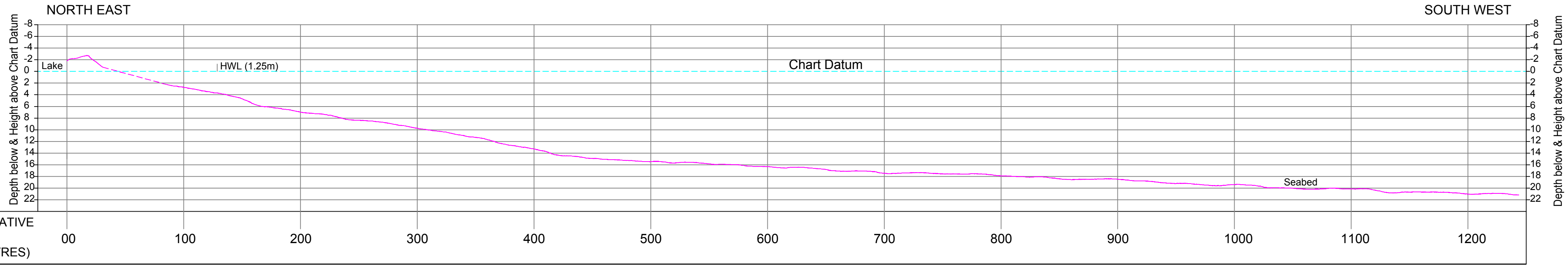
Cross Section Line No.CSP-15
(April 2019)



Cross Shore Profile
<u>SCALE :</u>

HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-16
(April 2019)



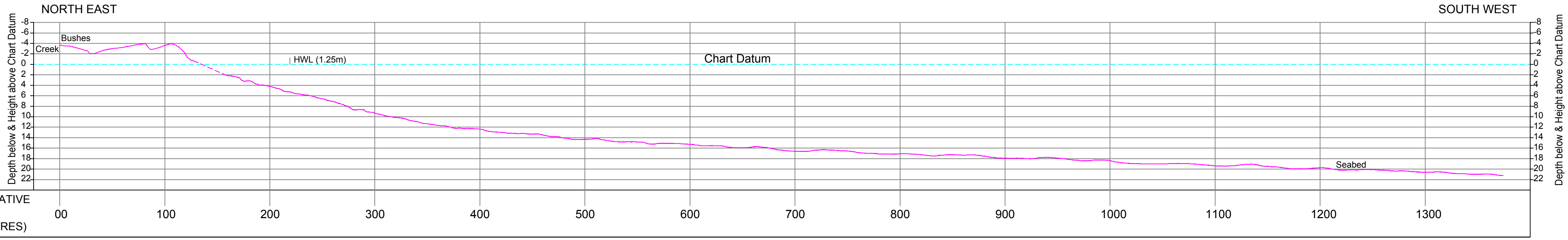
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-17
(April 2019)



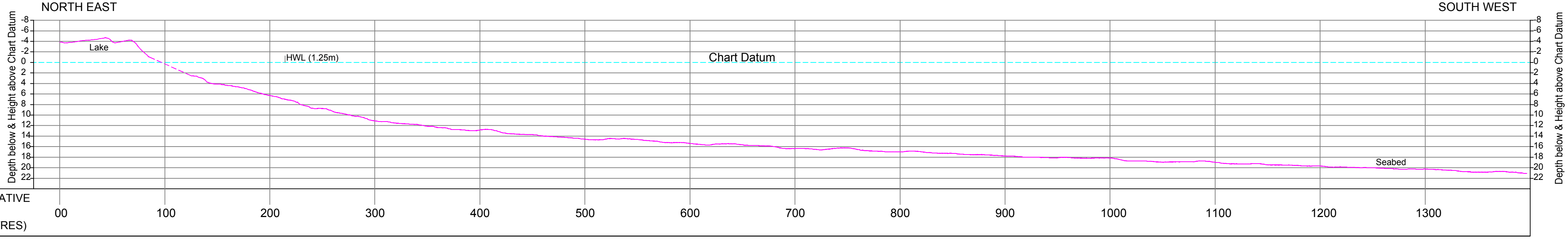
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

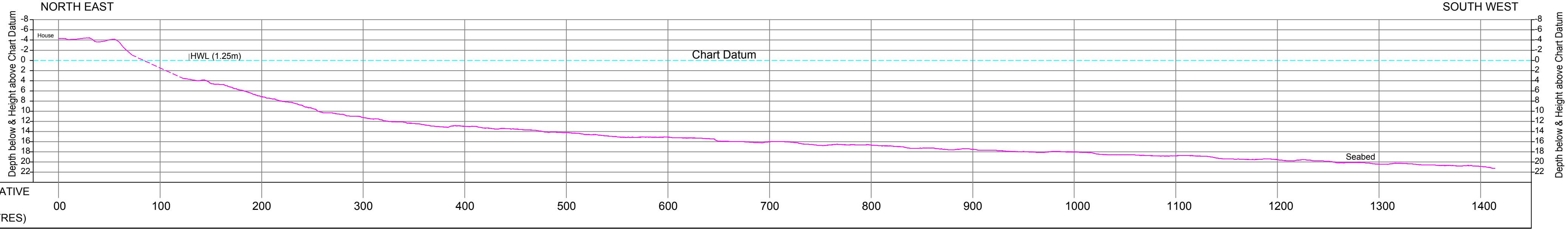
Cross Section Line No.CSP-18
(April 2019)



Cross Shore Profile
SCALE :

HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-19
(April 2019)



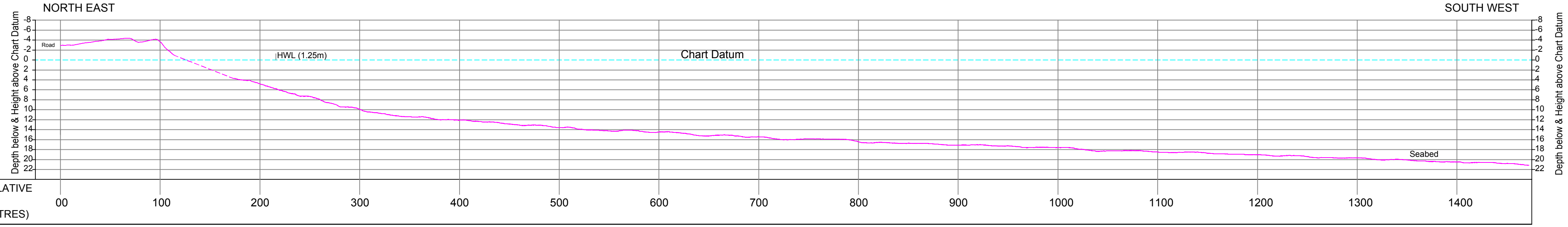
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-20
(April 2019)



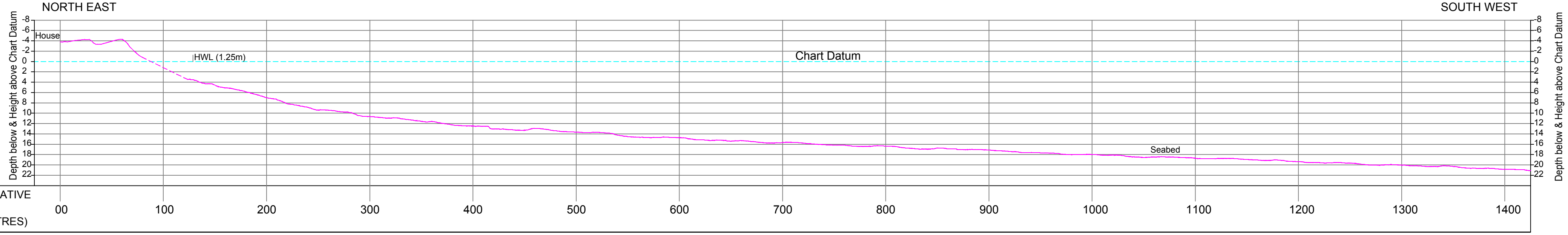
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

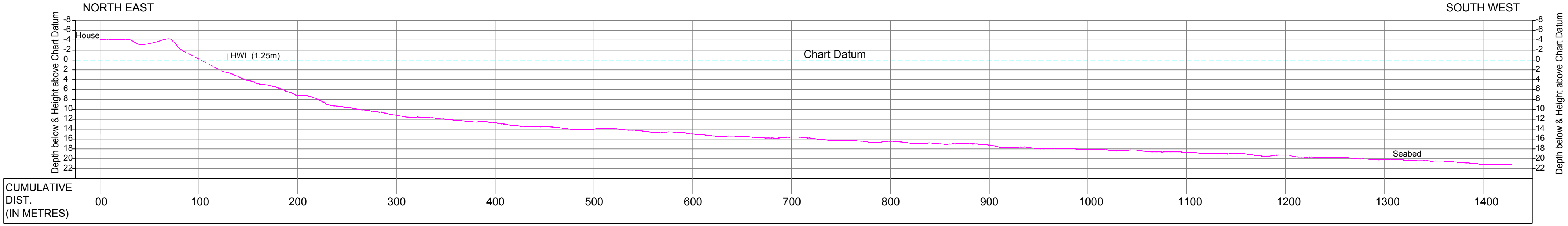
VERTICAL 1: 400

Cross Section Line No.CSP-21
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-22
(April 2019)



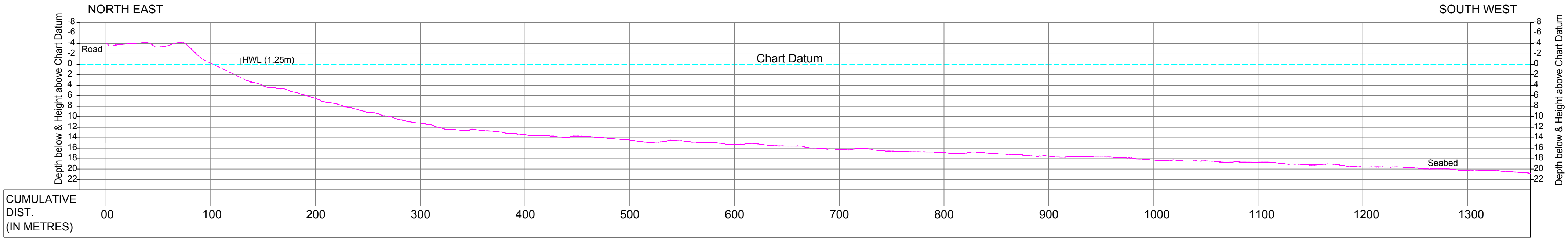
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

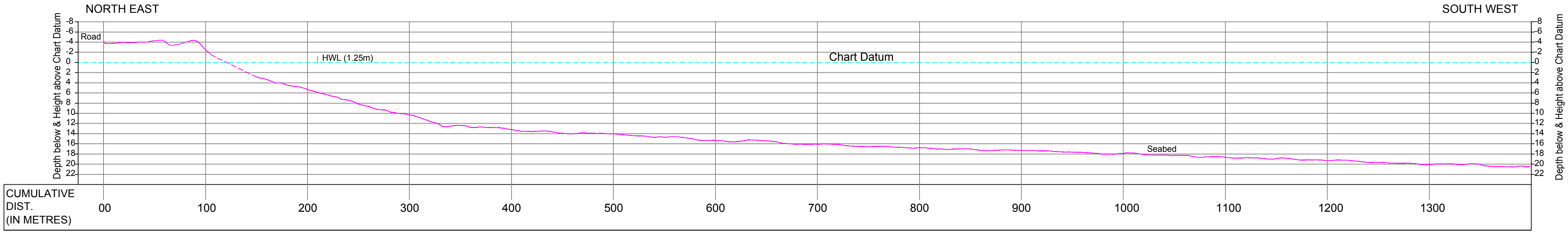
VERTICAL 1: 400

Cross Section Line No.CSP-23
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

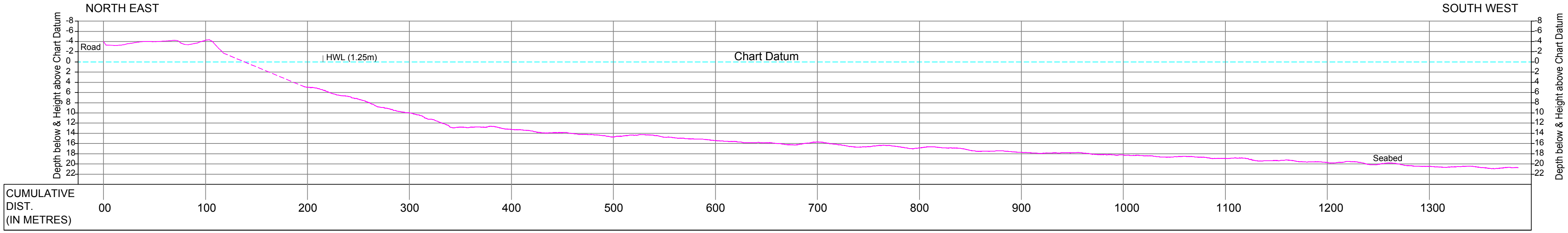
Cross Section Line No.CSP-24
(April 2019)



Cross Shore Profile
SCALE :

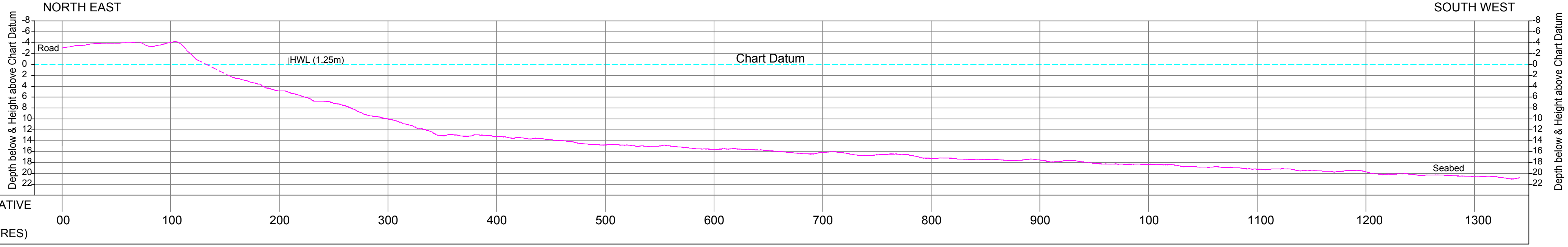
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-25
(April 2019)



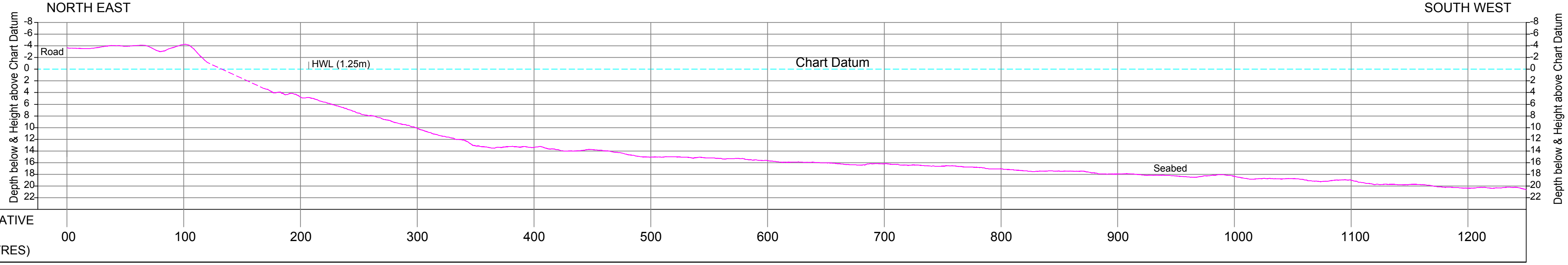
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-26
(April 2019)



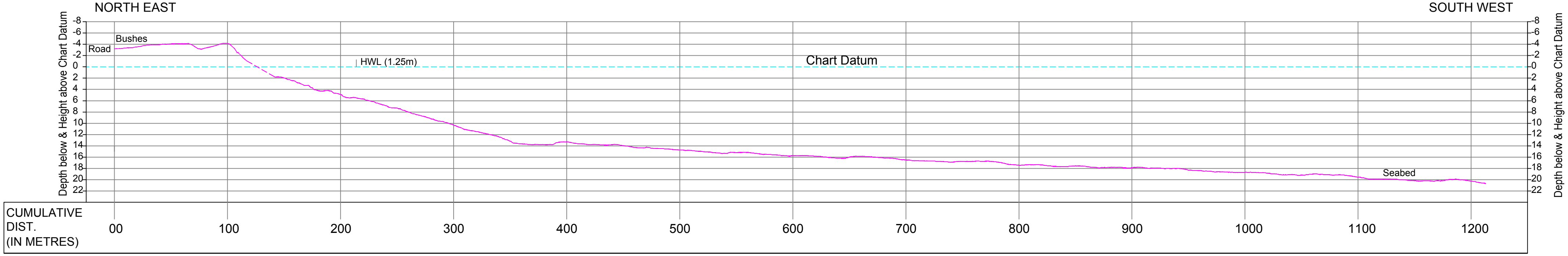
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-27
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-28
(April 2019)



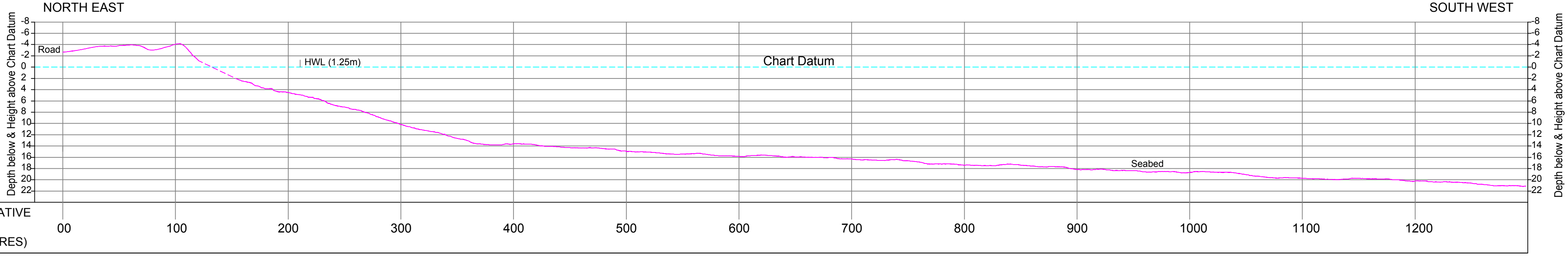
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

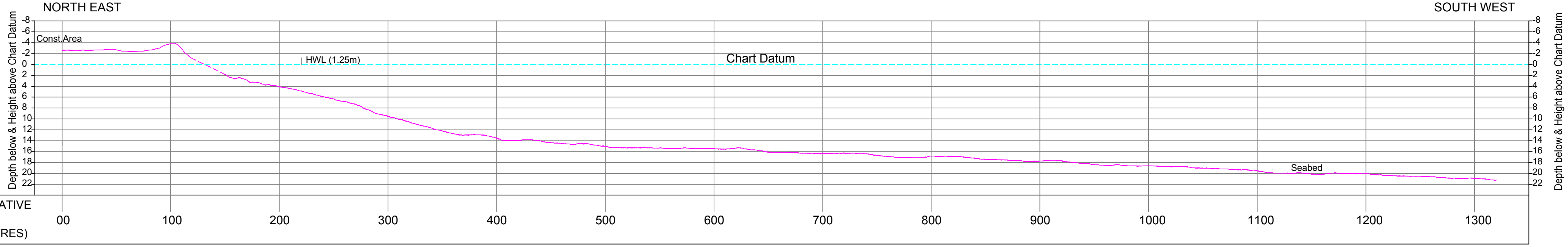
VERTICAL 1: 400

Cross Section Line No.CSP-29
(April 2019)



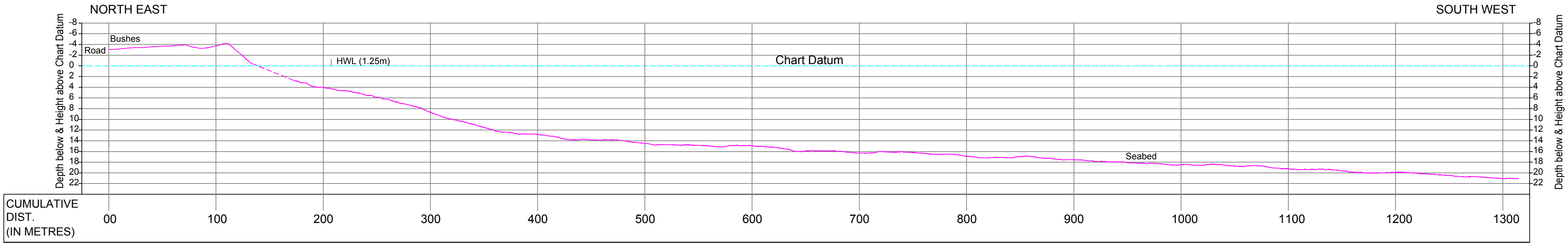
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-30
(April 2019)



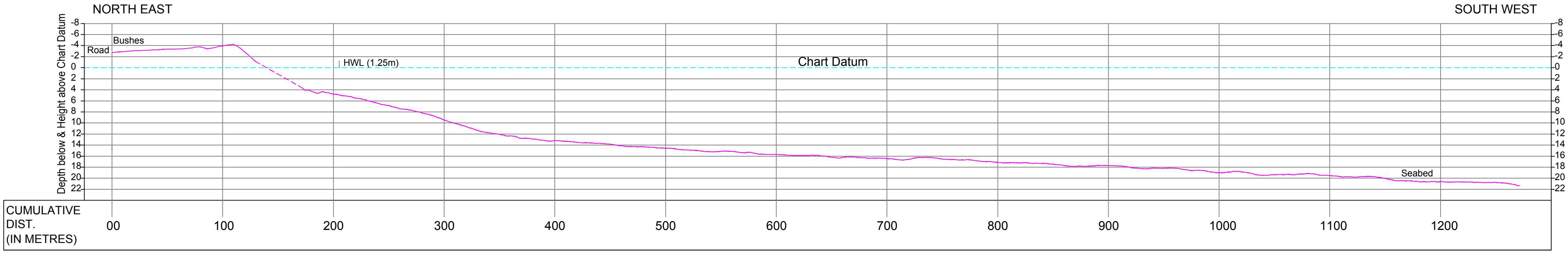
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-31
(April 2019)



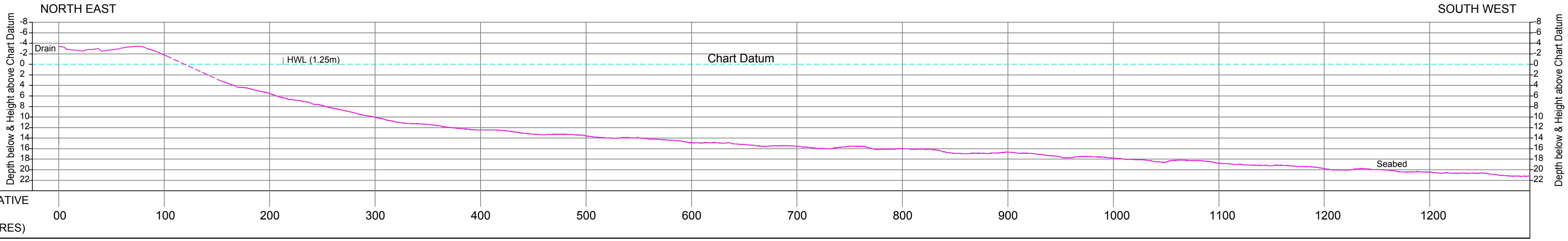
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-32
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-33
(April 2019)



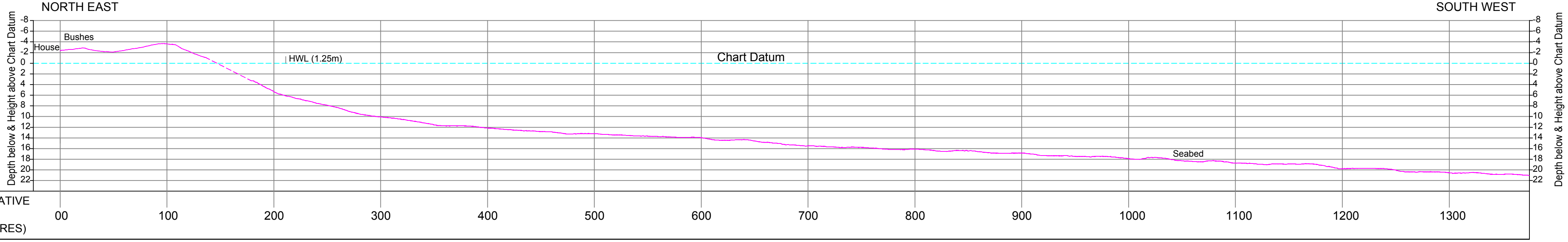
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-34
(April 2019)



Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

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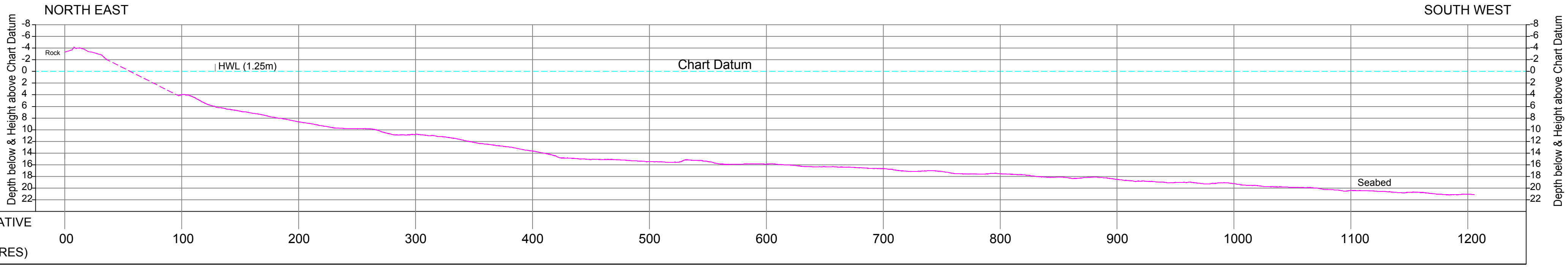
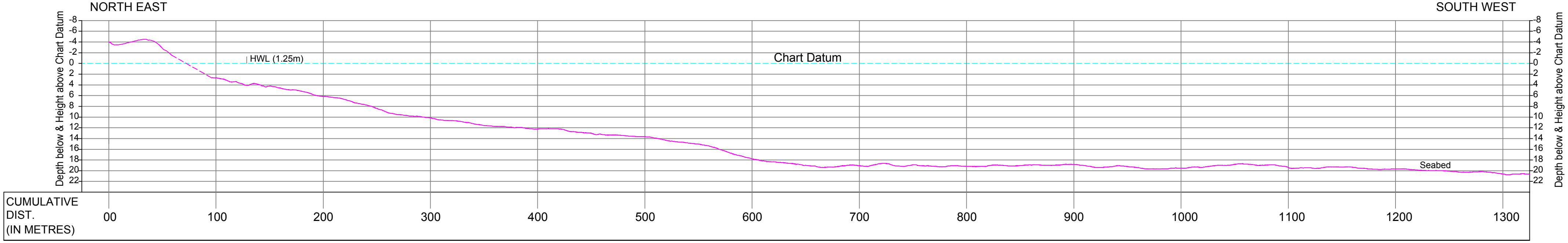
Cross Section Line No.CSP-35
(April 2019)



Cross Shore Profile
<u>SCALE :</u>
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-36
(April 2019)



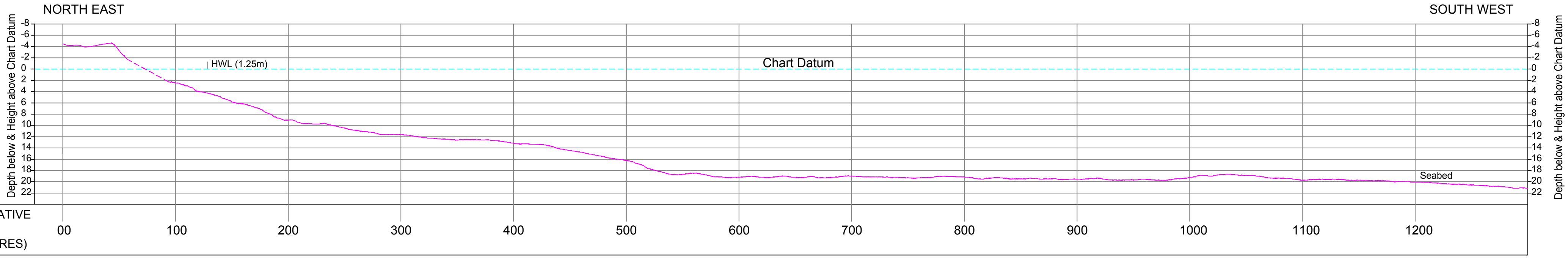
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-37
(April 2019)



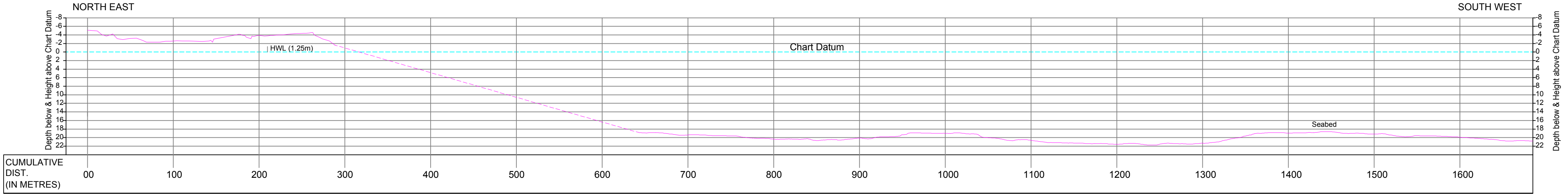
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

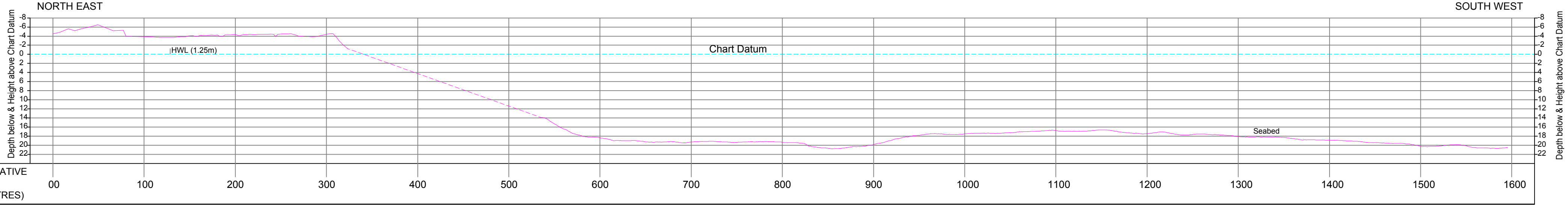
VERTICAL 1: 400

Cross Section Line No.CSP-38
(April 2019)



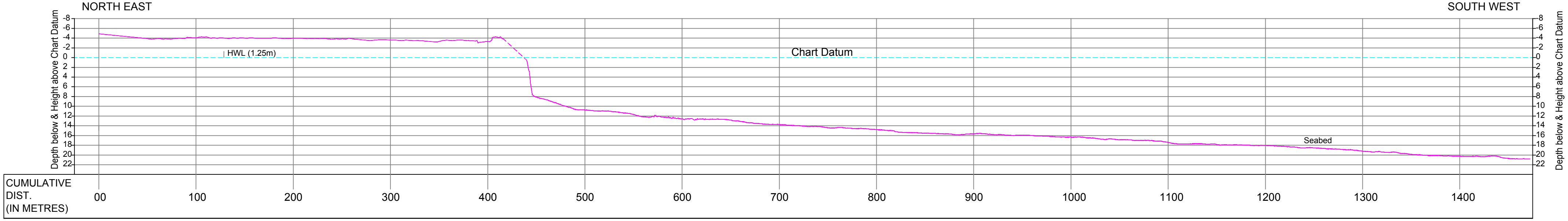
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-39
(April 2019)



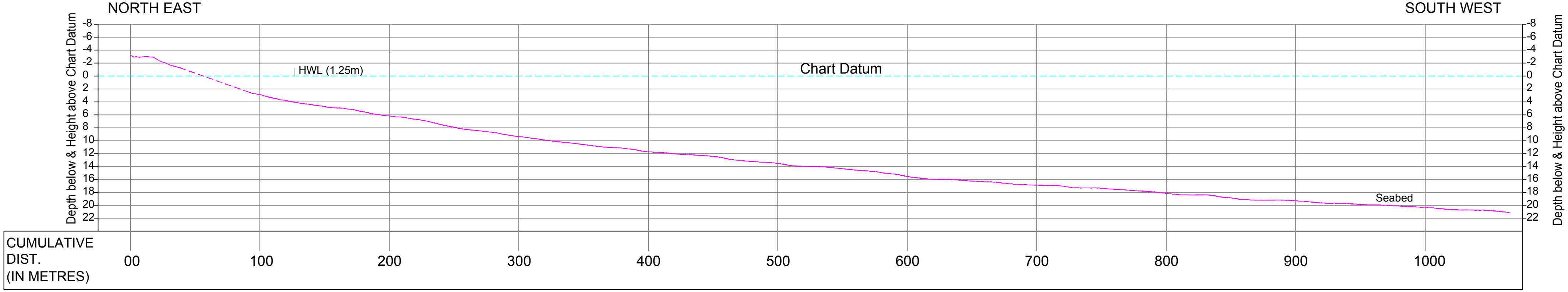
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-40
(April 2019)



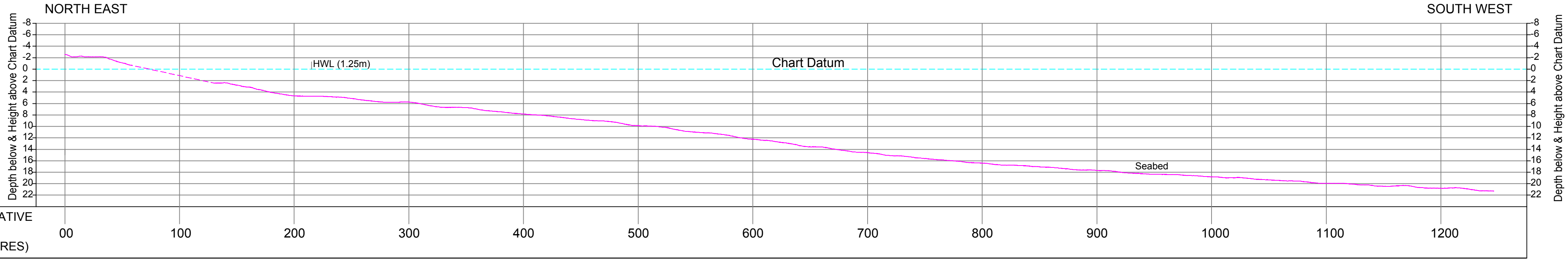
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-41
(April 2019)



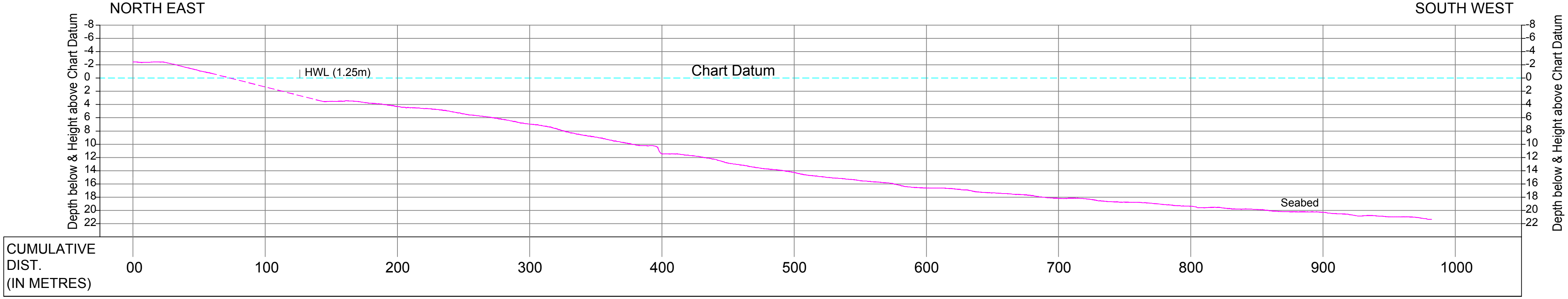
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-42
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-43
(April 2019)



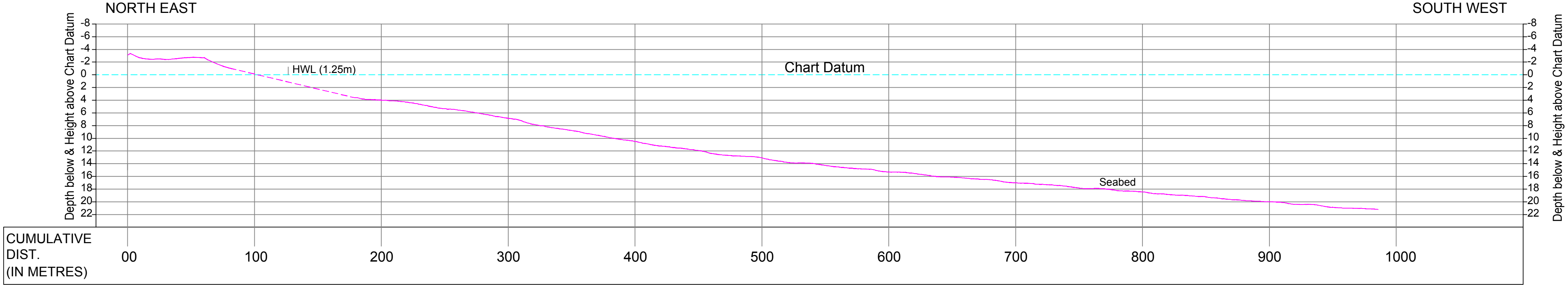
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

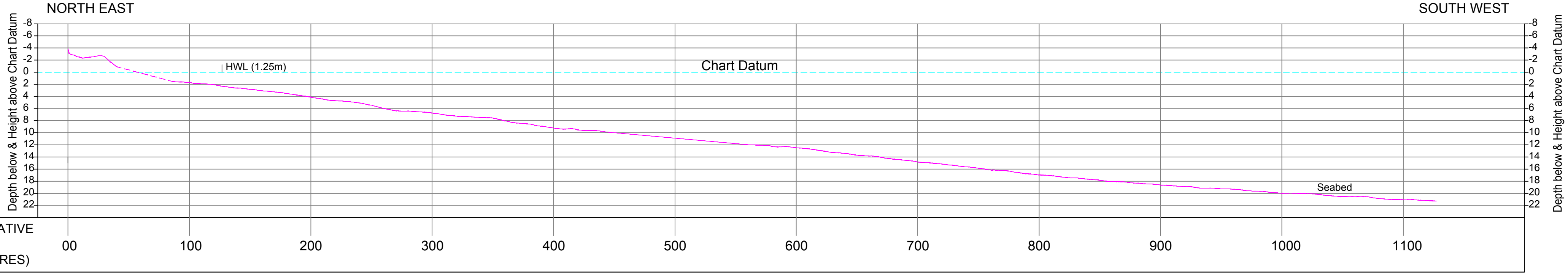
VERTICAL 1: 400

Cross Section Line No.CSP-44
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

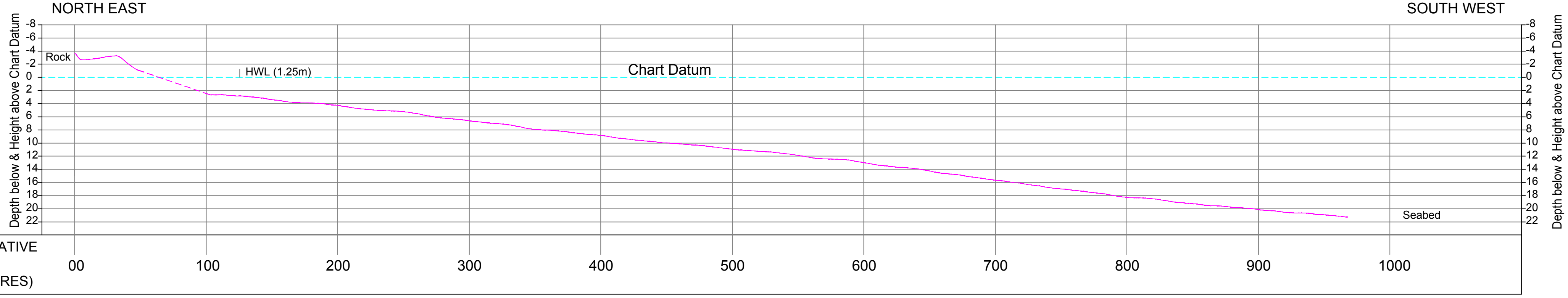
Cross Section Line No.CSP-45
(April 2019)



Cross Shore Profile
SCALE :

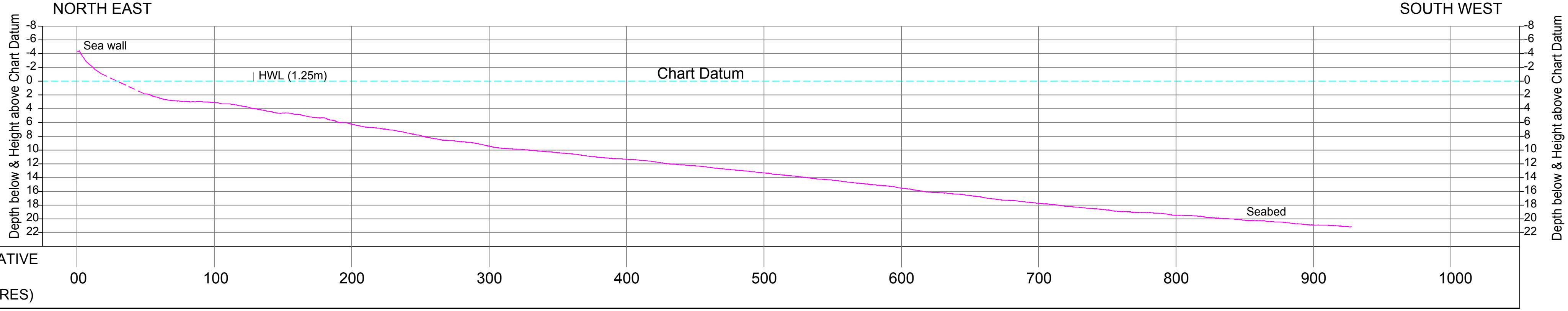
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-46
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

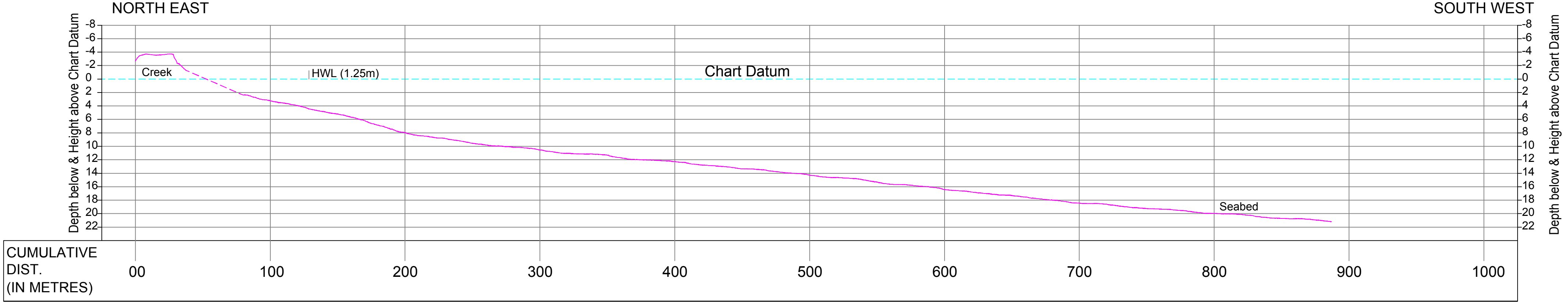
Cross Section Line No.CSP-47
(April 2019)



Cross Shore Profile
SCALE :

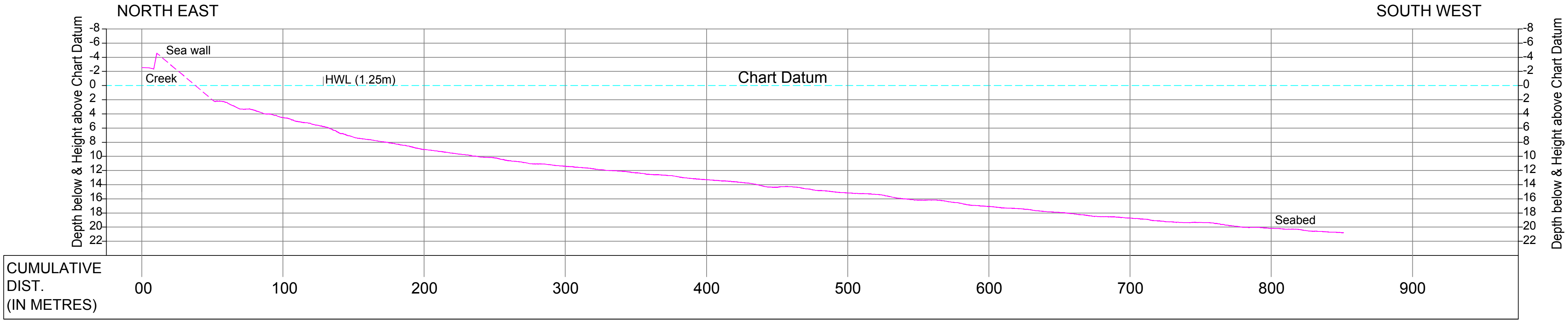
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-48
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

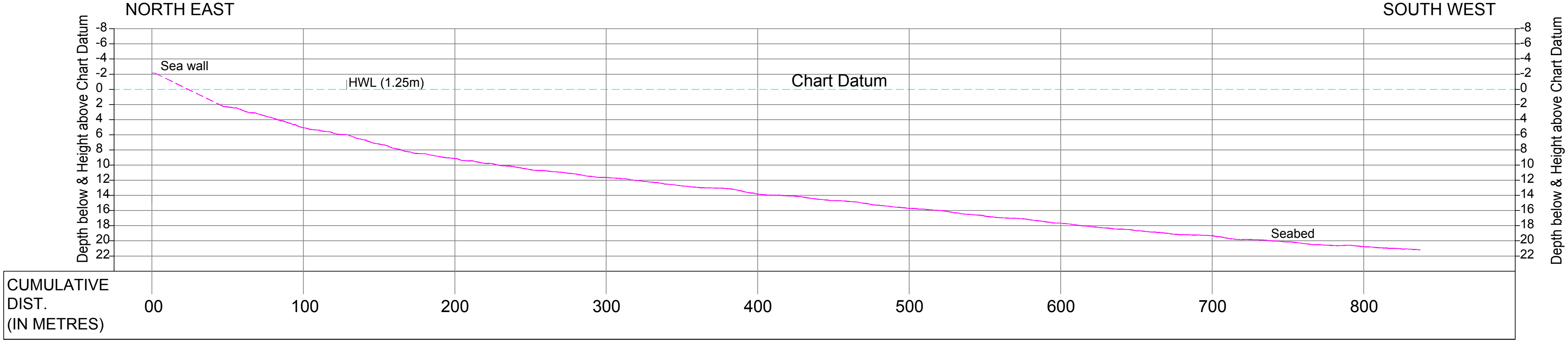
Cross Section Line No.CSP-49
(April 2019)



Cross Shore Profile
SCALE :

HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-50
(April 2019)



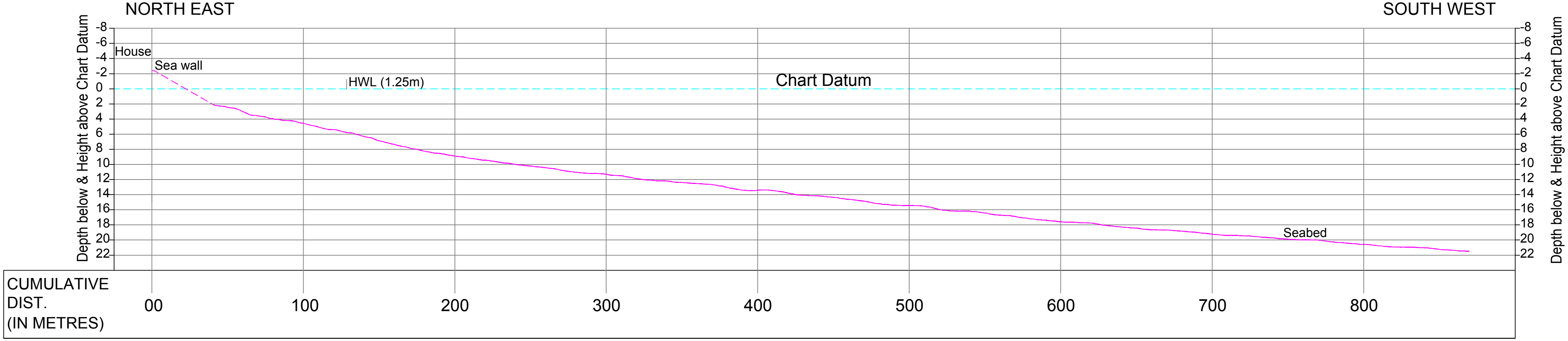
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-51
(April 2019)



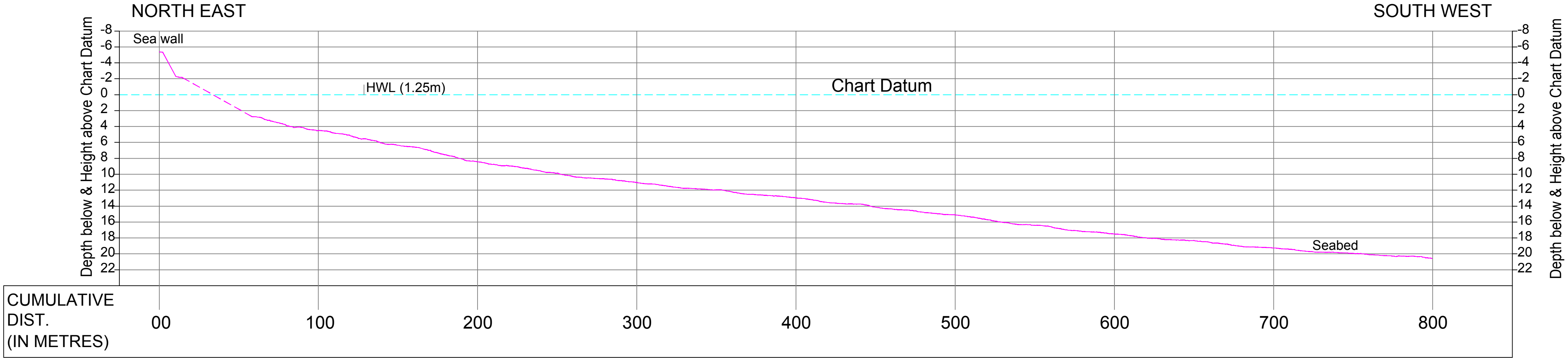
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

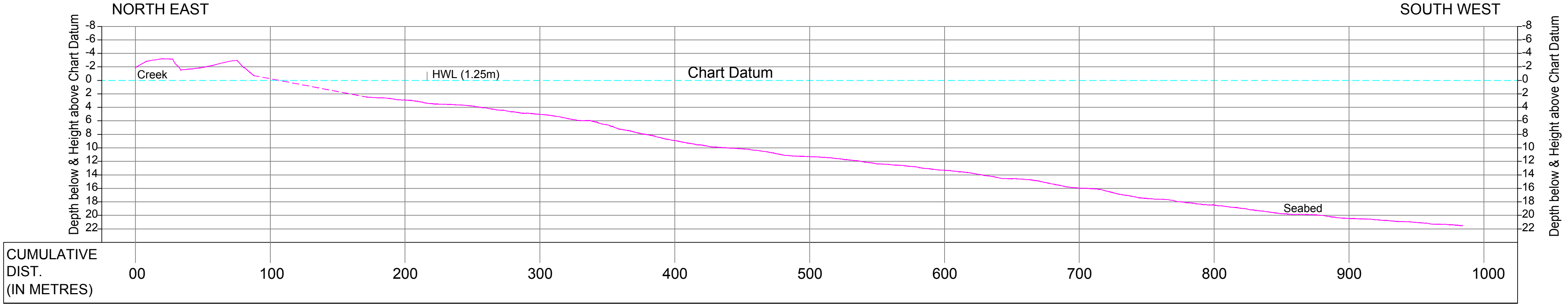
Cross Section Line No.CSP-52
(April 2019)



Cross Shore Profile
SCALE :

HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-53
(April 2019)



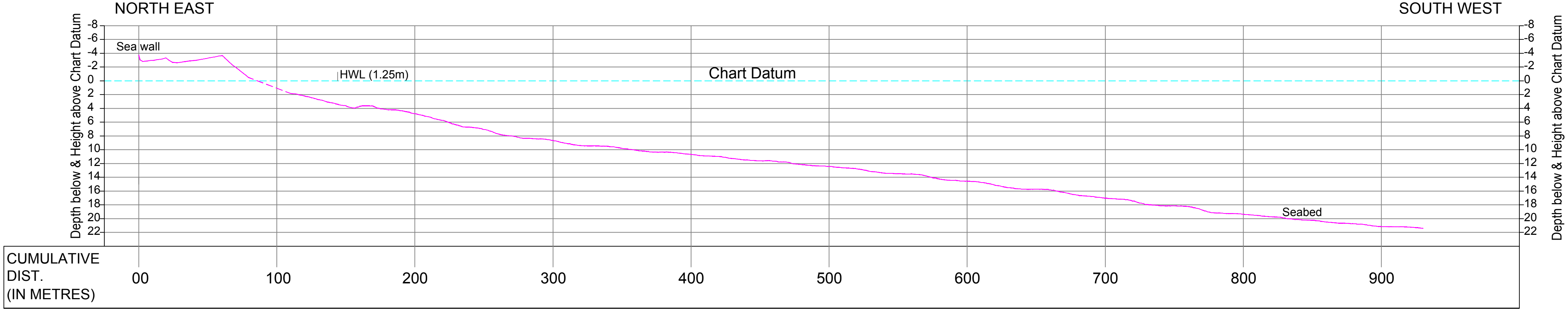
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

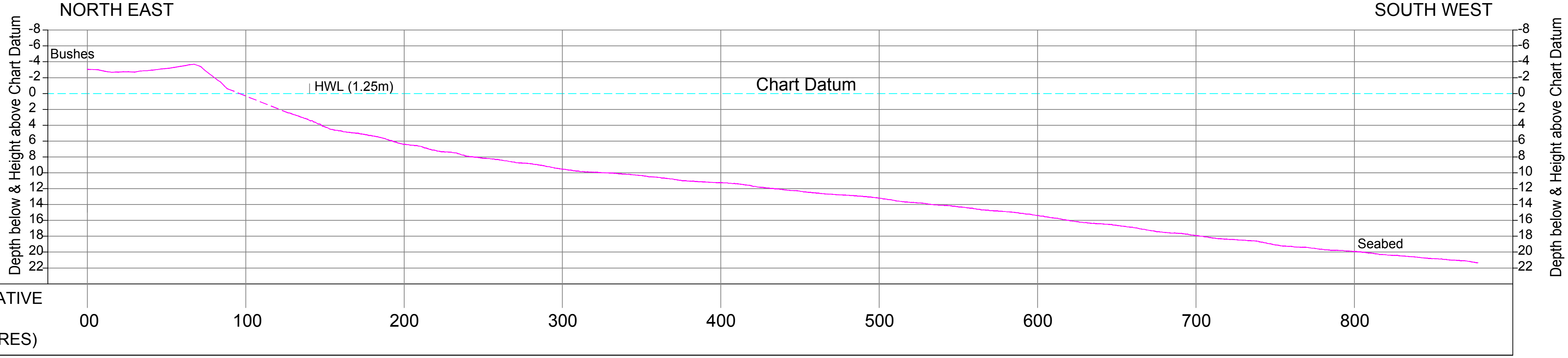
Cross Section Line No.CSP-54
(April 2019)



Cross Shore Profile
<u>SCALE :</u>

HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-55
(April 2019)



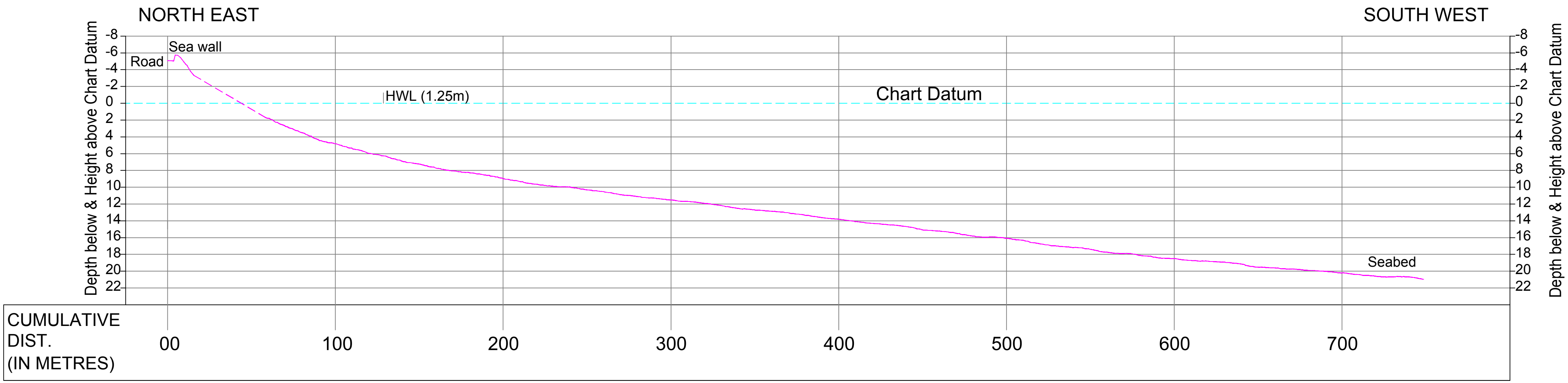
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-56
(April 2019)



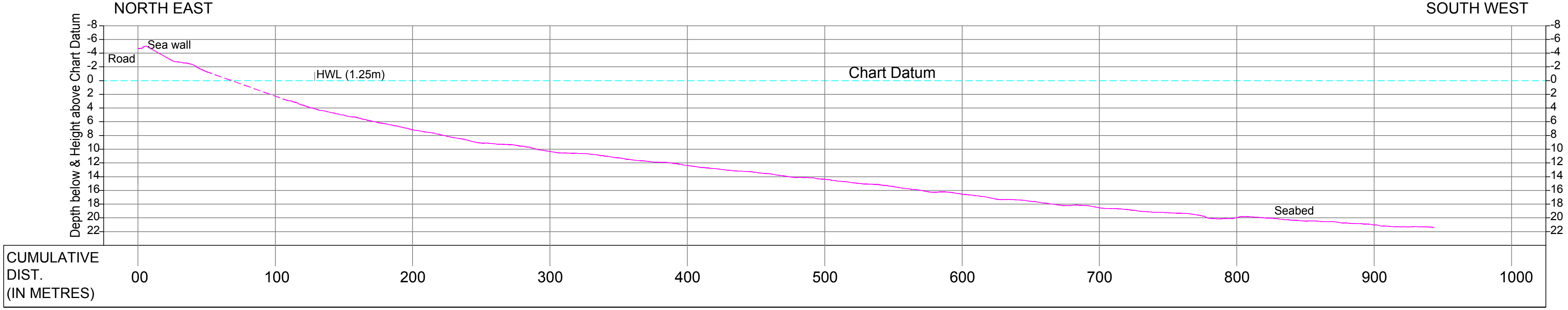
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-57
(April 2019)



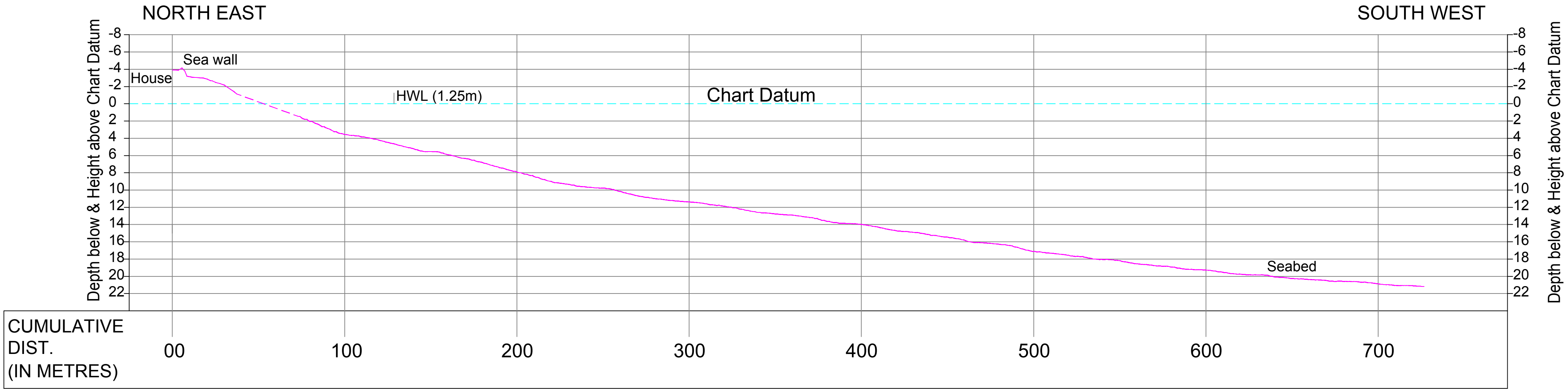
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-58
(April 2019)



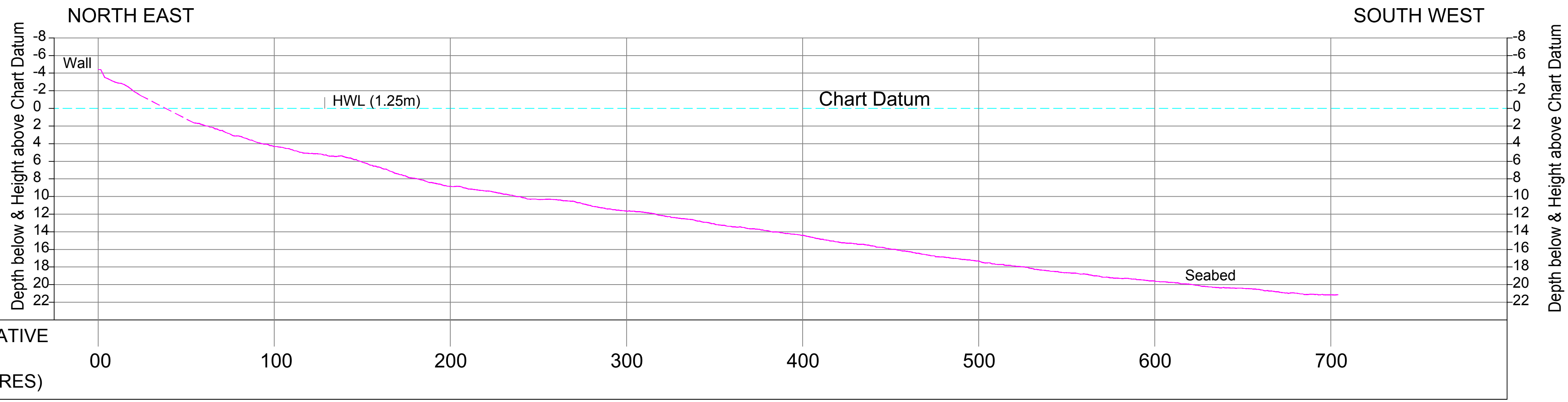
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

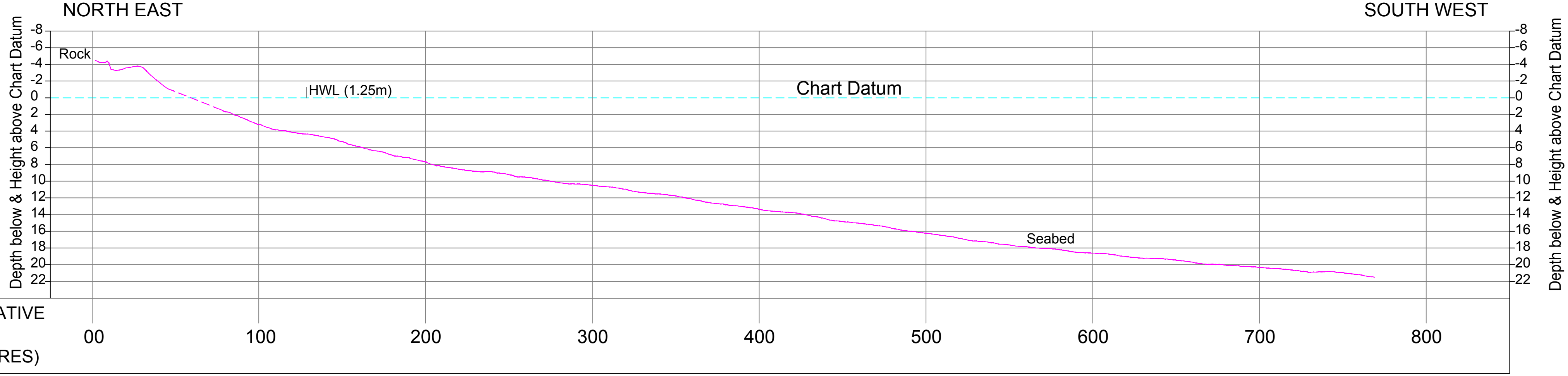
VERTICAL 1: 400

Cross Section Line No.CSP-59
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

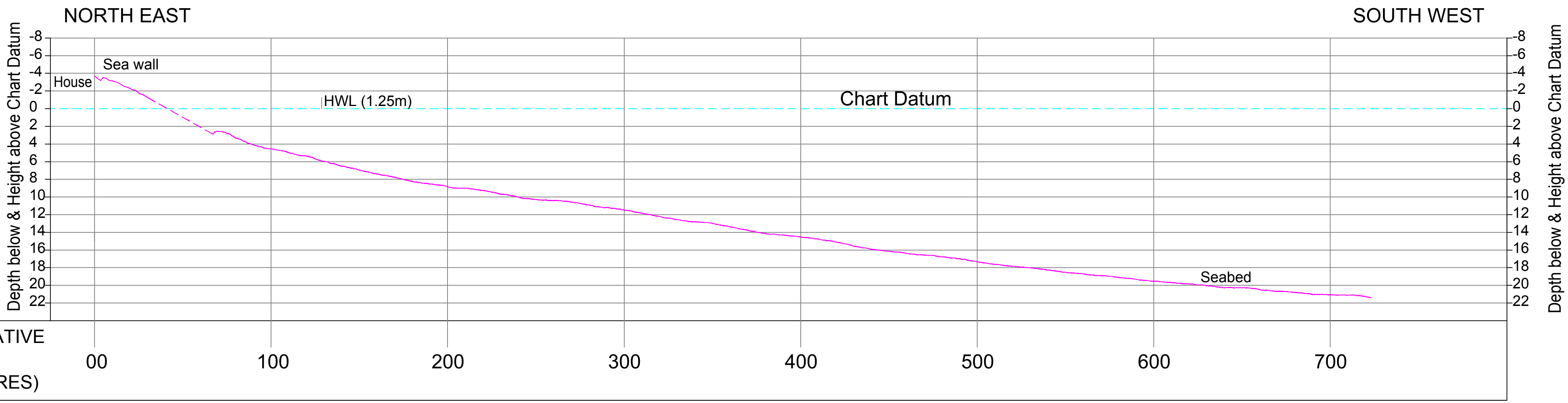
Cross Section Line No.CSP-60
(April 2019)



Cross Shore Profile
SCALE :

HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-61
(April 2019)



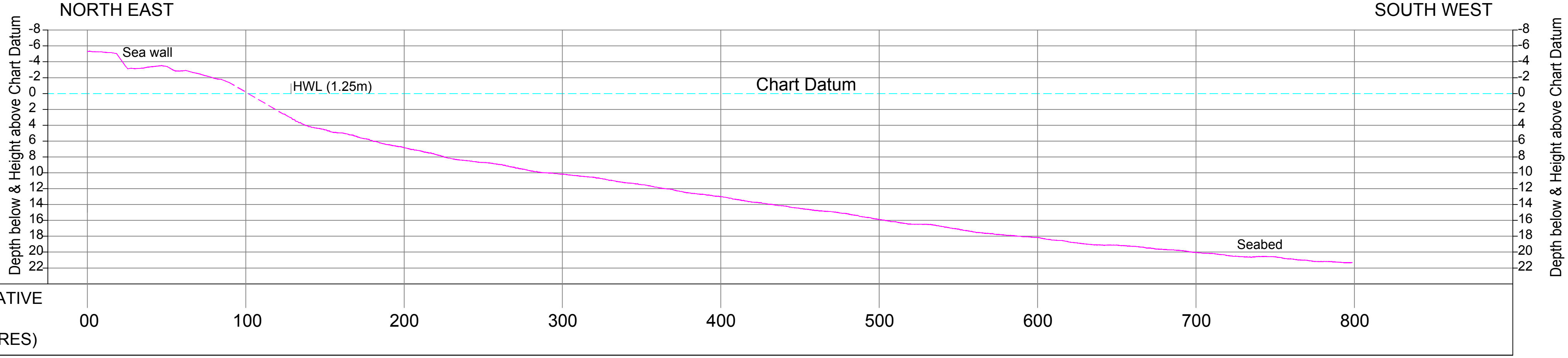
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

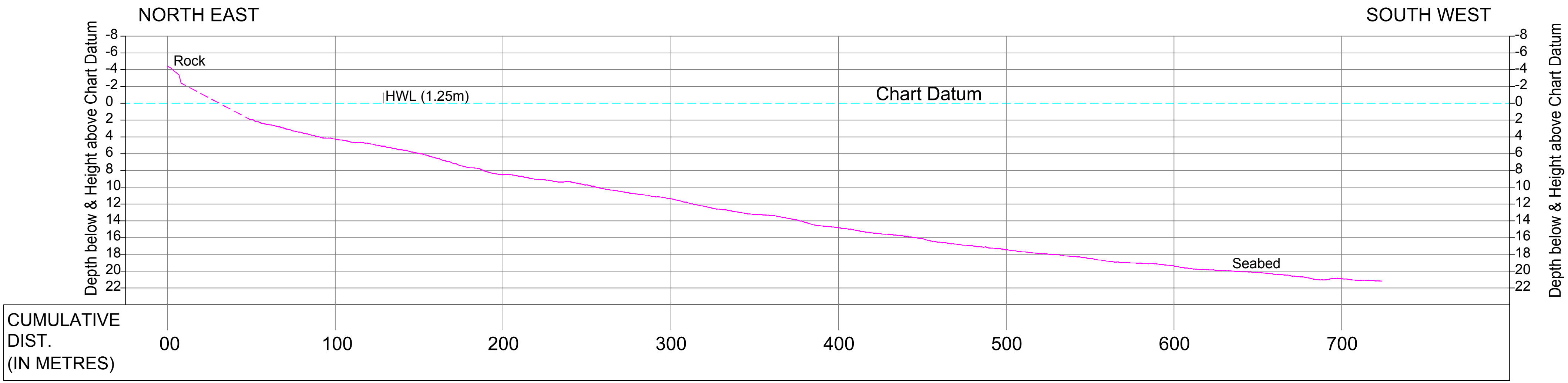
VERTICAL 1: 400

Cross Section Line No.CSP-62
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-63
(April 2019)



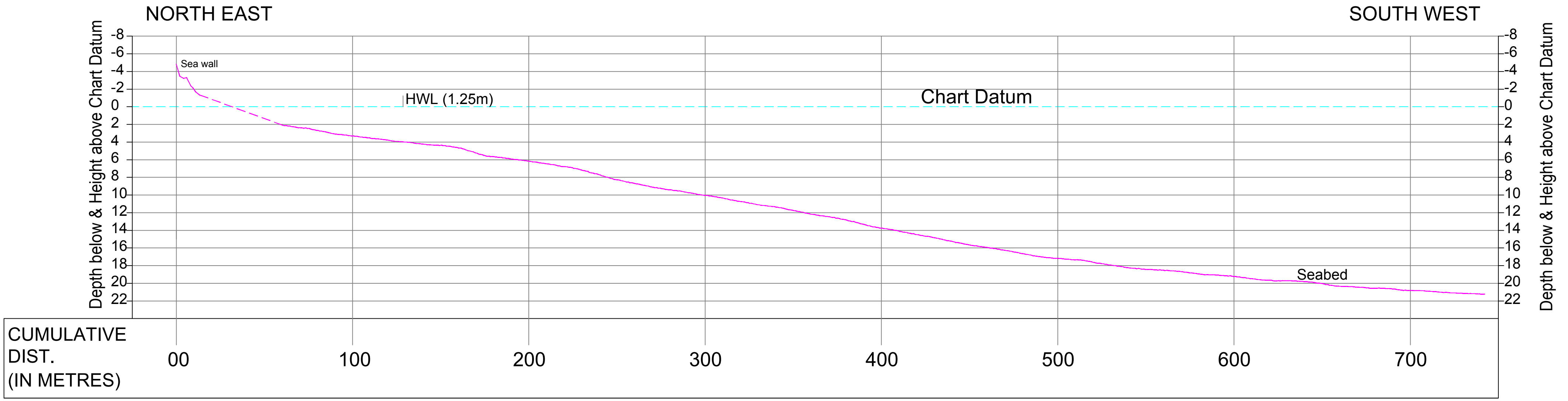
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

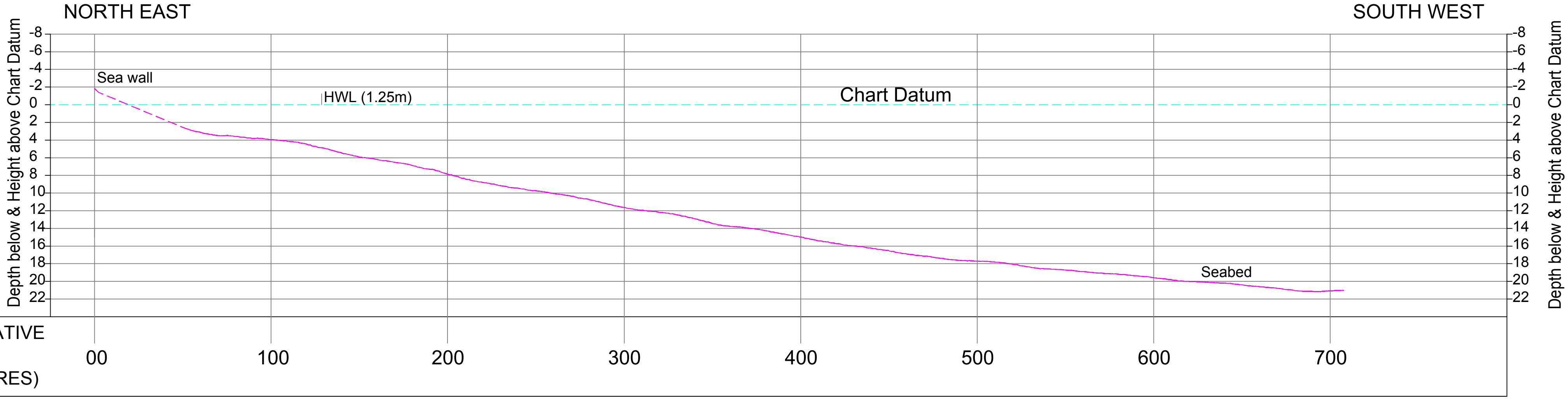
VERTICAL 1: 400

Cross Section Line No.CSP-64
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-65
(April 2019)



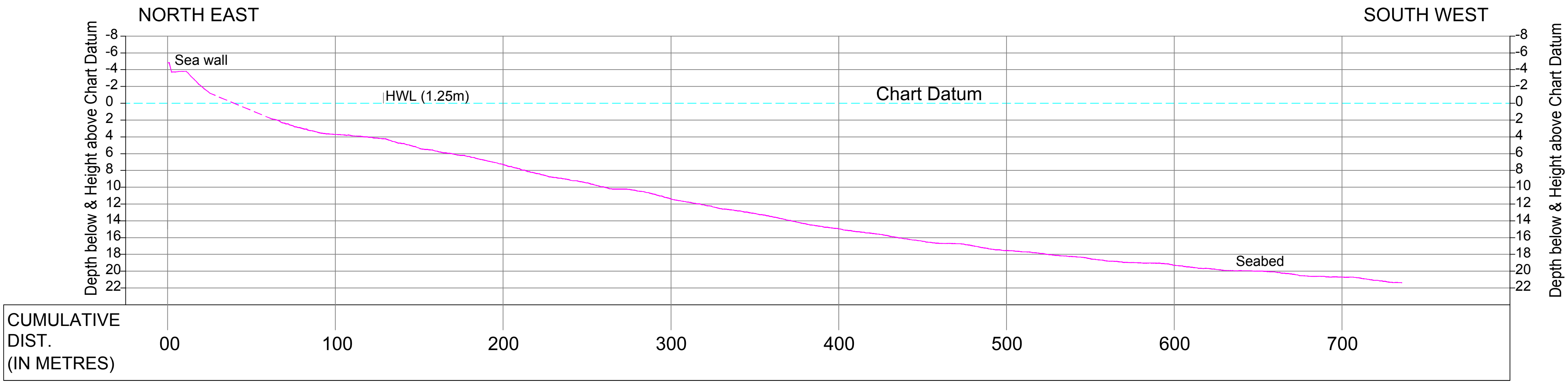
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

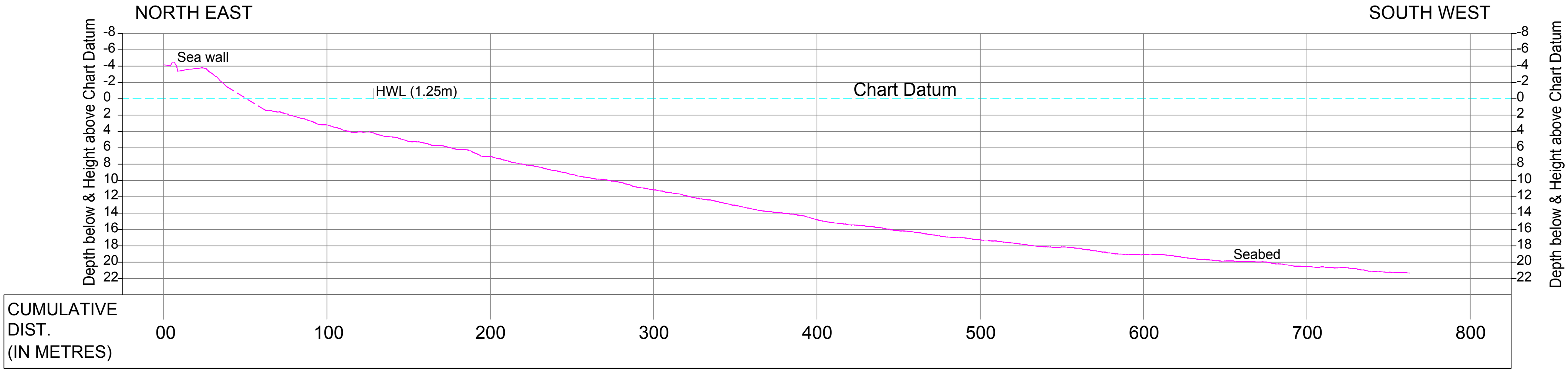
VERTICAL 1: 400

Cross Section Line No.CSP-66
(April 2019)



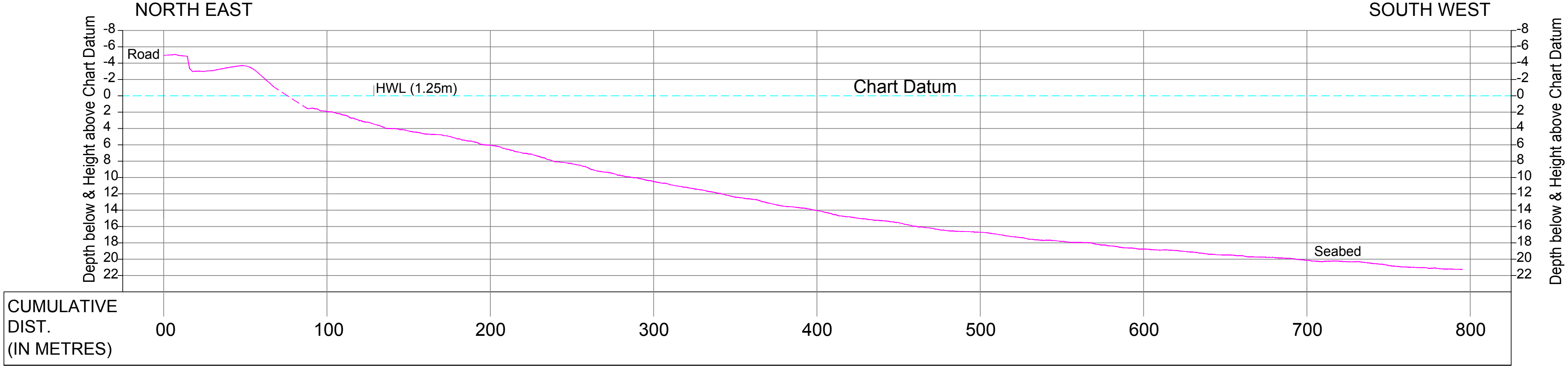
Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-67
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-68
(April 2019)



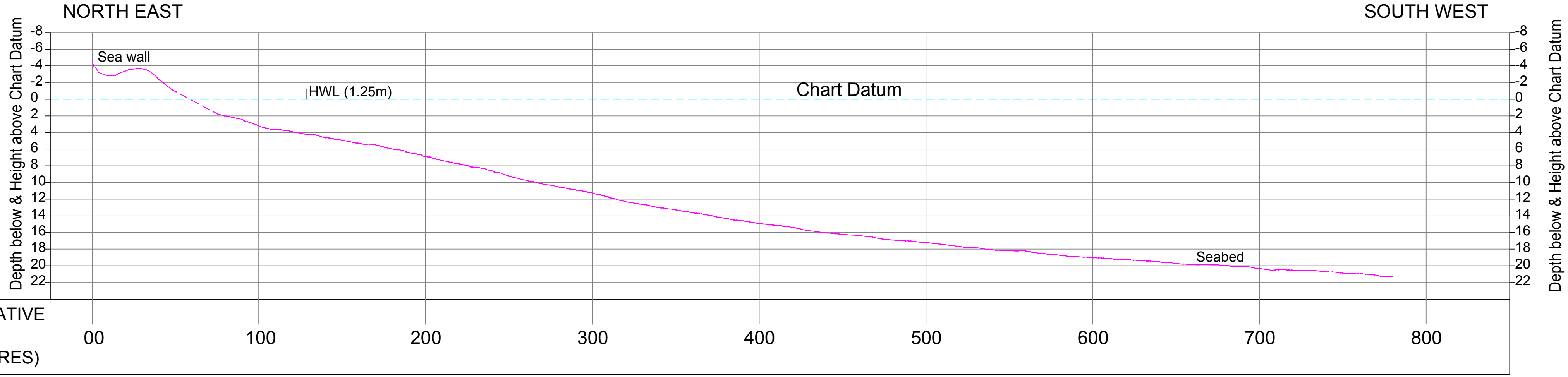
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-69
(April 2019)



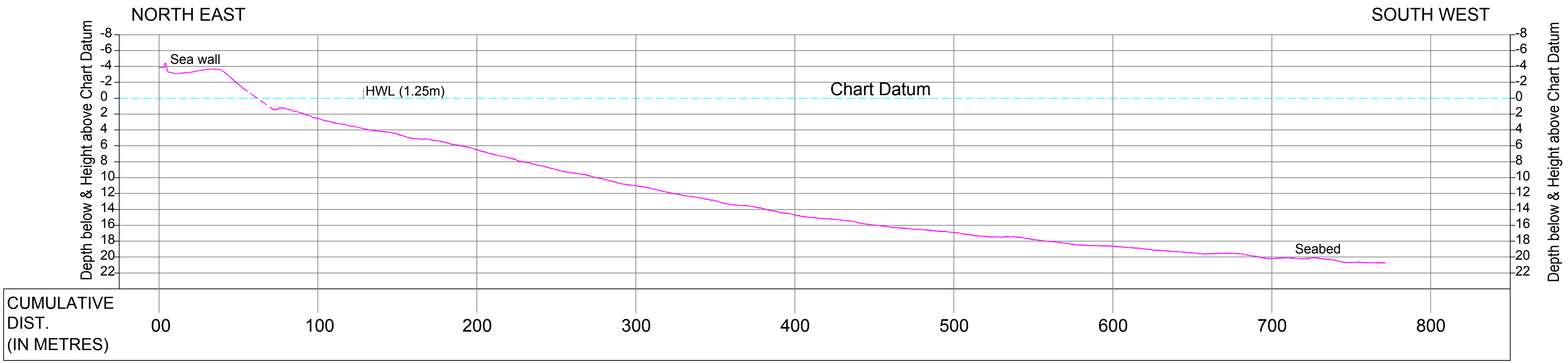
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-70
(April 2019)



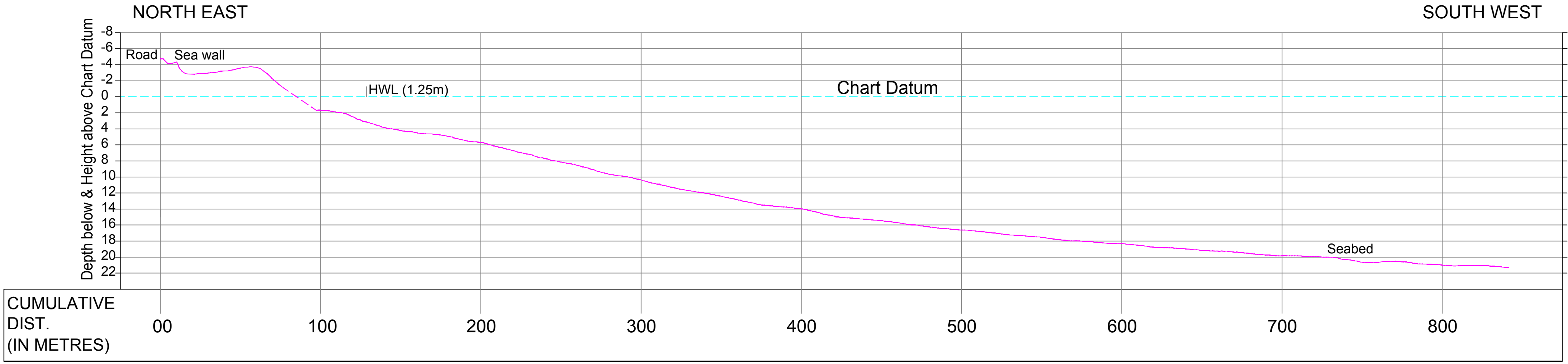
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-71
(April 2019)



Cross Shore Profile

SCALE :

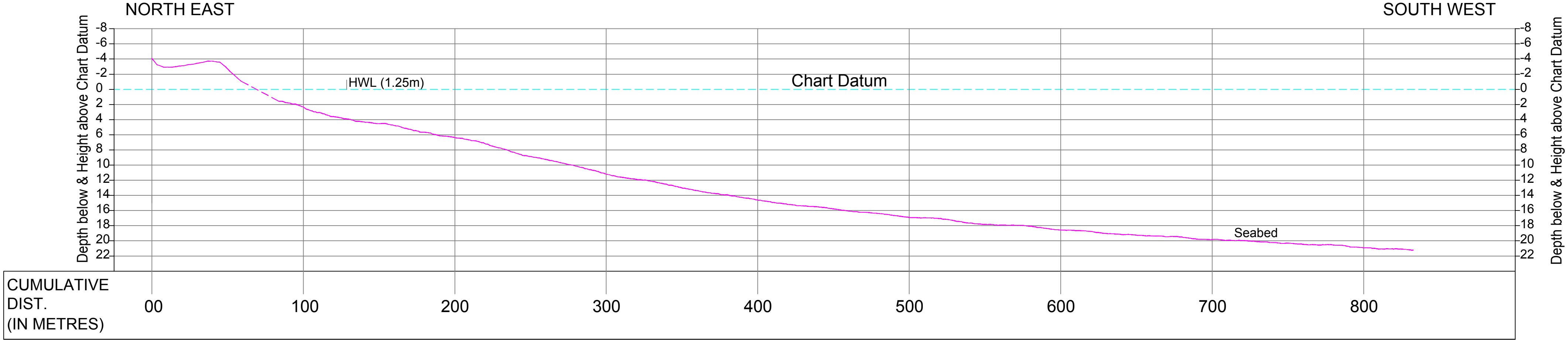
HORIZONTAL 1: 2000

VERTICAL 1: 400

adani

OCEAN Science & Surveying

Cross Section Line No.CSP-72
(April 2019)



Cross Shore Profile

SCALE :

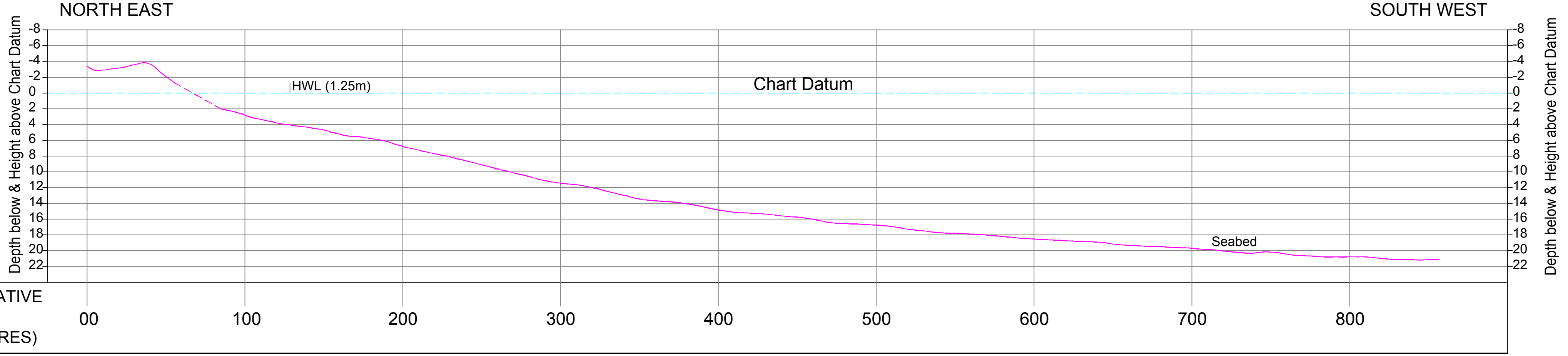
HORIZONTAL 1: 2000

VERTICAL 1: 400

adani

OCEAN Science & Surveying

Cross Section Line No.CSP-73
(April 2019)



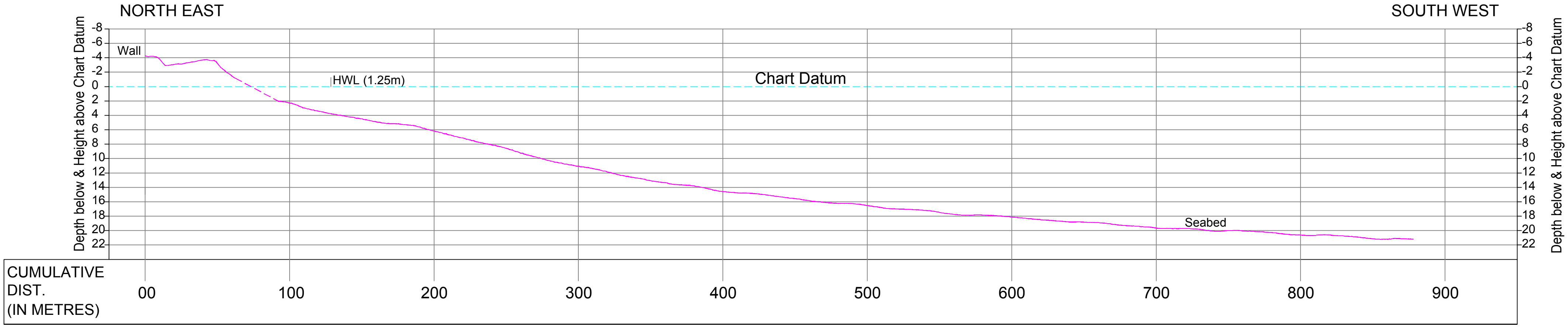
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-74
(April 2019)



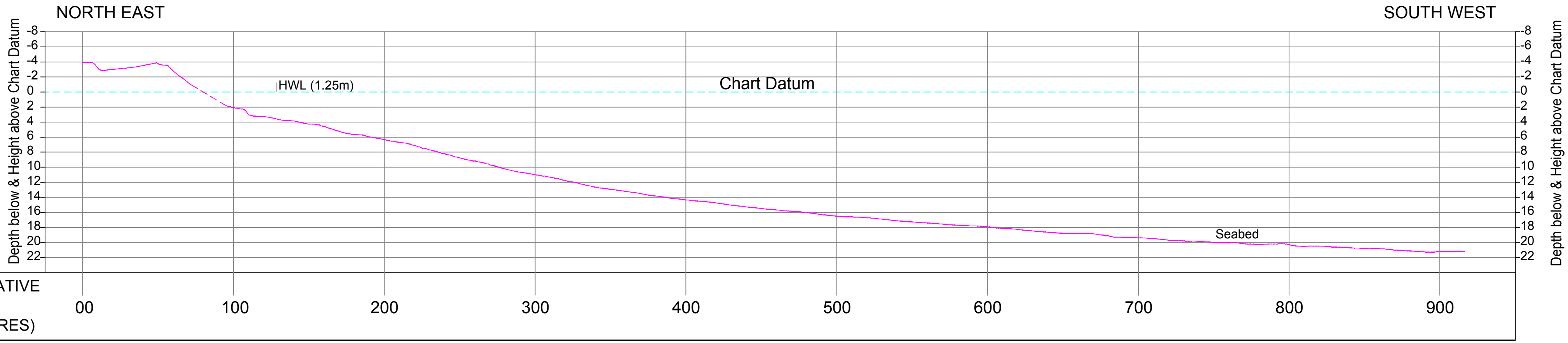
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-75
(April 2019)



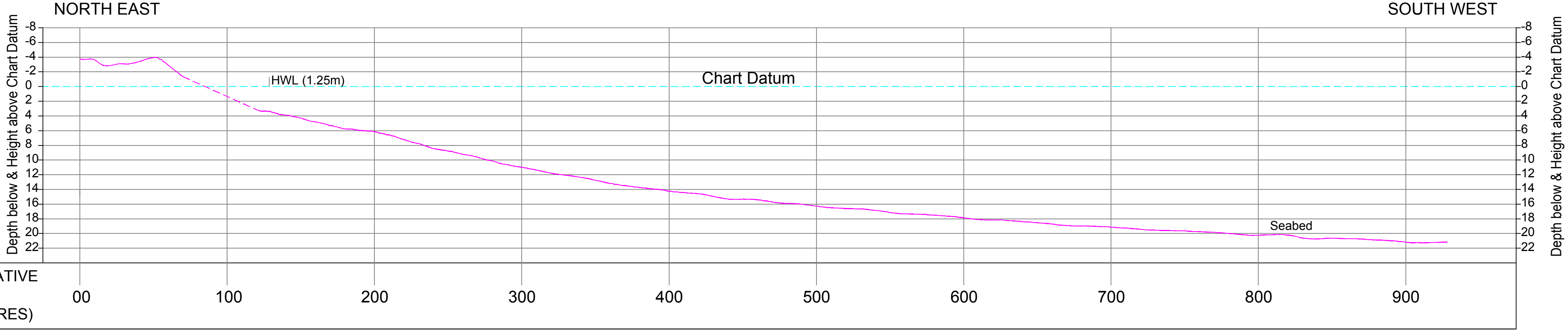
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

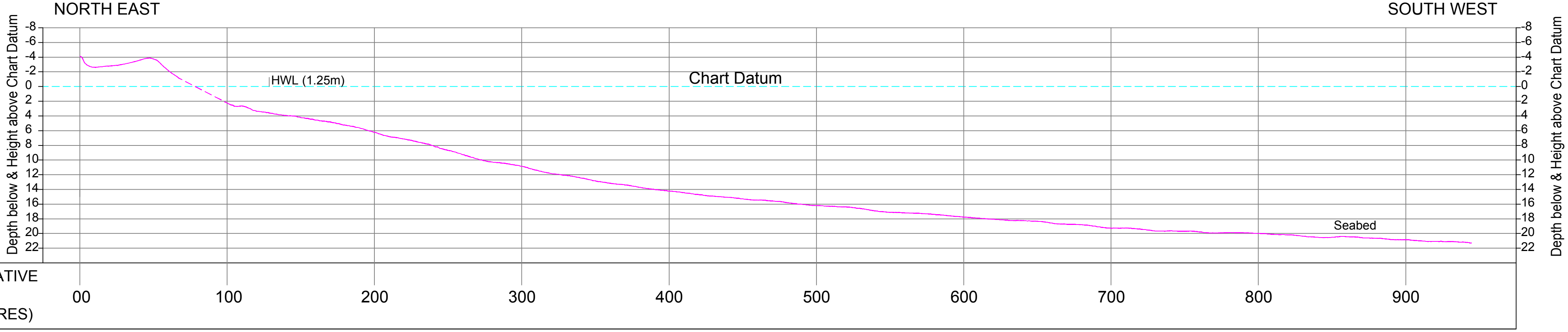
Cross Section Line No.CSP-76
(April 2019)



Cross Shore Profile
SCALE :

HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-77
(April 2019)



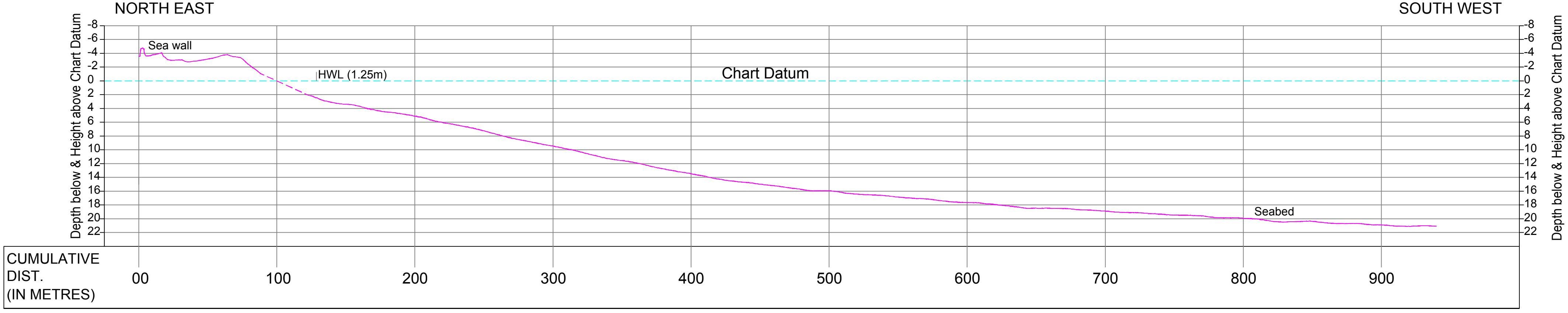
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

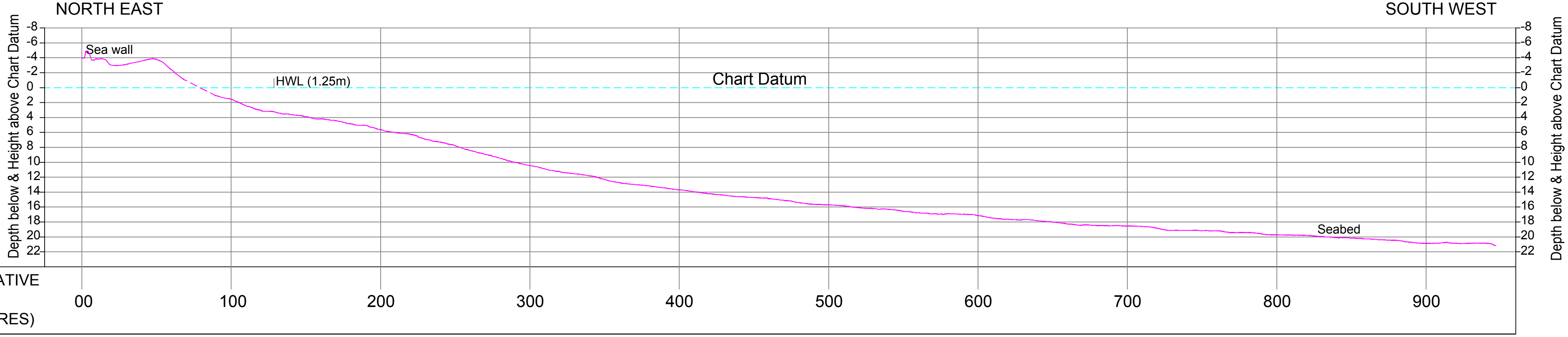
VERTICAL 1: 400

Cross Section Line No.CSP-78
(April 2019)



Cross Shore Profile
SCALE :
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-79
(April 2019)



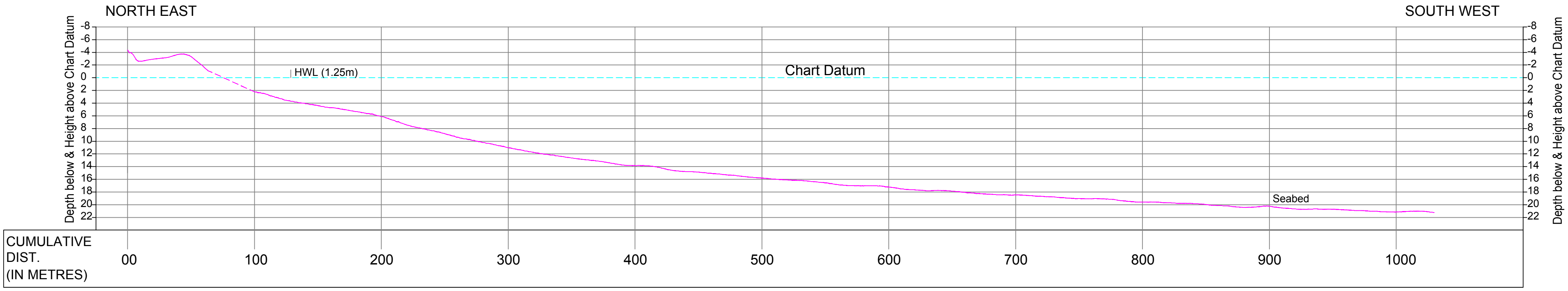
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-80
(April 2019)



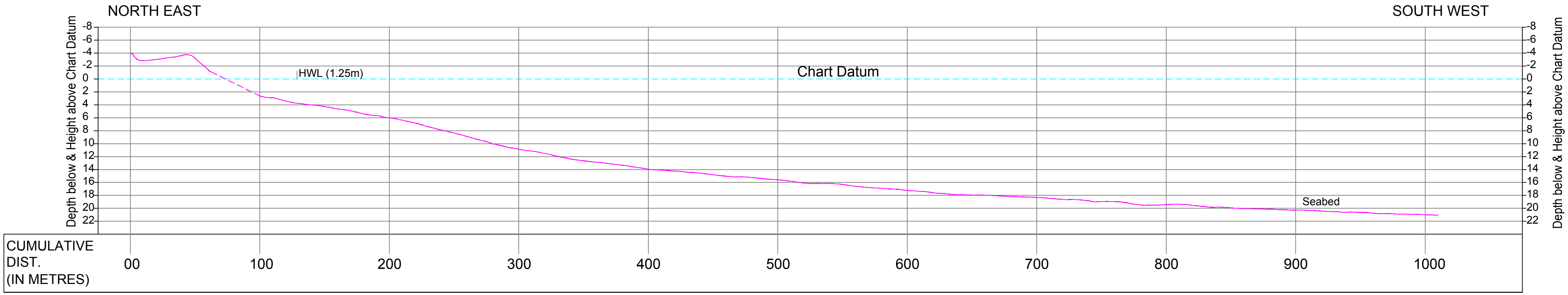
Cross Shore Profile

SCALE :

HORIZONTAL 1: 2000

VERTICAL 1: 400

Cross Section Line No.CSP-81
(April 2019)



Cross Shore Profile

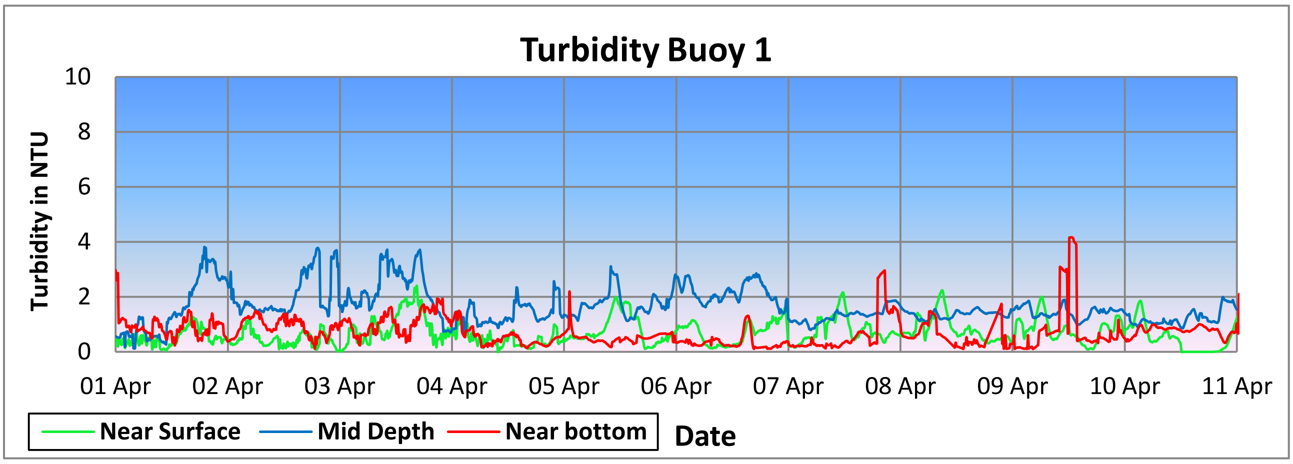
SCALE :

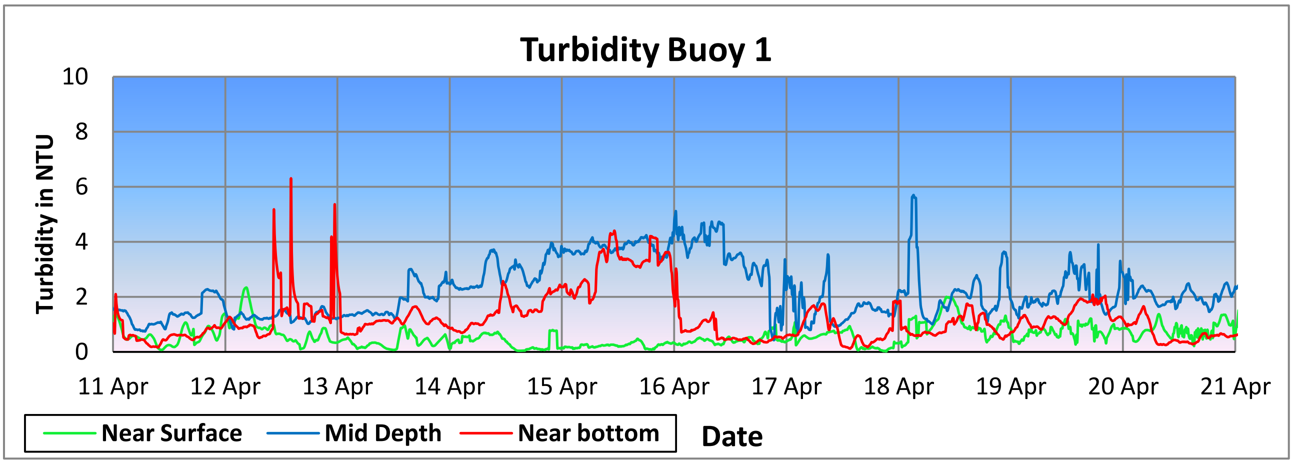
HORIZONTAL 1: 2000

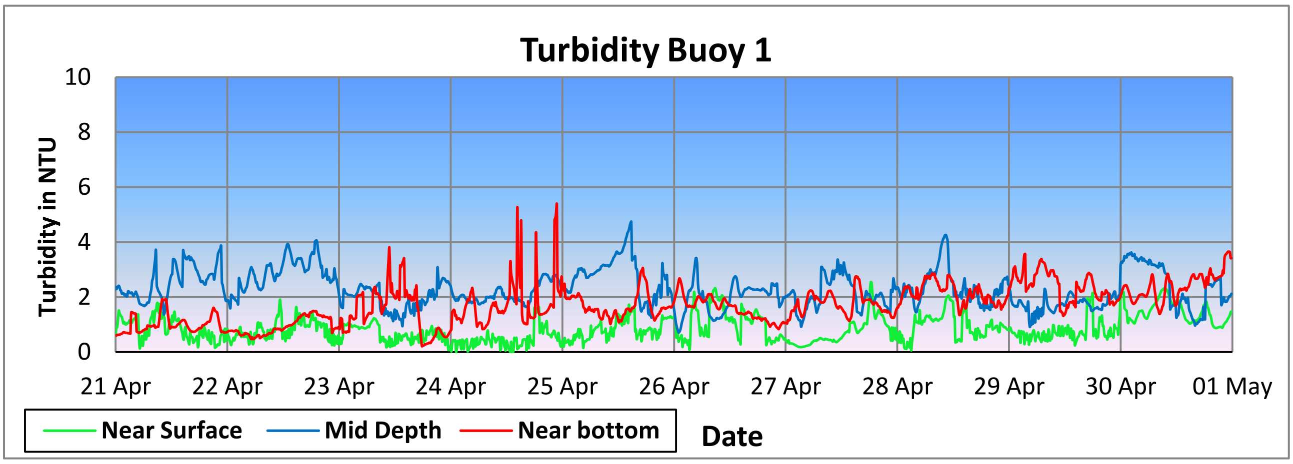
VERTICAL 1: 400

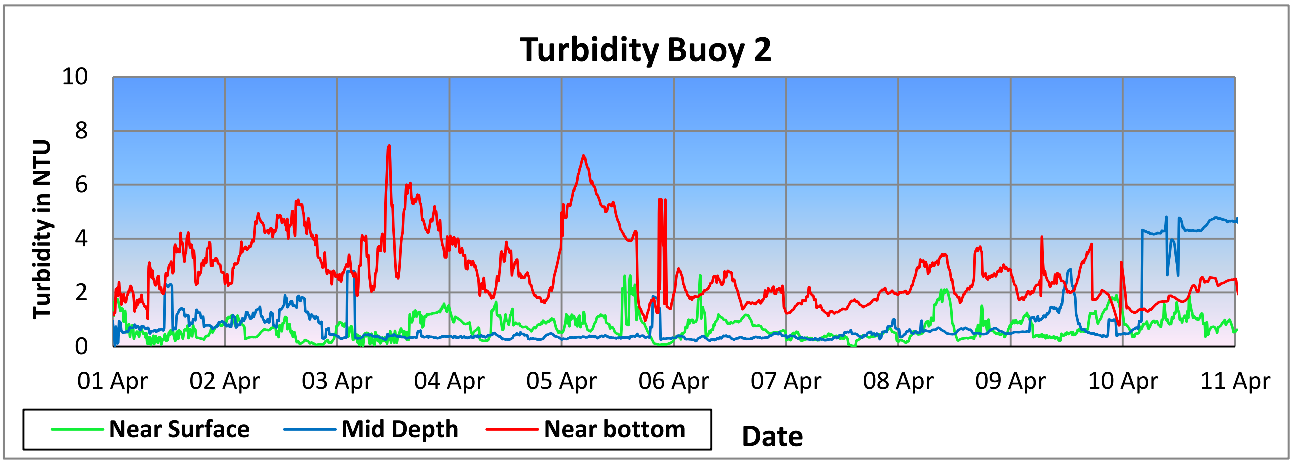
Annexure VII

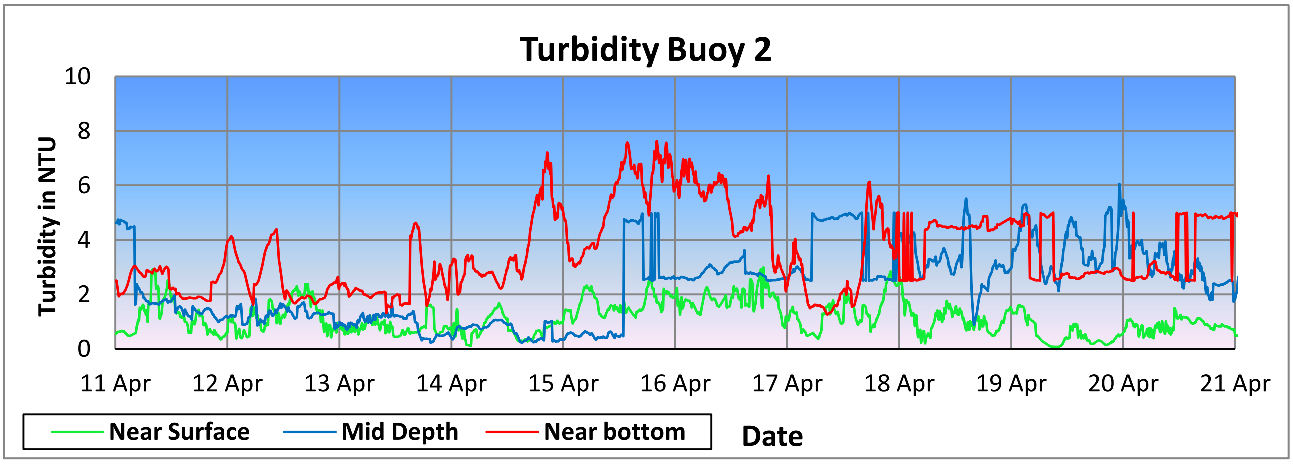
Turbidity Data

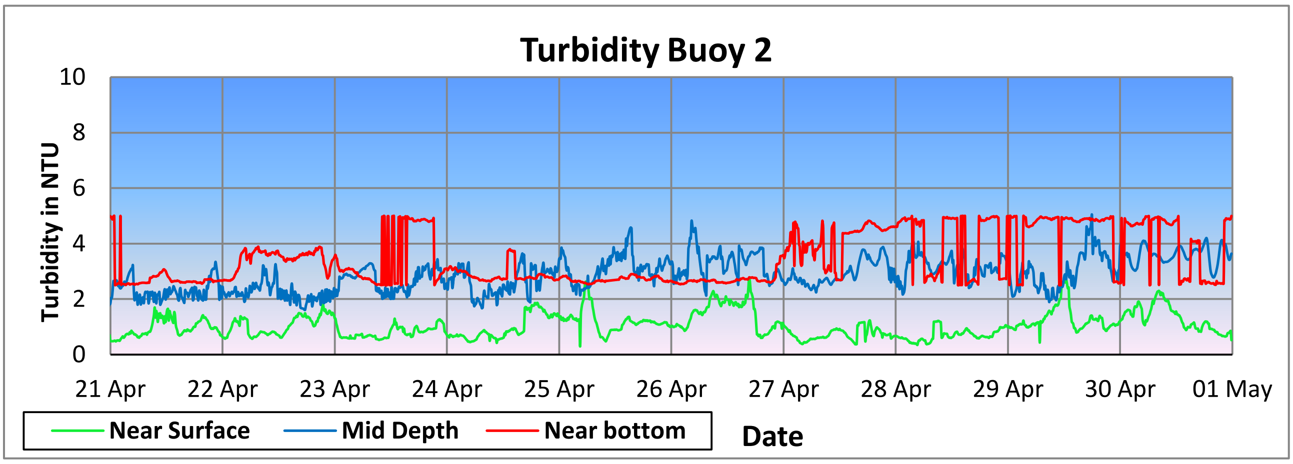

Turbidity Buoy 1
Turbidity in NTU
10
8
6
4
2
0
01 Apr
02 Apr
03 Apr
04 Apr
05 Apr
06 Apr
07 Apr
08 Apr
09 Apr
10 Apr
11 Apr
Near Surface
Mid Depth
Near bottom
Date

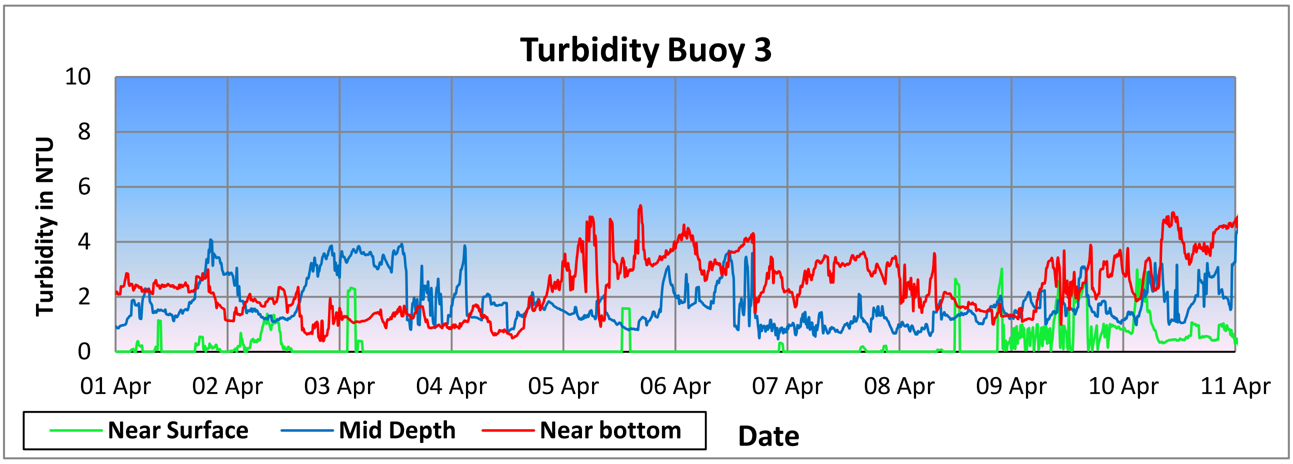

Turbidity Buoy 1
Turbidity in NTU
10
8
6
4
2
0
11 Apr
12 Apr
13 Apr
14 Apr
15 Apr
16 Apr
17 Apr
18 Apr
19 Apr
20 Apr
21 Apr
Near Surface
Mid Depth
Near bottom
Date

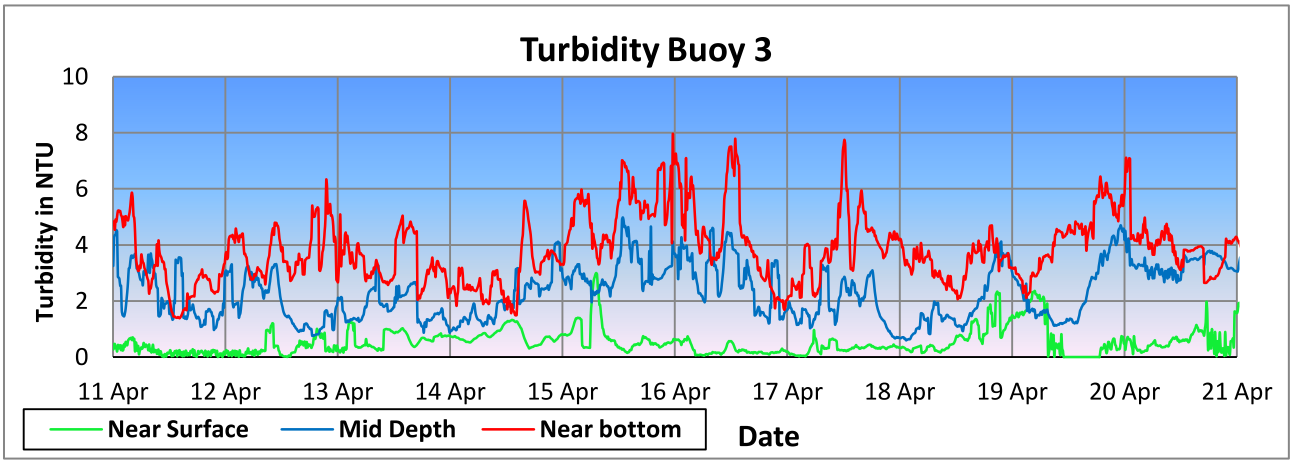

Turbidity Buoy 1
Turbidity in NTU
10
8
6
4
2
0
21 Apr
22 Apr
23 Apr
24 Apr
25 Apr
26 Apr
27 Apr
28 Apr
29 Apr
30 Apr
01 May
Near Surface
Mid Depth
Near bottom
Date

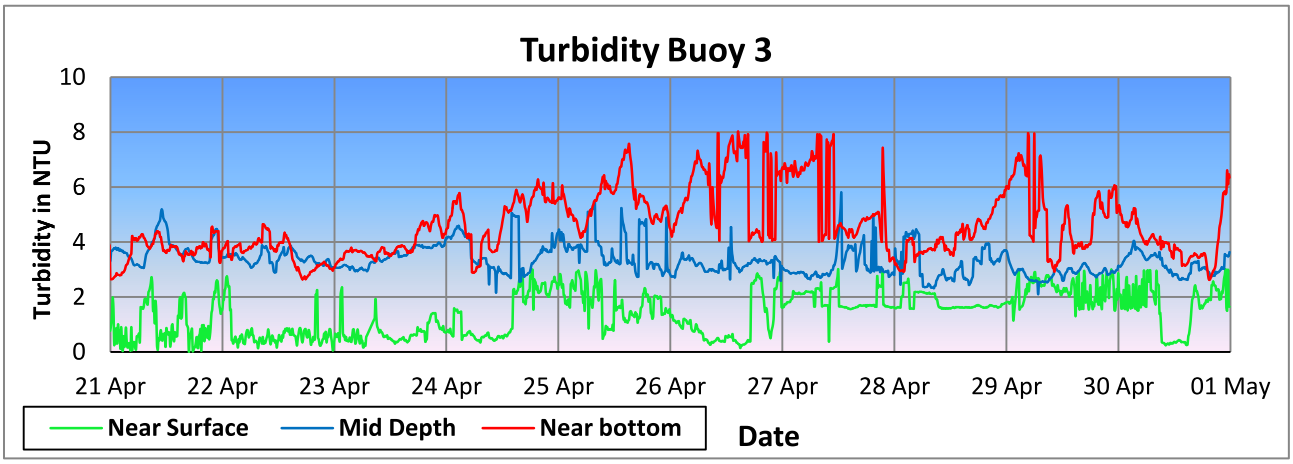

Turbidity Buoy 2
Turbidity in NTU
10
8
6
4
2
0
01 Apr
02 Apr
03 Apr
04 Apr
05 Apr
06 Apr
07 Apr
08 Apr
09 Apr
10 Apr
11 Apr
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 2
Turbidity in NTU
10
8
6
4
2
0
11 Apr
12 Apr
13 Apr
14 Apr
15 Apr
16 Apr
17 Apr
18 Apr
19 Apr
20 Apr
21 Apr
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 2
Turbidity in NTU
10
8
6
4
2
0
21 Apr
22 Apr
23 Apr
24 Apr
25 Apr
26 Apr
27 Apr
28 Apr
29 Apr
30 Apr
01 May
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 3
Turbidity in NTU
10
8
6
4
2
0
01 Apr
02 Apr
03 Apr
04 Apr
05 Apr
06 Apr
07 Apr
08 Apr
09 Apr
10 Apr
11 Apr
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 3
Turbidity in NTU
10
8
6
4
2
0
11 Apr
12 Apr
13 Apr
14 Apr
15 Apr
16 Apr
17 Apr
18 Apr
19 Apr
20 Apr
21 Apr
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 3
Turbidity in NTU
10
8
6
4
2
0
21 Apr
22 Apr
23 Apr
24 Apr
25 Apr
26 Apr
27 Apr
28 Apr
29 Apr
30 Apr
01 May
Near Surface
Mid Depth
Near bottom
Date

Report on

Oceanographic & Bathymetric Data Collection for

Assessment of Shoreline Changes

(PSR-39, May 2019)

For Adani Vizhinjam Port Pvt. Ltd.

Client

Adani Vizhinjam Port Pvt. Ltd.
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Submitted to	Adani Vizhinjam Port Pvt. Ltd.
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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 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 a water body moves in the ocean. The speed is denoted in cm/s
Rip Current	A relatively strong, narrow current flowing outward from the beach through the surf zone
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 in m/s
Wind Direction	Wind direction is an indicator of the direction that the wind is **blowing 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 vapour density (mass per unit volume) to the saturation water vapour density, usually expressed in percent
Turbidity	Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air.

ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
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
Mg/L	Milligram per litre
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
NTU	Nephelometric Turbidity Units

PEP	Project Execution Plan
PVD	Progressive vector diagram
PPP	Public Private Partnership
ppt	Parts per Thousand
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 a Public-Private Partnership (PPP) 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 continuation of the contract Ocean Science had with VISL earlier, which came to an end on 18th February 2016.

As part of the contract, turbidity measurements at three locations from three levels were to be monitored on a real time basis. Two turbidity buoys were installed on 19th November 2016 and the third one was installed on 9th December 2016.

This report provides the results of the data collected from 01st to 31st May 2019.

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 coastal village 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 8th Century AD.

The port is proposed to be developed in a PPP model. The investment for land, external infrastructure (rail, water and power) and breakwater will be borne by the VISL/GoK. The investments for other port infrastructure (dredging & reclamation, berths, terminals, superstructure & equipments) will be shared on PPP basis availing Viability Gap Funding (VGF) from Government of India. The PPP concessionaire, AVPPL has been given the right to operate for 40 years full port not just phase 1. 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 is located at the southern tip of India, barely 10 nautical miles from the international sea route (Suez – Far East route & Far East – Middle East route), it 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 (Mar-May), monsoon (June-Oct), and post monsoon (Nov-Feb), 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 and river crossing survey.

A Google Earth image, showing the Multibeam survey area; locations of the observations, including the wave/current, tide and AWS measurement location, is given in **Figure 1 & 2**. The cross-shore profile lines, the LEO points and photographic documentation points are shown in **Figure 3**.

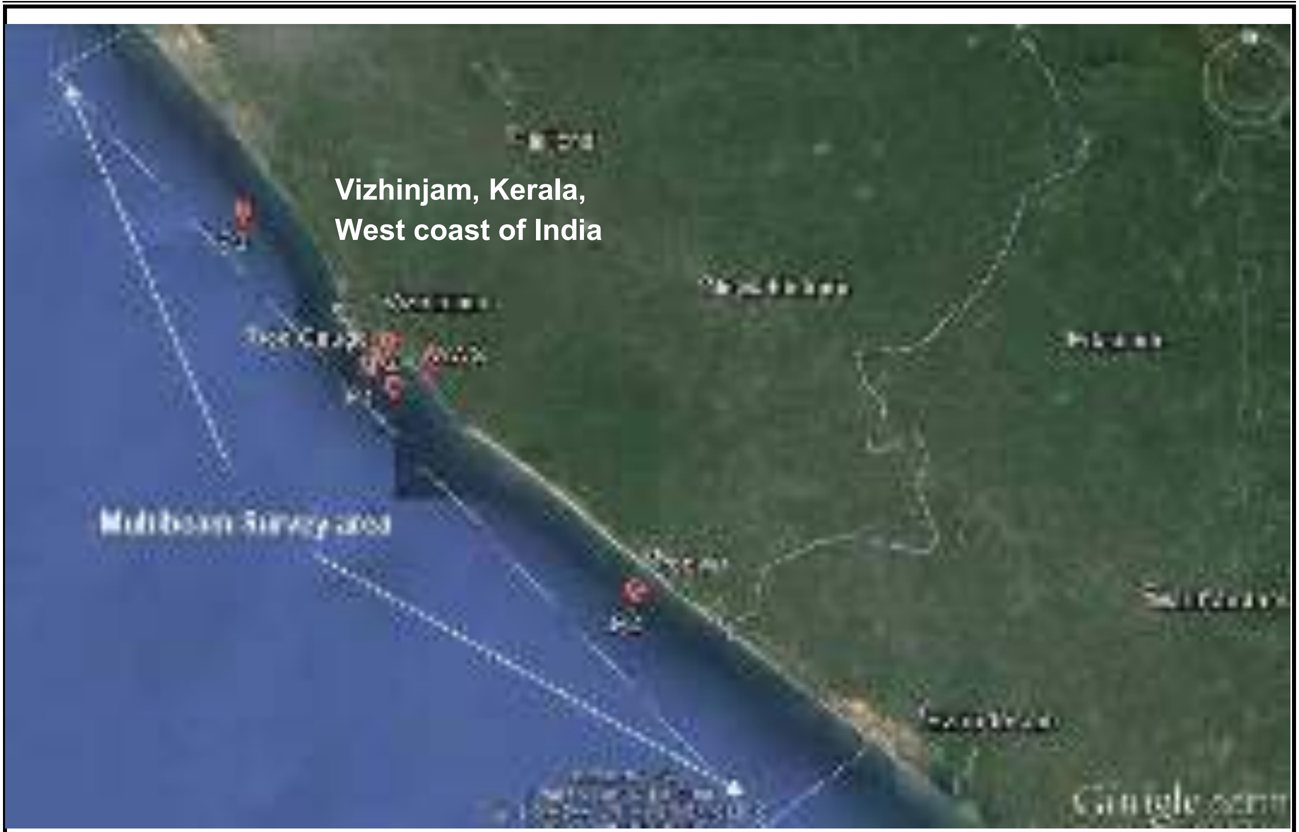


Figure 1– General survey location

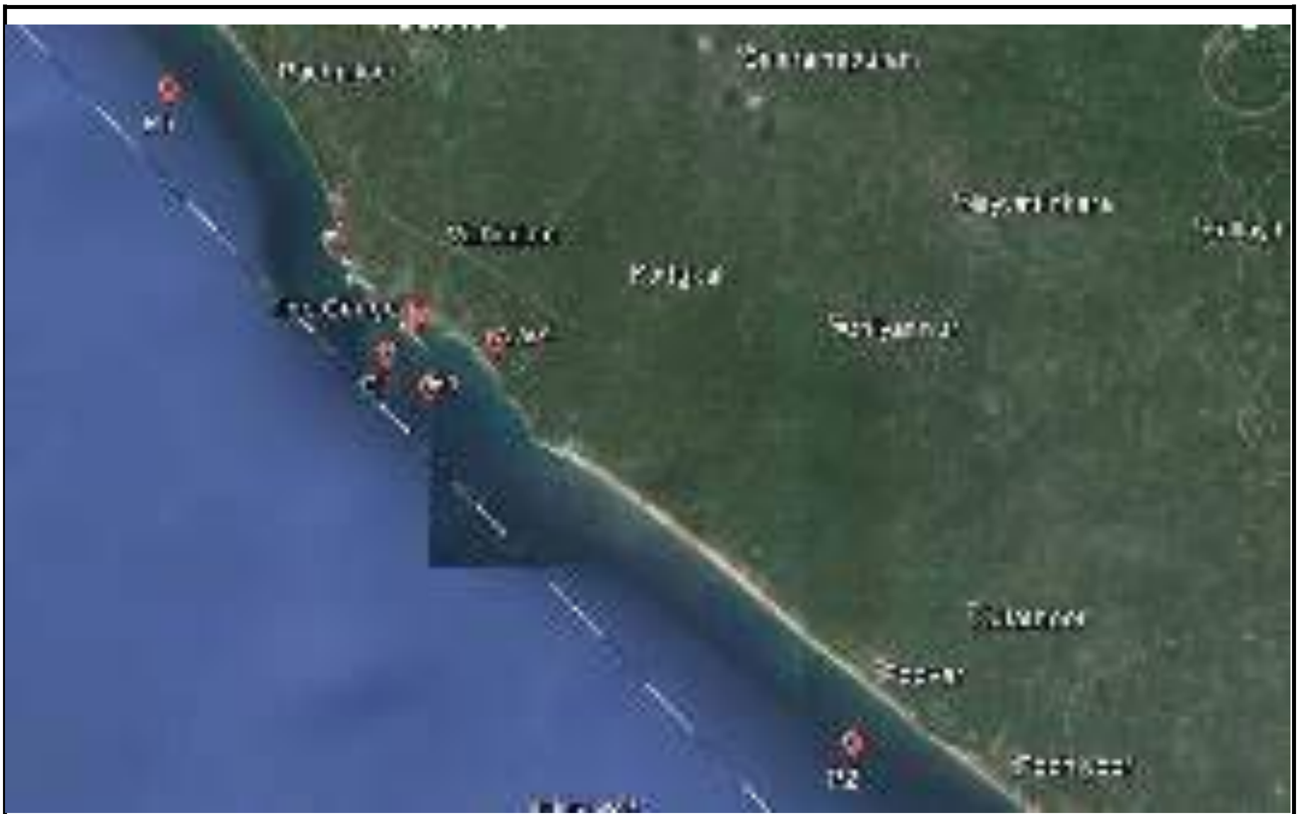


Figure 2–Location of ADCPs, Tide and Weather Station

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 and photographic documentation, 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 to the south of the existing Vizhinjam Harbour.

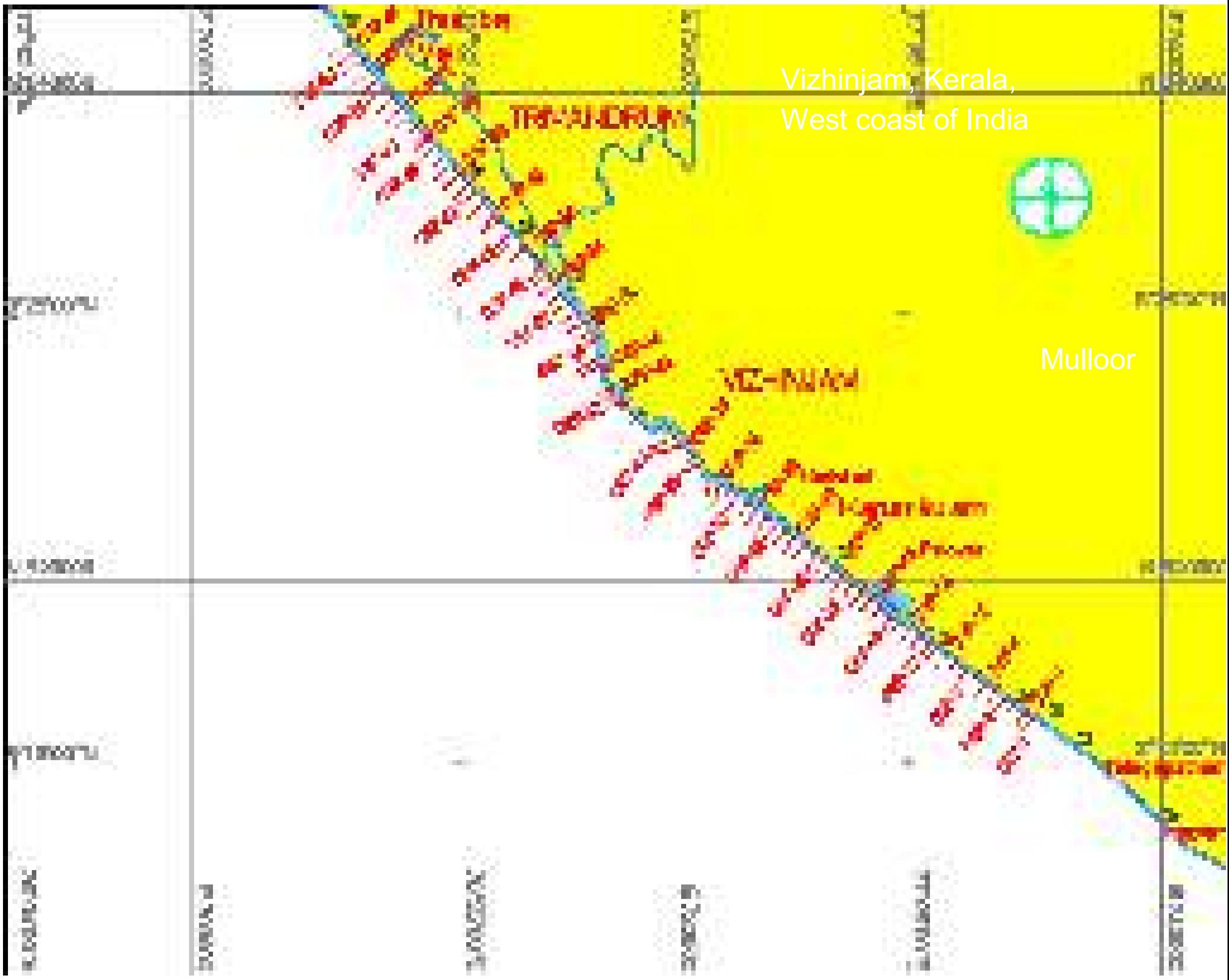


Figure 3– Cross-Shore Profile/LEO, Photographic Documentation Locations

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 20m 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 on 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.
- Continuous monitoring of turbidity at 3 location (1 upstream & 2 downstream of dredging location) - Online meter (3 levels) to be installed on buoys and data to be displayed at system in office
- Analysis and processing of the data and submission of periodic reports in soft & hard copies.

3.1 Location Co-ordinates

The location co-ordinates provided by the client forthe current and wave observations are given 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	21.4
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 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 wind speeds at 10m above MSL. The data provided is thus referenced to both the levels.

The location co-ordinates provided by the client for the turbidity observations are given below:

Location Co-ordinates WGS-84 Spheroid, UTM Projection, CM 75 East, Zone 43, North			
Name	**Latitude**	**Longitude**	**Depth w.r.t CD (m)**
Turbidity Buoy-1	08° 20' 58.6"N	77° 00' 08.1"E	21.1
Turbidity Buoy -2	08° 21' 49.9"N	76° 59' 14.3"E	21.2
Turbidity Buoy -3	08° 22' 27.6"N	76° 59' 16.1"E	15.3

Table 4: Turbidity buoy location

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 5: 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 SindhuYatraMatha

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**
Sisir K Patra	Project Manager / Oceanographer	Duration of Project
Abhilash Lal	Party Chief / Surveyor	01st to 31st May 2019
Anoop V M KUMAR	Jr. Oceanographer	Duration of Project
Gourav Sharma	Survey Engineer	01st to 31st May 2019
Adani Vizhinjam Port Pvt. Ltd.		
Name	**Designation**	**Period**
Hebin C.	Manager - Environment	Duration of Project

Table 6: Survey Personnel

5. SURVEY EQUIPMENT DETAILS

5.1 General

The Wave Rider Buoy was guarded by the vessel MFB Samuel for the month. The offshore cross-shore profiling was carried out using the survey boat Bethel fitted with the multibeam echo sounder. ADCPs were deployed from a locally hired boat for the period.

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.

The consistency check of DGPS is carried out routinely. The details of the check carried out on 07^{th} April 2019 are given below:

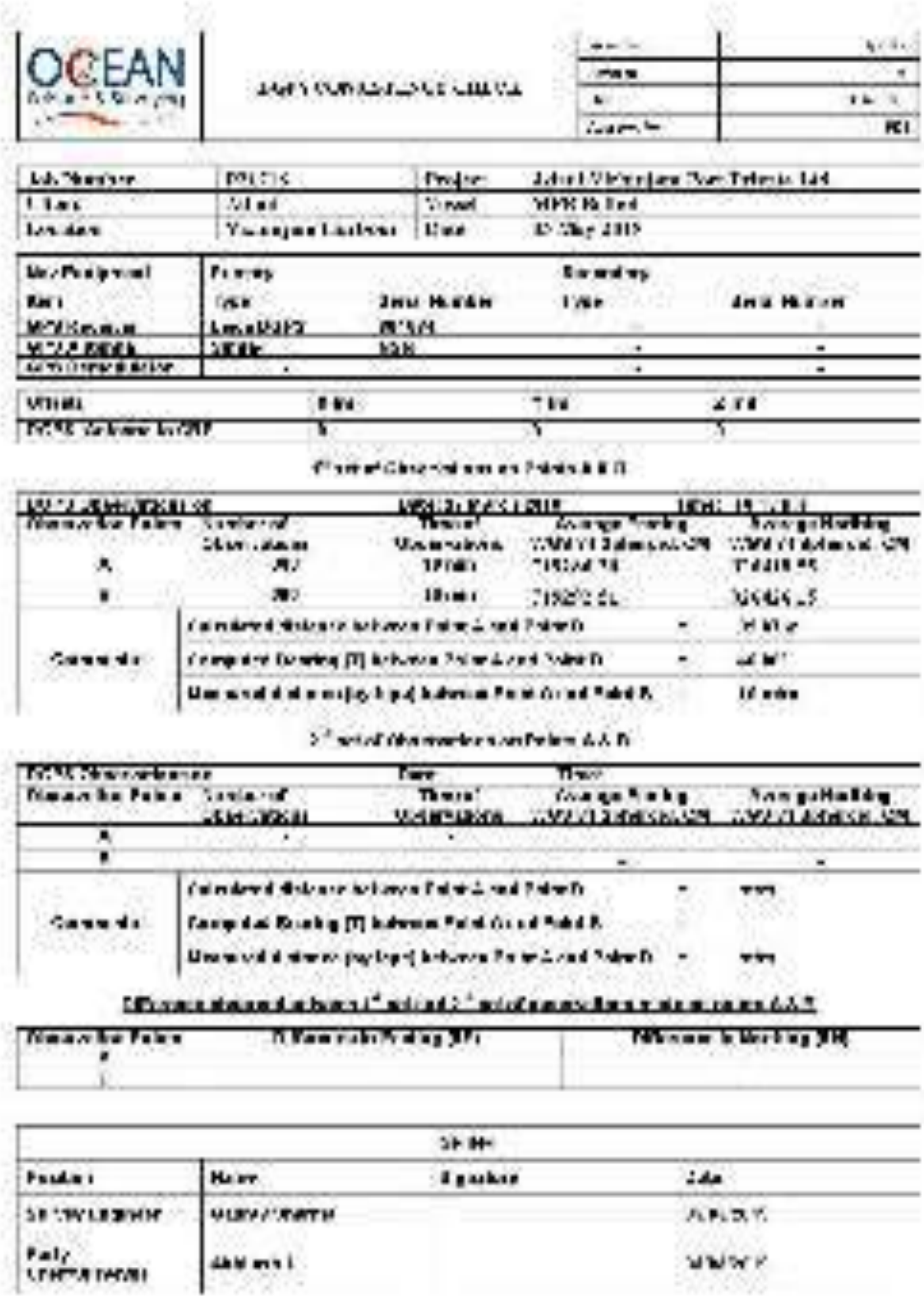


Figure 7: DGPS consistency check

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.

An Octans Gyro was used to obtain the accurate heading of the survey boat. The calibration of the gyro was carried out on 07th April 2019. The details are provided in the figure below:

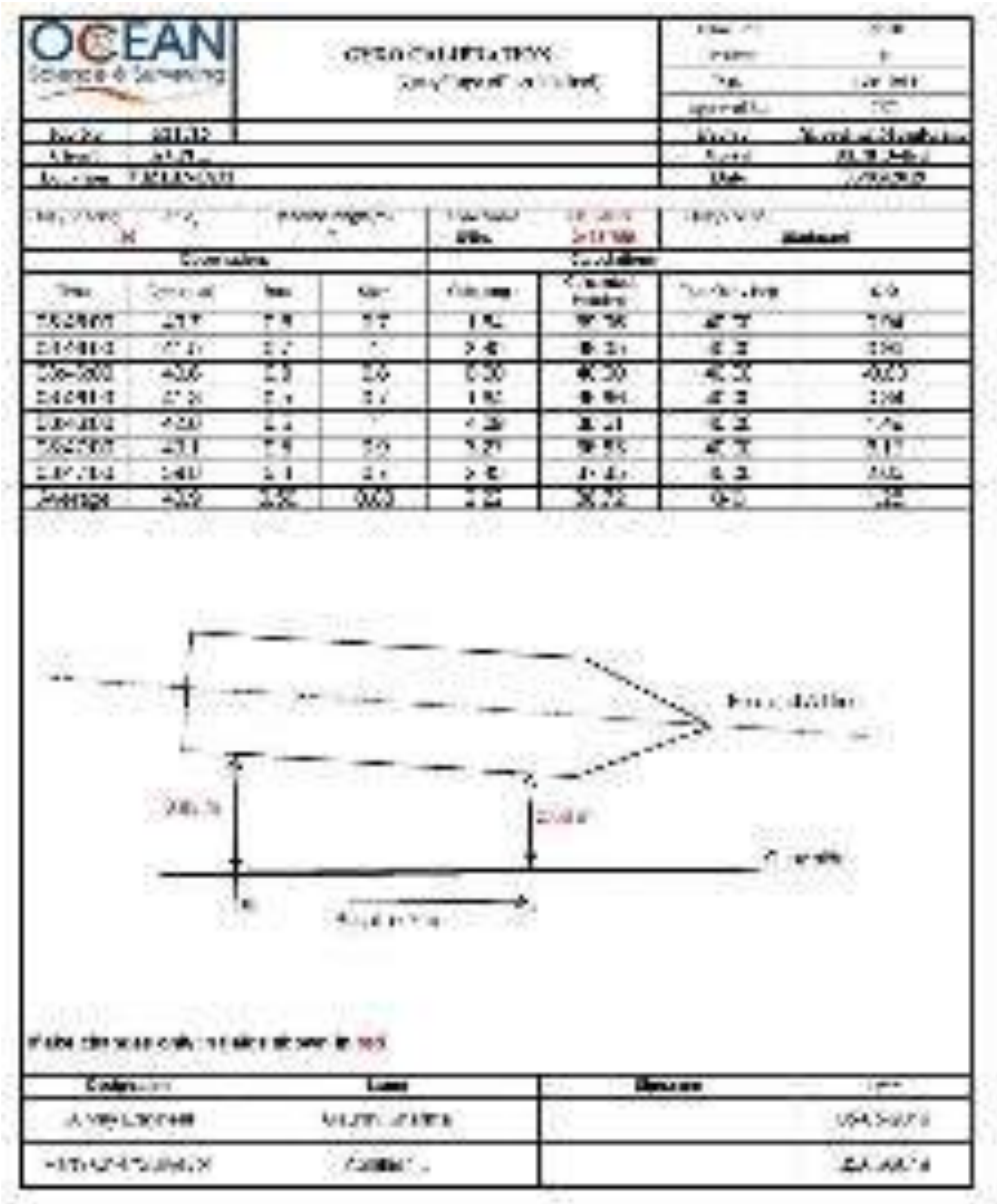


Figure 8: Gyro Calibration

5.4 Wave Rider Buoy

NIOT deployed the wave rider buoy in collaboration with VISL and AVPPL, under a tripartite agreement and is being monitored by Ocean Science. A Datawell DWR (G) wave buoy 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 setup at Ayur Bay.

The system consists of wave rider buoy (DWR G make) with HF whip/LED flasher, GPS antenna, 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 car passing nearby, 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.

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:

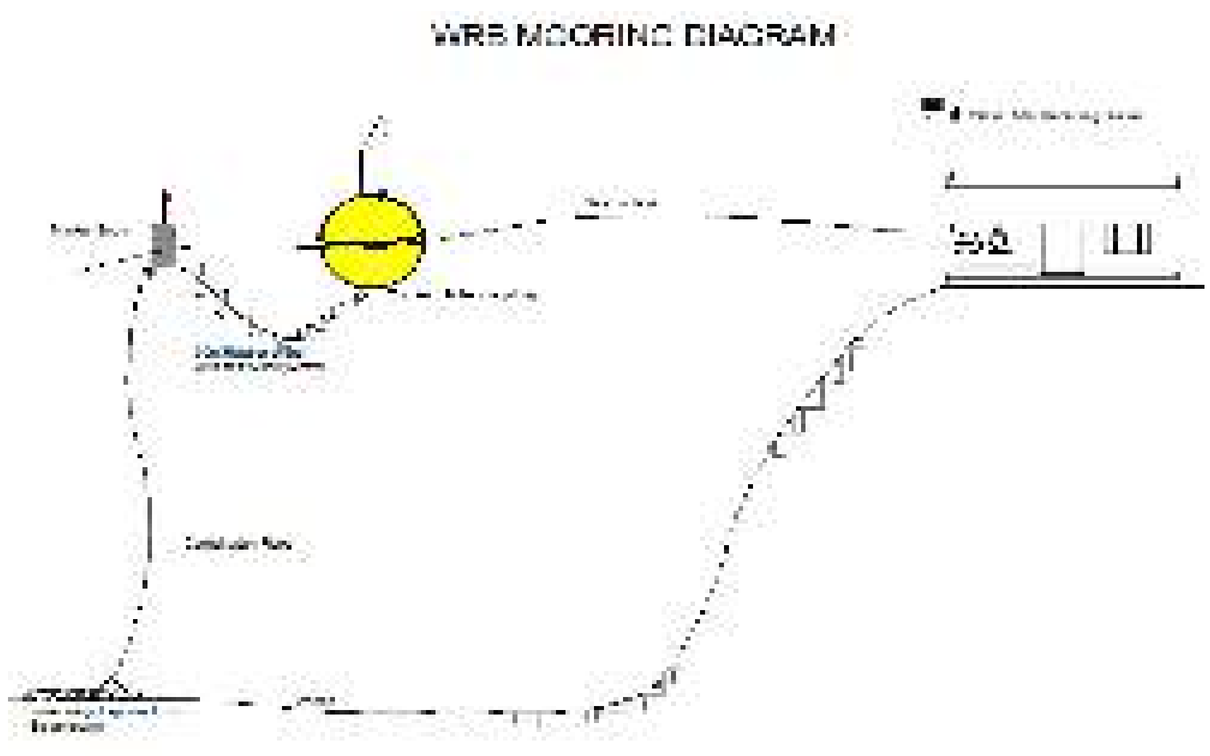


Figure 9– WRB Mooring Diagram

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.

5.5 Automatic Tide Gauge

A Valeport 740 Tide master 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
- Micro step pressure sensor
- Micro step relative humidity & temperature sensor
- Meteoservis Rain gauge
- Micro step data logger

The data is logged in a data logger installed at the receiving station at intervals of 10 minutes. The data is also transmitted from the data logger through a UHF linkto a remote PC for QC and processing.

An image of automatic weather station is provided below:

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

5.7 Real Time Kinematic (RTK) Survey

An 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 13 – RTK System fixed at BM-1

5.8 Bathymetric Survey

The cross-shore profiling from 10m CD to the shore was carried out using a Geoswath GS+ 500 kHz wide swath bathymetric system, which was calibrated on 07th April 2019. The calibration values obtained are given below:

Parameter	Value	Comments
Latency	0.54s	MX 420 DGPS system
Port Roll	-0.03º	Accuracy 0.05º in roll (~3.5cm at 40m)
Starboard Roll	0.25º	Accuracy 0.05º in roll (~3.5cm at 40m)
Pitch	0.00º	
Yaw	-3.60º	Accuracy better than 0.2°

Table 7: Calibration Results

5.9 Turbidity Monitoring

Optic sensors manufactured by Ponsel, France are used to measure the turbidity at all locations. The sensors are installed on a 6m buoy, in which is housed a telemetry module. The system is powered using a battery which is in turn charged with the aid of solar panels fitted on the buoy. The buoy is deployed on a two point mooring system as illustrated below:

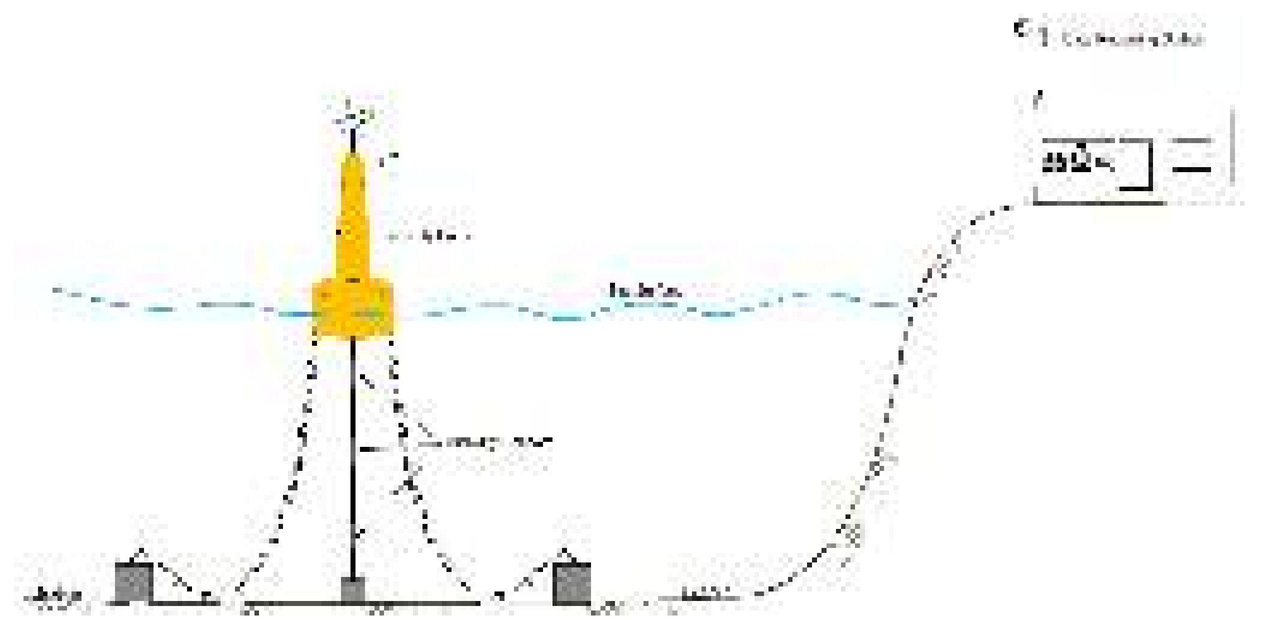


Figure 14 –Turbidity Buoy Mooring Diagram

An image of the buoy deployed at site is provided in the image below:

Figure 15 – Turbidity Buoy

The data from the buoy is received at the receiving centre at Ayur Bay resort at intervals of 10 minutes.

5.10 ADCP

The ADCP's were checked for correct pinging of each transducer heads, at site. The compass calibration was carried out for each ADCP's to check for any errors.

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 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 old VISL Project office)	8° 22’ 21”.7313 N 77° 00’ 03”.3253 E	720338.4535 mE 926061.5341 mE	44.0577

Table 8: Details of stations BM-1, BM-2& BM-3

Photographs of these stations were given in PSR-1 and hence are not repeated here.

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

Sl No.	Reference Point	Easting	Northing	Latitude	Longitude	Height above CD (m)
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
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_L EELA	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 9: 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. 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 3.251m above chart datum. An image of the TBM is provided below:

Figure 17– Location of TBM

The observed tides are mixed semi diurnal in nature. The maximum tidal 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. When the WRB became faulty, it was replaced on 29th June 2016 and is still continuing as part of the contract.

The data from the WRB was QC'ed and used to produce the time series and rose diagram, which are provided below:

Refer to the following rose plot of significant height Hs v/s direction for the period of 1st to 31st May 2019:

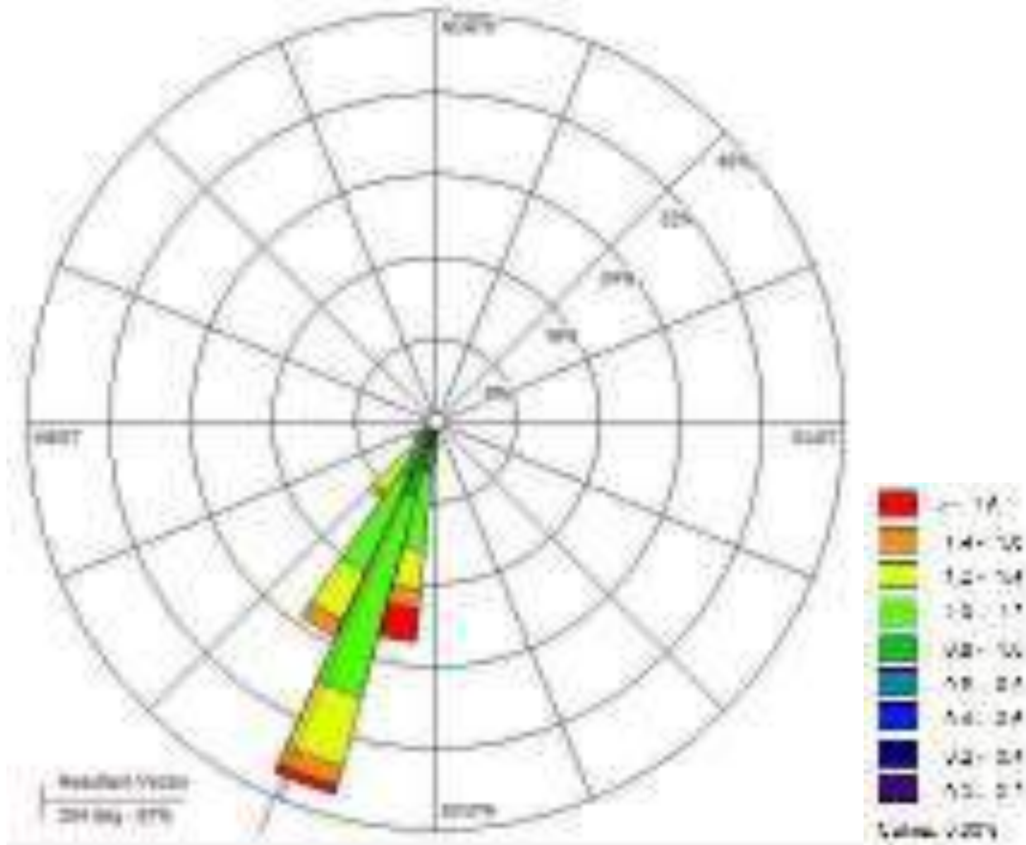


Figure 18– Wave Rose (Hs in metre v/s Direction) during 1st to 31st May 2019

The pre-dominant wave directions were South-Westerly (SW) during the period with significant wave height less than 1.6 m. As can be seen in the rose plot above, the wave heights were ranged between 0.2-1.6 m from SW directions.

The maximum significant wave height of 2.02 m was recorded on 2nd May 2019 at 07:09 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 - 0.2	0	0.00	0	0.00
0.2 - 0.4	0	0.00	0	0.00
0.4 - 0.6	0	0.00	0	0.00
0.6 - 0.8	49	3.25	0	0.00
0.8 - 1.0	398	26.38	1	0.07
1.0 - 1.2	624	41.35	77	5.17
1.2- 1.4	256	16.96	241	16.20
1.4- 1.6	91	6.03	361	24.26
> 1.6	91	6.03	808	54.30
Total	**1509**	**100**	**1488**	**100.000**

Table 10: Frequency Distribution of wave height (1st to 31st May 2019)

The histogram of significant wave height during the observation period of May 2019 is given below:

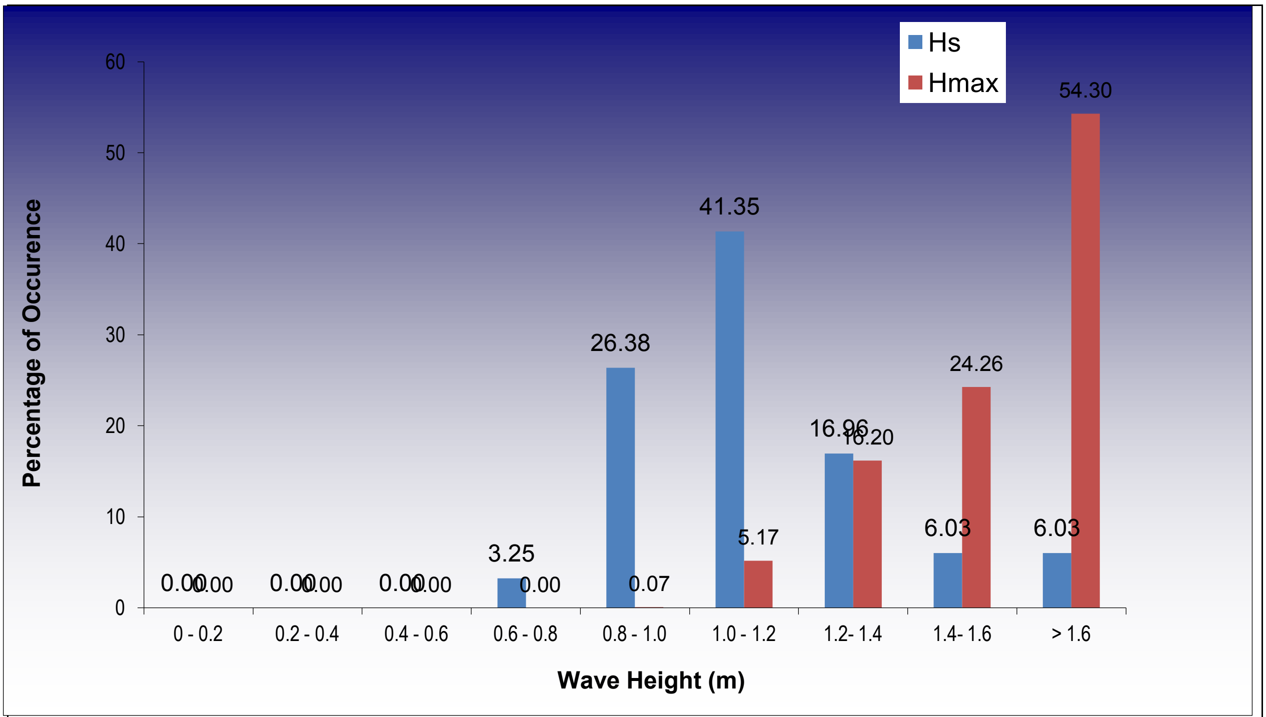


Figure 19 – Histogram of wave height (1st to 31st May 2019)

As can be observed above, about 99% of the observation the maximum wave height was more than 1m.

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

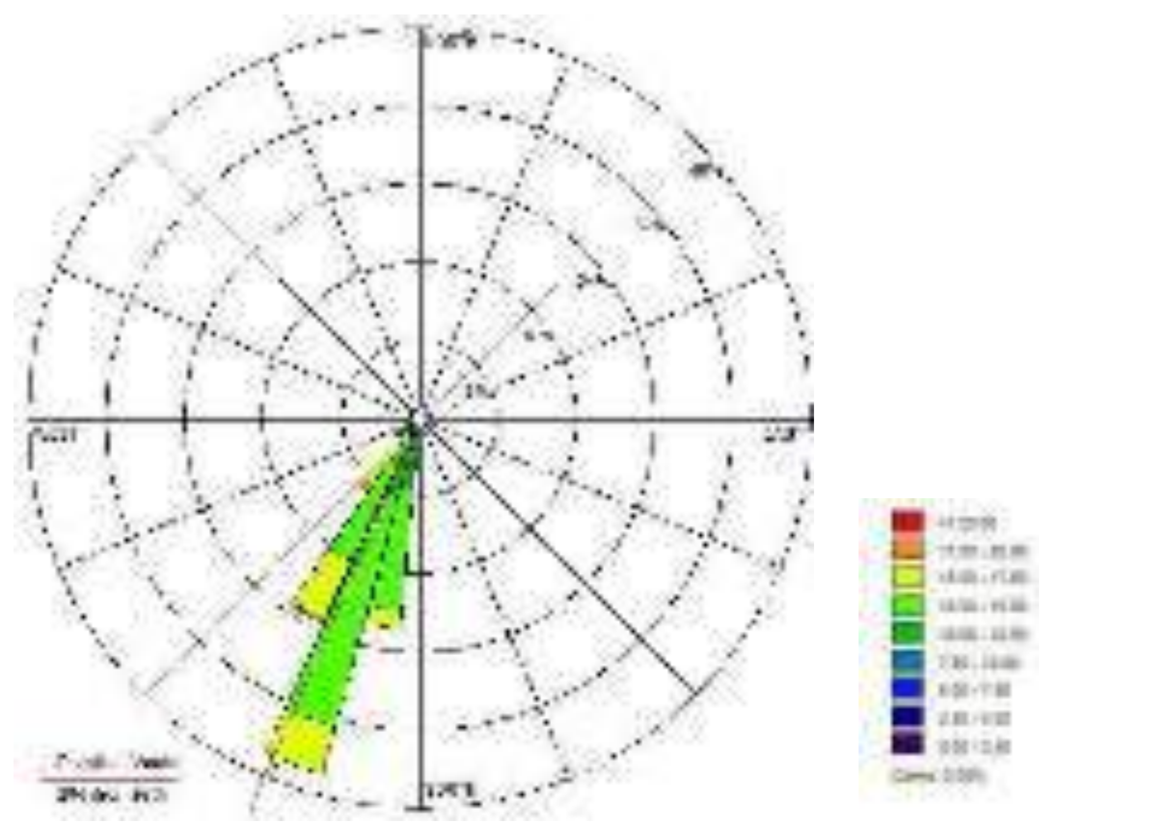


Figure 20– Wave Rose (Tp in seconds v/s Direction) during 01st to 31st May 2019

The histogram drawn for wave period for May 2019 is given below:

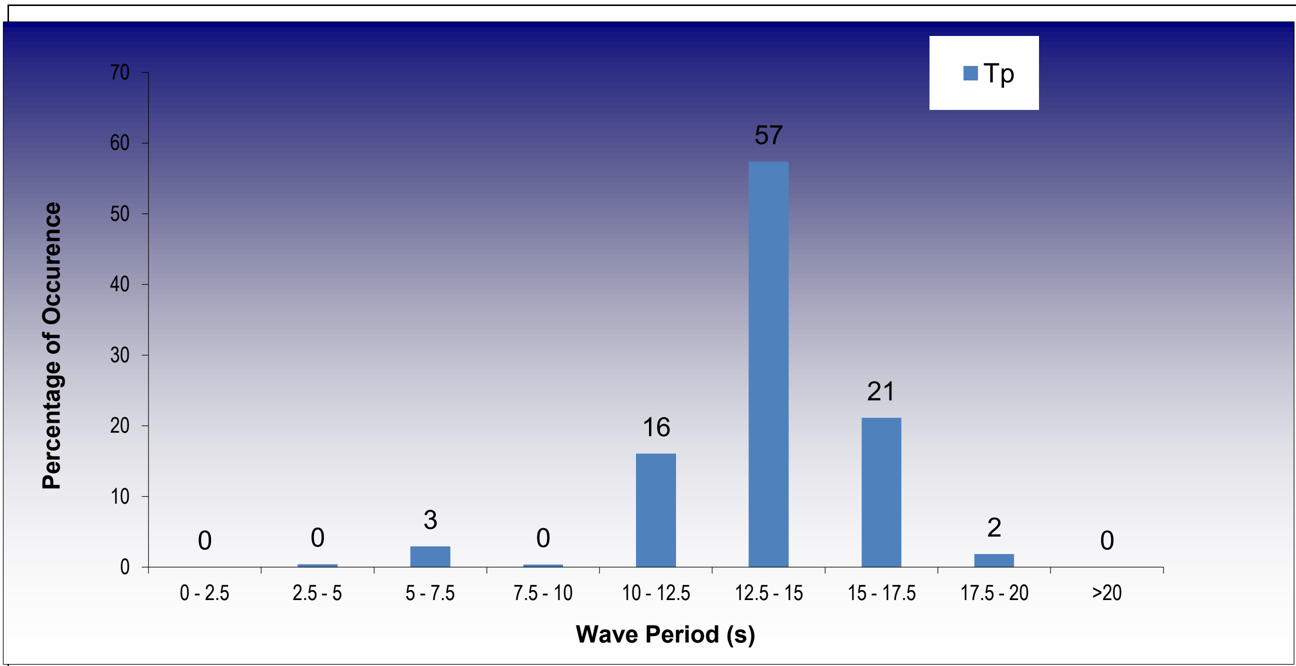


Figure 21 – Histogram of wave period (01st to 31st May 2019)

The above image indicates that during the period of observation, the wave period was in the range of 2.5 to 20 seconds, with 96% of the observations indicating long waves with a period of more than 10 seconds. The maximum period of 18.18 seconds was recorded on 03rd May 2019 at 15:39 hours.

The time series graph for the month of May 2019 is provided in Annexure II.

6.4 Measurement of Meteorological Parameters

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

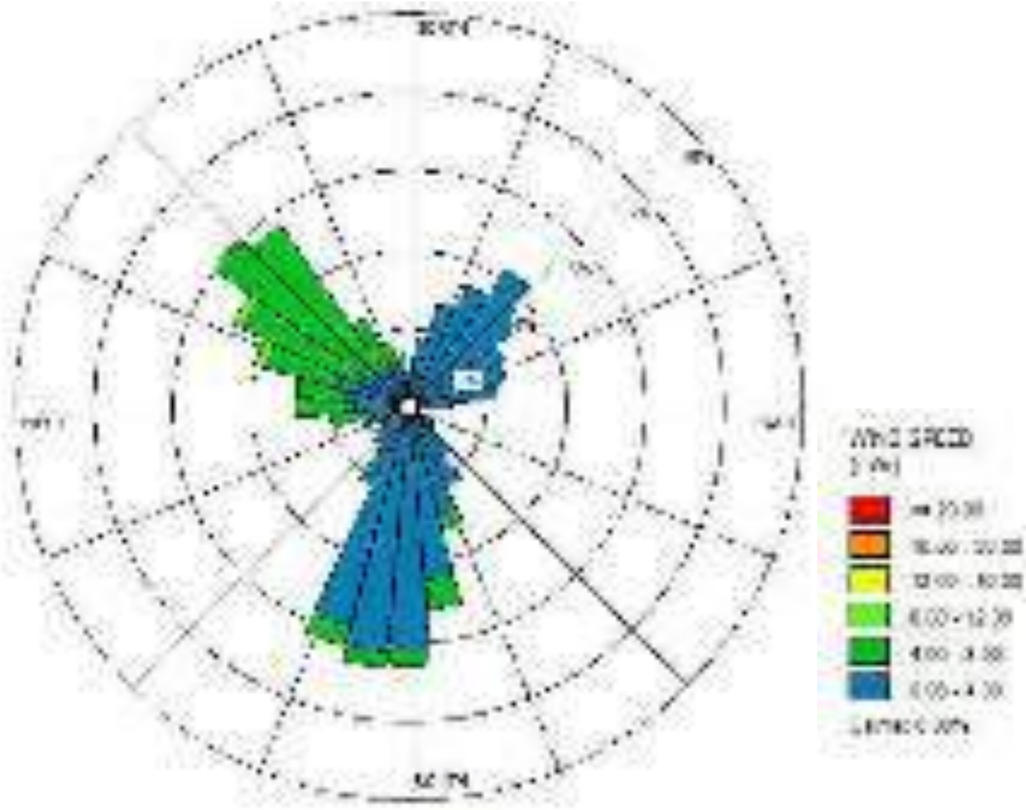


Figure 22– Wind Rose (Speed in m/s v/s Direction) during 1st to 31st May 2019

The rose plot reveals that the pre dominant wind directions are from South-westerly to Westerly and north easterly with maximum velocity magnitude up to 12 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 – 4	3368	76.06
4 – 8	1030	23.26
8 - 12	30	0.68
12 – 16	0	0.00
16 - 20	0	0.00
>20	0	0.00
Total	**4428**	**100.0**

Table 11: Frequency Distribution of wind speed (1st to 31st May 2019)

The histogram of wind speed for the period is given below:

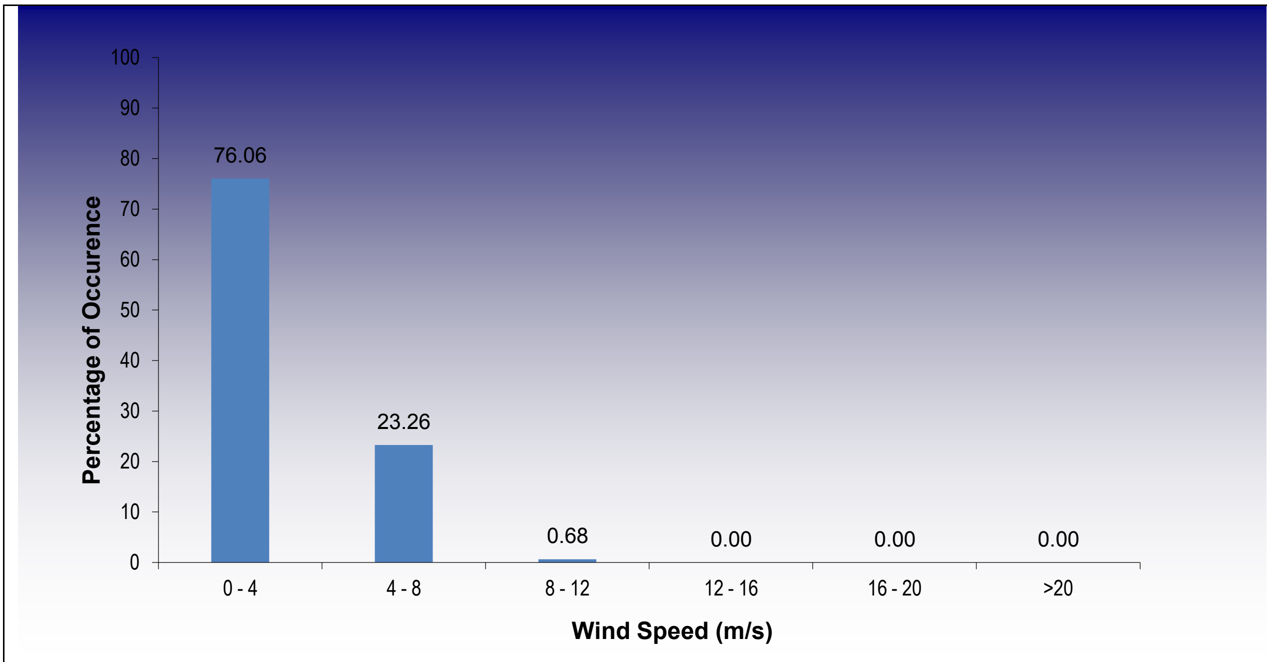


Figure 23 – Histogram of wind speed (1st to 31st May 2019)

Around 99% of winds are below 8 m/s, however the maximum wind speed in the month of May 2019 was 12 m/s, recorded on 28th May 2019 at 14:10 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	1	0.02
1000-1004	1204	27.19
1004 – 1008	3208	72.45
> 1008	15	0.34
Total	4428	100.00
Temperature	**No. of observations**	**Percentage of Occurrence**
20-24	1	0.02
24-28	1925	43.47
28-32	2502	56.50
>32	0	0.00
Total	4428	100.0
RH	**No. of observations**	**Percentage of Occurrence**
50-60	244	5.51
60-70	202	4.56
70-80	659	14.89
>80	3322	75.04
Total	4427	100

Table 12: Frequency Distribution of Met parameters (1st to 31st May 2019)

The histogram drawn for the parameters for the period (1st to 31st May 2019) is shown below:

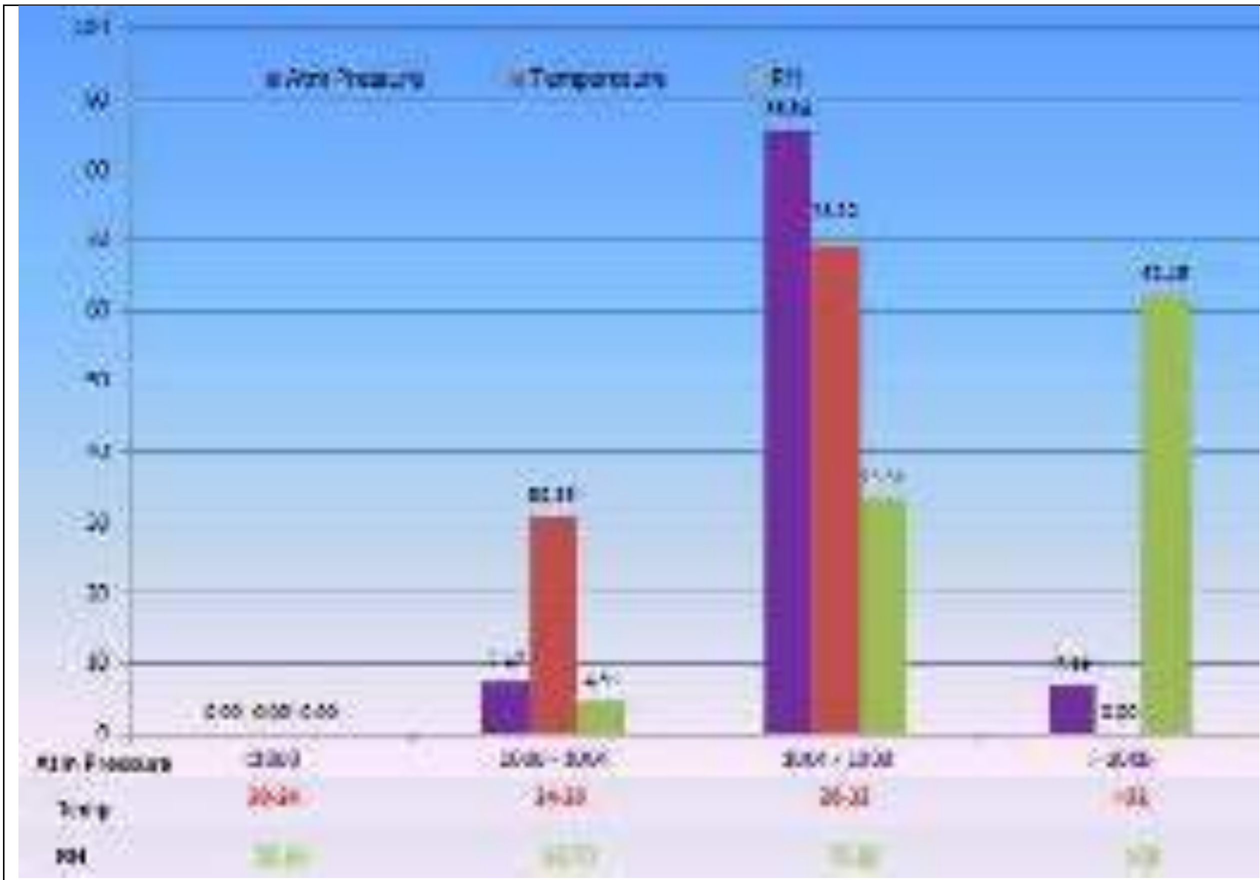


Figure 24 – Histogram of met parameters (1st to 31st May 2019)

The data represented above reveals that about 73% of the atmospheric pressure recorded for the month was above 1004 mb. The temperature hovered around 20 to 32°C during the month. The relative humidity was greater than 80% during observations indicating Pre-monsoonal conditions.

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

6.5 Littoral Environmental Observations

The LEO was carried out at 81 out of 81 locations. The LEO plate was deployed at the desired locations and the same was tracked for about five to ten minutes, as per the site conditions. The initial and final GPS positions were then used to calculate the SOG and COG. The estimated wave height, angle of wave, period and the stretch of breakers were also noted down in the log. The data sheets for all the locations are placed at Annexure IV.

The along shore current was mainly towards the North during the period of monitoring. The maximum speed of 41.53cm/s was observed at CSP-18. Rip currents were observed in the locations CSP 05, 06 and 41 .

6.6 Photographic Documentation

Photographic documentation was carried out for all the 81 locations, coinciding with the cross shore profiling. The photographs for the period are placed at Annexure V. As a common reference point, a 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.

6.7 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 wave breaker area, no data could be acquired and hence that area is shown in ‘dashed line’, in the enclosed AutoCAD/PDF charts.

The charts for the full period are placed in Annexure VI.

6.8 Turbidity Monitoring

Turbidity is the cloudiness or haziness of a fluid caused by suspended solids that are usually invisible to the naked eye. It is generally expressed as Nephelometric Turbidity Units (NTU).

*Nephele*isthe Greek word for "cloud" and *metric* means “measure. So, "Nephelometric, therefore, means "measuring cloudiness." All turbidity measurements detect the amount of light either transmitted through or scattered by the particles in a sample of water. Most nephelometers measure the scattered light at 90°(The light source and the detector are oriented at right angles to each other.) If more light is able to reach the detector it means that there are many small particles scattering the source beam. If less light reaches the detector it indicates less particles in the water, and hence less turbidity. The amount of light scattered is influenced by many aspects of the particles, like colour, shape, and reflectivity.

A summary of turbidity data (in NTU) recorded for the month of 01st to 31st May 2019 is given below:

Location	Surface			Mid Depth			Near Bottom		
	Max	Min	Median	Max	Min	Median	Max	Min	Median
Turbidity Buoy-1	3.9	0.0	0.9	5.0	0.4	1.6	7.0	1.1	3.1
Turbidity Buoy -2	4.0	0.0	0.7	5.0	0.1	2.5	7.0	1.3	3.9
Turbidity Buoy -3	5.5	0.0	1.2	6.0	0.4	2.9	8.9	1.2	4.7

Table 13: Summary of Turbidity values in NTU

For the period of 1st to 30th May 2019, the maximum turbidity value recorded at location 1 is 7 NTU (recorded at near-bottom), maximum turbidity recorded at location 2 is 7 NTU (recorded at near-bottom) and maximum turbidity recorded at location 3 is 8.7 NTU (recorded at near-bottom)

The entire time series curve from the three turbidity buoys are placed at Annexure VII.

6.9 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, during the three seasons. The samples were analysed at an NABL accredited laboratory in Kochi; (Standard Environmental & Analytical Laboratories, Accreditation and Approval: NABL as per ISO 17025:2005).

33 samples were collected from each location from 06th to 11th May 2019 and were analysed during May 2019 for turbidity, total suspended solids and salinity.

The maximum values obtained for each parameter – Turbidity in NTU, Total Suspended Sediments in mg/L and Salinity in parts per thousand, from each location are tabulated below:

Location	Surface			Mid Depth			Near Bottom		
	Turbidity	TSS	Salinity	Turbidity	TSS	Salinity	Turbidity	TSS	Salinity
L1 (Mulloor)	0.1	1	39.8	0.8	4.1	39.8	2.8	10.3	39.8
L2 (Proposed Dredge dumping)	0.6	3.8	39.8	3.1	12.4	39.8	1.0	5.1	39.8
L3 (Pachalloor)	2.8	10.0	39.8	1.8	8.6	38.9	5.8	22.4	39.8
L4 (Poovar)	1.7	7.2	39.8	2.1	10.40	39.8	1.8	8.8	39.8

Table 14: Summary of Turbidity, TSS and Salinity

As can be observed from the above table, the turbidity values were less than 5.8 NTU with total suspended solids less than 22.4 mg/litre except at Bottom L3 location. The maximum salinity of 39.8 ppt was observed at surface samples of Mullar.

The complete results are placed at Annexure VIII.

6.10 Beach Sampling

As part of the contract, the beach sediment were collected during May, 2019 period from the beach foreshore and analysed from the Standard Laboratory, Cochin for sediment grain size. There are total 72 samples collected out of (81) and the results are plotted in Annexure IX. The sediment grain size (D50) ranged between 0.01 to 0.4 mm (average of 0.22 mm).

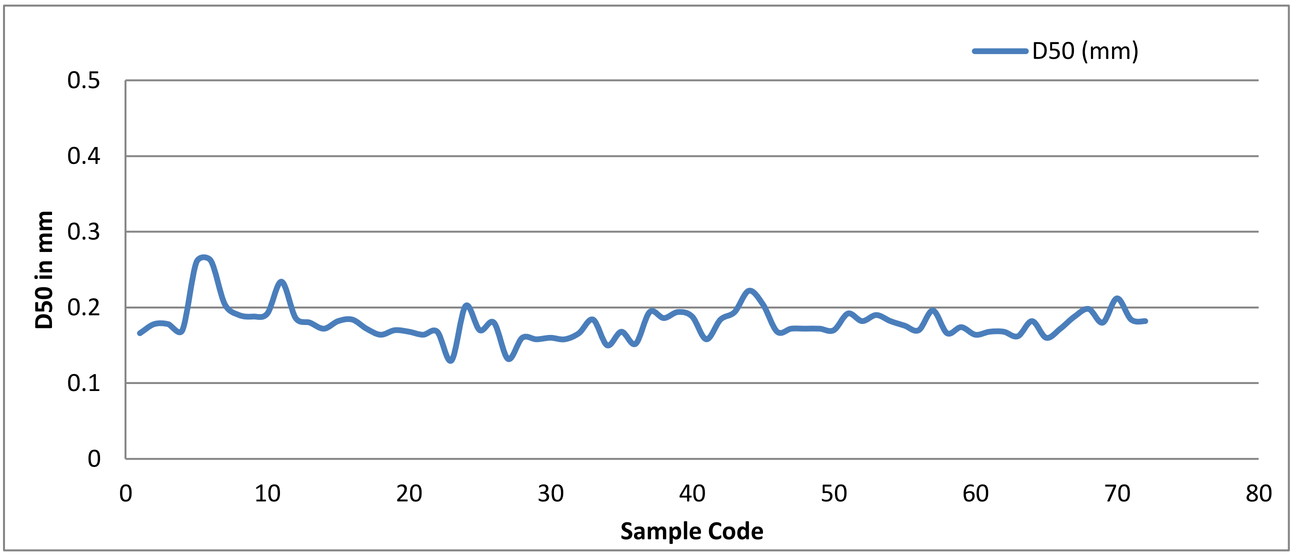


Figure 25– Sediment grain size distribution

6.11 Current Measurements

Acoustic Doppler Current Profilers (ADCP) were mobilised to measure the current speed and direction at the four locations. 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)	21.2	23rd April to 25th May2019	08° 21' 49"N	76° 58' 57"E	600 kHz
P2 (Poovar)	23.7	23rd April to 25th May2019	08° 17' 34"N	77° 04' 11"E	600 kHz
P3 (Pachalloor)	26.2	09th April to 25th May 2019	08° 24' 01"N	76° 56' 20"E	600 kHz
P4 (Mulloor)	23.5	23rd April to 25th May 2019	08° 21' 41"N	76° 59' 31"E	600 kHz

Table 15: ADCP Mooring Locations

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

6.11.1Location P1 (Vizhinjam)

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed on a seabed frame in an upward looking condition.

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

A maximum current of 0.819 m/s was measured at the water surface on 04th May 2019 at 22:50 hrs.

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

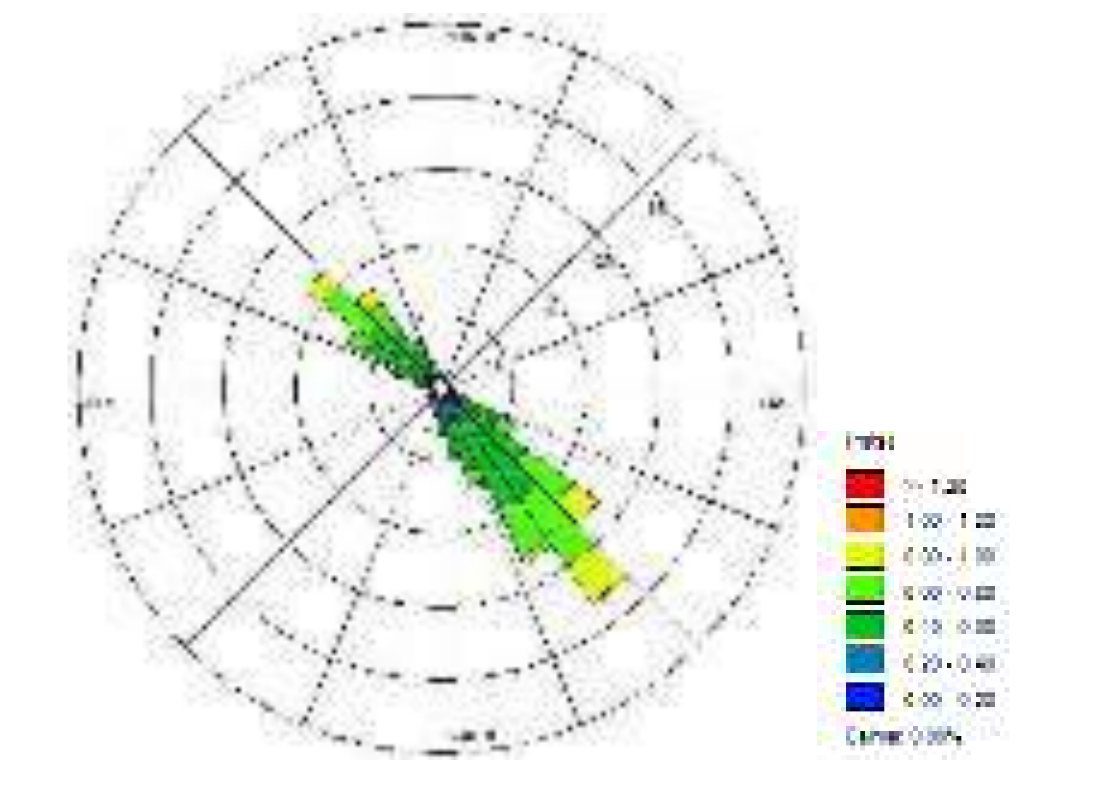


Figure 26 – Rose plot (Surface speed in m/s) – P1

The data reveals that the surface currents were parallel to the shore in the north-west south-east direction.

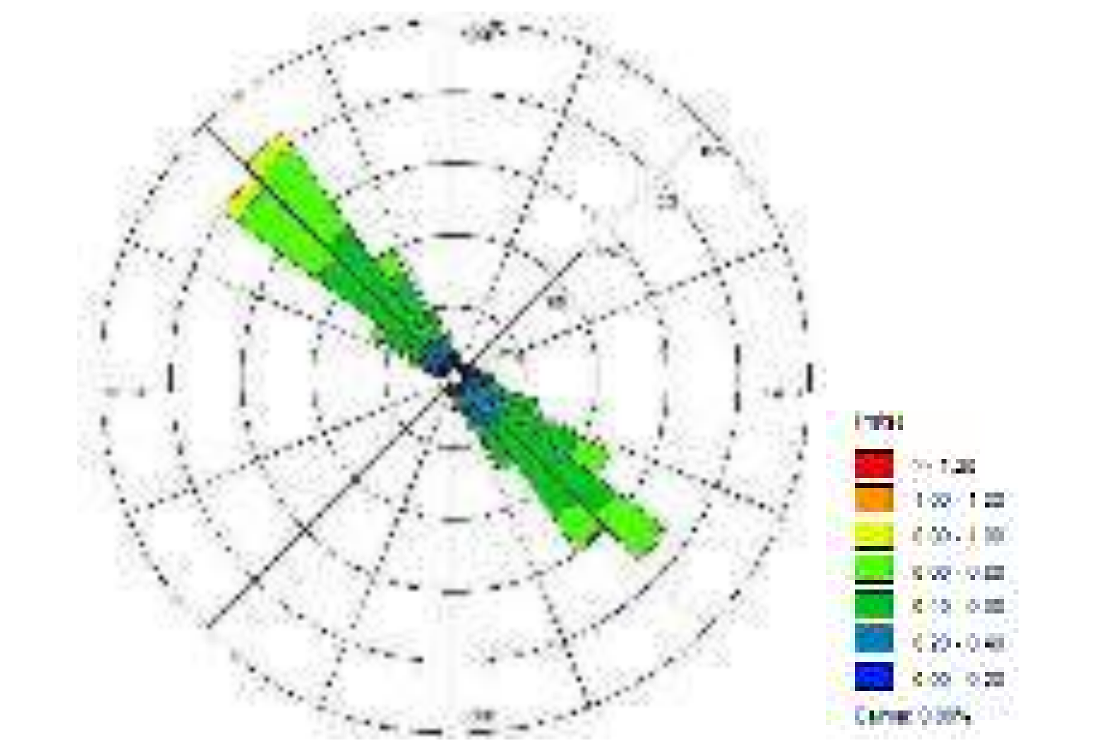


Figure 27 – Rose plot (Mid depth speed in m/s) – P1

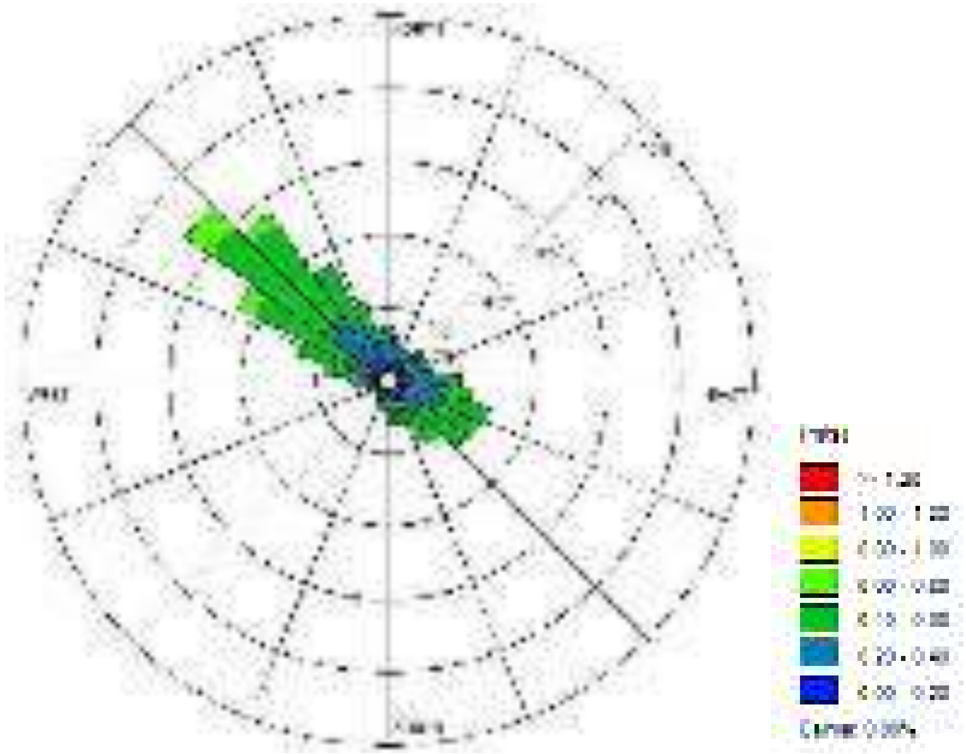


Figure 28 – Rose plot (Near Bottom speed in m/s) – P1

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	42.5	55.9	73.7
0.2 - 0.4	37.3	32.7	24.9
0.4 - 0.6	16.4	11.0	1.4
0.6 - 0.8	3.8	0.4	0.0
0.8 - 1.0	0.0	0.0	0.0
1.0 - 1.2	0.0	0.0	0.0
> 1.2	0.0	0.0	0.0
Total	100.0	100.0	100.0

Table 16: Frequency Distribution of current speed - P1

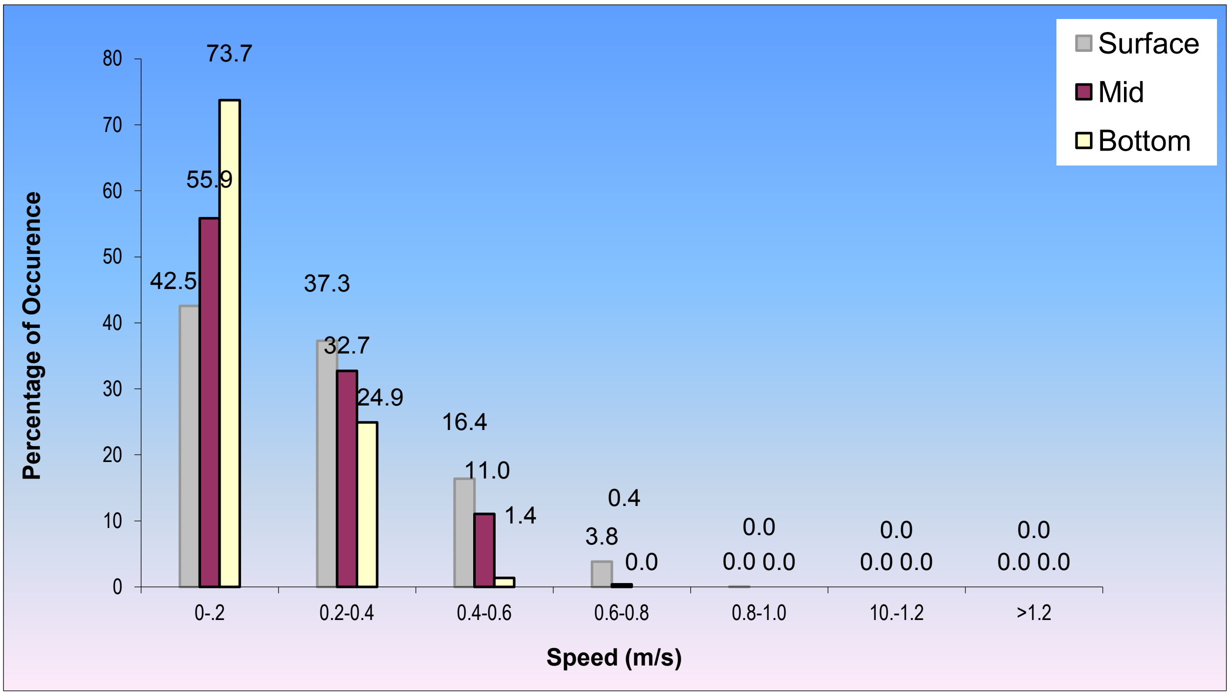


Figure 29 – Frequency Distribution of current speed – P1

Frequency Distribution			
Speed (m/s)	**% of Surface**	**% of Mid**	**% of Bottom**
0.0	100	100	100
0.2	57.46	44.15	26.27
0.4	20.19	11.41	1.36
0.6	3.83	0.39	0.00
0.8	0.02	0.00	0.00
1.0	0.00	0.00	0.00
1.2	0.00	0.00	0.00

Table 17: Percentage of Exceedance of current speed – P1

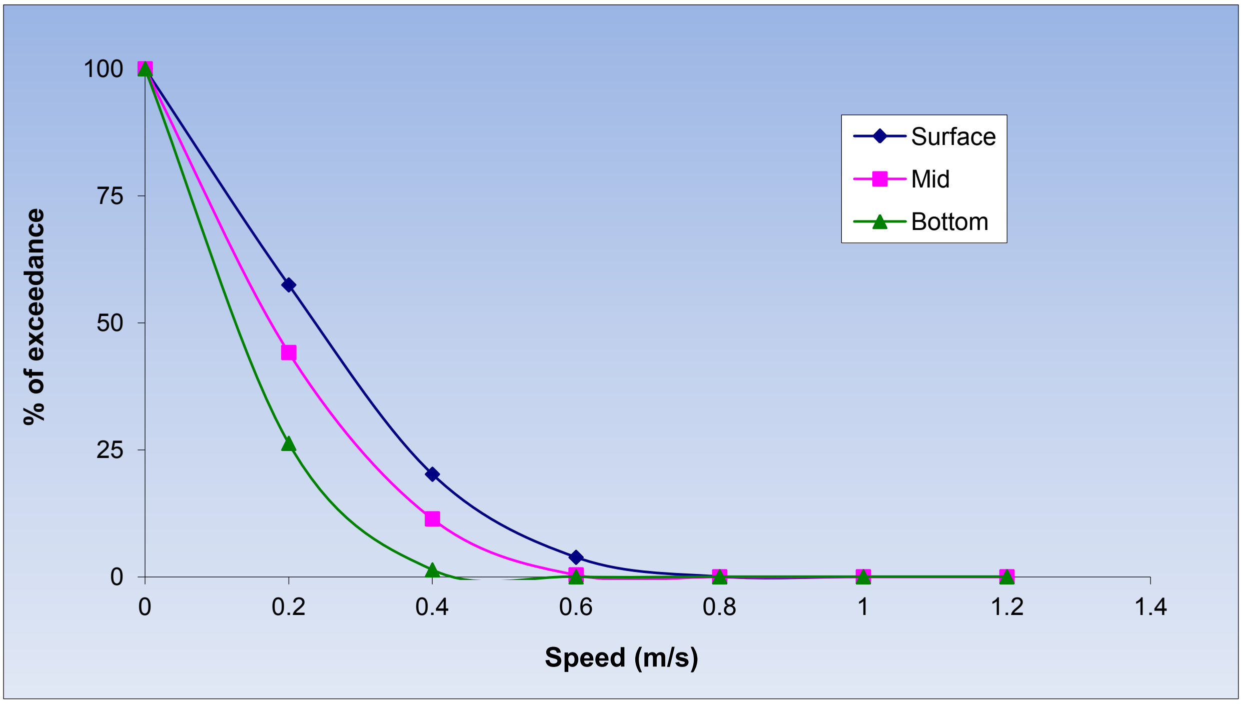


Figure 30 – Frequency Distribution of current speed – P1

The exceedance curve reveals that the surface current speed was mainly in the range of 0 to 0.8 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, 5 and 9 respectively).

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

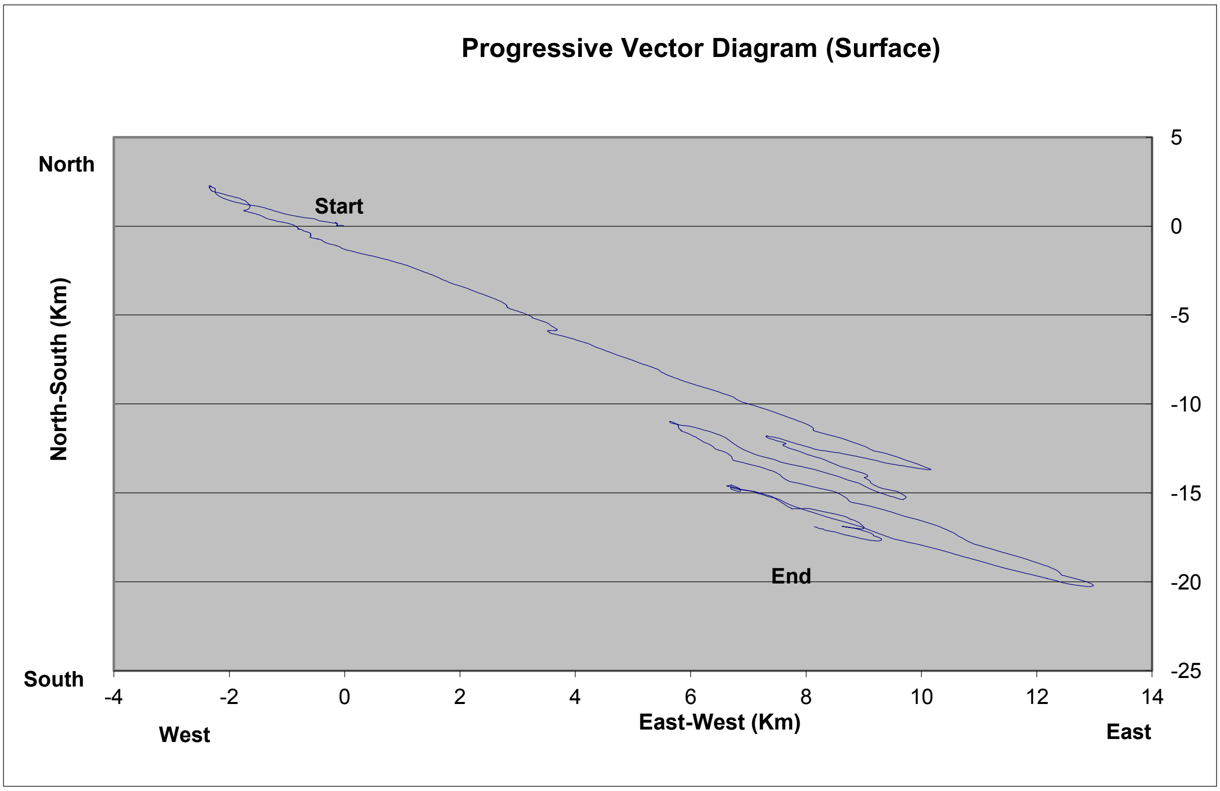


Figure 31 – Progressive Vector Diagram – P1

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. From the data collected it can be observed that, the water parcel was having an oscillatory motion and was travelling for about 15 km towards north-west and 30 km towards south-east.

6.11.2 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 deployment period was from 23th April to 25th May 2019.

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

A maximum current of 0.908 m/s was measured at the water surface on 18th May 2019 at 04:50 hrs.

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

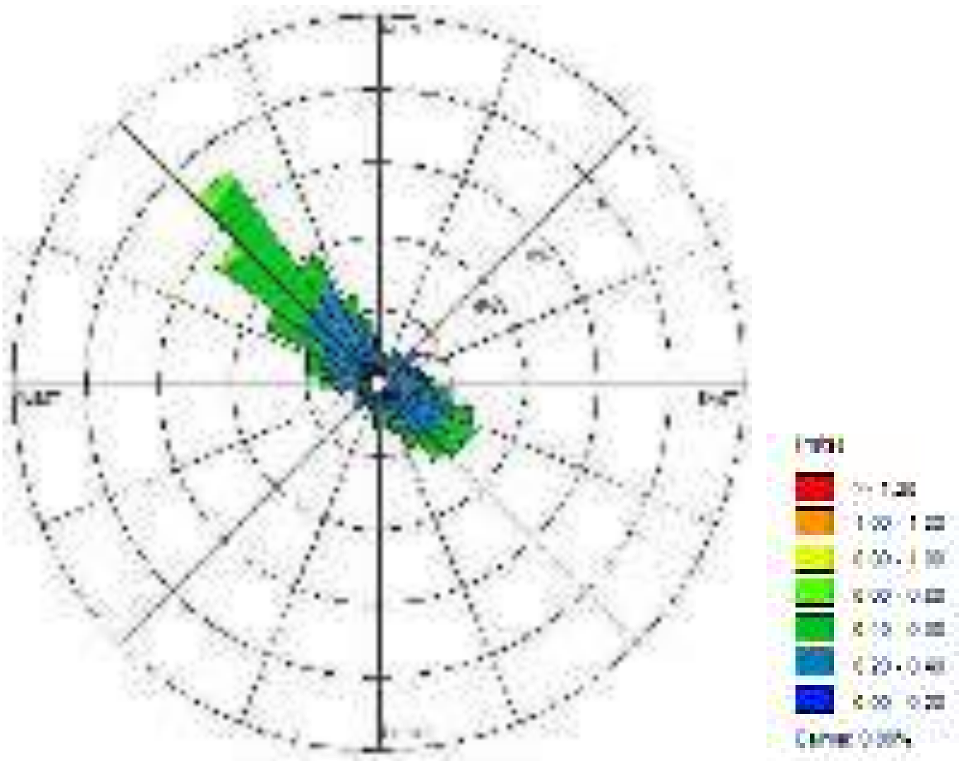


Figure 32 – Rose plot (Surface speed in m/s) – P2

The currents were parallel to the shore with strong currents towards south-east than north-west direction.

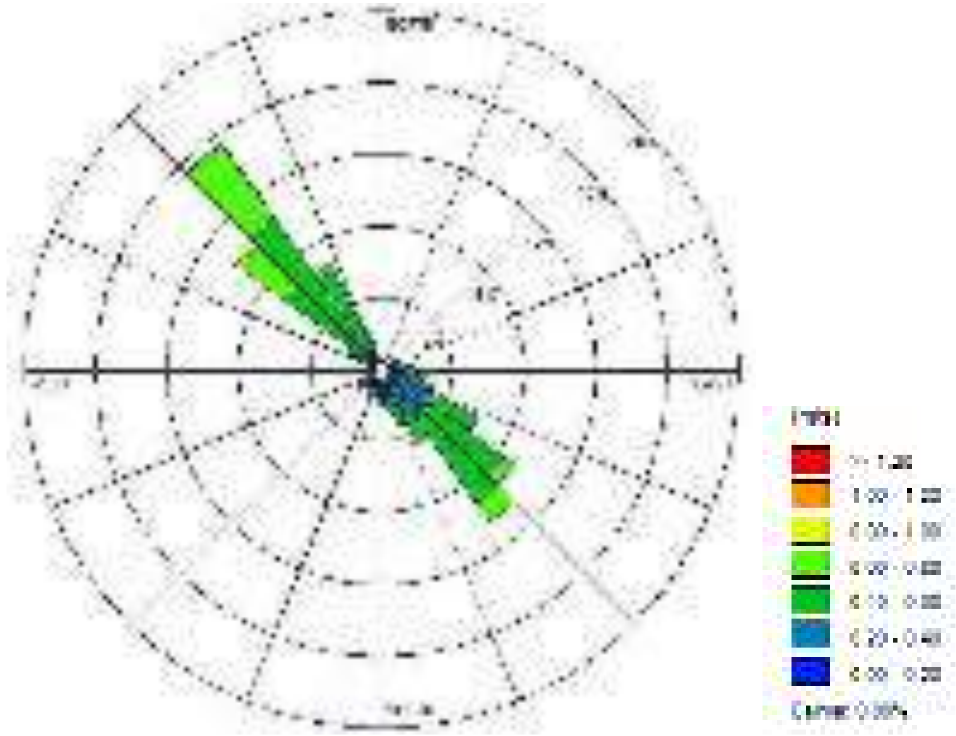


Figure 33 – Rose plot (Mid Depth speed in m/s) – P2

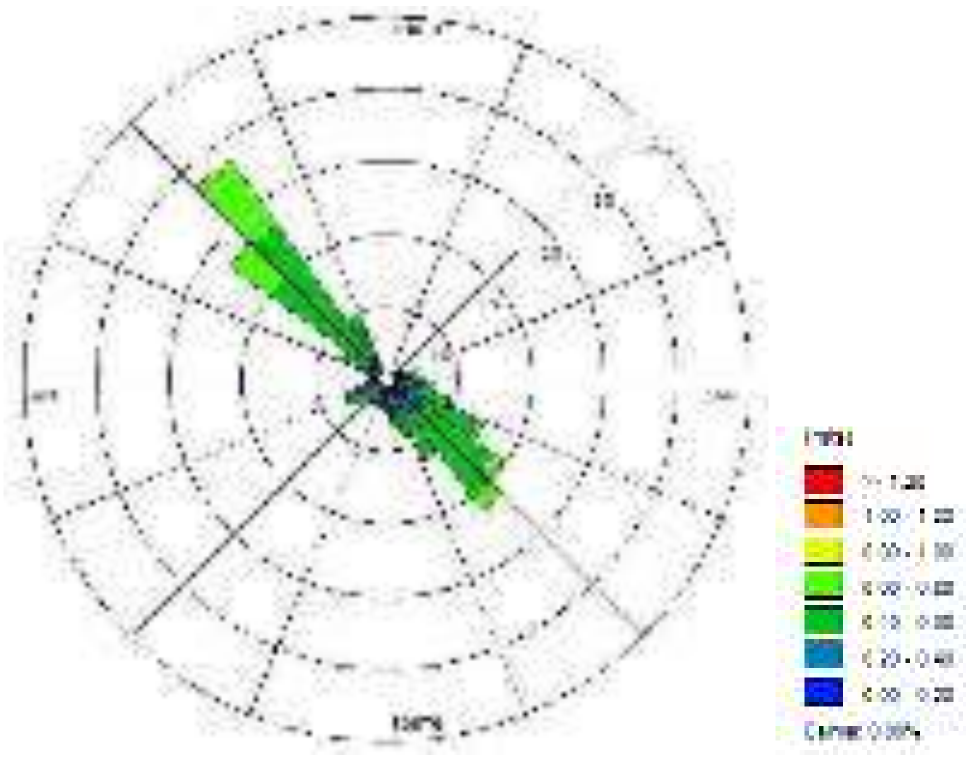


Figure 34 – Rose plot (Near Bottom speed in m/s) – P2

The bottom currents were lesser compared to the surface currents.

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	39.9	49.4	56.5
0.2 - 0.4	36.3	34.4	36.1
0.4 - 0.6	17.7	13.5	7.3
0.6 - 0.8	5.5	2.6	0.2
0.8 - 1.0	0.6	0.0	0.0
1.0 - 1.2	0.0	0.0	0.0
> 1.2	0.0	0.0	0.0
Total	100.0	100.0	100.0

Table 18: Frequency Distribution of current speed – P2

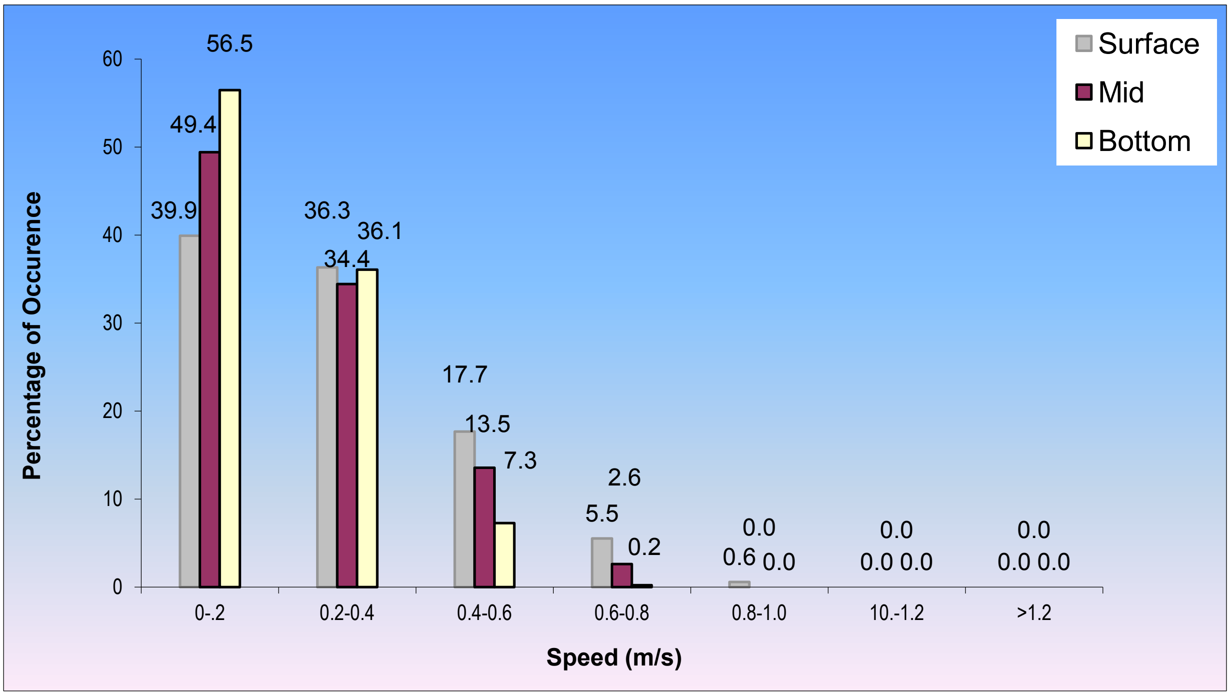


Figure 35 – Frequency Distribution of current speed – P2

Frequency Distribution			
Speed (m/s)	% of Surface	% of Mid	% of Bottom
0.0	100	100	100
0.2	60.08	50.58	43.54
0.4	23.76	16.16	7.46
0.6	6.08	2.62	0.20
0.8	0.56	0.00	0.00
1.0	0.00	0.00	0.00
1.2	0.00	0.00	0.00

Table 19: Percentage of Exceedance of current speed – P2

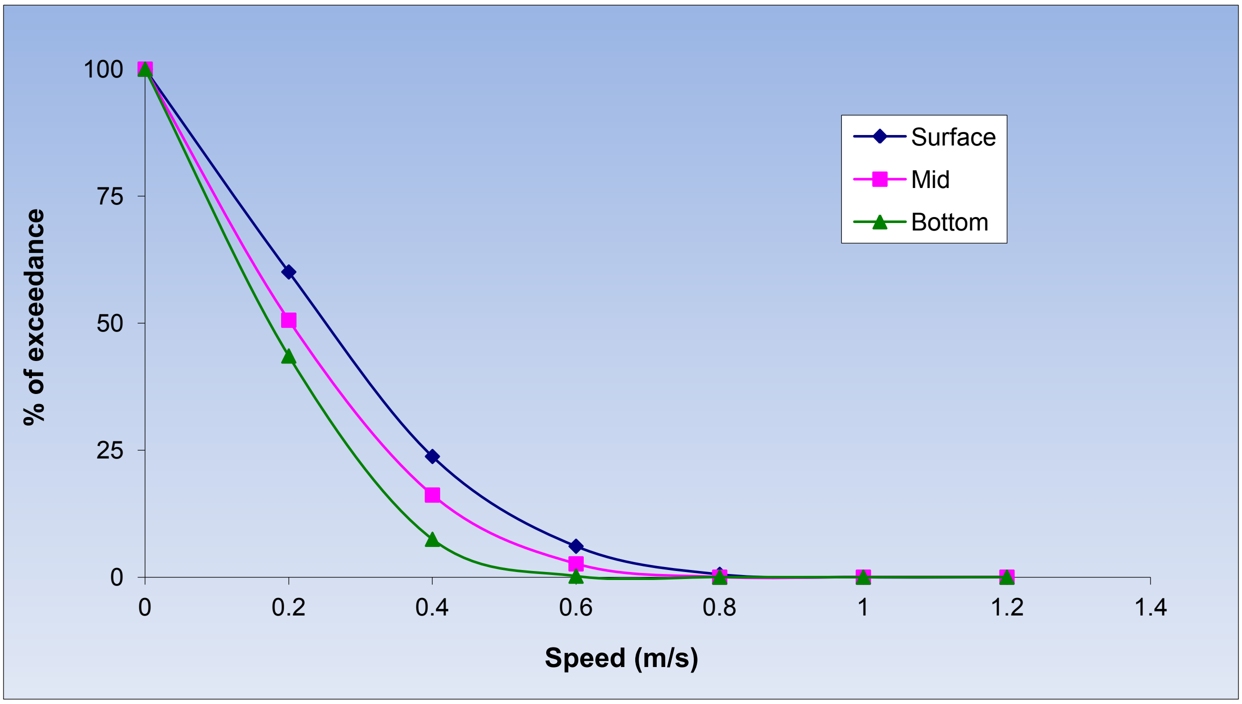


Figure 36 – Exceedance Curve of current speed – P2

The exceedance curve reveals that the surface speed exceeded 0.8 m/s about 2.5% of the observation period.

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

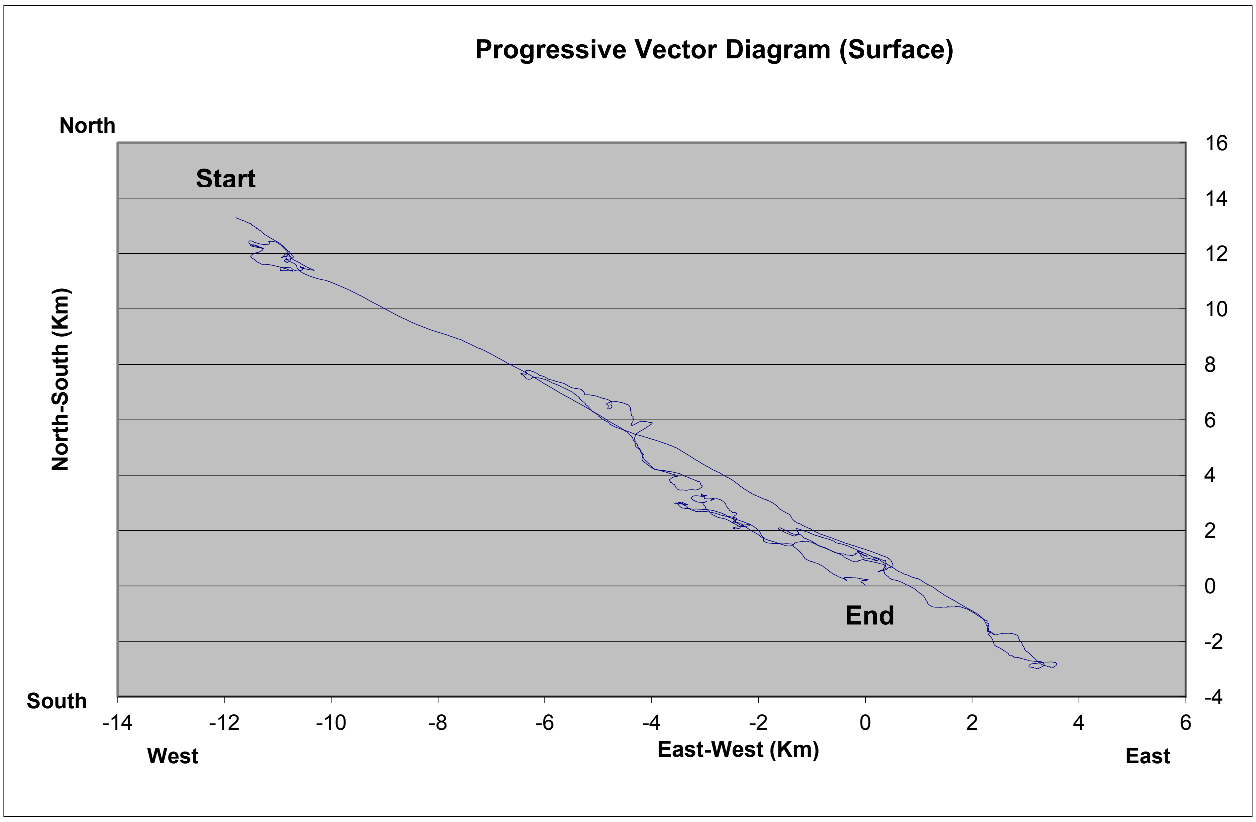


Figure 37 – Progressive Vector Diagram – P2

The above figure reveals a similar trend observed at location P1. The water movement was travelling towards north-west and to south-east during the one lunar cycle.

6.11.3 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. The deployment period was from 09th April to 25th May 2019.

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

A maximum speed of 0.810 m/s was observed on 20th May 2019 at 05:00 hrs.

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

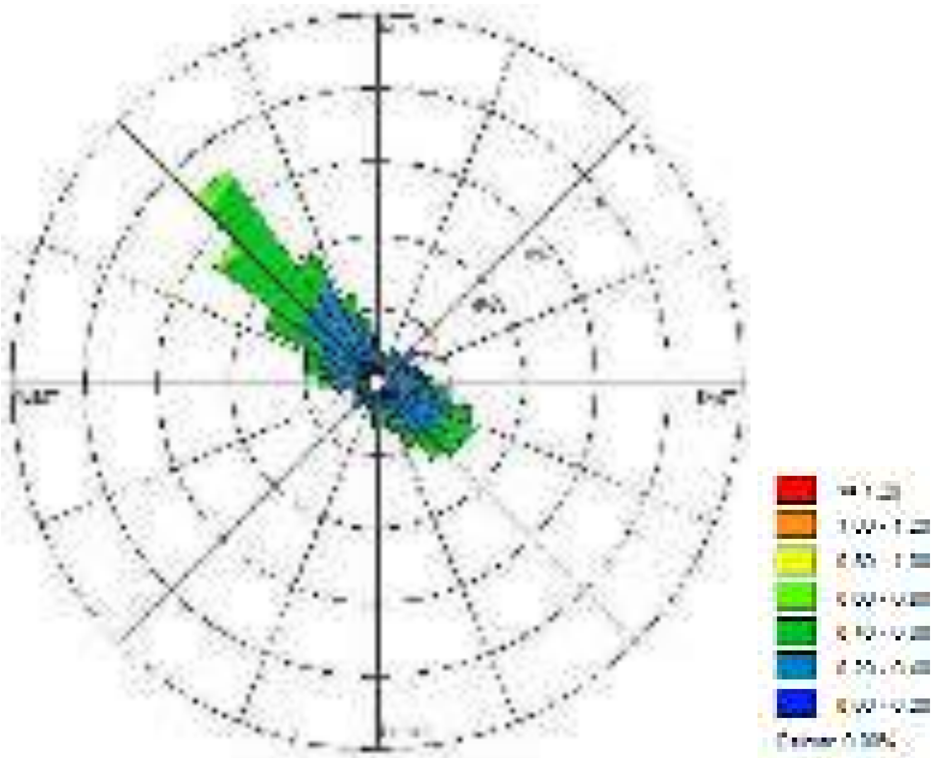


Figure 38 – Rose plot (Near Surface speed in m/s) – P3

The surface currents followed a similar pattern as previous locations, with currents parallel to the shore.

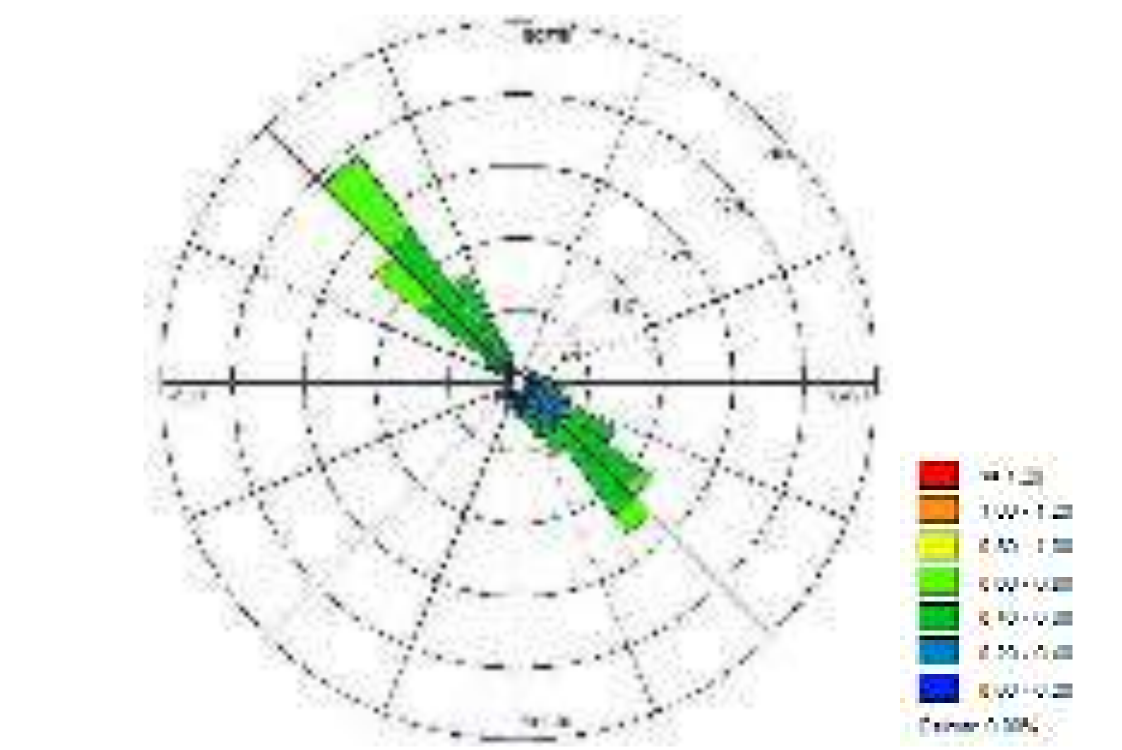


Figure 39 – Rose plot (Mid depth speed in m/s) – P3

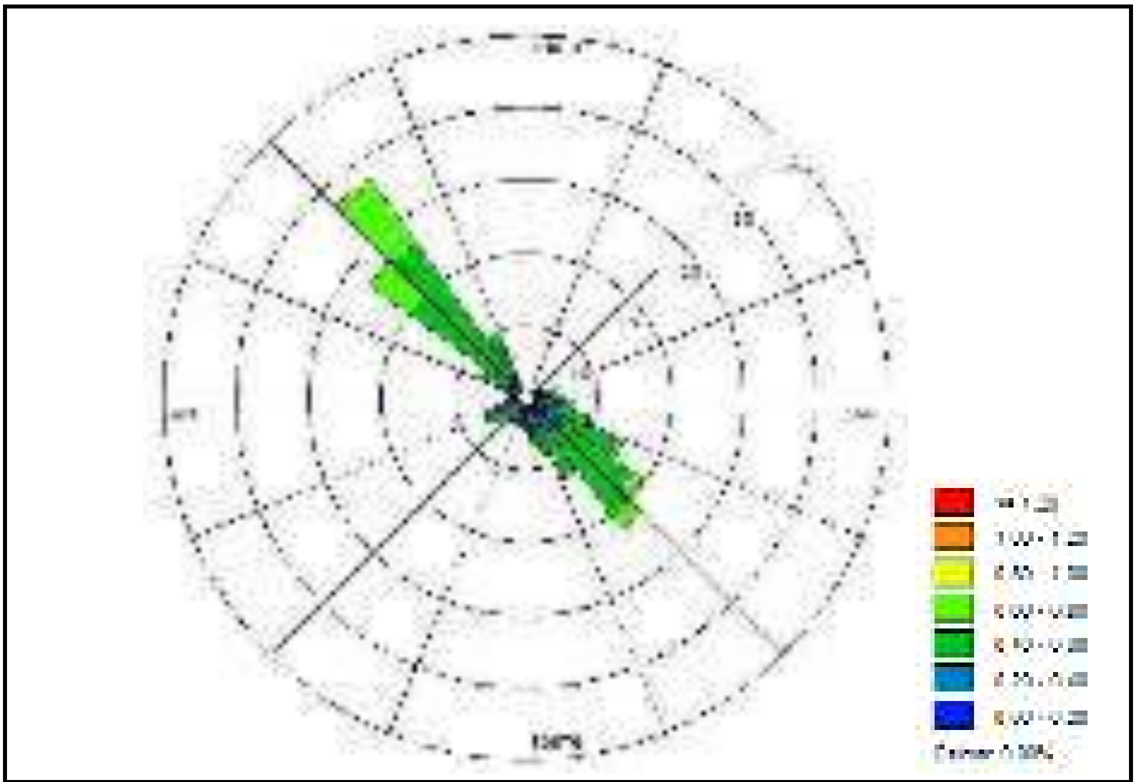


Figure 40 – Rose plot (Near Bottom speed in m/s) – P3

The data reveals a north-westerly flow near to seabed up to 0.65m/s.

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

Frequency Distribution (%)			
Speed (cm/s)	Surface	Mid	Bottom
0 - 0.2	31.4	41.4	49.5
0.2 - 0.4	40.2	36.8	39.2
0.4 - 0.6	22.6	17.8	9.1
0.6 - 0.8	5.6	4.0	2.2
0.8 - 1.0	0.1	0.0	0.0
1.0 - 1.2	0.0	0.0	0.0
> 1.2	0.0	0.0	0.0
Total	100.0	100.0	100.0

Table 20: Frequency Distribution of current speed - P3

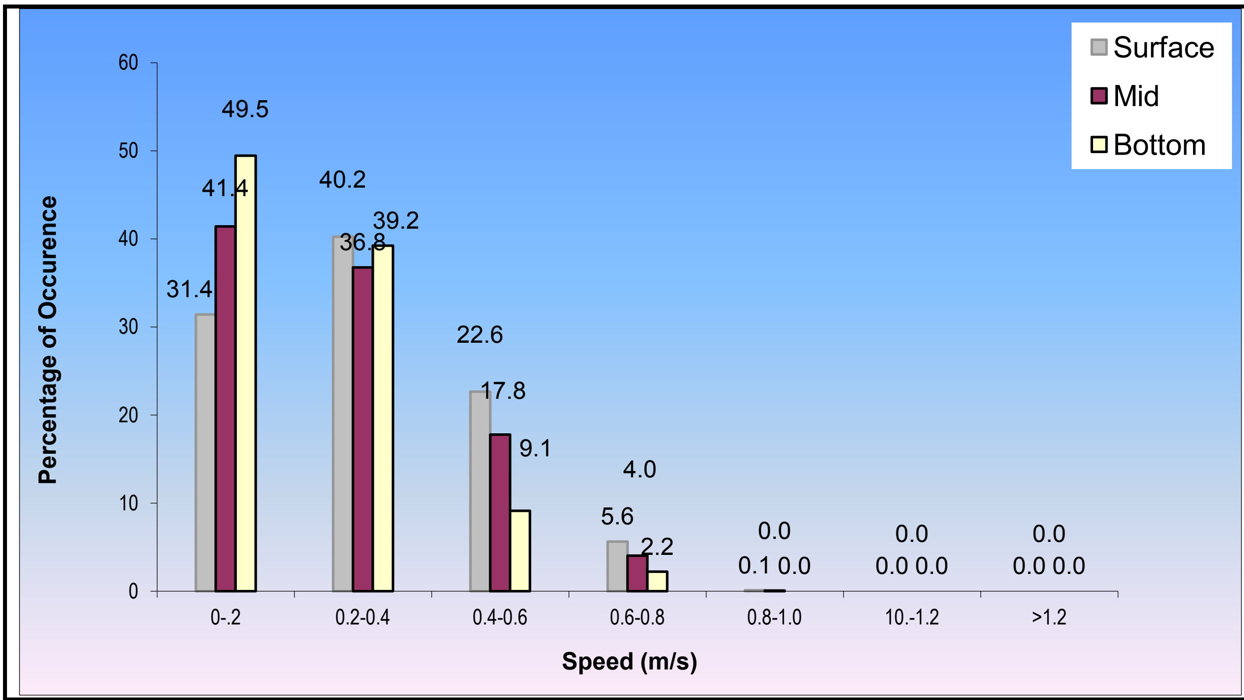


Figure 41 – Histogram of current speed – P3

Frequency Distribution			
Speed (m/s)	% of Surface	% of Mid	% of Bottom
0	100	100	100
0.2	68.58	58.58	50.55
0.4	28.36	21.83	11.32
0.6	5.71	4.06	2.19
0.8	0.09	0.05	0.00
1.0	0.00	0.00	0.00
1.2	0.00	0.00	0.00

Table 21: Percentage of Exceedance – P3

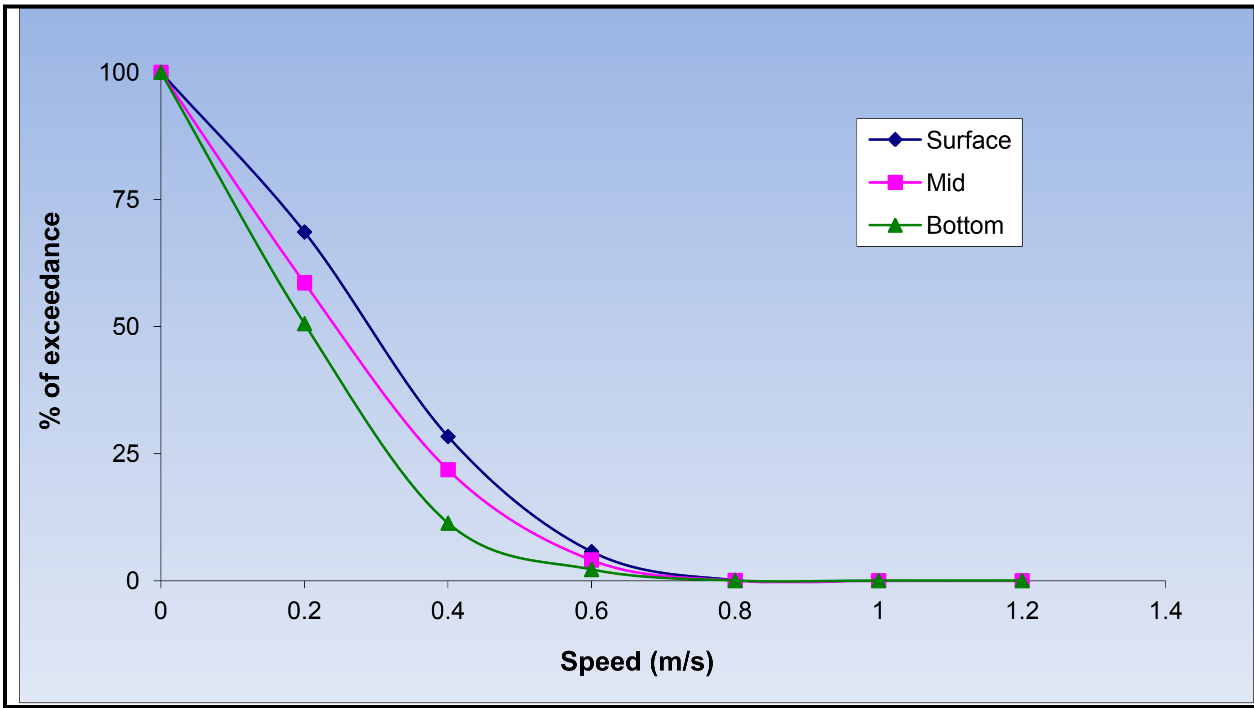


Figure 42 – Exceedance Curve – P3

The data reveals that about 6.5% of the observations, surface current speed exceeded 0.8 m/s.

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

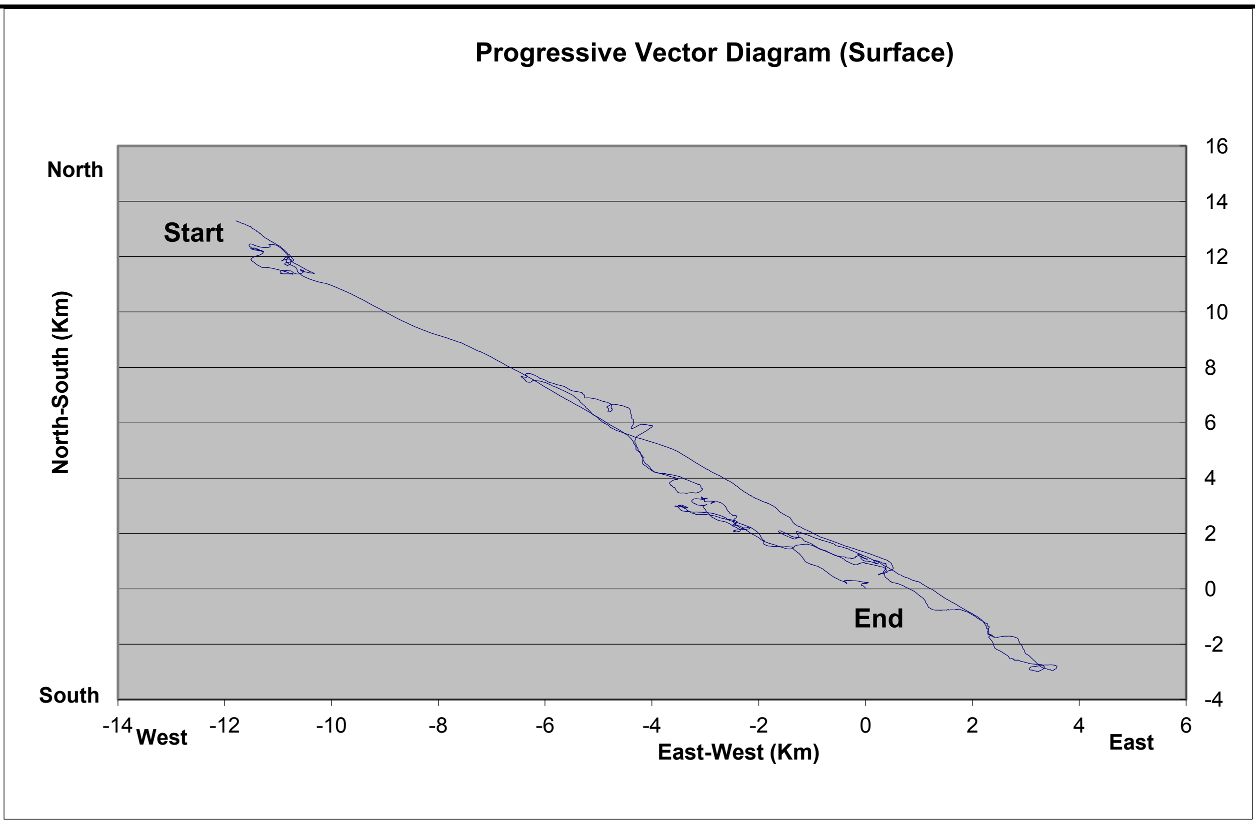


Figure 43 – Progressive Vector Diagram – P3

The above PVD shows the water parcel moving to north-west to a distance of about 10 km and to south-east to a distance of 28 Km as observed in other locations, during one lunar cycle.

6.11.4 Location P4 (Mulloor)

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed on a seabed frame in an upward looking mode from 23rd April to 25th May 2019.

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

A maximum speed of 0.739 m/s was observed on 05th May 2019 at 00:00 hours.

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

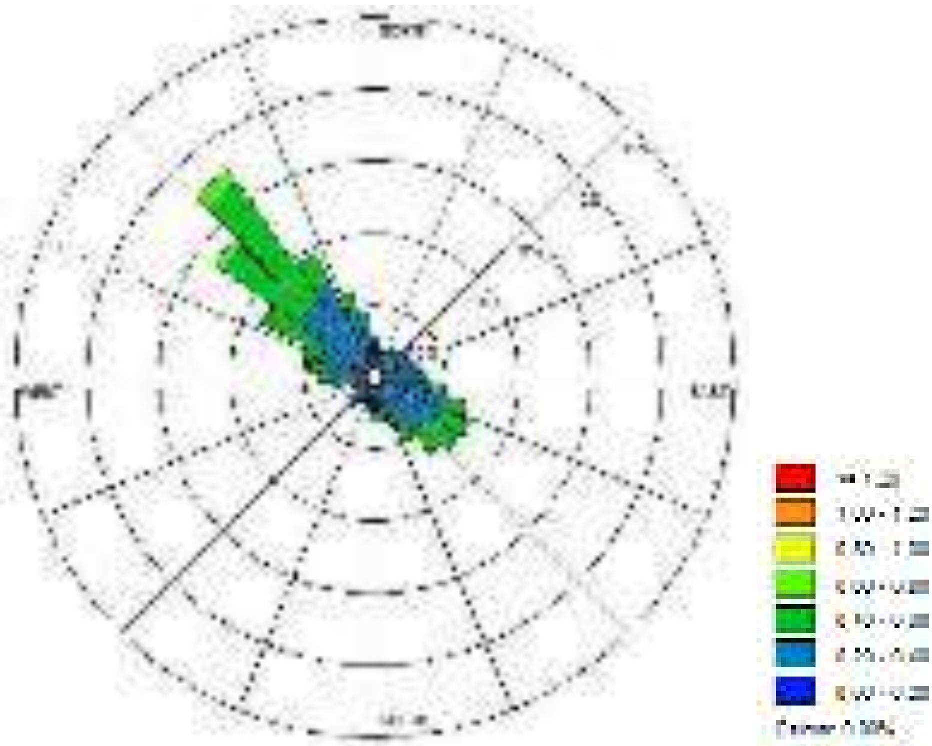


Figure 44 – Rose plot (Surface speed in m/s) – P4

The surface currents were parallel to the shore and were flowing in the north-west south-east directions.

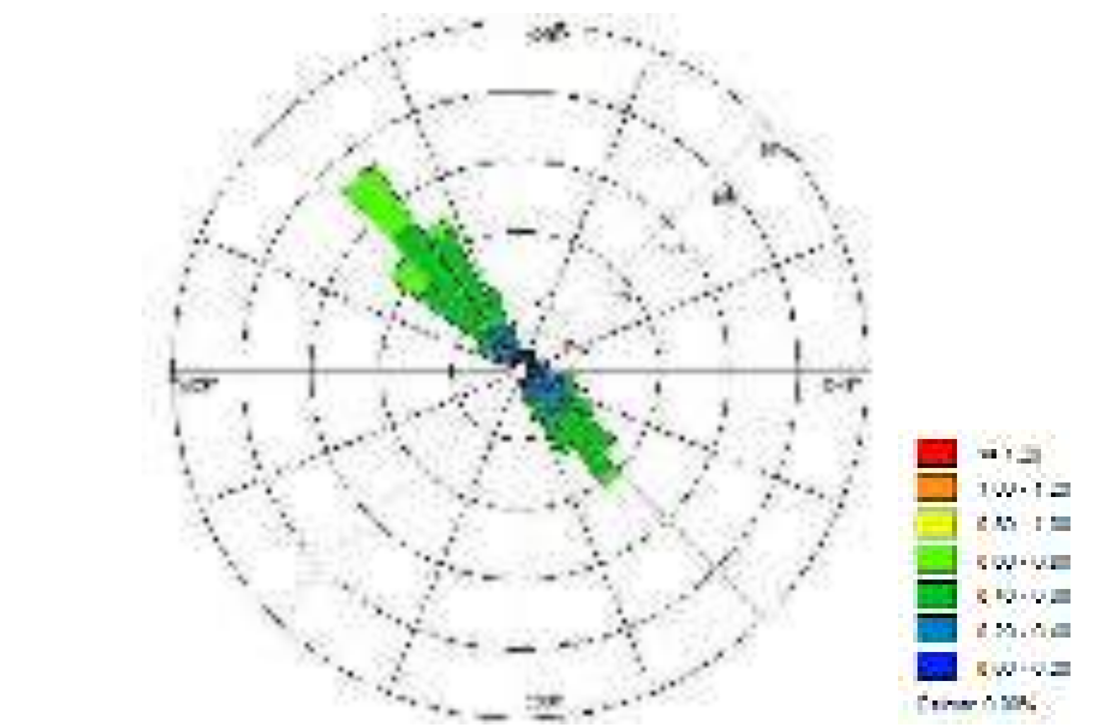


Figure 45 – Rose plot (Mid Depth speed in m/s) – P4

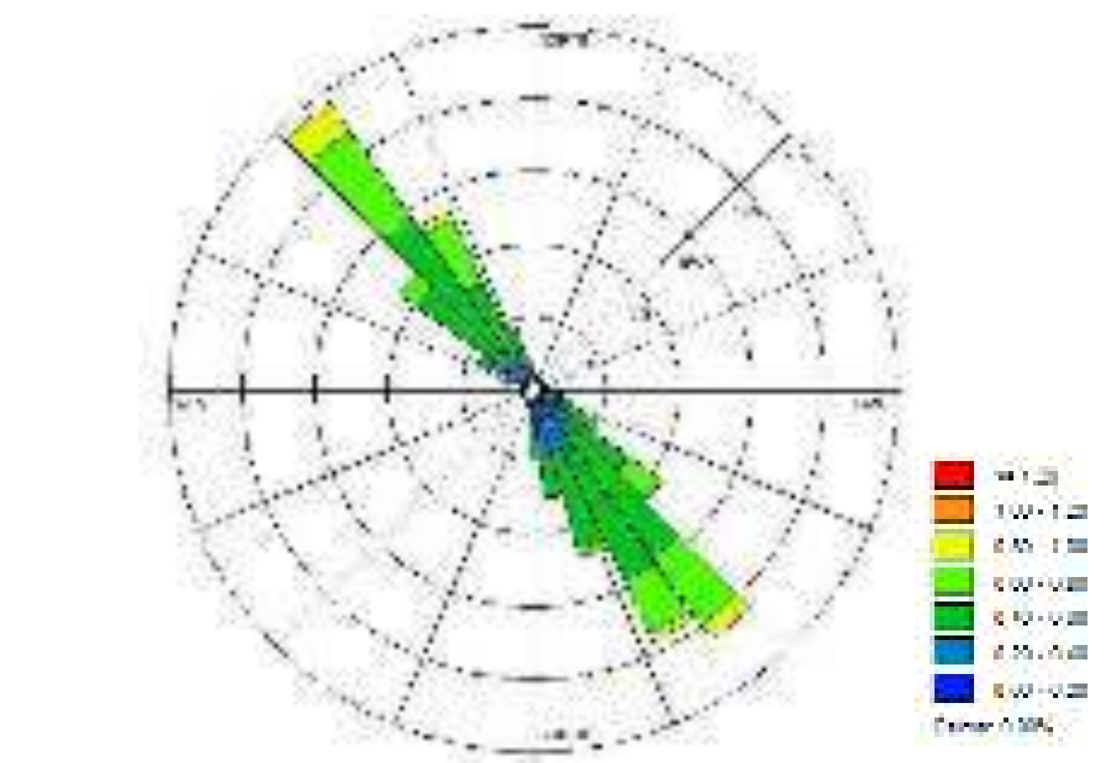


Figure 46 – Rose plot (Near Bottom speed in m/s) – P4

The currents observed at Mulloor also show the same trend as all the previous locations, except for the bottom currents which are spread out may be due to the local topography.

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	85.9	66.7	51.9
0.2 - 0.4	13.4	29.1	34.0
0.4 - 0.6	0.7	4.2	12.6
0.6 - 0.8	0.0	0.0	1.6
0.8 - 1.0	0.0	0.0	0.0
1.0 - 1.2	0.0	0.0	0.0
> 1.2	0.0	0.0	0.0
Total	100.0	100.0	100.0

Table 22: Frequency Distribution of current speed – P4

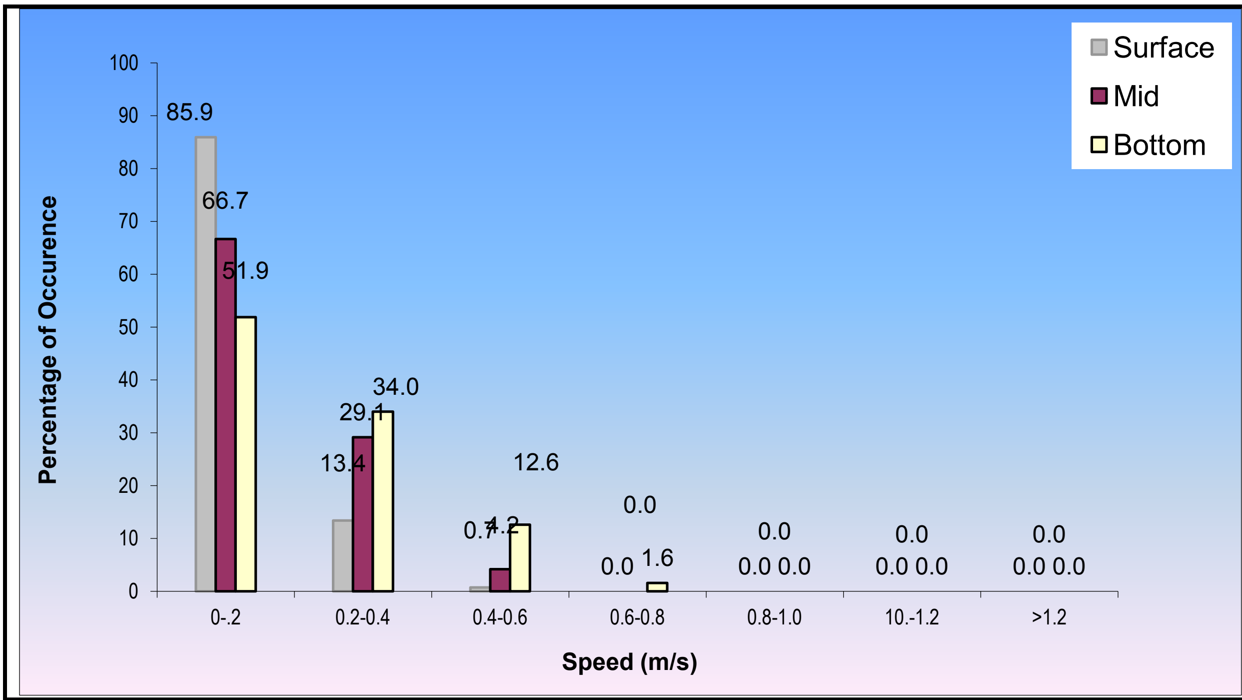


Figure 47 – Histogram of current speed – P4

Frequency Distribution			
Speed (m/s)	% of Surface	% of Mid	% of Bottom
0.0	100	100	100
0.2	14.10	33.33	48.13
0.4	0.71	4.20	14.14
0.6	0.00	0.00	1.55
0.8	0.00	0.00	0.00
1.0	0.00	0.00	0.00
1.2	0.00	0.00	0.00

Table 23: Percentage of Exceedance – P4

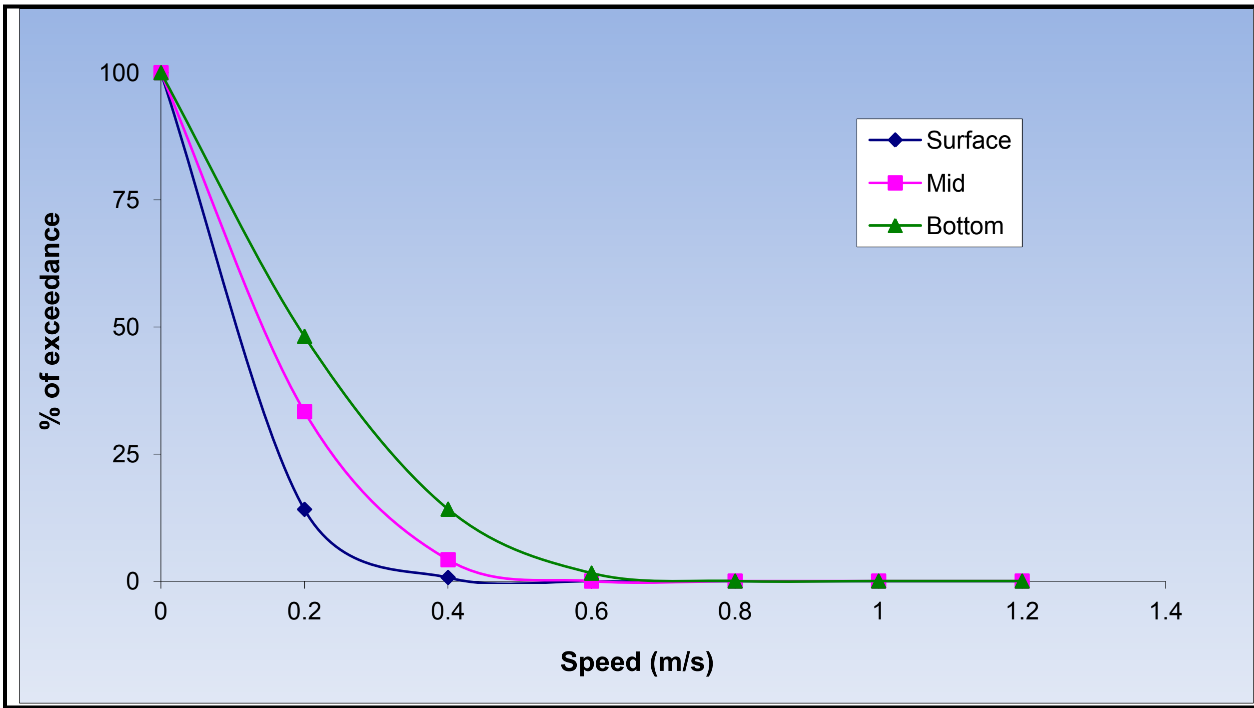


Figure 48 – Exceedance Curve – P4

The surface speed was more than 0.6m/s, about 2.2% of the observation period.

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

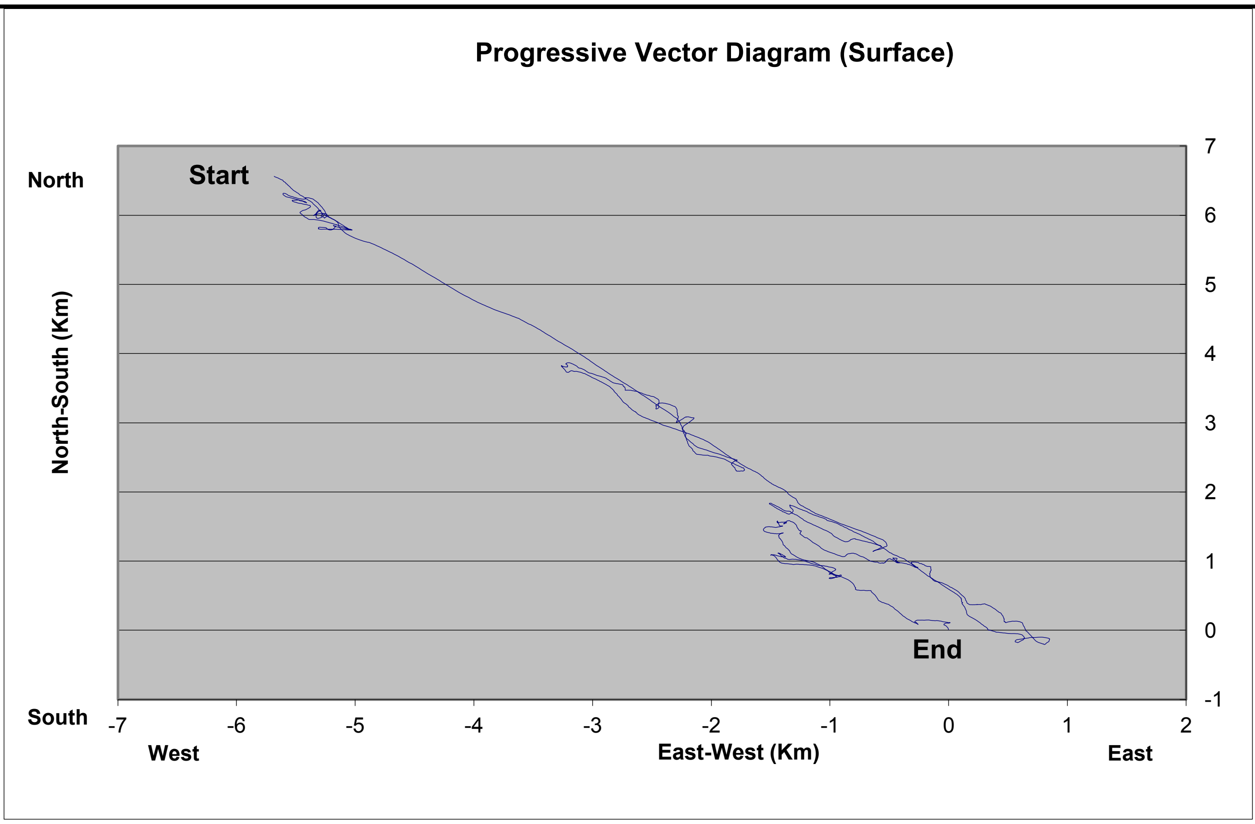


Figure 49 – Progressive Vector Diagram – P4

The above PVD shows the parcel moving towards north-west and to south-east as was observed in all the locations, during the lunar cycle.

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

7. WEATHER

During the month of May 2019, the Pre monsoon was active in the entire Kerala state, mostly calm except long swells that hamper survey for few days.

8. CONCLUSIONS

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

1. Tide was semi diurnal with a maximum range of 1.058m during spring tide.
2. The significant wave heights ranged between 1-2 m recorded from SW directions. During same period the predominant winds of 4-8 m/s observed mostly from north-easterly directions.
3. The long-shore transport was recorded in a Northerly direction, with maximum velocity of about 41.53 cm/s recorded at CSP-18.
4. The cross-shore profiling indicates erosion of beach in some locations.
5. The maximum turbidity value recorded at location 1 is 7 NTU, at location 2 is 7 NTU and at location 3 is 8.7 NTU; all observed near seabed.
6. Salinity was in the range of 35.4-39.8 ppt in May 2019 in all the locations.
7. The total suspended solids were in the range of 1.0–22.4mg/L in June 2019 in all the locations.

8. The beach samples collected were fine to medium sand.
9. The currents observed were in the order of 0.908 m/s and were following parallel to the shore.

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 from February 2016 to April 2019, OSaS/P21716/AVPPL/PSR-1(to PSR-38)/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)

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.

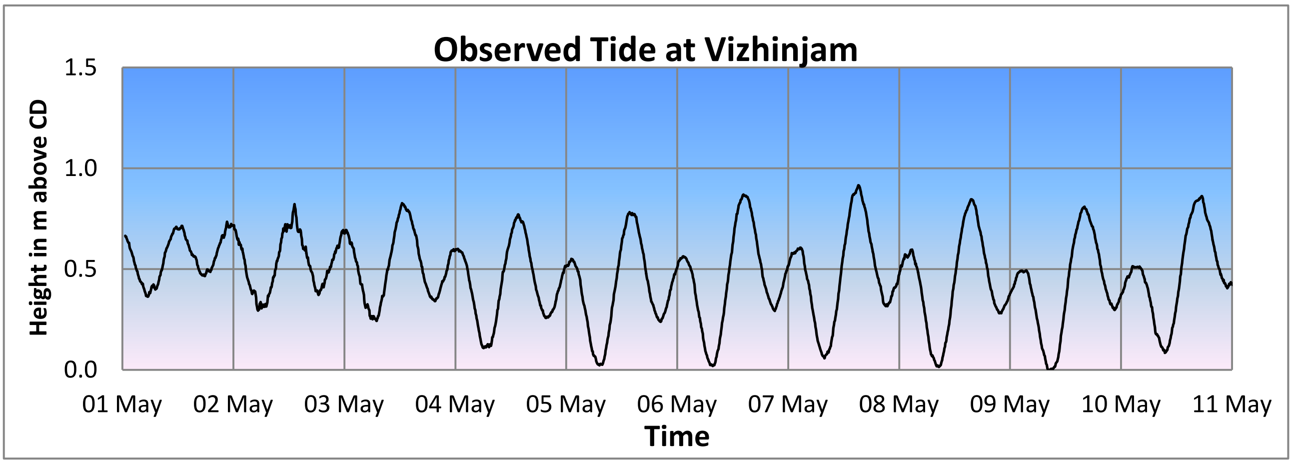
The scientists/technicians from NIOT are also acknowledged for their support and guidance during the course of the project.

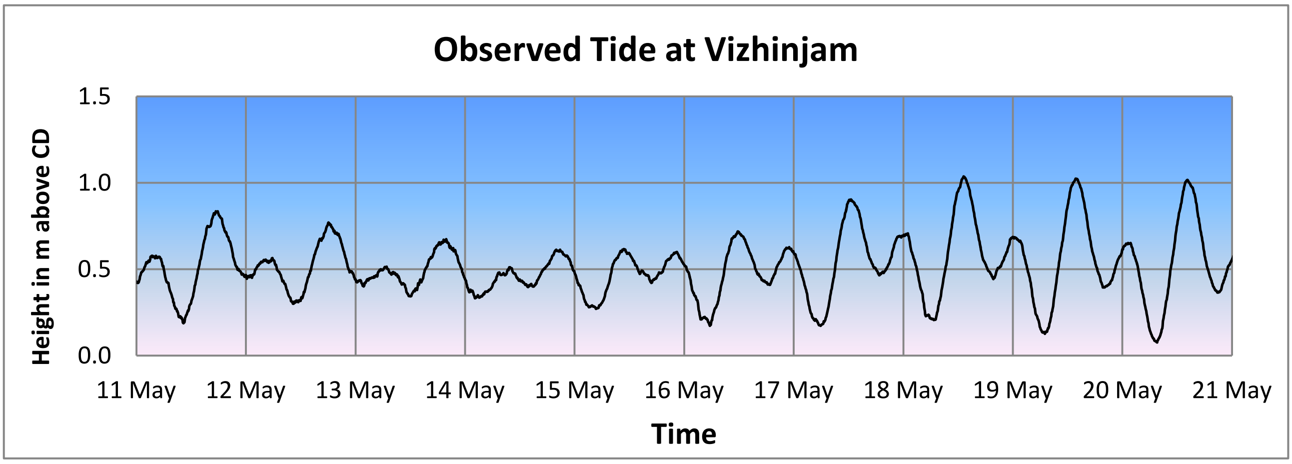
The crew of the boat and all local support obtained during the observation are also acknowledged.

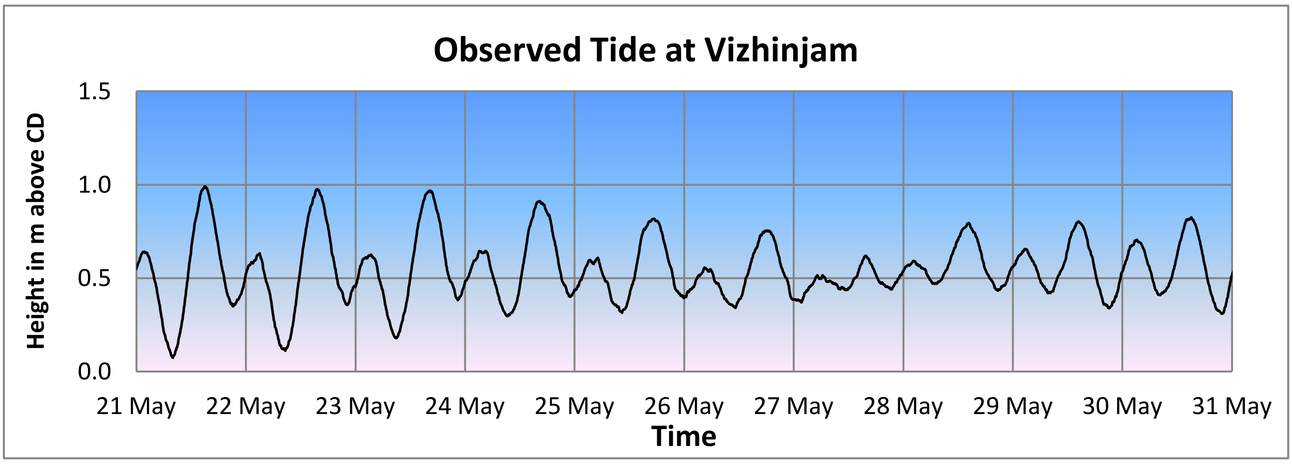
Weather forecast during the period was regularly observed at INCOIS and India Meteorological Department's web site.

Annexure I

Tide Curves

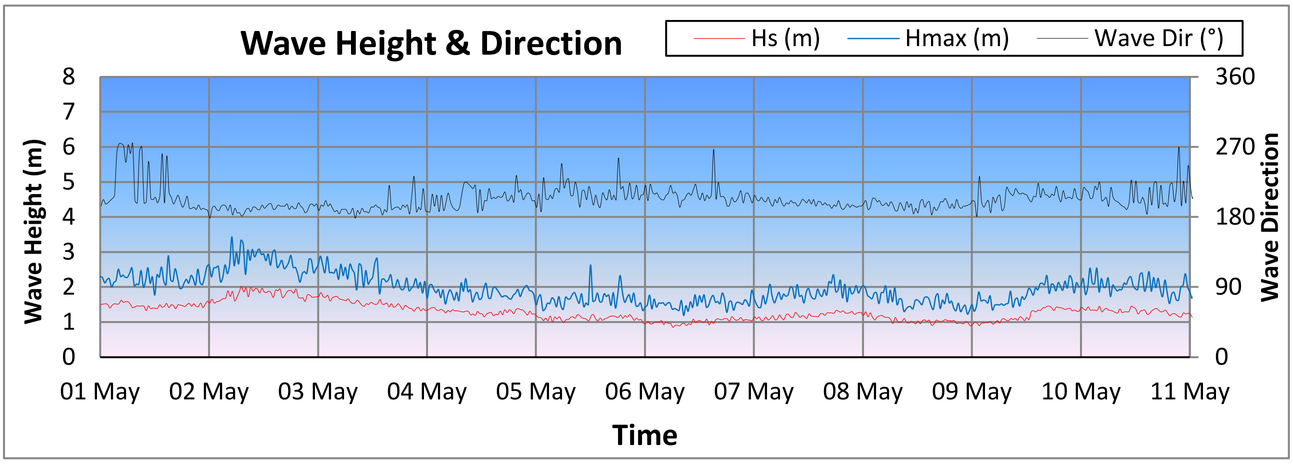

Observed Tide at Vizhinjam
Height in m above CD
1.5
1.0
0.5
0.0
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
11 May
Time

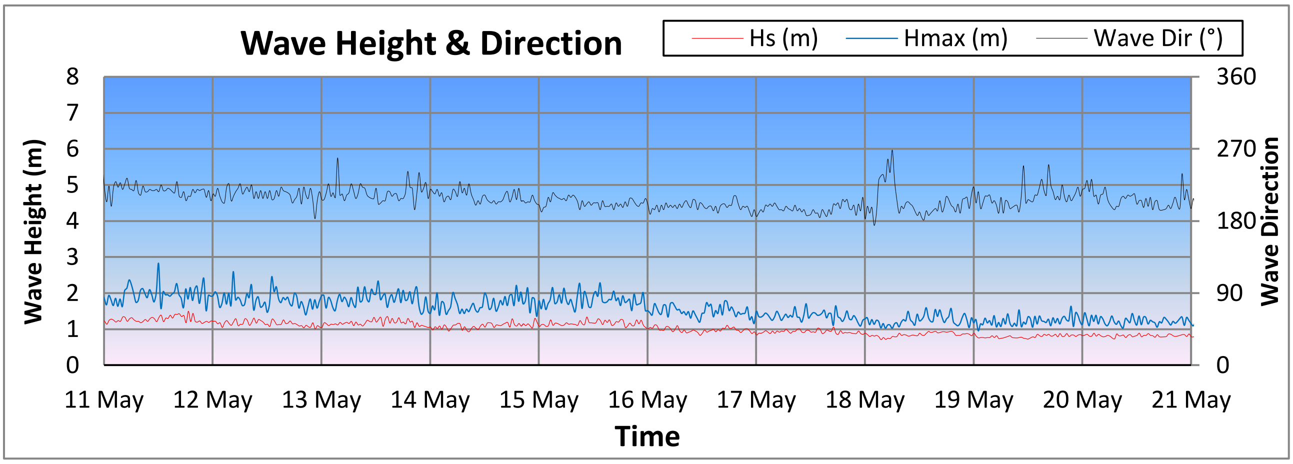

Observed Tide at Vizhinjam
Height in m above CD
1.5
1.0
0.5
0.0
11 May
12 May
13 May
14 May
15 May
16 May
17 May
18 May
19 May
20 May
21 May
Time

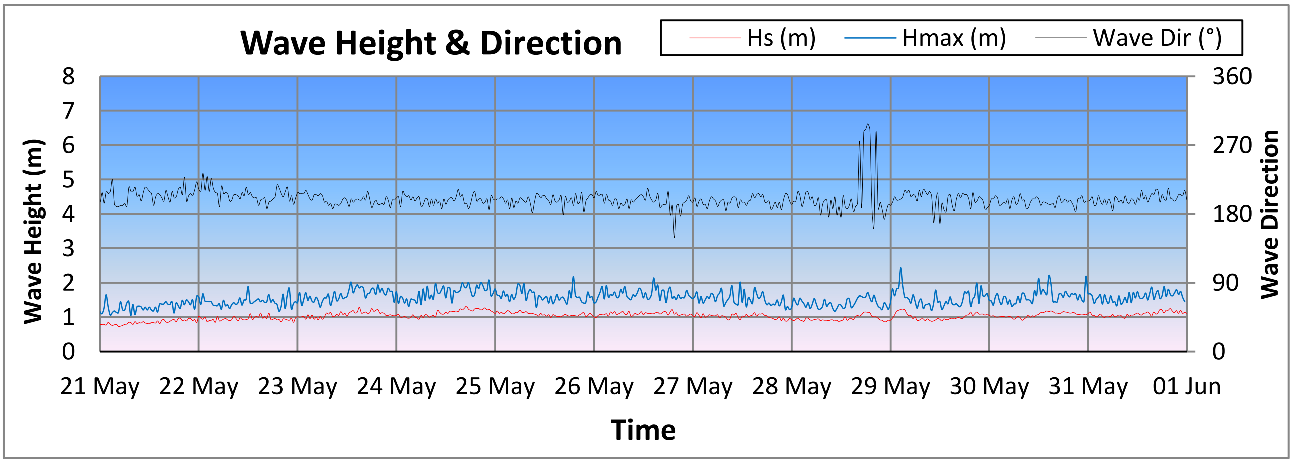

Observed Tide at Vizhinjam
Height in m above CD
1.5
1.0
0.5
0.0
21 May
22 May
23 May
24 May
25 May
26 May
27 May
28 May
29 May
30 May
31 May
Time

Annexure II

Wave Data

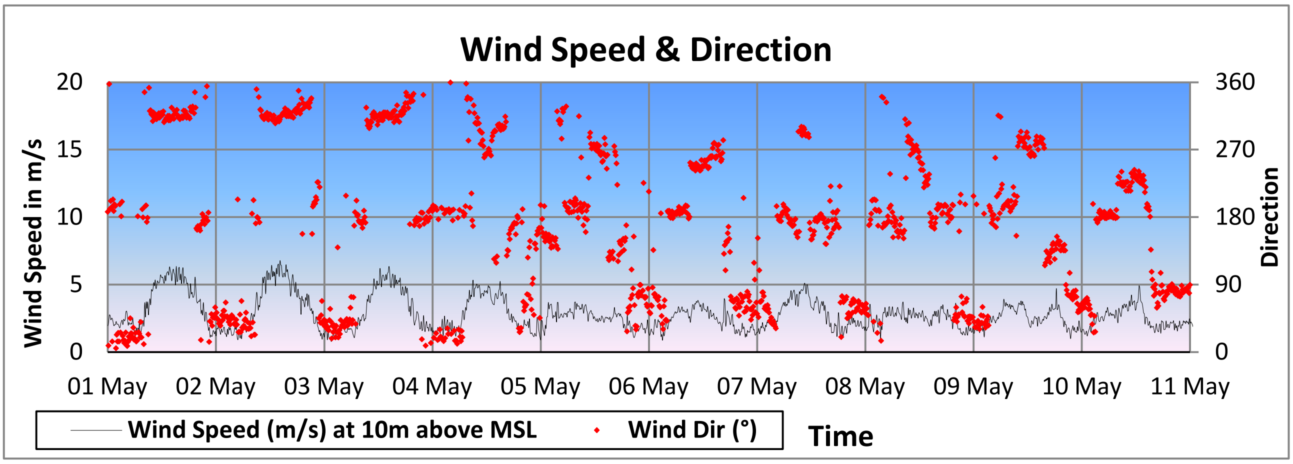

Wave Height & Direction
Hs (m)
Hmax (m)
Wave Dir (°)
Wave Height (m)
Wave Direction
Time
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
11 May
0
1
2
3
4
5
6
7
8
0
90
180
270
360

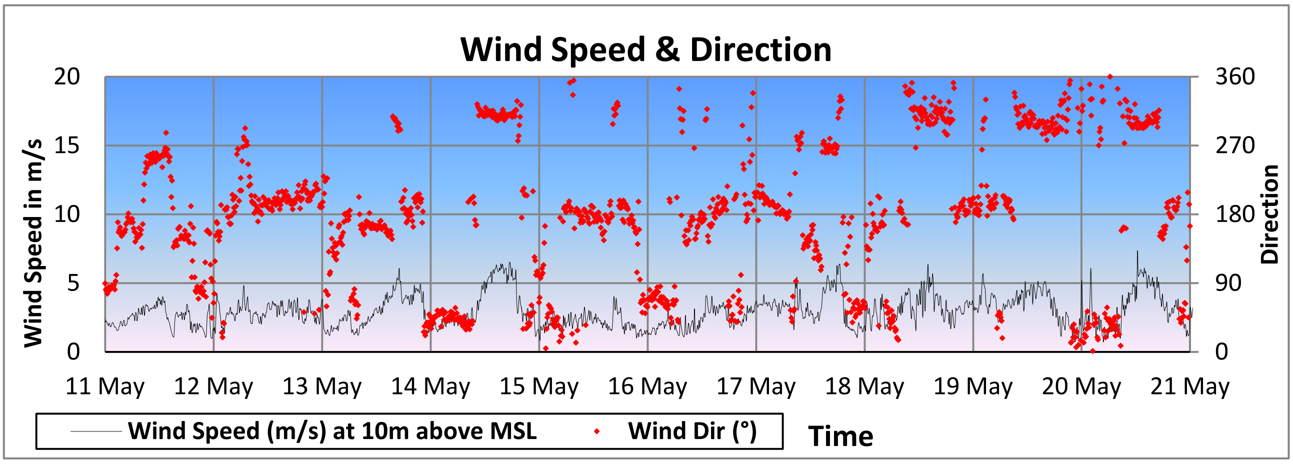

Wave Height & Direction
Hs (m)
Hmax (m)
Wave Dir (°)
Wave Height (m)
Wave Direction
Time
11 May
12 May
13 May
14 May
15 May
16 May
17 May
18 May
19 May
20 May
21 May
0
1
2
3
4
5
6
7
8
0
90
180
270
360

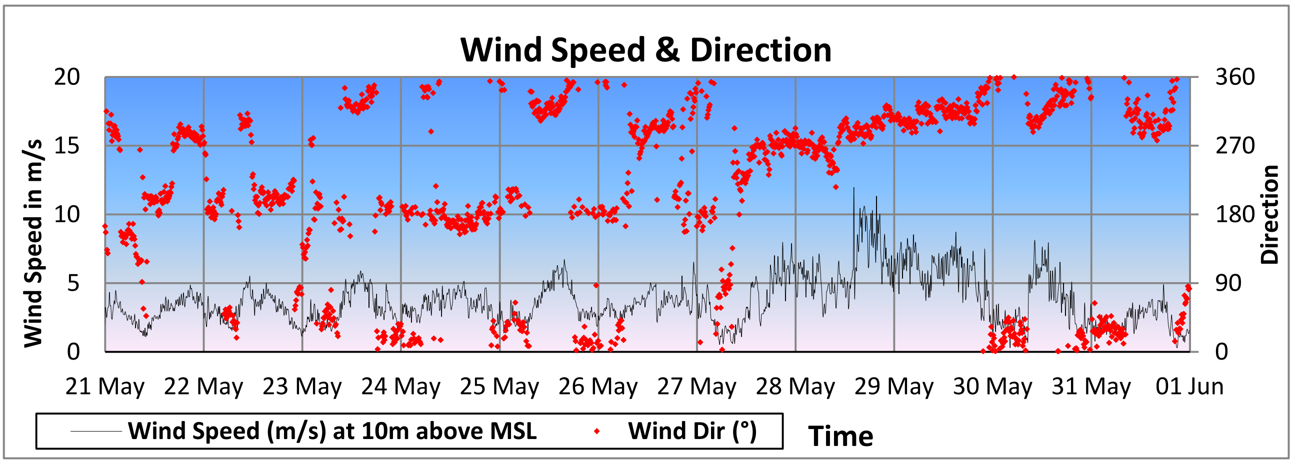

Wave Height & Direction
Hs (m)
Hmax (m)
Wave Dir (°)
Wave Height (m)
Wave Direction
Time
21 May
22 May
23 May
24 May
25 May
26 May
27 May
28 May
29 May
30 May
31 May
01 Jun
0
1
2
3
4
5
6
7
8
0
90
180
270
360

Annexure III

Wind Data


Wind Speed & Direction
Wind Speed in m/s
Direction
20
15
10
5
0
360
270
180
90
0
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
11 May
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
11 May
12 May
13 May
14 May
15 May
16 May
17 May
18 May
19 May
20 May
21 May
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
21 May
22 May
23 May
24 May
25 May
26 May
27 May
28 May
29 May
30 May
31 May
01 Jun
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

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									
				Northing	Easting	Northing	Easting								
01/05/2019	CSP-1	10:36	10:42	914453.1488	734900.34	914448.574	734903.8671	1.61	308	L	90	1.5	11	5	Rocky area
01/05/2019	CSP-2	10:24	10:30	914744.2891	734480.93	914733.409	734505.3837	7.44	336	L	90	1.5	11	15	
01/05/2019	CSP-3	10:10	10:16	915035.357	734076.1	915030.833	734082.7454	2.23	326	L	90	2	11	10	Rocky area
01/05/2019	CSP-4	10:57	11:03	915325.4193	733666.75	915320.372	733674.3545	2.54	326	L	90	2	11	5	
01/05/2019	CSP-5	11:08	11:14	915621.3726	733260.9	915618.733	733264.1857	1.17	321	L	90	1.5	11	20	Rip Current
01/05/2019	CSP-6	11:16	11:22	915912.4103	732854.3	915910.277	732856.6082	0.87	317	L	90	1.5	11	20	Rip Current
01/05/2019	CSP-7	11:23	11:29	916207.137	732449.17	916205.691	732452.4879	1.00	336	L	90	2	11	20	
01/05/2019	CSP-8	11:31	11:37	916494.6796	732038.53	916492.56	732041.5567	1.03	325	L	90	2	11	20	
01/05/2019	CSP-9	11:39	11:45	916791.9685	731633.38	916790.241	731636.4674	0.98	331	L	90	1.5	11	20	
01/05/2019	CSP-10	11:47	11:53	917089.4427	731231.43	917084.156	731240.3263	2.87	329	L	90	1.5	11	20	
02/05/2019	CSP-11	09:06	09:12	917381.7652	730826.15	917396.47	730811.925	5.68	134	R	90	1.5	11	20	
02/05/2019	CSP-12	09:14	09:20	917571.0783	730555.37	917609.345	730518.1421	14.83	134	R	90	1.5	11	20	
02/05/2019	CSP-13	09:23	09:29	917870.9103	730152.56	917943.948	730056.3916	33.54	143	R	90	1.5	11	20	
02/05/2019	CSP-14	09:34	09:40	918165.861	729748.22	918233.444	729664.086	29.98	141	R	90	1.5	11	20	
02/05/2019	CSP-15	09:45	10:01	918455.9692	729339.28	918564.982	729195.3175	18.81	143	R	90	1.5	11	20	
02/05/2019	CSP-16	10:04	10:10	918730.3382	728938.74	918783.325	728880.4091	21.89	138	R	90	1.5	11	20	
02/05/2019	CSP-17	10:55	11:01	919067.3334	728548.55	919155.365	728453.9643	35.89	137	R	90	2	11	20	
02/05/2019	CSP-18	11:05	11:11	919385.4632	728165.33	919475.8	728046.217	41.53	143	R	90	1.5	11	20	
02/05/2019	CSP-19	11:16	11:22	919688.3371	727766.1	919753.708	727678.132	30.44	143	R	90	1.5	11	20	
02/05/2019	CSP-20	11:28	11:34	919987.1863	727365.25	920058.162	727269.3885	33.13	143	R	90	1	11	20	
02/05/2019	CSP-21	11:40	11:46	920286.8993	726962.53	920363.889	726860.8518	35.43	143	R	90	1	11	20	
02/05/2019	CSP-22	11:51	11:57	920596.338	726568.58	920681.779	726466.2351	37.03	140	R	90	1	11	20	
02/05/2019	CSP-23	12:01	12:07	920913.7793	726183.91	920984.225	726098.0957	30.84	141	R	90	1	11	20	
03/05/2019	CSP-24	08:59	09:05	921233.8808	725801.55	921267.072	725760.1108	14.75	141	R	90	1	11	10	Rocky area
03/05/2019	CSP-25	09:10	09:16	921553.2321	725409.49	921585.266	725378.1155	12.46	134	R	90	1	11	20	
03/05/2019	CSP-26	09:22	09:28	921868.1962	725022.24	921915.131	724967.4437	20.04	139	R	90	1	11	20	
03/05/2019	CSP-27	09:33	09:39	922181.4188	724628.33	922209.173	724596.3243	11.77	139	R	90	1	10	20	
03/05/2019	CSP-28	09:45	09:51	922485.5529	724238.35	922522.686	724192.0348	16.49	141	R	90	1	10	20	
03/05/2019	CSP-29	09:58	10:04	922778.0217	723846.83	922818.567	723792.1031	18.92	143	R	90	1	10	20	
03/05/2019	CSP-30	10:12	10:18	923055.3042	723454.28	923074.365	723432.5354	8.03	139	R	90	1	10	20	
03/05/2019	CSP-31	11:00	11:06	923355.0869	723047.79	923388.339	722998.4176	16.54	146	R	90	1	10	25	
03/05/2019	CSP-32	11:21	11:27	923644.7991	722624.48	923659.7	722597.9101	8.46	151	R	90	1	10	25	

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									
				Northing	Easting	Northing	Easting								
03/05/2019	CSP-33	11:39	11:45	923884.6024	722250.78	923898.9	722221.3728	9.08	154	R	90	1	10	15	
03/05/2019	CSP-34	11:55	12:01	924136.5238	721773.98	924126.767	721768.2132	3.15	239	L	90	1	10	15	
03/05/2019	CSP-35	12:11	12:17	924286.6241	721428.13	924288.952	721421.8832	1.85	160	R	90	1	10	10	Rocky area
07/02/2019	CSP-36	08:54	09:00	924800.7674	721102.37	924806.5	721094.6343	2.68	143	R	90	1.5	10	15	
07/02/2019	CSP-37	09:07	09:13	925148.6329	720765.79	925160.761	720754.9878	4.51	132	R	90	2	10	20	
07/02/2019	CSP-38	11:49	11:55	925561.245	720322.22	925565.473	720319.775	1.36	120	R	95	1.5	10	20	
07/02/2019	CSP-39	09:41	09:47	925885.3721	719934.79	925891.764	719927.6195	2.67	138	R	95	1.5	10	15	
07/02/2019	CSP-40	09:53	09:59	926063.883	719567.79	926068.745	719563.7463	1.76	130	R	95	1.5	10	5	Rotary motion due to seawall
07/02/2019	CSP-41	10:17	10:23	926882.1429	718521.34	926881.758	718525.2509	1.09	354	L	95	1	10	15	Rip Current
07/02/2019	CSP-42	10:58	11:04	927280.7528	717990.62	927273.318	717990.2877	2.07	267	L	95	1	10	15	
07/02/2019	CSP-43	11:03	11:09	927536.9393	717784.82	927530.332	717795.0358	3.38	327	L	95	1	10	15	
07/02/2019	CSP-44	11:11	11:17	927906.2454	717492.97	927896.22	717502.443	3.83	313	L	95	1	10	15	
06/05/2019	CSP-45	08:02	08:08	928529.3979	717225.28	928537.456	717228.5334	2.41	68	R	95	1	10	15	
06/05/2019	CSP-46	08:11	08:17	928869.2748	717230.27	928857.804	717231.1628	3.20	274	L	95	1	10	15	
06/05/2019	CSP-47	08:22	08:28	929305.1911	717067.35	929300.815	717069.3897	1.34	295	L	95	1	10	5	Seawall area
06/05/2019	CSP-48	08:40	08:46	929958.406	716790.82	929949.86	716795.8265	2.75	300	L	95	1	11	5	Seawall area
06/05/2019	CSP-49	08:56	09:02	930239.3623	716609.93	930235.806	716613.1191	1.33	312	L	95	1	11	5	Seawall area
06/05/2019	CSP-50	09:01	09:07	930661.4169	716355.54	930656.186	716359.007	1.74	304	L	95	1	11	5	Seawall area
06/05/2019	CSP-51	09:05	09:11	931093.3945	716078.86	931089.408	716081.2877	1.30	301	L	95	1.5	11	5	Seawall area
06/05/2019	CSP-52	09:10	09:16	931494.1588	715787.91	931486.699	715794.064	2.69	310	L	95	1.5	11	5	Seawall area
08/05/2019	CSP-53	10:52	10:58	931937.3064	715526.15	931961.939	715506.8117	8.70	128	R	95	1.5	11	15	
08/05/2019	CSP-54	10:41	10:47	932279.1965	715237.04	932304.693	715210.0159	10.32	137	R	95	1	11	15	
08/05/2019	CSP-55	10:29	10:35	932675.2885	714871.69	932698.773	714856.6401	7.75	123	R	90	1	11	15	
08/05/2019	CSP-56	09:56	10:02	933015.1464	714523.59	933027.584	714511.0278	4.91	135	R	90	1	11	15	
08/05/2019	CSP-57	09:48	09:54	933378.1744	714201.65	933384.24	714194.779	2.55	139	R	90	1	11	15	
08/05/2019	CSP-58	08:44	08:50	933792.8723	713895.43	933798.529	713891.183	1.96	127	R	90	1	11	15	
08/05/2019	CSP-59	08:54	09:00	934165.7781	713591.59	934189.848	713575.0995	8.11	124	R	90	1	11	15	Between seawall
08/05/2019	CSP-60	09:37	09:43	934573.7386	713265.76	934605.106	713230.8713	13.03	138	R	90	1	11	15	
08/05/2019	CSP-61	08:21	08:27	934944.0668	712930.45	934953.493	712921.2259	3.66	134	R	90	1	11	5	Seawall area
08/05/2019	CSP-62	09:06	09:12	935340.239	712617.74	935336.014	712615.0405	1.39	237	L	90	1	10	20	
05/05/2019	CSP-63	08:59	09:05	935708.8423	712287.3	935738.256	712259.8477	11.18	133	R	90	1	10	5	Seawall area
05/05/2019	CSP-64	08:52	08:58	936086.6836	711967.57	936093.635	711960.3822	2.78	136	R	90	1	10	20	

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									
				Northing	Easting	Northing	Easting								
05/05/2019	CSP-65	08:45	08:51	936421.1374	711658.52	936428.899	711650.1033	3.18	137	R	90	1	10	20	
05/05/2019	CSP-66	07:43	07:49	936819.6318	711304.95	936832.396	711295.3204	4.44	127	R	90	1	10	20	
05/05/2019	CSP-67	07:51	07:57	937204.4116	710961.24	937232.202	710937.9284	10.08	130	R	90	1	10	20	
05/05/2019	CSP-68	07:59	08:05	937562.3927	710608.78	937605.474	710570.7003	15.97	131	R	90	1	10	20	
05/05/2019	CSP-69	08:11	08:17	937931.0575	710273.13	937965.937	710244.5918	12.52	129	R	90	1	10	20	
05/05/2019	CSP-70	08:25	08:31	938307.1117	709941.92	938350.468	709902.6259	16.25	132	R	90	1	10	20	
05/05/2019	CSP-71	08:34	08:40	938450.3472	709818.83	938474.158	709800.5371	8.34	128	R	90	1	10	20	
05/05/2019	CSP-72	10:14	10:20	938824.6255	709486.24	938842.922	709472.9061	6.29	126	R	90	1	10	20	
04/05/2019	CSP-73	11:06	11:12	939203.8953	709161.44	939245.643	709125.4916	15.30	131	R	90	1	10	20	
04/05/2019	CSP-74	10:55	11:01	939580.1952	708832.4	939618.276	708798.2755	14.20	132	R	90	1	10	20	
04/05/2019	CSP-75	10:43	10:49	939985.6431	708477.55	939955.082	708501.1499	10.73	308	L	90	1	10	20	
04/05/2019	CSP-76	10:31	10:37	940339.8892	708179.93	940378.858	708147.29	14.12	130	R	90	1	10	20	
04/05/2019	CSP-77	10:13	10:20	940723.6716	707860.67	940749.152	707838.9812	7.97	130	R	90	1	10	20	
04/05/2019	CSP-78	09:51	09:57	941102.7768	707536.2	941127.96	707517.9336	8.64	126	R	90	1	10	20	
04/05/2019	CSP-79	09:58	10:04	941501.6375	707234.93	941529.761	707213.389	9.84	127	R	90	1	10	20	
04/05/2019	CSP-80	09:39	09:45	941897.4464	706924.94	941923.809	706904.5461	9.26	128	R	90	1	10	20	
04/05/2019	CSP-81	09:26	09:32	942291.8305	706615.35	942320.841	706590.3906	10.63	131	R	90	1	10	20	

Annexure V

Photo Documentation at CSP Locations - MAY 2019

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

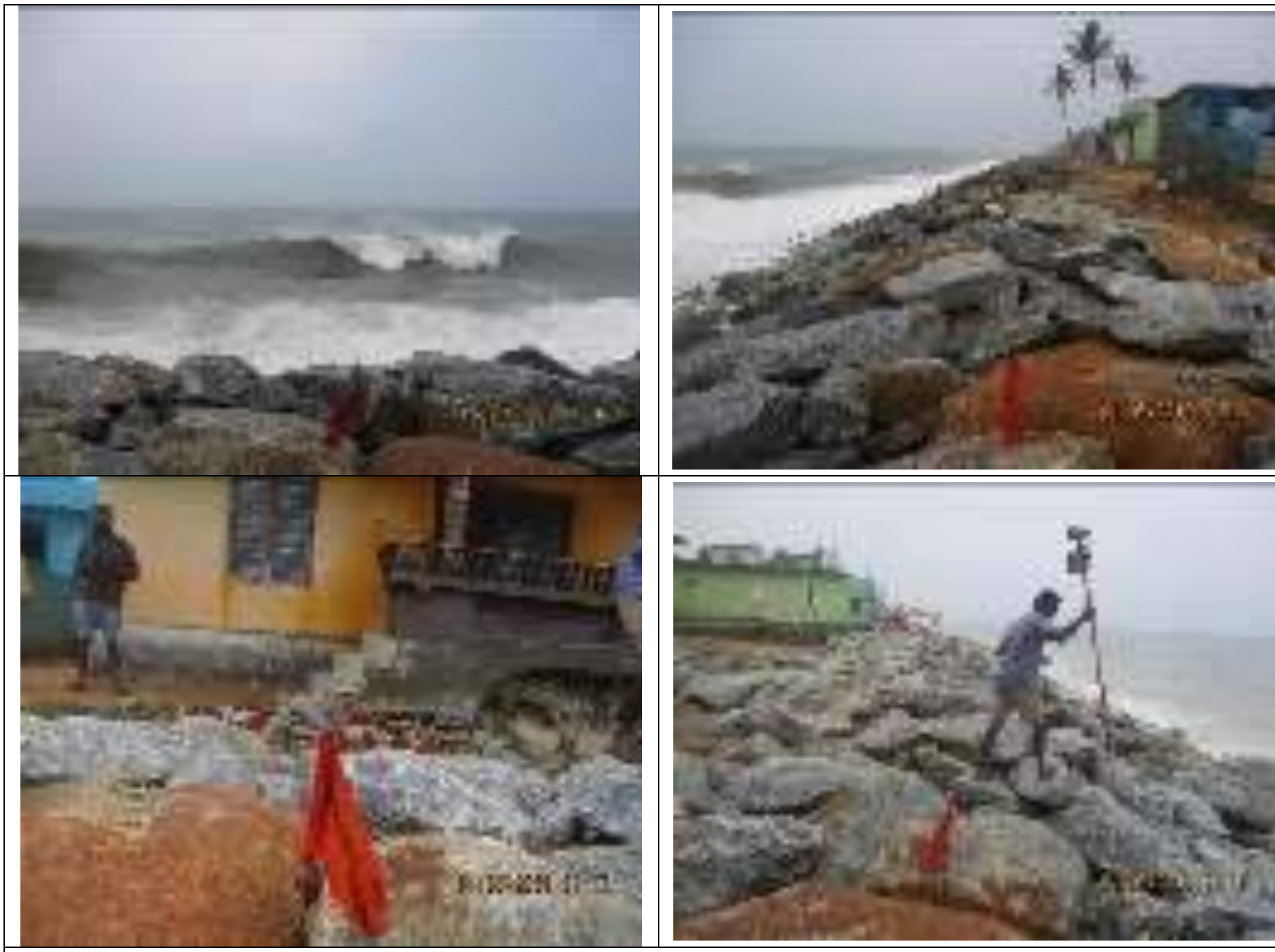


Figure 06:- May_CSP 06

Figure 07:- May_CSP 07

Figure 08:- May_CSP 08

Figure 09:- May_CSP 09

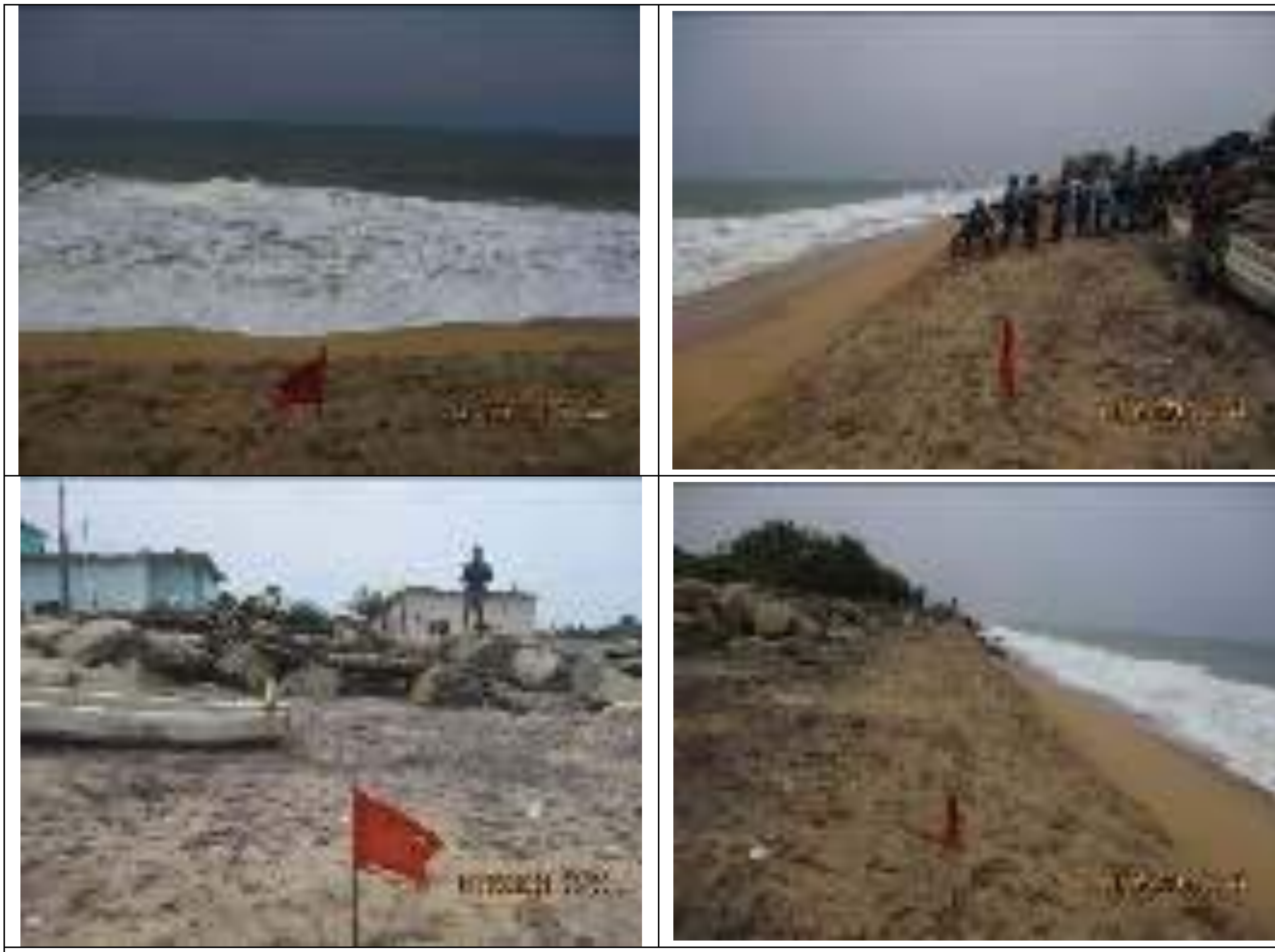


Figure 10:- May_CSP 10

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

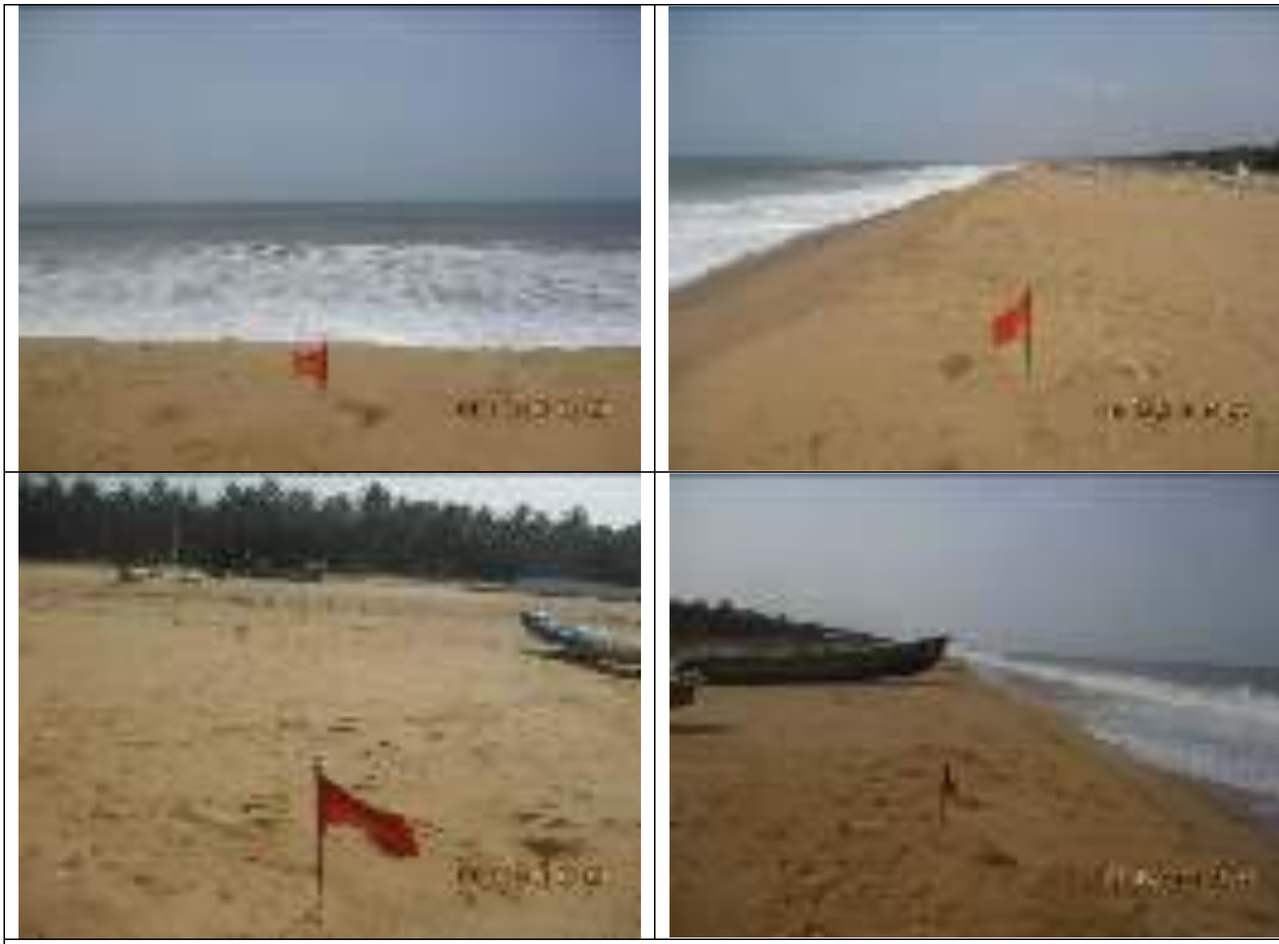


Figure 24:- May_CSP 24

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

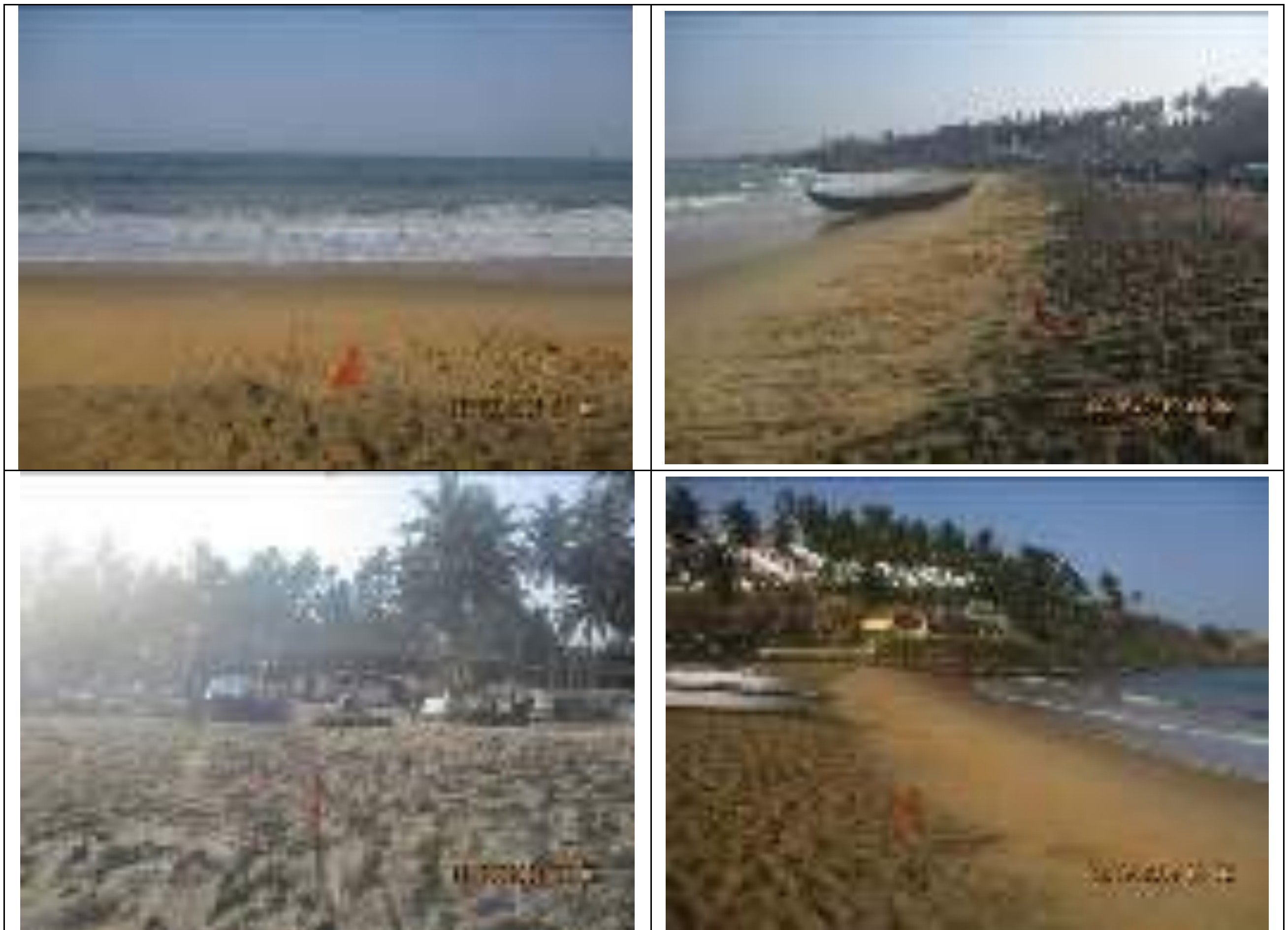


Figure 45:- May_CSP 45

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

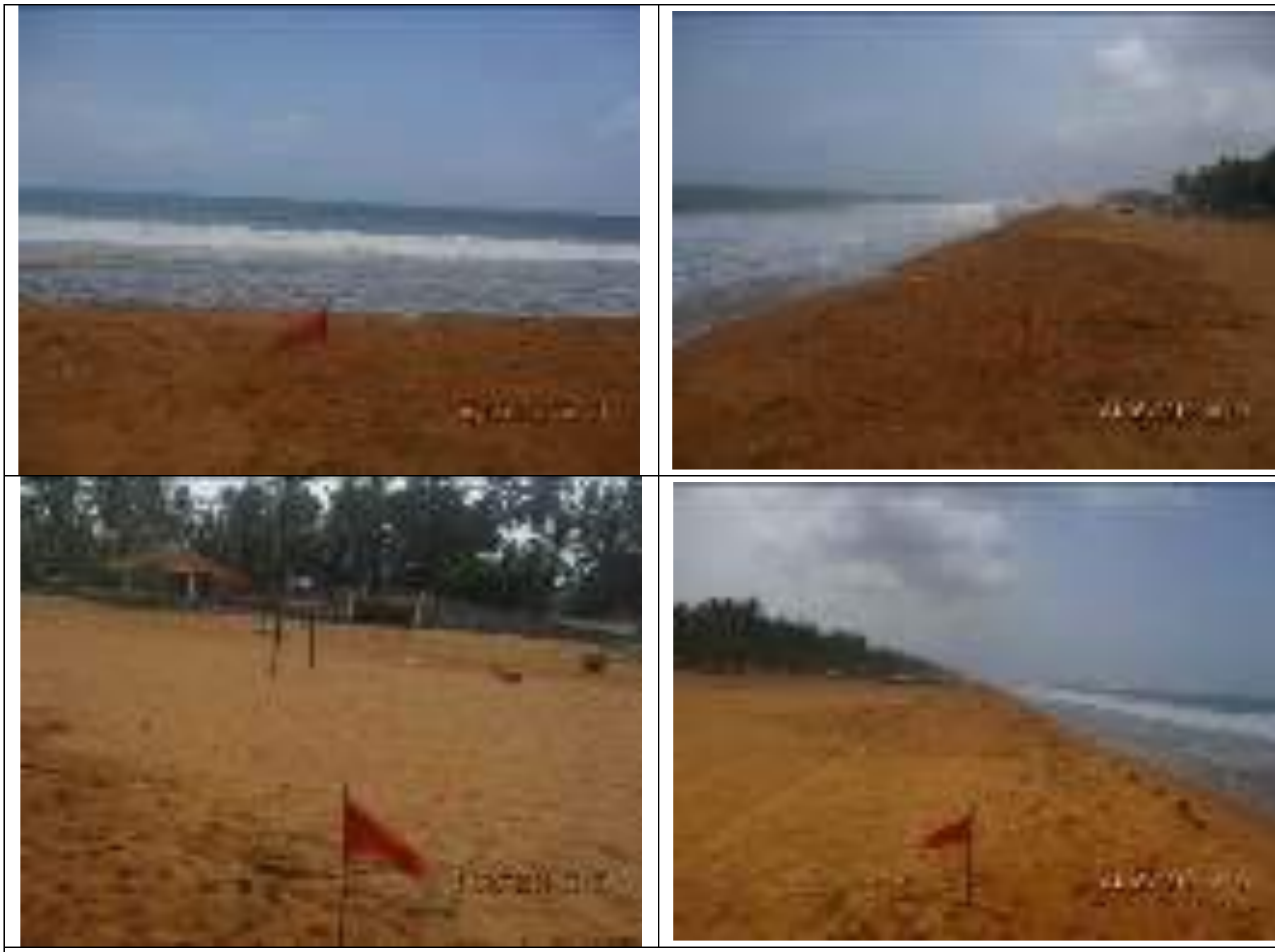


Figure 77:- May_CSP 77

Figure 78:- May_CSP 78

Figure 79:- May_CSP 79

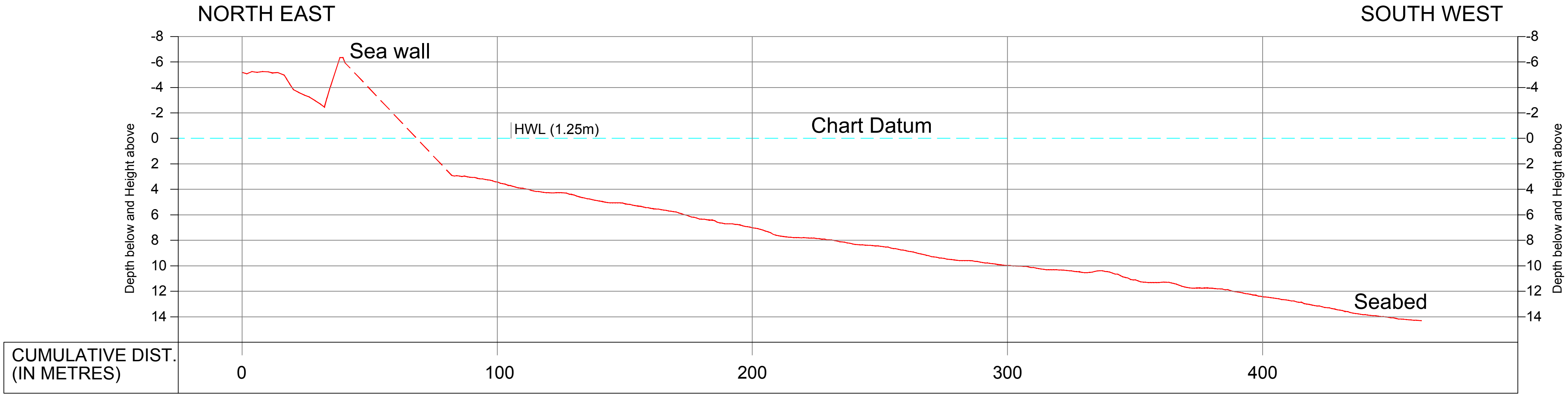
Figure 80:- May_CSP 80

Figure 81:- May_CSP 81

Annexure VI

Cross Section Profiles

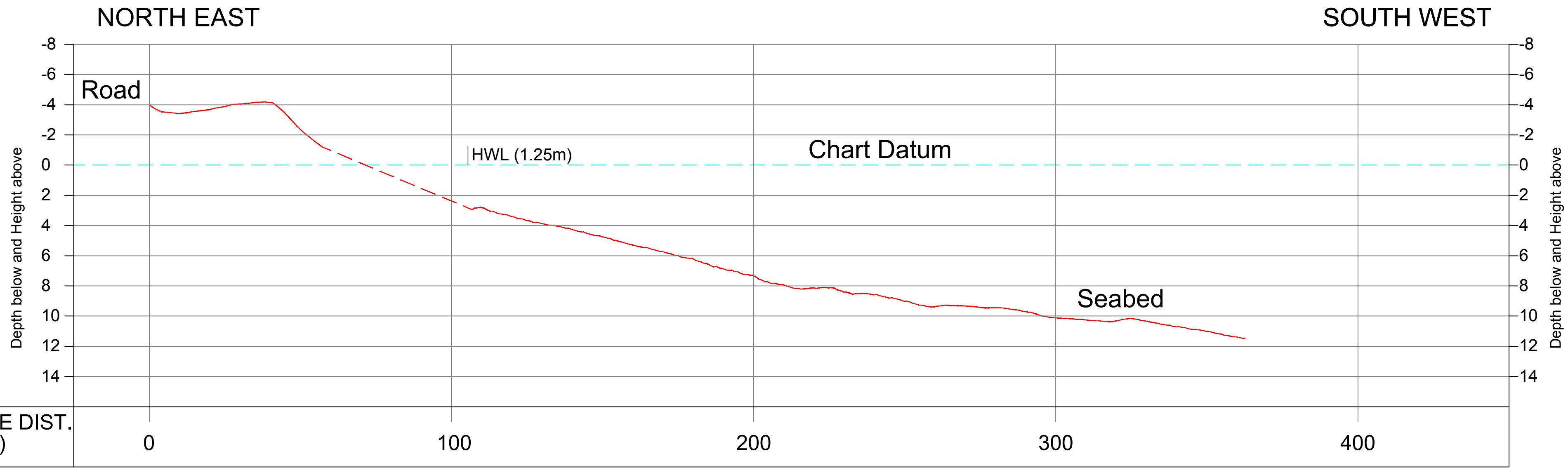
Cross Section Line No.CSP-01
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-02
(May 2019)



Cross Shore Profile

SCALE
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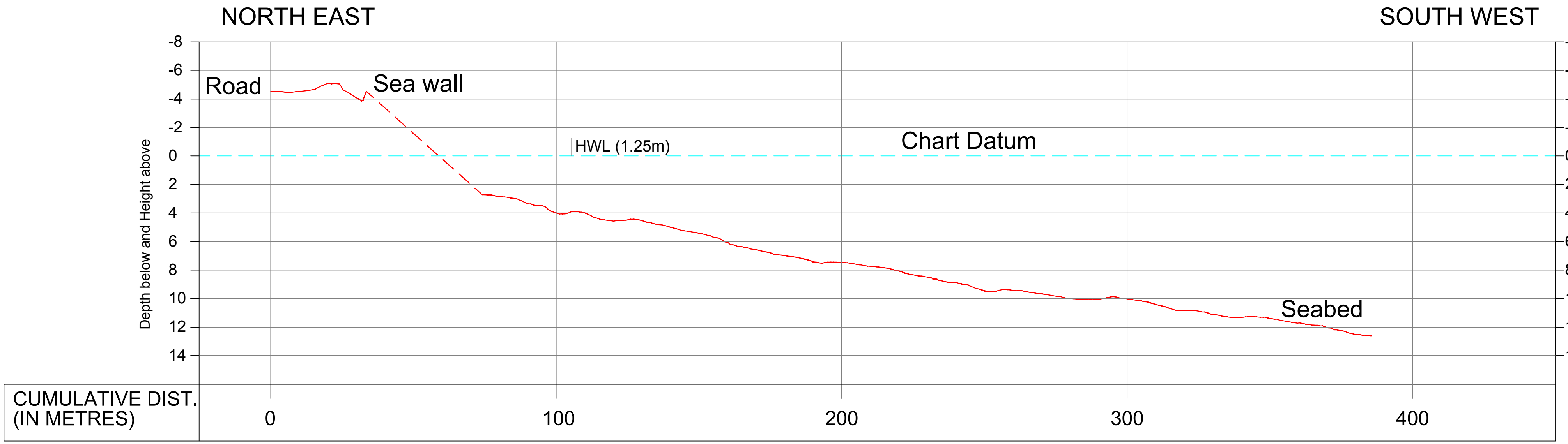
VERTICAL 1: 400

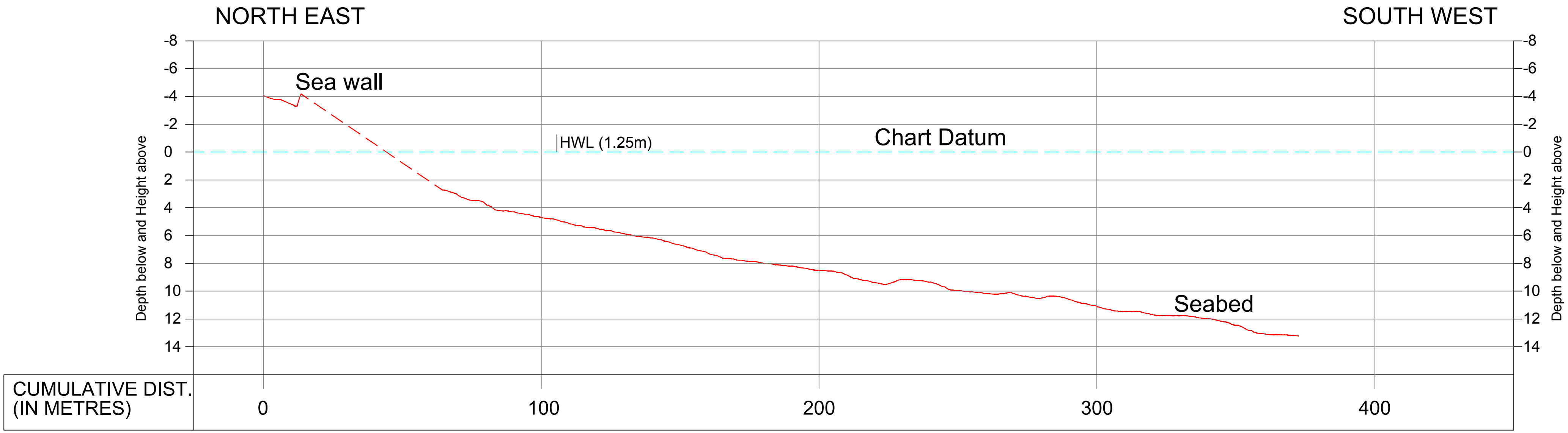
Cross Section Line No.CSP-03
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-04
(May 2019)



Cross Shore Profile

SCALE
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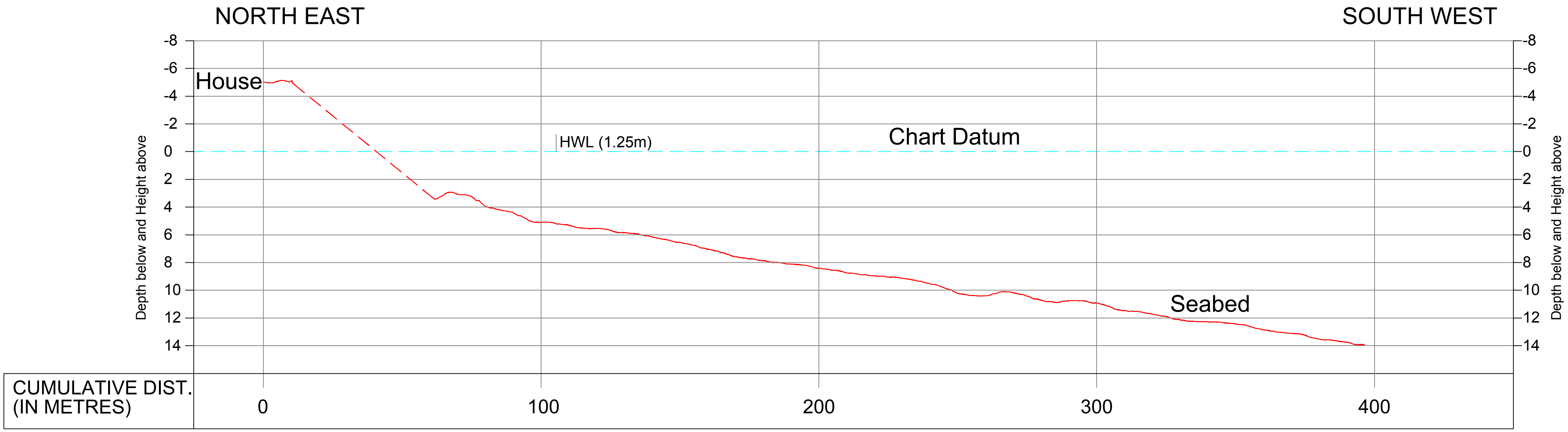
VERTICAL 1: 400

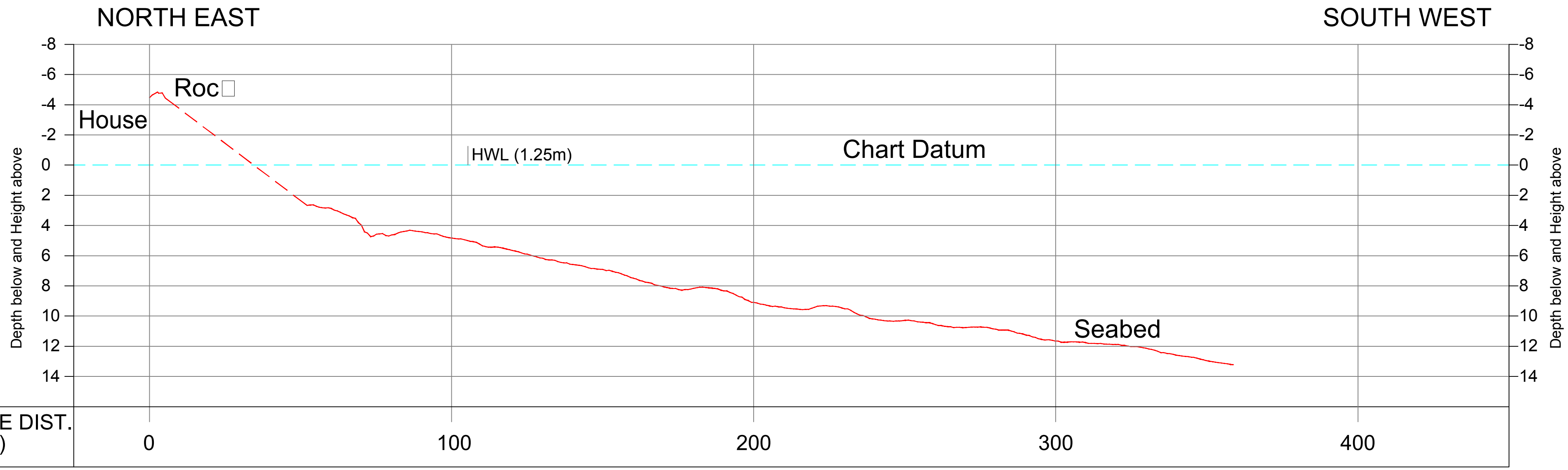
Cross Section Line No.CSP-05
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

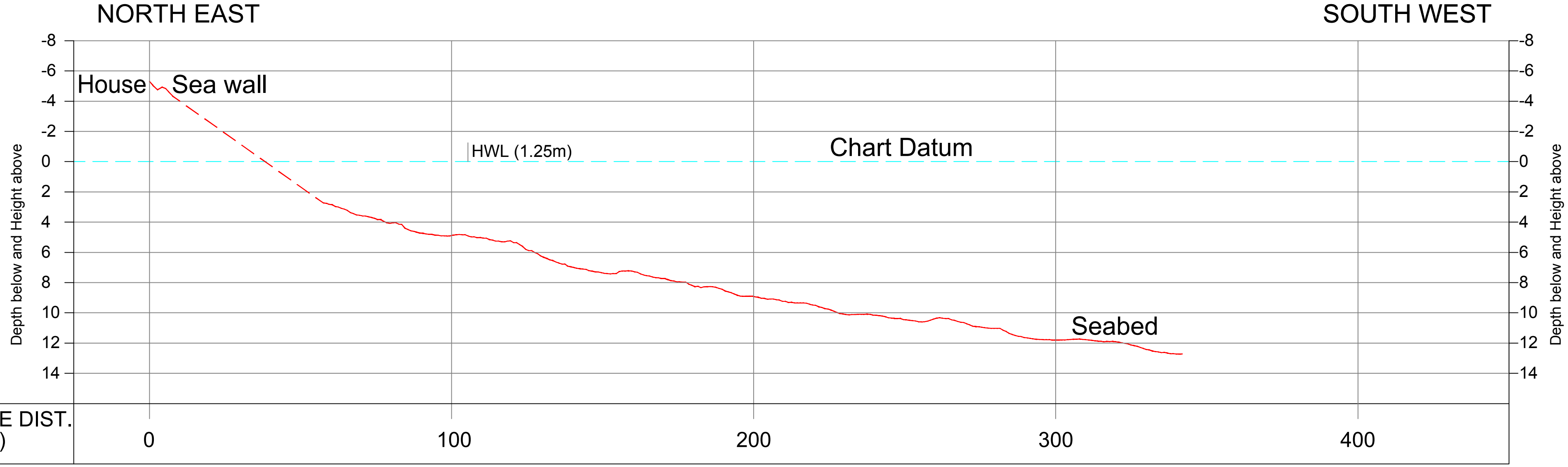
Cross Section Line No.CSP-06
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

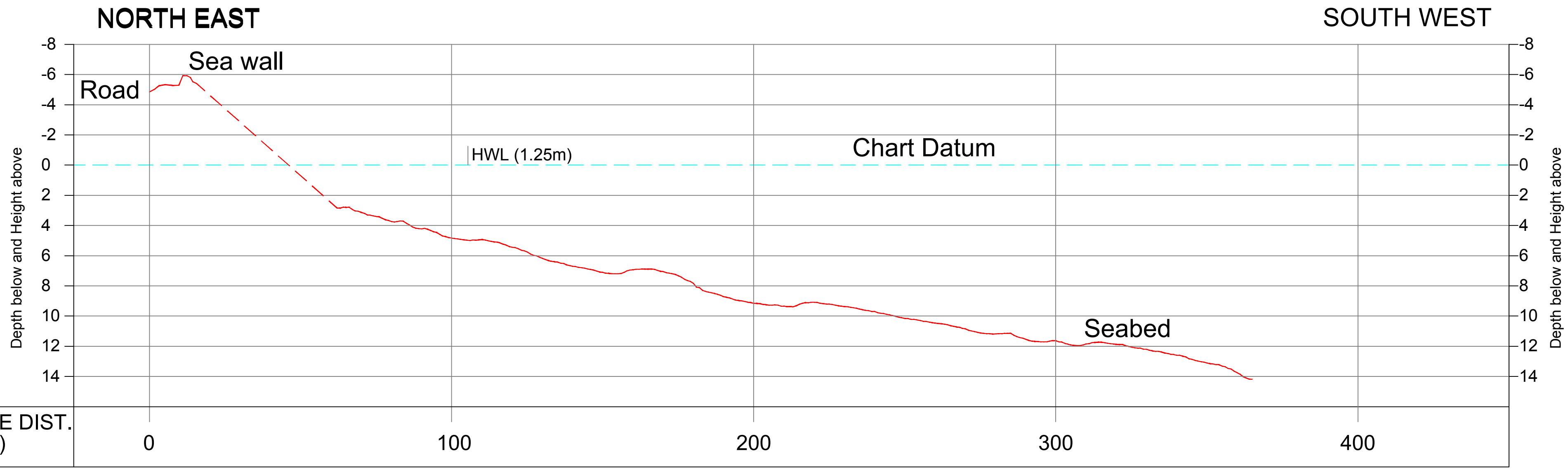
Cross Section Line No.CSP-07
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

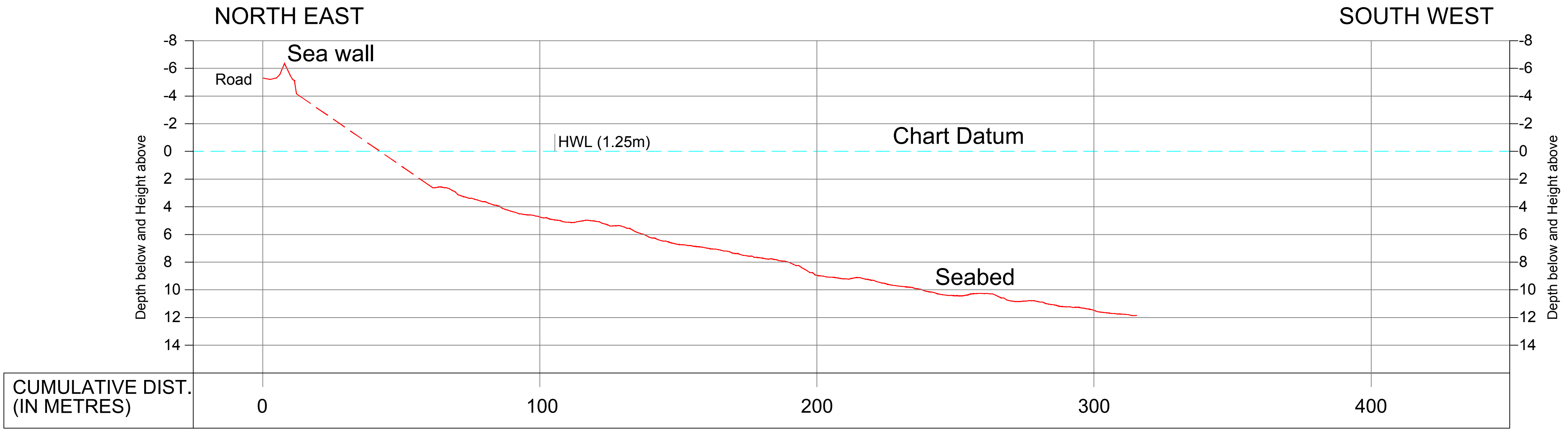
Cross Section Line No.CSP-08
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

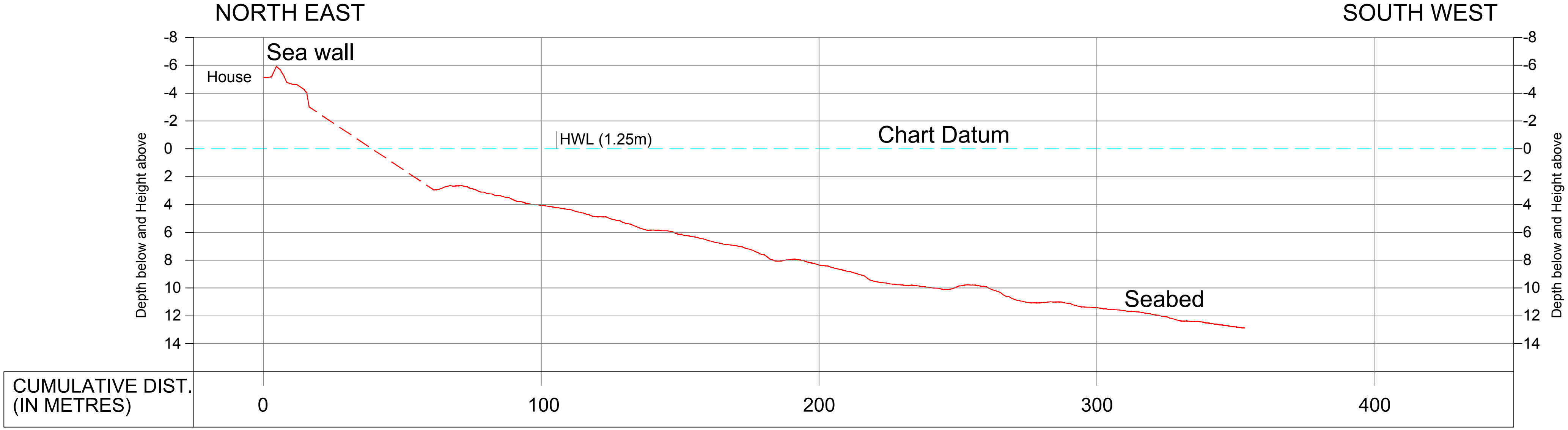
Cross Section Line No.CSP-09
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

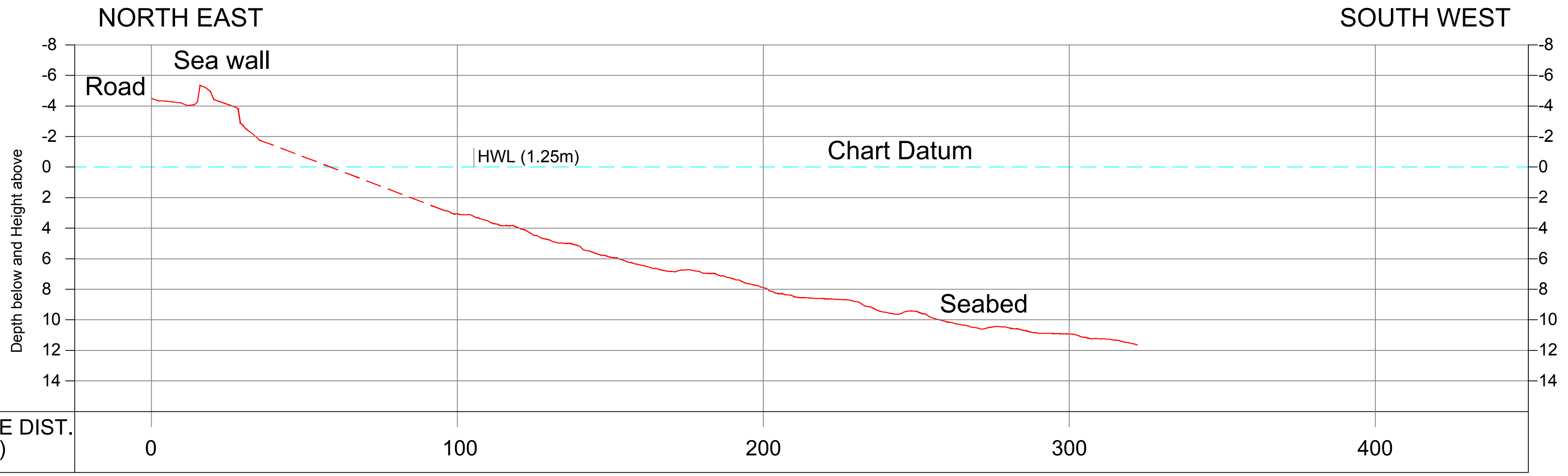
Cross Section Line No.CSP-10
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

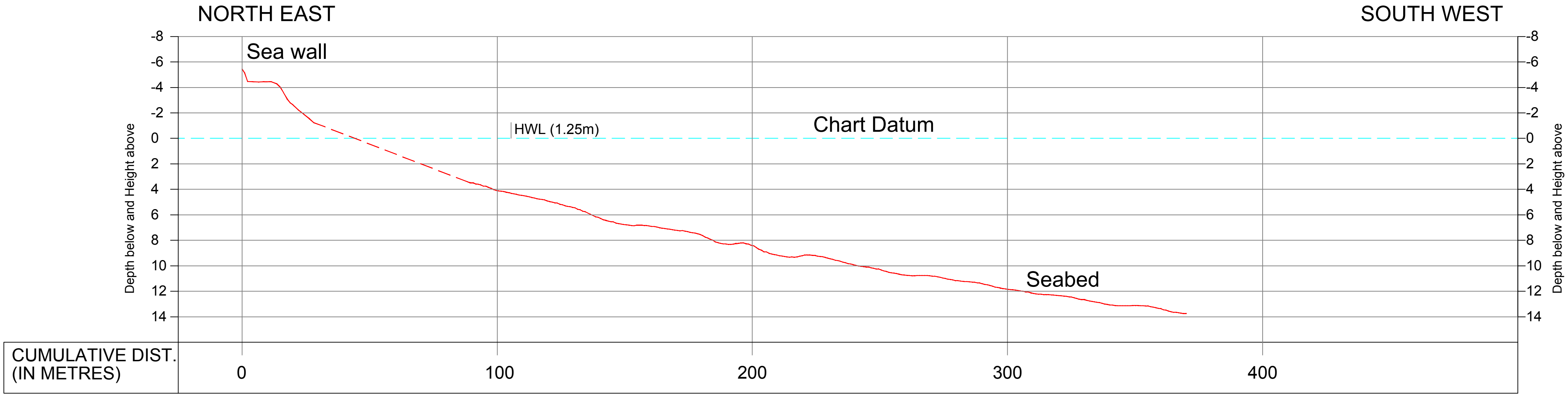
Cross Section Line No.CSP-11
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

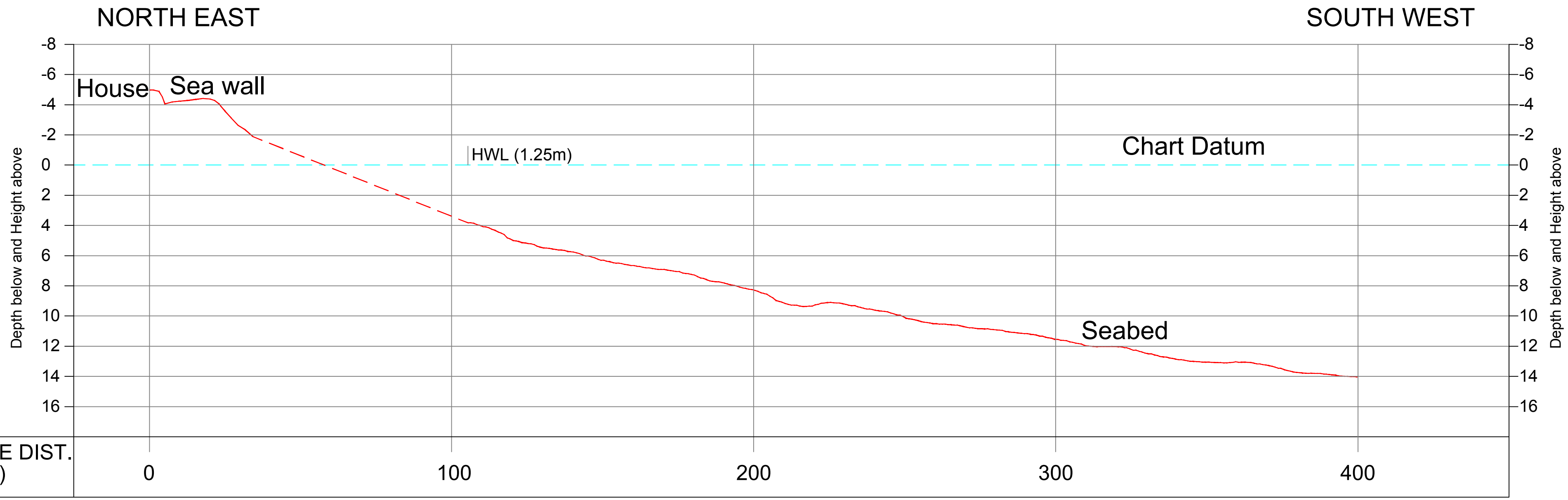
Cross Section Line No.CSP-12
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

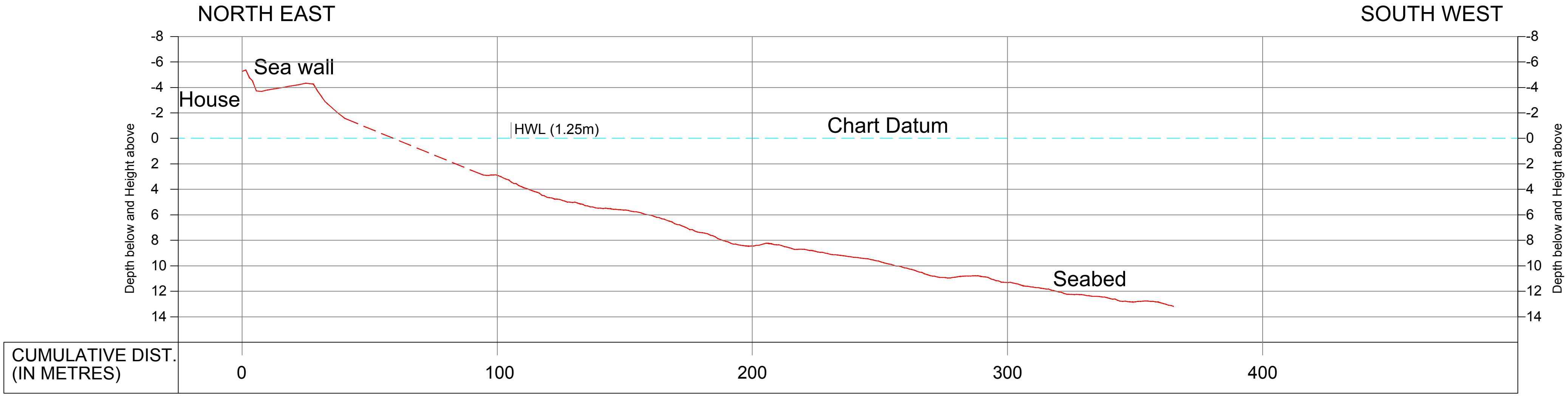
Cross Section Line No.CSP-13
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-14
(May 2019)

