Vizhinjam International Seaport Limited

(A Government of Kerala Undertaking)

VISL/53/2021-GM1(E)/627

Dated 22/11/2021

Additional Principal Chief Conservator of Forests (C),
Ministry of Environment Forest and Climate Change (MoEF&CC)
Regional Office (SZ), Kendriya Sadan,
4th Floor, E&F Wings, 17th Main Road,
Koramangala II Block, Bangalore-560034 (Karnataka)
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Sub: Half Yearly Compliance Report (HYCR) of Environmental and CRZ Clearance for Vizhinjam International Multipurpose Deepwater Seaport for the period **April 2021 to September 2021** – reg.

Ref: 1) File No. 11-122/2011-IA.III dated 3rd January 2014
2) Letter No. 1285/A3/13/KCZMA/S&TD dated 24th August 2013
3) File No: EP/12.1/7/2013-14/Ker 829 dated 20th August 2019
4)F.No.11-122/2011-IA.III Proposal No. IA/KL/MIS/178082/2020 dated 29th Dec 2020

Dear Sir,

This has reference to the Environmental & CRZ Clearance (EC) issued vide reference first cited by the Ministry of Environment, Forest & Climate Change, for the proposed Vizhinjam International Multipurpose Deepwater Seaport at Vizhinjam in Kerala State based on the recommendation of KCZMA (vide reference second cited). The validity of EC was subsequently extended by MoEF&CC (vide reference fourth cited).

The Half Yearly Compliance Report (HYCR) of the conditions stipulated in the references cited for the period from **April 2021 to September 2021** is enclosed herewith for record and reference.

As per the MoEF&CC letter (vide the reference third cited), submission of HYCRs by email/soft copy iss declared acceptable. Therefore, the HYCR for the period **April 2021 to September 2021** is being submitted to the MoEF&CC, Regional Office (Bangalore), Zonal office of the CPCB (Bangalore), KSPCB & KCZMA via email.

Yours Sincerely
For Vizhinjam International Seaport Ltd

Chief Executive Officer

Encl: As stated above

Copy to: MD & CEO Adani Vizhinjam Port Private Ltd. (AVPPL), 3rd Floor, Aspinwall House, Kuravankonam, Trivandrum, Kerala-695 003.

Development of Vizhinjam International Deepwater Multipurpose Seaport

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

Half Yearly Compliance Report (HYCR) for the Period April 2021 to September 2021

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 2021

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
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 renewed CTE was submitted to Ministry of Environment and Climate Change (MoEF&CC) with the Half Yearly Compliance Report (HYCR) for the period April 2018 to September 2018.
(ii)	Project Proponent shall carry out intensive monitoring with regulatory reporting six monthly on shoreline changes to the Regional Office, MoEF.	**Being Complied** Based on the Shoreline Monitoring Plan prepared by L&T Infra Engineers Ltd (L&T IEL) under the guidance of National Institute of Ocean Technology (NIOT), 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 HYCR. Broadly the scope covers: • Wave Observations • Onshore Cross beach profiling • Offshore Cross beach profiling • Littoral Environmental Observations (LEO) • Beach Sampling • Multi-beam Echo Sounder (MBES) survey • River cross section surveys • Grab Sampling • Current Observations • Tide Observations • Weather Observations • Water Sampling • Turbidity Measurements

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
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		Shoreline Monitoring Report for the period April 2021 to September 2021 is enclosed as **Annexure I**. L&T IEL had prepared Mathematical Modelling Reports based on Shoreline Monitoring data; which were vetted by NIOT. Four mathematical modelling reports have been prepared by L&T IEL so far and submitted to MoEF&CC; as detailed below: <table><tr><th>Data Period</th><th>Submitted with HYCR for the Period</th></tr><tr><td>Feb 2015 to Feb 2017</td><td>Apr 2017 to Sep 2017</td></tr><tr><td>Mar 2017 to Feb 2018</td><td>Apr 2018 to Sep 2018</td></tr><tr><td>Mar 2018 to Feb 2019</td><td>Apr 2019 to Sep 2019</td></tr><tr><td>Mar 2019 to Feb 2020</td><td>Apr 2020 to Sep 2020</td></tr></table> In continuation with the same practice Adani Vizhinjam Port Pvt. Ltd. (AVPPL) have submitted the shoreline data from March 2020 to February 2021 to L&T IEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. The mathematical modelling report for the period March 2020 to February 2021 vetted by NIOT is given as **Annexure II**. From all the data analyses and model studies carried out by L&T IEL, it has been 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.
(iii)	The capital dredged material (7.6 Mm^3) shall be utilized for reclamation of berths.	**Being Complied** No dredging or reclamation was carried out during the compliance period from April 2021 to September 2021. The dredged material till 30.09.2021 amounting to 2.90 Mm^3 has been utilized for reclamation of 36 Ha area.

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(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, in anticipation of finalising design mobilised the sub-contractor along with resources for construction of fishery harbour since March 2017. However, fishing boats docked in the proposed area need to be removed before the commencement of work. Government of Kerala (GoK) has initiated discussions with fishermen representatives for removal of the boats to facilitate construction work and these discussions are ongoing. *(Source: VISL)*
(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: • Work is 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 and navigational buoys/marker buoys are placed in the marine area for fishing boats to maintain a safe distance from the areas of breakwater construction. • For mutual understanding of the developmental activities with the local fishing community an exclusive CSR team has been assigned. • Using the technological advancements (such as WhatsApp), 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.

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		• AVPPL CSR team also provides regular updates to the committee which has been formed by the local church/other 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. The turbidity details for the compliance period are given in **Annexure I**. • Marine Water Quality is being monitored regularly and results are submitted as part of the compliance reports. No abnormal results were observed during the compliance period (**Refer Annexure III**).  **Navigational Buoy**  **Turbidity Buoy**

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(vi)	Steps would be taken to safeguard the interests of the fisheries sector as detailed in the Resettlement Action Plan (RAP), Corporate Social Responsibility (CSR) and in the Integrated Fishing Community Management (IFCMP), namely a component of Rs.7.1 crores as part of the compensation package for the fisheries sector, as livelihood restoration measures for mussel collectors, shore seine fishermen and others. Rs.41.30 crores as part of CSR activities in the fisheries sector under (i) water supply scheme (7.3crores) (ii) new fishing landing centre (16crores) (iii) adoption of existing fishing harbor (5crores) (iv) sea food park (4crores) (iii) skill development centre (4crores) (iv) environmental sanitation (3crores) and (v) solid waste management (2crores).	**Being Complied** In consultation with the fishermen, enhanced livelihood compensation of Rs. 101.86 Crores was sanctioned by GoK, instead of Rs. 8.55 crores; as suggested earlier in the EIA stage. Till date an amount of Rs. 94.39 crores have been disbursed till 30.09.2021 for a total number of 2631 Livelihood Affected Persons (LAPs) whose verification was complete in all respects; this includes boat owners to whom kerosene is supplied free of cost as well during the port construction period. Verification of the documents of few balance LAPs is in progress. *(Source: VISL)* The status of the Social Welfare 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 VISL by expending an amount of Rs. 8.10 crores. For Operation & Maintenance (O&M) of the same an amount of Rs. 5.38 crores has been spent up to 31.03.2021. From 04.04.2019 onwards, O&M of the scheme is being done by Kerala Water Authority (KWA). An additional amount of 1.74 crores has been sanctioned for extending water supply facilities to the community by VISL. The work is in progress by KWA. *(Source: VISL)* **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 in the form of a new fishing harbour. AVPPL is unable to start the construction activities since the proposed site is blocked by

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		fishermen with their fishing boats. The proposed area needs to be cleared for the commencement of works. GoK has initiated discussions with fishermen representatives for removal of the boats to facilitate construction work and discussions underway. *(Source: VISL)* **Existing Fishing Harbour**: Tender 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. Government has formed a higher level committee to prepare a master plan for the old fishing harbour. *(Source: VISL)* **Seafood Park**: Procurement of land for seafood park (Rs. 26.00 crores) by VISL has been completed. Action for development of seafood park is being planned so as to commission the same along with the completion of the new fishing harbour. *(Source: VISL)* **Skill Development:** Additional Skill Acquisition Program (ASAP) is a GoK initiative aimed at imparting skill courses to students for improving their employability. No Objection Certificate (NoC) has been granted to ASAP to proceed with the construction of a Community Skill Park (CSP) in an area of 1.5 acres of land at Vizhinjam. It is operates on a PPP model wherein 25000 sq. ft. building with facilities for students' hostel are being constructed by GoK under ASAP with ADB assistance, whereas the operation of the centre with logistics and other high-end courses is vested with Adani Skill Development Centre. Preference is being given to local people based on skill and

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		competency during the construction stage. Tender for fixing transaction advisor has been invited. *(Source: VISL)* **Environmental/Sanitation:** Adani Foundation has started a clean campaign programme in the community to have awareness on personal cleanliness, cleanliness of the surroundings and ensure proper community monitoring for its effectiveness; with strict COVID protocol. One of the livelihood groups, promoted under the CSR of AVPPL/Adani Foundation - Karsheeka Karma Sena is coordinating the campaign. Most of the members who are actively participating in the cleaning campaign are from widow's category as part of our Widow's engagement programme. VISL initiated action with Thiruvanathapuram Corporation, Clean Kerala Company to manage the Solid Waste Management in the Project Affected area. A Material Recovery Facility, Sufficient Number of Thumboor moozhies and LAgassy waste disposal are in planning stage. Once the proposals are finalised, VISL also assist in installing the required facilities in the Project affected areas. **Gangayar Canal:** As the community people reported the sand accumulation at Gangayar causing flooding and which has directly affected more than 100 houses during rainy season, AVPPL/Adani Foundation has been regularly removing sand from the mouth of Ganagayar to ensure proper water flow to sea. The dredging department of HOWE is doing the work at the mouth of Gangayar River joining sea at Valiyakadappuram every day. The proposed maintenance to ensure proper water flow and desilting of Gangayar initiated during the month of December 2020. The work has been entrusted to Minor Irrigation Department under the supervision

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		of Harbour Engineering Department (HED). The project cost of Rs. 89 lakhs for the same has been shared equally by AVPPL and VISL. But as the tenders for the work shown an additional expense of Rs. 30 lakhs and the same has been transferred and the works has been started by the Minor Irrigation Department. Desilting of waste up to 1 km from the mouth of the canal, Core wall (Break water) to block sand iteration at the southern side of the exiting Fishing Harbour and Installation of three Silt breakers at a distance of 500 m with footbridge are the major components of the work. Activities carried out by AVPPL as a part of CSR intervention for fishermen, fishing community and fisheries sector for the period of April 2021 to September 2021 is given in **Annexure IV**.
(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 submitted to Southern Railway for its approval. Geophysical and geomorphological studies have also has completed. All the required clarifications have been provided to Southern Railways and the approval is expected shortly. EC amendments in this regard would be sought for once the approval of DPR is obtained. *(Source: VISL)*
(viii)	Compensation packages in accordance with the Central/State Government norms shall be given to all the authorized-cum-affected	**Being Complied** Resort owners evicted have been compensated for land and not for the structures since they were in violation of CRZ notification. An area of 0.728 Ha has been acquired up to 30.09.2021 under negotiated

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	(having valid clearances as applicable) resort owners.	purchase. Remaining land of 2.865 Ha to be acquired by Land Acquisition (LA) process for which notification has been published and action initiated by the District Collector Thiruvananthapuram. *(Source: VISL)*
(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.	**Being 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. CSR activities are being taken up and carried out mainly in the fields of education, community health, sustainable livelihood development, community infrastructure development, COVID-19 relief activities and general administration. CSR. An amount of Rs. 50.59 Lakhs has been spent on CSR activities during the compliance period (April 2021 to September 2021) as shown below:

S. No.	Head	Amount (Rs. Lakhs)
1	Education	02.25
2	Health	36.50
3	Sustainable Livelihood Development	02.83
4	General Administration	09.01
	Total	**50.59**

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		Details on CSR activities carried out by AVPPL during compliance period (April 2021 to September 2021) are enclosed as **Annexure IV**.
(xi)	Oil Contingency Management Plan shall be put in place.	**Will be Complied** After duly incorporating the comments of Indian Coast Guard (ICG), the final facility Level Oil Spill Disaster Contingency Plan (OSDCP) in line with the National Oil Spill-Disaster Contingency Plan (NOS-DCP) has been submitted to ICG for approval vide letter No. AVPPL/ICG/2020-21/1134 dated 22.05.2020. After final review by PRT (West), ICG has made specific remarks on the compliance of OSDCP prepared in line with NOS-DCP guidelines; directing AVPPL to submit the OSDCP for approval only after pollution response equipment are in place. Considering that the procurement of pollution response equipment will be in line with the development of the port, the final OSDCP will be submitted to ICG for approval prior to commissioning of the port; when the pollution response equipment are in place.
(xii)	All the recommendations /conditions stipulated by Kerala Coastal Zone Management Authority (KCZMA) shall be complied with.	**Being Complied** AVPPL are complying with all the recommendations/conditions of KCZMA. Copies of the HYCRs are also being sent to KCZMA. Compliance to the recommendations/conditions of KCZMA for the period April 2021 to September 2021 is enclosed as **Annexure V**.
(xiii)	The responses/ commitments made during public hearing shall be complied with in letter and spirit.	**Being Complied** AVPPL are complying with the responses/commitments made during public hearing (as applicable). Status of the same is being submitted regularly with HYCRs to all the authorities concerned. The compliance status of the commitments made during Public Hearing & actions on the same during

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		the compliance period April 2021 to September 2021 is enclosed as **Annexure VI**.
(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 VII**.
(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, Ahmadabad 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. *(Source: VISL)*
(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 from the concerned State/Central Groundwater Board shall be obtained in this regard.	**Noted** There will not be any withdrawal of groundwater in CRZ Area. In case of requirement of groundwater withdrawal outside CRZ area, specific 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

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		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 was to 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 13 KLD water is being consumed for construction related activities during the compliance period (April 2021 to September 2021).
(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.	**Being Complied** Contractors working at site, under the EPC Contractor M/s. Howe Engineering Projects India Pvt. Ltd. (HEPIPL) have obtained separate consents from KSPCB for handling Hazardous Waste. During this compliance period (April 2021 to September 2021) 1355 L of used oil had been 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 Coastal Regulation Zone area.	**Being Complied** 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

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		implemented in line with CRZ Notification along with the commissioning of the project.
(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.	**Being Complied** 5 DG sets are presently being used at site. These are compliant to CPCB guidelines. If any oil spill occurs, it shall be properly collected and disposed as per the Rules.
(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 out as per the approval obtained under CRZ Notification.
(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 back-up areas and along the boundary of the project area in line with the establishment of the project. A greenbelt development plan has been considered in the Master Plan and

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		adequate budgetary provision has been kept for this purpose. **Compensatory Afforestation**: During the meeting with Hon'ble Minister dated 05.04.2017, it was decided that Forest Department shall identify land for compensatory afforestation in lieu of trees felled at port site areas; at the rate of 1:10. AVPPL, in collaboration with Forest department, have carried out compensatory afforestation of approximately 15,540 trees on 12.05 Ha land; as identified by social Forest Department in Sainik School, Trivandrum (at an aerial distance of 24 km from the Vizhinjam Port project site). The plantation is now in its Third Year. Rs. 80.50 Lakhs has been spent towards Phase-I of the compensatory 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. An amount of Rs. 2.11 Crores has been utilized towards EMP implementation measures during compliance period April 2021 to September 2021. Till date, an amount of Rs. 19.583 Crores has been spent on environmental protection measures. The EMP expenditure for the compliance period April 2021 to September 2021 is enclosed as **Annexure VIII**.
(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	**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 has also appointed competent and qualified professional for effective implementation of EHS safeguards & CSR activities. In addition to the above, independent environment,

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	stipulated EHS safeguards & CSR activities.	health and safety consultants have been appointed as per concession agreement signed between GoK and 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 IX**.
(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 amendments. All the construction designs/drawings relating to the proposed construction activities must have approvals of the concerned Statutory Departments / Agencies.	**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 construction activities 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. • CTE for consumer pump inside the Vizhinjam port premises was obtained on 07.03.2021 (Consent No.: PCB/TVM-DO/NTA/PTP/15/2021) for the period of 5 years valid up to 28.02.2026. • Consent to Operate (CTO) for Explosives Storage at Chappath area was obtained

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
		on 20.07.2021 (Consent No.: PCB/TVM-DO/ICO/NTA/HCS/49/2021) valid up to 31.12.2024 (A Copy of the CTO is Enclosed as **Annexure X**). • As per the exemption granted by 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 347 Nos. of employees, staff and construction workers are engaged in the port construction activities on a daily basis during the compliance period April 2021 to September 2021. Presently, during the compliance period, the contractors have demobilized and there are no labourers residing in the labour camps. It is ensured that construction workers who are staying outside in the contractor rented houses/apartments are provided with necessary infrastructure facilities.
(iii)	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.	**Being Complied** Mitigation measures are being followed while undertaking digging activities 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 III**. 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.	**Being Complied** Quarry material is being obtained from approved quarry sites only. The progress of road constructed so far include Hume Pipe laying, construction of retaining wall, drain works, sub grade works and piling in ponds for bridge.

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
	(b) No excavation or dumping shall be allowed on wetlands, forest areas or other ecologically valuable or sensitive locations. (c) Excavation work shall be done in close consultation with the Soil Conservation and Watershed Development Agencies working in the area, and (d) Construction spoils including bituminous material and other hazardous materials must not be allowed to contaminate water courses and the dump sites for such materials must be secured so that they shall not leach into the ground water.	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. • Kerala State Remote Sensing and Environment Centre (KSREC) have studied the impact due to construction of port approach road. Recommendations of KSREC are being implemented and suitable mitigation measures as suggested in the KSREC report are being adopted during construction. • No bituminous or hazardous material has been used.
(v)	The construction material shall be obtained only from approved quarries. In case new quarries are to be opened, specific approvals from the competent authority shall be obtained in this regard.	**Being Complied** The construction material was obtained from approved quarries only. As on date, AVPPL have obtained Environmental Clearance (EC) from the State Environmental Impact Assessment Authority (SEIAA) and Consent to Operate (CTO) from KSPCB for the following granite building stone quarries: • Block No.29, Re-Survey No.120/10 in Manickal Village, Nedumangad Taluk, Thiruvananthapuram District, Kerala (Details submitted along with the HYCR for the period October 2019 to March 2020) • Nagaroor Village, Chirayinkeezhu Taluk, Thiruvananthapuram District (Details submitted along with the HYCR for the period April 2019 to September 2019)

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
		In case of new quarries, necessary approvals will be obtained from the competent authority. Apart from these, the concessionaire is also sourcing rocks from the following private quarry owners in Kerala: • Vismaya Rocks Pvt. Ltd. Quarry at Kummil Village, Kottarakara Taluk, Kollam District, Kerala • Tasna Mines Quarry at Mancode Village, Kottarakara Taluk, Kollam District, Kerala The concessionaire is also sourcing rocks from several private quarry operators in Tamil Nadu. It is ensured that all private quarry owners have necessary approvals and permits from competent authorities.
(vi)	The project authorities shall make necessary arrangements for disposal of solid wastes and for the treatment of effluents by providing a proper wastewater treatment plant outside the CRZ area. The quality of treated effluents, solid wastes and noise level etc. must conform to the standards laid down by the competent authorities including the Central/State Pollution Control Board and the Union Ministry of Environment and Forests under the Environment (Protection) Act, 1986, whichever are more stringent.	**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. • Provision for installing Sewage Treatment Plant (STP) facility of adequate capacity in phased manner is being planned and will be implemented in line with CRZ Notification along with the commissioning of the project. • Environment Monitoring is being carried out as per Environment Monitoring Plan prescribed in EIA by NABL accredited agencies; during the compliance period, the contractor has been changed: M/s. Ashwamedh Engineers & Consultants till July 2021 and Standards Environmental & Analytical Laboratories from August 2021 onwards. • Summary of the Ambient Air Quality Monitoring (AAQM) during the compliance period April 2021 to September 2021 at 5 monitoring locations is mentioned below:

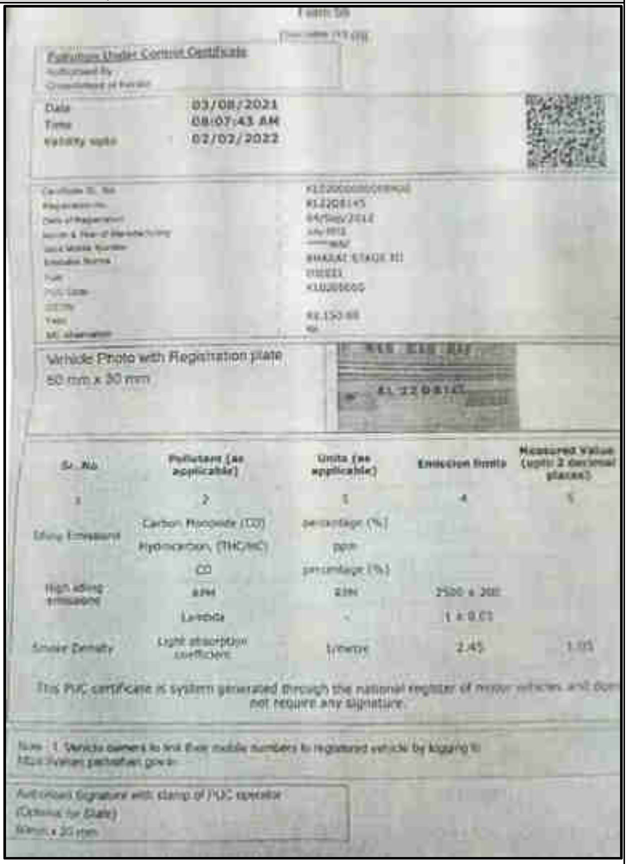
Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
		(table below)

Parameter	Unit	Max	Avg.	Min	Perm. Limit
PM_{10}	$\mu g/m^3$	92	44	18	100
$PM_{2.5}$	$\mu g/m^3$	38	15	5	60
SO_2	$\mu g/m^3$	8	4	2	80
NO_2	$\mu g/m^3$	13	5.8	2	80
CO	mg/m^3	BDL	BDL	BDL	4
HC	ppm	BDL	BDL	BDL	--

- Detailed Monitoring Reports for the period April 2021 to September 2021 is attached as **Annexure III**).
- All the monitored parameters were found within the prescribed limits.

S. No.	Conditions	Compliance Status as on 30.09.2021
(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 (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
		 Water Sprinkling in Progress  Tarpaulin Cover on Trucks

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
		 Pollution Under Control Certificate Date 03/08/2021 Time 08:07:43 AM Validity upto 02/02/2022 Vehicle Photo with Registration plate 50 mm x 30 mm This PUC certificate is system generated through the national register of motor vehicles and does not require any signature. **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** There was no visit by officers of Ministry/Regional Office at Bangalore during the compliance period. All necessary support will be extended to officers of this Ministry/Regional Office during inspection of the project/site visit; whenever planned.
(x)	Ministry of Environment & Forests or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment	**Noted for Compliance**

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
	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. Vizhinjam International Seaport Limited (VISL) is the nodal agency for development of the port on behalf of GoK. 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.
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	**Noted for Compliance** EC has been obtained from MoEF vide letter dated 03.01.2014 (F.No.11-122/2011-IA.III). As per EIA Notification 2006 and Office Memorandum (O.M.) dated 12.04.2016, the validity of the EC is for seven years up to

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021

S. No.	Conditions	Compliance Status as on 30.09.2021
	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.	03.01.2021. As per the provisions of MoEF&CC, the validity of the EC may be further extended for a maximum period of three years. VISL had submitted online application and required relevant documents on PARIVESH for extension of EC on 08.10.2020, 03.11.2020 and 19.11.2020. The Proposal (IA/KL/MIS/178082/2020) was considered in the 246th and 247th EAC meeting of Infra-1 committee of MoEF&CC held on 20.10.2020 and 23.11.2020; wherein VISL and NABET accredited consultant-L&T-IEL had made a presentation to the committee members. Thereafter, MoEF&CC vide letter No. IA/KL/MIS/178082/2020 dated 29.12.2020 (Copy of the same was submitted along with the compliance report for the period October 2020 to March 2021) have extended the validity of EC of Vizhinjam port by 3 years till 02.01.2024. Further, taking into account the outbreak of COVID-19 pandemic, MoEF&CC has amended the 2006 EIA Notification such that the period from the 01.04.2020 to the 31.03.2021 shall not be considered for the purpose of calculation of validity of existing ECs. Therefore, the EC of Vizhinjam port is valid till 01.01.2025.
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	**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

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
	proponents from the respective competent authorities.	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. • CTE for consumer pump inside the Vizhinjam port premises was obtained on 07.03.2021 (Consent No.: PCB/TVM-DO/NTA/PTP/15/2021) for the period of 5 years valid up to 28.02.2026. • Consent to Operate (CTO) for Explosives Storage at Chappath area was obtained on 20.07.2021 (Consent No.: PCB/TVM-DO/ICO/NTA/HCS/49/2021) valid up to 31.12.2024 (A Copy of the CTO is Enclosed as **Annexure X**). • As per the exemption granted by 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	**Complied** Details regarding the advertisement that the project had been accorded EC and copies of the clearance letter that were published in local newspapers was intimated (along 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 HYCR for the period October 2015 to March 2016). Copy of the EC 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)

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
	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.	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**
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 EC 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 EC 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 EC 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	**Being Complied** The copy of the latest HYCR for the period October 2020 to March 2021 including the

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
	conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM, SO_2, 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.	results of six monthly monitoring data for the same period has been uploaded on VISL website http://www.vizhinjamport.in and also on APSEZ website https://www.adaniports.com/Downloads. The HYCR for the period October 2020 to March 2021 has been submitted to the MoEF&CC, Regional Office (Bangalore), Zonal office of the CPCB (Bangalore), KSPCB & KCZMA vide email dated 30.05.2021 (a copy of the email is enclosed as **Annexure XI**). Environment Monitoring is being carried out as per Environment Monitoring Plan prescribed in EIA by NABL accredited agencies; during the compliance period, the contractor has been changed: M/s. Ashwamedh Engineers & Consultants till July 2021 and Standards Environmental & Analytical Laboratories from August 2021 onwards. Detailed Monitoring reports (Air, Water, Noise, Marine Water, and Sediment) for the Compliance Period April 2021 to September 2021 are enclosed as **Annexure III**. 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.	**Being Complied** HYCRs on the status of compliance of the stipulated clearance conditions including results of monitored data are regularly submitted to all the concerned agencies. As per the MoEF&CC Notification dated 26.11.2018, wherein submission of HYCRs by email/soft copy is declared acceptable, therefore the HYCR for the period October 2020 to March 2021 has been submitted to the MoEF&CC, Regional Office (Bangalore),

Half Yearly Compliance Report (HYCR) on Conditions Stipulated in Environmental & CRZ Clearance (EC) F.No.11-122/2011-IA.III dated 03.01.2014 for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
		Zonal office of the CPCB (Bangalore), KSPCB & KCZMA via email dated 30.05.2021 (a copy of the email is enclosed as **Annexure XI**).
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:	Shoreline Monitoring Report (April 2021 to September 2021)
Annexure II:	Mathematical Modelling Report (March 2020 to February 2021)
Annexure III:	Environment Monitoring Report (April 2021 to September 2021)
Annexure IV:	CSR Activities by AVPPL (April 2021 to September 2021)
Annexure V:	Compliance to Conditions of KCZMA Recommendation
Annexure VI:	Compliance of the Commitments made during Public Hearing
Annexure VII:	Status of Environment Management Plan
Annexure VIII:	EMP Expenditure (April 2021 to September 2021)
Annexure IX:	Environment Health, Safety & CSR Organizational Structure
Annexure X:	CTO For Explosives Storage
Annexure XI:	Email Submission of HYCR for the Period October 2020 to March 2021

Annexure I

Shoreline Monitoring Report

(April 2021 to September 2021)

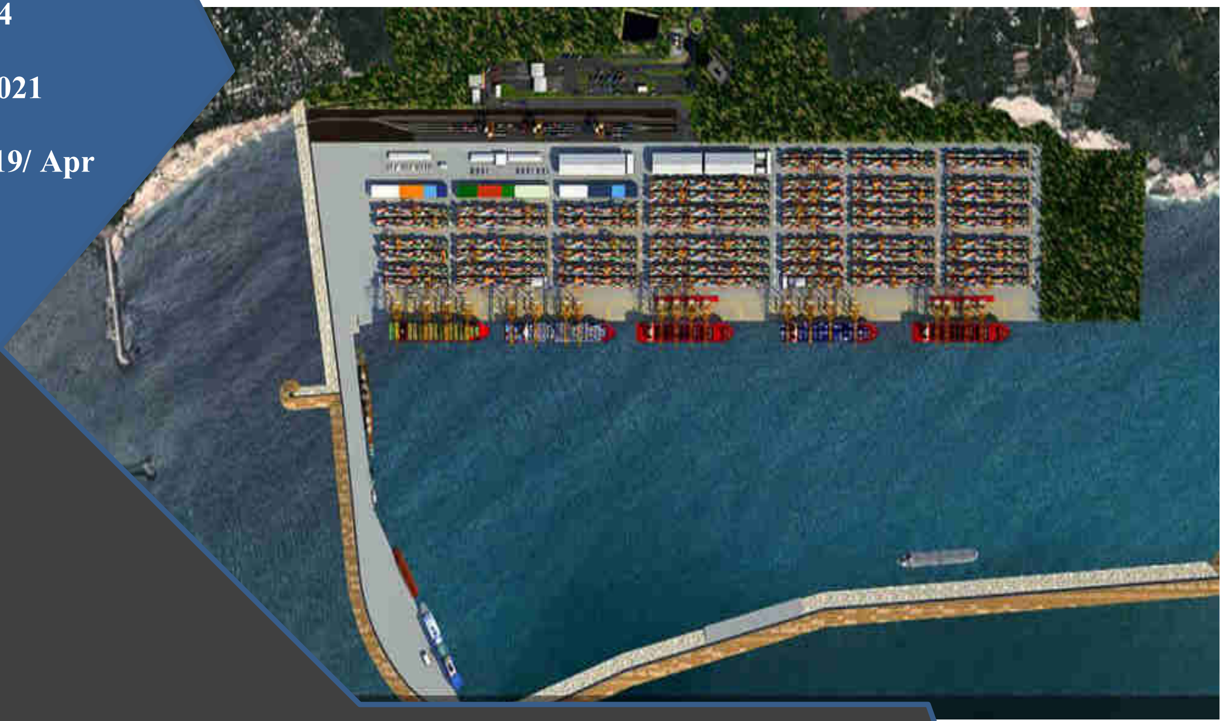
Adani Vizhinjam Port Pvt. Ltd

OCEANOGRAPHIC AND BATHYMETRIC DATA COLLECTION FOR ASSESSMENT OF SHORELINE CHANGES

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

Date: 27th November 2021

SAC Ref # SAC/P167-19/ Apr – Sep 2021 Rev 1



HALF YEARLY REPORT

(APRIL TO SEPTEMBER 2021)

"APPROVAL SHEET"

Prepared by:	*Signed*	*Date*
V Mehta		*27/11/2021*

Checked and Approved by:	*Signed*	*Date*
S Philip		*27/11/2021*

REVISION CONTROL

Date	Rev	Section / Page No.	Remarks	Comment by
15/11/2021	0		Submitted for approval	
27/11/2021	1	Sec 1, Pg 8	Changed 'ambitious' to 'prestigious' in first sentence as suggested. Added 'for the half yearly period' in last line.	AVPPL
		Sec 2, Pg 9	Added 'and Figure 2-2' in last line	AVPPL
		Sec 3, Pg 14	Short form 'AWS" added in first point. Removed 'in soft and hard copies' in last point.	AVPPL
		Sec 3.1, Pg 14	Removed 'provided by the client' as suggested	AVPPL
		Sec 3.2, Pg 16	Changed coordinates from UTM to geodetic format in Table 3-4	AVPPL
		Sec 3.3, Pg 16	Changed 'IS 1498' to 'Wentworth Classification'	AVPPL
		Sec 5.4, Pg 31	Most recent images of AWS added	AVPPL
		Sec 5.7, Pg 34	Full form of PDOP added in last paragraph	AVPPL
		Sec 5.7.1, Pg 34 & 35	Added '2021' after August in first paragraph. DGPS calibration positions provided in geodetic format in Table 5-2.	AVPPL

		Sec 6.2, Pg 46	Reason for data gap in wave data provided in the paragraph	NIOT
		Sec 6.5, Pg 62	Maximum speed and direction split in two separate columns in Table 6-11	AVPPL
		Sec 6.5, Pg 63	Added an image showing surface current directions in different seasons	AVPPL
		Sec 6.7, Pg 64	Separate paragraphs made as suggested. Few onshore profiles carried out for May and June 2021 mentioned.	AVPPL & NIOT
		Sec 6.8, Pg 67 & 68	Dates provided for water sampling in each season. Time series of TSS amended so as to show origin of y-axis as Minimum Detectable Limit (MDL), added a note on the MDL. Value of maximum TSS recorded changed from '9' to 3.9' mg/l after verifying.	AVPPL & NIOT
		Sec 6.8, Pg 70 & 71	Origin of y-axis for Turbidity changed to MDL	AVPPL
		Sec 6.9, Pg 71	Wentworth classification mentioned for classification of beach samples	AVPPL
		Sec 6.9, Pg 77	X-axis titles placed vertically in Figure 6-20 and Figure 6-21	AVPPL
		Sec 6.11, Pg 95	Replaced 'location' with 'coordinates' in second paragraph of results. Third paragraph removed as suggested	AVPPL
		Sec 6.12, Pg 97	Paragraphs merged as suggested. 4 rivers mentioned	AVPPL

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ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
APHA	American Public Health Association Guidelines
CES	Coastal Erosion Stone
AVPPL	Adani Vizhinjam Port Pvt. Ltd.
BDL	Below Detectable Level
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
EIL	Engineer In Charge
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 Waste water 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 on 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

① The **Vizhinjam International Deepwater Multipurpose Seaport** is a prestigious 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 5^{th} 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 3^{rd} 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 3^{rd} 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. Turbidity measurements at three locations from three levels is to be monitored on a real time basis, for which turbidity measuring buoys were deployed in the month of November 2019.

① This report provides the results of the data collected for the half yearly period from April to September 2021. All 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; Pre-monsoon (Mar-May), monsoon (Jun-Oct), and Post-monsoon period (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 (CSP) from 10m CD (4 CSP lines 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.

① A Google Earth image, showing the Multibeam survey area; locations of the observations, including the wave/current, tide and Automatic Weather Station (AWS) measurement location, is given in Figure 2-1 and Figure **2-2**.

P1, P2 and P3 correspond to Acoustic Doppler Current Profiler (ADCP) locations and P4 corresponds to both, ADCP and wave location.

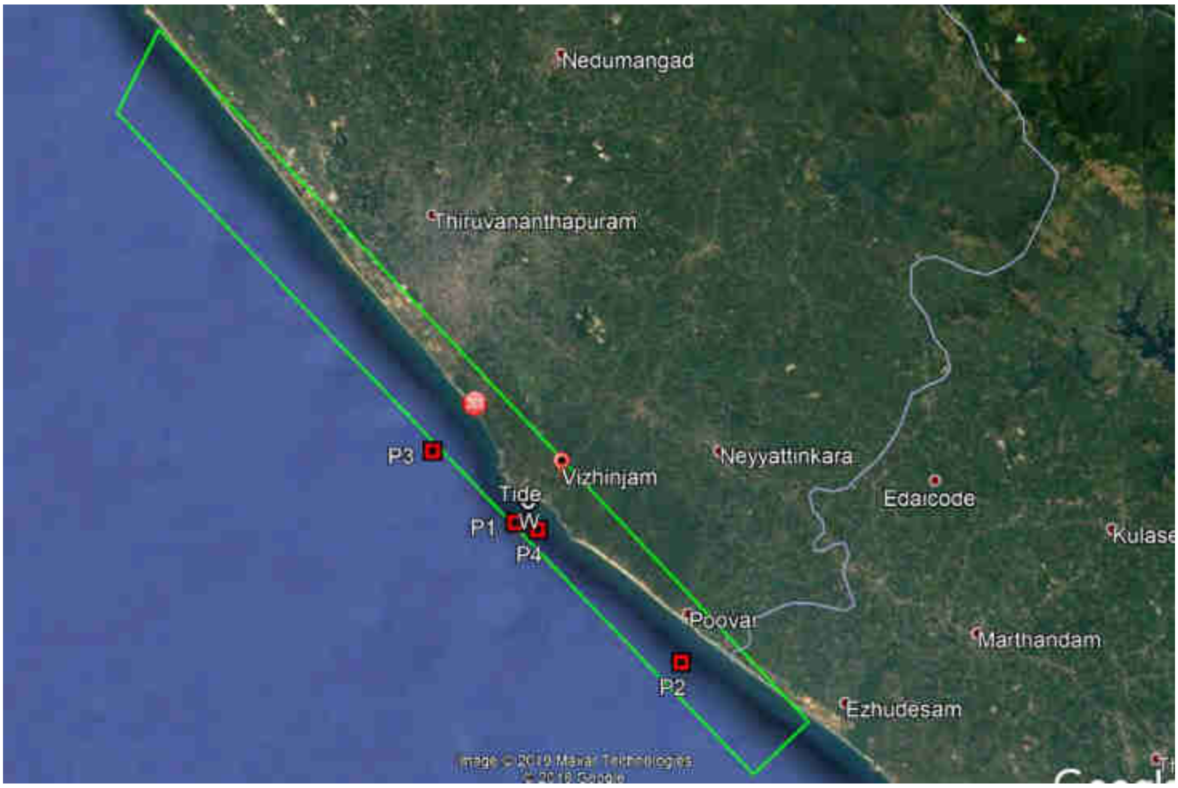


Figure 2-1: General Survey Location

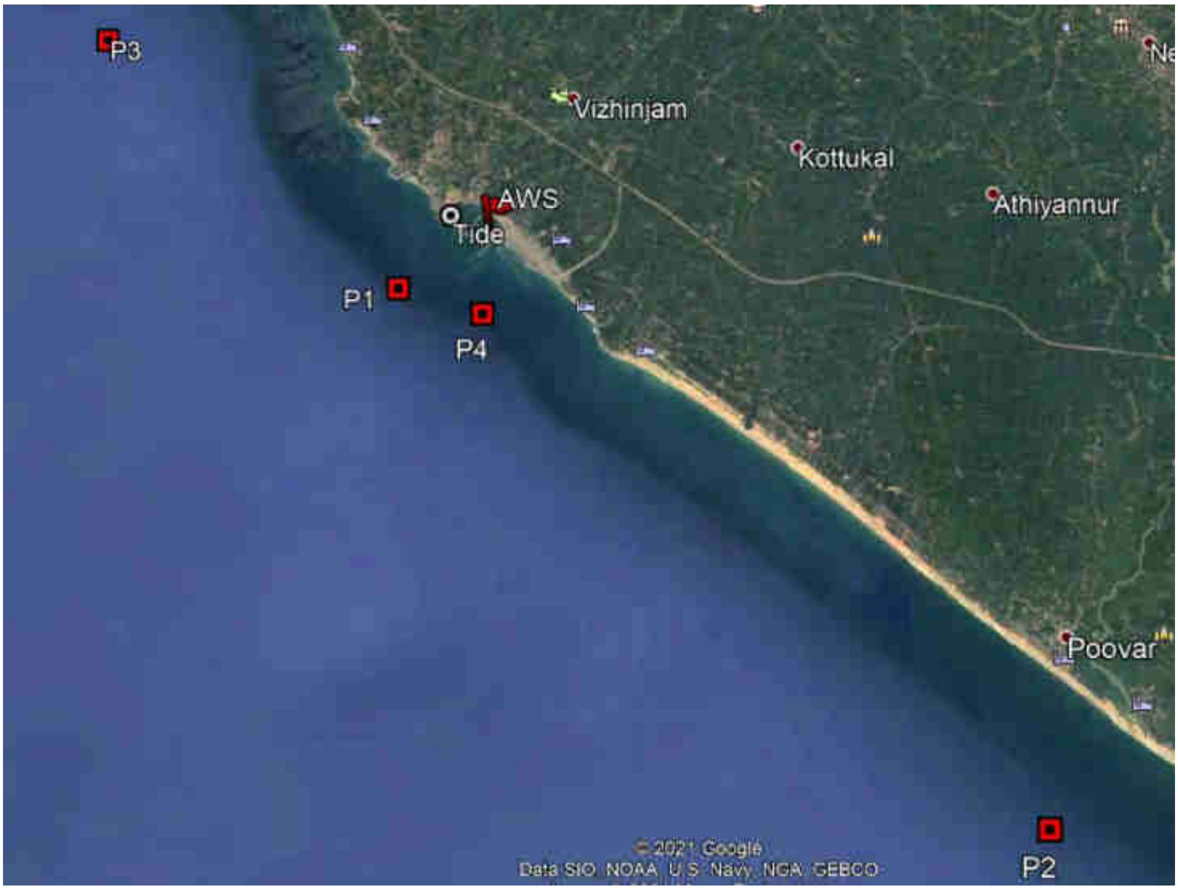


Figure 2-2: MetOcean Locations

The CSP lines, which coincide with the Littoral Environment Observation (LEO), beach sampling and photographic documentation, are indicated in Figure 2-3. 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, CSP-81 being the northernmost profile.

Figure 2-3: 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 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 CSP 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 CSP locations).
- Seasonal beach sediment sampling and analysis (at the CSP 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 Pre-monsoon (Mar-May), Monsoon (Jun-Oct) and Post-monsoon period (Nov-Feb).
- 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 (Engineer In Charge) by establishing an Automatic Weather Station (AWS).
- 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.

3.1 Location Coordinates

The location co-ordinates 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 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 Gill Metpack Automatic Weather Station with rain gauge was installed on the terrace of the Port Control Office building. The following table shows the coordinates of the AWS installation:

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 Port Control Office building)	08° 22’ 22.75” N	76° 59' 39.62" E	13.335

The wind sensor was installed at a height of 14.785m above MSL (15.335m above CD). As suggested by NIOT and as per the WMO standard, 7% of the speed was reduced to derive the wind speeds at 10m above MSL.

3.2 Turbidity Monitoring

Turbidity buoys were deployed in the month of November 2019 to measure the water turbidity at three locations. The turbidity from three different depths, i.e. surface, mid-depth and bottom was measured.

The location co-ordinates of the turbidity buoys are provided below:

Table 3-4: Turbidity buoy Locations

①

TURBIDITY BUOY LOCATIONS WGS-84, UTM Projection, CM 75° East, Zone 43, North						
Buoy No.	Latitude	Longitude	Water Depth (m)	Depth of sensor placement (m)		
				Surface	Mid-depth	Bottom
Turbidity Buoy-1	08° 20' 58.60" N	77° 00' 08.10" E	22.3	5.0	10.0	15.0
Turbidity Buoy-2	08° 21' 49.90" N	76° 59' 14.30" E	22.0	5.0	10.0	15.0
Turbidity Buoy-3	08° 22' 20.01" N	76° 59' 12.54" E	14.4	4.0	8.0	12.0

3.3 Beach and Water Sampling

① A total of 81 beach samples were to be collected in two seasons, as part of the contract. The samples were to be analyzed for grain size distribution as per Wentworth classification. The samples were collected in the month of April 2021 for the pre-monsoon period and in the month of August 2021 for the monsoon period. The coordinates of the beach sampling locations are provided in the table below.

Table 3-5: 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° 6.3980' E
BS-9	8° 17.2984' N	77° 6.1765' E
BS-10	8° 17.4586' N	77° 5.9566' E

BEACH SAMPLING LOCATIONS		
WGS-84, UTM Projection, CM 75° East, Zone 43, North		
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° 4.5120' 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
BS-27	8° 20.2492' N	77° 2.3841' E
BS-28	8° 20.4130' 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° 21.3210' N	77° 0.8491' E
BS-35	8° 21.3974' N	77° 0.6359' E
BS-36	8° 21.6830' N	77° 0.4829' E
BS-37	8° 21.8799' N	77° 0.2980' E
BS-38	8° 22.1369' N	77° 0.1947' E
BS-39	8° 22.3420' 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

BEACH SAMPLING LOCATIONS WGS-84, UTM Projection, CM 75° East, Zone 43, North		
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° 24.6320' 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° 26.1500' 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
BS-61	8° 27.2030' 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° 54.7840' 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° 29.5150' 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° 30.3450' N	76° 53.2940' E
BS-78	8° 30.5558' N	76° 53.1226' E

BEACH SAMPLING LOCATIONS WGS-84, UTM Projection, CM 75° East, Zone 43, North		
BS-79	8° 30.7701' N	76° 52.9558' E
BS-80	8° 30.9840' N	76° 52.7867' E
BS-81	8° 31.1988' N	76° 52.6188' E

The water samples (132 from four locations) were collected and 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 water samples were collected in the month of June 2021 for the pre-monsoon period and in September 2021 for the monsoon period.

The location co-ordinates of water sampling locations are provided below:

Table 3-6: Water Sampling Locations

WATER SAMPLING LOCATIONS WGS-84, UTM Projection, CM 75° East, Zone 43, North			
Location	**Water Depth (m)**	**Latitude**	**Longitude**
L1 (Mulloor)	21.1	08° 21.923' N	76° 58.860' E
L2 (Proposed Dredge dumping)	23.2	08° 21.705' N	76° 59.565' E
L3 (Pachalloor)	27.4	08° 24.143' N	76° 56.268' E
L4 (Poovar)	23.0	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 Hannemol

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 during the period.

Table 4-2: Personnel

Shankar And Co.	
Name	**Designation**
Vishtasp Mehta	Project Manager
Unnikrishnan K.U.	Party Chief / Surveyor
Vishnu Haridas	Land Surveyor
Vaishak K.R.	Land Surveyor
Vishnu Haridas	Land Surveyor
Sanjeevanee Khaire	Data Processor (Navi Mumbai office)
Adani Vizhinjam Port Pvt. Ltd.	
Name	**Designation**
Hebin C.	Manager - Environment
Jesse Fullonton	Assistant Manager - Environment

5 SURVEY EQUIPMENT DETAILS

5.1 Wave Rider Buoy

The Datawell DWR (G) Wave Rider Buoy (WRB) 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 WRB 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°.

Since the WRB is GPS based, it does not require any calibration.

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:

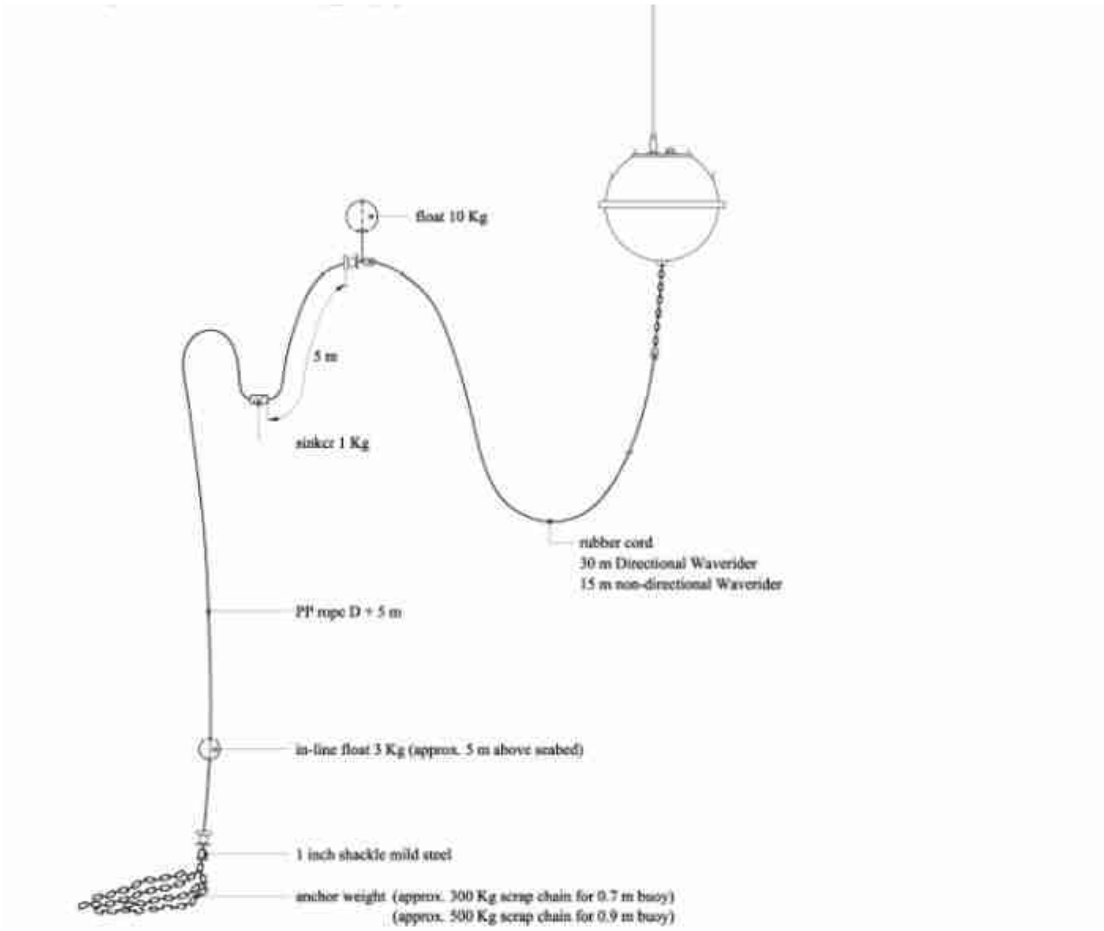


Figure 5-1: WRB Mooring Diagram

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 WRB without hindering the wave data measurements along with sufficient crew on board for around the clock watch-keeping.

A photograph of WRB deployed at the location is shown below:

Figure 5-2: WRB deployed at site

5.2 Current Meter

Teledyne Workhorse Sentinel 600 KHz Acoustic Doppler Current Profilers (ADCP) and Nortek Aquadopp 600 KHz ADCP's were installed at locations P1, P2, P3 and P4, namely, Vizhinjam, Poovar, Pachalloor and Mulloor for different seasons. 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 in an upward looking mode.

Figure 5-3: ADCP deployment at Vizhinjam

.

5.3 Automatic Tide Gauge

The Valeport Tidemaster Automatic Tide Gauge (ATG) was installed at the Coast Guard jetty, inside the fishing harbour for measuring the tides. The tide gauge is a pressure-sensor based instrument, measuring the water level due to change in pressure on the surface of sensor. The sensor was installed in a 6m 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 6-minute intervals throughout the duration of the project.

The ATG was shifted slightly towards northeast due to a concrete wall being constructed, which would otherwise cause an obstruction while carrying out maintenance or downloading the data. A new temporary benchmark was established with respect to the existing benchmark at the previous ATG location whose value is 3.447m above Chart Datum (CD). The levelling was carried out using an Autolevel. The x and y coordinates were established using RTK and the z value was also cross-checked. The elevation of the new benchmark was established at 3.268m above CD.

A photograph of the tide gauge location is shown below:

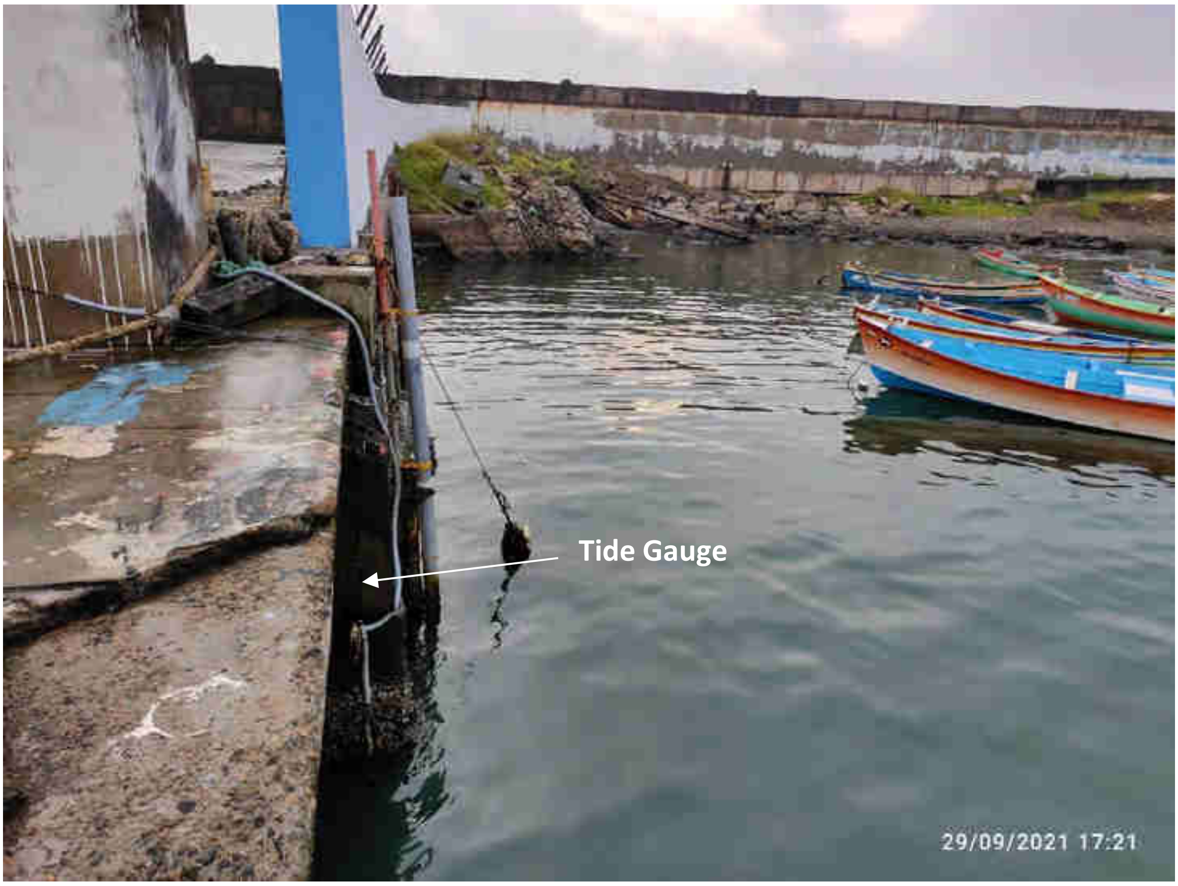


Figure 5-4: Tide Gauge

The specifications of Valeport Tidemaster ATG is provided below:

Model	:	Tidemaster
Type	:	Vented Strain Gauge with stainless steel mounting
Range	:	Standard 10 dBar (~10m)
Accuracy	:	±0.1 % Full scale

5.4 Automatic Weather Station (AWS)

A Gill Metpack Automatic Weather Station (AWS) was installed on the terrace of the Port Control Office building. The system measures wind speed/direction, atmospheric pressure, temperature, relative humidity and rainfall.

The system consists of the following:

- Sonic anemometer
- Relative humidity & temperature sensor
- Pressure sensor
- Rainfall 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.

Some images of the automatic weather station are provided below:

①

Figure 5-5: AWS on top of Port Control Office building

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 35 Pro RTK system with base station and rover. A photograph of the system is provided below:

Figure 5-6: RTK System with base station and rover

5.6 Multibeam Echo Sounder System

A Geoswath 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 prior to each survey. The calibration values obtained in the month of August 2021 are given below.

Table 5-1: MBES Calibration results

Parameter	Value	Comments
Latency	0.00s	Seapath 130 Positioning System with beacon corrections.
Port Roll	0.32°	Seapath 130-H MRU accuracy 0.03º in roll
Starboard Roll	-0.03°	Seapath 130-H MRU accuracy 0.03º in roll
Port Pitch	0.53°	
Starboard Pitch	0.04°	
Port Yaw	-5.20°	Accuracy better than 0.2°
Starboard Yaw	-4.50°	Accuracy better than 0.2°

5.7 DGPS Positioning System

Vessel positioning was carried out by the Seapath dual antenna 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
① numbers, depths, PDOP (Position Dilution of Precision) and along-line distances were logged to the hard drive.

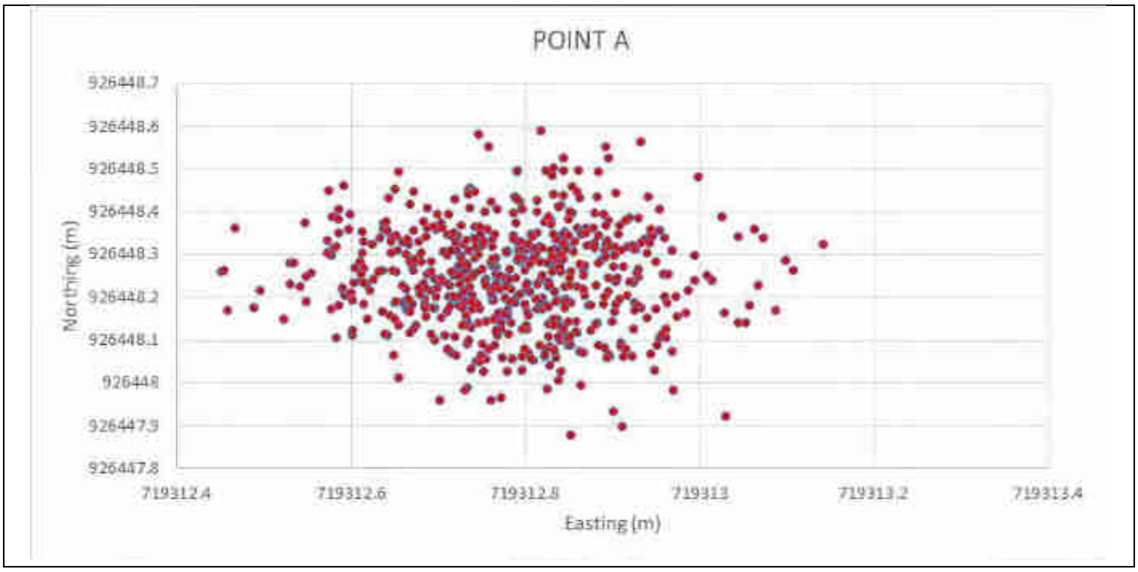
5.7.1 DGPS Consistency Check

In order to determine the integrity and reliability of the positioning system, the system was checked for its consistency during mobilization. The DGPS calibration for the month of August 2021 is provided in this report.

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 130H 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. The scatter plot of the DGPS calibration is shown in the figure below.



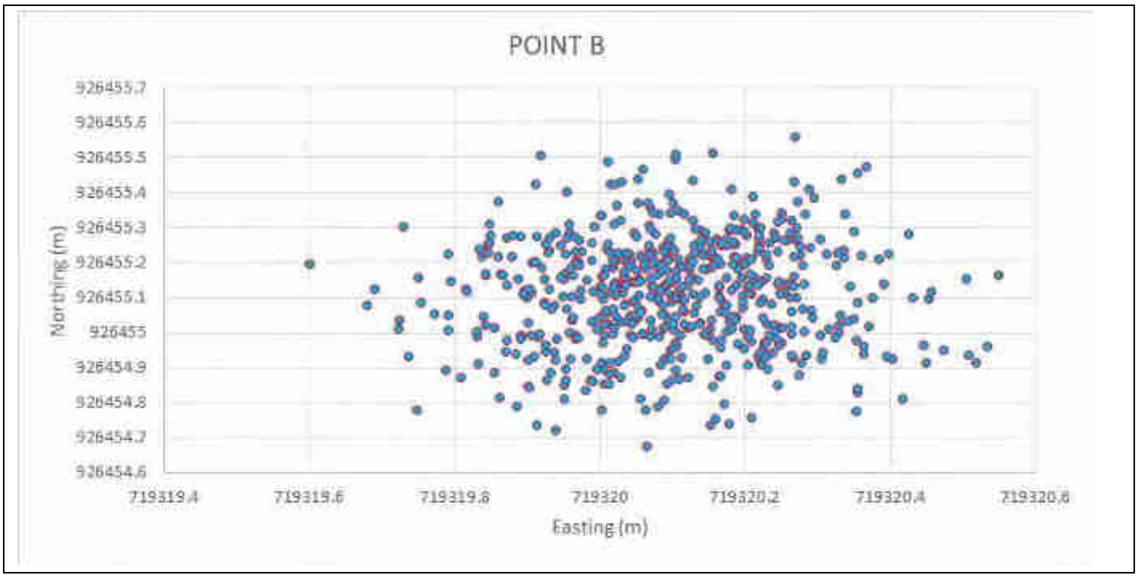


Figure 5-7: Scatter Plot of DGPS calibration on board M.F.B. Bethel

①

Table 5-2: DGPS Calibration results

AVERAGE POSITIONS		
POINT	**LATITUDE**	**LONGITUDE**
A	08° 22' 34.49" N	76° 59' 29.87" E
B	08° 22' 34.71" N	76° 59' 30.11" E
Distance between points		**10.03 m**
Measured Distance		**10.00 m**
Difference		**0.03 m**

5.7.2 Gyrocompass Calibration

The calculated heading of the vessel was compared with the recorded gyrocompass heading to derive a calculated-observed (C-O) value, which was entered into the navigation software before commencing the survey. The gyro calibration for the month of August 2021 is provided in the figure below.

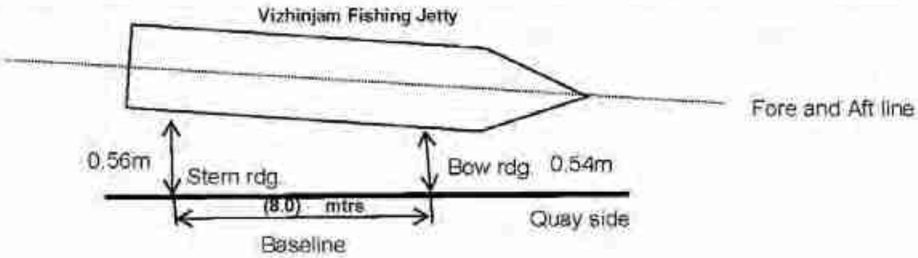
GYRO CALIBRATION

(Quay/Tape off set Method)

Job	AVPPL Shoreline Monitoring	Job No	P167-19
Client	AVPPL	Vessel	MFB Bathel
Location	Vizhinjam Fishing Jetty	Date	17-Aug-21
Gyro S/N	130-168		

Quay heading(T)	Baseline length(m)	Gyro Name : SEAPATH	Quayside on:
46.77	8.00	S/No. 130-168	Starboard

Observations				Calculations			
Time	Gyro (true)	Bow	Stern	Calc. angle	Calculated Heading	True Quay Hdg	C-O
11:00:00	46.6	0.4	0.9	3.58	43.02	46.77	3.75
11:00:10	46.7	0.3	0.5	1.43	45.27	46.77	1.50
11:00:20	46.3	0.7	0.6	-0.72	47.02	46.77	-0.25
11:00:30	46.8	0.9	0.3	-4.29	51.09	46.77	-4.32
11:00:40	46.8	0.5	0.8	2.15	44.65	46.77	2.12
11:00:50	46.6	0.7	0.2	-3.58	50.18	46.77	-3.41
11:01:00	46.9	0.3	0.6	2.15	44.75	46.77	2.02
Average	46.67	0.54	0.56	0.10	46.57	46.77	0.20



Note: Drawing not on scale only for representaion purpose

Signed			
Designation	Name	Signature	Date
Surveyor	Vishnu Haridas		17-Aug-21
Party Chief	Unnikrishnan K U		17-Aug-21

Figure 5-8: Gyrocompass Calibration on board M.F.B. Bethel

5.8 Turbidity Monitoring

Optic sensors manufactured by Ponsel, France were used to measure the turbidity at all locations. The sensors are installed on a 6m buoy which houses a telemetry module. A battery which is charged by solar panels fitted on the buoy is used to power the system. The buoy is deployed on a two-point mooring system as shown in the figure below.

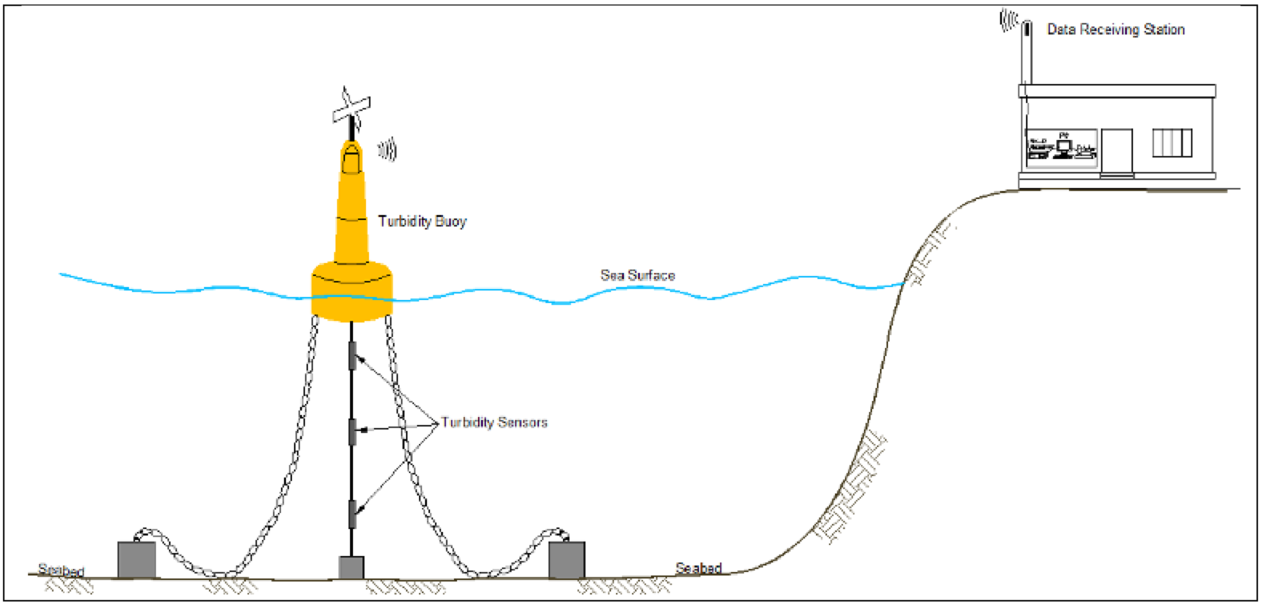


Figure 5-9: Turbidity buoy Mooring Diagram

The sensor details are provided below:

Make	:	Ponsel by Aqualabo France
Sensor Type	:	Nephelo/TU
Range	:	0 to 2000 NTU

The data from the turbidity buoys was transmitted and recorded on the server at an interval of every 10 minutes. A photograph of a turbidity buoy is shown in the figure below.

Figure 5-10: Turbidity Buoy-1

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 (TBM) is marked on the wharf and is 3.268m above chart datum. An image of the TBM is provided below:

Figure 6-1: Location of TBM

The data obtained from the ATG was validated by carrying out random manual tide checks using measuring tape. Some of the random manual tide checks for the month of September 2021 are given in the table below:

Table 6-1: Manual vs ATG tide reading comparison

Date & Time	ATG Reading (m)	Manual Reading (m)	Difference (m)
06/09/2021 16:00	1.182	1.16	0.02
06/09/2021 16:06	1.157	1.14	0.02
06/09/2021 16:12	1.131	1.12	0.01
06/09/2021 16:18	1.113	1.12	0.01
06/09/2021 16:24	1.074	1.10	0.03
06/09/2021 16:30	1.138	1.10	0.04
25/09/2021 10:06	1.009	1.01	0.00
25/09/2021 10:12	1.068	1.05	0.02
25/09/2021 10:18	1.092	1.08	0.01
25/09/2021 10:24	1.047	1.08	0.03
25/09/2021 10:30	1.093	1.11	0.02

From the above table it can be inferred that the data obtained from the ATG is meeting the required accuracy.

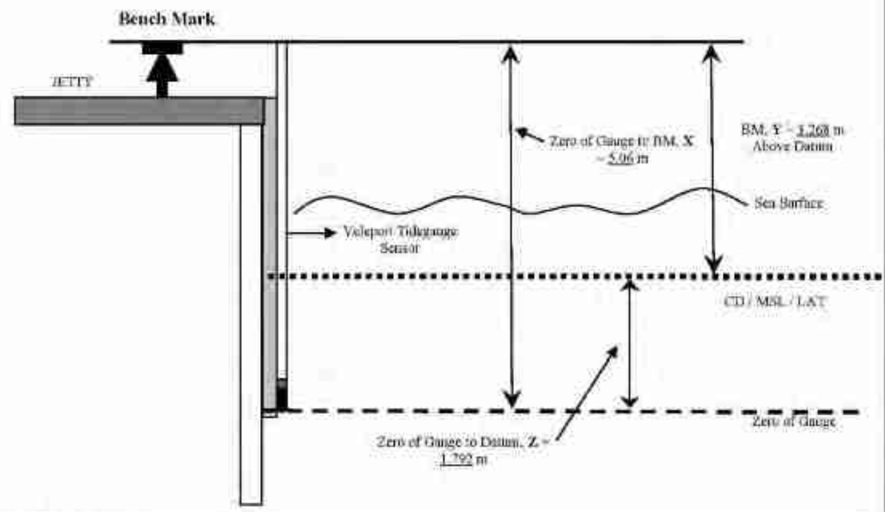
The offset calculation of the Tidemaster tide gauge based on the 'jetty top' value is given in the figure below:

TIDE GAUGE INSTALLATION

Job Number	P167-19	**Project**	Shoreline Monitoring at Vizhinjam
Client	Adani Vizhinjam Port Pvt. Ltd.		
Location	Vizhinjam	**Installation Date**	23/04/2021
Tide Gauge Sr. No.	75804	**Party Chief**	Unnikrishnan K U

Tide Gauge setup refers to:	✓	**CD**		**MSL**		**LAT**

Diagram



Bench Mark details:

Value of Bench Mark	**3.268 meters above the Chart Datum**
Levelled By	**Amit Giri Kumar**
Date	**23/04/2021**

Checked the level from zero of the gauge to BM on: 17/06/2021

Calculations:

X, Length from Bench Mark to Zero of Tide Gauge	**5.06 m**
Y, Level of Bench Mark above Datum	**3.268 m**
Z, Tide Correction factor, Z=X - Y	**1.792 m**
Tide height in m above Datum = Raw Tide reading - Z	

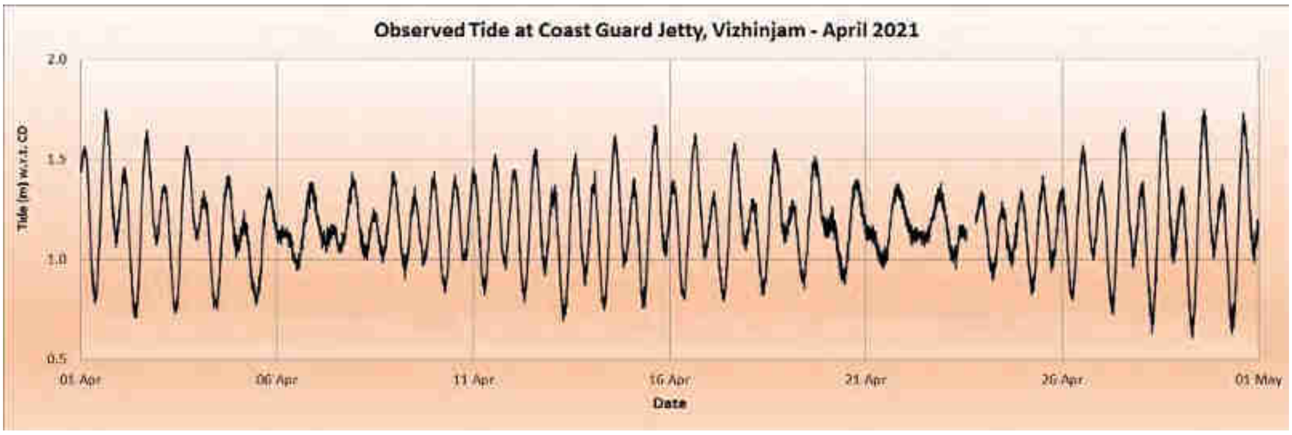
Signature:

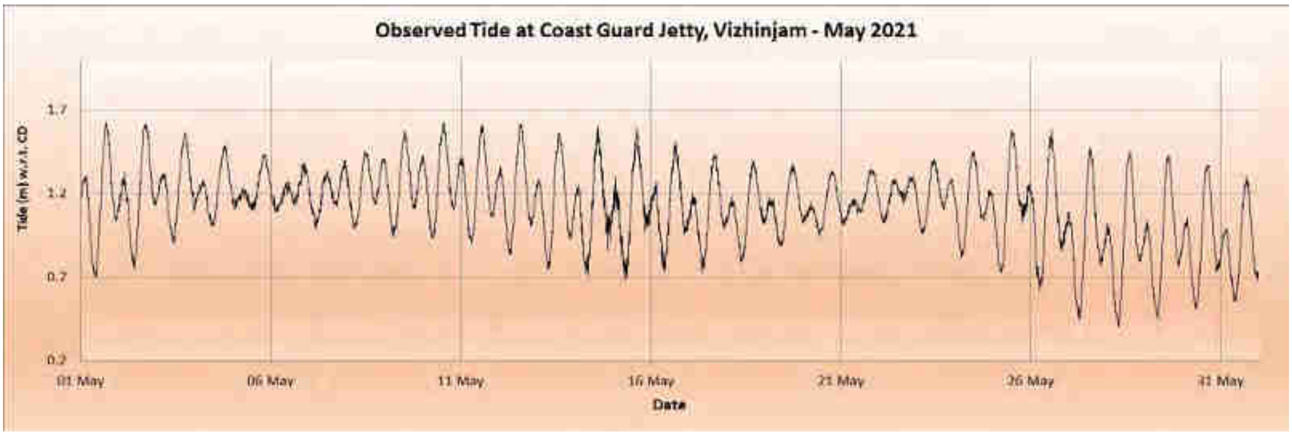
Surveyor / Engineer	**Vishnu Haridas**
Party Chief	**Unnikrishnan K U**

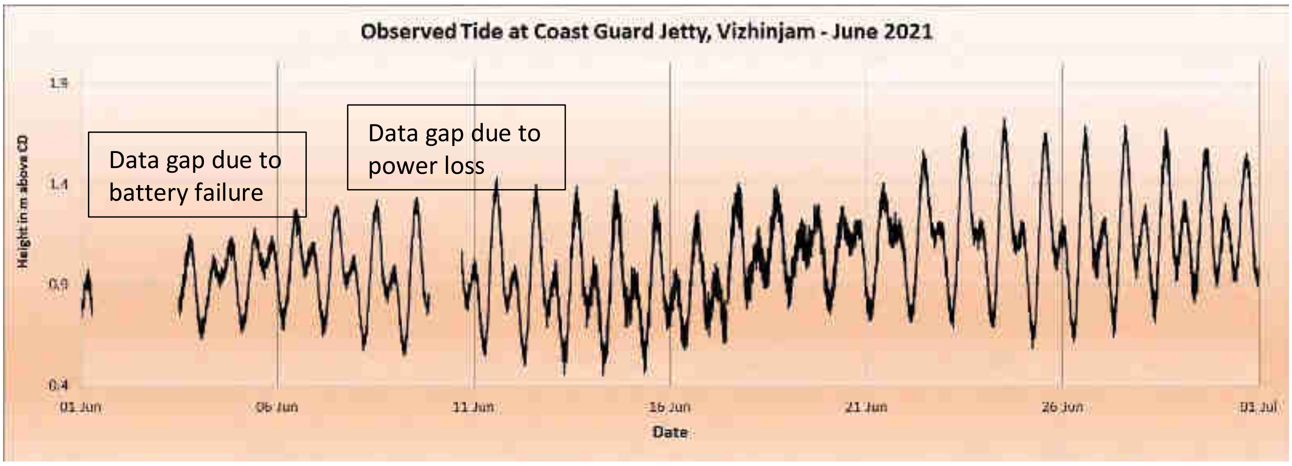
DOC-SAC Tide Gauge Installation Rev 0

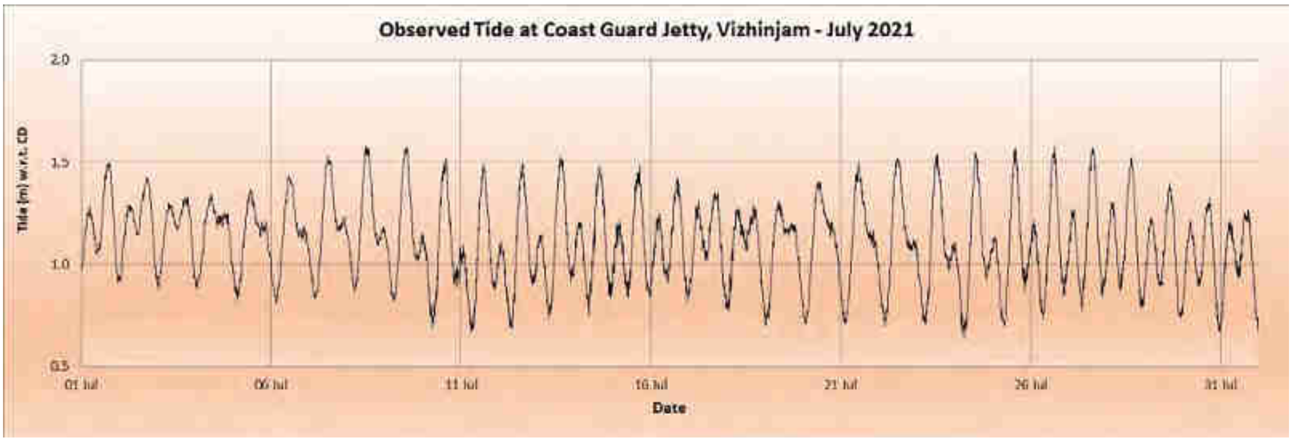
Figure 6-2: Schematic Diagram of Valeport Tidemaster Tide Gauge

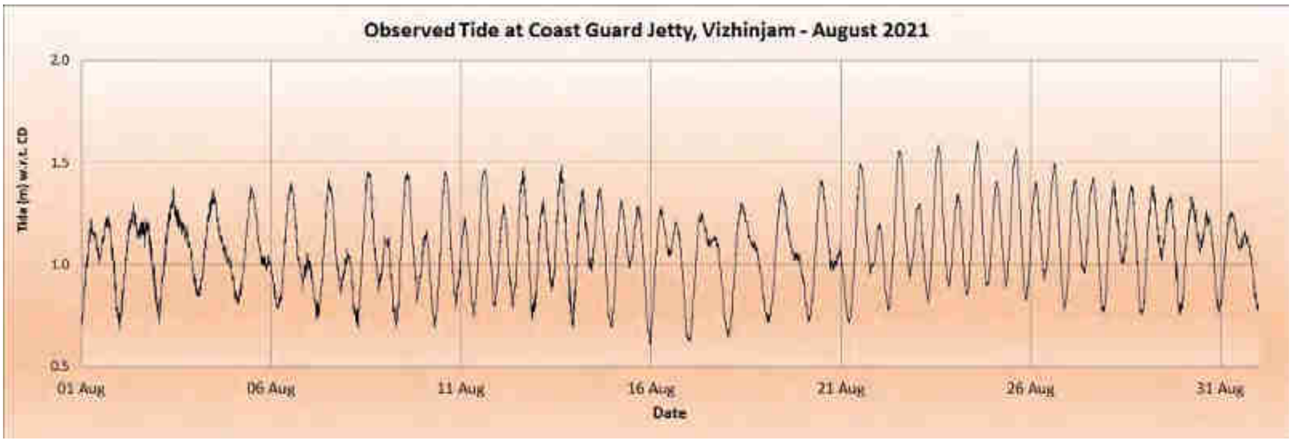
The tides observed are mixed semi-diurnal in nature, with the maximum range being observed in the springs. The representation of tide data collected, in the form of graphs is placed below.











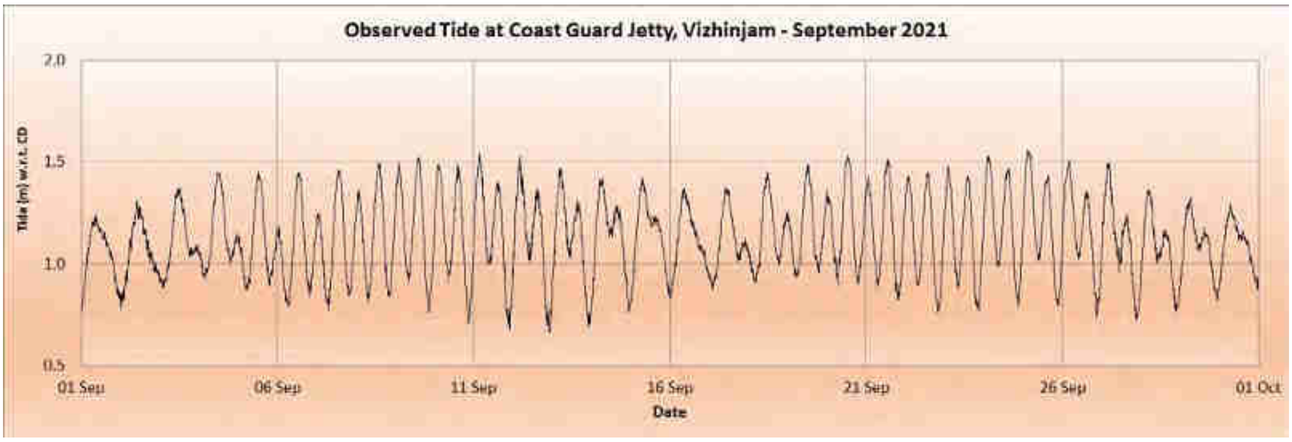


Figure 6-3: Time series of tide

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 plots of significant height (Hs) v/s direction for the entire period from April to September 2021:

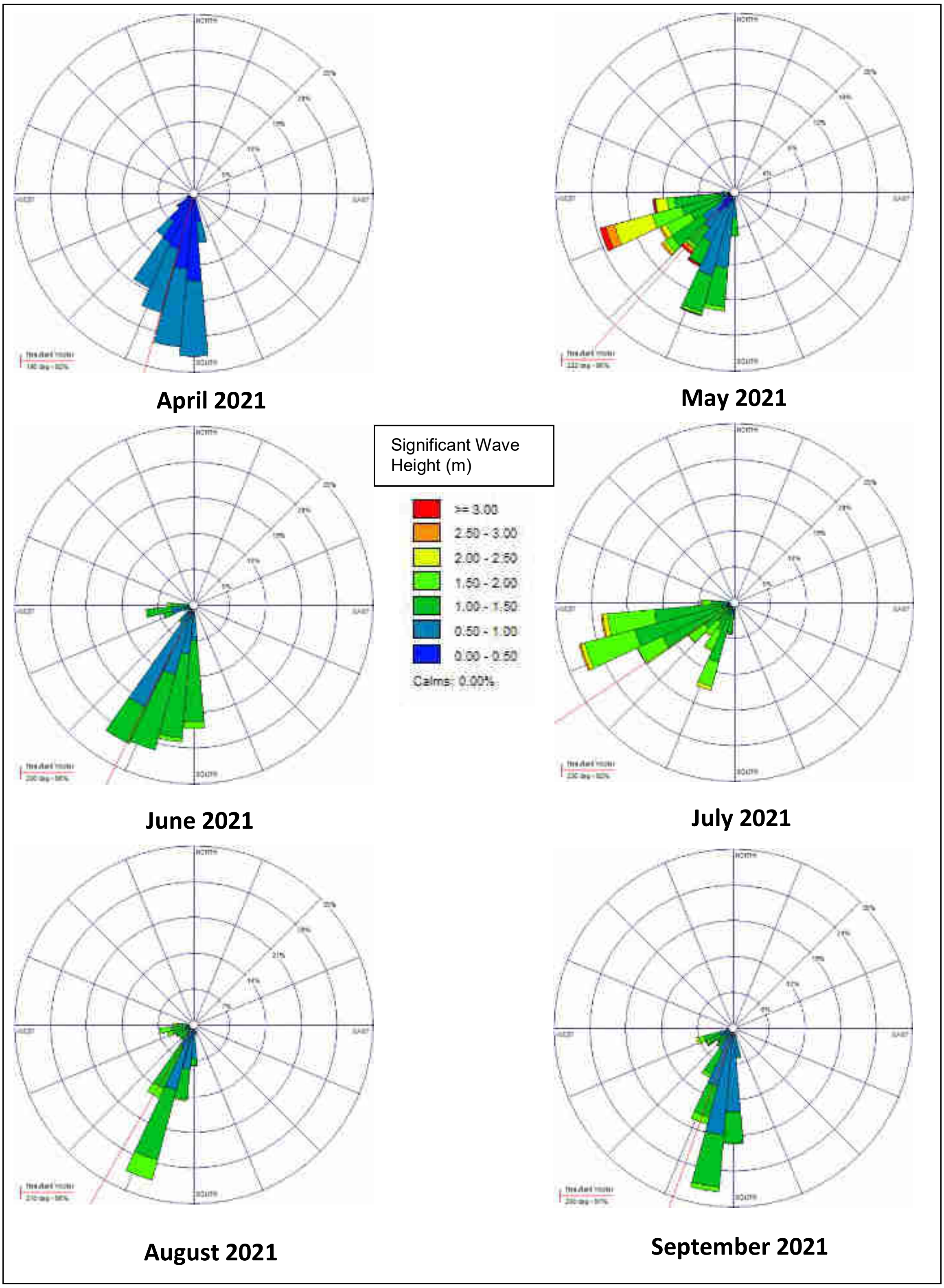


Figure 6-4: Wave Rose (Hs in metre v/s Direction)

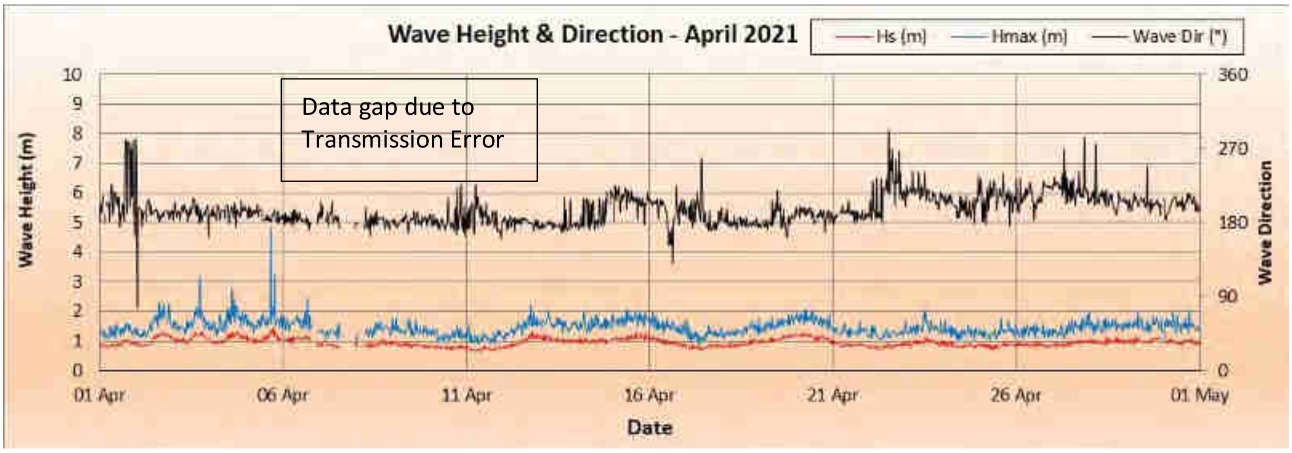
The following table provides the monthly maximum significant wave height (Hs) and wave period (Tp) observed during the seasons.

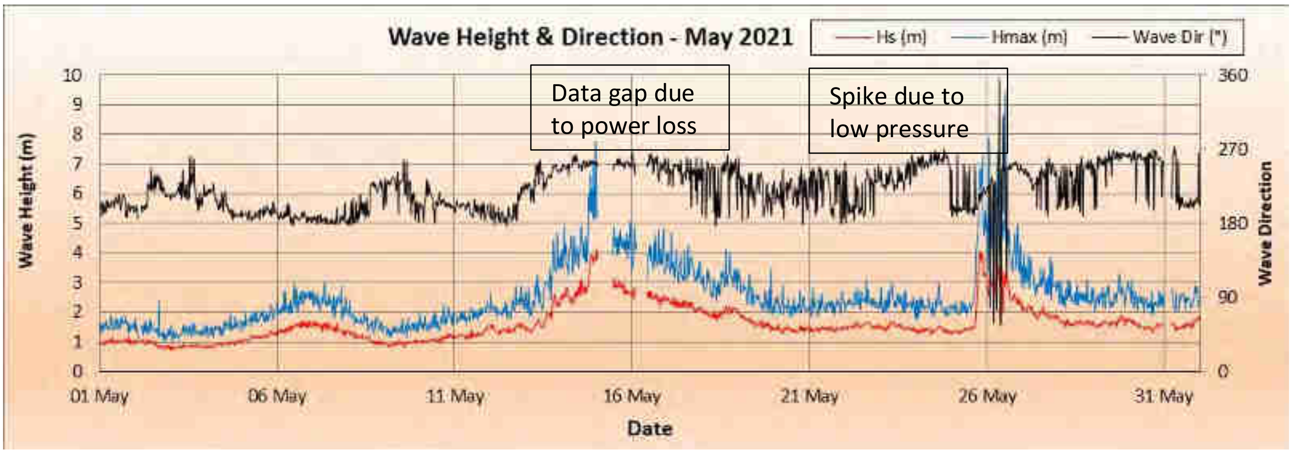
Table 6-2: Monthly maximum Hs, Hmax and Tp

Maximum significant wave height (Hs), Hmax and Maximum wave period (Tp)				
Month	**Hs (m)**	**Predominant Direction (°)**	**Hmax (m)**	**Tp (sec)**
April 2021	1.44	196	4.87	18.18
May 2021	4.12	222	9.44	18.18
June 2021	2.23	206	4.06	18.18
July 2021	3.38	236	5.74	18.18
August 2021	2.51	210	4.47	20.00
September 2021	2.99	200	6.67	18.18

The above table indicates that with the onset of monsoon, the wave heights increased.

① The time series of wave data from April to September 2021 is shown below. The data gaps are a result of either power loss at receiving station or transmission errors. On 9th June 2021, the WRB stopped transmitting data completely due to battery drainage. It was towed to shore and redeployed on 24th June after changing the battery and maintenance.


Wave Height & Direction - April 2021
Hs (m)
Hmax (m)
Wave Dir (°)
Data gap due to Transmission Error
Wave Height (m)
Wave Direction
01 Apr
06 Apr
11 Apr
16 Apr
21 Apr
26 Apr
01 May
Date


Wave Height & Direction - May 2021
Hs (m)
Hmax (m)
Wave Dir (°)
Data gap due to power loss
Spike due to low pressure
Wave Height (m)
Wave Direction
01 May
06 May
11 May
16 May
21 May
26 May
31 May
Date


Wave Height & Direction - June 2021
Hs (m)
Hmax (m)
Wave Dir (°)
Data gap due to Transmission Error
Data gap due to battery drained. WRB towed to shore and maintenance carried out by NIOT.
Data gap due to Power Loss
Wave Height (m)
Wave Direction
01 Jun
06 Jun
11 Jun
16 Jun
21 Jun
26 Jun
01 Jul
Date

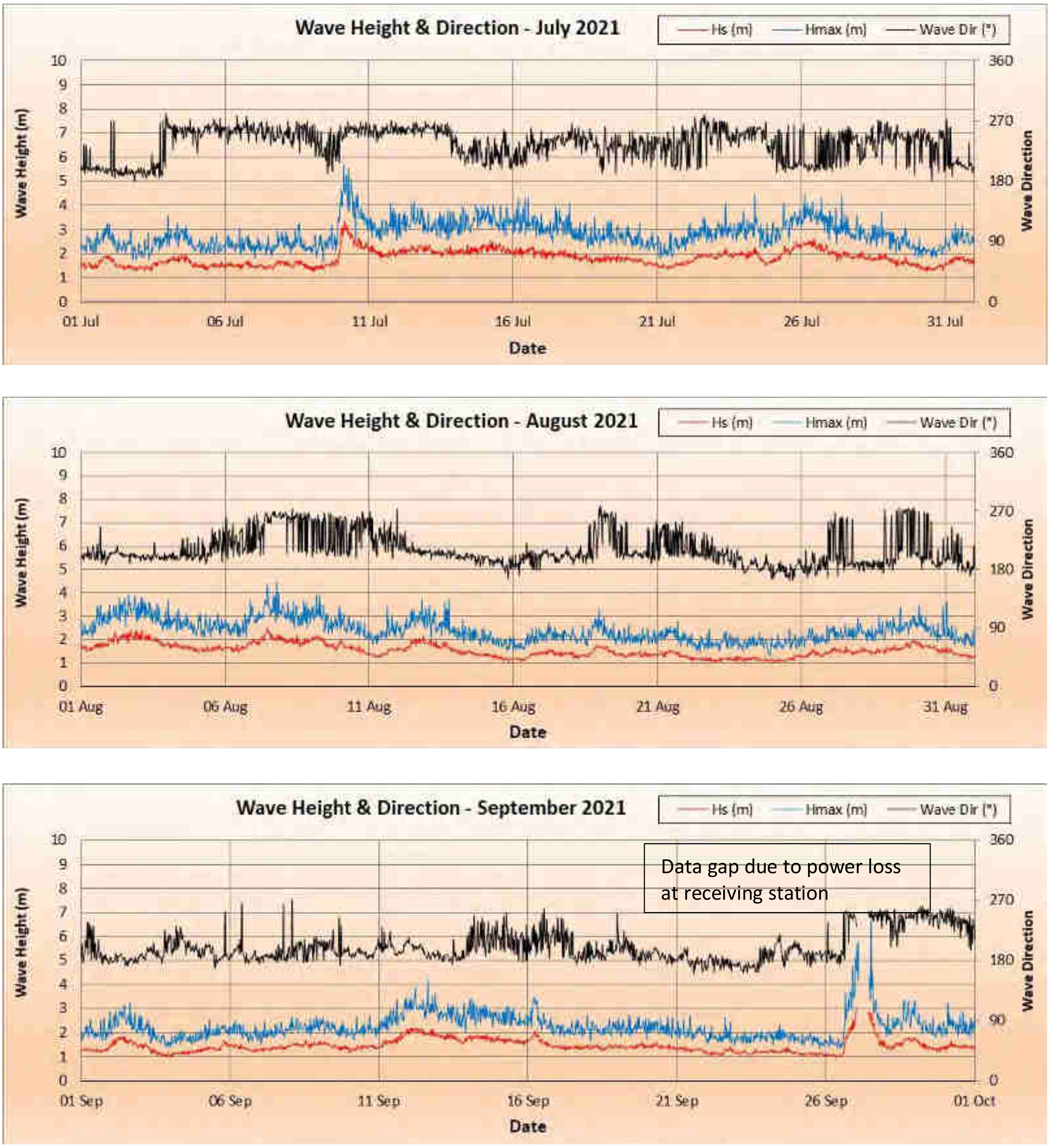


Figure 6-5: Time series of wave parameters

6.3 Current Measurements

Current meters were deployed at four locations during for pre-monsoon as well as monsoon period to measure the speed and direction of the current at three different levels, i.e., surface, mid-depth and near bottom.

The following table gives the deployment details of the ADCPs in the survey area for all the seasons.

Table 6-3: ADCP mooring locations and observation period

Location	Water Depth (m)	Period of Observation (Pre-monsoon 2021)	Latitude	Longitude	Frequency
P1 (Vizhinjam)	22.1	22nd Apr – 23rd May 2021 24th Aug – 18th Sep 2021	08° 21' 55.4"N	76° 58' 51.6"E	600 kHz
P2 (Poovar)	23.1	22nd Apr – 23rd May 2021 24th Aug – 12th Sep 2021	08° 17' 35.8"N	77° 04' 03.5"E	600 kHz
P3 (Pachalloor)	21.9	22nd Apr – 22nd May 2021 24th Aug – 23rd Sep 2021	08° 24' 08.6"N	76° 56' 16.1"E	600 kHz
P4 (Mulloor)	22.9	22nd Apr – 22nd May 2021 24th Aug – 23rd Sep 2021	08° 21' 42.3"N	76° 59' 33.9"E	600 kHz

The following table provides the maximum surface currents recorded at each location during the Pre-monsoon and monsoon 2021 periods.

Table 6-4: Maximum speed of surface currents

Maximum Surface Current Speed in cm/s				
Season	Location P1 (Vizhinjam)	Location P2 (Poovar)	Location P3 (Pachalloor)	Location P4 (Mulloor)
Pre-monsoon 2021	118.0	106.4	110.6	70.9
Monsoon 2021	81.8	76.8	117.1	137.9

The current rose plot of surface current speed at Location 1 (Vizhinjam) is shown below.

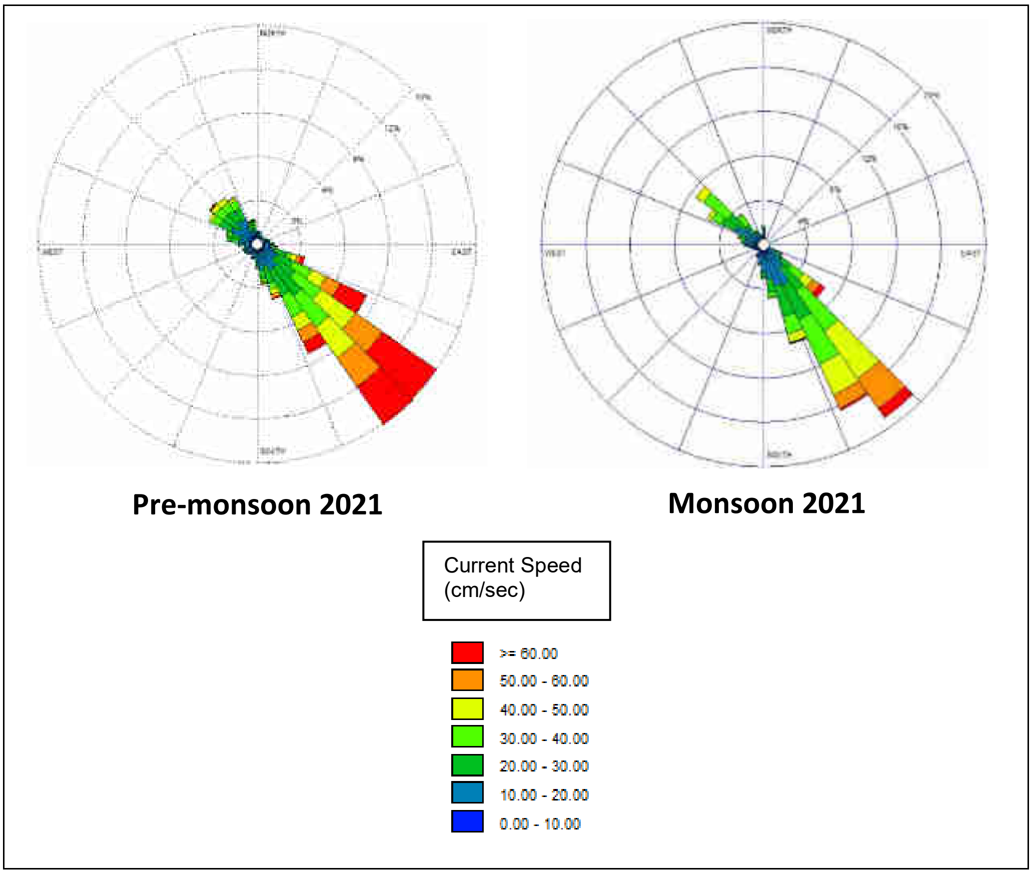


Figure 6-6: Rose Plot (surface speed in cm/sec) – P1 (Vizhinjam)

The rose plot reveals a flow parallel to the shore. During the observation period, the flow was predominantly towards the southeast.

The current rose plot of surface current speed at Location 2 (Poovar) is shown below.

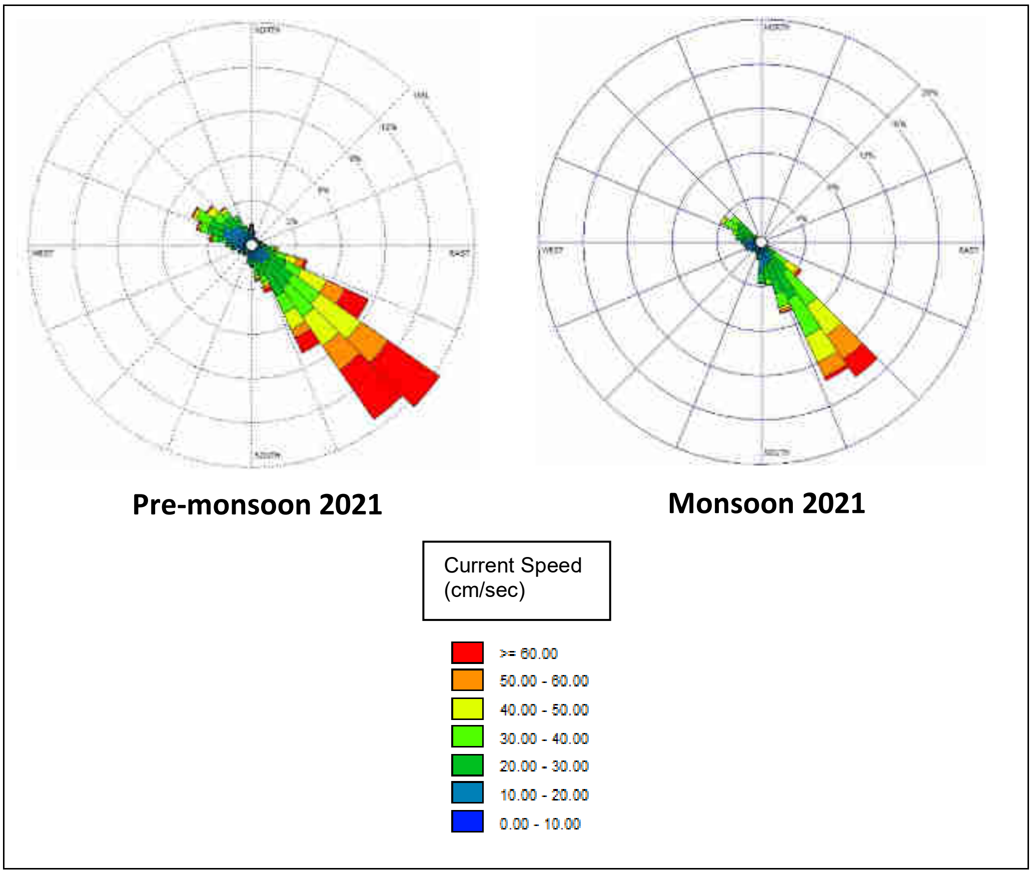


Figure 6-7: Rose Plot (surface speed in cm/sec) – P2 (Poovar)

The rose plot reveals a flow parallel to the shore. During the observation period, the flow was predominantly towards the southeast.

The current rose plot of surface current speed at Location 3 (Pachalloor) is shown below.

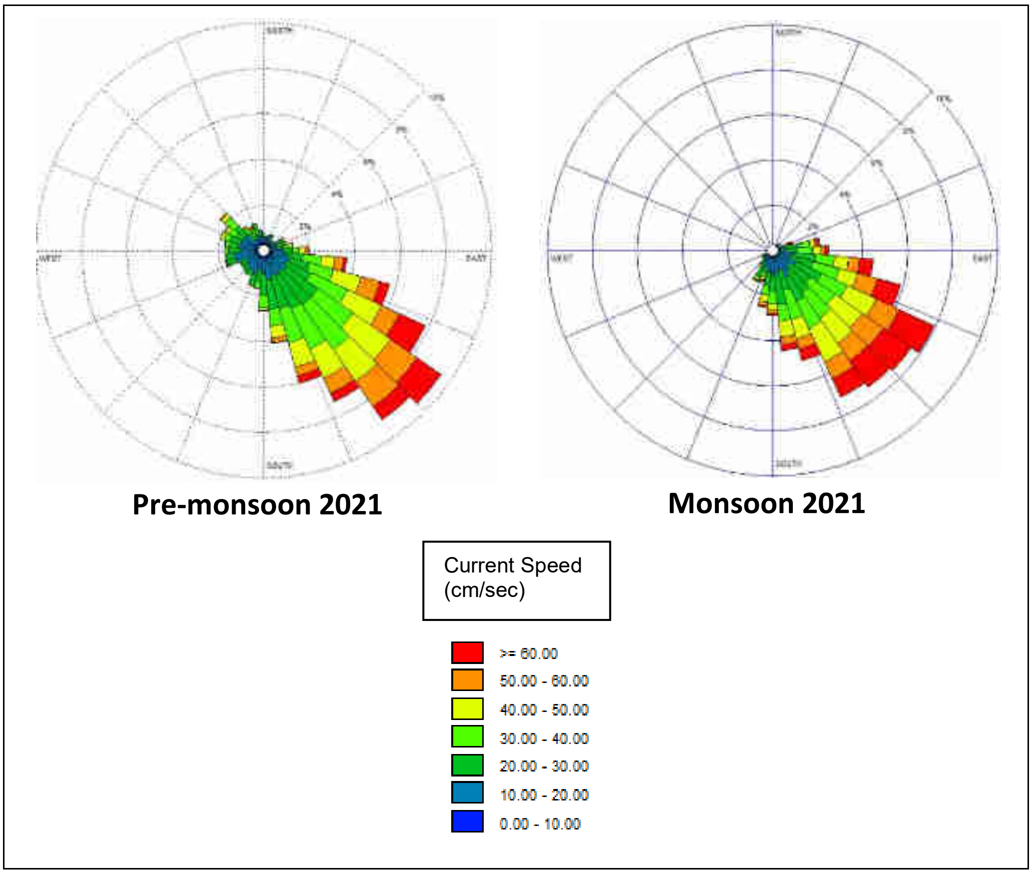


Figure 6-8: Rose Plot (surface speed in cm/sec) – P3 (Pachalloor)

The rose plot reveals a flow parallel to the shore and was predominantly towards the southeast.

The current rose plot of surface current speed at Location 4 (Mulloor) is shown below.

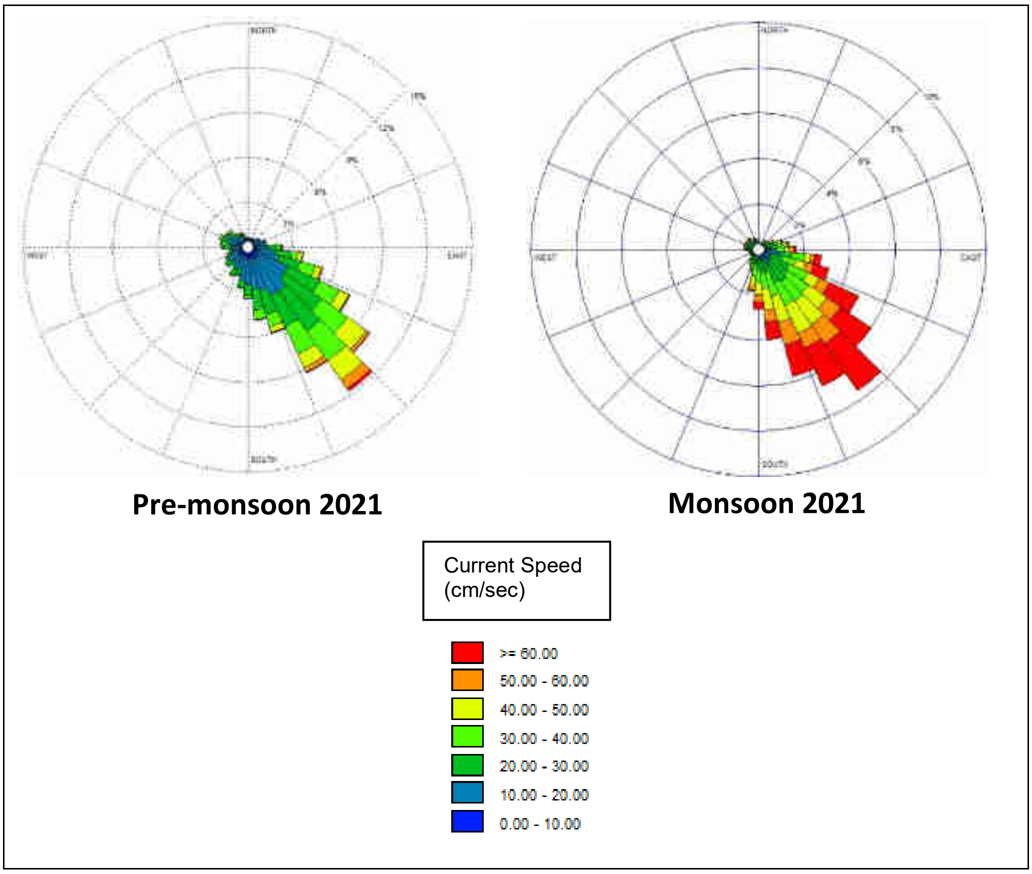


Figure 6-9: Rose Plot (surface speed in cm/sec) – P4 (Mulloor)

The rose plot reveals a flow parallel to the shore and was predominantly towards the southeast.

6.4 Measurement of Meteorological Parameters

The automatic weather station was installed on the terrace of the Port Control Office building. The wind data for all the months is compiled and presented in the form of rose plots below.

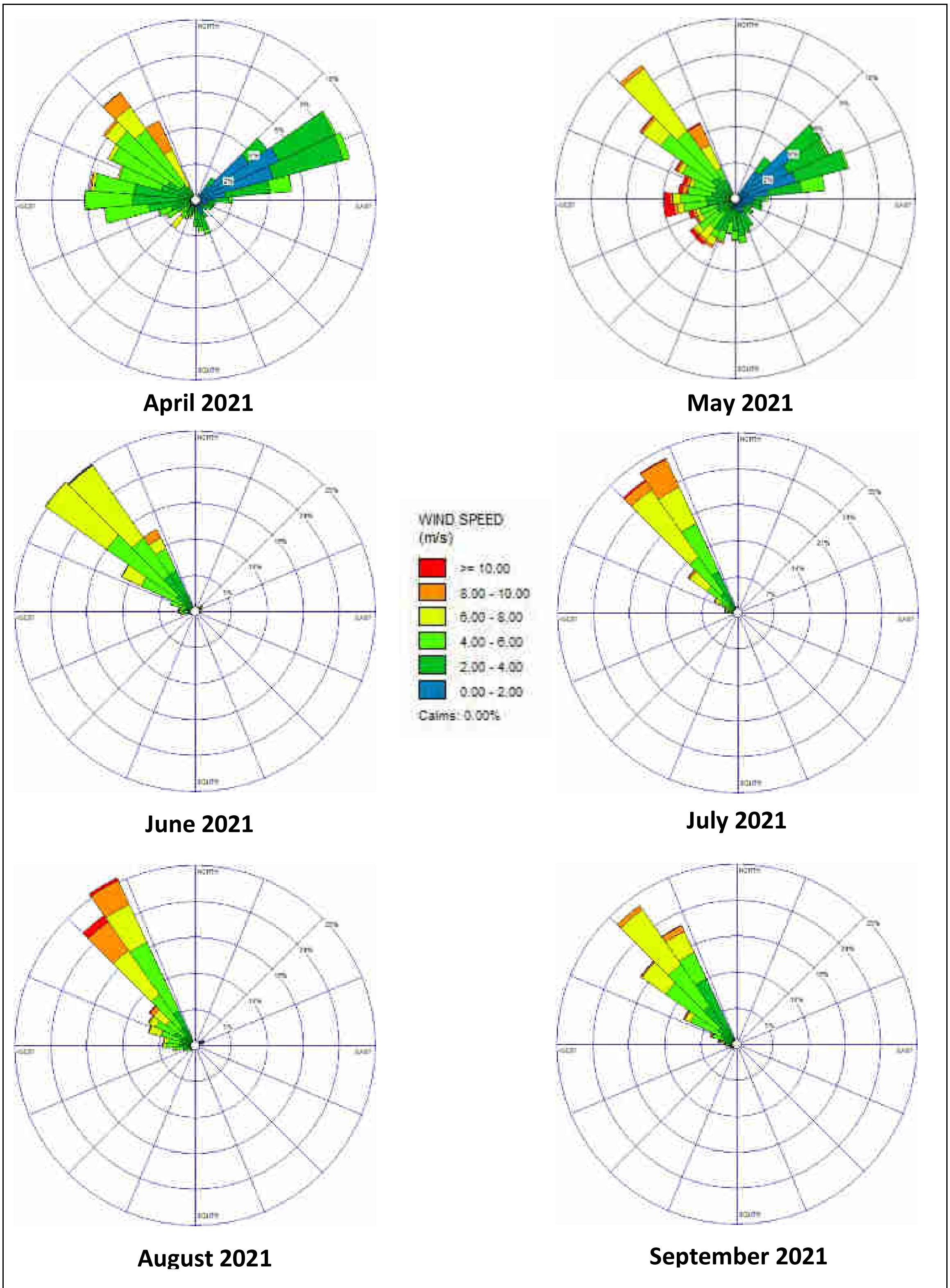


Figure 6-10: Wind rose (Speed in m/s vs direction)

The monthly maximum wind speed and predominant direction are provided in the tables below.

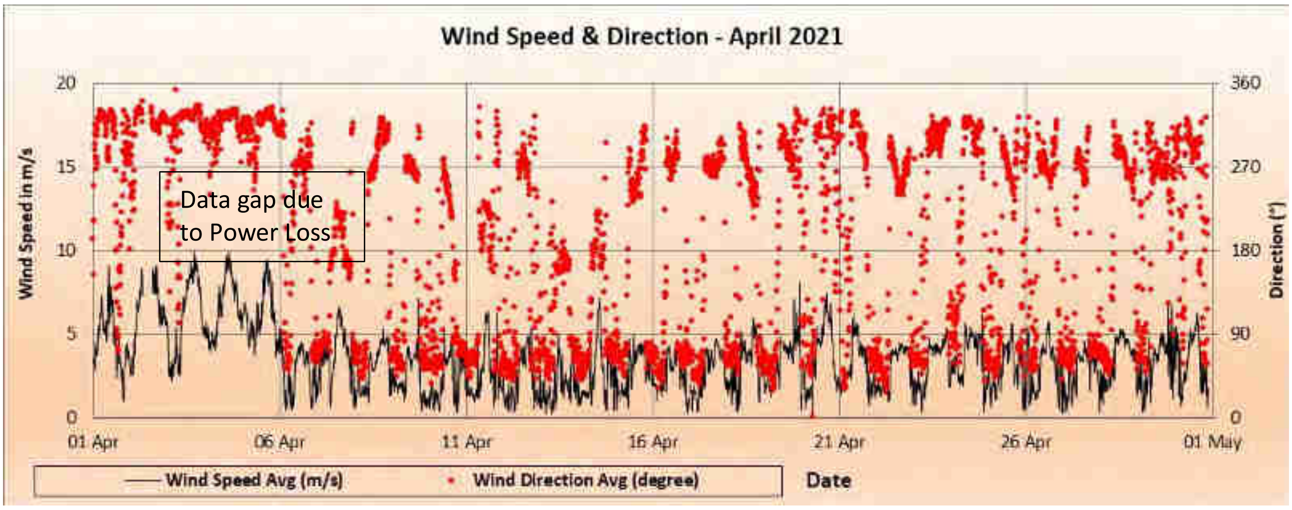
Table 6-5: Monthly maximum wind speed from seaside

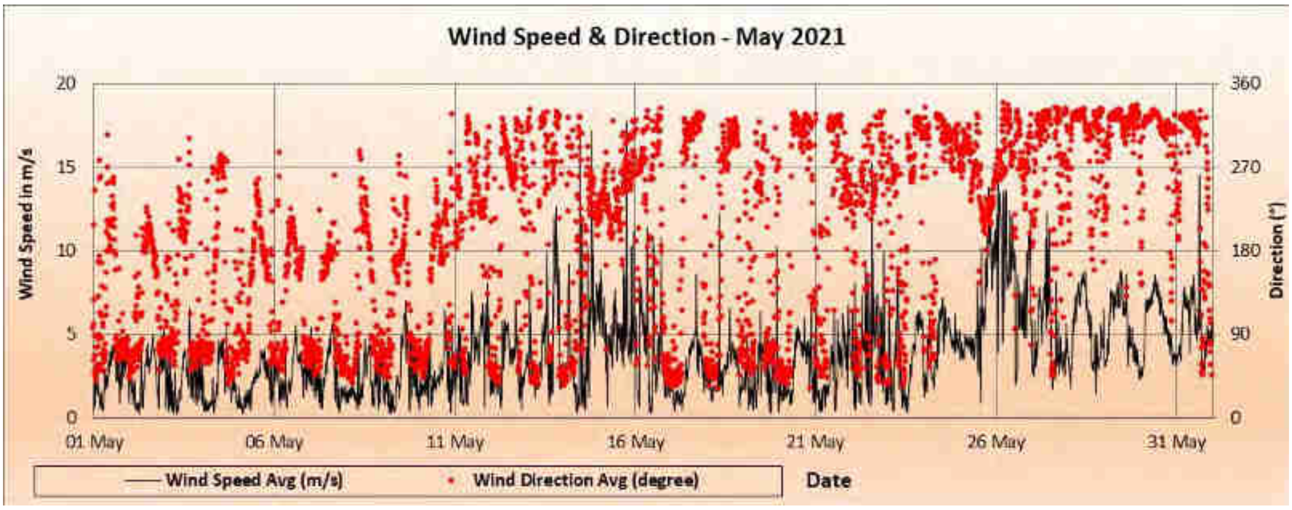
Month	Wind Speed (m/s)	Predominant Direction (°)
April 2021	9.99	285.0
May 2021	17.63	277.9
June 2021	16.72	312.1
July 2021	14.75	321.3
August 2021	16.57	316.8
September 2021	24.21	315.1

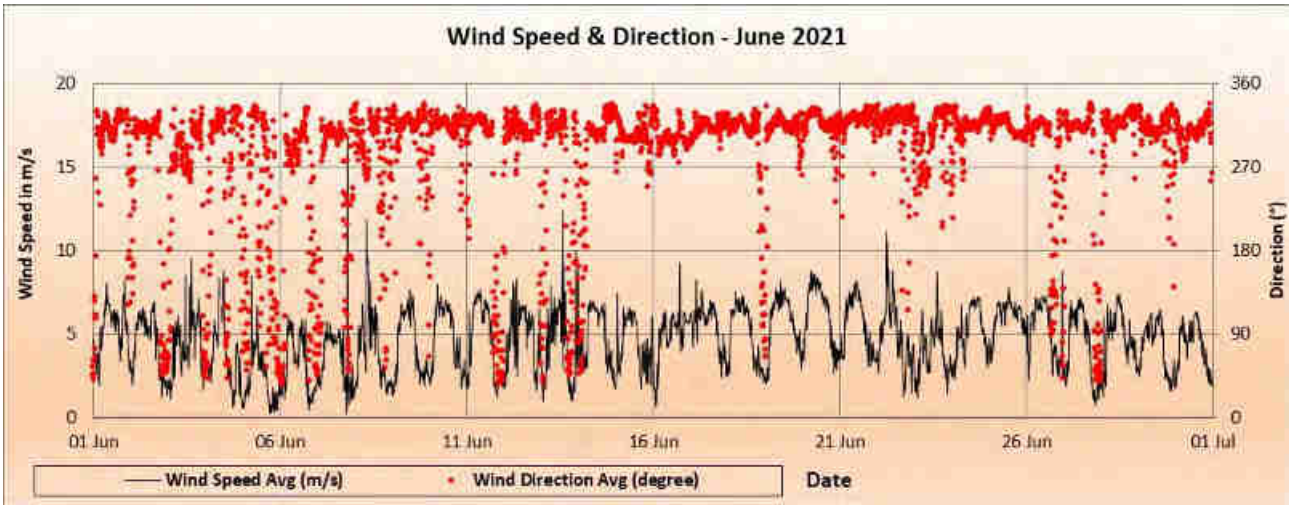
Table 6-6: Monthly maximum wind speed from landside

Month	Wind Speed (m/s)	Predominant Direction (°)
April 2021	7.10	70.3
May 2021	10.75	74.1
June 2021	5.10	89.4
July 2021	10.50	97.2
August 2021	9.72	81.1
September 2021	7.04	107.4

The time series of wind data from April to September 2021 is shown below.


Wind Speed & Direction - April 2021
Data gap due to Power Loss
Wind Speed in m/s
Direction (°)
0
5
10
15
20
0
90
180
270
360
01 Apr
06 Apr
11 Apr
16 Apr
21 Apr
26 Apr
01 May
Wind Speed Avg (m/s)
Wind Direction Avg (degree)
Date


Wind Speed & Direction - May 2021
Wind Speed in m/s
Direction (°)
0
5
10
15
20
0
90
180
270
360
01 May
06 May
11 May
16 May
21 May
26 May
31 May
Wind Speed Avg (m/s)
Wind Direction Avg (degree)
Date


Wind Speed & Direction - June 2021
Wind Speed in m/s
Direction (°)
0
5
10
15
20
0
90
180
270
360
01 Jun
06 Jun
11 Jun
16 Jun
21 Jun
26 Jun
01 Jul
Wind Speed Avg (m/s)
Wind Direction Avg (degree)
Date

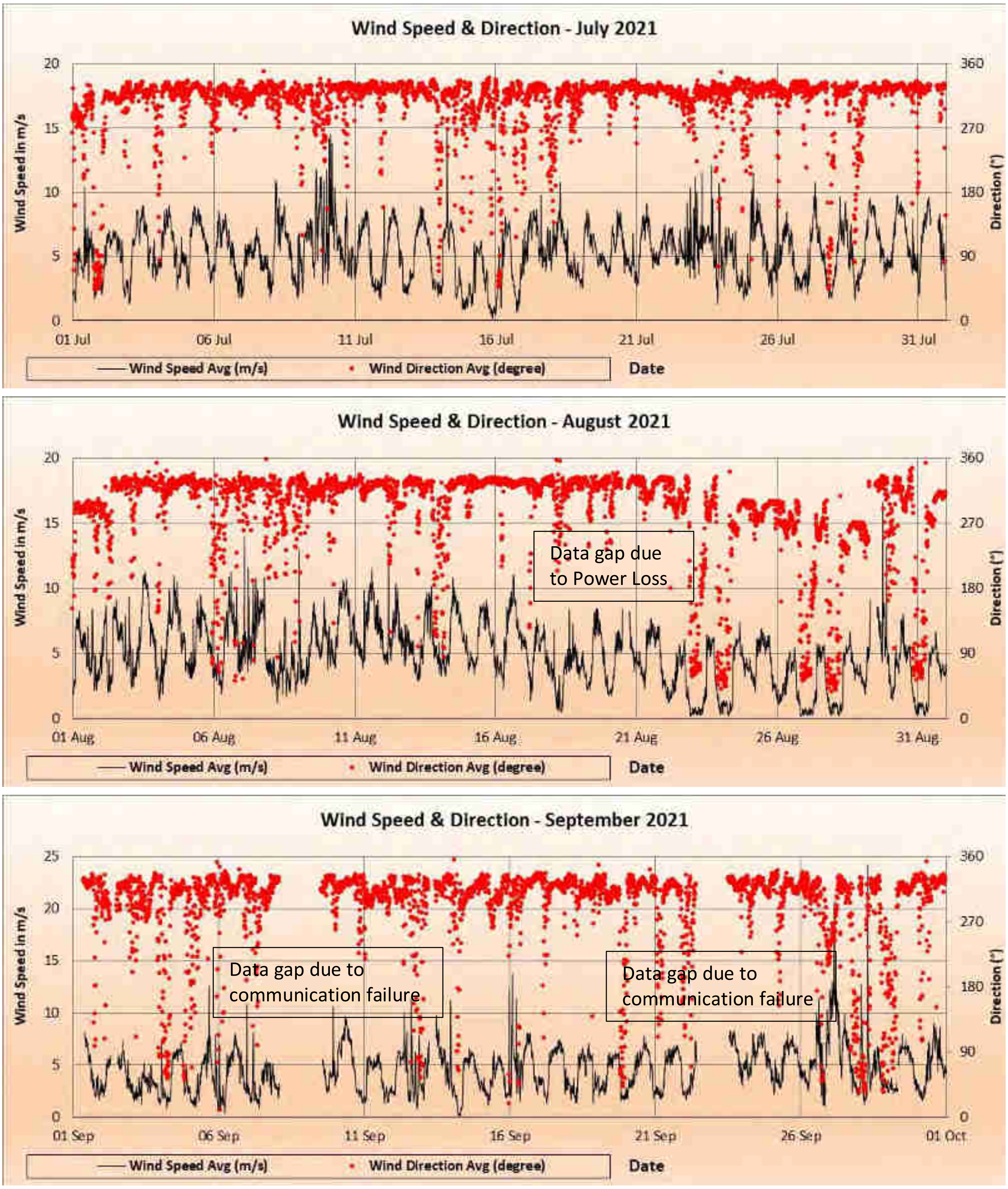


Figure 6-11: Time series of wind data

The percentage occurrence tables for atmospheric pressure, temperature and relative humidity for the period of April to September 2021 are shown below.

Table 6-7: Frequency distribution of atmospheric pressure

Frequency Distribution	**Apr-21**	**May-21**	**Jun-21**	**Jul-21**	**Aug-21**	**Sep-21**
Atm. Pressure (mb)	**Percentage Occurrence**					
<1000	0.00	0.00	0.00	0.00	0.00	0.00
1000-1004	0.68	2.31	0.00	3.95	0.57	1.76
1004-1008	43.04	74.93	60.15	67.62	34.96	63.43
>1008	56.28	22.76	39.85	28.43	64.47	34.81
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 6-8: Frequency distribution of temperature

Frequency Distribution	**Apr-21**	**May-21**	**Jun-21**	**Jul-21**	**Aug-21**	**Sep-21**
Temperature (°)	**Percentage Occurrence**					
20-24	0.00	0.09	0.79	1.56	6.11	1.05
24-28	33.53	53.48	73.69	93.13	81.60	95.71
28-32	66.47	46.43	25.52	5.31	12.29	3.24
>32	0.00	0.00	0.00	0.00	0.00	0.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 6-9: Frequency distribution of relative humidity

Frequency Distribution	**Apr-21**	**May-21**	**Jun-21**	**Jul-21**	**Aug-21**	**Sep-21**
Rel. Humidity (%)	**Percentage Occurrence**					
50-60	0.12	0.00	0.00	0.02	0.00	0.00
60-70	4.07	0.99	0.28	1.49	2.04	0.18
70-80	57.26	28.86	12.54	7.92	19.88	7.37
>80	38.54	70.15	87.18	90.56	78.08	92.45
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

The frequency histograms for atmospheric pressure, temperature and relative humidity for the period of April to September 2021 are shown below.

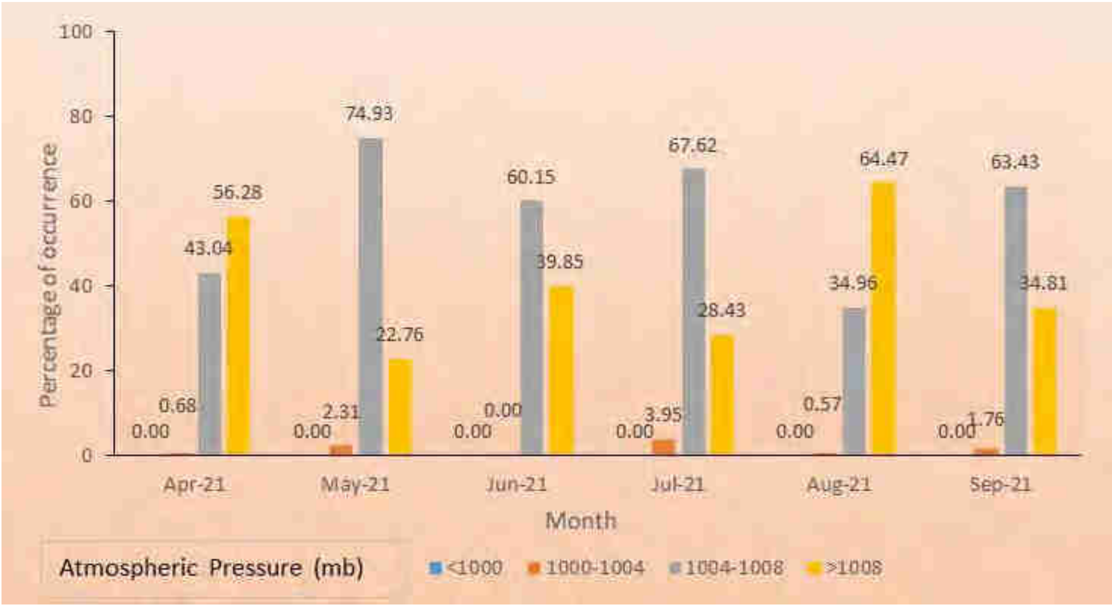


Figure 6-12: Histogram of atmospheric pressure

Figure 6-13: Histogram of temperature

Figure 6-14: Histogram of relative humidity

The following table shows the amount of rainfall received during the entire period from April to September 2021.

Table 6-10: Cumulative rainfall

Month	Cumulative Rainfall (mm)
April 2021	N/A
May 2021	326.6
June 2021	34.4
July 2021	156.2
August 2021	98.6
September 2021	326.4

The histogram of rainfall for the entire period is provided in the image below.

Figure 6-15: Histogram of cumulative rainfall

Note: Rainfall data is not available for the month of April 2021 as a result of a faulty electric contact in the rain gauge equipment.

6.5 Littoral Environment Observations

The LEO was carried out at all 81 locations in all the months. At CSP-32, the observations could not be carried out due to strong objection faced from the locals in the area up to the month of June 2021. 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 followed a northerly trend in the post-monsoon period and a northward trend during the pre-monsoon period. The following table shows the maximum along shore current speed recorded in each month.

① Table 6-11: Monthly maximum along shore current

Month	Max Speed (cm/s)	Predominant Direction	Line No.	Location
April 2021	15.99	North	CSP-77	Kochuveli
May 2021	27.00	North	CSP-78	Valiya Veli
June 2021	22.47	Bi-directional	CSP-53	Punthura
July 2021	62.90	South	CSP-54	Punthura
August 2021	20.38	South	CSP-54	Punthura
September 2021	15.80	South	CSP-54	Punthura

① A pictorial representation of the alongshore current direction for each of the seasons, i.e. pre-monsoon and monsoon 2021 is shown in the Google Earth image below.

Figure 6-16: Representation of surface current directions in different seasons

6.6 Photographic Documentation

Photographic documentation was carried out for all the 81 locations, coinciding with the cross-shore profiling.

The latest photographs for the month of September 2021 are provided in **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.

6.7 Cross Shore Profiles

The cross-shore profiling for the period was carried out using RTK in the onshore region and a wide swath bathymetric system in the offshore region. The nearest depth which could be attained was about 2 to 3m due to the presence of waves breaking in the zone. The boat is not able to approach this zone, due to breakers nearshore considering the safety of personnel onboard.

At CSP 32 in the onshore region, the cross shore profiling could not be carried out due to opposition from the local people. There is a steep hill which lies on the CSP 35 line, due to which cross-shore profiling is not possible in the onshore area.

① Due to entire field staff being under quarantine as a result of testing positive for Covid-19, the offshore part of the cross-shore profiling could not be carried out for the month of May 2021 and onshore profiling was also carried out for a few lines only i.e CSP 36, 37, 38, 39, 40, 40A, 75, 76, 77, 78, 79, 80 and 81.

In the month of June 2021, the field operations were severely hampered due to the government-imposed lockdown due to Covid-19 and the offshore CSP lines were carried out in extremely unfavourable weather, in which the data quality obtained was poor. Due to this, the data did not pass the quality control and was subsequently rejected. Onshore
① profiling could be carried out for CSP locations 36, 37, 38, 39, 40, 40A, 75, 77, 78, 79, 80 and 81 only.

The weather conditions further deteriorated in the month of July 2021 and offshore CSP survey could not be attempted, considering the safety of the boat, personnel and survey equipment.

On 27th September 2021, the multibeam survey boat capsized in the Vizhinjam Fishing Harbour due to high waves and strong wind caused due to the cyclone Gulab. The multibeam equipment was damaged and had to be sent for repair. As a result of this, only 60 offshore CSP lines were completed.

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

Table 6-12: CSP Location names

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

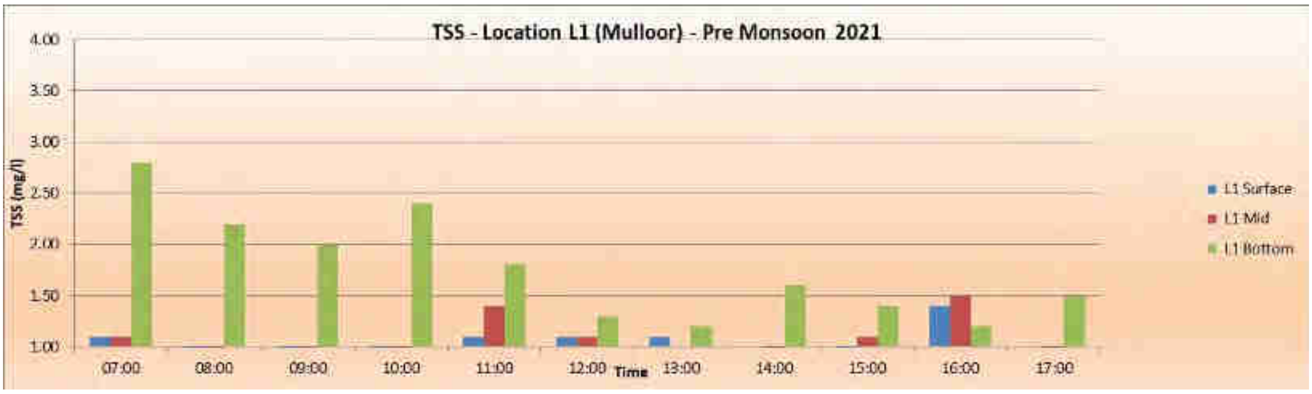
CSP NO.	LANDMARK	LOCATION	SITE CONDITION
CSP-38	ADANI PORT RECLAMATION AREA	ADANI PORT OFFICE VIZHINJAM	Seawall
CSP-39			Beach
CSP-40			Beach
CSP-40A			Beach
CSP-41	VIZHINJAM LIGHT HOUSE	KOVALAM	Beach
CSP-42			Beach
CSP-43			Beach
CSP-44			Beach
CSP-45			Seawall
CSP-46			Seawall
CSP-47	SAMUDRA BEACH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

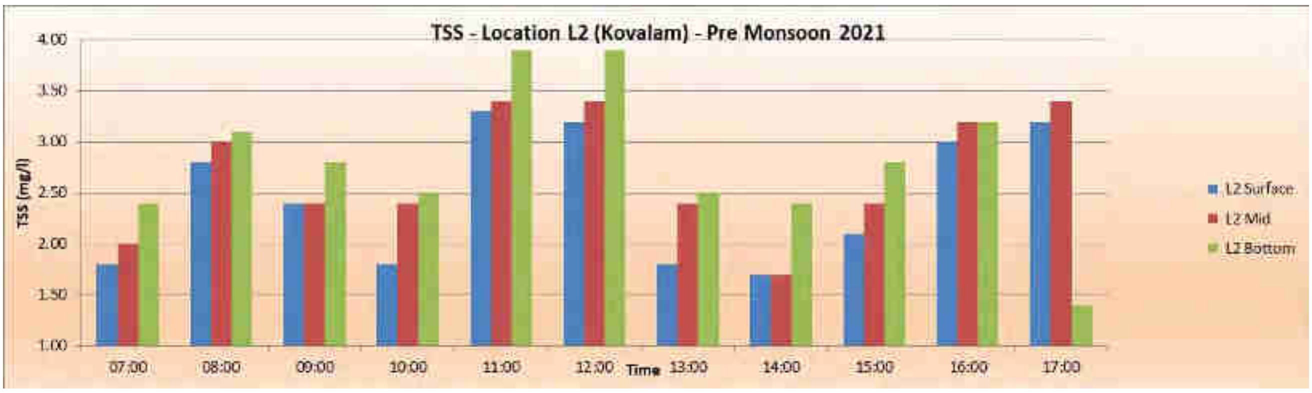
CSP NO.	LANDMARK	LOCATION	SITE CONDITION
CSP-76			Beach
CSP-77			Beach
CSP-78	ST. THOMAS' CHURCH	VALIYAVELI	Beach
CSP-79			Seawall
CSP-80	CHRISTIAN BROTHEREN CHURCH	THUMBA	Beach
CSP-81			Beach

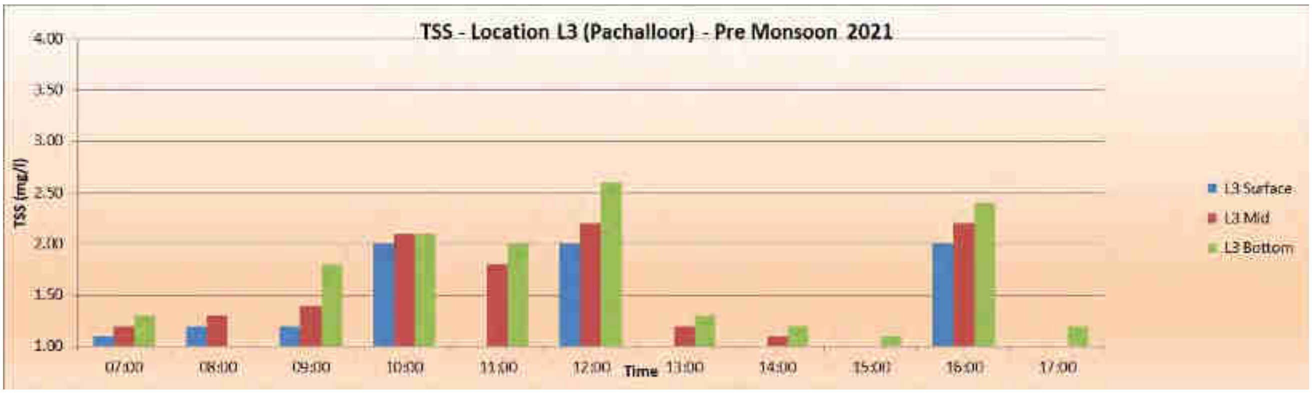
6.8 Water Sampling

① Water samples were collected from 4 locations, namely, L1 (Mulloor), L2 (Kovalam), L3 (Pachalloor) and L4 (Poovar) from three levels: surface, mid-depth and near bottom during the monsoon season from 25th to 30th June 2021 and post-monsoon season from 20th to 23rd September 2021. The parameters measured were Total Suspended Solids, Turbidity and Salinity at NABL accredited laboratory in Kochi (Standard's Environmental & Analytical Laboratories, Accreditation and Approval: NABL as per ISO 17025:2005).

① The time series for Total Suspended Solids (in mg/l) for the above locations are provided below.







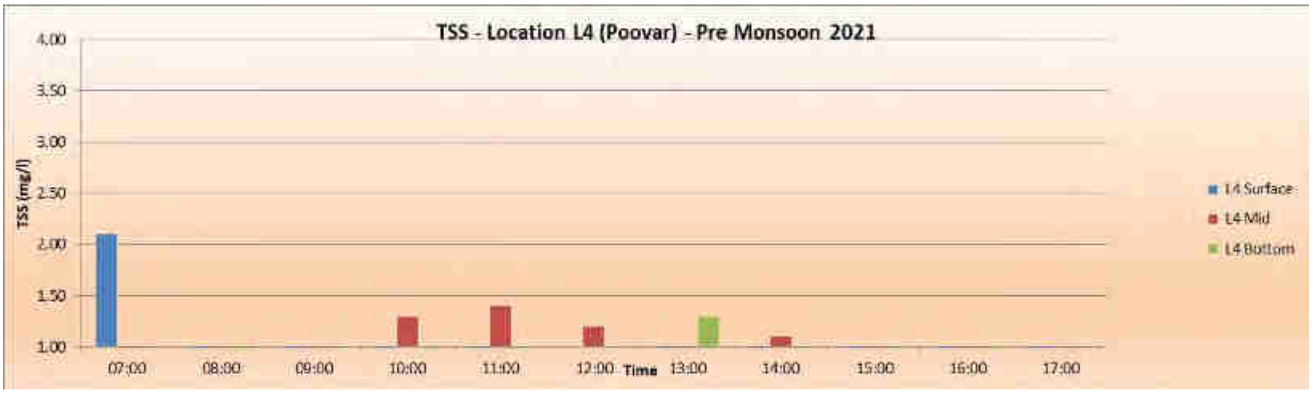
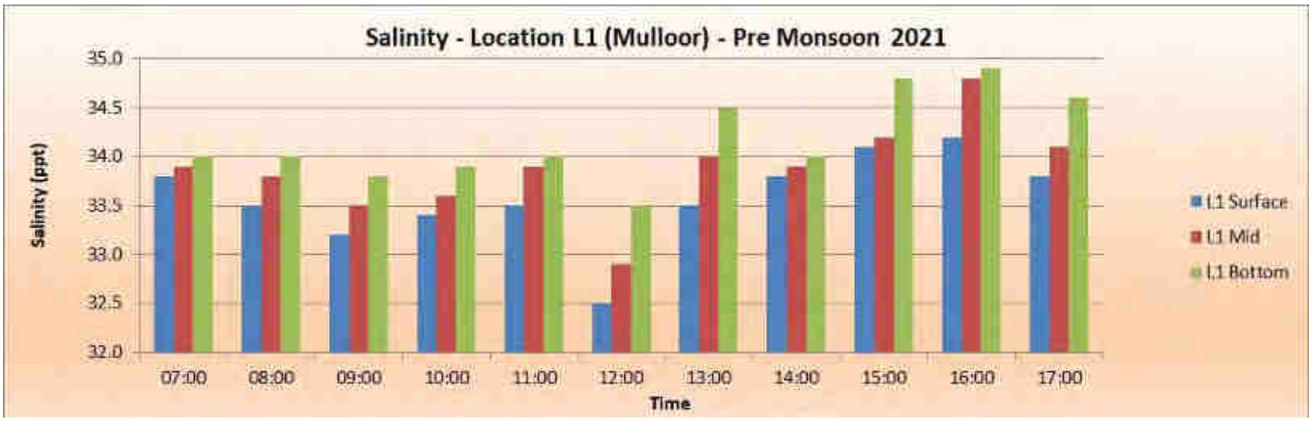


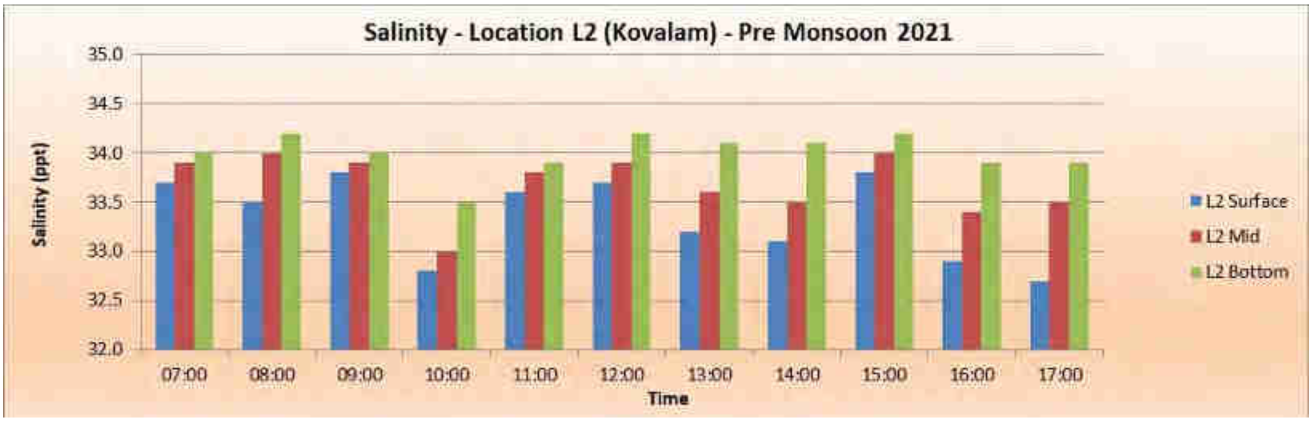
Figure 6-17: Time Series of TSS

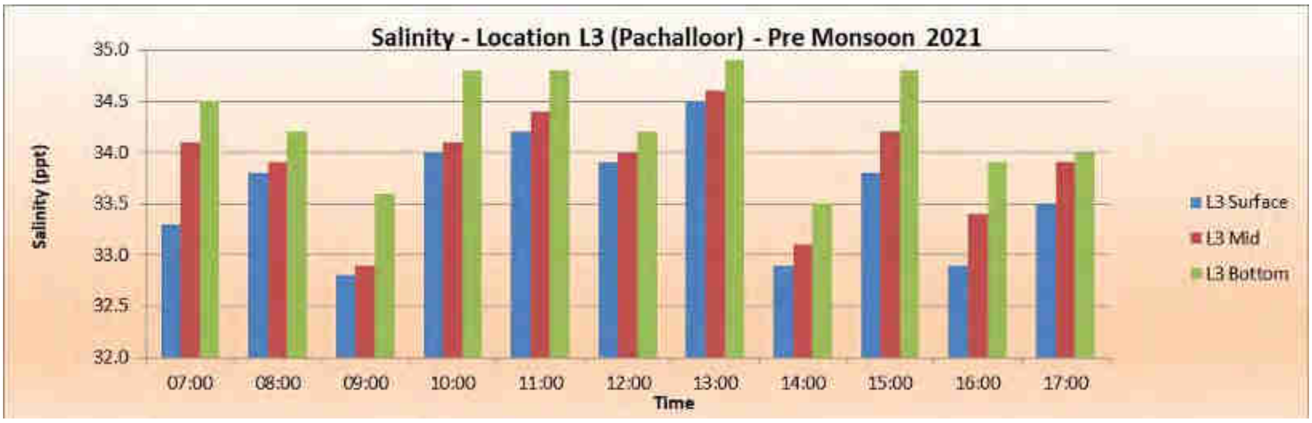
- The maximum Total Suspended Solids recorded was 3.9 mg/l near the bottom at Location L2 (Kovalam) for the pre-monsoon 2021 period.

- ***Note:*** *The Minimum Detectable Limit of the system is 1.00 mg/l. Any values below this are not shown in the bar chart.*

The time series for salinity at all three levels for all the locations is given as follows.







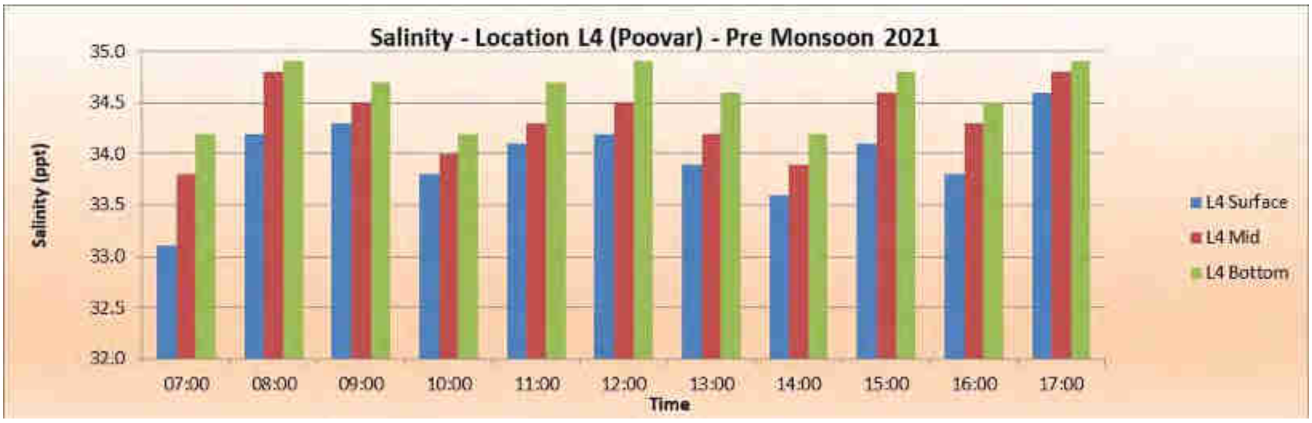
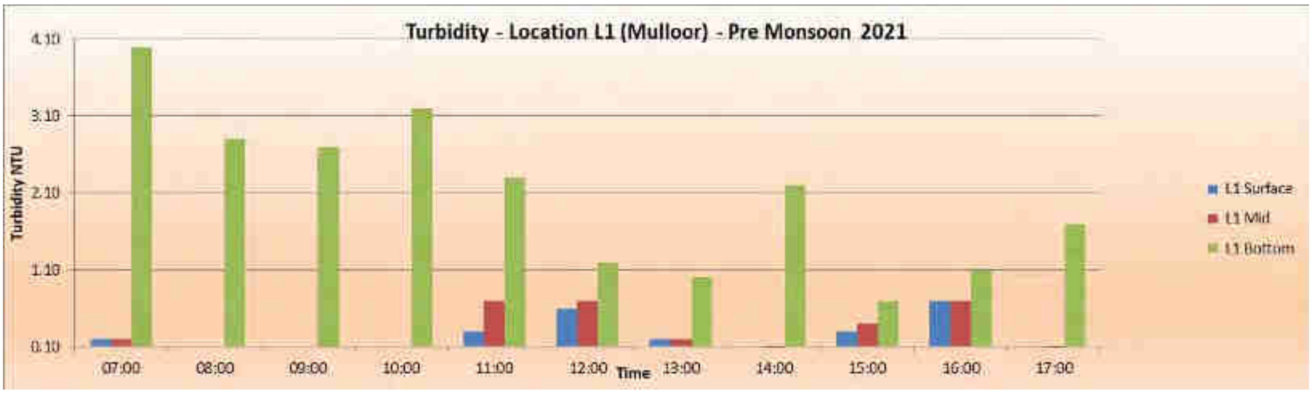
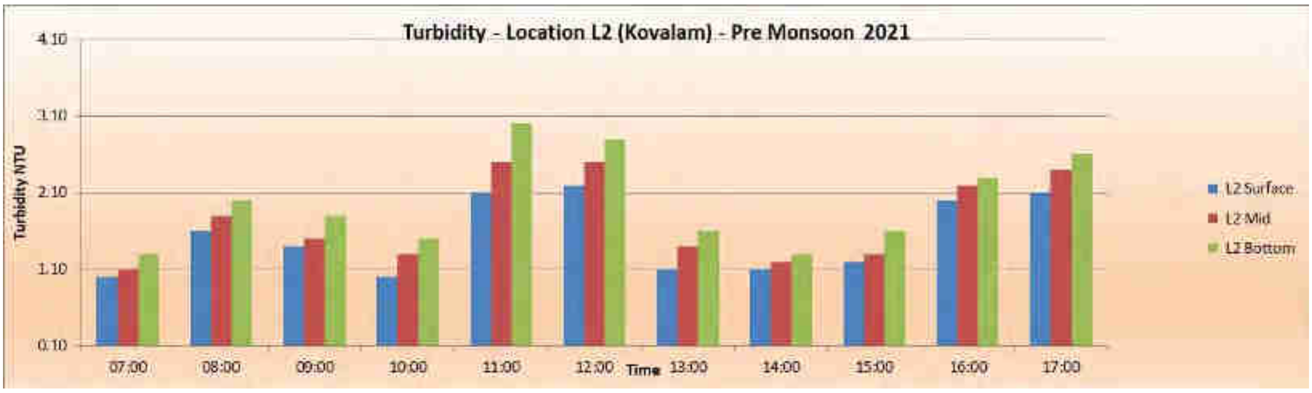


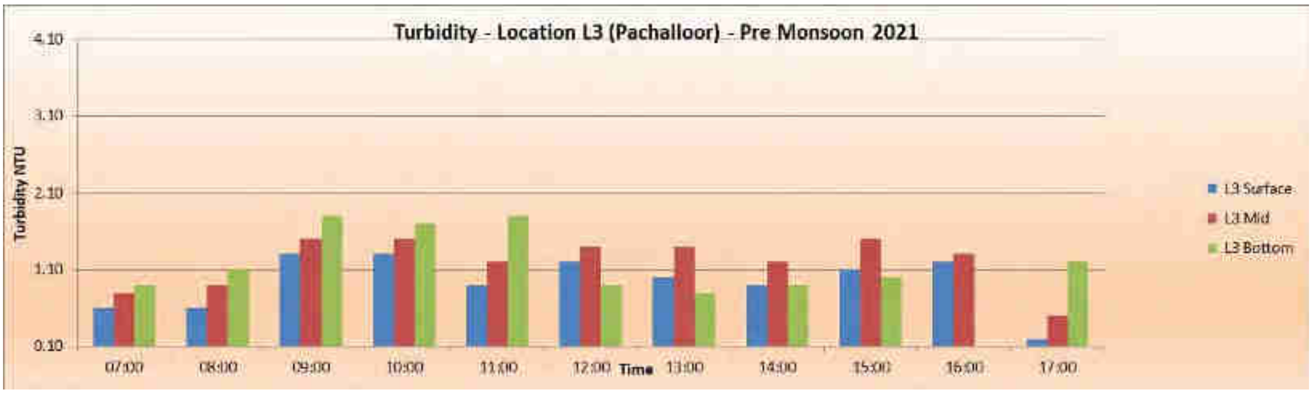
Figure 6-18: Time Series of salinity

For the pre-monsoon 2021 period, the salinity values are seen to be in the range of 32.5 and 34.9 ppt.

The time series for turbidity at all levels for the locations is shown below.

①

Turbidity - Location L1 (Mulloor) - Pre Monsoon 2021
Turbidity NTU
4.10
3.10
2.10
1.10
0.10
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
Time
L1 Surface
L1 Mid
L1 Bottom


Turbidity - Location L2 (Kovalam) - Pre Monsoon 2021
Turbidity NTU
4.10
3.10
2.10
1.10
0.10
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
Time
L2 Surface
L2 Mid
L2 Bottom


Turbidity - Location L3 (Pachalloor) - Pre Monsoon 2021
Turbidity NTU
4.10
3.10
2.10
1.10
0.10
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
Time
L3 Surface
L3 Mid
L3 Bottom

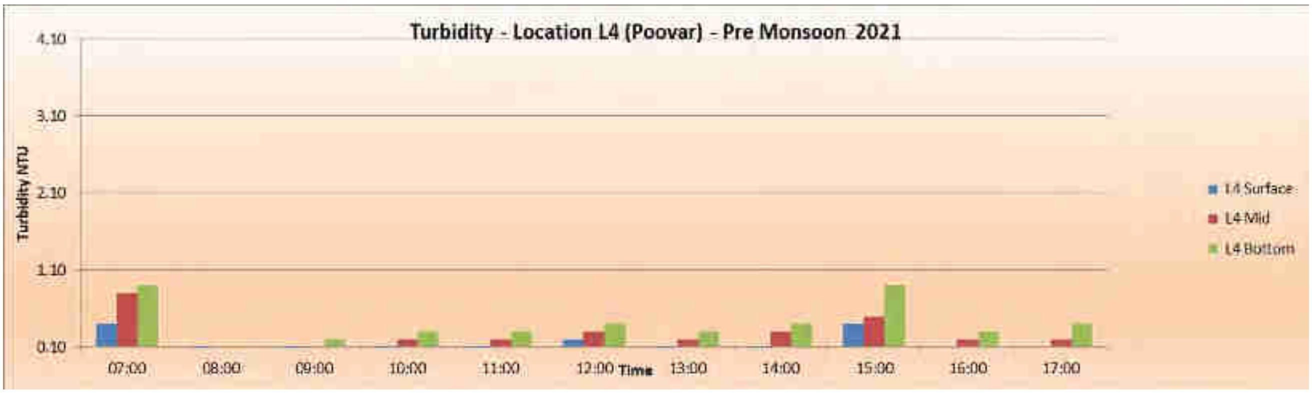


Figure 6-19: Time Series of Turbidity at water sampling locations

For the pre-monsoon 2021 period the maximum turbidity recorded was 4.0 NTU near the bottom at Location L1 (Mulloor).

***Note:** At times, when the value of Turbidity dropped to less than 0.1 NTU, it was Below Detectable Level (BDL) and the exact value could not be measured accurately and thus the column is not shown in the bar chart.*

6.9 Beach Sampling

Beach samples were collected at 68 out of the 81 locations for the pre-monsoon 2021 period. The samples which could not be collected due to lack of beach were BS-11 to BS-14, BS-32, BS-49 to BS-52, BS-59 and BS-63 to BS-67. In the monsoon period, 61 out of 81 beach samples were collected. The samples which could not be collected due to lack of beach were BS-3, BS-12, BS-14, BS-35, BS-41, BS-47 to 52, BS-57 to 59, BS-61, BS-63, BS-65 to 67and BS-70.

① The following table shows the D50 value (in mm) of the sediments collected along with the soil classification (Wentworth classification is followed) for the pre-monsoon 2021 period.

Table 6-13: Beach sample soil classification (Pre-monsoon period)

Sample Name	Gravel %	Sand %	Mud%	Total	D50 (mm)	Classification
BS-1	0	100	0	100	0.4367	Medium Sand
BS-2	0	100	0	100	0.3890	Medium Sand
BS-3	0	100	0	100	0.3730	Medium Sand
BS-4	0	100	0	100	0.4476	Medium Sand
BS-5	0	100	0	100	0.4592	Medium Sand
BS-6	0	100	0	100	0.4857	Medium Sand
BS-7	0	100	0	100	0.4817	Medium Sand
BS-8	0	100	0	100	0.5625	Coarse Sand
BS-9	0	100	0	100	0.5573	Coarse Sand
BS-10	0	100	0	100	0.6744	Coarse Sand
BS-11	Not Available					
BS-12	Not Available					
BS-13	Not Available					
BS-14	Not Available					
BS-15	0	100	0	100	0.4469	Medium Sand
BS-16	0	100	0	100	0.4996	Medium Sand
BS-17	0	100	0	100	0.4718	Medium Sand
BS-18	0	100	0	100	0.4526	Medium Sand
BS-19	0	100	0	100	0.5144	Coarse Sand
BS-20	0	100	0	100	0.5235	Coarse Sand
BS-21	0	100	0	100	0.4576	Medium Sand
BS-22	0	100	0	100	0.6107	Coarse Sand
BS-23	0	100	0	100	0.4904	Medium Sand
BS-24	0	100	0	100	0.5435	Coarse Sand
BS-25	0	100	0	100	0.4784	Medium Sand
BS-26	0	100	0	100	0.5276	Coarse Sand
BS-27	0	100	0	100	0.5369	Coarse Sand
BS-28	0	100	0	100	0.4993	Medium Sand
BS-29	0	100	0	100	0.5269	Coarse Sand
BS-30	0	100	0	100	0.5206	Coarse Sand
BS-31	0	100	0	100	0.4775	Medium Sand
BS-32	Not Available					
BS-33	0	100	0	100	0.5421	Coarse Sand
BS-34	0	100	0	100	0.5700	Coarse Sand
BS-35	0	100	0	100	0.4219	Medium Sand
BS-35A	0	100	0	100	0.5274	Coarse Sand
BS-36	0	100	0	100	0.6306	Coarse Sand
BS-37	0	100	0	100	0.3563	Medium Sand
BS-38	0	100	0	100	0.5685	Coarse Sand
BS-39	0	100	0	100	0.5696	Coarse Sand
BS-40	0	100	0	100	0.5912	Coarse Sand
BS-40A	0	100	0	100	0.6076	Coarse Sand
BS-41	0	100	0	100	0.2617	Medium Sand

Sample Name	Gravel %	Sand %	Mud%	Total	D50 (mm)	Classification
BS-42	0	100	0	100	0.1743	Fine Sand
BS-43	0	100	0	100	0.2802	Medium Sand
BS-44	0	100	0	100	0.3314	Medium Sand
BS-45	0	100	0	100	0.4404	Medium Sand
BS-46	0	100	0	100	0.4680	Medium Sand
BS-47	0	100	0	100	0.4601	Medium Sand
BS-48	0	100	0	100	0.4550	Medium Sand
BS-49	Not Available					
BS-50	Not Available					
BS-51	Not Available					
BS-52	Not Available					
BS-53	0	100	0	100	0.4553	Medium Sand
BS-54	0	100	0	100	0.2732	Medium Sand
BS-55	0	100	0	100	0.3340	Medium Sand
BS-56	0	100	0	100	0.3387	Medium Sand
BS-57	0	100	0	100	0.3342	Medium Sand
BS-58	0	100	0	100	0.3655	Medium Sand
BS-59						
BS-60	0	100	0	100	0.3452	Medium Sand
BS-61	0	100	0	100	0.3806	Medium Sand
BS-62	0	100	0	100	0.3560	Medium Sand
BS-63	Not Available					
BS-64	Not Available					
BS-65	Not Available					
BS-66	Not Available					
BS-67	Not Available					
BS-68	0	100	0	100	0.3763	Medium Sand
BS-69	0	100	0	100	0.3591	Medium Sand
BS-70	0	100	0	100	0.3851	Medium Sand
BS-71	0	100	0	100	0.3990	Medium Sand
BS-72	0	100	0	100	0.3960	Medium Sand
BS-73	0	100	0	100	0.3953	Medium Sand
BS-74	0	100	0	100	0.3836	Medium Sand
BS-75	0	100	0	100	0.3245	Medium Sand
BS-76	0	100	0	100	0.3816	Medium Sand
BS-77	0	100	0	100	0.3543	Medium Sand
BS-78	0	100	0	100	0.3293	Medium Sand
BS-79	0	100	0	100	0.4485	Medium Sand
BS-80	0	100	0	100	0.3604	Medium Sand
BS-81	0	100	0	100	0.3447	Medium Sand

The following table shows the D50 value (in mm) of the sediments collected along with the soil classification for the monsoon 2021 period.

Table 6-14: Beach sample soil classification (Monsoon period)

Sample Name	Gravel %	Sand %	Mud%	Total	D50 (mm)	Classification
BS-1	0	100	0	100	0.3379	Medium Sand
BS-2	0	100	0	100	0.3399	Medium Sand
BS-3	Not available					
BS-4	0	100	0	100	0.5545	Coarse Sand
BS-5	0	100	0	100	0.3120	Medium Sand
BS-6	0	100	0	100	0.4103	Medium Sand
BS-7	0	100	0	100	0.3729	Medium Sand
BS-8	0	100	0	100	0.4517	Medium Sand
BS-9	0	100	0	100	0.3021	Medium Sand
BS-10	0	100	0	100	0.4352	Medium Sand
BS-11	0	100	0	100	0.3907	Medium Sand
BS-12	Not available					
BS-13	0	100	0	100	0.5481	Coarse Sand
BS-14	Not available					
BS-15	0	100	0	100	0.4575	Medium Sand
BS-16	0	100	0	100	0.4321	Medium Sand
BS-17	0	100	0	100	0.4358	Medium Sand
BS-18	0	100	0	100	0.4156	Medium Sand
BS-19	0	100	0	100	0.4695	Medium Sand
BS-20	0	100	0	100	0.4397	Medium Sand
BS-21	0	100	0	100	0.5540	Coarse Sand
BS-22	0	100	0	100	0.4069	Medium Sand
BS-23	0	100	0	100	0.3865	Medium Sand
BS-24	0	100	0	100	0.3981	Medium Sand
BS-25	0	100	0	100	0.3954	Medium Sand
BS-26	0	100	0	100	0.4727	Medium Sand
BS-27	0	100	0	100	0.5830	Coarse Sand
BS-28	0	100	0	100	0.5523	Coarse Sand
BS-29	0	100	0	100	0.3848	Medium Sand
BS-30	0	100	0	100	0.5569	Coarse Sand
BS-31	0	100	0	100	0.4183	Medium Sand
BS-32	0	100	0	100	0.3697	Medium Sand
BS-33	0	100	0	100	0.4047	Medium Sand
BS-34	0	100	0	100	0.5459	Coarse Sand
BS-35	Not available					
BS-35A	0	100	0	100	0.6074	Coarse Sand
BS-36	0	100	0	100	0.6706	Coarse Sand
BS-37	0	100	0	100	0.7419	Coarse Sand
BS-38	0	100	0	100	0.6516	Coarse Sand
BS-39	0	100	0	100	0.4833	Medium Sand
BS-40	0	100	0	100	0.6665	Coarse Sand
BS-40A	0	100	0	100	0.7265	Coarse Sand
BS-41	Not available					

Sample Name	Gravel %	Sand %	Mud%	Total	D50 (mm)	Classification
BS-42	0	100	0	100	0.1446	Fine Sand
BS-43	0	100	0	100	0.4658	Medium Sand
BS-44	0	100	0	100	0.3209	Medium Sand
BS-45	0	100	0	100	0.3154	Medium Sand
BS-46	0	100	0	100	0.3234	Medium Sand
BS-47	Not available					
BS-48	Not available					
BS-49	Not available					
BS-50	Not available					
BS-51	Not available					
BS-52	Not available					
BS-53	0	100	0	100	0.3133	Medium Sand
BS-54	0	100	0	100	0.2941	Medium Sand
BS-55	0	100	0	100	0.2909	Medium Sand
BS-56	0	100	0	100	0.1791	Fine Sand
BS-57	Not available					
BS-58	Not available					
BS-59	Not available					
BS-60	0	100	0	100	0.3513	Medium Sand
BS-61	Not available					
BS-62	0	100	0	100	0.3895	Medium Sand
BS-63	Not available					
BS-64	0	100	0	100	0.3497	Medium Sand
BS-65	Not available					
BS-66	Not available					
BS-67	Not available					
BS-68	0	100	0	100	0.3692	Medium Sand
BS-69	0	100	0	100	0.4072	Medium Sand
BS-70	Not available					
BS-71	0	100	0	100	0.3722	Medium Sand
BS-72	0	100	0	100	0.3633	Medium Sand
BS-73	0	100	0	100	0.4200	Medium Sand
BS-74	0	100	0	100	0.3868	Medium Sand
BS-75	0	100	0	100	0.3816	Medium Sand
BS-76	0	100	0	100	0.4056	Medium Sand
BS-77	0	100	0	100	0.3537	Medium Sand
BS-78	0	100	0	100	0.3825	Medium Sand
BS-79	0	100	0	100	0.4018	Medium Sand
BS-80	0	100	0	100	0.3593	Medium Sand
BS-81	0	100	0	100	0.4117	Medium Sand

The classification is based on Wentworth scale as provided below:

Very fine Sand – 0.0625 to 0.125 mm
Fine Sand – 0.125 to 0.250 mm
Medium Sand – 0.250 to 0.500 mm
Coarse Sand – 0.500 to 1.000 mm
Very coarse Sand – 1.000 to 2.000 mm

① The following graph shows the distribution of D50 value of the sediments collected in each location during the pre-monsoon and monsoon 2021 periods.

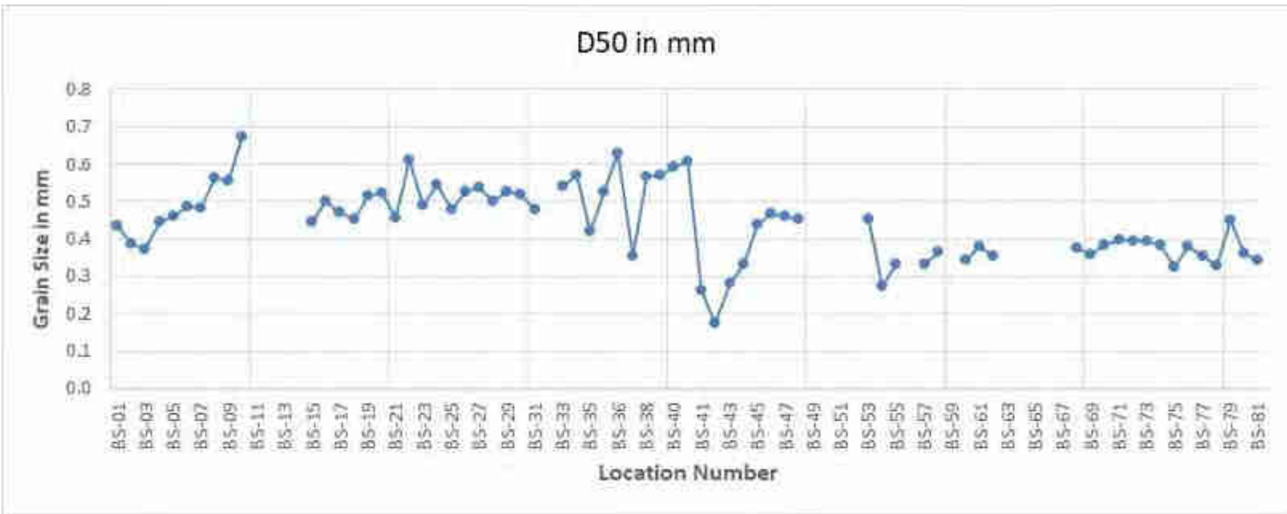


Figure 6-20: Distribution of D50 value of beach samples (Pre-monsoon 2021 period)

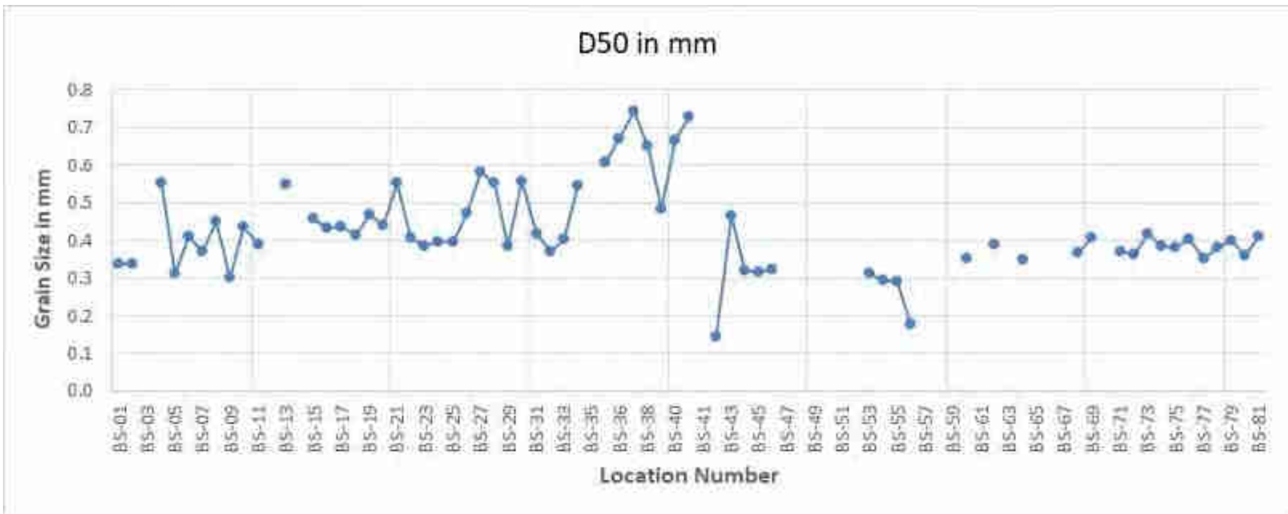


Figure 6-21: Distribution of D50 value of beach samples (Monsoon 2021 period)

Based on the above, it is inferred that the beach samples at the locations were mostly medium sand.

The following are some of the graphs of grain size distribution curves drawn for few beach samples (BS-15, BS-20, BS-25 and BS-30) for two seasons.