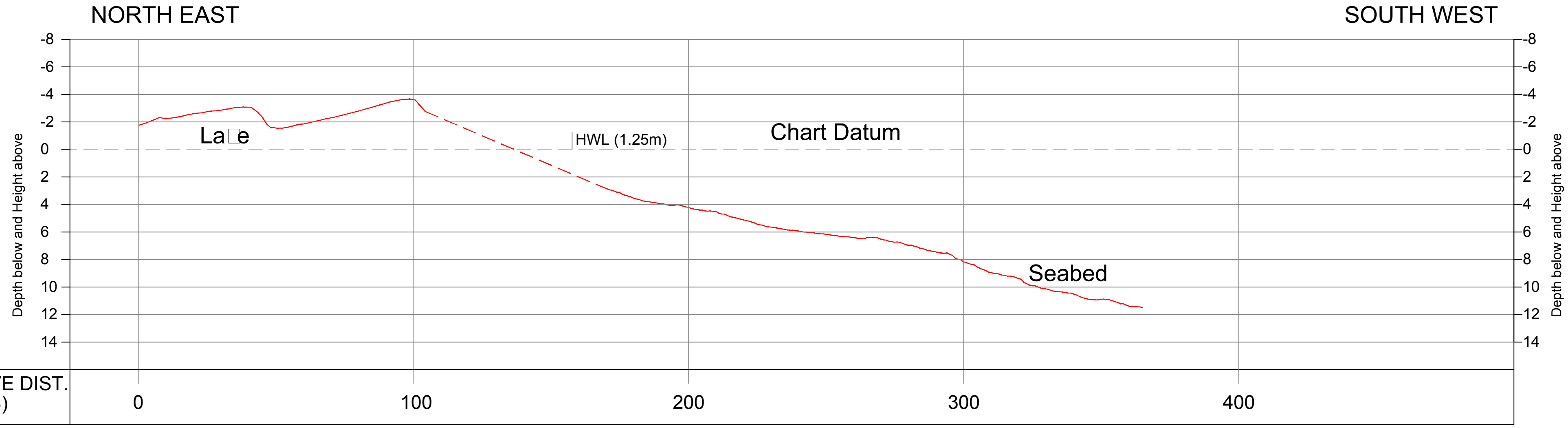


Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-15

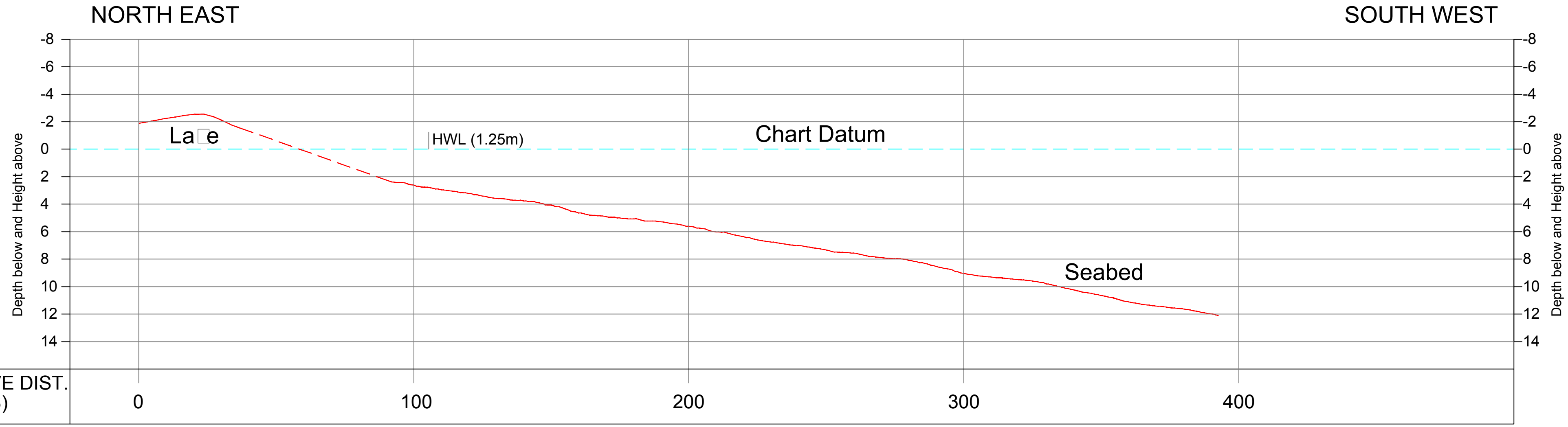
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

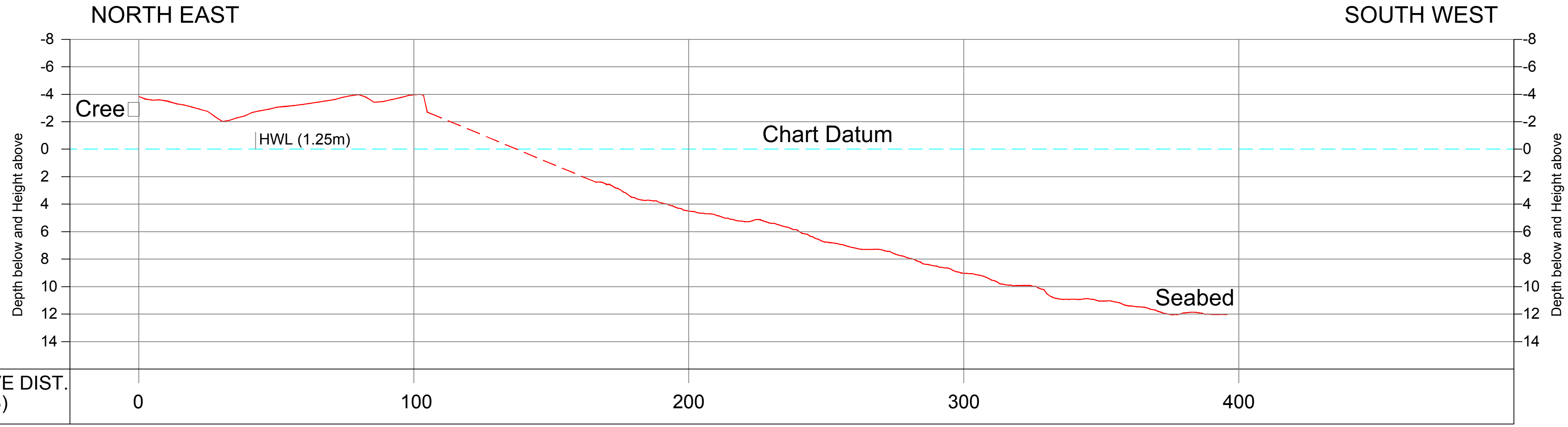
Cross Section Line No.CSP-16
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

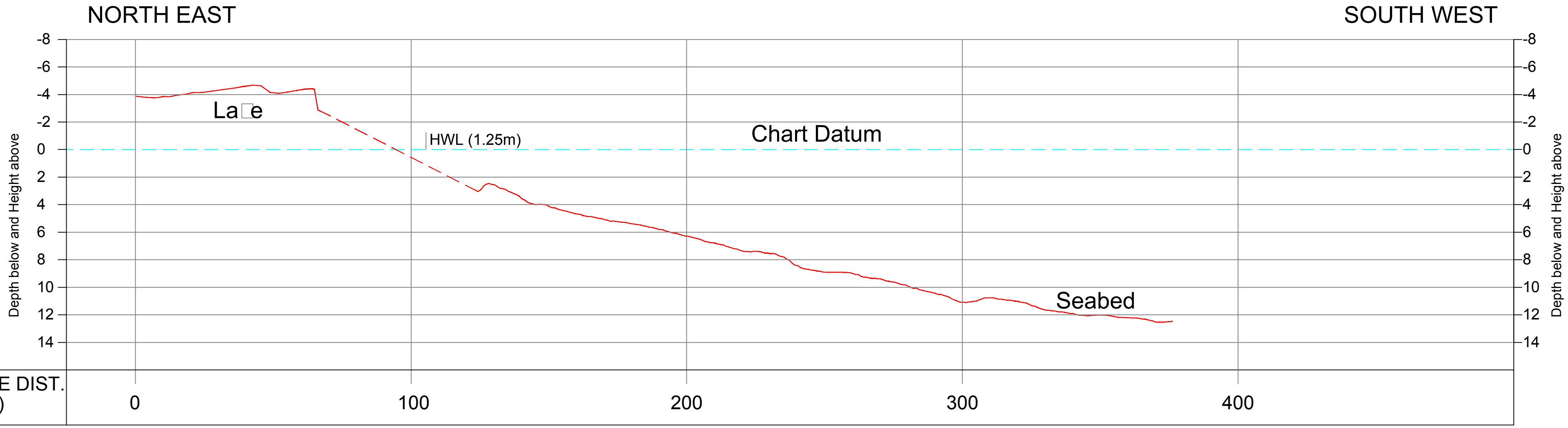
Cross Section Line No.CSP-17
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

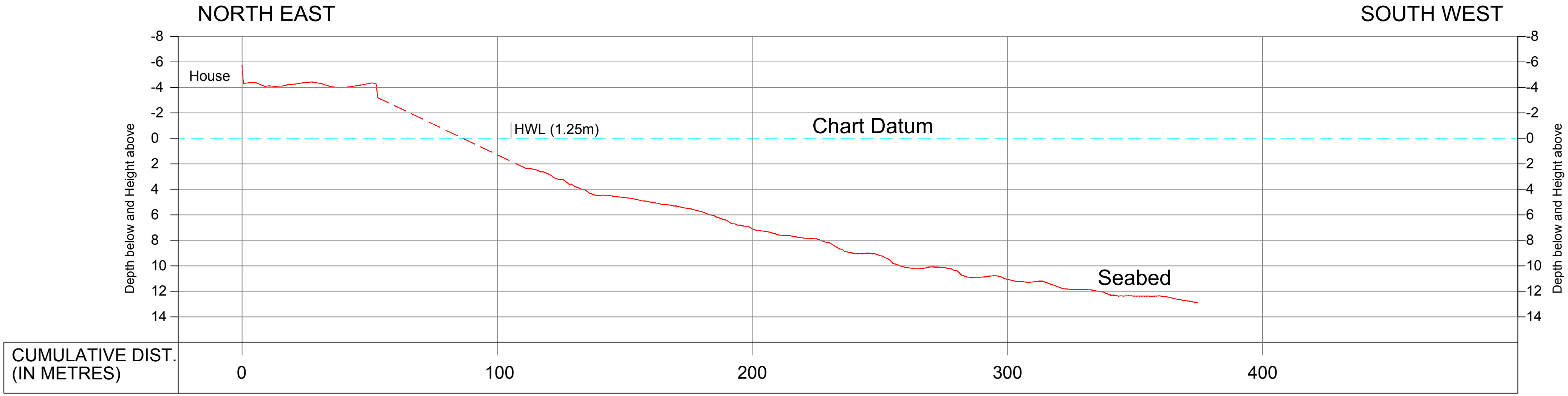
Cross Section Line No.CSP-18
(May 2019)



Cross Shore Profile

<u>SCALE</u>
HORIZONTAL 1: 2000
VERTICAL 1: 400

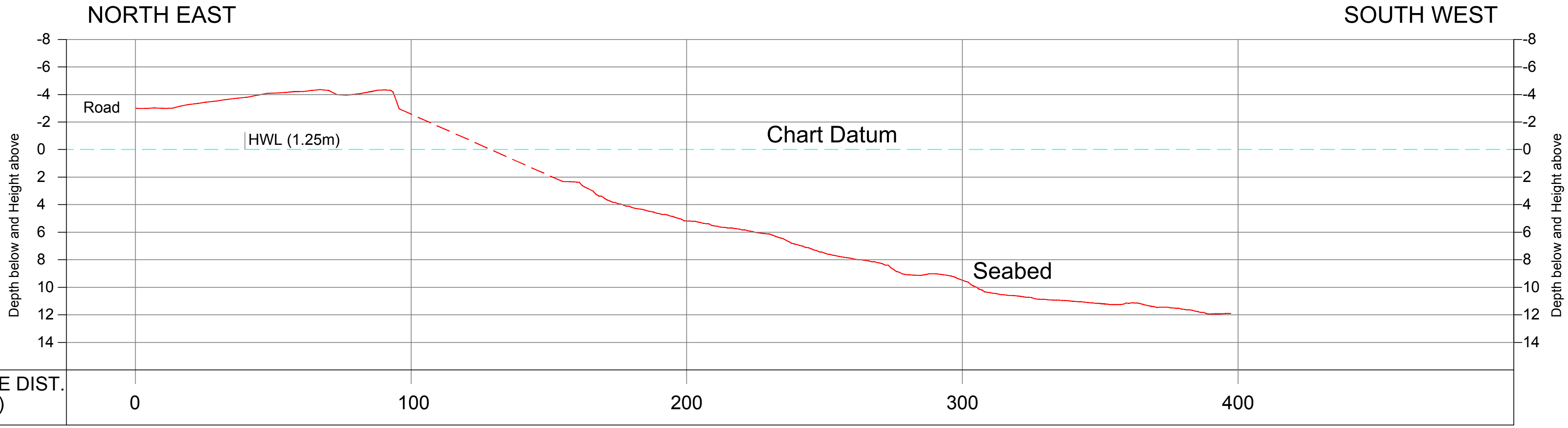
Cross Section Line No.CSP-19 (May 2019)



Cross Shore Profile

<u>SCALE</u>
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-20
(May 2019)

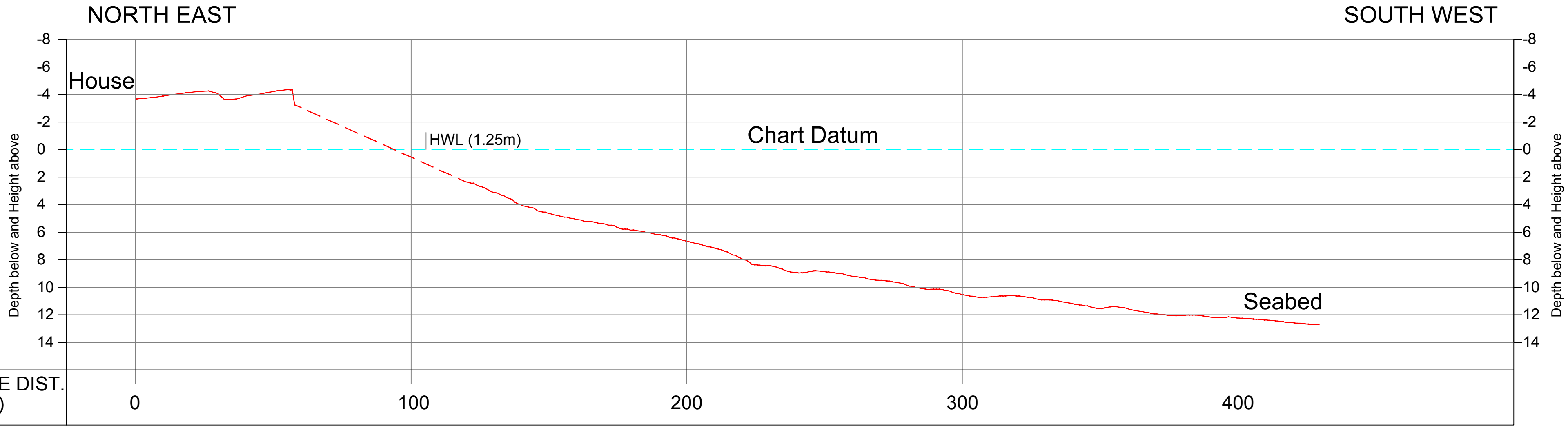


Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-21

(May 2019)



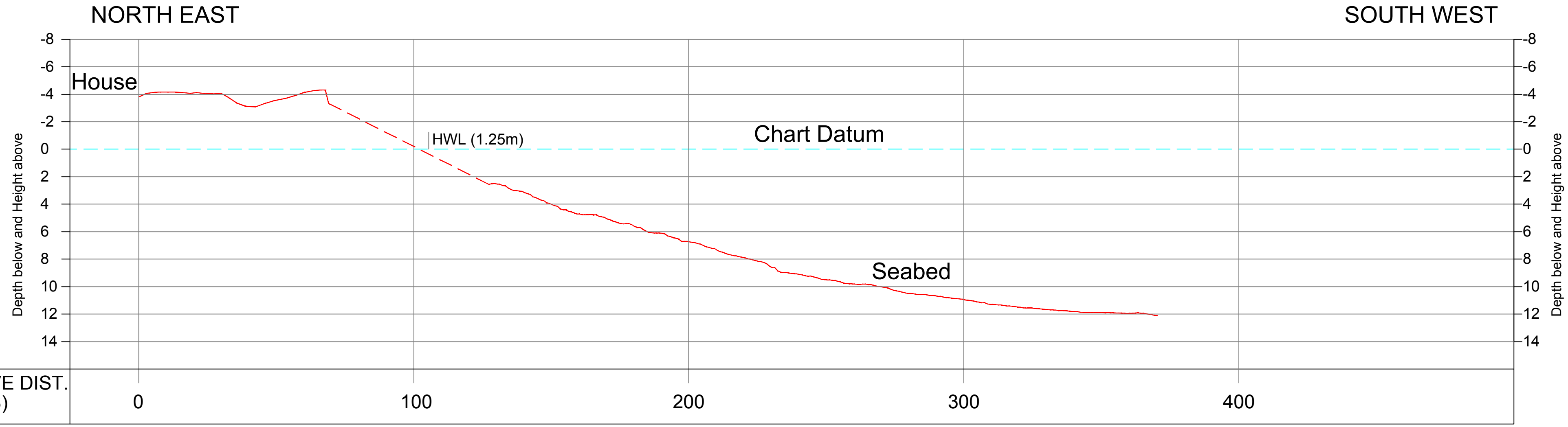
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

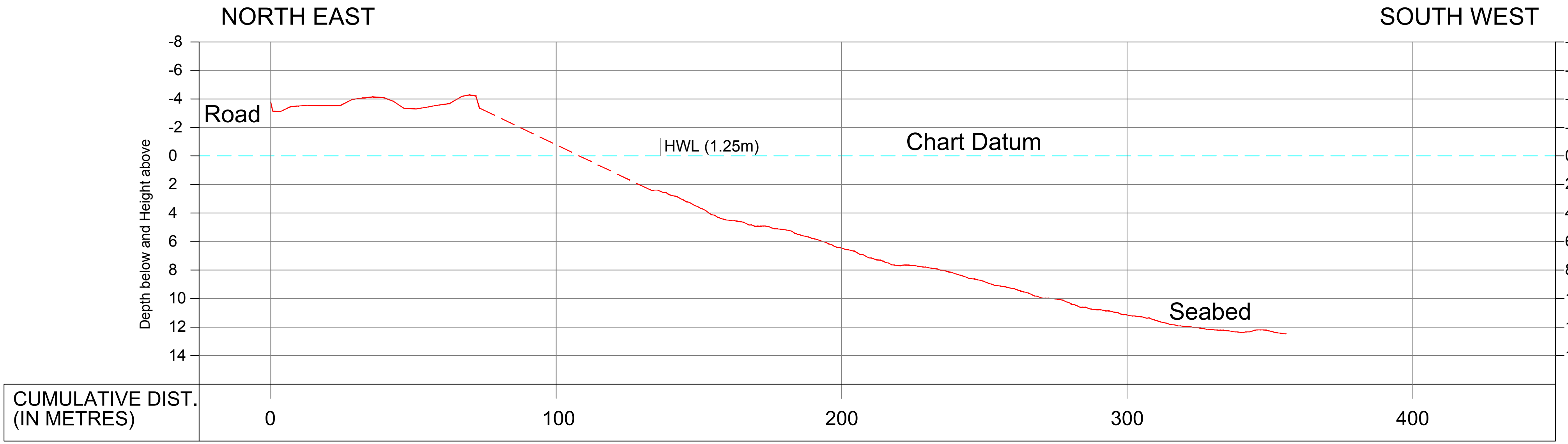
Cross Section Line No.CSP-22
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

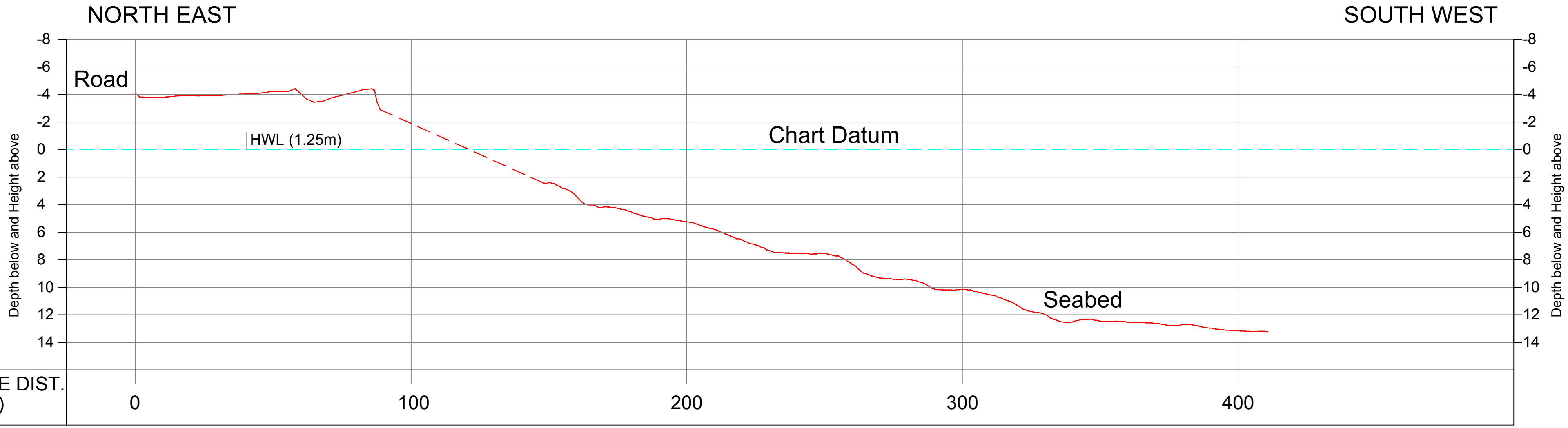
Cross Section Line No.CSP-23
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

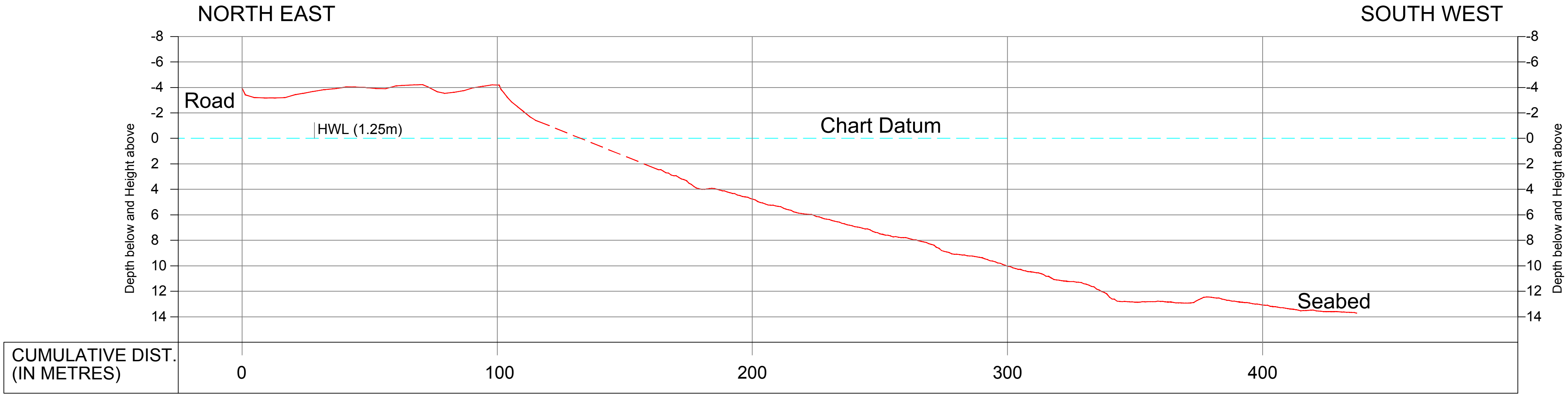
Cross Section Line No.CSP-24
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

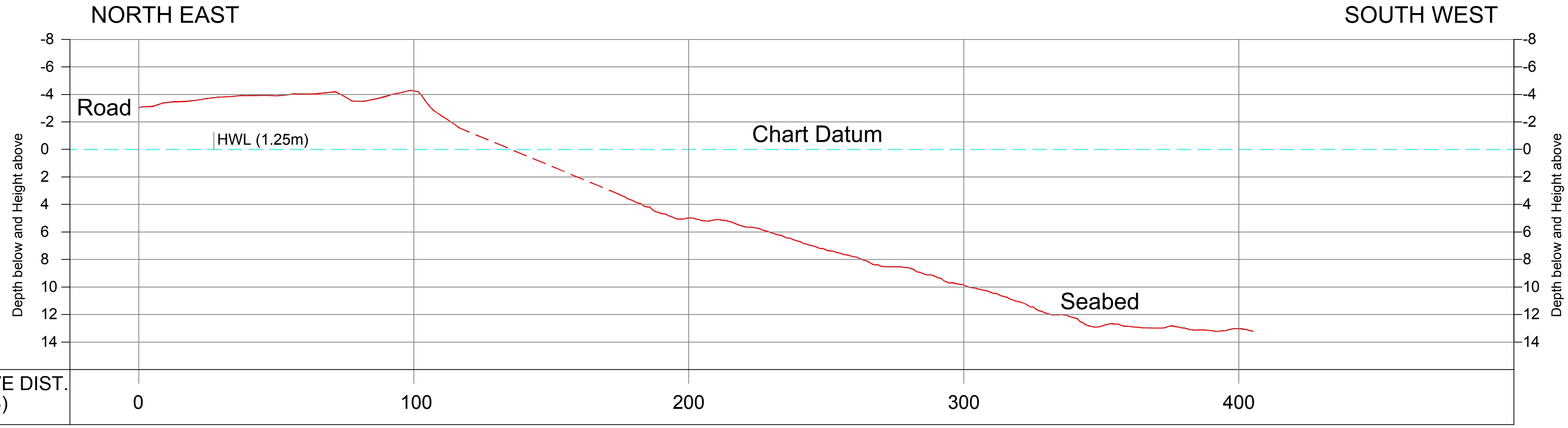
Cross Section Line No.CSP-25
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

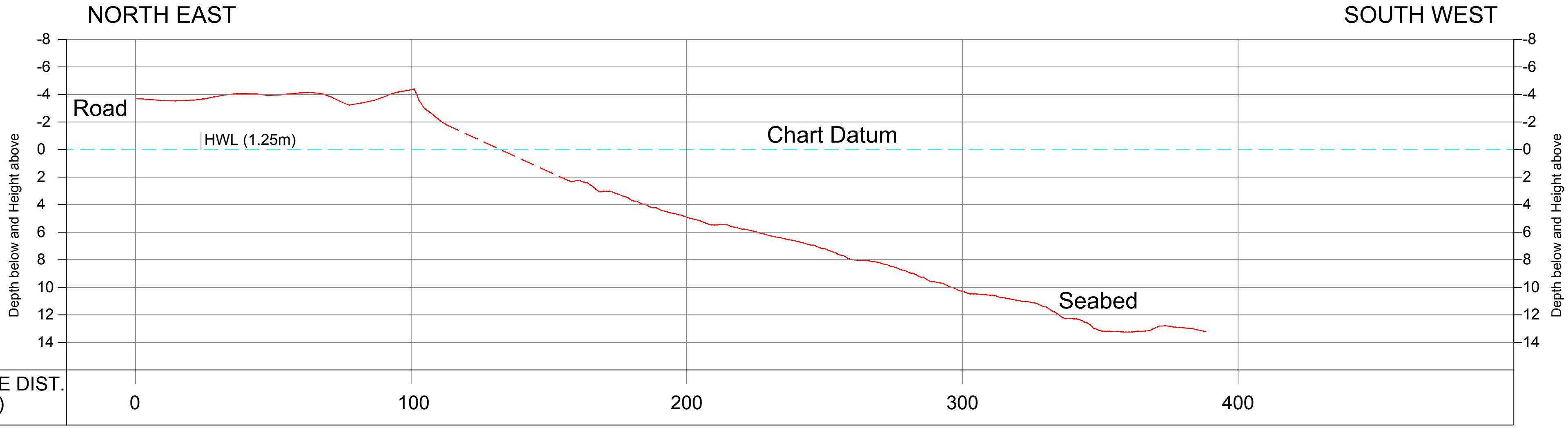
Cross Section Line No.CSP-26
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

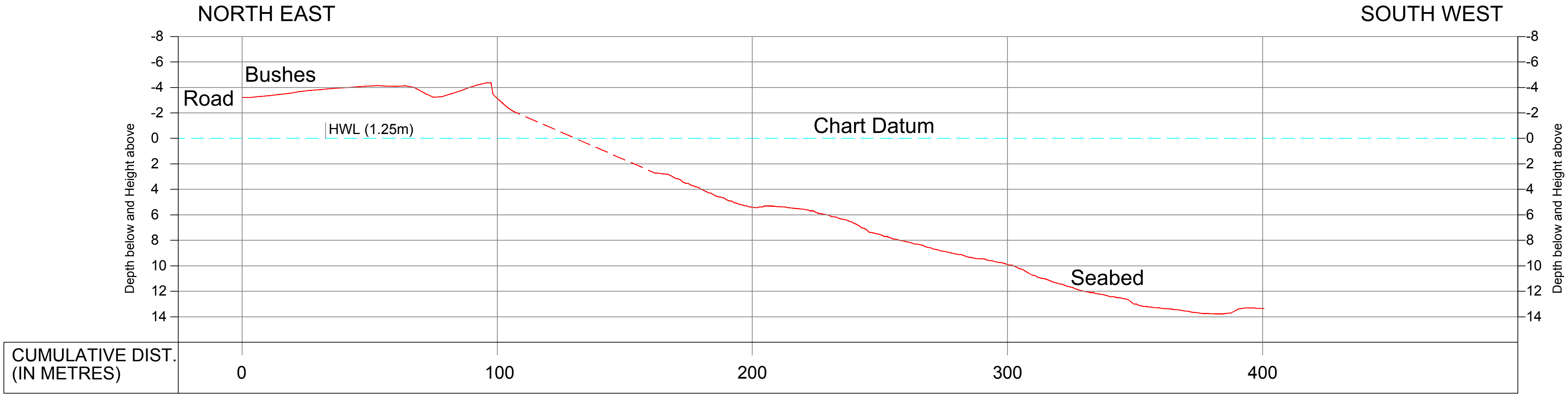
Cross Section Line No.CSP-27
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

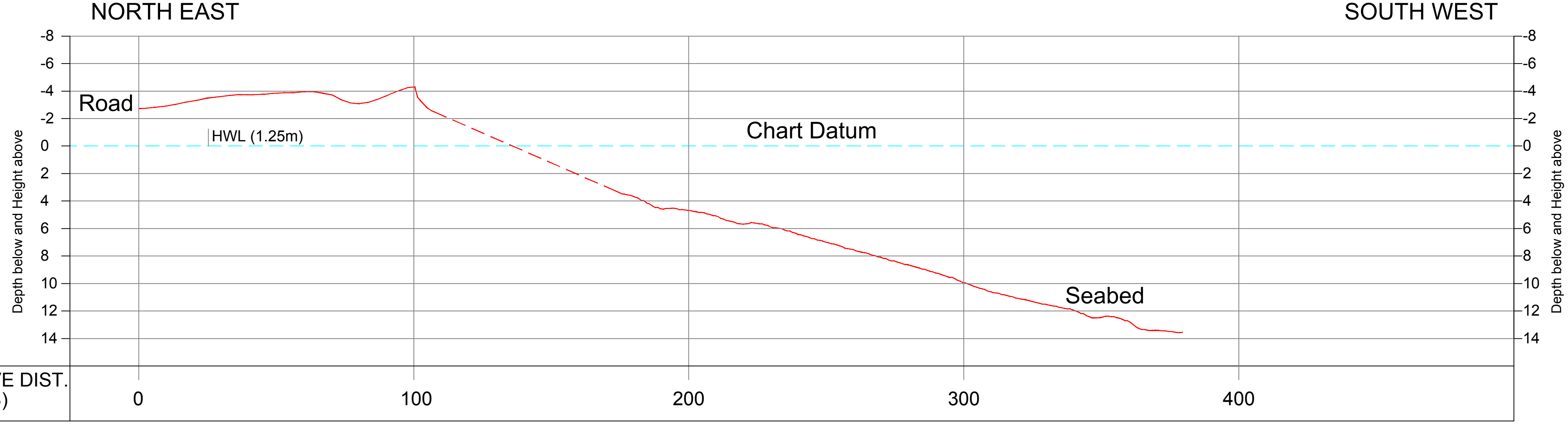
Cross Section Line No.CSP-28
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

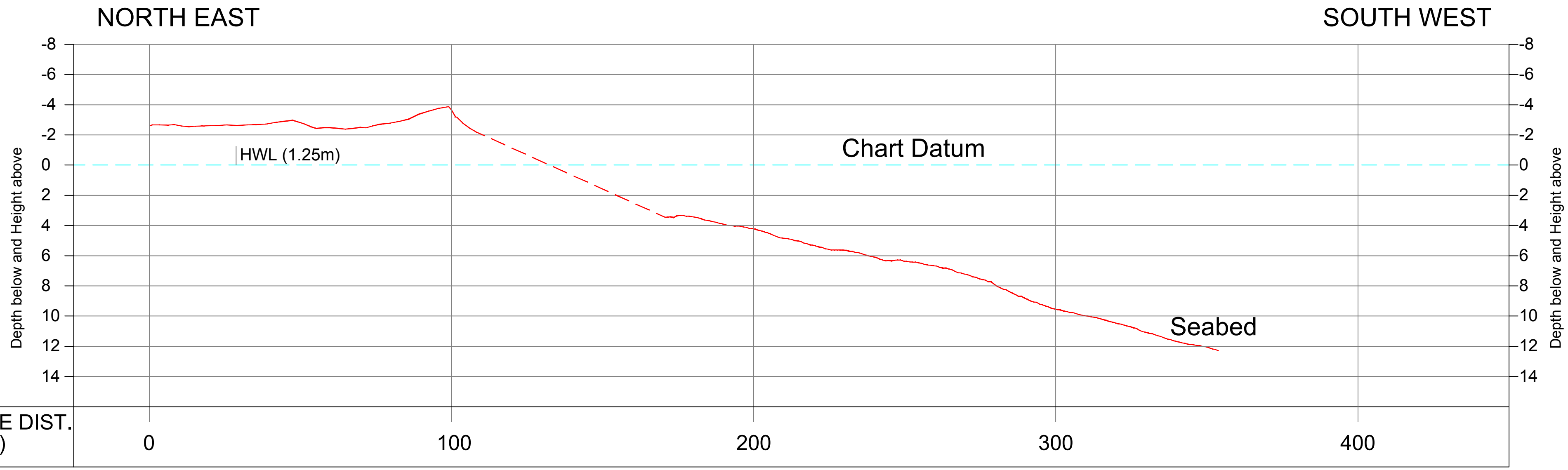
Cross Section Line No.CSP-29
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

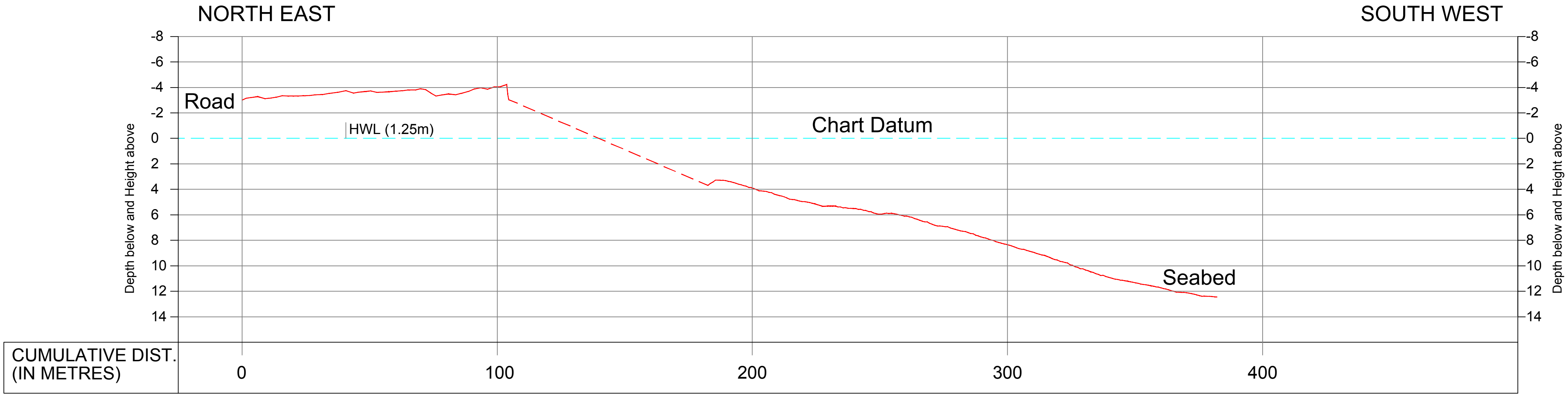
Cross Section Line No.CSP-30
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

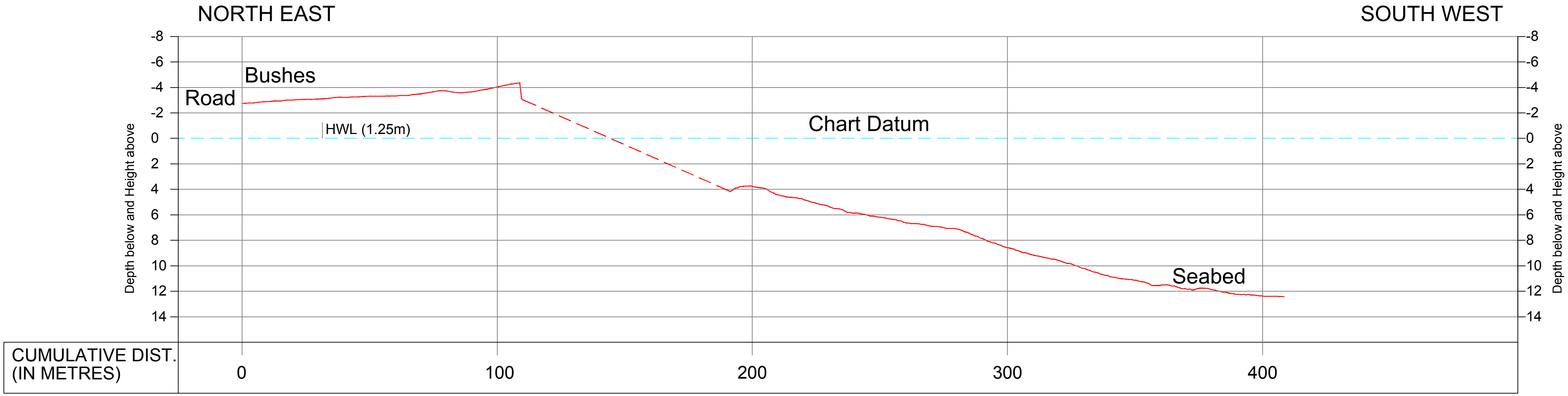
Cross Section Line No.CSP-31
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

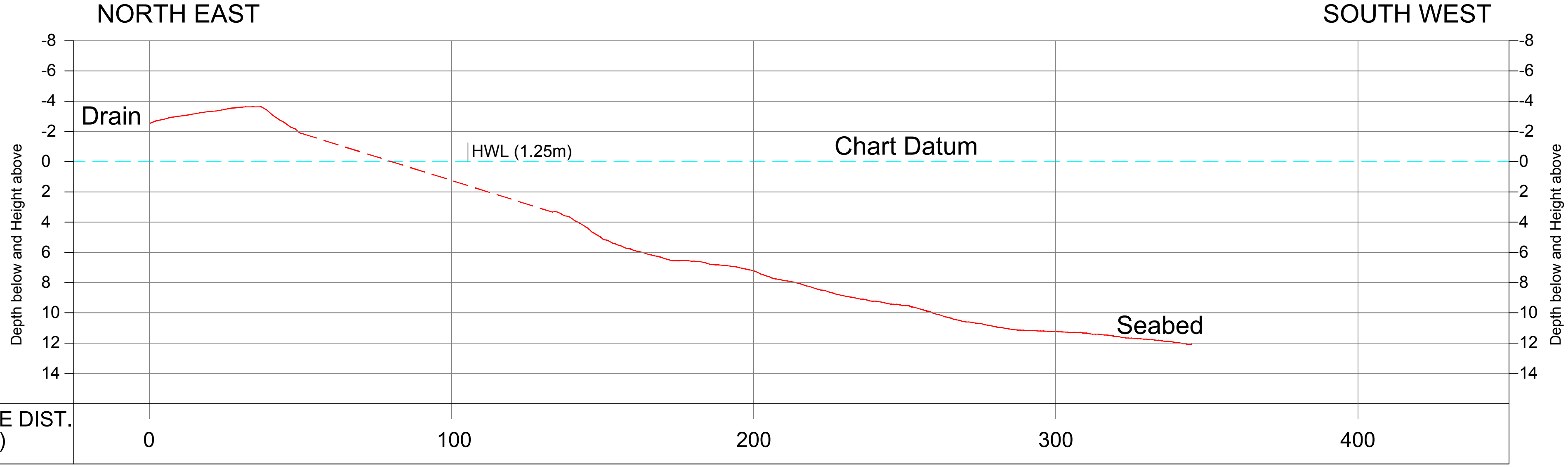
Cross Section Line No.CSP-32
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

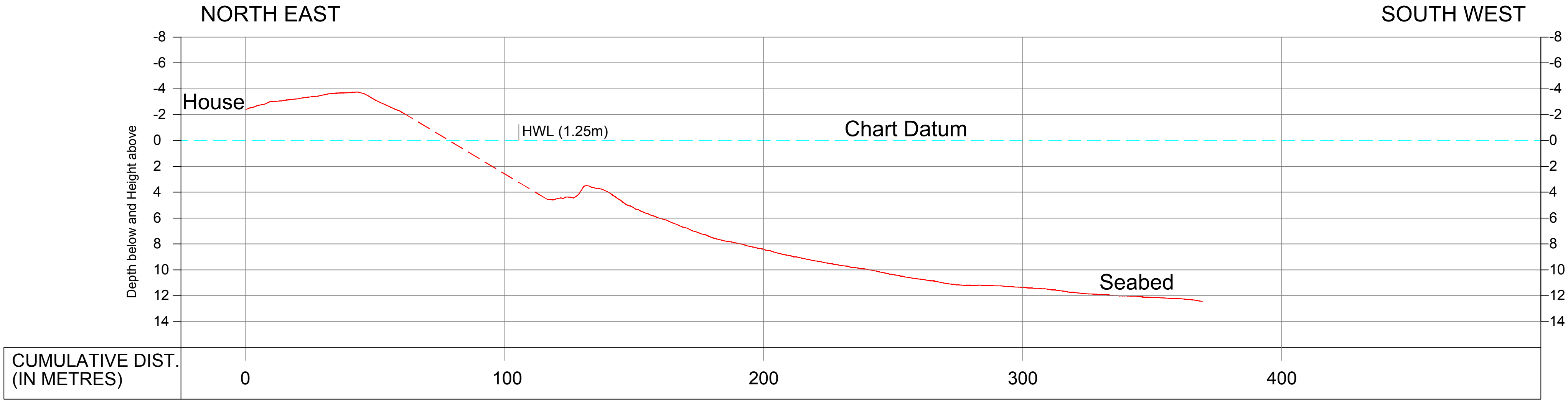
Cross Section Line No.CSP-33
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

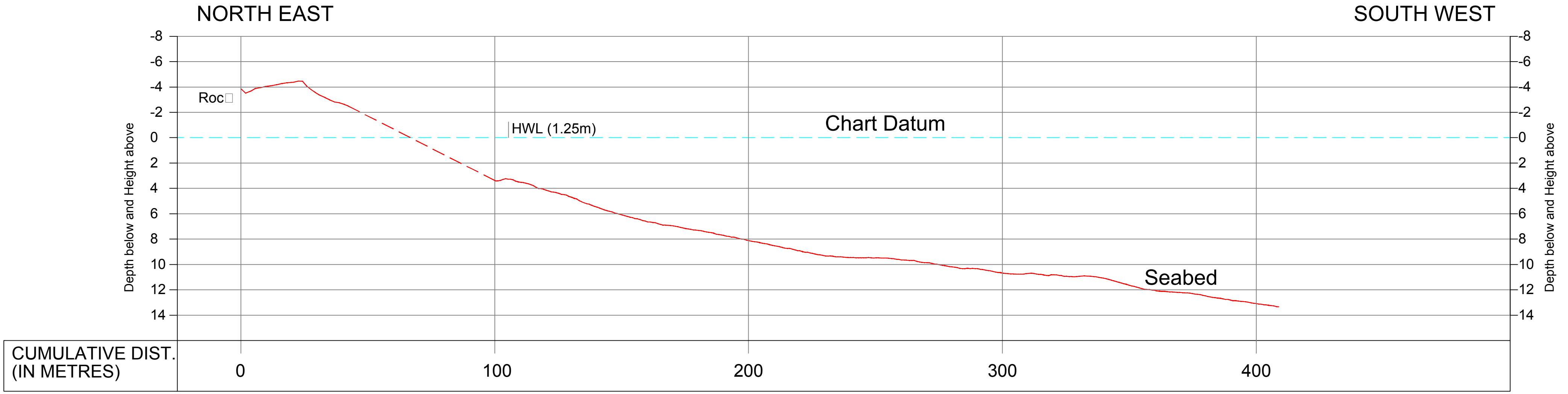
Cross Section Line No.CSP-34
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

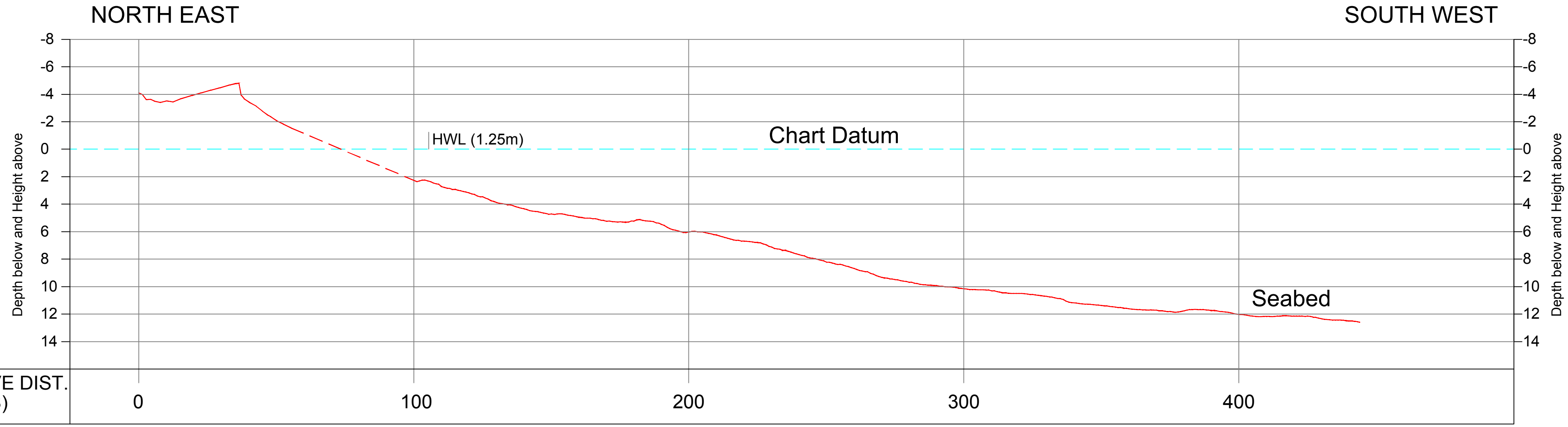
Cross Section Line No.CSP-35
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

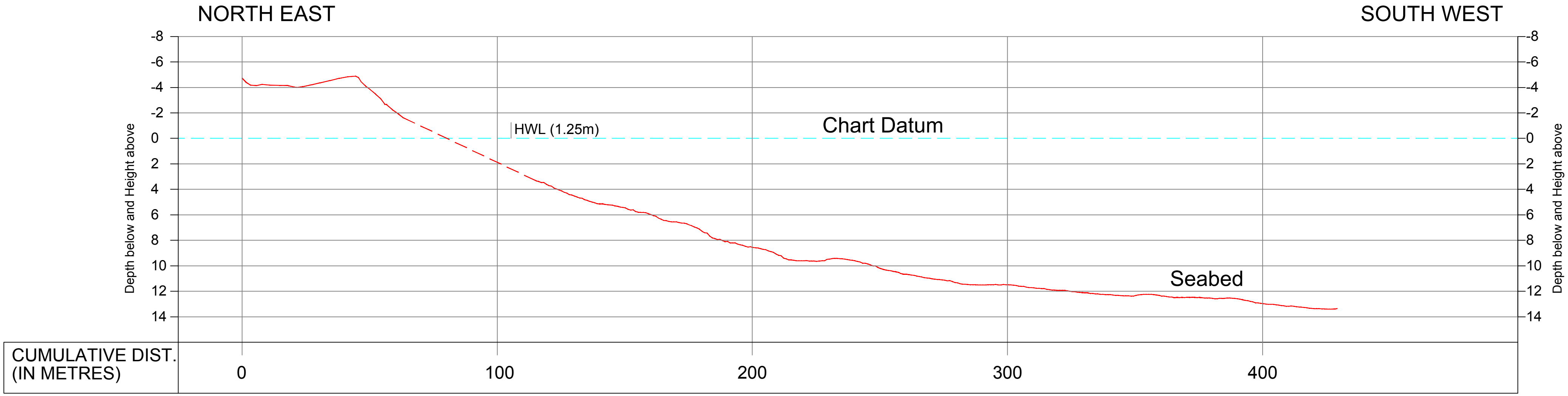
Cross Section Line No.CSP-36
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

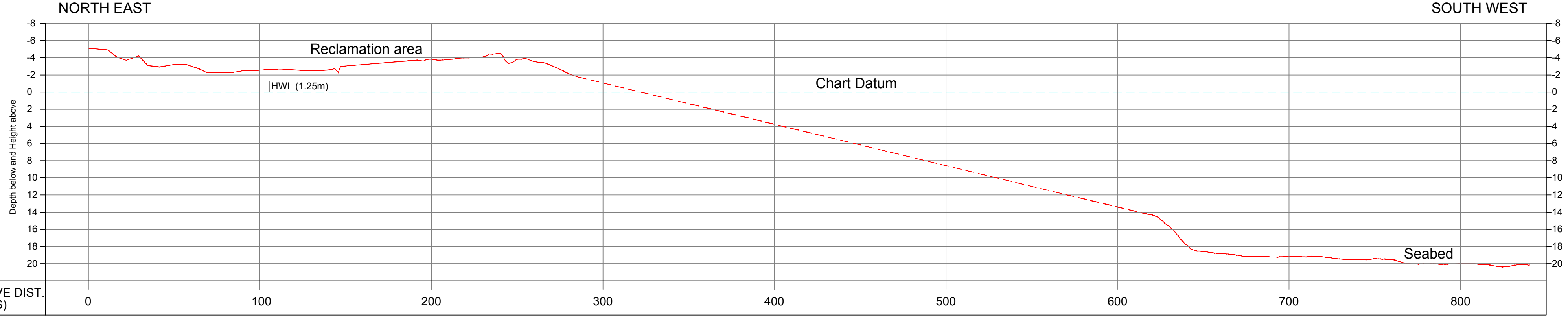
Cross Section Line No.CSP-37
(May 2019)



Cross Shore Profile

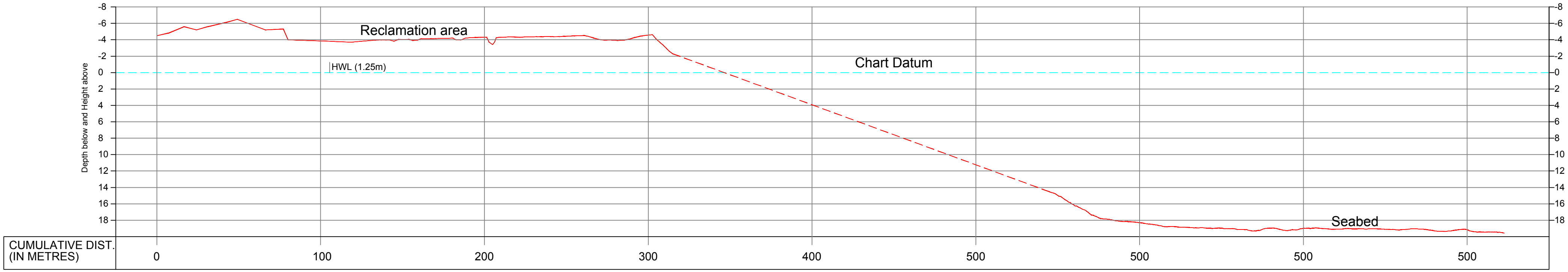
SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-38
(May 2019)



SCALE HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-39
(May 2019)



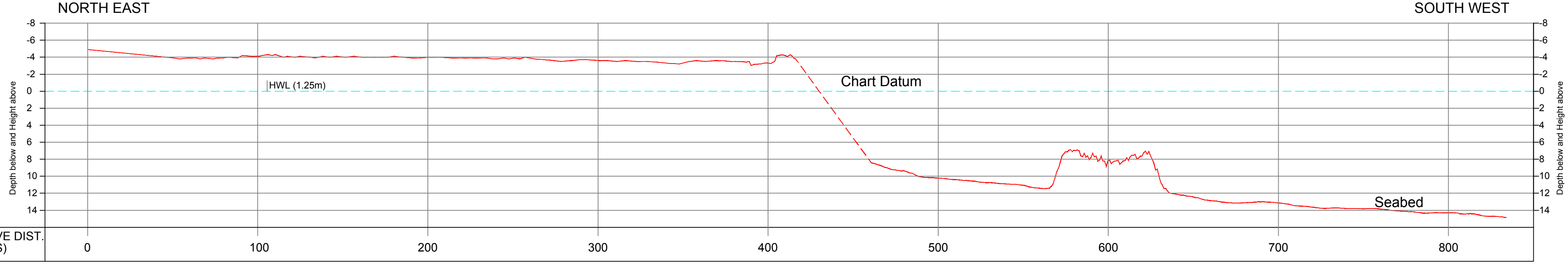
Cross Shore Profile

SCALE VERTICAL 1: 400

HORIZONTAL 1: 2000

Cross Section Line No.CSP-40

(May 2019)



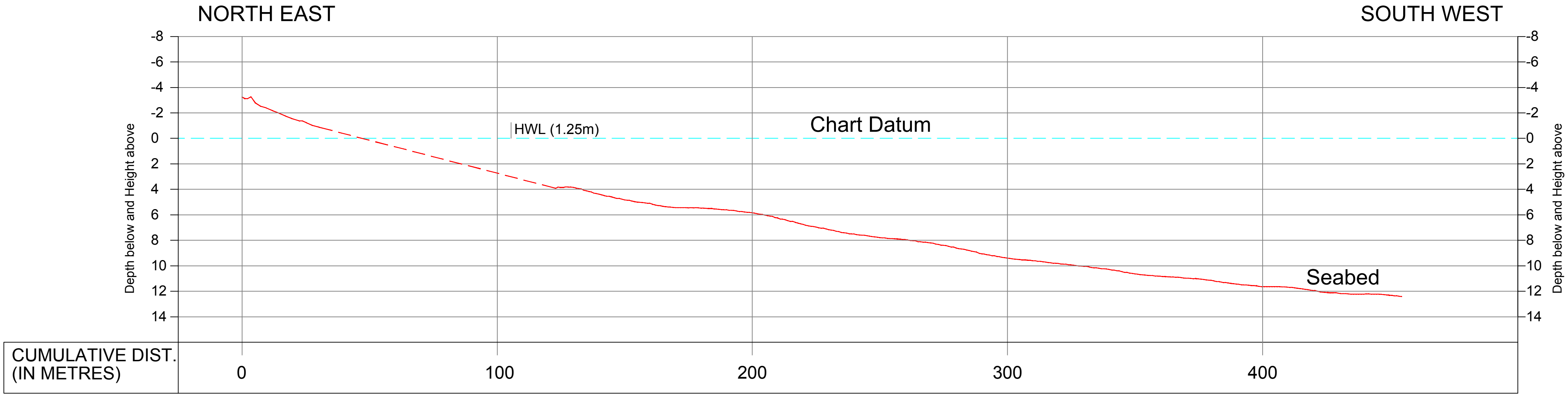
Cross Shore Profile

SCALE

HORIZONTAL 1: 2000

VERTICAL 1: 400

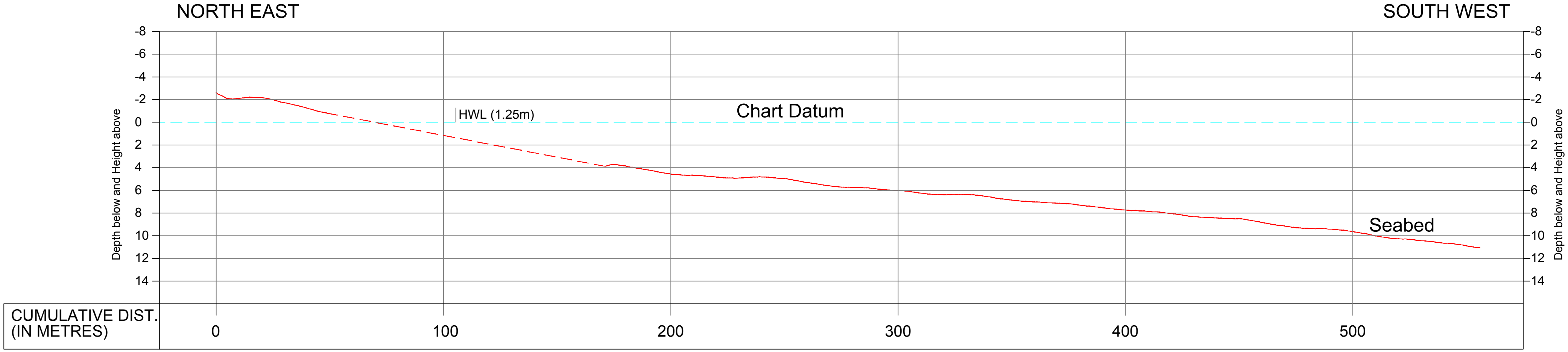
Cross Section Line No.CSP-41
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

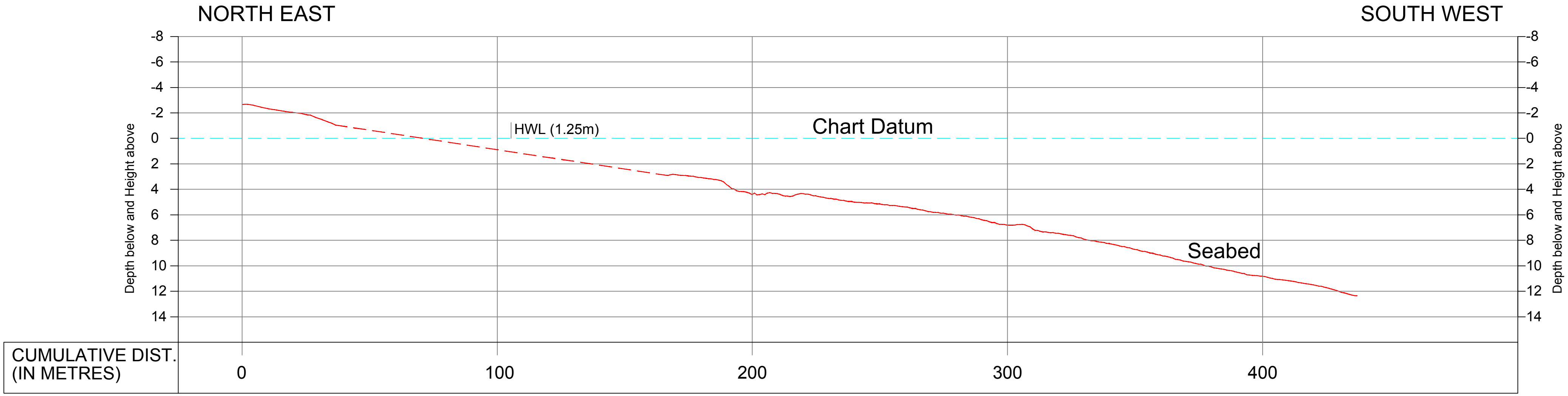
Cross Section Line No.CSP-42
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

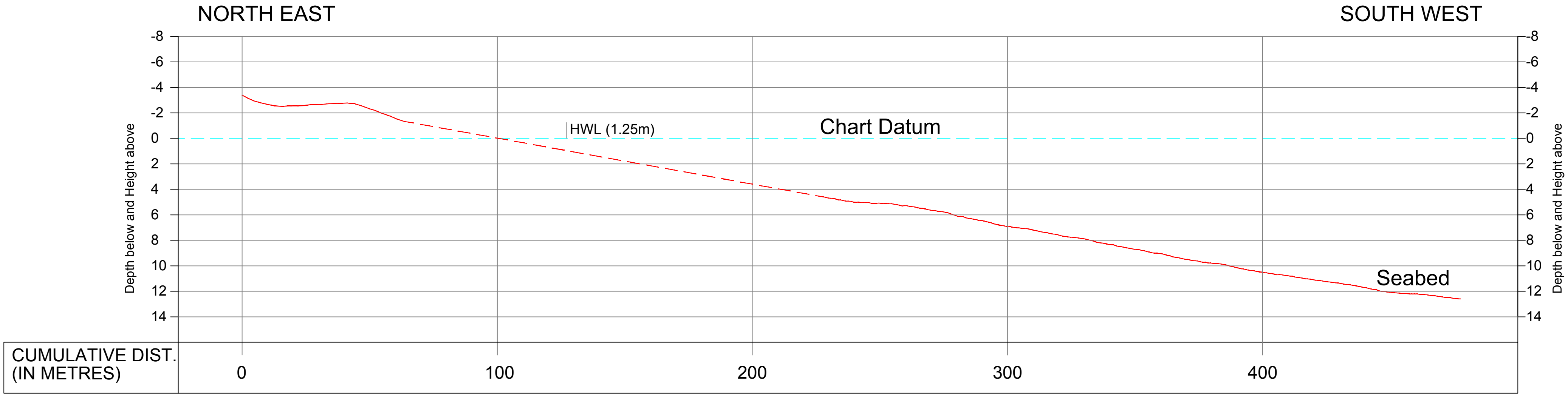
Cross Section Line No.CSP-43
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

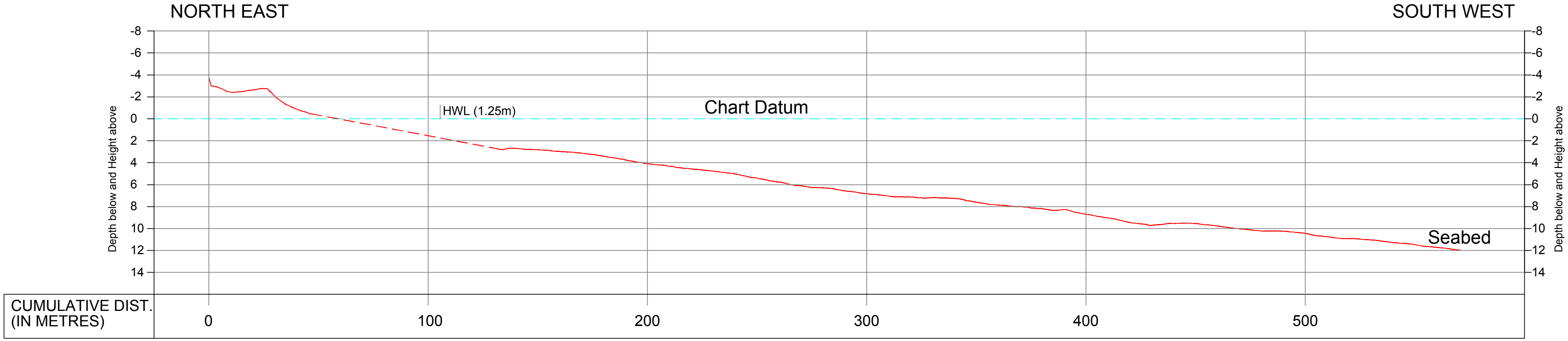
Cross Section Line No.CSP-44
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

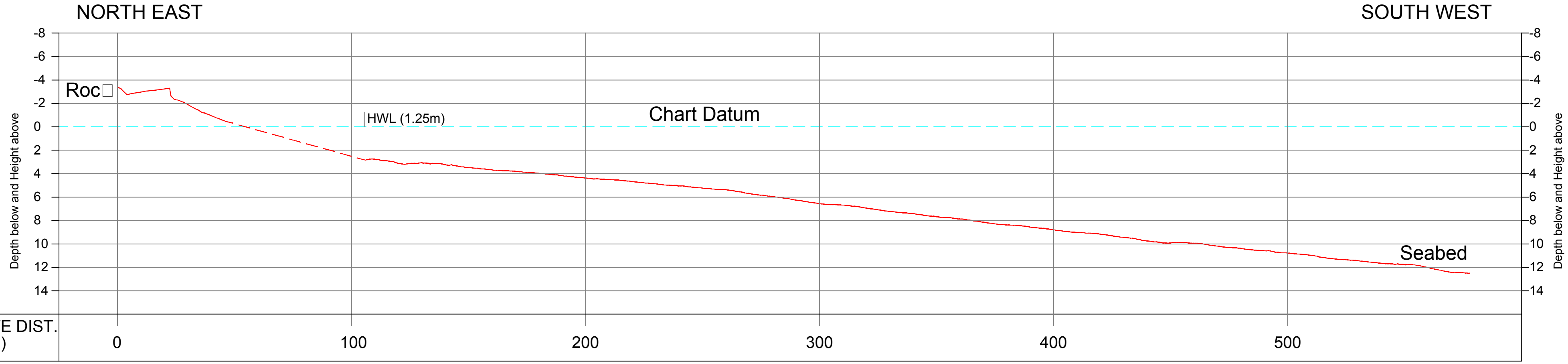
Cross Section Line No.CSP-45
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

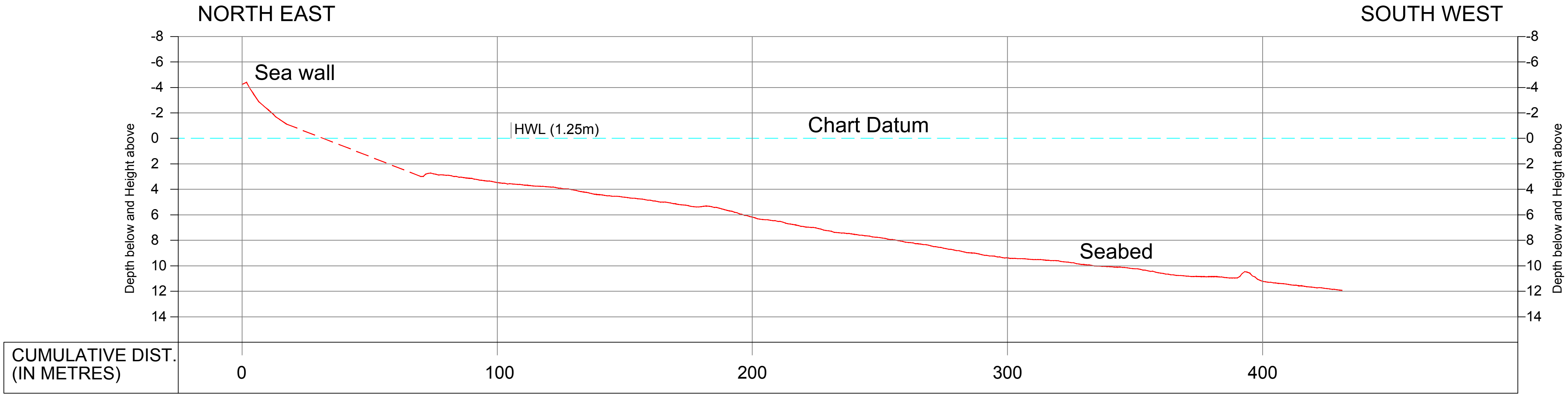
Cross Section Line No.CSP-46
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

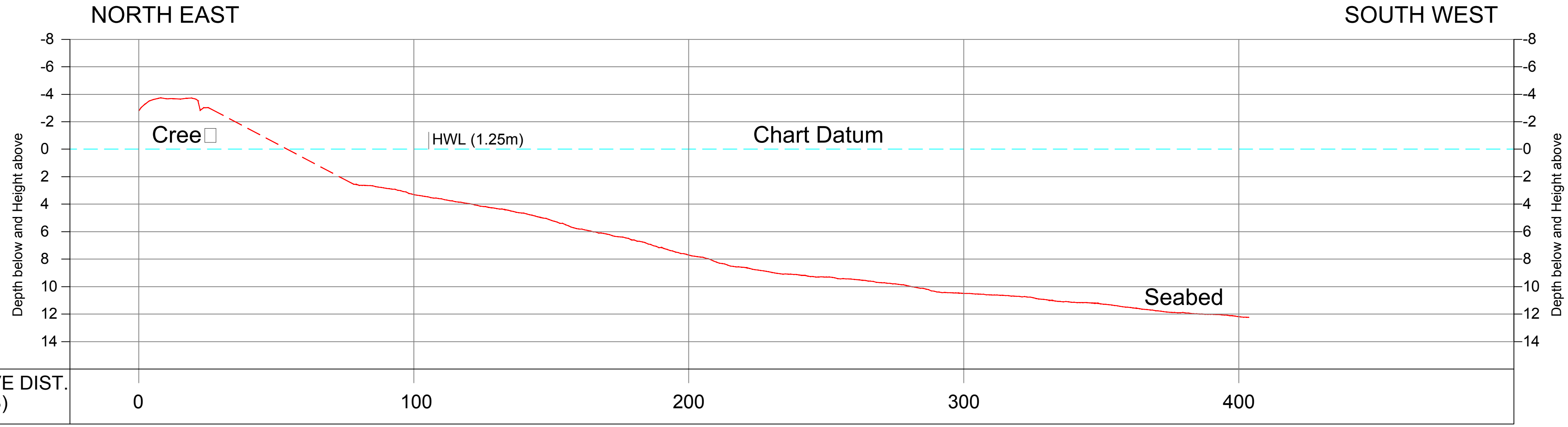
Cross Section Line No.CSP-47
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

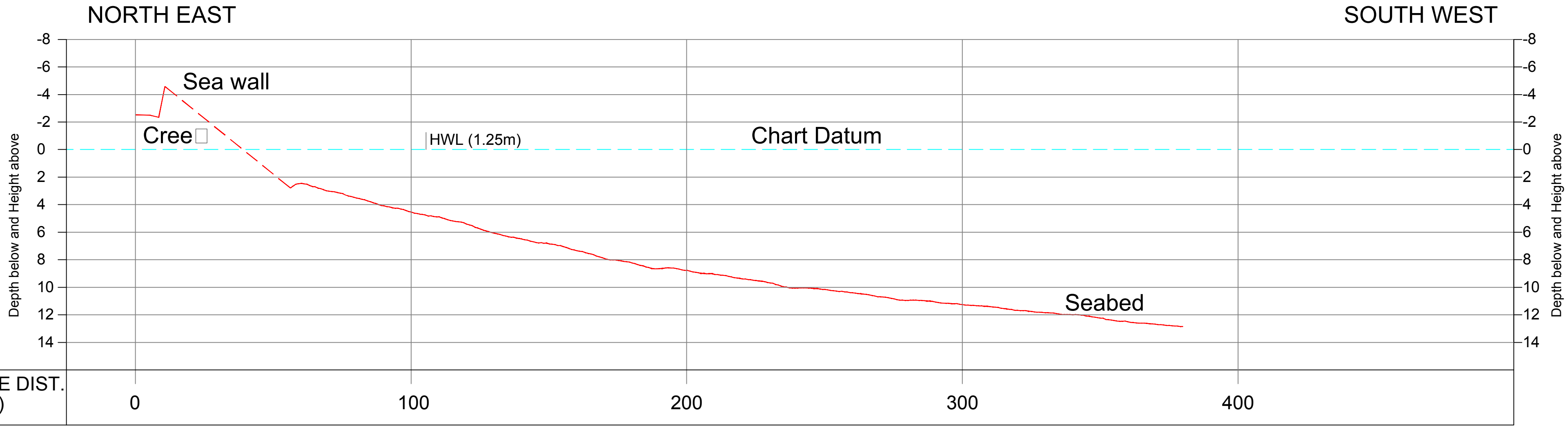
Cross Section Line No.CSP-48
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-49
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

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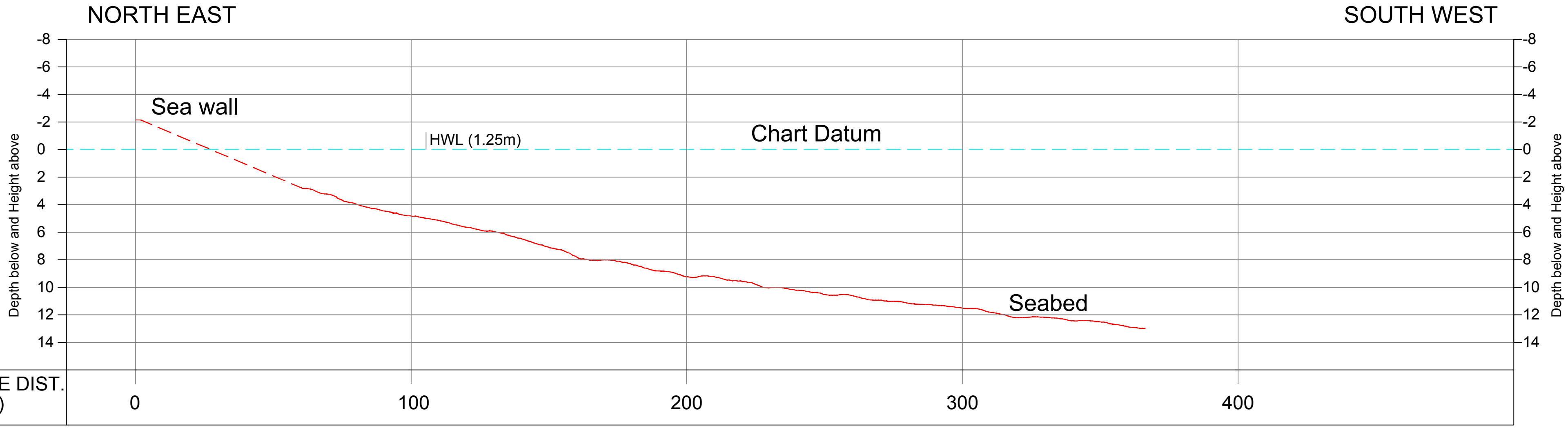
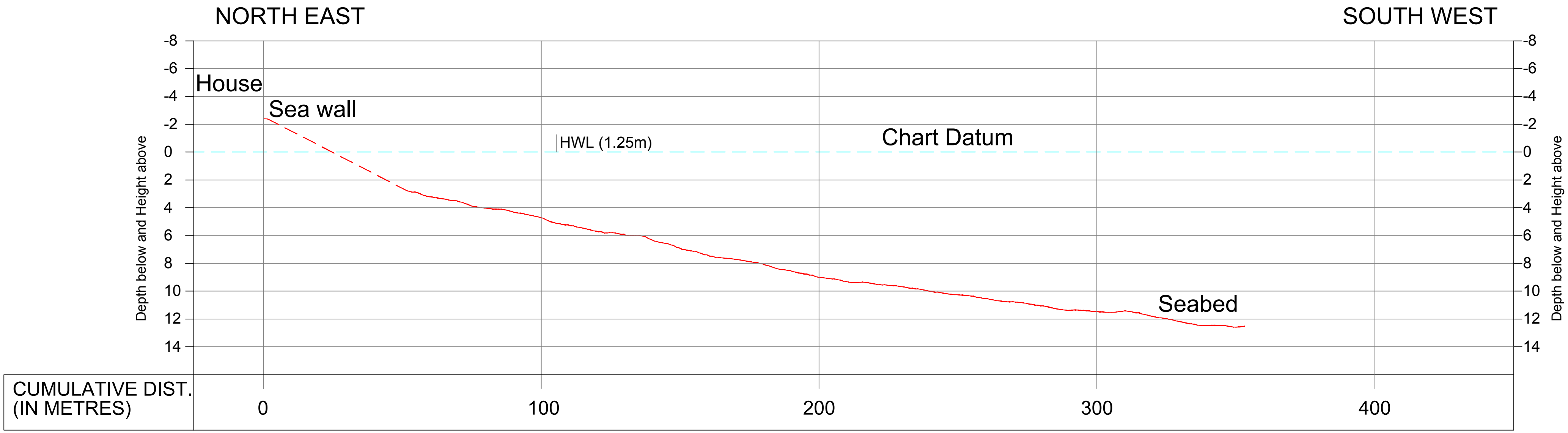
Cross Section Line No.CSP-50
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

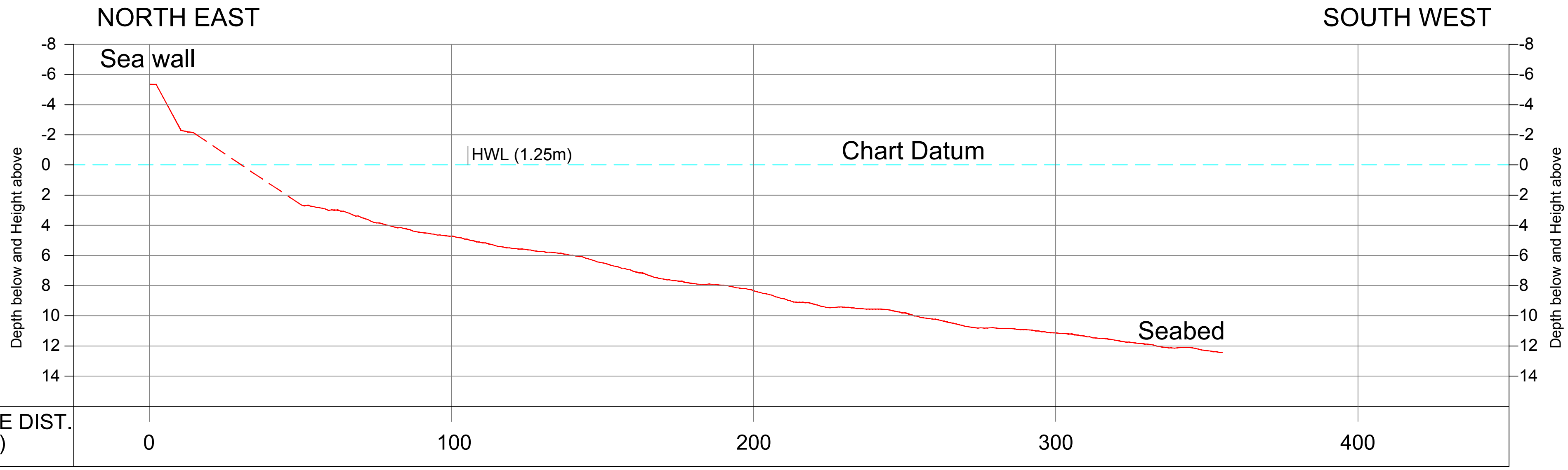
Cross Section Line No.CSP-51
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

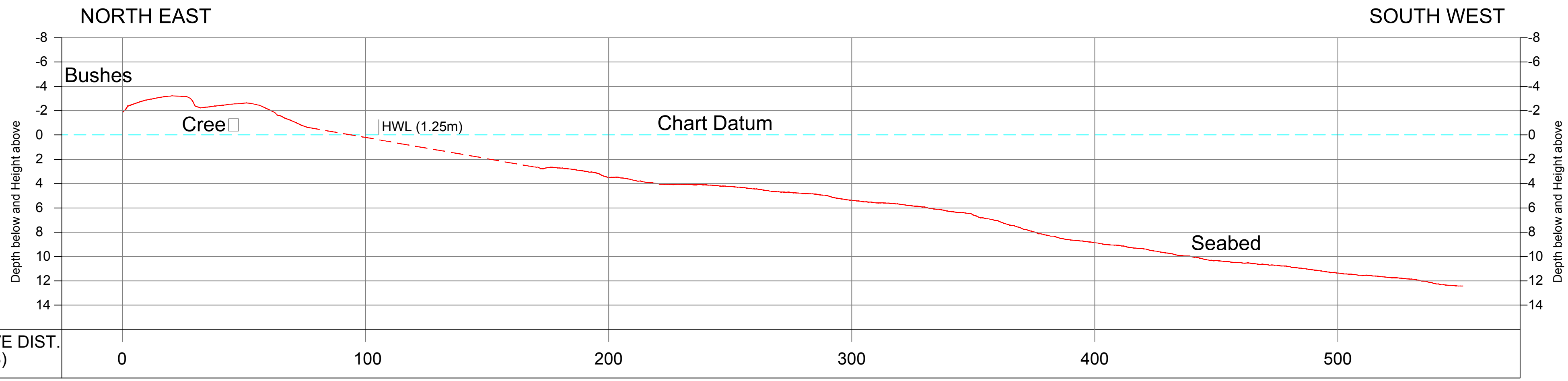
Cross Section Line No.CSP-52
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

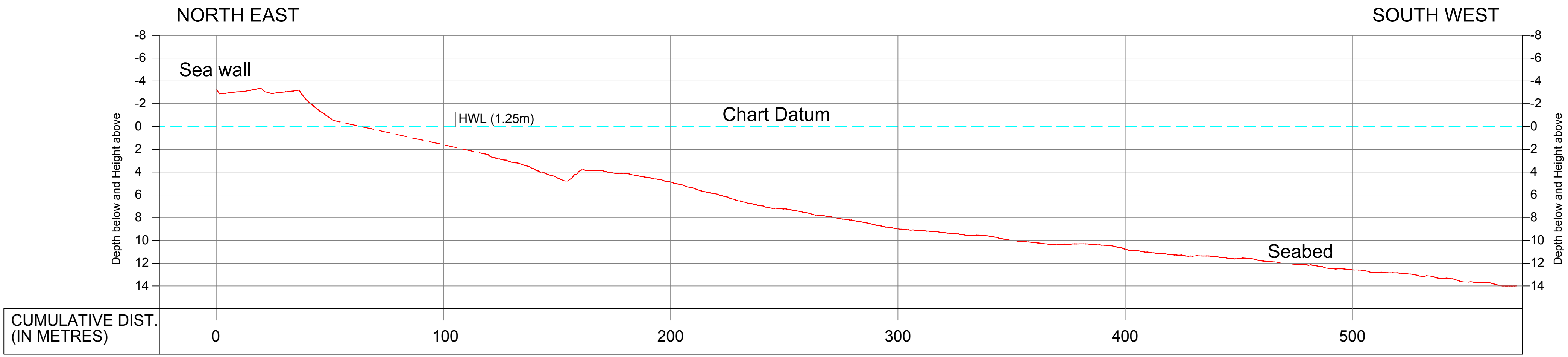
Cross Section Line No.CSP-53
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

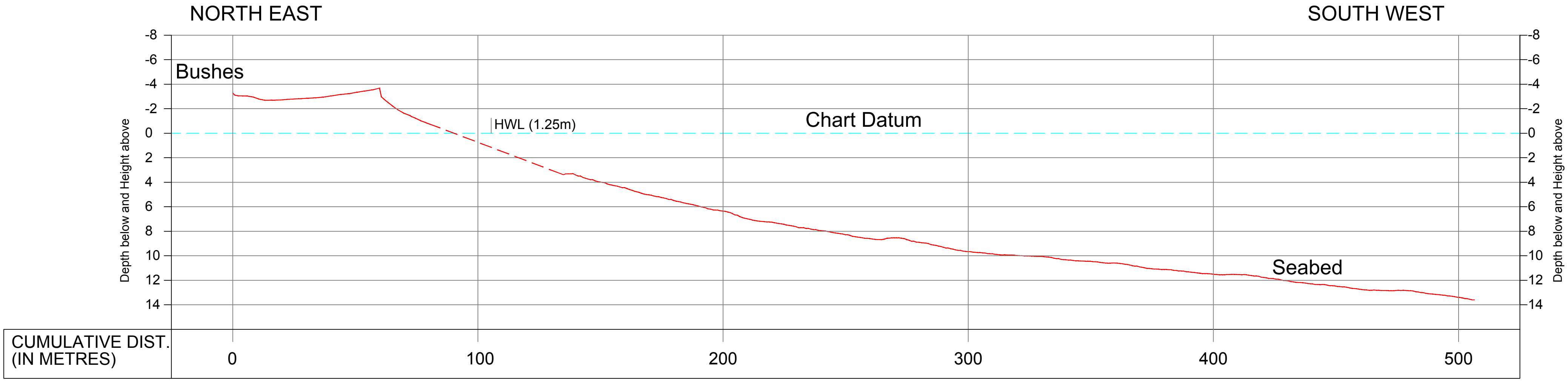
Cross Section Line No.CSP-54
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

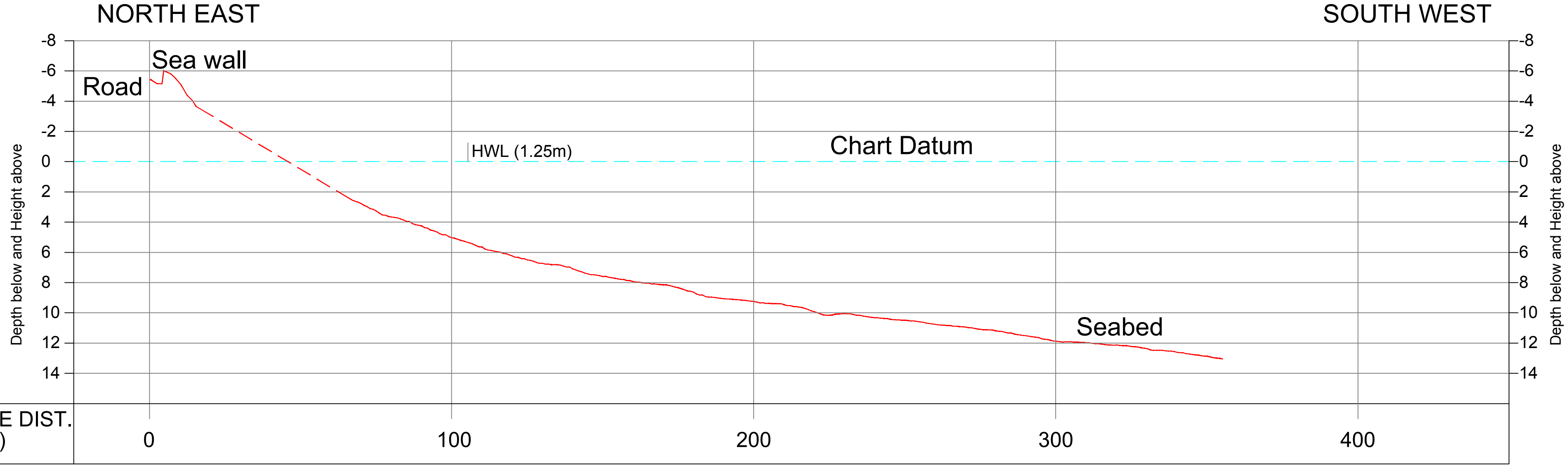
Cross Section Line No.CSP-55
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

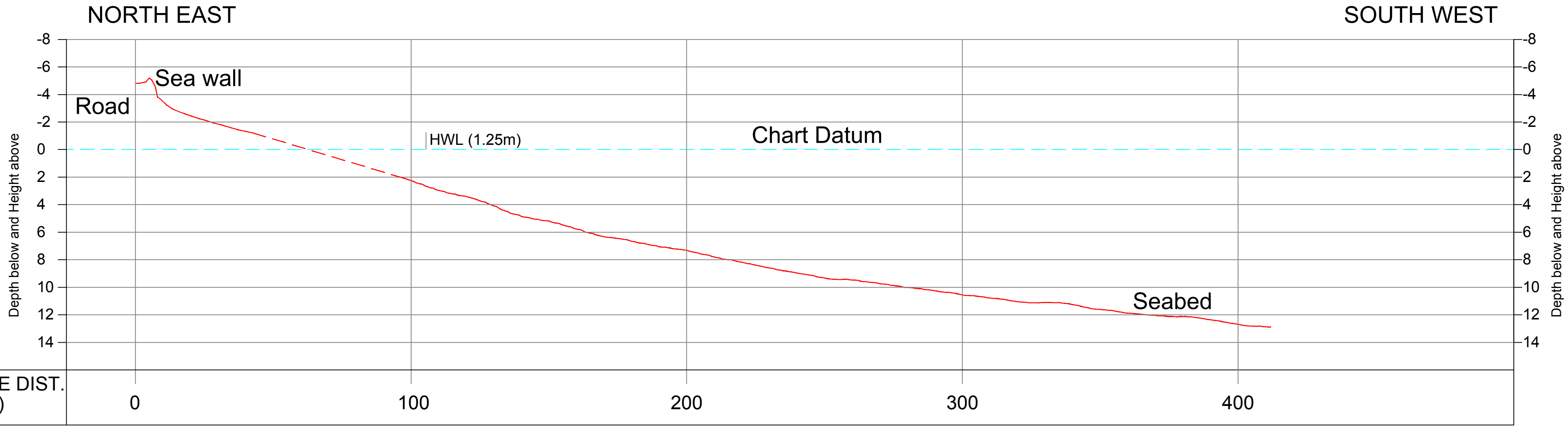
Cross Section Line No.CSP-56
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

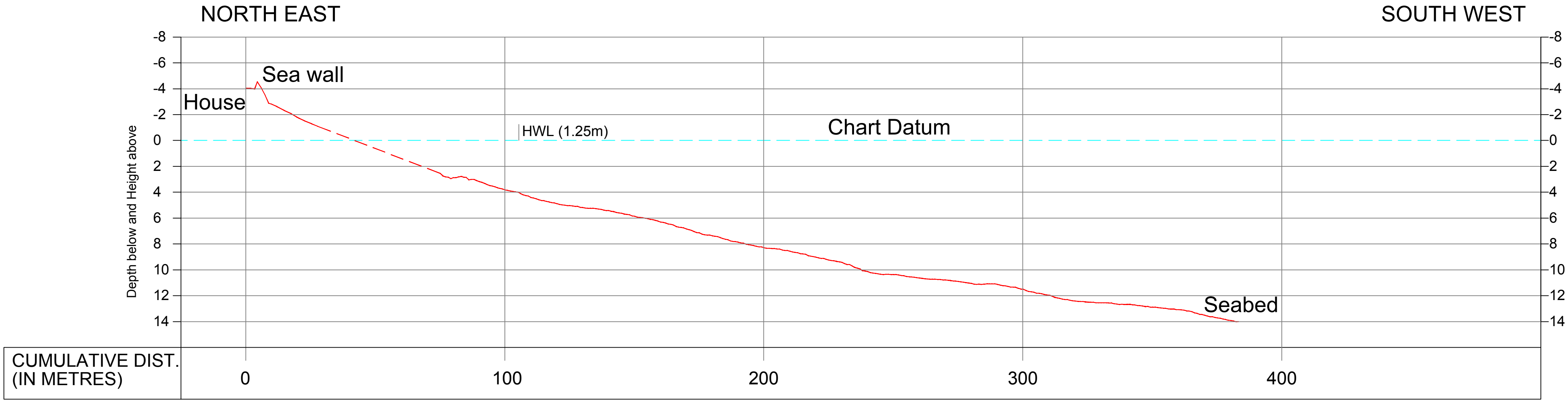
Cross Section Line No.CSP-57
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

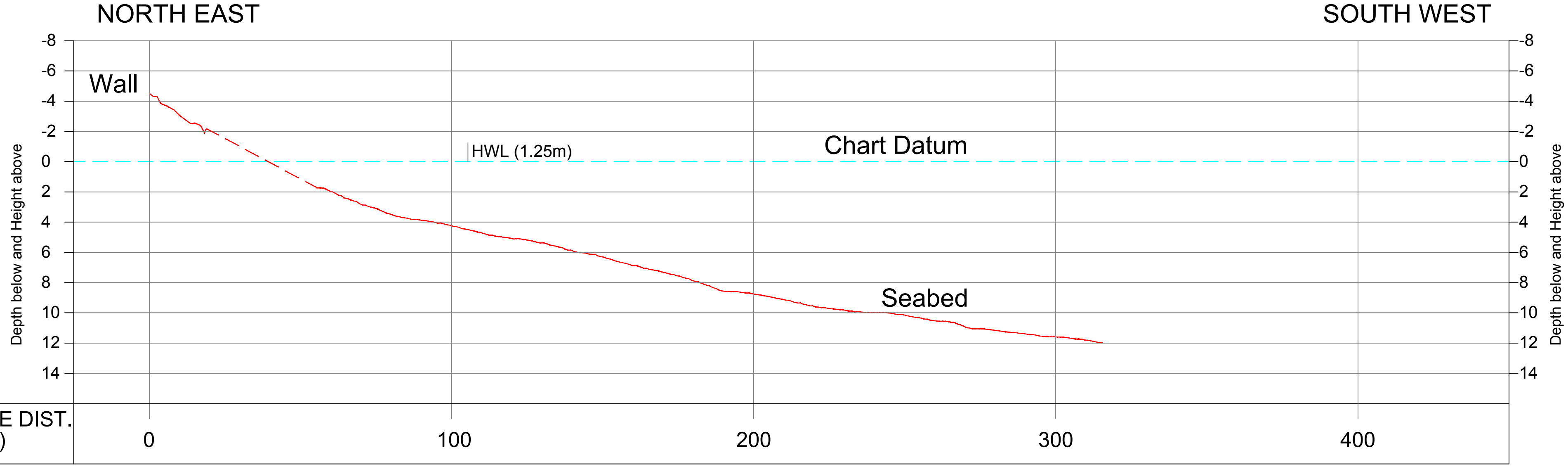
Cross Section Line No.CSP-58
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

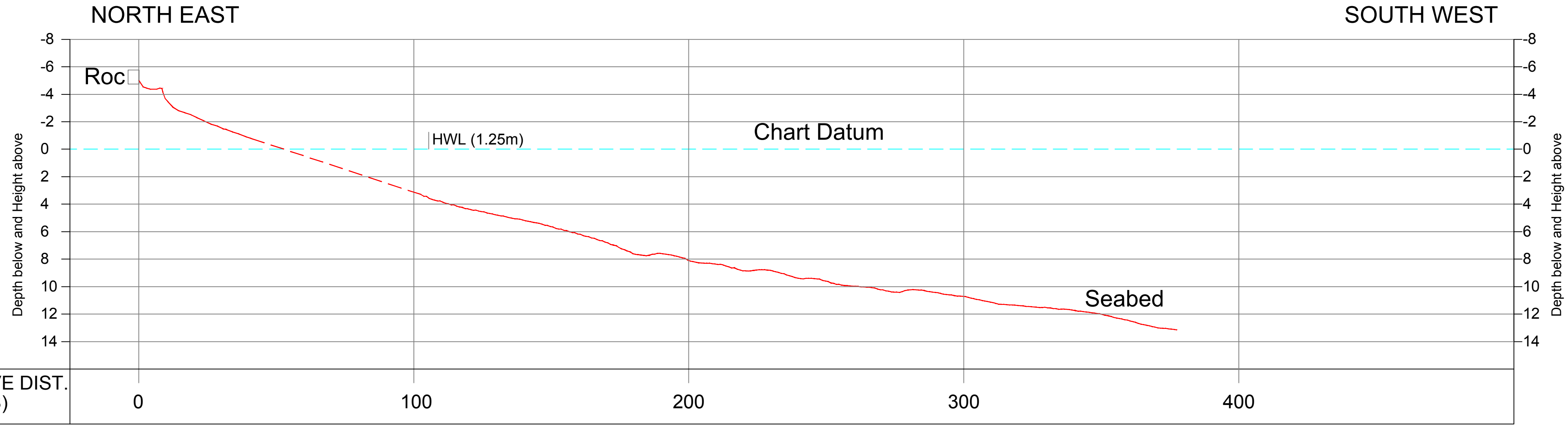
Cross Section Line No.CSP-59
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

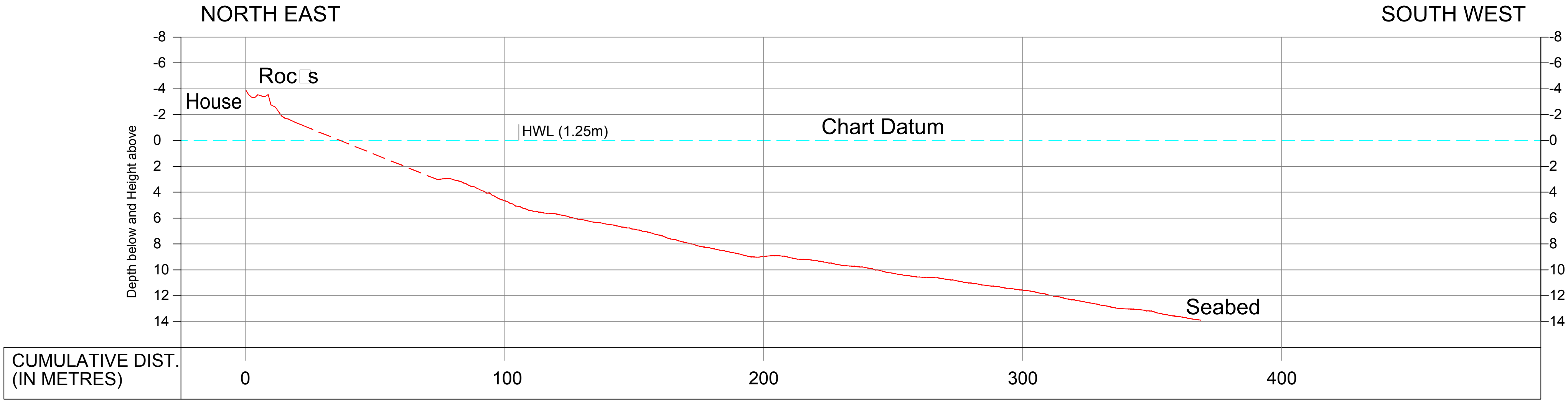
Cross Section Line No.CSP-60
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

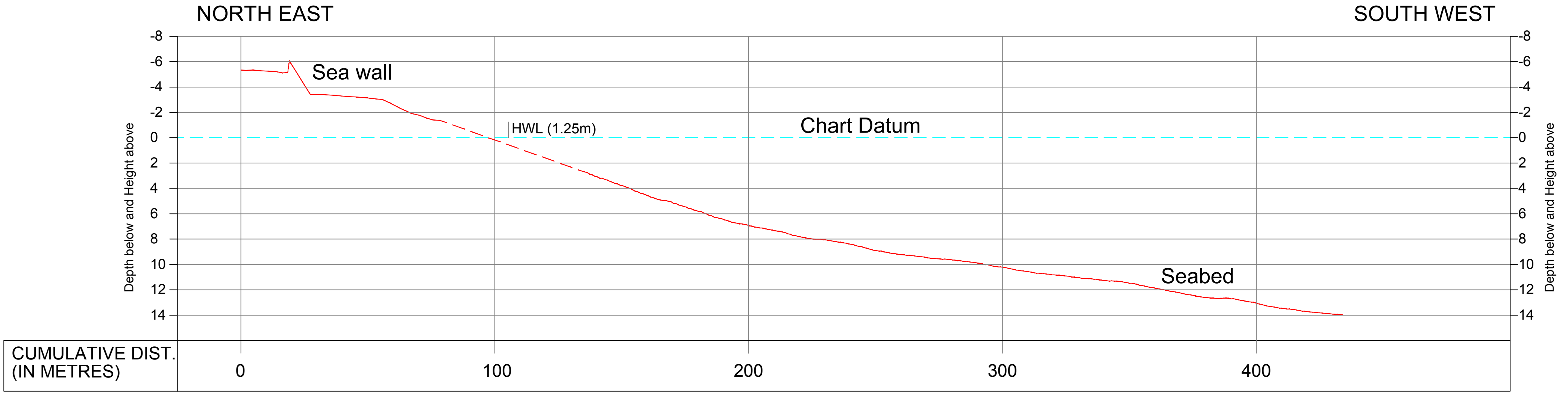
Cross Section Line No.CSP-61
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-62
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

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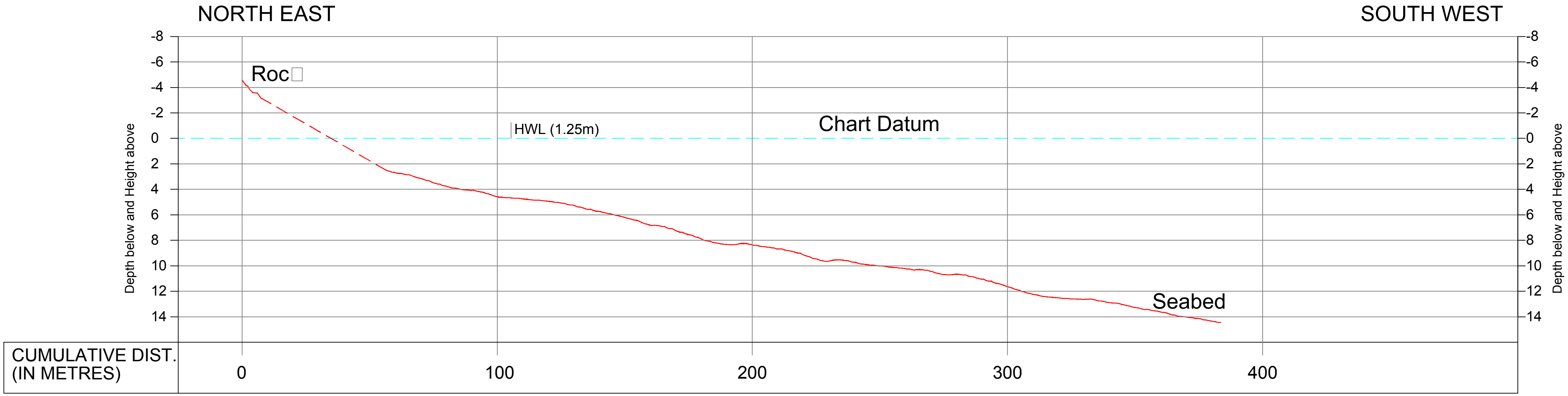
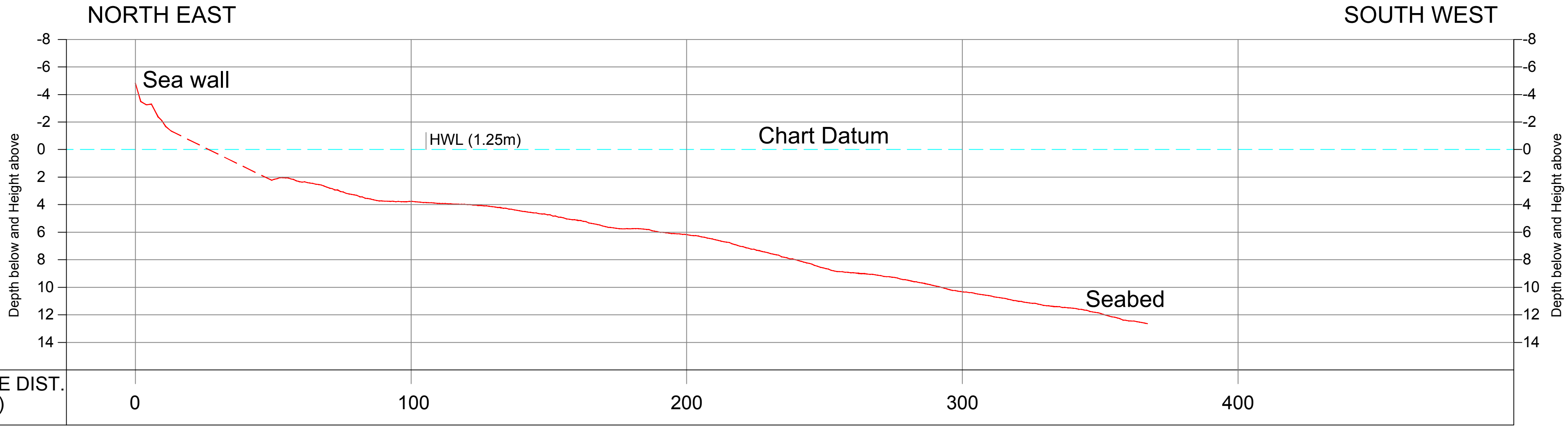
Cross Section Line No.CSP-63
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

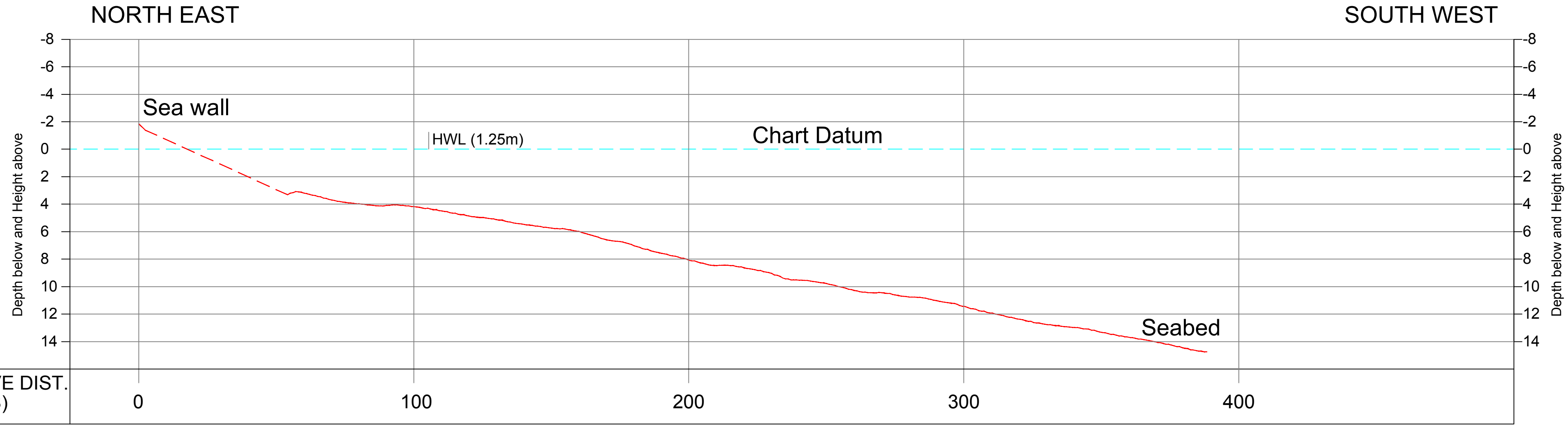
Cross Section Line No.CSP-64
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

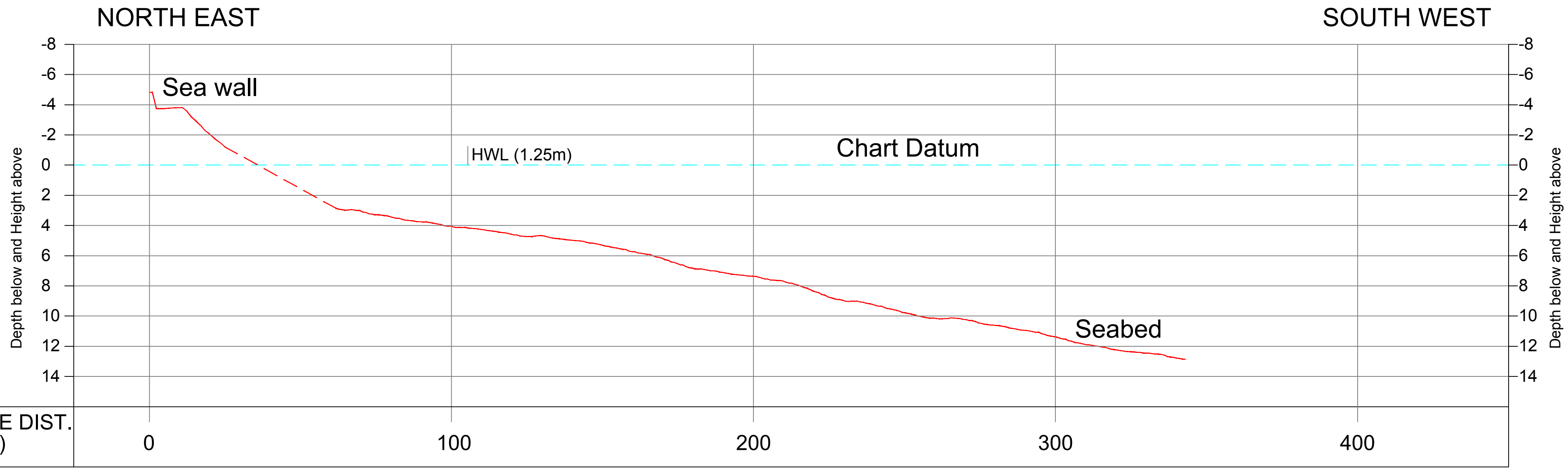
Cross Section Line No.CSP-65
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

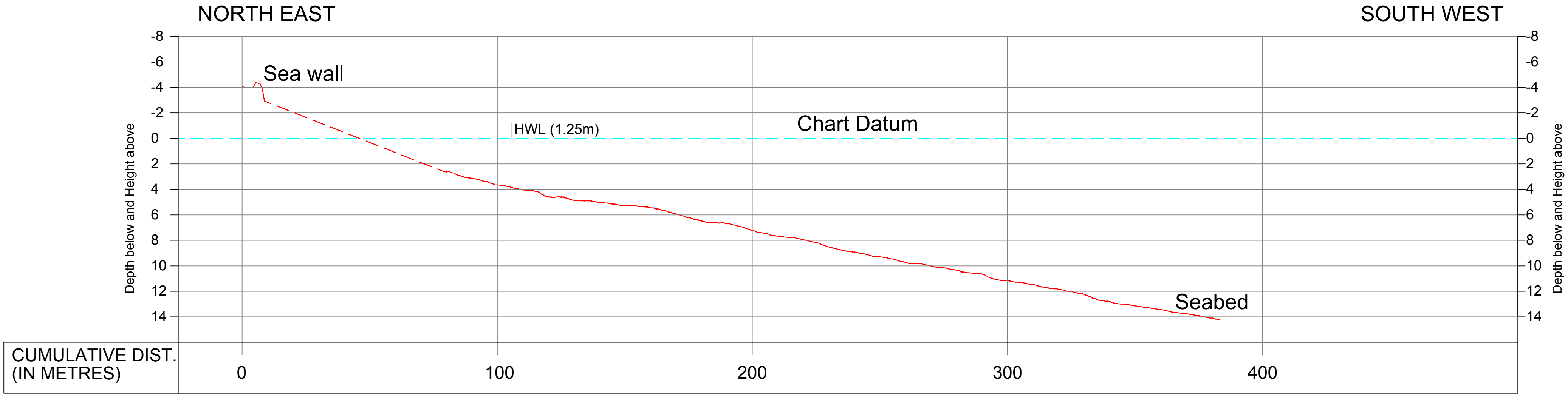
Cross Section Line No.CSP-66
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

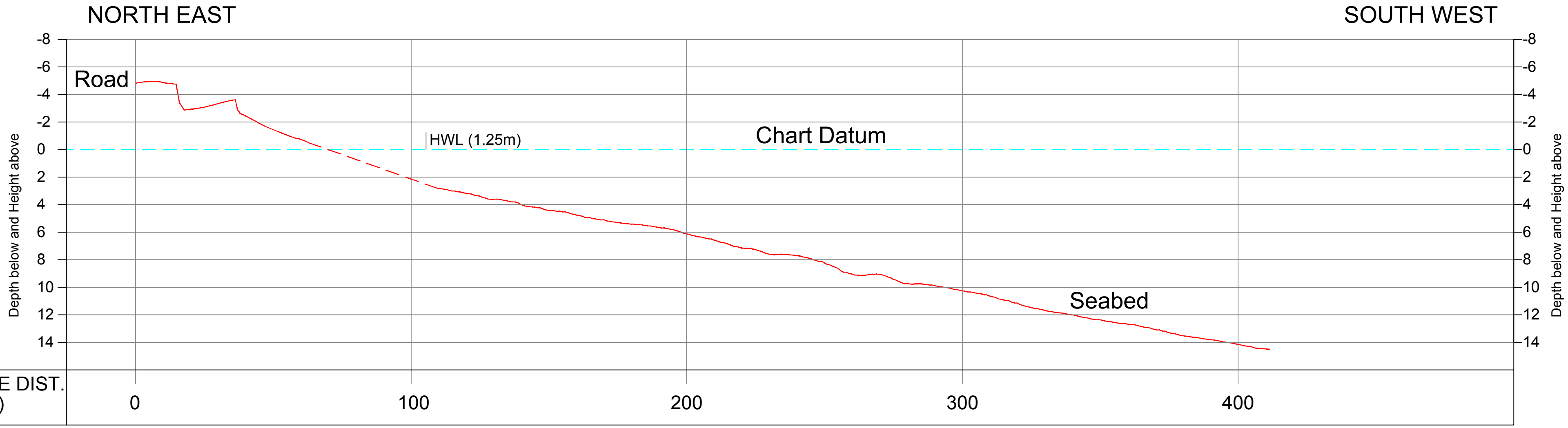
Cross Section Line No.CSP-67
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

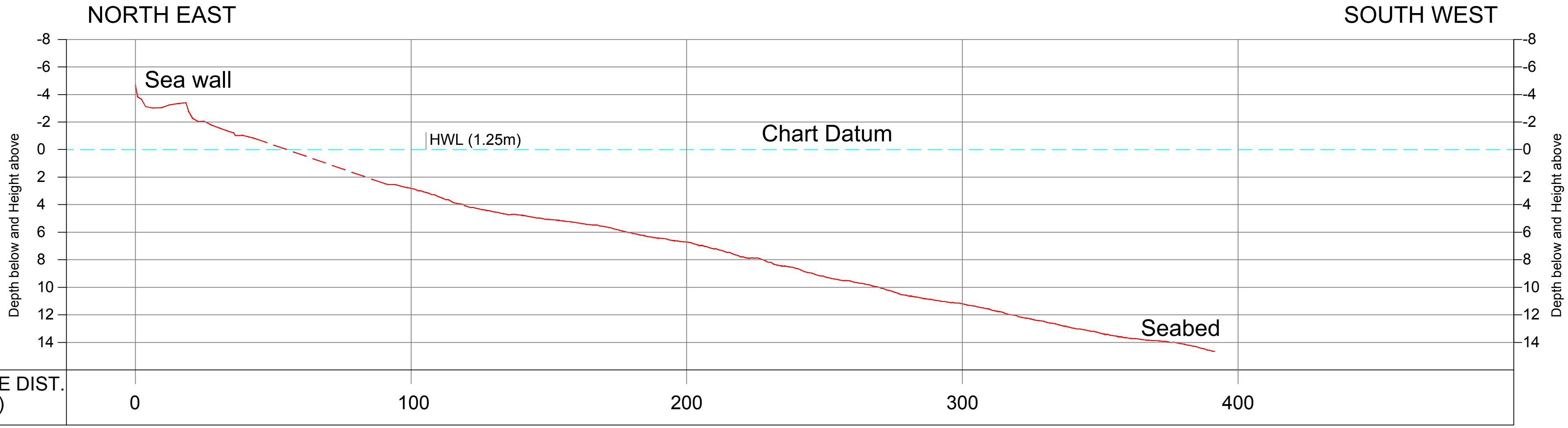
Cross Section Line No.CSP-68
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

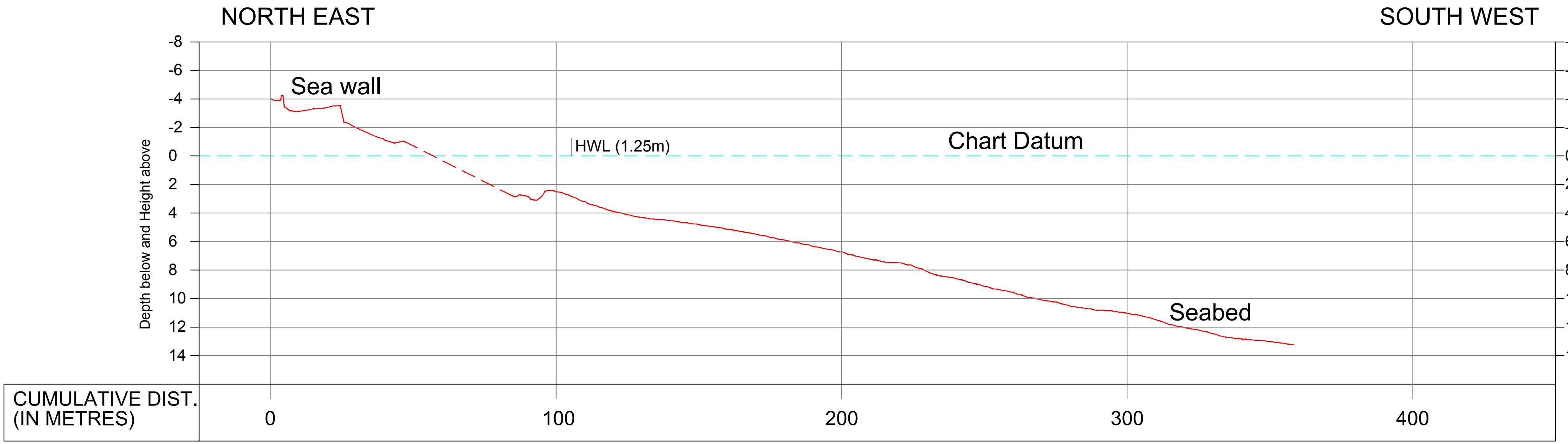
Cross Section Line No.CSP-69
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-70
(May 2019)

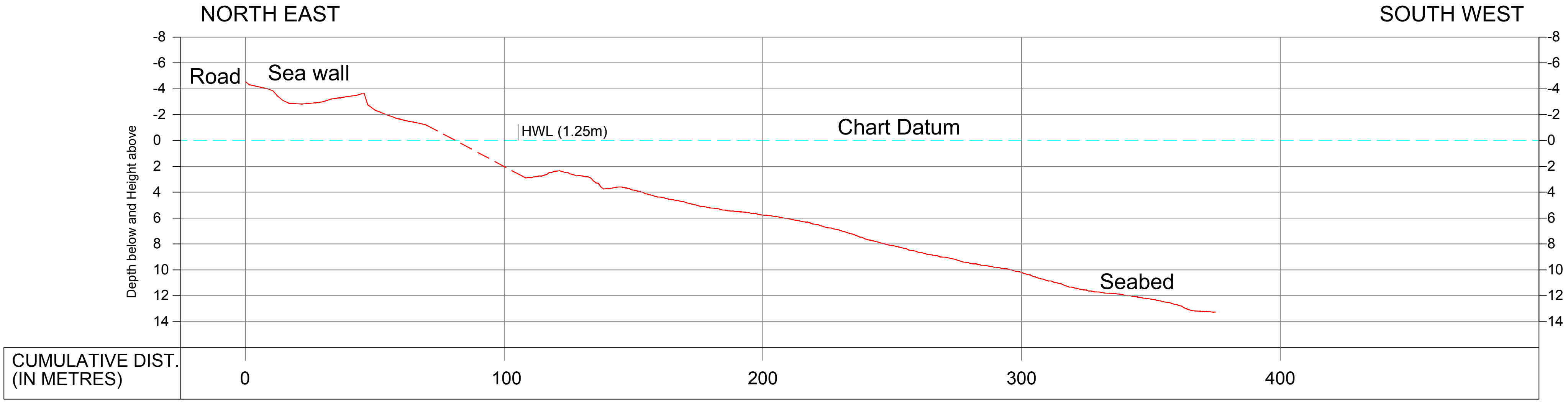


Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-71

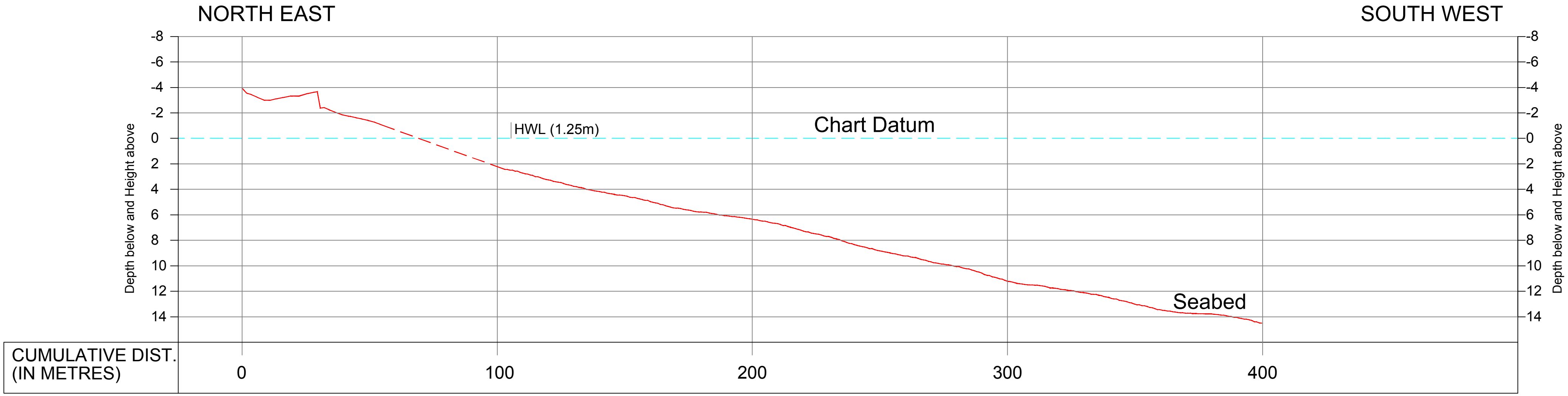
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

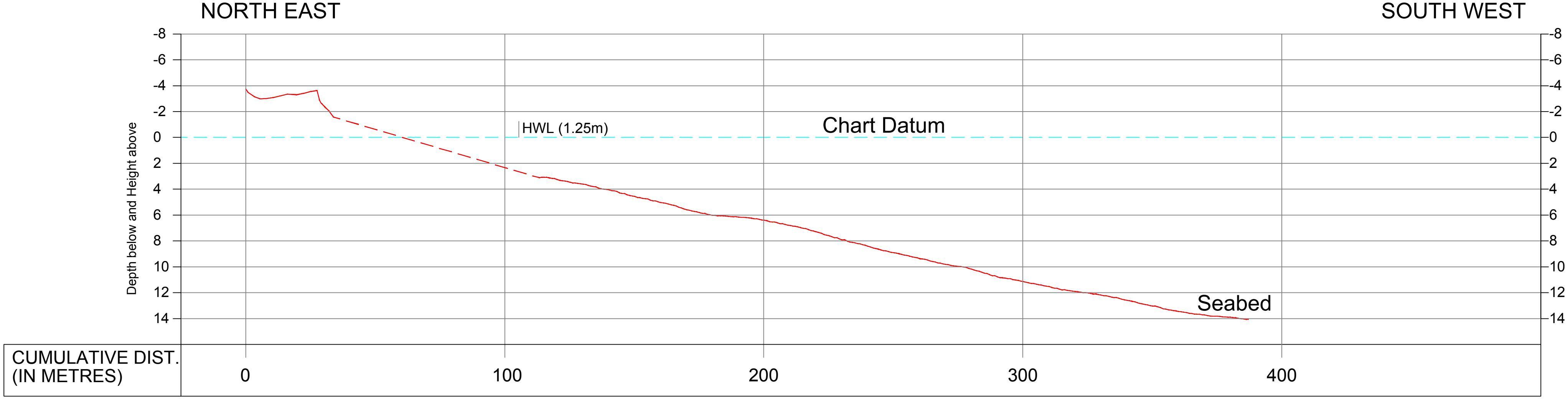
Cross Section Line No.CSP-72
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

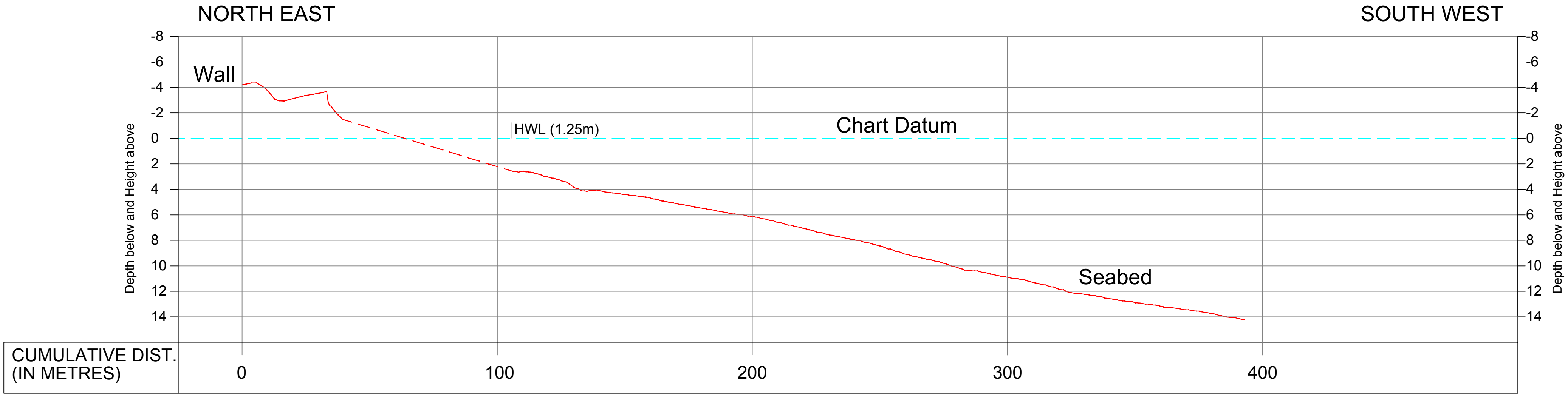
Cross Section Line No.CSP-73
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

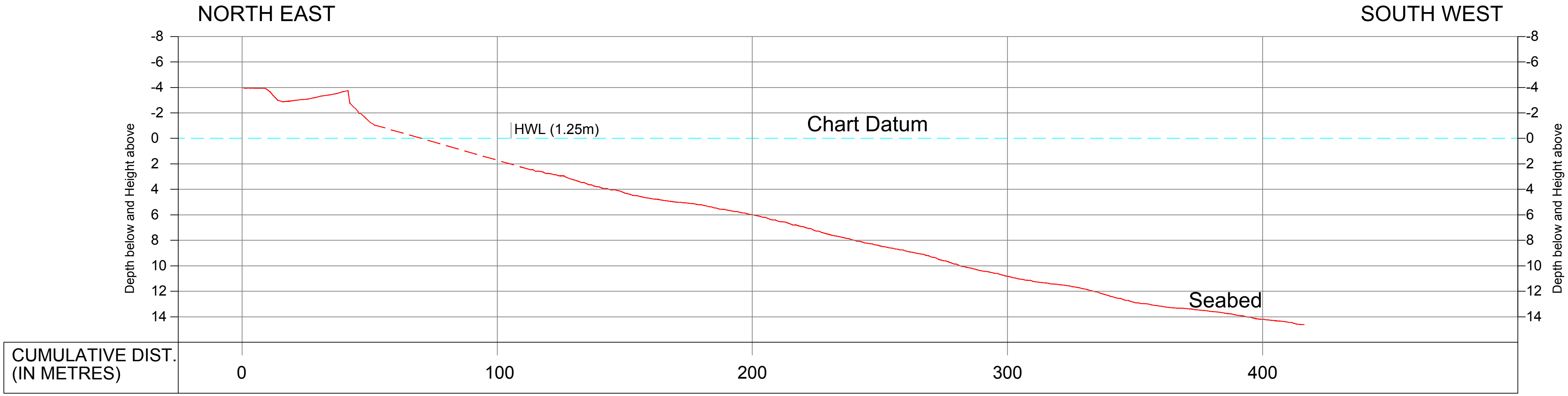
Cross Section Line No.CSP-74
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

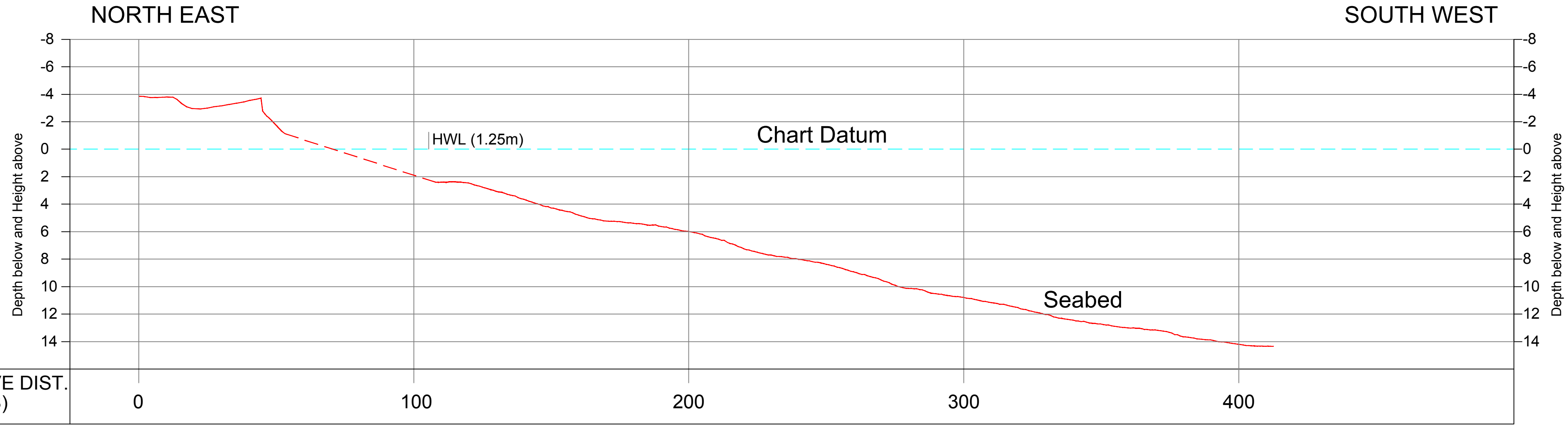
Cross Section Line No.CSP-75
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

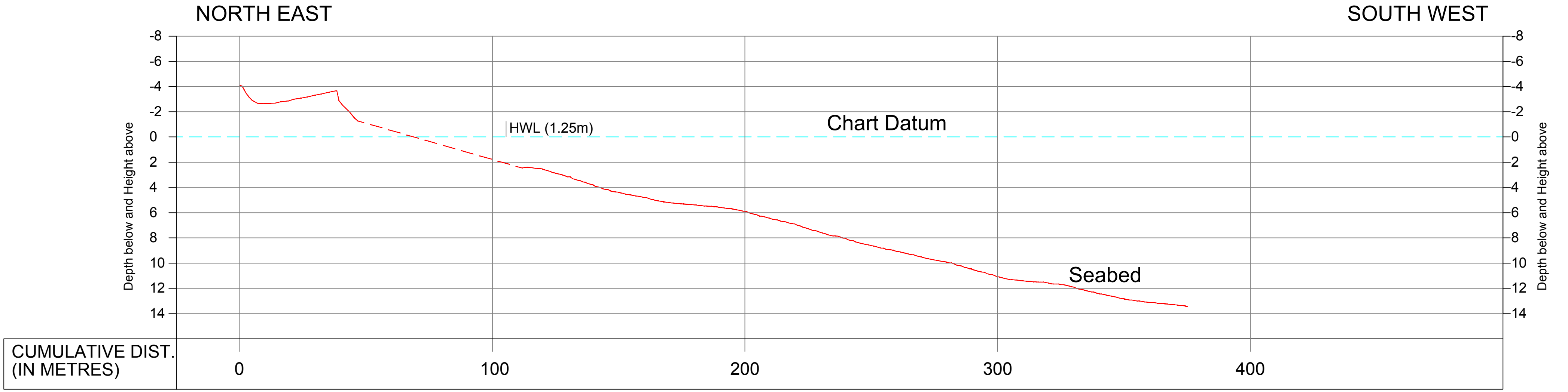
Cross Section Line No.CSP-76
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

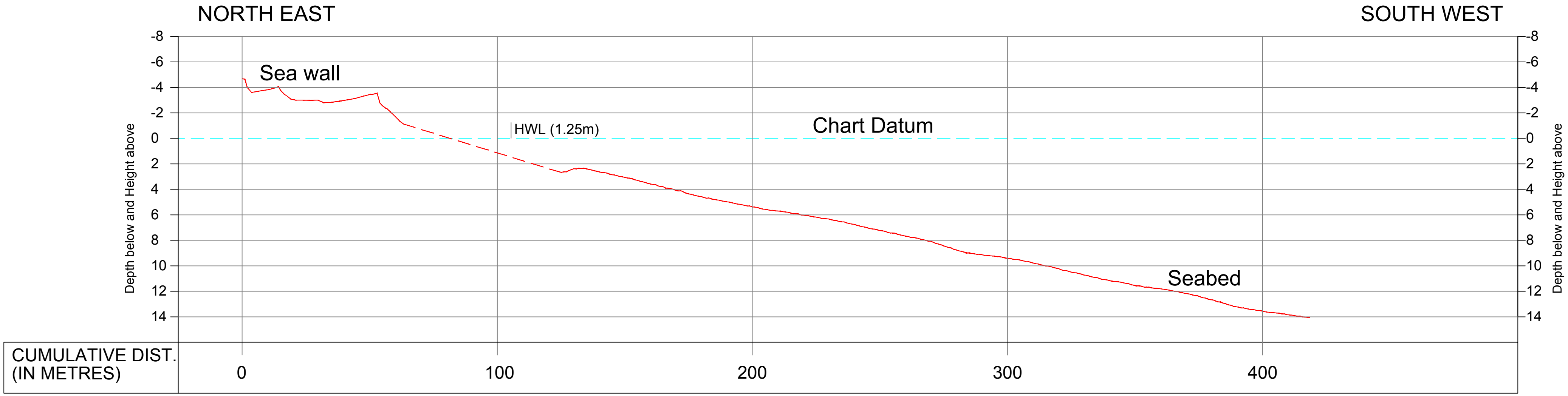
Cross Section Line No.CSP-77
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

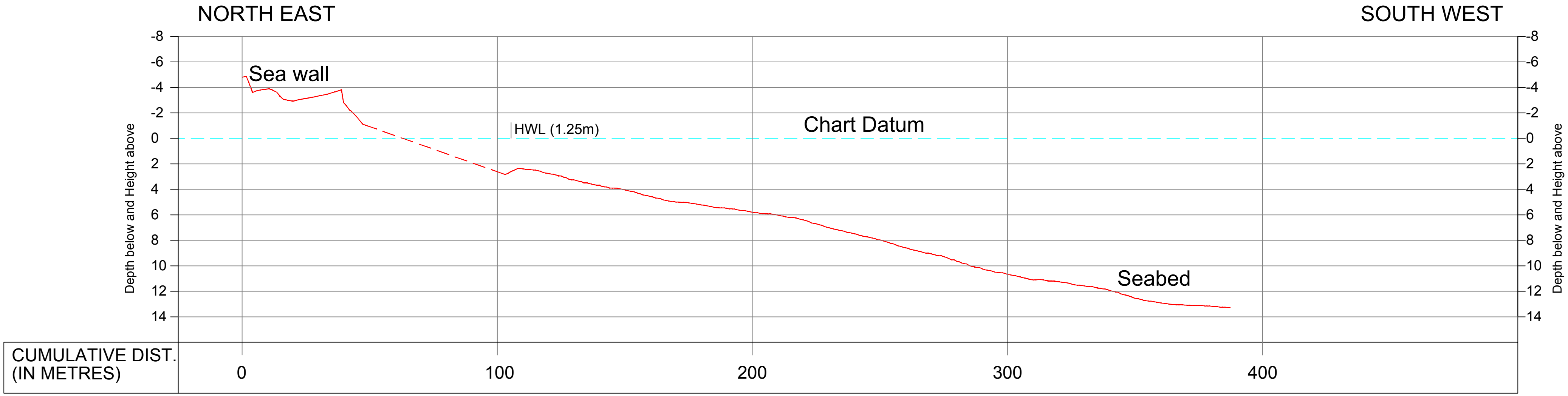
Cross Section Line No.CSP-78
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

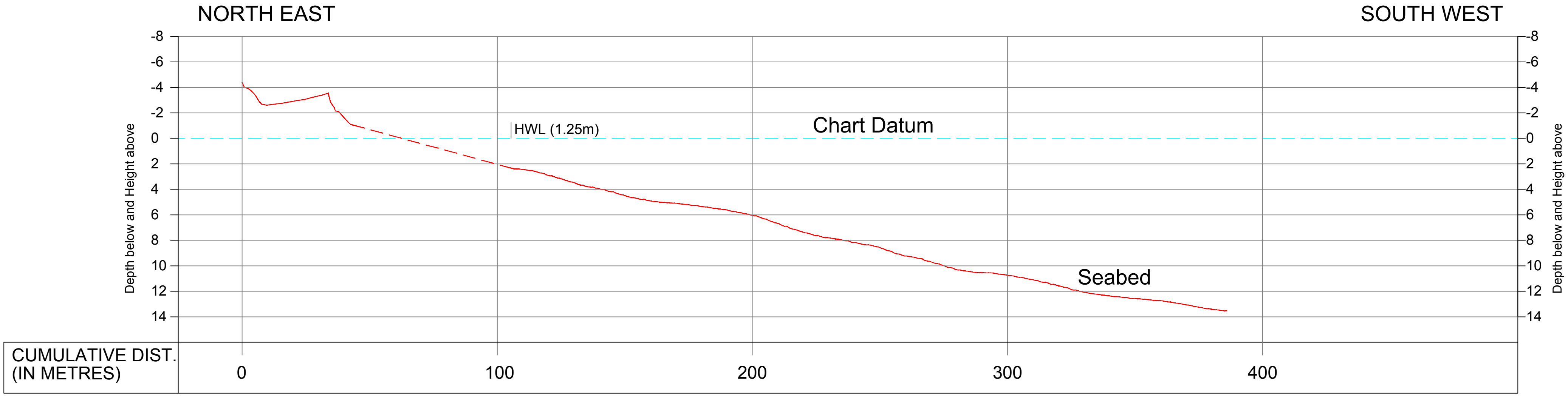
Cross Section Line No.CSP-79
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

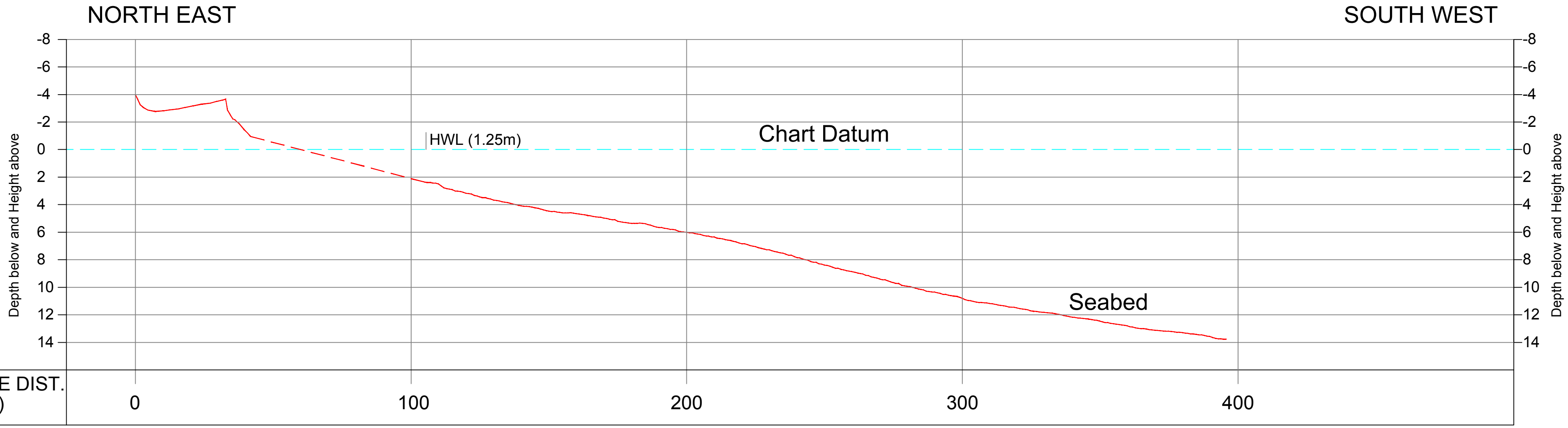
Cross Section Line No.CSP-80
(May 2019)



Cross Shore Profile

SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Cross Section Line No.CSP-81
(May 2019)

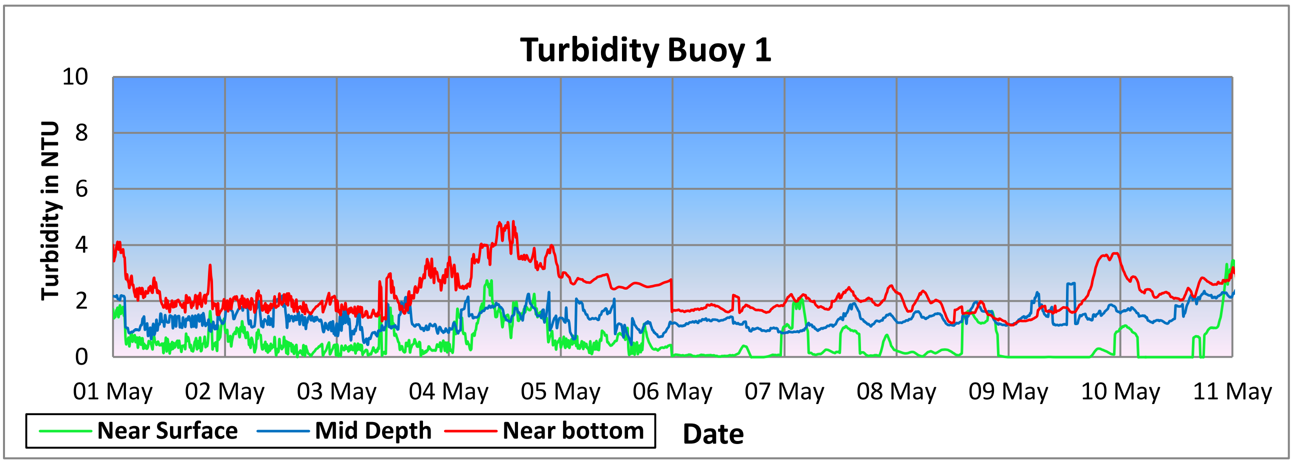


Cross Shore Profile

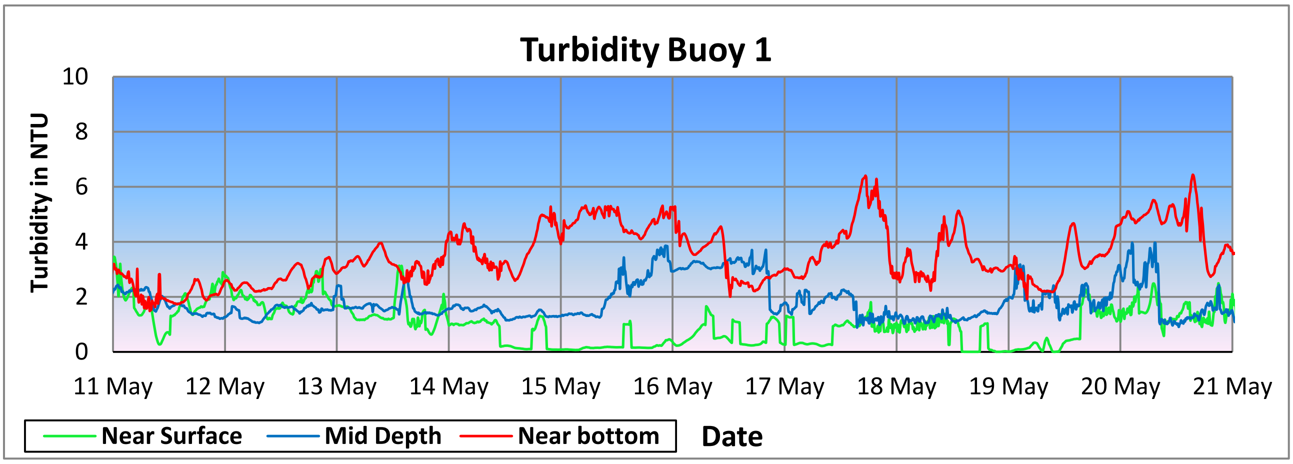
SCALE
HORIZONTAL 1: 2000
VERTICAL 1: 400

Annexure VII

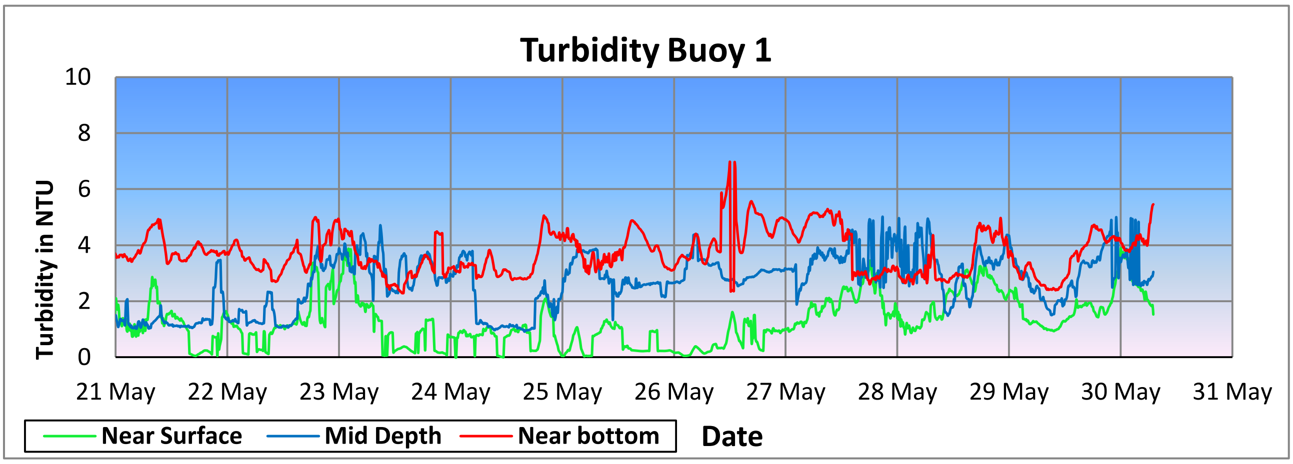
Turbidity Data



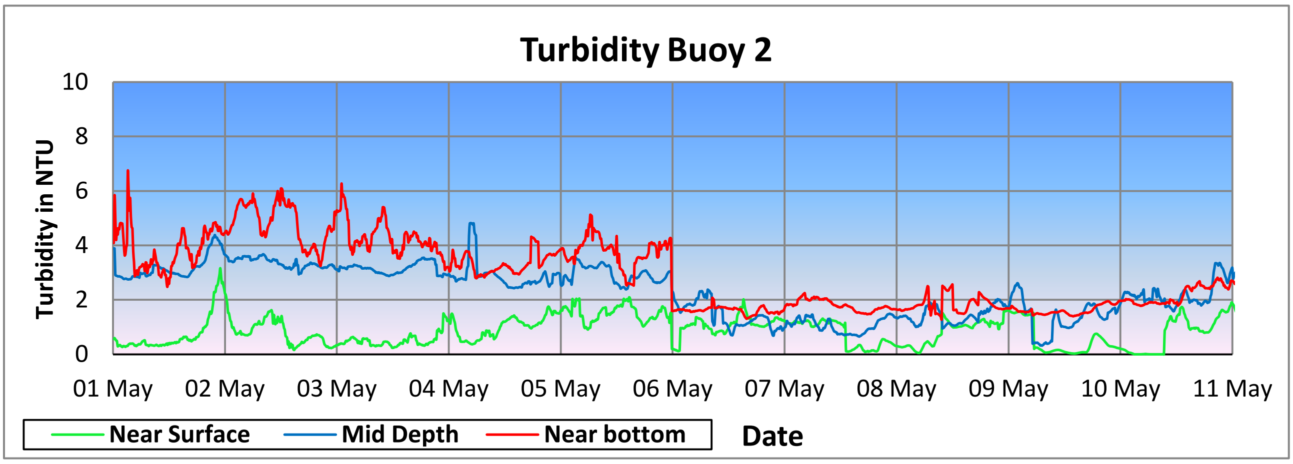
Turbidity Buoy 1
Turbidity in NTU
0
2
4
6
8
10
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
11 May
Near Surface
Mid Depth
Near bottom
Date

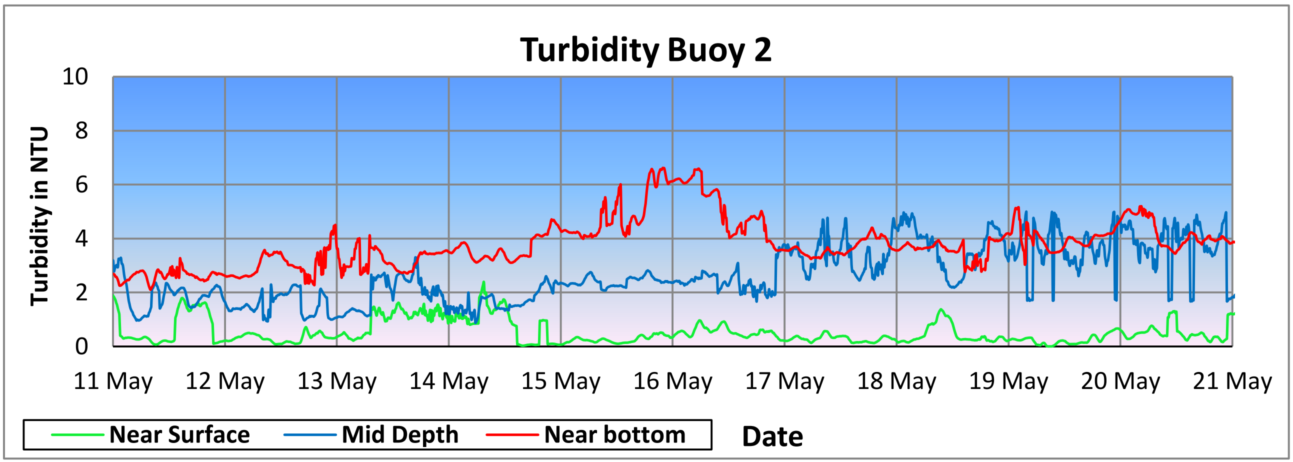


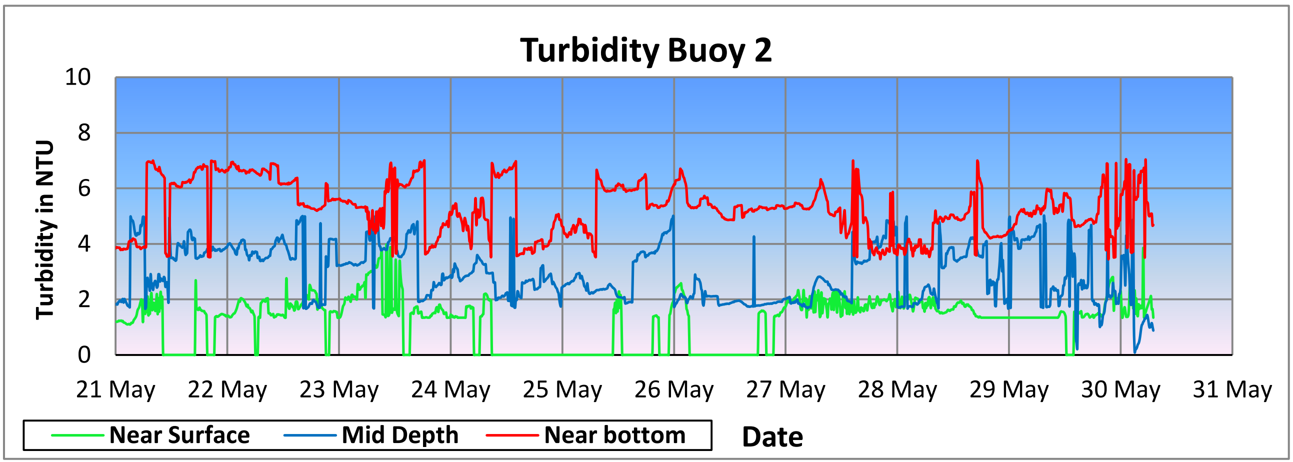
Turbidity Buoy 1
Turbidity in NTU
0
2
4
6
8
10
11 May
12 May
13 May
14 May
15 May
16 May
17 May
18 May
19 May
20 May
21 May
Near Surface
Mid Depth
Near bottom
Date

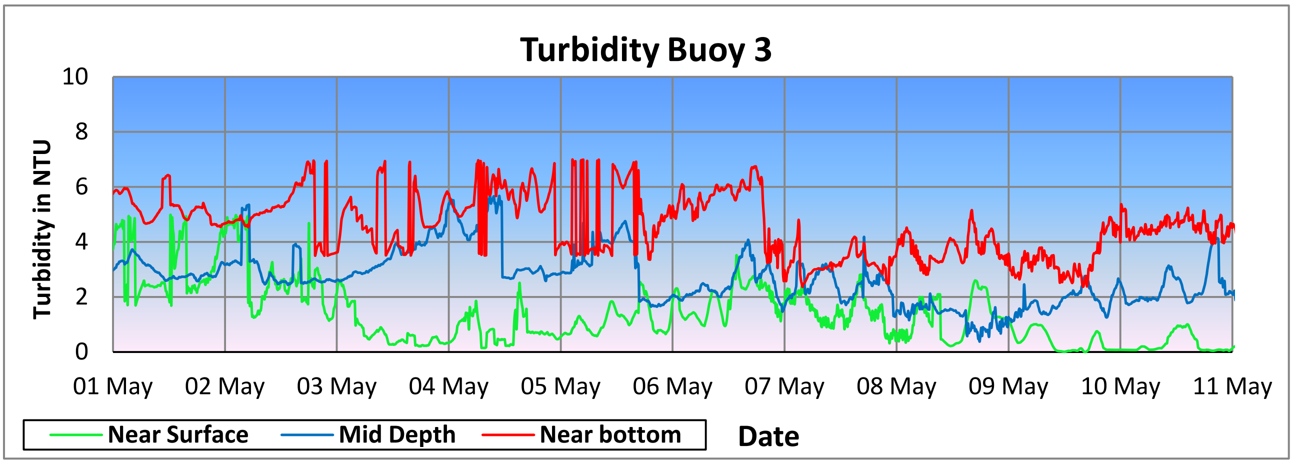


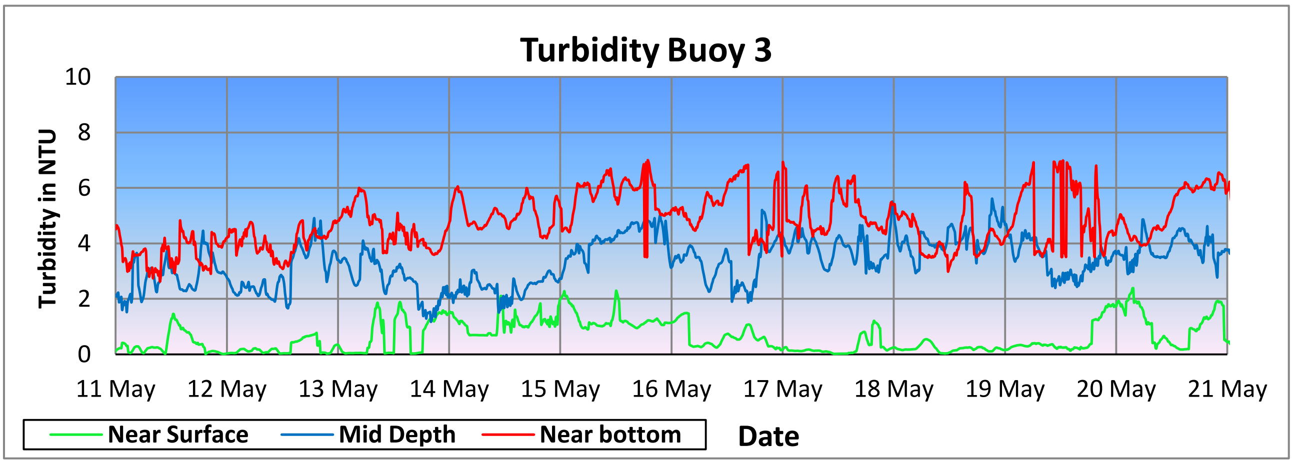
Turbidity Buoy 1
Turbidity in NTU
0
2
4
6
8
10
21 May
22 May
23 May
24 May
25 May
26 May
27 May
28 May
29 May
30 May
31 May
Near Surface
Mid Depth
Near bottom
Date

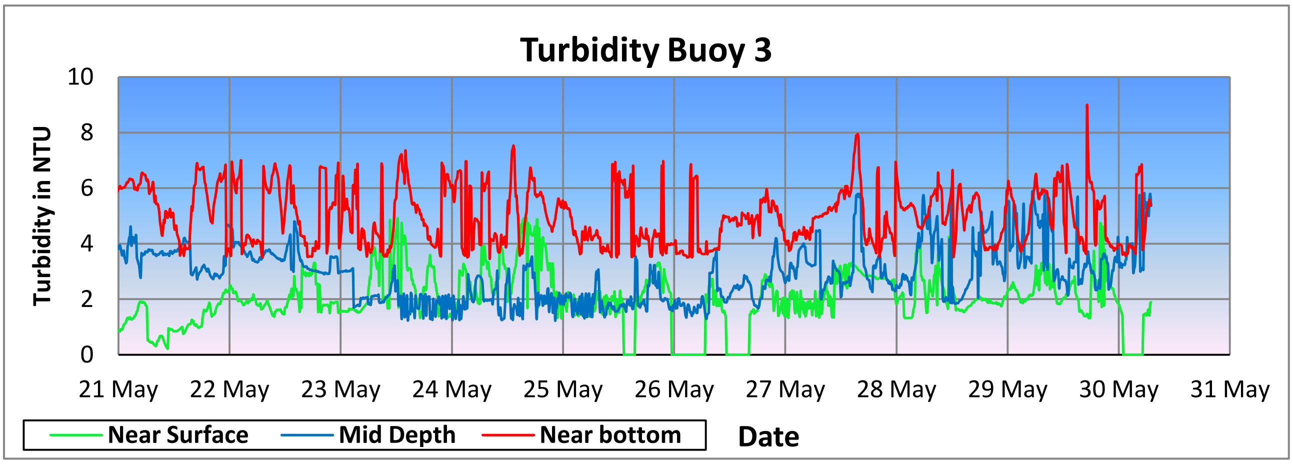

Turbidity Buoy 2
Turbidity in NTU
10
8
6
4
2
0
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
11 May
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 2
Turbidity in NTU
10
8
6
4
2
0
11 May
12 May
13 May
14 May
15 May
16 May
17 May
18 May
19 May
20 May
21 May
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 2
Turbidity in NTU
10
8
6
4
2
0
21 May
22 May
23 May
24 May
25 May
26 May
27 May
28 May
29 May
30 May
31 May
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 3
Turbidity in NTU
10
8
6
4
2
0
01 May
02 May
03 May
04 May
05 May
06 May
07 May
08 May
09 May
10 May
11 May
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 3
Turbidity in NTU
10
8
6
4
2
0
11 May
12 May
13 May
14 May
15 May
16 May
17 May
18 May
19 May
20 May
21 May
Near Surface
Mid Depth
Near bottom
Date


Turbidity Buoy 3
Turbidity in NTU
10
8
6
4
2
0
21 May
22 May
23 May
24 May
25 May
26 May
27 May
28 May
29 May
30 May
31 May
Near Surface
Mid Depth
Near bottom
Date

TEST REPORT

Test Report No: TC540219000002020P-2052P	Date: 23.05.2019	

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 13.05.2019	
SAMPLE DETAILS			
Sampling Site	Mulloor	Sample Received On	13.05.2019
Sample Name	Water	Sample Condition	Good
Sampled On	11.05.2019	Test Started On	17.05.2019
Sampled By	Customer	Test Completed On	22.05.2019

Sample Code	Sample Identification By Customer	Sampling Date	Sampling Time	Parameters		
				Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)*
				IS 3025 Part 10: 1984 (R A 2017)	IS 3025 Part 17: 1984 (R A 2017)	SEAAL/SOP/06
TC540219000002020P	WS_DD_Sur_892	11-05-19	7:00	< 0.10	< 1.00	37.2
TC540219000002021P	WS_DD_Mid_893	11-05-19	7:00	0.40	3.20	36.3
TC540219000002022P	WS_DD_Bot_894	11-05-19	7:00	1.60	8.80	38.1
TC540219000002023P	WS_DD_Sur_895	11-05-19	8:00	< 0.10	< 1.00	39.8
TC540219000002024P	WS_DD_Mid_896	11-05-19	8:00	< 0.10	< 1.00	39.8
TC540219000002025P	WS_DD_Bot_897	11-05-19	8:00	1.30	5.20	39.8
TC540219000002026P	WS_DD_Sur_898	11-05-19	9:00	< 0.10	< 1.00	37.2
TC540219000002027P	WS_DD_Mid_899	11-05-19	9:00	0.80	3.80	36.3
TC540219000002028P	WS_DD_Bot_900	11-05-19	9:00	< 0.1	< 1.00	37.2
TC540219000002029P	WS_DD_Sur_901	11-05-19	10:00	< 0.10	< 1.00	39.8
TC540219000002030P	WS_DD_Mid_902	11-05-19	10:00	0.80	4.10	39.8
TC540219000002031P	WS_DD_Bot_903	11-05-19	10:00	< 0.10	< 1.00	37.2
TC540219000002032P	WS_DD_Sur_904	11-05-19	11:00	< 0.10	< 1.00	36.3
TC540219000002033P	WS_DD_Mid_905	11-05-19	11:00	< 0.10	< 1.00	36.3
TC540219000002034P	WS_DD_Bot_906	11-05-19	11:00	1.30	7.20	37.2
TC540219000002035P	WS_DD_Sur_907	11-05-19	12:00	< 0.10	< 1.00	38.1
TC540219000002036P	WS_DD_Mid_908	11-05-19	12:00	<0.10	< 1.00	37.2
TC540219000002037P	WS_DD_Bot_909	11-05-19	12:00	0.90	4.80	35.4
TC540219000002038P	WS_DD_Sur_910	11-05-19	1:00	< 0.10	< 1.00	39.8

TEST REPORT

Test Report No: TC540219000002020P-2052P	Date: 23.05.2019	Page 2 of 2

Sample Code	Sample Identification By Customer	Sampling Date	Sampling Time	Parameters		
				Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)*
				IS 3025 Part 10: 1984 (R A 2017)	IS 3025 Part 17: 1984 (R A 2017)	SEAAL/SOP/06
TC540219000002039P	WS_DD_Mid_911	11-05-19	1:00	< 0.10	< 1.00	38.1
TC540219000002040P	WS_DD_Bot_912	11-05-19	1:00	1.20	6.40	36.3
TC540219000002041P	WS_DD_Sur_913	11-05-19	2:00	< 0.10	< 1.00	38.9
TC540219000002042P	WS_DD_Mid_914	11-05-19	2:00	<0.10	< 1.00	36.3
TC540219000002043P	WS_DD_Bot_915	11-05-19	2:00	1.00	4.90	38.1
TC540219000002044P	WS_DD_Sur_916	11-05-19	3:00	< 0.10	< 1.00	38.1
TC540219000002045P	WS_DD_Mid_917	11-05-19	3:00	< 0.10	< 1.00	35.4
TC540219000002046P	WS_DD_Bot_918	11-05-19	3:00	1.40	8.30	38.9
TC540219000002047P	WS_DD_Sur_919	11-05-19	4:00	< 0.10	< 1.00	38.9
TC540219000002048P	WS_DD_Mid_920	11-05-19	4:00	< 0.10	< 1.00	39.8
TC540219000002049P	WS_DD_Bot_921	11-05-19	4:00	2.80	10.30	38.9
TC540219000002050P	WS_DD_Sur_922	11-05-19	5:00	< 0.10	< 1.00	36.3
TC540219000002051P	WS_DD_Mid_923	11-05-19	5:00	< 0.10	< 1.00	36.3
TC540219000002052P	WS_DD_Bot_924	11-05-19	5:00	0.90	4.20	38.9

*Not Under NABL

End of Report

For and on behalf of
Standards Environmental & Analytical Laboratories

Authorized Signatory

TEST REPORT

Test Report No: TC540219000001987P-2019P	Date: 23.05.2019	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 13.05.2019	
SAMPLE DETAILS			
Sampling Site	Pachaloor	Sample Received On	13.05.2019
Sample Name	Water	Sample Condition	Good
Sampled On	08.05.2019	Test Started On	17.05.2019
Sampled By	Customer	Test Completed On	22.05.2019

Sample Code	Sample Identification By Customer	Sampling Date	Sampling Time	Parameters		
				Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)*
				IS 3025 Part 10: 1984 (R A 2017)	IS 3025 Part 17: 1984 (R A 2017)	SEAAL/SOP/06
TC540219000001987P	WS_PA_Sur_859	08-05-19	7:30	< 0.10	< 1.00	38.9
TC540219000001988P	WS_PA_Mid_860	08-05-19	7:30	0.40	3.20	38.9
TC540219000001989P	WS_PA_Bot_861	08-05-19	7:30	5.80	22.40	38.9
TC540219000001990P	WS_PA_Sur_862	08-05-19	8:30	1.00	4.40	39.8
TC540219000001991P	WS_PA_Mid_863	08-05-19	8:30	0.30	2.80	38.1
TC540219000001992P	WS_PA_Bot_864	08-05-19	8:30	3.10	10.80	39.8
TC540219000001993P	WS_PA_Sur_865	08-05-19	9:30	2.80	10.00	38.9
TC540219000001994P	WS_PA_Mid_866	08-05-19	9:30	1.80	8.60	37.2
TC540219000001995P	WS_PA_Bot_867	08-05-19	9:30	3.90	18.90	36.3
TC540219000001996P	WS_PA_Sur_868	08-05-19	10:30	< 0.10	< 1.00	38.1
TC540219000001997P	WS_PA_Mid_869	08-05-19	10:30	0.90	3.60	38.1
TC540219000001998P	WS_PA_Bot_870	08-05-19	10:30	1.00	4.20	39.8
TC540219000001999P	WS_PA_Sur_871	08-05-19	11:30	< 0.10	< 1.00	38.1
TC540219000002000P	WS_PA_Mid_872	08-05-19	11:30	1.20	4.50	38.1
TC540219000002001P	WS_PA_Bot_873	08-05-19	11:30	2.40	9.60	38.9
TC540219000002002P	WS_PA_Sur_874	08-05-19	12:30	< 0.10	< 1.00	38.9
TC540219000002003P	WS_PA_Mid_875	08-05-19	12:30	1.30	5.20	38.1
TC540219000002004P	WS_PA_Bot_876	08-05-19	12:30	2.90	10.80	38.1
TC540219000002005P	WS_PA_Sur_877	08-05-19	1:30	< 0.1	< 1.00	38.1

TEST REPORT

Test Report No: TC540219000001987P-2019P	Date: 23.05.2019	Page 2 of 2

Sample Code	Sample Identification By Customer	Sampling Date	Sampling Time	Parameters		
				Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)*
				IS 3025 Part 10: 1984 (R A 2017)	IS 3025 Part 17: 1984 (R A 2017)	SEAAL/SOP/06
TC540219000002006P	WS_PA_Mid_878	08-05-19	1:30	< 0.10	< 1.00	37.2
TC540219000002007P	WS_PA_Bot_879	08-05-19	1:30	3.40	12.80	37.2
TC540219000002008P	WS_PA_Sur_880	08-05-19	2:30	< 0.10	< 1.00	37.2
TC540219000002009P	WS_PA_Mid_881	08-05-19	2:30	0.90	3.80	38.9
TC540219000002010P	WS_PA_Bot_882	08-05-19	2:30	1.10	4.60	38.9
TC540219000002011P	WS_PA_Sur_883	08-05-19	3:30	< 0.10	< 1.00	39.8
TC540219000002012P	WS_PA_Mid_884	08-05-19	3:30	< 0.10	< 1.00	36.3
TC540219000002013P	WS_PA_Bot_885	08-05-19	3:30	1.40	7.10	36.3
TC540219000002014P	WS_PA_Sur_886	08-05-19	4:30	< 0.10	< 1.00	36.3
TC540219000002015P	WS_PA_Mid_887	08-05-19	4:30	1.00	4.30	37.2
TC540219000002016P	WS_PA_Bot_888	08-05-19	4:30	3.10	14.20	39.8
TC540219000002017P	WS_PA_Sur_889	08-05-19	5:30	< 0.10	< 1.00	37.2
TC540219000002018P	WS_PA_Mid_890	08-05-19	5:30	1.20	6.10	38.9
TC540219000002019P	WS_PA_Bot_891	08-05-19	5:30	2.10	8.50	36.3

*Not Under NABL

End of Report

For and on behalf of
Standards Environmental & Analytical Laboratories

Authorized Signatory

TEST REPORT

Test Report No: TC540219000001921P-1953P	Date: 23.05.2019	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 13.05.2019	
SAMPLE DETAILS			
Sampling Site	Poovar	Sample Received On	13.05.2019
Sample Name	Water	Sample Condition	Good
Sampled On	06.05.2019	Test Started On	17.05.2019
Sampled By	Customer	Test Completed On	22.05.2019

Sample Code	Sample Identification By Customer	Sampling Date	Sampling Time	Parameters		
				Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)*
				IS 3025 Part 10: 1984 (R A 2017)	IS 3025 Part 17: 1984 (R A 2017)	SEAAL/SOP/06
TC540219000001921P	WS_PO_Sur_793	06-05-19	7:00	1.20	6.80	35.4
TC540219000001922P	WS_PO_Mid_794	06-05-19	7:00	0.80	3.20	39.8
TC540219000001923P	WS_PO_Bot_795	06-05-19	7:00	1.30	8.80	38.9
TC540219000001924P	WS_PO_Sur_796	06-05-19	8:00	1.10	6.00	38.1
TC540219000001925P	WS_PO_Mid_797	06-05-19	8:00	1.00	5.20	38.9
TC540219000001926P	WS_PO_Bot_798	06-05-19	8:00	1.40	6.80	37.2
TC540219000001927P	WS_PO_Sur_799	06-05-19	9:00	< 0.1	< 1.00	39.8
TC540219000001928P	WS_PO_Mid_800	06-05-19	9:00	0.30	4.20	38.9
TC540219000001929P	WS_PO_Bot_801	06-05-19	9:00	< 0.10	< 1.00	37.2
TC540219000001930P	WS_PO_Sur_802	06-05-19	10:00	1.70	7.20	37.2
TC540219000001931P	WS_PO_Mid_803	06-05-19	10:00	< 0.10	< 1.00	38.9
TC540219000001932P	WS_PO_Bot_804	06-05-19	10:00	0.80	3.20	38.9
TC540219000001933P	WS_PO_Sur_805	06-05-19	11:00	< 0.1	< 1.00	38.1
TC540219000001934P	WS_PO_Mid_806	06-05-19	11:00	0.80	3.80	38.9
TC540219000001935P	WS_PO_Bot_807	06-05-19	11:00	0.20	1.10	36.3
TC540219000001936P	WS_PO_Sur_808	06-05-19	12:00	< 0.10	< 1.00	38.9
TC540219000001937P	WS_PO_Mid_809	06-05-19	12:00	< 0.10	< 1.00	37.2
TC540219000001938P	WS_PO_Bot_810	06-05-19	12:00	< 0.10	< 1.00	38.1
TC540219000001939P	WS_PO_Sur_811	06-05-19	1:00	< 0.1	< 1.00	39.8

TEST REPORT

Test Report No: TC5402190000001921P-1953P	Date: 23.05.2019	Page 2 of 2

Sample Code	Sample Identification By Customer	Sampling Date	Sampling Time	Parameters		
				Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)*
				IS 3025 Part 10: 1984 (R A 2017)	IS 3025 Part 17: 1984 (R A 2017)	SEAAL/SOP/06
TC5402190000001940P	WS_PO_Mid_812	06-05-19	1:00	< 0.10	< 1.00	38.9
TC5402190000001941P	WS_PO_Bot_813	06-05-19	1:00	< 0.10	< 1.00	39.8
TC5402190000001942P	WS_PO_Sur_814	06-05-19	2:00	< 0.10	< 1.00	38.9
TC5402190000001943P	WS_PO_Mid_815	06-05-19	2:00	2.10	10.40	39.8
TC5402190000001944P	WS_PO_Bot_816	06-05-19	2:00	1.70	7.10	38.9
TC5402190000001945P	WS_PO_Sur_817	06-05-19	3:00	< 0.10	< 1.00	39.8
TC5402190000001946P	WS_PO_Mid_818	06-05-19	3:00	< 0.10	< 1.00	38.1
TC5402190000001947P	WS_PO_Bot_819	06-05-19	3:00	0.80	4.20	38.9
TC5402190000001948P	WS_PO_Sur_820	06-05-19	4:00	< 0.10	< 1.00	35.4
TC5402190000001949P	WS_PO_Mid_821	06-05-19	4:00	0.90	4.90	38.9
TC5402190000001950P	WS_PO_Bot_822	06-05-19	4:00	0.50	3.80	38.9
TC5402190000001951P	WS_PO_Sur_823	06-05-19	5:00	0.30	2.20	36.3
TC5402190000001952P	WS_PO_Mid_824	06-05-19	5:00	1.40	6.90	38.9
TC5402190000001953P	WS_PO_Bot_825	06-05-19	5:00	1.80	4.10	39.8

*Not Under NABL

End of Report

For and on behalf of
Standards Environmental & Analytical Laboratories

Authorized Signatory

TEST REPORT

Test Report No: TC540219000001954P-1986P	Date: 23.05.2019	

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 13.05.2019	
SAMPLE DETAILS			
Sampling Site	Dredge Dumping/Vizhinjam	Sample Received On	13.05.2019
Sample Name	Water	Sample Condition	Good
Sampled On	07.05.2019	Test Started On	17.05.2019
Sampled By	Customer	Test Completed On	22.05.2019

Sample Code	Sample Identification By Customer	Sampling Date	Sampling Time	Parameters		
				Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)*
				IS 3025 Part 10: 1984 (R A 2017)	IS 3025 Part 17: 1984 (R A 2017)	SEAAL/SOP/06
TC540219000001954P	WS_DD_Sur_826	07-05-19	7:00	< 0.10	< 1.00	39.8
TC540219000001955P	WS_DD_Mid_827	07-05-19	7:00	< 0.10	< 1.00	39.8
TC540219000001956P	WS_DD_Bot_828	07-05-19	7:00	< 0.10	< 1.00	39.8
TC540219000001957P	WS_DD_Sur_829	07-05-19	8:00	0.60	3.80	38.9
TC540219000001958P	WS_DD_Mid_830	07-05-19	8:00	3.10	12.40	39.8
TC540219000001959P	WS_DD_Bot_831	07-05-19	8:00	< 0.10	< 1.00	37.2
TC540219000001960P	WS_DD_Sur_832	07-05-19	9:00	< 0.10	< 1.00	39.8
TC540219000001961P	WS_DD_Mid_833	07-05-19	9:00	< 0.10	< 1.00	37.2
TC540219000001962P	WS_DD_Bot_834	07-05-19	9:00	< 0.10	< 1.00	36.3
TC540219000001963P	WS_DD_Sur_835	07-05-19	10:00	< 0.10	< 1.00	38.9
TC540219000001964P	WS_DD_Mid_836	07-05-19	10:00	< 0.10	< 1.00	38.9
TC540219000001965P	WS_DD_Bot_837	07-05-19	10:00	< 0.10	< 1.00	38.9
TC540219000001966P	WS_DD_Sur_838	07-05-19	11:00	< 0.10	< 1.00	39.8
TC540219000001967P	WS_DD_Mid_839	07-05-19	11:00	< 0.10	< 1.00	39.8
TC540219000001968P	WS_DD_Bot_840	07-05-19	11:00	< 0.10	< 1.00	38.9
TC540219000001969P	WS_DD_Sur_841	07-05-19	12:00	< 0.10	< 1.00	38.9
TC540219000001970P	WS_DD_Mid_842	07-05-19	12:00	< 0.10	< 1.00	38.1
TC540219000001971P	WS_DD_Bot_843	07-05-19	12:00	< 0.10	< 1.00	39.8
TC540219000001972P	WS_DD_Sur_844	07-05-19	1:00	< 0.10	< 1.00	39.8

TEST REPORT

Test Report No: TC5402190000001954P-1986P	Date: 23.05.2019	

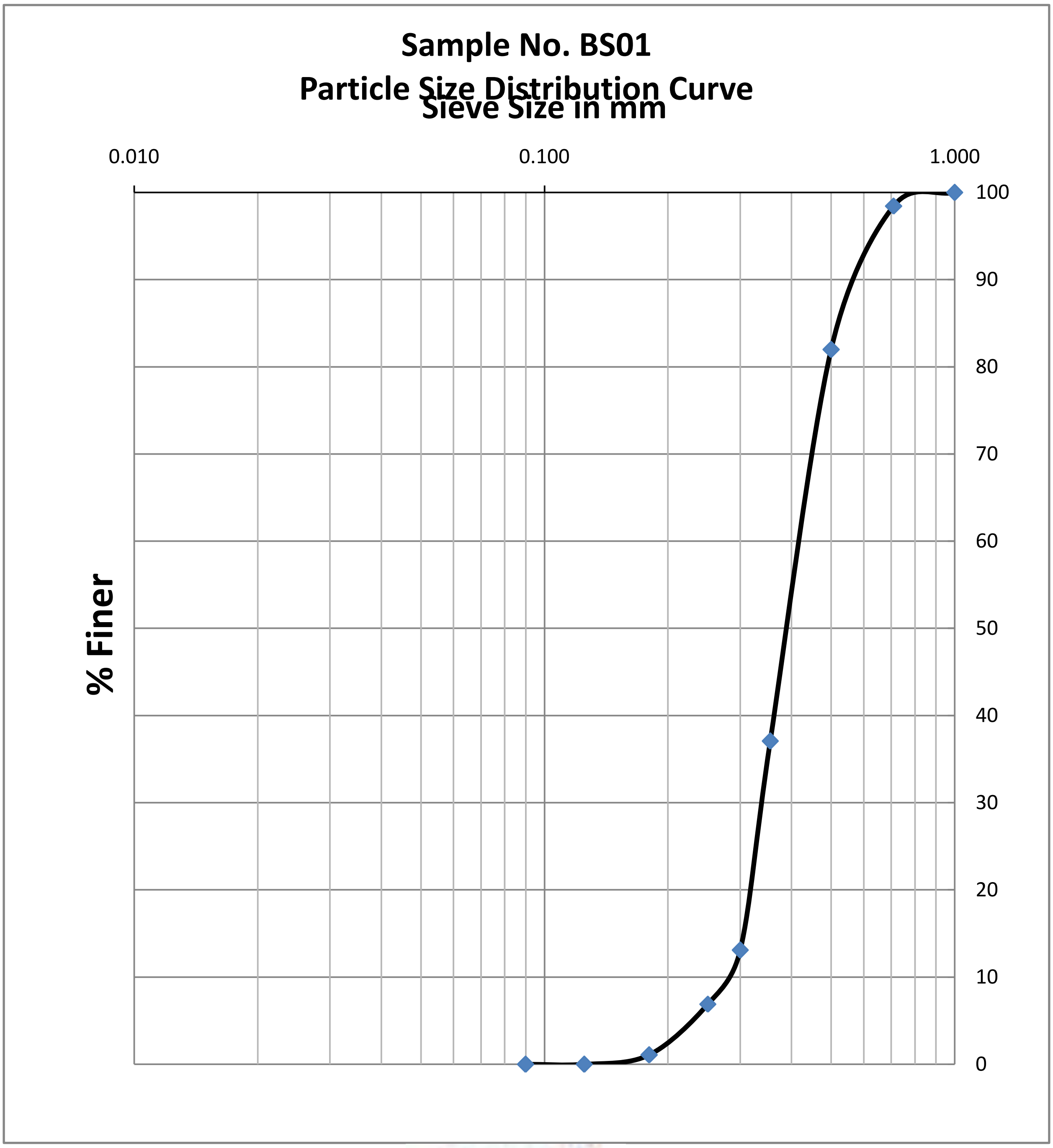
Sample Code	Sample Identification By Customer	Sampling Date	Sampling Time	Parameters		
				Turbidity (NTU)	Total Suspended Solids (mg/L)	Salinity (ppt)*
				IS 3025 Part 10: 1984 (R A 2017)	IS 3025 Part 17: 1984 (R A 2017)	SEAAL/SOP/06
TC540219000001973P	WS_DD_Mid_845	07-05-19	1:00	< 0.10	< 1.00	38.1
TC540219000001974P	WS_DD_Bot_846	07-05-19	1:00	< 0.10	< 1.00	39.8
TC540219000001975P	WS_DD_Sur_847	07-05-19	2:00	< 0.10	< 1.00	38.9
TC540219000001976P	WS_DD_Mid_848	07-05-19	2:00	0.90	4.50	38.9
TC540219000001977P	WS_DD_Bot_849	07-05-19	2:00	< 0.10	< 1.00	38.9
TC540219000001978P	WS_DD_Sur_850	07-05-19	3:00	< 0.10	< 1.00	39.8
TC540219000001979P	WS_DD_Mid_851	07-05-19	3:00	< 0.10	< 1.00	38.9
TC540219000001980P	WS_DD_Bot_852	07-05-19	3:00	0.80	3.80	39.8
TC540219000001981P	WS_DD_Sur_853	07-05-19	4:00	< 0.10	< 1.00	38.1
TC540219000001982P	WS_DD_Mid_854	07-05-19	4:00	< 0.10	< 1.00	39.8
TC540219000001983P	WS_DD_Bot_855	07-05-19	4:00	1.00	5.10	38.9
TC540219000001984P	WS_DD_Sur_856	07-05-19	5:00	< 0.10	< 1.00	39.8
TC540219000001985P	WS_DD_Mid_857	07-05-19	5:00	< 0.10	< 1.00	39.8
TC540219000001986P	WS_DD_Bot_858	07-05-19	5:00	0.80	3.20	39.8

*Not Under NABL

End of Report

For and on behalf of
Standards Environmental & Analytical Laboratories

Authorized Signatory



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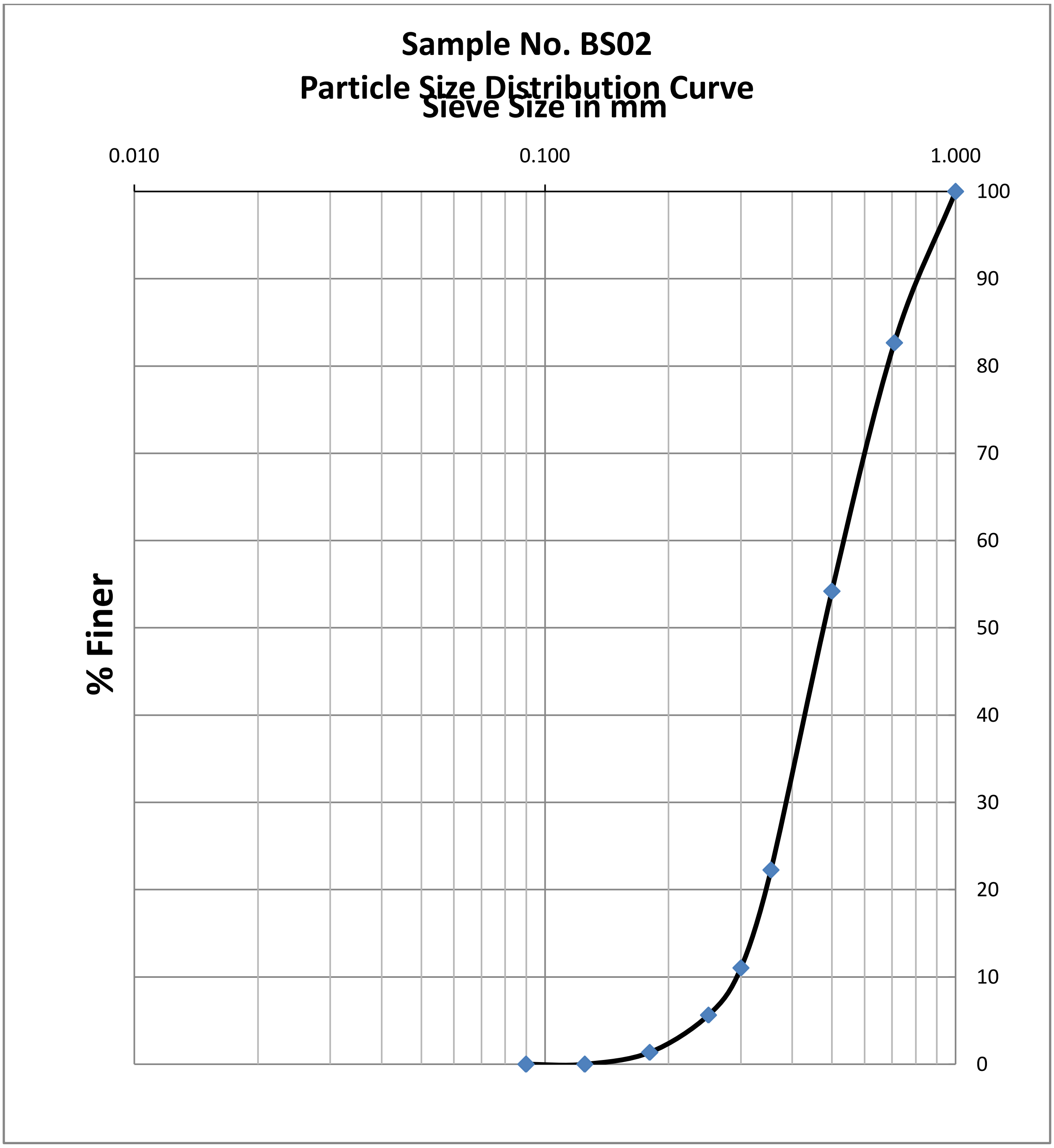

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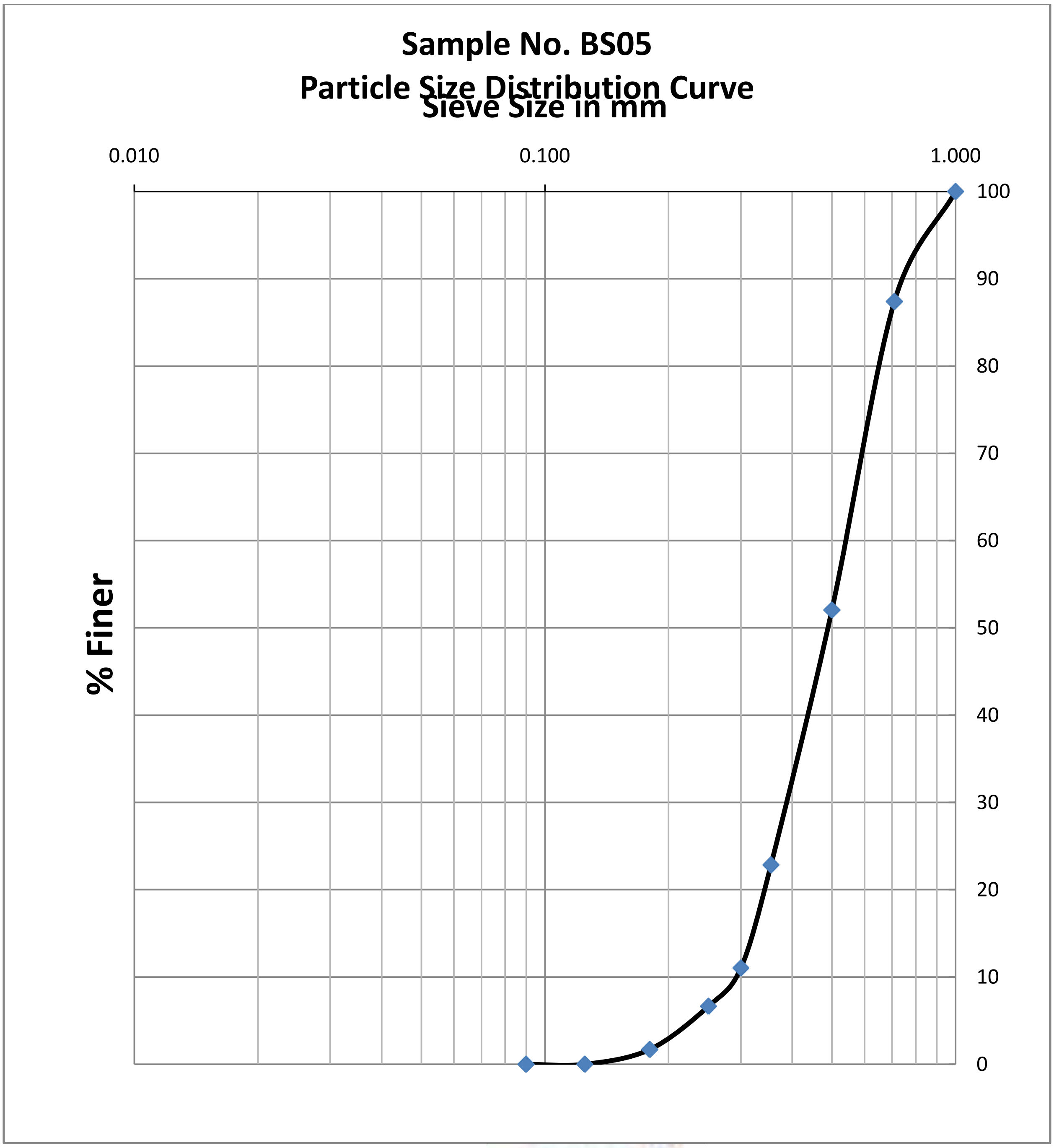

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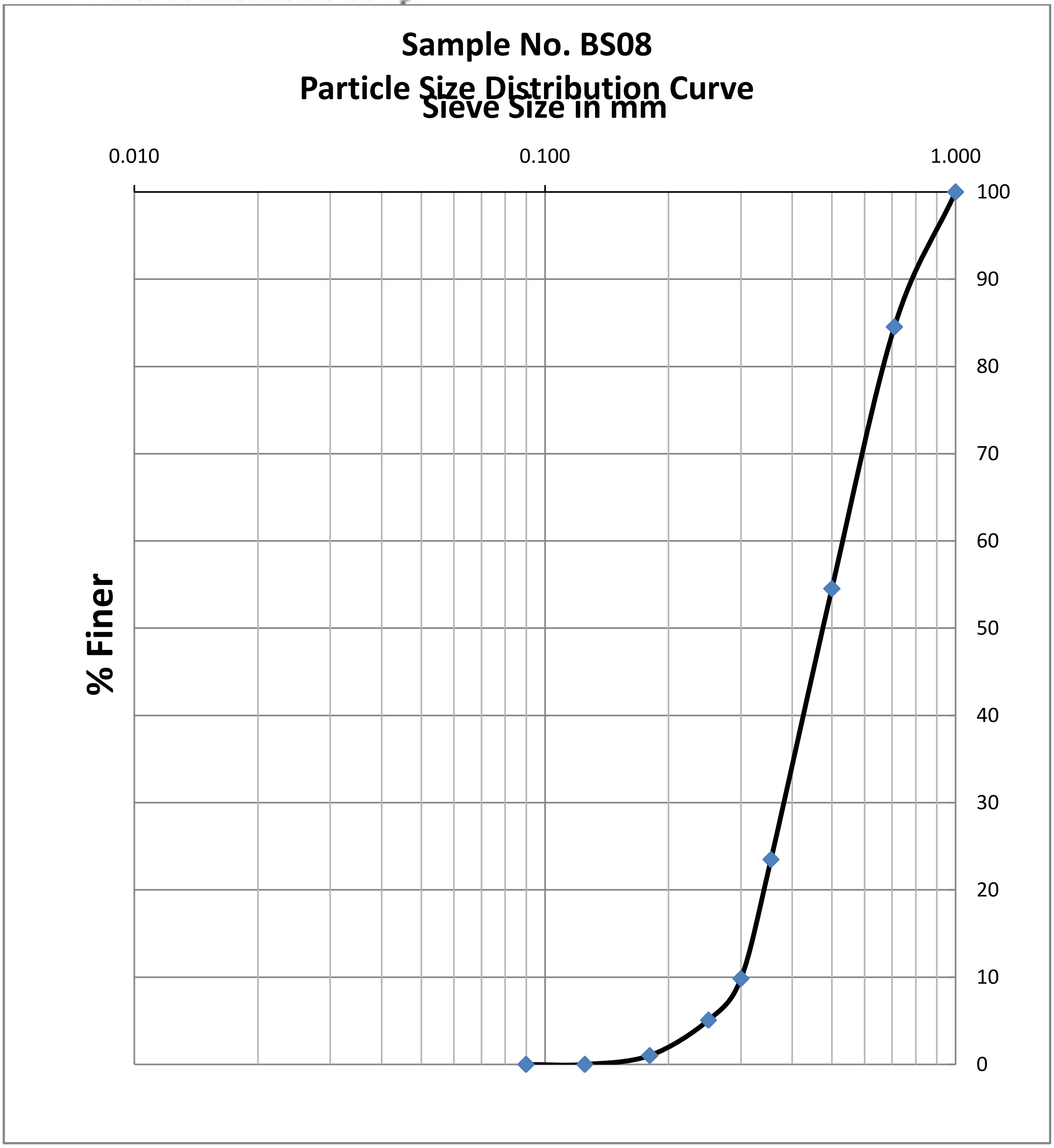

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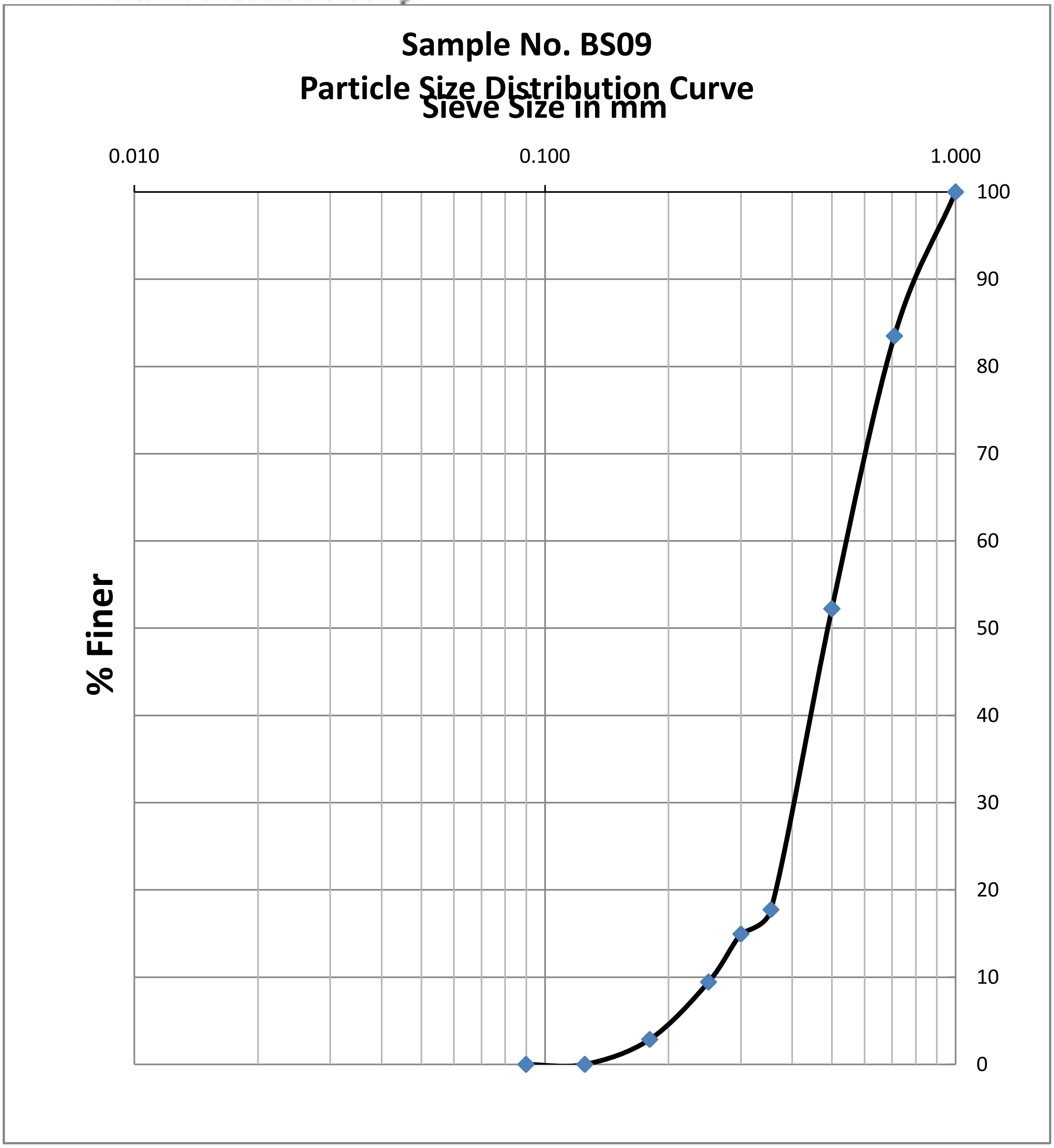

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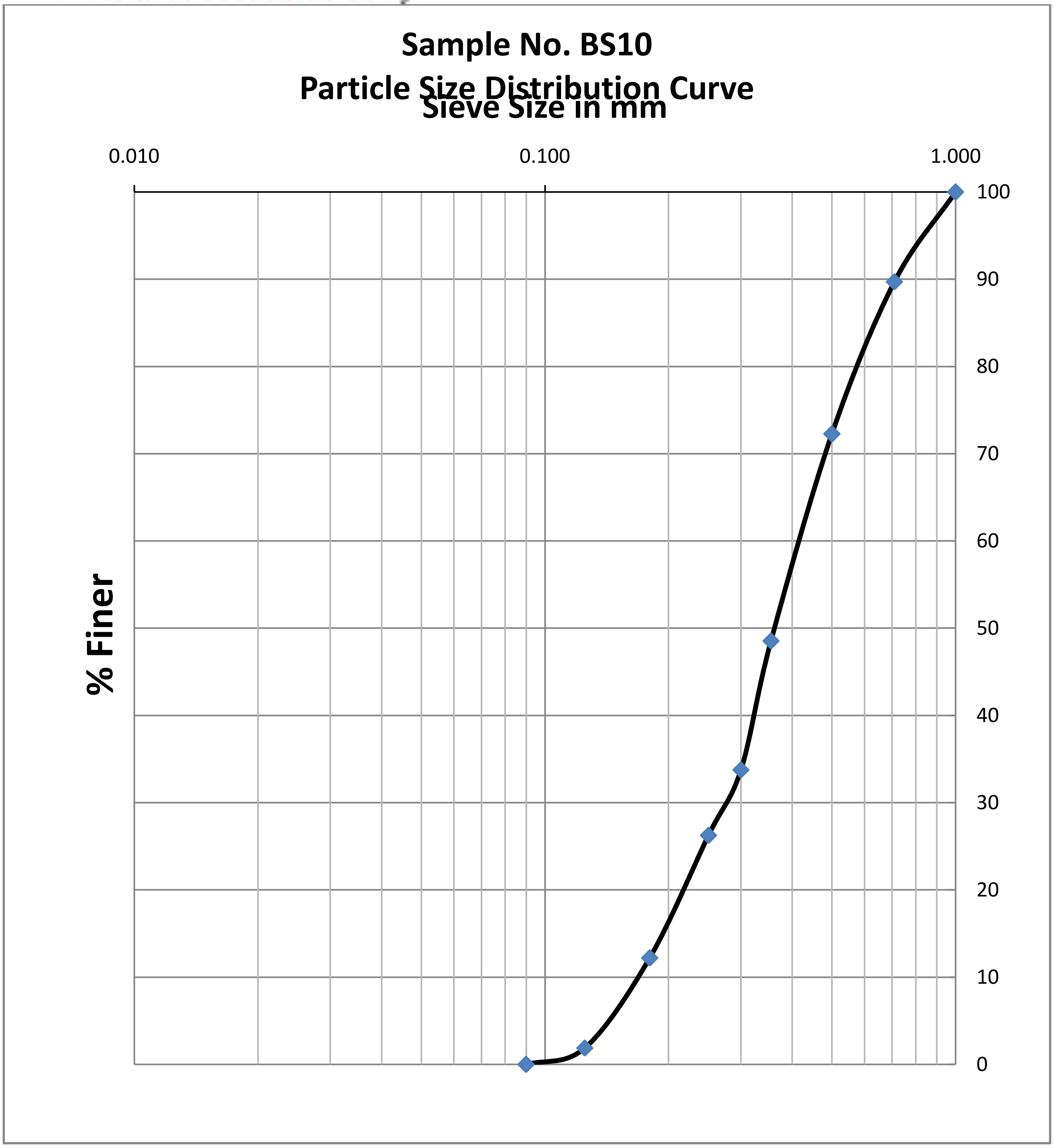

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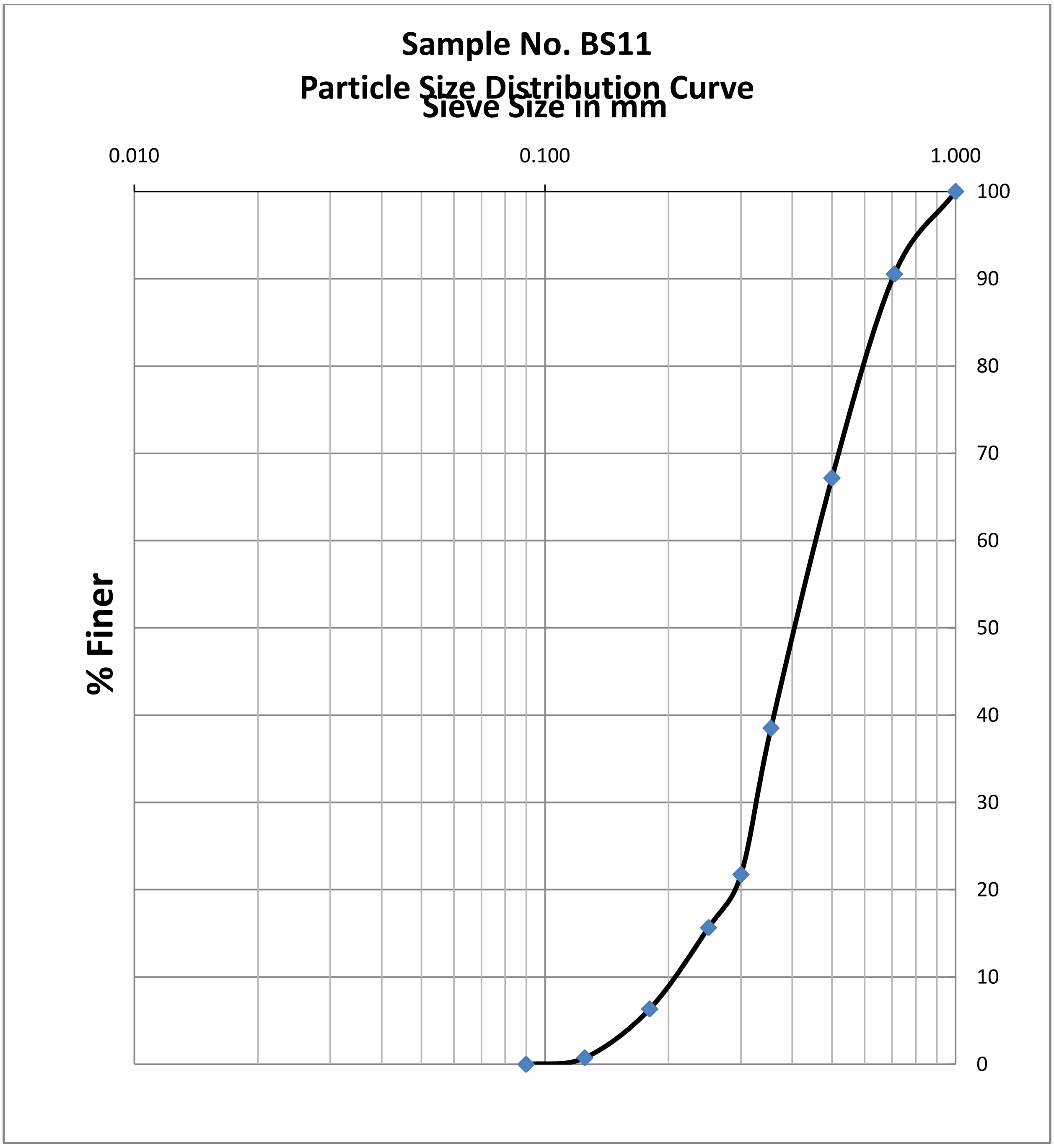

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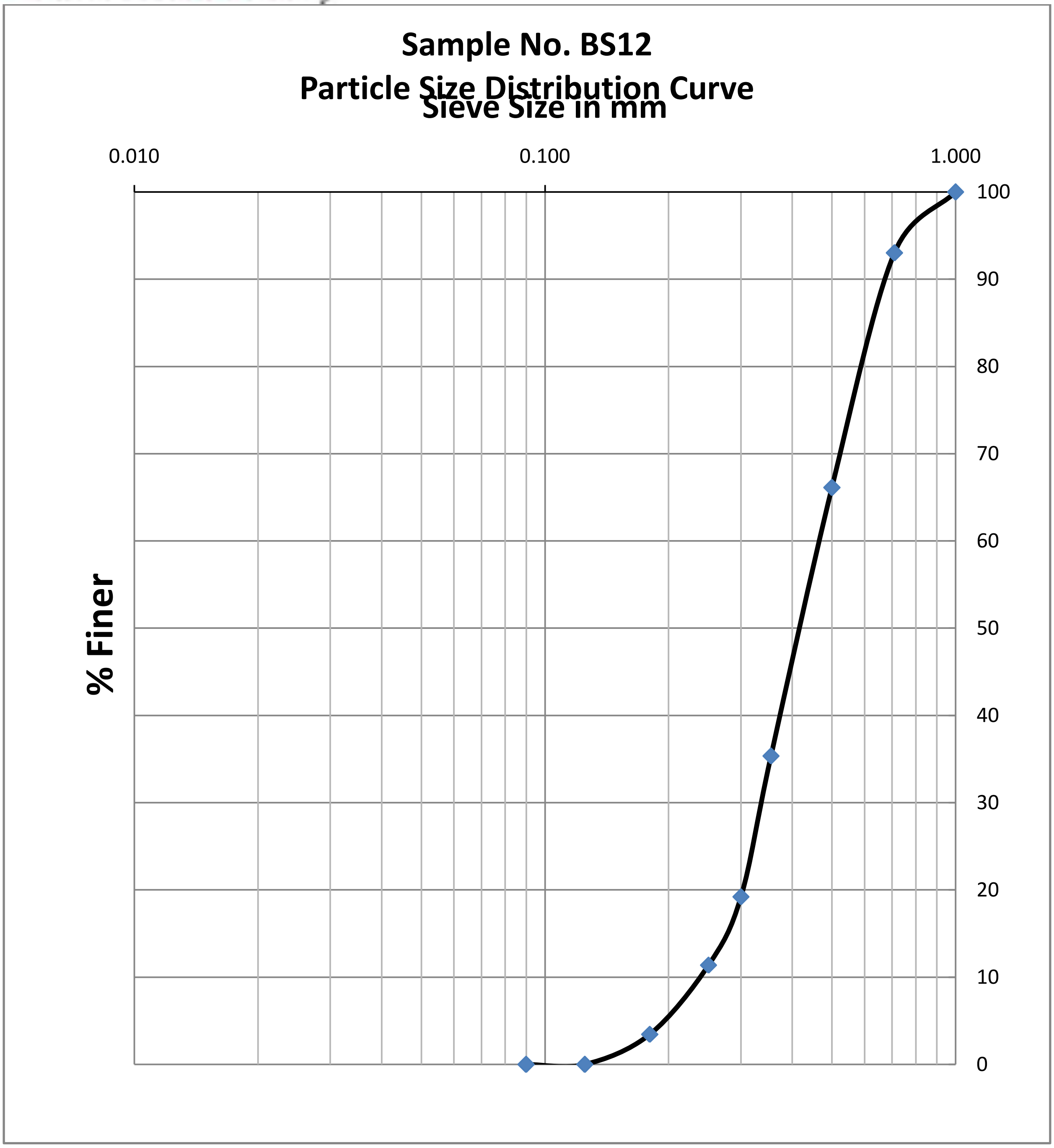

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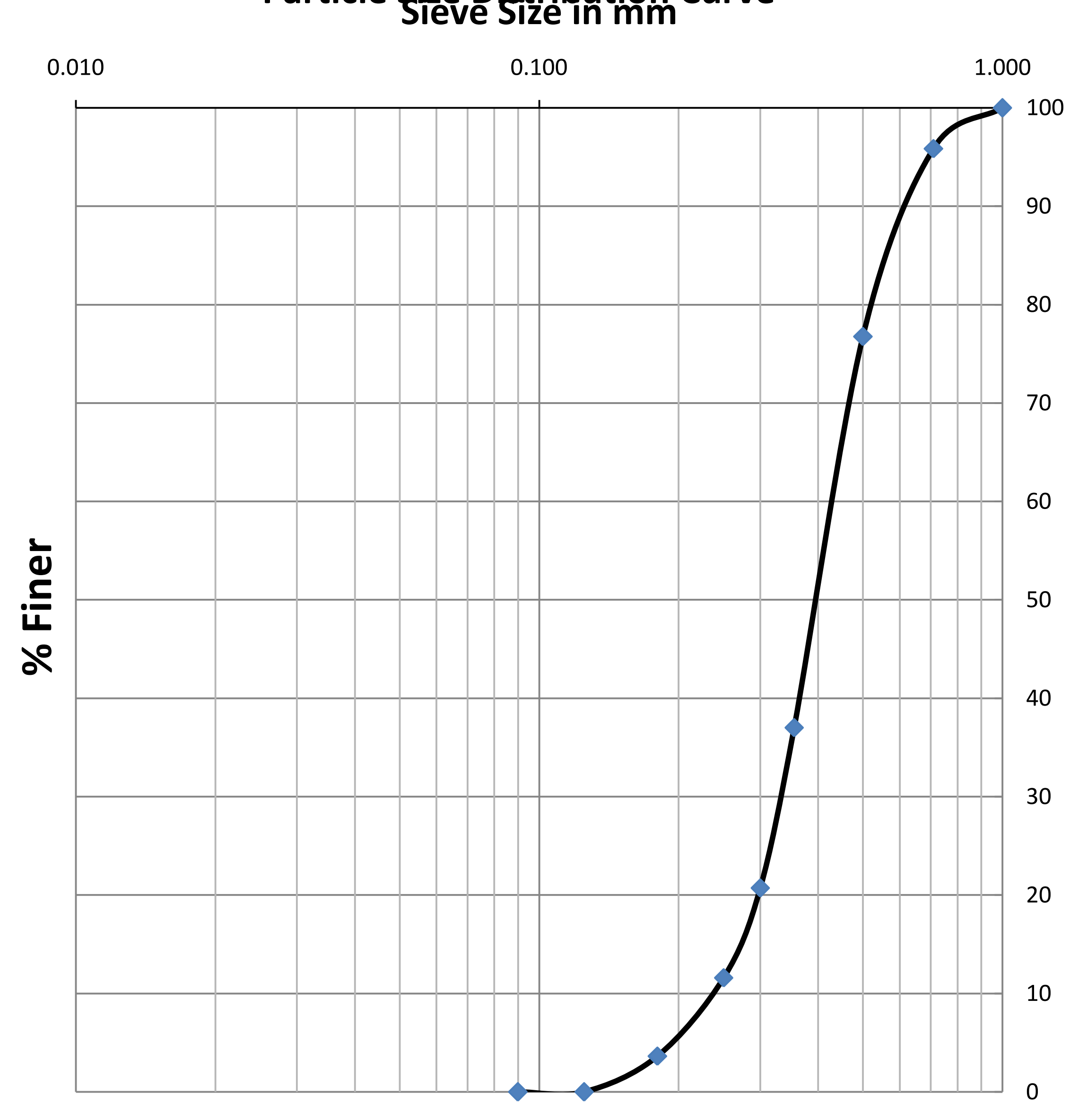
Sample No. BS13
Particle Size Distribution Curve



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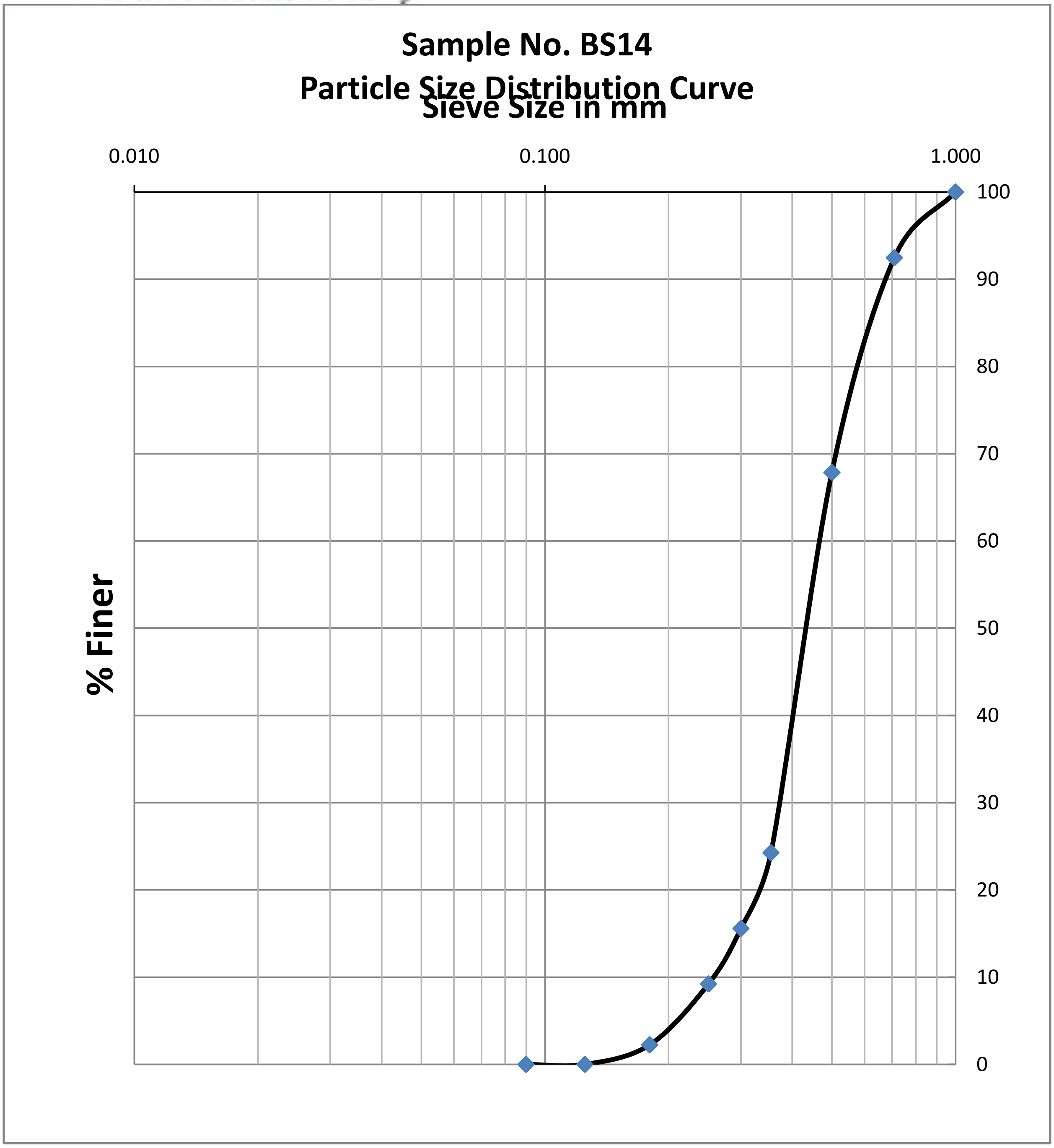

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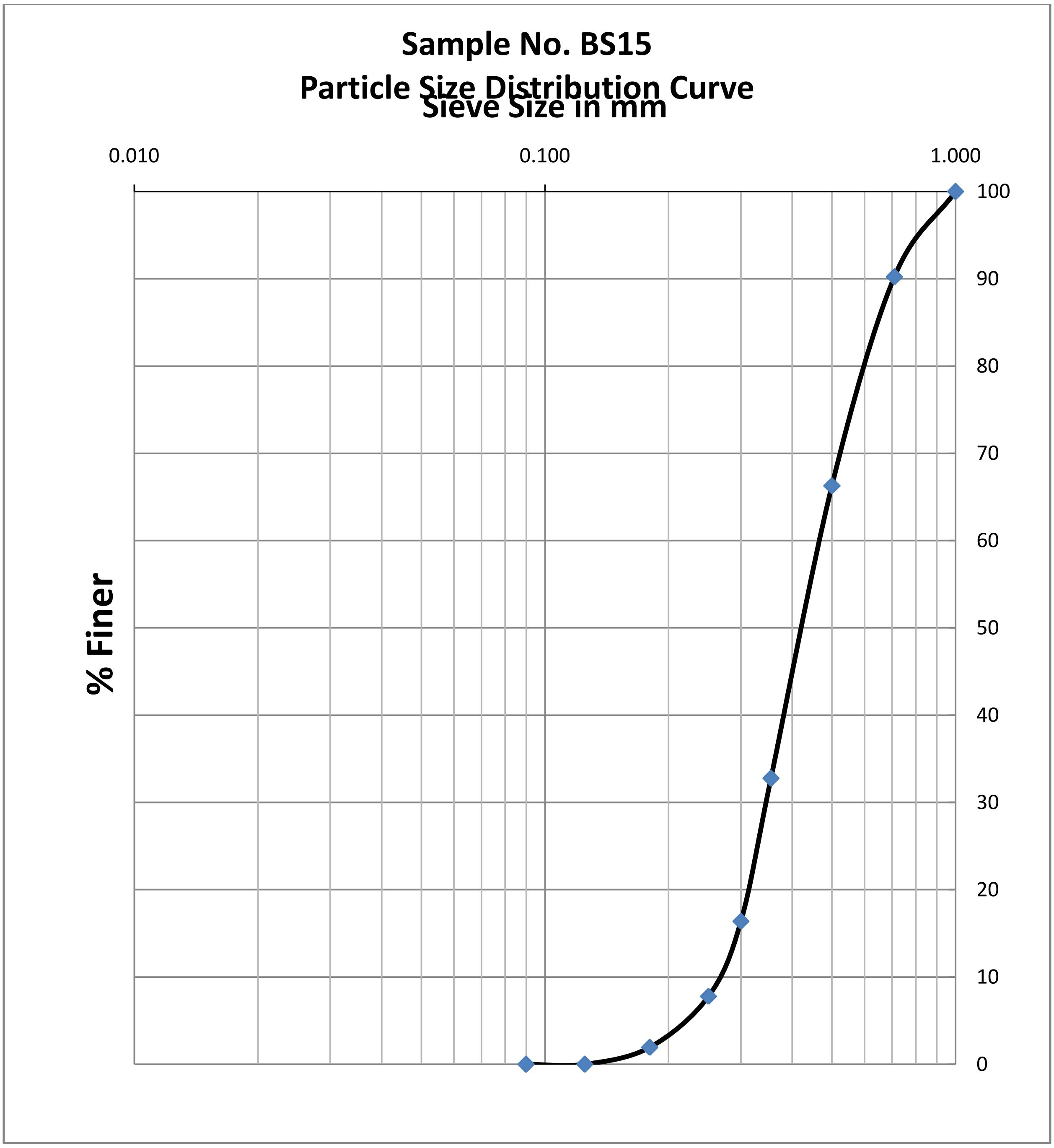

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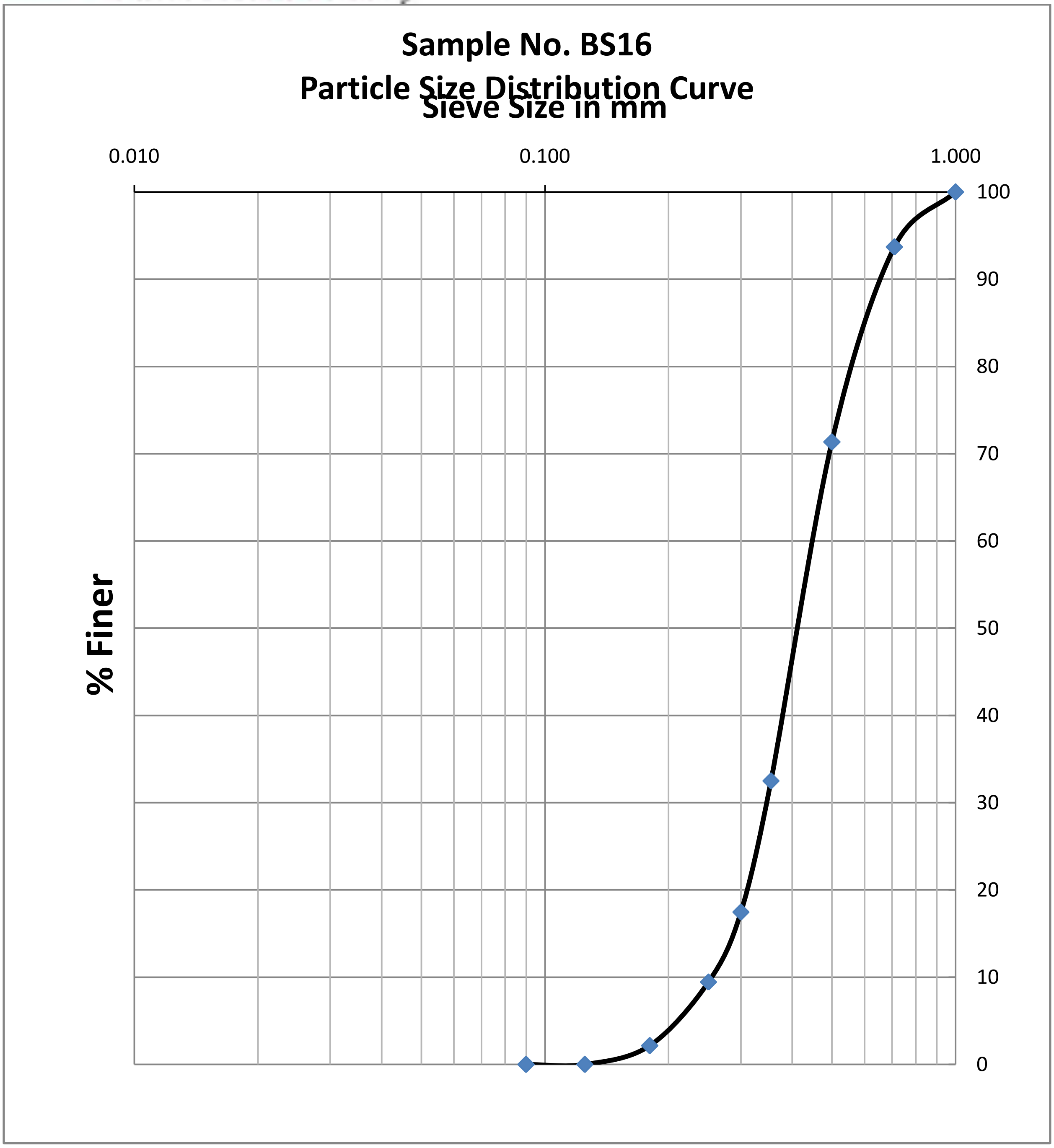

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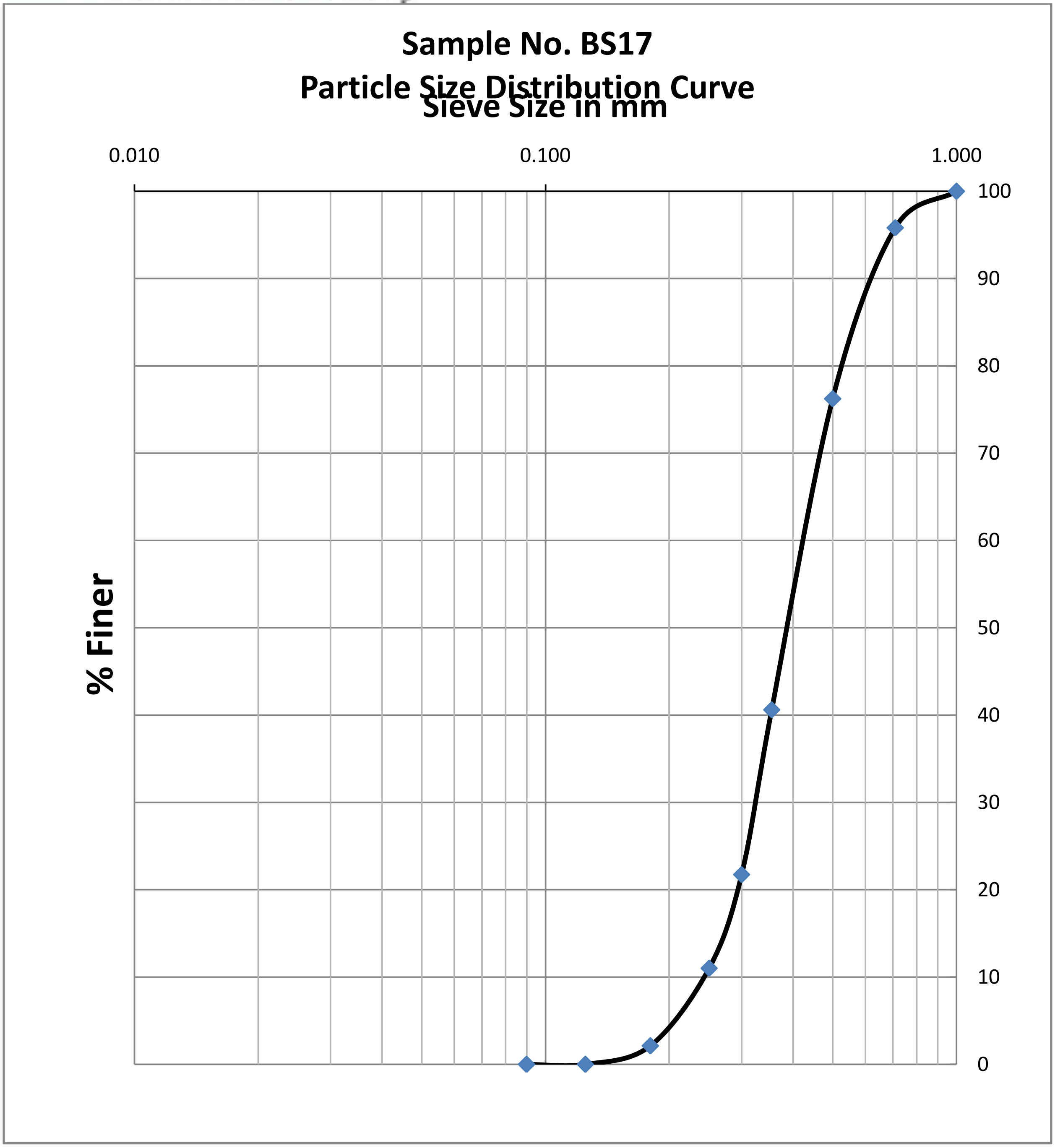

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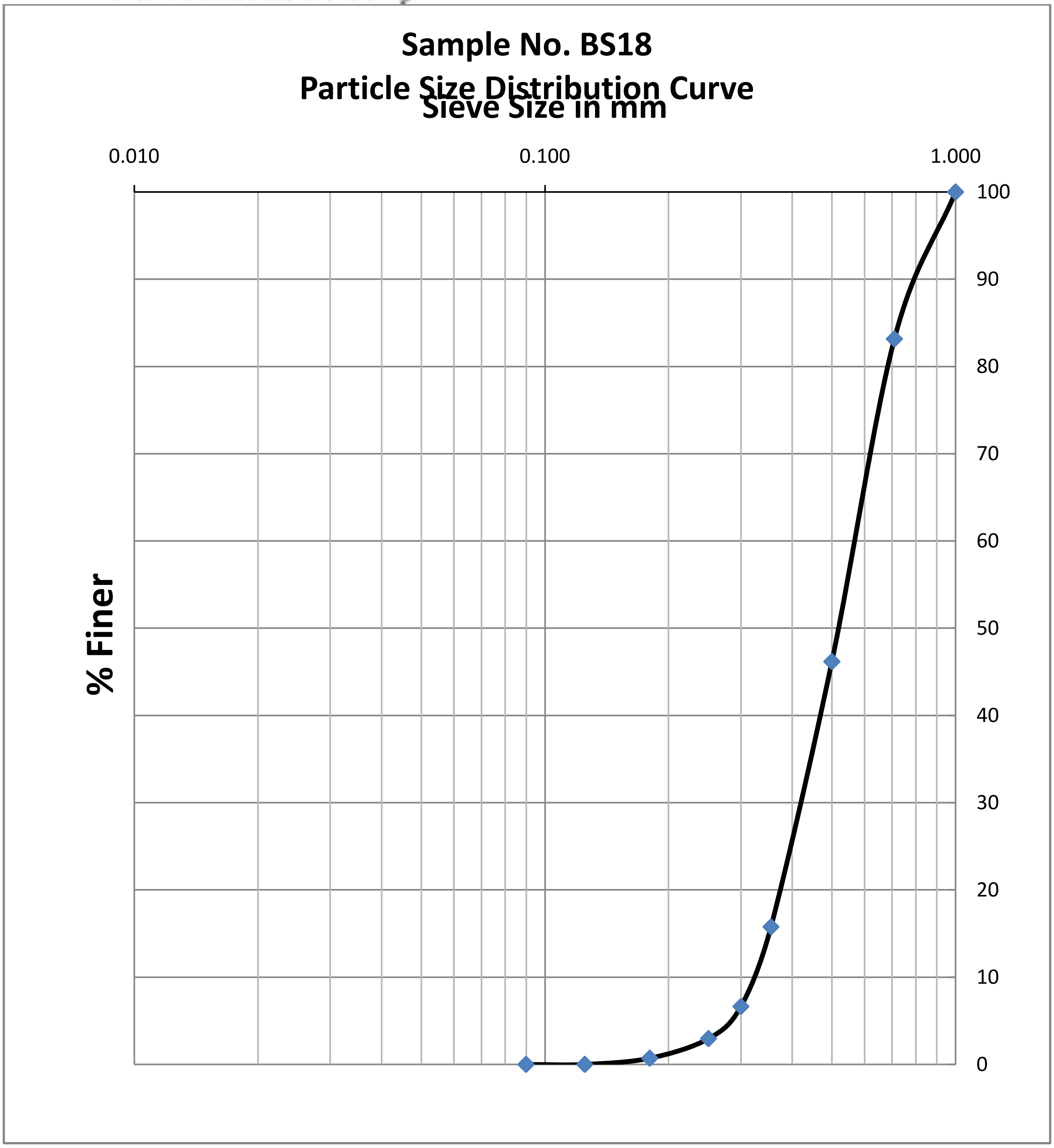

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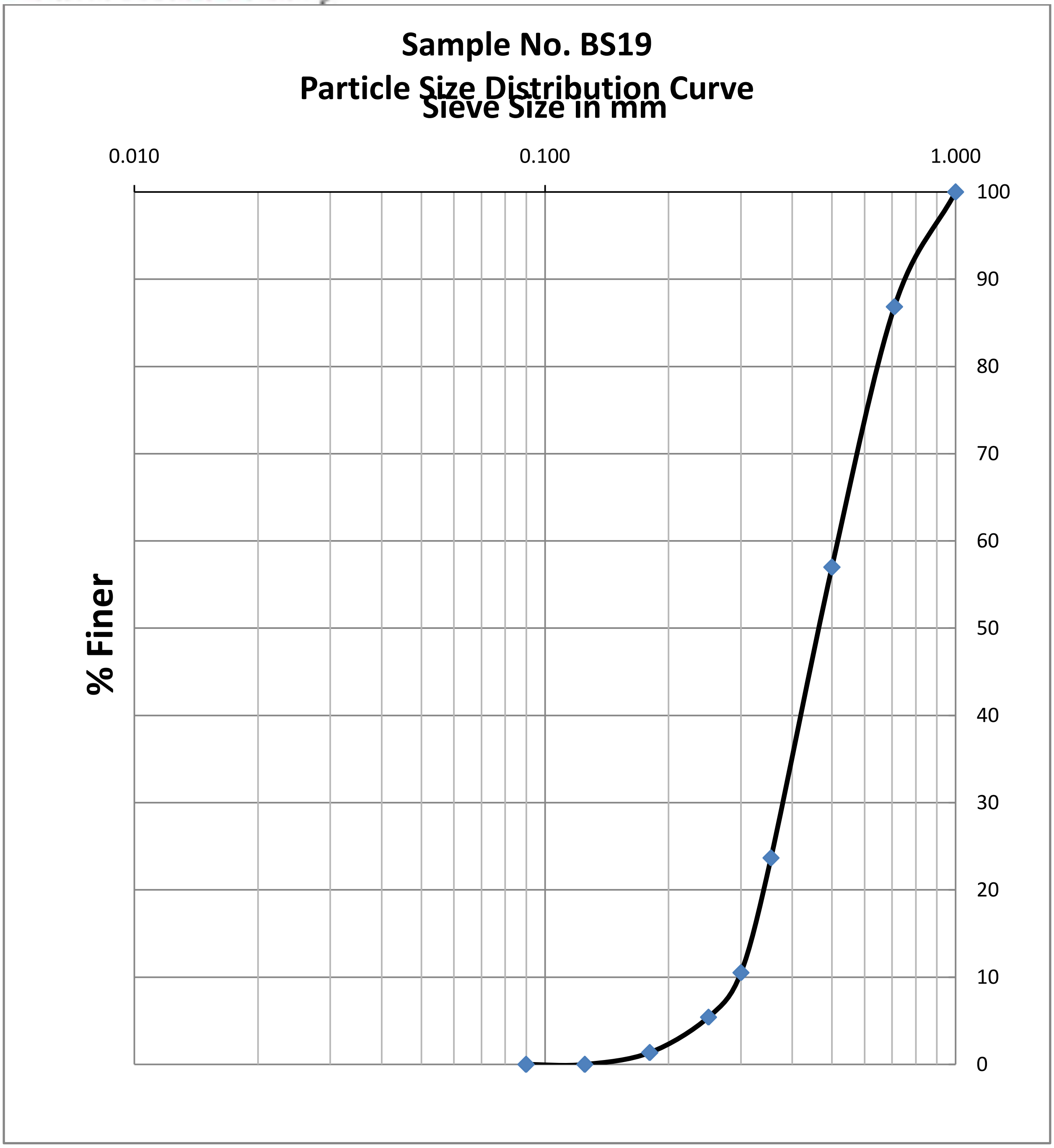

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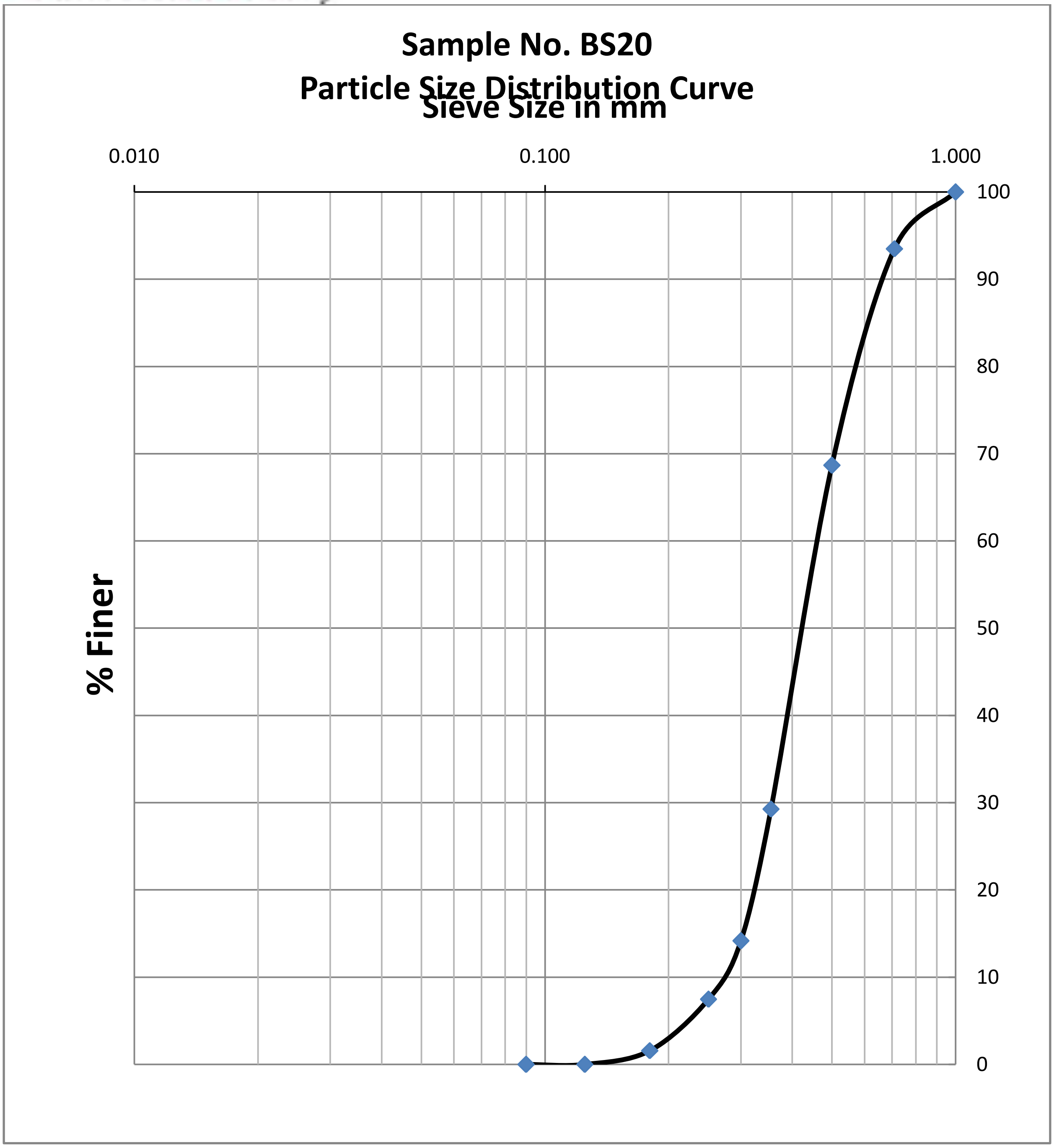

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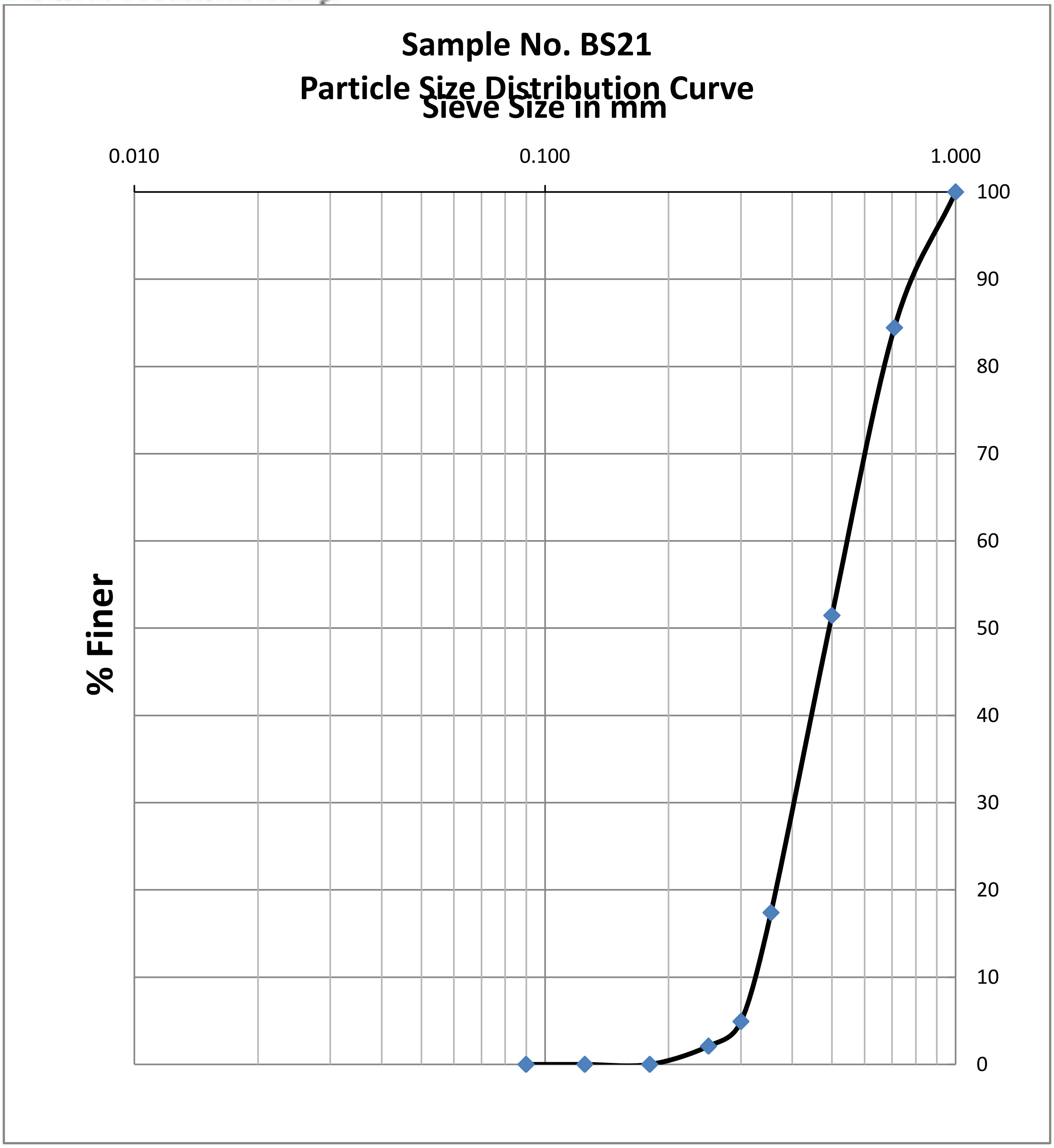

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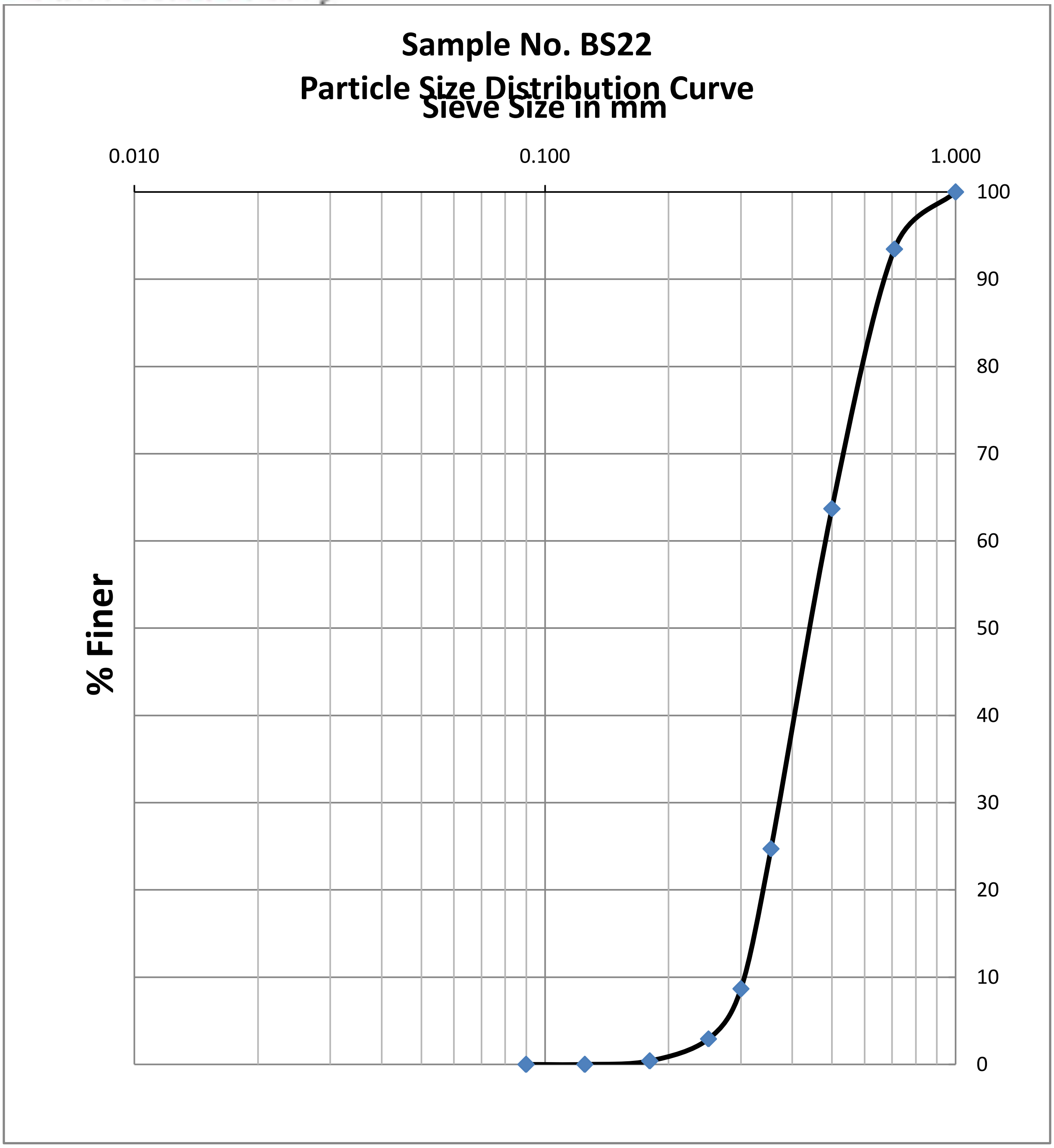

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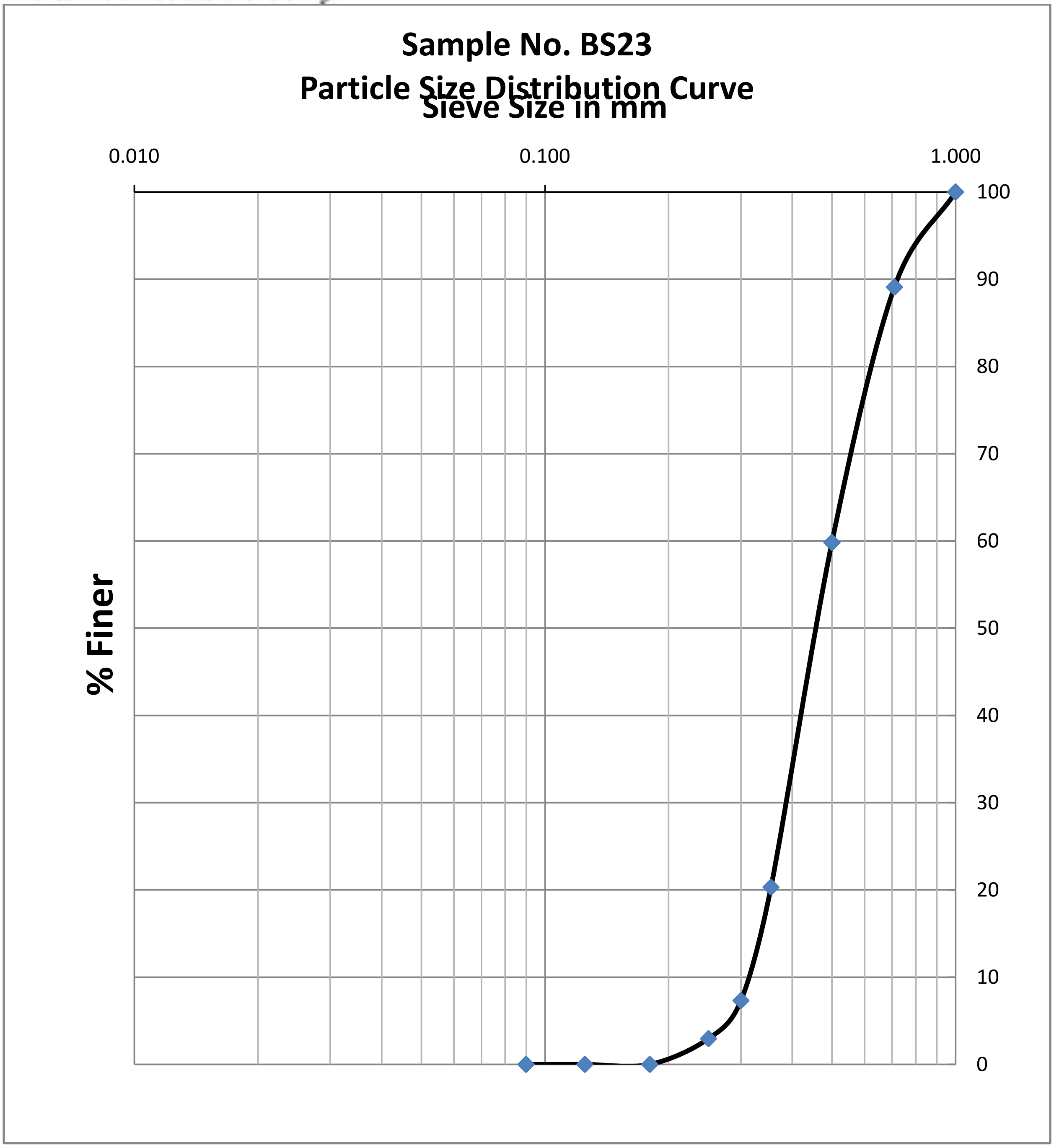

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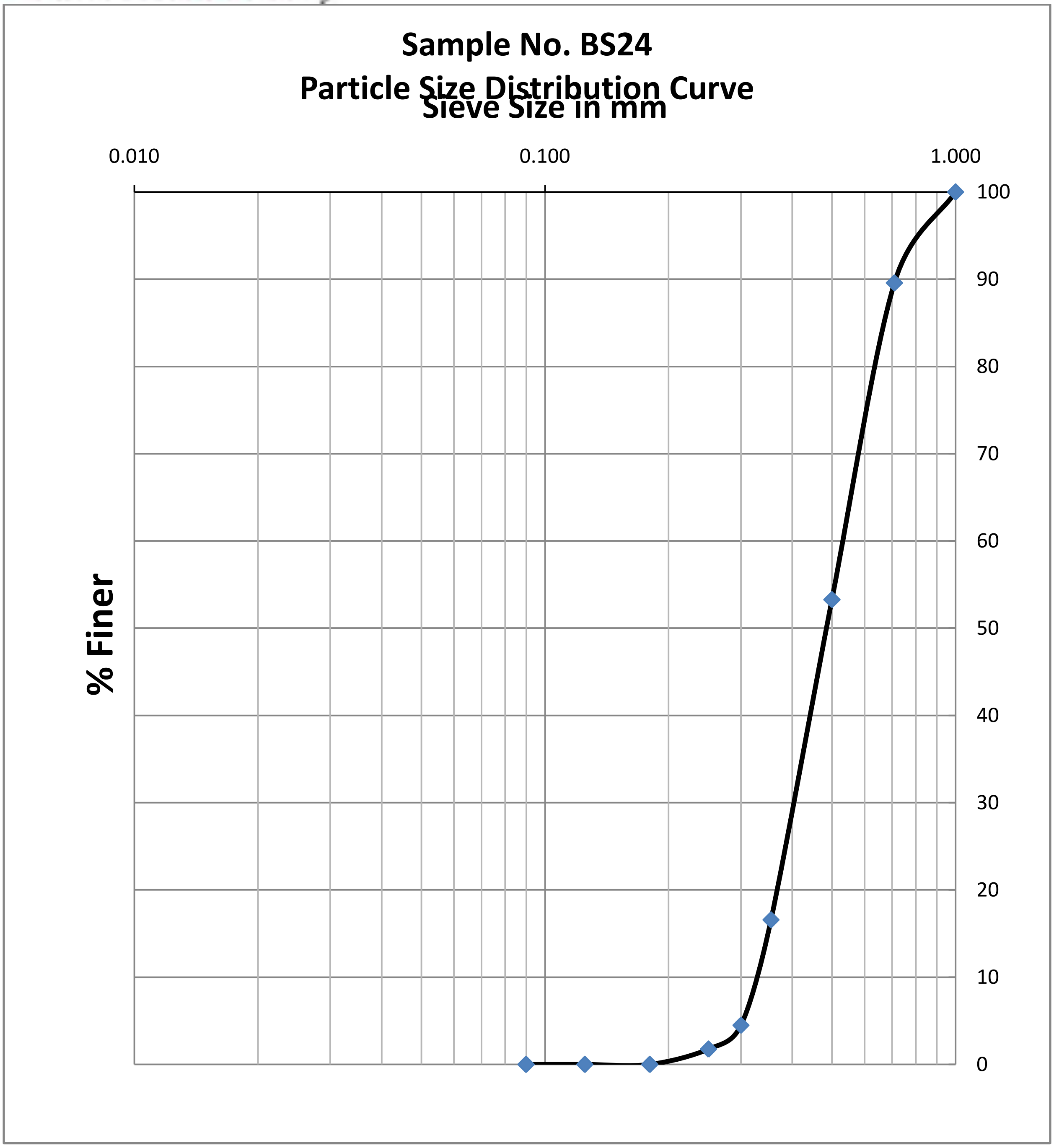

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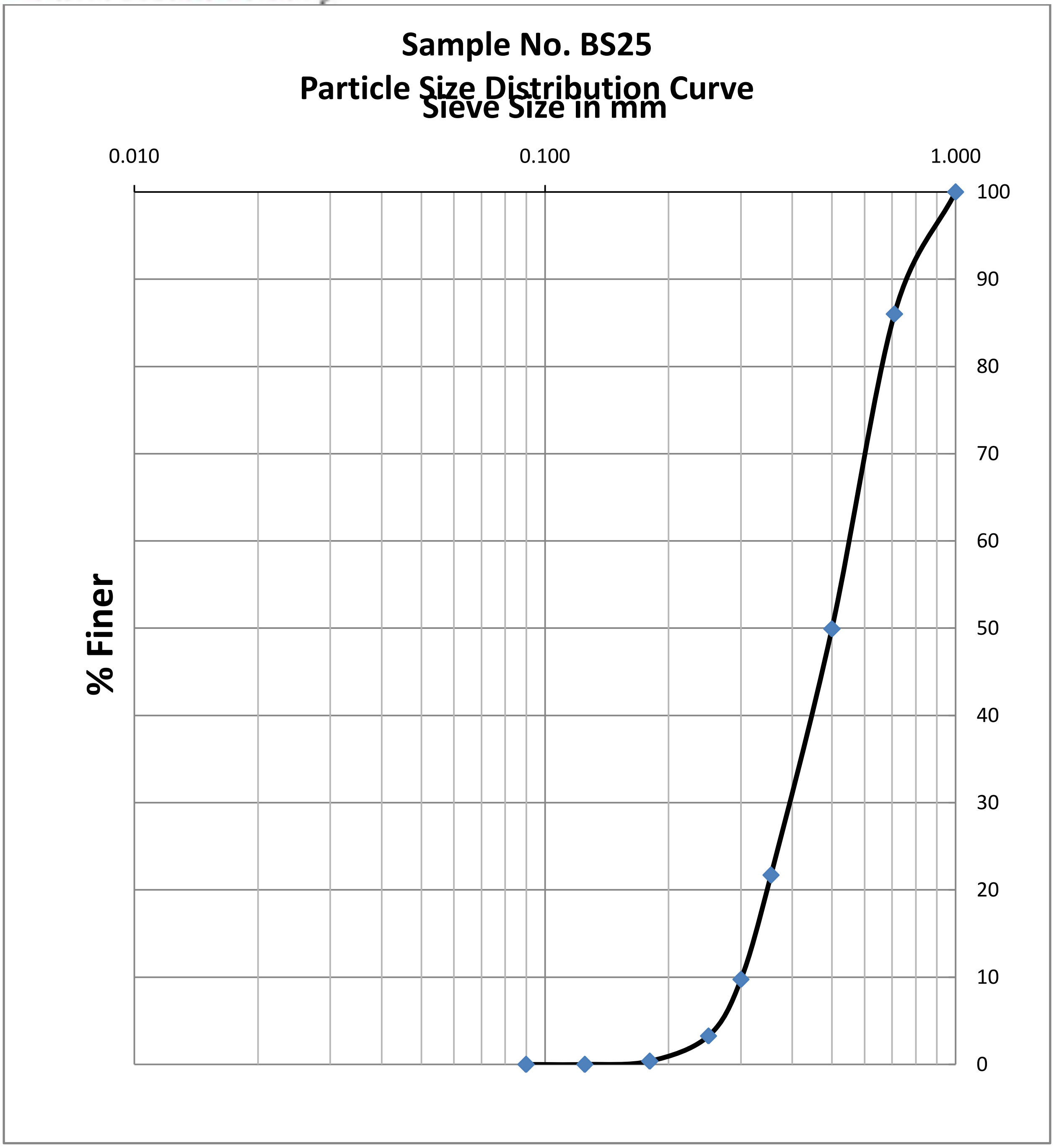

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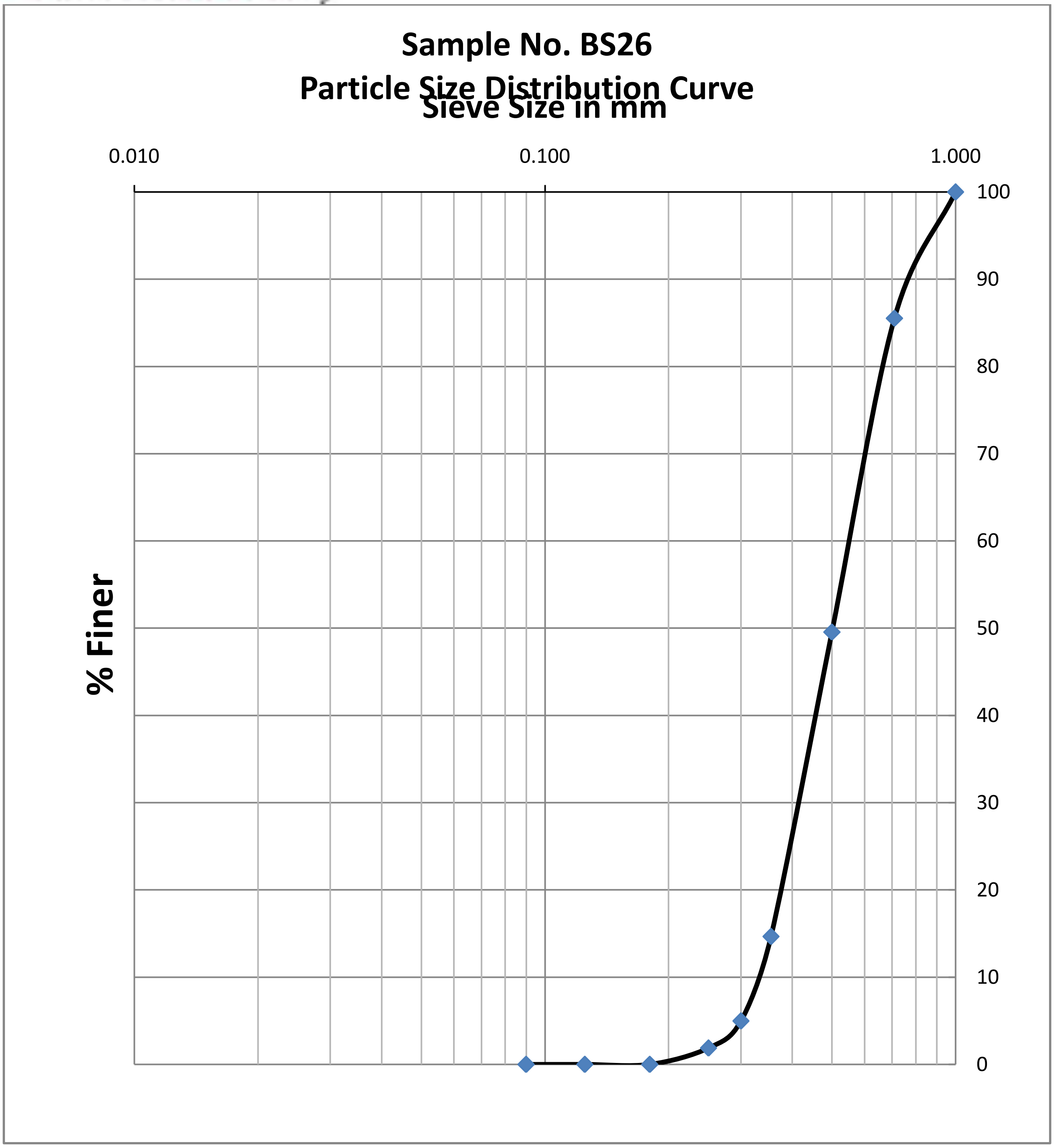

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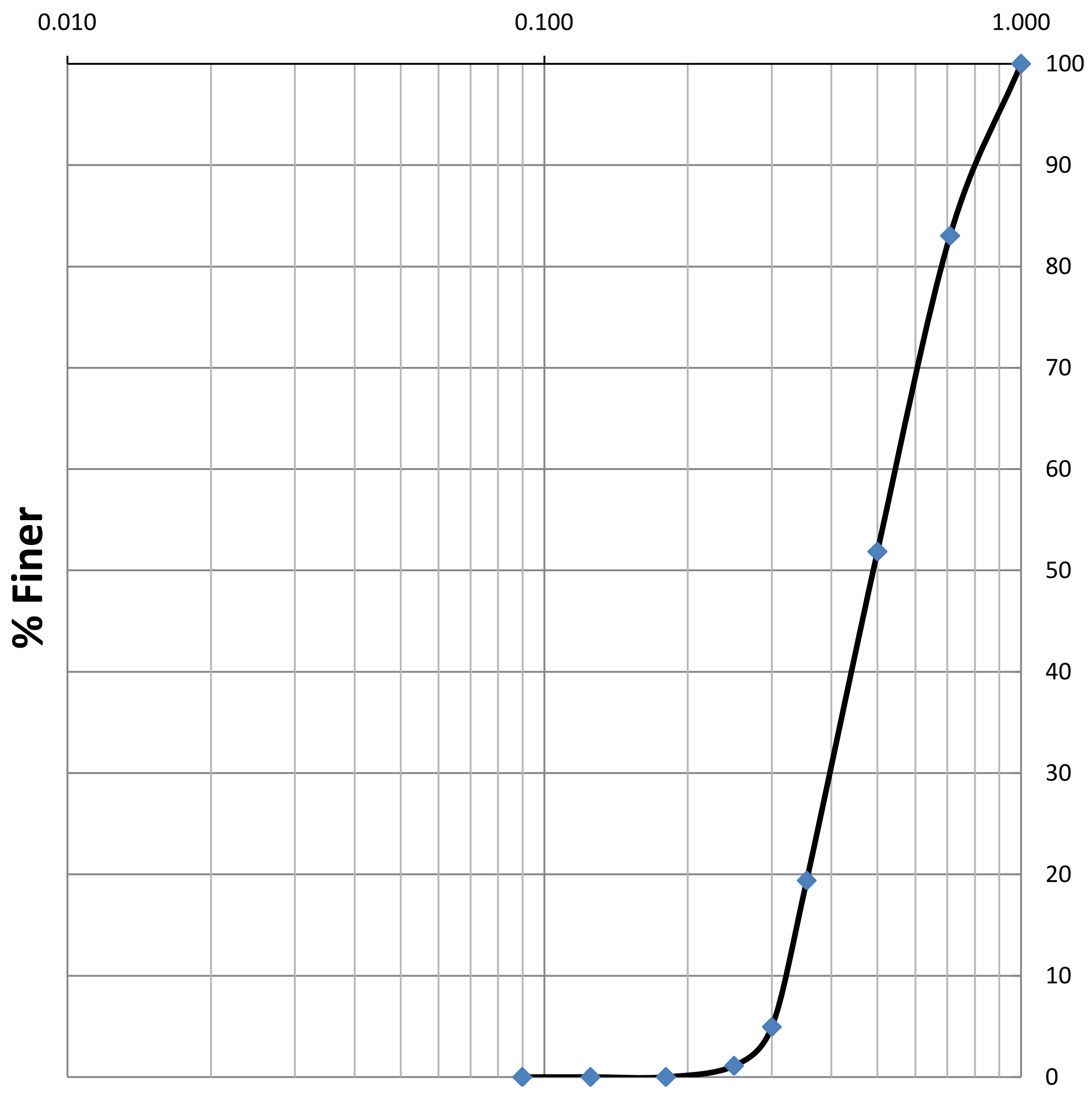
Sample No. BS27
Particle Size Distribution Curve



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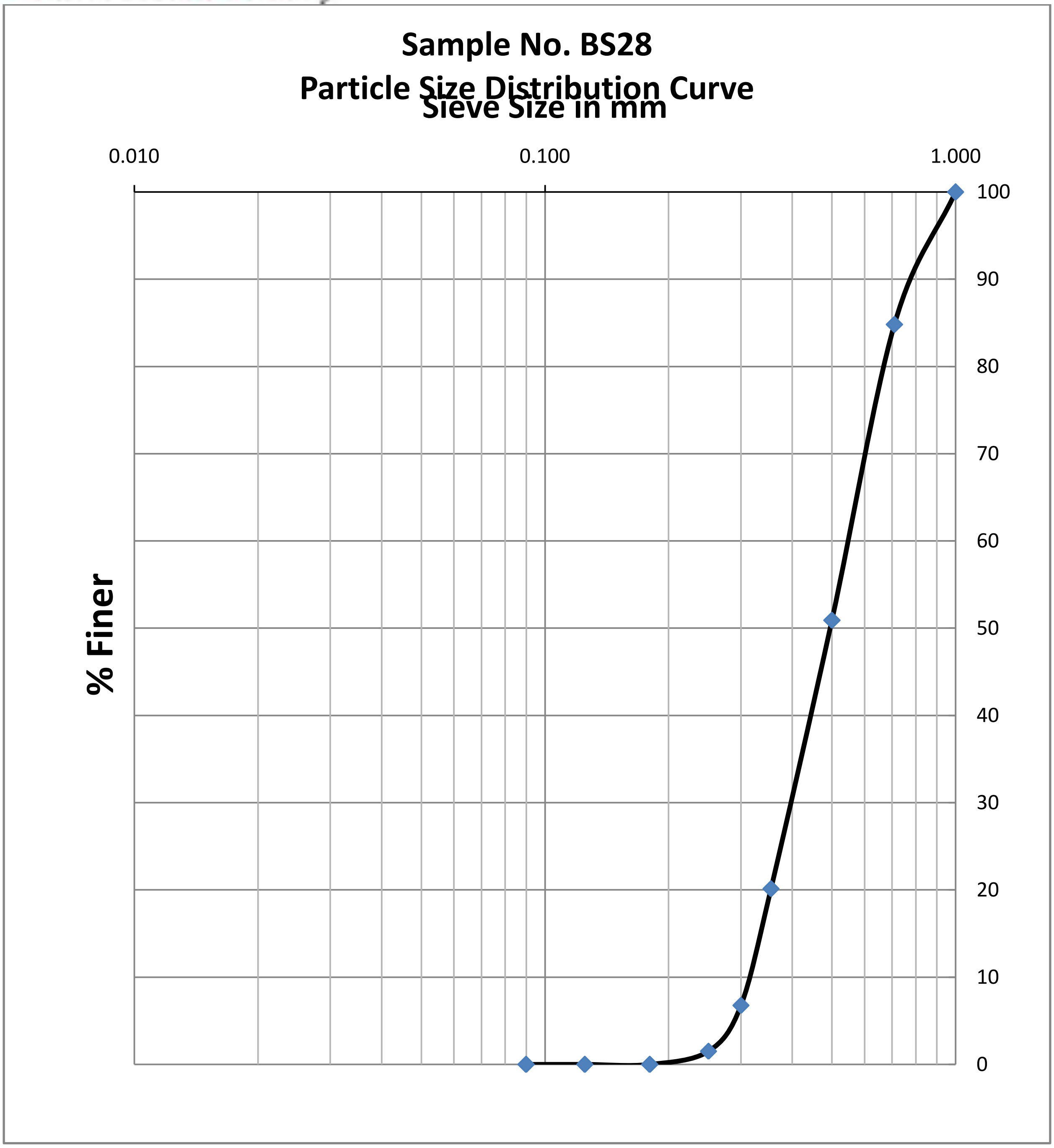

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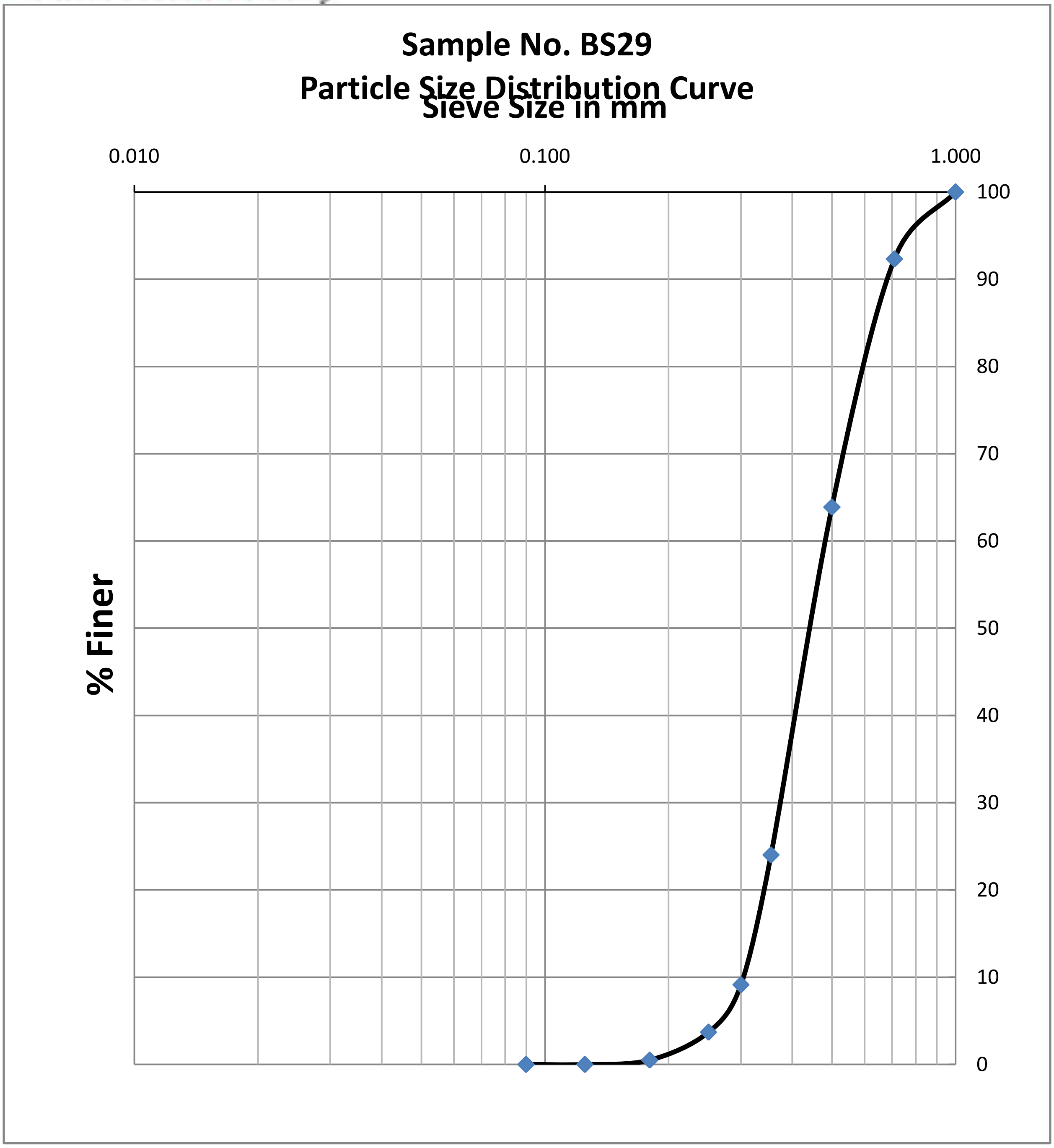

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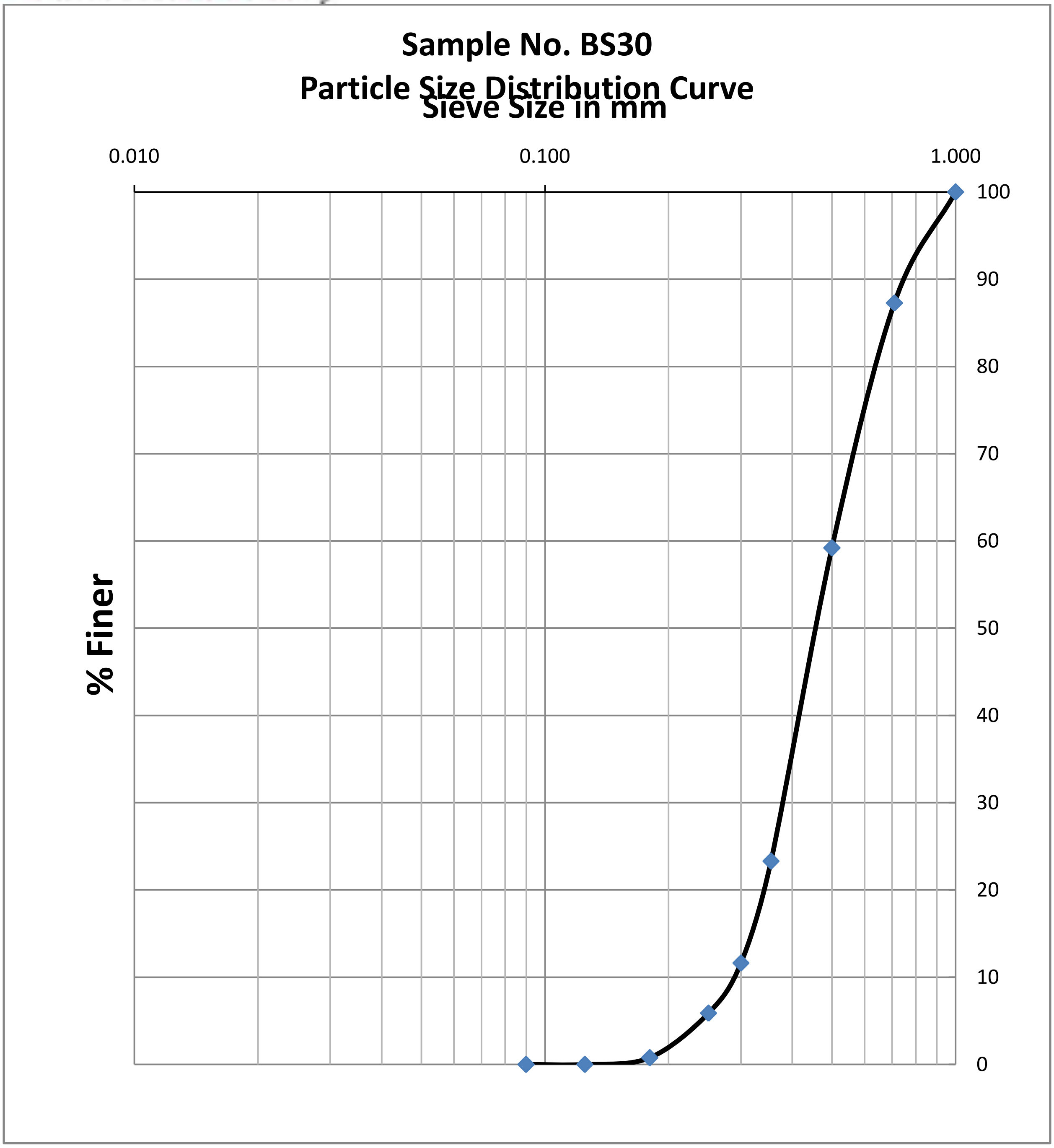

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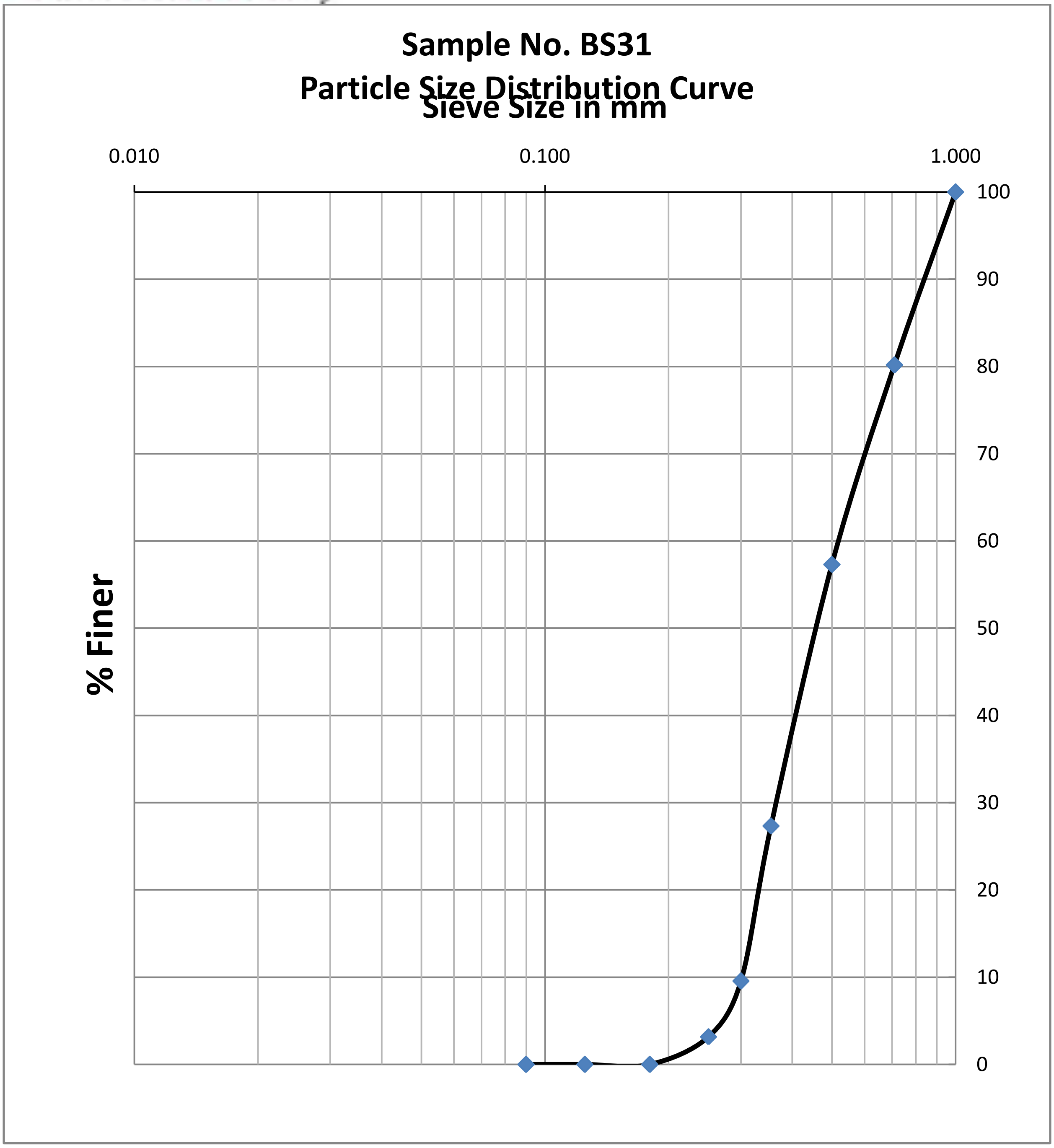

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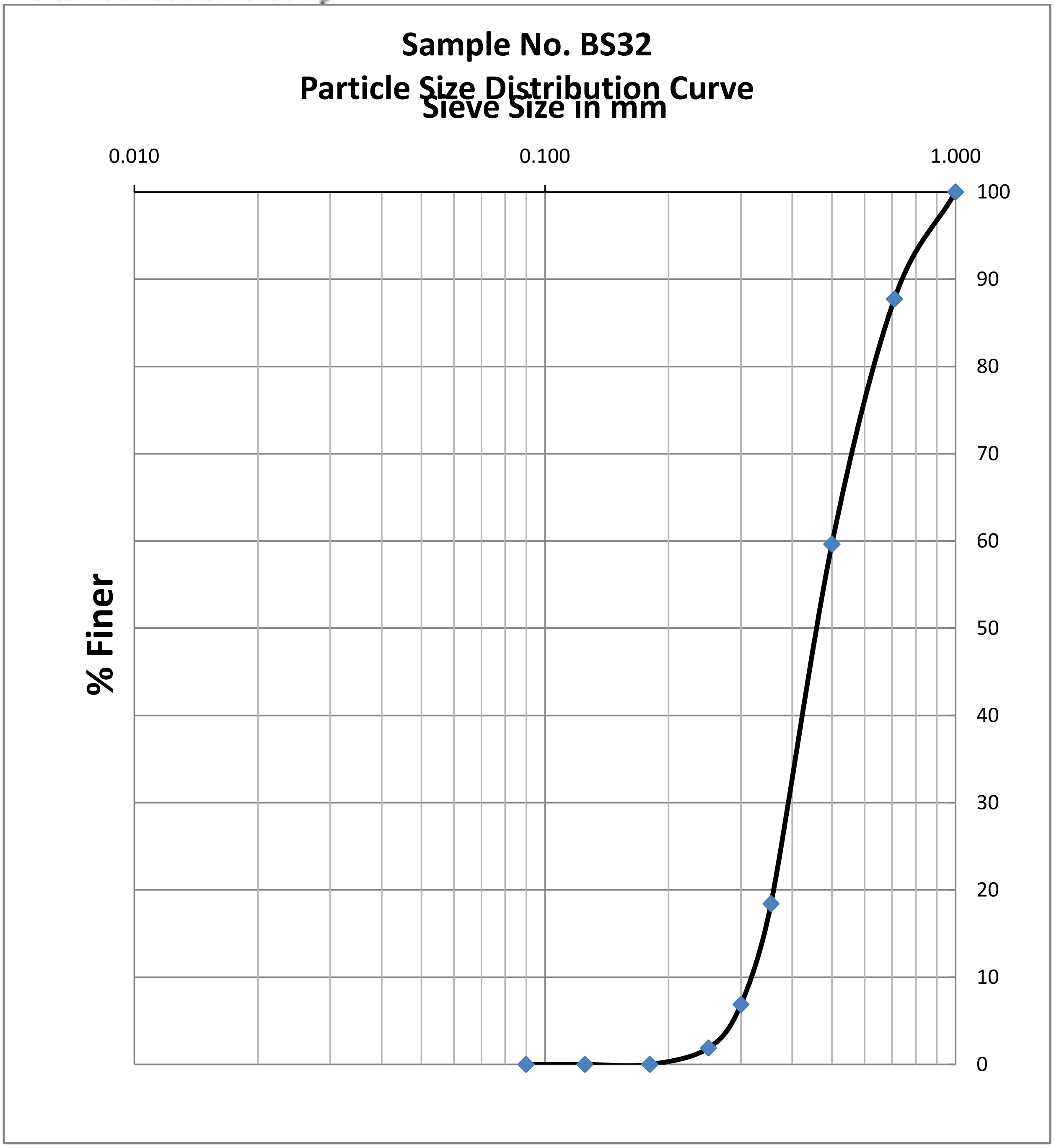

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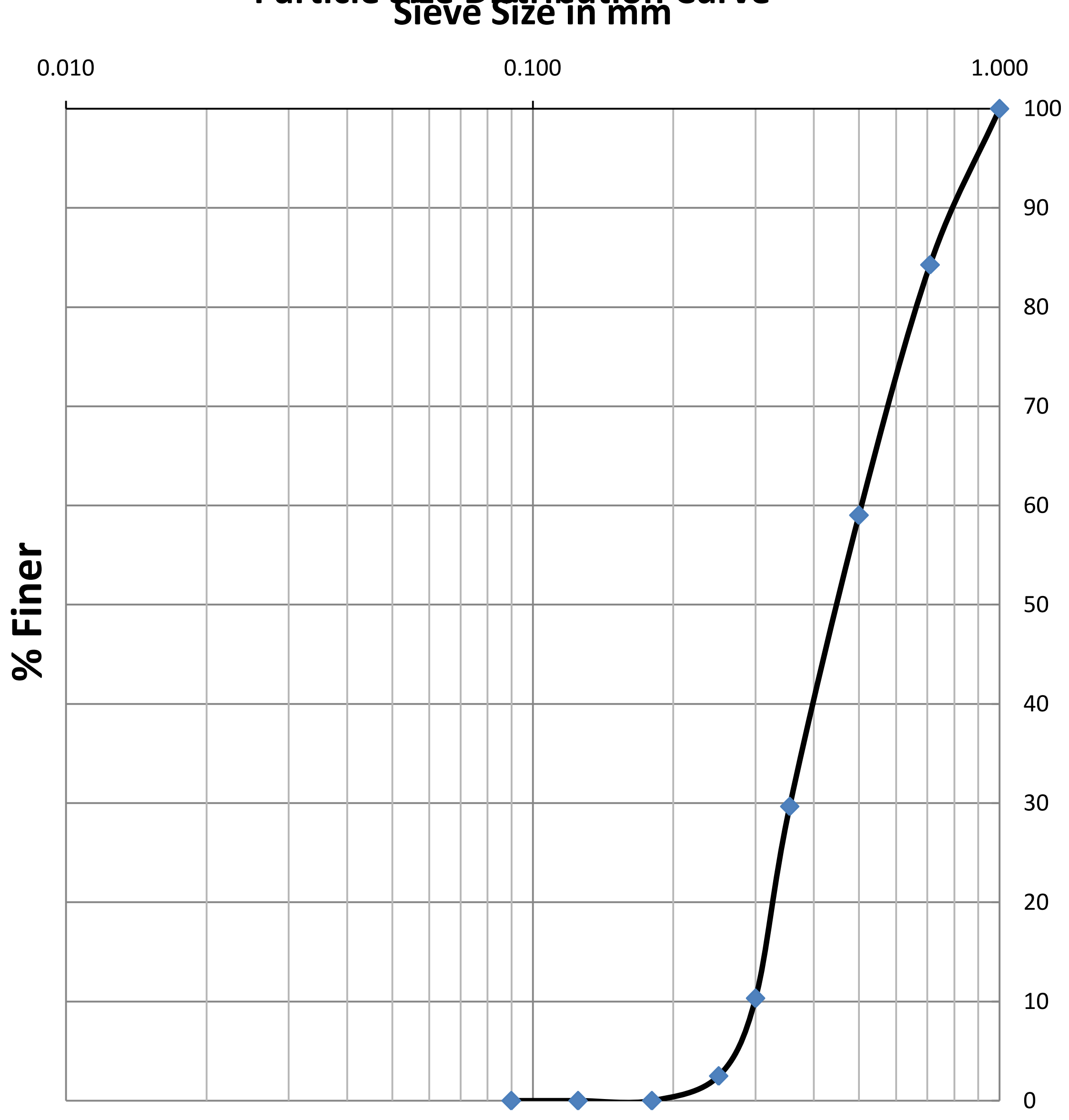
Sample No. BS33

Particle Size Distribution Curve



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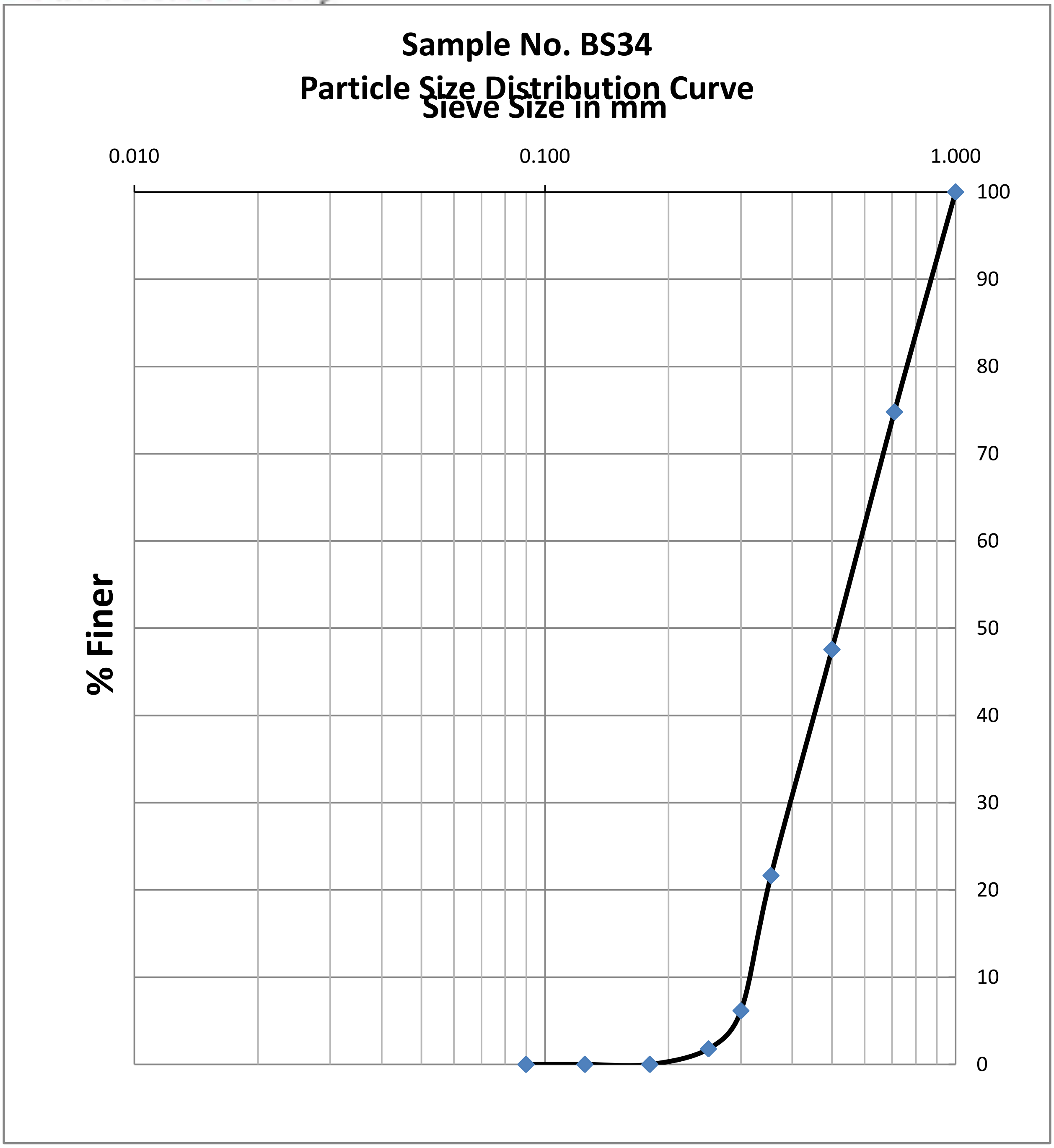

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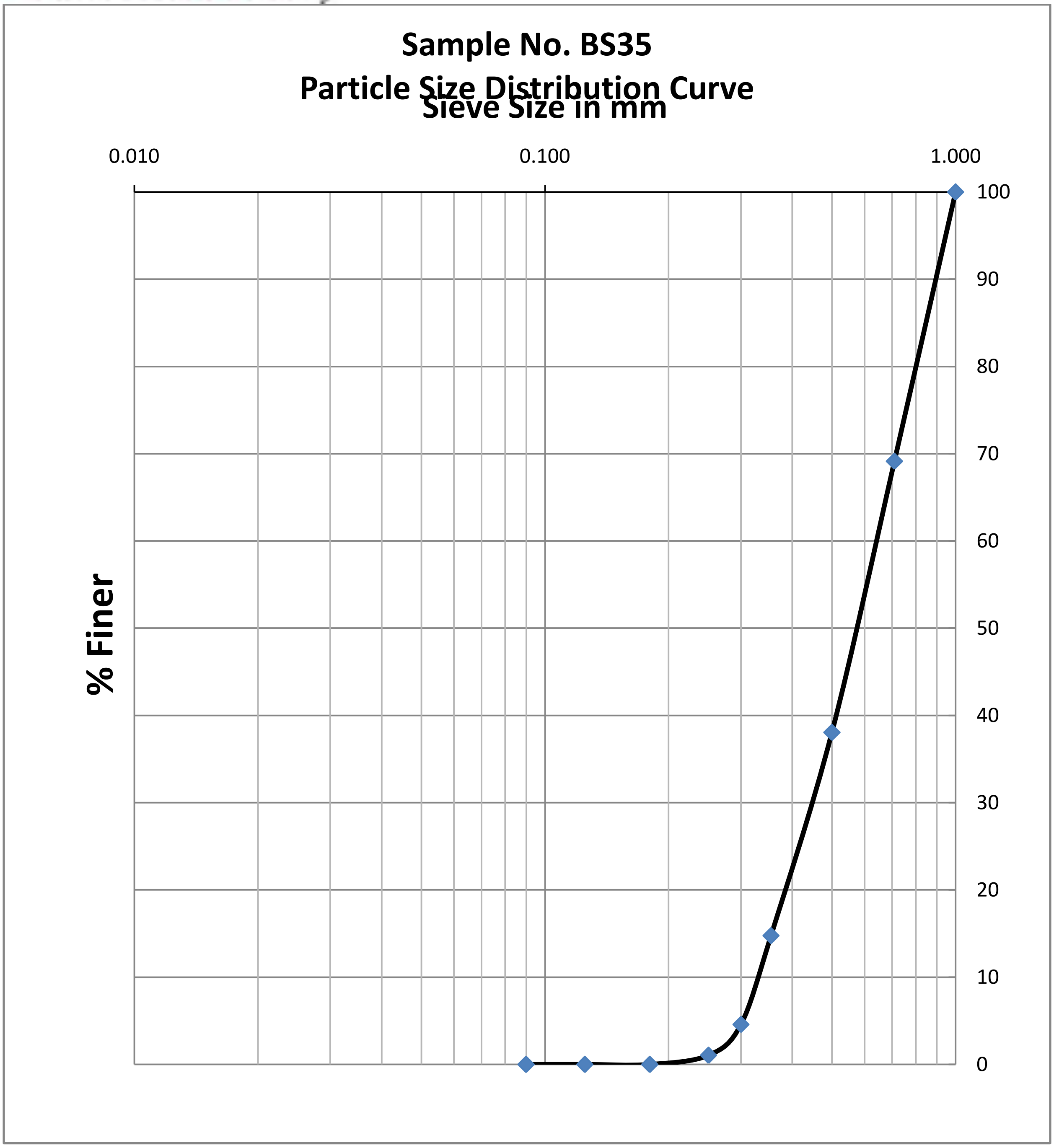

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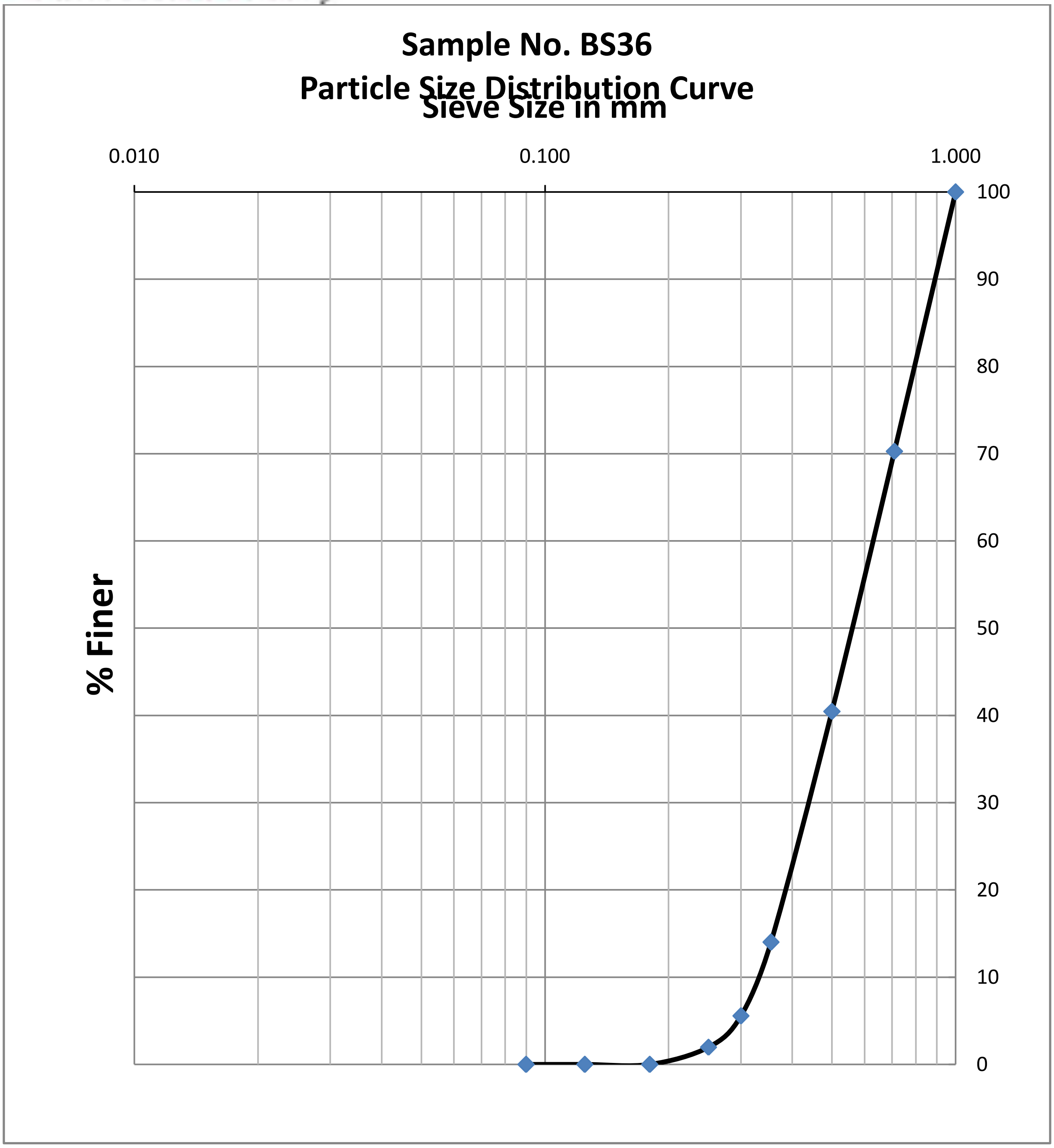

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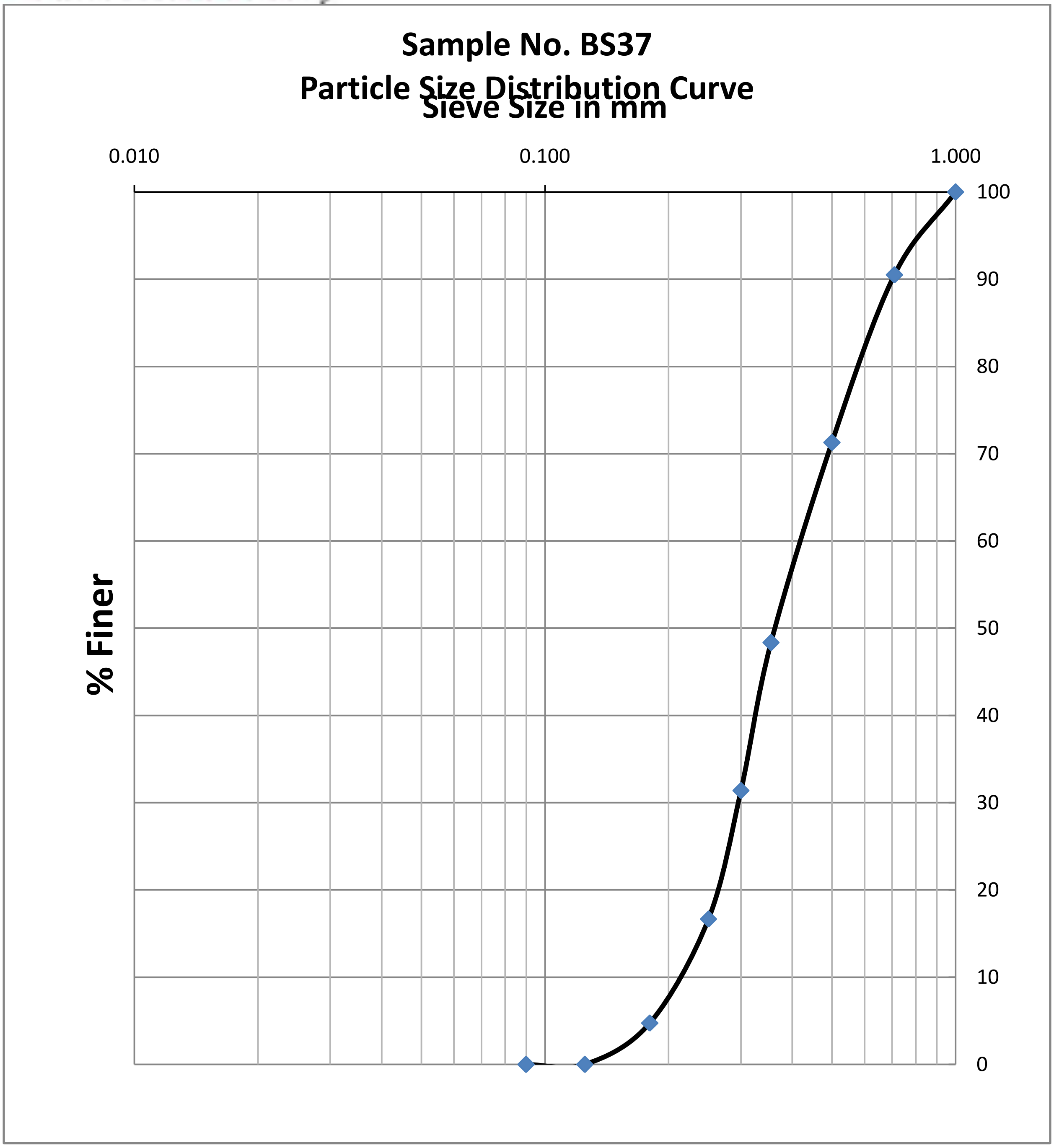

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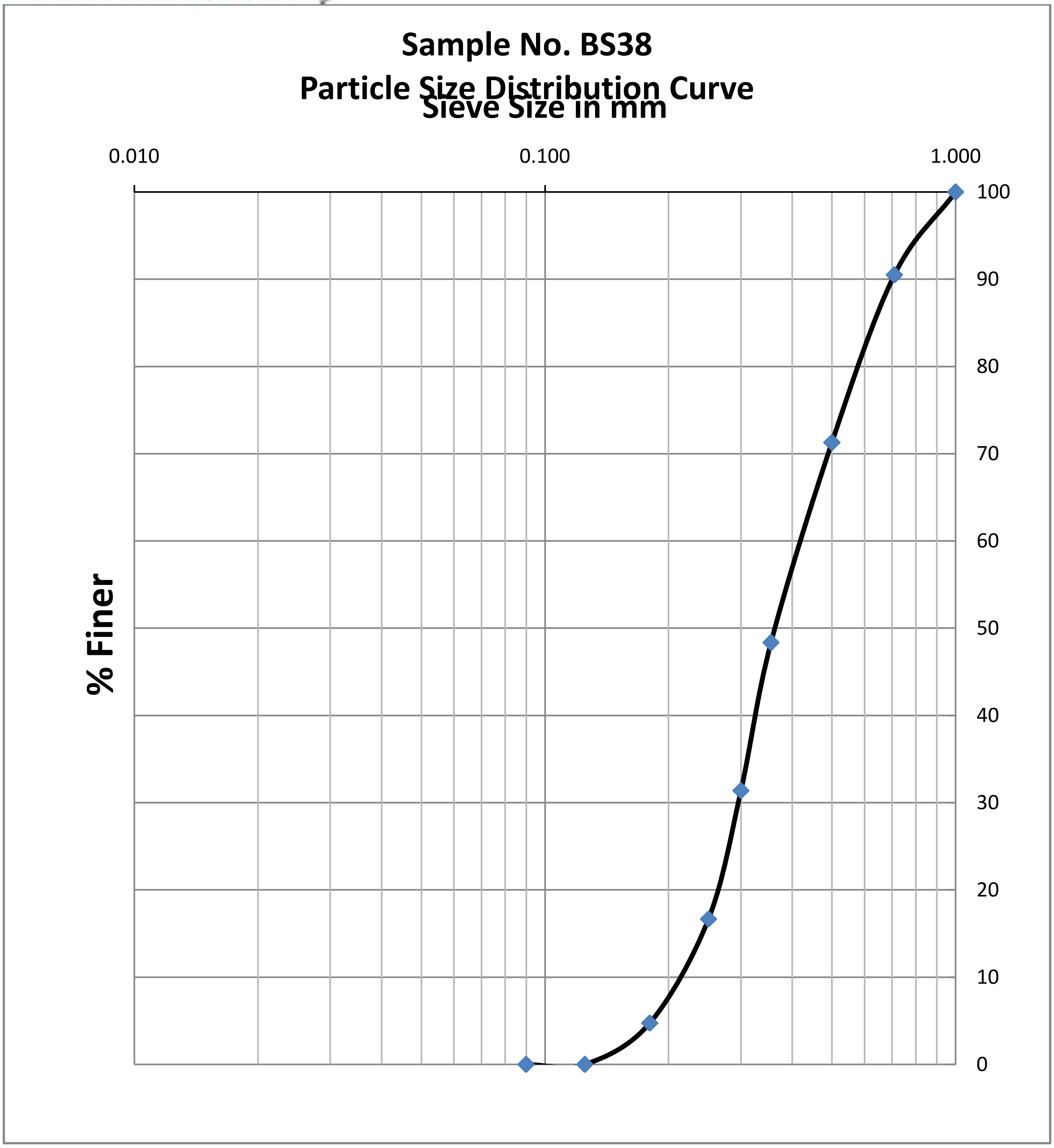

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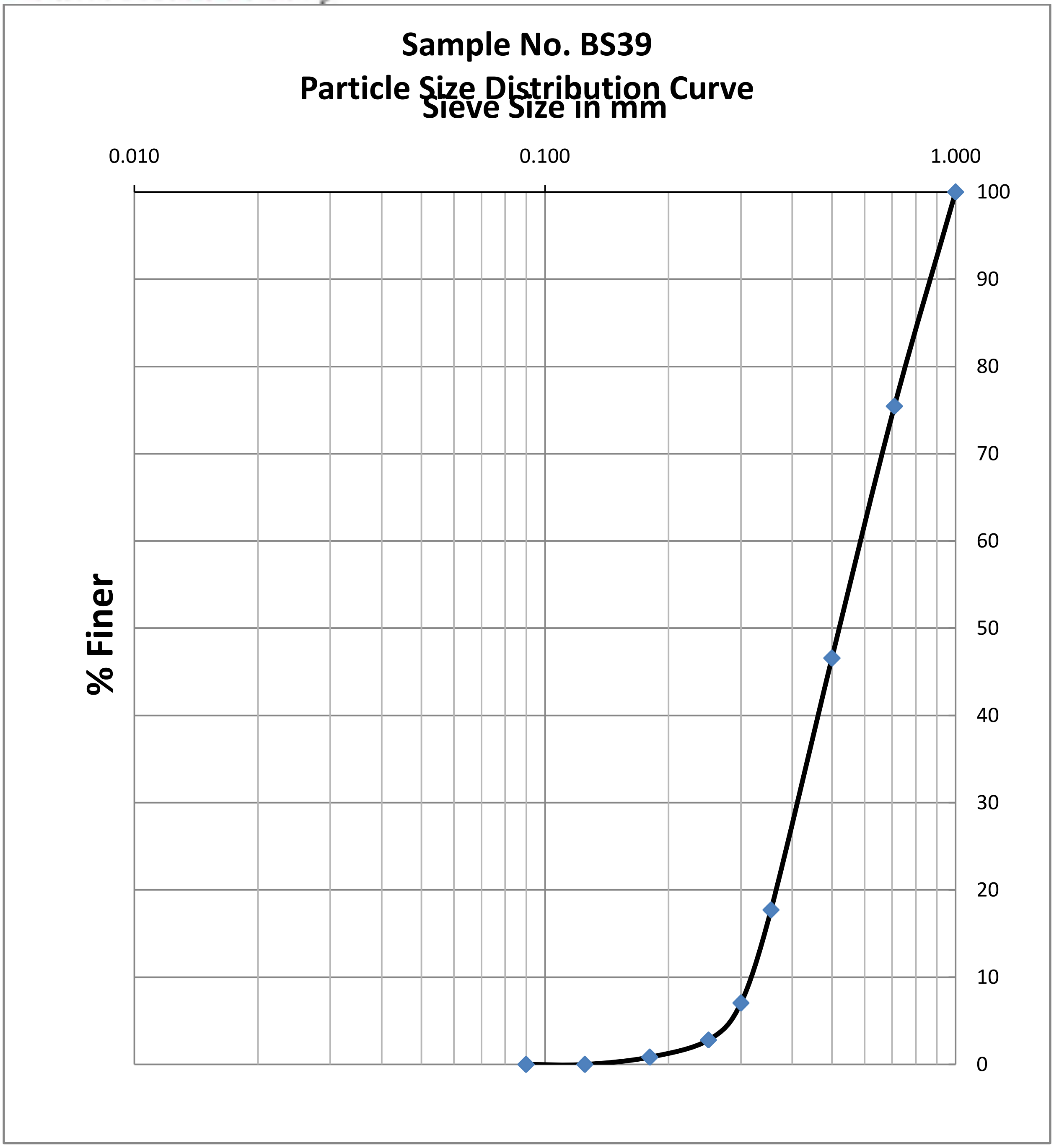

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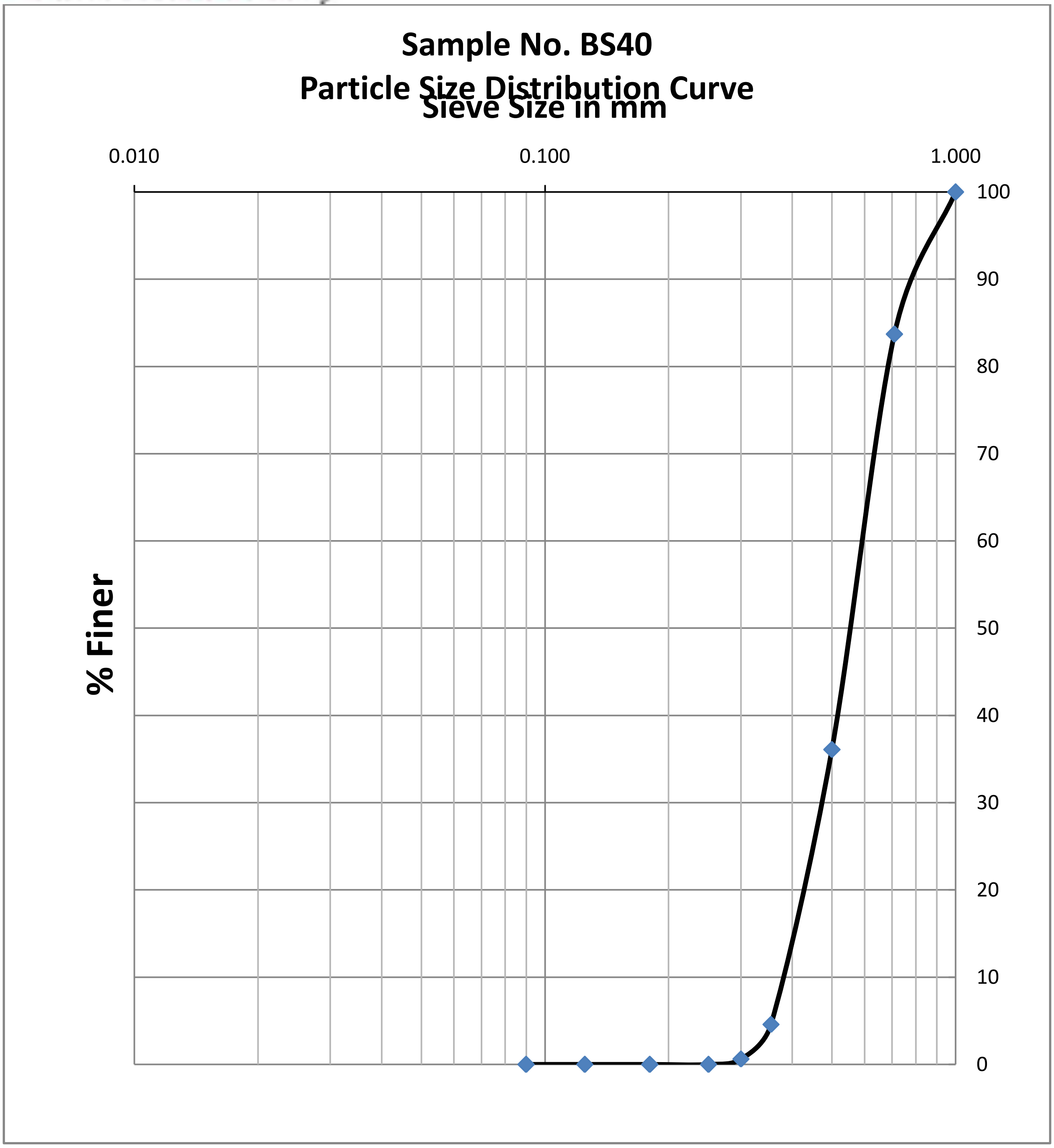

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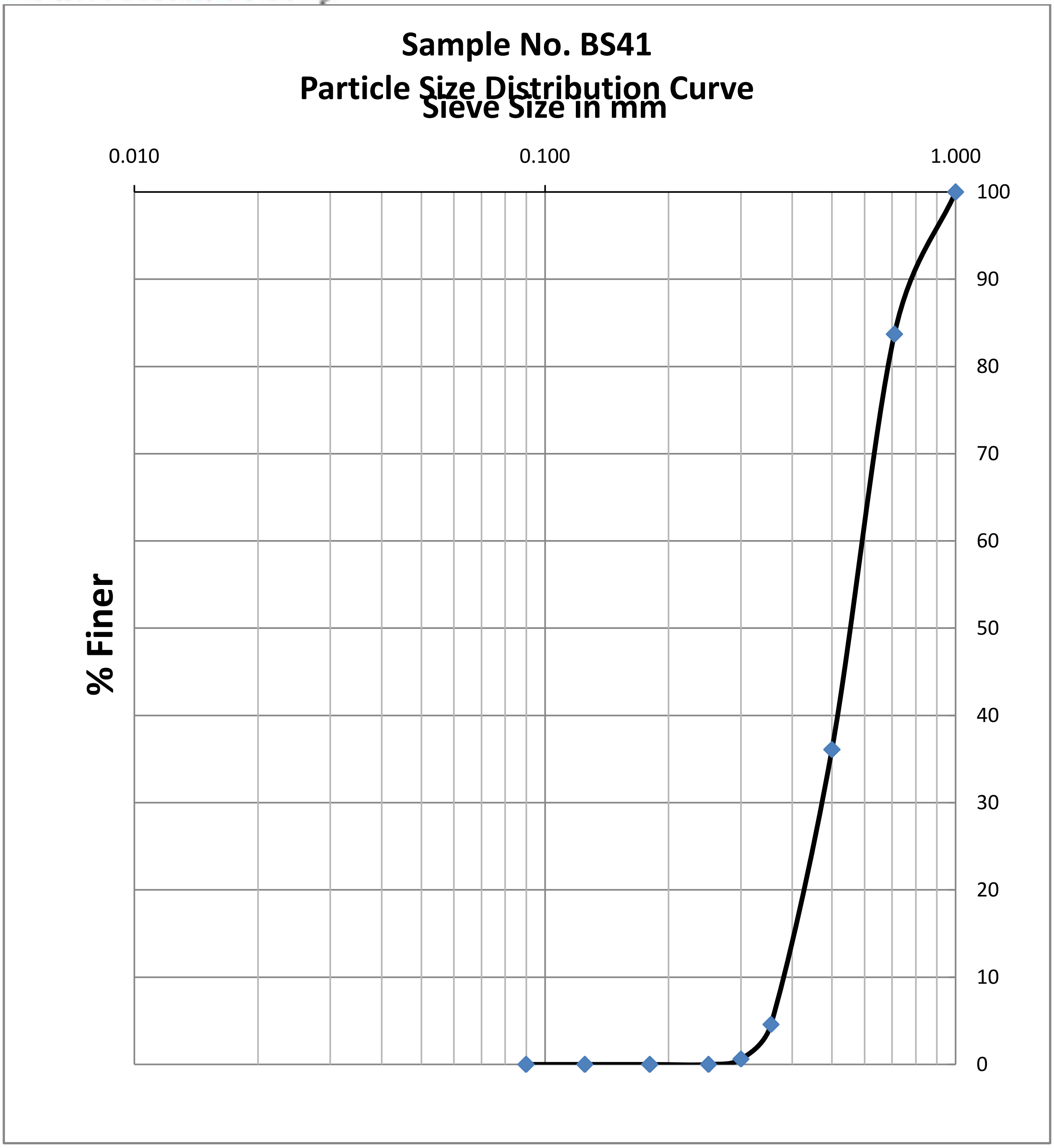

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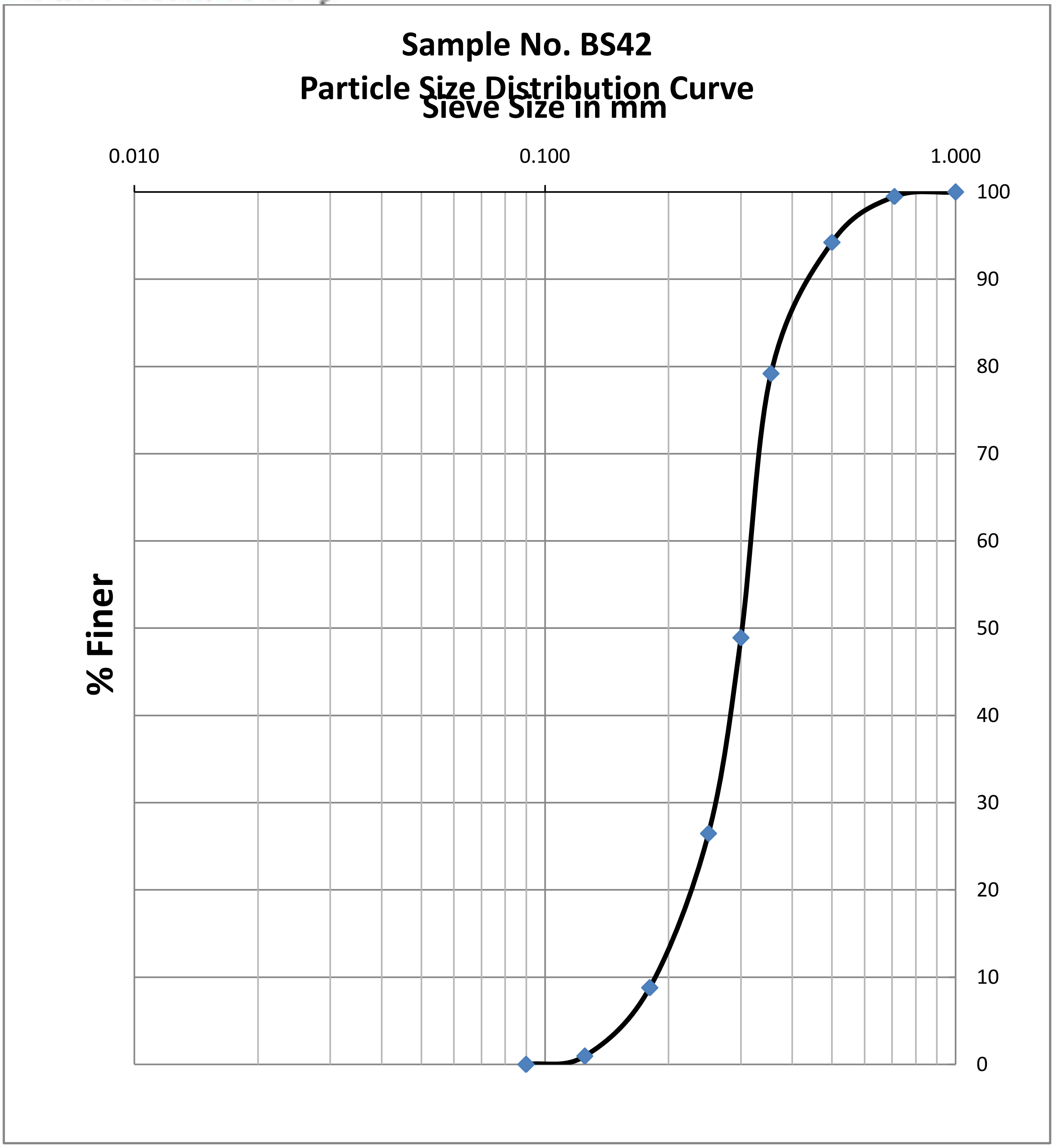

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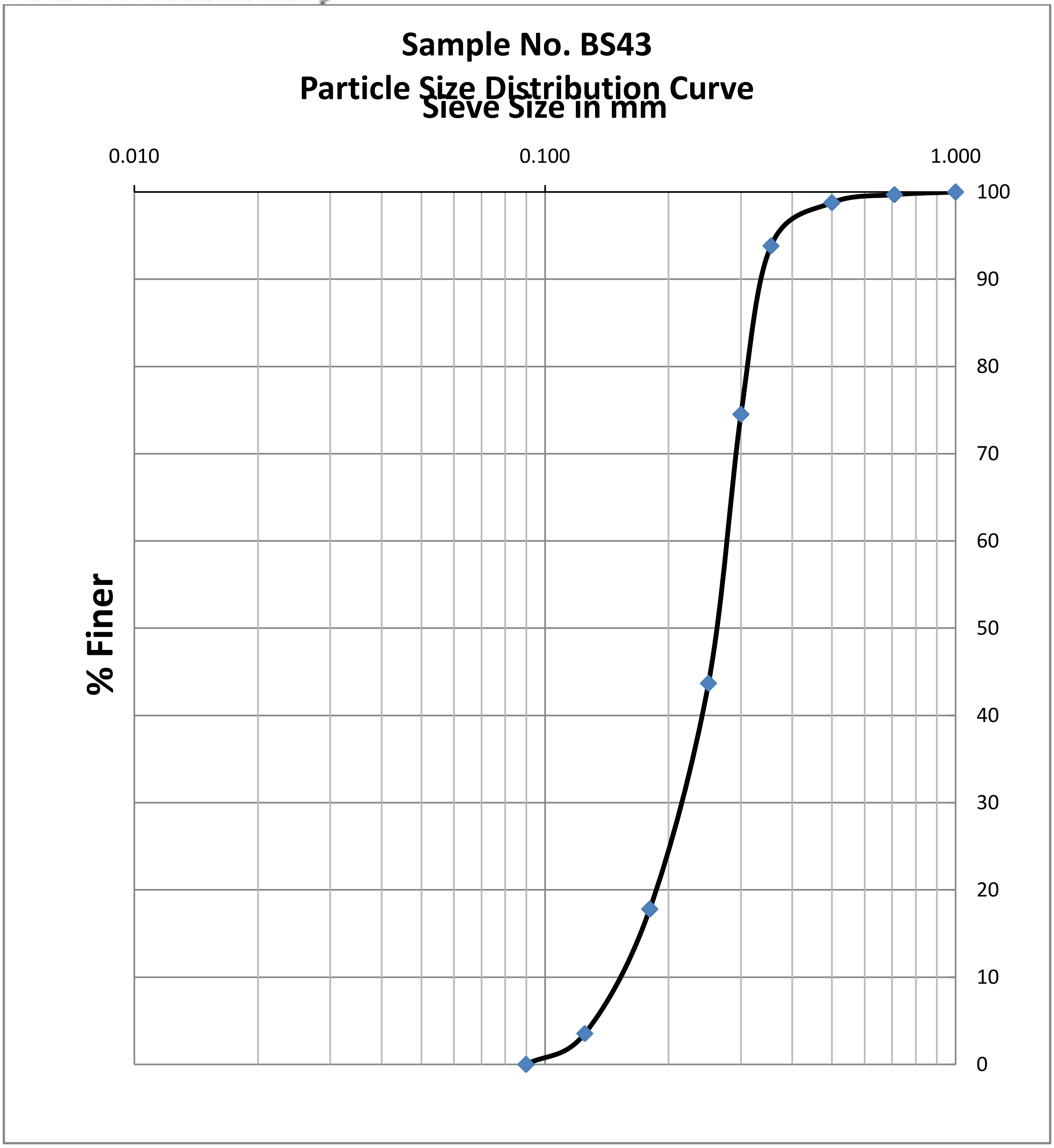

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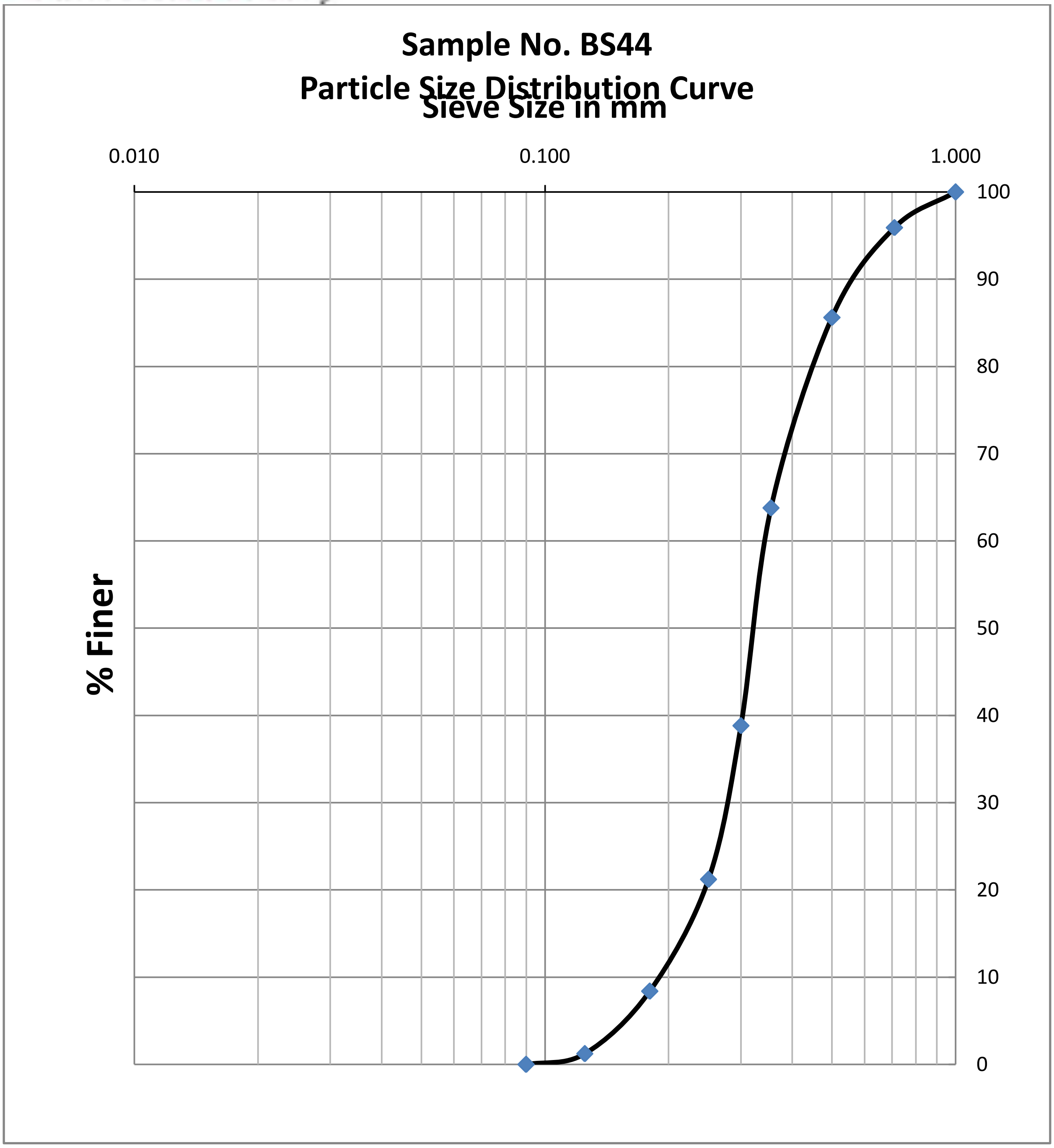

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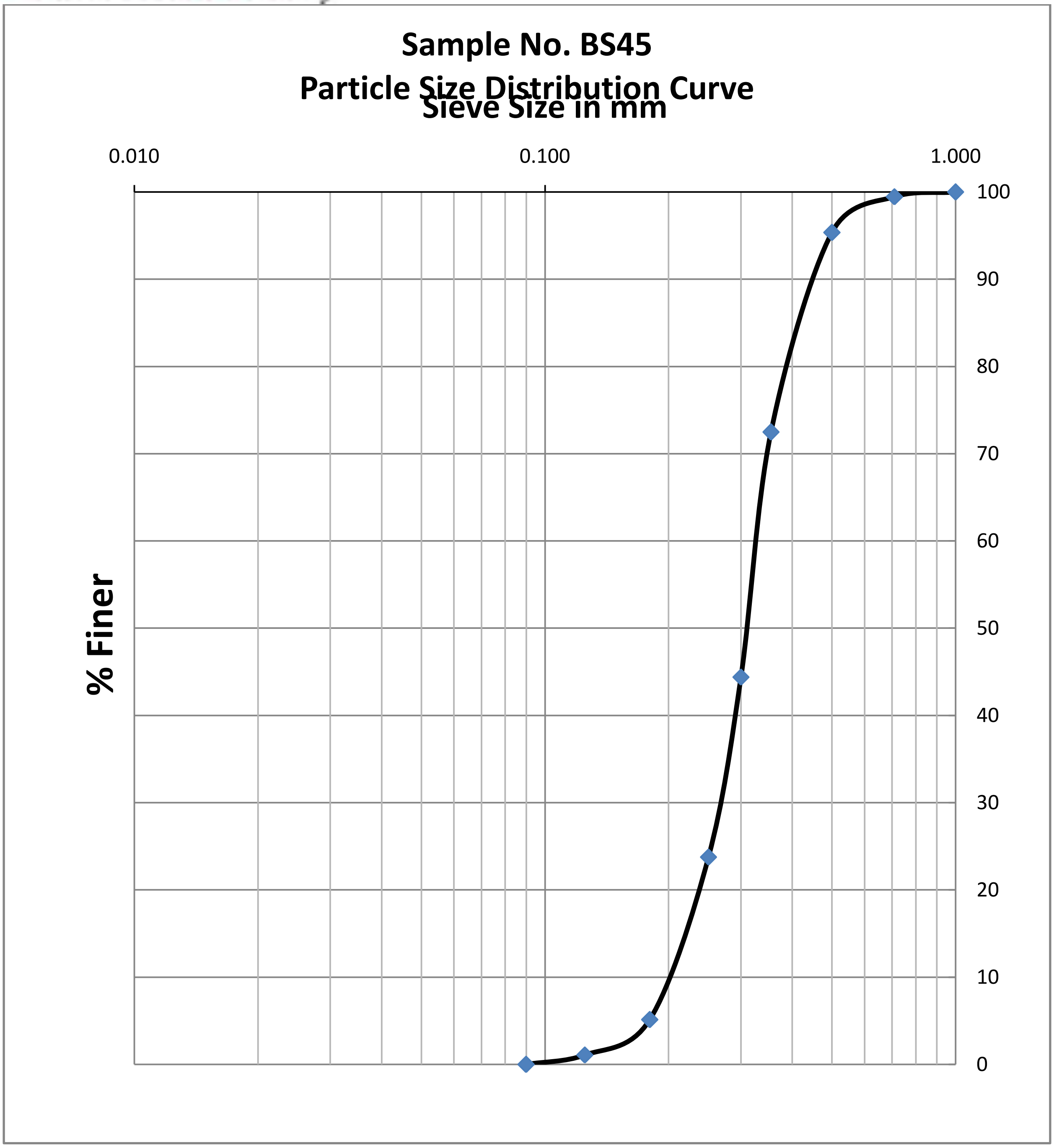

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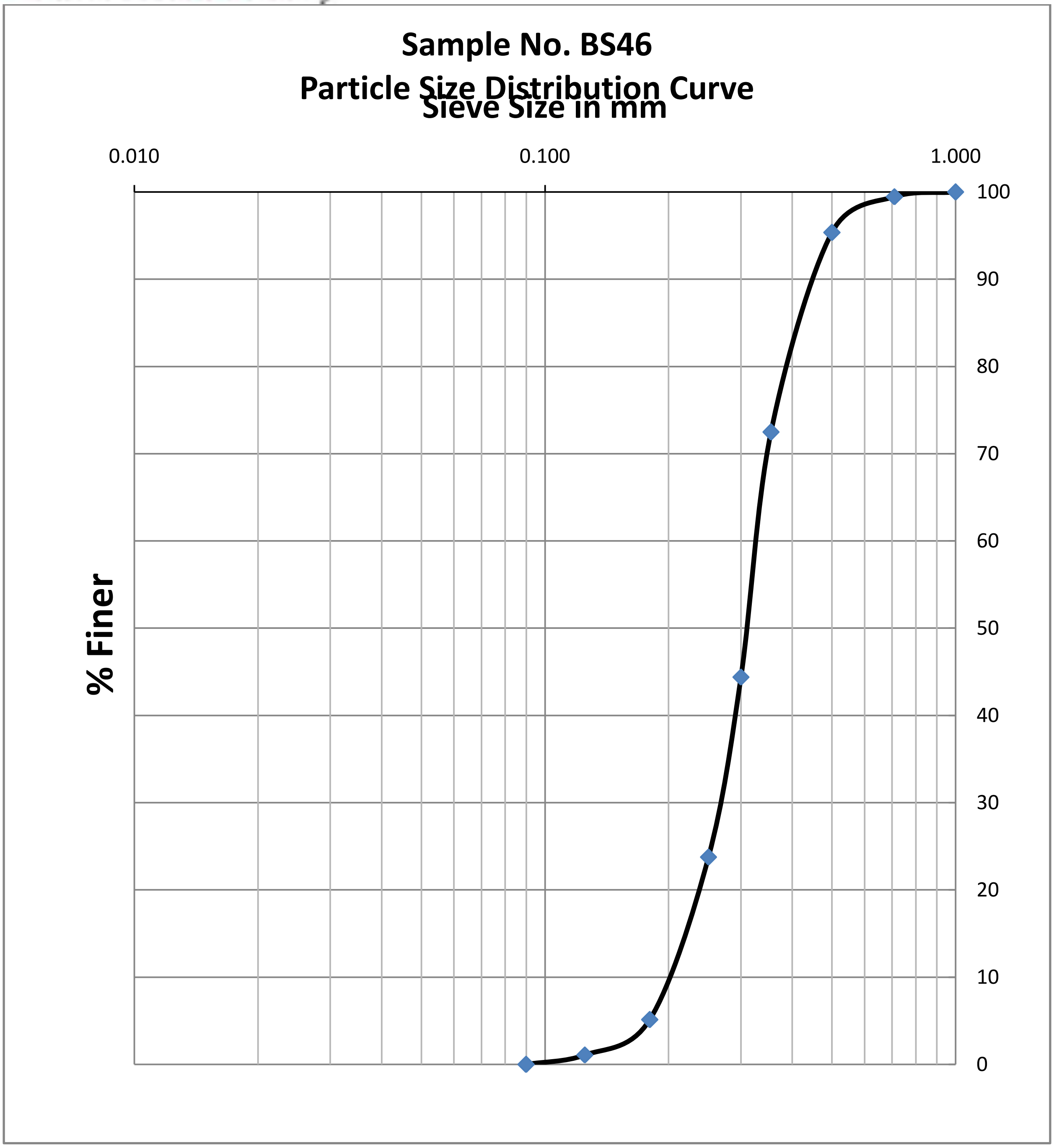

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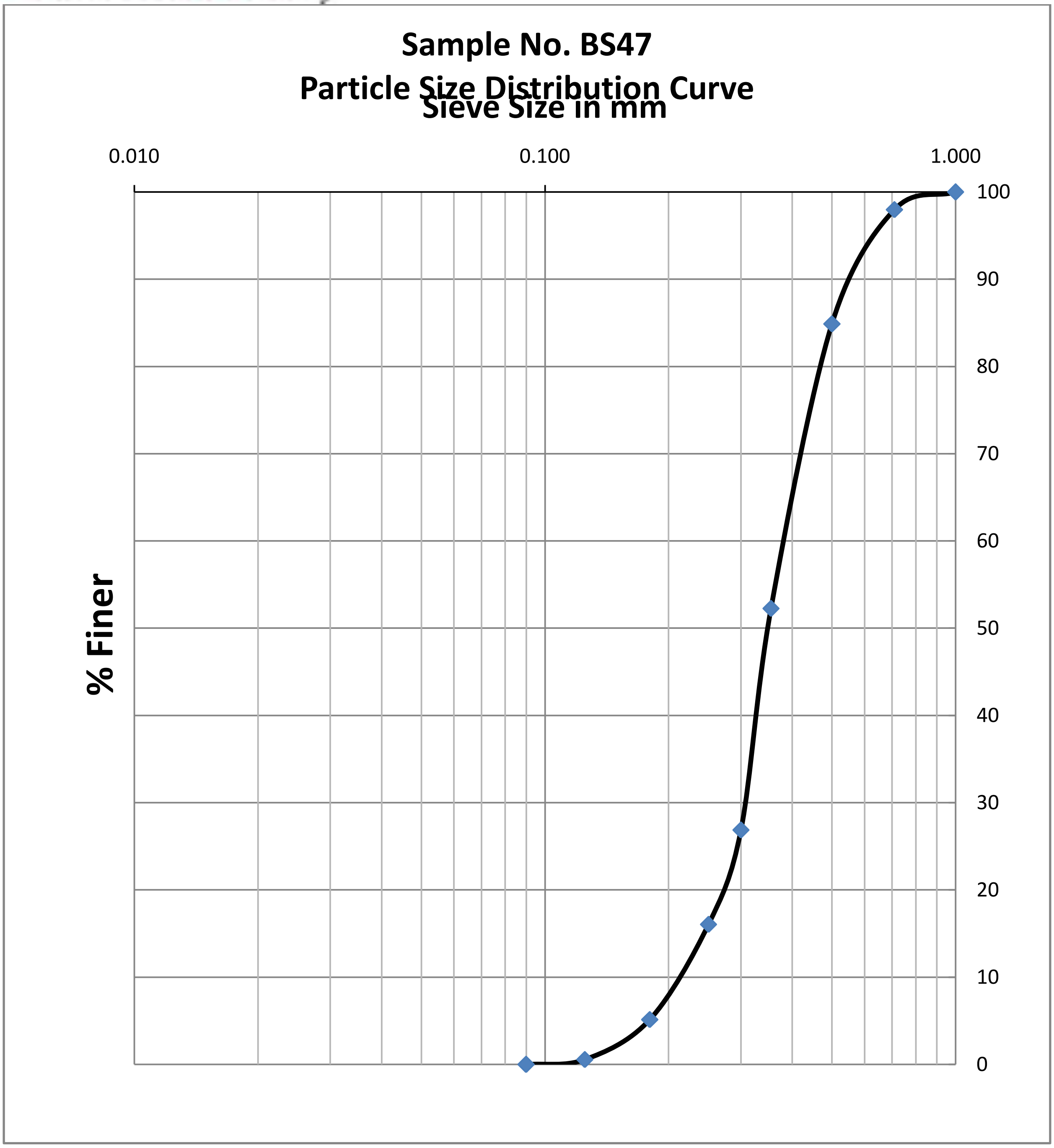