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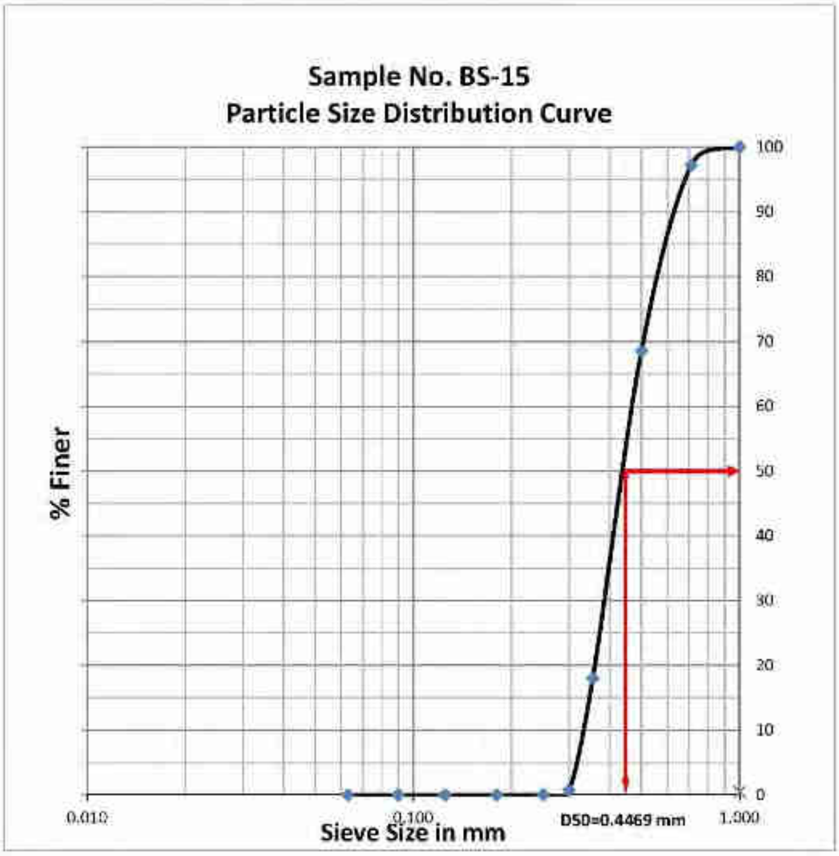

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Web: www.sealabs.in, E-mail: sealab@gmail.com, info@sealabs.in

Figure 6-22: Grain size distribution curve for BS-15 (Pre-monsoon)

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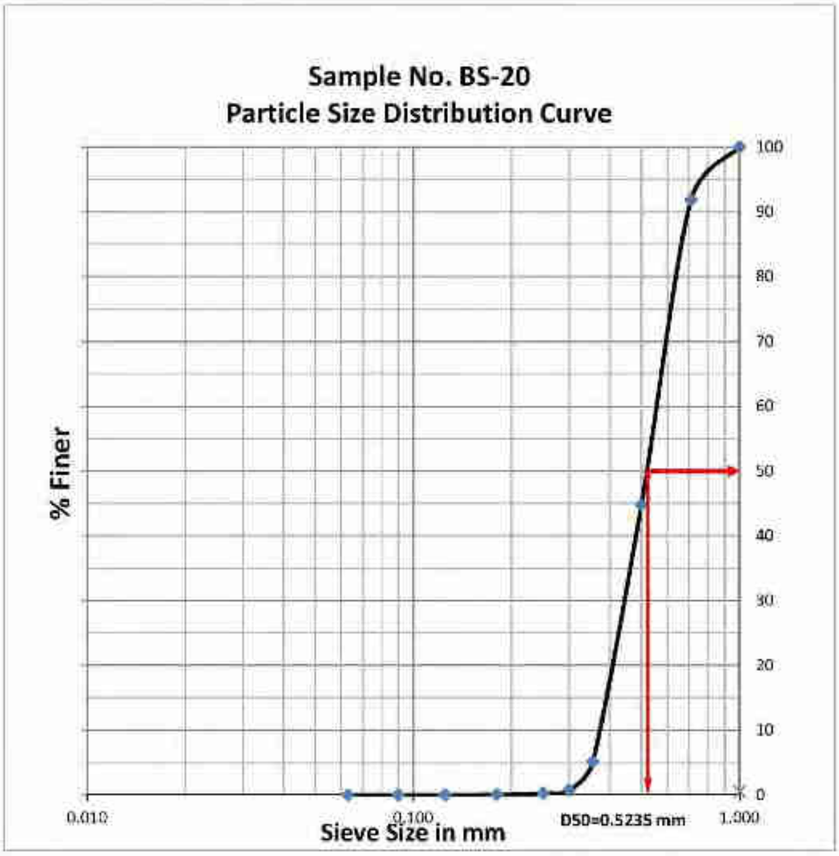

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Figure 6-23: Grain size distribution curve for BS-20 (Pre-monsoon)

Standard^S
Environmental Monitoring

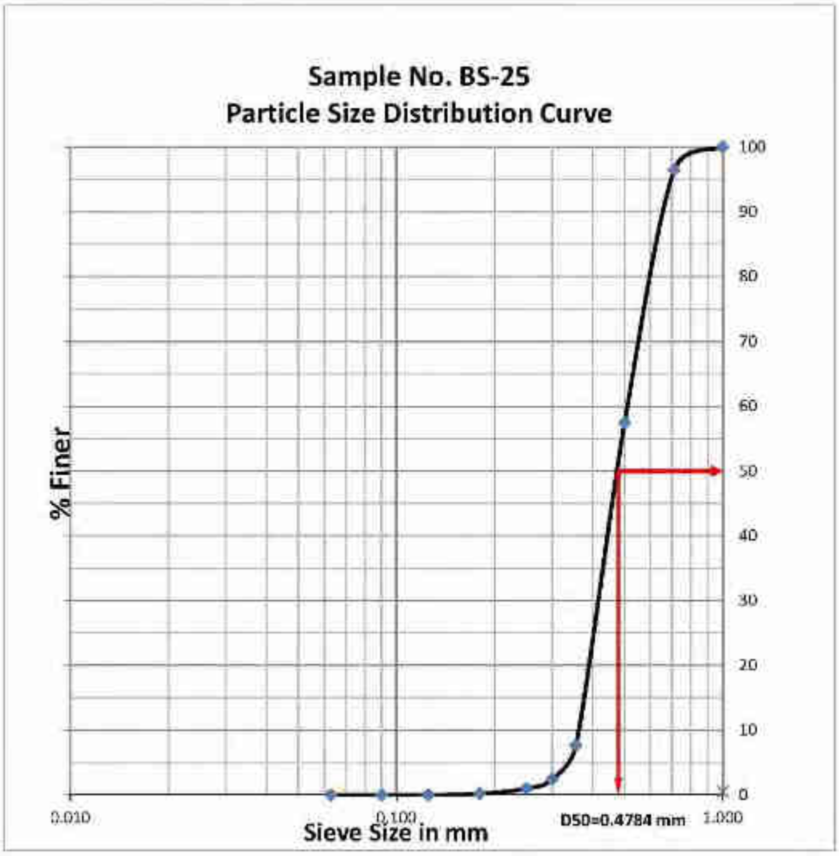

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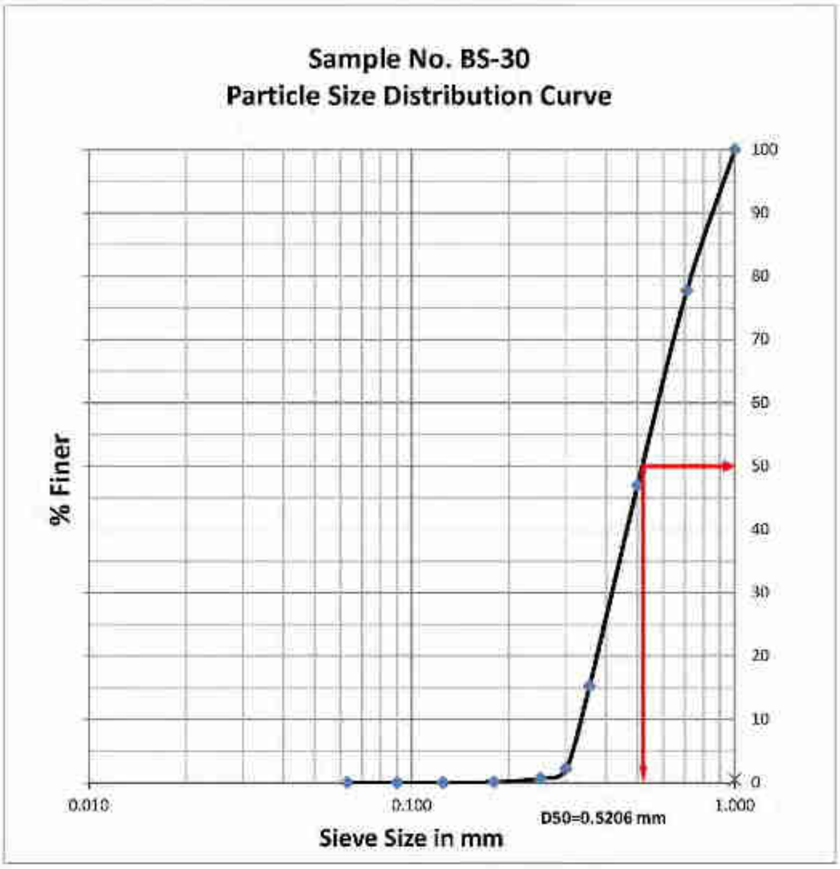
Figure 6-24: Grain size distribution curve for BS-25 (Pre-monsoon)

Standard[S]
Environmental Monitoring



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Web: www.sealabs.in, E-mail: sealab@gmail.com, info@sealabs.in

Figure 6-25: Grain size distribution curve for BS-30 (Pre-monsoon)

Standard^{S}
Environmental Monitoring

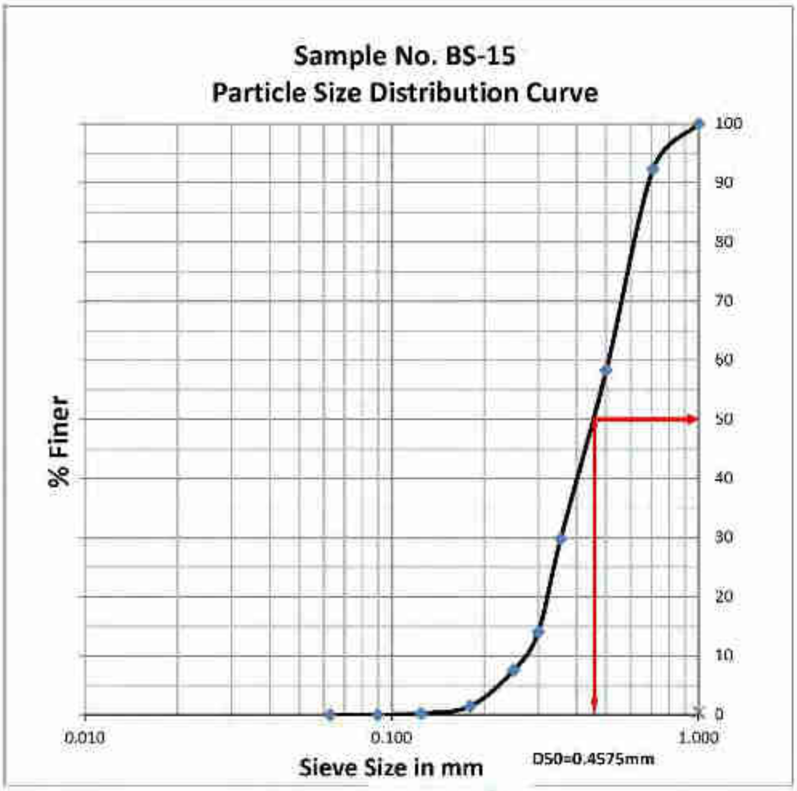

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Figure 6-26: Grain size distribution curve for BS-15 (Monsoon)

Standard[S]
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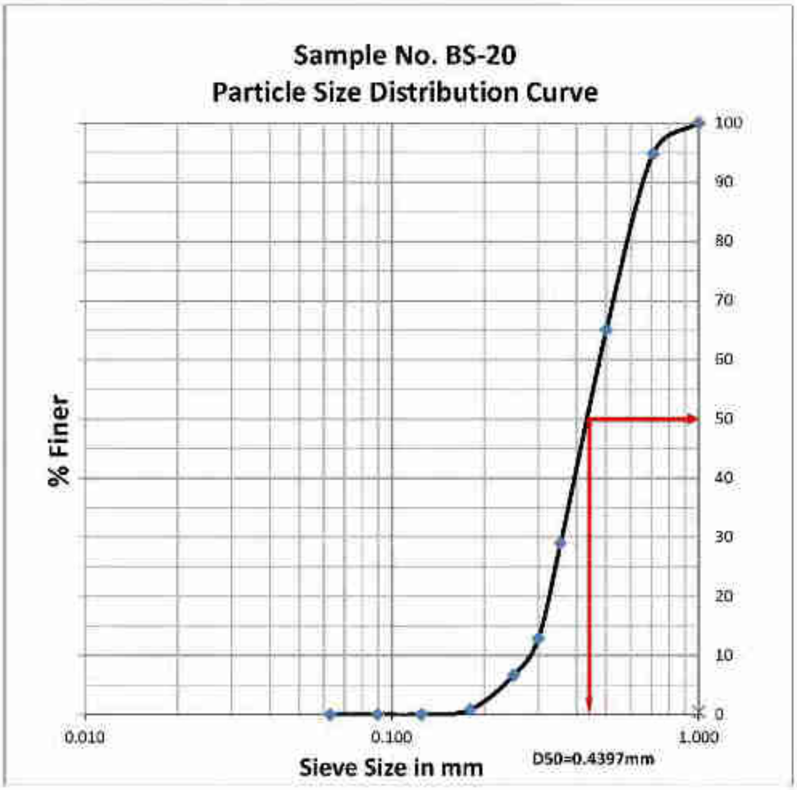

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Figure 6-27: Grain size distribution curve for BS-20 (Monsoon)

Standard[S]
Environmental Monitoring

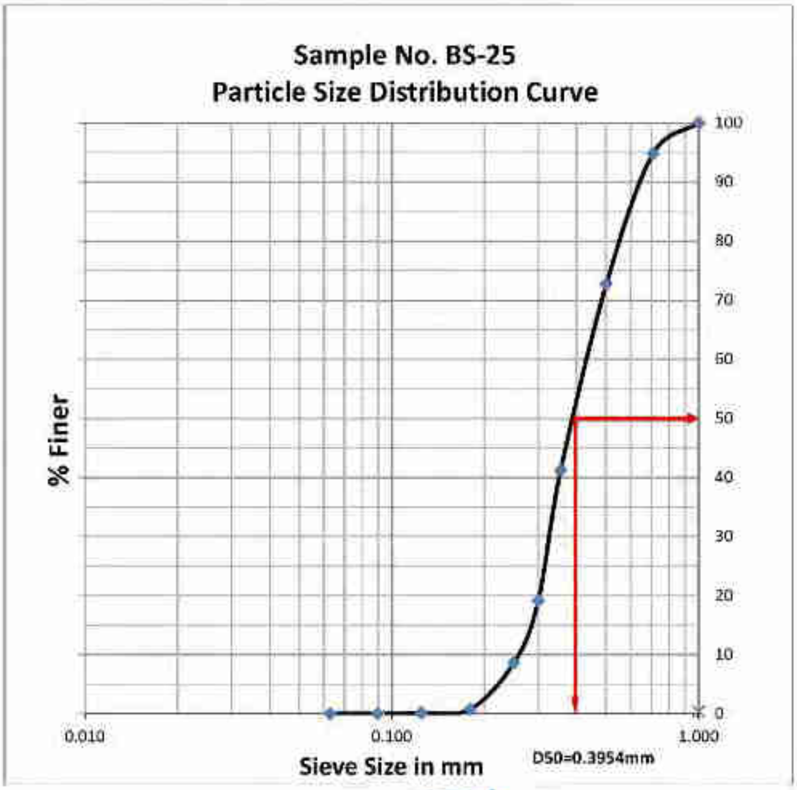

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Figure 6-28: Grain size distribution curve for BS-25 (Monsoon)

Standard^S
Environmental Monitoring

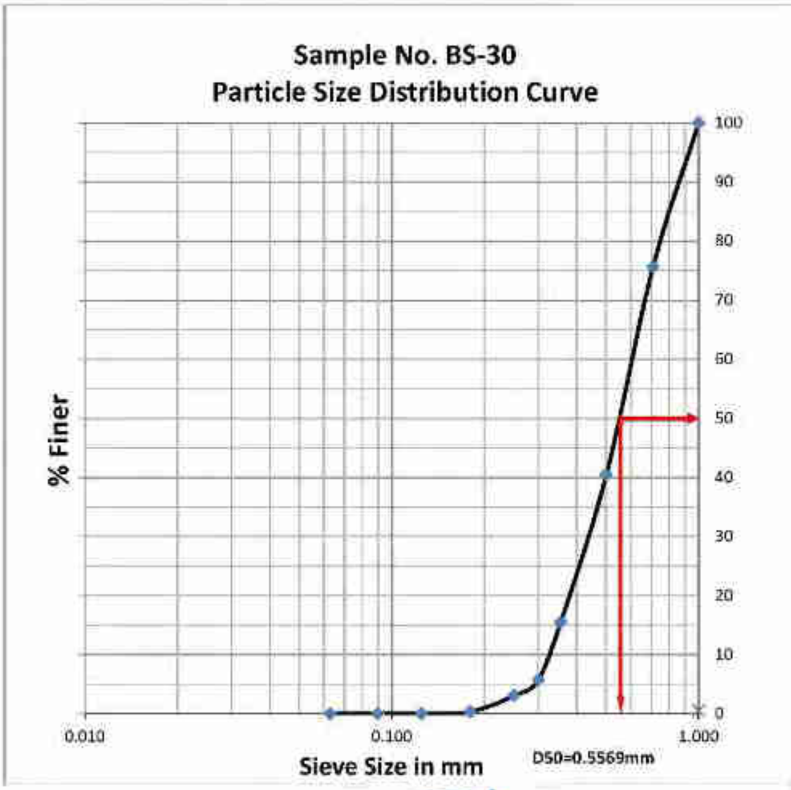

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Figure 6-29: Grain size distribution curve for BS-30 (Monsoon)

6.10 Turbidity Measurements

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).

Nepheleisthe, Greek word for "cloud" and metric means “measure”. 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.

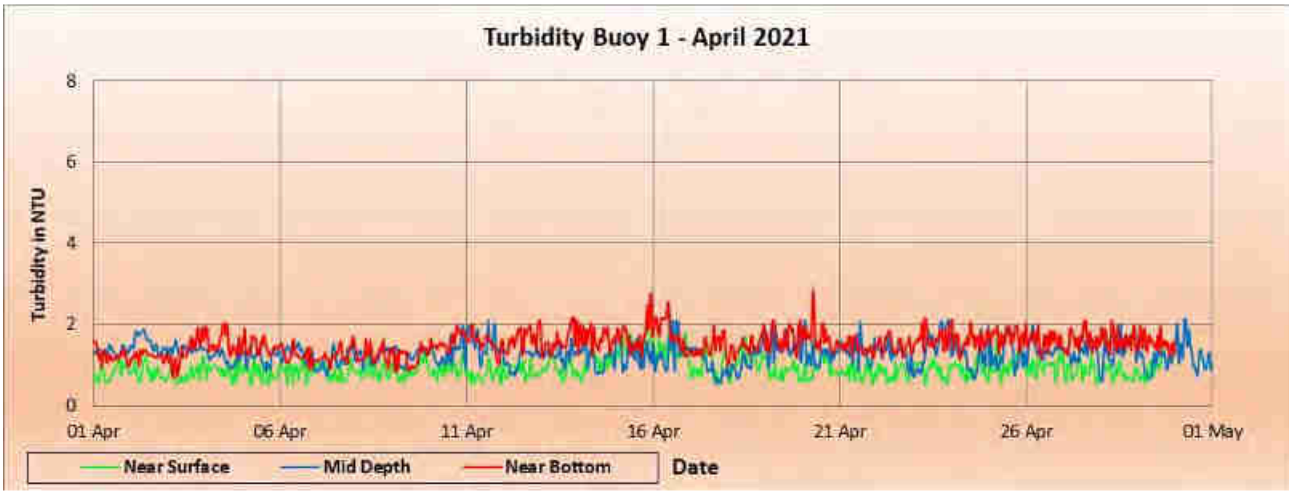
Turbidity monitoring buoys were deployed at three locations and the turbidity was measured at three different depths i.e. surface, mid-depth and bottom.

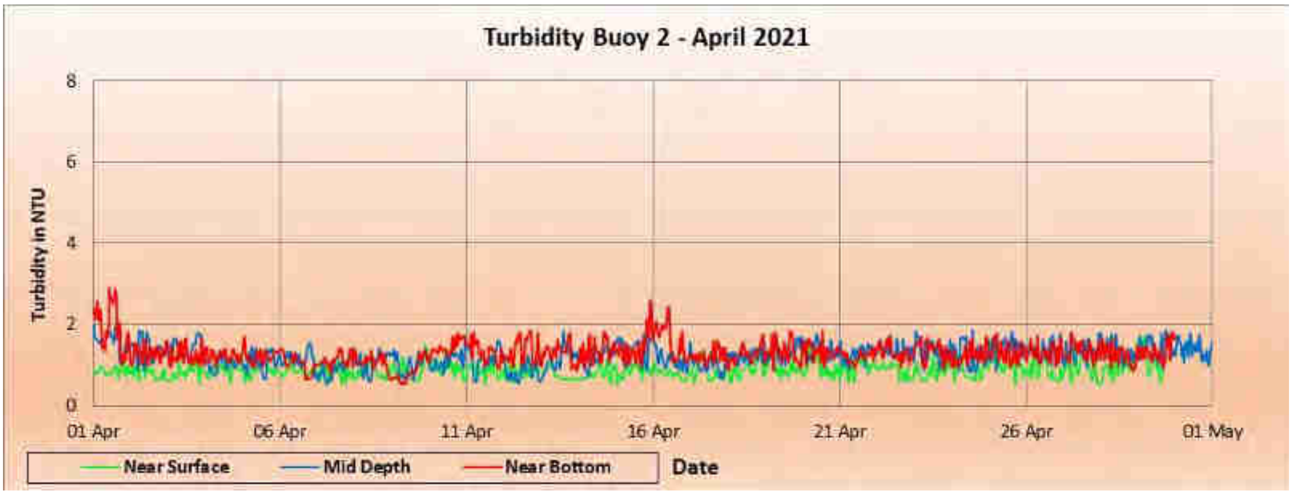
A summary of the maximum turbidity data (measured in NTU) recorded for the period of April to September 2021 at each turbidity buoy location is placed in the table below.

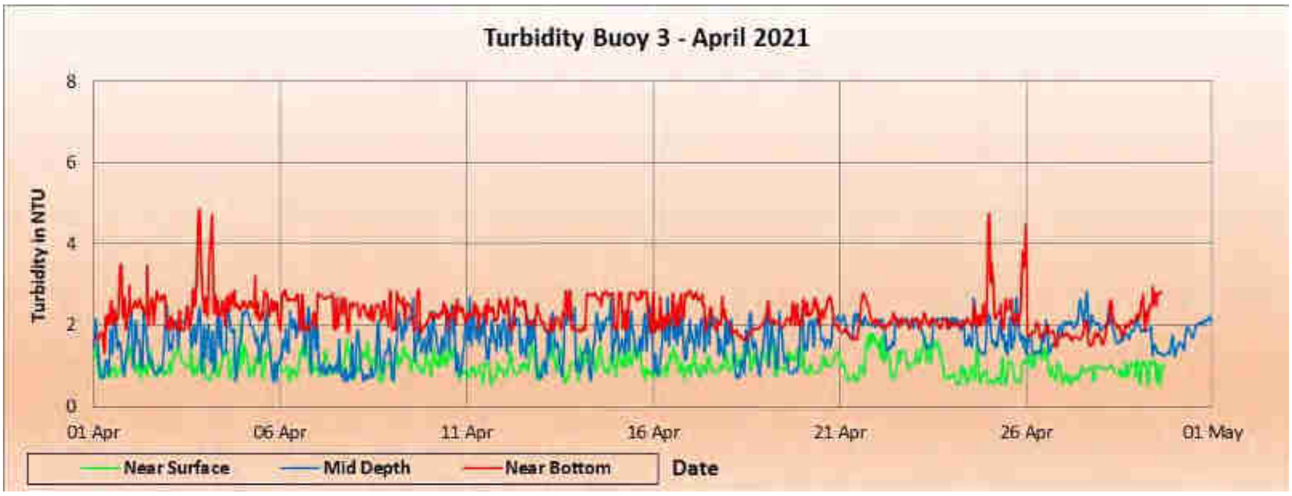
Table 6-15: Summary of maximum turbidity values in NTU

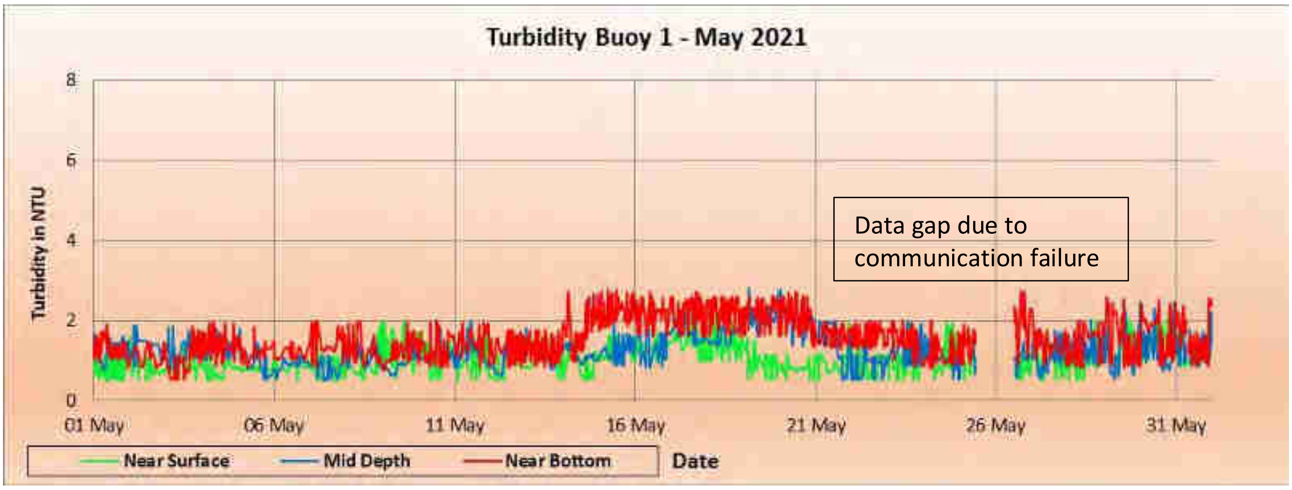
Location	Maximum Turbidity (NTU)	Depth	Month and Year
Turbidity Buoy-1	4.06	Near Bottom	June 2021
Turbidity Buoy-2	3.36	Near Bottom	August 2021
Turbidity Buoy-3	4.85	Near Bottom	April 2021

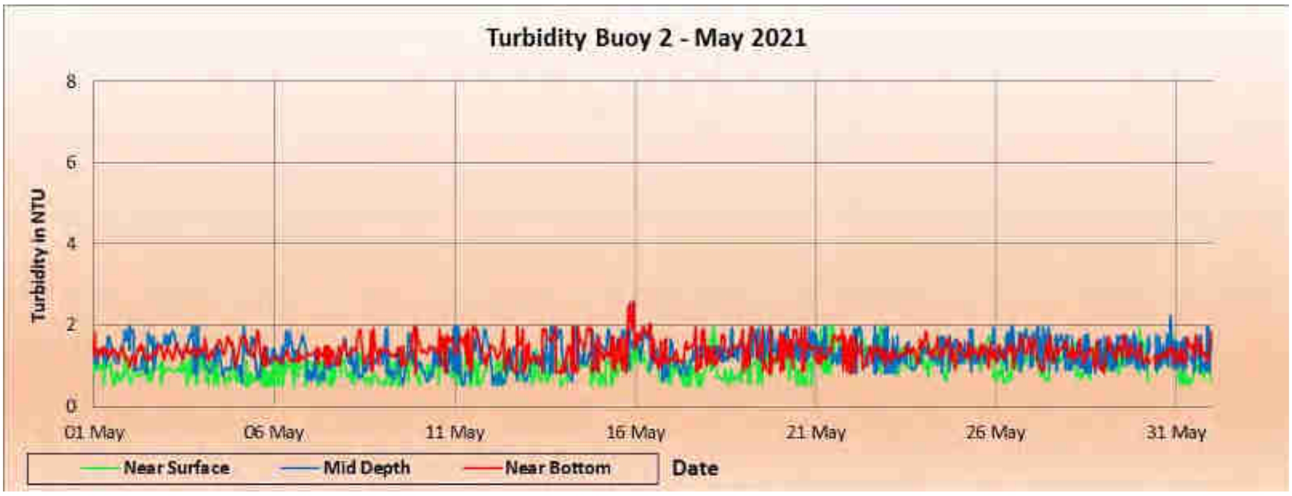
The time series curves of turbidity measurements from April to September 2021 are shown below.

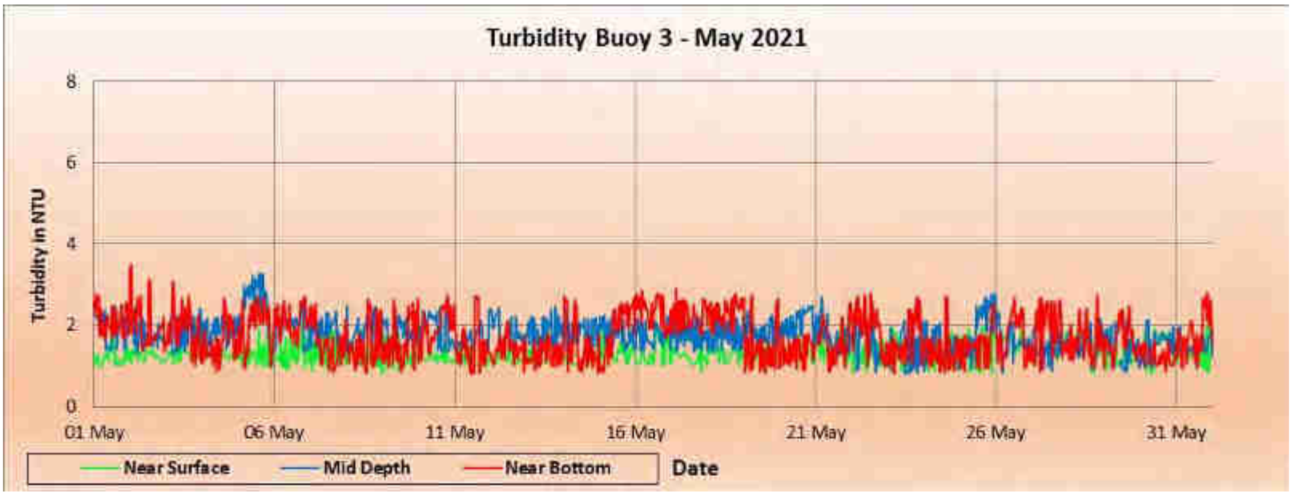

Turbidity Buoy 1 - April 2021
Turbidity in NTU
0
2
4
6
8
01 Apr
06 Apr
11 Apr
16 Apr
21 Apr
26 Apr
01 May
Near Surface
Mid Depth
Near Bottom
Date

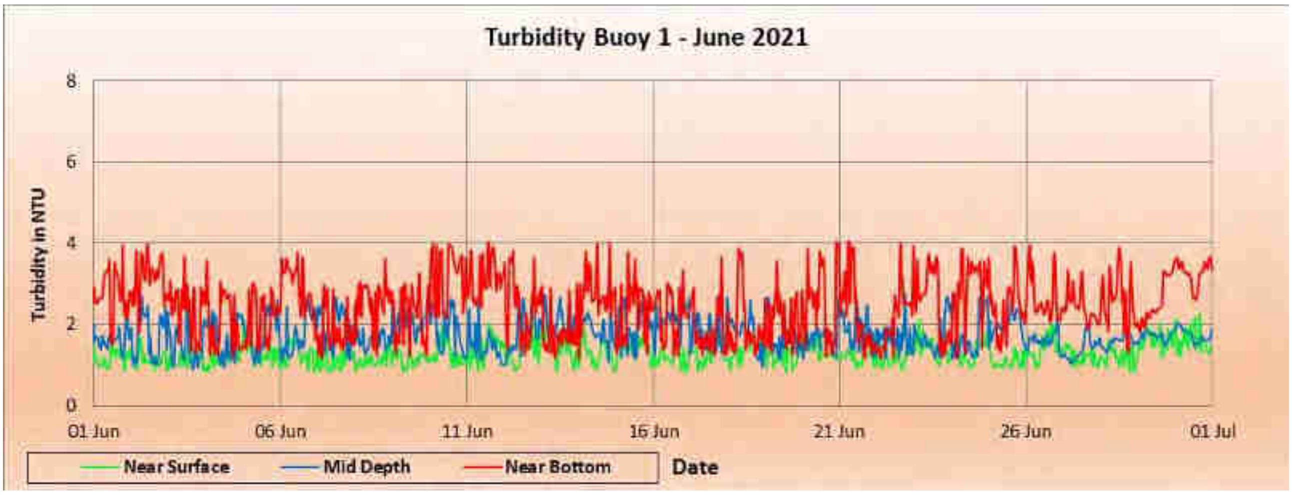

Turbidity Buoy 2 - April 2021
Turbidity in NTU
0
2
4
6
8
01 Apr
06 Apr
11 Apr
16 Apr
21 Apr
26 Apr
01 May
Near Surface
Mid Depth
Near Bottom
Date

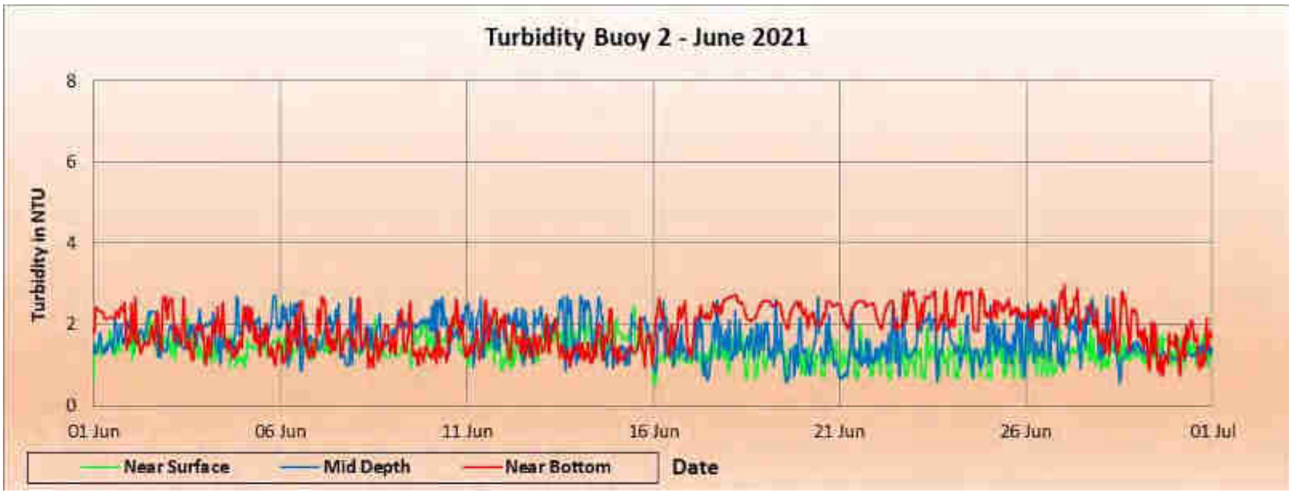

Turbidity Buoy 3 - April 2021
Turbidity in NTU
0
2
4
6
8
01 Apr
06 Apr
11 Apr
16 Apr
21 Apr
26 Apr
01 May
Near Surface
Mid Depth
Near Bottom
Date

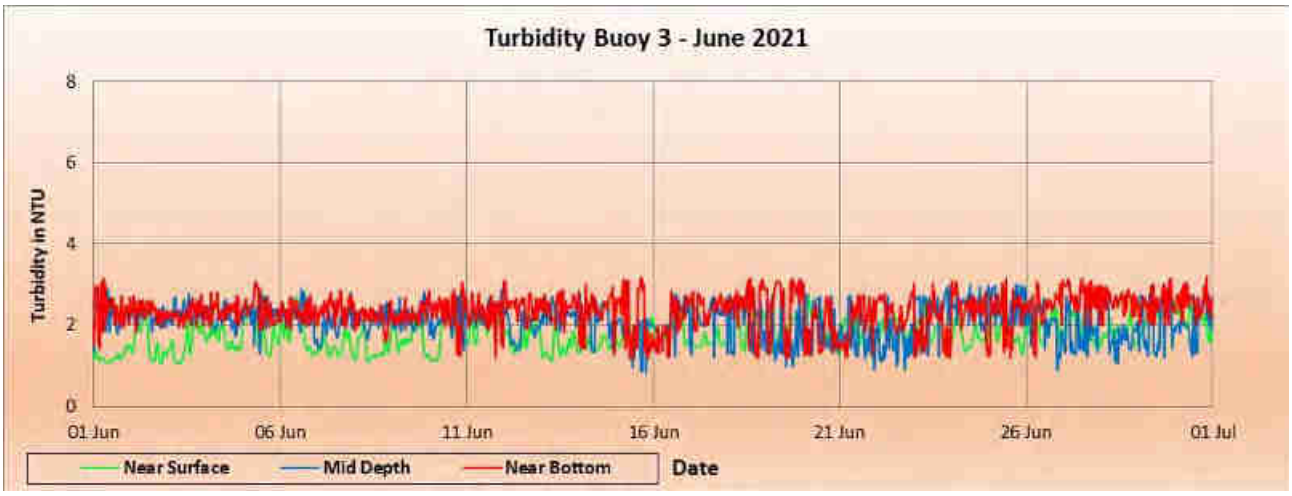

Turbidity Buoy 1 - May 2021
Turbidity in NTU
8
6
4
2
0
Data gap due to communication failure
01 May
06 May
11 May
16 May
21 May
26 May
31 May
Near Surface
Mid Depth
Near Bottom
Date

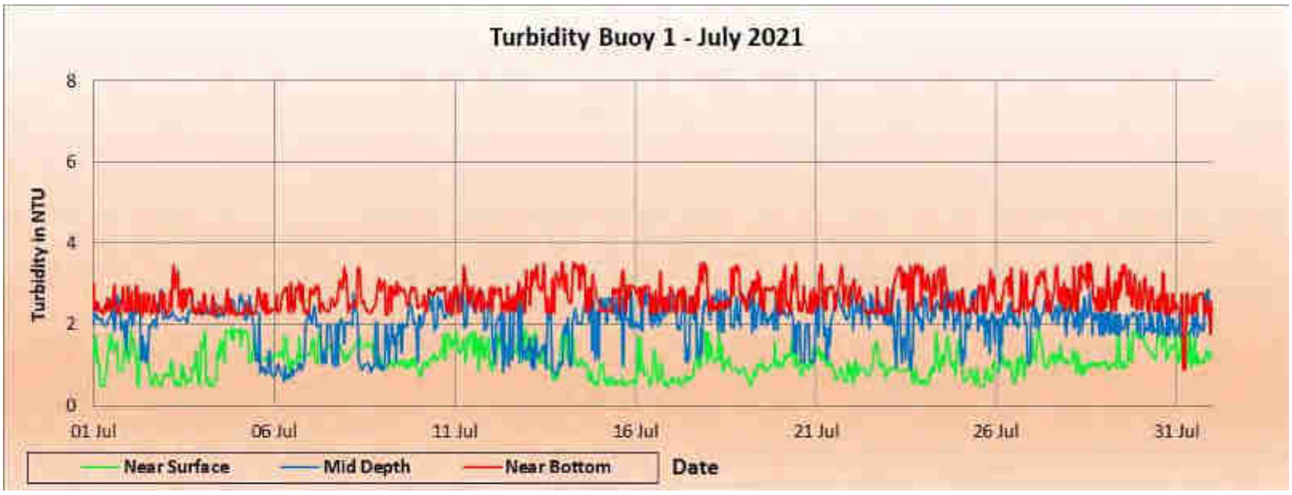

Turbidity Buoy 2 - May 2021
Turbidity in NTU
8
6
4
2
0
01 May
06 May
11 May
16 May
21 May
26 May
31 May
Near Surface
Mid Depth
Near Bottom
Date

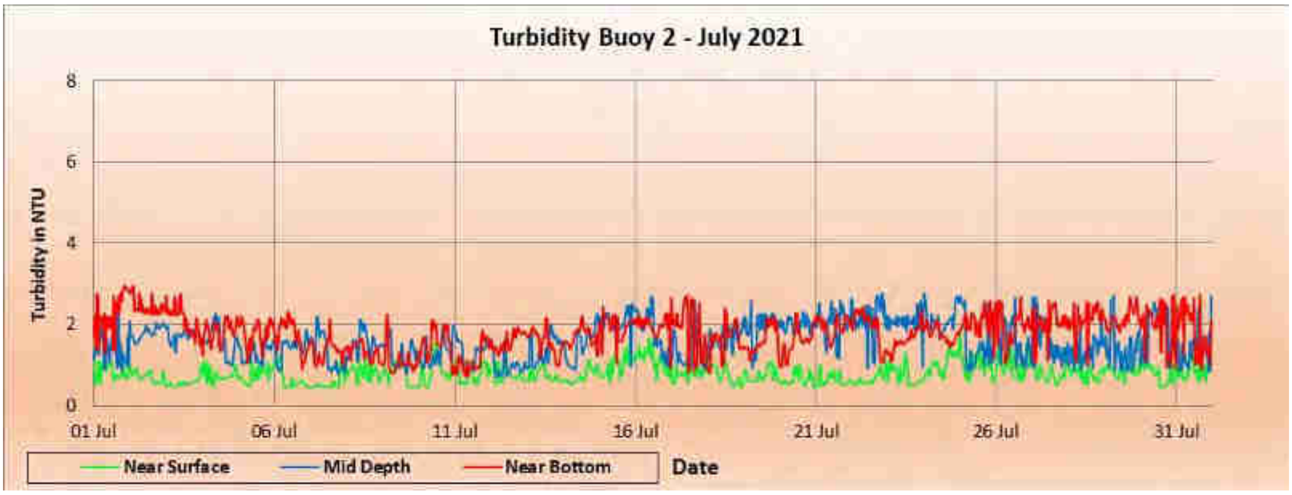

Turbidity Buoy 3 - May 2021
Turbidity in NTU
8
6
4
2
0
01 May
06 May
11 May
16 May
21 May
26 May
31 May
Near Surface
Mid Depth
Near Bottom
Date

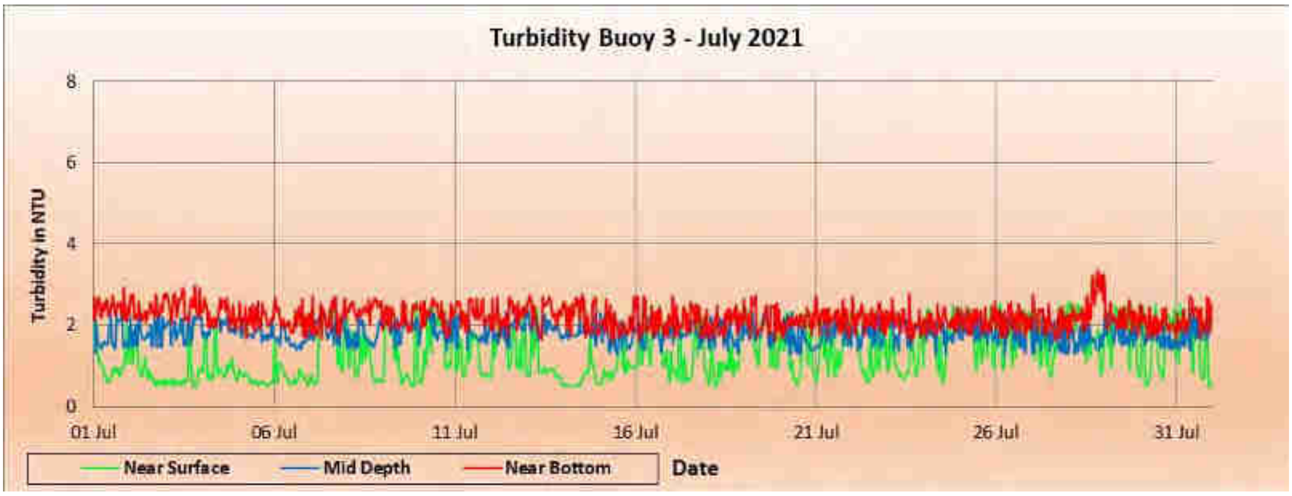

Turbidity Buoy 1 - June 2021
Turbidity in NTU
0
2
4
6
8
01 Jun
06 Jun
11 Jun
16 Jun
21 Jun
26 Jun
01 Jul
Near Surface
Mid Depth
Near Bottom
Date

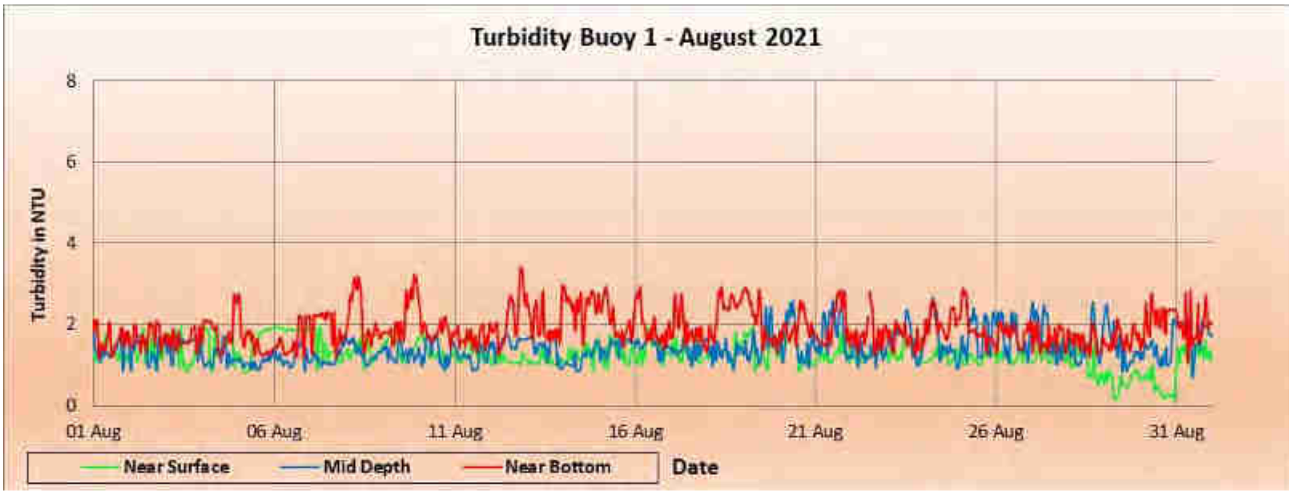

Turbidity Buoy 2 - June 2021
Turbidity in NTU
0
2
4
6
8
01 Jun
06 Jun
11 Jun
16 Jun
21 Jun
26 Jun
01 Jul
Near Surface
Mid Depth
Near Bottom
Date

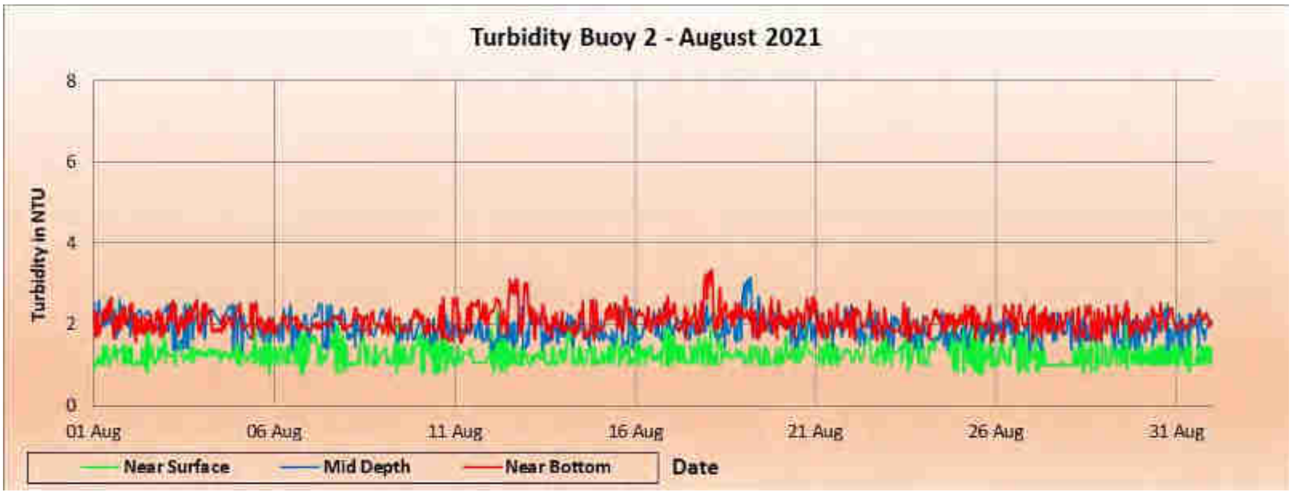

Turbidity Buoy 3 - June 2021
Turbidity in NTU
0
2
4
6
8
01 Jun
06 Jun
11 Jun
16 Jun
21 Jun
26 Jun
01 Jul
Near Surface
Mid Depth
Near Bottom
Date

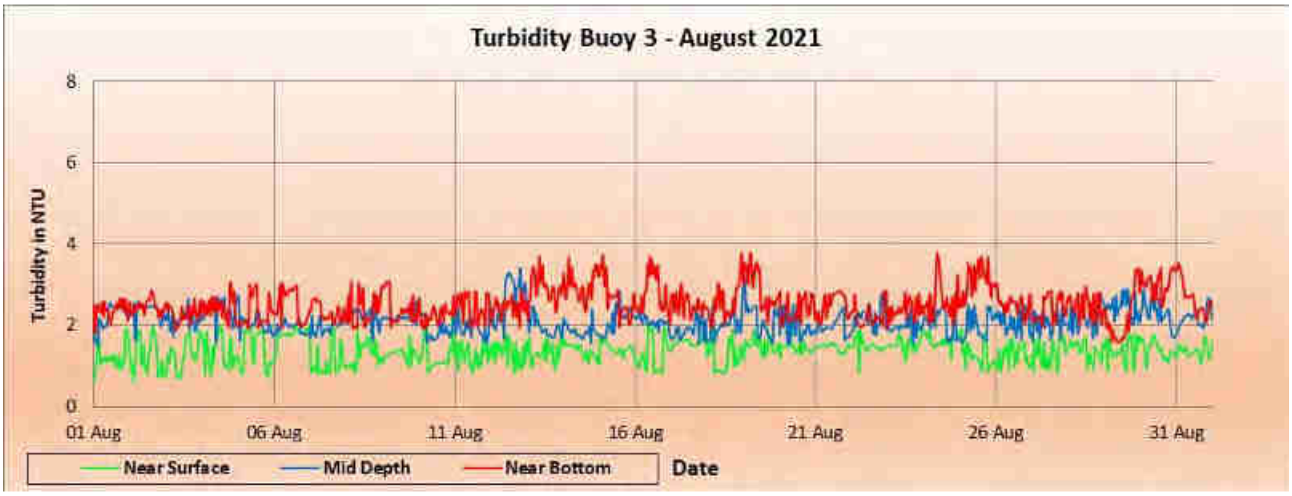

Turbidity Buoy 1 - July 2021
Turbidity in NTU
0
2
4
6
8
01 Jul
06 Jul
11 Jul
16 Jul
21 Jul
26 Jul
31 Jul
Near Surface
Mid Depth
Near Bottom
Date

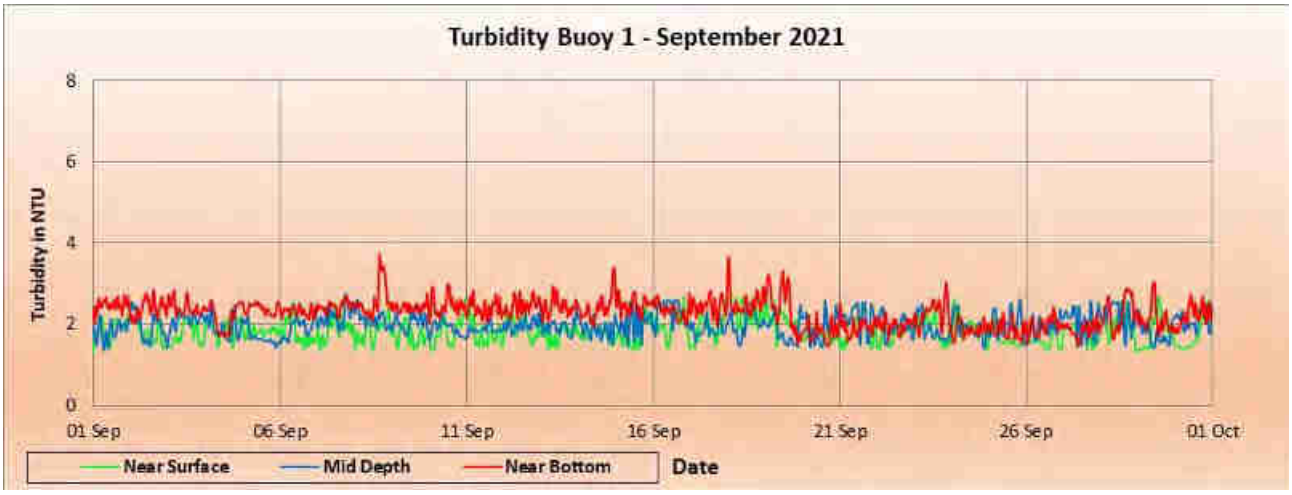

Turbidity Buoy 2 - July 2021
Turbidity in NTU
0
2
4
6
8
01 Jul
06 Jul
11 Jul
16 Jul
21 Jul
26 Jul
31 Jul
Near Surface
Mid Depth
Near Bottom
Date

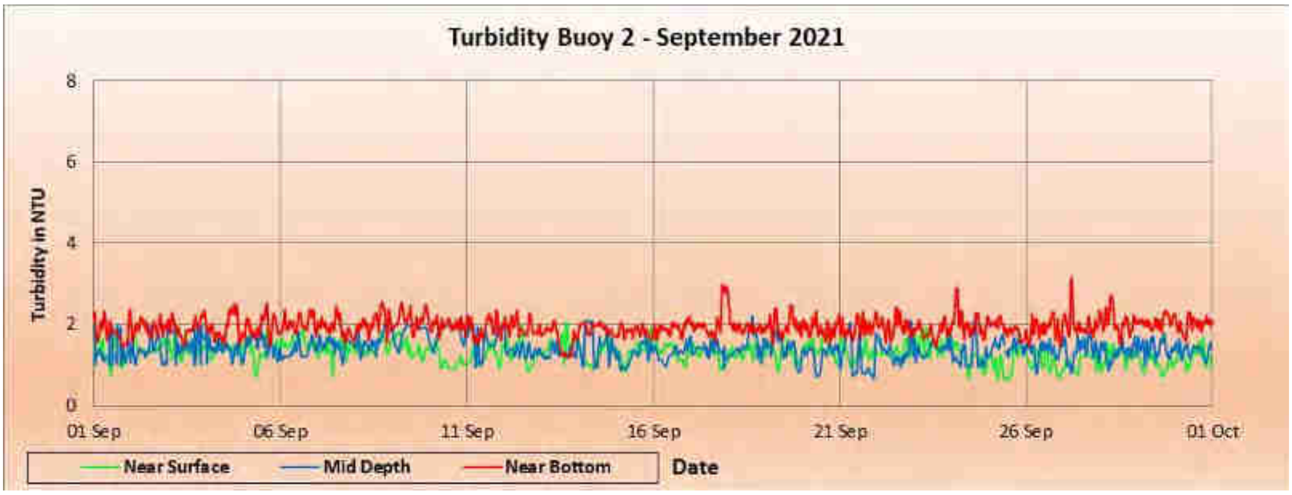

Turbidity Buoy 3 - July 2021
Turbidity in NTU
0
2
4
6
8
01 Jul
06 Jul
11 Jul
16 Jul
21 Jul
26 Jul
31 Jul
Near Surface
Mid Depth
Near Bottom
Date


Turbidity Buoy 1 - August 2021
Turbidity in NTU
8
6
4
2
0
01 Aug
06 Aug
11 Aug
16 Aug
21 Aug
26 Aug
31 Aug
Near Surface
Mid Depth
Near Bottom
Date


Turbidity Buoy 2 - August 2021
Turbidity in NTU
8
6
4
2
0
01 Aug
06 Aug
11 Aug
16 Aug
21 Aug
26 Aug
31 Aug
Near Surface
Mid Depth
Near Bottom
Date


Turbidity Buoy 3 - August 2021
Turbidity in NTU
8
6
4
2
0
01 Aug
06 Aug
11 Aug
16 Aug
21 Aug
26 Aug
31 Aug
Near Surface
Mid Depth
Near Bottom
Date





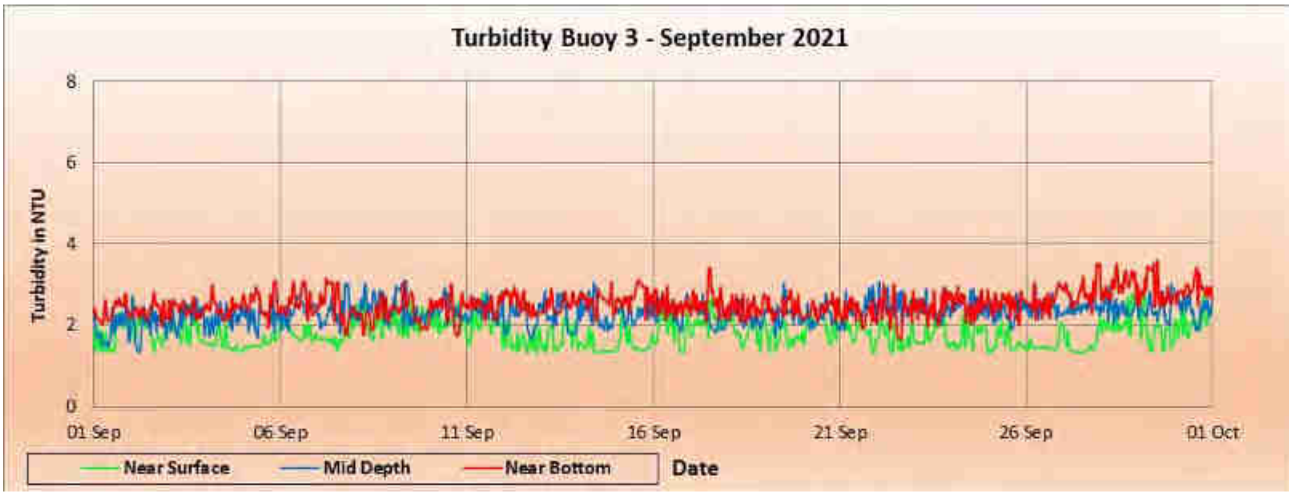


Figure 6-30: Time Series of Turbidity measurements

The validation of turbidity sensor data was carried out for the Pre-monsoon 2021 period. The samples were collected on 30th June 2021. The following table provides the turbidity values measured from the buoys and from that of the collected samples, which were analysed for turbidity as per IS 3025, Part 10:1984 (reaffirmed 2017) in a NABL approved laboratory.

Table 6-16: Turbidity Values

Turbidity Values in NTU						
Buoy No.	**Observed from Buoy**			**Values from Collected Water Samples**		
	Sur	Mid	Bot	Sur	Mid	Bot
Turbidity Buoy-1	1.36	1.78	3.25	1.40	1.80	3.10
Turbidity Buoy-2	1.35	1.27	1.63	1.50	1.40	1.60
Turbidity Buoy-3	1.96	1.97	2.96	2.00	1.90	2.80

On comparing both the values, the integrity of the data obtained from the turbidity buoy sensors can be verified and it can be inferred that the sensors are performing as desired.

6.11 Bathymetry

Survey Location

The following image shows the coverage of the area surveyed using Geoswath multibeam echo sounder.

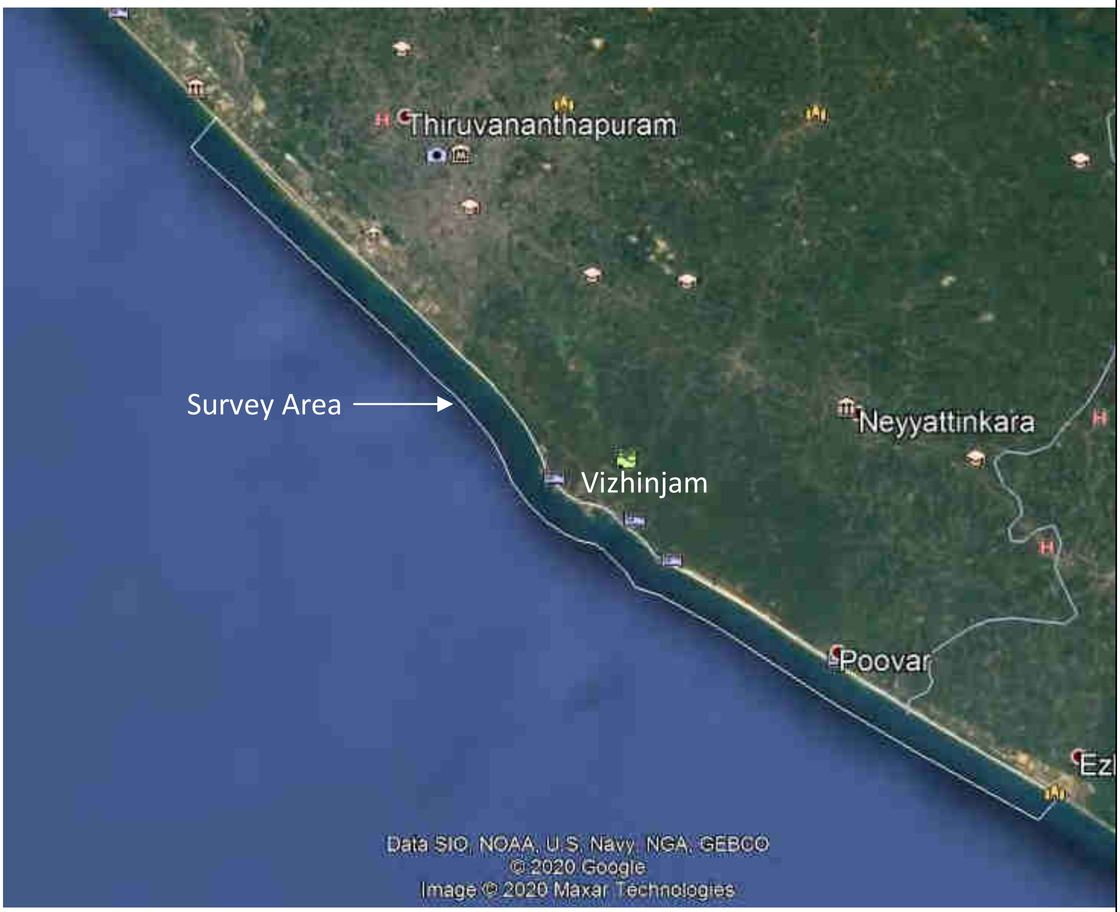


Figure 6-31: Bathymetry area coverage

Line Plan and Survey Methodology

The survey lines were planned at intervals of 25m parallel to the coast up to the depth of 20m. The vessel was positioned using a Seapath DGPS system which also provided the heading. The vessel tracks and offset positions were recorded digitally and the data from the multibeam echo sounder was logged digitally within the GS+ data acquisition software.

Prior to commencement of the survey, the DGPS and gyrocompass calibrations were carried out when the survey vessel was berthed at the Vizhinjam Fishing Jetty. The multibeam echo sounder was calibrated by conducting the patch test. The bathymetric data was reduced to Chart Datum (CD) by using the observed tides from the tide gauge installed at the Coast Guard Jetty. An AML MINOS Sound Velocity Probe (SVP) was used to measure the speed of sound of in the water column. Motion compensation was achieved by the Seapath Motion Reference Unit (MRU). Quality checks were constantly performed at every step of the data processing. Data was processed using Hypack software. Calibration values obtained from the patch test were applied to the acquired data along with the required sound velocity profile and tide data for creation of final xyz file.

Results

The bathymetric survey of the area about 40 km in length was carried out up to the 20m contour using a multibeam echo sounder.

① The maximum depth recorded by multibeam echo sounder is 24.9m below CD in the northwestern part at coordinates 713600.5 mE, 934750.5 mN. The seabed is seen to slope gently towards the southwest.

An image of colour coded bathymetry of the area is provided below:

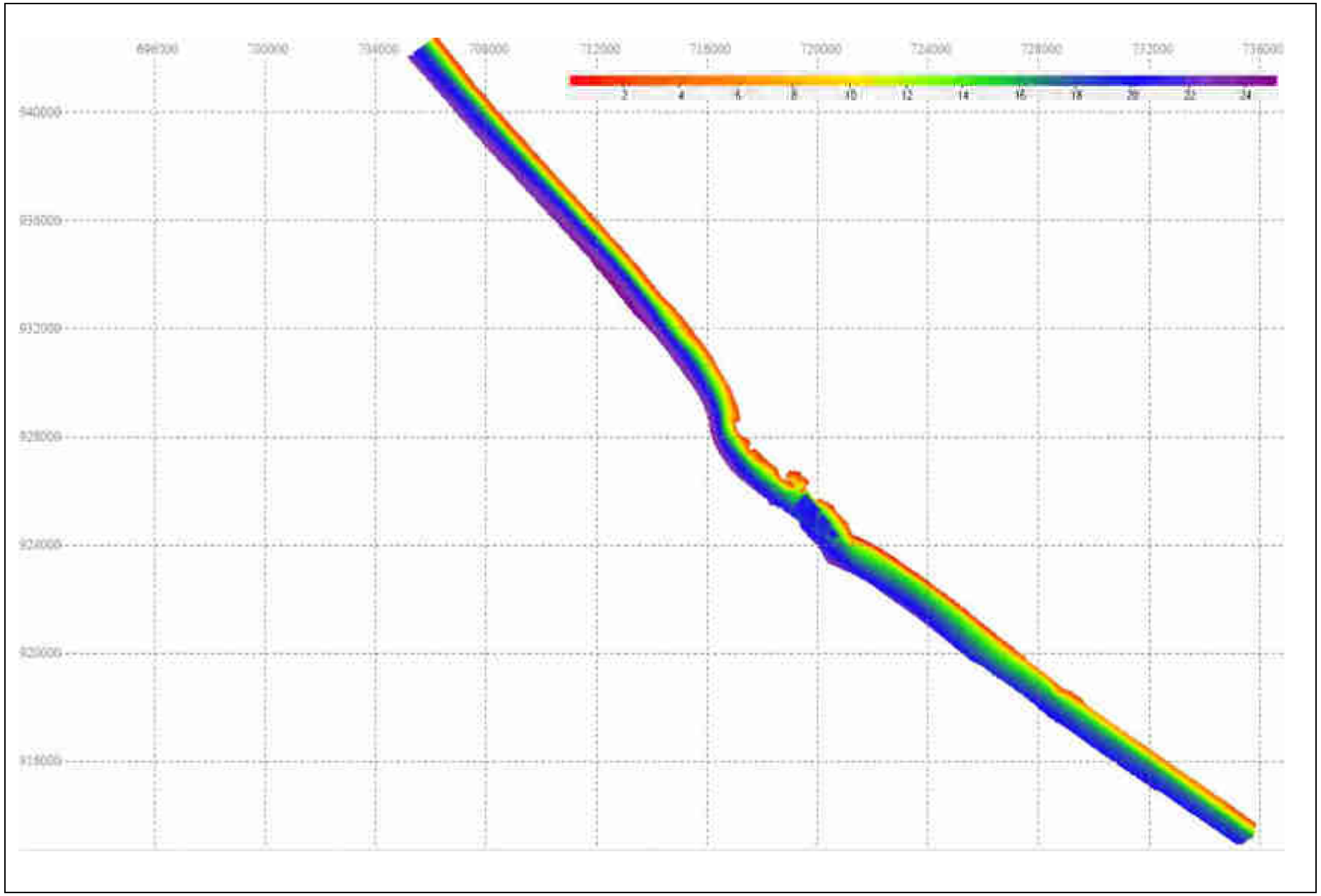


Figure 6-32: Colour coded Bathymetry

6.12 River Surveys

① The river crossing survey was carried out at 6 river/stream crossings. The survey was carried out for 500m length of 4 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 25th August to 1st September 2021.

The river/stream wise survey findings are given below:

6.12.1 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 in the northern part of the river. Maximum elevation obtained by RTK was 3m above CD.

6.12.2 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 depth of 5.5m was recorded toward the north-western. Towards south-east of the river, the depths vary from 1 to 2.9m. The maximum elevation obtained is 2.4m above CD in the southeastern part on the southern bank.

6.12.3 Chovara River

Chovara River lies between Vizhinjam and Poovar river. This river is land-locked during a major part of the year. A maximum depth of 2.5m is observed in the central part of the river. 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. The maximum elevation obtained is 2.6m above CD on the western bank of the river.

6.12.4 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 10.3m 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. The maximum elevation obtained is 4.3m above CD on the western bank of the river.

6.12.5 Gangayattumkara Canal

The stream runs next to the fishing harbour. The spot values obtained from the RTK system are shown in the chart, referenced to the Chart Datum. The maximum elevation obtained by RTK is 6.2m above CD.

6.12.6 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. The maximum elevation obtained by RTK is 7.2m above CD.

7 WEATHER

During the monsoon period, the weather was extremely unfavourable for survey operations. On 27th September 2021, the multibeam survey boat capsized in the Vizhinjam Fishing Harbour due to high waves and strong wind caused due to the cyclone Gulab. The multibeam equipment was damaged and had to be sent for repair. While carrying out the cross-shore profiles, due to the breakers near shore the data collection was severely hampered. At times, the boat had to take a turn between 4 to 5m water depth, due to heavy breakers in the nearshore section, considering the safety of personnel and the multibeam system.

8 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
- Monthly survey reports from April to September 2021

9 CONCLUSIONS

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

1. Tide was mixed semi diurnal with a maximum range being observed during spring tide.
2. The significant wave heights increased considerably during the monsoon period. The maximum wind speeds were blowing from the northwesterly direction.
3. The current direction was predominantly towards southeast in all locations, with surface currents showing more speed than those recorded at mid-depth and near the bottom.
4. The long-shore current speed was recorded in a northerly direction in the pre-monsoon months changed towards south in the monsoon period.
5. The salinity was in the range of 32.5 and 34.9 ppt for the samples collected in the pre-monsoon period.

6. The Total Suspended Solids were less than 9 mg/l during the pre-monsoon period in all the locations.
7. The maximum turbidity recorded at the water sampling locations was 4.0 NTU near the bottom of Location L1 (Mulloor) during the monsoon period.
8. At the location of the turbidity buoys, the maximum turbidity recorded at Location 1 was 4.06 NTU near the bottom in the month of June 2021, maximum turbidity measured at Location 2 was 3.36 NTU near the bottom in the month of August 2021 and that recorded at Location 3 was 4.85 NTU near the bottom in the month of April 2021.
9. The beach samples consisted mainly of medium sand.
10. The seabed is seen to slope gently towards the southwest. The maximum depth recorded by multibeam echo sounder is 24.9m below CD in the northwestern part of the survey area at coordinates 713600.5 mE, 934750.5 mN.

10 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 is also hereby appreciated. The boat crew and all others, who had supported us during the project is also acknowledged.

Annexure I

Photo Documentation of CSP Locations - September 2021

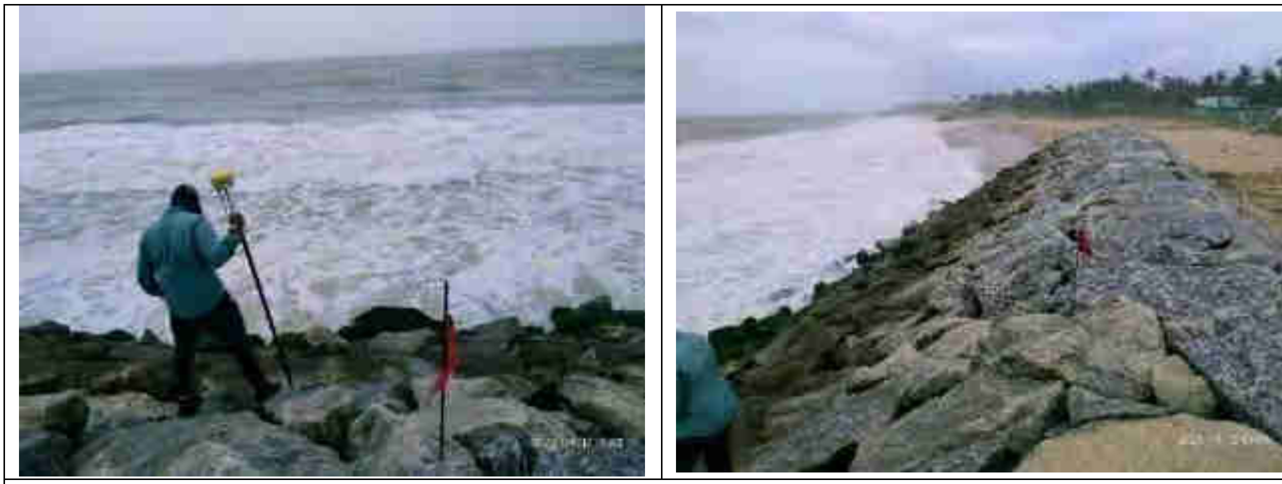


Figure 1- September CSP 01

Figure 2- September CSP 02

Figure 3- September CSP 03

Figure 4- September CSP 04


Figure 5- September CSP 05


Figure 6- September CSP 06


Figure 7- September CSP 07


Figure 8- September CSP 08


Figure 9- 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

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Figure 18- September CSP 18

Figure 19- September CSP 19

Figure 20- September CSP 20


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Figure 22- September CSP 22

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Figure 29- September CSP 29

Figure 30- September CSP 30


Figure 31- September CSP 31


Figure 32- September CSP 32

 

Figure 33- September CSP 33

 

Figure 34- September CSP 34


Figure 35- September CSP 35


Figure 36- September CSP 35-A

Figure 37- September CSP 36

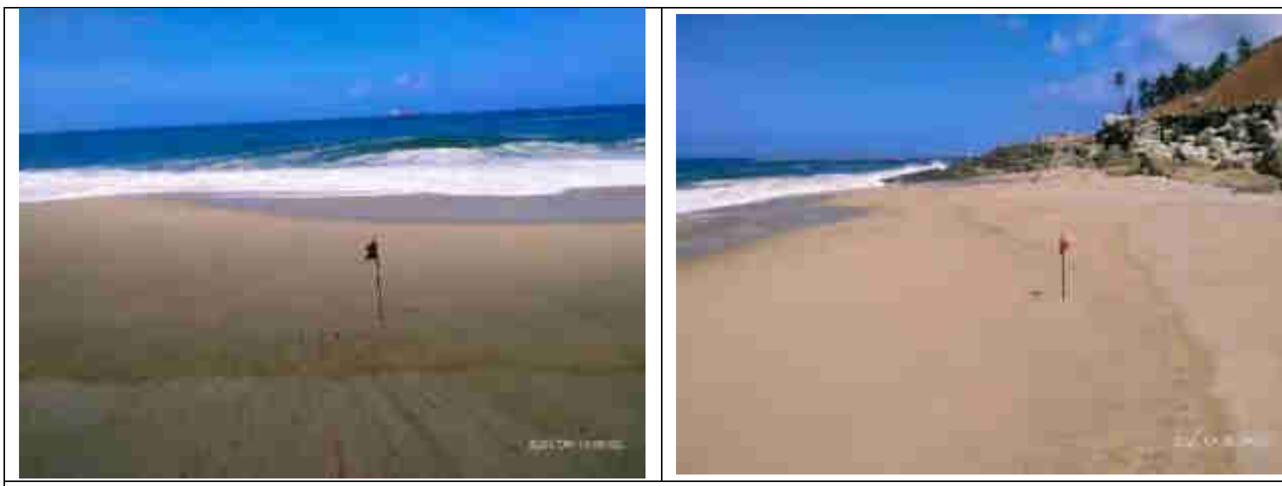

Figure 38- September CSP 37

Figure 39- September CSP 38

Figure 40- September CSP 39

Figure 41- September CSP 40

Figure 42- September CSP 40-A

Figure 43- September CSP 41

Figure 44- September CSP 42


Figure 45- September CSP 43


Figure 46- September CSP 44

Figure 47- September CSP 45

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Figure 79- September CSP 77

Figure 80- September CSP 78

Figure 81- September CSP 79

Figure 82- September CSP 80

	

Figure 83- September CSP 81

Annexure II

Mathematical Modelling Report

(March 2020 to February 2021)

L&T Infra Engineering

L&T Infrastructure Engineering Ltd.

Client:	**Adani Vizhinjam Port Private Limited** Vizhinjam		
Project:	Data Analysis & Model Studies for Vizhinjam Port using data collected by AVPPL (2020-2021)	**Project No.:** C1211501	
Title:	Data Analysis and Final Model Study Report March 2020- February 2021	**Document No.:** RP004	**Rev.:** 0

File path:
I:\ports\2021\c1211502 - adani_visl_model_study_2020-21\deliverables\reports\rp004-r0-ttn-report on data analysis-20-21 and final model studies report.docx

Notes:

1.

Revision Details:

0	26/11/2021	First Submission	PSJ		RRJ		PRJ	
Rev.	**Date**	**Details**	**Init.**	**Sign.**	**Init.**	**Sign.**	**Init.**	**Sign.**
			Prepared		**Checked**		**Approved**	

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LIST OF ABBREVIATIONS

ADCP	: Acoustic Doppler current profiler
ATG	: Automatic Tide Gauge
AVPPL	: Adani Vizhinjam Port Private Limited
AWS	: Automatic Weather Station
CD	: Chart Datum
CS	: Cross Section
CSP	: Cross Shore Profile
E	: East
EOF	: Empirical Orthogonal Function
FSINPVT	: Fugro Survey India Private Limited
GNSS	: Global Navigation Satellite System
GPS	: Global Positioning System
HD	: Hydrodynamics
H_{m0}	: Wave height
H_s	: Significant Wave Height
HTL	: High Tide Level
IMD	: Indian Meteorological Department
LNTIEL	: L & T Infrastructure Engineering Limited
LST	: Longshore Sediment Transport
LSTR	: Longshore 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
PCA	: Principal Component Analysis
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 2020, LNTIEL submitted a report based on the data received from February 2015 - February 2020. 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 2020 to February 2021. AVPPL entrusted LNTIEL to conduct 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.

With this background, LNTIEL has prepared this report by carrying out the analysis of the data received from March 2020-February 2021 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 7 transect lines perpendicular to the shore; four on the North of port, two on the South of port and one near the port. Cross sections of bathymetries from Pre monsoon 2015 to Post monsoon 2020 were compared. From the analysis, no significant change in bathymetry is observed even though some localized changes have occurred due to dredging and reclamation near the port.
- The observed wave data provided by AVPPL for the period of March 2020 to February 2021 is analysed and compared with the observed wave data for February 2018 to February 2020. Majority of the waves observed at the project location fall in the range of 0.5-1.5 m. From these comparisons, the variability of wave heights and directions are within expected ranges. It was also noted that some of the higher events were as a direct result of the moving storms & depressions in the sea and that these events caused a direct impact on the wave heights.
- The current data was provided for the pre-monsoon, monsoon and post-monsoon of 2020 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 0.8 m/s. However, occasionally maximum current speed observed during all the seasons is in the range of 0.8 to 1.0 m/s.

- Continuous monitoring of turbidity using buoys has been carried out during March 2020 to February 2021 in three locations. It is perceptible from time series plots that the turbidity fluctuates all year round, though the values were lower than 5 NTU for almost all the time showing that the water is clear. A spike during March 2020 was attributed to erroneous reading due to lack of maintenance of the machines due to lockdown for Covid 19.
- 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 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. Furthermore, the increase in wave heights due to storm events in subsequent years is making the beach recovery more difficult.
- Further LNTIEL extracted (+) 2 m contour from cross shore profile data. The time series plot of (+) 2 m contour over four years 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 not much accretion was noticed during fair weather 2017 and pre-monsoon 2018. In addition, because of monsoon 2018 and 2019 the beach got further eroded compared to previous monsoon seasons.
- From the LEO data, it can be observed that the movement is towards south during monsoon and from earlier analysis, it was found that erosion on the northern side of the port takes place during the monsoon times. So therefore, the results of this analysis suggest that the erosion in the north during monsoon is not due to the port.

2) Model Studies

a) Near Shore Wave Transformation

- Offshore wave data from March 2020 to February 2021 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, 2019 and 2020) 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) 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.
- To compute longshore 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 5 years data (Feb 2015 – Feb 2020). 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).

d) Analysis of beach volume

- An analysis was done to calculate the sediment volume from the available beach profile data. LNTIEL used average profiles and filled data gaps using an interpolation technique to carry out the analysis.
- The beach profile volume and seabed profile volume combined represents the net volume (m^3/m alongshore). The Feb 2015 (start of survey) profile is considered as baseline to estimate the volume changes.
- From the volume analysis it was found that near the port, the net volume change is minimal and it remains so for stretches near the port location. Only net volume change seems to be higher in stretches of Valiyathura, Shangumugham and beyond towards Northern Kerala. Therefore since around the port and upto a significant distance (at least 10km to the north of the port) the net volume change is minimal, the port cannot have effects on what is happening in Valiyathura, Shangumugham and beyond otherwise the effects would have shown in the nearby regions as well

LNTIEL carried out data analysis and model studies for the aforementioned project and it was found that wave activity has increased in this location in past three years post Ockhi Cyclone. The beaches that are trying to form back are not getting formed to its prior position because of the increased activity. Also, from the model studies it was found that the bathymetry of the port location has no effect on the current patterns and the current patterns have remained fairly the same. The port has no effect on the erosion and accretion at Valiyathura & Shangumugham, hence concluded from all the analyses.

1 Introduction

Government of Kerala is setting up a green field, modern deep water, multipurpose seaport 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 seaport.

In this regard, VISL had appointed Royal Haskoning DHV India (RHI) as their technical consultant in April 2010 and entrusted RHI with the task of preparing the concept port Master Plan. The port layout and the conceptual design were provided by RHI. As an initial study, Ministry of Environment and Forests (MoEF) had suggested VISL to explore the likely impacts on the existing fishing harbour and adjacent coastal regions due to the proposed port. Later, as part of the EIA studies, VISL appointed AECOM India Private Limited (AEIPL) to prepare the Detailed Project Report (DPR) for the Development of Vizhinjam Port. As a part of DPR and EIA studies, the design criterion for the port as well as the impact of the port on the marine environment was studied.

L&T Infrastructure Engineering Limited (LNTIEL) (formerly known as L&T Rambøll Consulting Engineers Limited) has been long associated with VISL. 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 appointed 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 assessment of 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 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 this context, LNTIEL have been carrying out data analysis and the required model studies based on the data collected from 2015 to February 2020, LNTIEL has produced reports containing analyses for all these years and has drawn out comparisons with the baseline data (2015; pre-project scenario). In continuation, AVPPL has measured oceanographic data from March 2020 to February 2021 and has awarded the job to LNTIEL for carrying out the data analysis and accompanying model study for the data collected in this period. This report contains the analysis of data & required model studies carried out to fulfil the scope of work.

1.1 Project location

The deep-water port is being constructed at Vizhinjam in Thiruvananthapuram District of Kerala. A Vizhinjam fishing harbour is located at about 300m north of the port and is a major landmark at this location. The port location is shown in Figure 1-2.

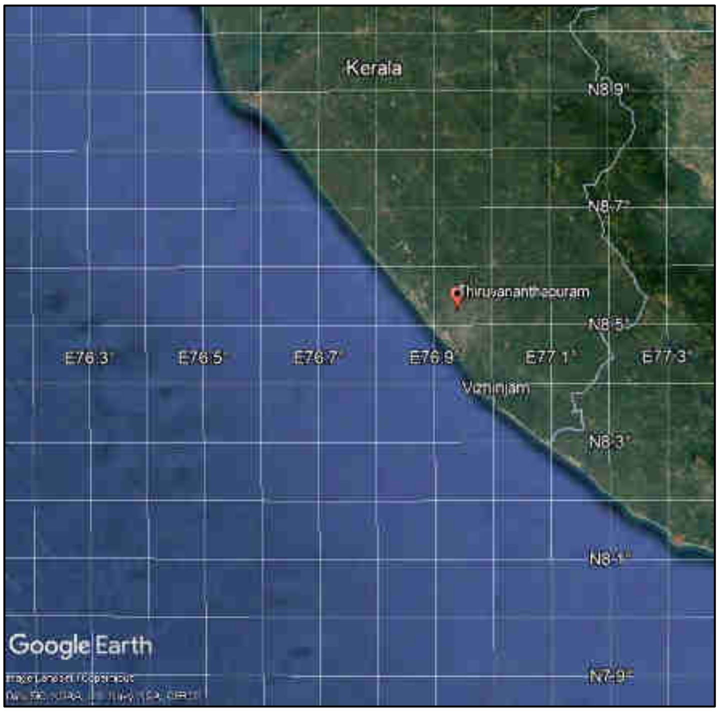


Figure 1-1 Location map of Vizhinjam

Figure 1-2 Location of the port (zoomed in)

2 Data Analysis

AVPPL has measured oceanographic data from March 2020 to February 2021 and has shared the list of data presented in Table 2-1.

Table 2-1 Data received

S. No	Data received
1	Long term observation of water level variations for the period March 2020 to February 2021
2	Wave data recorded continuously during the period of March 2020 to February 2021
3	Current data for one month for each season (Pre-monsoon, Monsoon and Post-monsoon) from March 2020 to February 2021
4	Measurement of wind speed and direction from March 2020 to February 2021
5	Littoral Environment Observations; monthly data from March 2020 to February 2021
6	Photographic Documentation; monthly data from March 2020 to February 2021
7	Cross shore beach profiles at 81 locations which cover approximately 40 km along the coastline.
8	Turbidity data from March 2020 to February 2021 in 10 min intervals collected from three locations near the port area
9	Surveyed bathymetry for the Pre-Monsoon 2020 and Post Monsoon 2020

2.1 Waves

Wave data is being recorded continuously off Vizhinjam since early 2015. This section of the report discusses about the wave parameters based on the observed wave data. Wave parameters were measured using WRB (Mulloor) at 08°21' 43.15" N, 76°59'25.86" E (-23.2 m) during the period of 01st March 2020 to 28th February 2021 for this cycle of study. The measured significant wave height, peak wave period and direction are represented in the form of graphs and are presented in Figure 2-1 to Figure 2-3.

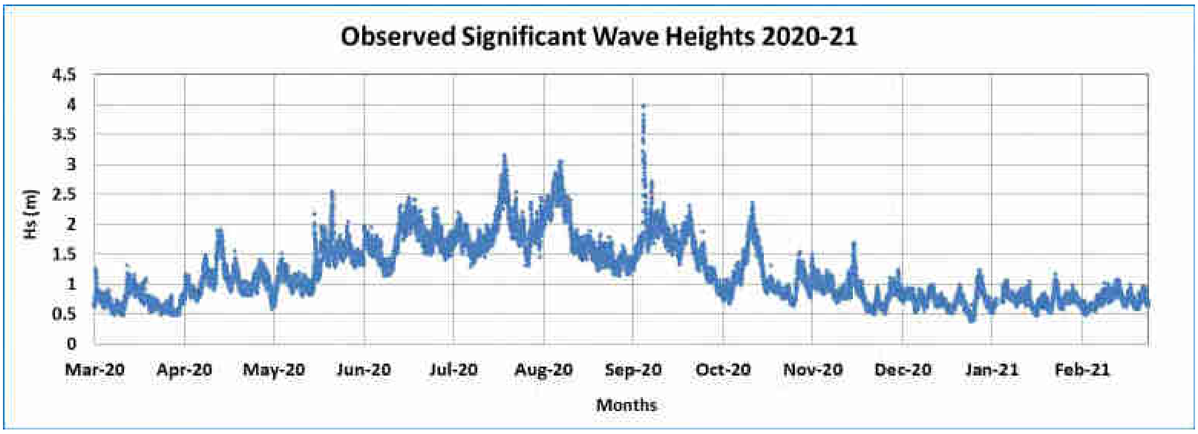


Figure 2-1 Temporal plot of wave height for observed wave data

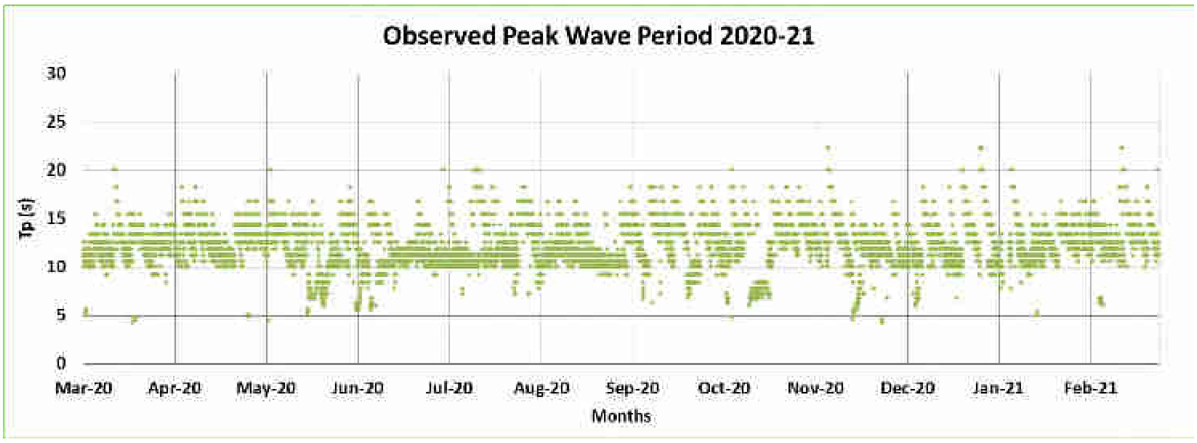


Figure 2-2 Temporal plot of peak wave period for observed wave data

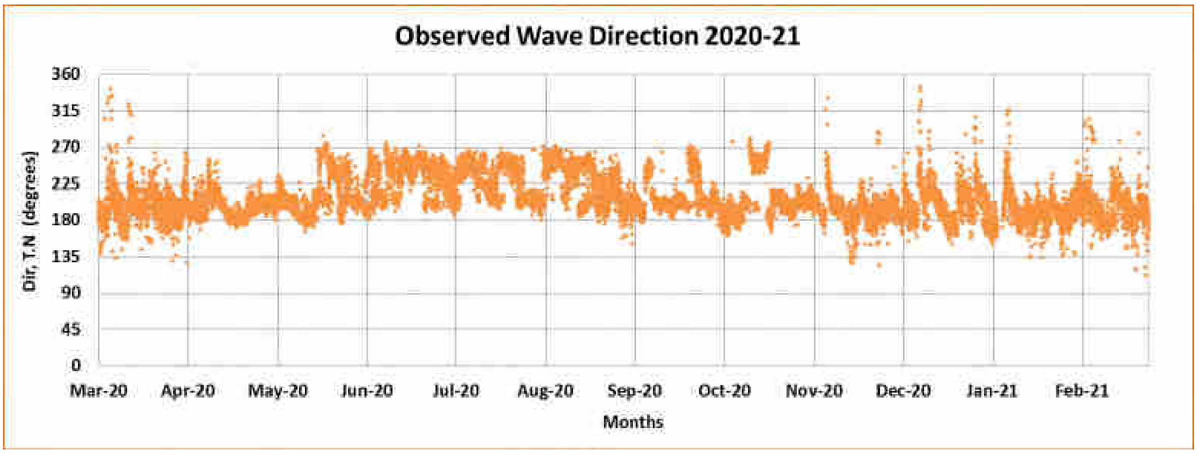


Figure 2-3 Temporal plot of wave direction for observed wave data

From the above graphs, we can observe that the significant wave heights are mostly in the range of 0.5 m – 1.5 m during non-monsoon period and it reaches around 4 m during monsoon period.

It can be observed 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.

The following table accounts for the higher wave events that can be noticed in the graph for wave heights. It may be noted that in most of these events, the cause was either a storm or a depression. As a general trend, an increase in wave heights is observed over past few years and at least one strong event per year.

Table 2-2 Storm events observed during Mar 2020 to Feb 2021

S. No.	Date	Reason
1	16^{th} to 22^{nd} May 2020	Cyclone Amphan
2	31^{st} May to 4^{th} June 2020	Cyclone Nisarga
3	17^{th} to 19^{th} June 2020	Monsoon

S. No.	Date	Reason
4	20th July 2020	Monsoon
5	8th August 2020	Monsoon
6	6th to 9th September 2020	Low pressure area formed under the influence of cyclonic circulation
7	20th to 22nd September 2020	Low pressure area over North East Bay of Bengal
8	13th to 14th October 2020	Deep depression over East Central Bay of Bengal
9	17th November 2020	Cyclone Gati

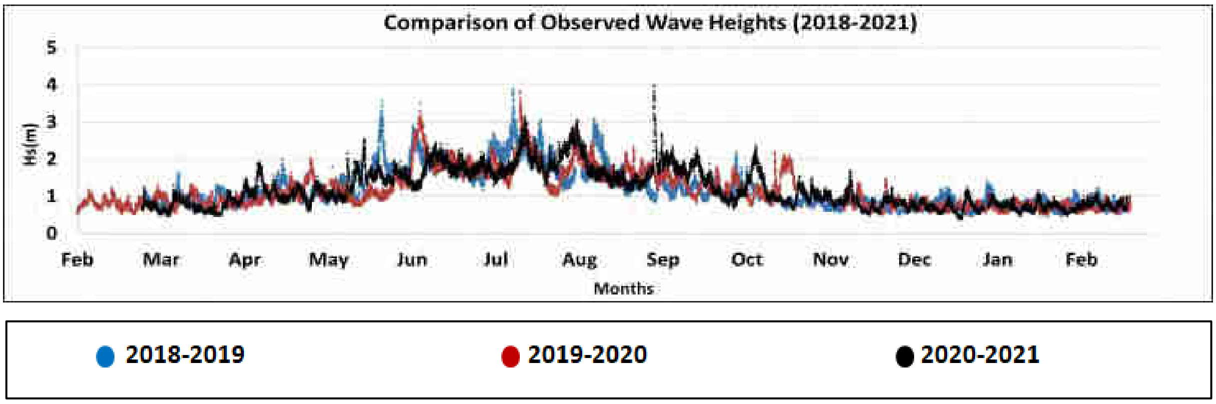


Figure 2-4 Comparison of wave heights for past 3 years (2018-2021)

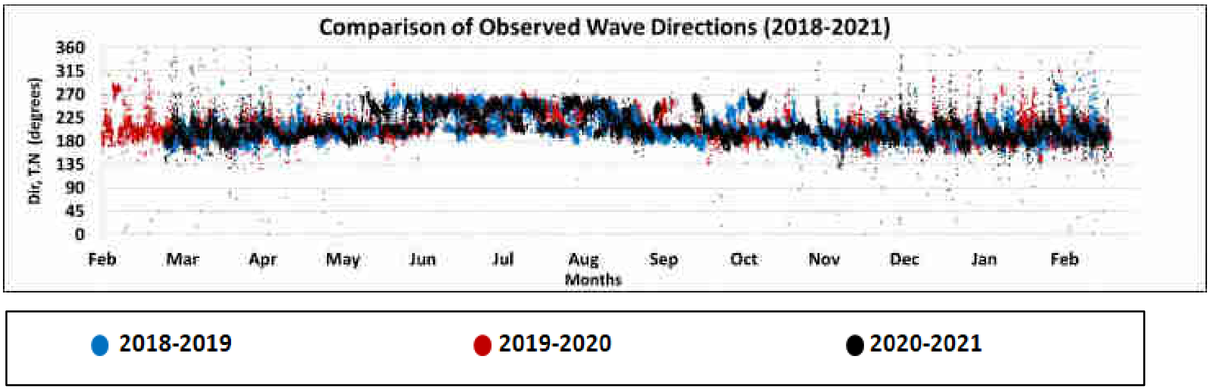


Figure 2-5 Comparison of wave directions for past 3 years (2018-2021)

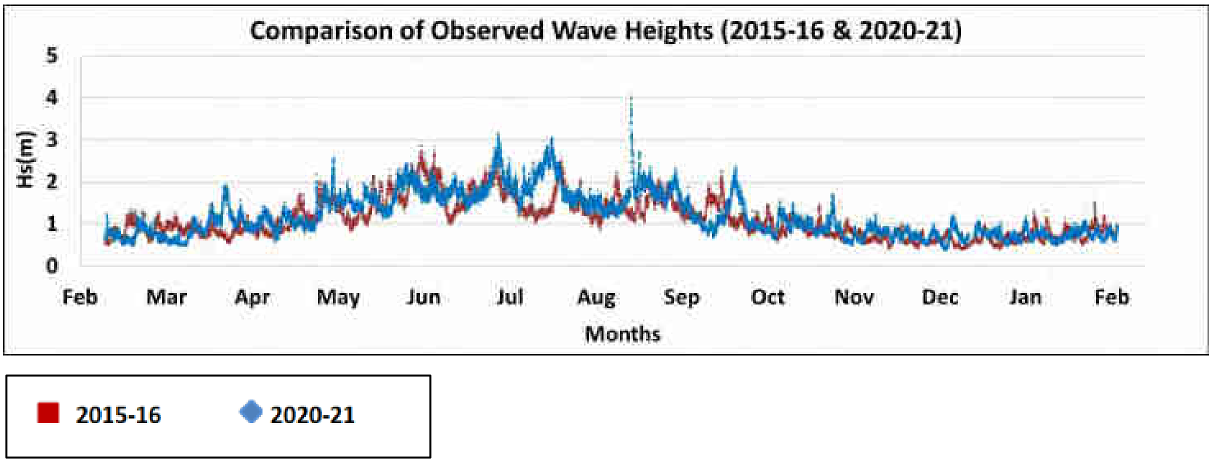


Figure 2-6 Comparison of wave heights (2015-16 & 2020-21)

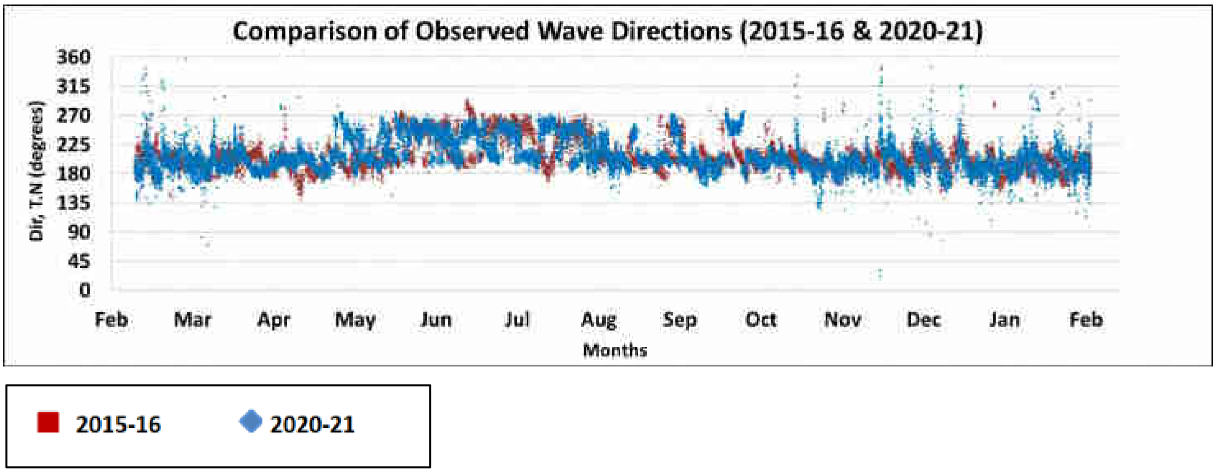


Figure 2-7 Comparison of wave directions (2015-16 & 2020-21)

From these comparisons, the variability of wave heights and directions are within expected ranges. It was also noted that some of the higher events were as a direct result of the moving storms & depressions in the sea and that these events caused a direct impact on the wave heights. Compared to 2015-16 data, a greater number of higher wave events were noticed in the years 2018-20. This shows that the wave activity may be increasing all along the coast.

2.2 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. In addition to these data, in-situ tide measurements using ATG were also available in old reports. Due to the 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, 01st March 2017 to 28th February 2018 and February 2018 to February 2019. For the period March 2019 to June 2020, OSAS collected data at 08° 22' 33.68" N, 76° 59' 16.65" E and at a depth of 3.3 m. Shankar & Co. collected data from July 2019 to February 2020. These data were reported in the earlier reports by LNTIEL.

Subsequently, Shankar And Co (SAC) collected data, at the above mentioned location, for the period March 2020 to February 2021. The measured tide is presented in Figure 2-8.

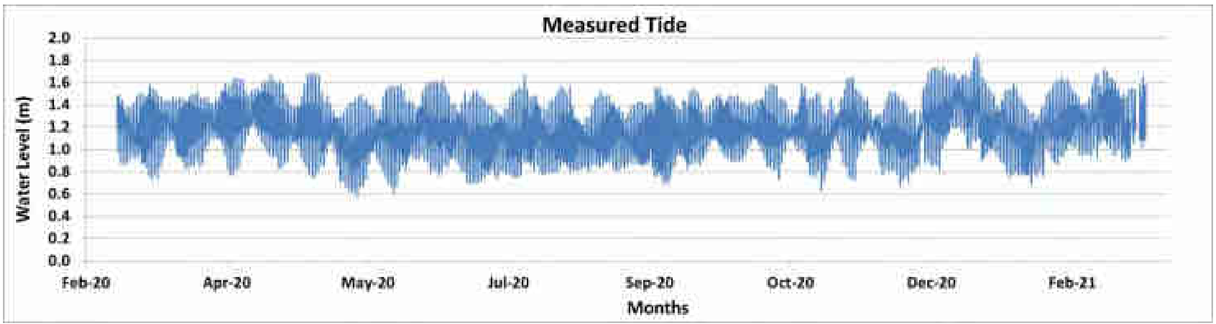


Figure 2-8 Tide data measured during Mar 2020 to Feb 2021

2.3 Currents

Measured current speeds and directions at different depths as given in Table 2-3 at four different locations Pachalloor, Vizhinjam, Mulloor and Poovar as presented in Figure 2-9. AVPPL provided the current data for one month for each season from March 2020 to February 2021 (Pre-monsoon, Monsoon and Post-monsoon). The data collected for each season are presented in Figure 2-18 to Figure 2-31.

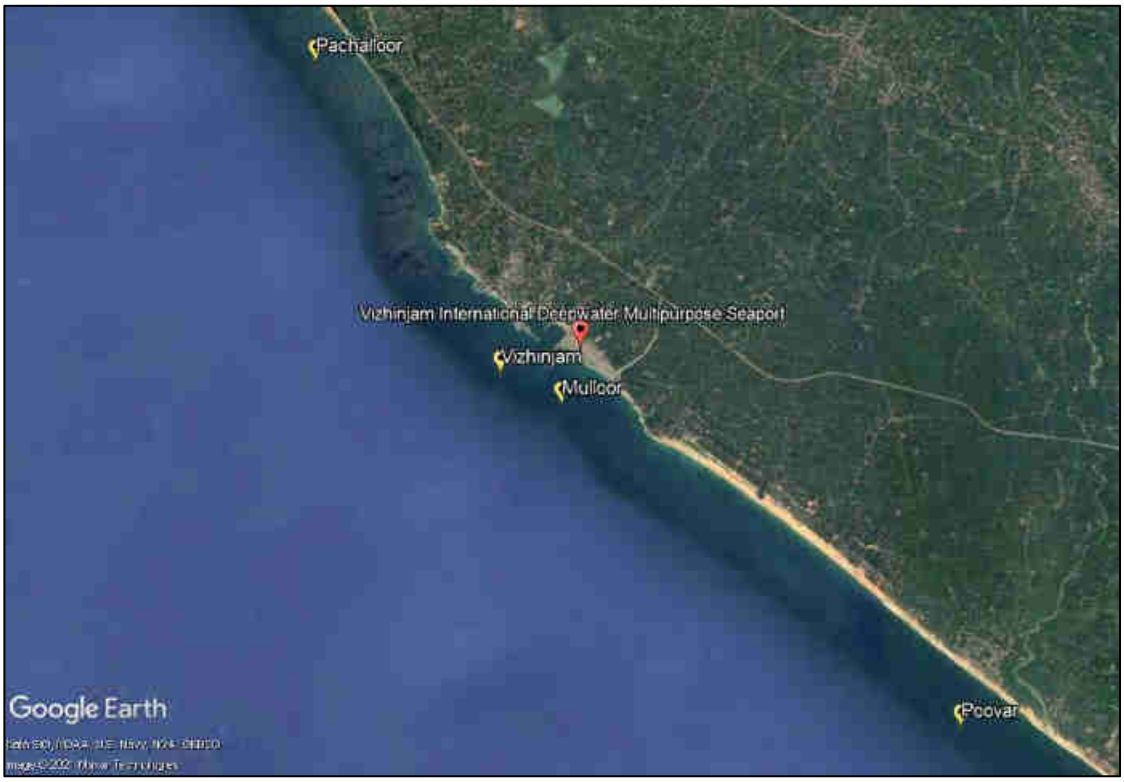


Figure 2-9 Locations from where the current data are collected

Table 2-3 Observed Current Speed and Direction (March 2020 to February 2021)

	Coordinates	Pre Monsoon	Monsoon	Post Monsoon

Location and Depth (CD,m)	**Latitude**	**Longitude**	**Current Speed Range (m/s)**	**Predominant Current Direction**	**Current Speed Range (m/s)**	**Predominant Current Direction**	**Current Speed Range (m/s)**	**Predominant Current Direction**
Vizhinjam 21.1	8^{0}21’55.4”	76^{0}58’51.6”	0.1-0.55	NW	0.1-0.7	SE	0.1-0.65	SE
Poovar 23.0	8^{0}17’35.8”	77^{0}04’03.5”	0.1-0.55	NW	0.1-0.9	SE	0.1-0.65	SE
Pachalloor 21.4	8^{0}24’08.6”	76^{0}56’16.1”	0.1-0.65	NW	–	–	0.1-0.5	SE
Mulloor 23.2	8^{0}21’42.3”	76^{0}59’33.9”	0.1-0.6	NW	0.1-1.0	SE	0.1-0.65	SE

The monsoon measured current speed and direction, at Pachalloor, are not presented due to data unavailability. In the September 2020 report (Periodic Survey Report - PSR 16), SAC has reported loss of boat and equipment subjected for data collection at Pachalloor and hence no data has been provided.

The current speed and the current direction for different seasons at four different locations are shown in Figure 2-18 to Figure 2-31. Start and end times of observed currents in three seasons is as shown in Table 2-4.

Table 2-4 Current observation timeline

Location	Coordinates		Pre Monsoon		Monsoon		Post Monsoon	
	Latitude	Longitude	Start date	End date	Start date	End date	Start date	End date
Pachalloor	8^{0}24’08.6”	76^{0}56’16.1”	24/04/20	25/05/20	–	–	13/01/21	12/02/21
Vizhinjam	8^{0}21’55.4”	76^{0}58’51.6”	25/04/20	26/05/20	17/08/20	20/09/20	12/01/21	12/02/21
Mulloor	8^{0}21’42.3”	76^{0}59’33.9”	24/04/20	25/05/20	17/08/20	20/09/20	12/01/21	13/02/21
Poovar	8^{0}17’35.8”	77^{0}04’03.5”	24/04/20	26/05/20	17/08/20	20/09/20	12/01/21	12/02/21

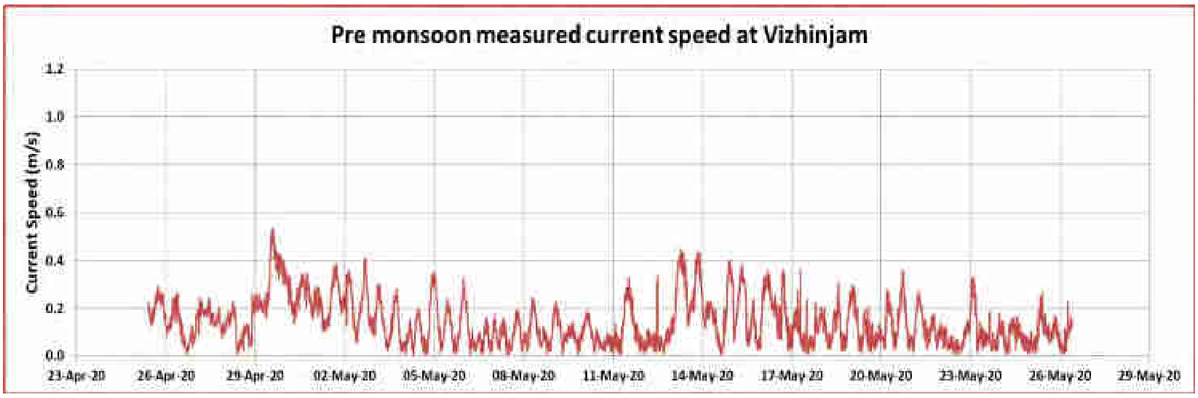


Figure 2-10 Pre-Monsoon measured current speed at Vizhinjam during May 2020

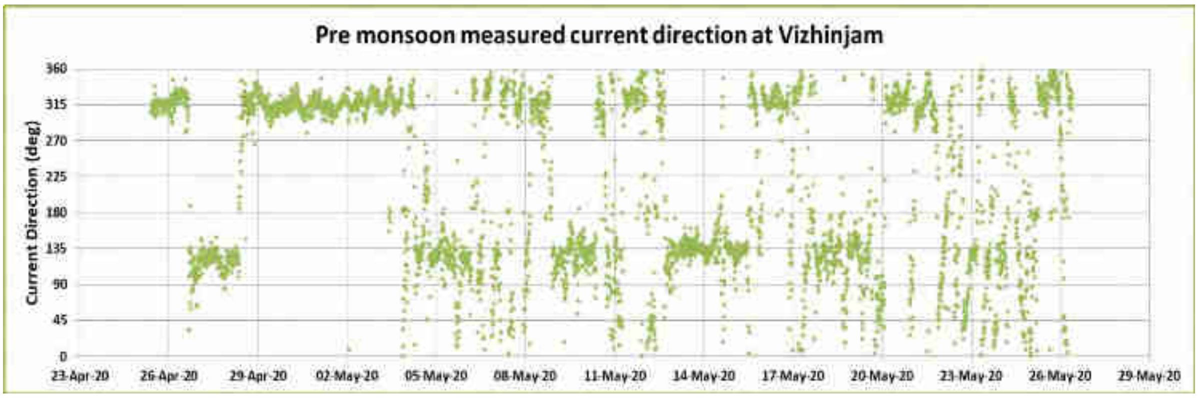


Figure 2-11 Pre-Monsoon measured current direction at Vizhinjam during May 2020

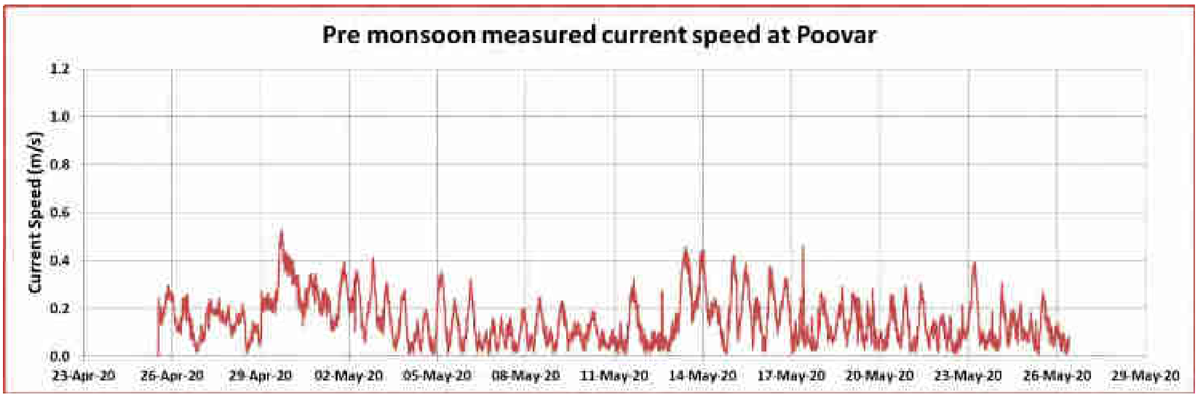


Figure 2-12 Pre-Monsoon measured current speed at Poovar during May 2020

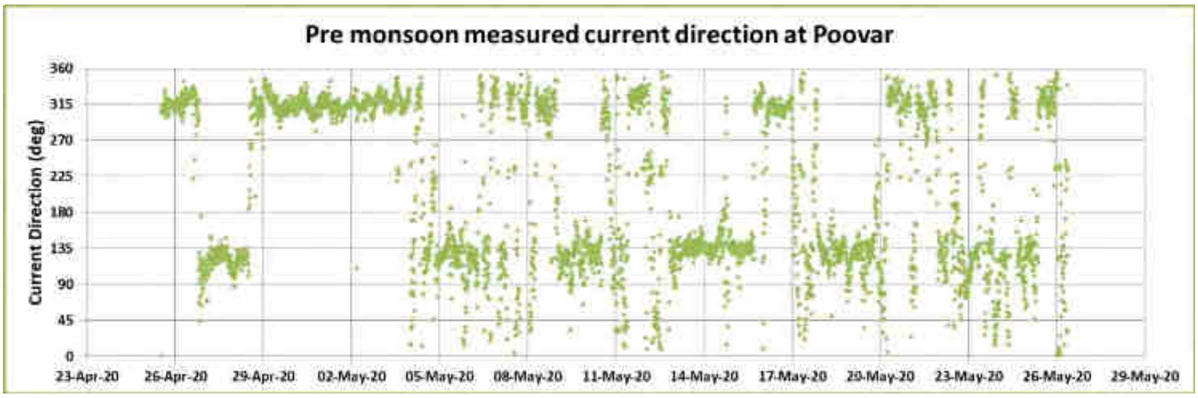


Figure 2-13 Pre-Monsoon measured current direction at Poovar during May 2020

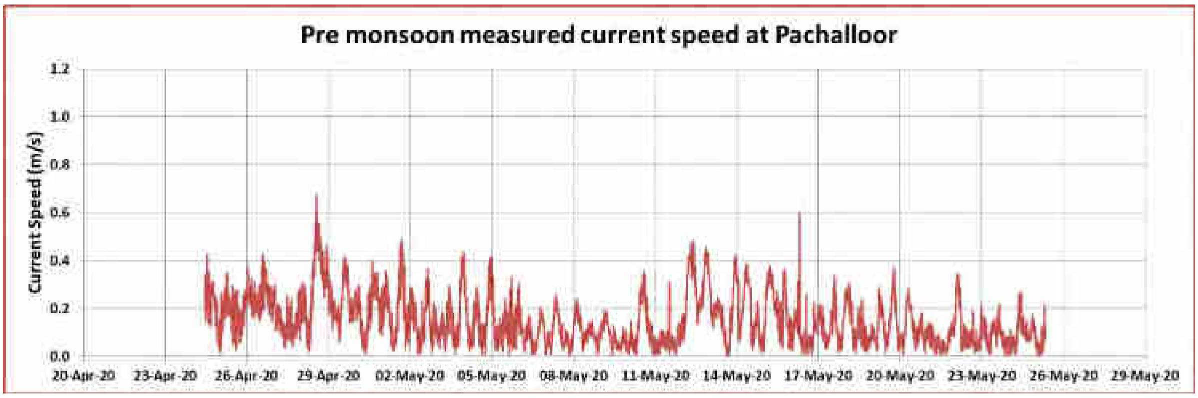


Figure 2-14 Pre-Monsoon measured current speed at Pachalloor during May 2020

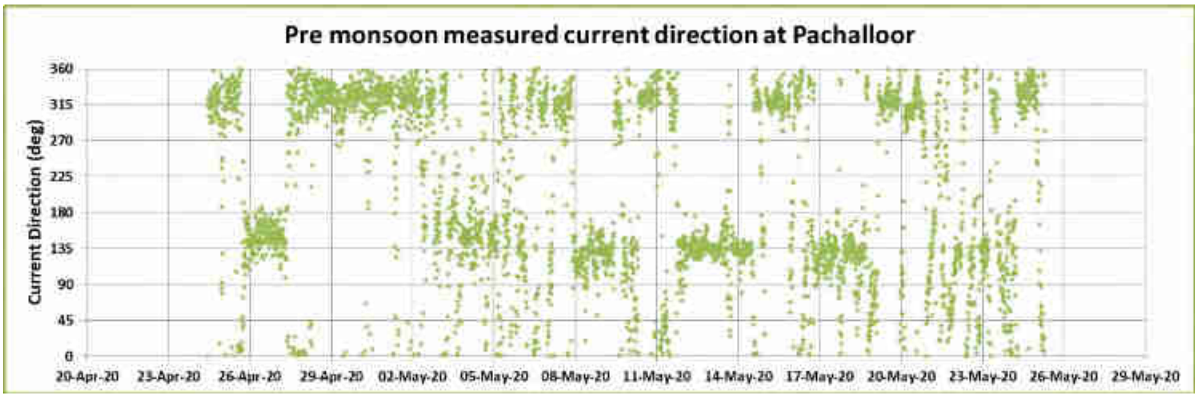


Figure 2-15 Pre-Monsoon measured current direction at Pachalloor during May 2020

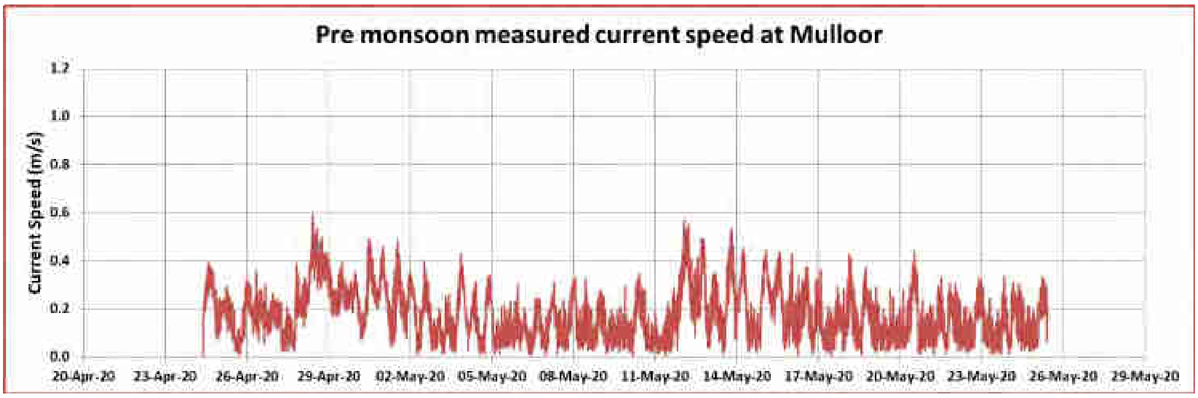


Figure 2-16 Pre-Monsoon measured current speed at Mulloor during May 2020

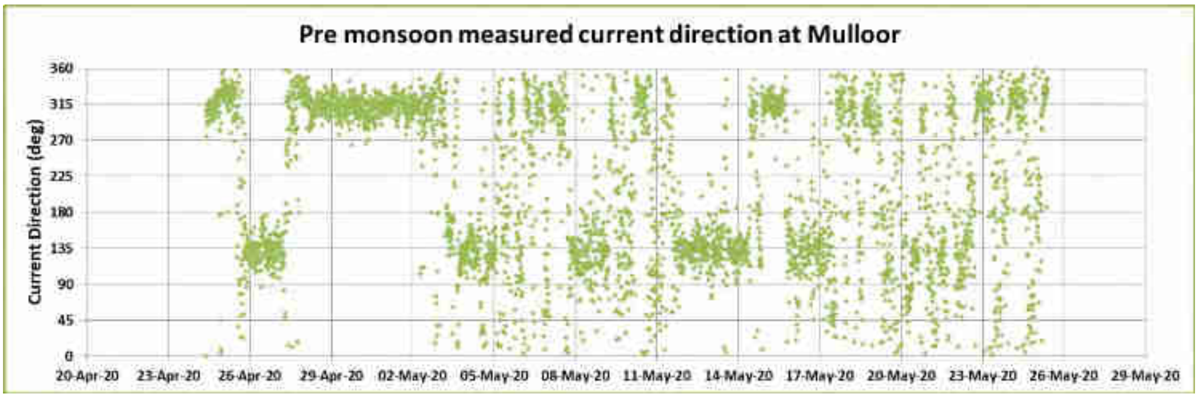


Figure 2-17 Pre-Monsoon measured current direction at Mulloor during May 2020

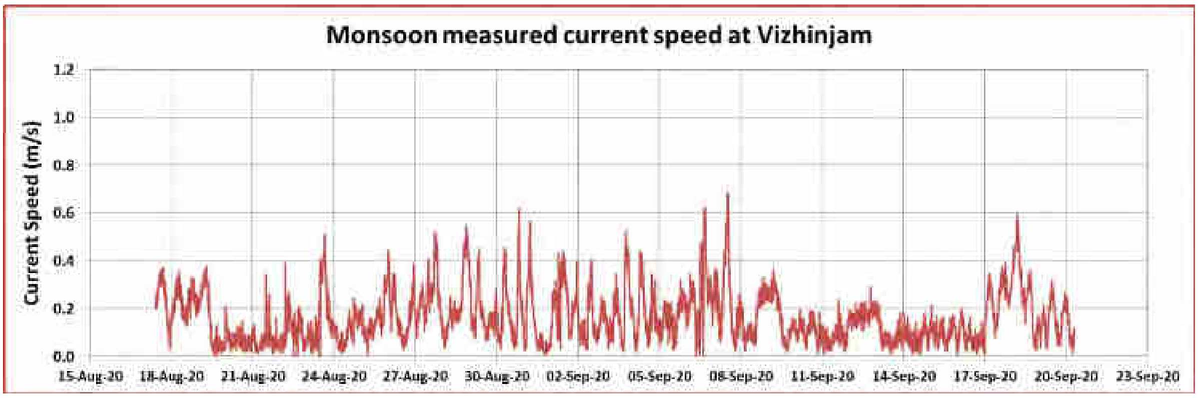


Figure 2-18 Monsoon measured current speed at Vizhinjam during Aug to Sept 2020

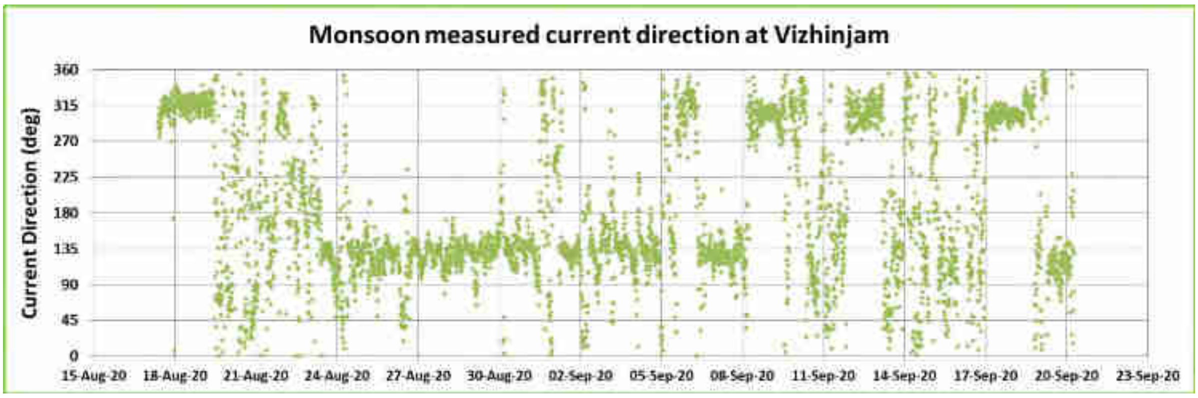


Figure 2-19 Monsoon measured current direction at Vizhinjam during Aug to Sept 2020

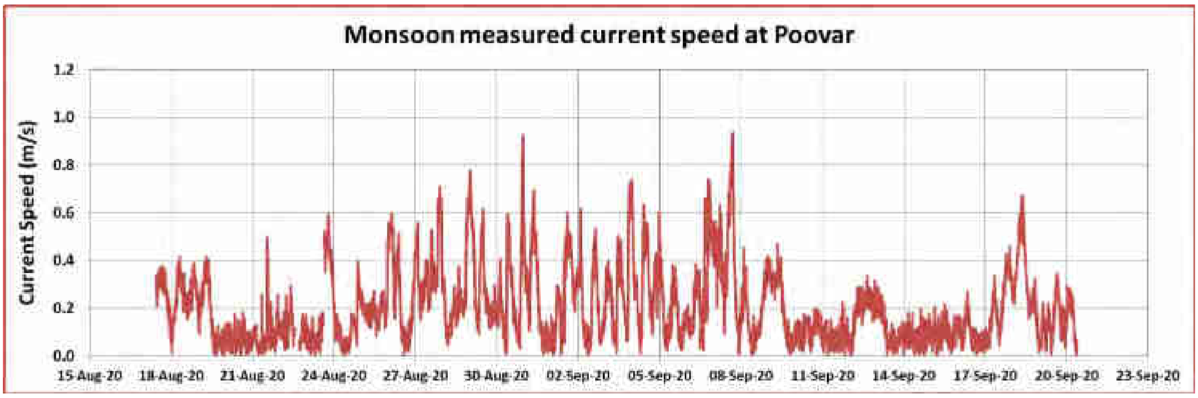


Figure 2-20 Monsoon measured current speed at Poovar during Aug to Sept 2020

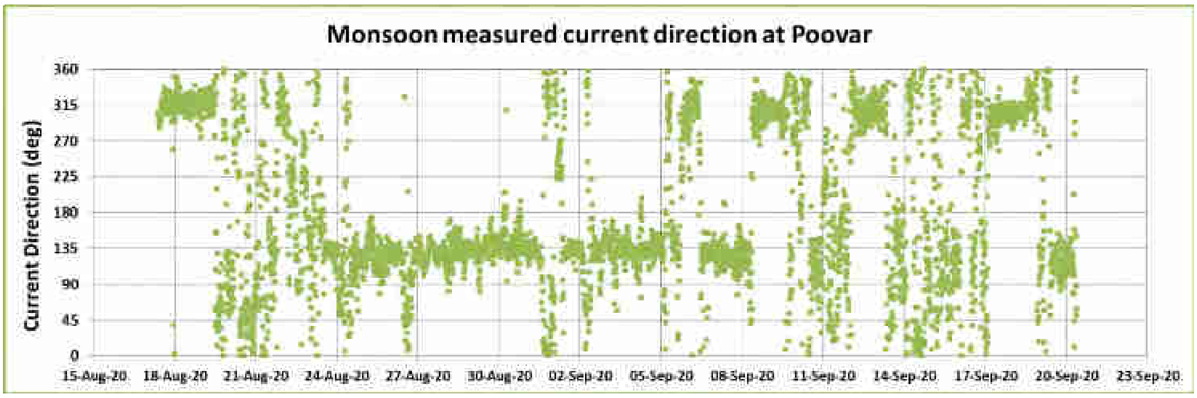


Figure 2-21 Monsoon measured current direction at Poovar during Aug to Sept 2020

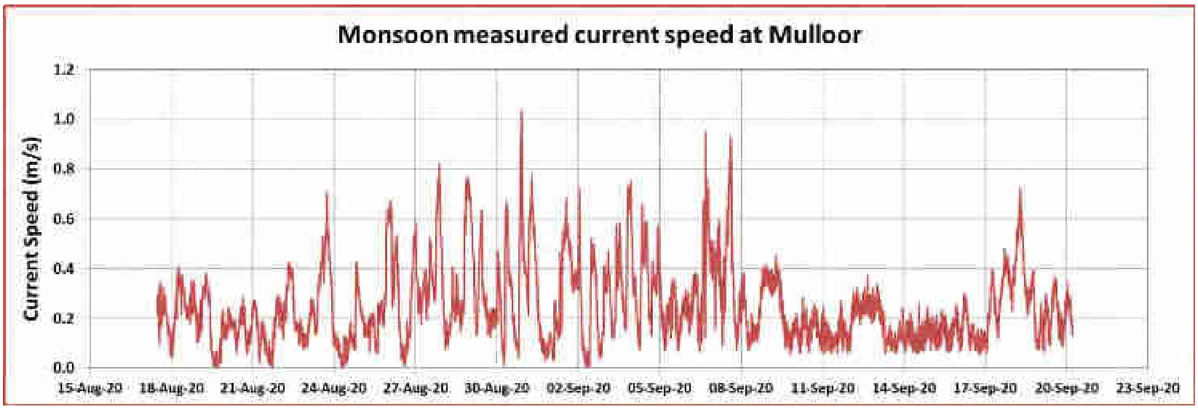


Figure 2-22 Monsoon measured current speed at Mulloor during Aug to Sept 2020

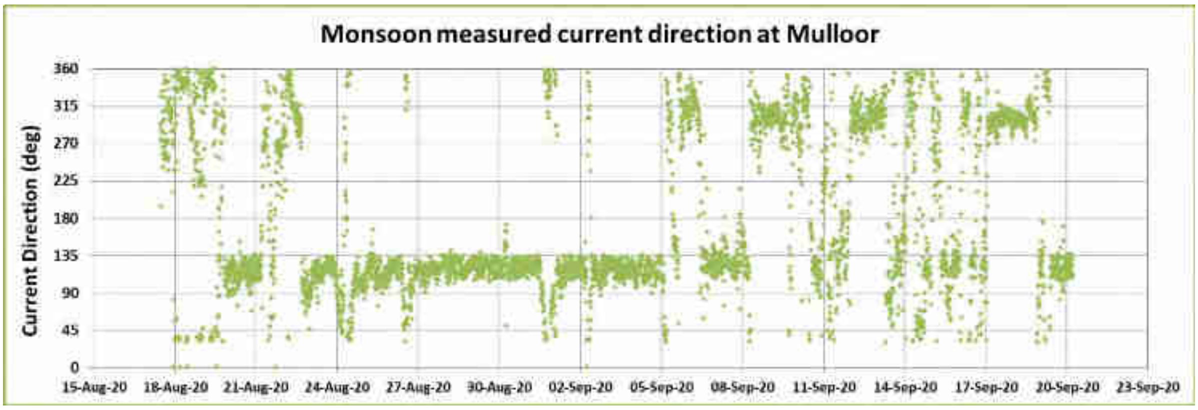


Figure 2-23 Monsoon measured current direction at Mulloor during Aug to Sept 2020

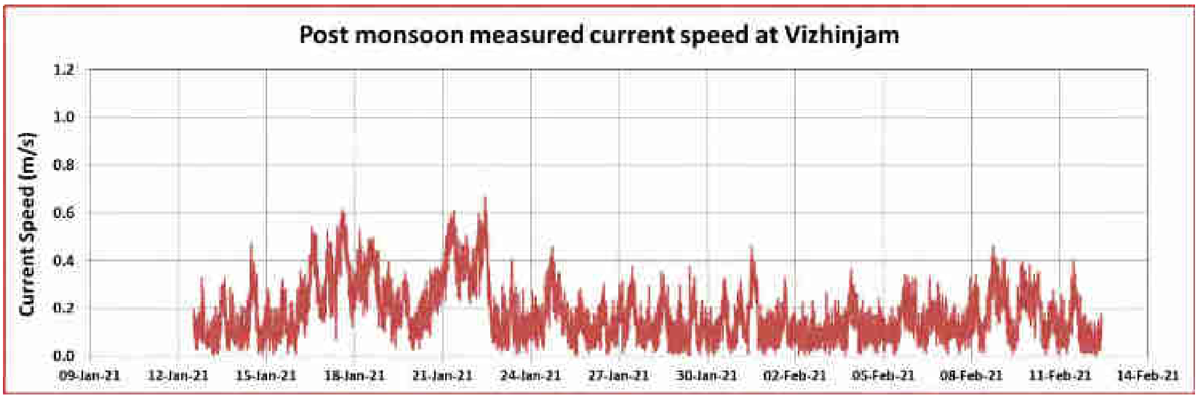


Figure 2-24 Post Monsoon measured current speed at Vizhinjam during Jan to Feb 2021

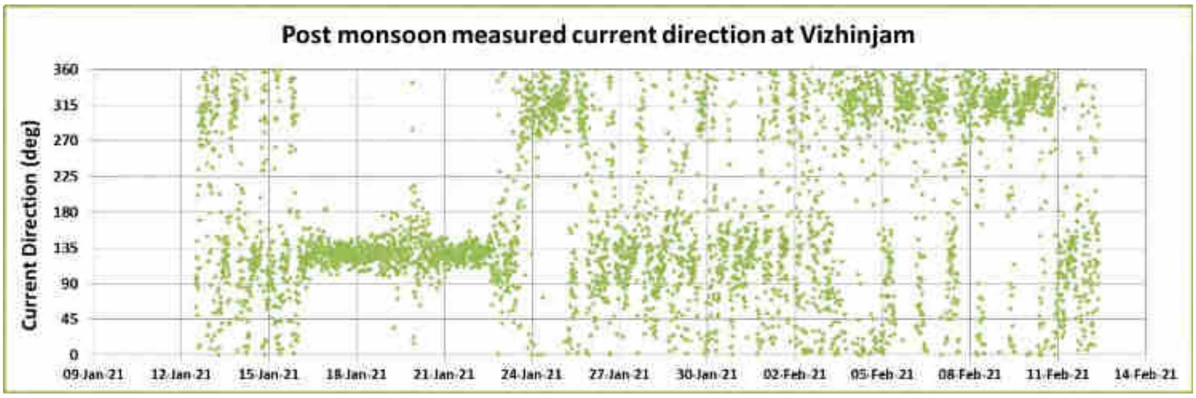


Figure 2-25 Post Monsoon measured current direction at Vizhinjam during Jan to Feb 2021

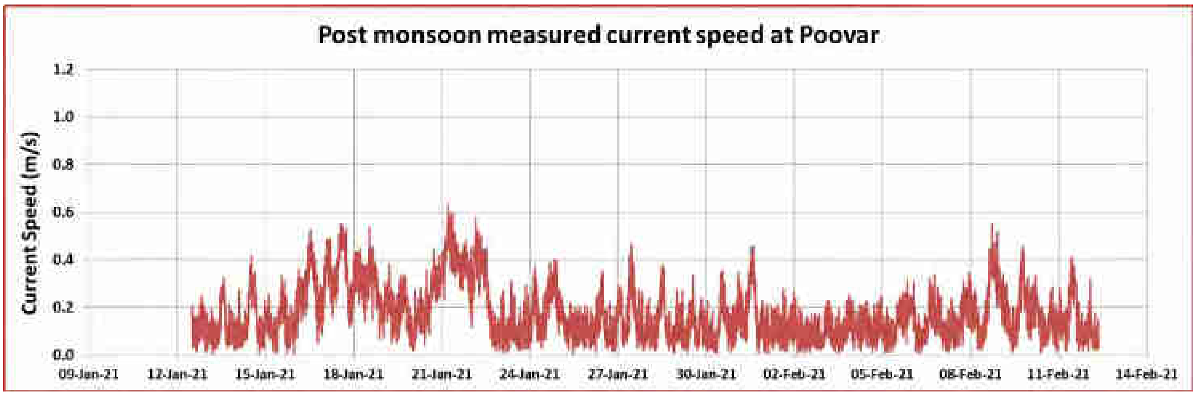


Figure 2-26 Post Monsoon measured current speed at Poovar during Jan to Feb 2021

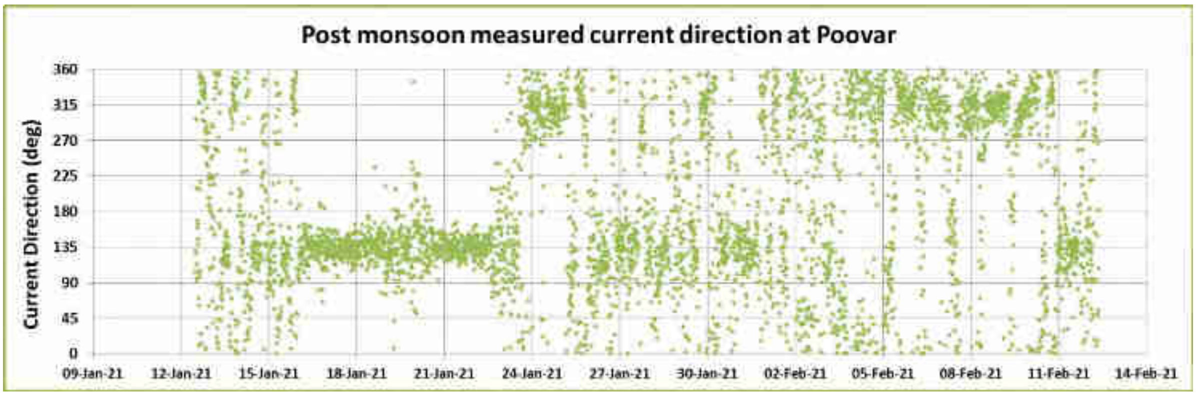


Figure 2-27 Post Monsoon measured current direction at Poovar during Jan to Feb 2021

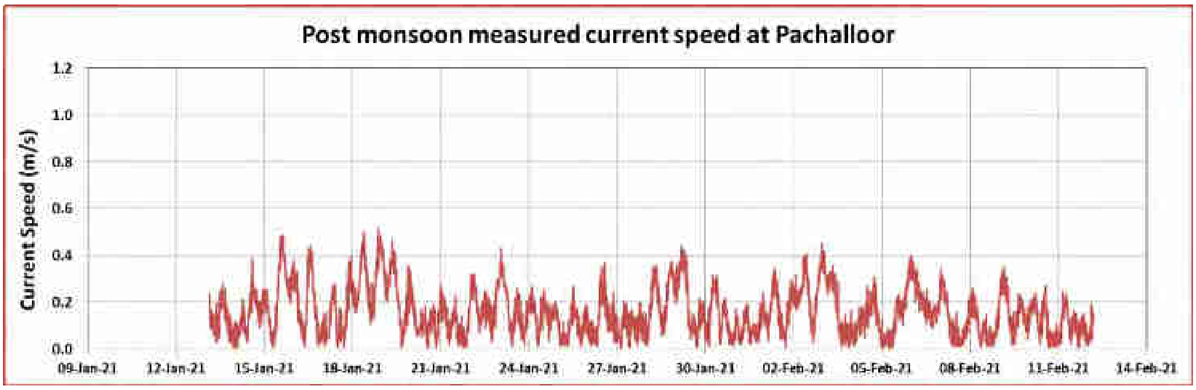


Figure 2-28 Post Monsoon measured current speed at Pachalloor during Jan to Feb 2021

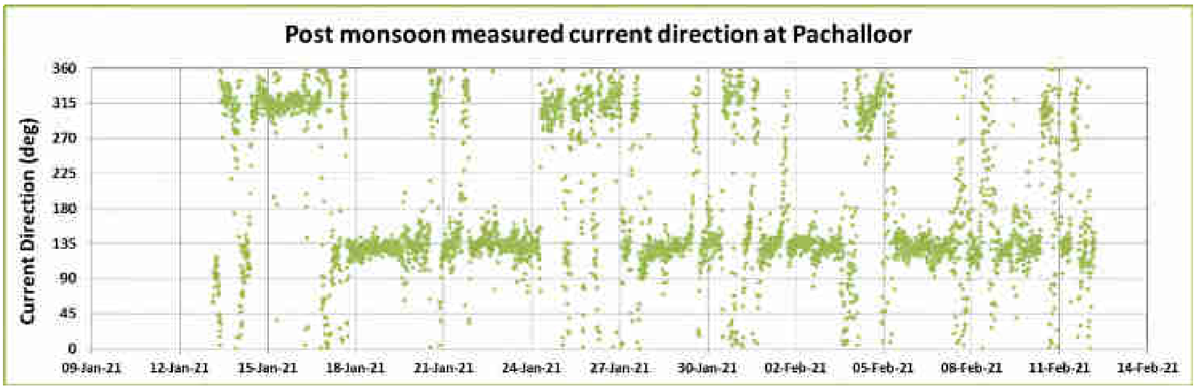


Figure 2-29 Post Monsoon measured current direction at Pachalloor during Jan to Feb 2021

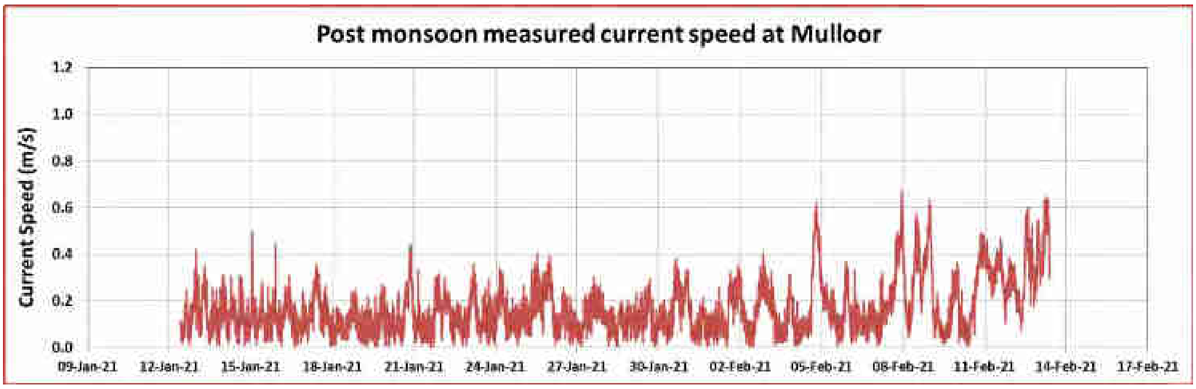


Figure 2-30 Post Monsoon measured current speed at Mulloor during Jan to Feb 2021

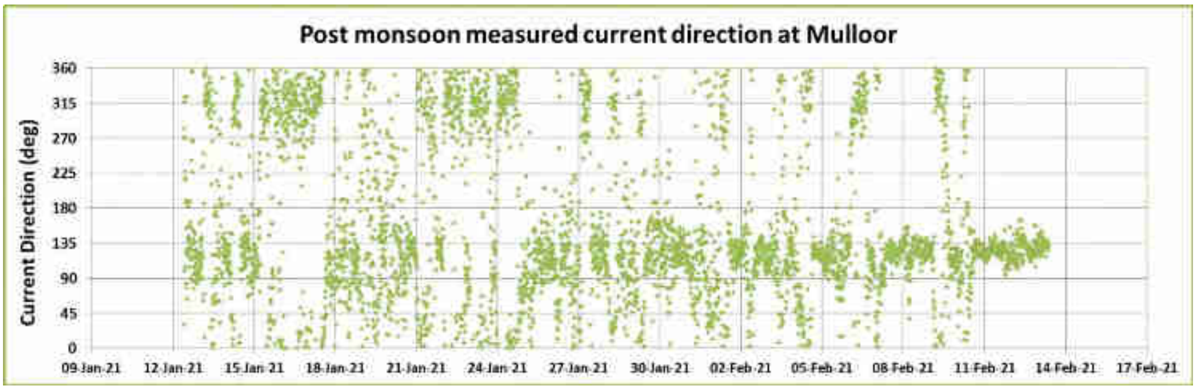


Figure 2-31 Post Monsoon measured current direction at Mulloor during Jan to Feb 2021

It can be noticed 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.

2.4 Wind

AVPPL provided the measurement of wind speed and direction from 1st March 2020 to 28th February 2021. The mostly wind speed varies from 3 to 4 m/s and the maximum wind speed measured is 10 m/s. It is observed that the wind speed is in expected range as in previous year. The graph showing the variation of wind speed and wind direction, measured at an elevation of 10m with respect to MSL is presented in Figure 2-33 and Figure 2-34.

Figure 2-32 Location of AWS

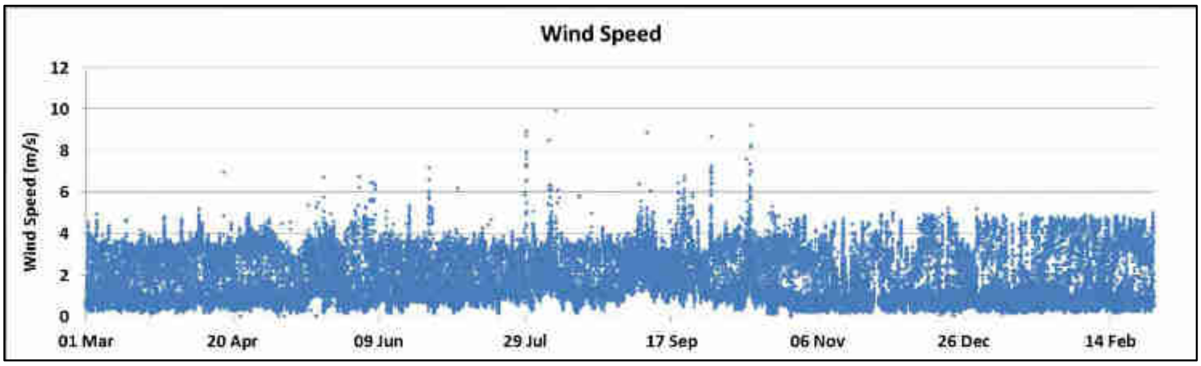


Figure 2-33 Wind speed measured during March 2020 to February 2021

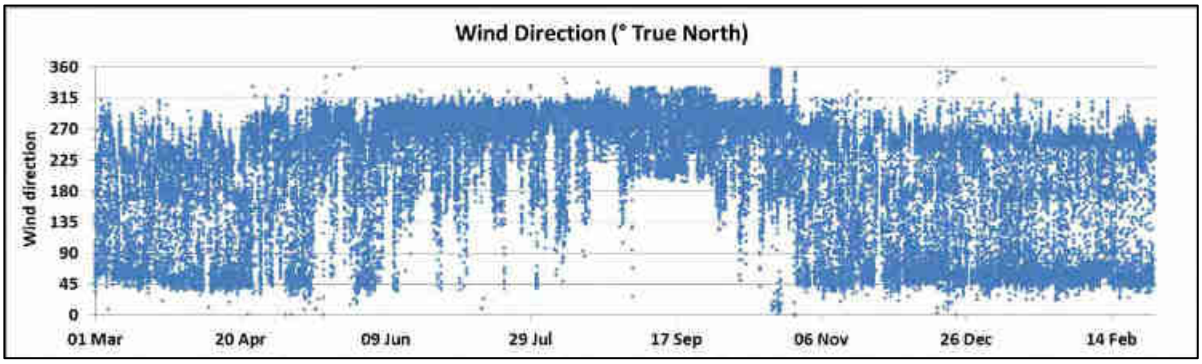


Figure 2-34 Wind direction measured during March 2020 to February 2021

2.5 Turbidity

AVPPL has provided the turbidity data from 1st March 2020 to 28th February 2021 in 10 min intervals collected from three locations near the port area as presented in Figure 2-35 using turbidity buoys.

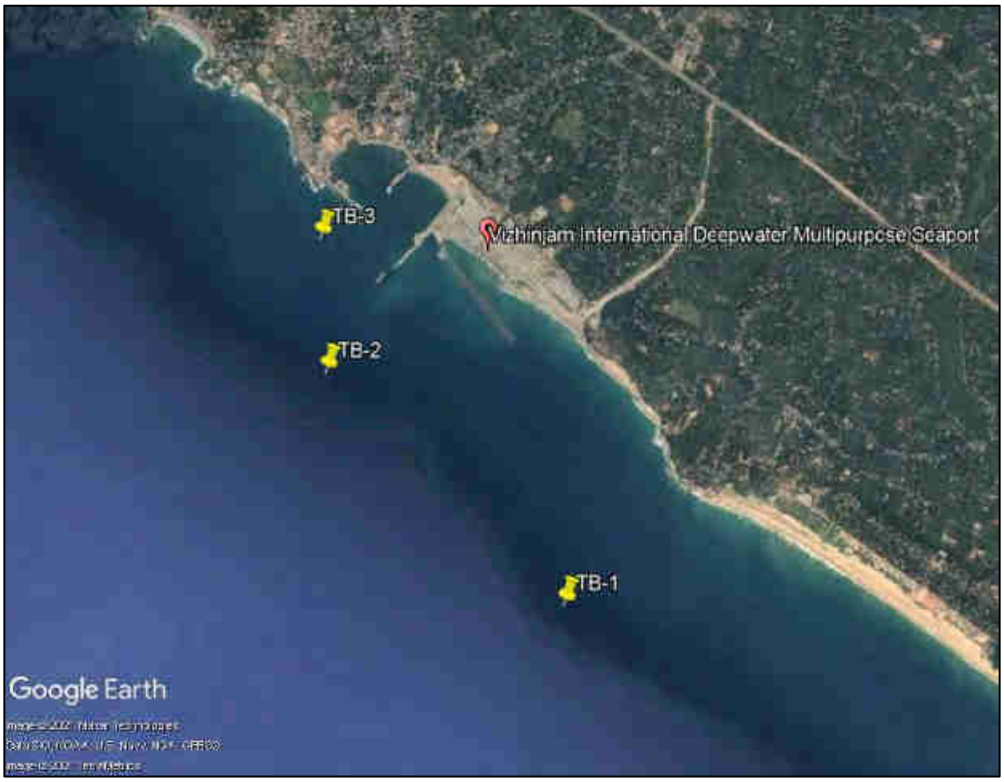


Figure 2-35 Location of Turbidity Buoys

The time series plotted using this turbidity data are presented in Figure 2-36 to Figure 2-38 for all the three locations.

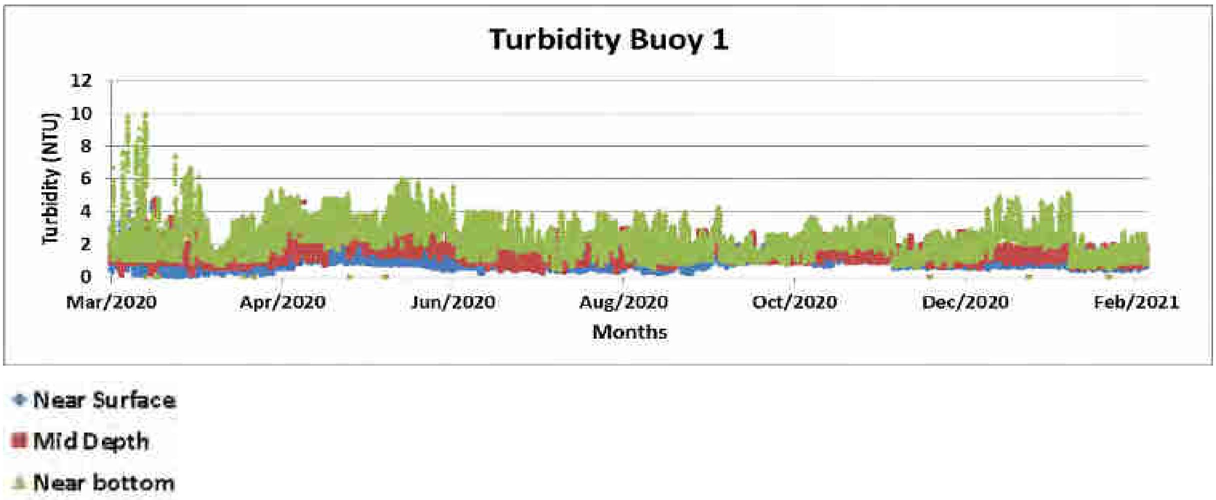


Figure 2-36 Time series plotted with the turbidity data collected from Turbidity Buoy 1

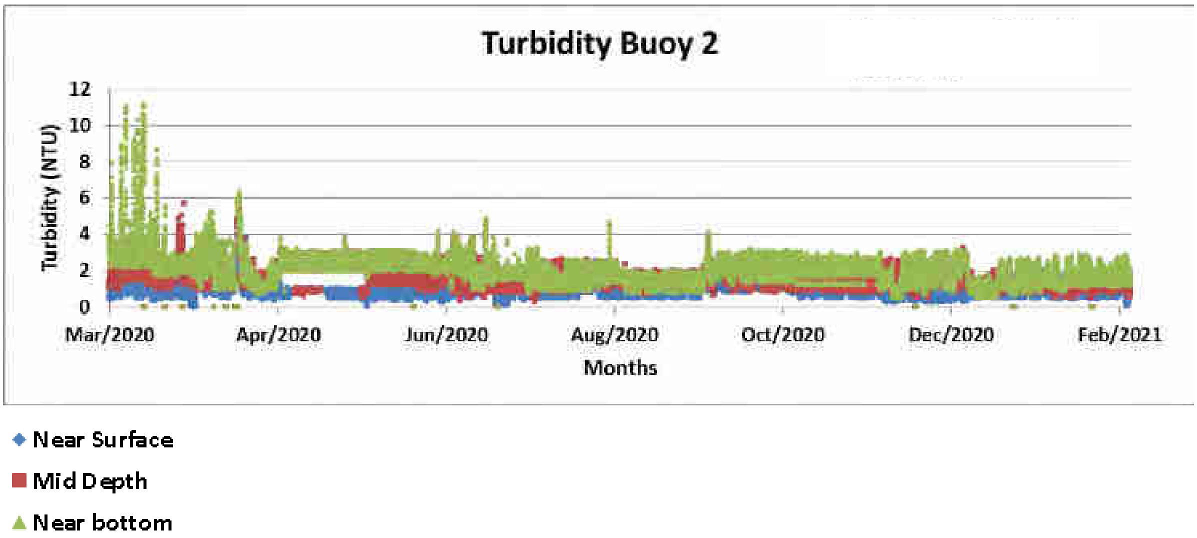


Figure 2-37 Time series plotted with the turbidity data collected from Turbidity Buoy 2

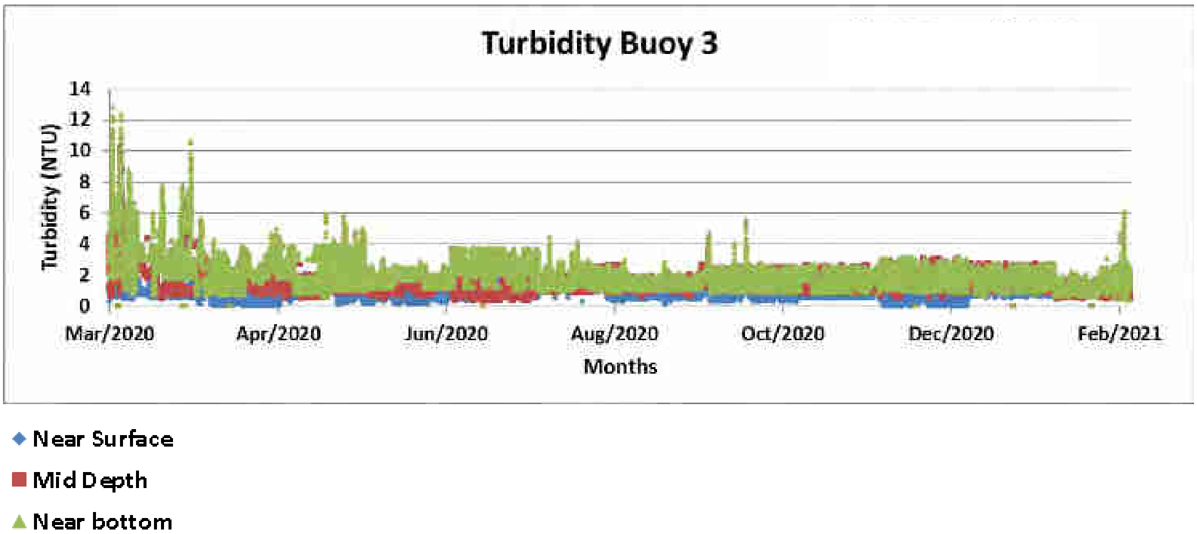


Figure 2-38 Time series plotted with the turbidity data collected from Turbidity Buoy 3

It is perceptible from time series plots that the turbidity fluctuates all year round. It may be noted that the values were lower than 5 NTU for almost all the time and the values were found to be relatively lower than the turbidity measured last year (2019-20). The spike in turbidity values, seen around March 2020, is due to the hindrance in routine maintenance activities because of COVID-19 lockdown.

2.6 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). 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 reports submitted earlier was created by combining the primary data from the surveys by NIOT and FSINPVT with those available from NHO Charts and ETOPO1.

The surveyed bathymetry for the Pre-Monsoon 2020 and Post Monsoon 2020 are shown in Figure 2-39 and Figure 2-40.

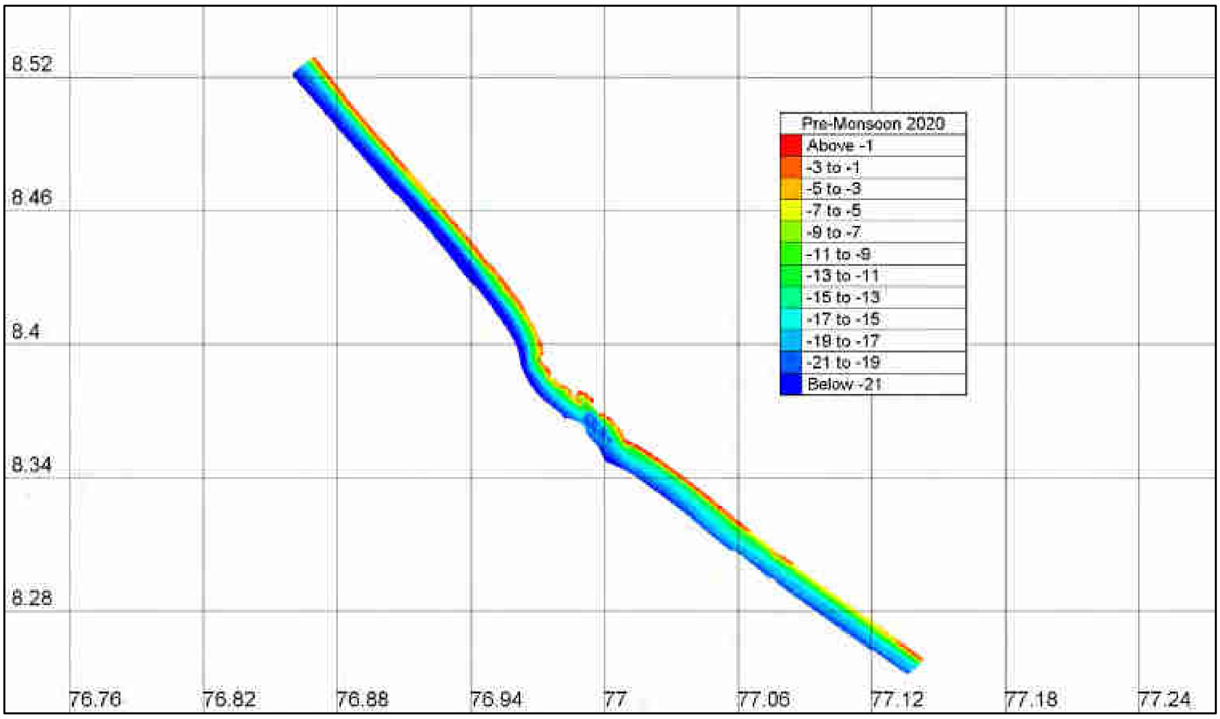


Figure 2-39 Bathymetry survey data using MBES for Pre-Monsoon 2020

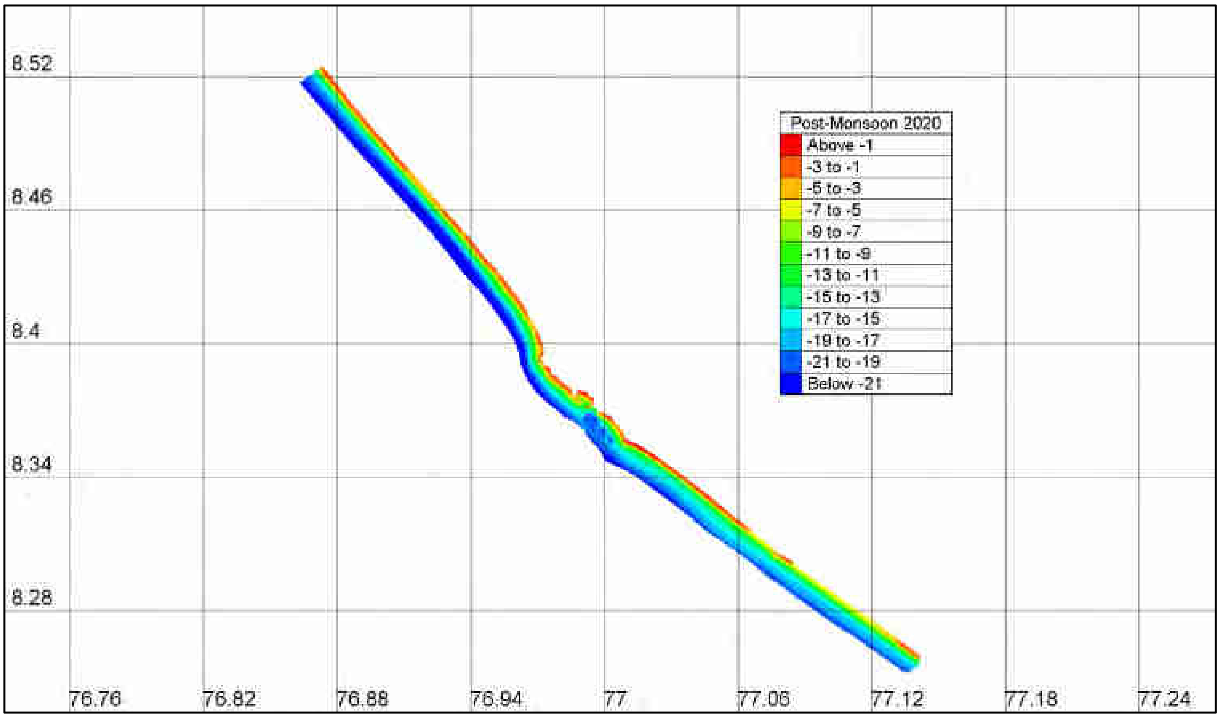


Figure 2-40 Bathymetry survey data using MBES for Post Monsoon 2020

A comparison was made between Pre-Monsoon 2019 MBES data and Pre-Monsoon 2020 MBES data as shown in Figure 2-41. The same comparison was done for Post monsoon 2019 and Post monsoon 2020 MBES data and is shown in Figure 2-42. The comparisons of bathymetry between pre monsoon 2020 and post monsoon 2020 are presented in Figure 2-43.

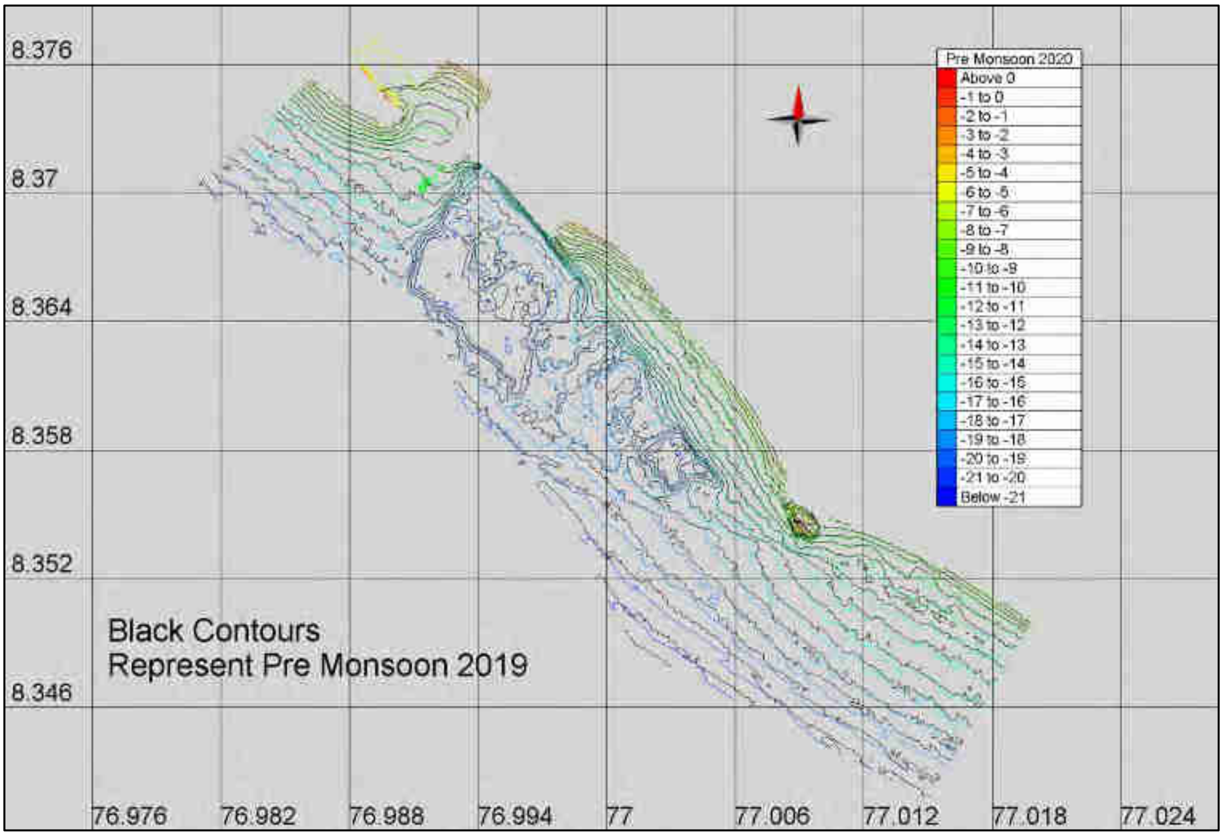


Figure 2-41 Difference in Bathymetry during Pre monsoon 2019 and 2020

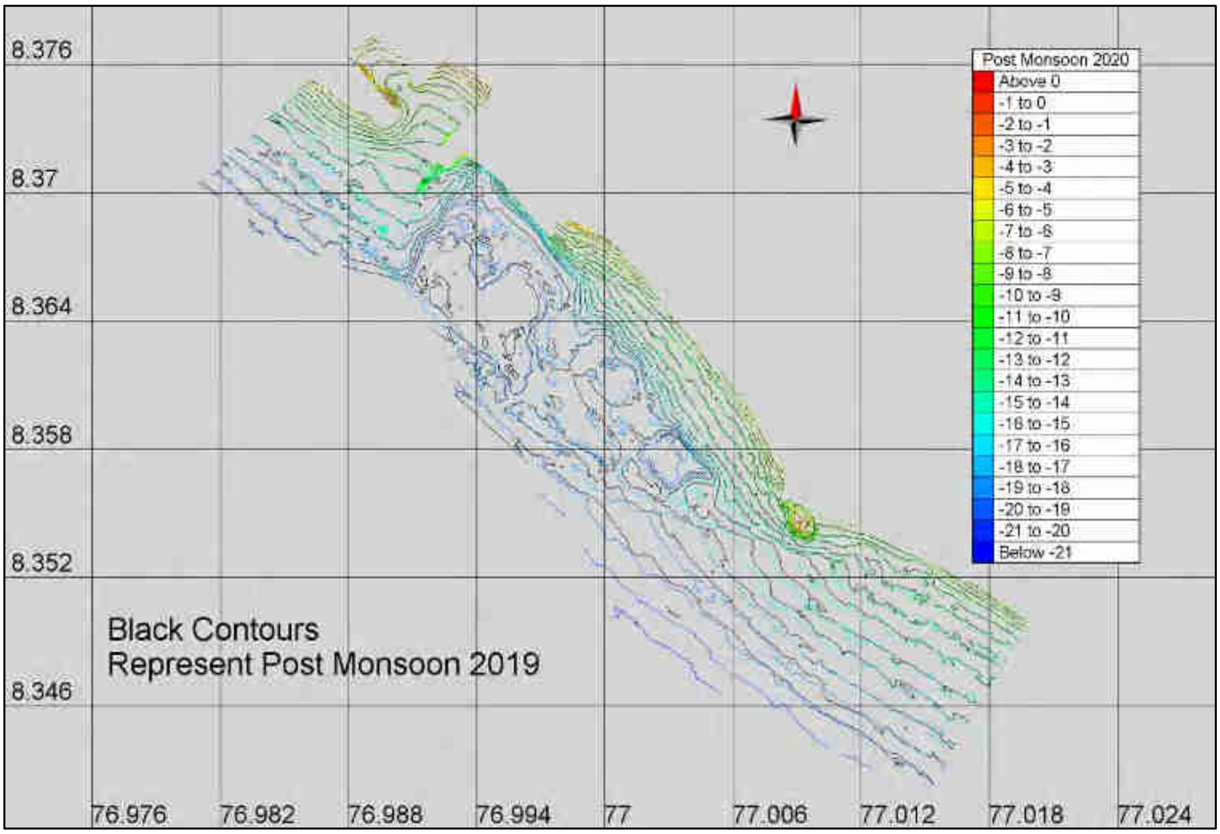


Figure 2-42 Difference in Bathymetry during Post monsoon 2019 and 2020

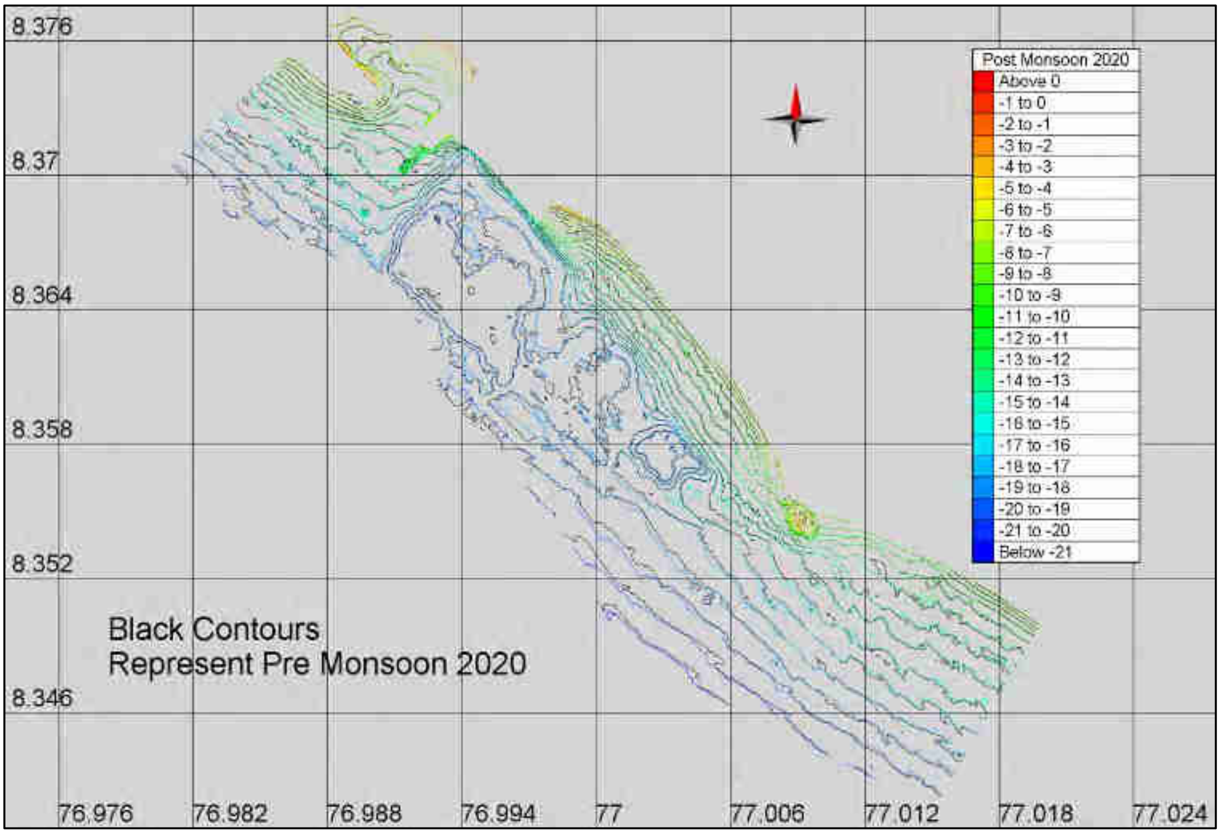


Figure 2-43 Difference in Bathymetry during Pre monsoon and Post monsoon 2020

Along with these comparisons, similar comparisons of bathymetry in Valiyathura and Shangumugham region were also carried out and are presented from Figure 2-41 to Figure 2-46.