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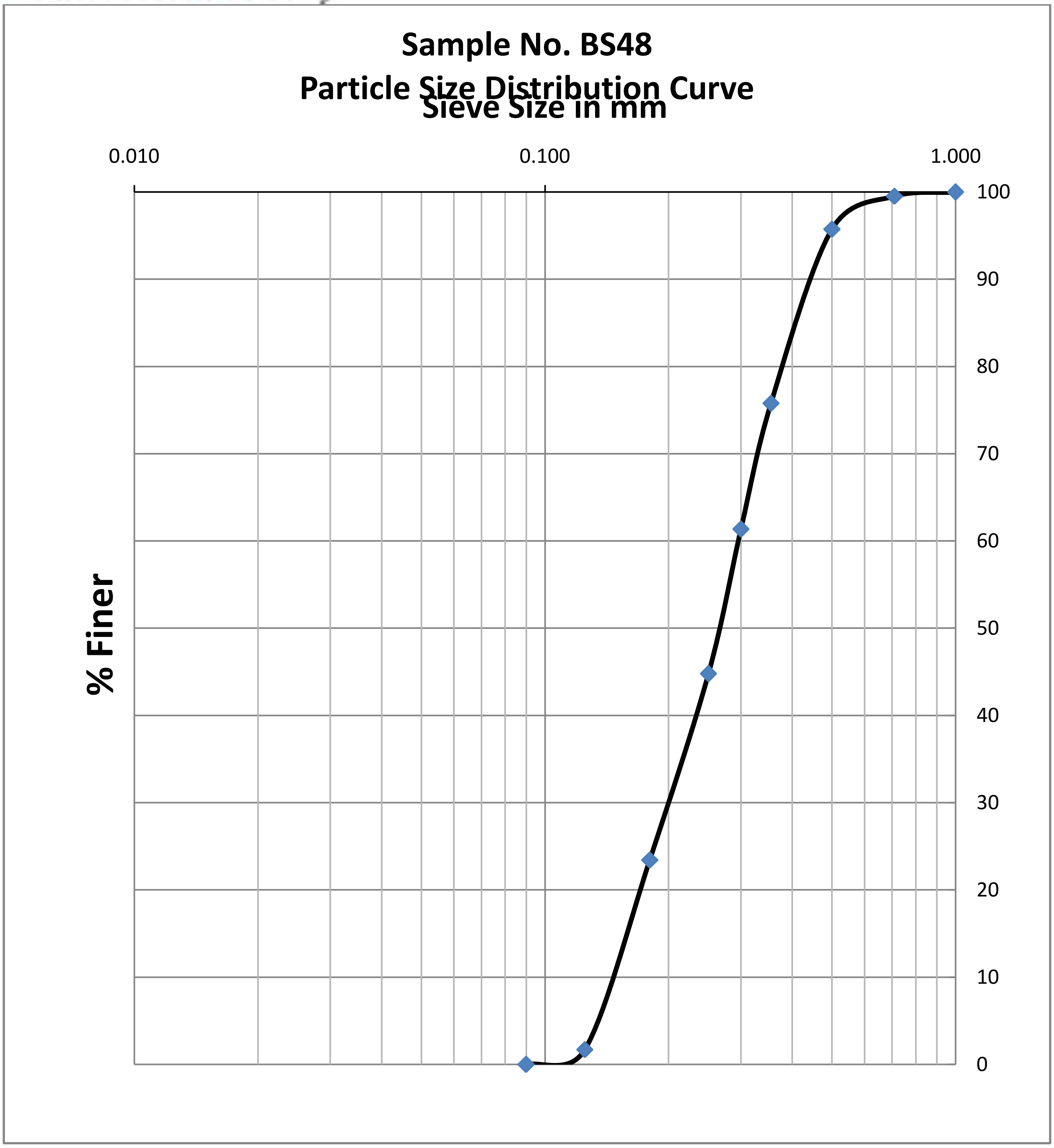

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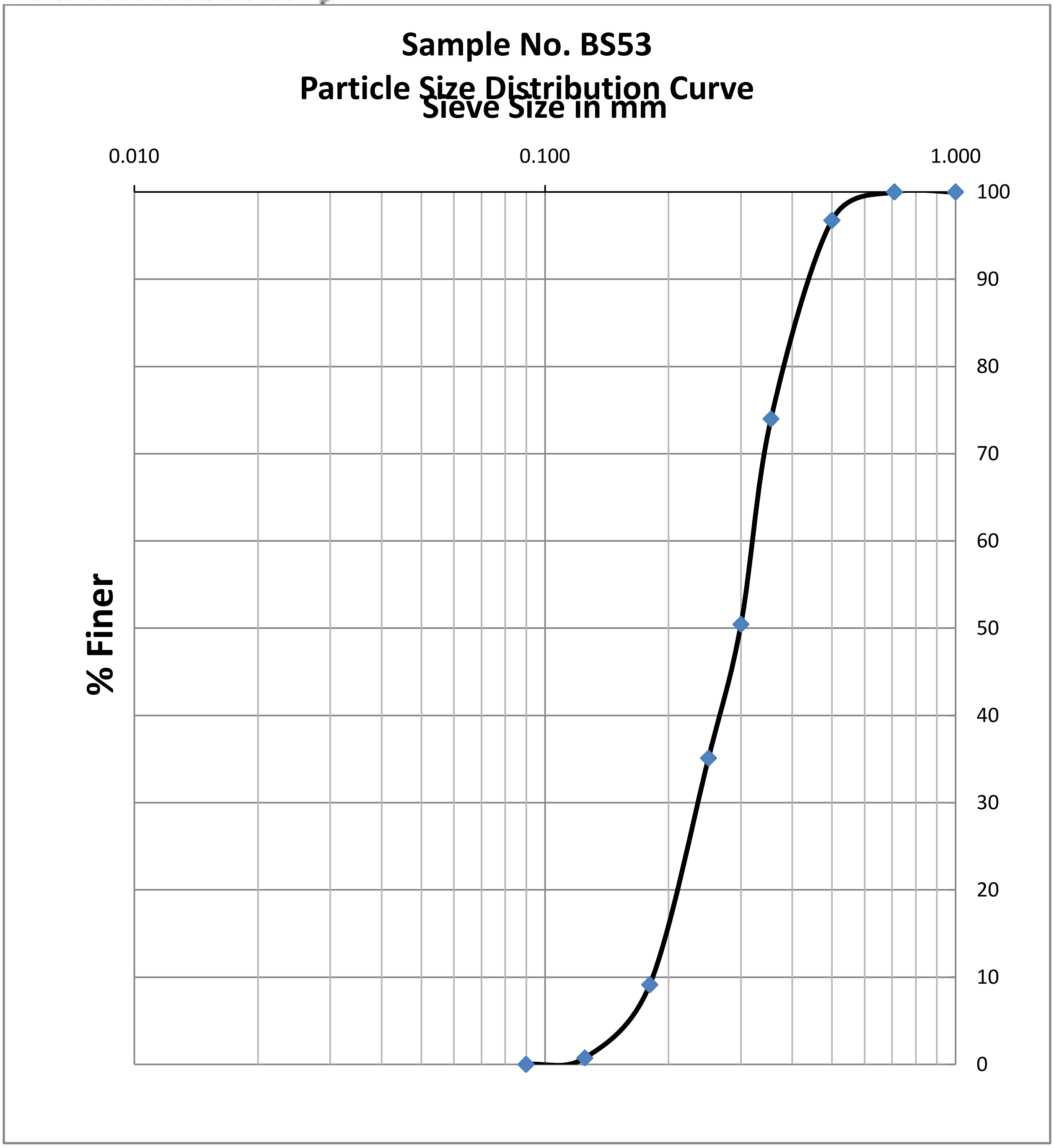

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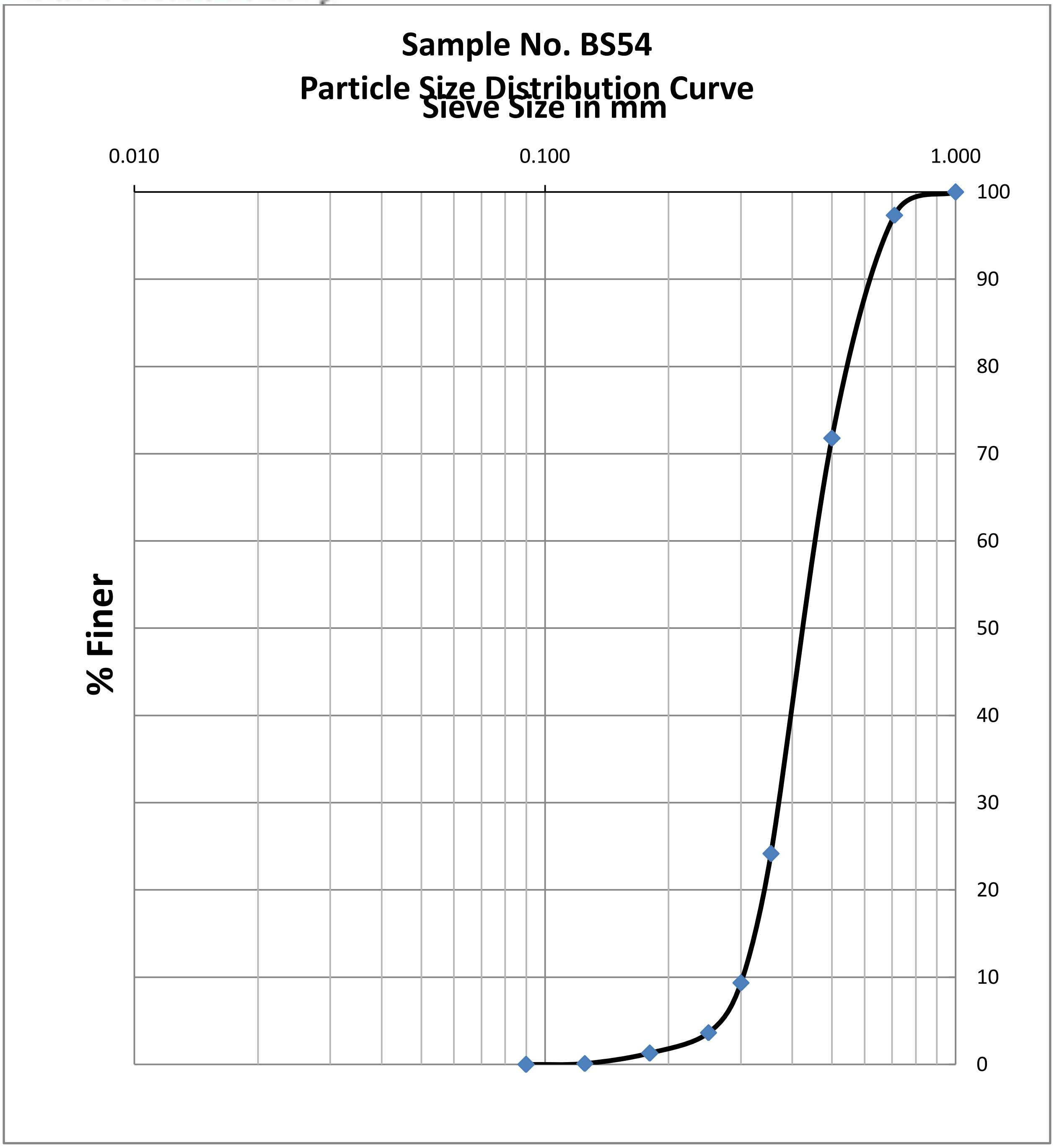

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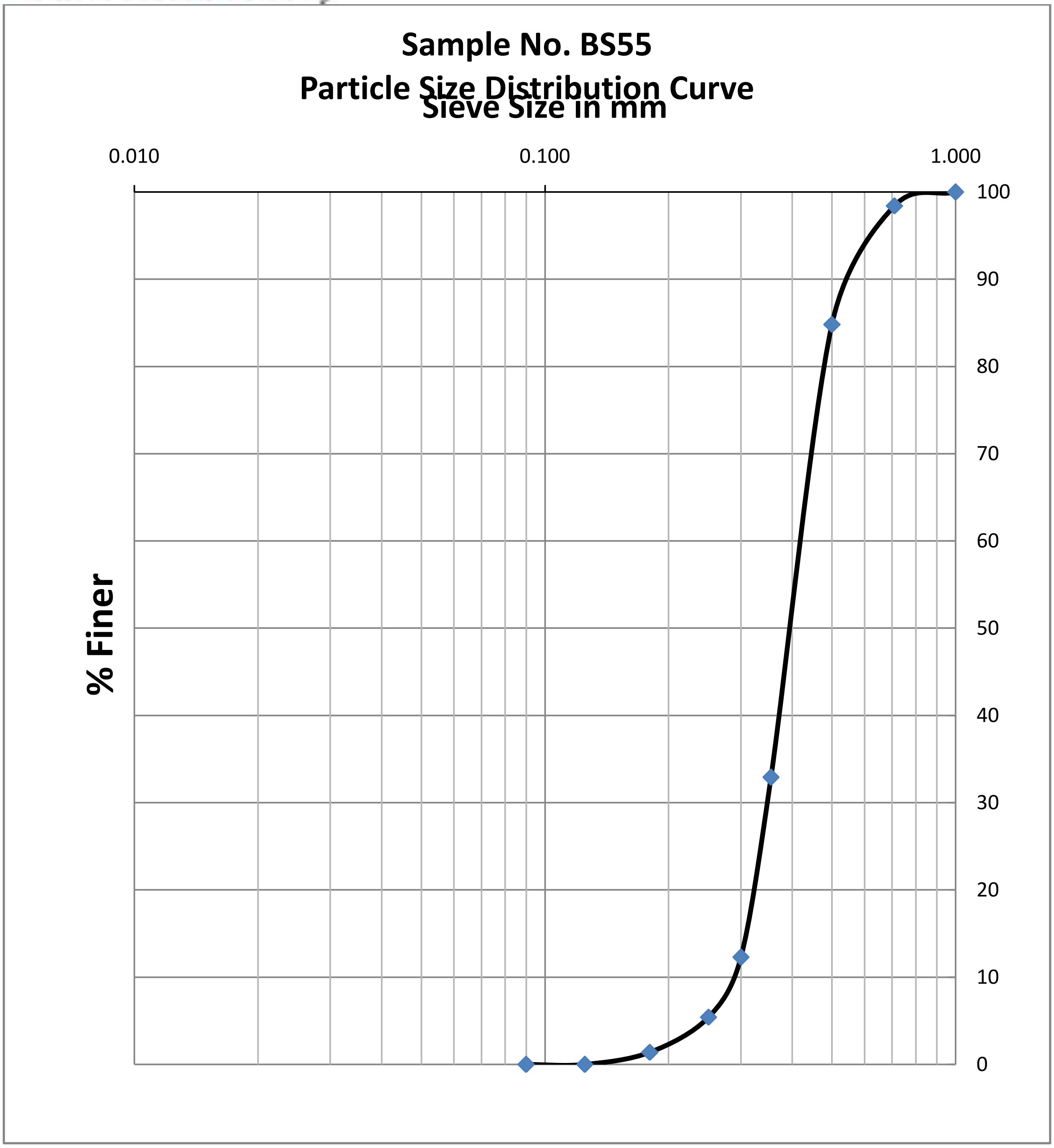

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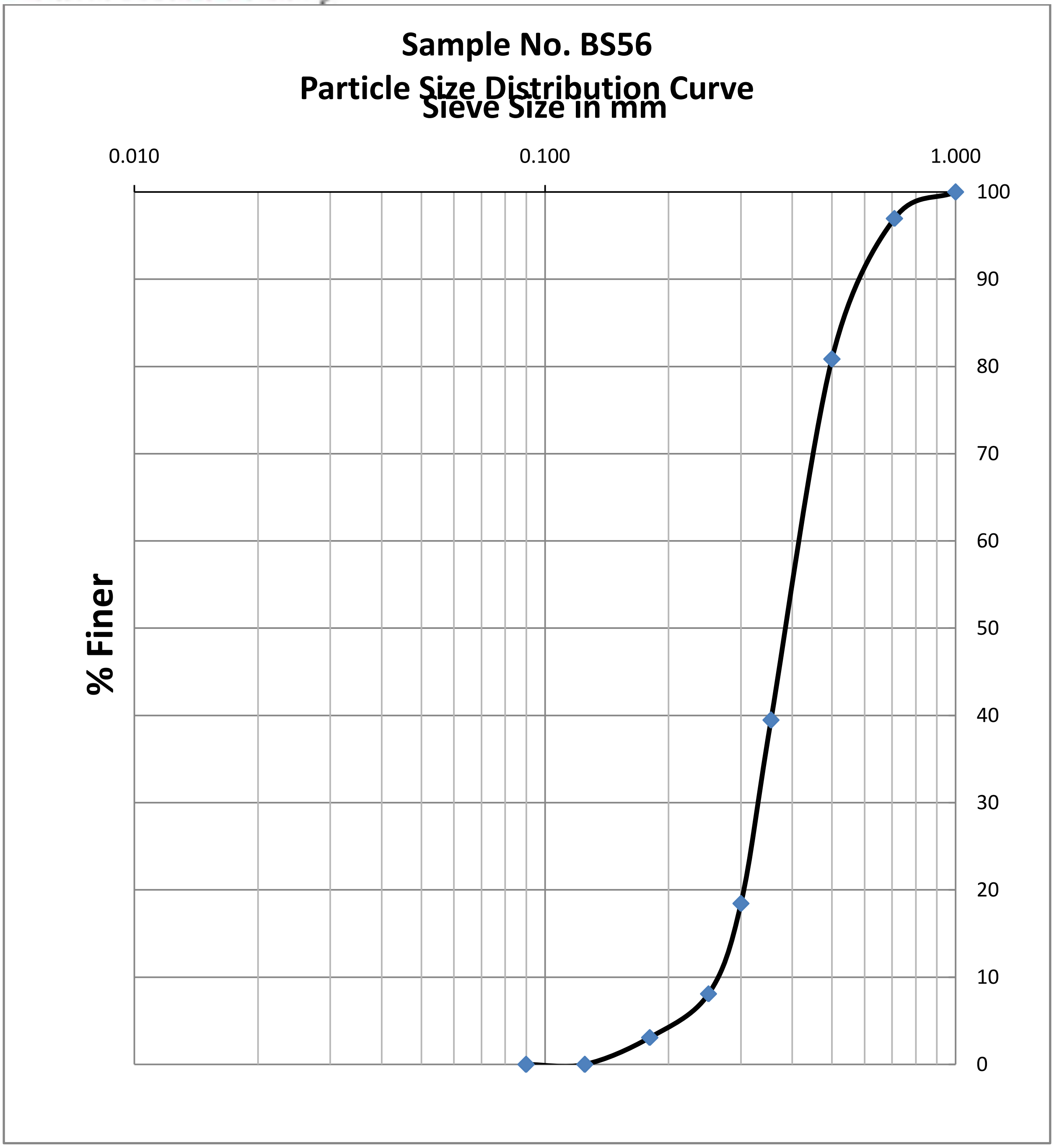

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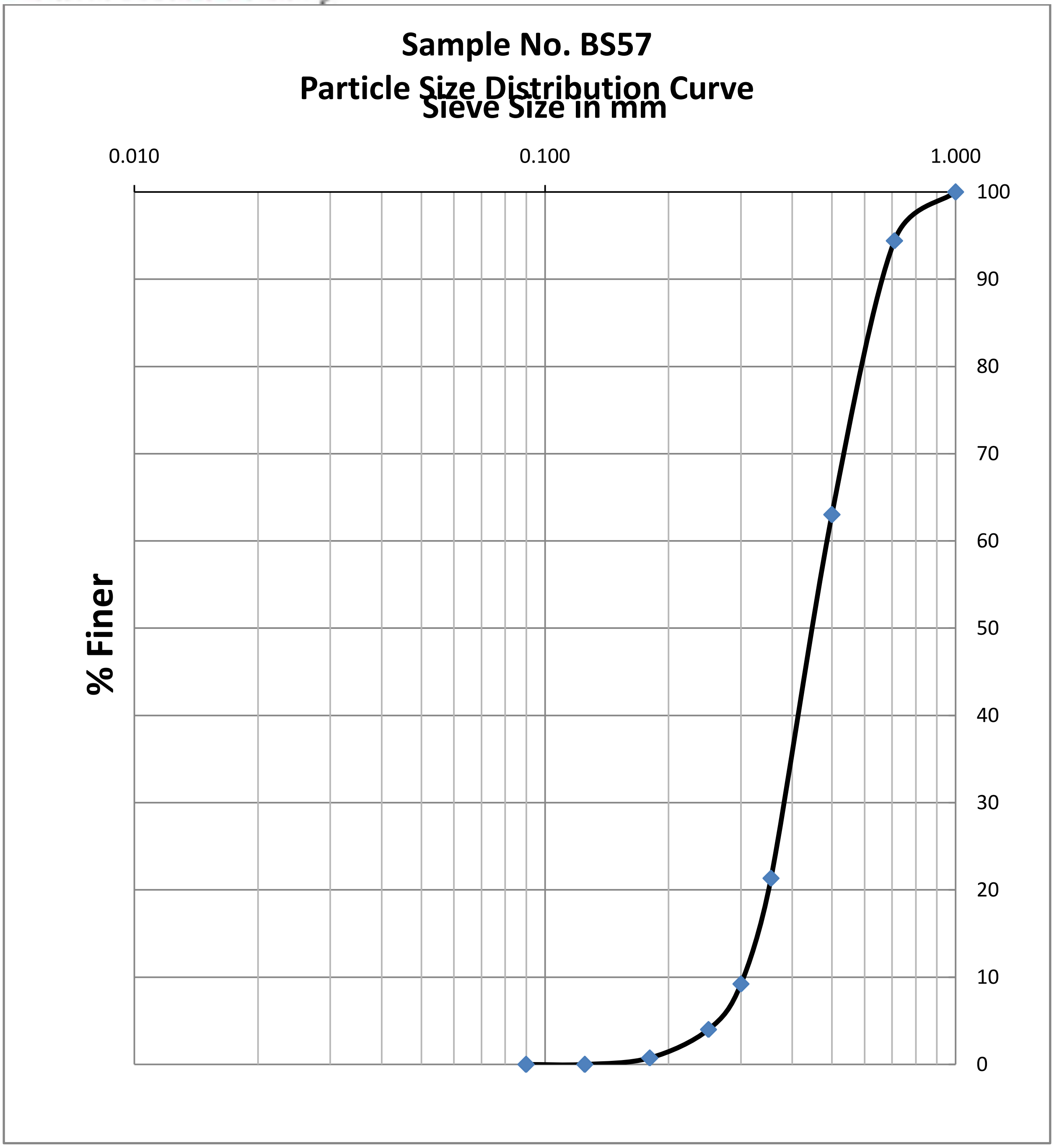

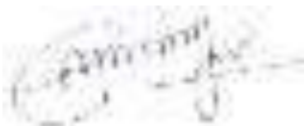

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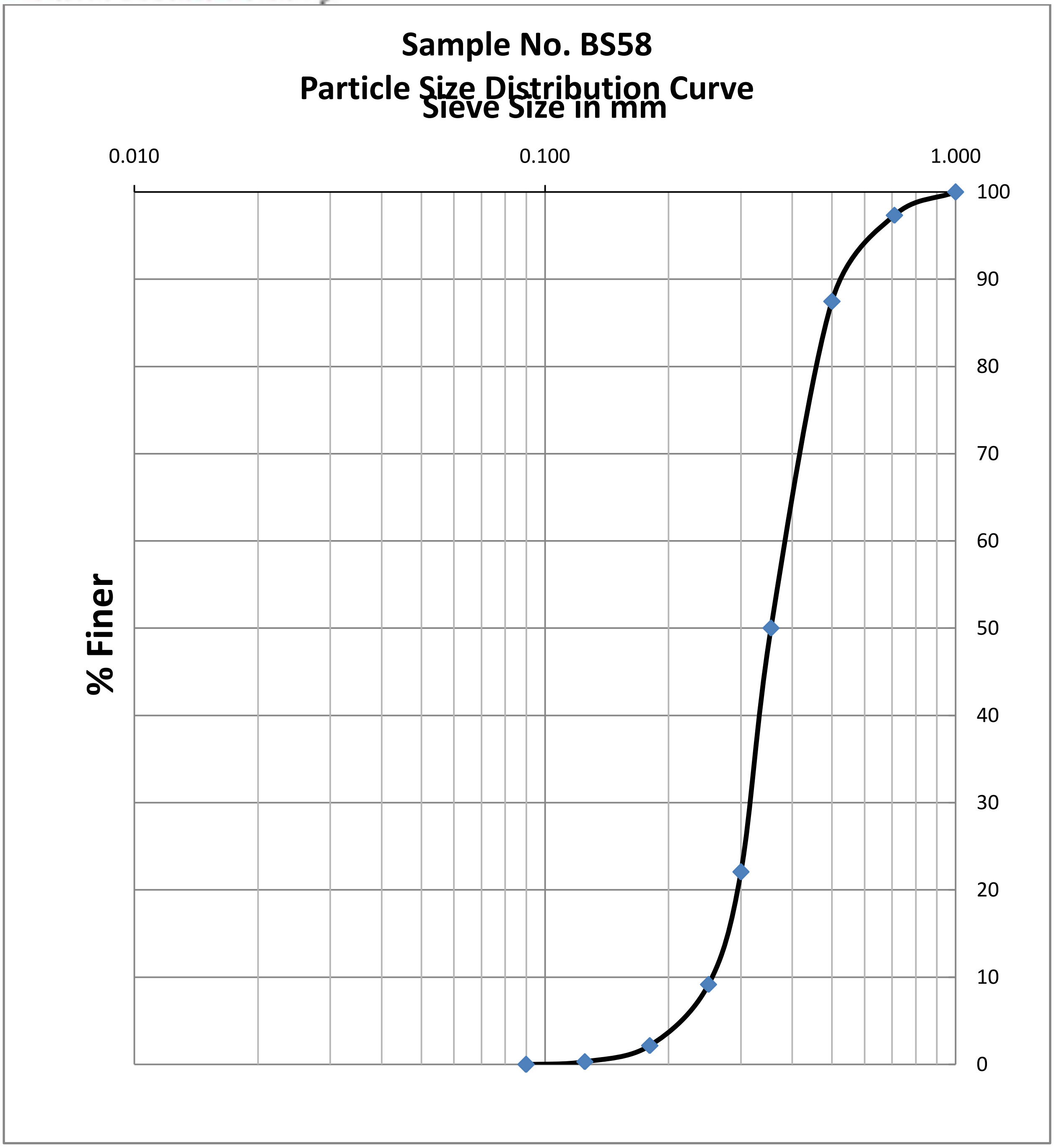

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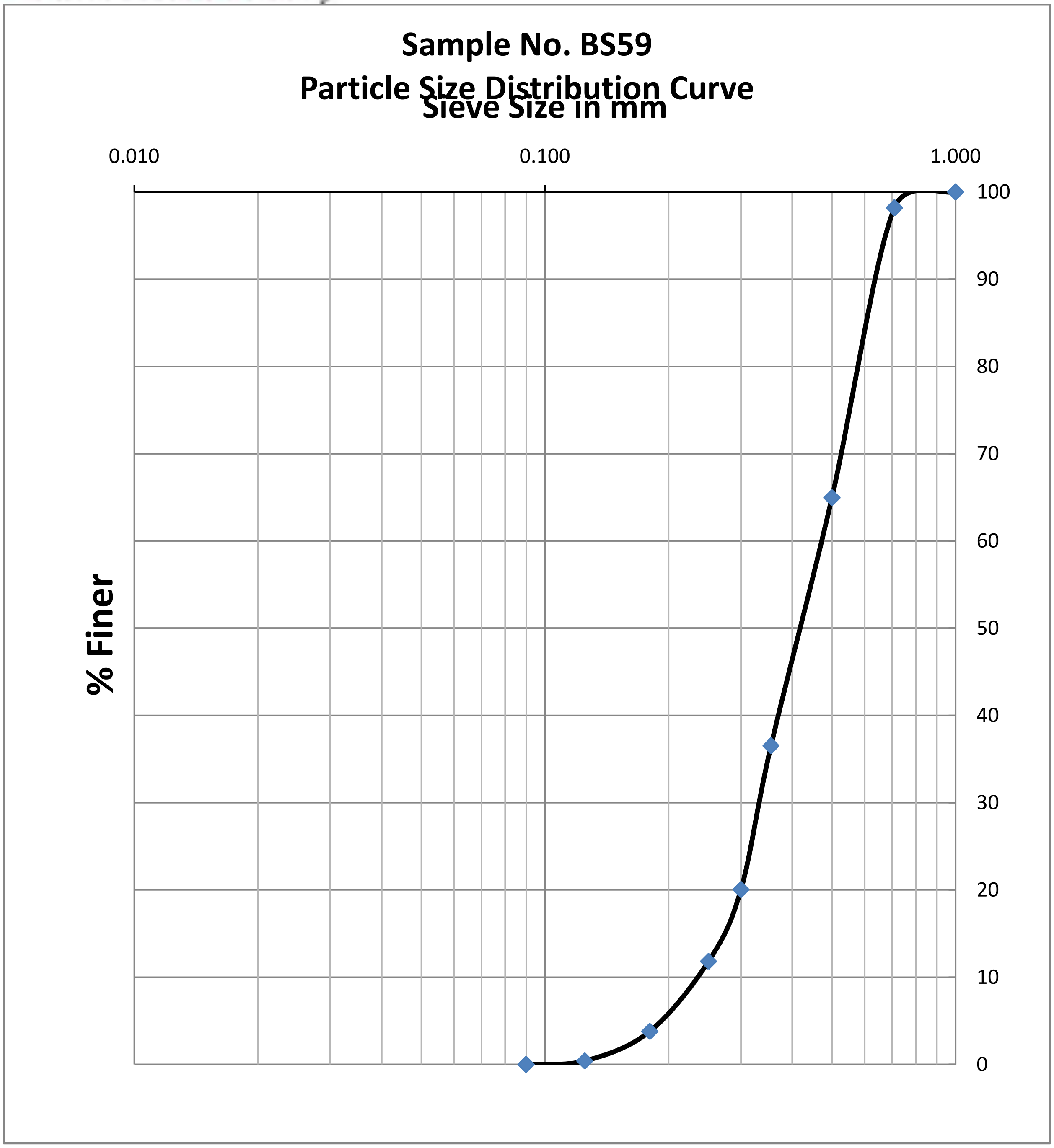

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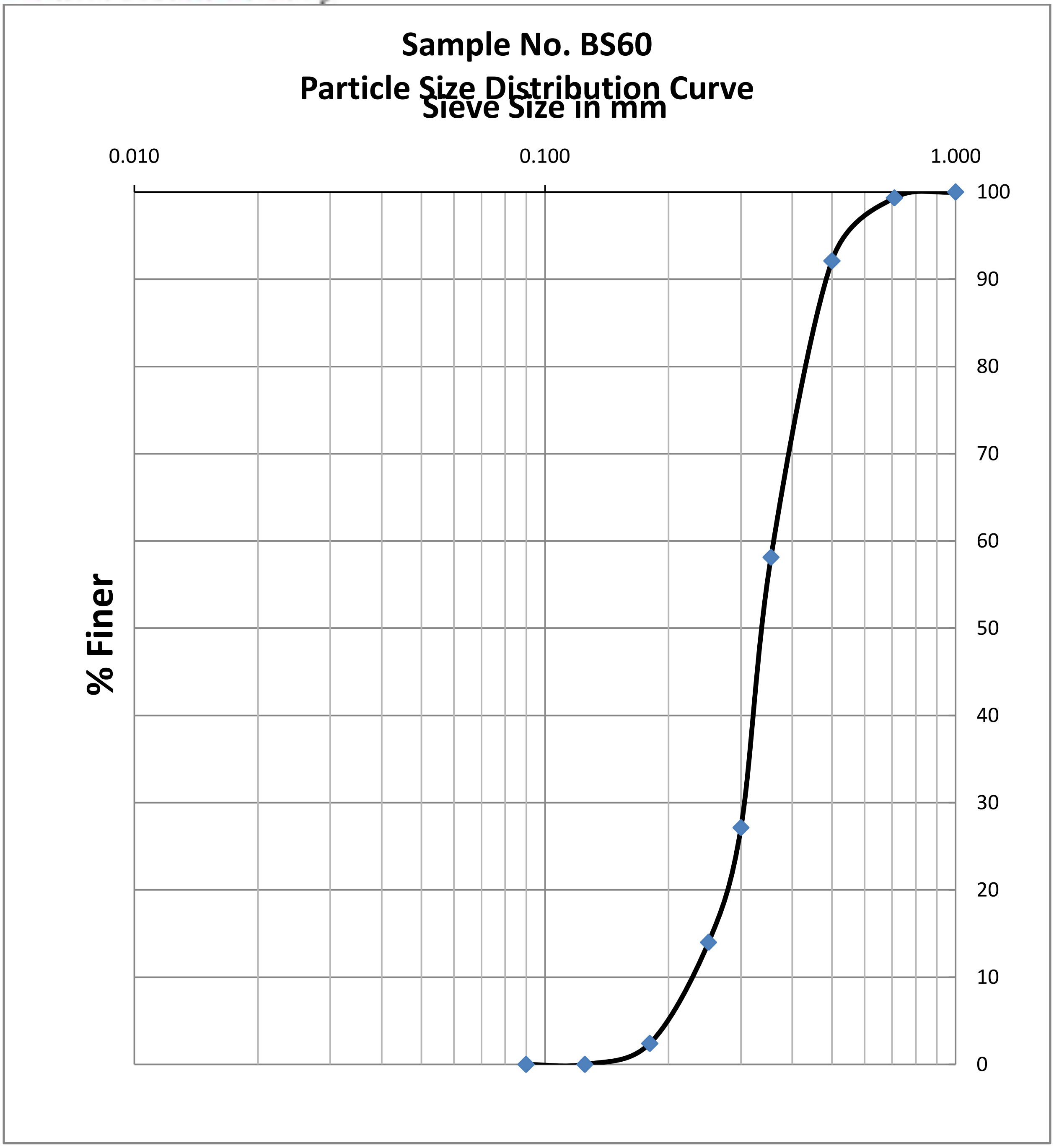

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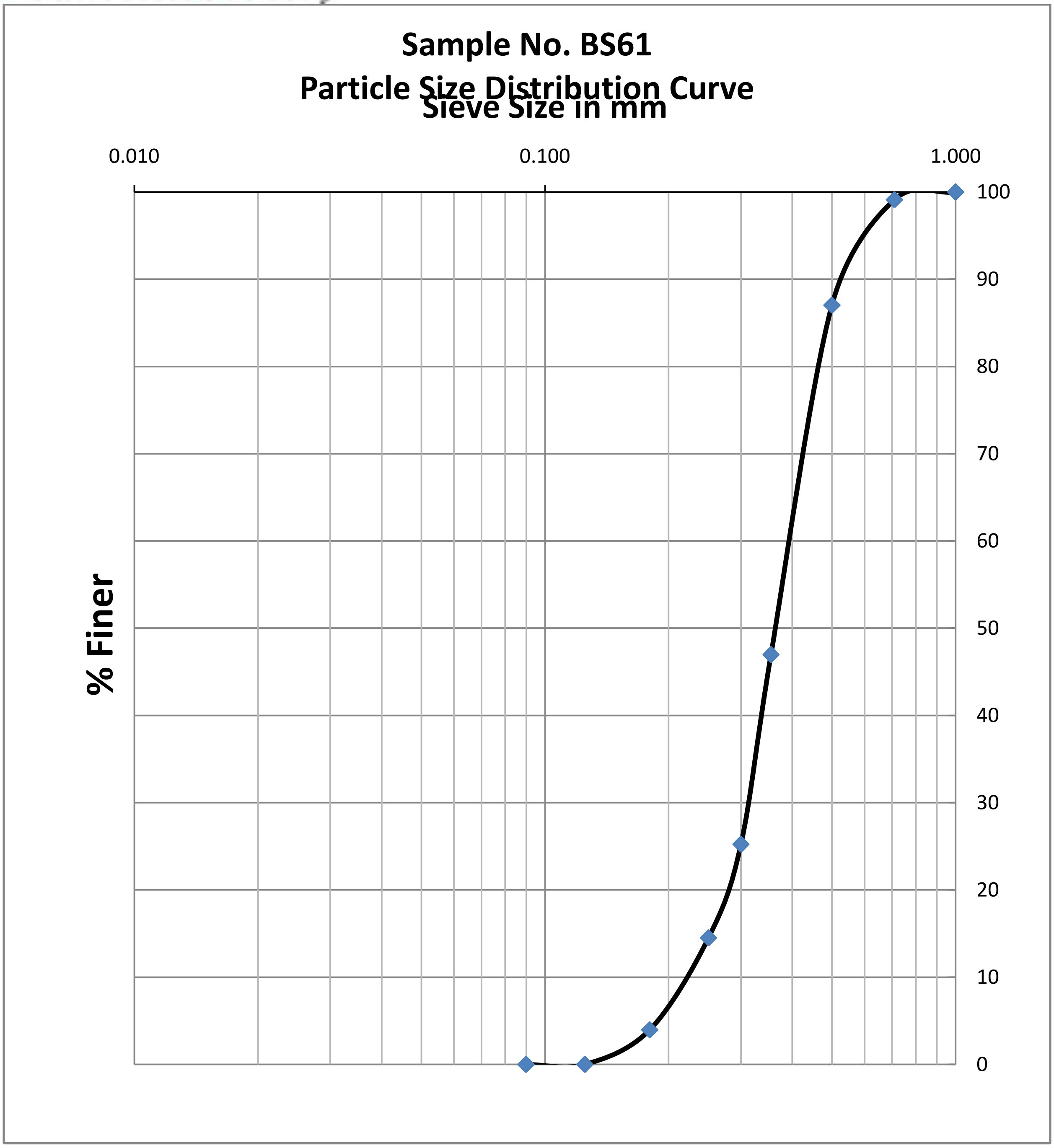

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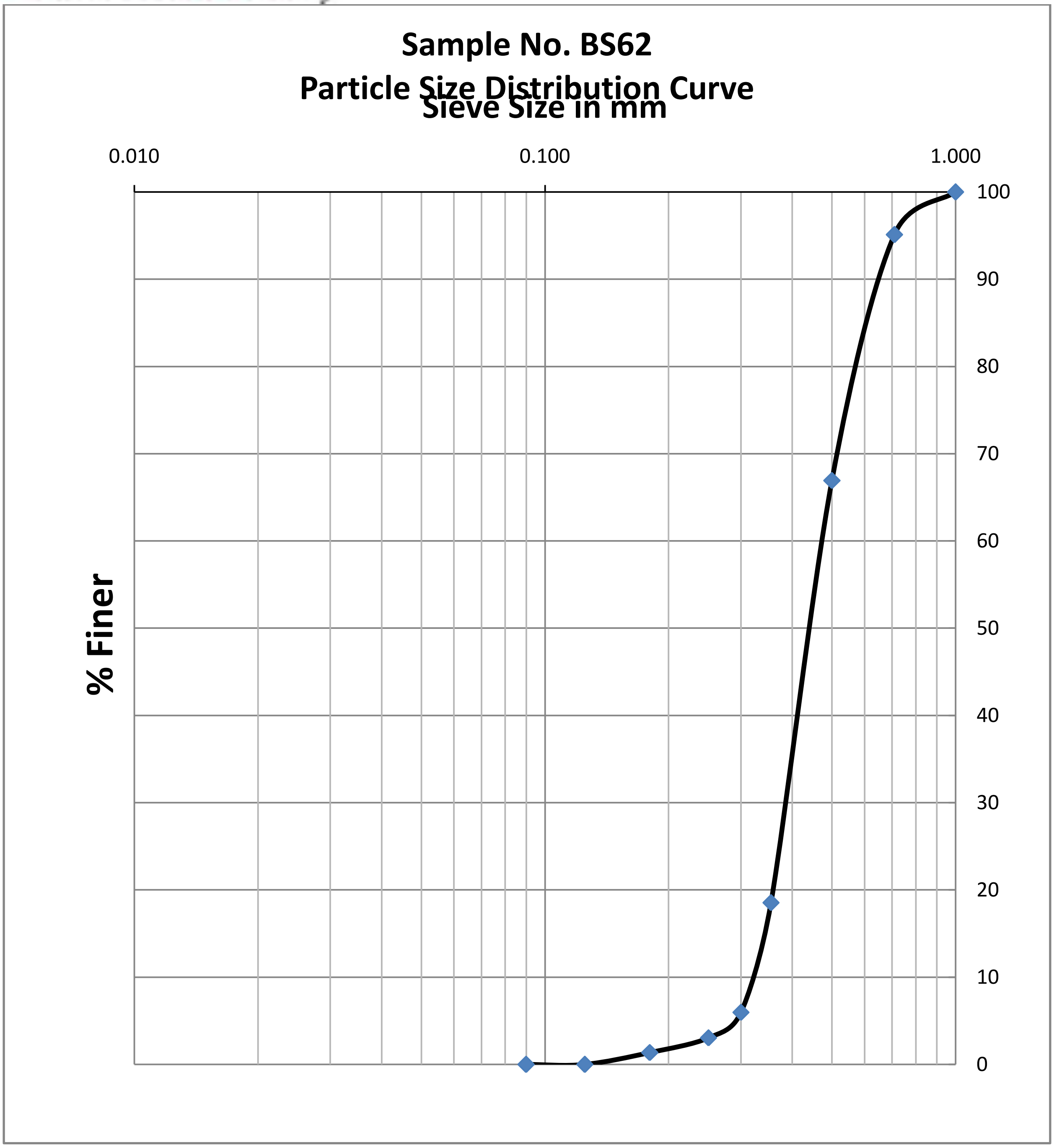

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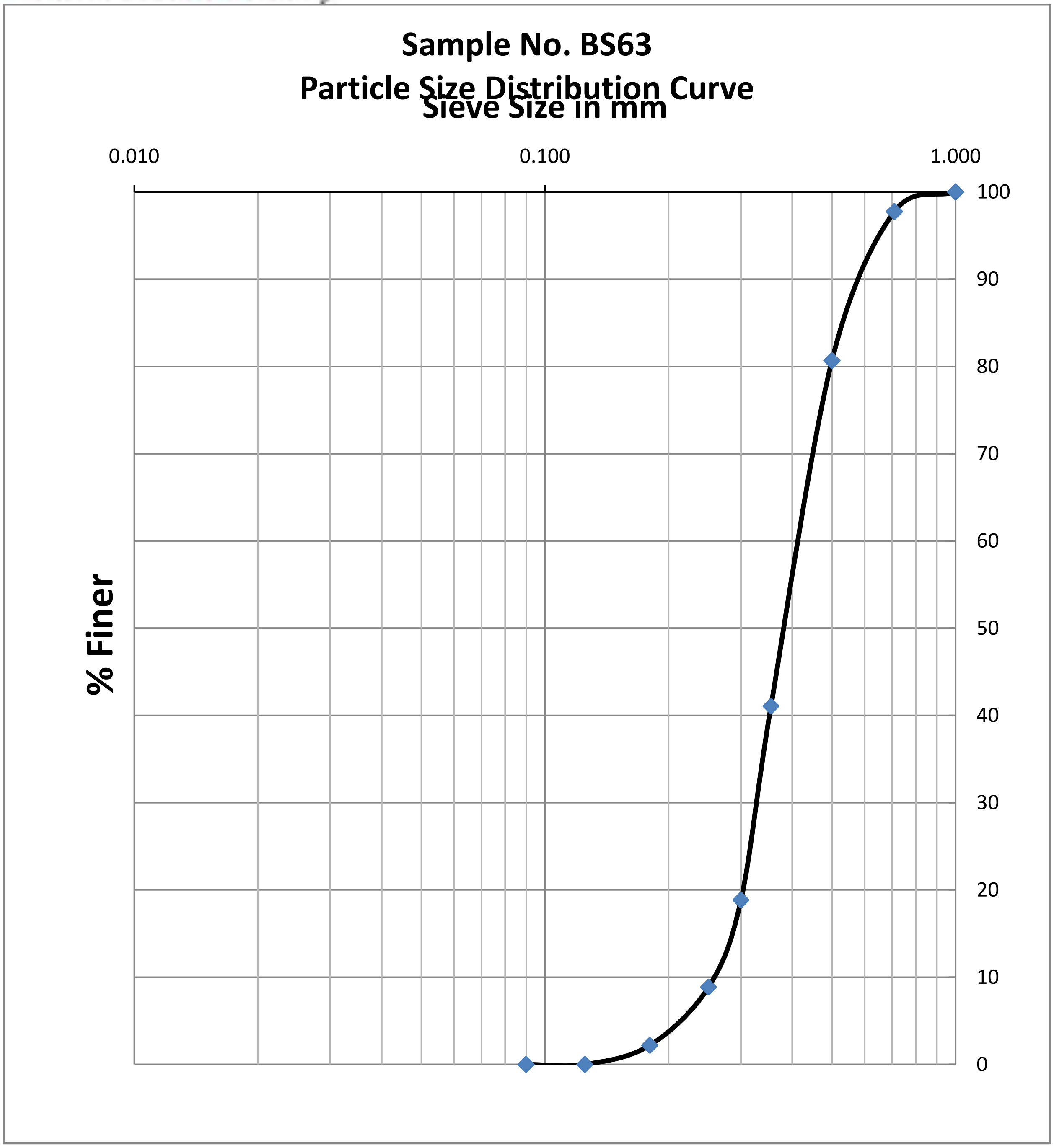

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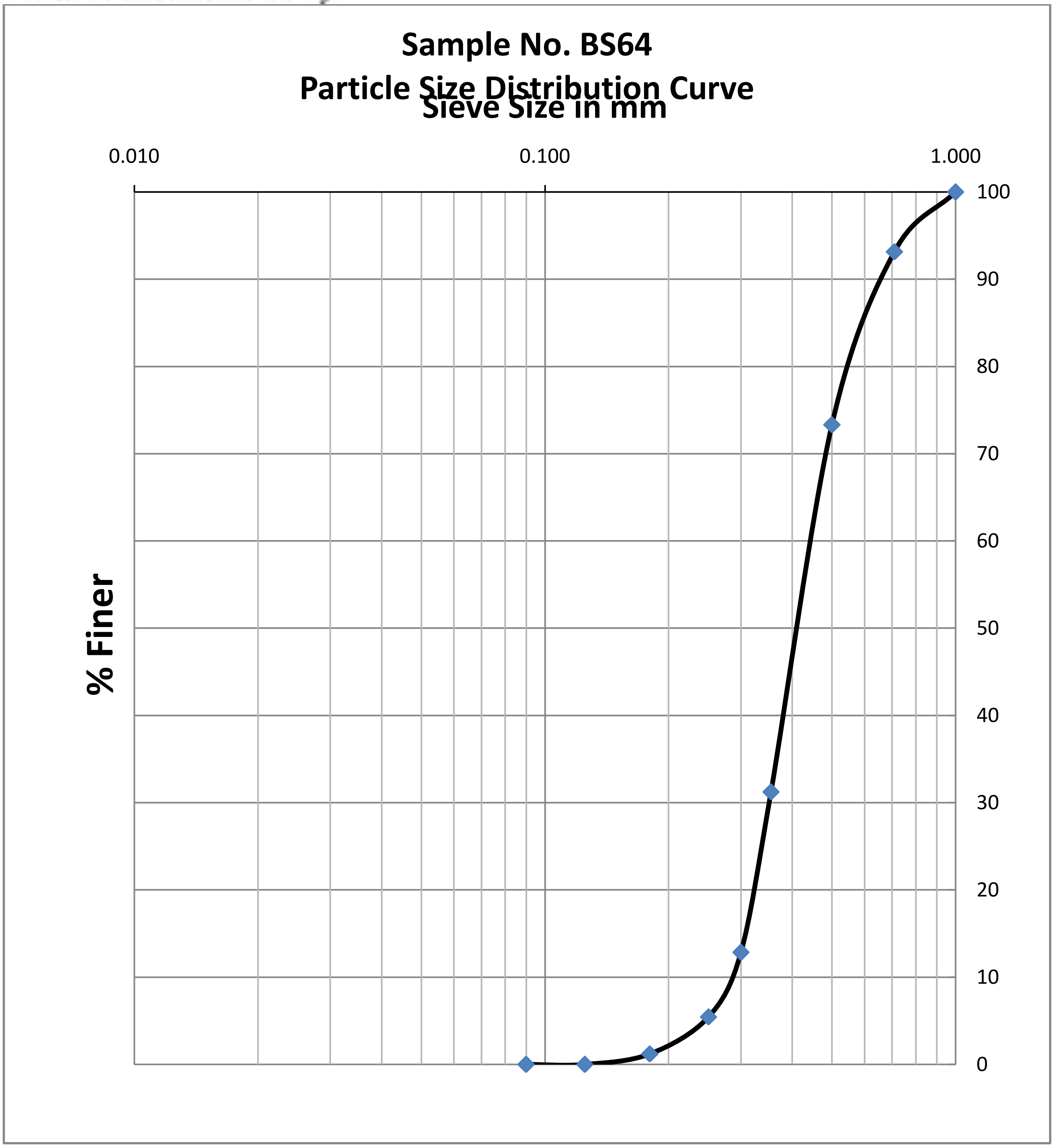

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(Laboratory Head)
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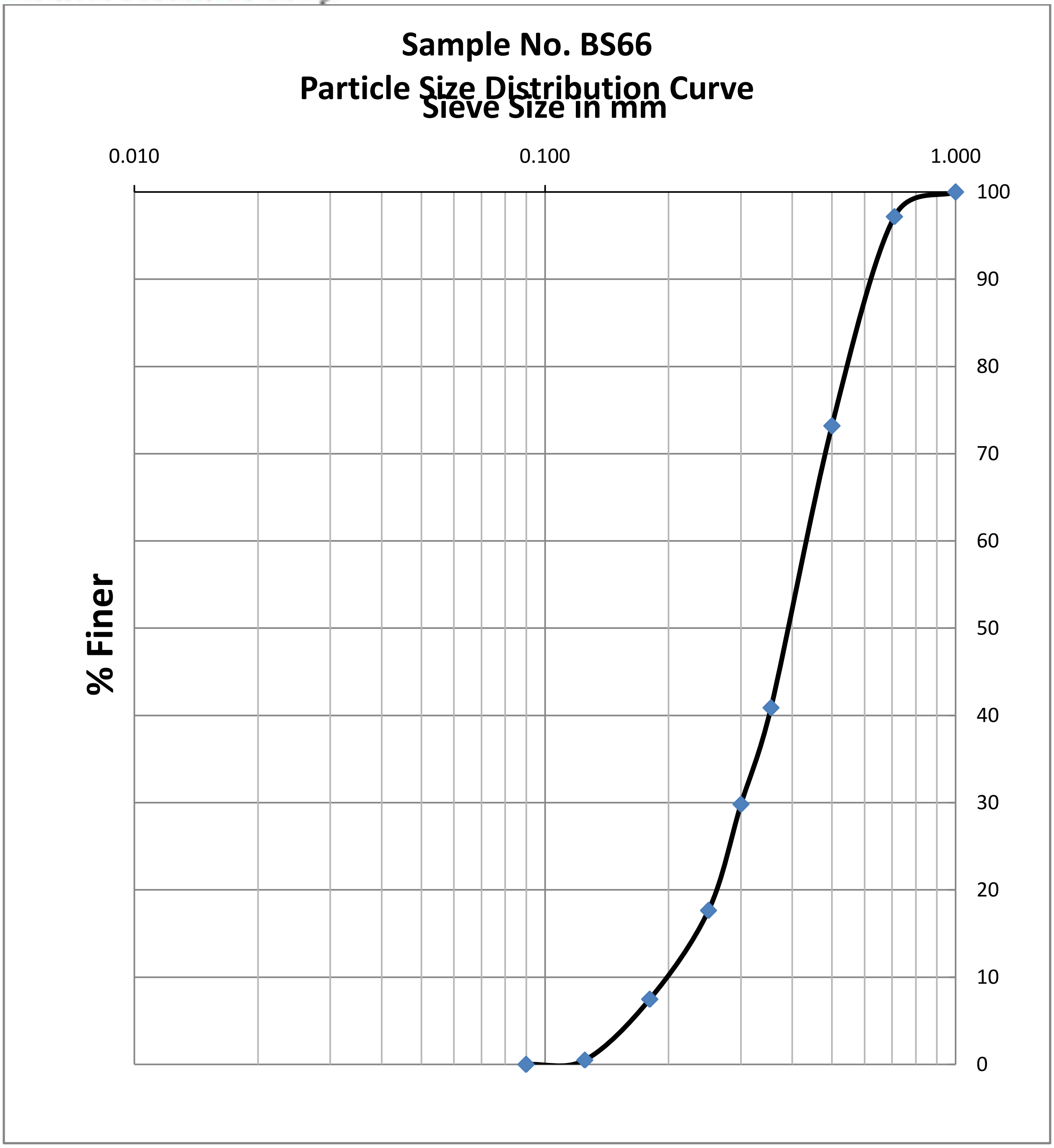
Environmental Monitoring



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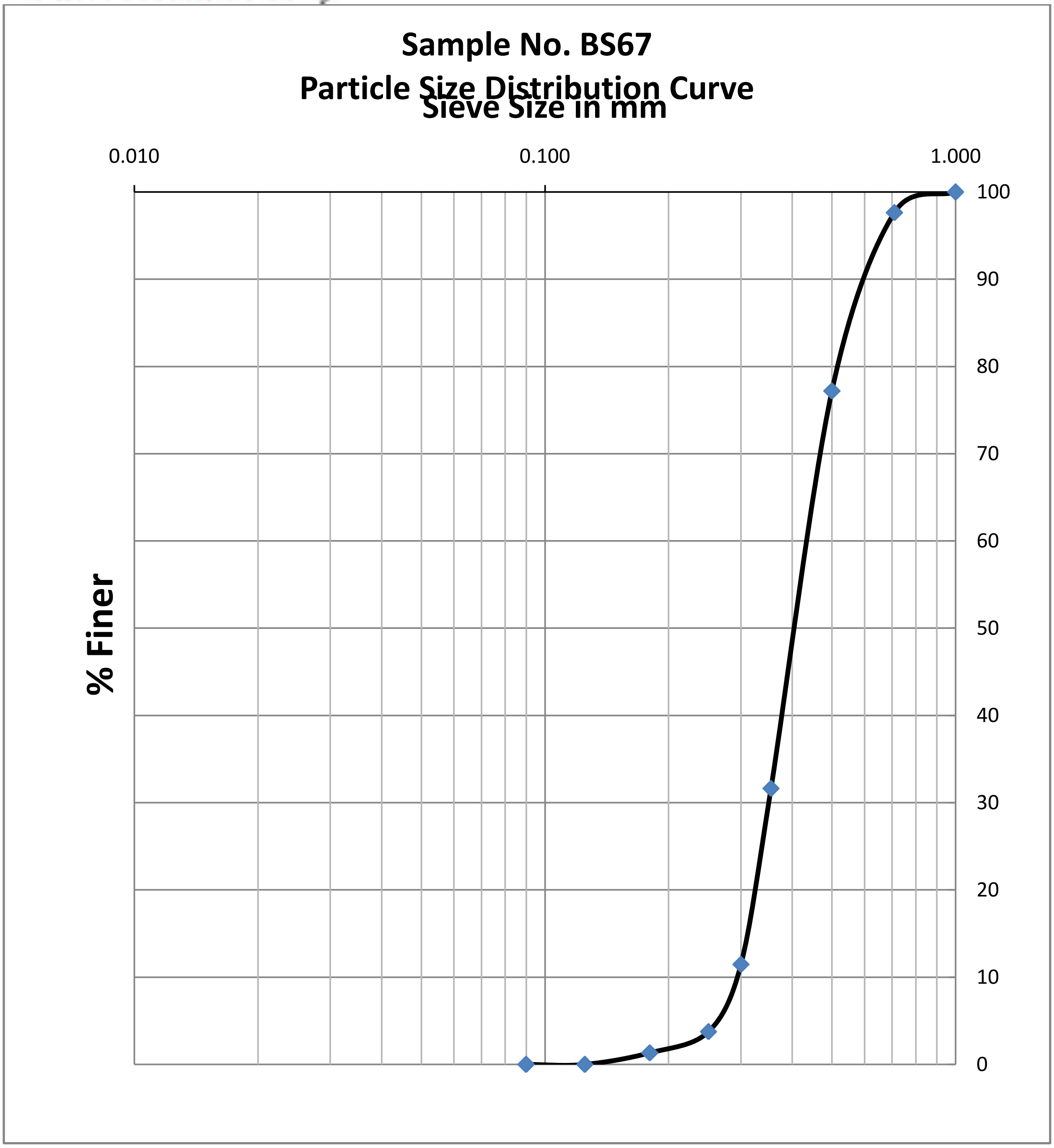
(Laboratory Head)
Standard[s] Environmental & Analytical Laboratories.



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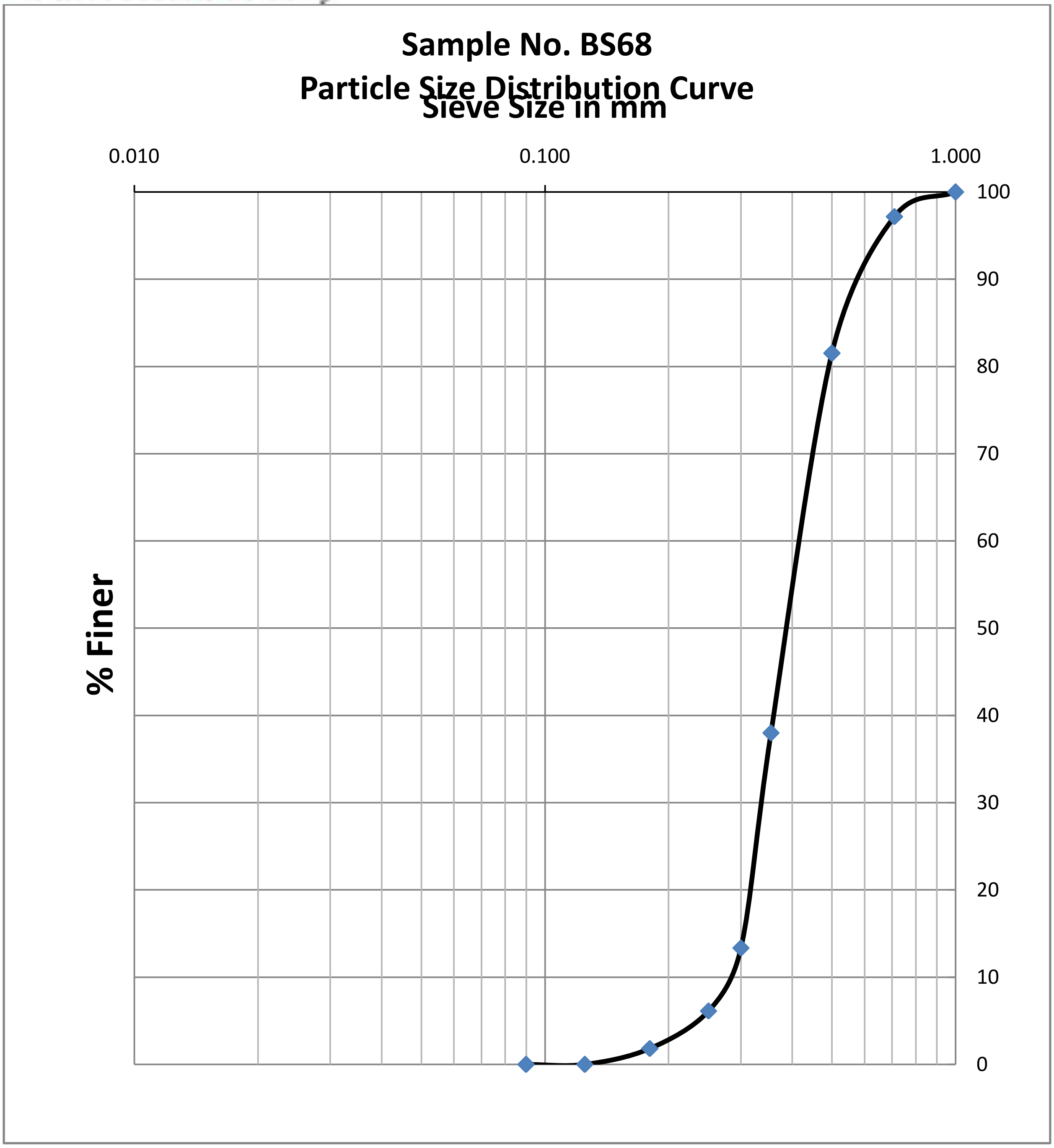

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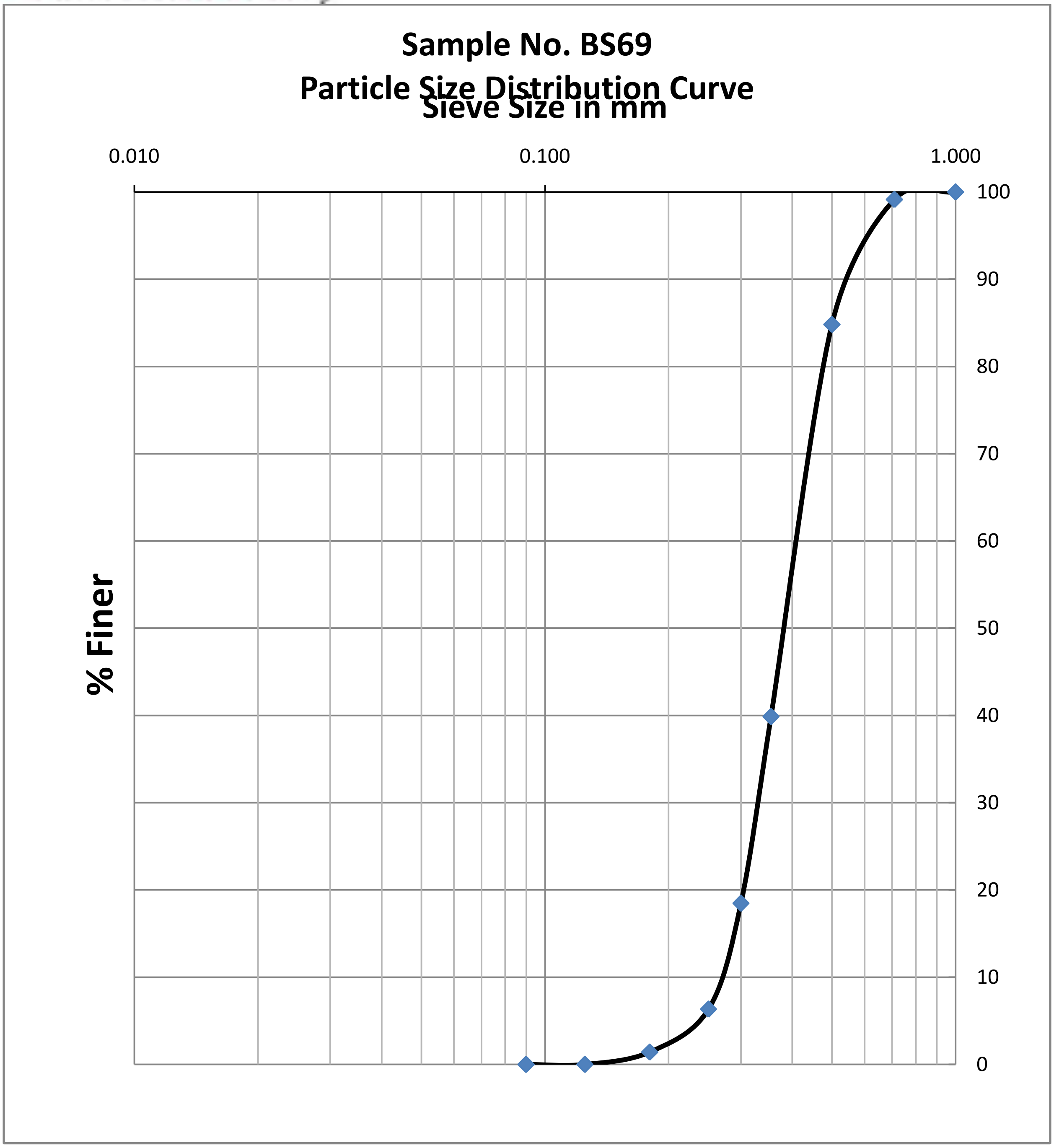
Standard^S Environmental Monitoring



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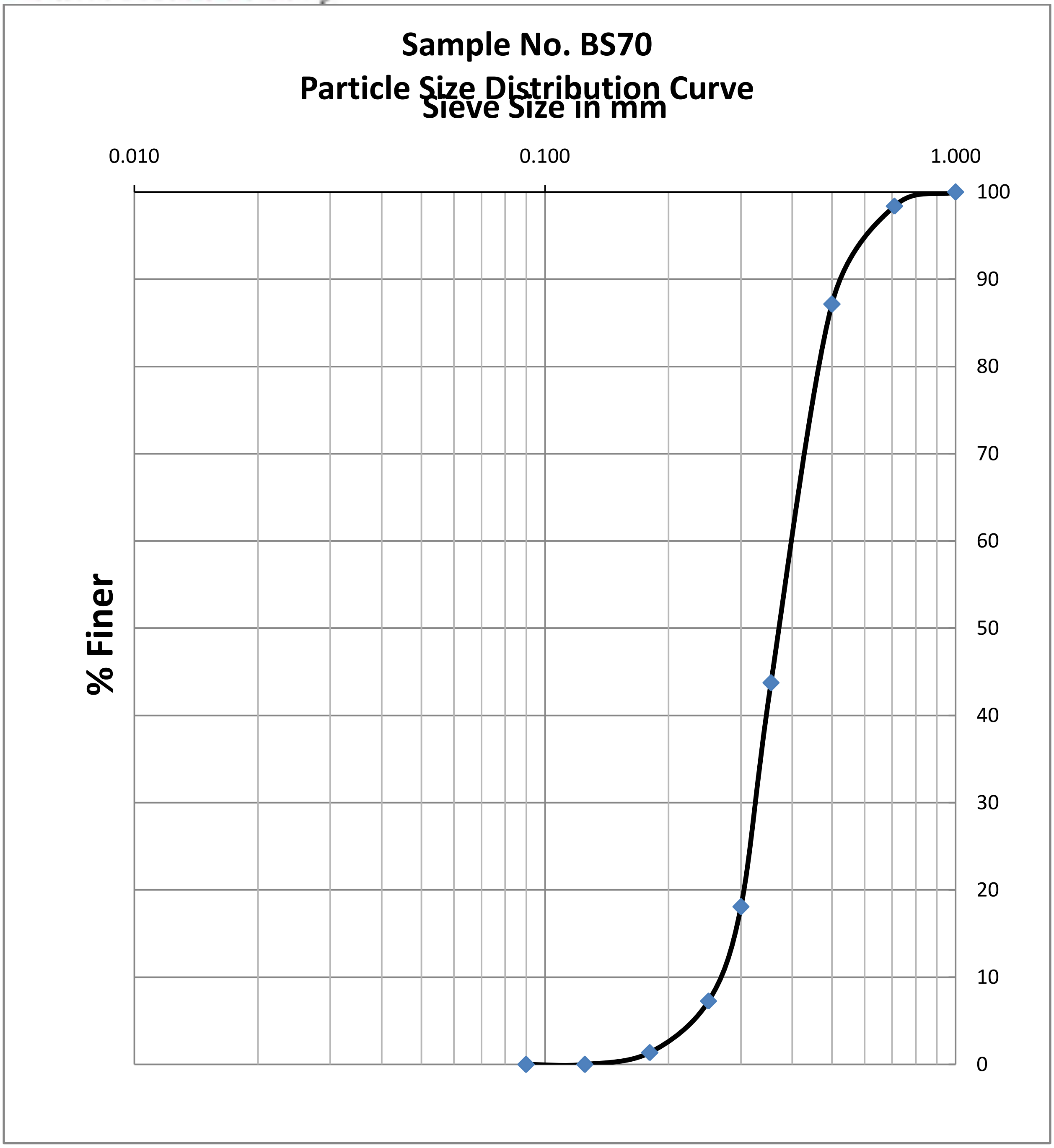
Standards Environmental Monitoring



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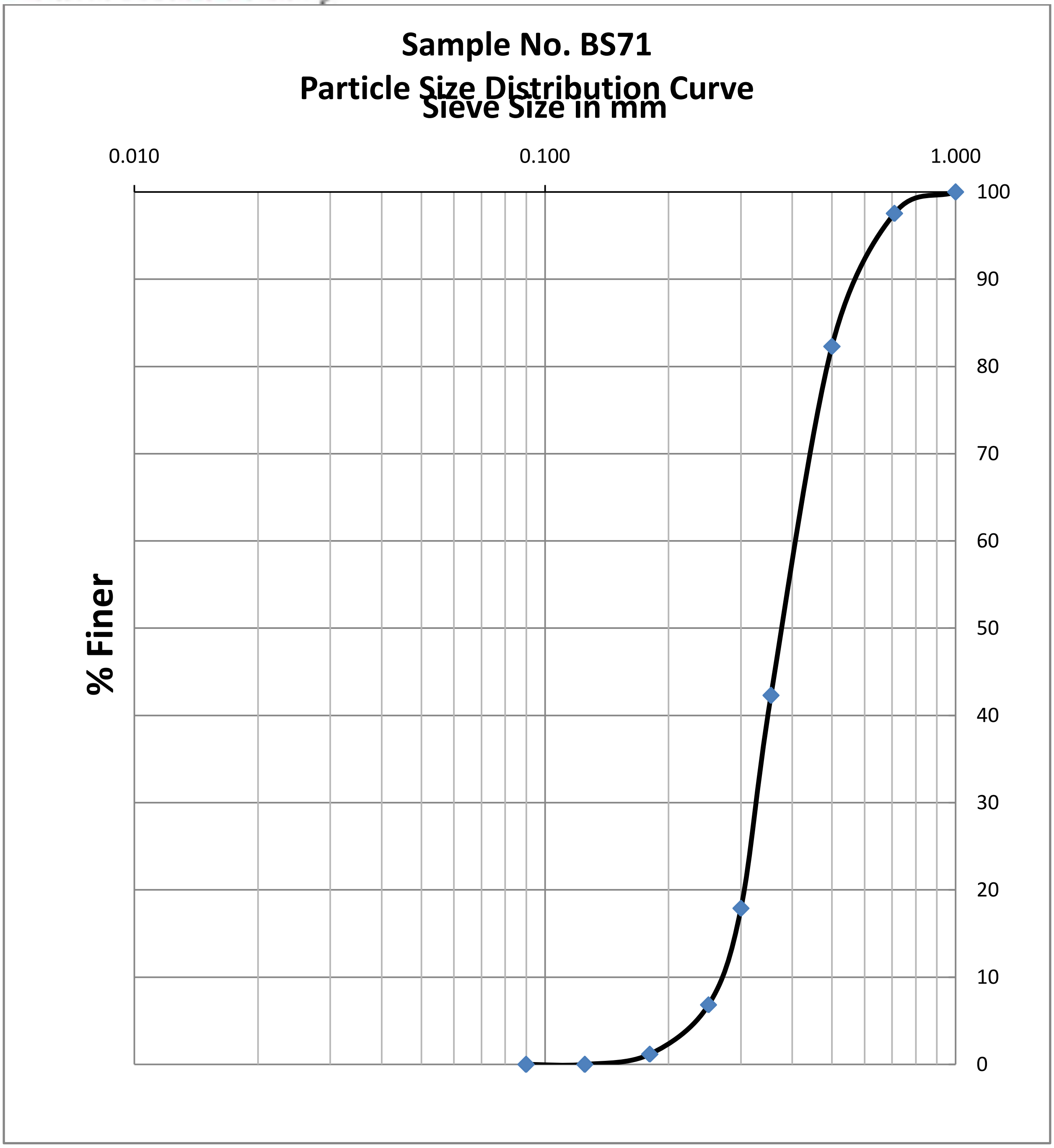

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(Laboratory Head)
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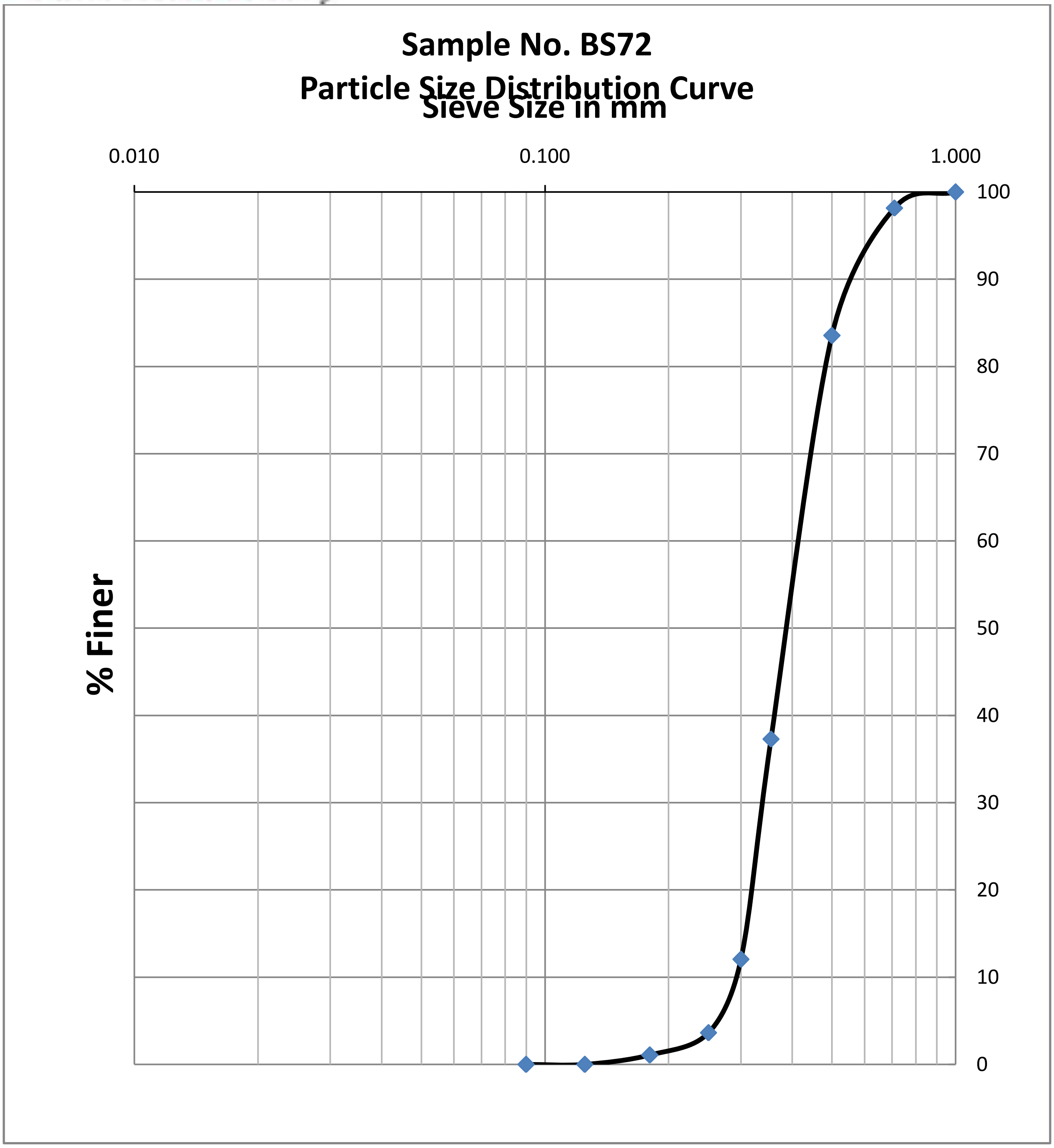

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(Laboratory Head)
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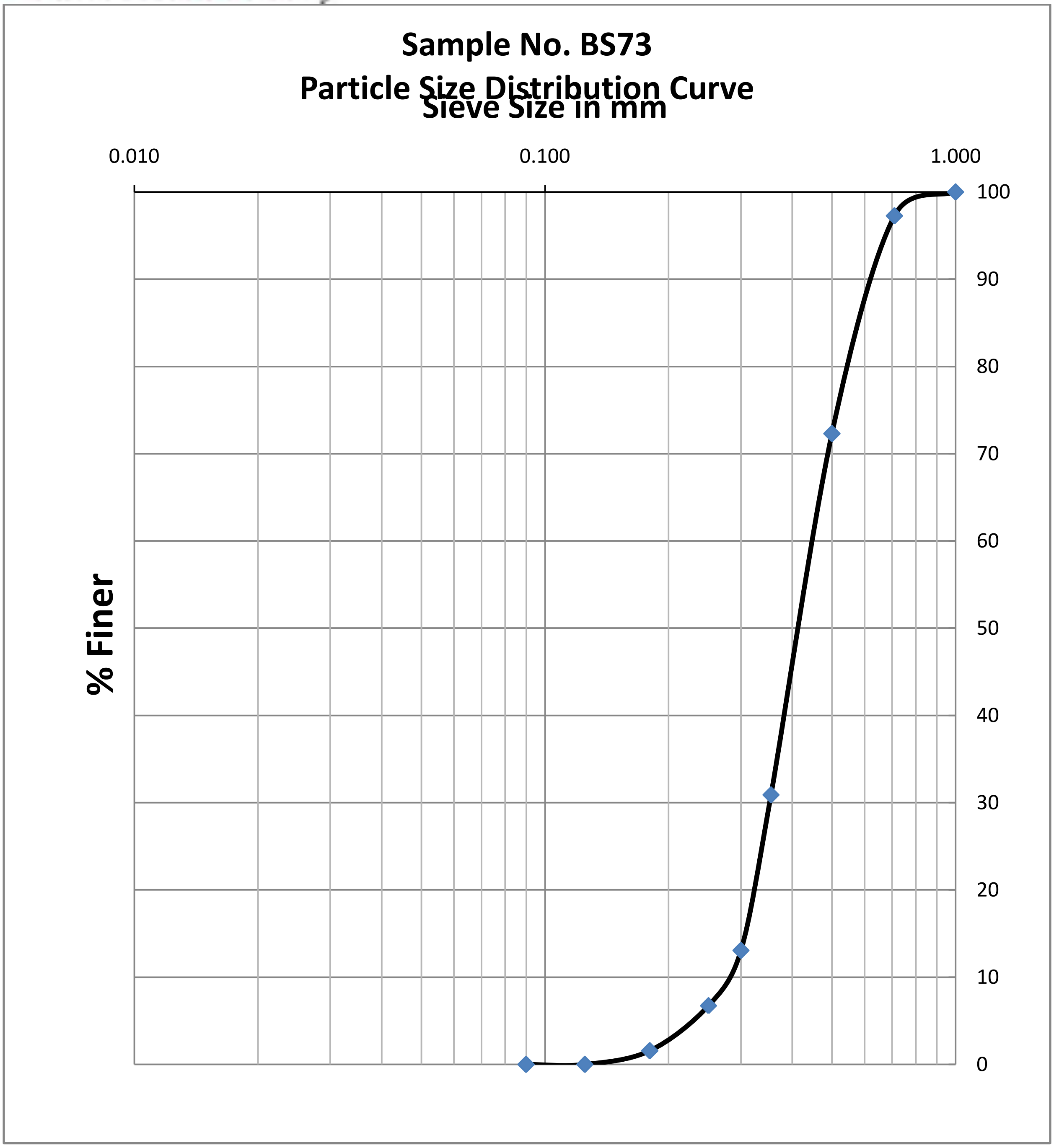

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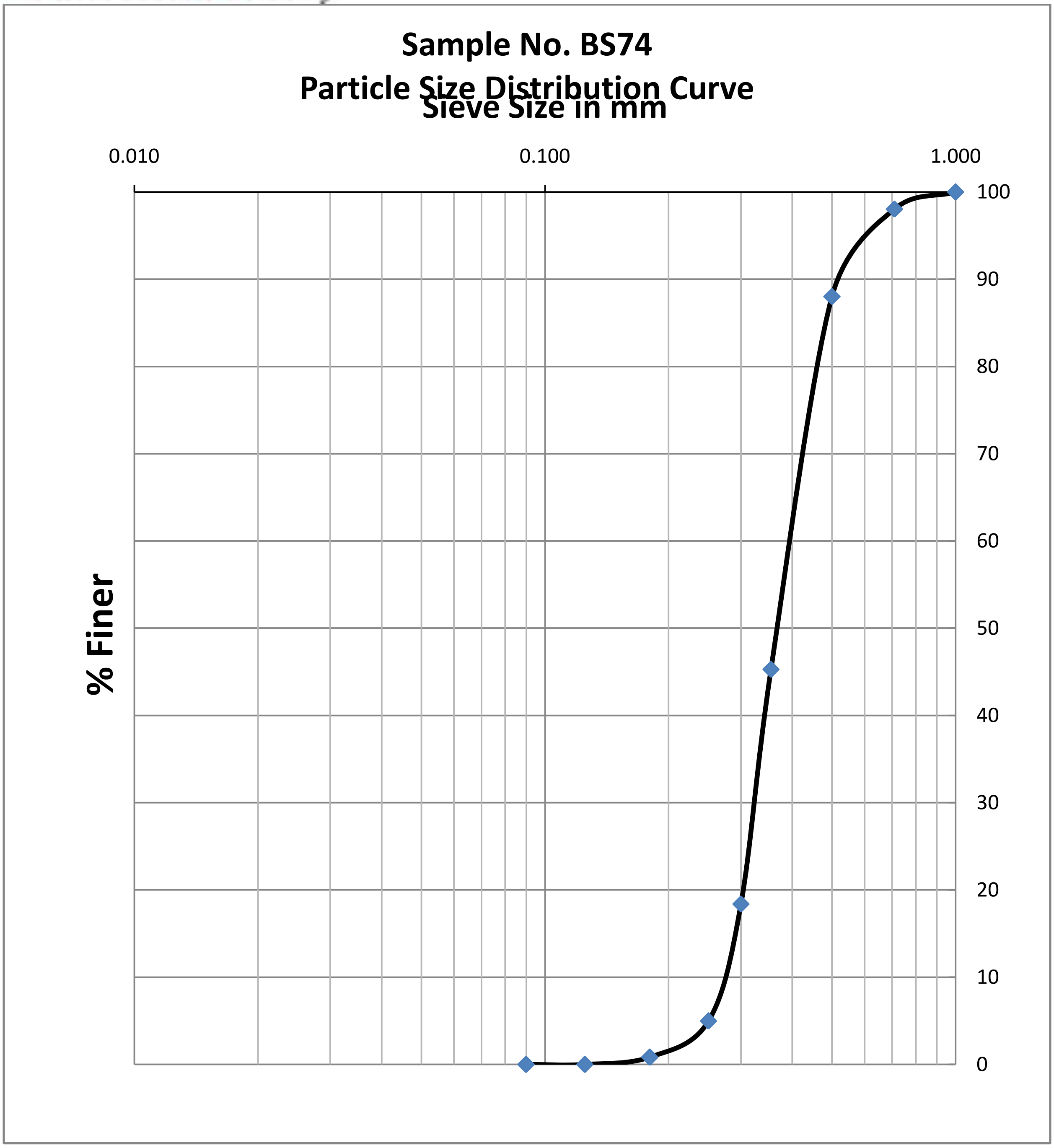

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(Laboratory Head)
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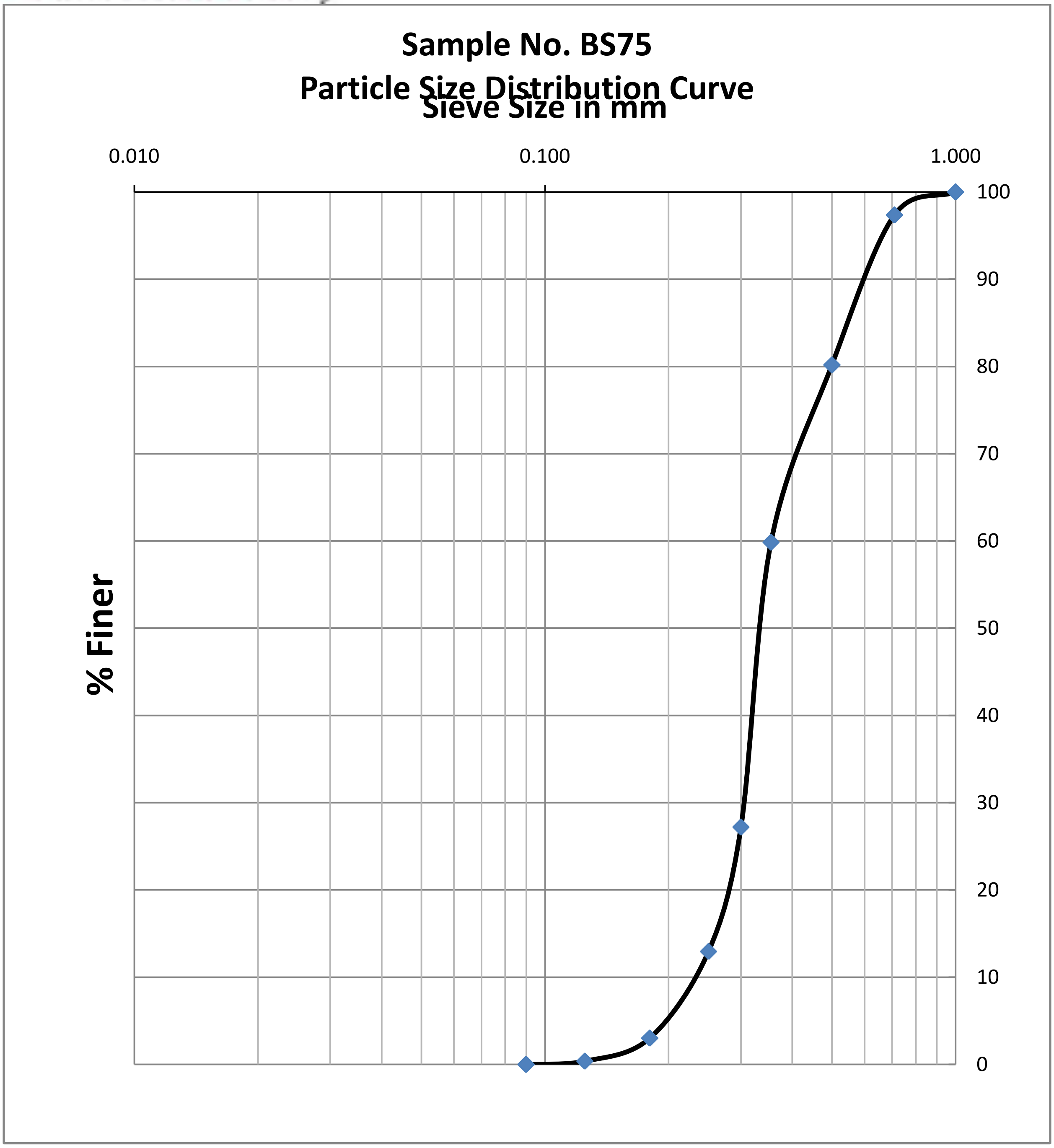

Laiju Narayanan
(Laboratory Head)
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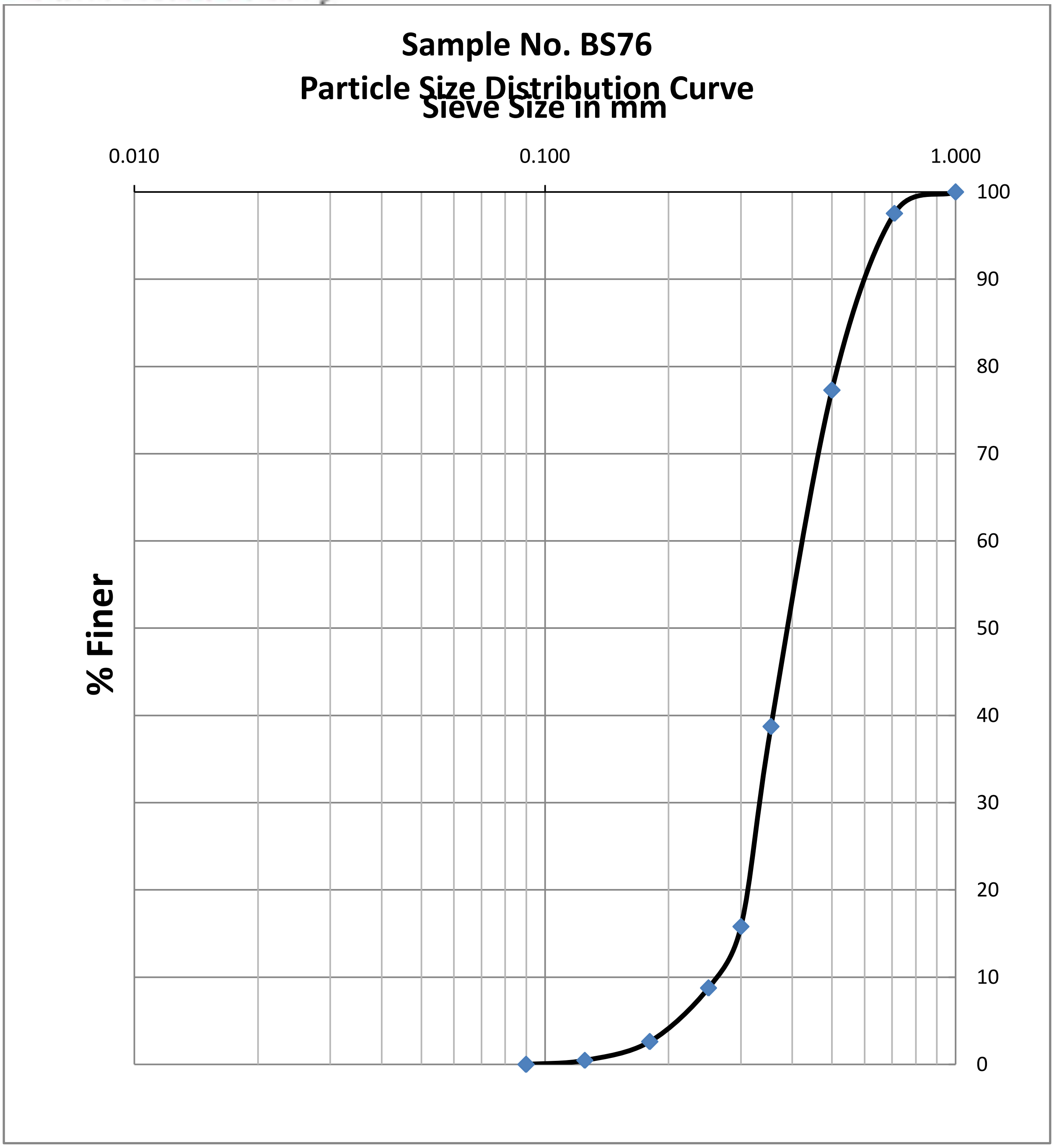

Laiju Narayanan
(Laboratory Head)
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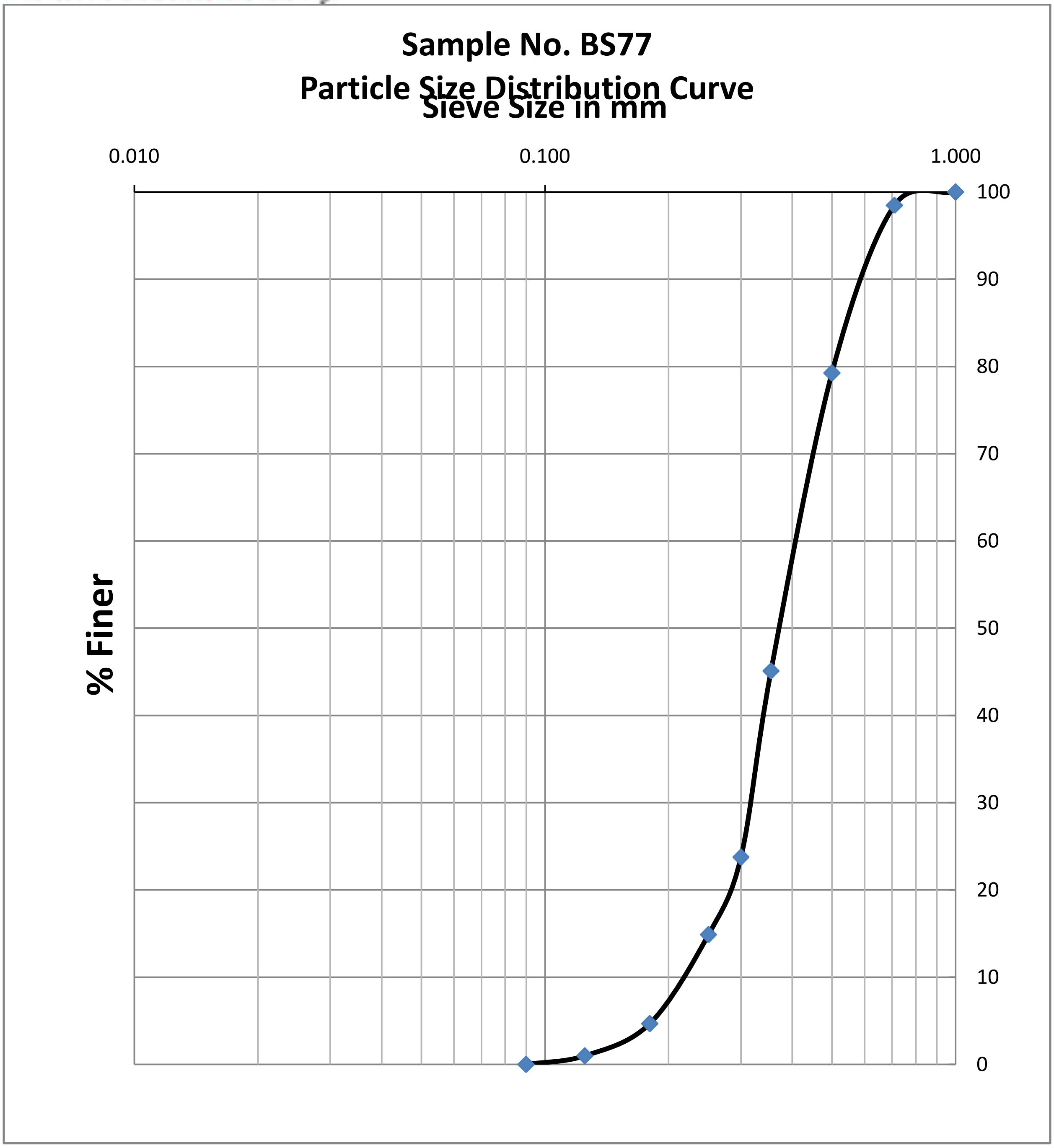
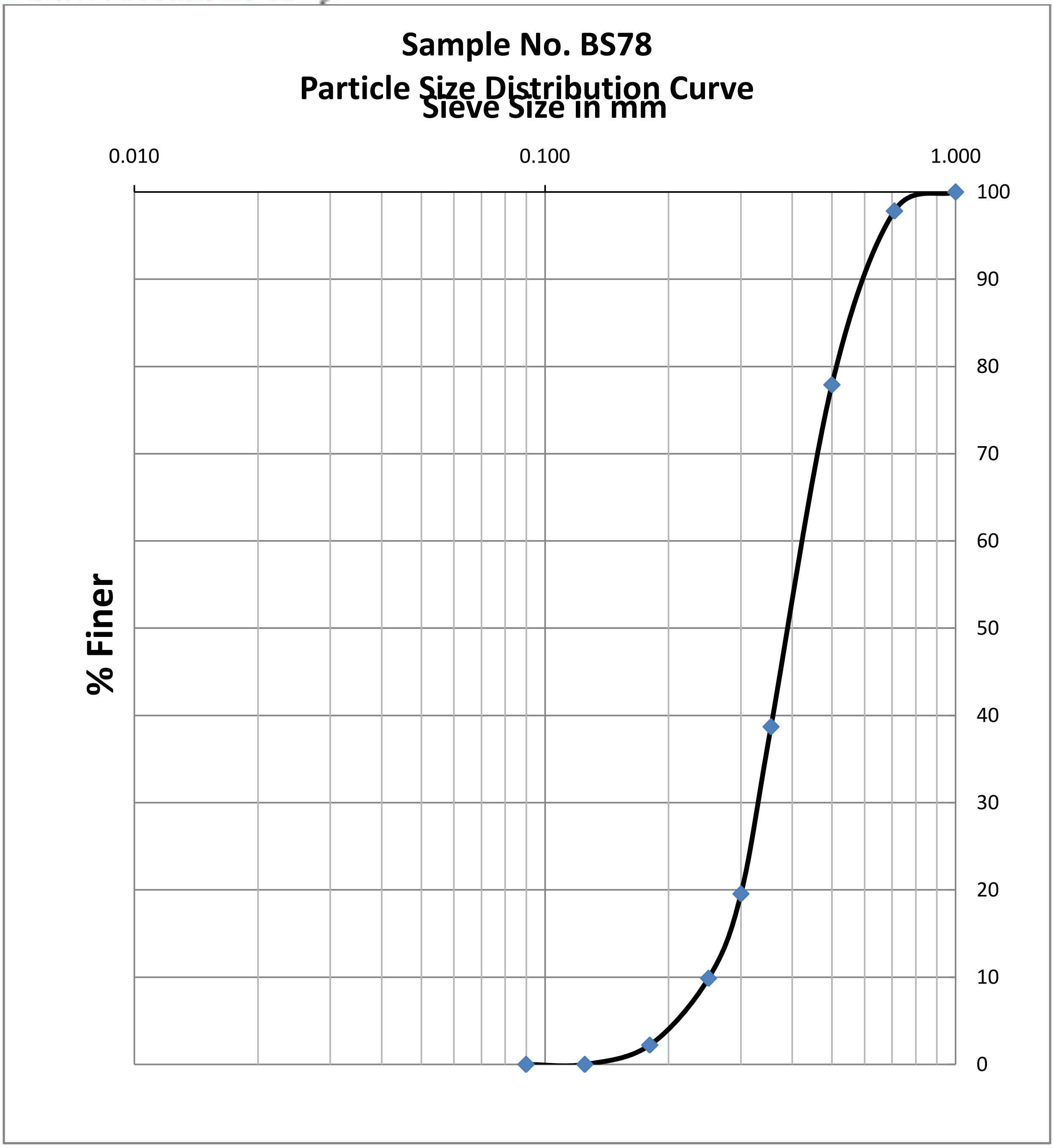


Laiju Narayanan
(Laboratory Head)
Standards Environmental & Analytical Laboratories.



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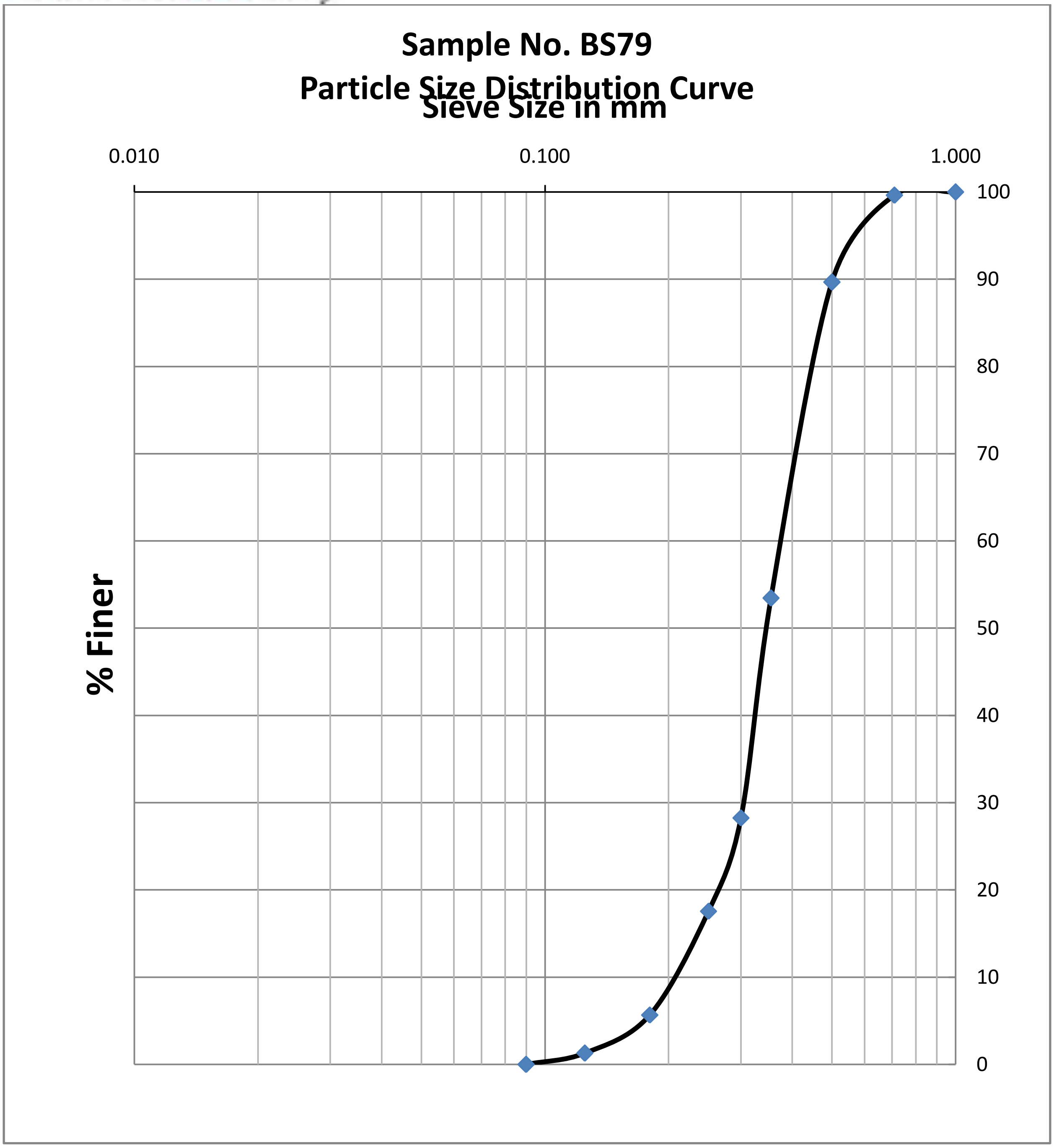

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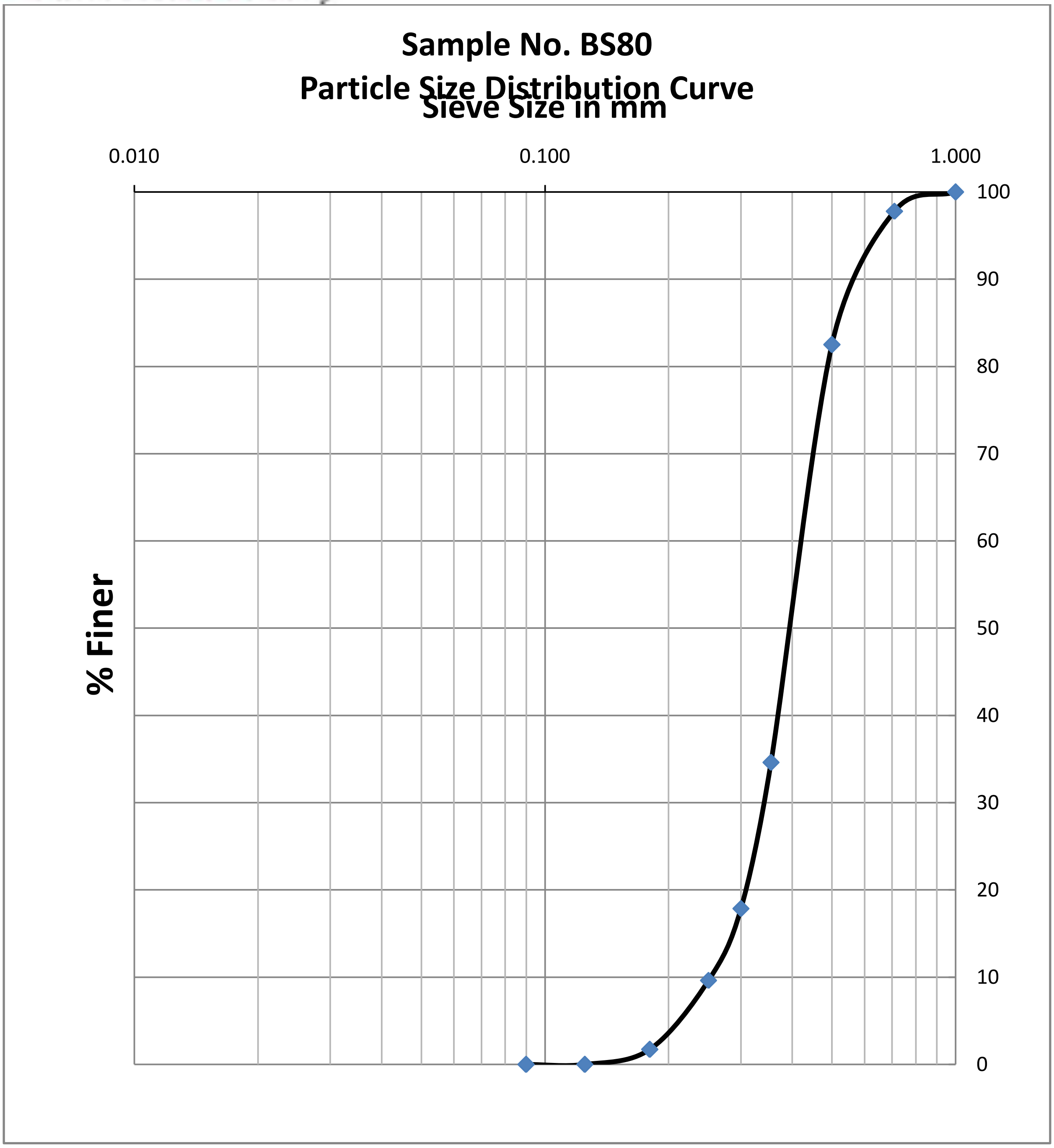

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(Laboratory Head)
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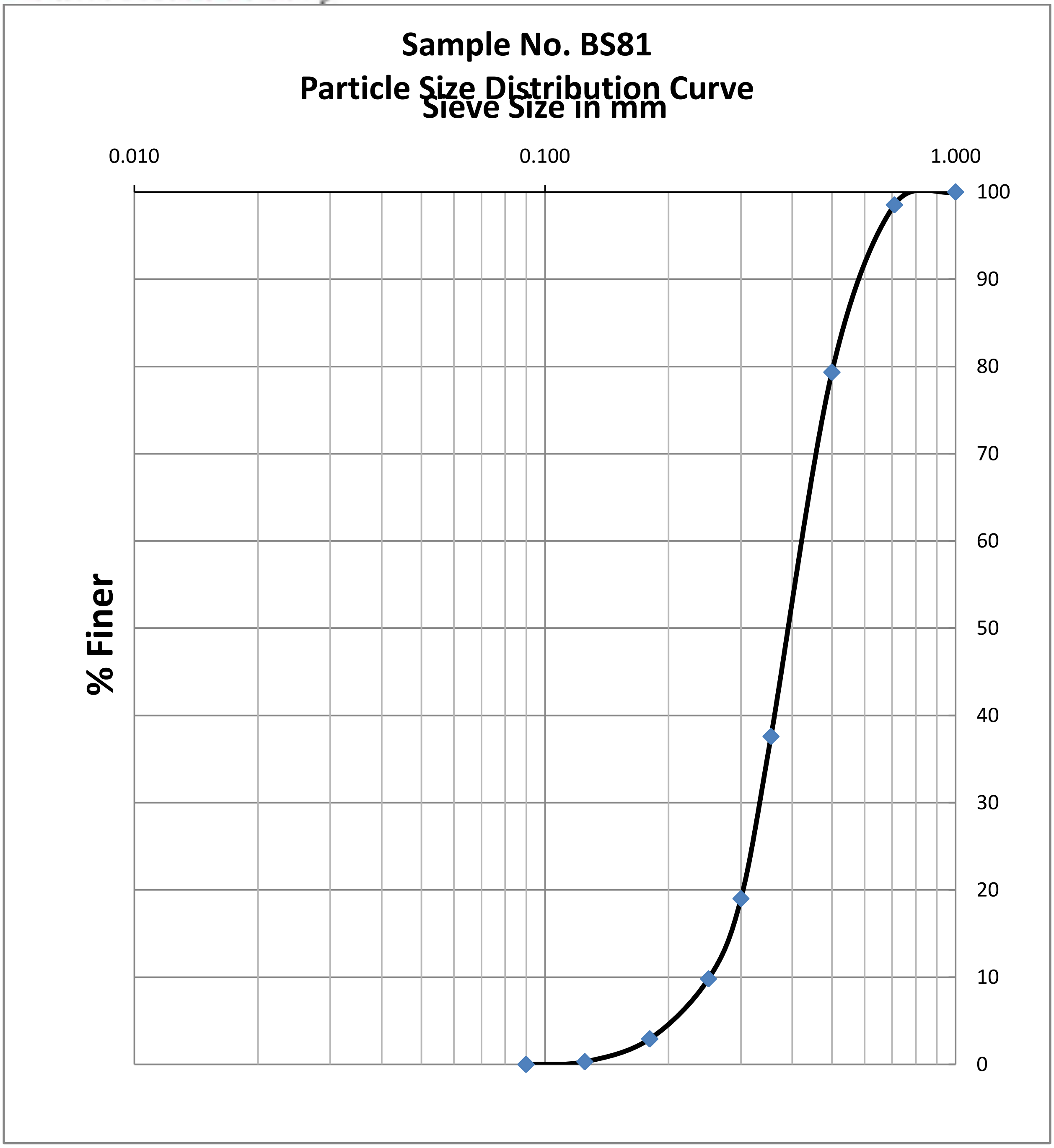

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(Laboratory Head)
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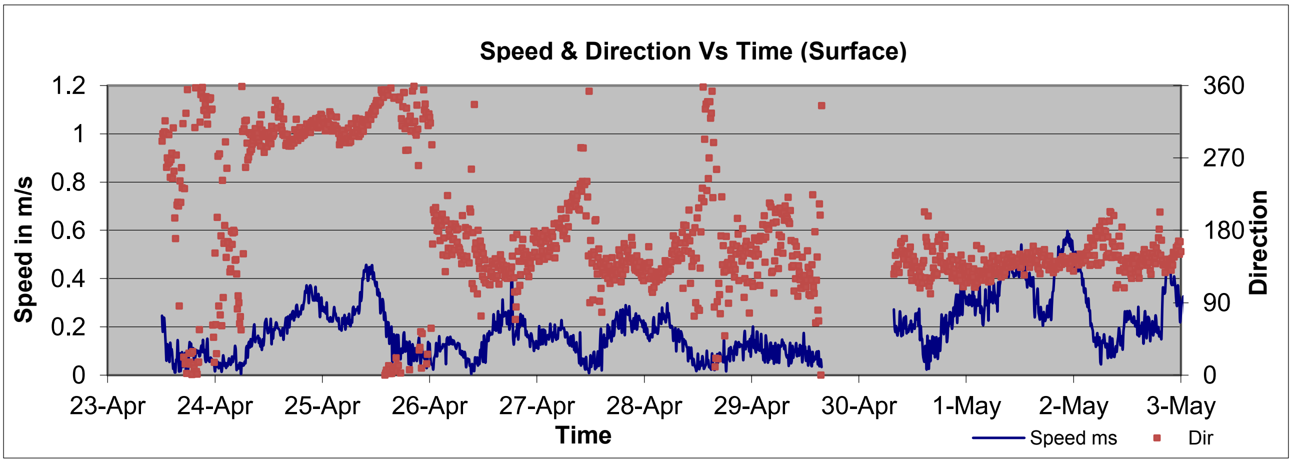
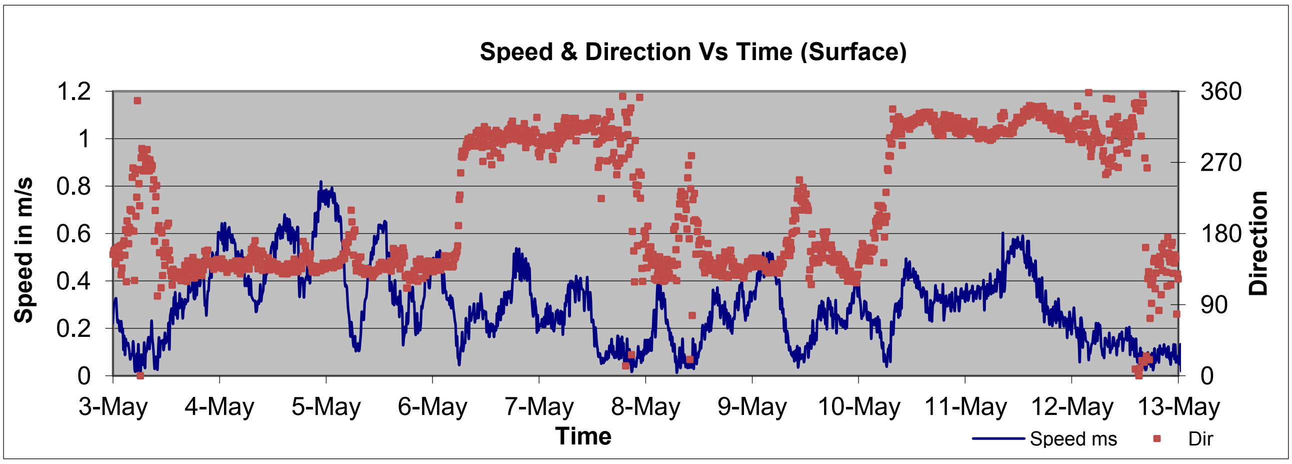
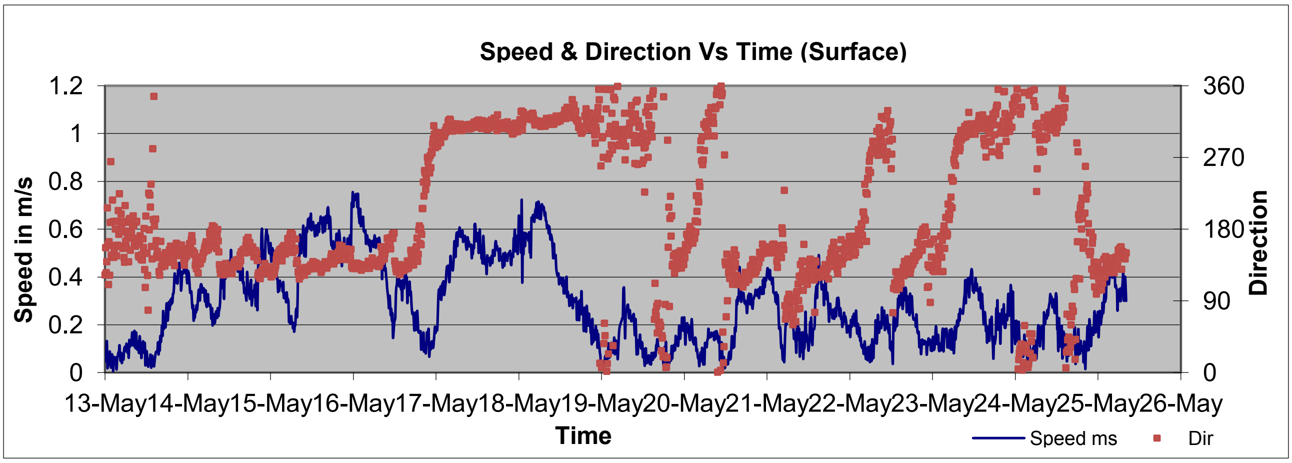
Annexure X

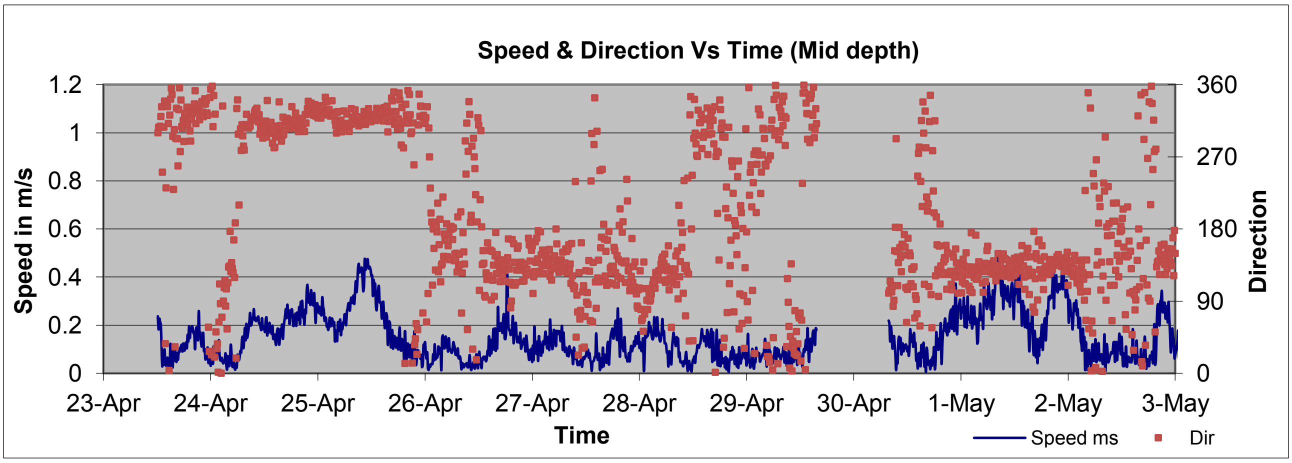
Current Data

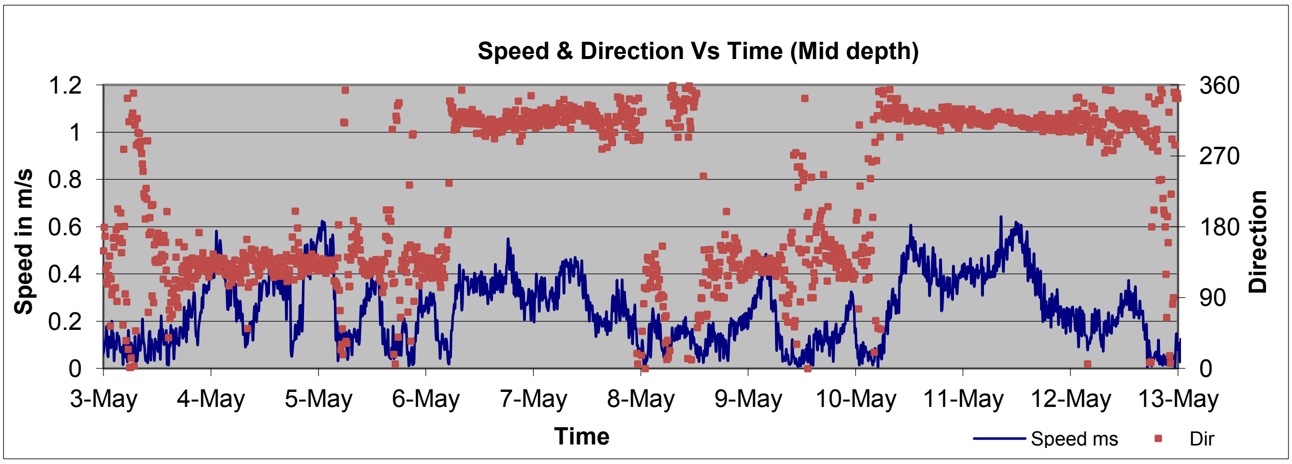
Location P1 (Vizhinjam)

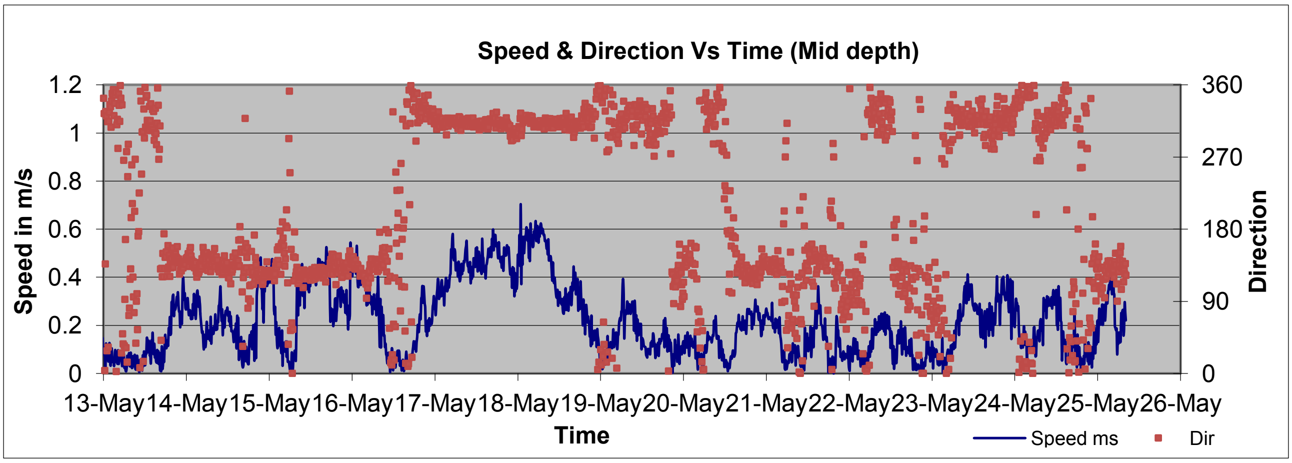

Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
Speed ms
Dir

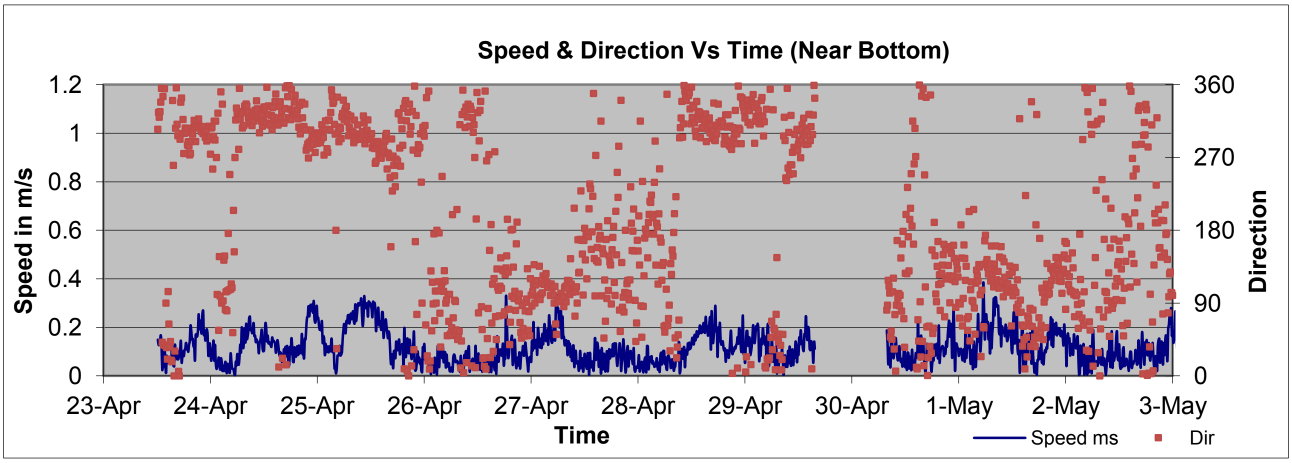

Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
3-May
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
12-May
13-May
Speed ms
Dir

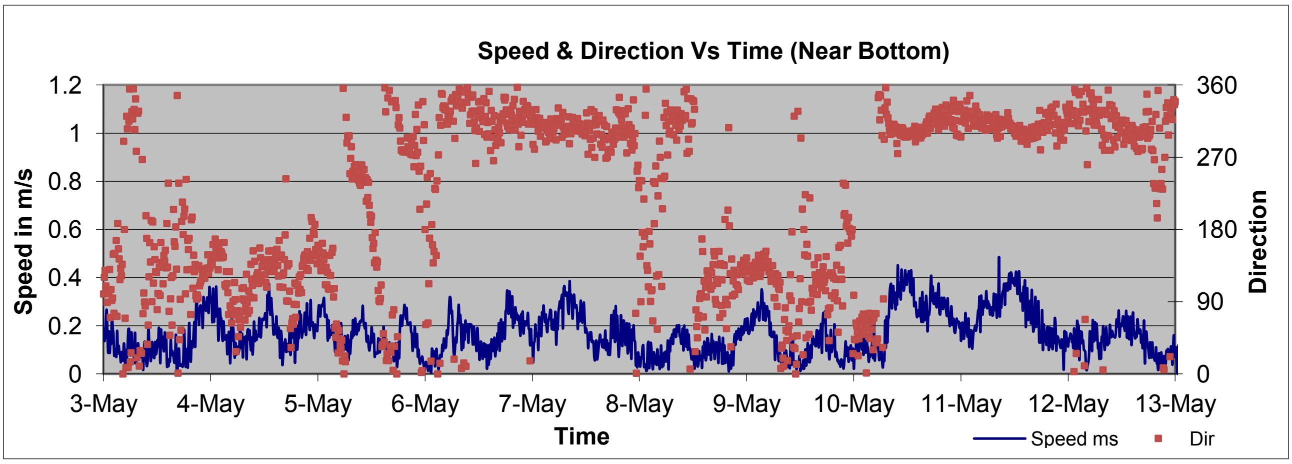

Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
21-May
22-May
23-May
24-May
25-May
26-May
Speed ms
Dir

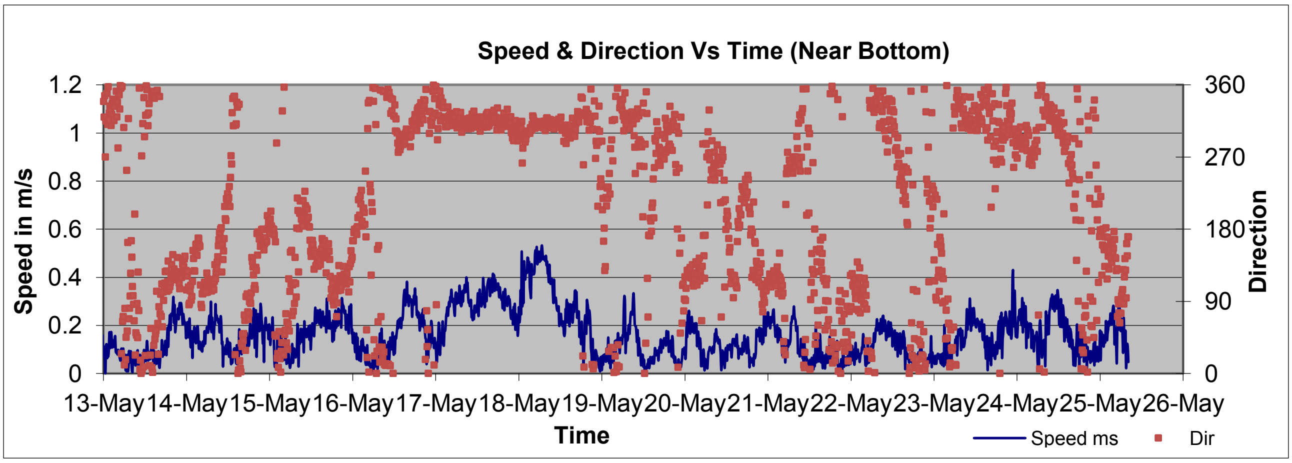

Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
Time
Speed ms
Dir


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


Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
21-May
22-May
23-May
24-May
25-May
26-May
Time
Speed ms
Dir

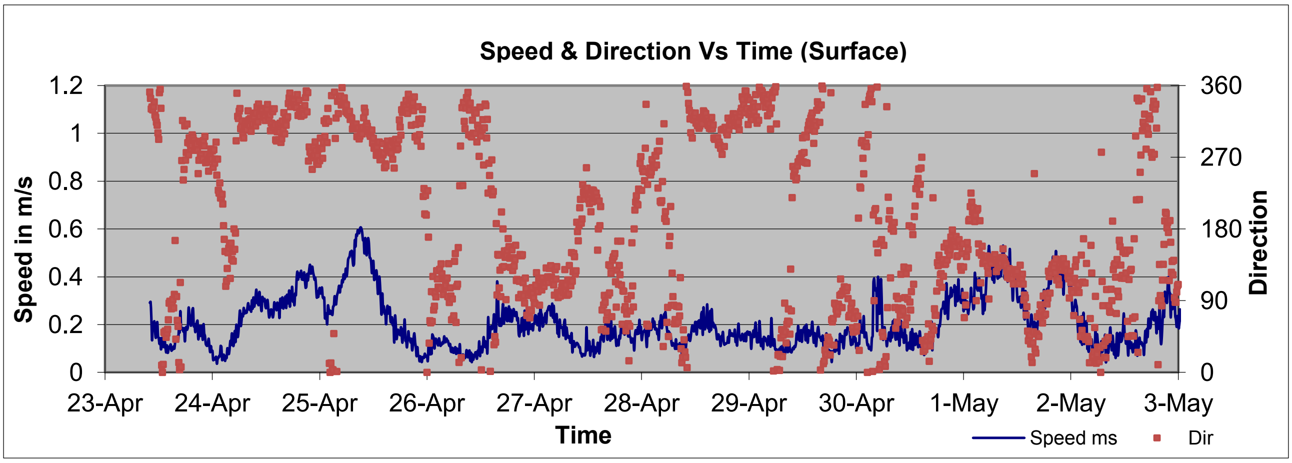

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
Time
Speed ms
Dir

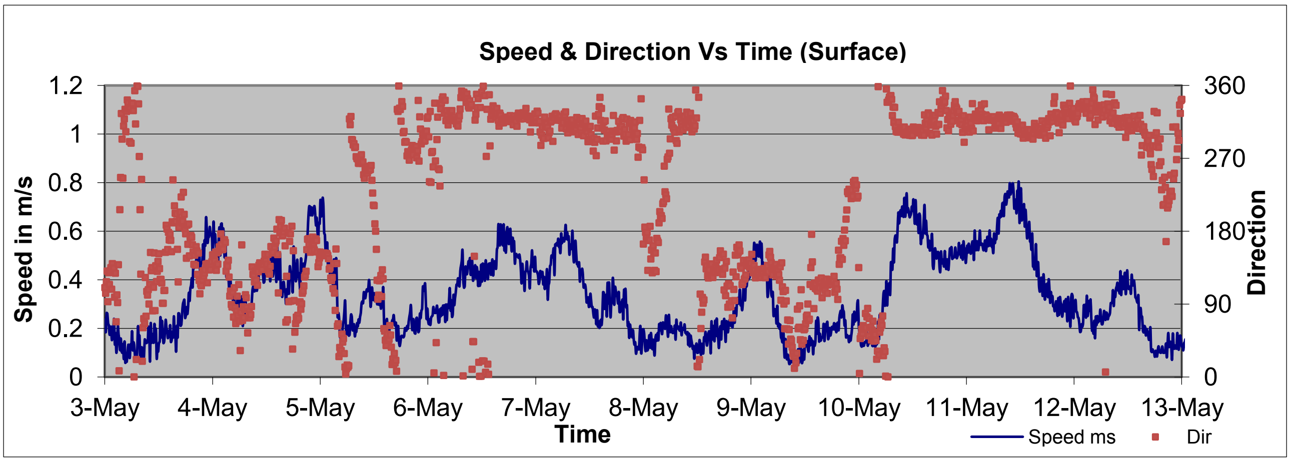

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
3-May
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
12-May
13-May
Time
Speed ms
Dir

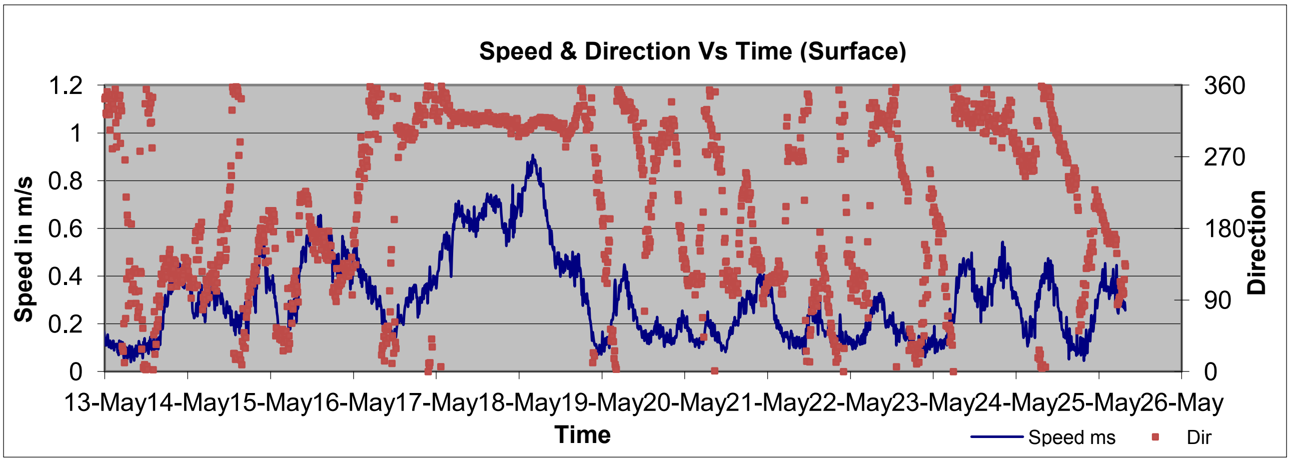

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
13-May
14-May
15-May
16-May
17-May
18-May
19-May
20-May
21-May
22-May
23-May
24-May
25-May
26-May
Time
Speed ms
Dir

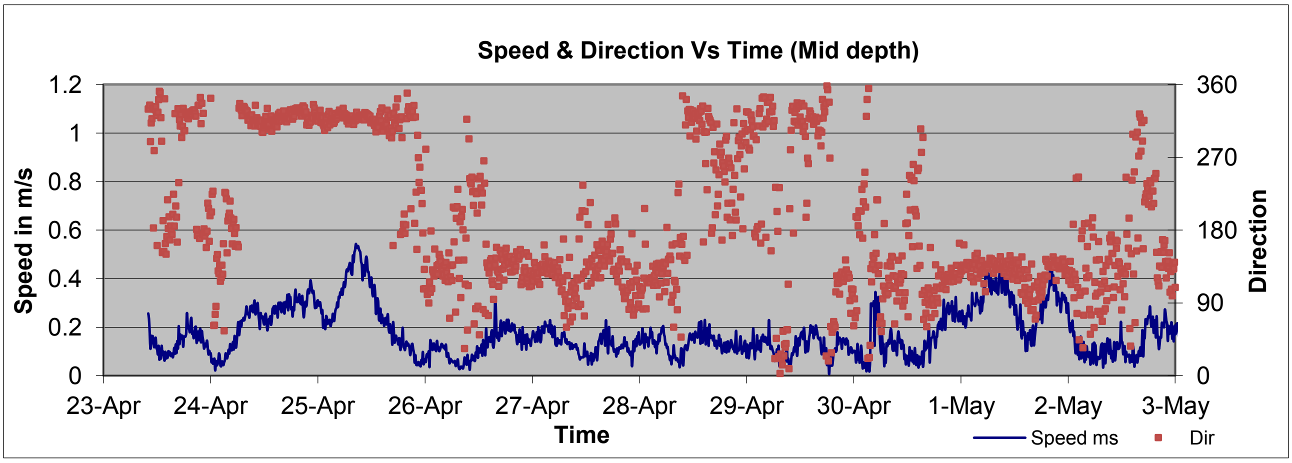
Current Data

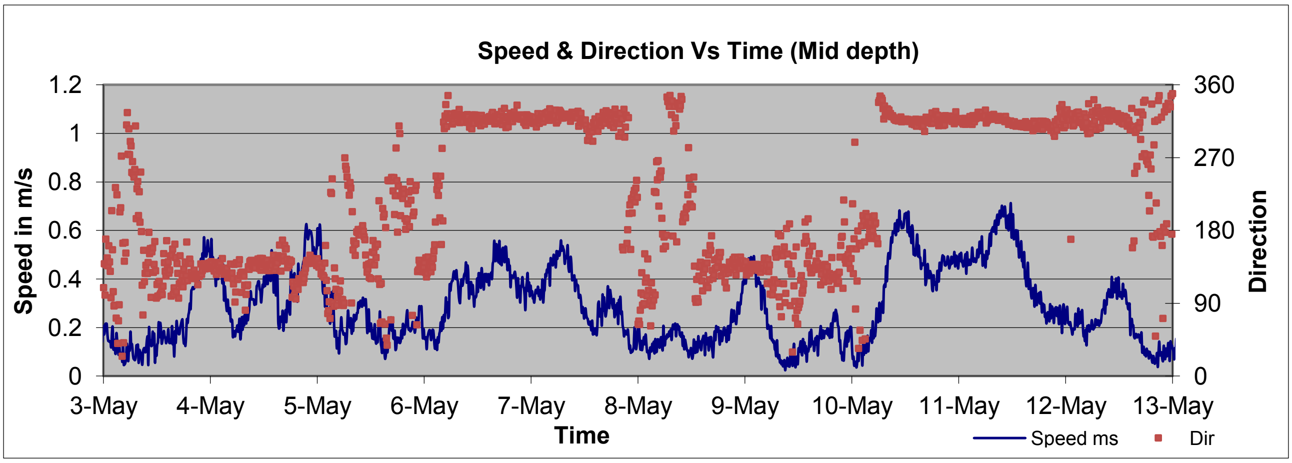
Location P2 (Poovar)

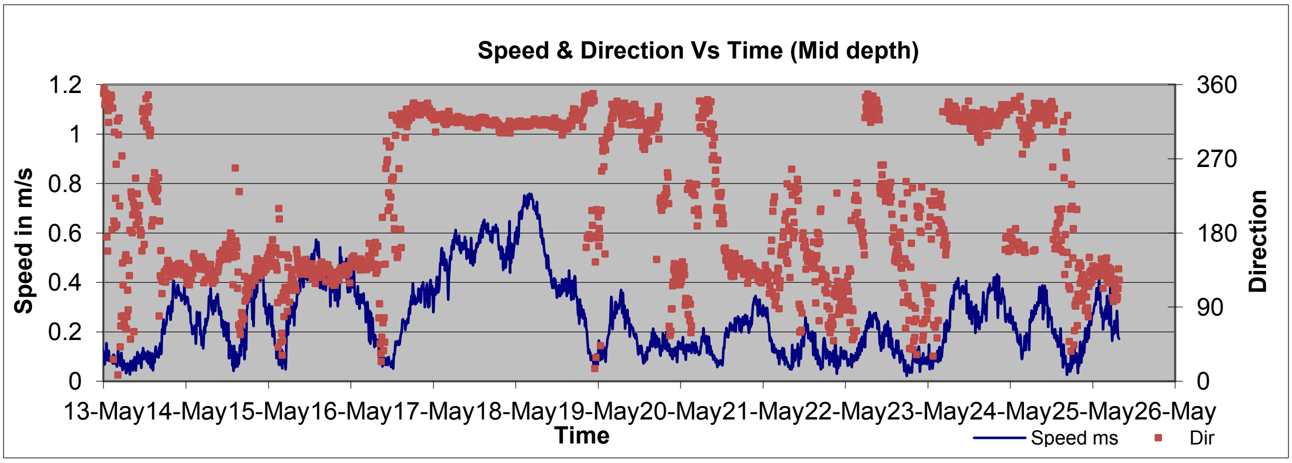

Speed & Direction Vs Time (Surface)
1.2
1
0.8
0.6
0.4
0.2
0
Speed in m/s
360
270
180
90
0
Direction
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
Time
Speed ms
Dir

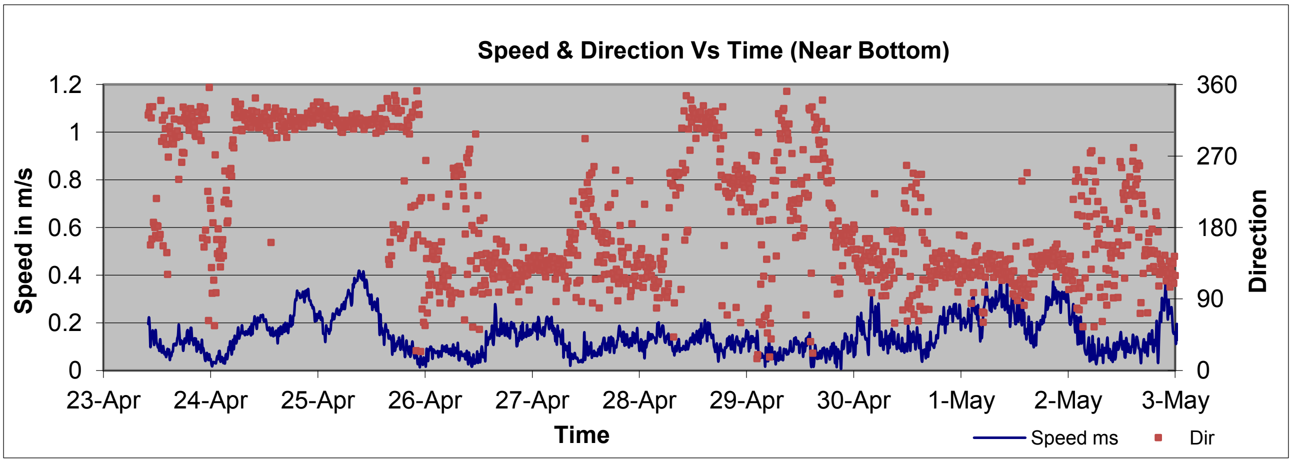

Speed & Direction Vs Time (Surface)
1.2
1
0.8
0.6
0.4
0.2
0
Speed in m/s
360
270
180
90
0
Direction
3-May
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
12-May
13-May
Time
Speed ms
Dir

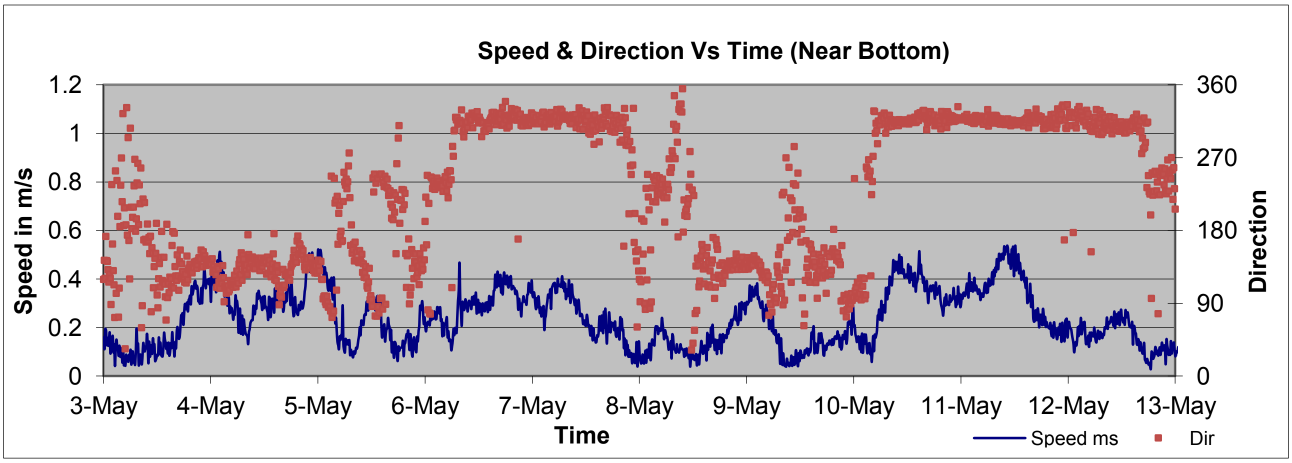

Speed & Direction Vs Time (Surface)
1.2
1
0.8
0.6
0.4
0.2
0
Speed in m/s
360
270
180
90
0
Direction
13-May14-May15-May16-May17-May18-May19-May20-May21-May22-May23-May24-May25-May26-May
Time
Speed ms
Dir

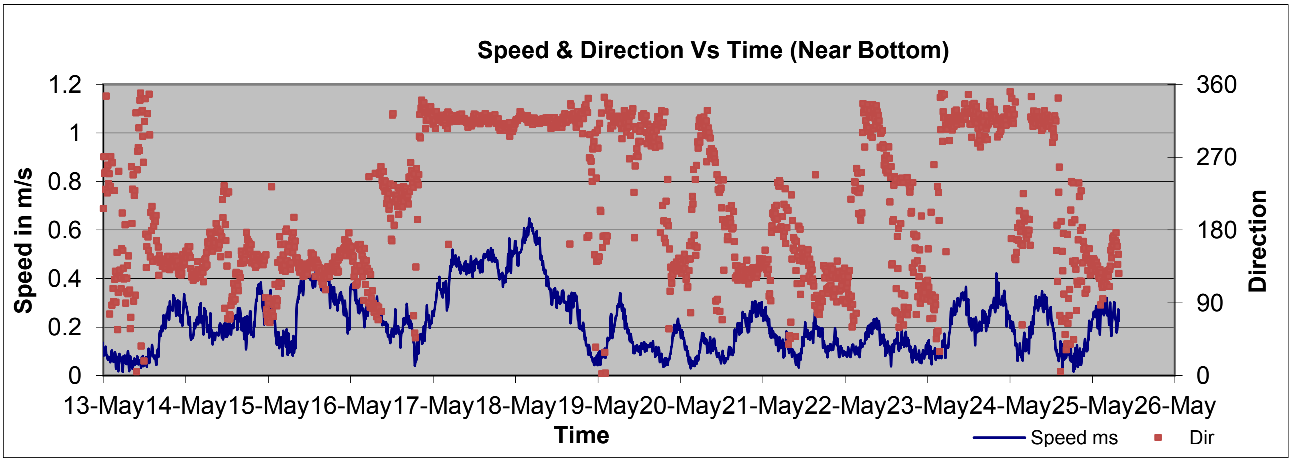

Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
23-Apr 24-Apr 25-Apr 26-Apr 27-Apr 28-Apr 29-Apr 30-Apr 1-May 2-May 3-May
Time
Speed ms
Dir


Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
3-May 4-May 5-May 6-May 7-May 8-May 9-May 10-May 11-May 12-May 13-May
Time
Speed ms
Dir


Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
360
270
180
90
0
Direction
13-May14-May15-May16-May17-May18-May19-May20-May21-May22-May23-May24-May25-May26-May
Time
Speed ms
Dir

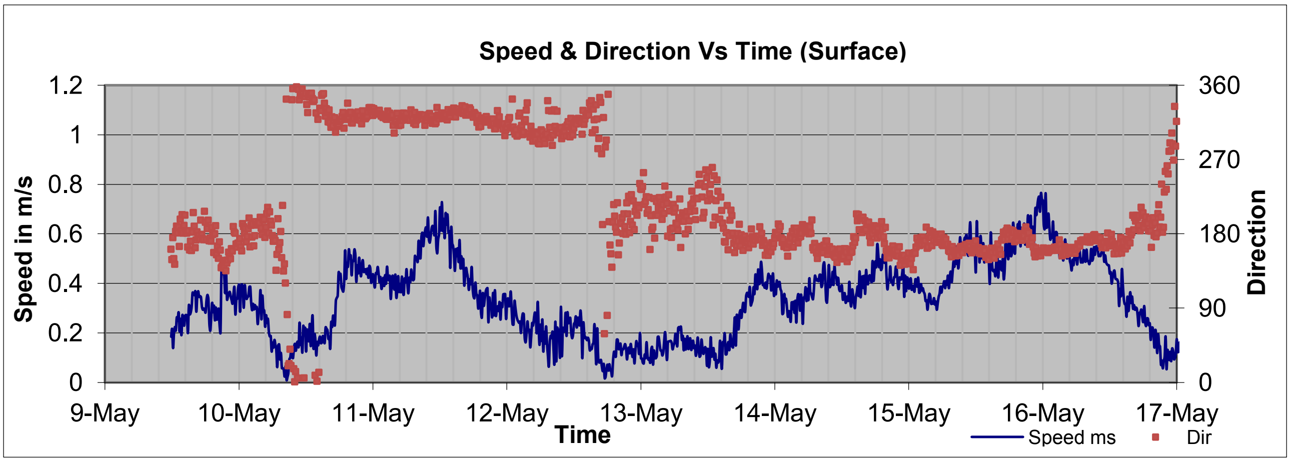

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
Direction
360
270
180
90
0
23-Apr
24-Apr
25-Apr
26-Apr
27-Apr
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
Time
Speed ms
Dir

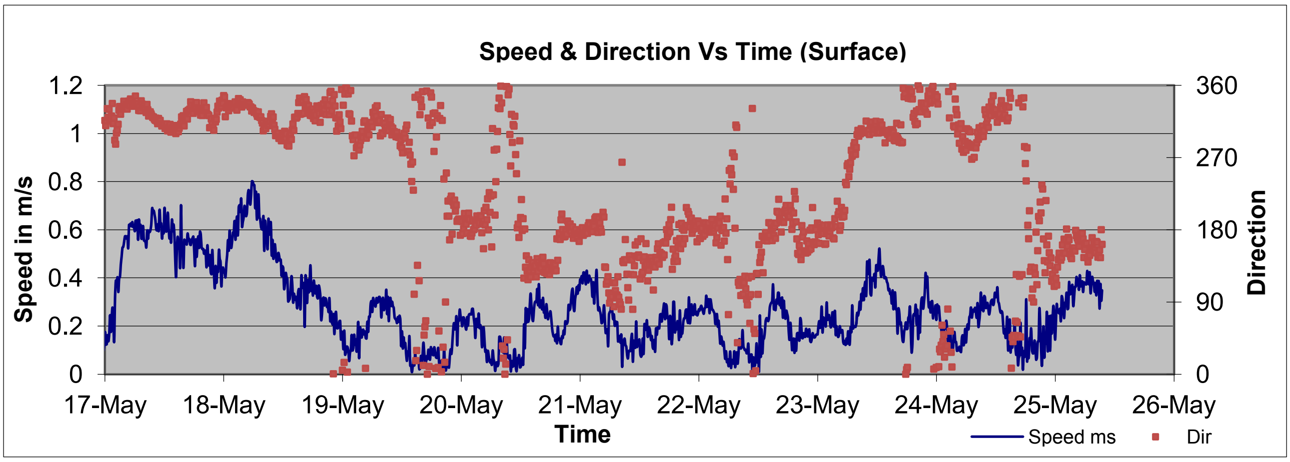

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
Direction
360
270
180
90
0
3-May
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
12-May
13-May
Time
Speed ms
Dir

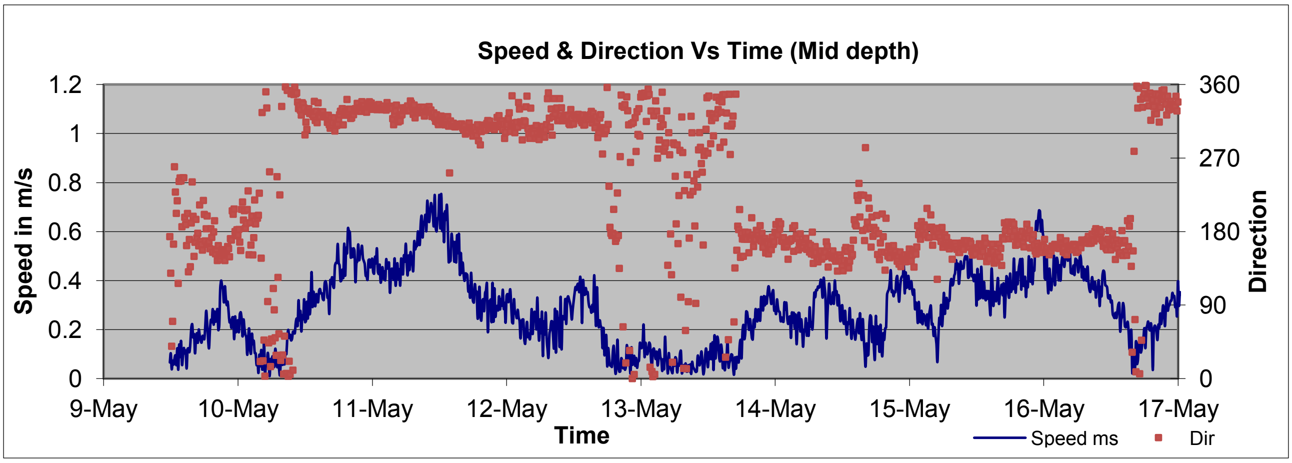

Speed & Direction Vs Time (Near Bottom)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
Direction
360
270
180
90
0
13-May14-May15-May16-May17-May18-May19-May20-May21-May22-May23-May24-May25-May26-May
Time
Speed ms
Dir

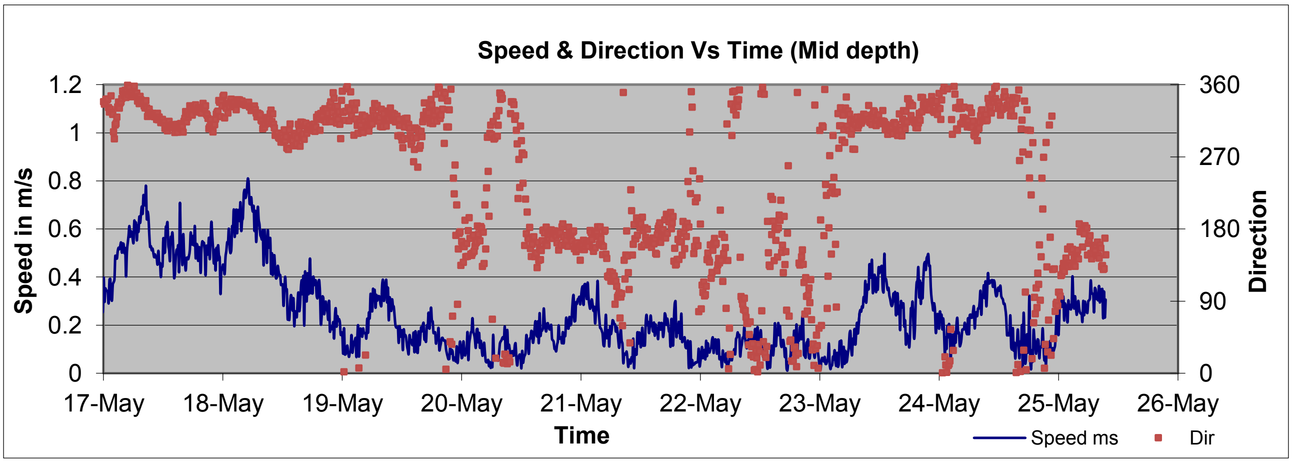
Current Data

Location P3 (Pachalloor)


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


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


Speed & Direction Vs Time (Mid depth)
Speed in m/s
1.2
1
0.8
0.6
0.4
0.2
0
Direction
360
270
180
90
0
9-May
10-May
11-May
12-May
13-May
14-May
15-May
16-May
17-May
Time
Speed ms
Dir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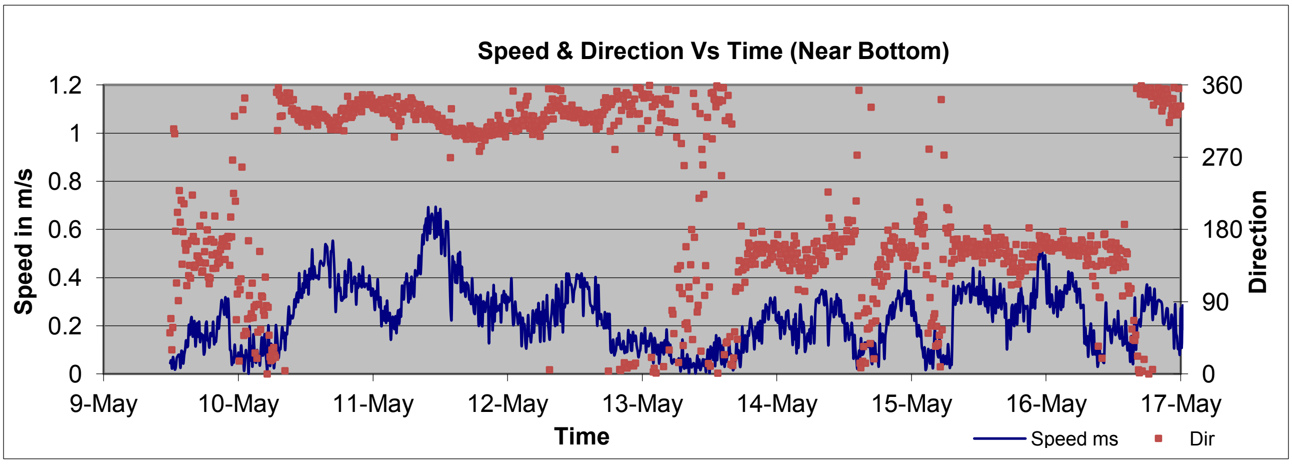
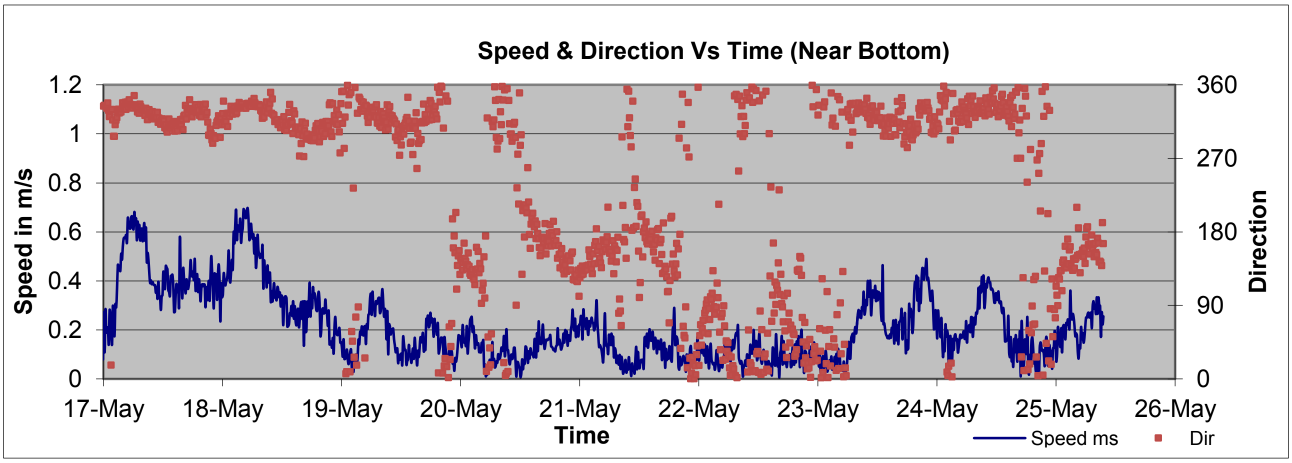
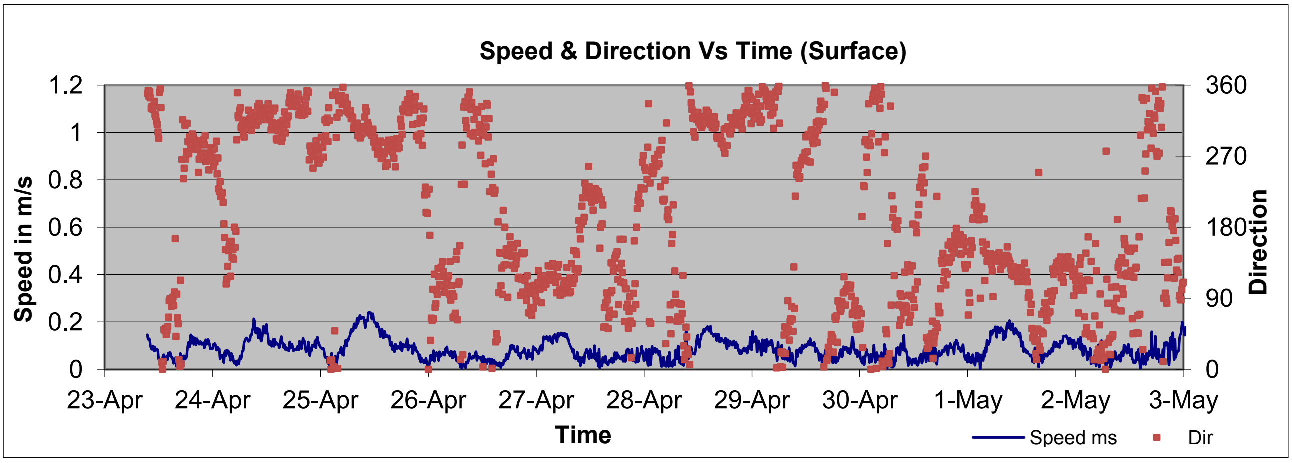
1
0.8
0.6
0.4
0.2
0
Speed in m/s
360
270
180
90
0
Direction
17-May
18-May
19-May
20-May
21-May
22-May
23-May
24-May
25-May
26-May
Time
Speed ms
Dir


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


Speed & Direction Vs Time (Near Bottom)
1.2
1
0.8
0.6
0.4
0.2
0
Speed in m/s
360
270
180
90
0
Direction
17-May
18-May
19-May
20-May
21-May
22-May
23-May
24-May
25-May
26-May
Time
Speed ms
Dir

Current Data

Location P4 (Mulloor)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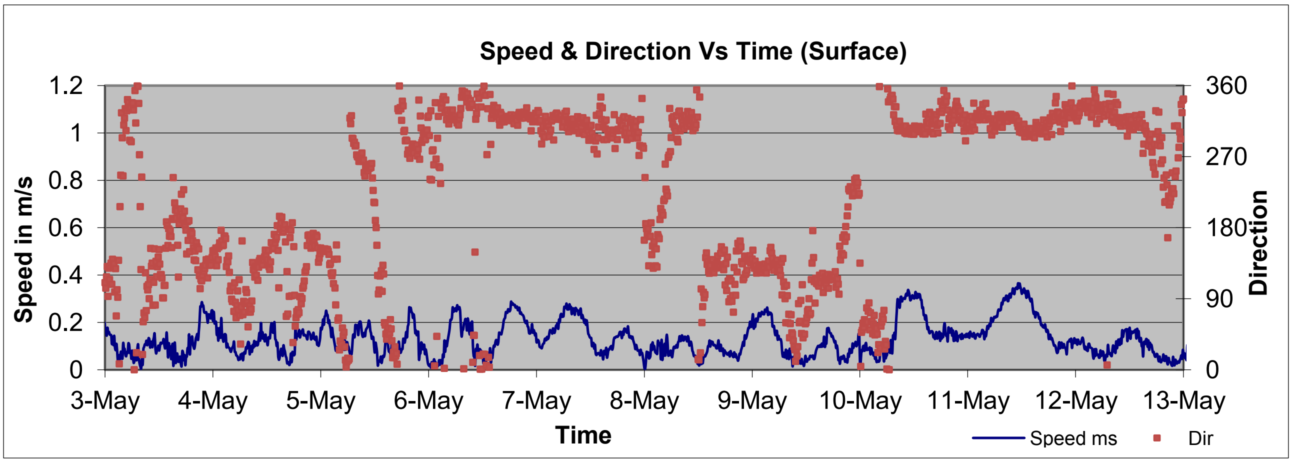
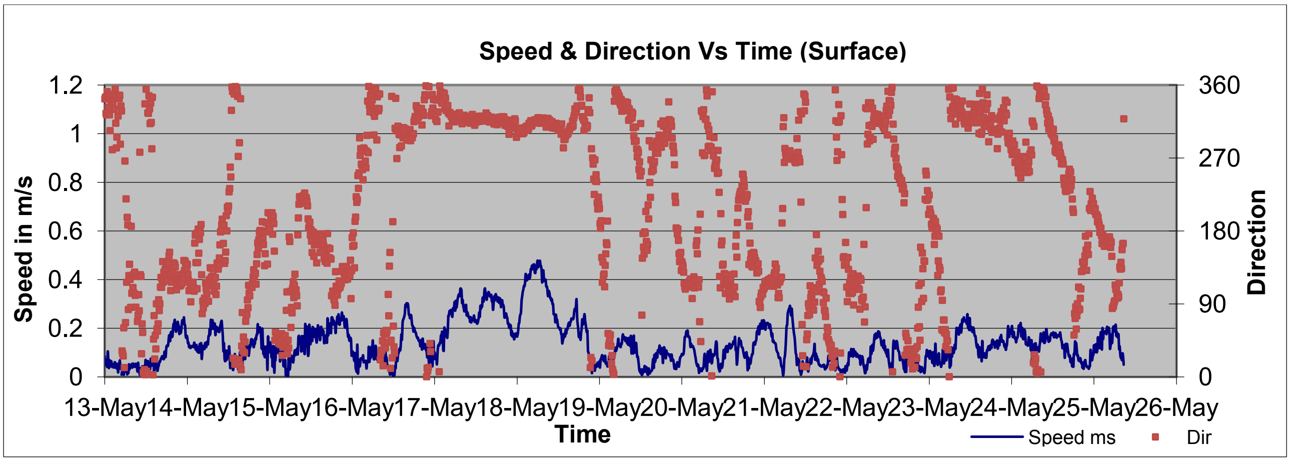
Speed in m/s
Direction
Time
23-Apr 24-Apr 25-Apr 26-Apr 27-Apr 28-Apr 29-Apr 30-Apr 1-May 2-May 3-May
Speed ms
Dir


Speed & Direction Vs Time (Surface)
Speed in m/s
Direction
Time
3-May 4-May 5-May 6-May 7-May 8-May 9-May 10-May 11-May 12-May 13-May
Speed ms
Dir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Speed in m/s
Direction
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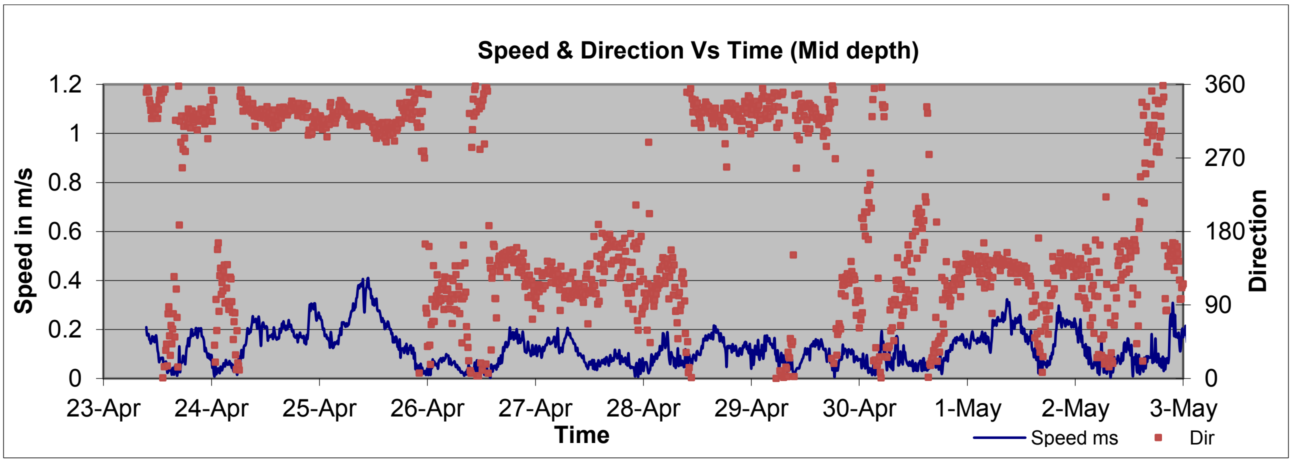
Speed ms
Dir



Speed & Direction Vs Time (Mid depth)
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Direction
Time
23-Apr
24-Apr
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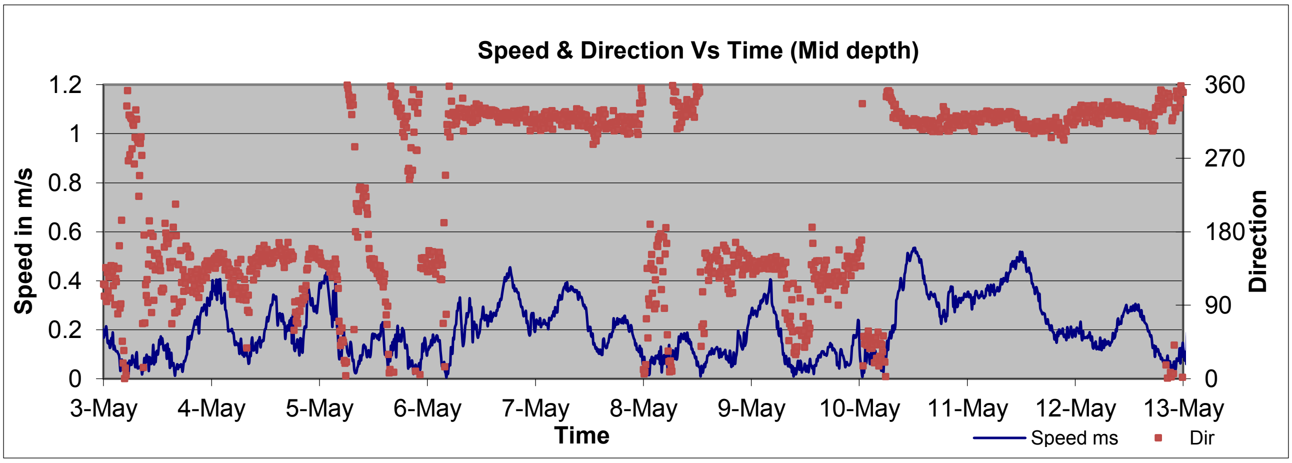
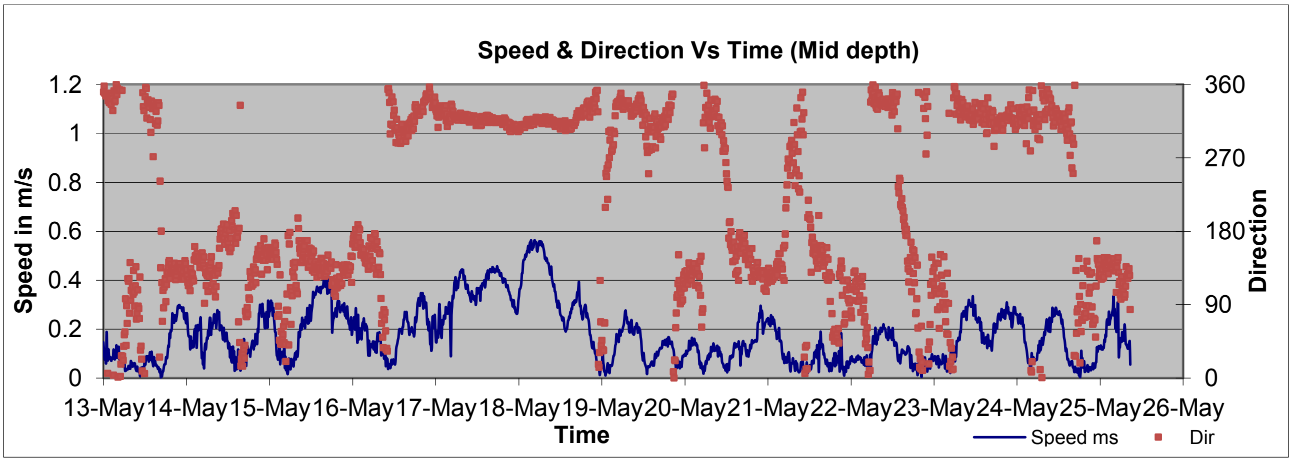
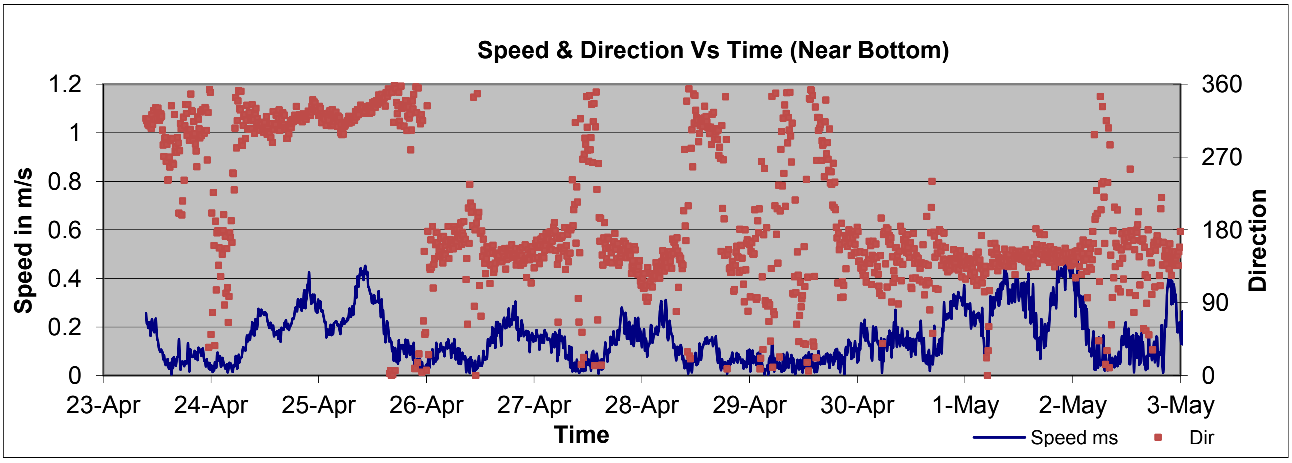
28-Apr
29-Apr
30-Apr
1-May
2-May
3-May
Speed ms
Dir



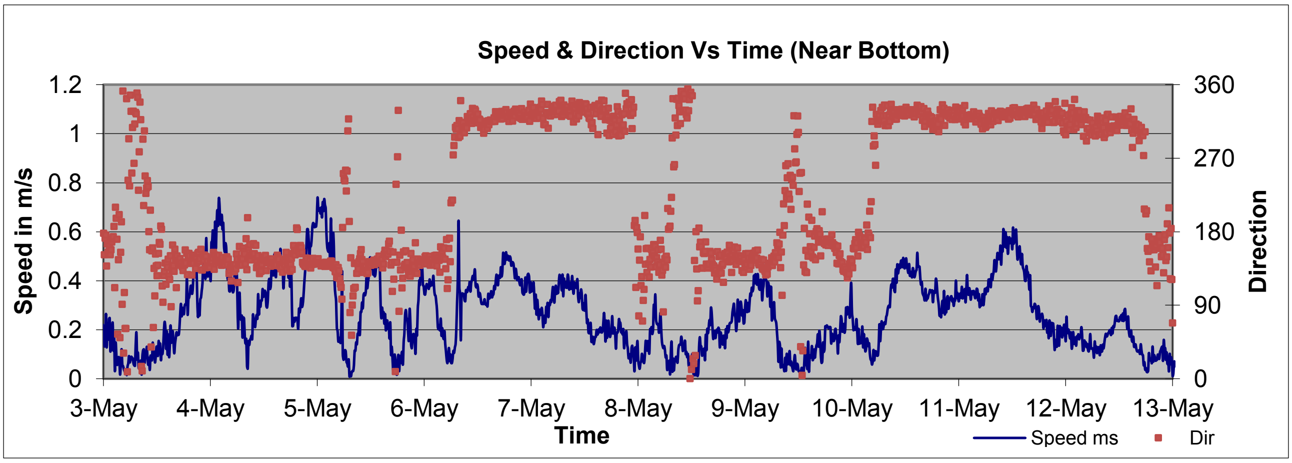
Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
3-May
4-May
5-May
6-May
7-May
8-May
9-May
10-May
11-May
12-May
13-May
Speed ms
Dir



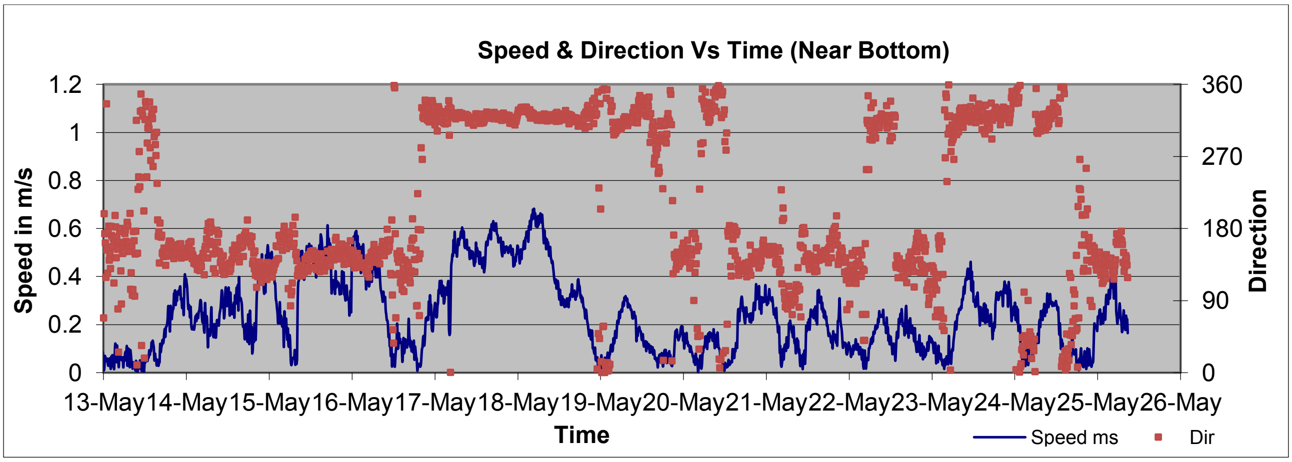
Speed & Direction Vs Time (Mid depth)
Speed in m/s
Direction
Time
13-May 14-May 15-May 16-May 17-May 18-May 19-May 20-May 21-May 22-May 23-May 24-May 25-May 26-May
Speed ms
Dir



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



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



Speed & Direction Vs Time (Near Bottom)
Speed in m/s
Direction
Time
13-May
14-May
15-May
16-May
17-May
18-May
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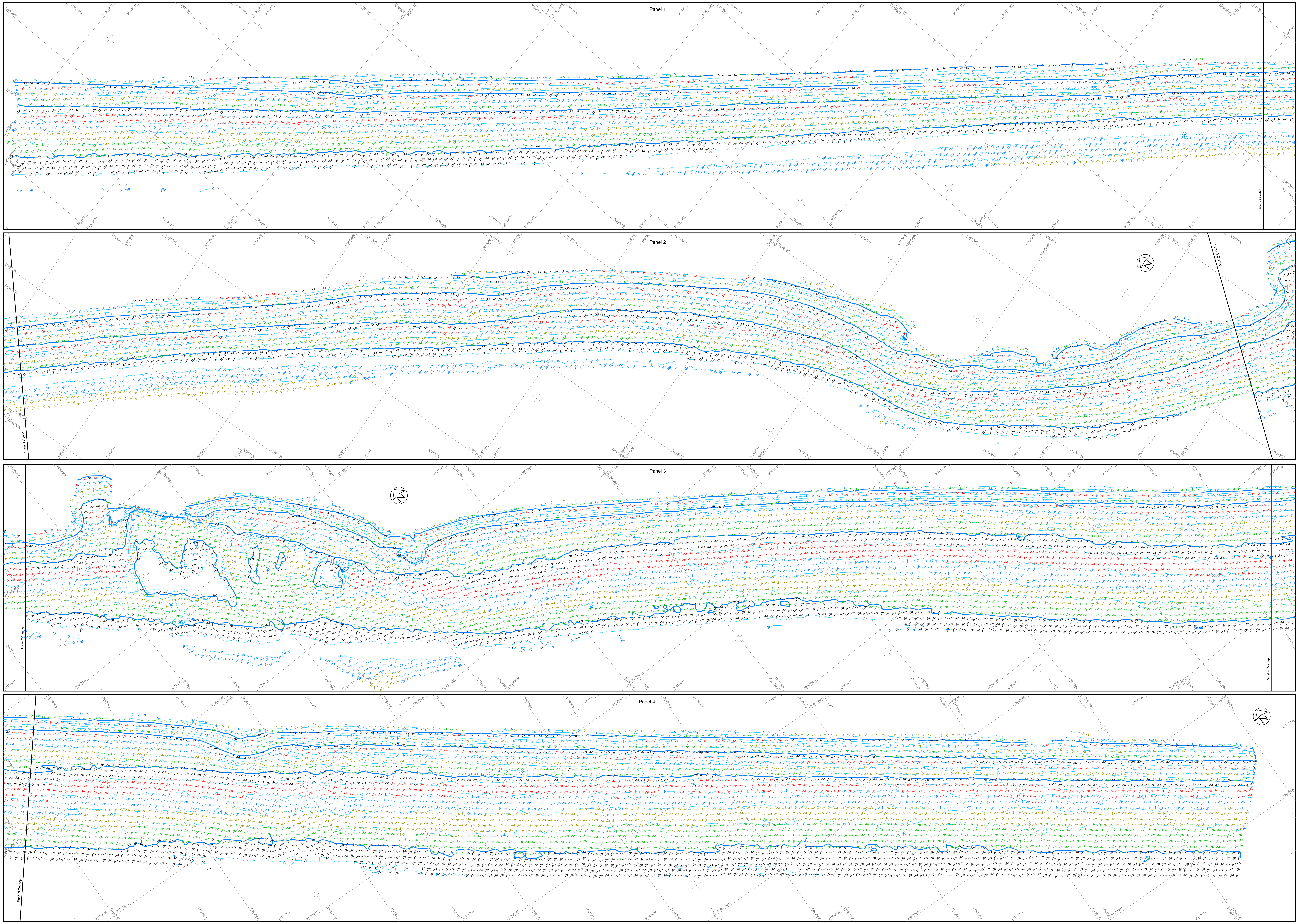
20-May
21-May
22-May
23-May
24-May
25-May
26-May
Speed ms
Dir



Notes :

1. Background details shown in the charts are extracted from NHO navigation chart No. 222
2. Observed tides at Vizhinjam Harbour is used to reduce the raw bathy to chart datum.

LEGEND

935000mN	UTM Grid Line & Text
76°56'00"E	Lat/Long Grid Line & Text
	Matchline
21_1 19_3 17_7 10_1 16_5	Water depth in metres & decimetres below chart datum
6	Minor depth contours in metres below chart datum
10	Major depth contours in metres below chart datum

Survey Notes :

Survey dates	:	06th April to 27th May 2019
Survey boats	:	MFB Bethel
Surface positioning	:	Leica MX 420 series DGPS
Bathymetry acquired using	:	GeoAcoustics Geo Swath Plus MBES

Geodetic parameters :

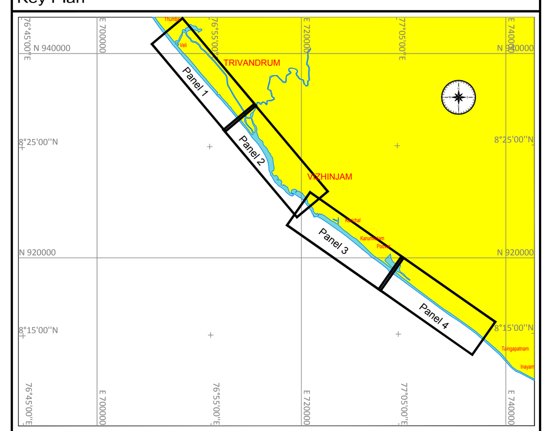
Horizontal Coordinate System	:	WGS84
Geodetic Datum / Spheroid	:	WGS84
Semi-Major Axis (a) (meters)	:	6378137.000m
Semi-Minor Axis	:	6356752.314245m
Inverse Flattening	:	298.2572235630
Projection	:	Universal Transverse Mercator
Longitude of Origin (CM)	:	75° E (Zone 43)
Latitude of Origin	:	0° N (Equator)
Hemisphere	:	North
False Easting	:	500 000 m
False Northing	:	0 m
Scale Factor at CM	:	0.9996
Units	:	Metres

Scale

HORIZONTAL 1 : 10,000

200 0 200 400 600 800 1000metres

Key Plan



Client

Adani Vizhinjam Port Private Limited
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Thycaud, Thiruvananthapuram 695014
Kerala, India
Tel : +91 471 2328614 Tel/Fax: +91 471 2328616

Survey contractor

OCEAN SCIENCE & SURVEYING PVT LTD
(Formerly known as EGS SURVEY PVT. LTD.)
C005/006, Platform Floor,
Tower No.8, Railway Station Complex,
CBD Belapur, Navi Mumbai - 400 614
Maharashtra, India.

Project

Oceanographic & Bathymetric Data Collection
For
Assessment of Shoreline Changes
For
Vizhinjam International Seaport Limited

Drawing Title

Bathymetric Chart
(Pre Monsoon 2018)

Rev.No.	Description	Date
0	First issue	13.06.2019

Drawn : Mansuri M.I. | Interpreted : Gaurav K. / Sanjeev K. | Approved : Patra S. P.

Dwg. No. : OSaS_P21716_Adani_Pre Monsoon_April-May 2019 Bathy_01

adani

Adani Vizhinjam Port Pvt. Ltd

OCEANOGRAPHIC AND BATHYMETRIC DATA COLLECTION FOR ASSESSMENT OF SHORELINE CHANGES

Shankar And Co.
115, Neco Chambers
CBD Belapur
Navi Mumbai – 400 614

Date: 11th July 2019

SAC Ref #: SAC/P167-19/PSR-1

PERIODIC SURVEY REPORT – PSR1 (JUNE 2019)

"APPROVAL SHEET"

Prepared by:	***Signed***	***Date***
V Mehta		*17/07/2019*

Approved by:	***Signed***	***Date***
S Philip		*17/07/2019*

REVISION CONTROL

Date	Rev	Section / Page No.	Remarks
11/07/2019	0		Submitted for approval
17/07/2019	1	Sec 1, Pg 6	Second paragraph of executive summary removed.
		Sec 2, Pg 8	First and fourth paragraphs of introduction removed, minor grammatical corrections in second paragraph as suggested.
		Sec 2, Pg 10	CSP-81 shifted in figure as suggested.
		Sec 4.2, Pg 15 and 16	Boat photographs with time stamp added.
		Sec 5.1, Pg 19, Fig 5-2	Image of WRB added
		Sec 5.4, Pg 22	RTK system photograph with time stamp added.
		Sec 6.1, Pg 23	AVPPL replaced by VISL as suggested.
		Sec 6.2, Pg 26	Corrections made as suggested, legend added to Figure 6-4
		Sec 6.2, Pg 28	August 2018 replaced by June 2019.
		Sec 6.3, Pg 30	Figure 6-6 adjusted for clarity.
		Sec 6.3, Pg 31 and 32	Decimal point system amended.
		Sec 6.4, Pg 34	Correction made in CSP Nos.
		Sec 10, Pg 38	Last line of conclusions removed.

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ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
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
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
Mg/L	Milligram per litre
MoEF	Ministry of Environment & Forests
MoU	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
NTU	Nephelometric Turbidity Units
PEP	Project Execution Plan
PVD	Progressive vector diagram
PPP	Public Private Partnership
ppt	Parts per Thousand
RTK	Real Time Kinematics
SAC	Shankar And Co.
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

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	Shankar And Co, Navi Mumbai, India (SAC)
Survey Requirement	Oceanographic & Bathymetric Survey for Shoreline Monitoring
Chart Datum	Chart datum is the level to which soundings on 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 a water body moves in the ocean. The speed is denoted in cm/s
Rip Current	A relatively strong, narrow current flowing outward from the beach through the surf zone
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 in m/s
Wind Direction	Wind direction is an indicator of the direction that the wind is **blowing 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
Turbidity	Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air.

1 EXECUTIVE SUMMARY

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

① **Vizhinjam International Seaport Ltd** (VISL) - a company fully owned by Government of Kerala (GoK) 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.
(Source: https://www.vizhinjamport.in/home.html)

Shankar And Co, hereinafter referred to as SAC, based in Navi Mumbai 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 5700267194 dated 3rd May 2019 by AVPPL.

As part of the study, NIOT provided a wave rider buoy to be deployed off Mulloor and the data and watch & ward of the buoy was to be monitored by SAC.

As part of the contract, turbidity measurements at three locations from three levels is to be monitored on a real time basis from October 2019. This was decided during the kick-off meeting held at AVPPL office on 27th May 2019.

This report provides the results of the data collected from 01st to 30th June 2019.

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

The proposed project is being developed as a PPP project on a design, build, finance, operate and transfer ("DBFOT") basis in accordance with the terms and conditions set forth in the concession agreement signed between AVPPL and GoK/VISL. 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 & equipment) will be shared on 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 is located at the southern tip of India, barely 10 nautical miles from the international sea route (Suez – Far East route & Far East – Middle East route), it has the potential to become the future trans-shipment hub of the country.
(Source : https://www.vizhinjamport.in/download/Feasibility-Report.pdf)

① The study includes carrying out MetOcean observations (wave, meteorological parameters and tide) at one location, to measure current for 30 days each, at four locations, during 3 different seasons; summer (Mar-May), monsoon (June-Oct), and post monsoon (Nov-Feb), to measure in real-time turbidity from three levels and three locations, 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 and river crossing survey. All these are to be carried out for a period of 3 years commencing June 2019.

A Google Earth image, showing the Multibeam survey area; locations of the observations, including the wave/current, tide and AWS measurement location, is given in Figure 2-1. The cross-shore profile lines, the LEO points and photographic documentation points are shown in Figure 2-1.

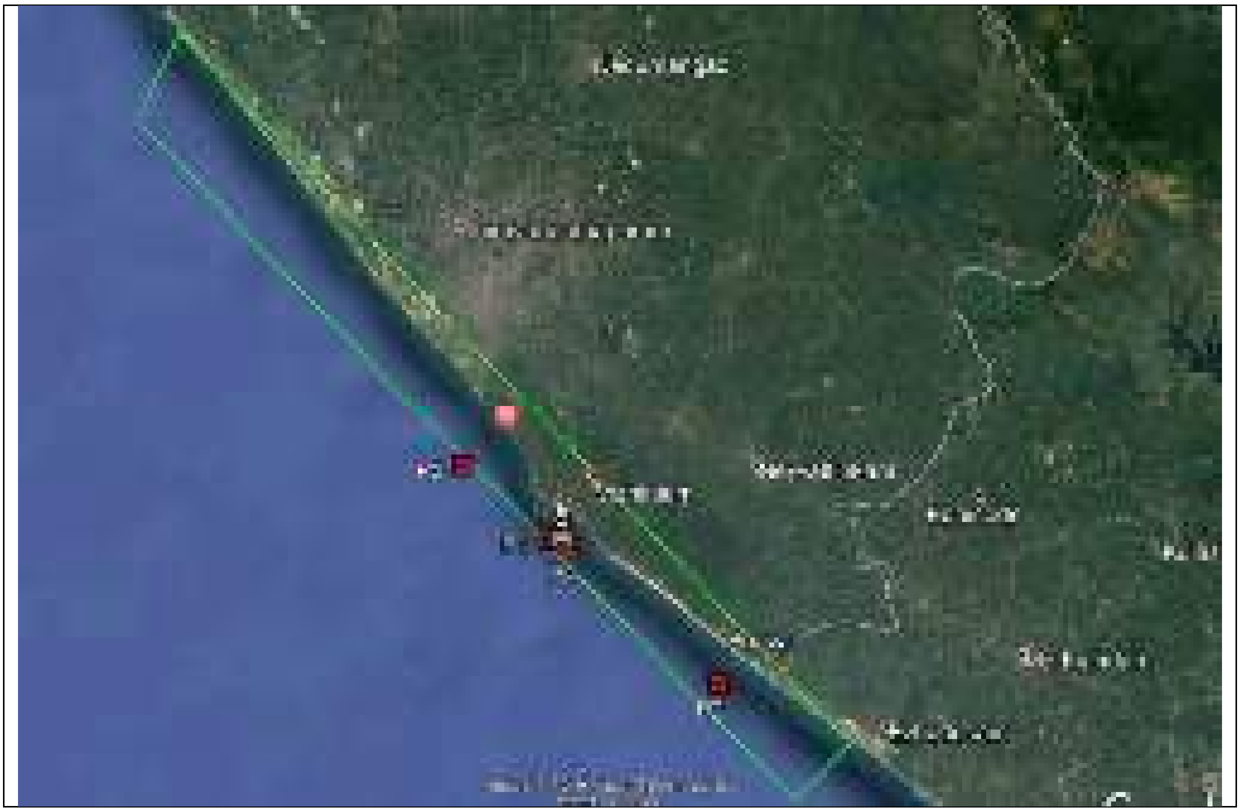


Figure 2-1: General Survey Location

P1, P2 and P3 correspond to ADCP locations and P4 corresponds to both, ADCP and wave location.

The cross-shore profiling lines, which coincides with the LEO, beach sampling and photographic documentation, 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 to the south of the existing Vizhinjam Harbour.

Figure 2-2: CSP, LEO and Photographic Documentation Locations

3 SCOPE OF WORK

The survey scope of work as provided in the RFQ and as per the contract includes 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 shoreline.
- 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 on 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.

- Collection of wind speed & direction, atmospheric pressure, humidity, temperature at 1 location specified by the client/EIC by establishing an automatic weather station.
- Continuous monitoring of turbidity at 3 location (1 upstream & 2 downstream of dredging location) - Online meter (3 levels) to be installed on buoys and data to be displayed at system in office.
- Analysis and processing of the data and submission of periodic reports in soft & hard copies.

3.1 Location Coordinates

The location co-ordinates provided by the client for the current and wave observations are given 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	21.4
ADCP/Wave - P4 (Mulloor)	08° 21' 42.3"N	76° 59' 33.9"E	23.2

Table 3-1: Current / Wave locations

The current observations are to be carried out for 30 days in each of the seasons at the above locations.

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	3.447

Table 3-2: Tide station location coordinates

The location of the weather station is 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 3-3: Weather station location coordinates

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 10m above MSL.

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 4-1: Geodetic Parameters

4.2 Survey Vessels

The following vessel was utilized for the survey operation:

Figure 4-1: Watch keeping vessel MFB Samuel

Figure 4-2: Transit vessel MFB Sindhu Yatra Matha

4.3 Personnel

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

Shankar And Co.		
Name	**Designation**	**Period**
Saju Cherian	Project Manager	Duration of Project
Unnikrishnan K.U.	Party Chief / Surveyor	01st to 30th June 2019
Arun P.K.	Surveyor / Survey Engineer	01st to 30th June 2019
Vishnu Haridas	Land Surveyor	01st to 30th June 2019
Adani Vizhinjam Port Pvt. Ltd.		
Name	**Designation**	**Period**
Hebin C.	Manager - Environment	Duration of Project

Table 4-2: Personnel

5 SURVEY EQUIPMENT DETAILS

5.1 Wave Rider Buoy

The Datawell DWR (G) wave rider buoy was deployed by NIOT in collaboration with VISL and AVPPL, under a tripartite agreement and is being monitored and maintained by Shankar And Co. 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 Ayur Bay resort.

The system consists of wave rider buoy (DWR G make) with HF whip/LED flasher, GPS antenna, 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 are 1.5° within the range of 0° to 360°.

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

5.1.1 Principles of wave measurement

The GPS wave buoy measurement principle bears a strong analogy with the Doppler-shift phenomenon of a car passing nearby, 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.

5.1.2 Instrument Mooring

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:

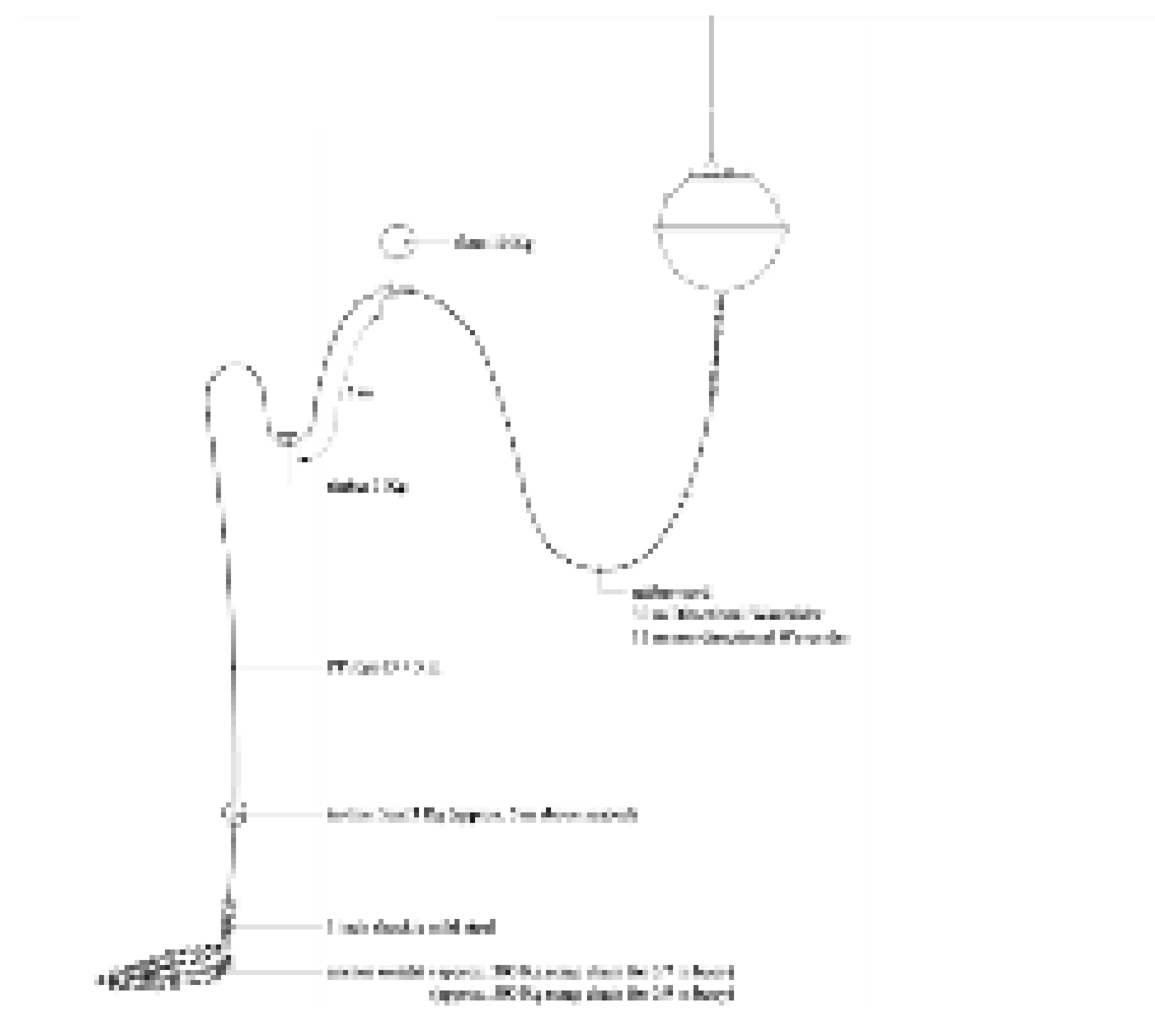


Figure 5-1: WRB Mooring Diagram

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.

The image of WRB deployed at the location is provided below:

Figure 5-2: WRB deployed at site

5.2 Automatic Tide Gauge

An EMCON automatic tide gauge was installed near the Coast Guard jetty, inside the fishing harbour for measuring the tides. The tide gauge is a capacitance-based instrument, measuring the water level due to change in capacitance on the surface of sensor. The sensor was installed on a 2.5m long pipe to ensure that the zero of sensor is always in water, irrespective of the phases of tide. This was levelled to the local benchmark, situated on top of the jetty. The tide station was programmed to measure the tide at 5-minute intervals throughout the duration of the project.

A photograph of the tide gauge location is provided below:

Figure 5-3: Tide Gauge

5.3 Automatic Weather Station (AWS)

An EMCON Automatic Weather Station (AWS) was installed atop Ayur Bay Resort at Nellikunnu. The system measures wind speed/direction, atmospheric pressure, temperature and relative humidity.

The system consists of the following:

- 3 cup anemometer
- Wind wane
- Relative humidity & temperature sensor
- Pressure sensor
- Datalogger

The data is logged in a data logger installed at the receiving station at intervals of 10 minutes. The data is also transmitted from the data logger to a cloud bases server for further processing and QC checks.

An image of automatic weather station is provided below:

Figure 5-4: AWS on toop of Ayur Bay Resort, Nellikunnu (Mulloor)

5.4 Real Time Kinematic (RTK) Survey

An RTK system was mobilized at site to carry out cross-shore profiling on the landward side. The system used was a Geomax Zenith 10/20 RTK system with base station and rover. A photograph of the system is provided below:

Figure 5-5: RTK System with base station and rover

6 SURVEY RESULTS

6.1 Tidal Measurements

① The tides were observed near the Coast Guard jetty. 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 3.447 above chart datum. An image of the TBM is provided below:

Figure 6-1: Location of TBM

The offset calculation of tide gauge based on the 'jetty top' value is given in the image below:

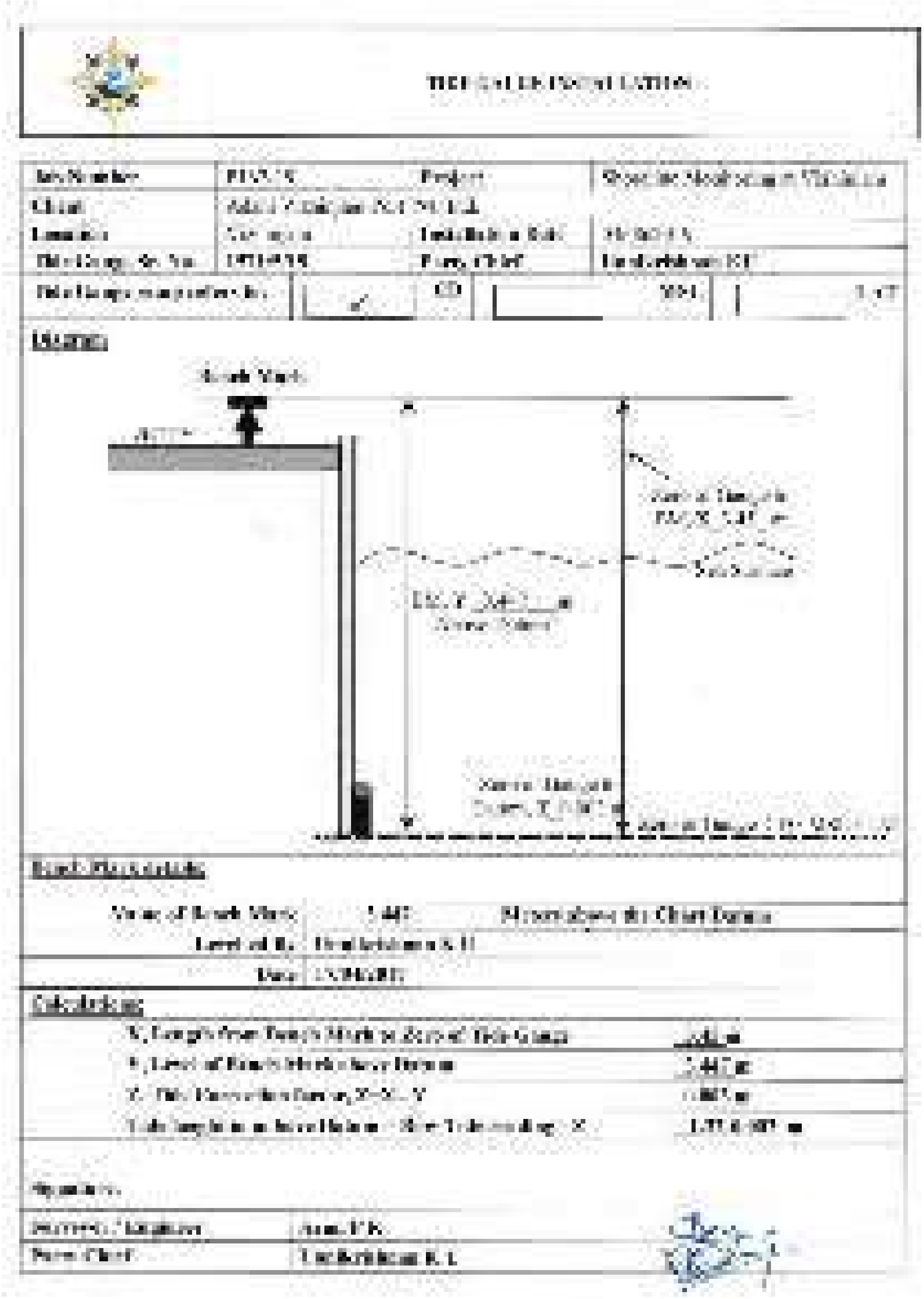
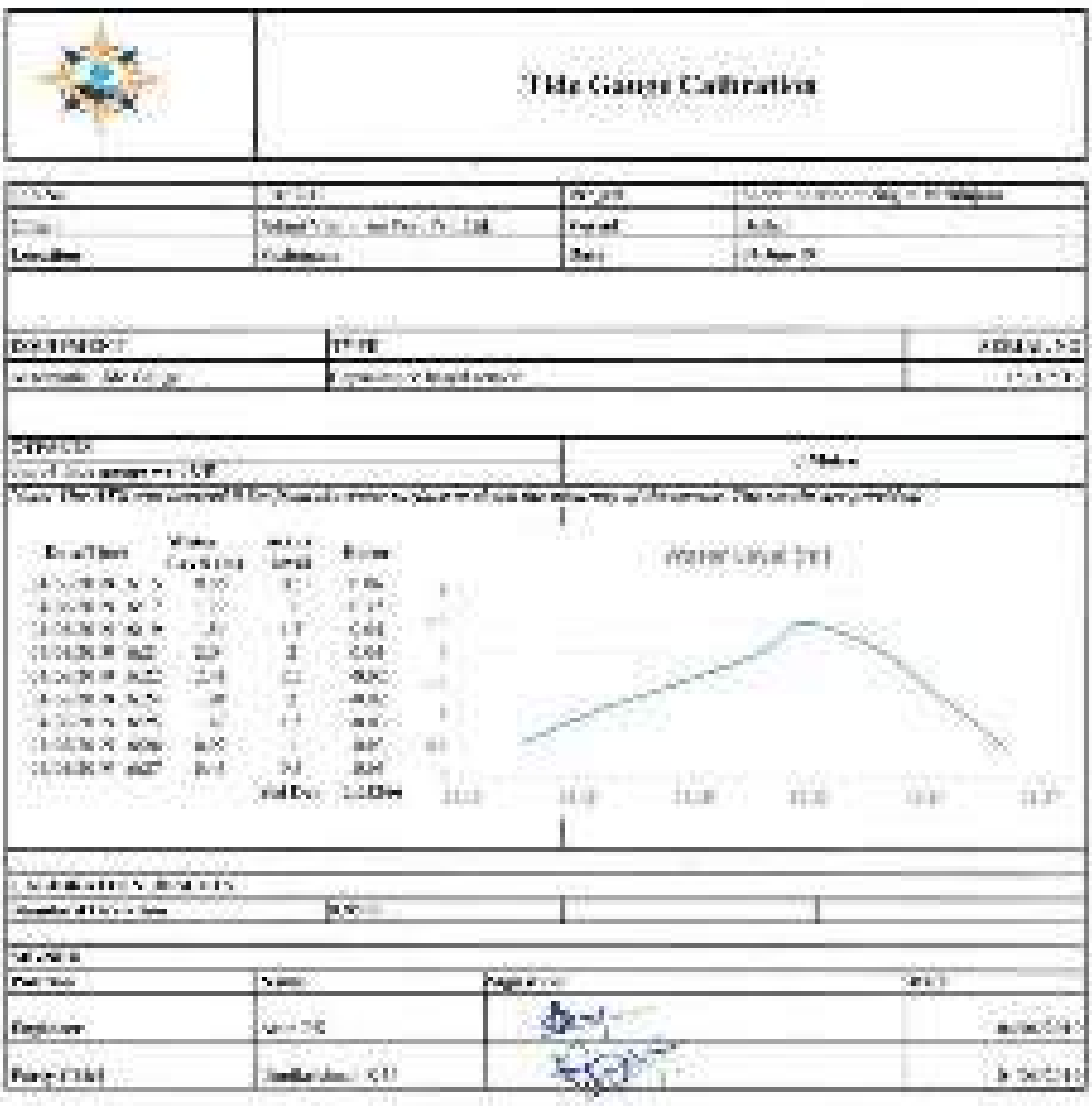


Figure 6-2: Offset Diagram of Tide Gauge

The calibration carried out at site is provided in the follolwing image:



Tide Gauge Calibration

Figure 6-3: Calibration of Tide Gauge at site

The tides observed are mixed semi-diurnal in nature, with the maximum range being observed in the springs.

The tide data collected is placed in Annexure I.

6.2 Wave Measurements

The data from the WRB (provided by NIOT) was downloaded and processed to produce the time series and rose diagram, which are provided below:

Refer to the following rose plot of significant height (Hs) v/s direction for the period of 01st to 30th June 2019:

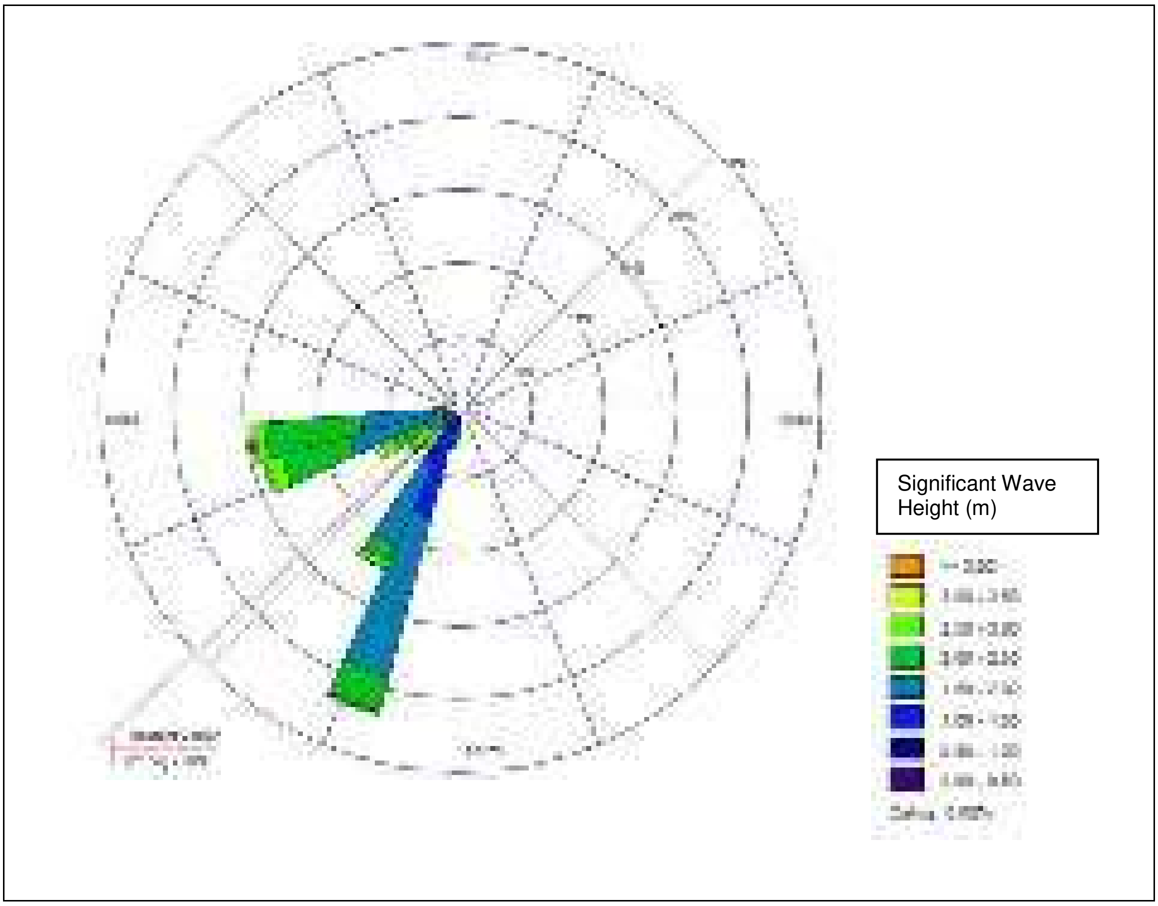


Figure 6-4: Wave Rose (Hs in metre v/s Direction) from 1st to 30th June 2019

The wave direction was south-southwesterly to westerly during the period with wave heights less than 3.5 m. As can be seen in the rose plot above, the significant wave heights were more than 2m in the west of south-westerly direction, due to the onset of monsoon.

A maximum significant wave height of 3.49 m was recorded on 11th June 2018 at 22:29 hrs.

The frequency distribution table and histogram are 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	0	0.00	0	0.00
1.0 - 1.5	631	45.89	3	0.22
1.5 - 2.0	520	37.82	146	10.60
2.0 - 2.5	124	9.02	294	21.35
2.5 - 3.0	98	7.13	464	33.70
3.0 - 3.5	2	0.15	273	19.83
> 3.5	0	0.00	197	14.31
Total	**1335**	**100**	**1377**	**100.000**

Table 6-1: Frequency distribution of wave height (1st June to 30th June 2019)

The histogram of significant wave height during the observation period of June 2019 is given below:

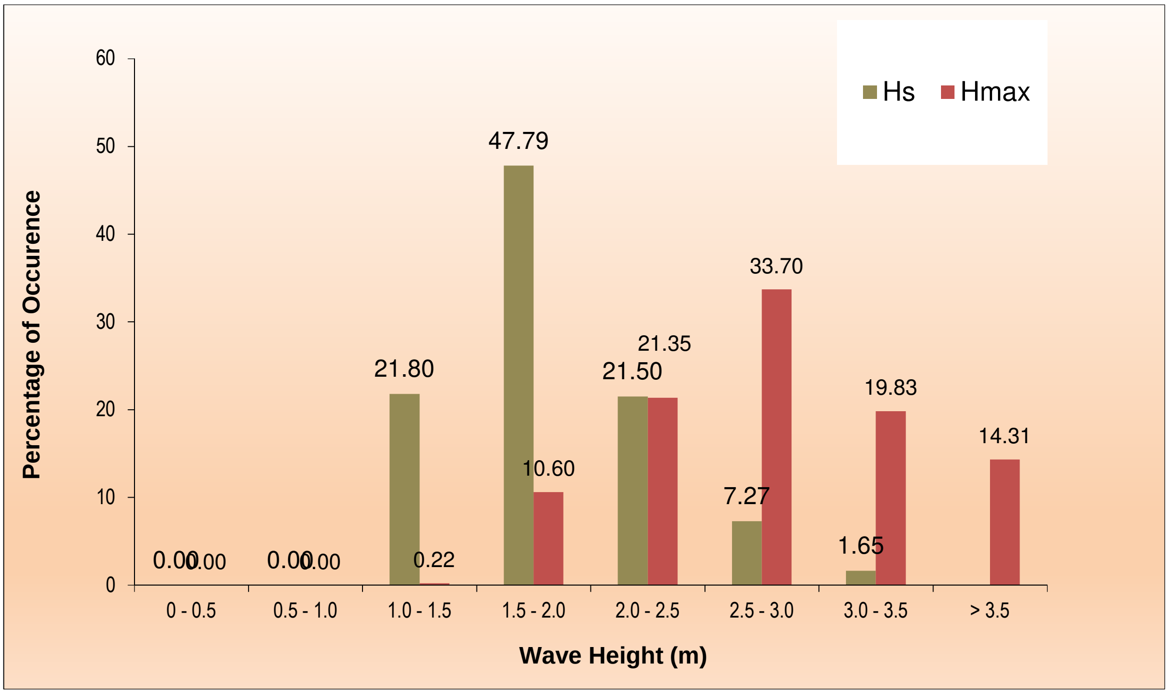


Figure 6-5: Histogram of wave height from 1st to 30th June 2019

As can be seen from the above histogram, about 30% of the observation of significant wave height was greater than 2m.

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

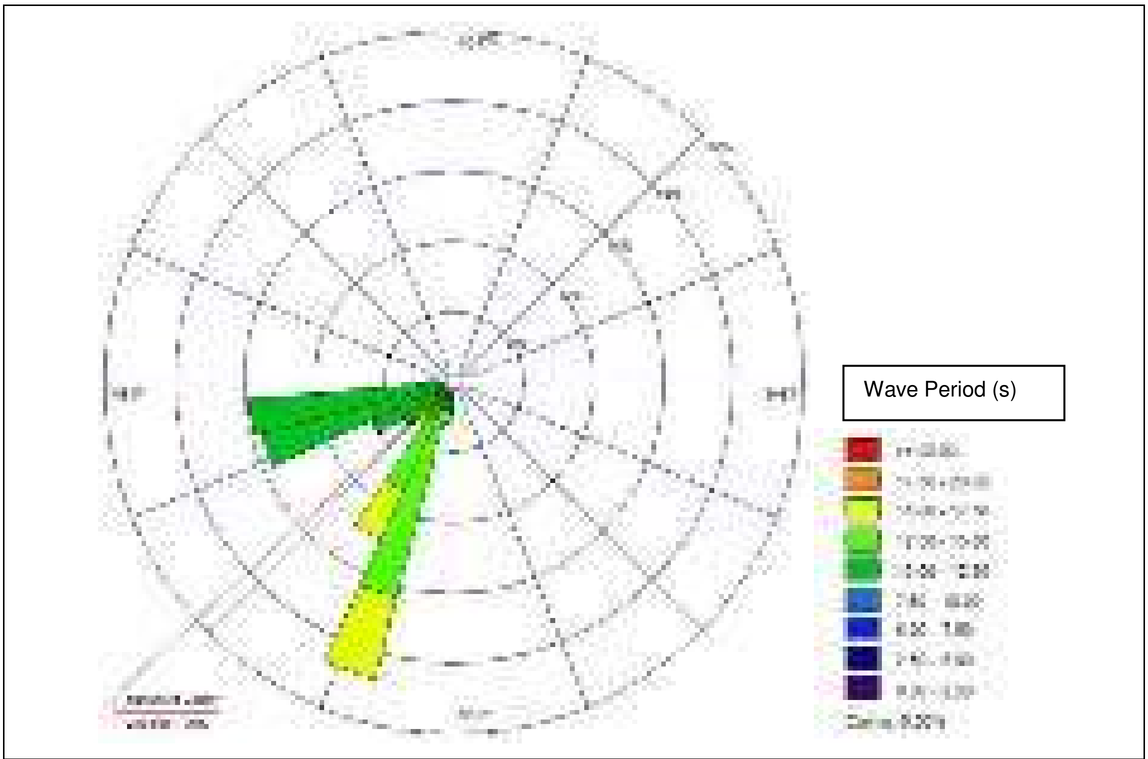


Figure 6-6: Wave Rose (Tp vs direction) from 1st to 30th June 2019

① The histogram drawn for wave period for June 2019 is given below:

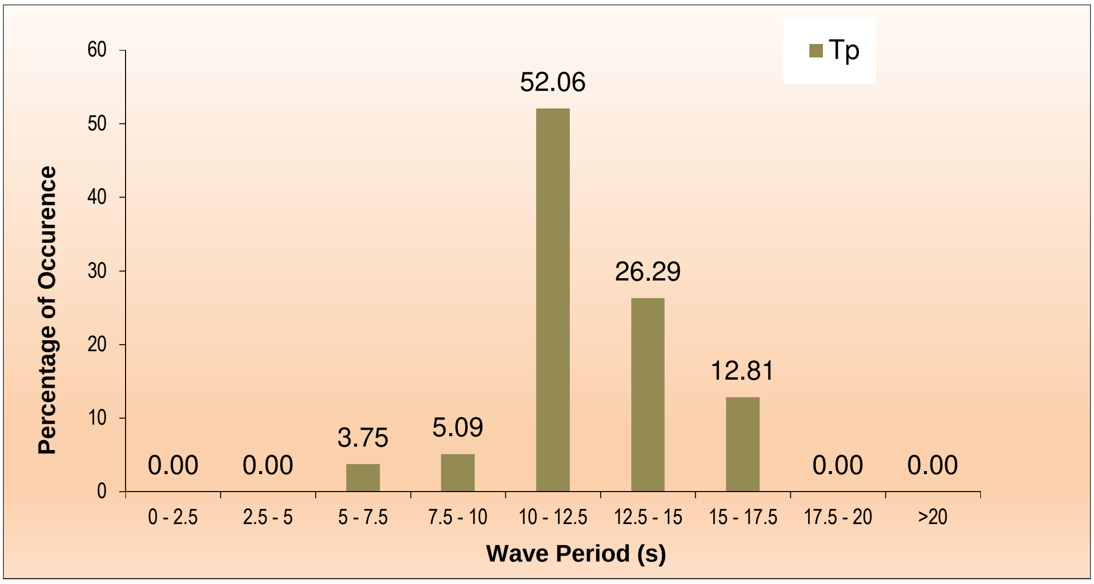


Figure 6-7: Histogram of wave period from 1st to 30th June 2019

The above image indicates that during the period of observation, the wave period was in the range of 5 to 17.5 seconds, with 91% of the observations indicating long waves with a period of more than 10 seconds. The maximum period of 16.67 seconds was recorded on 29th June 2018 at 22:25 hours.

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

6.3 Measurement of Meteorological Parameters

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

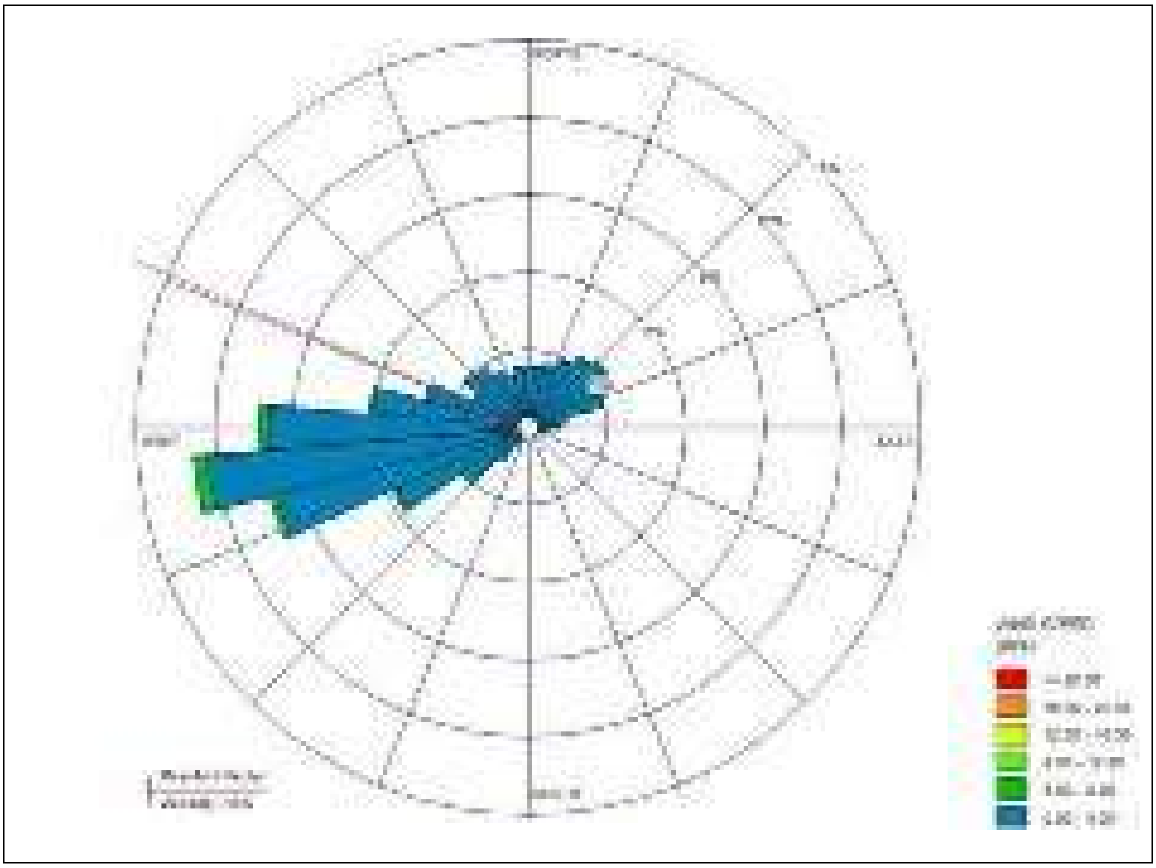


Figure 6-8: Wind rose (Speed in m/s vs direction) from 4th to 30th June 2019

The rose plot reveals south-westerly to north-northeasterly winds with velocities up to 7.65m/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 – 4	3274	97.18
4 – 8	95	2.82
8 - 12	0	0.00
12 – 16	0	0.00
16 - 20	0	0.00
>20	0	0.00
Total	**3369**	**100.00**

Table 6-2: Frequency distribution of wind speed (4th June to 30th June 2019)

The histogram of wind speed for the period is provided below:

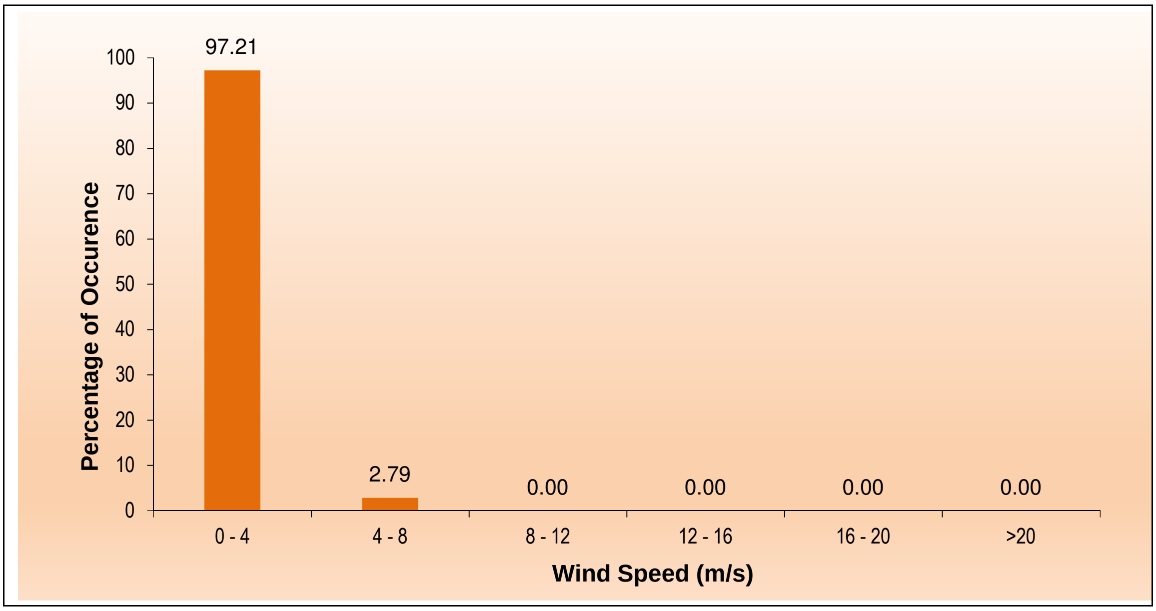


Figure 6-9: Histogram of wind speed from 4th to 30th June 2019

As can be seen from the above histogram, the winds were less than 8 m/s throughout the period. The maximum wind speed in the month of June 2019 was 7.65 m/s, recorded on 8th June 2019 at 07:30 hrs.

The percentage occurrence tables drawn for atmospheric pressure, temperature and relative humidity are presented below:

Frequency Distribution		
Atm Pressure	**No. of observations**	**Percentage of Occurrence**
<1000	0	0.00
1000 - 1004	992	29.47
1004 - 1008	2374	70.53
> 1008	0	0.00
Total	**3366**	**100.00**

Frequency Distribution		
Temperature	**No. of observations**	**Percentage of Occurrence**
20-24	0	0.00
24-28	922	27.37
28-32	2447	72.63
>32	0	0.00
Total	**3369**	**100.00**

Frequency Distribution		
RH	**No. of observations**	**Percentage of Occurrence**
50-60	10	0.30
60-70	78	2.31
70-80	763	22.69
>80	2512	74.70
Total	**3363**	**100.00**

Table 6-3: Frequency distribution of Met parameters (4th June to 30th June 2019)

The histogram drawn for the parameters for the period is provided below:

Figure 6-10: Histogram of Met parameters from 4th to 30th June 2019

The data represented above reveals that about 99% of the atmospheric pressure recorded for the month was between 1000mb and 1004 mb. The temperature was between 24 to 32°C during the month. The relative humidity was greater than 80% during 74.7% of the observations indicating monsoonal conditions.

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

6.4 Littoral Environment Observations

The LEO was carried out at 81 locations. The LEO plate was deployed at all the locations and the same was tracked for about five to ten minutes, as per the site conditions. The initial and final GPS positions were then used to calculate the SOG and COG. The estimated wave height, angle of wave, period and the stretch of breakers were also noted down in the log. The data sheets for all the locations are placed at Annexure IV.

① The along shore current was mainly towards the south during the period of monitoring. The maximum speed of 63.56 cm/s was observed at CSP-34. Rip currents were observed in the locations CSP 37,41,42,43,45,46,47,57,58,60,62,64,65,66,69,71,72,73 and 74.

6.5 Photographic Documentation

Photographic documentation was carried out for all the 81 locations, coinciding with the cross-shore profiling. The photographs for the period are placed at Annexure V. As a common reference point, a 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. As the monsoon commenced, the beaches were almost inundated with sea water and vast stretches of the shoreline were engulfed by waves. Most of the area near Vallavilay and Valiyathura; the damage has been extensive.

6.6 Cross Shore Profiles

The cross-shore profiling for the period was carried out using RTK in the onshore region. In the wave breaker area, no data could be acquired and hence that area is shown in 'dashed line', in the enclosed AutoCAD/PDF charts. At the locations CSP-6 (Vallavilay) and CSP-65 (Valiyathura), even the onshore profiles could not be carried out to massive destruction due to the wave action.

The offshore profiling could not be carried out during the month of June 2019, due to rough weather conditions.

The following table provides the identification of CSP vis-à-vis the local name:

CSP NO.	LANDMARK	LOCATION
CSP-01	CATHOLIC CRISMATIC PRAYER CENTER	EDAPPADU BEACH
CSP-02		
CSP-03		
CSP-04	ST. MARY'S CHURCH	VALLAVILAY
CSP-05		
CSP-06		
CSP-07	ST. NICOLAS' CHURCH	NEERODY
CSP-08		
CSP-09		
CSP-10	SREE BHADRAKALI TEMPLE	POZHIYOOR
CSP-11		
CSP-12		
CSP-13	ST. MATHEW'S CHURCH	PARUTHIYOOR
CSP-14	CHURCH OF CHRIST	
CSP-15	POOVAR ISLAND RESORT	POOVAR BEACH SOUTH
CSP-16		
CSP-17		
CSP-18	POZHIKARA BEACH	POOVAR
CSP-19		
CSP-20	ST. ANTONY'S CHAPEL	POOVAR BEACH NORTH
CSP-21		
CSP-22	ST. ANTONY'S CHURH	KARUMKULAM
CSP-23		
CSP-24		
CSP-25		
CSP-26		
CSP-27	GOTHAMBU ROAD	PULLUVILA
CSP-28		
CSP-29		
CSP-30		
CSP-31	ADIMALATHURA CATHOLIC CHURCH	ADIMALATHURA
CSP-32		
CSP-33		
CSP-34		
CSP-35	AZHIMALA TEMPLE	AZHIMALA
CSP-36	NAGAR BHAGAVATHY TEMPLE	MULLUR
CSP-37		

CSP NO.	LANDMARK	LOCATION
CSP-38	ADANI PORT RECLAMATION AREA	ADANI PORT OFFICE VIZHINJAM
CSP-39		
CSP-40		
CSP-41	VIZHINJAM LIGHT HOUSE	KOVALAM
CSP-42		
CSP-43		
CSP-44		
CSP-45		
CSP-46		
CSP-47	SAMUDRA BEACH PARK	KOVALAM
CSP-48	MOSQUE	PANATHURA
CSP-49		
CSP-50	PANATHURA TEMPLE	PANATHURA
CSP-51		
CSP-52		
CSP-53	PUNTHURA FISH MARKET	PUNTHURA
CSP-54		
CSP-55		
CSP-56		
CSP-57		
CSP-58	BEEMA PALLY	BEEMA PALLY
CSP-59		
CSP-60		
CSP-61	CHERIYATHURA SPORTS GROUND	CHERIYATHURA
CSP-62		
CSP-63	VALIYATHURA BRIDGE	VALIYATHURA
CSP-64		
CSP-65		
CSP-66		
CSP-67		
CSP-68	SHANGUMUGHAM BEACH	SHANGUMUGHAM
CSP-69		
CSP-70	ST. PETER'S CHURCH	SHANGUMUGHAM
CSP-71		
CSP-72	VETTUCAUD CHURCH	VETTUCAUD
CSP-73		
CSP-74		
CSP-75	VELI CHILDRENS PARK	KOCHUVELI
CSP-76		
CSP-77		

CSP NO.	LANDMARK	LOCATION
CSP-78	ST. THOMAS' CHURCH	VALIYA VELI
CSP-79		
CSP-80	CHRISTIAN BROTHEREN CHURCH	THUMBA
CSP-81		

Table 6-4: CSP Location names

The cross-shore profiles for the full period are placed in Annexure VI.

7 OVERALL PROGRESS

Up to 30th June 2019, the following image provides the overall progress chart.

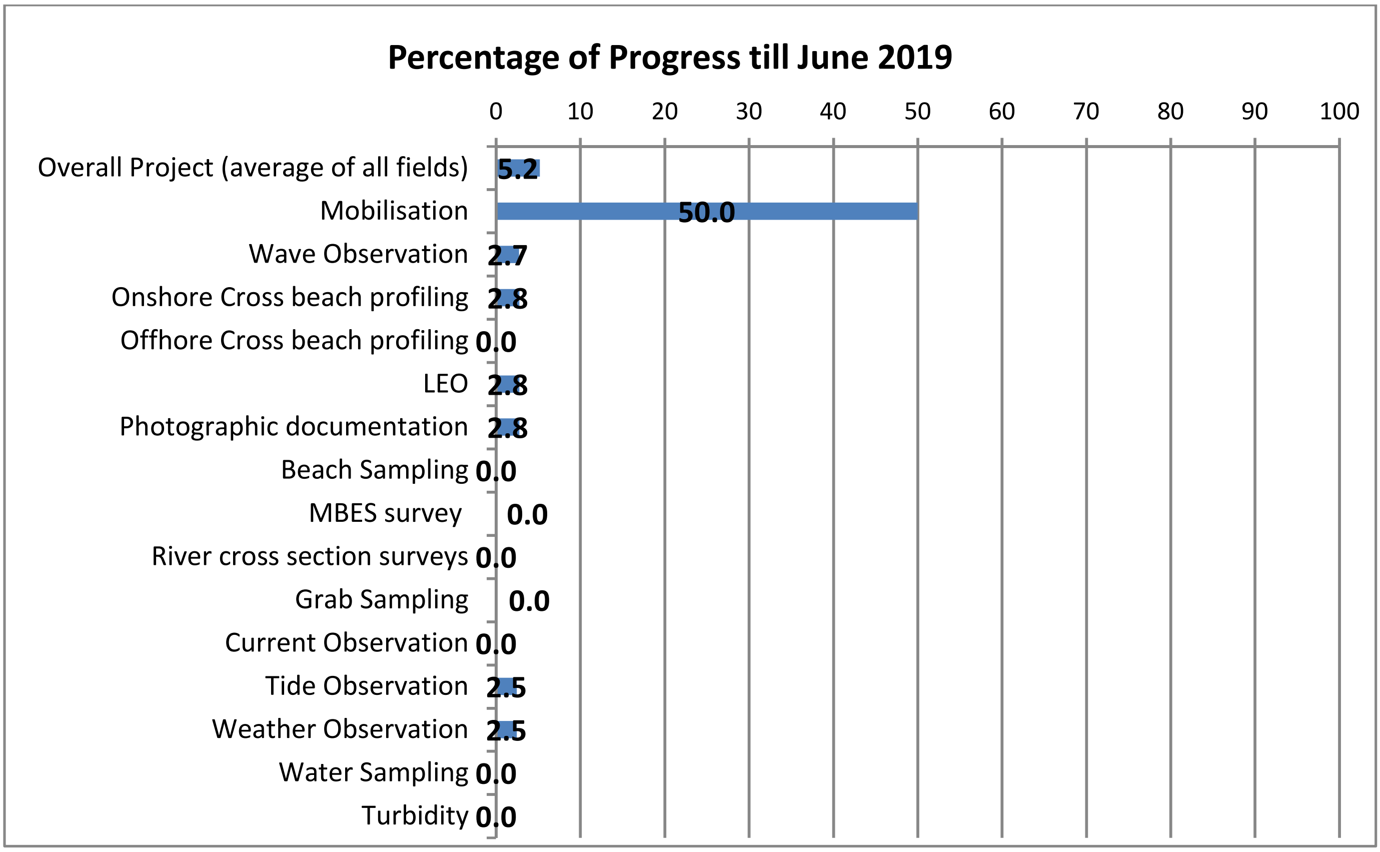


Figure 7-1: Overall Progress Chart

The above calculation is based on number of observations for 3 years. Since the turbidity buoys are not mobilised, the field is shown as 50%.

8 WEATHER

During the survey period, the monsoon had hit the Kerala coast and accordingly sea was rough to carry out any offshore works. The offshore cross shore profiles could not be carried out due to rough sea conditions, considering the safety of personnel and equipment.

9 REFERENCES

The following documents/web sites were referenced during the preparation of the report.

- AVPPL Service order 5700267194 dated 3rd May 2019
- Web site https://www.vizhinjamport.in/home.html, and https://www.vizhinjamport.in/download/Feasibility-Report.pdf
- WMO manual, section 5.2.2
- SAC Project Execution Plan SAC/P167-19/PEP AVPPL

10 CONCLUSIONS

The following conclusions were made during this phase of the project:

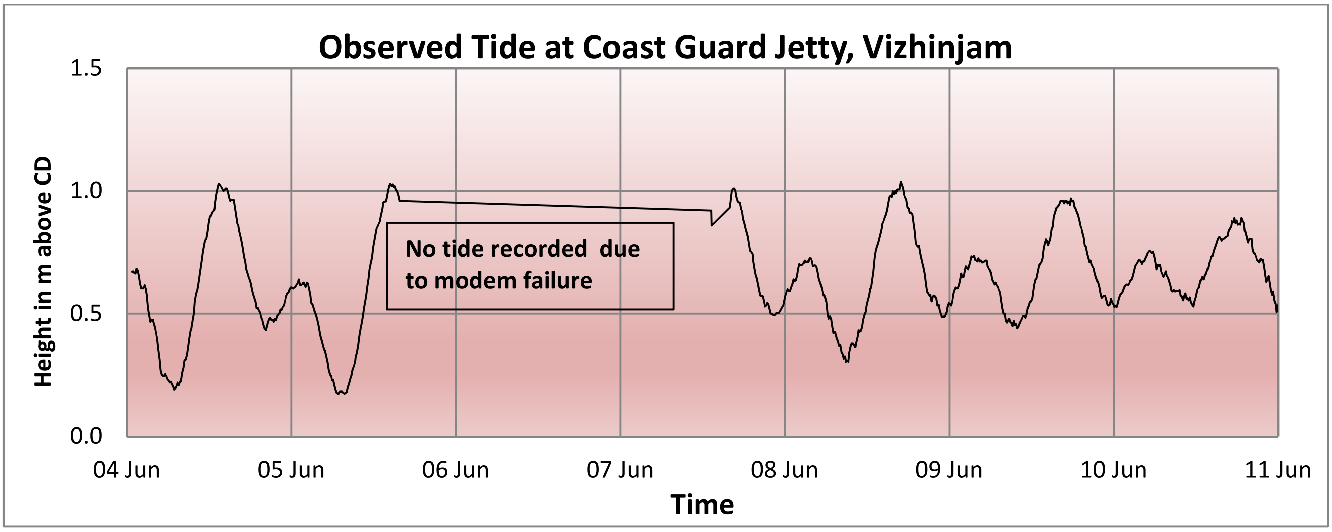
1. Tide was mixed semi diurnal with a maximum range of 1.15 m during spring tide.
2. The wave heights were less than 3.5m with winds of up to 9 m/s blowing from north-westerly direction.
3. The long-shore transport was recorded in a southerly direction, with maximum velocity of about 63.56 cm/s recorded at CSP-34.

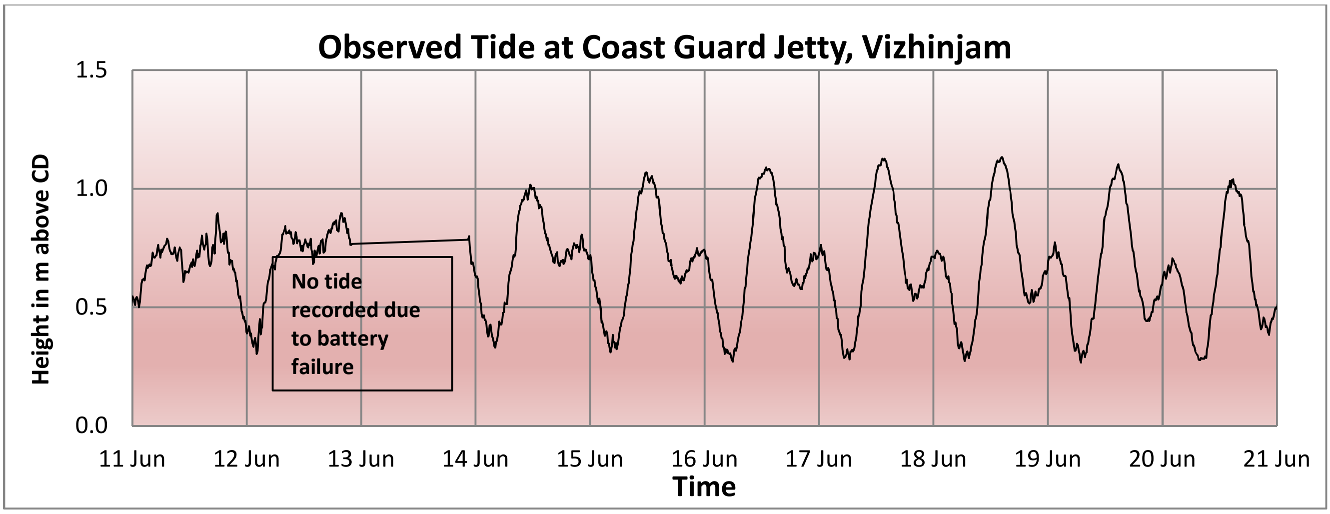
11 ACKNOWLEDGEMENTS

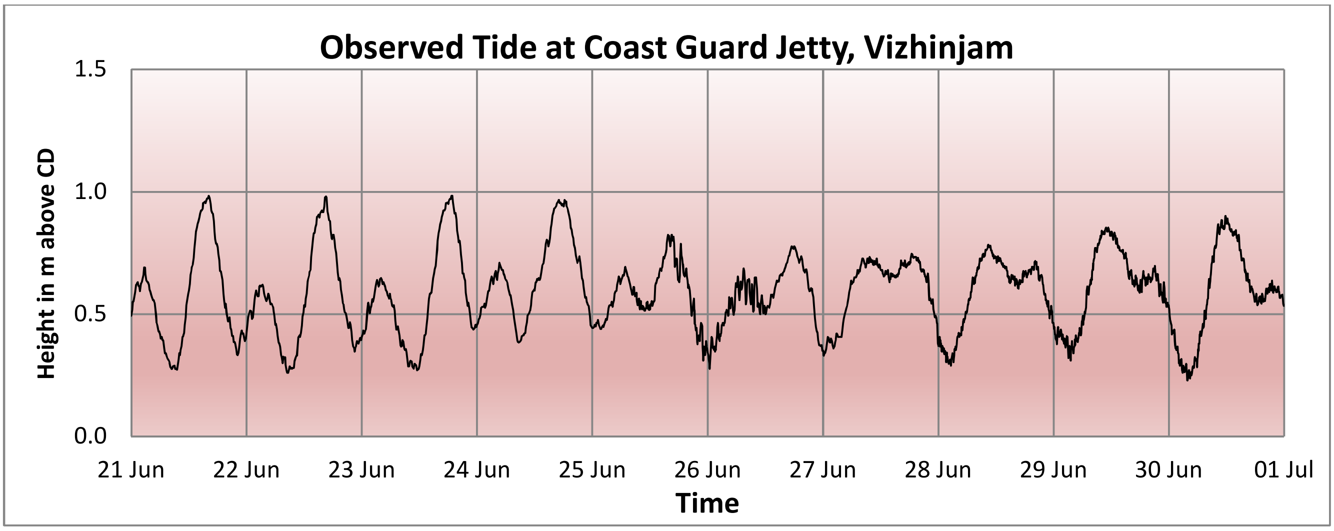
During the course of project, the support received from AVPPL staff is highly appreciated and acknowledged. The guidance received throughout the project from NIOT scientists are also hereby appreciated. The boat crew and all others, who had supported us during the project is also acknowledged.

Annexure I

Tide Curves - June 2019

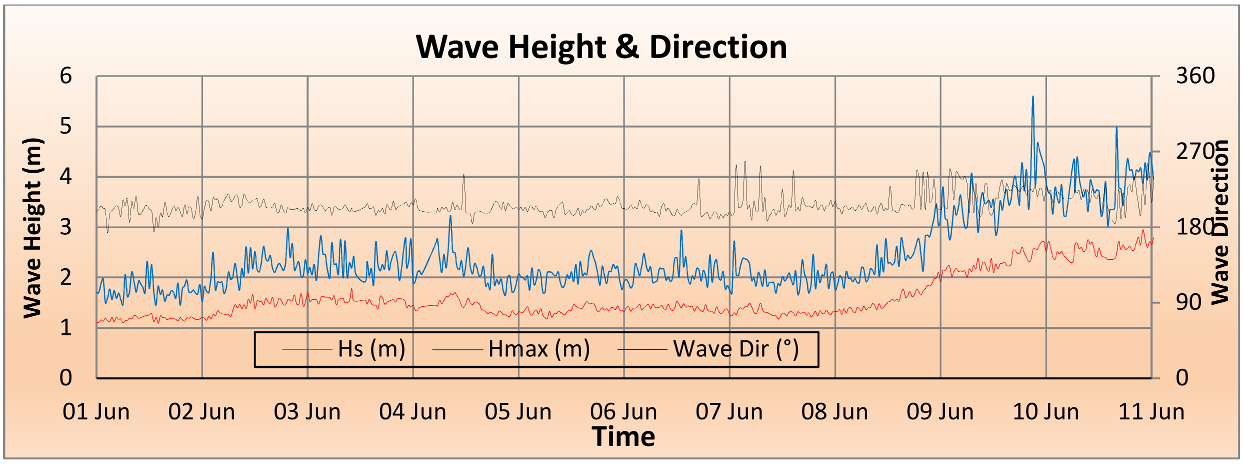

Observed Tide at Coast Guard Jetty, Vizhinjam
Height in m above CD
1.5
1.0
0.5
0.0
No tide recorded due to modem failure
04 Jun
05 Jun
06 Jun
07 Jun
08 Jun
09 Jun
10 Jun
11 Jun
Time

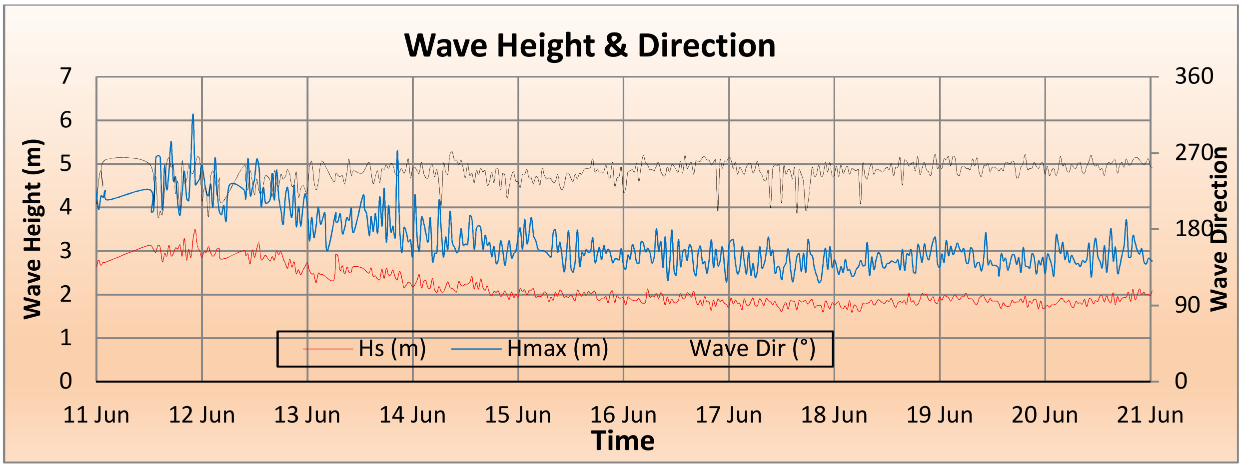

Observed Tide at Coast Guard Jetty, Vizhinjam
Height in m above CD
1.5
1.0
0.5
0.0
No tide recorded due to battery failure
11 Jun
12 Jun
13 Jun
14 Jun
15 Jun
16 Jun
17 Jun
18 Jun
19 Jun
20 Jun
21 Jun
Time

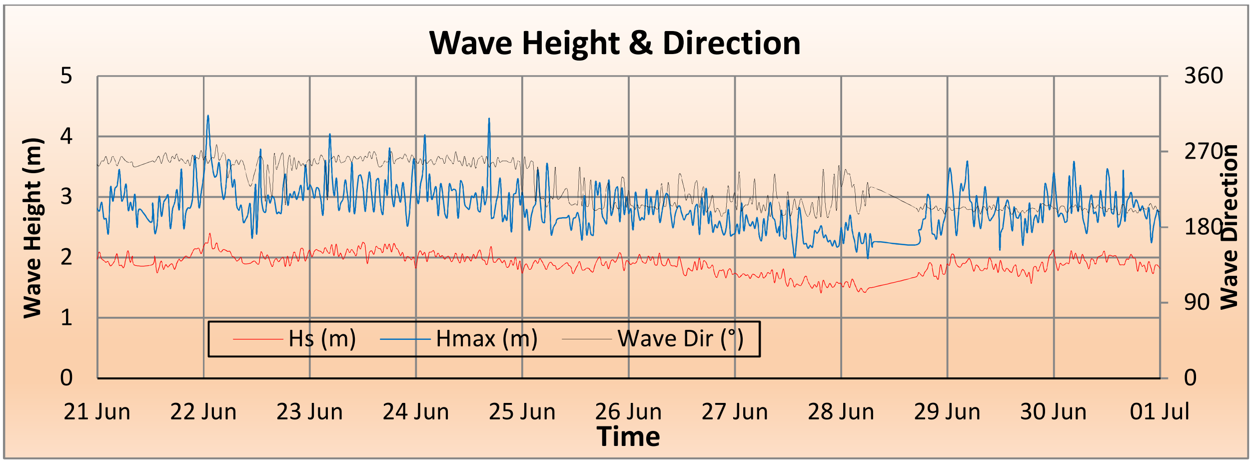

Observed Tide at Coast Guard Jetty, Vizhinjam
Height in m above CD
1.5
1.0
0.5
0.0
21 Jun
22 Jun
23 Jun
24 Jun
25 Jun
26 Jun
27 Jun
28 Jun
29 Jun
30 Jun
01 Jul
Time

Annexure II

Wave Data - June 2019

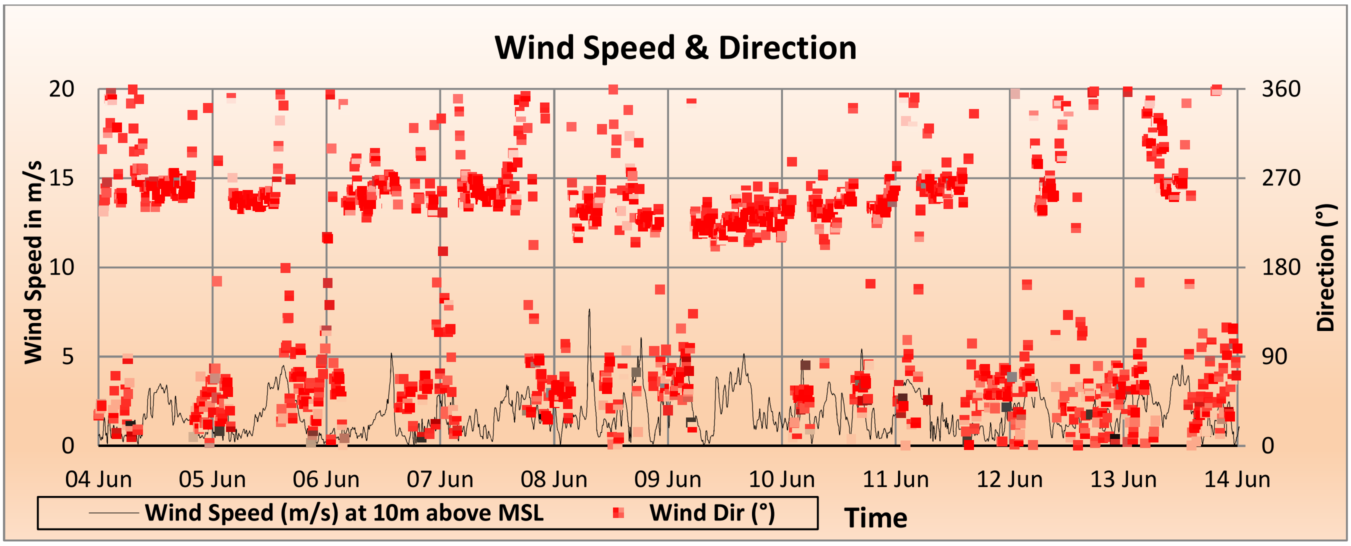

Wave Height & Direction
Wave Height (m)
6
5
4
3
2
1
0
360
270
180
90
0
Wave Direction
Hs (m)
Hmax (m)
Wave Dir (°)
01 Jun
02 Jun
03 Jun
04 Jun
05 Jun
06 Jun
07 Jun
08 Jun
09 Jun
10 Jun
11 Jun
Time

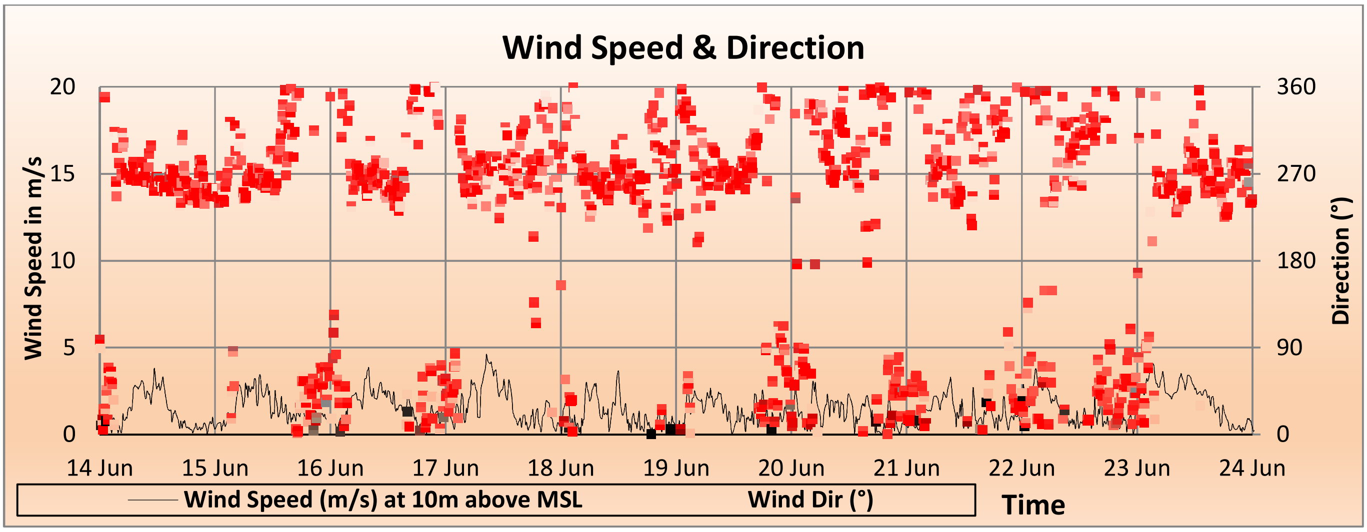

Wave Height & Direction
Wave Height (m)
7
6
5
4
3
2
1
0
360
270
180
90
0
Wave Direction
Hs (m)
Hmax (m)
Wave Dir (°)
11 Jun
12 Jun
13 Jun
14 Jun
15 Jun
16 Jun
17 Jun
18 Jun
19 Jun
20 Jun
21 Jun
Time

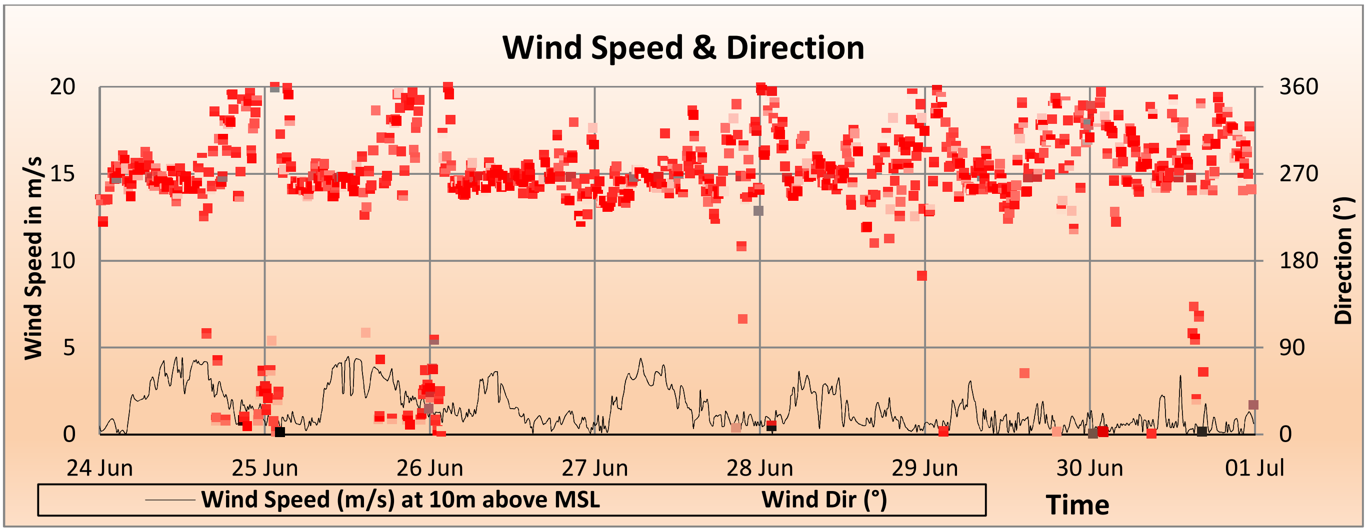

Wave Height & Direction
Wave Height (m)
Wave Direction
0
1
2
3
4
5
0
90
180
270
360
21 Jun
22 Jun
23 Jun
24 Jun
25 Jun
26 Jun
27 Jun
28 Jun
29 Jun
30 Jun
01 Jul
Time
Hs (m)
Hmax (m)
Wave Dir (°)

Annexure III

Wind Data - June 2019


Wind Speed & Direction
Wind Speed in m/s
Direction (°)
20
15
10
5
0
360
270
180
90
0
04 Jun
05 Jun
06 Jun
07 Jun
08 Jun
09 Jun
10 Jun
11 Jun
12 Jun
13 Jun
14 Jun
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
14 Jun
15 Jun
16 Jun
17 Jun
18 Jun
19 Jun
20 Jun
21 Jun
22 Jun
23 Jun
24 Jun
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
24 Jun
25 Jun
26 Jun
27 Jun
28 Jun
29 Jun
30 Jun
01 Jul
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

Annexure IV

LEO Data - June 2019

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									
				Northing	Easting	Northing	Easting								
15/06/2019	CSP-1	10:25	10:30	914451.5	734902.1	914446.1	734905.0	2.03	298	L	90	1.5	10	5	Rotary motion due to seawall
15/06/2019	CSP-2	10:40	10:45	914781.4	734507.6	914802.8	734479.7	11.70	142	R	100	1	10	10	
15/06/2019	CSP-3	10:53	10:58	915041.1	734082.6	915044.8	734077.0	2.25	146	R	100	1.5	10	5	Rotary motion due to seawall
15/06/2019	CSP-4	11:27	11:32	915331.4	733672.2	915335.2	733665.5	2.56	150	R	90	1.5	12	5	Rotary motion due to seawall
15/06/2019	CSP-5	11:42	11:47	915626.1	733262.3	915638.0	733249.0	5.93	138	R	100	1.5	10	5	
15/06/2019	CSP-6	11:56	12:01	915918.9	732853.1	915921.5	732849.3	1.52	146	R	100	1.5	12	5	Rotary motion due to seawall
15/06/2019	CSP-7	12:14	12:19	916212.6	732448.8	916215.3	732443.8	1.91	152	R	100	1.5	12	5	Rotary motion due to seawall
15/06/2019	CSP-8	12:27	12:32	916498.9	732041.7	916501.5	732035.5	2.24	157	R	95	1.5	12	5	Rotary motion due to seawall
15/06/2019	CSP-9	12:41	12:46	916795.4	731638.5	916788.0	731647.4	3.84	320	L	95	1.5	12	5	Rotary motion due to seawall
15/06/2019	CSP-10	13:06	13:11	917097.0	731238.9	917093.5	731243.9	2.06	325	L	100	1.5	12	10	Rotary motion due to seawall
15/06/2019	CSP-11	13:18	13:23	917390.9	730833.1	917380.8	730847.0	5.70	324	L	100	1.5	12	15	
15/06/2019	CSP-12	13:27	13:32	917584.2	730565.6	917552.6	730611.0	18.43	325	L	100	1.5	12	25	
15/06/2019	CSP-13	13:40	13:45	917883.7	730164.7	917861.8	730197.4	13.12	326	L	100	1.5	12	25	
16/06/2019	CSP-14	09:05	09:10	918179.8	729757.9	918142.2	729807.8	20.81	323	L	100	2	12	20	
16/06/2019	CSP-15	09:35	09:40	918470.0	729352.2	918448.8	729385.9	13.30	328	L	100	2	12	20	
16/06/2019	CSP-16	11:00	11:05	918808.6	728971.9	918816.8	729014.7	14.54	11	L	95	1	12	20	
16/06/2019	CSP-17	10:35	10:40	919075.7	728558.3	919026.0	728614.9	25.10	319	L	95	2	12	20	
14/06/2019	CSP-18	12:30	12:35	919395.7	728173.4	919370.7	728206.2	13.77	323	L	95	2	12	20	
14/06/2019	CSP-19	12:15	12:20	919699.9	727775.7	919669.1	727817.3	17.25	323	L	95	2	12	15	
14/06/2019	CSP-20	12:00	12:05	919998.1	727372.8	919972.0	727408.7	14.81	324	L	95	2	12	15	
12/06/2019	CSP-21	12:10	12:15	920291.2	726974.6	920256.4	727020.9	19.32	323	L	95	2	13	15	
12/06/2019	CSP-22	11:55	12:00	920605.3	726578.3	920547.8	726648.9	30.35	321	L	95	2	13	15	
12/06/2019	CSP-23	11:45	11:50	920922.7	726189.7	920879.0	726242.4	22.81	320	L	95	2	13	15	
12/06/2019	CSP-24	11:35	11:40	921251.2	725797.4	921177.8	725885.4	38.20	320	L	95	2	13	20	
12/06/2019	CSP-25	11:25	11:30	921567.3	725416.5	921519.2	725474.9	25.22	321	L	95	2	13	20	
12/06/2019	CSP-26	11:15	11:20	921881.6	725033.1	921820.6	725109.2	32.51	321	L	95	2	12.5	20	
12/06/2019	CSP-27	11:05	11:10	922188.4	724648.8	922131.0	724726.2	32.12	323	L	90	2	12.5	20	
12/06/2019	CSP-28	10:45	10:50	922501.6	724252.2	922463.1	724305.4	21.92	324	L	95	2.5	12	20	
12/06/2019	CSP-29	10:25	10:30	922790.9	723851.9	922761.6	723892.8	16.75	324	L	95	2.5	12	20	
12/06/2019	CSP-30	10:10	10:15	923069.2	723468.8	923038.1	723509.2	17.01	322	L	95	2.5	12	15	
16/06/2019	CSP-31	13:40	13:45	923350.4	723062.0	923308.6	723123.8	24.89	326	L	90	2.5	11	15	

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									
				Northing	Easting	Northing	Easting								
16/06/2019	CSP-32	13:20	13:25	923641.0	722626.2	923595.4	722697.0	28.09	327	L	90	2.5	11	15	
16/06/2019	CSP-33	13:05	13:10	923883.4	722248.2	923853.0	722302.6	20.77	331	L	90	2.5	11	15	
16/06/2019	CSP-34	12:40	12:45	924136.7	721801.9	924049.7	721971.6	63.56	333	L	90	1.5	11	15	
08/06/2019	CSP-35	09:00	09:05	924298.3	721419.0	924295.3	721423.9	1.90	329	L	90	1.5	13.1	15	Rocky area
18/06/2019	CSP-36	12:20	12:25	924800.6	721103.1	924775.1	721126.0	11.44	312	L	90	1.5	13.1	15	
08/06/2019	CSP-37	10:05	10:10	925157.4	720775.5	925151.2	720779.8	2.52	305	L	90	1.5	13.1	15	Rip Current
18/06/2019	CSP-38	14:00	14:05	925564.6	720340.7	925554.9	720351.2	4.76	318	L	90	1.5	13	10	
18/06/2019	CSP-39	14:25	14:30	925890.3	719947.7	925879.4	719960.3	5.54	319	L	90	1.5	13	10	
08/06/2019	CSP-40	11:40	11:45	926056.8	719575.8	926053.7	719578.0	1.26	305	L	90	1.5	13.6	10	Rotary motion due to seawall
13/06/2019	CSP-41	09:35	09:40	926894.7	718535.1	926890.1	718538.2	1.87	304	L	90	1.5	13	15	Rip Current
07/06/2019	CSP-42	07:55	08:00	927280.9	718003.5	927290.5	718003.1	3.20	92	R	85	1	13.6	15	Rip Current
07/06/2019	CSP-43	08:05	08:10	927528.9	717776.6	927530.9	717772.6	1.50	153	R	85	1	13.6	15	Rip Current
18/06/2019	CSP-44	10:20	10:25	927913.2	717524.1	927900.2	717541.4	7.21	323	L	95	1.5	12.7	15	
18/06/2019	CSP-45	10:10	10:15	928523.4	717239.0	928514.5	717233.4	3.49	238	L	90	1.5	12.7	15	Rip Current
07/06/2019	CSP-46	09:35	09:40	928872.5	717231.7	928865.0	717235.6	2.83	298	L	90	1.5	12.7	15	Rip Current
07/06/2019	CSP-47	09:55	10:00	929301.4	717068.8	929294.2	717072.7	2.72	298	L	90	1.5	12.8	15	Rip Current
18/06/2019	CSP-48	10:50	10:55	929953.0	716802.9	929948.5	716805.1	1.68	296	L	90	1.5	12.8	15	Seawall area
07/06/2019	CSP-49	10:25	10:30	930239.9	716612.4	930235.3	716613.0	1.54	277	L	90	1.5	12.8	15	Seawall area
07/06/2019	CSP-50	10:45	10:50	930666.1	716352.5	930659.7	716354.1	2.20	284	L	90	1.5	12.8	15	Seawall area
07/06/2019	CSP-51	10:55	11:00	931109.9	716069.1	931105.7	716071.8	1.69	303	L	90	1.5	12.8	15	Seawall area
07/06/2019	CSP-52	11:05	11:10	931493.0	715786.7	931488.6	715789.0	1.66	297	L	90	1.5	12.8	15	Seawall area
17/06/2019	CSP-53	16:40	16:45	931946.9	715549.9	931935.4	715561.4	5.44	315	L	95	2	13.4	20	
10/06/2019	CSP-54	11:00	11:05	932309.0	715219.9	932286.5	715243.9	10.97	317	L	95	2	13.4	20	
10/06/2019	CSP-55	10:40	10:45	932685.4	714882.8	932667.7	714898.4	7.87	311	L	95	2	13.4	20	
10/06/2019	CSP-56	11:45	11:50	933020.7	714528.2	933017.7	714531.1	1.38	315	L	90	2	13.6	15	Seawall area
10/06/2019	CSP-57	11:55	12:00	933405.0	714205.2	933400.7	714207.6	1.67	299	L	90	2	13.6	15	Rip Current
10/06/2019	CSP-58	12:10	12:15	933805.7	713906.0	933800.8	713910.0	2.10	310	L	90	2	13.6	15	Rip Current
09/06/2019	CSP-59	12:20	12:25	934169.1	713597.1	934165.1	713599.0	1.47	295	L	90	2	13.6	15	Between seawall
13/06/2019	CSP-60	10:55	11:00	934592.4	713280.5	934586.0	713286.7	2.97	314	L	90	2	10	15	Rip Current
13/06/2019	CSP-61	11:15	11:20	934951.8	712939.7	934944.1	712945.6	3.24	308	L	90	2	10	15	Seawall area
13/06/2019	CSP-62	11:30	11:35	935337.0	712615.9	935343.9	712610.5	2.92	128	R	90	2	10	15	Rip Current

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									
				Northing	Easting	Northing	Easting								
13/06/2019	CSP-63	12:00	12:05	935707.6	712285.4	935719.6	712276.7	4.94	126	R	90	2	11	15	Seawall area
09/06/2019	CSP-64	09:25	09:30	936079.5	711970.4	936087.8	711966.2	3.09	117	R	90	2	12	15	Rip Current
09/06/2019	CSP-65	09:35	09:40	936420.8	711658.7	936428.1	711654.2	2.84	121	R	90	2	12	15	Rip Current
09/06/2019	CSP-66	09:45	09:50	936834.4	711293.2	936838.0	711290.1	1.57	131	R	90	2	12	15	Rip Current
09/06/2019	CSP-67	10:00	10:05	937203.7	710962.9	937221.7	710947.4	7.91	131	R	90	2	12	15	
09/06/2019	CSP-68	10:15	10:20	937570.8	710619.7	937581.3	710610.4	4.65	132	R	90	2	12	15	
09/06/2019	CSP-69	10:30	10:35	937938.3	710281.9	937933.2	710286.4	2.26	311	L	90	2	12	15	Rip Current
09/06/2019	CSP-70	10:45	10:50	938315.0	709948.8	938304.0	709957.9	4.77	310	L	90	2	12	15	
17/06/2019	CSP-71	13:30	13:35	938471.9	709845.1	938466.5	709850.7	2.58	316	L	90	2	12	15	Rip Current
09/06/2019	CSP-72	11:05	11:10	938825.7	709490.0	938820.6	709495.3	2.47	316	L	90	2	13	15	Rip Current
06/06/2019	CSP-73	09:35	09:40	939192.5	709148.4	939202.1	709142.4	3.78	122	R	85	2	13	15	Rip Current
06/06/2019	CSP-74	09:20	09:25	939570.2	708818.8	939578.9	708812.8	3.50	125	R	85	2	12.7	15	Rip Current
17/06/2019	CSP-75	13:15	13:20	939969.8	708516.6	939991.3	708501.7	8.74	125	R	85	2	12.4	15	
06/06/2019	CSP-76	08:40	08:45	940330.3	708176.4	940354.8	708155.9	10.65	130	R	85	2	12.4	15	
17/06/2019	CSP-77	12:50	12:55	940740.1	707868.5	940768.6	707849.6	11.40	124	R	85	2	12.4	15	
17/06/2019	CSP-78	13:55	14:00	941123.6	707561.7	941142.6	707543.4	8.79	134	R	85	2	13.2	20	
17/06/2019	CSP-79	14:05	14:10	941514.3	707252.1	941561.0	707211.9	20.56	131	R	85	2	13.1	20	
17/06/2019	CSP-80	14:15	14:20	941912.6	706937.5	941956.5	706902.3	18.74	129	R	85	2	13.2	20	
05/06/2019	CSP-81	09:20	09:25	942290.4	706606.7	942328.2	706572.7	16.94	132	R	85	2	13.1	20	

Annexure V

Photo Documentation at CSP Locations - June 2019

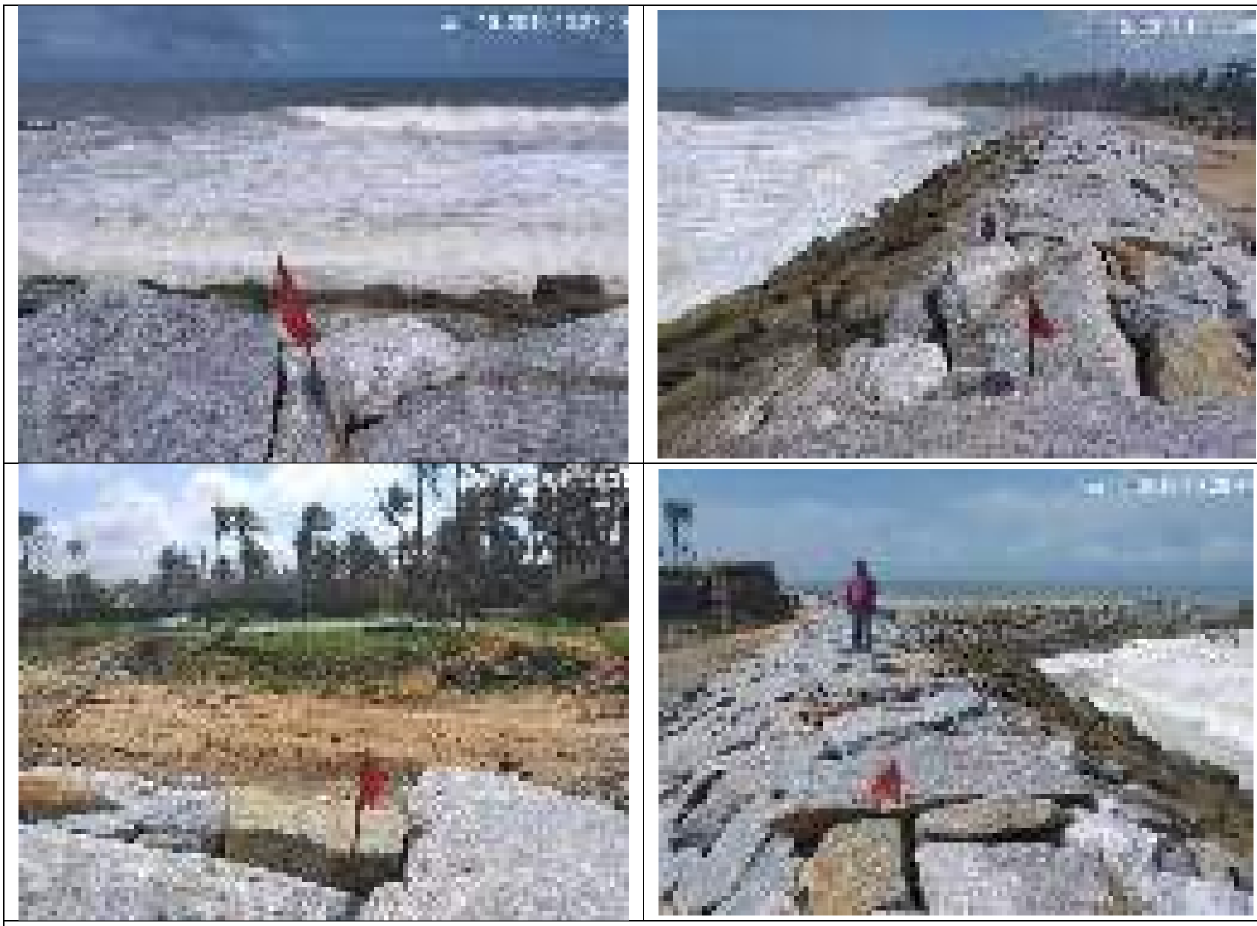


Figure 01:- June CSP 01

Figure 02:- June CSP 02

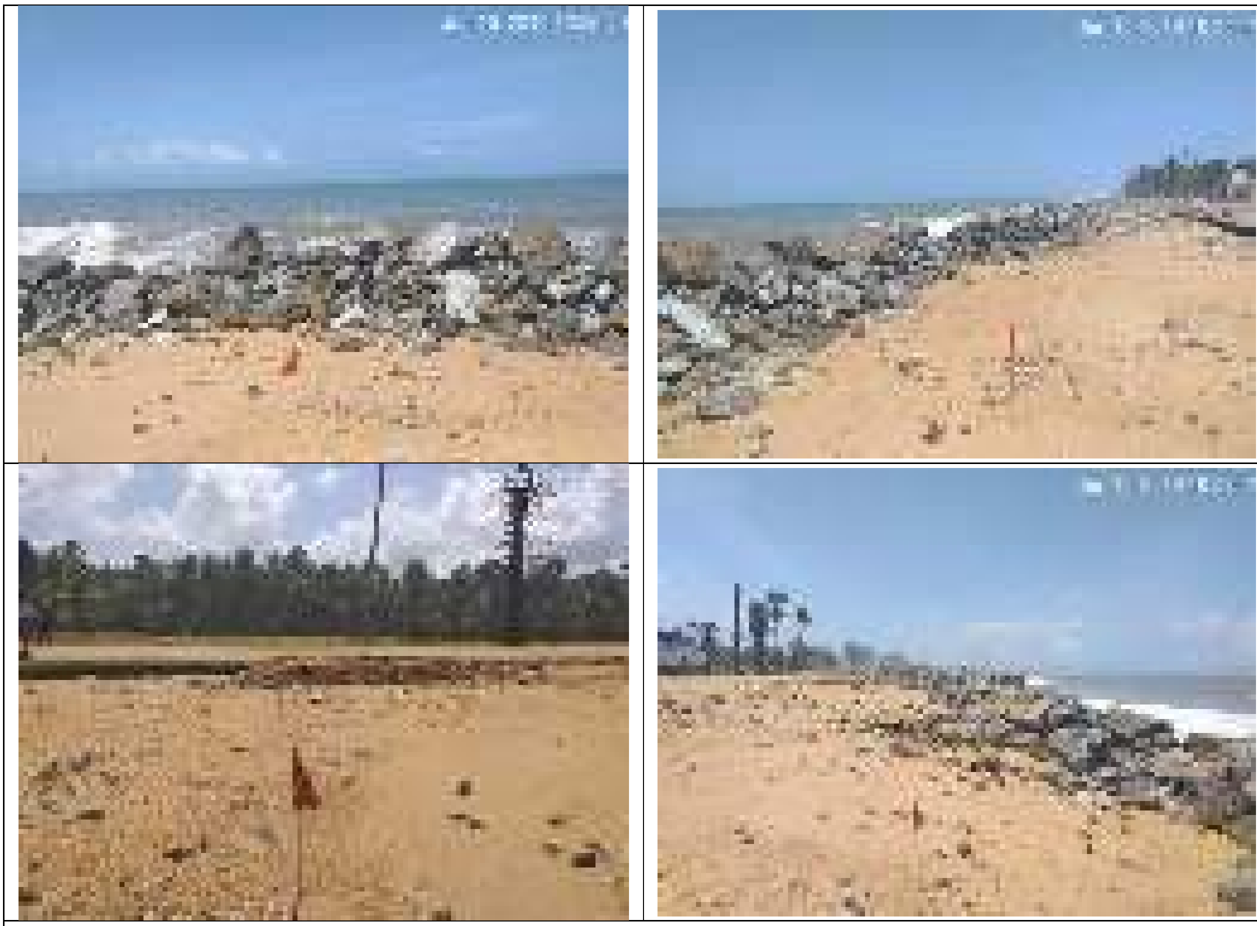


Figure 03:- June CSP 03

Figure 04:- June CSP 04

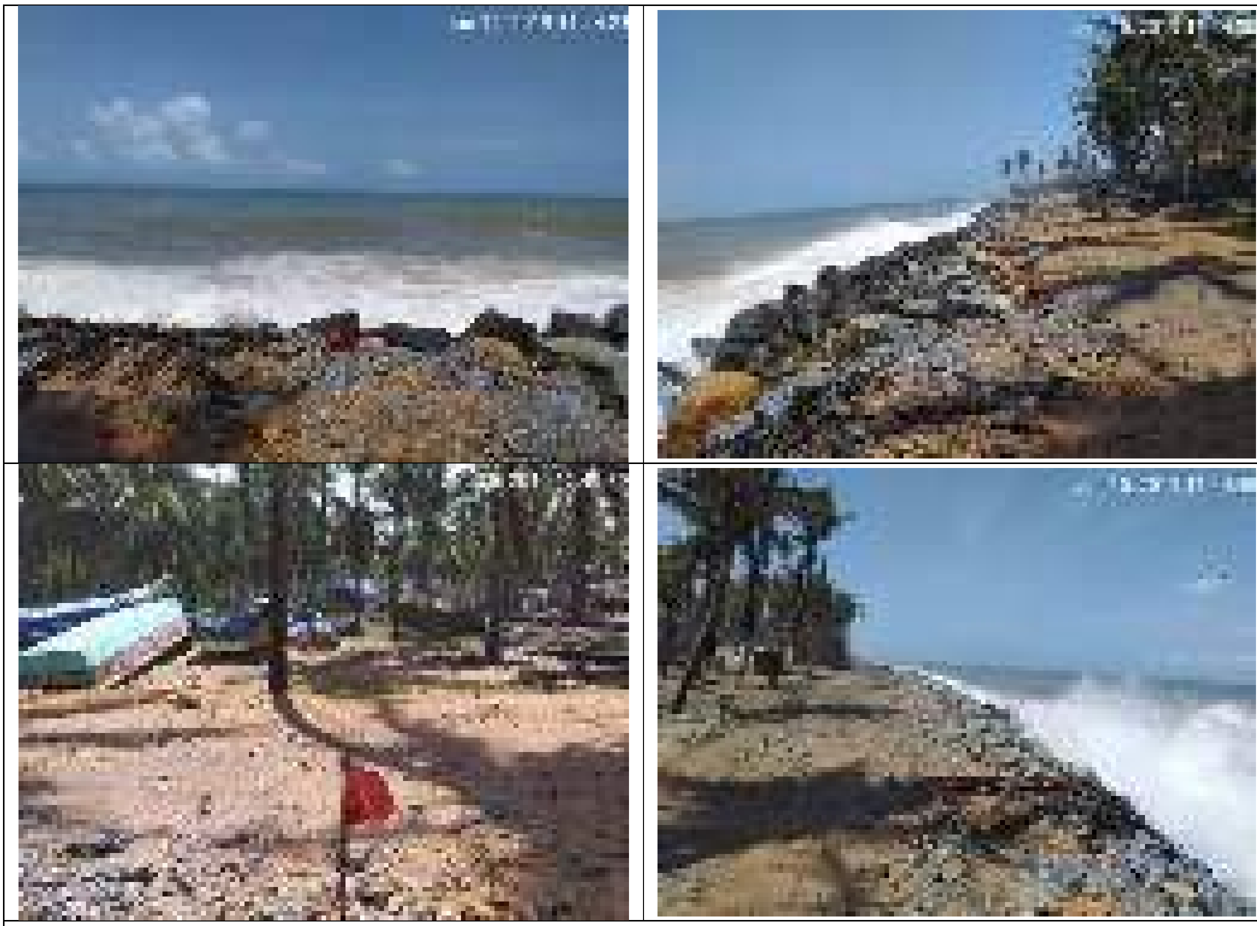


Figure 05:- June CSP 05

Figure 06:- June CSP 06

Figure 07:- June CSP 07

Figure 08:- June CSP 08

Figure 09:- June CSP 09

Figure 10:- June CSP 10

Figure 11:- June CSP 11

Figure 12:- June CSP 12

Figure 13:- June CSP 13

Figure 14:- June CSP 14

Figure 15:- June CSP 15

Figure 16:- June CSP 16

Figure 17:- June CSP 17

Figure 18:- June CSP 18

Figure 19:- June CSP 19

Figure 20:- June CSP 20

Figure 21:- June CSP 21

Figure 22:- June CSP 22

Figure 23:- June CSP 23

Figure 24:- June CSP 24

Figure 25:- June CSP 25

Figure 26:- June CSP 26

Figure 27:- June CSP 27

Figure 28:- June CSP 28

Figure 29:- June CSP 29

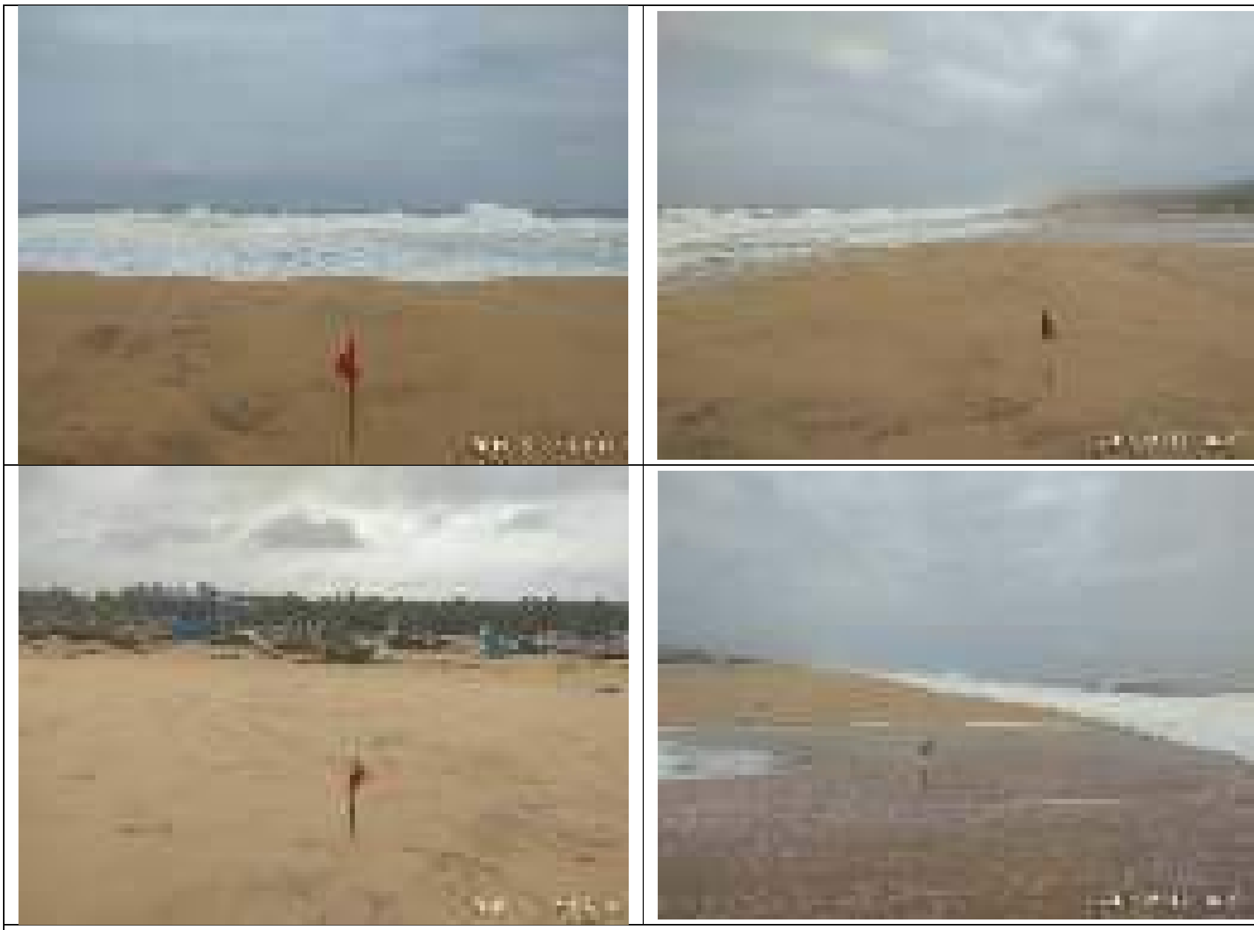


Figure 30:- June CSP 30

Figure 31:- June CSP 31

Figure 32:- June CSP 32

Figure 33:- June CSP 33

Figure 34:- June CSP 34

Figure 35:- June CSP 35

Figure 36:- June CSP 36

Figure 37:- June CSP 37

Figure 38:- June CSP 38

Figure 39:- June CSP 39

Figure 40:- June CSP 40




Figure 41:- June CSP 41

Figure 42:- June CSP 42

Figure 43:- June CSP 43

Figure 44:- June CSP 44

Figure 45:- June CSP 45

Figure 46:- June CSP 46

Figure 47:- June CSP 47

Figure 48:- June CSP 48

Figure 49:- June CSP 49

Figure 50:- June CSP 50

Figure 51:- June CSP 51

Figure 52:- June CSP 52

Figure 53:- June CSP 53

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Figure 55:- June CSP 55

Figure 56:- June CSP 56

Figure 57:- June CSP 57

Figure 58:- June CSP 58

Figure 59:- June CSP 59

Figure 60:- June CSP 60

Figure 61:- June CSP 61

Figure 62:- June CSP 62

Figure 63:- June CSP 63

Figure 64:- June CSP 64

Figure 65:- June CSP 65

Figure 66:- June CSP 66

Figure 67:- June CSP 67

Figure 68:- June CSP 68

Figure 69:- June CSP 69

Figure 70:- June CSP 70

Figure 71:- June CSP 71

Figure 72:- June CSP 72

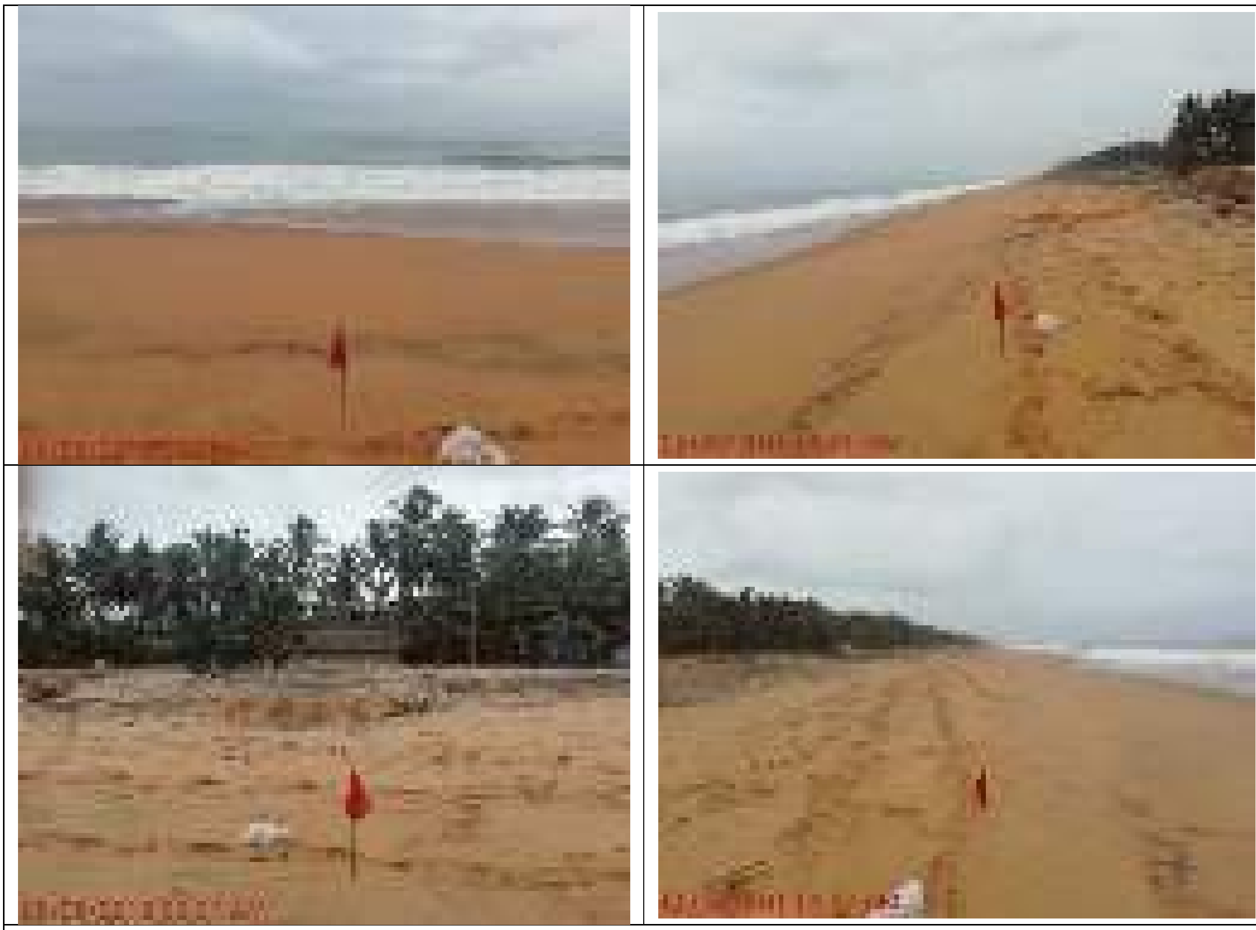


Figure 73:- June CSP 73

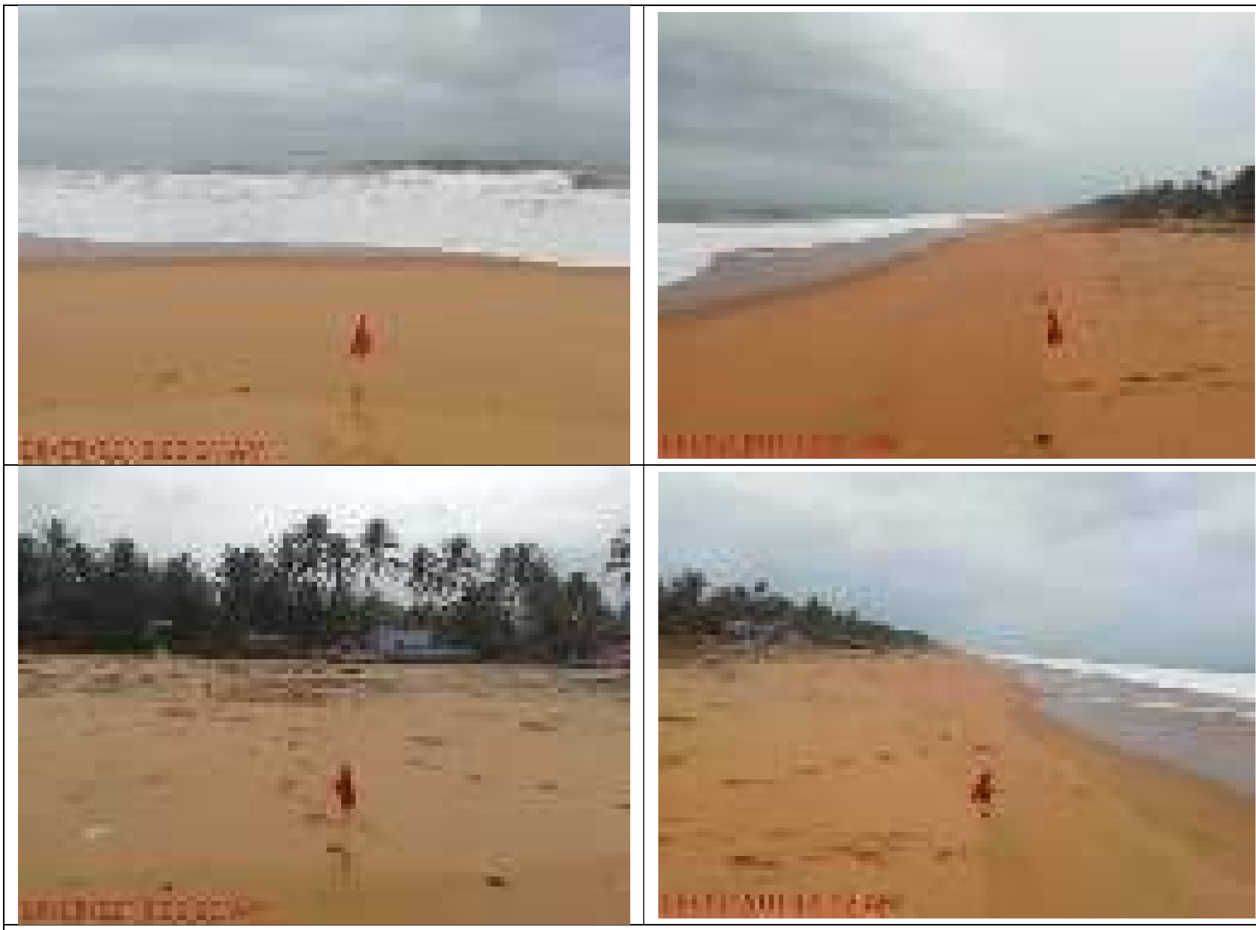


Figure 74:- June CSP 74

Figure 75:- June CSP 75

Figure 76:- June CSP 76

Figure 77:- June CSP 77

Figure 78:- June CSP 78

Figure 79:- June CSP 79

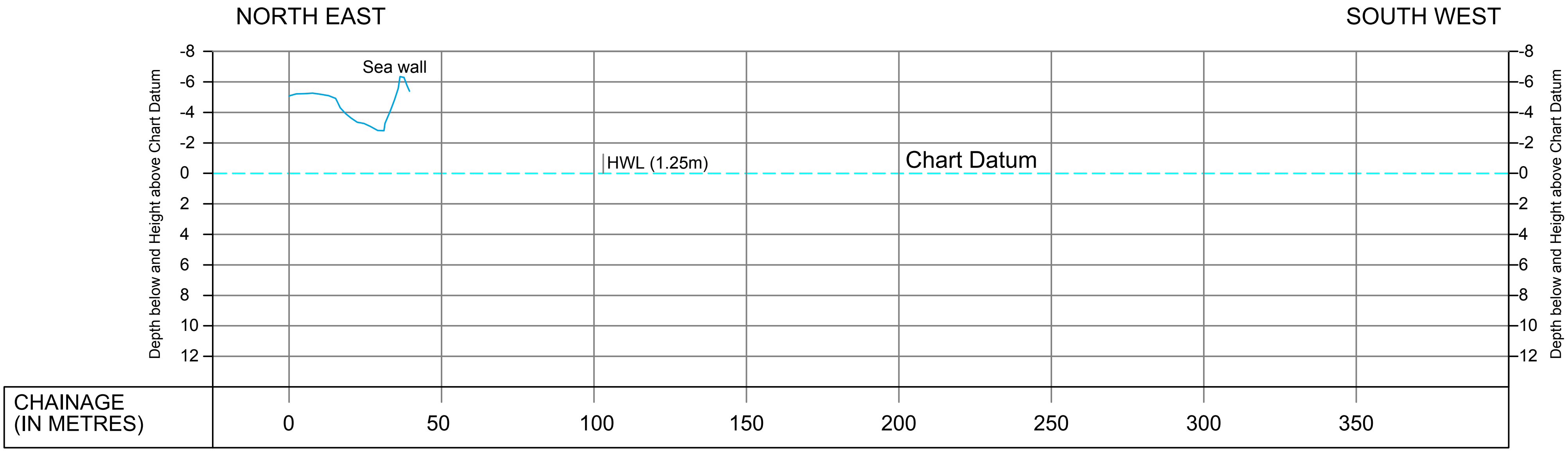
Figure 80:- June CSP 80

Figure 81:- June CSP 81

Annexure VI

Cross Shore Profiles - June 2019

Cross Section Line No.CSP-01 (June 2019)



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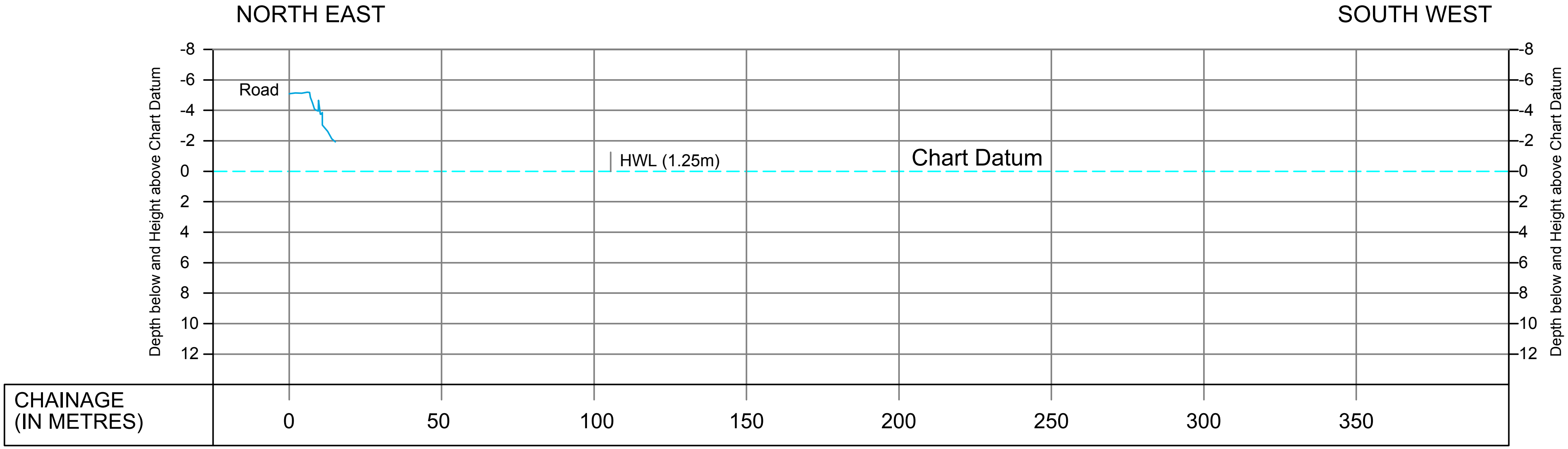
VERTICAL 1: 200

Cross Section Line No.CSP-02 (June 2019)



SCALE
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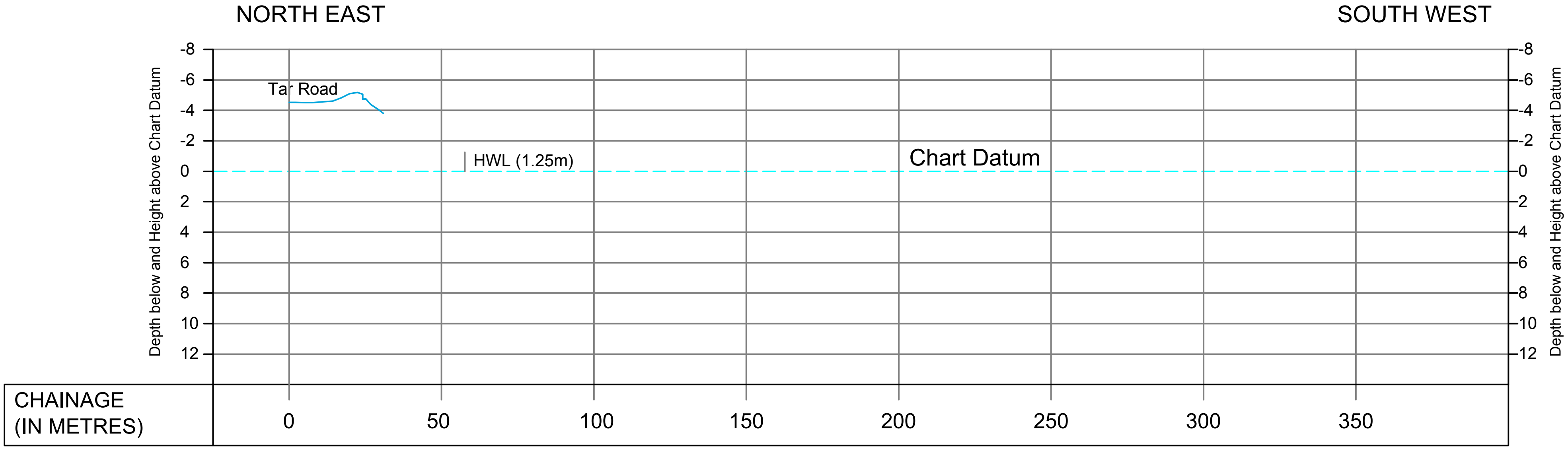
VERTICAL 1: 200

Cross Section Line No.CSP-03 (June 2019)



SCALE
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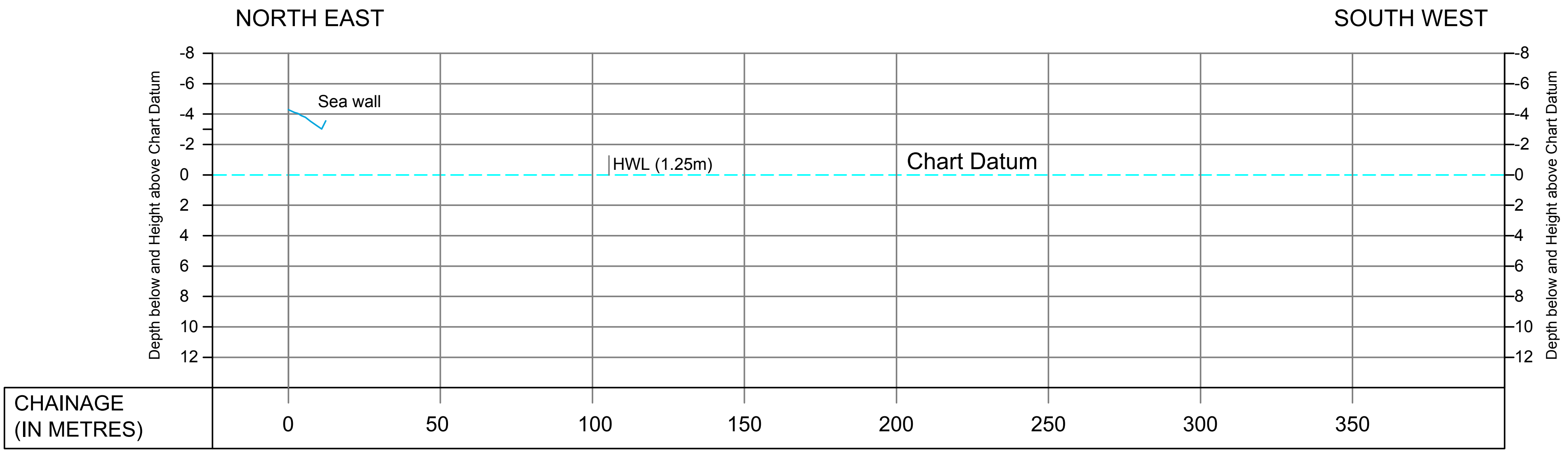
VERTICAL 1: 200

Oceanographic & Bathymetric data collection for Assessment
of Shoreline Changes at Vizhinjam for AVPPL
Annexure VI - Cross Shore Profiles
PSR-1, June 2019

Cross Section Line No.CSP-04 (June 2019)



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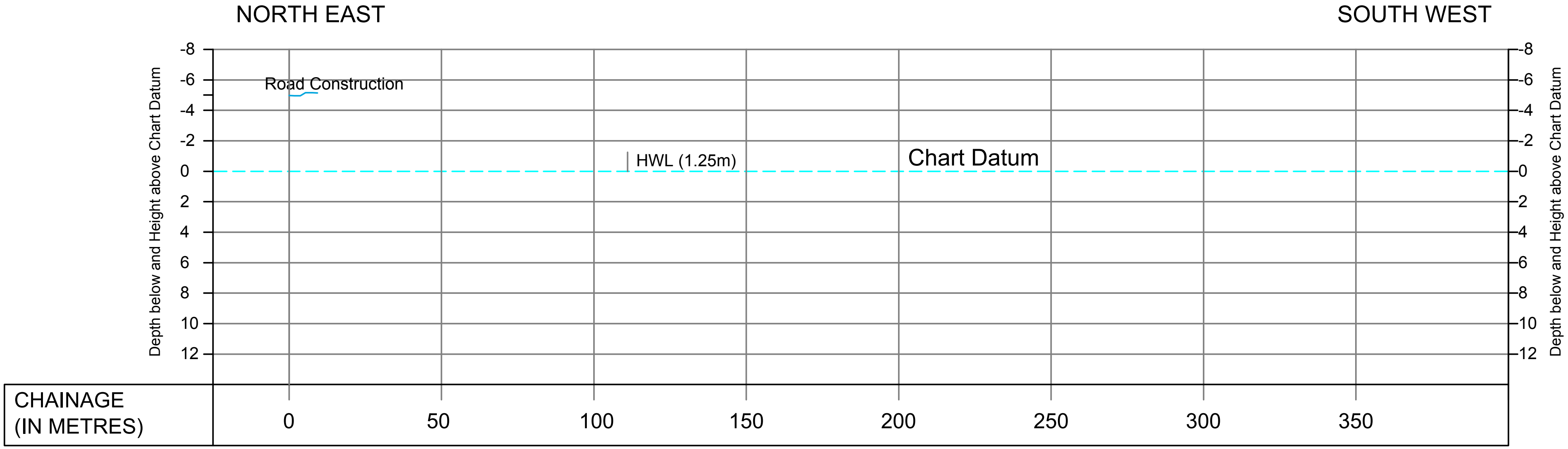
VERTICAL 1: 200

Cross Section Line No.CSP-05 (June 2019)



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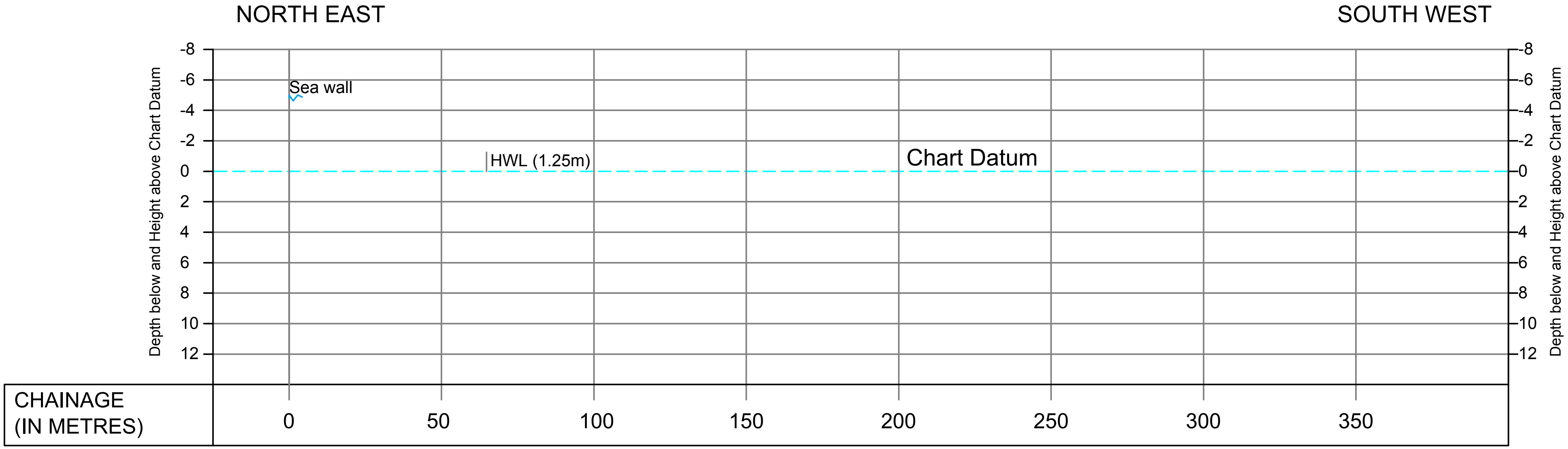
VERTICAL 1: 200

Cross Section Line No.CSP-07 (June 2019)



SCALE
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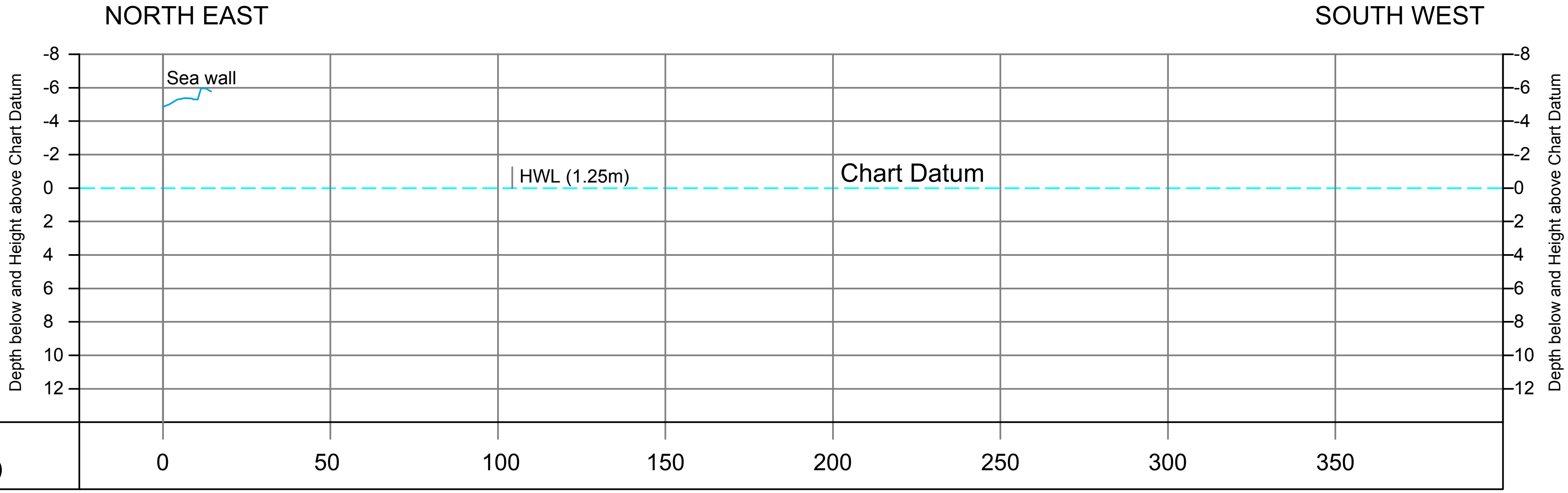
VERTICAL 1: 200

Cross Section Line No.CSP-08 (June 2019)



SCALE
HORIZONTAL 1: 1000
VERTICAL 1: 200

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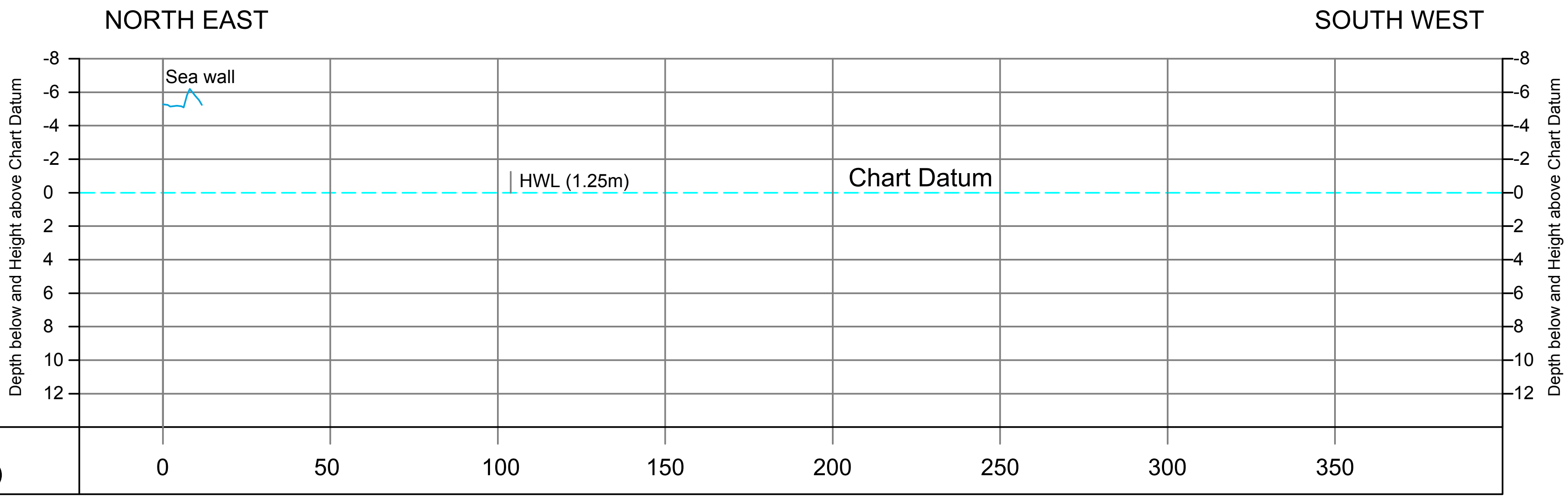
Cross Section Line No.CSP-09 (June 2019)



SCALE
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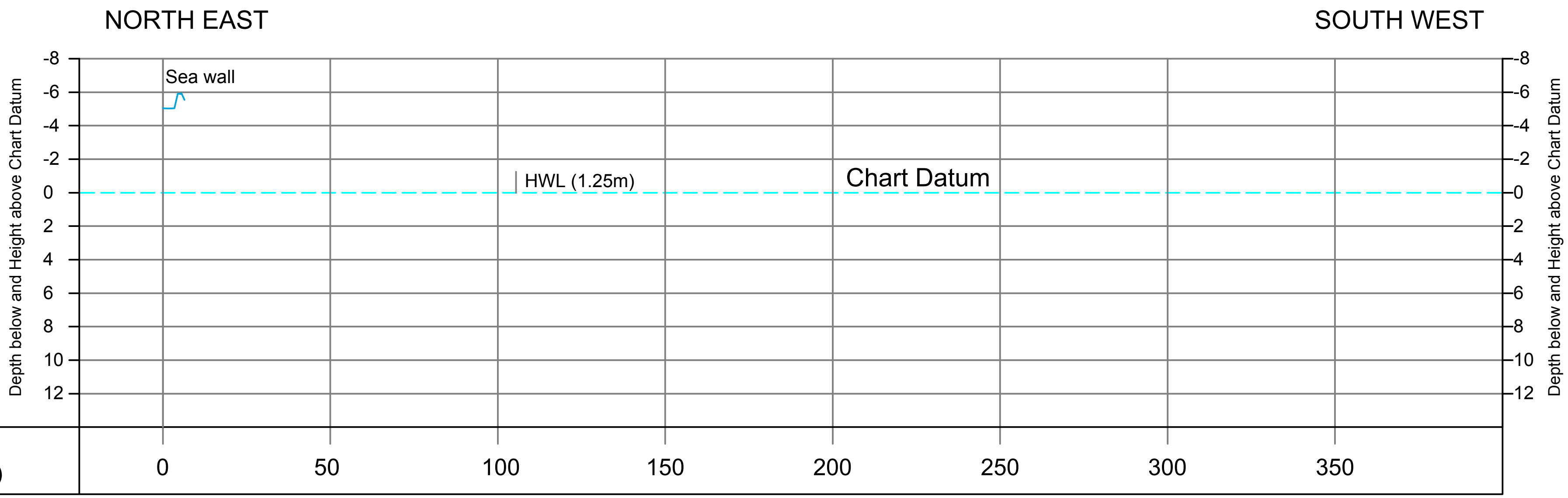
VERTICAL 1: 200

Cross Section Line No.CSP-10 (June 2019)



SCALE
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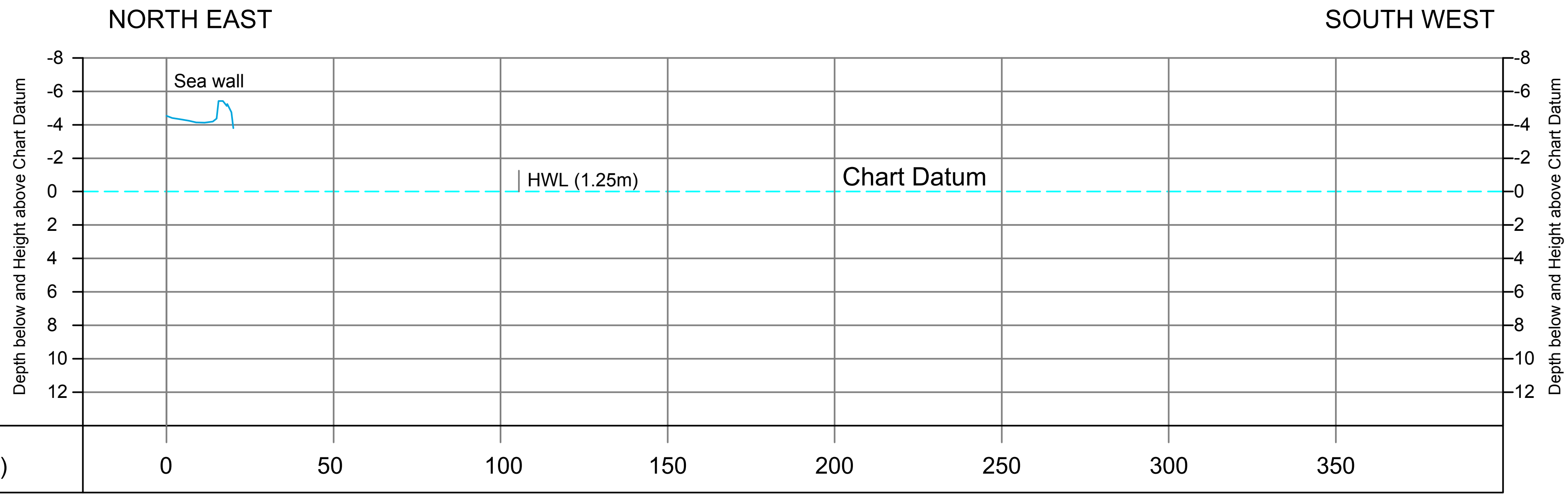
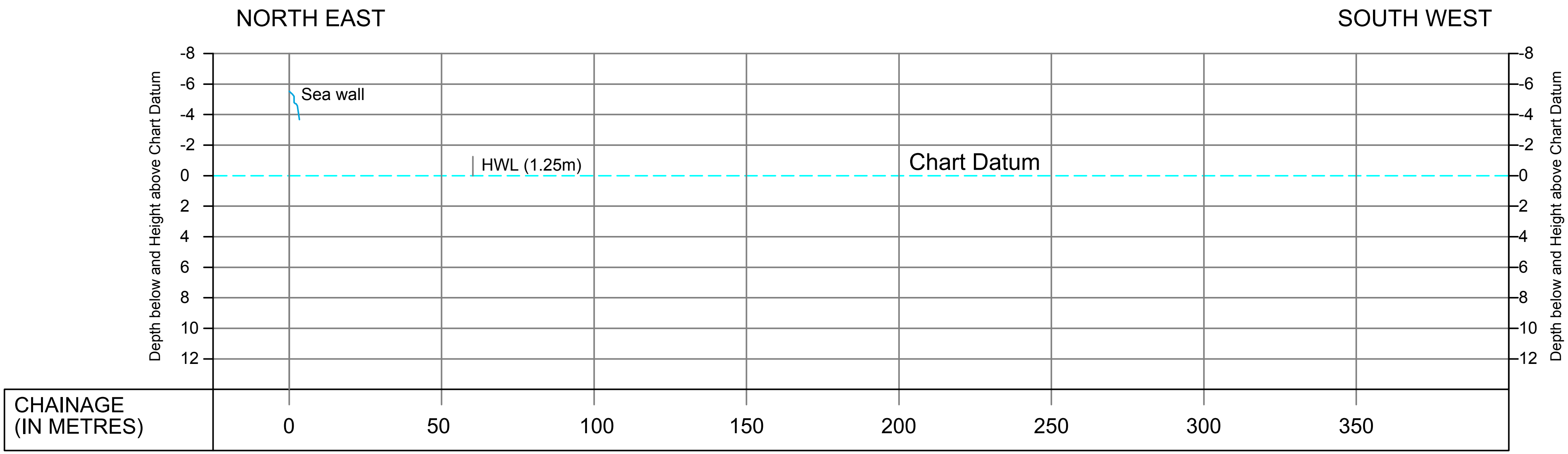
VERTICAL 1: 200

Cross Section Line No.CSP-11 (June 2019)



SCALE
HORIZONTAL 1: 1000
VERTICAL 1: 200

Cross Section Line No.CSP-12 (June 2019)



SCALE
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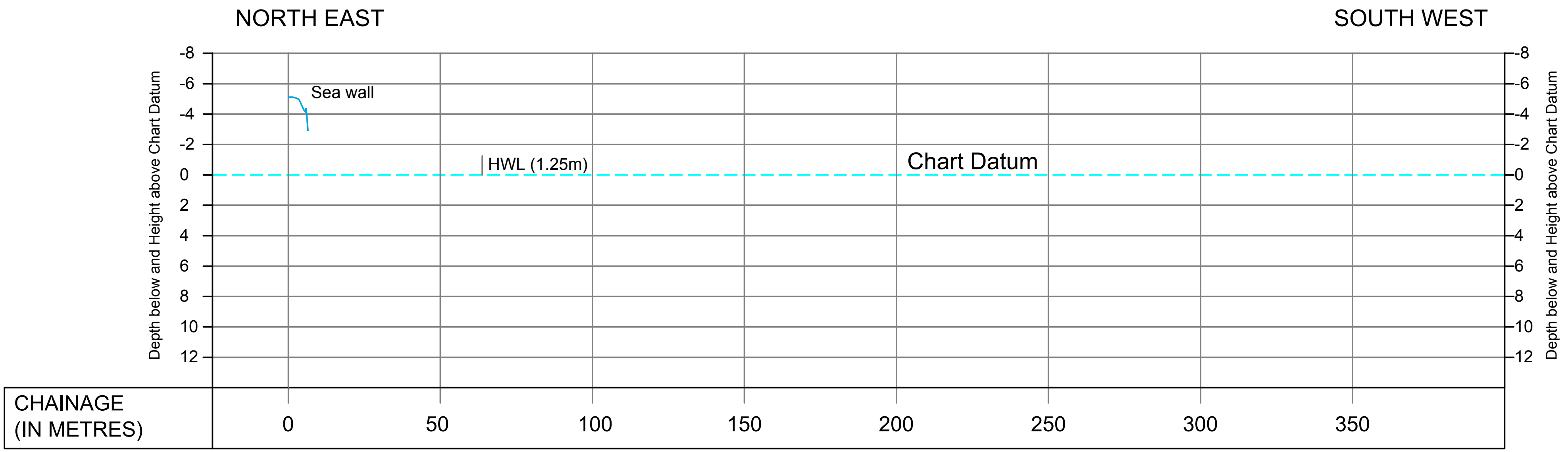
VERTICAL 1: 200

Cross Section Line No.CSP-13 (June 2019)



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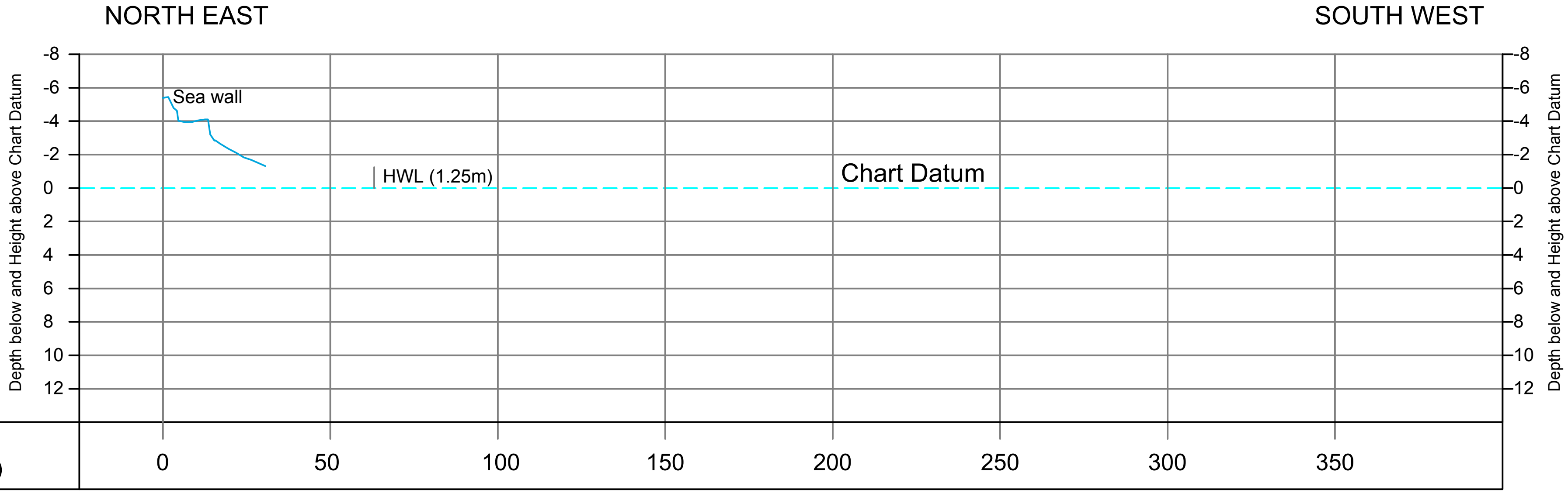

SCALE
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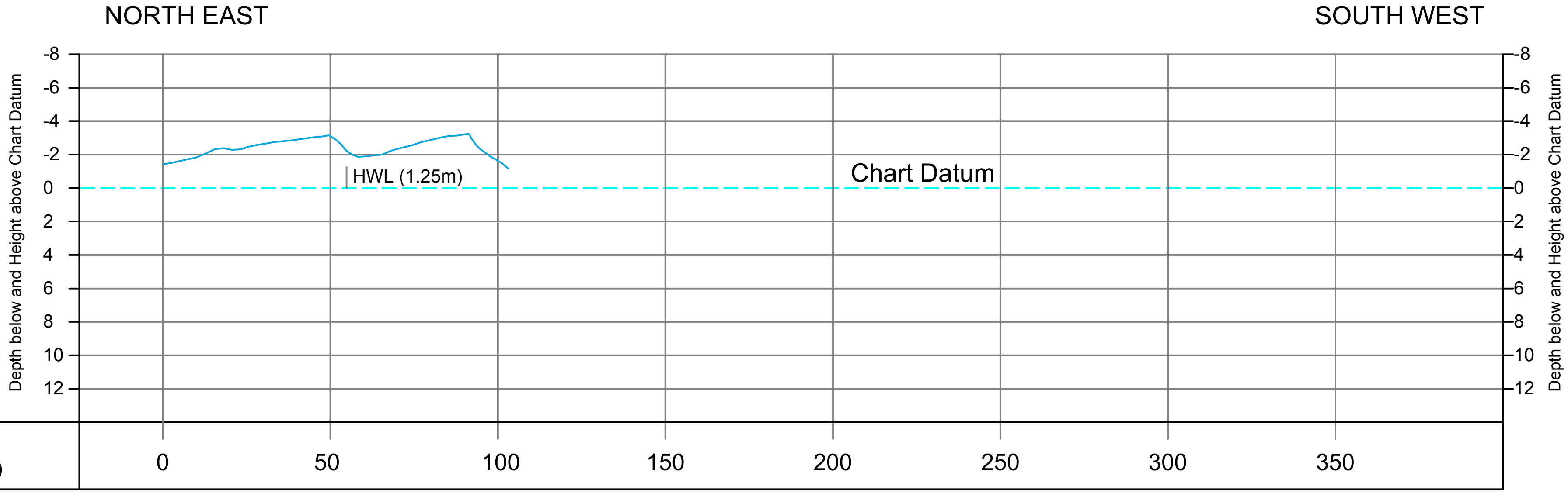
Cross Section Line No.CSP-15 (June 2019)



SCALE
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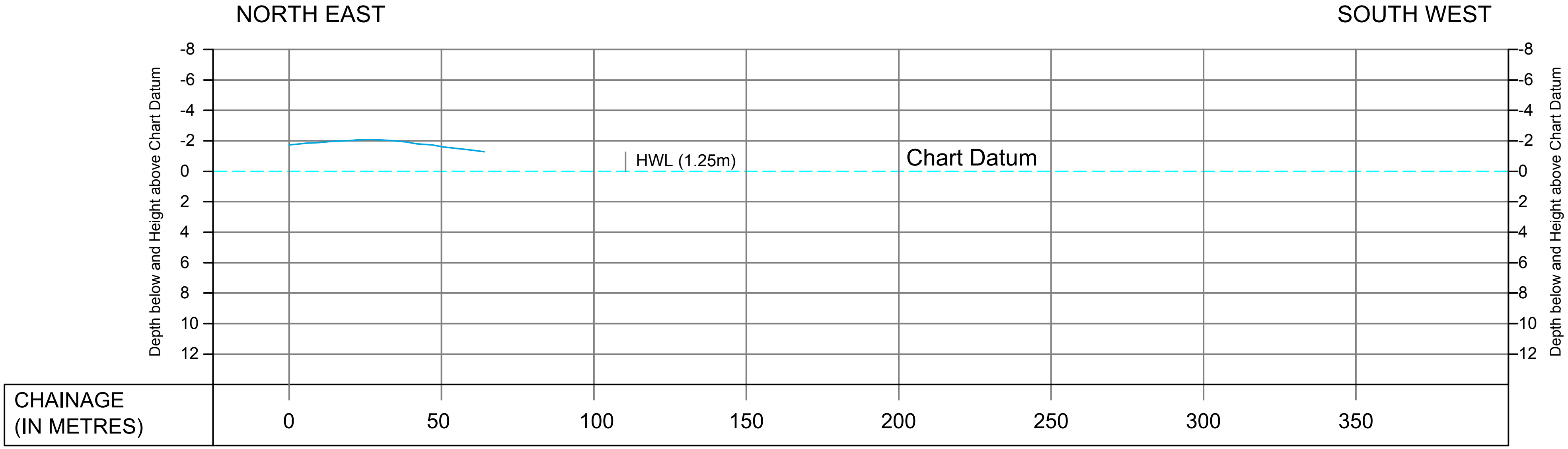
VERTICAL 1: 200

adani

Cross Section Line No.CSP-16 (June 2019)



SCALE
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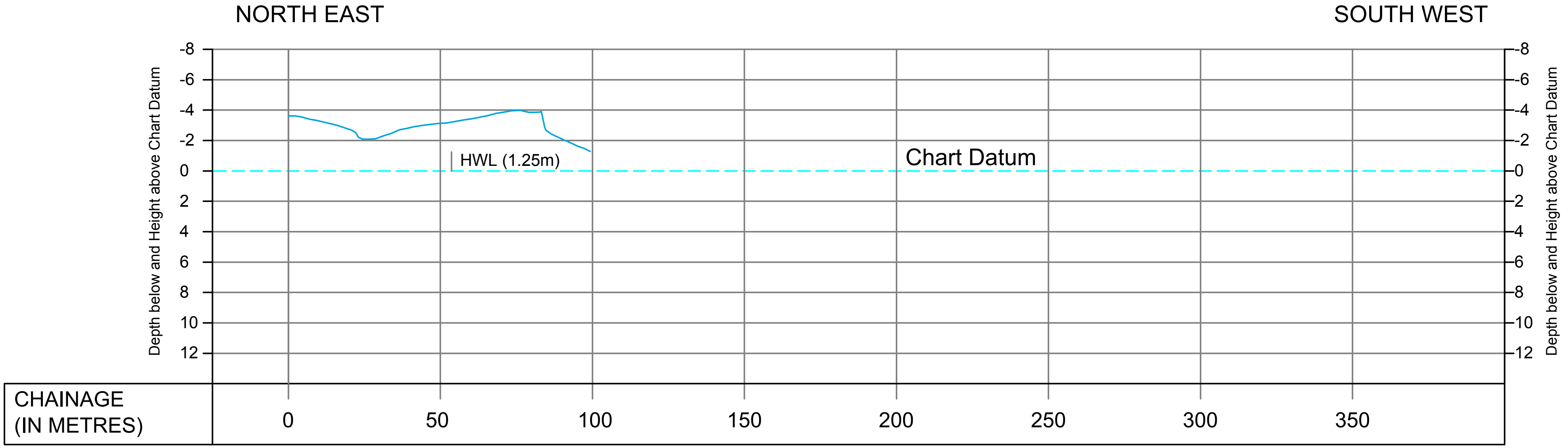
Cross Section Line No.CSP-17 (June 2019)



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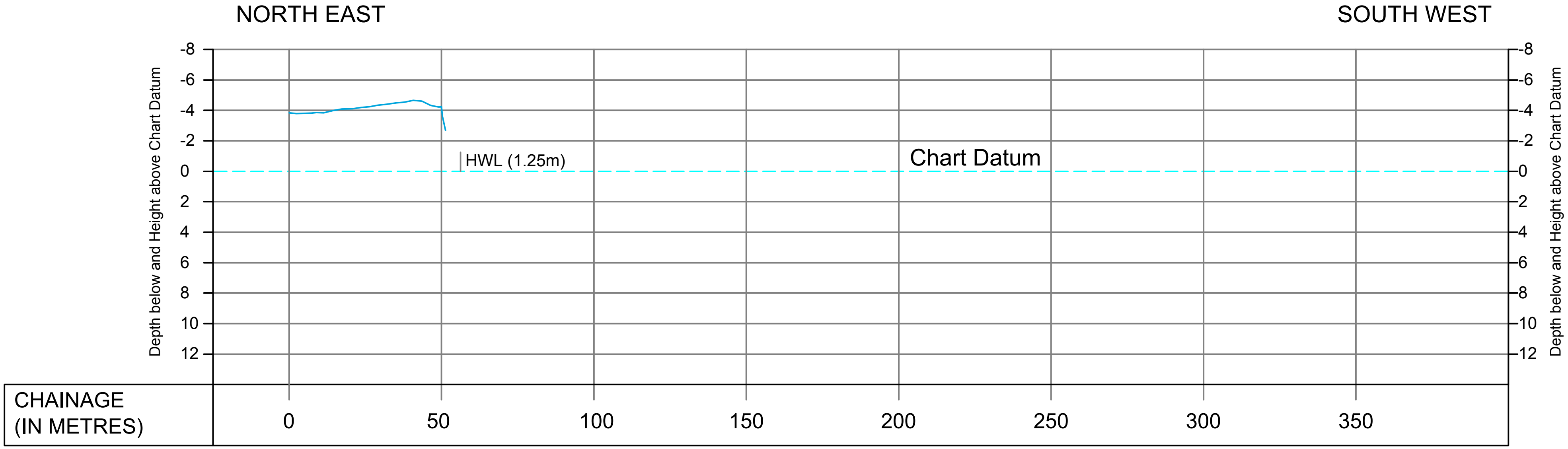

SCALE
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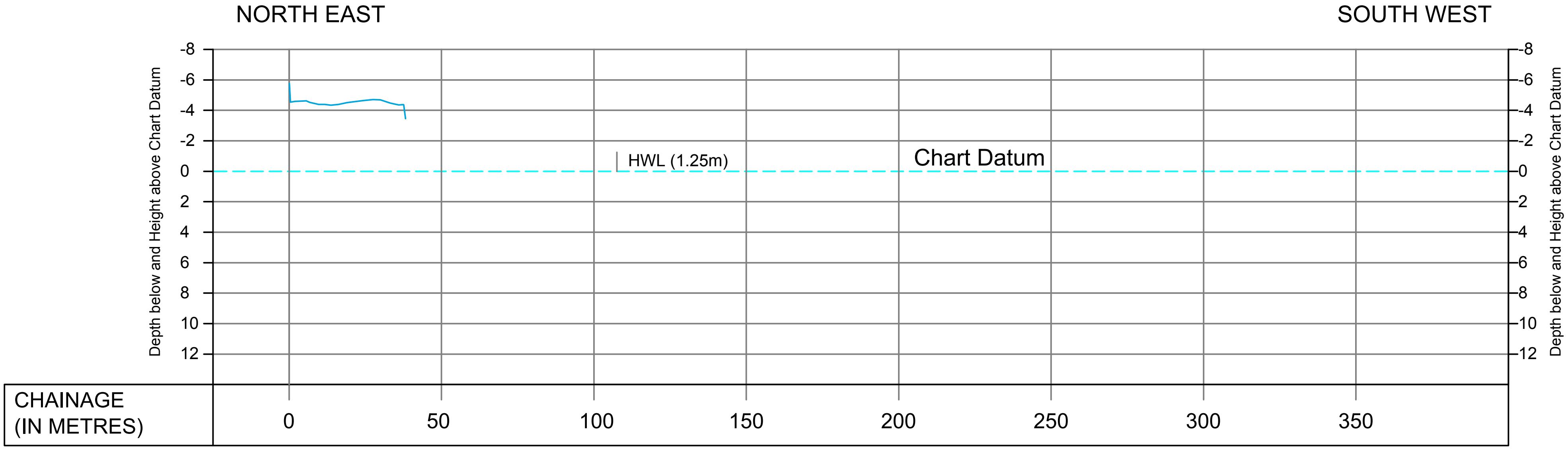
Cross Section Line No.CSP-19 (June 2019)



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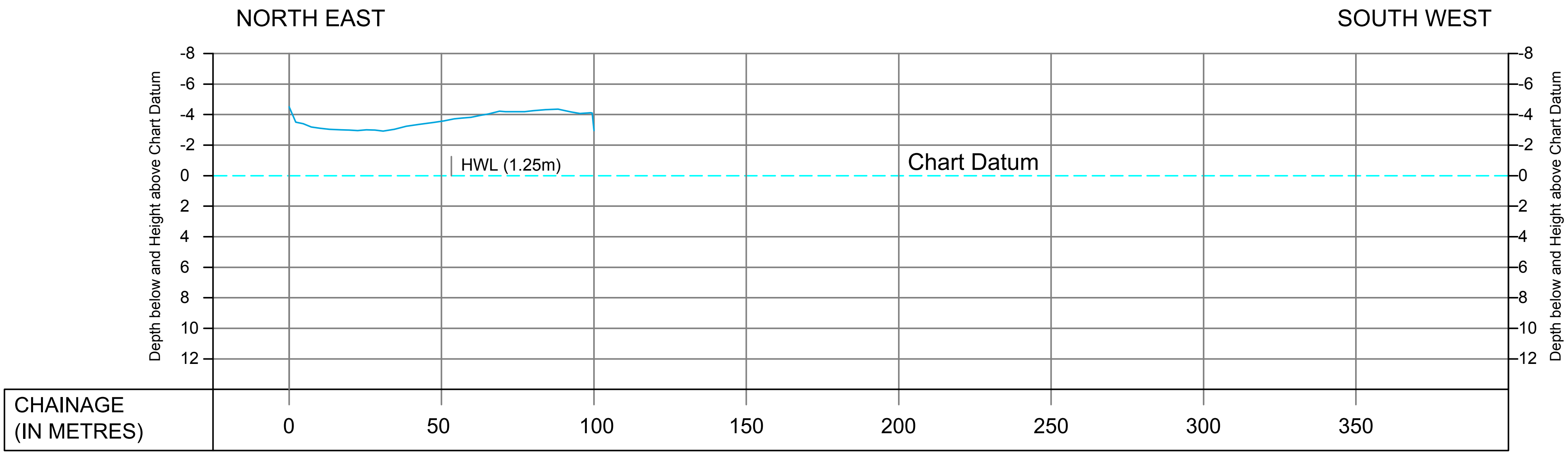

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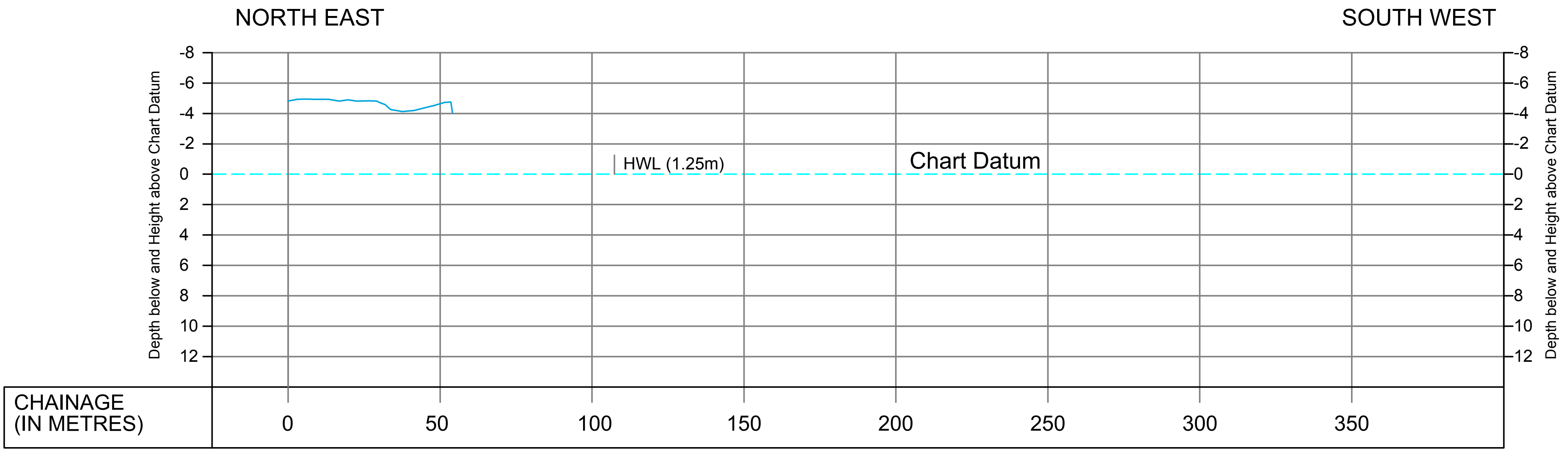

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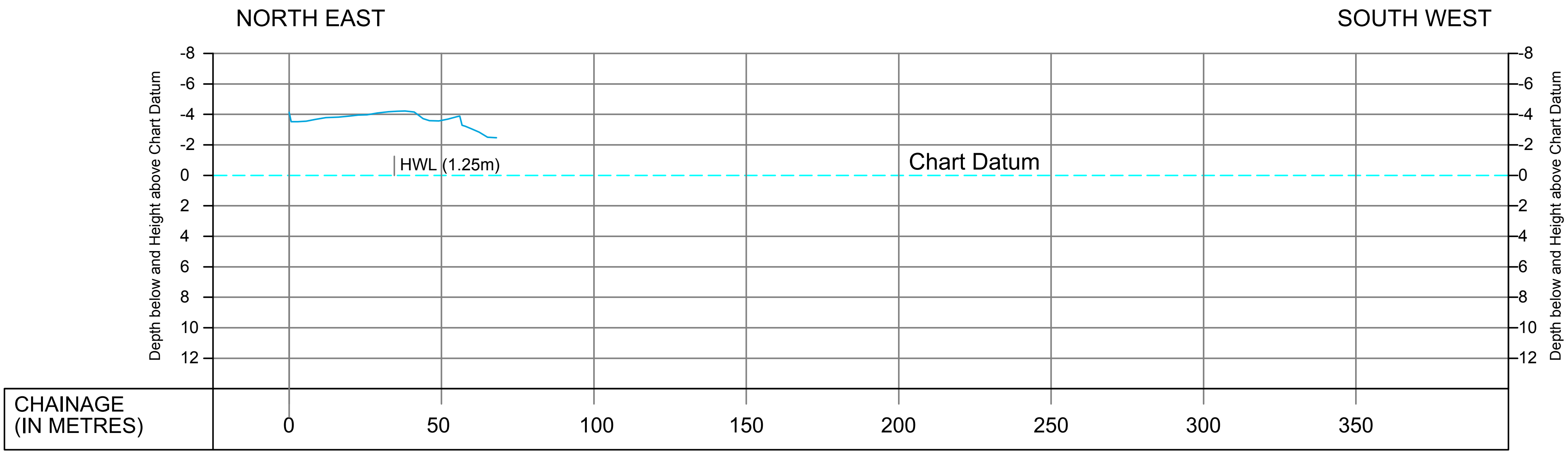

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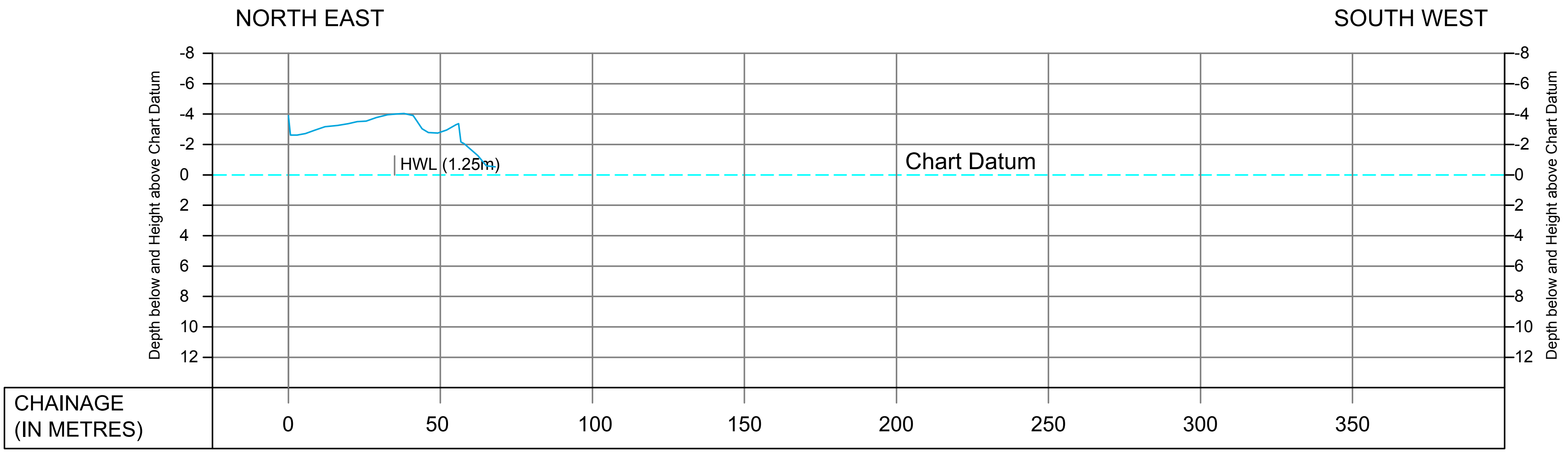
Cross Section Line No.CSP-23 (June 2019)



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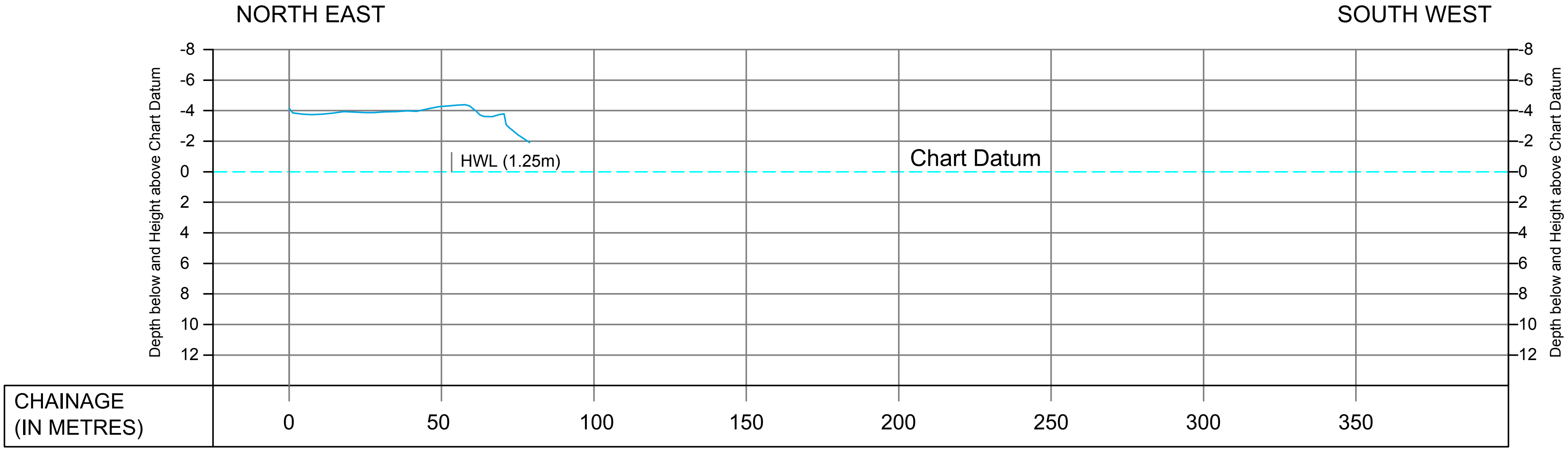

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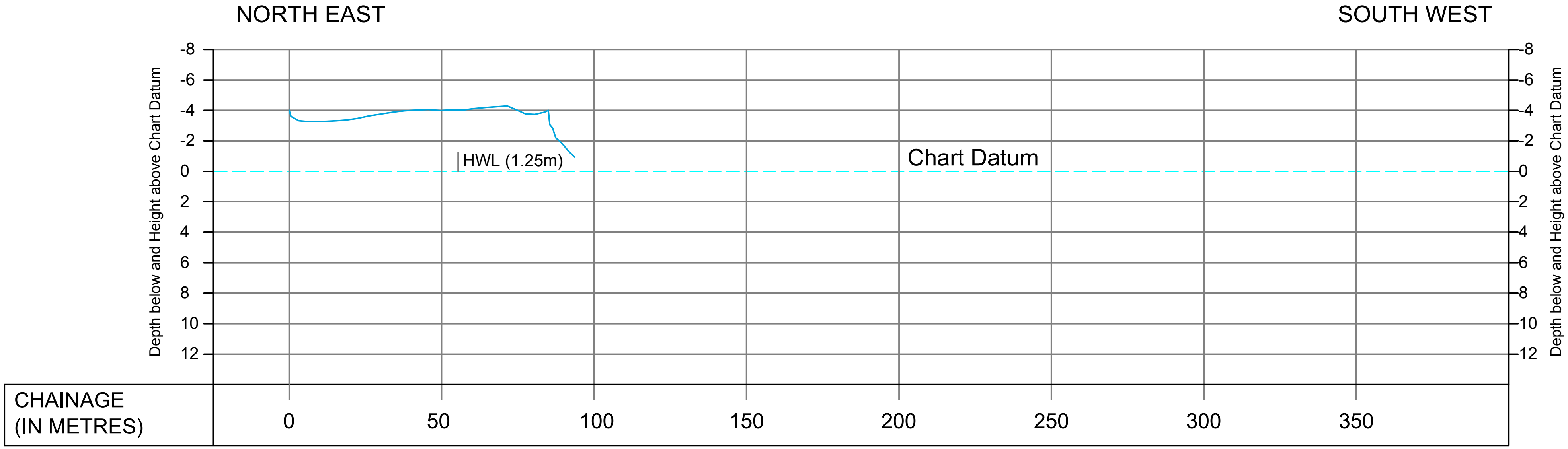

SCALE
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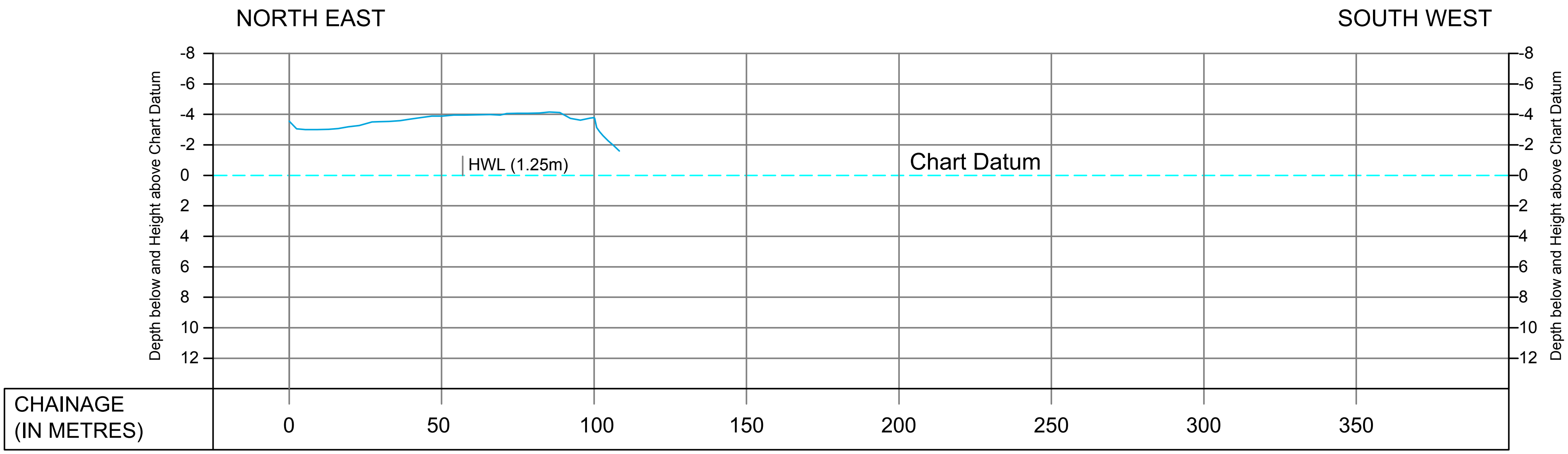
VERTICAL 1: 200

Oceanographic & Bathymetric data collection for Assessment
of Shoreline Changes at Vizhinjam for AVPPL
Annexure VI - Cross Shore Profiles
PSR-1, June 2019

Cross Section Line No.CSP-26 (June 2019)



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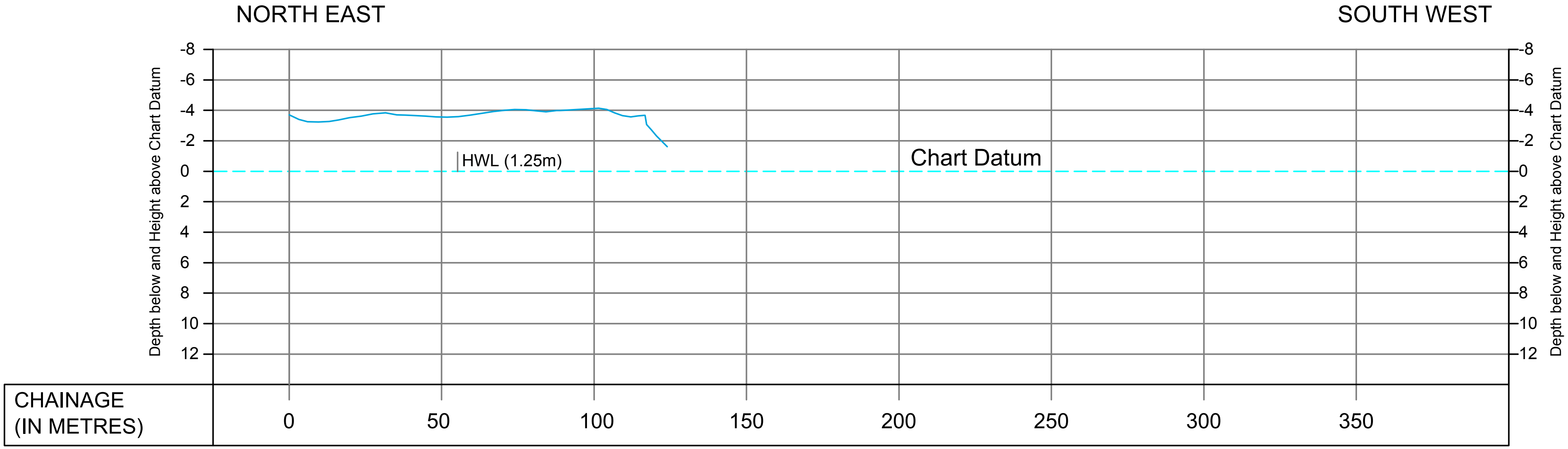
Cross Section Line No.CSP-27 (June 2019)



SCALE
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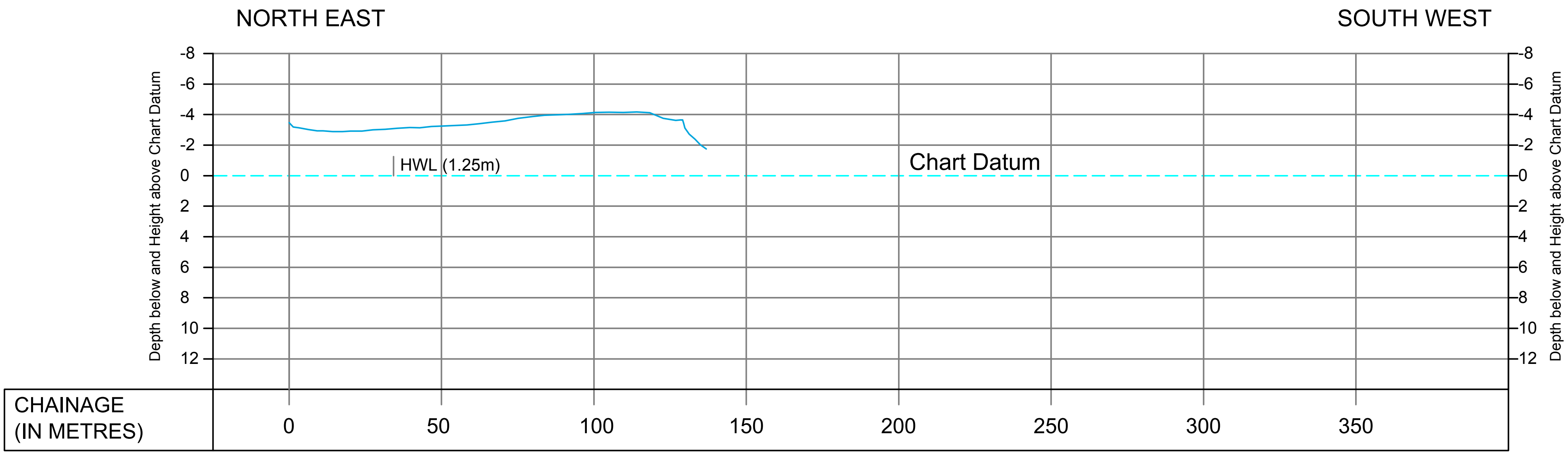
VERTICAL 1: 200

Oceanographic & Bathymetric data collection for Assessment
of Shoreline Changes at Vizhinjam for AVPPL
Annexure VI - Cross Shore Profiles
PSR-1, June 2019

Cross Section Line No.CSP-28 (June 2019)



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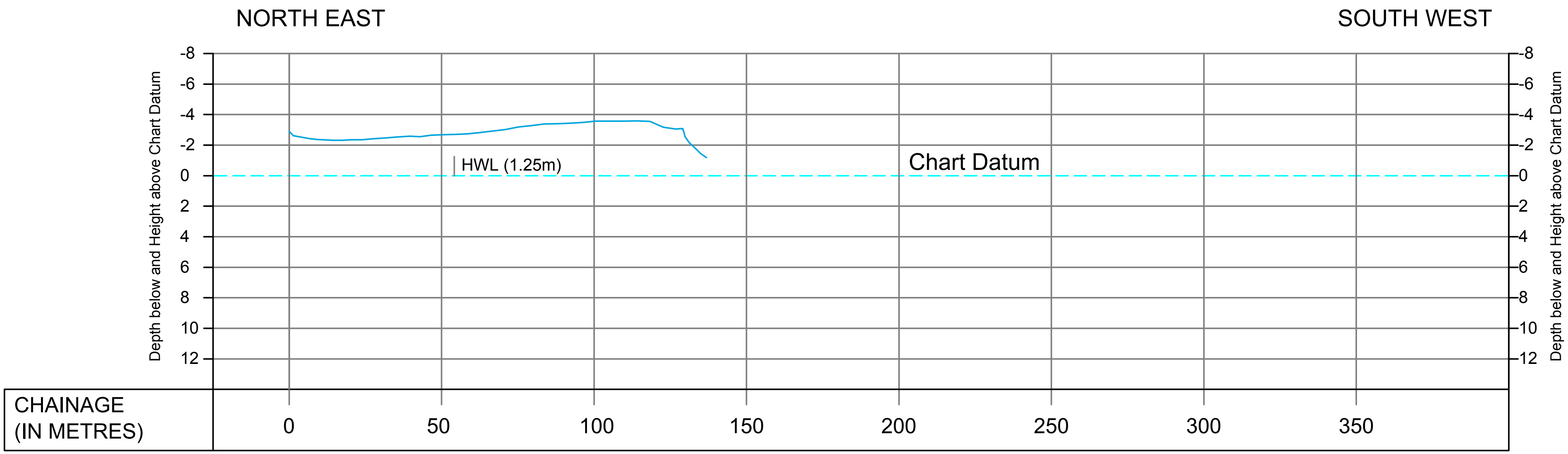
Cross Section Line No.CSP-29 (June 2019)



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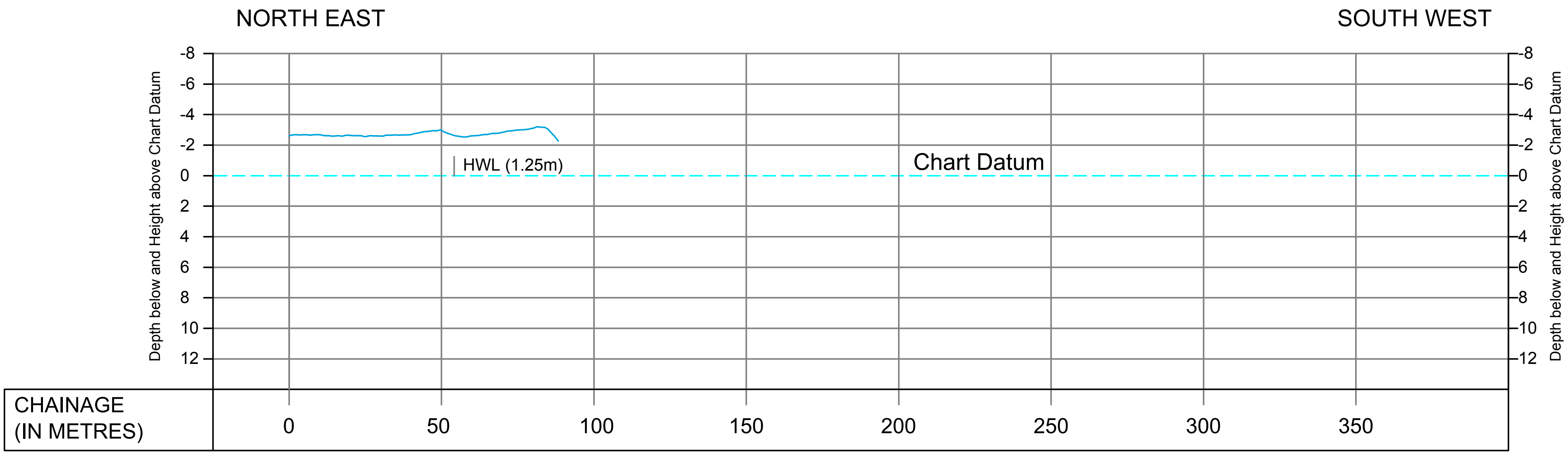

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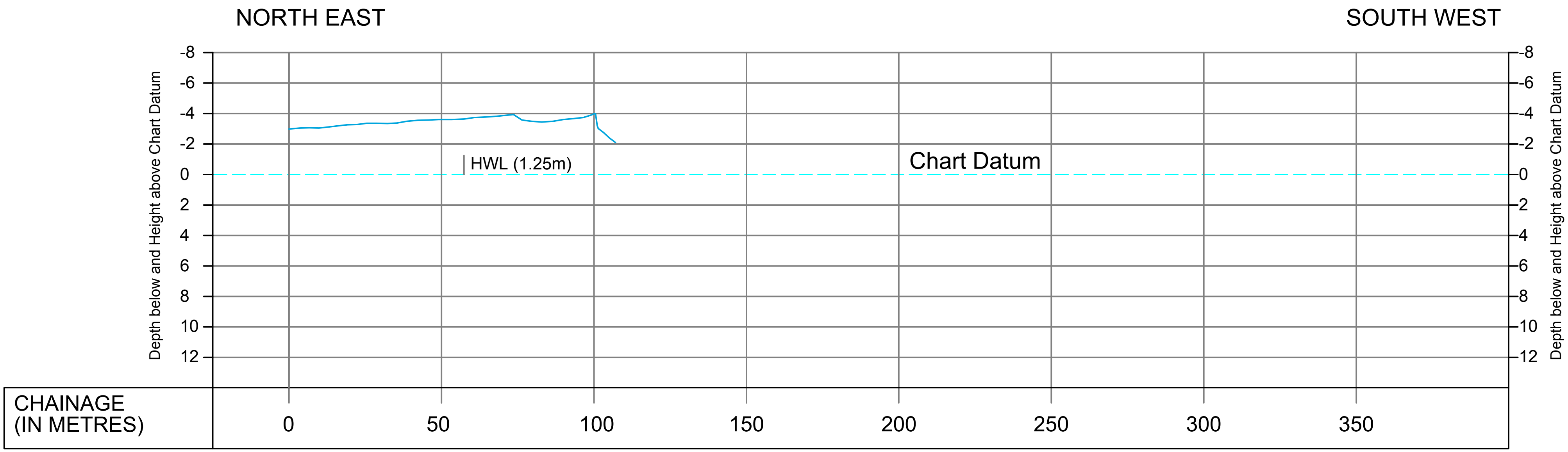

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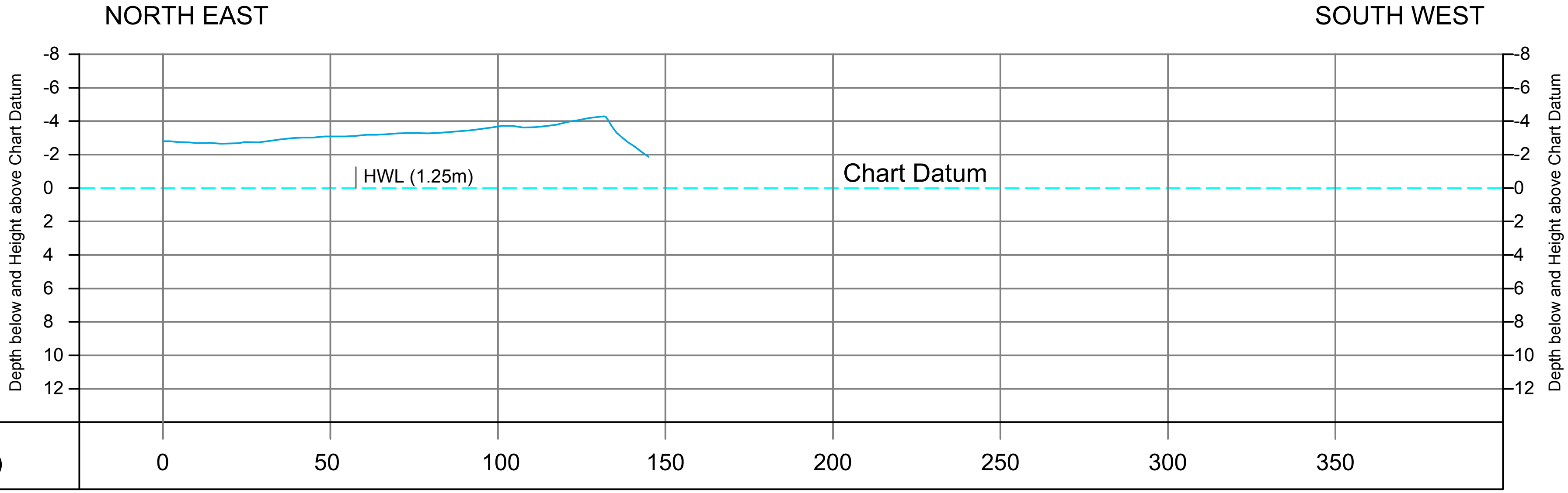

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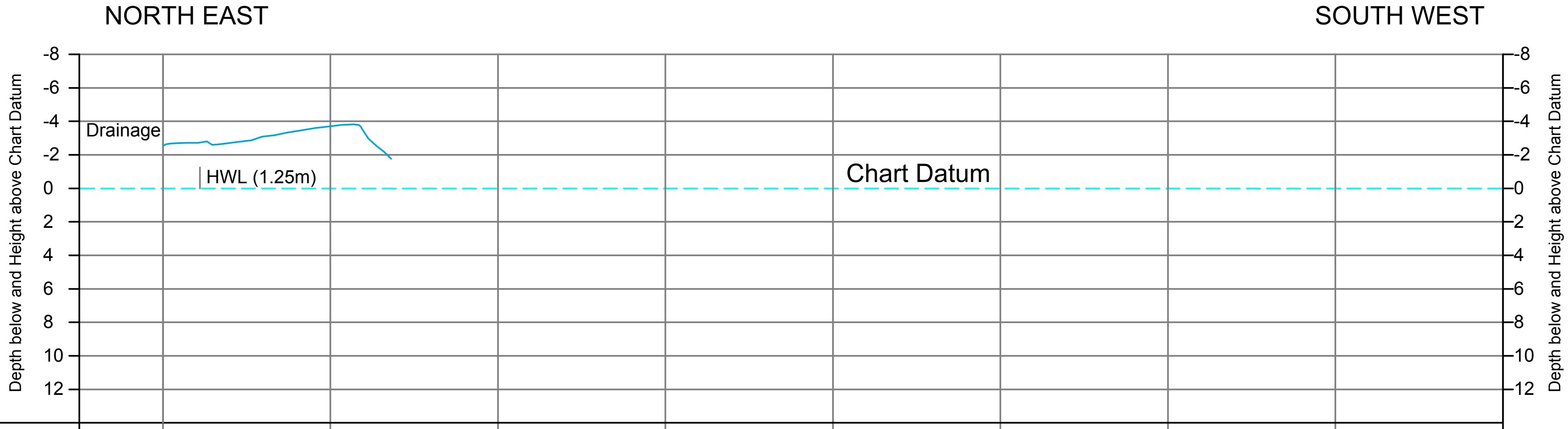

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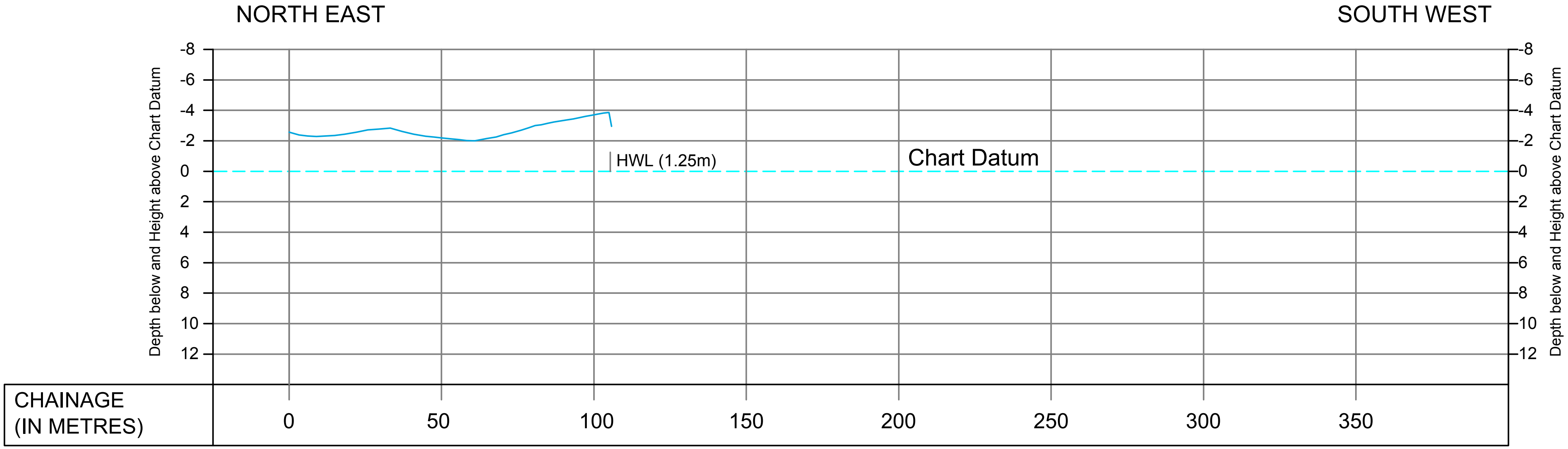

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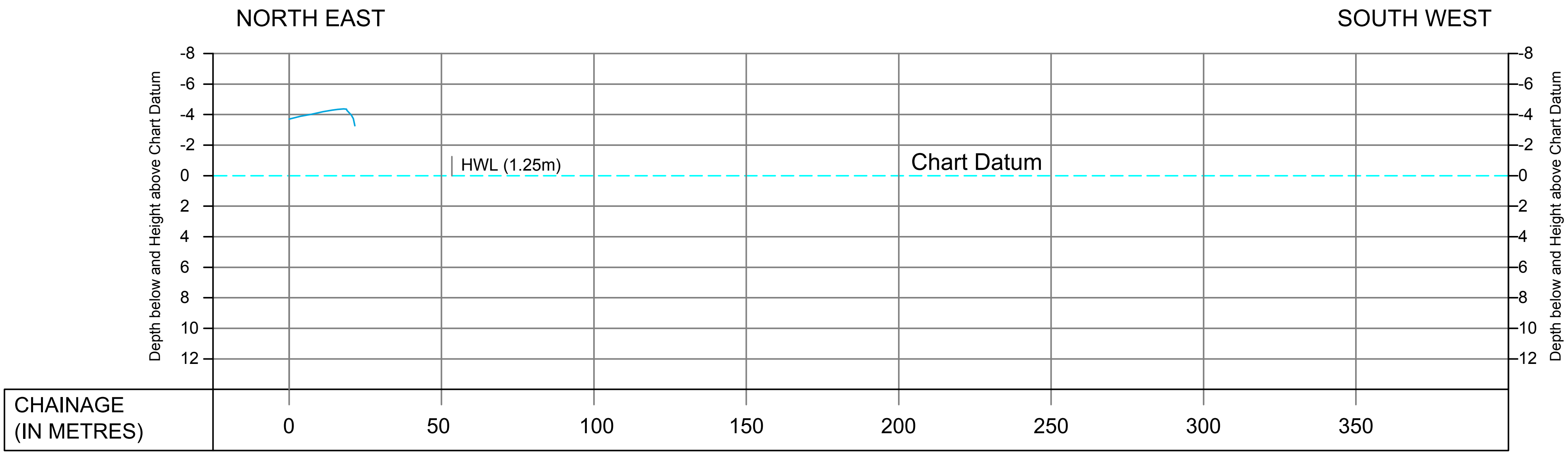

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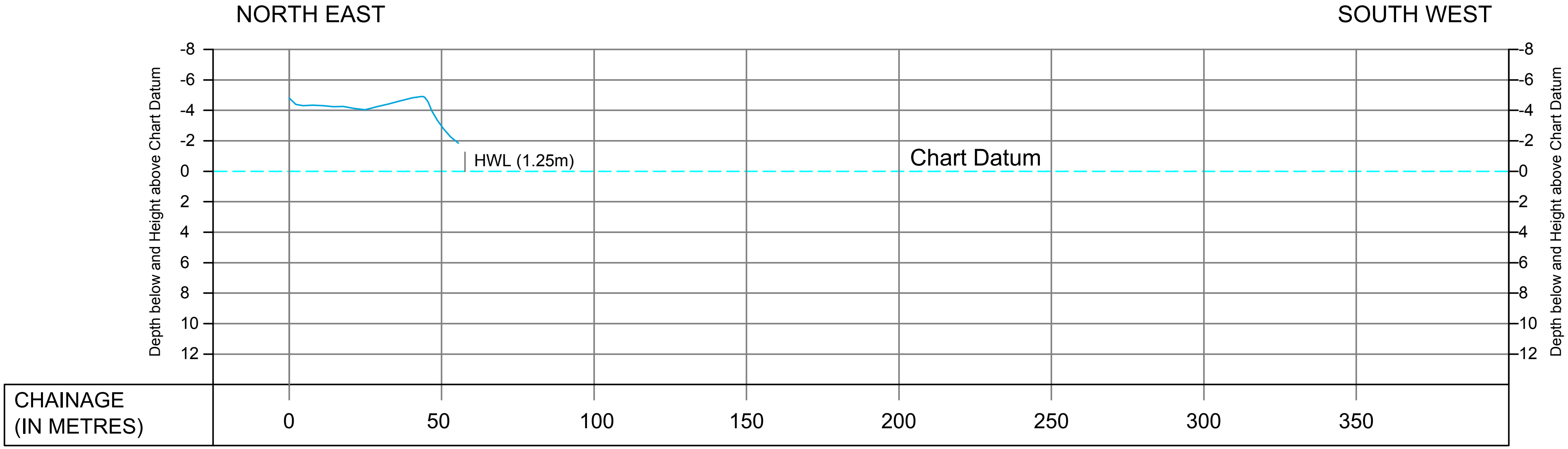
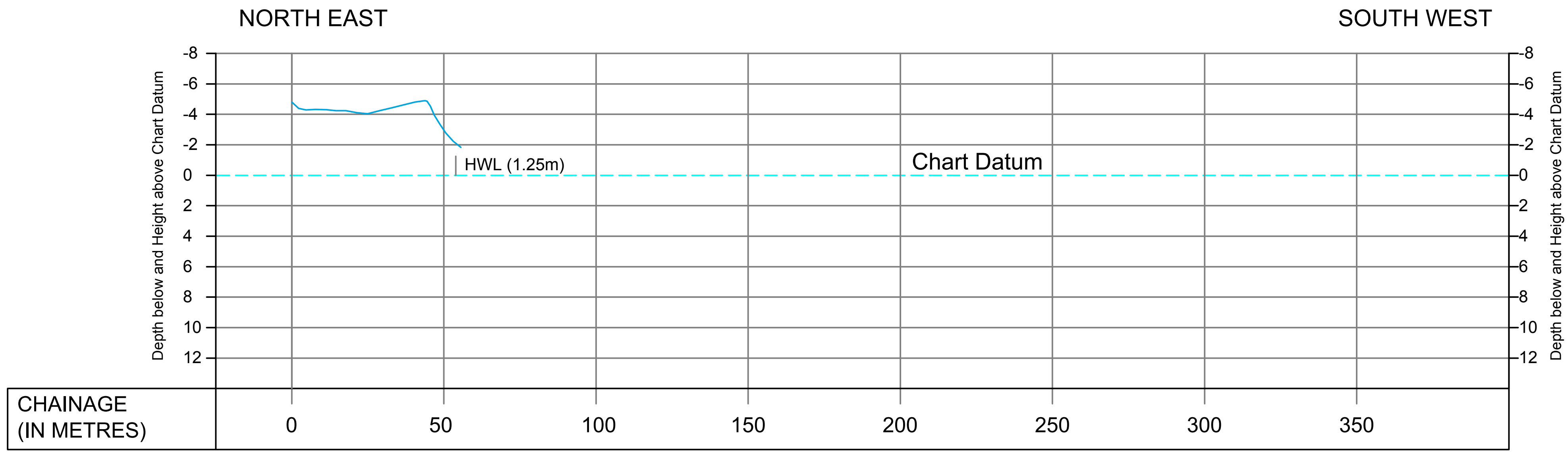


SCALE
HORIZONTAL 1: 1000
VERTICAL 1: 200

adani

Cross Section Line No.CSP-37 (June 2019)



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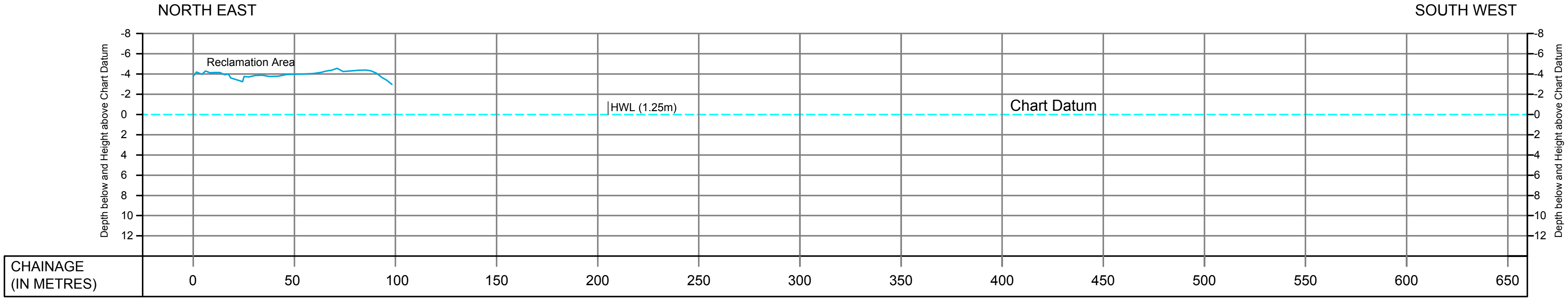

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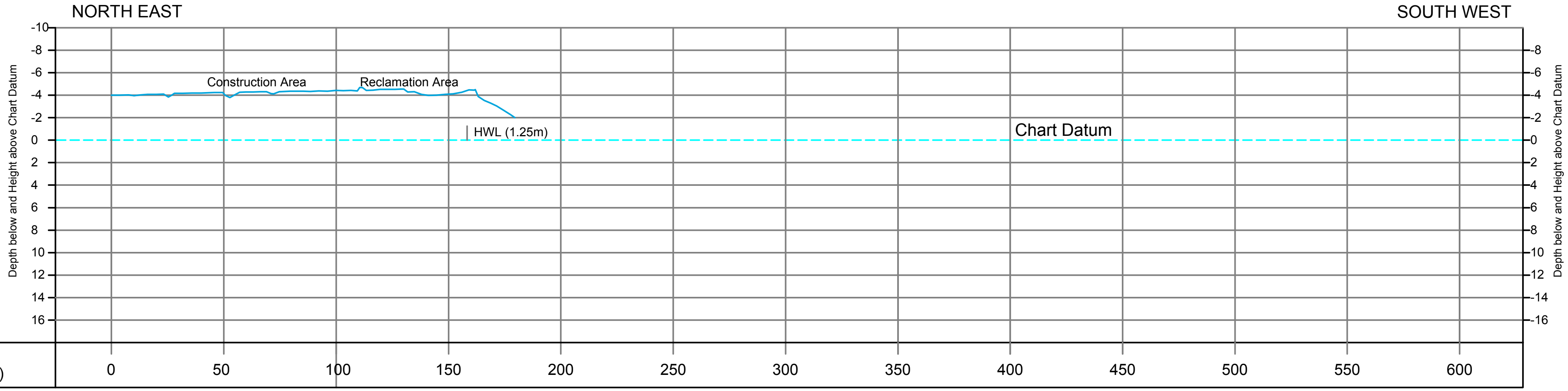

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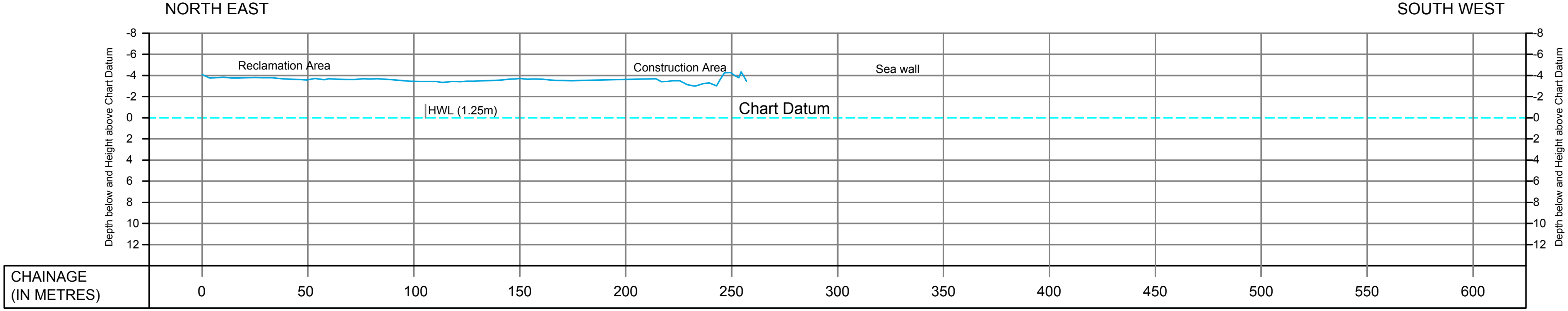

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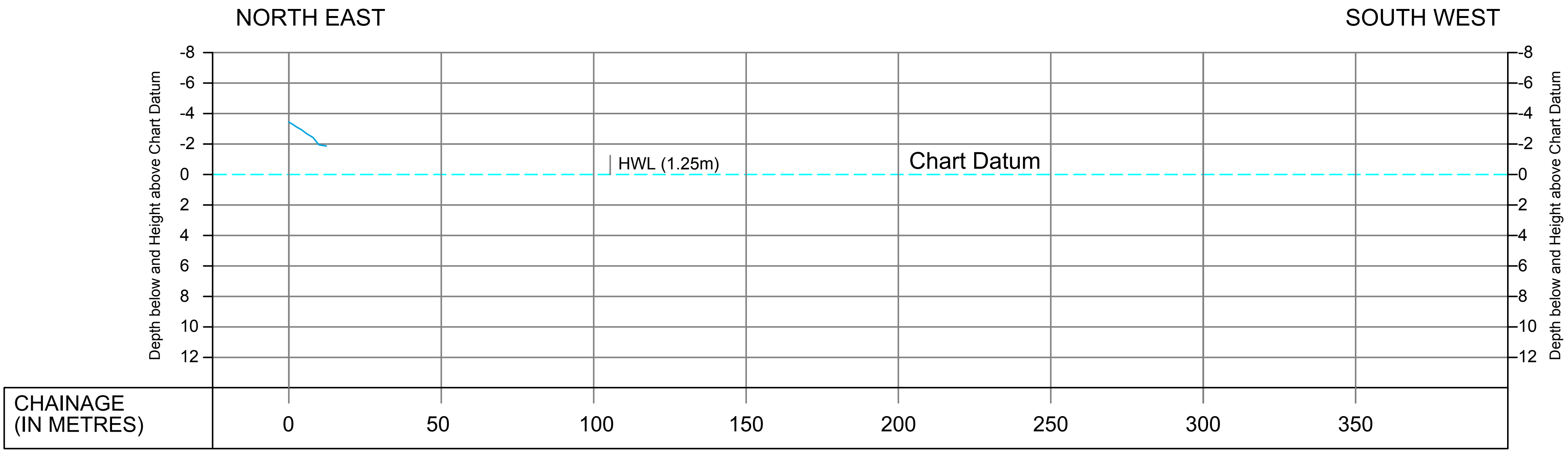
Cross Section Line No.CSP-41 (June 2019)



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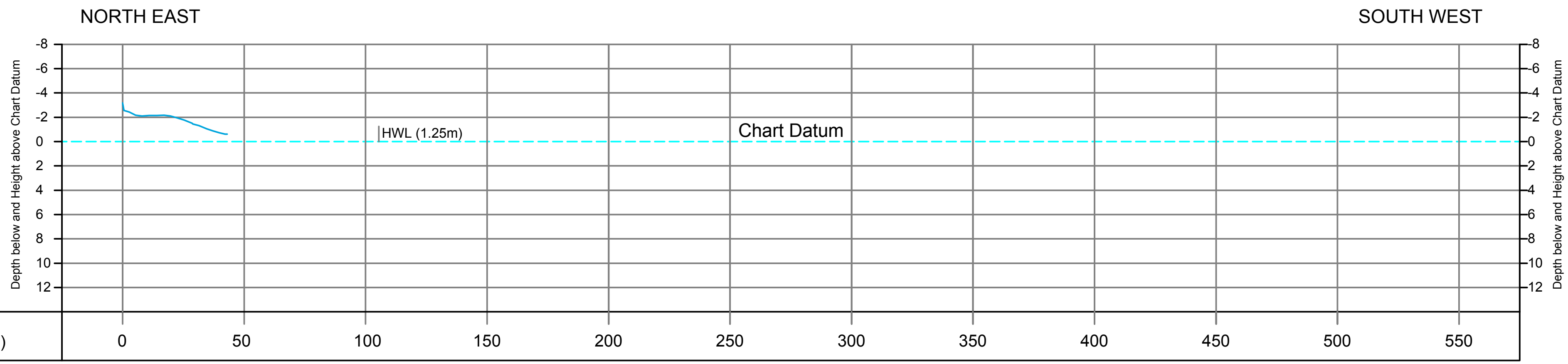
Cross Section Line No.CSP-42 (June 2019)



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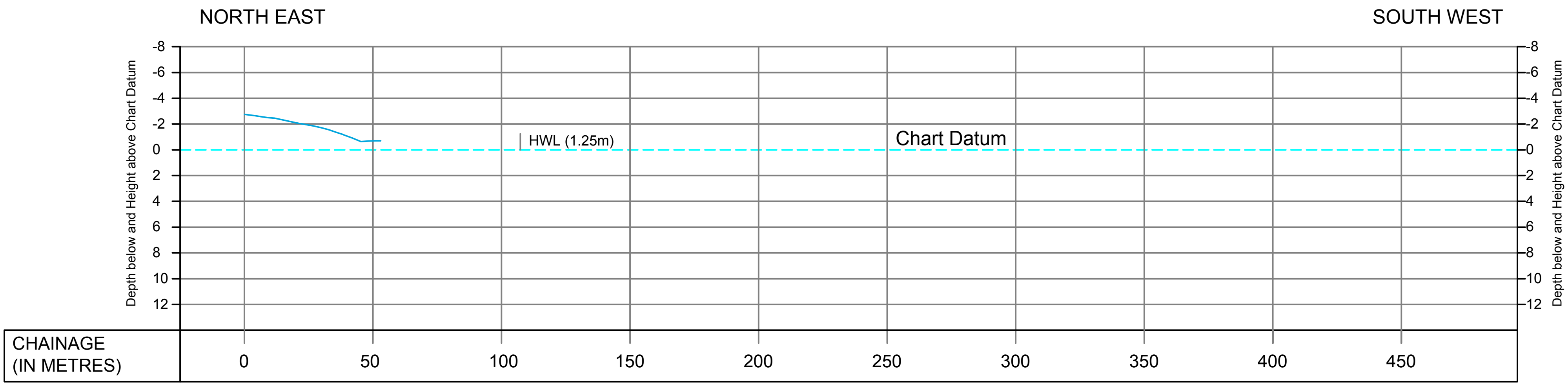

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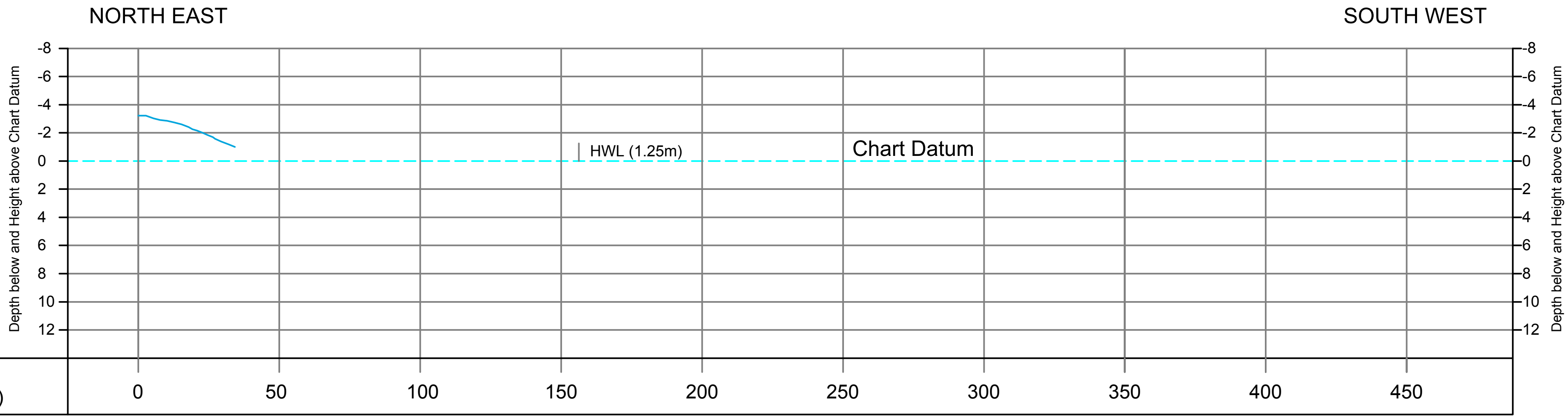

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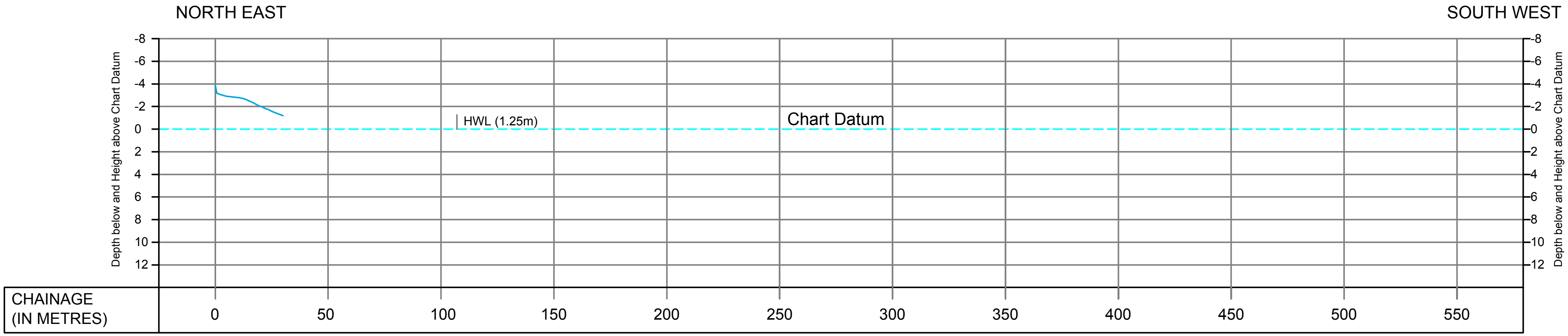

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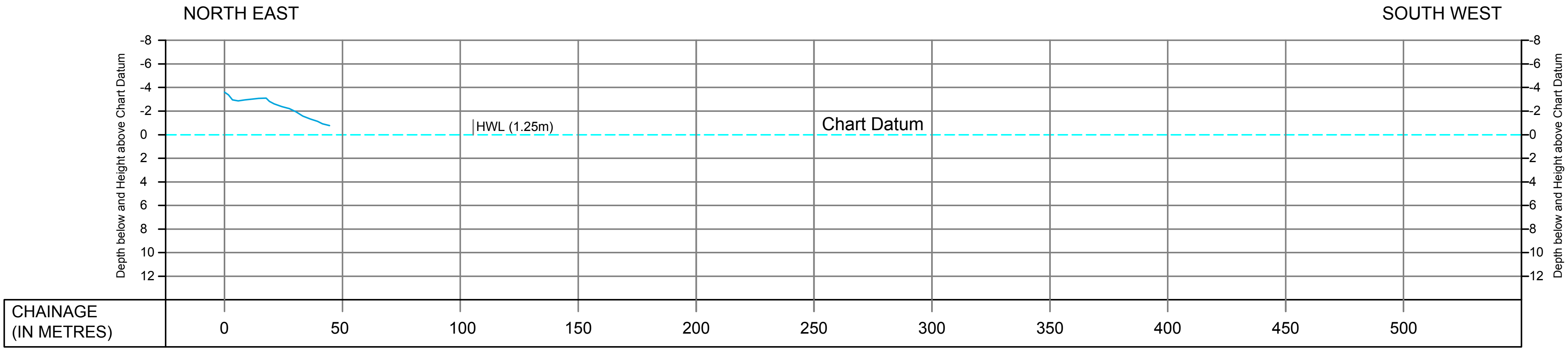

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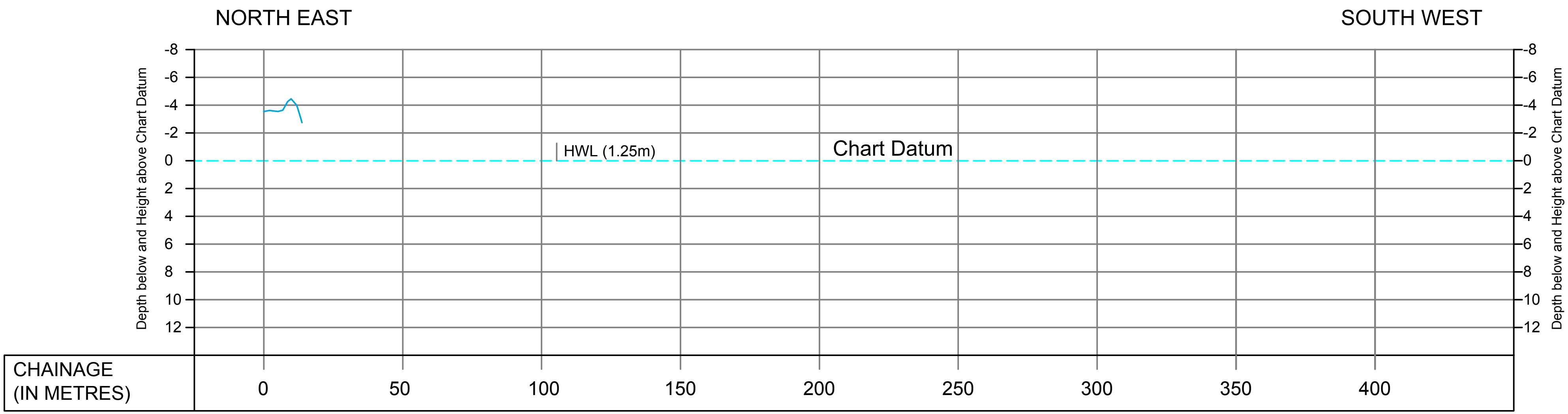
Cross Section Line No.CSP-47 (June 2019)



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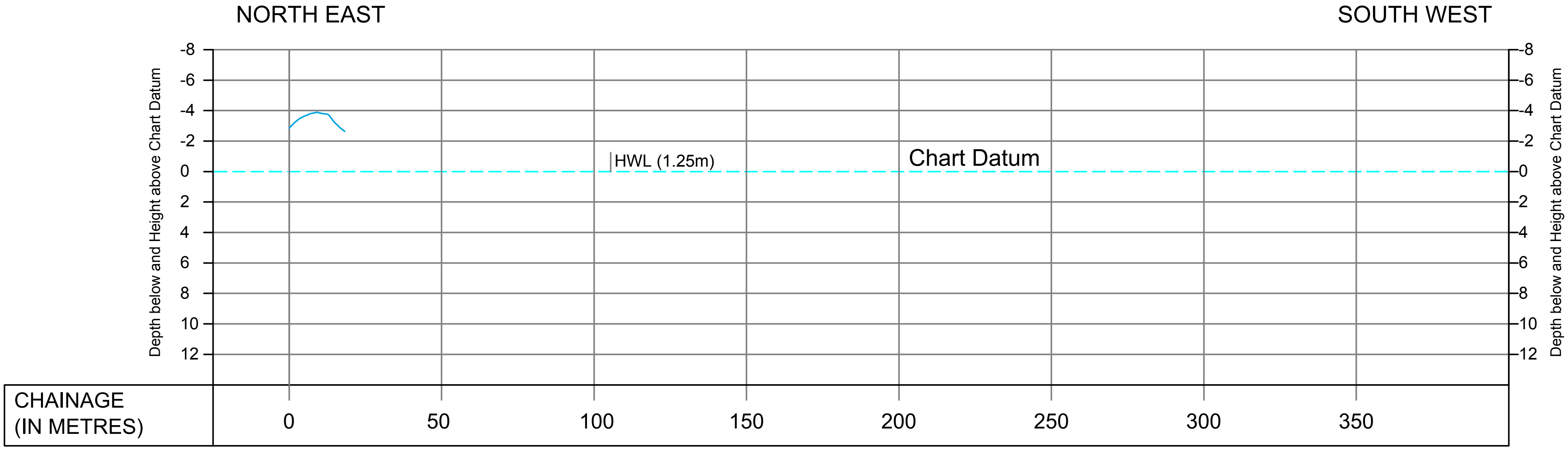

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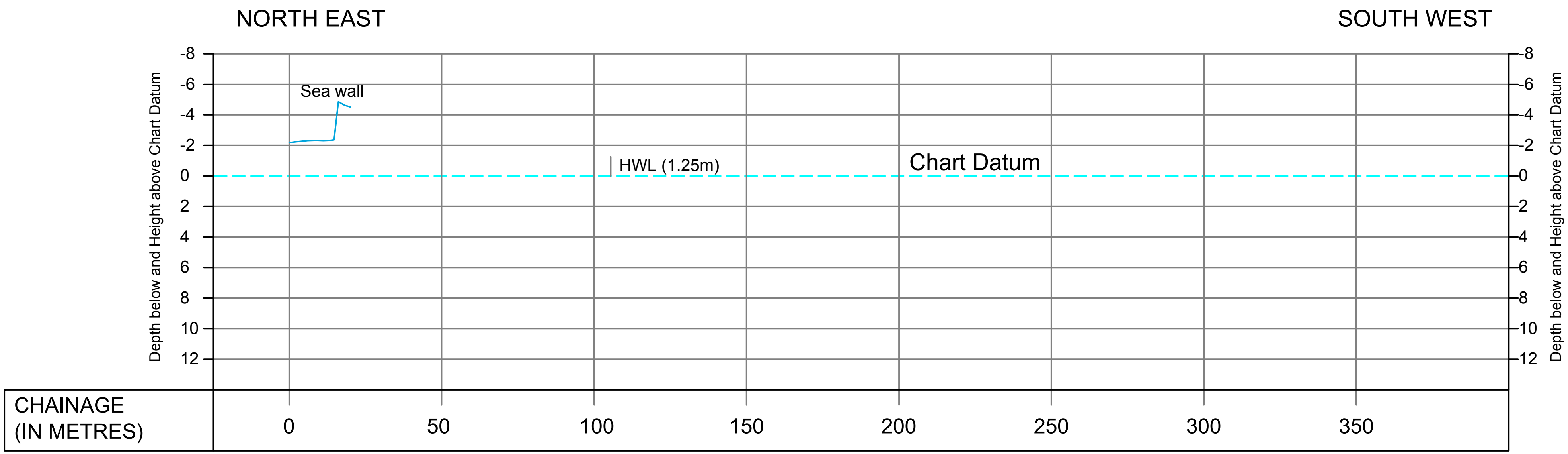

SCALE
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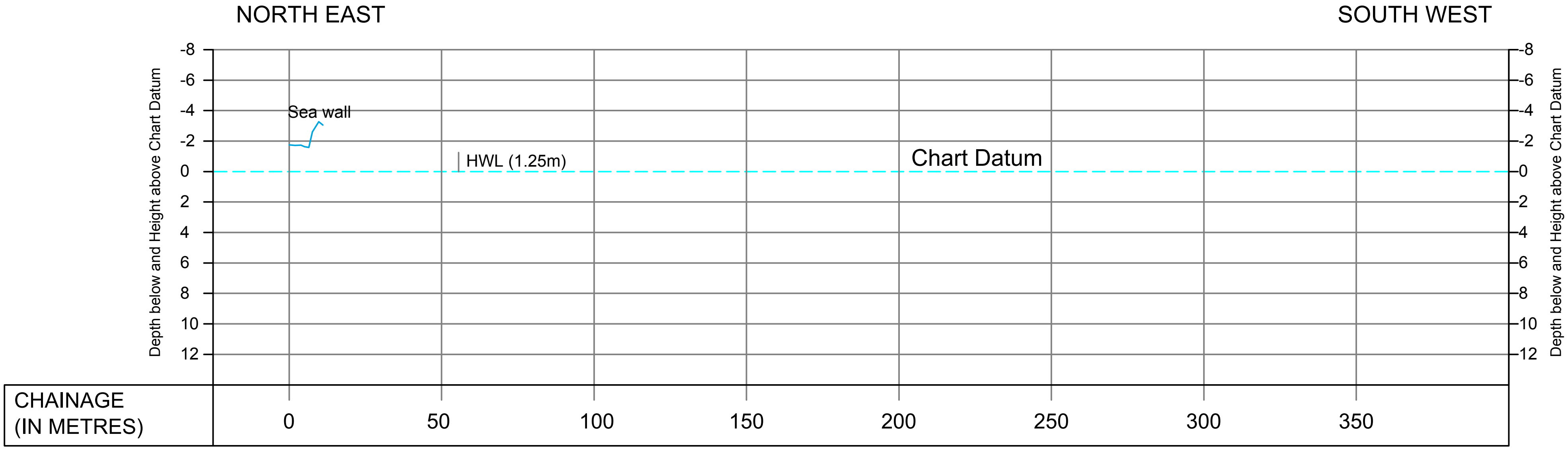
Cross Section Line No.CSP-50 (June 2019)



SCALE
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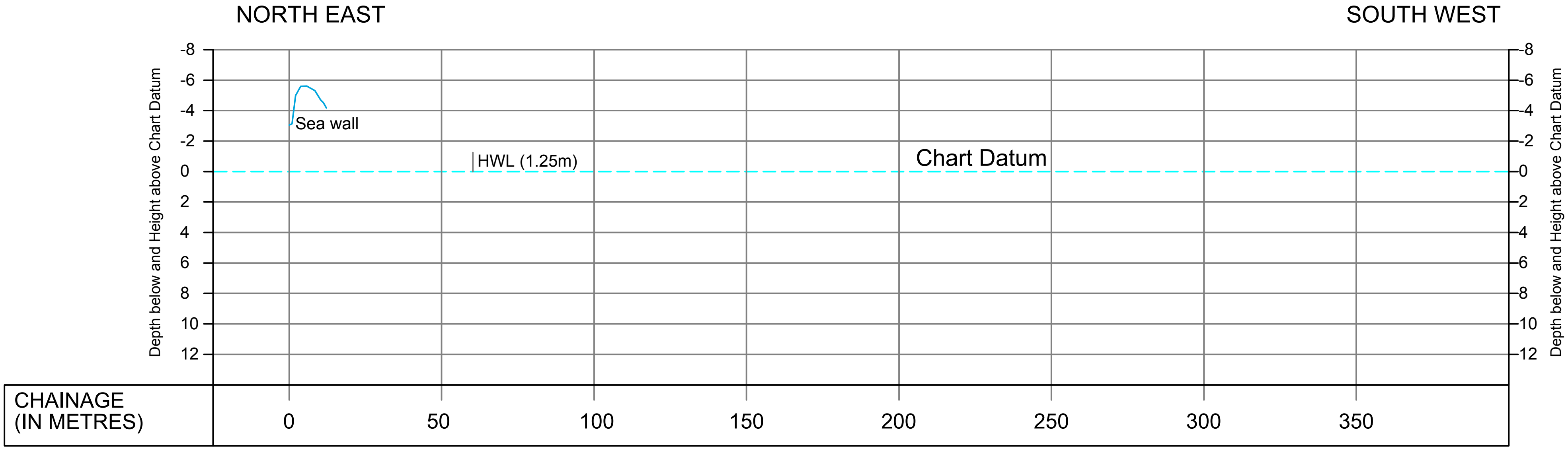
Cross Section Line No.CSP-51 (June 2019)



SCALE
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VERTICAL 1: 200

Oceanographic & Bathymetric data collection for Assessment
of Shoreline Changes at Vizhinjam for AVPPL
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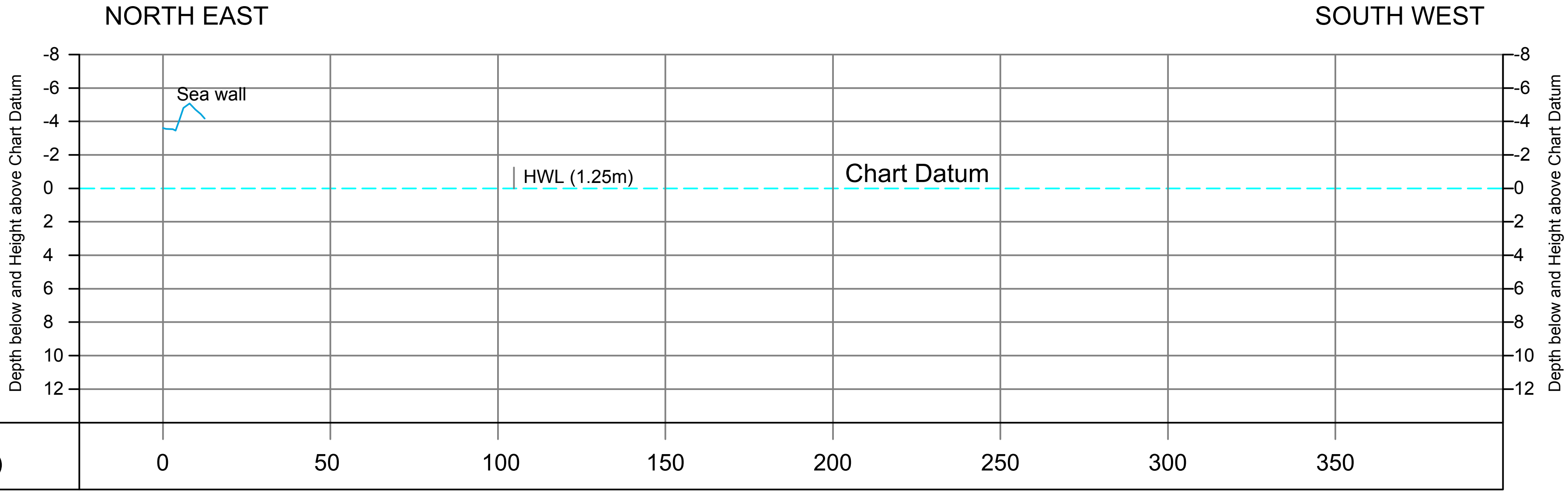
Cross Section Line No.CSP-52 (June 2019)



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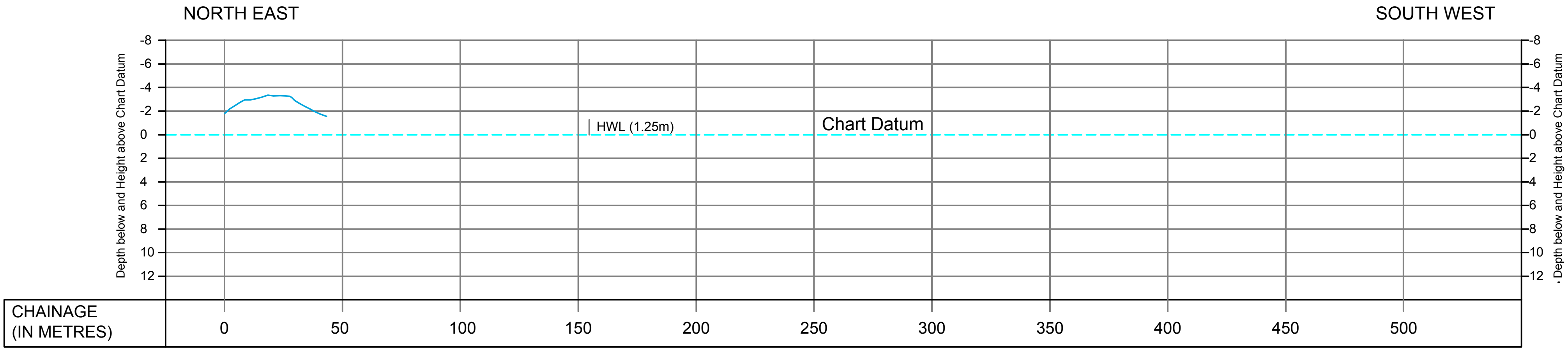
Cross Section Line No.CSP-53 (June 2019)



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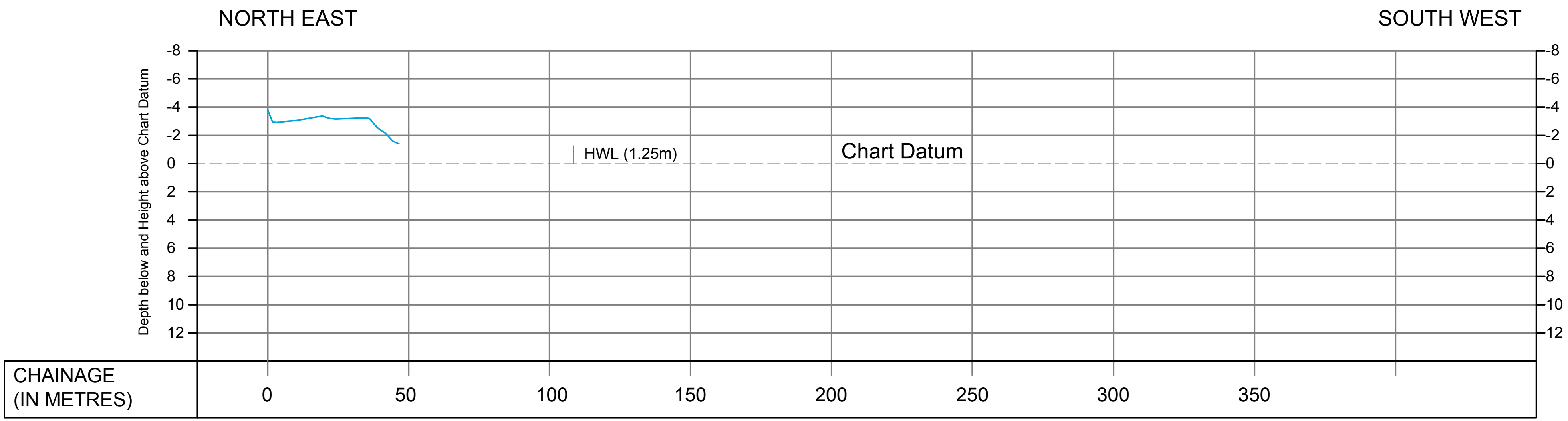
Cross Section Line No.CSP-54 (June 2019)



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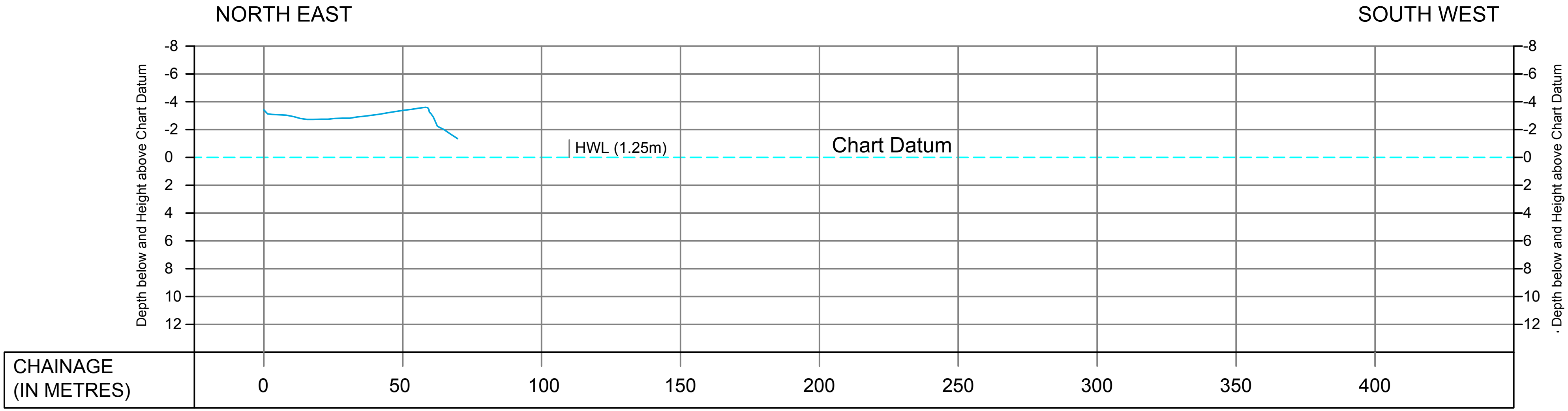
Cross Section Line No.CSP-55 (June 2019)



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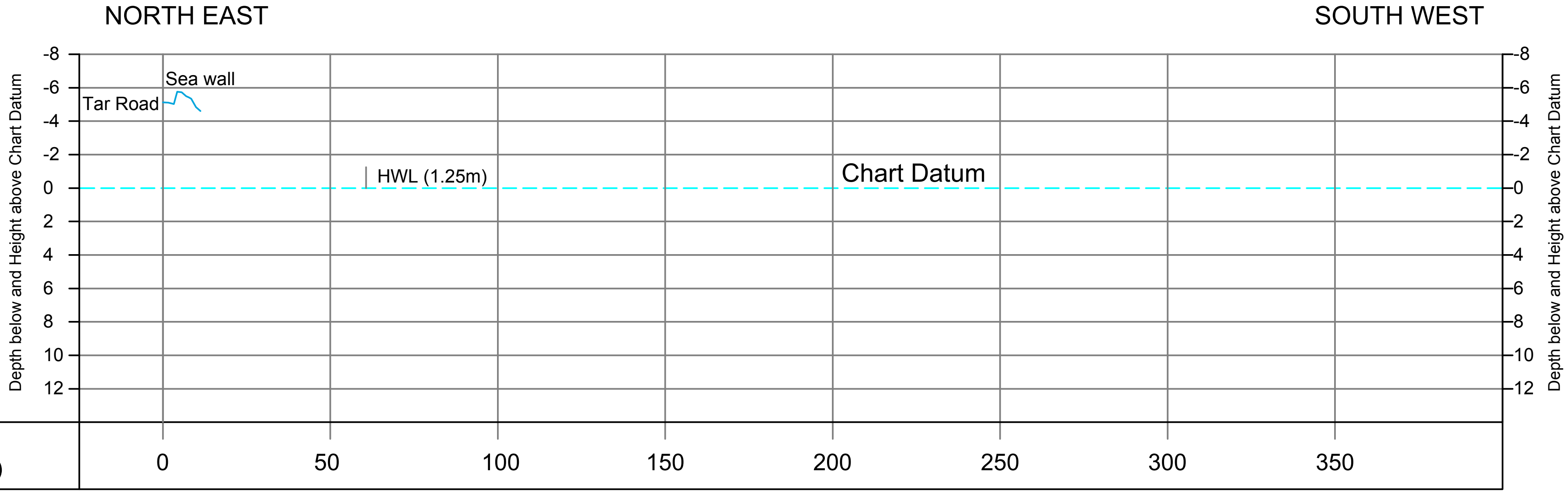
Cross Section Line No.CSP-56 (June 2019)



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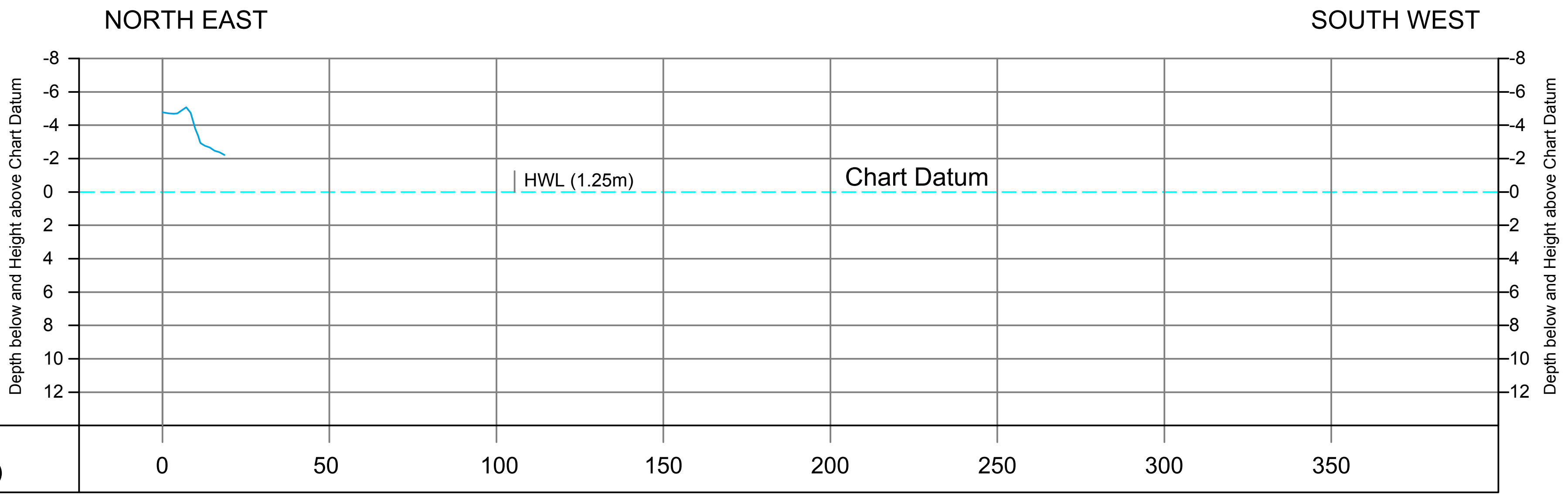
Cross Section Line No.CSP-57 (June 2019)



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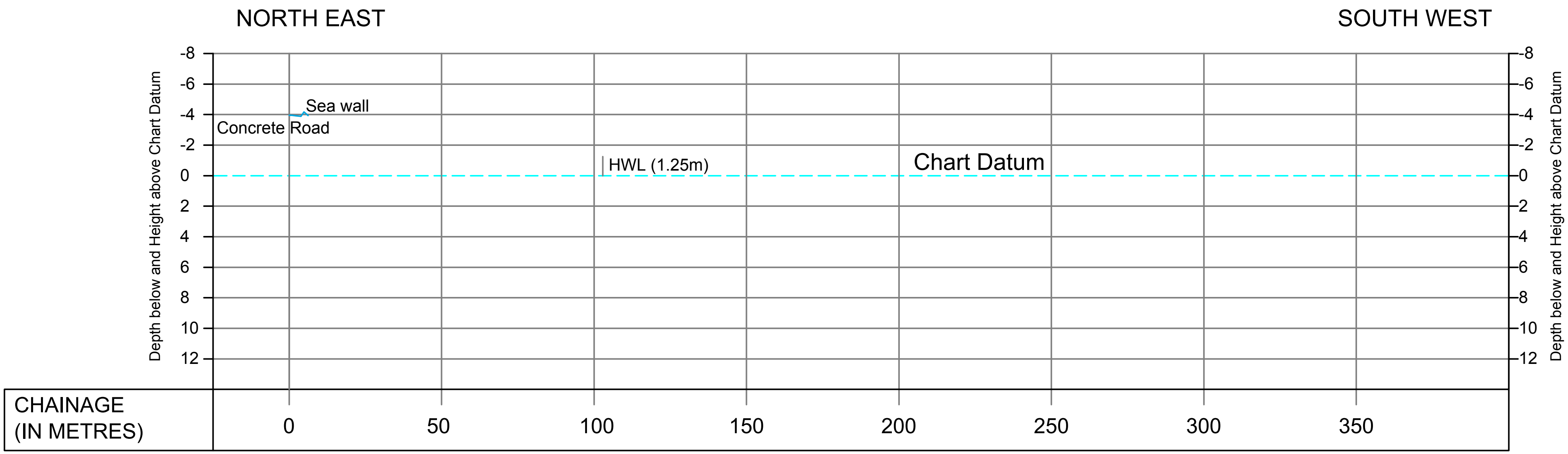
Cross Section Line No.CSP-58 (June 2019)



SCALE
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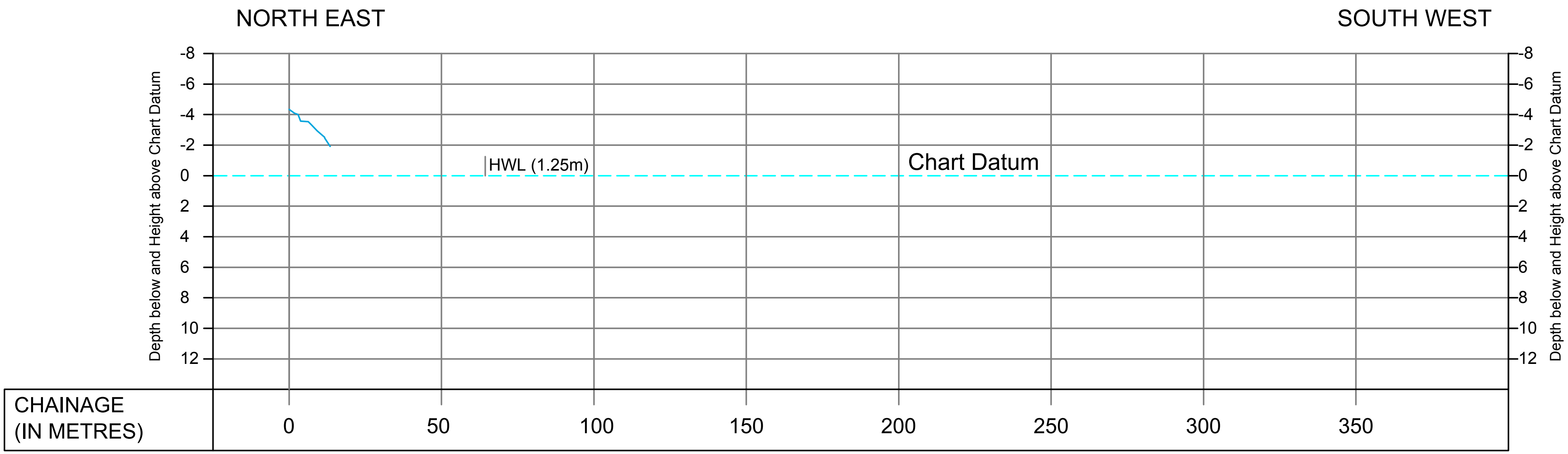
Cross Section Line No.CSP-59 (June 2019)



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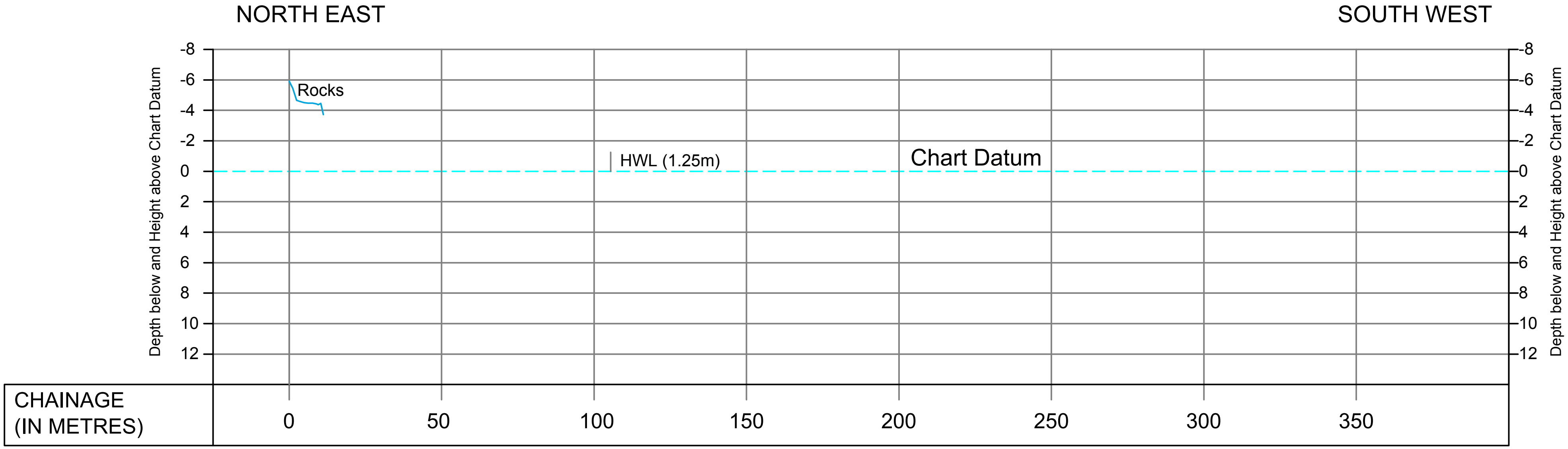

SCALE
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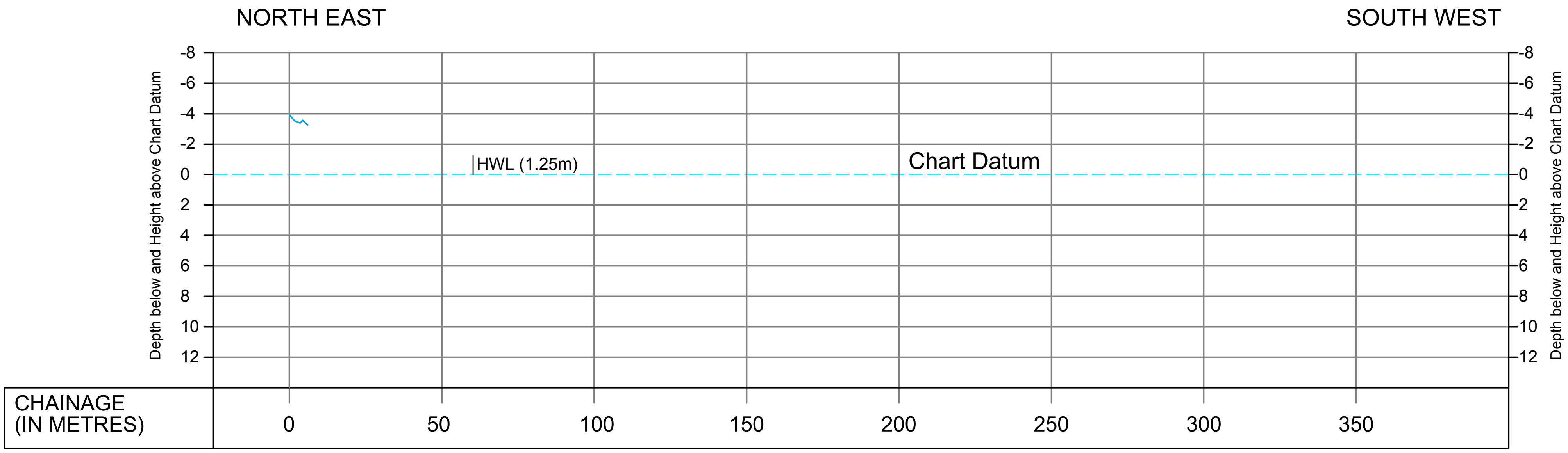
Cross Section Line No.CSP-61 (June 2019)



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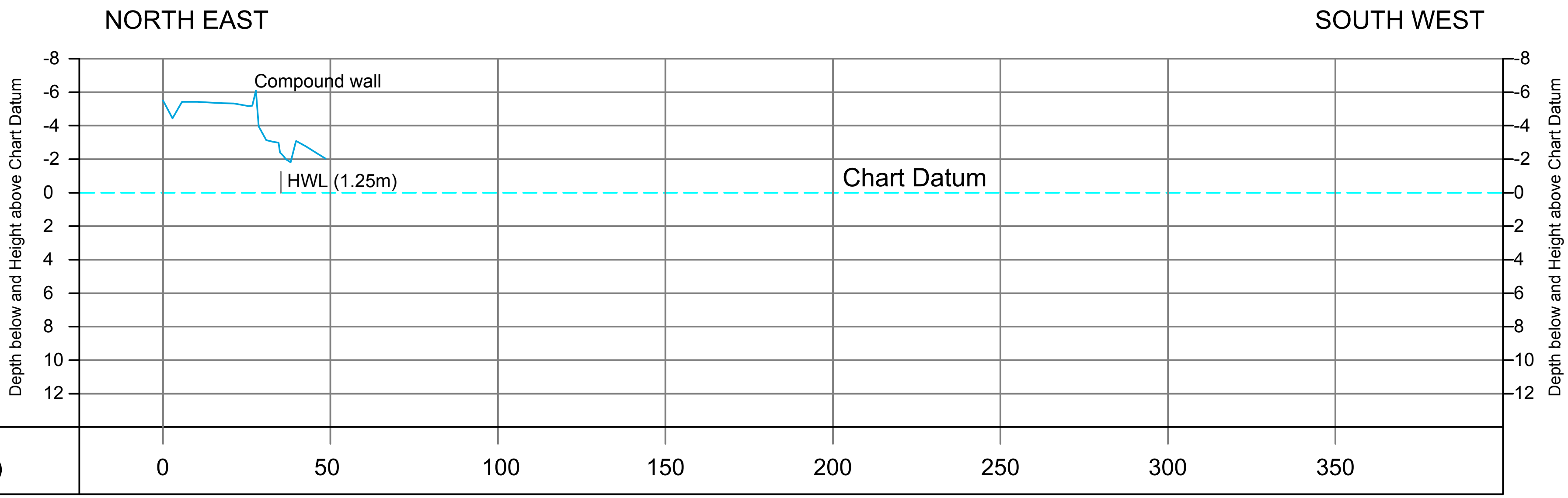
Cross Section Line No.CSP-62 (June 2019)



SCALE
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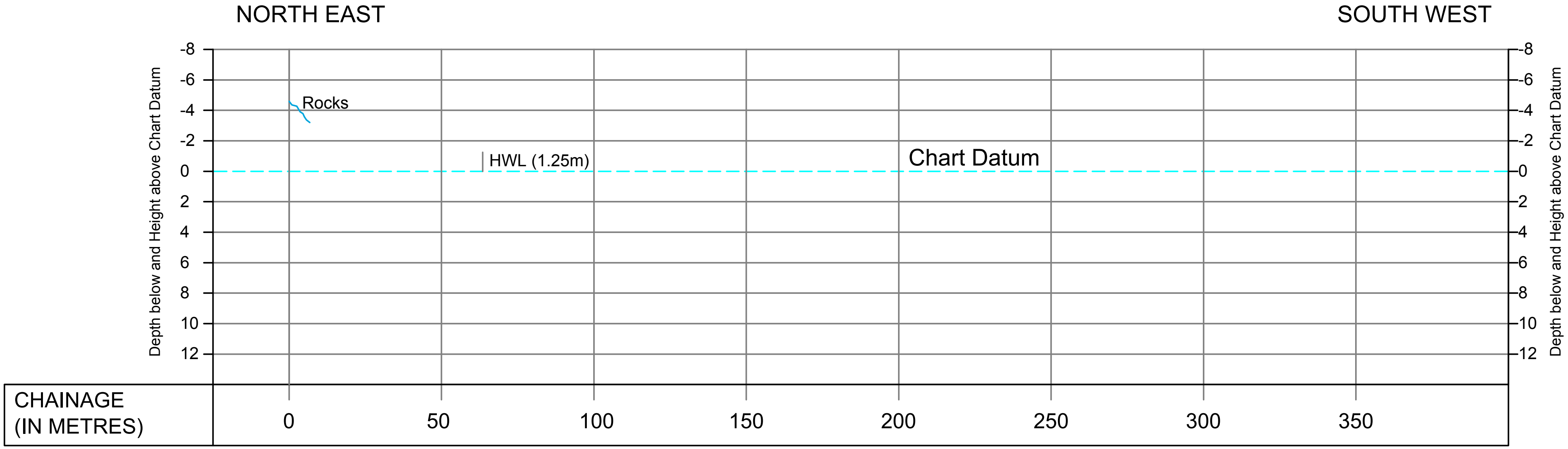
Cross Section Line No.CSP-63 (June 2019)



SCALE
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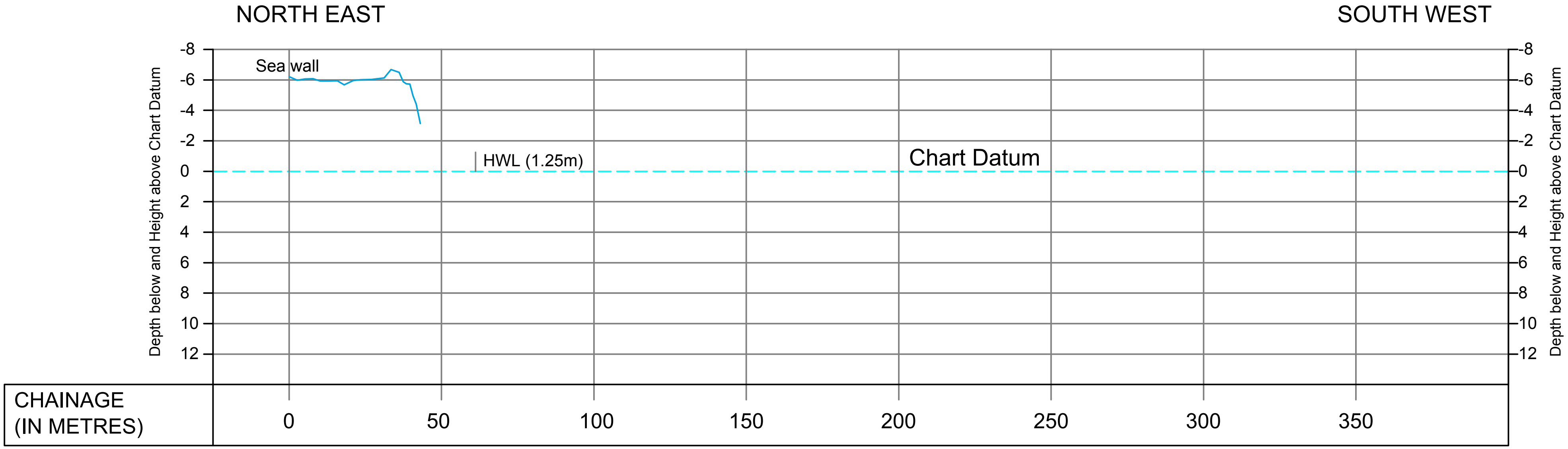
VERTICAL 1: 200

Cross Section Line No.CSP-64 (June 2019)



SCALE
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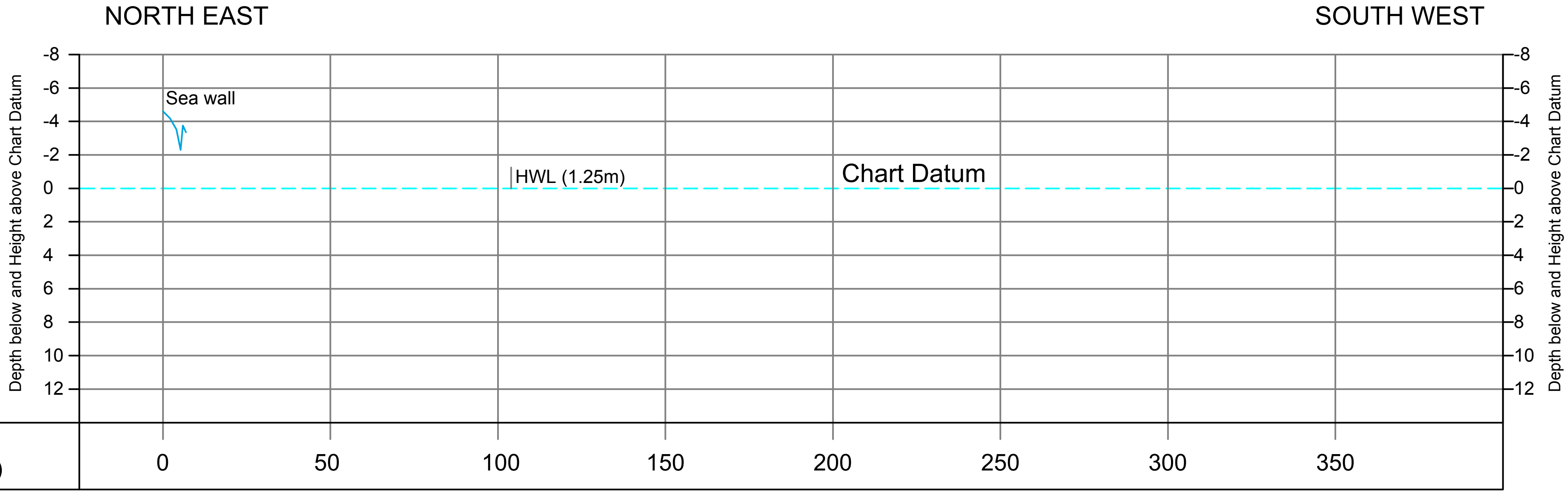
Cross Section Line No.CSP-66 (June 2019)



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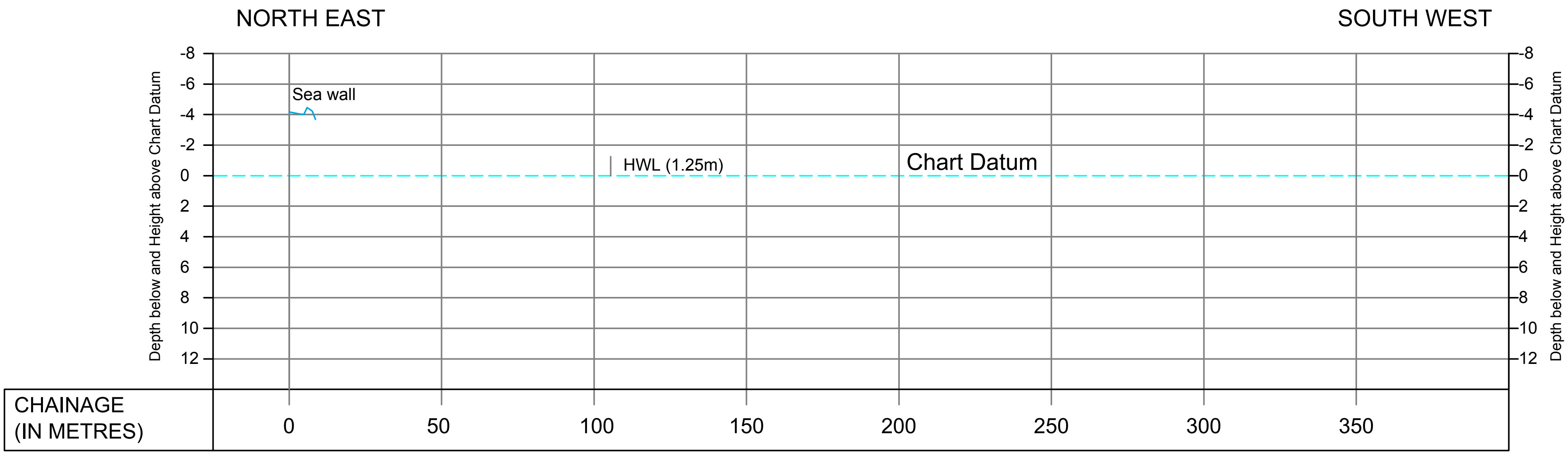
Cross Section Line No.CSP-67 (June 2019)



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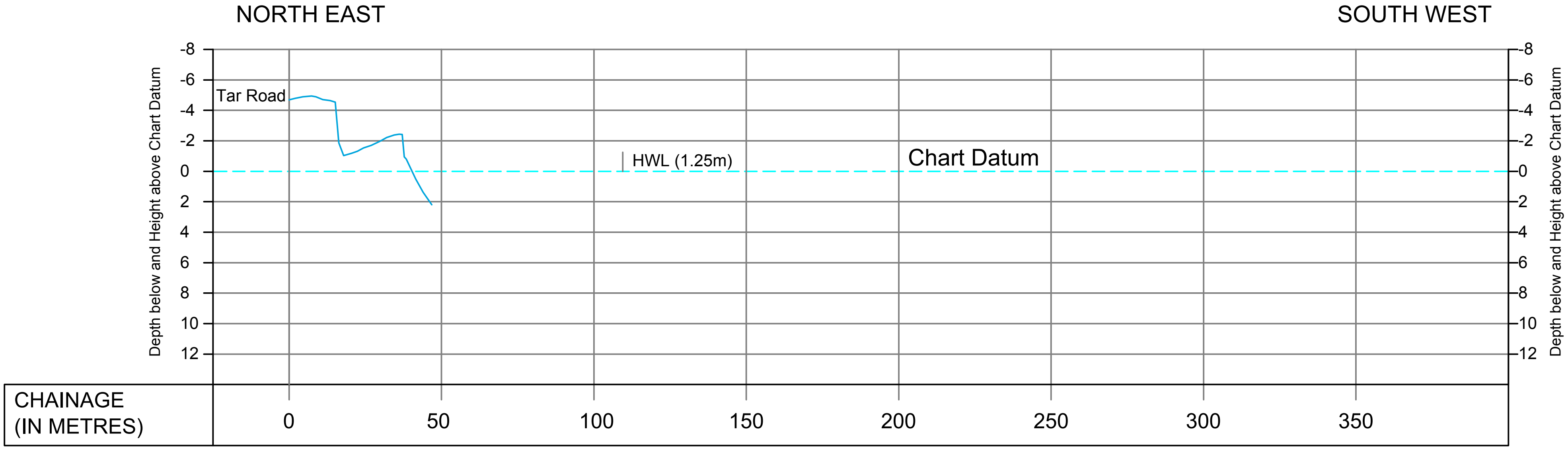
Cross Section Line No.CSP-68 (June 2019)



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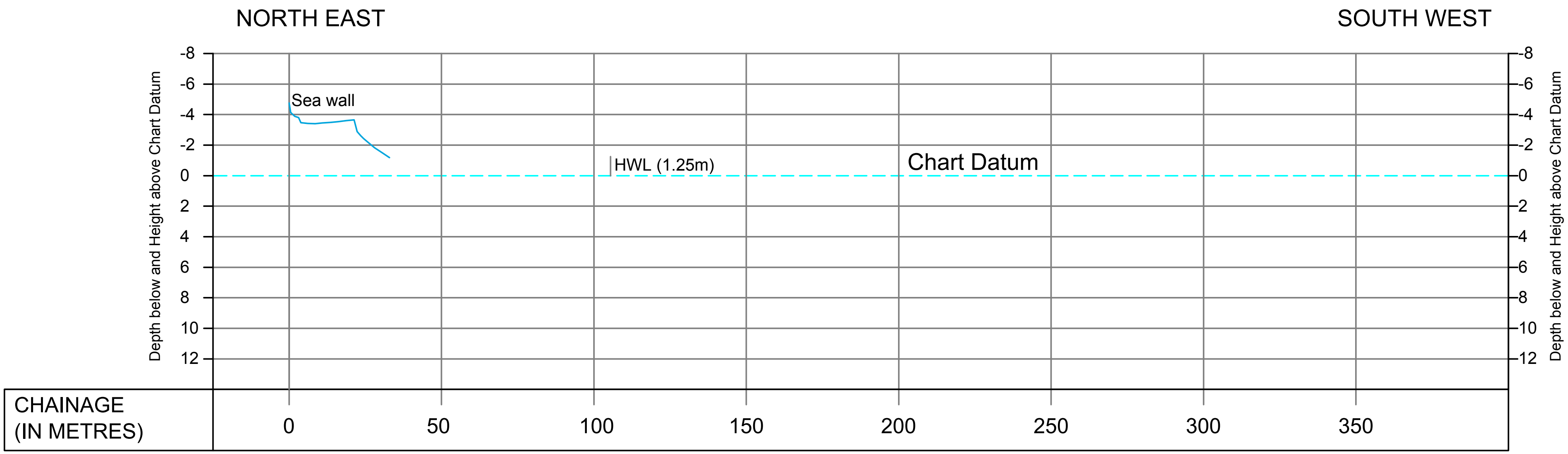
Cross Section Line No.CSP-69 (June 2019)



SCALE
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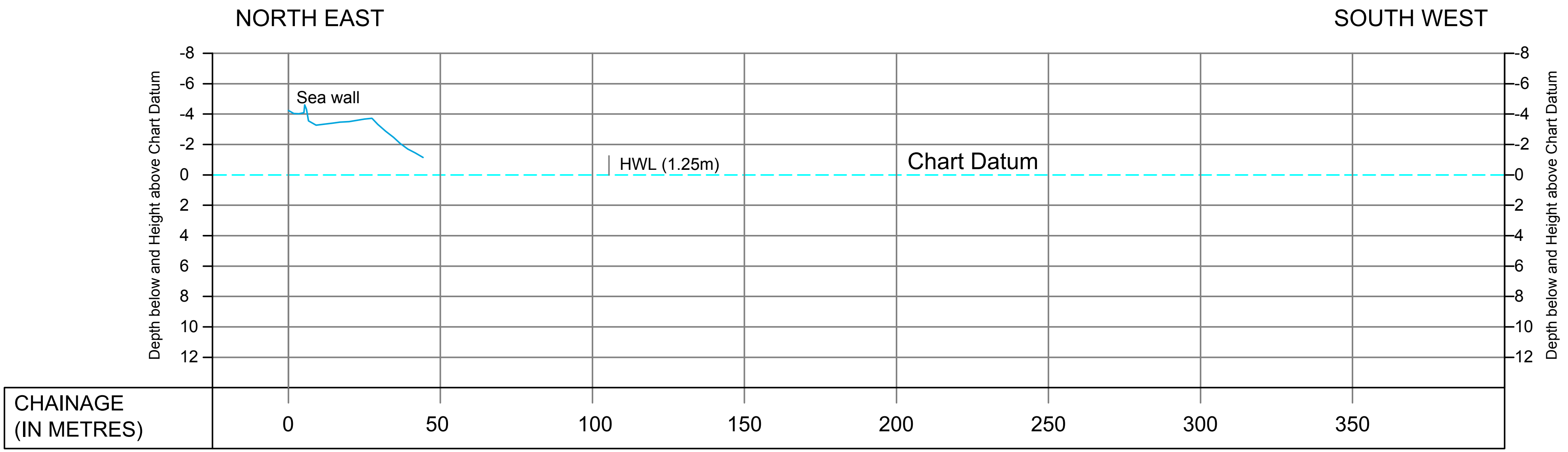
Cross Section Line No.CSP-70 (June 2019)



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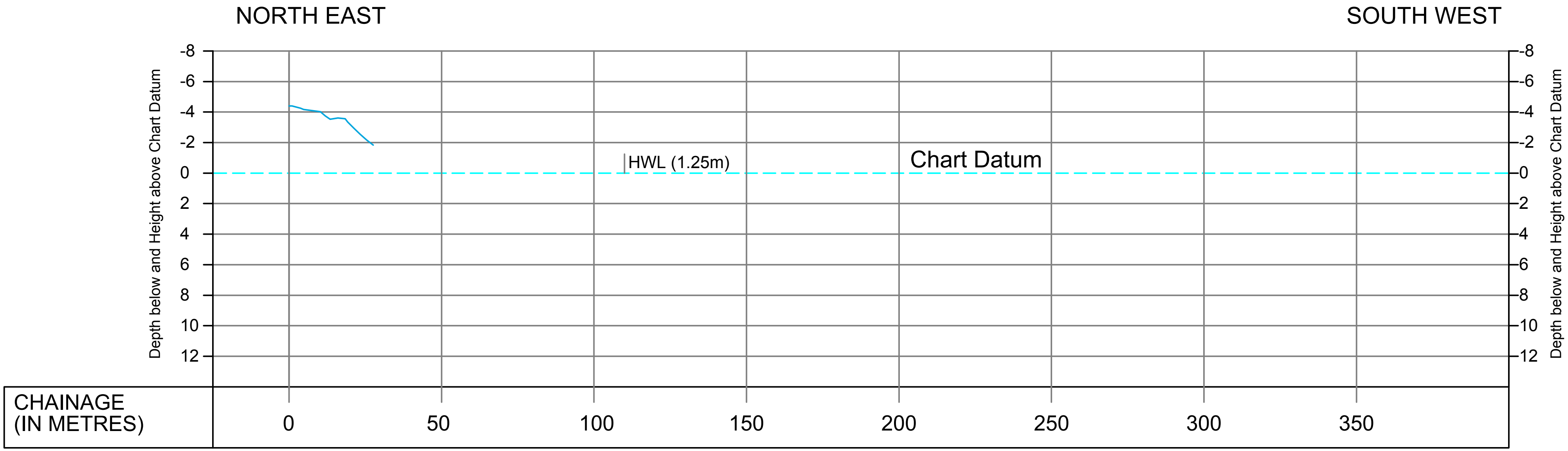

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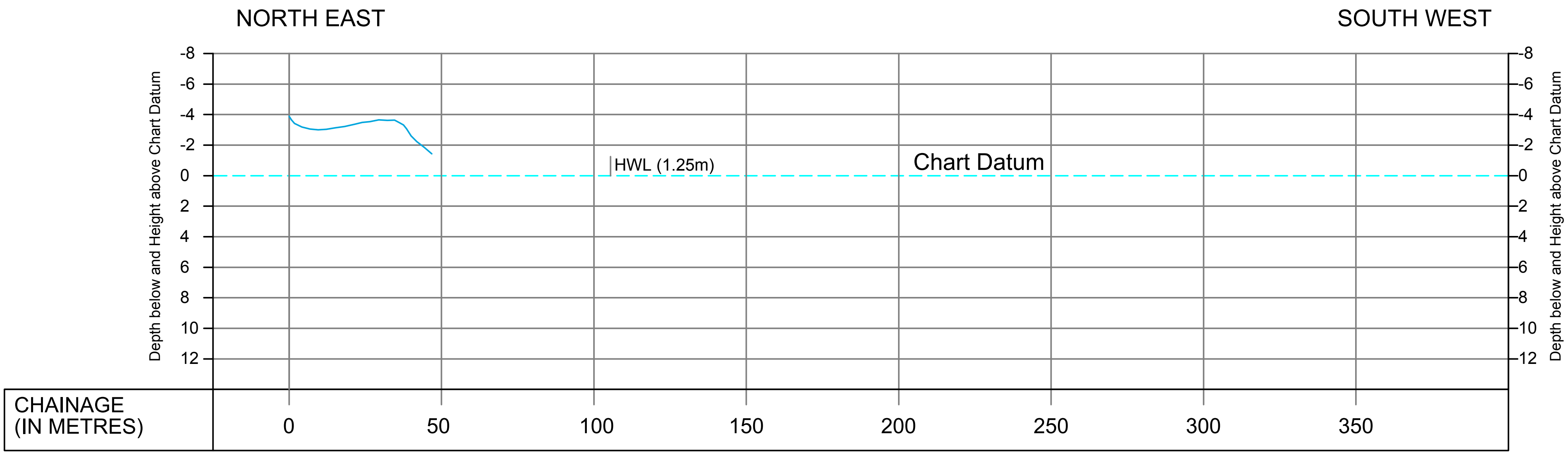

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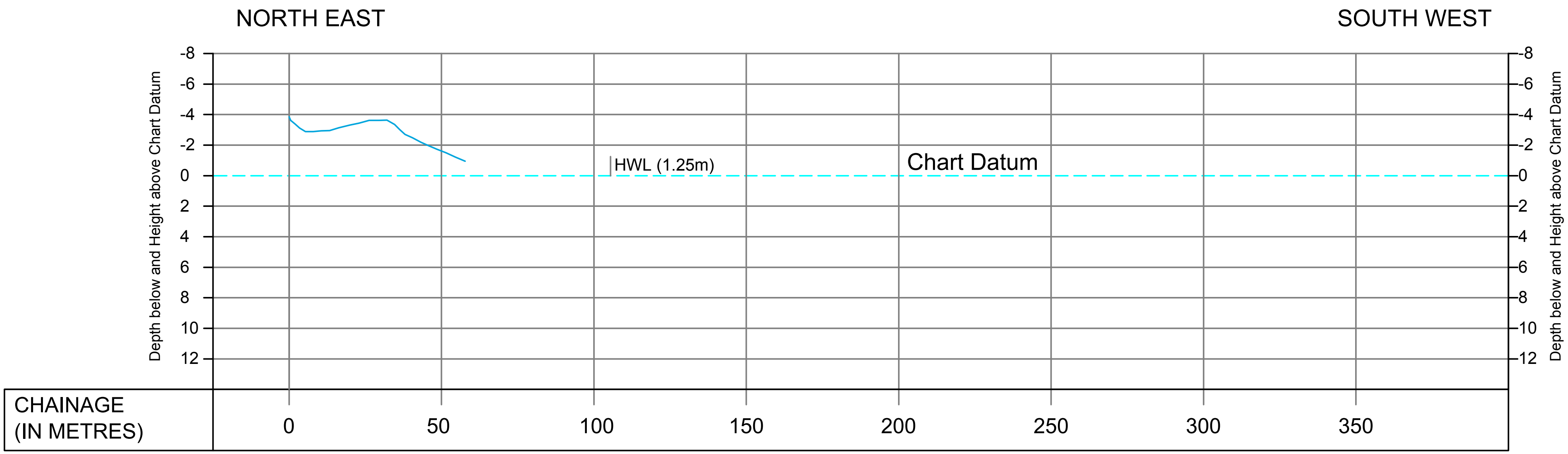

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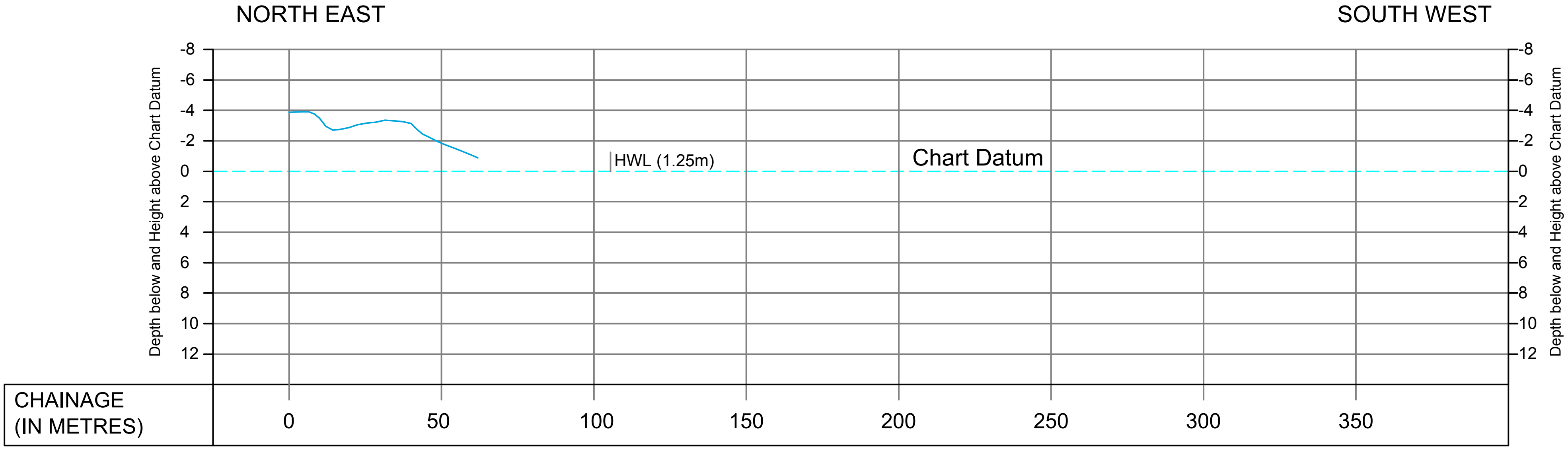

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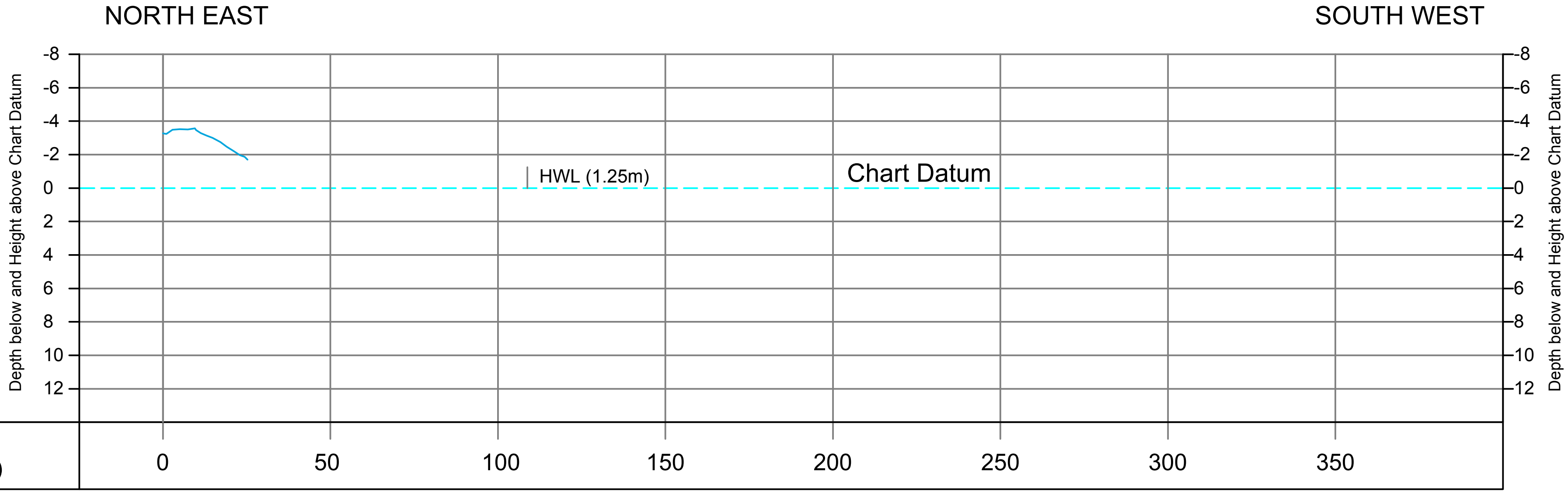

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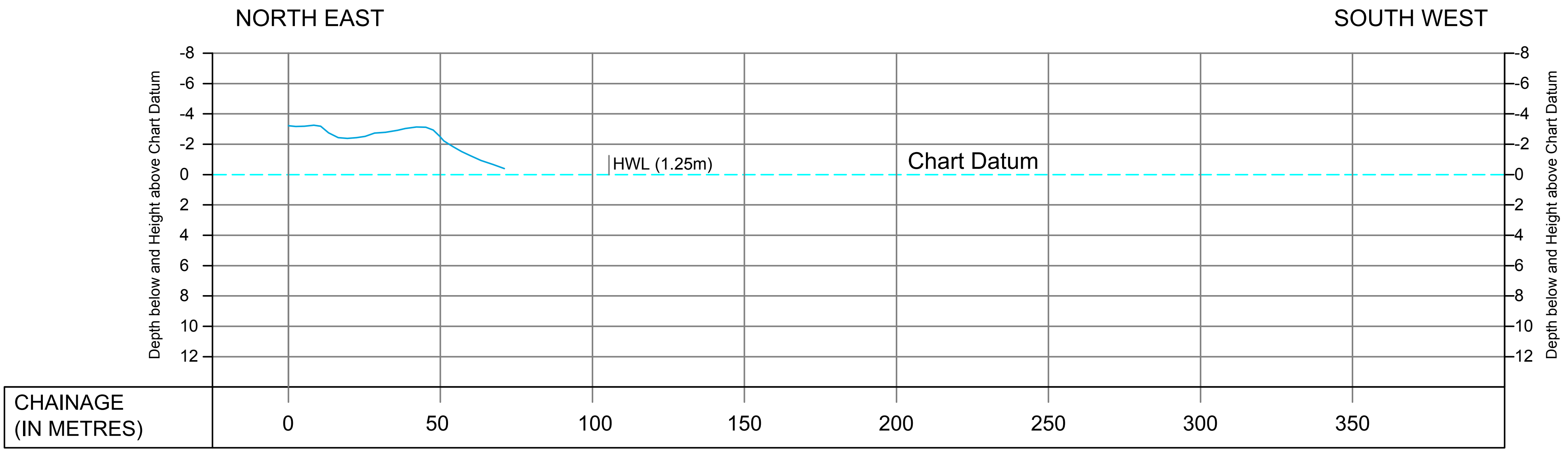

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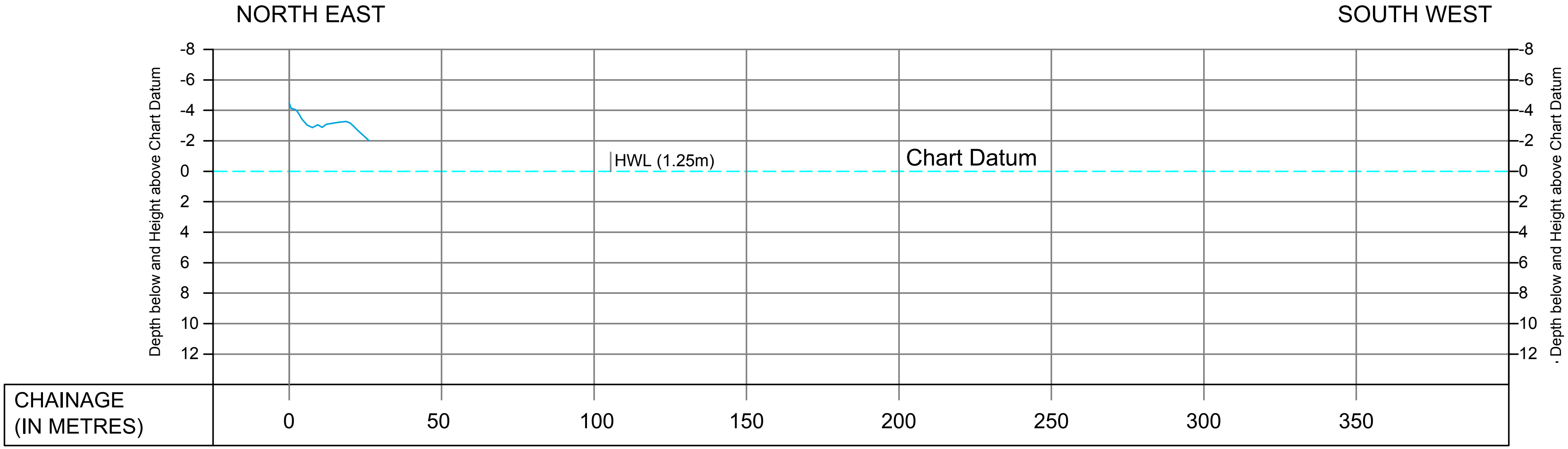

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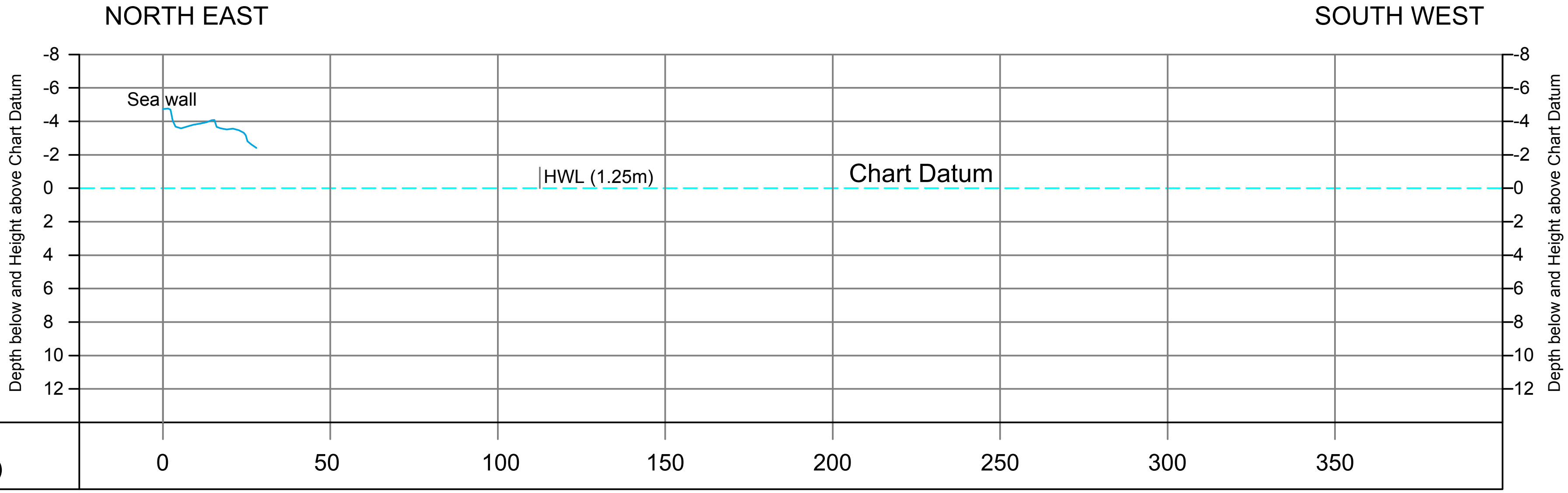

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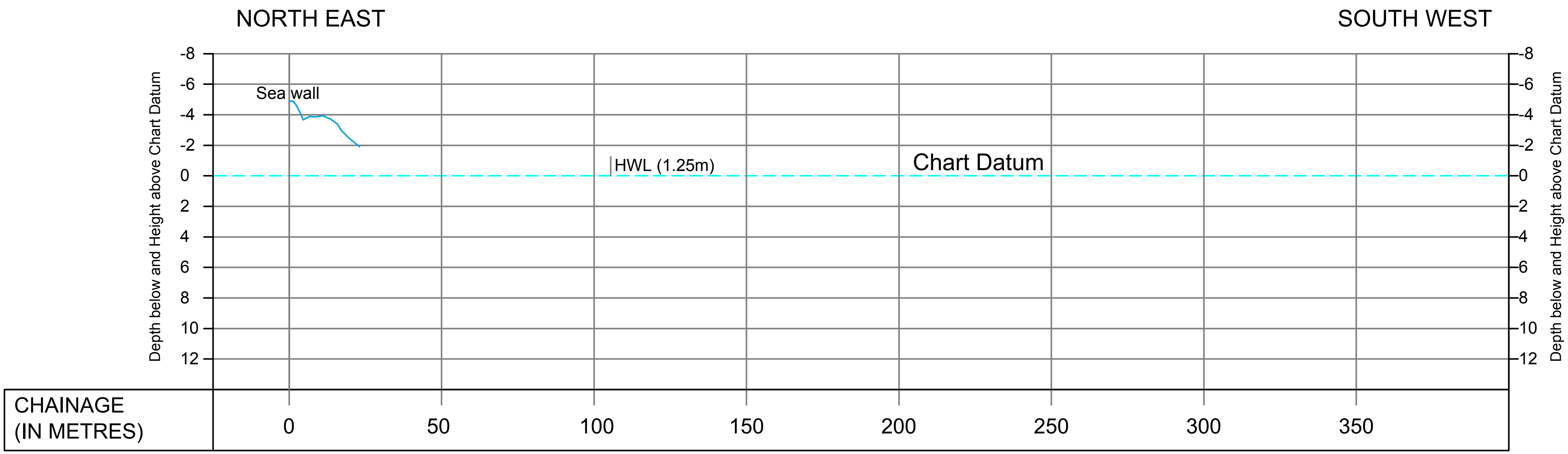

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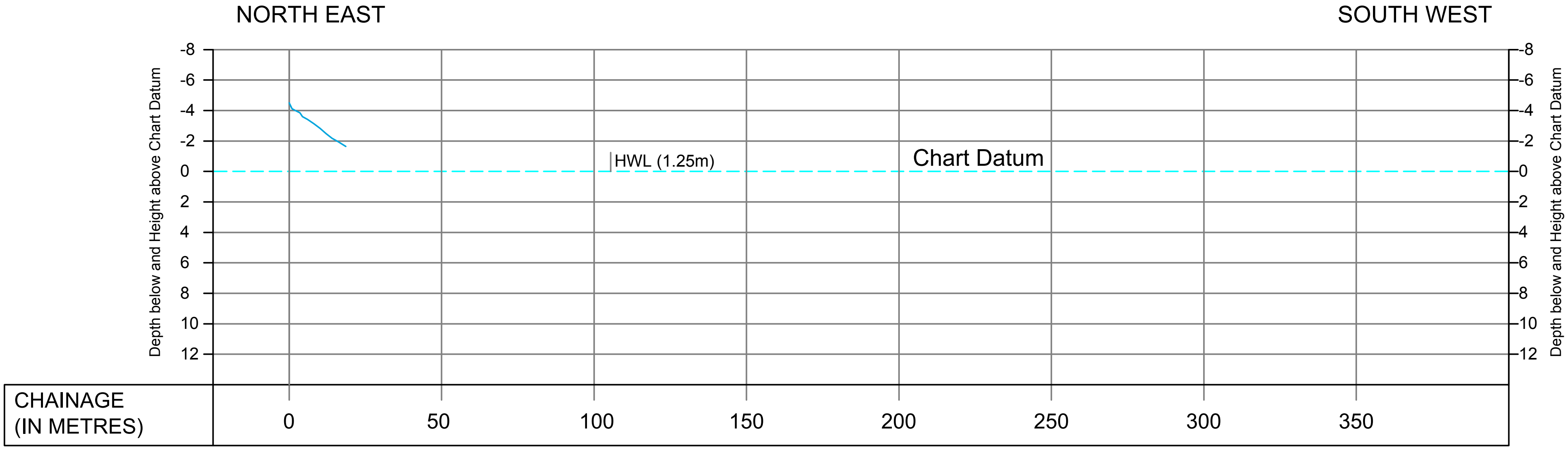

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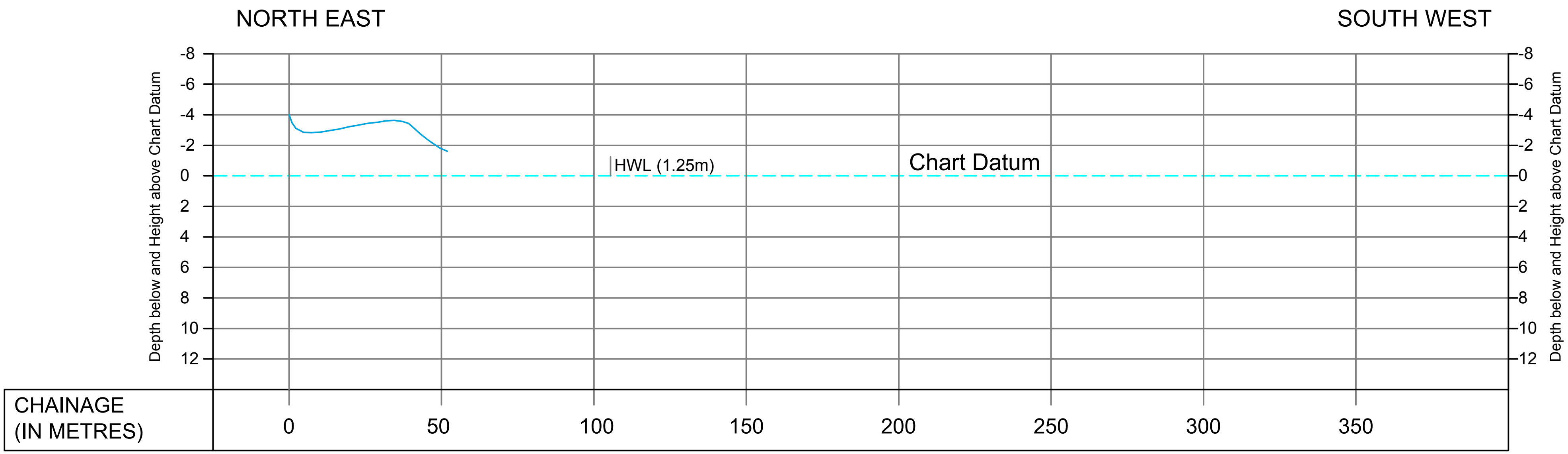

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Adani Vizhinjam Port Pvt. Ltd

OCEANOGRAPHIC AND BATHYMETRIC DATA COLLECTION FOR ASSESSMENT OF SHORELINE CHANGES

Shankar And Co.
115, Neco Chambers
CBD Belapur
Navi Mumbai – 400 614

Date: 20th August 2019
SAC Ref #: SAC/P167-19/PSR-2 Rev 1

PERIODIC SURVEY REPORT – PSR2 (JULY 2019)

"APPROVAL SHEET"

Prepared by:	*Signed*	*Date*
V Mehta		*20/08/2019*

Checked by:	*Signed*	*Date*
S Cherian		*20/08/2019*

Approved by:	*Signed*	*Date*
S Philip		*20/08/2019*

REVISION CONTROL

Date	Rev	Section / Page No.	Remarks
13/08/2019	0		Submitted for approval
20/08/2019	1	Definition, Page 5	Added short form of NIOT
		Sec 1, Page 6	Corrected the executive summary
		Sec 2, Page 7	Corrected the introduction
		Sec 2, Page 8	Added CSP
		Sec 3, Page 10	Corrected figure number
		Table headings	Moved to top of table
		Sec 4.2, Page 15	Corrected to 'Veli Lake'
		Sec 4.3, Page 16	Added name
		Sec 6.2, Page 26	Corrected the sentence
		Sec 6.2, Page 27	Corrected the month
		Sec 6.2, Page 29	Corrected the month
		Sec 6.3, Page 30, 31	Changed the scale of wind speed; corrected the month
		Sec 6.3, Page 32,33	Added units
		Sec 6.5, Page 34	Paragraph corrected

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ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
CES	Coastal Erosion Stone
C.M.	Central Meridian
CD	Chart Datum
cm	Centimetre
COG	Course over ground
CSP	Cross Shore Profiles
dd mm.mmm	Degrees minutes. decimal minutes
DGPS	Differential Global Positioning System
DTM	Digital Terrain Model
EC	Environmental & CRZ Clearance
EEZ	Exclusive Economic Zone
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
Mg/L	Milligram per litre
MoEF	Ministry of Environment & Forests
MoU	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
NTU	Nephelometric Turbidity Units
PEP	Project Execution Plan
PVD	Progressive vector diagram
PPP	Public Private Partnership
ppt	Parts per Thousand
RTK	Real Time Kinematics
SAC	Shankar And Co.
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

DEFINITIONS

Project Owner	Vizhinjam International Seaport Ltd (VISL)
Project Concessionaire	Adani Vizhinjam Port Pvt. Ltd. (AVPPL)
Advisor to VISL	National Institute of Ocean Technology (NIOT), Chennai
Survey Contractor	Shankar And Co, Navi Mumbai, India (SAC)
Survey Requirement	Oceanographic & Bathymetric Survey for Shoreline Monitoring
Chart Datum	Chart datum is the level to which soundings on 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 a water body moves in the ocean. The speed is denoted in cm/s
Rip Current	A relatively strong, narrow current flowing outward from the beach through the surf zone
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 in m/s
Wind Direction	Wind direction is an indicator of the direction that the wind is **blowing 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
Turbidity	Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air.

1 EXECUTIVE SUMMARY

① The **Vizhinjam International Deepwater Multipurpose Seaport** is an ambitious project taken up by the Government of Kerala, (GoK). It is designed primarily to cater to container trans-shipment besides multi-purpose and break-bulk cargo. The port is being currently developed in a Public-Private Partnership (PPP) component on a design, build, finance, operate and transfer ("DBFOT") basis. The private partner, the Concessionaire **M/s Adani Vizhinjam Port Private limited** (AVPPL) had commenced construction on 5th December 2015.

Vizhinjam International Seaport Ltd (VISL) - a company fully owned by GoK is the implementing agency for the project, will be responsible for all obligations and responsibilities of GoK 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 (MoES), for a long-term shoreline monitoring programme including the seasonal bathymetry mapping.
(Source: https://www.vizhinjamport.in/home.html)

Shankar And Co, hereinafter referred to as SAC, based in Navi Mumbai 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 5700267194 dated 3rd May 2019 by AVPPL.

As part of the study, NIOT provided a wave rider buoy to be deployed off Mulloor and the data and watch & ward of the buoy was to be monitored by SAC.

As part of the contract, turbidity measurements at three locations from three levels is to be monitored on a real time basis from October 2019.
This report provides the results of the data collected from 01st to 31st July 2019.

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

① The proposed project is being developed as a PPP project on a DBFOT basis in accordance with the terms and conditions set forth in the concession agreement signed between AVPPL and GoK/VISL. 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 & equipment) will be shared on PPP basis availing Viability Gap Funding (VGF). The PPP concessionaire, AVPPL has been given the right to operate the port 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 is located at the southern tip of India, barely 10 nautical miles from the international sea route (Suez – Far East route & Far East – Middle East route), it has the potential to become the future trans-shipment hub of the country.
(Source : https://www.vizhinjamport.in/download/Feasibility-Report.pdf)

The study includes carrying out MetOcean observations (wave, meteorological parameters and tide) at one location, to measure current for 30 days each, at four locations, during 3 different seasons; summer (Mar-May), monsoon (June-Oct), and post monsoon (Nov-Feb), to measure in real-time turbidity from three levels and three locations, 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 and river crossing survey. All these are to be carried out for a period of 3 years commencing June 2019.

A Google Earth image, showing the Multibeam survey area; locations of the observations, including the wave/current, tide and AWS measurement location, is given in Figure 2-1. The cross-shore profile lines, the LEO points and photographic documentation points are shown in Figure 2-2.

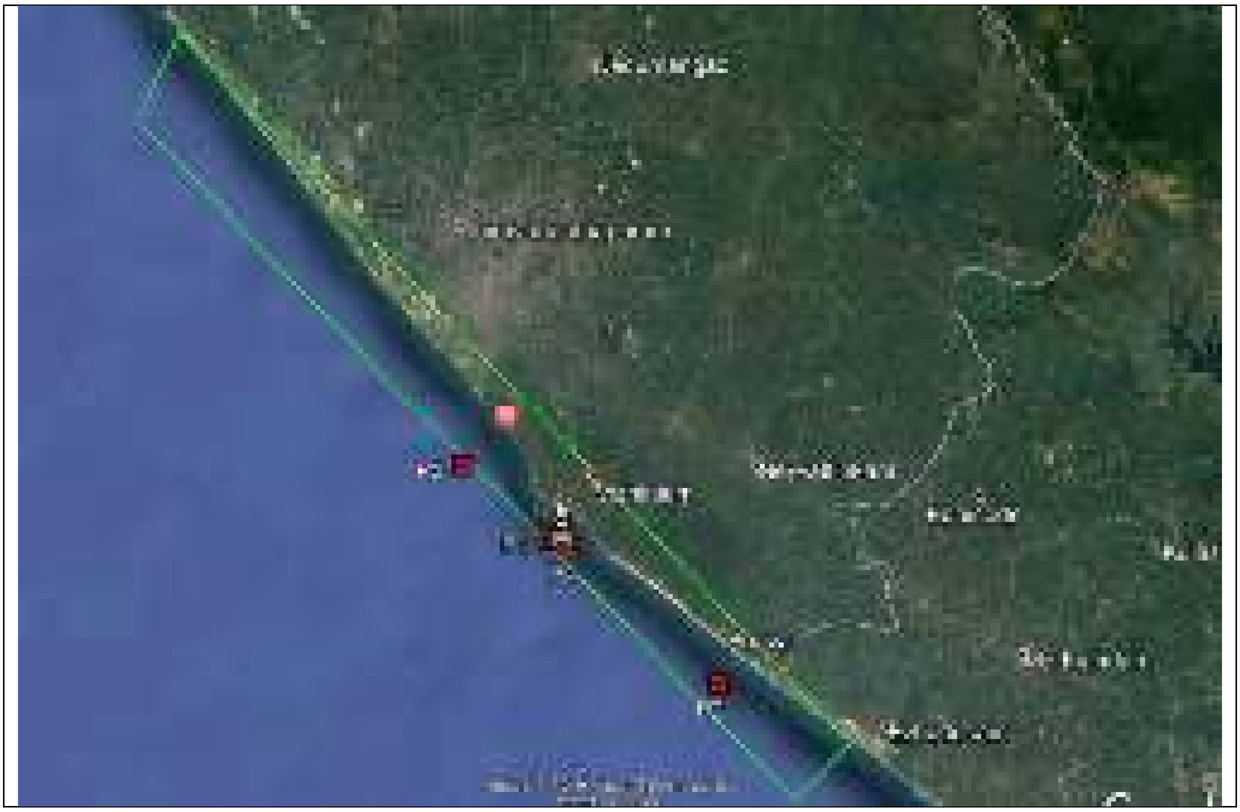


Figure 2-1: General Survey Location

P1, P2 and P3 correspond to ADCP locations and P4 corresponds to both, ADCP and wave location.

The cross-shore profiling (CSP) lines, which coincides with the LEO, beach sampling and photographic documentation, 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 to the south of the existing Vizhinjam Harbour.

Figure 2-2: CSP, LEO, Beach Sampling and Photographic Documentation Locations

3 SCOPE OF WORK

The survey scope of work as provided in the RFQ and as per the contract includes 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 shoreline.
- 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 2-1, 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 on 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.

- Collection of wind speed & direction, atmospheric pressure, humidity, temperature at 1 location specified by the client/EIC by establishing an automatic weather station.
- Continuous monitoring of turbidity at 3 location (1 upstream & 2 downstream of dredging location) - Online meter (3 levels) to be installed on buoys and data to be displayed at system in office.
- Analysis and processing of the data and submission of periodic reports in soft & hard copies.

3.1 Location Coordinates

The location co-ordinates provided by the client for the current and wave observations are given below:

Table 3-1: Current / Wave locations

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	21.4
ADCP/Wave - P4 (Mulloor)	08° 21' 42.3"N	76° 59' 33.9"E	23.2

The current observations are to be carried out for 30 days in each of the seasons at the above locations.

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

Table 3-2: Tide station location coordinates

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	3.447

The location of the weather station is provided below:

Table 3-3: Weather station location coordinates

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

Since the weather station 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 10m above MSL.

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.

Table 4-1: Geodetic Parameters

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

4.2 Survey Vessels

The following vessels were utilized for the survey operation:

Figure 4-1: Watch keeping vessel MFB Samuel

Figure 4-2: Transit vessel MFB Sindhu Yatra Matha

Figure 4-3: Survey Vessel M.V. Aruvi used at Veli Lake

Figure 4-4: Survey Vessel used at Poovar, Chovara and Thiruvallam rivers

4.3 Personnel

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

Table 4-2: Personnel

Shankar And Co.		
Name	**Designation**	**Period**
Saju Cherian	Project Manager	Duration of Project
Unnikrishnan K.U.	Party Chief / Surveyor	01st to 31st July 2019
Arun P.K.	Survey Engineer	01st to 31st July 2019
Harikrishnan P.	Land Surveyor	13th to 31st July 2019
Vishnu Haridas	Land Surveyor	01st to 31st July 2019
Adani Vizhinjam Port Pvt. Ltd.		
Name	**Designation**	**Period**
Hebin C.	Manager - Environment	Duration of Project
Jesse Fullonton	Assistant Manager	Duration of Project

5 SURVEY EQUIPMENT DETAILS

5.1 Wave Rider Buoy

The Datawell DWR (G) wave rider buoy was deployed by NIOT in collaboration with VISL and AVPPL, under a tripartite agreement and is being monitored and maintained by Shankar And Co. 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 Ayur Bay resort.

The system consists of wave rider buoy (DWR G make) with HF whip/LED flasher, GPS antenna, 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 are 1.5° within the range of 0° to 360°.

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

5.1.1 Principles of wave measurement

The GPS wave buoy measurement principle bears a strong analogy with the Doppler-shift phenomenon of a car passing nearby, 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.

5.1.2 Instrument Mooring

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:

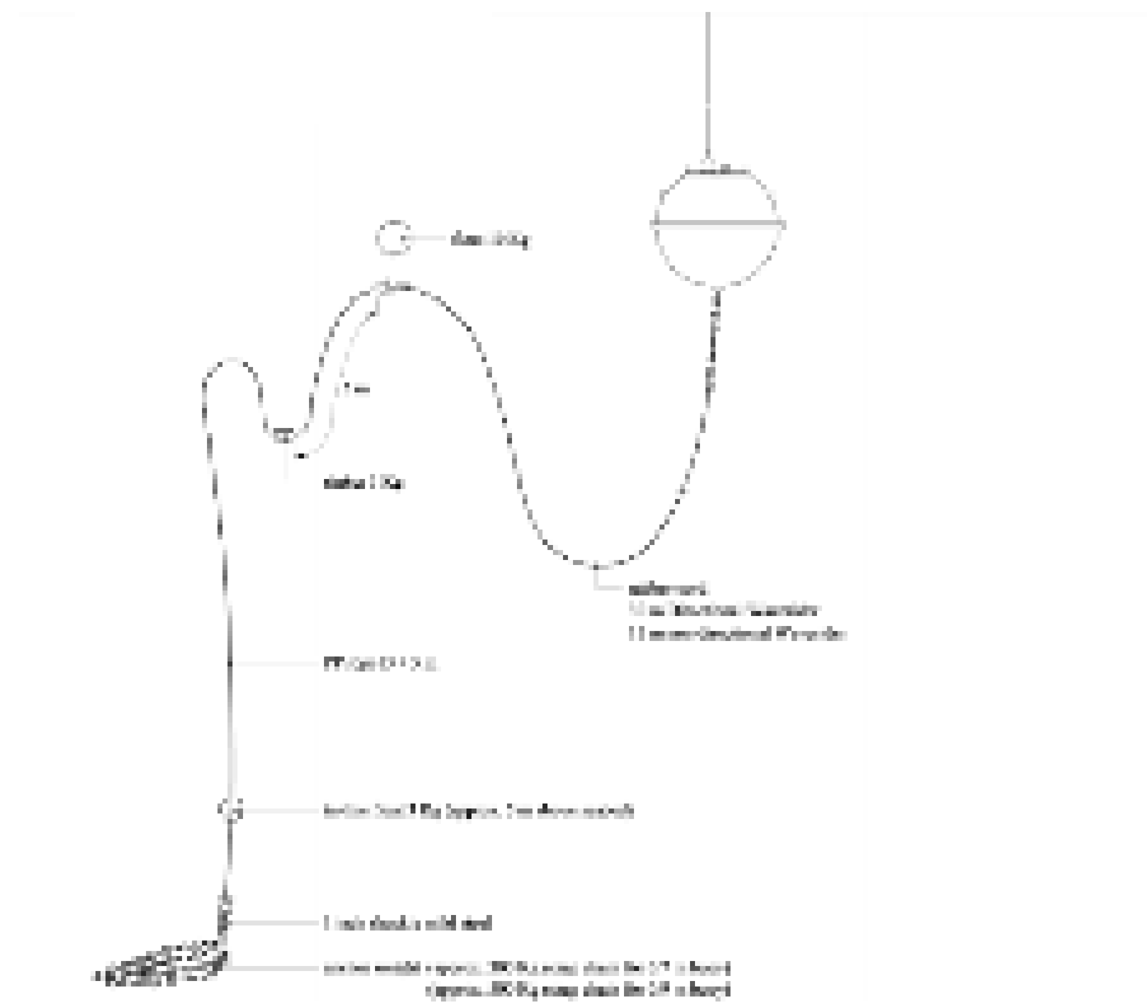


Figure 5-1: WRB Mooring Diagram

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.

The image of WRB deployed at the location is provided below:

Figure 5-2: WRB deployed at site

5.2 Automatic Tide Gauge

An EMCON automatic tide gauge was installed near the Coast Guard jetty, inside the fishing harbour for measuring the tides. The tide gauge is a capacitance-based instrument, measuring the water level due to change in capacitance on the surface of sensor. The sensor was installed on a 2.5m long pipe to ensure that the zero of sensor is always in water, irrespective of the phases of tide. This was levelled to the local benchmark, situated on top of the jetty. The tide station was programmed to measure the tide at 5-minute intervals throughout the duration of the project.

A photograph of the tide gauge installed at the location is provided below:

Figure 5-3: Tide Gauge

5.3 Automatic Weather Station (AWS)

An EMCON Automatic Weather Station (AWS) was installed atop Ayur Bay Resort at Nellikunnu. The system measures wind speed/direction, atmospheric pressure, temperature and relative humidity.

The system consists of the following:

- 3 cup anemometer
- Wind wane
- Relative humidity & temperature sensor
- Pressure sensor
- Datalogger

The data is logged in a data logger installed at the receiving station at intervals of 10 minutes. The data is also transmitted from the data logger to a cloud bases server for further processing and QC checks.

An image of automatic weather station is provided below:

Figure 5-4: AWS on toop of Ayur Bay Resort, Nellikunnu (Mulloor)

5.4 Real Time Kinematic (RTK) Survey

An RTK system was mobilized at site to carry out cross-shore profiling on the landward side. The system used was a Geomax Zenith 10/20 RTK system with base station and rover. A photograph of the system is provided below:

Figure 5-5: RTK System with base station and rover

5.5 Bathymetric Survey

A SyQuest Bathy 500 MF single beam echo sounder was used to carry out bathymetric survey of 4 river sections, namely, Chovara River, Veli River, Poovar River and Thiruvallam River. A photograph of the echo sounder system mobilized in the boat and the calibration carried out by the 'bar-check' method is shown below.

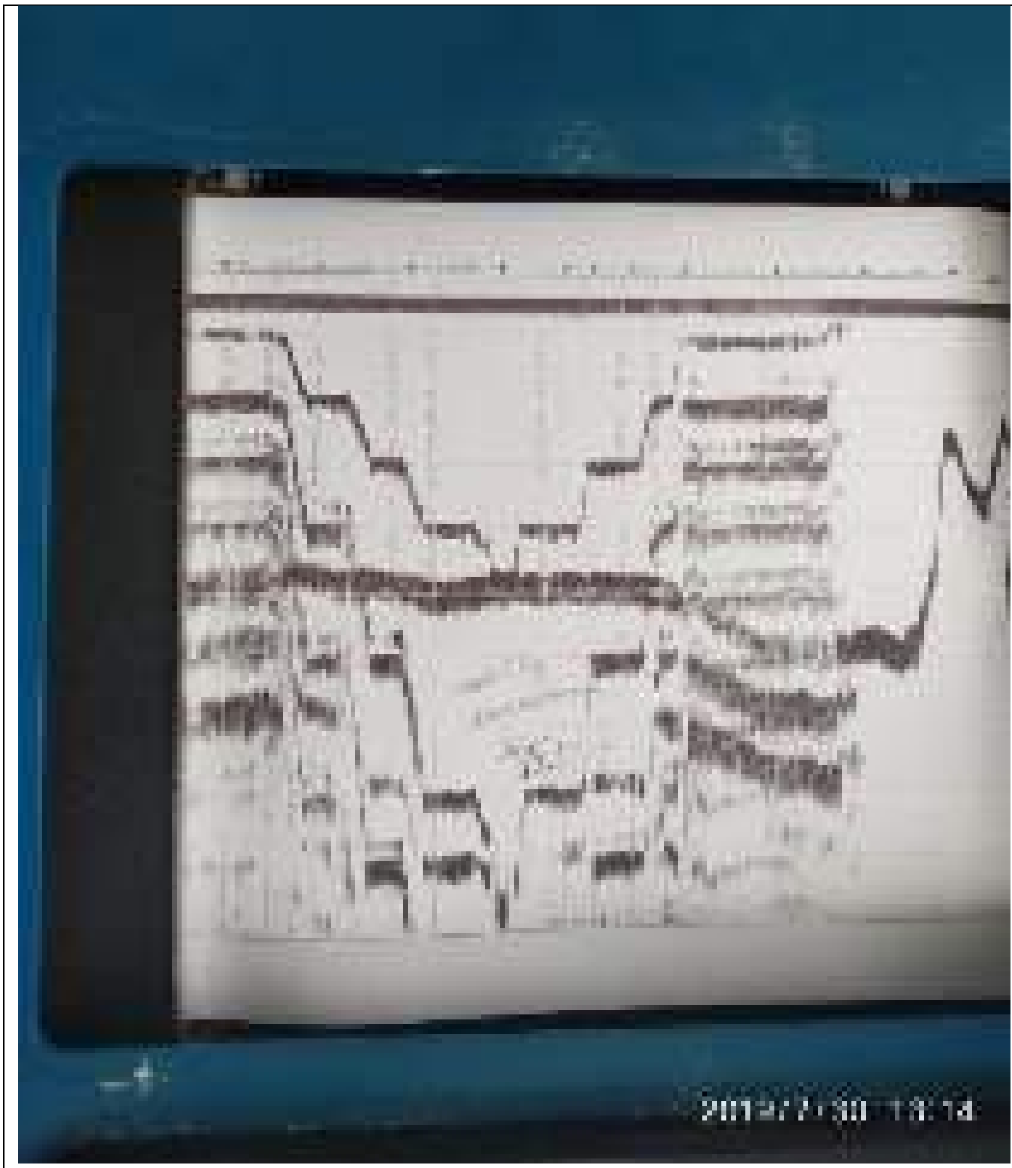


Figure 5-6: Bar check carried out on Syqwest Bathy 500 MF single beam echo sounder

6 SURVEY RESULTS

6.1 Tidal Measurements

The tides were observed near the Coast Guard jetty. 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 3.447 above chart datum. An image of the TBM is provided below:

Figure 6-1: Location of TBM

The offset calculation of tide gauge based on the ‘jetty top’ value is given in the image below:

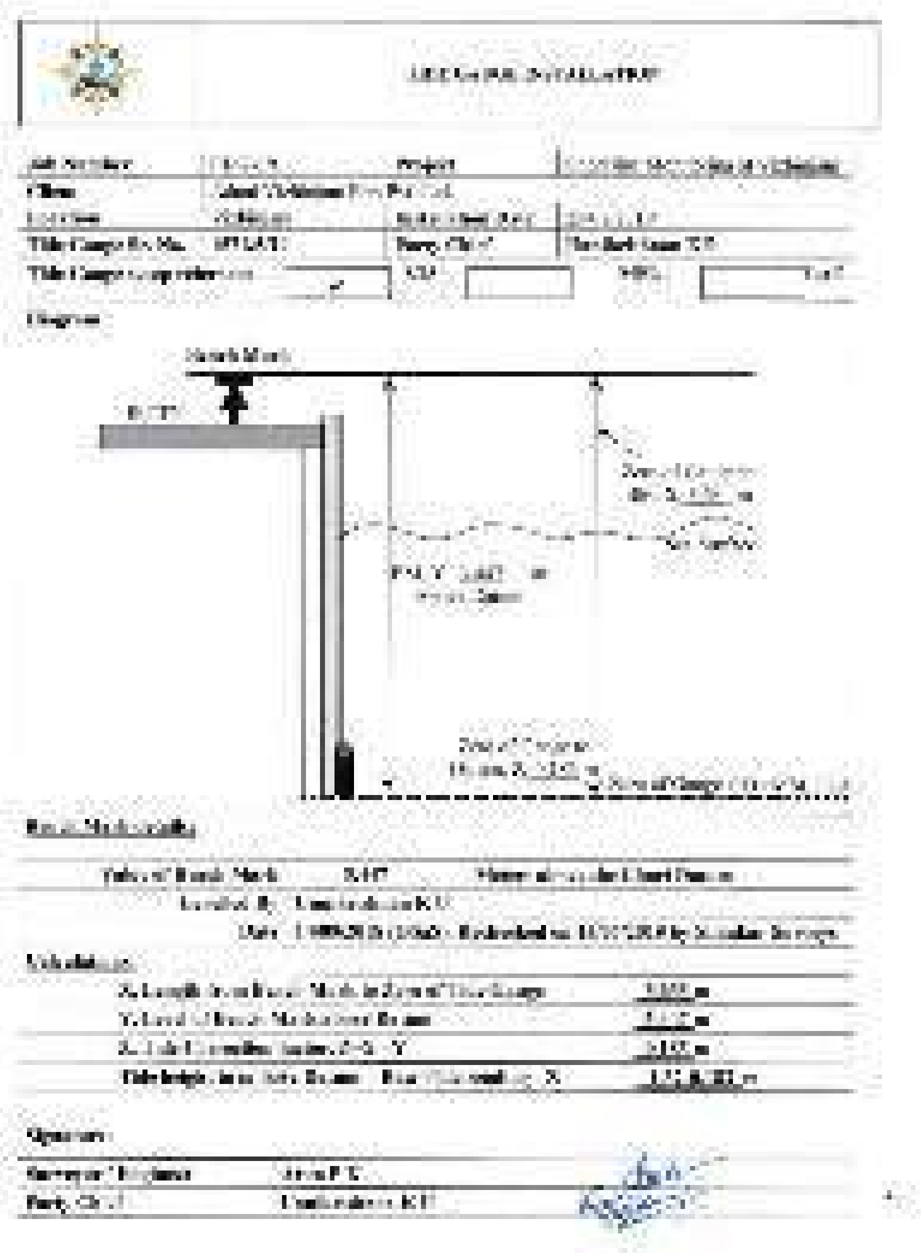


Figure 6-2: Schematic Diagram of Tide Gauge

The tides observed are mixed semi-diurnal in nature, with the maximum range being observed in the springs. The tide data collected is placed in Annexure I.

6.2 Wave Measurements

The data from the WRB (provided by NIOT) was downloaded and processed to produce the time series and rose diagram, which are provided below:

Refer to the following rose plot of significant height (Hs) v/s direction for the period of 01st to 31st July 2019:

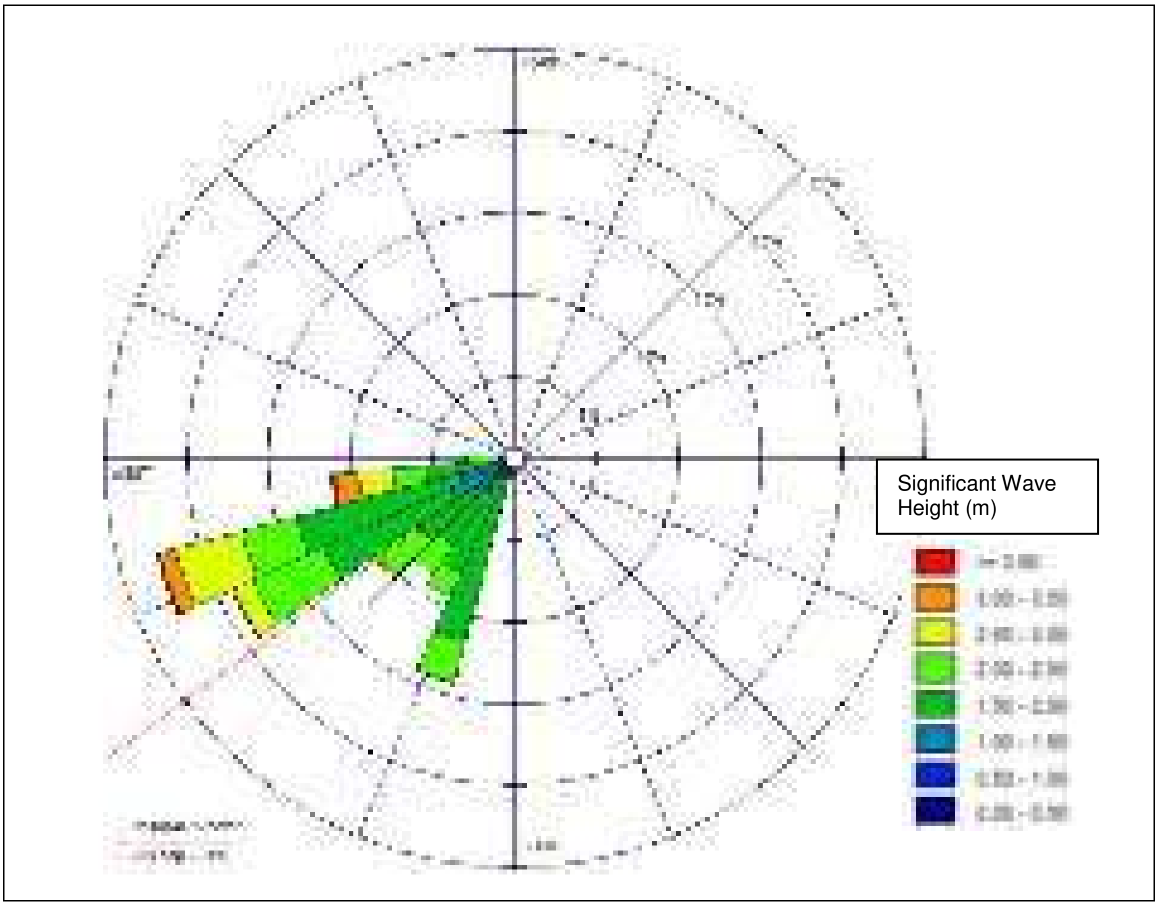


Figure 6-3: Wave Rose (Hs in metre v/s Direction) from 1st to 31st July 2019

① The wave direction was west-southwesterly to westerly during the period with waves up to 3.82m. As can be seen in the rose plot above, the significant wave heights were more than 2m in the west of south-westerly direction, due to the active monsoon.

A maximum significant wave height of 3.82 m was recorded on 19th July 2019 at 00:18 hrs.

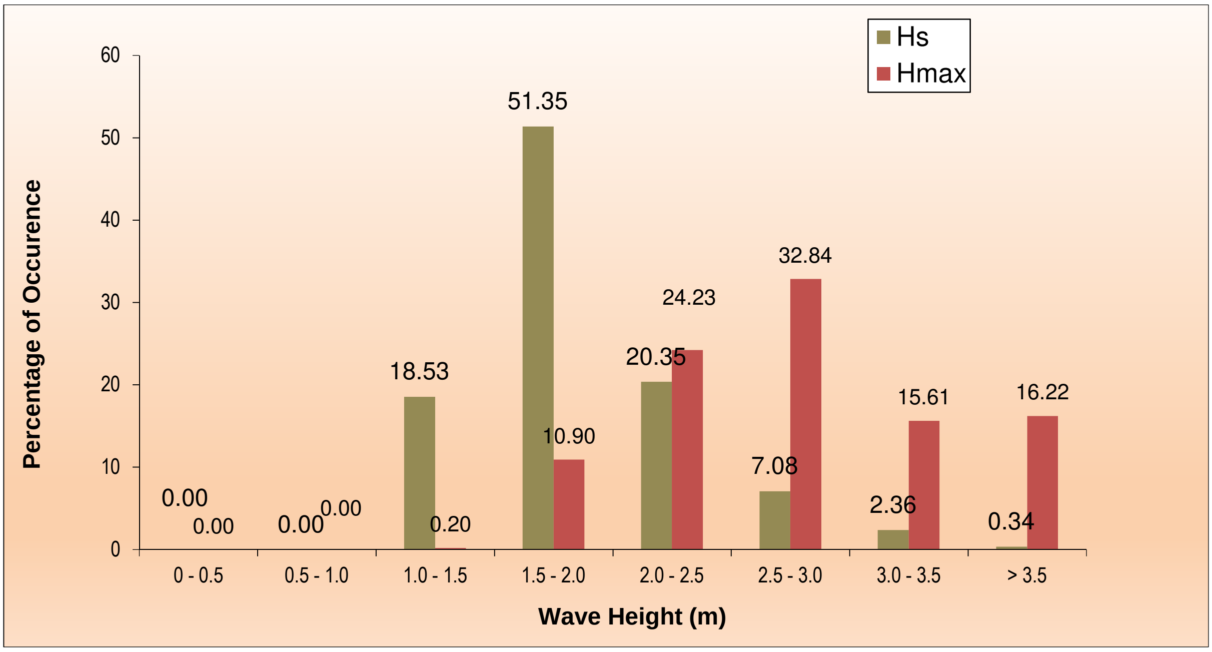
The frequency distribution table and histogram are provided below:

Table 6-1: Frequency distribution of wave height (1st to 31st July 2019)

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	0	0.00	0	0.00
1.0 - 1.5	275	18.53	3	0.20
1.5 - 2.0	762	51.35	162	10.90
2.0 - 2.5	302	20.35	360	24.23
2.5 - 3.0	105	7.08	488	32.84
3.0 - 3.5	35	2.36	232	15.61
> 3.5	5	0.34	241	16.22
Total	**1484**	**100**	**1486**	**100.000**

The histogram of significant wave height during the observation period of July 2019 is given below:

Figure 6-4: Histogram of wave height from 1st to 31st July 2019



As can be seen from the above histogram, about 30% of the observation of significant wave height was greater than 2m.

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

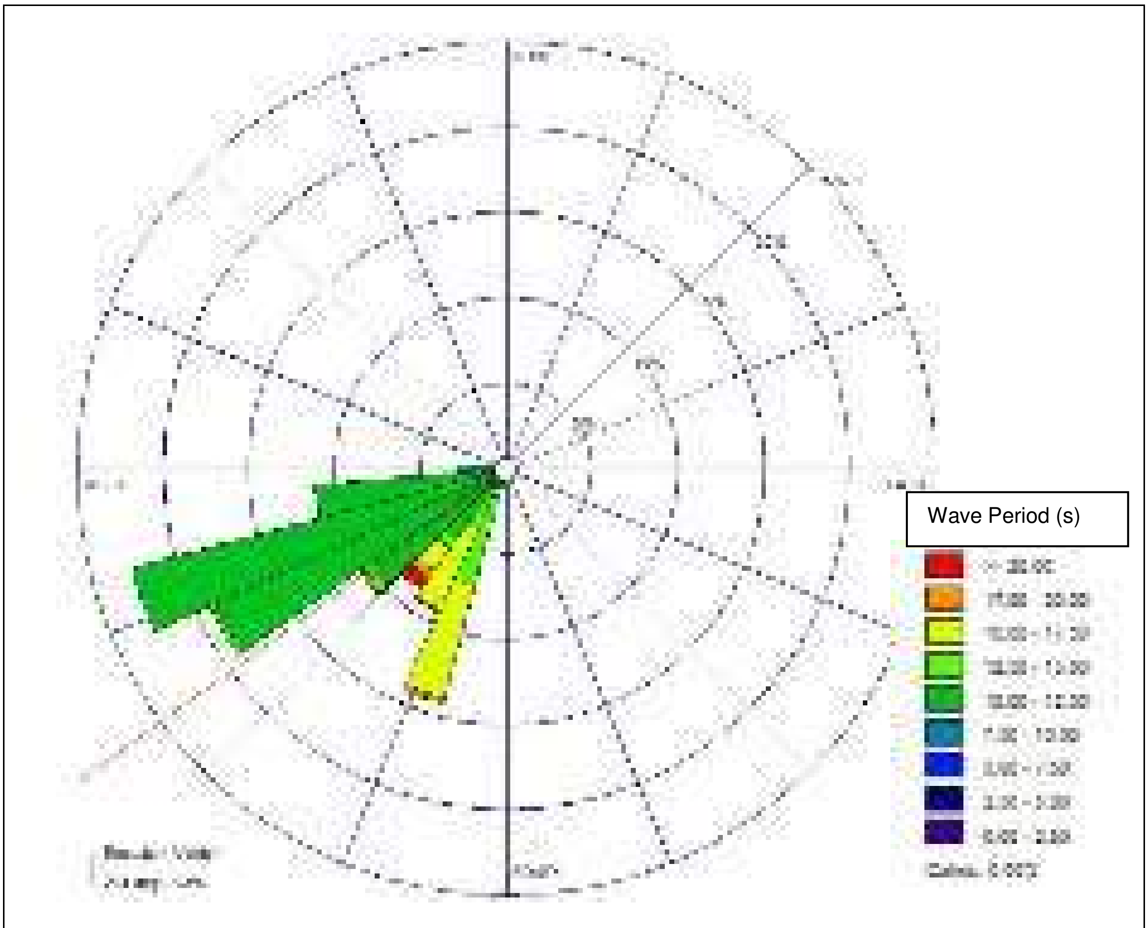
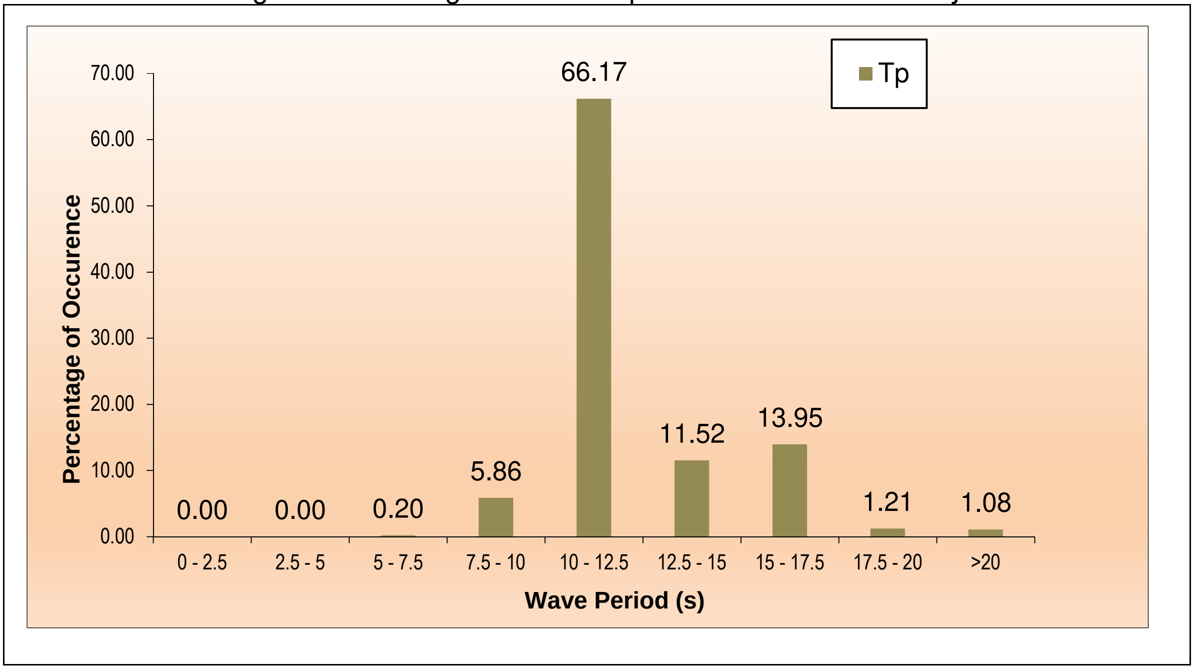


Figure 6-5: Wave Rose (Tp vs direction) from 1st to 31st July 2019

The histogram drawn for wave period for July 2019 is given below:

Figure 6-6: Histogram of wave period from 1st to 31st July 2019



The above image indicates that during the period of observation, the wave period was in the range of 7.5 to more than 20 seconds, with 91% of the observations indicating long waves with a period of more than 10 seconds. The maximum period of 20 seconds was recorded on 15th July 2019 at 20:20 hours.

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

6.3 Measurement of Meteorological Parameters

① The data for the month was downloaded and after quality control checks, is presented below:

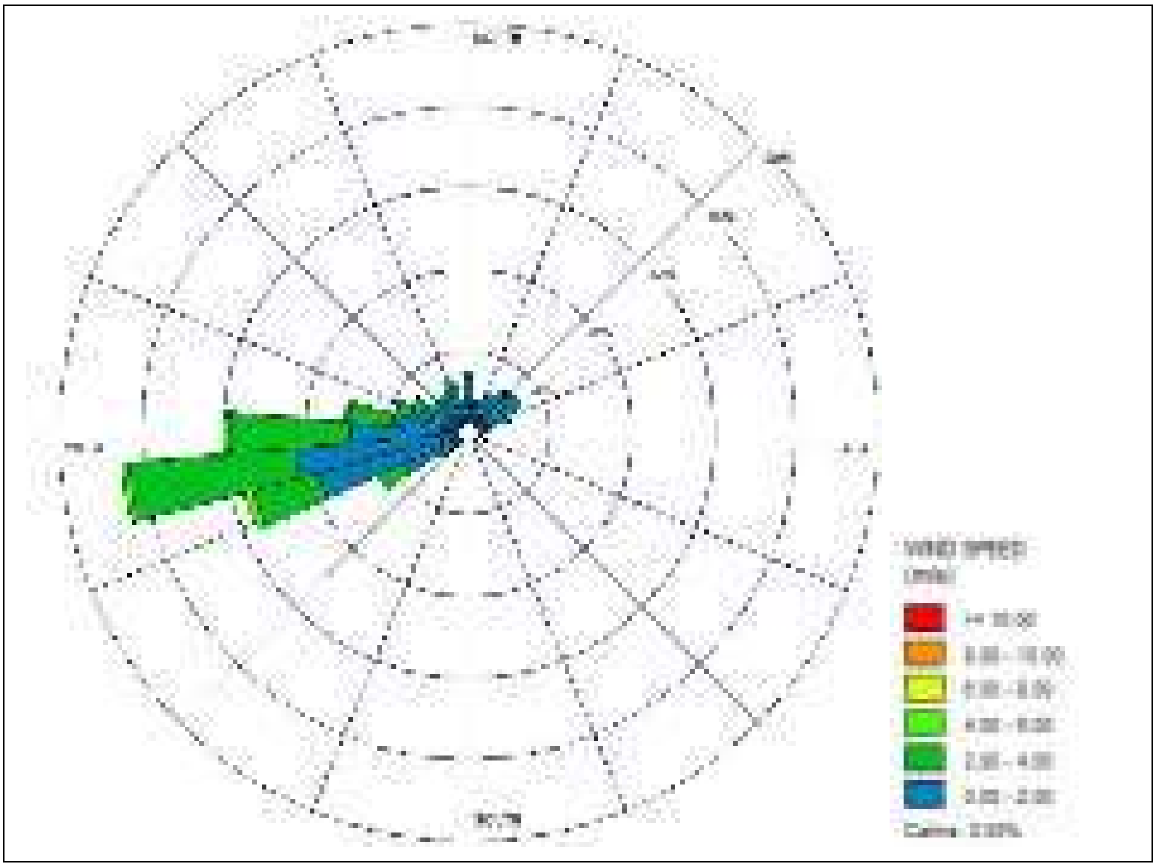


Figure 6-7: Wind rose (Speed in m/s vs direction) from 1st to 31st July 2019

The rose plot reveals south-westerly to north-northeasterly winds with velocities up to 5.07m/s.

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

Table 6-2: Frequency distribution of wind speed (1st to 31st July 2019)

Frequency Distribution		
Wind Speed (m/s)	**No. of observations**	**Percentage of Occurrence**
0 - 2	2086	72.53
2 - 4	754	26.22
4 - 6	36	1.25
6 - 8	0	0.00
8 - 10	0	0.00
>10	0	0.00
Total	**2876**	**100.00**

The histogram of wind speed for the period is provided below:

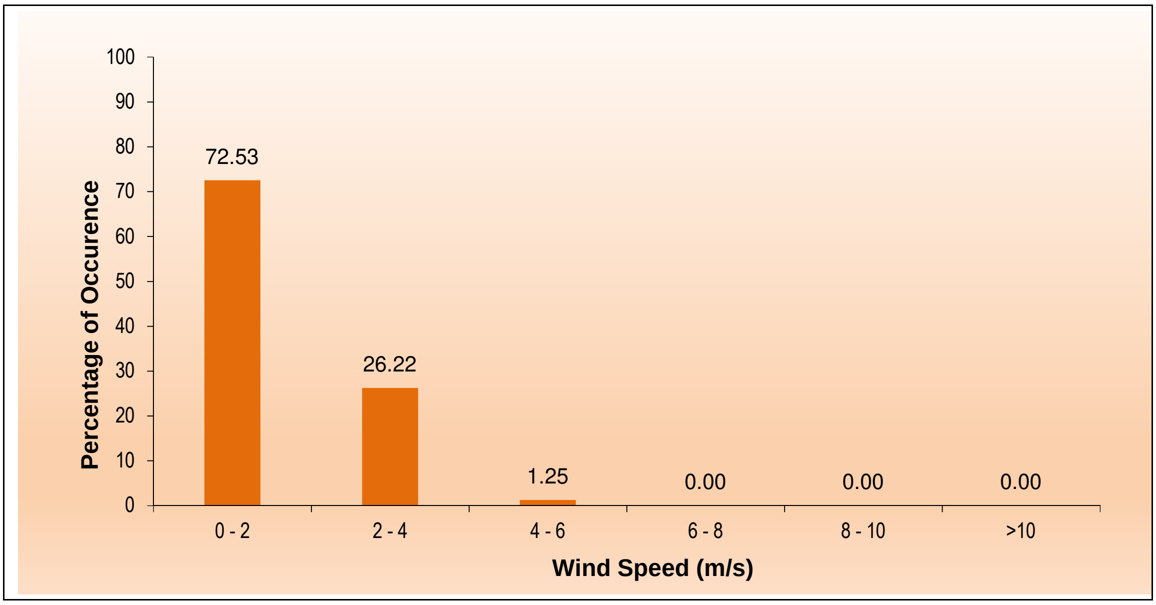


Figure 6-8: Histogram of wind speed from 1st to 31st July 2019

As can be seen from the above histogram, the winds were less than 6 m/s throughout the period. The maximum wind speed in the month of July 2019 was 5.07 m/s, recorded on 19th July 2019 at 20:15 hrs.

The percentage occurrence tables drawn for atmospheric pressure, temperature and relative humidity are presented below:

Table 6-3: Frequency distribution of Met parameters (1st to 31st July 2019)

Frequency Distribution		
Atm Pressure (mb)	**No. of observations**	**Percentage of Occurrence**
<1000	1	0.04
1000 - 1004	5	0.20
1004 - 1008	36	1.42
> 1008	2490	98.34
Total	**2532**	**100.00**

Frequency Distribution		
Temperature (°C)	**No. of observations**	**Percentage of Occurrence**
20-24	35	1.21
24-28	1348	46.58
28-32	1511	52.21
>32	0	0.00
Total	**2894**	**100.00**

Frequency Distribution		
RH (%)	**No. of observations**	**Percentage of Occurrence**
50-60	0	0.00
60-70	136	4.07
70-80	854	25.57
>80	2350	70.36
Total	**3340**	**100.00**

The histogram drawn for the parameters for the period is provided below:

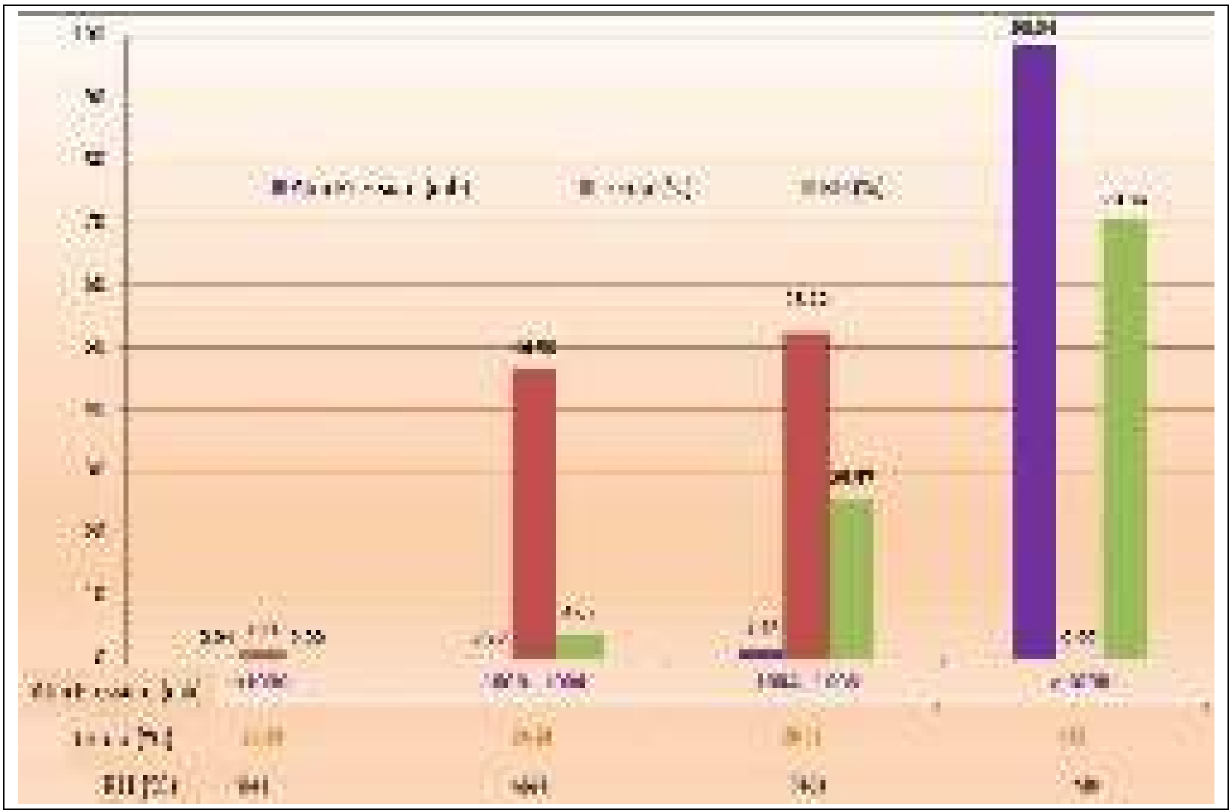


Figure 6-9: Histogram of Met parameters from 1st to 31st July 2019

The data represented above reveals that about 98% of the atmospheric pressure recorded for the month was more than 1008 mb. The temperature was between 24 to 32°C during the month. The relative humidity was greater than 80% during 70% of the observations indicating rainy conditions.

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

6.4 Littoral Environment Observations

The LEO was carried out at 81 locations. The LEO plate was deployed at all the locations and the same was tracked for about five to ten minutes, as per the site conditions. The initial and final GPS positions were then used to calculate the SOG and COG. The estimated wave height, angle of wave, period and the stretch of breakers were also noted down in the log. The data sheets for all the locations are placed at Annexure IV.

The along shore current was mainly towards the south during the period of monitoring. The maximum speed of 32.19 cm/s was observed at CSP-34. Rip currents were observed in the locations CSP 37, 41, 42, 43, 45, 46, 47, 57, 58, 60, 62, 64, 65, 66, 69, 71, 72, 73 and 74.

6.5 Photographic Documentation

① Photographic documentation was carried out for all the 81 locations, coinciding with the cross-shore profiling. The photographs for the period are placed at Annexure V. As a common reference point, a 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. As the monsoon commenced, the beaches were almost inundated with sea water and vast stretches of the shoreline were engulfed by waves.

6.6 Cross Shore Profiles

The cross-shore profiling for the period was carried out using RTK in the onshore region. In the wave breaker area, no data could be acquired and hence that area is shown in ‘dashed line’, in the enclosed AutoCAD/PDF charts. At the location CSP-35 the onshore profiles could not be carried out as the beach could not be approached.

The offshore profiling could not be carried out during the month of July 2019, due to rough weather conditions.

The following table provides the identification of CSP vis-à-vis the local name:

Table 6-4: CSP Location names

CSP NO.	LANDMARK	LOCATION
CSP-01	CATHOLIC CRISMATIC PRAYER CENTER	EDAPPADU BEACH
CSP-02		
CSP-03		
CSP-04	ST. MARY'S CHURCH	VALLAVILAY
CSP-05		
CSP-06		
CSP-07	ST. NICOLAS' CHURCH	NEERODY
CSP-08		
CSP-09		
CSP-10	SREE BHADRAKALI TEMPLE	POZHIYOOR
CSP-11		
CSP-12		
CSP-13	ST. MATHEW'S CHURCH	PARUTHIYOOR
CSP-14	CHURCH OF CHRIST	
CSP-15	POOVAR ISLAND RESORT	POOVAR BEACH SOUTH
CSP-16		
CSP-17		
CSP-18	POZHIKARA BEACH	POOVAR
CSP-19		
CSP-20	ST. ANTONY'S CHAPEL	POOVAR BEACH NORTH
CSP-21		
CSP-22	ST. ANTONY'S CHURH	KARUMKULAM
CSP-23		
CSP-24		
CSP-25		
CSP-26		
CSP-27	GOTHAMBU ROAD	PULLUVILA
CSP-28		
CSP-29		
CSP-30		
CSP-31	ADIMALATHURA CATHOLIC CHURCH	ADIMALATHURA
CSP-32		
CSP-33		
CSP-34		
CSP-35	AZHIMALA TEMPLE	AZHIMALA
CSP-36	NAGAR BHAGAVATHY TEMPLE	MULLUR
CSP-37		

CSP NO.	LANDMARK	LOCATION
CSP-38	ADANI PORT RECLAMATION AREA	ADANI PORT OFFICE VIZHINJAM
CSP-39		
CSP-40		
CSP-41	VIZHINJAM LIGHT HOUSE	KOVALAM
CSP-42		
CSP-43		
CSP-44		
CSP-45		
CSP-46		
CSP-47	SAMUDRA BEACH PARK	KOVALAM
CSP-48	MOSQUE	PANATHURA
CSP-49		
CSP-50	PANATHURA TEMPLE	PANATHURA
CSP-51		
CSP-52		
CSP-53	PUNTHURA FISH MARKET	PUNTHURA
CSP-54		
CSP-55		
CSP-56		
CSP-57		
CSP-58	BEEMA PALLY	BEEMA PALLY
CSP-59		
CSP-60		
CSP-61	CHERIYATHURA SPORTS GROUND	CHERIYATHURA
CSP-62		
CSP-63	VALIYATHURA BRIDGE	VALIYATHURA
CSP-64		
CSP-65		
CSP-66		
CSP-67		
CSP-68	SHANGUMUGHAM BEACH	SHANGUMUGHAM
CSP-69		
CSP-70	ST. PETER'S CHURCH	SHANGUMUGHAM
CSP-71		
CSP-72	VETTUCAUD CHURCH	VETTUCAUD
CSP-73		
CSP-74		
CSP-75	VELI CHILDRENS PARK	KOCHUVELI
CSP-76		
CSP-77		

CSP NO.	LANDMARK	LOCATION
CSP-78	ST. THOMAS' CHURCH	VALIYA VELI
CSP-79		
CSP-80	CHRISTIAN BROTHEREN CHURCH	THUMBA
CSP-81		

The cross-shore profiles for the full period are placed in Annexure VI.

6.7 River Crossing Surveys

The river crossing survey was carried out at 6 river/stream crossings.

The survey was carried out for 500m length of rivers debouching in the 40 km stretch of the sea. In the major rivers (Poovar, Chovara, Thiruvallam and Veli) survey was carried out using a single beam echo sounder. The other two streams were surveyed using the RTK system. The water depths shown in the chart for the major rivers are the actual water levels recorded using the echo sounder. The boundary of the rivers was fixed using RTK and those (dry) heights are denoted with respect to Chart Datum. The survey was carried out from 29th July to 1st August 2019.

The river/stream wise survey findings are given below:

6.7.1 Veli River

Veli River runs north of the Thiruvananthapuram airport. It is a tourist spot with many tourist boats plying in the river. The raw depths recorded are shown in the chart along with the spot values fixed using RTK, with respect to CD. The maximum depth of 5.1m was observed north of the river.

6.7.2 Thiruvallam River

Thiruvallam River lies north of Vizhinjam. This is a confluence of two rivers. The survey was carried out using a shallow draft boat and the depth as recorded is provided without applying any tide. About 7.1m of water was observed in the northern part of the river. The spot values fixed using RTK is also shown which is referenced to CD.

6.7.3 Gangayattumkara Stream

The stream runs next to the fishing harbour. A considerable amount of rain water is discharged through this stream during the rainy season. The spot values obtained from the RTK system are shown in the chart, referenced to the Chart Datum.

6.7.4 Karimpallickara Stream

This narrow stream lies between Mulloor and Vizhinjam. The spot values obtained using the RTK system is provided in this section. The heights are with respect to CD.

6.7.5 Chovara River

Chovara River lies between Vizhinjam and Poovar river. This river is land-locked during a major part of the year. The depth is uniform along the centre of the river with a depth of 2 to 2.6m. The depth provided is the raw depth and no tide is applied to the recorded depth. The drying heights shown in the chart are fixed using RTK which is referenced to chart datum.

6.7.6 Poovar River

Poovar River lies south of Vizhinjam, and is also land-locked during a major part of the year. During the monsoon, the wave action breaks the natural partition, and the river joins with the sea. The river is a tourist spot with numerous resorts situated along the banks, with tourist boats plying in the area.

A maximum water level of 5.5m was recorded toward the north-western portion. Towards south-east of the river, the depths vary from less than 1 to 2.5m.

The charts of all the river/stream sections are placed at Annexure VII.

7 OVERALL PROGRESS

Up to 31st July 2019, the following graph provides the overall progress chart.

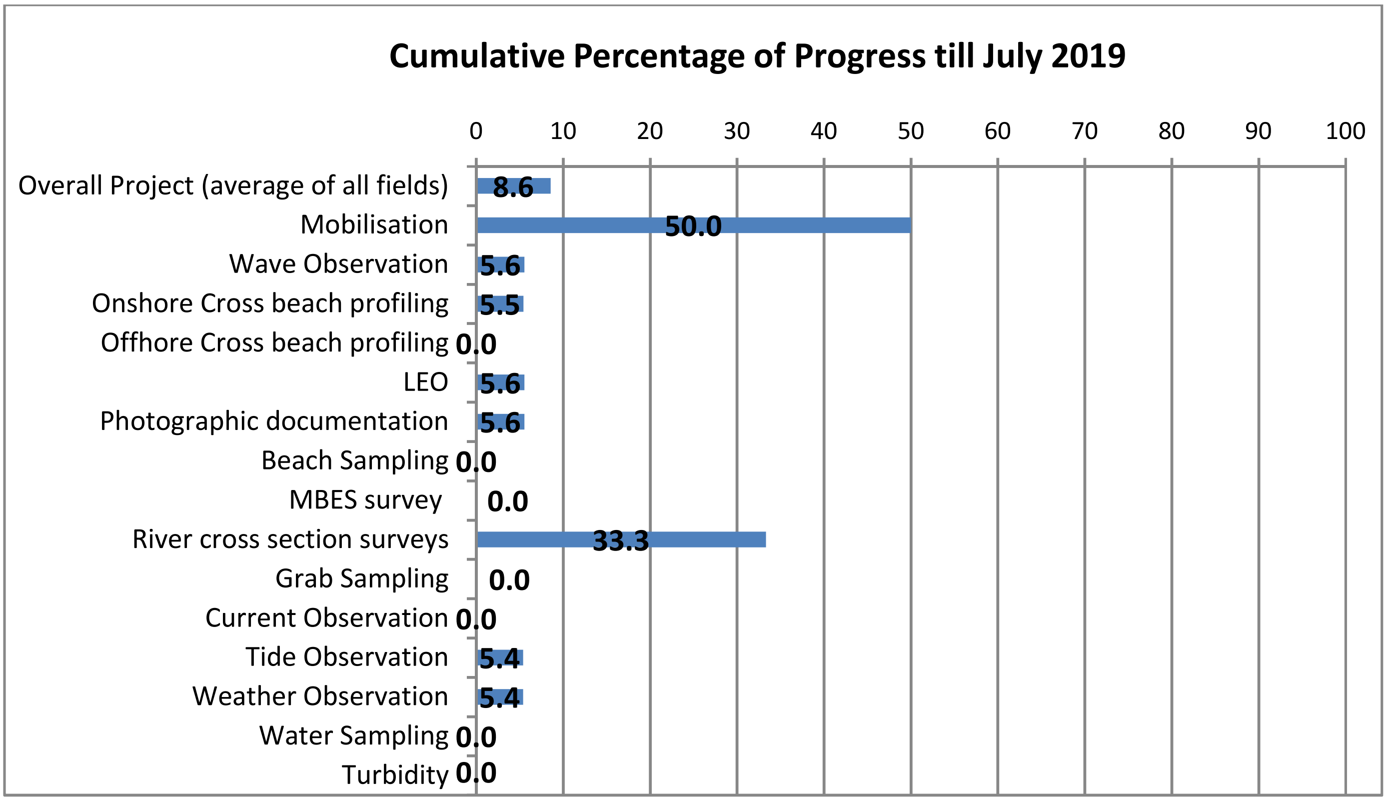


Figure 7-1: Overall Progress Chart

The above calculation is based on number of observations for 3 years. Since the turbidity buoys are not mobilised, the mobilization field is shown as 50%.

8 WEATHER

During the survey period, the monsoon was in full swing and the sea was rough to carry out any offshore works. The offshore cross shore profiles could not be carried out due to rough sea conditions, considering the safety of personnel and equipment.

9 REFERENCES

The following documents/web sites were referenced during the preparation of the report.

- AVPPL Service order 5700267194 dated 3rd May 2019
- Web site https://www.vizhinjamport.in/home.html, and https://www.vizhinjamport.in/download/Feasibility-Report.pdf
- WMO manual, section 5.2.2
- SAC Project Execution Plan SAC/P167-19/PEP AVPPL
- PSR-1 Rev 1 dated 17th July 2019

10 CONCLUSIONS

The following conclusions were made during this phase of the project:

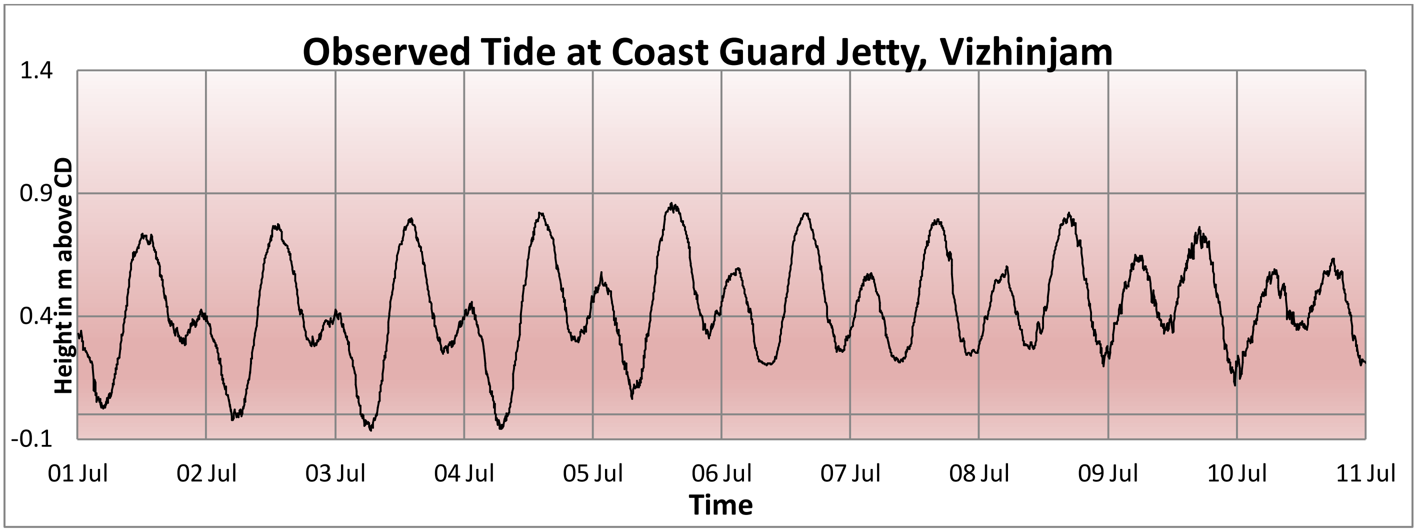
1. Tide was mixed semi diurnal with a maximum range of 1.15 m during spring tide.
2. The wave heights were up to 3.82m with winds of up to 5 m/s blowing from north-westerly direction.
3. The long-shore transport was recorded in a southerly direction, with maximum velocity of about 32.19 cm/s recorded at CSP-34.
4. In all the rivers, the water depth was more towards the upstream of the river.

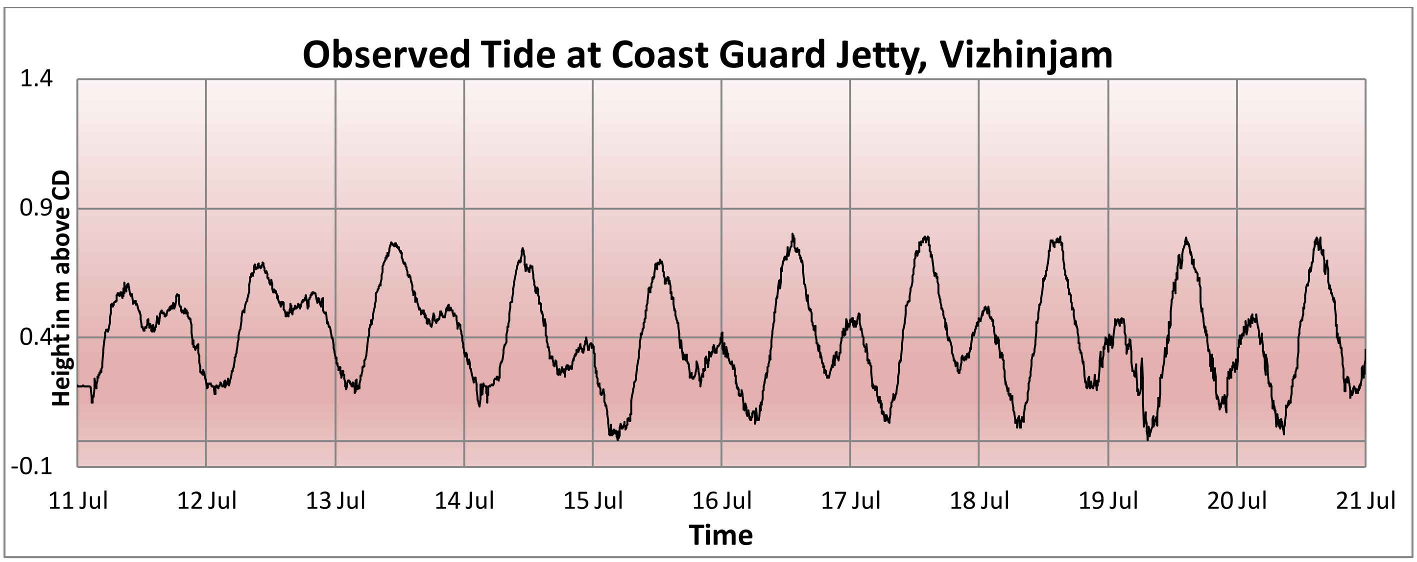
11 ACKNOWLEDGEMENTS

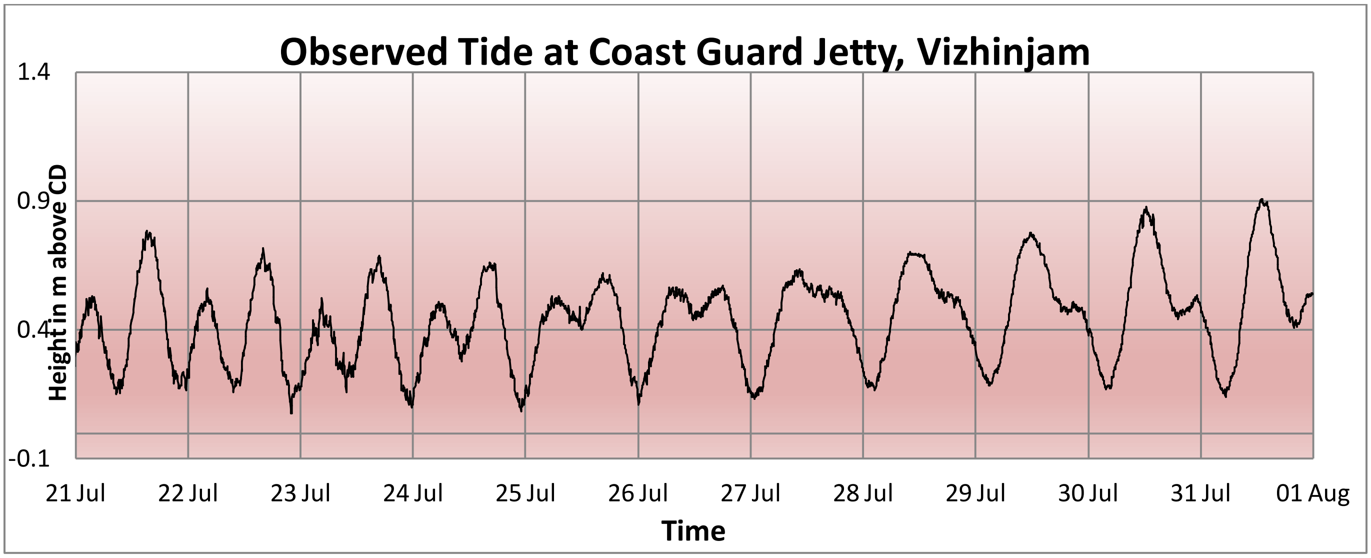
During the course of project, the support received from AVPPL staff is highly appreciated and acknowledged. The guidance received throughout the project from NIOT scientists are also hereby appreciated. The boat crew and all others, who had supported us during the project is also acknowledged.

Annexure I

Tide Curves - July 2019

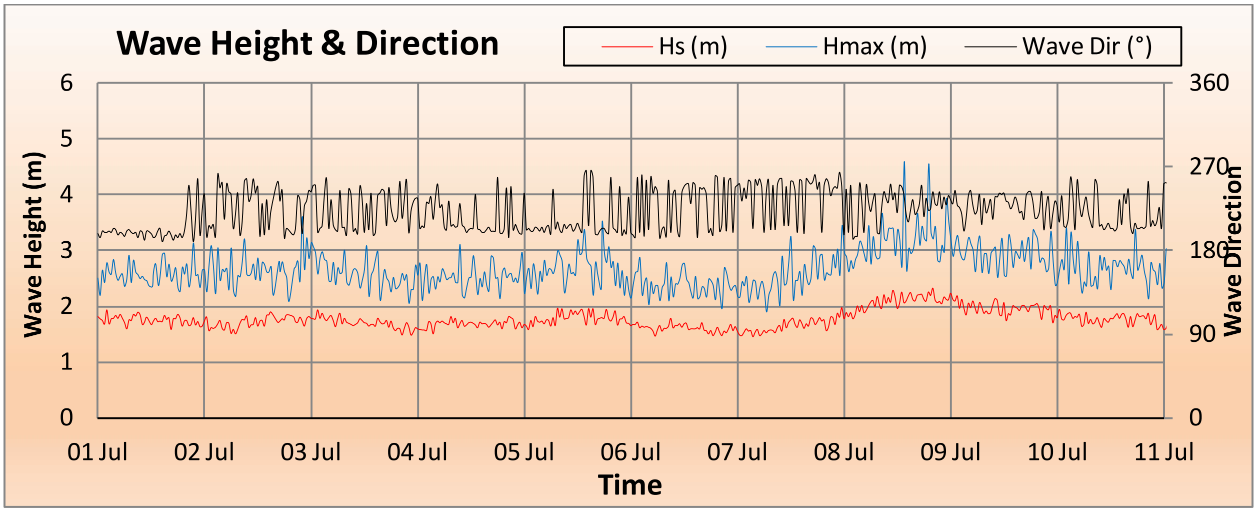

Observed Tide at Coast Guard Jetty, Vizhinjam
1.4
0.9
0.4
-0.1
Height in m above CD
01 Jul
02 Jul
03 Jul
04 Jul
05 Jul
06 Jul
07 Jul
08 Jul
09 Jul
10 Jul
11 Jul
Time

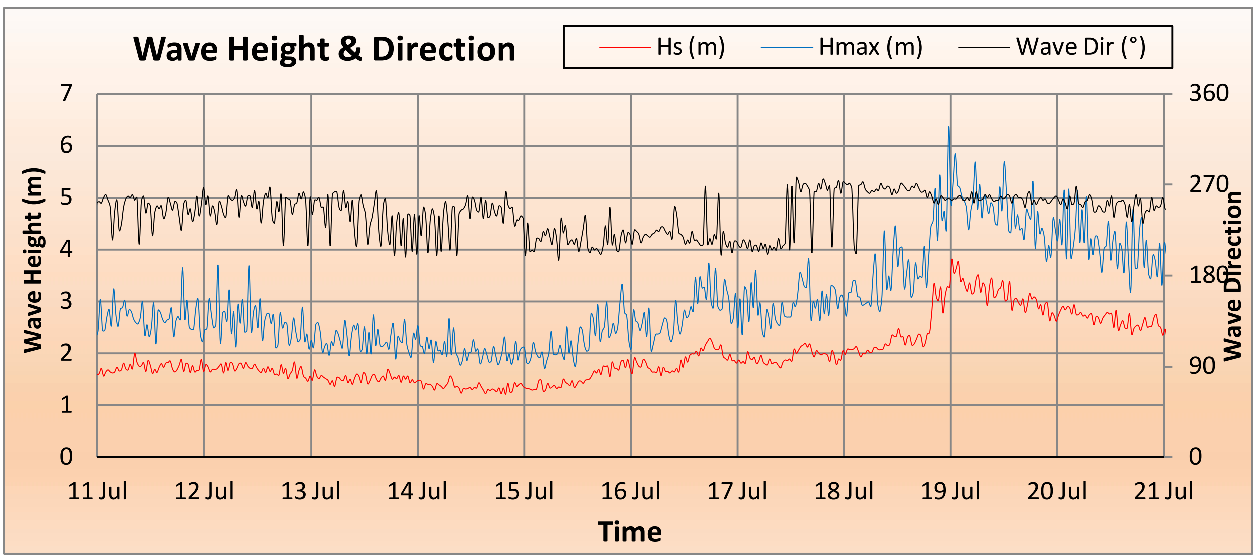

Observed Tide at Coast Guard Jetty, Vizhinjam
1.4
0.9
0.4
-0.1
Height in m above CD
11 Jul
12 Jul
13 Jul
14 Jul
15 Jul
16 Jul
17 Jul
18 Jul
19 Jul
20 Jul
21 Jul
Time

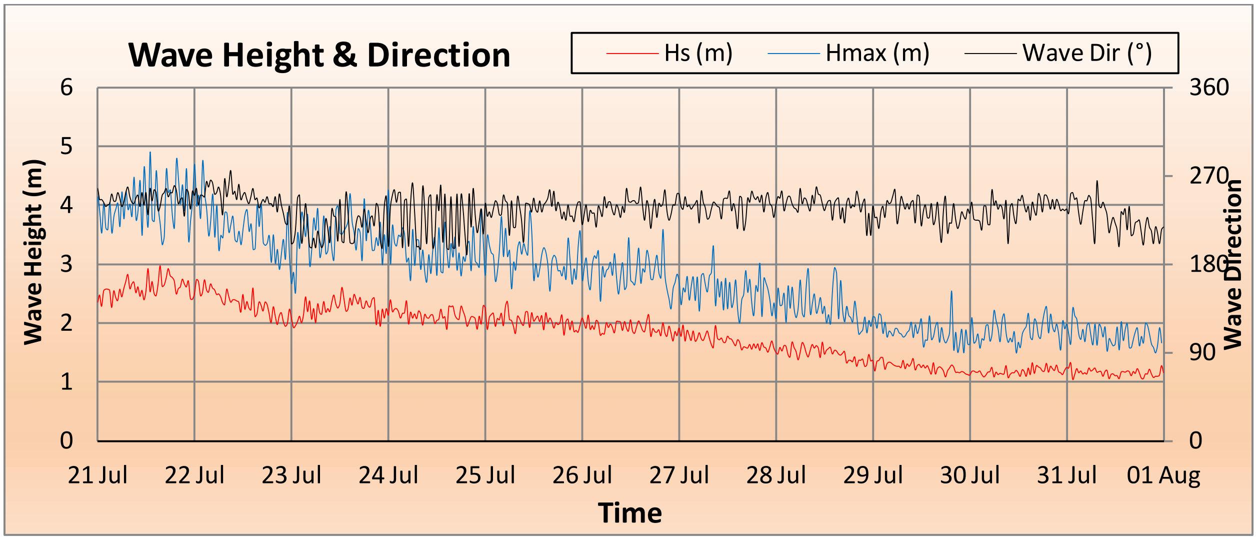

Observed Tide at Coast Guard Jetty, Vizhinjam
1.4
0.9
0.4
-0.1
Height in m above CD
21 Jul
22 Jul
23 Jul
24 Jul
25 Jul
26 Jul
27 Jul
28 Jul
29 Jul
30 Jul
31 Jul
01 Aug
Time

Annexure II

Wave Data - July 2019

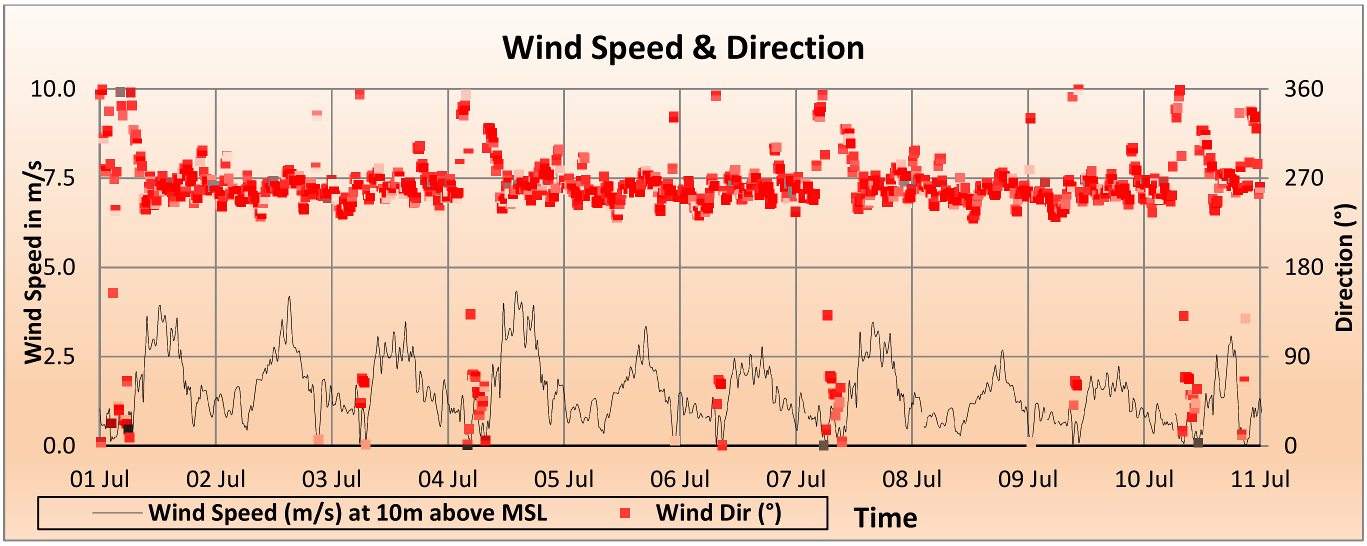

Wave Height & Direction
Hs (m)
Hmax (m)
Wave Dir (°)
Wave Height (m)
Wave Direction
6
5
4
3
2
1
0
360
270
180
90
0
01 Jul
02 Jul
03 Jul
04 Jul
05 Jul
06 Jul
07 Jul
08 Jul
09 Jul
10 Jul
11 Jul
Time

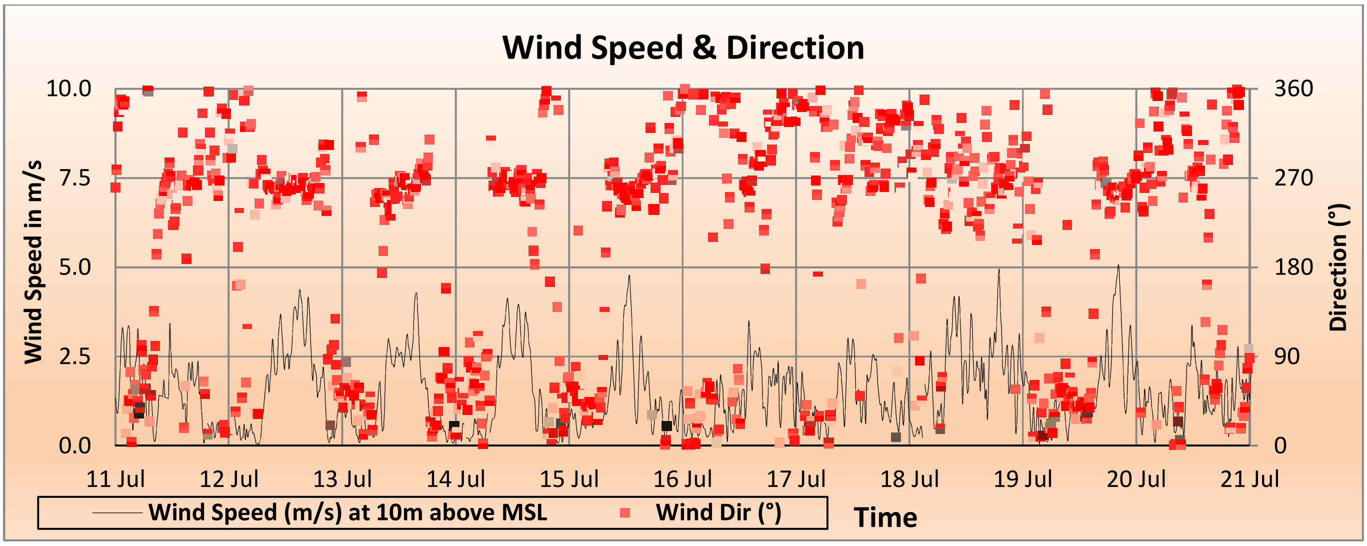

Wave Height & Direction
Hs (m)
Hmax (m)
Wave Dir (°)
Wave Height (m)
Wave Direction
7
6
5
4
3
2
1
0
360
270
180
90
0
11 Jul
12 Jul
13 Jul
14 Jul
15 Jul
16 Jul
17 Jul
18 Jul
19 Jul
20 Jul
21 Jul
Time

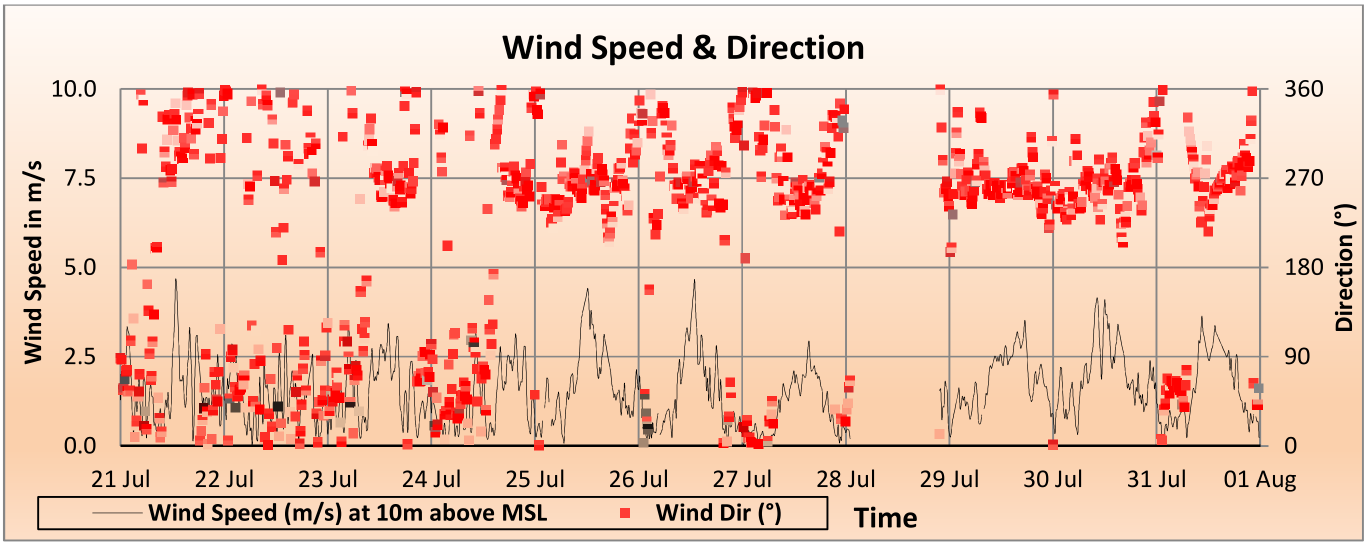

Wave Height & Direction
Hs (m)
Hmax (m)
Wave Dir (°)
Wave Height (m)
Wave Direction
Time
0
1
2
3
4
5
6
0
90
180
270
360
21 Jul
22 Jul
23 Jul
24 Jul
25 Jul
26 Jul
27 Jul
28 Jul
29 Jul
30 Jul
31 Jul
01 Aug

Annexure III

Wind Data - July 2019


Wind Speed & Direction
Wind Speed in m/s
Direction (°)
10.0
7.5
5.0
2.5
0.0
360
270
180
90
0
01 Jul
02 Jul
03 Jul
04 Jul
05 Jul
06 Jul
07 Jul
08 Jul
09 Jul
10 Jul
11 Jul
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time


Wind Speed & Direction
Wind Speed in m/s
Direction (°)
10.0
7.5
5.0
2.5
0.0
360
270
180
90
0
11 Jul
12 Jul
13 Jul
14 Jul
15 Jul
16 Jul
17 Jul
18 Jul
19 Jul
20 Jul
21 Jul
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time


Wind Speed & Direction
Wind Speed in m/s
10.0
7.5
5.0
2.5
0.0
Direction (°)
360
270
180
90
0
21 Jul
22 Jul
23 Jul
24 Jul
25 Jul
26 Jul
27 Jul
28 Jul
29 Jul
30 Jul
31 Jul
01 Aug
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

Annexure IV

LEO Data - Ju□□ 2019

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									
				Northing	Easting	Northing	Easting								
05/07/2019	CSP-1	10:15	10:20	914453.6	734900.1	914445.5	734905.7	3.29	305	L	85	1	13.5	10	Rotary motion due to seawall
05/07/2019	CSP-2	10:35	10:40	914777.8	734503.7	914797.9	734471.4	12.69	148	R	85	1.5	13.2	20	
05/07/2019	CSP-3	11:00	11:05	915038.2	734079.5	915041.4	734074.7	1.91	146	R	90	1	13.5	5	Rotary motion due to seawall
05/07/2019	CSP-4	11:25	11:30	915328.0	733668.9	915332.1	733664.2	2.06	139	R	90	1	13.5	5	Rotary motion due to seawall
05/07/2019	CSP-5	11:40	11:45	915623.7	733261.6	915629.2	733254.8	2.89	141	R	90	1	13	5	
05/07/2019	CSP-6	12:00	12:05	915912.7	732852.8	915917.1	732848.7	1.99	133	R	90	1.5	13	5	Rotary motion due to seawall
05/07/2019	CSP-7	12:10	12:15	916208.4	732448.6	916212.3	732443.5	2.12	142	R	90	1.5	13	5	Rotary motion due to seawall
06/07/2019	CSP-8	10:30	10:35	916493.3	732036.3	916487.2	732049.4	4.83	335	L	90	1	12.6	5	Rotary motion due to seawall
06/07/2019	CSP-9	10:20	10:25	916791.2	731633.0	916787.4	731641.7	3.17	336	L	90	1	12.7	5	Rotary motion due to seawall
06/07/2019	CSP-10	10:05	10:10	917091.9	731231.7	917084.2	731242.2	4.35	324	L	90	1	12.5	20	Rotary motion due to seawall
06/07/2019	CSP-11	09:50	09:55	917381.5	730827.5	917371.1	730843.3	6.32	327	L	90	1	12.5	25	
06/07/2019	CSP-12	09:35	09:40	917576.8	730554.3	917588.5	730538.7	6.50	143	R	90	1	12.4	25	
06/07/2019	CSP-13	10:45	10:50	917872.5	730153.9	917880.2	730145.8	3.72	136	R	90	1.5	12.4	20	
06/07/2019	CSP-14	11:05	11:10	918171.8	729749.5	918181.5	729739.6	4.63	135	R	90	1.5	12.5	20	
06/07/2019	CSP-15	11:15	11:20	918462.3	729345.6	918474.4	729323.0	8.54	152	R	90	1.5	12.3	20	
06/07/2019	CSP-16	11:50	11:55	918749.3	728942.5	918757.5	728931.2	4.62	144	R	90	1.5	12.2	20	
06/07/2019	CSP-17	12:10	12:15	919067.7	728559.8	919079.1	728546.2	5.91	140	R	90	1.5	12.2	20	
09/07/2019	CSP-18	10:20	10:25	919382.7	728167.0	919372.6	728180.0	5.46	322	L	95	1.5	12.3	15	
09/07/2019	CSP-19	10:05	10:10	919688.6	727771.8	919648.9	727827.7	22.85	325	L	95	1.5	12.8	15	
09/07/2019	CSP-20	09:45	09:50	919986.4	727367.7	919958.8	727405.4	15.57	324	L	95	1.5	13.1	20	
09/07/2019	CSP-21	10:35	10:40	920286.9	726966.7	920260.0	727011.2	17.33	329	L	90	1.5	12.5	20	
09/07/2019	CSP-22	10:50	10:55	920606.2	726578.3	920589.3	726601.1	9.48	323	L	90	1.5	12.5	20	
09/07/2019	CSP-23	11:05	11:10	920925.2	726191.6	920913.7	726204.8	5.85	319	L	90	1	11	10	
09/07/2019	CSP-24	11:15	11:20	921246.7	725806.3	921228.7	725831.5	10.34	324	L	90	1	10.8	10	
09/07/2019	CSP-25	11:25	11:30	921565.7	725422.8	921559.7	725430.5	3.24	322	L	90	1	10.7	10	
09/07/2019	CSP-26	11:45	11:50	921885.6	725036.6	921866.1	725062.8	10.89	323	L	90	1	11.5	15	
10/07/2019	CSP-27	01:25	01:30	922192.6	724636.6	922167.4	724671.7	14.42	324	L	95	1	13	15	
10/07/2019	CSP-28	01:05	01:10	922496.5	724247.2	922460.5	724302.1	21.88	327	L	95	1	13	15	
10/07/2019	CSP-29	12:45	12:50	922789.8	723855.6	922755.3	723899.7	18.68	322	L	90	1.5	12	15	

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									
				Northing	Easting	Northing	Easting								
10/07/2019	CSP-30	12:30	12:35	923065.3	723463.9	923039.0	723508.2	17.16	329	L	90	1	12	15	
10/07/2019	CSP-31	12:15	12:20	923353.7	723040.3	923307.3	723119.3	30.54	330	L	95	1	12	15	
10/07/2019	CSP-32	11:50	11:55	923640.3	722623.5	923604.1	722675.7	21.16	325	L	95	1	12	15	
10/07/2019	CSP-33	11:35	11:40	923889.5	722248.2	923862.2	722294.9	18.05	330	L	95	1.5	12	20	
10/07/2019	CSP-34	11:10	11:15	924168.8	721812.3	924120.3	721895.8	32.19	330	L	95	1	11	10	
11/07/2019	CSP-35	10:40	10:45	924319.8	721422.0	924318.8	721427.0	1.71	349	L	90	1.5	10	10	Rocky area
11/07/2019	CSP-36	10:50	10:55	924785.6	721070.9	924771.3	721080.1	5.67	303	L	90	1.5	10	15	
11/07/2019	CSP-37	11:55	12:00	925157.8	720770.7	925167.9	720761.9	4.46	131	R	95	1	10	20	Rip Current
11/07/2019	CSP-38	12:20	12:25	925569.7	720357.7	925554.0	720373.2	7.37	314	L	95	1	10	25	
11/07/2019	CSP-39	12:50	12:55	925891.5	719946.9	925877.2	719961.1	6.71	315	L	95	1	11	25	
11/07/2019	CSP-40	01:00	01:05	926072.0	719561.4	926066.2	719567.0	2.68	314	L	95	1	10	5	Rotary motion due to seawall
11/07/2019	CSP-41	10:15	10:20	926892.1	718527.1	926894.8	718520.5	2.37	158	R	90	1	10	15	Rip Current
03/07/2019	CSP-42	10:16	10:21	927279.5	718024.4	927285.9	718025.8	2.18	78	R	85	0.5	8	20	Rip Current
03/07/2019	CSP-43	10:30	10:35	927553.1	717805.4	927539.9	717827.7	8.64	329	L	90	1	10	25	Rip Current
03/07/2019	CSP-44	10:48	10:53	927916.5	717529.2	927899.9	717543.3	7.26	310	L	90	0.5	10	20	
03/07/2019	CSP-45	12:02	12:07	928519.1	717239.8	928532.9	717249.8	5.68	54	R	90	0.5	10	20	Rip Current
03/07/2019	CSP-46	11:47	11:52	928890.6	717261.2	928884.5	717260.3	2.06	262	L	90	0.5	10	20	Rip Current
03/07/2019	CSP-47	12:22	12:27	929310.2	717066.2	929304.7	717073.3	2.99	322	L	90	1.5	11	5	Rip Current
03/07/2019	CSP-48	12:36	12:41	929957.2	716801.5	929947.2	716807.0	3.80	299	L	95	1	12	5	Seawall area
02/07/2019	CSP-49	13:31	13:36	930246.6	716606.9	930239.5	716611.6	2.83	303	L	95	1.5	10	30	Seawall area
02/07/2019	CSP-50	13:23	13:28	930663.0	716354.4	930654.2	716359.2	3.35	299	L	95	1.5	10	25	Seawall area
02/07/2019	CSP-51	13:15	13:20	931105.9	716076.0	931098.4	716079.0	2.69	292	L	100	1	8	25	Seawall area
02/07/2019	CSP-52	13:07	13:12	931493.6	715788.3	931487.6	715790.5	2.14	289	L	95	1.5	10	5	Seawall area
02/07/2019	CSP-53	12:15	12:20	931949.5	715548.1	931931.8	715568.4	8.96	319	L	95	1.5	10	5	
02/07/2019	CSP-54	11:55	12:00	932315.3	715225.8	932276.2	715265.7	18.59	316	L	95	1.5	10	5	
02/07/2019	CSP-55	11:41	11:46	932703.3	714907.1	932628.0	714965.7	31.80	308	L	95	1.5	10	5	
02/07/2019	CSP-56	10:55	11:00	933020.8	714528.2	932998.5	714551.0	10.65	316	L	95	1.5	10	5	Seawall area
02/07/2019	CSP-57	11:05	11:10	933408.2	714207.2	933404.2	714210.4	1.71	309	L	90	1.5	10	15	Rip Current
02/07/2019	CSP-58	11:15	11:20	933802.9	713906.2	933806.4	713903.7	1.45	126	R	90	1.5	10	15	Rip Current
07/07/2019	CSP-59	10:35	10:40	934171.0	713599.5	934139.4	713622.9	13.11	306	L	95	1	12	15	Between seawall
07/07/2019	CSP-60	10:20	10:25	934591.7	713281.4	934570.7	713302.9	10.01	316	L	95	1	12	15	Rip Current

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									
				Northing	Easting	Northing	Easting								
07/07/2019	CSP-61	10:05	10:10	934951.0	712940.0	934936.1	712951.0	6.17	306	L	90	1	12	10	Seawall area
07/07/2019	CSP-62	09:50	09:55	935329.8	712615.7	935336.7	712608.9	3.24	134	R	90	1	12	10	Rip Current
07/07/2019	CSP-63	09:35	09:40	935727.3	712270.7	935696.4	712293.7	12.82	307	L	90	1	12.5	5	Seawall area
07/07/2019	CSP-64	09:25	09:30	936096.9	711960.5	936079.0	711970.7	6.87	300	L	90	1	12.5	10	Rip Current
07/07/2019	CSP-65	11:15	11:20	936431.2	711654.5	936422.4	711662.0	3.87	310	L	90	1	12.4	5	Rip Current
07/07/2019	CSP-66	11:30	11:35	936831.3	711297.7	936810.2	711313.2	8.75	306	L	90	1	12.3	5	Rip Current
07/07/2019	CSP-67	11:40	11:45	937207.3	710962.3	937173.0	710993.5	15.45	312	L	90	1	11.5	20	
07/07/2019	CSP-68	11:50	11:55	937580.8	710632.6	937555.8	710656.7	11.57	314	L	90	1	12	25	
07/07/2019	CSP-69	12:10	12:15	937952.1	710300.7	937924.0	710332.4	14.13	318	L	90	1	12	15	Rip Current
07/07/2019	CSP-70	12:25	12:30	938326.4	709963.9	938295.2	709988.0	13.14	308	L	90	1.5	12.5	10	
07/07/2019	CSP-71	12:35	12:40	938465.9	709839.0	938440.0	709863.4	11.89	313	L	90	1.5	12.5	10	Rip Current
07/07/2019	CSP-72	12:45	12:50	938833.7	709498.9	938802.7	709532.2	15.19	317	L	95	1.5	12.6	20	Rip Current
07/07/2019	CSP-73	12:50	12:55	939211.5	709172.3	939181.5	709202.6	14.22	315	L	95	1.5	12.6	20	Rip Current
08/07/2019	CSP-74	11:55	12:00	939590.2	708841.6	939577.0	708851.5	5.49	307	L	90	1.5	11.1	25	Rip Current
08/07/2019	CSP-75	11:45	11:50	939966.0	708515.1	939947.7	708529.5	7.79	308	L	90	1.5	11.5	15	
08/07/2019	CSP-76	11:25	11:30	940351.1	708192.1	940358.3	708185.4	3.29	133	R	90	1.5	12	20	
08/07/2019	CSP-77	10:30	10:35	940735.7	707876.7	940726.0	707882.7	3.82	302	L	90	1.5	12	20	
08/07/2019	CSP-78	12:15	12:20	941112.4	707544.6	941123.8	707538.1	4.35	120	R	90	1.5	11.7	20	
08/07/2019	CSP-79	12:30	12:35	941512.3	707244.7	941522.9	707236.2	4.53	129	R	90	1.5	12.3	25	
08/07/2019	CSP-80	12:40	12:45	941905.9	706937.0	941914.0	706930.1	3.56	131	R	90	1.5	12.3	15	
08/07/2019	CSP-81	12:55	13:00	942304.4	706629.2	942314.1	706620.6	4.32	131	R	90	1.5	12.4	15	

Annexure VII

Photo Documentation at CSP Locations - July 2019

Figure 01:- July CSP 01

Figure 02:- July CSP 02

Figure 03:- July CSP 03

Figure 04:- July CSP 04

Figure 05:- July CSP 05

Figure 06:- July CSP 06

Figure 07:- July CSP 07

Figure 08:- July CSP 08

Figure 09:- July CSP 09

Figure 10:- July CSP 10

Figure 11:- July CSP 11

Figure 12:- July CSP 12

Figure 13:- July CSP 13

Figure 14:- July CSP 14

Figure 15:- July CSP 15

Figure 16:- July CSP 16

Figure 17:- July CSP 17

Figure 18:- July CSP 18

Figure 19:- July CSP 19

Figure 20:- July CSP 20

Figure 21:- July CSP 21

Figure 22:- July CSP 22

Figure 23:- July CSP 23

Figure 24:- July CSP 24

Figure 25:- July CSP 25

Figure 26:- July CSP 26

Figure 27:- July CSP 27

Figure 28:- July CSP 28

Figure 29:- July CSP 29

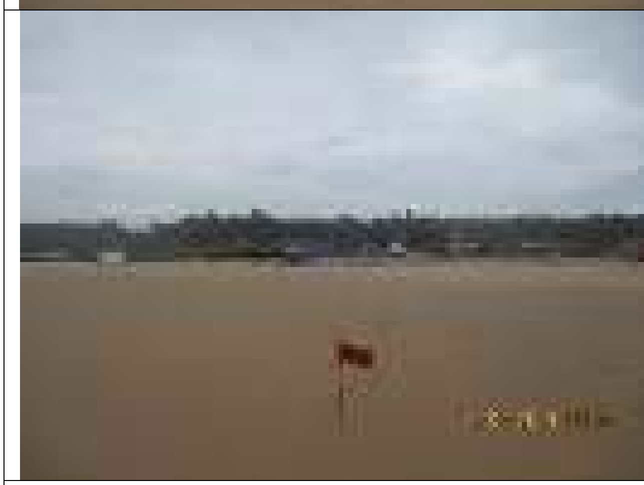


Figure 30:- July CSP 30

Figure 31:- July CSP 31

Figure 32:- July CSP 32

Figure 33:- July CSP 33

Figure 34:- July CSP 34

Figure 35:- July CSP 35

Figure 36:- July CSP 36

Figure 37:- July CSP 37

Figure 38:- July CSP 38

Figure 39:- July CSP 39

Figure 40:- July CSP 40

Figure 41:- July CSP 41

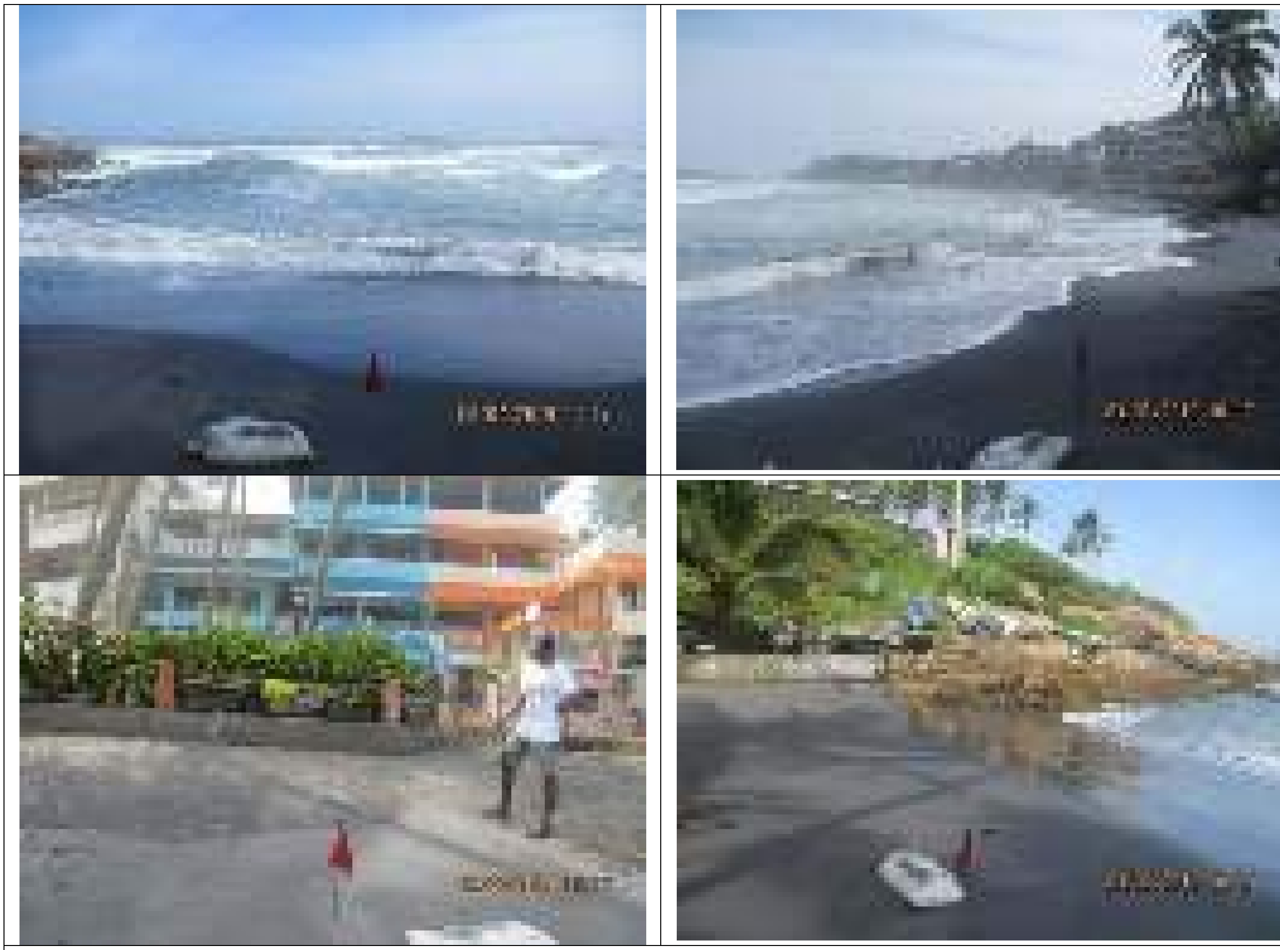


Figure 42:- July CSP 42

Figure 43:- July CSP 43

Figure 44:- July CSP 44

Figure 45:- July CSP 45

Figure 46:- July CSP 46

Figure 47:- July CSP 47

Figure 48:- July CSP 48

Figure 49:- July CSP 49

Figure 50:- July CSP 50

Figure 51:- July CSP 51

Figure 52:- July CSP 52

Figure 53:- July CSP 53

Figure 54:- July CSP 54

Figure 55:- July CSP 55

Figure 56:- July CSP 56

Figure 57:- July CSP 57

Figure 58:- July CSP 58

Figure 59:- July CSP 59

Figure 60:- July CSP 60

Figure 61:- July CSP 61

Figure 62:- July CSP 62

Figure 63:- July CSP 63

Figure 64:- July CSP 64

Figure 65:- July CSP 65

Figure 66:- July CSP 66

Figure 67:- July CSP 67

Figure 68:- July CSP 68

Figure 69:- July CSP 69

Figure 70:- July CSP 70

Figure 71:- July CSP 71

Figure 72:- July CSP 72

Figure 73:- July CSP 73

Figure 74:- July CSP 74

Figure 75:- July CSP 75

Figure 76:- July CSP 76

Figure 77:- July CSP 77

Figure 78:- July CSP 78

Figure 79:- July CSP 79

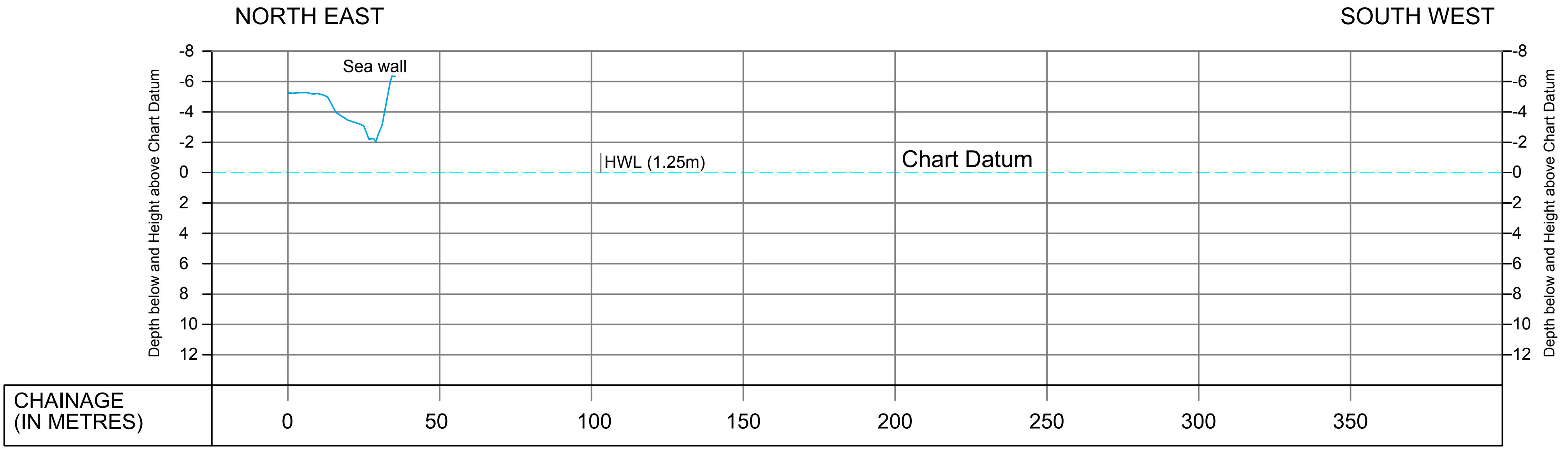
Figure 80:- July CSP 80

Figure 81:- July CSP 81

Annexure VI

Cross Shore Profiles - July 2019

Cross Section Line No.CSP-01 (July 2019)



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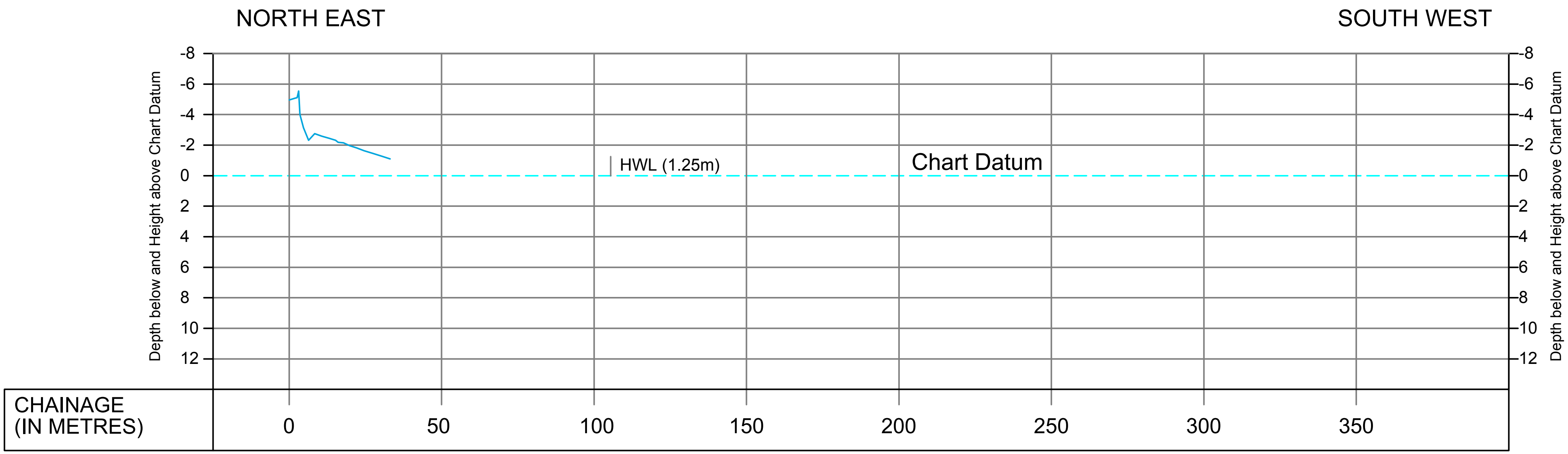
Cross Section Line No.CSP-02 (July 2019)



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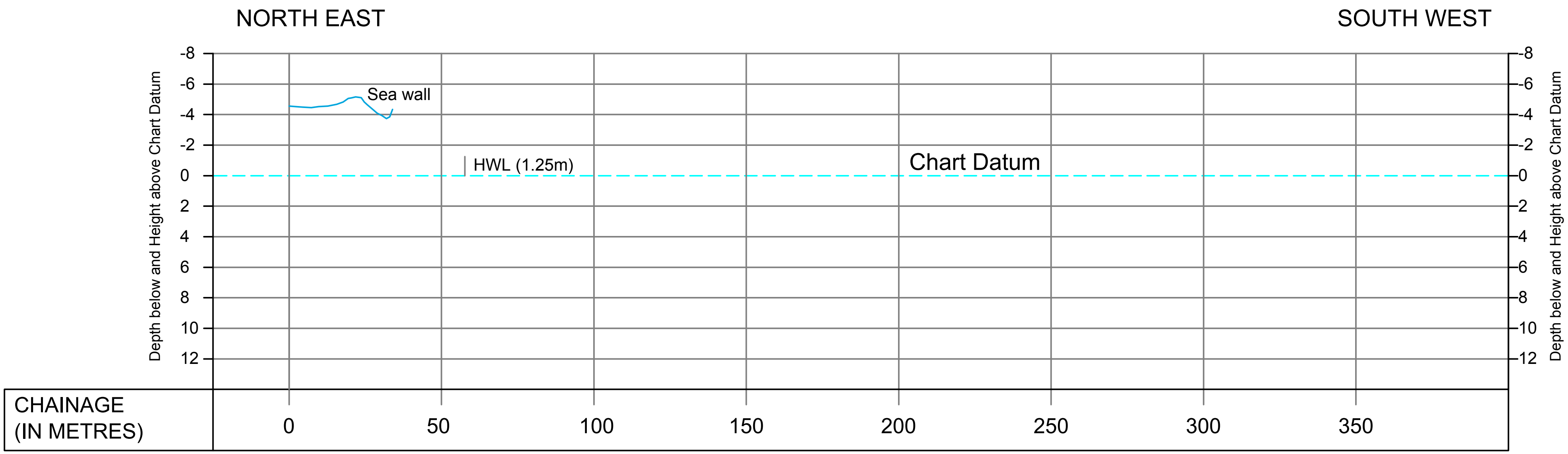
Cross Section Line No.CSP-03 (July 2019)



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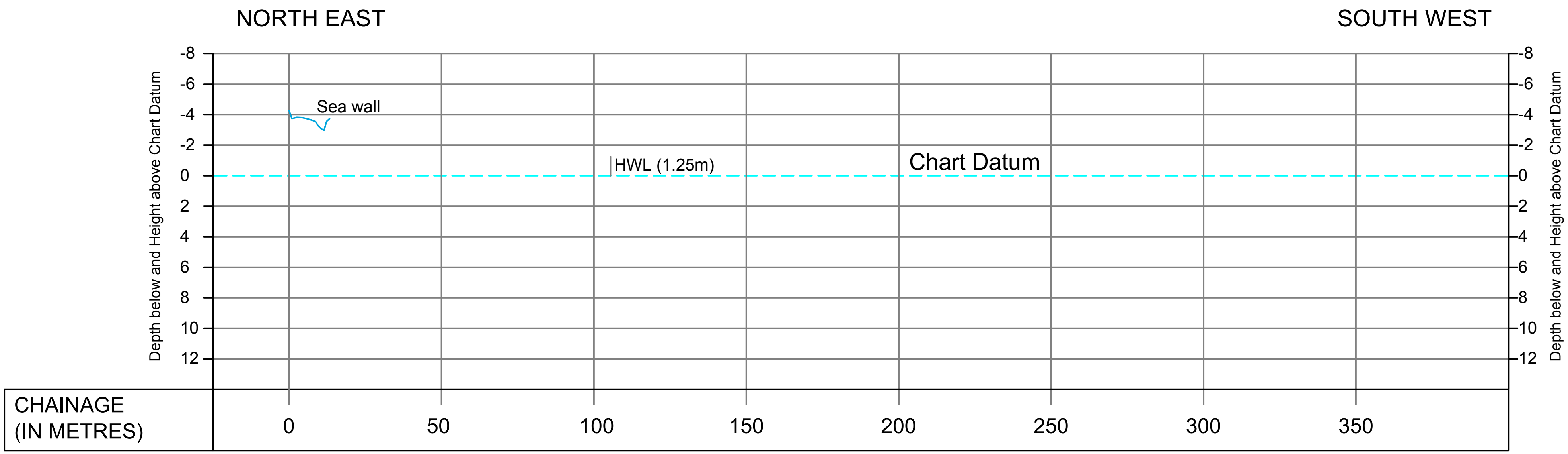
Cross Section Line No.CSP-04 (July 2019)



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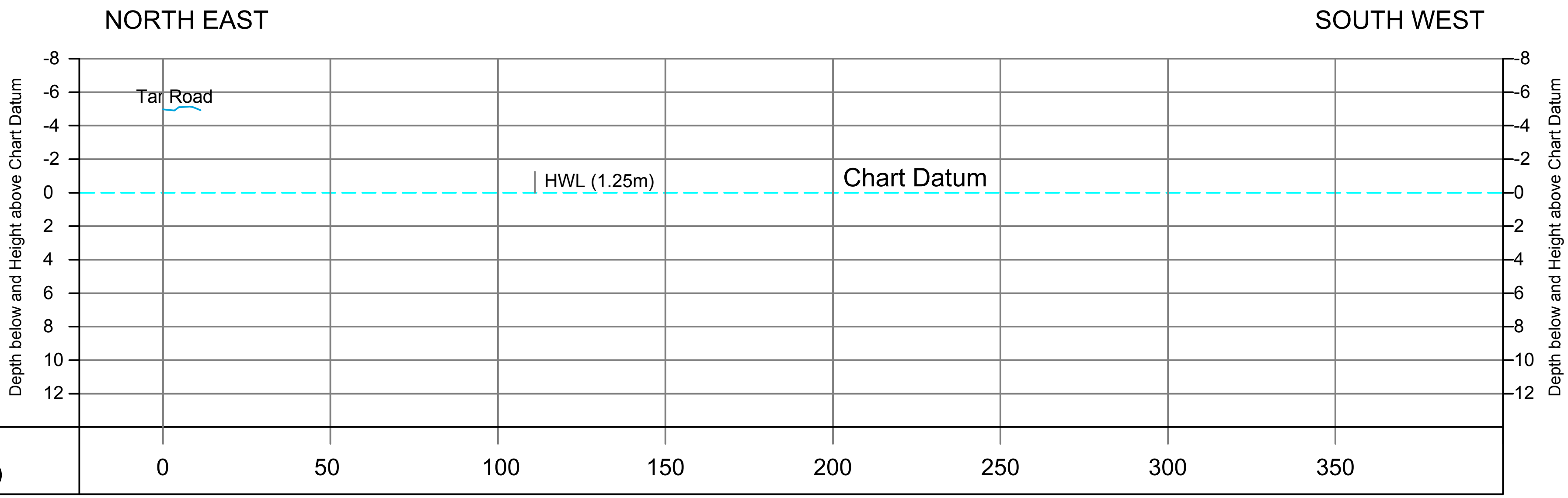
Cross Section Line No.CSP-05 (July 2019)



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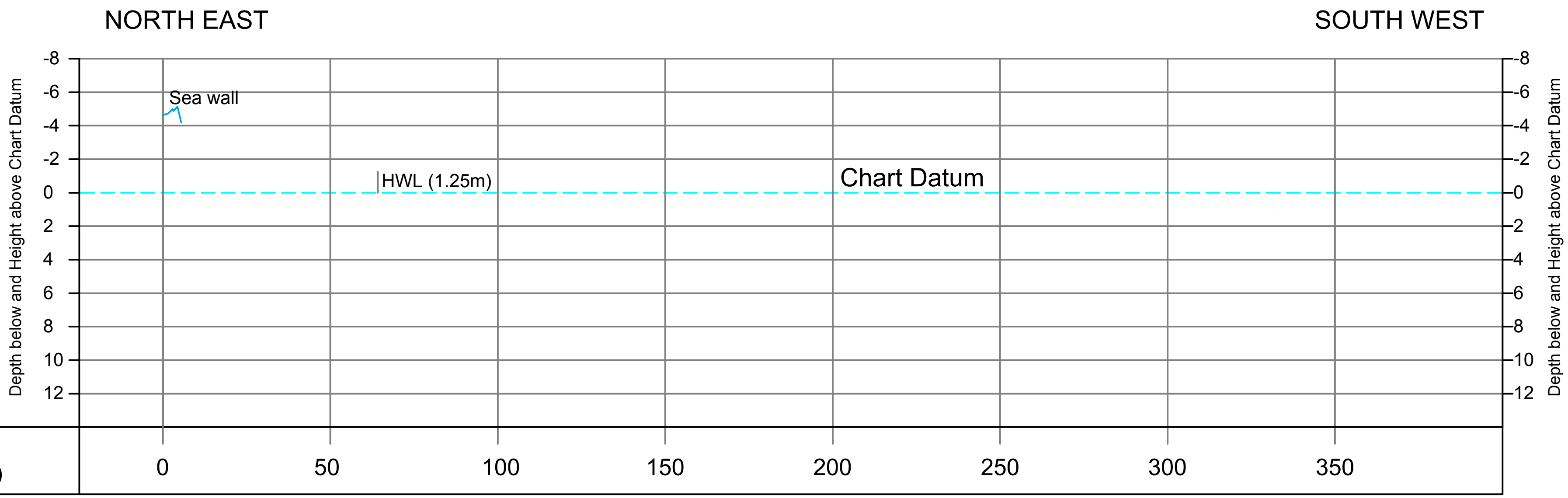
Cross Section Line No.CSP-06 (July 2019)



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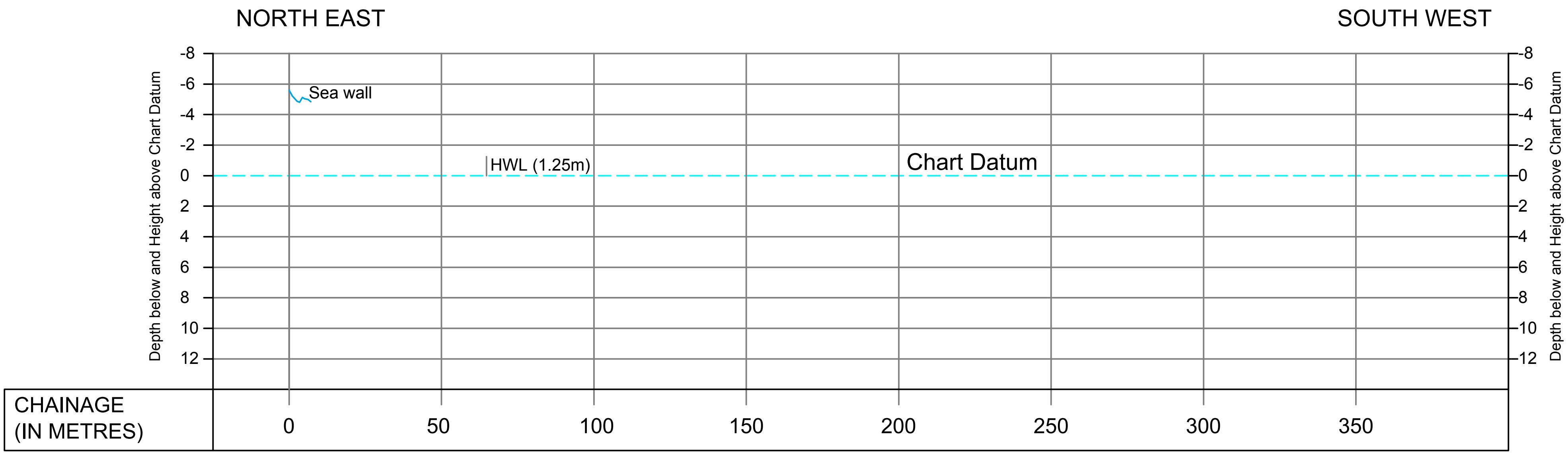
Cross Section Line No.CSP-07 (July 2019)



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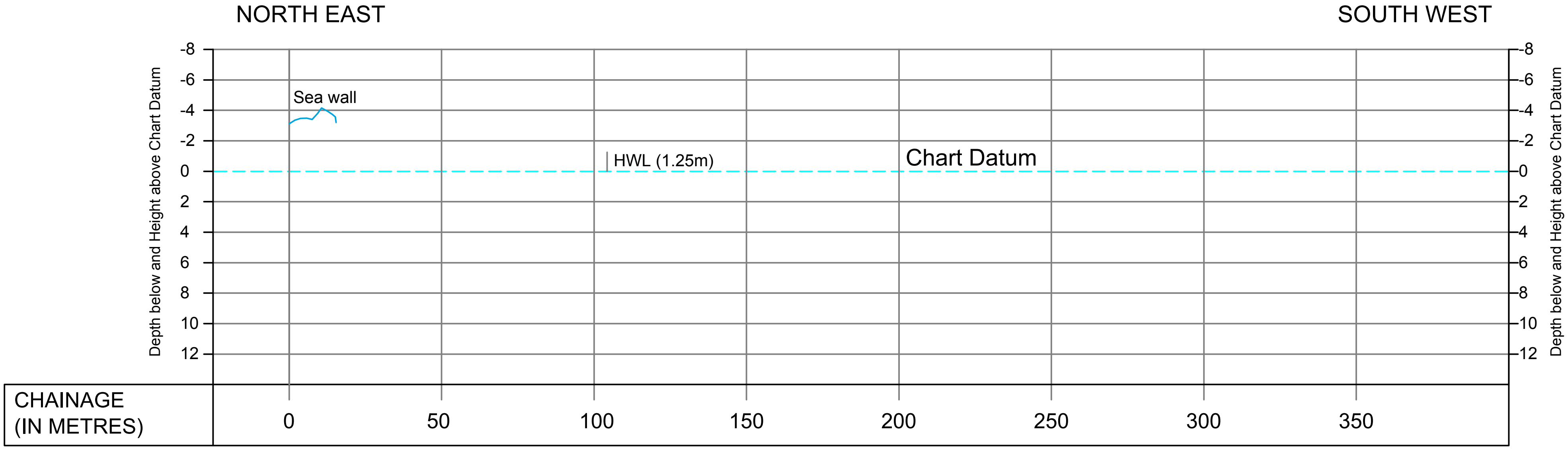
VERTICAL 1: 200

Oceanographic & Bathymetric data collection for Assessment
of Shoreline Changes at Vizhinjam for AVPPL
Annexure VI - Cross Shore Profiles
PSR-2, July 2019

Cross Section Line No.CSP-08 (July 2019)



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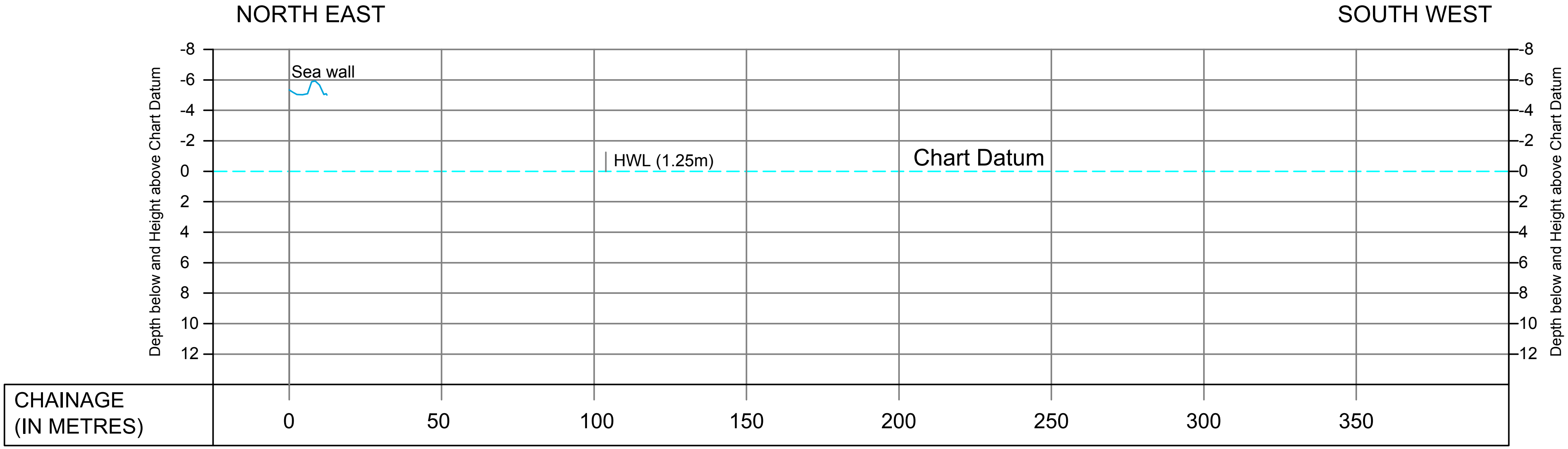
VERTICAL 1: 200

Cross Section Line No.CSP-09 (July 2019)



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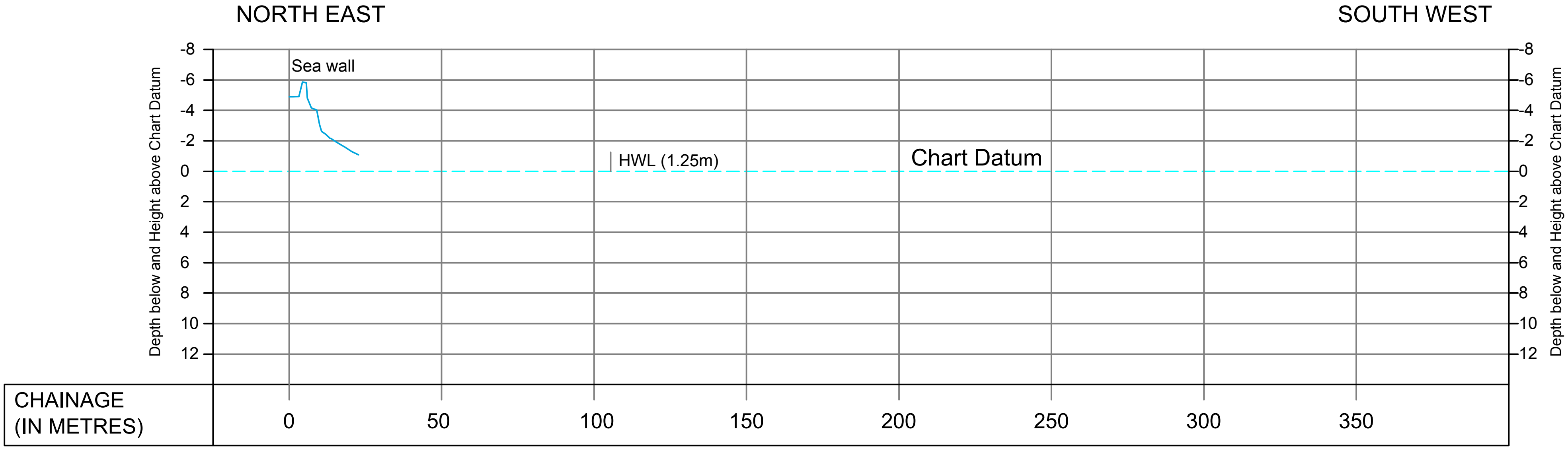
Cross Section Line No.CSP-10 (July 2019)



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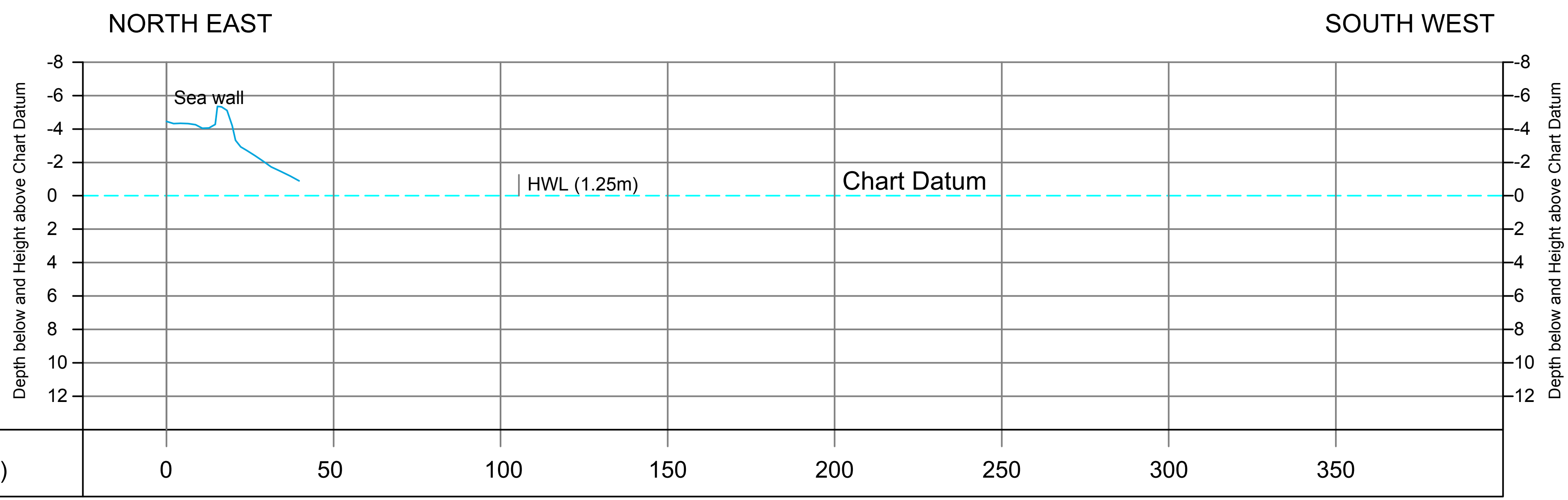
Cross Section Line No.CSP-11 (July 2019)



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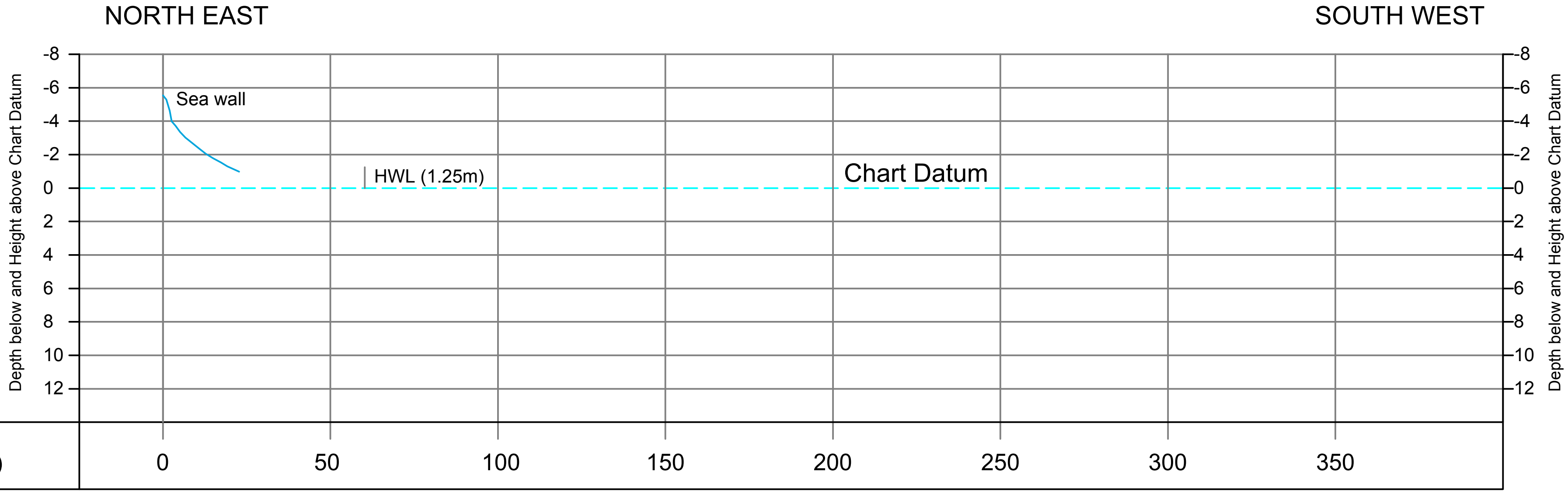
Cross Section Line No.CSP-12 (July 2019)



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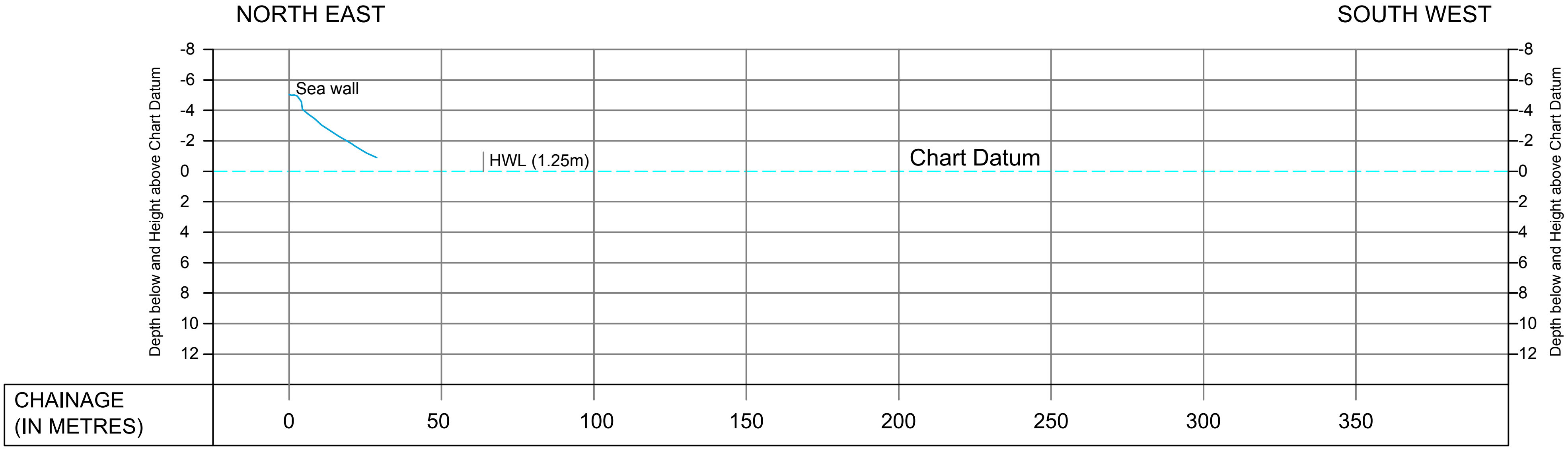
Cross Section Line No.CSP-13 (July 2019)



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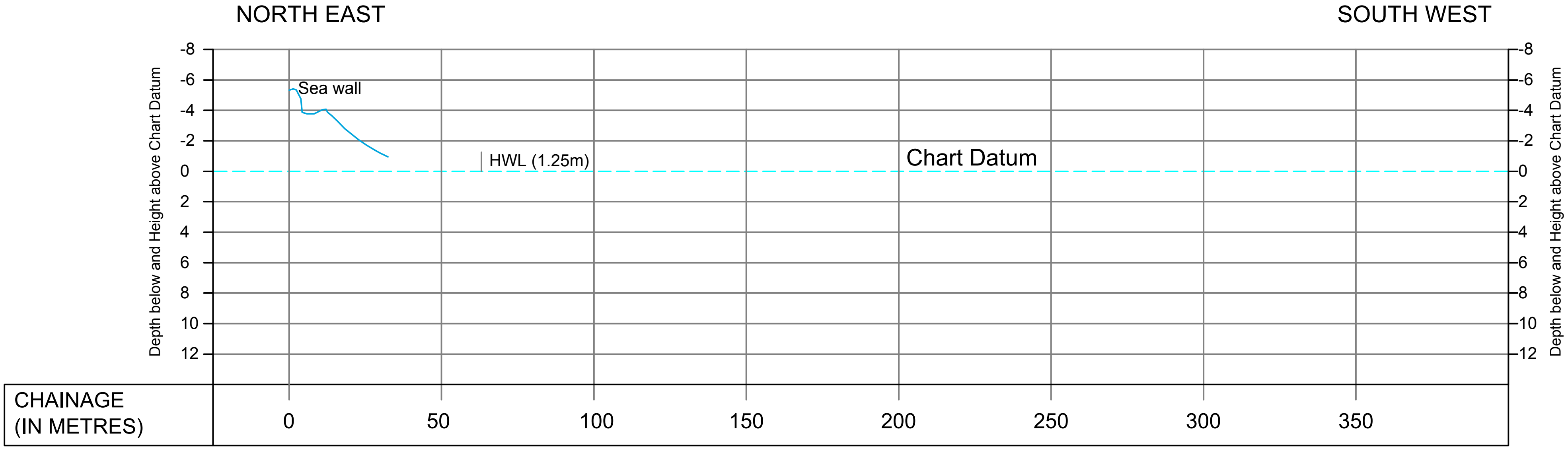
Cross Section Line No.CSP-14 (July 2019)



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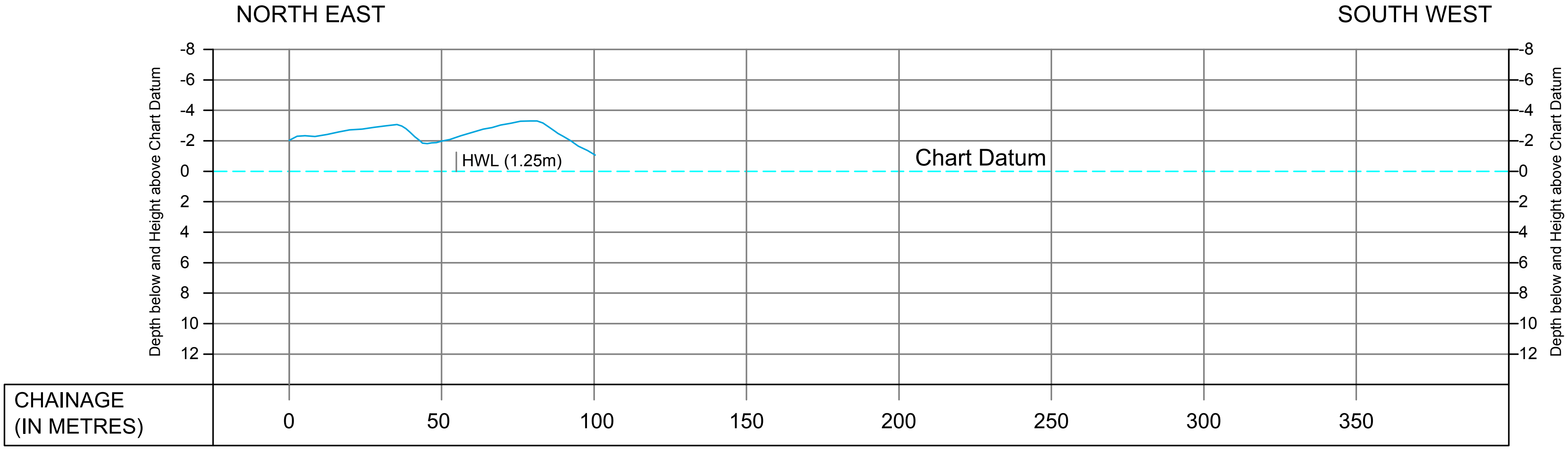
Cross Section Line No.CSP-15 (July 2019)



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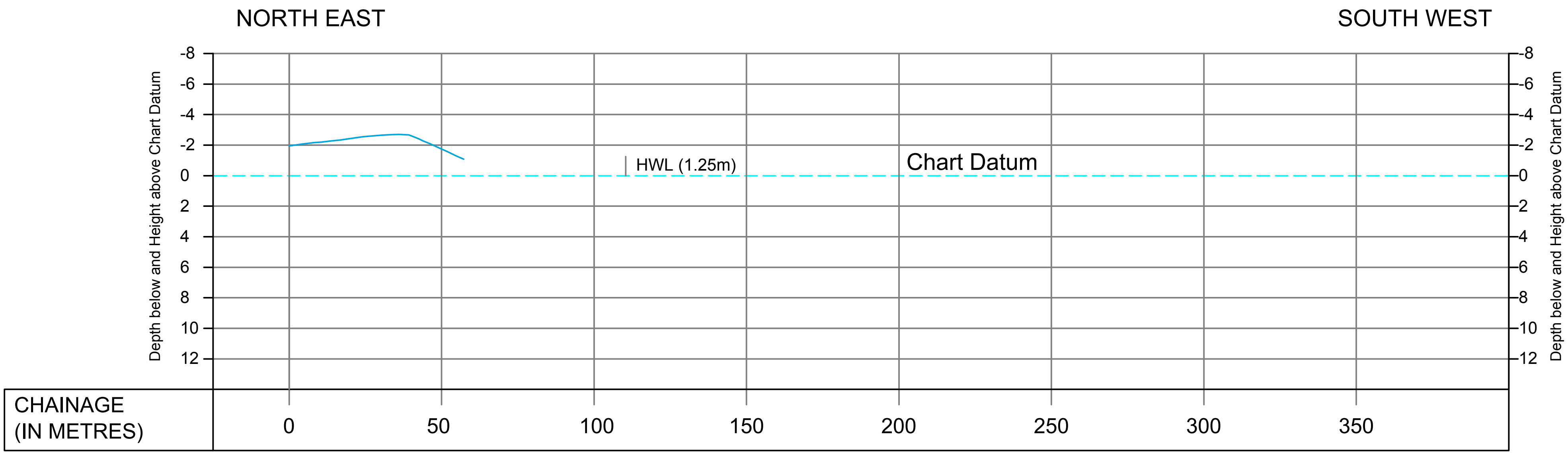
Cross Section Line No.CSP-16 (July 2019)



SCALE
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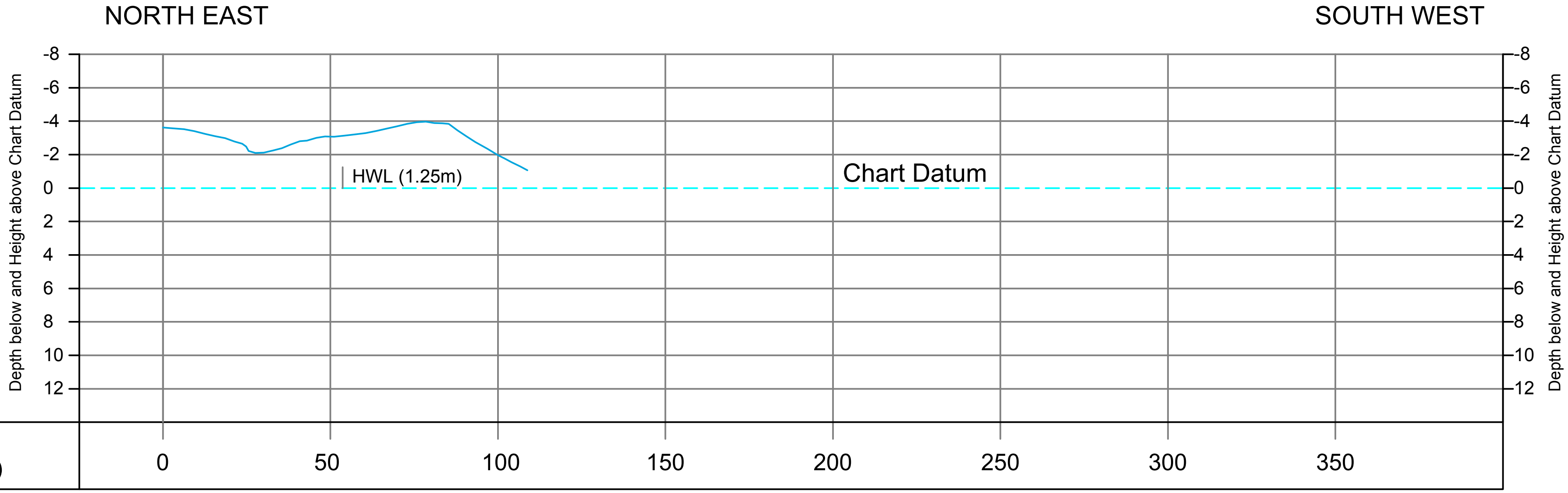
VERTICAL 1: 200

Cross Section Line No.CSP-17 (July 2019)



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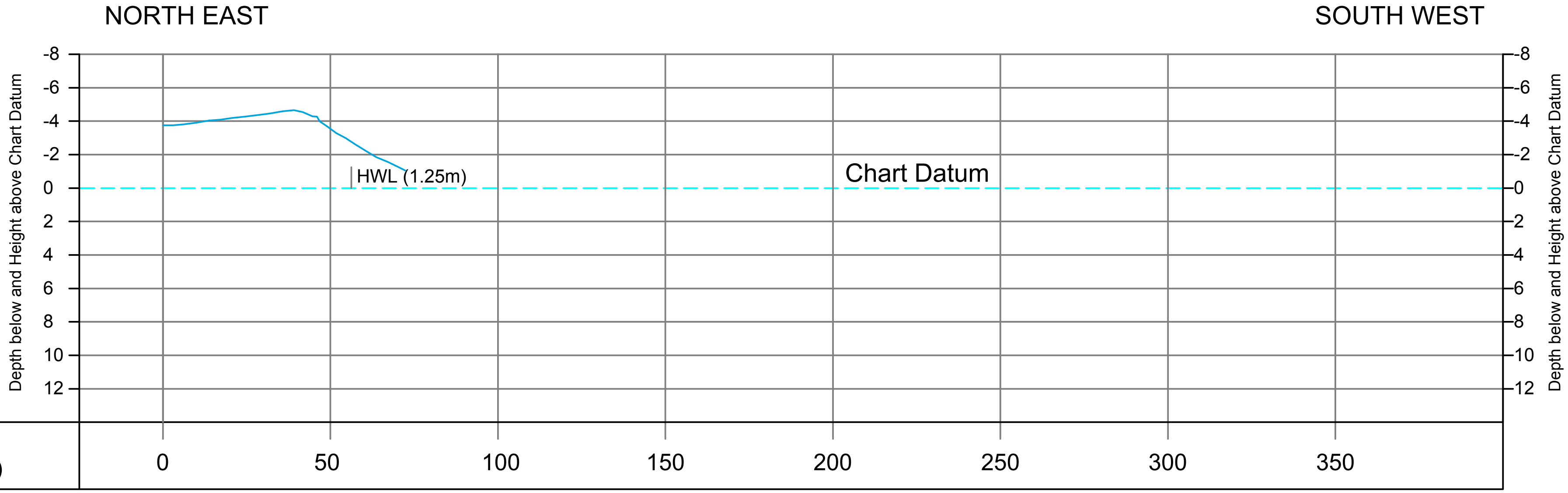
VERTICAL 1: 200

Cross Section Line No.CSP-18 (July 2019)



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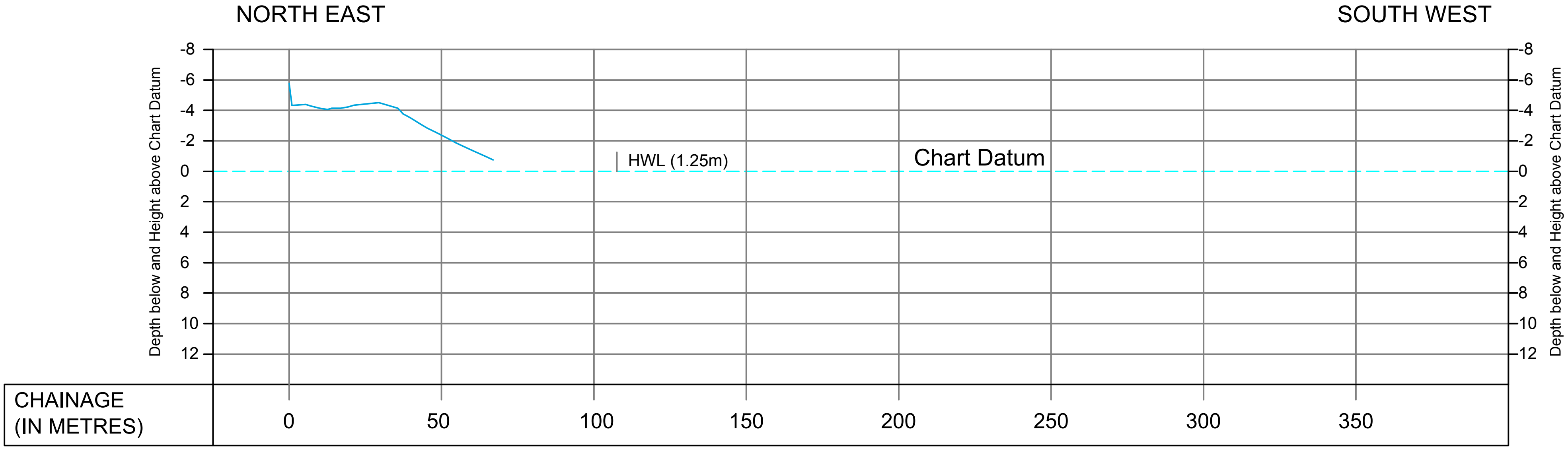
Cross Section Line No.CSP-19 (July 2019)



SCALE
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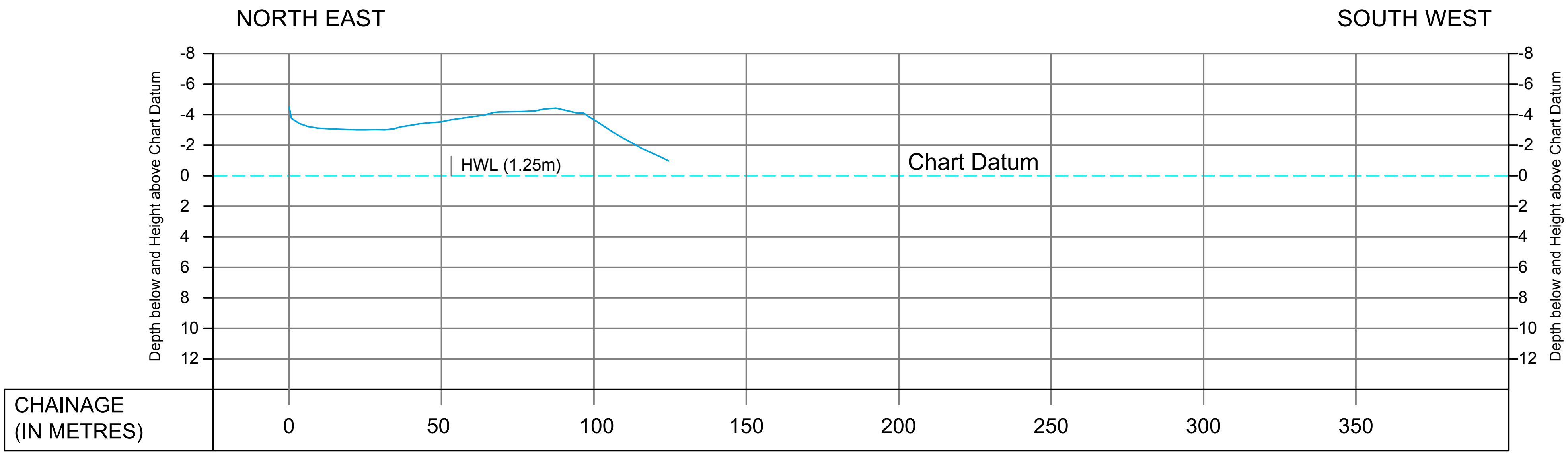
VERTICAL 1: 200

Cross Section Line No.CSP-20 (July 2019)



SCALE
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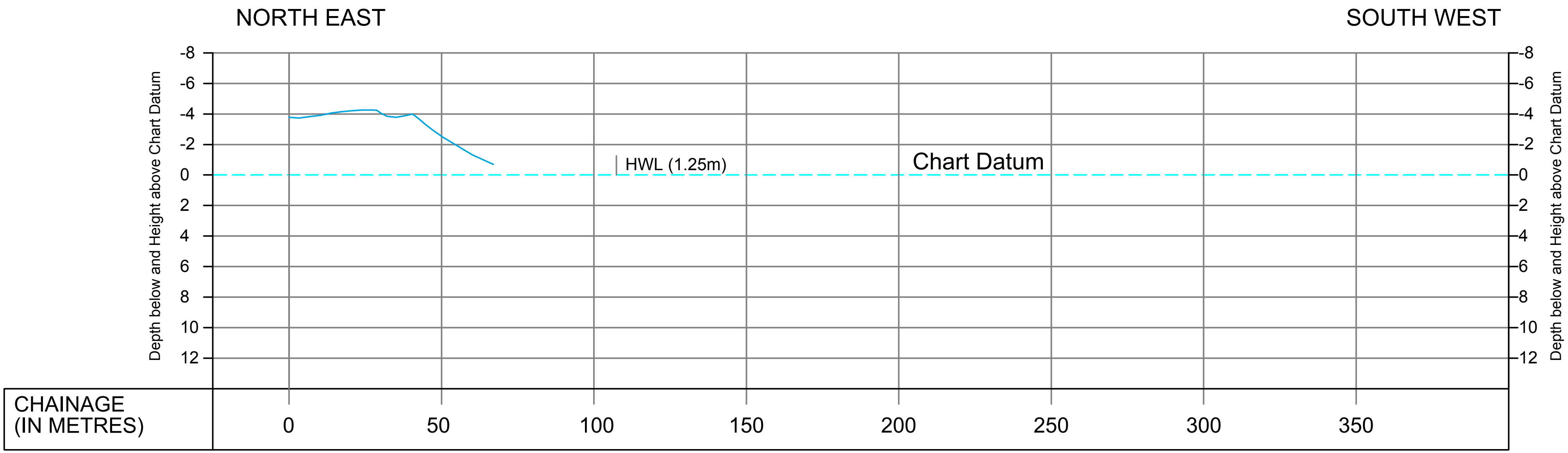
VERTICAL 1: 200

adani

Cross Section Line No.CSP-21 (July 2019)



SCALE
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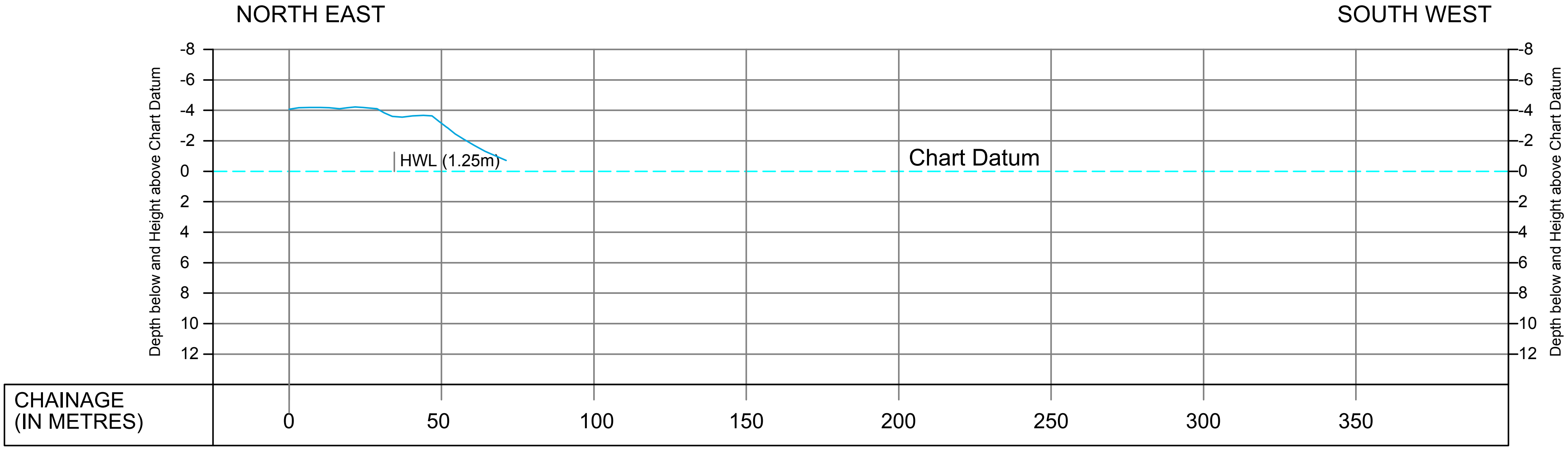
Cross Section Line No.CSP-22 (July 2019)



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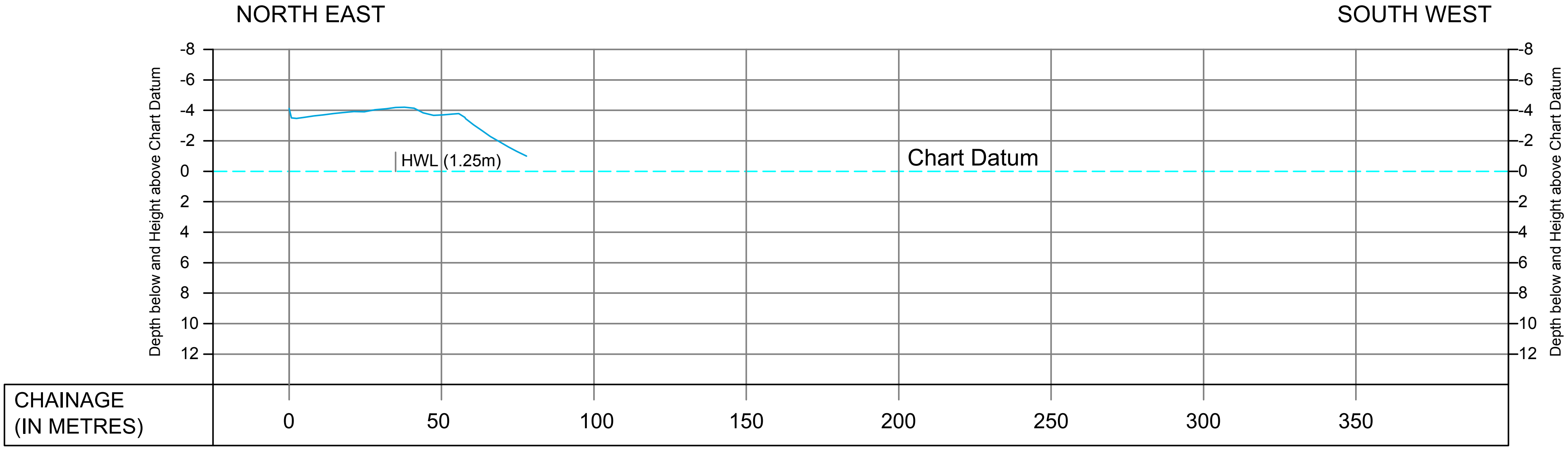

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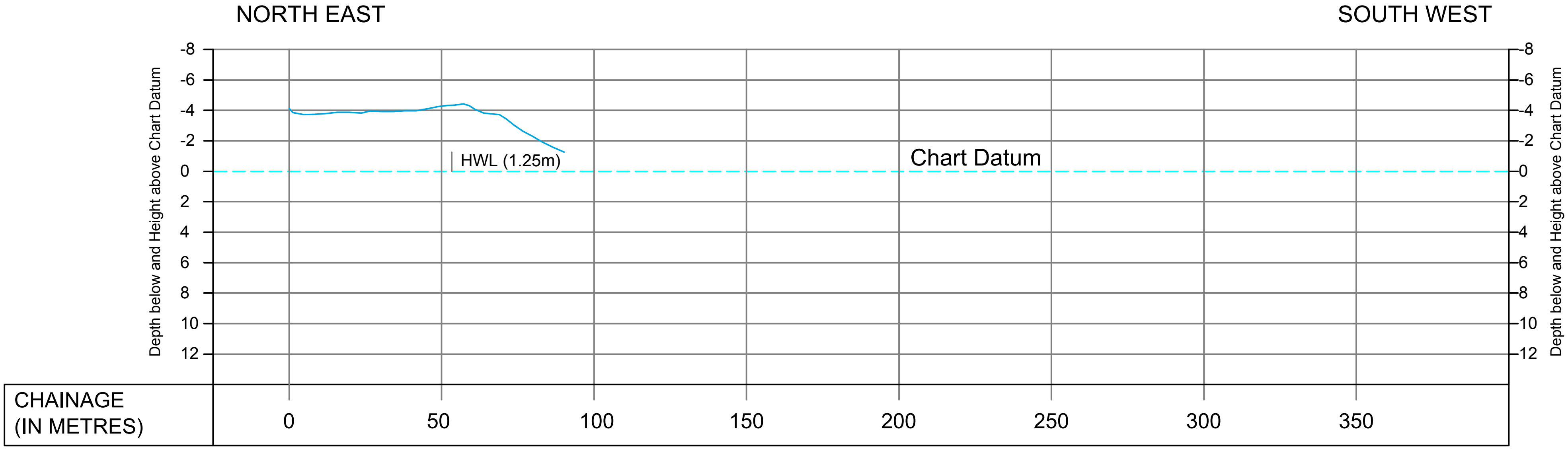

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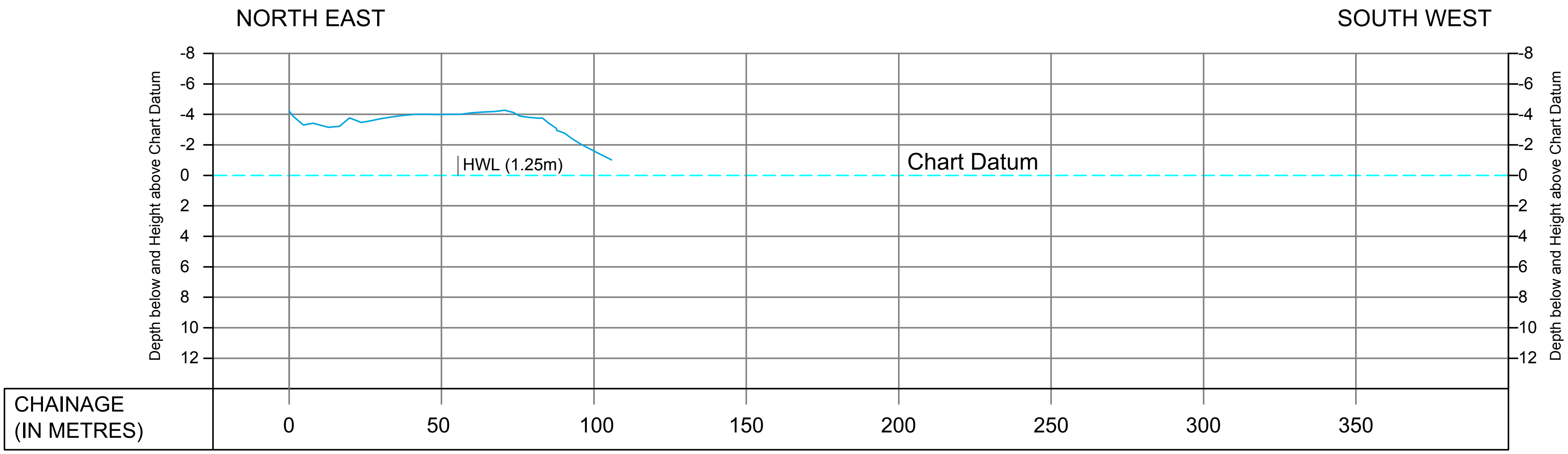

SCALE
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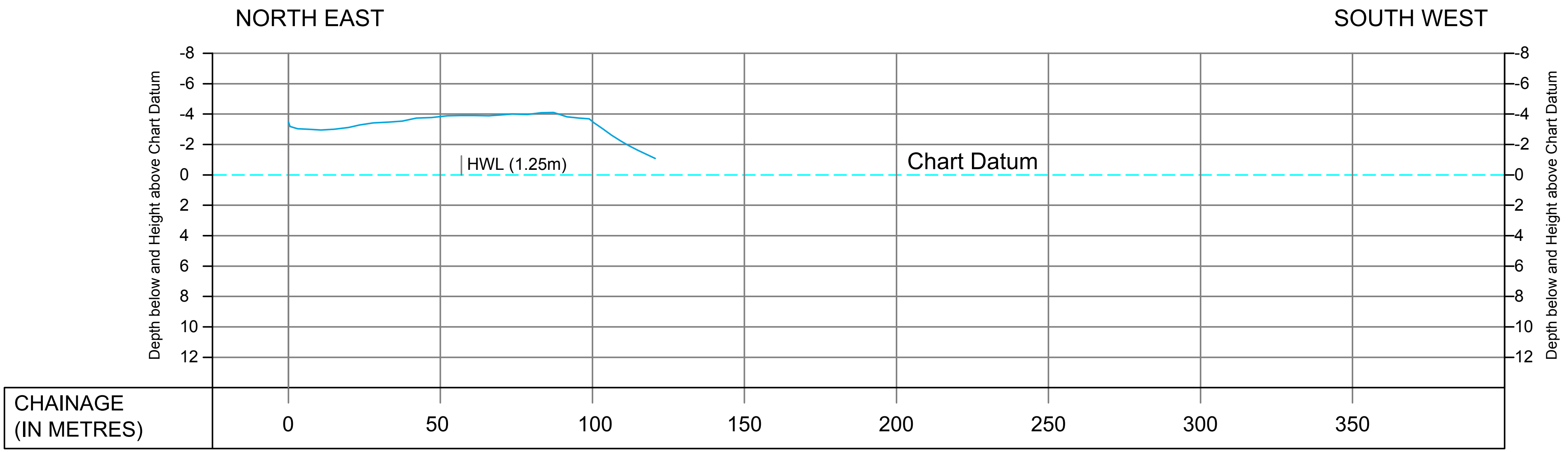
adani

Cross Section Line No.CSP-26 (July 2019)



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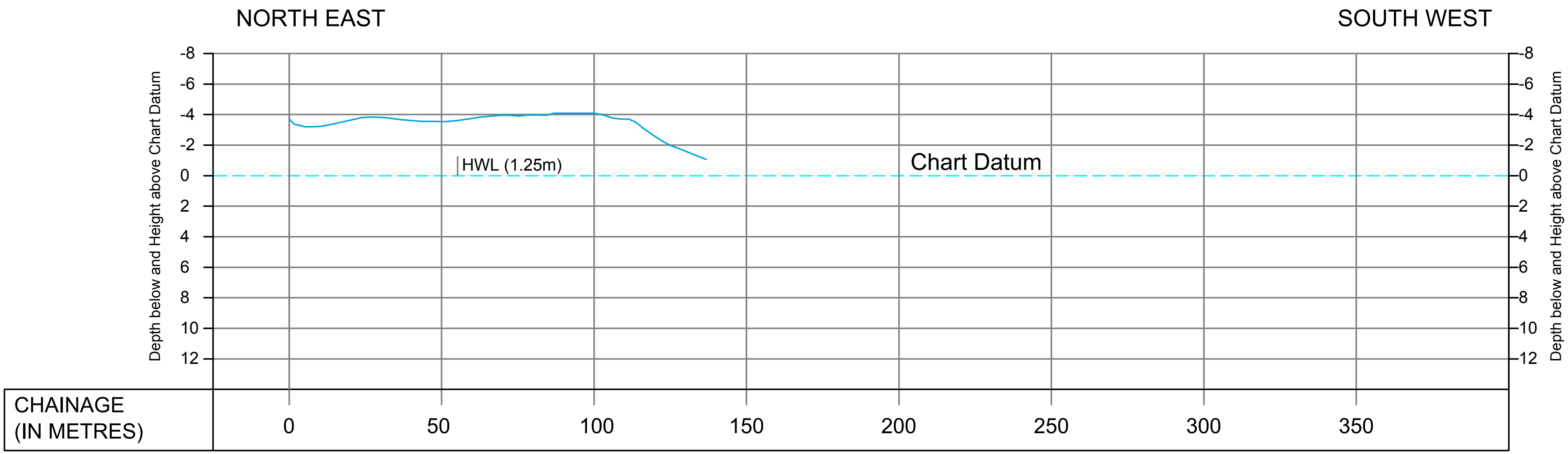

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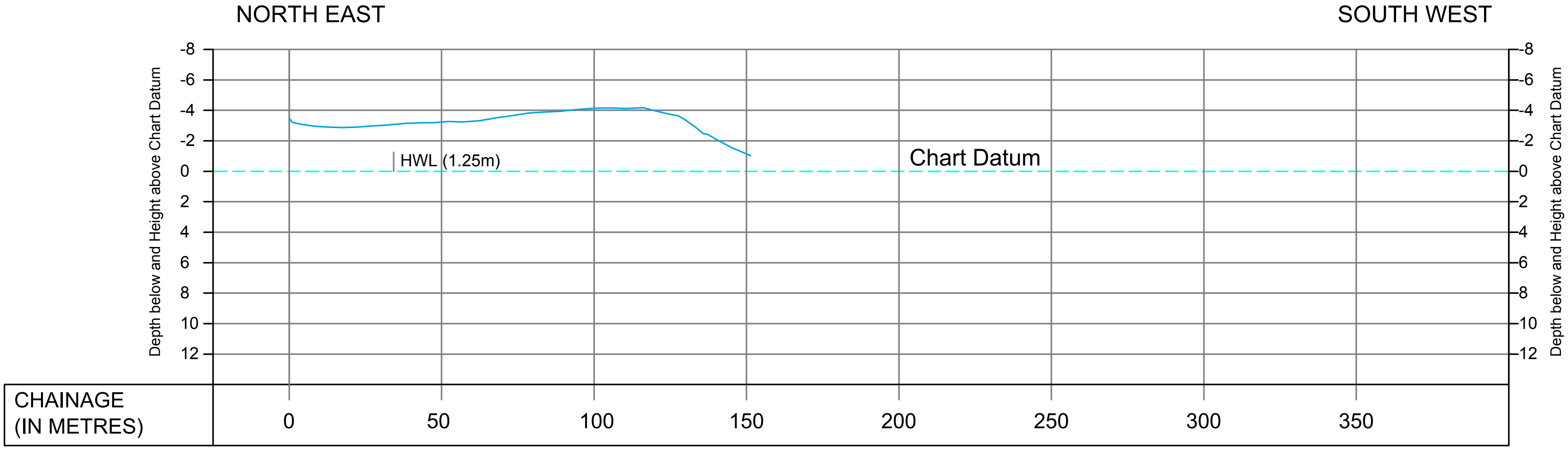

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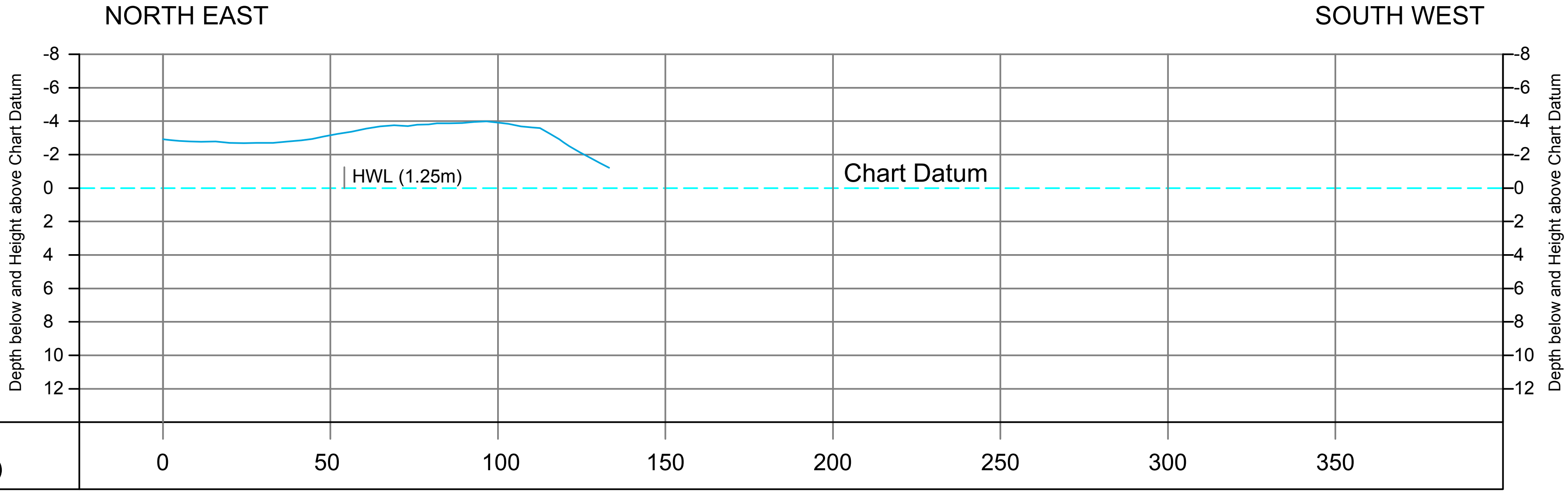

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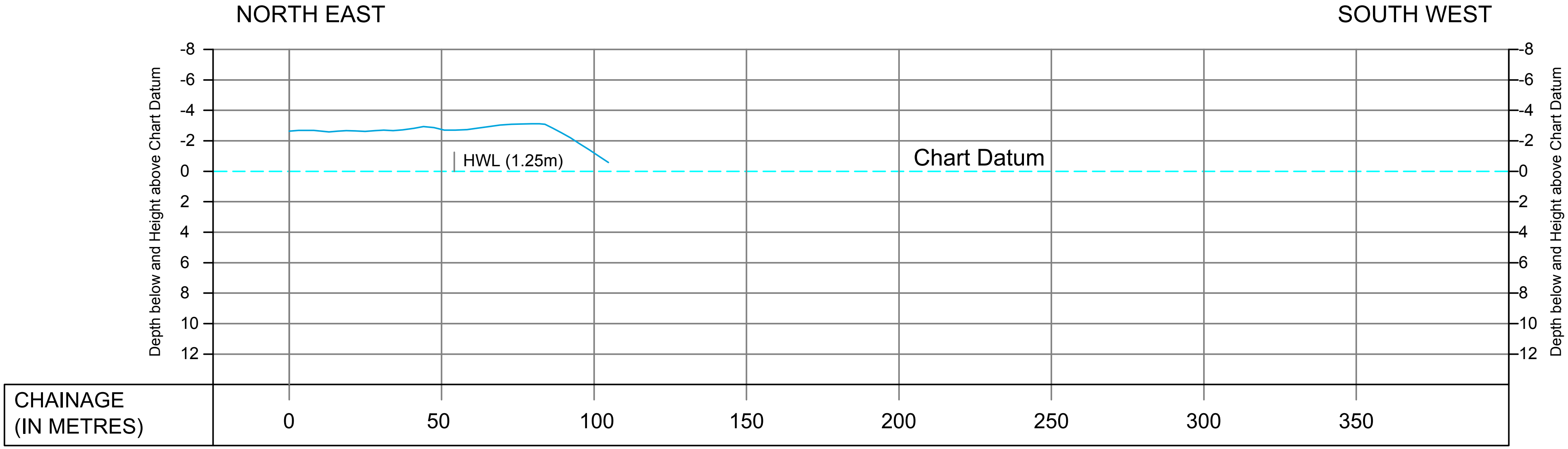

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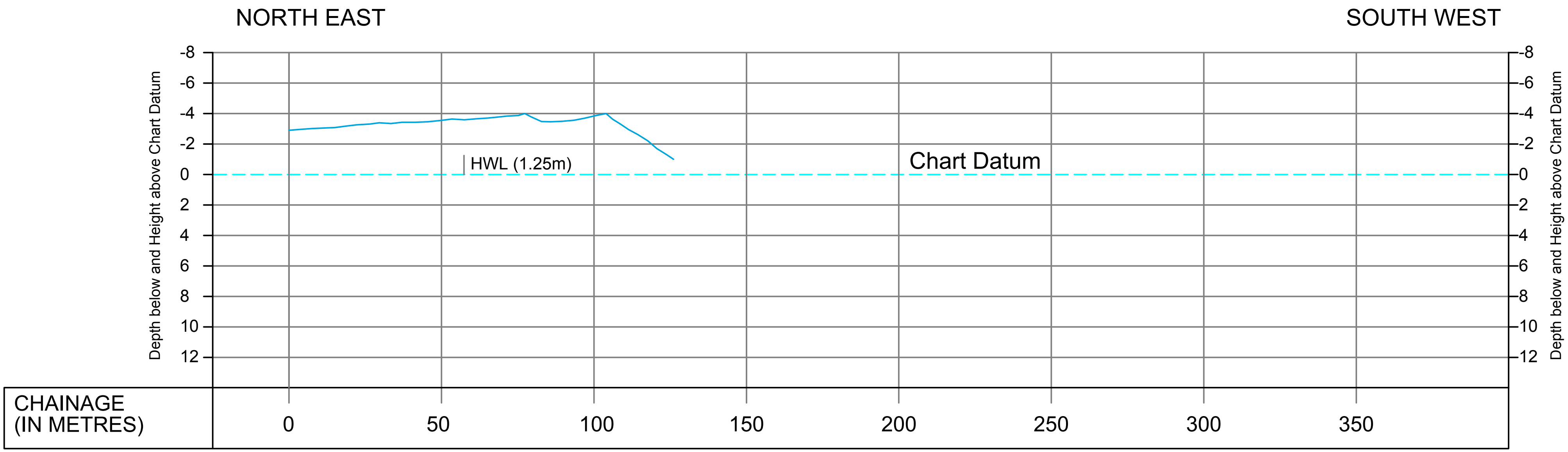

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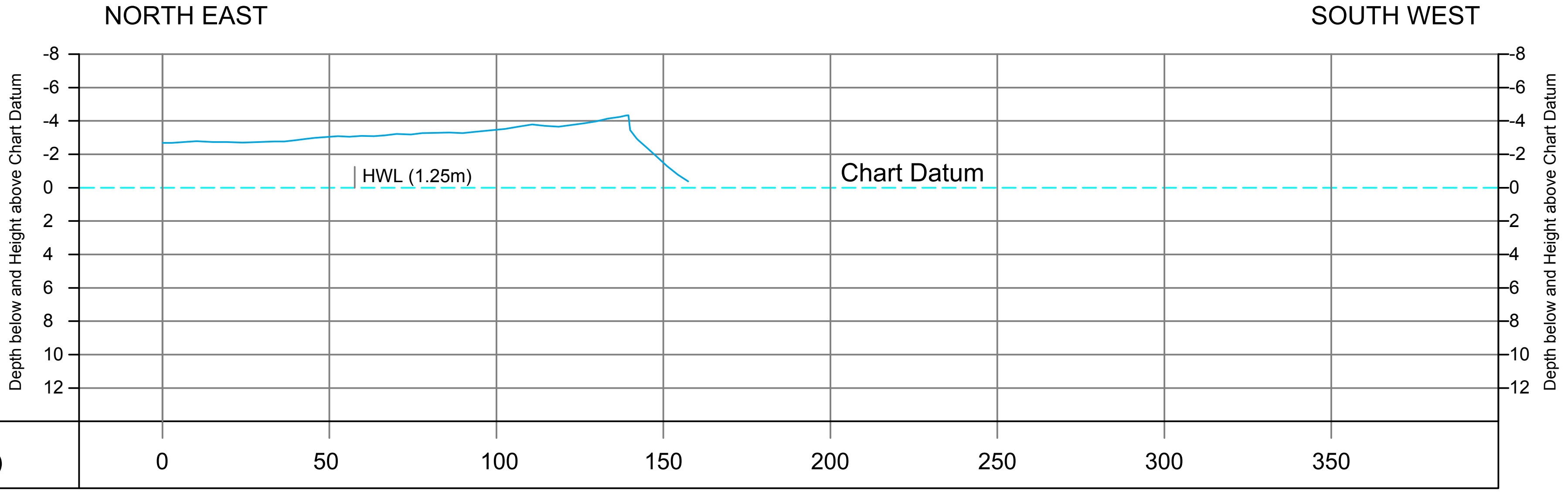

SCALE
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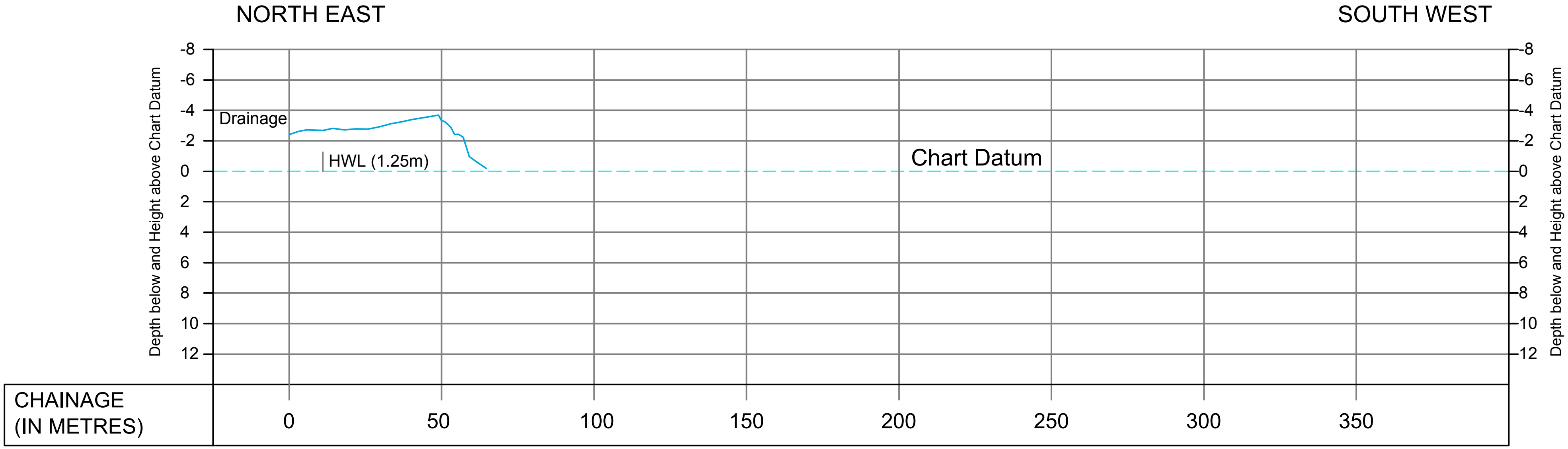

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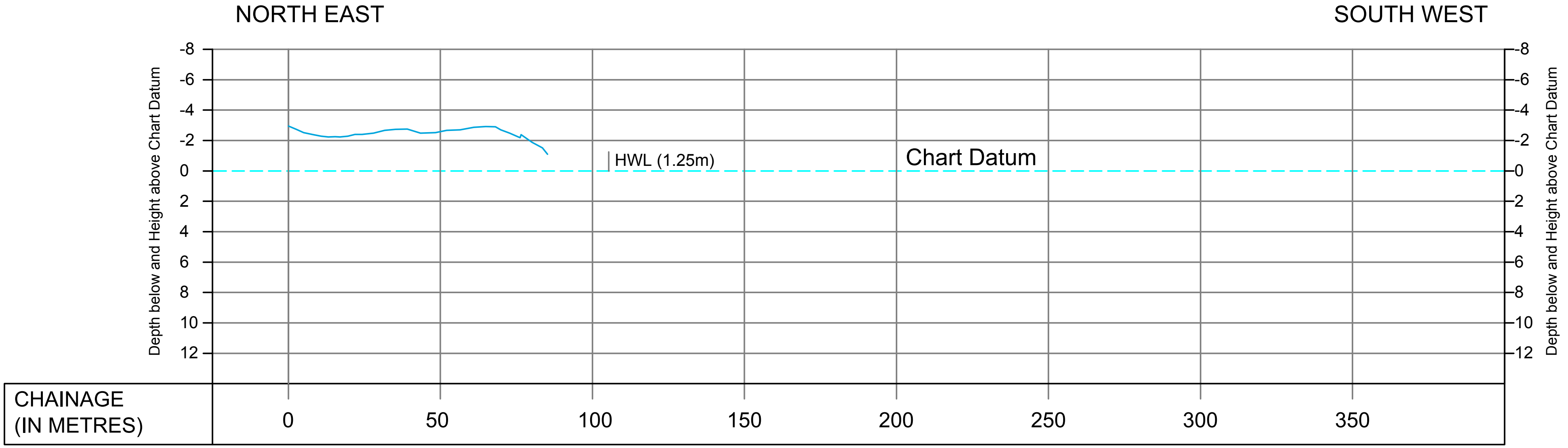

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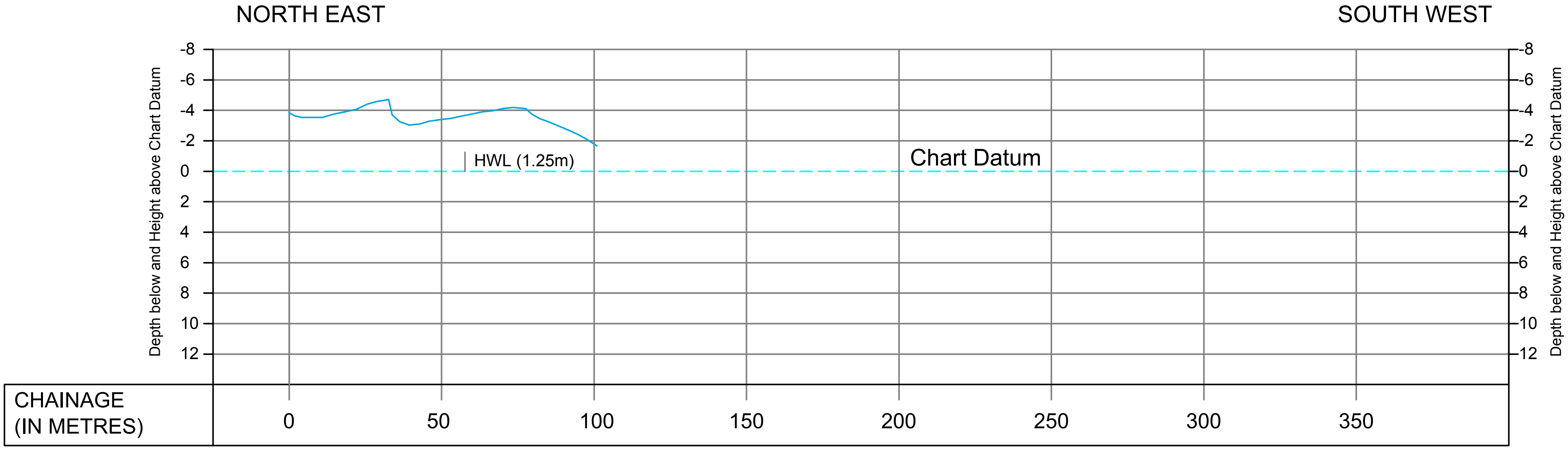

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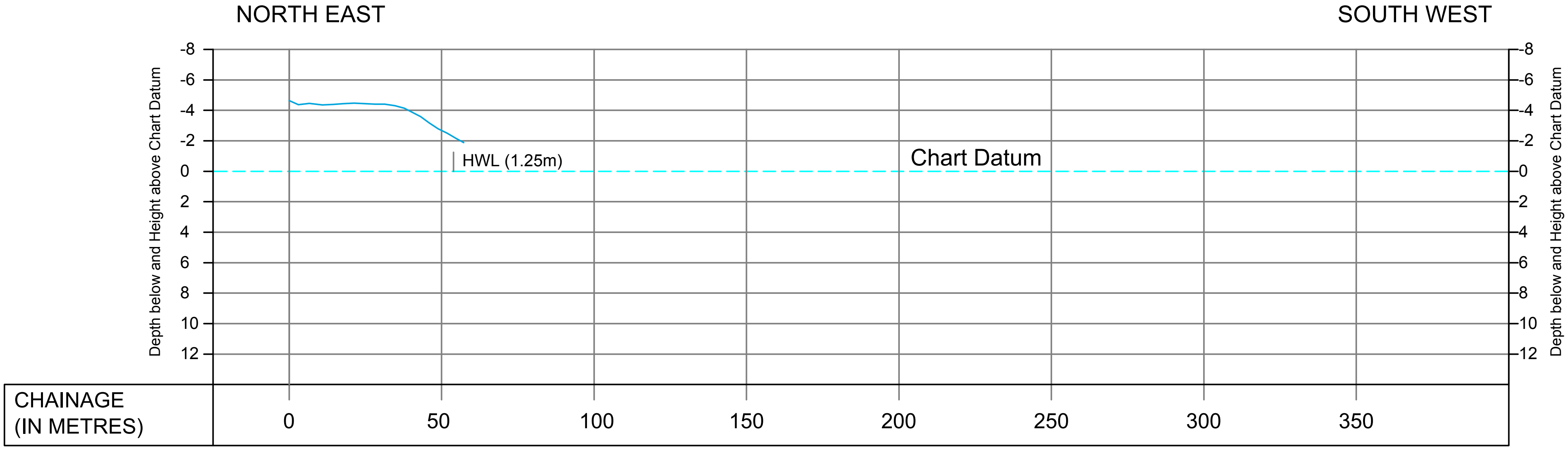

SCALE
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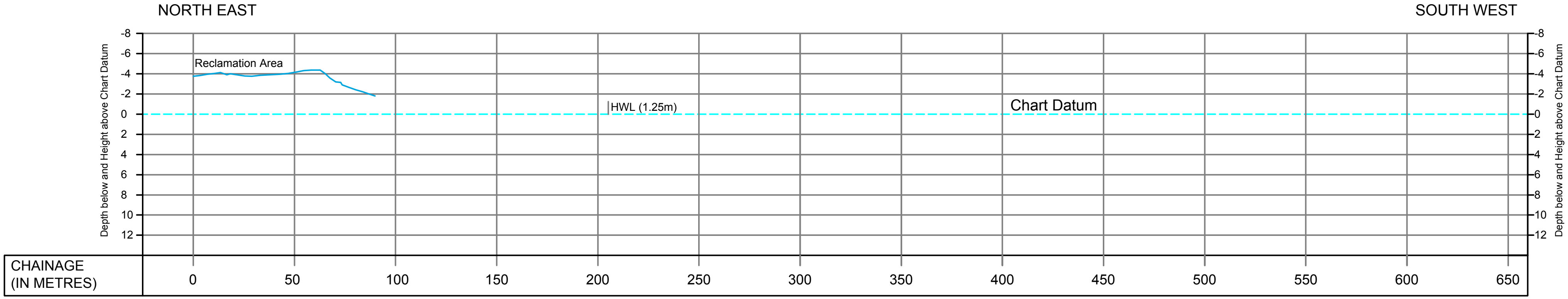

SCALE
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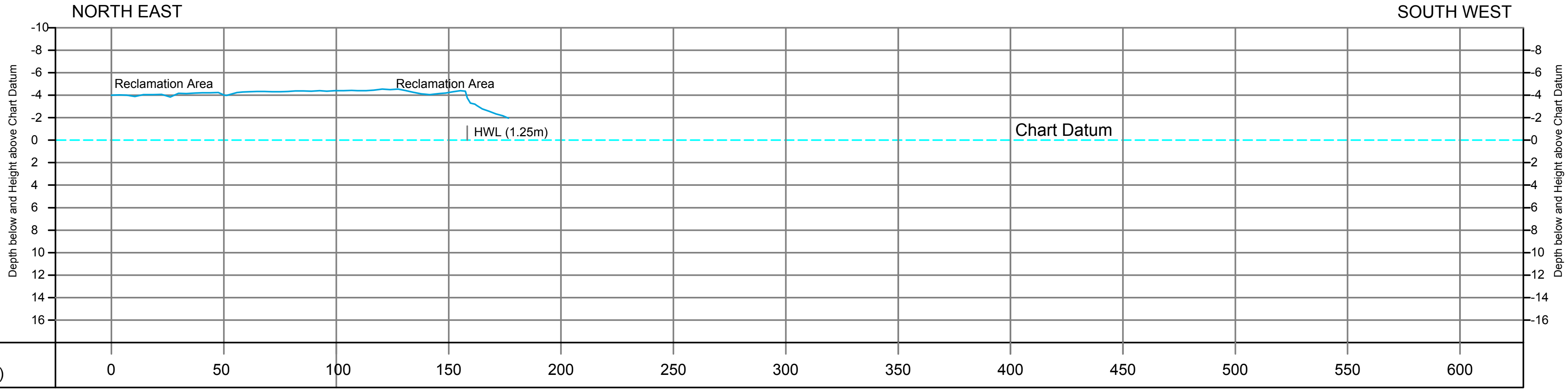
Cross Section Line No.CSP-39 (July 2019)



SCALE
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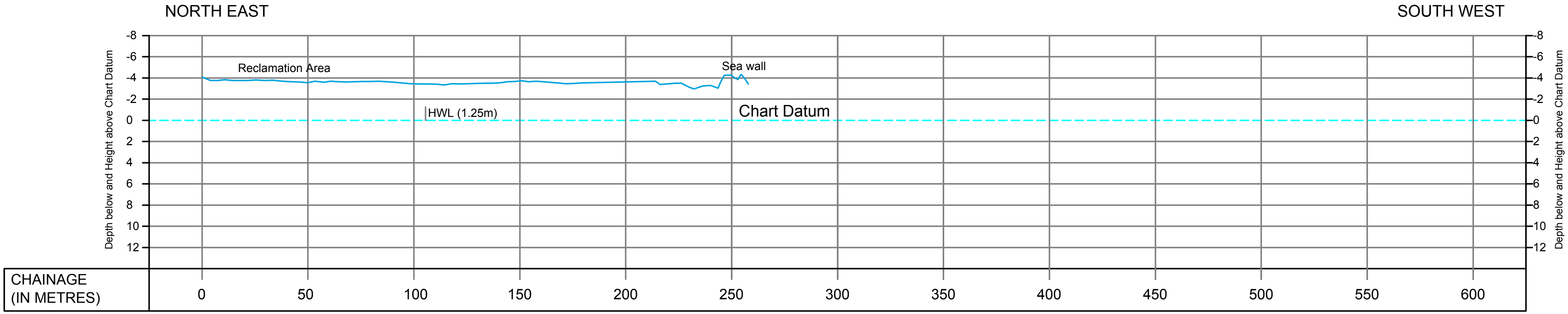
Oceanographic & Bathymetric data collection for Assessment
of Shoreline Changes at Vizhinjam for AVPPL
Annexure VI - Cross Shore Profiles
PSR-2, July 2019

Cross Section Line No.CSP-40 (July 2019)



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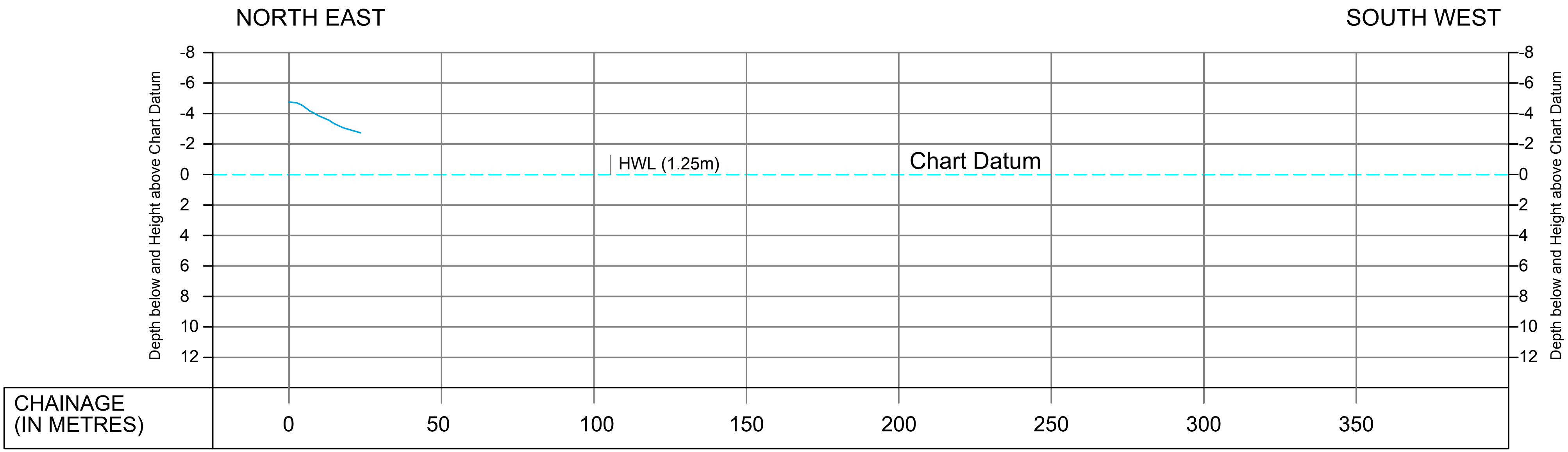
Cross Section Line No.CSP-41 (July 2019)



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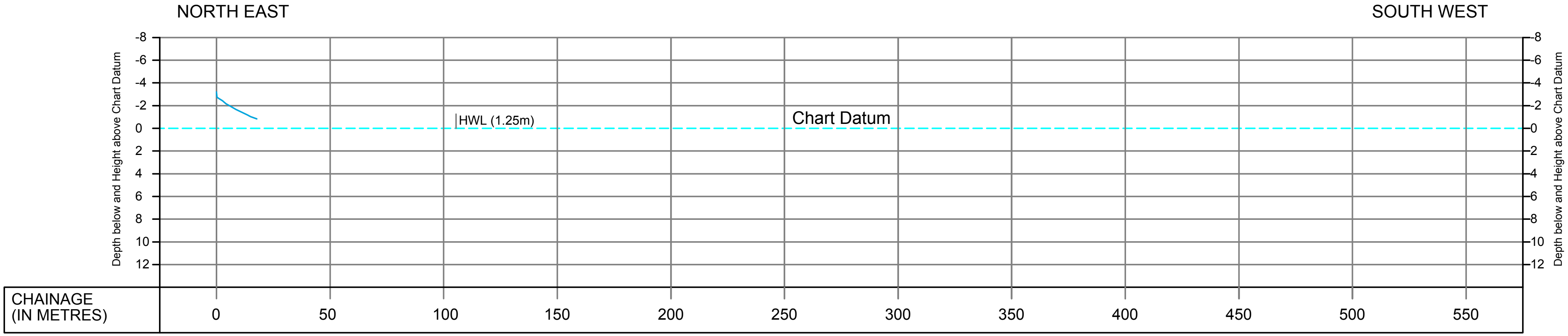

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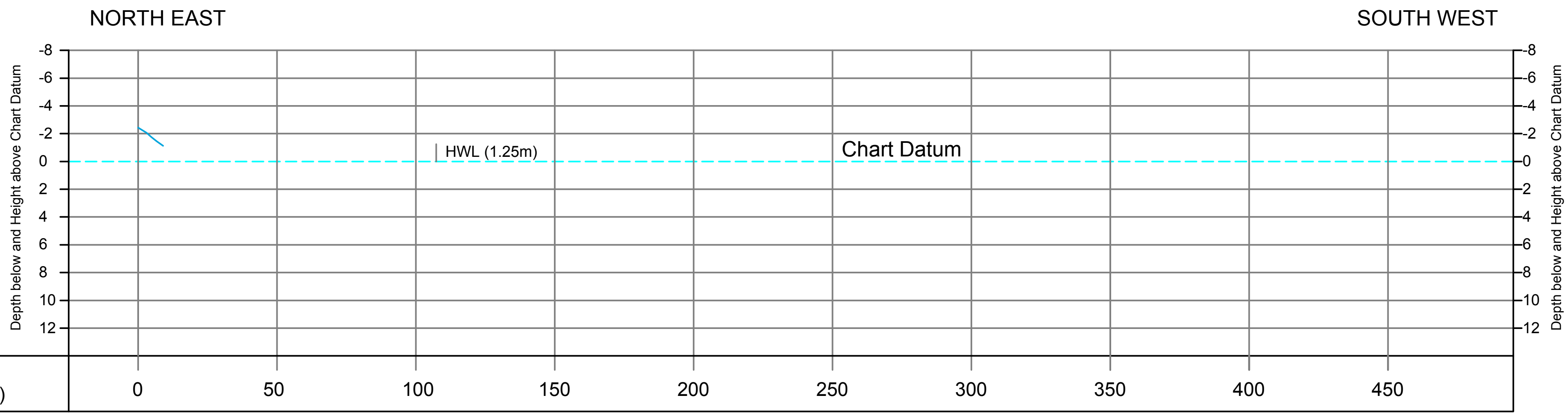