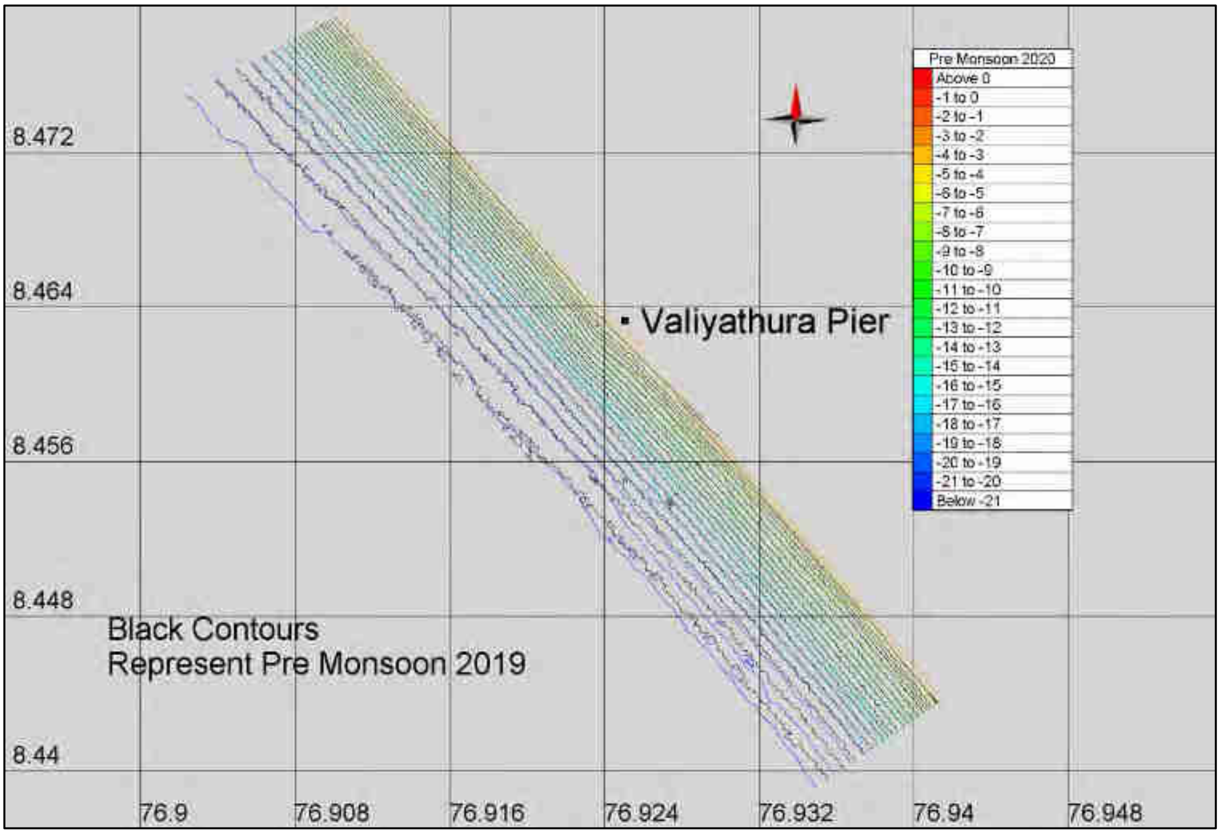


Figure 2-44 Difference in Bathymetry Pre monsoon 2019 and 2020 in Valiyathura region

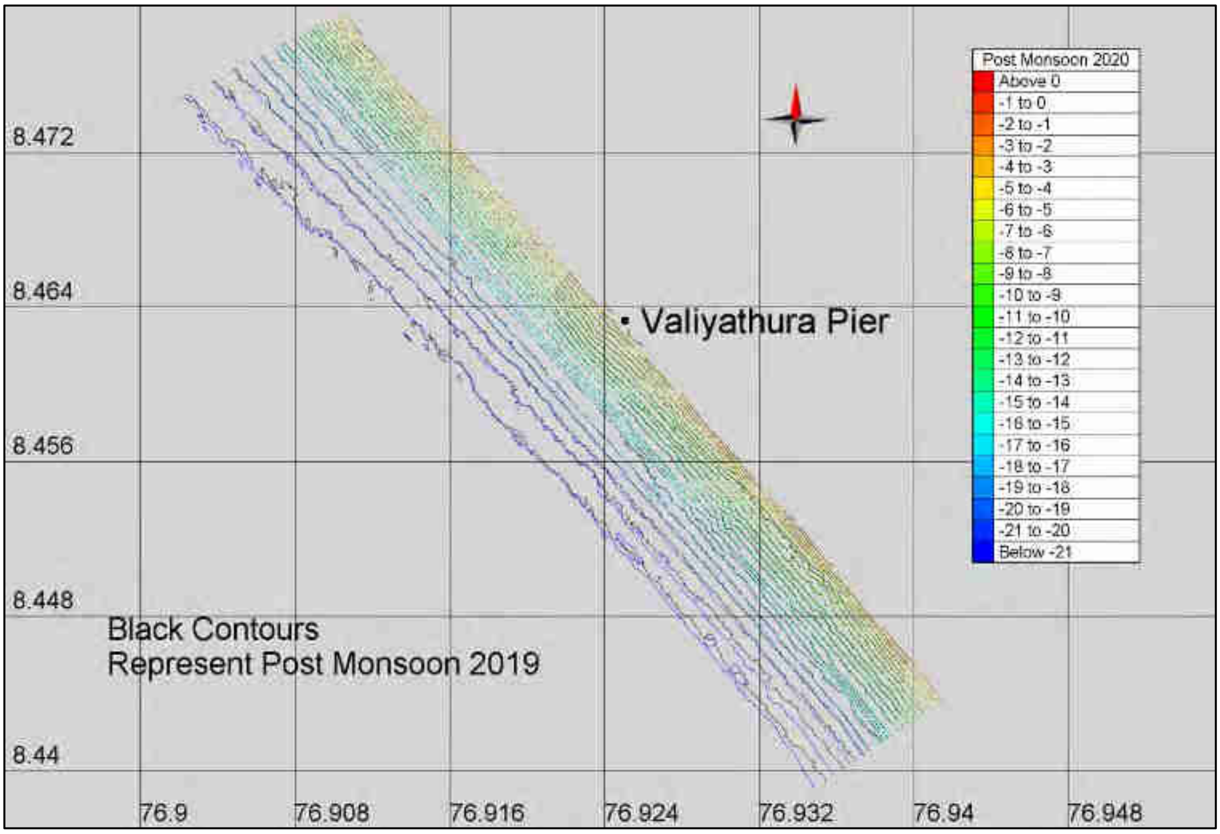


Figure 2-45 Difference in Bathymetry Post monsoon 2019 and 2020 in Valiyathura region

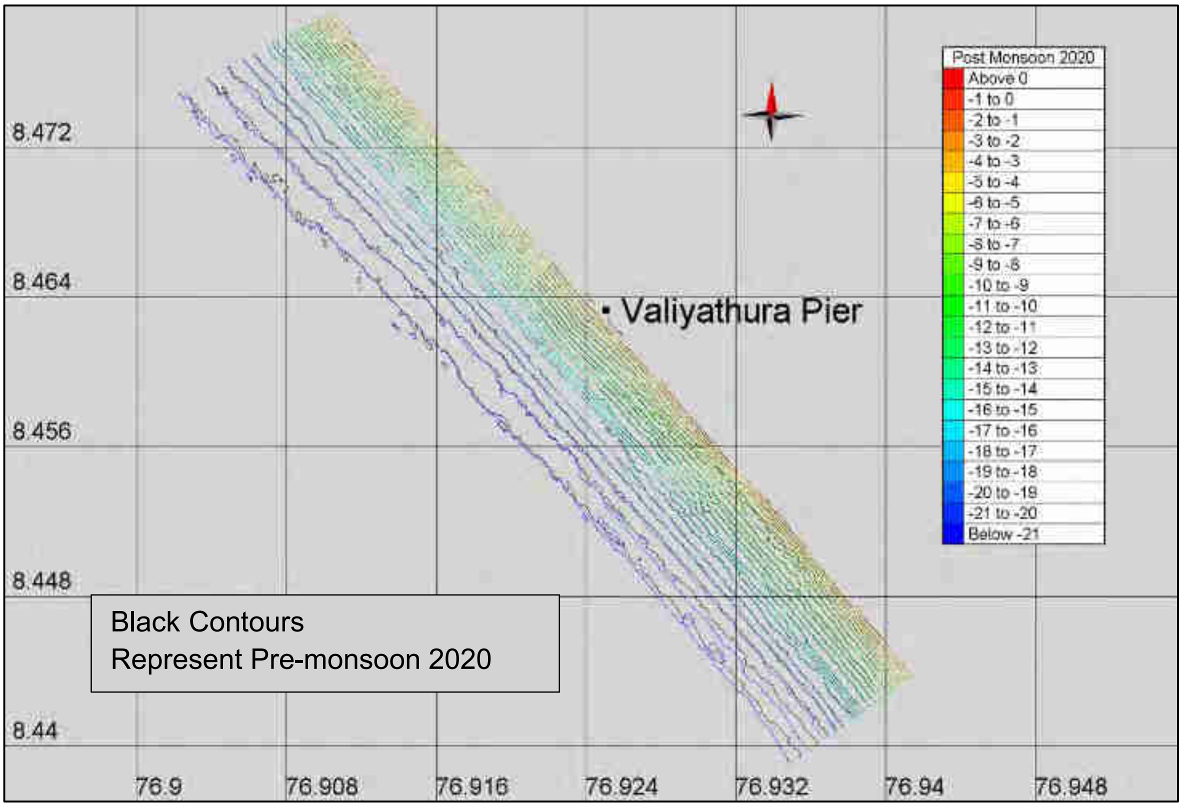


Figure 2-46 Difference in Bathymetry during Pre monsoon and Post monsoon 2020 in Valiyathura region

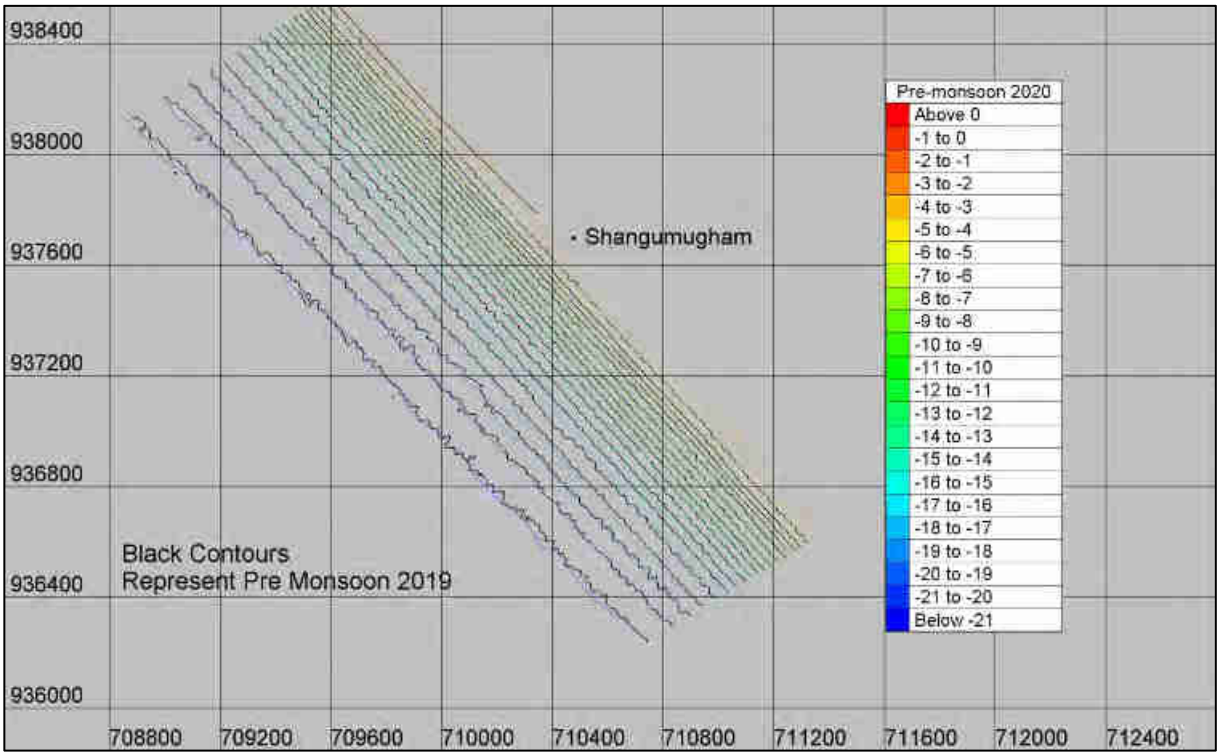


Figure 2-47 Difference in Bathymetry Pre monsoon 2019 and 2020 in Shangumugham region

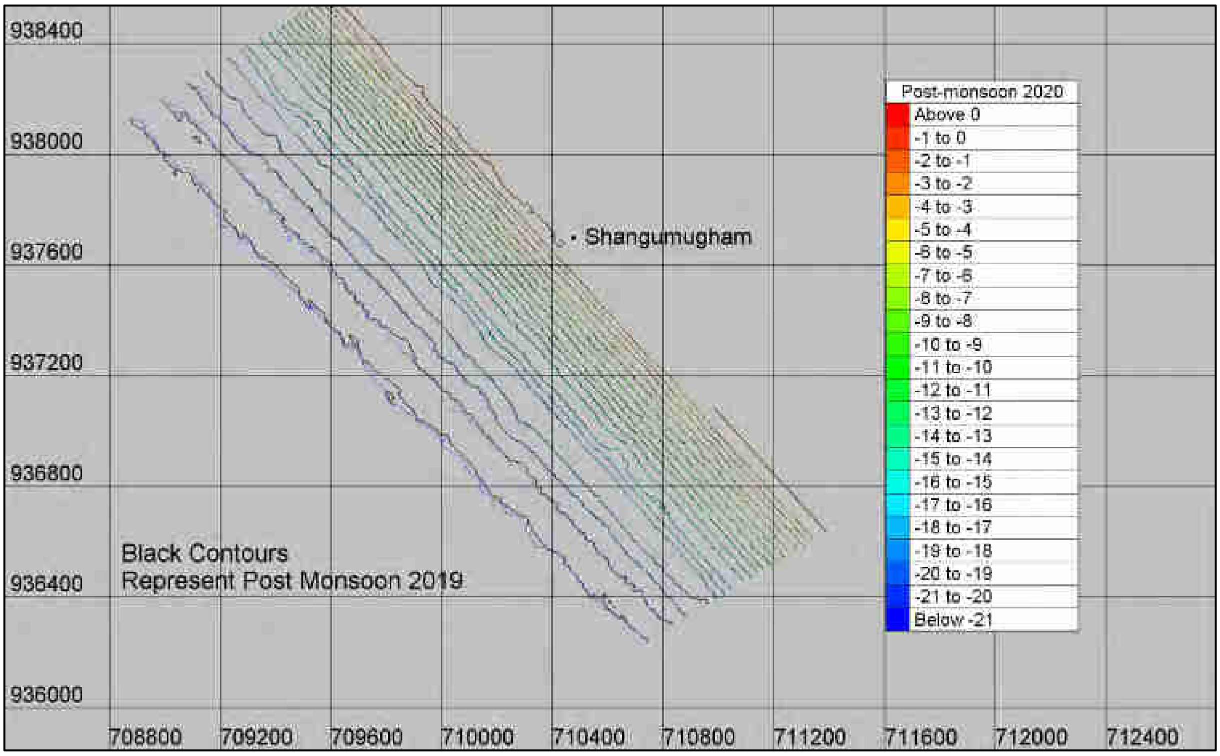


Figure 2-48 Difference in Bathymetry Post monsoon 2019 and 2020 in Shangumugham region

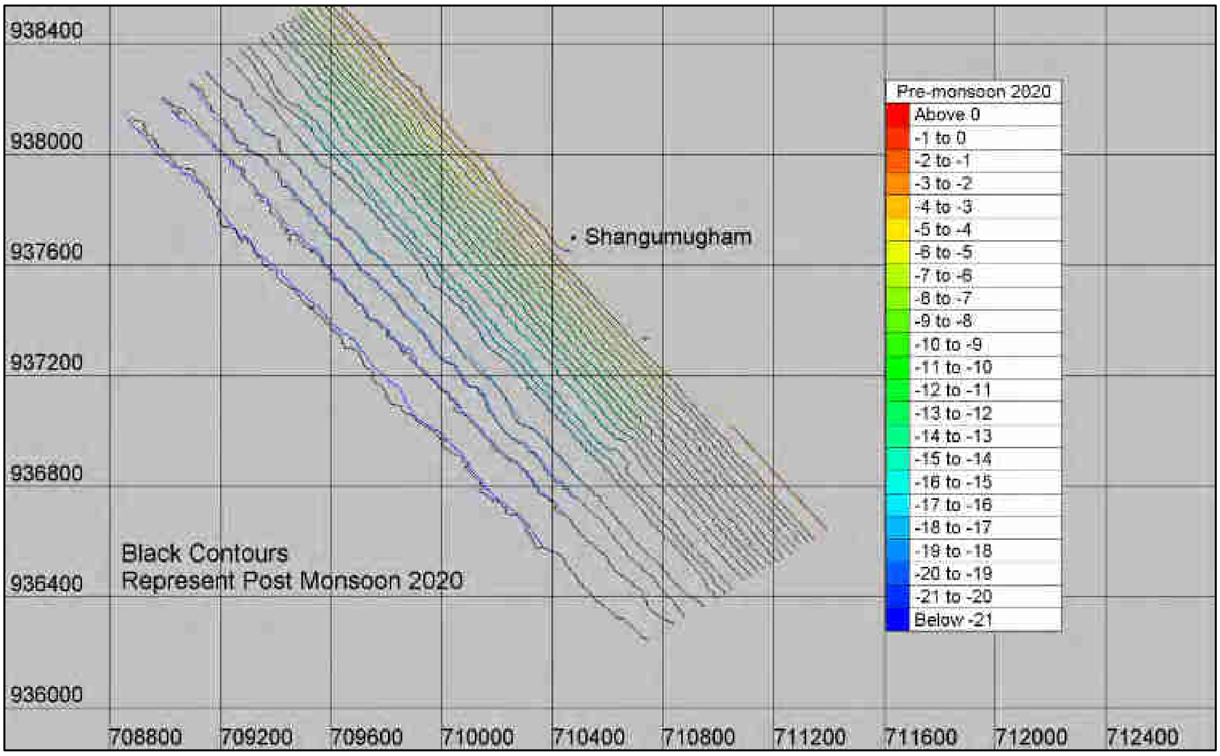


Figure 2-49 Difference in Bathymetry during Pre monsoon and Post monsoon 2020 in Shangumugham region

In addition to the above-mentioned analysis, seven lines were selected to check the variation in bathymetry profiles for different seasons (Pre monsoon 2015, Post monsoon 2015, Pre monsoon 2016, Post monsoon 2016, Pre monsoon 2017, Post monsoon 2017, Pre monsoon 2018, Post monsoon 2018, Pre monsoon 2019, Post monsoon 2019, Pre monsoon 2020 &

Post monsoon 2020). The locations of these sections are as shown in Figure 2-50. 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.

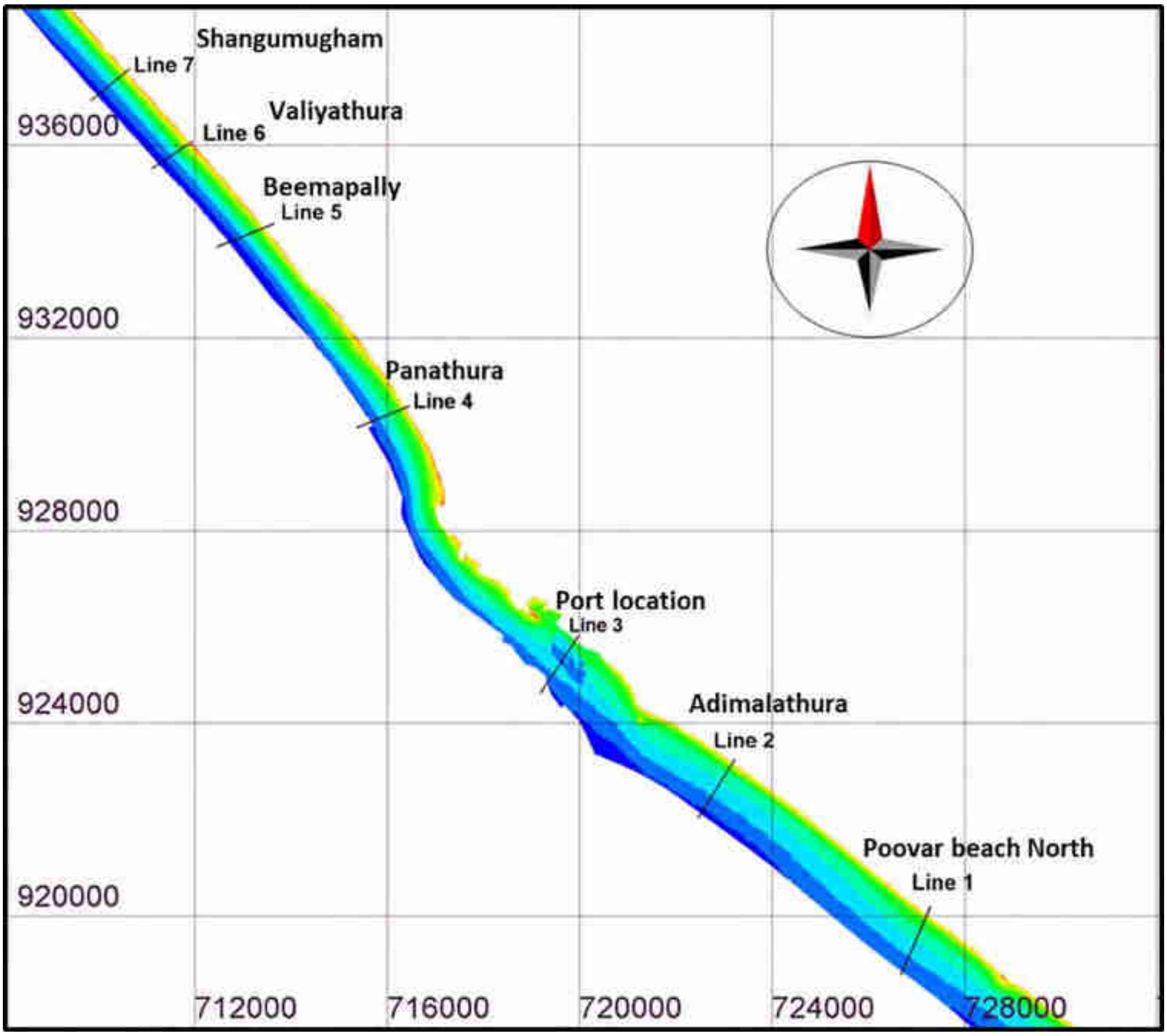


Figure 2-50 Location of the selected transect lines

Figure 2-51 to Figure 2-70 shows the comparison of Pre monsoon and Post monsoon of five years (2015, 2016, 2017, 2018, 2019 & 2020) bathymetry data along the selected sections.

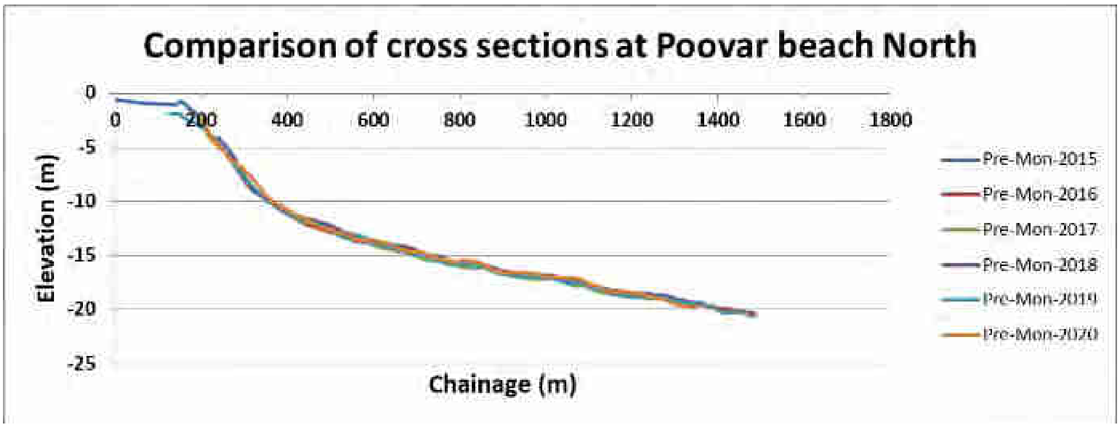


Figure 2-51 Bathymetry – Cross section comparison at Poovar beach North (Pre-monsoon)

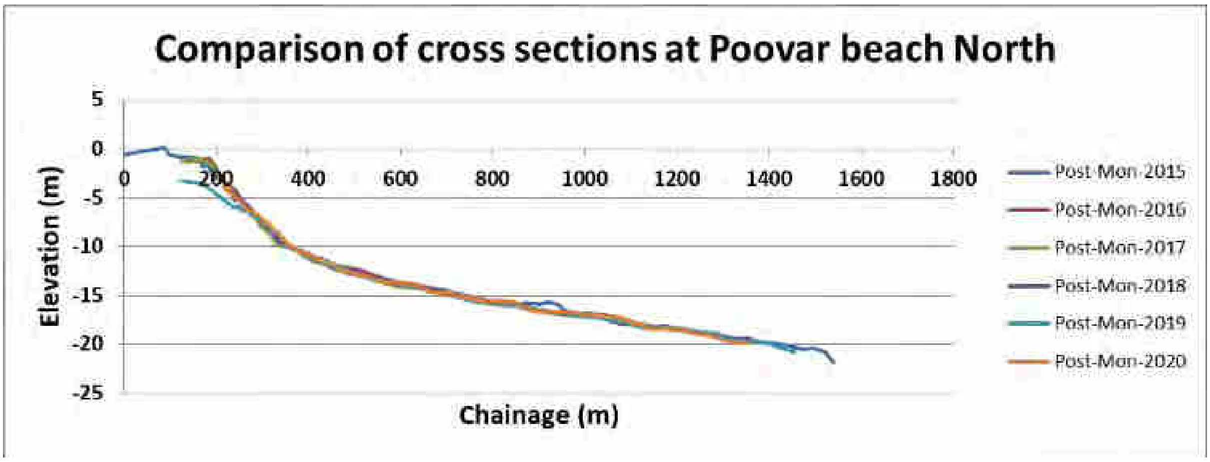


Figure 2-52 Bathymetry – Cross section comparison at Poovar beach North (Post-monsoon)

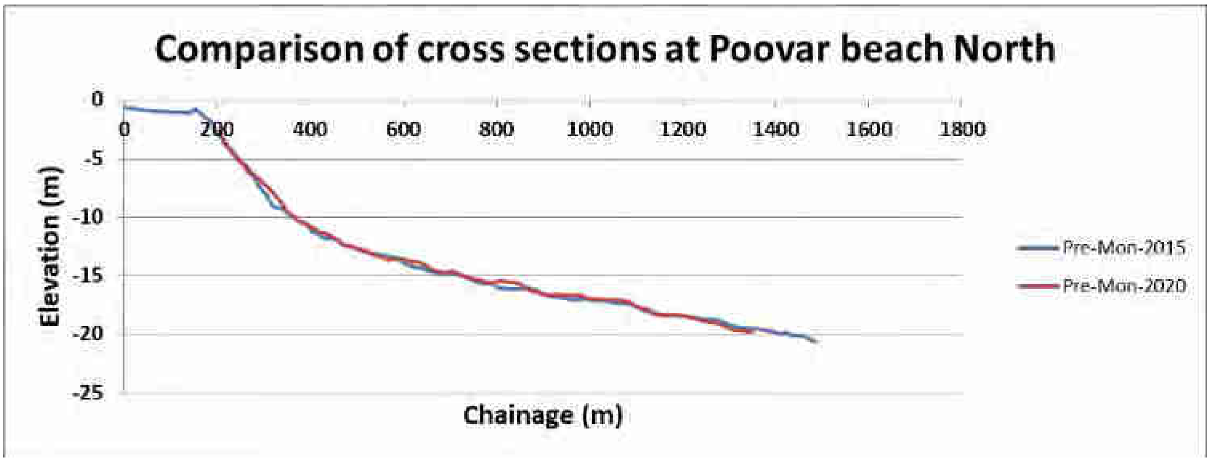


Figure 2-53 Bathymetry – Cross section comparison between 2015 and 2020 at Poovar beach North (Pre-monsoon)

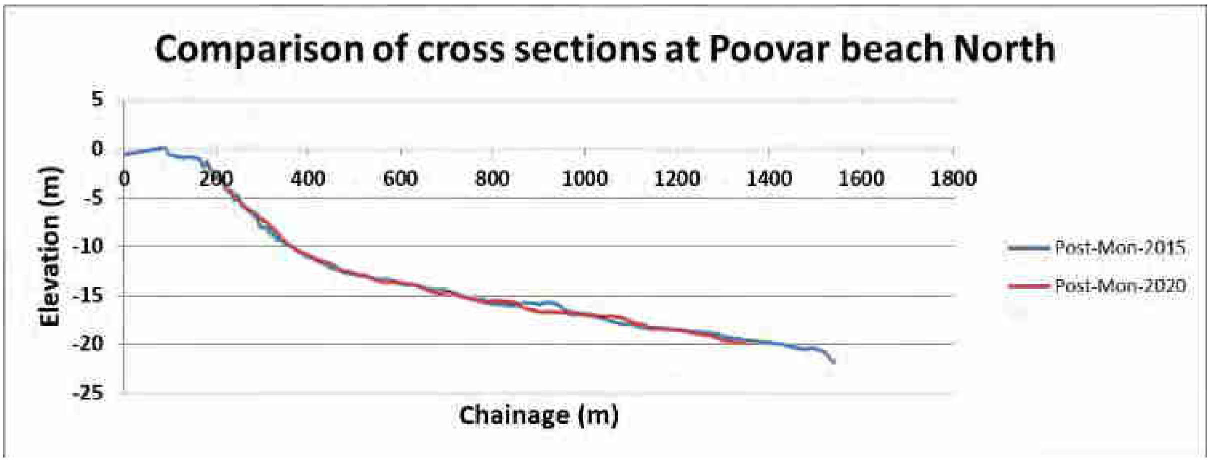


Figure 2-54 Bathymetry – Cross section comparison between 2015 and 2020 at Poovar beach North (Post-monsoon)

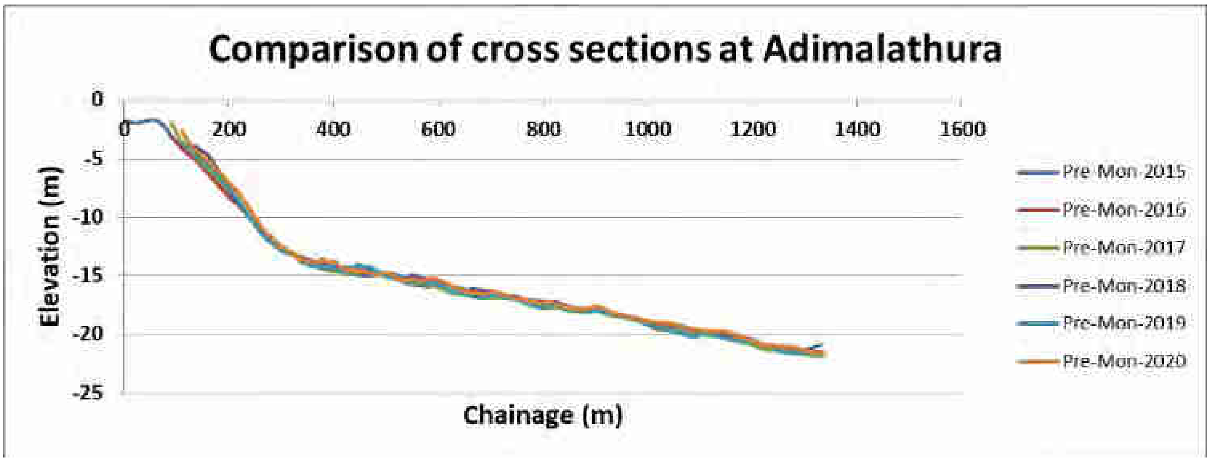


Figure 2-55 Bathymetry – Cross section comparison at Adimalathura (Pre-monsoon)

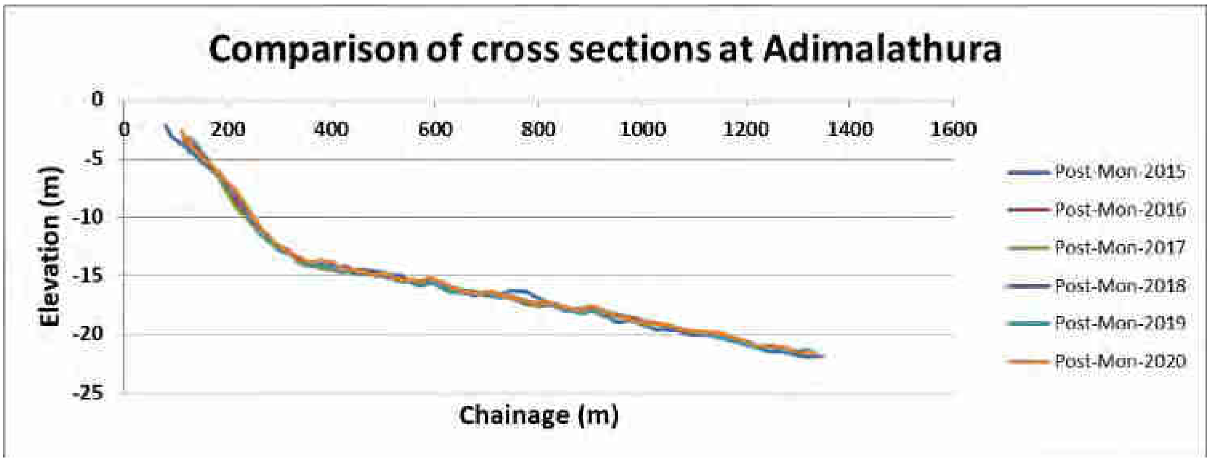


Figure 2-56 Bathymetry – Cross section comparison at Adimalathura (Post-monsoon)

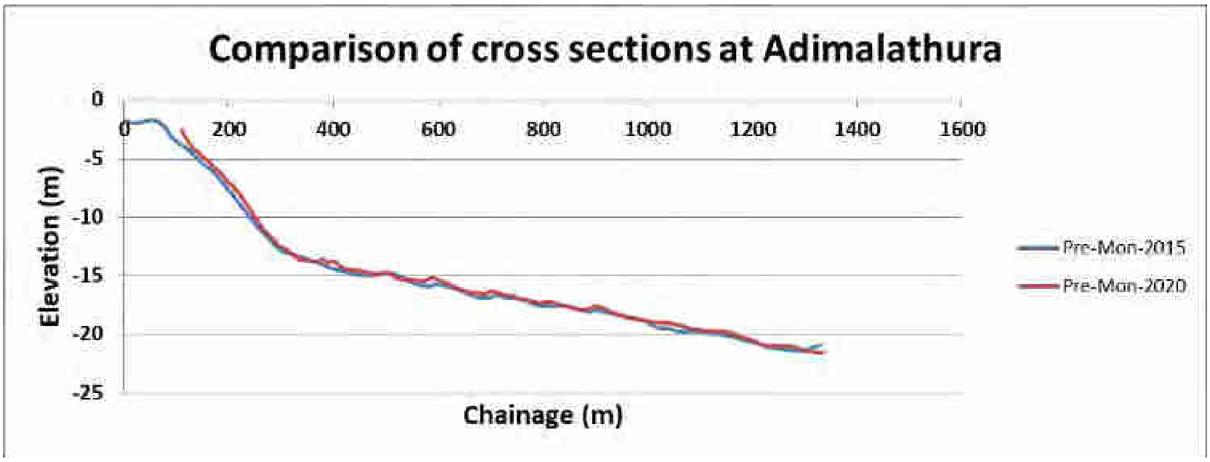


Figure 2-57 Bathymetry – Cross section comparison between 2015 and 2020 at Adimalathura (Pre-monsoon)

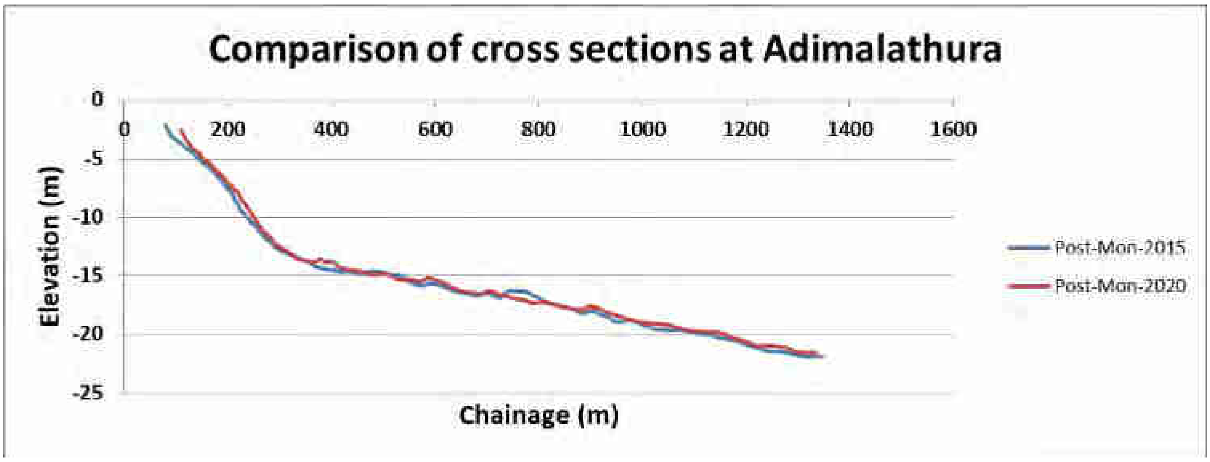


Figure 2-58 Bathymetry – Cross section comparison between 2015 and 2020 at Adimalathura (Post-monsoon)

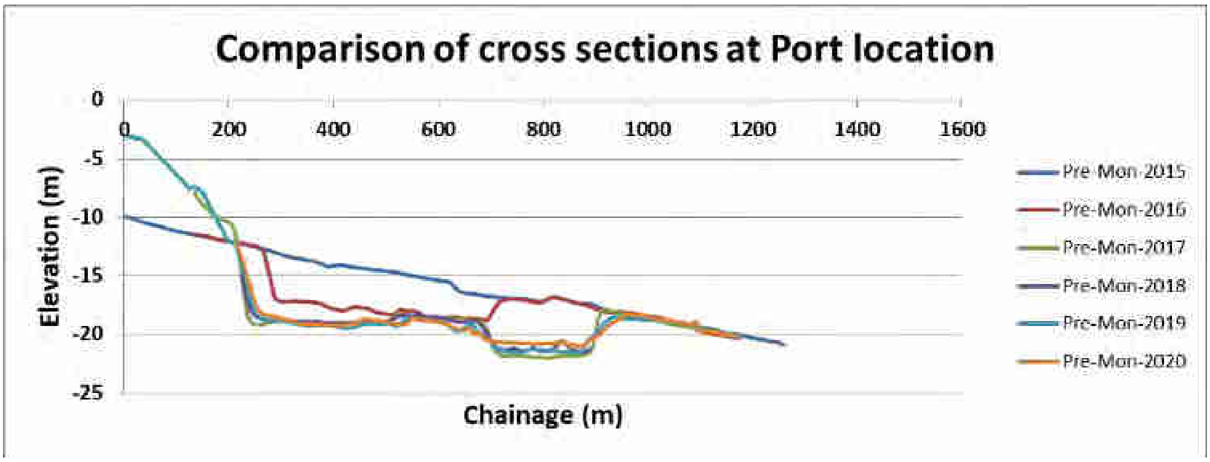


Figure 2-59 Bathymetry – Cross section comparison at Port location (Pre-monsoon)

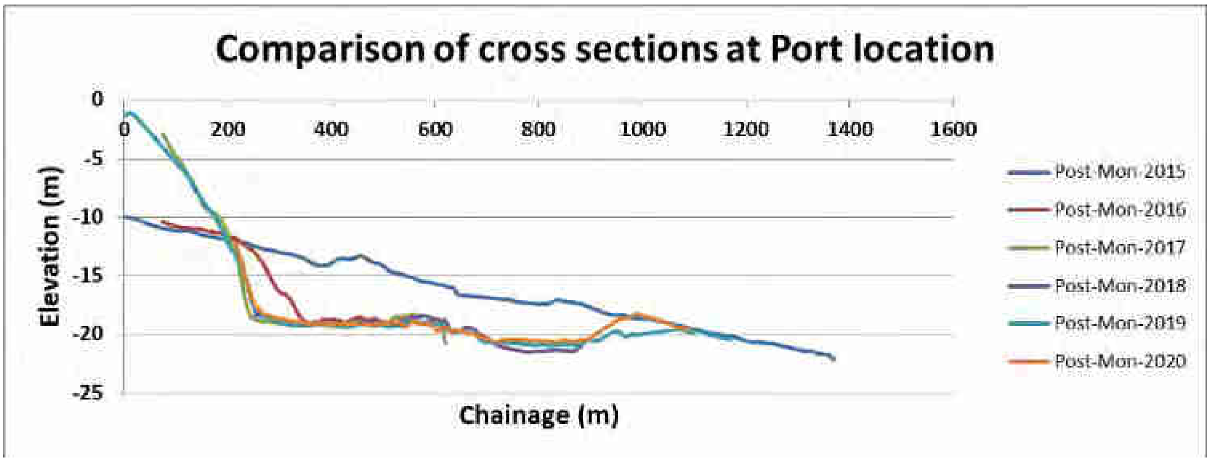


Figure 2-60 Bathymetry – Cross section comparison at Port location (Post-monsoon)

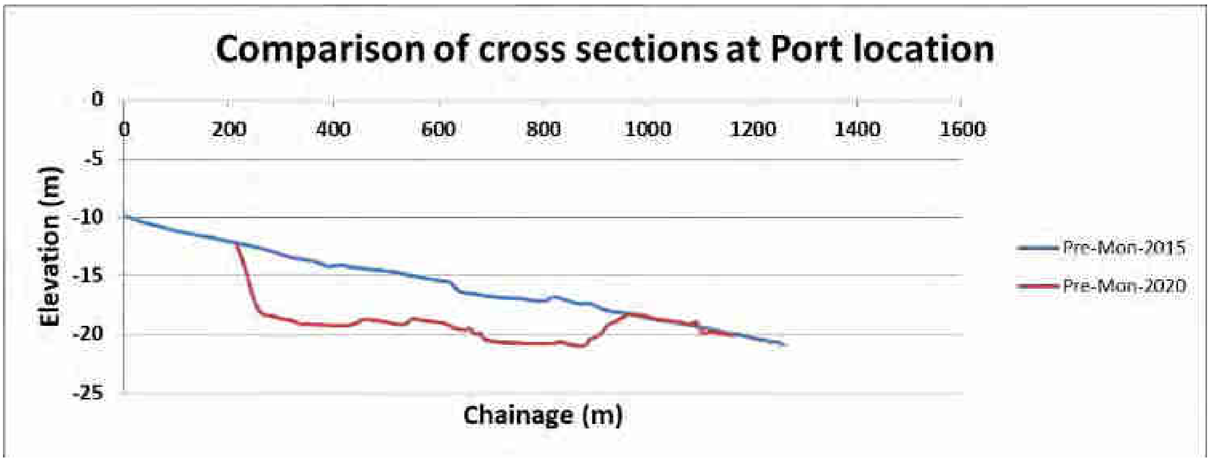


Figure 2-61 Bathymetry – Cross section comparison between 2015 and 2020 at Port location (Pre-monsoon)

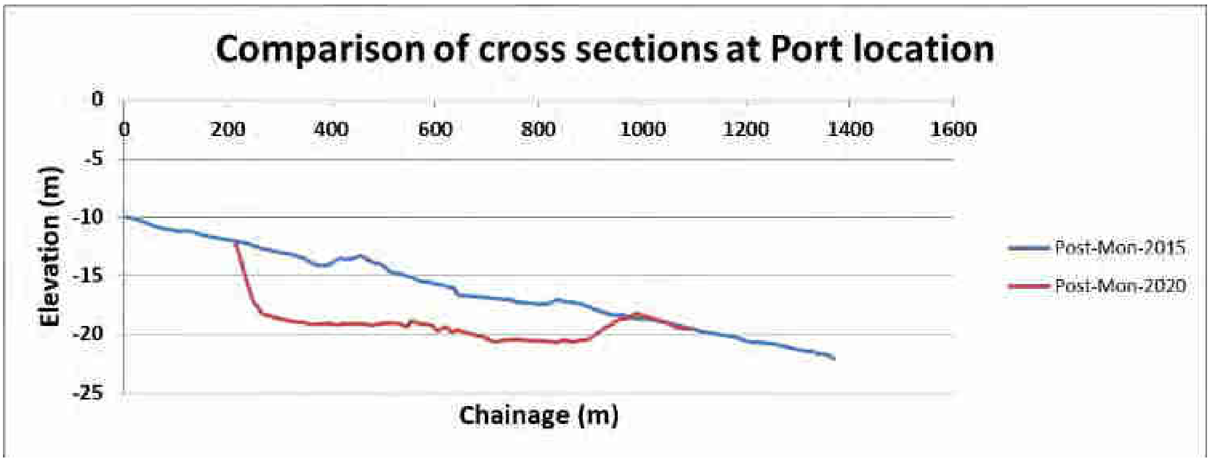


Figure 2-62 Bathymetry – Cross section comparison between 2015 and 2020 at Port location (Post-monsoon)

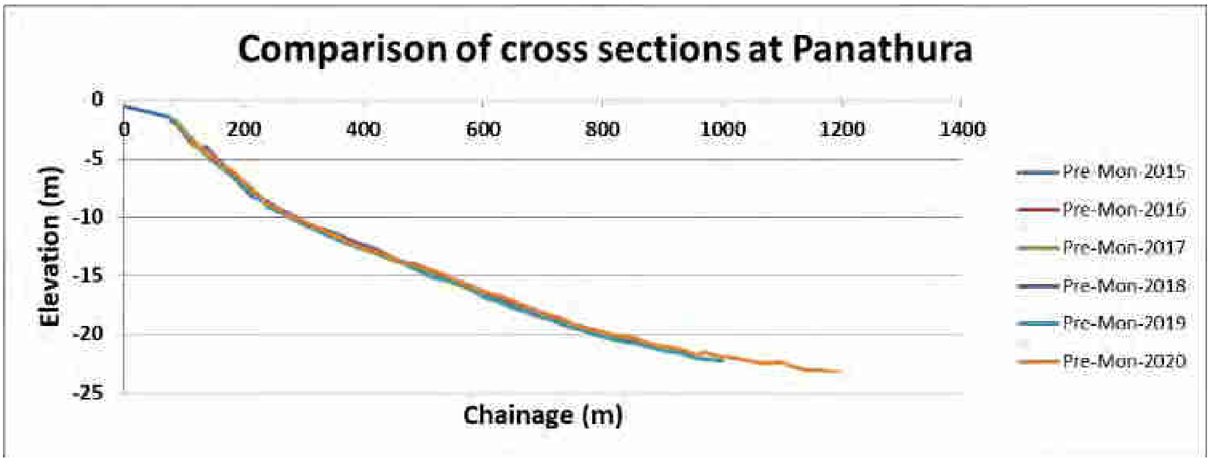


Figure 2-63 Bathymetry – Cross section comparison at Panathura (Pre-monsoon)

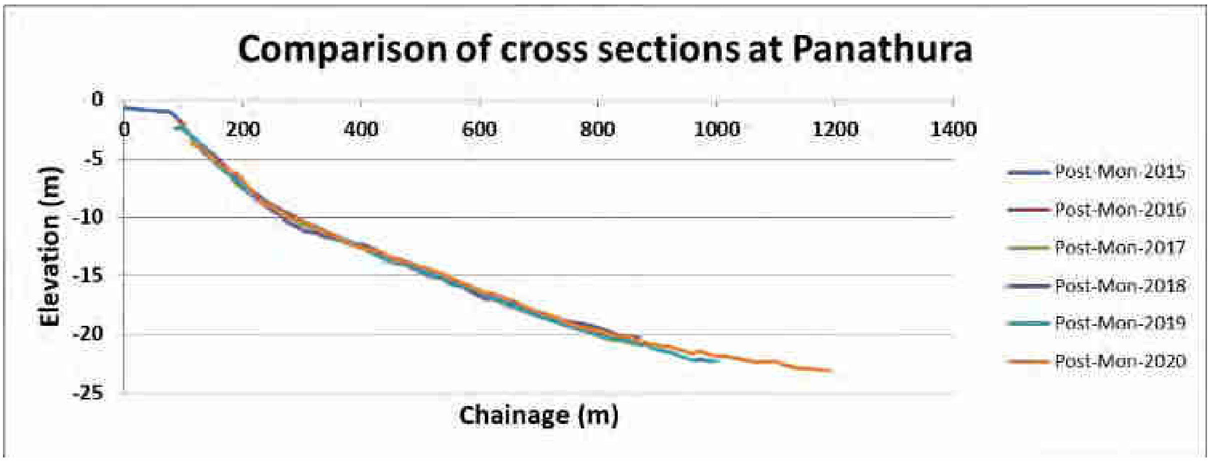


Figure 2-64 Bathymetry – Cross section comparison at Panathura (Post-monsoon)

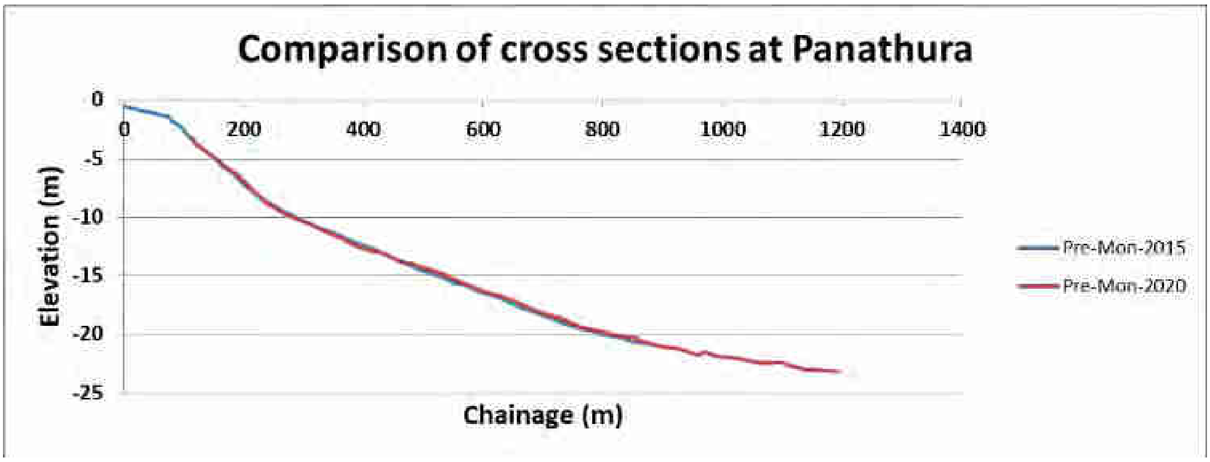


Figure 2-65 Bathymetry – Cross section comparison between 2015 and 2020 at Panathura (Pre-monsoon)

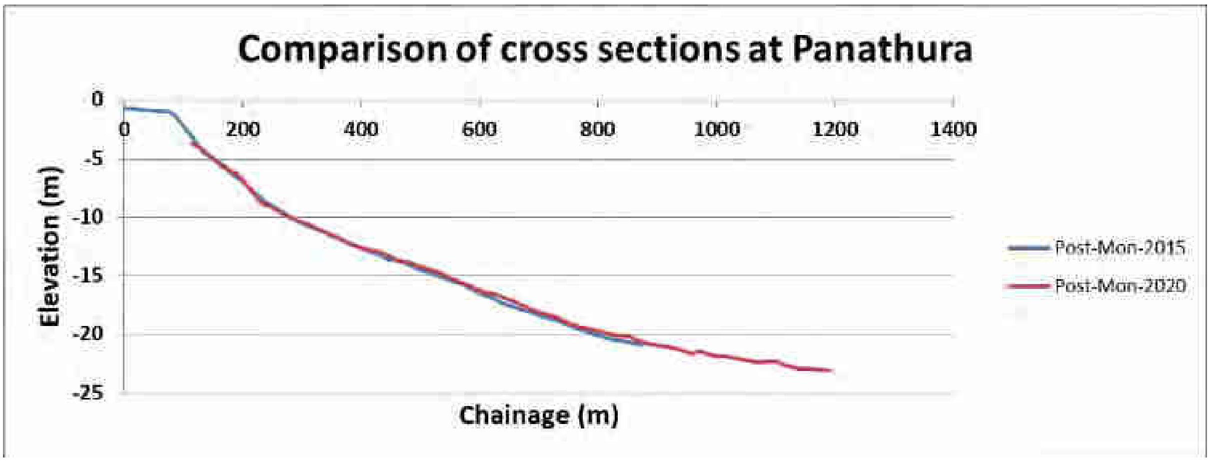


Figure 2-66 Bathymetry – Cross section comparison between 2015 and 2020 at Panathura (Post-monsoon)

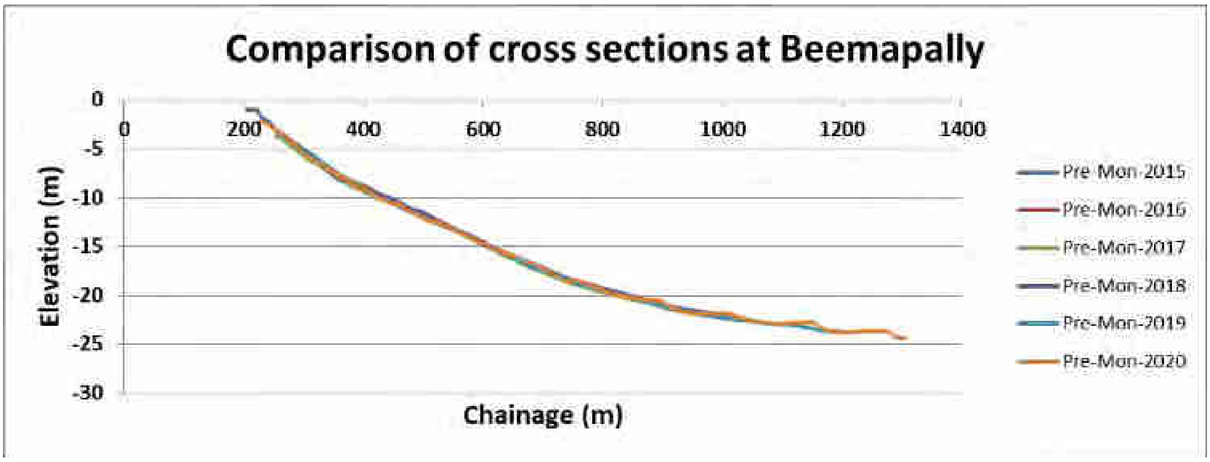


Figure 2-67 Bathymetry – Cross section comparison at Beemapally (Pre-monsoon)

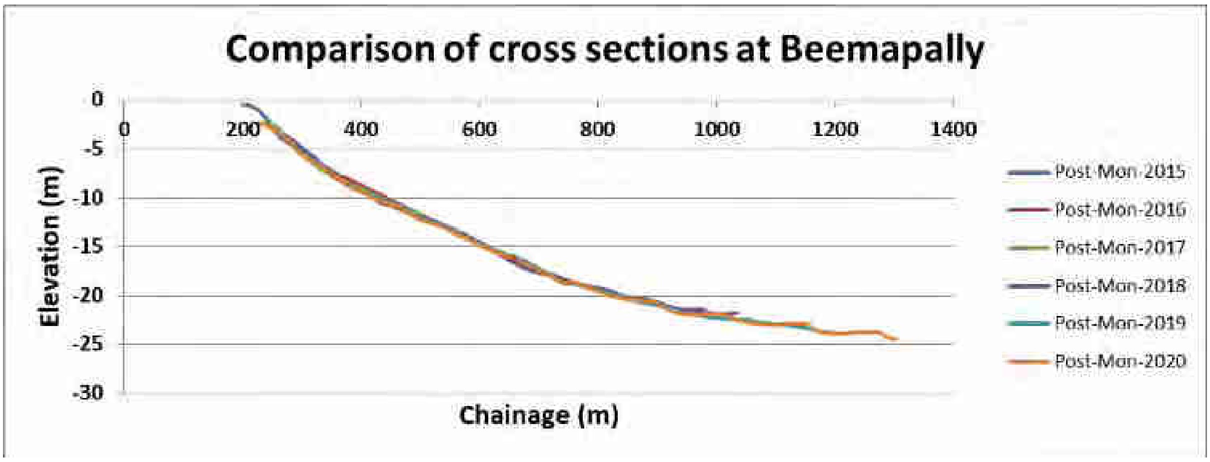


Figure 2-68 Bathymetry – Cross section comparison at Beemapally (Post-monsoon)

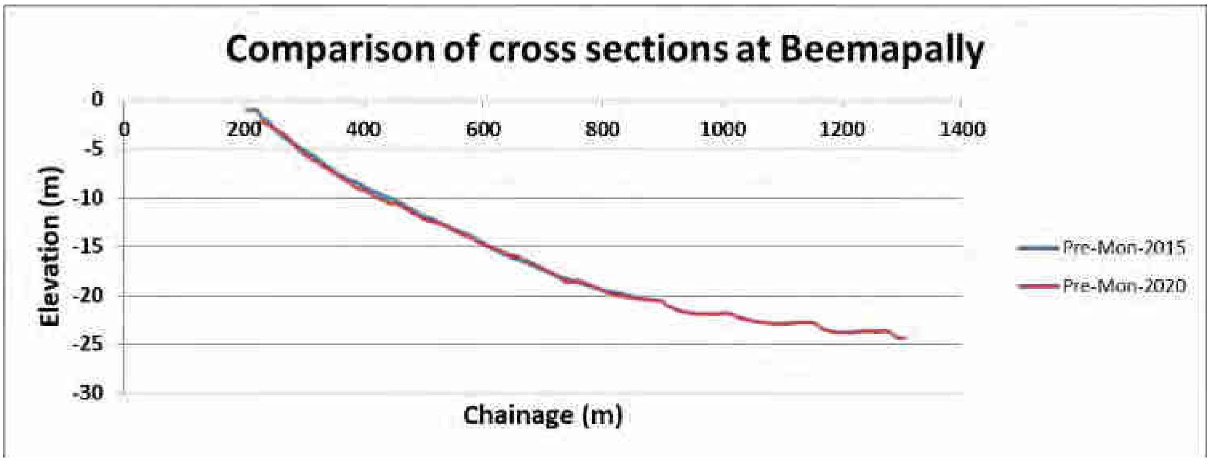


Figure 2-69 Bathymetry – Cross section comparison between 2015 and 2020 at Beemapally (Pre-monsoon)

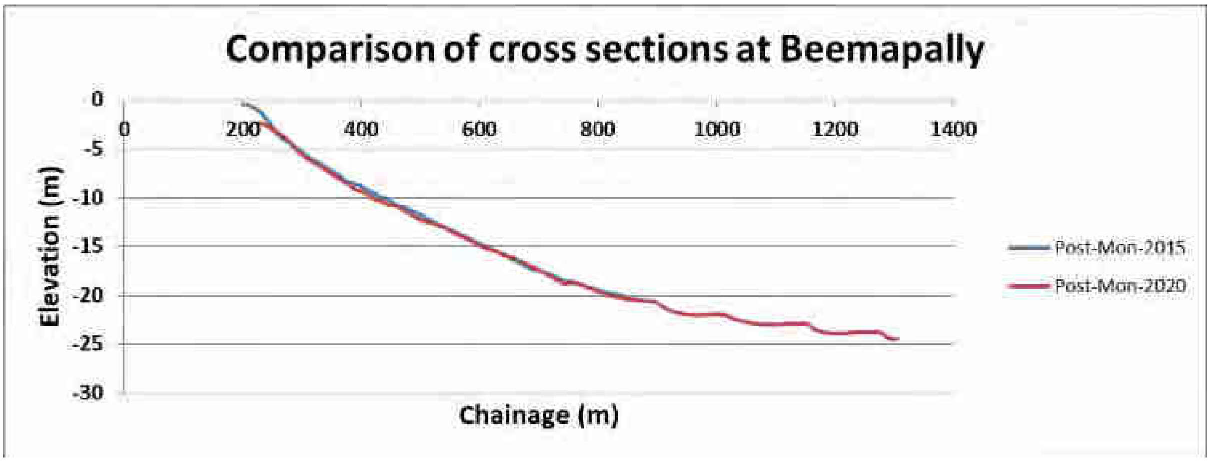


Figure 2-70 Bathymetry – Cross section comparison between 2015 and 2020 at Beemapally (Post-monsoon)

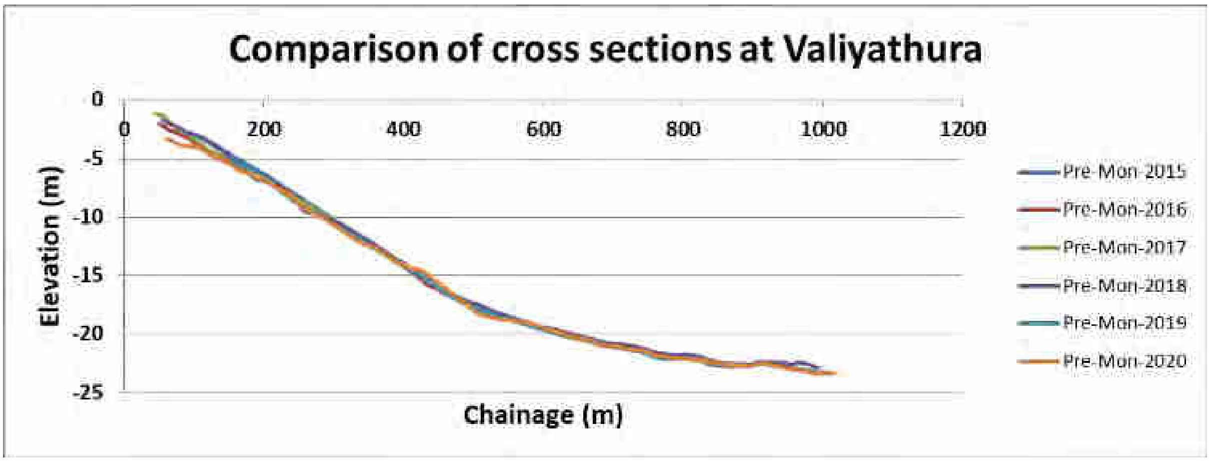


Figure 2-71 Bathymetry – Cross section comparison at Valiyathura (Pre-monsoon)

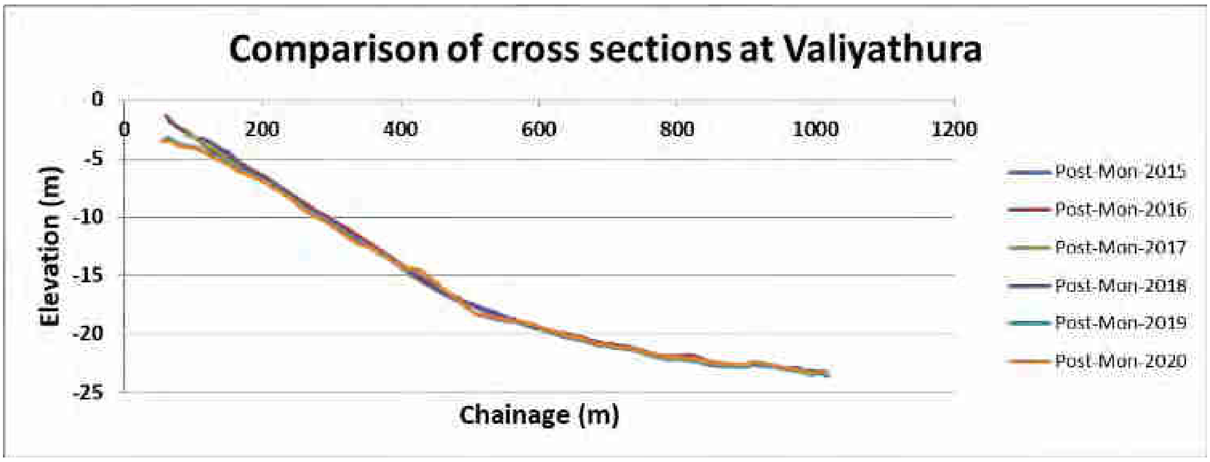


Figure 2-72 Bathymetry – Cross section comparison at Valiyathura (Post-monsoon)

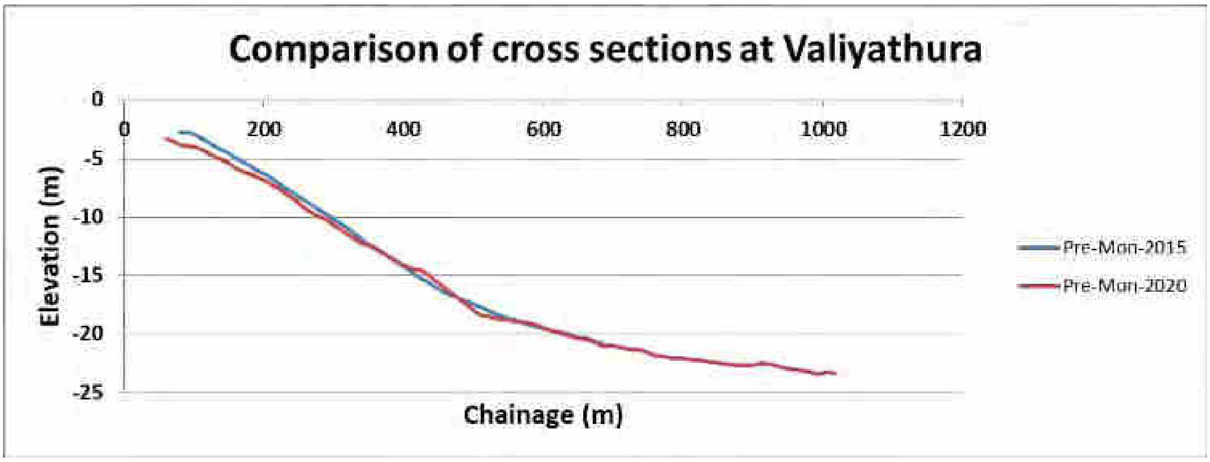


Figure 2-73 Bathymetry – Cross section comparison between 2015 and 2020 at Valiyathura (Pre-monsoon)

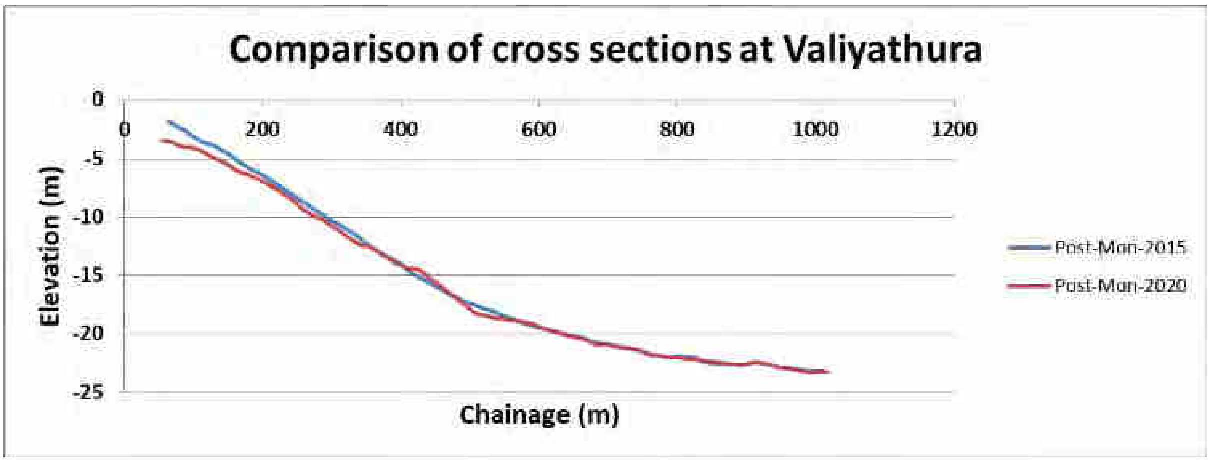


Figure 2-74 Bathymetry – Cross section comparison between 2015 and 2020 at Valiyathura (Post-monsoon)

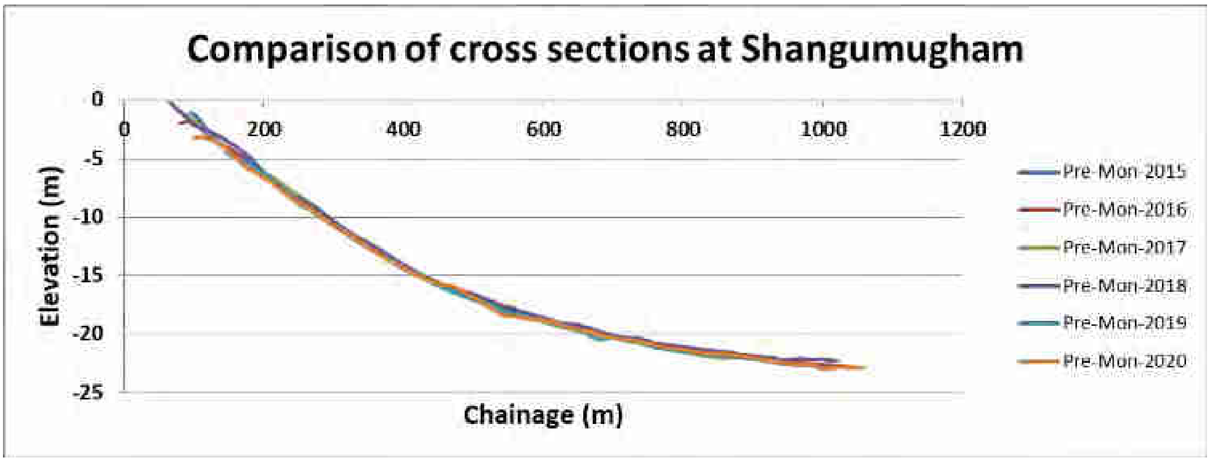


Figure 2-75 Bathymetry – Cross section comparison at Shangumugham (Pre-monsoon)

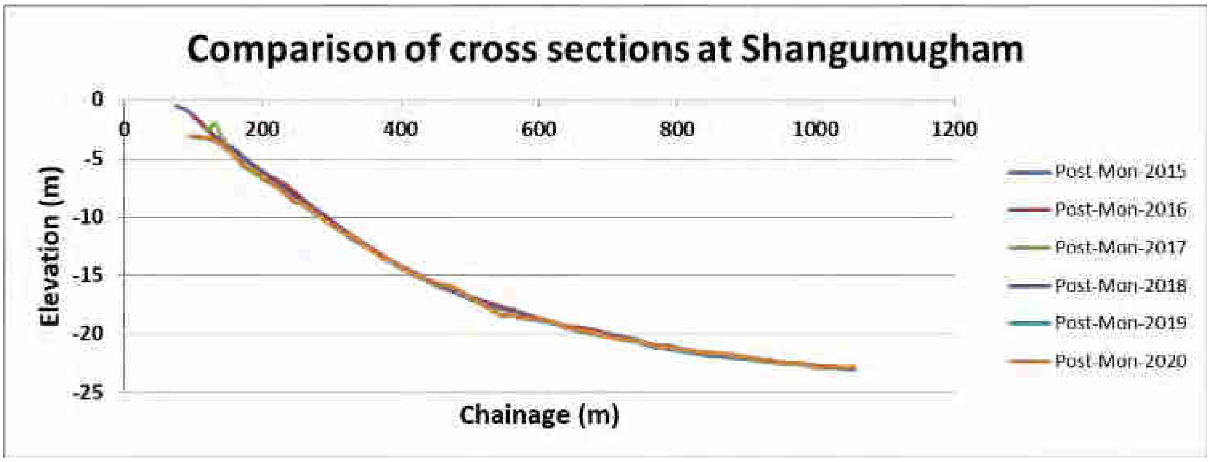


Figure 2-76 Bathymetry – Cross section comparison at Shangumugham (Post-monsoon)

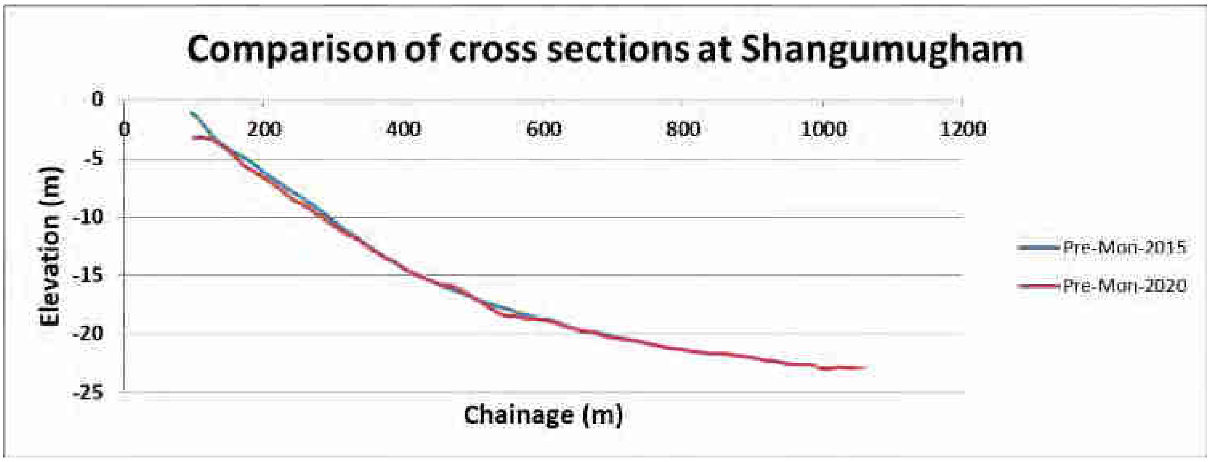


Figure 2-77 Bathymetry – Cross section comparison between 2015 and 2020 at Shangumugham (Pre-monsoon)

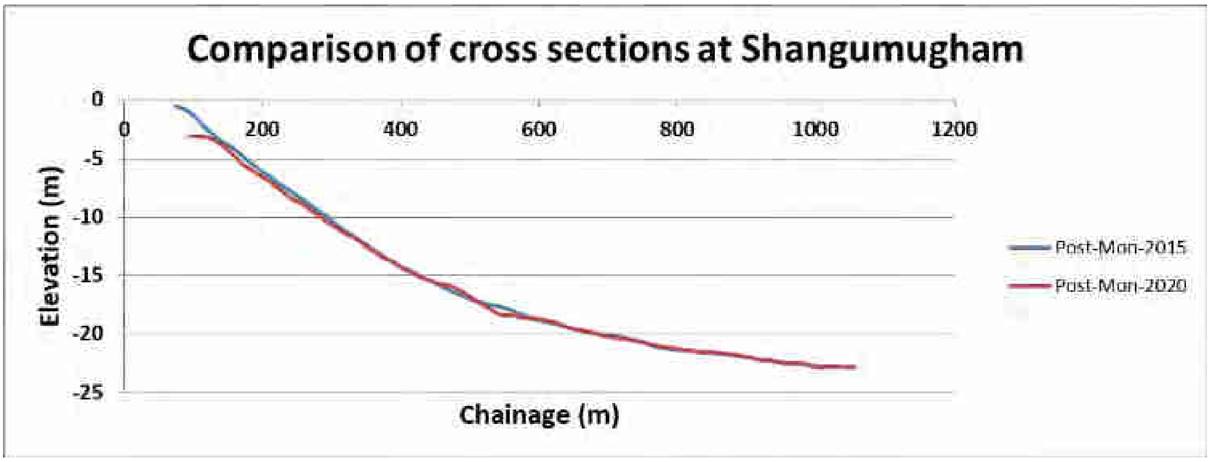


Figure 2-78 Bathymetry – Cross section comparison between 2015 and 2020 at Shangumugham (Post-monsoon)

2.7 Cross Shore Profile

Cross shore beach profiles were collected by AVPPL at 81 locations which cover approximately 40 km along the coastline. The spacing between two adjacent cross sections is approximately 0.5 km. Among the 81 locations, 41 are to the north of port, 37 are to the south of port and 3 are at the port location. Survey data from February 2015 to February 2021 is available. The cross-shore profile locations are shown in Figure 2-79.

Figure 2-79 Cross Shore Profile Locations

AVPPL provided names of the 81 locations and the respective landmarks for easy identification and discussion. Table 2-5 shows the names of the landmarks and the corresponding CSP numbers.

Table 2-5 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 NO.	Land Mark	Location
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-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 NO.	Land Mark	Location
CSP-70	St.Peters Church	Shangumugham
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		

2.7.1 Survey Methodology

The survey area was divided into land side and sea side. On the land side, the survey was carried out using Real Time Kinematic (RTK) system up to 100 m from HTL or +2 m of HTL. On the sea side bathymetric survey was carried out using Multi Beam Echo Sounder (MBES) up to a depth of 10m till August 2018 and later on survey was conducted up to a depth of 20m till April 2019 as per the guideline of shoreline committee. Further during the shoreline committee meeting held on 13-03-2019, it was decided that: Only 4 CSP lines needs to be carried out up to a depth of 20 m in the month of January, May, August and October. All other lines, during all months need to be carried up to a depth of 10 m only. Accordingly, two lines were selected (CSP 2 & CSP 35) to south of the port and two more lines (CSP 64 & CSP 74) to north of the port to carry out the survey up to 20m depth.

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 in the foreshore zone (as shown in Figure 2-80) due to inaccessible depths and due to rough weather condition during survey period (i.e. whenever rough weather occurred in the period March 2020 to February 2021). July 2020 month data was not received during survey period due to lockdown in the state of Kerala & Tamil Nadu as a result of the on-going Covid-19 pandemic and October 2020 month data was removed from analysis which did not pass the quality control. The details of data included in analysis were shown in Table 2-6.

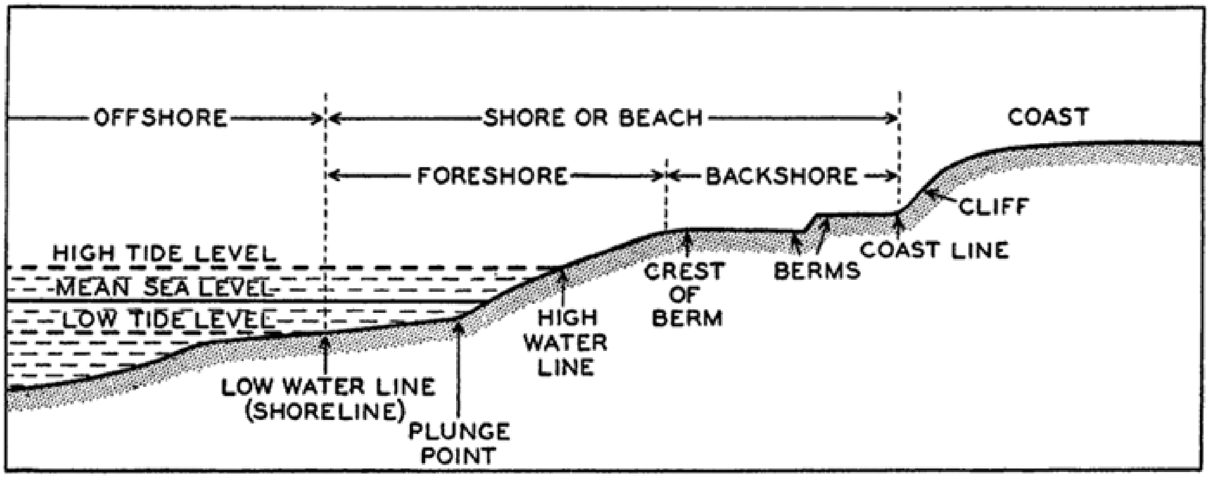


Figure 2-80 Beach profile terminology

Status of data received							
	2015	2016	2017	2018	2019	2020	2021
Jan							
Feb							
Mar					Only 52 profiles		
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							

	Data not collected:		Data omitted due to lack of offshore data
	June - Aug 2019 due to Monsoon and change of contractor		Data included
	July 2020 due to COVID-19 restrictions		

Table 2-6 Details of CSP data included in analysis

2.7.2 Analysis of cross shore profiles

The data received by LNTIEL was analysed by plotting each of the profiles. The aim of this comprehensive exercise was to check the data quality and to compare profiles with surveyed data from different locations which would help to visualise erosion or accretion during different seasons and locations. The assessment of the profiles before/during 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.

At first, 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. Therefore, the monthly profiles 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 2020 to March 2021, the seasons will be as follows:

Pre-Monsoon 2020 – April 2020 to May 2020

Monsoon 2020 – June 2020 to September 2020

Post-Monsoon 2020 – October 2020 to November 2020

Fair Weather 2020 – December 2020 to March 2021

The focus was on comparison of profiles of different seasons over a year (seasonal comparison) and comparison of same seasonal profiles of different years (yearly comparison) at a particular location to thoroughly understand the seasonal variations. As there were many cross-shore profiles over a stretch of 40km, it was not feasible to show all the profiles in the report. Therefore, LNTIEL grouped similar sections into a category and presented one of the sections in each category to report. Thus, LNTIEL selected three sections to South of the Port (CS-07 – Neerody, CS-12 – Pozhiyoor and CS-26 – Karumkulam) and three sections to North of the Port (CS-49 – Panathura, CS-58 – Beemapally and CS-74 – Vettucaud). The plots are shown in Figure 2-81 to Figure 2-128. In Figure 2-81, Abscissa represents the distance in meters from an arbitrary point which is constant for all profiles at a cross section, ordinate represents elevation in meter and legend is self-explanatory. First chart (Figure 2-81) shows comparison of profiles of different seasons in a particular year (Seasonal charts) and second chart (Figure 2-82) shows comparison of profiles of different years of a particular season (Yearly charts).

Legend: CSP – Cross Shore Profile, CS – Cross Section

Stretch	Cross sections		Selected Cross section
	From	To	
1	3	10	7
2	11	14	12
3	18	34	26
4	47	52	49
5	56	65	58,62
6	66	81	74

Table 2-7 Classification of stretches

Legend of seasonal charts

Legend of yearly charts

2.7.2.1 Stretch 1

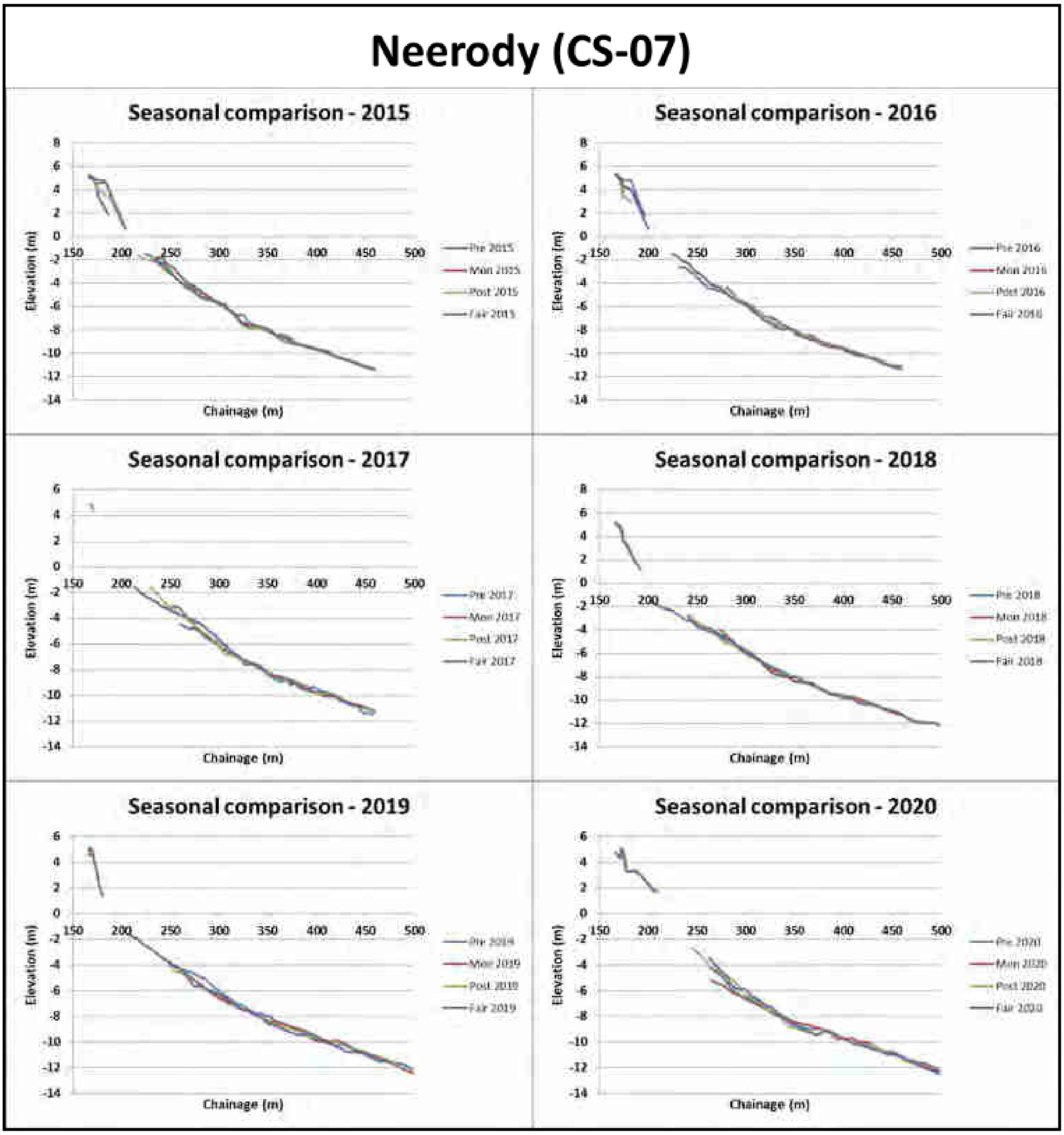


Figure 2-81 Profiles at Neerody (CS 07) – Seasonal comparison

Seawalls are present in the stretch of CS 3 to CS 10. Among these sections, CS 7 which is at Neerody, in Tamil Nadu, was chose to illustrate the seasonal trends over six years. In this stretch, construction activities (groins) were noticed during fair weather season of 2019.

From Figure 2-81 and Figure 2-82, it can be noticed that the seasonal variations were very minimal. However, minimal accretion was observed in foreshore zone during Ockhi (December 2017).

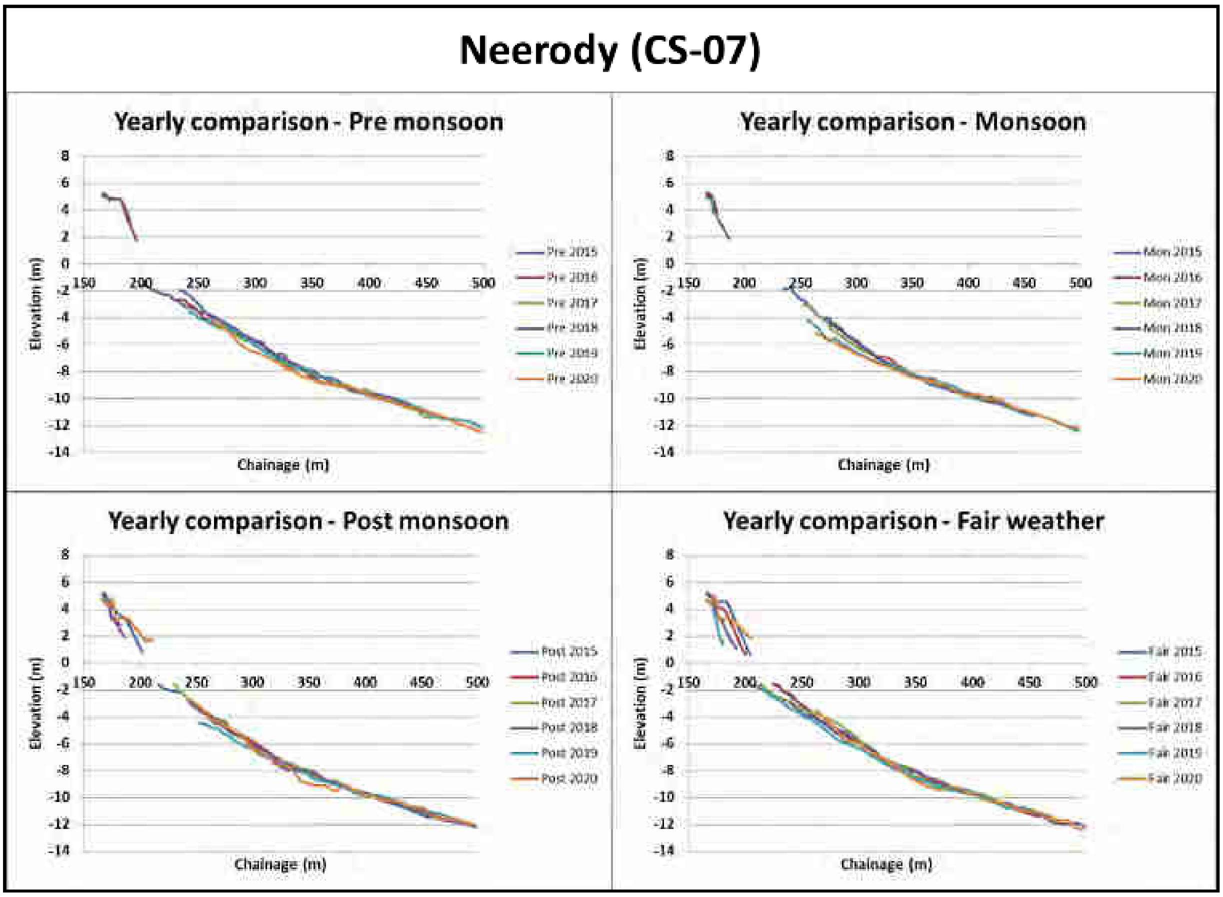


Figure 2-82 Profiles at Neerody (CS 07) – Yearly comparison

LNTIEL extracted +2m (not extracted at the location where seawall is present), -3m, -4m, -6m, -8m and -10m contours from cross shore profile data at Neerody and below plots are time series of respective contours over six years data. The time scale is similar. The plots represent the contour distances with respect to an arbitrary point which is constant for all profiles at a cross section and represent the seasonal variations of erosion and accretion in this stretch.

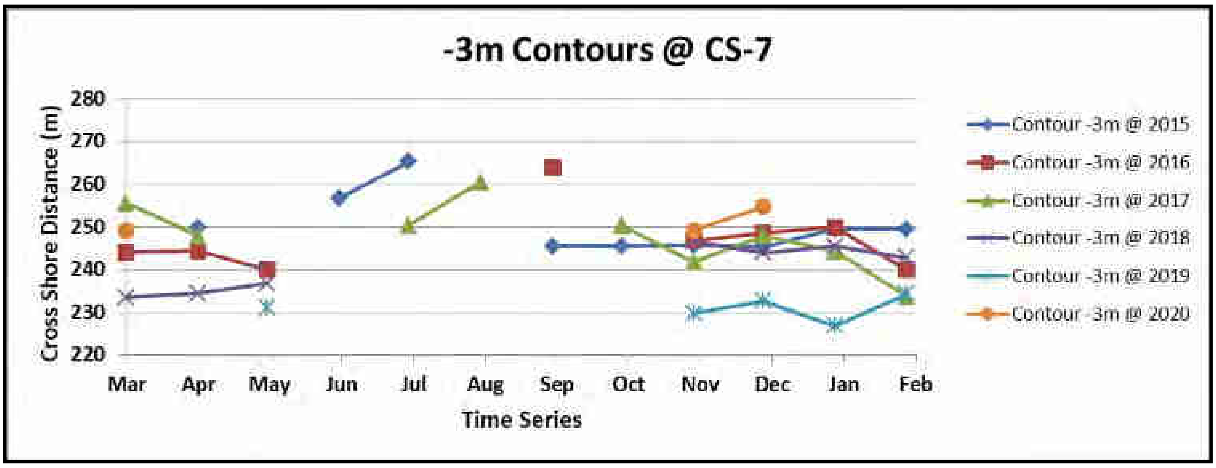


Figure 2-83 Time series of (–) 3 m contour at Neerody (CS 07)

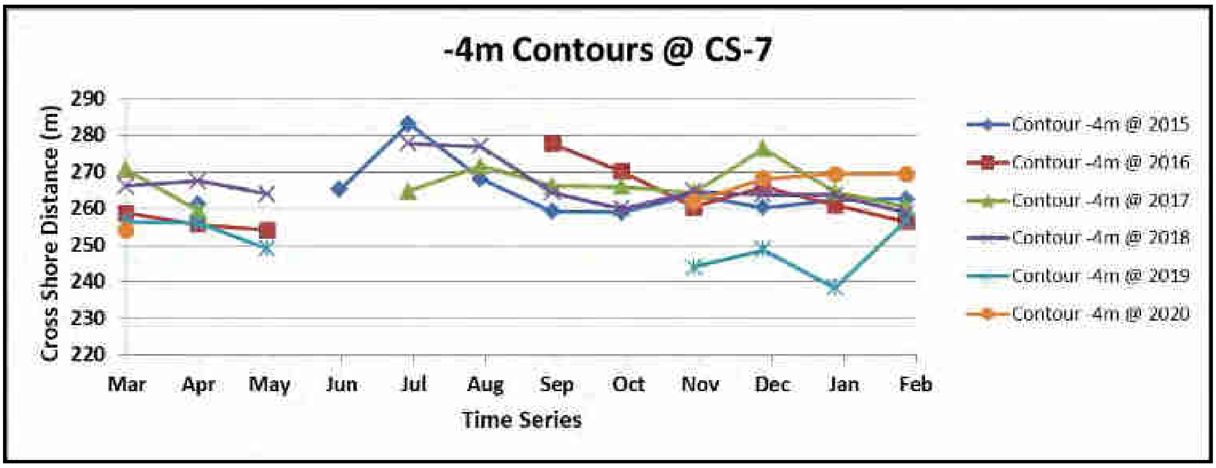


Figure 2-84 Time series of (–) 4 m contour at Neerody (CS 07)

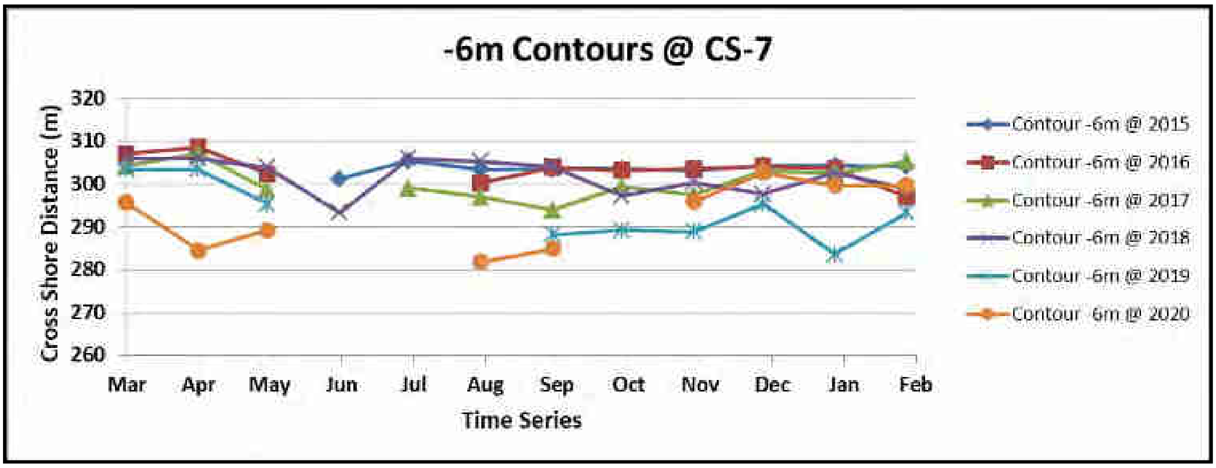


Figure 2-85 Time series of (–) 6 m contour at Neerody (CS 07)

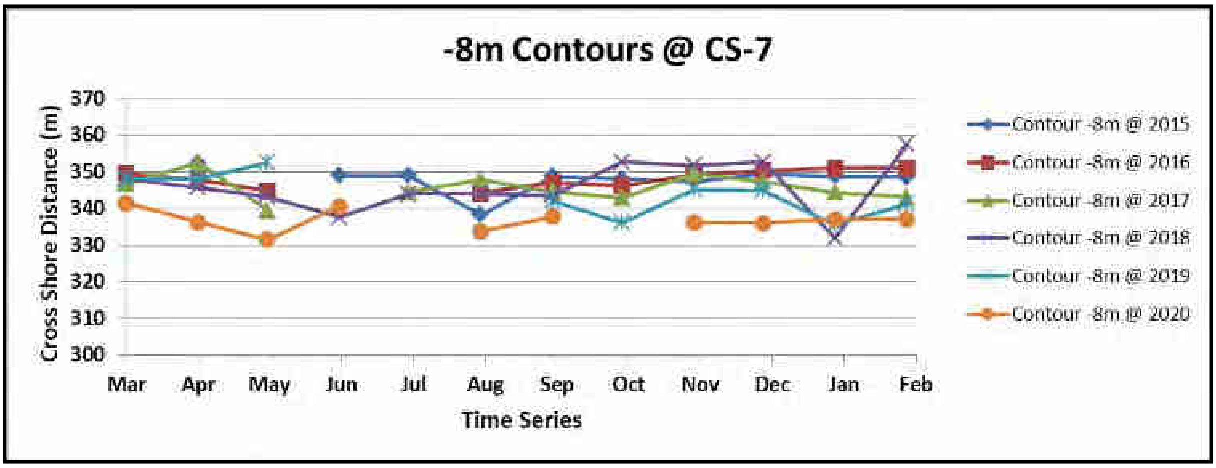


Figure 2-86 Time series of (–) 8 m contour at Neerody (CS 07)

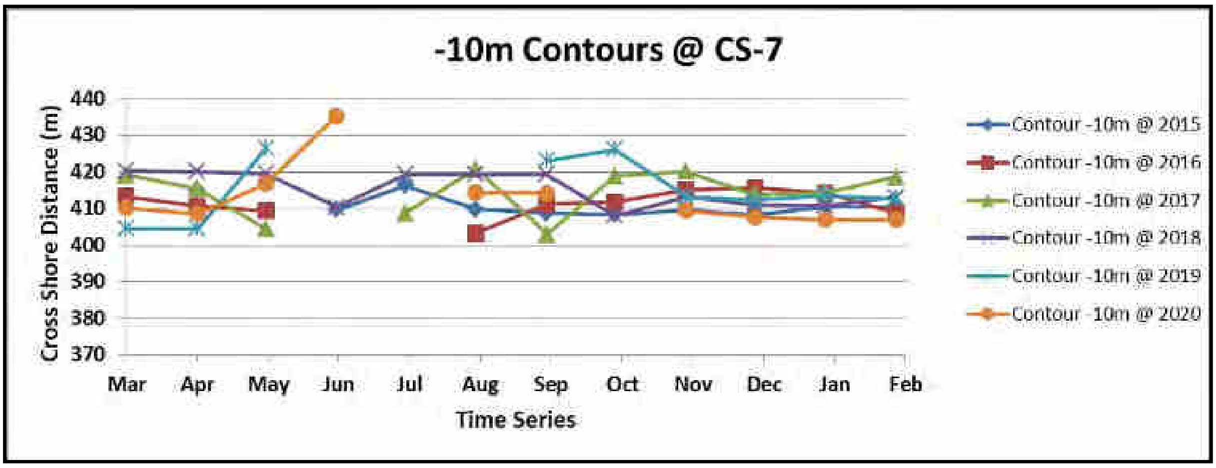


Figure 2-87 Time series of (–) 10 m contour at Neerody (CS 07)

In addition to above, continuous variation of contour distances over 6 years was provided for better clarity as shown in Figure 2-88.

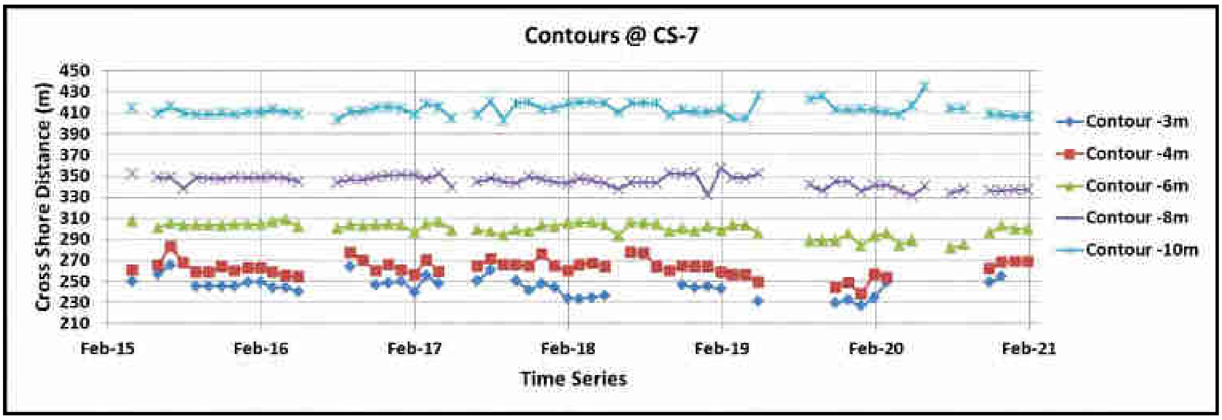


Figure 2-88 Continuous time series of contours at Neerody (CS 07)

2.7.2.2 Stretch 2

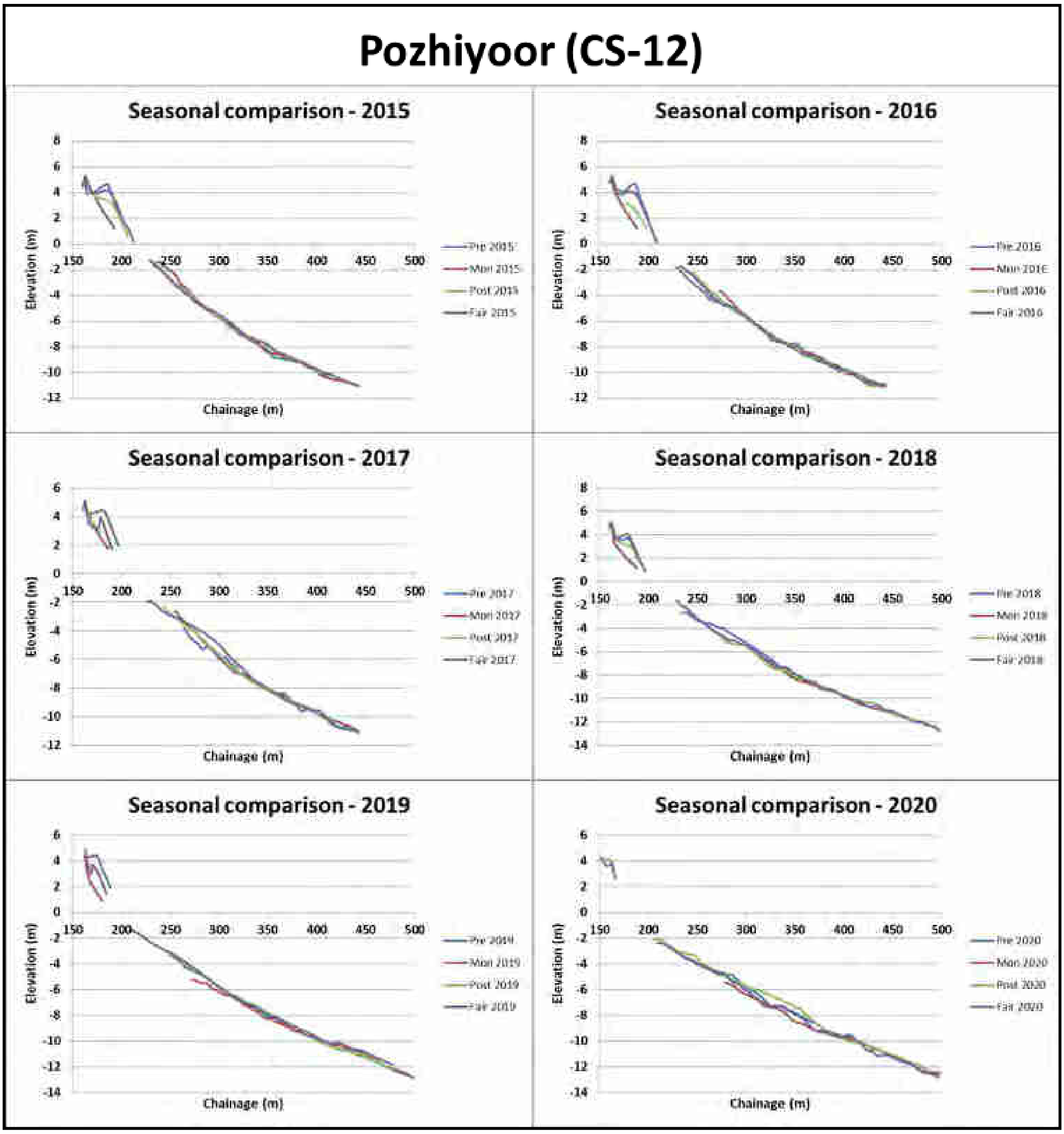


Figure 2-89 Profiles at Pozhiyoor (CS 12) – Seasonal comparison

Beach was present in front of seawall in the stretch of CS 11 to CS 14 till Feb 2020. Subsequently seawall was noticed throughout the year in this stretch. Among these sections, CS 12 which is at Pozhiyoor in Kerala was chose to illustrate the seasonal trends over six years.

From Figure 2-89 and Figure 2-90, it can be noticed that the coast experiences significant seasonal variations over a year. The general trend seems to be that of a stable beach during pre-monsoon seasons, of beach erosion and deposition in offshore region during monsoon seasons and of gradual beach build up during post monsoon & fair-weather seasons.

In 2017 the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi (December 2017) during fair weather season and the cyclone resulted in severe erosion all along the coast. After Ockhi, erosion was noticed during fair weather 2017 and pre monsoon

2018 seasons on the land side. Recently, this has been compounded by the prevalence of the higher events related to storms & depressions and in addition construction activities happened to the South of this stretch.

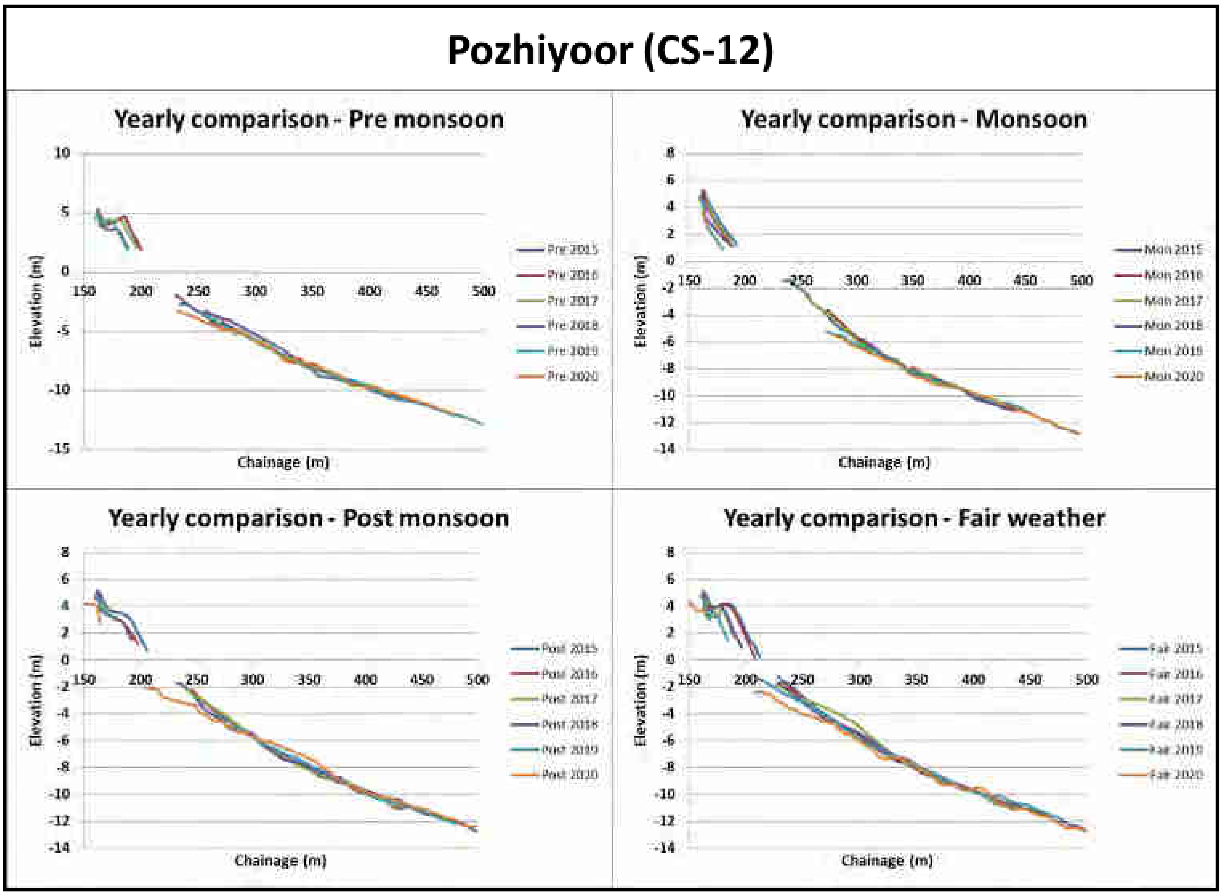


Figure 2-90 Profiles at Pozhiyoor (CS 12) – Yearly comparison

LNTIEL extracted +2m, -3m, -4m, -6m, -8m and -10m contours from cross shore profile data at Pozhiyoor and below plots are time series of contours over six years.

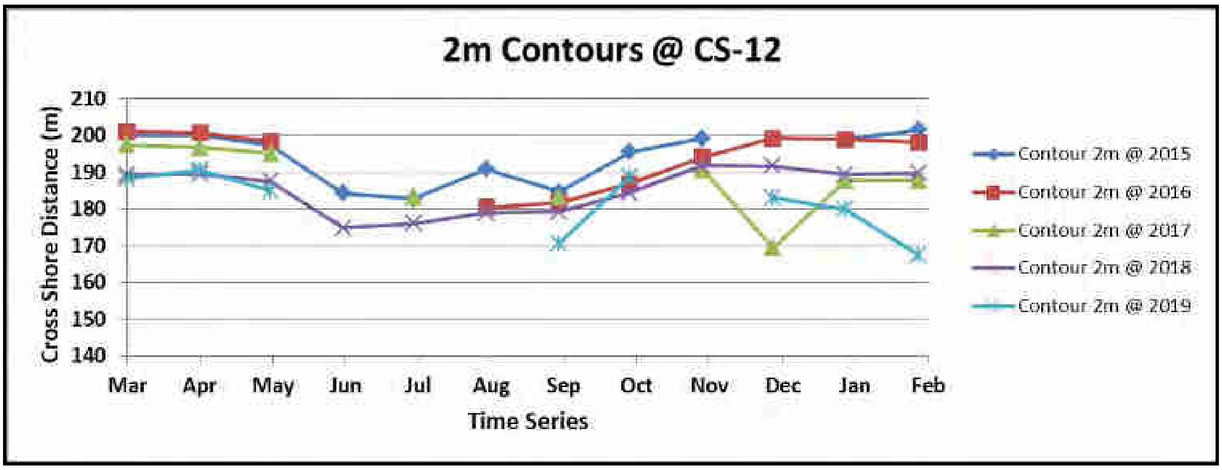


Figure 2-91 Time series of (+) 2 m contour at Pozhiyoor (CS 12)

Figure 2-91 is the time series of (+) 2 m contour data at Pozhiyoor. From this plot it can be noticed that the beach experiences seasonal variations resulting in erosion during monsoon season and accretion during other seasons. During Ockhi the beach was exposed to severe erosion and minimal accretion was noticed during fair weather 2017 and pre-monsoon 2018 in the course of which beach was supposed to build up. In addition, as a result of monsoon 2018 and 2019 the beach further eroded than previous monsoon seasons. The recent storms are proving to be further detrimental to the beach accretion.

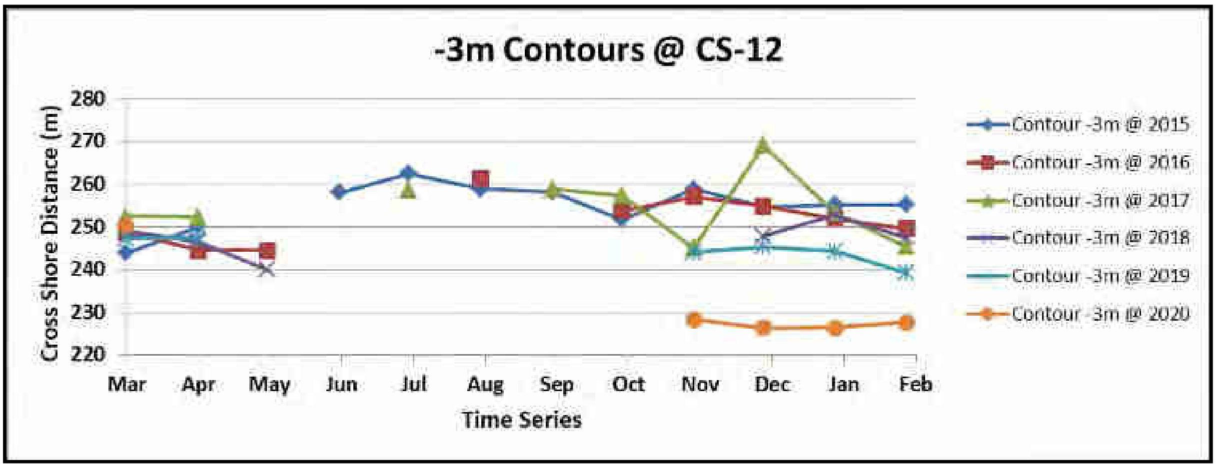


Figure 2-92 Time series of (–) 3 m contour at Pozhiyoor (CS 12)

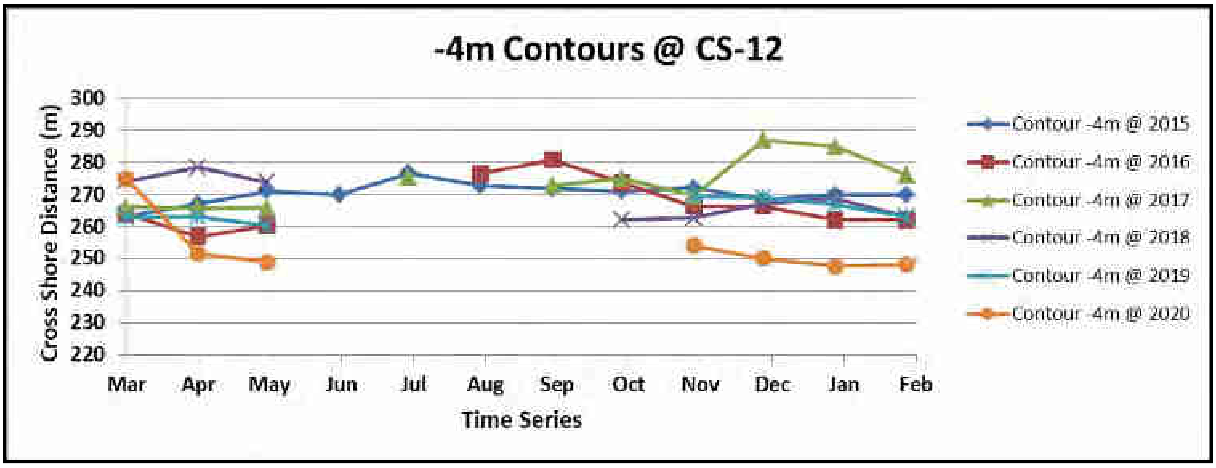


Figure 2-93 Time series of (–) 4 m contour at Pozhiyoor (CS 12)

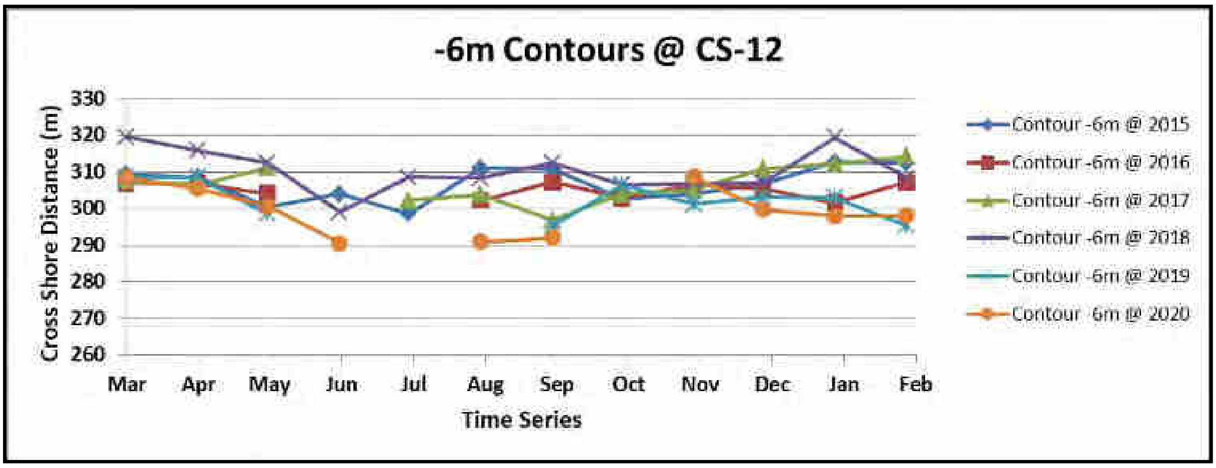


Figure 2-94 Time series of (–) 6 m contour at Pozhiyoor (CS 12)

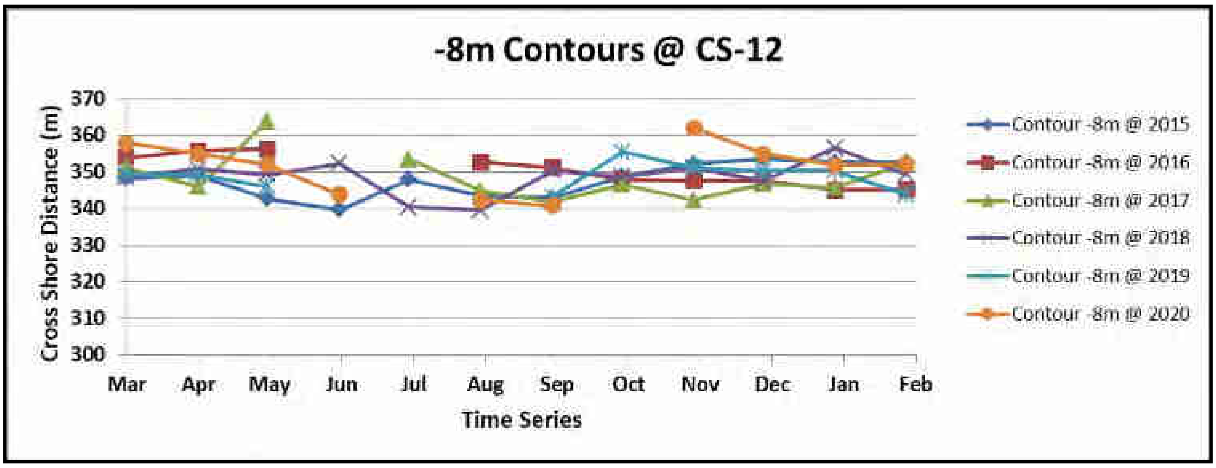


Figure 2-95 Time series of (–) 8 m contour at Pozhiyoor (CS 12)

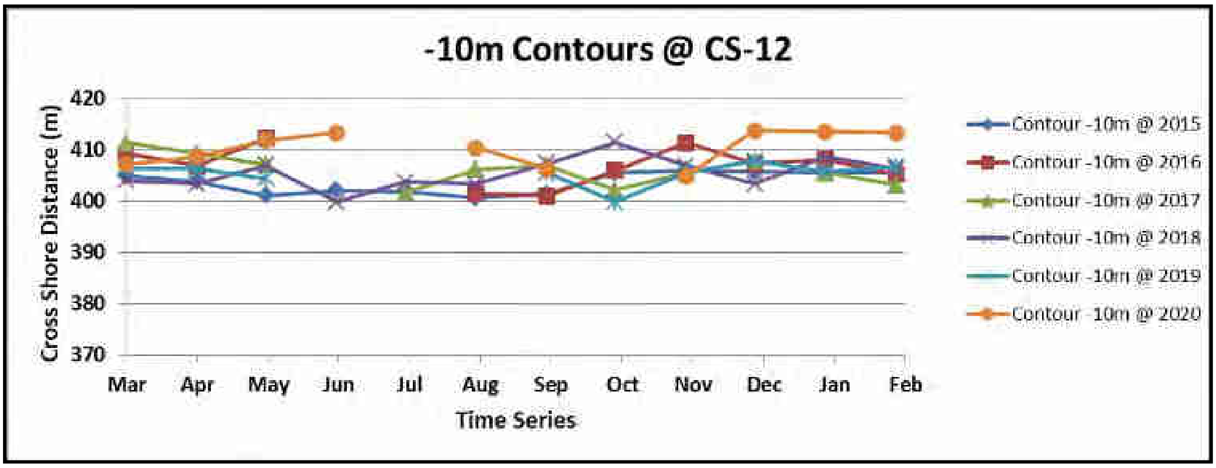


Figure 2-96 Time series of (–) 10 m contour at Pozhiyoor (CS 12)

In addition to above, the +2m, -3m, -4m, -6m, -8m and -10m contours continuous variation of contour distances over 6 years was provided for better clarity as shown in Figure 2-97.

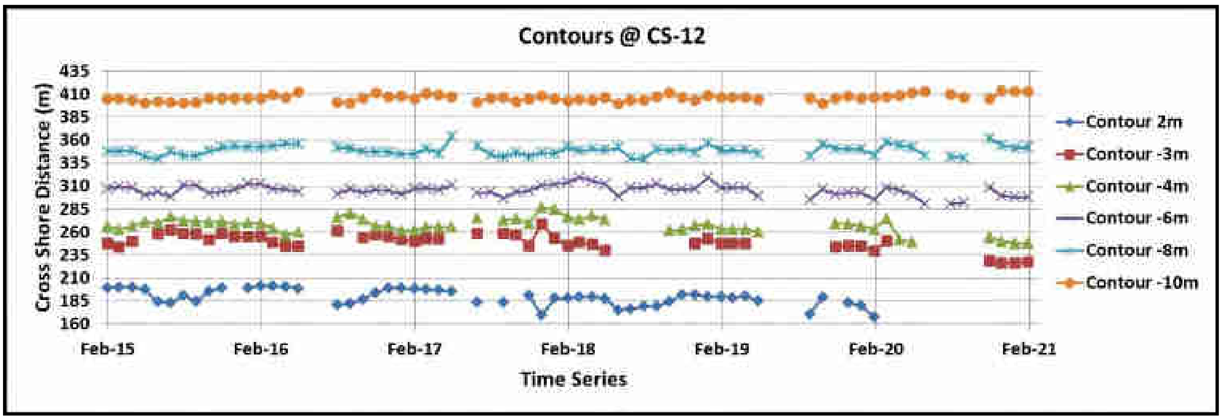


Figure 2-97 Continuous time series of contours at Pozhiyoor (CS 12)

Figure 2-97 shows the variation of contour distances from common arbitrary point on land side. It can be observed that most of the sediment exchange was in between +2m and -3m contours prior to Ockhi i.e. simultaneous erosion on beach side & accretion on sea side and vice versa. This phenomenon in turn indicates that cross shore transport is predominant in this stretch. Post Ockhi such trend could not be traced due to various reasons such as lack of adequate survey data, construction activities happened to the South of this stretch and subsequent higher monsoonal events.

2.7.2.3 Stretch 3

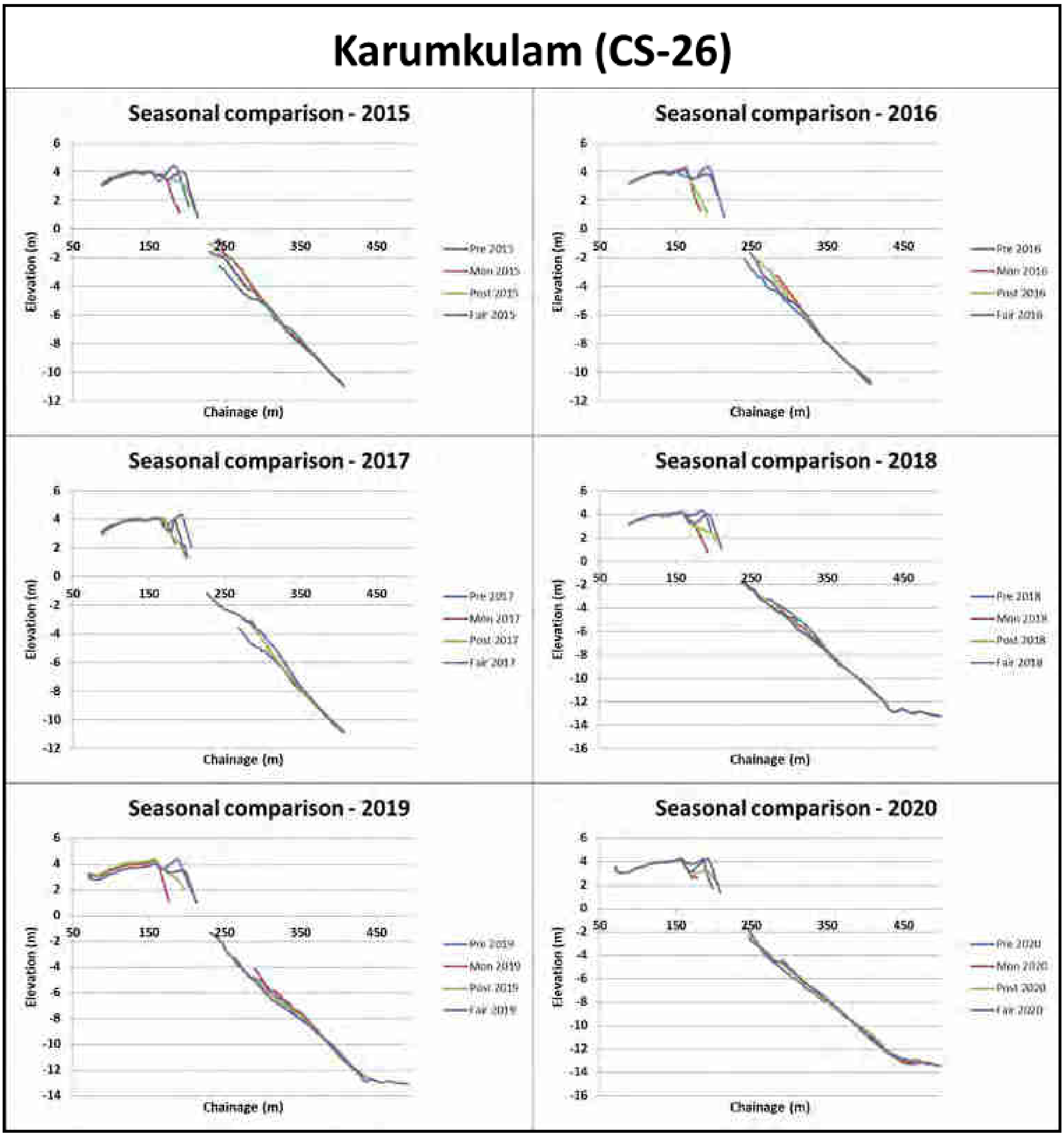


Figure 2-98 Profiles at Karumkulam (CS 26) – Seasonal comparison

Beach is present throughout the year in the stretch of CS 18 to CS 34. Among these sections, CS 26 which is at Karumkulam in Thiruvananthapuram district of Kerala was chosen to illustrate the seasonal trends over six years. From Figure 2-98, it can be noticed that the coast experience seasonal variations over a year. In general, it seems to have a stable beach during pre-monsoon seasons, beach erosion and deposition in offshore region during monsoon seasons and gradual beach build up during post monsoon & fair weather seasons whereas in 2017 the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi (December 2017) during fair weather season and resulted in severe erosion all along the coast. After Ockhi the erosion was noticed during fair weather 2017 and pre monsoon 2018 seasons on land side. Recently, this has been compounded by the prevalence of the higher events related to storms.

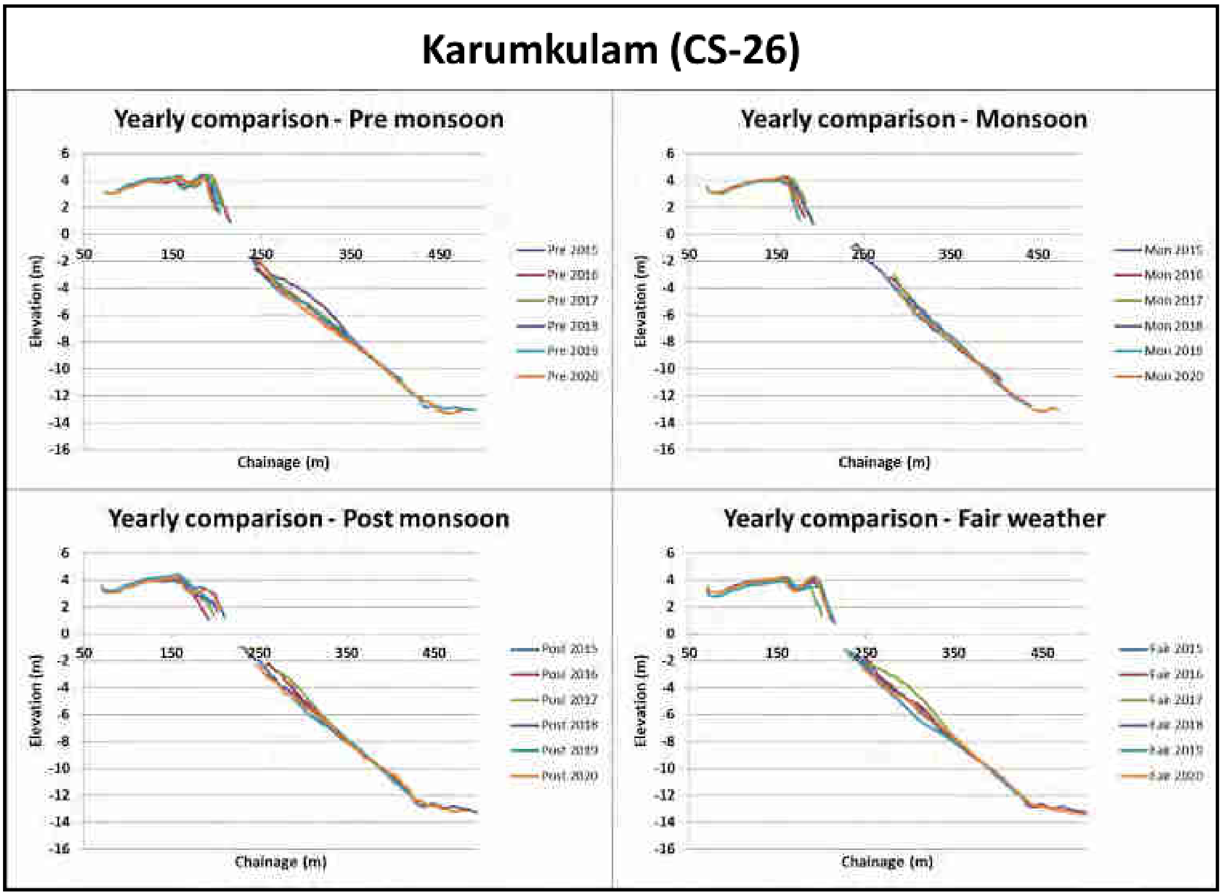


Figure 2-99 Profiles at Karumkulam (CS 26) – Yearly comparison

Figure 2-99 plots represent comparison of profiles of season over different years. 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 is undergoing processes to recover from this impact, and this can be observed from fair weather seasons comparison plot.

LNTIEL extracted +2m, -3m, -4m, -6m, -8m and -10m contours from cross shore profile data at Karumkulam and below plots were time series of respective contours over six years data with similar time scale. The plots represent the contour distances with respect to an arbitrary point which is constant for all profiles at a cross section and show the monthly variations of erosion (downward drift) and accretion (upward drift) in this stretch.

Figure 2-100 is the time series of (+) 2 m contour at Karumkulam. From this plot it can be noticed that the beach experiences seasonal variation of erosion during monsoon season and accretion during other seasons. During Ockhi the beach was exposed to severe erosion and minimal accretion was noticed during fair weather 2017 and pre-monsoon 2018 in the course of which beach was supposed to build up. In addition, as a result of monsoon 2018 and 2019 the beach further eroded than previous monsoon seasons. The recent storms are proving to be further detrimental to the beach accretion.

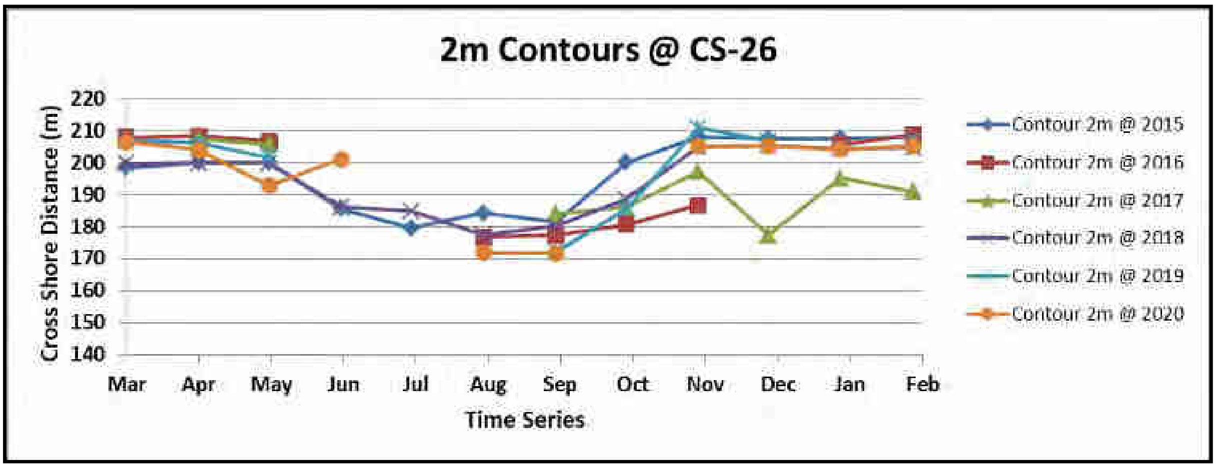


Figure 2-100 Time series of (+) 2 m contour at Karumkulam (CS 26)

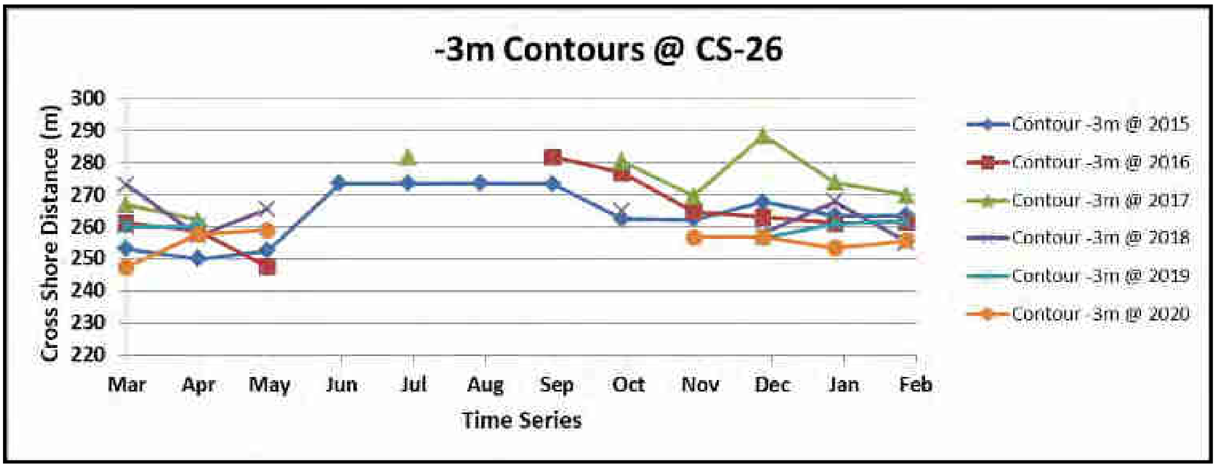


Figure 2-101 Time series of (–) 3 m contour at Karumkulam (CS 26)

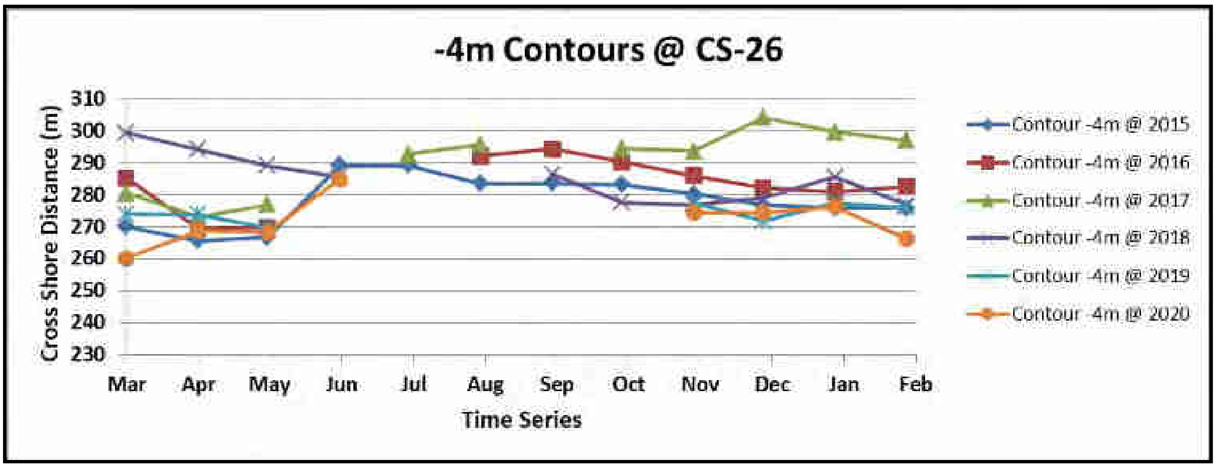


Figure 2-102 Time series of (–) 4 m contour at Karumkulam (CS 26)

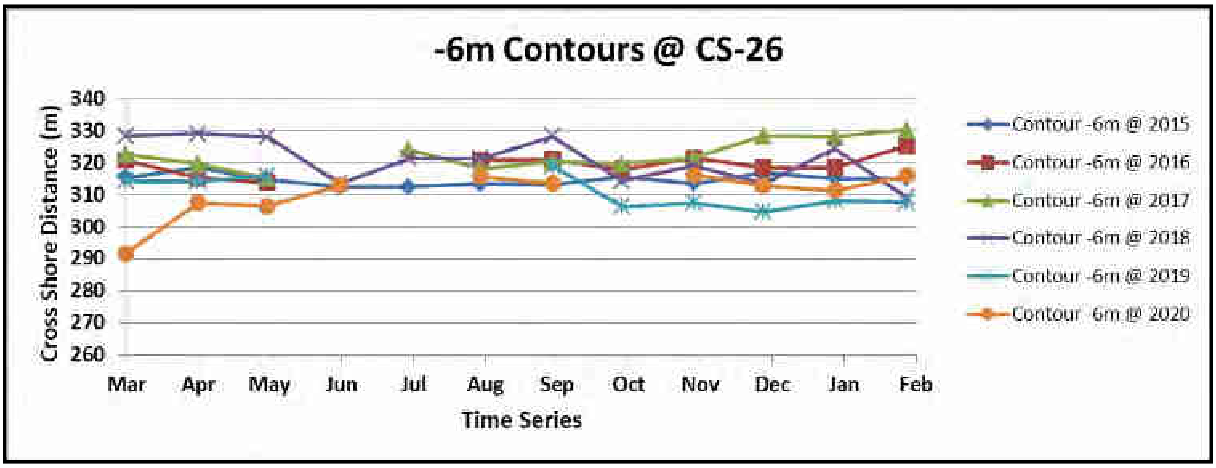


Figure 2-103 Time series of (–) 6 m contour at Karumkulam (CS 26)

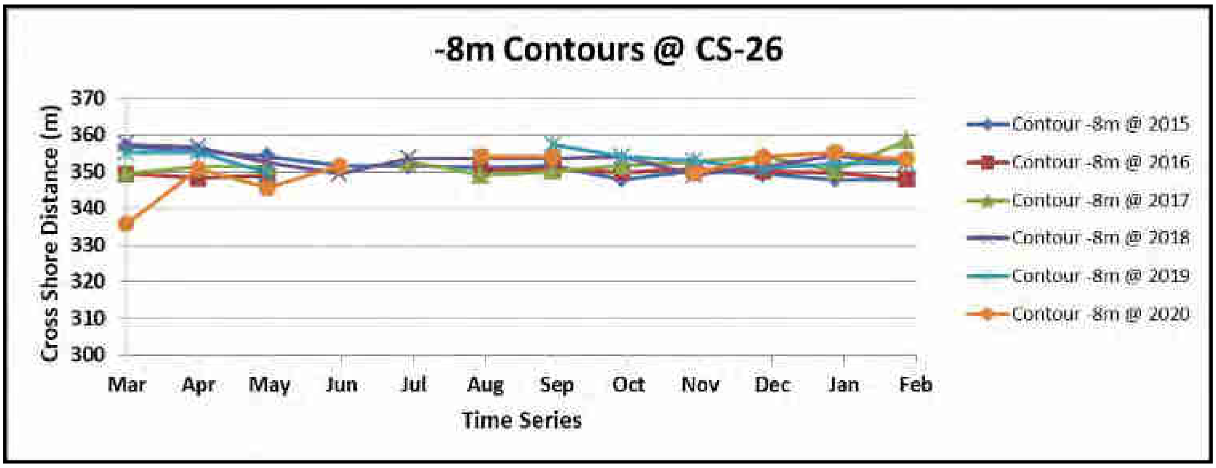


Figure 2-104 Time series of (–) 8 m contour at Karumkulam (CS 26)

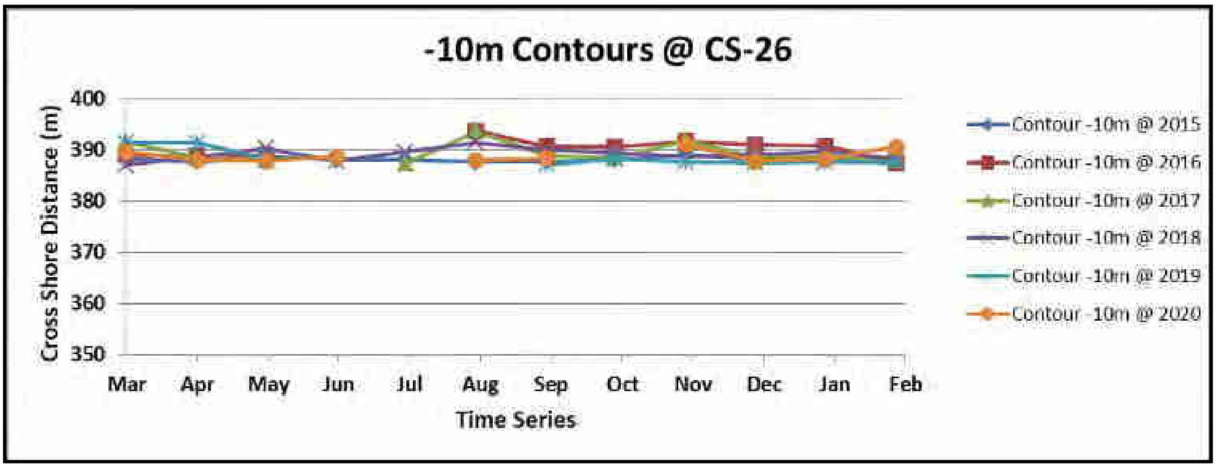


Figure 2-105 Time series of (–) 10 m contour at Karumkulam (CS 26)

In addition to above, the +2m, -3m, -4m, -6m, -8m and -10m contours continuous variation of contour distances over 6 years was provided for better clarity as shown in Figure 2-106.

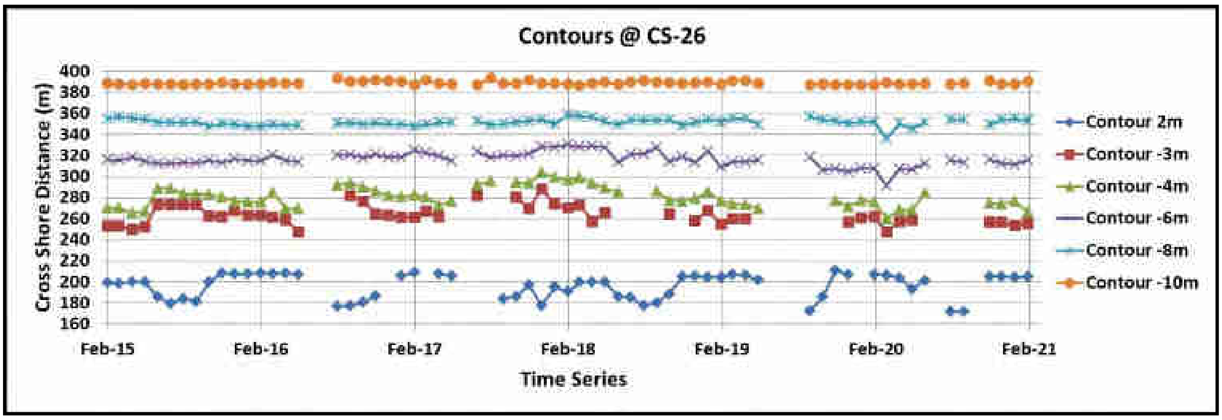


Figure 2-106 Continuous time series of contours at Karumkulam (CS 26)

Figure 2-106 shows the variation of respective contour distances from common arbitrary point on land side. It can be observed that most of the sediment exchange was in between +2m and -3m contours i.e. simultaneous erosion on beach side & accretion on sea side and vice versa. This phenomenon in turn indicates that cross shore transport is predominant in this stretch.

2.7.2.4 Stretch 4

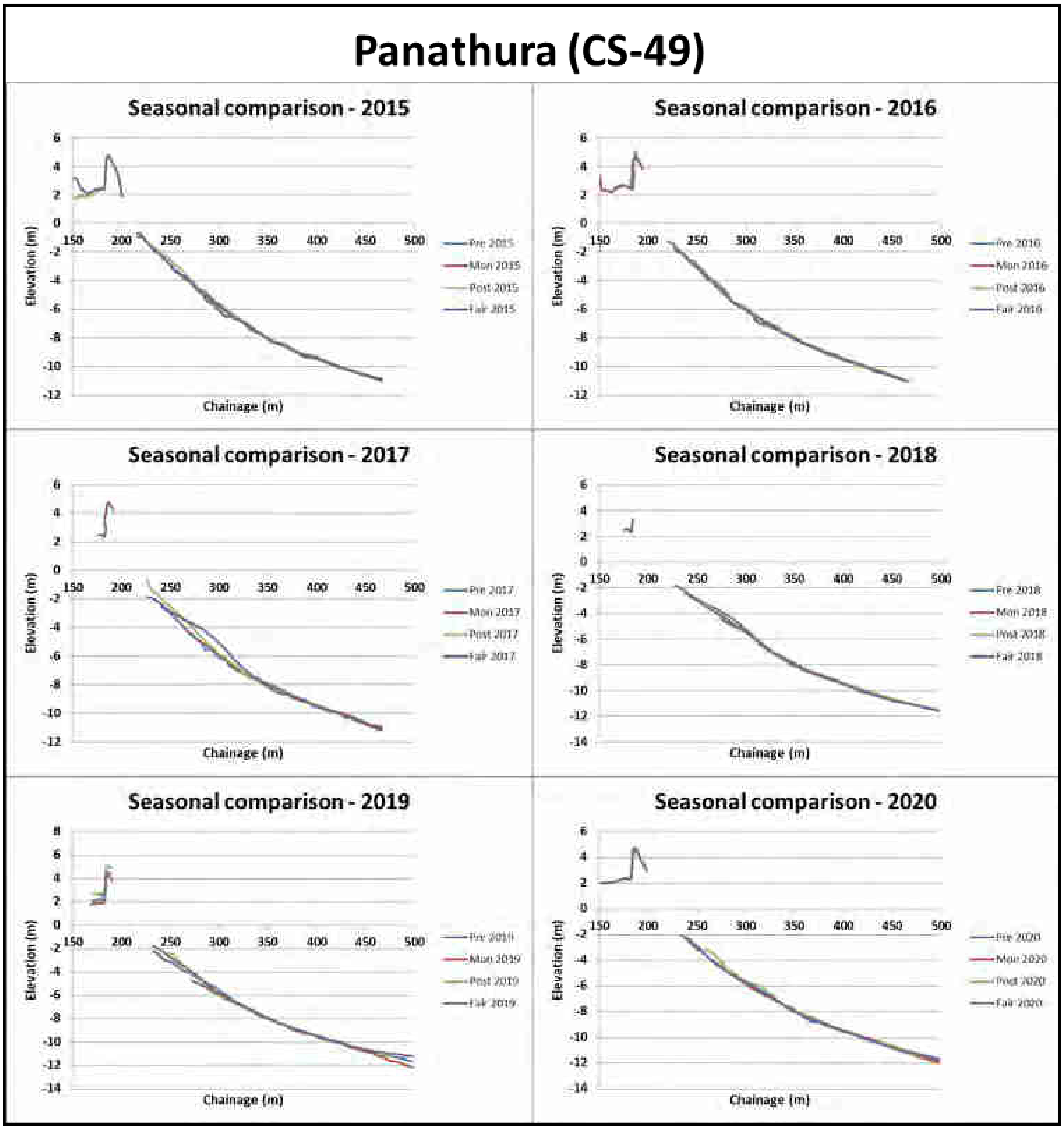


Figure 2-107 Profiles at Panathura (CS 49) – Seasonal comparison

Seawalls are present in the stretch of CS 47 to CS 52. Among these sections, CS 49 which is at Panathura in Thiruvananthapuram district was chosen to illustrate the seasonal trends over six years.

From Figure 2-107, it can be noticed that the seasonal variations are very minimal. However, accretion was observed in foreshore zone during Ockhi (December 2017). Figure 2-108 plots represent comparison of profiles of different seasons over different years. These plots suggest that there was an accretion in offshore region during fair weather 2017 and pre-monsoon 2018 seasons.

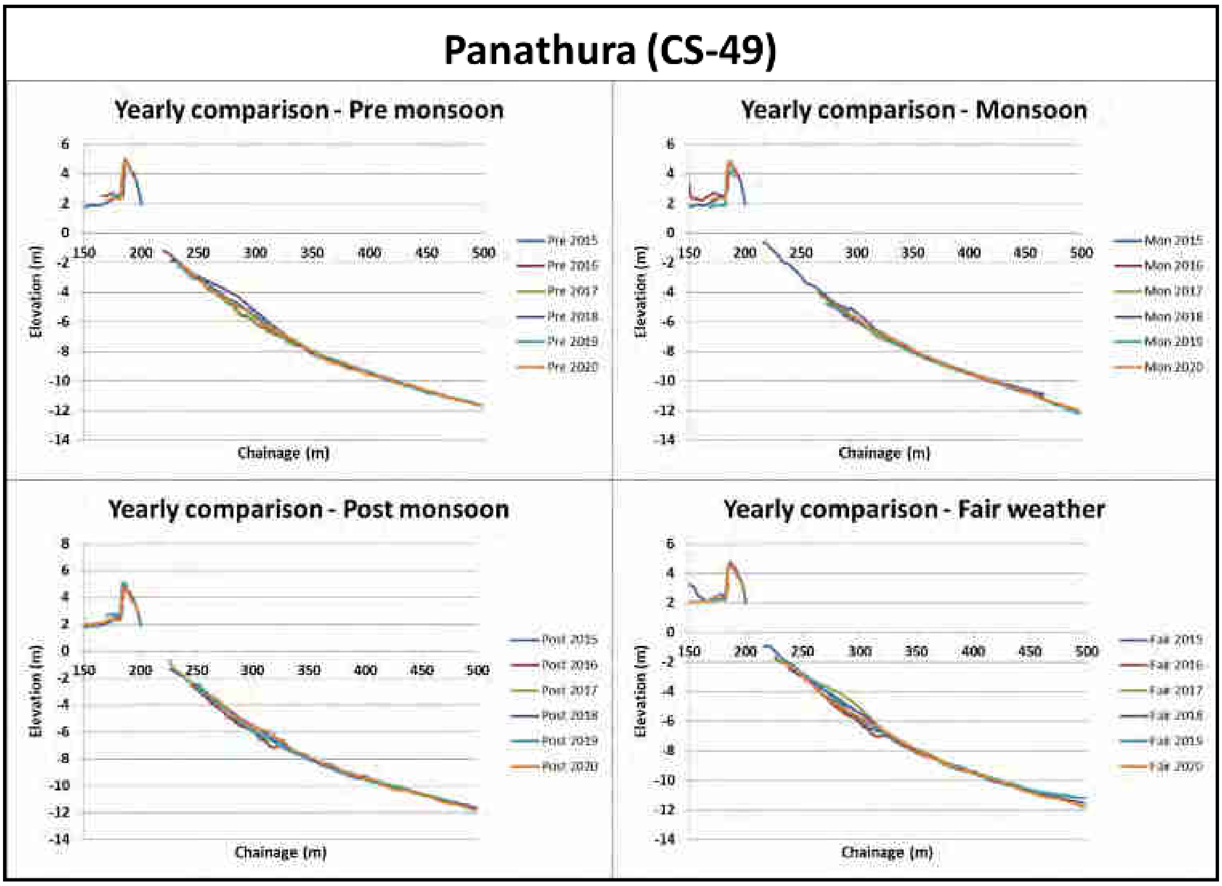


Figure 2-108 Profiles at Panathura (CS 49) – Yearly comparison

LNTIEL extracted +2m (not extracted at the location where seawall is present), -3m, -4m, -6m, -8m and -10m contours from cross shore profile data at Panathura and below plots are time series of respective contours. The plots represent the contour distances with respect to an arbitrary point which is constant for all profiles at a cross section and show the monthly variations of erosion (downward drift) and accretion (upward drift) in this stretch.

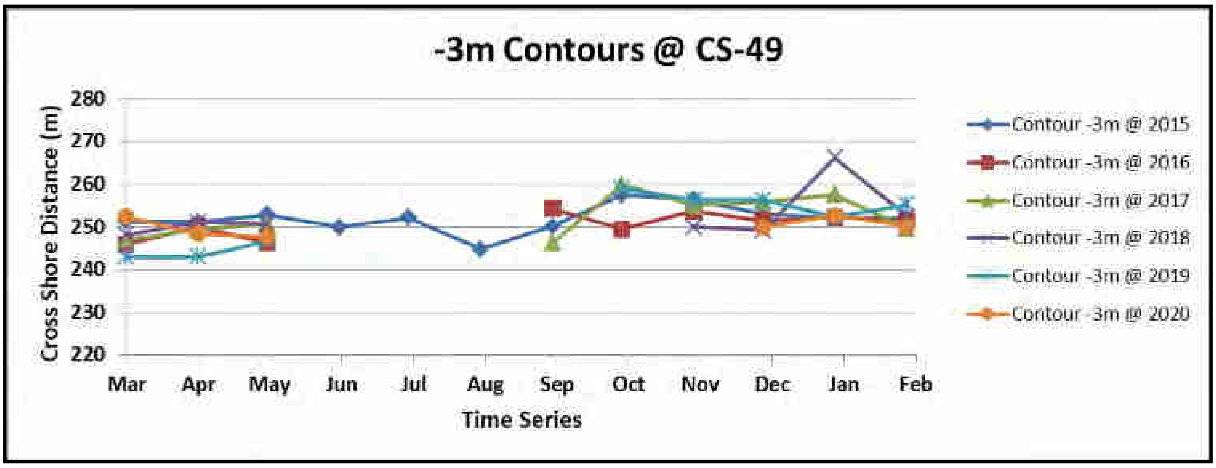


Figure 2-109 Time series of (–) 3 m contour at Panathura (CS 49)

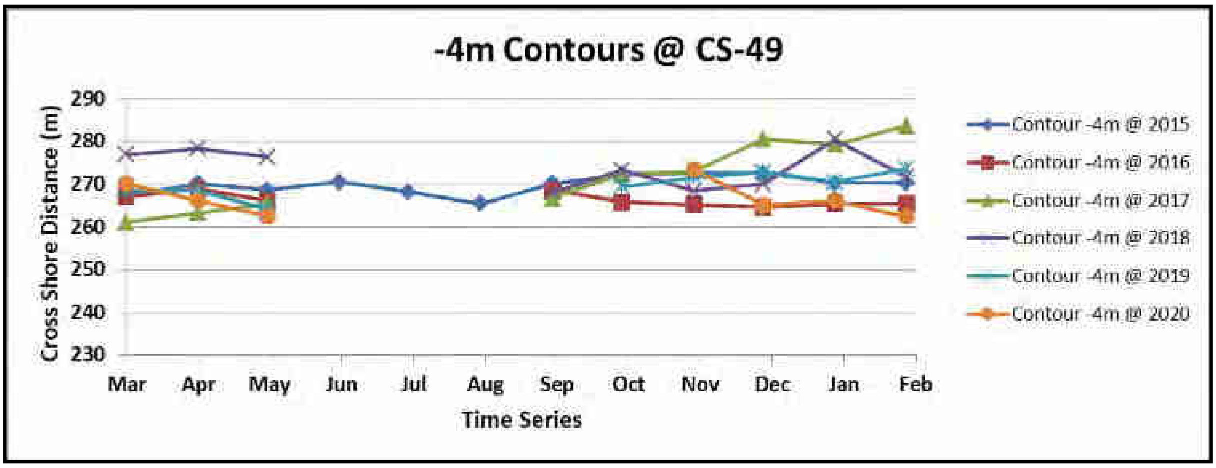


Figure 2-110 Time series of (–) 4 m contour at Panathura (CS 49)

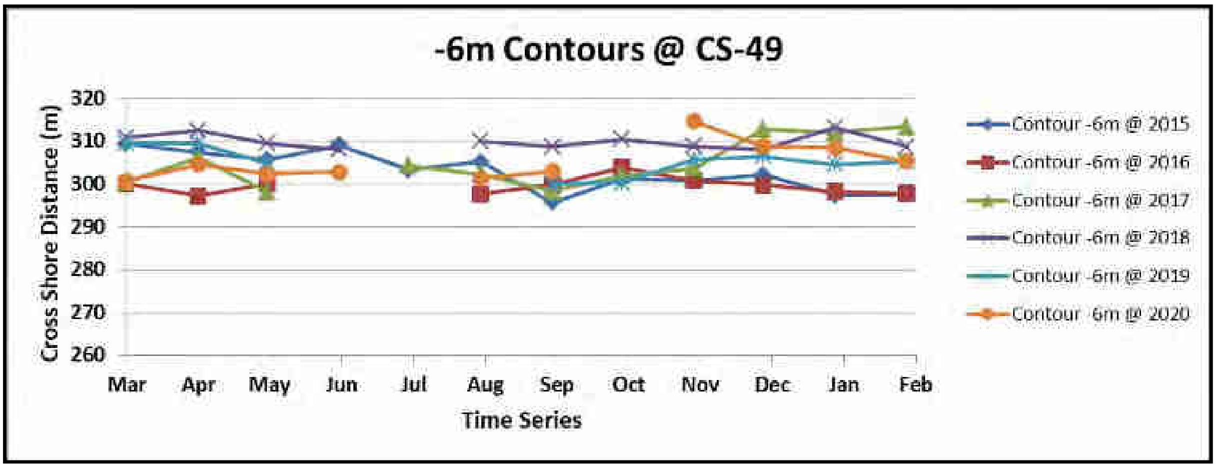


Figure 2-111 Time series of (–) 6 m contour at Panathura (CS 49)

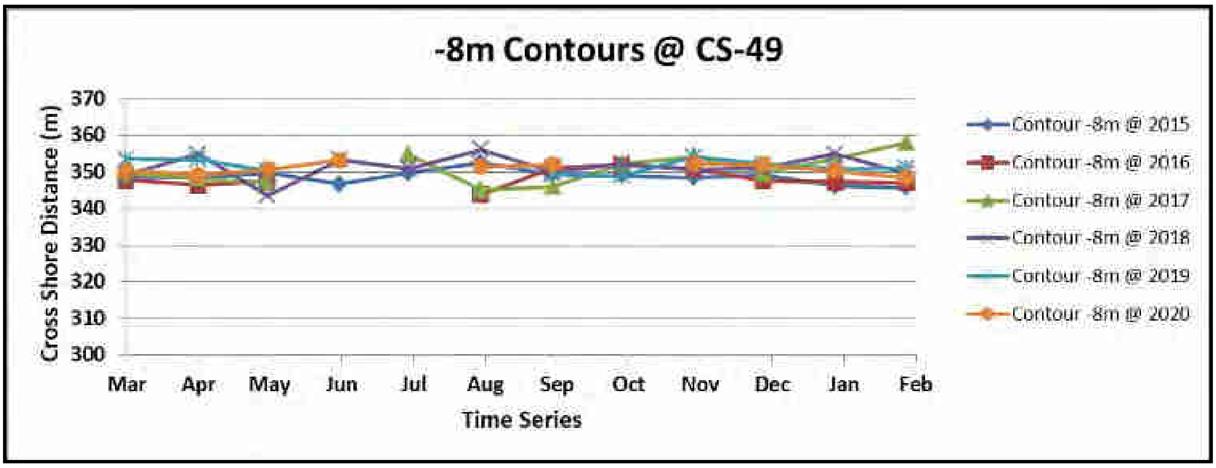


Figure 2-112 Time series of (–) 8 m contour at Panathura (CS 49)

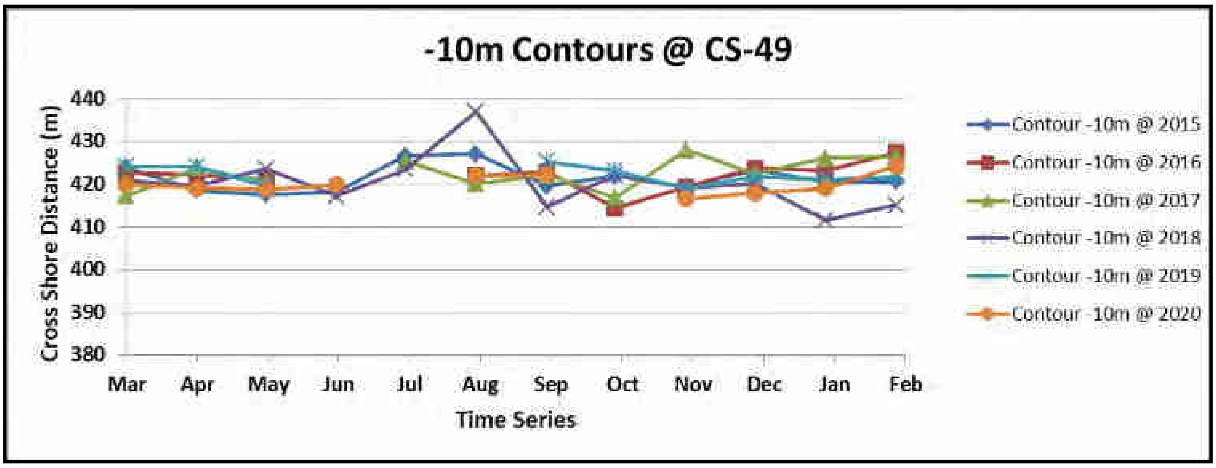


Figure 2-113 Time series of (–) 10 m contour at Panathura (CS 49)

In addition to above, the +2m (not extracted at the location where seawall is present), -3m, -4m, -6m, -8m and -10m contours continuous variation of contour distances over 6 years was provided for better clarity as shown in Figure 2-114.

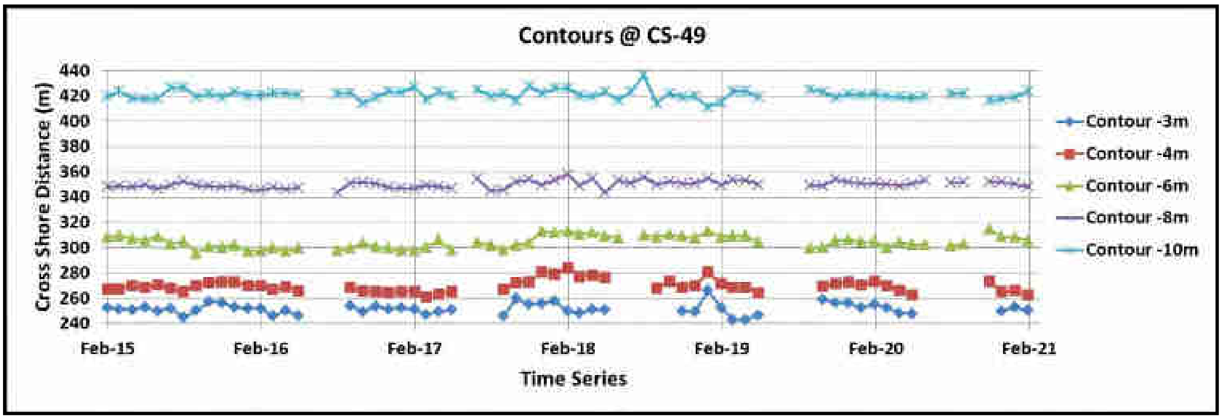


Figure 2-114 Continuous time series of contours at Panathura (CS 49)

2.7.2.5 Stretch 5

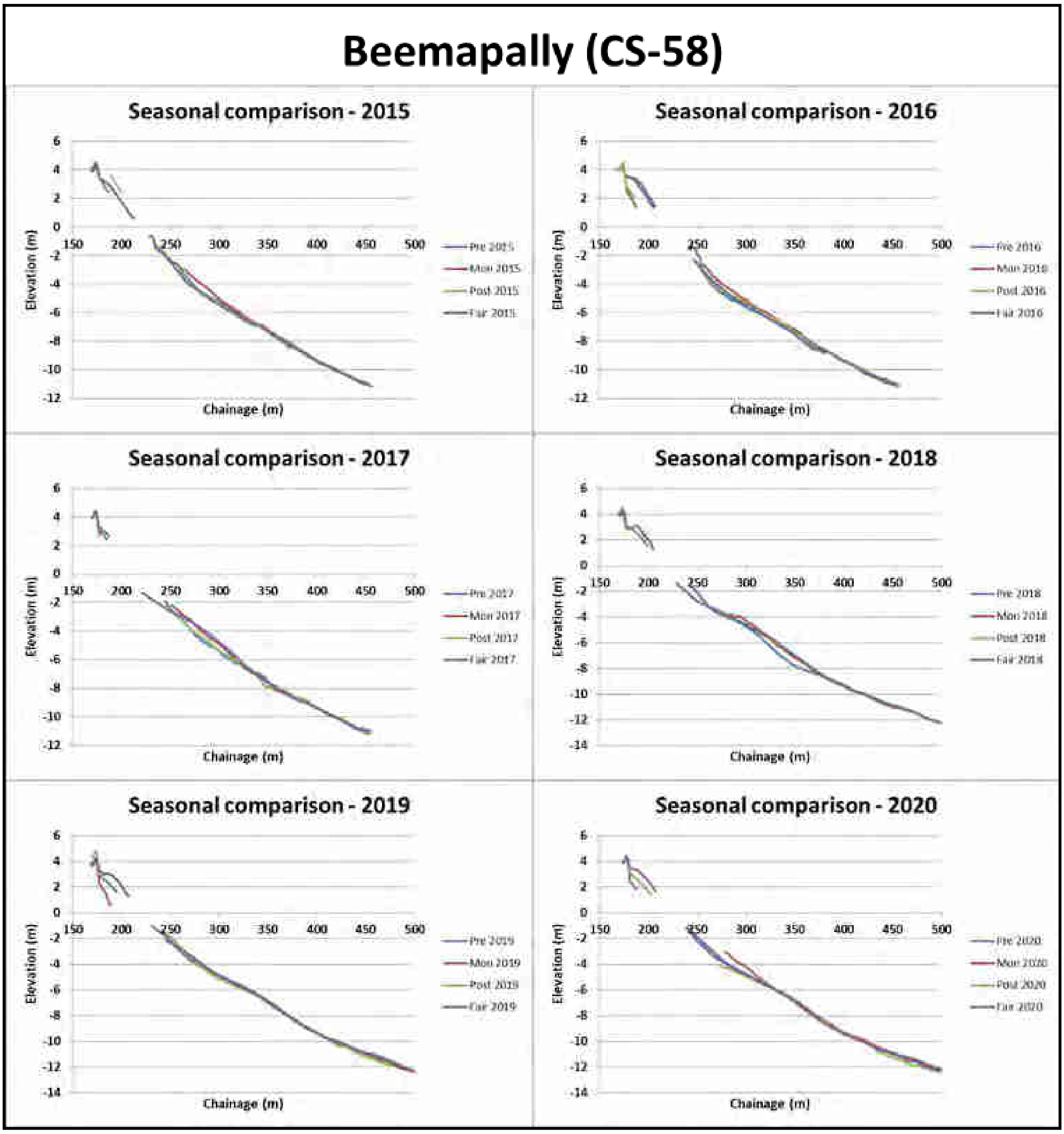


Figure 2-115 Profiles at Beemapally (CS 58) – Seasonal comparison

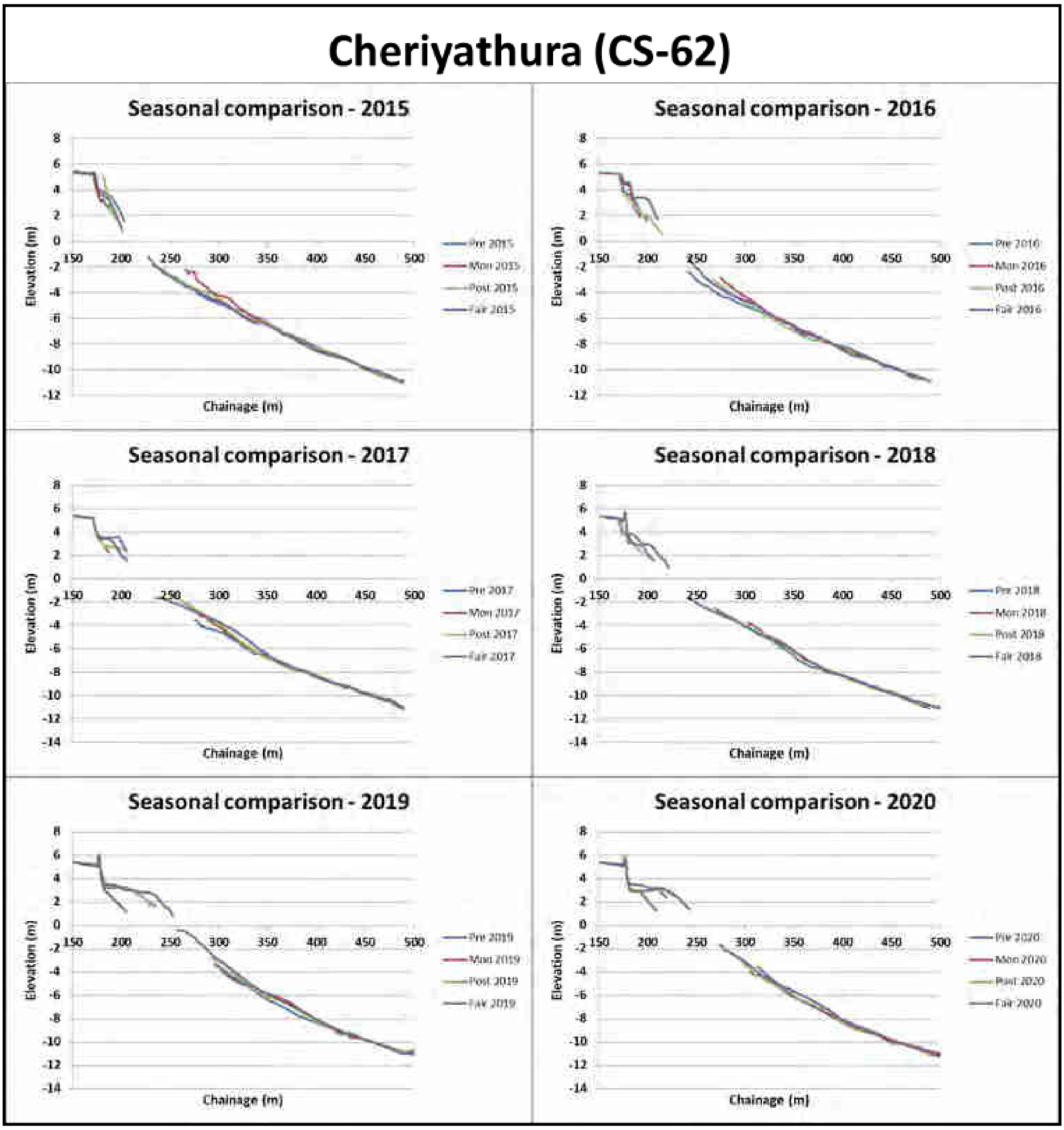


Figure 2-116 Profiles at Cheriyathura (CS 62) – Seasonal comparison

Seawall along with groynes are present in the stretch of CS 56 to CS 65 out of which CS 56 to CS 59 can be denoted as groyne field 1 (exists from start of survey period) and CS 60 to CS 63 can be denoted as groyne field 2 (since it was constructed after survey commence as shown in Figure 2-117). Among these sections, CS 58 and CS 62 which are at Beemapally and Cheriyathura locations in Thiruvananthapuram district of Kerala state were chosen to illustrate the seasonal trends over six years. From Figure 2-115 and Figure 2-116, it can be noticed that the coast experience seasonal variations over a year. The general phenomenon seems to be stable beach during pre-monsoon seasons, beach erosion and deposition in offshore region during monsoon seasons and gradual beach build up during post monsoon & fair weather seasons whereas in 2017 the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi (December 2017) during fair weather season and resulted in severe erosion all along the coast. After Ockhi the erosion was noticed during fair weather 2017 and pre monsoon 2018 seasons on land side. Recently, this has been compounded by the prevalence of the higher events related to storms and construction activities happened in this stretch.

(a) Before construction of groyne field 2 (Source: Google earth – 10/2016)

(b) After construction of groyne field 2 (Source: Google earth – 01/2019)

Figure 2-117 Groyne construction activities after commencement of survey

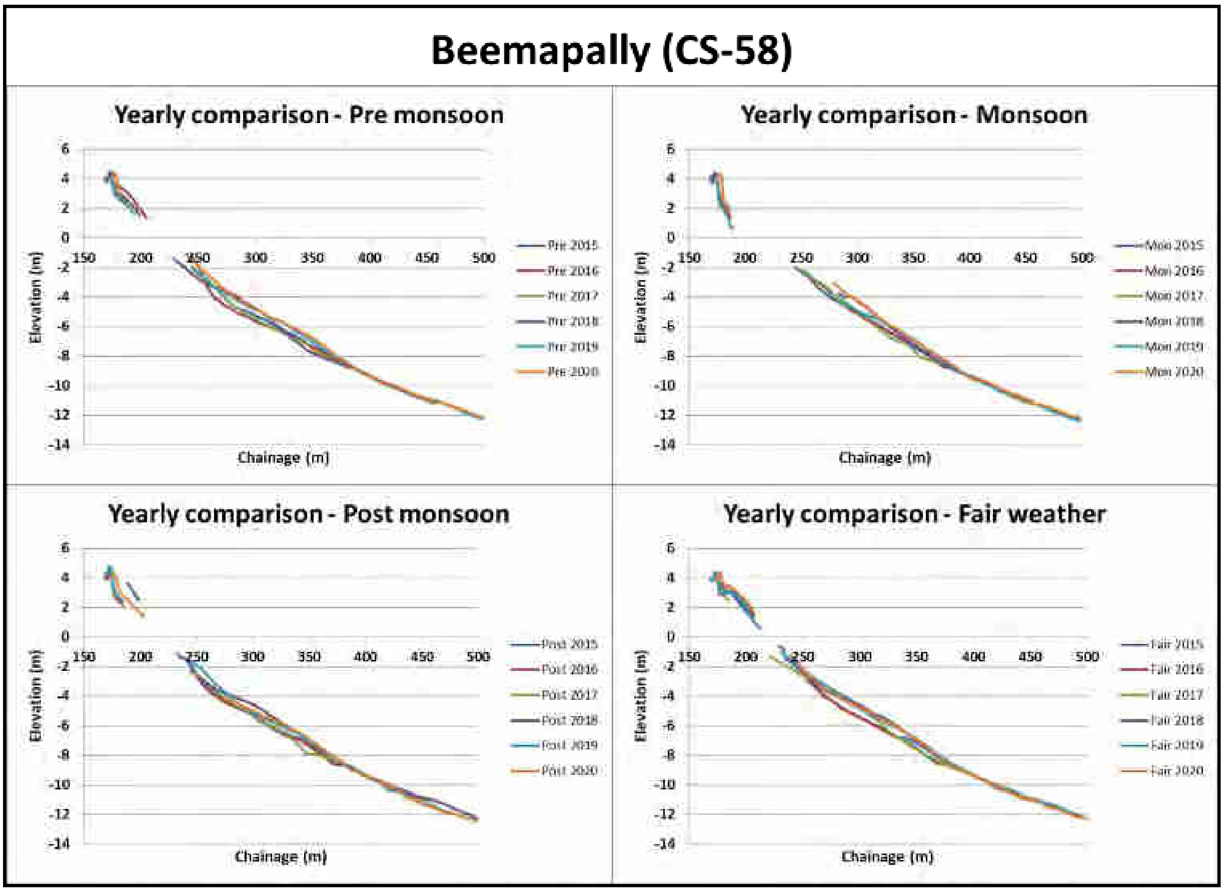


Figure 2-118 Profiles at Beemapally (CS 58) – Yearly comparison

Figure 2-118 plots represent comparison of profiles of a particular season over different years. These plots suggest that yearly trend was as per normal sequence till post monsoon 2017. During fair weather season of 2017, unprecedented event Ockhi cyclone hit the coast and impact of Ockhi cyclone can be evidently noticed in fair weather 2017 and pre-monsoon 2018 seasonal profiles. Subsequently lasting accretion can be noticed in offshore region as shown in yearly comparison plot of fair weather seasons. Also, fair weather profiles can be categorised into two sets based on their pre and post Ockhi behaviour.

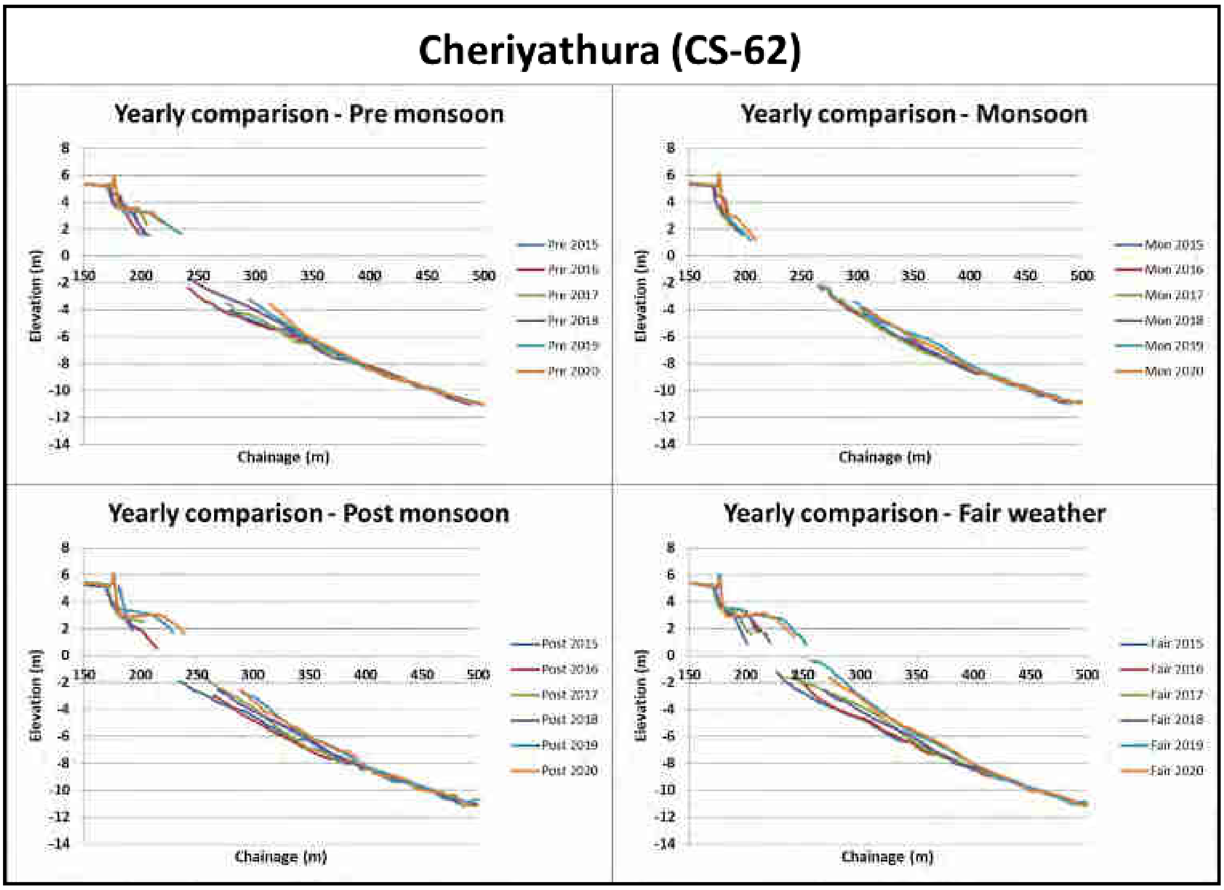
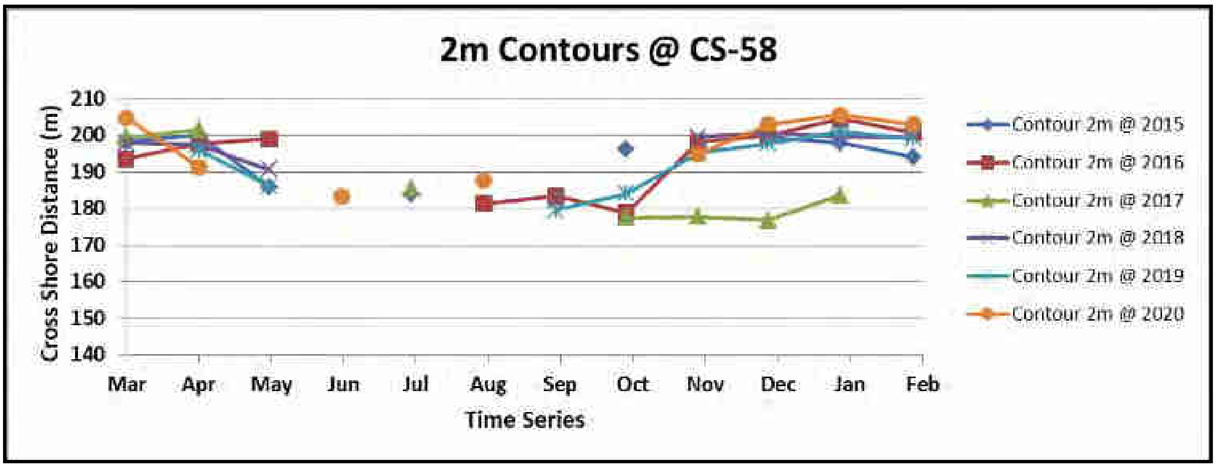


Figure 2-119 Profiles at Cheriyathura (CS 62) – Yearly comparison

Figure 2-119 plots represent comparison of profiles over different years. In addition to Ockhi cyclone, some anthropogenic activities took place in this stretch. Yearly comparison plots show three distinguish set of profiles based on their behaviour after Ockhi and anthropogenic activities compared to initial set.