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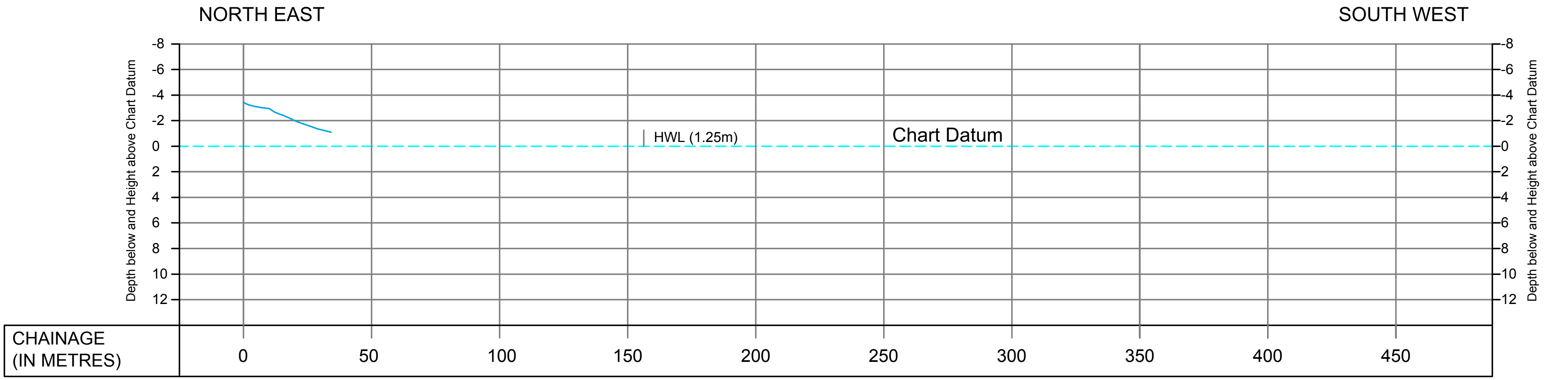

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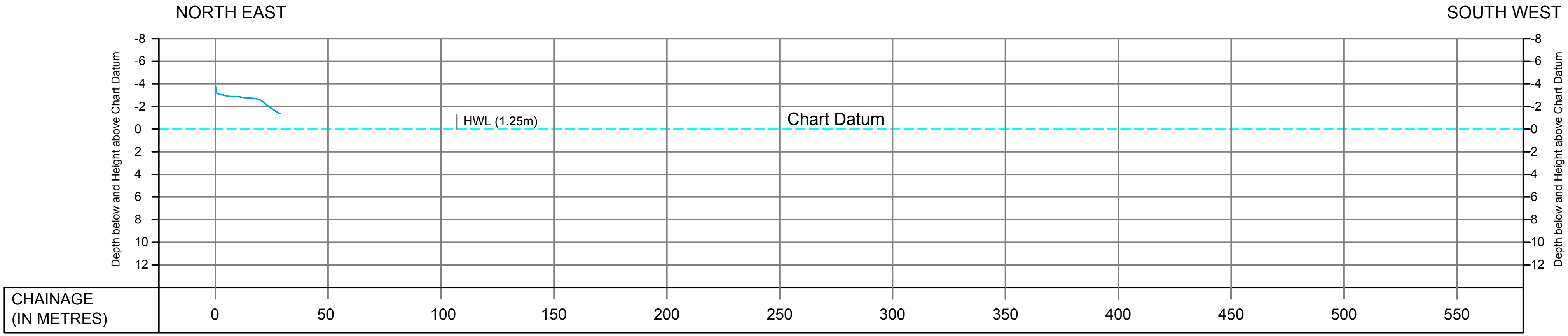

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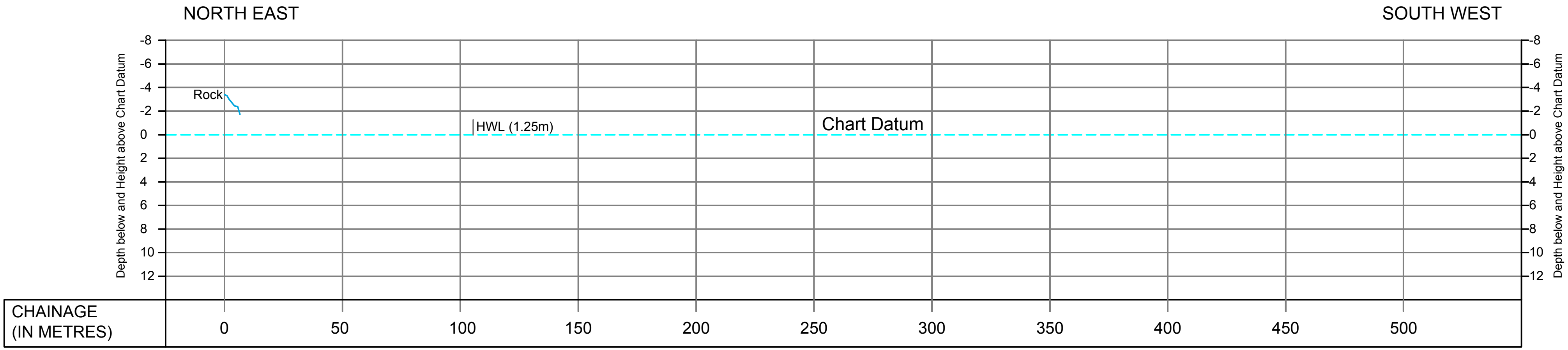

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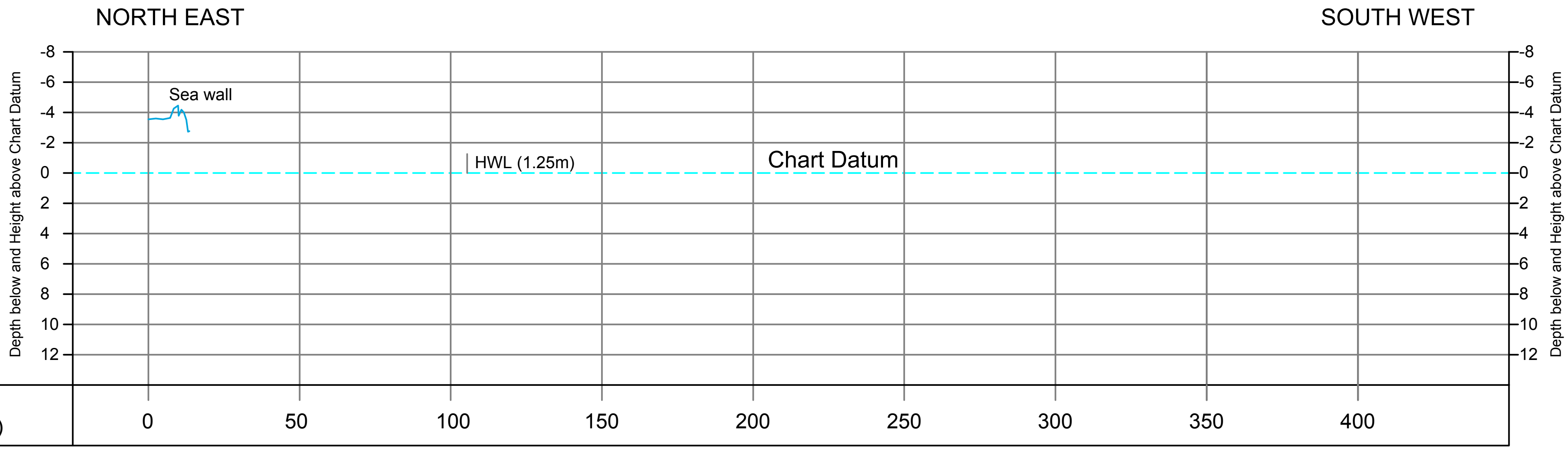

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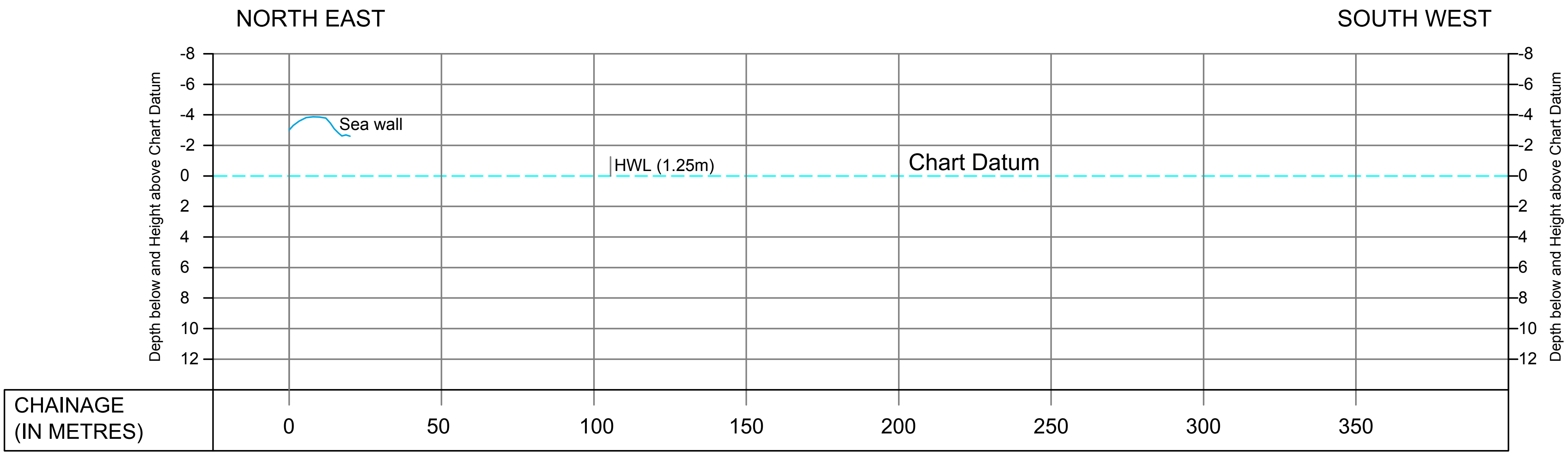

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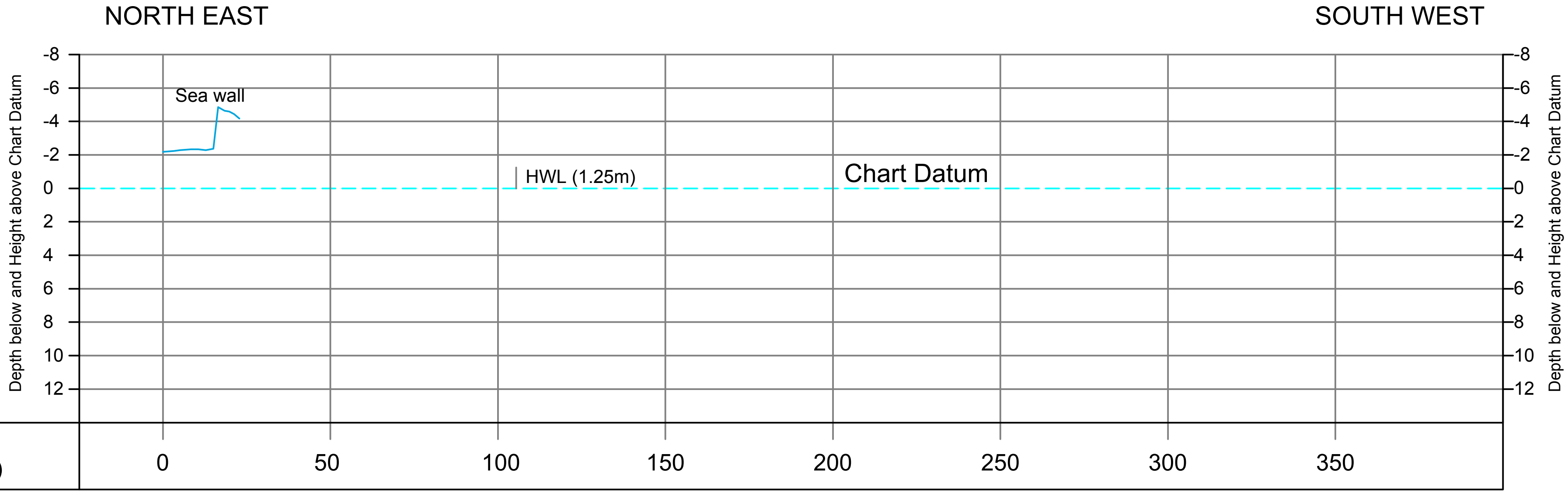

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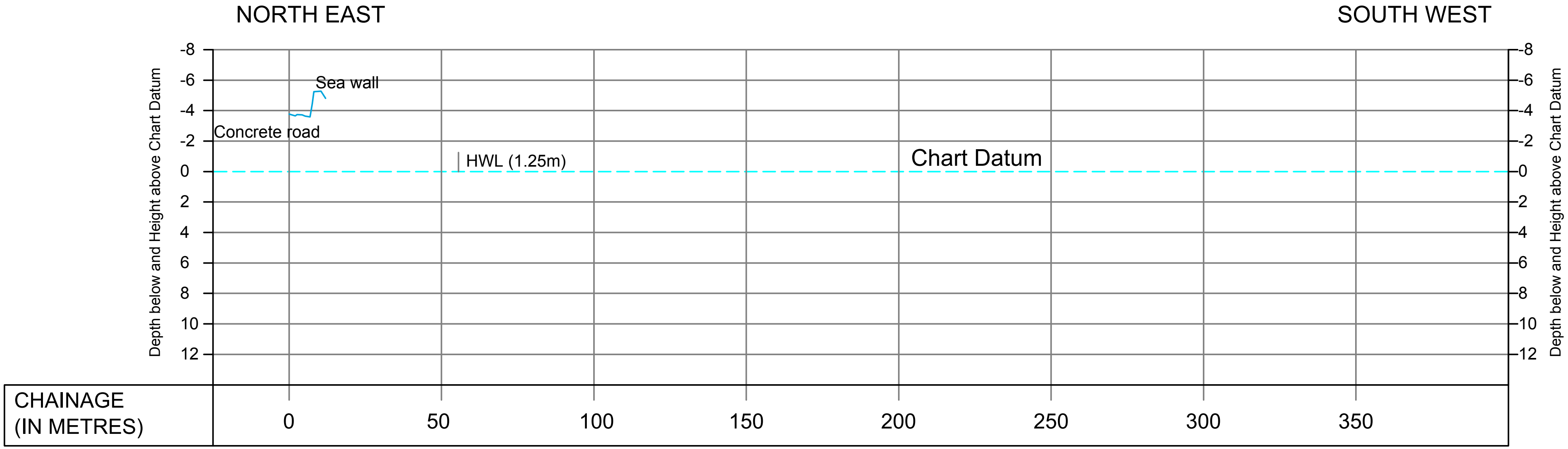

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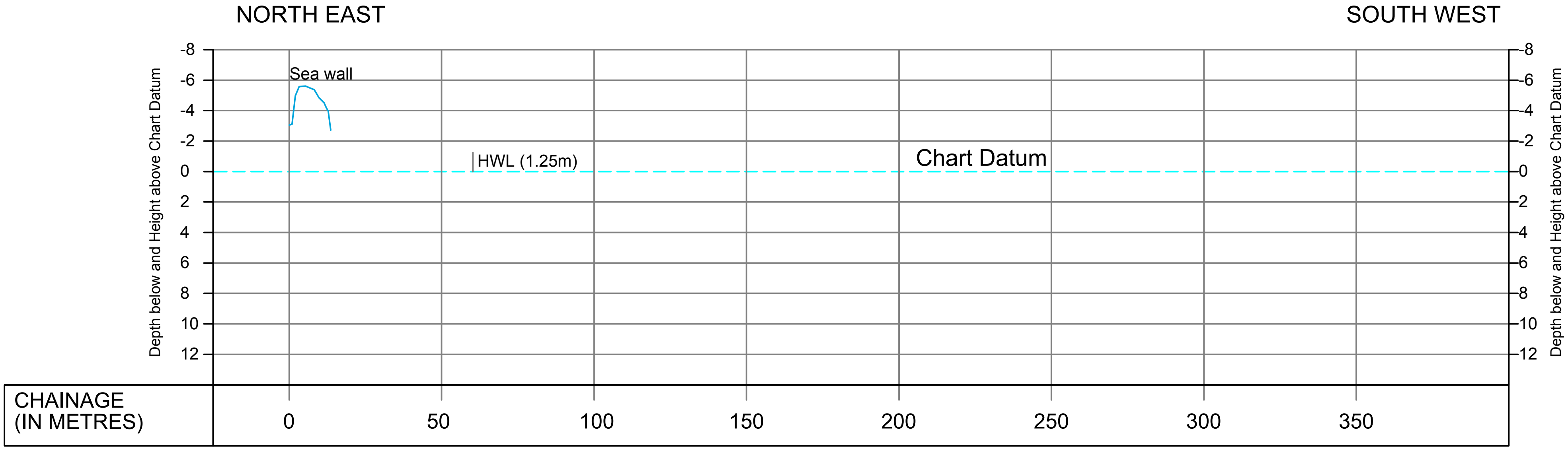

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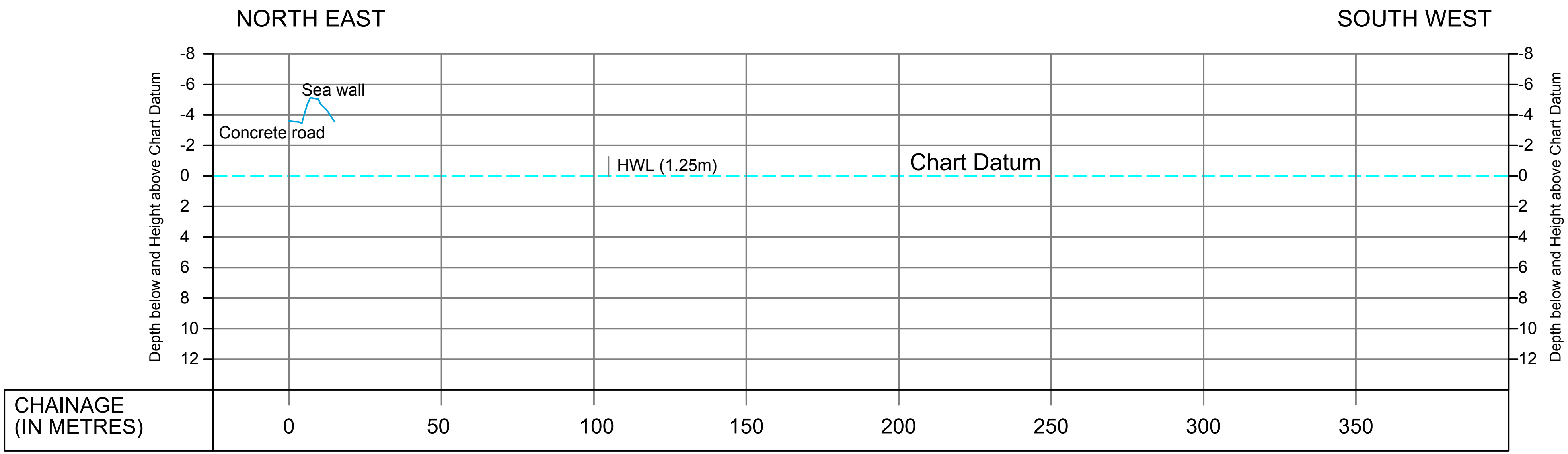

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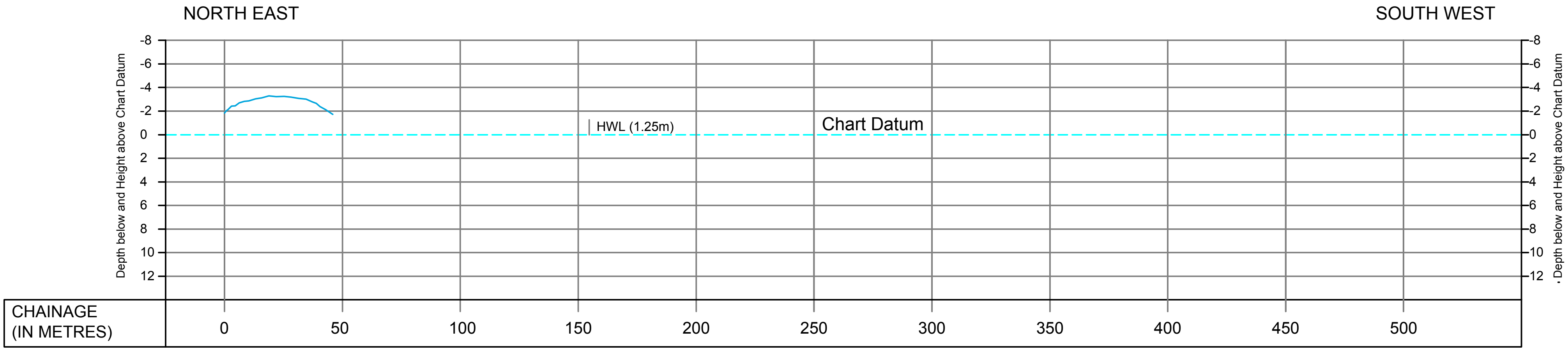

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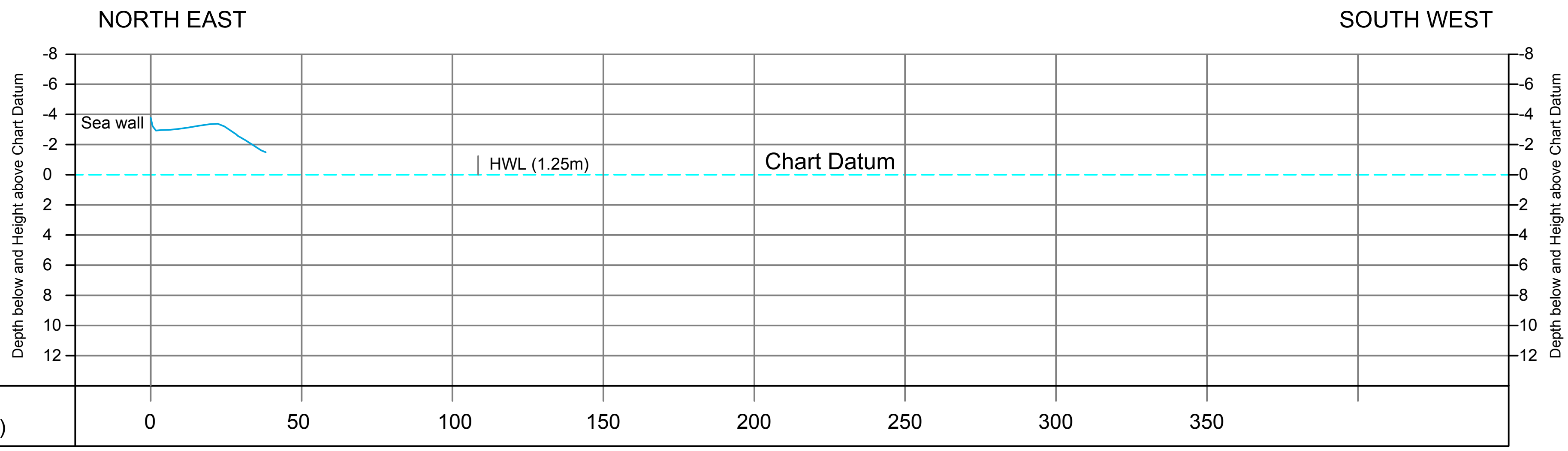

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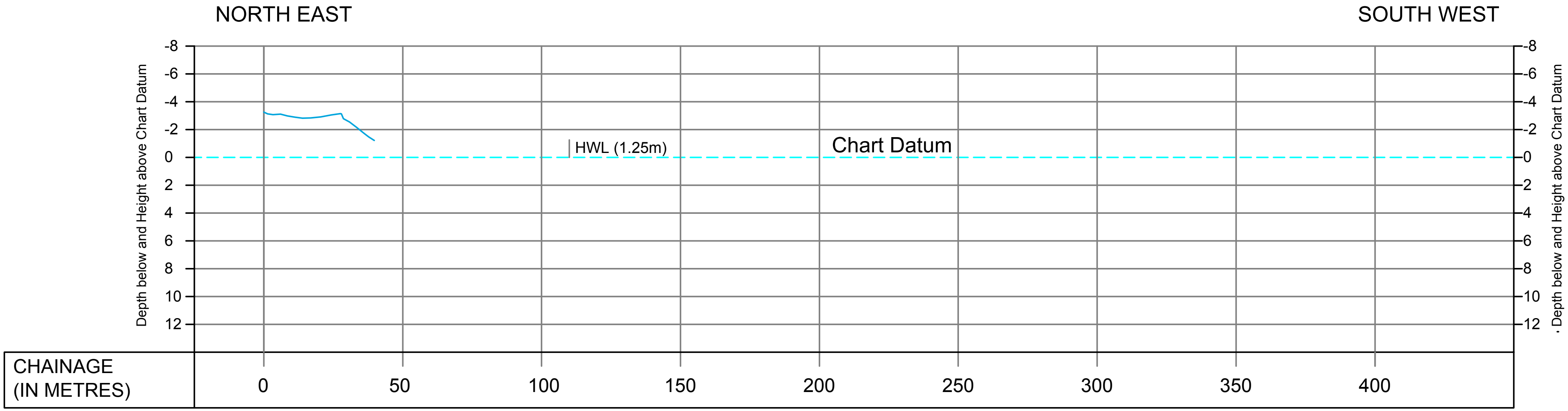

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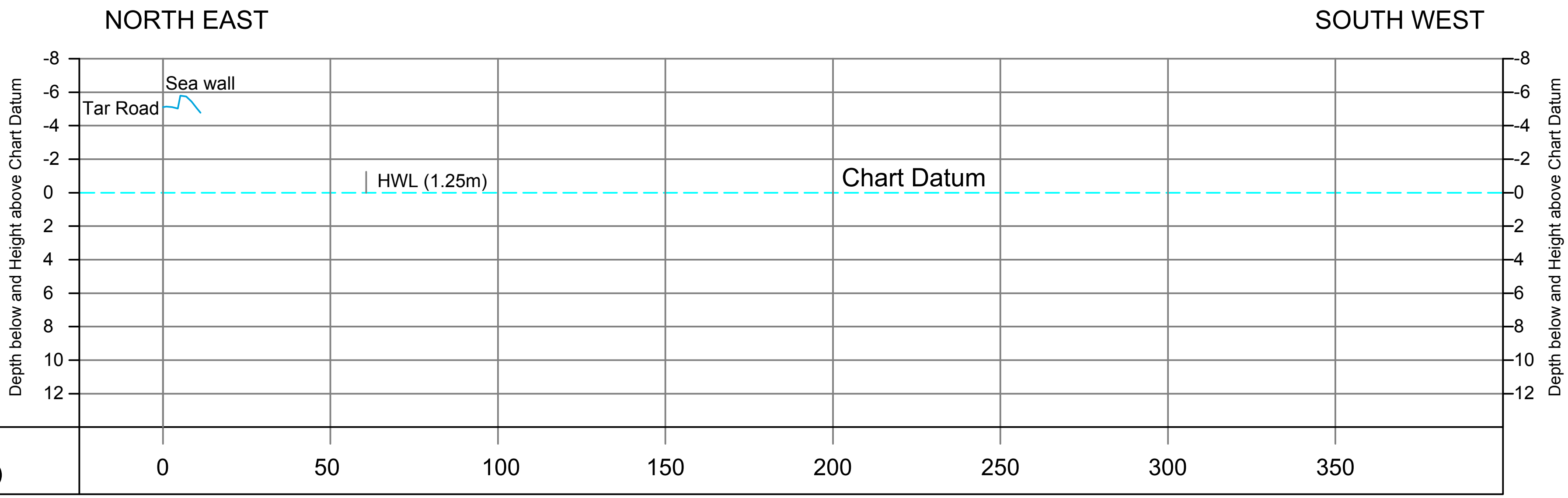

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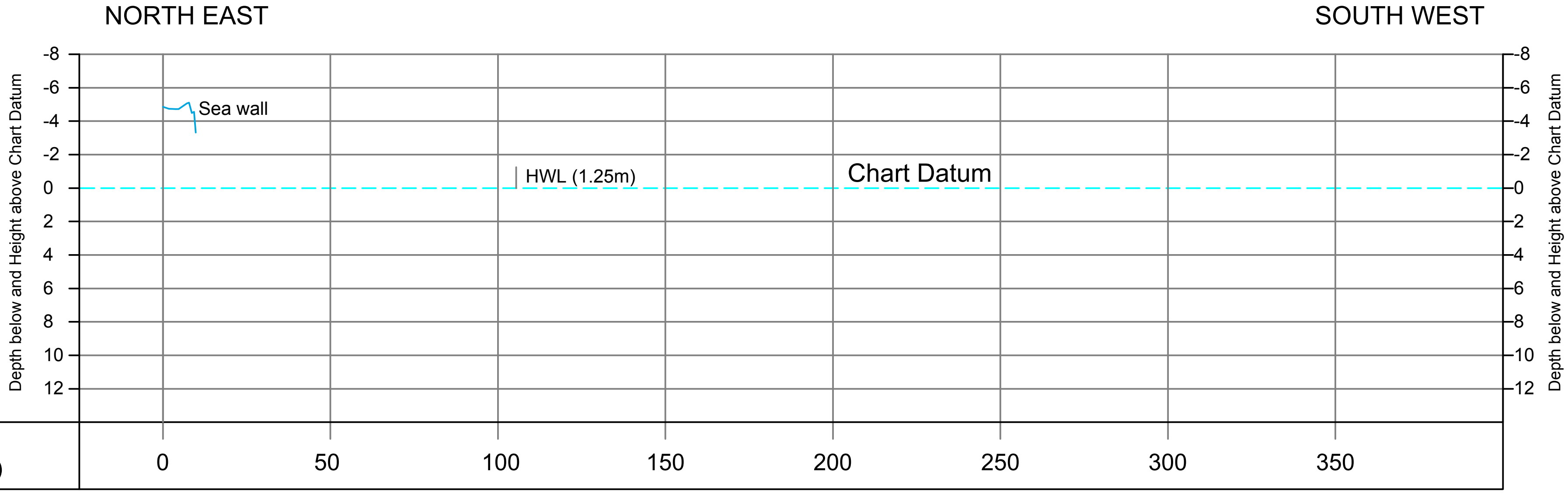

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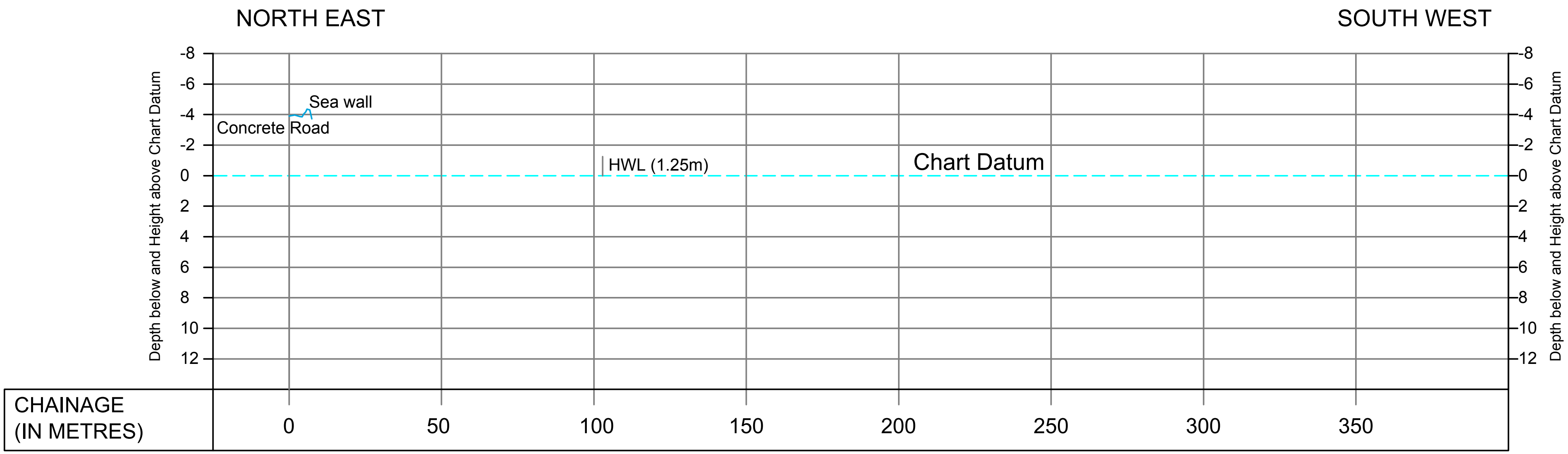

SCALE
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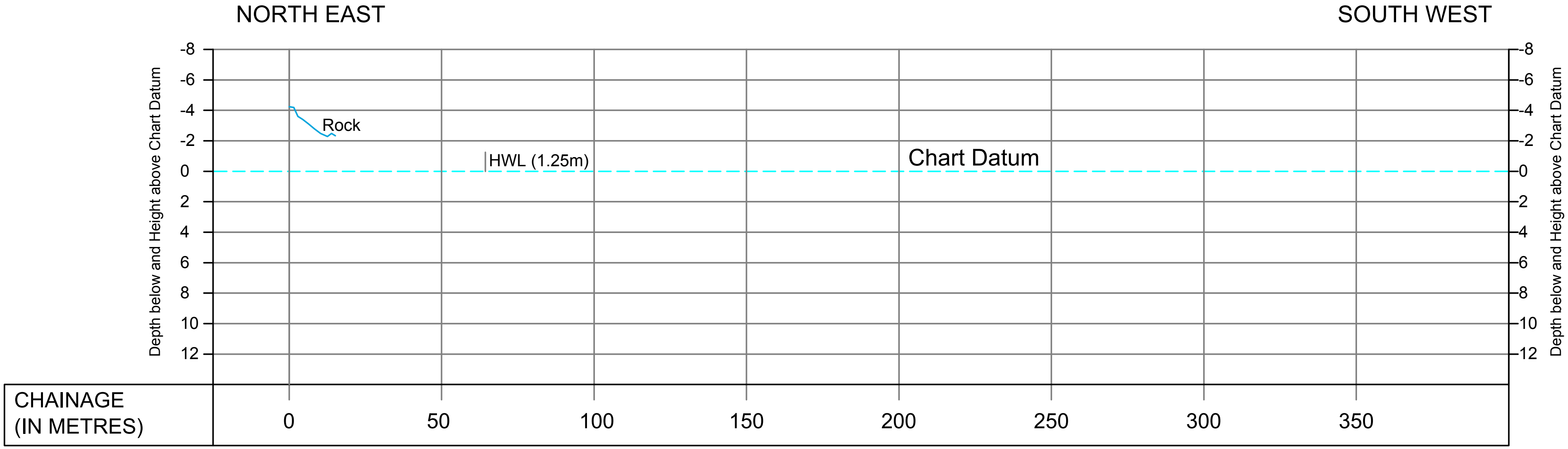
adani

Cross Section Line No.CSP-59 (July 2019)



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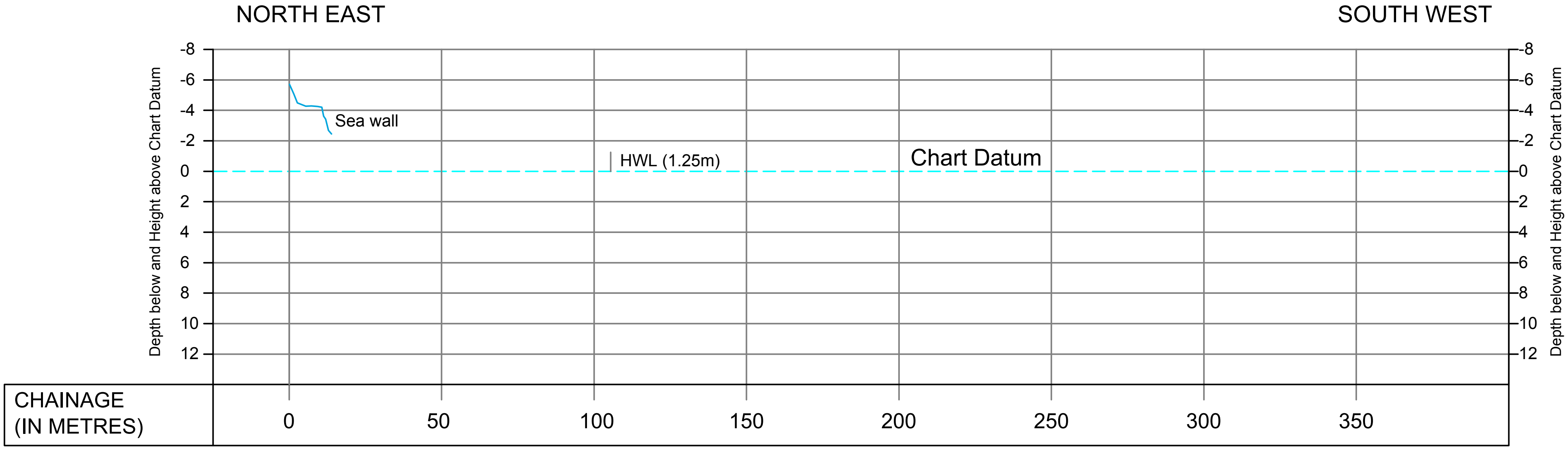

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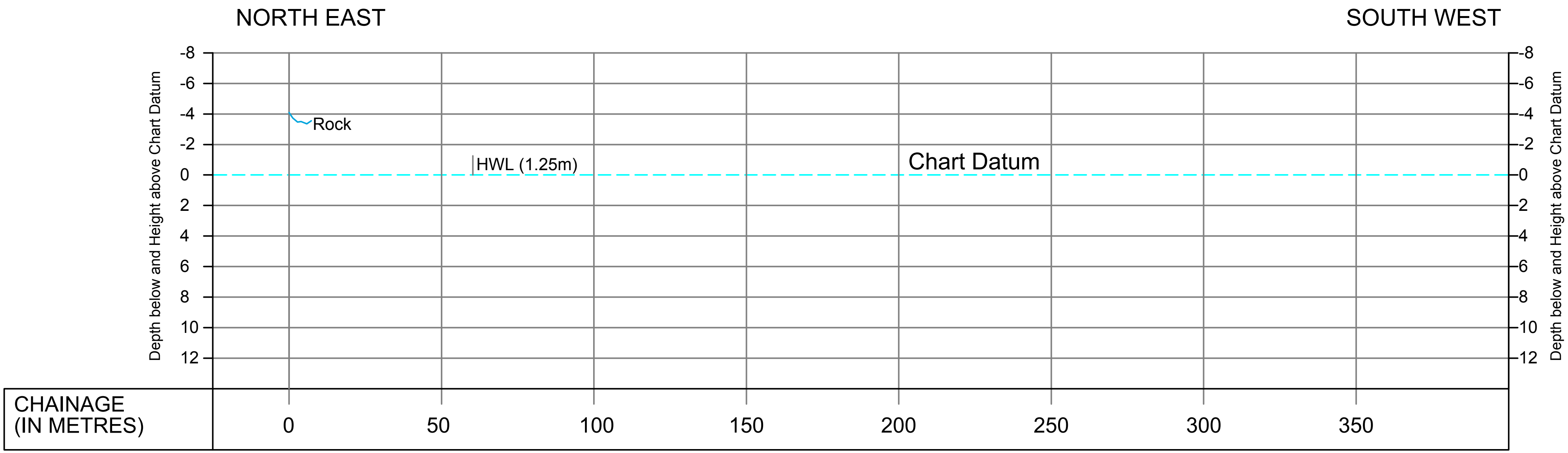

SCALE
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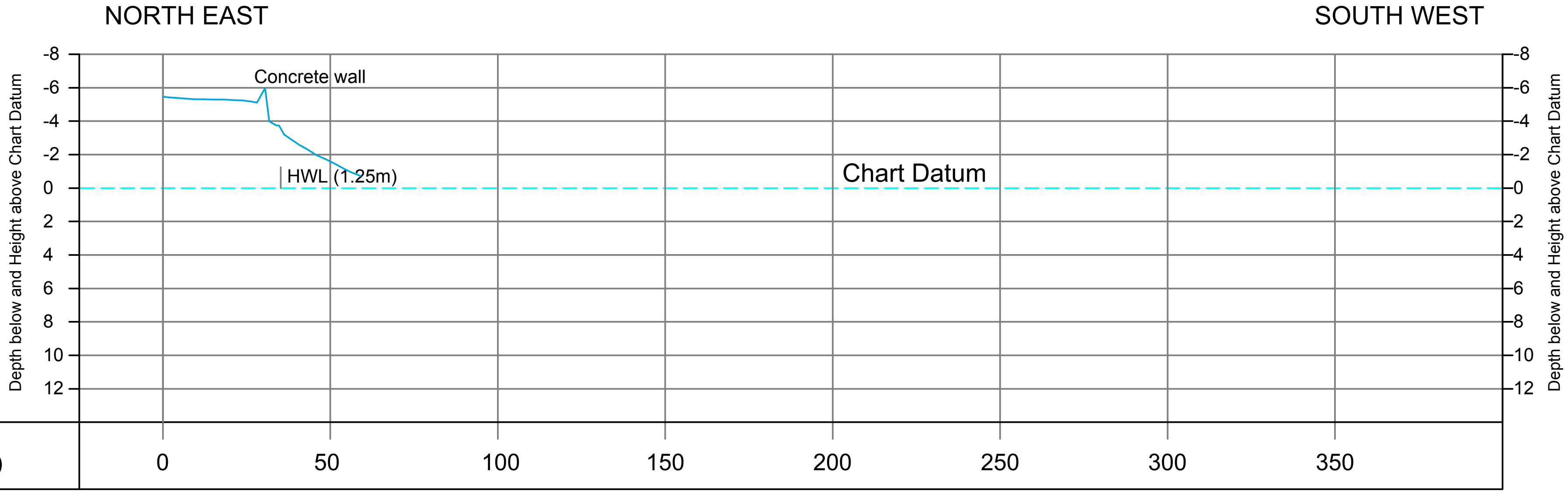

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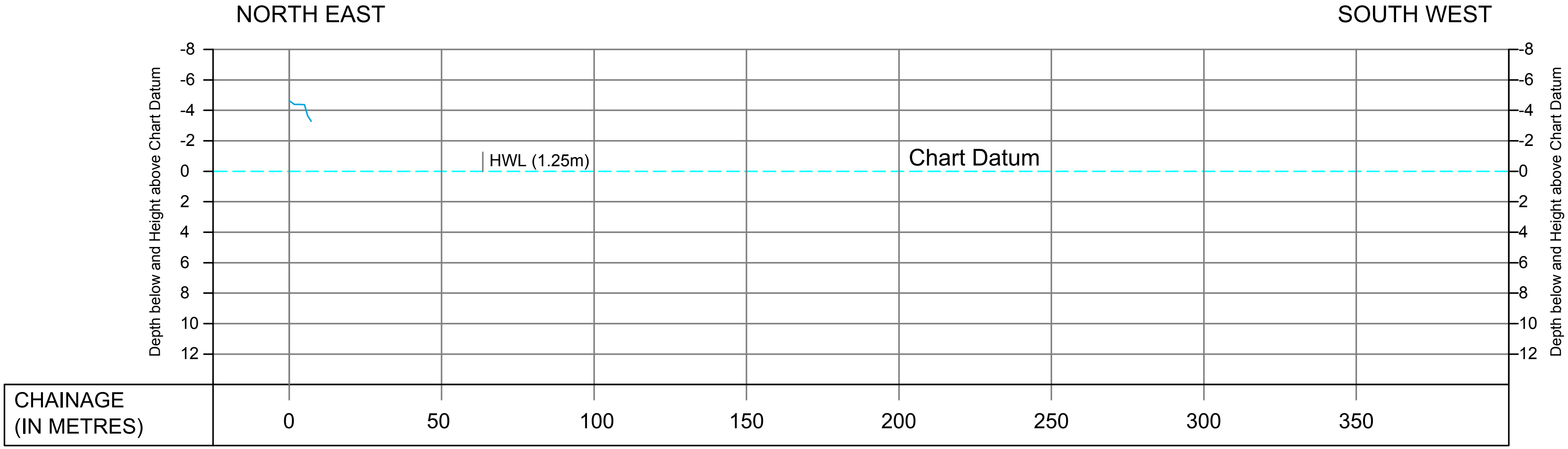

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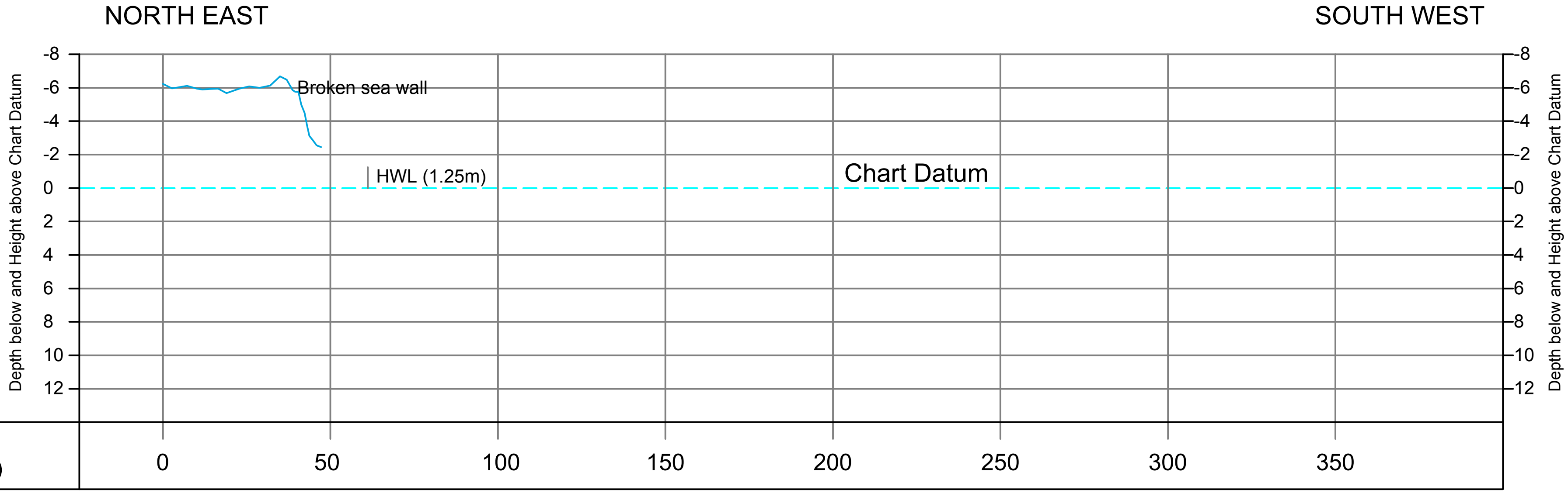

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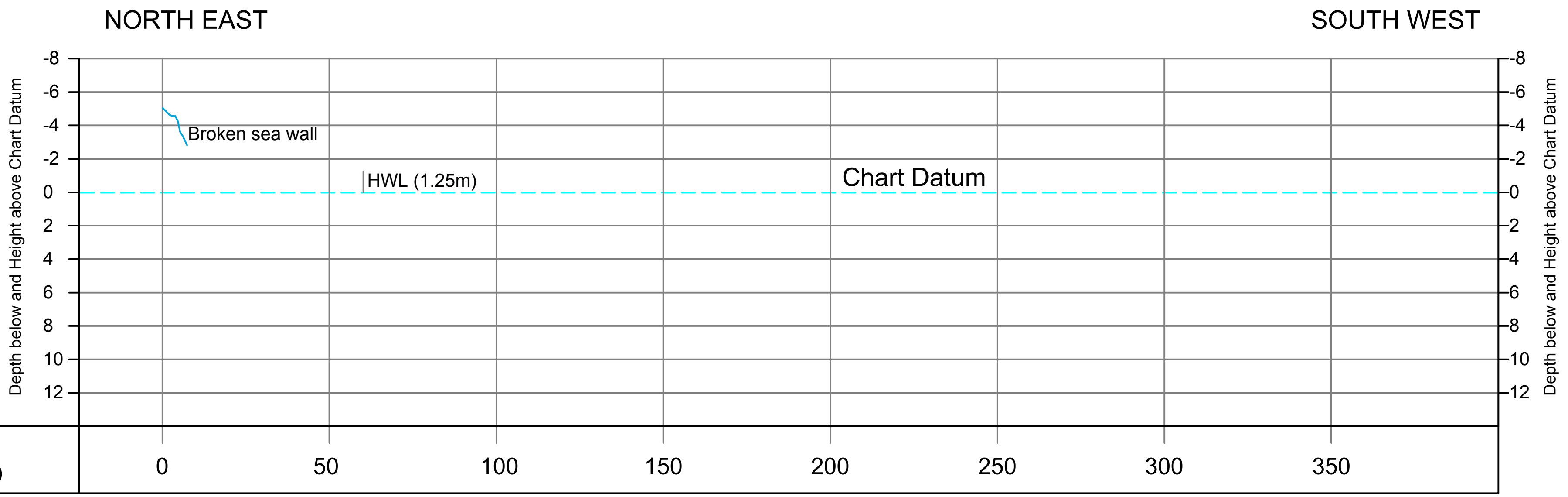

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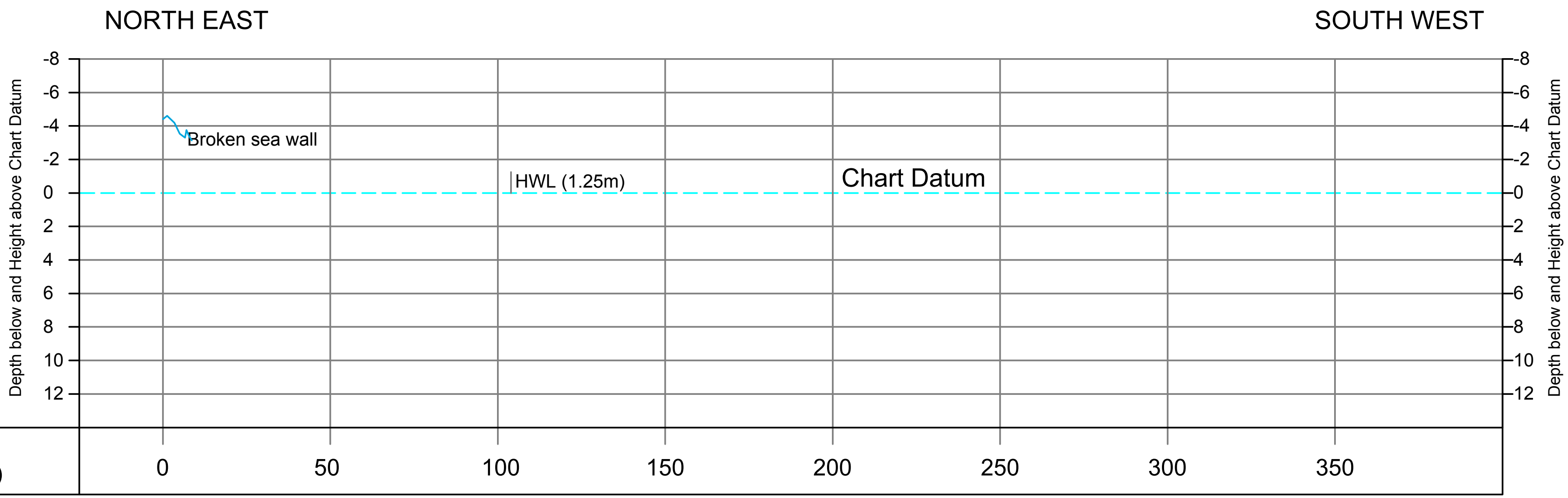

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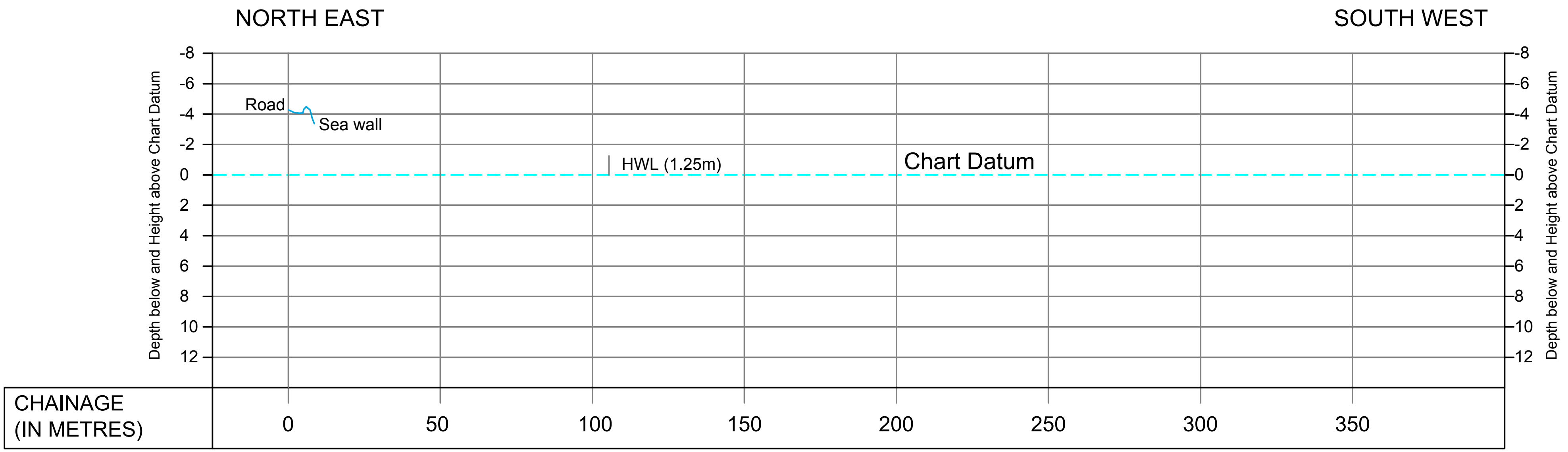

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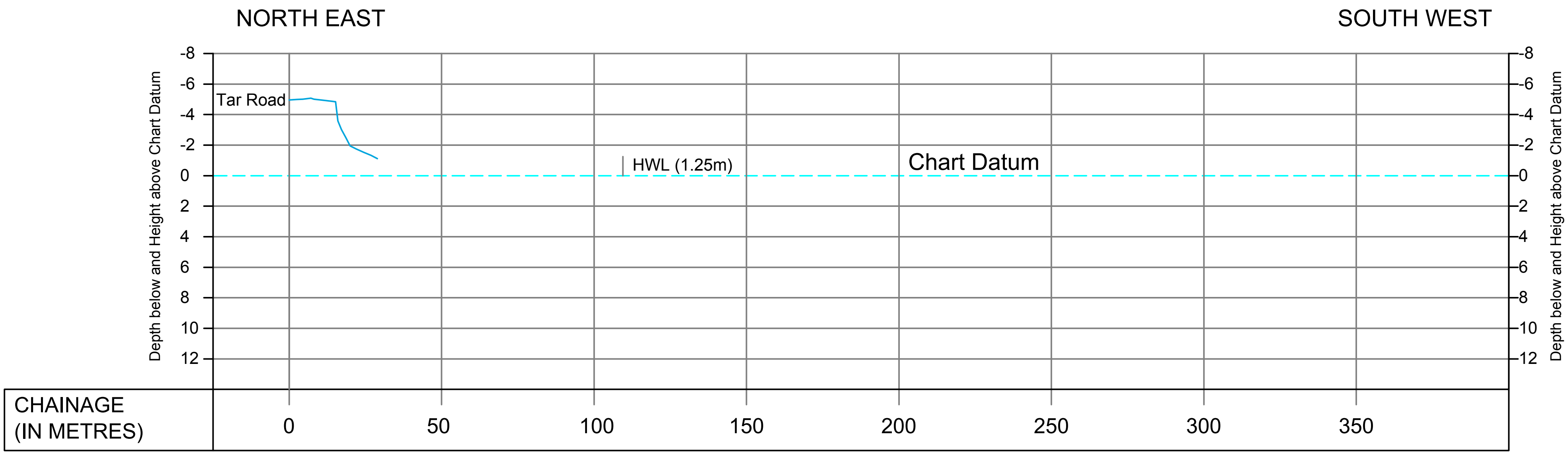

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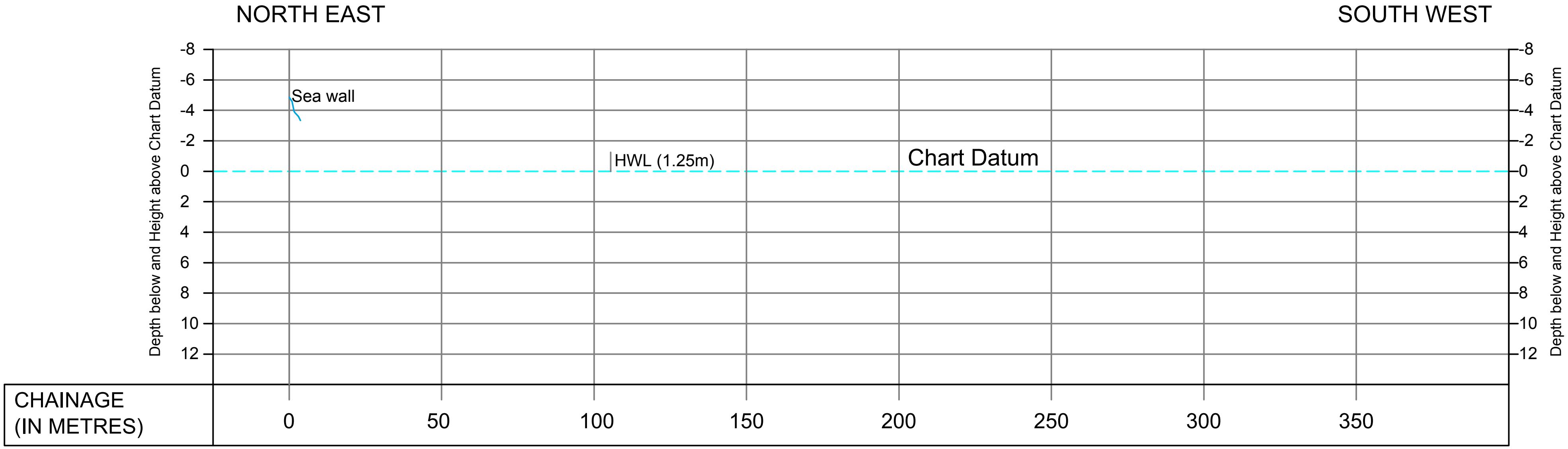

SCALE
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VERTICAL 1: 200

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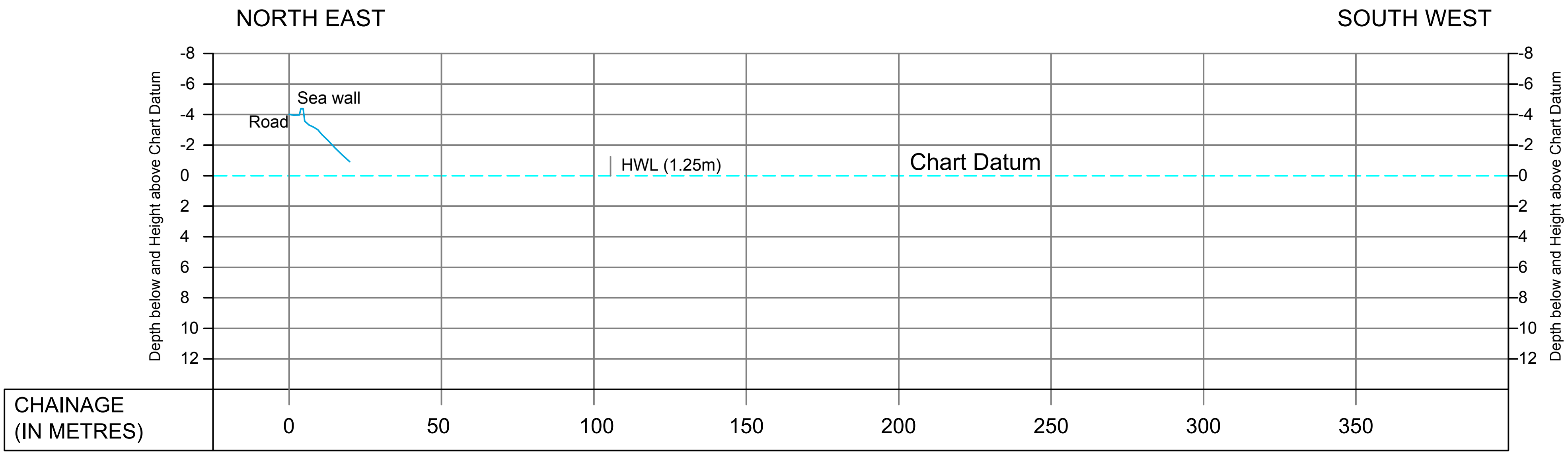
Cross Section Line No.CSP-70 (July 2019)



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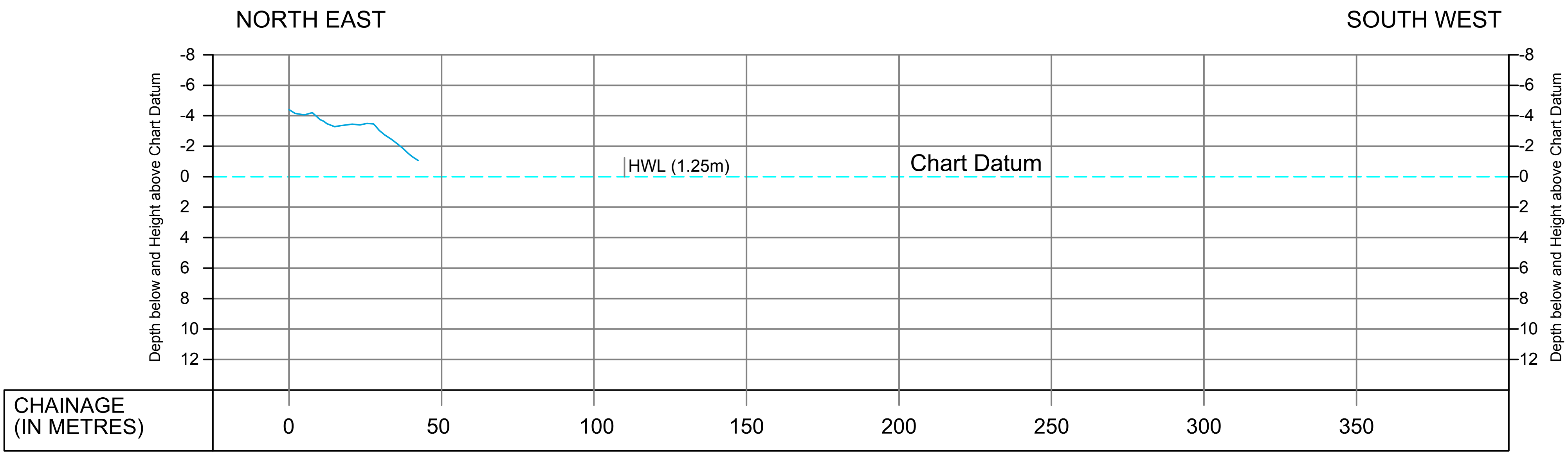

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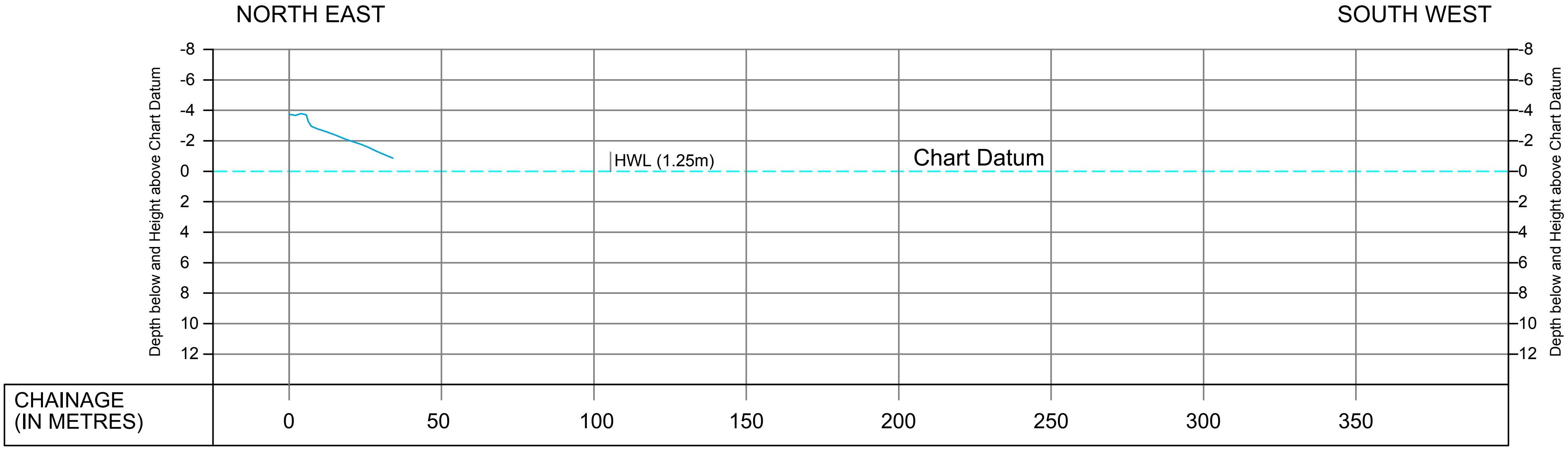

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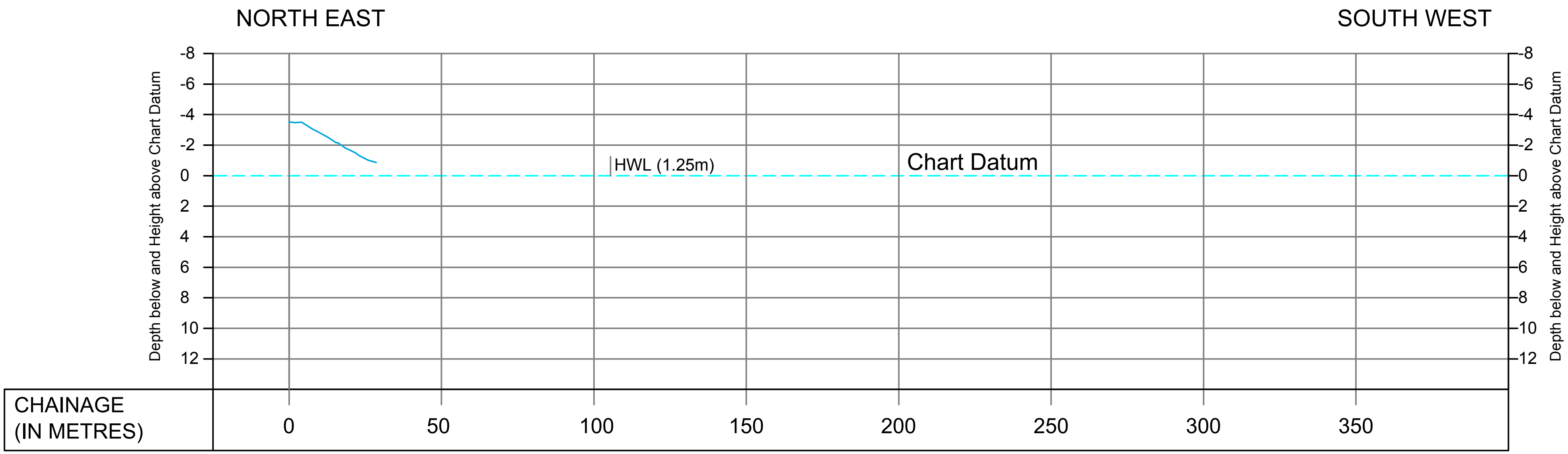

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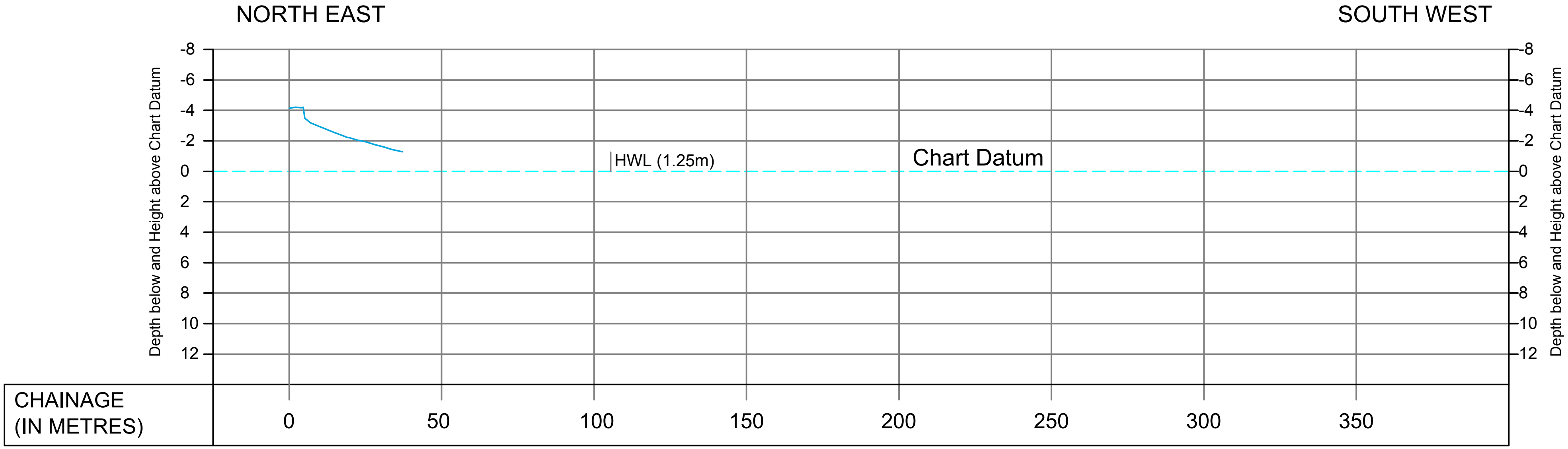

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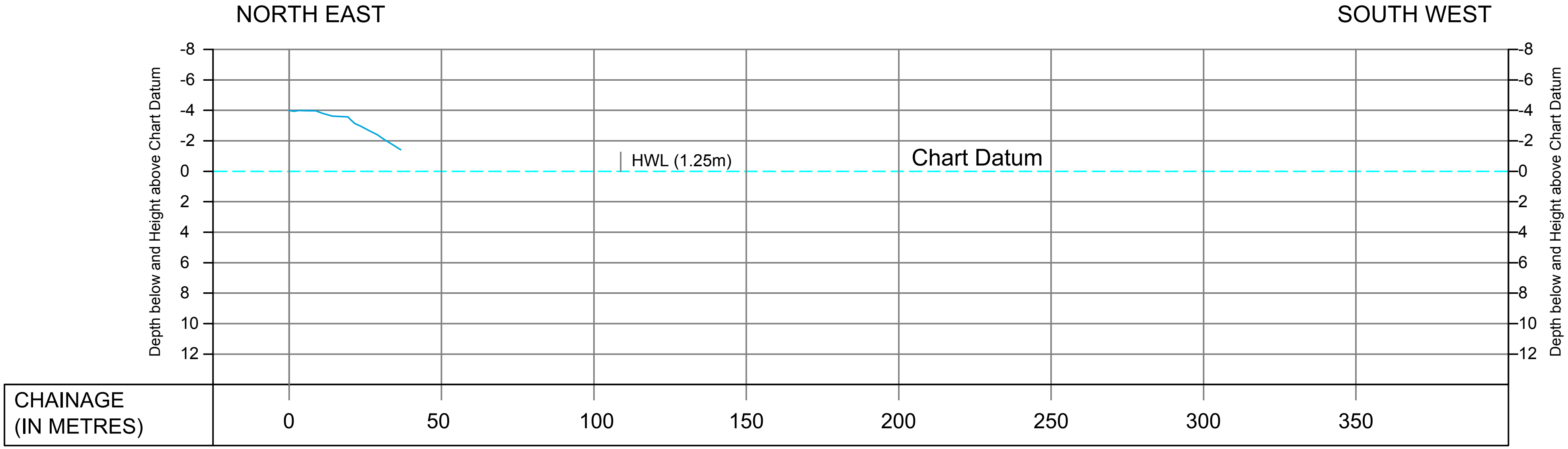

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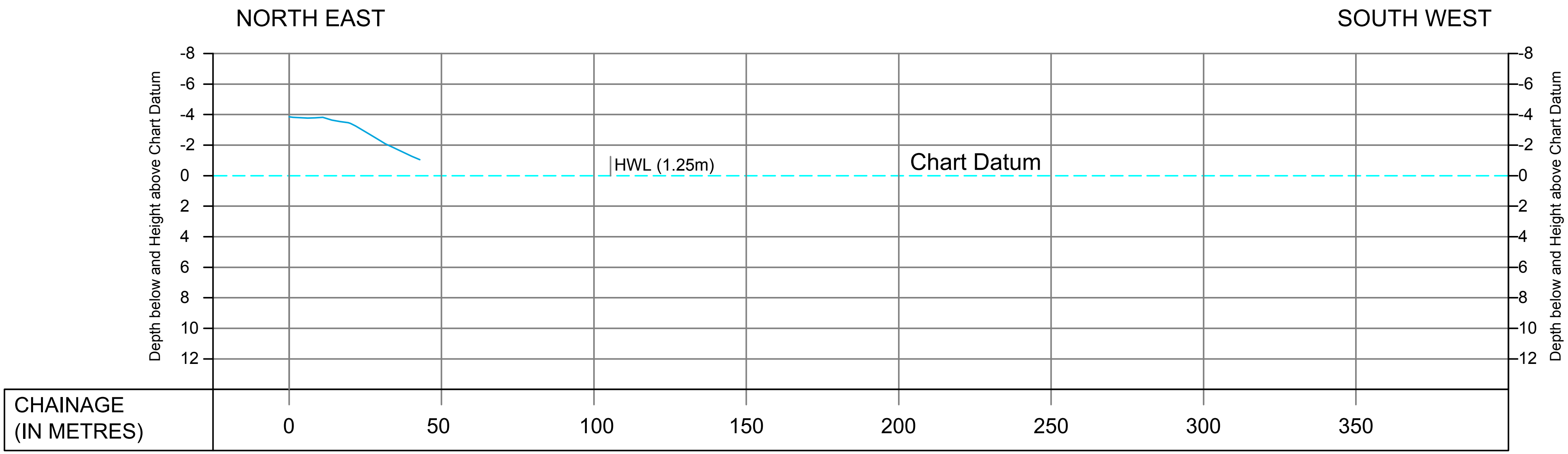

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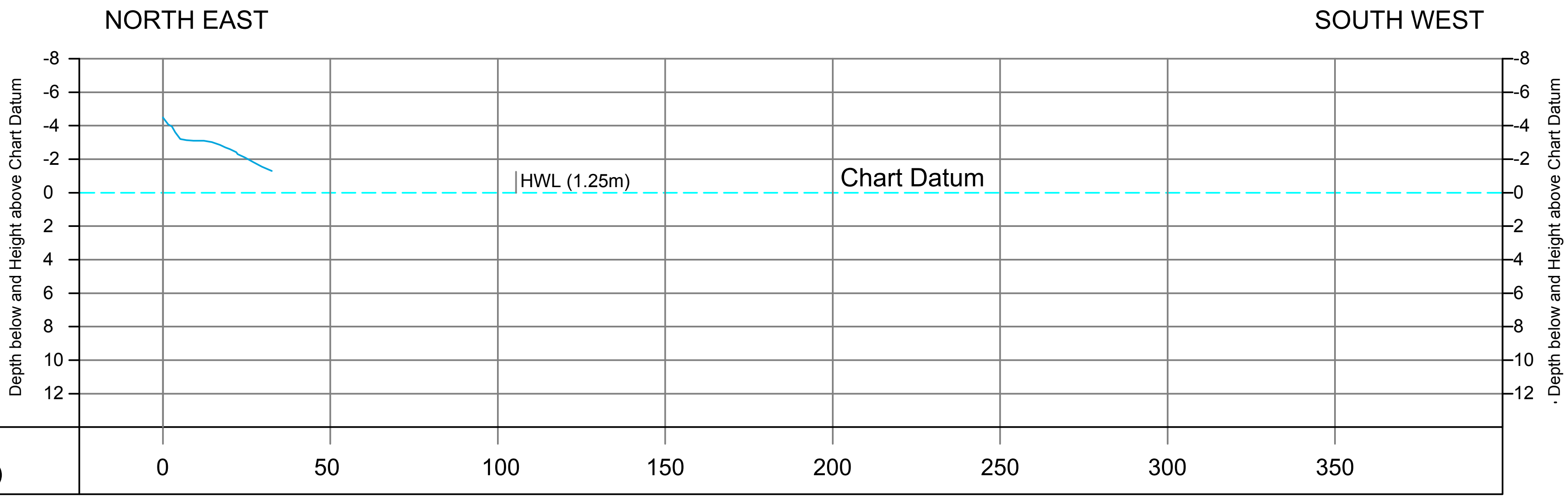

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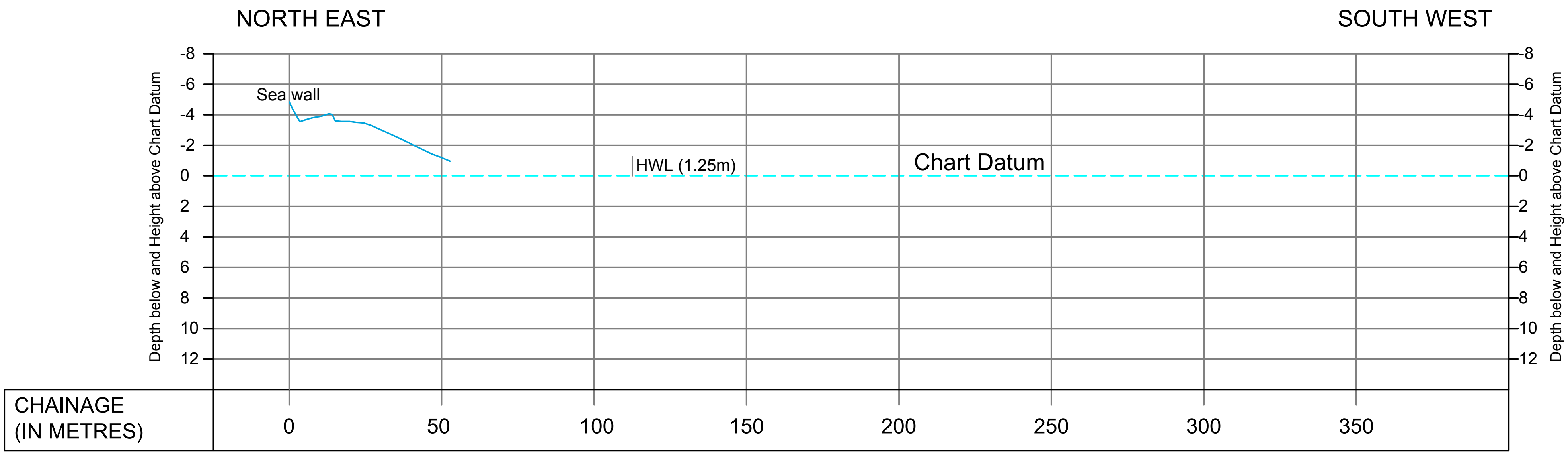

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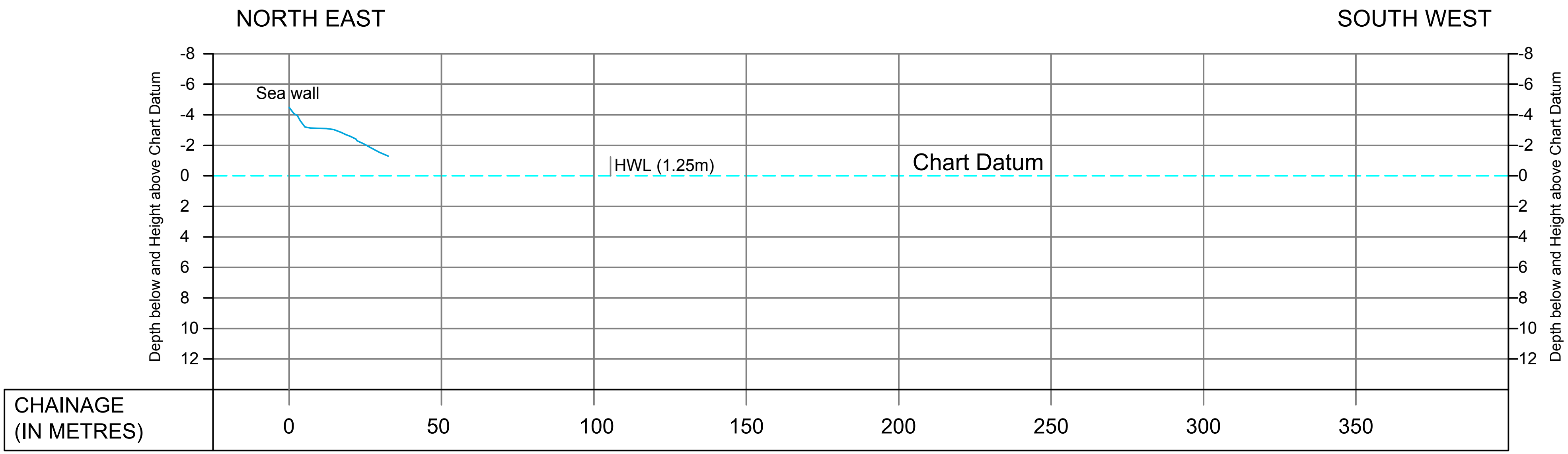
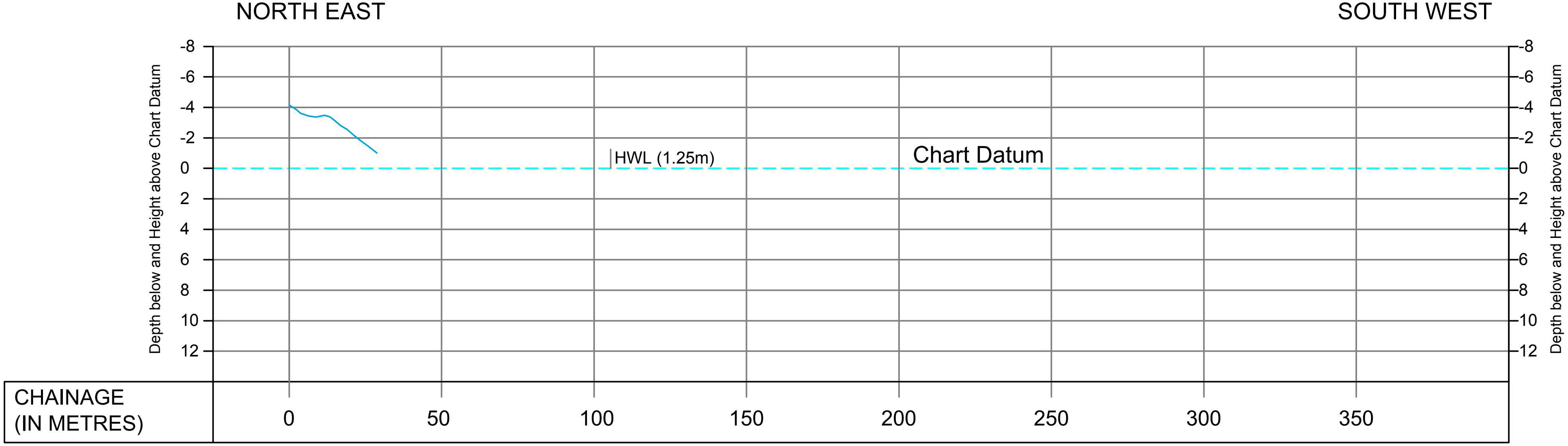
VERTICAL 1: 200

Cross Section Line No.CSP-79 (July 2019)



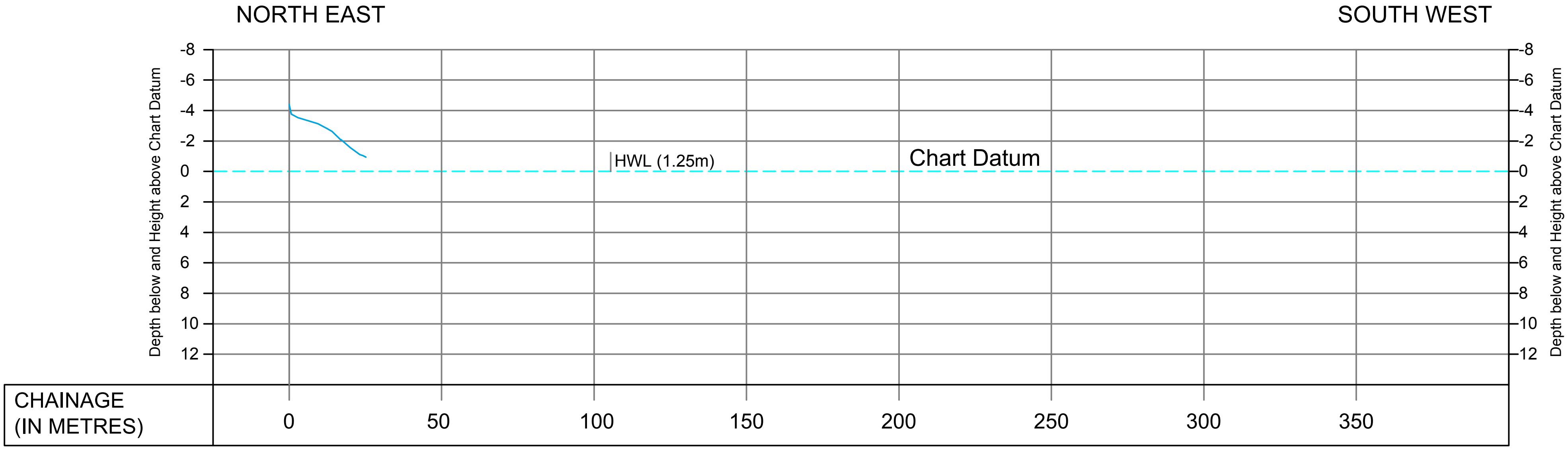
SCALE
HORIZONTAL 1: 1000
VERTICAL 1: 200

Cross Section Line No.CSP-80 (July 2019)



SCALE
HORIZONTAL 1: 1000
VERTICAL 1: 200

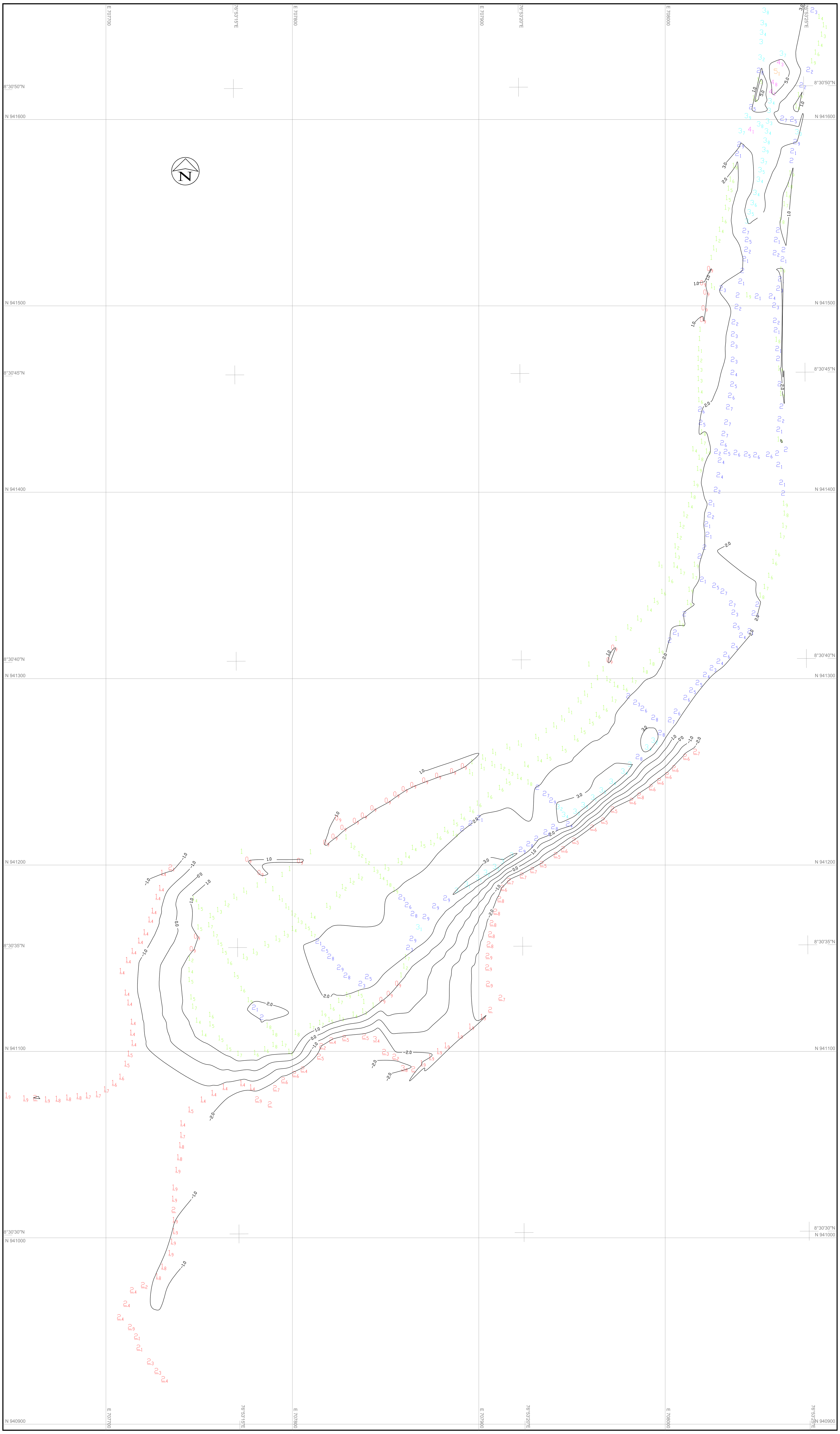
Cross Section Line No.CSP-81 (July 2019)



SCALE
HORIZONTAL 1: 1000
VERTICAL 1: 200

Annexure VII

River Crossing Surveys - July 2019



Notes :

1. Tide is not applied to the raw depth. The depth given is the actual observed water level from surface.

LEGEND

N 908000 — UTM Grid Line & Text

8°12'30"N — Lat/Long Grid Line & Text

Water level measured from surface

Height above chart datum recorded using RTK system

Depth contours in metres

Survey Notes :

Survey date	:	29 - July 2019
Survey boat	:	M V Aruvi
Surface positioning	:	Trimble DGPS, Geomax Zenith 10/20 RTK
Bathymetry acquired using	:	Syqwest Bathy 500 MF

Geodetic parameters :

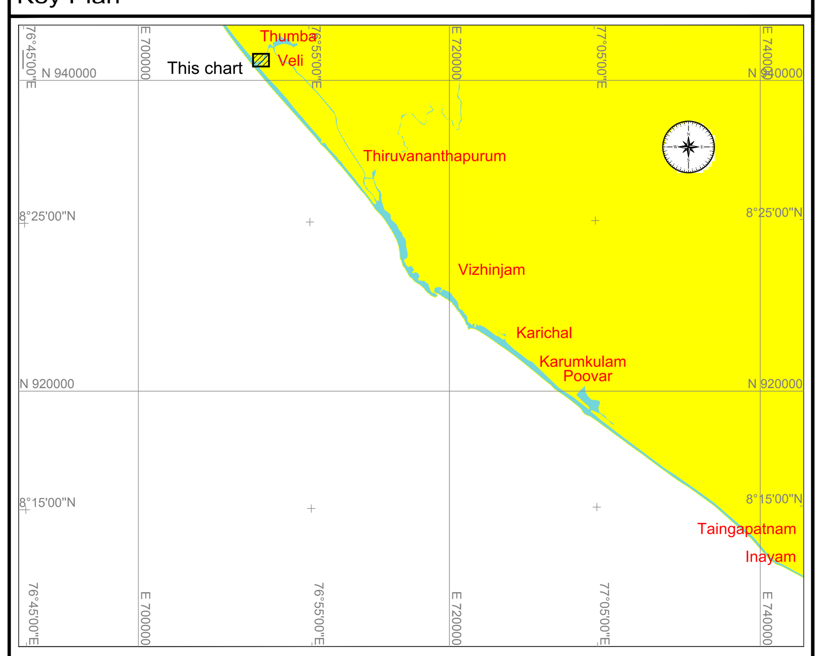
Horizontal Coordinate System	:	WGS84
Geodetic Datum / Spheroid	:	WGS84
Semi-Major Axis (a) (meters)	:	6378137.000m
Semi-Minor Axis	:	6356752.314245m
Inverse Flattening	:	298.2572235630
Projection	:	Universal Transverse Mercator
Longitude of Origin (CM)	:	75° E (Zone 43)
Latitude of Origin	:	0° N (Equator)
Hemisphere	:	North
False Easting	:	500 000 m
False Northing	:	0 m
Scale Factor at CM	:	0.9996
Units	:	Metres

Scale

HORIZONTAL 1 : 1,000

20 0 20 40 60 80 100metres

Key Plan



Client

ADANI VIZHINJAM PORT PVT. LTD.
2nd Floor, Vipanchika Towers,
Thycaud, Thiruvananthapuram,
Kerala, India. 695014

Survey contractor

SHANKAR AND CO.
115, 1st Floor, Neco Chambers
Sector 11, CBD Belapur, Navi Mumbai
Tele/Fax:- 022 27562900
E-mail : info@shankarsurveys.com

Project

Oceanographic & Bathymetric Data Collection
For
Assessment of Shoreline Changes
For
Adani Vizhinjam port Pvt. Ltd.

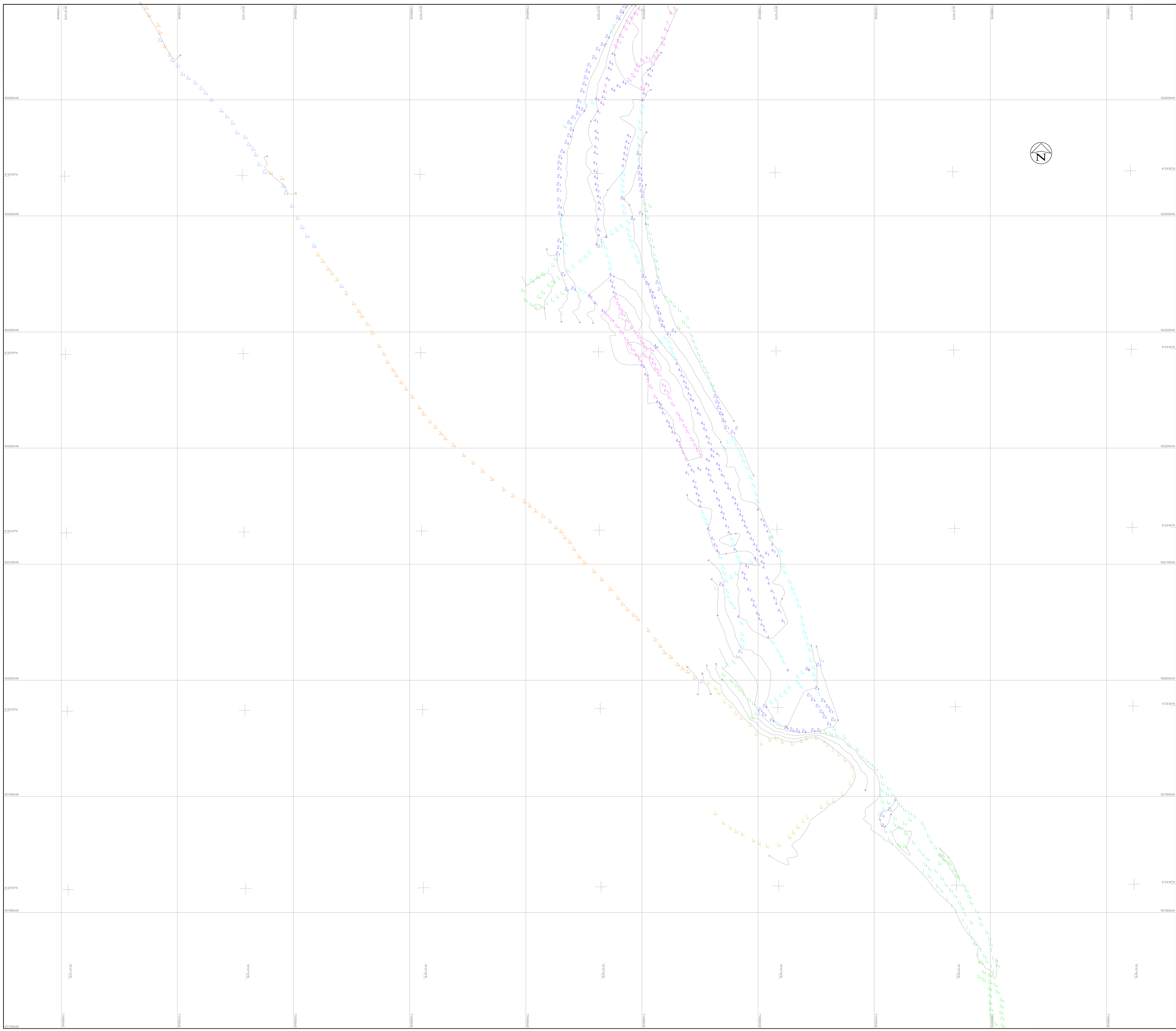
Drawing Title

Bathymetric Chart
(Veli River)

Rev.No.	Description	Date
0	First issue	07.08.2019

Drawn : Sanjeevanee Khaire	Interpreted : V. Mehta	Approved : S. Philip

Dwg. No. SAC_P167-19_AVPPL_Sheet No_01



Notes :

1. Tide is not applied to the raw depth. The depth given is the actual observed water level from surface.

LEGEND

N 908000	UTM Grid Line & Text
8°12'30"N	Lat/Long Grid Line & Text
2 9 3 6 4 5	Water level measured from surface
3 5 3 3 3 1	Height above chart datum recorded using RTK system
-3.0 -2.0	Depth contours in metres

Survey Notes :

Survey date	:	01 August 2019
Survey boat	:	M V Poyka
Surface positioning	:	Trimble DGPS, Geomax Zenith 10/20 RTK
Bathymetry acquired using	:	Syqwest Bathy 500 MF

Geodetic parameters :

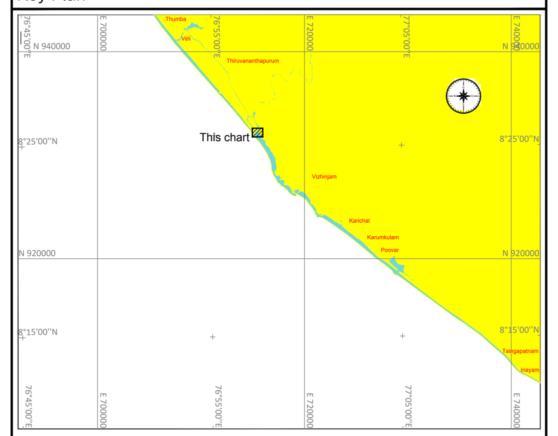
Horizontal Coordinate System	:	WGS84
Geodetic Datum / Spheroid	:	WGS84
Semi-Major Axis (a) (meters)	:	6378137.000m
Semi-Minor Axis	:	6356752.314245m
Inverse Flattening	:	298.2572235630
Projection	:	Universal Transverse Mercator
Longitude of Origin (CM)	:	75° E (Zone 43)
Latitude of Origin	:	0° N (Equator)
Hemisphere	:	North
False Easting	:	500 000 m
False Northing	:	0 m
Scale Factor at CM	:	0.9996
Units	:	Metres

Scale

HORIZONTAL 1 : 1,000

20 0 20 40 60 80 100metres

Key Plan



Client

ADANI VIZHINJAM PORT PVT. LTD.
2nd Floor, Vipanchika Towers,
Thycaud, Thiruvananthapuram,
Kerala, India. 695014

Survey contractor

SHANKAR AND CO.
115, 1st Floor, Neco Chambers
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Tele/Fax:- 022 27562900
E-mail : info@shankarsurveys.com

Project

Oceanographic & Bathymetric Data Collection
For
Assessment of Shoreline Changes
For
Adani Vizhinjam port Pvt. Ltd.

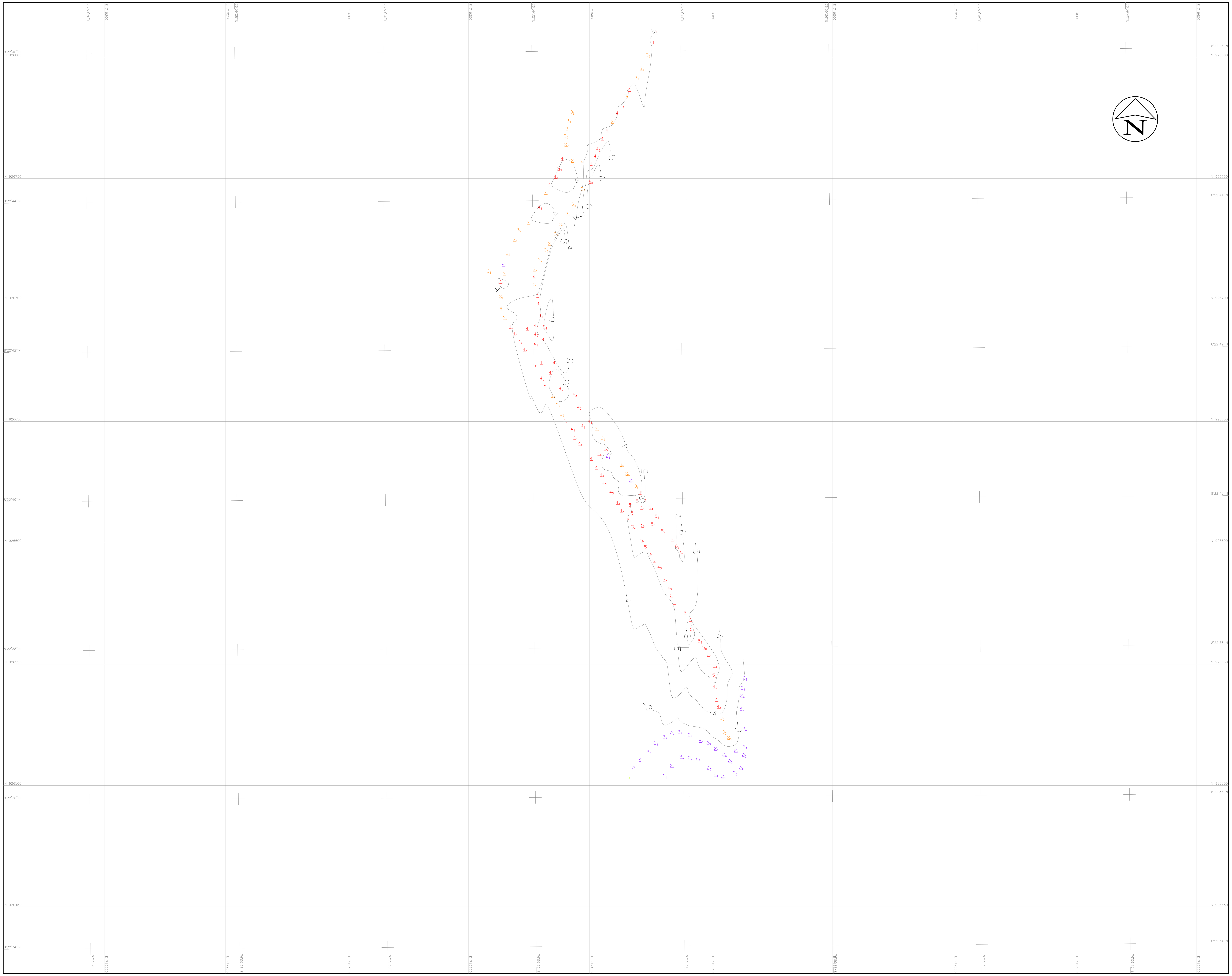
Drawing Title

Bathymetric Chart
(Thiruvallam River)

Rev.No.	Description	Date
0	First issue	07.08.2019

Drawn : Sanjeevanee Khaire | Interpreted : V. Mehta | Approved : S. Philip

Dwg. No. SAC_P167-19_AVPPL_Sheet No_02



Notes :

1. Tide is not applied to the raw depth. The depth given is the actual observed water level from surface.

LEGEND

N 908000	UTM Grid Line & Text
8°12'30"N	Lat/Long Grid Line & Text
2_4 4_5 3_9	Height above chart datum recorded using RTK system

Survey Notes :

Survey date	:	02 August 2019
Surface positioning	:	Trimble DGPS, Geomax Zenith 10/20 RTK

Geodetic parameters :

Horizontal Coordinate System	:	WGS84
Geodetic Datum / Spheroid	:	WGS84
Semi-Major Axis (a) (meters)	:	6378137.000m
Semi-Minor Axis	:	6356752.314245m
Inverse Flattening	:	298.2572235630
Projection	:	Universal Transverse Mercator
Longitude of Origin (CM)	:	75° E (Zone 43)
Latitude of Origin	:	0° N (Equator)
Hemisphere	:	North
False Easting	:	500 000 m
False Northing	:	0 m
Scale Factor at CM	:	0.9996
Units	:	Metres

Scale

HORIZONTAL 1 : 500

10 0 10 20 30 40 50metres

Key Plan

Client

ADANI VIZHINJAM PORT PVT. LTD.
2nd Floor, Vipanchika Towers,
Thycaud, Thiruvananthapuram,
Kerala, India. 695014

Survey contractor

SHANKAR AND CO.
115, 1st Floor, Neco Chambers
Sector 11, CBD Belapur, Navi Mumbai
Tele/Fax:- 022 27562900
E-mail : info@shankarsurveys.com

Project

Oceanographic & Bathymetric Data Collection
For
Assessment of Shoreline Changes
For
Adani Vizhinjam port Pvt. Ltd.

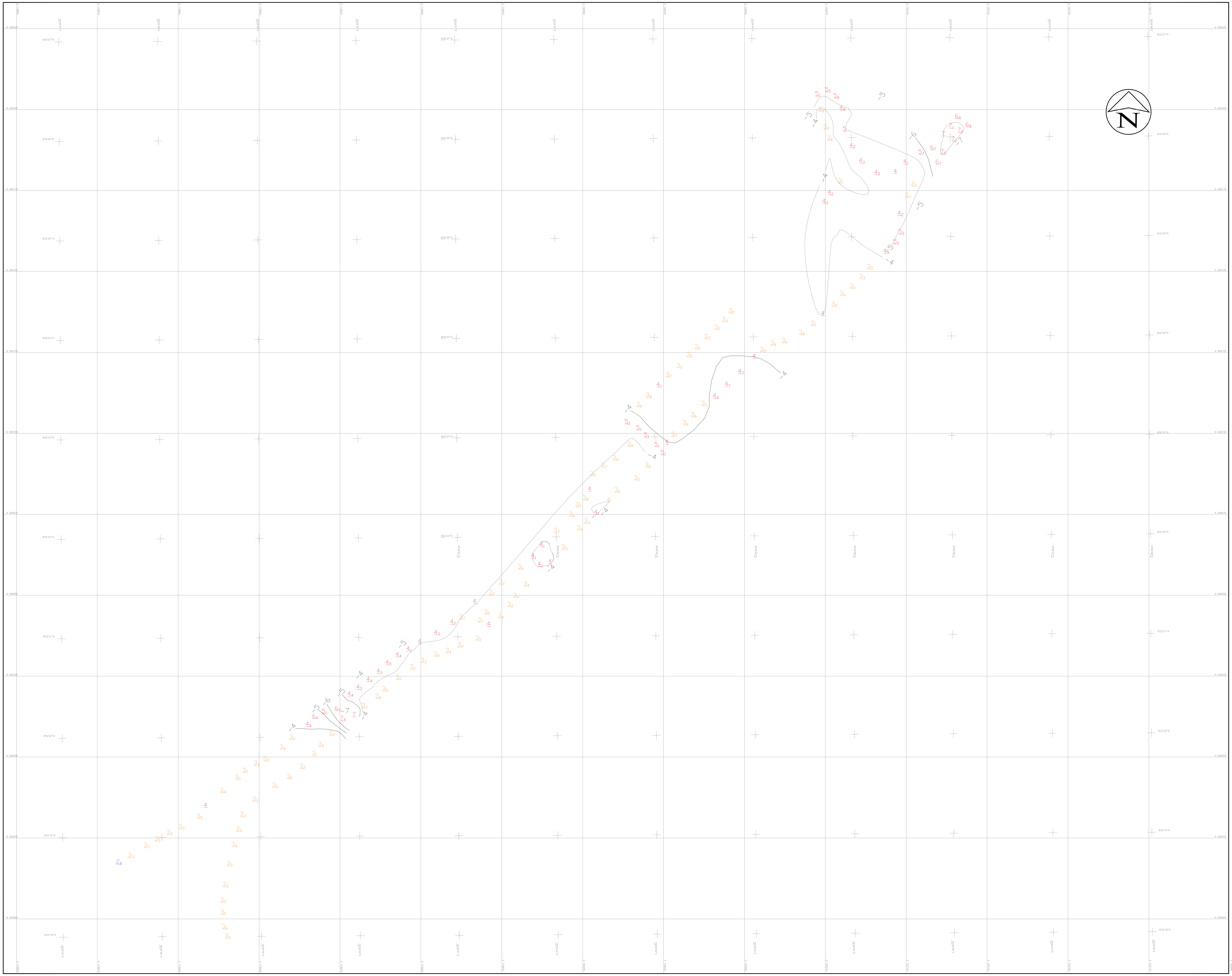
Drawing Title

Bathymetric Chart
(Gangayattumkara Canal)

Rev.No.	Description	Date
0	First issue	07.08.2019

Drawn : Sanjeevanee Khaire	Interpreted : V. Mehta	Approved : S. Philip

Dwg. No. SAC_P167-19_AVPPL_Sheet No_03



Notes :

1. Tide is not applied to the raw depth. The depth given is the actual observed water level from surface.

LEGEND

N 926225 — UTM Grid Line & Text

8°22'27"N — Lat/Long Grid Line & Text

5_7 6_7 7_2 — Height above chart datum recorded using RTK system

Survey Notes :

Survey date	:	03 August 2019
Surface positioning	:	Trimble DGPS, Geomax Zenith 10/20 RTK

Geodetic parameters :

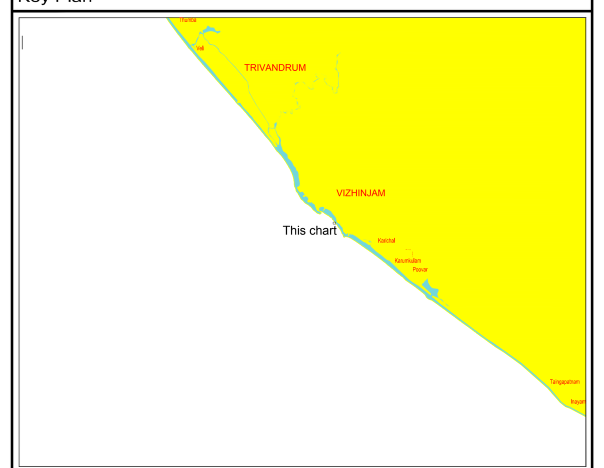
Horizontal Coordinate System	:	WGS84
Geodetic Datum / Spheroid	:	WGS84
Semi-Major Axis (a) (meters)	:	6378137.000m
Semi-Minor Axis	:	6356752.314245m
Inverse Flattening	:	298.2572235630
Projection	:	Universal Transverse Mercator
Longitude of Origin (CM)	:	75° E (Zone 43)
Latitude of Origin	:	0° N (Equator)
Hemisphere	:	North
False Easting	:	500 000 m
False Northing	:	0 m
Scale Factor at CM	:	0.9996
Units	:	Metres

Scale

HORIZONTAL 1 : 250

5 0 5 10 15 20 25 metres

Key Plan



Client

ADANI VIZHINJAM PORT PVT. LTD.
2nd Floor, Vipanchika Towers,
Thycaud, Thiruvananthapuram,
Kerala, India. 695014

Survey contractor

SHANKAR AND CO.
115, 1st Floor, Neco Chambers
Sector 11, CBD Belapur, Navi Mumbai
Tele/Fax:- 022 27562900
E-mail : info@shankarsurveys.com

Project

Oceanographic & Bathymetric Data Collection
For
Assessment of Shoreline Changes
For
Adani Vizhinjam port Pvt. Ltd.

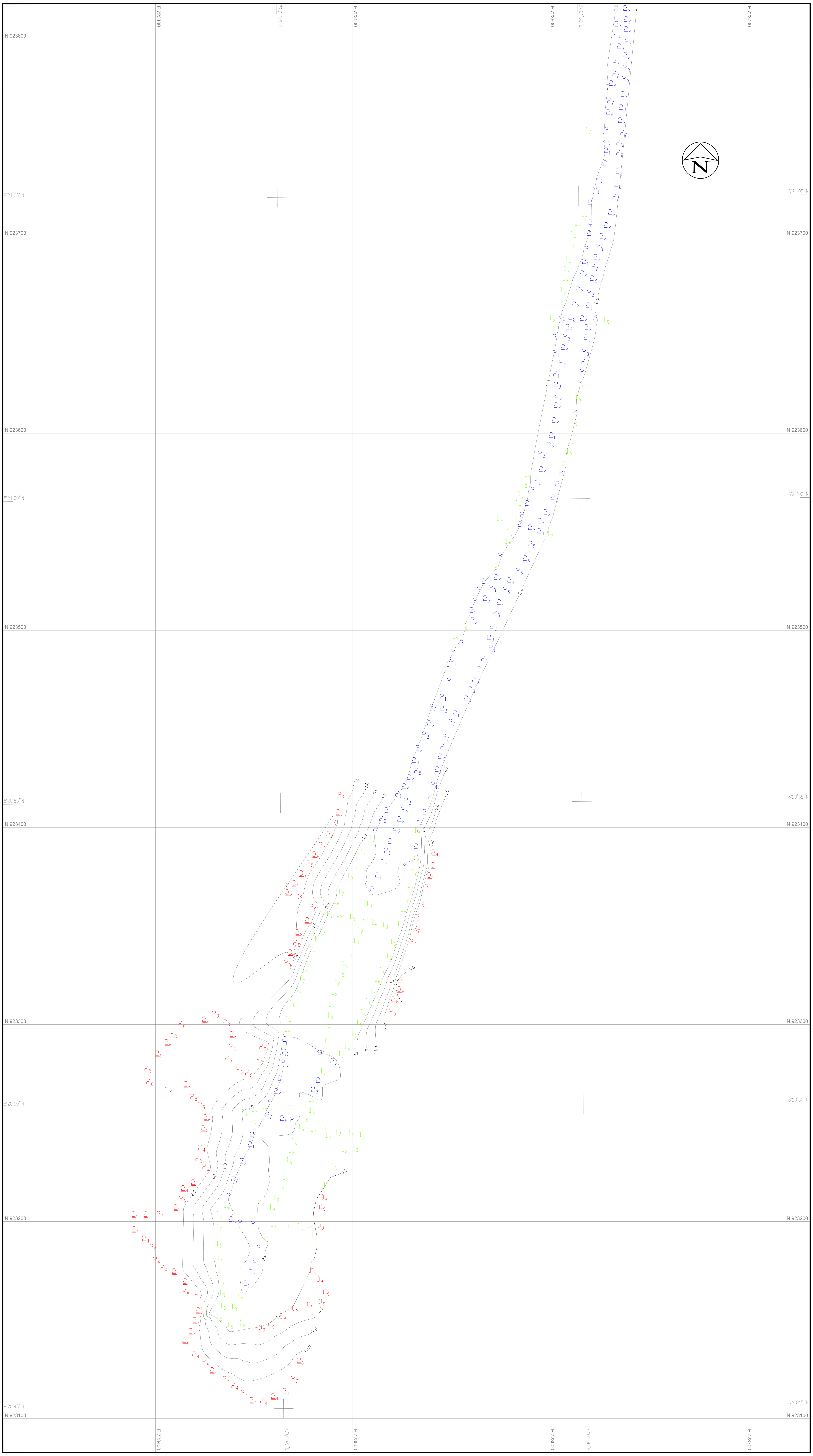
Drawing Title

Bathymetric Chart
(Karimpallickara Stream)

Rev.No.	Description	Date
0	First issue	07.08.2019

Drawn : Sanjeevanee Khaire | Interpreted : V. Mehta | Approved : S. Philip

Dwg. No. SAC_P167-19_AVPPL_Sheet No_04



Notes :

2. Tide is not applied to the raw depth. The depth given is the actual observed water level from surface.

LEGEND

N 908000 — UTM Grid Line & Text

8°12'30"N — Lat/Long Grid Line & Text

Water level measured from surface

Height above chart datum recorded using RTK system

Depth contours in metres

Survey Notes :

Survey date	:	31 July 2019
Survey boat	:	M V Poyka
Surface positioning	:	Trimble DGPS, Geomax Zenith 10/20 RTK
Bathymetry acquired using	:	Syqwest Bathy 500 MF

Geodetic parameters :

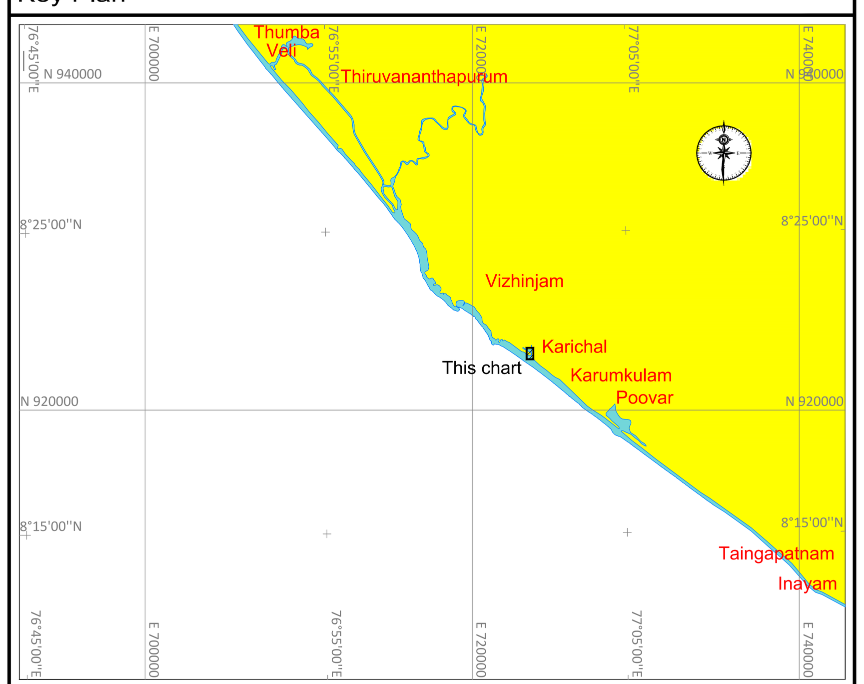
Horizontal Coordinate System	:	WGS84
Geodetic Datum / Spheroid	:	WGS84
Semi-Major Axis (a) (meters)	:	6378137.000m
Semi-Minor Axis	:	6356752.314245m
Inverse Flattening	:	298.2572235630
Projection	:	Universal Transverse Mercator
Longitude of Origin (CM)	:	75° E (Zone 43)
Latitude of Origin	:	0° N (Equator)
Hemisphere	:	North
False Easting	:	500 000 m
False Northing	:	0 m
Scale Factor at CM	:	0.9996
Units	:	Metres

Scale

HORIZONTAL 1 : 1,000

20 0 20 40 60 80 100metres

Key Plan



Client

ADANI VIZHINJAM PORT PVT. LTD.
2nd Floor, Vipanchika Towers,
Thycaud, Thiruvananthapuram,
Kerala, India. 695014

Survey contractor

SHANKAR AND CO.
115, 1st Floor, Neco Chambers
Sector 11, CBD Belapur, Navi Mumbai
Tele/Fax:- 022 27562900
E-mail : info@shankarsurveys.com

Project

Oceanographic & Bathymetric Data Collection
For
Assessment of Shoreline Changes
For
Adani Vizhinjam port Pvt. Ltd.

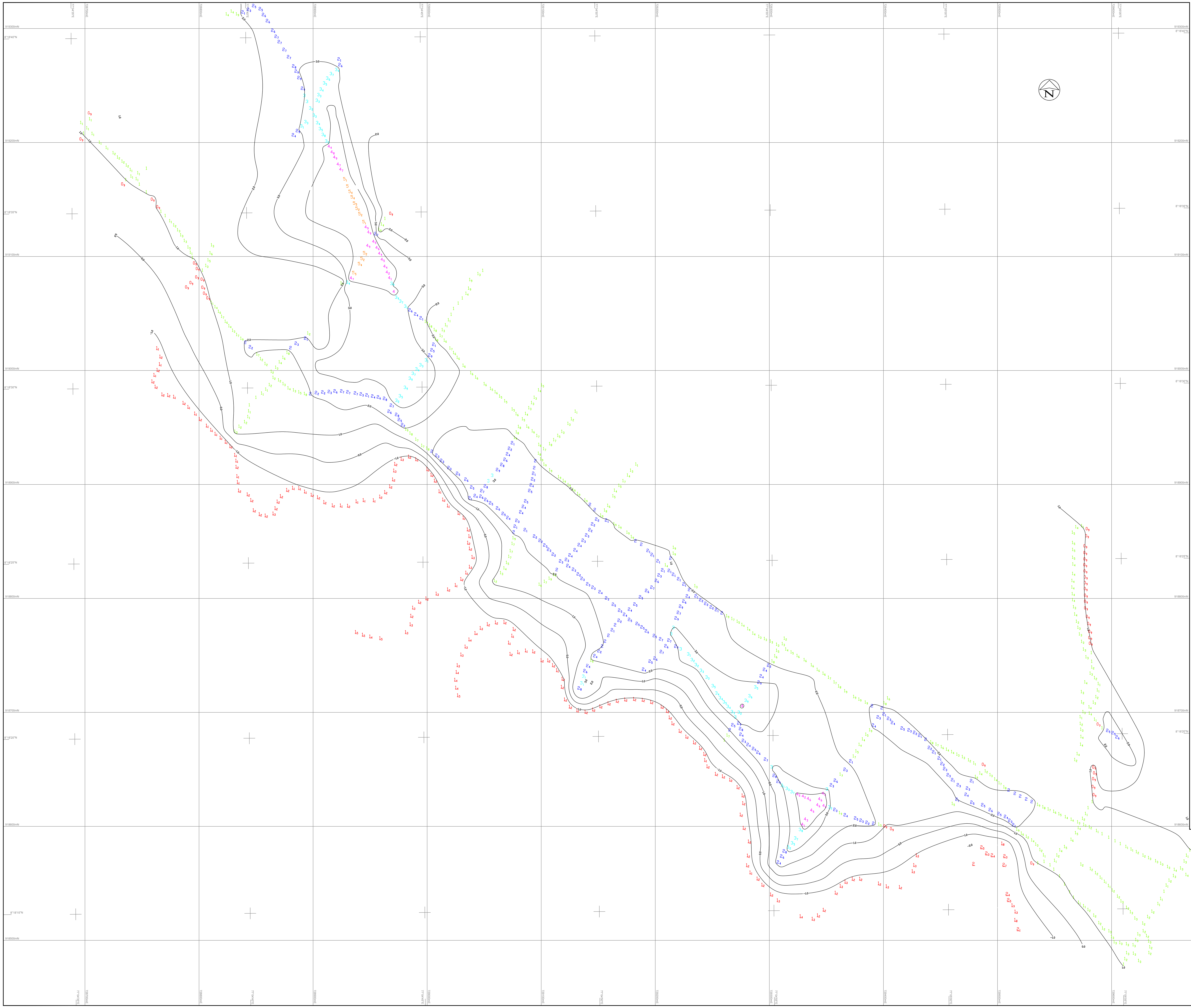
Drawing Title

Bathymetric Chart (Chovara River)

Rev.No.	Description	Date
0	First issue	07.08.2019

Drawn : Sanjeevanee Khaire | Interpreted : V. Mehta | Approved : S. Philip

Dwg. No. SAC_P167-19_AVPPL_Sheet No_05



Notes :

1. Tide is not applied to the raw depth. The depth given is the actual observed water level from surface.

LEGEND

N 908000 — UTM Grid Line & Text

8°12'30"N — Lat/Long Grid Line & Text

1_8 2_1 2_4 — Water level measured from surface

1_3 1_4 2_5 — Height above chart datum recorded using RTK system

Depth contours in metres

Survey Notes :

Survey date	:	30 July 2019
Survey boat	:	M V Poyka
Surface positioning	:	Trimble DGPS, Geomax Zenith 10/20 RTK
Bathymetry acquired using	:	Syqwest Bathy 500 MF

Geodetic parameters :

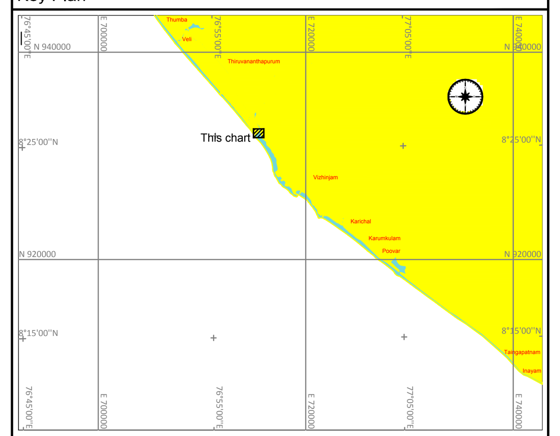
Horizontal Coordinate System	:	WGS84
Geodetic Datum / Spheroid	:	WGS84
Semi-Major Axis (a) (meters)	:	6378137.000m
Semi-Minor Axis	:	6356752.314245m
Inverse Flattening	:	298.2572235630
Projection	:	Universal Transverse Mercator
Longitude of Origin (CM)	:	75° E (Zone 43)
Latitude of Origin	:	0° N (Equator)
Hemisphere	:	North
False Easting	:	500 000 m
False Northing	:	0 m
Scale Factor at CM	:	0.9996
Units	:	Metres

Scale

HORIZONTAL 1 : 1,000

20 0 20 40 60 80 100metres

Key Plan



Client

ADANI VIZHINJAM PORT PVT. LTD.
2nd Floor, Vipanchika Towers,
Thycaud, Thiruvananthapuram,
Kerala, India. 695014

Survey contractor

SHANKAR AND CO.
115, 1st Floor, Neco Chambers
Sector 11, CBD Belapur, Navi Mumbai
Tele/Fax:- 022 27562900
E-mail : info@shankarsurveys.com

Project

Oceanographic & Bathymetric Data Collection
For
Assessment of Shoreline Changes
For
Adani Vizhinjam port Pvt. Ltd.

Drawing Title

Bathymetric Chart
(Poovar River)

Rev.No.	Description	Date
0	First issue	07.08.2019

Drawn : Sanjeevanee Khaire | Interpreted : V. Mehta | Approved : S. Philip

Dwg. No. SAC_P167-19_AVPPL_Sheet No_06

Adani Vizhinjam Port Pvt. Ltd

OCEANOGRAPHIC AND BATHYMETRIC DATA COLLECTION FOR ASSESSMENT OF SHORELINE CHANGES

Shankar And Co.
115, Neco Chambers
CBD Belapur
Navi Mumbai – 400 614

Date: 10th August 2019

SAC Ref #: SAC/P167-19/PSR-3
Rev 1

PERIODIC SURVEY REPORT – PSR3 (AUGUST 2019)

"APPROVAL SHEET"

Prepared by:	*Signed*	*Date*
V Mehta		*25/09/2019*

Checked by:	*Signed*	*Date*
S Cherian		*25/09/2019*

Approved by:	*Signed*	*Date*
S Philip		*25/09/2019*

REVISION CONTROL

Date	Rev	Section / Page No.	Remarks
12/09/2019	0		Submitted for approval
25/09/2019	1	Introduction, Page 7	Added CSP lines to be surveyed till 20m
		Introduction, Page 8	Added more clarity in the CSP
		Section 3, Page 10 & 11	Item 3, CSP survey to 20m added; Deployment of ADCP added
		Section 6.1, Page 24	Maximum range added, sentence modified
		Section 6.2, Page 30	Maximum period observed on different occasions added
		Section 6.3, Pages 32, 34, 35	Month added; units added, temperature range corrected
		Section 6.5, Pages 38, 39	Name of location added
		Section 6.6, Page 39	Name of location added
		Section 10, Page 44	Values corrected

Table of Contents

List of Tables

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ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
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
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
Mg/L	Milligram per litre
MoEF	Ministry of Environment & Forests
MoU	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
NTU	Nephelometric Turbidity Units
PEP	Project Execution Plan
PVD	Progressive vector diagram
PPP	Public Private Partnership
ppt	Parts per Thousand
RTK	Real Time Kinematics
SAC	Shankar And Co.
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

DEFINITIONS

Project Owner	Vizhinjam International Seaport Ltd (VISL), Thiruvananthapuram
Project Concessionaire	Adani Vizhinjam Port Pvt. Ltd. (AVPPL), Thiruvananthapuram
Advisor to VISL	National Institute of Ocean Technology (NIOT), Chennai
Survey Contractor	Shankar And Co (SAC), Navi Mumbai
Survey Requirement	Oceanographic & Bathymetric Survey for Shoreline Monitoring
Chart Datum	Chart datum is the level to which soundings on 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 a water body moves in the ocean. The speed is denoted in cm/s
Rip Current	A relatively strong, narrow current flowing outward from the beach through the surf zone
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 in m/s
Wind Direction	Wind direction is an indicator of the direction that the wind is **blowing 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
Turbidity	Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air.

1 EXECUTIVE SUMMARY

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

Vizhinjam International Seaport Ltd (VISL) - a company fully owned by GoK is the implementing agency for the project, will be responsible for all obligations and responsibilities of GoK 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 (MoES), for a long-term shoreline monitoring programme including the seasonal bathymetry mapping.
(Source: https://www.vizhinjamport.in/home.html)

Shankar And Co, hereinafter referred to as SAC, based in Navi Mumbai 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 5700267194 dated 3rd May 2019 by AVPPL.

As part of the study, NIOT provided a wave rider buoy to be deployed off Mulloor and the data and watch & ward of the buoy was to be monitored by SAC.

As part of the contract, turbidity measurements at three locations from three levels is to be monitored on a real time basis from October 2019.
This report provides the results of the data collected from 01st to 31st August 2019.

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

The proposed project is being developed as a PPP project on a DBFOT basis in accordance with the terms and conditions set forth in the concession agreement signed between AVPPL and GoK/VISL. 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 & equipment) will be shared on PPP basis availing Viability Gap Funding (VGF). The PPP concessionaire, AVPPL has been given the right to operate the port 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 is located at the southern tip of India, barely 10 nautical miles from the international sea route (Suez – Far East route & Far East – Middle East route), it has the potential to become the future trans-shipment hub of the country.
(Source : https://www.vizhinjamport.in/download/Feasibility-Report.pdf)

① The study includes carrying out MetOcean observations (wave, meteorological parameters and tide) at one location, to measure current for 30 days each, at four locations, during 3 different seasons; summer (Mar-May), monsoon (June-Oct), and post monsoon (Nov-Feb), to measure in real-time turbidity from three levels and three locations, bathymetric survey of up to 20m contour in two seasons, cross-shore profiling from 10m CD (4 CSP lines to be carried out up to a depth of 20m during the months of January, May, August and October) to 100m inland from the high water line along a stretch of 40 km, water & grab sampling, littoral environmental observation and river crossing survey. All these are to be carried out for a period of 3 years commencing June 2019.

A Google Earth image, showing the Multibeam survey area; locations of the observations, including the wave/current, tide and AWS measurement location, is given in Figure 2-1. The cross-shore profile lines, the LEO points and photographic documentation points are shown in Figure 2-2.

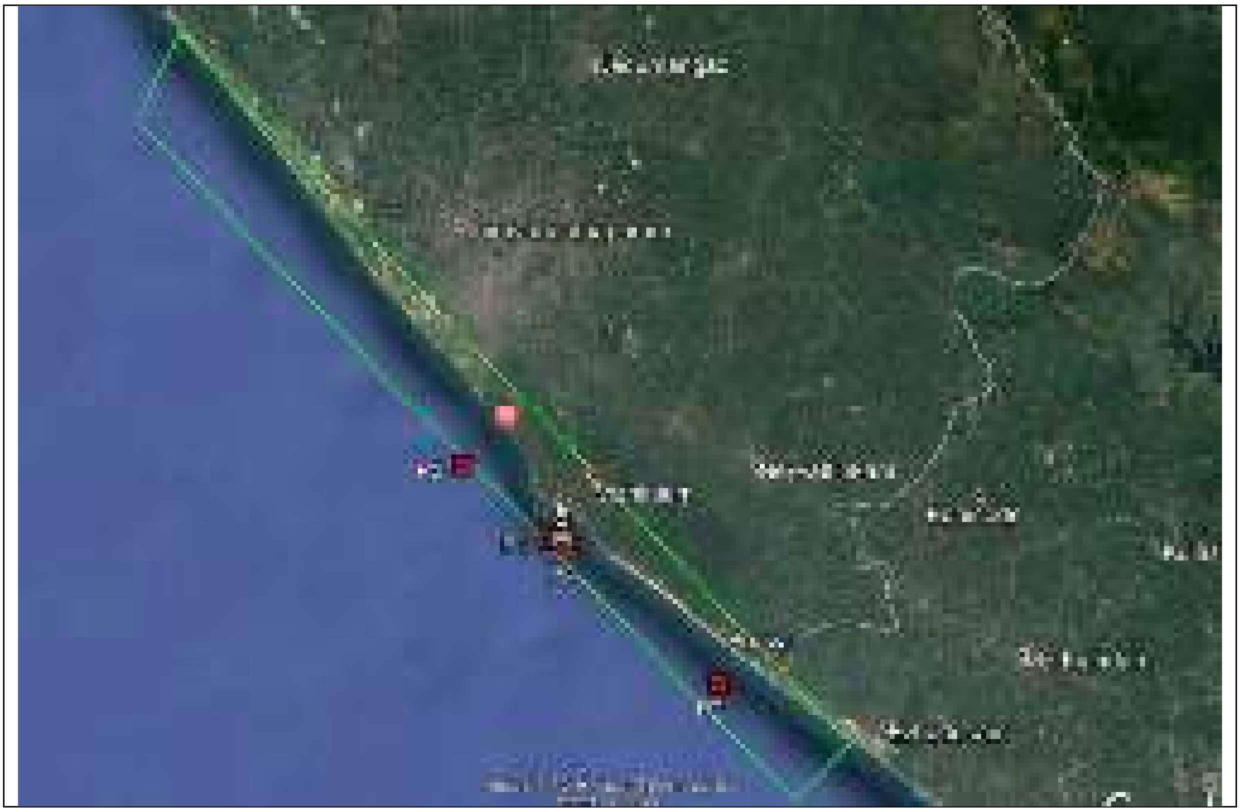


Figure 2-1: General Survey Location

P1, P2 and P3 correspond to ADCP locations and P4 corresponds to both, ADCP and wave location.

① The cross-shore profiling (CSP) lines, which coincides with the LEO, beach sampling and photographic documentation, 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 to the south of the existing Vizhinjam Harbour and gradually increases progressing towards north for the entire 40 km stretch (20 km on either side of the port) with a 500 m interval between each CSP line.

Figure 2-2: CSP, LEO and Photographic Documentation Locations

3 SCOPE OF WORK

The survey scope of work as provided in the RFQ and as per the contract includes 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 shoreline.
- 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 (4 CSP Lines will be carried out up to a depth of 20 m in the months of January, May, August and October).
- 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 2-1, 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 on 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.

- Collection of wind speed & direction, atmospheric pressure, humidity, temperature at 1 location specified by the client/EIC by establishing an automatic weather station.
- Continuous monitoring of turbidity at 3 location (1 upstream & 2 downstream of dredging location) - Online meter (3 levels) to be installed on buoys and data to be displayed at system in office.
- Analysis and processing of the data and submission of periodic reports in soft & hard copies.

3.1 Location Coordinates

The location co-ordinates provided by the client for the current and wave observations are given below:

Table 3-1: Current / Wave locations

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	21.4
ADCP/Wave - P4 (Mulloor)	08° 21' 42.3"N	76° 59' 33.9"E	23.2

① The current observations are to be carried out for 30 days in each of the seasons at the above locations. The ADCP's were deployed on 16th August 2019.

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

Table 3-2: Tide station location coordinates

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	3.447

A Gill Maximet weather station was replaced with the EMCON weather station on 14th August 2019 which was installed at the Ayur Bay Resort and the coordinates are provided in the table below:

Table 3-3: Weather station location coordinates

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

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 10m above MSL.

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.

Table 4-1: Geodetic Parameters

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

4.2 Survey Vessels

The following vessel was utilized for the survey operation:

Figure 4-1: Watch keeping vessel MFB Samuel

Figure 4-2: Transit vessel MFB Sindhu Yatra Matha

4.3 Personnel

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

Table 4-2: Personnel

Shankar And Co.		
Name	**Designation**	**Period**
Saju Cherian	Project Manager	Duration of Project
Unnikrishnan K.U.	Party Chief / Surveyor	Duration of Project
Arun P.K.	Survey Engineer	01st to 31st Aug 2019
Harikrishnan P.	Land Surveyor	01st to 31st Aug 2019
Vishnu Haridas	Land Surveyor	01st to 17th Aug, 20th to 31st Aug
Adani Vizhinjam Port Pvt. Ltd.		
Name	**Designation**	**Period**
Hebin C.	Manager - Environment	Duration of Project
Jesse Fullonton	Assistant Manager	Duration of Project

5 SURVEY EQUIPMENT DETAILS

5.1 Wave Rider Buoy

The Datawell DWR (G) wave rider buoy was deployed by NIOT in collaboration with VISL and AVPPL, under a tripartite agreement and is being monitored and maintained by Shankar And Co. 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 Ayur Bay resort.

The system consists of wave rider buoy (DWR G make) with HF whip/LED flasher, GPS antenna, 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 are 1.5° within the range of 0° to 360°.

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

5.1.1 Principles of wave measurement

The GPS wave buoy measurement principle bears a strong analogy with the Doppler-shift phenomenon of a car passing nearby, 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.

5.1.2 Instrument Mooring

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:

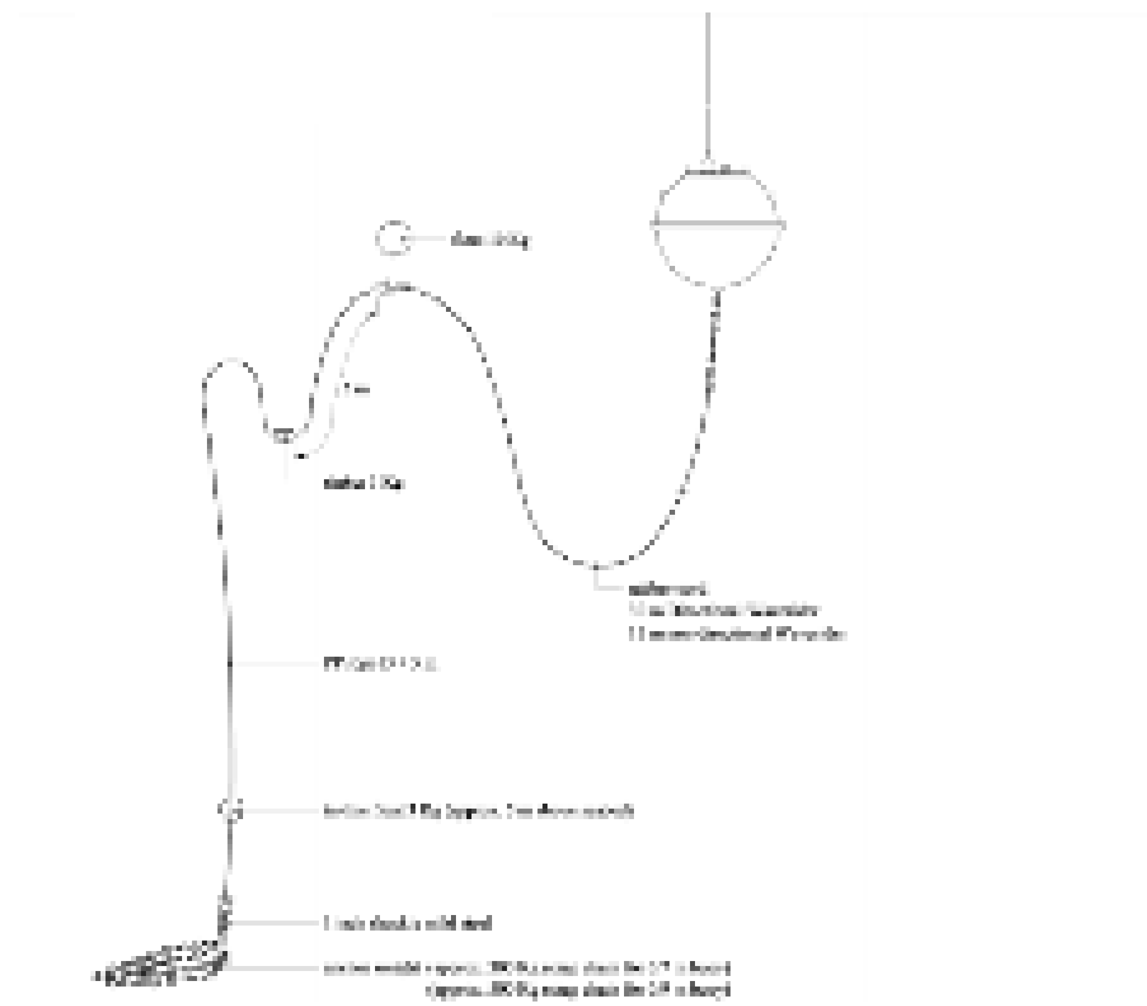


Figure 5-1: WRB Mooring Diagram

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.

The image of WRB deployed at the location is provided below:

Figure 5-2: WRB deployed at site

5.2 Automatic Tide Gauge

An EMCON automatic tide gauge was installed near the Coast Guard jetty, inside the fishing harbour for measuring the tides. The tide gauge is a capacitance-based instrument, measuring the water level due to change in capacitance on the surface of sensor. The sensor was installed on a 2.5m long pipe to ensure that the zero of sensor is always in water, irrespective of the phases of tide. This was levelled to the local benchmark, situated on top of the jetty. The tide station was programmed to measure the tide at 5-minute intervals throughout the duration of the project.

A photograph of the tide gauge location is provided below:

Figure 5-3: Tide Gauge

5.3 Automatic Weather Station (AWS)

A Gill Maximet Automatic Weather Station (AWS) was installed atop Ayur Bay Resort at Nellikunnu. The system measures wind speed/direction, atmospheric pressure, temperature and relative humidity.

The system consists of the following:

- Sonic anemometer
- Relative humidity & temperature sensor
- Pressure sensor
- Datalogger

The data is logged in a data logger installed at the receiving station at intervals of 10 minutes. The data is also transmitted from the data logger to a cloud bases server for further processing and QC checks.

An image of automatic weather station is provided below:

Figure 5-4: AWS on toop of Ayur Bay Resort, Nellikunnu (Mulloor)

5.4 Real Time Kinematic (RTK) Survey

An RTK system was mobilized at site to carry out cross-shore profiling on the landward side. The system used was a Geomax Zenith 10/20 RTK system with base station and rover. A photograph of the system is provided below:

Figure 5-5: RTK System with base station and rover

5.5 Beach Sampling

Beach samples were collected from 62 out of the 81 cross shore profile locations. The samples could not be collected at 19 locations because no beach was available for sample collection. The samples were handed over to the laboratory and results are awaited.

6 SURVEY RESULTS

6.1 Tidal Measurements

The tides were observed near the Coast Guard jetty. 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 3.447 above chart datum. An image of the TBM is provided below:

Figure 6-1: Location of TBM

The offset calculation of tide gauge based on the 'jetty top' value is given in the image below:

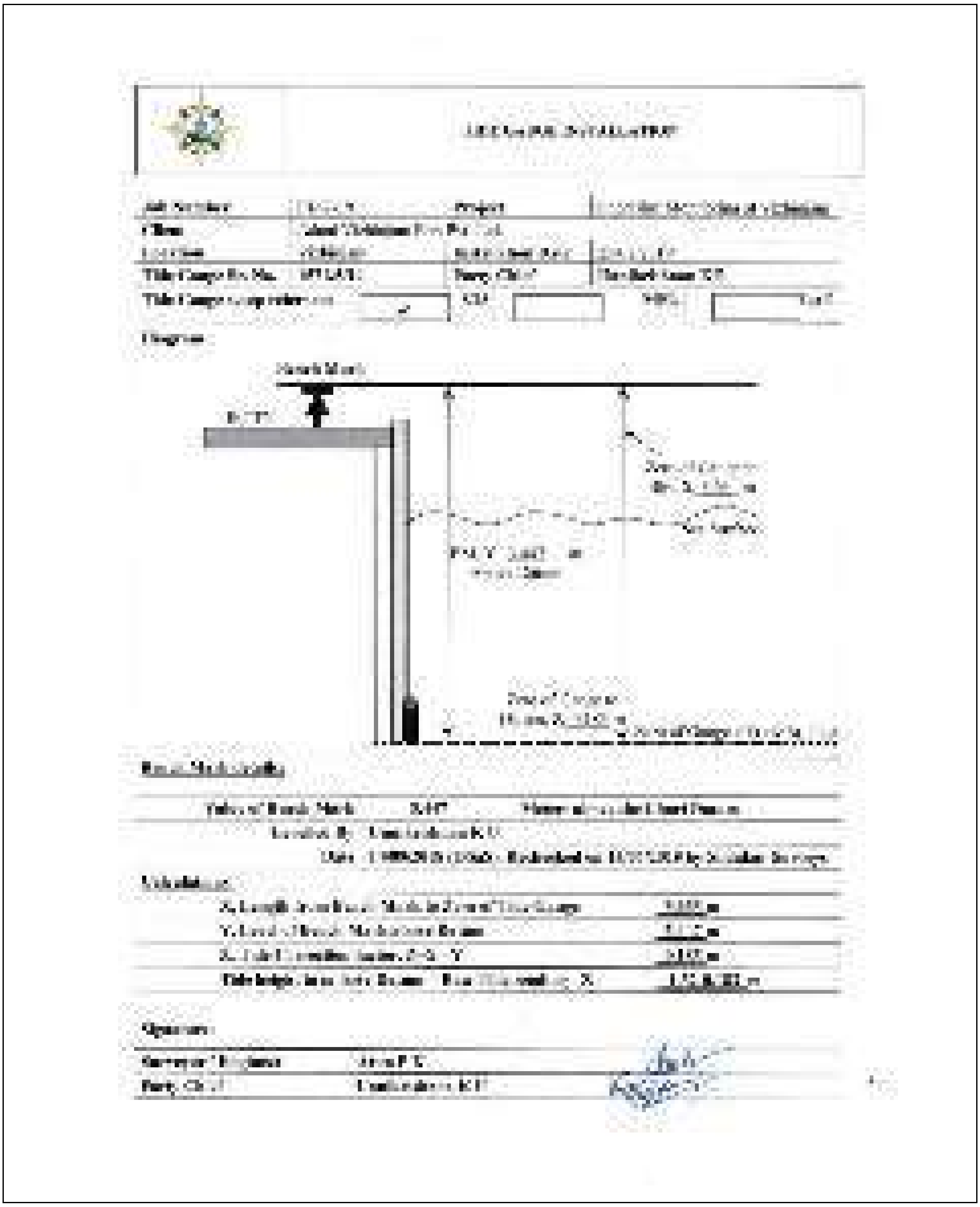
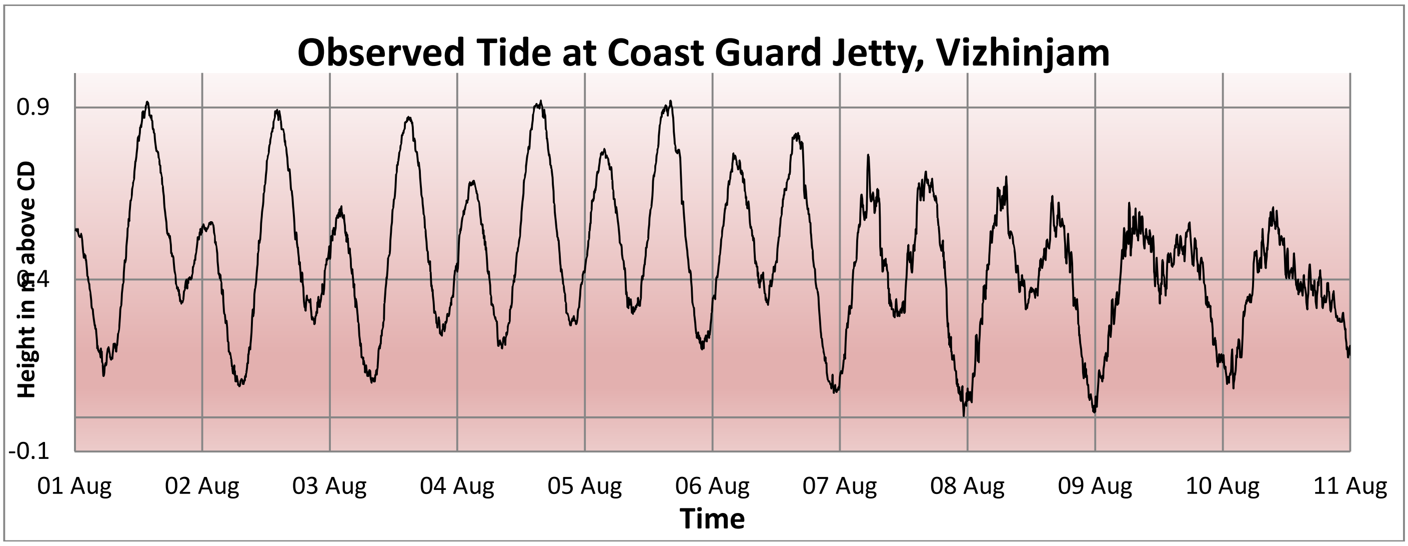
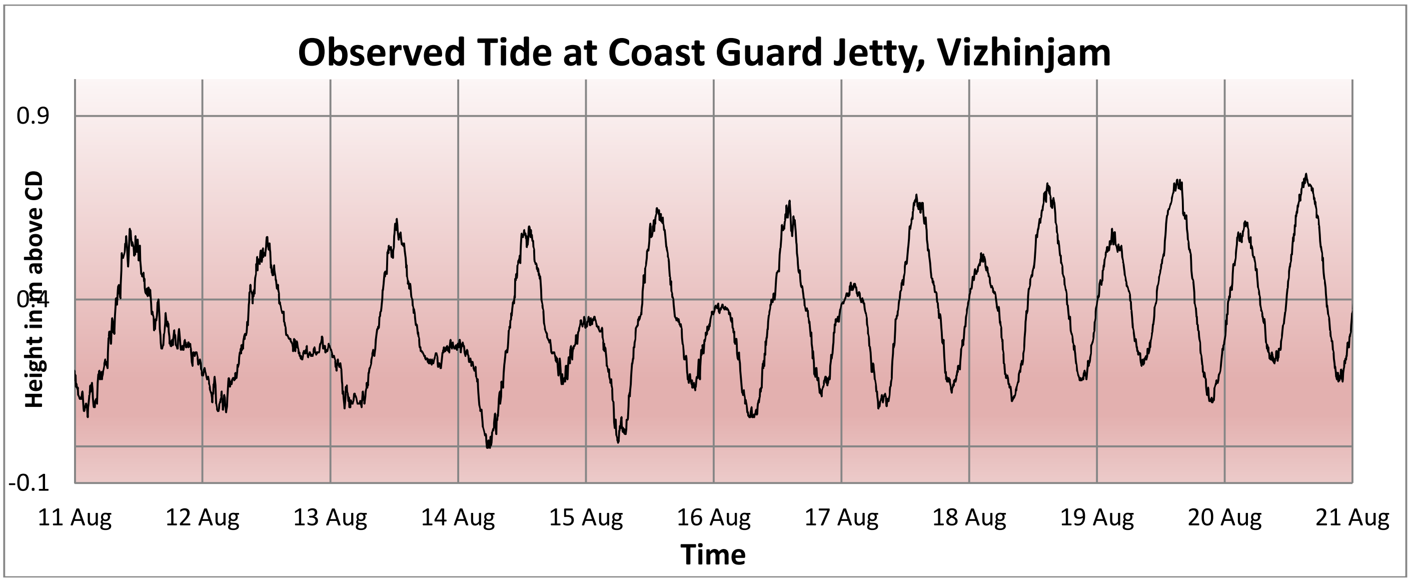
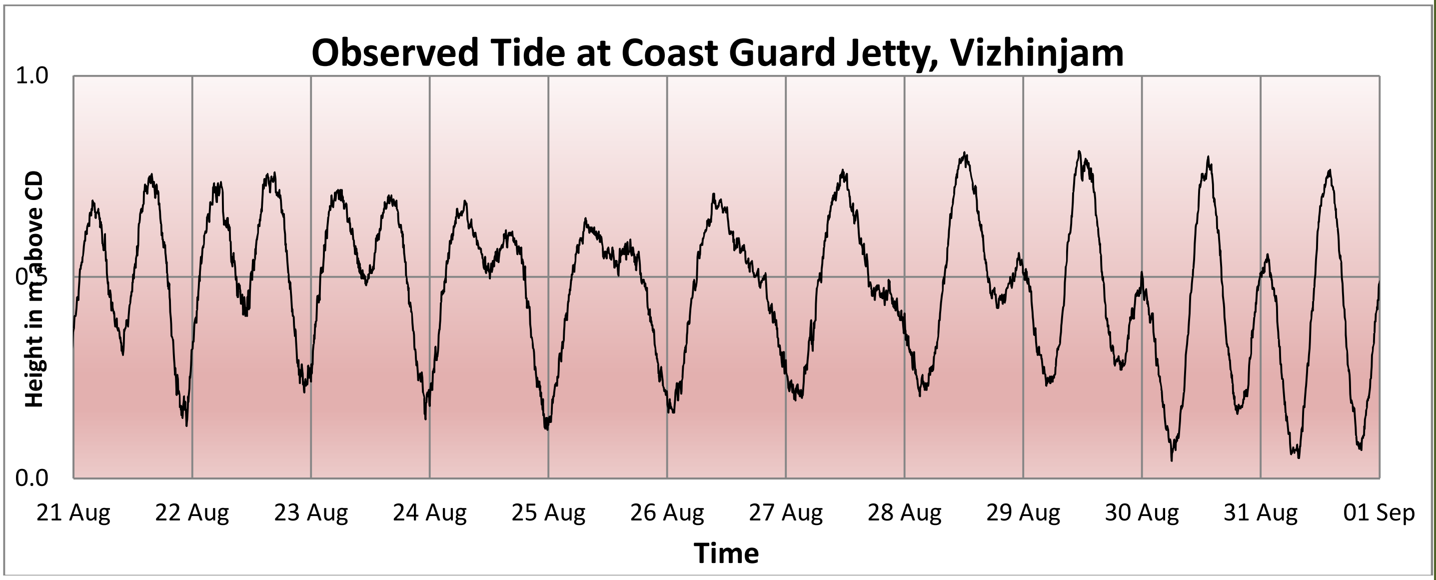


Figure 6-2: Schematic Diagram of Tide Gauge

① The tides observed are mixed semi-diurnal in nature, with the maximum range of 0.86m being observed in the springs. The representation of tide data collected, in the form of graphs is placed overleaf.


Observed Tide at Coast Guard Jetty, Vizhinjam
Height in m above CD
0.9
0.4
-0.1
01 Aug
02 Aug
03 Aug
04 Aug
05 Aug
06 Aug
07 Aug
08 Aug
09 Aug
10 Aug
11 Aug
Time


Observed Tide at Coast Guard Jetty, Vizhinjam
Height in m above CD
0.9
0.4
-0.1
11 Aug
12 Aug
13 Aug
14 Aug
15 Aug
16 Aug
17 Aug
18 Aug
19 Aug
20 Aug
21 Aug
Time


Observed Tide at Coast Guard Jetty, Vizhinjam
1.0
0.5
0.0
Height in m above CD
21 Aug
22 Aug
23 Aug
24 Aug
25 Aug
26 Aug
27 Aug
28 Aug
29 Aug
30 Aug
31 Aug
01 Sep
Time

6.2 Wave Measurements

The data from the WRB (provided by NIOT) was downloaded and processed to produce the time series and rose diagram, which are provided below:

Refer to the following rose plot of significant height (Hs) v/s direction for the period of 01st to 31st August 2019:

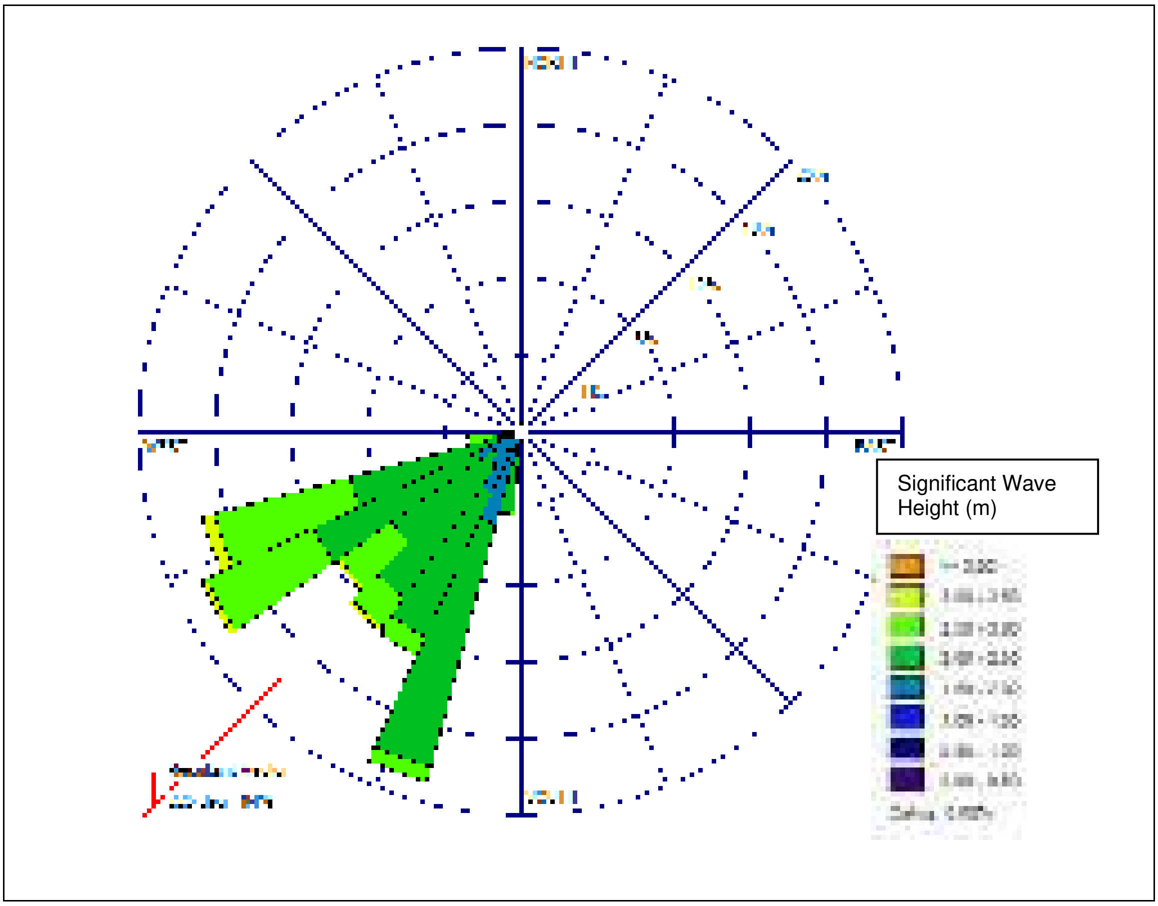


Figure 6-3: Wave Rose (Hs in metre v/s Direction) from 1st to 31st August 2019

The wave direction was south-southwesterly to west-southwesterly during the period with wave heights less than 3m. As can be seen in the rose plot above, the significant wave heights were more than 2m in the west of south-westerly direction, due to the active monsoon.

A maximum significant wave height of 2.87 m was recorded on 8th August 2019 at 08:15 hrs.

The frequency distribution table and histogram are provided below:

Table 6-1: Frequency distribution of wave height (1st to 31st August 2019)

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	1	0.07	0	0.00
1.0 - 1.5	335	22.47	3	0.20
1.5 - 2.0	842	56.47	132	8.85
2.0 - 2.5	296	19.85	550	36.89
2.5 - 3.0	17	1.14	475	31.86
3.0 - 3.5	0	0.00	227	15.22
> 3.5	0	0.00	104	6.98
Total	**1491**	**100.00**	**1491**	**100.00**

The histogram of significant wave height during the observation period of August 2019 is given below:

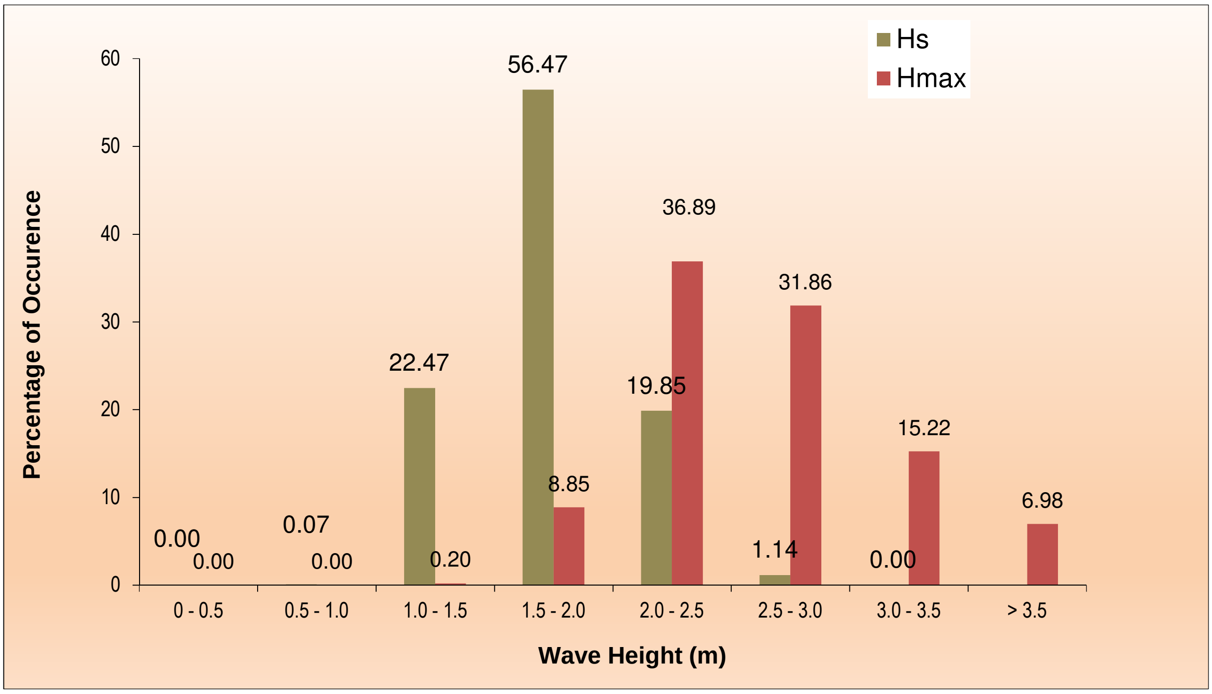


Figure 6-4: Histogram of wave height from 1st to 31st August 2019

As can be seen from the above histogram, about 21% of the observation of significant wave height was greater than 2m indicating rough conditions.

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

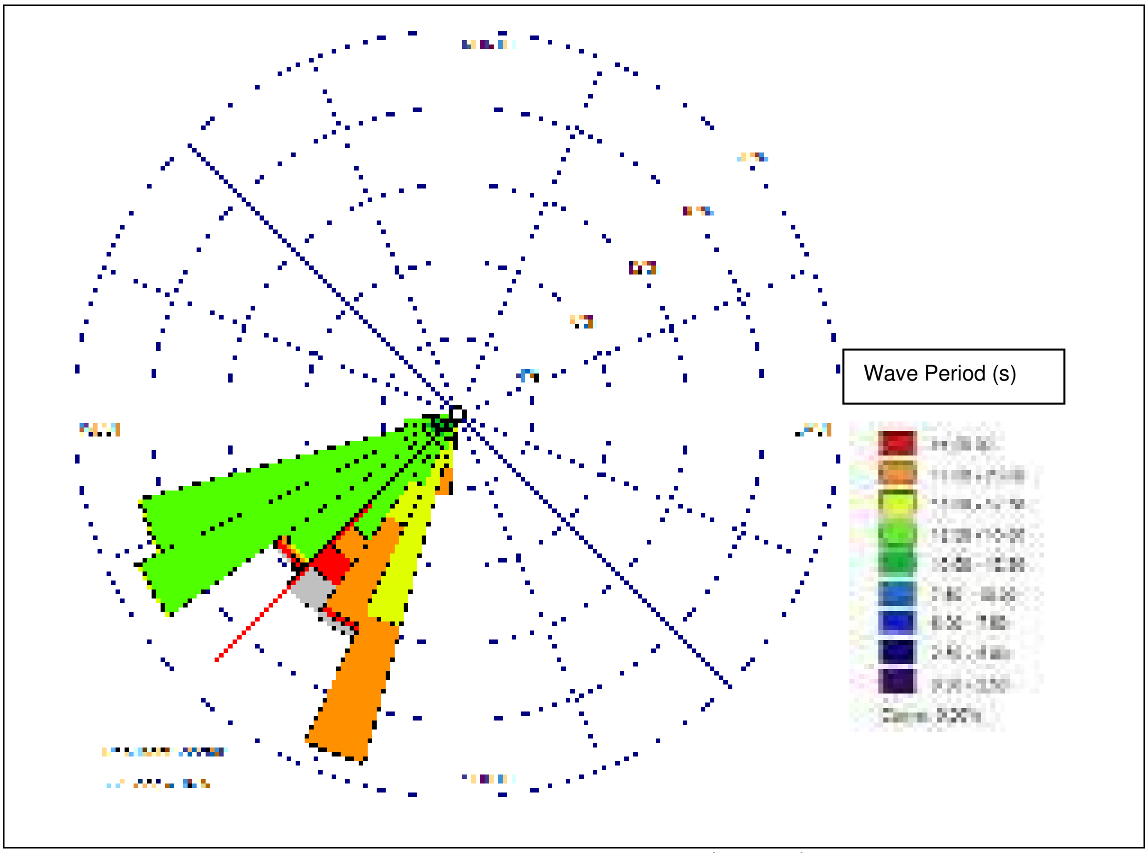


Figure 6-5: Wave Rose (Tp vs direction) from 1st to 31st August 2019

The histogram drawn for wave period for August 2019 is given below:

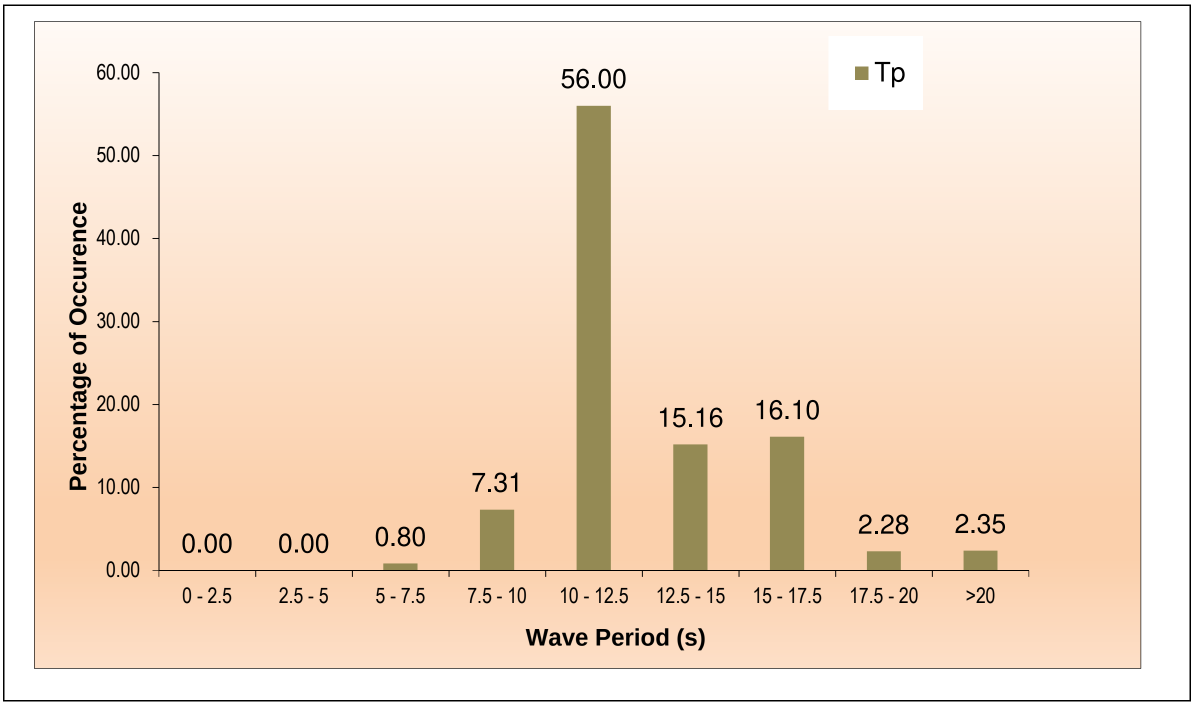
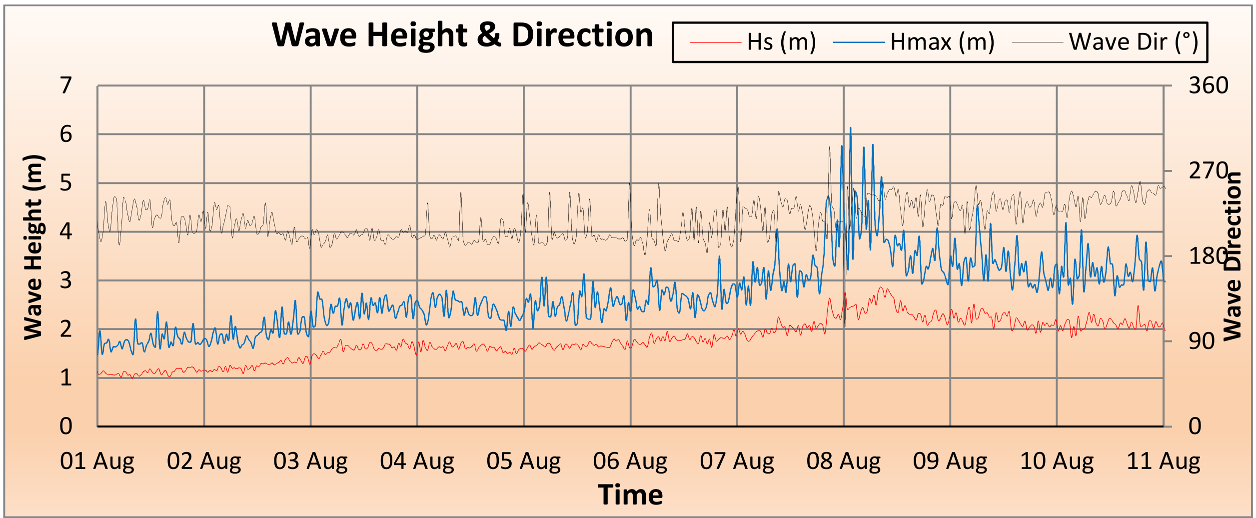
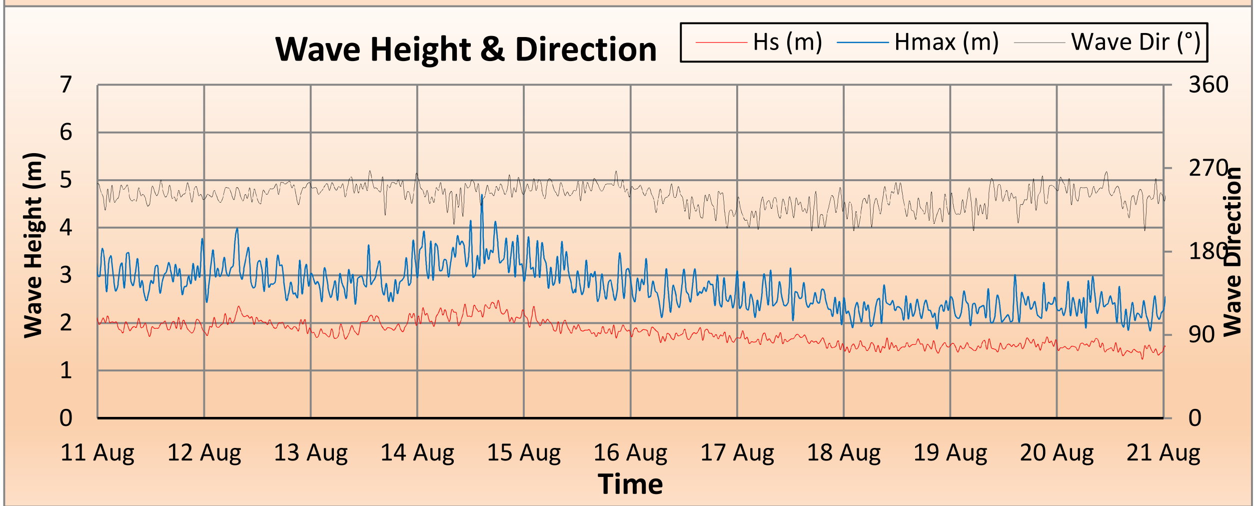


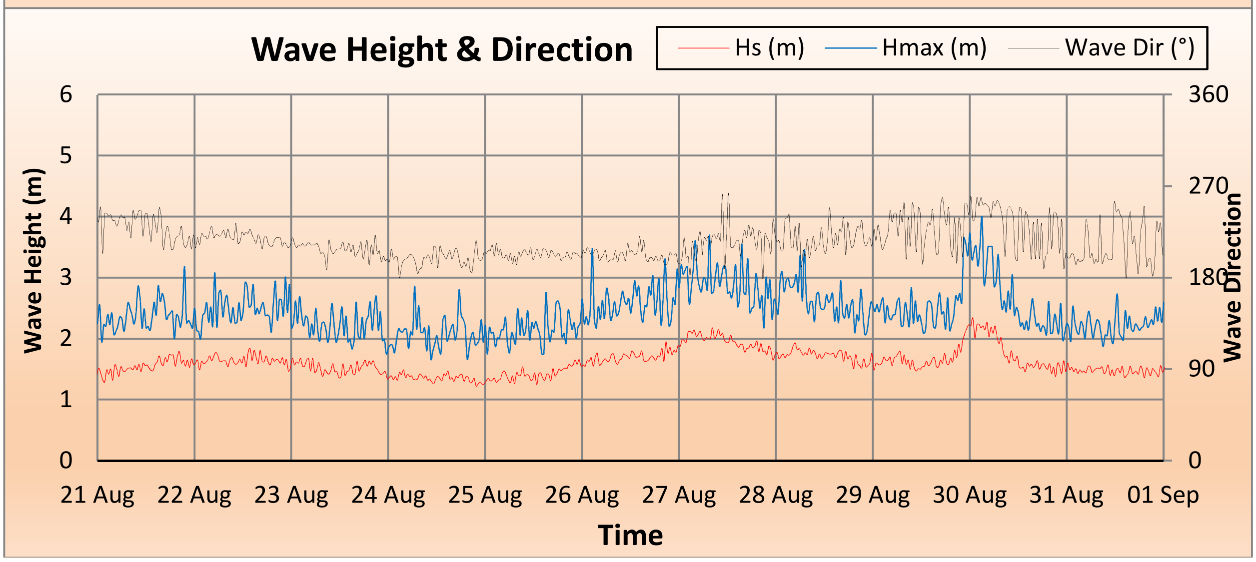
Figure 6-6: Histogram of wave period from 1st to 31st August 2019

① The above image indicates that during the period of observation, the wave period was in the range of 5 to more than 20 seconds, with 91% of the observations indicating long waves with a period of more than 10 seconds. The maximum period of 22.2 seconds was recorded on 21st August 2019 at 14:44, 16:44 and 17:44 hours. A period of 22.22 seconds was also recorded on 27th August 2019 at 01:14 hours.

The time series graphs for the period are provided below:







6.3 Measurement of Meteorological Parameters

① The data for the month of August 2019 was downloaded and after quality control checks, is presented below:

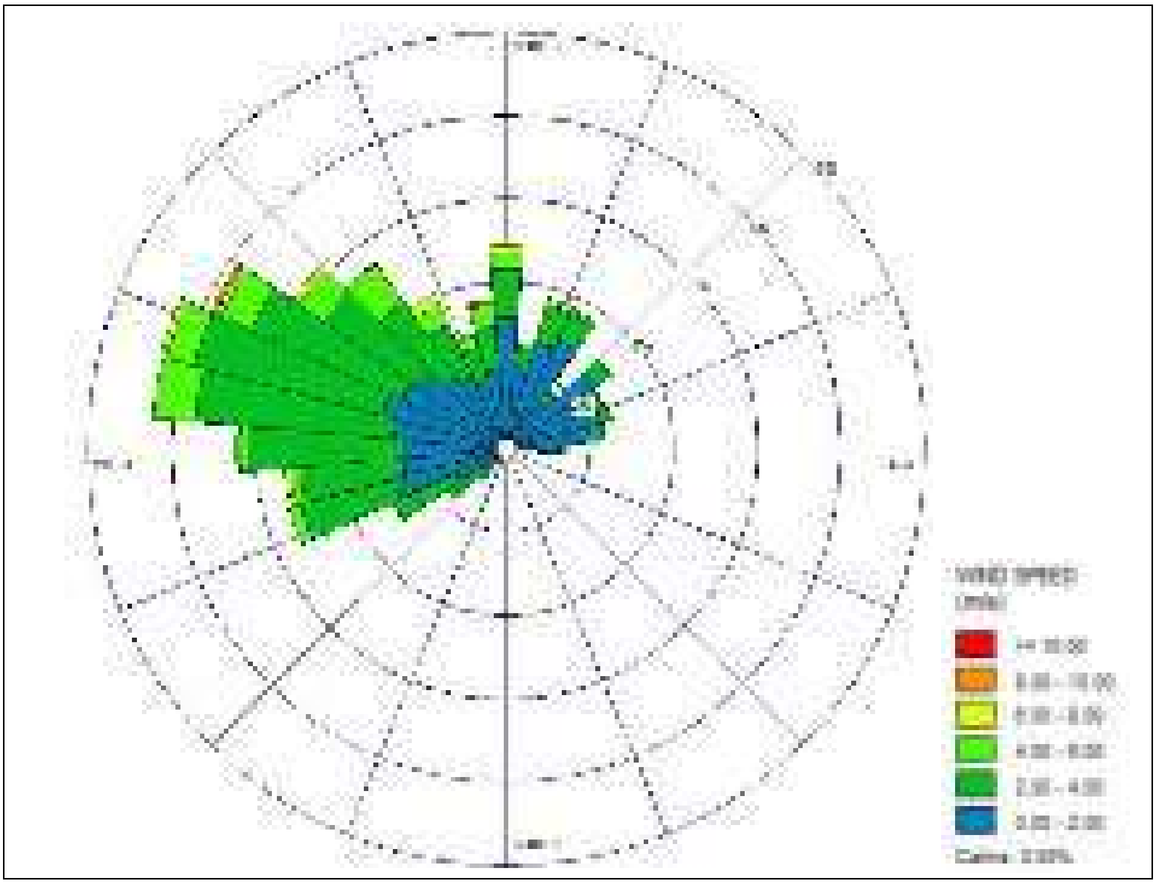


Figure 6-7: Wind rose (Speed in m/s vs direction) from 1st to 31st August 2019

The rose plot reveals south-westerly to north-northeasterly winds with velocities up to 9.4m/s.

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

Table 6-2: Frequency distribution of wind speed (1st to 31st August)

Frequency Distribution		
Wind Speed (m/s)	**No. of observations**	**Percentage of Occurrence**
0 - 2	2526	63.02
2 - 4	1209	30.16
4 - 6	232	5.79
6 - 8	37	0.92
8 - 10	4	0.10
>10	0	0.00
Total	**4008**	**100.00**

The histogram of wind speed for the period is provided below:

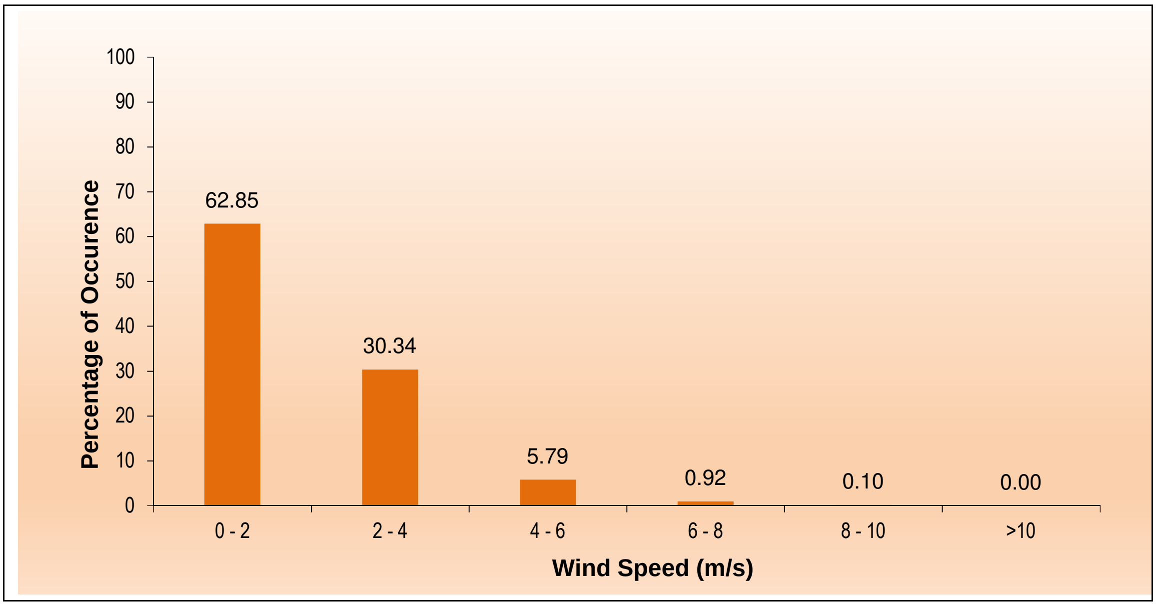


Figure 6-8: Histogram of wind speed from 1st to 31st August 2019

As can be seen from the above histogram, the winds were less than 9.5 m/s throughout the period. The maximum wind speed in the month of August 2019 was 9.34 m/s, recorded on 11th August 2019 at 17:10 hrs.

The percentage occurrence tables drawn for atmospheric pressure, temperature and relative humidity are presented below:

Table 6-3: Frequency distribution of Met parameters (1st to 31st August 2019)

Frequency Distribution		
Atm Pressure (mb)	**No. of observations**	**Percentage of Occurrence**
<1000	17	0.42
1000 - 1004	535	13.36
1004 - 1008	1722	43.01
> 1008	1730	43.21
Total	**4004**	**100.00**

Frequency Distribution		
Temperature (°C)	**No. of observations**	**Percentage of Occurrence**
20-24	234	5.85
24-28	2608	65.18
28-32	1157	28.92
>32	2	0.05
Total	**4001**	**100.00**

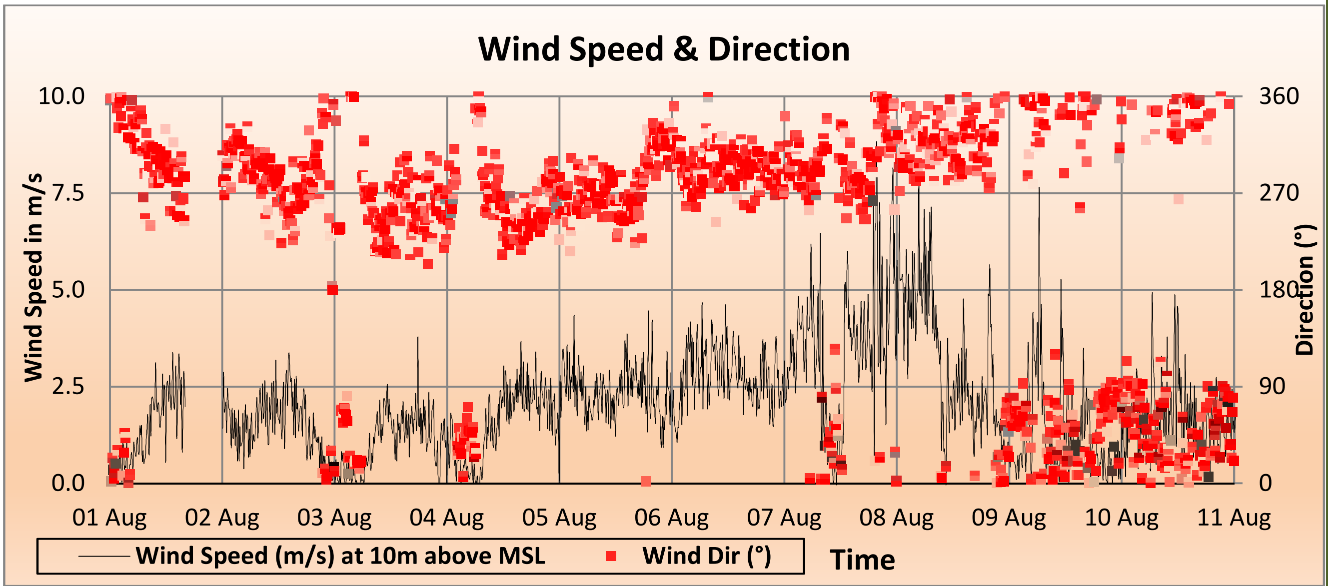
Frequency Distribution		
RH (%)	**No. of observations**	**Percentage of Occurrence**
50-60	0	0.00
60-70	16	0.40
70-80	594	14.83
>80	3396	84.77
Total	**4006**	**100.00**

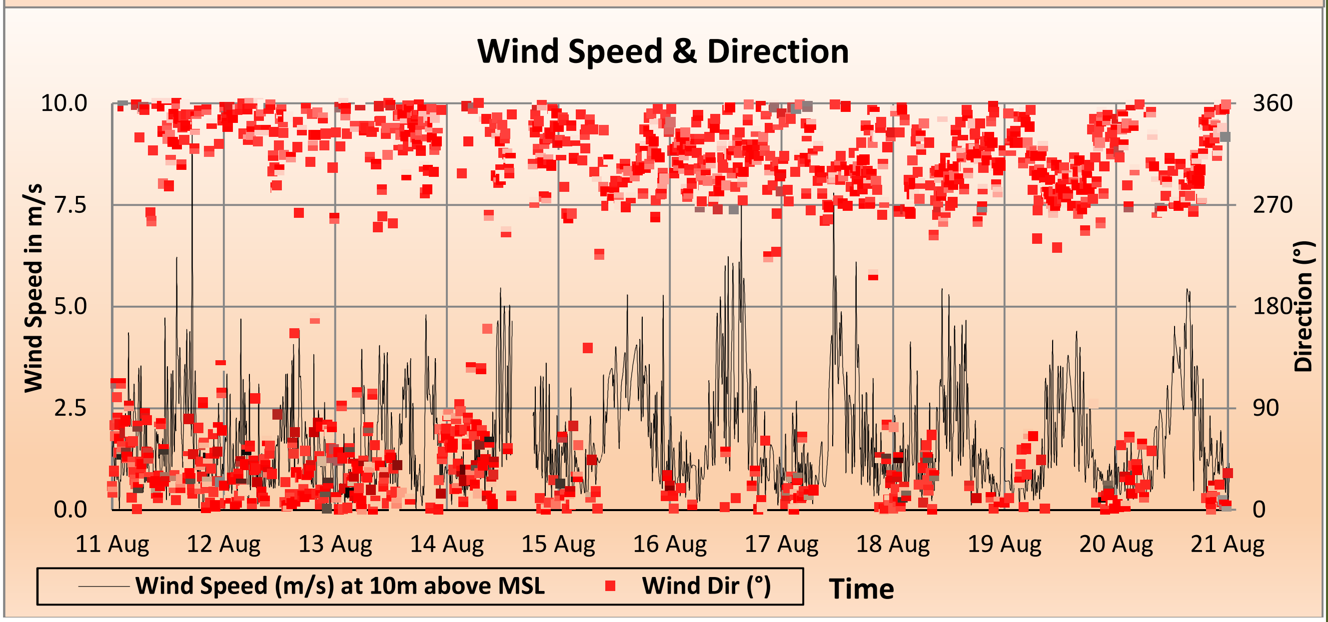
The histogram drawn for the parameters for the period is provided below:

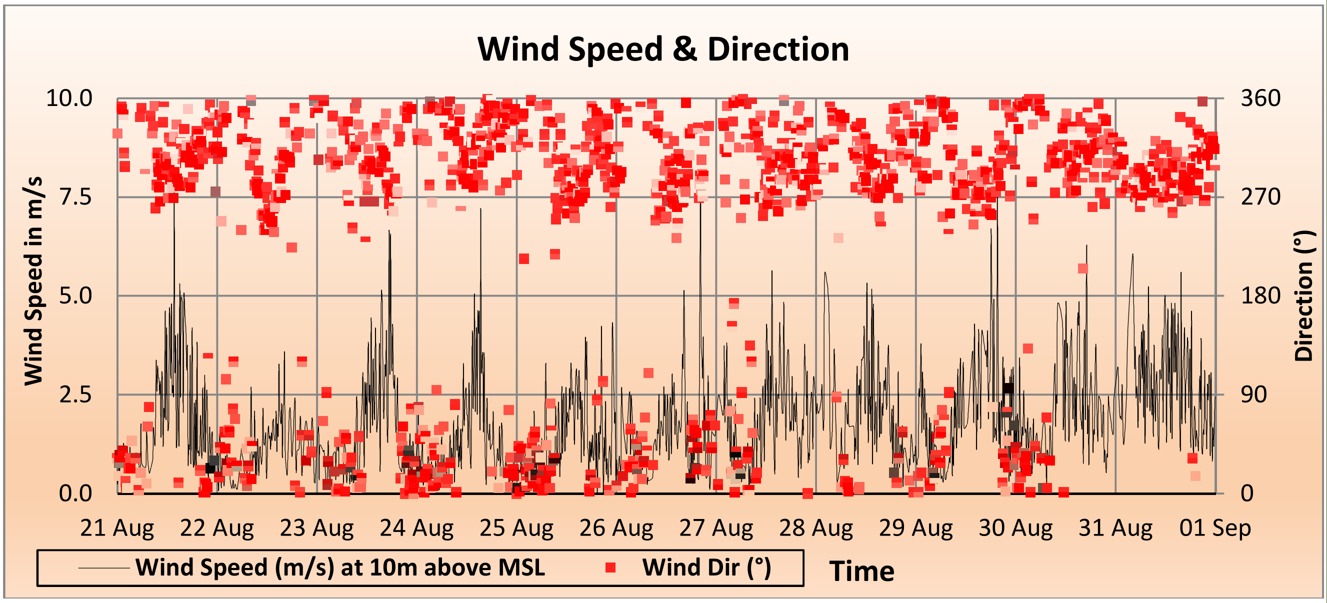
Figure 6-9: Histogram of Met parameters from 1st to 31st August 2019

① The data represented above reveals that about 99.5% of the atmospheric pressure recorded for the month was between 1000mb and 1004 mb. The temperature was between 21 to 33°C during the month. The relative humidity was greater than 80% during 84.7% of the observations indicating rainy conditions.

The time series graphs for the period are provided below:






Wind Speed & Direction
Wind Speed in m/s
10.0
7.5
5.0
2.5
0.0
Direction (°)
360
270
180
90
0
21 Aug
22 Aug
23 Aug
24 Aug
25 Aug
26 Aug
27 Aug
28 Aug
29 Aug
30 Aug
31 Aug
01 Sep
Wind Speed (m/s) at 10m above MSL
Wind Dir (°)
Time

6.4 Littoral Environment Observations

The LEO was carried out at 81 locations. The LEO plate was deployed at all the locations and the same was tracked for about five to ten minutes, as per the site conditions. The initial and final GPS positions were then used to calculate the SOG and COG. The estimated wave height, angle of wave, period and the stretch of breakers were also noted down in the log.

The along shore current was mainly towards the south during the period of monitoring. The maximum speed of 38.44 cm/s was observed at CSP-27. Rip currents were observed in the locations CSP 34, 41, 42, 43, 44, 45, 46, 47, 57, 58, 60, 62, 65, 66, 67, 69, 70, 74, 76, 80 and 81.

6.5 Photographic Documentation

Photographic documentation was carried out for all the 81 locations, coinciding with the cross-shore profiling. The photographs for the period are placed at Annexure I. As a common reference point, a 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. As the monsoon commenced, the beaches were almost inundated with sea water and vast stretches of the shoreline were engulfed by waves.
Few photographs of location where the beaches were not present during the season, are given below for reference:


Figure 6-10 – CSP 10 (Pozhiyoor)

Figure 6-11 – CSP 47 (Samudra Beach, Kovalam)

6.6 Cross Shore Profiles

The cross-shore profiling for the period was carried out using RTK in the onshore region. Except for CSP-35 (Azhimala area) where there was no beach, all onshore locations were carried out.

The offshore profiling could not be carried out during the month of August 2019, due to rough weather conditions. The offshore activities shall commence by mid-September 2019.

The following table provides the identification of CSP vis-à-vis the local name:

Table 6-4: CSP Location names

CSP NO.	LANDMARK	LOCATION
CSP-01	CATHOLIC CRISMATIC PRAYER CENTER	EDAPPADU BEACH
CSP-02		
CSP-03		
CSP-04	ST. MARY'S CHURCH	VALLAVILAY
CSP-05		
CSP-06		
CSP-07	ST. NICOLAS' CHURCH	NEERODY
CSP-08		
CSP-09		
CSP-10	SREE BHADRAKALI TEMPLE	POZHIYOOR
CSP-11		
CSP-12		
CSP-13	ST. MATHEW'S CHURCH	PARUTHIYOOR
CSP-14	CHURCH OF CHRIST	
CSP-15	POOVAR ISLAND RESORT	POOVAR BEACH SOUTH
CSP-16		
CSP-17		
CSP-18	POZHIKARA BEACH	POOVAR
CSP-19		
CSP-20	ST. ANTONY'S CHAPEL	POOVAR BEACH NORTH
CSP-21		
CSP-22	ST. ANTONY'S CHURH	KARUMKULAM
CSP-23		
CSP-24		
CSP-25		
CSP-26		
CSP-27	GOTHAMBU ROAD	PULLUVILA
CSP-28		
CSP-29		
CSP-30		
CSP-31	ADIMALATHURA CATHOLIC CHURCH	ADIMALATHURA
CSP-32		
CSP-33		
CSP-34		
CSP-35	AZHIMALA TEMPLE	AZHIMALA
CSP-36	NAGAR BHAGAVATHY TEMPLE	MULLUR
CSP-37		

CSP NO.	LANDMARK	LOCATION
CSP-38	ADANI PORT RECLAMATION AREA	ADANI PORT OFFICE VIZHINJAM
CSP-39		
CSP-40		
CSP-41	VIZHINJAM LIGHT HOUSE	KOVALAM
CSP-42		
CSP-43		
CSP-44		
CSP-45		
CSP-46		
CSP-47	SAMUDRA BEACH PARK	KOVALAM
CSP-48	MOSQUE	PANATHURA
CSP-49		
CSP-50	PANATHURA TEMPLE	PANATHURA
CSP-51		
CSP-52		
CSP-53	PUNTHURA FISH MARKET	PUNTHURA
CSP-54		
CSP-55		
CSP-56		
CSP-57		
CSP-58	BEEMA PALLY	BEEMA PALLY
CSP-59		
CSP-60		
CSP-61	CHERIYATHURA SPORTS GROUND	CHERIYATHURA
CSP-62		
CSP-63	VALIYATHURA BRIDGE	VALIYATHURA
CSP-64		
CSP-65		
CSP-66		
CSP-67		
CSP-68	SHANGUMUGHAM BEACH	SHANGUMUGHAM
CSP-69		
CSP-70	ST. PETER’S CHURCH	SHANGUMUGHAM
CSP-71		
CSP-72	VETTUCAUD CHURCH	VETTUCAUD
CSP-73		
CSP-74		
CSP-75	VELI CHILDRENS PARK	KOCHUVELI
CSP-76		
CSP-77		

CSP NO.	LANDMARK	LOCATION
CSP-78	ST. THOMAS’ CHURCH	VALIYA VELI
CSP-79		
CSP-80	CHRISTIAN BROTHEREN CHURCH	THUMBA
CSP-81		

7 OVERALL PROGRESS

Up to 31st August 2019, the following image provides the overall progress chart.

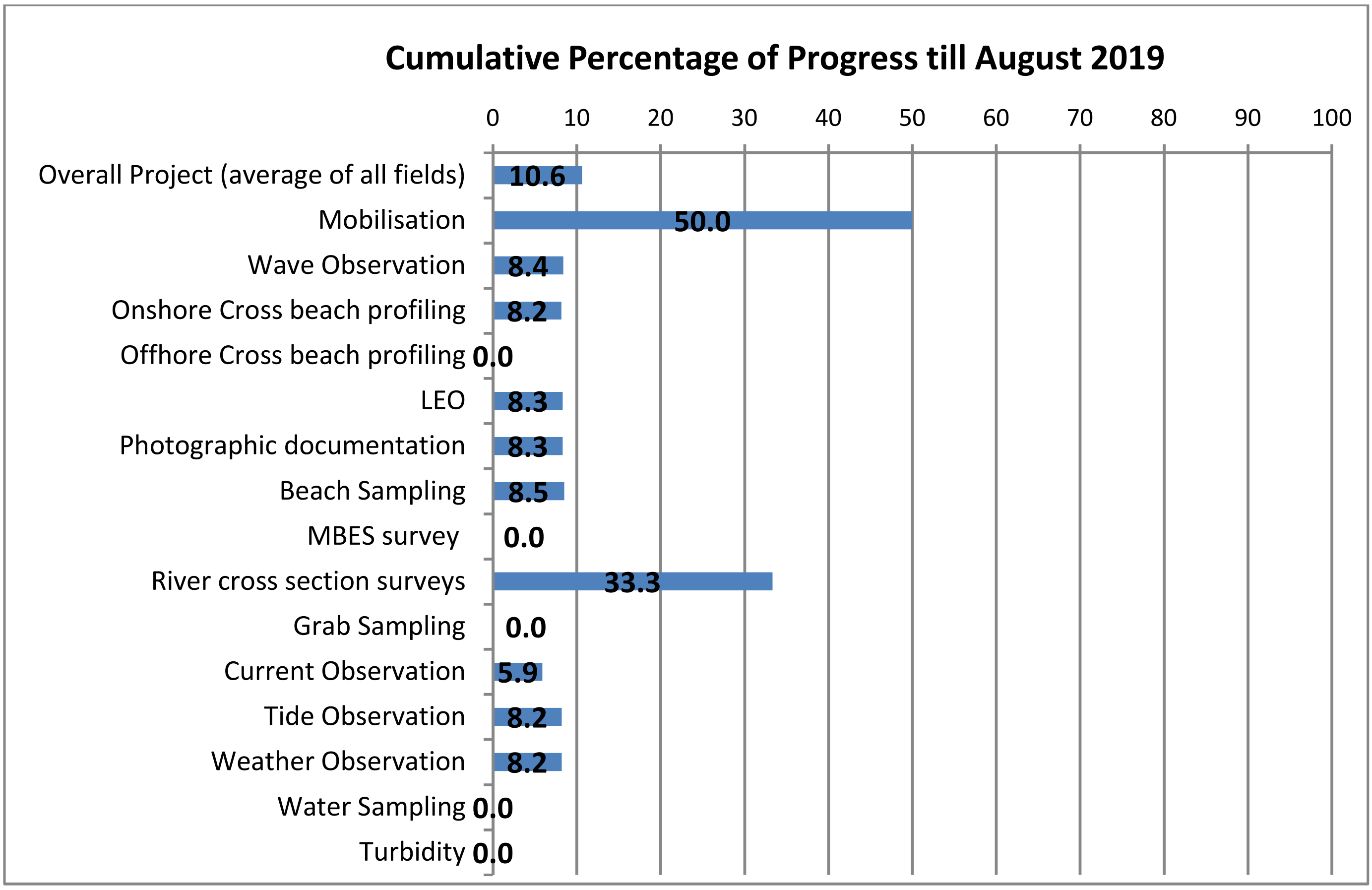


Figure 7-1: Overall Progress Chart

The above calculation is based on number of observations for 3 years. Since the turbidity buoys are not mobilised, the field is shown as 50%.

8 WEATHER

During the survey period, the monsoon was in full swing and the sea was rough to carry out any offshore works. The offshore cross shore profiles could not be carried out due to rough sea conditions, considering the safety of personnel and equipment.

9 REFERENCES

The following documents/web sites were referenced during the preparation of the report.

- AVPPL Service order 5700267194 dated 3rd May 2019
- Web site https://www.vizhinjamport.in/home.html, and https://www.vizhinjamport.in/download/Feasibility-Report.pdf
- WMO manual, section 5.2.2
- SAC Project Execution Plan SAC/P167-19/PEP AVPPL
- Periodic survey reports till July 2019

10 CONCLUSIONS

The following conclusions were made during this phase of the project:

1. Tide was mixed semi diurnal with a maximum range of 0.86 m during spring tide.
2. The wave heights were less than 3m with winds of up to 9.3 m/s blowing from north-westerly direction.
3. The long-shore transport was recorded in a southerly direction, with maximum velocity of about 38.44 cm/s recorded at CSP-27.

11 ACKNOWLEDGEMENTS

During the course of project, the support received from AVPPL staff is highly appreciated and acknowledged. The guidance received throughout the project from NIOT scientists are also hereby appreciated. The boat crew and all others, who had supported us during the project is also acknowledged.

Annexure I

Photo Documentation at CSP Locations – August 2019

Figure 01:- August CSP 01

Figure 02:- August CSP 02

Figure 03:- August CSP 03

Figure 04:- August CSP 04

Figure 05:- August CSP 05

Figure 06:- August CSP 06

Figure 07:- August CSP 07

Figure 08:- AUGUSTCSP 08

Figure 09:- August CSP 09

Figure 10:- August CSP 10




Figure 11:- August CSP 11

Figure 12:- August CSP 12

Figure 13:- August CSP 13

Figure 14:- August CSP 14

Figure 15:- August CSP 15

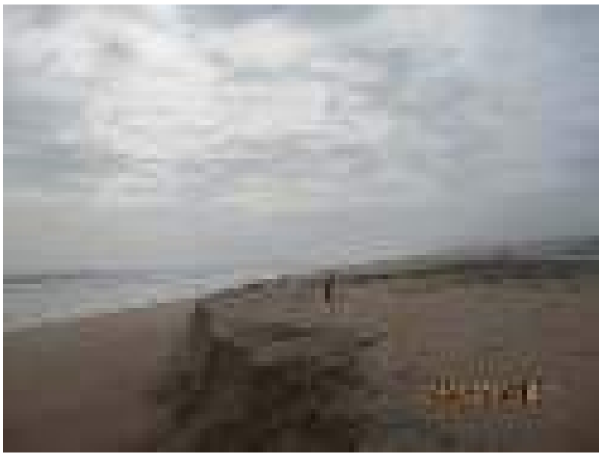
	
	

Figure 16:- August CSP 16

Figure 17:- August CSP 17

Figure 18:- August CSP 18

Figure 19:- August CSP 19

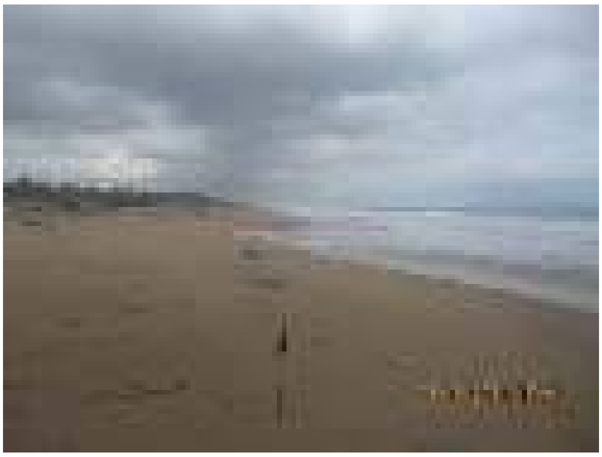
	
	

Figure 20:- August CSP 20

Figure 21:- August CSP 21

Figure 22:- August CSP 22

Figure 23:- August CSP 23

Figure 24:- August CSP 24

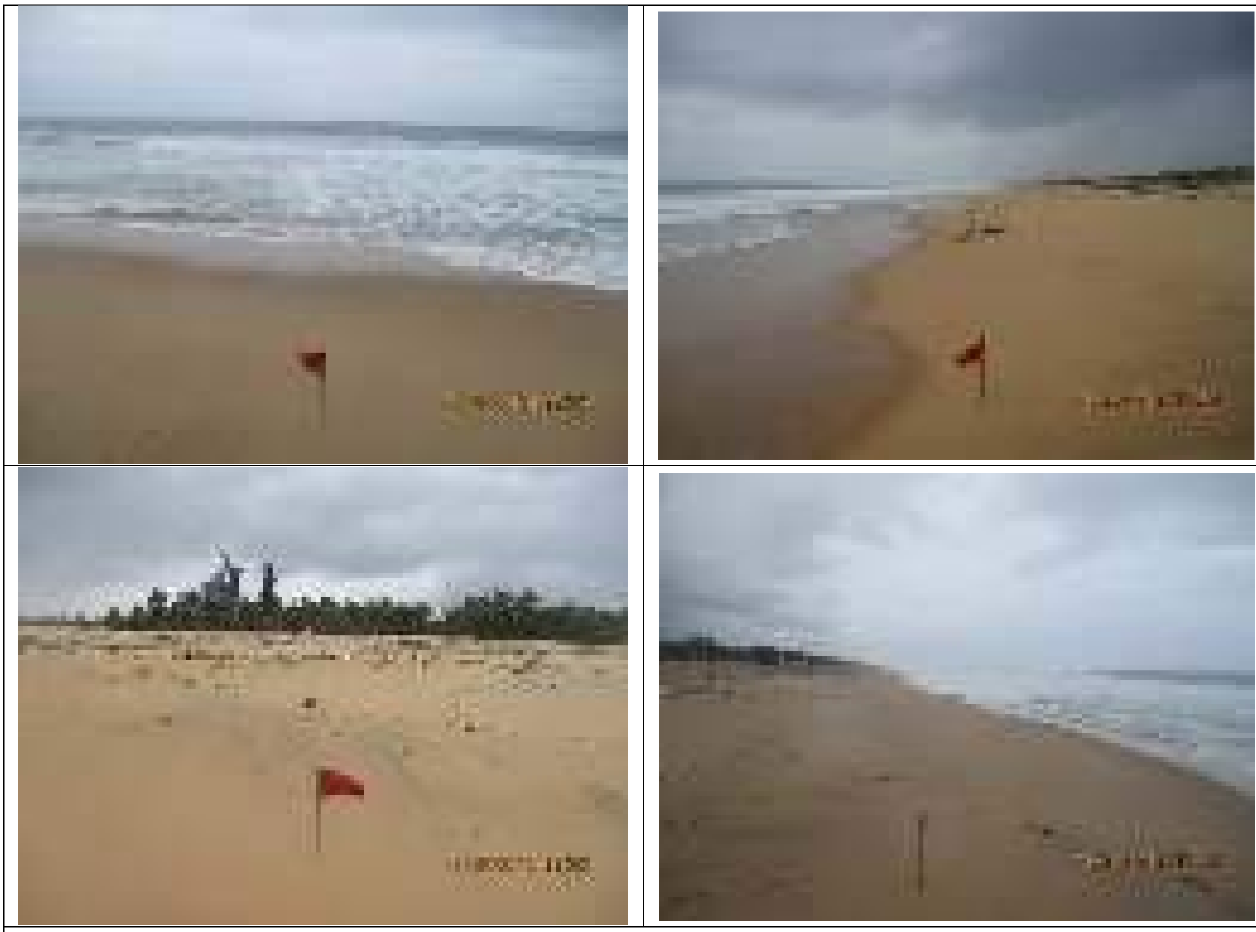


Figure 25:- August CSP 25

Figure 26:- August CSP 26

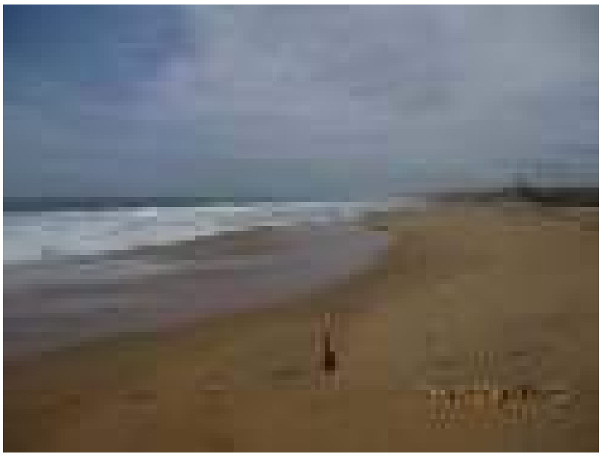
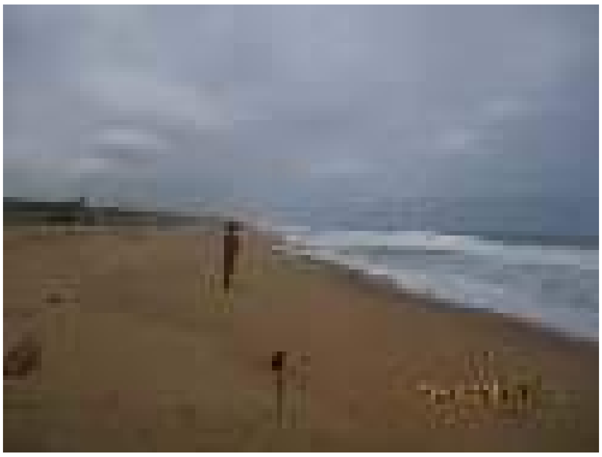
	
	

Figure 27:- August CSP 27

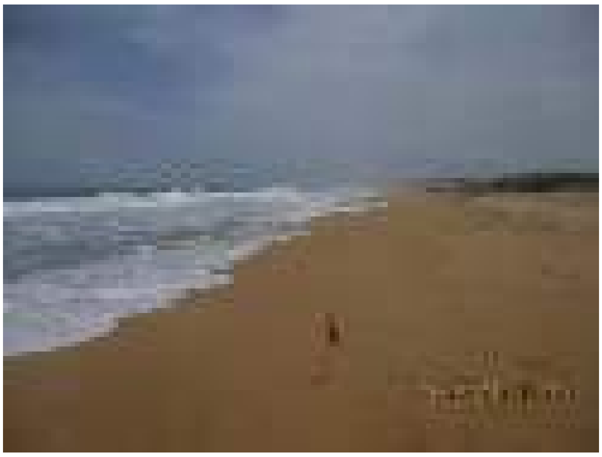


Figure 28:- August CSP 28

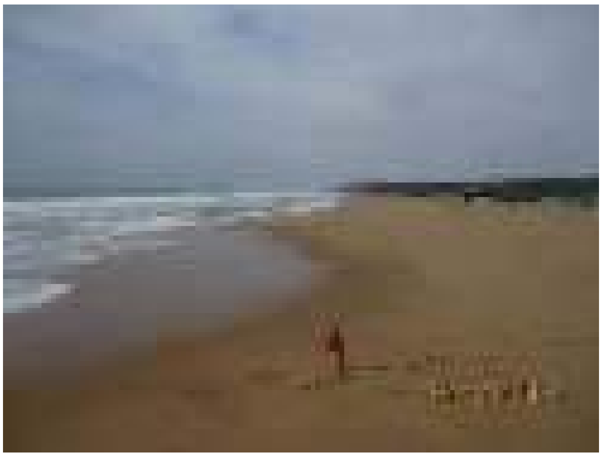



Figure 29:- August CSP 29

Figure30:- August CSP 30

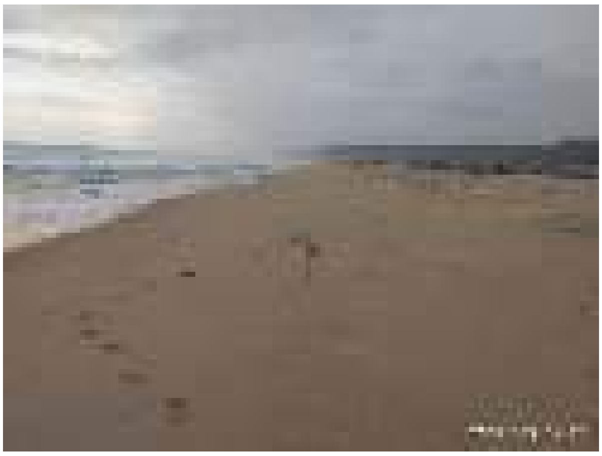
	
	

Figure31:- August CSP 31

Figure32:- August CSP 32

Figure33:- August CSP 33

Figure34:- August CSP 34

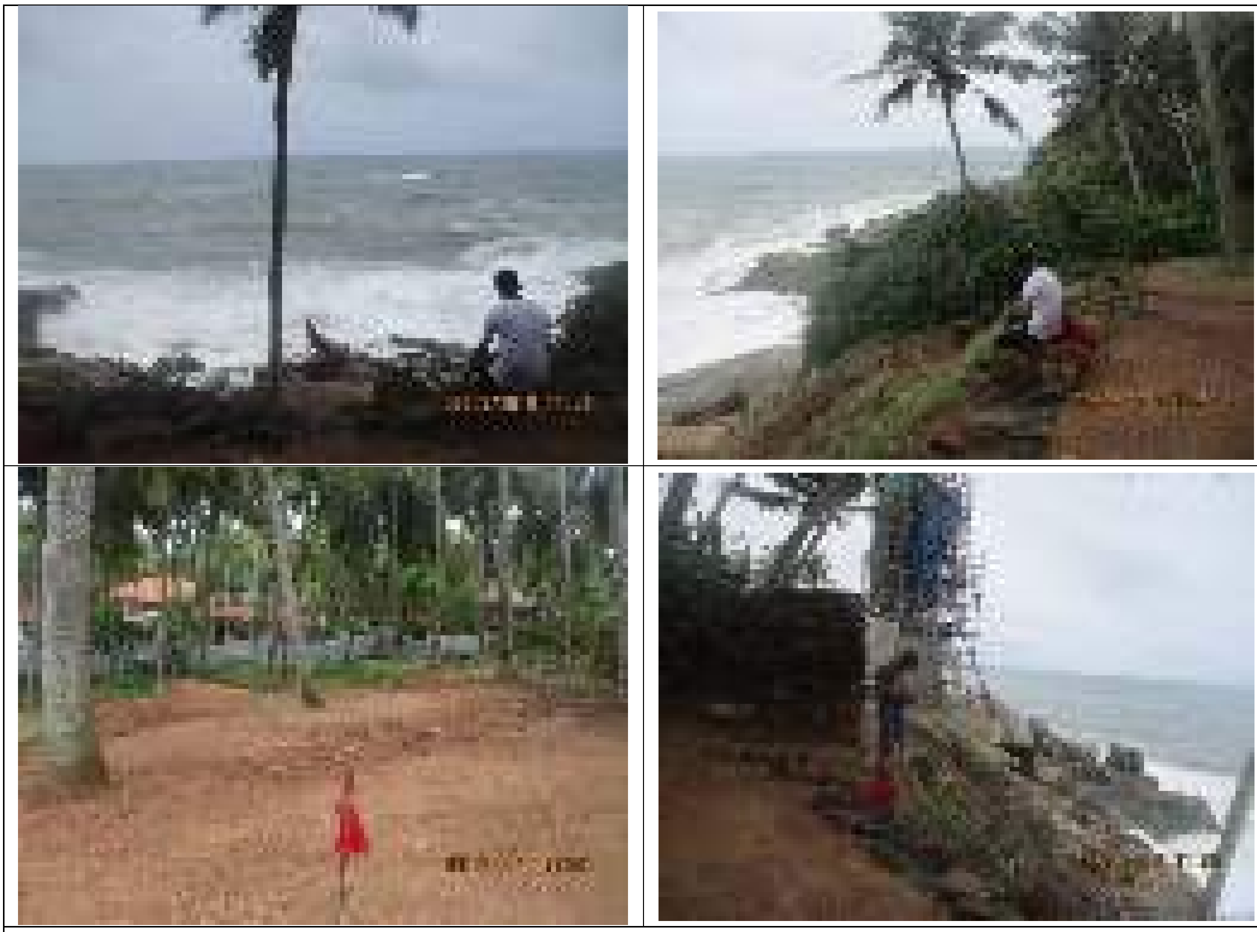


Figure35:- August CSP 35

Figure36:- August CSP 36

Figure37:- August CSP 37

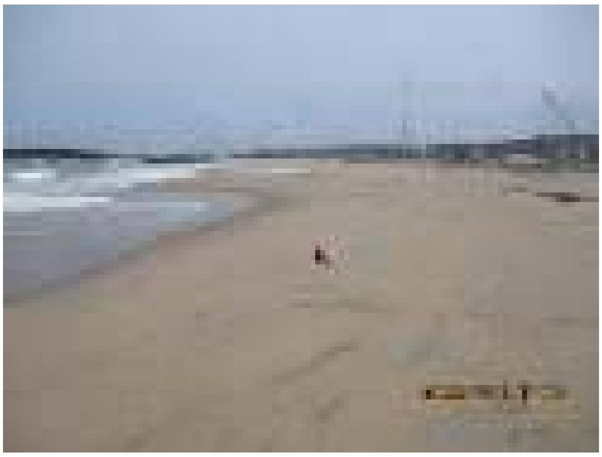
	
	

Figure38:- August CSP 38

Figure39:- August CSP 39

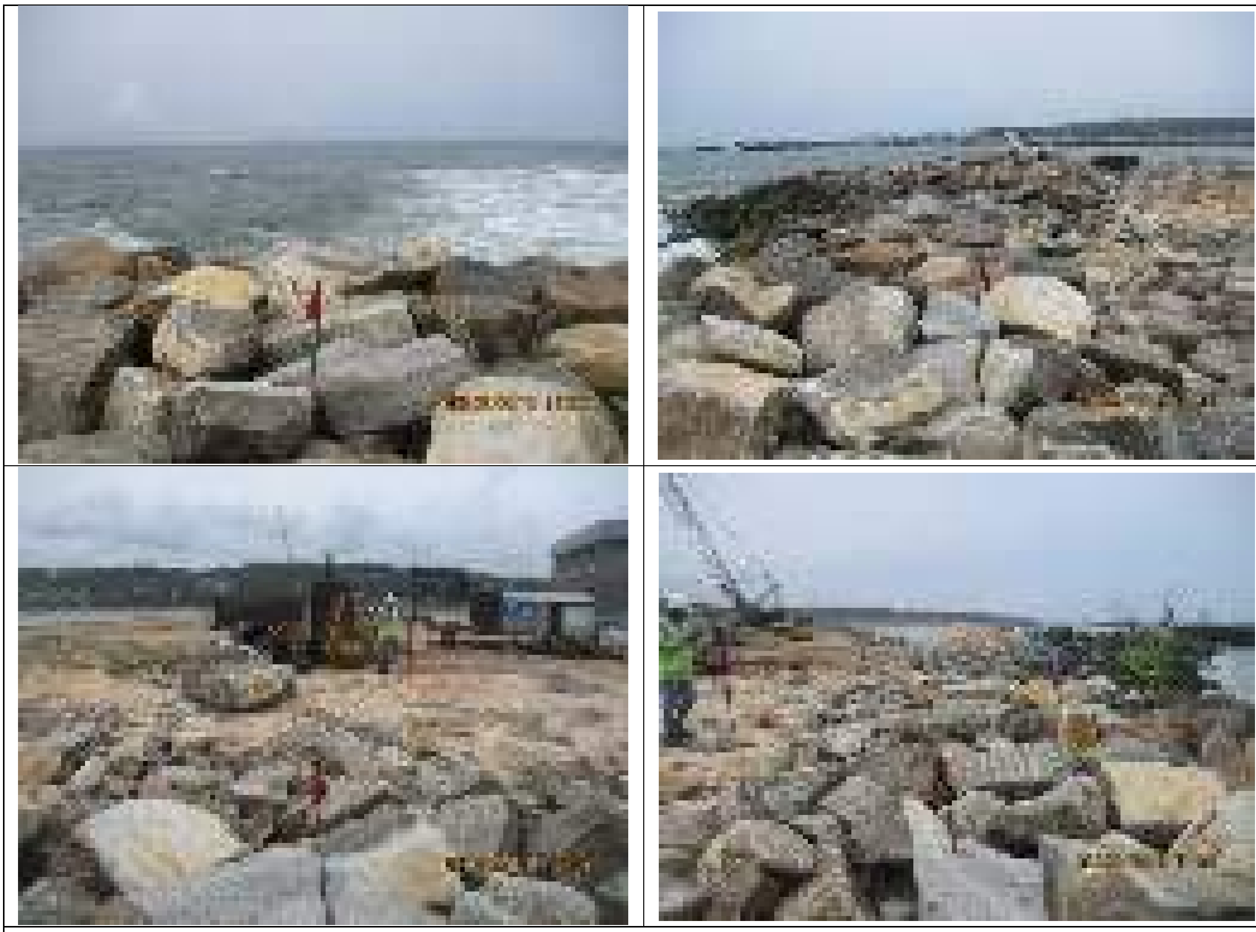


Figure40:- August CSP 40

Figure 41:- August CSP 41

Figure 42:- August CSP 42

Figure 43:- August CSP 43




Figure44:- August CSP 44

Figure45:- August CSP 45

Figure 46:- August CSP 46

Figure 47:- August CSP 47

Figure 48:- August CSP 48

Figure 49:- August CSP 49

Figure 50:- AUGUSTCSP 50

Figure 51:- August CSP 51

Figure 52:- August CSP 52

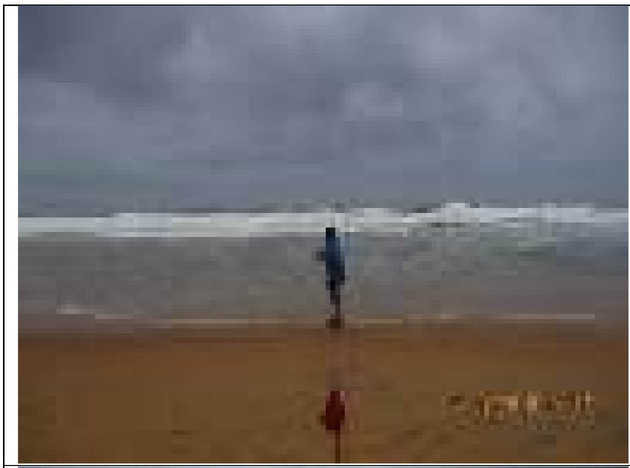
	
	

Figure 53:- August CSP 53

Figure 54:- August CSP 54

Figure 55:- August CSP 55

Figure 56:- August CSP 56

Figure 57:- August CSP 57

Figure 58:- August CSP 58

Figure 59:- August CSP 59

Figure 60:- August CSP 60

Figure 61:- August CSP 61

Figure 62:- August CSP 62

Figure 63:- August CSP 63

Figure 64:- August CSP 64

Figure 65:- August CSP 65

Figure 66:- August CSP 66

Figure 67:- August CSP 67

Figure 68:- August CSP 68

Figure 69:- August CSP 69

Figure 70:- August CSP 70

Figure 71:- August CSP 71

Figure 72:- August CSP 72

Figure 73:- August CSP 73

Figure 74:- August CSP 74

Figure 75:- August CSP 75

Figure 76:- August CSP 76

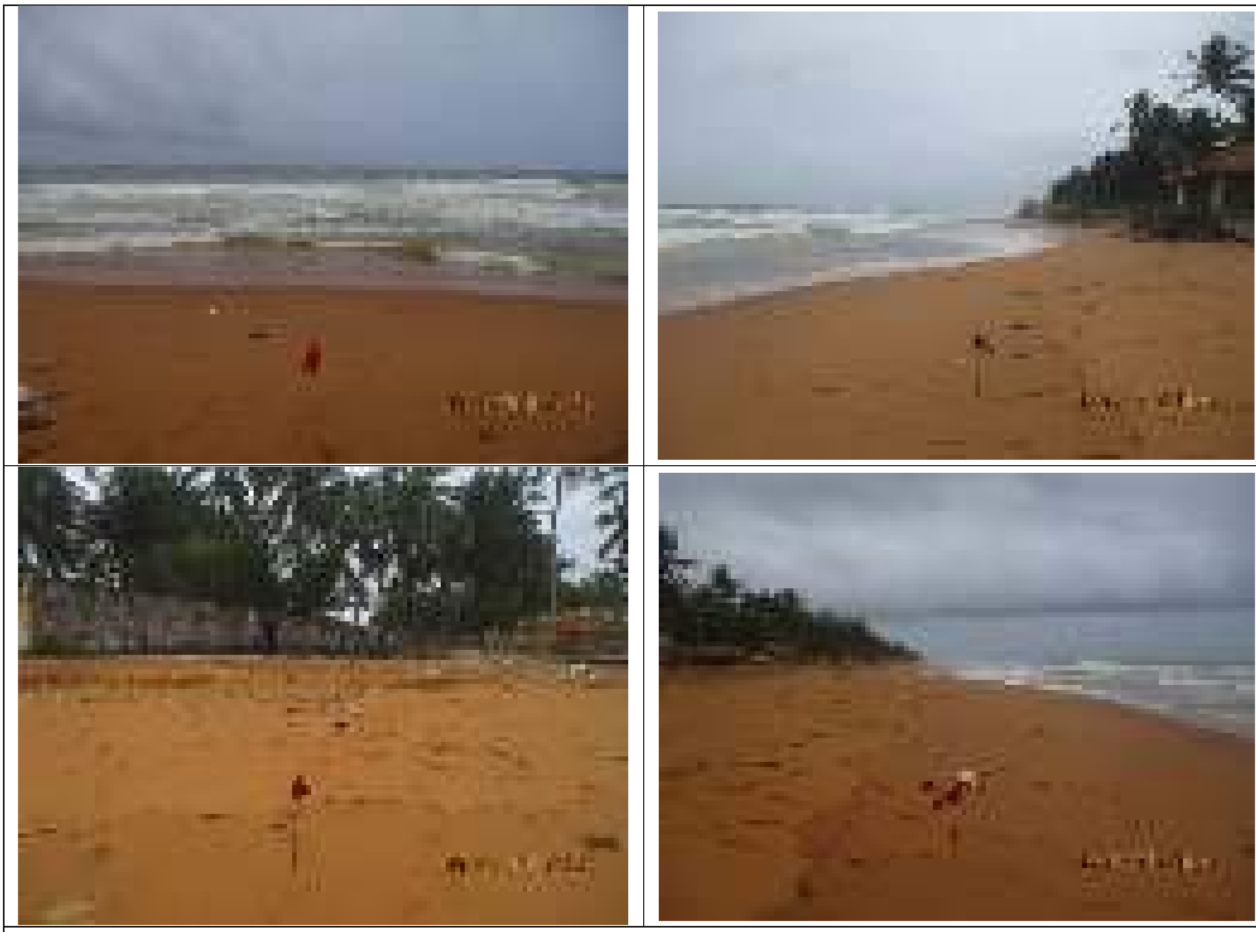


Figure 77:- August CSP 77

Figure 78:- August CSP 78

Figure 79:- August CSP 79

Figure 80:- August CSP 80

Figure 81:- August CSP 81

Adani Vizhinjam Port Pvt. Ltd

OCEANOGRAPHIC AND BATHYMETRIC DATA COLLECTIONFOR ASSESSMENT OF SHORELINECHANGES

Shankar And Co.
115, Neco Chambers
CBD Belapur
Navi Mumbai – 400 614

Date: 23rd November 2019

SAC Ref #: SAC/P167-19/PSR-4
Rev 1

PERIODIC SURVEY REPORT – PSR4 (SEPTEMBER 2019)

"APPROVAL SHEET"

Prepared by:	*Signed*	*Date*
V Mehta		*22/10/2019*

Checked by:	*Signed*	*Date*
S Cherian		*22/10/2019*

Approved by:	*Signed*	*Date*
S Philip		*22/10/2019*

REVISION CONTROL

Date	Rev	Section / Page No.	Remarks
22/10/2019	0		Submitted for approval
23/11/2019	1	Sec 1, Pg 7	Changed 'limited' to 'Limited'
		Sec 2, Pg 8	Space added between 'and' and 'GoK'
		Sec 3, Pg 11	Removed 'as provided in the RFQ and' in the Scope of Work
		Sec 5.1, Pg 22	Changed 'Shankar And Co' to 'SAC'
		Sec 5.2, Pg 25	Changed 'at an interval of 1m' to 'at every 1m bin'
		Sec 5.4, Pg 32	Added 'Rain Gauge'
		Sec 6.2, Pg 42	Space added between ')' and 'was'
		Sec 6.2, Pg 43	Changed '5' to '4' in Table 6.1
		Sec 6.2, Pg 45	Added space between '7.5' and '20'
		Sec 6.3.1, Pg 50	Added dashes in Table 6-2
		Sec 6.3.1, Pg 51	Changed 'Frequency' to 'Percentage' in Table 6-3
		Sec 6.3.1, Pg 51	Added 'x-axis' in paragraph
		Sec 6.3.2, Pg 55	Changed 'Frequency' to 'Percentage' and added dashes in Table 6-4
		Sec 6.3.3, Pg 58	Changed time from 23:15 to 23:10

		Sec 6.3.3, Pg 60	Changed 'Frequency' to 'Percentage' in Table 6-6 and added dashes
		Sec 6.3.4, Pg 65	Changed 'Frequency' to 'Percentage' in Table 6-8 and added dashes, extra row removed
		Sec 6.3.4, Pg 66	Removed extra row in Table 6-9
		Sec 6.4, Pg 68	Changed '7.9' to '7.87' m/s
		Sec 6.4, Pg 72 and 73	Changed temperature and atmospheric pressure values, individual histograms for meteorological parameters
		Sec 6.6, Pg 74	Changed CSP location from CSP-10 to CSP-50
		Sec 6.8, Pg 79	Details of BS-31 and BS-32 added in Table 6-13, total beach samples collected are 62
		Sec 6.8, Pg 80	Figure 6-36 updated
		Sec 10, Pg 82	Correction made in point 2

Table of Contents

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Annexure I – Photo Documentation of CSP Locations

ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
APHA	American Public Health Association Guidelines
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
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
IS 1498	Indian Standard for Classification and Identification of Soils for General Engineering Purposes
IS 3025	Indian Standard or Methods of Sampling and Test for Water and Wastewater Part 1 - Sampling
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
Mg/L	Milligram per litre
MoEF	Ministry of Environment & Forests

MoU	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
NTU	Nephelometric Turbidity Units
PEP	Project Execution Plan
PVD	Progressive vector diagram
PPP	Public Private Partnership
ppt	Parts per Thousand
RTK	Real Time Kinematics
SAC	Shankar And Co.
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

DEFINITIONS

Project Owner	Vizhinjam International Seaport Ltd (VISL), Thiruvananthapuram
Project Concessionaire	Adani Vizhinjam Port Pvt. Ltd. (AVPPL), Thiruvananthapuram
Advisor to VISL	National Institute of Ocean Technology (NIOT), Chennai
Survey Contractor	Shankar And Co. (SAC), Navi Mumbai
Survey Requirement	Oceanographic & Bathymetric Survey for Shoreline Monitoring
Chart Datum	Chart datum is the level to which soundings on 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 a water body moves in the ocean. The speed is denoted in cm/s
Rip Current	A relatively strong, narrow current flowing outward from the beach through the surf zone
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 in m/s
Wind Direction	Wind direction is an indicator of the direction that the wind is **blowing 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
Turbidity	Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air.

1 EXECUTIVE SUMMARY

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

Vizhinjam International Seaport Ltd (VISL) - a company fully owned by GoK is the implementing agency for the project, will be responsible for all obligations and responsibilities of GoK 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 (MoES), for a long-term shoreline monitoring programme including the seasonal bathymetry mapping.
(Source: https://www.vizhinjamport.in/home.html)

Shankar And Co, hereinafter referred to as SAC, based in Navi Mumbai 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 5700267194 dated 3rd May 2019 by AVPPL.

As part of the study, NIOT provided a wave rider buoy to be deployed off Mulloor and the data and watch & ward of the buoy was to be monitored by SAC.

As part of the contract, turbidity measurements at three locations from three levels is to be monitored on a real time basis from October 2019.
This report provides the results of the data collected from 1st to 30th September 2019.

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

The proposed project is being developed as a PPP project on a DBFOT basis in accordance with the terms and conditions set forth in the concession agreement signed between AVPPL and GoK/VISL. 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 & equipment) will be shared on PPP basis availing Viability Gap Funding (VGF). The PPP concessionaire, AVPPL has been given the right to operate the port 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 is located at the southern tip of India, barely 10 nautical miles from the international sea route (Suez – Far East route & Far East – Middle East route), it has the potential to become the future trans-shipment hub of the country.
(Source : https://www.vizhinjamport.in/download/Feasibility-Report.pdf)

The study includes carrying out MetOcean observations (wave, meteorological parameters and tide) at one location, to measure current for 30 days each, at four locations, during 3 different seasons; summer (Mar-May), monsoon (June-Oct), and post monsoon (Nov-Feb), to measure in real-time turbidity from three levels and three locations, bathymetric survey of up to 20m contour in two seasons, cross-shore profiling from 10m CD (4 CSP lines to be carried out up to a depth of 20m during the months of January, May, August and October) to 100m inland from the high water line along a stretch of 40 km, water & grab sampling, littoral environmental observation and river crossing survey. All these are to be carried out for a period of 3 years commencing June 2019.

A Google Earth image, showing the Multibeam survey area; locations of the observations, including the wave/current, tide and AWS measurement location, is given in Figure 2-1. The cross-shore profile lines, the LEO points and photographic documentation points are shown in Figure 2-2.

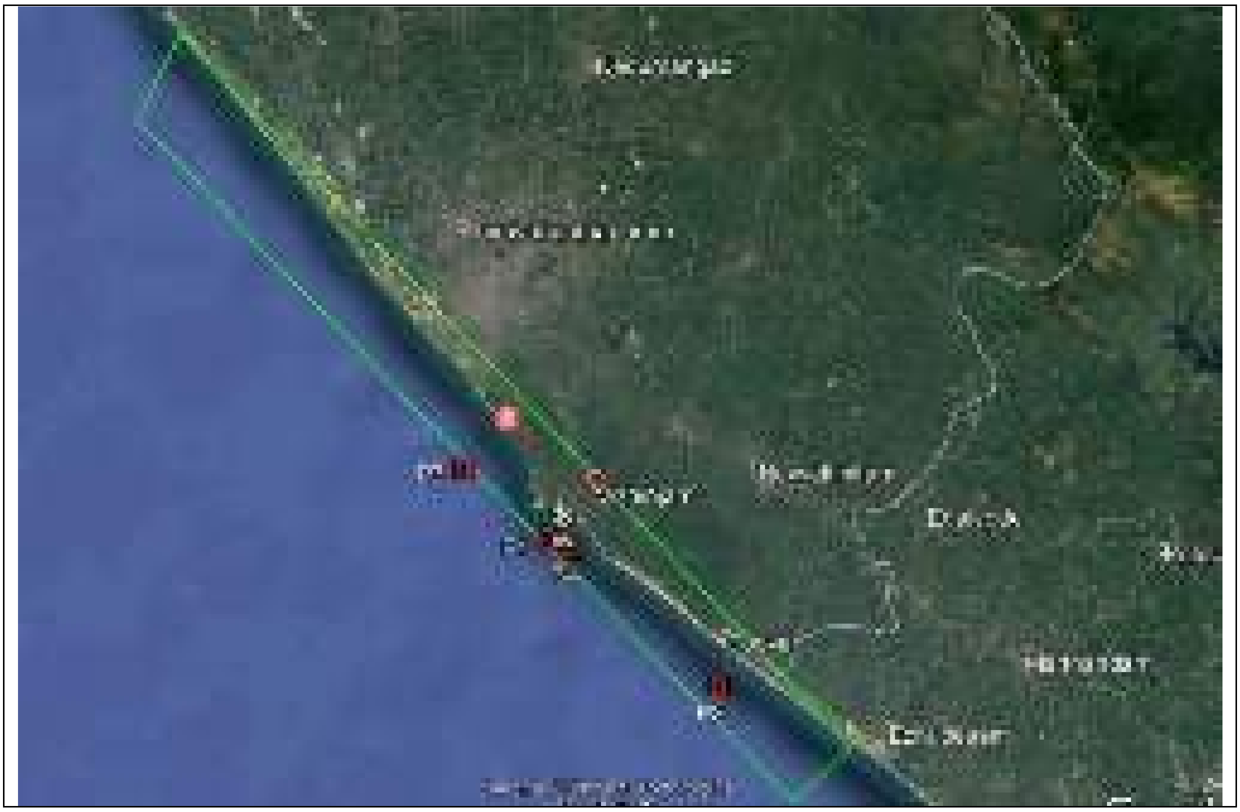


Figure 2-1: General Survey Location

P1, P2 and P3 correspond to ADCP locations and P4 corresponds to both, ADCP and wave location.

The cross-shore profiling (CSP) lines, which coincides with the LEO, beach sampling and photographic documentation, 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 to the south of the existing Vizhinjam Harbourand gradually increases progressing towards north for the entire 40 km stretch (20 km on either side of the port) with a 500 m interval between each CSP line.

Figure 2-2: CSP, LEO and Photographic Documentation Locations

3 SCOPE OF WORK

The survey scope of work as per the contract includes 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 shoreline.
- 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 (4 CSP Lines will be carried out up to a depth of 20 m in the months of January, May, August and October).
- 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 2-1, 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 on 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.

- Collection of wind speed & direction, atmospheric pressure, humidity, temperature at 1 location specified by the client/EIC by establishing an automatic weather station.
- Continuous monitoring of turbidity at 3 location (1 upstream & 2 downstream of dredging location) - Online meter (3 levels) to be installed on buoys and data to be displayed at system in office.
- Analysis and processing of the data and submission of periodic reports in soft & hard copies.

3.1 Location Coordinates

The location co-ordinates provided by the client for the current and wave observations are given below:

Table 3-1: Current / Wave locations

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	22.1
ADCP- P2 (Poovar)	08° 17' 35.8"N	77° 04' 03.5"E	23.1
ADCP- P3 (Pachalloor)	08° 24' 08.6"N	76° 56' 16.1"E	21.9
ADCP/Wave - P4 (Mulloor)	08° 21' 42.3"N	76° 59' 33.9"E	22.9

The current observations are to be carried out for 30 days in each of the seasons at the above locations. The ADCP's were deployed on 16th August 2019 and recovered on 16th September 2019 after 30 days of data collection.

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

Table 3-2: Tide station location coordinates

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	3.447

A Gill Maximet weather station was replaced with the Gill Metpack weather station with rain gauge on 18th September 2019 which was installed at the Ayur Bay Resort and the coordinates are provided in the table below:

Table 3-3: Weather station location coordinates

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

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 10m above MSL.

3.2 Beach and Water Sampling

A total of 81 beach are to be collected in three seasons, as part of the contract. During monsoon 2019, 62 samples could be collected since other locations were not approachable due to lack of beach. The samples were analysed as per IS 1498 for grain size distribution.

The co-ordinates of beach samples are provided in the following table:

Table 3-4: Beach Sampling Locations

BEACH SAMPLING LOCATIONS WGS-84, UTM Projection, CM 75° East, Zone 43, North		
Location	**Latitude**	**Longitude**
BS-1	8° 16.0265’ N	77° 7.9532’ E
BS-2	8° 16.1775’ N	77° 7.7195’ E
BS-3	8° 16.3348’ N	77° 7.4987’ E
BS-4	8° 16.4955’ N	77° 7.2778’ E
BS-5	8° 16.6565’ N	77° 7.0579’ E
BS-6	8° 16.8176’ N	77° 6.8379’ E
BS-7	8° 16.9782’ N	77° 6.6187’ E
BS-8	8° 17.1382’ N	77° 6.398’ E
BS-9	8° 17.2984’ N	77° 6.1765’ E
BS-10	8° 17.4586’ N	77° 5.9566’ E
BS-11	8° 17.6207’ N	77° 5.7379’ E
BS-12	8° 17.7276’ N	77° 5.5946’ E
BS-13	8° 17.8899’ N	77° 5.3756’ E
BS-14	8° 18.0524’ N	77° 5.1568’ E
BS-15	8° 18.2151’ N	77° 4.9388’ E
BS-16	8° 18.3603’ N	77° 4.7165’ E
BS-17	8° 18.5517’ N	77° 4.512’ E
BS-18	8° 18.7213’ N	77° 4.3003’ E
BS-19	8° 18.8852’ N	77° 4.0829’ E
BS-20	8° 19.0488’ N	77° 3.8659’ E
BS-21	8° 19.2152’ N	77° 3.6499’ E
BS-22	8° 19.3848’ N	77° 3.4369’ E
BS-23	8° 19.5582’ N	77° 3.2282’ E
BS-24	8° 19.7318’ N	77° 3.0196’ E
BS-25	8° 19.9075’ N	77° 2.8098’ E
BS-26	8° 20.0796’ N	77° 2.5989’ E

BEACH SAMPLING LOCATIONS		
WGS-84, UTM Projection, CM 75° East, Zone 43, North		
BS-27	8° 20.2492' N	77° 2.3841' E
BS-28	8° 20.413' N	77° 2.1703' E
BS-29	8° 20.5731' N	77° 1.9581' E
BS-30	8° 20.7305' N	77° 1.7499' E
BS-31	8° 20.8951' N	77° 1.5274' E
BS-32	8° 21.0493' N	77° 1.2973' E
BS-33	8° 21.1815' N	77° 1.0911' E
BS-34	8° 21.321' N	77° 0.8491' E
BS-35	8° 21.3974' N	77° 0.6359' E
BS-36	8° 21.683' N	77° 0.4829' E
BS-37	8° 21.8799' N	77° 0.298' E
BS-38	8° 22.1369' N	77° 0.1947' E
BS-39	8° 22.342' N	76° 59.9895' E
BS-40	8° 22.5417' N	76° 59.7689' E
BS-41	8° 22.8201' N	76° 59.0753' E
BS-42	8° 23.0287' N	76° 58.7934' E
BS-43	8° 23.1727' N	76° 58.6741' E
BS-44	8° 23.3709' N	76° 58.5145' E
BS-45	8° 23.7061' N	76° 58.3743' E
BS-46	8° 23.8974' N	76° 58.3798' E
BS-47	8° 24.1304' N	76° 58.2814' E
BS-48	8° 24.4789' N	76° 58.1346' E
BS-49	8° 24.632' N	76° 58.0289' E
BS-50	8° 24.8665' N	76° 57.8917' E
BS-51	8° 25.0976' N	76° 57.7474' E
BS-52	8° 25.3176' N	76° 57.5868' E
BS-53	8° 25.5653' N	76° 57.4562' E
BS-54	8° 25.7602' N	76° 57.2767' E
BS-55	8° 25.9643' N	76° 57.0963' E
BS-56	8° 26.15' N	76° 56.9073' E
BS-57	8° 26.3461' N	76° 56.7308' E
BS-58	8° 26.5741' N	76° 56.5678' E
BS-59	8° 26.7782' N	76° 56.4051' E
BS-60	8° 26.9997' N	76° 56.2272' E

BEACH SAMPLING LOCATIONS		
WGS-84, UTM Projection, CM 75° East, Zone 43, North		
BS-61	8° 27.203’ N	76° 56.0492’ E
BS-62	8° 27.4175’ N	76° 55.8762’ E
BS-63	8° 27.6142’ N	76° 55.6937’ E
BS-64	8° 27.8102’ N	76° 55.5014’ E
BS-65	8° 28.0132’ N	76° 55.3255’ E
BS-66	8° 28.2159’ N	76° 55.1437’ E
BS-67	8° 28.4224’ N	76° 54.9642’ E
BS-68	8° 28.6228’ N	76° 54.784’ E
BS-69	8° 28.8276’ N	76° 54.6048’ E
BS-70	8° 29.0316’ N	76° 54.4243’ E
BS-71	8° 29.1104’ N	76° 54.3586’ E
BS-72	8° 29.3118’ N	76° 54.1755’ E
BS-73	8° 29.515’ N	76° 53.9964’ E
BS-74	8° 29.7202’ N	76° 53.8181’ E
BS-75	8° 29.9258’ N	76° 53.6393’ E
BS-76	8° 30.1345’ N	76° 53.4652’ E
BS-77	8° 30.345’ N	76° 53.294’ E
BS-78	8° 30.5558’ N	76° 53.1226’ E
BS-79	8° 30.7701’ N	76° 52.9558’ E
BS-80	8° 30.984’ N	76° 52.7867’ E
BS-81	8° 31.1988’ N	76° 52.6188’ E

The water samples (132 from four locations) were collected in the month of September 2019 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.

The location co-ordinates of water sampling locations are provided below:

Table 3-5: Water Sampling Locations

WATER SAMPLING LOCATIONS WGS-84, UTM Projection, CM 75° East, Zone 43, North				
Location	**Water Depth (m)**	**Sampling date**	**Latitude**	**Longitude**
L1 (Mulloor)	21.1	19th October 2019	08° 21.923’ N	76° 58.86' E
L2 (Proposed Dredge dumping)	23.2	20th October 2019	08° 21.705’ N	76° 59.565’ E
L3 (Pachalloor)	27.4	17th October 2019	08° 24.143' N	76° 56.268' E
L4 (Poovar)	23.0	18th October 2019	08° 17.597’ N	77° 04.058’ E

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.

Table 4-1: Geodetic Parameters

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

4.2 Survey Vessels

The following vessels were utilized for the survey operation:

Figure 4-1: Watch keeping vessel MFB Samuel

Figure 4-2: Transit vessel MFB Sindhu Yatra Matha

Figure 4-3: Multibeam Survey boat MFB Bethel

4.3 Personnel

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

Table 4-2: Personnel

Shankar And Co.		
Name	**Designation**	**Period**
Saju Cherian	Project Manager	Duration of Project
Unnikrishnan K.U.	Party Chief / Surveyor	Duration of Project
Arun P.K.	Survey Engineer	01^{st} to 02^{nd} Sep, 09^{th} to 30^{th} Sep 2019
Vishnu Haridas	Land Surveyor	01^{st} to 09^{th} Sep, 13^{th} to 19^{th} Sep, 23^{rd} to 30^{th} Sep 2019
Ravinder M.	Survey Engineer	16^{th} to 27^{th} Sep 2019
Balaji R.	Survey Engineer	16^{th} to 19^{th} Sep 2019
Adani Vizhinjam Port Pvt. Ltd.		
Name	**Designation**	**Period**
Hebin C.	Manager - Environment	Duration of Project
Jesse Fullonton	Assistant Manager	Duration of Project

5 SURVEY EQUIPMENT DETAILS

5.1 Wave Rider Buoy

The Datawell DWR (G) wave rider buoy was deployed by NIOT in collaboration with VISL and AVPPL, under a tripartite agreement and is being monitored and maintained by SAC. 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 Ayur Bay resort.

The system consists of wave rider buoy (DWR G make) with HF whip/LED flasher, GPS antenna, 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 are 1.5° within the range of 0° to 360°.

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

5.1.1 Principles of wave measurement

The GPS wave buoy measurement principle bears a strong analogy with the Doppler-shift phenomenon of a car passing nearby, 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.

5.1.2 Instrument Mooring

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:

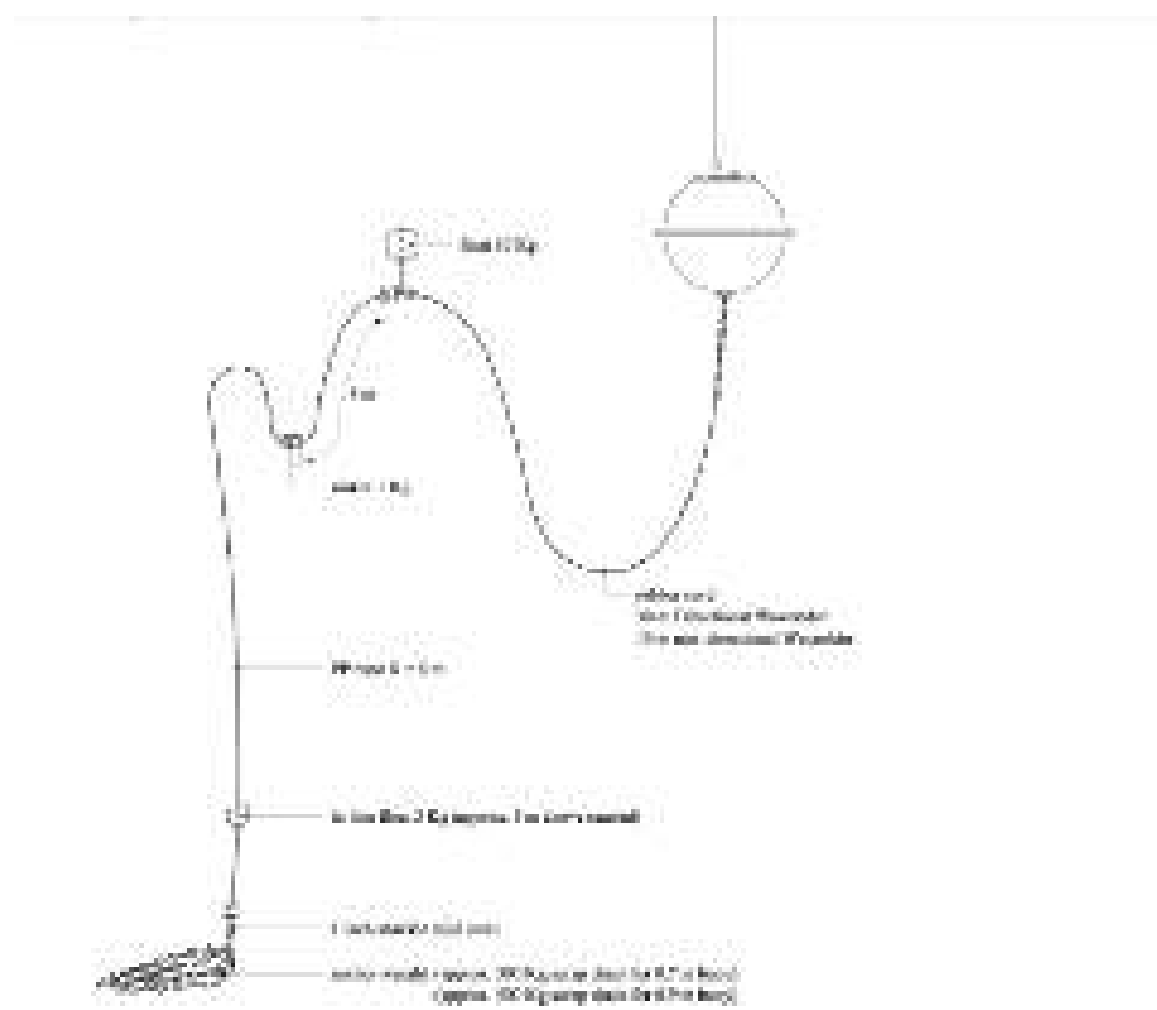


Figure 5-1: WRB Mooring Diagram

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.

The image of WRB deployed at the location is provided below:

Figure 5-2: WRB deployed at site

5.2 Current Meter

4 Teledyne Workhorse Sentinel 600 KHz Acoustic Doppler Current Profilers (ADCP) were installed at locations P1, P2, P3 and P4, namely, Vizhinjam, Poovar, Pachalloor and Mulloor. The current meters were installed in a downward looking mode. The current speed and direction were measured at intervals of every 10 minutes from surface to seabed at every 1m bin. Data from three various depths i.e. at the surface, mid-depth and bottom at each location are provided in the report. The following figure shows the ADCP installation on the vessel at various locations.

Figure 5-3: ADCP deployed at Vizhinjam

Figure 5-4: ADCP deployed at Mulloor

Figure 5-5: ADCP deployed at Poovar

5.3 Automatic Tide Gauge

An EMCON Automatic Tide Gauge (ATG) was installed near the Coast Guard jetty, inside the fishing harbour for measuring the tides. The tide gauge is a capacitance-based instrument, measuring the water level due to change in capacitance on the surface of sensor. The sensor was installed on a 2.5m long pipe to ensure that the zero of sensor is always in water, irrespective of the phases of tide. This was levelled to the local benchmark, situated on top of the jetty. The tide station was programmed to measure the tide at 5-minute intervals throughout the duration of the project.

A photograph of the tide gauge location is provided below:

Figure 5-6: Tide Gauge

5.4 Automatic Weather Station (AWS)

A Gill Metpack Automatic Weather Station (AWS) was installed atop Ayur Bay Resort at Nellikunnu. The system measures wind speed/direction, atmospheric pressure, temperatureandrelative humidity.

The system consists of the following:

- Sonic anemometer
- Relative humidity & temperature sensor
- Pressure sensor
- Rain Gauge
- Datalogger

The data is logged in a data logger installed at the receiving station at intervals of 10 minutes. The data is also transmitted from the data logger to a cloud based server for further processing and QC checks.

An image of automatic weather station is provided below:

Figure 5-7: AWS on toop of Ayur Bay Resort, Nellikunnu (Mulloor)

5.5 Real Time Kinematic (RTK) Survey

An RTK system was mobilized at site to carry out cross-shore profiling on the landward side. The system used was a Geomax Zenith 10/20 RTK system with base station and rover. A photograph of the system is provided below:

Figure 5-8: RTK System with base station and rover

5.6 Multibeam Echo Sounder System

A GeoAcoustics Geoswath Plus Multibeam Echo Sounder, operating at a frequency of 500 kHz, was used to delineate the topography of the seabed. The measured sound velocity and observed tide was fed into the system during data processing.

The swath bathymetry system was calibrated according to methods described in the manufacturer’s manual. The swath transducer system was aligned with the roll/pitch/heave sensor. Great care was taken to mount the heads and pitch/roll/heave sensor as accurately as possible and the final calibration was carried out during sea trials by running three reciprocal lines near the survey area. The following calibrations were carried out:

- Alignment of sonar heads
- Roll calibration
- Pitch calibration
- Latency checks

Figure 5-9: Multibeam echo sounder deck unit

5.6.1 Multibeam Swath Calibration Report

The calibration (or patch test) of the GeoSwath MBES was used to fix the time and angle offsets between the various positioning systems and the transducer head. This was done after mobilization.

The system offsets were entered in the acquisition software prior to surveying and raw data acquisition. Some of these were easily measured and entered and others were corrected through the calibration procedure.

Offsets:

The directly measured system offsets are:

- Transducer sensor offsets measured as the distance from the COG to the transducer point (X= 0.000, Y= 1.200 m for M.F.B. Bethel).
- Antenna offsets measured as the distance from the COG to the antenna (X= -0.448 m, Y= 1.200 m and Z = 3.200m from water line).
- Heave offset measured as the vertical distance from the centre of the transducer to the water surface (Z= -0.750 m for M.F.B. Bethel).
- Time offset (latency) introduced by DGPS computer/ navigation computers or during the serial data transfers.

Note: COG assigned for GS+ is centre of vessel where as COG for navigation was assigned over the MBES transducer pole. For GS+ portside value is positive and aft side is negative.

A Seapath 130H MRU provided compensation for vessel heave, roll, pitch and yaw. The sound velocity profiles and tide readings were used to get an accurate calibration form the patch test.

The recommended order of calibration is:

- Calibrate for Latency
- Calibrate for Roll
- Calibrate for Pitch
- Calibrate for Yaw

This is called the LRPY sequence. The figure below shows the sensor offsets for the survey vessel M.F.B. Bethel.

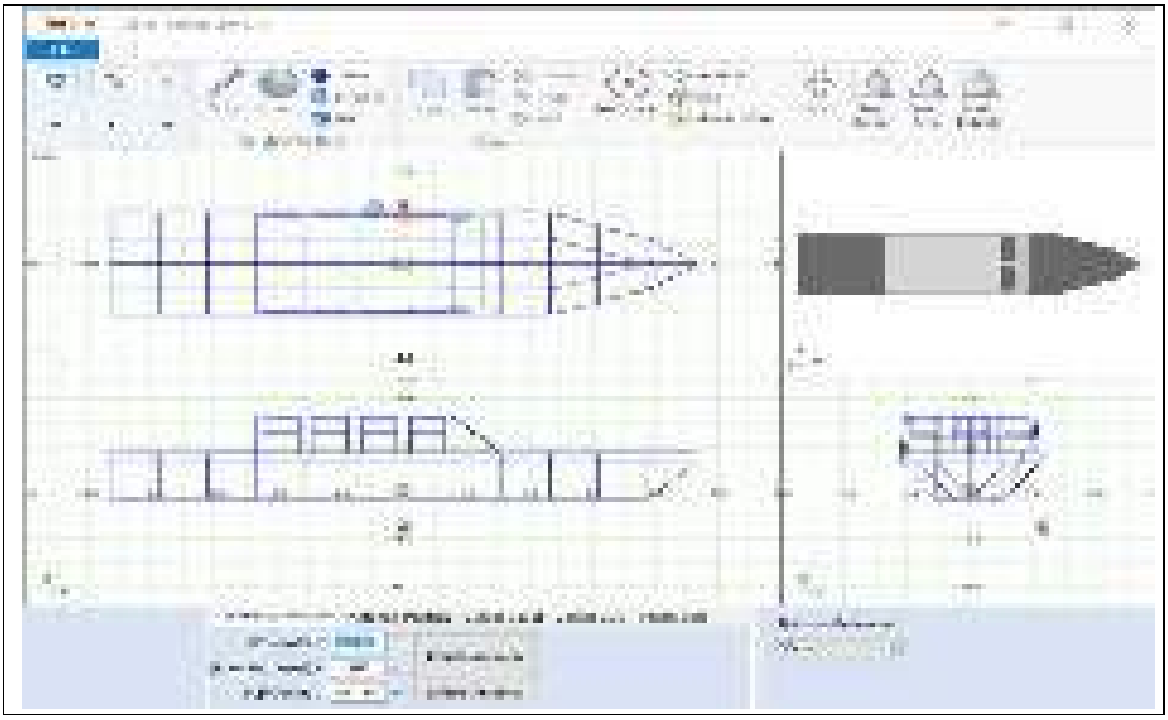


Figure 5-10: Multibeam sensor offsets of M.F.B. Bethel

Roll Calibration:

- Three survey lines, were run in opposite directions at 4 knots over flat topography approximately 700 m long with 100% overlap before the start of the survey.
- The sound velocity profile was carried out before running the calibration lines.
- Observed ATG tide of Coast guard jetty at Vizhinjam was applied with respect to Chart Datum correction to the calibration files.

Pitch Bias and Navigation Delay Calibration:

- Unlike the roll offset, these offsets will not cause false depth values, but will assign the measured depth values to wrong positions. Both calibrations are dependent on each other and have to be separated by calculating the offsets in a fixed order.
- Three lines were run in opposite directions for pitch and two lines were run in the same direction at different speeds, over a distinct object or a steep slope perpendicular to the contours.

Yaw Calibration:

Three lines were run in opposite directions for yaw correction on either side of a conspicuous object. This is often the same object that is used calculate the residual pitch bias and navigation time delay.

- The lines length was approximately 700 m since the seabed feature exhibited a good slope in the area.
- The lines were run at normal survey speed, approximately 4 knots, to obtain a "suitably high resolution".

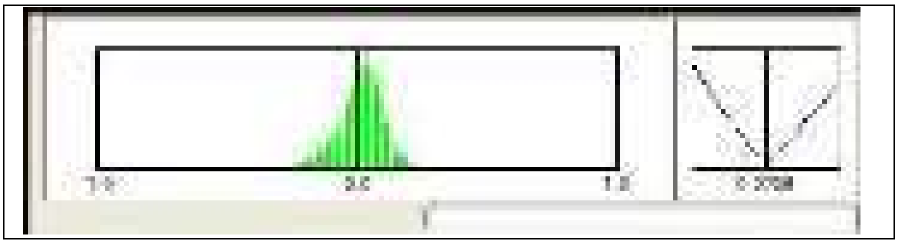


Figure 5-11: Calibration Statistics Status Window

The above Calibration Statistics Status window shows the population of data within the bins generated at the gridding stage of the calibration process. Automatic iterations are made and mean difference values are determined from the spread of the data around the mean.

MBES Calibration Results:

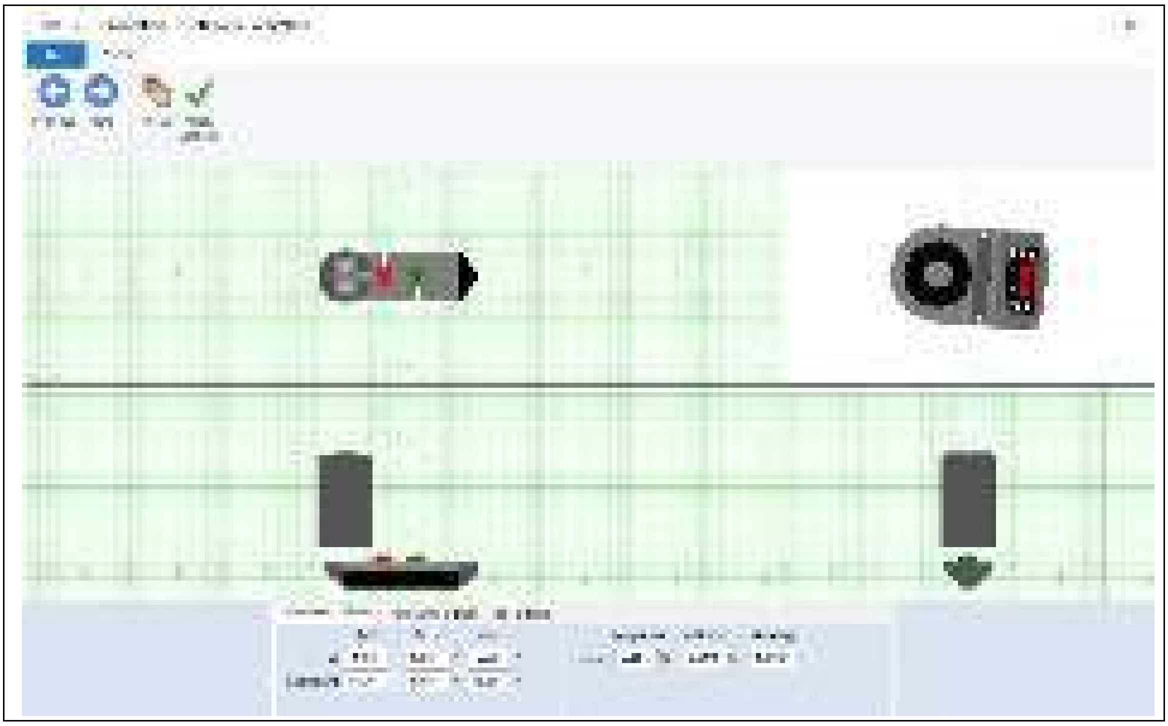


Figure 5-12: Calibration results in Editor

Table 5-1: MBES Calibration results

Parameter	Value	Comments
Latency	0.19s	Seapath 130 Positioning System with beacon corrections.
Port Roll	-0.08º	Seapath 130-H MRU accuracy 0.03º in roll
Starboard Roll	0.25º	Seapath 130-H MRU accuracy 0.03º in roll
Pitch	0.00º	
Yaw	-3.80º	Accuracy better than 0.2°

Calibration Profile Status and Grid Comparison:

A cross-section of two grids (with and without calibration) was compared to show the result of calibrations in the figure below. In the Calibration Profile Status window, this provides an additional 'visual' check to the veracity of the calibration offsets generated.

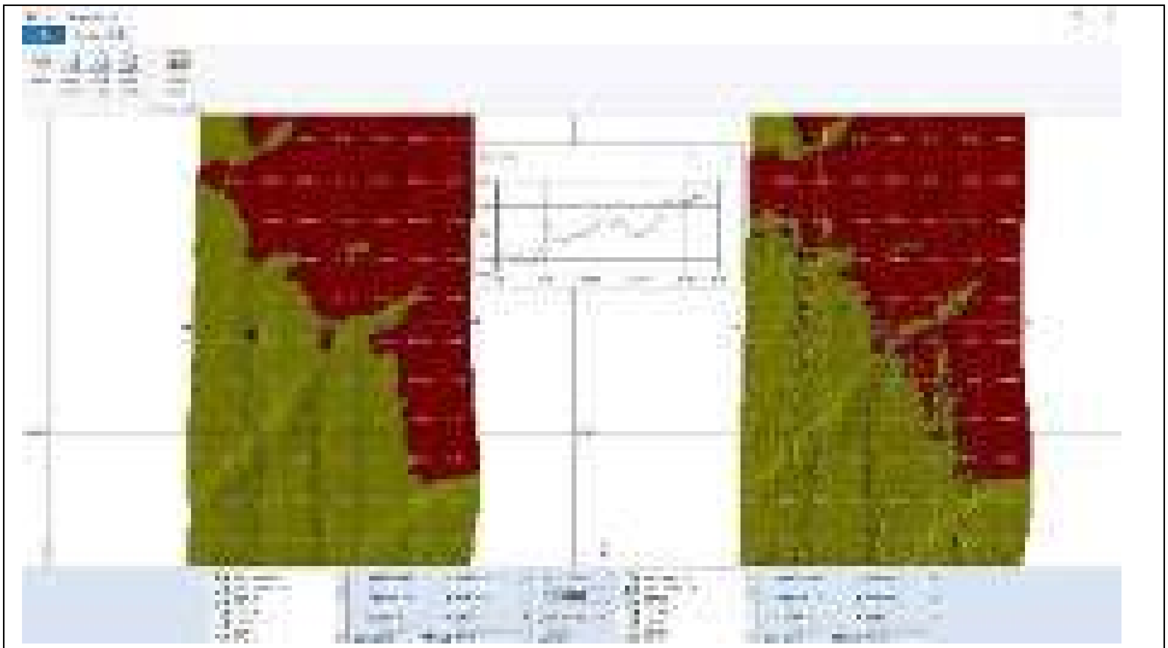


Figure 5-13: Calibration results with cross profiles (Left: with calibration, Right: without calibration)

5.7 DGPS Positioning System

Vessel positioning was carried out by the Seapath 130 DGPS system which also provides the heading. Vessel track and offset positions were recorded digitally in the navigation software. The positioning system was interfaced to the navigation software as well as the digital data acquisition system. DGPS positioning accuracy of the moving vessel was better than ±1m.

The computed position of the vessel from the DGPS receiver was interfaced to the navigation computer system. Hypack navigation and data acquisition software was used to provide track guidance information to the survey crew and also output the position of the vessel to assist the helmsman in maintaining the selected track guidance line. The VDU displays the selected survey line, the position of the vessel in relation to that line and numerical data to assist the helmsman such as the along-line and off-line distances, vessel speed and course made good, gyro heading, distance and bearing to end of line and water depth. The position of each fix, together with other information such as fix numbers, depths, PDOP and along-line distances were logged to the hard drive.

5.7.1 DGPS Consistency Check

In order to determine the integrity and reliability of the positioning system, the system was checked for its consistency during mobilization.

This position verification check was conducted for the Seapath positioning system when the vessel M.F.B. Bethel was berthed at the fishing jetty on 20th September 2019. After installing the Seapath DGPS positioning system on board the vessel, two points were marked on the jetty. The DGPS antenna was set up on the jetty at these two points, designated as Point A and Point B.

Time was synchronized between Seapath/Hypack and the observer’s watch, for which local time (GMT+5.30) was used. The Seapath 130 DGPS antenna positions were logged in the Hypack navigation software. The logged data was processed to derive the final positions of both the points.

The difference between the calculated distance and measured distance was found to be within the permissible accuracy limit as mentioned in the DGPS position comparison shown in the table below.

[illegible]

Figure 5-14: DGPS Consistency Check on board M.F.B. Bethel

5.7.2 Gyrocompass Calibration

After establishing a base line on the jetty, gyro calibration was carried out on 20th September 2019 for M.F.B. Bethel using the baseline as a reference. This was done by measuring the distance between it and the centre line of the vessel at the bow and stern simultaneously with the help of two measuring tapes. Gyro readings were also logged simultaneously. The calculated heading of the vessel was compared with the recorded gyrocompass heading to derive a calculated-observed (C-O) value. A final C-O of 0.40° was obtained, which was entered into the navigation software before commencing the survey. The Gyro Verification table is placed below.

Figure 5-15: Gyrocompass Calibration on board M.F.B. Bethel

6 SURVEY RESULTS

6.1 Tidal Measurements

The tides were observed near the Coast Guard jetty. 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 3.447m above chart datum. An image of the TBM is provided below:

Figure 6-1: Location of TBM

The offset calculation of tide gauge based on the 'jetty top' value is given in the image below:

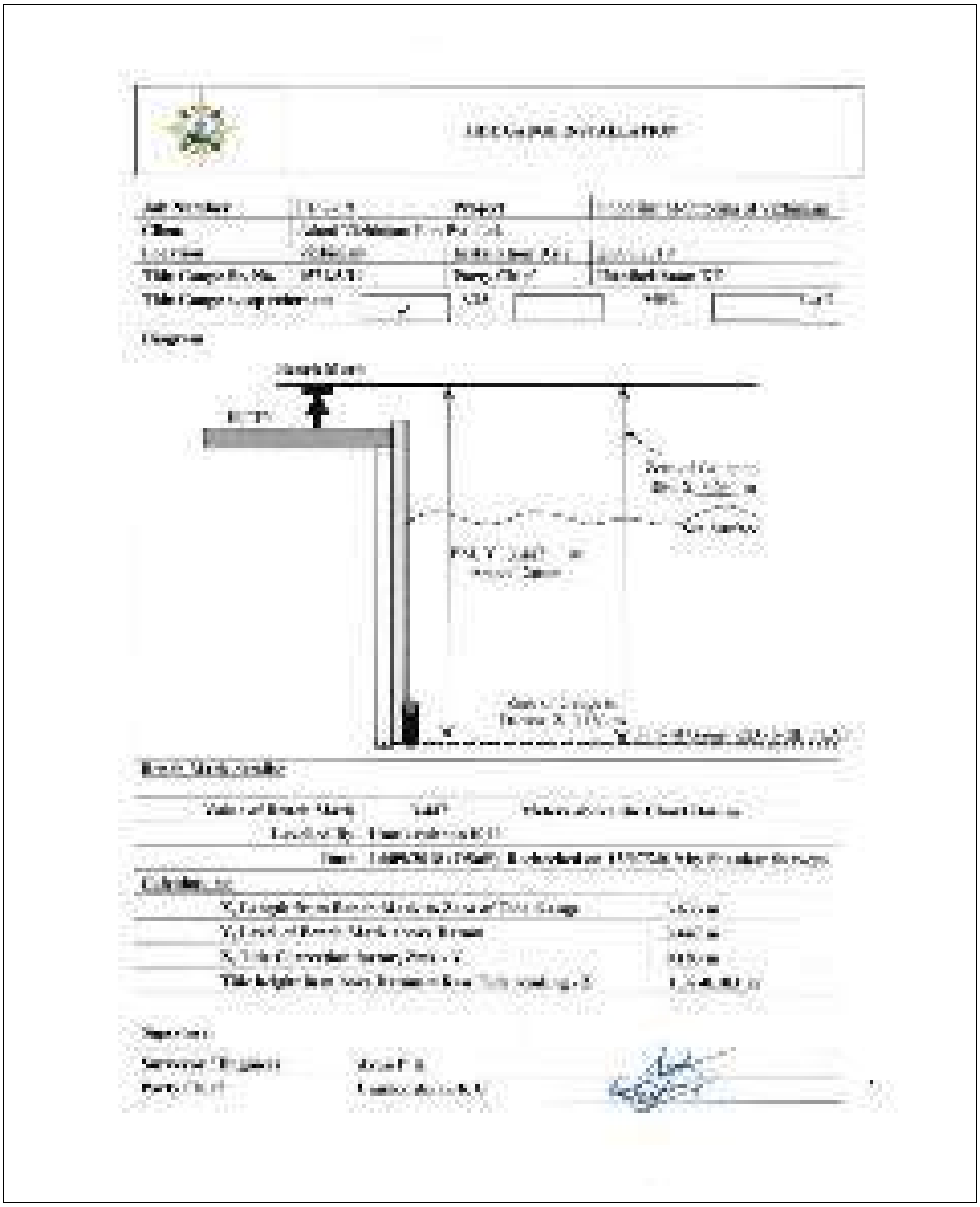
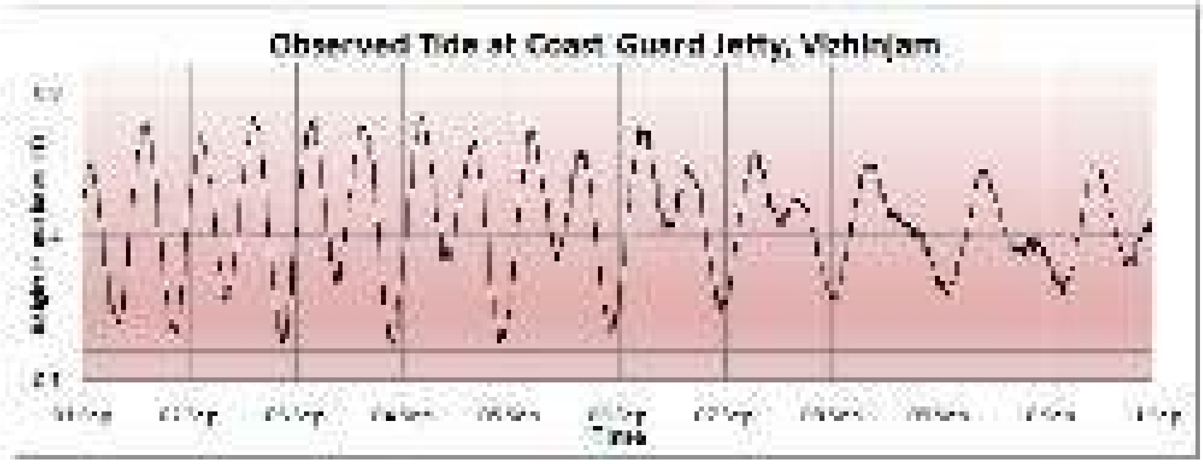
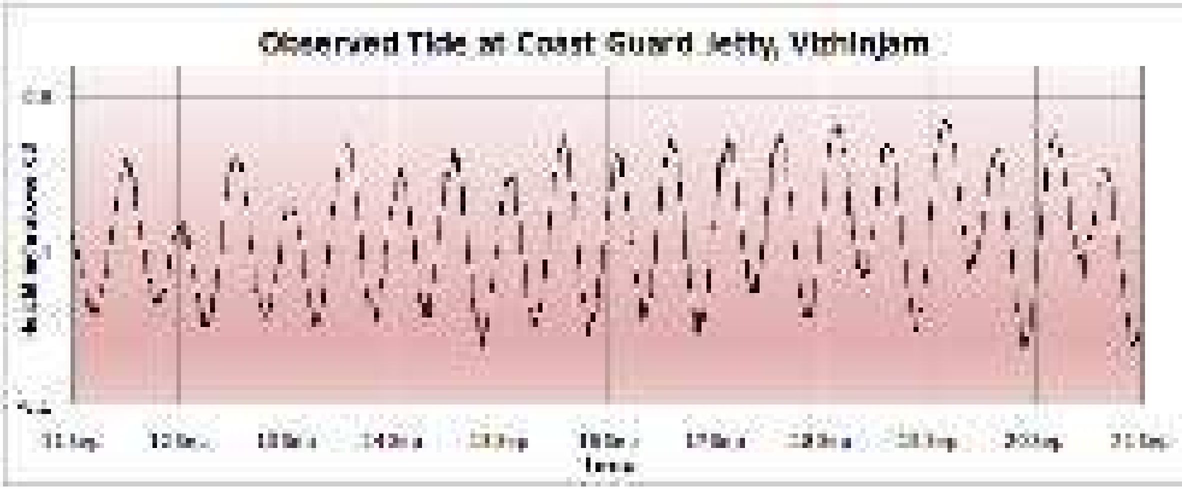
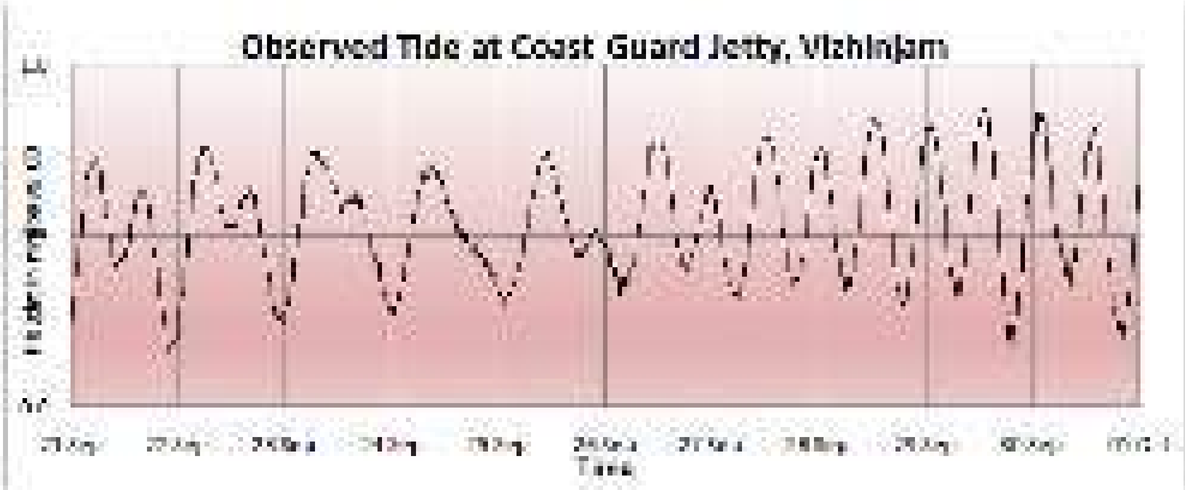


Figure 6-2: Schematic Diagram of Tide Gauge

The tides observed are mixed semi-diurnal in nature, with the maximum range of 0.92m being observed in the springs. The representation of tide data collected, in the form of graphs is placed below.


Observed Tide at Coast Guard Jetty, Vizhinjam


Observed Tide at Coast Guard Jetty, Vizhinjam


Observed Tide at Coast Guard Jetty, Vizhinjam

6.2 Wave Measurements

The data from the WRB (provided by NIOT) was downloaded and processed to produce the time series and rose diagram, which are provided below:

Refer to the following rose plot of significant height (Hs) v/s direction for the period of 01st to 30th September 2019:

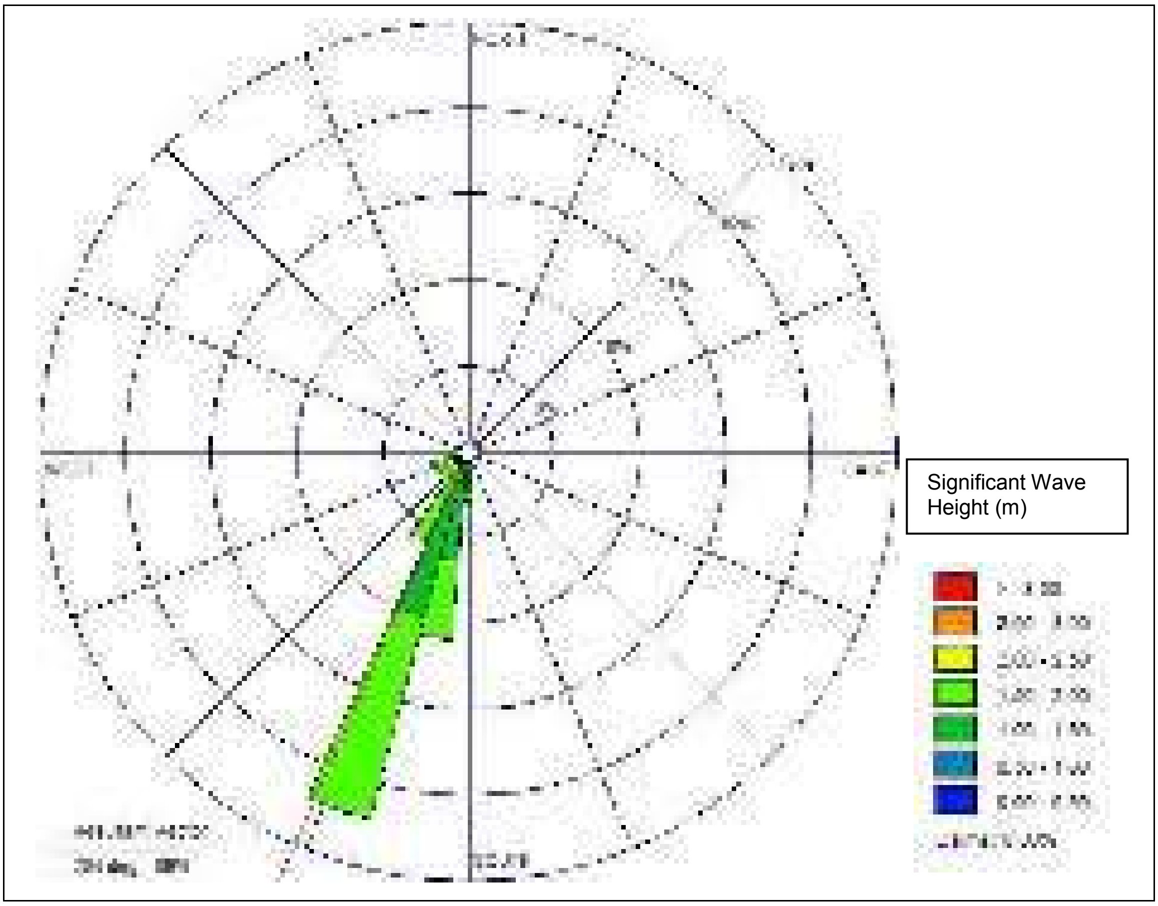


Figure 6-3: Wave Rose (Hs in metre v/s Direction) from 1st to 30th September 2019

The wave direction was south-southwesterly during the period with wave heights less than 2m. As can be seen in the rose plot above, the significant wave heights were less than 2m in the south-southwesterly direction.

A maximum significant wave height of 1.99 m was recorded on 2nd September 2019 at 05:44 hrs.

The frequency distribution table and histogram are provided below:

Table 6-1: Frequency distribution of wave height (1st to 30th September 2019)

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	45	3.46	0	0.00
1.0 - 1.5	652	50.08	60	4.59
1.5 - 2.0	605	46.47	367	28.06
2.0 - 2.5	0	0.00	571	43.65
2.5 - 3.0	0	0.00	279	21.33
3.0 - 3.5	0	0.00	27	2.06
> 3.5	0	0.00	4	0.31
Total	**1302**	**100.00**	**1308**	**100.00**

The histogram of significant wave height during the observation period of September 2019 is given below:

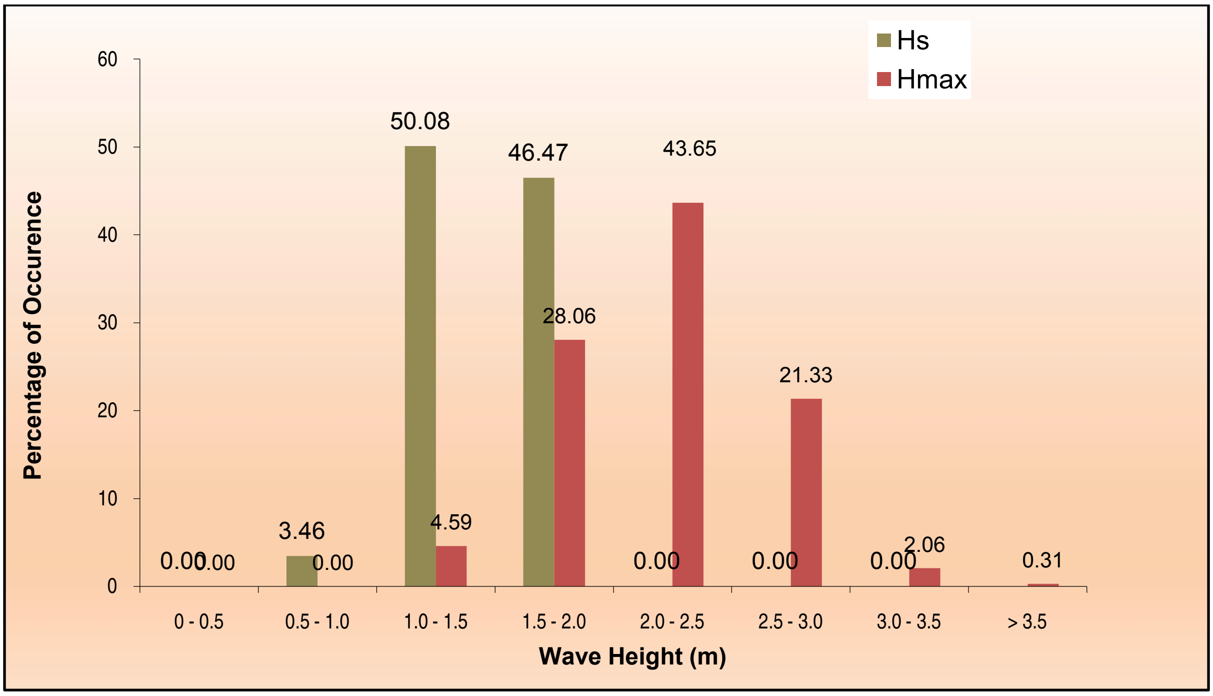


Figure 6-4: Histogram of wave height from 1st to 30th September 2019

As can be seen from the above histogram, about 46% of the observation of significant wave height was between 1.5 to 2m indicating regressing monsoon.

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

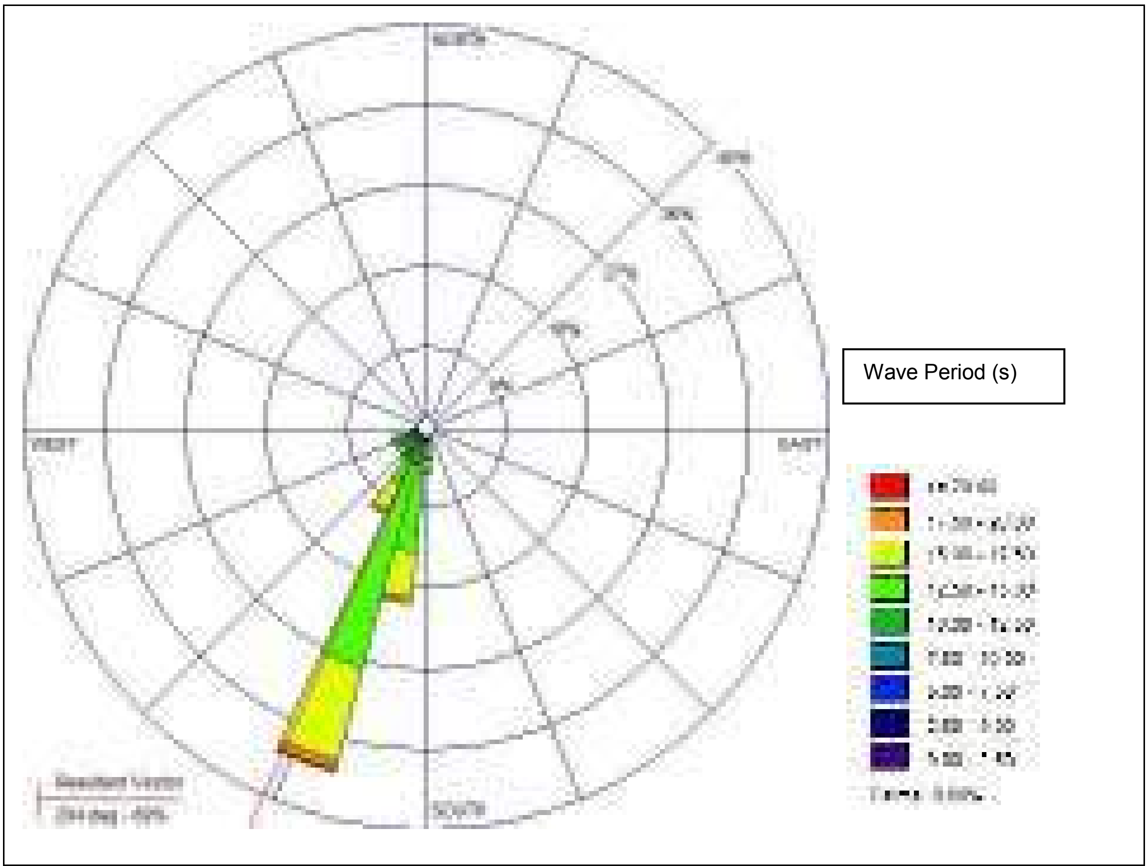


Figure 6-5: Wave Rose (Tp vs direction) from 1st to 30th September 2019

The histogram drawn for wave period for September 2019 is given below:

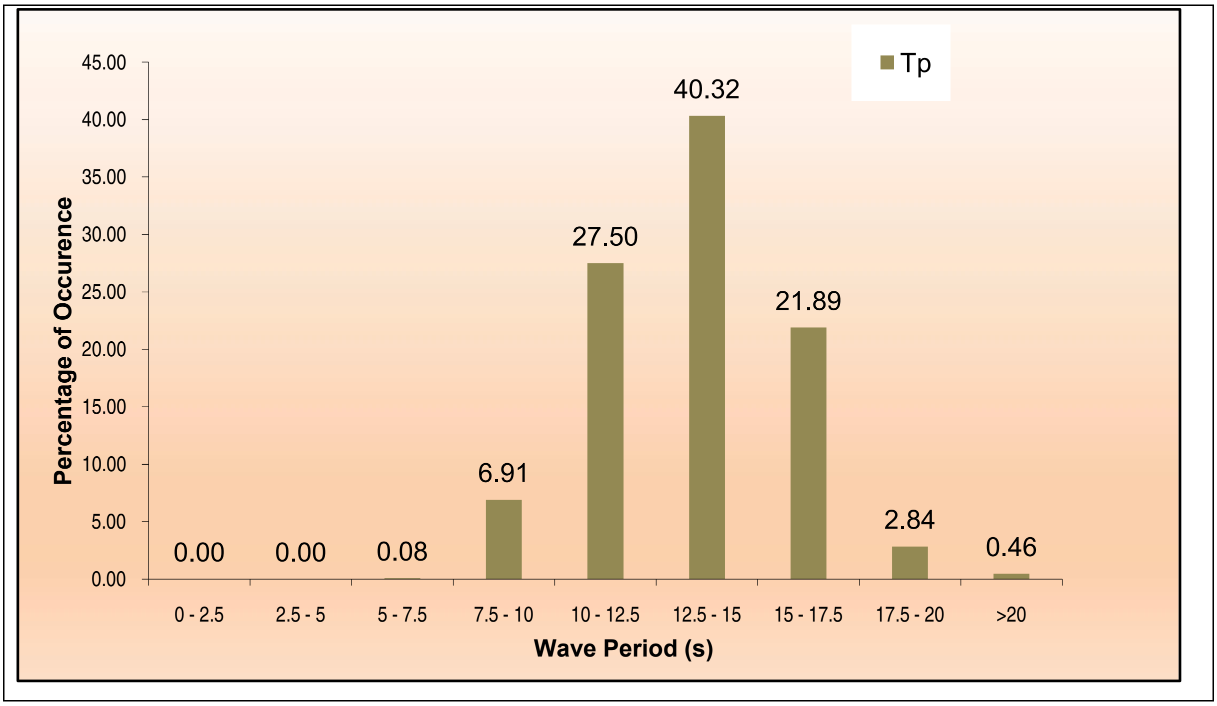
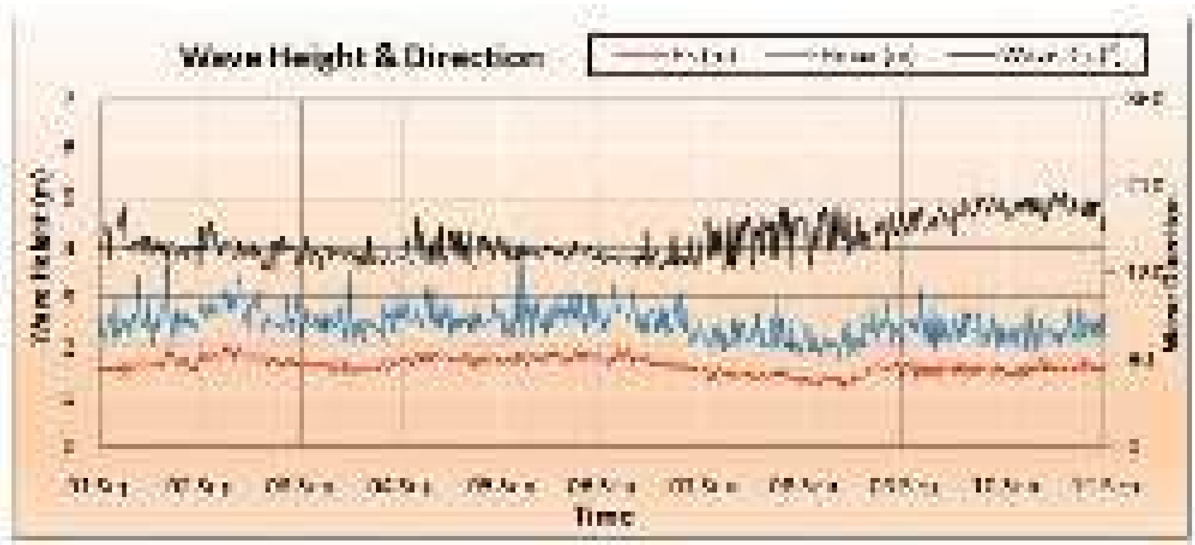
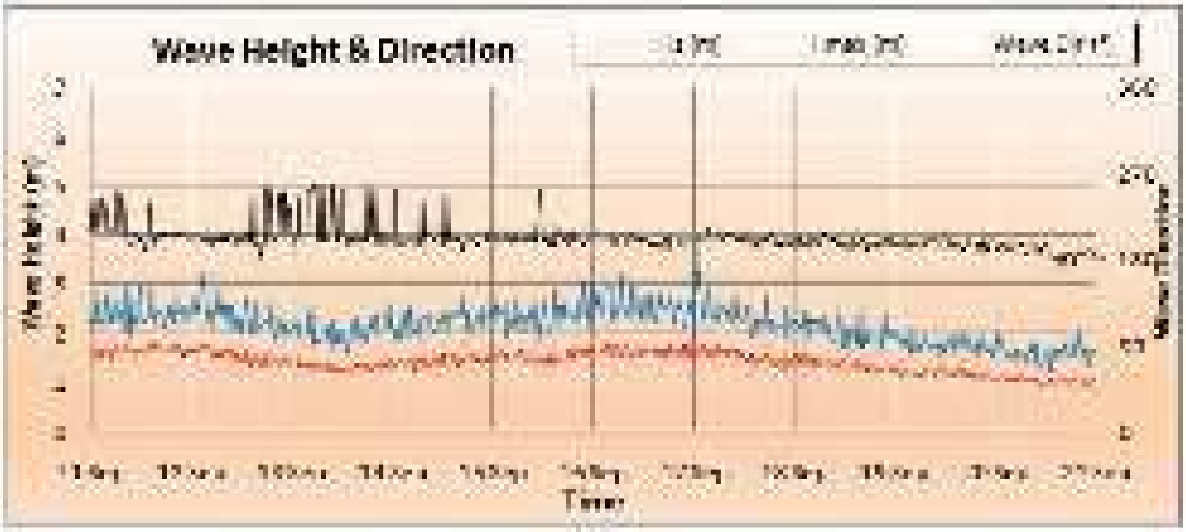


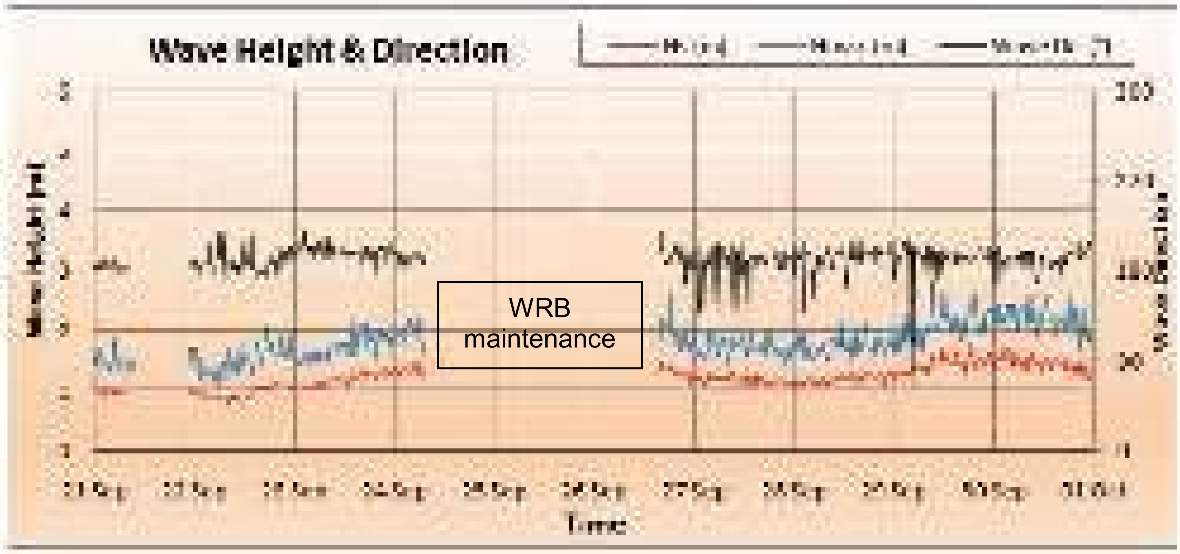
Figure 6-6: Histogram of wave period from 1st to 30th September 2019

The above image indicates that during the period of observation, the wave period was in the range of 7.5 to 20 seconds, with 90% of the observations indicating long waves with a period of more than 10 seconds. The maximum period of 20 seconds was recorded on 28th September 2019 at 17:39 hours, 19:09 hours, 19:39 hours, 21:39 hours, 22:39 hours and 23:39 hours.

The time series graph for the month is provided in the images below.




Wave Height & Direction
Time


Wave Height & Direction
WRB maintenance
Time

6.3 Current Measurements

Current meters were deployed at four locations to measure the speed and direction of the current at three different levels. During bad weather period, the watch keeping boat along with the ADCP had to return to port, as per the verbal warning issued by Coast Guard boat to the watch keeping boat personnel. Accordingly, there is a data gap in the results which is indicated.

The results of the data obtained from the ADCPs at the four locations are documented below.

6.3.1 Location P1 - Vizhinjam

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed in a downward looking mode.

The ADCP was recovered after the requisite days of observation and after QC of the data, the spurious values were filtered out.

A maximum current of 990 mm/sec was observed at the water surface on 04th September 2019 at 17:30hrs.

Refer to the following rose plots for speed and direction of the currents at three different levels i.e. surface, mid-depth and bottom, where speed is plotted in mm/sec.

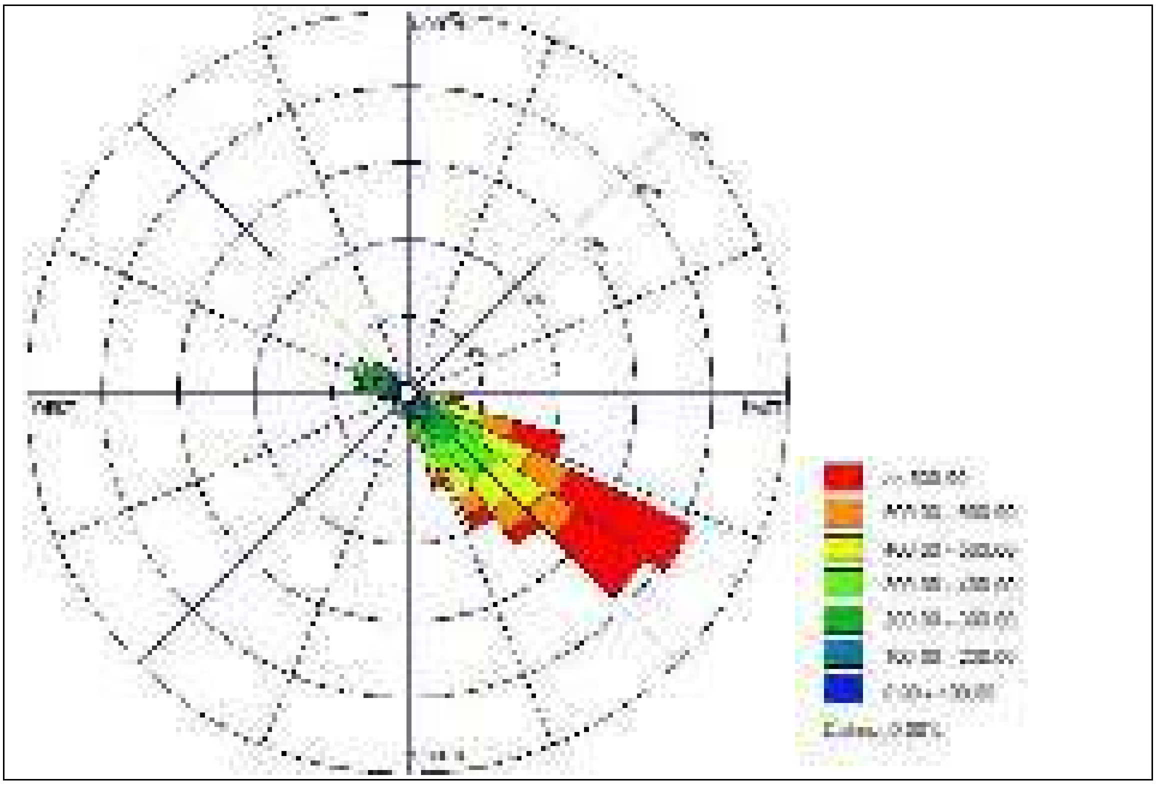


Figure 6-7: Rose Plot (surface speed in mm/sec) – P1

The data reveals that the surface currents were parallel to the shore in the northwest-southeast direction, with predominant flow towards southeast.

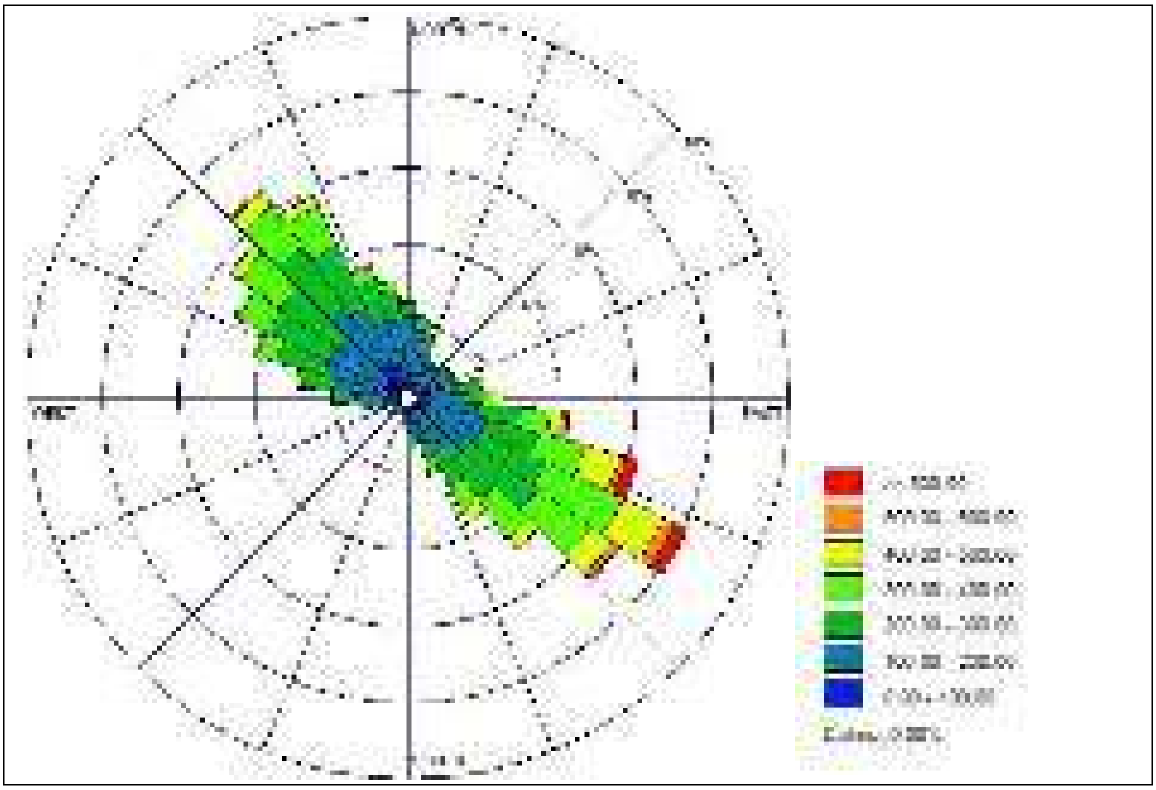


Figure 6-8: Rose Plot (mid-depth speed in mm/sec) – P1

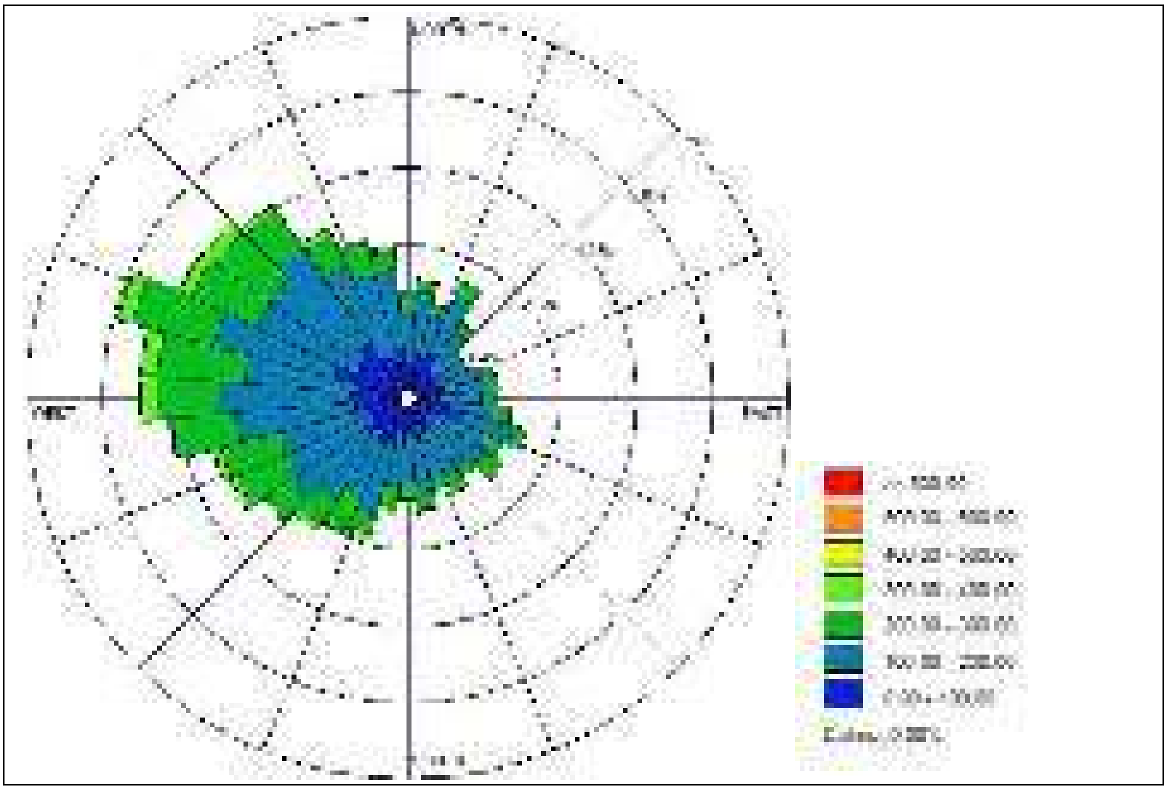


Figure 6-9: Rose Plot (near bottom speed in mm/sec) – P1

The current speed is seen to decrease towards the seabed as compared to the surface currents. The following table and figures provide the frequency histogram and percentage exceedance curve of the current speed.

Table 6-2: Percentage distribution of current speed – P1

Speed (mm/s)	Percentage Distribution		
	Surface	Mid	Bottom
0 - 100	10.36	19.00	31.12
100 - 200	23.60	34.83	47.68
200 - 300	14.91	24.72	18.27
300 - 400	12.41	14.58	2.56
400 - 500	12.96	5.07	0.35
500 - 600	9.54	1.05	0.03
>600	16.23	0.75	0.00
Total	**4005**	**4005**	**3991**

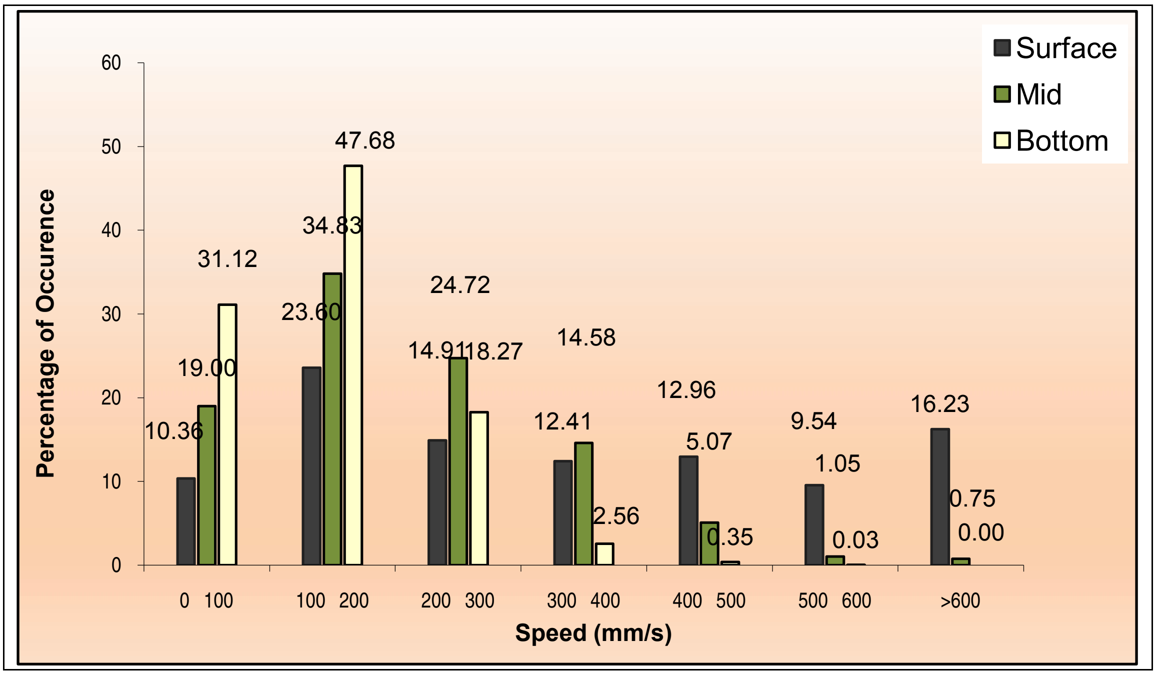


Figure 6-10: Histogram showing current speed – P1

Table 6-3: Percentage exceedance of current speed – P1

Percentage Distribution			
Speed (mm/s)	**% of Surface**	**% of Mid**	**% of Bottom**
0	100	100	100
100	89.64	81.00	68.88
200	66.04	46.17	21.20
300	51.14	21.45	2.93
400	38.73	6.87	0.38
500	25.77	1.80	0.03
600	16.23	0.75	0.00

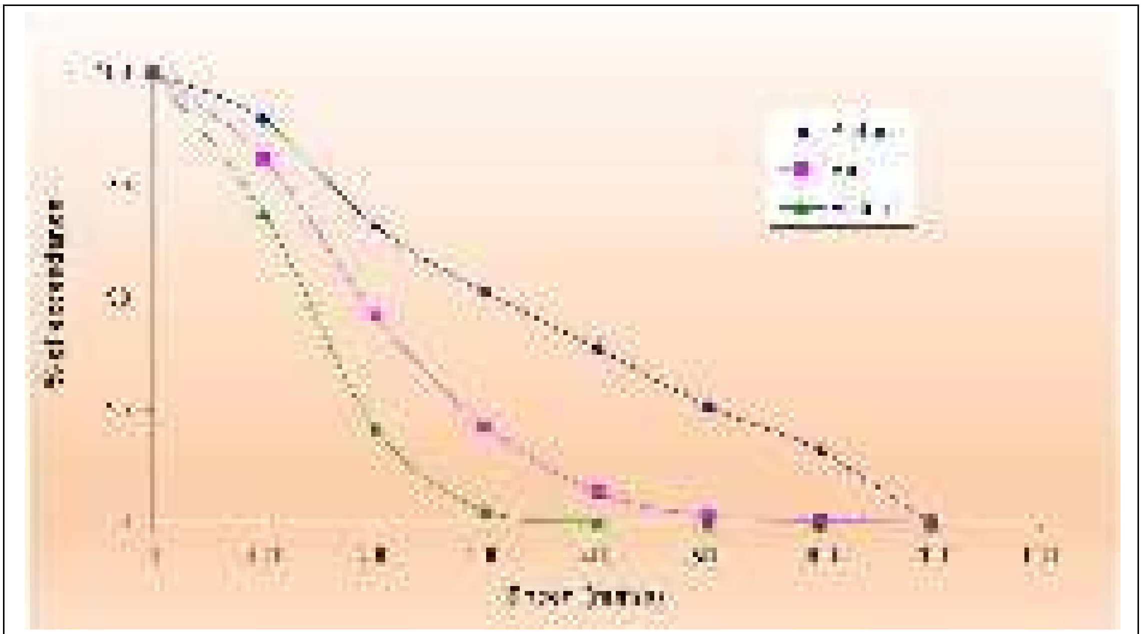


Figure 6-11: Exceedance curve of current speed – P1

The exceedance curve reveals that the surface current speed was evenly distributed from 0 to 100 mm/sec to > 600mm/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, 11 and 22 respectively).

The progressive vector diagram for the observation period is provided below:

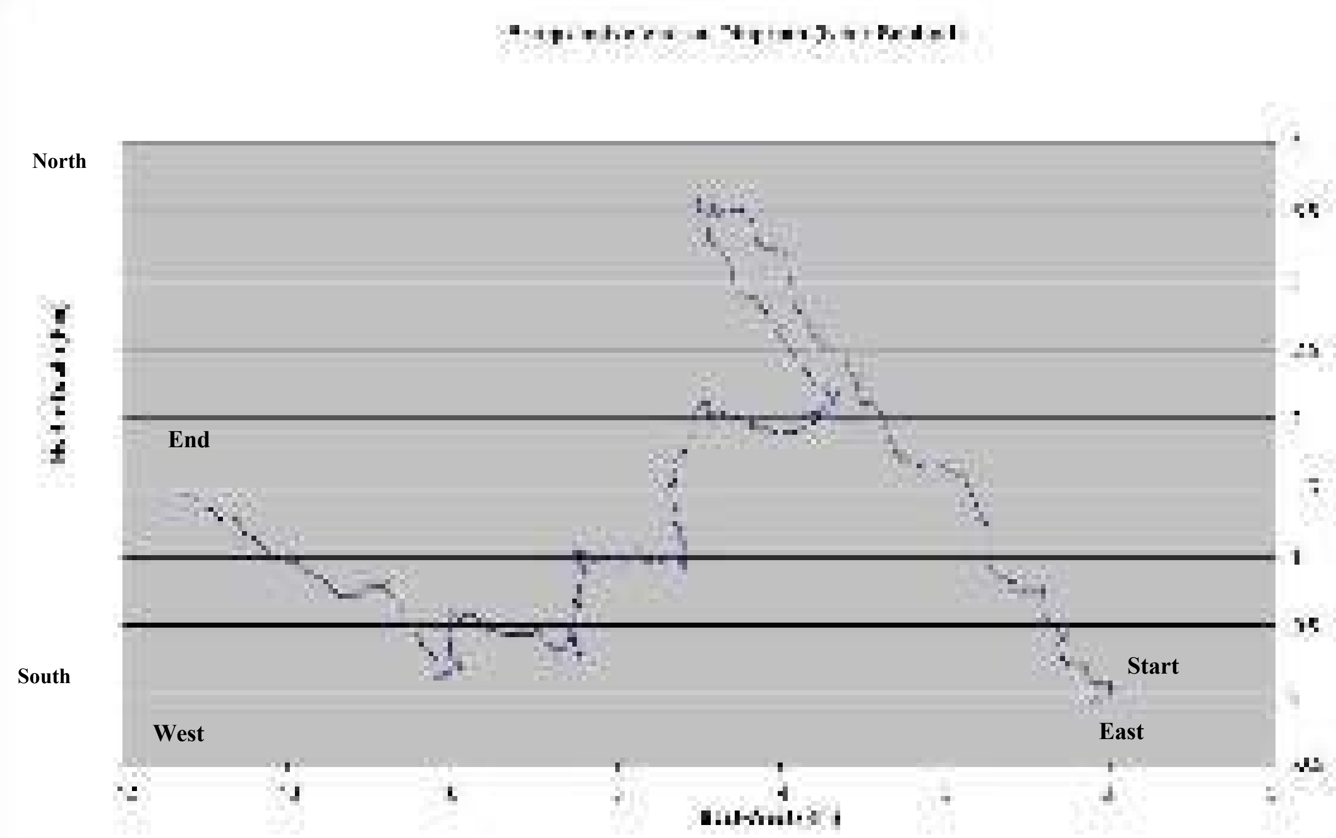


Figure 6-12: Progressive Vector Diagram – P1

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-axis 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.From the data collected over a lunar cycle for the period it can be observed that, the water parcel was having an oscillatory motion and was travelling for about 4 km towards north-west and 7 km towards south-east.

6.3.2 Location P2 – Poovar

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed from a boat in a downward looking mode, mounted on an L frame.

The deployment period was from 16th August to 16th September 2019.
A maximum current of 932 mm/sec was observed at the water surface on 08th September 2019 at 19:30hrs.

Refer to the following rose plots for speed and direction of the currents at three different levels i.e. surface, mid-depth and bottom, where speed is plotted in mm/sec.

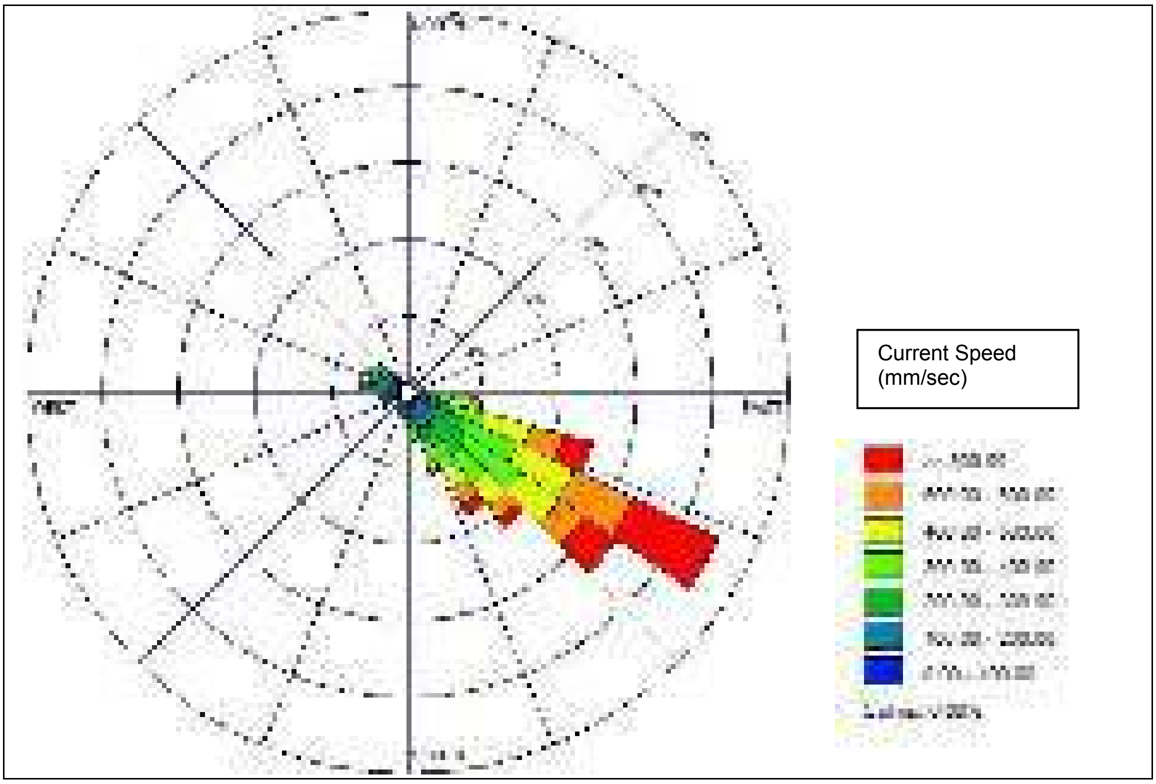


Figure 6-13: Rose Plot (surface speed in mm/sec) – P2

The data reveals that the surface currents were parallel to the shore in the northwest-southeast direction, with flow towards southeast being more predominant.

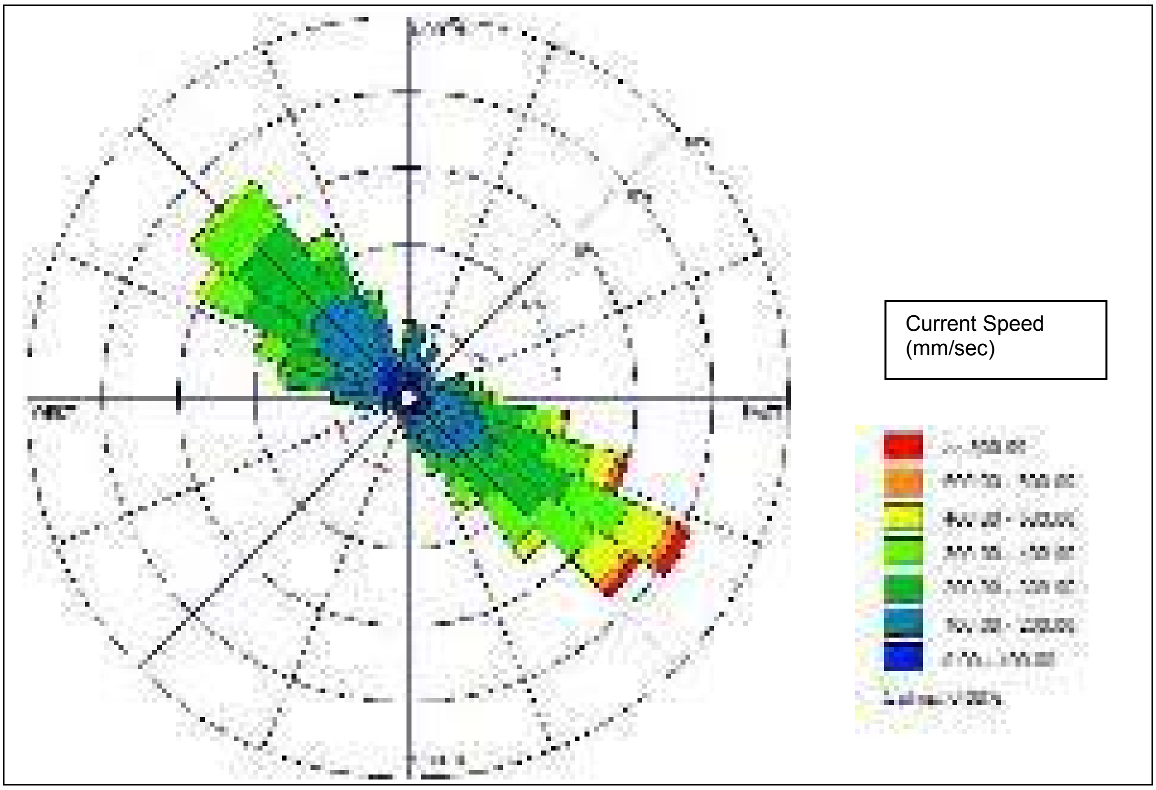


Figure 6-14: Rose Plot (mid-depth speed in mm/sec) – P2

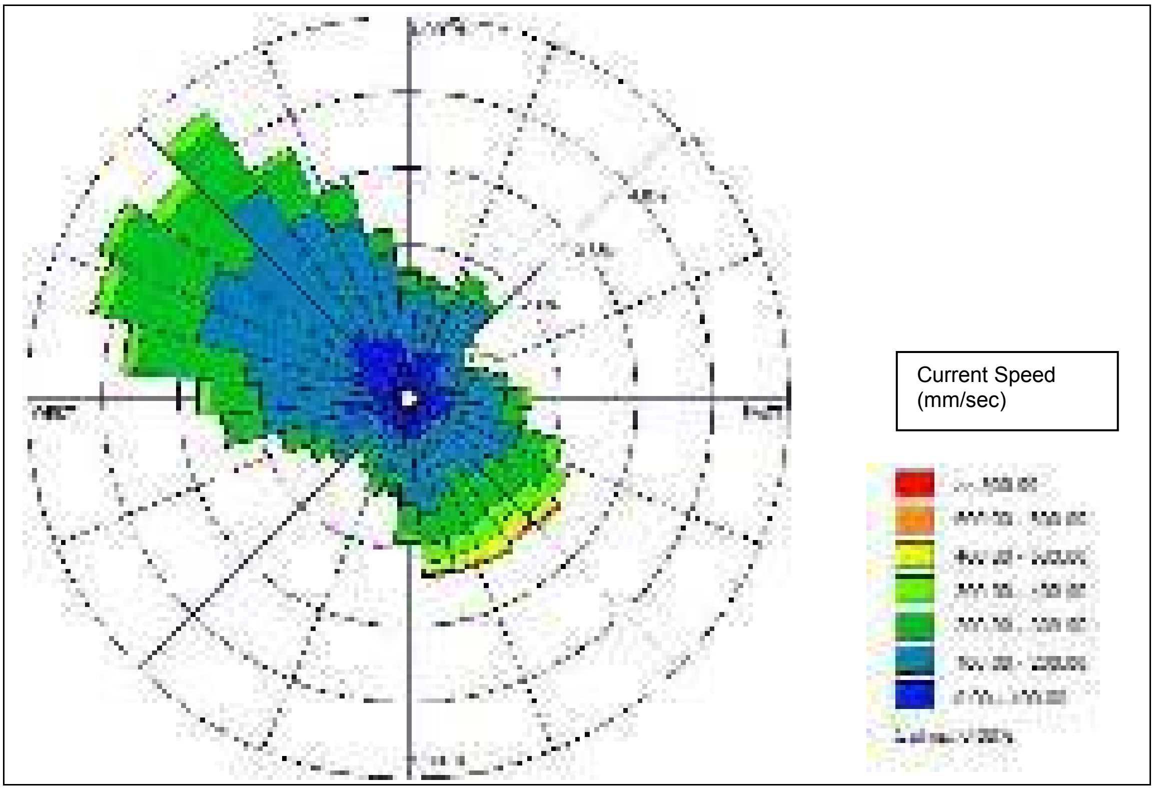


Figure 6-15: Rose Plot (near bottom speed in mm/sec) – P2

The current speed is seen to decrease towards the seabed as compared to the surface currents. The following table and figures provide the frequency histogram and percentage exceedance curve of the current speed.

Table 6-4: Percentage distribution of current speed – P2

Speed (mm/s)	Percentage Distribution		
	Surface	Mid	Bottom
0 - 100	18.40	22.97	36.96
100 - 200	24.95	35.92	39.61
200 - 300	14.83	24.55	17.24
300 - 400	15.87	12.20	4.42
400 - 500	11.97	3.97	1.22
500 - 600	7.75	0.39	0.43
>600	6.23	0.00	0.12
Total	**100**	**100**	**100**

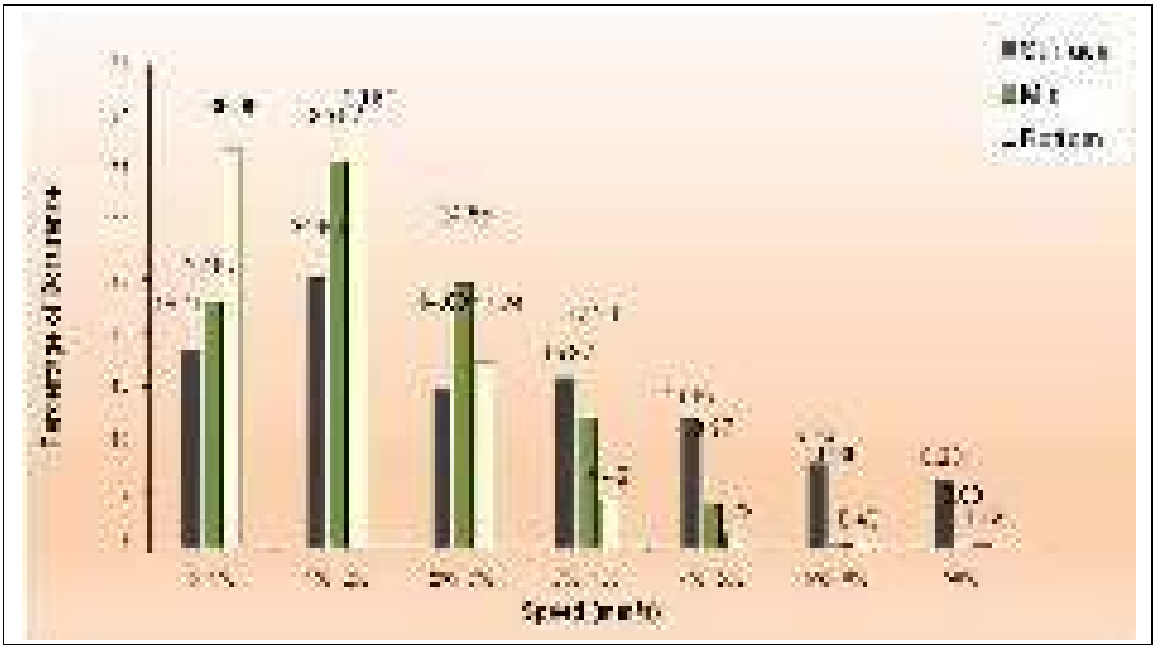


Figure 6-16: Histogram showing current speed – P2

Table 6-5: Percentage exceedance of current speed – P2

Percentage Distribution			
Speed (mm/s)	**% of Surface**	**% of Mid**	**% of Bottom**
0	100	100	100
100	81.60	77.03	63.04
200	56.65	41.11	23.43
300	41.82	16.56	6.19
400	25.95	4.37	1.78
500	13.98	0.39	0.55
600	6.23	0.00	0.12

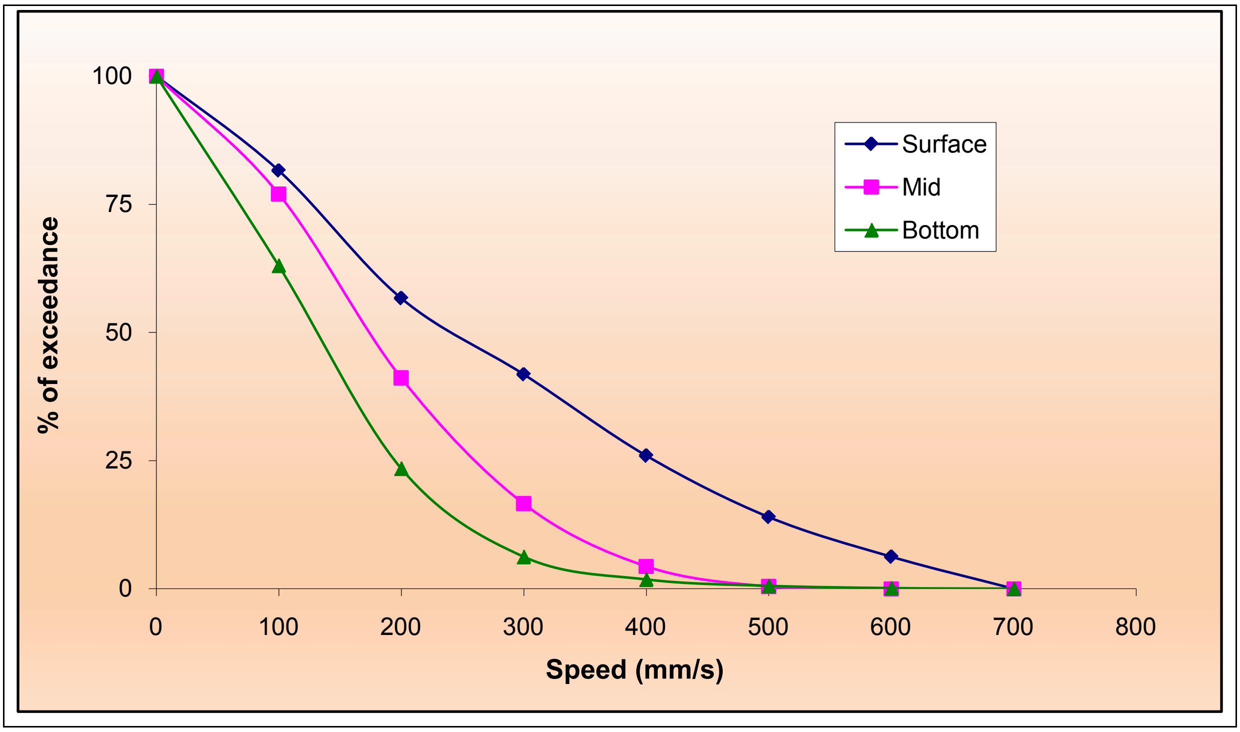


Figure 6-17: Exceedance curve of current speed – P2

The exceedance curve reveals that the surface current speed was evenly distributed in all selected classes 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, 11 and 22 respectively).

The progressive vector diagram for the observation period is provided below:

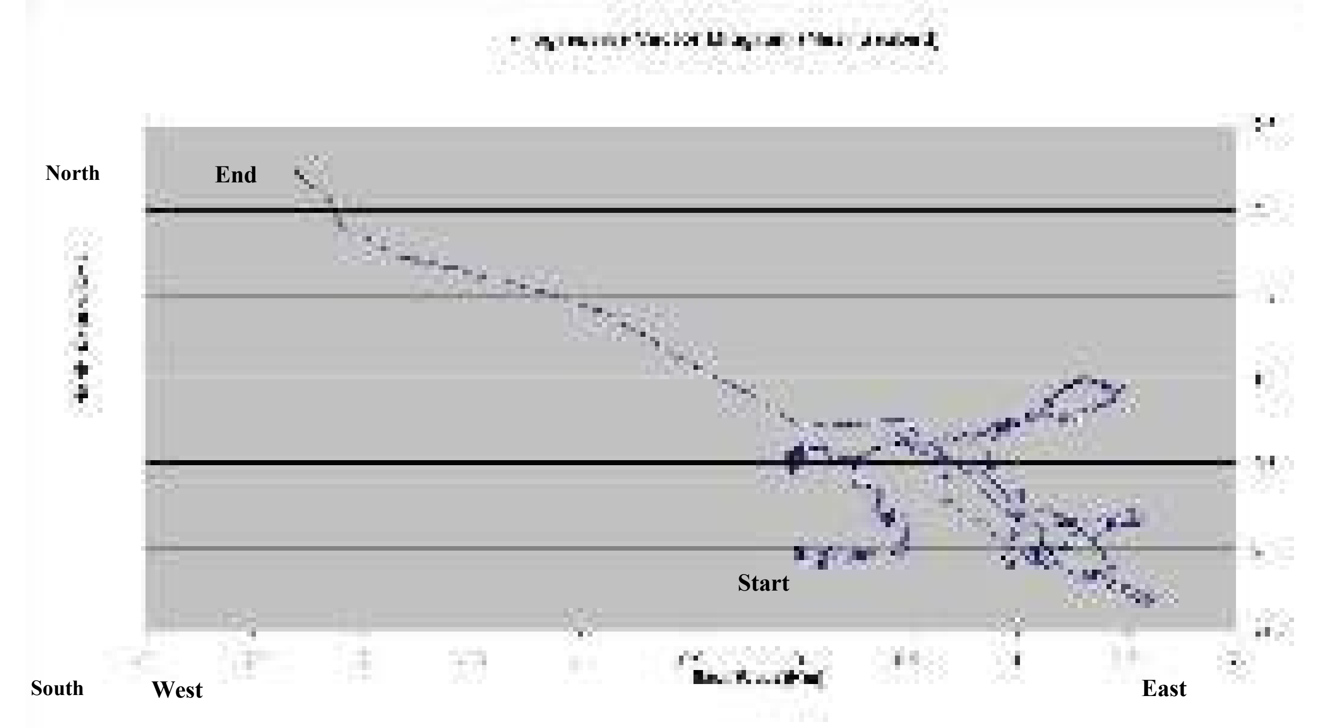


Figure 6-18: Progressive Vector Diagram – P2

As observed in the progressive vector diagram the water parcel was moving towards northwest at a distance of 2 km.

6.3.3 Location P3 – Pachalloor

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed from a boat in a downward looking mode, mounted on an L frame.

The deployment period was from 16th August to 15th September 2019.

① A maximum current of 1035 mm/sec was observed at the water surface on 30th August 2019 at 23:10hrs.

Refer to the following rose plots for speed and direction of the currents at three different levels i.e. surface, mid-depth and bottom, where speed is plotted in mm/sec.

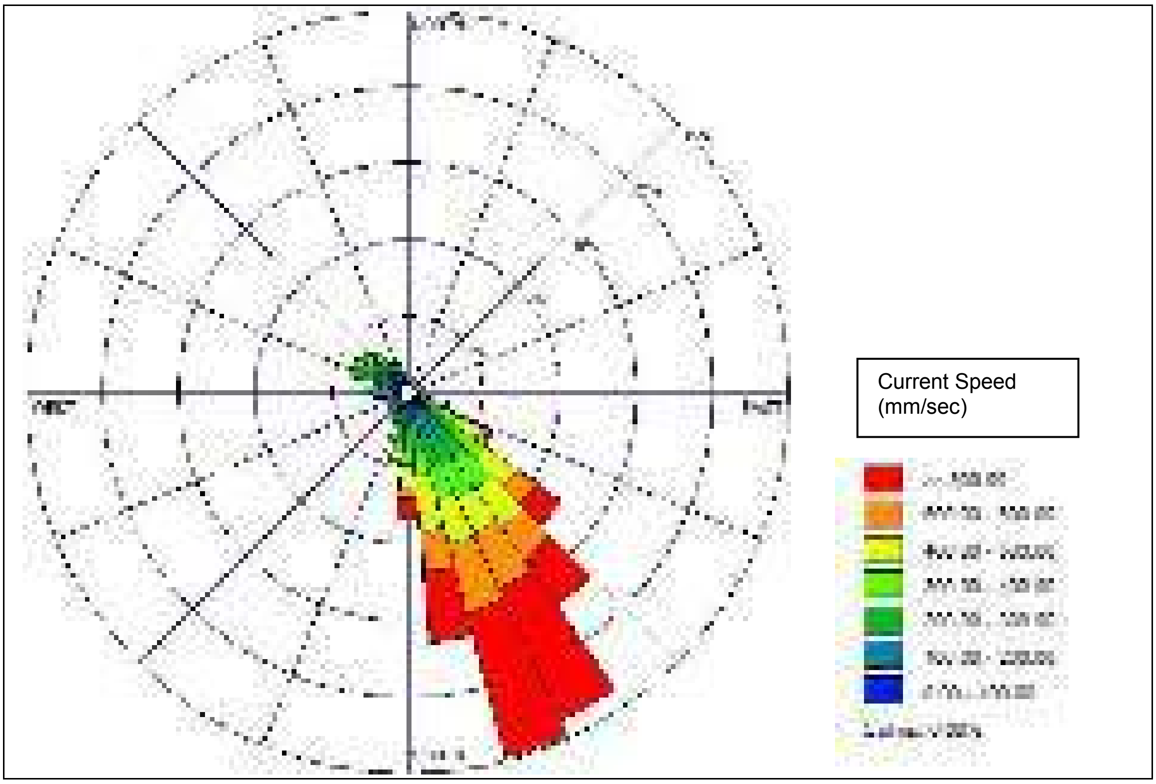


Figure 6-19: Rose Plot (surface speed in mm/sec) – P3

The data reveals that the surface currents were parallel to the shore in the northwest-southeast direction.

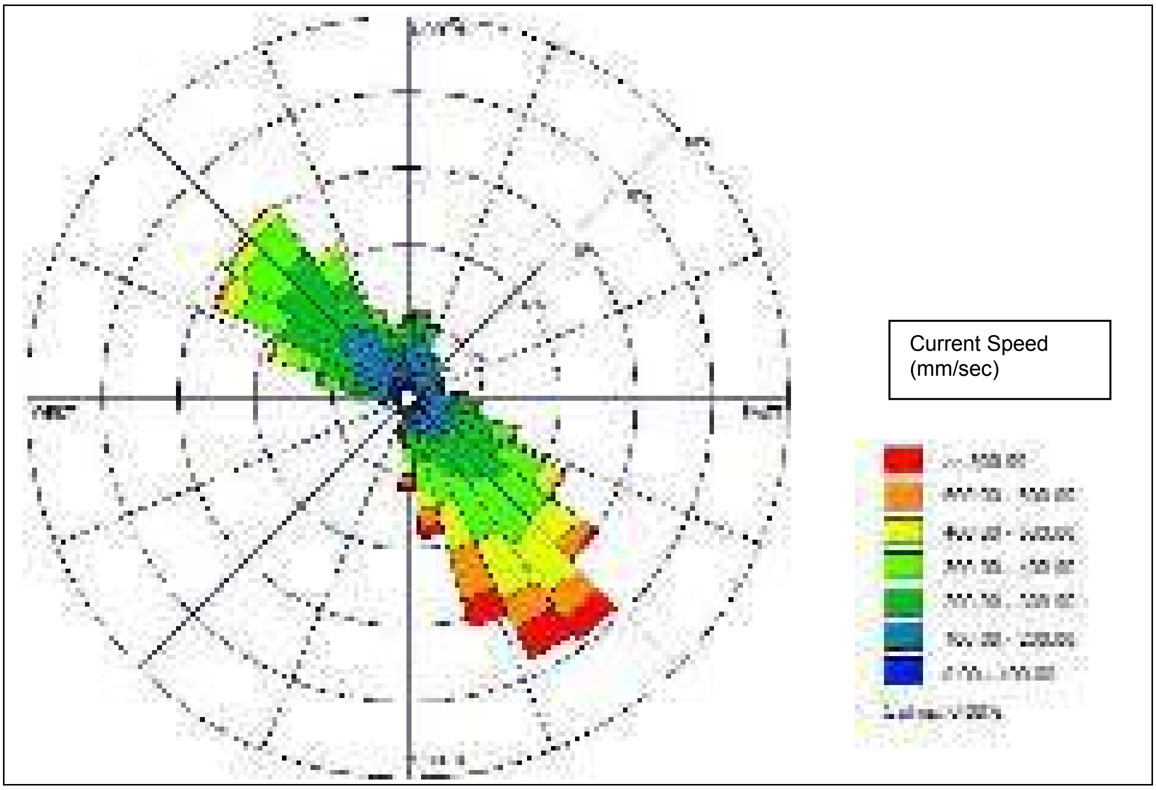


Figure 6-20: Rose Plot (mid-depth speed in mm/sec) – P3

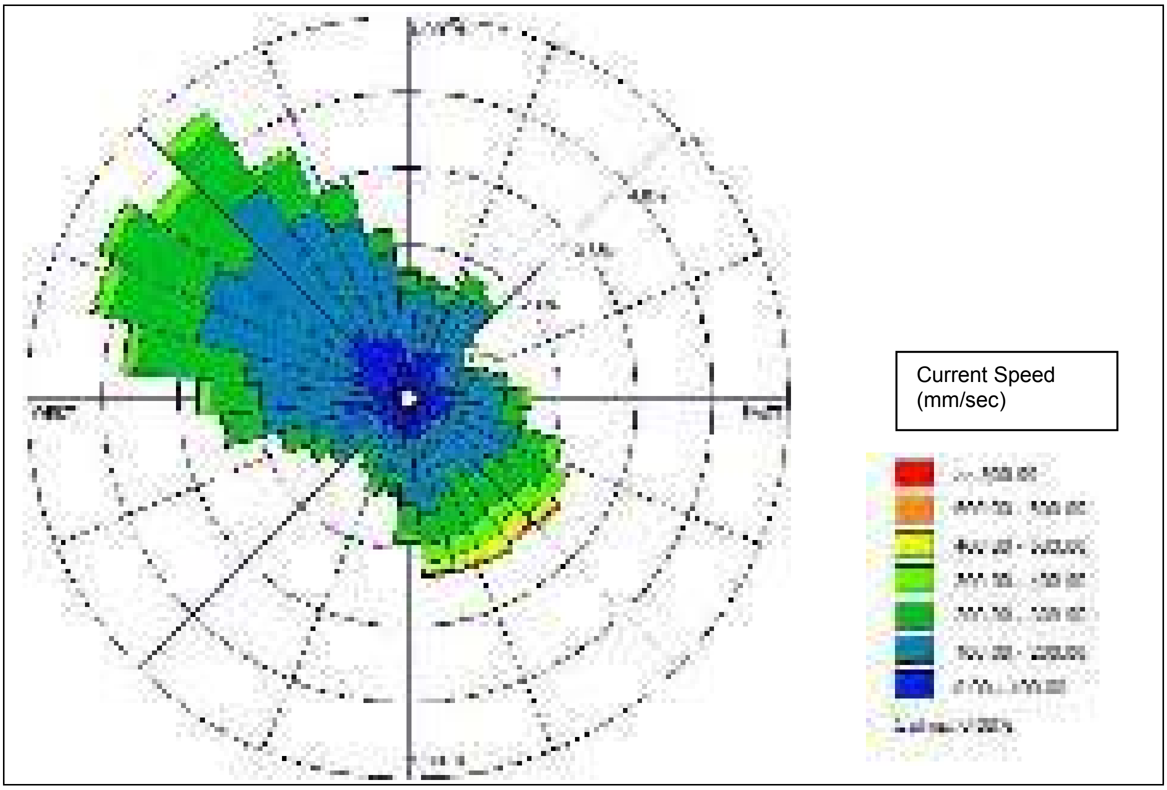


Figure 6-21: Rose Plot (near bottom speed in mm/sec) – P3

The current speed is seen to decrease towards the seabed as compared to the surface currents. The following table and figures provide the frequency histogram and percentage exceedance curve of the current speed.

Table 6-6: Percentage distribution of current speed – P3

Speed (mm/s)	Percentage Distribution		
	Surface	Mid	Bottom
0 - 100	11.14	14.49	28.61
100 - 200	21.73	28.73	45.41
200 - 300	14.23	24.10	19.99
300 - 400	11.46	16.23	4.33
400 - 500	12.30	8.99	1.39
500 - 600	10.27	4.58	0.27
>600	18.86	2.88	0.00
Total	**100**	**100**	**100**

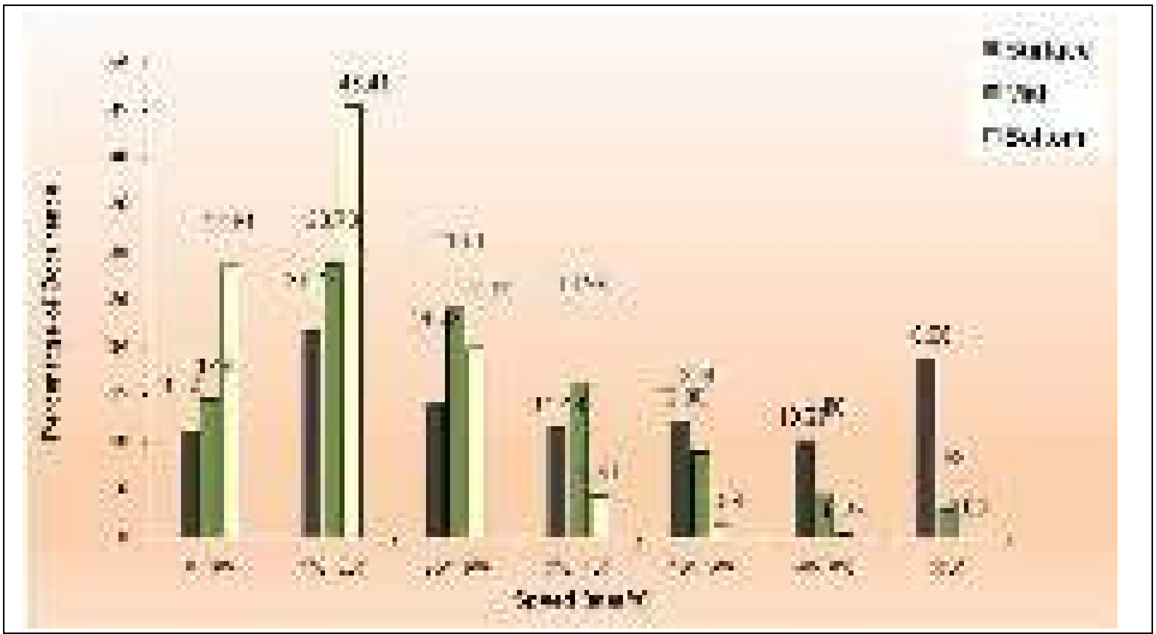


Figure 6-22: Histogram showing current speed – P3

Table 6-7: Percentage exceedance of current speed – P3

Percentage Distribution			
Speed (mm/s)	**% of Surface**	**% of Mid**	**% of Bottom**
0	100	100	100
100	88.86	85.51	71.39
200	67.12	56.78	25.98
300	52.89	32.68	5.99
400	41.44	16.45	1.66
500	29.14	7.46	0.27
600	18.86	2.88	0.00
700	0.00	0.00	0.00

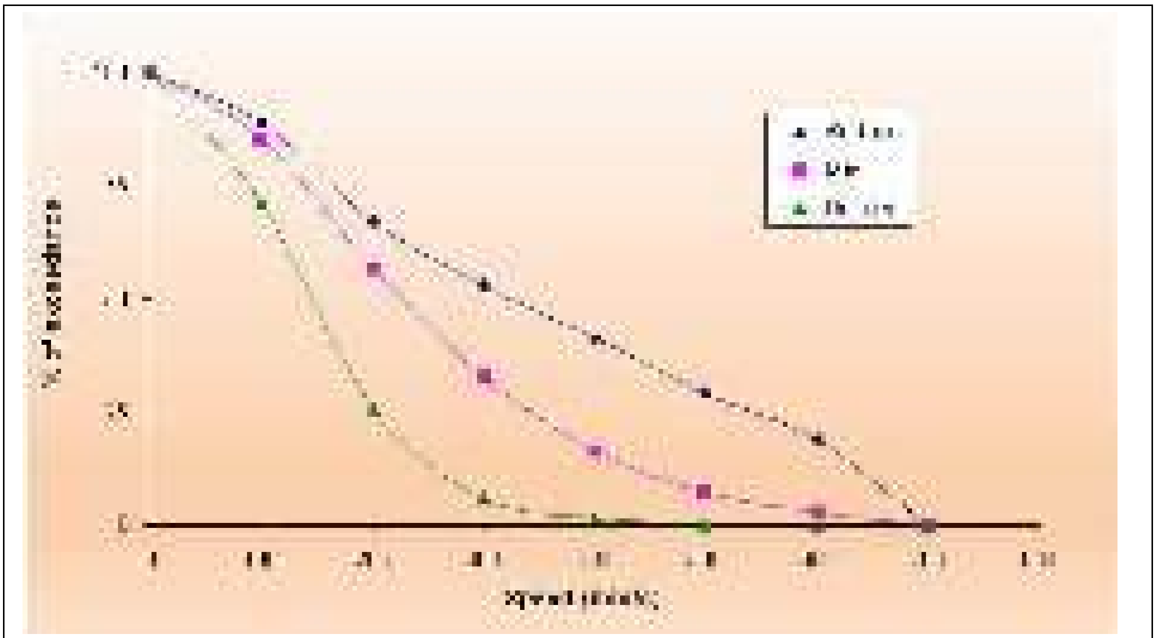


Figure 6-23: Exceedance curve of current speed – P3

The exceedance curve reveals that the surface current speed was evenly distributed 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, 11 and 22 respectively).

The progressive vector diagram for the observation period is provided below:

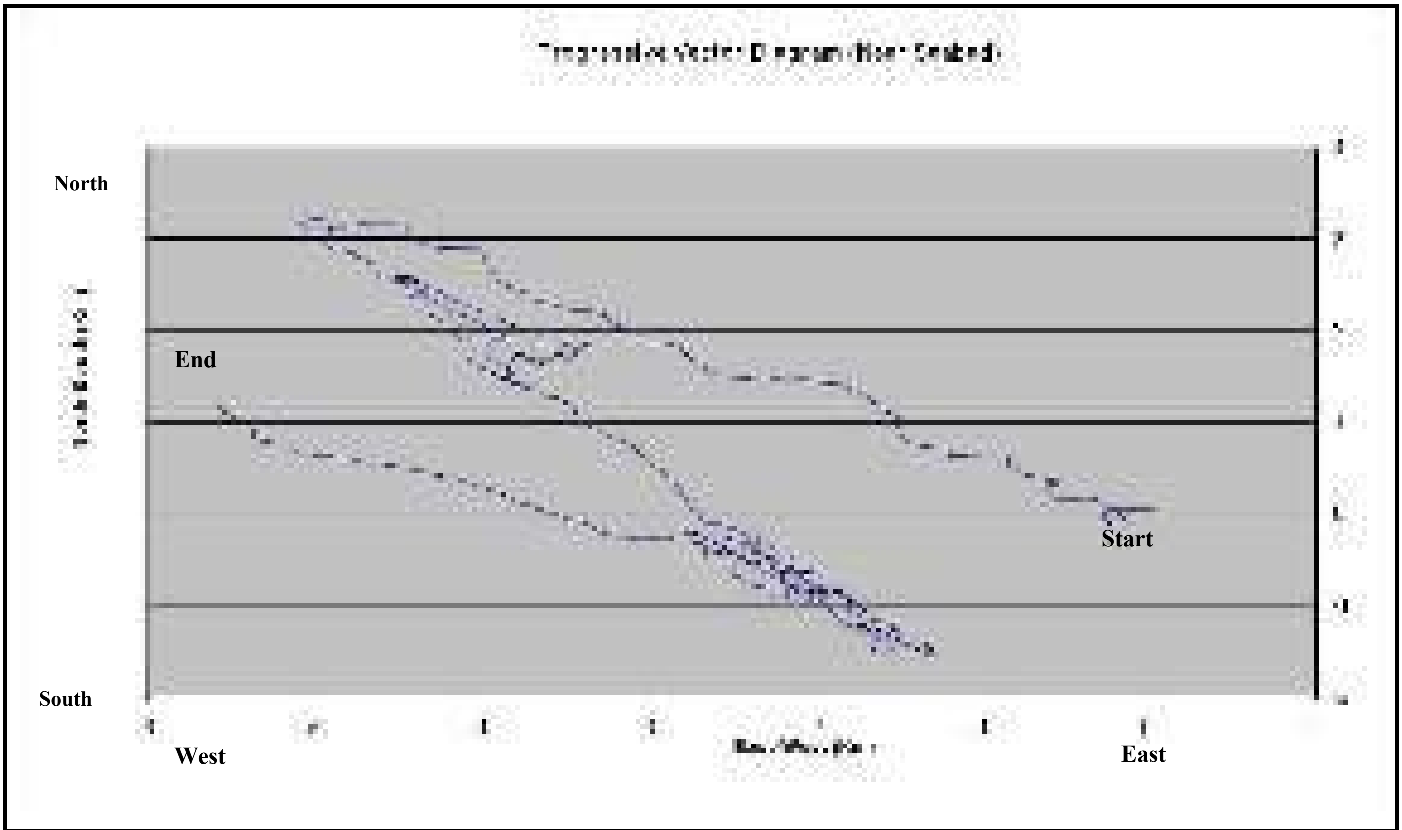


Figure 6-24: Progressive Vector Diagram – P3

As observed in the progressive vector diagram the water parcel was moving towards northwest at a distance of 3.5 km and to southeast to a distance of 3.5 km and further towards northwest to about 4 Km.

6.3.4 Location P4 – Mulloor

The ADCP was deployed for a period of 30 days to cover one lunar cycle. It was deployed from a boat in a downward looking mode, mounted on an L frame.

The deployment period was from 16th August to 15th September 2019.
A maximum current of 1053 mm/sec was observed at the water surface on 04th September 2019 at 17:30hrs.

Refer to the following rose plots for speed and direction of the currents at three different levels i.e. surface, mid-depth and bottom, where speed is plotted in mm/sec.

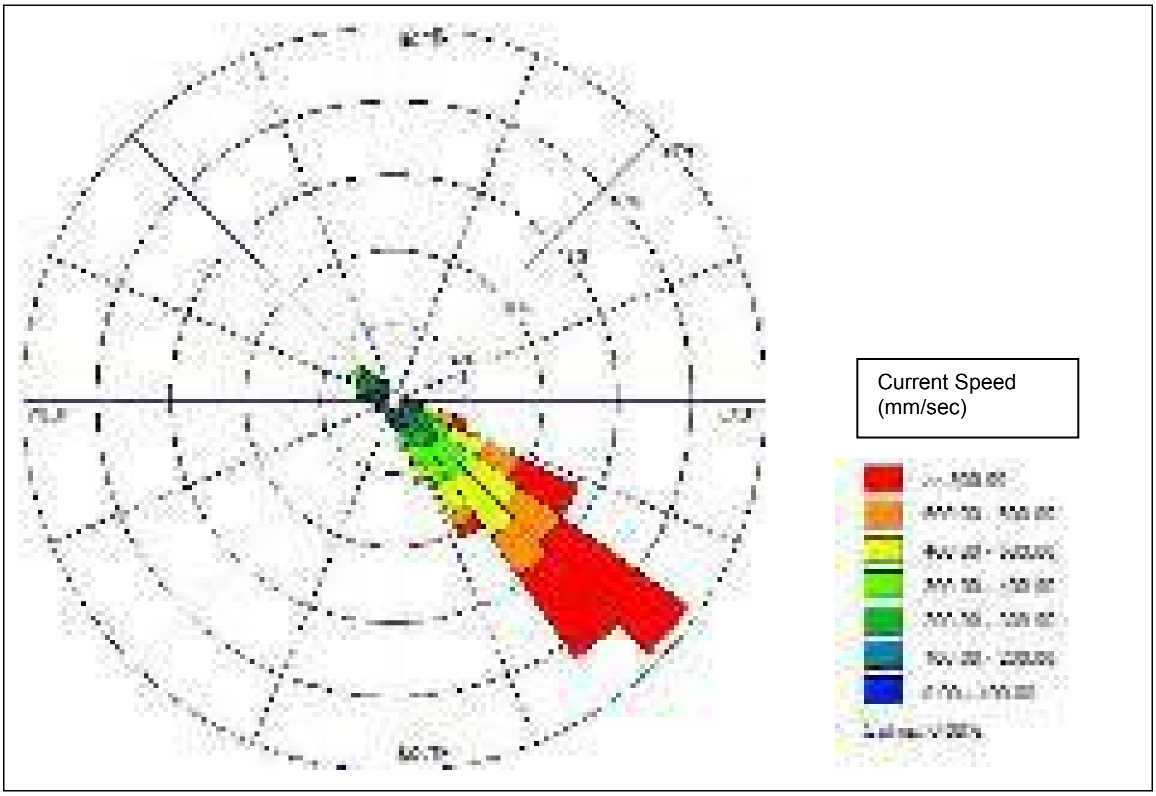


Figure 6-25: Rose Plot (surface speed in mm/sec) – P4

The data reveals that the surface currents were parallel to the shore in the northwest-southeast direction as seen at all the locations.

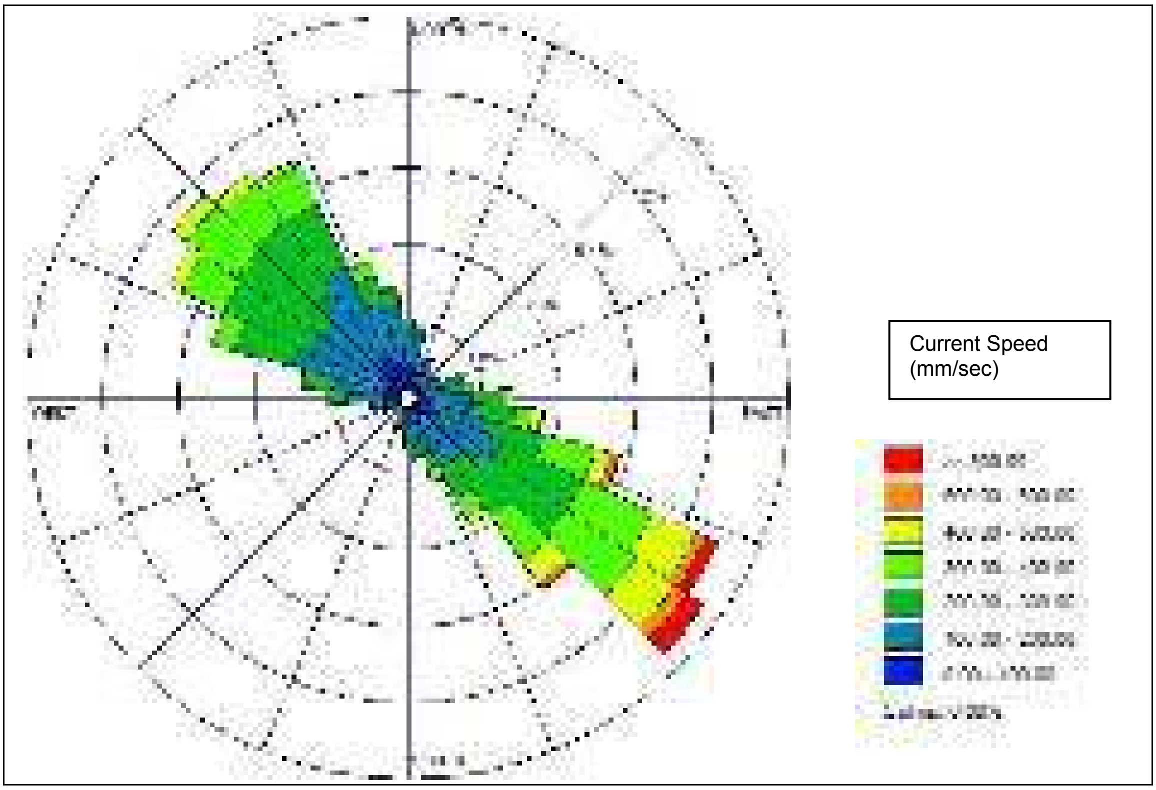


Figure 6-26: Rose Plot (mid-depth speed in mm/sec) – P4

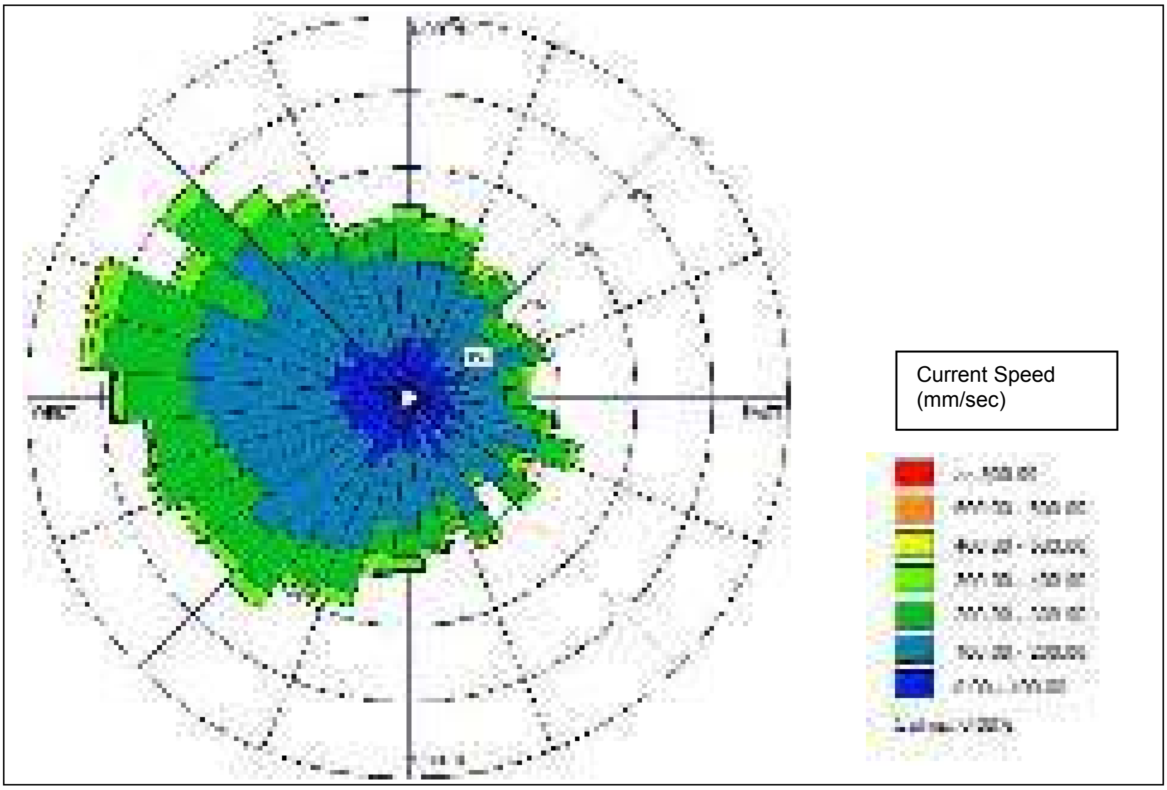


Figure 6-27: Rose Plot (near bottom speed in mm/sec) – P4

The current speed is seen to decrease towards the seabed as compared to the surface currents. The following table and figures provide the frequency histogram and percentage exceedance curve of the current speed.

Table 6-8: Percentage distribution of current speed – P4

Speed (mm/s)	**Percentage Distribution**		
	Surface	Mid	Bottom
0 - 100	12.66	20.21	29.03
100 - 200	22.95	35.72	42.29
200 - 300	14.47	25.71	20.59
300 - 400	11.82	13.38	6.03
400 - 500	13.14	4.26	1.46
500 - 600	9.77	0.68	0.60
>600	15.19	0.04	0.00
Total	**100**	**100**	**100**

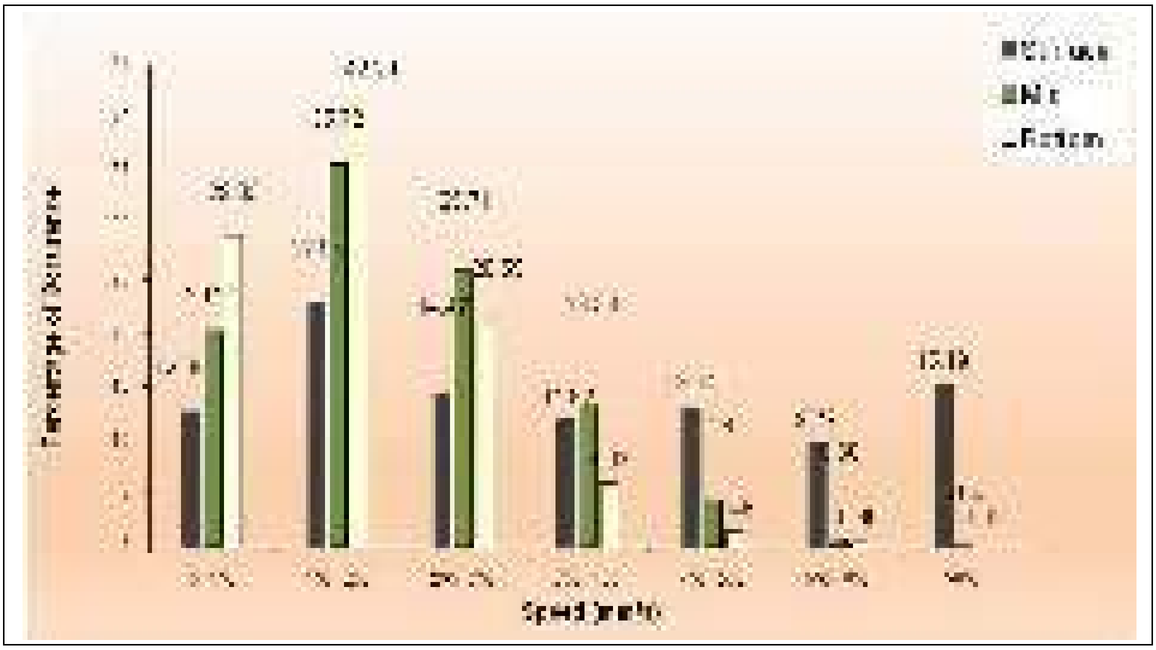


Figure 6-28: Histogram showing current speed – P4

Table 6-9: Percentage exceedance of current speed – P4

Percentage Distribution			
Speed (m/s)	**% of Surface**	**% of Mid**	**% of Bottom**
0	100	100	100
100	87.34	79.79	70.97
200	64.39	44.07	28.68
300	49.92	18.36	8.10
400	38.10	4.98	2.07
500	24.96	0.72	0.60
600	15.19	0.04	0.00

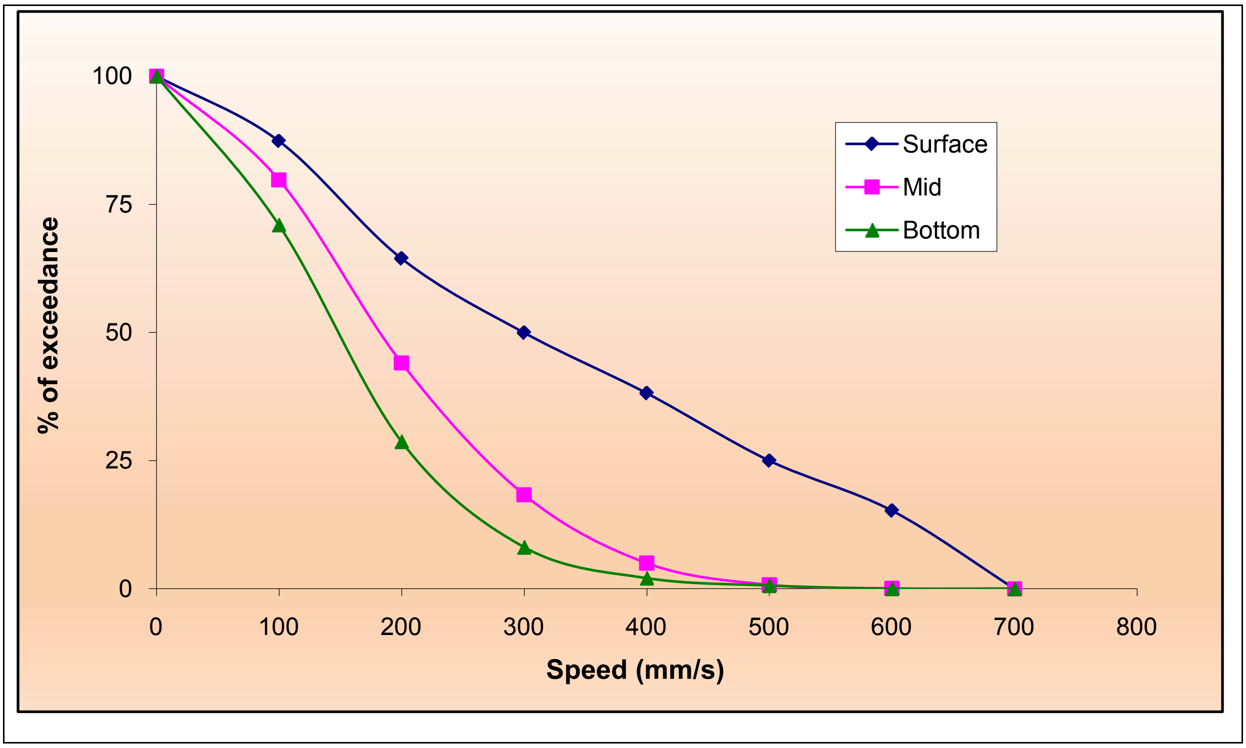


Figure 6-29: Exceedance curve of current speed – P4

The exceedance curve reveals that the surface current speed was evenly distributed in all defined class as seen at all the other locations, 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, 11 and 22 respectively).

The progressive vector diagram for the observation period is provided below:

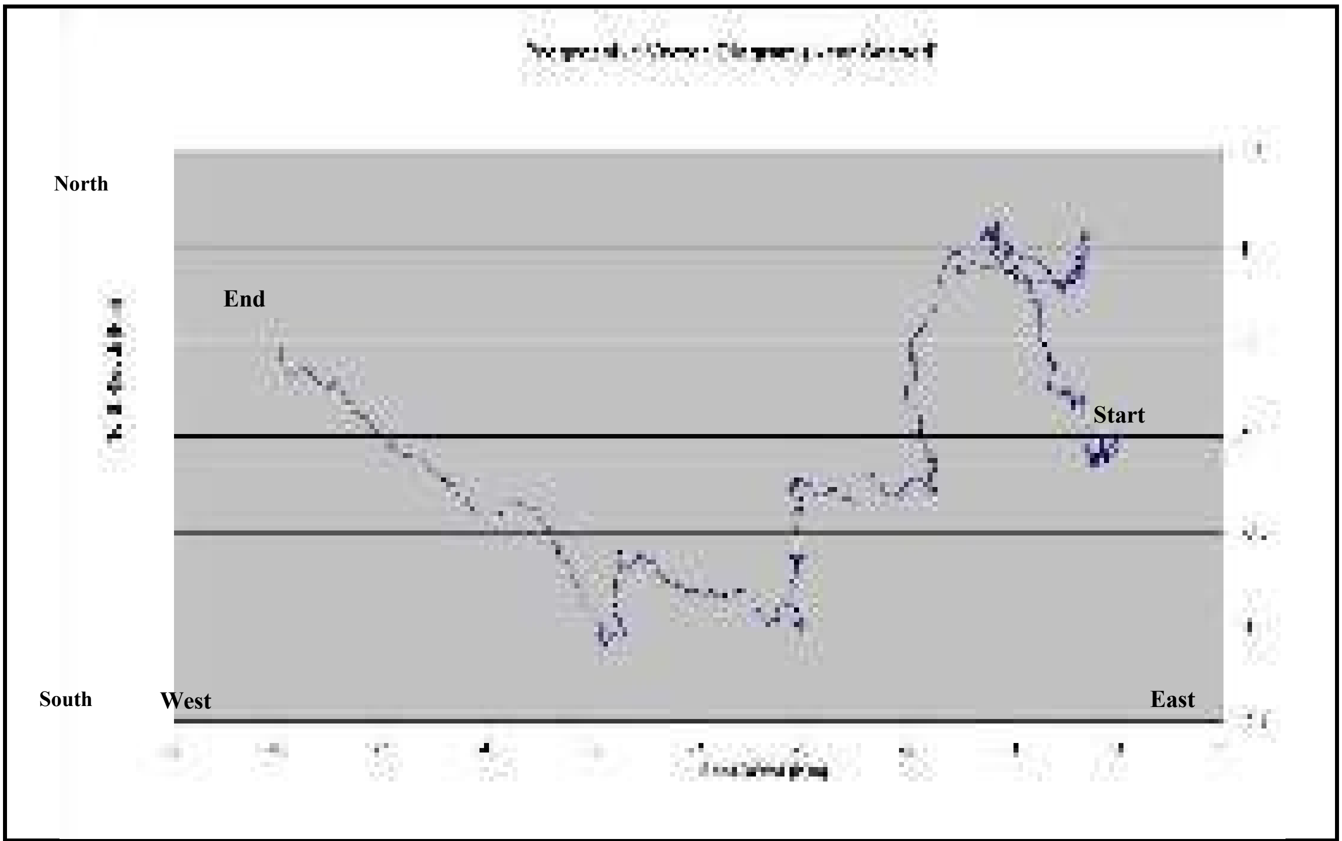


Figure 6-30: Progressive Vector Diagram – P4

As observed in the progressive vector diagram the water parcel was moving towards northwest and to south and then to northwest again. The total distance travelled was about 8 km.

6.4 Measurement of Meteorological Parameters

The data for the month of September 2019 was downloaded and after quality control checks, is presented below:

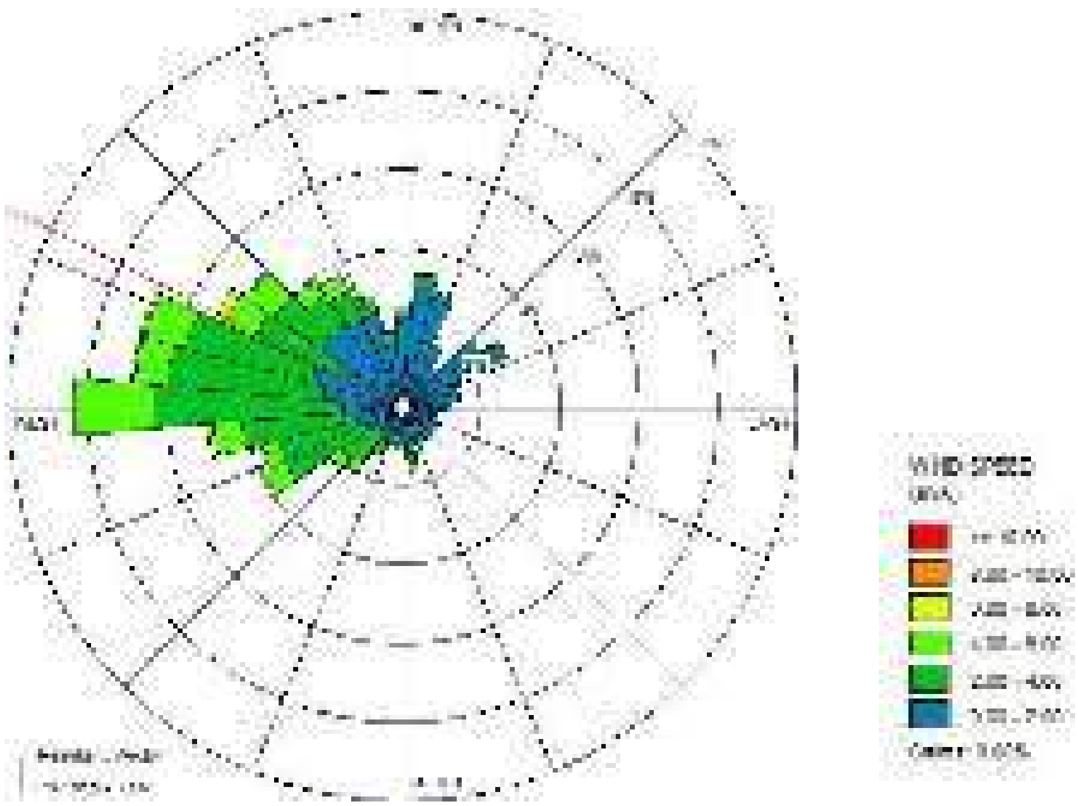


Figure 6-31: Wind rose (Speed in m/s vs direction) from 1st to 30th September 2019

The rose plot reveals south-westerly to north-northeasterly winds with velocities up to 7.87m/s.

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

Table 6-10: Frequency distribution of wind speed (1st to 30th September)

Frequency Distribution		
Wind Speed (m/s)	**No. of observations**	**Percentage of Occurrence**
0 - 2	2421	59.46
2 - 4	1225	30.08
4 - 6	387	9.50
6 - 8	39	0.96
8 - 10	0	0.00
>10	0	0.00
Total	**4072**	**100.00**

The histogram of wind speed for the period is provided below:

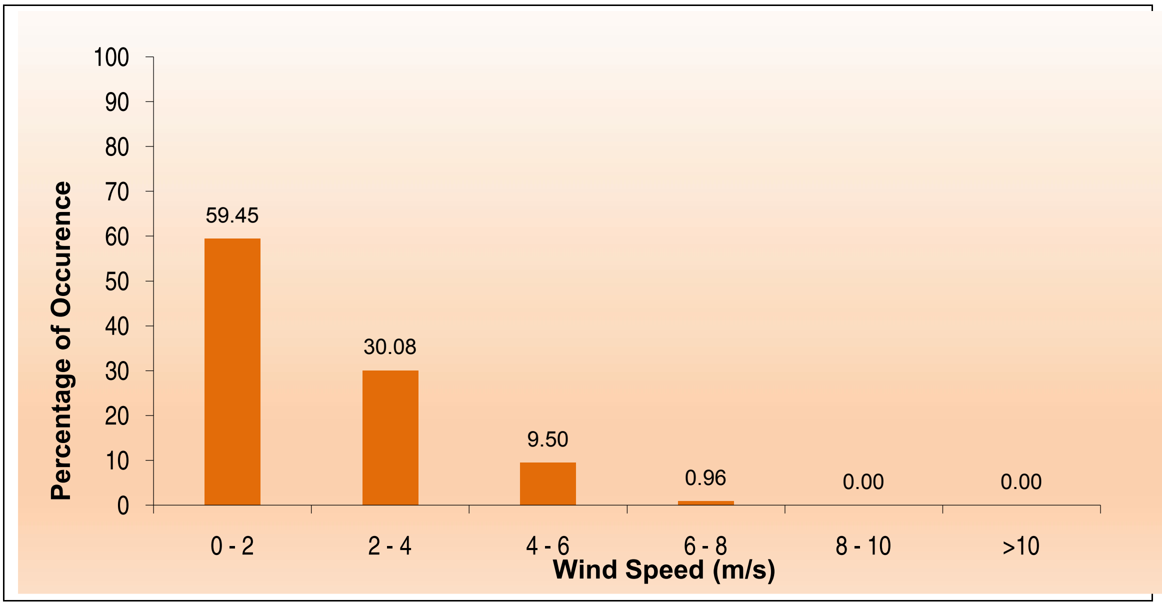
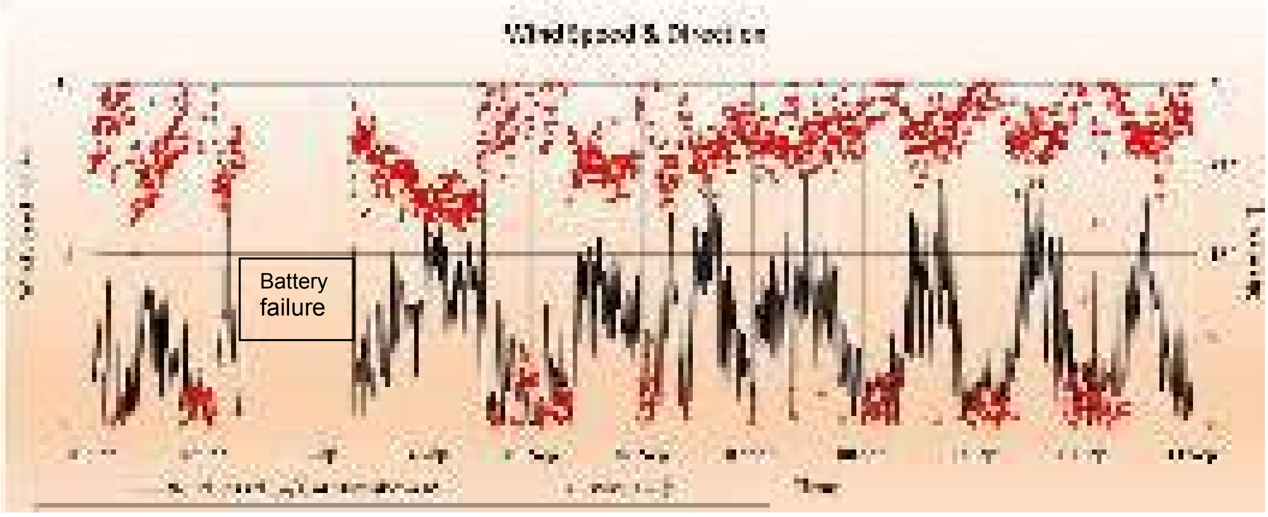
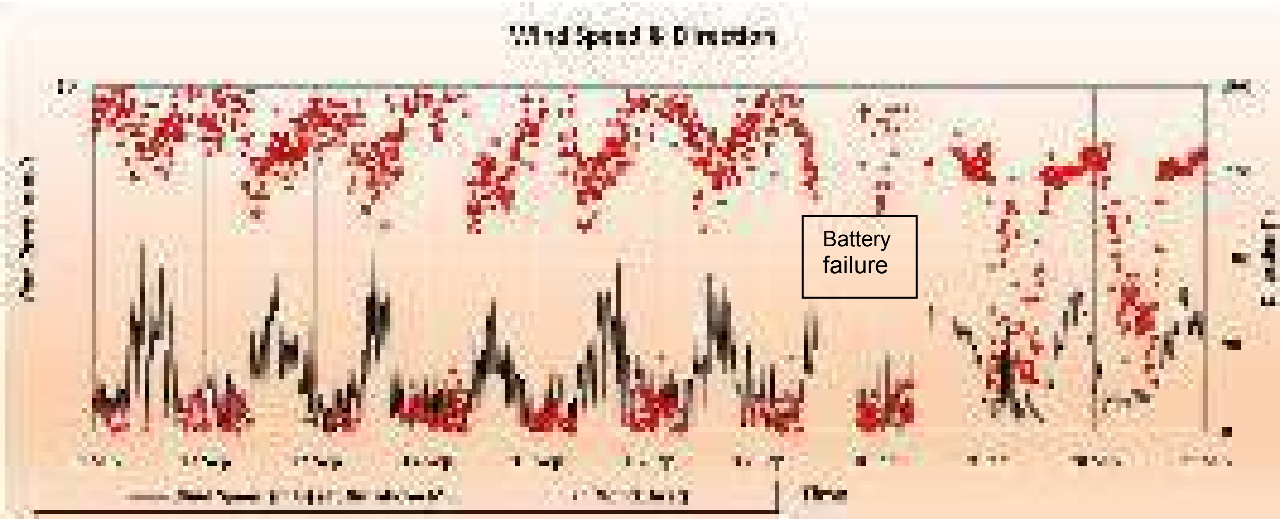


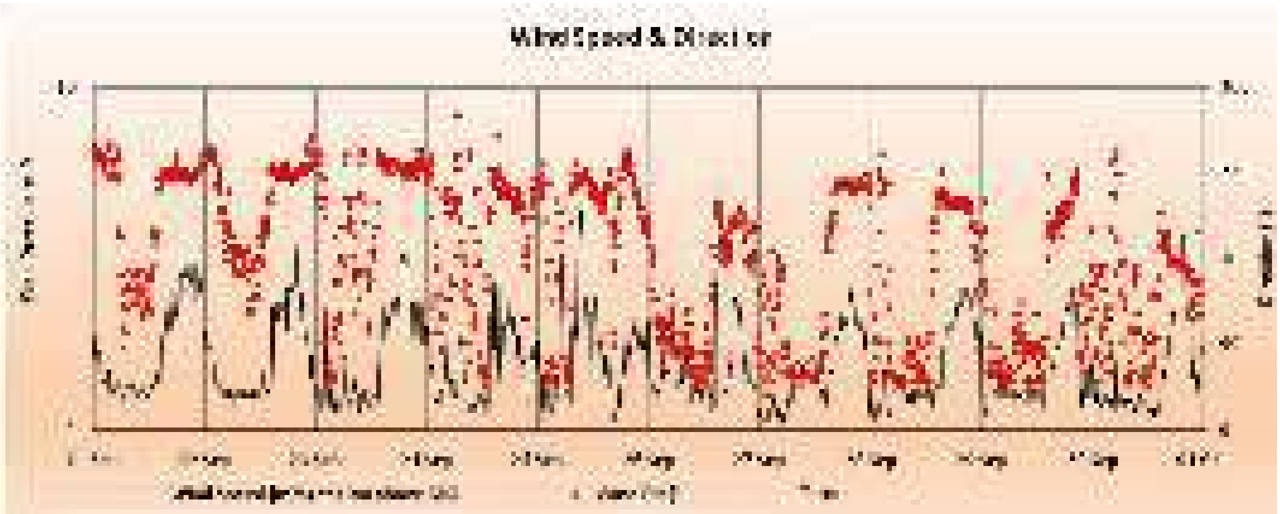
Figure 6-32: Histogram of wind speed from 1st to 30th September2019

As can be seen from the above histogram, the winds were less than 8 m/s throughout the period. The maximum wind speed in the month of September 2019 was 7.87m/s, recorded on 02nd September 2019 at 05:30 hrs.

The time series graphs for the period are placed below:







The percentage occurrence tables drawn for atmospheric pressure, temperature and relative humidity are presented below:

Table 6-11: Frequency distribution of Met parameters (1st to 30th September 2019)

Frequency Distribution		
Atm Pressure (mb)	**No. of observations**	**Percentage of Occurrence**
<1000	761	18.98
1000 - 1004	213	5.31
1004 - 1008	1186	29.58
> 1008	1849	46.12
Total	**4009**	**100.00**

Frequency Distribution		
Temperature (°C)	**No. of observations**	**Percentage of Occurrence**
20-24	252	5.98
24-28	2790	66.26
28-32	1168	27.74
>32	1	0.02
Total	**4211**	**100.00**

Frequency Distribution		
RH (%)	**No. of observations**	**Percentage of Occurrence**
50-60	0	0.00
60-70	144	3.55
70-80	995	24.50
>80	2923	71.96
Total	**4006**	**100.00**

The histogram drawn for the parameters for the period is provided below:

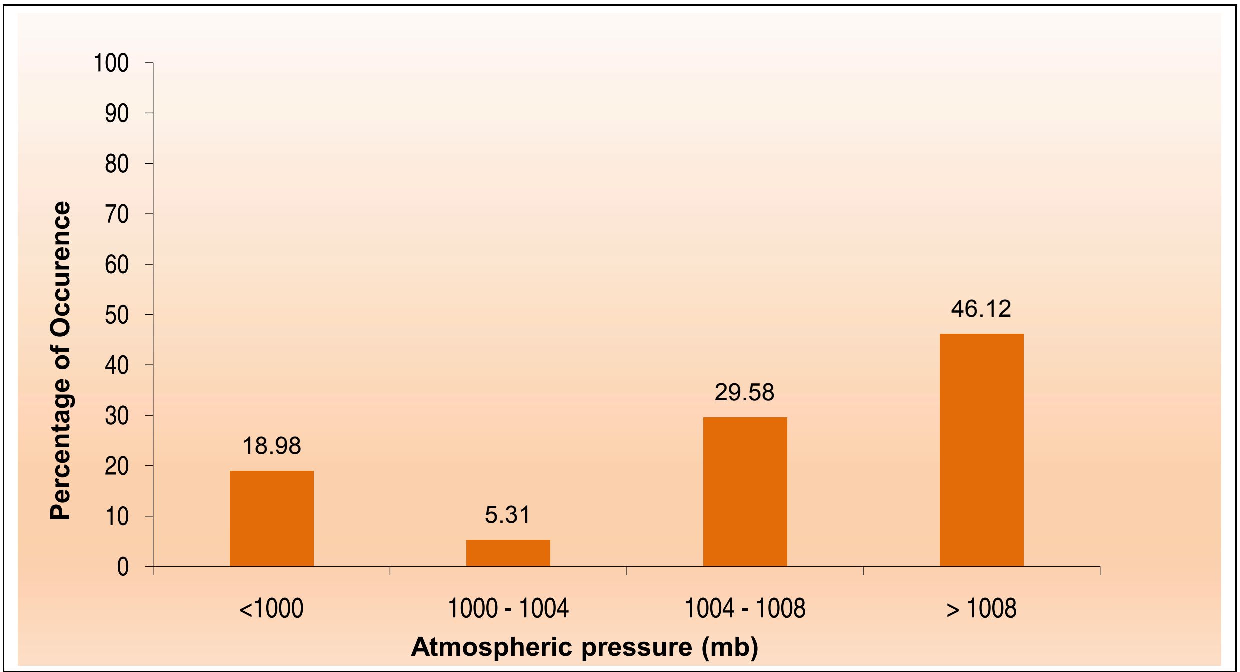


Figure 6-33: Histogram of Atmospheric Pressure from 1st to 30th September 2019

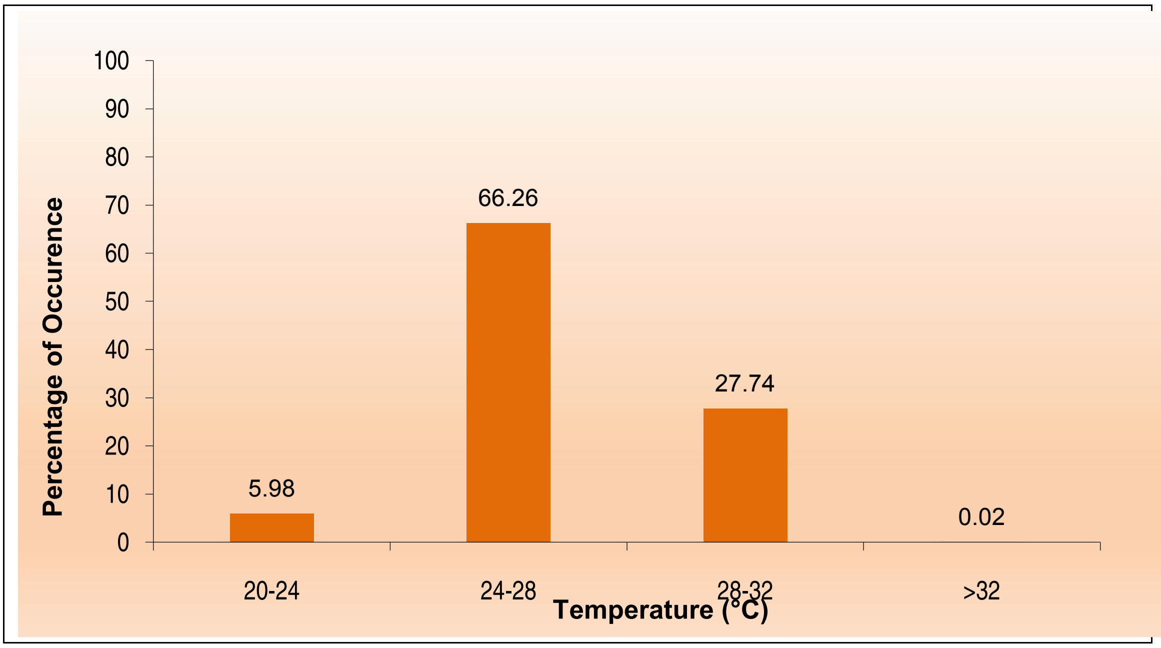


Figure 6-34: Histogram of Temperature from 1st to 30th September 2019

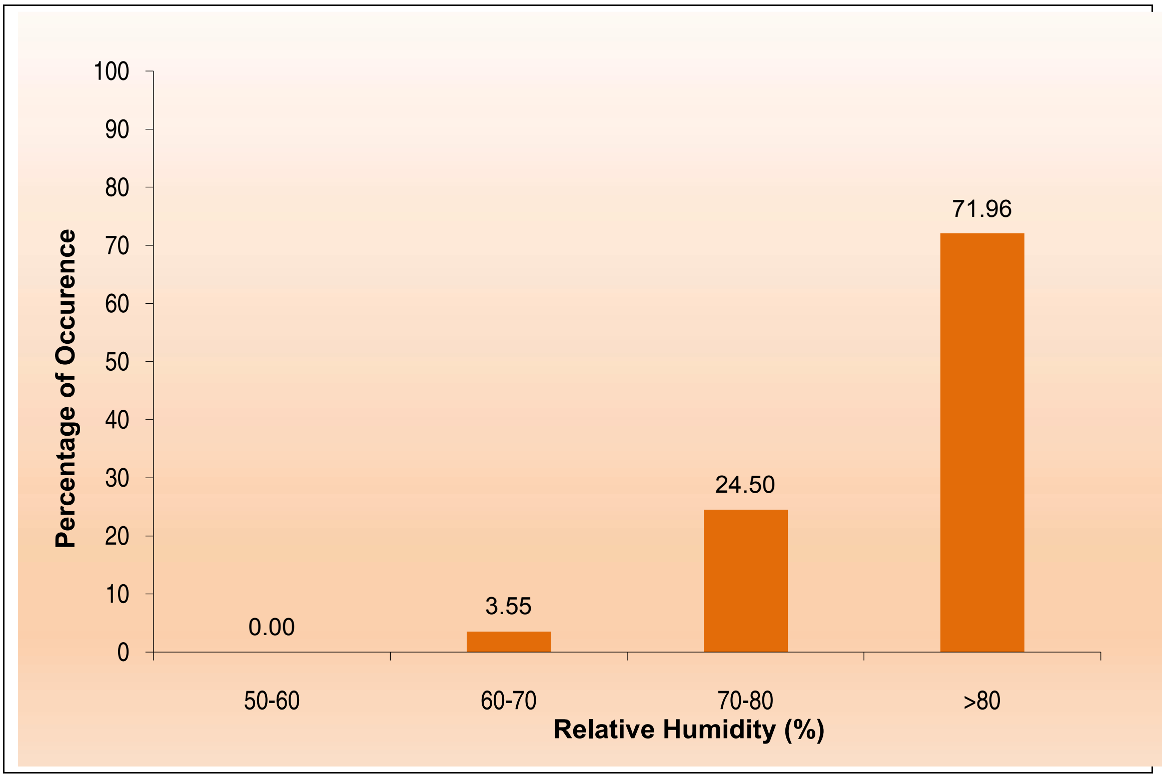


Figure 6-35: Histogram of Relative Humidity from 1st to 30th September 2019

The data represented above reveals that about 29.58% of the atmospheric pressure recorded for the month was between 1004 mb and 1008 mb. The temperature was between 21.4 to 32.1°C during the month. The relative humidity was greater than 80% during 71.96% of the observations indicating rainy conditions.

The rainfall data collected during the period 18th September to 30th September indicates rainy days during most of the days. A cumulative rainfall of *191.8mm* was recorded during the period.

6.5 Littoral Environment Observations

The LEO was carried out at 81 locations. The LEO plate was deployed at all the locations and the same was tracked for about five to ten minutes, as per the site conditions. The initial and final GPS positions were then used to calculate the SOG and COG. The estimated wave height, angle of wave, period and the stretch of breakers were also noted down in the log.

The along shore current was mainly towards the south during the period of monitoring. The maximum speed of 43.76 cm/s was observed at CSP-74. Rip currents were observed in the locations CSP 2, 11, 13, 14, 15, 17 to 22, 41 to 46, 48, 54, 55, 60, 64, 70, 72, 75, 76, 78 and 81.

6.6 Photographic Documentation

Photographic documentation was carried out for all the 81 locations, coinciding with the cross-shore profiling. The photographs for the period are placed at Annexure I. As a common reference point, a 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. As the monsoon was active during the observation period, the beaches were almost inundated with sea water and vast stretches of the shoreline were engulfed by waves.

Few photographs of location where the beaches were not present during the season, are given below for reference:

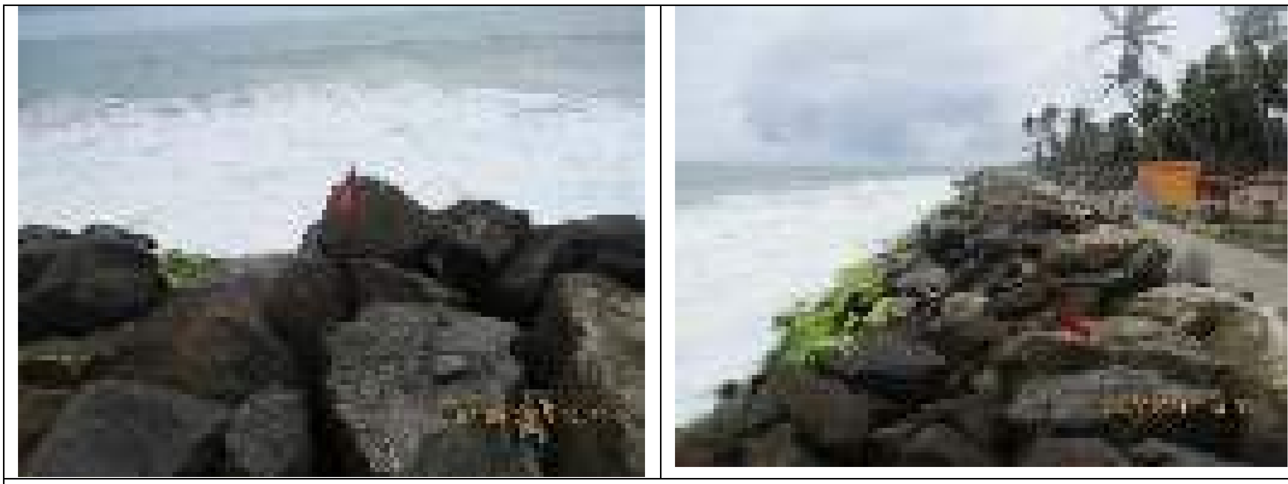


Figure 6-36: CSP 50 (Panathura Temple)

Figure 6-37: CSP 47 (Samudra Beach, Kovalam)

6.7 Cross Shore Profiles

The cross-shore profiling for the period was carried out using RTK in the onshore region. Except for CSP-35 (Azhimala area) where there was no beach, all onshore locations were carried out.

The offshore profiling was carried out during the month of September 2019 during good weather conditions using a GeoSwath 500 KHz multibeam echo sounder. During the survey period, due to breakers nearshore, the boat could not approach the shore. Hence the first data obtained was about 100 to 450m towards offshore, from the 0m line. In most of the lines, the nearest depth which could be attained was greater than 5m. The boat could not be approached nearshore, considering the safety of personnel onboard.

The following table provides the identification of CSP vis-à-vis the local name:

Table 6-12: CSP Location names

CSP NO.	LANDMARK	LOCATION
CSP-01	CATHOLIC CRISMATIC PRAYER CENTER	EDAPPADU BEACH
CSP-02		
CSP-03		
CSP-04	ST. MARY'S CHURCH	VALLAVILAY
CSP-05		
CSP-06		
CSP-07	ST. NICOLAS' CHURCH	NEERODY
CSP-08		
CSP-09		
CSP-10	SREE BHADRAKALI TEMPLE	POZHIYOOR
CSP-11		
CSP-12		
CSP-13	ST. MATHEW'S CHURCH	PARUTHIYOOR
CSP-14	CHURCH OF CHRIST	
CSP-15	POOVAR ISLAND RESORT	POOVAR BEACH SOUTH
CSP-16		
CSP-17		
CSP-18	POZHIKARA BEACH	POOVAR
CSP-19		
CSP-20	ST. ANTONY'S CHAPEL	POOVAR BEACH NORTH
CSP-21		
CSP-22	ST. ANTONY'S CHURH	KARUMKULAM
CSP-23		
CSP-24		
CSP-25		
CSP-26		
CSP-27	GOTHAMBU ROAD	PULLUVILA
CSP-28		
CSP-29		
CSP-30		
CSP-31	ADIMALATHURA CATHOLIC CHURCH	ADIMALATHURA
CSP-32		
CSP-33		
CSP-34		
CSP-35	AZHIMALA TEMPLE	AZHIMALA
CSP-36	NAGAR BHAGAVATHY TEMPLE	MULLUR
CSP-37		

CSP NO.	LANDMARK	LOCATION
CSP-38	ADANI PORT RECLAMATION AREA	ADANI PORT OFFICE VIZHINJAM
CSP-39		
CSP-40		
CSP-41	VIZHINJAM LIGHT HOUSE	KOVALAM
CSP-42		
CSP-43		
CSP-44		
CSP-45		
CSP-46		
CSP-47	SAMUDRA BEACH PARK	KOVALAM
CSP-48	MOSQUE	PANATHURA
CSP-49		
CSP-50	PANATHURA TEMPLE	PANATHURA
CSP-51		
CSP-52		
CSP-53	PUNTHURA FISH MARKET	PUNTHURA
CSP-54		
CSP-55		
CSP-56		
CSP-57		
CSP-58	BEEMA PALLY	BEEMA PALLY
CSP-59		
CSP-60		
CSP-61	CHERIYATHURA SPORTS GROUND	CHERIYATHURA
CSP-62		
CSP-63	VALIYATHURA BRIDGE	VALIYATHURA
CSP-64		
CSP-65		
CSP-66		
CSP-67		
CSP-68	SHANGUMUGHAM BEACH	SHANGUMUGHAM
CSP-69		
CSP-70	ST. PETER'S CHURCH	SHANGUMUGHAM
CSP-71		
CSP-72	VETTUCAUD CHURCH	VETTUCAUD
CSP-73		
CSP-74		
CSP-75	VELI CHILDRENS PARK	KOCHUVELI
CSP-76		
CSP-77		

CSP NO.	LANDMARK	LOCATION
CSP-78	ST. THOMAS' CHURCH	VALIYA VELI
CSP-79		
CSP-80	CHRISTIAN BROTHEREN CHURCH	THUMBA
CSP-81		

6.8 Beach Sampling

Beach samples were collected from 62 out of the 81 locations. The following table shows the D50 value (in mm) of the sediments collected along with the soil classification.

Table 6-13: Beach sample soil classification

Sample Name	Gravel %	Sand%	Mud%	Total	D50 (mm)	Classification
BS-01	0	100	0	100	0.4272	Medium sand
BS-02	0	100	0	100	0.4614	Medium sand
BS-03	Not collected					
BS-04	Not collected					
BS-05	Not collected					
BS-06	Not collected					
BS-07	Not collected					
BS-08	0	100	0	100	0.4191	Fine sand
BS-09	0	100	0	100	0.3488	Fine sand
BS-10	Not collected					
BS-11	Not collected					
BS-12	Not collected					
BS-13	0	100	0	100	0.4606	Medium sand
BS-14	0	100	0	100	0.4266	Medium sand
BS-15	0	100	0	100	0.4711	Medium sand
BS-16	0	100	0	100	0.4215	Fine sand
BS-17	0	100	0	100	0.3949	Fine sand
BS-18	0	100	0	100	0.5529	Medium sand
BS-19	0	100	0	100	0.4929	Medium sand
BS-20	0	100	0	100	0.4916	Medium sand
BS-21	0	100	0	100	0.5015	Medium sand
BS-22	0	100	0	100	0.4599	Medium sand
BS-23	0	100	0	100	0.6527	Medium sand
BS-24	0	100	0	100	0.4811	Medium sand
BS-25	0	100	0	100	0.4347	Medium sand
BS-26	0	100	0	100	0.401	Fine sand
BS-27	0	100	0	100	0.4636	Medium sand
BS-28	0	100	0	100	0.4395	Medium sand
BS-29	0	100	0	100	0.5719	Medium sand

Sample Name	Gravel %	Sand%	Mud%	Total	D50 (mm)	Classification
BS-30	0	100	0	100	0.5011	Medium sand
BS-31	0	100	0	100	0.4254	Medium sand
BS-32	0	100	0	100	0.4124	Fine sand
BS-33	0	100	0	100	0.5336	Medium sand
BS-34	0	100	0	100	0.3528	Fine sand
BS-35	Not collected					
BS-36	0	100	0	100	0.542	Medium sand
BS-37	0	100	0	100	0.5595	Medium sand
BS-38	0	100	0	100	0.3899	Fine sand
BS-39	0	100	0	100	0.6176	Medium sand
BS-40	0	100	0	100	0.6668	Medium sand
BS-41	0	100	0	100	0.4101	Fine sand
BS-42	0	100	0	100	0.1627	Fine sand
BS-43	0	100	0	100	0.1756	Fine sand
BS-44	0	100	0	100	0.3692	Fine sand
BS-45	0	100	0	100	0.3126	Fine sand
BS-46	0	100	0	100	0.3371	Fine sand
BS-47	Not collected					
BS-48	0	100	0	100	0.4323	Medium sand
BS-49	Not collected					
BS-50	Not collected					
BS-51	Not collected					
BS-52	Not collected					
BS-53	0	100	0	100	0.3411	Fine sand
BS-54	0	100	0	100	0.3075	Fine sand
BS-55	0	100	0	100	0.3496	Fine sand
BS-56	0	100	0	100	0.3558	Fine sand
BS-57	0	100	0	100	0.387	Fine sand
BS-58	0	100	0	100	0.343	Fine sand
BS-59	Not collected					
BS-60	0	100	0	100	0.3383	Fine sand
BS-61	Not collected					
BS-62	0	100	0	100	0.3669	Fine sand
BS-63	Not collected					
BS-64	0	100	0	100	0.4776	Medium sand
BS-65	Not collected					
BS-66	0	100	0	100	0.5734	Medium sand
BS-67	Not collected					
BS-68	0	100	0	100	0.3843	Fine sand
BS-69	0	100	0	100	0.3235	Fine sand
BS-70	0	100	0	100	0.2191	Fine sand
BS-71	0	100	0	100	0.1931	Fine sand
BS-72	0	100	0	100	0.2856	Fine sand
BS-73	0	100	0	100	0.3075	Fine sand

Sample Name	Gravel %	Sand%	Mud%	Total	D50 (mm)	Classification
BS-74	0	100	0	100	0.414	Fine sand
BS-75	0	100	0	100	0.4556	Medium sand
BS-76	0	100	0	100	0.4487	Medium sand
BS-77	0	100	0	100	0.4187	Fine sand
BS-78	0	100	0	100	0.4288	Medium sand
BS-79	0	100	0	100	0.4217	Fine sand
BS-80	0	100	0	100	0.4062	Fine sand
BS-81	0	100	0	100	0.3724	Fine sand

The classification was based on IS 1498 as provided below:

Fine Sand – 0.425 to 0.075 mm
Medium Sand – 2 to 0.425 mm
Coarse Sand – 4.75 to 2 mm

The following graph shows the distribution of D50 value of the sediments collected in each location.

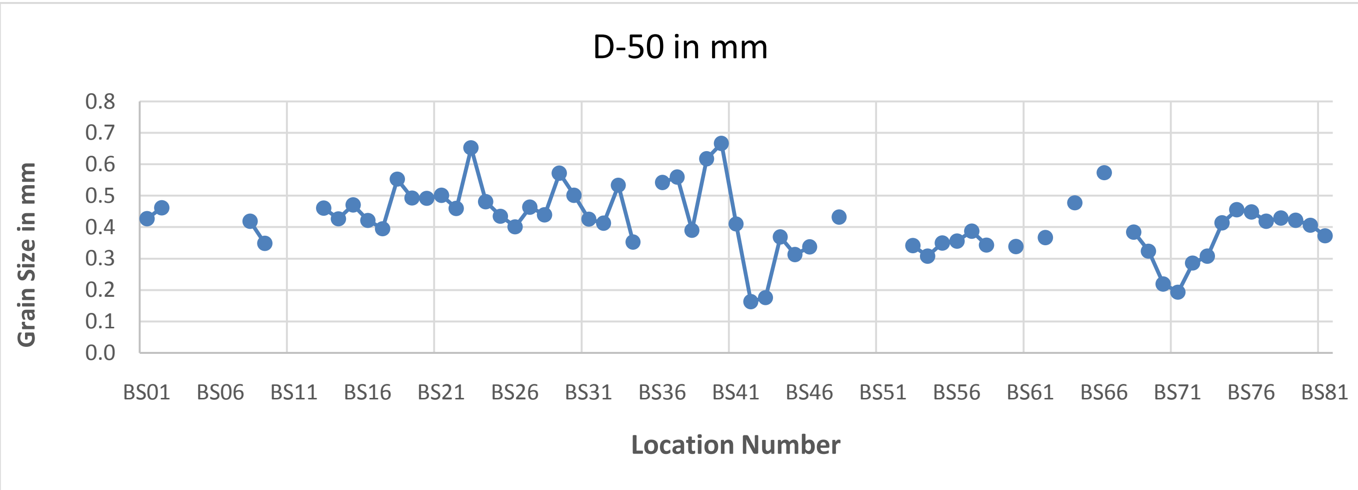


Figure 6-38: Distribution of D50 value of sediments

Based on the above, it is inferred that the beach samples at the locations were mostly medium to fine sand.

7 OVERALL PROGRESS

Up to 30th September 2019, the following image provides the overall progress chart.

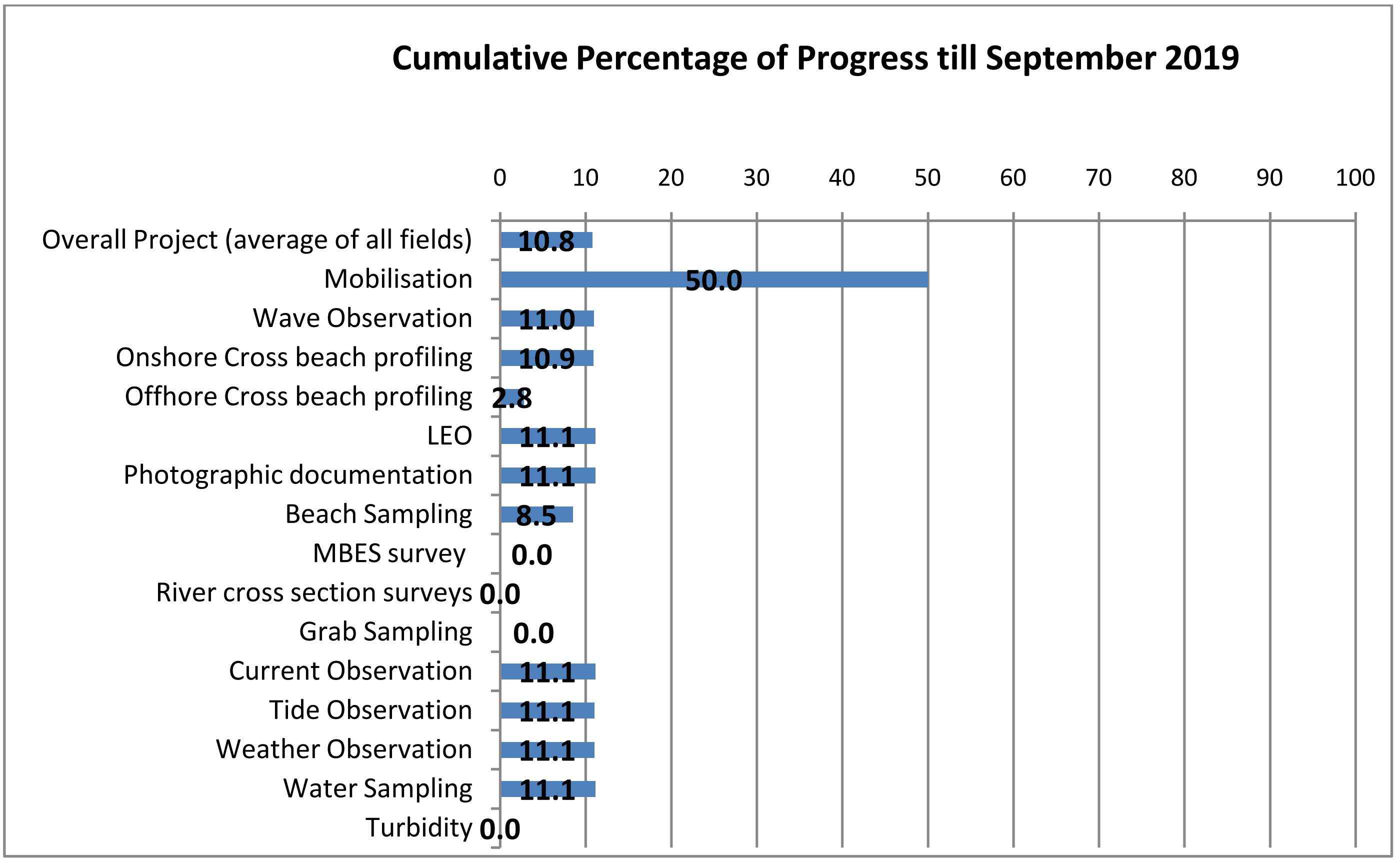


Figure 7-1: Overall Progress Chart

The above calculation is based on number of observations for 3 years. Since the turbidity buoys are not mobilised, the field is shown as 50%.

8 WEATHER

During the survey period, the monsoon was regressing and offshore cross shore profiles were carried out during relatively calm conditions, considering the safety of personnel and equipment.

9 REFERENCES

The following documents/web sites were referenced during the preparation of the report.

- AVPPL Service order 5700267194 dated 3rd May 2019
- Web site https://www.vizhinjamport.in/home.html, and https://www.vizhinjamport.in/download/Feasibility-Report.pdf
- WMO manual, section 5.2.2
- SAC Project Execution Plan SAC/P167-19/PEP AVPPL
- Periodic survey reports up to August 2019

10 CONCLUSIONS

The following conclusions were made during this phase of the project:

1. Tide was mixed semi diurnal with a maximum range of 0.92 m during spring tide.
2. The wave heights were less than 2m with winds of up to 7.87 m/s blowing from north-northeasterly direction.
3. The long-shore transport was recorded in a southerly direction, with maximum velocity of about 43.76 cm/s recorded at CSP-74.

11 ACKNOWLEDGEMENTS

During the course of project, the support received from AVPPL staff is highly appreciated and acknowledged.The guidance received throughout the project from NIOT scientists are also hereby appreciated. The boat crew and all others, who had supported us during the project is also acknowledged.

Annexure I

Photo Documentation at CSP Locations – September 2019

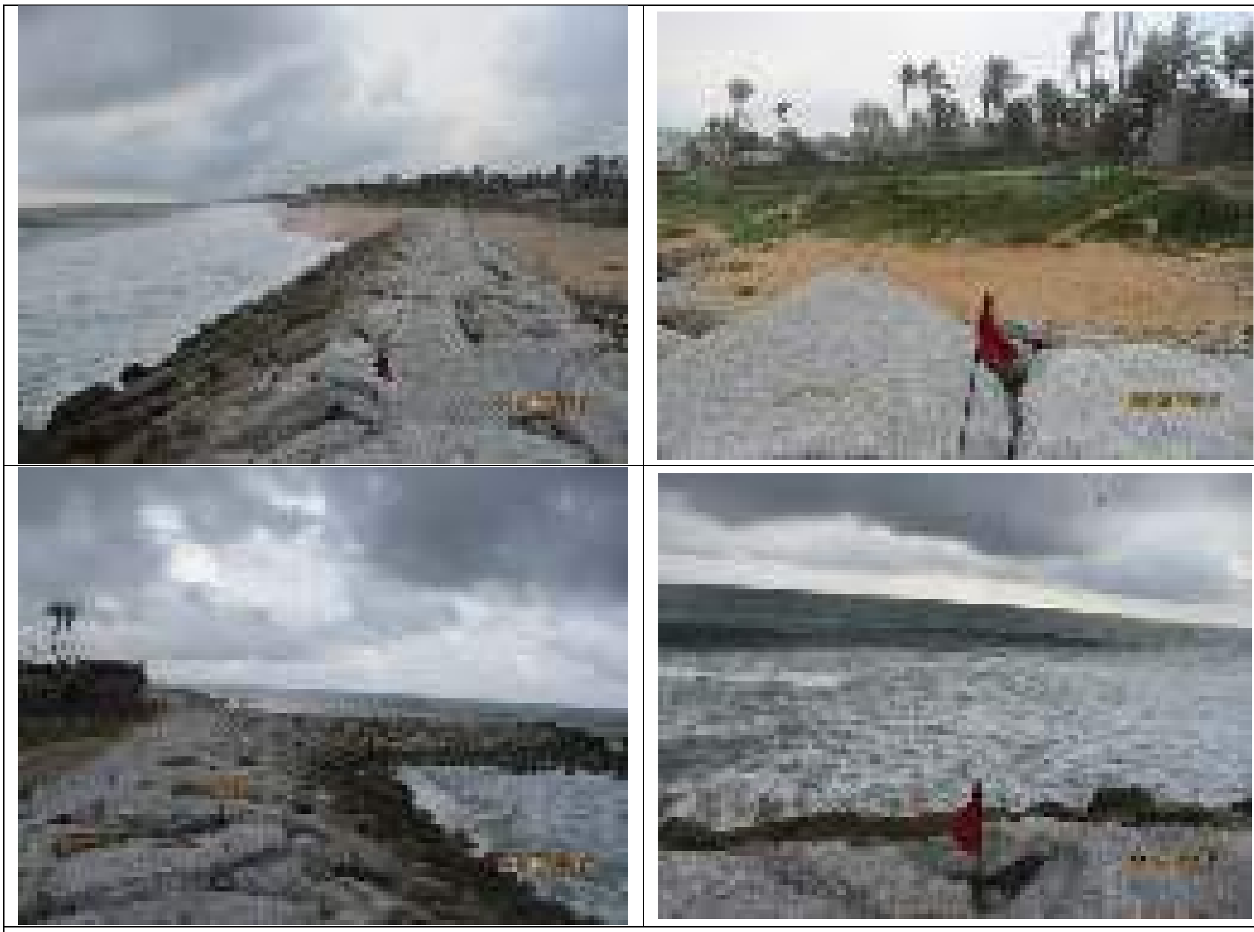


Figure 01:- September CSP-01

Figure 02:- September CSP-02

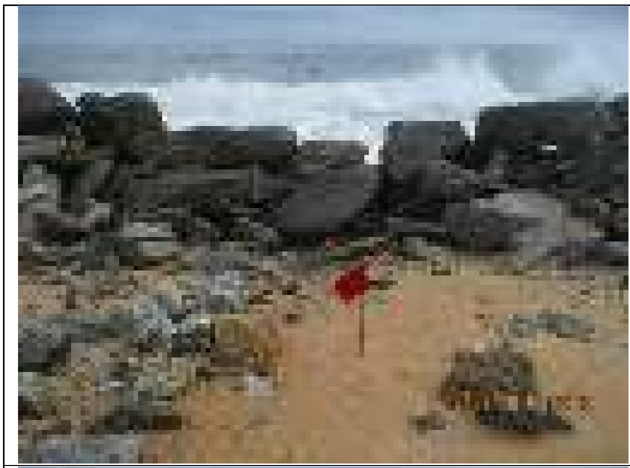



Figure 03:- September CSP-03

Figure 04:- September CSP-04

Figure 05:- September CSP-05

Figure 06:- September CSP-06

Figure 07:- September CSP-07

Figure 08:- SeptemberCSP-08

Figure 09:- September CSP-09

Figure 10:- September CSP-10

Figure 11:- September CSP-11

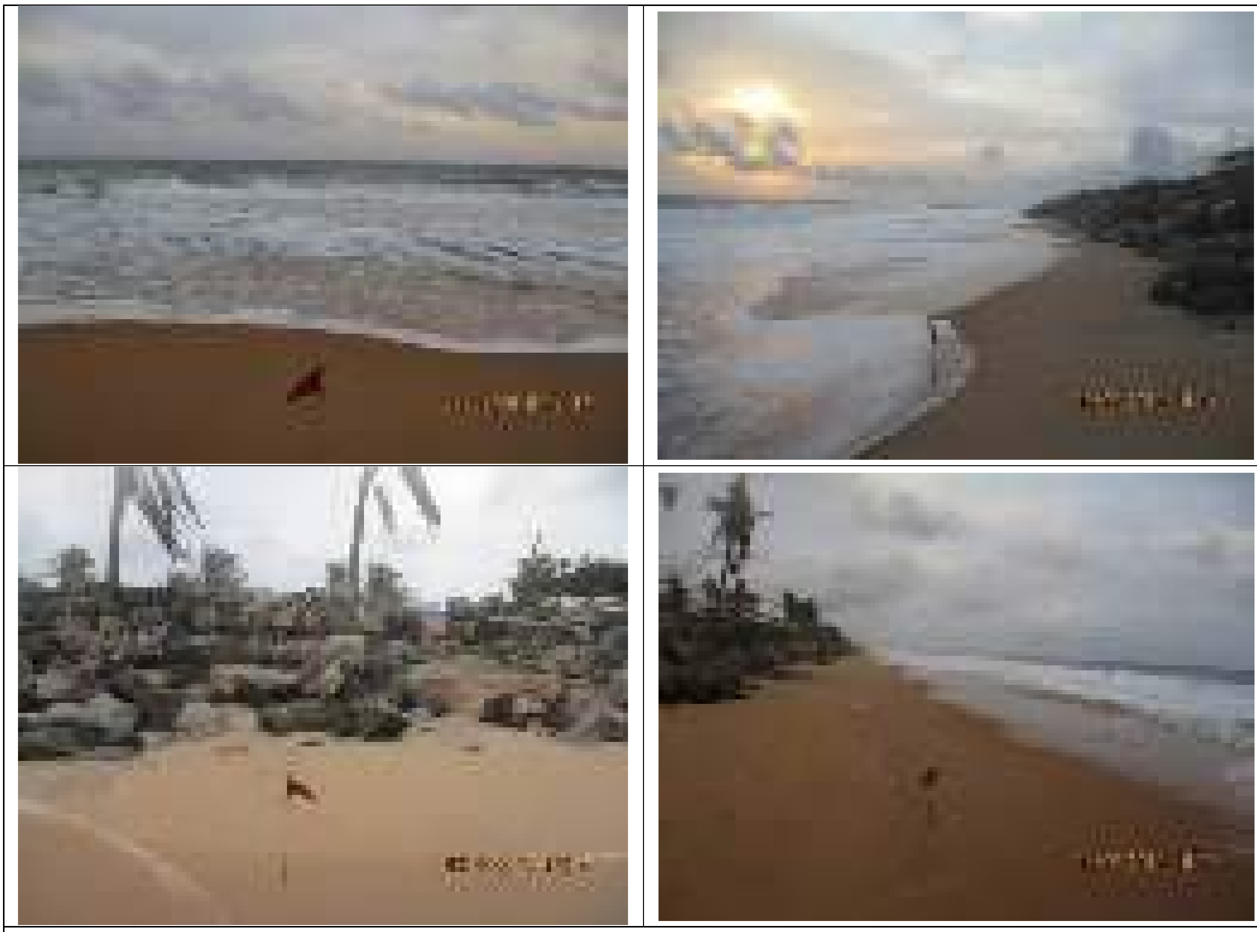


Figure 12:- September CSP-12

Figure 13:- September CSP-13



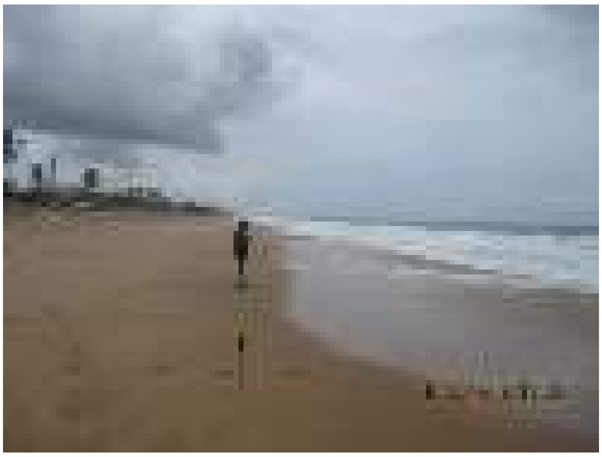



Figure 14:- September CSP-14

Figure 15:- September CSP-15

Figure 16:- September CSP-16

Figure 17:- September CSP-17

Figure 18:- September CSP-18

Figure 19:- September CSP-19

Figure 20:- September CSP-20

Figure 21:- September CSP-21

Figure 22:- September CSP-22

Figure 23:- September CSP-23

Figure 24:- September CSP-24

Figure 25:- September CSP-25

Figure 26:- September CSP-26

Figure 27:- September CSP-27

Figure 28:- September CSP-28

Figure 29:- September CSP-29

Figure30:- September CSP-30

Figure31:- September CSP-31

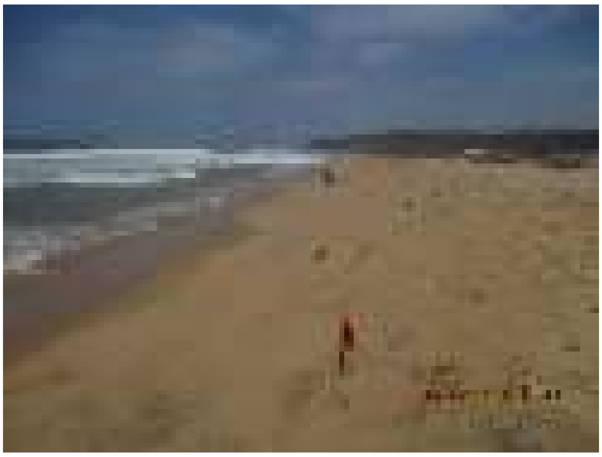



Figure32:- September CSP-32

Figure33:- September CSP-33

Figure34:- September CSP-34

Figure35:- September CSP-35

Figure36:- September CSP-36

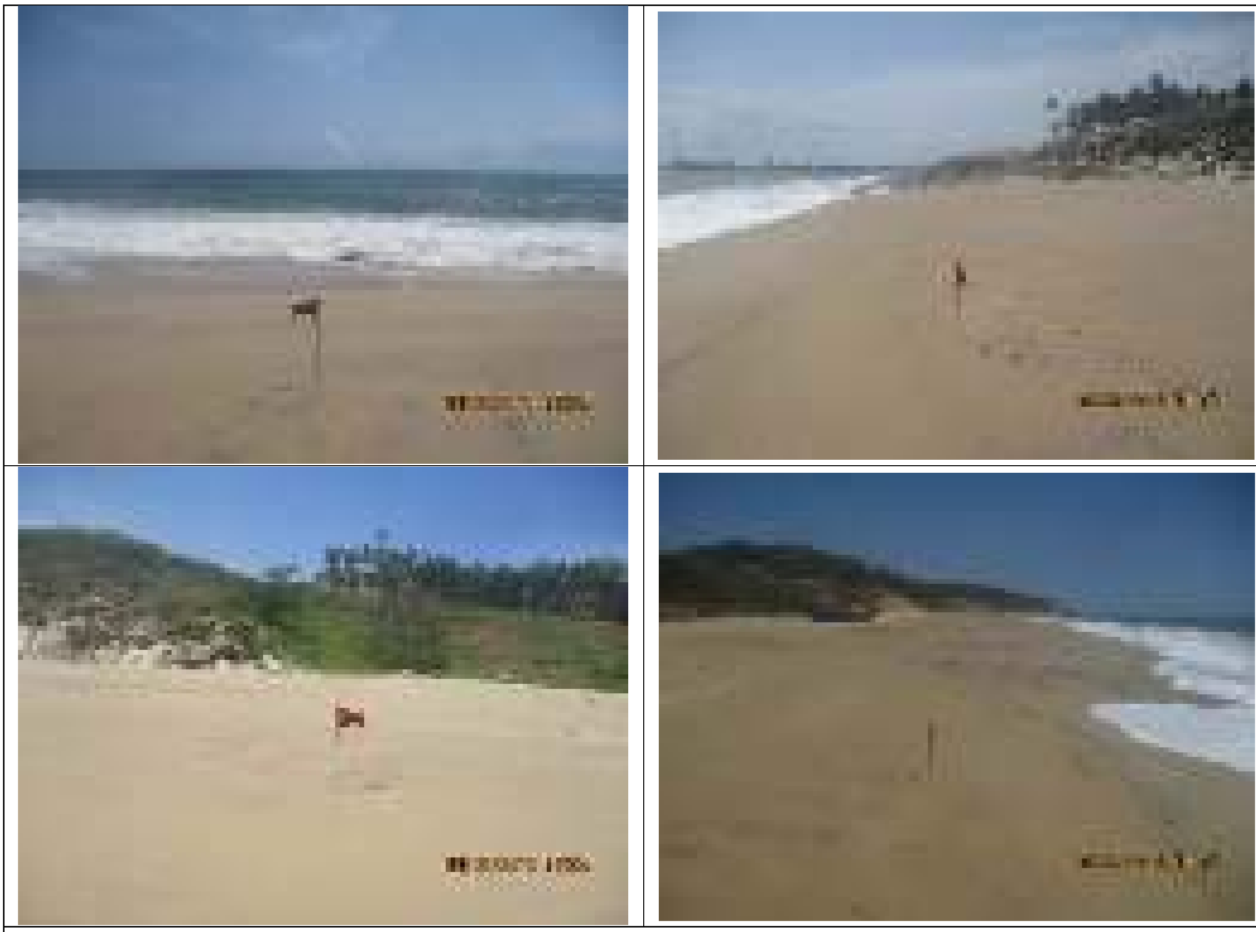


Figure37:- September CSP-37

Figure38:- September CSP-38

Figure39:- September CSP-39

Figure40:- September CSP-40

Figure 41:- September CSP-41

Figure 42:- September CSP-42

Figure 43:- September CSP-43

Figure44:- September CSP-44

Figure45:- September CSP-45

Figure 46:- September CSP-46




Figure 47:- September CSP-47

Figure 48:- September CSP-48

Figure 49:- September CSP-49

Figure 50:- SeptemberCSP-50

Figure 51:- September CSP-51

Figure 52:- September CSP-52

Figure 53:- September CSP-53

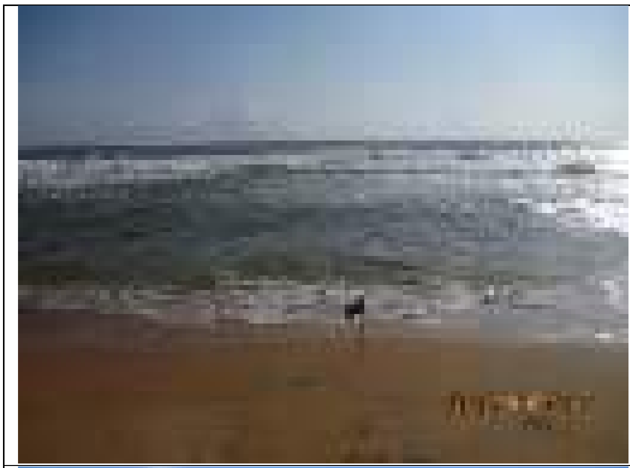



Figure 54:- September CSP-54

Figure 55:- September CSP-55

Figure 56:- September CSP-56

Figure 57:- September CSP-57

Figure 58:- September CSP-58




Figure 59:- September CSP-59

Figure 60:- September CSP-60

Figure 61:- September CSP- 61

Figure 62:- September CSP-62

Figure 63:- September CSP-63

Figure 64:- September CSP-64

Figure 65:- September CSP-65

Figure 66:- September CSP-66

Figure 67:- September CSP-67




Figure 68:- September CSP-68

Figure 69:- September CSP-69

Figure 70:- September CSP-70

Figure 71:- September CSP-71

Figure 72:- September CSP-72

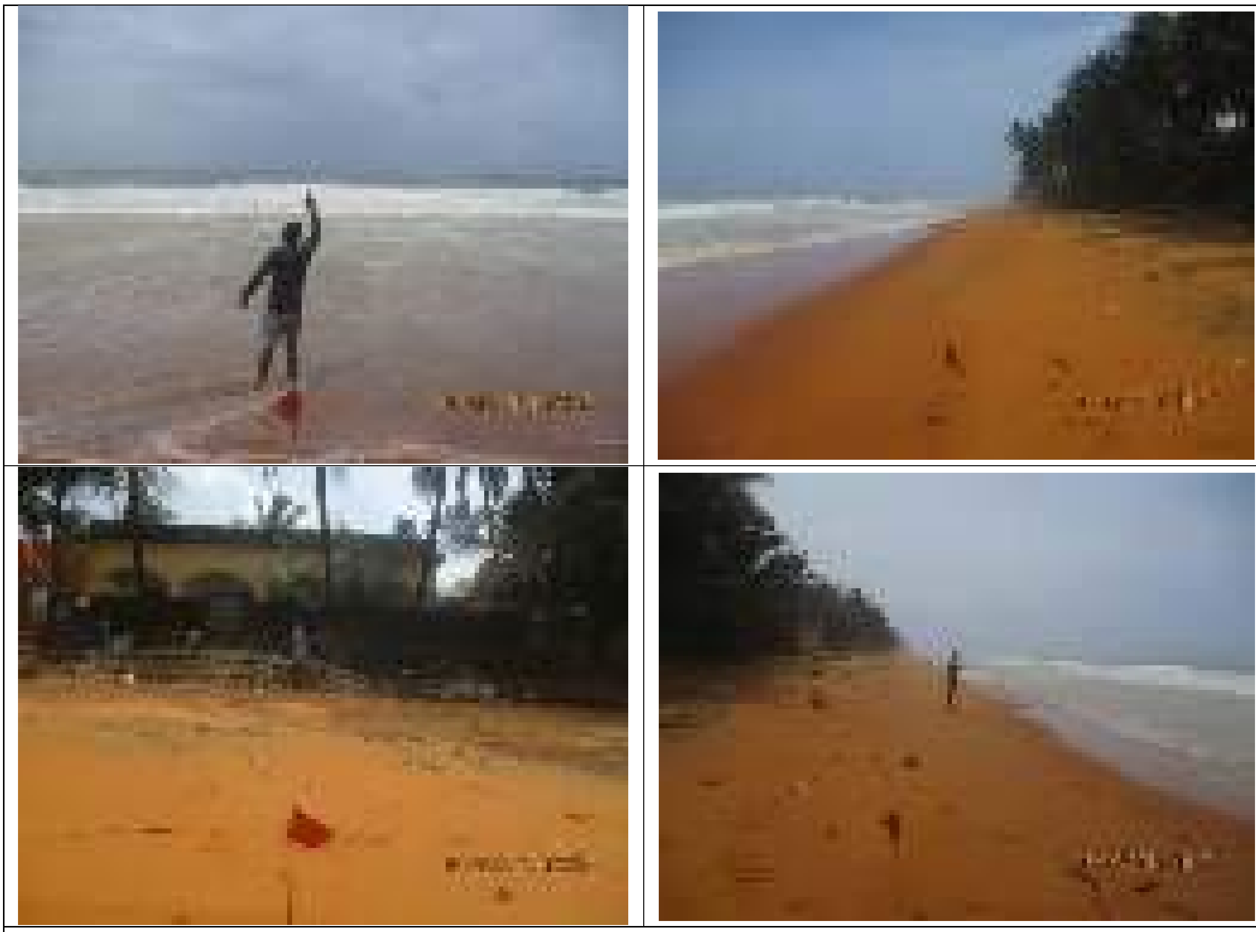


Figure 73:- September CSP-73

Figure 74:- September CSP-74

Figure 75:- September CSP-75

Figure 76:- September CSP-76

Figure 77:- September CSP-77

Figure 78:- September CSP-78

Figure 79:- September CSP- 79

Figure 80:- September CSP-80

Figure 81:- September CSP-81

Annexure II

Shoreline Mathematical Modelling Report

(March 2018 to February 2019)

L&T Infra Engineering

L&T Infrastructure Engineering Ltd.

Client:	**Adani Vizhinjam Port Private Limited**		
Project:	Data Analysis & Model Studies for Vizhinjam Port using data collected by AVPPL (Mar 2018 – Feb 2019)	**Project No.:** C1181504	
Title:	Data Analysis and Model Study Report	**Document No.:** RP004	**Rev.:** A

File path:
I:\ports\2018\c1181504 - adani-model-study-visl-2019\deliverables\reports\rp004\rp004-ra-psj-vrn-final data analysis and mathematical model study report.docx

Notes:

1.

Revision Details:

A	27/11/2019	After client comments	VRN		RRJ		PRJ	
0	26/11/2019	First Submission	VRN	Sd-/	RRJ	Sd-/	PRJ	Sd-/
Rev.	**Date**	**Details**	**Init.**	**Sign.**	**Init.**	**Sign.**	**Init.**	**Sign.**
			Prepared		**Checked**		**Approved**	

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LIST OF ENCLOSURES

LIST OF ABBREVIATIONS

ADCP	: Acoustic Doppler current profiler
ATG	: Automatic Tide Gauge
AVPPL	: Adani Vizhinjam Port Private Limited
CD	: Chart Datum
CS	: Cross Section
CSP	: Cross Shore Profile
E	: East
FSINPVT	: Fugro Survey India Private Limited
GNSS	: Global Navigation Satellite System
GPS	: Global Positioning System
H_{m0}	: Wave height
H_s	: Significant Wave Height
HTL	: High Tide Level
IMD	: Indian Meteorological Department
LNTIEL	: L & T Infrastructure Engineering Limited
LST	: Long shore Sediment Transport
LSTR	: Long shore Sediment Transport Rate
MBES	: Multi Beam Echo Sounder
MSL	: Mean Sea Level
N	: North
NCEP	: National Centers for Environmental Prediction
NHO	: Naval Hydro graphic Chart
NIOT	: National Institute of Technology
NOAA	: National Oceanic and Atmospheric Administration
NTU	: Nephelometric Turbidity Unit
NW	: North West

OSAS	: Ocean Science and Surveying
OSU	: Oregon State University
OTIS	: OSU Tide Inversion Software
OTPS	: OSU Tide Prediction Software
PBW	: Partial Break Water
RTK	: Real Time Kinetic
S	: South
SBES	: Single Beam Echo Sounder
SE	: South East
SSW	: South-South West
SW	: South West
SWAN	: Simulation of WAves Near shore
T_p	: Peak Wave period
TSS	: Total Suspended Solids
VISL	: Vizhinjam International Seaport Limited
VSCS	: Very Severe Cyclonic Storm
W	: West
WRB	: Wave Rider Buoy
WSW	: West South West

Executive Summary

Government of Kerala is planning to setup a green field modern deep water multipurpose sea port at Vizhinjam in Thiruvananthapuram District of Kerala. Vizhinjam International Seaport Limited (VISL), which is a fully owned Government of Kerala undertaking, has been entrusted with the task of developing the green field sea port. VISL has awarded Adani Vizhinjam Port Private Limited (AVPPL) the job of constructing the port. As a part of the project requirements, AVPPL has to continuously monitor the impact of the port construction on the surrounding environment. A continuous monitoring will help to assess if at all the port construction has any impact on the neighbouring environment.

LNTIEL has been long associated with VISL and had carried out comprehensive marine model studies in August 2013. In 2018, LNTIEL submitted a report based on the data received from February 2015 - February 2018. A report encompassing model studies was also submitted. In a follow up for the project, LNTIEL was awarded the job for carrying out the data analysis accompanying model study for the data collected in March 2018 to February 2019. AVPPL entrusted LNTIEL to help them in the data analysis and modelling. LNTIEL was given the task of assessing the impact of port construction on shoreline, beach morphology, water quality and effect of waves on fishing harbour. Parameters in consideration were waves, current, tides, wind, bathymetry, turbidity, beach profile, etc. Physical oceanographic parameters such as waves, current and tides are primary variables. The variation in these parameters will cause changes in the dependent variables such as bathymetry, turbidity and beach profile. In addition, impact of any major weather change has been evaluated. Since the trends are expected to change owing to the dynamic nature of the parameters, any abnormal changes in them was further investigated. In some cases numerical modelling tools would be required to confirm the cause of variation in these parameters. In this report, only those model studies (such as wave transformation and hydrodynamics) are carried out which can indicate if the marine environment is prevailing within expected variations. Accompanying model studies has been carried out depending on the results of these model studies.

With this background, LNTIEL has prepared this report by carrying out the analysis of the data received from March 2018-February 2019 and different model studies to assess the impact of port development.

Following are the summaries of the works carried out by LNTIEL to arrive at the intended scope of the project:-

1) Data Analysis

- The bathymetry analysis has been carried out to check whether any changes occurred in the sea water depth due to the impact of upcoming port. Analysis was carried out by considering 5 sections perpendicular to the shore; two on the North of port, two on the South of port and one near the port. Cross sections of bathymetries from Pre monsoon 2016 to Post monsoon 2018 were compared. From the analysis, no change in bathymetry is observed even though there is some localized changes have occurred due to dredging and reclamation. The bathymetry towards the north and south of the port has remained similar since 2015 (the time since continuous measurement was carried out) indicating that the dredging activities in the port area has minimal impact on the bathymetry of the neighbouring areas.
- The observed wave data provided by AVPPL for the period of March 2018 to February 2019 is analysed and compared with the observed wave data for February

2015 to February 2018. Majority of the waves observed at the project location fall in the range of 0.5-1.5 m. From these comparisons, it can be seen that the variability of wave heights and directions are within expected ranges.

- Based on the observed tidal levels provided by AVPPL and the tidal levels generated based on the harmonic constituents, the residual water level analysis has been carried out. The residual water level analysis has been carried out to check whether any considerable variations are there between observed and generated tidal data. The aim of this assessment was to notice if the port construction had any impact on the flow pattern inside the fishing harbour. It was observed that there is no significant variation in the residual water level and mostly the values range between -0.2 and 0.2 m.
- The current data was provided for the pre-monsoon, monsoon and post-monsoon of 2018 at four locations; Pachalloor, Vizhinjam, Mulloor and Poovar. Analysis has been carried out to check if there are any changes in the trend of current components from the previous years due to the construction of breakwater. It can be noticed that the current speed in the region is in the range of 0.1 to 0.6 m/s. However, occasionally maximum current speed observed during all the seasons is in the range of 0.8 to 1.0 m/s.
- Water sample analysis for the samples collected from four locations was carried out in order to assess the turbidity and total suspended solids for pre monsoon, monsoon and post monsoon. Using this data a relationship between turbidity and TSS was developed.
- Continuous monitoring of turbidity using buoys has been carried out during March 2018 to February 2019 in three locations. It is perceptible from time series plots that the turbidity fluctuates all year round and higher values during the monsoon season are due to the rain which increases sediment transport. In addition, the August 2018 Kerala floods may have increased the turbidity values during observation period. To sum up the turbidity values have increased only during rainfall events. All other values of turbidity are very less.
- 81 locations at 0.5 km interval were opted to collect beach sediments for each season. The data received by LNTIEL was analysed by plotting each of the profiles and cross shore profiles of different years of particular season were compared. The plots suggest that the shoreline movement of this portion of the coast is following its natural course till Ockhi. After this, the impact of Ockhi cyclone can be evidently noticed in fair weather 2017 and pre-monsoon 2018 seasonal profiles. The coast was undergoing processes to recover from this impact which can be observed from fair weather seasons comparison plot.
- Further LNTIEL extracted (+) 2 m contour from cross shore profile data. The time series plot of (+) 2 m contour over four year data with similar time scale were analysed. From this plot it can be noticed that the beach undergoes seasonal variation of erosion on monsoon season and accretion on other seasons. During Ockhi the beach was subjected to severe erosion and no much accretion was noticed during fair weather 2017 and pre-monsoon 2018. In addition, as a result of monsoon 2018 the beach got further eroded compared to previous monsoon seasons.

2) Model Studies

a) Near Shore Wave Transformation

- Offshore wave data from March 2018 to February 2019 was obtained from NCEP and near shore wave transformation was carried out with the latest bathymetry using SWAN model.
- The wave parameters are extracted from the swan model at the point of Wave rider buoy deployment location and compared with the observed wave data
- From observations, it was evident that the simulated and observed wave data were almost identical indicating good correlation.

b) Assessment of Hydrodynamics

- Earlier in 2013, LNTIEL had comprehensively covered the assessment of hydrodynamics in the port vicinity. To understand the impact of the port construction on the hydrodynamics, LNTIEL carried out the assessment of hydrodynamics with the latest surveyed bathymetries.
- From the assessment of hydrodynamics, it was found that current speeds prevailing near the project location over past years (2013, 2015, 2016, 2017 and 2018) were identical.
- In addition, the model was also calibrated using the latest data. From the model studies it was found that the tide and current pattern at several locations follow trends set in the previous years. This indicates that the flow field remains the same and the impacts on the siltation and the shoreline will be as expected (concluded in model studies report of 2012)

c) Effect of Waves inside the Fishery Harbour

- For the year March 2018 to February 2019, no event causing damage inside the fishing harbour was reported. In addition, there were only very few changes in the bathymetry and the surrounding environment.
- LNTIEL studied the effect of these minor changes on the impact on the fishing harbour by considering 2017-18's bathymetry and 2018-19's bathymetry and carried out wave propagation modelling
- Different combinations of wave events were chosen based on their extremities in wave height and peak wave period along with most prominent incident wave directions
- Same events were applied on different bathymetries and the results were compared. It may be noted that the wave height distribution along the selected section remains almost the same for both years. This shows that the conditions have not changed much between 2017-18 and 2018-19

d) Long shore sediment transport

- Long shore sediment transport refers to the cumulative movement of beach and near shore material parallel to the shore by the combined action of tides, wind, waves and the shore-parallel currents produced by them.
- The study area extends from Edappadu Beach (CS 01) in the South to Thumba (CS 81) in the North over a stretch of approximately 40km. This coast can be distinguished into two subsets depending on the coastal orientation. The shore angle on south side is in the range of 125^0 to 130^0 (True North) and shore angle on north side is in the range of 135^0 to 145^0 (True North). This change in orientation will have effect on long shore sediment transport and its behaviour.

- In order to compute long shore transport rate, breaking parameters need to be estimated first. The breaking parameters such as breaking wave height, breaking depth and breaking angle (shore normal) were calculated using depth limited criterion. The wave parameters were collected from WRB deployed at 23.2 m water depth and the breaking characteristics of waves were determined by combining wave refraction and shoaling calculations with wave breaking criteria.
- Depending on the coast orientation two average LSTR estimates were calculated based on available 4 years data (Feb 2015 – Feb 2019). The northerly and southerly (annual average) long shore sediment movement in south stretch is in the range of 0.16 to 0.18 M m^3/yr (Northwards) and -0.15 to -0.16 M m^3/yr (Southwards). In north stretch, the range is 0.24 to 0.26 M m^3/yr (Northwards) and -0.11 to -0.12 M m^3/yr (Southwards).The net annual average long shore sediment movement in south stretch is in the range of 0.01 to 0.02 M m^3/yr (Northwards) and in north stretch in the range of 0.13 to 0.14 M m^3/yr (Northwards).

From all the data analyses and model studies carried out by LNTIEL, it can be concluded that there was minimal variation on shoreline, beach morphology and water quality compared to the previous years and that the port construction has not caused any unnatural changes to these parameters in the vicinity of the port

1 Introduction

Government of Kerala is planning to setup a green field modern deep water multipurpose sea port at Vizhinjam in Thiruvananthapuram District of Kerala. Vizhinjam International Seaport Limited (VISL), which is a fully owned Government of Kerala undertaking, has been entrusted with the task of developing the green field sea port.

L&T Infrastructure Engineering Limited (LNTIEL) (formerly known as L&T Rambøll Consulting Engineers Limited) has been long associated with VISL in this regard. LNTIEL had assisted VISL in preparing a comprehensive model studies report containing details of effects of the port construction on various oceanic parameters such as wave, currents, sedimentation, shoreline changes, etc. LNTIEL had also assisted VISL in NGT hearings and other activities necessary to obtain clearances for development of the port.

With subsequent progress in the project, Adani Vizhinjam Port Private Limited (AVPPL) was hired as a concessionaire by VISL. During NGT's hearings it was ordered by the honourable court to carry out intense monitoring to assess the impact of the upcoming port on the environment. This included regular collection and assessment of environmental data and to assess the impacts of the port construction on environment through these data. As a concessionaire, AVPPL was assigned the task to collect environmental data at regular intervals. Considering LNTIEL's long association with this project and with the fact that LNTIEL had carried out most of the previous marine related model studies earlier, AVPPL approached LNTIEL with the task of assessing the data collected by AVPPL and to carry out model studies to study the impact on the environment due to the port construction.

In 2018, LNTIEL produced a report containing analysis of data received in Feb 2015 – Feb 2018. In a follow up for the project, LNTIEL was awarded the job for carrying out the data analysis and accompanying model study for the data collected from 1st March 2018 to 28th February 2019. This final report comprises of the analysis of data and required model studies carried out by LNTIEL.

2 Data Analysis

2.1 Project location

The Vizhinjam fishing harbour is located in Thiruvananthapuram district in the Indian state of Kerala. It is situated about 16 km south of Thiruvananthapuram. The proposed port location is situated at about 300 m from the existing fishing harbour and is shown in Figure 2-2.

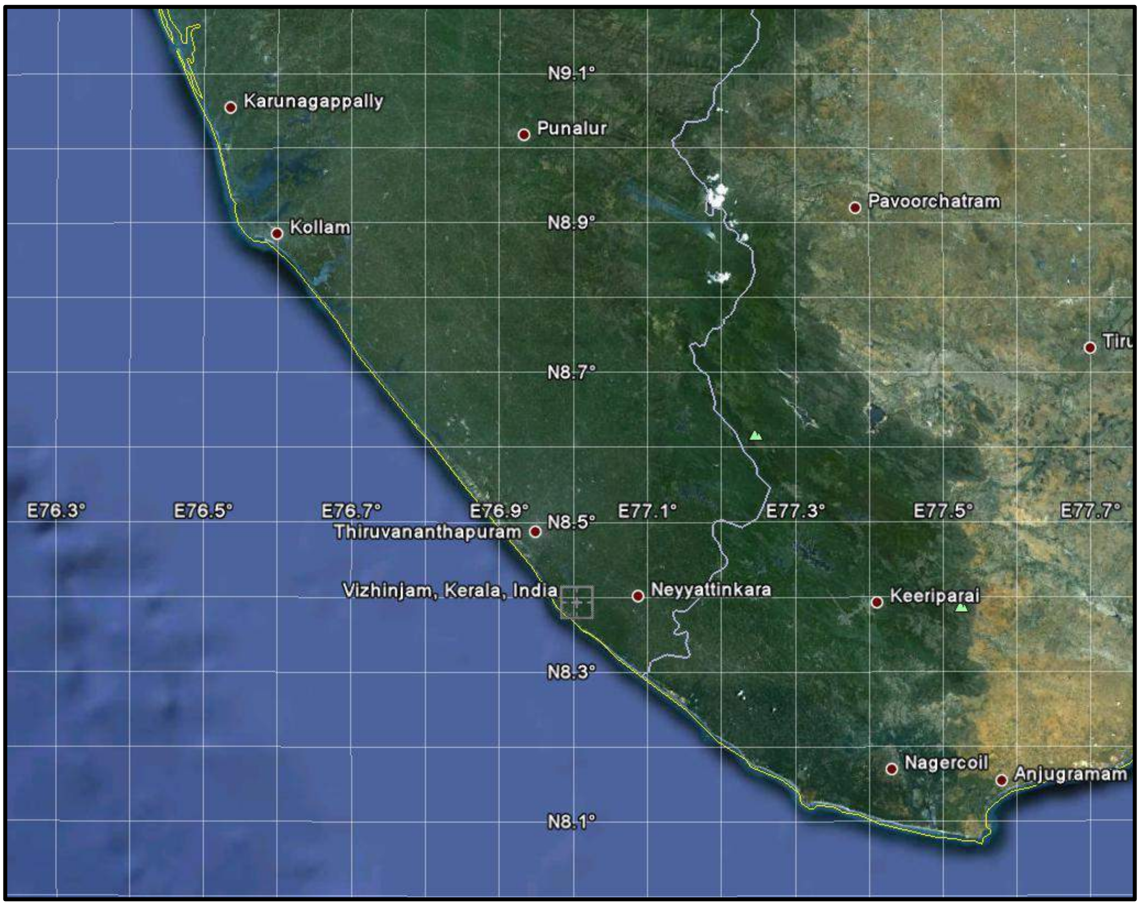


Figure 2-1 Google image of site

Figure 2-2 Location of port

2.2 Bathymetry

A bathymetry survey was done by National Institute of Ocean Technology (NIOT), in April 2003. The survey was carried out in a 1.5 km x 10 km wide corridor along the shore. The bathymetry survey for the proposed project area was done during February to March 2011 by Fugro Survey India Private Limited (FSINPVT). In general, the coastal zone has a steep slope until a depth of (-) 15m. Later the depth varies gradually up to deeper portion.

Secondary information on bathymetry from Naval Hydro graphic Chart (NHO – chart no. 2111) and those from ETOPO1 global relief model of NOAA were extracted for the project site. The bathymetry for the model study carried out earlier was created by combining the primary data from the surveys by NIOT and FSINPVT with those available from NHO Charts and ETOPO1.

Further to these surveys, OSAS has carried out bathymetry survey in project location for pre monsoon and monsoon during 2015 with Single Beam Echo Sounder (SBES) and Multi Beam Echo Sounder (MBES). For Pre monsoon and Post monsoon of 2016 and 2017 OSAS carried out bathymetry survey using MBES. Additionally in 2018, bathymetry survey was carried out for Pre Monsoon and Post Monsoon using MBES.

The digitised bathymetry for the Pre Monsoon 2018 and Post Monsoon 2018 are presented in Figure 2-3 and Figure 2-5.

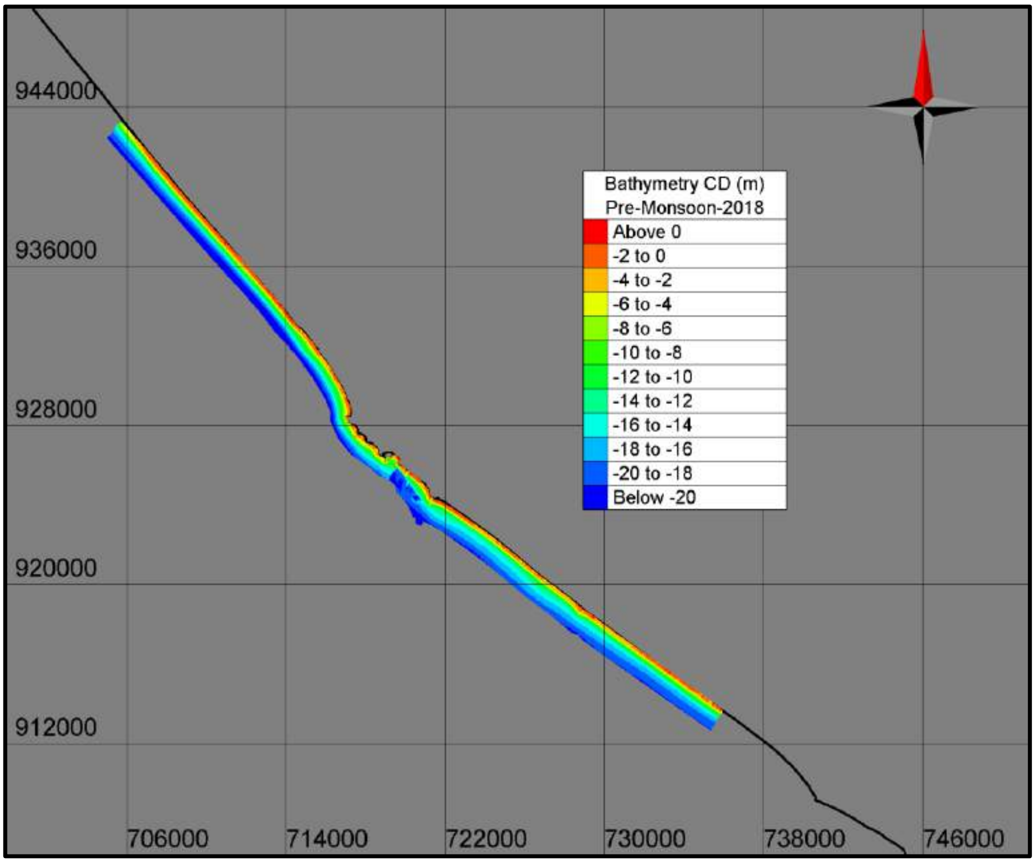


Figure 2-3 Bathymetry survey data using MBES for Pre Monsoon 2018

A comparison was carried out between Pre Monsoon 2017 and Pre Monsoon 2018 bathymetry data as presented in Figure 2-4. The same comparison was studied for Post monsoon 2017 and Post monsoon 2018 MBES data and is presented in Figure 2-6.

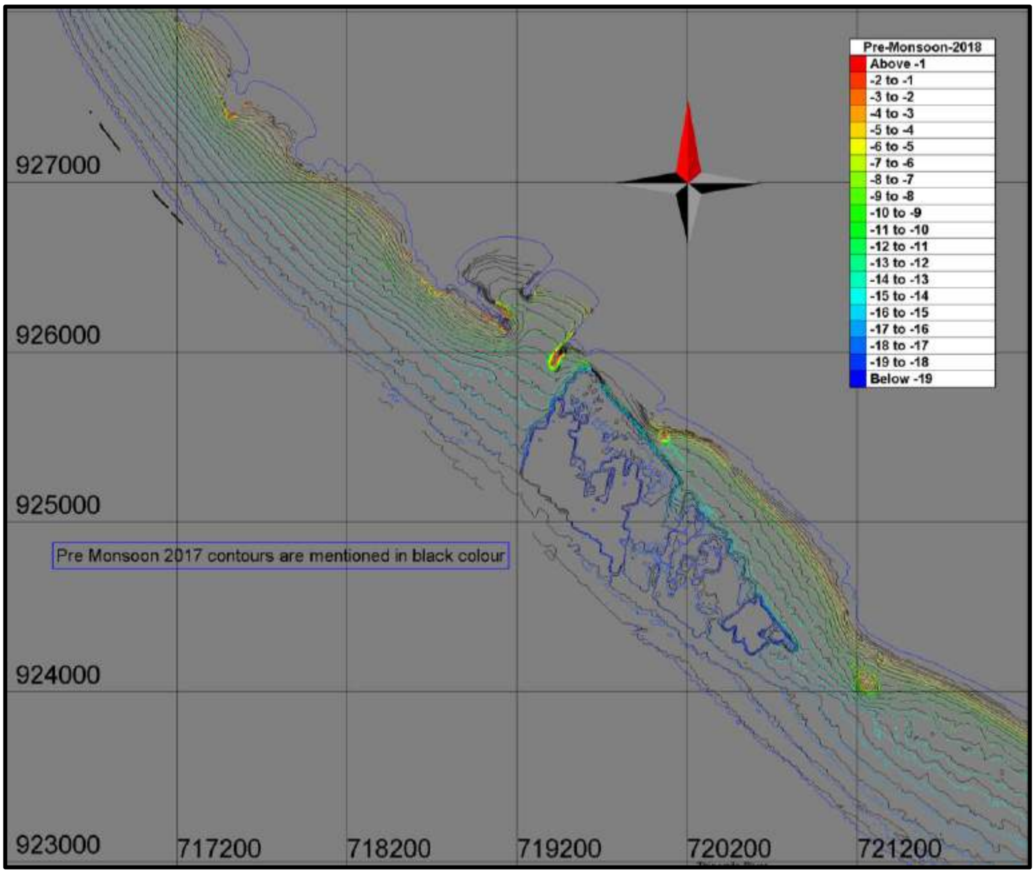


Figure 2-4 Comparison of Pre monsoon 2017 and 2018 bathymetry data

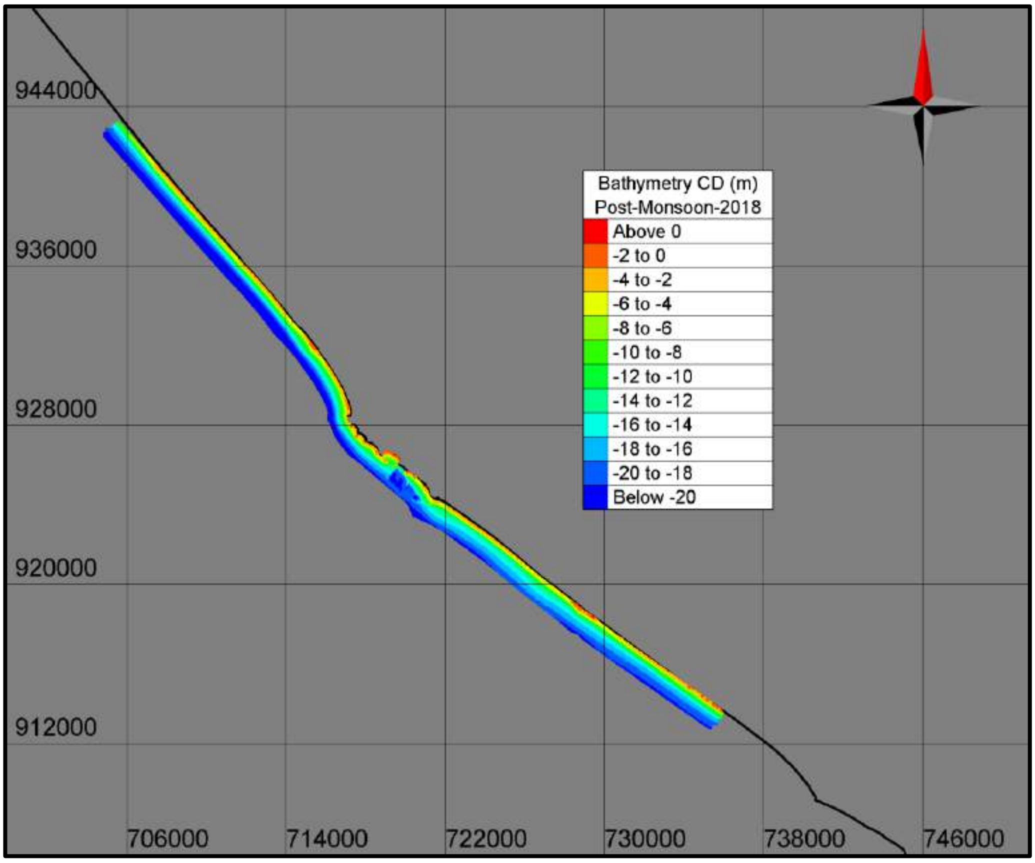


Figure 2-5 Bathymetry survey data using MBES for Post Monsoon 2018

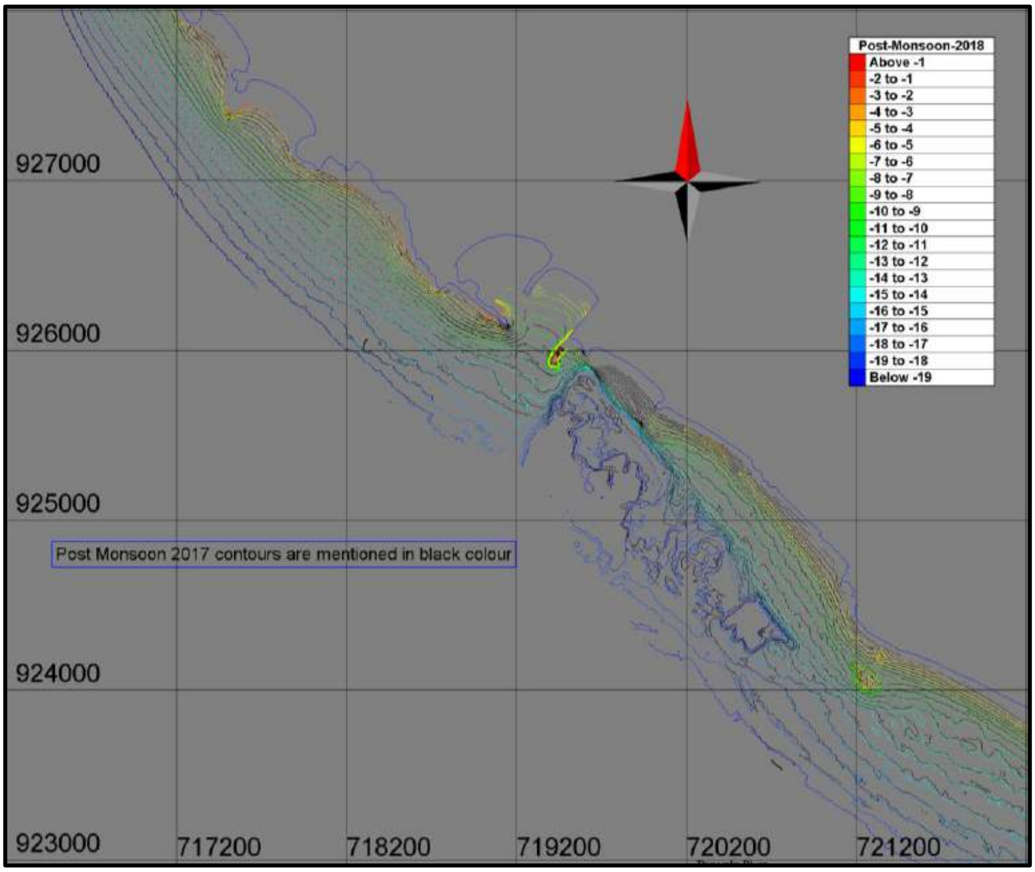


Figure 2-6 Comparison of Post monsoon 2017 and 2018 bathymetry data

In addition to the above mentioned analysis, five lines were selected to check the variation in bathymetry profiles for different seasons (Pre monsoon 2016, Post monsoon 2016, Pre monsoon 2017, Post monsoon 2017, Pre monsoon 2018 and Post monsoon 2018). The locations of these sections are as shown in Figure 2-7. The aim of this analysis is to identify any significant changes in bathymetry because of dredging and reclamation works carried out as on date near port vicinity.

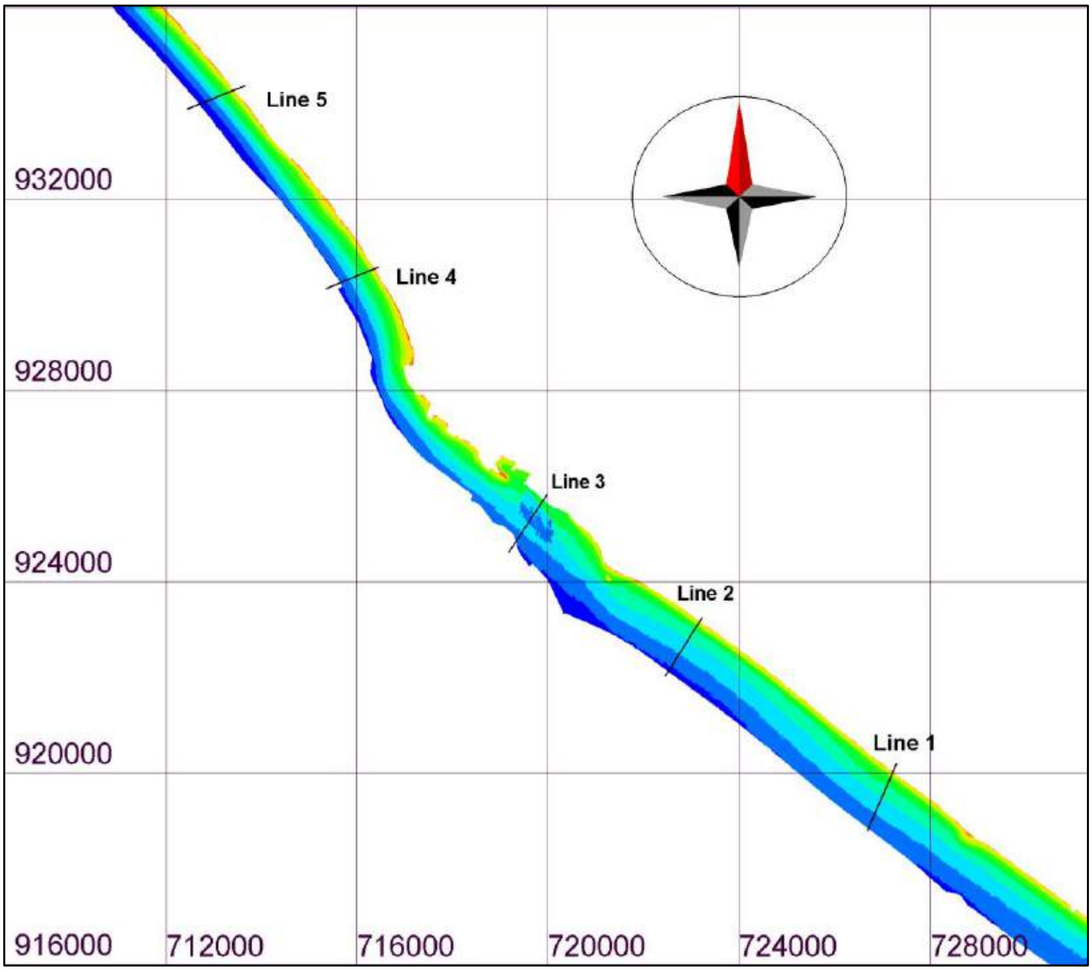


Figure 2-7 Location of the selected cross sections

Figure 2-8 to Figure 2-12 shows the comparison of Pre monsoon and Post monsoon of three years (2016, 2017 and 2018) bathymetry data along the selected sections. From these plots it was noticed that there was no change in bathymetry over past three years at lines 1, 2, 4 and 5 even though at line 3 (place where dredging was active) change was noticed. This indicates that the dredging activities in the port vicinity have minimal impact on the bathymetry elsewhere in the study region.

Legend of bathymetry comparison plots

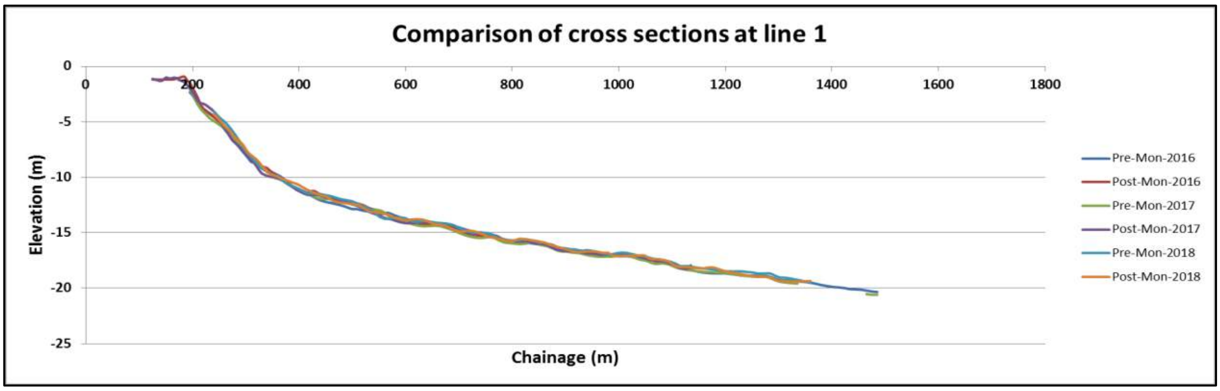


Figure 2-8 Bathymetry-Cross section comparison at line 1

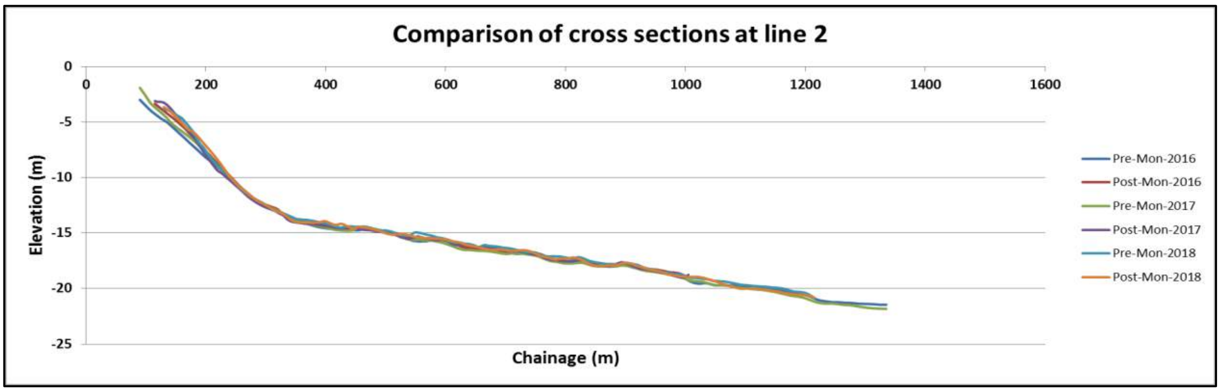


Figure 2-9 Bathymetry-Cross section comparison at line 2

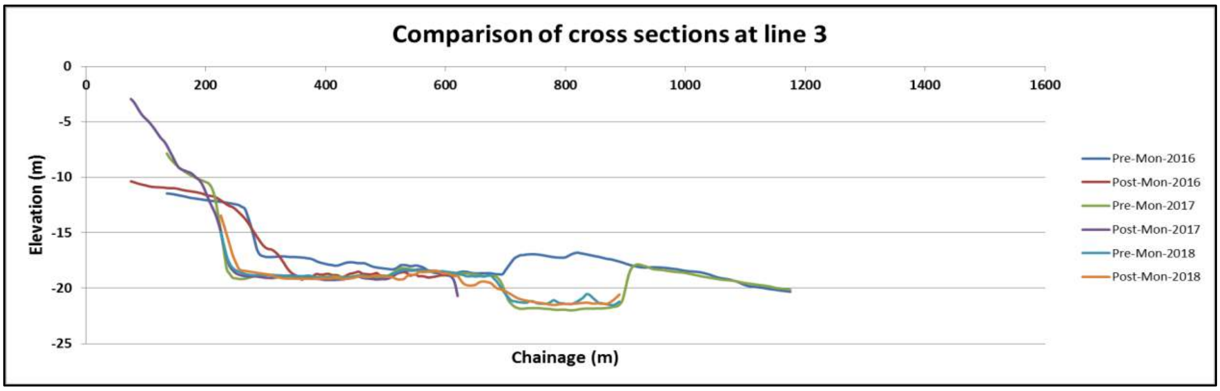


Figure 2-10 Bathymetry-Cross section comparison at line 3

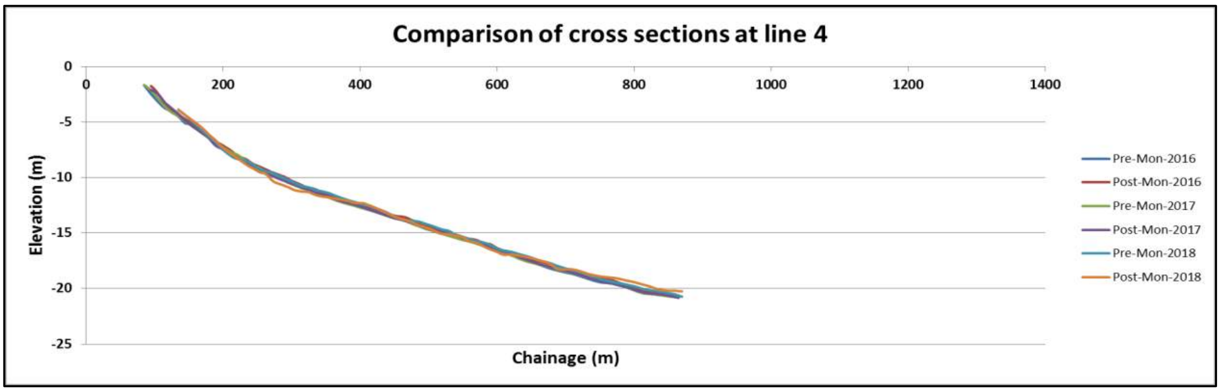


Figure 2-11 Bathymetry-Cross section comparison at line 4

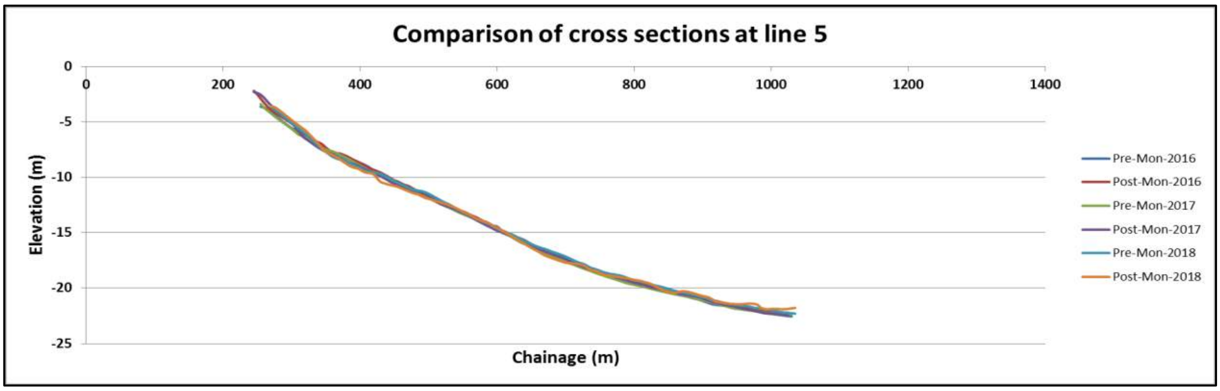


Figure 2-12 Bathymetry-Cross section comparison at line 5

2.3 Waves

Long term observation of wave heights at a location is useful as it provides the required data for estimating design wave height and for the prediction of wave heights at the location.

This section of the report mainly discuss regarding the wave parameters observed. Wave parameters were measured using WRB at Mulloor (08°21' 43.15" N, 76°59'25.86" E) during the period of 01st March 2018 to 28th February 2019. The measured wave height, direction and peak wave period are represented in the form of graphs and are presented in Figure 2-13 to Figure 2-15.

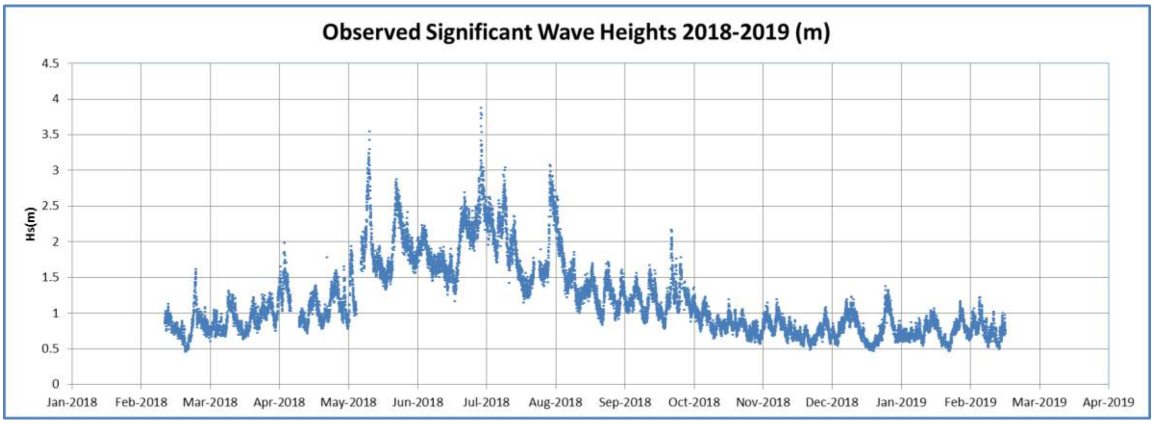


Figure 2-13 Time history plot of wave height for observed wave data

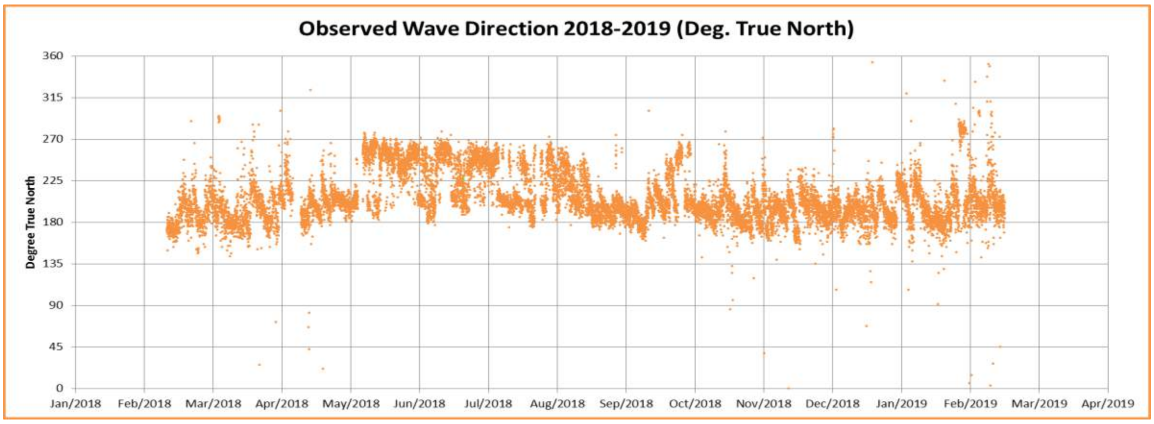


Figure 2-14 Time history plot of wave direction for observed wave data

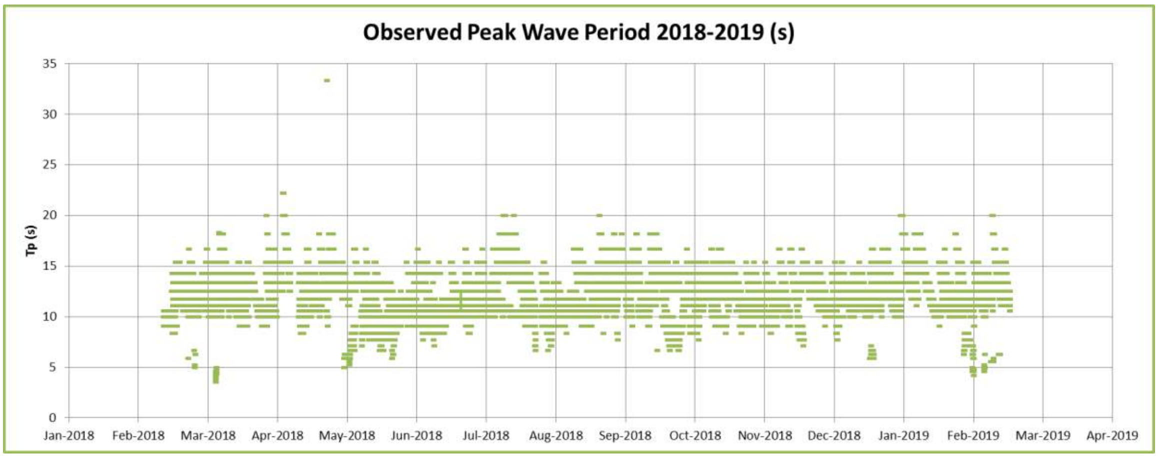


Figure 2-15 Time history plot of peak wave periods for observed wave data

From the above graphs, we can observe that the wave heights are mostly in the range of 0.5 m to 1.5 m during non-monsoon period and it reaches around 4 m during monsoon period. The parameters were observed to follow the same trend as in the previous years.

From Figure 2-14, it is noticed that wave direction throughout the period is mostly between 180^0 – 270^0 (S to W) with respect to true North. The predominant wave direction is observed to be from SSW. During monsoon season, wave direction is mainly from SW to W and during Non-monsoon season the direction is mainly from S to SW.

A comparison of wave heights and wave direction for the past 4 years has been carried out. The comparison is presented in Figure 2-16 and Figure 2-17.

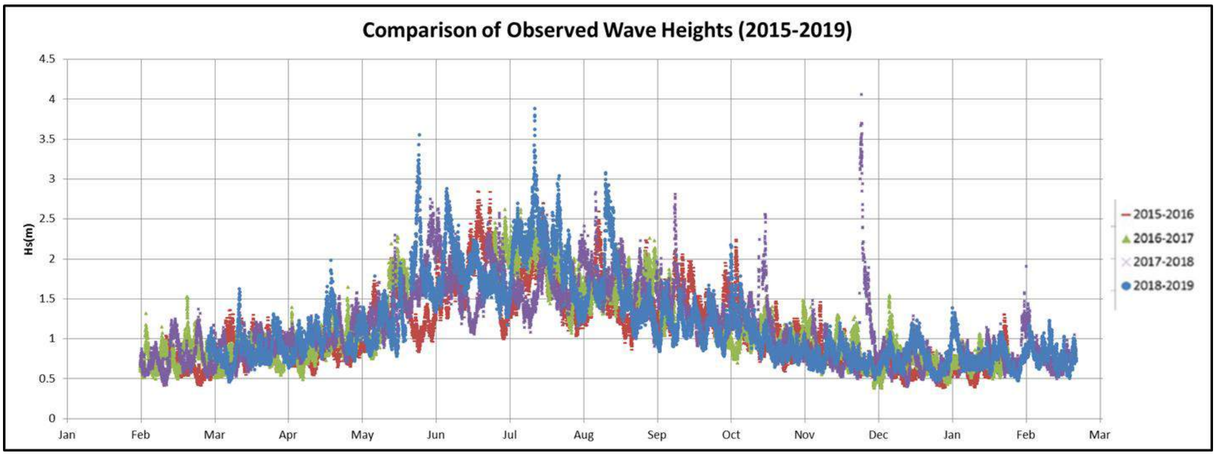


Figure 2-16 Comparison of wave height for past 4 years (Feb 2015 – Feb 2019)

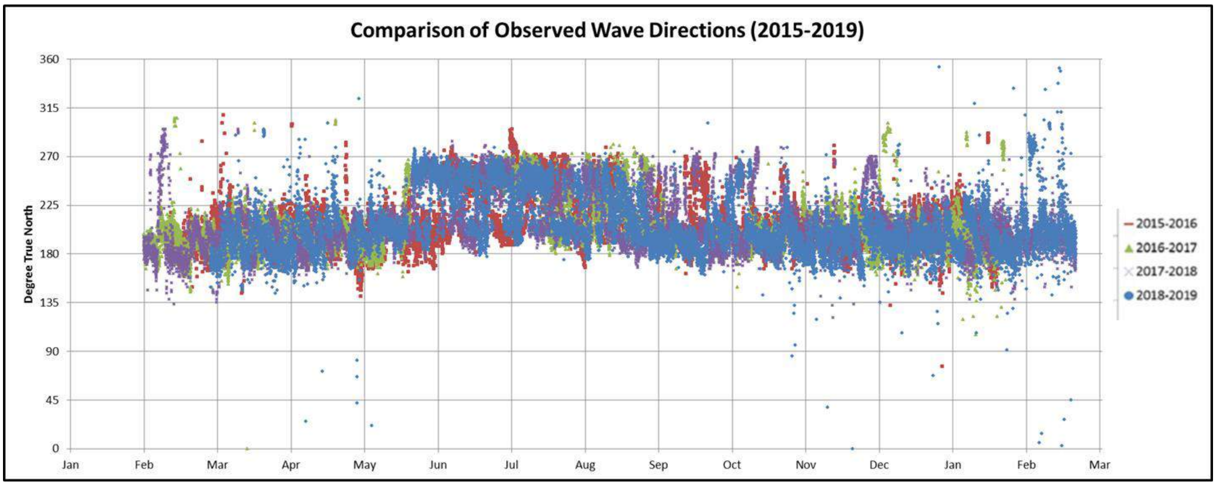


Figure 2-17 Comparison of wave direction for past 4 years (Feb 2015 – Feb 2019)

Wave parameters were measured using WRB during the period of 10th February 2015 to 28th February 2019 by OSAS at the project location. A comparison for percentage exceedance of wave heights observed for the past four years from 2015, 2016, 2017 and 2018 was carried out and the same is presented in Figure 2-18. From these comparisons, it can be seen that the variability of wave heights and directions are within expected ranges.

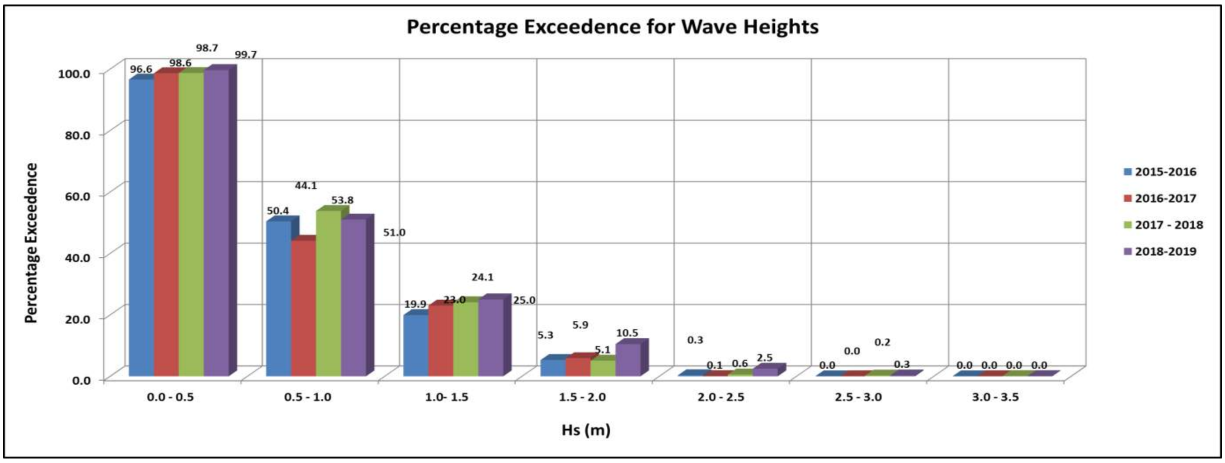


Figure 2-18 Percentage exceedance of wave heights for the observed data

Percentage occurrence of wave heights is plotted and the same is presented in Figure 2-19. Majority of the waves observed at the project location fall in the range of 0.5 to 1.5 m.

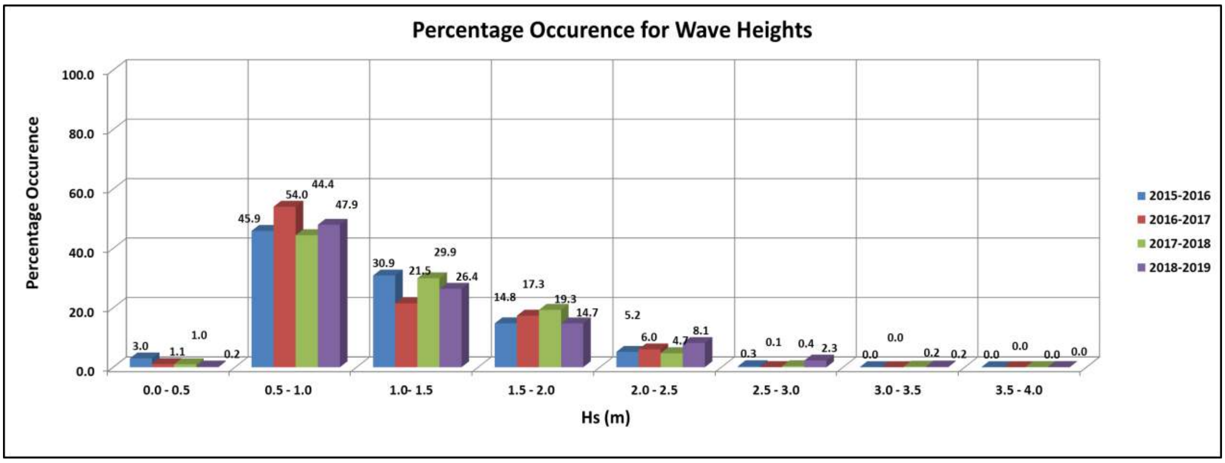


Figure 2-19 Percentage occurrence of wave heights in the observed data

From the above observations it is evident that the wave characteristics at the project location follow more or less the same trend for the past three years. The wave direction throughout the period of 1st March 2018 to 28th February 2019 is observed to be mostly between south to west whereas most of the wave height ranges from 0.5-1.5 m except during August 2018 with a maximum wave height of 3.8 m was observed.

2.4 Tide

Long term observation of water level variations at a location is useful as it provides the required data for estimating the tidal harmonic constituents, which can be used to arrive at the tidal statistics as well as for the prediction of tidal levels at the location. Long term observation of tidal elevation at Vizhinjam, though intermittent, is available from 1971 to present. The quality of the data was analysed for the present study and shifts in the datum used were observed. In addition to these data, in-situ tide measurements using ATG were also available in old reports. At this location, survey was done during 01st March 2018 to 28th February 2019 and was provided by AVPPL. The tidal range during the period of measurement is found to be about 1.2 m. Due to this low range, the influence of tide on the coastal currents is expected to be low. AVPPL also provided tide data collected by NIOT for the period from 03rd November 2012 to 7th March 2013, 25th May to 3rd August 2013, 7th February 2015 to 29th February 2016 and 01st March 2017 to 28th February 2018. These data were reported in the earlier reports by LNTIEL.

Subsequently, OSAS collected data at 08° 22' 33.68" N, 76° 59' 16.65" E, for the period 1st March 2018 to 28th February 2019. The measured tide is presented in the Figure 2-20.The tide levels shown in the graph are with respect to CD.

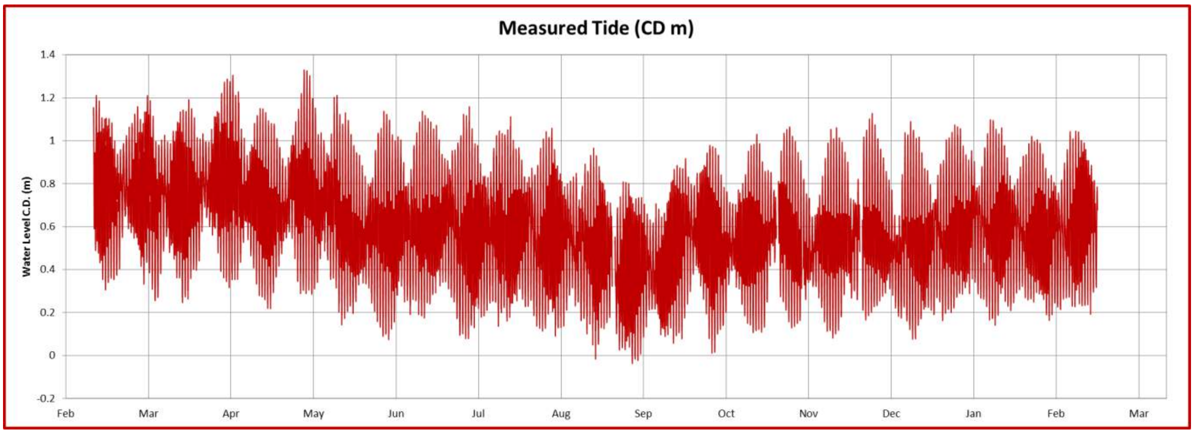


Figure 2-20 Measured tide data for the year 2018-19

2.4.1 Residual Water Level Analysis

2.4.1.1 Methodology

The methodology adopted is summarized as follows;

- The measured tide data from OSAS (for period 1st March 2018 to 28th February 2019) was taken for the study

- Tidal analysis of heights was performed and the astronomical constituents were derived using MIKE21 and the tidal levels based on the astronomical constituents have been generated.
- Based on the generated tidal levels, residual water level analysis has been done.

2.4.1.2 Results

Based on the analysis of the observed tidal data and predicted tidal data for the year 2015-18, the percentage of occurrence for different range of residual water levels has been derived and represented in the Table 2-1.

Table 2-1 Residual Water Level - Percentage of Occurrence

Residual Water Levels	Percentage of occurrence			
Range (m)	**2018-19**	**2017-18**	**2016-17**	**2015-16**
(-) 0.3 to (-) 0.2	3.6%	1.5%	0.7%	0.2%
(-) 0.2 to (-) 0.1	13.0%	16.8%	11.6%	6.9%
(-) 0.1 to (-) 0.05	16.4%	17.6%	16.4%	14.3%
(-) 0.05 to 0.05	33.9%	35.4%	42.3%	56.6%
0.05 to 0.1	12.6%	9.6%	17.0%	17.8%
0.1 to 0.2	16.8%	13.5%	10.6%	4.0%
0.2 to 0.3	3.6%	5.6%	1.4%	0.2%
Total	**100**	**100**	**100**	**100**

A histogram has been plotted for the above mentioned data and shown in the Figure 2-21.

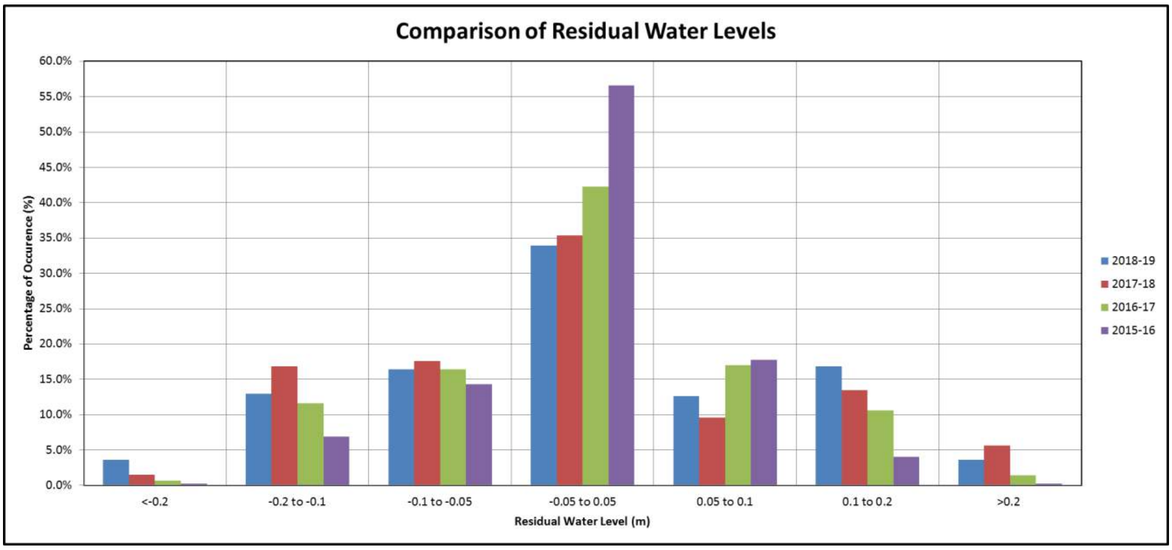


Figure 2-21 Histogram showing the comparison of residual water level for different years

From the above figure it is observed that there is no significant variation in the residual water level and mostly the values range between -0.2 and 0.2 m.

2.5 Current

OSAS had carried out measurement of current speeds and directions at different depths as given in Table 2-2 below at four different locations Pachalloor, Vizhinjam, Mulloor and Poovar. OSAS has collected the current data for one month for each season from 1st March 2018 to 28th February-2019 (Pre-monsoon, Monsoon and Post-monsoon). The data collected for each season are presented in Figure 2-22 to Figure 2-45. From these figures, it is noticed that there is a data gap in observations at Pachalloor and Mulloor locations during monsoon period. This data gap is due to non-recording of ADCP at these locations.

Table 2-2 Observed Current Speed and Direction during 2018

Location	Depth w.r.t CD (m)	Coordinates		Pre Monsoon		Monsoon		Post Monsoon	
		Northing	Easting	Current Speed Range (m/s)	Predominant Current Direction	Current Speed Range (m/s)	Predominant Current Direction	Current Speed Range (m/s)	Predominant Current Direction
Pachalloor	21.4	8^{0}24’08.6”	76^{0}56’16.1”	0.1-0.7	NW-SE	0.1-0.7	NW-SE	0.1-0.55	NW-SE
Vizhinjam	21.1	8^{0}21’55.4”	76^{0}58’51.6”	0.1-1.0	NW-SE	0.1-0.7	NW-SE	0.1-0.65	NW-SE
Mulloor	23.2	8^{0}21’42.3”	76^{0}59’33.9”	0.1-1.0	NW-SE	0.1-0.7	NW-SE	0.1-0.7	NW-SE
Poovar	23.0	8^{0}17’35.8”	77^{0}04’03.5”	0.1-0.9	NW-SE	0.1-0.8	NW-SE	0.1-0.7	NW-SE

It can be noticed from Table 2-2 that the current speed in the region will be in general in the range of 0.1 to 0.6 m/s. However, occasionally maximum current speed observed during all the seasons is in the range of 0.8 to 1.0 m/s. The current speed and the current direction for different seasons at four different locations are shown in Figures from Figure 2-22 to Figure 2-45. Start and end times of observed currents in three seasons is as shown in Table 2-3.

Table 2-3 Current observation timeline

Location	Coordinates		Pre Monsoon		Monsoon		Post Monsoon	
	Northing	Easting	Start date	End date	Start date	End date	Start date	End date
Pachalloor	8^{0}24’08.6”	76^{0}56’16.1”	12/04/18	12/05/18	29/07/18	28/08/18	13/12/18	12/01/19
Vizhinjam	8^{0}21’55.4”	76^{0}58’51.6”	12/04/18	12/05/18	24/07/18	29/08/18	13/12/18	12/01/19
Mulloor	8^{0}21’42.3”	76^{0}59’33.9”	12/04/18	12/05/18	29/07/18	28/08/18	14/12/18	13/01/19
Poovar	8^{0}17’35.8”	77^{0}04’03.5”	12/04/18	12/05/18	27/07/18	29/08/18	13/12/18	12/01/19

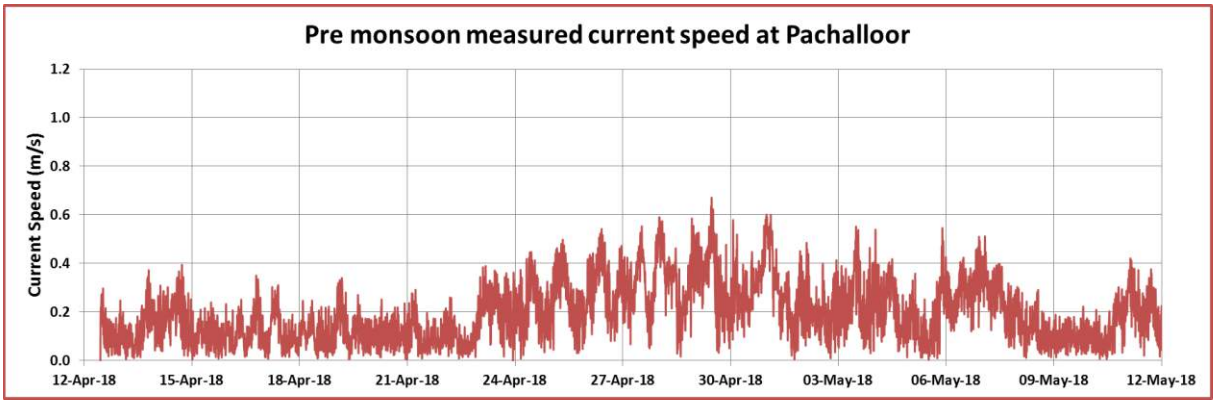


Figure 2-22 Pre Monsoon measured current speed at Pachalloor – May 2018

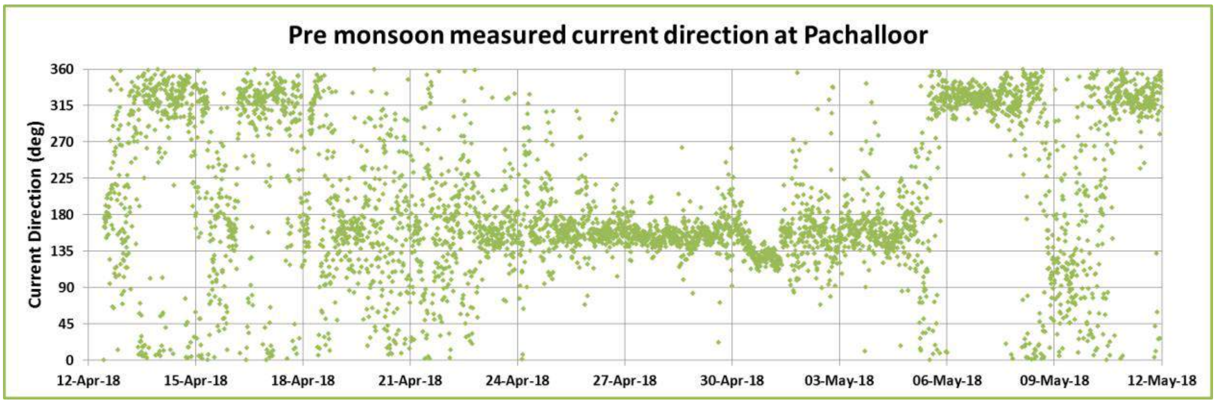


Figure 2-23 Pre Monsoon measured current direction at Pachalloor – May 2018

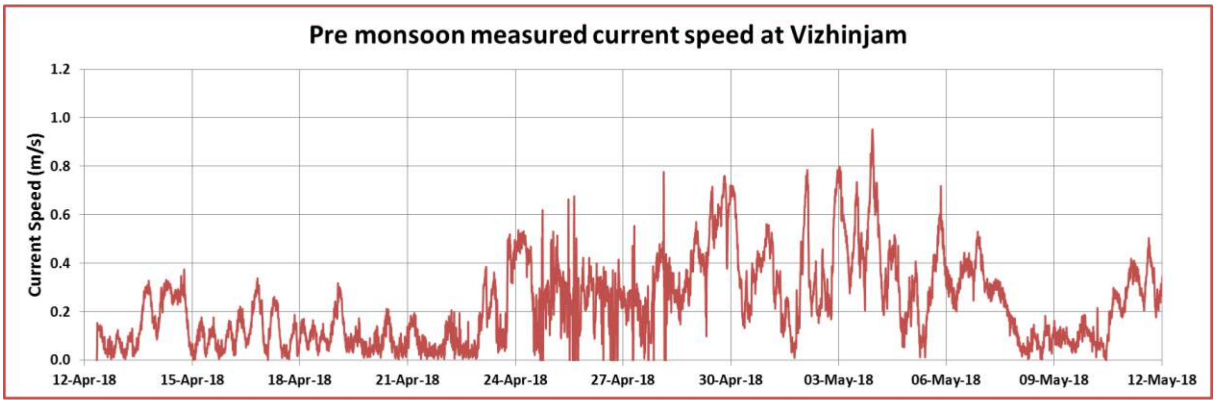


Figure 2-24 Pre Monsoon measured current speed at Vizhinjam – May 2018

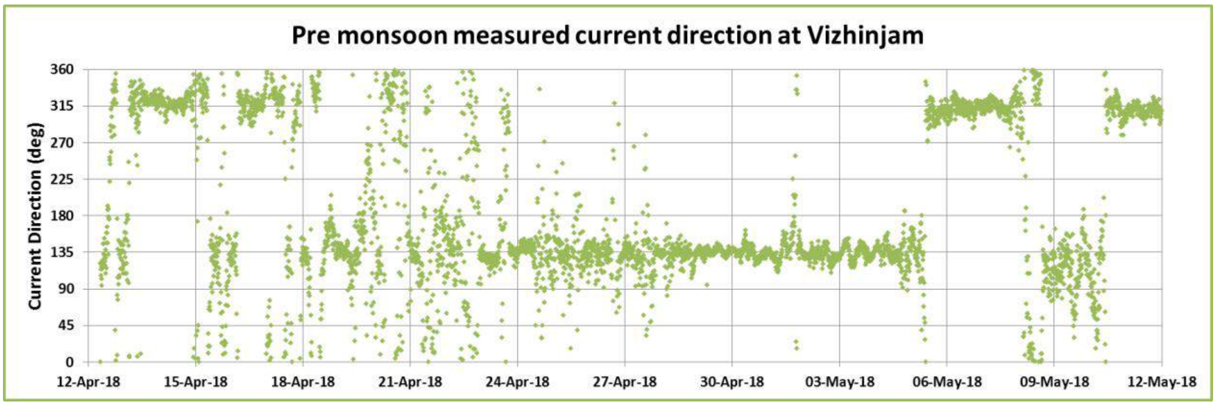


Figure 2-25 Pre Monsoon measured current direction at Vizhinjam – May 2018

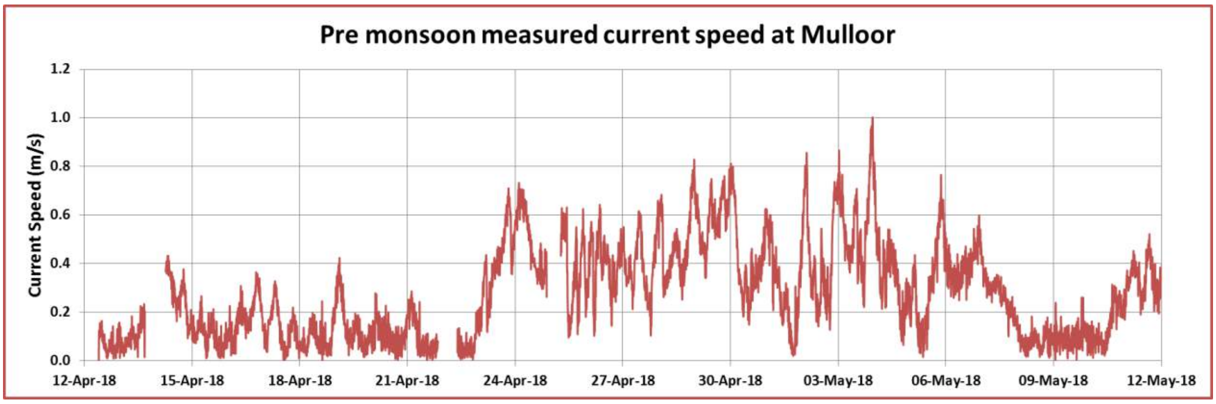


Figure 2-26 Pre Monsoon measured current speed at Mulloor – May 2018

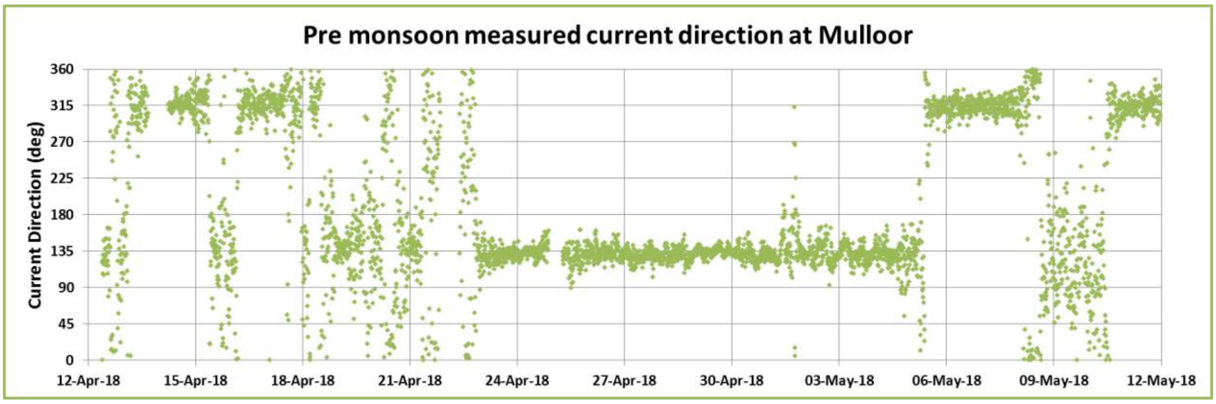


Figure 2-27 Pre Monsoon measured current direction at Mulloor – May 2018

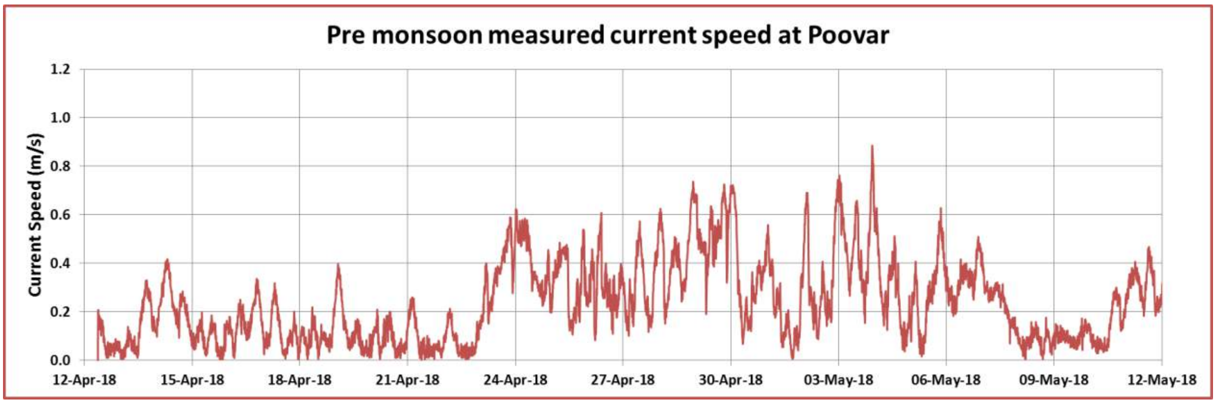


Figure 2-28 Pre Monsoon measured current speed at Poovar – May 2018

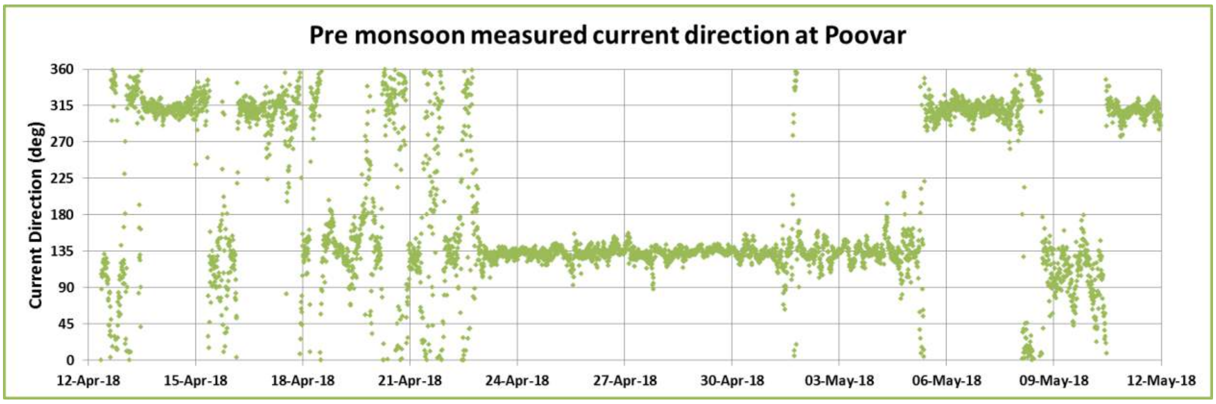


Figure 2-29 Pre Monsoon measured current direction at Poovar – May 2018

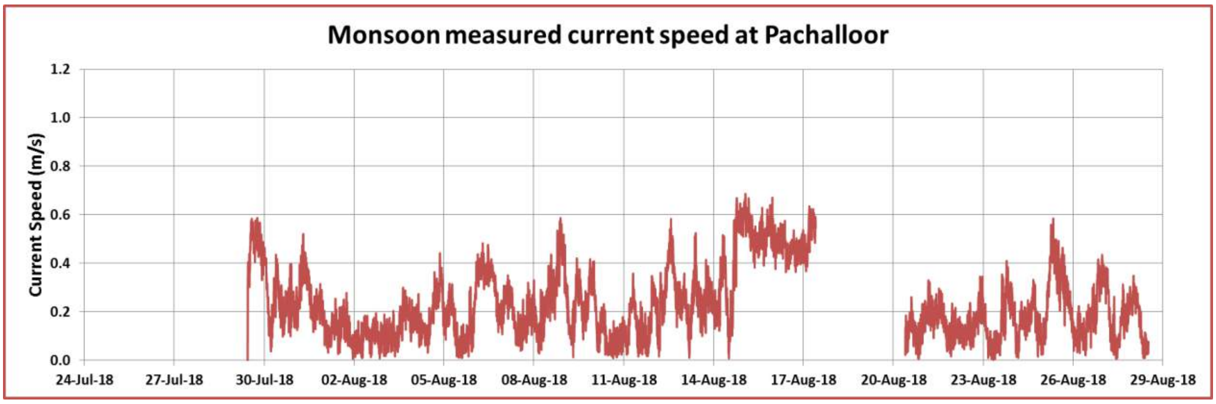


Figure 2-30 Monsoon measured current speed at Pachalloor – August 2018

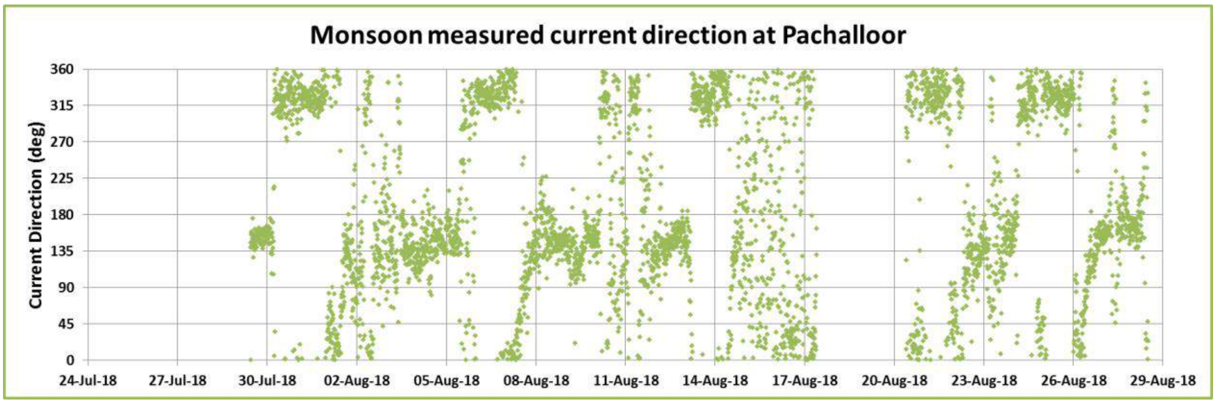


Figure 2-31 Monsoon measured current direction at Pachalloor – August 2018

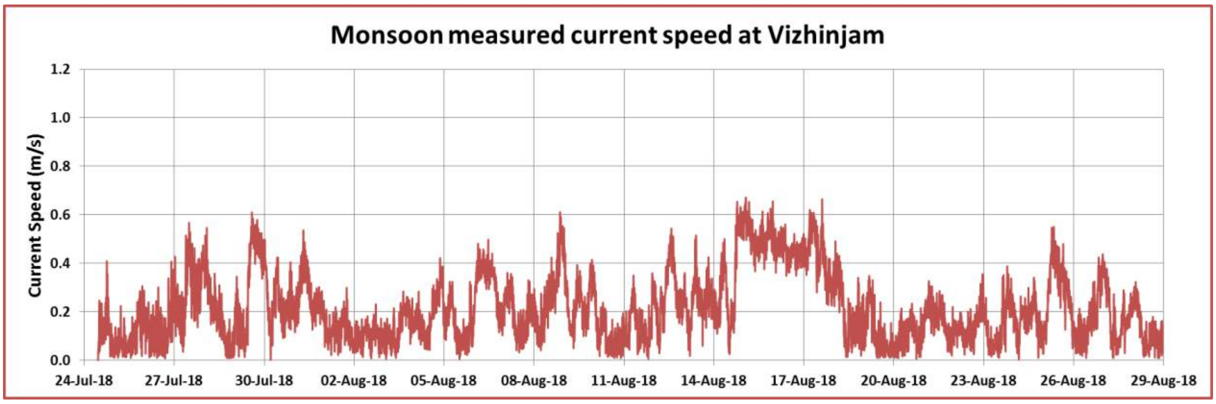


Figure 2-32 Monsoon measured current speed at Vizhinjam – August 2018

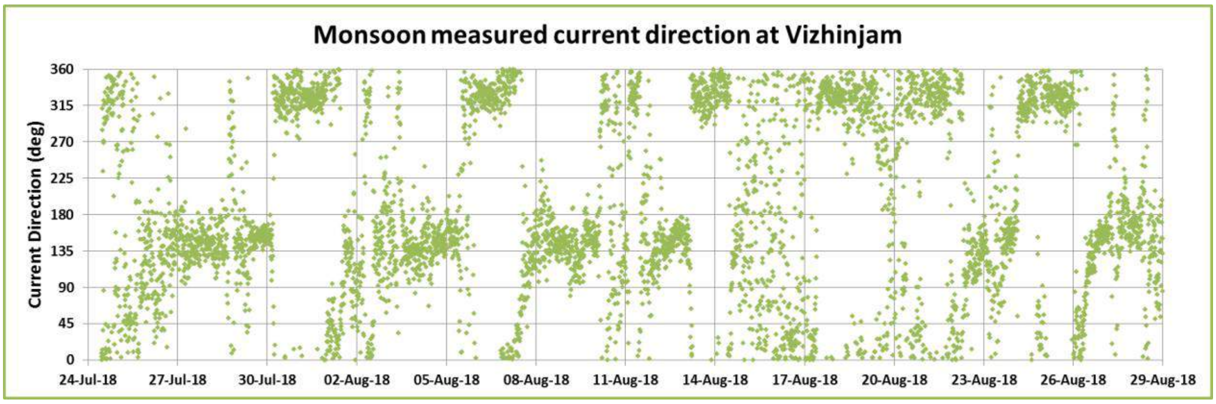


Figure 2-33 Monsoon measured current direction at Vizhinjam – August 2018

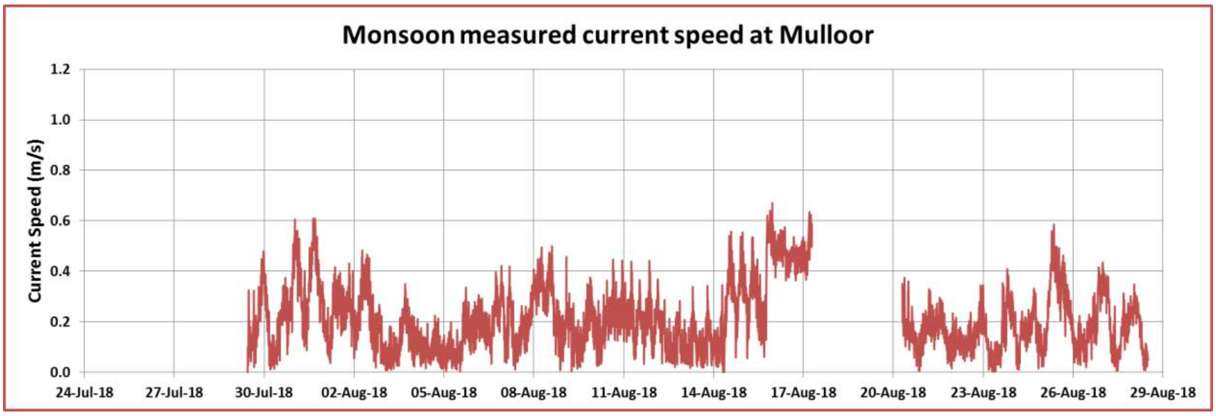


Figure 2-34 Monsoon measured current speed at Mulloor – August 2018

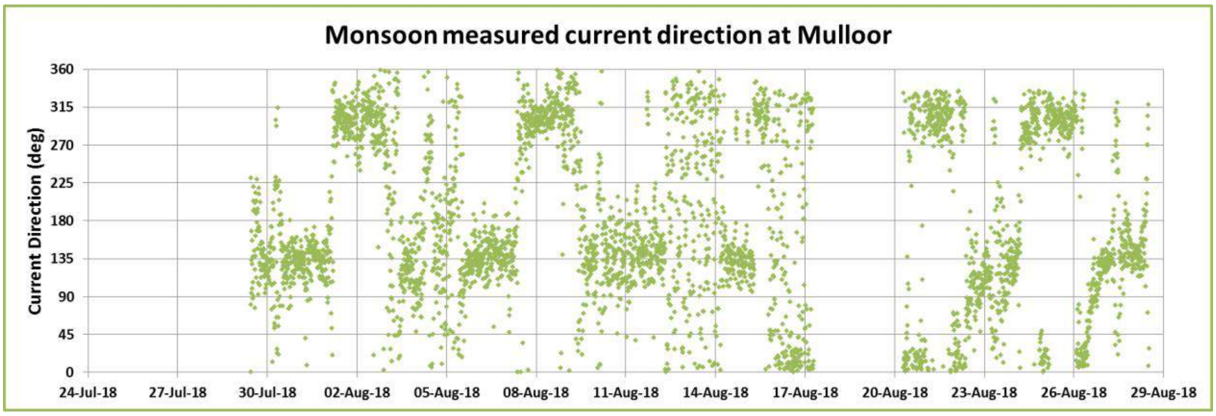


Figure 2-35 Monsoon measured current direction at Mulloor – August 2018

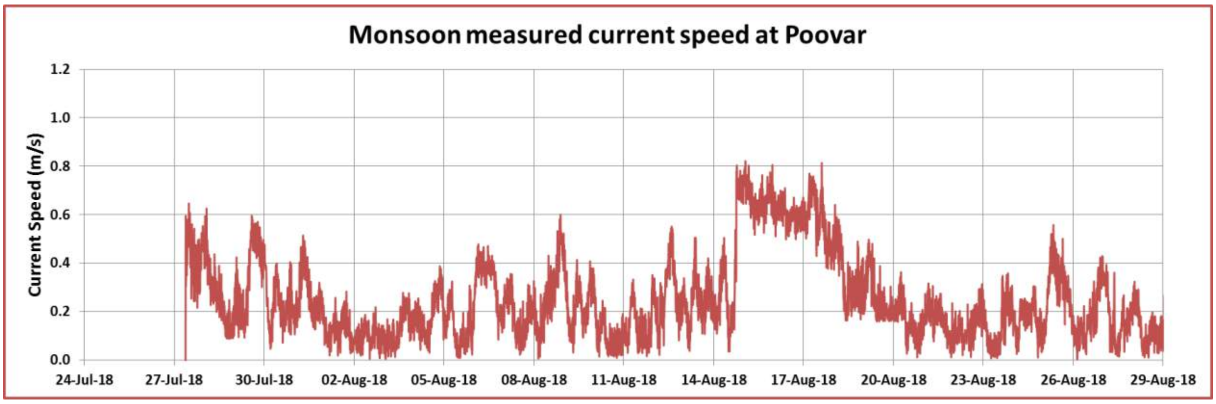


Figure 2-36 Monsoon measured current speed at Poovar – August 2018

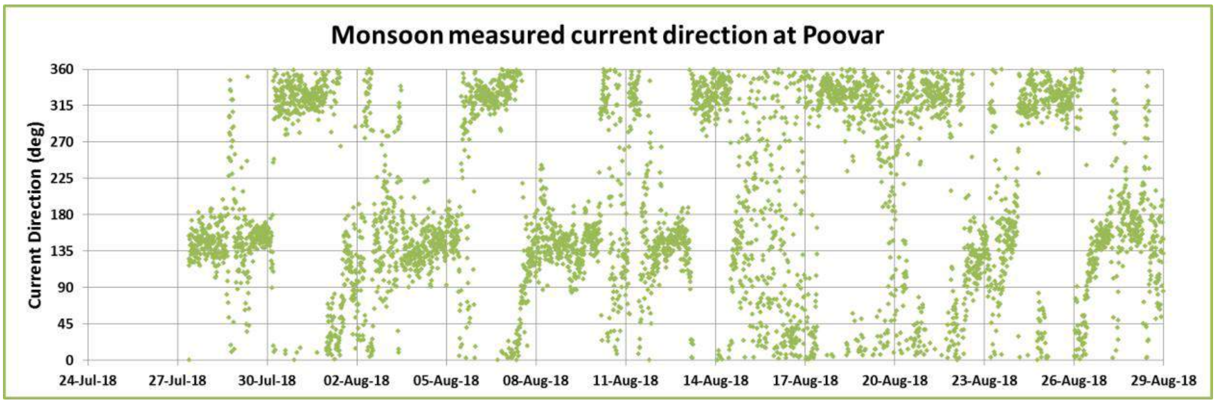


Figure 2-37 Monsoon measured current direction at Poovar – August 2018

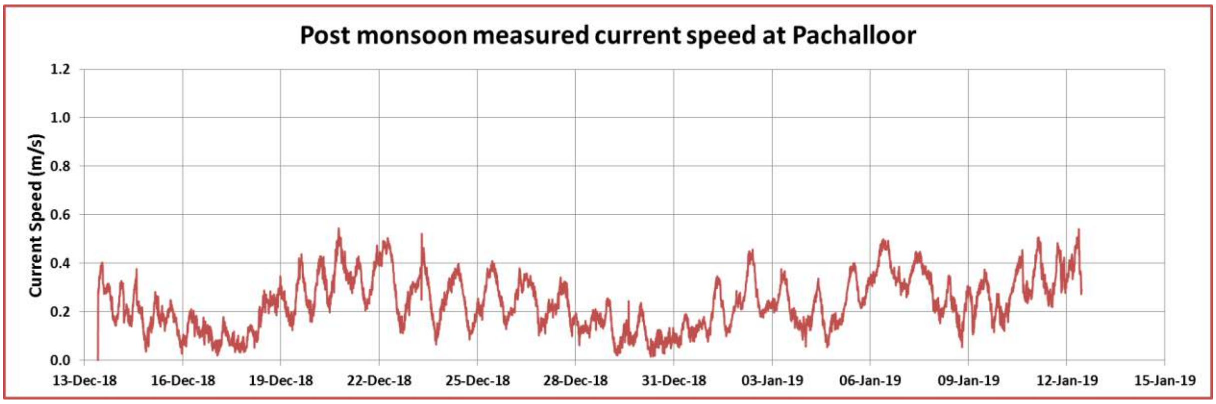


Figure 2-38 Post Monsoon measured current speed at Pachalloor – January 2019

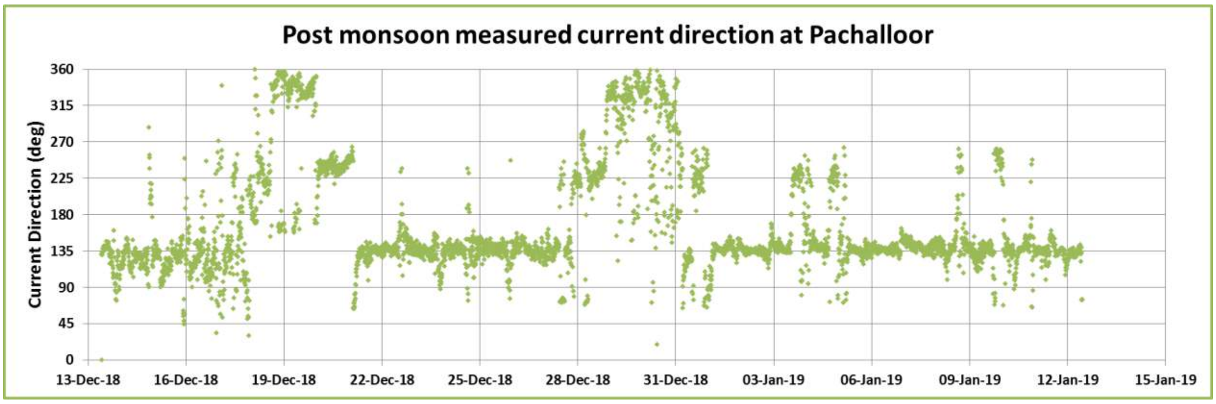


Figure 2-39 Post Monsoon measured current direction at Pachalloor – January 2019

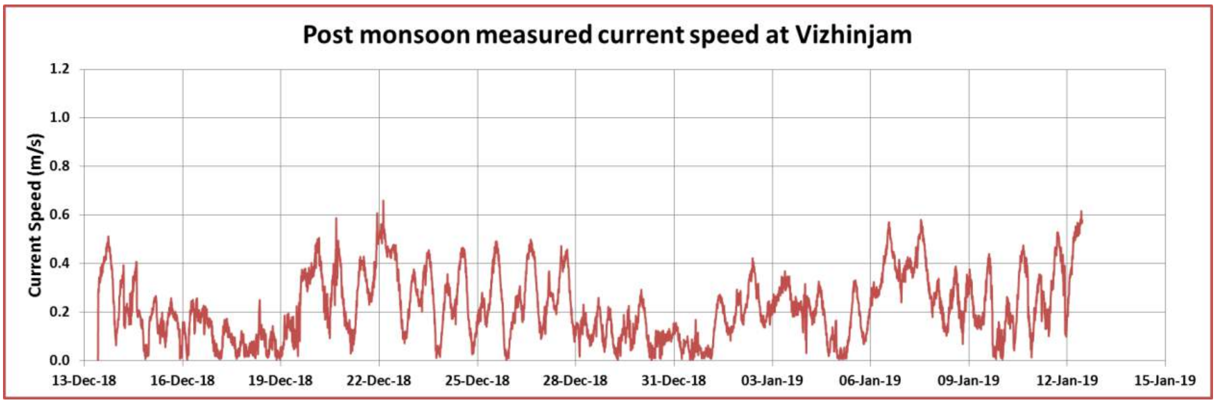


Figure 2-40 Post Monsoon measured current speed at Vizhinjam – January 2019

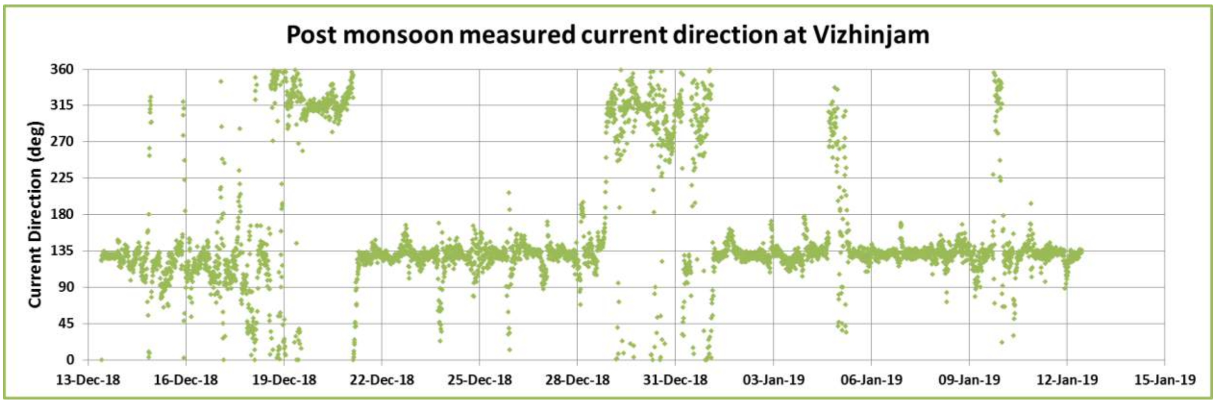


Figure 2-41 Post Monsoon measured current direction at Vizhinjam – January 2019

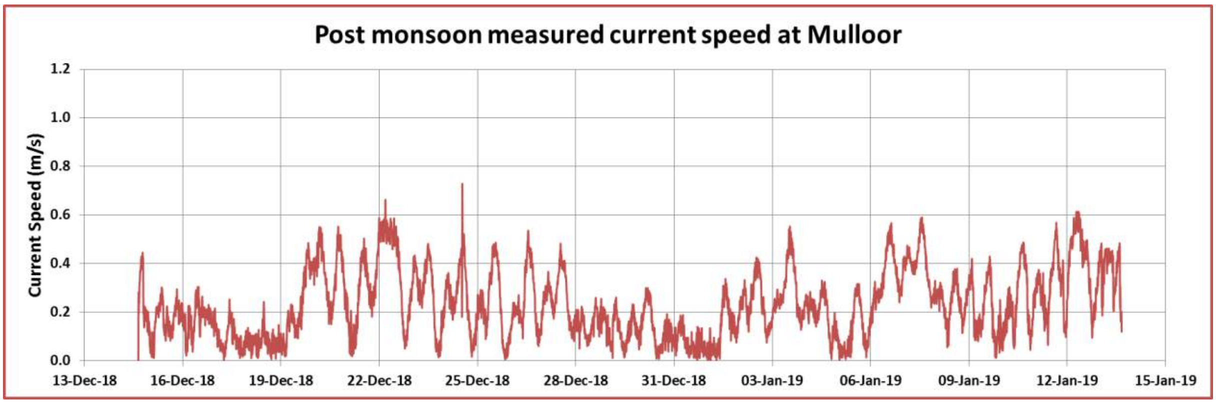


Figure 2-42 Post Monsoon measured current speed at Mulloor – January 2019

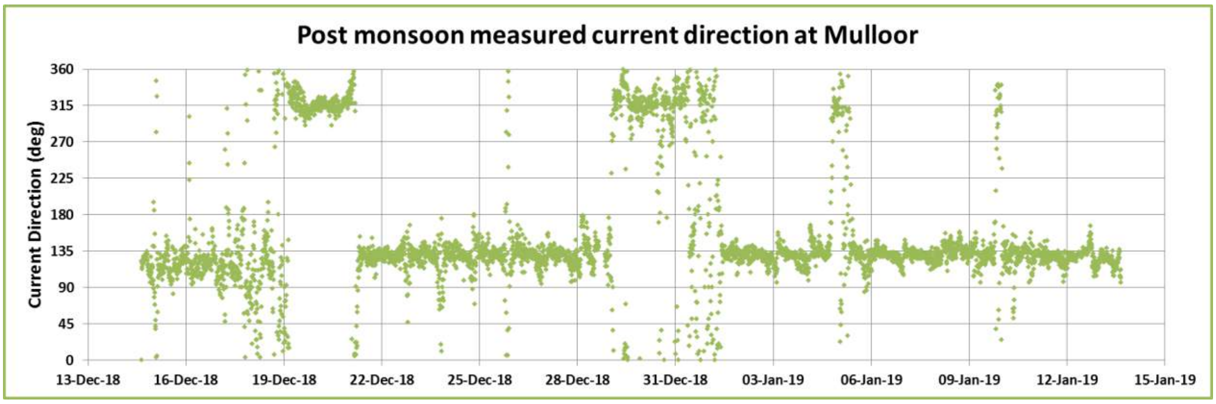


Figure 2-43 Post Monsoon measured current direction at Mulloor – January 2019

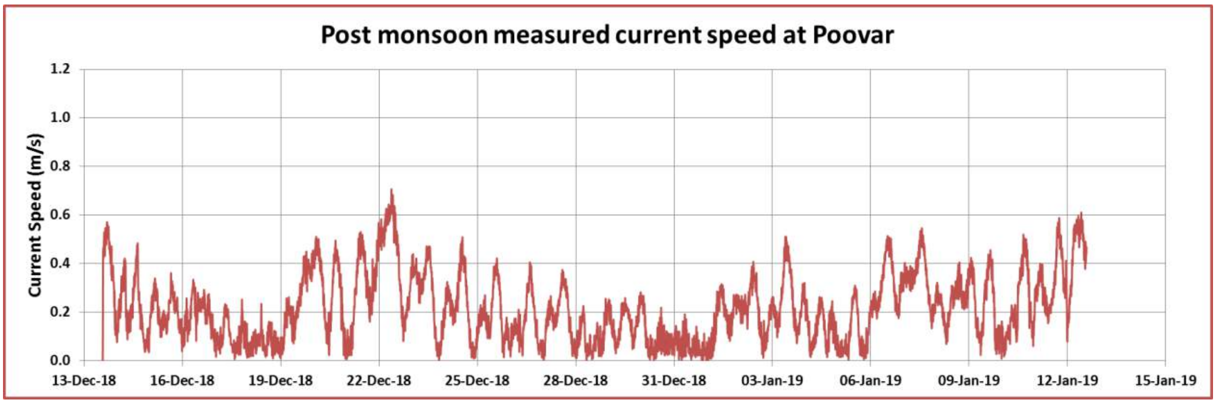


Figure 2-44 Post Monsoon measured current speed at Poovar – January 2019

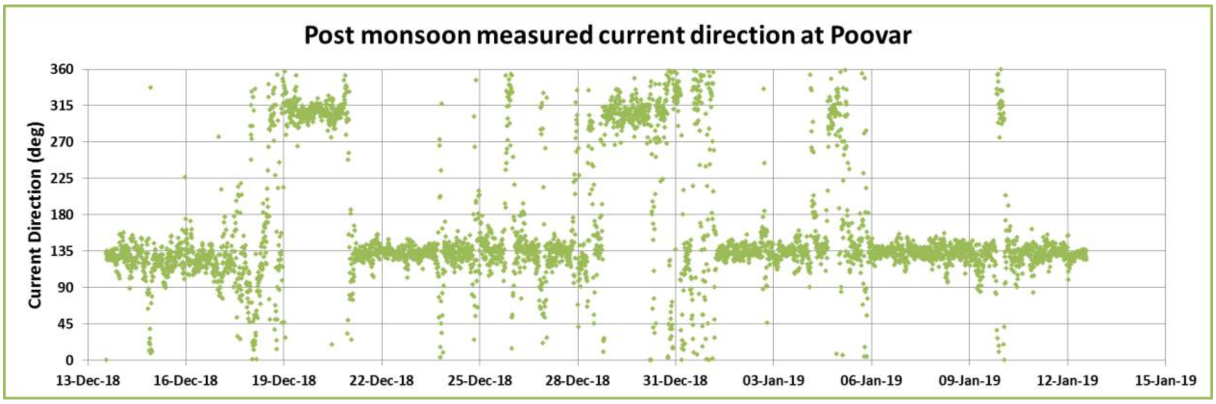


Figure 2-45 Post Monsoon measured current direction at Poovar – January 2019

2.6 Wind

OSAS had carried out the measurement of wind speed and direction from 01st January 2018 to 28th February 2019. The graph showing the variation of wind speed and wind direction measured by OSAS is presented in Figure 2-46 and Figure 2-47

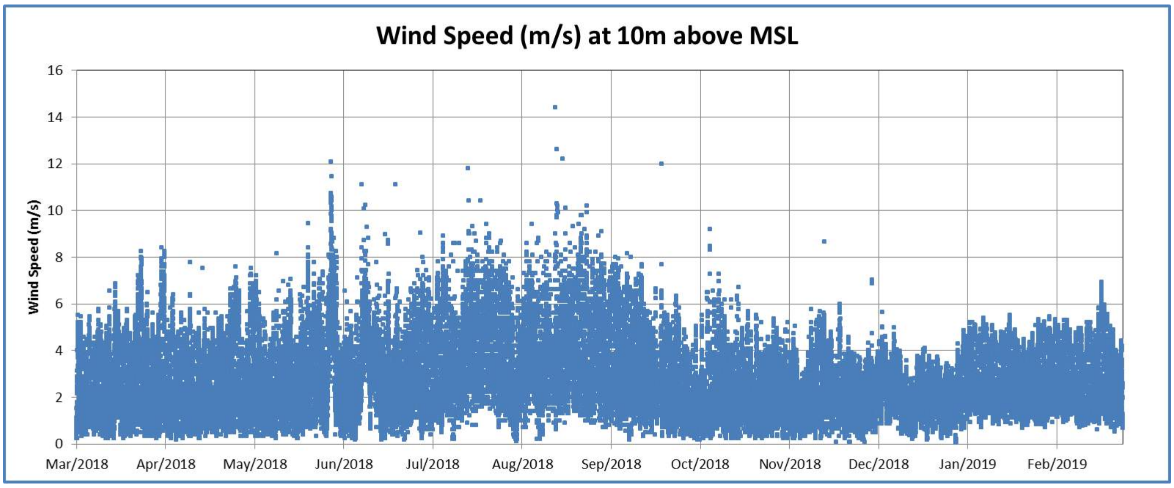


Figure 2-46 Wind Speed (Mar 2018 to Feb 2019)

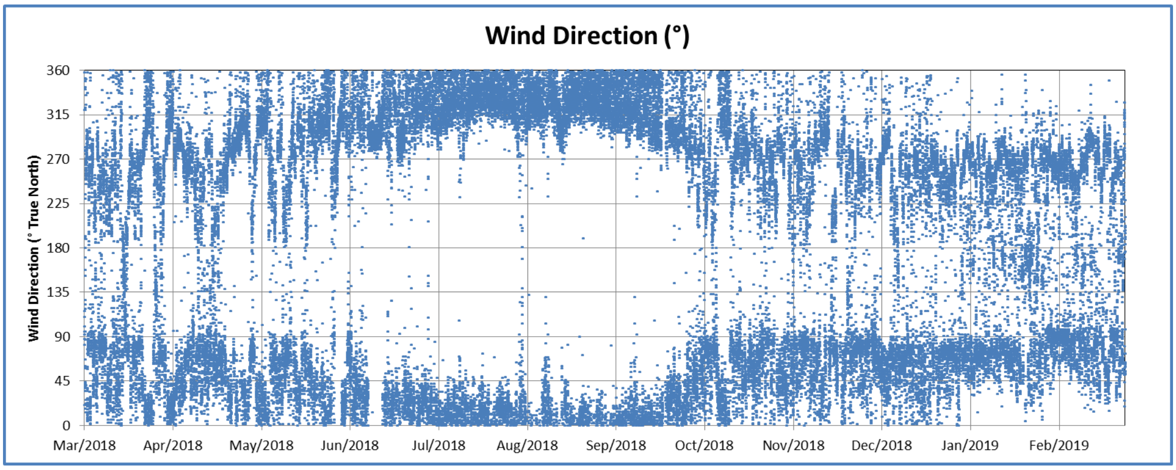


Figure 2-47 Wind Direction (Mar 2018 to Feb 2019)

2.7 Water Sample Data

Water sample analysis is carried out to identify and quantify the chemical components and properties of water samples. Water sample analysis is important to maintain the health of water system. Such methods need to be implemented and maintained to ensure the best practise and acknowledge any important alterations in water quality.

Water samples have been collected for the year 2018 to 2019 is provided by AVPPL. The collected data consists of salinity (mg/L), turbidity (NTU) and total suspended solids (mg/L) for three seasons such as pre-monsoon (April-2018), monsoon (June-2018) and post monsoon (December 2018-January 2019). Data was collected at four locations namely, Vizhinjam (08° 21' 55.4"N, 76° 58' 51.6"E), Pachalloor (08° 24' 08.6"N, 76° 56' 16.1"E), Mulloor (08° 21' 42.3"N, 76° 59' 33.9"E) and Poovar (08° 17' 35.8"N, 77° 04' 03.5"E) as presented in Figure 2-48 during all the three seasons in 2018-19.

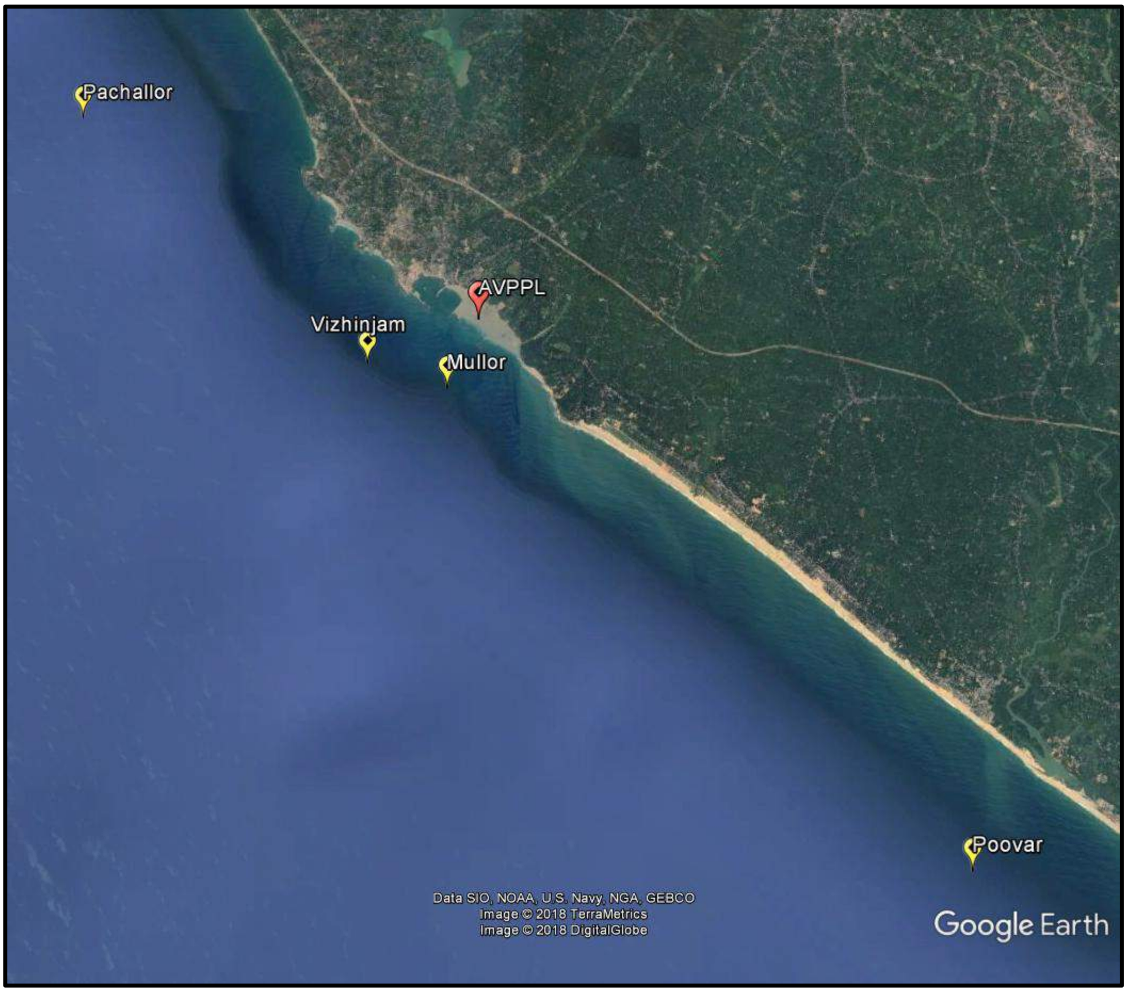
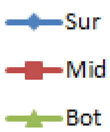


Figure 2-48 Locations from where water samples have collected

2.7.1 Turbidity

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates. The more total suspended solids in the water, the murkier it seems and the higher the turbidity. Turbidity is considered as a good measure of the quality of water and is measured in terms of NTU. Turbidity data collected in three seasons at four locations were provided by AVPPL. The comparison plots of turbidity measured at surface, mid depth and bottom during pre-monsoon 2018 are shown in Figure 2-49 to Figure 2-52. It is noticed that the turbidity values are within the range of 0.1 – 1.9 NTU during pre-monsoon 2018 at all locations.



Legend of Turbidity & TSS plots

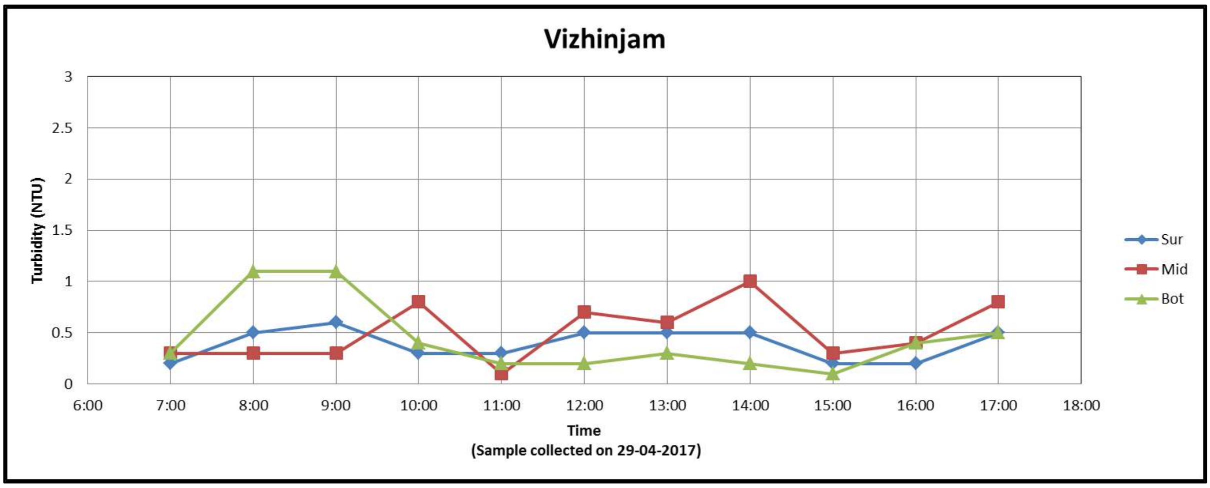


Figure 2-49 Turbidity at Vizhinjam during Pre-Monsoon 2018

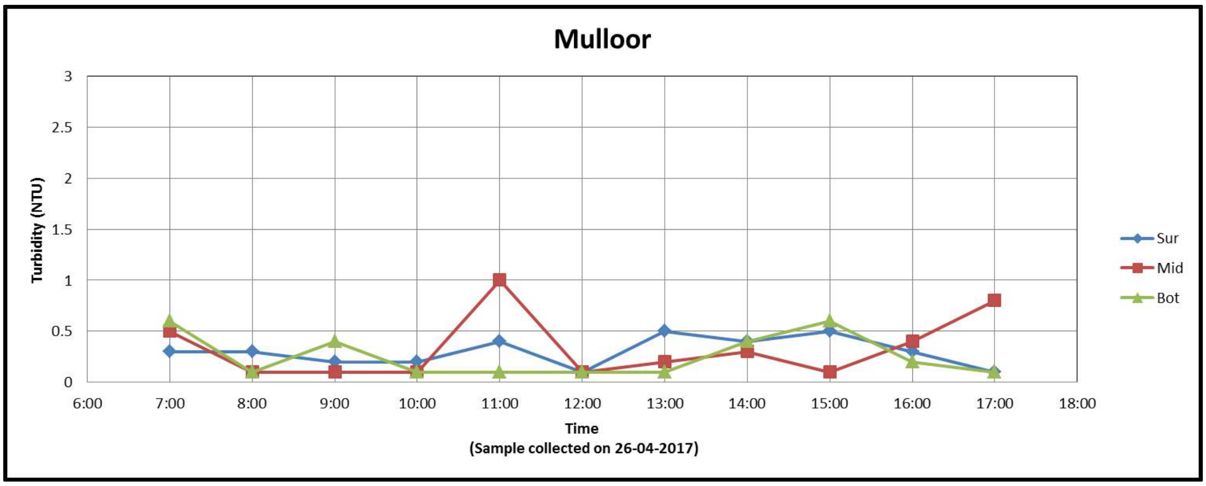


Figure 2-50 Turbidity at Mulloor during Pre-Monsoon 2018

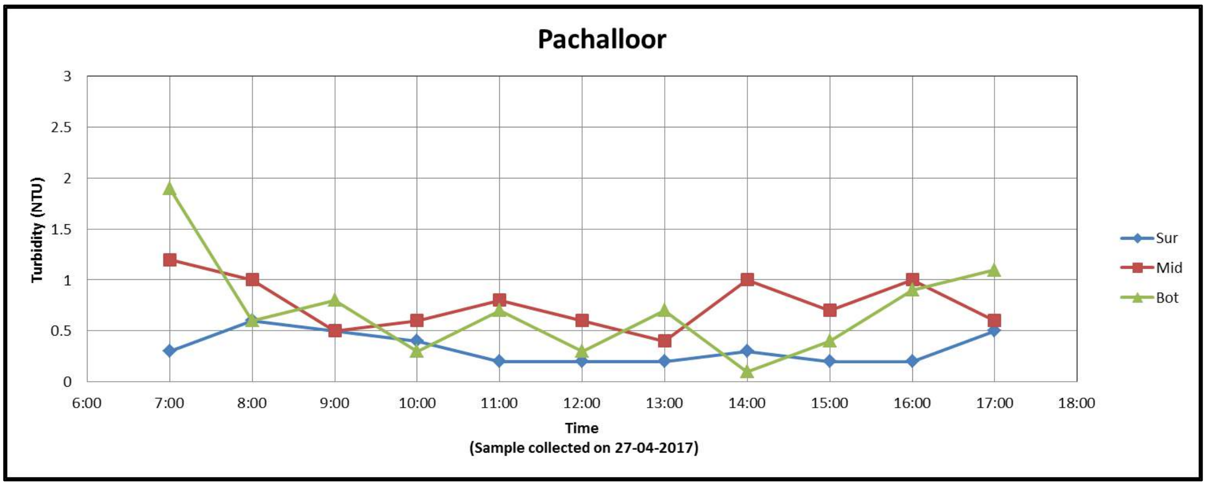


Figure 2-51 Turbidity at Pachalloor during Pre-Monsoon 2018

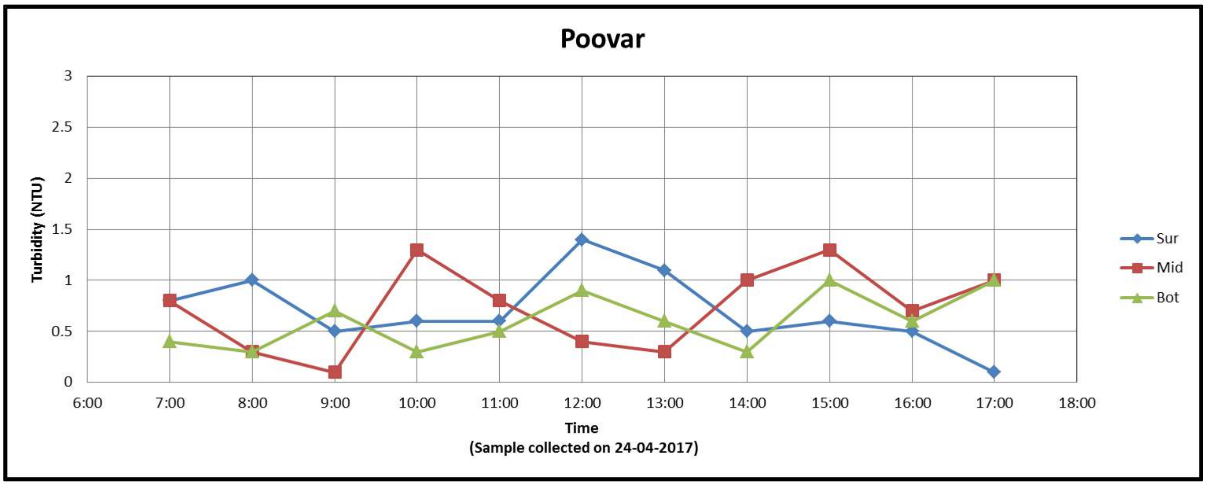


Figure 2-52 Turbidity at Poovar during Pre-Monsoon 2018

The comparison plots of turbidity measured at surface, mid depth and bottom during monsoon 2017 are presented in Figure 2-53 to Figure 2-56. It is noticed that the turbidity are in the range of 0.1 – 2.4 NTU during monsoon 2018 at all locations.

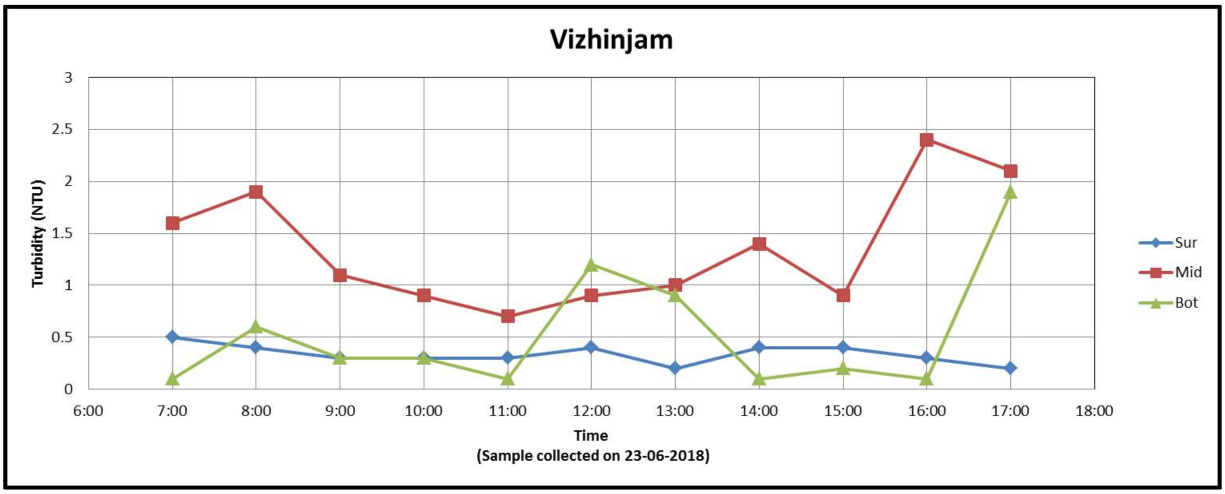


Figure 2-53 Turbidity at Vizhinjam during Monsoon 2018

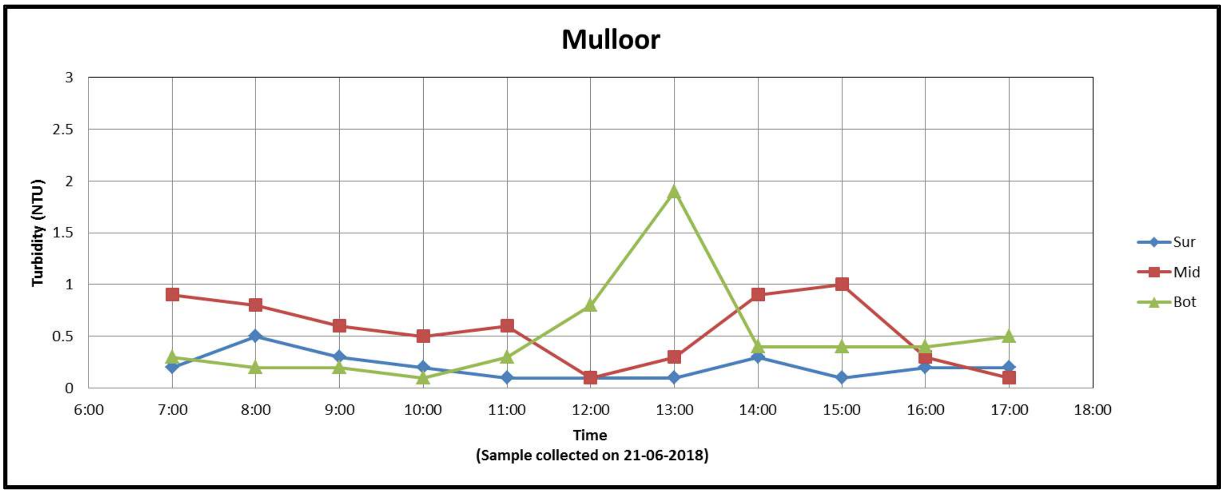


Figure 2-54 Turbidity at Mulloor during Monsoon 2018

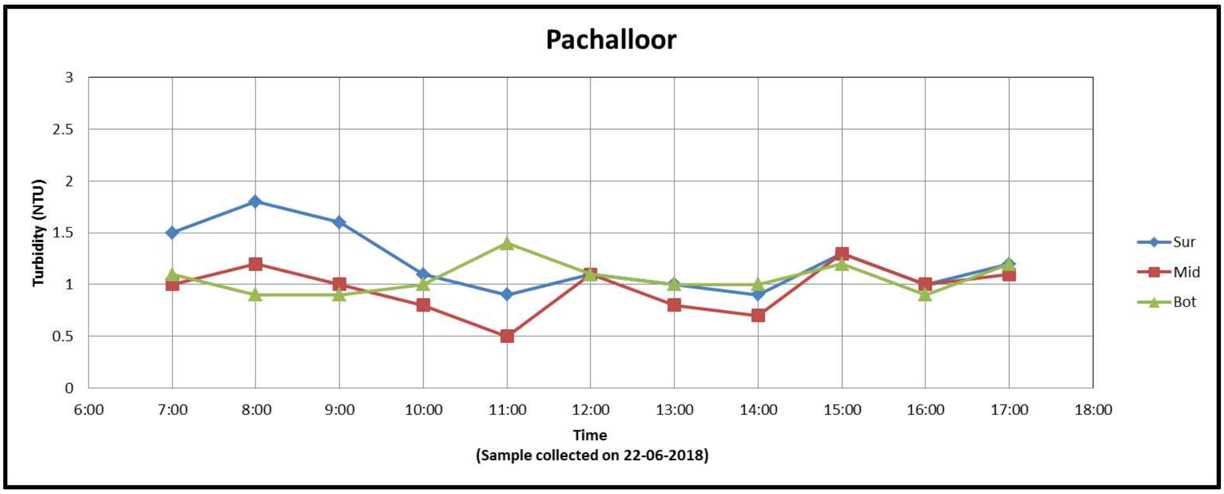


Figure 2-55 Turbidity at Pachalloor during Monsoon 2018

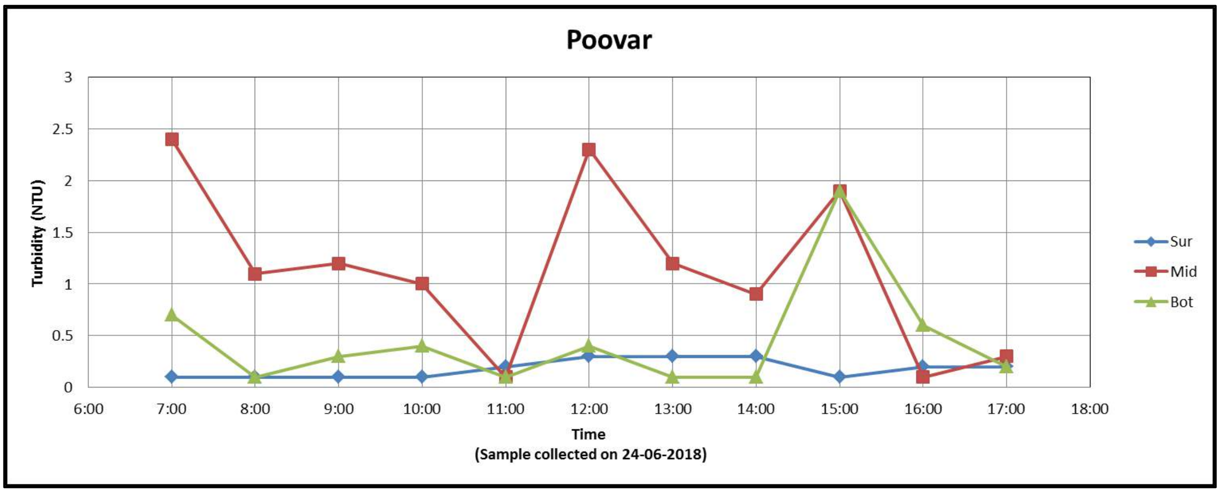


Figure 2-56 Turbidity at Poovar during Monsoon 2018

The comparison plots of turbidity measured at surface, mid depth and bottom during post monsoon 2018-19 are presented in Figure 2-57 to Figure 2-60. It is noticed that the turbidity are in the range of 0.1 – 2.9 NTU during Post Monsoon 2018 at all locations.

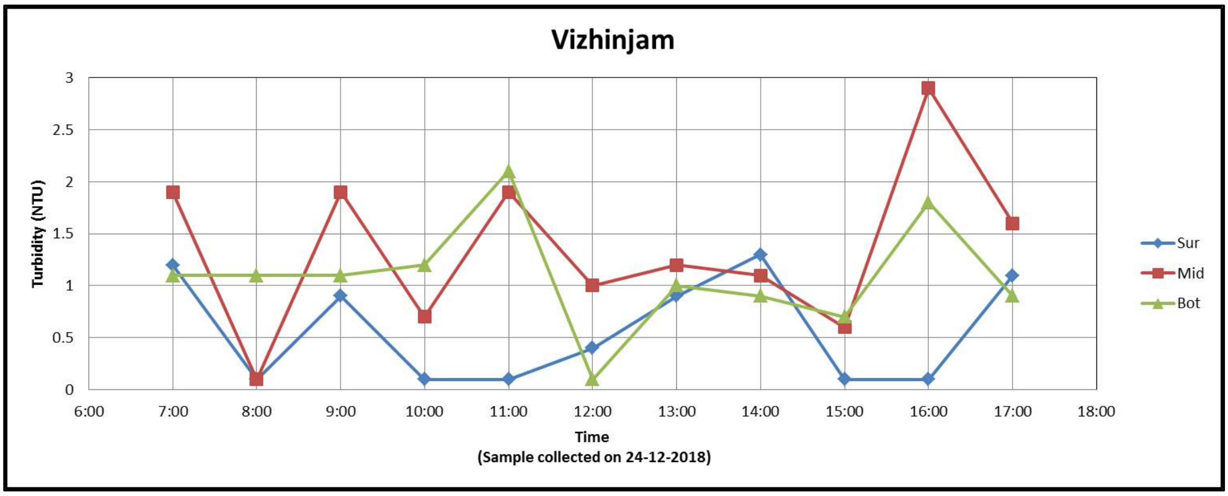


Figure 2-57 Turbidity at Vizhinjam during Post Monsoon 2018

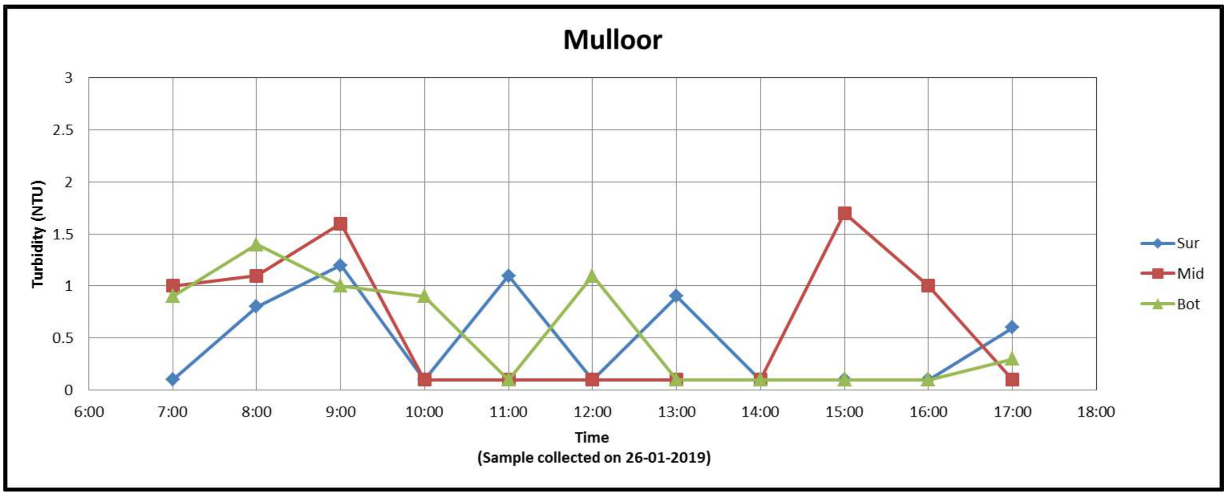


Figure 2-58 Turbidity at Mulloor during Post Monsoon 2018

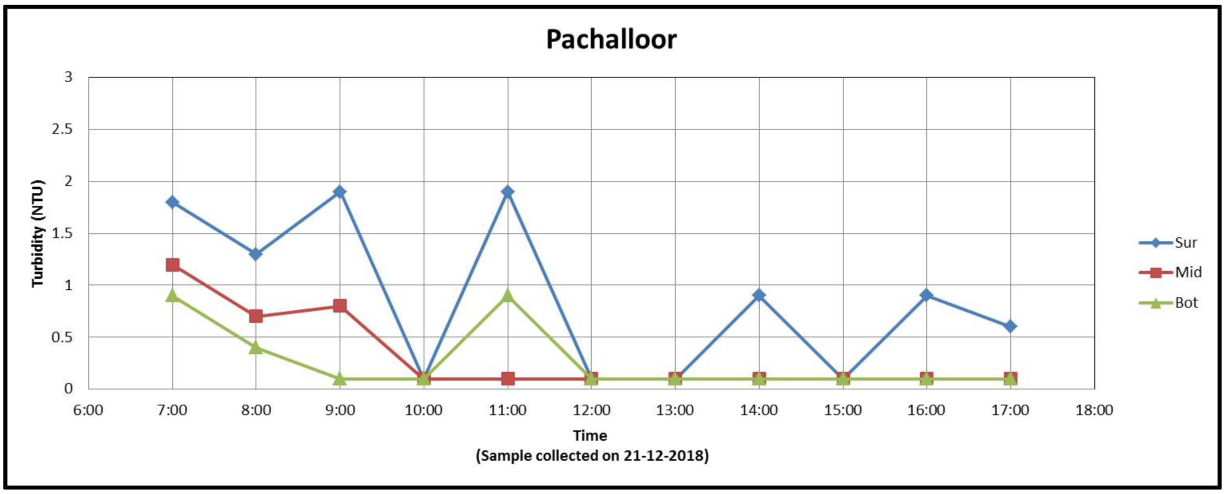


Figure 2-59 Turbidity at Pachalloor during Post Monsoon 2018

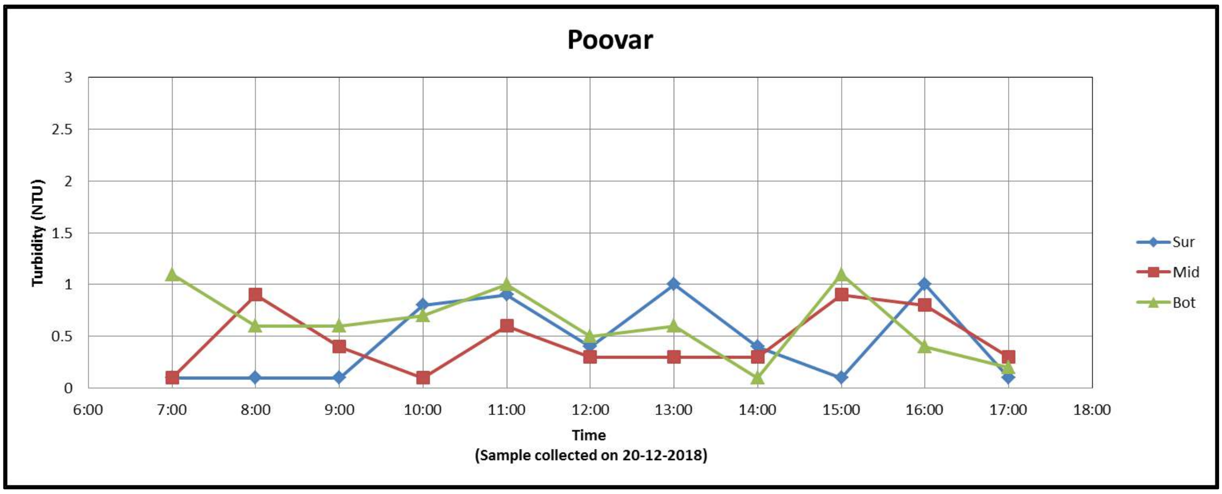


Figure 2-60 Turbidity at Poovar during Post Monsoon 2018

From the above comparison, it is observed that, the turbidity during 2018-19 is relatively lesser compared to the water sample analysis data of previous years (2015-2017).

2.7.2 Total suspended solids

Total suspended solids (TSS) are a significant factor in observing water clarity. The more solids present in the water, the less clear the water will be. The comparison plots of the TSS measured at the surface, mid depth and bottom during Pre-monsoon 2018 are shown in Figure 2-61 to Figure 2-64. It is noticed that the TSS values varies with in a range of 0.1 to 3.9 mg/L. All the four locations show lesser values of TSS below 10 mg/l.

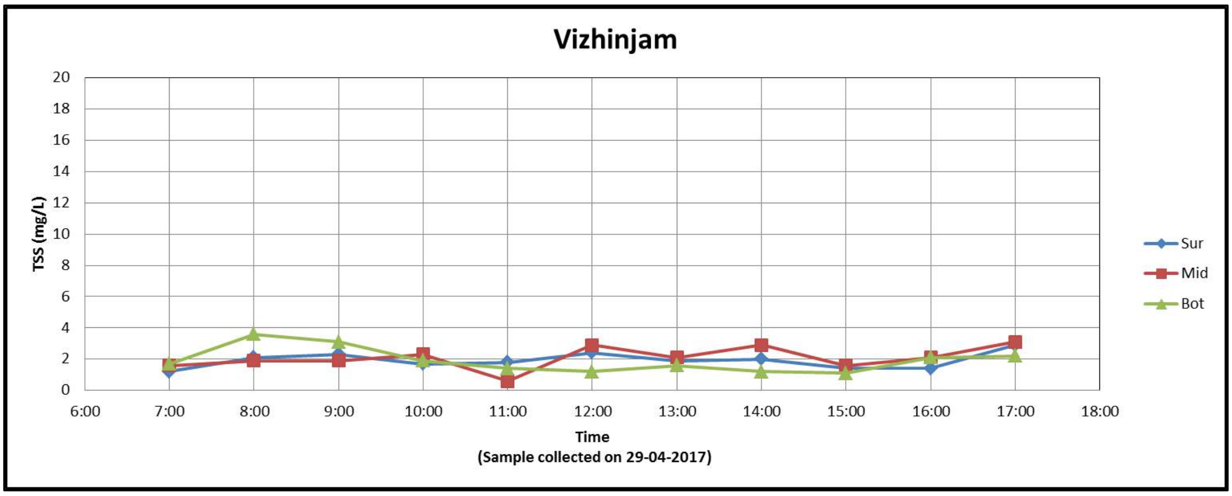


Figure 2-61 Total suspended solids at Vizhinjam during Pre Monsoon 2018

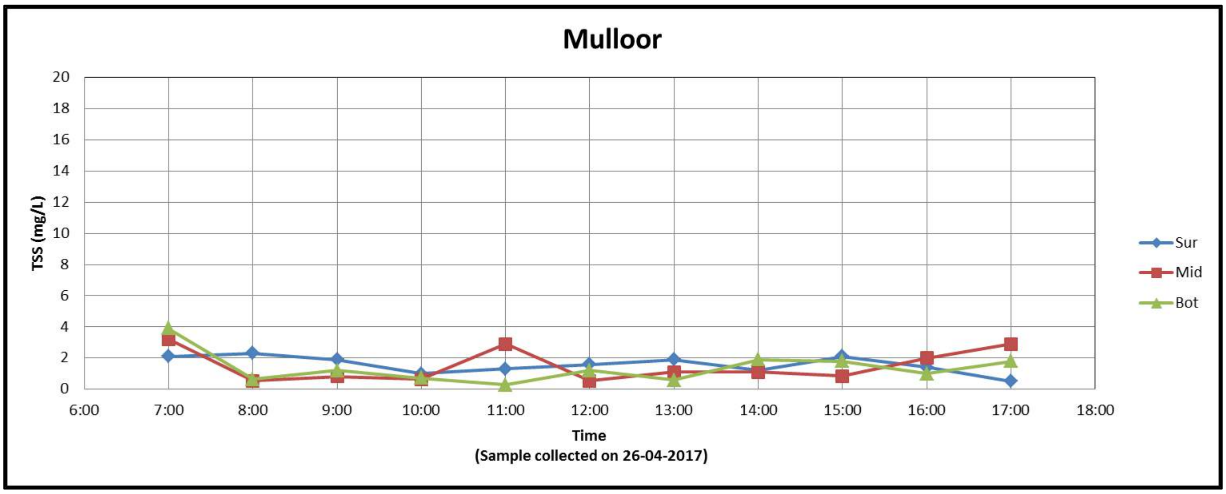


Figure 2-62 Total suspended solids at Mulloor during Pre Monsoon 2018

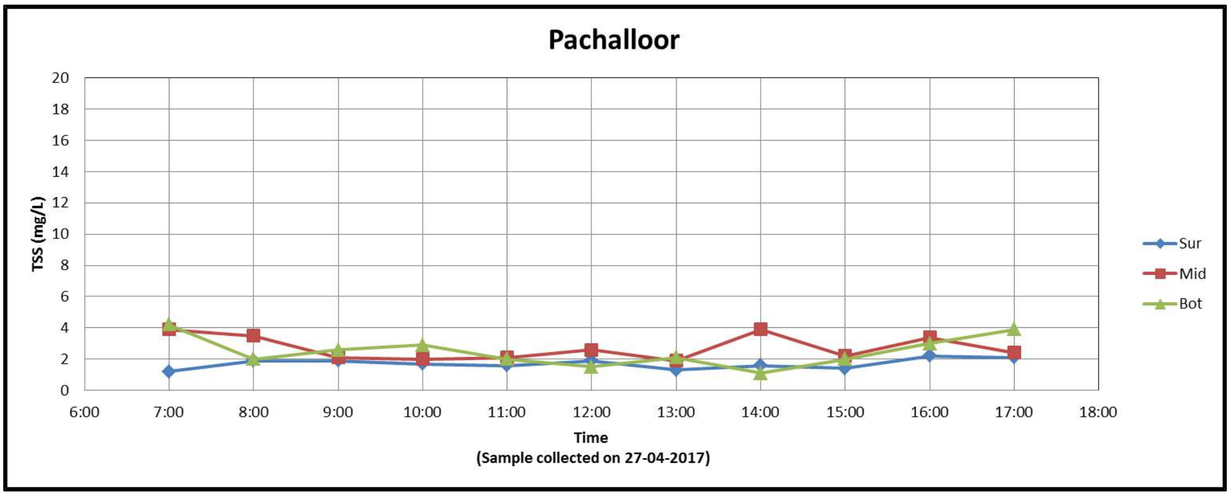


Figure 2-63 Total suspended solids at Pachalloor during Pre Monsoon 2018

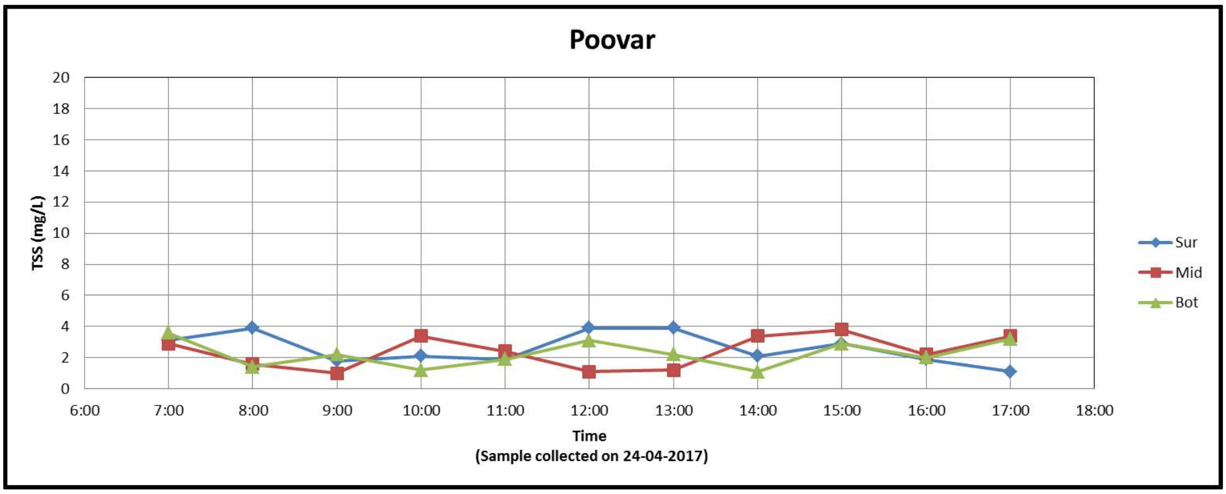


Figure 2-64 Total suspended solids at Poovar during Pre Monsoon 2018

The comparison plots of the TSS measured at the surface, mid depth and bottom during monsoon 2018 are presented in Figure 2-65 to Figure 2-68. It is noticed that the TSS values varies with in a range of 1.4 to 18.9 mg/L. Water samples from all the four locations showed lesser values of TSS except one water sample collected from Pachalloor showed higher value of TSS.

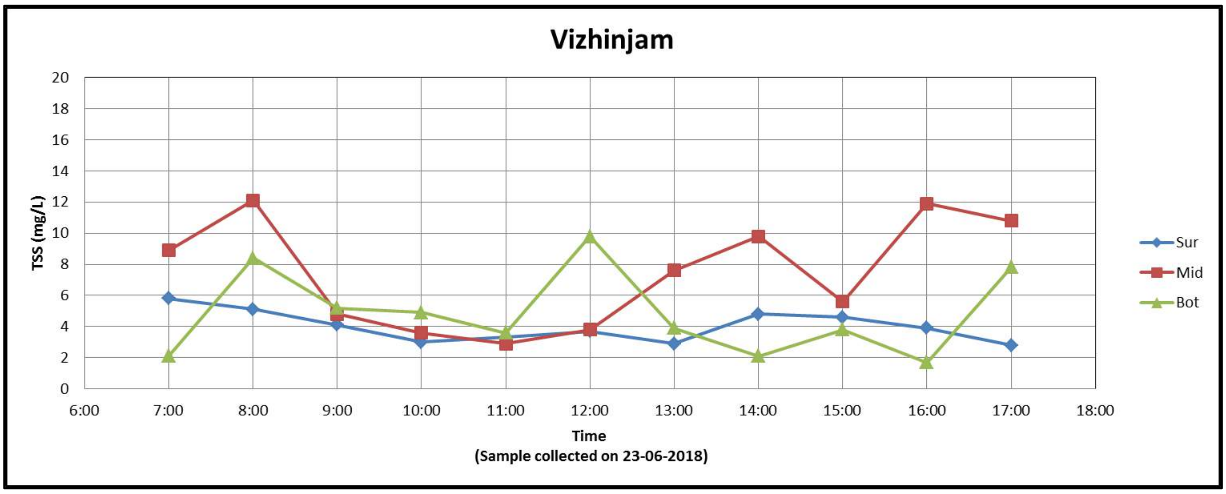


Figure 2-65 Total suspended solids at Vizhinjam during Monsoon 2018

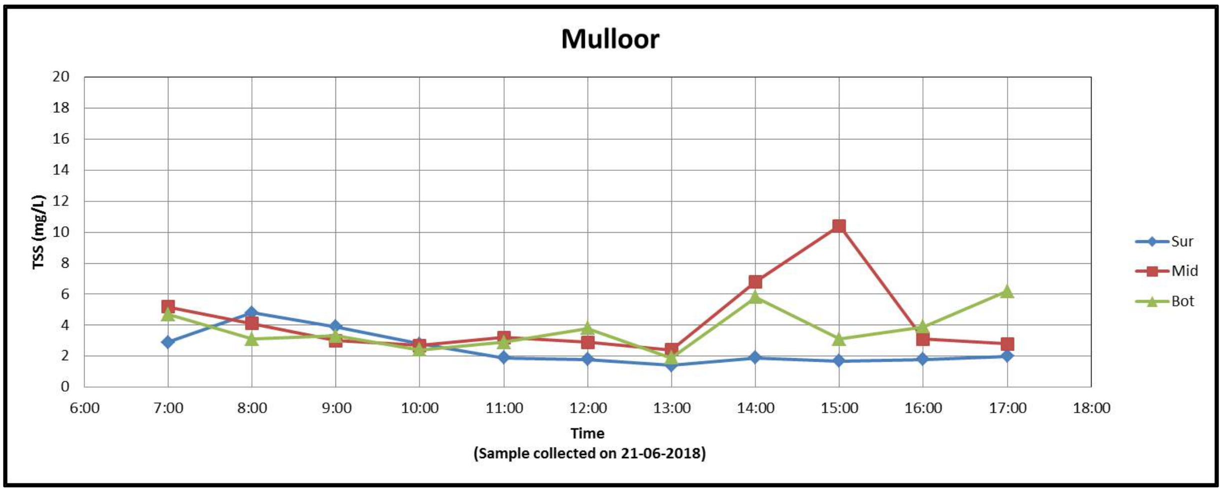


Figure 2-66 Total suspended solids at Mulloor during Monsoon 2018

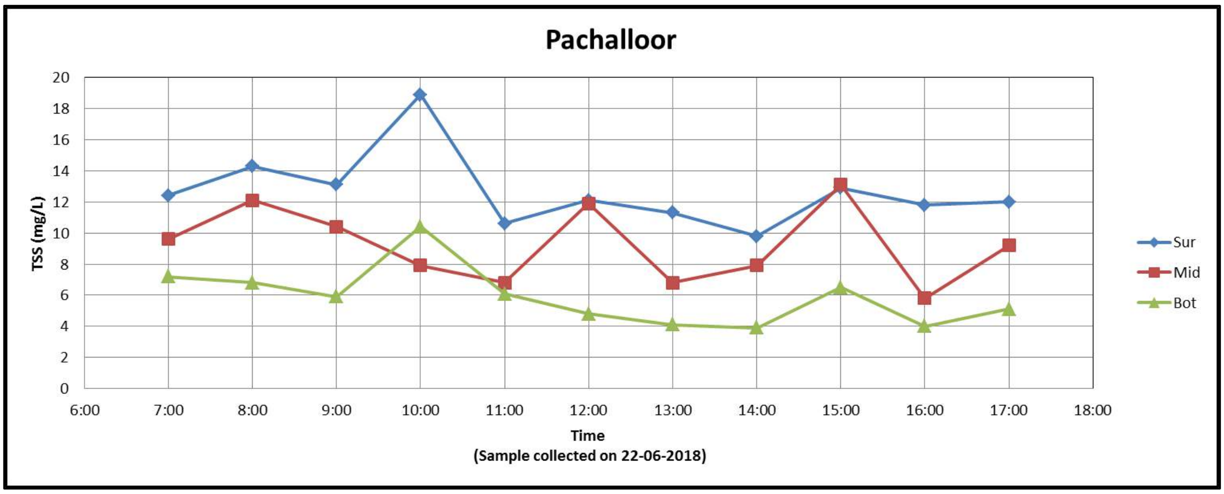


Figure 2-67 Total suspended solids at Pachalloor during Monsoon 2018

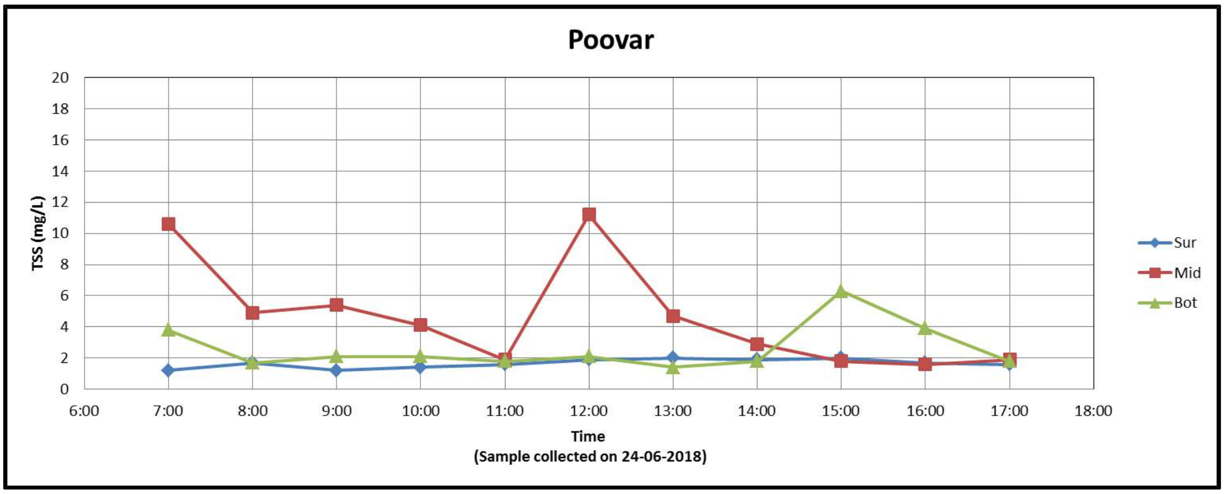


Figure 2-68 Total suspended solids at Poovar during Monsoon 2018

The comparison plots of the TSS measured at the surface, mid depth and bottom during Post Monsoon 2018 are presented in Figure 2-69 to Figure 2-72. It is noticed that the TSS values varies with in a range of 0.1 to 10.2 mg/L for all the locations.

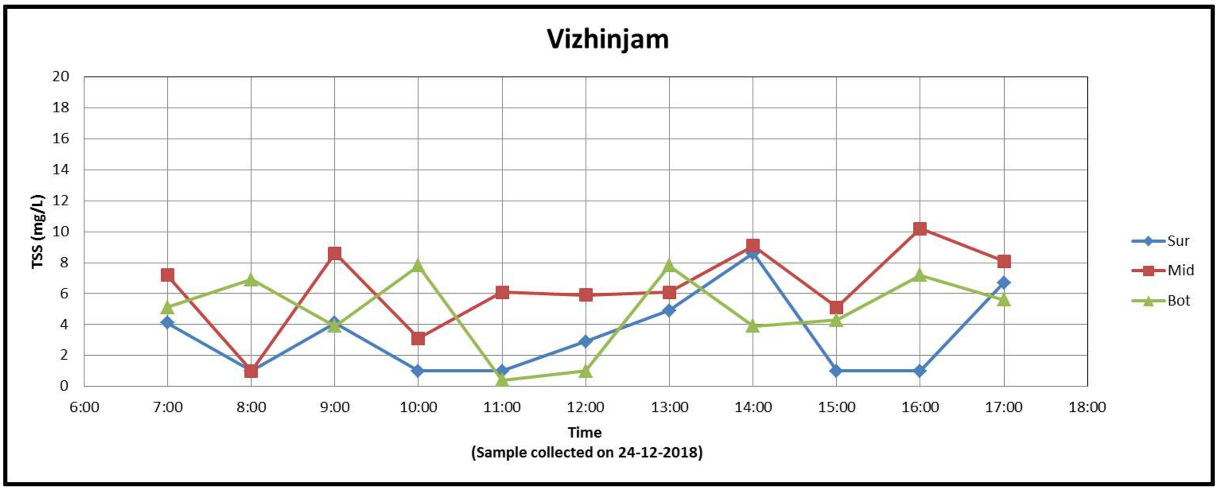


Figure 2-69 Total suspended solids at Vizhinjam during Post Monsoon 2018

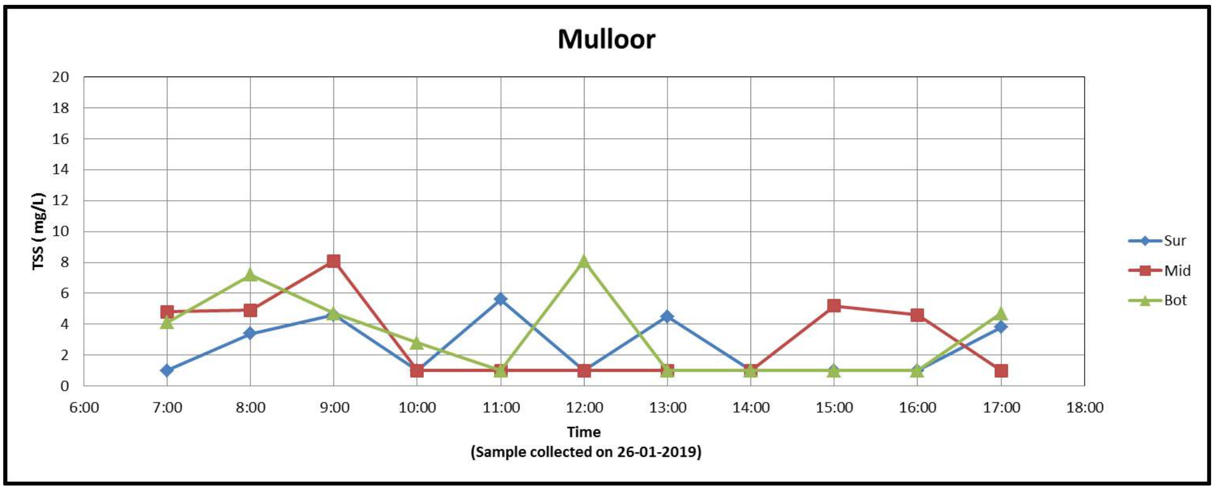


Figure 2-70 Total suspended solids at Mulloor during Post Monsoon 2018

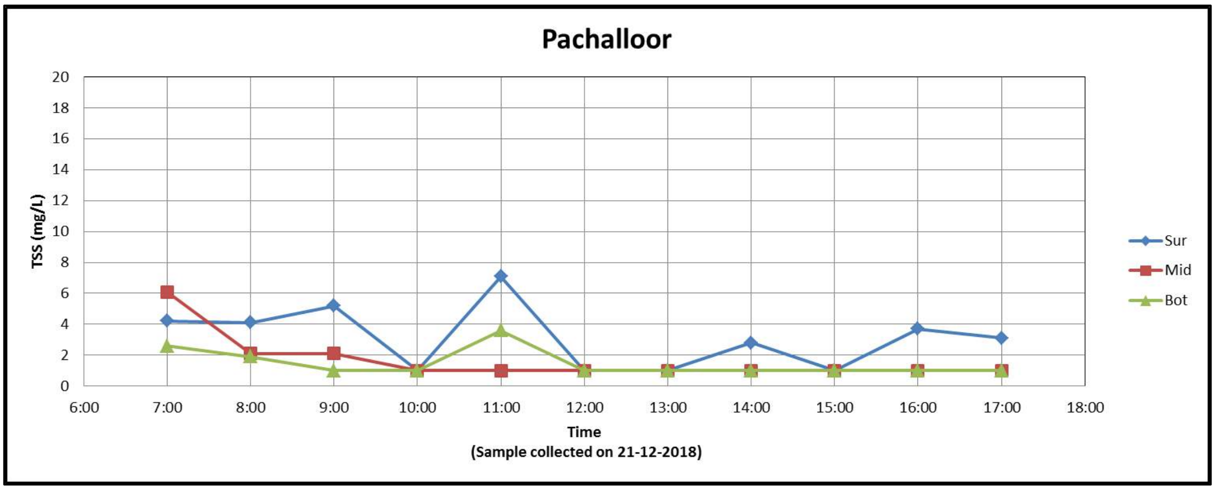


Figure 2-71 Total suspended solids at Pachalloor during Post Monsoon 2018

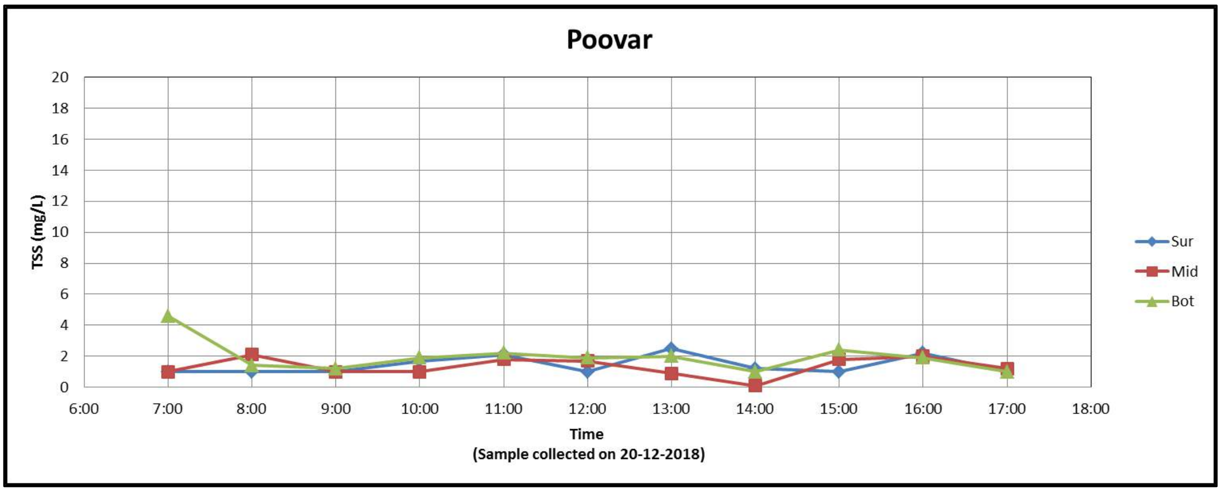


Figure 2-72 Total suspended solids at Poovar during Post Monsoon 2018

Observed TSS values are in higher during pre-monsoon and monsoon at Poovar location. However, the observed values of turbidity and TSS at all the locations during all seasons are very less.

2.7.3 Relationship between turbidity and TSS

The relationship between TSS and Turbidity is developed using data measured during period of 2018 to 2019 at the four locations. The trend observed between the values of TSS and turbidity collected during 2018-2019 is as shown in Figure 2-73. The trend line with higher slope is associated with lesser average turbidity with respect to average TSS.

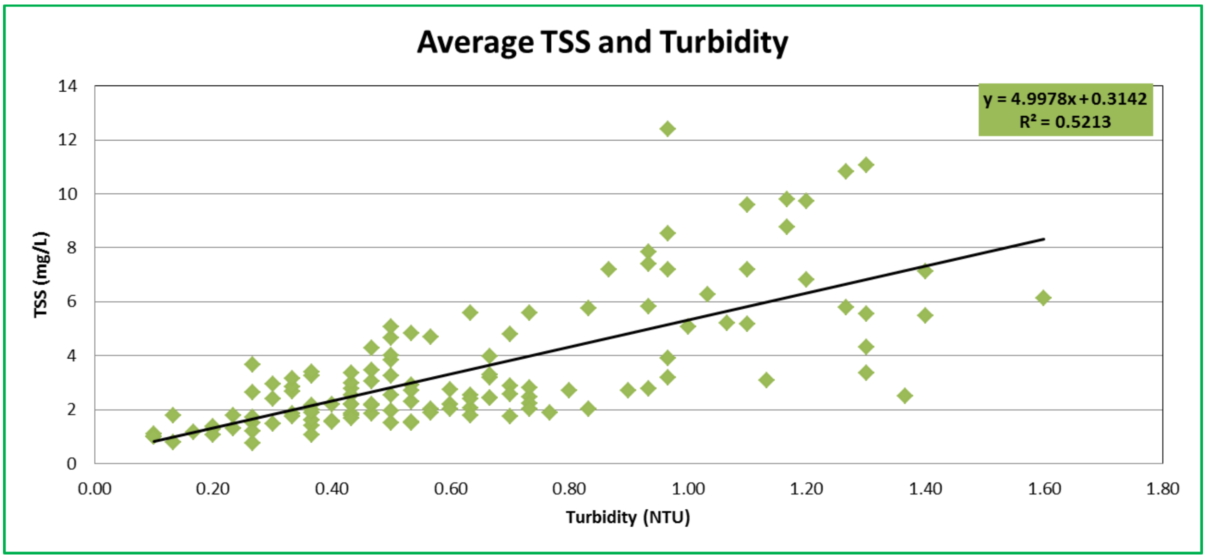


Figure 2-73 Relationship between Turbidity and TSS for the year 2018-2019

2.7.4 Turbidity data from monitoring buoys

During 1st March 2018 to 28th February 2019, continuous monitoring of turbidity was carried out at 3 locations near the port site as shown in Figure 2-74. Additional to water sample data, Client has provided the turbidity data from 1st March 2018 to 28th February 2019 in 10 min intervals collected from three locations near the port area using turbidity monitoring buoys.

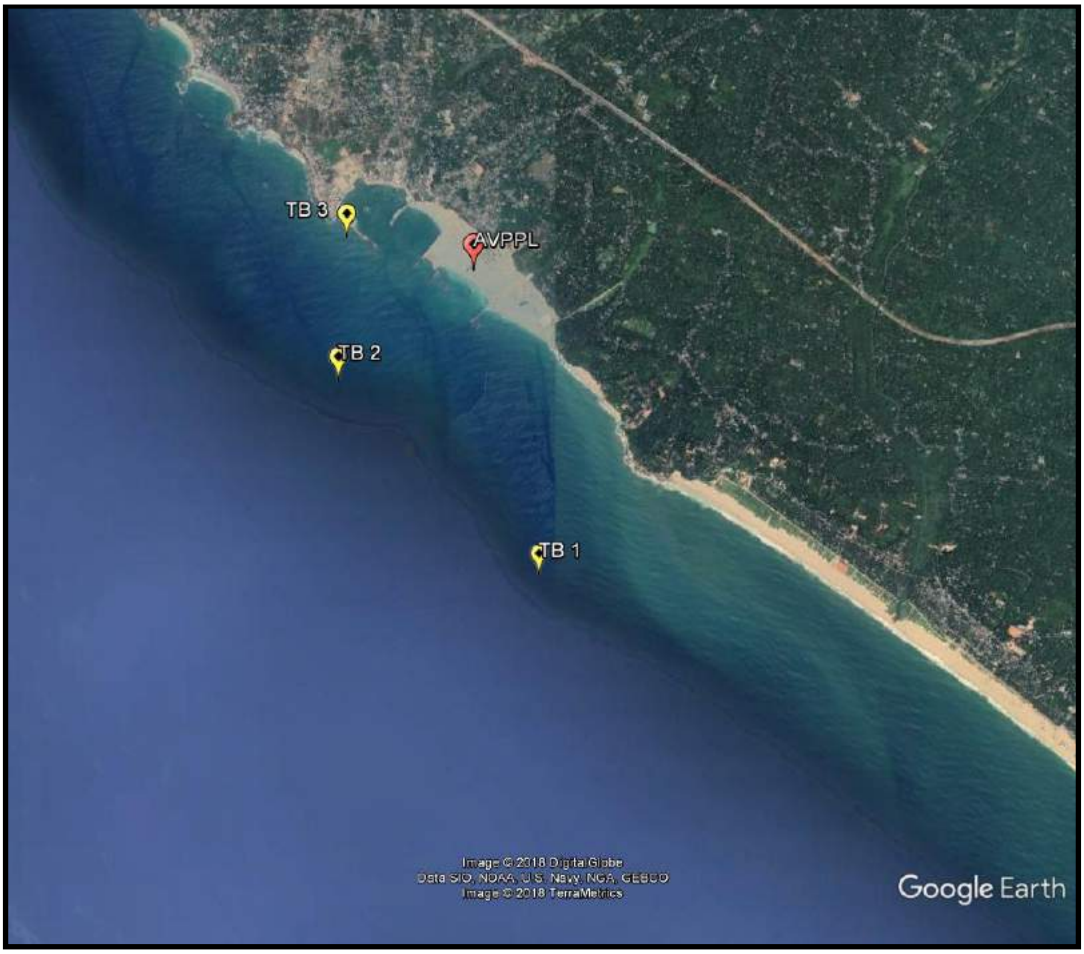


Figure 2-74 Location of Turbidity Buoys

The time series plotted using this turbidity data are presented in Figure 2-75 to Figure 2-77 for all the three locations. It has been informed by the AVPPL that the turbidity buoy 2 and turbidity buoy 3 were non-operational from May 2018 to June 2018 and from March 2018 to May 2018 respectively. Additionally, the estimated average TSS values corresponding to the average turbidity values from the relationship arrived as explained in section 2.7.3 are presented in Figure 2-78 to Figure 2-80. From the time series plot it is evident that the turbidity data in August 2018 shows higher values compared to other months. This may be due to severe floods happened in August 2018 consecutive to the unusual rainfall occurred during that period. But all turbidity values are well under the limit.

- Near Surface
- Near bottom
- Mid Depth

Legend of Turbidity data plot

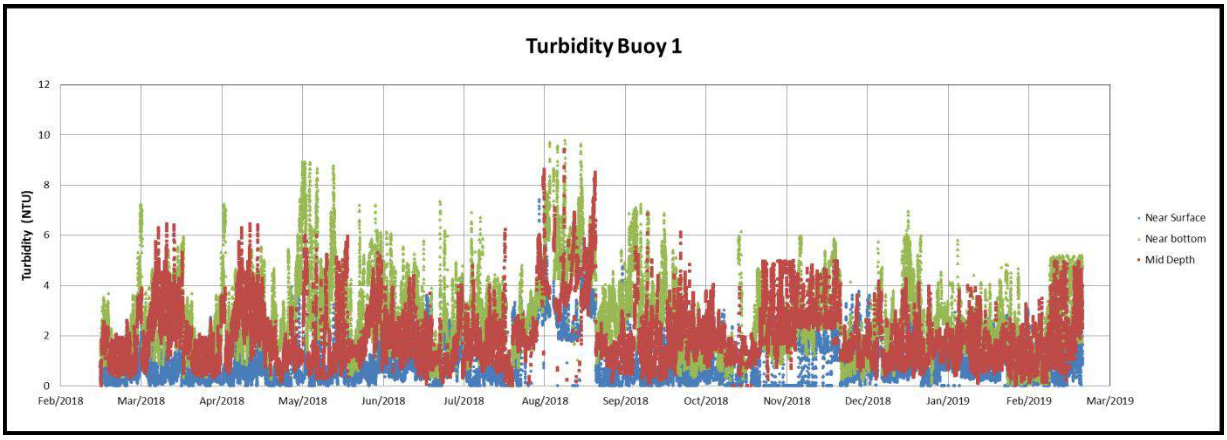


Figure 2-75 Time series plotted with the turbidity data collected from Turbidity Buoy 1

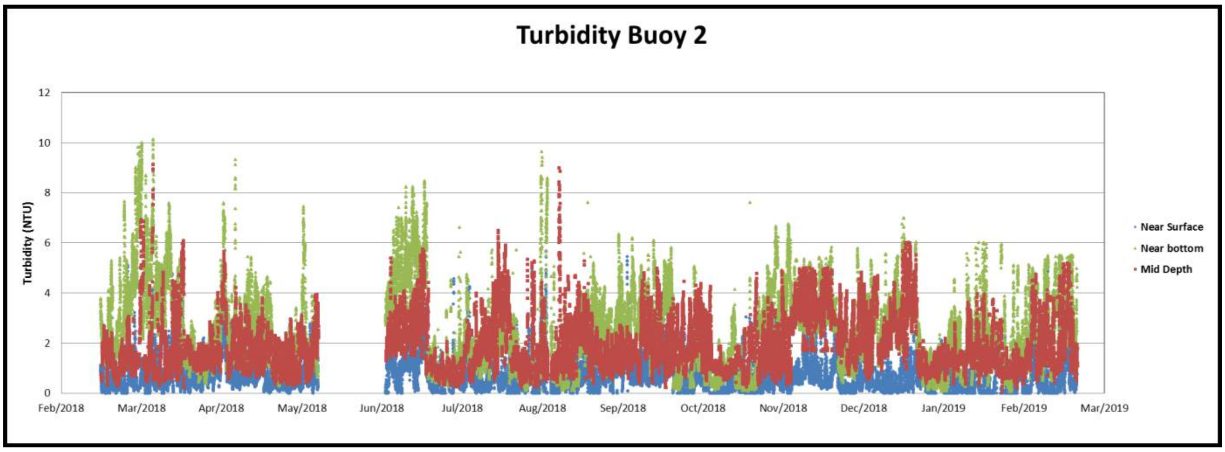


Figure 2-76 Time series plotted with the turbidity data collected from Turbidity Buoy 2

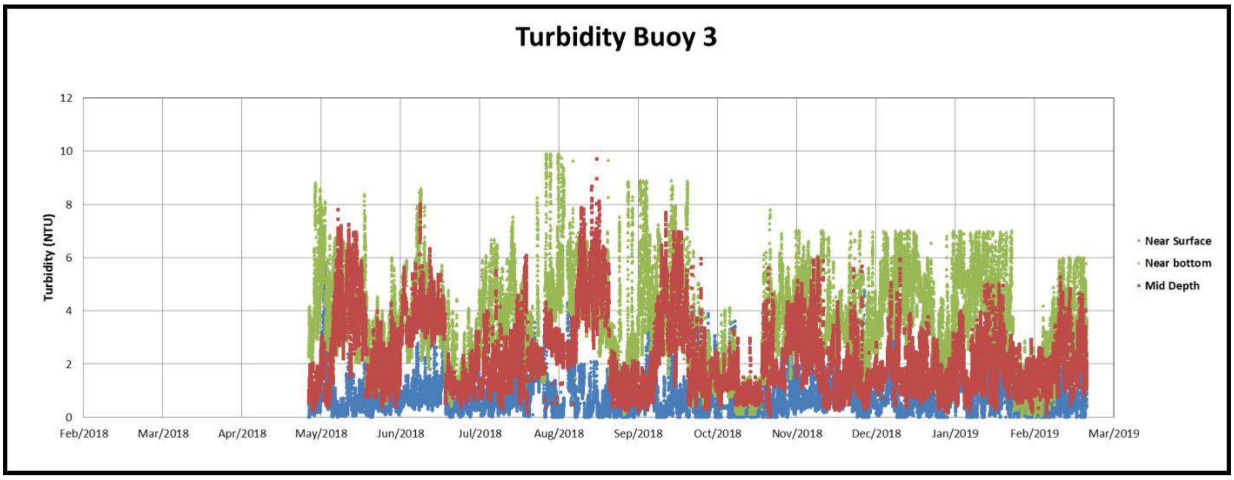


Figure 2-77 Time series plotted with the turbidity data collected from Turbidity Buoy 3

It is perceptible from these time series plots that the turbidity fluctuates all year round and higher values during the monsoon season are due to the rain which increases sediment transport. In addition, the August 2018 Kerala floods may have increased the turbidity values during observation period. To sum up the turbidity values have increased only during rainfall events. All other values of turbidity are very less.

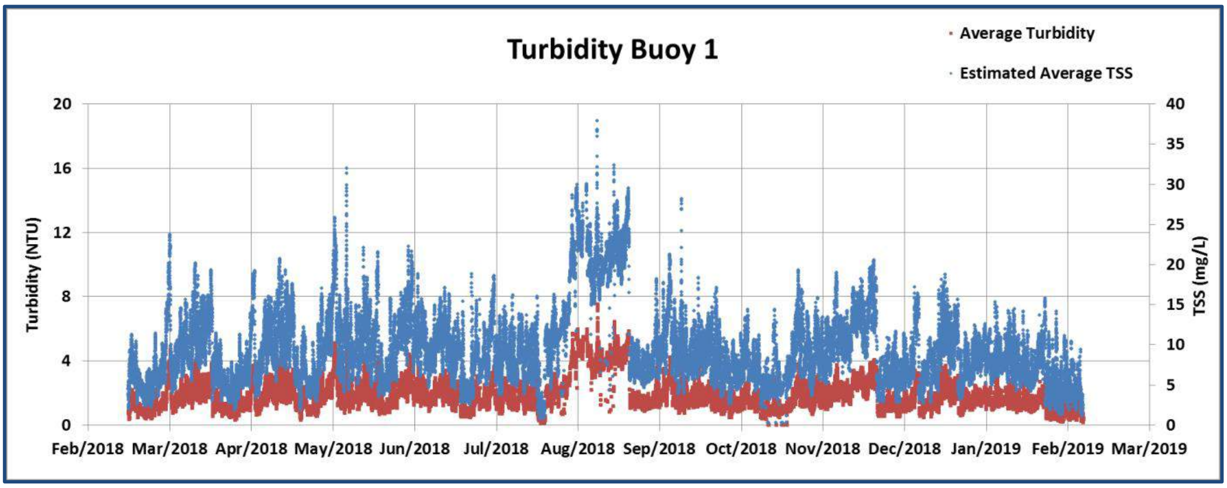


Figure 2-78 Average turbidity and average estimated TSS for Turbidity Buoy 1

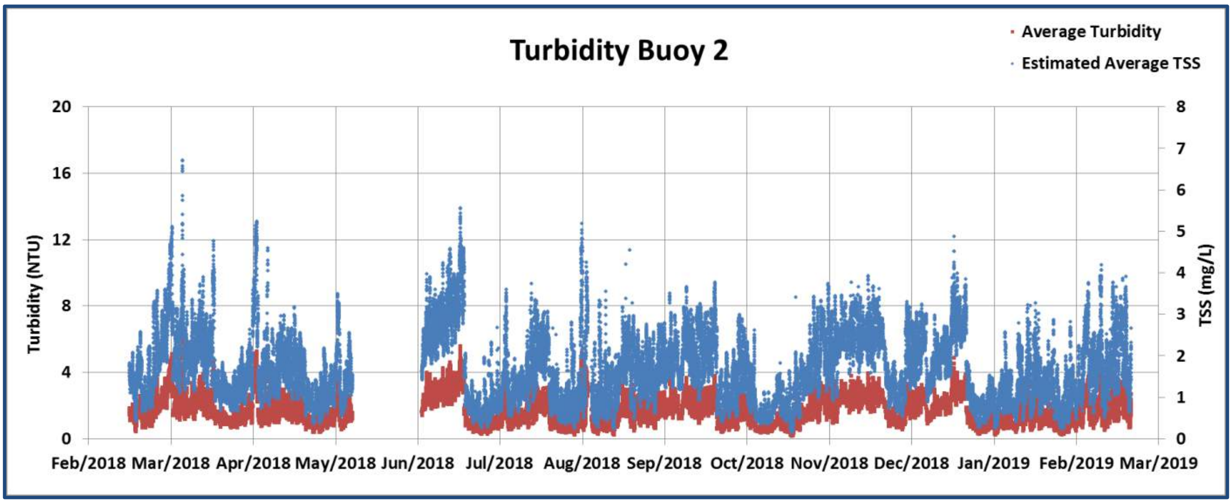


Figure 2-79 Average turbidity and average estimated TSS for Turbidity Buoy 2

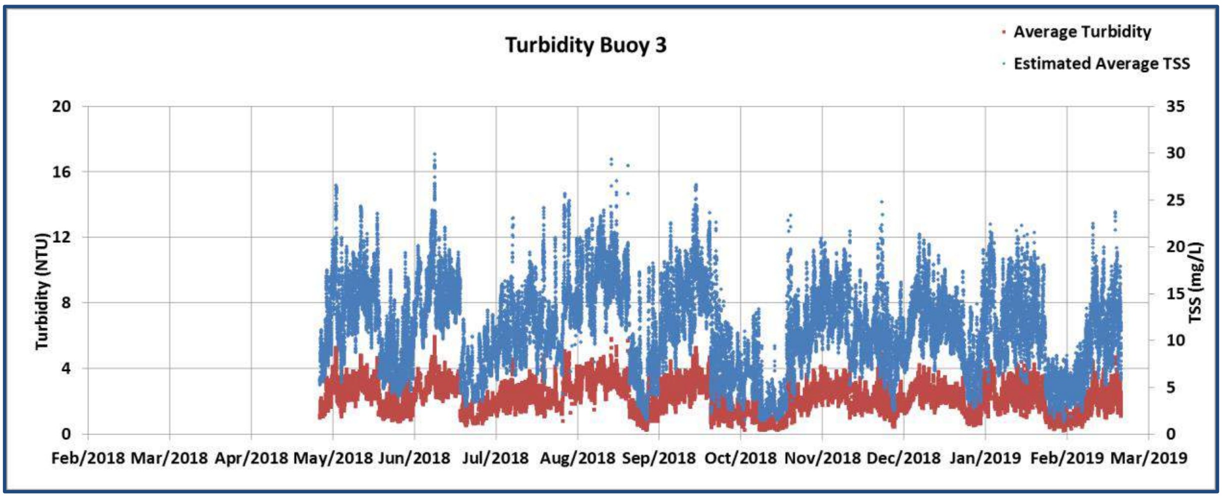


Figure 2-80 Average turbidity and average estimated TSS for Turbidity Buoy 3

2.8 Cross Shore Profile

Cross shore beach profiles were collected by AVPPL at 81 locations covering 40km along the coastline. The spacing between two adjacent cross sections is 0.5km. Among the 81 locations, 41 are to the north of port, 37 are to the south of port and 3 are at Vizhinjam port.

The survey data is available from February 2015 to February 2019 for most of the locations. The cross shore profile locations are shown in Figure 2-81.

Figure 2-81 Cross Shore Profile Locations

AVPPL provided names of 81 locations and respective landmarks for easy identification and discussion. Table 2-4 shows landmarks and corresponding CSP numbers.

Table 2-4 CSP Location Details

CSP NO.	Land Mark	Location
CSP-01	Catholic Crismatic Prayer Center	Edappadu Beach
CSP-02		
CSP-03		
CSP-04	St.Mary's Church	Vallavilai
CSP-05		
CSP-06		
CSP-07	St.Nicolas Church	Neerody
CSP-08		
CSP-09		
CSP-10	Sree Bhadrakali Temple	Pozhiyoor
CSP-11		
CSP-12		
CSP-13	St.Mathew's Church	Paruthiyoor
CSP-14	Church Of Christ	
CSP-15	Poovar Island Resort	Poovar Beach South
CSP-16		
CSP-17		
CSP-18	Pozhikara Beach	Poovar
CSP-19		
CSP-20	St.Antony's Chapel	Poovar Beach North
CSP-21		
CSP-22	St.Antony's Church	Karumkulam
CSP-23		
CSP-24		
CSP-25		
CSP-26		

CSP NO.	Land Mark	Location
CSP-27	Gothambu Road	Pulluvila
CSP-28		
CSP-29		
CSP-30		
CSP-31	Adimalathura Catholic Church	Adimalathura
CSP-32		
CSP-33		
CSP-34		
CSP-35	Azhimala Temple	Azhimala
CSP-36	Nagar Bhagavathy Temple	Mullur
CSP-37		
CSP-38	Adani Reclamation Area	Adani Port Office Vizhinjam
CSP-39		
CSP-40		
CSP-41	Vizhinjam Light House	Kovalam
CSP-42		
CSP-43		
CSP-44		
CSP-45		
CSP-46		
CSP-47	Samudra Beach Park	Kovalam
CSP-48	Mosque	Panathura
CSP-49		
CSP-50	Panathura Temple	Panathura
CSP-51		
CSP-52		
CSP-53	Punthura Fish Market	Punthura
CSP-54		
CSP-55		
CSP-56		
CSP-57		
CSP-58	Beemapally	Beemapally
CSP-59		
CSP-60		
CSP-61	Cheriyathura Sports Ground	Cheriyathura
CSP-62		
CSP-63	Valiyathura Bridge	Valiyathura
CSP-64		
CSP-65		
CSP-66		
CSP-67		
CSP-68	Shangumugham Beach	Shangumugham
CSP-69		
CSP-70	St.Peters Church	Shangumugham

CSP NO.	Land Mark	Location
CSP-71		
CSP-72	Vettucaud Church	Vettucaud
CSP-73		
CSP-74		
CSP-75	Veli Childrens Park	Kochuveli
CSP-76		
CSP-77		
CSP-78	St.Thomas Church	Valiya Veli
CSP-79		
CSP-80	Christian Brotheren Church	Thumba
CSP-81		

2.8.1 Survey Methodology

The survey area was divided into land side and sea side. On land side, the survey has been conducted using Real Time Kinematic (RTK) system up to 100m from HTL or +2m of HTL. On sea side bathymetric survey has been conducted using Multi Beam Echo Sounder (MBES) up to 10m contour till August 2018 and later on survey has been conducted up to 20m contour.

The RTK system comprises the following:

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

The bathymetric survey was carried out using the following systems:

- Geoswath GS+ 250 KHz wide swath bathymetric system for the Multi beam area

Data gaps were observed at foreshore zone (as shown in Figure 2-82) due to inaccessible depths and rough weather condition during survey period. Data gap was also noticed near seawalls during monsoon season which may be due to inability to access those areas during monsoon.

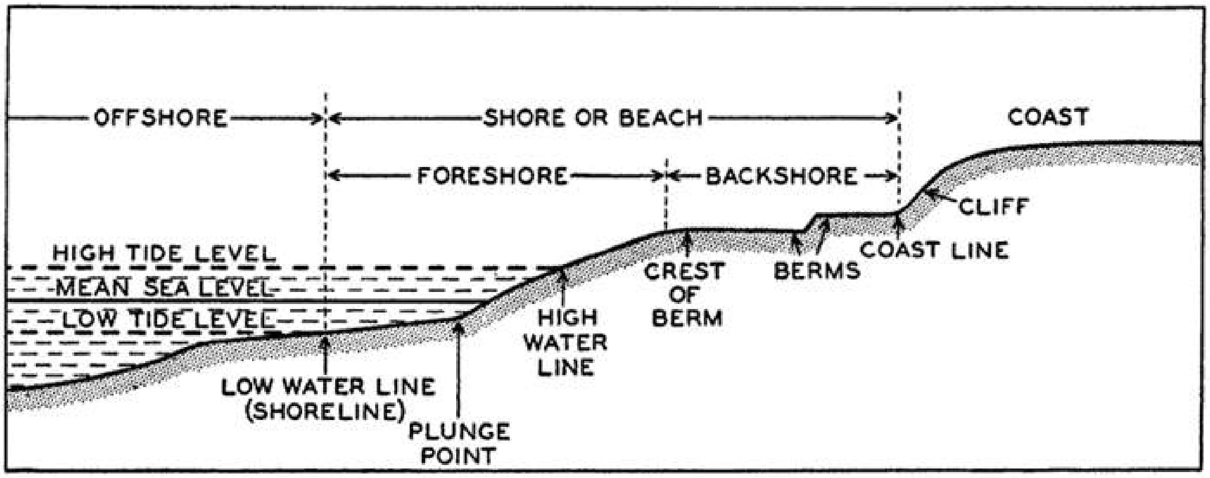


Figure 2-82 Beach profile terminology

2.8.2 Analysis of beach profiles

The data received by LNTIEL was analysed by plotting each of the profiles from 1st March 2018 to 28th February 2019. The aim of this comprehensive exercise was to check the data quality and to compare profiles with surveyed data from different locations which may help in grouping and for different seasons to visualise erosion or accretion. The assessment of the profiles before the construction of the port at Vizhinjam can be compared in future with the profiles collected after the port construction. Any difference, if arising, can be investigated further to understand if the port has any impact on the shoreline evolution.

As a preliminary step, LNTIEL analysed average profiles for different seasons and location wise. The trends of beach profile were assessed qualitatively. In general the beach profile variations tend to be daily, monthly, seasonal or annual. However, since the data is collected monthly once, analyses of daily variations are not possible. Even prediction of monthly variation of profiles will be difficult due to data gap near foreshore region. The monthly profiles of particular season were averaged to obtain seasonal profiles. The months considered for seasonal average was as follows:

Pre-Monsoon – April to May

Monsoon – June to September

Post-Monsoon – October to November

Fair Weather – December to March

The above seasons were adopted as advised in MOM of the shoreline committee meeting held on 13th February 2019.

For example if we consider April 2017 to March 2018, the seasons will be as follows:

Pre-Monsoon 2017 – April 2017 to May 2017

Monsoon 2017 – June 2017 to September 2017

Post-Monsoon 2017 – October 2017 to November 2017

Fair Weather 2017 – December 2017 to March 2018

The main focus was on seasonal variations by comparing different seasons of each year and different years of same season at particular location. As there were large numbers of cross shore profiles over a stretch of 40km it was not an easy task to group similar sections into one category. However, LNTIEL observed similar trends for some of the cross sections and opted one cross section from each group and reported. By this way, LNTIEL selected three sections on South of Port (CS-07 – Neerody, CS-12 – Pozhiyoor and CS-26 – Karumkulam) and three sections on North of Port (CS-49 – Panathura, CS-58 – Beemapally and CS-74 – Vettucaud) and shown the comparison in Figure 2-83 to Figure 2-90. In Figure 2-83, Abscissa represents the distance in meter from an arbitrary point which will be same for all profiles at one cross section, Ordinate represents elevation in meter and legend is self-explanatory. First column shows comparison of profiles of different seasons of a particular year and second column shows comparison of profiles of different years of a particular season.

Legend: CSP – Cross Shore Profile, CS – Cross Section

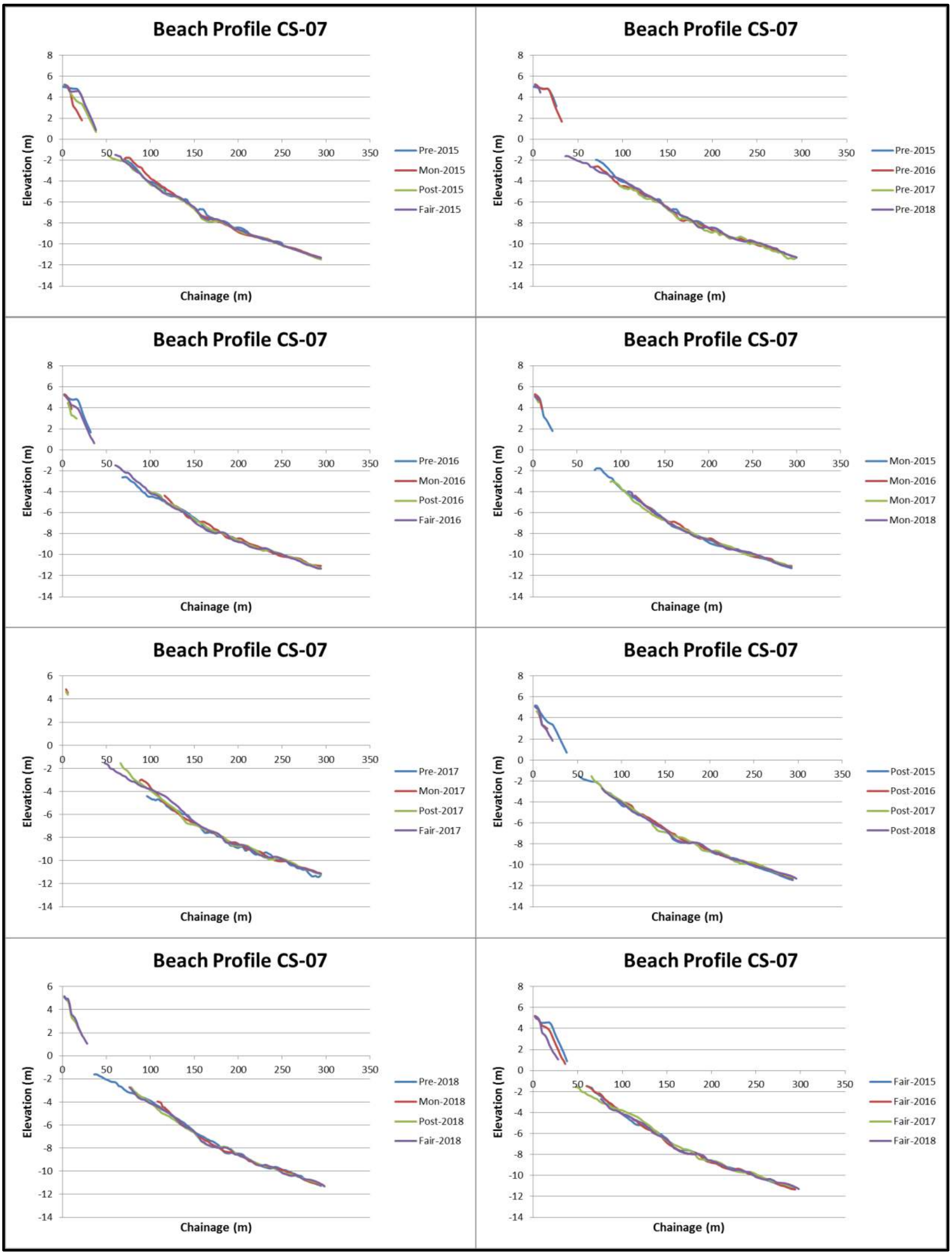
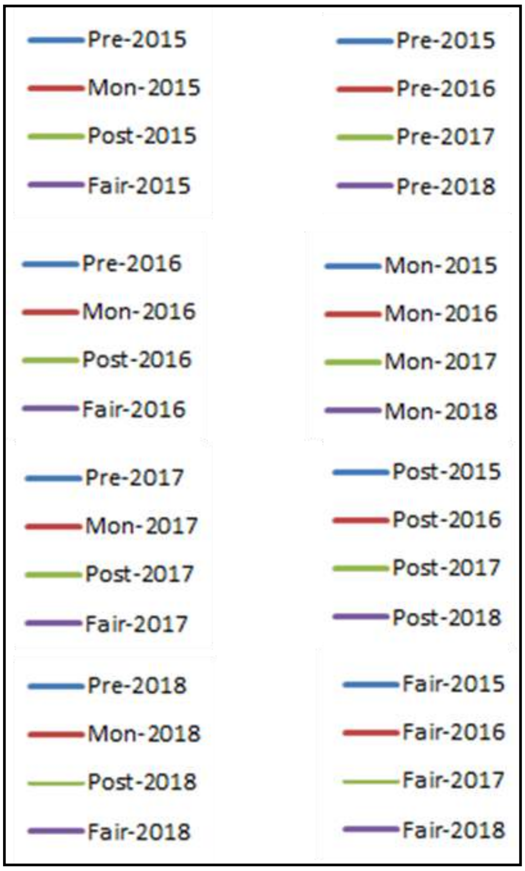


Figure 2-83 Cross Shore Profiles at CS 07 (Neerody)

Coastal protection structure known as seawall was present in the stretch of CS 3 to CS 9. Among these sections, CS 7 which is at Neerody location in Tamil Nadu state was chosen to illustrate the seasonal trends over four years. From Figure 2-83, it can be noticed that the coast undergoes seasonal variations during 2015 to 2018. Beach was noticed during pre-monsoon seasons. Later on beach got eroded and the sediment from the beach got deposited in offshore region at the time of monsoon seasons. Beach was gradually developed during post monsoon seasons and remains stable during fair weather seasons whereas in 2017 the trend got shifted as the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi (December 2017) during fair weather season resulted in severe erosion all along the coast and accretion was observed in foreshore zone. The plots in second column represent comparison of profiles of different years of particular season. These plots suggest that the shoreline movement of this portion of the coast is following its natural course and the port development has not affected the course.



Legend of cross section profiles

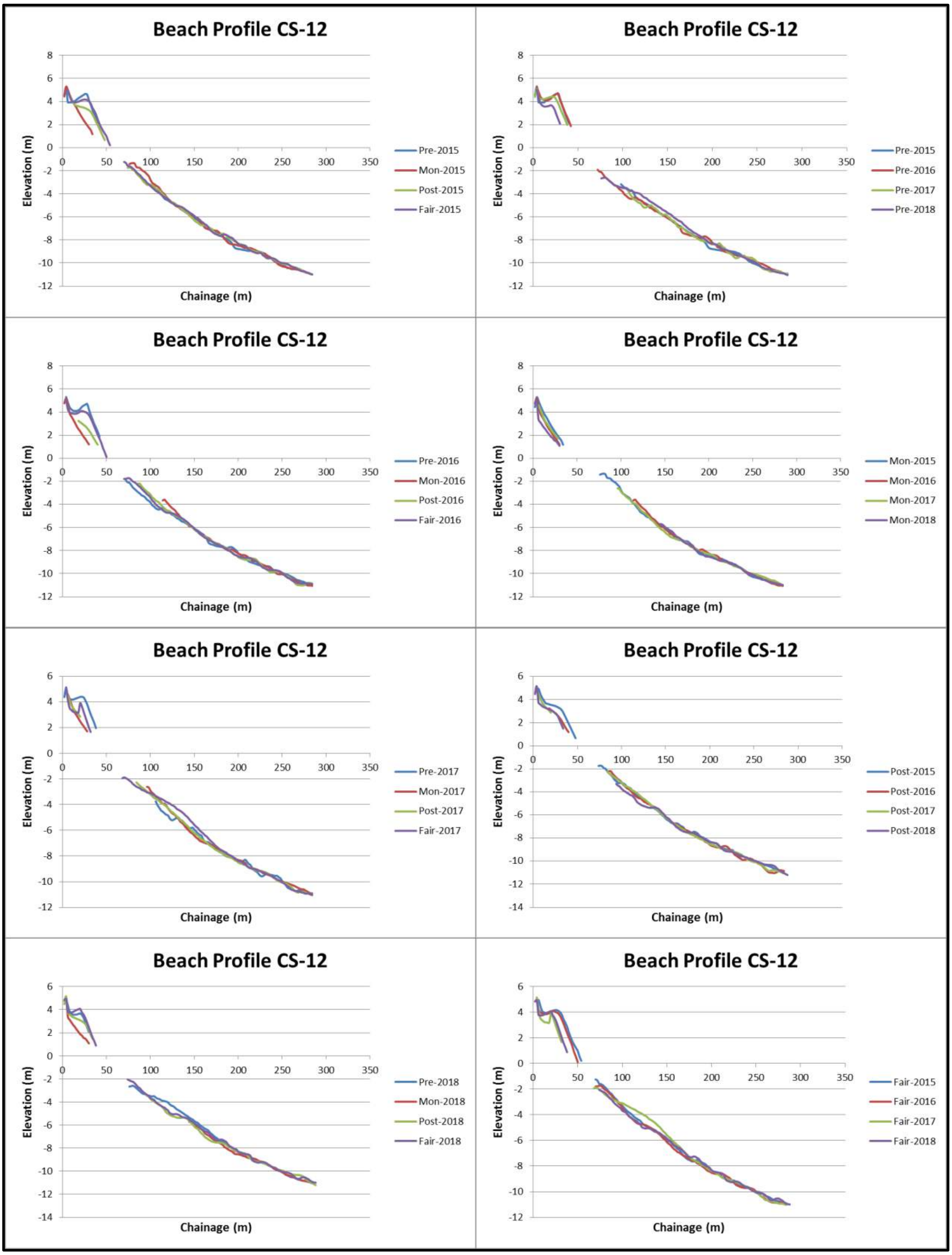


Figure 2-84 Cross Shore Profiles at CS 12 (Pozhiyoor)

Beach was present throughout the year in the stretch of CS 10 to CS 14. Among these sections, CS 12 which is at Pozhiyoor location in Kerala state was chosen to illustrate the seasonal trends over four years. From Figure 2-84, it can be noticed that the coast undergoes seasonal variations during 2015 to 2018. Beach was noticed during pre-monsoon seasons. Later on beach got eroded and deposited in offshore region at the time of monsoon seasons. Beach was gradually developed during post monsoon seasons and remains stable during fair weather seasons whereas in 2017 the trend got shifted as the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi during fair weather season resulted in severe erosion all along the coast and accretion was observed in foreshore zone. After Ockhi the erosion was noticed during fair weather 2017 and pre monsoon 2018 seasons on land side and deposition on sea side. The plots in second column represent comparison of profiles of different years of particular season. These plots suggest that yearly trend was as per normal sequence till post monsoon 2017. After this, the impact of Ockhi cyclone can be evidently noticed in fair weather 2017 and pre-monsoon 2018 seasonal profiles. The coast was undergoing processes to recover from this impact which can be observed from fair weather seasons comparison plot.

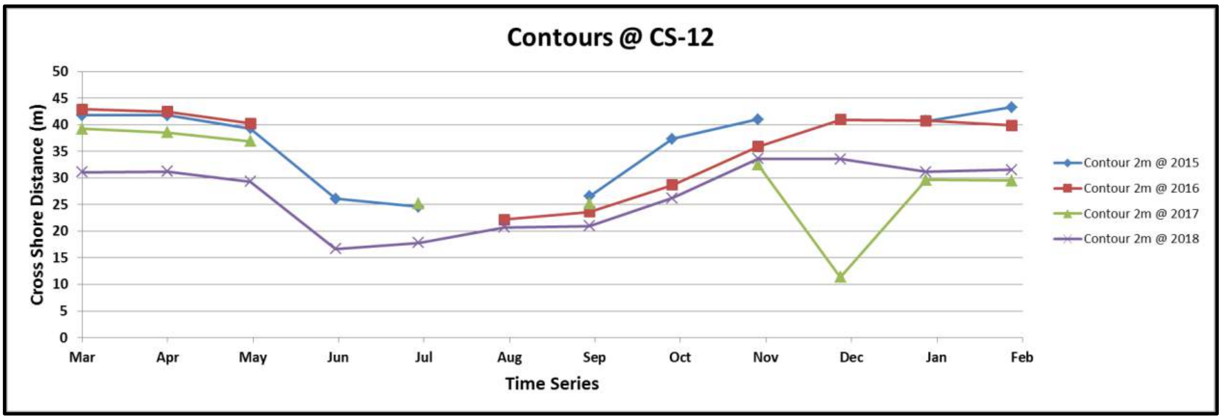
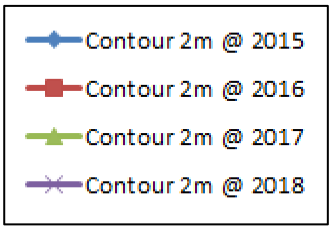


Figure 2-85 Time series of (+) 2 m contour at CS 12 (Pozhiyoor)

Further LNTIEL extracted (+) 2 m contour from cross shore profile data. The above plot is time series of (+) 2 m contour over four year data at CS 12 with similar time scale. From this plot it can be noticed that the beach undergoes seasonal variation of erosion on monsoon season and accretion on other seasons. During Ockhi the beach was subjected to severe erosion and no much accretion was noticed during fair weather 2017 and pre-monsoon 2018. In addition, as a result of monsoon 2018 the beach got further eroded compared to previous monsoon seasons.



Legend of time series of (+) 2 m contour

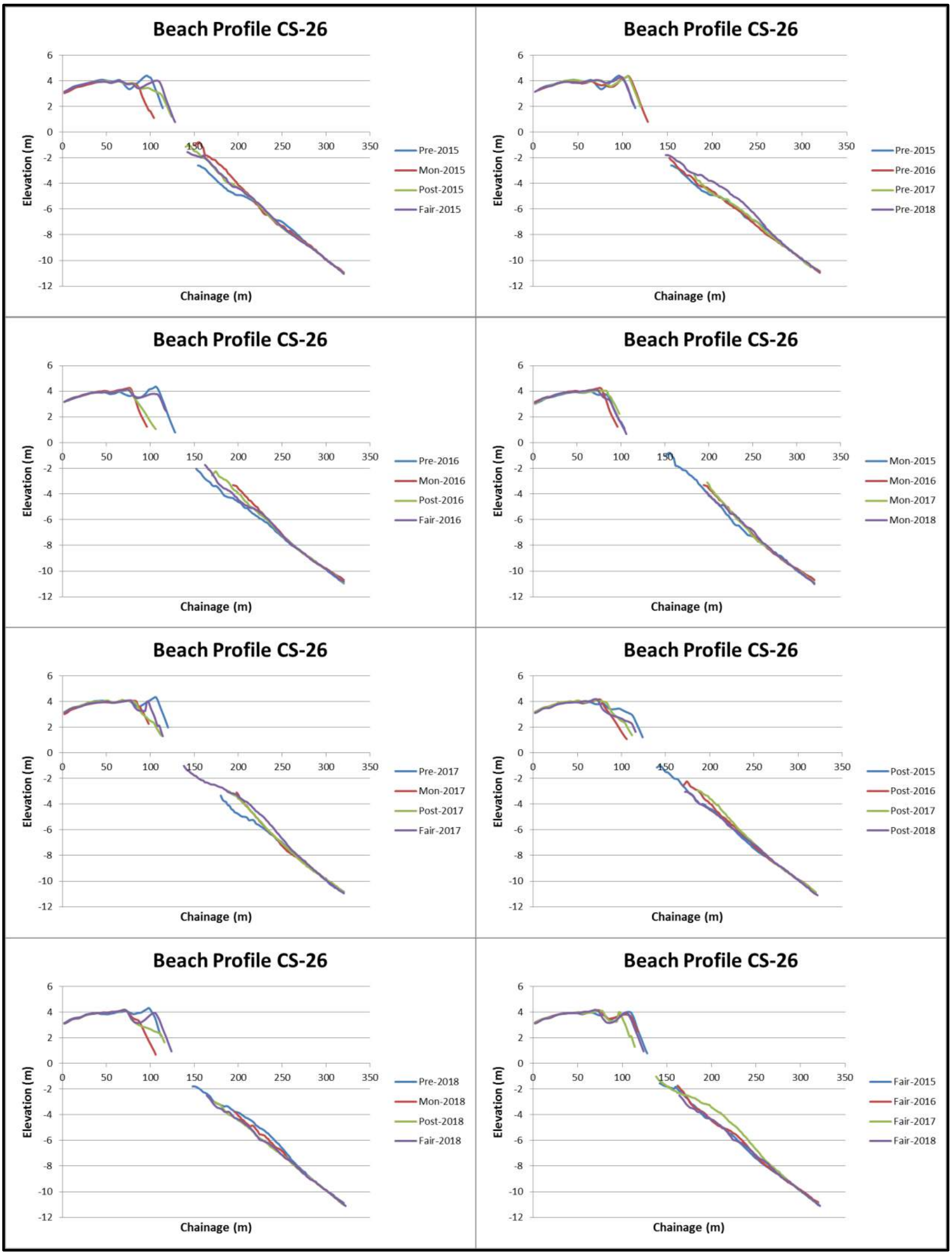


Figure 2-86 Cross Shore Profiles at CS 26 (Karumkulam)

Beach was present throughout the year in the stretch of CS 18 to CS 34. Among these sections, CS 26 which is at Karumkulam location in Thiruvananthapuram district of Kerala state was chosen to illustrate the seasonal trends over four years. From Figure 2-86, it can be noticed that the coast undergoes seasonal variations during 2015 to 2018. Beach was noticed during pre-monsoon seasons. Later on beach got eroded and deposited in offshore region at the time of monsoon seasons. Beach was gradually developed during post monsoon seasons and remains stable during fair weather seasons whereas in 2017 the trend got shifted as the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi during fair weather season resulted in severe erosion all along the coast and accretion was observed in foreshore zone. After Ockhi the erosion was noticed during fair weather 2017 and pre monsoon 2018 seasons on land side and deposition on sea side. The plots in second column represent comparison of profiles of different years of particular season. These plots suggest that yearly trend was as per normal sequence till post monsoon 2017. After this, the impact of Ockhi cyclone can be evidently noticed in fair weather 2017 and pre-monsoon 2018 seasonal profiles. The coast was undergoing processes to recover from this impact which can be observed from fair weather seasons comparison plot.

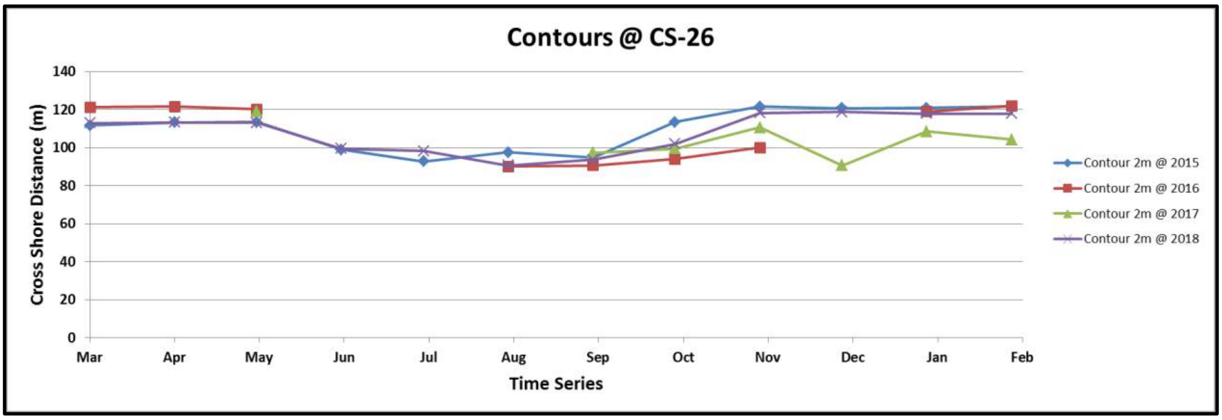


Figure 2-87 Time series of (+) 2 m contour at CS 26 (Karumkulam)

Further LNTIEL extracted (+) 2 m contour from cross shore profile data. The above plot is time series of (+) 2 m contour over four year data at CS 26 with similar time scale. From this plot it can be noticed that the beach undergoes seasonal variation of erosion on monsoon season and accretion on other seasons. During Ockhi the beach was subjected to erosion and no much accretion was noticed during fair weather 2017 and pre-monsoon 2018. However, the beach was developed during post monsoon and fair weather seasons of 2018 and almost in line with (+) 2m contour positions of 2015 and 2016.

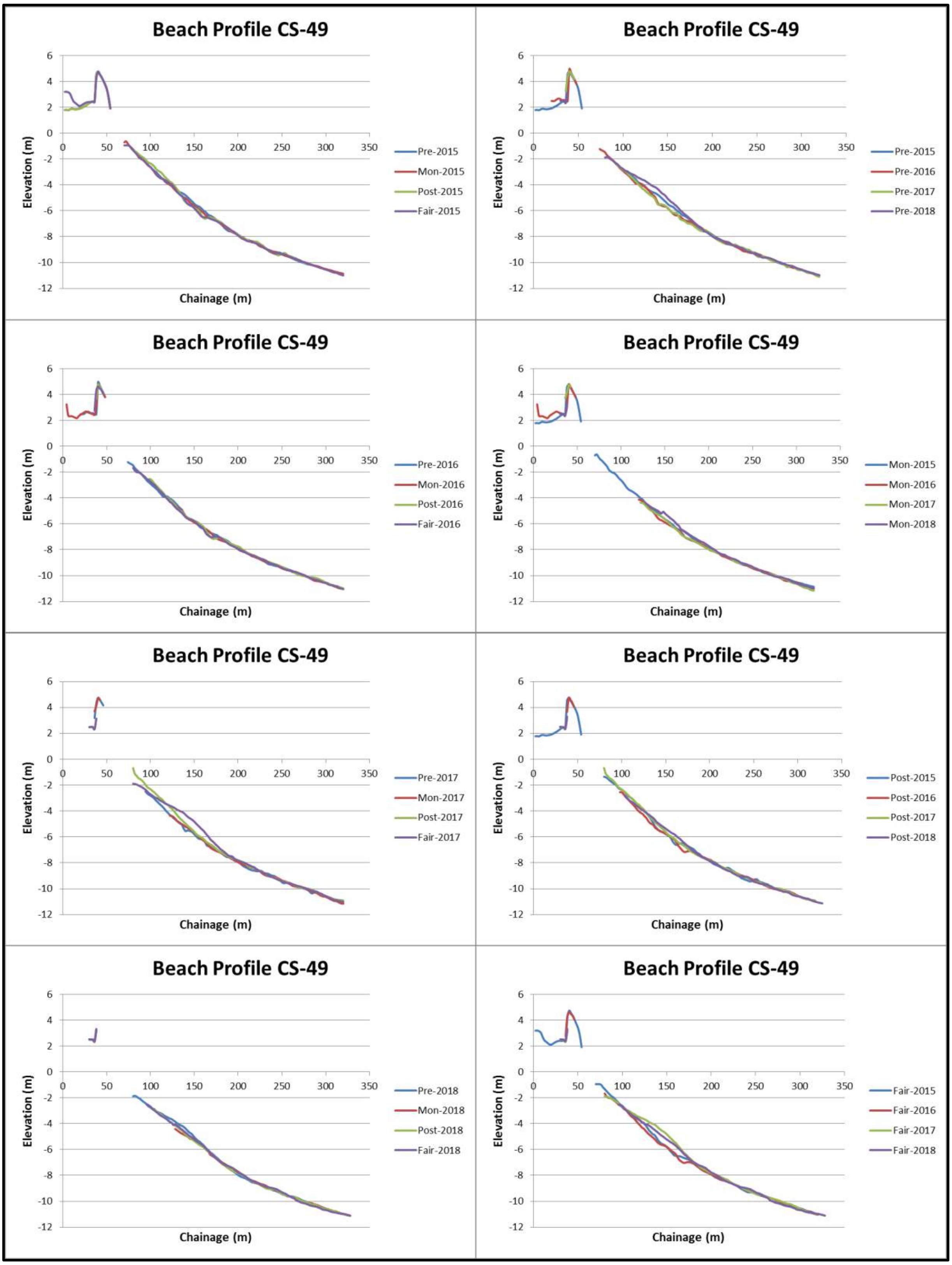


Figure 2-88 Cross Shore Profiles at CS 49 (Panathura)

Coastal protection structure known as seawall was present in the stretch of CS 47 to CS 52. Among these sections, CS 49 which is at Panathura location in Thiruvananthapuram district of Kerala state was chosen to illustrate the seasonal trends over four years. From Figure 2-88, it can be noticed that the coast undergoes seasonal variations during 2015 to 2018. No beach was noticed throughout the year. In 2017 the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi during fair weather season resulted in severe erosion all along the coast and accretion was observed in foreshore zone. The plots in second column represent comparison of profiles of different years of particular season. These plots suggest that there was an accretion in offshore region during fair weather 2017 and pre-monsoon 2018 seasons.

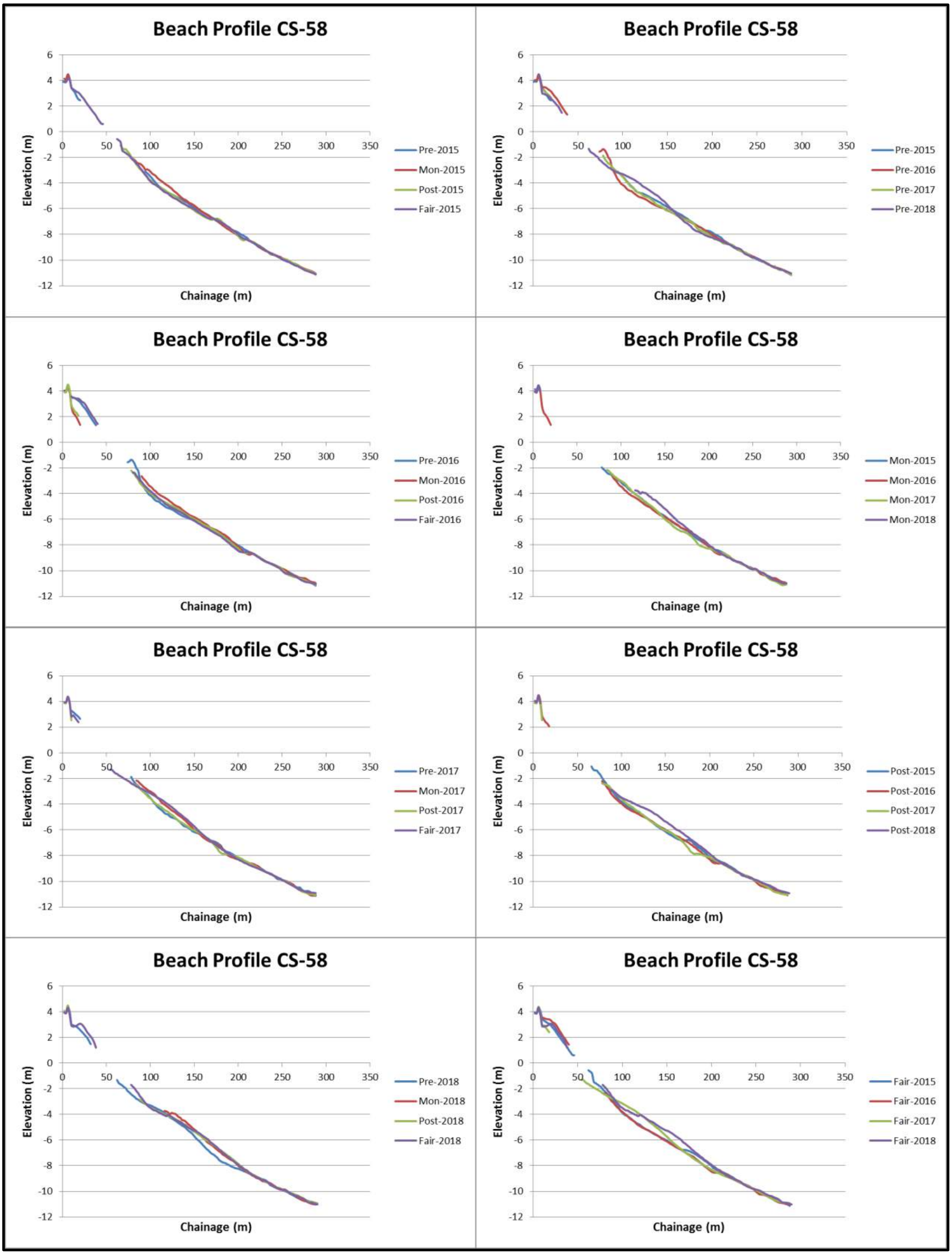


Figure 2-89 Cross Shore Profiles at CS 58 (Beemapally)

Coastal protection structure seawall along with groynes was present in the stretch of CS 56 to CS 67. Among these sections, CS 58 which is at Beemapally location in Thiruvananthapuram district of Kerala state was chosen to illustrate the seasonal trends over four years. From Figure 2-89, it can be noticed that the coast undergoes seasonal variations during 2015 to 2018. Beach was noticed during pre-monsoon seasons. Later on beach got eroded and deposited in offshore region at the time of monsoon seasons. Beach was gradually developed during post monsoon seasons and remains stable during fair weather seasons whereas in 2017 the trend got shifted as the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi during fair weather season resulted in severe erosion all along the coast and accretion was observed in foreshore zone. The plots in second column represent comparison of profiles of different years of particular season. These plots suggest that there was an accretion in offshore region after Ockhi cyclone.

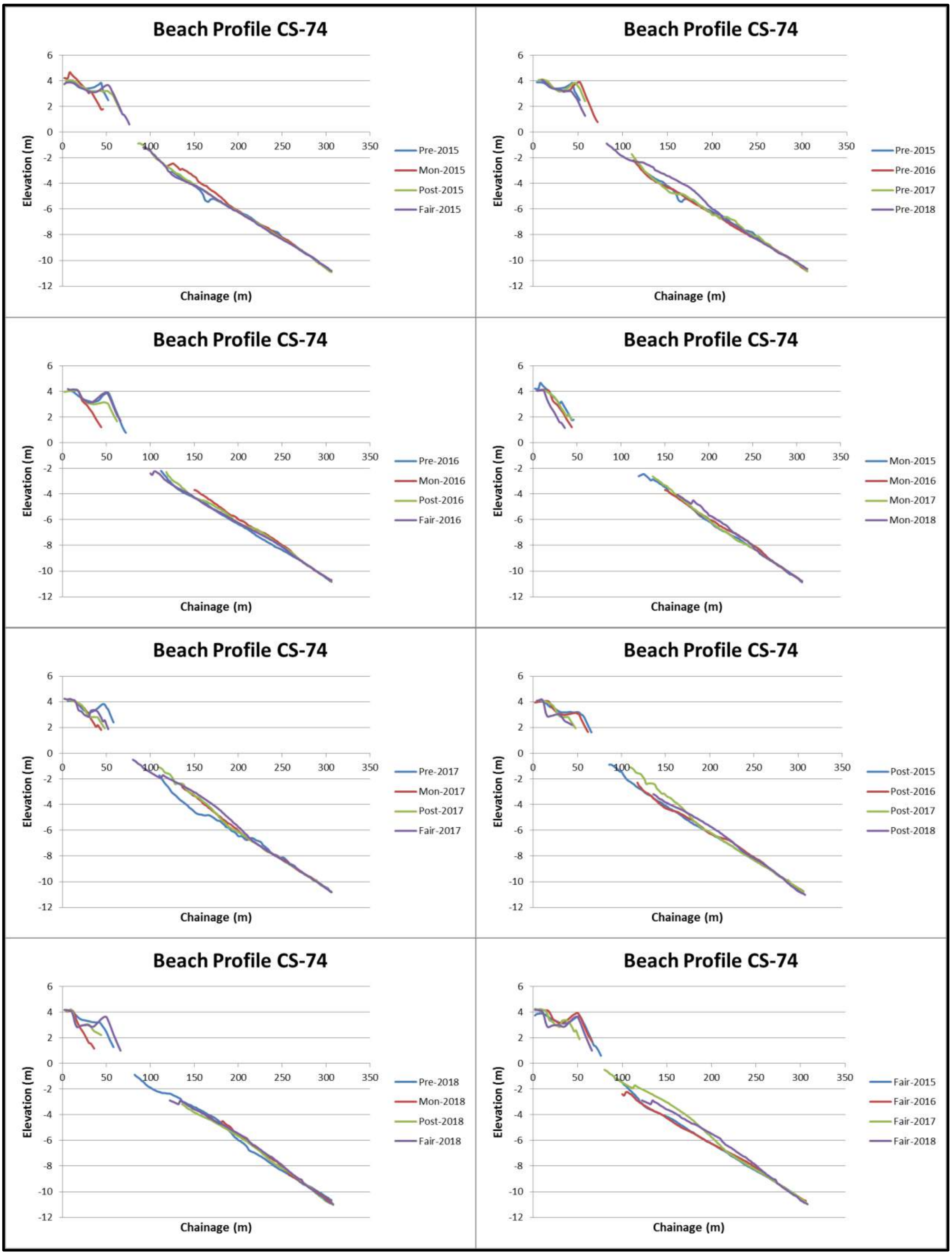


Figure 2-90 Cross Shore Profiles at CS 74 (Vettucaud)

Beach was present throughout the year in the stretch of CS 68 to CS 81. Among these sections, CS 74 which is at Vettucaud location in Thiruvananthapuram district of Kerala state was chosen to illustrate the seasonal trends over four years. From Figure 2-90, it can be noticed that the coast undergoes seasonal variations during 2015 to 2018. Beach was noticed during pre-monsoon seasons. Later on beach got eroded and deposited in offshore region at the time of monsoon seasons. Beach was gradually developed during post monsoon seasons and remains stable during fair weather seasons whereas in 2017 the trend got shifted as the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi during fair weather season resulted in severe erosion all along the coast and accretion was observed in foreshore zone. After Ockhi the erosion was noticed during fair weather 2017 and pre monsoon 2018 seasons on land side and deposition on sea side. The plots in second column represent comparison of profiles of different years of particular season. These plots suggest that yearly trend was as per normal sequence till post monsoon 2017. After this, the impact of Ockhi cyclone can be evidently noticed in fair weather 2017 and pre-monsoon 2018 seasonal profiles. The coast was undergoing processes to recover from this impact which can be observed from fair weather seasons comparison plot.

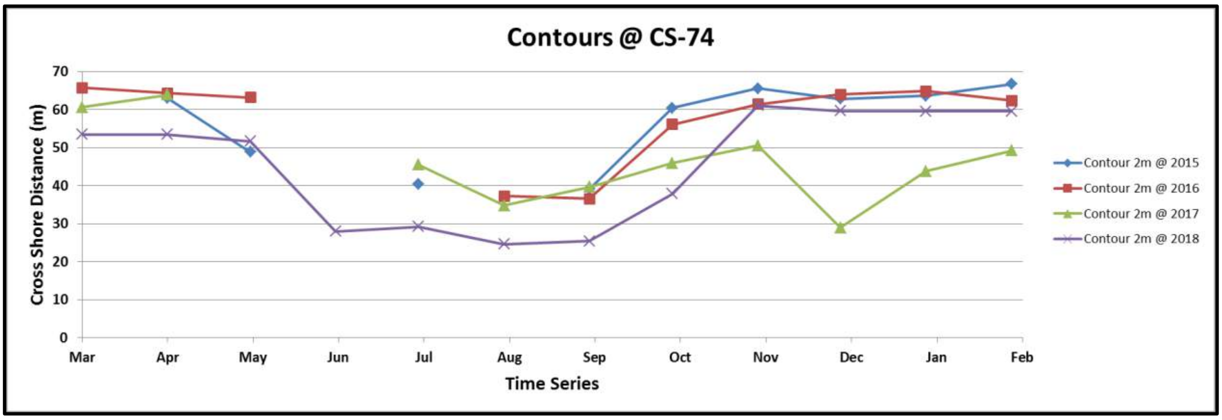


Figure 2-91 Time series of (+) 2 m contour at CS 74 (Vettucaud)

Further LNTIEL extracted (+) 2 m contour from cross shore profile data. The above plot is time series of (+) 2 m contour over four year data at CS 74 with similar time scale. From this plot it can be noticed that the beach undergoes seasonal variation of erosion on monsoon season and accretion on other seasons. During Ockhi the beach was subjected to severe erosion and no much accretion was noticed during fair weather 2017 and pre-monsoon 2018. In addition, as a result of monsoon 2018 the beach got further eroded compared to previous monsoon seasons. However, the beach was developed after monsoon season with high rates compared to post-monsoon 2017 and fair weather 2017.

Fair weather season is the best time to compare the coast as there will be not much cross shore movement and beach will be stable during this period after subjected to seasonal variations. February month of all years was chosen to evaluate the long shore scenario of the coast.

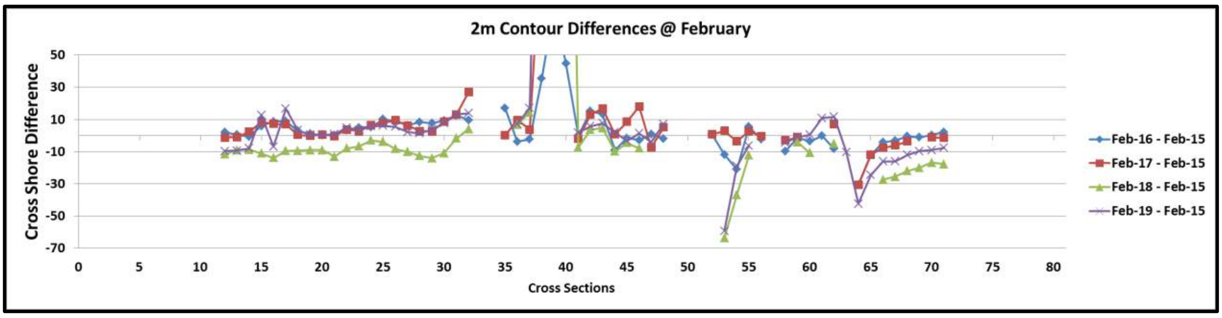


Figure 2-92 Long shore comparison of (+) 2m contour differences during February

LNTIEL extracted (+) 2m contour from February months of cross shore profile data at 81 locations. It was noticed that (+) 2m contour was not available in survey data at some cross sections which may be due to inaccessibility or protest and these values were not interpolated and left as it is.

Figure 2-92 shows the comparison of differences of (+) 2m contour of February months with reference to February 2015. Green line represents the long shore scenario of coast post Ockhi cyclone. It can be seen from this plot that the coast experienced severe erosion. Violet line represents the long shore scenario of coast after one year from Ockhi cyclone. It can be seen that the stretch south of Poovar River mouth was still in transition and stretch north of Poovar River mouth to Adimalathura seems to be recovered from Ockhi cyclone impact. Near Valiyathura bridge there was accretion on south of groyne and erosion on north of groyne which seems to be natural phenomenon due to construction of groyne. The coast from Shangumugham to Thumba is in the process of attaining its stable position.

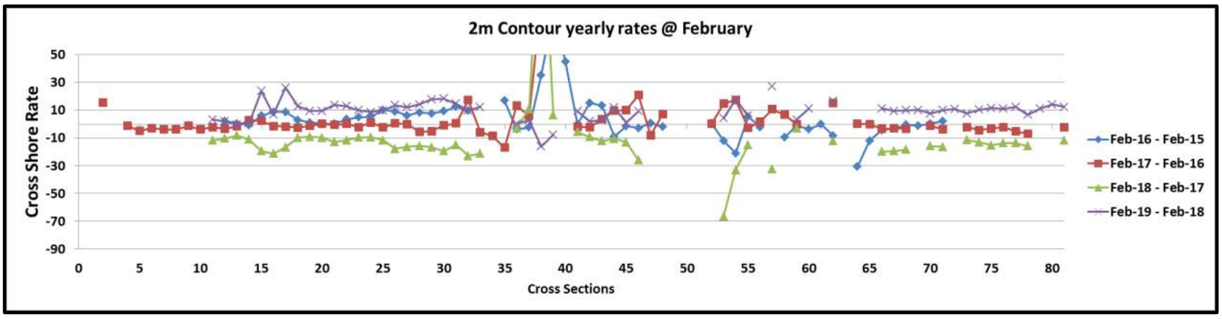


Figure 2-93 Long shore comparison of yearly rates during February

Further to above, LNTIEL analysed the yearly rates during February month. Figure 2-93 shows the comparison of yearly rates of (+) 2m contour of February month with reference to previous year February month. After Ockhi almost entire coast experienced severe erosion which can be noticed from Feb-18 – Feb-17 series (Green). Over a year the coast experienced seasonal variations and rates can be noticed from Feb-19 – Feb-18 series (Violet). From this we can observe that the yearly rate of current year was high along the coast compared to previous years probably because the coast is trying to attain its stable or equilibrium position.

3 Model Studies

3.1 Wave Transformation

Near shore wave transformation is carried out to assess the wave climate near the port construction site using the available offshore wave data. The offshore wave data obtained from NCEP is transformed to near shore region and wave parameters such as wave height, wave direction and wave period is extracted at the point at which wave observations were carried out using the WRB. The simulated wave data is then compared with the observed wave data.

3.1.1 SWAN of Delft Hydraulics

SWAN (Simulating Waves Near shore) is a third-generation wave model for obtaining realistic estimates of wave parameters in coastal areas, lakes and estuaries from given wind, bottom and current conditions. However, SWAN can be used on any scale relevant for wind-generated surface gravity waves. The model is based on the wave action balance equation with sources and sinks. The main goal of the SWAN model is to solve the spectral action balance equation without any a prior restrictions on the spectrum for the evolution of wave growth. The action balance equation, read as (e.g., Mei, 1983; Komen et al., 1994):

$$\frac{\partial N}{\partial t} + \nabla_{\vec{x}}.\left[(\vec{c_g} + \vec{U})N\right] + \frac{\partial c_\sigma N}{\partial \sigma} + \frac{\partial c_\sigma N}{\partial \theta} = \frac{S_{tot}}{\sigma}$$

The left-hand side is the kinematic part of this equation. The second term denotes the propagation of wave energy in two-dimensional geographical $\vec{x}$-space, with the group velocity

$$\vec{c_g} = \partial\sigma/\partial\vec{k}$$

following from the dispersion relation $\sigma^2 = g|\vec{k}|\tanh(|\vec{k}|d)$ where $\vec{k}$ is the wave number vector and *d* the water depth. The third term represents the effect of shifting of the radian frequency due to variations in depth and mean currents. The fourth term represents depth-induced and current-induced refraction. The quantities c_σ and c_θ are the propagation velocities in spectral space (σ, θ). The right-hand side contains S_{tot}, which is the source/sink term that represents all physical processes which generate, dissipate, or redistribute wave energy. Thus, this equation represents the effects of spatial propagation, refraction, shoaling, generation, dissipation and nonlinear wave-wave interactions.

Wind generated waves have irregular wave heights and periods, caused by the irregular nature of wind. Due to this irregular nature, the sea surface is continually varying, which means that a deterministic approach to describe the sea surface is not feasible. On the other hand, statistical properties of the surface, like average wave height, wave periods and directions, appear to vary slowly in time and space, compared to typical wave periods and wave lengths. The surface elevation of waves in the ocean, at any location and any time, can be seen as the sum of a large number of harmonic waves, each of which has been generated by turbulent wind in different places and times. They are therefore statistically independent in their origin. According to linear wave theory, they remain independent during their journey across the ocean. Under these conditions, the sea surface elevation on a time scale of one hundred characteristic wave periods is sufficiently well described as a stationary, Gaussian process. The sea surface elevation in one point as a function of time can be described as

$$\eta(t) = \sum_i a_i \cos(\sigma_i t + a_i)$$

with η the sea surface elevation, a_i the amplitude of the i^{th} wave component, σ_i the relative radian or circular frequency of the i^{th} wave component in the presence of the ambient current (equals the absolute radian frequency ω when no ambient current is present) and α_i the random phase of the i^{th} wave component. This is called the random-phase model. In the presence of the ambient current, it is assumed that it is uniform with respect to the vertical co-ordinate and the changes in the mean flow within a wave length are so small that they affect only negligibly the dispersion relation. The absolute radian frequency ω then equals the sum of the relative radian frequency σ and the multiplication of the wave number and ambient current velocity vectors:

$$\omega = \sigma + \vec{k}.\vec{u}$$

which is the usual Doppler shift. For linear waves, the relative frequency is given by

$$\sigma^2 = gk \tanh(kd)$$

Where g is the acceleration of gravity and d is the water depth.

3.1.2 Model simulations and results

Offshore wave data at 08°00' 00" N, 76°00'00" E were obtained from NCEP for which the time frame matches with that of the observed wave data collection period. The major wave parameters like significant wave height, wave direction and time period are thus obtained from NCEP. In order to reduce the simulation time, the wave records with similar characteristics were made in to bins and then grouped together. Such grouped wave events were then simulated using SWAN to obtain the corresponding near shore wave data.

The modelled near shore wave data are extracted at the point (08° 21' 42.3"N, 76° 59' 33.9"E) where the wave observation were carried out by OSAS. These near shore grouped wave events are again transformed back to the respective time frame and then compared with observed wave data provided by AVPPL. The comparison of modelled wave data and the observed wave data is plotted and shown from Figure 3-1 to Figure 3-3

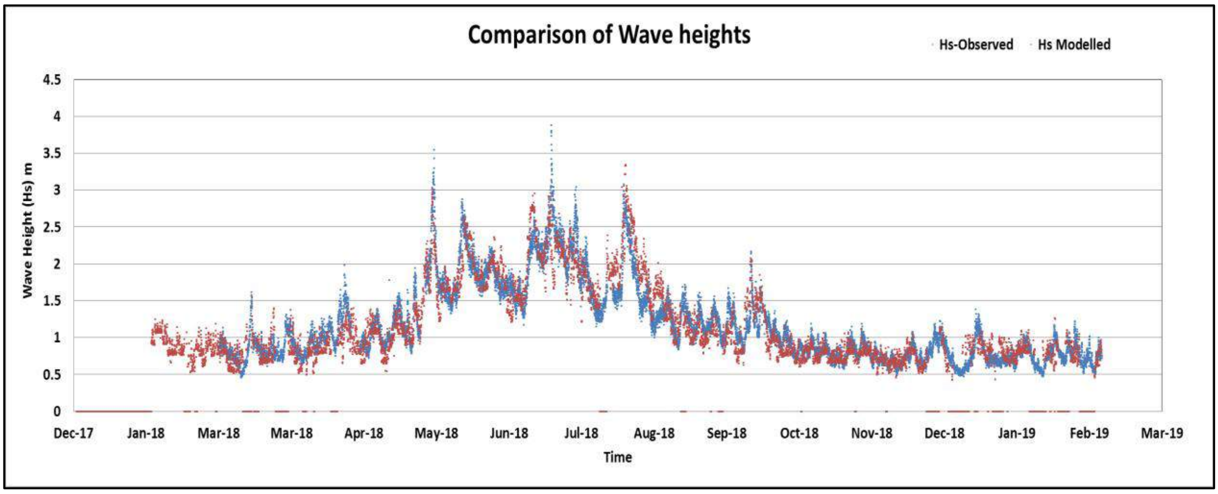


Figure 3-1 Comparison of wave heights (February 2018 to March 2019)

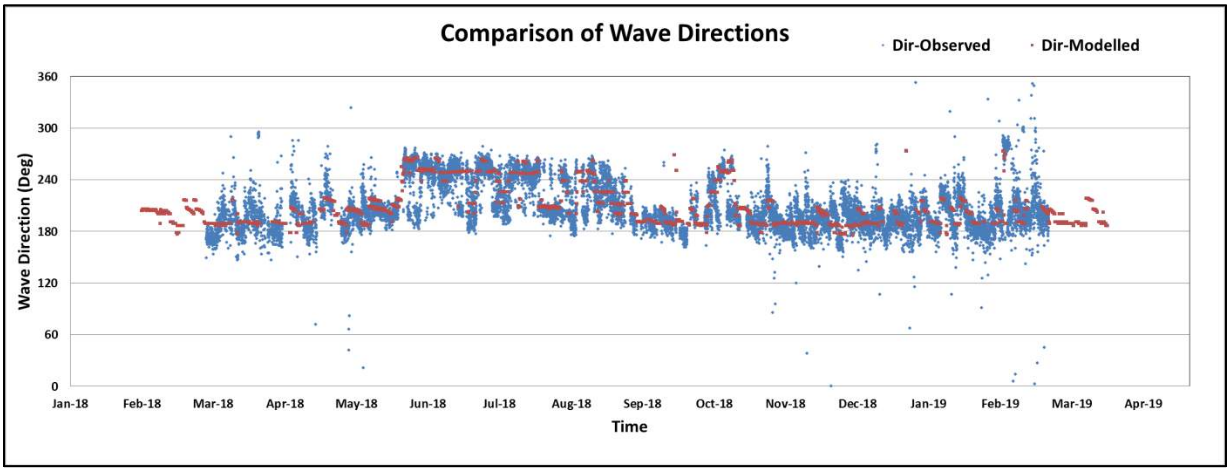


Figure 3-2 Comparison of wave directions (February 2018 to March 2019)

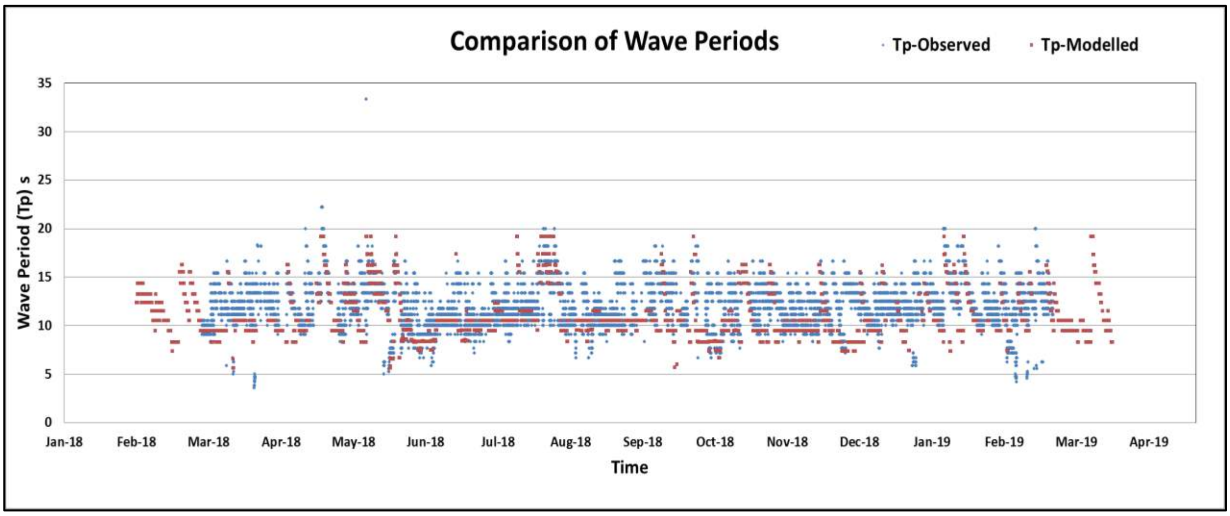


Figure 3-3 Comparison of peak wave periods (February 2018 to March 2019)

From the plots it can be observed that the wave parameters obtained from modelled wave data and observed wave data are in the same band. All the three parameters such as wave height, wave period and wave direction shows plausible comparison.