LNTIEL extracted +2m, -3m, -4m, -6m, -8m and -10m contours from cross shore profile data at Beemapally and Cheriyathura locations. Below plots were time series of respective contours over six year data with similar time scale. The plots represent the contour distances with respect to an arbitrary point which is constant for all profiles at a cross section.



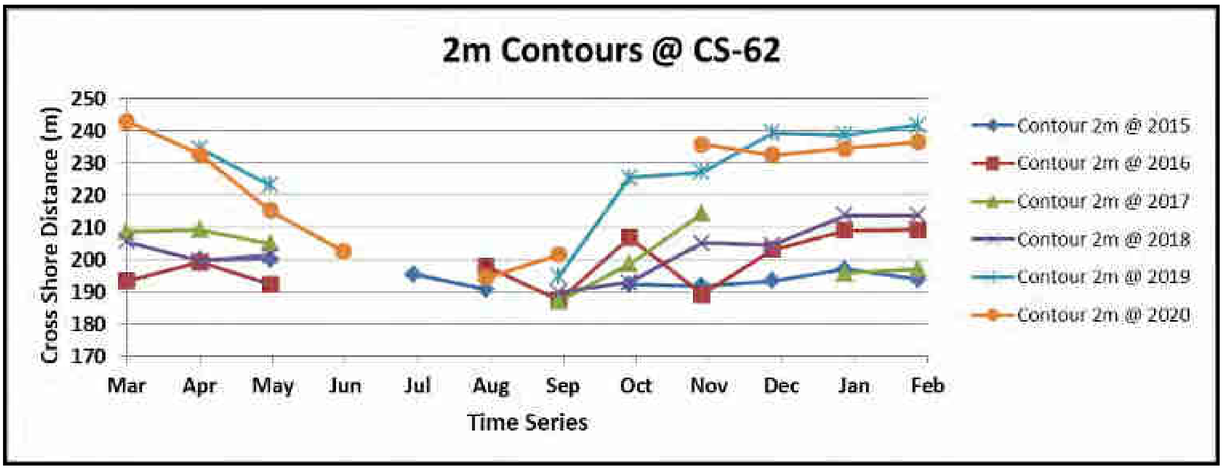
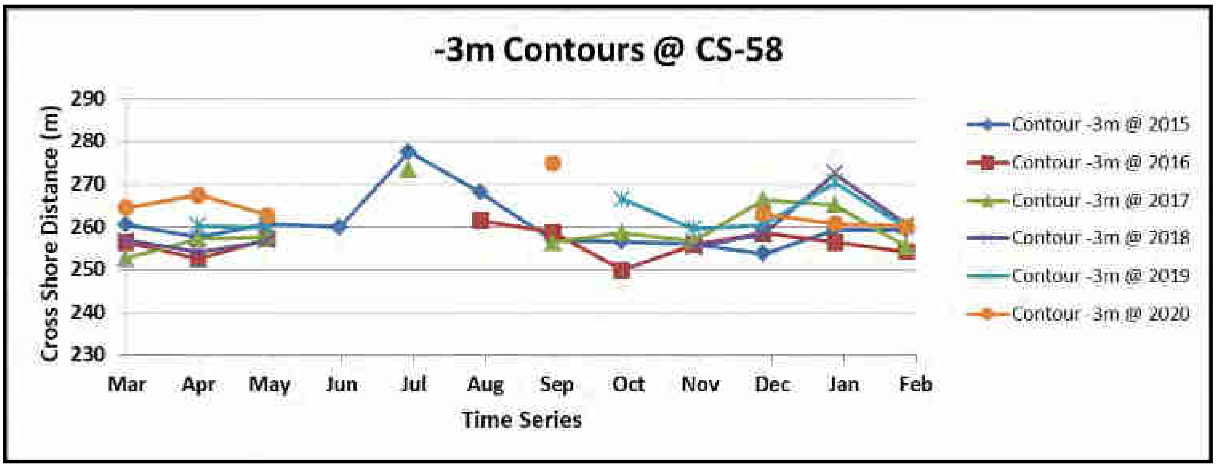


Figure 2-120 Time series of (+) 2 m contour at Beemapally and Cheriyathura (CS 58 & CS 62)



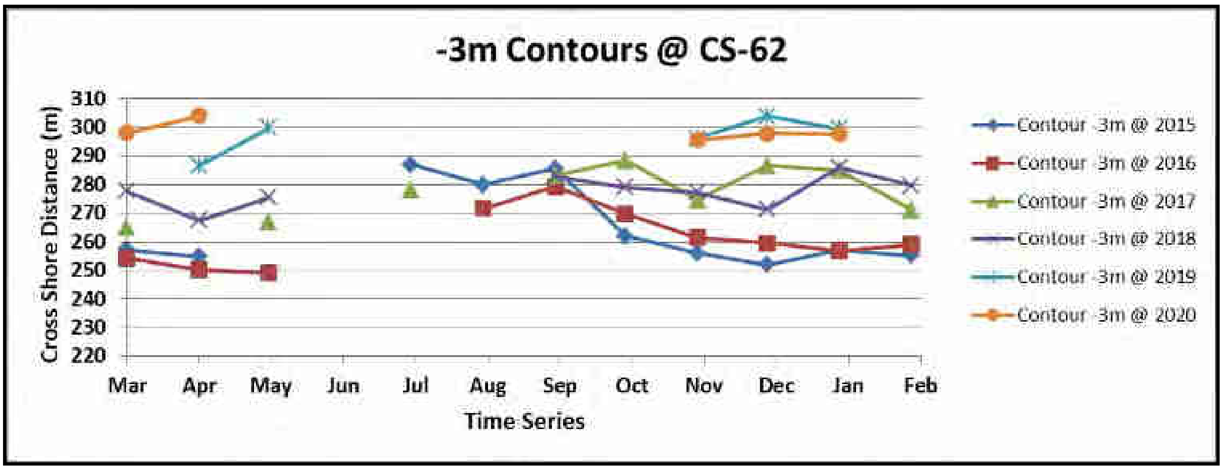


Figure 2-121 Time series of (–) 3 m contour at Beemapally and Cheriyathura (CS 58 & CS 62)

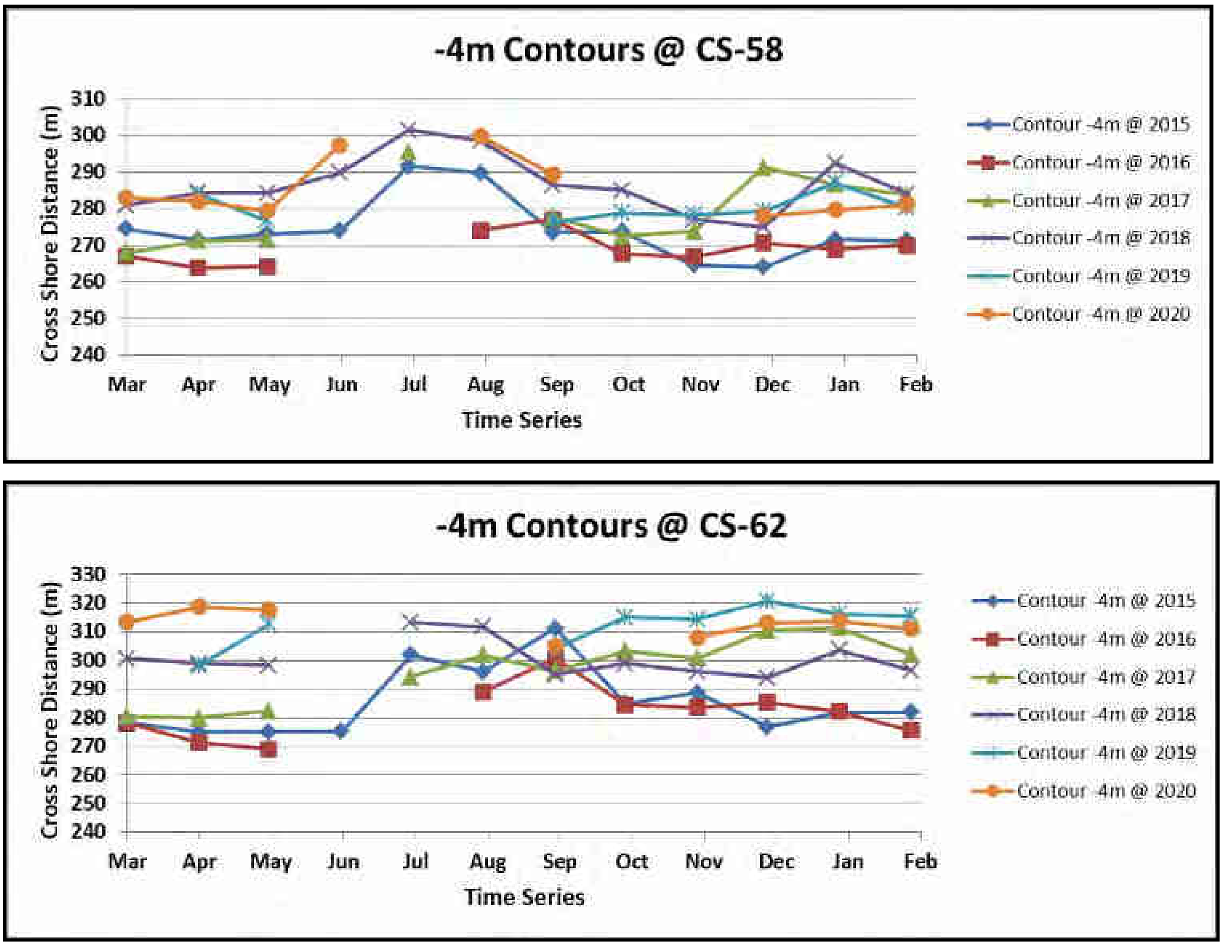
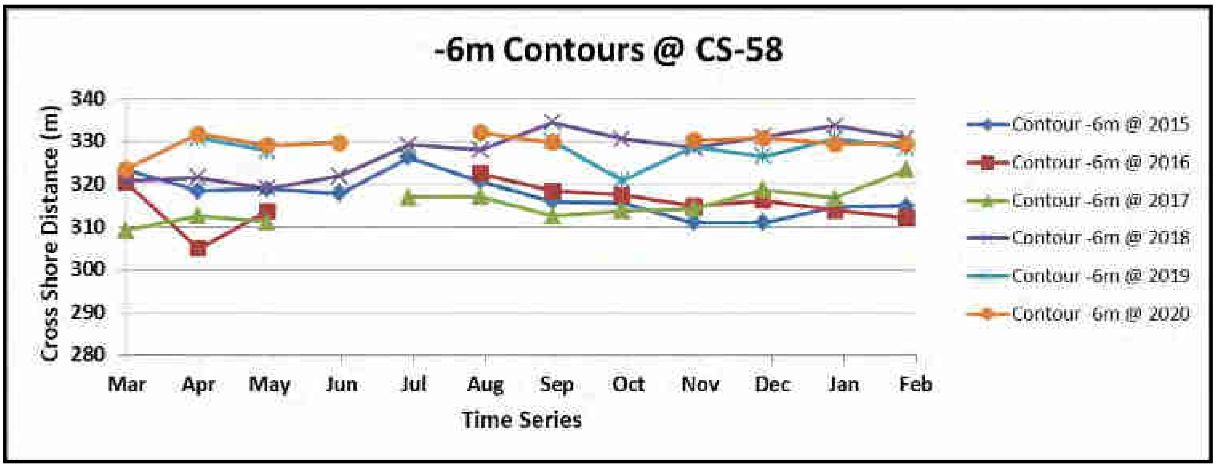


Figure 2-122 Time series of (–) 4 m contour at Beemapally and Cheriyathura (CS 58 & CS 62)



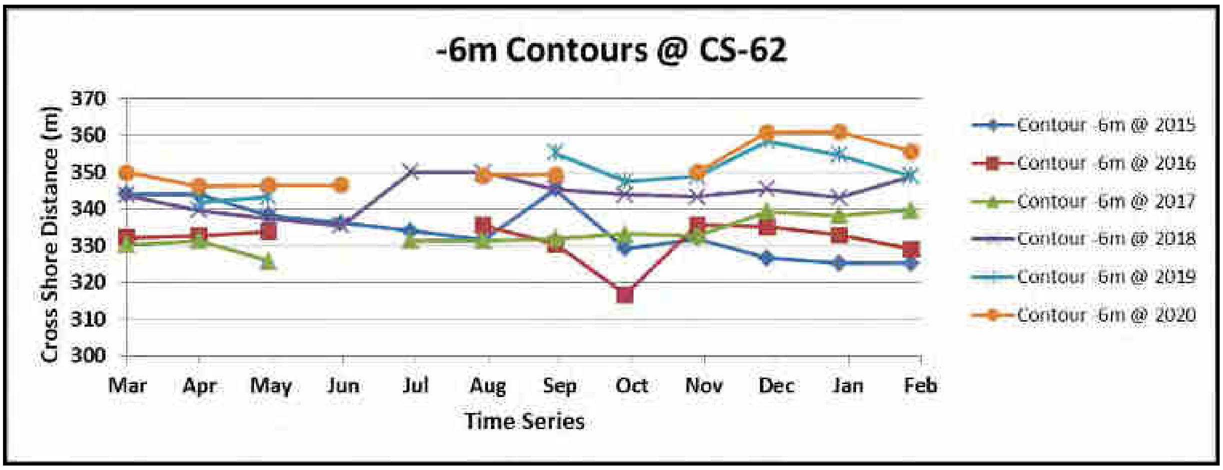
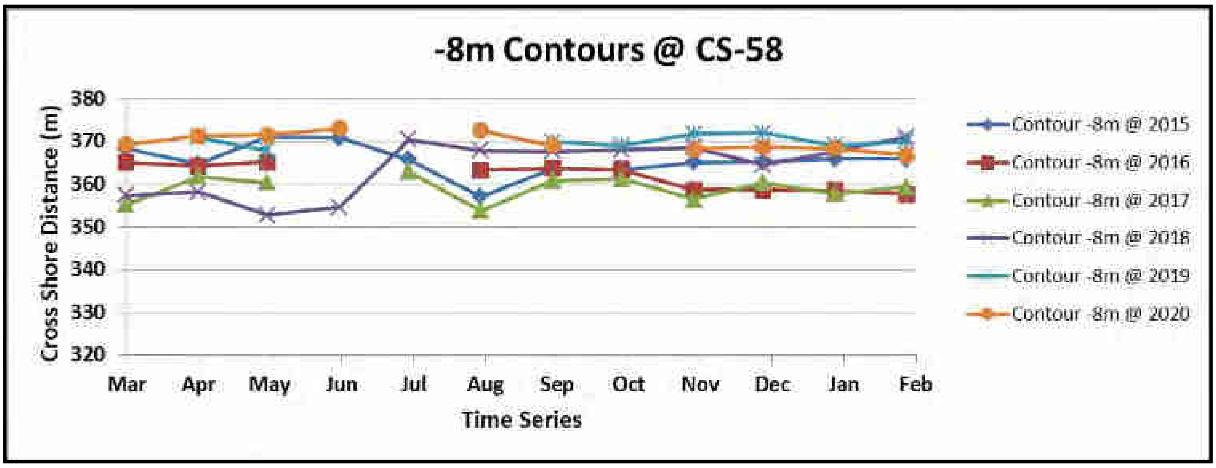


Figure 2-123 Time series of (–) 6 m contour at Beemapally and Cheriyathura (CS 58 & CS 62)



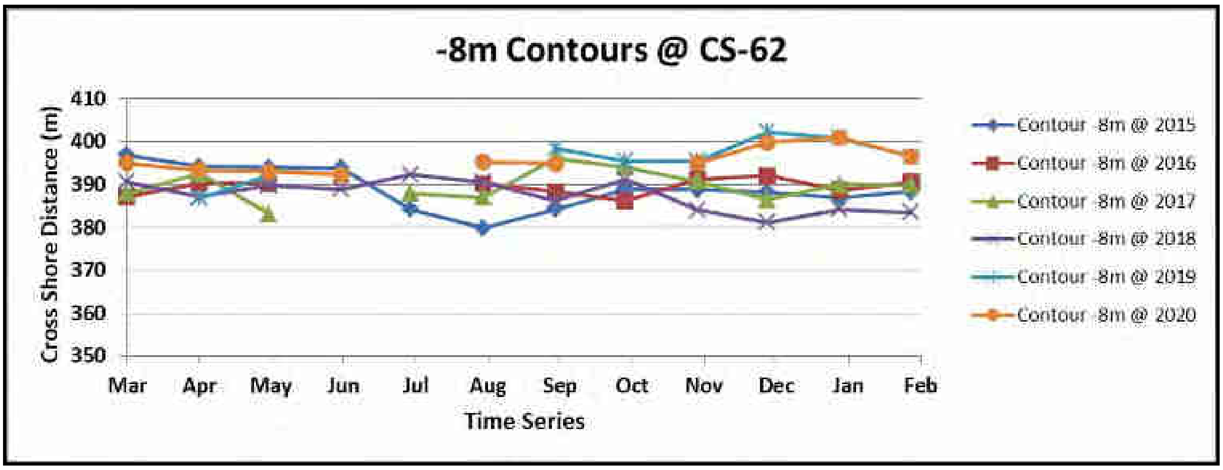
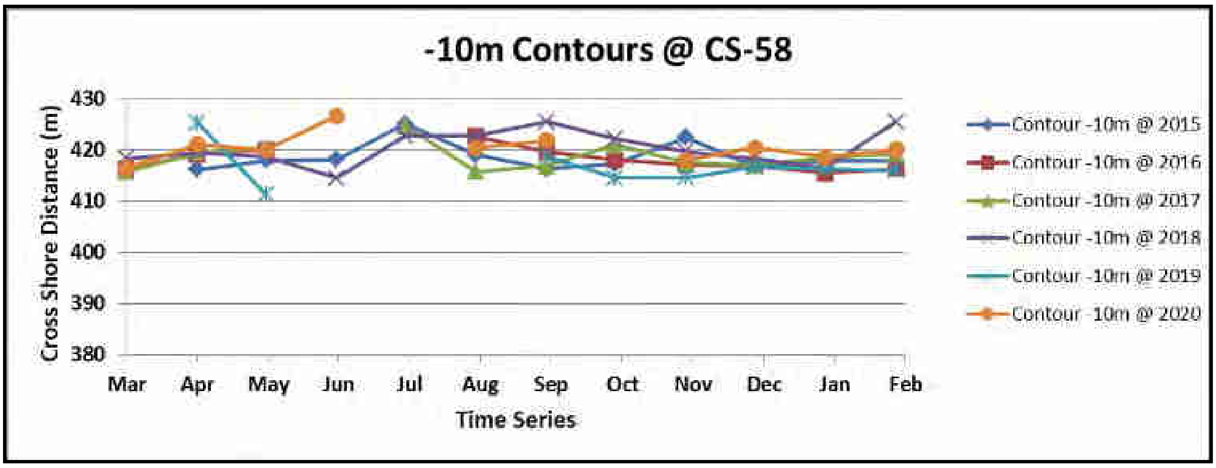


Figure 2-124 Time series of (–) 8 m contour at Beemapally and Cheriyathura (CS 58 & CS 62)



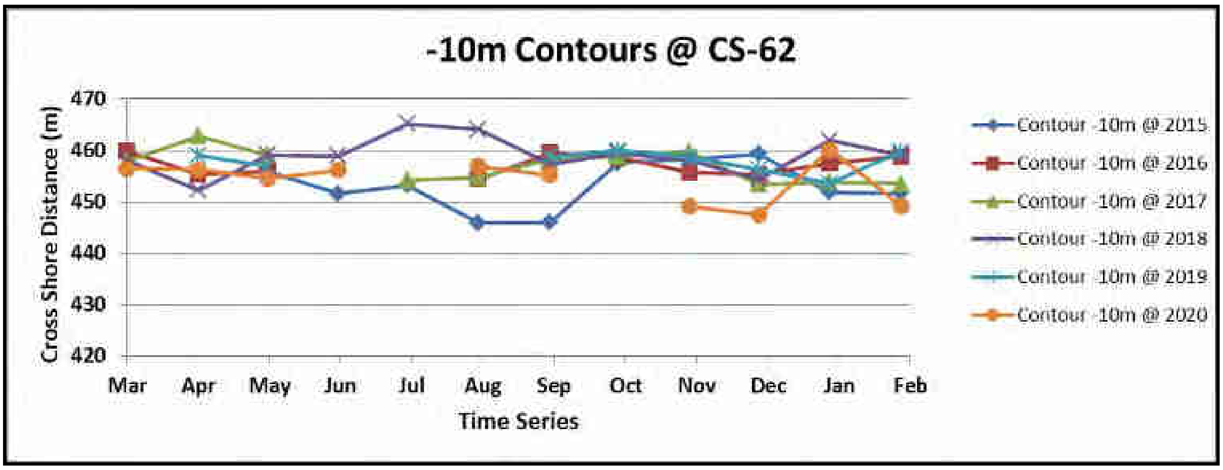
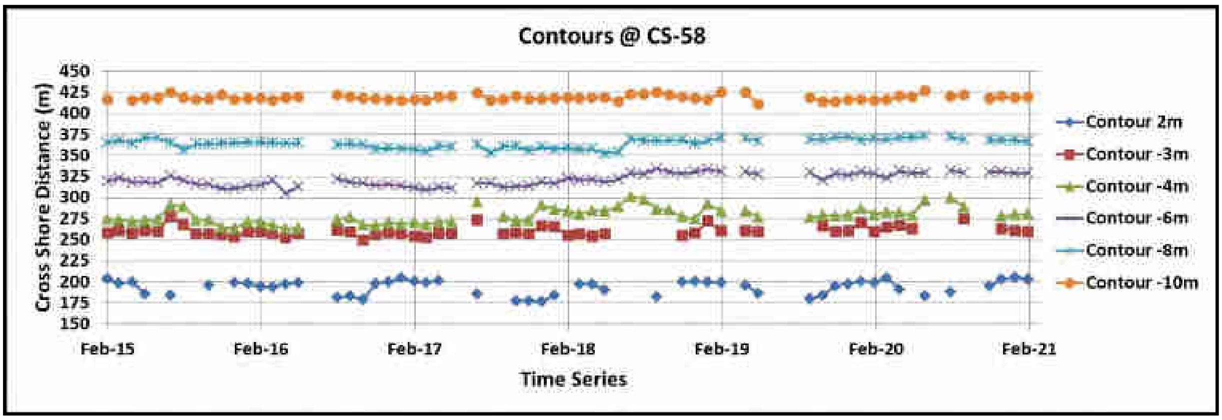


Figure 2-125 Time series of (–) 10 m contour at Beemapally and Cheriyathura (CS 58 & CS 62)

In addition to above, the +2m, -3m, -4m, -6m, -8m and -10m contours continuous variation of contour distances over 6 years was provided for better clarity as shown in Figure 2-126.



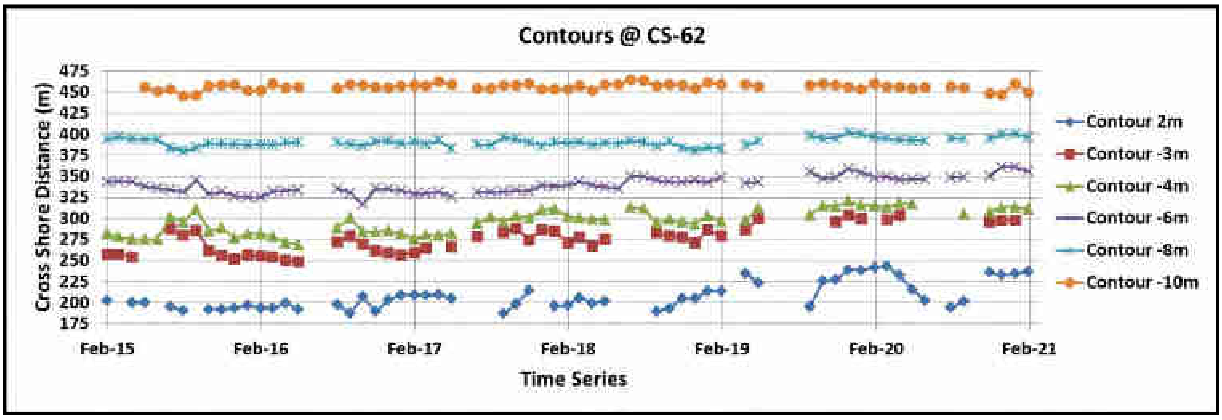


Figure 2-126 Continuous time series of contours at Beemapally and Cheriyathura (CS 58 & CS 62)

2.7.2.6 Stretch 6

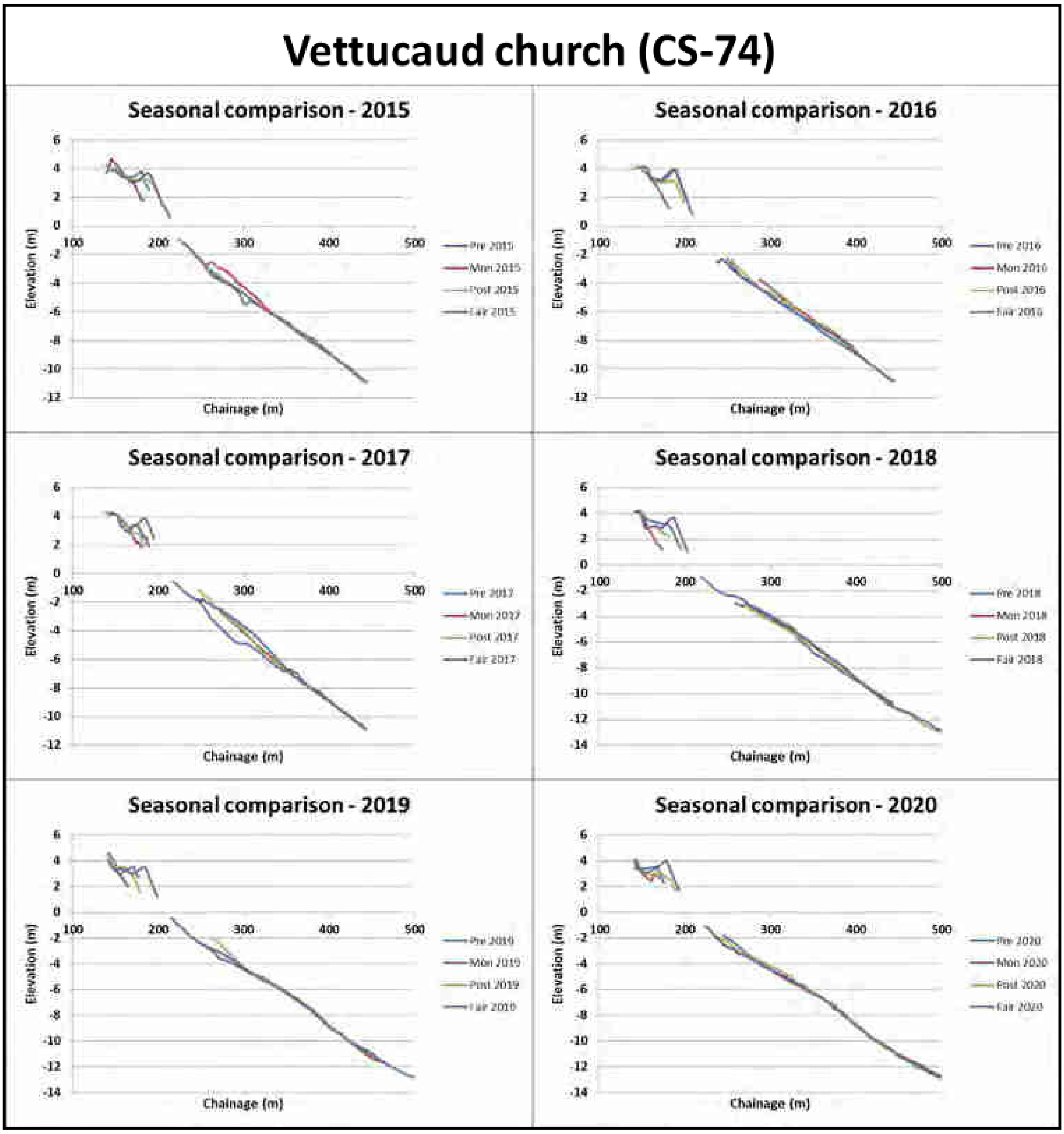


Figure 2-127 Profiles at Vettucaud (CS 74) – Seasonal comparison

Beach was present throughout the year in the stretch of CS 66 to CS 81. Among these sections, CS 74 which is at Vettucaud in Thiruvananthapuram district was chosen to illustrate the seasonal trends over six years. From Figure 2-127, it can be noticed that the coast experience seasonal variations over a year. The general phenomenon seems to be stable beach during pre-monsoon seasons, beach erosion and deposition in offshore region during monsoon seasons and gradual beach build up during post monsoon & fair weather seasons whereas in 2017 the coast experienced a very severe cyclonic storm (IMD Classification) named Ockhi (December 2017) during fair weather season and resulted in severe erosion all along the coast. After Ockhi the erosion was noticed during fair weather 2017 and pre monsoon 2018 seasons on land side. Recently, this has been compounded by the prevalence of the higher events related to storms.

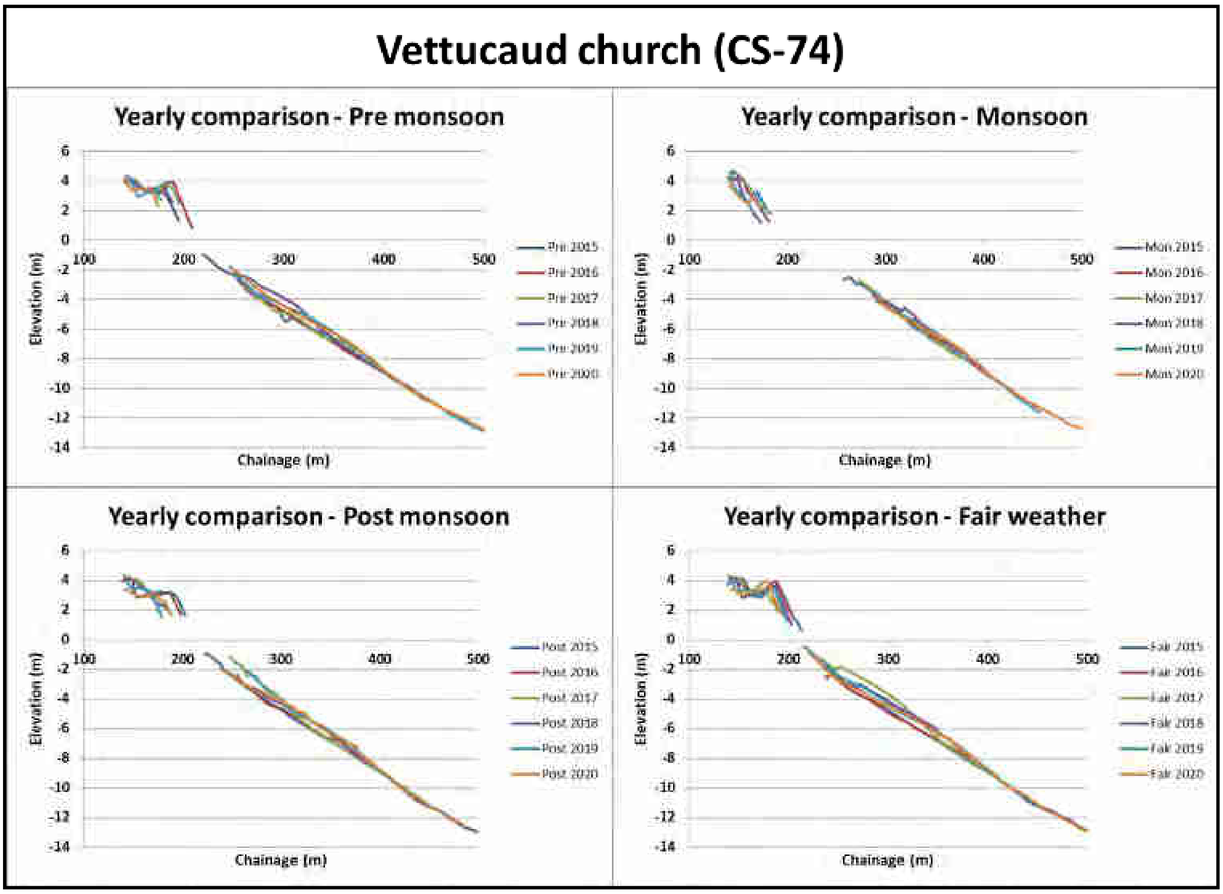


Figure 2-128 Profiles at Vettucaud (CS 74) – Yearly comparison

Figure 2-128 plots represent comparison of profiles of season over different years. 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 is undergoing processes to recover from this impact which can be observed from fair weather seasons comparison plot.

LNTIEL extracted +2m, -3m, -4m, -6m, -8m and -10m contours from cross shore profile data at Vettucaud and below plots were time series of respective contours over six years data with similar time scale. The plots represent the contour distances with respect to an arbitrary point which is constant for all profiles at a cross section.

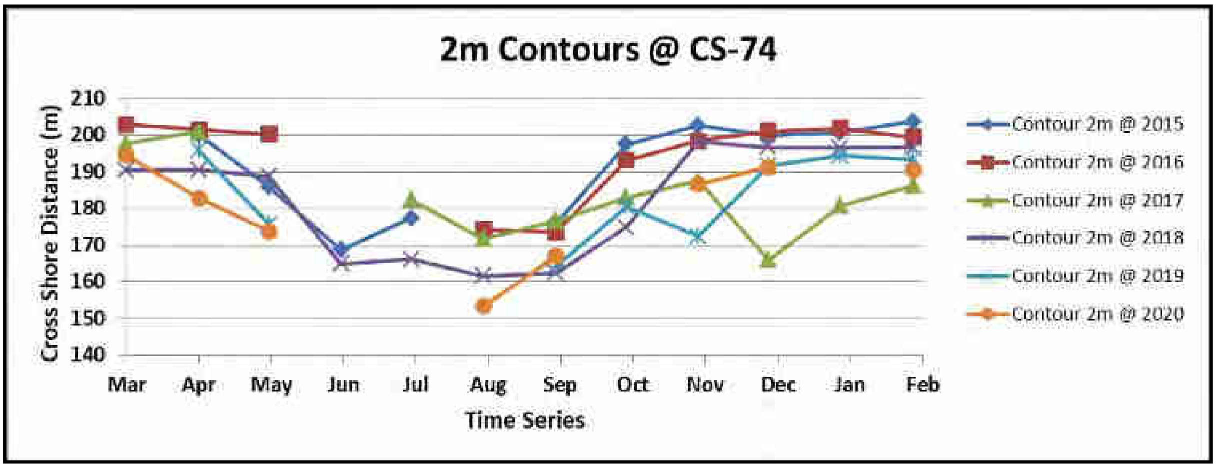


Figure 2-129 Time series of (+) 2 m contour at Vettucaud (CS 74)

Figure 2-129 was time series of (+) 2 m contour over six years at Vettucaud with similar time scale. From this plot it can be noticed that the beach experience seasonal variation of erosion during monsoon season and accretion during other seasons. During Ockhi the beach was exposed to severe erosion and minimal accretion was noticed during fair weather 2017 and pre-monsoon 2018 during which beach was supposed to build up. In addition, because of monsoon 2018 and 2019 the beach further eroded than previous monsoon seasons. The recent storms are proving to be further detrimental to the beach accretion.

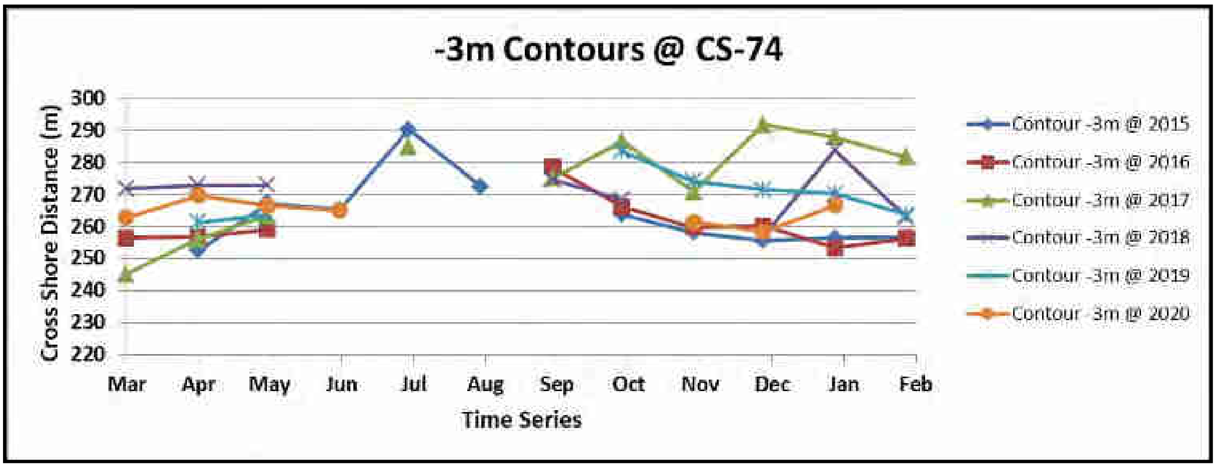


Figure 2-130 Time series of (–) 3 m contour at Vettucaud (CS 74)

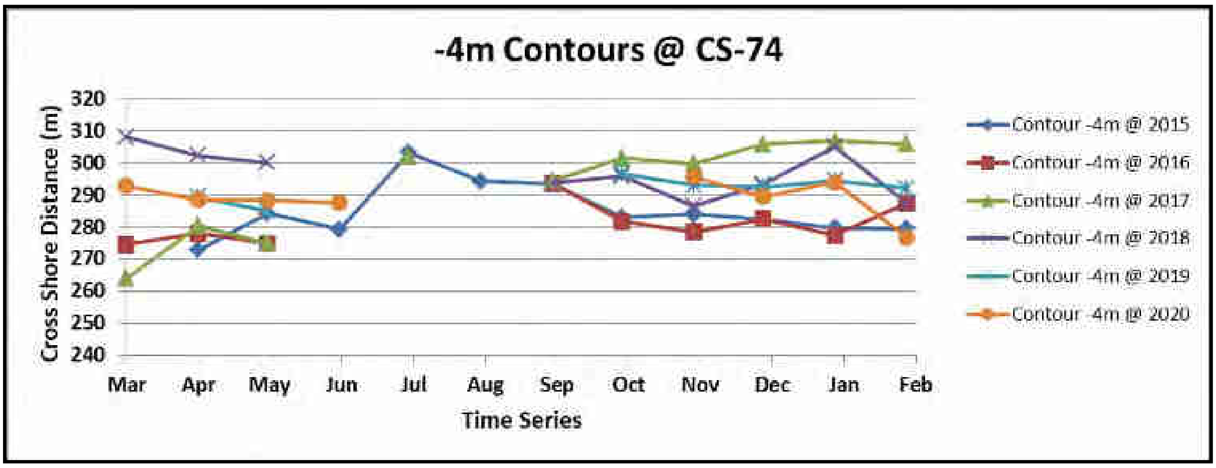


Figure 2-131 Time series of (–) 4 m contour at Vettucaud (CS 74)

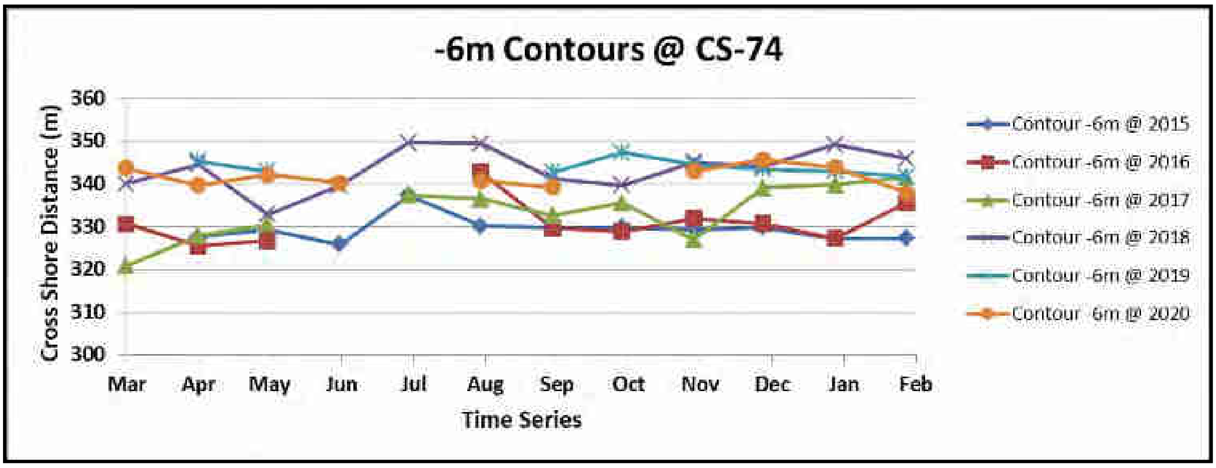


Figure 2-132 Time series of (–) 6 m contour at Vettucaud (CS 74)

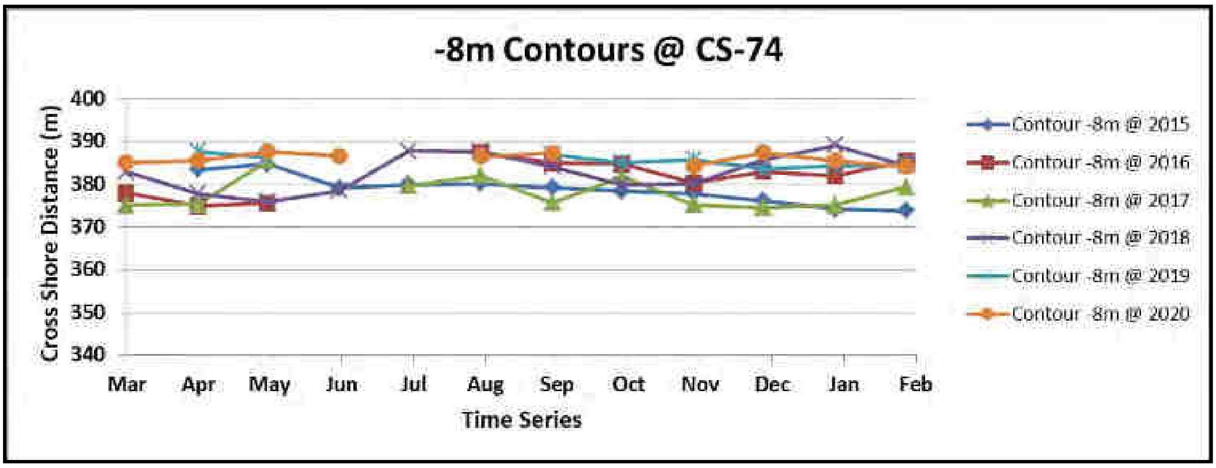


Figure 2-133 Time series of (–) 8 m contour at Vettucaud (CS 74)

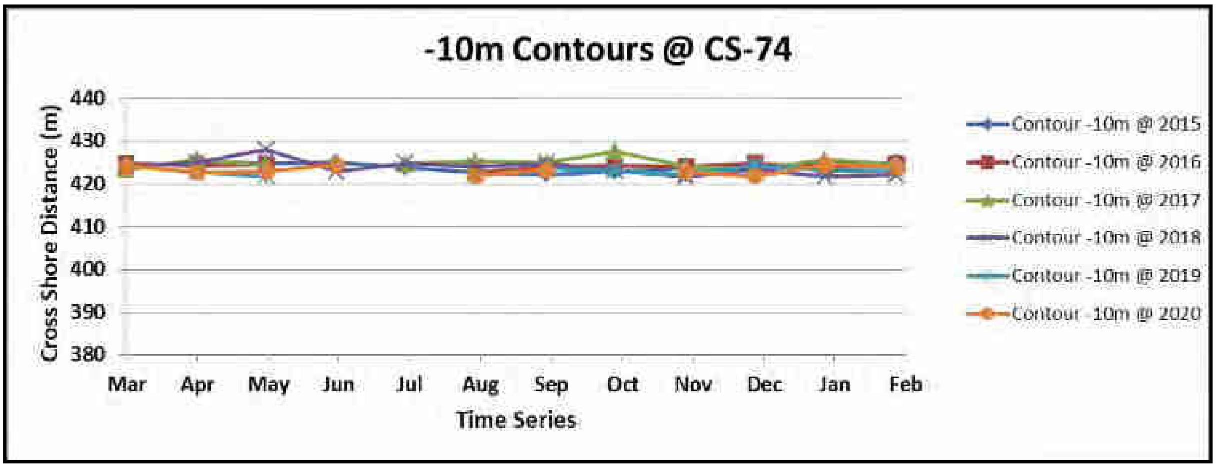


Figure 2-134 Time series of (–) 10 m contour at Vettucaud (CS 74)

In addition to above, the +2m, -3m, -4m, -6m, -8m and -10m contours continuous variation of contour distances over 6 years was provided for better clarity as shown in Figure 2-135.

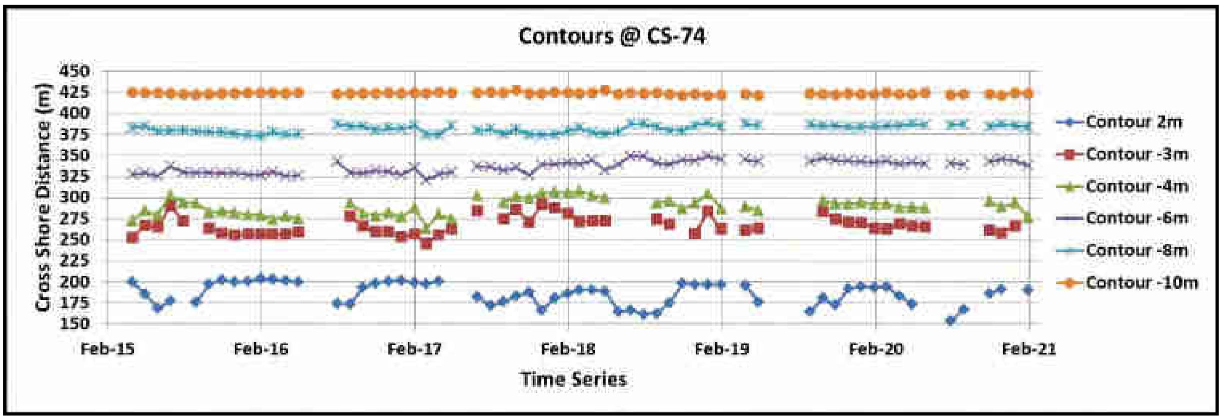


Figure 2-135 Continuous time series of contours at Vettucaud (CS 74)

Figure 2-135 shows the variation of respective contour distances from common arbitrary point on land side. It can be observed that most of the sediment exchange was in between +2m and -3m contours i.e. simultaneous erosion on beach side & accretion on sea side and vice versa. This phenomenon in turn indicates that cross shore transport is predominant in this stretch.

2.7.3 Alongshore comparison of contour differences

Fair weather season is the best time to compare the coasts as there will not be 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 alongshore scenario of the coast.

Figure 2-136 to Figure 2-141 show the variation of contours with respect to contours of February 2016. February 2016 was taken as the reference year in this case. Figure 2-142 to Figure 2-147 shows the variation of contours relative to the previous year (yearly rates).

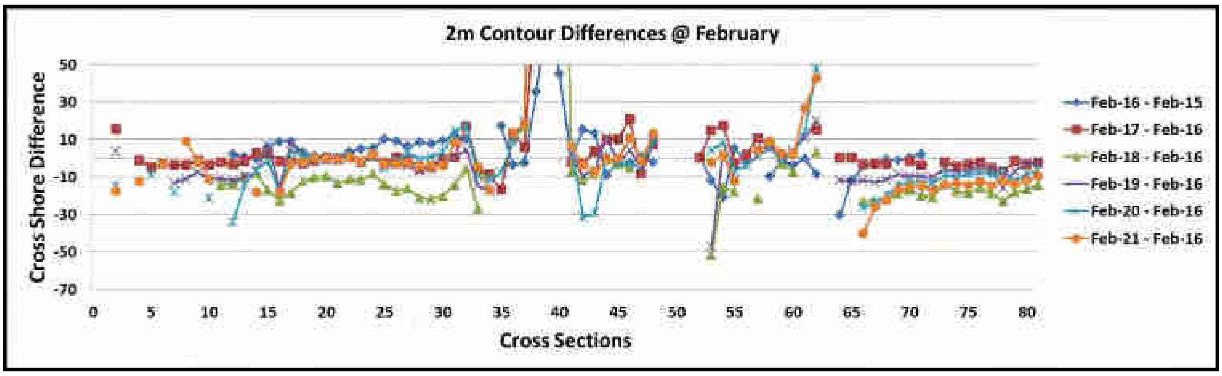


Figure 2-136 Alongshore comparison of (+) 2m contour differences during February

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 of the cross sections which could be due to inaccessibility or protest and these values were not interpolated and left as such.

Figure 2-136 shows the comparison of difference of (+) 2m contour of February 2016 with reference to February 2015. As February 2015 data consists of 61 locations and there was minimal variation between February 2016 and February 2015 (Blue line), February 2016 was considered as baseline for this analysis and remaining series are comparison of differences of (+) 2m contour of February months with reference to February 2016. Green line represents the alongshore scenario of coast after Ockhi cyclone. It can be seen from this plot that the coast experienced severe erosion. Violet, Cyan and orange lines represent the alongshore scenario of coast post Ockhi cyclone (subsequent years). The stretch south of Poovar River mouth is still in transition and stretch north of Poovar River mouth to Adimalathura seems to be recovered from Ockhi cyclone impact. Near Valiyathura pier there was accretion on south of groyne and erosion on north of groyne which seems to be natural phenomenon due to construction of groyne.

Similarly, -3m, -4m, -6m, -8m and -10m contour differences were shown in Figure 2-137 to Figure 2-141.

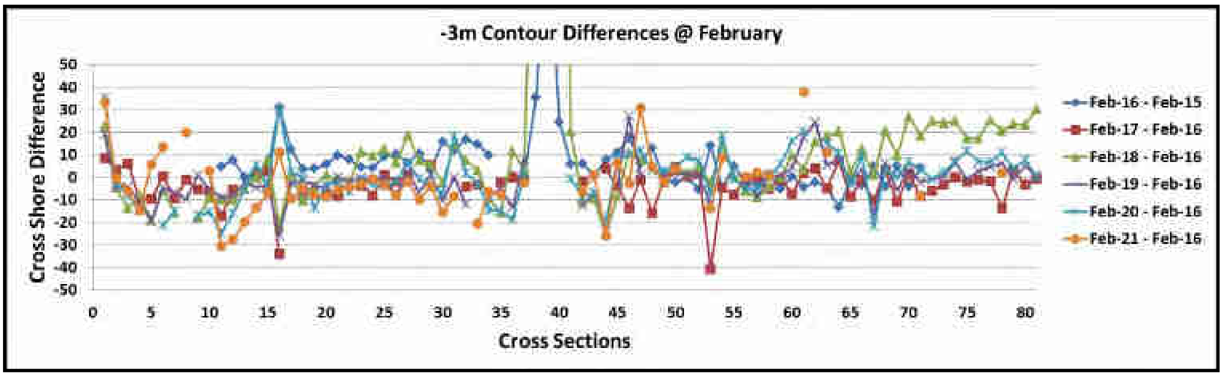


Figure 2-137 Alongshore comparison of (-) 3m contour differences during February

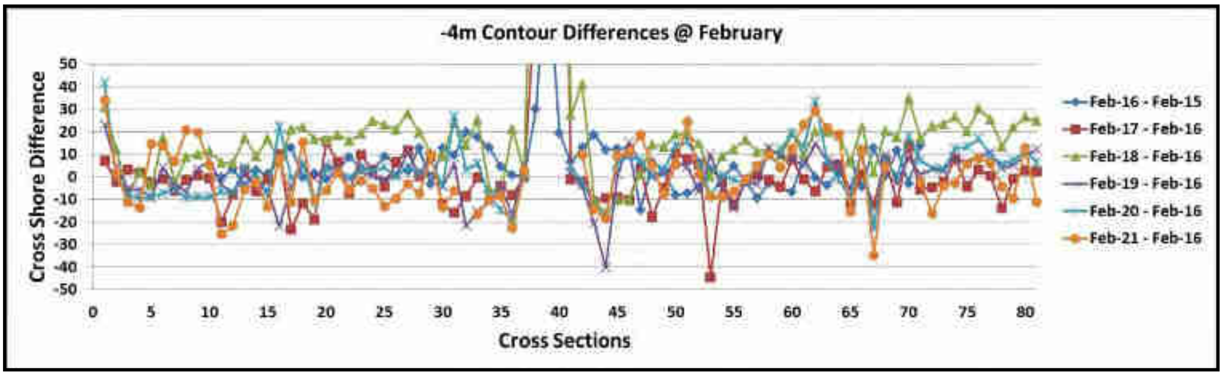


Figure 2-138 Alongshore comparison of (-) 4m contour differences during February

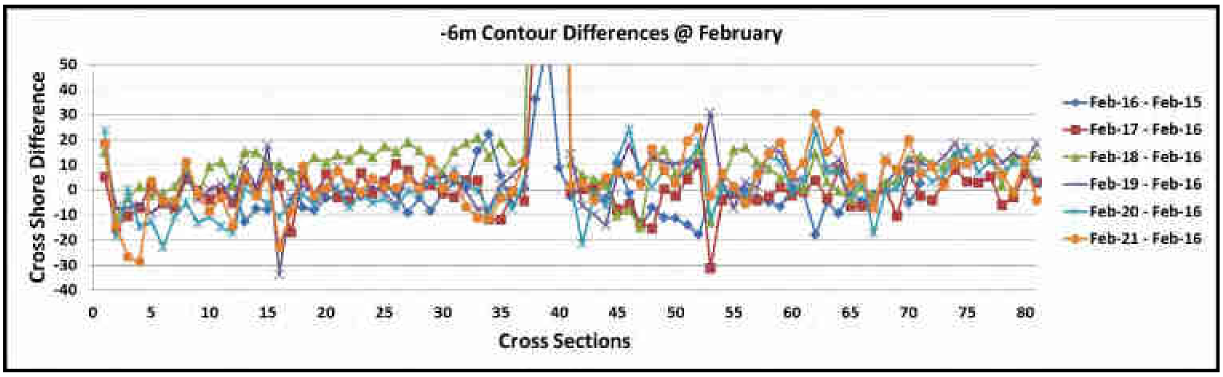


Figure 2-139 Alongshore comparison of (-) 6m contour differences during February

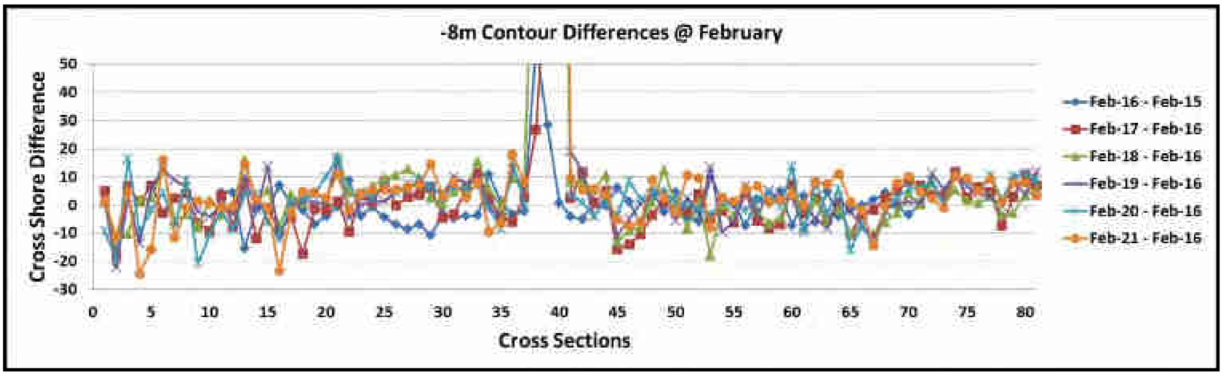


Figure 2-140 Alongshore comparison of (-) 8m contour differences during February

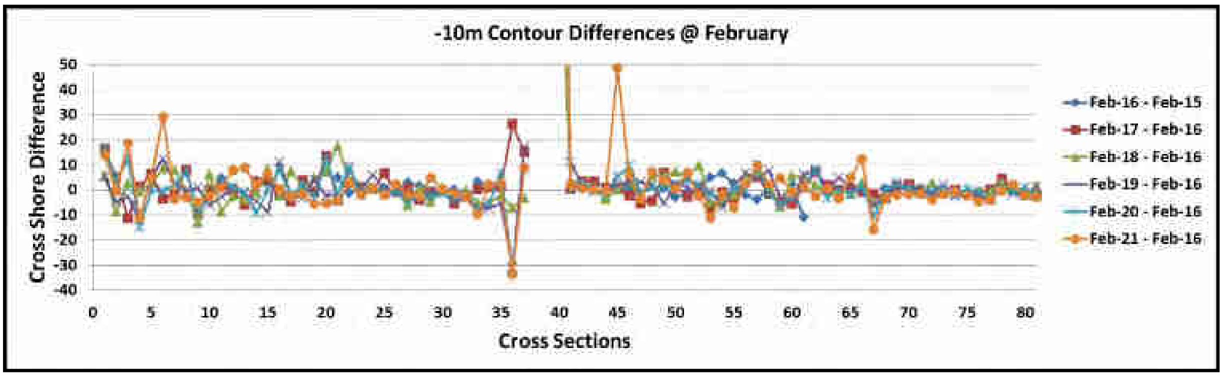


Figure 2-141 Alongshore comparison of (-) 10m contour differences during February

2.7.4 Alongshore comparison of contour yearly rates

LNTIEL analysed the yearly rates during February month. Figure 2-142 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). Post Ockhi coast experienced seasonal variations and rates can be noticed from Feb-19 – Feb-18 series (Violet) and Feb-20 – Feb-19 series (Cyan). From these we can observe that the yearly rate of 2018-2019 year was high along the coast compared to previous years probably because the coast was in the process to attain its stable or equilibrium position. In the period of March 2019 to February 2021 the rates were almost similar to pre Ockhi scenario.

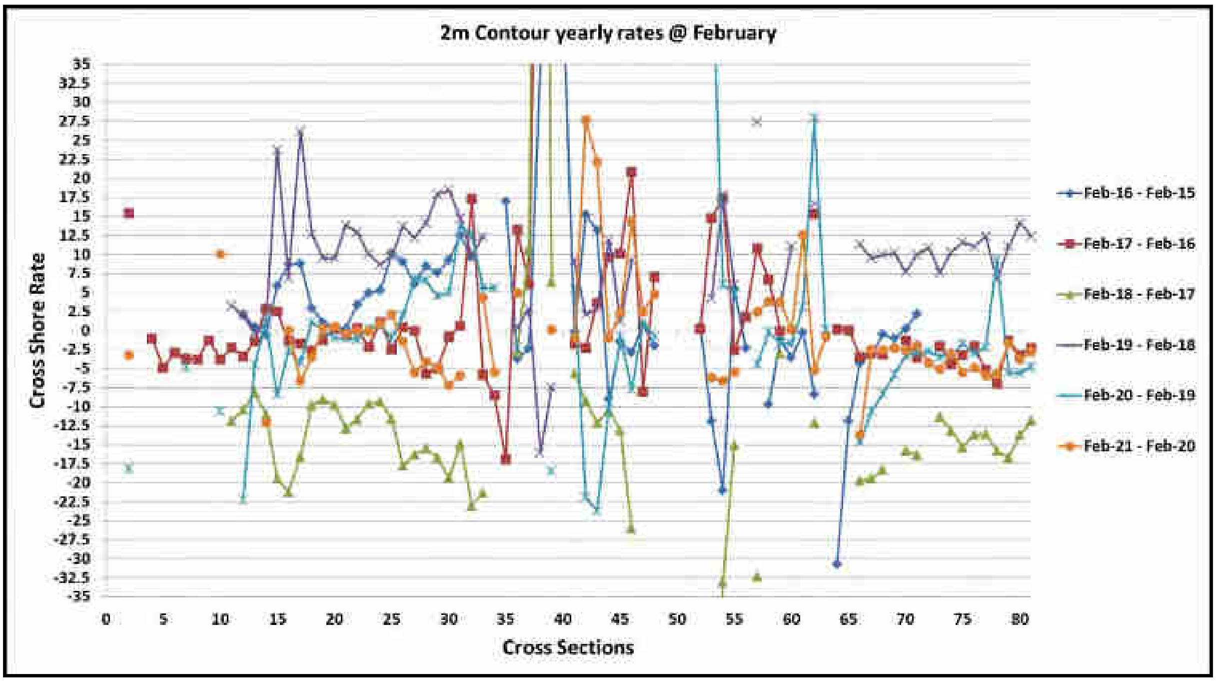


Figure 2-142 Alongshore comparison of (+) 2m contour yearly rates during February

Similarly, -3m, -4m, -6m, -8m and -10m contour differences are shown in Figure 2-143 to Figure 2-147.

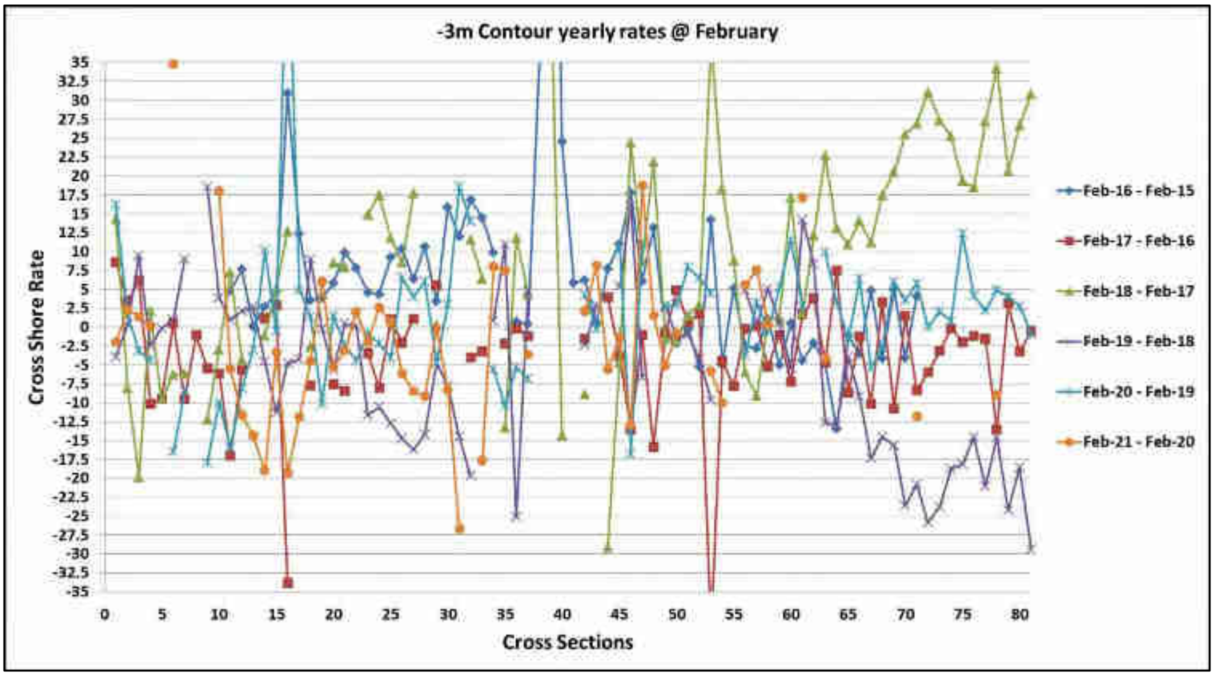


Figure 2-143 Alongshore comparison of (-) 3m contour yearly rates during February

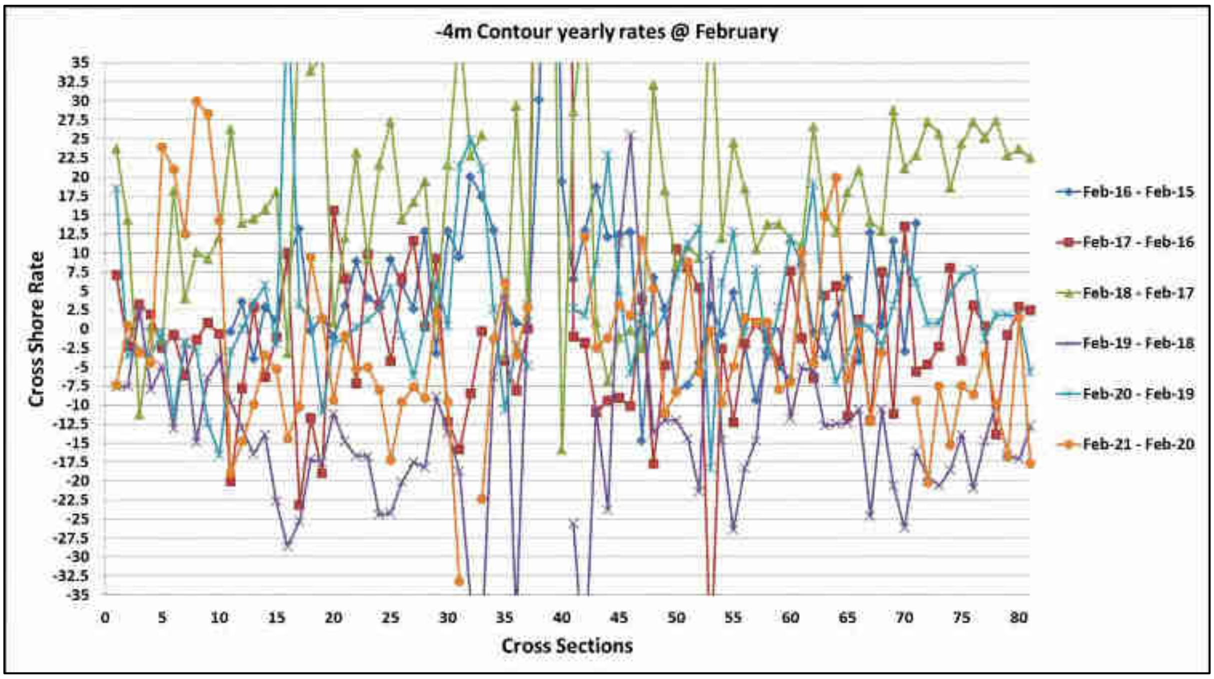


Figure 2-144 Alongshore comparison of (-) 4m contour yearly rates during February

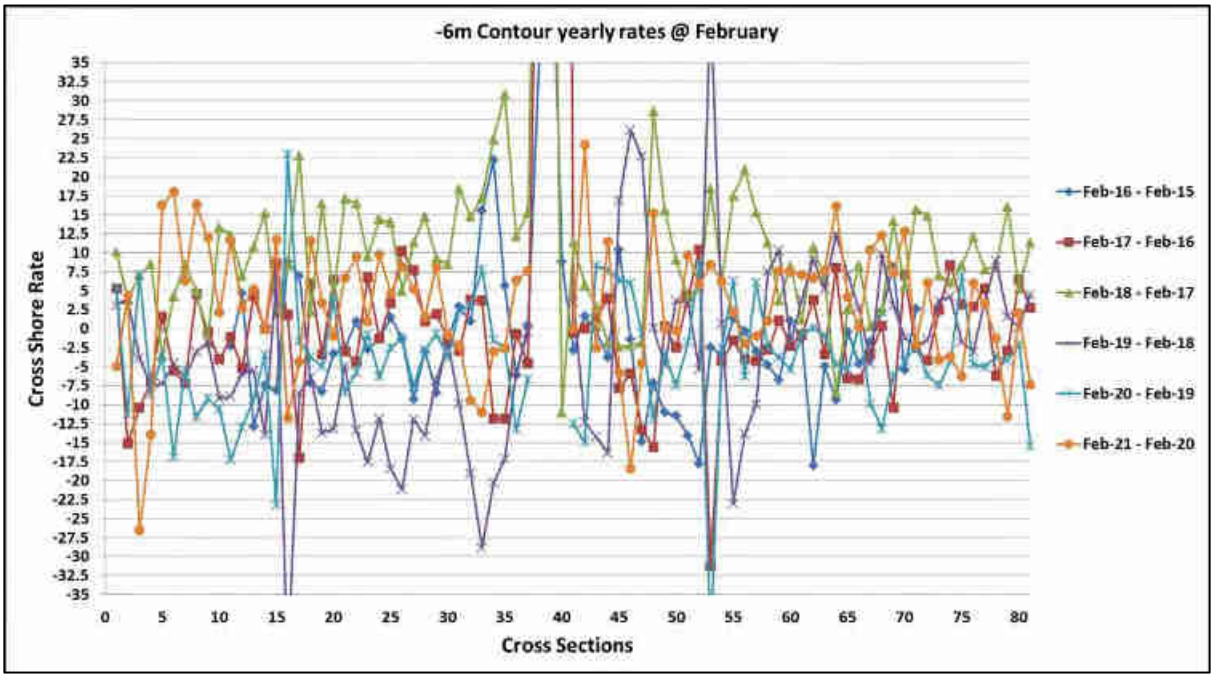


Figure 2-145 Alongshore comparison of (-) 6m contour yearly rates during February

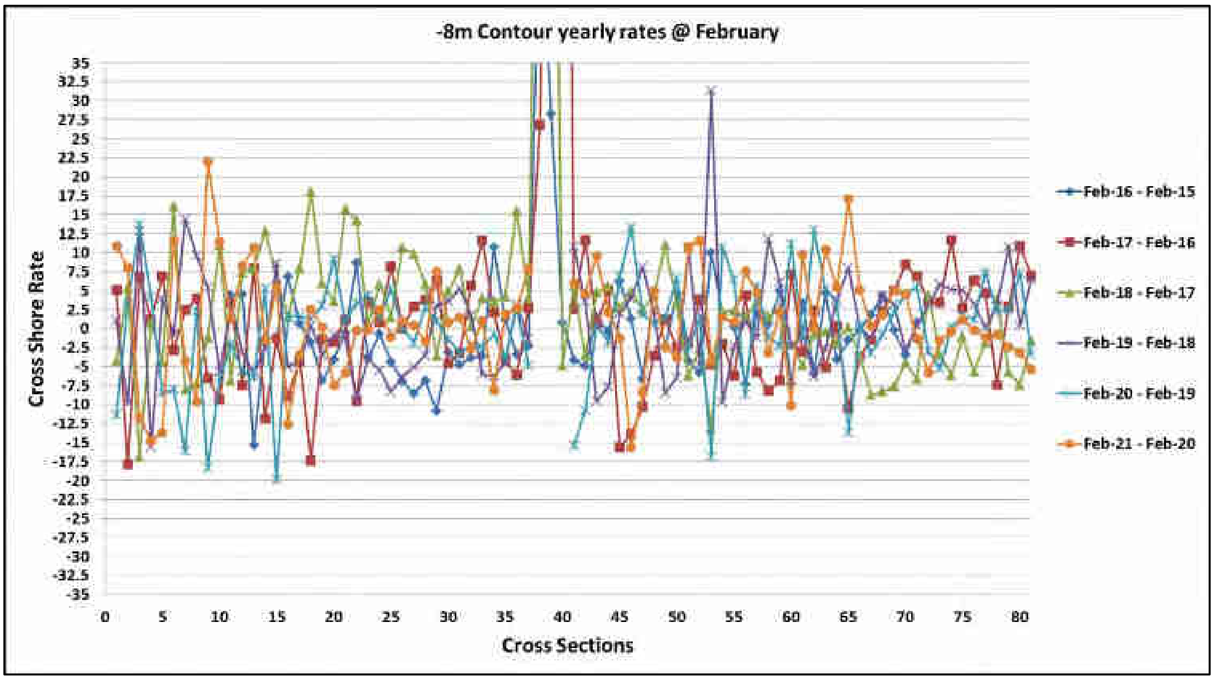


Figure 2-146 Alongshore comparison of (-) 8m contour yearly rates during February

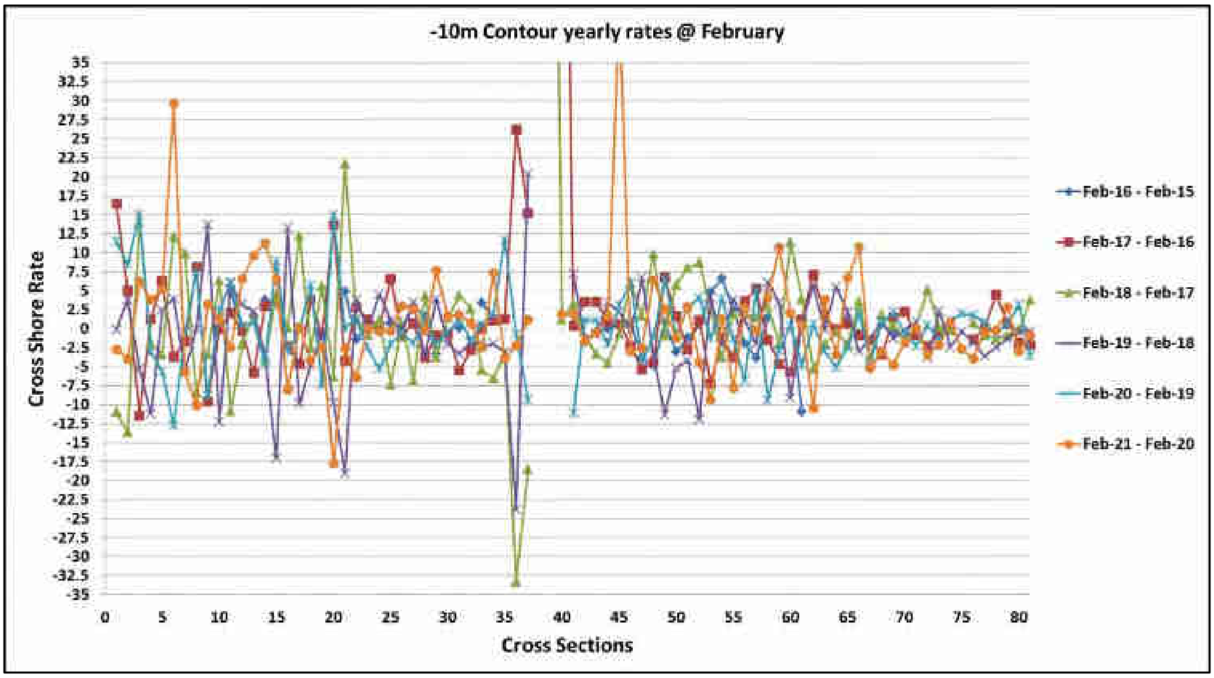


Figure 2-147 Alongshore comparison of (-) 10m contour yearly rates during February

2.7.5 Assessment of depth of closure

The term depth of closure, hereafter DoC, is a fundamental concept used to define the most landward depth of seaward beyond which there is no significant change in bottom elevation and no significant net sediment exchange between nearshore and offshore for a given time interval. The references to this study were taken from publications such as "Morang A., Birkemeier W.A. (2005) Depth of Closure on Sandy Coasts. In: Schwartz M.L. (eds) Encyclopedia of Coastal Science. Encyclopedia of Earth Science Series. Springer, Dordrecht."

To assess the DoC, the surveyed profiles at a particular location were averaged and standard deviation of profile was derived using statistics. Standard deviation is a measure of the degree of dispersion of points from its mean i.e. lower the dispersion better is the convergence. However, expectation of zero-meter dispersion from its mean may not be realistic approach because there can be chances of survey related errors. Therefore, threshold of 0.3m deviation from its mean was considered as reasonable limit. Another reason for a threshold value of 0.3m is that the survey errors are in the range on 0.3-0.4m and therefore any deviations below this range may confuse between actual change and survey error.

The average profile and the standard deviation of depths were plotted as function of the offshore distance as shown in Figure 2-148 to Figure 2-156. The respective DoCs are shown in plots with dash lines and their intersection points are also shown.

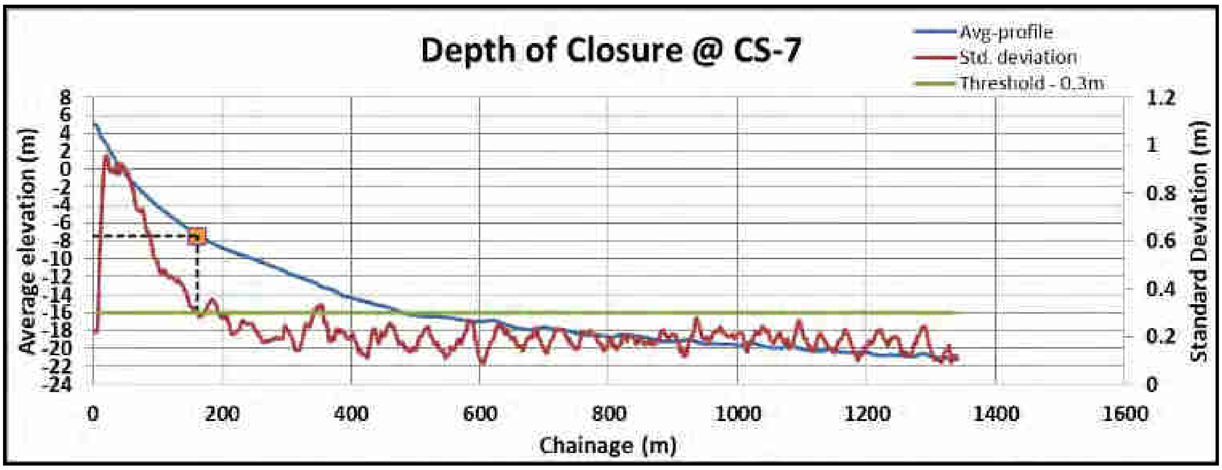


Figure 2-148 Depth of closure at Neerody location (CS 7)

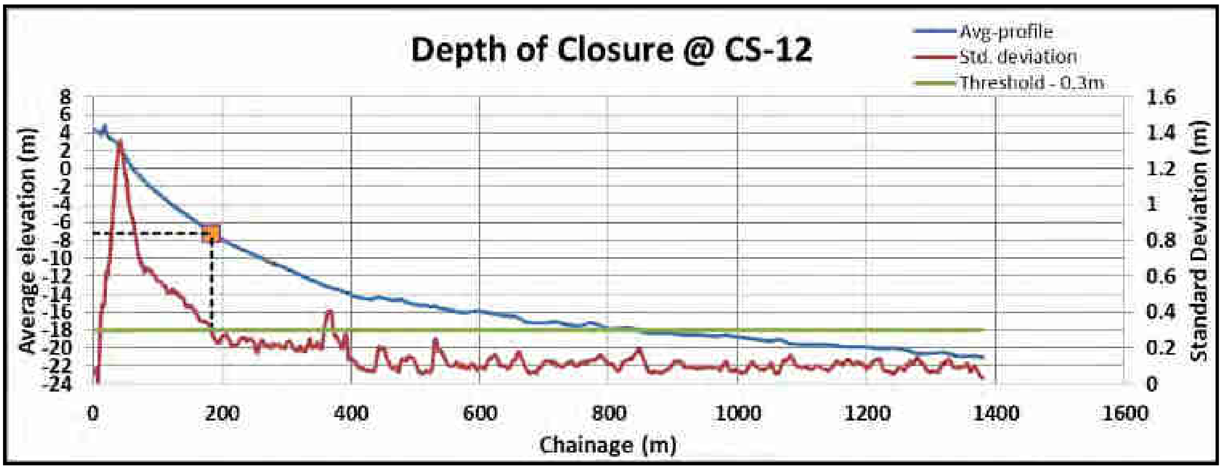


Figure 2-149 Depth of closure at Pozhiyoor location (CS 12)

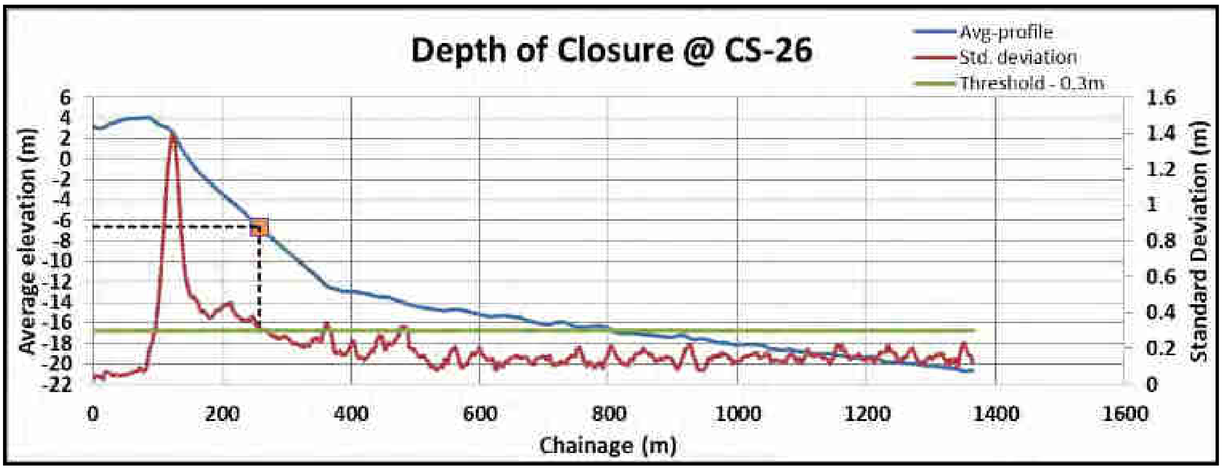


Figure 2-150 Depth of closure at Karumkulam location (CS 26)

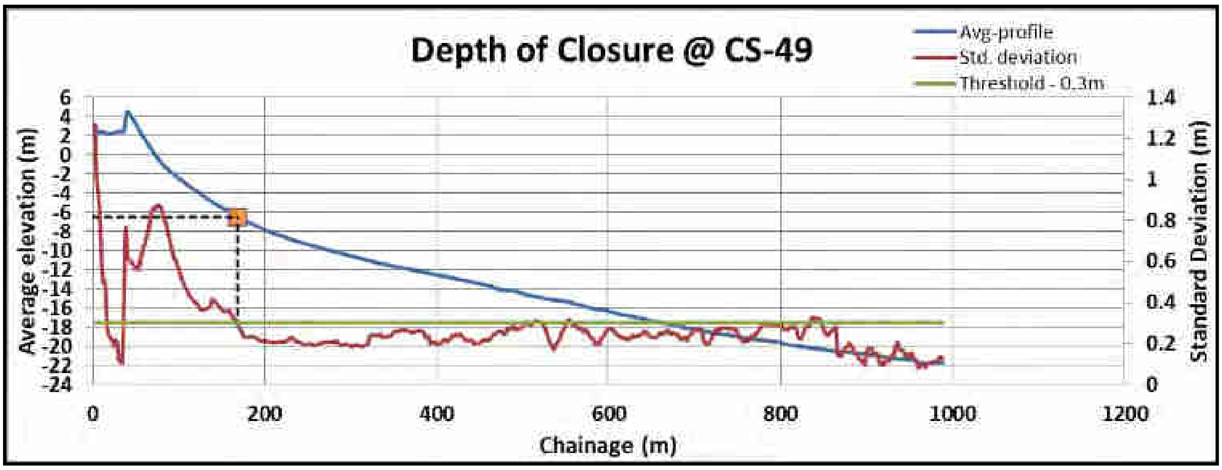


Figure 2-151 Depth of closure at Panathura location (CS 49)

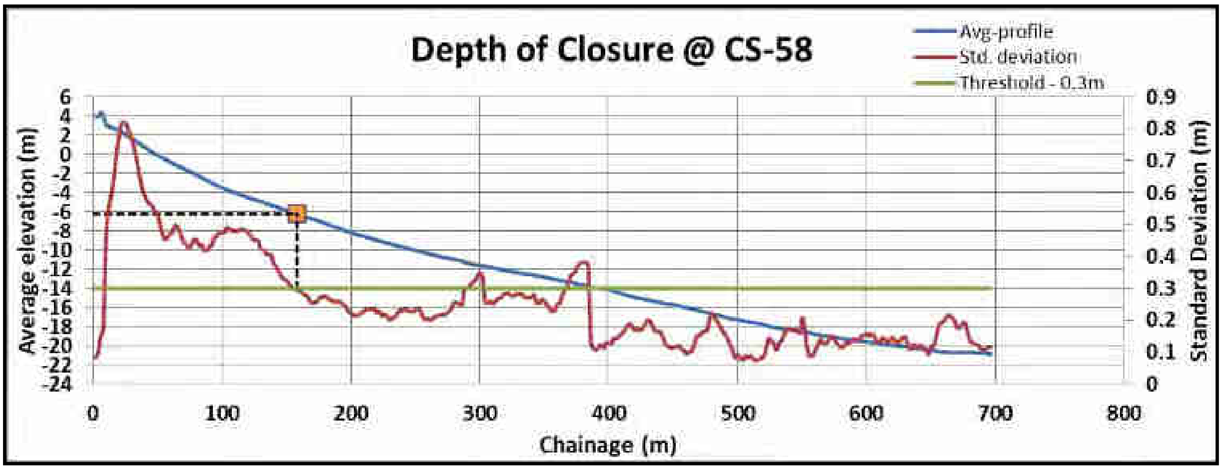


Figure 2-152 Depth of closure at Beemapally location (CS 58)

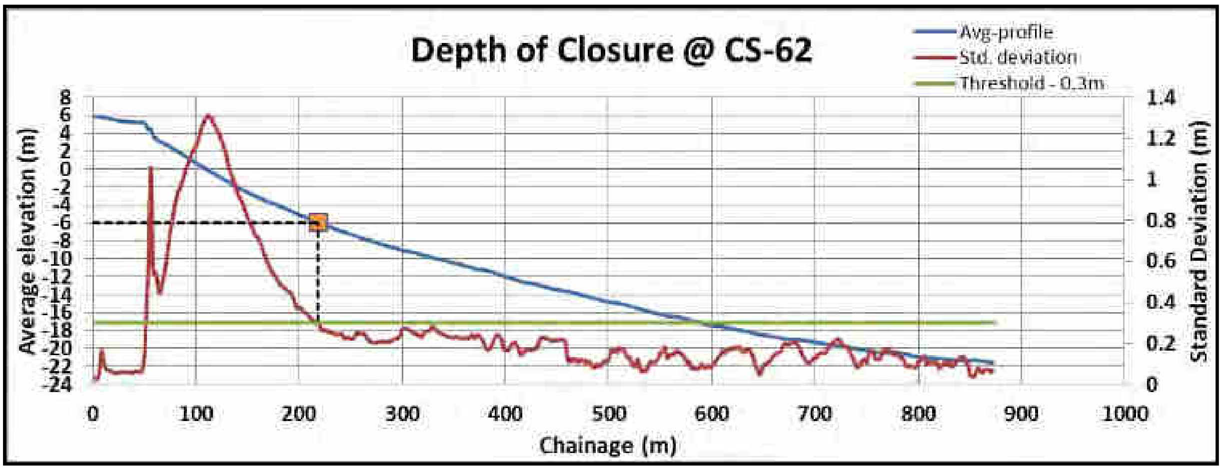


Figure 2-153 Depth of closure at Cheriyathura location (CS 62)

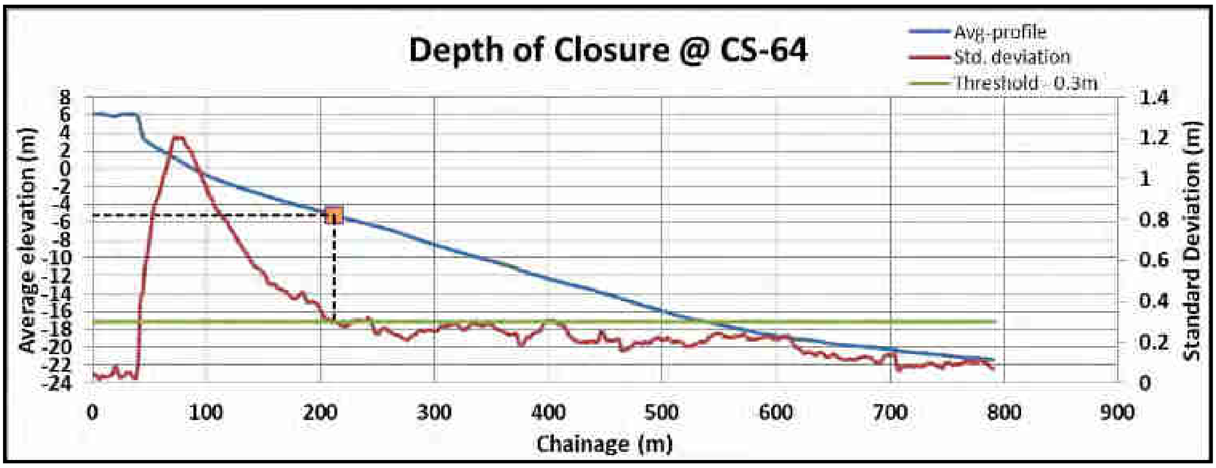


Figure 2-154 Depth of closure at Valiyathura location (CS 64)

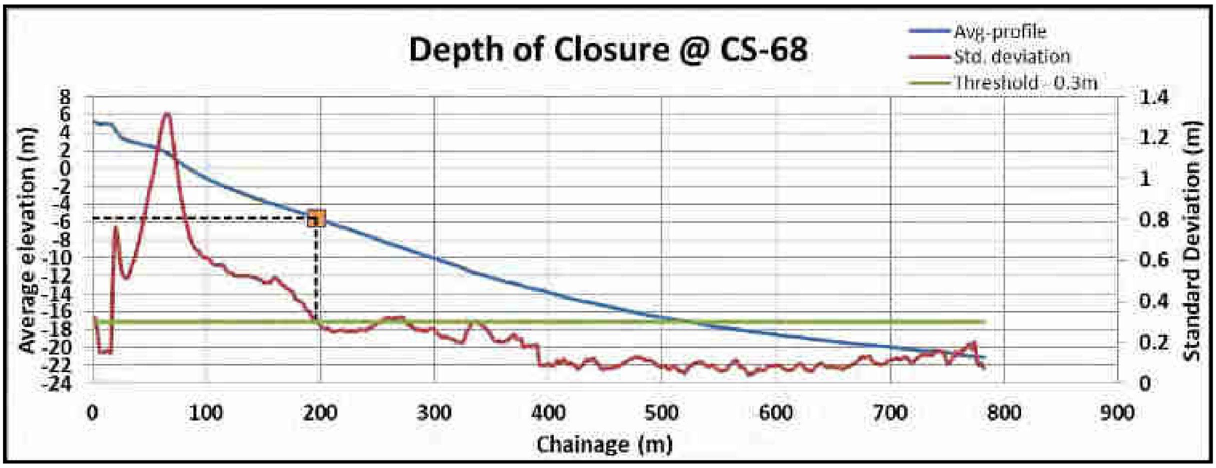


Figure 2-155 Depth of closure at Shangumugham location (CS 68)

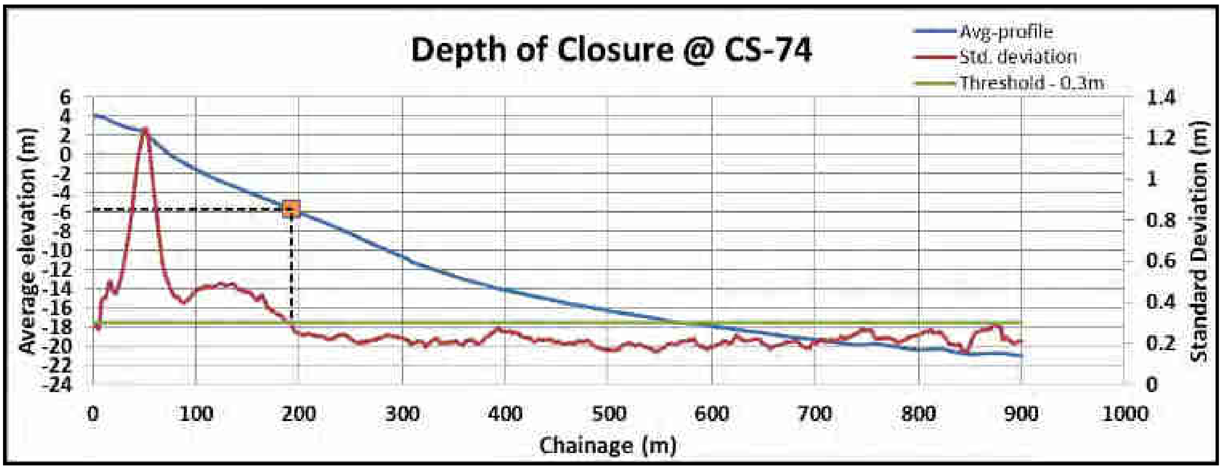


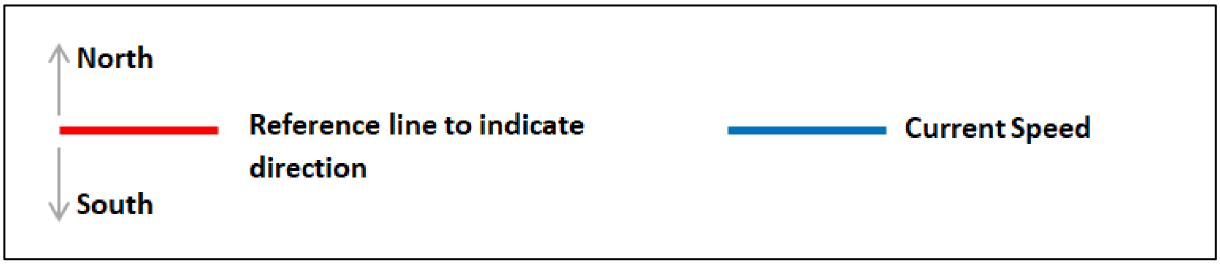
Figure 2-156 Depth of closure at Vettucaud location (CS 74)

2.8 Littoral environment observation

Littoral environment observation (LEO) data was provided by AVPPL at 81 locations. These locations were same as the cross-shore profile locations. In this type of survey, observers obtain monthly visual observations of coastal variables such as current speed, current direction, breaker angle, wave height, wave period and surf zone width.