3.2 Assessment of hydrodynamics

3.2.1 Introduction

Hydrodynamics is the branch of science which deals with the dynamics of fluid and aims at studying the forces exerted by fluids in motion. For a large water body such as sea, the study becomes very complex owing to vast number of processes going on simultaneously. Processes such as tides, waves and wind interactions cause motion of fluid which in turn has far reaching effects. The motion of fluid, otherwise called as currents can induce a number of phenomenon such as erosion and accretion along shoreline, morphological changes and forces on marine structures.

With development in advanced computing methods, numerical modelling has replaced the earlier methods of study. Various numerical modelling software packages have been developed for this purpose. These have the ability to solve complex equations involved in the study of hydrodynamics in efficient and less time consuming manner.

Earlier in 2013, LNTIEL had comprehensively covered the assessment of hydrodynamics in the port vicinity. To understand the impact of the port construction on the hydrodynamics, LNTIEL carried out the assessment of hydrodynamics with the latest surveyed bathymetries. This chapter of the report covers the assessment of hydrodynamics carried out by LNTIEL.

In this part of the study, the following tasks were identified:

- Comparison of results from the updated hydrodynamic model with the calibrated hydrodynamic model used in 2013.
- Assessment of the impact of change in bathymetry on prevailing water levels and currents by using the hydrodynamic model.

3.2.2 Model setup using TELEMAC-2D

In this study, the model domain is updated as per the latest February 2019 shoreline. The region of interest is situated along a coastline which is oriented in NW – SE direction and is straight. The model domain used for the study is almost parallel to the coastline. The model domain covers a region of about 50 X 22 km^2. The mesh size near target location was kept low (restricted to 30m) to resolve the proposed schemes and velocities properly. The mesh near the target location can be viewed in Figure 3-4. The model bathymetry was prepared using the available primary and secondary data and is shown in Figure 3-5.

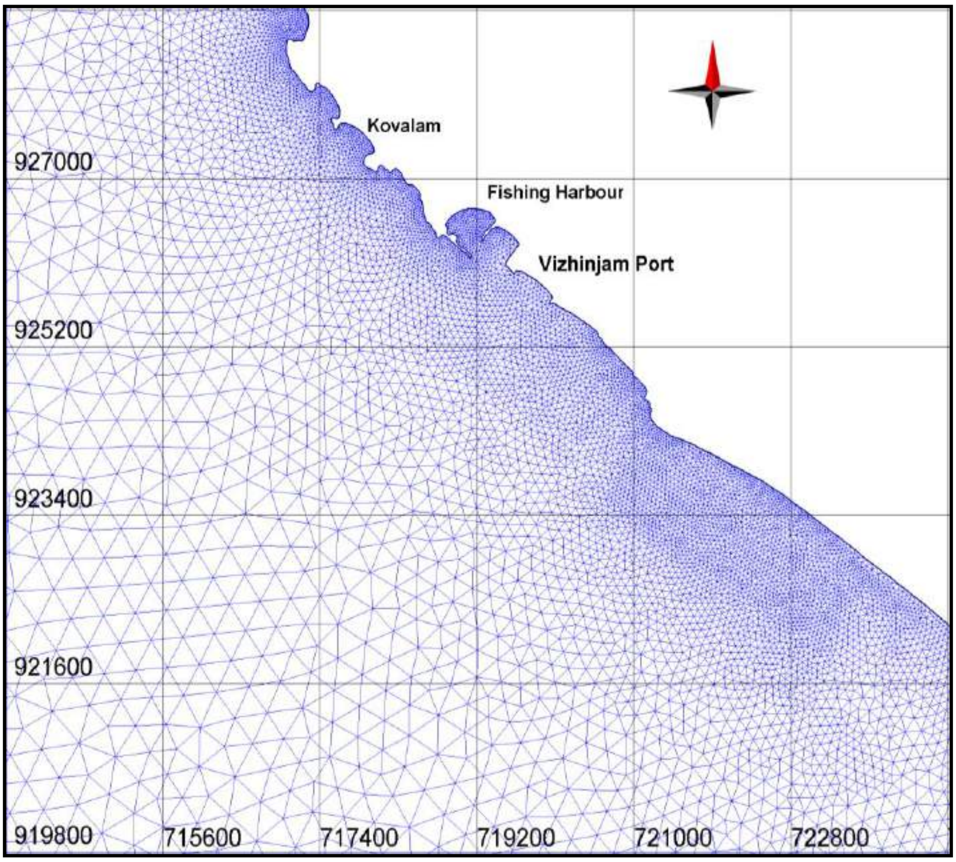


Figure 3-4 Fine mesh near project location

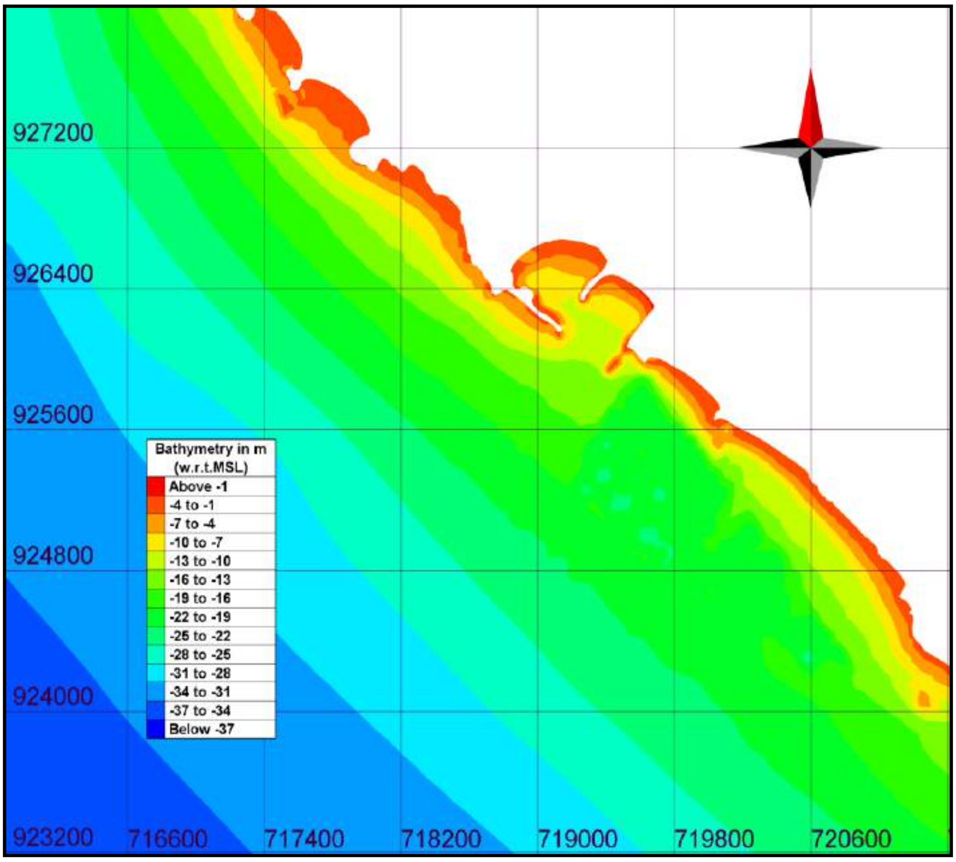


Figure 3-5 Pre-monsoon (2018) bathymetry with respect to MSL

3.2.2.1 Boundary conditions

Tidal levels were applied along the open boundary of the model domain. In order to set up the model, tidal elevations along the open boundary were predicted using OTPS developed by OSU.

OTPS accomplish 2 tasks:

- Extracting harmonic constants from barotropic tidal solutions in OTIS format at given locations
- Predicting tides at given times and locations

Predictions are based on global and/or regional barotropic inverse tidal solutions obtained with OTIS.

Wind was applied on the model to account for wind driven currents in the model. Time varying wind field was applied for model validation, as the variation in wind speed and direction may lead to change in current speed and direction.

3.2.2.2 Model comparison and validation

The aim of this study is to assess the impact of the change in bathymetry on the hydrodynamics of the region. A calibrated model was achieved and the results from the model were reported in the report of August 2013. In this present study, the model used in 2013 was updated with the pre monsoon bathymetries of 2015, 2016, 2017 and 2018 and simulations were carried out with the same parameters used in 2013.

Comparison between the tide and currents simulated by the two models were done. Figure 3-6 shows the comparison between the modelled tides put on similar time scales. Tide measurement carried out by AVPPL was also put on the scale. From the comparisons it can be seen that there is a good correlation between all the data which indicates that the change in bathymetry has no effect on the tidal variations.

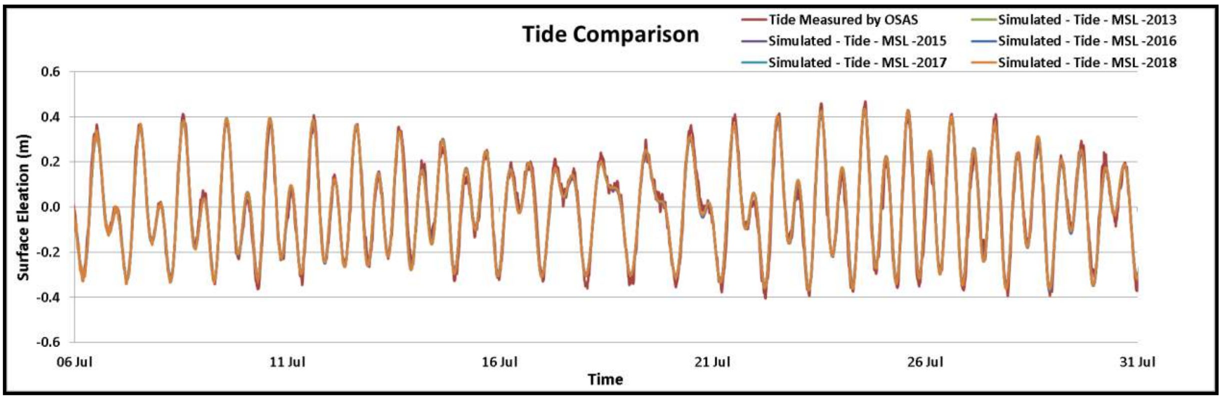
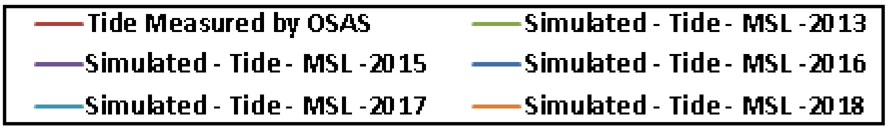
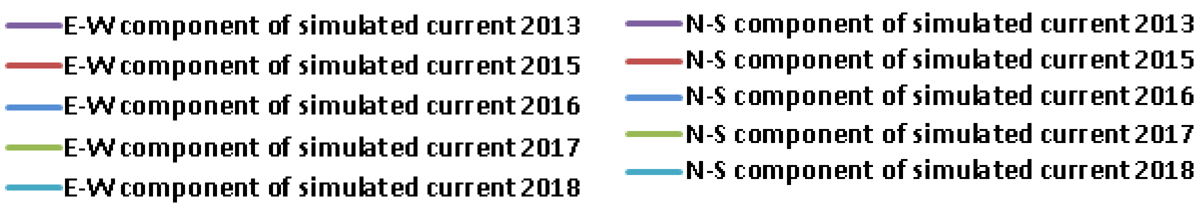


Figure 3-6 Comparison of simulated tide with AVPPL data 2013 (SW Monsoon)



Legend of Tide comparison plot

Figure 3-7 to Figure 3-12 shows the comparison of N-S and E-W components of simulated currents (2013, 2015, 2016, 2017 and 2018) at the measurement locations put on a similar time scale. As in the case of tides, it can be seen that all the three simulated currents show good correlation with each other. This shows that the effect of the change of bathymetry on the hydrodynamics of the area is negligible. Figure 3-13 and Figure 3-14 shows typical plots from the simulation.



Legend of current comparison plots at CM locations

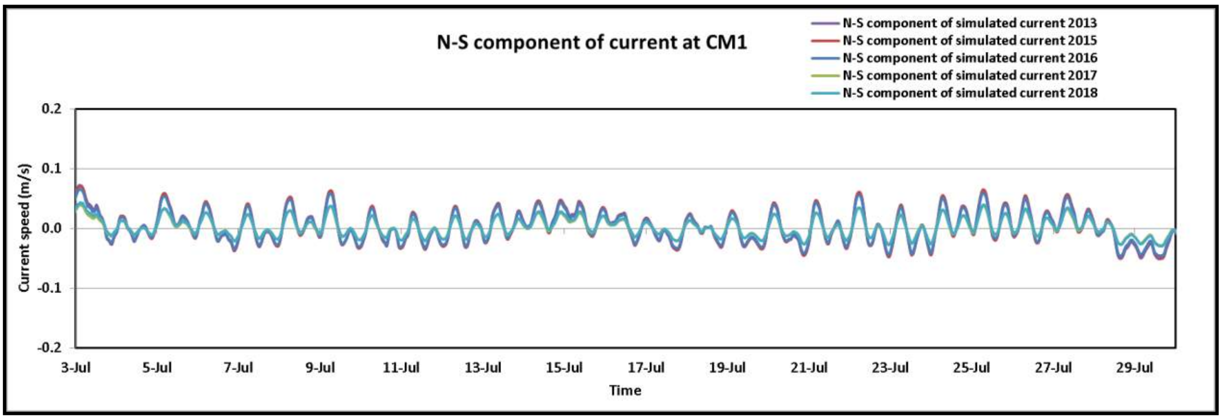


Figure 3-7 Comparison of N-S component of current at CM1 during SW-monsoon

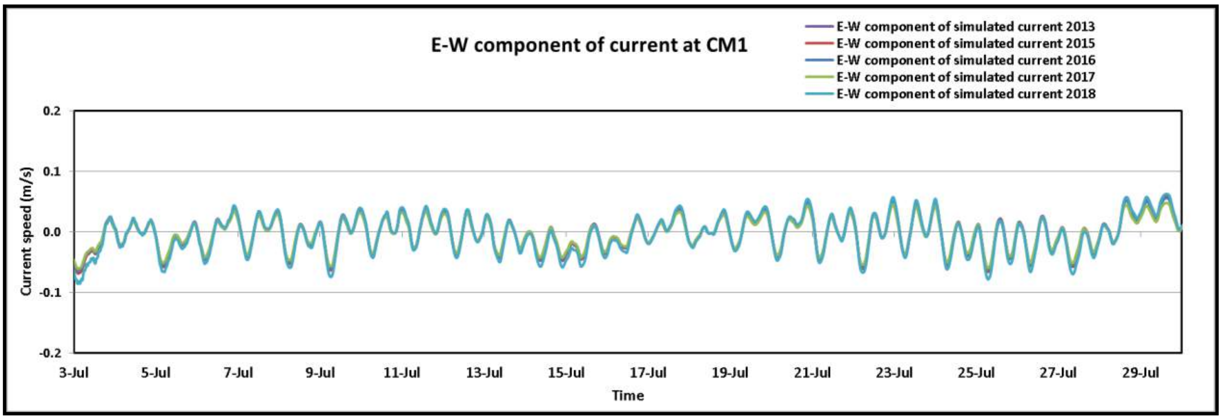


Figure 3-8 Comparison of E-W component of current at CM1 during SW-monsoon

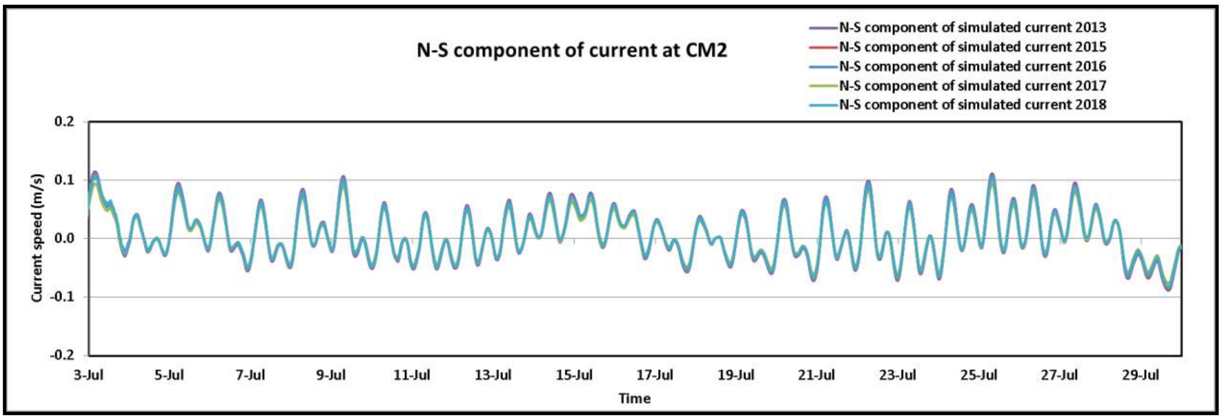


Figure 3-9 Comparison of N-S component of current at CM2 during SW-monsoon

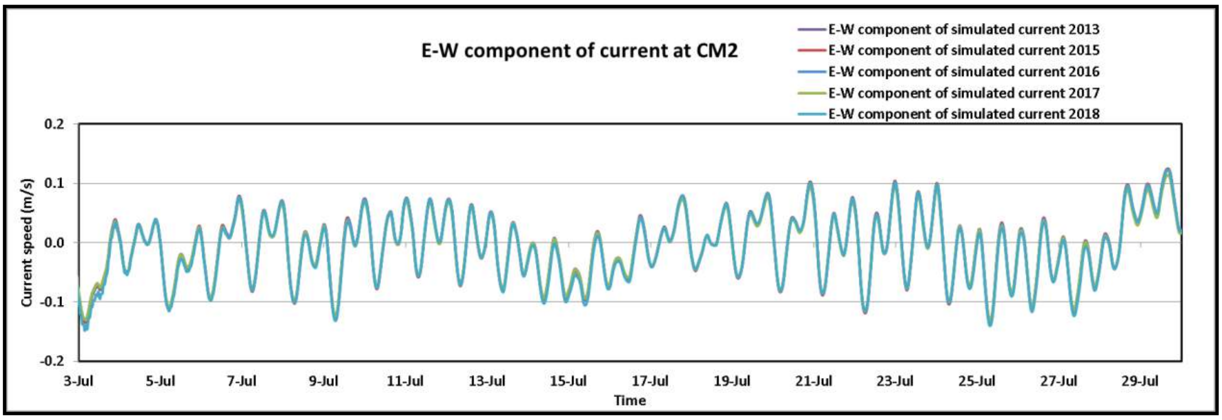


Figure 3-10 Comparison of E-W component of current at CM2 during SW-monsoon

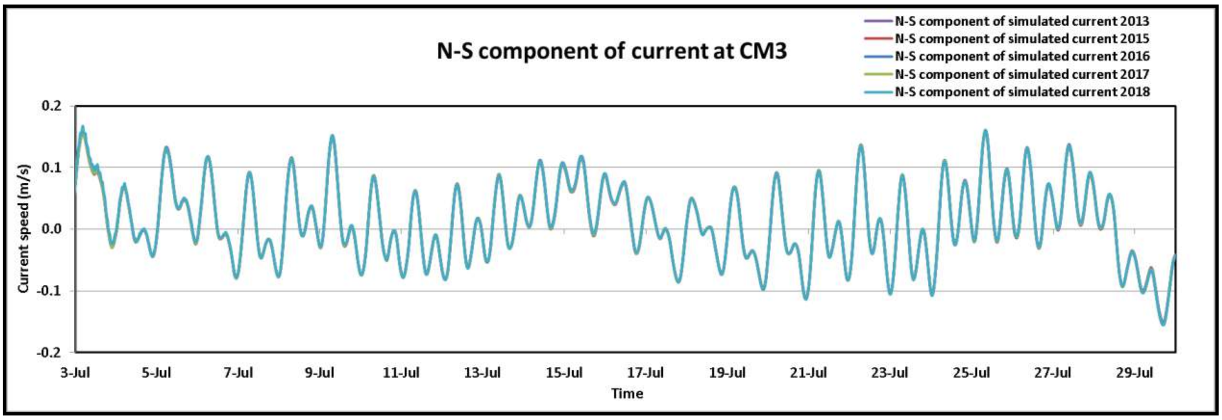


Figure 3-11 Comparison of N-S component of current at CM3 during SW-monsoon

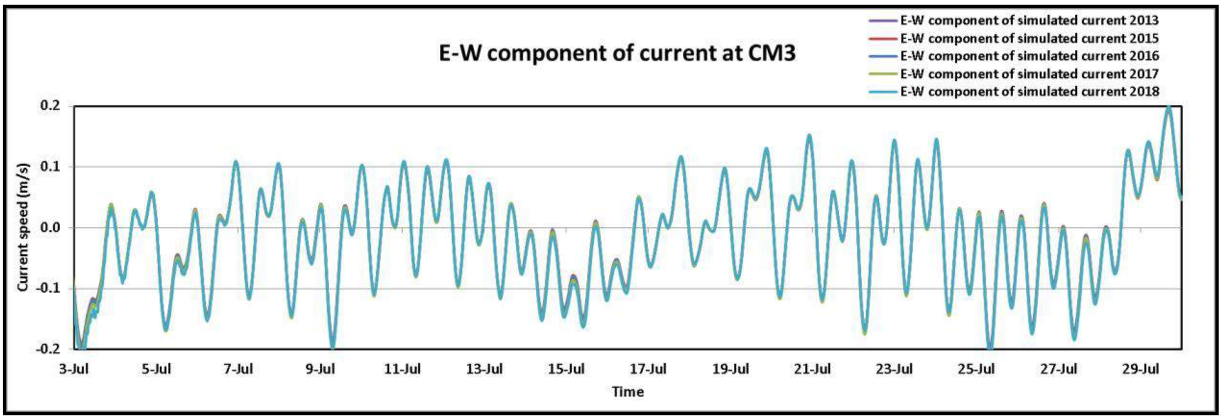


Figure 3-12 Comparison of E-W component of current at CM3 during SW-monsoon

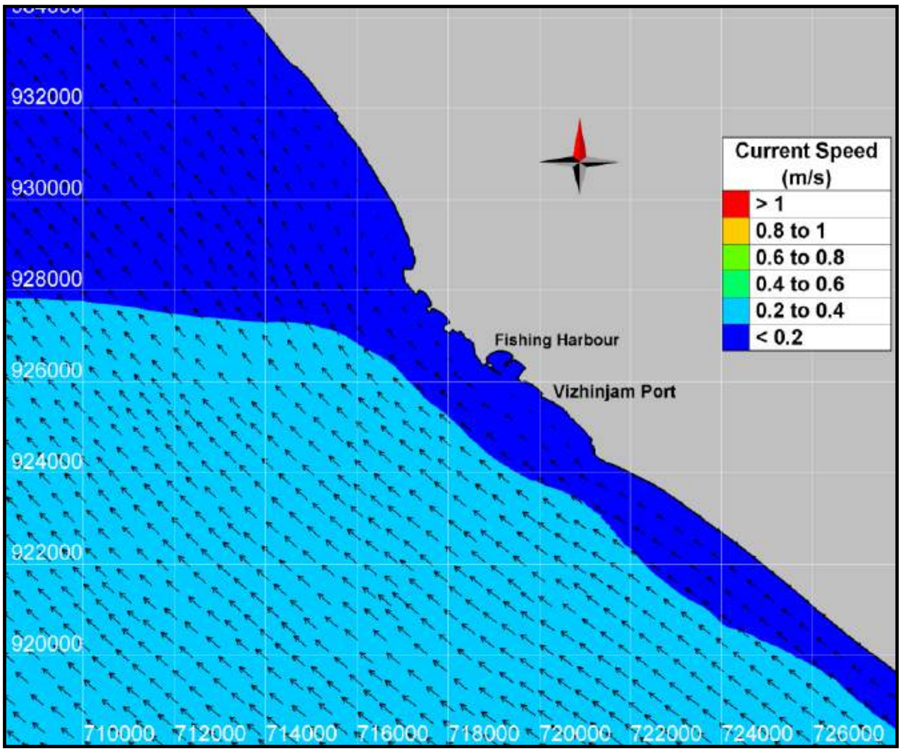


Figure 3-13 Current pattern showing north-westerly flow (typical during monsoon) for pre-monsoon bathymetry during 2018

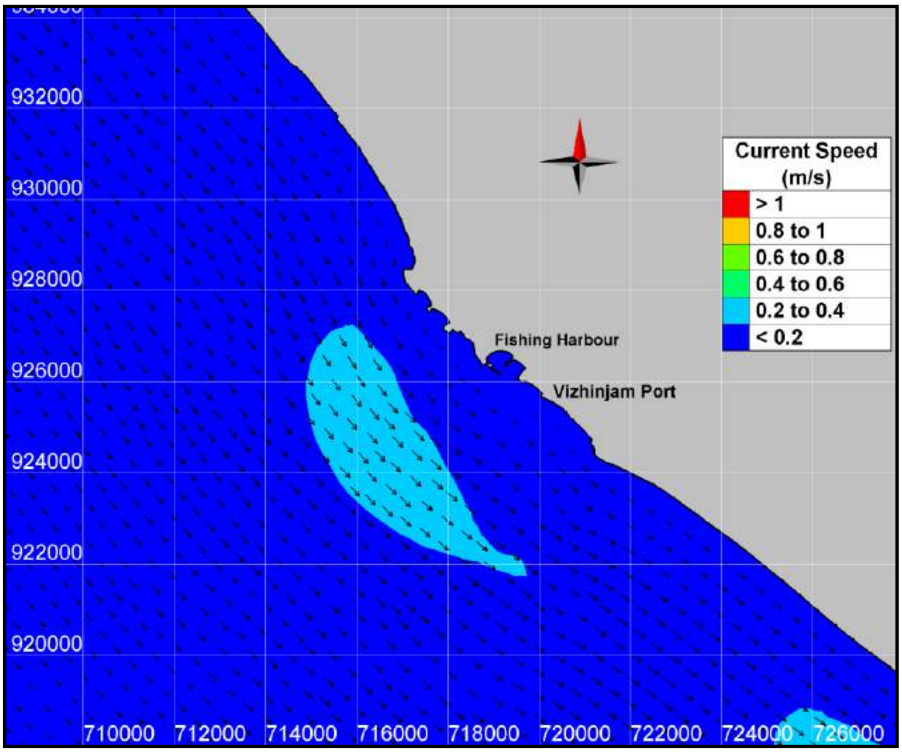


Figure 3-14 Current pattern showing south-easterly flow (typical during monsoon) for pre-monsoon bathymetry during 2018

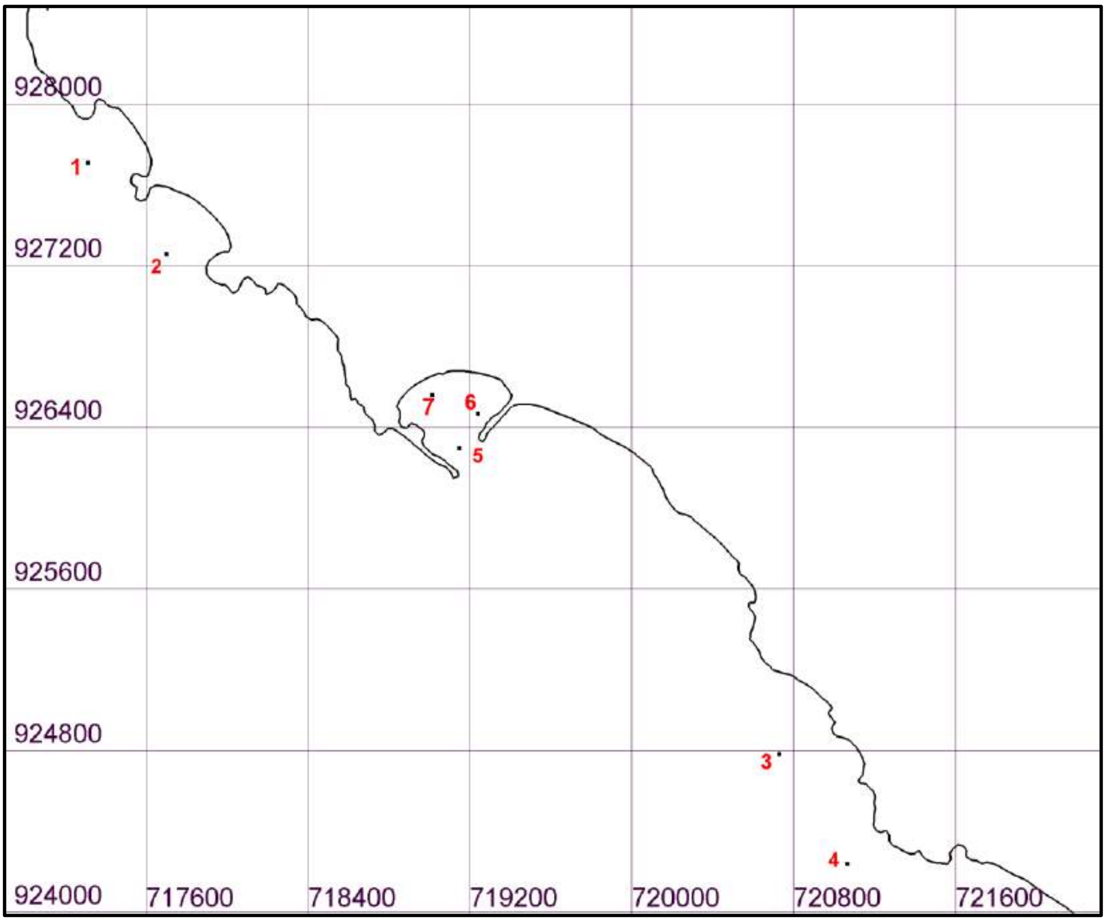


Figure 3-15 Current comparison points location (near shoreline)

Moreover the current patterns were compared at different locations around the project vicinity at shallow water depth to see if there are any changes in flow pattern. Total 7 points were chosen to cover Fishery harbour, North and South side of proposed port as shown in Figure 3-15. The current comparison plots were shown in Figure 3-16 to Figure 3-22. From these plots it was observed that there was no significant change in current speeds. This indicates that the flow pattern at these locations is not influenced by the construction activity.

Current simulation at 2013
Current Simulation at 2015
Current Simulation at 2016
Current Simulation at 2017
Current Simulation at 2018

Legend of current comparison plots at points

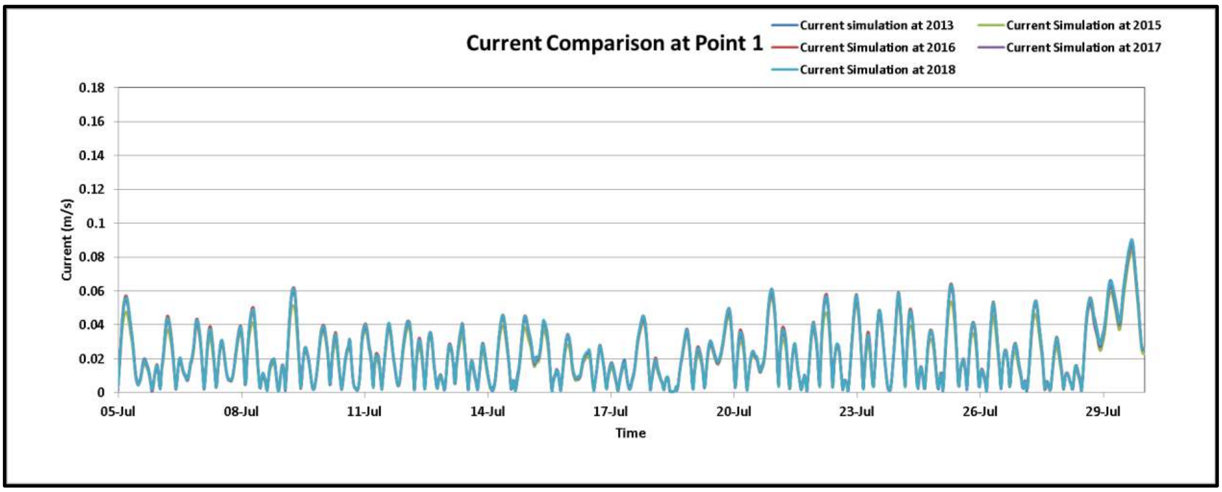


Figure 3-16 Current comparison at point 1

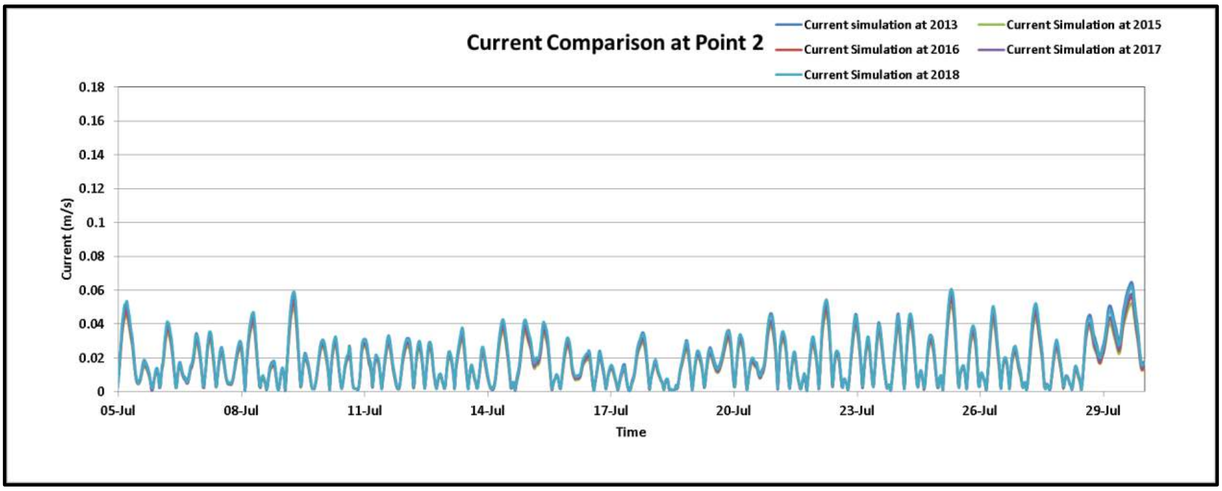


Figure 3-17 Current comparison at point 2

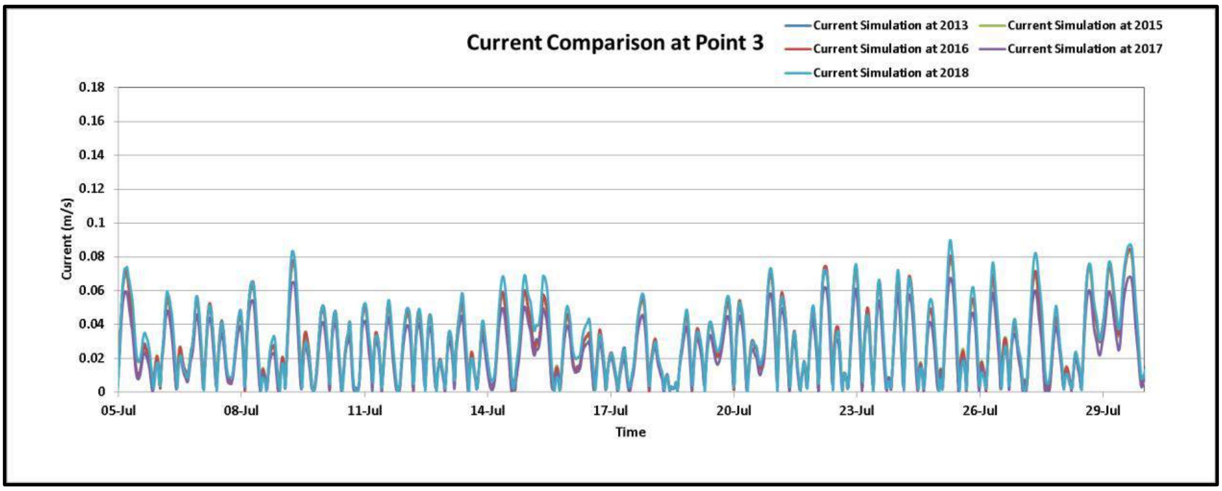


Figure 3-18 Current comparison at point 3

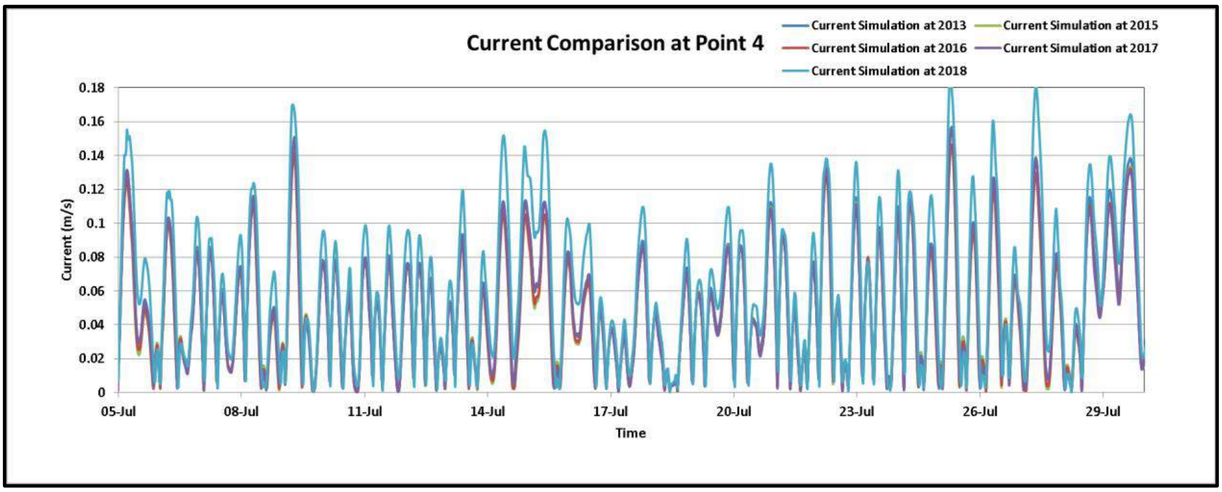


Figure 3-19 Current comparison at point 4

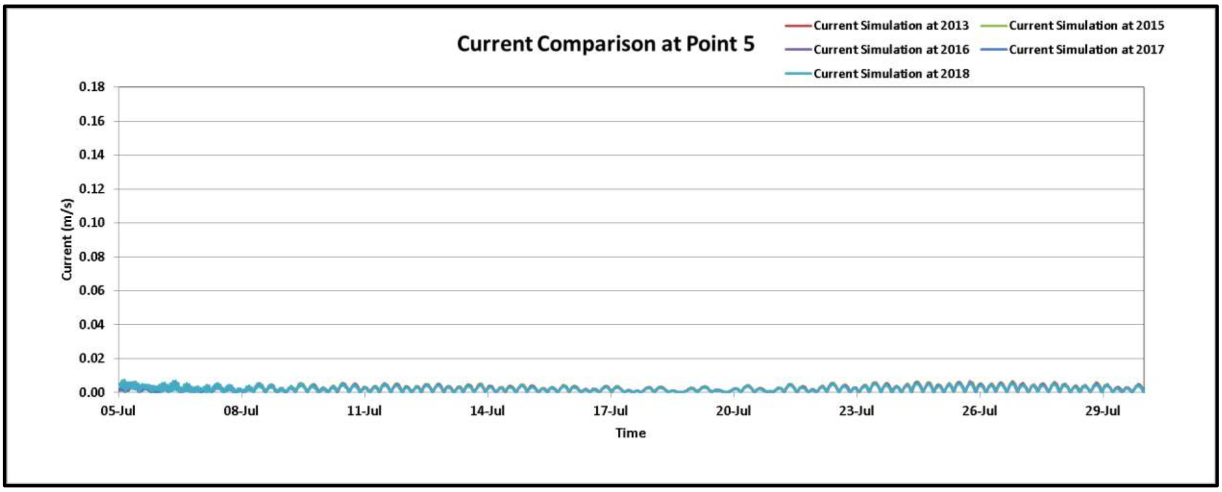


Figure 3-20 Current comparison at point 5

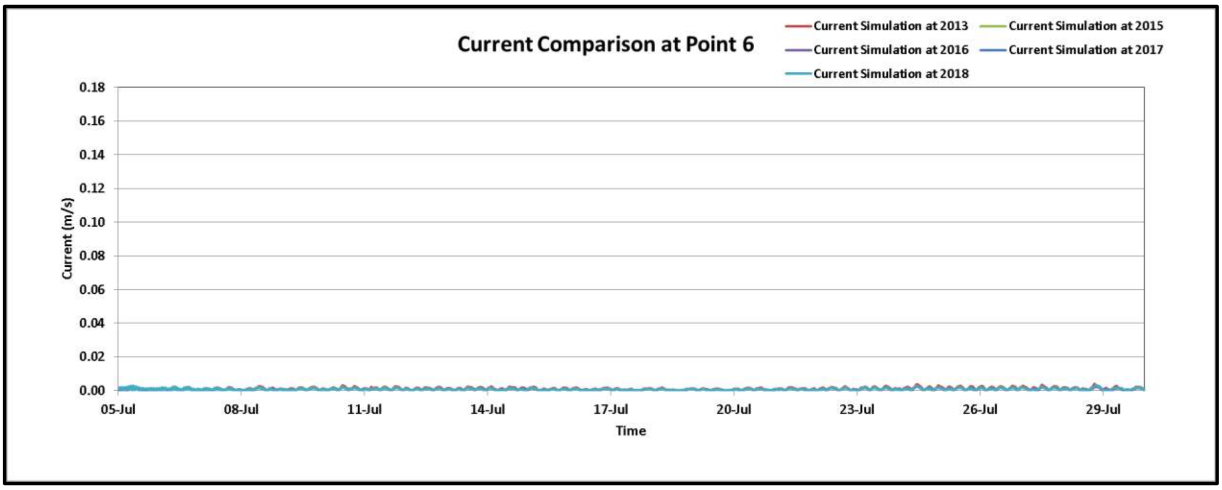


Figure 3-21 Current comparison at point 6

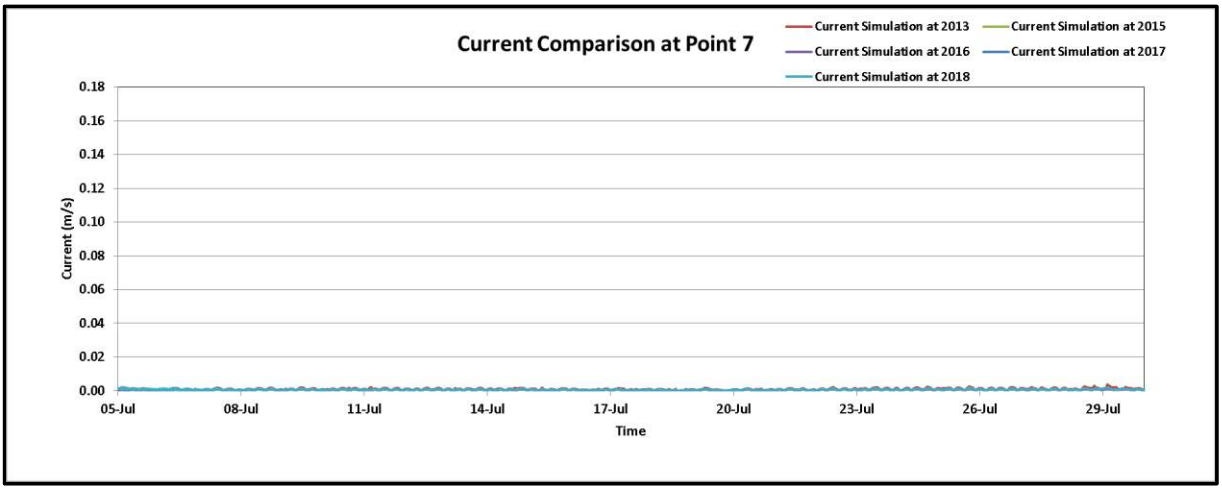


Figure 3-22 Current comparison at point 7

Also, model has been setup using latest surveyed bathymetry as on date i.e. Post Monsoon 2018. The same calibration parameters and boundary conditions as discussed in earlier sections are used to simulate hydrodynamics. The model bathymetry prepared using the available primary and secondary data is shown Figure 3-23.

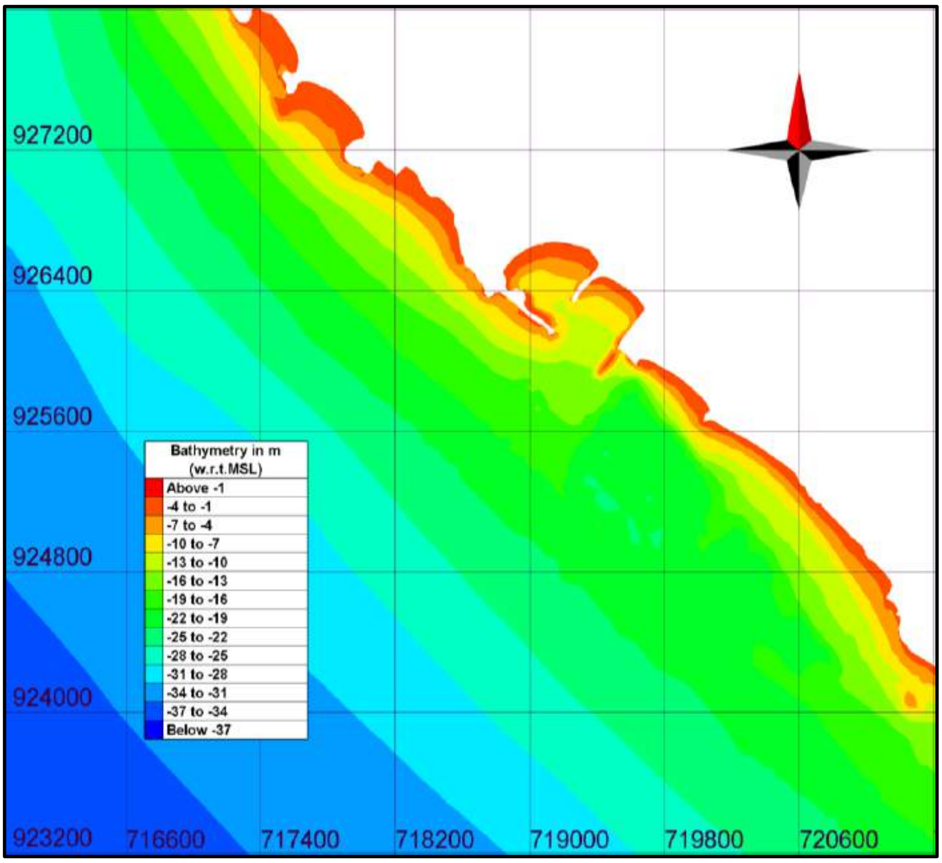


Figure 3-23 Post-Monsoon (2018) bathymetry with respect to MSL

Comparison between the simulated and observed tide and currents were done. Figure 3-24 shows the comparison between the modelled tide and observed tide measurement carried out by AVPPL. From the comparisons it can be seen that there is a good correlation between simulated and observed data which indicates that the change in bathymetry has no effect on the tidal variations.

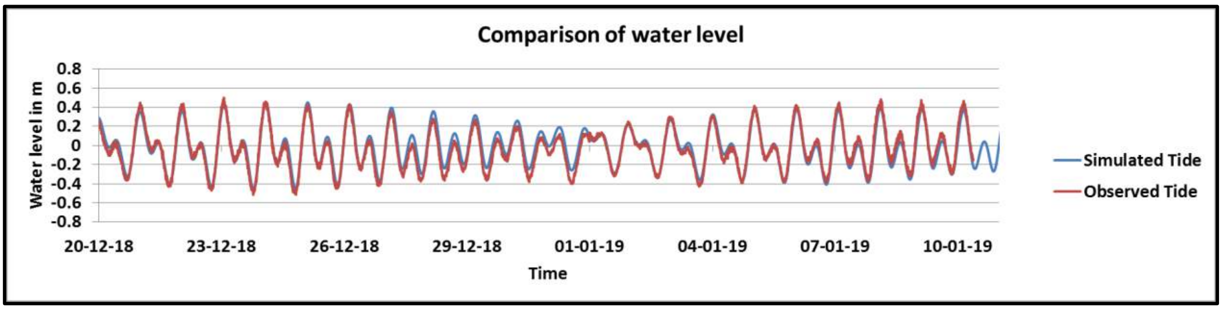


Figure 3-24 Comparison of simulated tide with observed tide (Post Monsoon 2018)

Figure 3-25 to Figure 3-32 represents the comparison of E-W and N-S components of current during Post monsoon 2018 at different locations (Vizhinjam, Pachalloor, Poovar and Mulloor). From the comparison plots it can be noticed that there is good correlation between simulated and observed current at all the locations. Figure 3-33 and Figure 3-34 shows typical plots from simulation.

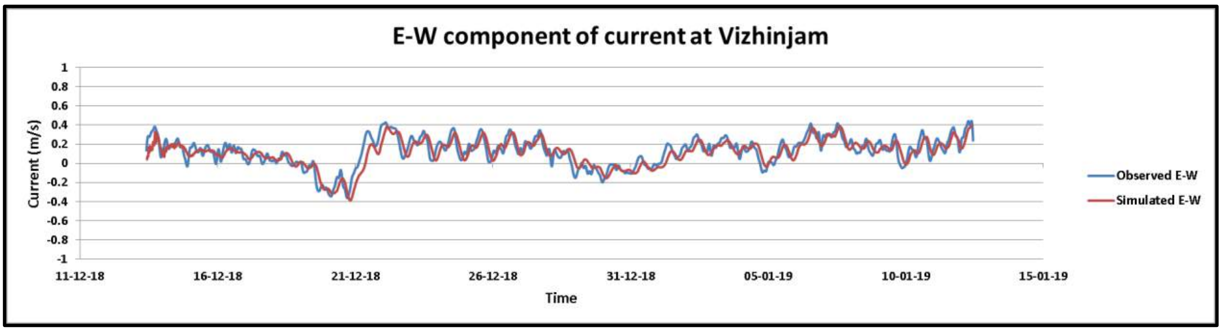


Figure 3-25 Comparison of E-W component of current at Vizhinjam (Post Monsoon 2018)

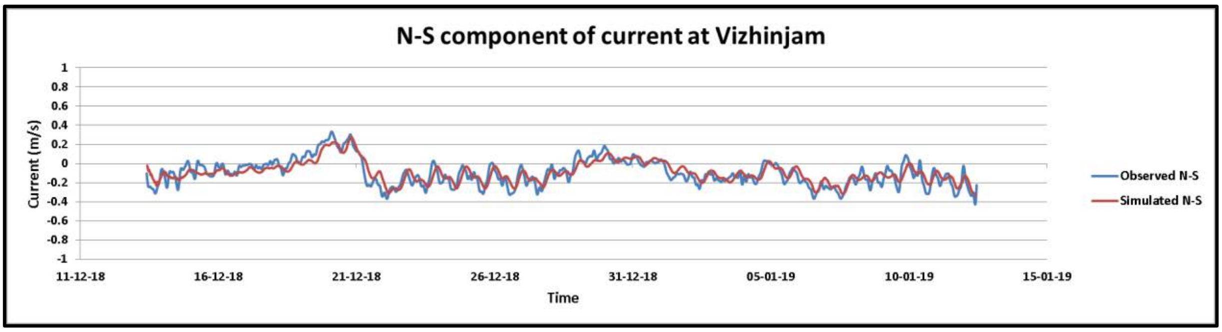


Figure 3-26 Comparison of N-S component of current at Vizhinjam (Post Monsoon 2018)

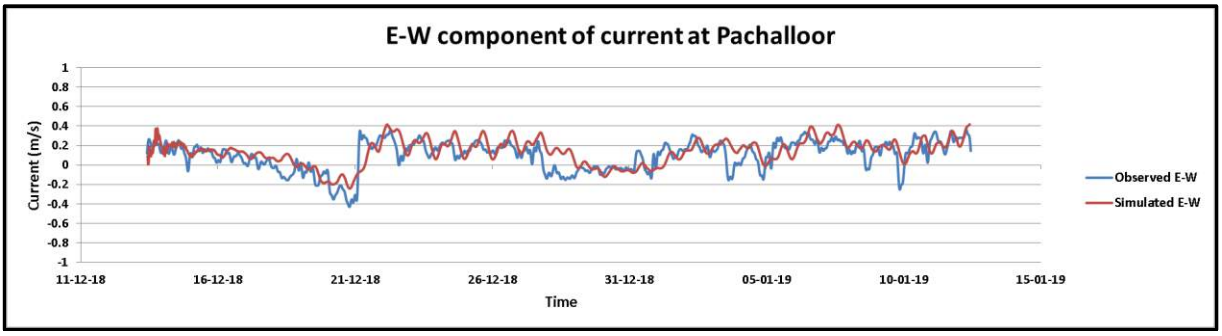


Figure 3-27 Comparison of E-W component of current at Pachalloor (Post Monsoon 2018)

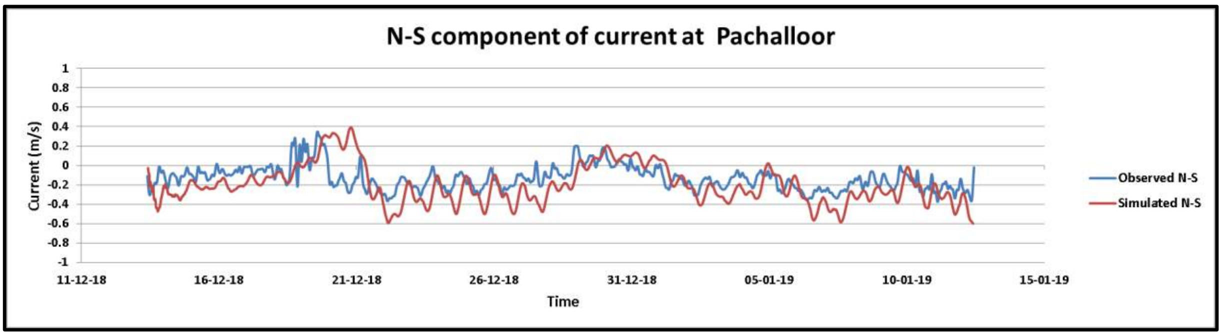


Figure 3-28 Comparison of N-S component of current at Pachalloor (Post Monsoon 2018)

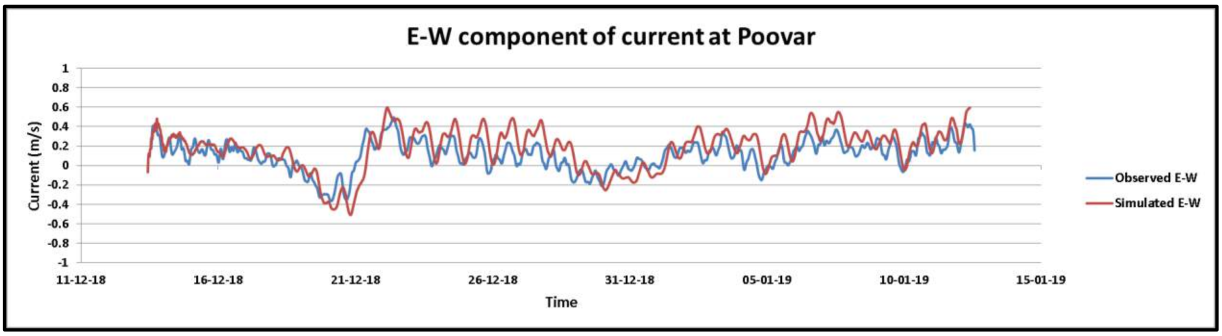


Figure 3-29 Comparison of E-W component of current at Poovar (Post Monsoon 2018)

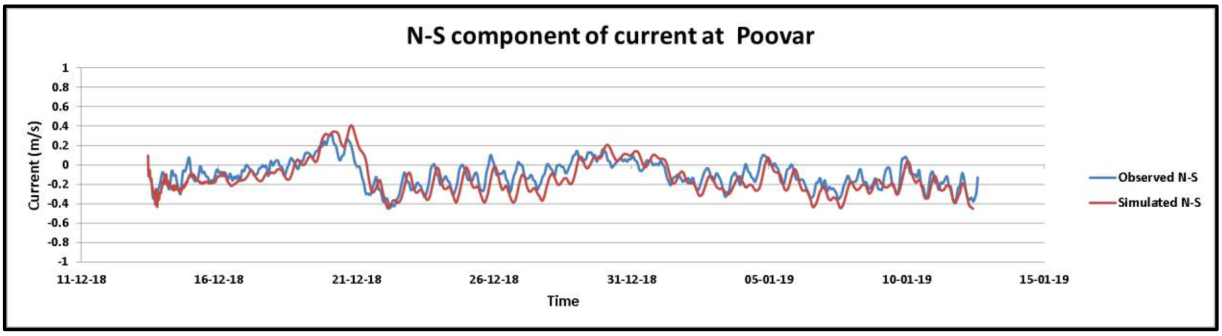


Figure 3-30 Comparison of N-S component of current at Poovar (Post Monsoon 2018)

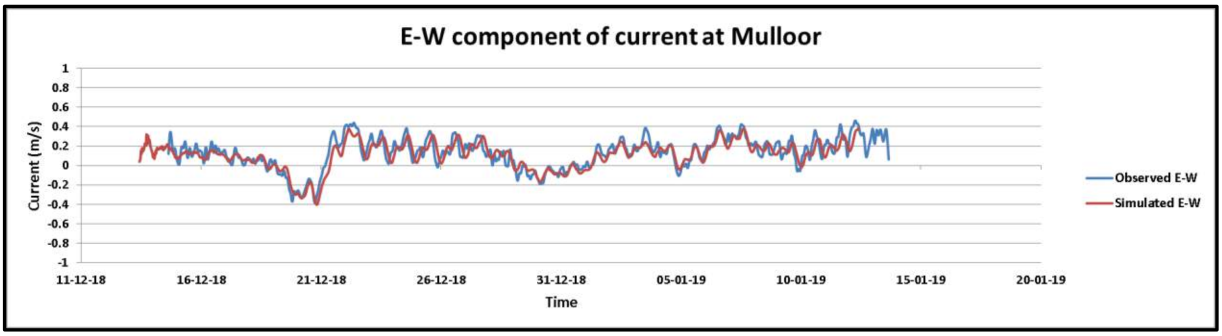


Figure 3-31 Comparison of E-W component of current at Mulloor (Post Monsoon 2018)

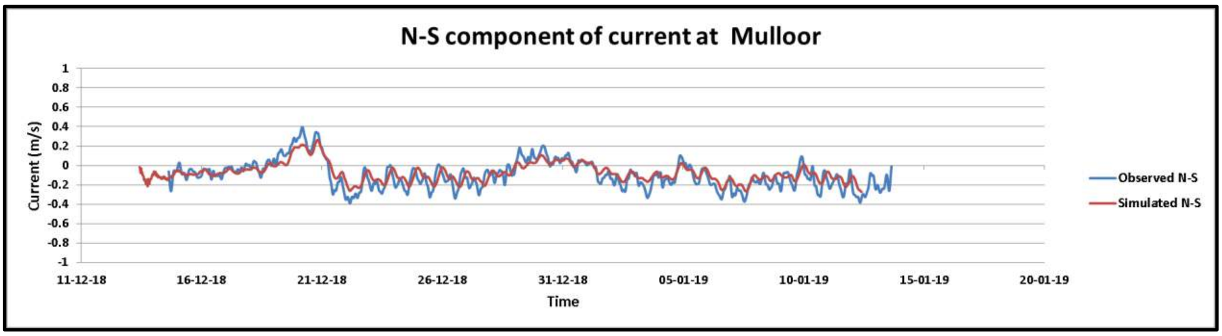


Figure 3-32 Comparison of N-S component of current at Mulloor (Post Monsoon 2018)

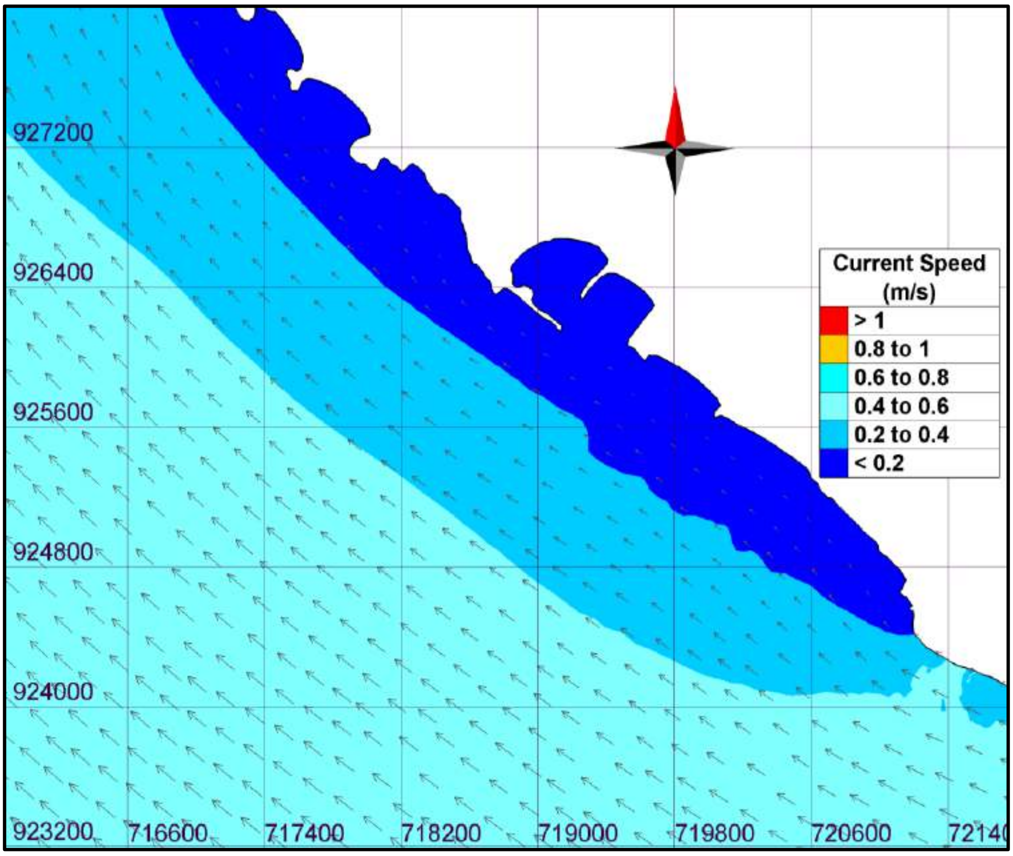


Figure 3-33 Typical plot of current pattern showing north-westerly flow

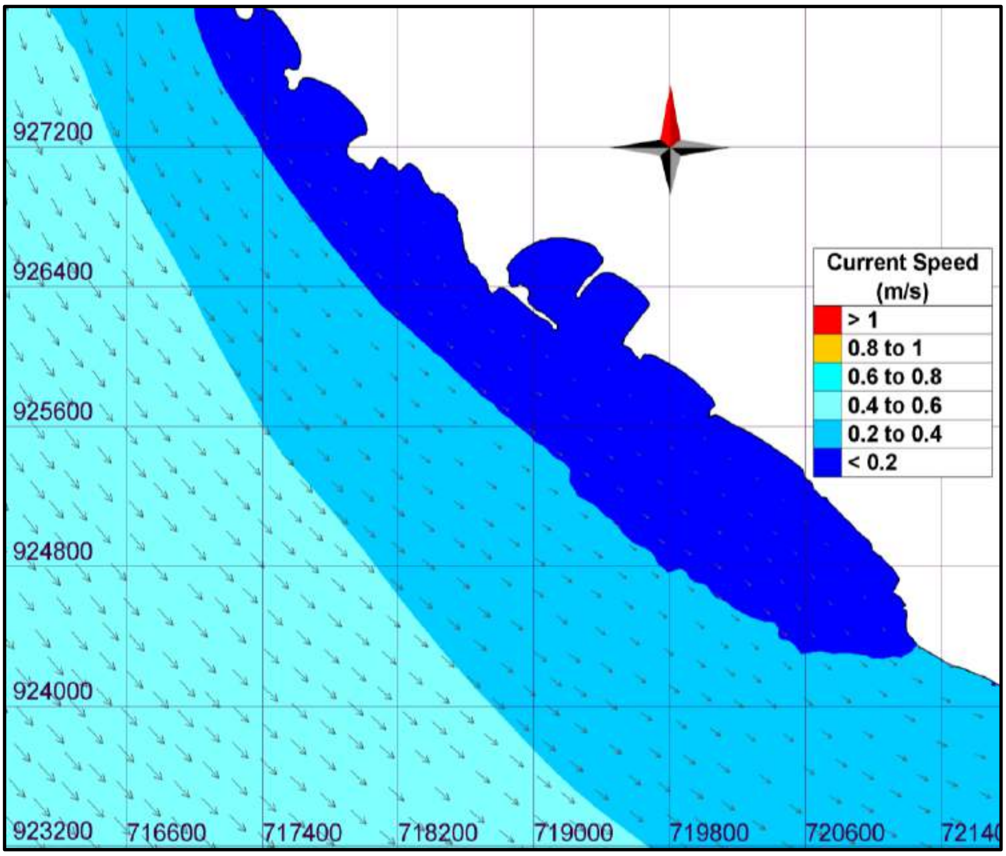


Figure 3-34 Typical plot of current pattern showing south-easterly flow

3.3 Model study for effect of waves on fishing harbour

LNTIEL had carried out model studies to evaluate the effect of waves on fishing harbor in 2018 *(RP003-RA-RTA-Data Analysis and Final Mathematical Model Study Report)*. It may be noted that during the period of February 2017 to February 2018, events which caused damage inside the fishing harbor were reported and LNTIEL investigated if the port construction has attributed to these damages. ARTEMIS model was set up with and without partial breakwater and the results were compared. According to the study, it was found that the disturbances inside the fishing harbour are not due to the construction of breakwater. From the simulation results, it was observed that the wave heights reduced with the introduction of partial breakwater (PBW). Moreover it was substantiated that the construction of port breakwater will shadow the fishing harbour and waves from south to south- south west are completely restricted due to this. Also, additional tranquillity will be achieved due to construction of spur for fish landing facility.

For the year March 2018 to February 2019, any event causing damage inside the fishing harbour was not reported. In addition, there were very few changes in the bathymetry and the surrounding environment. However, LNTIEL studied the effect of these minor changes on the impact on the fishing harbour. In order to do that, LNTIEL considered the 2017-18's bathymetry and 2018-19's bathymetry and carried out wave modelling. The results of the same are provided in the following section.

3.3.1 Model selection

ARTEMIS model was chosen to estimate the effect of waves on fishing harbour. ARTEMIS (TELEMAC MODELLING SYSTEM) is a part of the TELEMAC finite element hydraulic modelling systems. ARTEMIS, an acronym for "Agitation and Refraction with TElemac on the MIld Slope equation", predicts the wave conditions within ports and harbours and allows the use a flexible mesh. Using a flexible mesh has advantages when one has to define the structures in the domain with maximum accuracy. The model employs finite element technique to solve elliptic mild slope equation. At each node point of computational mesh, wave heights and phase of the wave are obtained from the result for each set of incident wave conditions. Various different phenomena are accounted in the model and can be identified as:-

- Wave reflection
- Wave diffraction
- Wave refraction
- Monochromatic or random wave
- Seabed friction
- Energy dissipation by wave breaking or bottom friction
- Partial or complete reflection from the model boundary

ARTEMIS solves the mild slope equation (or Berkhoff's equation), which is given by

$$\nabla\left[CC_g\nabla\phi\right]+\omega^2\frac{C_g}{C}\phi=0$$

$$C=\frac{\omega}{k}\quad and\qquad C_g=\frac{1}{2}\left[1+\frac{2kh}{\sinh(2kh)}\right]C$$

Where,

ω = angular frequency,

h = still water depth,

k = wave number,

ϕ = reduced velocity potential,

C_g = group velocity,

C = phase velocity

It is necessary to have a proper definition of all the port structures to account for the wave diffractions around the port structures. The model also has flexibilities while defining the reflection coefficient for different structures. Different portions of the model domain are allowed to have different reflection coefficients and this provides an additional flexibility. ARTEMIS model was set up for mono-directional random wave

3.3.2 Model inputs

The model has been set up with bathymetry of current year (March 2018 to February 2019) and previous year (March 2017 to February 2018) as presented in Figure 3-35 and Figure 3-36

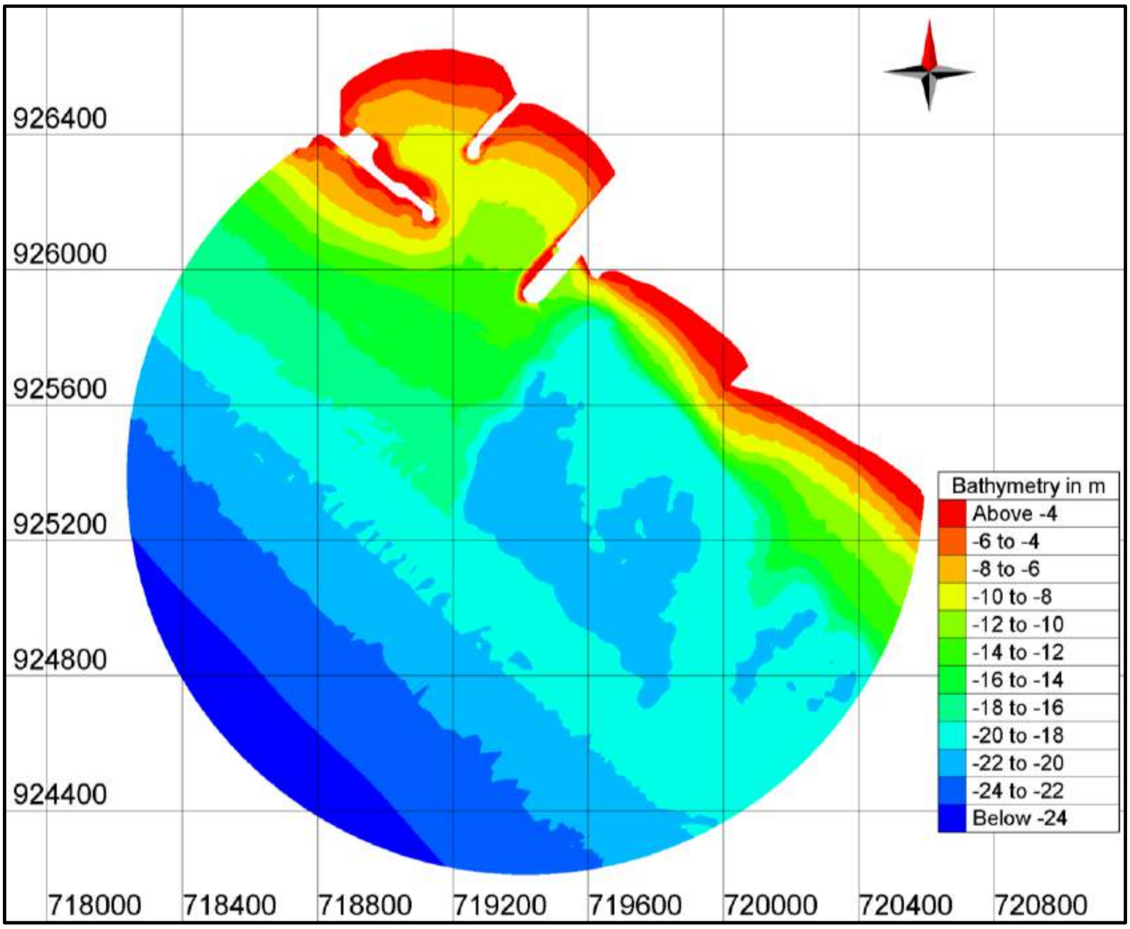


Figure 3-35 2018 Bathymetry considered for the model study

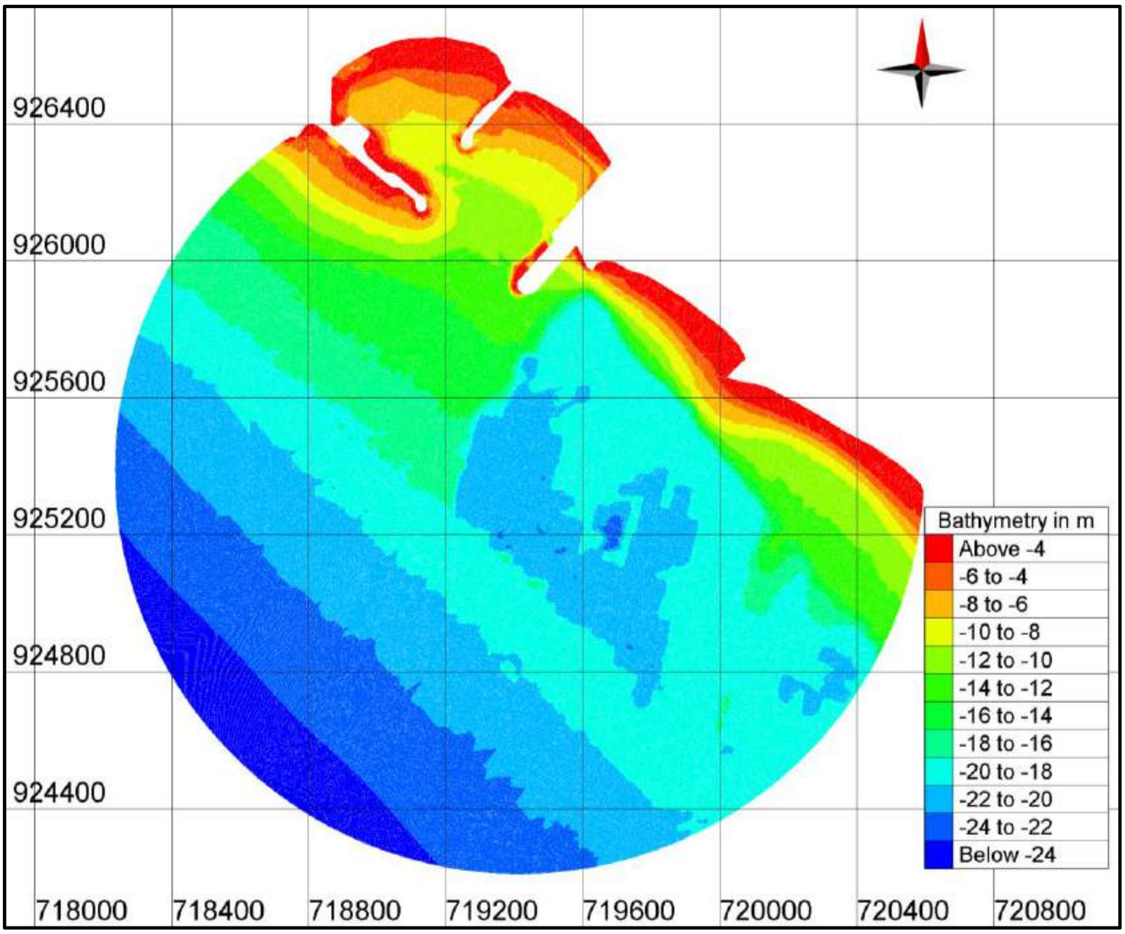


Figure 3-36 2017 Bathymetry considered for the model study

As stated before, unlike previous year no extreme events which caused disturbance inside the fishing harbour were reported during March 2018 to February 2019. However in order to be discreet, few events were chosen from the observed wave data provided by AVPPL to assess the wave climate inside the fishing harbour. Model has been set up for the two bathymetries and the wave distribution corresponding to the chosen wave events were compared. Different combinations of wave events were chosen based on their extremities in wave height and peak wave period along with most prominent incident wave directions as presented in Table 3-1.

Table 3-1 Input wave events considered

Wave Events	Incident Wave Height in m	Peak Wave Period in s	Incident Wave Direction in Deg (True North)
WAVE EVENT 1	3.8	16	202.5
WAVE EVENT 2	3.9	11	248.9
WAVE EVENT 3	1.8	33	253.1
WAVE EVENT 4	1.6	22	225.0
WAVE EVENT 5	0.9	3.5	292.5

WAVE EVENT 6	0.5	13	194.1

3.3.3 Results and discussions

Comparison of wave distribution for the both bathymetries was carried out. A section was considered from inner harbour to harbour entrance for the same as presented in Figure 3-37.

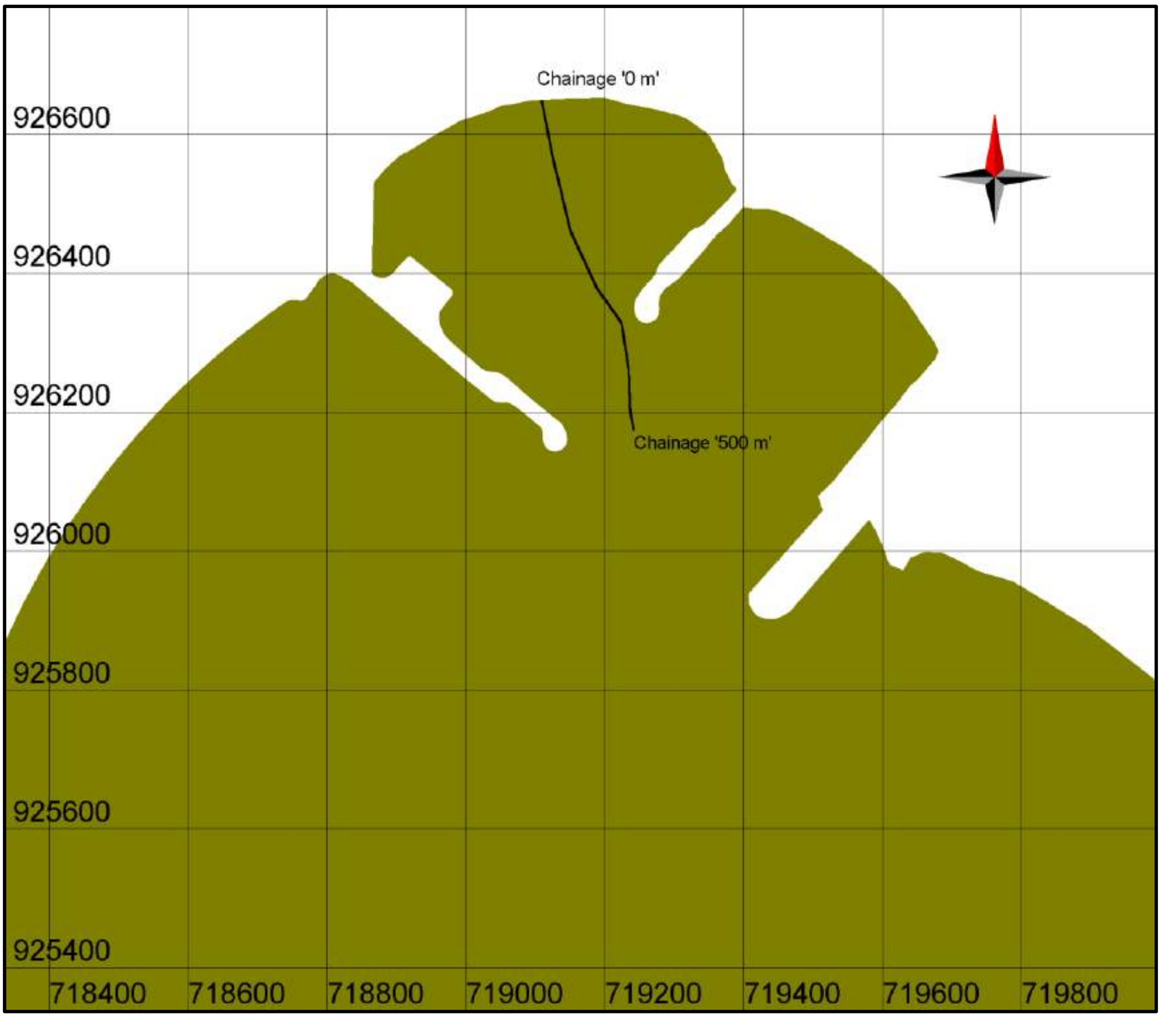


Figure 3-37 Section considered along the harbour entrance

Figure 3-38 to Figure 3-43 are the comparison plots along the sections as shown in Figure 3-37. The aim of these comparisons is to find the changes in the wave conditions between last year and the current year if the input wave events were same. As shown in Figure 3-37, chainage 0 is inside the fishing harbour and the chainage 500 is outside the fishing harbour.

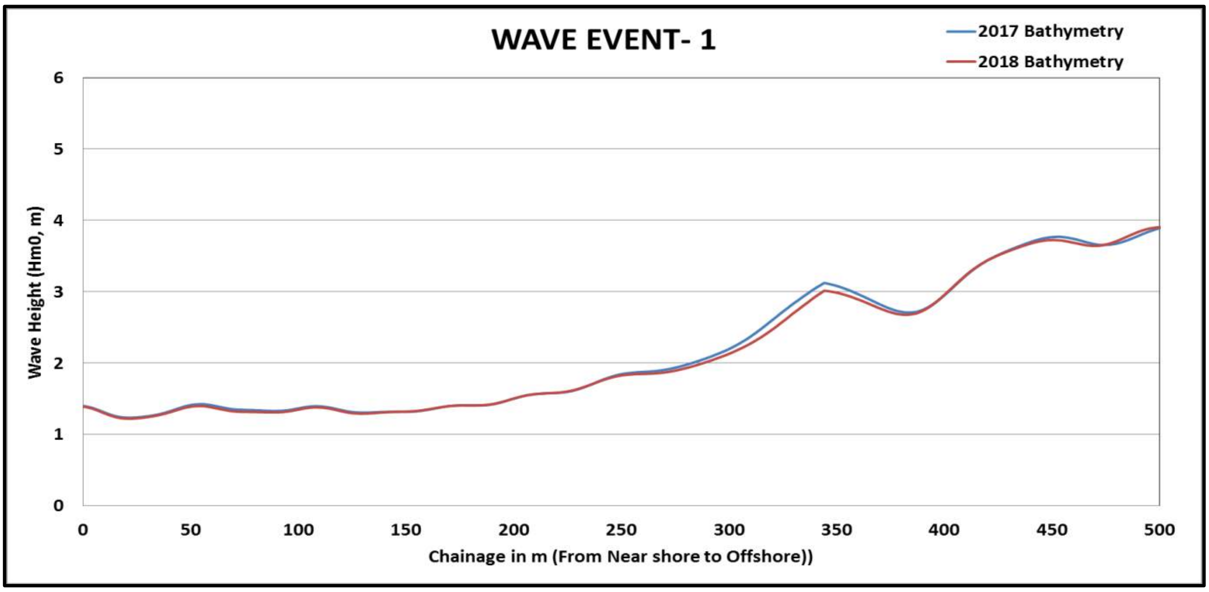


Figure 3-38 Variation of wave height from inner harbour to entrance (Hm0, m) for Wave Event - 1

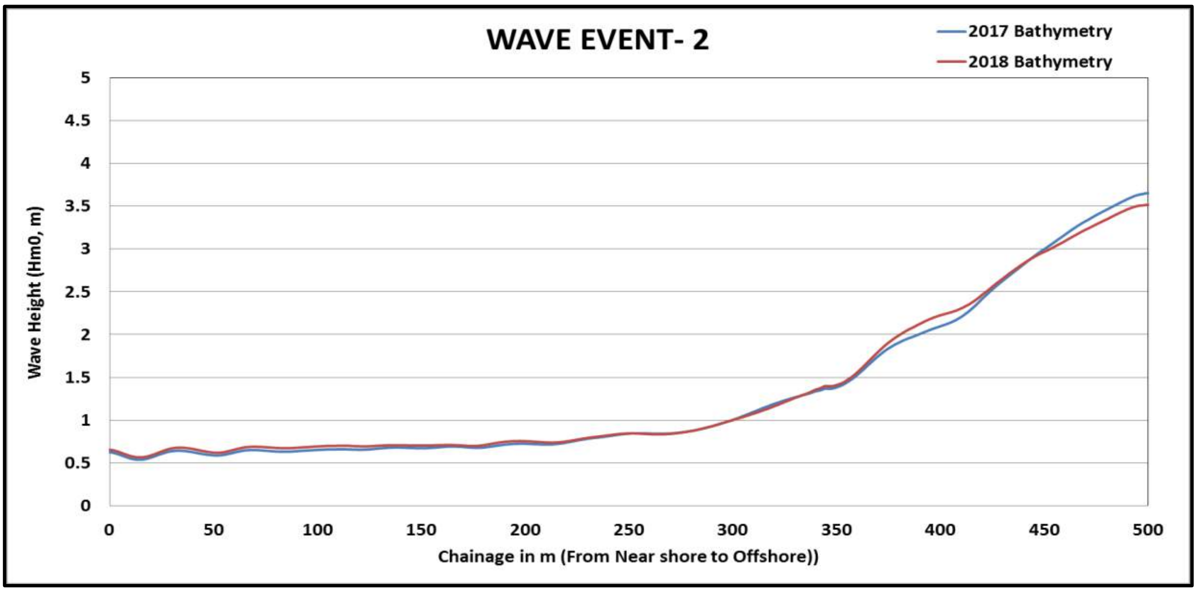


Figure 3-39 Variation of wave height from inner harbour to entrance (Hm0, m) for Wave Event - 2

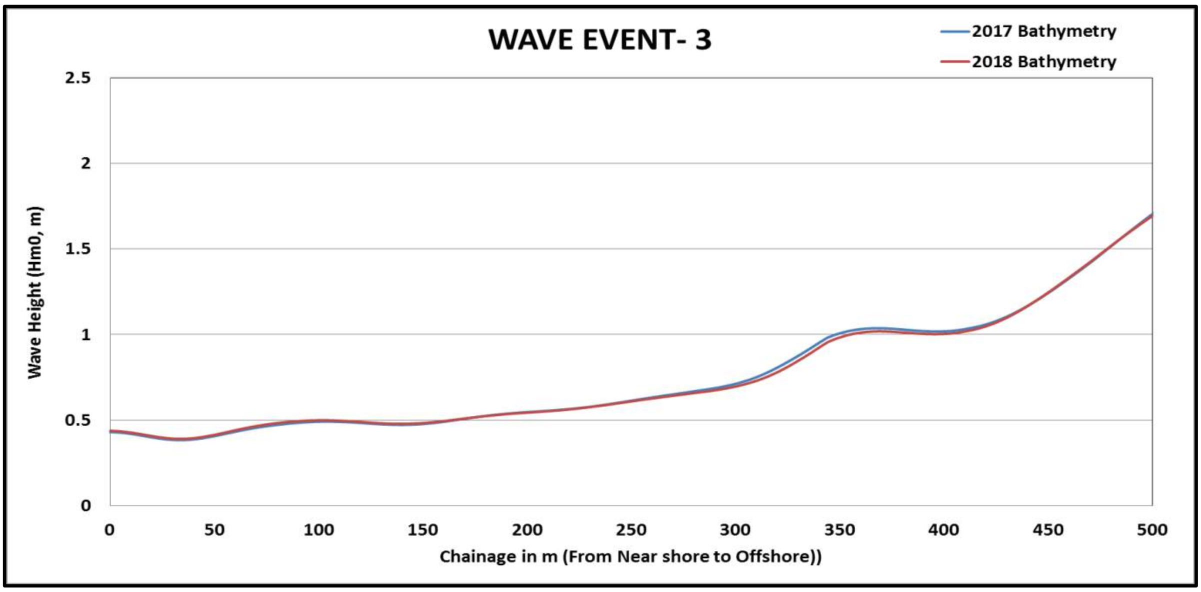


Figure 3-40 Variation of wave height from inner harbour to entrance (Hm0, m) for Wave Event - 3

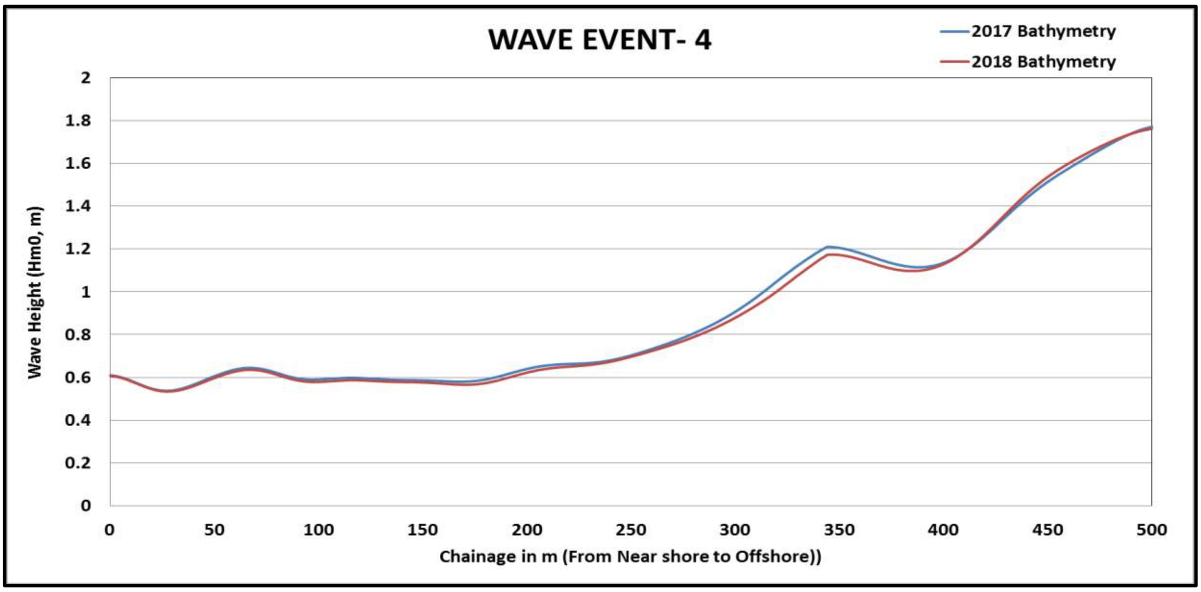


Figure 3-41 Variation of wave height from inner harbour to entrance (Hm0, m) for Wave Event - 4

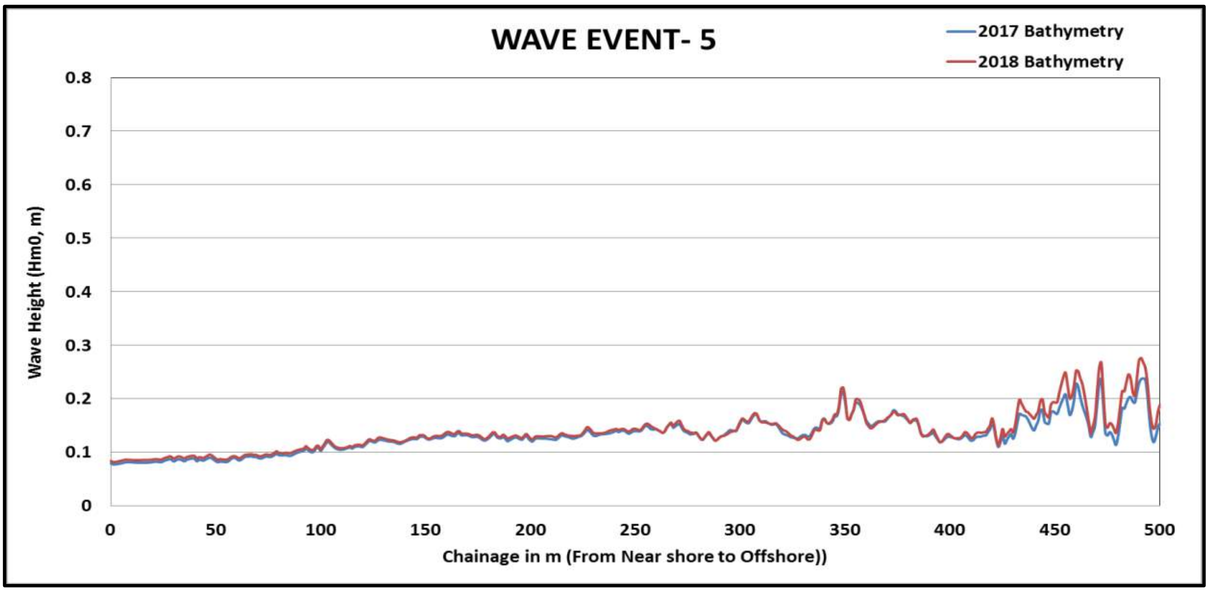


Figure 3-42 Variation of wave height from inner harbour to entrance (Hm0, m) for Wave Event - 5

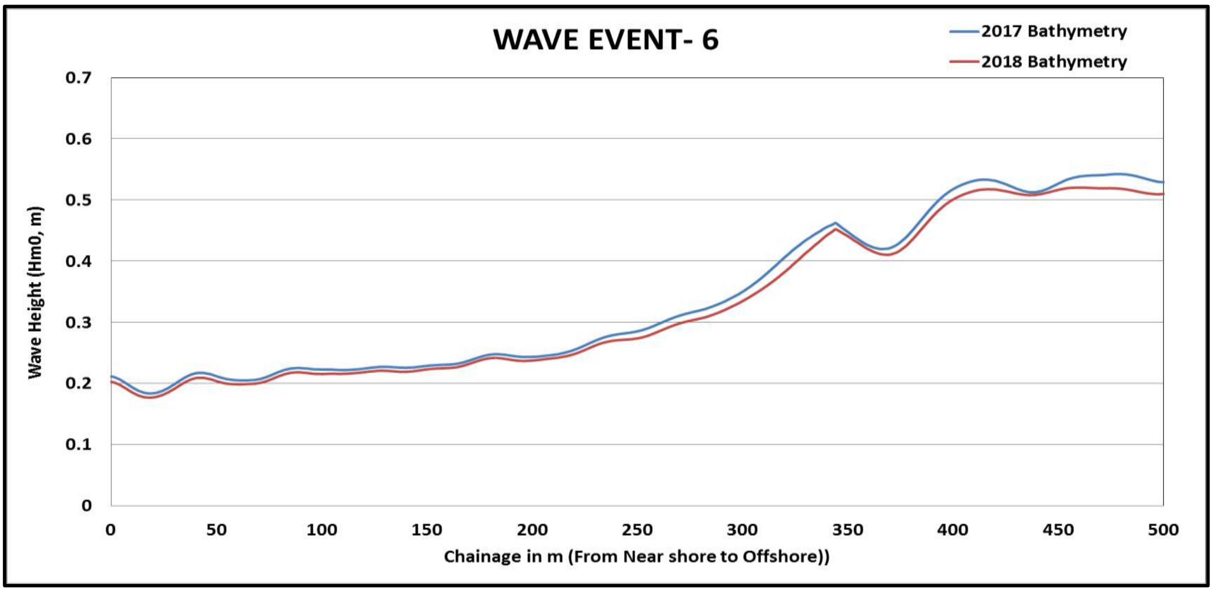


Figure 3-43 Variation of wave height from inner harbour to entrance (Hm0, m) for Wave Event – 6

From the above comparison, it may be noted that the wave height distribution along the section remains almost the same for both years. This shows that the conditions have not changed much between 2017-18 and 2018-19.

3.4 Long shore sediment transport

Long shore sediment transport refers to the cumulative movement of beach and near shore material parallel to the shore by the combined action of tides, wind, waves and the shore-parallel currents produced by them. These forces usually result in an almost continuous movement of material either in suspension or in bed load. The movement of water over the sea bed exerts a tractive force upon the surface particles on the bottom. When the force exerted exceeds the resistance of the particle to movement, transport takes place. The characteristics of transport are dependent principally upon the velocity and direction of water movement, sediment characteristics and upon the slope of the sea bed.

In earlier section, the offshore movement of the sediments were studied in the analysis of the cross shore profiles. The seasonal and annual movement of the shoreline was assessed and the various causes attributing to this movement were noted. However, along with the cross shore sediment transport, it is necessary to study the movement of the shoreline along the coast as well. A study on the same is covered in this section.

The study area extends from Edappadu Beach (CS 01) in the South to Thumba (CS 81) in the North over a stretch of approximately 40km as shown in Figure 3-44. This coast can be distinguished into two subsets depending on the coastal orientation. The shore angle on south side is in the range of 125^0 to 130^0 (True North) and shore angle on north side is in the range of 135^0 to 145^0 (True North). These orientations were shown with green and maroon lines in Figure 3-45. This change in orientation will have effect on long shore sediment transport and its behaviour.

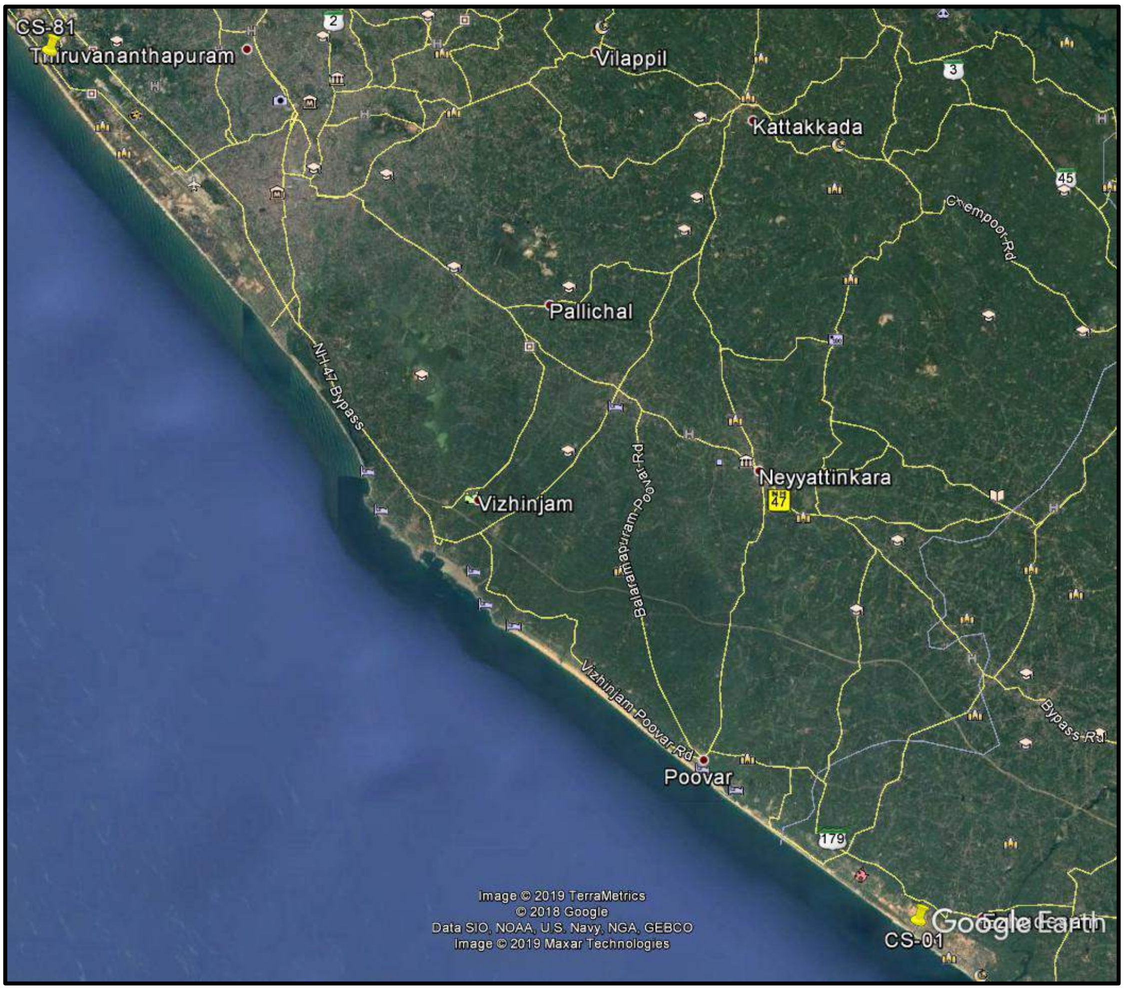
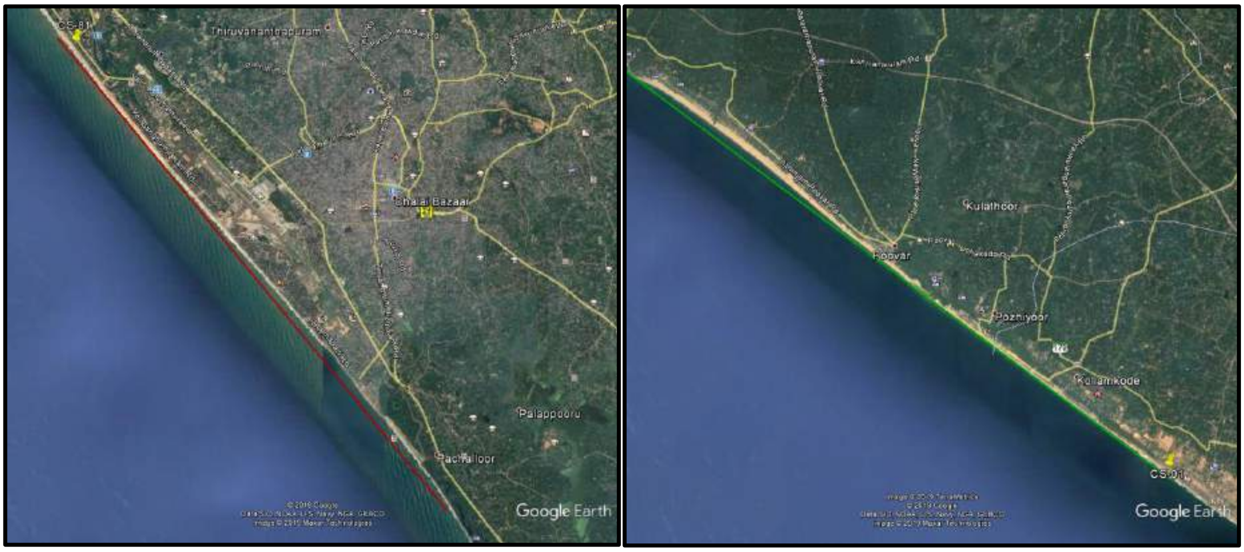


Figure 3-44 Study area



North orientation **South orientation**

Figure 3-45 Coast orientations

3.4.1 Long shore sediment transport due to breaking waves

In order to compute long shore transport rate, breaking parameters need to be estimated first. The breaking parameters such as breaking wave height, breaking depth and breaking angle (shore normal) were calculated using depth limited criterion. This expression includes the influence of beach slope m.

$$\frac{H_{sb}}{d_b} = 0.56\, e^{3.5m}$$

The wave parameters were collected from WRB deployed at 23.2 m water depth and the breaking characteristics of waves were determined by combining wave refraction and shoaling calculations with the above wave breaking criteria.

The dynamic equation of the long shore transport rate (LSTR), Q is

$$Q = (H^2C_g)_b[a_1 sin2\Theta_{bs} - a_2 cos\Theta_{bs}\frac{\partial H}{\partial x}]_b$$

$$a_1 = \frac{K_1}{16(s-1)(1-p)(1.416)^{5/2}}$$

$$a_2 = \frac{K_2}{8(s-1)(1-p)tan\beta(1.416)^{7/2}}$$

Where H is the breaking wave height, C_g is the breaking wave group velocity, x is the long shore direction, and θ_{bs} is the angle of breaking waves referenced to the shore perpendicular direction, a_1 and a_2 are the non-dimensional parameters, p is porosity of the sand on the bed, s is ratio of density of sand to density of water and *tan* β is the average near shore bottom slope. The first term considers sediment transport generated by the long shore component of the breaking wave energy flux (similar to CERC formula). The second term modifies the transport rate to account for long shore gradients in breaking wave height $\frac{\partial H}{\partial x}$. K_1 and K_2 are the two dimensionless calibration parameters for controlling the long shore sediment transport and offshore wave breaking.

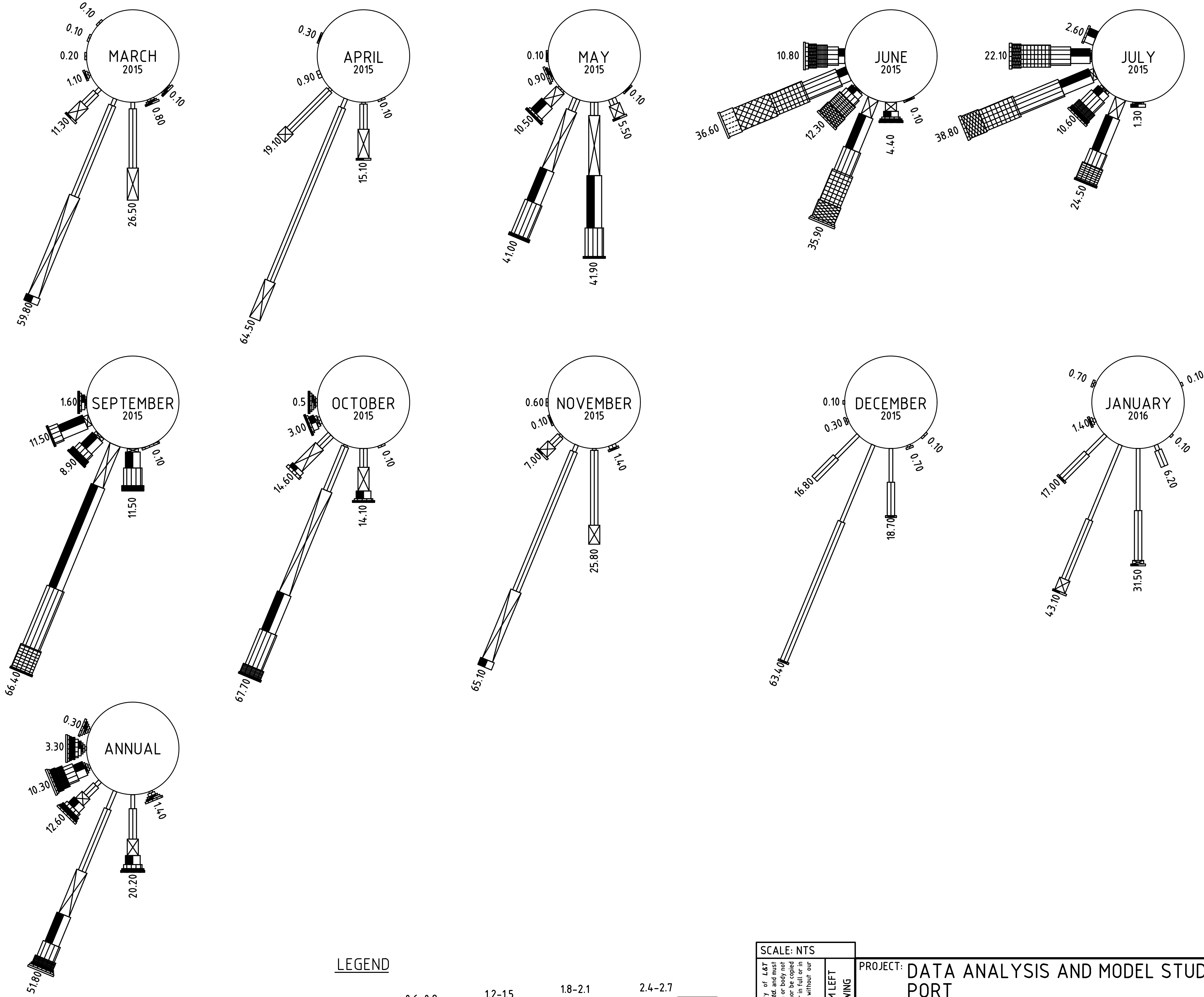
Following standard convention of long shore transport directed to the right of an observer on the beach facing the sea is positive (Northward transport in this study), and transport toward the left is negative. The long shore transport rates were calculated using dynamic equation at each section and net transport rate was estimated over a year. In LSTR computation, the effect of groins and seawalls was not considered.

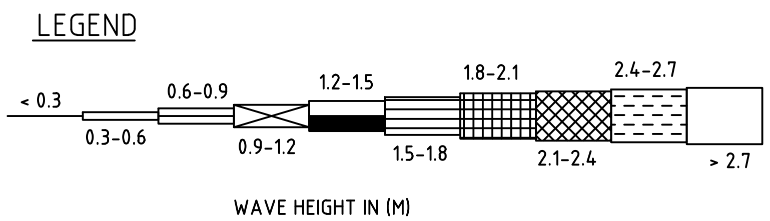
The cross shore profiles, compared over the same temporal scale, at a section will represent the cumulative effect of long shore and cross shore transport took place in a year. The common profiles were established within common start and end coordinates at each section. The cross sectional area between these common profiles was calculated and the net quantity was found by multiplying these cross sectional areas with long shore distance between adjacent sections (in this case 500m). However, data gap in surf zone of cross shore profiles may have slight deviations in the estimation of net quantity. This net quantity is resultant of long shore transport alone as cumulative effect of onshore to offshore transport or vice versa will be cancelled out by using trapezoidal formula. The observed cross shore profile of February months were chosen to estimate the net quantity of long shore transport took place in a year.

The difference in net long shore transport estimate between two adjacent sections was compared with net quantity obtained from cross shore profiles.

As explained earlier, depending on the coast orientation two average LSTR estimates were calculated based on available 4 years data (Feb 2015 – Feb 2019). The northerly and southerly (annual average) long shore sediment movement in south stretch is in the range of 0.16 to 0.18 M m^3/yr (Northwards) and -0.15 to -0.16 M m^3/yr (Southwards). In north stretch, the range is 0.24 to 0.26 M m^3/yr (Northwards) and -0.11 to -0.12 M m^3/yr (Southwards).The net annual average long shore sediment movement in south stretch is in the range of 0.01 to 0.02 M m^3/yr (Northwards) and in north stretch in the range of 0.13 to 0.14 M m^3/yr (Northwards).

Annexure – 1





SCALE: NTS

PATH: REFER BOTTOM LEFT CORNER OF THE DRAWING

PROJECT: DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT

TITLE: OBSERVED WAVE ROSE DIAGRAM (MAR 2015–FEB 2016)

L&T Infra Engineering

L&T Infrastructure Engineering Ltd.

REPORT NO: RP004	
PROJECT NO: C1181504	
DATE: 26/11/19	
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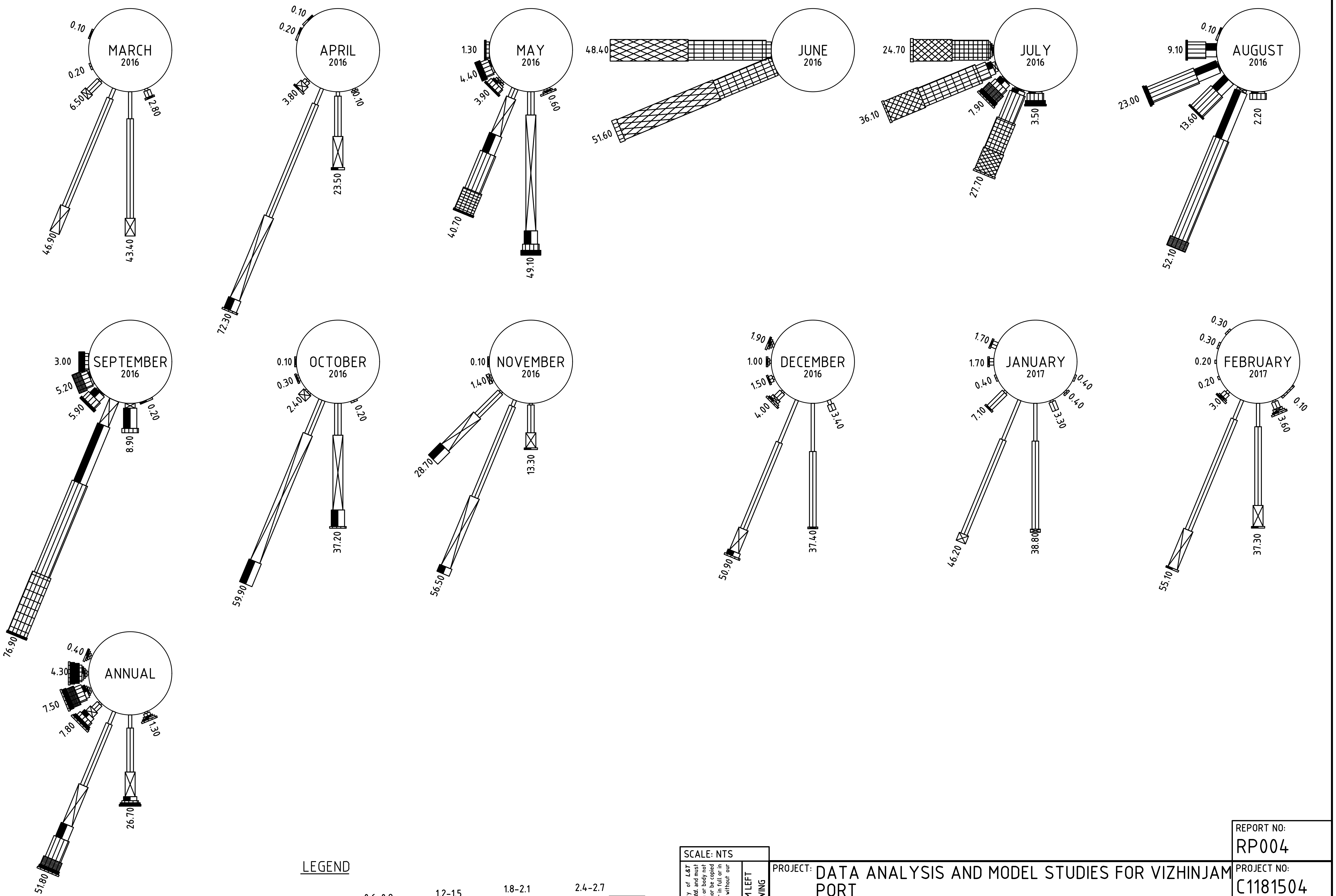
TBA



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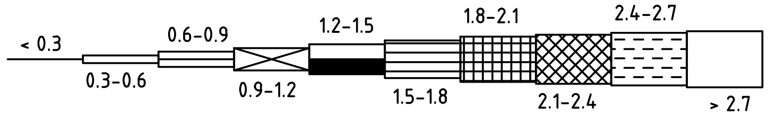

WAVE HEIGHT IN (M)

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PROJECT:	DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT
TITLE:	OBSERVED WAVE ROSE DIAGRAM (MAR 2016–FEB 2017)
REPORT NO:	RP004
PROJECT NO:	C1181504
DATE:	26/11/19
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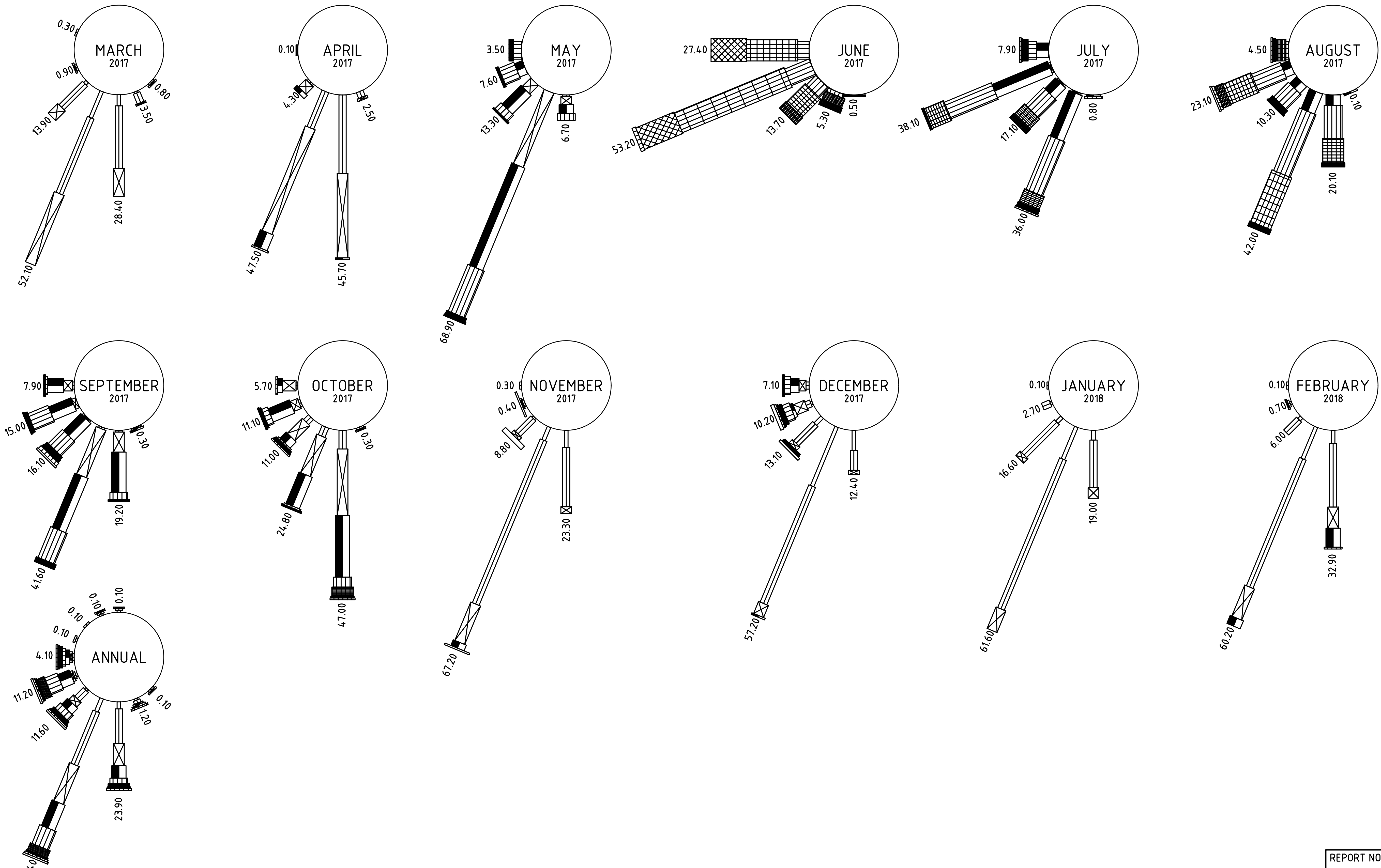

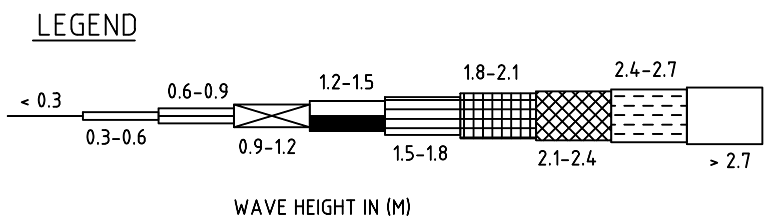

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TITLE:	OBSERVED WAVE ROSE DIAGRAM (MAR 2017-FEB 2018)
REPORT NO:	RP004
PROJECT NO:	C1181504
DATE:	26/11/19
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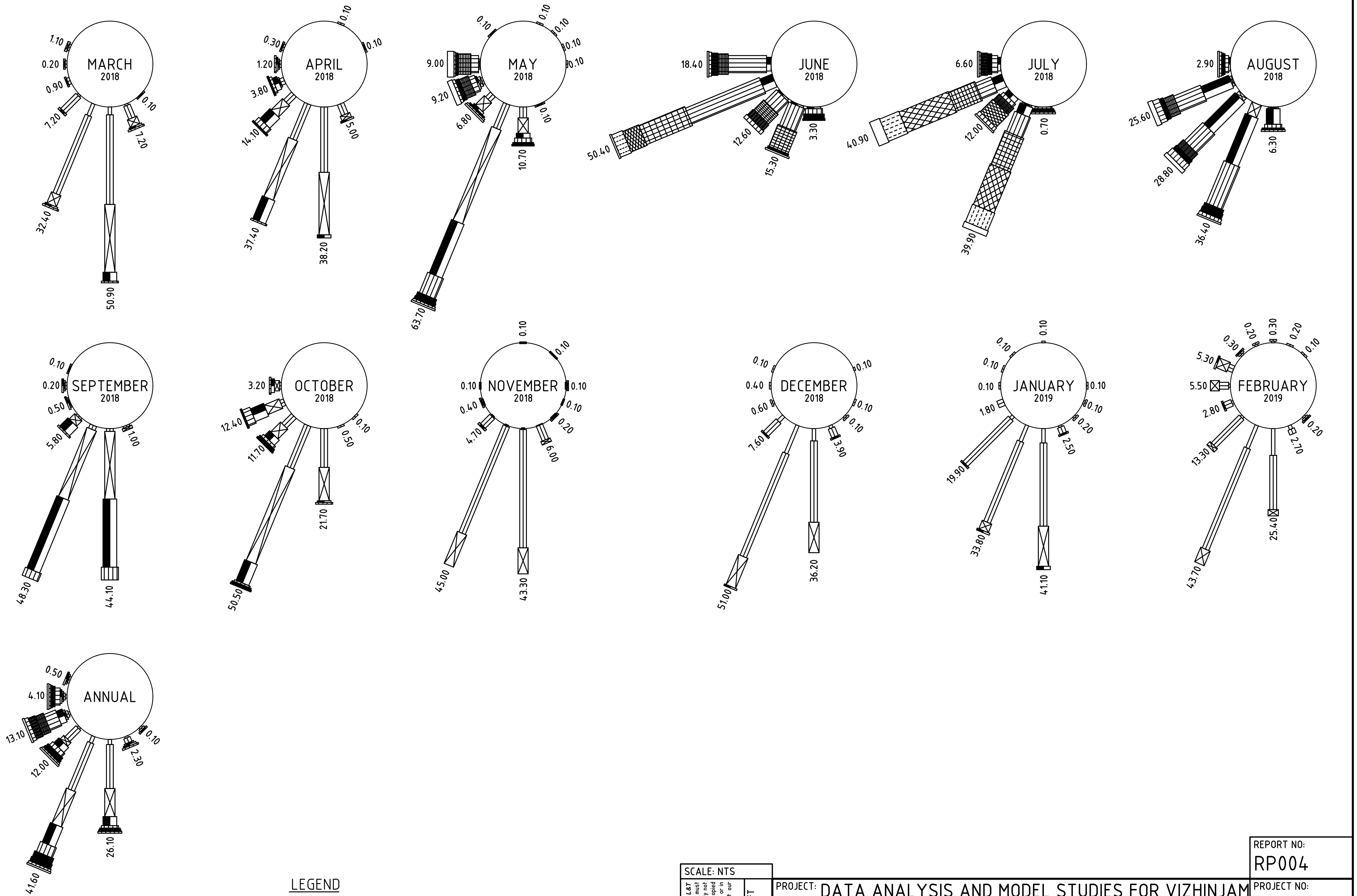

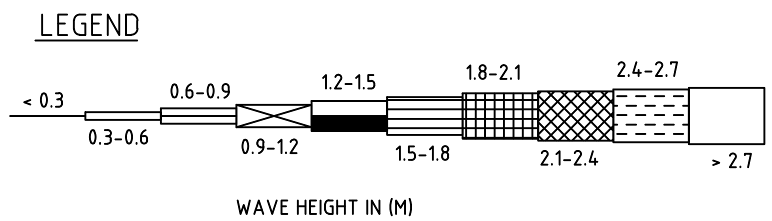

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PATH: REFER BOTTOM LEFT CORNER OF THE DRAWING

PROJECT: DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT

TITLE: OBSERVED WAVE ROSE DIAGRAM (MAR 2018-FEB 2019)

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REPORT NO: RP004

PROJECT NO: C1181504

DATE: 26/11/19

MADE: VVY

FIGURE NO: FD0204

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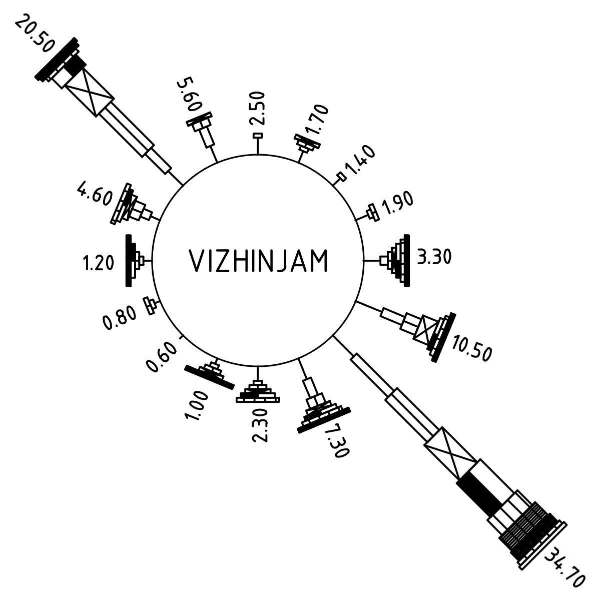
TBA

Annexure – 2



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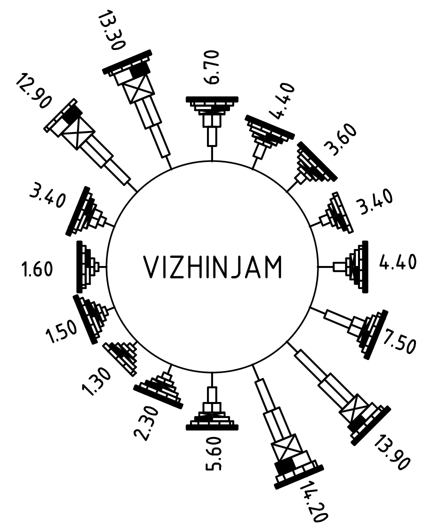
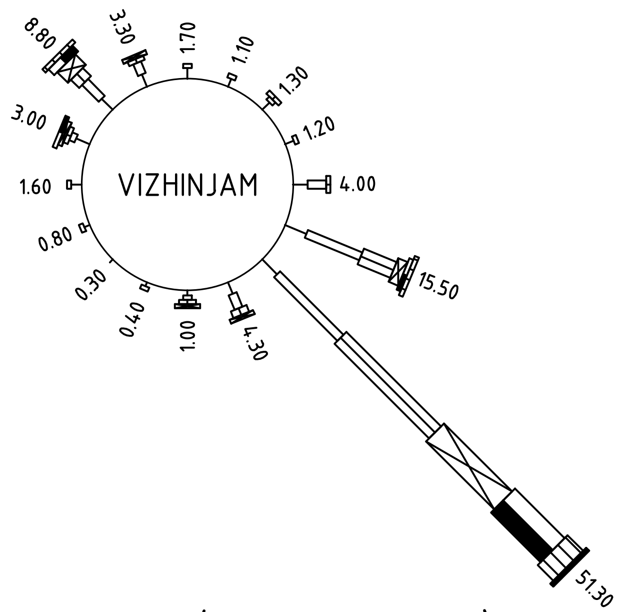


MONSOON (AUGUST-2018)



POST-MONSOON (JANUARY-2019)

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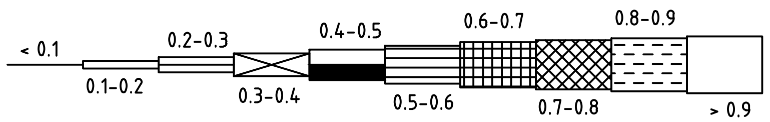

CURRENT SPEED - (M/S)

SCALE: NTS

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PATH: REFER BOTTOM LEFT CORNER OF THE DRAWING

PROJECT: DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT

TITLE: OBSERVED CURRENT ROSE DIAGRAM AT VIZHINJAM (MAR 2018-FEB 2019)

L&T Infra Engineering

L&T Infrastructure Engineering Ltd.

REPORT NO: RP004

PROJECT NO: C1181504

DATE: 26/11/19

MADE: VVY

FIGURE NO: FD0205

REV: 0

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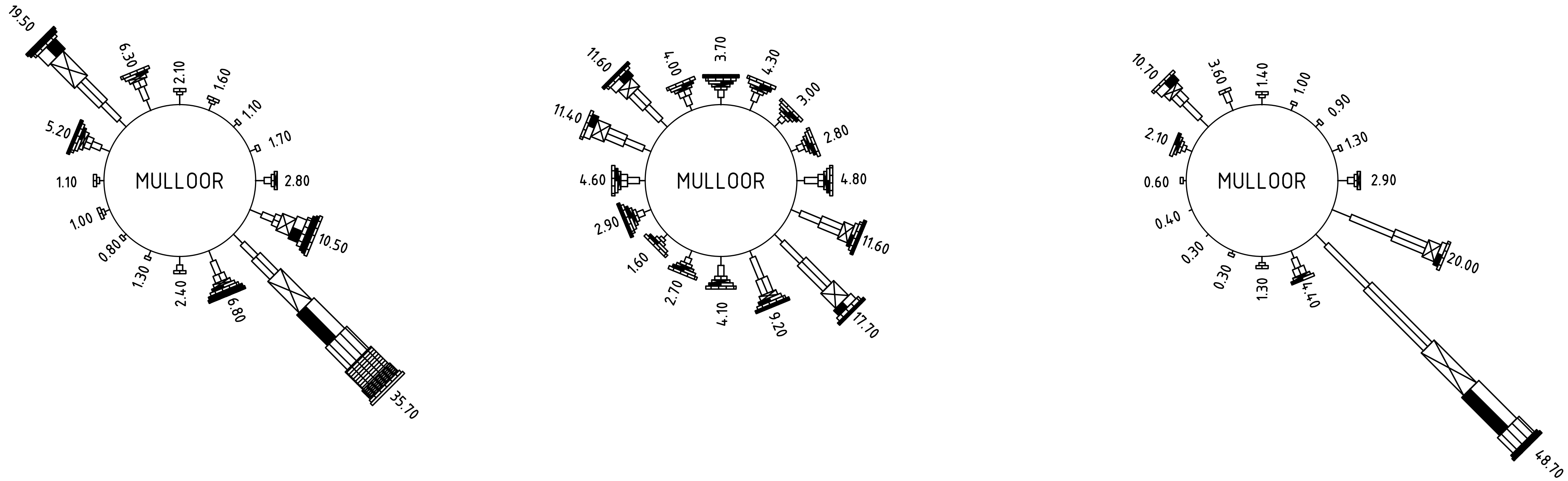
TBA

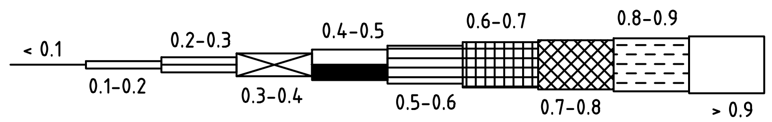


PRE-MONSOON (MAY-2018)

MONSOON (AUGUST-2018)

POST-MONSOON (JANUARY-2019)

LEGEND



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PROJECT:	DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT
TITLE:	OBSERVED CURRENT ROSE DIAGRAM AT MULLOOR (MAR 2018-FEB 2019)
L&T Infra Engineering	L&T Infrastructure Engineering Ltd.

REPORT NO: RP004

PROJECT NO: C1181504

DATE: 26/11/19

MADE: VVY

FIGURE NO: FD0206 REV: 0

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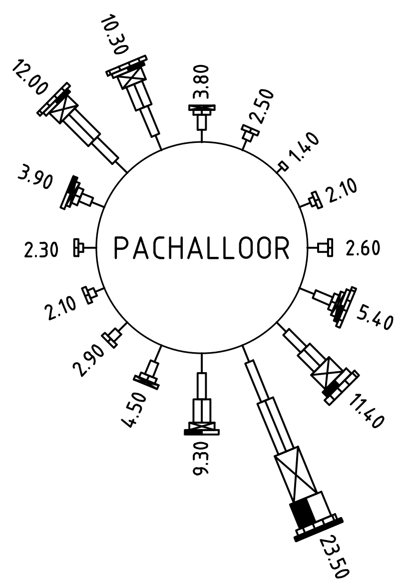
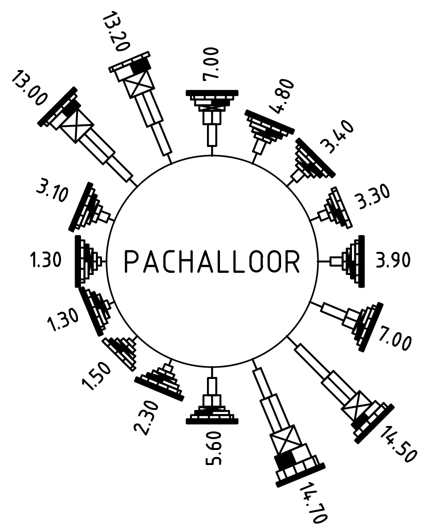
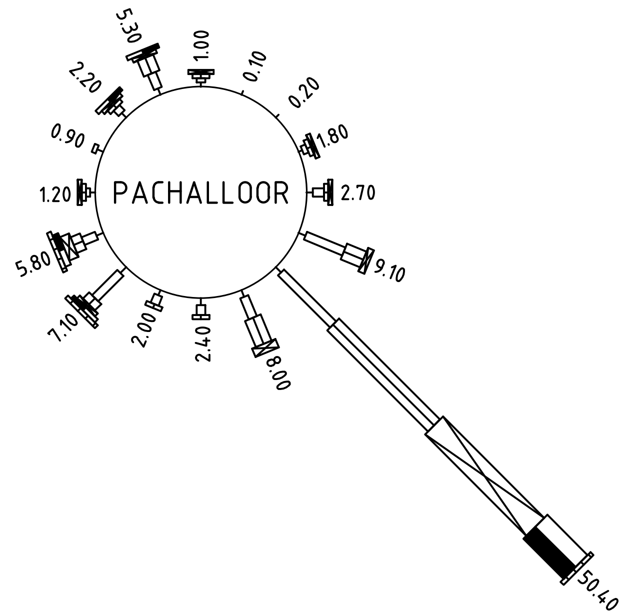
TBA



PRE-MONSOON (MAY-2018)



MONSOON (AUGUST-2018)



POST-MONSOON (JANUARY-2019)

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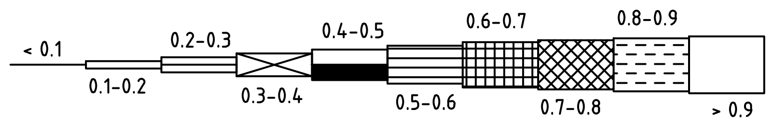

CURRENT SPEED - (M/S)

SCALE: NTS

PATH: REFER BOTTOM LEFT CORNER OF THE DRAWING

PROJECT: DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT

TITLE: OBSERVED CURRENT ROSE DIAGRAM AT PACHALLOOR (MAR 2018-FEB 2019)

L&T Infra Engineering

L&T Infrastructure Engineering Ltd.

REPORT NO: RP004

PROJECT NO: C1181504

DATE: 26/11/19

MADE: VVY

FIGURE NO: FD0207

REV: 0

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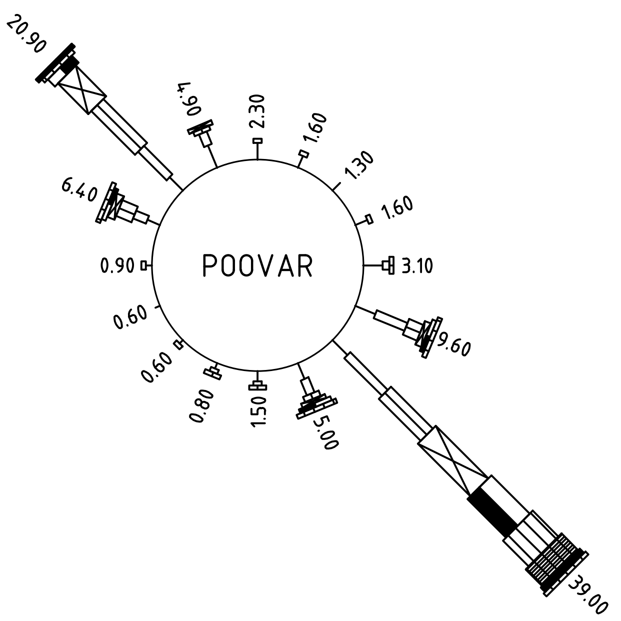
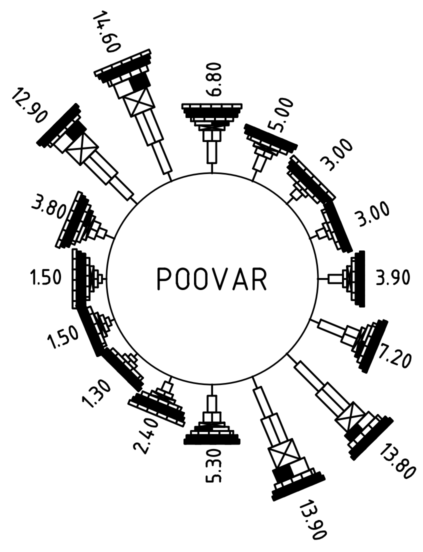
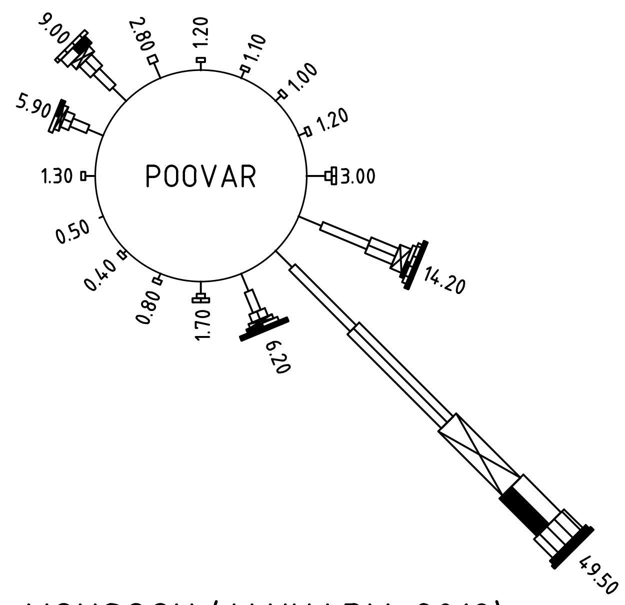
TBA



PRE-MONSOON (MAY-2018)



MONSOON (AUGUST-2018)



POST-MONSOON (JANUARY-2019)

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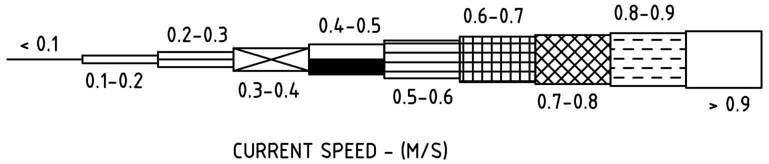

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PROJECT:	DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT
TITLE:	OBSERVED CURRENT ROSE DIAGRAM AT POOVAR (MAR 2018-FEB 2019)

L&T Infra Engineering

L&T Infrastructure Engineering Ltd.

REPORT NO: RP004	
PROJECT NO: C1181504	
DATE: 26/11/19	
MADE: VVY	
FIGURE NO: FD0208	REV: 0

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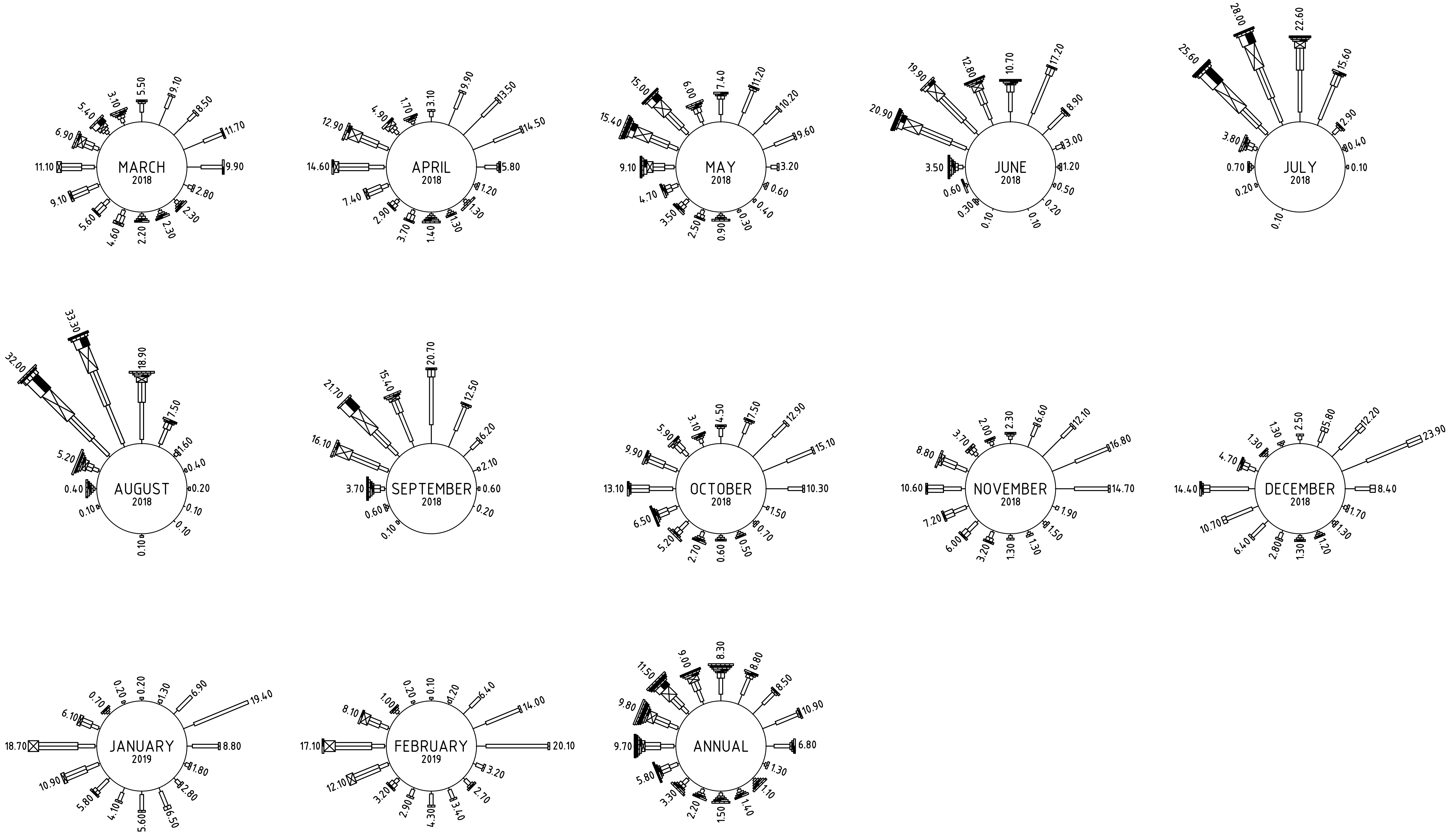
TBA

Annexure – 3



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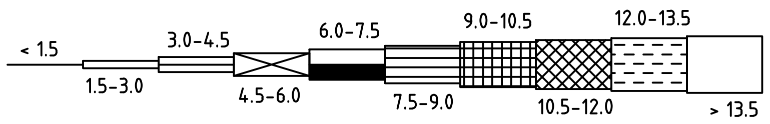

WIND SPEED - (M/S)

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PROJECT:	DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT
TITLE:	OBSERVED WIND ROSE DIAGRAM (MAR 2018-FEB 2019)
REPORT NO:	RP004
PROJECT NO:	C1181504
DATE:	26/11/19
MADE:	VVY
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REV:	0

L&T Infra Engineering

L&T Infrastructure Engineering Ltd.

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TBA

Annexure III

CSR Activities by AVPPL

(April 2019 to September 2019)

Annexure III

The CSR intervention during the reporting period (April 2019 to September 2019) focused on community development intervention in the following major heads.

1. Education
2. Community Health
3. Sustainable Livelihood Development
4. Community Infrastructure Development &
5. Others

1. EDUCATION

The intervention in education promotion focused on improvidng the quality of education and providing better facilities for children. Following major activites are carried out under Education during the period.

1.1. Distribution of School Kit under EVP

The employees of AVPPL, AF, HOWE, Security, Environment and drudging unit together supported providing School Kit to 104 students from the weaker sections of Vizhinjam under Employee Volunteering Programme on 1st of June 2019. The event was conducted with the support and voluntary spirit extended by the employees for the cause of poor children of Vizhinjam who are eagerly waiting for education kit when they go to the school in the new academic year.

Vizhinjam is an upcoming Port, where the number of employees is limited and hence it was planned initially to support 50 children under EVP. However, officers and the staff members have voluntarily agreed to support more than one child and thus the support has been extended to 104 children.

The school kit consist of the following items worth Rs.2000/- per kit

i. Premium quality school bag
ii. Ten Notebooks
iii. One steel lunch box
iv. One steel water bottle
v. One three-fold umbrella
vi. One Towel
vii. One instrument box &
viii. Set of Pencil & Pen

The distribution of school kit was formally inaugurated by Mr. Sushil Nair, Head Corporate Affairs on 01.06.2019 at CSR office Mukkola. Dr. Anil Balakrishnan-unit CSR head, Mr. Manoranjan Tripathy-Technical Head, Mr. Sabu Mathew-Security Head, Mr. Nilanjan Bhattacharya-Head Finance, Mr. Roy Kannanthanam, Mr. Biju Thomas Mathew, Mr. Rahul, Mr. Sreenath, Mr. Gopinathan Nair, Mr. Sanjay, Mr. Amrendra Sinha, Mr. Shaji Joseph, Mr. Jayesh, Mr. Phalgunan, Mr. Vineeth, and all CSR team members were present in the function.

The selection of the students was purely based on socio- economic condition and poverty index through the community health volunteers – Sanginies, ward counsellors, school authorities and CSR team members. The students and their parents expressed their grateful to the employees and Adani Group for making such an effort to reach to the needy children.

List of staff and the number of students @ Rs.2000/- per student supported

List of the selected students with the reference are as follows

Sl No	Name	Standard	Ward	Ref
1	Nandhana. T S	Plus One	Venganoor	Anitha. S K
2	Elkana	5 std	Venganoor	Anitha. S K
3	Hanani	3rd std	Venganoor	Anitha. S K
4	Bijo	2 nd std	Venganoor	Anitha. S K
5	Anandhu	6 std	Venganoor	Anitha. S K
6	Shahana	7th std	Harbour	Chandri. D
7	Neethu	Plus One	Harbour	Chandri. D
8	Shiva	2nd std	Harbour	Chandri. D
9	Sanooja	Plus One	Harbour	Chandri. D
10	Gifty Ashok	10th std	Harbour	Chandri. D
11	Dershana	6th std	Mulloor	Kavitha. A. S
12	Samvredha	10 th std	Mulloor	Kavitha. A. S
13	Shilpa	10 th std	Mulloor	Kavitha. A. S
14	Goweri	Plus One	Mulloor	Kavitha. A. S
15	Keerthi	2nd std	Mulloor	Kavitha. A. S
16	Abhirami	1st std	Vizhinjam	Sindhu. V

Sl No	Name	Standard	Ward	Ref
17	Adhithya	6th std	Vizhinjam	Sindhu. V
18	Rahual	10th std	Vizhinjam	Sindhu. V
19	Muhammad Asif	1st std	Vizhinjam	Sindhu. V
20	Devadhathan	10th std	Vizhinjam	Sindhu. V
21	Shamna	6th std	Harbour	Jasmine Rose
22	Ersmiya Sulthan	5th std	Harbour	Jasmine Rose
23	Sajeera	5th std	Harbour	Jasmine Rose
24	Abhirami	10th std	Harbour	Jasmine Rose
25	Subhana	5th std	Harbour	Jasmine Rose
26	Abhinav. S. Kumar	3rd std	Venganoor	George Zen
27	Anand. A	7th std	Mulloor	George Zen
28	Aparna. A	8th std	Mulloor	George Zen
29	Arathy. L R	5th std	Venganoor	George Zen
30	Anusha. A S	9th std	Venganoor	George Zen
31	Arya. B S	Plus One	Mulloor	Suja
32	Nayana	5th std	Mulloor	Suja
33	Adhithyan	3rd std	Mulloor	Suja
34	Krishna Priya	7th std	Mulloor	Suja
35	Arathy. R S	10th std	Mulloor	Suja
36	Ancy Antony	7th std	Mulloor	Raji
37	Athira	7th std	Mulloor	Raji
38	Aparna	6th std	Mulloor	Raji
39	Sree Hari	5th std	Mulloor	Raji
40	Vyshnavi	8th std	Mulloor	Raji
41	Kavya	6th std	Kottukal	Maya. G
42	Sujitha. S S	7th std	Kottukal	Maya. G
43	Abhirami B I	9th std	Kottukal	Maya. G
44	Michel.b	9th std	Kottukal	Maya. G
45	Akhil .b.s	10th std	Kottukal	Maya. G
46	Akhila	8th std	Punnamoodu	Maya. G
47	Sreesanth.S	9th std	Punnamoodu	Maya. G
48	Saniya	10th std	Punnamoodu	Maya. G
49	Amritha.S	8th std	Punnamoodu	Maya. G
50	Dhanush.U	8th std	Punnamoodu	Maya. G
51	Liju	7th std	Kottappuram	Maya. G
52	Obrin	7th std	Kottappuram	Maya. G
53	Fereena	8th std	Kottappuram	Maya. G
54	Pavin	8th std	Kottappuram	Maya. G
55	Sudhi	5th std	Venganoor	Maya. G
56	Tony	7th std	Venganoor	Maya. G
57	Sanju	6th std	Vizhinjam	Maya. G
58	Aleena	2nd std	Venganoor	Maya. G
59	Nyjil. V. N	6th std	Venganoor	Maya. G

Sl No	Name	Standard	Ward	Ref
60	Albin. J	2nd std	Mulloor	Maya. G
61	Vishnu. B. S	3rd std	Mulloor	Maya. G
62	Christ Claiviert	4th std	Chowara	Maya. G
63	Sangeetha. S	5th std	Kottukal	Maya. G
64	Nancy. S	5th std	Mulloor	Maya. G
65	Nandhana. T	6th std	Mulloor	Maya. G
66	Akhila. S	5th std	Mulloor	Omana
67	Bijoy. B. S	Plus One	Mulloor	Omana
68	Sharan. R	2nd std	Mulloor	Omana
69	Abhijith.S S	10 th std	Vizhinjam	Santhosh
70	Soorya Narayanan	9th std	Venganoor	Santhosh
71	Kanchana.M.S	6th std	Venganoor	Santhosh
72	Nishadh	5th std	Vizhinjam	Beevi
73	Usman	9th std	Vizhinjam	Beevi
74	Ramseena	3rd std	Vizhinjam	Beevi
75	Nandhana	10th std	Vizhinjam	Rasheed
76	Farsana	6th std	Vizhinjam	Rasheed
77	Aparna RG	Plus Two	Vizhinjam	Rasheed
78	Asna	Plus One	Vizhinjam	Rasheed
79	Aliya. S.S	6th std	Vizhinjam	Rasheed
80	Ananya. N	U K G	Kottappuram	Limna
81	Jithu	8th std	Venganoor	Suraja
82	Karthik	5th std	Venganoor	Suraja
83	Sreehari	4th std	Vizhinjam	Rasheed
84	Lidhina	9th std	Kottappuram	Shyni
85	Noumya	10th std	Kottappuram	Shyni
86	Nithin	9th std	Kottappuram	Shyni
87	Herickson	10th std	Kottappuram	George Zen
88	Joyal	2nd std	Kottappuram	George Zen
89	Kailas	1st std	Kottappuram	George Zen
90	Alan	5th std	Mulloor	George Zen
91	Sanoj	5th std	Kottappuram	George Zen
92	Jefrin John	10thstd	Venganoor	George Zen
93	Jeeva Kennady	8th std	Kottappuram	George Zen
94	Vinil	3rd std	Venganoor	George Zen
95	Abhijith A	4th std	Venganoor	George Zen
96	Vaiga Santhosh	Plus one	Venganoor	George Zen
97	Mohammed Yaseen M.	4th std	Vizhnjam	Rasheed
98	Sahad SR	Plus one	Vizhinjam	Rasheed
99	Shyma SL	10th std	Vizhinjam	Rasheed
100	Suji PM	8th std	Vizhinjam	Rasheed

Photos of Kids with Bag

1.2 **Monthly Open House**

Monthly Open House conducted for scholarship students to ensure better advancement in the academic performance and career selection. The sessions are conducted on every second Saturday from 2 p.m to 5 p.m.

Career Assessment Test on 13.04.2019: A parental awareness session based on the analysis report of **Career Assessment Test (CAT)** was held at CSR Training Centre, Mukkola on 13th April 2019. This was provided to the parents of 50 meritorious scholarship students under the CSR of AVPPL-AF. The main objective of the programme was to create awareness among the parents on the strenth and weakness of their children and to guide their career according the aptitiude of the child. This awareness session was handled by Mr. Praveen Parameswaran, Chief Executive Officer, "**Lifology.com**", Trivandrum. Followed by it, a seminar on "Career Possibilities" was taken for the student by the Resource Person explaining the new trends in various career scenarios. Then a General Knowledge Test was conducted for the students.

The test conducted to identify the general knowledge base of students attended by 42 students.

Score sheet of the students based on GK Test

SL.NO	NAME	SCORE
1	NIKHIL MOHAN M P	40
2	ABHISHEK S. S.	36
3	SANIKA	36
4	VISWAJITH G S	36
5	MOHAMMED HUVAIS	34
6	MEGHA M S	32
7	RESHMA B R	32
8	ABHIJITH S S	31
9	JIFFIN B J	31
10	SANA SATHEESH	29
11	ANJU M J	28
12	ILMUNISA S N	28
13	ADARSH M S	27
14	ARJUNA SARMA R	27
15	ANJANA S A	26
16	EMILIN S	25
17	SREEKUTTAN S	25
18	ANAND M A	24
19	NANDHA B S	24
20	SINDHU S	24
21	SAJITHA R	23
22	SALU S	23
23	SHAJINA J	23
24	ASWATHY A	22
25	JIBIN D BAIJU	22
26	SHANANYA D	22
27	SHIBIN S	22
28	LINIMOL L J	21
29	NAFILA S	21
30	GOURI A S	20
31	JOSHILA J	20
32	BIBIN C	19
33	SOORYA S S	19
34	ARATHY A S	18
35	ASWATHY B S	17
36	GIREESH RAJ	17
37	MIDHUN M	17
38	ABHILASH R	16
39	BIJITHA B S	16
40	GAYATHRI S	16
41	BHAGAVATHY V N	15
42	MIJU MATHIAS	15


Session on study skills and memory

As the schools reopens for new academic year in the month of June, a session organised on 'Study Skills and Memory technique" to motivate the selected scholarship students at CSR Training Centre, Mukkola on 11th May 2019. 41 students participated in the session. The session started with a memory test of 15 English words, and introduced a mnemonics for memory and study that is "FROLL"

F	-	First
R	-	Repeat
O	-	Outstanding
L	-	Link and
L	-	Last

Then discussed on how to study? Why to study? When to study? and Where to study? A study method was also explained in details that is P-U method

P – Preview; Q – Questions; R – Read; S – Summarise;

T – Test yourself and U – Use . The follow-up on how students are using it in the current academic year will be evaluated on a periodic basis.


Topic for monthly Open House		
Month and Date	**Topic for the day**	**Output**
April 13-04-2019	• Parental Orientation based on Career aptitude test of students. • The objective was to create awareness among the parents on the strength and weakness of their children and to guide their career according to their aptitiude.	• Parents got clarity on the skill set of their kids. • Supported to guide their kids in building the career. • Parents also got orientation of different courses suiting to the profile of kids. • Partent of 50 meritorious scholarship students participated.
May 11-05-2019	• Study Skills and Memory technique". • The session covered memory technique "FROLL" F -First, R-Repeat, O-Outstanding, L -Link and L – Last.	• 41 students participated in the session. • Students reflected tha the session gave them confidence and skill to improve their academic excellence.
June 08-06-2019	i. Various branches in Engineering courses and its career prospectus. ii. Option taking and allotment procedures of Engineering Agriculture Medical degree examination - KEAM 2019.	• Students got clarity on the details of 1671 various courses in 233 engineering institutions in Kerala. • The students appreciated the efforts and the topics covered were much relevant to build their career dreams.
July 13-07-2019	1. Team work 2. Use of digital platforms	• 30 students participated. • The session covered Open & honest communication, risk taking and change, mutually accountable & accept the responsibility. • Communicate freely and promoted Collaboration and Team trust

August 10-08-2019	• Public Speaking • Importance of Voice, Words, Gestures and Response	• 32 childrens participated. • Students prepared for Public Speaking and gained confidence to respond with audience according to their mood simultaneously.
September 14-09-2019	• Adolescent-problems and challenges. • Issues of transition between childhood and adulthood - from the ages of 11-19 and learned the adjustments required during the period.	• 22 students participated. • Exposed the deviant behaviors leads to moodiness, less affection shown to parents, involvement with cliques, improper sexual behaviours, experimentation on use of cigarettes / alcohol / drugs...etc • Understood the situation leads to delinquencies such as "stealing, destructive behavior, persistent negative attitude, frequent temper outbursts, regular use of alcohol and/or other drugs, suicidal ideas...etc.

1.3 Monthly meet - Poets and men of literature (08.06.2019)

Every second Saturday from 2 p.m to 5 p.m a Poets and Men of Literature meet was organised at C.V Smaraka library by CSR team.

Month – wise update of Literacy meets

Month and Date	Activities	Output
April 13-04-2019	1. Presentation and discussion on creative writing of participants 2. Presentation on following themes • Book review i. Kadalkkarayil written by OV Vijayan ii. Panchali-swayamvaram by Prabhakaran Khan • Centenary observation of Jaliayan Valabhag Massacre. 3. Presentation of current affairs for the month of April 2019. 4. Planning of summer Career training programmes.	• 6 writers and 21 students participated. • Two book-reviews held, one was a short story written by famous writer OV Vijayan – “Kadalkkarayil and the other one was a story written by Mr. Prabhakaran Khan – “Panchali swayamvaram”. • Planned for the conduct of summer career training programme for students of 9 to 12th standard and the annual day celebration of the monthly meet- poet and men of literature.
May 11-05-2019	Presentations of book reviews written by following students • Kumari Alfina on ‘SundaraKandam’ of V.P Remeshan. • Kumari Jefrin John on ‘Verittoru America’ of P. Valsala and • Kumari Jeeva Kennady on ‘Pravachakanmarude Randaam Pusthakam’ of Benyamin.	• 6 writers and 22 students participated. • Mr. Retnakaran, one of the mentors presented the theme “genesis of Malayalam language and early literary initiatives”. • Mr. Rajamoni led the session on current affairs for the month of May 2019 focused on the following areas. • International workers day • World press freedom day • Proposed launch of Chandrayaan2 in July 2019 • International firefighters day & • World laughter day
June 08-06-2019	• Presentation of Environment day theme - “Beat Air Pollution”	• 6 writers and 23 students participated. • Explained ill effects of air pollution, the current situation

	• Evaluation of the programme – Poet and men of literature. • Creative writing session on the topic "rain"	and results of poor air quality. • A pledge was taken to the cause of protection of the environment and air pollution.
July 13-07-2019	• Presentation on creative writings by students. • Presentation of the theme - "Malayalam Literature& Jnanpeeth Award (Gyanpeeth Award). • Presentation on the important days in July. • Quiz based on Gyanpeeth award. • Mr. Rajamoni presented the important national and international events during the month of July 2019. • It included National Doctor's Day, World Population day, national simplicity day, Pravasi Bharatiya Divas, Paper Bag day, World day for international Justice, Kargil Vijay Diwas, National Parent's Day and World Nature Conservation day. • The theme of the day was "Malayalam Literature and Jnanpith Award (Gyanpeeth Award)" presented by Mr. Retnakaran.	• Anjana, one of the students presented her short story "Yathrika". • The students Nandana, Alfiya, Jefrin, Vyga and Aparna presented their short stories. • Following students presented reviews. i. Kumari. Nandana (Aswametham by Vylopilli Sreedharamenon) ii. Kumari. Vyga (Poem of Ramapurath Varier) iii. Kumari. Alfia Kannada of Murugan Kattakkada iv. Master. Adhersh Pookkalam of Kumaranasan. v. Mr. Jaleel Sathyathinu Ethra Vayasayi – Vayalar vi. Dsicussed the follwoing important Jnanpith award holders 1. G. Sankara Kurup – 1965 2. S.K. Potteekkatt – 1980 3. Thakazhi Sivasankara Pillai – 1984 4. M.T. Vasudevan Nair – 1995.

	• He expressed in detail on Adhyatma Ramayanam Kilipattu, Mahabharatam Kilipattu and about the versatile malayalam poet “Kunchan Nambiar”.	
September 14-09-2019	Visited the following places in the city of Trivandrum. 1. Kerala Bio Diversity Museum. 2. Kerala Government Legislative assembly. 3. Kerala Science and technology	• 6 writers, 22 students and 3 parents participated. • Students got the opportunity to get a direct view of galleries depicting the ecosystem and biodiversity of India and sustainable utilization of biodiversity. • Team visited all the statues and collected data regarding those important personalities like Mahatma Gandhi, Jawaharlal Nehru, Dr. B.R. Ambedkar, E.M.S • Team got the exposure to the galleries on electricity, electronics, power and motion mechanics with more than 300 exhibits, galleries on Popular Science, Mathematics, Auto mobile,Bio-medical Engineering and Computer.

1.4 Career Development Programme – SPARK

The students from Vizhinjam particularly from fishing community lack the required confidence to compete with mainstream students in the competitive edge. To overcome this, a programme titled “SPARK” was introduced for class 8th to 12th class students with 100 hour module. It is comprised of softskill training focused on interpersonal skills, social skills and communication skills with practical exercises to mold character traits, attitudes, career attributes, social and emotional intelligence quotients. The programme covers Personal awareness, Communicative skills, Critical thinking, and General awareness, Interaction with the world around, Deportment, Manners and etiquette. It is a 12 day summer Career Development programme started on 24th April 2019.

1.5 Annual day celebration –Poet and Men of Literature

The annual day celebration of "literature meet" was held on 24.05.2019 at C.V. Smaraka Grandhasala, Thennoorkkonam, Vizhinjam. It was a day long programme covering various competitions, interaction with a famous young poet, honouring to top scorers in academics and valedictory function. The details of the competitions are as follows.

Sl. No	Items	Topic	Place	Name of the Winners
1	Drawing Competition	My Village	1st	Abhilash. R
			2nd	Midhushna Mathias
2	Essay Writing	Importance and limitations of Mother tongue	1st	Jefrin John
			2nd	Sajana
3	Short Story	Flood	1st	Anjana T.S
			2nd	Arif Muhammad
4	Literature Quiz		1st	Anjana T.S
			2nd	Alfiya. R
5	Recitation		1st	Anjana T.S
			2nd	Jeeva Kennady
6	Travelogue	Vizhinjam Port Visit	1st	Jefrin John
			2nd	Jeeva Kennady
7	Consolation Prize	For all items	1.	Arathy
			2.	Obri mole
			3.	Abhinav. S. Kumar
			4.	Ashersh S. Kumar

The importance of Malayalam poetry was discussed by the students during the interaction with the well-known young poet Mr. N.S. Sumesh Krishna, moderated by Mr. L.G. Reaches Fernandaz. The valedictory function of the annual day celebration was inaugurated by Mr. Sushil Nair, Head, Corporate Affairs presided over by Dr. Anil Balakrishnan, Unit Head CSR. It is planned to include the following items in the coming literature meets. Renowned poets from Vizhinjam Mr. Mukkola Retnakaran, Mr. L.G. Reaches Fernandez, V. Rajamony, Mr. Adolf Jerome, Mrs. T. Subhadhra, Mr. P.Mohan, Mr. S.K. Vijayakumar were also felicitated. Mr. Mukkola Retnakaran presented the way forward for the monthly meet – poet and men of Literature.

i. House visit and interaction with versatile poets and men of literature living in and around Thiruvananthapuram district.
ii. Visiting places of statues and prepare doc on them
iii. Reaching out the programme to more students
iv. Arrange more interaction with Poets and conduct seminars.



Currently trainings of following batches are going on.

Sl No	Venue	Number of Students
1	C V Smaraka Grandhashala	37
2	SNDP Hall Kovalam	26

3	CSR Office Mukkola	30
4	SNDP Hall Vellar	30
	Total	123

1.6 School opening celebration- Govt. UP School Mulloor

The new academic year started on 6th June 2019 in Kerala after summer holidays. Schools celebrated the day as 'Prevesanolsavam". Govt. UP School, Mulloor, Panavila also celebrated the opening day with Adani Foundation. School authorities, PTA members, SMC members, mothers PTA members, elected representatives, local leaders and parents of the students participated the event.

1.7 Inauguration of Govt. UP School, Mulloor, Panavila 03.07.2019

Inauguration for a two-story building with 10 class rooms worth 1.5 crore constructed under the Corporate Social Responsibility of Adani Vizhinjam Port Pvt Ltd - Adani Foundation for Govt. Upper Primary School, Mulloor was held on

03 July 2019. The building was formally inaugurated by Prof. C. Ravindranath, Minister for Education presided over by Shri. Ramachandran Kadannappally, Minister for Ports, Museum, Archology and Archives. Adv. M. Vincent, MLA delivered the key-note address and Adv. V.K. Prasanth, Mayor of Thiruvananthapuram Corporation was the chief guest of the programme.

Education minister said that the government aims to change "teacher-centric education process to student-centric system". He thanked Adani Foundation for donating the building. Mayor extended support for the school's furniture requirements. The other dignitaries presented are Dr. Jayakumar, CEO and Managing Director of VISL, Mr. C, Sudharsanan, Education Standing Committee chairman of Trivandrum Municipal Corporation, Mrs. Omana, Mulloor ward Counsellor, Mr. Sreekumar, SSK, Project Officer, Mr. Sushil Nair, Head Corporate relations, AVPPL, Dr. Anil Balakrishan, Head CSR, Mr. Sam, Headmaster, Mr. V. N. Aji, President, PTA, Mr. Vayalkara Sasidharan, Chairman, School Development, Mr. Ketan Dhave, Site Head, HOWE, Adv. P.S. Harikumar, Kovalam Area Secretary,CPM, Mr.K.V. Abhilash, Treasurer DCC, Mr. B Radhakrishan, Manadalam President BJP, Mr. Babu Raj, President, Kovalam Mandalam President, Congress S. Mr. Kanjiramkulam Goplakrishan, Area Secretary, CPI, Mr. Thenoorkonam Babu, Mandalam President, Janata Dal, Mr. Rajamoni, Former HM, Mr. S. Liju, Vice President PTA, Mrs. Beenamol, Chairperson, Mothers PTA, Mr. S.T. Siva Kumar, Staff Secretary and Kumari Ancy, School Leader. This is the second School building built under the CSR of AVPPL-AF, the former one was at Harbour Area LP school, Vizhinjam. That was also a 10 class room two storey building.

New buildIng constructed under CSR

Unveiling of Plaque

Feliciation by Corporate Affairs head –AVPPL, Shri.Sushil Nair

Lighting of Lamp by Education Minister Prof.Raveendra Nath

1.8 Coaching for success – Competitive Exam preparation Programme

Adani Foundation started a programme for the unemployed youth to prepare for Competitive Exams 'Coaching for Success' on 18th September 2019. Presently two batches with 80 students are going on. The programme aimed to train 200 youth during the year with general sessions on English Grammar, Mathematics, General Science and General Knowledge. The programme is is conducted regularly with four days contact clasees in a week for a period of six months initially. Every day there is two hour class room session and one hour preparatory exam tests. The programme is organised in association with Residence Associations and local Libraries.

2. COMMUNITY HEALTH

During the reporting half year, following important activities are carried out under Community Health

- i. Mobile Health Care Unit (MHCU) & Medical Camps
- ii. Suposhan
- iii. Swachhagraha

2.1 MOBILE HEALTH CARE UNIT (SDG No.3: Good Health and Well Being)

Adani Foundation is running a Mobile Healthcare Unit (MHU) in the neighbouring communities of Vizhinjam since June 2017. Helpage India is the partner for executing the project. The unit consists of an allopathic doctor, pharmacist and a social worker along with a mobile van and medicines operating 6 days a week. Every day the team visits two pre-fixed locations. There are 12 such locations where the MHU provide free medical check-up with necessary medicines. From June to September 7678 patients were treated with the support of MHU, wherein 1937 males and 5741 are females. The updates of MHU for months from April to September are as follows.

Month wise highest disease pattern

Diseases	April	May	June	July	August
Cough, cold and fever	13.36%	14.80%	18.66%	19.28%	18.50%

Diseases	April	May	June	July	August
Hypertension	9.88%	12.15%	16.93%	17.56%	16.93%
Osteoarthritis	8.74%	10.62%	7.36%	7.16%	7.32%

Regular MHU activities

Medical check –up

Health awareness session

House visit

Kamalakshi

Age: 85

Female

Place: Karayadivilla

Home visit

Name: Pathumuthu
Age: 65
Female
Place: Mulloor

Home visit

Name: Mariyapushpam
Age: 55
Female
Place: Thennoorkonnam

B P and Gluco Checkup

Monthly break-up of patient

Sl.No	MHU Sites/Halt Point	April	May	June	July	August	September
1	New Church	126	136	134	185	145	156
2	Kadaykkulam Resident's Association	91	75	73	99	127	112
3	Karayadivila	133	130	131	125	129	108
4	Thulavila (Near Health centre)	103	99	108	101	121	115
5	Nehru Memorial Library, Theruvu	195	225	131	158	207	164
6	SNDP Hall, Kovalam	81	97	72	79	104	88
7	Gateway Resident's Association Hall	103	133	108	112	104	117
8	Township Colony	162	187	161	158	165	172
9	Marian Nagar, Kottappuram	93	141	91	139	105	107
10	Near Aquarium	120	171	120	135	139	110
	Total	**1207**	**1394**	**1129**	**1291**	**1346**	**1249**

Health camp details (Month-Wise)

SN	Month	Regular Camp site	Male	Female	Total
1	April	Kottappuram	25	53	78
2	May	Alu ninna vila	11	22	33
3	June	Samudra	14	33	47
4	July	Harbour & Thottam	36	60	96
5	August	Harbour	13	38	51
6	September	Mukkola	16	33	49

Blood glucose test done (Month-wise)

Months	Total Tests			Total Positive cases of Blood Sugar		
	Male	Female	Total	Male	Female	Total
April	11	34	45	4	19	23
May	4	12	16	1	6	7
June	20	44	64	7	31	38

Months	Total Tests			Total Positive cases of Blood Sugar		
	Male	Female	Total	Male	Female	Total
July	24	35	59	9	12	21
August	32	57	89	21	32	53
September	19	34	53	8	19	27

Community level engagements

Months	Activities
April	• The programme at Manali, Venganoor was on 09/04/2019 with a participation of 25 community people. • Explained the communities on maintaining a Litter graph, Personal Hygiene, Consumption, and Waste management in their communities and houses. • It aims to highlight the prominence of their contribution in keeping our surroundings clean
May	• The programme at Sneha Counselling Centre, Kottappuram, Vizhinjam was held on 25.05.2019 with a participation of 55 students. • Project Officer explained in details about the swachhagraha programme and its five main themes of becoming a swachhagrahi, litter graph, personal hygiene, consumption, and waste management.

June	• Organized a program on world elder abuse day along with Samudra Residents Association and Netaji library. • Conducted a regular camp and awareness on elder abuse and introduced the helpline number of elders. • Gave awareness on Nipah virus and the precautions to be taken.
July	• 31st July was a special ritual day for the Hindus known as Vavubeli, paying homage to the soul of parents and elders. The MHU team organized a special camp at Karikkothi beach close to Port, for devotees on that day.
August	• A general medical camp was conducted for the public at Harbour division.

2.1.1 CASE STUDIES (Impact)

Nasiyance

Age: 43 male

Mariannagar

Nasiyance, is 43 years old man from mariyan nagar vizhinjam village. He is a fisherman going regularly for fishing, and with that income he takes care of the family and the education of the children. He is suffering from the back pain and leg pain. The income which he is getting from fishing is very less, so he doesn't want to go to hospital. And then he came to know the medical services provided by the Adani CSR team to the community. He got a good medical attention from the MHCU. He is happy of becoming healthy and able to walk in for his livelihood and contribute for the education of his children. He is very much happy for the health services from Vizhinjam MHU.

Name: Meenakshi

Age: 60

Sex: Female

Marital Status: widow

Address: Karayadivilla

Meenakshi is a regular beneficiary, undergoing treatment for Diabetes mellitus, systemic hypertension, coronary artery disease (cold), dyslipidaemia and peripheral vertigo at MHU. She comes to MHU every week, get checked and have medicines from the unit. Earlier for treatment from Vizhinjam Primary Health centre, used to spend rupees 200 for auto charge. Because of that, she rarely comes to hospital. But Adani MHU has provided the facility at her door step.

Meenakshi is widow, her husband died six years ago. She has five children, three boys and two girls. All are married and one of her daughter is also widow. Meenakshi's daughter is going as house maid. Meenakshi's other children are not helping her. Presently Meenakshi is very much happy and thankful for the medicine and support provided from Adani- MHCU

Ambujakshi
87 Female
Devani Vicar, Venganoor PO

Ambujakshi is an 87 year old widow from Venganoor village. She is presently staying with her daughter. Vizhinjam MHU involvement is very helpful in her life, because of the regular medical attention that she is receiving for the last six months. The reason is that it is very much difficult for her to go every week to hospital and is expensive. But now she is very happy because of the health services available close to her house. Now every week she comes to MHU and takes the medicines for diabetes and other health issues. She was in fact much depressed because of the death of her husband. But now she is happy as MHU is supporting her health along with her daughter.

Seethalekshmi

Age: 75 Female

Theruvu

Seethalekshmi is a 75 years old woman from Venganoor, Vizhinjam village. She was a good singer and did lot of stage performances. Presently she is not signing due her age old diseases. She was loved by everyone and received great appreciations. But now she is aged and nobody is giving much attention to her. The age old diseases worried her for the last two years. She is not having anybody to take her to hospital other than her aged husband. The MHCU of Adani Foundation supported her to get free check-up and diagnosed having BP and related diseases. Now she is taking medicines from MHU regularly and living happily with her husband. She tells to her friends and neighbors about the health services and MHU which brought her back to life.

Name: Ms. Thankam

Age: 77 years

Sex: Female

Marital Status: Married

Address: njaravillakom, Vizhinjam P.O. Thiruvananthapuram.

Thankam, aged 77 from Njaravilla, Vizhinjam is a house wife living with her husband. As the children are married and staying away, both of them are living in isolation. She is migrated from Tamil Nadu many years ago for the sake of job. She liked Kerala very much and said that the people of Kerala are very kind in helping. Their only source of income is the oldage pension receiving from welfare board. Though she was suffering from hypertension long back, the regular medication was a challenge as the health centre was away from her home. Because of oldage issues and no one to accompany, she seldom visited the health centre. Irregular medication was causing severe problems to her but she was helpless as her husband too was old and couldn't travel. It was at this juncture, the Mobile Health Care Unit of Adani Foundation started visiting the site near to her house. Thereafter she became a regular visitor and her BP and diabetes is now under control. The awareness sessions too has helped her to control the diet to keep BP and diabetes. Now she can travel alone and feel confident to do even household duties. She is very much happy with regard to the medical care provided by MHCU Vizhinjam and always urges her friends and neighbours to avail the health service provided by MHU. She says, "The MHCU Vizhinjam is God's gift to us and I am highly grateful to Adani Foundation for starting this mobile unit. She expressed her happiness that the regular treatment provided at their door step is a boon to hundreds of elder people like her.

2.2 SuPoshan - (SDG No.2 and SDG No4)

SuPoshan is the health care initiative of Adani Foundation aimed to curb malnutrition and anaemia among children below 5 years of age and women in reproductive age. Following are the major activities conducted under SuPoshan during the year 2019 (April to September).

a) **Community reach-out**

Breakup of Community Engagement programmes

Sl.No	Programme	April 2019	May 2019	June 2019	July 2019	August 2019	Sep 2019
1	House hold visits	895	1050	1110	980	635	467
2	Family based counselling	27	38	63	68	37	29
3	Anganwadi visits	63	72	108	112	57	28
4	Focus Group Discussions	63	42	47	47	47	33
5	Village Level Events	9	14	10	8	9	6
6	Anthropometric Measurements	362	440	439	410	423	256
7	HB Screening	-	142	347	363	117	85
	Total	**1419**	**1798**	**2124**	**1986**	**1325**	**904**

b. Breakup of Qualitative Change

Sl.No	Programme	April 2019	May 2019	June 2019	July 2019
1	Conversion from Severe Acute Malnourished (SAM) to Moderate Acute Malnourished (MAM)	-	-	-	1
2	Conversion from MAM to Healthy	2	2	3	6
3	Anaemia cases from Severe to Moderate	9	-	3	2
4	Anaemia cases from Moderate to mild	-	-	9	8
5.	Anaemia cases from Moderate to Normal	-	6	4	3
Total		11	8	19	20

Breakup of awareness through FGDs and Village Level Meetings

Sl No	Awareness Programme	April 2019		May 2019		June 2019		July 2019		August 2019		September 2019	
		No. of Programme	No. of Participants	No. of Programmes	No. of Programmes	No. of Participants	No.of Participants	No. of Programmes	No. of Participants	No.of Programmes	No.of Participants	No. of Programme	No.of Participants
1	FGD for Adolescent girls	23	160	21	28	252	183	22	261	23	249	17	143
2	FGD for Mothers	40	301	21	19	285	164	25	298	24	287	18	112
3	Village Lev Meeting	09	163	14	10	186	284	8	168	9	276	6	187
4	Adolescent fest - WMHD			1			150						
Total		72	64	57	781	57	723	55	727	56	812	41	442

During the reporting month, SuPoshan activities reached to 1325 families in the five wards of CSR intervention with focus on creating awareness on malnutrition and anaemia.

Community Awareness /Training Program details

Month	No. of Training/awareness Programs	Peoples Participated	Main Topics
April 2019	30	70	There was a demonstration of hand washing activity with the active participation of adolescents gathered over there. In the session, coordinator motivated the children to start doing some of the activities in their localities.
May 2019	39	127	Project Officer explained in details about the swachhagraha programme and its five main themes of becoming a swachhagrahi, litter graph, personal hygiene, consumption, and waste management. The Project Officer explained in details about the Swachhagraha programme and the community people together did a campaign of collecting plastics from the communities.
June 2019	57	723	a. Adolescent hygiene b. Menstruation c. Women empowerment d. Iron rich vegetables e. Rainy diseases f. Prevention and precautions – during monsoon g. Environment day – Beat air pollution h. Mosquito control measures during monsoon

July 2019	55	727	Nutrition during Pregnancy Importance of Proteins a. Importance of fats b. Role of Vitamin A c. IFA for Pregnant women d. World Population Day – importance of spacing, correlation of birth spacing and children's health e. Hygiene practice during menstruation f. Importance of sanitary napkin pad g. Water borne diseases h. Purity of water i. Seasonal calendar j. Homemade ORS k. Pitting Oedema, sign of Oedema, and its measurement l. Importance of hemoglobin m. Planning of breastfeeding day celebration
August 2019	56	812	a. Importance of breastfeeding b. Nutrition during pregnancy c. Importance of protein rich vegetables d. Importance of kitchen garden e. Hygiene practice during menstruation f. Importance of sanitary napkin pad g. Purity of water h. Seasonal calendar. i. Planning of national nutrition week
September 2019	41	442	a. Importance of Nutrition b. Nutrition month Celebrations c. Importance of menstrual hygiene d. Importance of 1000 days e. Importance of Health and hygiene especially in coastal areas f. Importance of teaching basic ethics to our children

c. Referral details (Month-wise)

Months	Beneficiary Name	Referral Date	MHU site	age	Gender	Referral reason	Referred to
April	Rechens	8/04/19	New Church	55	M	TB Cell	GH Trivnadrum
	Selvan	25/9/19	Marian Nagar	44	M	Ortho	GH Trivnadrum
May	Glory	7/5/2019	Thulavilla	70	F	ENT	GH Trivandrum
	Sabitha	17/5/2019	Icds	38	F	Ortho	GH Trivandrum
	Bhaskaran	23/5/2019	Gateway	80	M	Physician	CHC Vizhinjam
July	Vasudha	4/7/2019	Gateway	62	F	Gyneochologist	GH Trivandrum
	Francis	8/7/2019	Mariyananagar	55	M	Ortho	CHC Vizhinjam
	Rajam	29/7/2019	Kadaykulam	62	F	General	General TVM
	Ammu	29/7/2019	Kadaykulam	75	F	General	Medical college
August	Fathima	8/8/2019	Township	70	F	Ophthal Mology	GH Trivandrum
	Muthappan	19/8/2019	New church	50	M	Ortho	GH Trivandrum
	Leela	28/8/2019	thulavilla	72	F	Gyneacho Logist	General Hospital TVM
September	Karthi	3/9/2019	Kaday -kulam	74	F	Opthal-mology	GH Trivandrum
	Varghese	20/9/2019	Mariyan-nagar	77	M	Ortho	GH Trivandrum

d. Awareness sessions (Month- wise)

Month	**Name of the site**	**Date**	**No. of participants**	**Topic**	**Facilitator/ Speaker**
May	Kottappuram	19/5/2019	50	Hypertension	Intern
	karaadivilla	2/5/2019	28	Diabetes	Intern
	Thuavilla	2/5/2019	49	Sanitation	Doctor
	Theruvu	15/2/2019	49	Hypertension	Doctor
	New church	27/5/2019	29	Sanitation	Pharmacist

June	Samudra	15/6/2019	47	Elder abuse	Doctor
	ICDS	28/6/2019	29	Sanitation	Doctor
July	Theruvu	24/7/2019	42	Seasonal disease	Doctor
	NewChurch	15/7/2019	24	Seasonal disease	Doctor
August	Newchurch	5/8/2019	34	Hypertension	Doctor
	Harbour	31/8/2019	34	Hypertension	Doctor
	Harbour	31/8/2019	39	Diabetics	Pharmacist
September	Township	16/9/2019	32	Hypertension	Doctor
	Harbour	16/9/2019	32	diabeties	Doctor

Disease specific pattern reported in the month of April 2019

Disease	Grand total	%
Acid Peptic Disorder	238	6%
Aplastic and other Anemia	71	2%
Asthma	267	6%
Bronchiectasis	2	0%
Cancer / Neoplasms	3	0%
Candidiasis/ Fungal infections	60	1%
Cataract	49	1%
Chronic Obstructive Pulmonary Disease	136	3%
Conjunctivitis	17	0%
Corns and Calluses	0	0%
Coronary Artery Diseases/Stroke/Cardio	214	5%
Dental Caries/Gingivitis	84	2%
Diabetes Mellitus	476	11%
Diarrhea /Dysentery /Gastroenteritis	42	1%
Disability	0	0%
Fever/Pyrexia	176	4%
Glaucoma	1	0%
Hypertension	542	13%

Hyperthyroid	0	0%
Hypothyroid	190	5%
Injury/Burn	39	1%
Jaundice	1	0%
Leucorrhoea	0	0%
Malnutrition/Obesity	53	1%
Mental and Behavioral disorder	6	0%
Neuropathy/Disorder of peripheral nervous	0	0%
Osteo-Arthritis/Joint Pain/ Arthritis	470	11%
Otitis Media	0	0%
Refractive Error	0	0%
Skin Diseases	83	2%
Tuberculosis	0	0%
Upper Respiratory Tract Infection	72	2%
Urinary Tract Infection	63	2%
Weakness – Generalized	8	0%
Worms Infestation	23	1%
Other	811	19%

e. House visits (Month-wise)

Months	Name of the beneficiary	Age/Sex	Date	Site name	No. of visits	Reason for the visit
May	Shamsudheer	84 M	6/5/2019	Kadaykulam	2	Bedridden
	Suhaira beevi	65 F	6/5/2019	Kadaykulam	2	Not able to walk
	Leenamma	75 F	21/5/2019	Karayadivilla	15	Not able to walk
	Rabiyath beevi	65 F	29/2/2019	Theruvu	11	bedridden
June	Ambujakshi	87 F	11/6/2019	Karayadivilla	1	Bedridden
	Kamalakshi	85 F	11/6/2019	Karayadivilla	1	Not able to walk
	Leenamma	75 F	12/3/2019	Karayadivilla	15	Not able to walk

July	Leenamma	65 F	9/7/2019	Karayadivilla	17	Not able to walk
	Pathumma	65 F	29/7/2019	Kadaykulam	1	bedridden
August	Leenamma	65 F	27/8/2019	Karayadivilla	18	bedridden
	Mariyapushpam	55 F	8/8/2019	Mulloor	2	Leg fracture
September	Leenamma	65 F	10/9/2019	Karayadivilla	19	bedridden
	Mariyapushpam	55 F	10/9/2019	Mulloor	3	Leg fracture
	Shamsudheer	84 M	10/9/2019	Kadaykulam	4	Leg problem
	Suhairabeevi	65 F	10/9/2019	Kadaykulam	4	Not able to walk
	Karmeli	75 F	10/9/2019	New church	2	bedridden

f. Anganwadi opening celebrations – Prevesanolsavam

Anganwadi usually celebrates opening day in the month of June every year. This year the Sanginies joined with the Anganwadi workers for the programme and supported in decorating Anganwadis, inviting local leaders, elected representatives and ASHA workers. Sweets and toys are also distributed. Six of Sanginies participated in the Prevesanolsavam as special invitees.

g. World Environment day celebrations

All the 9 Sanginies conducted world environment day programmes at their respective locations on the theme "beat air pollution" clubbed with drawing competitions, pledge and talk show on the theme. Prizes were distributed to the winners.

h. **World elderly abuse awareness day**

A special medical camp and an awareness programme organized in association with Mobile Health Care unit on 15th June as part of the world elder abuse awareness day celebrations. The programme was arranged by the Sangini Chandri at Netaji Library, Samudra, Kovalam.

48 people participated in the awareness session. Dr. Vishnu, Medical Officer, MHU handled the session and emphasized the point on the solution for the abuses. The coordinator of MHU talked about the introduction of SOS App for elders. The medical camp was jointly organized by Mobile Health Care unit and Social Security Mission, Govt. of Kerala.

2.3 Swachhagraha – 'to create a culture of cleanliness'

"Swachhagraha – Swachhata ka Satyagraha" programme launched by Adani Foundation is getting good results from the schools and communities during the reporting period. The project covers 130 schools in Trivandrum by joining hands with the Department of Public Instructions. Following table gives the progress of Swachhagraha in schools. The objective of the project is to create a culture of cleanliness among students community. The activities in each school are coordinated by a Nodal teacher and a team of 20 students known as Dal group members.

Progress of Swachhagraha in schools

Swachhagraha School Wise Report 2019		
Sl No	Activities	No of Schools
1	Total Swachhagraha Schools	130
2	No of swachhagraha Preraks	133

3	No of Swachhagraha Dals	129
4	No of Swachhagraha Members	2566
5	No of School Orientation	10
6	No of School Visited	20
7	No of Swachhagraha walls	65
8	No of Map	22
9	No of no one is looking	4
10	No of Toilet Signage	30
11	No of Toilet etiquette Survey	30
12	No of Handwashing	42
13	No.of Case Studies	8
14	No of School Visit (Till now)	93

As the schools are closed for summer vacation, the focus during the month was in communities and institutions. In the month of April, 2019 Vizhinjam Swachhagraha has conducted three awareness programmes at community level. The details of the programmes as follows

1. Community awareness at Manali, venganoor, Vizhinjam
2. Community awareness at Kottappuram, Vizhinjam
3. Community awareness at SNDP, Kovalam

Community awareness at Manali, venganoor, Vizhinjam

- The programme at Manali, Venganoor was on 09/04/2019 with a participation of 25 community people.
- Explained the communities on maintaining a Litter graph, Personal Hygiene, Consumption, and Waste management in their communities and houses.

- It aims to highlight the prominence of their contribution in keeping our surroundings clean

Community awareness at Kottappuram, Vizhinjam

The second programme was at Kottappuram, Vizhinjam on 17/04/2019. It was participated by 20 children. After the session there was a demonstration of hand washing activity with the active participation of adolescents gathered over there. In the session, coordinator motivated the children to start doing some of the activities in their localities. The 5 Main theme of swachhagraha were also discussed.

Community awareness at SNDP,Kovalam

The third programme was at SNDP, Kovalam on 24/04/2019. 25 community

people participated in the awareness program. The awareness session mainly focused on hand wash, toilet manners, compost pit and behavior change education. End of session, the community people reflected cleanliness as a collective responsibility and most important practices which need to observe in life.

WORLD MENSTURAL HYGIENE DAY CELEBRATIONS – Adolescent fest

Theme: "it's time for action"

World menstrual hygiene day was observed on 28th May 2019 with an aim to break the silence, come forward to discuss on menstrual hygiene management.

The day was observed as a festival for adolescent girls. A day long programme was organized including the following parts

- Menstrual management message
- Sport competition for Adolescent girls (10 to 18 years)
- Arts competition for Adolescent girls (10 t0 18 years)
- Honouring first rank holder in MSc Analytical Chemistry from Kerala University.
- Prize distribution along with valedictory

The celebration was flagged off by Rev. Justin Judin, Vicar, Our lady of good voyage church, vizhinjam, presided over by Dr. Anil Balakrishnan, unit CSR head. The menstrual hygiene message covered the following topics

- Puberty – changes during puberty
- Menstruation – Process; physical and emotional symptoms
- Social taboos and myths related to menstruation
- Unhygienic practices and impact on health
- Use of sanitary napkins, management and disposal

Thereafter, a sport and arts competitions held at St. Mary's Higher Secondary School, Kottappuram, Vizhinjam. The details of the programs are as follows

Sl.No	Items	Category	Place	Winner
1. Arts Competitions				
1	Malayalam Recitation	UP	1	Krishna
			2	Nayana
			3	Hasna
2	Malayalam Recitation	HS	1	Abhirami
			2	Merin .S. Lopez
			3	Nandhana
3	Group Folk song	General	1	Nandhana, Noora,Irfana, Haseera, Afsana, Suchithra, Gayathry, Abhirami
			2	Sandra, Merin, Vyshnavy, Shilpa
			3	Hasna & Party
4	Patriotic Song	General	1	Nandhana, Irfana, Suchithra, Gayathry, Abhirami,
			2	Dhersana, Nayana, Archana

			3	Aroma Sharma, Krishna, Siyana
5	Light Music	UP	1	Krishana
			2	Merin
			3	Vidhya Antony
6	Light Music	HS	1	Abhirami
			2	Adhira
			3	Aroma Sharma
7	Mappila Song	General	1	Haseena
			2	Irfana
			3	Noora
8	Group Dance	UP	1	Athira & Party
			2	Ancy & Party
			3	Ashma & Party
9	Group Dance	HS	1	Gowri Nandana & Team
			2	Aroma Sarma & Party
			3	Abhirami & Party
10	Single Dance	UP	1	Nandhana
			2	Anjali
			3	Ashma
11	Single Dance	HS	1	Akamsha
			2	Athira
			3	Sanooju, Arathy
II. Sports competitions				
12	100 mtr Running race	UP	1	Deva Priya
			2	Asha Anilkumar
			3	Shijitha
13	100 mtr Running race	HS	1	Nandhana
			2	Adhithya
			3	Shalini
14	200 mtr Running race	UP	1	Deve Priya
			2	Aswathy
			3	Asha Anilkumar
15	200 mtr Running race	HS	1	Nandhana
			2	Dhersana , Aswathy
			3	Soumay Ahalaya

16	Musical chair	UP	1	Lekshmi
			2	Anamika
			3	Soumya
17	Musical chair	HS	1	Krishna Priya
			2	Hasna
			3	Sanooja
18	400 relay	UP	1	Vipin Kumar & Team
			2	Soumya & Team
			3	Sanooja& Team
19	400 relay	HS	1	Adhithya & Team
			2	Nandhana& Team
			3	Hasna & Team
20	Short put	HS	1	Nandhana
			2	Aswathy
			3	Sona Sooraj
21	Lemon & Spoon race	UP	1	Lekshmi
			2	Anamika
			3	Soumya
22	Lemon & Spoon race	HS	1	Nandhana
			2	Aswathy
			3	Sona Sooraj

World Breastfeeding week Celebrations

A week long world Breastfeeding week-2019 under the theme #Empower Parents Enable Breastfeeding was celebrated at Vizhinjam by Adani Foundation. The following programmes were conducted to celebrate the event.

List of events organized as part of WBDC

Sl No.	Project Venue	Date	No. of Participants	Activities in Brief
01	Harbour, Venganoor, Vizhinjam & Mukkola	01-08-2019	38	Breastfeeding week awareness class for Mothers and teenage girls
02	Harbour, Venganoor, Vizhinjam, Mukkola & Mulloor	03-08-2019	60	'Adhyamitram' Competition-Painting, essay and poems.
03	Harbour, Venganoor, Vizhinjam & Mulloor,	05-08-2019	24	Awareness session on importance of

	Kottappuram			breastfeeding for lactating mothers, competition for mothers on the theme.
04	Adani Livelihood centre, Vizhinjam	06-08-2019	85	Class for mothers and pregnant ladies about the importance of colostrum and how it will benefit the child's growth Distribution of grow bags and seeds for kitchen garden competition Prize distribution for "Adhyamitram – first Honey" competition
05	Kidarakkuzhy	07-08-2019	14	Class on importance of role of mothers in the developmental stages of children. Importance of having kitchen garden in each house.

Event in Detail

The World Breastfeeding day celebrations under the theme "Empower Parents Enable Breastfeeding" by SuPoshan started on 1st August 2019 to 7th August 2019 at Adani Livelihood Centre, Mukkola, Vizhinjam and 5 different wards. The following programs were organized as part of the celebrations

Adhyamritham- first honey competition

A competition was conducted for mothers, lactating mothers, pregnant ladies and adolescent girls in the 5 wards as part of Breastfeeding day celebrations. It was participated by 45 people. The competitions included essay writing, poems and paintings on the theme. Dr. Anil Balakrishnan, Unit Head CSR, Mrs. Soumya V, Agriculture

Officer, Vizhinjam, Mr. Sebastian Britto, Project Officer, has delivered messages and Prizes were distributed for the winners.

Distribution of grow bags and seeds for Kitchen Garden Competition

Distribution of growbag and seeds for Kitchen Garden was organized as part of world breastfeeding day celebrations on 6th August 2019 for the mothers, lactating mothers, pregnant ladies and Sanginies. 85 selected mothers from the five intervening wards of SuPoshan participated the programme. Dr. Anil Balakrishnan, Unit Head, CSR Vizhinjam inaugurated the program. Mr. Sebastian Britto, Project Officer, Adani Foundation, Vizhinjam gave awareness class on Importance of breastfeeding and guidelines for the competition. Mrs. Soumya, Agricultural Officer, Vizhinjam was the chief guest. She gave class on importance of kitchen garden for pregnant ladies and lactating mothers. She has also made a session on developing an effective kitchen garden.

Awareness programs

Awareness programs, teenage meetings, mothers meetings, village level meetings were done by Sanginies in 5 wards. They gave classes on the importance of breastfeeding and how it can help the physical, mental and psychological development of a child.

Output & Outcome

- 85 community people were made aware on the importance of breastfeeding.
- 3 different events with community people are organized as part of WBDC.

- Importance of breastfeeding which help the child's physical, mental and psychological development.
- Linked the importance of having kitchen garden for the health of pregnant ladies and mothers.


Nutrition Week / Month

The National Nutrition Week / Month Celebrations-2019 under the theme #Complementary Feeling was celebrated at Vizhinjam with the participation of 334 people. Part of the programme conducted awareness classes and kitchen garden promotion in collaboration with ICDS.

List of events organized as part of NNWC

SI No.	Project Venue	Date	No. of Participants	Activities in Brief
1.	Panavila, Venganoor, Harbour & Mukkola	02-09-2019	20	 Awareness class given for mothers about the importance of nutrition in day to day life and impact of Poshan Maah in every child's life.
2.	VenganoorVizhinjam,Mukkol	03-09-2019	13	Session on importance of complementary feeding for lactating mothers .

3.	a Vizhinjam, Thalacode,Mullor,Kottapuram	05-09-2019	15	 Awareness class for Mothers and pregnant ladies about the importance of green colored vegetables and kitchen garden and benefiting it in the overall development of the child. ICDS Supervisor Mrs. Sajitha gave class to Sanginis and Mothers on the importance of 1000 days in child's life.Also given guidance on the schemes available through Anganwadis and ICDS facilities.
4.	Adani Livelihood centre, Vizhinjam	06-09-2019	41	 Importance of having own vegetables in our plate and awareness to mothers.

Kitchen Garden

Distribution of growbag and seeds for Kitchen Garden was organized as part of World Breastfeeding Week celebrations on 6th August 2019 for mothers, lactating mothers, pregnant ladies and Sanginies. It was participated by selected 80 people from different wards of the area. All of them have done the seed sowing. 63 people used fertilizer and transplantation done for spinach. 17 people done weeding.






Collaboration with ICDS Team

Suposhan in collaboration with ICDS team gave awareness classes to Mothers in the intervening wards. ICDS Supervisor Mrs. Sajitha took classes on health concerns of mothers, schemes available for Children, importance of Nutrition, green leafy vegetables and importance of 1000 days and role of mothers in the developmental stage of a child.

Guidance to Suposhan Sanginis

Mrs.Sajitha also gave guidance to Suposhan Sanginis on different schemes available at Anganwadis and how well the department can help in restoring the child and mother health concerns and needs. Also appreciated Sanginis for taking their valuable time for Society's need.

Awareness programs

Awareness class to mothers and village level meetings were done by Sanginies in all intervening wards. They gave class on the importance of Nutrition and role of mothers in stages of development in child.

Progress of Swachhagraha in schools

Swachhagraha status till the month of September 2019		
Sl. No	Activities	No of Schools
1	Total Swachhagraha Schools	130
2	No of swachhagraha Preraks	134
3	No of Swachhagraha Dals	130
4	No of Swachhagraha Members	2586
5	No of School Orientation	10
6	No of School Visited	70
7	No of Swachhagraha walls	89
8	No of Map	38
9	No of no one is looking	11
10	No of Toilet Signage	40
11	No of Toilet etiquette Survey	40
12	No of Handwashing	52
13	No. of Case Studies	11
14	No of School Visit (Till now)	122
15	No. of Litter Graph	23

Apart from the ongoing activities, Vizhinjam Swachhagraha has conducted the following programmes.

Months	Name of Activities	Details	Photos
June	i. **Waste to resources**	The students of the Cotton Hill school did beautiful craft designs with coconut shell and used plastic bottles. Similarly, the dal members of PKHSS, Kanjiramkulam made dust bins from waste materials.	
	ii. **School compound cleaning**	At Govt. Krishna Vilasom Higher Secondary School, Aiyra, Swachhagraha members under the leadership of Perak cleaned all the class rooms, toilets and premises of the school	
	iii. **Reading day celebration**	Reading day programmes were organized at Govt. UP, School, Mulloor and St.	

		Mary School, Kottappuram. As part of reading day celebration on 19th June 2019, invited Elected Representatives, School authorities and parents teachers Association members for the programme. 163 students participated in the programme.	
July	1. **Observance of Plastic Bag Free Day**	Swachhagraha dal members celebrated international Plastic Bag Free day to bring the importance of day. Highlights of the programme as follows. International Plastic Bag Free anniversary celebrations held at Govt Girls HSS Cottonhill Vazhuthacaud, Trivandrum & Mount	 

		Carmel Residential Kanjiramkulam on 3rd July 2019.	
	Waste to wealth	As part of the swachhagraha programme, the students of the Govt. Junior Basic School Neyyattinkara did beautiful craft designs from waste material such as coconut shell and plastic bottles.	 
August	**Independence Day Celebration**	Swachhagraha dal members celebrated Independence Day to bring the importance of day to students at MCHSS Kottukalkonam & Govt Model HSS Punnamoodu on 15th August 2019. On the day, Dal members put forward a message that 'let's show that a clean world is possible'. Dal members prepared cotton flags and distributed to all	

		students. Students cleaned all class rooms and surroundings on the day and take Swachhagraha oath as part of celebrations.	
	Waste to Wealth	the students of the Govt. Junior Basic School Neyyattinkara did beautiful craft designs with waste materials coconut shells and plastic bottles. Similarly the dal members of Govt. Vocational Higher Secondary School also made beautiful items from waste materials. This was as part of making 'best out of waste' that make creative and usable things from waste. This activity taught the students on the principles of 'Reuse' and learning by doing.	 
	Bottle Craft work Exhibition	Swachhagraha Prerak Mrs.Vimala Bai & Dal Members of MCHSS	

		Kottukalkonam intervened to overcome the accumulation of littering Waste material in their School Premises. As part of their activities under Swachhagraha project, students collected waste materials and made beautiful products by adding artistic and creative elements. Posters and Signage were also put up on non-littering in school premises. They have done an exhibition with these products to motivate other students.	
	School Cleaning	Swachhagraha members under the leadership of respective Prerak Teachers cleaned all classrooms, dining halls, toilets and premises in VHSS Poovar and Model HSS Chavadinada.	

	Helping hand to flood affected people	Govt. Higher Secondary School, Cottonhill, Vazhuthacaud provided cleaning lotion free of cost for the flood affected people staying in the relief camps. As part of their community activities dal members initiated an idea to preparing lotion for flood relief people. All most all the students extended their support to this activity.	

Adani Foundation organized “Swachhagraha Felicitation and handing over workshop along with a craft exhibition made out of waste by Swachhagraha club members from different schools. The workshop was organized at St. Xavier’s Hall, Trivandrum Social Service Society, Bishop’s House compound, Vellayambalam, Thiruvananthapuram on 28th September 2019.

The workshop was inaugurated by the Sub Collector of Trivandrum Mr. Imbasekar IAS presided over by Mr. Rajesh Jha, CEO, Adani Vizhinjam Port Private Ltd. The other dignitaries participated in the programme are Mr.Aboobacker, Deputy Director Employment, General Education Department, Govt. of Kerala, Mrs. Shylaja. C.M, Asst. Education Officer Trivandrum, Mr.Sushil

Nair, Head Corporate Affairs, AVPPL Dr. Anil Balakrishnan Unit Head CSR Adani Foundation. Sub collector awarded trophies and certificates for the following schools.

Best Swachhagraha School

- Govt. Girls HSS Cotton Hill, Trivandrum
- Mount Carmel Residential School, Kanjiramkulam, Trivandrum
- HSS for girls, Venganoor, Trivandrum
- Govt. VHSS Kottual, Trivandrum
- MCHSSS Kottukalkonam, Trivandrum

Best student report

- Kumari. Rani lekshmi, Govt. Girls HSS Cotton Hill, Trivandrum
- Master. Jerin JM, Mount Carmel Residential School, Kanjiramkulam
- Kumari. Binisha Binu, MCHS, Kottukalkonam
- Kumari. Sandra.T.S, HSS For Girls Venganoor
- Kumari. Devika.V.S, Govt VHSS Kottual

Best Essay

- Kumari. Anagha K Ramanan, Govt. Girls HSS, Cotton Hill School
- Kumari. Vineeshma, Leo XIII, HSS, Pulluvila, Trivandrum
- Kumari. Adhithya K, Girls HSS, Venganoor
- Kumari. Adheena.S.S, Govt GHSS Cottonn Hill, Trivandrum
- Kumari. Athira.A, St.Paul's CSI Uchakkada, Trivandrum

Safai Ke Sithare

- Govt. VHSS, Vattiyoorkavu, Trivandrum
- Govt. VHSS, Kottukal, Trivandrum
- Vivekanda Vidhya Peedom, Pachaloor, Trivandrum
- Chinmaya Vidyalaya Kunnumpuram, Trivandrum
- St. Chrystom's HSS Nellimoodu, Trivandrum

Followed by the inauguration 'A Journey of Swachhagraha' was presented by Swachhagraha Dal members of Govt. Girls HSS, Cotton Hill, Trivandrum and Mount Carmel Residential School, Kanjiramkulam.

The teachers and Dal members shared that swachhagraha programme helped them a lot to inculcate a behavior of cleanliness among students. A video documented on the activities was also shown in the workshop.

An exhibition of craft made out of waste materials was also done along with the workshop by following schools

- Govt. Girls HSS, Cotton Hill
- HSS for Girls, Venganoor
- MCHSS, Kottukalkonam
- Govt. VHSS Kottukal
- St. Paul's CSI, Uchhakkada
- SAS UPS, Venganoor
- Govt. HSS, Kamaleswaram
- Govt. HSS, Balaramapuram
- Govt. HSS, Vattiyoorkkavu
- VPS for Boys, Venganoor
- Govt. HSS, Poovar
- SNDP UPS Karinkulam
- St. Mary's HSS, Vizhinjam
- Mount Carmel Residential School, Kanjiramkulam
- St. Michael's HSS, Kadinamkulam

The exhibition made everybody to think about the innovative and creative crafts that can be made out of waste. All items in the exhibition are made out waste materials by the students. It included beautiful bags, newspaper photo frames, wall hangings, flowers and penguin made of soft drink bottles, paintings on table calendars, compact disc etc. Not only that students made art and craft from coconut shell, ear buds, food grains, thermocol, plates, pencil etc. The programme was well appreciated by the teachers and thanked for the good initiative of Adani Foundation. They unanimously requested Adani Foundation to continue the Swachhagraha Programme.

Swachhagraha Review Meeting Inauguration

Best Swachhargaha School

Govt HSS For Girls Cottonhill

Mount Carmel Residential School Kanjiramkulam

HSS for Girls Venganoor	MCHSS Kottukalkonam	Govt VHSS Kottukal

Safai Ke Sitare Campaign Winners

St.Chrystom's HSS Nellimoodu

Vivekananda Vidya Peedom

Chinmaya Vidyalaya Kunnumpuram

Govt VHSS Vattiyoorkavu

Govt VHSS Kottukal

Best Student Report Winners

Rani Lekshmi – GGHSS Cottonhill

Jerin.J.M – Mount Carmel KanKanjiram

Binusha Binu – MCHSS Kottukalkonam

Sandra.T.S – HSS for Girls Venganoor

Devika.V.S – GVHSS Kottukal

Best Essay Writer Winners

Anagha.K.Ramanan-Cottonhill	Vineeshma - LEO XII Pulluvila

Adithya.K –HSS For Girls Venganoor	Adheena.S.S -Cottonhill	Athira.A –St.Paul's CSI Uchakkada



Craft Exhibition by students




International Yoga Day

Adani Foundation celebrated international Yoga day to bring the importance of yoga to students and teachers as part of the international yoga anniversary celebrations at St.Mary's HSS Kottappuram, Vizhinjam on 21 June 2019. Dr. Anil Balakrishnan, unit CSR Head inaugurated the event explaining the importance of yoga based on the theme, "**Climate Action**". Dr. Akhil, Member Homeopathic State committee and Mr. Reji Joy, Joint Secretary, Arogya Bharati, Venganoor were also joined to explain the need of Yoga for the students to practice. Headmistress Mrs. Ida Innet, sports teacher and other teachers participated in the session along with 110 school students.

Besides, Adani Foundation joined with Venganoor Gramam Panchayath in the rally '**Smriti Mandapam'** as part of the closing ceremony of Yoga Training held for 100 students of Venganoor girls Higher Secondary School and Chavadi Nada School under the leadership of Venganoor Grama Panchayat. Dr. Anil Balakrishan, Head CSR gave Keynote address in a function presided over by Smt.Sreekala, President of Venganoor Gram Panchayat. Mr. Satheesh, Vice President, Venganoor Grama Panchayat, Dr. Rekhu, professor, Homeo College, Prof. Durga Prasad Ayurveda Hospital, Smt. Sreelatha Devi, Headmistress, Mr. Hareendran Nair, PTA President, Mr. Rajan and Mr. Rajayyan, Panchayat members and school teachers were also present in the meeting. After that there was a Yoga practice participated by 150 students.




World Environment day celebrations (WED) #beatairpollution

Every year, 5th June is celebrated as World Environment Day (WED) to ensure the protection of planet and its natural resources. Adani Foundation celebrated Environment day here at Vizhinjam under the theme 'Beat Air Pollution' to raise awareness on ill effects of air pollution in line with theme of United Nations. Following are the important activities conducted under SuPoshan.

i. **Environmental day celebrations @ CSR office Mukkola**
   - Planted saplings in the premise of Kottappuram Community Centre
   - Environment day message delivered by the Project Officer, CSR

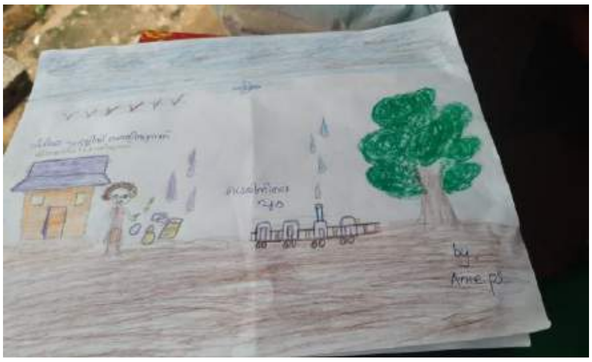

ii. **Environments day celebration by SuPoshan team.**

Location: Idi vizhunna vila, Vizhinjam (Anganwadi Centre)

Participation – 32 children

- Draining competition on the theme beat air pollution conducted
    - 1st Prize – Aniee P.S.
    - 2nd Prize – Arya L. Suresh
    - 3rd prize – Samvritha

Environment day message by Maya G., Swachhagraha coordinator

iii. **SuPoshan-Township Colony - Participated 18 Nos**

- Drawing completion – 26 kids participated
- 1st prize : Mster Aswin
- 2nd prize : Kumari Adithya
- 3rd prize : Master Anandhu

Environment day Message by Maya G, Swachhagraha Coordinator


iv. SuPoshan-Neelakanda Colony – (31 children participated)

- Theme based competition on slogans, public speaking, letter writing and drawings conducted
  - 1st prize for slogan : Kumari Shahana
  - 2nd Prize for slogan : Kumari Midhula Mahesh
  - Ist prize for drawing : Master Amina Shifudheen
  - Public speaking : Kumari Safna
  - Letter writing : Kumary Gifty Asokan

Environment day Message by Stephen Vinod, CSR staff


v. Environment day message to Digital Literacy groups @ Chavadinada NSS

Participation: 28 members participated
Message by Mr. Jithin J Kumar & Mr. George Zen


vi. Environment day message to Digital Literacy group- Ambedkar Gramam

No of Participation: 32 members

Message by Mr. Jithin J Kumar


vii. Environmental day celebrations at Adani Vizhinjam Port Site

The CSR team joined with Environment team in the week long celebrations organized by the environment team at site from June 03, 2019 to June 08, 2019. As the world marks 45th World Environment Day (WED), the celebrations provided an opportunity to broaden the basis for an enlightened opinion and responsible conduct by individuals, communities and as a company in preserving and enhancing the environment. Following are the important activities carried out at site.

- Training conducted with the security personnel of Vizhinjam port regarding Air Pollution to ensure that every vehicle entering the port premises had valid Pollution Under Control (PUC) certificates.
- Dusk masks were distributed to the security personnel and it was advised to wear the dusk masks while on duty.

- The environment team invited for a Facemask Challenge, slogan writing and online quiz competitions based on the theme “Beat Air Pollution”. As a token of encouragement to participate prizes were distributed to the winners.
- T-shirts were distributed by Environment team to all employees to mark the Environment Day program with the colour green.

Awareness Programme at Howe


Pledge by Howe team


Tree Plantation with Howe and AVPPL


Awareness at Shrine Engineering


Tree Plantation at Shrine Engineering


Tree Plantation at B&R

Rain Coat distribution to the sanitation workers

As monsoon start hitting Kerala in June 2019, one of the worst affected parties are the corporation sanitation workers. The sanitation workers are managing Thumboormozhi Aerobins as well as the public cleaning activity. More than 20 cleaning campaigns had jointly organized with zonal health wing. One of the requests from the sanitation workers was to provide them Rain Coat, so as to work efficiently even rainy time. Understanding the need of the workers, Adani Foundation provided Rain Coats to 50 Sanitation Workers here at Vizhinjam.

The rain coat distribution was held at the conference Hall of Trivandrum Municipal Corporation. Advocate V.K. Prasanth, Mayor of Thiruvananthapuram Corporation inaugurated the function presided over by the Health standing committee Chairman Shri.Sreekumar. Shri. Sushil Nair, Head, Corporate Affairss and Dr. Anil Balakrishnan, Unit CSR head, Ward Counsellors Mrs. C. Omana, Ms. W. Shiny, Mrs. Nisa Beevi, Mr. Santhosh, and Mr. Resheed have also participated in the programme. Mr. Prem Navas, Zonal Health Inspector; Mr. Shinu S Das, Junior Health inspectors, Mr. Rahim Khan, Mrs. Raji, and 50 Sanitation workers participated the programme. Hon'ble Mayor and other elected representatives along with Sanitation Workers appreciated the efforts of Adani Foundation.

Blood donation and Cloth distribution.

Adani group, Vizhinjam conducted a series of events as part of the Birth day celebrations of Group Chairman. It included the following activities.

i. Blood Donation

ii. Clothes to the inmates of Oldage Home

iii. Sowing of seeds to promote Kitchen Garden

I. Blood Donation

As part of the birth day celebrations of chairman Adani Group, Vizhinjam team conducted a blood donation camp in association with NIMS Medicity. The camp was formally inaugurated by Shri.Rajesh Jha, CEO, AVPPL. Close to 100 members have come forward to donate the blood, wherein collected from 56 members based on health check. Last year it was 28 numbers, and this year it got doubled. Interestingly, three Municipal Sanitation workers and six youth volunteers from the community have also voluntarily participated in the blood donation.

Blood Donation

II. Cloth Distribution

As part of the birth day celebrations, cloths were distributed to the inmates of Snehasandram, an old age home at Vizhinjam. This has been done under the Employee Volunteering Programme of Adani Foundation. The cloth kit contained a bedsheet, two pillow covers and a towel. Mr. Jerome Fernandez, play back singer from Vizhinjam joined the event and sang a song to make the day beautiful. All inmates and the coordinators joined together and prayed wishes to the chairman on his birthday.

III. Initiation of Kitchen Garden at CSR office

The Adani Foundation team started a kitchen garden close to CSR office as part of the birthday celebration. All the foundation staff members joined in ploughing and sowing the seeds. It was a two day event as part of the Birthday celebration.




3 SUSTAINABLE LIVELIHOOD DEVELOPMENT (SLD)

Following are the SLD activities conducted during the month

1. Skill Development
2. Digital Literacy &
3. Livelihood Development

3.1 Skill Development

Saksham Day Celebration

As part of Saksham Day on 16th May 2019, Adani Skill Development Centre Vizhinjam has conducted Saksham Day Celebration by the tagline "Saksham turns 3". The function was inaugurated by Dr. Anil Balakrishnan Unit CSR Head, Vizhinjam followed by a message of importance in Skilling and job opportunities in various sectors, participated by the students of various skill courses and the CSR team.

AWARD FROM ADANI SKILL DEVELOPMENT CENTER

Team Vizhinjam bagged with two awards from Disha-National Meet conducted by ASDC at Ahmedabad, happened on 25th and 26th of July. The awards are for the best outstanding performance from the team during the FY 2018-19 and for international placement done at centre. Hon. Chairperson of Adani Foundation presented award to the team

Felicitations from Adani Vizhinjam Port Pvt. Ltd

The AVPPL team joined to felicitate the CSR team for getting awards. The CEO of AVPPL Shri.Rajesh Jha appreciated the team for the achievement.


Gathering of Digital Literacy Community Resource Persons

A gathering of community resource persons of Digital literacy was organized to recognize the good work done the team in the field and to share happiness for the notable achievement in Digital Literacy. The team shared on how digital literacy has impacted the community though online transfer of money, e-payments, online shopping, bill payments and knowledge empowerment.

1. Adimalathura which is another coastal village near to Vizhinjam, where the church Vigor is keen to know about the programme. It has been planned to conduct multiple batches there, however the church Vigor hesitated to start more batches, as he wants to get feedback from the community. Thus the community trainers arranged certificate distribution programme by inviting the vigor. The students shared their experience that the training programme was very useful and opened a new window of digital world in e-transactions. Further expressed their wholehearted thanks to Adani Digital Literacy team to provide this. The feedback made by the students made the vigor to change from his negative stand and to become a supporter of digital literacy programme.
2. Prema, a deaf and dumb student from Mariyan Nagar batch joined the programme last month, who has studied only upto 9th std. She is now been active listener and supporting her family and the nearby community people in paying electricity bills, water bills and money transfer. She feels proud of herself by doing this, as the digital literacy paved an unequivocal platform.

3. One of the trainees who have already completed the training programme from punchakkari batch shared that three of them recently attended a PSC competitive exam and four questions were from IT part, which they answered correctly as learned from digital literacy.


Status of Ongoing courses

Activities done till April

Sl No	Name of Course	No of Students	Month of starting	Batch End Date	Exam Date	Activities
1	General Duty Assistant	30	03.10.18	22.12.18	16-03-19	• Batches Started after mobilization, orientation and those who enrolled had undergone entry gate assessment, periodic internal assessments • conducted PTA meetings for all batches to give a better idea to parents and students about the placement plan and career opportunities in the concerned sector • Placement Process of all Skill course started
2	Consignment Booking Assistant	25	03.10.18	22.12.18		
3	Fitness Trainer	25	22.11.18	01.01.19		
4	Automotive Service Technician two and Three wheeler	27	22.11.18	23.01.19	16-05-19	
5	General Duty Assistant(Batch 2)	30	03.12.18	10.02.19	17-03-19	
6	Trainee Associate Retail	30	03.12.18	31.01.19	30-03-19	

7	Trainee Associate Retail	25	15.01.19	30.04.19		• 15 out of 25 CBA trainees ,14 out of 27 Automotive students 30 out of 60 GDA trainees, 10 out of 25 fitness trainer students and 7 out of 30 Retail Trainee Associate students got placed at various organizations

- **Automotive Service Technician (Two & Three Wheeler)**

  The assessment for the Skill Development Course on Automotive Service Technician (Two & Three Wheeler) for the youth has conducted on 16.05.2019. The course is conducted at two centres, as theory classes is at Nehru Library and practical at Shiva Motors. The Batch started with 27 students wherein 16 out of 27 students attended the exam and expecting the result during the month of June.


- **Fitness Trainer**

  After the successful completion of the Skill Development course on Fitness Trainer for the youth at "Ash 2 Fitness Center", Kanjiramkulam the assessment of 8 students has been conducted on 20 Sep 2019. All the eight students have cleared the assessment test successfully. 10 students out of 25 students underwent fitness trainer course got placed in local gyms and 2 got international placement in Qatar.

- **Trainee Associate Retail**

  The Skill Development course on trainee associate retail for the omen group of livelihood trade mart has been completed. All the trained women are placed in the Vizmart, market center initiated under the

CSR of Adani Foundation. The assessment is planned in October 2019. The batch consists of 25 students.

3.2 Digital Literacy campaign

After the Successful skill training campaign on Digital literacy Programme, this year it is planned to conduct training for 1500 people. The significant achievement of digital literacy is that it helped to reach to the community deeply and more than 90% of the beneficiaries are women from the community itself. The programme aims to deliver about Internet banking, Social media, mobile banking, Digilocker, MS office, Cyber security, barcode etc...

Digital Literacy Details

Sl No	Location	Supporting Organization	Month wise Participants					
			April	May	June	July	August	September
1	Kanjirampara	Localites	30	30	30	25	25	25
2	Panapazhinji	Localites	20	20	20	16	16	16
3	Kuzhipallam	Localites	-	20	20	20	20	20
4	Muttacaud	Localites	-	28	29	31	31	31
5	Moonnattumukku	Localites	-	21	25	25	25	25
6	Adimalathura	Localites	-	20	20	25	25	25
7	Harbour	Localites	-	26	26	26	26	26
8	Uchakkada	Localites	-	-	-	25	25	25
9	Mariyan Nagar	Localites	-	-	-	32	32	36
10	Mariyan Nagar	Localites	-	-	-	20	20	19
11	Mariyan Nagar	Localites	-	-	-	24	24	14

12	Mariyan Nagar	Localites	-	-	-	21	21	18
13	Harbour	Localites	-	-	-	15	15	15
14	Harbour	Localites	-	-	-	16	16	16
15	TheathreJn	Localites	-	-	-	20	30	27
16	Ambalkulam	Localites	-	-	-	16	26	26
17	TownShip	Localites	-	-	-	20	19	17
18	Kamukinkuzhi	Localites	-	-	-	24	24	24
19	Uchakkada	Localites	-	-	-	-	10	10
20	Mulloor	Localites	-	-	-	-	12	12
21	Adimalathura	Localites	-	-	-	-	14	14
23	Chunnakkara	Localites	-	-	-	-	18	26
24	Venniyoor	Localites	-	-	-	-	-	32
25	K S Road	Localites	-	-	-	-	-	26
26	Sisilipuram	Localites	-	-	-	-	-	31
27	Sisilipuram	Localites	-	-	-	-	-	31
28	Kuzhipallam	Localites	-	-	-	-	-	18
		Total	50	165	170	401	500	605

- Another important achievement was that two of community resource person for Digital Literacy Mrs. Anjali has completed and secured her MSW degree and Mrs. Vijayarani completed her BA in Sociology. Both of them have dropped their studies due to some family issues and decided to complete the course with the motivation received from the trainings under digital literacy programme.

Vijayarani	Anjali
	

3.3 LIVELIHOOD UPDATES

Status of existing livelihood groups

Sl No	Name of Group	Type of Business	Status till September	Monthly Status
1	Clean 4 U	Hi Tech Cleaning for Houses, Flats, Hospitals, Offices, water tank, Vehicle	• Cleaning of CSR Office Mukkola • Cleaned one house • The Group turnover during the month was Rs.30,000-50,000	• Monthly Cleaning of CSR Office Mukkola • Cleaned 2 houses and one flat. • The Group turnover during the month was Rs.35, 000/- • Started new office at Viz mart on 05.09.2019
2	Anaswara Poultry Unit	Hitech poultry cages of two with a capacity of 45 chicken for each cage with waste collection system	• Getting 60-70 eggs per day for each group member a consolidated of 420-500 eggs for the group • Each member gets a revenue of 8000-10,000 per month	• Getting 60 eggs per day for each group member a consolidated of 420 eggs for the group • Each member gets revenue of 8000 per month. • A shop in the new Viz-mart is under progress.
3	Thripti Poultry Unit	Hitech poultry cages of two with a capacity of 45 chicken for each cage with waste collection system	• Getting 45-60 eggs per day for each group member a consolidated of 315 -280 eggs for the group • Each member gets a revenue of 5,300-7000 per month	• Getting 45 eggs per day for each group member a consolidated of 315 eggs for the group • Each member gets revenue of 5,300 per month. • A common selling point in the new Viz-mart is under progress.

4	Harbour Canteen Unit	Canteen unit specially for traditional seafood's	• Daily turnover of Rs.8,000 to Rs.12,500 and gets a profit of Rs.700-2000	• An average of profit of Rs.1,000 per day after all expenses in coming to group. Revenue of canteen is Rs.10,000 per day.
5	Sreebhadra Big Shopper Unit	Big shopper Unit	• Provided an average of Rs.1500-2500 cloth bag to local shops. • The group has made a turnover of Rs.15,000-25,000	• Provided an average of 1,500 cloth bag to local shops • The group has made a turnover of Rs.15,000
6	Vizhinjam Karshika Karmasena	Running of Eco shop, preparation of growbags & Agri. works	• Started selling organic vegetables from the farmers and sell it to the community	• New shop in Vizmart at Vizhinjam started on 05.09.2019 • New Karmasena with a group of four members is set-up. • Done an Onam Vipanana Mela during Onam season

7	Prime Events	Event Management & Marketing Team	• Proposal finalized, Shop Identified • Vendor registered • Subsidy of VISL under process	• New set of Laundry Machines ordered • Subsidy received from VISL and AF • Ironing unit started • Three phase electrical work and Plumbing works are going on • The group has made a turnover of Rs.6,000 from Ironing • A new counter at Viz mart started on 05.09.2019
8	Happy Days Napkin distributi on Unit	Sanitary Napkins distribution in tie up - HLL	• Pan Card received • Proposal under progress.	• Pan Card received • Proposal under progress
9	Data Plus	Data entry related works, Photostat, project works, designing and online jobs	• Shop commenced on 17.10.2018 • The group get a monthly turnover of Rs.17,000	• Shop commenced on 17.10.2018 • The group get a monthly turnover of Rs.18,000 • New centre being set-up at Vizhinjam.
10	Thattukkada Unit	Shop for preparation & Selling of steam based snacks	• The Shop runs from morning 4:30 AM to 9:30 AM • Providing fast food for the localities • The shop earns a turnover of Rs.2000/day	• The Shop runs from morning 4:30 AM to 9:30 AM • Providing fast food for the localities • The shop earns a f Rs.2500/day
11	Health Pro	Home based medical test and providing low cost specs	• Proposal ready • Group formed	• Registration process going on

12	Ooruvilakam Karshaka sangham	Vegetable cultivation	• Proposal under process • Group formed	• Registration process going on
13	Jojo Bakery & Stitching Centre	Tailoring and Snack bar	• Group Formed • Proposal under process	• Started the unit at VIZ mart on 05.09.2019

a) Inauguration of Power laundry / Cloth pressing unit

As part of the livelihood initiatives, a power laundry cum pressing unit has been initiated by the Prime Events group. This is started by a group of three members viz Raji SC, Diju S and Reji started the laundry unit.
The total project cost is Rs.5,50,000/- as detailed in the table.

Sl No	Particulars	Amount (Rs.)
1.	Bank Loan (40%)	2,20,000.00
2.	Beneficiary Contribution (10%)	55,000.00
3.	Subsidy from Adani Foundation (25%)	1,37,500.00
4.	Subsidy from VISL (25%)	1,37,500.00
	Total	5,50,000.00

The group initially started with an electric pressing unit on 10th June 2019. Now the procurement of equipments for power laundry is going on. The unit has a washing and ironing facility in a hall at Mulloor, whereas it has a counter for customer delivery at Vizhinjam Livelihood Mart initiated under the CSR of Adani Foundation. The power laundry machines may be installed by end of July 2019. The group members have under gone training though ASDC for building customer base and service etiquettes.

New laundry unit at Mulloor – Vizhinjam

b) Debriefing of livelihood project proposal under livelihood mart

Two rounds of debriefing workshops have been conducted with the nine livelihood groups proposed in the new livelihood mart at Vizhinjam. The meeting supported to finalize the action plan for bank linkages, sourcing of raw materials, reviewing the progress, developing market strategy and starting of the unit. The consultants from Alterneit Mr. Dhanesh and Mr. Sreenath provided the much required input during the debriefing workshops held on 12th and 14th June 2019.

c) Starting of livelihood unit on Fish Products

Dr. Nina Singh, a consultant from Orissa has visited the site and had a first round of training with selected women entrepreneur to start a livelihood unit on Fish products like fish fingers, fish pickles and Pearl culture. A project is under preparation to the initiate the unit.

d) VIZMART : THE MARKET SET FOR THE LIVELIHOOD UNITS OF COMMUNITY WOMEN

A new market outlet named **"Vizmart"** has been opened with 14 shops of community women on 05.09.2019. Adv. Rakhi Ravikumar, Deputy Mayor of Trivandrum Corporation inaugurated the function. The mart has been developed under the CSR of Adani Foundation and handed over to women groups on 29.08.2019 to source the products and arrange counters.

- This is one step ahead of handholding with better market connectivity for the livelihood groups and their products. The work for setting up of mart has been started on 15 March 2019 and completed in four months' time.

- The building belongs to Thiruvananthapuram Corporation, which has been taken on rental basis by the women groups under the guidance of Adani Foundation. As per the existing market rate the rent goes up to Rs.40000/- with a deposit of Rs. 2 lakhs. However, the discussion that the CSR team had with the Mayor of Trivandrum Corporation succeeded in getting the building for a monthly rent of Rs.12,500/- for the groups without any advance deposit.

- Adani Foundation entrusted "Alterneit" a livelihood consulting group to conceptualize and develop the mart to facilitate the women groups with a cost of Rs.10 lakhs under the CSR of Adani Foundation.
- The market has been developed with facilities to run 14 shops for different livelihood units. Further necessary training, souring of products for the groups, branding support, bank linkages, product packaging, linking of resources and market connected were also provided under the CSR of Adani Foundation.

- The units started functioning in this mart are (1) You, Me &Tea café shop, (2) Turn to Fresh - Organic Shop, (3) Agro clinic, (4) Vegetable Shop, (5) Textile shop, (6) SRM-stitching unit, (7) Laundry & ironing unit, (8) Elite Fancy shop, (9) Kitchen utensils unit, (10) Prime Hi-tech laundry unit (11) Data-plus unit, (12) Clean Four You (13) S.R.M Stitching Unit

During the formal inauguration of Vizmart on 05.09.2019, **Adv.Rakhi Ravikumar**, Dy. Mayor of Trivandrum Corporation said that the market developed by Adani Foundation is setting an example of professionalism and commitment of the company under its CSR to the community people. The other dignitaries participated in the event are Mr. Sushil Nair, Head, Corporate Affairs of Adani Vizhinjam Port Pvt Ltd, Mr. Ketan Dev site head - HOWE, Senior officials from AVPPL, HOWE and from the contractors. The ward councillors of all the five CSR intervention wards have also spoken on that occasion. The other participants included corporation officials, school teachers, sanginis, volunteers of Adani Foundation and the community people at large.

ORIGIN OF VIZMART

The concept of VIZMART - a market for selling the products of livelihood groups - is derived from the continued meetings and interventions of women's self-employment units under the CSR of Adani Foundation. There are 17 women's self-employment ventures started at Vizhinjam during 2017-18. The president and secretary of all these groups with the representative of Adani Foundation formed an Apex Society with the name of 'VIZMART'. The main objective of the society is to materialise a sustainable market for livelihood units. Following are the activities carried out in brief under VIZMART.

- The 'People's Hall" near the Vizhinjam Police Station situated in Venganoor Division of Thiruvananthapuram Municipal Corporation has been taken on a rental basis by VIZMART.
- The facilities in the building has been renovated and converted into a market space under the CSR of Adani Foundation. Further, the common branding has been done under the CSR of Adani Foundation.

- The individual shop branding, procurement of utensils, equipments, raw materials and day to day operations of the units are taken care by each livelihood unit.


VIZ MART – PROJECT FINANCE

Preparing feasible project proposal was one of the important activities facilitated by the CSR team. The proposals have been prepared for 20 different projects based on the interest of the group members. A bankers meeting was called at Vizhinjam with all nationalised banks and explained the process undertook to promote livelihood units. This has built the confidence of bankers to support the units.


Following projects got clearance from the banks to run the units initially.

		Amount in Rs.			
Sl.N	**Project**	**Beneficiary contribution**	**Loan Amount**	**CSR support of AF**	**Total project Cost**
1	Turn to Fresh (Organic Shop)	27,000	108,000	45,000	1,80,000.00

2	Frozen Days (Ice Cream & Juice)	18,000	60,000	72,000	1,50,000.00
3	Kitchen Store	21,850	131,100	65,550	2,18,500.00
4	SRM Stitching Centre	28,500	114,000	142,500	2,85,000.00
5	Vanitha Karshika Karma Sena)	22,000	87,000	36,000	1,45,000.00
6	U Me & Tea	36,800	180,250	150,950	3,68,000.00
7	Eco Shop	78,659	314,634	393,295	7,86,588.00
8	Data Plus	50,000	200,000	250,000	5,00,000.00
9	Laundry Unit	55,000	220,000	275,000	5,50,000.00
10	Elite Fancy Shop	15,000	60,000	75,000	1,50,000.00
11	Agro Enterprises	66,500	150,000	119,523	3,36,023.00
12	Clean 4 U (Expansion)	51,250	200,000	83,750	3.35,000.00
Total		**4,70,559**	**1,824,984**	**1,708,568**	**40,04,111**

PRODUCTS / SERVICES UNDER VIZMART

Following are the key units and its activities under VIZMART

Sl.N	Project	No of units	Activity	Number of members
1	Turn to Fresh	1	• Procurement and selling of organic items and coconut oil.	5
2	Frozen Days	1	• Ice Cream & Juice Shop	3

3	Kitchen Store	1	• Shop for all kitchen utensils	3
4	SRM Stitching & Textile Centre	2	• Stitching of dresses for women and children • A textile jointly with stitching unit.	3 + 10
5	Vegetable (Vanitha Karshika Karma Sena)	2	• Undertake all agri promotion, clinic and cultivation activities.	5
6	U, Me & Tea Cafe	2	• Quality food • Variety food	5
7	Eco Shop	1	• Vegetable vending • Market for local vegetables	3
8	Data Plus Services	1	• All digital services	3
9	Prime Laundry Unit	1	• Laundry and ironing services to the people at their door step.	5
10	Elite Fancy Shop	1	• All fancy items for girls, including costumes and cosmetics • Seasonal cards and other items	3
11	Clean 4 U (Expansion)	1	• Hi-tech cleaning of flats, institutions, hospitals, home...etc.	5
		14		53

ACTION PLAN - TIMELINE FOR STREAMLINING VIZMART

	ADANI FOUNDATION, ADANI VIZHINJAM PORT PVT. LTD					
	Activity chart for implementing VIZMART, a Livelihood Market at Vizhinjam under the CSR of AF					
Sl.No	**Activities**	**No of members**	**Time line**		**Present status**	**Remarks**
			Duration	**Period**		
1	**Training of livelihood members**					
1.1	Orientation and Registration	1046	4 hrs	2017-18	Completed	Still receiving registrations -

1.2	Training of Basic Management Modules i. Self-Management ii. Cash Management iii. Idea to Business iv. Debt Management v. Leadership & Communication	896 730 654 596 564	24 hrs 16 hrs 16 hrs 10 hrs 10 hrs	Sep 2018 to Dec 2018	Completed	High end modules like sales strategies, business management, product promotion, business forecasting... will be provided after the units start functioning.
1.2	Product / Service Training	35	310 hrs	Jan 2019 to Mar2019	Completed	Training on Retail, sales strategies and market linkages through ASDC
2	**Preparation of Project Proposal**					
2.1	Review of Feasibility of Project	110	1 month	Feb 2019 to June 2019	Completed	This is a participatory process, wherein the technical solution and market connect based on the skill set of members are considered
2.2	Developing technical and financial proposal	20	2months			
2.3	Finalising bankable proposal for each project	17	2months			
2	**Identifying members**					
2.1	Formation of groups according to the skill set, aptitude and available resources	20	2months	Jan 2019	Completed	This is the initial task carried out
2.2	Assessment and confirmation on willingness to take the business risk including loan liability	17	10 days	April 2019	Completed	These are Joint Liability Groups and hence written documentation in mandatory
3	**Debriefing of proposals**					
3.1	Explaining projects to the groups in detail on project cost, marketability, technical solution and challenges	210	1 month	May 2019	Completed	Connecting hi-tech technical solution to groups is important for success of units like cleaning, laundry, data-plus...etc.
3.2	Documentation – A signed copy of willingness of members to take the project	110	10 days	May 2019	Completed	Documentary evidence
3.3	Preparation of	110	1 month	Jun	Completed	Important to

	operational plan			2019		make the groups independent.
4	**Setting up of Livelihood Shops**					
4.1	Installation of Tea Snacks Counter	1	3 months	May2019 to July 2019	Completed	Modern shop with all facilities for the livelihood members to sell the products and having rest rooms, dress changing rooms and drinking water facility.
4.2	Installation of 12 Shop Counters	12				
4.3	Painting	14				
4.4	Bathroom Maintenance	2				
4.5	Electrical Works	14				
4.6	Plumbing works	14				
4.7	PVC flooring	14				
4.8	Installation of SMD-LED Scrolling Display	1				
5	**Finance Linkage - Availing Bank loans**					
5.1	Opening SB Account	17	Four months	March 2019 to Aug 2019	Completed	Process of linkages is a time consuming process needs constant follow-ups
5.2	SSI/ Society Registration	17				
5.3	Pan Card	17				
5.4	Submitting Proposal to banks, VISIL&AVPPL	17				
5.5	SIBIL Score	17				
5.6	Site visit and Verification	17				
5.7	Processing of loan	17				
5.8	Approval of Loan for the following groups	15				
6	**Common Branding**					
6.1	Brainstorming for Common Brand	50	15 hr	May 2019	Completed	Brands needs to be registered.
6.2	Finalisation of Brand	15				
6.5	Fixing Brand	15				
7	**Social Media Branding and Events**					
7.1	Brainstorming workshop for Social Media theme	10	On going	Since Aug 2019	On going	Product specific events, prices, qualities are important for better customer relations.
7.2	Finalisation of Social Media Theme	22				
7.3	Uploading	22				
7.4	Promotional events	20				
7.5	Monitoring	-				

8	**Preparation of Bye Laws & Code of Conduct**					
8.1	Brainstorming	10	30 hour	August 2019	Completed	Executive committee is entrusted to do timely updating of bylaws.
8.2	Draft bylaws	1				
8.4	Finalization of Byelaws	1				
8.5	Operational plan	1				
8.6	MOU for each unit with VIZMART	14				
9	**Commencement of Units**					
9.1	Positioning of units	14	Three months	June 2019 to August 2019	Completed	Identifying quality products at a better price. Ensuring backward linkages, buybacks ..etc.
9.2	Preparing list of items to be procured by each unit.	14				
9.3	Sourcing of items	-				
9.4	Finalsing the prize of products	-				
9.5	Delegation of roles	-				
10	**Monitoring Reports**					
10.1	Initial stock	14	On going	Since Sep 2019	Initiated	Separate forms and books are given to groups for recording of sales and consolidating on a monthly basis.
10.2	Monthly stock	14				
10.3	Monthly business	14				
10.4	Monthly profit/loss	14				
10.5	Sourcing of products	14				
10.6	Expansion / Diversification	14				

COMMUNITY SPORTS EVENTS

Part of promoting youth from community in sports events, Adani Foundation supported Kovalam FC, one of the upcoming football club to train and equip in developing a team of football players. Adani Foundation provided jersey, football and training equipment to the team. It has also been agreed to provide nutritious food to the team as part of CSR. The equipments and jersey were handed over to the team in a function held on 17th August 2019 inaugurated by Dr.Shashi Tharoor, hon'ble MP of Thiruvananthapuram. The efforts of Adani Foundation in supporting the local sports events has been well appreciated by the MP.

4. COMMUNITY INFRASTRUCUTRE DEVELOPMENT

4.1. Playground at Kottappuram

The inauguration of playground constructed under the CSR of Adani Foundation has been postponed to October 2019. However the ground is used by Kovalam FC, one of the reputed local clun supported under the CSR of AVPPL has regularly conducted training sessions in the new playground. It is also decided to provide more sports items to St. Mary's HSS, Kottappuram to upscale the capabilities of the students. It is planned to train the students regularly with the help of Sports Council of India from October 2019 onwards.

4.2 Public toilet at Kottappuram

The construction of public toilet at Kottappuram has been completed. Construction of Septic tank and laying of pipeline are about to complete. Presently 95% of the work completed.

4.3 Toilet for teachers, Ayyankali Smaraka UP School, Venganoor

The construction of toilet for teachers is progressing at Ayyankali School. Almost 80% of works completed. Plumbing and finishing work are going on. Last year one toilet block was constructed for the students of the school.

4.4. Community Health Centre, Vizhinjam

The construction of new building at Community Health Centre, Vizhinjam is progressing. Almost 10% of works completed. Harbour engineering department is executing and monitoring the work. Adani Foundation given the first instalment of Rs.1.18 crore out of 2.97 crore agreed for the project to Harbour Engineering Department.

4.5 Roofing of Thumboormuzhi aerobic bin at Harbour

The roofing of Thumboormozhi having 10 Aerobins at Harbour ward has been started. It is a work costing Rs.10 lakhs. Once the work is completed, would support around 1000 families in the vicinity to dispose their organic waste. The work has been appreciated by Trivandrum Municipal Corporation and the print medias.

4.6 Inauguration of Thumboormuzhi aerobic bin at Vizhinjam

The newly constructed Thumboormozhi aerobin at Pulloorkonam, Vizhinjam ward has been inaugurated by Shri. Sreekumar, Standing Committee Chairman, Trivandrum Municipal Corporation. The function was presided over by Shri. Rasheed, ward councilor, Vizhinjam participated by the Health Inspector, Sanitation workers and the community people. The facility would serve for the disposal of waste from 500 families in that area.

4.7 Other major projects under process for the year 2019-20

Sl No	Project
1	**Drainage facilities at Kottappuram, Vizhinjam and Mulloor**. (This is the work requested by the District Collector). • Plan prepared. • Estimate of 50 lakhs prepared for the same. • MoU given to the community for signature. • Beneficiary Committee constituted at Kottappuram for the same

2	Community Sitting Space with solar lights & small parks • Five numbers of Community Parks at various locations in & nearby villages, finalised 1. Harbour Road, Valiyaparambu, Vizhinjam 2. Veganoor ward (Nr. Nehru samarak grandhasala) 3. Mukkola Junction Vizhinjam, Bus Stop. 4. Vizhinjam, Harbour (Fisherman) 5. Vizhinjam Junction, Nr. Zonal office • Plan and Estimate prepared • Beneficiary committees under preparation	
3	Mudippura Nada LP School, Venganoor	Plan and estimate for the following works to be done inside the school i. Stage Platform ii. Washing Facility • Estimate prepared • NFA got approved.
4	HALP School, Harbour Road, Vizhinjam.	**Following works to be done, for which plan and estimate prepared.** 1. Side roofing to protect from rain water 2. A toilet block is proposed for boys (urinals) & staff with hand wash facility. 2 Water supply to be taken from old existing old building. (tapping point around 50 mtrs) 3 New pump is to be considered for water supply. • Estimate prepared • NFA under progress
5	LPS School, Kidarakuzhi	Plan and estimate for the works prepared: • Toilet block for boys & staff is to be made out from existing unused kitchen block. • To 8 urinals for boys, Soak pit & septic tank at right side of the existing block. • Plan and Estimate prepared • NFA under progress
6	Model Anaganwadi, Vizhinjam (Nr. Police Station)	• 1500 Sqft Montessori model Aganwadi at Govt. Vizhinjam LP School compound. • The plan and the location to be approved by social welfare department • Letter given to Government for allocation of land

7	Palliative Care Center	• Plan prepared for 9000 Sqft building for Palliative Care Center. • Estimate is under process • MoU drafted and given to church committee for approval. • Operational Plan is being prepared by the church committee • Church committee is under the search of Operating Partners for the same. • NFA will be prepared and work will be commenced only after the MoU is signed.
8	Oldage Home (Ambranchi villa, Andoorkonam, Vizhinjam)	Plan and estimate prepared for • Kitchen platforms, Toilet /wash rooms (2 nos,) refurbishment of existing building, cloth washing facility & bathrooms separately (3 nos), • Beautification works of existing well (Plaster, cleaning color etc.), • Outside area with IPS or paver, Light weight shed b/w two existing building, Racks for storage. • Paving/flooring inside the proposed shed and necessary electrification, area lighting, fans etc. • Refurbishment of existing (old) building. • MoU b/w AVPPL and Church committee given for signature

5. OTHERS

5.1 Local Employment:

As the end of September 2019, a total of 215 Keralite including 114 localities have been engaged in different construction and other jobs at Port.

5.2 Community Grievances

1. **Marian Nager – Water logging issue**

Based on the request from the community people, CSR team invited sanitation workers of Municipal Corporation and joined with the team in cleaning the water logging issue at Vayalinkara area. Further to that, the temporary drainage connecting to sea from Vayalinkara area has been widened by HOWE team considering the pity condition of people in that community.

A proper drainage facility with good pathways to the community has been designed under the CSR of Adani Foundation. However, the work will be initiated only after getting the consent letter from all families in the community and a note of agreement from the families to take care of the drains clean and neat with sufficient maintenance.

2. **Gangayar canal cleaning**

   The mouth of Gangayar River close to Port often gets closed near to the Port due to sand accumulation. The issue has been discussed with Church Committee and the drudging unit. Presently the cleaning is happening on a day to day basis. Conveyed that a permanent solution may be arrived only when the new fishing harbour is ready.

3. **Case of Vijin Victor**

   The case of Mr. Vijin Victor whose son was drowned three years before at Vizhinjam sea, has been supported through Umbrella Corporation one of the contractors of Vizhinjam Port. This included providing him livelihood assistance and clearing of his bank loan.

4. **OVER FLOW OF DRAINAGE** to the houses near to Port: The issue has been taken to the notice of sanitation wing of Trivandrum Corporation. It was due to the accumulation of waste and other filthy items in the drain. The drain has been cleaned by the Corporation sanitation workers on 13.07.2019 under the guidance of CSR team and HOWE team along with community people.


5. **Request for jobs & scholarships**

- During the month 16 applications for jobs has been received. The same has been handed over to the skilling division for assessing the skill requirements. A copy of the same may be handed over to Port contractors to see the requirements and engage the best possible.

- 23 applications received for higher education from the meritorious students, which may be scrutinized under the scholarship scheme of AVPPL-AF.

- **Obstruction of works at Port by Kottappuram Church committee:** On August 18, 2019, a survey point is erected in the proposed new fishing Harbour area near break water for conducting survey for the alignment for Konkan Railway line. The work was carried out by the contractor under the guidance of VISL. However, the Church Committee Kottappuram under the leadership of Parish Priest and Church secretary objected this and claimed that the land is belongs to fishermen community and may not allow any kind of intervention in that land.

The CSR team along with the representatives from Corporate Affairs department has discussed the issue with Kottappuram church. As the issue pertaining to land and their compensation belong to Governemnt, a meeting with higher authorities has been proposed.

- **Clearing of sand from road**

The debris remained after the civil work for the Toilet block construction at Kottappuram was making problem to the free flow of water. Localites requested to remove it and the same has been cleared with the help of Corporation Cleaning staff.

- **Complaint Regarding Tree cutting**

Received a complaint that someone have trespassed the Port acquired land near Petrol Pump, Mukkola and cut some trees illegally. Information forwarded to the Security wing for necessary action.

Facilitation for Port Ministers Meeting with Kottappuram Church committee: A protest was raised on August 18, 2019 by Kottappuram church regarding the survey point erected in the proposed new fishing

Harbour area near break water. It was for conducting survey for the alignment for Konkan Railway line. The committee demanded a meeting with minister to discuss on all those issues and the same has been conducted on 25th September 2019. Church committee raised the demands and requested for a meeting with CM.

a. **HALP School Maintenance**

A complaint received from HALP School regarding the leakage observed from terrace in the two storied building that we constructed under the CSR in HALP School. The engineering section of HOWE has reviewed it and recommended measures to rectify it at the earliest.

b. **Discussion with KIMS Team on CSR activities**

The KIMS Team had a meeting with Dr. Anil B unit CSR Head on the various CSR activities that can be conducted jointly by both the organizations. It was decided to begin the combined initiative with Medical camps, Training on First Aid & Education programs. Training will be in Basic Life Support, Infection Control and Dietary Habits. It is also scheduled a General Medical Camp with a specialty consultation. KIMS will arrange doctors, nurses and paramedical staff for the camp. Those patients requiring special medical attention will be referred to specialty centers.

c. NGT Meeting and presentation

The CSR activities during the period October 2018 to March 2019 has been presented before the expert committee of NGT on 06.09.2019.

Releasing of CSR Annual Report

The annual report of CSR for the period 2018-19 has been formally released by Shri.Ramachandran Kadannappalli, hon'ble Minister for Port on 27.09.2019. The first copy of the report has been handed over to Shri.Rajesh Jha, CEO AVPPL.

ICC Kerala Start Up Meet 2019

Adani Foundation team participated in the Kerala Start-up Meet conducted by Indian Chamber of Commerce on 13th June 2019 at Hotel Hilton Garden Inn, Trivandrum. Shri.Rajesh Jha, CEO of AVPPL was the president of the event. The theme for the meet was 'Ideate, innovate, implement'. Dr. Anil Balakrishanan, unit head, CSR did a presentation on "Preparing Women Entrepreneurs to grow". After the presentation, two business ties up enquires received from MIBIZ Consultancy Services - Citizen Advisor – consultancy service and Faith InfoTech headed by Mr. Saji Joseph for enhancing the market support for the livelihood units. Further, two magazines, Destination Kerala and Technopolis have come up to document the story of our livelihood initiatives.

AVPPL-CEO addressing the gathering

Session on preparing women entrepreneurs to grow

Clean-4-U & Laundry group members of Adani Livelihood initatives	Participation

QUARTERLY REVIEW MEETING

The progress of CSR projects for Quarter-1 of 2019 and the plan for Q-2 are reviewed through VC by HO-AF chaired by ED-AF.

PARTICIPATION

National CSR committee of CII

Representing Adani Foundation, the unit CSR head participated in the first meeting of CSR committee-2019 held at CII headquarters, New Delhi on 24 July 2019. The meeting chaired by Dr.Raghupati Singhania, chairman & MD of JK Tyre Industries Ltd. Representatives from different industries participated. It's a two hour meeting discussed on CSR Legislation, theme for National CSR summit and Knowledge Creation and Dissemination.

Core Committee meeting for the State CSR conclave by CII

Adani Vizhinjam Port Pvt Ltd – Adani Foundation has been invited to be part of the Core Committee meeting held on 30.07.2019 at Kochi to decide on CSR conclave. The conclave is proposed to organize in Nov 2019 and the theme proposed is 'Rebuild Kerala'. Conclave could discuss on how CSR fund can be used to support Government in rebuilding Kerala and how various NGOs can play a role in it. It is also recommended to focus the conclave on preparedness of NGOs, Employee Involvement, Outcome and Impact evaluation.

Meeting by ADM, Trivandrum

- The Port road connectivity meeting based on the study finding of Kerala State Remote Sensing and Environment Centre (KSREC) was held on 19.07.2019 at the chamber of ADM wherein the MLA of Kovalam Shri.M.Vincent, ward councillor Smt.Omana, local representatives from Mulloor ward, MD-VISL and the officials from VSIL and AVPPL participated. The meeting decided to start road construction activities by ensuring the recommendation of the study.

  - **Capacity Building Programme at IRMA**
  - Representing Adani Foundation, Mr. Sebastian Britto, the senior project Officer participated in the Capacity Building Programme jointly organised by Institute of Rural Management (IRMA), Anand, Gujarat and Gujarat CSR Authority. The programme on "Capacity Building for Strategising CSR" was held from August 29th to 31st. The Programme was focused on building capacity in strategizing CSR, Companies act, Project Management, Result based frame work, Monitoring and Evaluation, CSR Reporting, Stakeholder engagement, Team Building, Conflict resolution and Field visit to Amul Dairy – Cholate Factory, Anand, Navkaushalaya Project, Vadodara

- **Workshop on Problem Solving and Decision Making.**

Ms. Meera Mariyam, Coordinator SuPoshan and Mrs. Gayatri Pavithan, Skill Trainer participated in a one day workshop organized by HOWE India. The facilitator was Mr. Sachin Karve from Mumbai who is an expertise in Managerial Level Training for the past 25 year. The session included basic knowledge on Problem Solving and decision making, its steps, different techniques, approaches which can be widely used in personal as well as professional life.

- **Work shop on enhancing gender equity in employment in industries and business in Kerala**

Mr. Jithin Kumar, Project Coordinator, Adani Skill Development Center participated in the work shop on enhancing gender equity in employment in industries and business in Kerala held on August 27, 2019. The one day workshop was conducted by ASAP (Additional Skill Acquisition Programme) with Gender Park Trivandrum to find the challenges for creating an enabling environment that promotes women's engagement in the work force. The workshop also focused on the solutions and best practices that need to be focused to engage more women in work force and just to bring parity. The workshop was inaugurated by Srimathi. Mallika Sarabhai an activist and Indian classical dancer presided over by Dr K.T Jaleel Hon. Minister for higher education.

- **Birthday Celebration of Dr. Priti G. Adani, Chairperson, Adani Foundation**

On the occasion of celebrating B'day of Chairperson of Adani Foundation, CSR Vizhinjam handed over a sustainable market developed under CSR with space for 15 shops to our trained community livelihood women groups. It consist of organic shop, u & me coffee, textile & stitching unit, laundry unit, vegetable shop, kitchen utensil shop, provision store, clean 4 U, juice stall, and a fancy unit. The sales will start on 5th of September 2019. This is an experiment to promote handholding of livelihood groups for market connect, product promotion, buy-backs, backward linkages and making the units sustainable. The team also had a joint lunch with women sanitation workers of Trivandrum Corporation followed by a clean campaign organised as part of the celebration.

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MEDIA COVERAGE

1. News on Distribution of School kit to students under the EVP in Nautical Times on 2.6.19

അദാനി തുറമുഖ കമ്പനി കോർപ്പറേറ്റ് റിലേഷൻസ് മേധാവി ശ്രീ. സുശീൽ നായർ പഠനോപകരണങ്ങളുടെ വിതരണോദ്ഘാടനം നിർവഹിക്കുന്നു. തുറമുഖ കമ്പനി സാമൂഹ്യപ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോക്ടർ അനിൽ ബാലകൃഷ്ണൻ തുടങ്ങിയവർ സമീപം

തീരത്തെ വിദ്യാർത്ഥികൾക്ക് അദാനിയുടെ കൈത്താങ്ങ്

വിഴിഞ്ഞം: പുതിയ അധ്യയന വർഷത്തിൽ സ്കൂൾ വിദ്യാർത്ഥികൾക്ക് കൈത്താങ്ങായി അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനിയിലെ ജീവനക്കാർ. വിഴിഞ്ഞം മേഖലയിലെ നിർദ്ധനരായ 105 സ്കൂൾ വിദ്യാർഥികൾക്ക് സ്കൂൾ ബാഗ്, നോട്ട് ബുക്ക്, **instrument box**, ലഞ്ച് ബോക്സ്, പേന, പെൻസിൽ, ലഞ്ച് ടവ്വൽ എന്നിവ അടങ്ങിയ കിറ്റാണ് വിതരണം ചെയ്തത്. അദാനി എംപ്ലോയീസ് വോളണ്ടിയറിംഗ് പ്രോഗ്രാമിന്റെ ഭാഗമായി ജീവനക്കാർക്ക് സാമൂഹ്യസേവന പ്രവർത്തനങ്ങളിൽ ഏർപ്പെടാൻ അവസരമൊരുക്കുന്ന പ്രവർത്തനങ്ങളുടെ ഭാഗമായാണ് പഠനോപകരണങ്ങൾ വിതരണം ചെയ്തത് . അദാനി തുറമുഖ കമ്പനി കോർപ്പറേറ്റ് റിലേഷൻസ് മേധാവി ശ്രീ. സുശീൽ നായർ പഠനോപകരണങ്ങളുടെ വിതരണോദ്ഘാടനം നിർവഹിച്ചു. തുറമുഖ കമ്പനി സാമൂഹ്യപ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോക്ടർ അനിൽ ബാലകൃഷ്ണൻ, കമ്പനി ഉദ്യോഗസ്ഥരായ ശ്രീ. മനോരഞ്ജൻ ത്രിപാദി (ടെക്ക്നിക്കൽ ഹെഡ്), ശ്രീ സാബു മാത്യു (സെക്യൂരിറ്റി ഹെഡ്), ശ്രീ.നിലഞ്ജൻ ഭട്ടാചാര്യ (ഫിനാൻസ്) ശ്രീ. റോയി കണ്ണന്താനം, ശ്രീ. ബിജു തോമസ് മാത്യു ശ്രീ രാഹുൽ, ശ്രീ. ശ്രീനാഥ്, ഗോപിനാഥൻ നായർ, ശ്രീ. സഞ്ജയ് ,ശ്രീ. അമരേന്ദ്ര സിൻഹ, ശ്രീ. ഷാജി ജോസഫ് , ശ്രീ.ജയേഷ്, ശ്രീ .ഫൽഗുണൻ , ശ്രീ. ജ ശ്രീ.വിനീദ്, എന്നിവരെ കൂടാതെ സാമൂഹ്യ പ്രതിബദ്ധതാ വിഭാഗം പ്രവർത്തകരായ ശ്രീ. സെബാസ്റ്റ്യൻ, ശ്രീ. ജോർജ്ജ് സെൻ, ശ്രീ .വിനോദ് , ശ്രീ.ജിതിൻ കുമാർ ശ്രീ.ശ്രീനാഥ്, ശ്രീമതി. ലിംന, ശ്രീമതി. മായ എന്നിവർ ചടങ്ങുകൾക്ക് നേതൃത്വം നൽകി.

അദാനി ഫൗണ്ടേഷൻ സാമൂഹ്യ പ്രതിബദ്ധതാ പദ്ധതികളുടെ ഭാഗമായി വിദ്യാഭ്യാസം, പൊതുജനാരോഗ്യം, സുസ്ഥിര ഉപജീവന വികസനം, അടിസ്ഥാനസൗകര്യ വികസനം എന്നീ മേഖലകളിലായി നടത്തുന്ന പ്രവർത്തനങ്ങൾക്ക് പുറമേ ജീവനക്കാർക്ക് സാമൂഹ്യസേവന പ്രവർത്തനങ്ങളിൽ പങ്കു ചേരാനുള്ള അവസരമൊരുക്കുന്ന വിവിധ പ്രവർത്തനങ്ങൾ അദാനിയുടെ എല്ലാ സംരംഭങ്ങളിലും നടത്തി വരുന്നു. ഓഖി ദുരിതാശ്വാസ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി തീരദേശമേഖലയിൽ ഉള്ളവർക്ക് ഭക്ഷണം എത്തിക്കുന്നതിനുള്ള പ്രവർത്തനങ്ങളിലും വെള്ളപ്പൊക്ക ദുരിതാശ്വാസ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി പത്തനംതിട്ട, ആലപ്പുഴ ജില്ലകളിൽ ധാന്യ കിറ്റുകൾ വിതരണം ചെയ്യുന്നതിനും വെള്ളപ്പൊക്കത്തിന് ശേഷം രണ്ട് ദിവസം നീണ്ടുനിൽക്കുന്ന ക്ലീനിംഗ് പ്രവർത്തനങ്ങളിൽ ഏർപ്പെടുന്നതിനും ജീവനക്കാർ സജീവ സാന്നിധ്യമായിരുന്നു. വരുംവർഷങ്ങളിൽ കൂടുതൽ കൂടുതൽ സാമൂഹിക സേവന പ്രവർത്തനങ്ങളിൽ ഏർപ്പെടും എന്ന് ചടങ്ങിൽ പങ്കെടുത്ത് ജീവനക്കാർ അറിയിച്ചു.

2. News in Suprabhatam on 02.06,2019

പഠനോപകരണങ്ങൾ വിതരണം ചെയ്ത് അദാനി ഗ്രൂപ്പിലെ ജീവനക്കാർ

3. News in Malayala Manorama

സുപോഷൺ പദ്ധതി: കൗമാര കലോത്സവം

വിഴിഞ്ഞം● അദാനി ഫൗണ്ടേഷൻ നടപ്പിലാക്കുന്ന സുപോഷൺ പദ്ധതി ഭാഗമായി ആർത്തവ ശുചിത്വ സന്ദേശമുയർത്തി കൗമാര കലോത്സവം നടത്തി. വിഴിഞ്ഞം ഇടവക വികാരി ഫാ.ജസ്റ്റിൻ ജൂഡിൻ ഫ്ലാഗ് ഓഫ് ചെയ്തു. എംഎസ് സി അനലിറ്റിക്കൽ കെമിസ്ട്രിയിൽ ഒന്നാം റാങ്ക് നേടിയ ബി. എസ് .അനീഷ് ബാബുവിനെ ചടങ്ങിൽ അനുമോദിച്ചു.

കലാകായിക മത്സര വിജയികൾക്ക് സമ്മാനദാനം നടത്തി. സാമൂഹ്യപ്രതിബദ്ധതാ വിഭാഗം മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ, സെബാസ്റ്റ്യൻ ബ്രിട്ടോ, ജോർജ്ജ് സെൻ, വിനോദ്,ജിതിൻ കുമാർ, മായ, ലിംന, ശ്രീനാഥ്, സുജ, കവിത, അനിത, സിന്ധു, ചന്ദ്രി, ജാസ്മിൻ രാജി എന്നിവർ നേതൃത്വം നല്കി.

സ്കൂൾ കിറ്റ് വിതരണം

വിഴിഞ്ഞം●അദാനി എംപ്ലോയീസ് വൊളന്റിയറിങ് പദ്ധതിയുടെ ഭാഗമായി വിദ്യാർഥികൾക്ക് സ്കൂൾ കിറ്റ് വിതരണം നടത്തി. കിറ്റുകളുടെ വിതരണം അദാനി തുറമുഖ കമ്പനി കോർപ്പറേറ്റ് റിലേഷൻസ് മേധാവി സുശീൽ നായർ നിർവഹിച്ചു.

സാമൂഹ്യപ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ, സാങ്കേതിക വിഭാഗം മേധാവി മനോരഞ്ജൻ ത്രിപാഠി,സുരക്ഷാ മേധാവി സാബു മാത്യു, നിലഞ്ജൻ ഭട്ടാചാര്യ, റോയി കണ്ണന്താനം, ബിജു തോമസ് മാത്യു, രാഹുൽ, ശ്രീനാഥ്, ഗോപിനാഥൻ , സഞ്ജയ് ,അമരേന്ദ്ര സിൻഹ, ഷാജി ജോസഫ് , ജയേഷ്, .ഫൽഗുണൻ , വിനീത്, സെബാസ്റ്റ്യൻ,ജോർജ് സെൻ, വിനോദ് , ജിതിൻ കുമാർ ശ്രീനാഥ്, ലിംന, മായ എന്നിവർ നേതൃത്വം നൽകി.

4. News in Kerala Kaumudi on school kit distribution – 02.06.2019

കേരള കൗമുദി
SINCE 1911
Trivandrum
02 Jun 2019

അദാനി ഗ്രൂപ്പിന്റെ സ്കൂൾ കിറ്റ് വിതരണം

5. News in Mangalam on school kit distribution – 02.06.2019

▪ പഠനോപകരണങ്ങൾ ലഭിച്ച കുട്ടികളോടൊപ്പം സുശീൽ നായരം അദാനിഗ്രൂപ്പിലെ ജീവനക്കാരും.

സ്കൂൾ വിദ്യാർത്ഥികൾക്ക് പഠനോപകരണങ്ങളുമായി അദാനി ഗ്രൂപ്പിലെ ജീവനക്കാർ

വിഴിഞ്ഞം: പുതിയ അധ്യയന വർഷത്തിൽ അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനിയിലെ ജീവനക്കാർ.വിഴിഞ്ഞം മേഖലയിലെ നിർദ്ധനരായ 105 സ്കൂൾ വിദ്യാർഥികൾക്ക് സ്കൂൾ ബാഗ്, നോട്ട്ബുക്ക്,ഇൻസ്ട്രമെൻറ് ബോക്സ് ,ലഞ്ച് ബോക്സ്, പേന, പെൻസിൽ എന്നിവ അടങ്ങിയ കിറ്റുകൾ വിതരണം ചെയ്തു.അദാനി എംപ്ലോയീസ് വാളണ്ടിയറിംഗ് പ്രോഗ്രാമിന്റെ ഭാഗമായാണ് പഠനോപകരണങ്ങൾ വിതരണം ചെയ്തത്.കമ്പനി കോർപ്പറേറ്റ് റിലേഷൻസ് മേധാവി സുശീൽ നായർ പഠനോപകരണങ്ങളുടെ വിതരണോദ്ഘാടനം നിർവഹിച്ചു.

5. News on yoga day celebration in New Indian Express on 22.06.19

The yoga session organised by Adani Foundation, the CSR arm of the Adani Vizhinjam Port Private Limited, at the St Mary's Higher Secondary School, Kottappuram.

6. **News on yoga day celebration in Malayala Manorama on 22.06.19**

യോഗാ ദിനം വിവിധയിടങ്ങളിൽ ആചരിച്ചു

തിരുവനന്തപുരം● കവടിയാർ ആദായനികുതി വകുപ്പ് ഓഫിസിൽ യോഗദിനാചരണം നടത്തി. ആദായനികുതി വകുപ്പ് പ്രിൻസിപ്പൽ ചീഫ് കമ്മിഷണർ അഘോരി അജയ്ശങ്കർ നേതൃത്വം നൽകി. തിരുവനന്തപുരം ആദായനികുതി വകുപ്പ് ചീഫ് കമ്മിഷണർ രവീന്ദ്രകുമാർ, പ്രിൻസിപ്പൽ കമ്മിഷണർ രവി സാരംഗൽ എന്നിവരും മറ്റ് ഉദ്യോഗസ്ഥരും പങ്കെടുത്തു.

●വെങ്ങാനൂർ ഗവ മോഡൽ ഹയർ സെക്കൻഡറി സ്കൂൾ എൽ പി വിഭാഗത്തിലെ യോഗദിനാചരണം പ്രഥമാധ്യാപിക കല ഉത്ഘാടനം ചെയ്തു.രക്ഷകർത്തൃ പ്രതിനിധി പ്രവീൺ അധ്യക്ഷനായി. വിഷ്ണു ലാൽ .സുരേഷ്, ഗ്ലെൻ പ്രകാശ്, അഭിലാഷ്, രാധാകൃഷ്ണൻ എന്നിവർ പ്രസംഗിച്ചു.

വിഴിഞ്ഞം● വിദേശീയരുടെ പങ്കാളിത്വത്തിലൂടെ ചൊവ്വര സോമതീരം റിസർച്ച് ഇൻസ്റ്റിറ്റ്യൂട്ട് ആൻഡ് ആയുർവേദഹോസ്പിറ്റലിൽ ലോക യോഗദിനാചരണം നടത്തി.

സോമതീരം ഗ്രൂപ്പ് ചെയർമാൻ ബേബിമാത്യു സോമതീരവും ഡയറക്ടർ സാമ ബേബി മാത്യുവും ചേർന്നു ഉദ്ഘാടനം ചെയ്തു. തുടർന്നു നടന്ന സെമിനാർ ആയുർവേദ കോളജ് പ്രഫ. ഡോ. ഗോപകുമാർ നയിച്ചു.

വിഴിഞ്ഞം● സാമൂഹ്യ പ്രതിബദ്ധതാ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി അദാനി ഫൗണ്ടേഷൻ നേതൃത്വത്തിൽ വിവിധ സ്കൂളുകളിൽ യോഗ ദിനാഘോഷം നടത്തി.സാമൂഹിക പ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ ഉദ്ഘാടനം ചെയ്തു.

ഡോ. അഖിൽ കൃഷ്ണ, റെജി ജോയി, ഹെഡ്മിസ്ട്രസ് ഐഡാ ഇനറ്റ് എന്നിവർ പ്രസംഗിച്ചു. ഇതോടനുബന്ധിച്ച് വെങ്ങാനൂരിൽ റാലി നടത്തി. ഗ്രാമപഞ്ചായത്ത് പ്രസിഡന്റ് ശ്രീകല അധ്യക്ഷയായി. സതീഷ്, ഡോ.റെല്ലു,പ്രെഫ. ദുർഗ്ഗാപ്രസാദ്, ശ്രീലത ദേവി ,ഹരീന്ദ്രൻ നായർ, ഗ്രാമ ലാലൻ, രാജസ്സൻ, ജോർജ് സെൻ, വിനോദ്, ഗായത്രി, ശ്രീനാഥ് ,മായ, കുമാരി. മീര മറിയം സ്കറിയ, ലിംന എന്നിവർ പ്രസംഗിച്ചു.

കോവളം● വാഴമുട്ടം ഗവ ഹൈസ്കൂൾസ്റ്റുഡന്റ്പൊലീസ് നേതൃത്വത്തിൽ യോഗാ ദിനാചരണം ആർട്ട് ഓഫ് ലിവിംഗ് പരിശീലകൻ കെ. ഭുവനചന്ദ്രൻ നയിച്ചു. ഹെഡ്മിസ്ട്രസ് കലാദേവി, സ്റ്റുഡന്റ് പൊലീസ് ചുമതലയുള്ള ജയശ്രീകുമാർ ,ഡ്രിൽ ഇൻസ്ട്രക്ടർ മാരായ ബിജു, പ്രീതാലക്ഷ്മി എന്നിവർ നേതൃത്വം നൽകി.

7. **News on yoga day celebration in Kerala Kaumudi on 22.06.19**

കേരള കൗമുദി
SINCE 1911
Trivandrum 22 Jun 2019

അദാനി ഫൗണ്ടേഷൻ നേതൃത്വത്തിൽ നടത്തിയ യോഗാ ദിനാചരണം

അദാനി ഫൗണ്ടേഷന്റെ നേതൃത്വത്തിൽ അന്താരാഷ്ട്ര യോഗ ദിനാചരണം

വിഴിഞ്ഞം: അന്താരാഷ്ട്ര യോഗ ദിനാചരണത്തിന്റെ ഭാഗമായി അദാനി ഫൗണ്ടേഷന്റെ നേതൃത്വത്തിൽ കോട്ടപ്പുറം സെന്റ് മേരീസ് ഹയർ സെക്കൻഡറി സ്കൂളിൽ നടന്ന യോഗ ദിനാഘോഷങ്ങൾ അദാനി ഫൗണ്ടേഷൻ സാമൂഹിക പ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ ഉദ്ഘാടനം ചെയ്തു. ഹോമിയോഷതി സ്റ്റേറ്റ് കമ്മിറ്റി അംഗം ഡോക്ടർ അഖിൽ കൃഷ്ണ, ആരോഗ്യ ഭാരതി വെങ്ങാനൂർ ജോയിന്റ് സെക്രട്ടറി റെജി ജോയി, ഹെഡ്മിസ്ട്രസ് ഐഡാ ഇനറ്റ് എന്നിവർ പങ്കെടുത്തു.

ഒരു വർഷക്കാലമായി വെങ്ങാനൂർ ഗ്രാമ പഞ്ചായത്തിന്റെ നേതൃത്വത്തിൽ വെങ്ങാനൂർ ഗേൾസ് ഹയർ സെക്കൻഡറി സ്കൂൾ, ഗവ. മോഡൽ എച്ച്.എസ്.എസ് ചാവടിനട എന്നിവിടങ്ങളിലെ നൂറോളം വിദ്യാർത്ഥികൾക്കായി നടന്നുവന്ന യോഗ പരിശീലന കളരിയുടെ സമാപനത്തോടനുബന്ധിച്ച് അയ്യങ്കാളി സ്മൃതി മണ്ഡപത്തിൽ നിന്ന് റാലിയും നടത്തി. തുടർന്ന് വെങ്ങാനൂർ ഗേൾസ് ഹയർ സെക്കൻഡറി സ്കൂളിൽ നടന്ന യോഗ ദിനാചരണത്തിൽ അദാനി ഫൗണ്ടേഷൻ മേധാവി ബാലകൃഷ്ണൻ മുഖ്യ പ്രഭാഷണം നടത്തി. വെങ്ങാനൂർ ഗ്രാമപഞ്ചായത്ത് പ്രസിഡന്റ് ശ്രീകലയുടെ അദ്ധ്യക്ഷതയിൽ വൈസ് പ്രസിഡന്റ് സതീഷ്, ഹോമിയോ കോളേജ് പ്രൊഫസർ ഡോ. രഘു, ആയുർവേദ ഹോസ്പിറ്റൽ പ്രൊഫ. ദുർഗാപ്രസാദ്, ഹെഡ്മിസ്ട്രസ് ശ്രീലത ദേവി, പി.ടി.എ പ്രസിഡന്റ് ഹരീന്ദ്രൻ നായർ, ഗ്രാമപഞ്ചായത്ത് മെമ്പർമാരായ ലാലൻ, രാജയ്യൻ, അദാനി ഫൗണ്ടേഷൻ സി.എസ്.ആർ അംഗങ്ങളായ ജോർജ് സെൻ, വിനോദ്, ഗായത്രി, ശ്രീനാഥ്, മായ, മീര മറിയം സ്കറിയ, ലിംന എന്നിവർ പങ്കെടുത്തു.

KERALA KAUMUDI EPAPER
Clipping Kerala Kaumudi - Trivandrum

8. News on yoga day celebration in Nautical Times on 22.06.19

അദാനി ഫൗണ്ടേഷന്റെ നേതൃത്വത്തിൽ അന്താരാഷ്ട്ര യോഗാദിനം ആചരിച്ചു

വിഴിഞ്ഞം : അന്താരാഷ്ട്ര യോഗാ വാർഷിക ദിനാചരണവുമായി ബന്ധപ്പെട്ട് വിദ്യാർഥികളിലും അധ്യാപകരിലും യോഗയുടെ പ്രാധാന്യം എത്തിക്കുക എന്ന ലക്ഷ്യത്തോടെ അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനി സാമൂഹ്യ പ്രതിബദ്ധതാ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി അദാനി ഫൗണ്ടേഷന്റെ നേതൃത്വത്തിൽ കോട്ടപ്പുറം സെന്റ് മേരീസ് ഹയർ സെക്കണ്ടറി സ്കൂളിൽ യോഗ ദിനാഘോഷങ്ങൾ സംഘടിപ്പിച്ചു.

ഈ വർഷത്തെ അന്താരാഷ്ട്ര യോഗാ ദിനത്തിന്റെ സന്ദേശമായ 'ക്ലൈമറ്റ് അക്ഷൻ ' എന്ന വിഷയത്തെക്കുറിച്ചും കാലാവസ്ഥാ വ്യതിയാനം മൂലം ഉണ്ടാകുന്ന വിപത്തുകളെ കുറിച്ചും യോഗയുടെ പ്രാധാന്യത്തെക്കുറിച്ചും ആധികാരികമായി വിശദീകരിച്ചുകൊണ്ട് അദാനി ഫൗണ്ടേഷൻ സാമൂഹിക പ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോക്ടർ അനിൽ ബാലകൃഷ്ണൻ പ്രസ്തുത പരിപാടി ഉദ്ഘാടനം ചെയ്തു.

യോഗ ഇന്ത്യൻ സംസ്കാരത്തിന്റെ അഭിവാജ്യ ഘടകമാണ് എന്നും ശാരീരിക മാനസിക ആരോഗ്യം നിലനിർത്തുന്നതിൽ അത്ഭുതങ്ങൾ സൃഷ്ടിക്കാൻ യോഗയ്ക്ക് സാധിക്കും എന്നും അദ്ദേഹം തന്റെ സന്ദേശത്തിൽ ഊന്നിപ്പറഞ്ഞു.

വിദ്യാർഥികൾ യോഗ അഭ്യസിക്കേണ്ടതിന്റെ ആവശ്യകത വിശദീകരിക്കുവാനും വിദ്യാർത്ഥികളെ യോഗ അഭ്യസിപ്പിക്കുന്നതിനുമായി ഹോമിയോപ്പതി സ്റ്റേറ്റ് കമ്മറ്റി അംഗം ഡോക്ടർ. അഖിൽ കൃഷ്ണയും ആരോഗ്യ ഭാരതി വെങ്ങാനൂർ ജോയിന്റ് സെക്രട്ടറി ശ്രീ. റെജി ജോയിയും പരിപാടിയിൽ പങ്കു ചേർന്നു.

തുടർന്ന് നടന്ന യോഗാഭ്യാസത്തിൽ അറുപതോളം വിദ്യാർഥികൾ ഹെഡ്മിസ്ട്രസ് ശ്രീമതി.ഐഡാ ഇനറ്റ്, കായിക അദ്ധ്യാപകൻ, മറ്റ് അദ്ധ്യാപകർ എന്നിവർ പങ്കെടുത്തു.

കൂടാതെ കഴിഞ്ഞ ഒരു വർഷക്കാലമായി വെങ്ങാനൂർ ഗ്രാമ പഞ്ചായത്തിന്റെ നേതൃത്വത്തിൽ വെങ്ങാനൂർ ഗേൾസ് ഹയർ സെക്കണ്ടറി സ്കൂൾ, ഗവ: മോഡൽ എച്ച്.എസ്.എസ് ചാവടി നട എന്നീ സ്കൂളുകളിലെ നൂറോളം വിദ്യാർത്ഥികൾക്കായി നടന്നുവന്ന യോഗ പരിശീലന കളരിയുടെ സമാപനത്തോടനുബന്ധിച്ച് അന്താരാഷ്ട്ര യോഗ ദിനാചരണത്തിന്റെ ഭാഗമായി അയ്യൻകാളി സ്മൃതി മണ്ഡപത്തിൽ നിന്ന് ആരംഭിച്ച റാലിയിലും തുടർന്ന് വെങ്ങാനൂർ ഗേൾസ് ഹയർസെക്കൻഡറി സ്കൂളിൽ നടന്ന യോഗാ ദിനാചരണത്തിലും അദാനി ഫൗണ്ടേഷൻ മേധാവി ഡോക്ടർ. അനിൽ ബാലകൃഷ്ണൻ മുഖ്യപ്രഭാഷണം നടത്തുകയുണ്ടായി.

വെങ്ങാനൂർ ഗ്രാമപഞ്ചായത്ത് പ്രസിഡന്റ് ശ്രീമതി. ശ്രീകലയുടെ അധ്യക്ഷതയിൽ നടന്ന യോഗത്തിൽ വെങ്ങാനൂർ ഗ്രാമപഞ്ചായത്ത് വൈസ് പ്രസിഡന്റ് ശ്രീമാൻ സതീഷ്, ഹോമിയോ കോളേജ് പ്രൊഫസർ ഡോക്ടർ രഘു, ആയുർവേദ ഹോസ്പിറ്റൽ പ്രൊഫസർ ദുർഗ്ഗാപ്രസാദ്, ഹെഡ്മിസ്ട്രസ് ശ്രീമതി. ശ്രീലത ദേവി , പി.ടി .എ പ്രസിഡൻറ് ശ്രീ. ഹരീന്ദ്രൻ നായർ, ഗ്രാമ പഞ്ചായത്ത് മെമ്പർമാരായ ശ്രീ. ലാലൻ, ശ്രീ.രാജയ്യൻ, സ്കൂൾ അദ്ധ്യാപകർ എന്നിവർ പങ്കെടുത്തു. പ്രസ്തുത പരിപാടിക്ക് അദാനി ഫൗണ്ടേഷൻ സിഎസ്ആർ അംഗങ്ങളായ ശ്രീമാൻ. ജോർജ് സെൻ, ശ്രീ.വിനോദ്, ശ്രീമതി. ഗായത്രി, ശ്രീ. ശ്രീനാഥ് ,ശ്രീമതി.മായ, കുമാരി. മീര മറിയം സ്ക്കറിയ, ശ്രീമതി. ലിംന നേതൃത്വം നൽകി .

ടികൾ
എതിരെ

തൽ മുടക്കാനെത്തുന്ന സംരംഭകരെ പിന്നോട്ടടിക്കും. ഇത് വികസനത്തെ ബാധിക്കുമെന്നും ചീഫ് ജസ്റ്റിസ് ഋഷികേശ് റോയിയും ജസ്റ്റിസ് എ.കെ. ജയശങ്കരൻ നമ്പ്യാ

9. News on Blood donation and dress distribution under EVP in Nautical Times 25.06.2019

അദാനിയുടെ പിറന്നാൾ; വിഴിഞ്ഞത്ത് ജീവകാരുണ്യപ്രവർത്തനവുമായി കമ്പനി

10. News on Blood donation and dress distribution under EVP in Nautical Times 25.06.2019

കേരള കൗമുദി
SINCE 1911
Trivandrum 26 Jun 2019

അദാനി ഗ്രൂപ്പ് സ്നേഹ സാന്ദ്രം ഓൾഡേജ് ഹോമിലെ അന്തേവാസികൾക്ക് നടത്തിയ വസ്ത്ര വിതരണം

അദാനി ഗ്രൂപ്പിന്റെ നേതൃത്വത്തിൽ രക്ത ദാനവും വസ്ത്രവിതരണവും

വിഴിഞ്ഞം: അദാനി ഗ്രൂപ്പ് ഉടമ ഗൗതം അദാനിയുടെ ജന്മദിനം പ്രമാണിച്ച് രക്തദാനക്യാമ്പ് സംഘടിപ്പിച്ചു. അദാനി ഗ്രൂപ്പിന്റെ വിവിധ സാമൂഹ്യ സേവന പ്രവർത്തനങ്ങളുടെ ഭാഗമായി സംഘടിപ്പിച്ച ക്യാമ്പ് സി.ഇ.ഒ. രാജേഷ് ഝാ ഉദ്ഘാടനം ചെയ്തു. നെയ്യാറ്റിൻകര നിംസ് ആശുപത്രിയുടെ സഹകരണത്തോടെയാണ് രക്തദാന ക്യാമ്പ് സംഘടിപ്പിച്ചത്. കൂടാതെ ജന്മദിനാഘോഷങ്ങളുടെ ഭാഗമായി വിഴിഞ്ഞം കേന്ദ്രീകരിച്ച് പ്രവർത്തിക്കുന്ന സ്നേഹ സാന്ദ്രം ഓൾഡ് ഏജ് ഹോമിലെ അന്തേവാസികൾക്ക് അദാനി ജീവനക്കാർ വസ്ത്രങ്ങളും വിതരണം ചെയ്തു. വൃക്ഷത്തൈ നടൽ അദാനി ഫൗണ്ടേഷൻ സാമൂഹ്യ പ്രതിബദ്ധതാ വിഭാഗം മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ ഉദ്ഘാടനം ചെയ്തു. അദാനി ഫൗണ്ടേഷൻ പ്രവർത്തകരായ സെബാസ്റ്റ്യൻ ബ്രിട്ടോ, വിനോദ്, ജിതിൻ, ശ്രീനാഥ്, ലിംന, മായ, ഗായത്രി പവിത്രൻ, മീര മറിയം സ്കറിയ എന്നിവർ പങ്കെടുത്തു.

11. News on raincoat distribution in Kerala Kaumudi dated 28.06.2019

കേരളകൗമുദി
SINCE 1911
Trivandrum 28 Jun 2019

അദാനി ഗ്രൂപ്പിന്റെ നേതൃത്വത്തിൽ റെയിൻകോട്ട് വിതരണം

വിഴിഞ്ഞം: അദാനി ഗ്രൂപ്പിന്റെ സാമൂഹ്യപ്രതിബദ്ധത പ്രവർത്തനങ്ങളുടെ ഭാഗമായി മഴക്കാലത്ത് ക്ലീനിംഗ് ജോലികളിൽ ഏർപ്പെടുന്ന ജീവനക്കാർക്ക് റെയിൻകോട്ട് വിതരണം ചെയ്തു. റെയിൻകോട്ടുകളുടെ വിതരണം മേയർ വി.കെ. പ്രശാന്ത് നിർവഹിച്ചു.

ആരോഗ്യ സ്റ്റാൻഡിംഗ് കമ്മിറ്റി ചെയർമാൻ ശ്രീകുമാറിന്റെ അദ്ധ്യക്ഷതയിൽ അദാനി കോർപറേറ്റ് റിലേഷൻസ് മേധാവി സുശീൽകുമാർ, സാമൂഹ്യപ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോക്ടർ അനിൽ ബാലകൃഷ്ണൻ, വാർഡ് കൗൺസിലർമാരായ ഓമന, നിസാബി വി, ഡബ്ല്യു. ഷൈനി, സന്തോഷ്, റഷീദ് എന്നിവർ മുഖ്യാതിഥികളായിരുന്നു. നഗരസഭയിലെ വിഴിഞ്ഞം സോണിലെ 45 ജീവനക്കാർക്കാണ് കോട്ടുകൾ വിതരണം ചെയ്തത്.

വിഴിഞ്ഞം സോണൽ ഹെൽത്ത് ഇൻസ്പെക്ടറായ പ്രേം നവാസ്, ജൂനിയർ ഹെൽത്ത് ഇൻസ്പെക്ടർമാരായ ഷീന എസ്. ദാസ്, റഹിം ഖാൻ, രാജി .വി.എസ്, അദാനി സി.എസ്.ആർ പ്രവർത്തകരായ സെബാസ്റ്റ്യൻ ബ്രിട്ടോ, ജോർജ്, വിനോദ്, ജിതിൻ എന്നിവർ നേതൃത്വം നൽകി.

അദാനി തുറമുഖ കമ്പനിയുടെ നേതൃത്വത്തിൽ വിഴിഞ്ഞം നഗരസഭാ സോണൽ ഓഫീസ് സാനിട്ടേഷൻ ജീവനക്കാർക്കുള്ള റെയിൻകോട്ടിന്റെ വിതരണോദ്ഘാടനം മേയർ വി.കെ.പ്രശാന്ത് നിർവഹിക്കുന്നു.

12. .News on raincoat distribution in Nautical Times and Malayala Manorama

മഴക്കോട്ടുകൾ വിതരണം ചെയ്തു

വിഴിഞ്ഞം● അദാനി തുറമുഖ കമ്പനിയുടെ സാമൂഹിക പ്രതിബദ്ധതാ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി വിഴിഞ്ഞം മേഖലയിലെ ശുചീകരണ ജീവനക്കാർക്ക് മഴക്കോട്ടുകൾ വിതരണം ചെയ്തു. മേയർ വി.കെ. പ്രശാന്ത് വിതരണ ഉദ്ഘാടനം നിർവഹിച്ചു. ആരോഗ്യ സ്റ്റാൻഡിങ് കമ്മിറ്റി ചെയർമാൻ ശ്രീകുമാർ അധ്യക്ഷത വഹിച്ച ചടങ്ങിൽ അദാനി കോർപറേറ്റ് റിലേഷൻസ് മേധാവി സുശീൽകുമാർ, സാമൂഹിക പ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോ അനിൽ ബാലകൃഷ്ണൻ കൗൺസിലർമാരായ ഓമന, നിസാ ബിവി, ഡബ്ലിയു. ഷൈനി, സന്തോഷ്, റഷീദ് എന്നിവർ പ്രസംഗിച്ചു.

സാനിട്ടേഷൻ ജീവനക്കാർക്ക് മഴക്കോട്ടുമായി അദാനി തുറമുഖ കമ്പനി

വിഴിഞ്ഞം: അദാനി തുറമുഖ കമ്പനിയുടെ സാമൂഹ്യ പ്രതിബദ്ധതാ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി മഴക്കാലത്തും നിർബാധം ക്ലീനിങ് ജോലികളിൽ ഏർപ്പെടുന്നതായി വിഴിഞ്ഞം സോണിലെ സാനിട്ടേഷൻ ജീവനക്കാർക്ക് മഴക്കോട്ടുകൾ വിതരണം ചെയ്തു.

തിരുവനന്തപുരം കോർപ്പറേഷൻ ഓഫീസ് കോൺഫറൻസ് ഹാളിൽ വച്ച് നടന്ന മഴക്കോട്ടുകളുടെ വിതരണം ബഹുമാനപ്പെട്ട മേയർ അഡ്വ. വി.കെ. പ്രശാന്ത് അവർകൾ നിർവഹിച്ചു.

ബഹുമാനപ്പെട്ട ആരോഗ്യ സ്റ്റാൻഡിങ് കമ്മിറ്റി ചെയർമാൻ ശ്രീ. ശ്രീകുമാർ അധ്യക്ഷത വഹിച്ച ചടങ്ങിൽ അദാനി കോർപ്പറേറ്റ് റിലേഷൻസ് മേധാവി ശ്രീ. സുശീൽ കുമാർ, സാമൂഹ്യപ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോക്ടർ. അനിൽ ബാലകൃഷ്ണൻ വാർഡ് കൗൺസിലർമാരായ ശ്രീമതി. ഓമന, ശ്രീമതി. നിസ്സാബിവി, കുമാരി.ഡബ്ലിയു. ഷൈനി, ശ്രീ. സന്തോഷ്, ശ്രീ. റഷീദ് എന്നിവർ മുഖ്യാതിഥികളായിരുന്നു.

തിരുവനന്തപുരം നഗരസഭയിലെ വിഴിഞ്ഞം സോണിലെ 45 ജീവനക്കാർക്കാണ് മഴക്കോട്ടുകൾ വിതരണം ചെയ്തത്. വിഴിഞ്ഞം സോണൽ ഹെൽത്ത് ഇൻസ്പെക്ടറായ ശ്രീ പ്രേം നവാസ്, ജൂനിയർ ഹെൽത്ത് ഇൻസ്പെക്ടർമാരായ ശ്രീ. ഷിനു എസ് ദാസ്, ശ്രീ. റഹിം ഖാൻ, ശ്രീമതി. രാജി വി.എസ് എന്നിവരെ കൂടാതെ അദാനി സി.എസ് .ആർ പ്രവർത്തകരായ ശ്രീ. സെബാസ്റ്റ്യൻ ബ്രിട്ടോ, ശ്രീ ജോർജ് , ശ്രീ. വിനോദ്, ശ്രീ.ജിതിൻ എന്നിവർ മഴക്കോട്ട് വിതരണത്തിന് നേതൃത്വം നൽകി.

വിഴിഞ്ഞം പ്രദേശത്തെ ക്ലീനിങ് പ്രവർത്തനങ്ങളിലും മാലിന്യസംസ്കരണ പ്രവർത്തനങ്ങളിലും സാമൂഹ്യപ്രതിബദ്ധതാ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി നിർമ്മിച്ച തുമ്പൂർമുഴി എയറോബിക് ബിന്നുകളുടെയും ടോയ്‌ലറ്റുകളുടെ പരിപാലനത്തിനും സുതൃർഹമായ സേവനമാണ് അദാനി സാമൂഹ്യപ്രതിബദ്ധതാ പ്രവർത്തകരുടെ സഹായത്തോടെ സാനിട്ടേഷൻ ജീവനക്കാർ നിർവഹിക്കുന്നതെന്ന് മേയർ അഭിപ്രായപ്പെട്ടു. മാലിന്യസംസ്കരണ പ്രവർത്തനങ്ങളിലും മറ്റും തുടർന്നും അദാനി തുറമുഖ കമ്പനിയുടെ സേവനം ലഭ്യമാക്കുമെന്നും അദ്ദേഹം പറഞ്ഞു.

13. News on raincoat distribution in Mangalam on 28.06.2019

ശുചീകരണ തൊഴിലാളികൾക്കുള്ള മഴക്കോട്ടുകളുടെ വിതരണം മേയർ വി.കെ പ്രശാന്ത് നിർവഹിക്കുന്നു

നഗരസഭ ശുചീകരണ തൊഴിലാളികൾക്ക് മഴക്കോട്ടുകൾ വിതരണം ചെയ്തു

വിഴിഞ്ഞം: നഗരസഭയുടെ വിഴിഞ്ഞം സോണലിന് കീഴിലെ ശുചീകരണ തൊഴിലാളികൾക്ക്

അദാനി തുറമുഖ കമ്പനിയുടെ സാമൂഹ്യപ്രതിബദ്ധതാ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി മഴക്കോട്ടുകൾ വിതരണം ചെയ്തു. തിരുവനന്തപുരം കോർപ്പറേഷൻ ഓഫീസ് കോൺഫറൻസ് ഹാളിൽ നടന്ന ചടങ്ങിൽ മേയർ അഡ്വ. വി.കെ. പ്രശാന്ത് മഴക്കോട്ടുകൾ വിതരണം ചെയ്തു.

ആരോഗ്യ സ്റ്റാൻഡിംഗ് കമ്മിറ്റി ചെയർമാൻ ശ്രീകുമാർ അധ്യക്ഷത വഹിച്ചു. അദാനി കോർപ്പറേറ്റ് റിലേഷൻസ് മേധാവി സുധീർകുമാർ, സാമൂഹ്യപ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോക്ടർ. അനിൽ ബാലകൃഷ്ണൻ കൗൺസിലർമാരായ ഓമന, നിസ്സാബീവി, ഷൈനി, സന്തോഷ്, റഷീദ് എന്നിവർ പങ്കെടുത്തു. വിഴിഞ്ഞം സോണിലെ 45 ജീവനക്കാർക്കാണ് മഴക്കോട്ടുകൾ വിതരണം ചെയ്തത്.

ICC EVENT REVIEWS KERALA'S STARTUP ECOSYSTEM

The one-day event organised by Indian Chamber of Commerce included technical sessions, keynote speeches and idea pitching session by startups

Acknowledging the vibrant startup ecosystem in Kerala being nurtured with the ample backing of Kerala Startup Mission (KSUM), Indian Chamber of Commerce (ICC) organised ICC Kerala Startup Meet 2019 in Thiruvananthapuram on June 13. The first-of-its-kind event oraganised by the commerce body in Kerala was themed on 'Ideate, Innovate, Implement'.

The one-day event included technical sessions, keynote speeches and idea pitching session by startups which had registered for the event. The morning session, Challenges and Solutions for Funding of Startups & MSMEs, was chaired by Dr. Saji Gopinath, CEO, KSUM. P K Gopalakrishnan, Member, Indian Angel Network; B Jyothikumar, Executive Director, Kerala State Industrial Development Corporation (KSIDC); Suresh Babu A S, Director, Innovations Endeavours India; M R Narayanan, MD, Poovar Island Resort and Joseph Tharun, Manager, Small Industries Development Bank of India (SIDBI) took part in the deliberations.

"I am really confident that with the young population and Technopark in the near vicinity, there will be a lot of startups here which will be collaborating with Vizhinjam Seaport, creating a massive and vibrant ecosystem," said Rajesh Jha, MD & CEO, Adani Vizhinjam Ports at the inaugural session.

Sanjeev Kaushik, Chairman and MD, Kerala Financial Corporation (KFC) delivered the inaugural address. Speaking about startups, he said that it is important for the investors to realise that some of the startup experiments will be successful while some may fail. "However, it is important that you learn from each experiment and innovation," he said.

"The theme of the session is Ideation, Innovation and Implementation. I must congratulate ICC for coming up with this theme because it is a very relevant topic in the growth story of the country. People here are smart and they are good at ideating and innovating. However, we encounter problems when it comes to the implementing stage where execution and delivery are very important," he added.

There are many success stories in Kerala's startup ecosystem. However, absence of a formal hand-holding mechanism to guide the startups was pointed out as a major shortcoming of the ecosystem. "This is something we currently lack in India," the KFC chief observed.

Startups I Boson Innovation, Mibiz Consultancy Services, Sastra Robotics and Indo Grace E-commerce pitched ideas in the live idea pitching session.

P K Gopalakrishnan and Ajay Prabhu, members, Indian Angel Network; Dr. Anil Balakrishnan, Head CSR, Adani Foundation; Roy Verghese, Senior Partner, Roy Verghese & Associates; Robin Alex Panicker, entrepreneur and investor and Debmalya Banerjee, Regional Director, Indian Chamber of Commerce (ICC) were the jury members of the idea pitching session. The event organised by ICC was partnered by KSIDC, KSUM, SIDBI, KFC, SREI and Indian Angel Network.

Kerala Kaumudi News on Inauguration of two storied building at Govt. UPS Mulloor Panavila

കേരളകൗമുദി

ശാസ്ത്രത്തെ വിദ്യാർത്ഥി കേന്ദ്രീകൃതമാക്കും : മന്ത്രി രവീന്ദ്രനാഥ്

Mathrubhumi News on Inauguration of two storied building at Govt. UPS Mulloor Panavila

മുല്ലൂർ ഗവ. യു.പി.സ്കൂളിന് പുതിയ ഇരുനിലമന്ദിരമായി

വിഴിഞ്ഞം ► അദാനി തുറമുഖ കമ്പനിയുടെ സാമൂഹിക പ്രതിബദ്ധതാ പദ്ധതിയിലുൾപ്പെടുത്തി നിർമിച്ച ഗവ.മുല്ലൂർ പനവിള സ്കൂളിലെ പൂർത്തീകരിച്ച പത്ത് ക്ലാസ് മുറികളുള്ള ഇരുനിലമന്ദിരത്തിന്റെ ഉദ്ഘാടനം മന്ത്രി സി .രവീന്ദ്രനാഥ് നിർവഹിച്ചു.

സ്കൂളുകളുടെ അക്കാദമിക് മികവ് വർധിപ്പിക്കുന്നതിനായി 45000 വിദ്യാലയങ്ങളെ ഹൈടെക് ആക്കുന്ന പ്രക്രിയയിൽ ആദ്യഘട്ടത്തിൽത്തന്നെ ഗവ. യു.പി.സ്കൂളിനെ ഉൾപ്പെടുത്തുമെന്ന് അദ്ദേഹം പറഞ്ഞു. മന്ത്രി രാമചന്ദ്രൻ കടന്നപ്പള്ളി അധ്യക്ഷനായി.

ജീവകാരുണ്യ പ്രവർത്തനങ്ങളോടൊപ്പം വിദ്യാഭ്യാസ പുരോഗതിക്കായി അദാനി തുറമുഖ കമ്പനി നടത്തുന്ന പ്രവർത്തനങ്ങളും പ്രശംസനീയമാണെന്ന് മന്ത്രി രാമചന്ദ്രൻ കടന്നപ്പള്ളി പറഞ്ഞു. എം. വിൻസെന്റ് എം.എൽ.എ. മുഖ്യപ്രഭാഷണം നടത്തി. മേയർ വി.കെ.പ്രശാന്ത് മുഖ്യാതിഥിയായി. വിഴിഞ്ഞം ഇന്റർനാഷണൽ സീ പോർട്ട് എം.ഡി. ഡോ. ജയകുമാർ, തിരുവനന്തപുരം നഗരസഭാ വിദ്യാഭ്യാസ സ്റ്റാൻഡിങ് കമ്മിറ്റി ചെയർമാൻ സി. സുദർശൻ, കൗൺസിലർ സി.ഓമന, എസ്.എസ്.കെ.ഡിസ്ട്രിക്ട് പ്രോജക്ട് ഓഫീസർ ശ്രീകുമാരൻ, വിഴിഞ്ഞം പോർട്ട് കോർപ്പറേറ്റ് മേധാവി സുശീൽ നായർ, സാമൂഹിക പ്രതിബദ്ധതാ വിഭാഗം മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ, പി.ടി.എ. പ്രസിഡന്റ് വി.എൻ. അജി, സ്കൂൾ വികസനസമിതി ചെയർമാൻ വയൽക്കര ശശിധരൻ, സ്റ്റാഫ് സെക്രട്ടറി എസ്.ടി.ശിവകുമാർ എന്നിവർ സംസാരിച്ചു

ഗവ.മുല്ലൂർ പനവിള സ്കൂളിന് തുറമുഖ കമ്പനിയുടെ സാമൂഹിക പ്രതിബദ്ധതാ പദ്ധതിയിലുൾപ്പെടുത്തി നിർമിച്ച ക്ലാസ് മുറികളുടെ ഉദ്ഘാടനം മന്ത്രി സി.രവീന്ദ്രനാഥ് നിർവഹിക്കുന്നു

The Indian Express News on Inauguration of two storied building at Govt. UPS Mulloor Panavila

New building for Mulloor UP School

EXPRESS NEWS SERVICE
@T'Puram

THE two-storied building at Mulloor Panavila Government UP School constructed under the CSR programme of Adani Foundation was inaugurated by Education Minister Prof C Raveendranath on Wednesday. Ports Minister Kadannappally Ramachandran presided over the function. Kovalam MLA M Vincent delivered the keynote address. Mayor VK Prasanth was the chief guest.

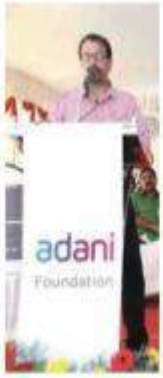
"The government aims to change the teacher-centric education process to student-centric system," Raveendranath said. He thanked the Adani Foundation for donating the building that was build at at a cost of ₹1.5 crore. The Mayor extended support for the school's furniture needs.

Vizhinjam International Sea Port M D Jayakumar, City Corporation's Education Standing Committee chairman C Sudarsan, Mulloor ward councillor C Omana, SSK district project officer C Sreekumar, Vizhinjam Port corporate head Sushil Nair, CSR head Anil Balakrishnan, PTA president V N Aji, School Development Group chairman Vayalakkara Sasidharan and others were also present at the function.

The previous of the group include a two-storied building at the Harbour Area LP school and a playground at the St. Mary's Higher Secondary School.

Nautical Times News on Inauguration of two storied building at Govt. UPS Mulloor Panavila

മുല്ലൂർ, പനവിള ഗവ. യു.പി. സ്കൂളിനായി നിർമ്മിച്ച പുതിയ ഇരുനില മന്ദിരം സ്കൂളിന് സമർപ്പിച്ചു



The Hindu News on Inauguration of two storied building at Govt. UPS Mulloor Panavila

IN BRIEF

Two-storey building under CSR initiative

THIRUVANANTHAPURAM

A ₹1.5 crore two-storey building constructed under the Corporate Social Responsiblity (CSR) of Adani Foundation for the Government Upper Primary Schoo, Mulloor Panavila near Vizhinjam was formally inaugurated by Minister for Education, C. Ravindranath on Wednesday.

Janayugam News on Inauguration of two storied building at Govt. UPS Mulloor Panavila

മുല്ലൂർ പനവിള ഗവ. യുപി സ്കൂളിന് പുതിയ ഇരുനില മന്ദിരം

Mangalam News on Inauguration of two storied building at Govt. UPS Mulloor Panavila

മുല്ലൂർ, പനവിള ഗവ.യു.പി. സ്കൂൾ മന്ദിരം ഉദ്ഘാടനം ചെയ്തു

Metro Vartha News on Inauguration of two storied building at Govt. UPS Mulloor Panav

മുല്ലൂർ ഗവ.യുപി സ്കൂളിന് പുതിയ ഇരുനില മന്ദിരം

മുല്ലൂർ പനവിള ഗവ. സ്കൂളിൽ പുതുതായി നിർമ്മിച്ച ഇരുനില മന്ദിരത്തിന്റെ ഉദ്ഘാടനം മന്ത്രി പ്രൊഫ. സി. രവീന്ദ്രനാഥ് നിർവഹിക്കുന്നു.

വിഴിഞ്ഞം: മുല്ലൂർ പനവിള ഗവ. സ്കൂളിൽ പുതുതായി നിർമ്മിച്ച 10 ക്ലാസ് മുറികളുള്ള ഇരുനില മന്ദിരത്തിന്റെ ഉദ്ഘാടനം മന്ത്രി പ്രൊഫ.സി. രവീന്ദ്രനാഥ് നിർവഹിച്ചു. മന്ത്രി രാമചന്ദ്രൻ കടന്നപ്പള്ളി അധ്യക്ഷത വഹിച്ചു. അഡ്വ. എം. വിൻസെന്റ് എംഎൽഎ മുഖ്യപ്രഭാഷണം നടത്തി. മേയർ അഡ്വ. വി.കെ. പ്രശാന്ത് വിശിഷ്ടാതിഥിയായി.

അക്കാദമിക്ക് മികവ് വർധിപ്പിക്കുന്നതിനായി 45,000 വിദ്യാലയങ്ങളെ ഹൈടെക്ക് ആക്കുന്ന പ്രക്രിയയിൽ ആദ്യഘട്ടത്തിൽ തന്നെ ഗവ. പനവിള യുപി സ്കൂളിനെ ഉൾപ്പെടുത്തുമെന്ന് മന്ത്രി. സാമൂഹ്യ പ്രതിബദ്ധതാ പദ്ധതിയിൽ ഒന്നരക്കോടിയോളം രൂപ മുടക്കി സ്കൂളിനായി മനോഹരമായ ഇരുനില മന്ദിരം നിർമ്മിച്ചു നൽകിയ അദാനി തുറമുഖ കമ്പനിയെ സർക്കാരിനു വേണ്ടി മന്ത്രി അഭിനന്ദിച്ചു. വിഴിഞ്ഞം ഇന്റർനാഷണൽ സീ പോർട്ട് എംഡി ഡോ. ജയകുമാർ, തിരുവനന്തപുരം നഗരസഭ വിദ്യാഭ്യാസ സ്റ്റാൻഡിങ് കമ്മിറ്റി ചെയർമാൻ സി. സുദർശൻ, മുല്ലൂർ വാർഡ് കൗൺസിലർ സി. ഓമന, എസ്എസ്കെ ഡിസ്ട്രിക്ട് പ്രൊജക്ട് ഓഫീസർ ശ്രീകുമാരൻ, വിഴിഞ്ഞം പോർട്ട് കോർപ്പറേറ്റ് ഹെഡ് സുശീൽ നായർ, സാമൂഹ്യ പ്രതിബദ്ധത വിഭാഗം മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ, പിടിഎ പ്രസിഡന്റ് വി.എൻ. അജി, സ്കൂൾ വികസന സമിതി ചെയർമാൻ വയൽക്കര ശശിധരൻ എന്നിവർ സംസാരിച്ചു. വിഴിഞ്ഞം തുറമുഖ കമ്പനിയുടെ സാമൂഹ്യപ്രതിബദ്ധതാ പദ്ധതിയിലുൾപ്പെടുത്തി നിർമ്മിക്കുന്ന രണ്ടാമത്തെ സ്കൂൾ മന്ദിരമാണ് മുല്ലൂർ ഗവൺമെന്റ് യുപി സ്കൂളിലേത്.

കൂടാതെ സെന്റ് മേരീസ് ഹയർ സെക്കൻഡറി സ്കൂളിൽ നിർമാണം പൂർത്തിയായി വരുന്ന ഫുട്ബോൾ, ബാസ്കറ്റ്ബോൾ, വോളിബോൾ, ലോംഗ്ജമ്പ് പിറ്റുകൾ അടങ്ങിയ കളിസ്ഥലം വരും ദിവസങ്ങളിൽ സ്കൂളിന് കൈമാറുമെന്ന് സാമൂഹ്യ പ്രതിബദ്ധതാ വിഭാഗം പ്രതിനിധികൾ പറഞ്ഞു.

മെട്രോ വാർത്ത Fri, 05 July 2019
epaper.metrovaartha.com/c/41071378

Dainik Bhaskar, 05/07/2019

नए स्कूल भवन के उद्घाटन के साथ अदाणी फाउंडेशन ने ज्ञान की रोशनी फैलाई

आगरा। अदाणी फाउंडेशन ने केरल के विजिनजाम में मुल्लूर उच्च प्राथमिक विद्यालय के नवनिर्मित भवन का उद्घाटन किया। इस अवसर पर स्कूल परिसर में आयोजित एक समारोह में राज्य के शिक्षा मंत्री प्रो. सी. रवींद्रनाथ और बंदरगाह राज्य मंत्री रामचंद्रन कदनापल्ली उपस्थित रहे।

एक साल पहले, स्कूल प्रशासन, जिला प्रशासन और अदाणी फाउंडेशन ने साथ मिलकर संकटग्रस्ती स्कूल को उसका पुराना गौरव वापस दिलाया था। अदाणी फाउंडेशन ने छात्रों को गुणवत्ता वाले बुनियादी ढांचा प्रदान करने के लिए दो मंजिला स्कूल भवन का निर्माण किया, जो ज्ञानार्जन की प्रक्रिया का अभिन्न अंग है। इसके परिणामस्वरूप, स्कूल में छात्रों की संख्यान अब 168 हो गई है।

''अदाणी फाउंडेशन का मानना है कि शिक्षा गरिमा और समानता के साथ जीवन जीने के लिए उठाया गया पहला कदम है। जब हम प्रभावी ज्ञानार्जन के लिए सक्षम करने वाला सुविधाजनक वातावरण बनाते हैं, तो हम अपने बच्चों को राष्ट्र निर्माण की दिशा में भावी प्रयासों के लिए तैयार करते हैं।'' डॉ. प्रीति अदाणी, चेयरपर्सन, अदाणी फाउंडेशन ने कहा अदाणी स्कूल और इसके अभिनव शिक्षा कार्यक्रम, हर साल हजारों युवाओं को उच्च प्रतिस्पर्धा वाली दुनिया की चुनौतियों का सफलतापूर्वक सामना करने और उज्ज्वल भविष्य को सुरक्षित करने के लिए तैयार कर रहे हैं।

Adani Foundation brings the joy of learning with new school building

Adani Foundation inaugurated the newly constructed building of Mulloor Upper Primary School in Vizhinjam, Kerala, in the presence of State Education Minister Prof. C. Raveendranath and State Minister for Ports Mr. Ramachandran Kadanapalli, in a ceremony at the school premises. A year ago, the school authorities, the District Administration and Adani Foundation came together to bring the ailing school to its former glory. Adani Foundation constructed the two-story school building to provide students with quality infrastructure which is an integral part of the learning process.As a result, the school has attracted 168 students now. "Adani Foundation believes that Education is the stepping stone to lead a life of dignity and equality. When we create a facilitating environment that enables effective learning, we make our children ready for future endeavours towards nation building," said Dr. Priti Adani, Chairperson, Adani Foundation. When we create a facilitating environment that enableseffective learning, we make our children ready for future endeavours towards nation building.

Yug Marg, 05/07/2019

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CHANDIGARH: Adani Foundation inaugurated the newly constructed building of Mulloor Upper Primary School in Vizhinjam, Kerala, in the presence of State Education Minister Prof.C. Ravindranath andState Minister for Ports Mr. Ramachandran Kadannappally, in a ceremony at the school premises. A year ago, the school authorities, the District Administration and Adani Foundation came together to bring theailing school to its former glory. Adani Foundation constructed the two-story school building to provide students with quality infrastructure which is an integral part of the learning process. As a result, the school has attracted 168 students now."Adani Foundation believes that Education is the stepping stone to lead a life of dignity and equality. When we create a facilitating environment that enables effective learning, we make our children ready for future endeavours towards nation building," said Dr.Priti Adani, Chairperson, Adani Foundation. Adani schools and its innovative education programmes have been preparing thousands of young minds every year to navigate the challenges of a highly competitive world successfully and secure a bright future.

नए स्कूल भवन के उद्घाटन के साथ अदाणी फाउंडेशन ने ज्ञान की रोशनी फैलायी

नई दिल्ली। अदाणी फाउंडेशन ने केरल के विजिनजाम में मुल्लू र उच्च प्राथमिक विद्यालय के नवनिर्मित भवन का उद्घाटन किया। इस अवसर पर स्कूल परिसर में आयोजित एक समारोह में राज्य के शिक्षा मंत्री प्रोण सीण रवींद्रनाथ और बंदरगाह राज्य मंत्री श्री रामचंद्रन कदनापल्ली उपस्थिति रहे।

एक साल पहले स्कूल प्रशासनए जिला प्रशासन और अदाणी फाउंडेशन ने साथ मिलकर संकटग्रस्तव स्कूल को उसका पुराना गौरव वापस दिलाया था। अदाणी फाउंडेशन ने छात्रों को गुणवत्ता वाले बुनियादी ढांचा प्रदान करने के लिए दो मंजिला स्कूल भवन का निर्माण कियाए जो ज्ञानार्जन की प्रक्रिया का अभिन्न अंग है। इसके परिणामस्वरूपए स्कूल में छात्रों की संख्याा अब 168 हो गई है।

श्अदाणी फाउंडेशन का मानना है कि शिक्षा गरिमा और समानता के साथ जीवन जीने के लिए उठाया गया पहला कदम है। जब हम प्रभावी ज्ञानार्जन के लिए सक्षम करने वाला सुविधाजनक वातावरण बनाते हैंए तो हम अपने बच्चों को राष्ट्र निर्माण की दिशा में भावी प्रयासों के लिए तैयार करते हैंएश डॉण प्रीति अदाणीए चेयरपर्सनए अदाणी फाउंडेशन ने कहा।

Navsatta, 05/07/2019

नए स्कूल भवन के उद्घाटन के साथ अदाणी फाउंडेशन ने ज्ञान की रोशनी फैलायी

संवाददाता

लखनऊ, 04 जुलाई (नवसत्ता)। अदाणी फाउंडेशन ने केरल के विजिनजाम में मुल्लूजर उच्च प्राथमिक विद्यालय के नवनिर्मित भवन का उद्घाटन किया। इस अवसर पर स्कूल परिसर में आयोजित एक समारोह में राज्य के शिक्षा मंत्री प्रो. सी. रवींद्रनाथ और बंदरगाह राज्य मंत्री रामचंद्रन कदनापल्ली उपस्थित रहे। एक साल पहले, स्कूल प्रशासन, जिला प्रशासन और अदाणी फाउंडेशन ने साथ मिलकर संकटग्रस्त स्कूल को उसका पुराना गौरव वापस दिलाया था। अदाणी फाउंडेशन ने छात्रों को गुणवत्ता वाले बुनियादी ढांचा प्रदान करने के लिए दो मंजिला स्कूल भवन का निर्माण किया, जो ज्ञानार्जन की प्रक्रिया का अभिन्न अंग है। इसके परिणामस्वरूप, स्कूल में छात्रों की संख्या अब 168 हो गई है। अदाणी फाउंडेशन का मानना है कि शिक्षा गरिमा और समानता के साथ जीवन जीने के लिए उठाया गया पहला कदम है। जब हम प्रभावी ज्ञानार्जन के लिए सक्षम करने वाला सुविधाजनक वातावरण बनाते हैं, तो हम अपने बच्चों को राष्ट्र निर्माण की दिशा में भावी प्रयासों के लिए तैयार करते हैं, डॉ. प्रीति अदाणी, चेयरपर्सन, अदाणी फाउंडेशन ने कहा। अदाणी स्कूल और इसके अभिनव शिक्षा कार्यक्रम, हर साल हजारों युवाओं को उच्च प्रतिस्पर्धा वाली दुनिया की चुनौतियों का सफलतापूर्वक सामना करने और उज्ज्वल भविष्य को सुरक्षित करने के लिए तैयार कर रहे हैं। अहमदाबाद (गुजरात), भद्रेश्वर (गुजरात) और सरगुजा (छत्तीसगढ़) में अदाणी विद्या मंदिर निम्न आय वर्ग के परिवारों के 2100 बच्चों को मुफ्त शिक्षा प्रदान करते हैं। इन स्कूलों में अत्याधुनिक बुनियादी ढांचा और काफी योग्य शिक्षक कार्यरत हैं। मुंद्रा (गुजरात) में अदाणी पब्लिक स्कूल, तिरोरा (महाराष्ट्र) और कवाई (राजस्थान) में अदाणी विद्यालय, धामरा (ओडिशा) में अदाणी डीएवी पब्लिक स्कूल और हजीरा (गुजरात) में नवचेतन विद्यालय सहायता प्राप्त गुणवत्ता शिक्षा प्रदान करते हैं। अदाणी विद्या मंदिर, अहमदाबाद (एवीएमए) भारत का पहला लागत-मुक्त शिक्षा देने वाला विद्यालय है जिसे भारतीय गुणवत्ता परिषद द्वारा एनएबीईटी मान्यता प्राप्त है। इसके अलावा, एवीएमए भारत का एकमात्र स्कूल है जिसने कोडिंग सैंडपिट को अपने नियमित पाठ्यक्रम में शामिल किया है। संयोगवश, अदाणी पब्लिक स्कूल, मुंद्रा सौराष्ट्र और कच्छ क्षेत्र में पहला एनएबीईटी मान्यता प्राप्त स्कूल है। अदाणी फाउंडेशन ज्ञानोदय स्मार्ट ई-लर्निंग कक्षाओं जैसे अभिनव शिक्षण कार्यक्रमों को बढ़ावा दे रहा है, जिसने झारखंड के गोड्डा जिले के 157 ग्रामीण स्कूलों में शिक्षण और सीखने की गुणवत्ता में सुधार किया है। एक वर्ष के भीतर, कक्षा 9 के परिणामों के मामले में गोड्डा जिला ने राज्य के निचले सात जिलों से ऊपर आकर शीर्ष पांच जिलों में अपना स्थान बना लिया है। इसके अलावा, अदाणी फाउंडेशन देश भर में 600 सरकारी स्कूलों और बालवाड़ियों को सहायता प्रदान कर 100,000 बच्चों की गुणवत्तापूर्ण शिक्षा सुनिश्चित कर रहा है।

Dainik Kausar, 05/07/2019

नए स्कूल भवन के उद्घाटन के साथ अदाणी फाउंडेशन ने ज्ञान की रोशनी फैलायी

भोपाल नप्र। अदाणी फाउंडेशन ने केरल के विजिनजाम में मुल्?लूर उच्च प्राथमिक विद्यालय के नवनिर्मित भवन का उद्घाटन किया। इस अवसर पर स्कूल परिसर में आयोजित एक समारोह में राज्य के शिक्षा मंत्री प्रो. सी. रवींद्रनाथ और बंदरगाह राज्य मंत्री श्री रामचंद्रन कदनापल्ली उपस्थित रहे। एक साल पहले, स्कूल प्रशासन, जिला प्रशासन और अदाणी फाउंडेशन ने साथ मिलकर संकटग्रस्?त स्कूल को उसका पुराना गौरव वापस दिलाया था। अदाणी फाउंडेशन ने छात्रों को गुणवत्ता वाले बुनियादी ढांचा प्रदान करने के लिए दो मंजिला स्कूल भवन का निर्माण किया, जो ज्ञानार्जन की प्रक्रिया का अभिन्न अंग है। इसके परिणामस्वरूप, स्कूल में छात्रों की संख्?या अब 168 हो गई है। अदाणी फाउंडेशन का मानना है कि शिक्षा गरिमा और

समानता के साथ जीवन जीने के लिए उठाया गया पहला कदम है। जब हम प्रभावी ज्ञानार्जन के लिए सक्षम करने वाला सुविधाजनक वातावरण बनाते हैं, तो हम अपने बच्चों को राष्ट्र निर्माण की दिशा में भावी प्रयासों के लिए तैयार करते हैं, डॉ. प्रीति अदाणी, चेयरपर्सन, अदाणी फाउंडेशन ने कहा। अदाणी स्कूल और इसके अभिनव शिक्षा कार्यक्रम, हर साल हजारों युवाओं को उच्च प्रतिस्पर्धा वाली दुनिया की चुनौतियों का सफलतापूर्वक सामना करने और उज्ज्वल भविष्य को सुरक्षित करने के लिए तैयार कर रहे हैं। अहमदाबाद (गुजरात), भद्रेश्वर (गुजरात) और सरगुजा (छत्तीसगढ़) में अदाणी विद्या मंदिर निम्न आय वर्ग के परिवारों के 2100 बच्चों को मुफ्त शिक्षा प्रदान करते हैं। इन स्कूलों में अत्याधुनिक बुनियादी ढांचा और काफी योग्य शिक्षक कार्यरत हैं। मुंद्रा (गुजरात) में अदाणी पब्लिक स्कूल, तिरोरा (महाराष्ट्र) और कवाई (राजस्थान) में अदाणी विद्यालय, धामरा (ओडिशा) में अदाणी डीएवी पब्लिक स्कूल और हजीरा (गुजरात) में नवचेतन विद्यालय सहायता प्राप्?त गुणवत्ता शिक्षा प्रदान करते हैं।

Fine Times, 05/07/2019

नए स्कूल भवन के उद्घाटन के साथ अदाणी फाउंडेशन ने ज्ञान की रोशनी फैलायी

अदाणी फाउंडेशन ने केरल के विजिनजाम में मुल्लूर उच्च प्राथमिक विद्यालय के नवनिर्मित भवन का उद्घाटन किया। इस अवसर पर स्कूल परिसर में आयोजित एक समारोह में राज्य के शिक्षा मंत्री प्रोण् सीण् रवींद्रनाथ और बंदरगाह राज्य मंत्री श्री रामचंद्रन कदनापल्ली उपस्थित रहे।

एक साल पहलेए स्कूल प्रशासनए जिला प्रशासन और अदाणी फाउंडेशन ने साथ मिलकर संकटग्रस्त स्कूल को उसका पुराना गौरव वापस दिलाया था। अदाणी फाउंडेशन ने छात्रों को गुणवत्ता वाले बुनियादी ढांचा प्रदान करने के लिए दो मंजिला स्कूल भवन का निर्माण कियाए जो ज्ञानार्जन की प्रक्रिया का अभिन्न अंग है। इसके परिणामस्वरूपए स्कूल में छात्रों की संख्या अब 168 हो गई है।

श्अदाणी फाउंडेशन का मानना है कि शिक्षा गरिमा और समानता के साथ जीवन जीने के लिए उठाया गया पहला कदम है। जब हम प्रभावी ज्ञानार्जन के लिए सक्षम करने वाला सुविधाजनक वातावरण बनाते हैंए तो हम अपने बच्चों को राष्ट्र निर्माण की दिशा में भावी प्रयासों के लिए तैयार करते हैंएश् डॉण् प्रीति अदाणीए चेयरपर्सनए अदाणी फाउंडेशन ने कहा।

अदाणी स्कूल और इसके अभिनव शिक्षा कार्यक्रमए हर साल हजारों युवाओं को उच्च प्रतिस्पर्धा वाली दुनिया की चुनौतियों का सफलतापूर्वक सामना करने और उज्ज्वल भविष्य को सुरक्षित करने के लिए तैयार कर रहे हैं।

अहमदाबाद ;गुजरातद्धए भद्रेश्वर ;गुजरातद्ध और सरगुजा ;छत्तीसगढ़द्ध में अदाणी विद्या मंदिर निम्न आय वर्ग के परिवारों के 2100 बच्चों को मुफ्त शिक्षा प्रदान करते हैं। इन स्कूलों में अत्याधुनिक बुनियादी ढांचा और काफी योग्य शिक्षक कार्यरत हैं।

मुंद्रा ;गुजरातद्ध में अदाणी पब्लिक स्कूलए तिरोरा ;महाराष्ट्रद्ध और कवाई ;राजस्थानद्ध में अदाणी विद्यालयए धामरा ;ओडिशाद्ध में अदाणी डीएवी पब्लिक स्कूल और हजीरा ;गुजरातद्ध में नवचेतन विद्यालय सहायता प्राप्त गुणवत्ता शिक्षा प्रदान करते हैं।

अदाणी विद्या मंदिरए अहमदाबाद ;एवीएमएद्ध भारत का पहला लागत.मुक्त शिक्षा देने वाला विद्यालय है जिसे भारतीय गुणवत्ता परिषद द्वारा एनएबीईटी मान्यता प्राप्त है। इसके अलावाए एवीएमए भारत का एकमात्र स्कूल है जिसने कोडिंग सैंडपिट को अपने नियमित पाठ्यक्रम में शामिल किया है। संयोगवशए अदाणी पब्लिक स्कूलए मुंद्रा सौराष्ट्र और कच्छ क्षेत्र में पहला एनएबीईटी मान्यता प्राप्त स्कूल है।

अदाणी फाउंडेशन ज्ञानोदय स्मार्ट ई.लर्निंग कक्षाओं जैसे अभिनव शिक्षण कार्यक्रमों को बढ़ावा दे रहा हैए जिसने झारखंड के गोड्डा जिले के 157 ग्रामीण स्कूलों में शिक्षण और सीखने की गुणवत्ता में सुधार किया है। एक वर्ष के भीतरए कक्षा 9 के परिणामों के मामले में गोड्डा जिला ने राज्य के निचले सात जिलों से ऊपर आकर शीर्ष पांच जिलों में अपना स्थान बना लिया है। इसके अलावाए अदाणी फाउंडेशन देश भर में 600 सरकारी स्कूलों और बालवाड़ियों को सहायता प्रदान कर 100ए000 बच्चों को गुणवत्तापूर्ण शिक्षा सुनिश्चित कर रहा है।

Pradesh Times, 05/07/2019

नए स्कूल भवन के उद्घाटन के साथ अदाणी फाउंडेशन ने ज्ञान की रोशनी फैलायी

इंदौर। अदाणी फाउंडेशन ने केरल के विजिनजाम में मुल्लूर उच्च प्राथमिक विद्यालय के नवनिर्मित भवन का उद्घाटन किया। इस अवसर पर स्कूल परिसर में आयोजित एक समारोह में राज्य के शिक्षा मंत्री प्रो. सी. रवींद्रनाथ और बंदरगाह राज्य मंत्री श्री रामचंद्रन कदनापल्ली उपस्थित रहे। एक साल पहले, स्कूल प्रशासन, जिला प्रशासन और अदाणी फाउंडेशन ने साथ मिलकर संकटग्रस्त स्कूल को उसका पुराना गौरव वापस दिलाया था। अदाणी फाउंडेशन ने छात्रों को गुणवत्ता वाले बुनियादी ढांचा प्रदान करने के लिए दो मंजिला स्कूल भवन का निर्माण किया, जो ज्ञानार्जन की प्रक्रिया का अभिन्न अंग है। इसके परिणामस्वरूप, स्कूल में छात्रों की संख्यान अब 168 हो गई है। अदाणी फाउंडेशन का मानना है कि शिक्षा गरिमा और समानता के साथ जीवन जीने के लिए उठाया गया पहला कदम है। जब हम प्रभावी ज्ञानार्जन के लिए सक्षम करने वाला सुविधाजनक वातावरण बनाते हैं, तो हम अपने बच्चों को राष्ट्र निर्माण की दिशा में भावी प्रयासों के लिए तैयार करते हैं,डॉ. प्रीति अदाणी, चेयरपर्सन, अदाणी फाउंडेशन ने कहा। अदाणी स्कूल और इसके अभिनव शिक्षा कार्यक्रम, हर साल हजारों युवाओं को उच्च प्रतिस्पर्धा वाली दुनिया की चुनौतियों का सफलतापूर्वक सामना करने और उज्ज्वल भविष्य को सुरक्षित करने के लिए तैयार कर रहे हैं। अहमदाबाद (गुजरात), भद्रेश्वर (गुजरात) और सरगुजा (छतीसगढ़) में अदाणी विद्या मंदिर निम्न आय वर्ग के परिवारों के 2100 बच्चों को मुफ्त शिक्षा प्रदान करते हैं। इन स्कूलों में अत्याधुनिक बुनियादी ढांचा और काफी योग्य शिक्षक कार्यरत हैं। मुंद्रा (गुजरात) में अदाणी पब्लिक स्कूल, तिरोरा (महाराष्ट्र) और कवाई (राजस्थान) में अदाणी विद्यालय, धामरा (ओडिशा) में अदाणी डीएवी पब्लिक स्कूल और हजीरा (गुजरात) में नवचेतन विद्यालय सहायता प्राप्त गुणवत्ता शिक्षा प्रदान करते हैं।

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प्रदेश टाईम्स ■ इंदौर

अदाणी फाउंडेशन ने केरल के विजिनजाम में मुल्लूर उच्च प्राथमिक विद्यालय के नवनिर्मित भवन का उद्घाटन किया। इस अवसर पर स्कूल परिसर में आयोजित एक समारोह में राज्य के शिक्षा मंत्री प्रो. सी. रवींद्रनाथ और बंदरगाह राज्य मंत्री श्री रामचंद्रन कदनापल्ली उपस्थित रहे। एक साल पहले, स्कूल प्रशासन, जिला प्रशासन और अदाणी फाउंडेशन ने साथ मिलकर संकटग्रस्त स्कूल को उसका पुराना गौरव वापस दिलाया था। अदाणी फाउंडेशन ने छात्रों को गुणवत्ता वाले बुनियादी ढांचा प्रदान करने के लिए दो मंजिला स्कूल भवन का निर्माण किया, जो ज्ञानार्जन की प्रक्रिया का अभिन्न अंग है। इसके परिणामस्वरूप, स्कूल में छात्रों की संख्यान अब 168 हो गई है।

शिक्षा गरिमा और समानता के साथ जीवन जीने के लिए उठाया गया पहला कदम है। जब हम प्रभावी ज्ञानार्जन के लिए सक्षम करने वाला सुविधाजनक वातावरण बनाते हैं, तो हम अपने बच्चों को राष्ट्र निर्माण की दिशा में भावी प्रयासों के लिए तैयार करते हैं,डॉ. प्रीति अदाणी, चेयरपर्सन, अदाणी फाउंडेशन ने कहा। अदाणी स्कूल और इसके अभिनव शिक्षा कार्यक्रम, हर साल हजारों युवाओं को उच्च प्रतिस्पर्धा वाली दुनिया की चुनौतियों का सफलतापूर्वक सामना करने और उज्ज्वल भविष्य को सुरक्षित करने के लिए तैयार कर रहे हैं। अहमदाबाद (गुजरात), भद्रेश्वर (गुजरात) और सरगुजा (छत्तीसगढ़) में अदाणी विद्या मंदिर निम्न आय वर्ग के परिवारों के 2100 बच्चों को मुफ्त शिक्षा प्रदान करते हैं। इन स्कूलों में अत्याधुनिक बुनियादी ढांचा और काफी योग्य शिक्षक कार्यरत हैं। मुंद्रा (गुजरात) में अदाणी पब्लिक स्कूल, तिरोरा (महाराष्ट्र) और कवाई (राजस्थान) में अदाणी विद्यालय, धामरा (ओडिशा) में अदाणी डीएवी पब्लिक स्कूल और हजीरा (गुजरात) में नवचेतन विद्यालय सहायता प्राप्त गुणवत्ता शिक्षा प्रदान करते हैं। अदाणी विद्या मंदिर, अहमदाबाद (एवीएमए) भारत का पहला लागत-मुक्त शिक्षा देने वाला विद्यालय है जिसे भारतीय गुणवत्ता परिषद द्वारा एनएबीईटी मान्यता प्राप्त है। इसके अलावा, एवीएमए भारत का एकमात्र स्कूल है जिसने कोडिंग मैडपिट को अपने नियमित पाठ्यक्रम में शामिल किया है। अदाणी पब्लिक स्कूल, मुंद्रा सौराष्ट्र और कच्छ क्षेत्र में पहला एनएबीईटी मान्यता प्राप्त स्कूल है। अदाणी फाउंडेशन ज्ञानोदय स्मार्ट ई-लर्निंग कक्षाओं जैसे अभिनव शिक्षण कार्यक्रमों को बढ़ावा दे रहा है, जिसने झारखंड के गोड्डा जिले के 157 ग्रामीण स्कूलों में शिक्षण और सीखने की गुणवत्ता में सुधार किया है। एक वर्ष के भीतर, कक्षा 9 के परिणामों के मामले में गोड्डा जिला ने राज्य के निचले सात जिलों से ऊपर आकर शीर्ष पांच जिलों में अपना स्थान बना लिया है। इसके अलावा, अदाणी फाउंडेशन देशभर में 600 सरकारी स्कूलों और बालवाडि को सहायता प्रदान कर 100,000 बच्चों की गुणवत्तापूर्ण शिक्षा सुनिश्चित कर रहा है।

Samaya, 05/07/2019

ଆଦାନୀ ଫାଉଣ୍ଡେସନ ପକ୍ଷରୁ ନୂତନ ଶ୍ରେଣୀଗୃହ ନିର୍ମାଣ

ଭଦ୍ରକ, (ନିପ୍ର) : ଆଦାନୀ ଫାଉଣ୍ଡେସନ ପକ୍ଷରୁ ନିର୍ମିତ କେରଳର ତିରିଙ୍ଗଲାମସ୍ଥିତ ମୁଲୁର ଉଚ୍ଚ ପ୍ରାଥମିକ ସ୍କୁଲର ନବ ନିର୍ମିତ ଶ୍ରେଣୀଗୃହ ଆଜି ରାଜ୍ୟ ଶିକ୍ଷାମନ୍ତ୍ରୀ ପ୍ରଫେସର ରବୀନ୍ଦ୍ର ନାଥ ଏବଂ ରାଜ୍ୟ ଜାହାଜ ଚଳାଚଳ ମନ୍ତ୍ରୀ ରାମଚନ୍ଦ୍ରନ କଡ଼ନପଲ୍ଲୀଙ୍କ ଉପସ୍ଥିତିରେ ସ୍କୁଲ ପରିସରରେ ଏକ ସ୍ୱତନ୍ତ୍ର କାର୍ଯ୍ୟକ୍ରମରେ ଉଦ୍‌ଘାଟିତ ହୋଇଯାଇଛି। ଏକ ବର୍ଷ ପୂର୍ବେ ସ୍କୁଲ କର୍ତ୍ତୃପକ୍ଷ, ଜିଲ୍ଲା ପ୍ରଶାସନ ଏବଂ ଆଦାନୀ ଫାଉଣ୍ଡେସନ ମିଳିତ ଭାବେ ସ୍କୁଲର ପୂର୍ବ ଗୌରବକୁ ଫେରାଇ ଆଣିବା ପାଇଁ ଏକତ୍ରିତ ହୋଇଥିଲେ। ପରେ ୯୦ ଜଣ ଛାତ୍ରଛାତ୍ରୀ ସ୍କୁଲରେ ନାମ ଲେଖାଇଥିଲେ। ଆଦାନୀ ଫାଉଣ୍ଡେସନ ପକ୍ଷରୁ ନିର୍ମିତ ଏହି ଅତ୍ୟାଧୁନିକ ଶ୍ରେଣୀଗୃହ ଯାହାଦ୍ୱାରା ଛାତ୍ରଛାତ୍ରୀମାନଙ୍କୁ ଗୁଣାତ୍ମକ ମାନର ଭିତ୍ତିଭୂମି ଯାହା ଶିକ୍ଷାଦାନର ଏକ ଗୁରୁତ୍ୱପୂର୍ଣ୍ଣ ଅଂଶ ସଦୃଶ କାର୍ଯ୍ୟ କରିବ। ଯଦ୍ୱାରା ବର୍ତ୍ତମାନ ସମୁଦାୟ

ଛାତ୍ରଛାତ୍ରୀଙ୍କ ସଂଖ୍ୟା ୧୬୮ରେ ପହଞ୍ଚି ପାରିଛି। ଆଦାନୀ ଫାଉଣ୍ଡେସନ ବିଶ୍ୱାସ କରେ ଯେ, ଜୀବନରେ ସମ୍ମାନ ଏବଂ ଗୁଣାତ୍ମକ ମାନ ବୃଦ୍ଧି କରିବାରେ ଶିକ୍ଷା ସର୍ବଦା ସହାୟକ ହୋଇଥାଏ। ଆମେ ଯେତେବେଳେ ଶିକ୍ଷାଦାନରେ ସୁବିଧା ଏବଂ ସହଯୋଗ ପ୍ରଦାନ କରୁ, ସେତେବେଳେ ଆମ ପିଲାମାନଙ୍କୁ ଜାତି ନିର୍ମାଣ ଉଦ୍ଦେଶ୍ୟରେ ମଧ୍ୟ ପ୍ରସ୍ତୁତ କରିଥାଉ ବୋଲି ଆଦାନୀ ଫାଉଣ୍ଡେସନର ଅଧ୍ୟକ୍ଷା ଡଃ ପ୍ରୀତି ଆଦାନୀ କହିଛନ୍ତି। ଆଦାନୀ ସ୍କୁଲ ଏବଂ ଏହାର ଅଭିନବ ଶିକ୍ଷାଗତ କାର୍ଯ୍ୟକ୍ରମ ଛାତ୍ରଛାତ୍ରୀଙ୍କ ସୁସ୍ଥ ମାନସିକତାକୁ ଏକ ଉଚ୍ଚ ପ୍ରତିଯୋଗିତାମୂଳକସ୍ତରୀୟ ଆହ୍ୱାନକୁ ସଫଳତାପୂର୍ବକ ଆମନ୍ତ୍ରଣ କରିବା ଏବଂ ଭବିଷ୍ୟତ ସୃଷ୍ଟିକ କରିବା ନିମନ୍ତେ ପ୍ରସ୍ତୁତ କରିଥାଏ। ଆଦାନୀ ବିଦ୍ୟାମନ୍ଦିର ଅହମ୍ମଦାବାଦ (ଗୁଜରାଟ), ଭଦ୍ରେଶ୍ୱର (ଗୁଜରାଟ) ଏବଂ ସରଗୁଜା (ଛତିଶଗଡ଼) ପକ୍ଷରୁ ସ୍ୱଳ୍ପ ଆୟ ଥିବା ପରିବାରର ୨୧୦୦ ଛାତ୍ରଛାତ୍ରୀଙ୍କୁ ନିଶୁଳ୍କ ଶିକ୍ଷାଦାନ ଯୋଗାଇ ଦିଆଯାଉଛି। ଏହି ବିଦ୍ୟାଳୟଗୁଡ଼ିକରେ ଅତ୍ୟାଧୁନିକ ଶ୍ରେଣୀଗୃହ ଏବଂ ଉଚ୍ଚ ଶିକ୍ଷିତ ଶିକ୍ଷକମାନେ ଶିକ୍ଷାଦାନ କରୁଛନ୍ତି। ଆଦାନୀ ପବ୍ଲିକ ସ୍କୁଲ ମୁନ୍ଦ୍ରା (ଗୁଜରାଟ), ତିରୋରା (ମହାରାଷ୍ଟ୍ର) ଏବଂ କାୱାଇ (ରାଜସ୍ଥାନ)ସ୍ଥିତ ଆଦାନୀ ବିଦ୍ୟାଳୟ, ଧାମରା (ଓଡ଼ିଶା)ସ୍ଥିତ ଏବଂ ହାଜିରା (ଗୁଜରାଟ) ସ୍ଥିତ ନବଚେତନ ବିଦ୍ୟାଳୟରେ ଗୁଣାତ୍ମକ ଶିକ୍ଷା ପ୍ରଦାନ କରାଯାଉଛି। ଆଦାନୀ ବିଦ୍ୟାମନ୍ଦିର ଅହମ୍ମଦାବାଦ (ଗୁଜରାଟ) ହେଉଛି ନିଶୁଳ୍କ ଶିକ୍ଷାଦାନରେ ଭାରତର ପ୍ରଥମ ବିଦ୍ୟାଳୟ ଯିଏ କି କ୍ୱାଲିଟି କାଉନସିଲ ଅଫ ଇଣ୍ଡିଆ ଦ୍ୱାରା ନାବେଟ୍ ମାନ୍ୟତା ପ୍ରାପ୍ତ କରିଛି। ଏତଦ୍‌ବ୍ୟତୀତ ନିୟମିତ ଶିକ୍ଷାଦାନ କାର୍ଯ୍ୟକ୍ରମରେ କୋଡିଂ ସ୍ୟାଣ୍ଡପିଟକୁ ପ୍ରଚଳନ କରିଥିବା ଆଦାନୀ ବିଦ୍ୟାମନ୍ଦିର (ଅହମ୍ମଦାବାଦ) ଭାରତର ପ୍ରଥମ ବିଦ୍ୟାଳୟ।

Suryaprava, 05/07/2019

ଆଦାନୀ ଫାଉଣ୍ଡେସନ ପକ୍ଷରୁ ନୂତନ ଶ୍ରେଣୀଗୃହ ନିର୍ମାଣ

॥ ପ୍ରଭାନ୍ୟୁଜ ॥ ଭଦ୍ରକ,୪।୭: ଆଦାନୀ ଫାଉଣ୍ଡେସନ ପକ୍ଷରୁ ନିର୍ମିତ କେରଳର ତିରିଙ୍ଗଲାମସ୍ଥିତ ମୁଲୁର ଉଚ୍ଚ ପ୍ରାଥମିକ ବିଦ୍ୟାଳୟର ନବ ନିର୍ମିତ ଶ୍ରେଣୀଗୃହ ରାଜ୍ୟ ଶିକ୍ଷାମନ୍ତ୍ରୀ ପ୍ରଫେସର ରବୀନ୍ଦ୍ର ନାଥ ଏବଂ ରାଜ୍ୟ ଜାହାଜ ଚଳାଚଳ ମନ୍ତ୍ରୀ ରାମଚନ୍ଦ୍ରନ କଡ଼ନପଲ୍ଲୀଙ୍କ ଉପସ୍ଥିତିରେ ବିଦ୍ୟାଳୟ ପରିସରରେ ଏକ ସ୍ୱତନ୍ତ୍ର କାର୍ଯ୍ୟକ୍ରମରେ ଉଦ୍‌ଘାଟିତ ହୋଇଯାଇଛି।

ଏକ ବର୍ଷ ପୂର୍ବେ ବିଦ୍ୟାଳୟ ପ୍ରଶାସନ, ଜିଲ୍ଲା ପ୍ରଶାସନ ଏବଂ ଆଦାନୀ ଫାଉଣ୍ଡେସନ ମିଳିତ ଭାବେ ବିଦ୍ୟାଳୟର ପୂର୍ବ ଗୌରବକୁ ଫେରାଇ ଆଣିବା ପାଇଁ ଏକତ୍ରିତ ହୋଇଥିଲେ। ପରେ ୯୦ ଜଣ ଛାତ୍ରଛାତ୍ରୀ ବିଦ୍ୟାଳୟରେ ନାମ ଲେଖାଇଥିଲେ। ଆଦାନୀ ଫାଉଣ୍ଡେସନ ପକ୍ଷରୁ ନିର୍ମିତ ଏହି ଅତ୍ୟାଧୁନିକ ଶ୍ରେଣୀଗୃହ ଯାହାଦ୍ୱାରା ଛାତ୍ରଛାତ୍ରୀମାନଙ୍କୁ ଗୁଣାତ୍ମକ ମାନର ଭିତ୍ତିଭୂମି ଯାହା ଶିକ୍ଷାଦାନର ଏକ ଗୁରୁତ୍ୱପୂର୍ଣ୍ଣ ଅଂଶ ସଦୃଶ କାର୍ଯ୍ୟ କରିବ। ଯଦ୍ୱାରା ବର୍ତ୍ତମାନ ସମୁଦାୟ ଛାତ୍ରଛାତ୍ରୀଙ୍କ ସଂଖ୍ୟା ୧୬୮ରେ ପହଞ୍ଚି ପାରିଛି। ଆଦାନୀ ଫାଉଣ୍ଡେସନ ବିଶ୍ୱାସ କରେ ଯେ, ଜୀବନରେ ସମ୍ମାନ ଏବଂ ଗୁଣାତ୍ମକ ମାନ ବୃଦ୍ଧି କରିବାରେ ଶିକ୍ଷା

ସର୍ବଦା ସହାୟକ ହୋଇଥାଏ। ଆମେ ଯେତେବେଳେ ଶିକ୍ଷାଦାନରେ ସୁବିଧା ଏବଂ ସହଯୋଗ ପ୍ରଦାନ କରୁ, ସେତେବେଳେ ଆମ ପିଲାମାନଙ୍କୁ ଜାତି ନିର୍ମାଣ ଉଦ୍ଦେଶ୍ୟରେ ମଧ୍ୟ ପ୍ରସ୍ତୁତ କରିଥାଉ ବୋଲି ଆଦାନୀ ଫାଉଣ୍ଡେସନର ଅଧ୍ୟକ୍ଷା ଡଃ ପ୍ରୀତି ଆଦାନୀ କହିଛନ୍ତି। ଆଦାନୀ ସ୍କୁଲ ଏବଂ ଏହାର ଅଭିନବ ଶିକ୍ଷାଗତ କାର୍ଯ୍ୟକ୍ରମ ଛାତ୍ରଛାତ୍ରୀଙ୍କ ସୁସ୍ଥ ମାନସିକତାକୁ ଏକ ଉଚ୍ଚ ପ୍ରତିଯୋଗିତାମୂଳକ ସ୍ତରୀୟ ଆହ୍ୱାନକୁ ସଫଳତାପୂର୍ବକ ଆମନ୍ତ୍ରଣ କରିବା ଏବଂ ଭବିଷ୍ୟତ ସୃଷ୍ଟିକ କରିବା ନିମନ୍ତେ ପ୍ରସ୍ତୁତ କରିଥାଏ। ଆଦାନୀ ବିଦ୍ୟାମନ୍ଦିର ଅହମ୍ମଦାବାଦ (ଗୁଜରାଟ), ଭଦ୍ରେଶ୍ୱର (ଗୁଜରାଟ) ଏବଂ ସରଗୁଜା (ଛତିଶଗଡ଼) ପକ୍ଷରୁ ସ୍ୱଳ୍ପ ଆୟ ଥିବା ପରିବାରର ୨୧୦୦ ଛାତ୍ରଛାତ୍ରୀଙ୍କୁ ନିଶୁଳ୍କ ଶିକ୍ଷାଦାନ ଯୋଗାଇ ଦିଆଯାଉଛି। ଏହି ବିଦ୍ୟାଳୟଗୁଡ଼ିକରେ ଅତ୍ୟାଧୁନିକ ଶ୍ରେଣୀଗୃହ ଏବଂ ଉଚ୍ଚ ଶିକ୍ଷିତ ଶିକ୍ଷକମାନେ ଶିକ୍ଷାଦାନ କରୁଛନ୍ତି। ଆଦାନୀ ପବ୍ଲିକ ସ୍କୁଲ ମୁନ୍ଦ୍ରା (ଗୁଜରାଟ), ତିରୋରା (ମହାରାଷ୍ଟ୍ର) ଏବଂ କାୱାଇ (ରାଜସ୍ଥାନ)ସ୍ଥିତ ଆଦାନୀ ବିଦ୍ୟାଳୟ, ଧାମରା (ଓଡ଼ିଶା)ସ୍ଥିତ ଏବଂ ହାଜିରା (ଗୁଜରାଟ) ସ୍ଥିତ ନବଚେତନ ବିଦ୍ୟାଳୟରେ ଗୁଣାତ୍ମକ ଶିକ୍ଷା ପ୍ରଦାନ କରାଯାଉଛି। ଆଦାନୀ ବିଦ୍ୟାମନ୍ଦିର ଅହମ୍ମଦାବାଦ (ଗୁଜରାଟ) ହେଉଛି ନିଶୁଳ୍କ ଶିକ୍ଷାଦାନରେ ଭାରତର ପ୍ରଥମ ବିଦ୍ୟାଳୟ ଯିଏ କି କ୍ୱାଲିଟି କାଉନସିଲ ଅଫ ଇଣ୍ଡିଆ ଦ୍ୱାରା 'ନାବେଟ୍' ମାନ୍ୟତା ପ୍ରାପ୍ତ କରିଛି। ଏତଦ୍‌ବ୍ୟତୀତ ନିୟମିତ ଶିକ୍ଷାଦାନ କାର୍ଯ୍ୟକ୍ରମରେ କୋଡିଂ ସ୍ୟାଣ୍ଡପିଟକୁ ପ୍ରଚଳନ କରିଥିବା ଆଦାନୀ ବିଦ୍ୟାମନ୍ଦିର (ଅହମ୍ମଦାବାଦ) ଭାରତର ପ୍ରଥମ ବିଦ୍ୟାଳୟ। ସେହିଭଳି, ମୁନ୍ଦ୍ରାସ୍ଥିତ ଆଦାନୀ ପବ୍ଲିକ ସ୍କୁଲ ସୌରାଷ୍ଟ୍ର ଏବଂ କଚ୍ଛ ଅଞ୍ଚଳରେ 'ନାବେଟ' ମାନ୍ୟତା ପ୍ରାପ୍ତ ପ୍ରଥମ ବିଦ୍ୟାଳୟ। ଝାଡ଼ଖଣ୍ଡର ଗୋଡ୍ଡା ଜିଲ୍ଲାରେ ୧୫୭ ଟି ଗ୍ରାମାଞ୍ଚଳ ବିଦ୍ୟାଳୟରେ ଗୁଣାତ୍ମକ ଶିକ୍ଷାର ବିକାଶ ନିମନ୍ତେ ଆଦାନୀ ଫାଉଣ୍ଡେସନ ଅଭିନବ ଶିକ୍ଷାଦାନ କାର୍ଯ୍ୟକ୍ରମ ଆରୋହଣ ସୂର୍ଯ୍ୟ ଇ-ଲର୍ଣ୍ଣିଂ ଶିକ୍ଷା ଯୋଗାଇ ଆସୁଛି। ଗୋଟିଏ ବର୍ଷ ମଧ୍ୟରେ ଏହି ଜିଲ୍ଲା ୯ମ ଶ୍ରେଣୀ ଫଳାଫଳରେ ସପ୍ତମ ସ୍ଥାନରୁ ରାଜ୍ୟର ପ୍ରଥମ ୫ଟି ବିଦ୍ୟାଳୟ ମଧ୍ୟରେ ସ୍ଥାନ ପାଇବାରେ ଖ୍ୟାତି ଅର୍ଜନ କରିଛି। ସମଗ୍ର ଦେଶର ପ୍ରାୟ ୬୦୦ ସରକାରୀ ବିଦ୍ୟାଳୟ ଏବଂ ଅଙ୍ଗନୱାଡ଼ି କେନ୍ଦ୍ରର ୧ ଲକ୍ଷ ଛାତ୍ରଛାତ୍ରୀଙ୍କୁ ଆଦାନୀ ଫାଉଣ୍ଡେସନ ଗୁଣାତ୍ମକ ମାନର ଶିକ୍ଷା ସୁନିଶ୍ଚିତ କରିଛନ୍ତି।

അദാനി ഫൗണ്ടേഷന്റെ നേതൃത്വത്തിൽ വിഴിഞ്ഞത്ത് അടുക്കളത്തോട്ടം മത്സരം

വിഴിഞ്ഞം : അദാനി വിഴി ഞ്ഞം തുറമുഖ പദ്ധതിയുടെ സാമൂഹ്യ പ്രതിബദ്ധതാ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി വിഴിഞ്ഞം പ്രദേശത്തെ അമ്മമാർക്ക് ഇടയിൽ വീട്ടുവളപ്പിലെ പച്ചക്കറി കൃഷി പ്രോത്സാഹിപ്പിക്കുന്നതിനായി അടുക്കളത്തോട്ട മത്സരം സംഘടിപ്പിക്കുന്നു.

തിരഞ്ഞെടുത്ത 100 വീട്ടമ്മമാരാണ് മത്സരത്തിൽ പങ്കെടുക്കുന്നത്. ഒരു മത്സരാർത്ഥിക്ക് 20 ഗ്രോബാഗ് ,ചുവന്ന ചീര, വെണ്ട, വഴുതന, പയർ, തക്കാളി എന്നിങ്ങനെ ആറ് ഇനം വിത്തുകളാണ് നൽകുന്നത്. വിത്തുകളുടെ വിതരണ ഉദ്ഘാടനവും മത്സരാർത്ഥികൾക്ക് അടുക്കളത്തോട്ടം പരിപാലനത്തെ കുറിച്ച് നടത്തിയ ബോധവൽക്കരണ ക്ലാസ്സും വിഴിഞ്ഞം കൃഷി ഓഫീസർ ശ്രീമതി. സൗമ്യ വി.ഐ നിർവഹിച്ചു. സാമൂഹ്യ പ്രതിബദ്ധതാ വിഭാഗം മേധാവി ഡോ.അനിൽ ബാലകൃഷ്ണൻ അധ്യക്ഷത വഹിച്ചു.

അഞ്ചുവയസ്സിൽ താഴെയുള്ള കുട്ടികളിലെ പോഷക ശോഷണവും പെൺകുട്ടികളെയും സ്ത്രീകളെയും പരിഹരിക്കുന്നതിനായി അദാനി ഫൗണ്ടേഷൻ നടപ്പിലാക്കിവരുന്ന 'സുപോഷൺ". പദ്ധതിയുടെ ഭാഗമായാണ് അടുക്കളത്തോട്ടം മത്സരം നടത്തുന്നത്.

ഏറ്റവും നന്നായി പരിപാലനം നടത്തി കൂടുതൽ ഉത്പാദിപ്പിക്കുന്നവർക്ക് അവാർഡുകൾ നൽകുന്നതാണ്. രാസവള പ്രയോഗം കൂടാതെ തികച്ചും ജൈവമായി കൃഷി ചെയ്യുന്നവരെയാണ് അവാർഡിന് തിരഞ്ഞെടുക. കാർഷിക വിദഗ്ദ്ധരുടെ മേൽനോട്ടത്തിലായിരിക്കും മികച്ച കർഷകരെ തിരഞ്ഞെടുക്കുന്നത്.

കൂടാതെ മുലപ്പാലിന്റെ പ്രാധാന്യത്തെ കുറിച്ച് അവബോധം സൃഷ്ടിക്കുന്നതിന് ലോകമെമ്പാടും എല്ലാ വർഷവും ആഗസ്റ്റ് 1 മുതൽ 7 വരെ നടത്തി വരുന്ന ലോക മുലയൂട്ടൽ വാരാചരണവും സംഘടിപ്പിച്ചു.

തിരുവനന്തപുരം കോർപ്പറേഷൻ പരിധിയിലുള്ള ഹാർബർ, വിഴിഞ്ഞം, കോട്ടപ്പുറം, വെങ്ങാനൂർ, മുല്ലൂർ വാർഡുകളിലായി 49 അംഗൻവാടികൾ കേന്ദ്രീകരിച്ചാണ് ഓഗസ്റ്റ് 1 മുതൽ 7 വരെ ലോക മുലയൂട്ടൽ വാരാഘോഷങ്ങൾ സംഘടിപ്പിച്ചത്. ഓരോ കുഞ്ഞിനും പ്രകൃതി കനിഞ്ഞ് നൽകിയ ദിവ്യൗഷധം ആണ് അമ്മയുടെ പാൽ. അമ്മയുടെയും കുഞ്ഞിനെയും ആരോഗ്യസംരക്ഷണത്തിലും രോഗപ്രതിരോധത്തിലും കുഞ്ഞിന്റെ ബുദ്ധി വികാസത്തിലും മുലപ്പാൽ പ്രാധാന്യം വഹിക്കുന്നു. ഈ ആശയം പ്രചരിപ്പിക്കുന്നതിനായി ലോക മുലയൂട്ടൽ വാരാഘോഷത്തിന്റെ ഭാഗമായി സംഘടിപ്പിച്ച 'ആദ്യാമൃതം ' രചനാ മത്സരത്തിൽ ലേഖനം, കവിത, ചിത്രരചന, എന്നീ വിഭാഗങ്ങളിൽ ഒന്നും രണ്ടും മൂന്നും സ്ഥാനങ്ങൾ നേടിയവർക്ക് ചടങ്ങിൽ സമ്മാനങ്ങൾ വിതരണംചെയ്തു. ശ്രീ. സെബാസ്റ്റ്യൻ ബ്രിട്ടോ, കുമാരി. മീര മറിയം സ്കറിയ, ശ്രീ. ജോർജ്ജ്, ശ്രീ. വിനോദ്, ശ്രീ. അമിത്ത്, ശ്രീ. ശ്രീനാഥ്, ശ്രീമതി. ലിംന, ശ്രീമതി. മായ, ഫീൽഡ് തല പ്രവർത്തകരായ സംഗിനിമാർ എന്നിവർ നേതൃത്വം നൽകി.

Annexure IV

Environment Monitoring Report

(April 2019 to September 2019)

Annexure IV

HALF YEARLY ENVIRONMENT MONITORING REPORT

For the period April 2019 to September 2019

CONTENTS

CHAPTER 1

Introduction

Ashwamedh Engineers and Consultants (AEC) was established in May 1986. The company is engaged in providing Environmental pollution testing, Food and agriculture testing and Consultancy Services. Our affiliates are established all over India and overseas. Ashwamedh has steadily achieved growth up to such an extent that it has become India's foremost analytical laboratory with several branch offices. The well-equipped laboratory and office set up of about 28000 sq. ft. is at Nashik, Maharashtra. The strength of our organization is the years of hard work, dedication and contribution made by our staffs who are experts in their respective fields and they produce innovative ideas for the growth of the organization.

Ashwamedh has made itself capable of testing of water, waste water, air, food, noise monitoring, hazardous and non-hazardous waste testing, fuel and agriculture testing. We have a state-of-art Laboratory set-up for Chemical, Mechanical and Microbiological Analysis at Nashik. Our Laboratory is accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with ISO/IEC 17025:2005 in the Chemical, Biological and Mechanical Testing fields (Certificate numbers: T-5509). Our Laboratory is recognized by the Ministry of Environment, Forests & Climate Change (MoEF&CC), Govt. of India (GoI), New Delhi under Environment (Protection) Act, 1986. We are also ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007 certified organization.

Our Laboratory is recognized by Bureau of Indian Standard for Packaged Drinking Water and Packaged Natural Mineral Water also recognised by Agricultural and Processed Food Products Export Development Authority (APEDA). Our laboratory is approved by Food Safety & Standards Authority of India (FSSAI) for food testing also approved by Agricultural Marketing (AGMARK) and State Agriculture Department.

AEC was engaged by Adani Vizhinjam Port Pvt. Ltd. (AVPPL) for the Post EIA Environmental Monitoring as per Environmental Monitoring Plan mentioned in EIA and EC. AVPPL issued service order no. 5700182233 dated: 31.05.2016 and S.O.

No. 5700273929 dated: 07.08.2019; which mentions the matrix, parameters and frequency of environmental monitoring. AEC carried out said environmental monitoring strictly as per above mention service order. As per the service order Ambient Air Monitoring (twice in a week), Ambient Noise Monitoring (fortnightly), Marine Ecological Survey including marine water, sediment, phytoplankton and zooplankton analysis (monthly), Ground Water and Surface Water Analysis (monthly), Soil Analysis (yearly).

AEC is submitting monthly reports of Environmental Monitoring which includes details of sampling locations, methodology used, analytical results and summary of reports. The monthly environmental monitoring report serves the information about the present environmental status as per terms and condition mentioned in service order.

This present report is the consolidated half yearly report over the six month period of April 2019 to September 2019.

CHAPTER 2

Quality Assurance /Quality Control Procedure

The quality assurance and quality control plan include following elements:

1. Sample collection, preservation and transportation of sample
2. Chain of custody
3. Laboratory Analysis
4. Data evaluation and validation

1. Sample collection, preservation and transportation of sample:

The Team leader ensures that selected members of the study team meet all the selection criteria identified. Prior to the starting of the study, individual team members were put to test in the laboratory for their competency in carrying out typical environmental sampling/monitoring for different parameters as per the requirements of the project.

The team leader has ensured that the selected procedures are documented and the study team members are familiar with the sampling and analytical procedures. Before commencement of work, the team leader has checked for availability of all the items required for sampling at site and in the laboratory. In case of any missing items, suitable alternate arrangements have been made and required materials were procured.

Precautions are taken to protect the samples, the material being sampled, the sampling instruments and containers for samples from contamination. Samples are sufficient in volume and frequency is decided based on scope of work. Samples are collected, packed and transported prior to analysis in a manner that safeguards against change in the particular constituents or properties to be examined.

For the collection of samples appropriate containers are used with respective sample matrix and parameters analysed as per the method reference.

Labelling of samples is done at site only and it includes the name of location, date of sample collection. Sampling sheet is filled at site with required information. The sample is sent along with the sampling sheet to laboratory for further analysis.
For the preservation of sample appropriate preservation techniques with respect to parameters analysed is followed and samples are transported with due care to the laboratory.

2. Chain of Custody:

Firstly, after receiving the samples in the laboratory, assigning Sample ID is a very systematic and methodical way of representing samples identification as Sample ID is a Permanent Identification Number of a sample and it maintains traceability and transparency throughout the process.

It is the format for communication between Sample Receipt Department and the Laboratory. Laboratory also communicates to the Sample Receipt Department. It gives all details of sample except its company name. It includes parameters to be analysed, method reference for each parameter analysed, units in which the analytical results to be expressed, results of each parameter analysed, date at which the analysis was started and date at which the analysis was completed.

After completion of analysis, analytical values duly filled in by respective analyst with the help of test data in respective report format. This draft report is verified and approved by Technical Manager. Final reports are prepared and authorised by Technical Manager and sent to client.

3. Laboratory Analysis:

All physiochemical and biological analysis, as per the scope of work, are carried out at our permanent facility at Nashik, Maharashtra. For the sampling and analysis of samples standard reference methods are used.

4. Data evaluation and validation:

For the quality control and validation, laboratory follow the following procedures:

1. Participation in Inter-Laboratory Comparison (ILC) with NABL accredited laboratories.

2. The results obtained from all laboratories are recorded and reviewed for performance by Quality Manager and acceptance criteria is satisfactory $\leq$ 2.
3. The laboratory also participates in Proficiency testing (PT) programmes conducted by NABL/Central Pollution Control Board (CPCB)/other Proficiency testing (PT) providers depending on the availability of the programme.
4. The results received from nodal laboratory are recorded and reviewed for performance.
5. Replicate testing is done on received samples in a planned manner as per schedule. Replicate testing is done by same/different analysts or using same/different methods.
6. Reviewing the results of replicate testing for performance evaluation is done by Quality Manager.
7. Acceptance criteria in case of replicate/duplicate testing is </20% relative standard deviation.
8. Testing of retained samples is carried out, by allotting a new sample ID and sending it to laboratory for retesting done by same/different analyst or using same/different methods.
9. Reviewing the results of retesting for performance evaluation is done by Quality Manager.
10. Acceptance criteria in case of retesting is </20% relative standard deviation.
11. Correlation of results for different characteristics like TDS/EC ratio. Anion/cation balance, COD/BOD correlation is carried out.
12. The quality control data is analysed and where they are found to be outside predefined criteria, planned action is taken to correct the problem and to prevent incorrect results from being reported.

Table 2.1 Check list format for sampling

Note: It is not necessary that this form be filled each sample/sampling point. It is sufficient if the deviations if any are recorded in the log books.

Table 2.2 Check list for sample Integrity

Item	Yes or No	If No, reason and Justification for acceptance
Is the chain of custody record attached?	Yes	
Is the chain of custody record filled in properly	Yes	
Is the sample received within the holding time?	Yes	
Is the sample seal on sample containers intact?	Yes	
Is the sample received in proper storage condition?	Yes	
Is the sample quantity adequate for required analysis?	Yes	
Checked By: Team In – charge		

Note: It is not necessary that this form be filled each sample/sampling point. It is sufficient if the deviations if any are recorded in the log books.

Item	Yes or No	If No, reason and Justification for acceptance
Was the sampling point correctly located?	Yes	
Permanent facility available?	Yes	
Was the correct sample used?	Yes	
Were the proper types of sample containers used?	Yes	
Were the replicates or multiple samples taken as required?	Yes	
Were adequate quantities of samples taken?	Yes	
Were the sample containers properly labelled?	Yes	
Were the preservatives added and sample containers sealed as required?	Yes	
Were the sealed sample containers maintained at required storage condition?	Yes	
Checked by: Team In-charge	Yes	

Table 2.3 Check list format for analysis

Item	Yes or No	If No, reason and Justification for acceptance
Was the correct method used for the analysis?	Yes	
Were the correct instruments, equipment and apparatus used for the analysis?	Yes	
Was the competence of the analyst deployed for the analysis verified?	Yes	
Were the instruments, equipment and apparatus used pre-calibrated as required?	Yes	
Was the sample correctly and adequately identified and described in the analysis logbook?	Yes	
Were all the raw data properly recorded?	Yes	
Were the correct equations and units used?	Yes	
Checked By: Lab Manager		

Note: It is not necessary that this form be filled each sample/sampling point. It is sufficient if the deviations if any are recorded in the log books.

Table 2.4 Check list format for quality check in the field

Parameters	Comments (Yes/No)	Remarks
Sample bottle labelled?	Yes	
Sample container rinsed with D.D. water?	Yes	
Field equipment blanks are identified	Yes	
Is the preservative has been added after sampling or preserved as per sampling/ Test method?	Yes	
Are proper storage conditions are maintained?	Yes	
The sample quantity is adequate?	Yes	
Is sample properly identified?	Yes	
Is proper type of container used?	Yes	
Checked By: Lab Manager		

Note: It is not necessary that this form be filled each sample/sampling point. It is sufficient if the deviations if any are recorded in the log books.

Table 2.5 Check list format for quality check in the lab

Parameters	Comments (Yes/No)	Remarks
Is the sample details entered into Raw data register?	Yes	
Sample quantity measured?	Yes	
Glassware is calibrated?	Yes	
Balance/equipment is calibrated?	Yes	
Data entered in the analyst work book or not?	Yes	

Note: It is not necessary that this form be filled each sample/sampling point. It is sufficient if the deviations if any are recorded in the log books.

CHAPTER 3

Ambient Air Quality Monitoring

1. Ambient Air Quality Monitoring location details:

This chapter describes the sampling location, methodology adopted for monitoring ambient air quality and analysis of Ambient Air Quality results. The prime objective of the environment monitoring with respect to ambient air quality is to establish the present air quality and its conformity to ambient air quality standards. Ambient Air quality monitoring was carried out at five (5) locations including Venganoor, Proposed Port Estate Area, Port Site, Chani and Balaramapuram during April 2019 to September 2019.

Table 3.1 Ambient Air Quality Monitoring Locations

Sr. No.	Location	Latitude	Longitude
1.	Venganoor	8^0,23',55.10" N	77^0,00',11.30" E
2.	Proposed Port Estate Area	8^0,22',41.47" N	77^0,01',02.94" E
3.	Port Site	8^0,22',06.03" N	77^0,00',17.03" E
4.	Chani	8^0,20',56.86" N	77^0,03',16.19" E
5.	Balaramapuram	8^0,25',42.67" N	77^0,02',13.78" E

Figure 3.1 Google earth view of AAQM stations

2. Methodology of Sampling and Analysis:

Table 3.2 Ambient Air Quality Monitoring Methodology

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
1.	Particulate Matter (size less than 10 μm) or PM_{10}	$\mu g/m^3$	2	IS 5182 (Part 23): 2006, AEC/C/SAP/AA-1
2.	Particulate Matter (size less than 2.5 μm) or $PM_{2.5}$	$\mu g/m^3$	0.4	CPCB Guidelines, Volume I,36/2012-13, Page no. 15, AEC/C/SAP/AA-1,
3.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	4.0	IS 5182 (Part 2): 2001,Reaffirmed 2006, AEC/C/SAP/AA-2,
4.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	6.5	IS 5182 (Part 6): 2006, AEC/C/SAP/AA-3
5.	Carbon Monoxide (CO)	mg/m^3	0.5	By portable CO meter
6.	Hydrocarbon (HC)	ppm	1.0	By portable HC meter

3. National Ambient Air Quality Standards:

Table 3.3 National Ambient Air Quality Standards Dated 16th November 2009

Sr. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural & other areas	Ecologically Sensitive Areas
1.	Sulphur dioxide (SO_2), $\mu g/m^3$	Annual	50	20
		24 h	80	80
2.	Nitrogen Dioxide (NO_2), $\mu g/m^3$	Annual	40	30
		24 h	80	80
3.	Particulate matter (size less than 10μm) or PM_{10}, $\mu g/m^3$	Annual	60	60
		24 h	100	100
4.	Particulate matter (size less than 2.5μm) or $PM_{2.5}$, $\mu g/m^3$	Annual	40	40
		24 h	60	60
5.	Carbon Monoxide (CO), $\mu g/m^3$	8 h	02	02
		1 h	04	04
6.	Hydrocarbon (HC), ppm	-	-	-

4. **Ambient Air Quality Monitoring Results for the period April 2019 to September 2019:**

Table 3.4 - Location: Venganoor

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
01.04.2019	78	28	7.33	9.77	BDL	BDL
04.04.2019	82	29	6.60	9.69	BDL	BDL
08.04.2019	68	22	6.66	9.69	BDL	BDL
11.04.2019	70	23	7.55	8.75	BDL	BDL
15.04.2019	72	24	6.42	7.86	BDL	BDL
18.04.2019	68	22	5.84	6.45	BDL	BDL
22.04.2019	73	26	6.22	8.12	BDL	BDL
25.04.2019	86	32	7.64	8.66	BDL	BDL
29.04.2019	80	29	5.33	7.89	BDL	BDL
02.05.2019	75	25	5.52	8.96	BDL	BDL
06.05.2019	80	28	5.52	8.53	BDL	BDL
09.05.2019	65	20	5.25	8.01	BDL	BDL
13.05.2019	55	18	5.46	9.35	BDL	BDL
16.05.2019	78	24	5.24	8.43	BDL	BDL
20.05.2019	84	30	5.54	8.99	BDL	BDL
23.05.2019	78	27	7.87	8.21	BDL	BDL
27.05.2019	82	28	6.36	9.40	BDL	BDL
30.05.2019	69	23	5.85	7.85	BDL	BDL
03.06.2019	63	17	5.28	8.38	BDL	BDL
06.06.2019	70	22	4.72	7.71	BDL	BDL
10.06.2019	81	30	5.24	8.42	BDL	BDL
13.06.2019	64	20	5.44	8.42	BDL	BDL
17.06.2019	58	18	4.24	BDL	BDL	BDL
20.06.2019	72	24	4.66	BDL	BDL	BDL
24.06.2019	66	18	BDL	BDL	BDL	BDL
27.06.2019	54	16	5.05	BDL	BDL	BDL
01.07.2019	74	20	6.47	9.15	BDL	BDL
04.07.2019	76	23	5.75	BDL	BDL	BDL
08.07.2019	81	25	5.75	8.57	BDL	BDL
11.07.2019	62	18	BDL	BDL	BDL	BDL
15.07.2019	54	15	BDL	BDL	BDL	BDL
18.07.2019	56	16	BDL	BDL	BDL	BDL
22.07.2019	68	20	BDL	BDL	BDL	BDL
25.07.2019	72	23	4.62	BDL	BDL	BDL
29.07.2019	70	22	BDL	BDL	BDL	BDL
01.08.2019	33	10	5.64	7.84	BDL	BDL
05.08.2019	59	17	BDL	BDL	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
08.08.2019	68	20	7.27	7.90	BDL	BDL
12.08.2019	80	21	BDL	BDL	BDL	BDL
15.08.2019	65	18	5.85	7.50	BDL	BDL
19.08.2019	56	15	5.47	8.40	BDL	BDL
22.08.2019	70	16	BDL	BDL	BDL	BDL
26.08.2019	62	16	BDL	BDL	BDL	BDL
29.08.2019	80	22	BDL	BDL	BDL	BDL
02.09.2019	48	9	BDL	BDL	BDL	BDL
05.09.2019	65	19	BDL	BDL	BDL	BDL
09.09.2019	61	15	5.85	8.84	BDL	BDL
12.09.2019	58	12	6.25	8.84	BDL	BDL
16.09.2019	67	18	6.25	8.43	BDL	BDL
19.09.2019	59	16	BDL	BDL	BDL	BDL
23.09.2019	45	7	BDL	BDL	BDL	BDL
26.09.2019	50	10	BDL	BDL	BDL	BDL
30.09.2019	69	20	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	**-**

*BDL: Below Detection Limit/Level

Table 3.5 - Location: Proposed Port Estate Area

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
01.04.2019	68	23	5.85	10.5	BDL	BDL
04.04.2019	91	32	7.33	10.6	BDL	BDL
08.04.2019	61	21	6.06	9.27	BDL	BDL
11.04.2019	52	18	8.46	11.00	BDL	BDL
15.04.2019	70	25	6.12	7.46	BDL	BDL
18.04.2019	65	22	5.89	8.12	BDL	BDL
22.04.2019	86	28	5.64	6.42	BDL	BDL
25.04.2019	83	26	6.72	7.89	BDL	BDL
29.04.2019	78	24	7.88	8.55	BDL	BDL
02.05.2019	92	35	5.31	7.10	BDL	BDL
06.05.2019	90	32	5.87	8.46	BDL	BDL
09.05.2019	88	30	5.55	7.58	BDL	BDL
13.05.2019	79	25	5.29	8.92	BDL	BDL
16.05.2019	86	28	5.34	8.14	BDL	BDL
20.05.2019	69	24	5.25	9.26	BDL	BDL
23.05.2019	72	26	6.77	8.57	BDL	BDL
27.05.2019	85	29	5.87	7.88	BDL	BDL
30.05.2019	80	28	7.69	9.55	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
03.06.2019	78	26	4.69	8.90	BDL	BDL
06.06.2019	82	31	4.48	7.57	BDL	BDL
10.06.2019	60	20	4.64	7.16	BDL	BDL
13.06.2019	58	18	4.84	7.58	BDL	BDL
17.06.2019	68	22	4.24	BDL	BDL	BDL
20.06.2019	72	24	5.05	BDL	BDL	BDL
24.06.2019	62	21	5.85	BDL	BDL	BDL
27.06.2019	54	16	BDL	BDL	BDL	BDL
01.07.2019	72	23	6.68	7.41	BDL	BDL
04.07.2019	83	25	5.93	8.11	BDL	BDL
08.07.2019	68	20	6.41	8.77	BDL	BDL
11.07.2019	70	22	BDL	BDL	BDL	BDL
15.07.2019	56	15	BDL	BDL	BDL	BDL
18.07.2019	54	14	BDL	BDL	BDL	BDL
22.07.2019	66	18	BDL	BDL	BDL	BDL
25.07.2019	80	22	5.12	6.61	BDL	BDL
29.07.2019	50	12	BDL	BDL	BDL	BDL
01.08.2019	67	18	5.35	8.61	BDL	BDL
05.08.2019	80	22	BDL	BDL	BDL	BDL
08.08.2019	72	20	6.49	8.90	BDL	BDL
12.08.2019	64	18	BDL	BDL	BDL	BDL
15.08.2019	58	16	6.10	7.90	BDL	BDL
19.08.2019	76	20	9.79	6.91	BDL	BDL
22.08.2019	80	20	BDL	BDL	BDL	BDL
26.08.2019	60	18	BDL	BDL	BDL	BDL
29.08.2019	59	15	BDL	BDL	BDL	BDL
02.09.2019	52	11	BDL	BDL	BDL	BDL
05.09.2019	55	14	BDL	BDL	BDL	BDL
09.09.2019	63	17	5.85	8.42	BDL	BDL
12.09.2019	82	27	6.25	8.84	BDL	BDL
16.09.2019	70	24	5.85	7.58	BDL	BDL
19.09.2019	60	16	BDL	BDL	BDL	BDL
23.09.2019	68	18	BDL	BDL	BDL	BDL
26.09.2019	50	10	BDL	BDL	BDL	BDL
30.09.2019	72	25	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

Table 3.6 - Location: Port Site

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
01.04.2019	96	35	6.83	10.4	BDL	BDL
04.04.2019	87	25	7.26	9.79	BDL	BDL
08.04.2019	78	22	6.66	9.69	BDL	BDL
11.04.2019	92	29	8.59	9.46	BDL	BDL
15.04.2019	88	26	7.42	8.61	BDL	BDL
18.04.2019	90	32	6.42	7.49	BDL	BDL
22.04.2019	76	21	5.89	6.89	BDL	BDL
25.04.2019	70	18	6.88	8.44	BDL	BDL
29.04.2019	82	24	7.12	8.26	BDL	BDL
02.05.2019	89	30	6.32	8.19	BDL	BDL
06.05.2019	97	36	5.13	8.99	BDL	BDL
09.05.2019	86	28	5.25	8.85	BDL	BDL
13.05.2019	78	26	5.34	9.43	BDL	BDL
16.05.2019	70	22	4.47	8.07	BDL	BDL
20.05.2019	90	32	4.57	8.24	BDL	BDL
23.05.2019	82	25	6.77	8.57	BDL	BDL
27.05.2019	88	29	9.60	10.2	BDL	BDL
30.05.2019	76	24	8.67	9.71	BDL	BDL
03.06.2019	80	24	4.64	8.77	BDL	BDL
06.06.2019	89	30	5.35	7.92	BDL	BDL
10.06.2019	90	34	5.10	8.11	BDL	BDL
13.06.2019	84	23	4.84	8.42	BDL	BDL
17.06.2019	70	22	5.25	BDL	BDL	BDL
20.06.2019	86	28	4.68	BDL	BDL	BDL
24.06.2019	78	24	BDL	BDL	BDL	BDL
27.06.2019	91	32	5.34	BDL	BDL	BDL
01.07.2019	90	28	6.77	8.14	BDL	BDL
04.07.2019	66	18	6.03	10.10	BDL	BDL
08.07.2019	86	24	6.06	9.27	BDL	BDL
11.07.2019	82	26	BDL	BDL	BDL	BDL
15.07.2019	76	20	BDL	BDL	BDL	BDL
18.07.2019	68	19	BDL	BDL	BDL	BDL
22.07.2019	72	20	BDL	BDL	BDL	BDL
25.07.2019	80	22	4.58	6.82	BDL	BDL
29.07.2019	74	21	BDL	BDL	BDL	BDL
01.08.2019	90	26	5.43	8.28	BDL	BDL
05.08.2019	86	25	BDL	BDL	BDL	BDL
08.08.2019	78	20	6.17	8.8	BDL	BDL
12.08.2019	60	15	BDL	BDL	BDL	BDL
15.08.2019	57	12	6.97	7.10	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
19.08.2019	84	24	4.70	7.64	BDL	BDL
22.08.2019	66	15	BDL	BDL	BDL	BDL
26.08.2019	77	23	BDL	BDL	BDL	BDL
29.08.2019	72	18	BDL	BDL	BDL	BDL
02.09.2019	55	15	BDL	BDL	BDL	BDL
05.09.2019	57	16	6.05	8.00	BDL	BDL
09.09.2019	80	22	5.51	8.53	BDL	BDL
12.09.2019	79	21	6.25	8.84	BDL	BDL
16.09.2019	75	20	6.46	9.26	BDL	BDL
19.09.2019	53	14	5.54	7.71	BDL	BDL
23.09.2019	78	21	6.16	9.31	BDL	BDL
26.09.2019	60	16	BDL	BDL	BDL	BDL
30.09.2019	72	18	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

Table 3.7 - Location: Chani

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
01.04.2019	65	22	7.06	9.27	BDL	BDL
04.04.2019	76	26	6.06	9.69	BDL	BDL
08.04.2019	52	14	6.46	9.27	BDL	BDL
11.04.2019	53	16	7.59	9.85	BDL	BDL
15.04.2019	88	30	6.12	7.58	BDL	BDL
18.04.2019	79	28	5.86	7.46	BDL	BDL
22.04.2019	82	29	5.98	6.82	BDL	BDL
25.04.2019	64	24	6.12	8.55	BDL	BDL
29.04.2019	72	25	5.89	6.42	BDL	BDL
02.05.2019	76	26	5.74	8.99	BDL	BDL
06.05.2019	80	28	5.65	8.85	BDL	BDL
09.05.2019	82	30	5.75	8.99	BDL	BDL
13.05.2019	67	22	5.51	8.92	BDL	BDL
16.05.2019	74	24	5.79	8.64	BDL	BDL
20.05.2019	86	31	4.03	8.85	BDL	BDL
23.05.2019	80	28	6.86	7.81	BDL	BDL
27.05.2019	66	21	6.00	6.48	BDL	BDL
30.05.2019	76	26	7.87	8.43	BDL	BDL
03.06.2019	78	25	5.42	6.97	BDL	BDL
06.06.2019	62	20	5.42	7.84	BDL	BDL
10.06.2019	57	13	4.64	7.58	BDL	BDL
13.06.2019	81	29	5.24	8.84	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
17.06.2019	72	24	4.64	BDL	BDL	BDL
20.06.2019	80	28	4.62	BDL	BDL	BDL
24.06.2019	69	22	BDL	BDL	BDL	BDL
27.06.2019	74	26	5.95	BDL	BDL	BDL
01.07.2019	86	28	7.12	9.35	BDL	BDL
04.07.2019	72	22	6.98	8.83	BDL	BDL
08.07.2019	80	26	5.67	8.46	BDL	BDL
11.07.2019	70	18	BDL	BDL	BDL	BDL
15.07.2019	65	16	BDL	BDL	BDL	BDL
18.07.2019	78	24	BDL	BDL	BDL	BDL
22.07.2019	56	14	BDL	BDL	BDL	BDL
25.07.2019	66	16	4.62	6.72	BDL	BDL
29.07.2019	72	22	BDL	BDL	BDL	BDL
01.08.2019	68	18	5.95	8.99	BDL	BDL
05.08.2019	56	15	BDL	BDL	BDL	BDL
08.08.2019	81	22	7.41	7.10	BDL	BDL
12.08.2019	60	18	BDL	BDL	BDL	BDL
15.08.2019	52	10	5.57	8.18	BDL	BDL
19.08.2019	76	20	4.94	7.18	BDL	BDL
22.08.2019	57	11	BDL	BDL	BDL	BDL
26.08.2019	50	15	BDL	BDL	BDL	BDL
29.08.2019	82	25	BDL	BDL	BDL	BDL
02.09.2019	56	14	BDL	BDL	BDL	BDL
05.09.2019	58	16	5.85	9.26	BDL	BDL
09.09.2019	76	21	5.44	8.00	BDL	BDL
12.09.2019	57	15	6.05	9.26	BDL	BDL
16.09.2019	46	13	6.05	8.42	BDL	BDL
19.09.2019	50	10	BDL	BDL	BDL	BDL
23.09.2019	51	12	BDL	BDL	BDL	BDL
26.09.2019	48	11	BDL	BDL	BDL	BDL
30.09.2019	64	18	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

Table 3.8 - Location: Balaramapuram

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
01.04.2019	88	35	7.18	9.85	BDL	BDL
04.04.2019	82	30	6.69	10.80	BDL	BDL
08.04.2019	70	27	6.11	9.35	BDL	BDL
11.04.2019	92	45	7.78	9.93	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
15.04.2019	85	34	5.48	6.84	BDL	BDL
18.04.2019	79	28	6.12	6.45	BDL	BDL
22.04.2019	80	31	5.22	8.12	BDL	BDL
25.04.2019	72	26	7.12	8.64	BDL	BDL
29.04.2019	76	29	6.10	7.42	BDL	BDL
02.05.2019	84	30	5.29	9.27	BDL	BDL
06.05.2019	78	28	5.52	8.95	BDL	BDL
09.05.2019	90	32	5.29	8.07	BDL	BDL
13.05.2019	75	26	5.22	8.28	BDL	BDL
16.05.2019	64	22	5.55	8.83	BDL	BDL
20.05.2019	79	27	4.38	8.72	BDL	BDL
23.05.2019	86	29	6.37	7.98	BDL	BDL
27.05.2019	91	34	7.55	9.19	BDL	BDL
30.05.2019	72	25	5.62	8.58	BDL	BDL
03.06.2019	70	21	4.93	8.89	BDL	BDL
06.06.2019	84	30	4.97	8.97	BDL	BDL
10.06.2019	72	22	5.19	8.67	BDL	BDL
13.06.2019	80	26	4.44	7.58	BDL	BDL
17.06.2019	60	20	5.05	BDL	BDL	BDL
20.06.2019	57	18	4.52	BDL	BDL	BDL
24.06.2019	77	24	BDL	BDL	BDL	BDL
27.06.2019	82	28	4.31	BDL	BDL	BDL
01.07.2019	80	29	5.65	8.43	BDL	BDL
04.07.2019	75	27	7.09	8.72	BDL	BDL
08.07.2019	67	18	5.22	7.84	BDL	BDL
11.07.2019	70	20	BDL	BDL	BDL	BDL
15.07.2019	59	15	BDL	BDL	BDL	BDL
18.07.2019	82	28	BDL	BDL	BDL	BDL
22.07.2019	60	16	BDL	BDL	BDL	BDL
25.07.2019	58	14	4.38	BDL	BDL	BDL
29.07.2019	72	24	BDL	BDL	BDL	BDL
01.08.2019	70	20	5.28	7.06	BDL	BDL
05.08.2019	78	20	BDL	BDL	BDL	BDL
08.08.2019	80	21	5.64	7.58	BDL	BDL
12.08.2019	72	19	BDL	BDL	BDL	BDL
15.08.2019	81	22	5.77	8.61	BDL	BDL
19.08.2019	64	15	4.49	6.39	BDL	BDL
22.08.2019	76	18	BDL	BDL	BDL	BDL
26.08.2019	60	14	BDL	BDL	BDL	BDL

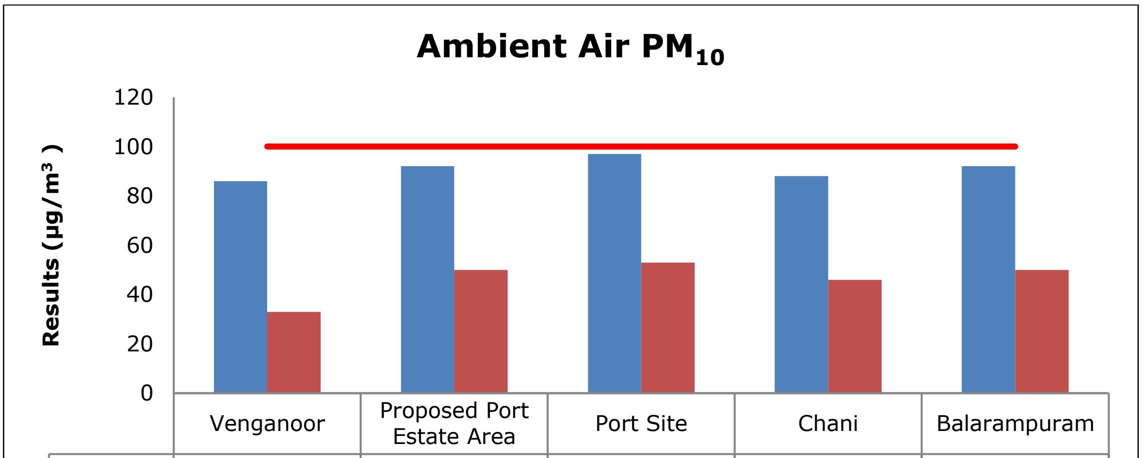
Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
29.08.2019	58	17	BDL	BDL	BDL	BDL
02.09.2019	56	16	BDL	BDL	BDL	BDL
05.09.2019	70	21	6.25	9.69	BDL	BDL
09.09.2019	78	24	4.21	5.26	BDL	BDL
12.09.2019	80	25	5.65	8.42	BDL	BDL
16.09.2019	64	17	5.65	8.00	BDL	BDL
19.09.2019	50	14	BDL	BDL	BDL	BDL
23.09.2019	55	15	BDL	BDL	BDL	BDL
26.09.2019	60	16	BDL	BDL	BDL	BDL
30.09.2019	81	26	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

5. Monthly Average Results of Ambient Air Quality Monitoring

Table 3.9: Monthly Average Results

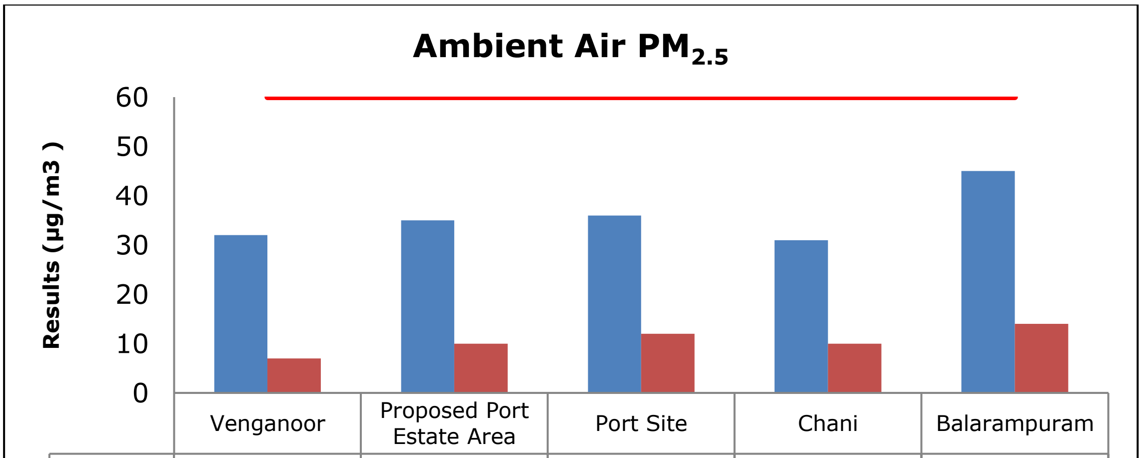
Parameter	NAAQS 2009	Month	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balaramapuram
Particulate matter (size less than 10µm) or PM10, µg/ m^3	100	April-19	75.2	72.7	84.3	70.1	80.4
		May-19	74.0	82.3	84.0	76.3	79.9
		June-19	66.0	66.8	83.5	71.6	72.8
		July-19	68.1	66.6	77.1	71.7	69.2
		Aug-19	63.7	32.4	34.7	64.7	71.0
		Sept-19	58.0	63.6	67.7	56.2	66.0
Particulate matter (size less than 2.5µm) or $PM_{2.5}$, µg/ m^3	60	April-19	26.1	24.3	25.8	23.8	31.7
		May-19	24.8	28.6	28.0	26.2	28.1
		June-19	20.6	22.3	27.1	23.4	23.6
		July-19	20.2	19.0	22.0	20.7	21.2
		Aug-19	17.2	13.4	13.7	17.1	18.4
		Sept-19	14.0	18.0	18.1	14.4	19.3
Sulphur dioxide (SO_2), µg/m^3	80	April-19	6.6	6.7	7.0	6.3	6.4
		May-19	5.8	5.9	6.2	5.9	5.6
		June-19	4.9	4.8	5.0	5.1	4.8
		July-19	5.6	6.0	5.9	6.1	5.6
		Aug-19	6.1	7.5	6.9	6.0	5.3
		Sept-19	6.1	6.0	6.0	5.8	5.4
Nitrogen Dioxide (NO_2), µg/ m^3	80	April-19	8.5	8.9	8.8	8.3	8.6
		May-19	8.6	8.4	8.9	8.4	8.7
		June-19	8.2	7.8	8.3	7.8	8.5
		July-19	8.9	7.7	8.6	8.3	8.3
		Aug-19	7.9	8.1	8.0	7.9	7.4
		Sept-19	8.7	8.3	8.6	8.7	7.8
Carbon Monoxide (CO), µg/m^3	4	April-19	BDL	BDL	BDL	BDL	BDL
		May-19	BDL	BDL	BDL	BDL	BDL
		June-19	BDL	BDL	BDL	BDL	BDL
		July-19	BDL	BDL	BDL	BDL	BDL
		Aug-19	BDL	BDL	BDL	BDL	BDL
		Sept-19	BDL	BDL	BDL	BDL	BDL
Hydrocarbon (HC), ppm	-	April-19	BDL	BDL	BDL	BDL	BDL
		May-19	BDL	BDL	BDL	BDL	BDL
		June-19	BDL	BDL	BDL	BDL	BDL
		July-19	BDL	BDL	BDL	BDL	BDL
		Aug-19	BDL	BDL	BDL	BDL	BDL
		Sept-19	BDL	BDL	BDL	BDL	BDL

6. Graphical representation of Results for the period April 2019 to September 2019



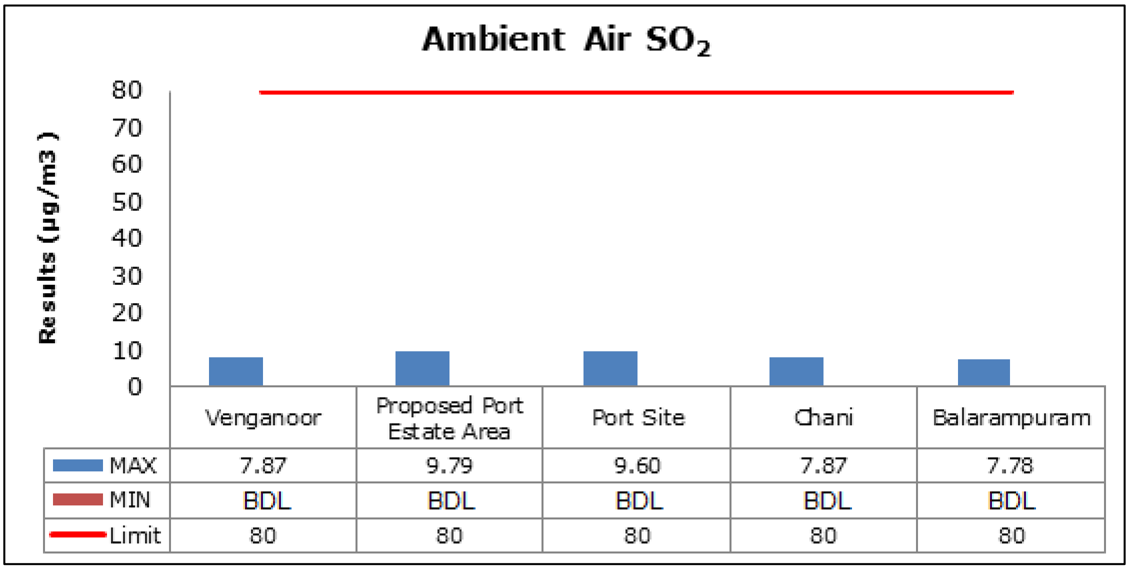
	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
MAX	86	92	97	88	92
MIN	33	50	53	46	50
Limit	100	100	100	100	100

Figure 3.2 Particulate matter (size less than 10µm) (PM_{10})



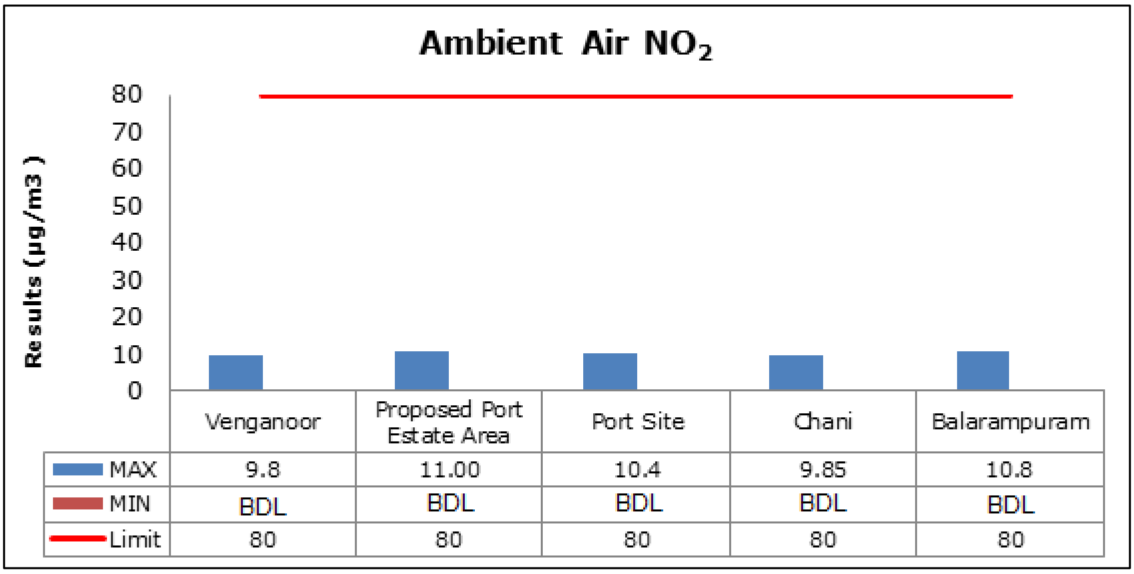
	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
MAX	32	35	36	31	45
MIN	7	10	12	10	14
Limit	60	60	60	60	60

Figure 3.3 Particulate matter (size less than 2.5µm) ($PM_{2.5}$)



	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
MAX	7.87	9.79	9.60	7.87	7.78
MIN	BDL	BDL	BDL	BDL	BDL
Limit	80	80	80	80	80

Figure 3.4: Sulphur dioxide (SO_2)



	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
MAX	9.8	11.00	10.4	9.85	10.8
MIN	BDL	BDL	BDL	BDL	BDL
Limit	80	80	80	80	80

Figure 3.5 Nitrogen Dioxide (NO_2)

7. Summary - Ambient Air Quality

During the period April 2019 to September 2019, at the location **Venganoor**, the concentration of PM_{10} was observed in the range between 33 - 86 µg/m^3 with an average of 67.5 µg/m^3, $PM_{2.5}$ was observed in the range between 7 - 32 µg/m^3 with an average of 20.5 µg/m^3, SO_2 was observed in the range between BDL – 7.9 µg/m^3 with an average of 5.9 µg/m^3, NO_2 was observed in the range between BDL – 9.8

μg/m^3 with an average of 8.5 μg/m^3, CO and HC were observed BDL for all six months.

At the location **Proposed Port Colony**, concentration of PM_{10} was observed in the range between 50 - 92 μg/m^3 with an average of 70.1 μg/m^3, $PM_{2.5}$ was observed in the range between 10 - 35 μg/m^3 with an average of 21.8 μg/m^3, SO_2 was observed in the range between BDL – 9.8 μg/m^3 with an average of 6.0 μg/m^3, NO_2 was observed in the range between BDL – 11.0 μg/m^3 with an average of 8.3 μg/m^3, CO and HC were observed BDL for all six months.

At the location **Port site**, concentration of PM_{10} was observed in the range between 53 - 97 μg/m^3 with an average of 78.4 μg/m^3, $PM_{2.5}$ was observed in the range between 12 - 36 μg/m^3 with an average of 23.4 μg/m^3, SO_2 was observed in the range between BDL – 9.6 μg/m^3 with an average of 6.1 μg/m^3, NO_2 was observed in the range between BDL – 10.4 μg/m^3 with an average of 8.6 μg/m^3, CO and HC were observed BDL for all six months.

At the location **Chani**, concentration of PM_{10} was observed in the range between 46 - 88 μg/m^3 with an average of 68.4 μg/m^3, $PM_{2.5}$ was observed in the range between 10 - 31 μg/m^3 with an average of 20.9 μg/m^3, SO_2 was observed in the range between BDL – 7.9 μg/m^3 with an average of 5.9 μg/m^3, NO_2 was observed in the range between BDL – 9.9 μg/m^3 with an average of 8.3 μg/m^3, CO and HC were observed BDL for all six months.

At the location **Balaramapuram**, concentration of PM_{10} was observed in the range between 50- 92 μg/m^3 with an average of 73.2 μg/m^3, $PM_{2.5}$ was observed in the range between 14 - 45 μg/m^3 with an average of 23.7 μg/m^3, SO_2 was observed in the range between BDL – 7.8 μg/m^3 with an average of 5.6 μg/m^3, NO_2 was observed in the range between BDL – 10.8 μg/m^3 with an average of 8.3 μg/m^3, CO and HC were observed BDL for all six months.

The obtained results were compared with National Ambient Air Quality Standards (NAAQS), 2009. The results were well within the limit on all monitoring days at all 5 locations.

CHAPTER 4

Ambient Noise Monitoring

1. Ambient Noise Monitoring location details

This chapter describes the sampling location, methodology adopted for monitoring ambient noise and analysis of monitored results. Ambient Noise Monitoring during April 2019 to September 2019 was carried out at Venganoor, Proposed Port Estate Area, Port Site, Chani and Balaramapuram. Classification of locations as per the Noise Pollution (Regulation & Control) Rules, 2000 (Rules 3 (1) and 4(1)) are as below:

Table 4.1: Ambient Noise Monitoring Stations details

Sr. No.	Location	Area Type	Latitude	Longitude
1.	Port Site	Industrial	8^0,22',06.03" N	77^0,00',17.03" E
2.	Balaramapuram	Commercial	8^0,25',37.60" N	77^0,02',43.80" E
3.	Proposed Port Estate Area	Residential	8^0,22',41.47" N	77^0,01',02.94" E
4.	Chani	Residential	8^0,20',56.86" N	77^0,03',16.19" E
5.	Venganoor	Residential	8^0,23',55.10" N	77^0,00',11.30" E

Figure 4.1 Google earth view of Ambient Noise Monitoring Stations

2. Methodology of Sampling

Ambient Noise Monitoring is being carried out as per IS 9876: 1981, CPCB Protocol for Ambient Level Noise Monitoring, July 2015 & Manufacturer Manual, WI/S/5/35 & 36, Issue No.3, Issue date 01.09.2016

3. Ambient Noise Standards

As per the Noise Pollution (Regulation & Control) Rules, 2000 (Rules 3 (1) and 4(1))

Table 4.2: Ambient Noise Standard

Area Code	Area Type	Limits in dB (A) Leq	
		Day (6 a.m. to 10 p.m.)	Night (10 p.m. to 6 a.m.)
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45

4. Ambient Noise Monitoring Results for the period April 2019 to September 2019

Table 4.3 – Location : Port Site (Industrial)

Month	Date	L_{max} Day time	L_{max} Night time	L_{min} Day time	L_{min} Night time	L_{eq} Day time	L_{eq} Night time
		dB (A)					
Aprl-19	11.04.2019	83.2	78.5	48.3	46.2	74.8	66.6
	25.04.2019	84.7	81.9	44.1	40.9	64.5	56.0
May-19	09.05.2019	88.9	84.5	45.8	43.9	69.4	61.2
	23.05.2019	94.3	90.1	45.5	44.6	67.3	56.0
June-19	06.06.2019	96.4	85.3	44.6	44.6	68.2	62.0
	20.06.2019	98.8	85.2	59.8	56.9	72.1	68.9
July-19	11.07.2019	95.5	78.5	44.5	51.2	71.1	60.9
	25.07.2019	88.4	87.8	46.6	40.2	66.3	60.3
Aug-19	08.08.2019	90.0	86.7	43.2	40.2	64.6	59.4
	22.08.2019	94.4	88.9	52.5	53.1	69.5	63.9
Sept-19	05.09.2019	94.5	86.4	52.4	46.5	67.2	63.2
	26.09.2019	93.5	79.7	47.3	53.6	65.9	57.9

As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]	75	70

Table 4.4 - Location: Balaramapuram (Commercial)

Month	Date	L_{max} Day time	L_{max} Night time	L_{min} Day time	L_{min} Night time	L_{eq} Day time	L_{eq} Night time
		dB (A)					
Aprl-19	15.04.2019	82.4	74.8	39.4	39.4	61.0	49.9
	29.04.2019	82.2	66.9	39.0	37.3	59.6	44.2
May-19	13.05.2019	85.3	71.4	43.7	41.5	63.4	49.3
	27.05.2019	90.1	73.0	36.8	39.6	60.2	48.9
June-19	10.06.2019	93.2	73.5	41.4	41.3	60.3	50.6
	24.06.2019	90.3	74.1	39.9	39.6	62.6	48.5
July-19	15.07.2019	90.8	77.3	40.3	41.7	59.2	51.9
	29.07.2019	87.1	82.4	39.2	38.6	59.4	52.8
Aug-19	12.08.2019	92.1	74.4	42.4	41.8	59.2	50.5
	26.08.2019	92.1	84.0	37.9	36.9	60.8	51.7
Sept-19	09.09.2019	89.7	82.3	43.5	43.6	64.2	54.8
	30.09.2019	91.9	77.3	42.8	42.9	62.9	50.9
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						65	55

Table 4.5 - Location: Proposed Port Estate Area (Residential)

Month	Date	L_{max} Day time	L_{max} Night time	L_{min} Day time	L_{min} Night time	L_{eq} Day time	L_{eq} Night time
		dB (A)					
Aprl-19	12.04.2019	85.2	70.5	37.2	36.1	54.2	44.8
	26.04.2019	83.9	69.7	39.2	36.9	54.8	44.5
May-19	10.05.2019	86.0	67.8	37.7	38.5	54.7	44.2
	24.05.2019	83.6	73.2	37.8	37.4	54.3	44.4
June-19	07.06.2019	82.8	70.9	41.8	40.9	54.6	44.9
	21.06.2019	82.8	69.2	39.2	39.8	54.3	44.7
July-19	12.07.2019	82.4	71.4	38.6	41.4	54.1	44.4
	26.07.2019	82.4	69.4	35.7	35.6	54.8	44.0
Aug-19	09.08.2019	82.1	75	33.5	35.4	54.8	44.0
	23.08.2019	82.0	73.9	36.7	36.4	54.0	43.6

Month	Date	L_{max} Day time	L_{max} Night time	L_{min} Day time	L_{min} Night time	L_{eq} Day time	L_{eq} Night time
		dB (A)					
Sept-19	06.09.2019	91.9	77.3	37.1	35.3	53.5	44.6
	27.09.2019	83.3	71.5	40.9	39.6	54.5	44.5
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						55	45

Table 4.6 - Location: Chani (Residential)

Month	Date	L_{max} Day time	L_{max} Night time	L_{min} Day time	L_{min} Night time	L_{eq} Day time	L_{eq} Night time
		dB (A)					
Aprl-19	13.04.2019	83.6	67.0	36.2	35.2	53.5	44.6
	27.04.2019	73.6	70.6	36.9	37.9	51.9	42.2
May-19	11.05.2019	83.0	70.4	38	36.1	54.4	43.7
	25.05.2019	88.8	68.2	34.4	34.3	53.0	41.7
June-19	08.06.2019	80.0	73.7	35.6	35.3	51.3	43.0
	22.06.2019	85.7	70.9	37.4	37.2	55.0	45.3
July-19	13.07.2019	80.2	71.9	39.5	39.1	53.8	43.9
	27.07.2019	81.8	70.2	37.9	36.9	54.3	43.1
Aug-19	10.08.2019	83.5	67.5	38.2	38.7	52.7	43.2
	24.08.2019	85.6	72.8	37.6	35.9	54.7	44.2
Sept-19	07.09.2019	89.7	69.0	34.4	35.1	54.3	44.1
	28.09.2019	89.7	69.0	34.4	35.1	54.3	44.3
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						55	45

Table 4.7 - Location: Venganoor (Residential)

Month	Date	L_{max} Day time	L_{max} Night time	L_{min} Day time	L_{min} Night time	L_{eq} Day time	L_{eq} Night time
		dB (A)					
Aprl-19	14.04.2019	76.2	63.1	33.1	35.3	51.8	39.9
	28.04.2019	75.6	65.7	35.1	34.1	45.9	41.5
May-19	12.05.2019	78.4	68.9	34.7	34.7	51.3	42.9
	26.05.2019	84.4	69.7	34.4	35.4	48	40.4
June-19	09.06.2019	76.7	68.2	35.4	35.9	49.8	41.6

Month	Date	L_{max} Day time	L_{max} Night time	L_{min} Day time	L_{min} Night time	L_{eq} Day time	L_{eq} Night time
		dB (A)					
	23.06.2019	81.5	71.3	34.3	34.7	51.2	42.8
July-19	14.07.2019	75.1	70.4	38.2	37.9	50.5	41.7
	28.07.2019	70.3	61.9	35.4	35.4	45.9	42.0
Aug-19	11.08.2019	75.2	68.9	35.7	35.4	46.2	41.8
	25.08.2019	76.1	67.4	36.3	35.1	48.0	41.5
Sept-19	08.09.2019	73.0	67.5	34.3	34.6	43.8	39.9
	29.09.2019	73.0	67.5	34.3	34.6	44.7	41.5
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						**55**	**45**

5. **Half Yearly Average Results of Ambient Noise Monitoring**

Table 4.8: Half Yearly Average Results

Parameter		Proposed Port Estate Area	Chani	Venganoor	Port Site	Balaramapuram
		Residential			Industrial	Commercial
		Day Time (55) Night Time (45)			Day Time (75) Night Time (70)	Day Time (65) Night Time (55)
L_{max} Day time dB (A)	Max	91.9	89.7	84.4	98.8	93.2
	Min	82.0	73.6	70.3	83.2	82.2
	Avg	84.0	83.8	76.3	91.9	88.9
L_{max} Night time dB (A)	Max	77.3	73.7	71.3	90.1	84.0
	Min	67.8	67.0	61.9	78.5	66.9
	Avg	71.7	70.1	67.5	84.5	76.0
L_{min} Day time dB (A)	Max	41.8	39.5	38.2	59.8	43.7
	Min	33.5	34.4	33.1	43.2	36.8
	Avg	38.0	36.7	35.1	47.9	40.5
L_{min} Night time dB (A)	Max	41.4	39.1	37.9	56.9	43.6
	Min	35.3	34.3	34.10	40.2	36.90
	Avg	37.8	36.4	35.3	46.8	40.4
Leq Day time dB (A)	Max	54.8	55.0	51.8	74.8	64.2
	Min	53.5	51.3	43.8	64.5	59.2
	Avg	54.4	53.6	48.1	68.4	61.1
Leq	Max	44.9	45.3	42.9	68.9	54.8

Parameter		Proposed Port Estate Area	Chani	Venganoor	Port Site	Balaramapuram
		Residential			Industrial	Commercial
		Day Time (55) Night Time (45)			Day Time (75) Night Time (70)	Day Time (65) Night Time (55)
Night time dB (A)	Min	43.6	41.7	39.9	56.0	44.2
	Avg	44.4	43.6	41.5	61.4	50.3

6. **Graphical representation of Results for the period April 2019 to September 2019**

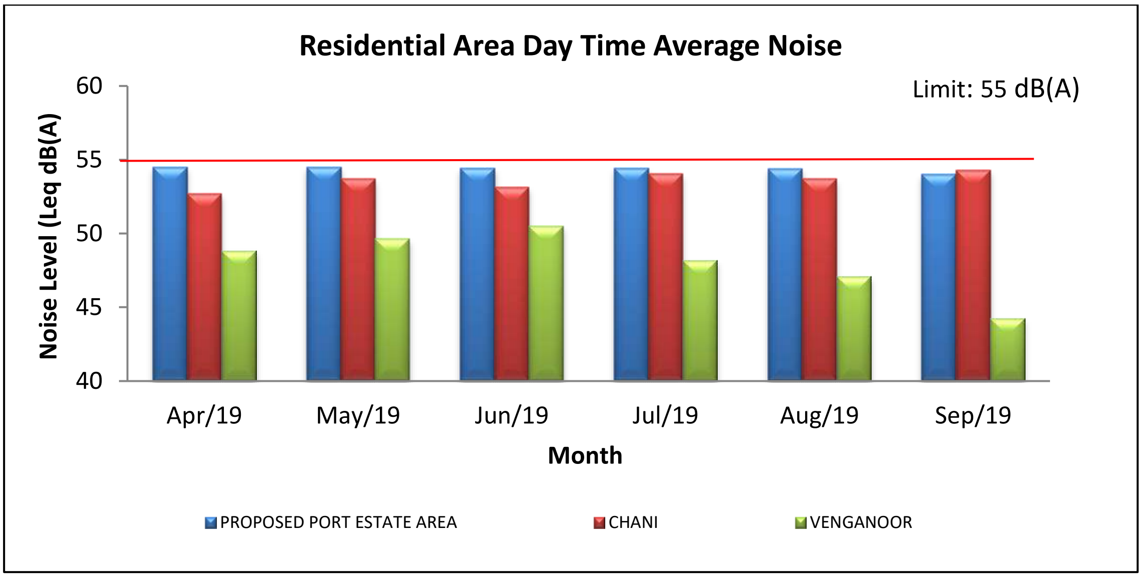


Figure 4.2 Residential Area Noise Level at day time

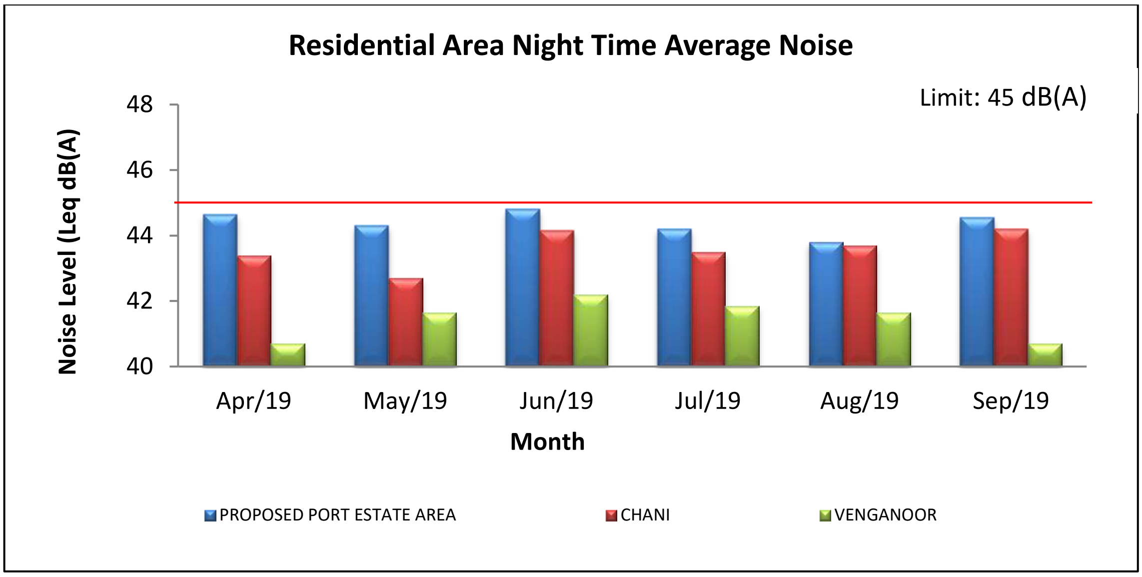


Figure 4.3 Residential Area Noise Level at night time

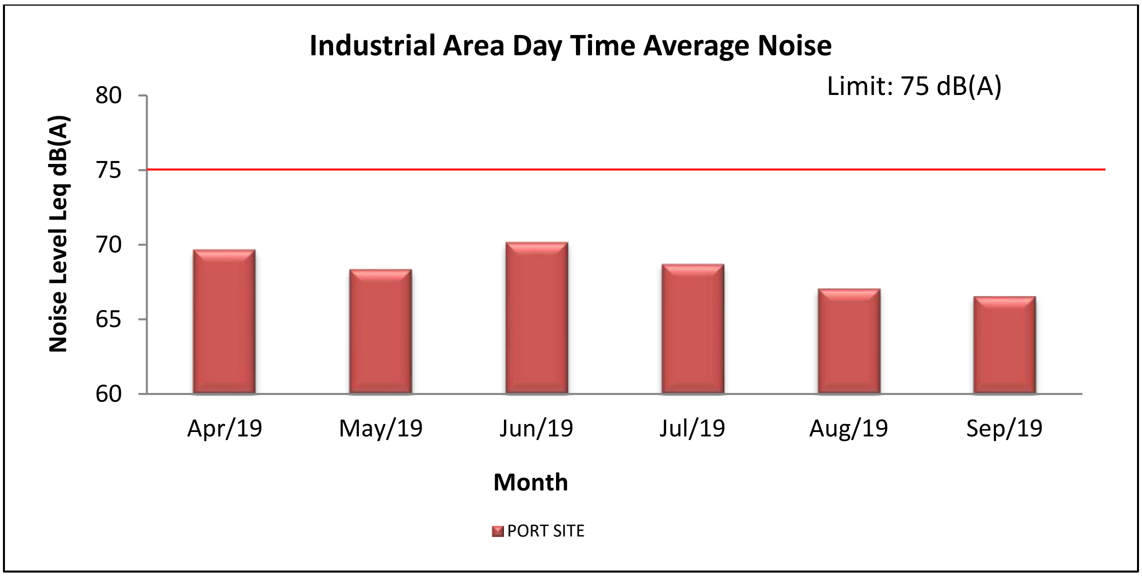


Figure 4.4 Industrial Area Noise Level at day time

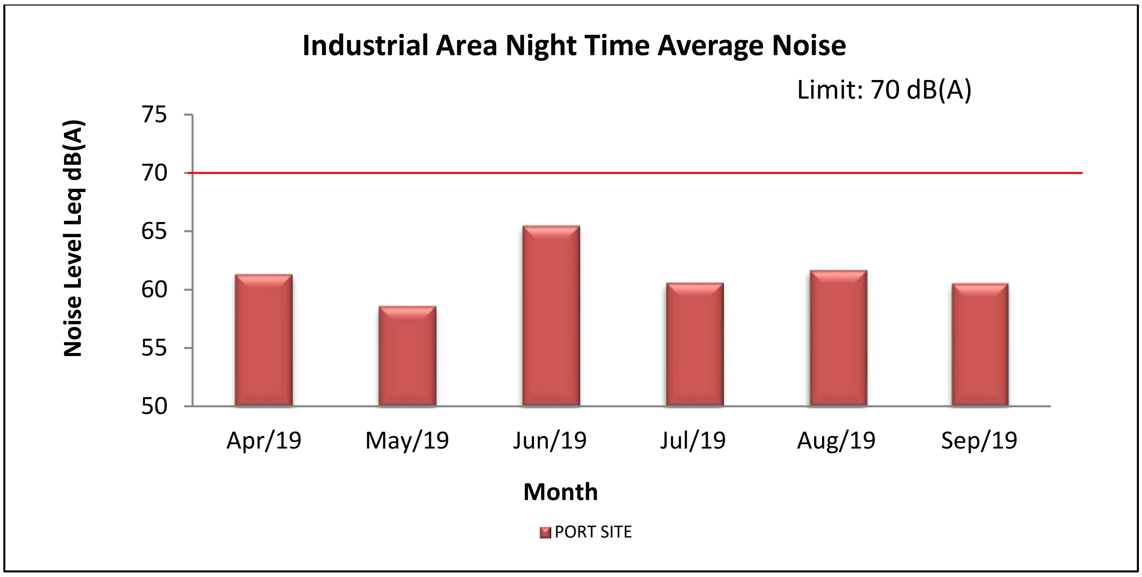


Figure 4.5 Industrial Area Noise Level at night time

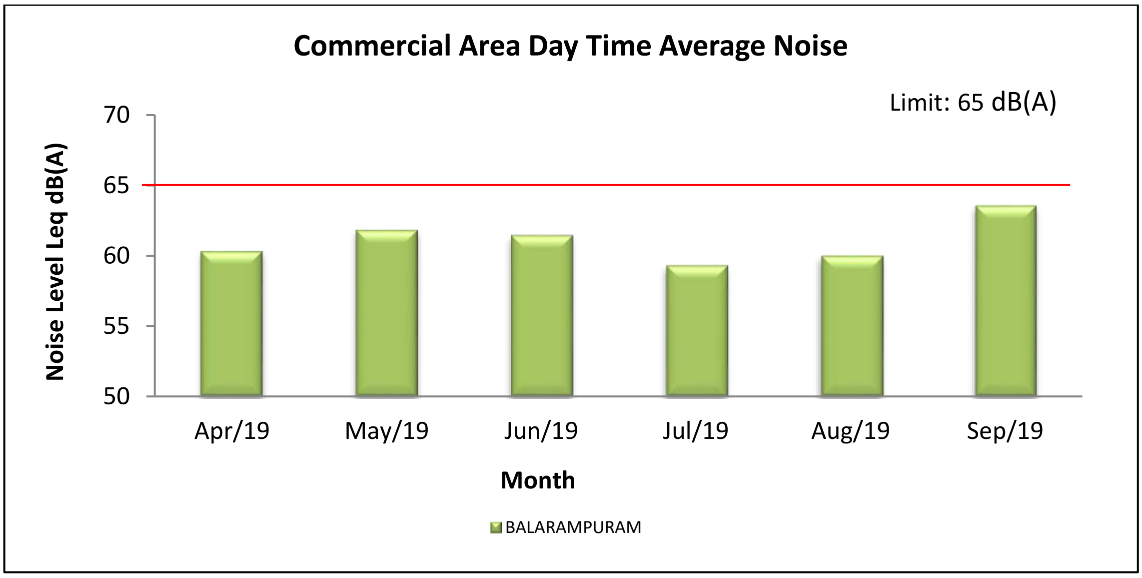


Figure 4.6 Commercial Area Noise Level at day time

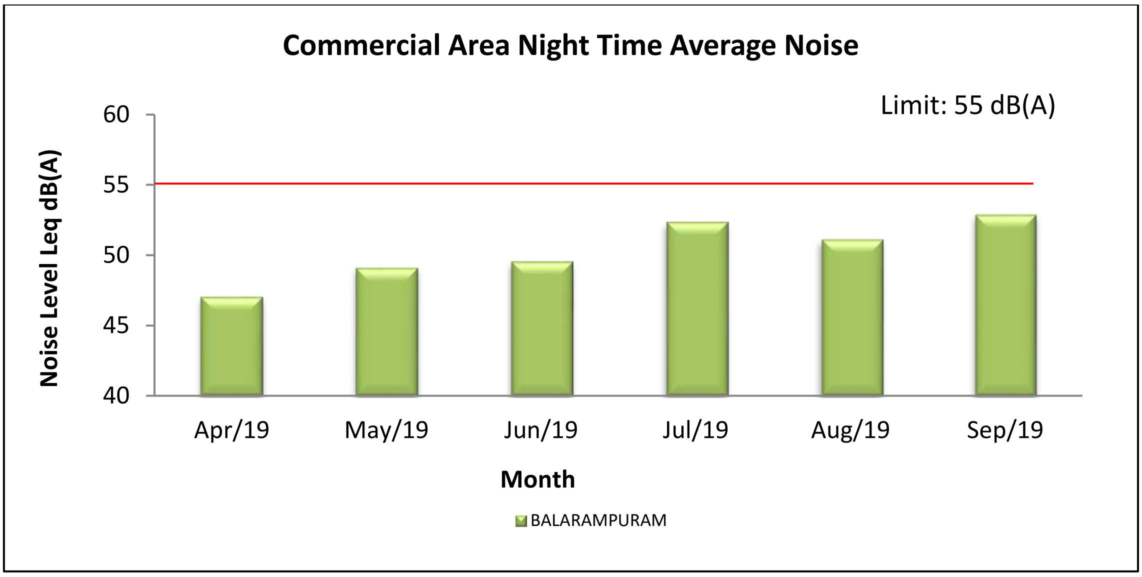


Figure 4.7 Commercial Area Noise Level at night time

7. Summary - Ambient Noise Monitoring

During the period April 2019 to September 2019, average noise level observed at residential areas i.e. at Proposed Port Estate Area, Chani and Venganoor during day time were 54.4 dB(A), 53.6 dB(A) and 48.1 dB(A) respectively and during night time 44.4 dB(A), 43.6 dB(A) and 41.5 dB(A) respectively.

At industrial area i.e. at Port Site area average noise level observed at day time 68.4 dB(A) and at night time 61.4 dB(A).

At commercial area i.e. Balaramapuram area average noise level observed at day time 61.1 dB(A) and at night time 50.3 dB(A).

CHAPTER 5

Marine Water and Sediment Analysis

1. Marine Water and Sediment Sampling location details:

This chapter describes the sampling location, methodology adopted for analysis and the analysis of monitored data for Marine Water and Sediment. Sampling and analysis of marine water at high tide and low tide during April 2019 to September 2019 carried out at different locations such as; Near Kovalam Beach, Proposed Dredge Material Disposal Site, South of Break Water, Port Basin, Inner Approach Channel and Kovalam Beach. Classification of locations as per the Noise Pollution (Regulation & Control) Rules, 2000 (Rules 3 (1) and 4(1)) is as below:

Table 5.1 Marine Water and Sediment sampling locations details

Sr. No.	Location	Latitude	Longitude
1.	Near Kovalam Beach	8^0,22',28.20" N	76^0,58',48.70" E
2.	Proposed Dredge Material Disposal Site	8^0,21',54.40" N	76^0,59',27.90" E
3.	South of Break Water	8^0,22',03.20" N	76^0,59',46.50" E
4.	Port Basin	8^0,22',00.00" N	77^0,00',03.30" E
5.	Inner Approach Channel	8^0,21',05.90" N	77^0,00',40.70" E
6.	Kovalam Beach	8^0,23',03.61" N	76°,58',37.62" E

Figure 5.1 Google earth view of Marine Water and Sediment Sampling Locations

2. Methodology of Sampling and Analysis

Table 5.2 Sampling and Analysis Methodology

S. No.	Parameter	Unit	Detection Limit	Method Reference
Marine Water Analysis				
1.	Temperature	^0C	0	IS 3025 (Part 9):1984
2.	pH Value	-	1	IS 3025 (Part 11):1983
3.	Turbidity	N.T.U.	0.1	IS 3025 (Part 10):1984
4.	Electrical Conductivity (at 25°C)	µmho/cm	0.1	IS 3025(Part 14): 1984
5.	Total Suspended Solids	mg/L	5	IS 3025 (Part 17): 1984
6.	Total Dissolved Solids	mg/L	5	IS 3025 (Part 16):1984
7.	Dissolved Oxygen	mg/L	0.05	IS 3025 (Part 38): 1989
8.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	1	IS 3025 (Part 44): 1993
9.	Floating Materials – Oil, Grease and Scum (Including Petroleum Products)	mg/L	0.005	APHA, 23rd Ed., 2017,5520-B, 5-40 and Clause 6 of IS: 3025 (Part 39): 1991, Amds.2, Sept 2013
10.	Nitrite (as NO_2)	mg/L	0.01	APHA, 23rd Ed., 2017, 4500-NO2-B,4-124
11.	Nitrate (as NO_3)	mg/L	0.2	APHA, 23rd Ed., 2017, 4500-NO3 B-4-127
12.	Phenolic Compounds (as C_6H_5OH)	mg/L	0.001	APHA, 23rd Ed., 2017, 5530- B & C, 5-49
13.	Ammonical Nitrogen (as NH_3-N)	mg/L	5	APHA, 23rd Ed., 2017, 4500 NH3, B & C, 4 -114, 4-116
14.	Total Nitrogen (as N)	mg/L	0.1	APHA, 23rd Ed., 2017, 4500 NH3, B & C, 4 -114, 4-116
15.	Total Phosphorous (as P)	mg/L	0.1	APHA, 23rd Ed., 2017, 4500 P,E, 4-155
16.	Reactive Phosphorous	mg/L	0.1	APHA, 23rd Ed., 2017, 4500 P,E, 4-155
17.	Polycyclic Aromatic Hydrocarbon	mg/L	0.00007	APHA, 23rd Ed., 2017, 6440, 6-94
18.	Salinity	‰	0.01	CPCB ADSORBS /8/1983-84
19.	Total Chlorophyll	mg/L	ND	APHA, 23rd Ed.,2017, 10200 H
20.	Total Coliforms	MPN Index	1.8	APHA, 23rd Ed., 2017, 9221-B, 9-69

S. No.	Parameter	Unit	Detection Limit	Method Reference
		/100 ml		
21.	Faecal Coliforms	MPN Index /100ml	1.8	APHA, 23rd Ed., 2017, 9221-E, 9-77
22.	Phytoplanktons	No./100ml	ND	APHA, 23rd Ed., 2017
23.	Zooplanktons	No./100ml	ND	APHA, 23rd Ed., 2017
Sediment Analysis				
1.	Texture	-	Qualitative	AEC/C/SAP/S-3
2.	Organic Matter	%	0.043	FAO 1976, Sec. III,3, Page no.73
3.	Total Phosphorus (as P)	mg/kg	5	WLII, B-10a,Page no. 16
4.	Aluminium (as Al)	mg/kg	1	USEPA / SW 846/ 6010 C
5.	Chromium (as Cr)	mg/kg	1	USEPA / SW 846/ 6010 C
6.	Copper (as Cu)	mg/kg	0.08	USEPA / SW 846/ 6010 C
7.	Iron (as Fe)	mg/kg	1	USEPA / SW 846/ 6010 C
8.	Lead (as Pb)	mg/kg	0.1	USEPA / SW 846/ 6010 C
9.	Manganese (as Mn)	mg/kg	0.5	USEPA / SW 846/ 6010 C
10.	Mercury (as Hg)	mg/kg	0.01	USEPA / SW 846/ 6010 C
11.	Zinc (as Zn)	mg/kg	0.5	USEPA / SW 846/ 6010 C
12.	Nickel (as Ni)	mg/kg	0.1	USEPA / SW 846/ 6010 C
13.	Benthic Organism	/m^2	ND	APHA, 23rd Ed., 2017
Note: **ND:** Not Detected				

3. Marine Water Analysis Result for the period April 2019 to September 2019

Table 5.4: Marine Water Analysis Results

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
1	Temperature (°C)	Aprl-19	High tide	28.7	29.2	29.2	29.3	28.6	28.7
			Low tide	28.7	29.2	29.2	29.3	28.6	28.7
		May-19	High tide	29.2	28.9	28.7	28.6	28.3	29.2
			Low tide	28.4	28.1	28.2	28.3	28.1	28.5
		June-19	High tide	28.6	28.4	28.4	28.6	28.1	28.6
			Low tide	28.1	28.2	28.1	28.2	28	28.2
		July-19	High tide	28.3	27.8	27.7	28.1	27.6	28.3
			Low tide	28.4	27.9	27.9	28.2	27.8	28.4
		Aug-19	High tide	27.5	27.4	27.9	27.9	27.3	27.5
			Low tide	27.4	27.3	27.8	27.8	27.2	27.4
		Sept-19	High tide	28.1	27.7	27.9	27.9	27.6	28.1
			Low tide	27.9	27.5	27.7	27.7	27.5	27.9
2	Colour and Odour	April-19 May-19 June-19 July-19 Aug-19 Sept-19	High tide & Low tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
3	pH Value	Aprl-19	High tide	8.36	8.37	8.39	8.37	8.42	8.14
			Low tide	8.23	8.28	8.32	8.21	8.22	8.24
		May-19	High tide	8.31	8.30	8.28	8.69	8.67	8.58
			Low tide	8.57	8.35	8.73	8.36	8.59	8.18
		June-19	High tide	8.20	8.37	8.36	8.44	8.40	8.36
			Low tide	8.4	8.47	8.47	8.54	8.44	8.5
		July-19	High tide	8.44	8.28	8.51	8.46	8.49	8.13
			Low tide	7.91	8.15	8.40	8.53	8.46	8.35
		Aug-19	High tide	8.17	8.02	8.05	8.05	8.06	8.15
			Low tide	7.84	7.99	8.00	8.01	8.01	8.01
		Sept-19	High tide	8.14	8.03	8.12	8.19	8.27	8.20
			Low tide	7.93	8.02	8.15	8.22	8.19	8.02
4	Turbidity	Aprl-19	High tide	0.5	0.4	0.5	0.6	0.6	0.5
			Low tide	0.3	0.3	0.5	0.7	0.4	0.6
		May-19	High tide	0.2	0.3	0.3	0.4	0.3	0.3
			Low tide	0.2	0.4	0.4	0.3	0.4	0.4
		June-19	High tide	0.6	0.7	0.4	0.3	0.6	0.6
			Low tide	0.4	0.5	0.5	0.8	0.2	0.5
		July-19	High tide	0.6	0.7	0.6	0.85	0.7	0.6
			Low tide	0.7	0.8	0.7	0.6	0.7	0.6
		Aug-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
		Sept-19	High tide	1.57	1.51	1.58	1.33	1.46	0.94
			Low tide	0.91	1.72	1.72	1.04	2.21	1.53
5	Electrical Conductivity (at 25°C)	Aprl-19	High tide	48000	46000	53300	50712	47000	55704
			Low tide	52300	55700	55300	58012	57000	57500
		May-19	High tide	48000	44821	51964	50712	46785	55535
			Low tide	55400	55353	55710	58571	58467	55732
		June-19	High tide	48350	46981	48178	47140	53230	51553
			Low tide	50200	53178	51600	51553	47170	51170
		July-19	High tide	59357	57357	53767	53625	57357	62802
			Low tide	61214	55086	55322	58892	57357	57875
		Aug-19	High tide	44630	47570	48940	47820	48010	43710
			Low tide	44480	43910	43342	45072	45375	48300
		Sept-19	High tide	39400	39500	39300	39700	39500	39800
			Low tide	41000	39900	39900	40400	39250	40400
6	Total Suspended Solids	Aprl-19	High tide	8	6	7	7	7	6
			Low tide	6	6	6	7	5	6
		May-19	High tide	9	7	6	8	7	7
			Low tide	5	8	5	6	6	6
		June-19	High tide	5	BDL	5	6	6	6
			Low tide	7	BDL	5	5	5	6
		July-19	High tide	6	8	7	8	8	6
			Low tide	8	6	6	6	5	8

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
		Aug-19	High tide	6	7	6	7	6	6
			Low tide	6	6	8	8	7	6
		Sept-19	High tide	8	10	8	12	6	8
			Low tide	8	6	6	6	6	8
7	Total Dissolved Solids	Aprl-19	High tide	26880	25900	29900	29000	26500	31200
			Low tide	31500	31200	31200	32500	32200	32200
		May-19	High tide	24770	25080	29090	28400	26200	31090
			Low tide	31020	30990	31190	32620	32740	31200
		June-19	High tide	27080	26270	26980	26400	29830	28870
			Low tide	28120	29780	28900	28870	26420	28660
		July-19	High tide	39240	32120	30110	30030	32120	35170
			Low tide	34280	30820	30980	32980	32120	32410
		Aug-19	High tide	24990	26640	27410	26780	26880	24480
			Low tide	24910	24590	24250	25240	25410	27210
		Sept-19	High tide	26800	26860	28290	27010	28940	26200
			Low tide	27910	27130	27230	27480	26690	25050
8	Dissolved Oxygen	Aprl-19	High tide	3.5	3.7	3.9	3.7	3.8	3.8
			Low tide	3.2	3.5	3.8	3.5	3.3	3.5
		May-19	High tide	2.1	3.1	2.9	3.1	2.3	2.4
			Low tide	2.3	2.6	2.2	3.4	2.2	2.5
		June-19	High tide	3.8	3.6	3.7	3.8	3.7	3.6
			Low tide	4.1	3.5	3.5	3.7	3.8	3.5

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
		July-19	High tide	4.1	3.8	4.1	4.0	3.8	3.9
			Low tide	4.2	4.0	3.8	3.9	4.0	3.8
		Aug-19	High tide	5.9	5.9	5.4	5.3	5.8	6.6
			Low tide	6.2	6.3	6.3	6.0	6.2	6.4
		Sept-19	High tide	5.8	6.1	5.6	5.5	5.6	6.1
			Low tide	5.9	5.9	5.5	5.4	5.8	5.9
9	Biochemical Oxygen Demand (3 days, 27°C)	Aprl-19	High tide	6.4	7.0	6.1	8.0	6.1	5.0
			Low tide	7.1	7.8	6.3	9.0	7.0	6.0
		May-19	High tide	6.8	6.0	6.5	10	7.0	7.0
			Low tide	7.2	8.1	6.8	8.0	8.0	5.0
		June-19	High tide	5.1	5.0	4.0	3.0	4.5	4.7
			Low tide	4.9	4.0	5.0	3.8	5.0	4.9
		July-19	High tide	4.8	4.8	4.0	3.2	4.7	4.6
			Low tide	4.7	4.0	4.9	3.6	4.9	4.8
		Aug-19	High tide	4.1	3.2	4.8	4.6	4.1	3.8
			Low tide	4.0	2.8	4.2	4.5	3.8	4.0
		Sept-19	High tide	3.8	3.1	4.5	4.4	4.3	4.1
			Low tide	3.5	3.4	4.6	4.5	3.9	4.2
10	Floating Materials (Oil, Grease and Scum) (Including Petroleum	Aprl-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		May-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
	Products)		Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		June-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		July-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Aug-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sept-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
11	Nitrite (as NO_2)	Aprl-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		May-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		June-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		July-19	High tide	0.01	0.03	0.02	0.02	0.03	0.01
			Low tide	0.02	0.03	0.00	0.02	0.03	0.02
		Aug-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sept-19	High tide	0.01	0.02	0.02	BDL	0.01	0.01
			Low tide	0.02	BDL	BDL	BDL	BDL	0.01
12	Nitrate (as NO_3)	Aprl-19	High tide	1.40	1.79	1.60	1.55	1.86	1.09

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
			Low tide	2.11	1.70	1.41	1.74	1.50	1.63
		May-19	High tide	1.23	1.76	1.50	1.57	1.64	1.06
			Low tide	2.00	2.22	1.50	1.60	1.40	1.54
		June-19	High tide	3.52	2.83	3.87	3.96	1.92	2.54
			Low tide	3.63	2.88	2.78	2.9	2.93	3.75
		July-19	High tide	3.87	4.72	4.28	4.00	3.43	3.77
			Low tide	4.38	4.23	3.75	5.01	4.02	4.23
		Aug-19	High tide	2.39	3.12	2.64	2.68	3.19	1.95
			Low tide	2.89	2.88	3.27	2.95	2.64	2.49
		Sept-19	High tide	2.10	2.31	2.21	1.98	2.30	1.83
			Low tide	2.44	2.32	2.18	2.08	1.91	2.14
13	Phenolic Compounds (as C_6H_5OH)	Aprl-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		May-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		June-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		July-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Aug-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sept-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
14	Ammonical Nitrogen (as NH_3-N	Aprl-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		May-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		June-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		July-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Aug-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sept-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
15	Total Nitrogen (as N)	Aprl-19	High tide	0.76	0.95	0.93	0.9	0.75	0.63
			Low tide	0.80	0.73	0.76	0.83	0.67	0.81
		May-19	High tide	0.94	0.89	0.83	0.89	0.76	0.68
			Low tide	0.78	0.71	0.67	0.8	0.65	0.79
		June-19	High tide	1.55	3.30	1.97	2.1	2.54	2.23
			Low tide	1.80	1.63	1.84	1.42	1.65	2.16
		July-19	High tide	1.41	1.59	1.5	1.55	1.19	1.38
			Low tide	1.63	1.6	1.6	1.88	1.55	1.49
		Aug-19	High tide	0.63	1.01	1.12	1.00	1.10	0.64

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
			Low tide	1.07	1.07	1.38	1.08	0.91	0.87
		Sept-19	High tide	0.90	1.30	1.00	1.10	0.96	0.85
			Low tide	1.33	1.26	1.26	1.13	0.98	1.14
16	Total Phosphorous (as P)	Aprl-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		May-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		June-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		July-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Aug-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sept-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
17	Reactive Phosphorous	Aprl-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		May-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		June-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		July-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Aug-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sept-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
18	Polycyclic Aromatic Hydrocarbon	Aprl-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		May-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		June-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		July-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Aug-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sept-19	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
19	Salinity	Aprl-19	High tide	44.2	43.3	50.5	50.5	44.2	53.2
			Low tide	54.1	54.1	53.2	55.0	55.0	55.0
		May-19	High tide	43.9	43.0	50.1	50.1	43.9	53.0
			Low tide	54.1	52.8	52.8	54.6	54.6	53.7
		June-19	High tide	39.7	39.7	39.7	41.5	46.0	41.5

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
			Low tide	41.5	40.6	45.1	40.6	40.5	45.1
		July-19	High tide	48.6	48.6	45.0	46.8	46.8	53.2
			Low tide	51.4	48.6	48.6	52.3	48.6	48.6
		Aug-19	High tide	41.3	44.0	44.9	44.9	45.1	41.4
			Low tide	40.6	40.4	39.7	41.3	41.3	44.0
		Sept-19	High tide	35.1	39.7	40.8	38.8	43.3	43.3
			Low tide	44.2	35.2	40.5	38.5	37.9	32.5
20	Total Chlorophyll	Aprl-19	High tide	1.3	1.3	0.9	0.7	0.8	0.6
			Low tide	1.4	1.2	0.8	0.6	0.6	0.8
		May-19	High tide	1.4	1.1	1.1	0.9	1.2	0.8
			Low tide	1.2	1.3	0.9	0.8	0.9	1.1
		June-19	High tide	1.2	1.0	0.8	0.8	1.0	0.7
			Low tide	1.1	1.2	0.8	0.7	0.8	0.9
		July-19	High tide	1.3	1.1	0.9	0.9	1.1	0.8
			Low tide	1.1	1.3	1.0	0.7	1.2	0.9
		Aug-19	High tide	1.2	1.3	1.1	1.0	1.2	0.9
			Low tide	1.1	1.2	1.2	0.8	1.1	1.0
		Sept-19	High tide	1.1	1.2	1.2	1.1	1.1	1.1
			Low tide	1.0	1.1	1.1	1.0	1.0	1.0
21	Total Coliforms	Aprl-19	High tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
			Low tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
		May-19	High tide	<1.8	22	23	79	130	<1.8

S. No.	Parameter	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
			Low tide	<1.8	79	49	34	27	<1.8
		June-19	High tide	7.8	170	33	13	<1.8	49
			Low tide	7.8	33	23	7.8	<1.8	<1.8
		July-19	High tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
			Low tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
		Aug-19	High tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
			Low tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
		Sept-19	High tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
			Low tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
22	Faecal Coliforms	Aprl-19	High tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
			Low tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
		May-19	High tide	<1.8	17	13	27	34	<1.8
			Low tide	<1.8	22	33	27	22	<1.8
		June-19	High tide	7.8	49	13	4.5	<1.8	27
			Low tide	<1.8	4.5	4	<1.8	<1.8	<1.8
		July-19	High tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
			Low tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
		Aug-19	High tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
			Low tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
		Sept-19	High tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
			Low tide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8

*BDL: Below Detection Limit/Level

4. Graphical representation of Marine Water Results for the period April 2019 to September 2019

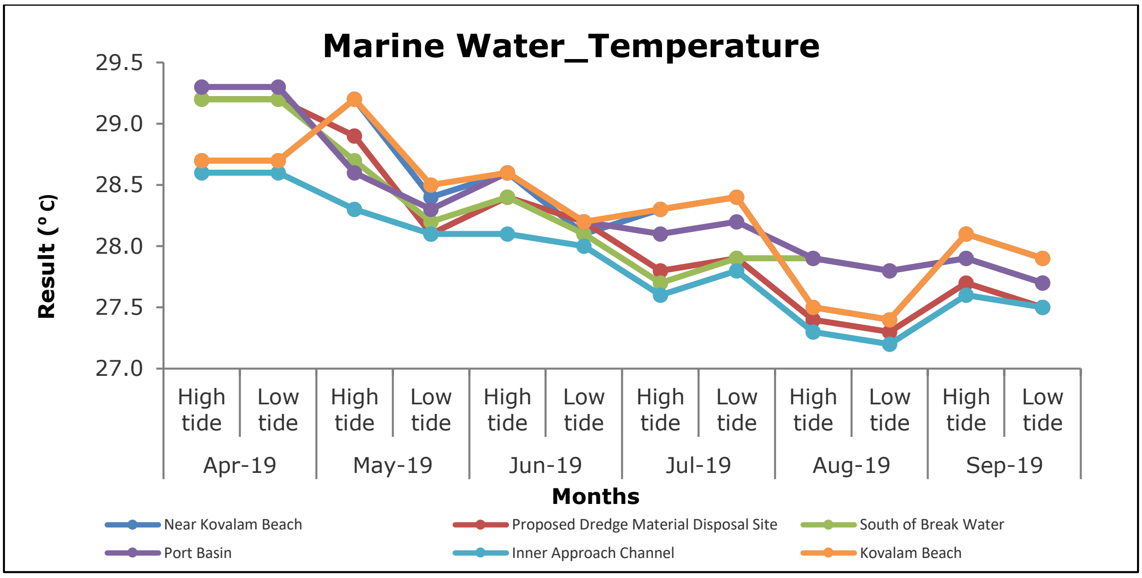


Figure 5.2 Marine Water Analysis for Temperature

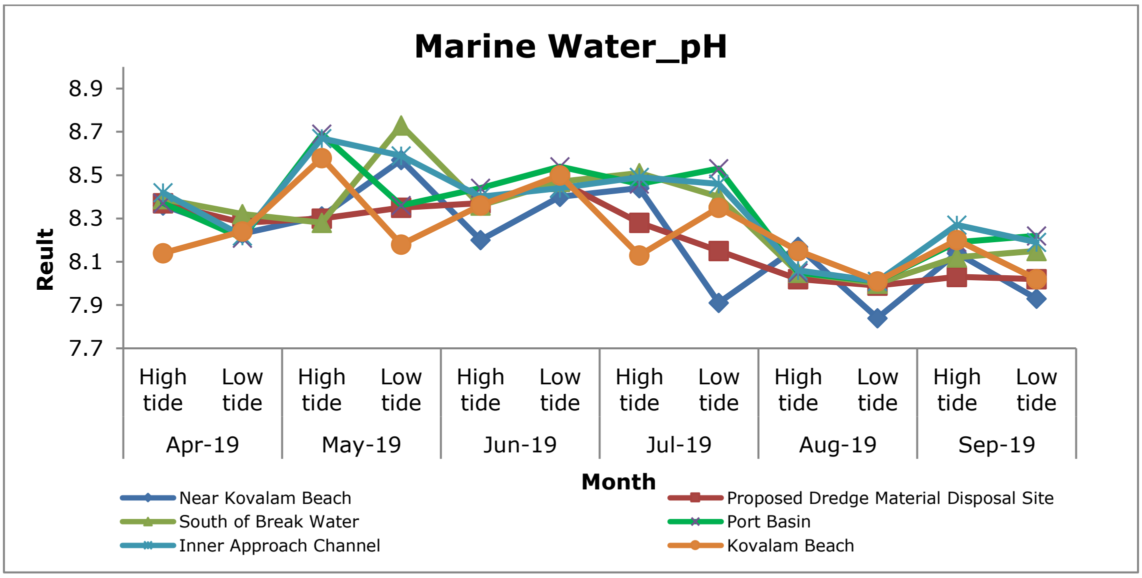


Figure 5.3 Marine Water Analysis for pH

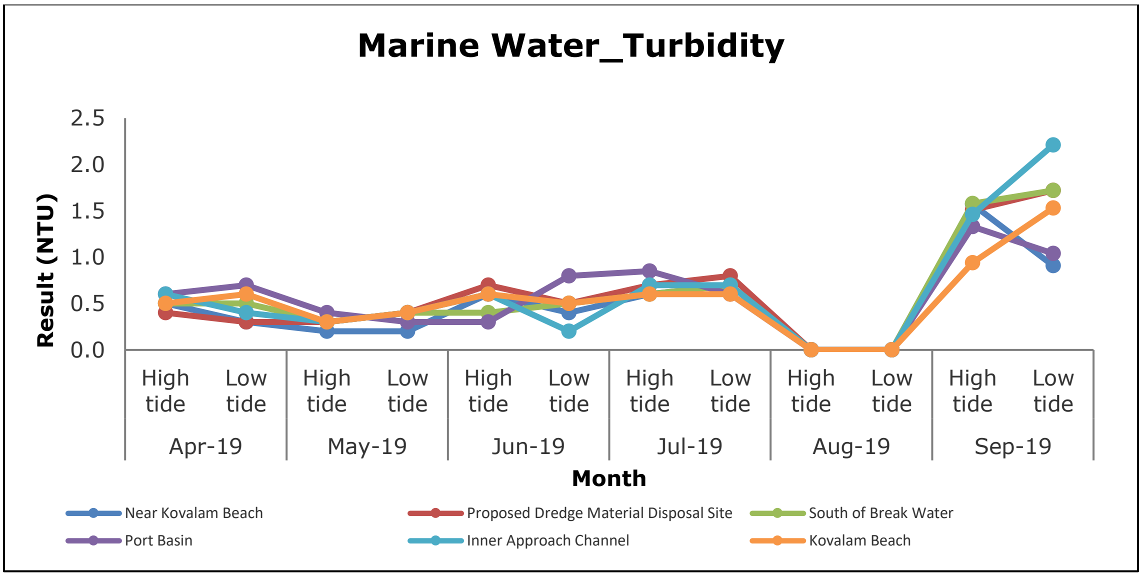


Figure 5.4 Marine Water Analysis for Turbidity

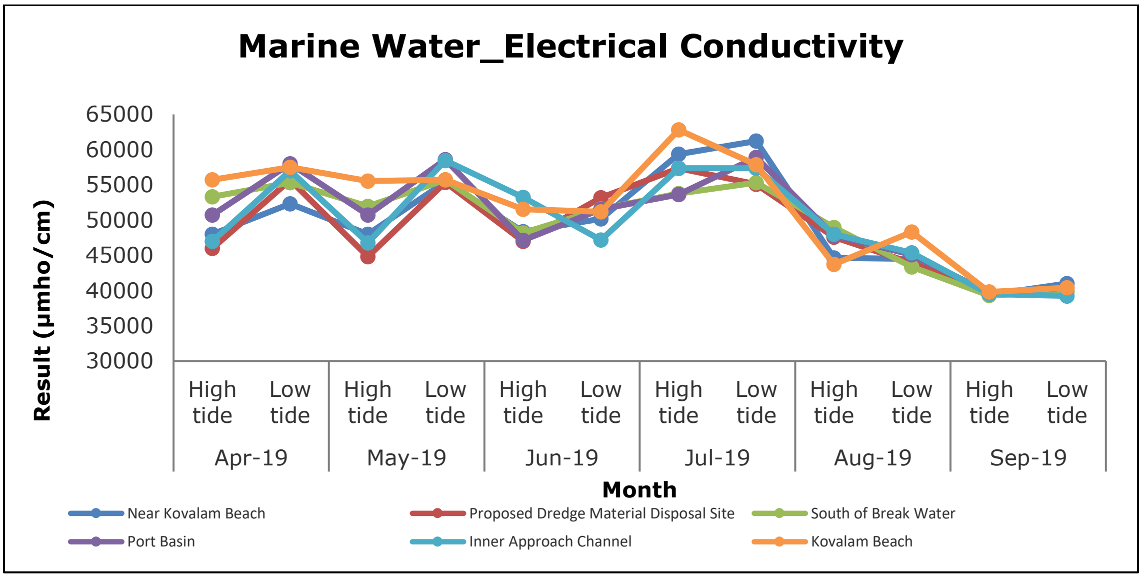


Figure 5.5 Marine Water Analysis for Electrical Conductivity

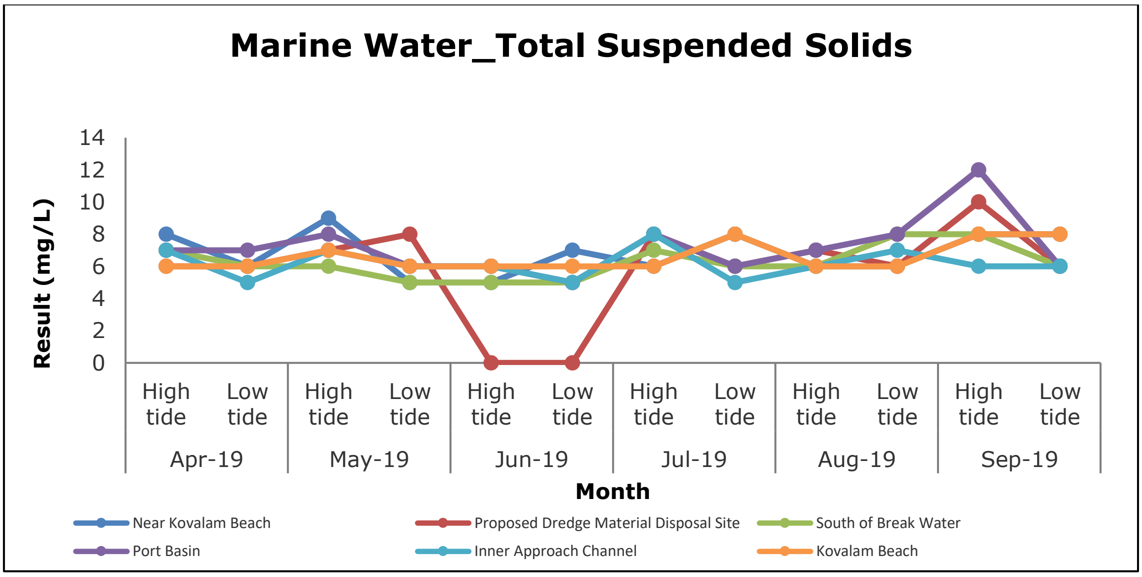


Figure 5.6 Marine Water Analysis for Total Suspended Solids

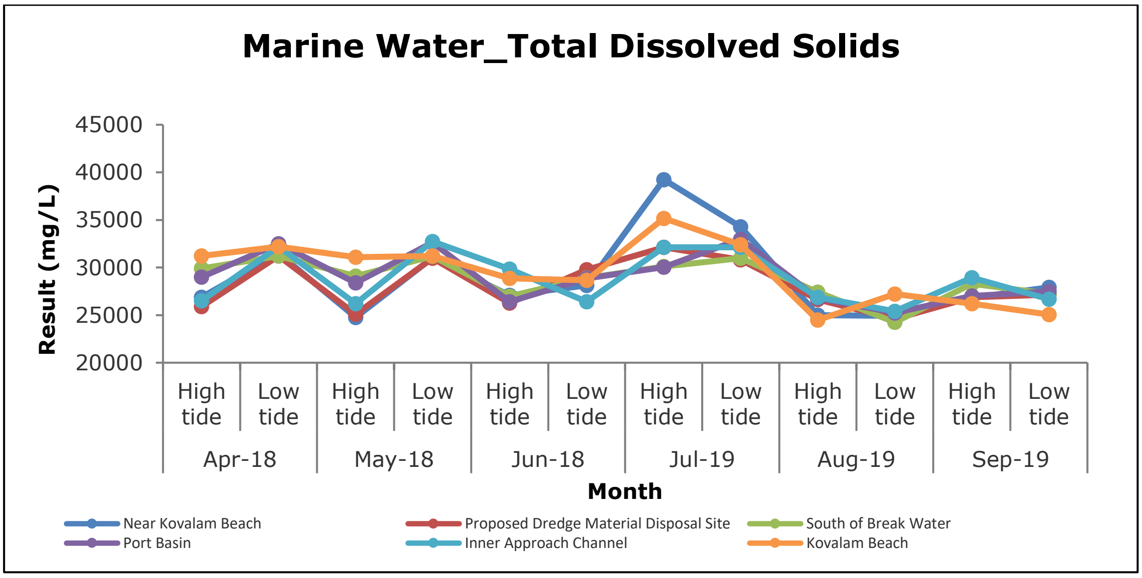


Figure 5.7 Marine Water Analysis for Total Dissolved Solids

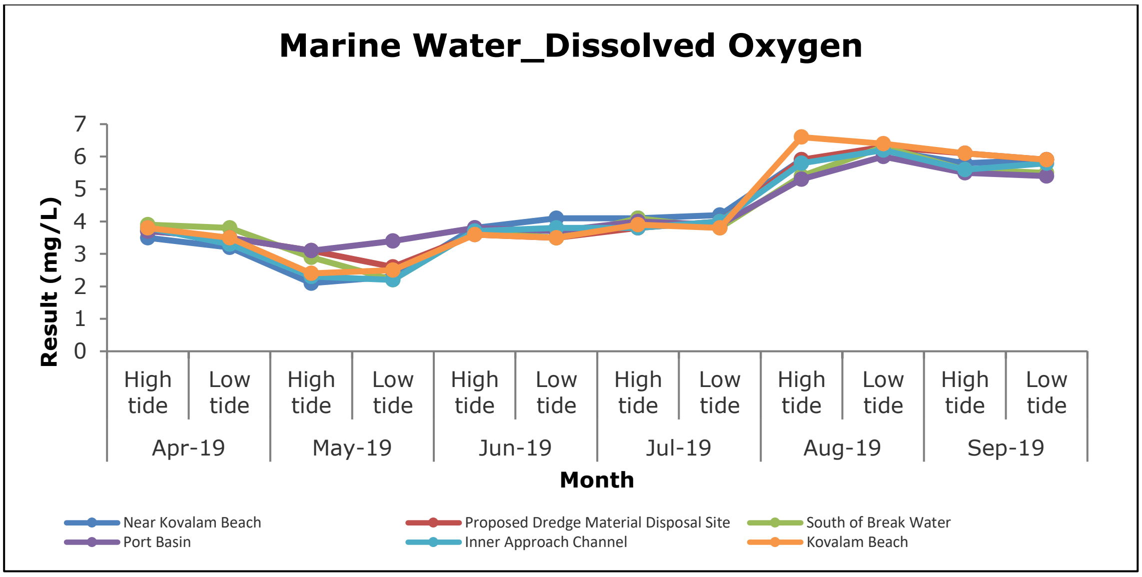


Figure 5.8 Marine Water Analysis for Dissolved Oxygen

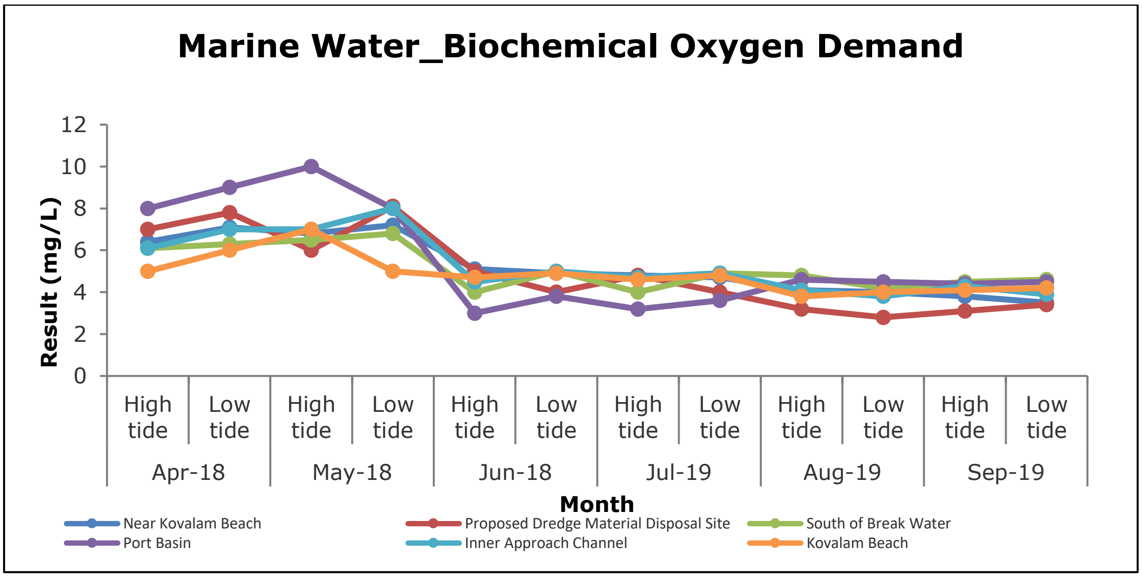


Figure 5.9 Marine Water Analysis for Biochemical Oxygen Demand

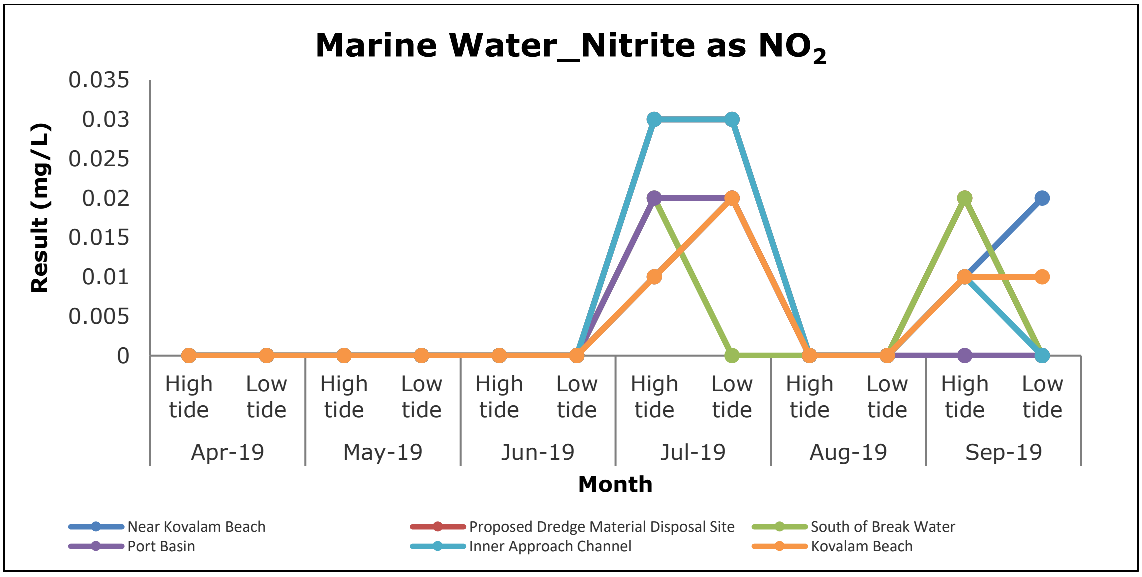


Figure 5.10 Marine Water Analysis for Nitrite as NO_2

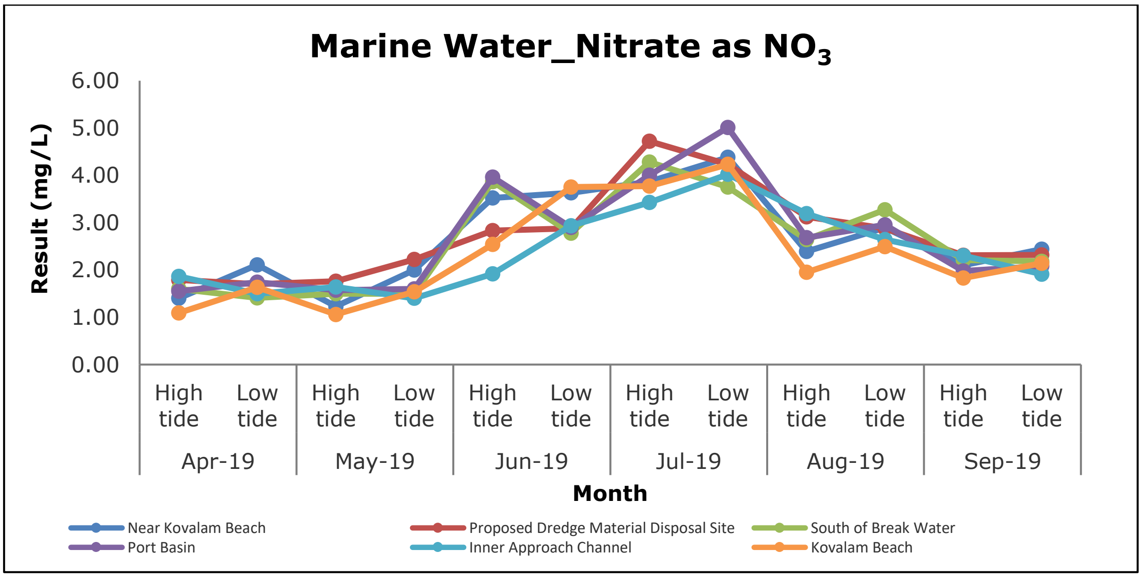


Figure 5.11 Marine Water Analysis for Nitrate as NO_3

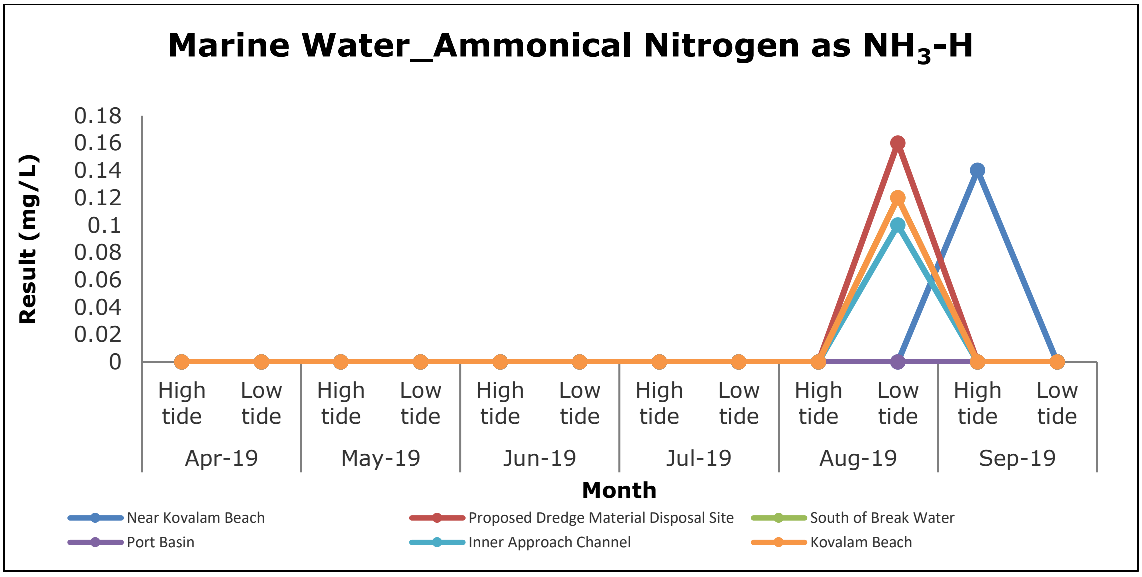


Figure 5.12 Marine Water Analysis for Ammonical Nitrogen as NH_3-H

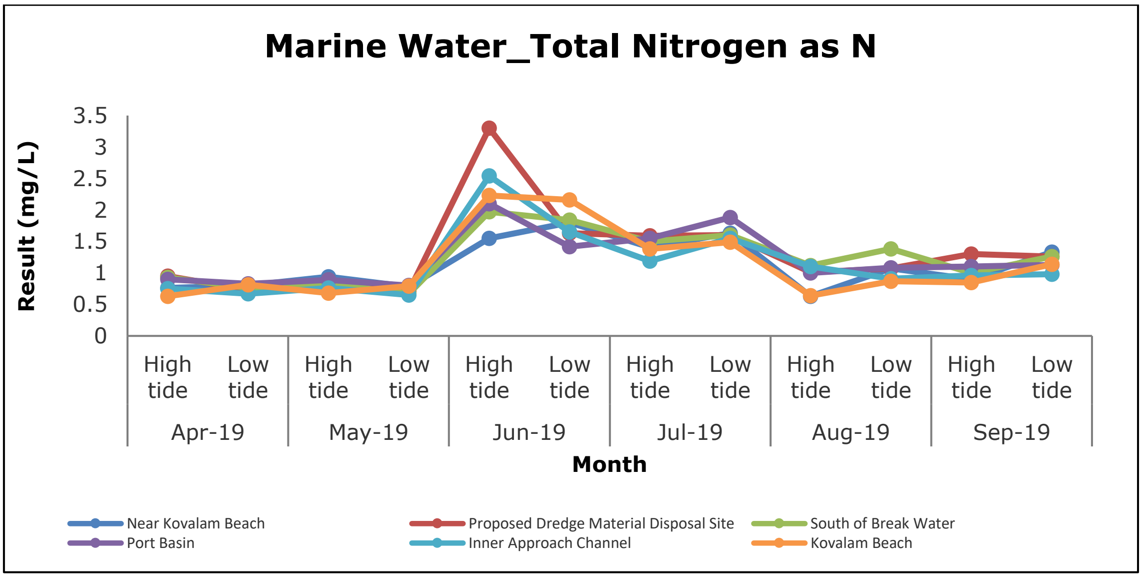


Figure 5.13 Marine Water Analysis for Total Nitrogen as N

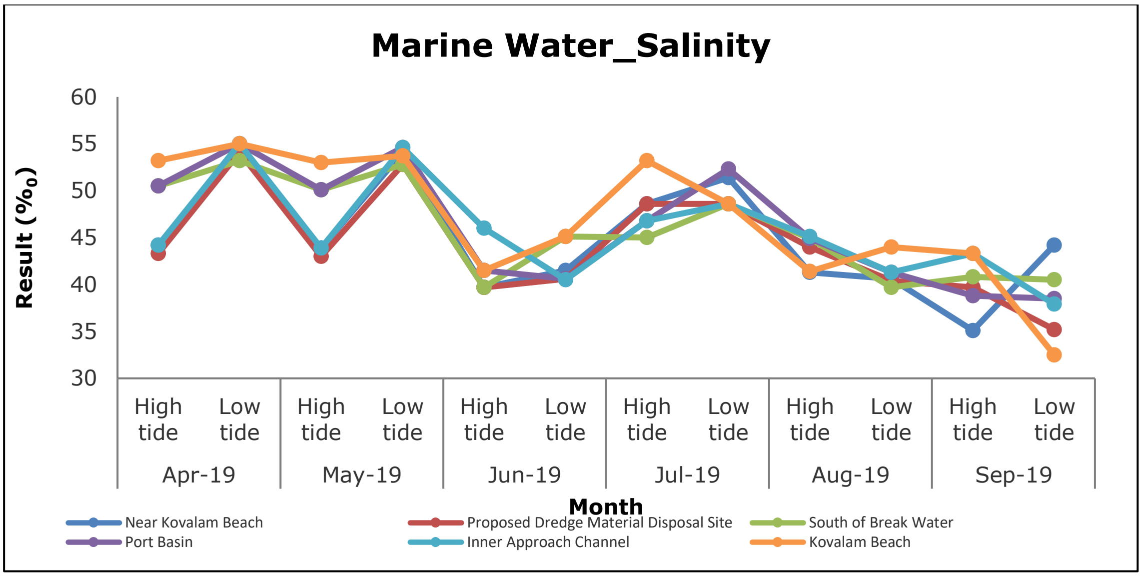


Figure 5.14 Marine Water Analysis for Salinity

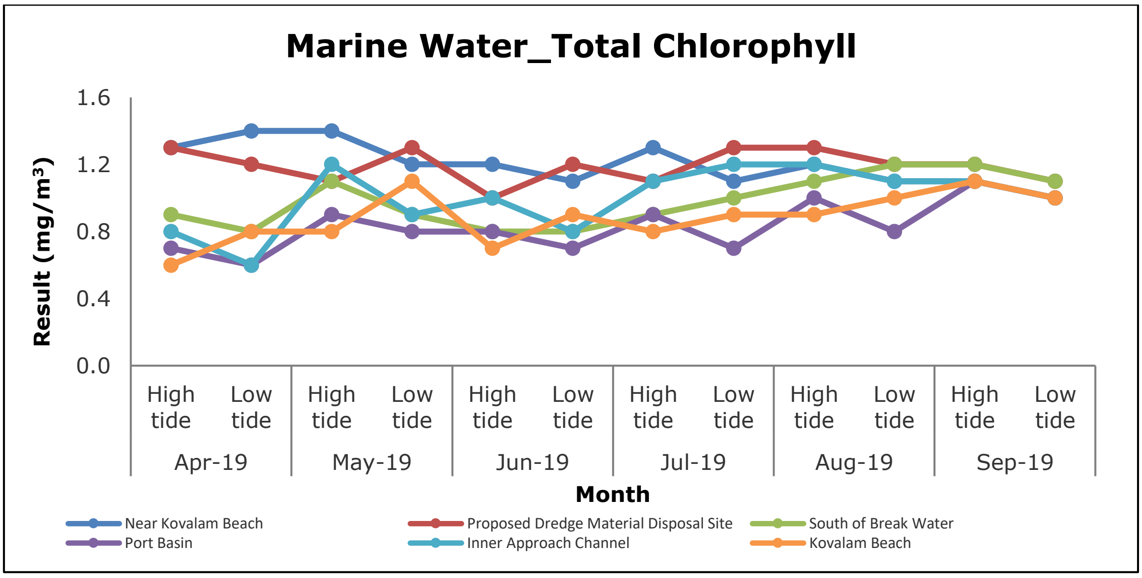


Figure 5.15 Marine Water Analysis for Total Chlorophyll

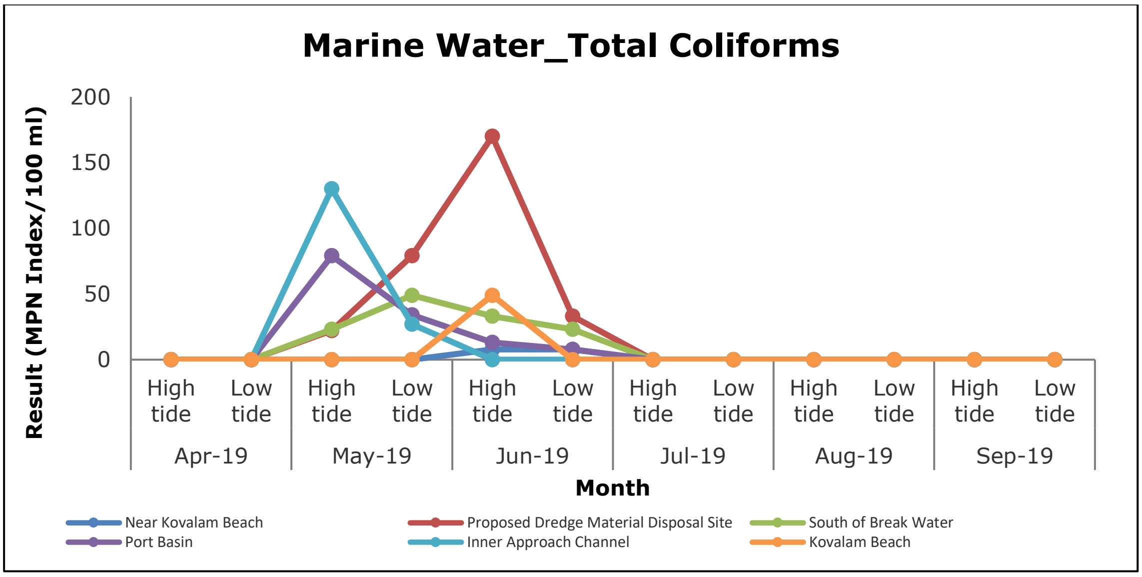


Figure 5.16 Marine Water Analysis for Total Coliforms

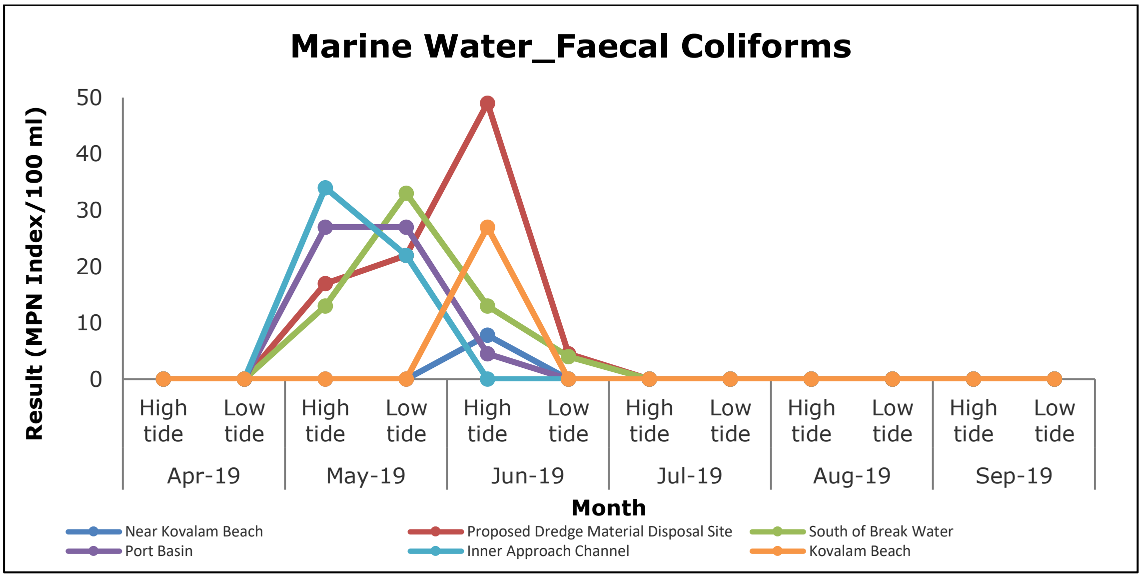


Figure 5.17 Marine Water Analysis for Faecal Coliforms

5. Summary - Marine water analysis:

During the period April 2019 to September 2019, at the location **Near Kovalam Beach**, the low tide and high tide Temperature was observed in the range between 27.4 - 29.2 ^{0}C, No visible colour or offensive odour was observed, concentration of pH were observed in the range between 7.84 – 8.57, Turbidity was observed in the range between 0.20 - 1.57 N.T.U, Electrical Conductivity (at 25°C) was observed in the range between 39400 – 61214 µmho/cm, Total Suspended Solids was observed in the range between 5 – 9 mg/L, Total Dissolved Solids was observed in the range between 24770 – 39240 mg/L, Dissolved Oxygen was observed in the range between 2.1 – 6.2 mg/L, Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between 3.5 – 7.2 mg/L, , Nitrite (as NO_2) was observed in the range between BDL – 0.02 mg/L, Nitrate (as NO_3) was observed in the range between 1.23 – 4.38 mg/L, , Ammonical Nitrogen (as NH_3-N) was observed in the range between BDL – 0.14 mg/L, Total Nitrogen (as N) was observed in the range between 0.63 – 1.80 mg/L. Floating materials, Phenolic Compounds (as C_6H_5OH), Total Phosphorous (as P), Reactive Phosphorous and Polycyclic Aromatic Hydrocarbon were observed below the detection limits. Salinity was observed in the range between 35.1 – 54.1 ‰, Total Chlorophyll was observed in the range between 1.00 – 1.40 mg/m^3, Total Coliforms were observed in the range between <1.8 – 7.8 MPN Index/100 ml and Faecal Coliforms were observed in the range between <1.8 – 7.8 MPN Index/100 ml.

At the location **Proposed Dredge Material Disposal Site**, the low tide and high tide Temperature was observed in the range between 27.3 - 29.2 ^{0}C, No visible colour or offensive odour was observed, concentration of pH were observed in the range between 7.99 – 8.47, Turbidity was observed in the range between 0.30 - 1.72 N.T.U, Electrical Conductivity (at 25°C) was observed in the range between 39500 – 57357 µmho/cm, Total Suspended Solids was observed in the range between 6 – 10 mg/L, Total Dissolved Solids was observed in the range between 24590 – 32120 mg/L, Dissolved Oxygen was observed in the range between 2.6 – 6.3 mg/L, Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between 2.8 – 8.1 mg/L, , Nitrite (as NO_2) was observed in the range between BDL – 0.03 mg/L, Nitrate (as NO_3) was observed in the range between 1.70 – 4.72 mg/L, Ammonical Nitrogen (as NH_3-N) was observed in the range between BDL – 0.16 mg/L, Total Nitrogen (as N) was observed in the range between 0.71 – 3.30 mg/L. Floating materials, Phenolic Compounds (as C_6H_5OH), Total Phosphorous (as P), Reactive Phosphorous and Polycyclic Aromatic Hydrocarbon were observed below the detection limits. Salinity was observed in the range between 35.2 – 54.1‰, Total Chlorophyll was observed in the range between 1.0 – 1.3 mg/m^3, Total Coliforms were observed in the range between <1.8 – 170 MPN Index/100 ml and Faecal Coliforms were observed in the range between <1.8 – 49 MPN Index/100 ml.

At the location **South of Break Water**, the low tide and high tide Temperature was observed in the range between 27.7 - 29.2^{0}C, No visible colour or offensive odour was observed, concentration of pH were observed in the range between 8.00 – 8.73, Turbidity was observed in the range between 0.30-1.72 N.T.U, Electrical Conductivity (at 25°C) was observed in the range between 39300 – 55710 µmho/cm, Total Suspended Solids was observed in the range between 5 – 8 mg/L, Total Dissolved Solids was observed in the range between 24250 – 31200 mg/L, Dissolved Oxygen was observed in the range between 2.2 – 6.3 mg/L, Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between 4.0 – 6.8 mg/L, , Nitrite (as NO_2) was observed in the range between BDL – 0.02 mg/L, Nitrate (as NO_3) was observed in the range between 1.41 – 4.28 mg/L, Ammonical Nitrogen (as NH_3-N) was observed in the range between BDL – 0.12 mg/L, Total Nitrogen (as N) was observed in the range between 0.67 – 1.97 mg/L. Floating materials, Phenolic Compounds (as C_6H_5OH), Total Phosphorous (as P), Reactive Phosphorous and Polycyclic Aromatic Hydrocarbon were observed below the detection limits. Salinity was observed in the range between 39.70 – 53.20‰, Total Chlorophyll was observed in the range between 0.80 – 1.20 mg/m^3, Total Coliforms were observed in the range between <1.8 – 49 MPN Index/100 ml and Faecal Coliforms were observed in the range between <1.8 – 33 MPN Index/100 ml.

At the location **Port Basin**, the low tide and high tide Temperature was observed in the range between 27.7 - 29.3 ^{0}C, No visible colour or offensive odour was observed, concentration of pH were observed in the range between 8.01 – 8.69, Turbidity was observed in the range between 0.30 - 1.33 N.T.U, Electrical Conductivity (at 25°C) was observed in the range between 39700 – 58892 µmho/cm, Total Suspended Solids was observed in the range between 5 – 12 mg/L, Total Dissolved Solids was observed in the range between 25240 – 32980 mg/L, Dissolved Oxygen was observed in the range between 3.1 – 6.0 mg/L, Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between 3 – 10 mg/L, , Nitrite (as NO_2) was observed in the range between BDL – 0.02 mg/L, Nitrate (as NO_3) was observed in the range between 1.55 – 5.01 mg/L, , , Total Nitrogen (as N) was observed in the range between 0.80 – 2.10 mg/L. Floating materials, Phenolic Compounds (as C_6H_5OH), Ammonical Nitrogen (as NH_3-N), Total Phosphorous (as P), Reactive Phosphorous and Polycyclic Aromatic Hydrocarbon were observed below the detection limits. Salinity was observed in the range between 38.5 – 55.0‰, Total Chlorophyll was observed in the range between 0.60 – 1.10 mg/m^3, Total Coliforms were observed in the range between <1.8 – 79 MPN Index/100 ml and Faecal Coliforms were observed in the range between <1.8 – 27 MPN Index/100 ml.

At the location **Inner Approach Channel**, the low tide and high tide Temperature was observed in the range between 27.2 - 28.6 ^{0}C, No visible colour or offensive odour was observed, concentration of pH were observed in the range between 8.01 – 8.67, Turbidity was observed in the range between 0.20 - 2.21 N.T.U, Electrical Conductivity (at 25^{o}C) was observed in the range between 39250 – 58467 µmho/cm, Total Suspended Solids was observed in the range between 5 – 8 mg/L, Total Dissolved Solids was observed in the range between 25410 – 32740 mg/L, Dissolved Oxygen was observed in the range between 2.2 – 6.2 mg/L, Biochemical Oxygen Demand (3 days, 27^{o}C) was observed in the range between 3.8 – 8.0 mg/L, , Nitrite (as NO_2) was observed in the range between BDL – 0.03 mg/L, Nitrate (as NO_3) was observed in the range between 1.40 – 4.02 mg/L, , Ammonical Nitrogen (as NH_3-N) was observed in the range between BDL – 0.10 mg/L, Total Nitrogen (as N) was observed in the range between 0.65 – 2.54 mg/L. Floating materials, Phenolic Compounds (as C_6H_5OH), Total Phosphorous (as P), Reactive Phosphorous and Polycyclic Aromatic Hydrocarbon were observed below the detection limits. Salinity was observed in the range between 37.9 – 55‰, Total Chlorophyll was observed in the range between 0.6 – 1.2 mg/m^3, Total Coliforms were observed in the range between <1.8 – 130 MPN Index/100 ml and Faecal Coliforms were observed in the range between <1.8 – 34 MPN Index/100 ml.

At the location **Kovalam Beach**, the low tide and high tide Temperature was observed in the range between 27.4 - 29.2^{0}C, No visible colour or offensive odour was observed, concentration of pH were observed in the range between 8.01 – 8.58, Turbidity was observed in the range between 0.30 - 1.53 N.T.U, Electrical Conductivity (at 25^{o}C) was observed in the range between 39800 – 62802 µmho/cm, Total Suspended Solids was observed in the range between 6 – 8 mg/L, Total Dissolved Solids was observed in the range between 24480 – 35170 mg/L, Dissolved Oxygen was observed in the range between 2.4 – 6.6 mg/L, Biochemical Oxygen Demand (3 days, 27^{o}C) was observed in the range between 3.8 – 7.0 mg/L, Nitrite (as NO_2) was observed in the range between BDL limit – 0.02 mg/L, Nitrate (as NO_3) was observed in the range between 1.06 – 4.23 mg/L, Ammonical Nitrogen (as NH_3-N) was observed in the range between BDL – 0.12 mg/L, Total Nitrogen (as N) was observed in the range between 0.63 – 2.23 mg/Floating materials, Phenolic Compounds (as C_6H_5OH), Total Phosphorous (as P), Reactive Phosphorous, Polycyclic Aromatic Hydrocarbon were observed below the detection limits. Salinity was observed in the range between 32.5 – 55.0‰, Total Chlorophyll was observed in the range between 0.60 – 1.10 mg/m^3, Total Coliforms were observed in the range between <1.8 – 49 MPN Index/100 ml and Faecal Coliforms were observed in the range between <1.8 – 27 MPN Index/100 ml.

6. Sediment Analysis Result

Table 5.5: Near Kovalam Beach

Parameter	Unit	April-19	May-19	Jun-19	July-19	Aug-19	Sept-19
Texture	-	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy
Organic Matter	%	1.220	1.680	1.480	2.530	2.510	0.491
Total Phosphorus (as P)	mg/kg	13.8	13.9	13.9	14.5	13.0	27.2
Aluminium (as Al)	mg/kg	228	203	196	223	815	376
Chromium (as Cr)	mg/kg	7.36	9.94	6.07	BDL	BDL	BDL
Copper (as Cu)	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL
Iron (as Fe)	mg/kg	4121	3027	4055	3754	3752	3800
Lead (as Pb)	mg/kg	25.4	23.9	12.9	15.4	20.5	12.0
Manganese (as Mn)	mg/kg	10.30	9.69	12.00	12.90	13.00	18.70
Mercury (as Hg)	mg/kg	0.129	0.100	BDL	BDL	BDL	0.043
Zinc (as Zn)	mg/kg	4.26	6.05	5.1	5.34	5.41	2.99
Nickel (as Ni)	mg/kg	6.22	5.47	5.23	6.81	6.96	8.12
Benthic Organism							
Micro Benthic Organism	/m^2	87200	86000	90000	92000	93000	94800
Macro Benthic Organism	/m^2	82000	81000	85000	87000	88000	89000
Total	**/m^2**	**169200**	**167000**	**175000**	**179000**	**181000**	**183800**

*BDL: Below Detection Limit/Level

Table 5.6: Proposed Dredge Material Disposal Site

Parameter	Unit	Aprl-19	May-19	Jun-19	July-19	Aug-19	Sept-19
Texture	-	Sandy	Sandy	Sandy	Sandy	Clay	Sandy
Organic Matter	%	2.82	3.08	3.17	2.87	2.96	1.95
Total Phosphorus (as P)	mg/kg	9.72	10.20	10.80	11.10	12.80	18.0
Aluminium (as Al)	mg/kg	224	205	204	216	778	373
Chromium (as Cr)	mg/kg	8.19	11	BDL	BDL	BDL	9.08
Copper (as Cu)	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL
Iron (as Fe)	mg/kg	2626	2986	4036	4036	3793	1100
Lead (as Pb)	mg/kg	23.9	25.6	12.7	15.8	19.9	16.1
Manganese (as Mn)	mg/kg	9.0	10.2	11.8	12.4	12.9	18.3
Mercury (as Hg)	mg/kg	0.155	0.105	BDL	BDL	BDL	0.062
Zinc (as Zn)	mg/kg	4.45	6.11	5.13	5.51	5.57	3.21
Nickel (as Ni)	mg/kg	5.89	6.37	6.20	6.92	7.21	7.06
Benthic Organism							
Micro Benthic Organism	$/m^2$	13000	12000	12800	13500	14100	14800
Macro Benthic Organism	$/m^2$	91000	90000	95000	98000	99000	99800
Total	**$/m^2$**	**104000**	**102000**	**107800**	**111500**	**113100**	**114600**

Table 5.7: South of Breakwater

Parameter	Unit	Aprl-19	May-19	Jun-19	July-19	Aug-19	Sept-19
Texture	-	Sandy	Sandy	Sandy	Sandy	Clay	Sandy
Organic Matter	%	1.28	0.99	0.99	2.41	2.10	3.53
Total Phosphorus (as P)	mg/kg	23.3	19.9	20.3	19.8	20.5	19.1
Aluminium (as Al)	mg/kg	243	206	159	163	605	277
Chromium (as Cr)	mg/kg	9.95	8.86	BDL	BDL	BDL	2.80
Copper (as Cu)	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL
Iron (as Fe)	mg/kg	3336	4019	2583	3853	3831	757
Lead (as Pb)	mg/kg	24.40	26.40	7.29	24.40	20.60	18.20

Parameter	Unit	Aprl-19	May-19	Jun-19	July-19	Aug-19	Sept-19
Manganese (as Mn)	mg/kg	9.85	10.50	13.20	13.00	12.80	4.18
Mercury (as Hg)	mg/kg	0.090	0.144	BDL	BDL	BDL	BDL
Zinc (as Zn)	mg/kg	4.68	4.80	2.76	4.87	5.43	1.87
Nickel (as Ni)	mg/kg	6.23	6.47	6.65	6.77	7.36	8.06
Benthic Organism							
Micro Benthic Organism	/m^2	36000	34000	38000	40000	42000	43000
Macro Benthic Organism	/m^2	21000	20000	25000	27000	28000	29200
Total	**/m^2**	**57000**	**54000**	**63000**	**67000**	**70000**	**72200**

Table 5.8: Port Basin

Parameter	Unit	Aprl-19	May-19	Jun-19	July-19	Aug-19	Sept-19
Texture	-	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy
Organic Matter	%	0.983	1.290	1.260	1.250	0.840	1.330
Total Phosphorus (as P)	mg/kg	9.38	6.79	7.66	11.00	12.20	BDL
Aluminium (as Al)	mg/kg	193	120	163	164	580	283
Chromium (as Cr)	mg/kg	9.10	7.96	BDL	BDL	BDL	9.87
Copper (as Cu)	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL
Iron (as Fe)	mg/kg	3000	4514	2511	2701	3757	663
Lead (as Pb)	mg/kg	21.60	22.90	6.95	22.40	21.10	14.50
Manganese (as Mn)	mg/kg	9.34	9.95	12.70	12.80	13.60	4.57
Mercury (as Hg)	mg/kg	0.103	0.124	BDL	BDL	BDL	BDL
Zinc (as Zn)	mg/kg	5.86	6.16	2.80	3.43	5.51	1.85
Nickel (as Ni)	mg/kg	4.92	5.87	6.15	6.57	7.45	9.82
Benthic Organism							
Micro Benthic Organism	/m^2	78000	70000	75000	77000	78000	78900
Macro Benthic Organism	/m^2	61000	60000	69000	70000	71000	72000
Total	**/m^2**	**139000**	**130000**	**144000**	**147000**	**149000**	**150900**

Table 5.9: Inner Approach Channel

Parameter	Unit	Aprl-19	May-19	Jun-19	July-19	Aug-19	Sept-19
Texture	-	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy
Organic Matter	%	0.413	0.482	0.530	0.689	0.750	1.750
Total Phosphorus (as P)	mg/kg	15.3	11.4	11.8	17.8	13.1	38.1
Aluminium (as Al)	mg/kg	238	121	231	245	931	1012
Chromium (as Cr)	mg/kg	7.66	8.99	BDL	BDL	BDL	BDL
Copper (as Cu)	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL
Iron (as Fe)	mg/kg	3985	2996	3677	2734	3757	3786
Lead (as Pb)	mg/kg	25.10	25.50	7.75	24.10	20.30	18.40
Manganese (as Mn)	mg/kg	10.60	8.99	11.20	12.50	13.10	10.70
Mercury (as Hg)	mg/kg	0.099	0.150	BDL	BDL	BDL	BDL
Zinc (as Zn)	mg/kg	4.40	5.76	4.65	4.87	5.57	5.12
Nickel (as Ni)	mg/kg	5.39	6.74	6.33	6.77	7.52	8.41
Benthic Organism							
Micro Benthic Organism	/m^2	30500	29000	30000	35000	36000	37000
Macro Benthic Organism	/m^2	6000	5000	6000	7000	8000	9000
Total	**/m^2**	**36500**	**34000**	**36000**	**42000**	**44000**	**46000**

Table 5.10: Kovalam Beach

Parameter	Unit	Aprl-19	May-19	Jun-19	July-19	Aug-19	Sept-19
Texture	-	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy
Organic Matter	%	0.940	1.100	1.20	2.630	2.190	0.558
Total Phosphorus (as P)	mg/kg	11.10	9.50	9.76	10.90	14.20	47.00
Aluminium (as Al)	mg/kg	244	121	226	246	222	380
Chromium (as Cr)	mg/kg	6.67	9.97	BDL	BDL	BDL	BDL
Copper (as Cu)	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL
Iron (as Fe)	mg/kg	4310	4301	3714	3041	3794	3692

Parameter	Unit	Aprl-19	May-19	Jun-19	July-19	Aug-19	Sept-19
Lead (as Pb)	mg/kg	23.30	24.70	6.24	15.30	19.00	12.50
Manganese (as Mn)	mg/kg	9.56	9.62	11.70	12.40	13.30	10.60
Mercury (as Hg)	mg/kg	0.08	0.14	BDL	BDL	BDL	BDL
Zinc (as Zn)	mg/kg	4.86	5.61	4.98	5.13	5.56	5.83
Nickel (as Ni)	mg/kg	6.52	6.98	6.19	6.97	7.16	12.00
Benthic Organism							
Micro Benthic Organism	/m^2	90400	89000	94000	98000	99000	99000
Macro Benthic Organism	/m^2	80000	79000	80000	90000	95000	95000
Total	**/m^2**	**170400**	**168000**	**174000**	**188000**	**194000**	**194000**

7. Graphical representation of Sediment Analysis Results for the period April 2019 to September 2019

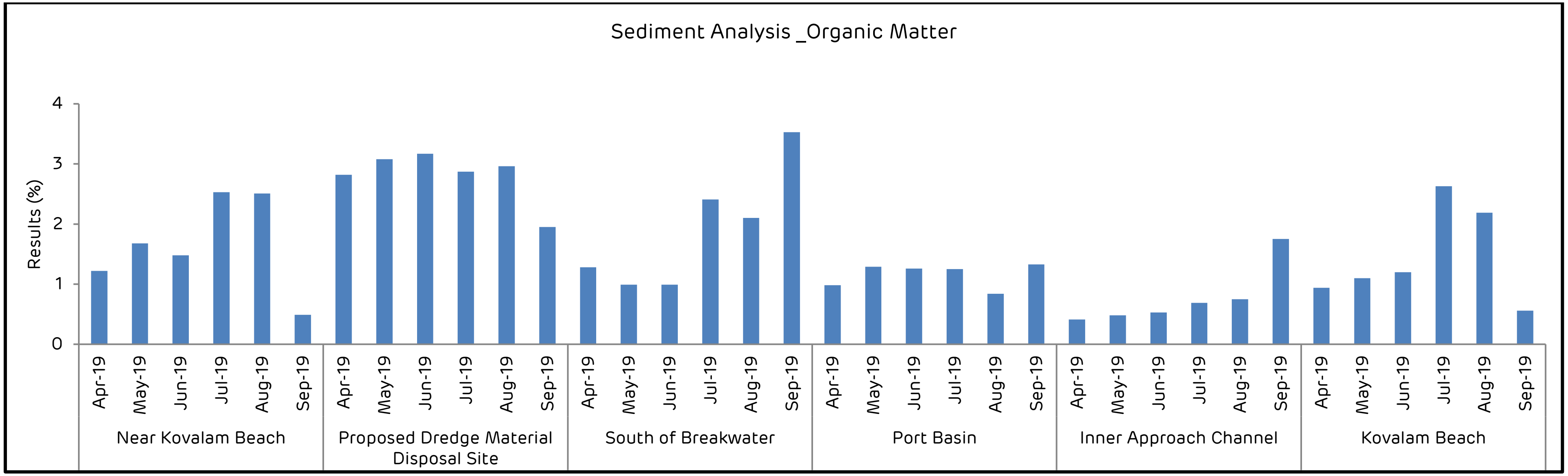


Figure 5.18: Sediment analysis for Organic Matter

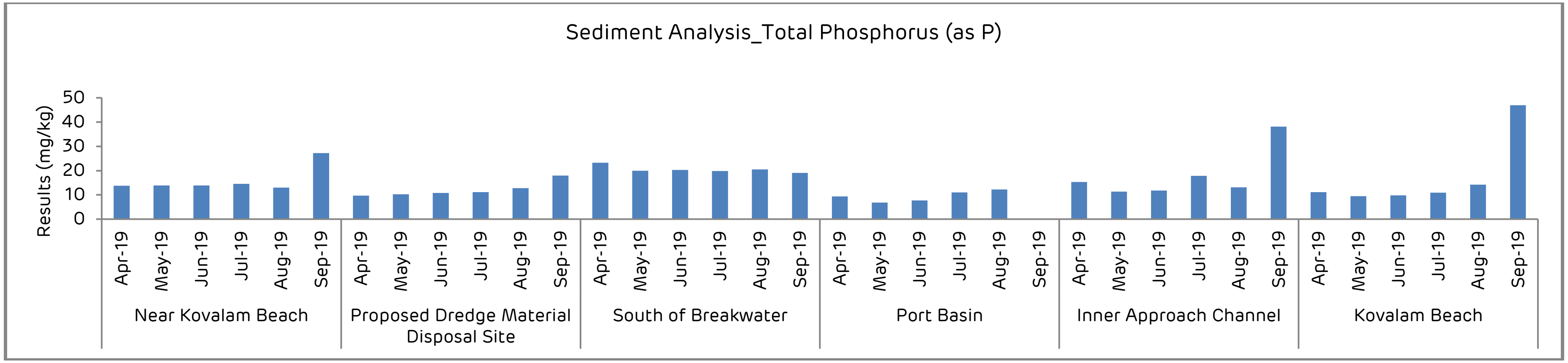


Figure 5.19: Sediment analysis for Total Phosphorus

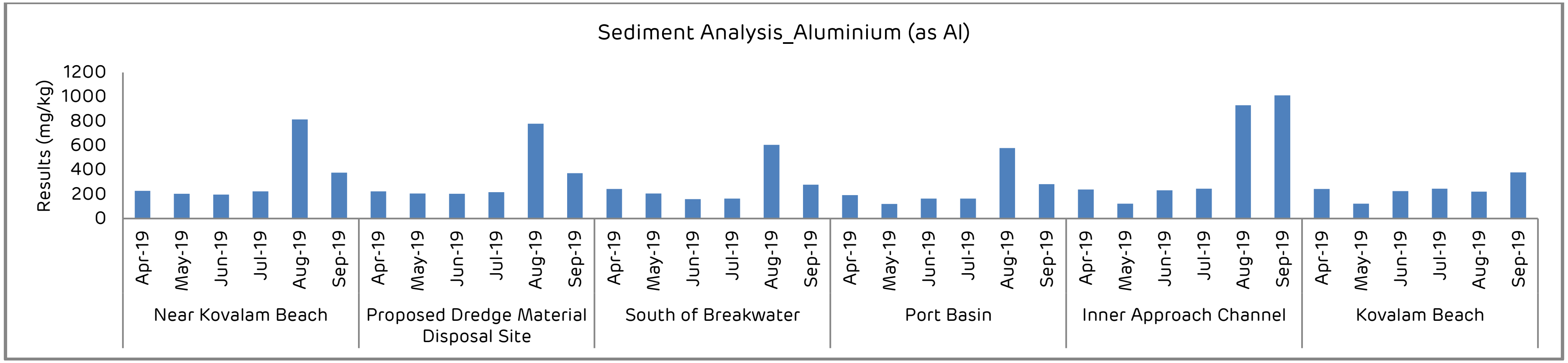


Figure 5.20: Sediment analysis for Aluminium

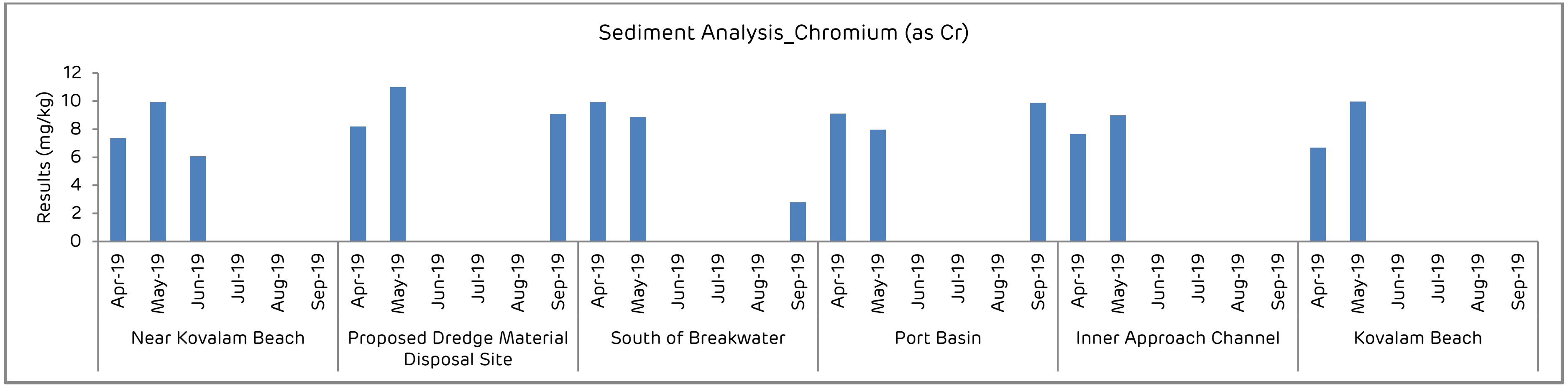


Figure 5.21: Sediment analysis for Chromium

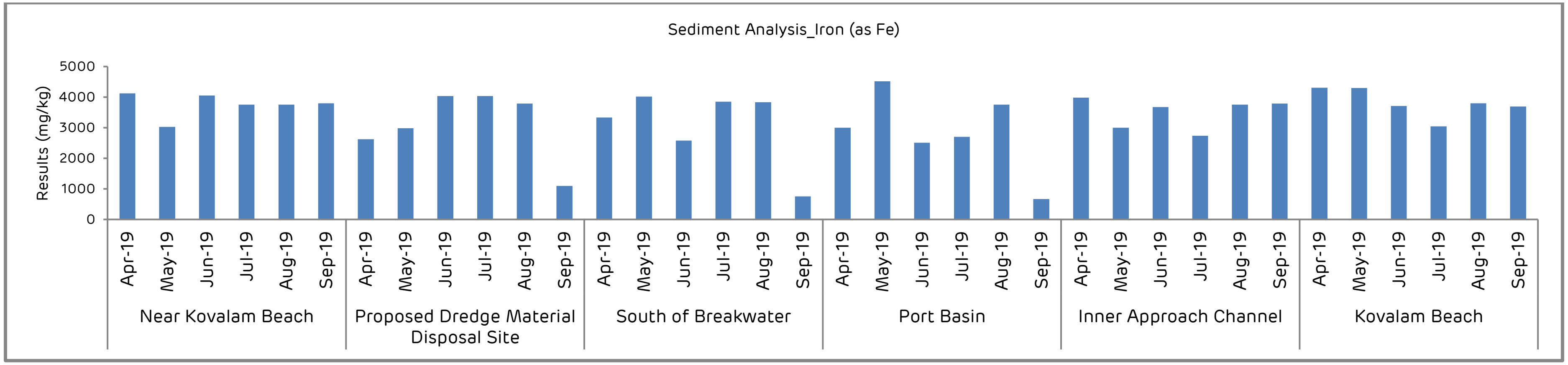


Figure 5.22: Sediment analysis for Iron

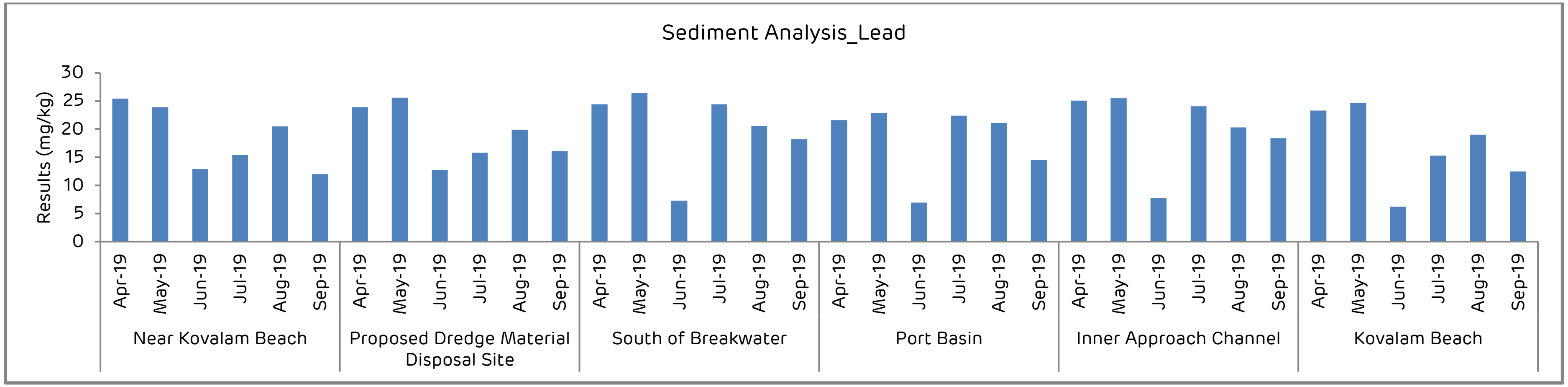


Figure 5.23: Sediment analysis for Lead

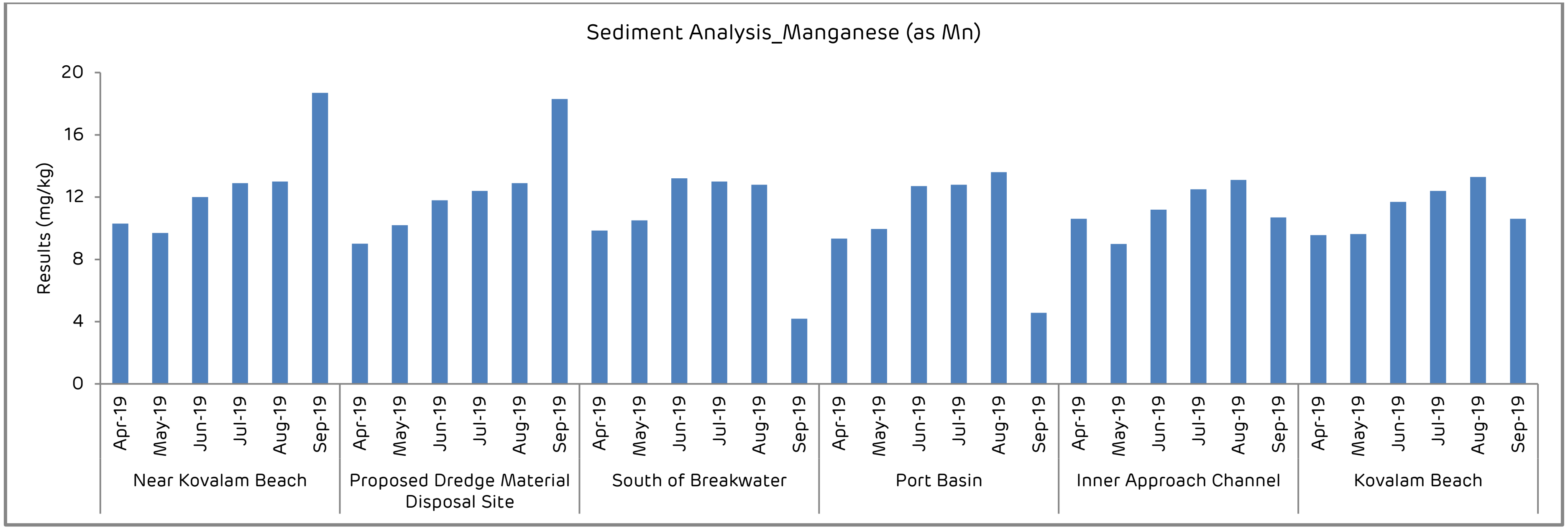


Figure 5.24: Sediment analysis for Manganese

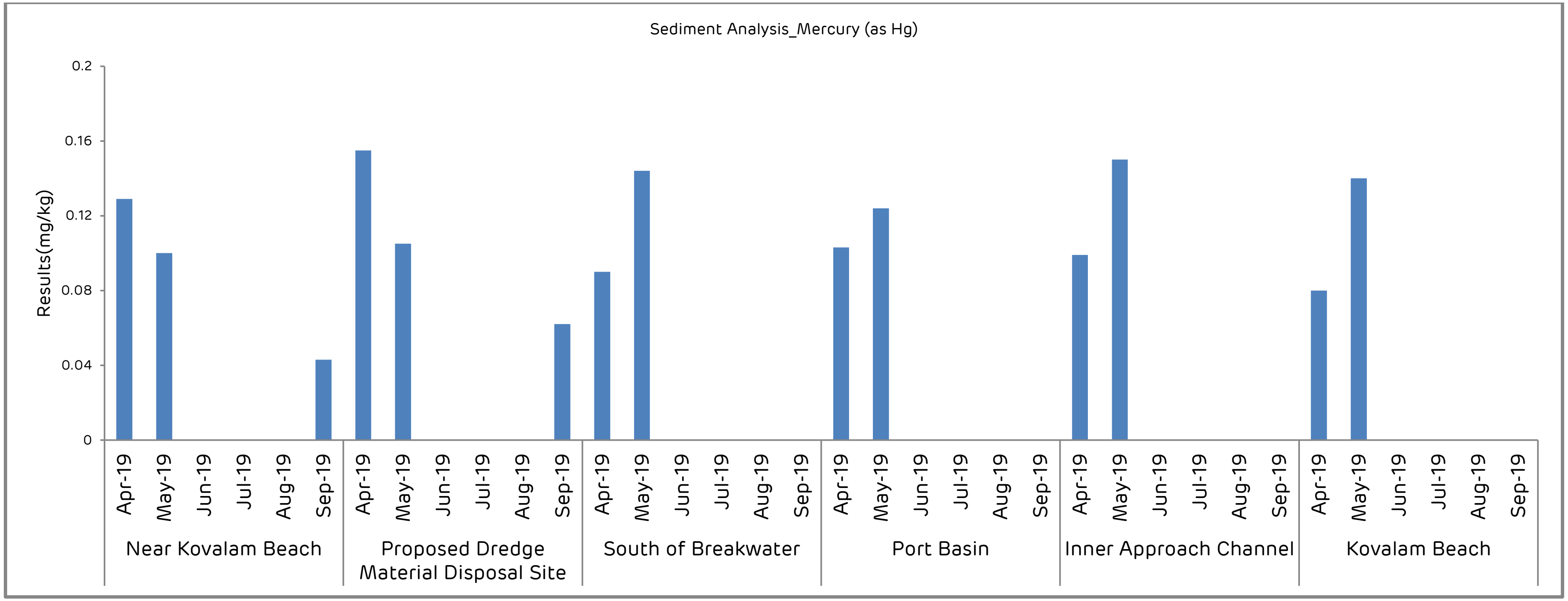


Figure 5.25: Sediment analysis for Mercury

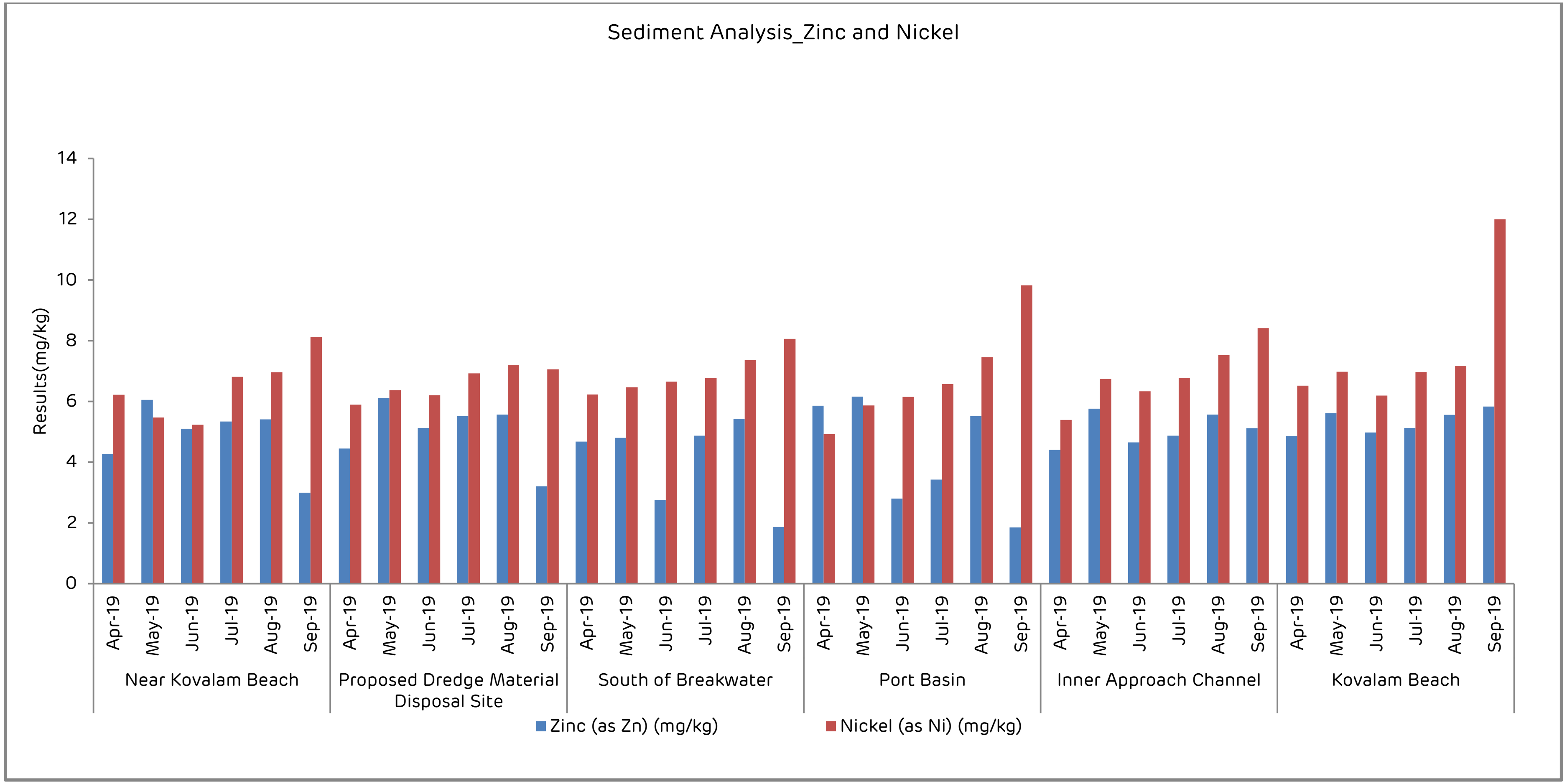


Figure 5.26: Sediment analysis for Zinc and Nickel

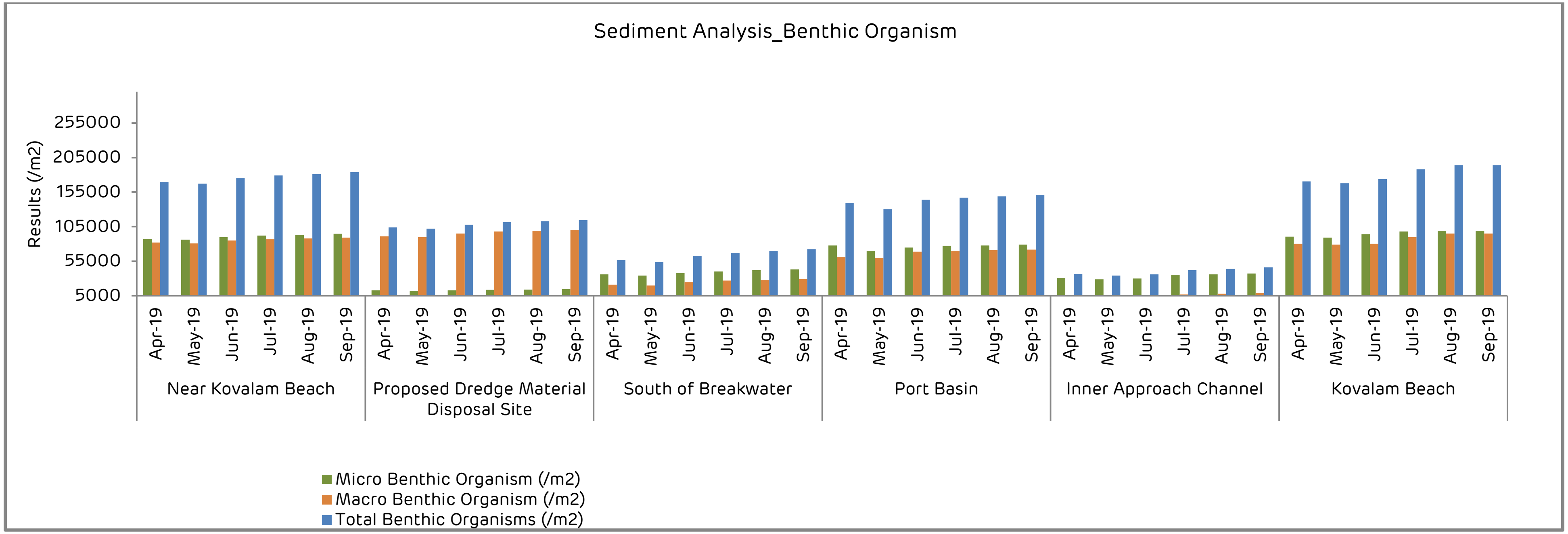


Figure 5.27: Sediment analysis for Benthic Organism

8. Summary- Sediment Analysis:

During the period April 2019 to September 2019, At the location **Near Kovalam Beach**, the observed texture was sandy, Organic matter was observed in the range between 0.491 – 2.530%, Total Phosphorus (as P) was observed in the range between 13.0 – 27.2 mg/kg. Aluminium (as Al) was observed in the range between 196 - 815 mg/kg. Chromium (as Cr) was observed in the range between BDL – 9.94 mg/kg. Copper (as Cu) was observed below the detection level. Iron (as Fe) was observed in the range between 3027 - 4121 mg/kg. Lead (as Pb) was observed in the range between 12.0 – 25.4 mg/kg. Manganese (as Mn) was observed in the range between 9.69 – 18.70 mg/kg. Mercury (as Hg) was observed in the range between BDL – 0.129 mg/kg. Zinc (as Zn) was observed in the range between 2.99 – 6.05 mg/kg. Nickel (as Ni) was observed in the range between 5.23 – 8.12 mg/kg. Micro benthic organisms were observed in the range between 86000 – 94800/m^2 and macro benthic organisms were observed in the range between 81000 – 89000/m^2.

At the location **Proposed Dredge Material Disposal site**, the observed texture was clay and sandy, Organic matter was observed in the range between 1.95 – 3.17%, Total Phosphorus (as P) was observed in the range between 9.72 – 18.00 mg/kg. Aluminium (as Al) was observed in the range between 204 - 778 mg/kg. Chromium (as Cr) was observed in the range between between BDL – 11 mg/kg. Copper (as Cu) was observed below the detection limit. Iron (as Fe) was observed in the range between 1100 - 4036 mg/kg. Lead (as Pb) was observed in the range between 12.7 – 25.6 mg/kg. Manganese (as Mn) was observed in the range between 9.0 – 18.3 mg/kg. Mercury (as Hg) was observed in the range between BDL – 0.155 mg/kg. Zinc (as Zn) was observed in the range between 3.21 – 6.11 mg/kg. Nickel (as Ni) was observed in the range between 5.89 – 7.21 mg/kg. Micro benthic organisms were observed in the range between 12000 – 14800/m^2 and macro benthic organisms were observed in the range between 90000 – 99800/m^2.

At the location **South of break water**, the observed texture was clay and sandy, Organic matter was observed in the range between 0.99 – 3.53%, Total Phosphorus (as P) was observed in the range between 19.1 – 23.3 mg/kg. Aluminium (as Al) was observed in the range between 159 - 605 mg/kg. Chromium (as Cr) was observed in the range between BDL – 9.95 mg/kg. Copper (as Cu) was observed below the detection limit. Iron (as Fe) was observed in the range between 757 - 4019 mg/kg. Lead (as Pb) was observed in the range between 7.29 – 26.40 mg/kg. Manganese (as Mn) was observed in the range between 4.18 – 13.20 mg/kg. Mercury (as Hg) was observed in the range between BDL – 0.144 mg/kg. Zinc (as Zn) was observed in the range between 1.87 – 5.43 mg/kg. Nickel (as Ni) was observed in the range between below 6.23 – 8.06 mg/kg. Micro benthic organisms were observed in the range between 34000 – 43000/m^2 and macro benthic organisms were observed in the range 20000 – 29200/m^2.

At the location **Port Basin**, the observed texture was sandy, Organic matter was observed in the range between 0.84 – 1.33%, Total Phosphorus (as P) was observed in the range between 6.79 – 12.20 mg/kg. Aluminium (as Al) was observed in the range between 120 - 580 mg/kg. Chromium (as Cr) was observed in the range between BDL – 9.87 mg/kg. Copper (as Cu) was observed below the detection limit. Iron (as Fe) was observed in the range between 663 - 4514 mg/kg. Lead (as Pb) was observed in the range between 6.95 – 22.90 mg/kg. Manganese (as Mn) was observed in the range between 4.57 – 13.60 mg/kg. Mercury (as Hg) was observed in the range between BDL – 0.124 mg/kg. Zinc (as Zn) was observed in the range between 1.85 – 6.16 mg/kg. Nickel (as Ni) was observed in the range between 4.92 – 9.82 mg/kg. Micro benthic organisms were observed in the range between 70000 – 78900/m^2 and macro benthic organisms were observed in the range between 60000 - 72000/m^2.

At the location **Inner Approach Channel**, the observed texture was sandy, Organic matter was observed in the range between 0.413 – 1.750%, Total Phosphorus (as P) was observed in the range between 11.4 – 38.1 mg/kg. Aluminium (as Al) was observed in the range between 121 - 1012 mg/kg. Chromium (as Cr) was observed in the range between BDL – 8.99 mg/kg. Copper (as Cu) was observed below the detection limit. Iron (as Fe) was observed in the range between 2734 - 3985 mg/kg. Lead (as Pb) was observed in the range between 7.75 – 25.50 mg/kg. Manganese (as Mn) was observed in the range between 8.99 – 13.10 mg/kg. Mercury (as Hg) was observed in the range between BDL – 0.15 mg/kg. Zinc (as Zn) was observed in the range between 4.40 – 5.76 mg/kg. Nickel (as Ni) was observed in the range between 5.39 – 8.41 mg/kg. Micro benthic organisms were observed in the range between 29000 – 37000/m^2 and macro benthic organisms were observed in the range between 5000 – 9000/m^2.

At the location **Kovalam Beach**, the observed texture was sandy, Organic matter was observed in the range between 0.558 – 2.630%, Total Phosphorus (as P) was observed in the range between 9.5 – 47.0 mg/kg. Aluminium (as Al) was observed in the range between 121 - 380 mg/kg. Chromium (as Cr) was observed in the range between BDL – 9.97 mg/kg. Copper (as Cu) was observed below the detection limit. Iron (as Fe) was observed in the range between 3041 – 4310 mg/kg. Lead (as Pb) was observed in the range between 6.24 – 24.70 mg/kg. Manganese (as Mn) was observed in the range between 9.56 – 13.30 mg/kg. Mercury (as Hg) was observed in the range between BDL – 0.08 mg/kg. Zinc (as Zn) was observed in the range between 4.86 to 5.83 mg/kg. Nickel (as Ni) was observed in the range between 6.19 – 12.00 mg/kg. Micro benthic organisms were observed in the range between 89000 – 99000 /m^2 and macro benthic organisms were observed in the range between 79000 - 95000 /m^2.

9. Marine Water Analysis for Phytoplankton and Zooplankton

Table 5.11: Total Phytoplankton and Zooplankton Results

Parameter	Month	Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break water	Port Basin	Inner Approach Channel	Kovalam Beach
Total Phytoplankton No/100 mL	Apr-19	4213600	354800	1380200	122800	1309000	4306800
	May-19	4085500	341500	1345900	118200	1259000	4209600
	June-19	4113400	352600	1366200	123100	1284000	4233700
	July-19	4107300	365700	1412500	127000	1304000	4342800
	Aug-19	4183000	381000	1441600	132000	1364000	4448900
	Sept-19	4369000	396000	1466800	137000	1420000	4556000
Total Zooplankton No/100 mL	Apr-19	8060	9117	8776	4925	10212	8387
	May-19	7610	8542	8338	4679	9953	8046
	June-19	7906	8788	8478	5044	10238	8499
	July-19	8200	9074	8811	5385	10820	8780
	Aug-19	8636	9436	9384	5638	11119	9187
	Sept-19	8470	9216	9263	5437	10772	9198

10. Graphical representation of Phytoplankton and Zooplankton Results for the period April 2019 to September 2019

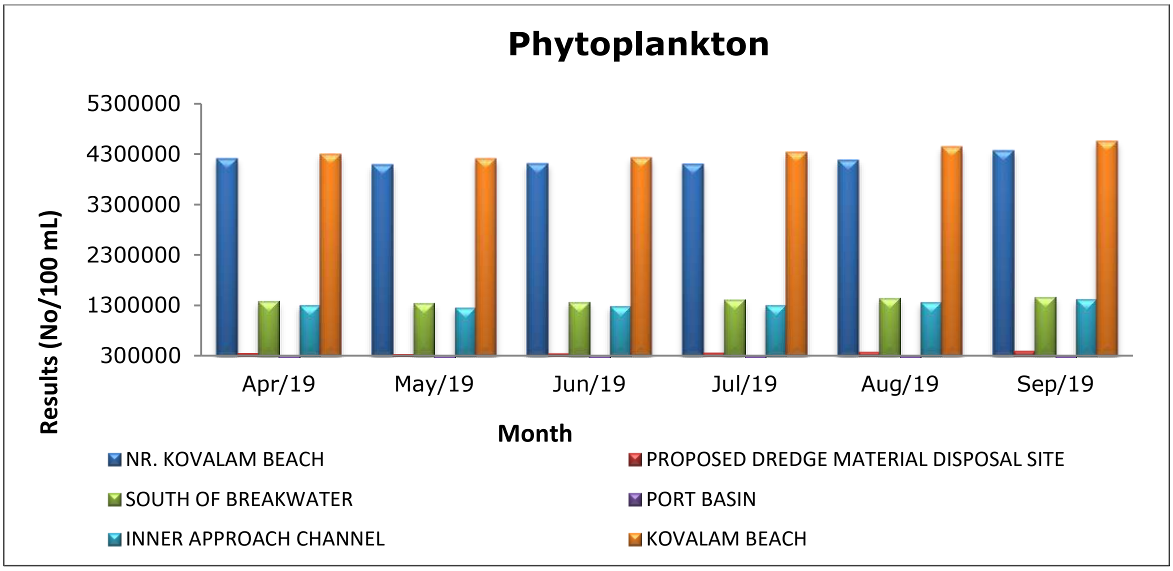


Figure 5.28: Marine Water Analysis for Total Phytoplankton

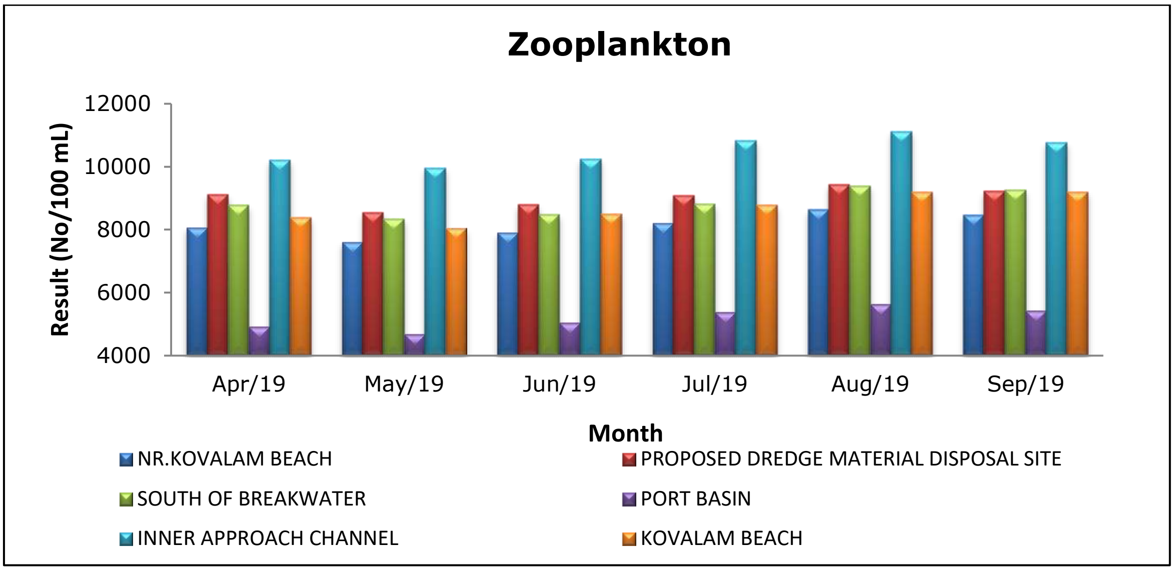


Figure 5.29: Marine Water Analysis for Total Zooplankton

11. Summary- Marine Water Analysis for Phytoplankton and Zooplanktons

During the period April 2019 to September 2019, at the location **Near Kovalam Beach**, Phytoplanktons were observed in the range between 4085500 - 4369000 No/100 mL and Zooplanktons were observed in the range between 7610 - 8636 No/100 m.

At the location **Proposed Dredge Material Disposal site**, Phytoplanktons were observed in the range between 341500 - 396000 No/100 mL and Zooplanktons were observed in the range between 8542 – 9436 No/100 mL.

At the location **South of Break water**, Phytoplanktons were observed in the range between 1345900 - 1466800 No/100 mL and Zooplanktons were observed in the range between 8338 – 9384 No/100 mL.

At the location **Port Basin**, Phytoplanktons were observed in the range between 118200 – 137000 No/100 mL and Zooplanktons were observed in the range between 4679 – 5638 No/100 mL.

At the location **Inner Approach Channel**, Phytoplanktons were observed in the range between 1259000 - 1420000 No/100 mL and Zooplanktons was observed in the range between 9953 – 11119 No/100 mL.

At the location **Kovalam Beach**, Phytoplanktons were observed in the range between 4209600 - 4556000 No/100 mL and Zooplanktons was observed in the range between 8046 – 9198 No/100 mL.

CHAPTER 6

Water Analysis

1. Ground water and surface water sources details:

This chapter describes the sampling location, methodology adopted for analysis and analysis results of Ground water and Surface water during the period April 2019 to September 2019. Ground water sampling was carried out at three locations including Port Site, PAF Area and Proposed Port Estate Area and surface water sampling was carried out at Poovar West Canal, Vizhinjam Branch Canal and Vellayani Lake.

Table 6.1: Ground Water Location details

Sr. No.	Location	Latitude	Longitude
Ground Water			
1.	Port Site	8^0,22',06.03" N	77^0,00',17.03" E
2.	PAF Area	8^0,22',13.17" N	77^0,00',09.68" E
3.	Proposed Port Estate Area	8^0,22',24.64" N	77^0,01',46.27" E
Surface Water			
1.	Poovar West Canal	8^0,19',08.18" N	77^0,04',35.30" E
2.	Vizhinjam Branch Canal	8^0,22',49.55" N	76^0,59',35.01" E
3.	Vellayani Lake	8^0,25',30.71" N	76^0,59',37.70" E

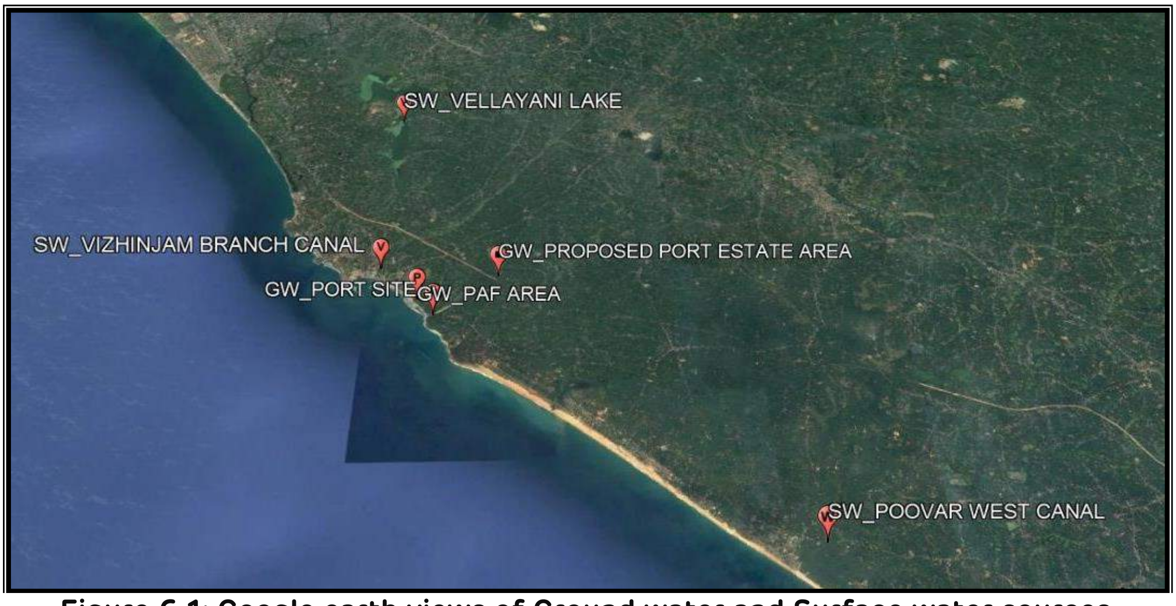


Figure 6.1: Google earth views of Ground water and Surface water sources

2. Methodology of Sampling and Analysis:

Table 6.2: Ground Water and Surface Water methodology

S. No.	Parameter	Unit	Detection Limit	Method Reference
1.	Colour	Hazen Units	1	IS 3025(Part 4): 1983,
2.	Odour	-	Qualitative	IS 3025 (Part 5): 1983
3.	pH Value	-	1-14	IS 3025(Part 11):1983
4.	Turbidity	N.T.U.	0.1	IS 3025(Part 10):1984
5.	Electrical Conductivity (at 25°C)	µmho/cm	0.1	IS 3025(Part 14): 1984
6.	Total Dissolved Solids	mg/L	5	IS 3025 (Part 16):1984
7.	Dissolved Oxygen	mg/L	0.05	IS 3025 (Part 38): 1989,
8.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	1	IS 3025 (Part 44): 1993
9.	Oil & Grease	mg/L	1	APHA, 23rd Ed., 2017,5520-B, 5-40
10.	Aluminium (as Al)	mg/L	0.025	IS 3025 (Part 55):2003
11.	Ammonia (as NH_3- N)	mg/L	0.1	APHA, 23rd Ed., 2017,4500 NH3, B & C, 4 -110, 4-112,
12.	Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	0.1	APHA, 23rd Ed., 2017, 5540-B&C,5-51& 5-53,
13.	Barium (as Ba)	mg/L	0.1	IS 3025(Part 2): 2004
14.	Boron (as B)	mg/L	0.1	IS 13428:2005, Amds.4 IS 3025 (Part 57):2003,
15.	Calcium (as Ca)	mg/L	0.4	IS 3025(Part 40): 1991
16.	Chloramines (as Cl_2)	mg/L	0.05	APHA, 22nd Ed., 2012, 4500-Cl-G, 4-69
17.	Chloride (as Cl)	mg/L	0.25	IS 3025 (Part 32):1988
18.	Copper (as Cu)	mg/L	0.02	IS 3025(Part 2): 2004
19.	Fluoride (as F)	mg/L	0.05	IS 3025(Part 60): 2008
20.	Iron (as Fe)	mg/L	0.06	IS 3025(Part 2): 2004
21.	Magnesium (as Mg)	mg/L	0.02	IS 3025(Part 46):1994
22.	Manganese (as Mn)	mg/L	0.02	IS 3025(Part 2): 2004
23.	Mineral Oil	mg/L	0.005	Clause 6 of IS: 3025 (Part 39): 1991, Amds.2, Sept 2013
24.	Nitrate (as NO_3)	mg/L	0.2	APHA, 23rd Ed., 2017,4500-NO3,B-4-122
25.	Phenolic Compounds (as C_6H_5OH)	mg/L	0.001	APHA, 23rd Ed., 2017,5530- B & C, 5-47
26.	Selenium (as Se)	mg/L	0.005	IS 3025(Part 2): 2004
27.	Silver (as Ag)	mg/L	0.005	IS 3025(Part 2): 2004
28.	Sulphate (as SO_4)	mg/L	2	IS 3025 (Part 24): 1986
29.	Sulphide (as H_2S)	mg/L	0.025	IS 3025 (Part 29) 1986
30.	Total Phosphate (as PO_4)	mg/L	0.1	APHA, 23rd Ed., 2017,4500 P,E, 4-155
31.	Total Alkalinity (as $CaCO_3$)	mg/L	0.5	IS 3025(Part 23): 1986
32.	Total Hardness (as $CaCO_3$)	mg/L	0.5	IS 3025(Part 21): 1983
33.	Calcium Hardness (as $CaCO_3$)	mg/L	-	IS 3025(Part 21): 1983

S. No.	Parameter	Unit	Detection Limit	Method Reference
34.	Zinc (as Zn)	mg/L	0.05	IS 3025(Part 2): 2004
35.	Sodium (as Na)	mg/L	0.2	IS 3025 (Part 45):1993
36.	Potassium (as K)	mg/L	0.06	IS 3025(Part 45): 1993
37.	Sodium Absorption Ratio	-	-	IS 11624:1986
38.	Cadmium (as Cd)	mg/L	0.002	IS 3025(Part 2): 2004
39.	Cyanide (as CN)	mg/L	0.001	APHA, 23rd Ed., 2017, 4500-CN, C & E, 4-41 & 4-44
40.	Lead (as Pb)	mg/L	0.008	IS 3025(Part 2): 2004
41.	Mercury (as Hg)	mg/L	0.0008	IS 3025(Part 2): 2004
42.	Molybdenum (as Mo)	mg/L	0.002	IS 3025(Part 2): 2004
43.	Nickel (as Ni)	mg/L	0.01	IS 3025(Part 2): 2004
44.	***Pesticide Residues***			
i.	Alachlor	µg/L	0.01	US EPA 525.2,1995
ii.	Atrazine	µg/L	0.01	US EPA 525.2,1995
iii.	Aldrin/Dieldrin	µg/L	0.01	US EPA 525.2,1995
iv.	Alpha HCH	µg/L	0.01	US EPA 525.2,1995
v.	Beta HCH	µg/L	0.01	US EPA 525.2,1995
vi.	Butachlor	µg/L	0.01	US EPA 525.2,1995
vii.	Chlorpyrifos	µg/L	0.05	US EPA 525.2,1995
viii.	Delta HCH	µg/L	0.01	US EPA 525.2,1995
ix.	2,4D chlorophenoxyacetic acid	µg/L	0.07	US EPA 515.1,1995
x.	DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	0.01	US EPA 525.2,1995
xi.	Endosulfan (, & Sulphate)	µg/L	0.01	US EPA 525.2,1995
xii.	Ethion	µg/L	0.05	US EPA 525.2,1995
xiii.	γ HCH (Lindane)	µg/L	0.01	US EPA 525.2,1995
xiv.	Isoproturon	µg/L	0.07	US EPA 532,2000
xv.	Malathion	µg/L	0.05	US EPA 525.2,1995
xvi.	Methyl Parathion	µg/L	0.05	US EPA 525.2,1995
xvii.	Monocrotophos	µg/L	0.05	US EPA 525.2,1995
xviii.	Phorate	µg/L	0.07	US EPA 8141B ,Rev2,Feb2007
45.	Polychlorinated Biphenyls (PCB)	mg/L	0.00007	Annex M of IS 13428:2005 ,Amds.4
46.	Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	0.00007	APHA, 23rd Ed., 2017,,6440, 6-94
47.	Total Arsenic (as As)	mg/L	0.005	IS 3025(Part 2): 2004
48.	Total Chromium (as Cr)	mg/L	0.02	IS 3025(Part 2): 2004
49.	**Trihalomethanes**			
a)	Bromoform	mg/L	0.01	AEC/C/SAP/INS/5-16
b)	Dibromochloromethane	mg/L	0.01	AEC/C/SAP/INS/5-16
c)	Bromodichloroethane	mg/L	0.01	AEC/C/SAP/INS/5-16
d)	Chloroform	mg/L	0.01	AEC/C/SAP/INS/5-16
50.	*E. coli*	MPN Index /100 ml	1.8	APHA, 23rd Ed., 2017, 9221-E, G, 9-80

S. No.	Parameter	Unit	Detection Limit	Method Reference
51.	Total Coliforms	MPN Index /100 ml	1.8	APHA, 23rd Ed., 2017, 9221-B, 9-69
52.	Faecal Coliforms	MPN Index /100ml	1.8	APHA, 23rd Ed., 2017, 9221-E, 9-77

3. Ground Water Analysis Results for the period April 2019 to September 2019:

Table 6.3 - Location: Port Site

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Organoleptic & Physical Parameters								
Colour	Hazen Units	*Max.* 5	1	1	1	1	1	1
Odour	-	Agreeable	Agreeable					
pH Value	-	6.5 to 8.5	6.91	7.00	6.91	6.79	6.72	6.73
Turbidity	N.T.U.	*Max.* 1	BDL	BDL	BDL	BDL	BDL	BDL
Total Dissolved Solids	mg/L	*Max.* 500	380	391	210	198	192	202
General Parameters concerning substances undesirable in excessive amounts								
Aluminium (as Al)	mg/L	*Max.* 0.03	BDL	BDL	BDL	BDL	BDL	BDL
Ammonia (as NH_3- N)	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	*Max.* 0.7	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	*Max.* 0.5	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	*Max.* 75	38.5	40.8	17.6	20.8	20.8	20.0
Chloramines (as Cl_2)	mg/L	*Max.* 4.0	BDL	BDL	BDL	BDL	BDL	BDL
Chloride (as Cl)	mg/L	*Max.*250	105.0	110.0	76.0	76.0	68.0	73.9
Copper (as Cu)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	*Max.* 1	BDL	0.5	0.2	0.2	0.3	0.3
Iron (as Fe)	mg/L	*Max.*0.3	0.253	0.268	BDL	BDL	0.120	0.089
Magnesium (as Mg)	mg/L	*Max.* 30	15.80	22.80	16.00	11.60	7.29	9.72
Manganese (as Mn)	mg/L	*Max.*0.1	BDL	BDL	BDL	BDL	BDL	BDL
Mineral Oil	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	*Max.*45	0.58	0.90	0.75	0.30	4.94	5.78
Phenolic Compounds (as C_6H_5OH)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	*Max.* 200	32.0	20.0	25.0	16.6	18.2	17.3
Sulphide (as H_2S)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	*Max.*200	120.0	122.0	62.5	62.5	40.0	45.0
Total Hardness (as	mg/L	*Max.* 200	140	196	110	100	82	90

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
$CaCO_3$)								
Zinc (as Zn)	mg/L	*Max.* 5	BDL	BDL	BDL	BDL	BDL	BDL
Parameters Concerning Toxic Substances								
Cadmium (as Cd)	mg/L	*Max.* 0.003	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Molybdenum (as Mo)	mg/L	*Max.* 0.07	BDL	BDL	BDL	BDL	BDL	BDL
Nickel (as Ni)	mg/L	*Max.*0.02	BDL	BDL	BDL	BDL	BDL	BDL
Pesticide Residues								
Alachlor	µg/L	20	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	0.03	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	125	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o, p & p,p- Isomers of DDT, DDE, DDD)	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b& Sulphate)	µg/L	0.4	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	3	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	9	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	190	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	0.3	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Polychlorinated Biphenyls (PCB)	mg/L	*Max.*0.0005	BDL	BDL	BDL	BDL	BDL	BDL
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	*Max.*0.0001	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Trihalomethanes								
Bromoform	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Dibromochloro Methane	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloroethane	mg/L	*Max.* 0.06	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Bacteriological Analysis								
E. coli	MPN Index/ 100 mL	Not Detectable	Absent	Absent	11	11	<1.8	<1.8
Total Coliforms	MPN Index/ 100 mL	-	130	350	280	17	<1.8	11

*BDL: Below Detection Limit/Level

Table 6.4 - Location: Proposed Port Estate Area

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Organoleptic & Physical Parameters								
Colour	Hazen Units	*Max.* 5	1	1	1	1	1	1
Odour	-	Agreeable						
pH Value	-	6.5 to 8.5	6.80	6.70	6.90	6.79	6.82	6.91
Turbidity	N.T.U.	*Max.* 1	BDL	BDL	BDL	BDL	BDL	1.9
Total Dissolved Solids	mg/L	*Max.* 500	185	190	60	52	48	50
General Parameters concerning substances undesirable in excessive amounts								
Aluminium (as Al)	mg/L	*Max.* 0.03	BDL	BDL	BDL	BDL	BDL	BDL
Ammonia (as NH_3- N)	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	*Max.* 0.7	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	*Max.* 0.5	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	*Max.* 75	20.50	21.20	8.01	4.80	5.61	5.61
Chloramines (as Cl_2)	mg/L	*Max.* 4.0	BDL	BDL	BDL	BDL	BDL	BDL
Chloride (as Cl)	mg/L	*Max.*250	70.0	29.0	16.5	16.0	14.5	14.5
Copper (as Cu)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	*Max.* 1	BDL	BDL	0.80	0.05	0.20	BDL
Iron (as Fe)	mg/L	*Max.*0.3	0.200	0.240	0.288	0.266	0.200	0.071
Magnesium (as Mg)	mg/L	*Max.* 30	10.00	12.00	4.37	1.94	2.91	3.40
Manganese (as Mn)	mg/L	*Max.*0.1	0.031	BDL	0.040	0.026	BDL	BDL
Mineral Oil	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	*Max.*45	1.12	1.62	1.45	1.36	1.93	0.83
Phenolic Compounds (as C_6H_5OH)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	*Max.* 200	35.00	36.00	5.15	5.15	4.90	5.10

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Sulphide (as H_2S)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	*Max.*200	65.0	69.0	22.5	20.0	15.0	12.5
Total Hardness (as $CaCO_3$)	mg/L	*Max.* 200	82	88	38	20	26	28
Zinc (as Zn)	mg/L	*Max.* 5	BDL	BDL	BDL	BDL	BDL	BDL
Parameters Concerning Toxic Substances								
Cadmium (as Cd)	mg/L	*Max.* 0.003	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Molybdenum (as Mo)	mg/L	*Max.* 0.07	BDL	BDL	BDL	BDL	BDL	BDL
Nickel (as Ni)	mg/L	*Max.*0.02	BDL	BDL	BDL	BDL	BDL	BDL
Pesticide Residues								
Alachlor	µg/L	20	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	0.03	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	125	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	0.4	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	3	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	9	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	190	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	0.3	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Polychlorinated Biphenyls (PCB)	mg/L	*Max.*0.0005	BDL	BDL	BDL	BDL	BDL	BDL
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	*Max.*0.0001	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Dibromochloro Methane	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloroethane	mg/L	*Max.* 0.06	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Bacteriological Analysis								
E. coli	MPN Index/ 100 mL	Absent	Absent	Absent	14	9.3	<1.8	<1.8
Total Coliforms	MPN Index/ 100 mL	140	140	110	220	23	<1.8	9.3

Table 6.5 - Location: PAF Area

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Organoleptic & Physical Parameters								
Colour	Hazen Units	*Max.* 5	1	1	1	1	1	1
Odour	-	Agreeable	Agreeable					
pH Value	-	6.5 to 8.5	6.85	6.90	6.80	6.90	6.89	6.72
Turbidity	N.T.U.	*Max.* 1	BDL	BDL	BDL	0.3	BDL	1.3
Total Dissolved Solids	mg/L	*Max.* 500	492	495	330	202	340	342
General Parameters concerning substances undesirable in excessive amounts								
Aluminium (as Al)	mg/L	*Max.* 0.03	BDL	BDL	BDL	BDL	BDL	BDL
Ammonia (as NH_3-N)	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	*Max.* 0.7	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	*Max.* 0.5	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	*Max.* 75	52.1	55.0	32.0	30.4	33.6	32.9
Chloramines (as Cl_2)	mg/L	*Max.* 4.0	BDL	BDL	BDL	BDL	BDL	BDL
Chloride (as Cl)	mg/L	*Max.*250	232.0	238.0	172.0	67.9	147.0	142.0
Copper (as Cu)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	*Max.* 1	0.30	BDL	0.28	0.20	0.30	0.20
Iron (as Fe)	mg/L	*Max.*0.3	0.07.	0.21.	0.06.	0.066	0.12.	0.071
Magnesium (as Mg)	mg/L	*Max.* 30	25.0	23.3	18.4	18.4	19.4	17.0
Manganese (as Mn)	mg/L	*Max.*0.1	BDL	BDL	0.046	0.03	BDL	BDL
Mineral Oil	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	*Max.*45	9.56	8.35	8.42	1.43	8.24	9.9
Phenolic Compounds (as C_6H_5OH)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Selenium (as Se)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	*Max.* 200	45.90	46.00	5.83	5.30	41.0	40.10
Sulphide (as H_2S)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	*Max.*200	54.0	58.0	35.0	25.0	45.0	37.5
Total Hardness (as $CaCO_3$)	mg/L	*Max.* 200	198	195	156	152	160	152
Zinc (as Zn)	mg/L	*Max.* 5	BDL	BDL	BDL	BDL	BDL	BDL
Parameters Concerning Toxic Substances								
Cadmium (as Cd)	mg/L	*Max.* 0.003	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Molybdenum (as Mo)	mg/L	*Max.* 0.07	BDL	BDL	BDL	BDL	BDL	BDL
Nickel (as Ni)	mg/L	*Max.*0.02	BDL	BDL	BDL	BDL	BDL	BDL
Pesticide Residues								
Alachlor	µg/L	20	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	0.03	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	125	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	0.4	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	3	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	9	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	190	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	0.3	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Polychlorinated Biphenyls (PCB)	mg/L	*Max.*0.0005	BDL	BDL	BDL	BDL	BDL	BDL
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	*Max.* 0.0001	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Trihalomethanes								
Bromoform	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Dibromochloro Methane	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloroethane	mg/L	*Max.* 0.06	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Bacteriological Analysis								
E. coli	MPN Index/ 100mL	Not Detectable	Absent	Absent	<1.8	<1.8	<1.8	<1.8
Total Coliforms	MPN Index/ 100mL	-	170	170	140	<1.8	<1.8	22

4. **Graphical representation of Ground Water Results for the period April 2019 to September 2019:**

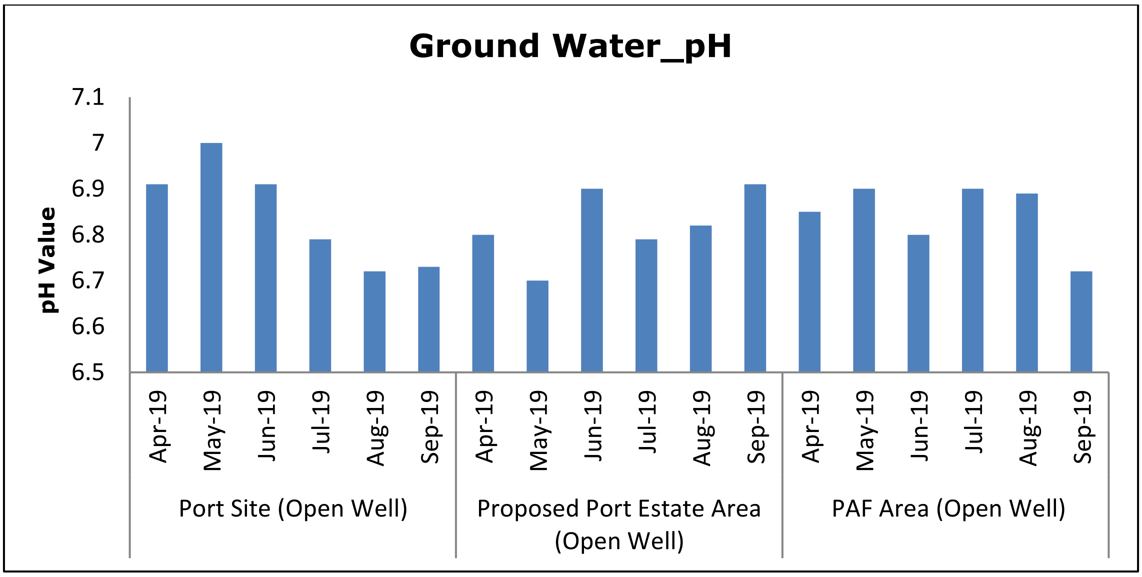


Figure 6.2: Ground Water Analysis for pH

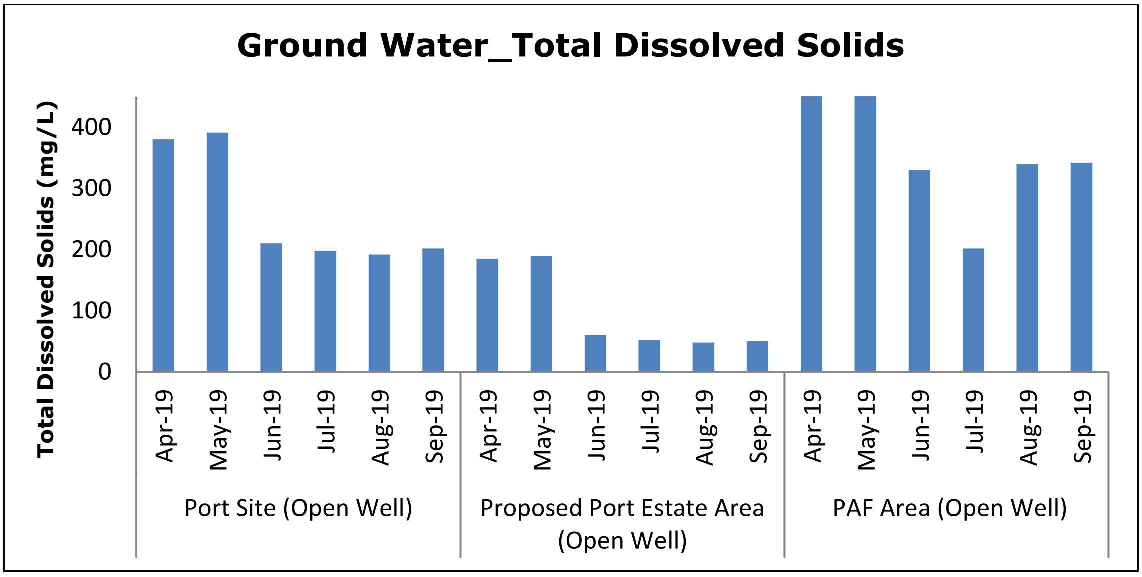


Figure 6.3: Ground Water Analysis for Total Dissolved Solids

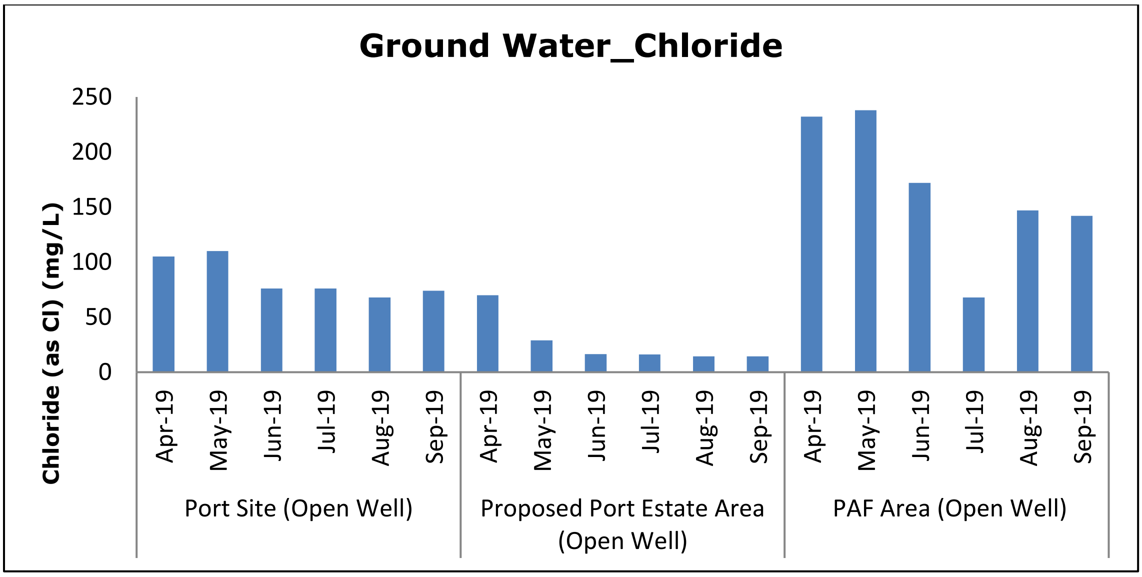


Figure 6.4: Ground Water Analysis for Chloride

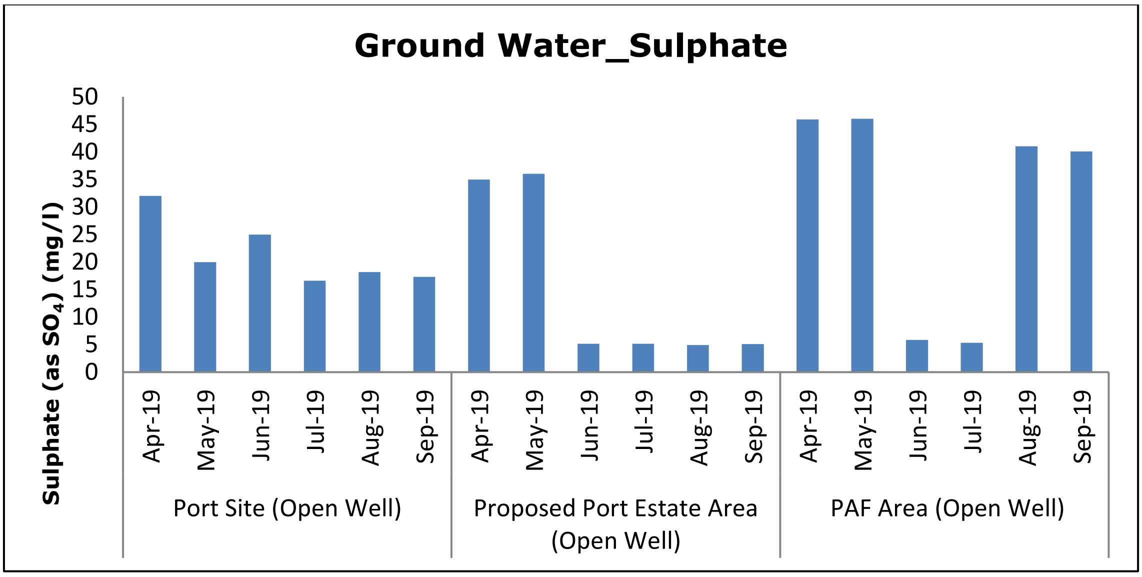


Figure 6.5: Ground Water Analysis for Sulphate

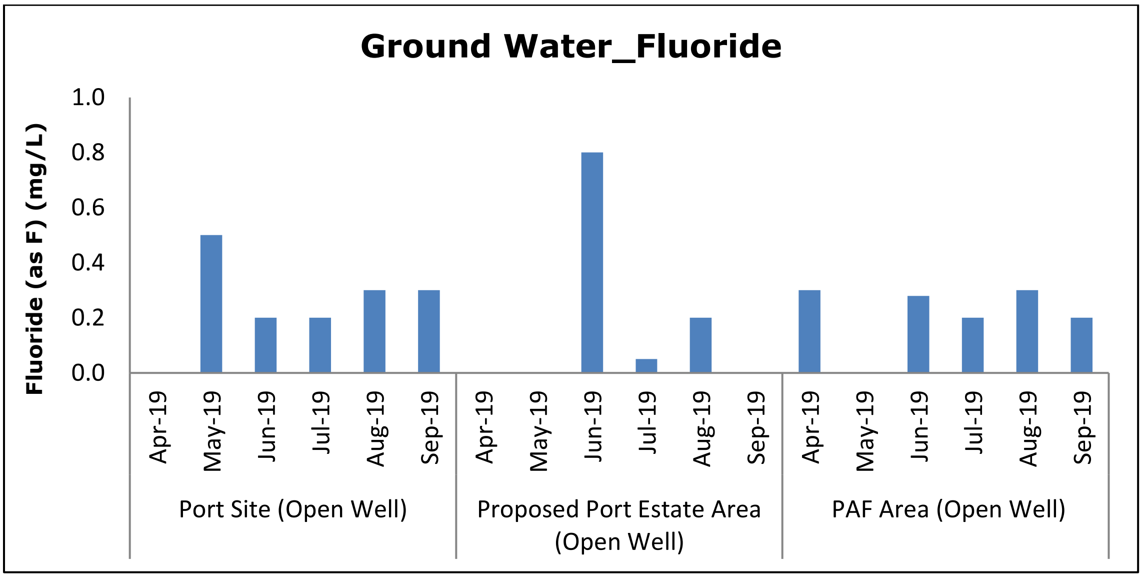


Figure 6.6: Ground Water Analysis for Fluoride

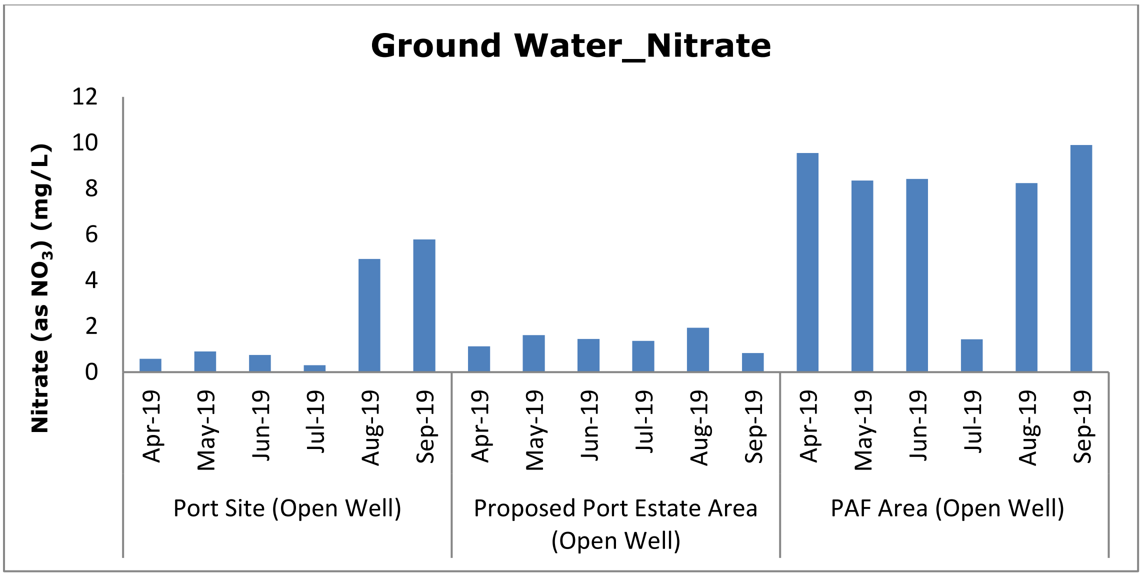


Figure 6.7: Ground Water Analysis for Nitrate

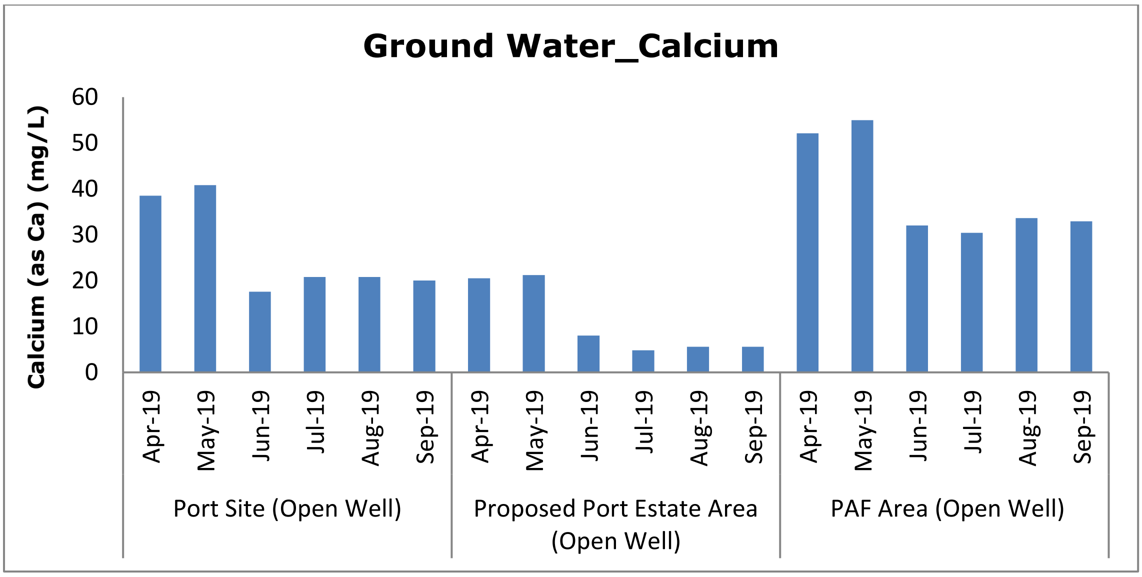


Figure 6.8: Ground Water Analysis for Calcium

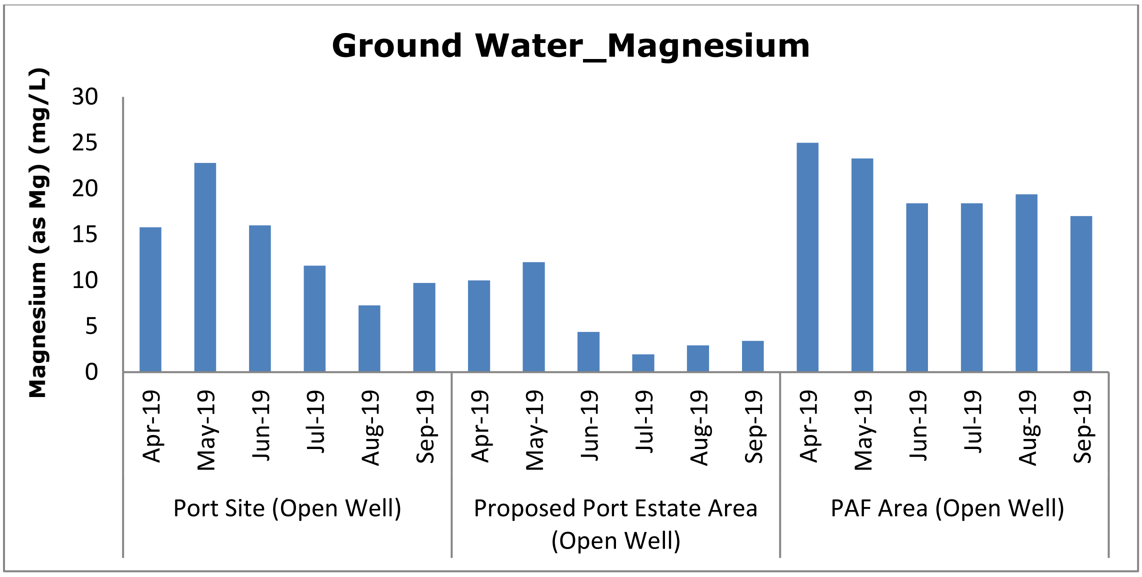


Figure 6.9: Ground Water Analysis for Magnesium

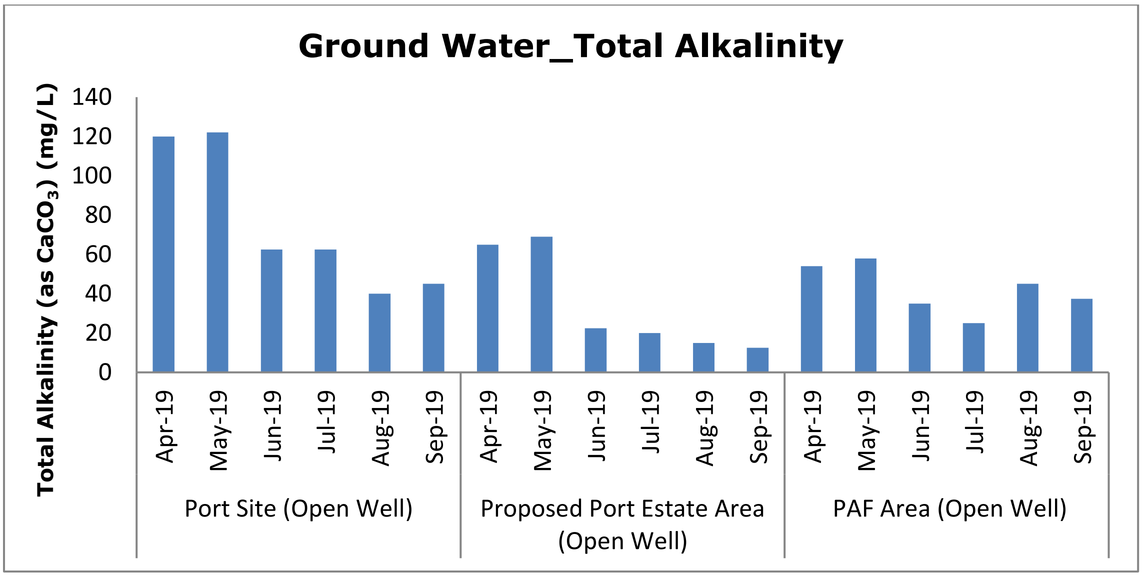


Figure 6.10: Ground Water Analysis for Total Alkalinity

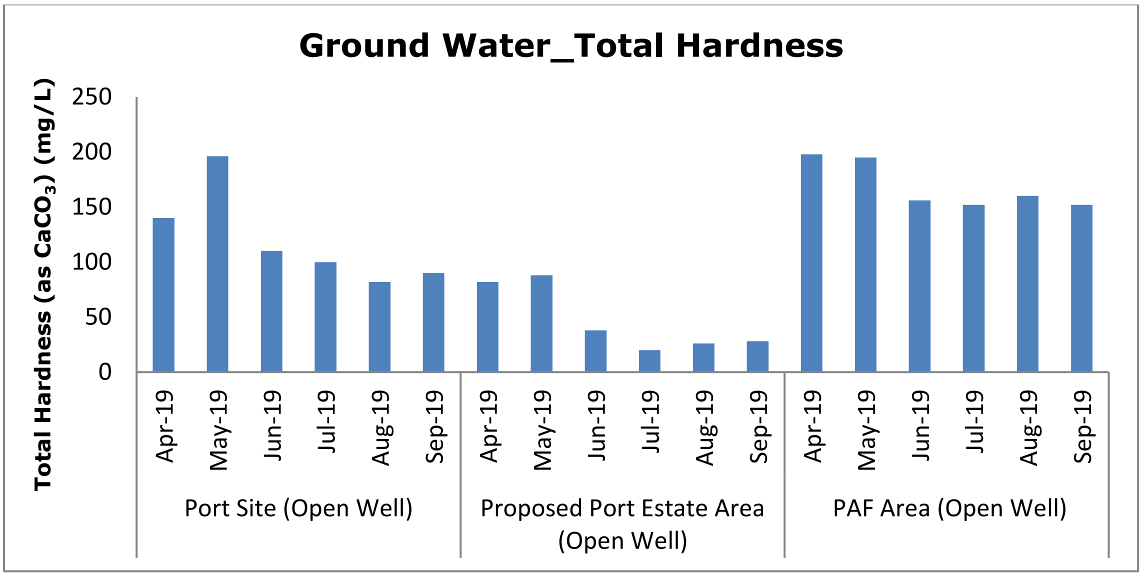


Figure 6.11: Ground Water Analysis for Total Hardness

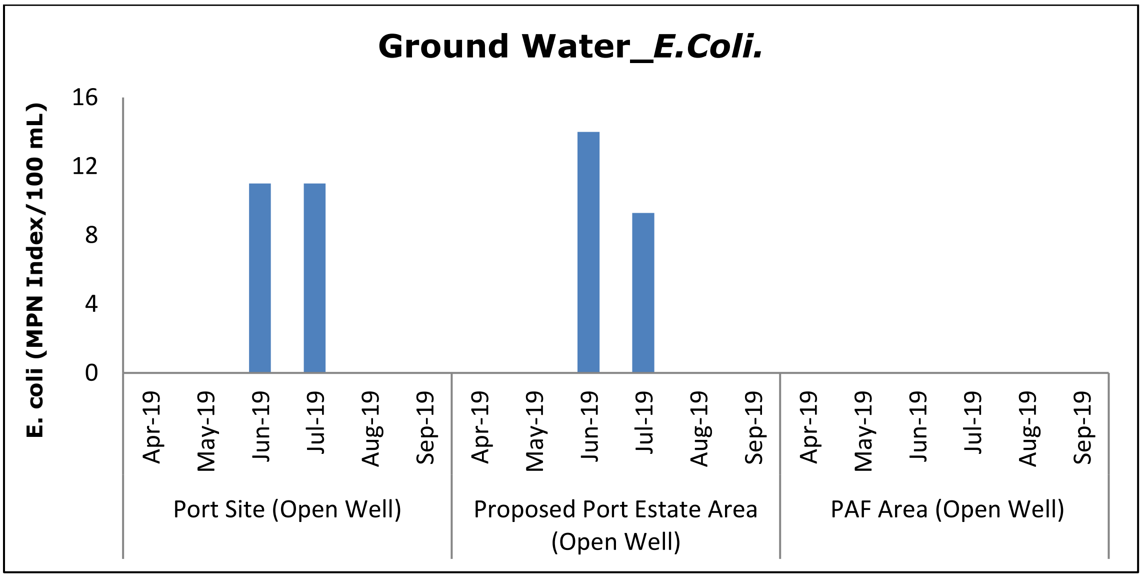


Figure 6.12: Ground Water Analysis for *E.Coli.*

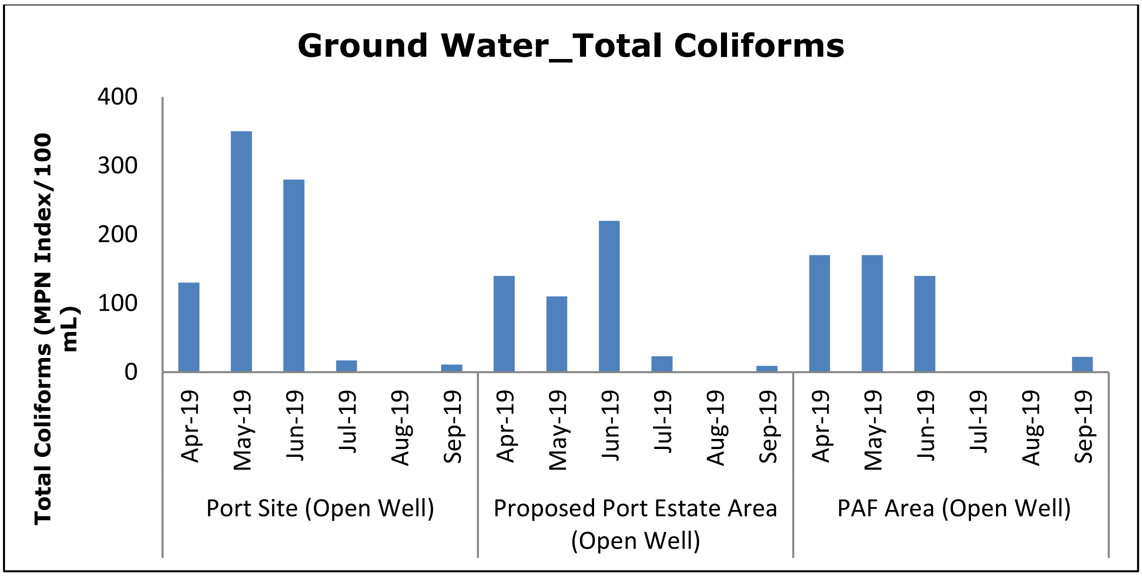


Figure 6.13: Ground Water Analysis for Total Coliforms

5. Summary-Ground Water Analysis

During the period April 2019 to September 2019, at the location **Port Site** (Open Well), the Colour observed was 1 Hazen unit and the odour was agreeable. pH was observed in the range between 6.72 – 7.00. . Total Dissolved Solids was observed in the range between 192 - 391 mg/L. limit. Calcium (as Ca) was observed in the range between 17.6 – 40.8 mg/L. Chloride (as Cl) was observed in the range between 68 – 110 mg/L. Fluoride (as F) was observed in the range between BDL to 0.5 mg/L. Iron (as Fe) was observed in the range between BDL to 0.268 mg/L. Magnesium (as Mg) was observed in the range between 7.29 – 22.80 mg/L. . Nitrate (as NO_3) was observed in the range between 0.30 – 5.78 mg/L. Sulphate (as SO_4) was observed in the range between 16.6 – 32.0 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 40 - 122 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 82 - 196 mg/L. Turbidity, Manganese (as Mn), Aluminium (as Al), Ammonia (as NH_3- N), Anionic Detergents, Barium (as Ba), Boron, Chloramines (as Cl_2), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se), Silver (as Ag), Sulphide (as H_2S), Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues, Trihalomethanes, Polychlorinated Biphenyls (PCB) and Polynuclear Aromatic Hydrocarbons (PAH) were observed BDL. Bacteriological parameters such as *E.coli* was observed in the range between <1.8

– 11 MPN Index/100 mL and Total Coliforms were observed in the range between <1.8 - 350 MPN Index/100 mL.

At the location **Proposed Port Estate Area** (Open Well), the Colour observed was 1 Hazen unit and the odour was agreeable. pH was observed in the range between 6.70 – 6.91. Turbidity was observed in the range between BDL to 1.9 NTU. Total Dissolved Solids was observed in the range between 48 - 190 mg/L. Calcium (as Ca) was observed in the range between 4.8 – 21.2 mg/L. Chloride (as Cl) was observed in the range between 14.5 – 70.0 mg/L. Fluoride (as F) was observed in the range between BDL – 0.8 mg/L. Iron (as Fe) was observed in the range between below 0.071 – 0.288 mg/L. Magnesium (as Mg) was observed in the range between 1.94 – 12,00 mg/L. Manganese (as Mn) was observed in the range between BDL to 0.04 mg/L. Nitrate (as NO_3) was observed in the range between 0.83 – 1.93 mg/L. Sulphate (as SO_4) was observed in the range between 4.9 – 36.0 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 12.5 – 69.0 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 20 – 88 mg/L. Aluminium (as Al), Ammonia (as NH_3- N), Anionic Detergents, Barium (as Ba), Boron, Chloramines (as Cl_2), Copper (as Cu), Iron (as Fe), Mineral Oil, Phenolic Compounds(as C_6H_5OH), Selenium (as Se) and Silver (as Ag), Sulphide (as H_2S) Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues, Trihalomethanes, Polychlorinated Biphenyls (PCB) and Polynuclear Aromatic Hydrocarbons (PAH) were observed BDL. Bacteriological parameters such as *E.coli* was observed in the range between <1.8 - 14 MPN Index/100 mL and Total Coliforms were observed in the range between <1.8 - 220 MPN Index/100 mL.

At the location **Proposed PAF Area** (Open Well), the Colour observed was 1 Hazen unit and the odour was agreeable. pH was observed in the range between 6.72 – 6.90. Turbidity was observed in the range between BDL – 1.3 NTU. Total Dissolved Solids was observed in the range between 202 - 495 mg/L. Calcium (as Ca) was observed in the range between 30.4 – 55.0 mg/L. Chloride (as Cl) was observed in the range between 67.9 – 238.0 mg/L. Fluoride (as F) was observed in the range between BDL - 0.30 mg/L. Iron (as Fe) was observed in the range between 0.06 - 0.21 mg/L. Magnesium (as Mg) was observed in the range between 17 – 25 mg/L. Manganese (as Mn) was observed in the range between BDL to 0.046 mg/L. Nitrate (as NO_3) was observed in the range between 1.43 – 9.90 mg/L. Sulphate (as SO_4) was observed in the range between 5.3 – 46.0 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 25 – 58 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 152 – 198 mg/L. Aluminium, Ammonia (as NH_3- N), Anionic Detergents and Barium (as Ba), Boron (as B), Chloramines (as Cl_2), Copper (as Cu), Manganese (as Mn), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se) and Silver (as Ag), Sulphide (as H_2S), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues, Trihalomethanes, Polychlorinated Biphenyls (PCB), Polynuclear Aromatic Hydrocarbons (PAH) and Zinc (as Zn) were observed BDL. Bacteriological parameters such as *E.coli* were and Total Coliforms were observed in the range BDL to 170 MPN Index/100 mL.

6. Surface Water Analysis Results for the period April 2019 to September 2019:

Table 6.6 - Location: Poovar West Canal

Parameter	Unit	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Physical Parameters							
Colour	Hazen Units	1	1	1	1	1	1
Odour	-	Agreeable					
pH Value	-	6.62	7.18	6.66	7.07	6.60	6.73
Turbidity	N.T.U.	BDL	BDL	0.28	BDL	BDL	2.10
Electrical Conductivity (at 25°C)	μmho/cm	750	162	374	1962	265	260
Total Dissolved Solids	mg/L	414	90	210	1096	148	146
Chemical Parameters							
Dissolved Oxygen	mg/L	5.5	5.5	5.6	5.7	6.0	7.6
Biochemical Oxygen Demand (3 days, 27°C)	mg/L	2.8	4.0	2.0	1.9	5.0	1.2
Oil & Grease	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Free Ammonia	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	20.80	8.01	20.00	49.60	16.80	7.21

Parameter	Unit	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Chloride (as Cl)	mg/L	247.0	37.0	42.5	680.0	45.9	44.5
Copper (as Cu)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	0.5	BDL	0.3	0.8	0.2	0.4
Iron (as Fe)	mg/L	0.255	0.134	1.120	BDL	0.569	0.145
Magnesium (as Mg)	mg/L	11.60	3.88	5.83	26.20	4.37	10.20
Manganese (as Mn)	mg/L	0.021	BDL	BDL	BDL	BDL	BDL
Mineral Oil	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	6.89	1.57	5.10	2.03	4.24	3.20
Phenolic Compounds (as C_6H_5OH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	26.90	15.00	14.00	7.58	7.90	8.10
Total Phosphate (as PO_4)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	27.5	35.0	30.0	32.5	47.5	10.0
Total Hardness (as $CaCO_3$)	mg/L	100	36	74	232	60	60
Calcium Hardness (as $CaCO_3$)	mg/L	52	20	50	124	42	18
Zinc (as Zn)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sodium (as Na)	mg/L	102	9.5	78.3	96	20.6	18.7
Potassium (as K)	mg/L	4.6	1.2	4.0	10.1	10.1	5.0
Sodium Absorption Ratio	-	4.47	0.97	3.97	2.74	1.15	1.07
Cadmium (as Cd)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Pesticide Residues							
Alachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL

Parameter	Unit	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Monocrotophos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Biological Analysis							
Total Coliforms	MPN Index/ 100 mL	170	280	350	240	110	280
Faecal Coliforms	MPN Index/ 100 mL	49	130	110	<1.8	<1.8	6.8

*BDL: Below Detection Limit/Level

Table 6.7 - Location: Vizhinjam Branch Canal

Parameter	Unit	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Physical Parameters							
Colour	Hazen Units	1	1	1	1	1	1
Odour	-	Agreeable					
pH Value	-	6.66	7.00	7.00	7.00	7.08	7.34
Turbidity	N.T.U.	BDL	BDL	BDL	BDL	BDL	1.5
Electrical Conductivity (at 25°C)	µmho/ cm	295	201	180	277	263	278
Total Dissolved Solids	mg/L	118	130	100	154	130	156
Chemical Parameters							
Dissolved Oxygen	mg/L	5.3	5.9	5.2	5.4	6.1	7.5
Biochemical Oxygen Demand (3 days, 27°C)	mg/L	3.0	2.0	2.0	1.8	3.0	1.4
Oil & Grease	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Free Ammonia	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	20.8	16.8	12.0	12.0	11.0	16.0
Chloride (as Cl)	mg/L	32.5	20.0	18.0	55.5	52.4	53.0
Copper (as Cu)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	0.05	BDL	0.80	0.10	0.20	0.30
Iron (as Fe)	mg/L	0.335	0.227	0.393	0.107	0.119	0.147
Magnesium (as Mg)	mg/L	10.60	4.86	2.70	6.80	6.50	9.72
Manganese (as Mn)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mineral Oil	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	0.99	2.18	2.10	4.43	3.15	6.82

Parameter	Unit	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Phenolic Compounds (as C_6H_5OH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	11.20	4.47	7.58	14.00	12.50	13.00
Total Phosphate (as PO_4)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	350	200	18.0	52.5	27.5	45.0
Total Hardness (as $CaCO_3$)	mg/L	96	62	42	58	56	80
Calcium Hardness (as $CaCO_3$)	mg/L	52	42	20	30	28	40
Zinc (as Zn)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sodium (as Na)	mg/L	17.9	64.3	54.5	16.9	66.5	20.1
Potassium (as K)	mg/L	2.20	3.80	2.40	0.98	24.60	7.80
Sodium Absorption Ratio	-	0.78	5.07	1.59	0.97	1.65	0.97
Cadmium (as Cd)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Pesticide Residues							
Alachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Biological Analysis							
Total Coliforms	MPN	240	130	920	70	130	220

Parameter	Unit	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
	Index/ 100 mL						
Faecal Coliforms	MPN Index/ 100 mL	34	34	220	<1.8	<1.8	39

Table 6.8 - Location: Vellayani Lake

Parameter	Unit	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Physical Parameters							
Colour	Hazen Units	1	1	1	1	1	1
Odour	-	Agreeable					
pH Value	-	6.68	7.00	6.73	6.78	6.68	6.68
Turbidity	N.T.U.	BDL	BDL	0.26	BDL	0.34	0.58
Electrical Conductivity (at 25°C)	µmho/ cm	169	150	150	160	155	121
Total Dissolved Solids	mg/L	94	82	84	90	88	68
Chemical Parameters							
Dissolved Oxygen	mg/L	4.7	3.8	5.2	5.3	7.0	7.6
Biochemical Oxygen Demand (3 days, 27°C)	mg/L	2.0	40	3.0	2.8	2.1	1.1
Oil & Grease	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Free Ammonia	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	17.60	7.21	7.21	6.41	6.61	8.81
Chloride (as Cl)	mg/L	300	28.0	28.5	32.5	28.5	25.4
Copper (as Cu)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	0.05	BDL	0.3	0.05	0.211	BDL
Iron (as Fe)	mg/L	0.731	0.299	0.437	BDL	0.711	0.089
Magnesium (as Mg)	mg/L	9.23	2.43	2.91	5.34	3.88	1.94
Manganese (as Mn)	mg/L	0.046	BDL	0.048	0.048	BDL	BDL
Mineral Oil	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	1.57	0.93	2.15	2.32	2.17	0.76
Phenolic Compounds (as C_6H_5OH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	2.04	3.98	3.79	5.53	4.42	3.74
Total Phosphate (as PO_4)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	35.0	20.0	30.0	32.5	30.0	22.5
Total Hardness (as $CaCO_3$)	mg/L	82	28	30	38	40	30

Parameter	Unit	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Calcium Hardness (as $CaCO_3$)	mg/L	44	18	18	16	24	22
Zinc (as Zn)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sodium (as Na)	mg/L	15.5	7.1	2.7	14.2	14.2	9.6
Potassium (as K)	mg/L	2.30	1.00	0.34	1.10	5.60	4.50
Sodium Absorption Ratio	-	0.74	0.81	0.20	1.00	0.98	0.75
Cadmium (as Cd)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Pesticide Residues							
Alachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Biological Analysis							
Total Coliforms	MPN Index/ 100 mL	220	350	280	49	110	58
Faecal Coliforms	MPN Index/ 100 mL	39	110	<1.8	<1.8	<1.8	14

7. Graphical representation of Surface Water Results for the period April 2019 to September 2019:

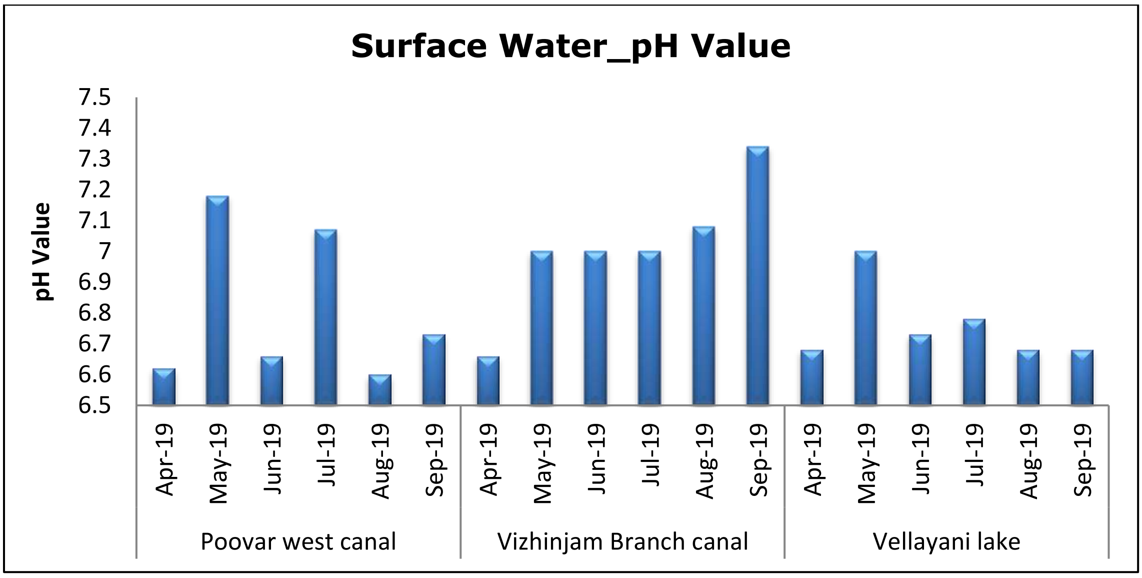


Figure 6.14: Surface Water Analysis for pH value

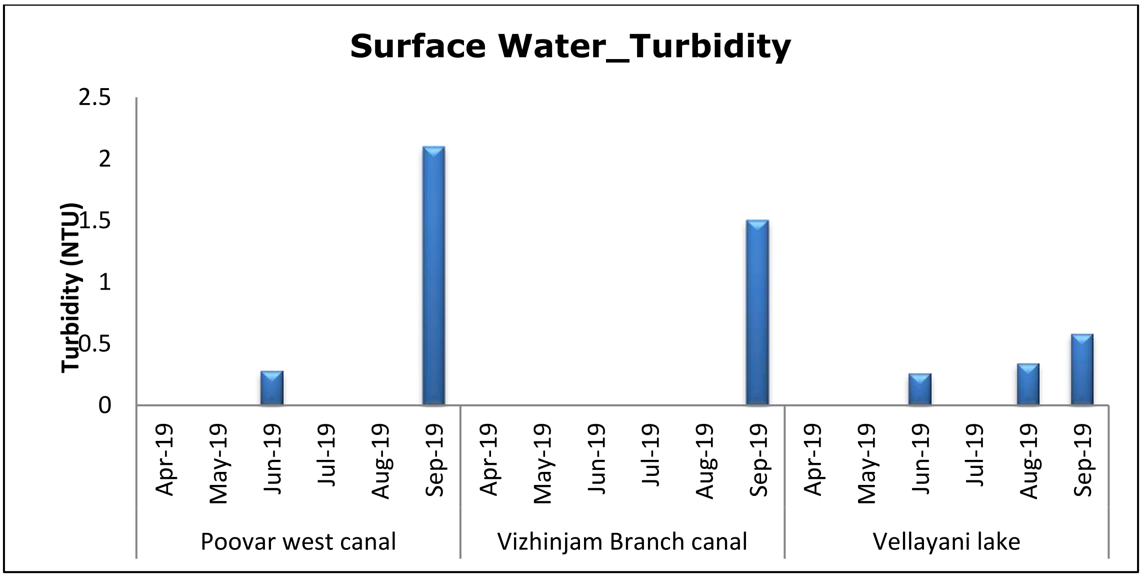


Figure 6.15: Surface Water Analysis for Turbidity

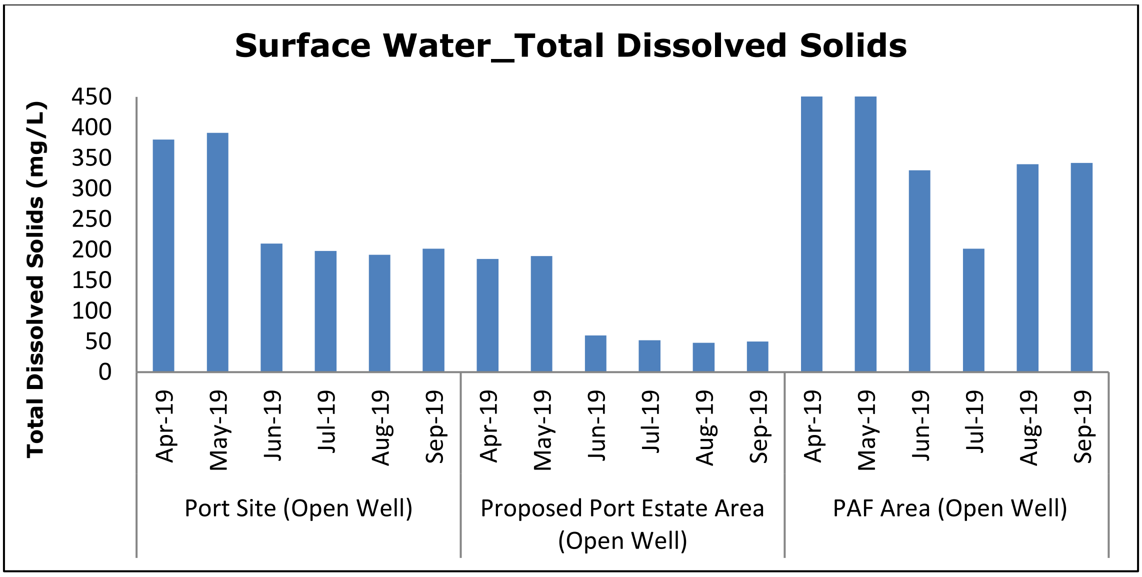


Figure 6.16: Surface Water Analysis for Total Dissolved Solids

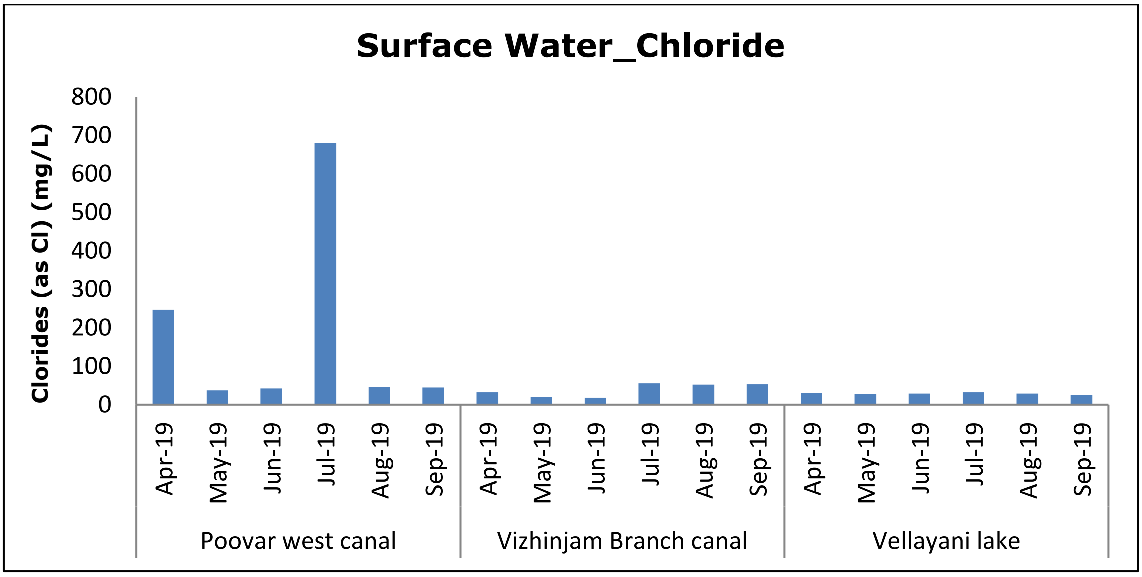


Figure 6.17: Surface Water Analysis for Chloride

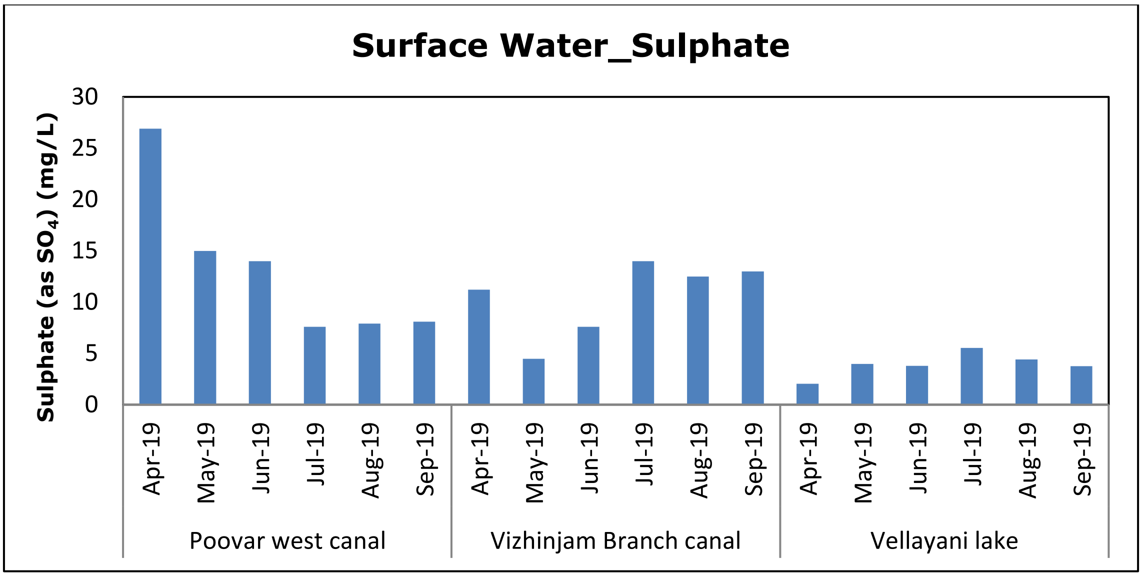


Figure 6.18: Surface Water Analysis for Sulphate

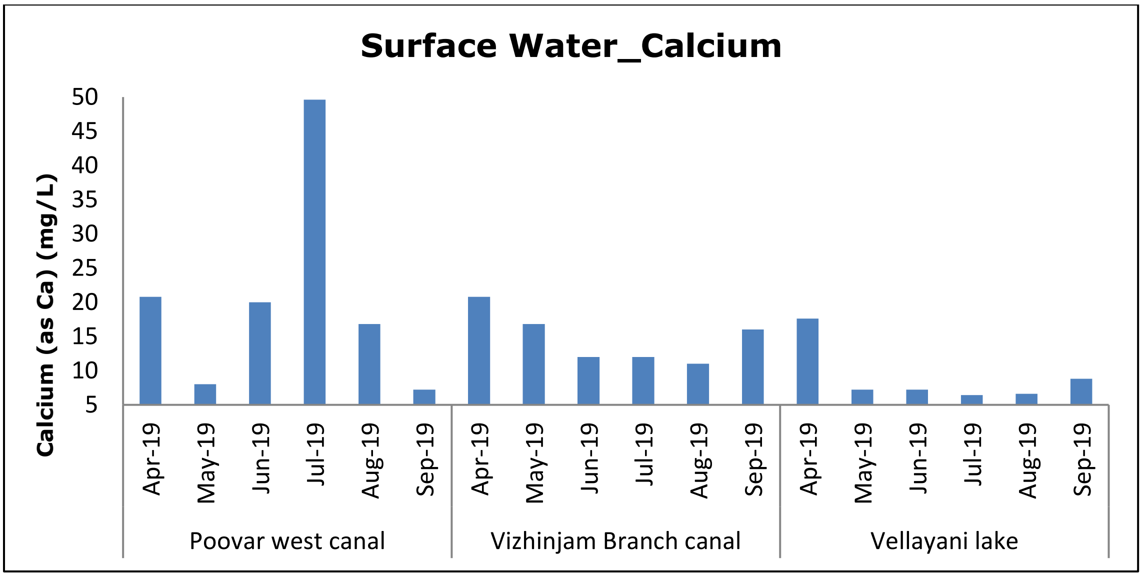


Figure 6.19: Surface Water Analysis for Calcium

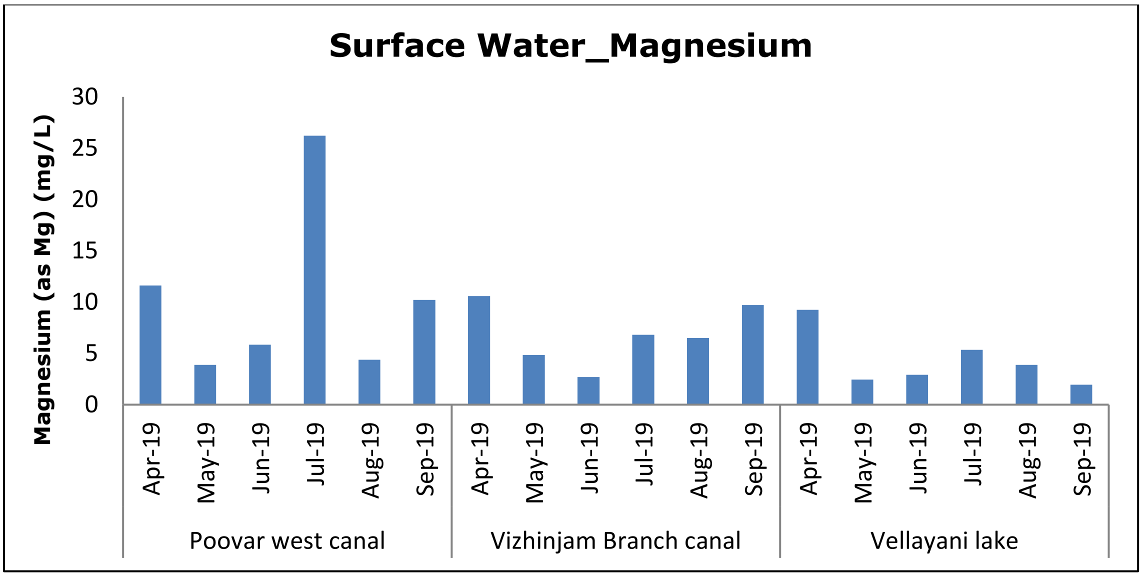


Figure 6.20: Surface Water Analysis for Magnesium

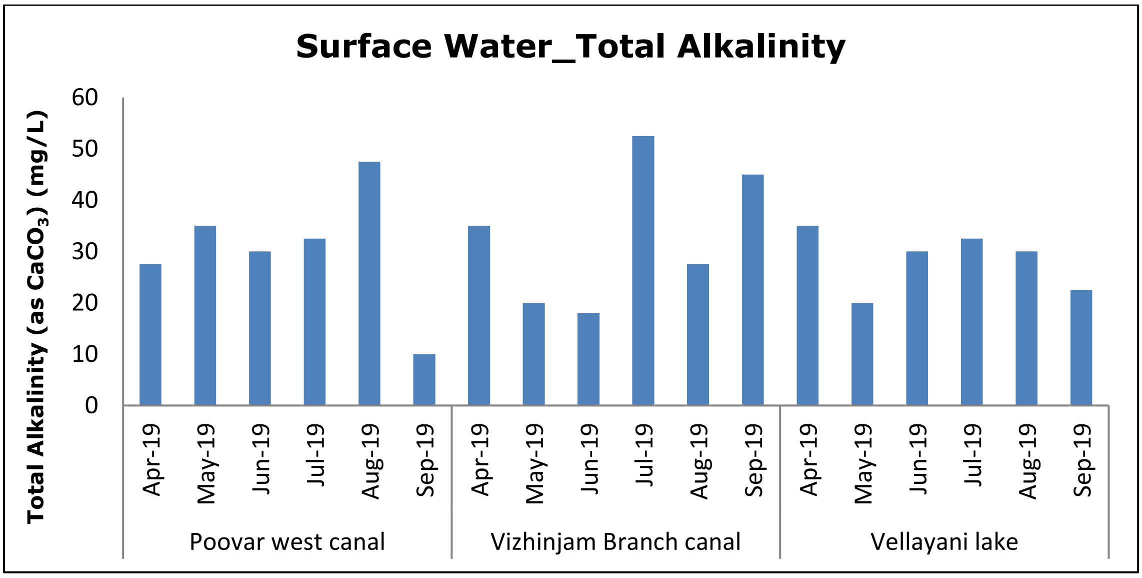


Figure 6.21: Surface Water Analysis for Total Alkalinity

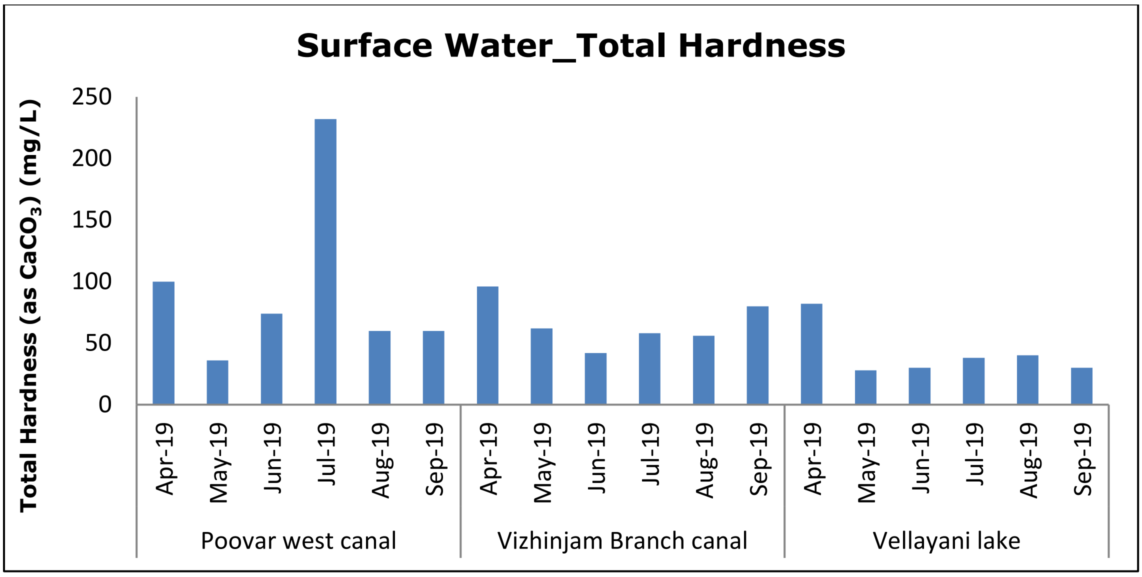


Figure 6.22: Surface Water Analysis for Total Hardness

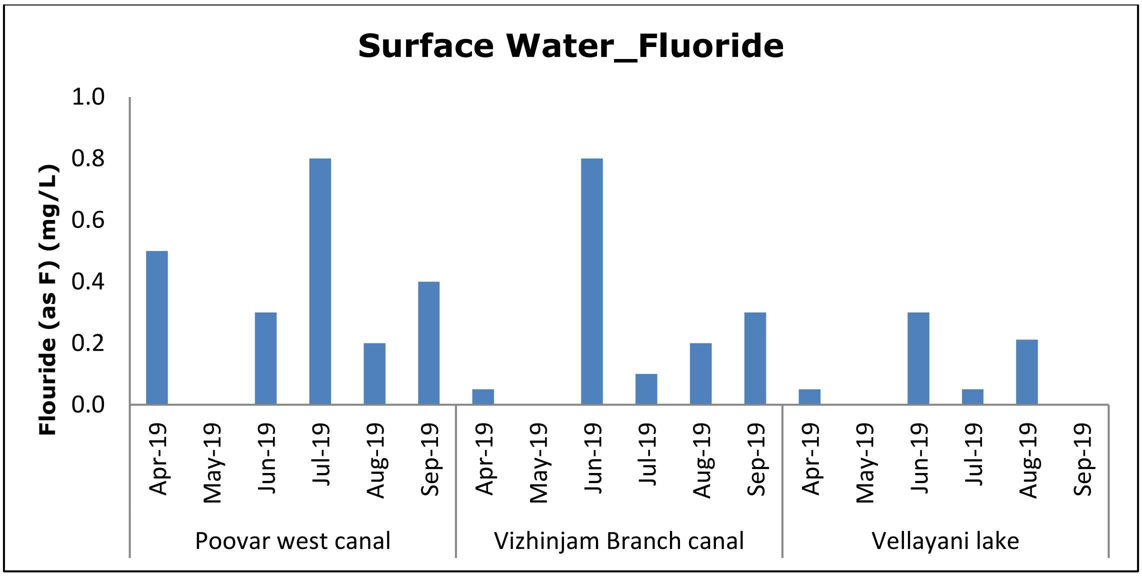


Figure 6.23: Surface Water Analysis for Fluoride

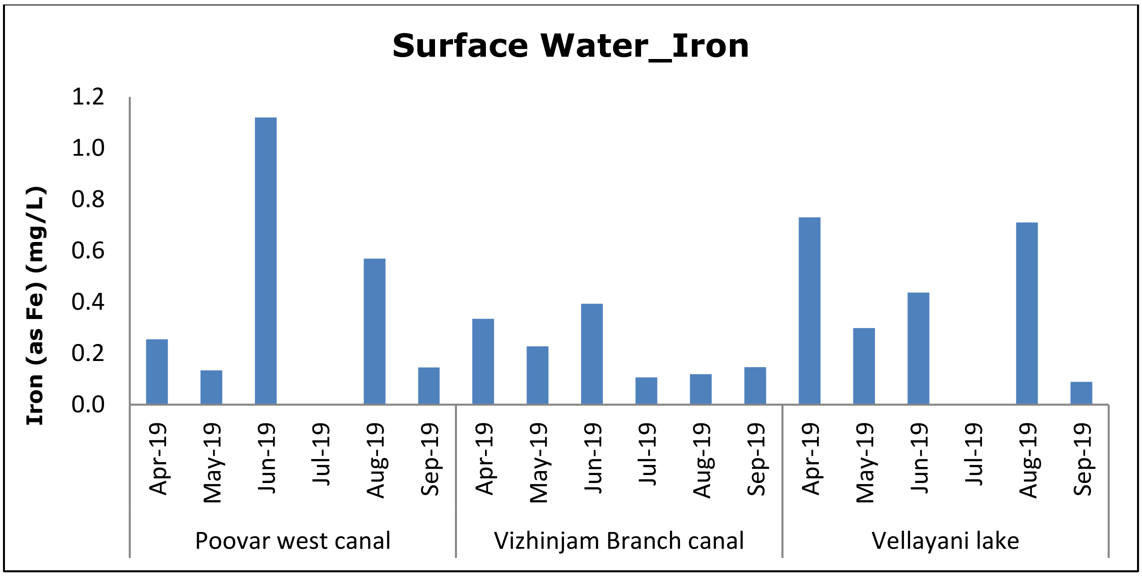


Figure 6.24: Surface Water Analysis for Iron

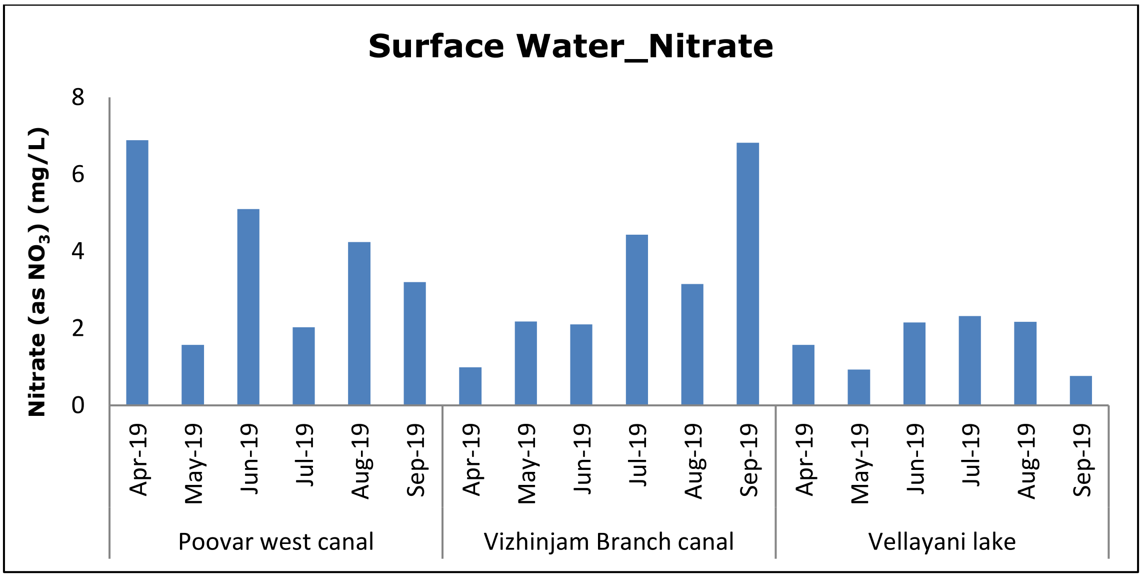


Figure 6.25: Surface Water Analysis for Nitrate

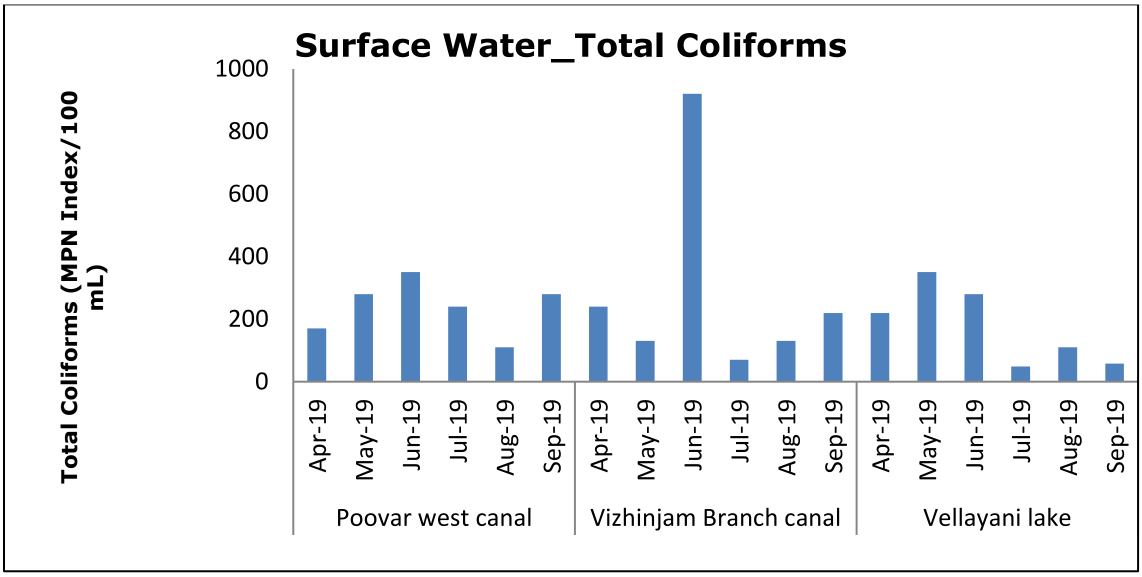


Figure 6.26: Surface Water Analysis for Total Coliforms

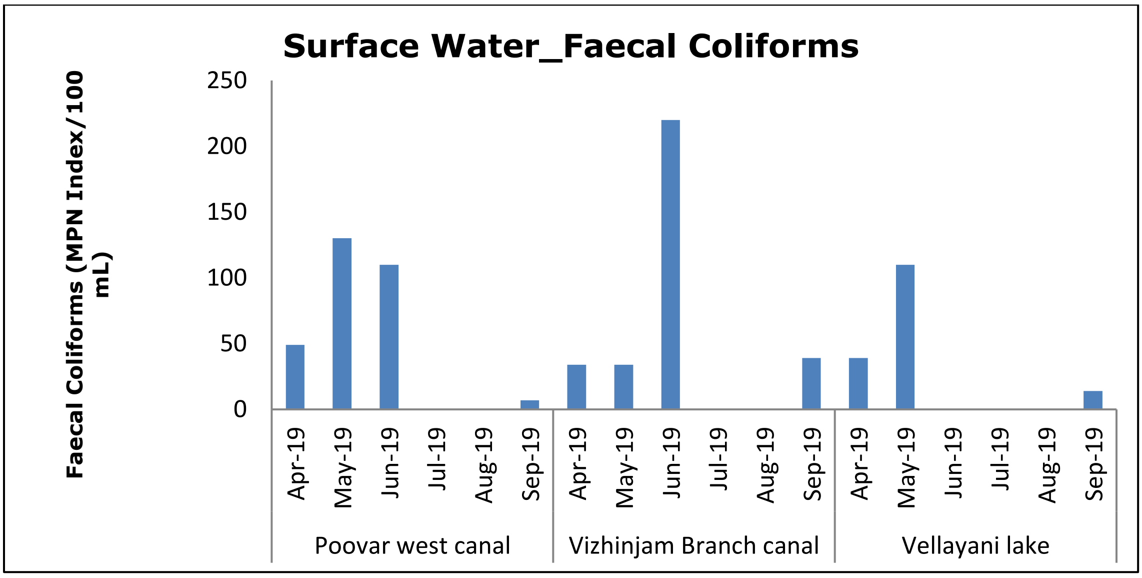


Figure 6.27: Surface Water Analysis for Faecal Coliforms

8. Summary of Surface water

During the period April 2019 to September 2019, at the location **Poovar West Canal**, Colour was observed 1 Hazen unit and odour was agreeable. pH was observed in the range between 6.60 – 7.18. Turbidity was observed in the range between BDL – 2.1 NTU. Total Dissolved Solids was observed in the range between 90 - 1096 mg/L. Electrical Conductivity was observed in the range between 162 - 1962 µmho/cm. Dissolved Oxygen was observed in the range between 5.5 – 7.6 mg/L. Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between 1.20 – 5.00 mg/L. Calcium (as Ca) was observed in the range between 7.21 – 49.60 mg/L. Chloride (as Cl) was observed in the range between 37 - 680 mg/L. Fluoride (as F) was observed in the range BDL – 0.80 mg/L. Iron (as Fe) was observed in the range between BDL – 1.12 mg/L. Magnesium (as Mg) was observed in the range between 3.88 – 26.20 mg/L. Manganese (as Mn) was observed in the range between BDL and 0.02 mg/L. Nitrate (as NO_3) was observed in the range between 1.57 – 6.89 mg/L. Sulphate (as SO_4) was observed in the range between 7.58 – 26.90 mg/L. . Total Alkalinity (as $CaCO_3$) was observed in the range between 10 – 47.5 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 36 – 232 mg/L. Calcium Hardness (as $CaCO_3$) was observed in the range between 18 – 124 mg/L. Sodium (as Na) was observed in the range between 9.5 – 102.0 mg/L. Potassium (as K) was observed in the range between 1.20 – 10.10 mg/L. Sodium Absorption Ratio was observed in the range between 0.97 – 4.47 mg/L. Free Ammonia, Total Phosphate (as PO_4), Oil & Grease, Anionic Detergents and Barium (as Ba), Boron (as B), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se) and Silver (as Ag), Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues and Polynuclear Aromatic Hydrocarbons (PAH) were observed below detection limit. Bacteriological parameters such as Total Coliforms were observed in the range between 110 to 350 MPN Index/100 mL and Faecal Coliforms were observed in the range between <1.8 to 130 MPN Index/100 mL.

At the location **Vizhinjam Branch Canal**, Colour was observed 1 Hazen unit and odour was agreeable. pH was observed in the range between 6.66 – 7.34. Turbidity was observed in the range between BDL – 1.5 NTU. Total Dissolved Solids was observed in the range between 100 - 156 mg/L. Electrical Conductivity was observed in the range between 180 - 295 µmho/cm. Dissolved Oxygen was observed in the range between 5.20 – 7.50 mg/L. Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between 1.40 – 3.00 mg/L. Calcium (as Ca) was observed in the range between 11.00 – 20.80 mg/L. Chloride (as Cl) was observed in the range between 18.0 – 55.5 mg/L. Fluoride (as F) was observed in the range between BDL - 0.80 mg/L. Iron (as Fe) was observed in the range between 0.11 – 0.39 mg/L. Magnesium (as Mg) was observed in the range between 2.70 – 10.60 mg/L. Nitrate (as NO_3) was observed in the range between 0.99 – 6.82 mg/L. Sulphate (as SO_4) was observed in the range between 4.47 – 14.00 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 18.0 – 52.5 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 42 – 96 mg/L. Calcium Hardness (as $CaCO_3$) was observed in the range between 20 – 52 mg/L. Sodium (as Na) was observed in the range between 16.9 – 66.5 mg/L. Potassium (as K) was observed in the range between 0.98 – 24.6 mg/L. Sodium Absorption Ratio was observed in the range between 0.78 – 5.07. Manganese (as Mn), Oil & Grease, Free Ammonia, Anionic Detergents and Barium (as Ba), Boron (as B), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se), Silver (as Ag), Total Phosphate (as PO_4), Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues and Polynuclear Aromatic Hydrocarbons (PAH) were observed BDL. Bacteriological parameters such as Total Coliforms were observed in the range between 70 to 920 MPN Index/100 mL and Faecal Coliforms were observed in the range between BDL - 220 MPN Index/100 mL.

At the location **Vellayani Lake**, Colour was observed 1 Hazen unit and odour was agreeable. pH was observed in the range between 6.68 – 7.00. Turbidity was observed in the range between BDL to 0.58 NTU. Total Dissolved Solids was observed in the range between 68 - 94 mg/L. Electrical Conductivity was observed in the range between 121 - 169 µmho/cm. Dissolved Oxygen was observed in the range between 3.8 – 7.6 mg/L. Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between 1.1 – 4.0 mg/L. . Calcium (as Ca) was observed in the range between 6.41 – 17.6 mg/L. Chloride (as Cl) was observed in the range between 25.4 – 32.5 mg/L. Fluoride (as F) was observed in the range between BDL - 0.30 mg/L. Iron (as Fe) was observed in the range between BDL - 0.73 mg/L. Magnesium (as Mg) was observed in the range between 1.94 – 9.23 mg/L. Manganese (as Mn) was observed in the range between BDL – 0.048 mg/L. Nitrate (as NO_3) was observed in the range between 0.76 – 2.32 mg/L. Sulphate (as SO_4) was observed in the range between 2.04 – 5.53 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 20 – 35 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 28 – 82 mg/L. Calcium Hardness (as $CaCO_3$) was observed in the range between 16 – 44 mg/L. Sodium (as Na) was observed in the range between 2.70 – 15.50 mg/L. Potassium (as K) was observed in the range between 0.34 – 5.60 mg/L. Sodium Absorption Ratio was observed in the range between 0.20 – 1.00. Free Ammonia, Oil & Grease, Anionic Detergents and Barium (as Ba), Boron (as B), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se) and Silver (as Ag), Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Total Arsenic (as As), Total Chromium (as Cr), Total Phosphate (as PO_4), Pesticide Residues and Polynuclear Aromatic Hydrocarbons (PAH) were observed below detection limit. Bacteriological parameters such as Total Coliforms were observed in the range between 49 to 350 MPN Index/100 mL and Faecal Coliforms were observed in the range between BDL - 110 MPN Index/100 mL.

Annexure V

Submission Letter of Oil Spill Response Plan to Indian Coast Guard (ICG)

adani

O/C

Ref: AVPPL/ICG/2019-20/872

Date: 2nd September 2019

To,
The Commander,
District Operational and Plans Officer,
No. 4, Coast Guard District (Kerala & Mahe)
Kalvathy Road, Fort Kochi – 682 001

Sub: Facility Level Oil Spill Disaster Contingency Plan for Vizhinjam International Transshipment Deep-Water Multipurpose Seaport – Submission of Facility Level Contingency Plan towards Approval - Reg.

Ref: NOS-DCP, 2015 and Subsequent Circulars Issued by Indian Coast Guard

Dear Sir,

Government of Kerala (GoK) has taken up an ambitious project of development of an International Seaport at Vizhinjam; where natural advantages offer huge potential for a deep water seaport operation.

Adani Vizhinjam Port Private Ltd (AVPPL) has signed a Concession Agreement with Government of Kerala on 17th Aug 2015 for development and operation of Vizhinjam International Seaport. The Port is proposed to be developed in three phases; Phase 1 as an International Container Transshipment Terminal, Phase 2 and 3 developments are planned in turn to develop the facility as an all-cargo handling facility including dedicated liquid berth for handling oil and chemical tankers. The port construction is ongoing and planned to initiate the operation by October 2020.

In line with the NOS-DCP requirements, we have carried out essential studies and prepared an Oil Spill Contingency Plan for Vizhinjam Port. The Contingency plan is presented as 3 hard copies with 4 Volumes as below:

- Volume I – Strategy, Actions and Operations
- Volume II – Data Directory
- Volume III – Annexures
- Volume IV – Oil Spill Modelling Report

Adani Vizhinjam Port Private Limited
2nd Floor, Vipanchika Tower, Thycaud
Thiruvananthapuram
Kerala-695014

www.adani.com
CIN -U61200GJ2015PTC083954
Registered Office: Adani House, Nr Mithakhali Circle, Navrangpura, Ahmedabad 380 009, Gujarat, India

Received three sets of LCP for Adani Port.
(CKL Arun)
Comdt.

Annexure VI

Compliance of Conditions of KCZMA Recommendation for EC/CRZ Clearance

Annexure VI

Half Yearly Compliance Report Of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
(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.	**Complied** 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 (CTE) No. PCB/HO/TVM/ICE/08/2015 dated 15.09.2015 valid up to 31.07.2018 was renewed from State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE-R/02/2018, dated 19.07.2018 valid up to 31/07/2023. • Airport Authority of India NOC vide NOC no AAI/SR/NOC/RHQ dated 7.12.2015 (Submitted along with the compliance report for the period October 2015 to March 2016). • As per the exemption granted by Government of Kerala (GoK) G.O. No. 310/2015/LSGD dated 01/10/2015, AVPPL is not required to obtain any further building permit/permission to construct port related building within the port premises.
(ii)	Since the project envisages development of roads, infrastructural facilities, dredging of the lake and kayals proper environmental safety measures must be ensured.	**Complied** All safety measures are being adopted. Full time Environment & Safety professionals are employed by AVPPL, contractors & subcontractors to oversee the implementation of environmental safety measures. Organizational Structure for Environment, Health, and Safety (EHS) & CSR for construction phase is enclosed as **Annexure XI**. All work plans are executed after assessing the defined EHS plans.

Half Yearly Compliance Report Of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		It is also submitted 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.	**Complied** CTE has been obtained from Kerala State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE/08/2015, dated 15.09.2015 valid up to 31.07.2018. Subsequently, the CTE was renewed vide Consent No. PCB/HO/TVM/ICE-R/02/2018 dated 19.07.2018 valid up to 31.07.2023.
(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.	**Not Applicable** There are no mangroves 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.	**Being Complied** As prescribed in EIA during construction stage, the contractors have been made responsible for management of Solid Waste. Necessary arrangement has been made for collection, segregation and disposal of Solid Waste as per Solid Waste Management Rules, 2016, as amended. A dedicated integrated solid waste management facility is planned which will be constructed along with project. • No solid waste is being disposed of in the CRZ area. • Currently no effluent is generated; domestic wastewater generated is treated in STP at labour camps and treated water is used for sprinkling within port area.
(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.	**Being Complied** NGT Expert committee and shoreline monitoring cell visited the site on 05.09.2019 and reviewed the compliance conditions of Environmental & CRZ Clearance on 05.09.2019 and 06.09.2019. All necessary facilities/support was extended to the officials during the

Half Yearly Compliance Report Of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		compliance review/site visit; and the same will be provided during any future planned inspection of the project site. Additionally, AVPPL meet regularly with Member Secretary & officials of KCZMA from time to time for suggestions and to apprise them of various project related work. Copy of half yearly Environmental & CRZ Clearance compliance report is being sent to KCZMA regularly. The same will be continued in future.
(vii)	The KCZMA may be duly informed of any construction/developmental works/major activities undertaken in the CRZ area of the project	**Complied** • Member Secretary KCZMA is also the member secretary of NGT appointed committee; the committee meets every six months to review the compliance of Environmental & CRZ Clearance. • Regular meetings are held with officials of KCZMA to appraise them on various project related activities. • Half yearly reports are being furnished to KCZMA including the details of the development works. Following construction activities have taken place during the compliance period April 2019 to September 2019: • No dredging was carried out during the compliance period from April 2019 to September 2019. The dredged material till 30.09.2019 amounting to 2.90 Mm^3 has been utilized for reclamation of 36 Ha area. The dredged material has been used for reclamation. • Piling (617 Nos.) and casting of pile muffs have been completed. • Boundary wall work has been initiated; but is on hold at various locations due to local issues • Work on following buildings are in progress:

Half Yearly Compliance Report Of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		○ Gas Insulated Substation (GIS) substation ○ Substation building (Inside port) ○ Port Operation Building ○ RMU buildings-yard ○ RMU buildings-berth ○ Workshop Building ○ Gate Complex ○ Driver Rest Room ○ DG Shed Building ○ Water Tank & Pump House ○ Security Building ○ PUB Building ○ Port Canteen • Storm water drain construction is in progress • Yard development works in progress: ○ Reefer structure foundation and structure erection ○ Compact sub-station, high mast foundation and erection, CRMG beam works ○ Firefighting pipeline laying ○ Paver block casting for yard development ○ Backup yard development • Port Access Road: Excavation/Rock Breaking, Construction of Electrical Pits, laying of Hume Pipe along with Retaining Wall are in progress from chainage 0 to 520 m work • Electrical Installation works are in progress
(viii)	Environmental clearance must be obtained from the Ministry of Environment & Forests.	**Complied** Environment & CRZ Clearance has been obtained from Ministry of Environment & Forest vide MoEF letter dated 03.01.2014 (F.No.11-122/2011-IA.III).
(ix)	An adequate financial provision has to be made for environmental protection measures.	**Complied** A total of Rs. 40 Crore has been set aside for environment protection measures as per the EIA report. Activity wise Fund Break up

Half Yearly Compliance Report Of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance		
S. No.	**Conditions**	**Compliance Status as on 30.09.2019**
		and expenditure during the compliance period April 2019 to September 2019 is attached as **Annexure X**.
(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 challan receipt in original be forwarded to the Science & Technology Department quoting this letter.	**Not Applicable** The condition is not applicable since the application for Environmental & CRZ clearance was submitted by Vizhinjam International Seaport Ltd. (VISL), a Government of Kerala undertaking.

Annexure VII

Compliance of the Response/Commitments made during Public Hearing

Annexure VII

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
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	**Being Complied** In consultation with the fishermen, enhanced livelihood compensation of Rs. 99.75 Cr was sanctioned by Government of Kerala (GoK), instead of Rs. 7.10 crores suggested earlier in the EIA stage. Out of this amount, Rs. 83.11 crores have been disbursed till 30.09.2019 for a total number of 2621 Livelihood Affected Persons (LAPs) whose verification was complete in all respects; this includes boat owners as well to whom kerosene is supplied free of cost during the port construction period. Verification of the documents of balance LAPs is in progress. Out of the 5 identified EMP areas, work has started in Port Site, Road/Rail Corridor and in PAF (Project Annex Facility)). Recommendations of the Construction stage EMP for these areas are being implemented and strict adherence to EMP compliance with all relevant rules and regulations is being done. Status of construction stage EMP in matrix format is enclosed as **Annexure VIII**.
2	Land under the Jamaath which includes Karimppaly, Magham, Varuthari Pally, etc. need to be protected and should not be acquired.	**Complied** These lands have not been acquired.
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.	**Complied** Compensation for all the procured land has been disbursed along with R&R package. Same policy will be followed for the remaining extent of land also.
4	Additional fish landing centre will be constructed	**Being Complied** The work for construction of the fish landing centre (Rs. 16.00 crores) and

Compliance of the Response/Commitments made during Public Hearing

S. No.	Responses/Commitments	Status as on 30.09.2019
		the fishery breakwater (Rs. 131.12 crores) has been initiated as part of the funded work component of the concession agreement with AVPPL. The EPC Contractor is finalising the design for the fishing berth and has mobilised the sub-contractor along with resources for construction of fishery harbour since March 2017, however, AVPPL is unable to start the construction activities. Fishing boats docked in the proposed area need to be removed before the commencement of work. GoK has initiated discussions with fishermen representatives for removal of the boats to facilitate construction work and these discussions are ongoing.
5	Existing harbour will be improved under the CSR provisions of the project	**Being Complied** Tenders for modernization of the existing fishing harbour was invited by Harbour Engineering Department (HED) and work awarded. However the works could not be initiated due to sectoral protests among different fishermen groups.
6	Fisherman will get first preference to cross the ship channel	**Will be Complied** 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.	**Being Complied** Shoreline monitoring for a stretch of 40 km (20 km on both sides of the project site) is being done and reports are being regularly submitted to MoEF&CC as a part of the half yearly compliance report. Report for the period April 2019 to September 2019 is enclosed as **Annexure I**. L&T Infrastructure Engineering Pvt. Ltd. (LNTIEL) had prepared the Mathematical Modelling Reports based on Shoreline Monitoring data; which

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
		were vetted by National Institute of Ocean Technology (NIOT). The 1st (for the period February 2015 to February 2017) and 2nd (March 2017 to February 2018) modelling reports had been submitted with the compliance report for the period April 2017 to September 2017 and April 2018 to September 2018 respectively. These mathematical modelling reports have affirmed that the shoreline change is in line with what was predicted as part of the EIA study. In continuation with the same practise Adani Vizhinjam Port Pvt. Ltd. (AVPPL) have submitted the shoreline data from March 2018 to February 2019 to LNTIEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. The Mathematical modelling report for the period March 2018 to February 2019 vetted by NIOT is given as **Annexure II**.
8	Water supply provision to the Vizhinjam fishing village	**Complied** Water Supply Scheme for provision to the local people has been commissioned in April 2013 by VISL by expending an amount of Rs. 7.30 crores. For Operation & Maintenance (O&M) of the same an amount of Rs. 5.20 crores has been spent till date. From 04.04.2019 onwards, O&M of the scheme is being done by Kerala Water Authority (KWA).
9	Construction of the new fishing harbour will be simultaneously completed with the port project	**Being Complied** Refer Point No. 4
10	Railway work will be initiated after Environment Clearance (EC)	**Complied** Konkan Railway Corporation Limited (KRCL) has been engaged as a consultant for turnkey execution of the project. Out of the total rail route length of 10.7 km, 9.0 km is planned to be

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
		passing through an underground tunnel to minimize the disturbance to the local population. Detailed Project Report (DPR) has been completed and has been submitted to Southern Railway for its approval. All the required clarifications have been provided to Southern Railways and the approval is expected shortly.
11	Job Opportunity - Preference will be given to local people during construction stage	**Being complied** Preference is being given to local people based on Skill & competency during the construction stage. Out of the total persons employed at site for different construction activities, 215 people are from Kerala and out of them 114 are from nearby wards of the project site.
12	Rehabilitation measures ensures employment opportunities for fishermen	**Being Complied** Refer point No. 1
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 Complied** Is being 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	**Being Complied** Refer point No. 1
15	Compensation, Resettlement and Rehabilitation benefits to all the livelihood affected and displaced fisherman will be implemented after the Environment Clearance	**Being Complied** Refer point No. 1
16	Waste management is included in the EMP and C&D waste management is part of the SWMP.	**Being Complied** Adequate budgetary provision has been kept for waste management as part of EMP as well as CSR. As mentioned in EIA, contractors have been made responsible for management

Compliance of the Response/Commitments made during Public Hearing		
S. No.	Responses/Commitments	Status as on 30.09.2019
		of Waste including waste from labour colony during the construction stage. All contractors working at site are following the waste management practices in line to waste management rules 2016, as amended. A dedicated integrated solid waste management facility is planned which will be constructed along with project. For solid waste management of local community 26 Thumboormozhi Aero Bins were installed under CSR. Three sanitation workers are engaged in each location by the Corporation to manage and monitor the Aero Bins. The roofing of Thumboormozhi having 10 Aerobins at Harbour ward has been initiated at a cost of Rs.10 lakhs. Once the work is completed, would support around 1000 families in the vicinity to dispose their organic waste. More than 20 cleaning campaigns had jointly organized with zonal health wing under CSR activities. In addition to this, through awareness classes, people of the local communities were educated about the swachhagraha programme on importance of segregation of solid waste and explained on maintaining a litter graph, personal hygiene, consumption, and waste management in their communities and houses.
17	Upgradation of PHC at Vizhinjam will be carried out	**Being Complied** The construction of new building at Community Health Centre (CHC), Vizhinjam is progressing and Upgradation with one floor and equipment's in the new building is being planned.

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
		The new building plan for CHC consists of basement, ground floor, first floor and second floor; wherein the cost for the construction of second floor would be met from the CSR of AVPPL-Adani Foundation. Almost 10% of works are completed. HED is executing and monitoring the work; who in turn entrusted to another contractor. The total project cost is Rs. 7.79 crore out of which Rs. 2.97 crore will be contributed by Adani Foundation and the first instalment for the construction activities agreed of Rs. 1.18 crore has already been paid for the project to Harbour Engineering Department.
18	New fishing harbour with all the infrastructural facilities will be constructed with reserved rights to mooring/berthing the boats	**Being Complied** Refer point No. 9
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	**Being Complied** Based on G.O.(Rt) No.2021/2017/RD dated 27.04.2017 and modified by G.O.(Rt) No.17/2018/F&PD dated 09.06.2018, government ordered to pay compensation for land and not for the structures since they were in violation of CRZ notification. Action in this respect is being taken and an area of 72.79 Ares is acquired up to 30.09.2019.
20	Rail, Road, Coastal and Inland Waterways connectivity will be ensured to the rest of Kerala and other Indian Peninsula Ports	**Being Complied** 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	**Noted for Compliance**
22	Shoreline monitoring on 15 km both	**Being Complied**

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
	sides on regular basis during construction and operation as suggested in EIA report will be carried out	Refer point No. 7
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** No dredging was carried out during the compliance period from April 2019 to September 2019. The dredged material till 30.09.2019 amounting to 2.90 Mm^3 has been utilized for reclamation of 36 Ha area. The dredged material has been used for reclamation. Dredging and reclamation will resume once fair weather prevails from October/November 2019. Turbidity buoys at 3 locations identified by NIOT had been deployed and continuous monitoring was carried out to assess the real time turbidity till 31.05.2019. Due to change in contractor and due to rough sea conditions during the monsoon period, the turbidity buoys were not deployed from 01.06.2019 till end of the compliance period; i.e. 30.09.2019. Continuous real time turbidity monitoring will be resumed after monsoon. Turbidity results for the months of April 2019 and May 2019 are comparable with baseline.
24	Appropriate measures relating to maintenance of health, hygiene, safety and security will be implemented as per EIA report	**Being Complied** Appropriate institutional mechanism for maintenance of health, hygiene, safety, security has been put in place. 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, Horticulture. In addition to the above, independent environment, health

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
		and safety consultants have been appointed as required in the concession agreement signed with AVPPL. Organizational Structure for Environment, Health, and Safety (EHS) & CSR for construction phase is enclosed as **Annexure XI**. It is also ensured that contractors working at site also deploy EHS professional to implement suggested EMP measures. Proper provisions for maintenance of health, hygiene, safety, security for workforce in labour colony has also been provided/ ensured.
25	VISL will ensure that livelihood issues of Mussel collectors are addressed as per the EIA report	**Being Complied** Government Orders have been issued for disbursal of Rs. 12.65 Crore for 271 mussel collectors. Till date 261 Mussel collectors have collected the compensation amount totalling to Rs. 12.34 Crore. Although they were offered alternate livelihood plan through cage fishing they opted for one time settlement citing the risks involved in such fishing.
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** AVPPL had awarded the work to Kerala State Remote Sensing and Environment Centre (KSREC) to undertake study on Groundwater impact due to construction of port approach road. KSREC has submitted the final report with certain recommendations on 01.04.2019. Port Access Road works are in progress. The Konkan Railway Corporation Limited (KRCL) has been engaged as a consultant for turnkey execution of the project. Out of the total rail route length of 10.7 km, 9.0 km is planned to be

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
		passing through an underground tunnel to minimize the disturbance to the local population. Detailed Project Report (DPR) has been completed and has been submitted to Southern Railway for its approval. Comments from Southern Railway have been received and replies to the comments for further needful was submitted to Southern Railway for resolution. Awaiting DPR approval. CSR activities are detailed in **Annexure III**. Status of construction stage EMP in matrix format is enclosed as **Annexure VIII**.
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** Refer point 24 above. Regular monitoring of Environment Parameters are being carried out. Detailed Monitoring Reports for the period April 2019 to September 2019 is enclosed as **Annexure IV**. Half yearly compliance reports are submitted to all regulatory authorities concerned. Six monthly reports on the status of compliance of the stipulated clearance conditions including results of monitored data are regularly submitted to all the concerned agencies. The Half Yearly Compliance Report for the period October 2018 to March 2019 has been submitted to the MoEF&CC, Regional Office (Bangalore), Zonal office of the CPCB (Bangalore), KSPCB & KCZMA vide letter No. VISL/2016-17/EE&EI-19/176 dated 27.05.2019 in hard copy as well as through email on 27.05.2019 (**Annexure XII**).
28	Special care will be taken to minimise the tree felling in the	**Being Complied** Being complied with the extent

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
	backup area and to plan the development in tune with the topography.	possible, but in line with the technical requirements of the project. Due permission is taken for the same from concerned department (Forest Department). For carrying out compensatory afforestation in lieu of the trees felled, AVPPL in collaboration with forest department has carried out afforestation on 12 Ha land in Sainik School, Trivandrum.
29	The livelihood restoration measures for fishermen affected during construction phase as reported in the EIA has to be implemented	**Being Complied** Refer point No. 1 and point No. 25
30	Dredging materials will be used for reclaiming (filling) the sea and additional materials are not required	**Being Complied** No dredging was carried out during the compliance period from April 2019 to September 2019. The dredged material till 30.09.2019 amounting to 2.90 Mm^3 has been utilized for reclamation of 36 Ha area. The dredged material has been used for reclamation. Dredging and reclamation will resume once fair weather prevails from October/November 2019.
31	The number of fishermen who will be temporarily affected in the Adimalathura stretch have been assessed and livelihood restoration measures have been framed for the construction period	**Being Complied** Earlier it was proposed that the fishermen at Adimalathura will be compensated for the construction period of three years, treating them as temporarily affected. However based on the request of the fishermen (stating that demarcation of the shipping channel and movement of ships would affect them permanently) their compensation has been enhanced considering seven years of livelihood loss. The GoK order to this effect has been issued on 31.05.2018 and compensation has been disbursed to 598 eligible fishermen amounting to a total of Rs. 35.03 Crore. Verification of

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
		the document of balance fishermen is in progress.
32	There will be no erosion on the shoreline on account of dredging the deep sea at (-) 18m to (-) 20m	**Being Complied** Refer Point No. 7
33	An Area Development Plan (ADP) is being prepared by CEPT University (Ahmedabad) for planned development of the region to avoid haphazard development.	**Being Complied** The final Integrated Area Development Plan prepared through CEPT university, in consultation with Town Planning, Tourism, Industry and other line departments was reviewed by the expert committee constituted by GoK. The Master Plan will be forwarded to Joint Planning Committee (JPC) for further action.
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** During 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	**Being Complied** Refer point No. 4
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.	**Being Complied** Details of CSR activities carried out during the compliance period are given in **Annexure III**. Refer point 33 above for area

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
		development plan.
37	"Inconvenience Allowances" during construction period of three years to the fisherman (As per EIA Report)	**Being Complied** An amount of Rs. 27.18 Crores have been sanctioned by the GoK as inconvenience allowance in the form of kerosene in November 2017. Rs. 12.48 Crore has been given till 30.09.2019 to the disbursal agency identified for the work.
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	**Complied** Compensation for livelihood loss; Rs 6.08 Crores out of allocated 6.11 Crores has been disbursed to 211 out of 211 number of resort workers and settled completely.
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.	**Will be Complied** Refer point No. 31.
40	Ensure that all EMP related aspects are properly implemented during construction and operational phase	**Being Complied** As the project is in construction stage, construction stage EMP is being implemented. Operation stage EMP will be implemented during operation stage. Refer **Annexure VIII** for status of Construction stage EMP.
41	A dedicated port road directly connecting to NH-47 bypass is envisaged.	**Being Complied** This is part of the concession agreement signed with AVPPL and is in the process of being developed.
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** Refer point No. 26
43	The port project will not affect the inflow of Neyyar river and AVM canal	**Noted for Compliance** Not affected, since both are away from the project site.

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
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	**Will be Complied** 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	Where ever possible and based on eligibility, local people will be employed	**Will be Complied** Refer Point No. 11
46	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	**Being Complied** Being complied on a routine basis through HED; the maintenance agency for the fishing harbour and the coastal road network.
47	The development of the warehouse area will be taken up	**Will be Complied** This is part of the proposed port estate development.
48	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	**Will be Complied** Refer point No. 1 Refer point No. 31
49	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 employed based on their merit. However during construction period the EIA study has suggested to adequately employ local population to the maximum extent possible	**Being Complied** Additional Skill Acquisition Program (ASAP) is a GoK initiative aimed at imparting skill courses to students to improve their employability. No Objection Certificate (NoC) has been granted to ASAP to proceed with the construction of a Community Skill Park (CSP) in the 1.5 acres of land. The land has been identified with an approximate cost being Rs. 3.5 Crore. The upcoming CSP is planned to conduct various training programs which will help in providing skilled workforce for filling up the various job roles that would arise

Compliance of the Response/Commitments made during Public Hearing		
S. No.	Responses/Commitments	Status as on 30.09.2019
		with the operation of the port. Preference is being given to local people based on Skill & competency during the construction stage. Out of the total persons employed at site for different construction activities, an average of 212 people are from Kerala and 111 out of them are from nearby wards from the project site.
50	Loss of livelihood to the traditional fishermen 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.	**Being Complied** Refer point No. 25
51	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.
52	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.	**Being Complied** GoK notified the limits of the Vizhinjam International Deepwater Multipurpose Seaport and altered the limits of the existing Vizhinjam Port (Vizhinjam Fishing harbour) vide G.O. (P) No. 22/2019/F&D dated 21.05.2019. Restrictions on fishing will be as per the applicable laws.
53	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.	**Noted**

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2019**
54	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.	**Being Complied** Refer Point 32
55	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	**Being Complied** Refer point No. 19
56	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	**Noted for Compliance** 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.
57	CSR activity considers training the local people to adapt to the new economic development of the area	**Being Complied** Refer point No. 50

Annexure VIII

Status of Environment Management Plan

Annexure VIII

Status of Environment Management Plan-Port Site-Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
1	Capital dredging	Marine water quality Marine ecology	○ 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	Being Compiled ○ No dredging was carried out during the compliance period from April 2019 to September 2019. The dredged material till 30.09.2019 amounting to 2.90 Mm3 has been utilized for reclamation of 36 Ha area. The dredged material has been used for reclamation. ○ Turbidity buoys at 3 locations identified by NIOT had been deployed and continuous monitoring was carried out to assess the real time turbidity till 31.05.2019. Due to change in contractor and due to rough sea conditions during the monsoon period, the turbidity buoys were not deployed from 01.06.2019 till end of the compliance period; i.e. 30.09.2019. Continuous real time turbidity monitoring will be resumed after monsoon. ○ Dredging Management plan has been prepared ○ Discharge of waste into sea is prohibited ○ Work has been awarded to M/s. KITCO for developing a facility Level Oil Spill Response Plan (OSRP) In line with the

Status of Environment Management Plan-Port Site-Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
				National Oil Spill-Disaster Contingency Plan (NOS-DCP) requirements. The Final ORSP for Vizhinjam Port was submitted to Indian Coast Guard (ICG) for approval on 24.09.2019. The submission letter is enclosed as **Annexure V**. ○ Marine Environmental Monitoring at 5 locations as per the Environment Monitoring Plan prescribed in EIA has commenced since August 2016, one additional marine water monitoring location has been added from October 2017 after suggestion from NGT committee and the parameters are within permissible limits. ○ Six monthly monitoring reports are regularly submitted to regulatory authorities as a part of Environmental & CRZ clearance compliance.
2	Material transport and construction activities	Air Quality	○ 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 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.	**Being Complied** ○ Trial run of rock placing for breakwater construction was initiated using the stones brought through barges from nearby harbours. ○ It is ensured that all vehicles entering the Port have a valid PUC certification ○ Adequate sized construction yard has been provided for storage of construction

Status of Environment Management Plan-Port Site-Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
			○ 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 ○ 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	materials, equipment tools, earthmoving equipment, etc. ○ The dumpers have speed governors ensuring adherence to speed limit ○ Signage for speed control are displayed inside port area ○ Water sprinkling is carried out for supressing dust ○ It is ensured that all trucks transporting material are covered by tarpaulin. ○ Regular awareness programme on various Environment aspects is being imparted to workers and employees.
		Noise	○ Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB	**Being Complied** ○ Noise levels are being monitored every fortnight and are found to be well within

Status of Environment Management Plan-Port Site-Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
			○ 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 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	the permissible limits within the project area. ○ Contractors are also monitoring the Noise level in their work area and results are within the stipulated limits. ○ Protective gear like earplugs, muffs are provided to workers exposed to noise level beyond threshold limits.
		Disturbance to Natural Drainage pattern	○ Port development is mostly on reclaimed land ○ Rainwater/surface water harvesting pond included in design ○ Existing drainage near port boundary (backup area) will be integrated with port storm water	**Being Complied** ○ 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.

Status of Environment Management Plan-Port Site-Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
			drainage & management plan o 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	o A study has been conducted to access the rainwater harvesting potential and recommend for planning and implementation of rainwater harvesting structures within the proposed sites for the sustainable development of existing groundwater resources o Provision for installing Sewage Treatment Plant (STP) facility of adequate capacity in phased manner is being planned and will be implemented in line to CRZ Notification along with the commissioning of the project in consultation with KSPCB. The process of finalizing a contractor for detailed engineering and construction of the STP is underway. AVPPL had submitted relevant documents including Location Plan, Process, Design, Capacity, Layout and other details to KSPCB seeking approval from the board as per the CTE obtained for the project; awaiting approval of the proposed STP scheme from KPSCB. o No work has started in warehouse area and drains/streams passing through the area are not closed/ diverted.
		Vegetation and Strain on existing	o Port development is planned mostly on reclaimed land;	**Being Complied** o Care is taken to limit the felling of trees to

Status of Environment Management Plan-Port Site-Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
		infrastructure	○ Land use at backup area, PAF Zone and warehouse area will be mostly coconut 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.	the bare minimum. Plantation of saplings along the road margins, road medians and port boundary are planned as part of the master plan development. ○ Temporary Worker camp has been provided with all necessary infrastructure facilities (Water, Electricity, Sanitation, Fuel, etc.)
		Existing Traffic	○ 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	**Being Complied** ○ Traffic monitoring & regularization is being carried out for maximum efficiency. ○ Trial run of rock placing for breakwater construction was initiated using the stones brought through barges from nearby harbours. ○ Konkan Railway Corporation Limited (KRCL) has been engaged as a consultant for turnkey execution of the project. Out of the total rail route length of 10.7 km, 9.0 km is planned to be passing through an underground tunnel to minimize the disturbance to the local population. Detailed Project Report (DPR) has been completed and has been submitted to Southern Railway for its approval. All the required clarifications have been provided to Southern Railways and the approval is

Status of Environment Management Plan-Port Site-Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
				expected shortly.
3.	Land Reclamation	Existing Water Resources like Groundwater and surface water	○ Land to be reclaimed will be separated from adjoining land by creating containment bund. ○ Return sea water will be sent back to sea through appropriate channels.	**Being Complied** ○ No dredging was carried out during the compliance period from April 2019 to September 2019. The dredged material till 30.09.2019 amounting to 2.90 Mm^3 has been utilized for reclamation of 36 Ha area. The dredged material has been used for reclamation. Dredging and reclamation will resume once fair weather prevails. ○ During dredging return sea water is sent back to sea through appropriate channels. ○ The existing drains are maintained for unhindered disposal of surface drainage water.
4.	Solid Waste Management	Soil quality	○ 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.	**Being Complied** ○ Construction waste is used within port site for filling of low lying areas in line to C&D Waste Management Rules 2016, as amended. ○ No burning of refuse at construction sites is being done. ○ Contractors working at the site have been made responsible for management of Solid Waste during construction stage. They are complying with the provisions pertaining to management of Solid Waste in line to Solid

Status of Environment Management Plan-Port Site-Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
			○ Burning of refuse at construction sites will be prohibited. ○ All control measure will be taken to avoid the contamination of groundwater during construction phase	Waste Management Rules 2016, as amended. ○ 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	○ 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 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.	**Being Complied** ○ Adequate safety measures as per OSHA standards are adopted as and when necessary as per the HSE Plan. ○ Construction site is being secured by fencing with controlled/limited entry points. ○ Medical facilities including first aid are available for attending to injured workers. Ambulance is also available at site for shifting the injured to the nearby hospitals. ○ Handling and storage is as per statutory guidelines. ○ Hazardous waste is disposed through approved KSPCB/CPCB vendors.
6.	Water Resources	Water scarcity / Pollution	○ Water requirement during the construction is expected to be around 0.10 MLD	**Being Complied** ○ A 3.00 MLD water supply scheme for the

Status of Environment Management Plan-Port Site-Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
			○ 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	project had been commissioned with the source of water being Vellayani Lake whose raw water will be available for treatment. The net availability of treated water from this supply scheme is 2.49 MLD of potable water out of which 1.49 MLD of water shall be distributed to the local people as part of social welfare measures of VISL. The balance 1.0 MLD would be used for port related activities. However, at present, the entire treated water from the scheme is being utilised by the community. Due to this reason, the water for construction purposes for the port is being sourced from the open market/private suppliers. ○ On an average about 148 KLD of water is being consumed for construction related activities.
7.	Fishing	Fishermen and fishing villages	○ Signboards will be placed at the 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	**Being Complied** ○ Signboards have been placed for demarcation of construction area. ○ Using the technological advancement the dedicated CSR team of AVPPL are in constant touch with the fishermen/fishing community members to facilitate the flow of various project related information/updates.

Status of Environment Management Plan-Port Site-Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
				○ AVVPL CSR team also provides regular updates to the committee which has been formed by the local church representatives adjoining to the port area, who in turn pass on port project execution information to the fishermen.
8.	Tourism	Effect on tourism	○ 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. ○ 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	**Being Complied** ○ The tourism activity in the nearby Kovalam area is not impacted by the construction of the port. ○ Shoreline monitoring for a stretch of 40 Km (20 Km on both sides of the project site) is being done and reports are regularly submitted to regulatory authorities. ○ 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 ○ Based on G.O. (Rt) No.2021/2017/RD dated 27.04.2017 and modified by G.O.(Rt)

Status of Environment Management Plan-Port Site-Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
				No.17/2018/F&PD dated 09.06.2018, government ordered to pay compensation for land and not for the structures since they were in violation of CRZ notification. Action in this respect is being taken and an area of 72.79 Ares is acquired up to 30.09.2019.
9	Breakwater	Change in shoreline	○ Shoreline monitoring shall be carried out ○ Suitable Shoreline protection measures will be implemented based on the observations	**Being Complied** Comprehensive Shoreline Monitoring is being carried out under the technical Guidance of NIOT and Six monthly monitoring reports are being submitted regularly as part of EC & CRZ Compliance. The existing Shoreline Monitoring arrangement consists of: ○ Cross Shore Beach Profiling perpendicular to the shoreline 20 KM on either side of the port at 500 m intervals which includes bathymetry survey up to CD -10 and landside survey up to HTL + 100 m and photographic documentation of morphological changes, seasonal beach sediment sampling and analysis at 81 locations, bathymetry survey of 40 km x 15 km twice in a year, monthly monitoring of littoral zone, seabed sediment sampling per sq.km in 80 sq.km, current

Status of Environment Management Plan-Port Site-Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
				measurement with ADCP at four locations for 3 seasons, tide measurement, continuous wave measurement by wave rider buoy, water sampling and analysis, continuous turbidity monitoring at 3 locations, bathymetry and cross section survey of 6 rivers debouching into the sea in 40 Km stretch study area, continuous weather monitoring by Automatic Weather Station. ○ LNTIEL had prepared the Mathematical Modelling Reports based on Shoreline Monitoring data; which were vetted by NIOT. The 1st (for the period February 2015 to February 2017) and 2nd (March 2017 to February 2018) modelling reports had been submitted with the compliance report for the period April 2017 to September 2017 and April 2018 to September 2018 respectively. These mathematical modelling reports have affirmed that the shoreline change is in line with what was predicted as part of the EIA study. ○ In continuation with the same practice AVPPL have submitted the shoreline data

Status of Environment Management Plan-Port Site-Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
				from March 2018 to February 2019 to LNTIEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. The Mathematical modelling report for the period March 2018 to February 2019 vetted by NIOT is given as **Annexure II**.
10	Effect on existing fishing harbour	Movement of fishing boats	o 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 o Traffic of Marine vessel/ fishing boats will be planned without affecting each other o Adoption of fishing harbour to manage it to perform as per International standard o A new fishing harbour provided under CSR initiatives because of additional tranquillity creator. o Loss of livelihood will be either taken care of in the new port premises or adequately compensated mostly in the form of employment	**Being Complied** o 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 has been further evaluated. o LNTIEL had prepared the Mathematical Modelling Reports based on Shoreline Monitoring data; which were vetted by NIOT. The 1st (for the period February 2015 to February 2017) and 2nd (March 2017 to February 2018) modelling reports had been submitted with the compliance report for the period April 2017 to September 2017 and April 2018 to September 2018 respectively. These mathematical modelling reports have affirmed that the shoreline change is in line with what was predicted as part of the EIA study.

Status of Environment Management Plan-Port Site-Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
				○ In continuation with the same practice AVPPL have submitted the shoreline data from March 2018 to February 2019 to LNTIEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. The Mathematical modelling report for the period March 2018 to February 2019 vetted by NIOT is given as **Annexure II**. ○ During operation phase traffic of Marine vessel/fishing boats will be planned without affecting each other ○ The work for construction of the fish landing center (Rs. 16.00 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. The EPC Contractor is finalising the design for the fishing berth and has mobilised the sub-contractor along with resources for construction of fishery harbour since March 2017. Fishing boats docked in the proposed area need to be removed before the commencement of work. GoK has initiated discussions with fishermen representatives for removal of

Status of Environment Management Plan-Port Site-Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
				the boats to facilitate construction work and these discussions are ongoing. ○ In consultation with the fishermen, enhanced livelihood compensation of Rs. 99.75 Cr was sanctioned by Government of Kerala (GoK), instead of Rs. 7.10 crores suggested earlier in the EIA stage. Out of this amount, Rs. 83.11 crores have been disbursed till 30.09.2019 for a total number of 2621 Livelihood Affected Persons (LAPs) whose verification was complete in all respects; this includes boat owners as well to whom kerosene is supplied free of cost during the port construction period. Verification of the documents of balance LAPs is in progress.
11	Shoreline changes	erosion/accretion	Final shoreline Impact management plan will be prepared in consultation with agencies like CESS/INCOIS, NGO and local bodies and will implemented.	**Being Complied** ○ NIOT has been engaged to give technical advice on aspects related to shoreline monitoring & shoreline evolution. ○ Comprehensive Shoreline Monitoring is being carried out under the technical Guidance of NIOT and six monthly monitoring reports are being submitted regularly as part of EC & CRZ Compliance. ○ Wave, current and tide data are being

Status of Environment Management Plan-Port Site-Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
				monitored a 40 km stretch. ○ LNTIEL had prepared the Mathematical Modelling Reports based on Shoreline Monitoring data; which were vetted by NIOT. The 1st (for the period February 2015 to February 2017) and 2nd (March 2017 to February 2018) modelling reports had been submitted with the compliance report for the period April 2017 to September 2017 and April 2018 to September 2018 respectively. These mathematical modelling reports have affirmed that the shoreline change is in line with what was predicted as part of the EIA study. ○ In continuation with the same practice AVPPL have submitted the shoreline data from March 2018 to February 2019 to LNTIEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. The Mathematical modelling report for the period March 2018 to February 2019 vetted by NIOT is given as **Annexure II**.

Environmental Management Plan – Rail*/Road# Corridors
***No Construction work was carried out during the compliance period; #Minimal work had taken place during the compliance period**

S. No.	Environmental Impacts and Issues	Mitigation Measures	Status as on 30.09.2019
1	Environmental Management and Monitoring Facility Equipment for EMP (Meters, Vehicles and Buildings)	This will include institutional requirements, training, environmental management and monitoring. Provision for purchasing required equipment.	**Noted for Compliance** ○ 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. Organizational Structure for Environment, Health, and Safety & CSR for construction phase is enclosed as **Annexure XI**. ○ Necessary equipment will be purchased. ○ Third party environmental monitoring has commenced since August 2016 and the monitoring results are satisfactory.
2	Altered Road embankment	Retaining walls and gabions should be provided	**Noted for Compliance** ○ AVPPL had awarded the work to Kerala State Remote Sensing and Environment Centre (KSREC) to undertake study on Groundwater impact due to construction of port approach road. KSREC has

Environmental Management Plan – Rail*/Road# Corridors
***No Construction work was carried out during the compliance period; #Minimal work had taken place during the compliance period**

S. No.	Environmental Impacts and Issues	Mitigation Measures	Status as on 30.09.2019
			submitted the final report with certain recommendations on 01.04.2019. ○ Suitable mitigation measures as suggested in the KSREC report will be adopted during construction.
3	Dust	○ 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.	**Will be Compiled**
4	Air Pollution	○ Vehicles and machinery are to be maintained so that emissions conform to National and State standards. ○ All vehicles and machineries should obtain Pollution Under Control Certificates (PUC).	**Being Complied** ○ Ambient air quality monitoring is carried out at 5 locations as per the Environment Monitoring Plan prescribed in EIA and has commenced since August 2016, the results obtained are within the limits prescribed by National Ambient Air Quality Standards (NAAQS) ○ It is ensured that all vehicles entering port have Pollution Under Control (PUC) Certificate.
5	Noise	○ Machinery and vehicles will be maintained to keep their noise to a minimum. ○ Construction of noise barriers of an average length of 100m and eight feet height wherever	**Being Compiled** ○ All the machinery and vehicles are maintained to keep the noise at minimum ○ Noise monitoring is being done since

Environmental Management Plan – Rail*/Road# Corridors *No Construction work was carried out during the compliance period; #Minimal work had taken place during the compliance period			
S. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Status as on 30.09.2019**
		necessary. o Proper maintenance of the rail track and rail wagon, by frequent lubrication to avoid frictional noise. o Regular monitoring shall be carried out as per the Environmental Monitoring Plan.	August 2016, and the readings are within the limits at port site o Regular monitoring of ambient Noise is carried out since August 2016 as per the Environmental Monitoring Plan prescribed in EIA and results are within the prescribed limit at port site.
6	Loss of low lying land and ponds	o Impacted ponds can be enhanced by constructing bridged structures like Gabions to avoid plugging of springs. o Mitigation/Compensation shall be affected for the completely impacted ponds. o 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.	**Will be complied** o AVPPL had awarded the work to Kerala State Remote Sensing and Environment Center (KSREC) to undertake study on Groundwater impact due to construction of port approach road and also suggest mitigation measures. o For impacted ponds in road alignment suitable mitigation measure as suggested in the KSREC report will be adopted during construction. o Konkan Railway Corporation Limited (KRCL) has been engaged as a consultant for turnkey execution of the project. Out of the total rail route length of 10.7 km, 9.0 km is planned to be passing through an underground tunnel to minimize the disturbance to the local population. Detailed Project Report (DPR) has been completed and has been submitted to Southern Railway for its approval. All the

Environmental Management Plan – Rail*/Road# Corridors *No Construction work was carried out during the compliance period; #Minimal work had taken place during the compliance period			
S. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Status as on 30.09.2019**
			required clarifications have been provided to Southern Railways and the approval is expected shortly. Railway is to be developed by VISL.
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.	**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 on water quality. ○ 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.	**Will be Complied**
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.	**Will be Complied**
10	Borrow pits	Borrow pits are to be identified, opened and closed after consultations and proper documentation.	**Will be Complied as and when required**
11	Quarrying and Material sources	○ Quarrying will be carried out at approved and licensed quarries only.	**Will be Complied** The road constructed so far has been made with material available on site.
12	Soil Erosion and Soil Conservation	○ On slopes and other suitable places along the two proposed corridors, trees and grass should be	**Will be Complied**

Environmental Management Plan – Rail*/Road# Corridors
***No Construction work was carried out during the compliance period; #Minimal work had taken place during the compliance period**

S. No.	Environmental Impacts and Issues	Mitigation Measures	Status as on 30.09.2019
		planted. ○ 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.	
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.	**Will be Complied**
14	Compaction of Soil and Damage to Vegetation	Construction vehicles should operate within the Corridor of Impact avoiding damage to soil and vegetation.	**Will be 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.	**Being Compiled** ○ 12,05 Ha of land was identified by forest department to carry out compensatory afforestation activities (at an aerial distance of 24 km from project site). AVPPL in collaboration with forest department has carried out afforestation on 12 Ha land in Sainik School, Trivandrum.
16	Vegetation clearance	Tree clearing within the ROW should be avoided beyond that which is directly required for construction activities and/ or to reduce accidents.	**Will be complied** ○ Special care is taken to minimize the tree felling to the extent possible, but in line

Environmental Management Plan – Rail*/Road# Corridors *No Construction work was carried out during the compliance period; #Minimal work had taken place during the compliance period			
S. No.	Environmental Impacts and Issues	Mitigation Measures	Status as on 30.09.2019
		Especially in plantation and house garden areas both along road and rail alignment.	with the technical requirements of the project. Due prior permission is taken for tree felling from Forest Department.
17	Fauna	Construction workers should protect natural resources and animals. Hunting of birds and other local animals is prohibited.	**Being Complied** ○ Construction workers are housed in labour camp near the project site and are provided with all the basic amenities such as drinking water, proper sanitation, canteen etc. Regular awareness sessions are conducted for the construction workers regarding importance of natural resources and animals. ○ Hunting of birds & other local animals is strictly prohibited
18	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.	**Will be Complied**
19	Health and Safety	All contractors' staff and workers must wear high visibility purpose made overalls or trousers/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.	**Being Compiled** ○ All the workers are provided with Personal Protective Equipment's (PPE) and it is ensured that they wear it all the time ○ Also all the contractors working at site have a dedicated health and safety person to oversee the work carried out.
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.	**Will be Complied**
21	Cultural Remains	Construction should be stopped until authorised	**Will be Complied**

Environmental Management Plan – Rail*/Road# Corridors *No Construction work was carried out during the compliance period; #Minimal work had taken place during the compliance period			
S. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Status as on 30.09.2019**
		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.	

Environment Management Plan – Warehouse Area (Construction Phase)

***Minimal work was carried out in Warehouse area during compliance period**

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
1	Material transport and construction activities	Air Quality/Dust	○ 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 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.	**Complied** ○ Monthly Environment Monitoring is being carried out and all the parameters are within the stipulated limit ○ It is ensured that all vehicles entering the area have a valid PUC certification ○ It is ensured that all the vehicles entering the site are following speed limit ○ Tarpaulin cover is used in vehicles

Environment Management Plan – Warehouse Area (Construction Phase)

***Minimal work was carried out in Warehouse area during compliance period**

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
			○ 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 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.	**Complied** ○ Ambient Noise is being monitored fortnightly for Day & Night time and results are within the prescribed limit. Construction equipment machinery procurement is done in accordance with specifications conforming prescribed standard. Personnel engaged in construction activity are provided with appropriate PPE's (Earplugs/muffs)

Environment Management Plan – Warehouse Area (Construction Phase)

***Minimal work was carried out in Warehouse area during compliance period**

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
			○ 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	○ 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.	**Will be Complied** At present no trees are cut in the warehouse area
		Water Environment	○ 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 the stream through the boundary ○ An application has been filed with the irrigation department for permission.	**Will be Complied** Will be appropriately planned in consultation with the concerned departments
			○ The low lying area in the region is already made use by the local people, and has been degraded.	**Will be Complied** Will be appropriately planned in consultation with the concerned

Environment Management Plan – Warehouse Area (Construction Phase)

***Minimal work was carried out in Warehouse area during compliance period**

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
			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. o Filling of low lying areas (if required) shall be done	departments
			o 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.	**Will be Complied**
		Disturbance to Natural Drainage pattern	o As mentioned above, formidable measures will be taken to avoid the disturbance to the natural flow of water. If some structure or building comes in the way of the existing flow of water, the flow will be redirected to the closest stream in the drainage pattern. o 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.	**Will be Complied**

Environment Management Plan – Warehouse Area (Construction Phase)

***Minimal work was carried out in Warehouse area during compliance period**

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
			○ 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 EMP.	
		Existing Traffic	○ 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.	**Will be Complied**
3	Solid Waste Management	Soil quality	○ 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. ○ 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.	**Will be Complied**

Project Annex Facility (PAF) Zone - Construction Phase
***Construction work was carried out in a limited way during the compliance period in PAF Zone**

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
1	Material transport and construction activities	Air Quality/Dust	○ 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 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.	**Complied** ○ Monthly Environment Monitoring is being carried out and all the parameters are within the stipulated limit ○ It is ensured that all vehicles entering the area have a valid PUC certification ○ Vehicles entering the site have are following speed limit ○ Tarpaulin cover is used for vehicles transporting the construction material ○ Water sprinkling is carried out on the temporary roads by contractors ○ Environment awareness program is provided to the personnel engaged in development work

Project Annex Facility (PAF) Zone - Construction Phase *Construction work was carried out in a limited way during the compliance period in PAF Zone				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
			○ 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 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.	**Complied** ○ Ambient Noise is being monitored fortnightly for Day & Night time and results are within the prescribed limit. Construction equipment machinery procurement is done in accordance with specifications conforming prescribed standard. Personnel engaged in construction activity are provided with appropriate PPE's (Earplugs/muffs)

Project Annex Facility (PAF) Zone - Construction Phase *Construction work was carried out in a limited way during the compliance period in PAF Zone				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
			○ High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am to 10 pm) 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	
2	Construction of Buildings, Roads, Parking features, etc.	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** Will be complied alongside the road and port boundaries.
		Existing Traffic	○ 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**

Project Annex Facility (PAF) Zone - Construction Phase *Construction work was carried out in a limited way during the compliance period in PAF Zone				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
		Solid Waste	○ 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 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.	**Will be Complied**

BACK UP AREA – Construction Phase *Construction of buildings has commenced in reclaimed area during the compliance period				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
1	Material transport and construction activities	Air Quality	○ 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 ○ 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	**Being Complied** ○ Ambient air quality monitoring is carried out at 5 locations as per the Environment Monitoring Plan prescribed in EIA and has commenced since August 2016, the results obtained are within the limits prescribed by National Ambient Air Quality Standards (NAAQS) ○ It is ensured that all vehicles entering the port have Pollution Under Control Certificate (PUC) ○ Water sprinkling was carried out at regular interval over the temporary road during transportation of cut material. ○ All the trucks transporting material are covered by tarpaulin cover. ○ Signage's for speed control are placed within the port area ○ Adequate storage for construction material is provided within the port area on reclaimed land ○ Environmental awareness program was

BACK UP AREA – Construction Phase *Construction of buildings has commenced in reclaimed area during the compliance period				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2019**
				carried out for contractors working at site.
		Noise	○ 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 minimise noise impacts ○ Personnel exposed to noise levels beyond threshold limits will be provided with protective	**Being Compiled** ○ All the machinery and vehicles are maintained to keep the noise at minimum ○ Regular Noise monitoring is being carried since August 2016, and the readings are within the limits at port site ○ At present only building work has commenced in limited way and barriers will be installed where ever necessary in future ○ Regular monitoring of ambient Noise is carried out since August 2016 as per the Environmental Monitoring Plan prescribed in EIA

BACK UP AREA – Construction Phase
***Construction of buildings has commenced in reclaimed area during the compliance period**

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
			gear like earplugs, muffs, etc. ○ Ambient noise levels will be monitored at regular intervals	
2	Construction Activities	Water Environment	○ Formation level should be raised according to the design and the cross drainage structures suitably planned for the flood events. ○ All justifiable measures will be taken to prevent the wastewater produced during construction from entering directly into the water bodies.	**Being Compiled** ○ The contractors working at site have obtained separate consent from KSPCB for their batching plant and they have constructed settling pond for wash water generated. ○ No wash water is disposed into the water bodies.
		Land Environment	○ On slopes and other suitable places along the two proposed corridors, trees and grass should be planted. ○ 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.	**Will be Complied**
			○ Arable land should not be used for topsoil borrowing. ○ Topsoil will be kept and reused after excavation is	**Will be Complied**

BACK UP AREA – Construction Phase
***Construction of buildings has commenced in reclaimed area during the compliance period**

S. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2019
			over. ○ Any surplus to be used on productive agricultural land.	
			○ Construction vehicles should operate within the Backup Areas avoiding damage to soil and vegetation.	Will be complied alongside the road and port boundaries
			○ 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.	Refer point No.15 of Environment Management Plan – Road/Rail Corridors
			○ 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

Annexure IX

Submission Letter to KSPCB regarding additional details sought post site visit of proposed STP

adani

Ref: AVPPL/KSPCB/2019-20/878 Date: 18/09/2019

The Chairman,
Kerala State Pollution Control Board (KSPCB),
Pattom, Thiruvananthapuram – 695004

Sub: Sewage Treatment Plant (STP) – Approval of the Board – Reg.

Ref:

1. Consent No. PCB/HO/TVM/ICE/08/2015 dated 15/09/2015
2. Consent Renewal vide Consent No. PCB/HO/TVM/ICE-R/02/2018 dated 19/07/2018
3. Our Letter AVPPL/KSPCB/2019/823 dated 02/07/2019
4. Site Visit by KSPCB dated 21/08/2019

Dear Sir,

This is with reference to the development of 150 KLD STP at Vizhinjam International Deepwater Multipurpose Seaport in line with the Consent to Establish (CTE) received vide reference 1 and 2 above. As our earlier submissions vide reference 3 and as per the site visit of KPSCB on August 21, 2019 vide reference 4, we are hereby submitting the following documents:

1. Sewarage Service Plan/Flow Layout
2. Proposed Estimated Capacity of STP

Based on these, we are requesting your good office to provide approval for the proposed scheme of STP as early as possible. We are in the process of finalizing a contractor for development of the STP.

Thanking You.

Yours Sincerely,

Manoranjan Tripathy
Associate General Manager (Projects)

Copy to: The Managing Director & CEO, Vizhinjam International Seaport Limited

Encl: As Stated Above

Annexure X

EMP Budgetary Provision and Expenditure

(April 2019 to September 2019)

Annexure X

S. No.	Environmental Management Plan Commitment	Cost Provision in EIA (INR Crores)
1.	Cost of Contractors EMP for all planned EMP implementation measures (Action plan report)	1.00
2.	Cost of Capacity building- Training and Institutional strengthening (Training workshop)	0.20
3.	Compensatory afforestation for the green cover lost for the port and its associated facilities (2500 plants per Ha for 25 Ha area)	1.25
4.	Air quality monitoring at sensitive locations	0.252
5.	Water quality monitoring at major water bodies	0.054
6.	Noise monitoring at sensitive locations	0.009
7.	Soil quality monitoring at sensitive locations	0.002
8.	Marine water quality and sediment and marine biology	1.08
9.	Shoreline changes	0.30
10.	Cost of Median planting with a suitable species of creepers and metallic wire mesh fencing along the road (2000 m long median planting)	0.83
11.	Solid waste management (sector wise)-Collection disposal system	2.50
12.	Storm water Management	5.00
13.	Marine Life Protection out of Oil Spill(Provision for scavenger boat)One tugboat with booms and skimmer and dust exhausting equipment	20.00
14.	Cost of scavenger boat including manpower(Cost of boat)	0.20
15.	Dust Sweeper (2 nos)	0.60
16.	Air Pollution Control (Four water tankers for wetting of road surface and springing system)	1.00
17.	Water and waste water treatment plants	4.00
18.	Battery of toilets with bimonthly maintenance provision	1.00
19.	Desilting and strengthen of Streams	0.50
20.	Enhancement of water bodies (ponds along road & rail)	0.10
21.	Enhancement of religious structures (Temple)	0.05
22.	Cultural property rehabilitation cost for sacred grove	0.01
Total		**39.937 (Rounded off to 40 Crores)**

Expenditure (April 2019 to September 2019):

S. No.	Activity	Expenditure (April 2019 to September 2019) (INR Crores)
1.	Comprehensive Shoreline Monitoring	0.70
2.	Continuous Turbidity Monitoring	0.08
3.	Air, Noise, Surface Water, Ground Water & Marine Water Monitoring	0.30
4.	Zero waste display board	0.01
5.	Environmental Awareness Program	0.01
6.	Consultancy fee for expert on shoreline monitoring	0.06
7.	Water Sprinkling for dust suppression	0.03
8.	Marine Ecological studies	0.18
	Total	**1.37**

Annexure XI

Organizational Structure-EMP Implementation

Annexure XI

S. No.	Name	Designation	Experience	Qualification	Organization
1.	Narayanan M	Engineer (Infra) Coordinator Environment and Welfare Measure	30 Years	B Tech (Civil Engg.)	VISL
2.	Anil Balakrishnan	Head – CSR	22 Years	MSW, Phd.	AVPPL
3.	Y D Manmohan	Environment Specialist	28 Years	PG in Env. Engg.	STUP
4.	Sebastian Britto	Project Officer	20 Years	MA, Economics	AVPPL
5.	Stephen Vinod	Community Mobilizer	12 Years	BA, Economics	AVPPL
6.	George Zen	Community Mobilizer	31 Years	BA, Sociology	AVPPL
7.	Meera Mariyam Skariah	Community Mobilizer	2 Years	MSW	AVPPL
8.	Hebin C	Head – Environment	12 Years	MS, Oceanography & Coastal Area Studies	AVPPL
9.	Jesse Benjamin Fullonton	Assistant Manager - Environment	8 Years	BSc. Chemical Technology; Msc. Environmental Technology	AVPPL
10.	Kanwar P Malik	Head- Horticulture	14 Years	BSc - Agriculture	AVPPL
11.	Amrendra Sinha	Head – Safety	17 Years	Diploma in Industrial Safety and Fire Safety	HOWE
12.	Shaji Joseph	Safety Executive	12 Years	Diploma in mechanical & Diploma in fire and safety	HOWE

Annexure XII

Submission Letter of EC Compliance for the Period October 2018 to March 2019

प्रेषणकर्ता
DESPACTCHER
पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय 28/5/19
Ministry of Environment, Forests & Climate Change
क्षेत्रीय कार्यालय, दक्षिण वलय
Regional Office, Southern Zone
केन्द्रीय सदन, चौथा तल, कोरमंगला
Kendriya Sadan, 4th Floor, Koramangala
बेंगलूरु/Bengaluru-560 034

O/C

Vizhinjam International Seaport Limited

(A Government of Kerala Undertaking)

VISL/2016-17/EE&EI-19/176

27th May 2019

To

Additional Principal Chief Conservator of Forests (C),
Ministry of Environment Forest and Climate Change (MoEF&CC),
Regional Office (SZ), KendriyaSadan, 4th Floor, E&F Wings, 17th Main Road,
Koramangala II Block, Bangalore-560034 (Karnataka)

Sir,

Sub: Half yearly Compliance report of Environmental and CRZ clearance for Vizhinjam International Multipurpose Deepwater Seaport for the period of **October 2018 to March 2019** – Reg.

Ref: 1) F.No.11-122/2011-IA.III dated 3rd January 2014 of MoEF issuing Environmental Clearance
2) No.1285/A3/13/KCZMA/S&TD dated 24th August 2013
3) Our email dtd 27-May-2019

This has reference to the Environmental & CRZ Clearance (EC) issued on 3rd January 2014 (Ref 1) by the Ministry of Environment, Forest & Climate Change (MoEF&CC) to the proposed Vizhinjam International Multipurpose Deepwater Seaport at Vizhinjam in Thiruvananthapuram District of Kerala State based on the recommendation of KCZMA vide the reference cited (2).

The compliance report of the conditions stipulated in the reference cited for the half yearly period from **October 2018 to March 2019** is enclosed herewith in soft copy for record and reference.

Yours Sincerely
For Vizhinjam International Seaport Ltd

Managing Director& CEO

Encl: Compliance Report (soft copy)

Copy to: (1)**The Director (Monitoring-IA II Division)**, Ministry of Environment, Forest & Climate Change, IndraParyavaranBhavan, JorBagh, New Delhi - 110003
(2)**The Zonal Officer**, Central Pollution Control Board (CPCB), Zonal Office, 1st& 2nd Floors, NisargaBhavan, A Block, Thimmiah Main Road, 7th D Cross Shivanagar, Opp. Pushpanjalai Theatre, Bengluru – 560 010.
(3)**The Member Secretary**, Kerala State Pollution Control Board, Thiruvananthapuram Regional Office, Plamoodu, Pattom P.O., Thiruvananthapuram – 695 004
(4)**The Member Secretary**, KCZMA, 4th Floor, KSRTC Bus Terminal, Thampanoor, Thiruvananthapuram – 695 001
(5) **Shri. Rajesh Jha**, MD& CEO Adani Vizhinjam Port Private Ltd. (AVPPL), 2nd Floor, Vipanchika Tower, Near Govt. Guest House, Thycaud P.O., Thiruvananthapuram- 14

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 for the Period April 2019 to September 2019

November 2019