Analysis was done for the period of February 2015 to February 2021. The focus was given to alongshore current behaviour over months. Some of the observations are shown in Figure 2-157 to Figure 2-174.

Legend of Leo observation charts



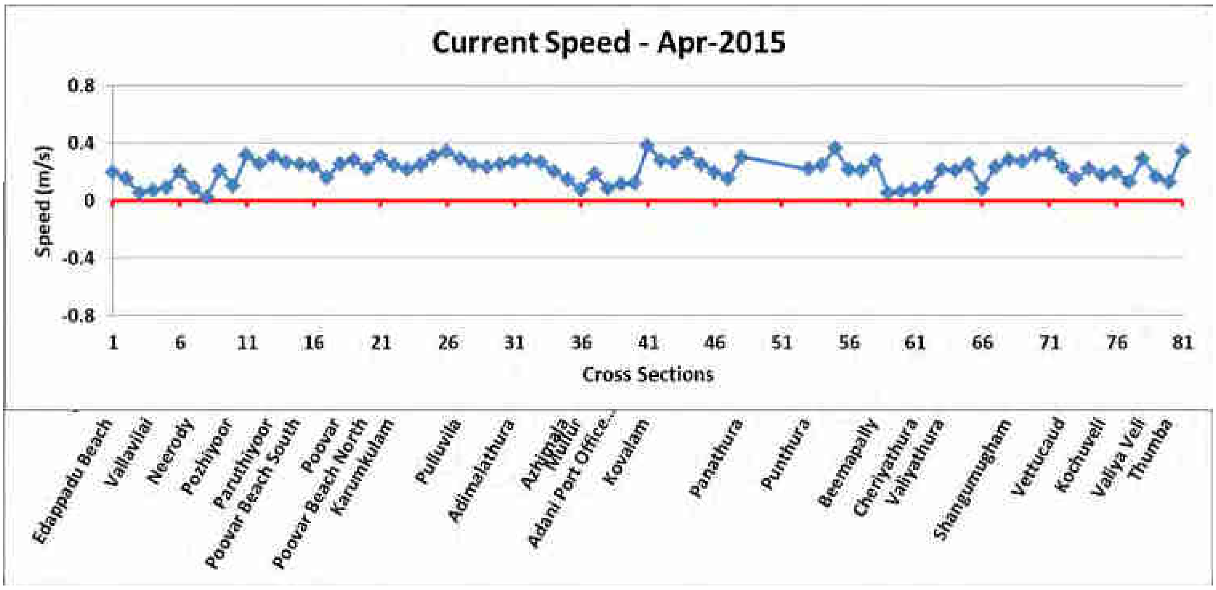


Figure 2-157 Alongshore current speed during April 2015

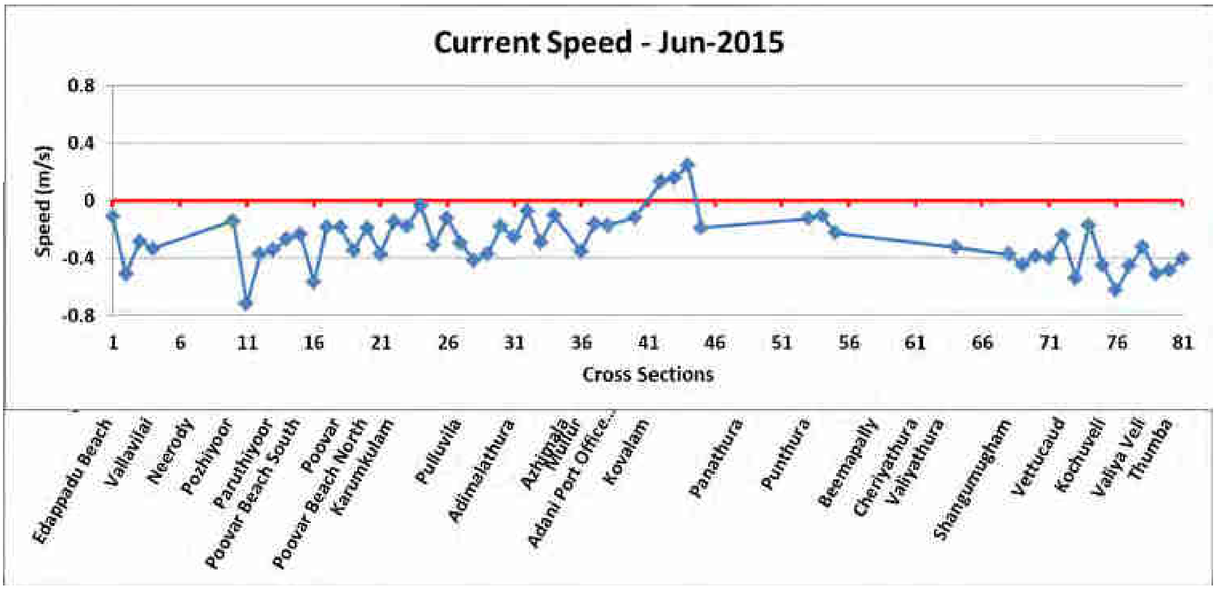


Figure 2-158 Alongshore current speed during June 2015

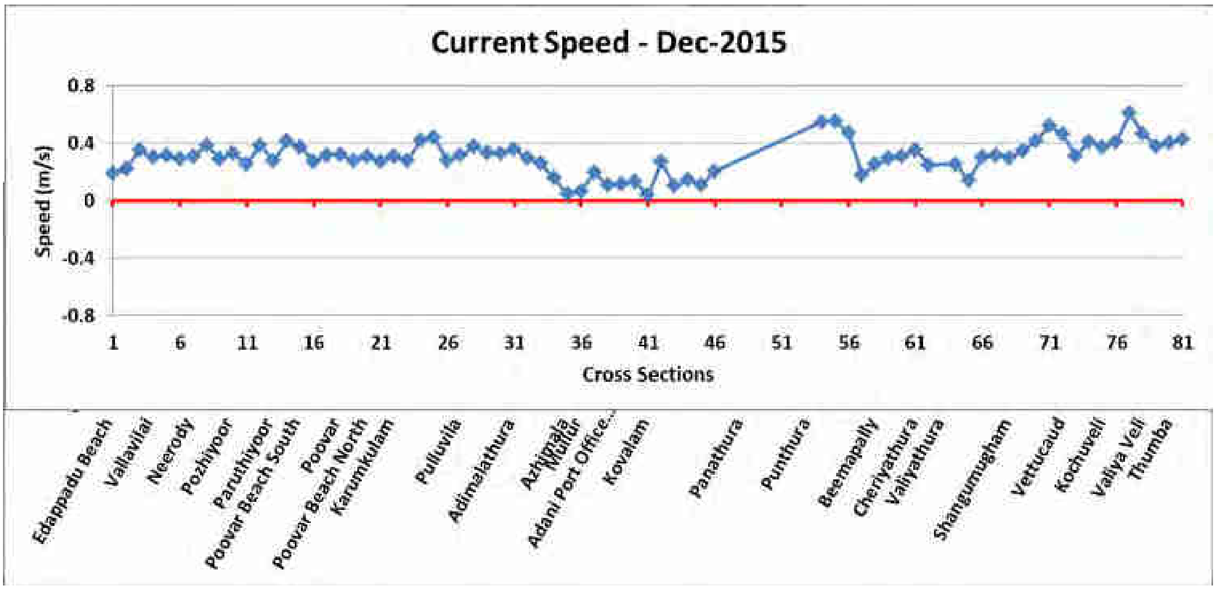


Figure 2-159 Alongshore current speed during December 2015

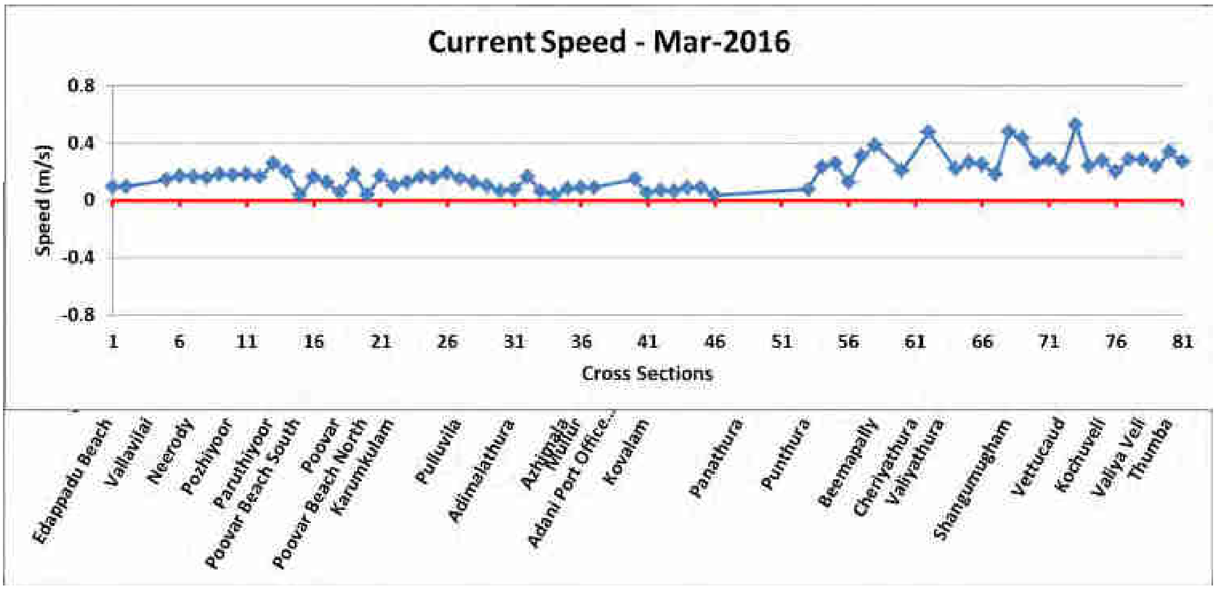


Figure 2-160 Alongshore current speed during March 2016

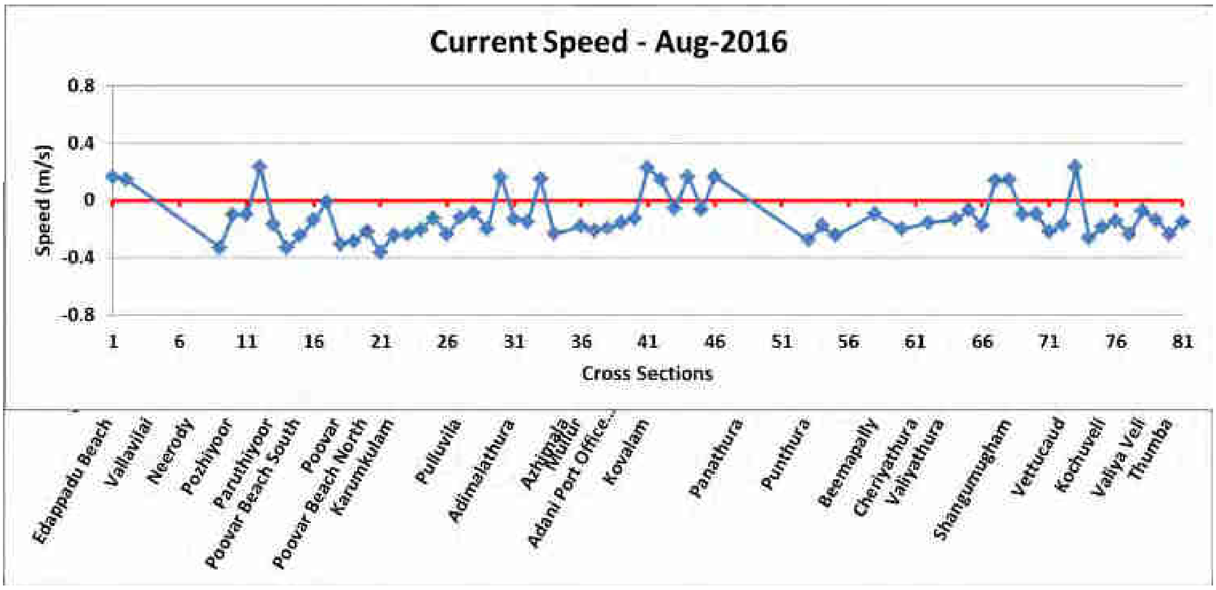


Figure 2-161 Alongshore current speed during August 2016

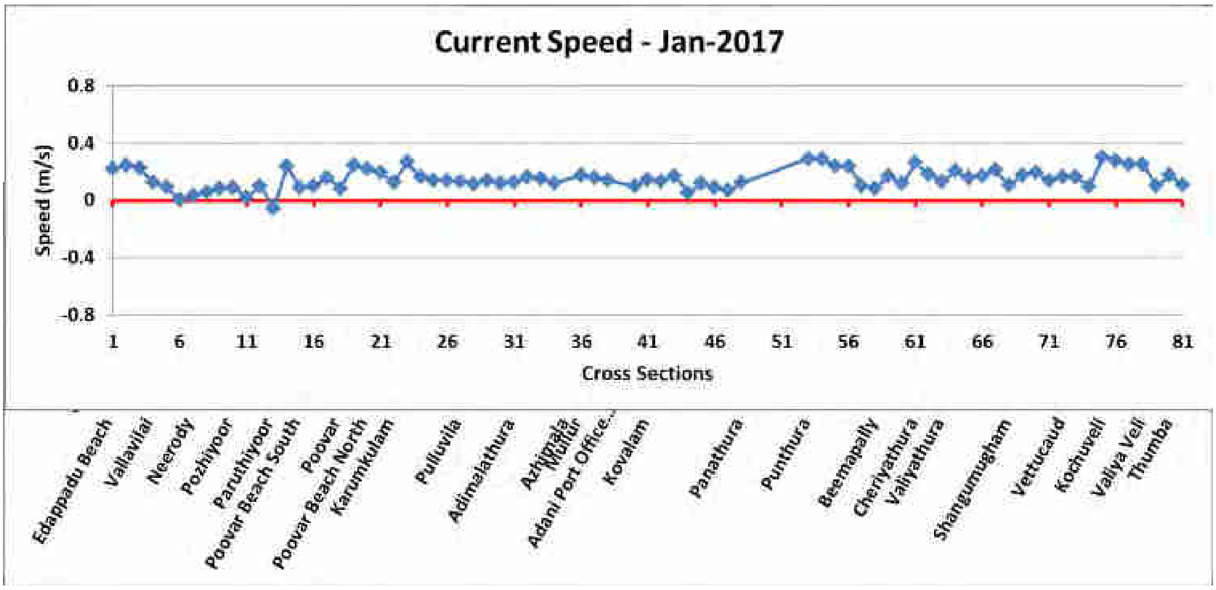


Figure 2-162 Alongshore current speed during January 2017

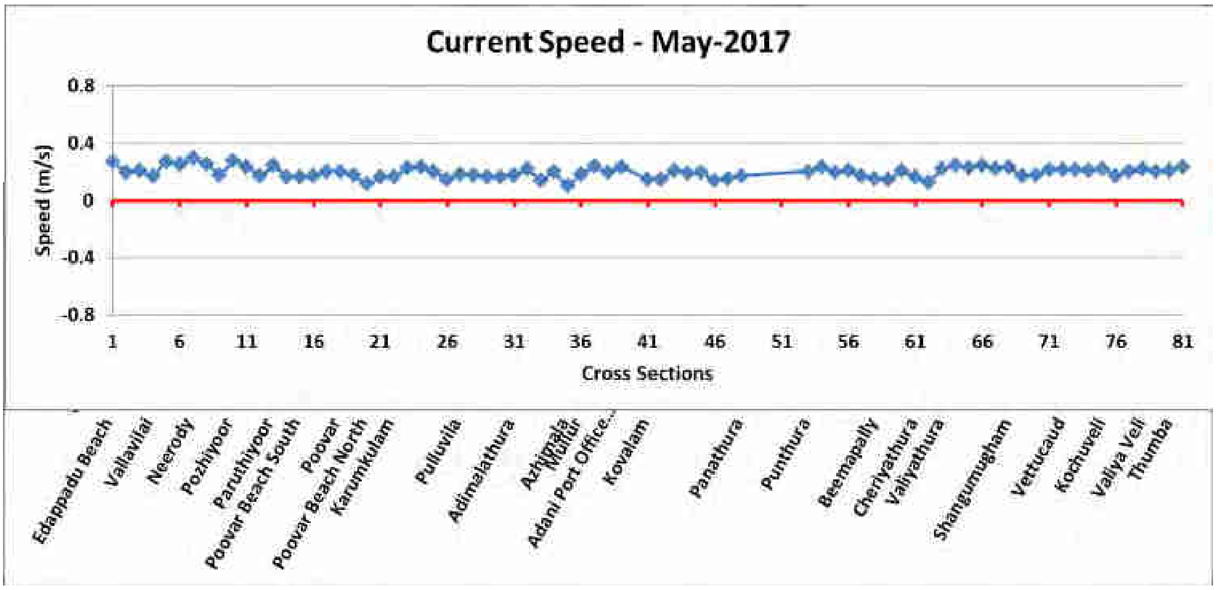


Figure 2-163 Alongshore current speed during May 2017

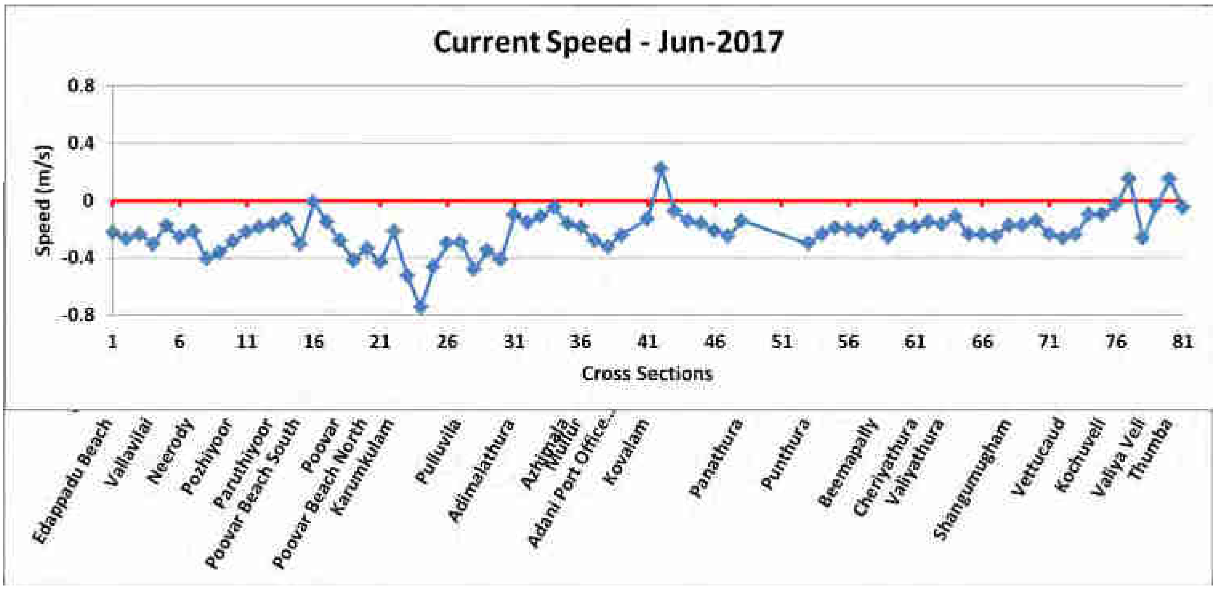


Figure 2-164 Alongshore current speed during June 2017

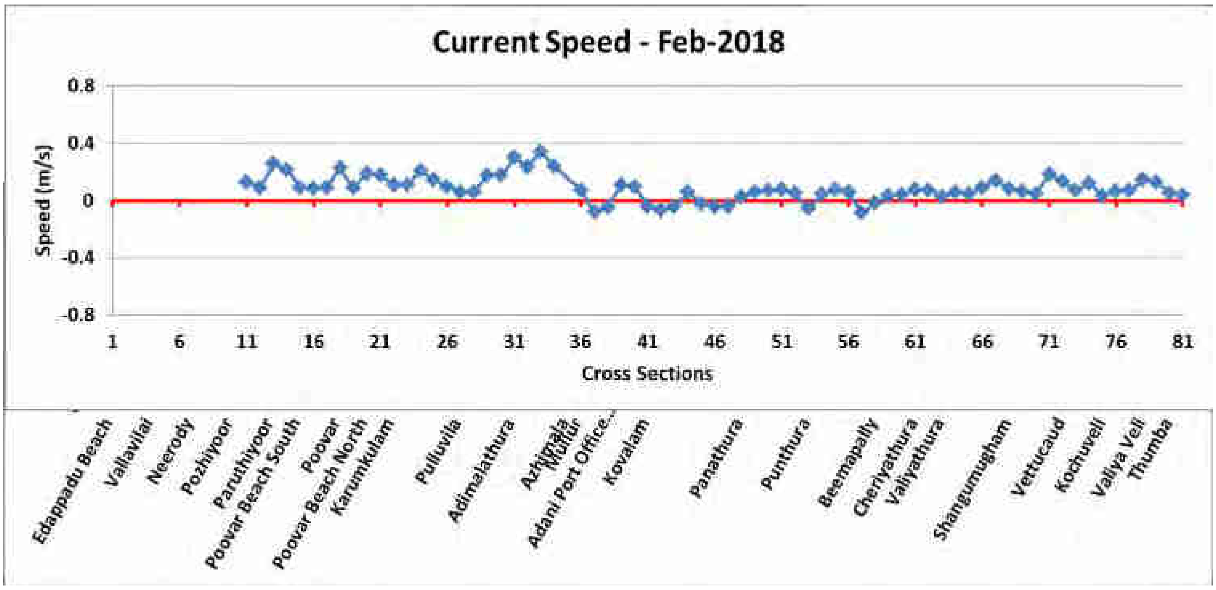


Figure 2-165 Alongshore current speed during February 2018

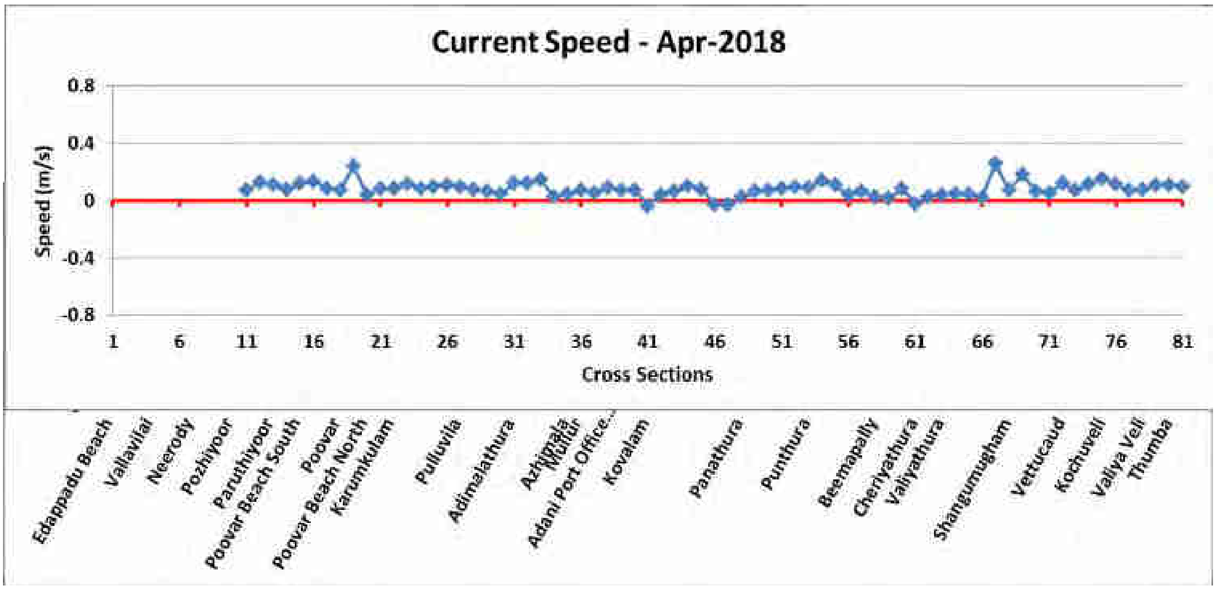


Figure 2-166 Alongshore current speed during April 2018

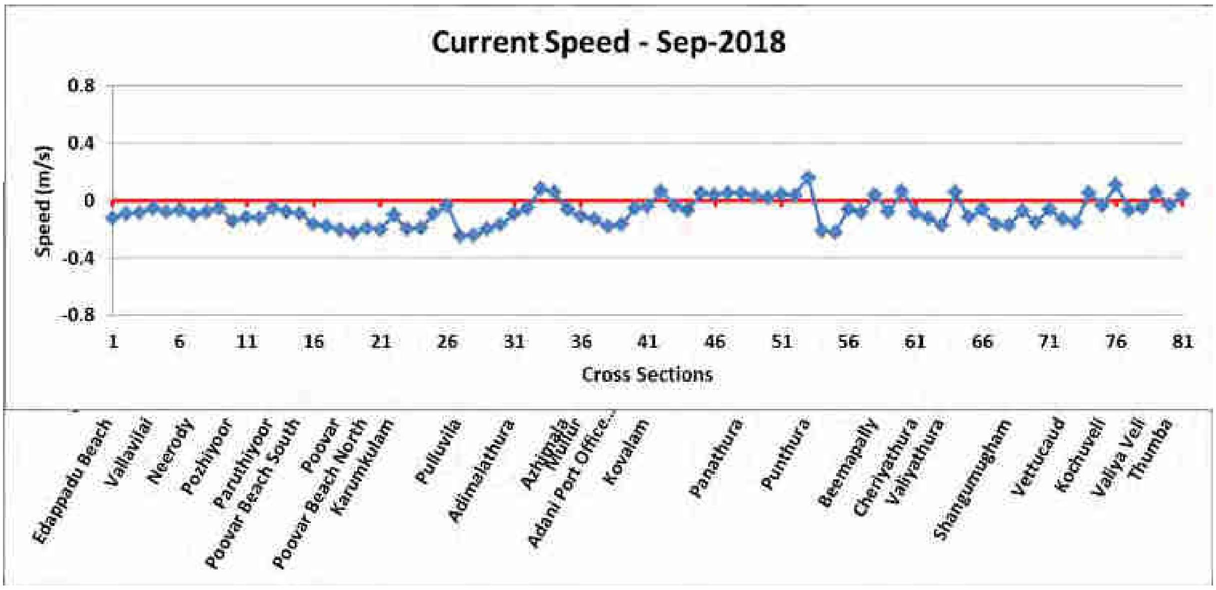


Figure 2-167 Alongshore current speed during September 2018

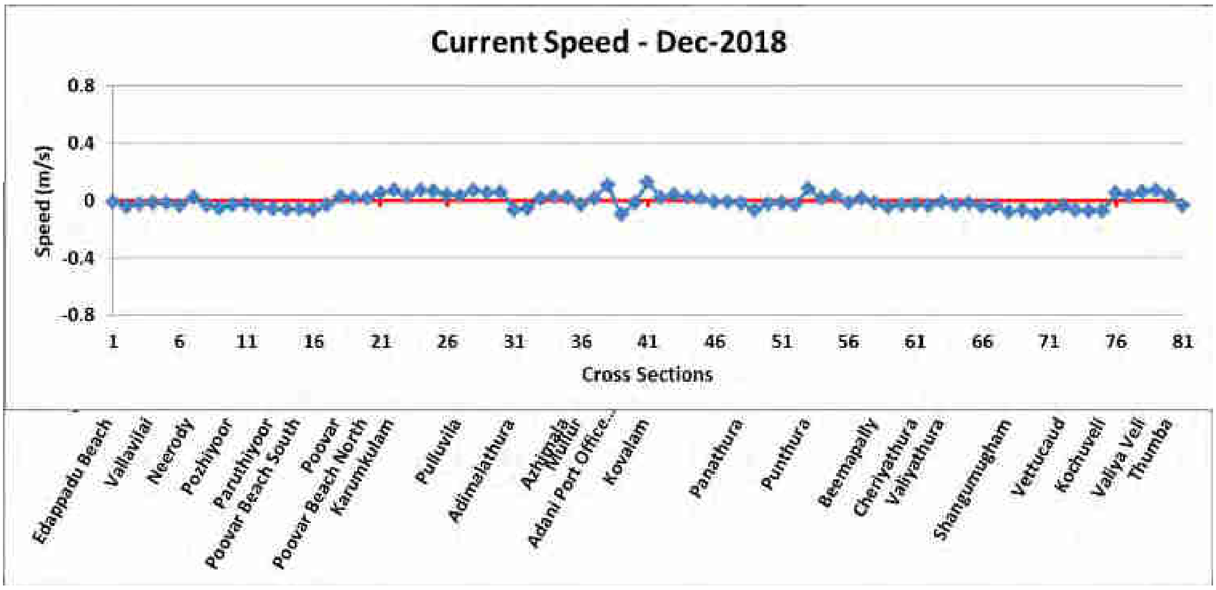


Figure 2-168 Alongshore current speed during December 2018

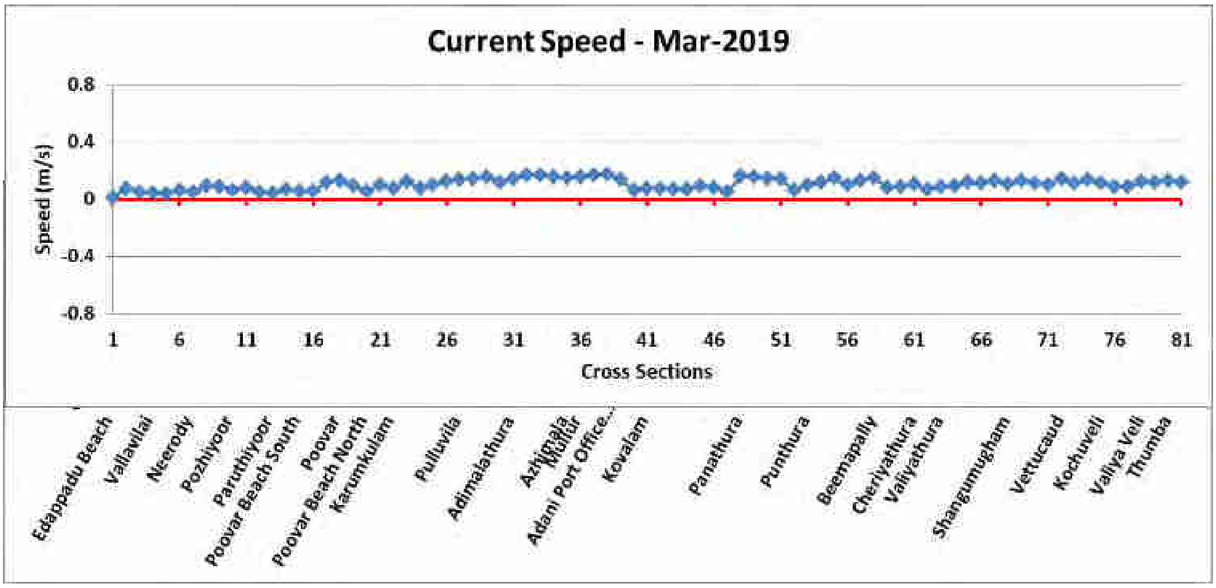


Figure 2-169 Alongshore current speed during March 2019

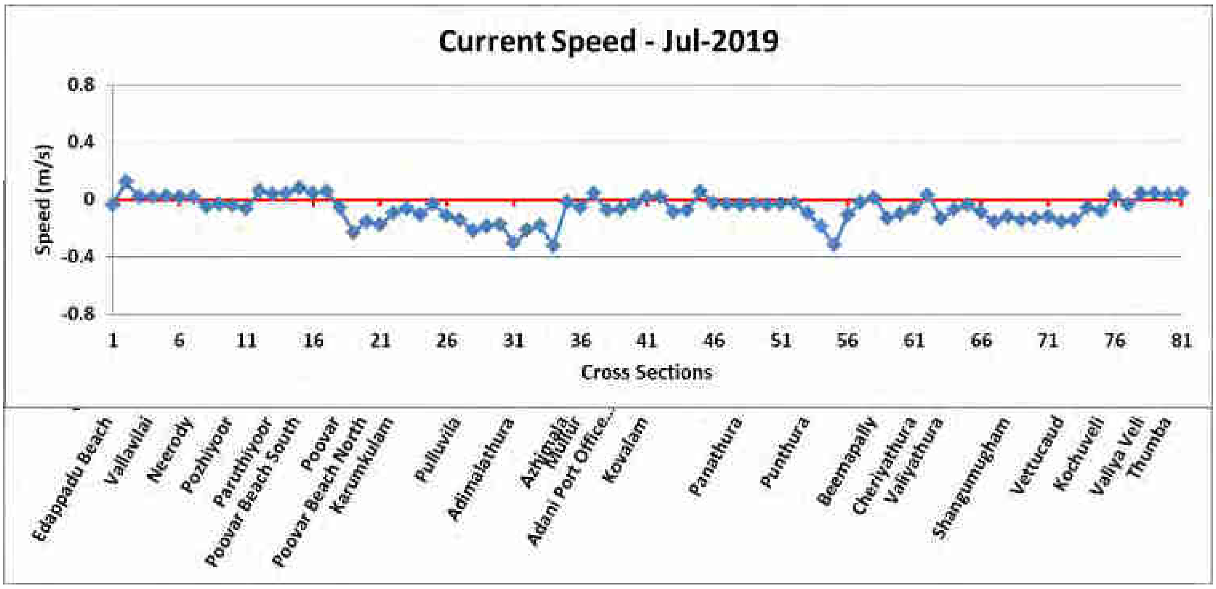


Figure 2-170 Alongshore current speed during July 2019

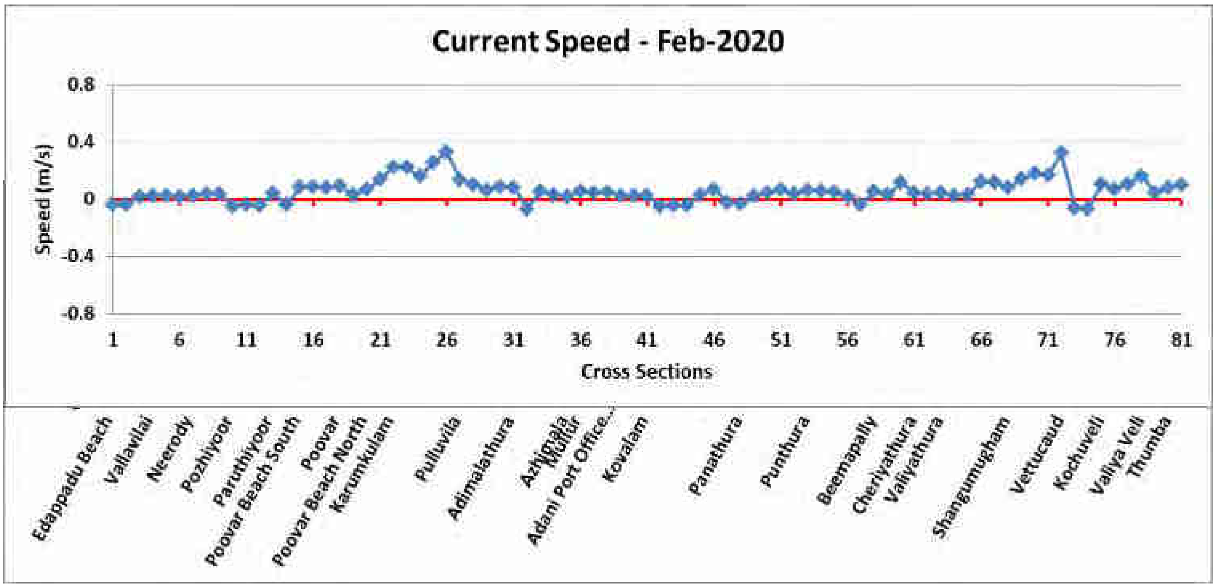


Figure 2-171 Alongshore current speed during February 2020

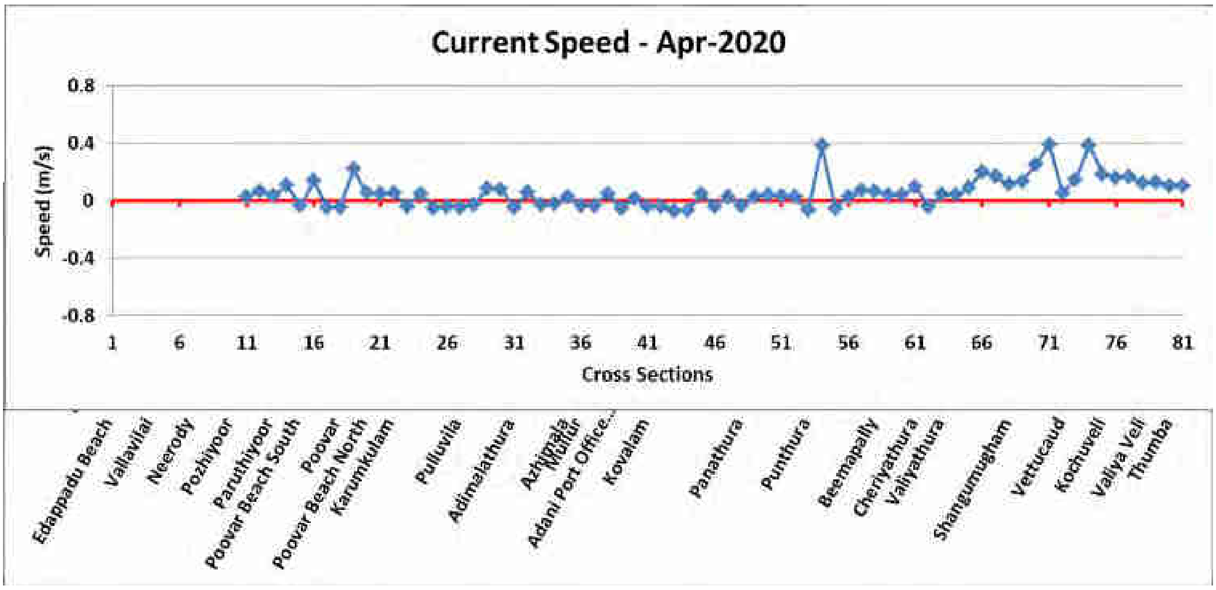


Figure 2-172 Alongshore current speed during April 2020

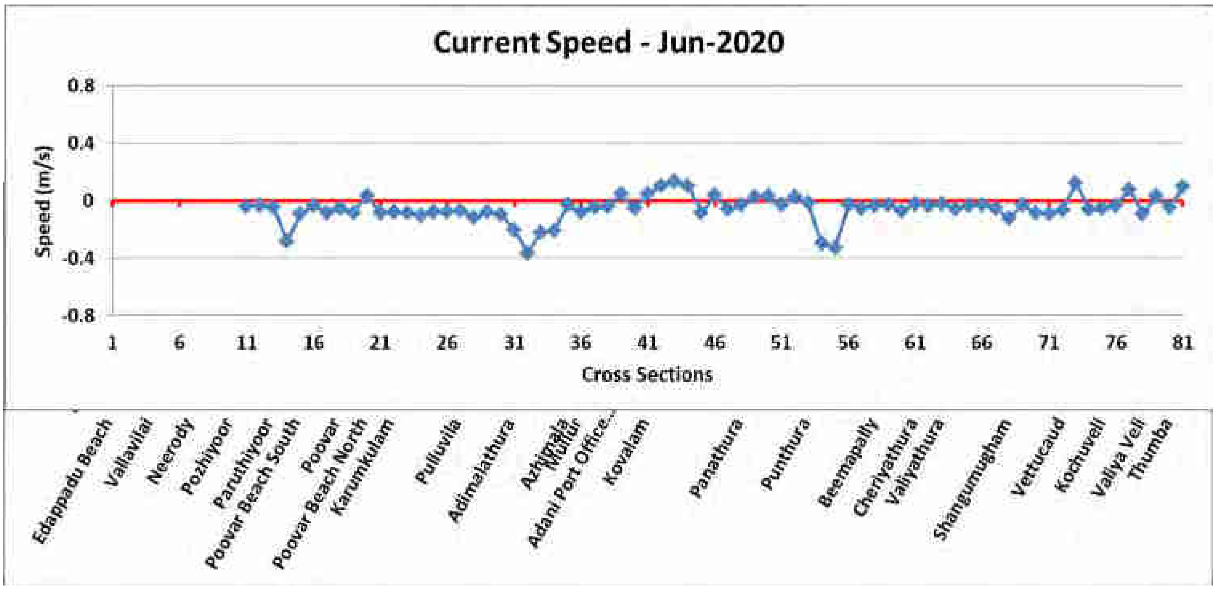


Figure 2-173 Alongshore current speed during June 2020

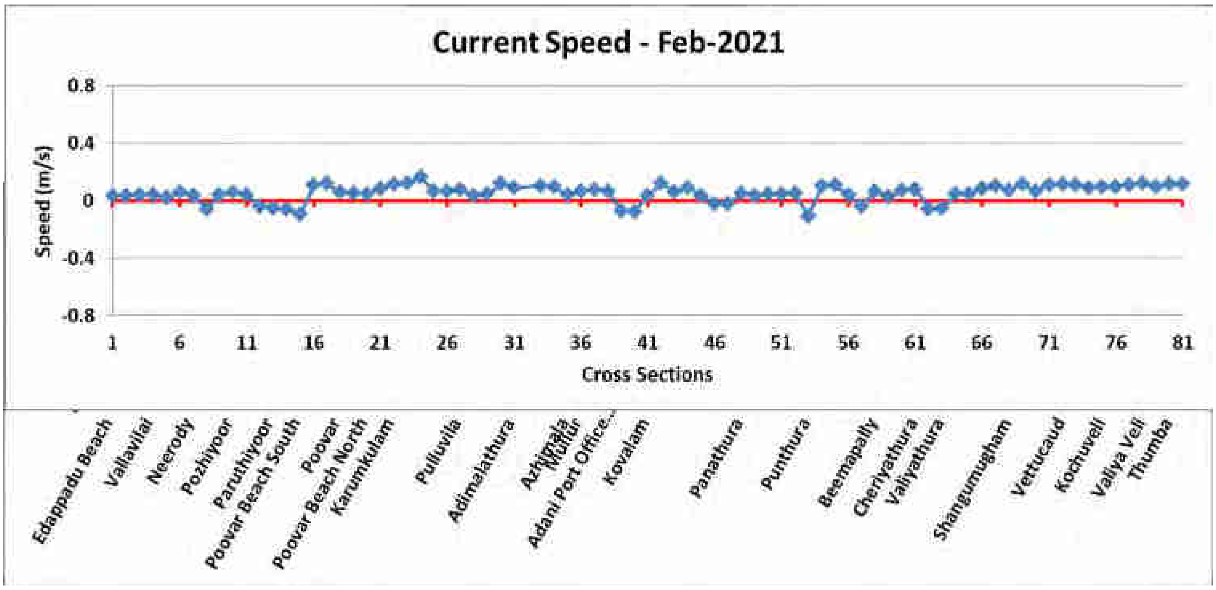


Figure 2-174 Alongshore current speed during February 2021

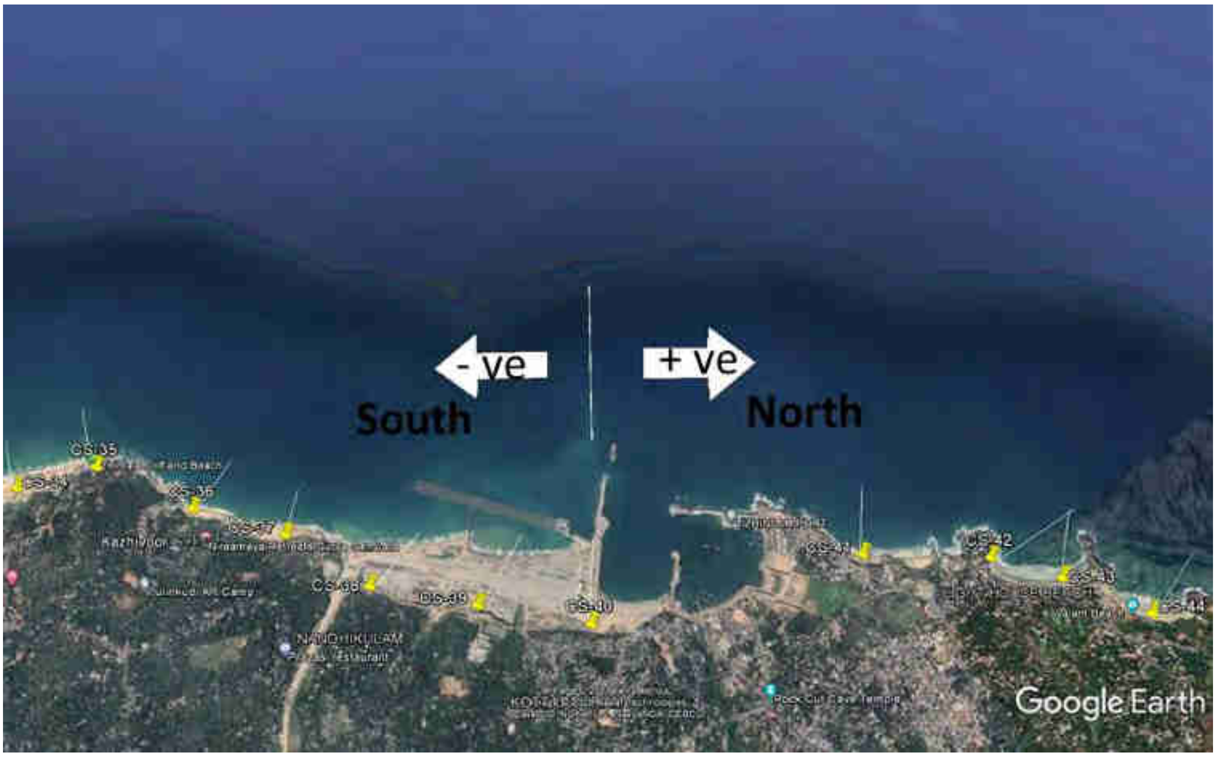


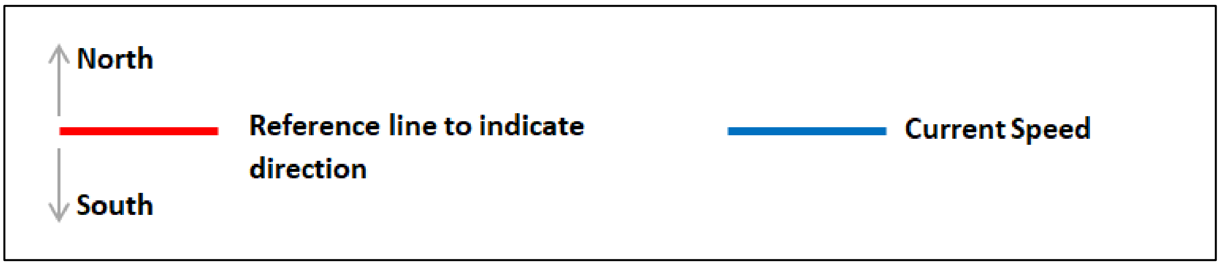
Figure 2-175 Sign Convention of current speed

The sign convention of current speed is considered positive if an observer stands on the beach facing to sea, notices rightward movement and negative if the movement is leftwards to the same observer. A representation is shown in Figure 2-175.

General trend of current movement towards North is noticed during Monsoon and towards South during other seasons.

The time series for selected sections on North and South side of proposed port are shown from Figure 2-176 to Figure 2-199.

Legend of Leo observation plots at selected CSP



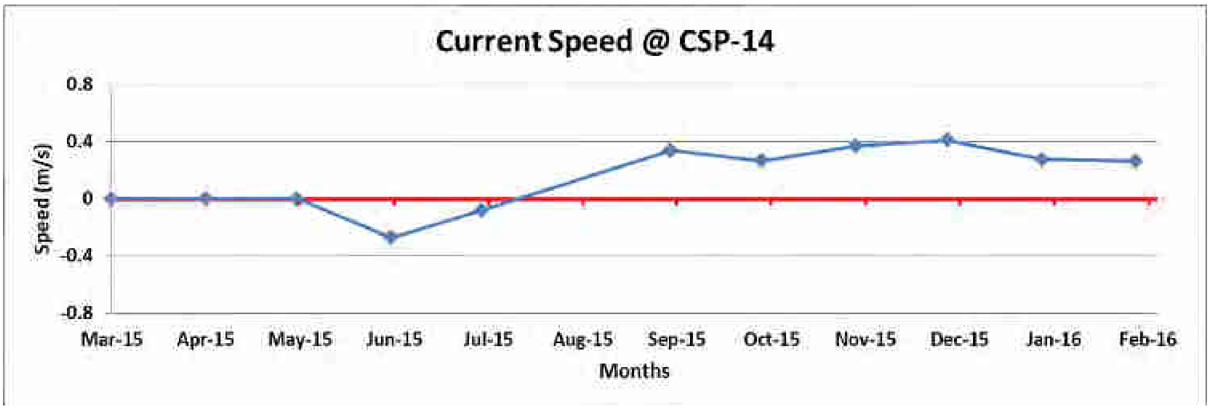


Figure 2-176 Time series of current speed at Paruthiyoor (March 2015 – February 2016)

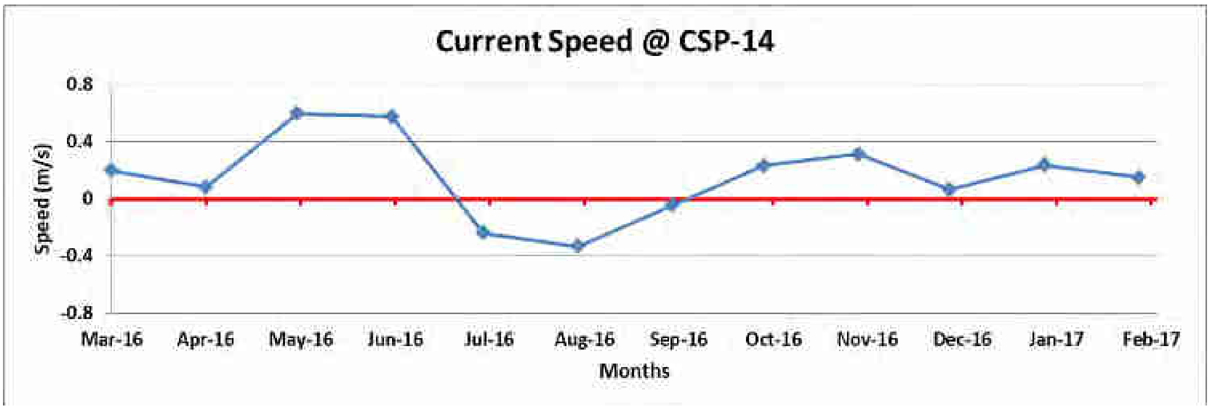


Figure 2-177 Time series of current speed at Paruthiyoor (March 2016 – February 2017)

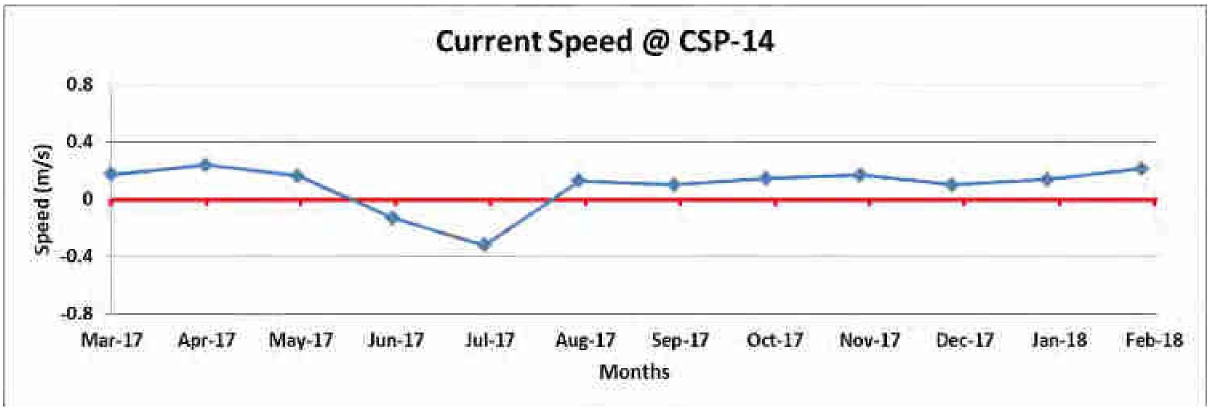


Figure 2-178 Time series of current speed at Paruthiyoor (March 2017 – February 2018)

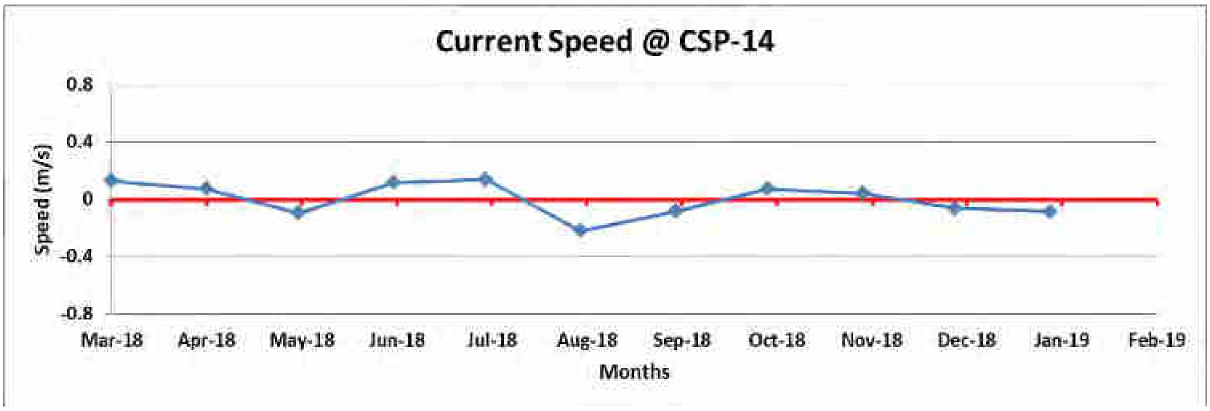


Figure 2-179 Time series of current speed at Paruthiyoor (March 2018 – February 2019)

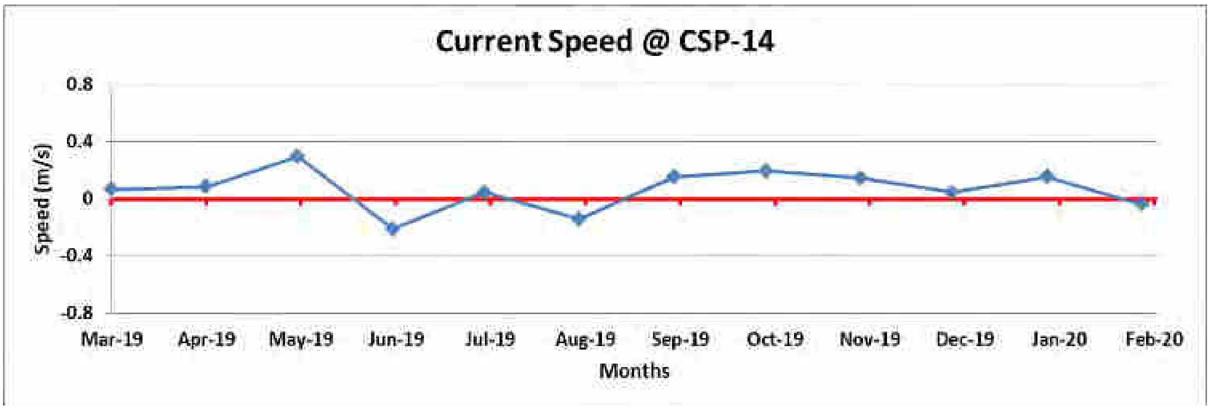


Figure 2-180 Time series of current speed at Paruthiyoor (March 2019 – February 2020)

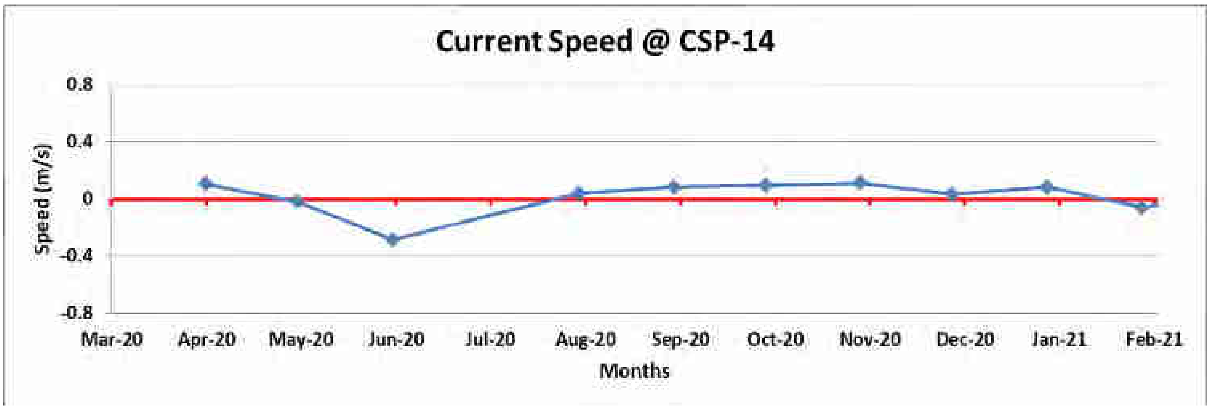


Figure 2-181 Time series of current speed at Paruthiyoor (March 2020 – February 2021)

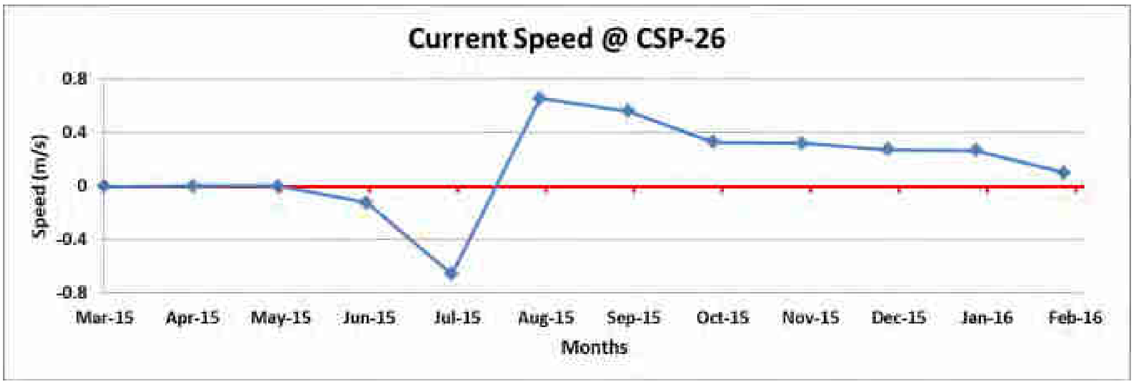


Figure 2-182 Time series of current speed at Karumkulam (March 2015 – February 2016)

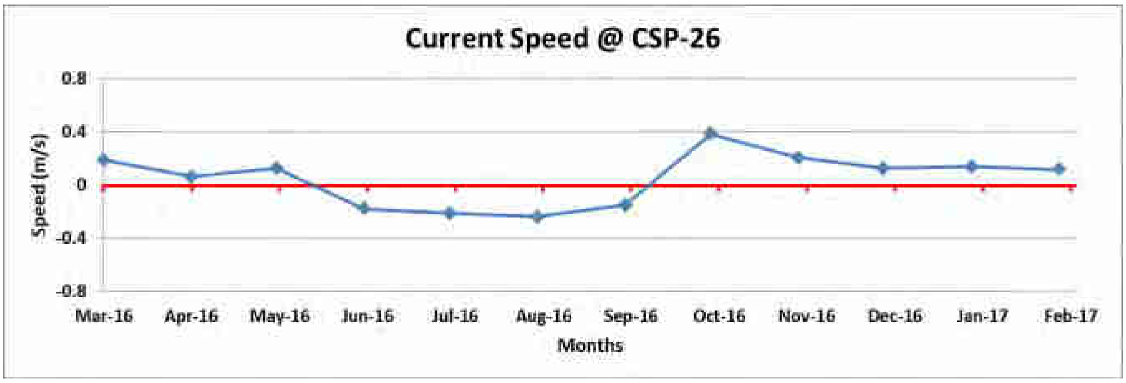


Figure 2-183 Time series of current speed at Karumkulam (March 2016 – February 2017)

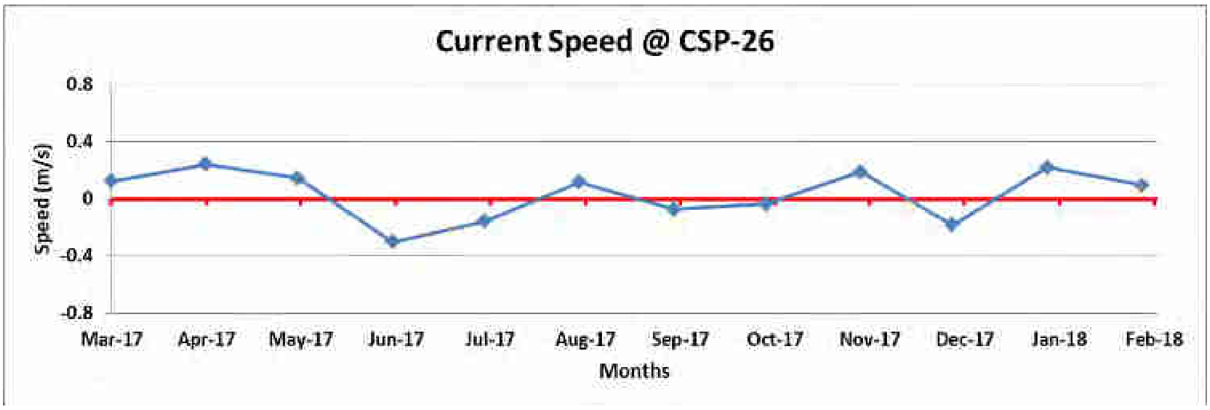


Figure 2-184 Time series of current speed at Karumkulam (March 2017 – February 2018)

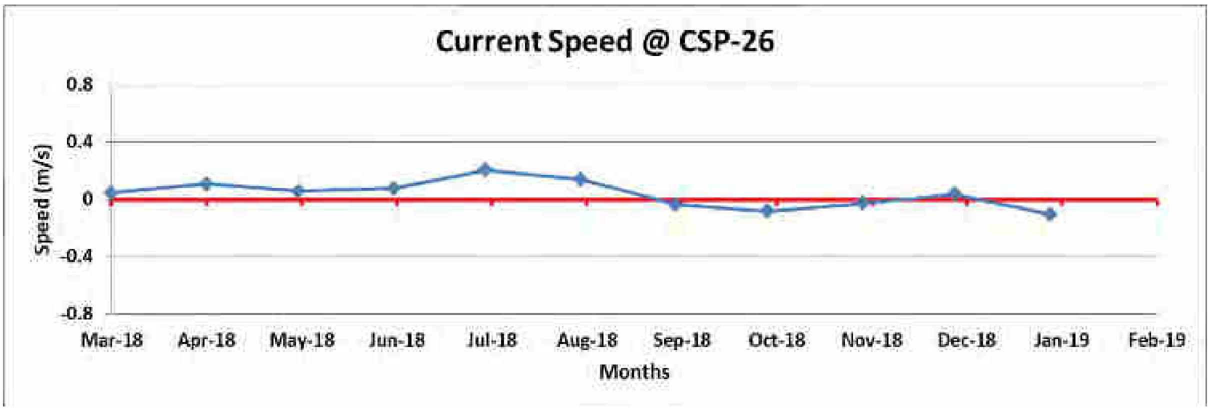


Figure 2-185 Time series of current speed at Karumkulam (March 2018 – February 2019)

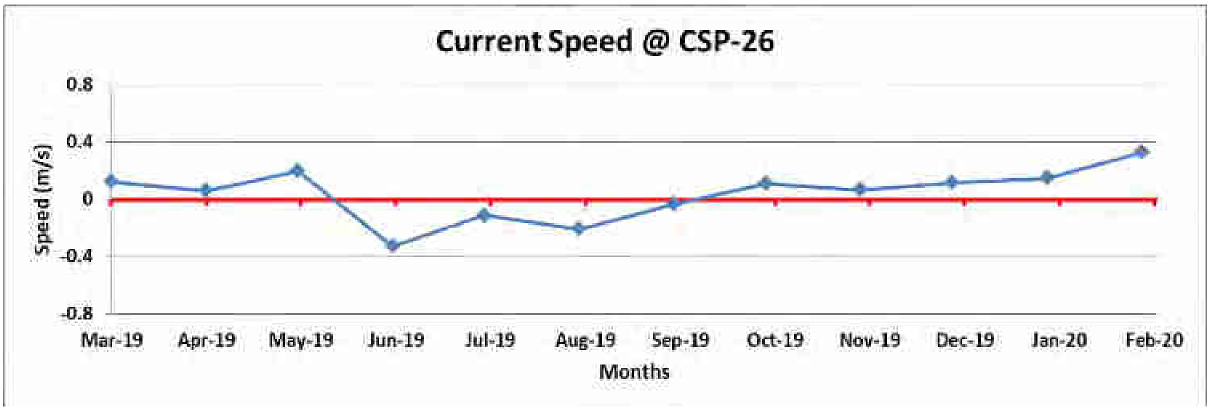


Figure 2-186 Time series of current speed at Karumkulam (March 2019 – February 2020)

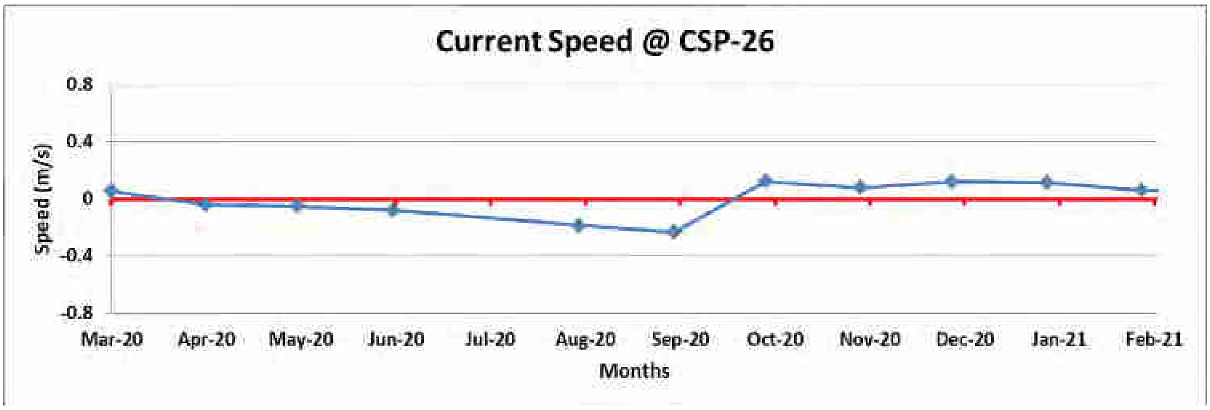


Figure 2-187 Time series of current speed at Karumkulam (March 2020 – February 2021)

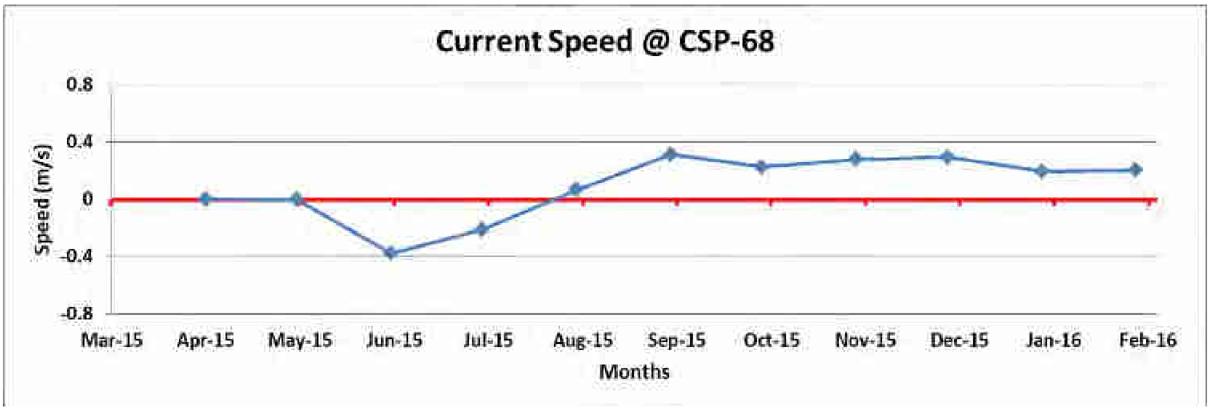


Figure 2-188 Time series of current speed at Shagumugham (March 2015 – February 2016)

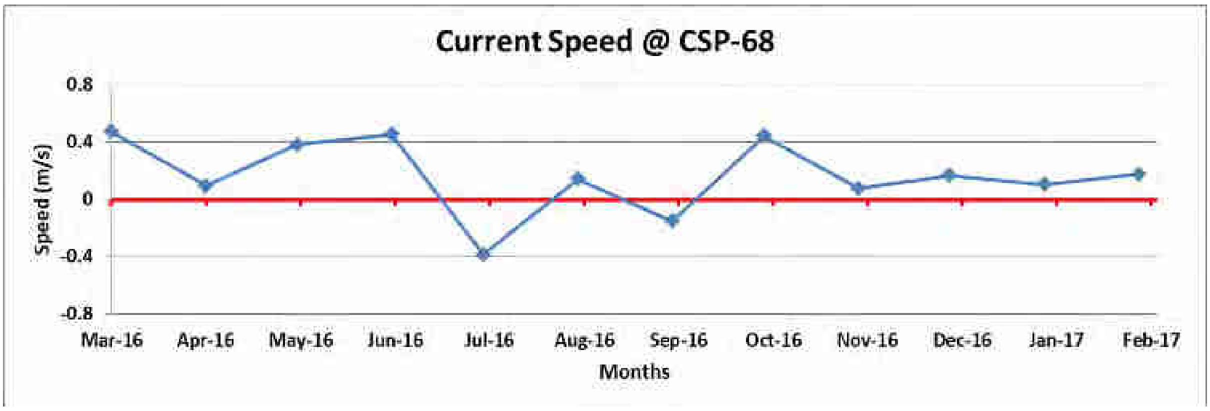


Figure 2-189 Time series of current speed at Shagumugham (March 2016 – February 2017)

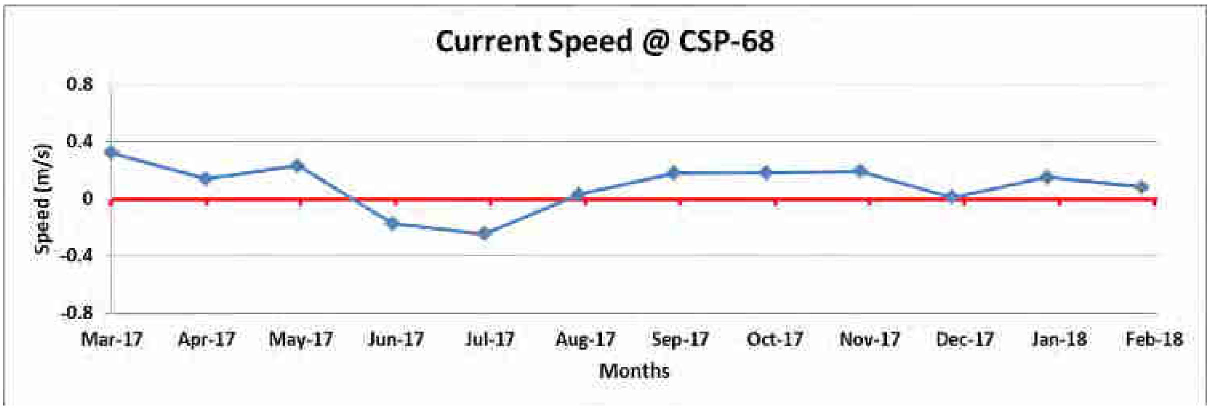


Figure 2-190 Time series of current speed at Shagumugham (March 2017 – February 2018)

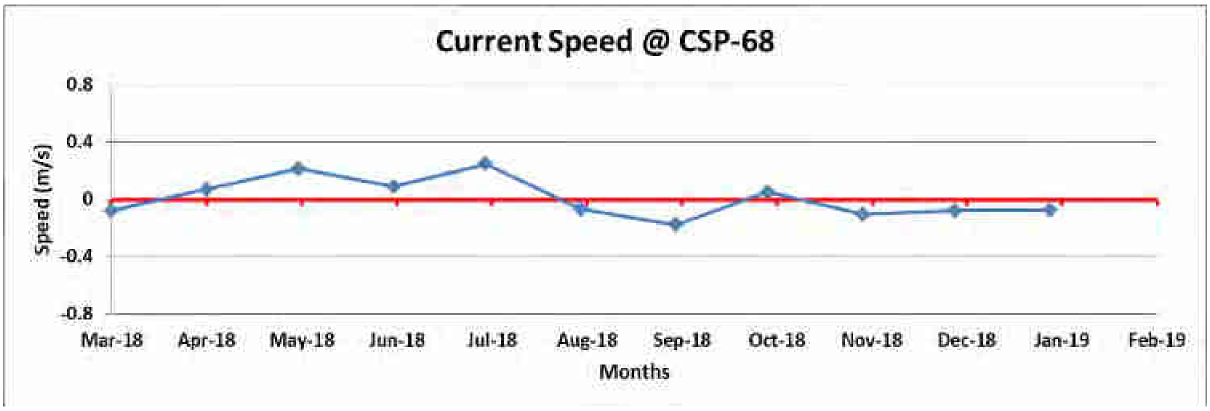


Figure 2-191 Time series of current speed at Shagumugham (March 2018 – February 2019)

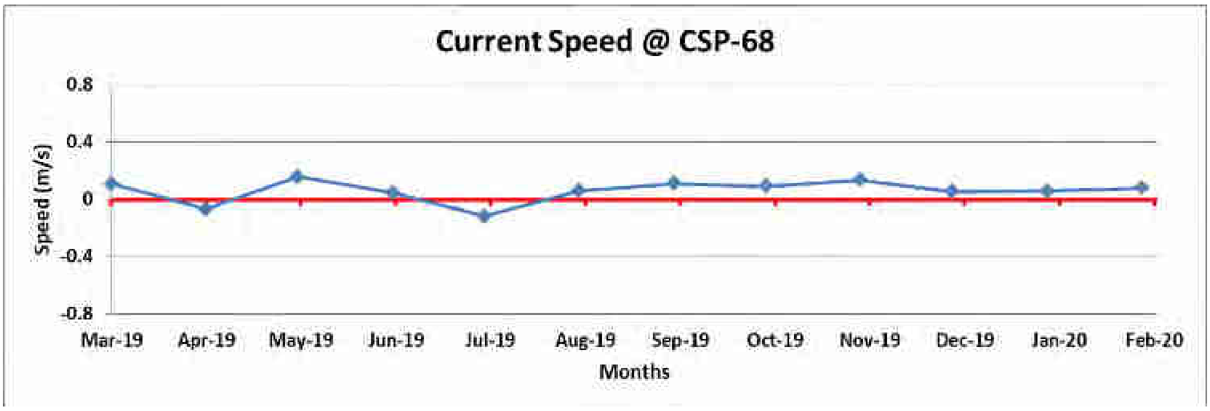


Figure 2-192 Time series of current speed at Shagumugham (March 2019 – February 2020)

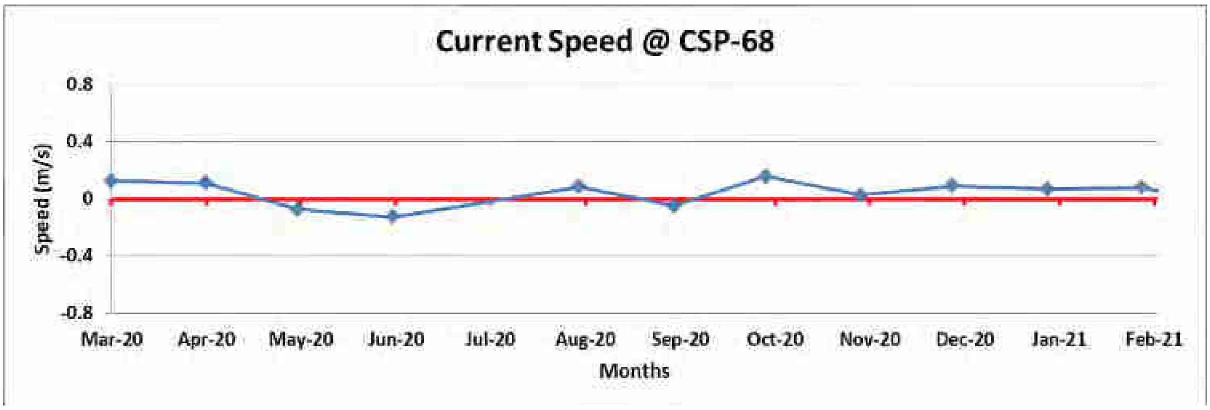


Figure 2-193 Time series of current speed at Shagumugham (March 2020 – February 2021)

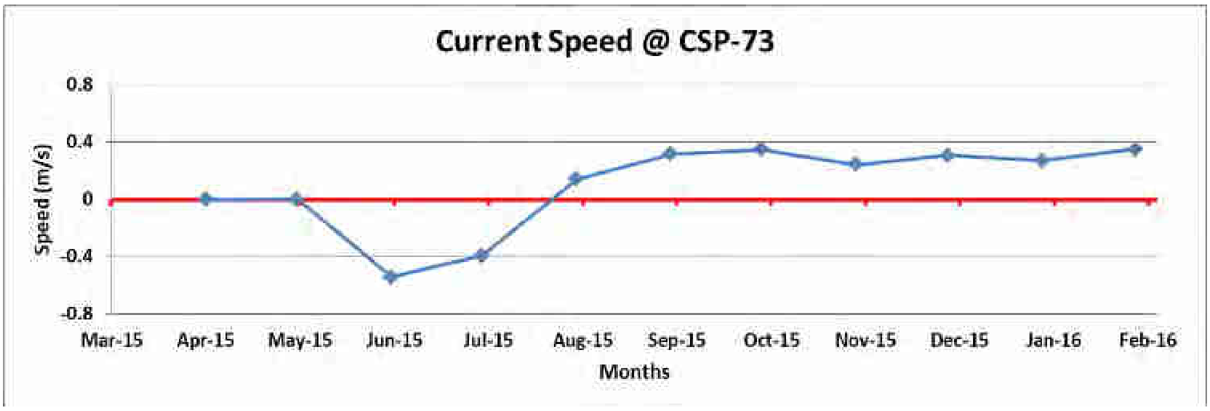


Figure 2-194 Time series of current speed at Vettucaud (March 2015 – February 2016)

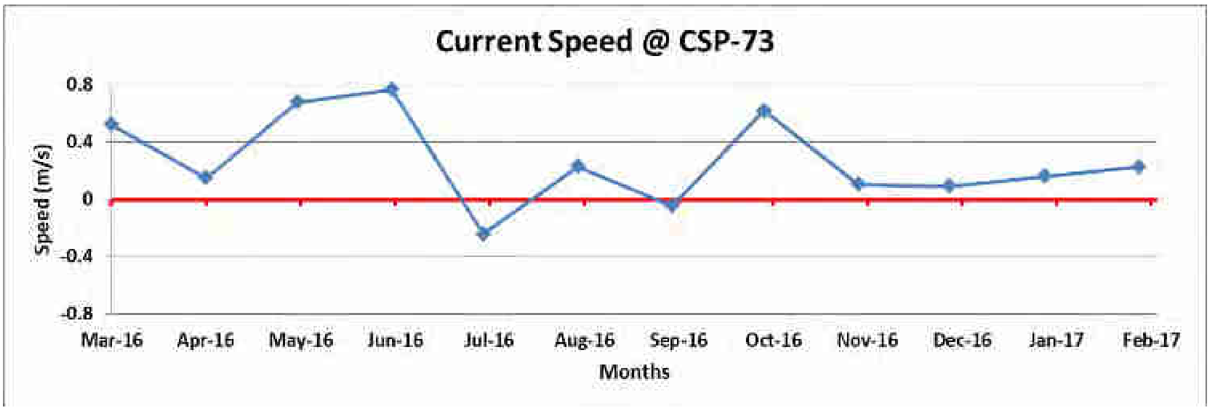


Figure 2-195 Time series of current speed at Vettucaud (March 2016 – February 2017)

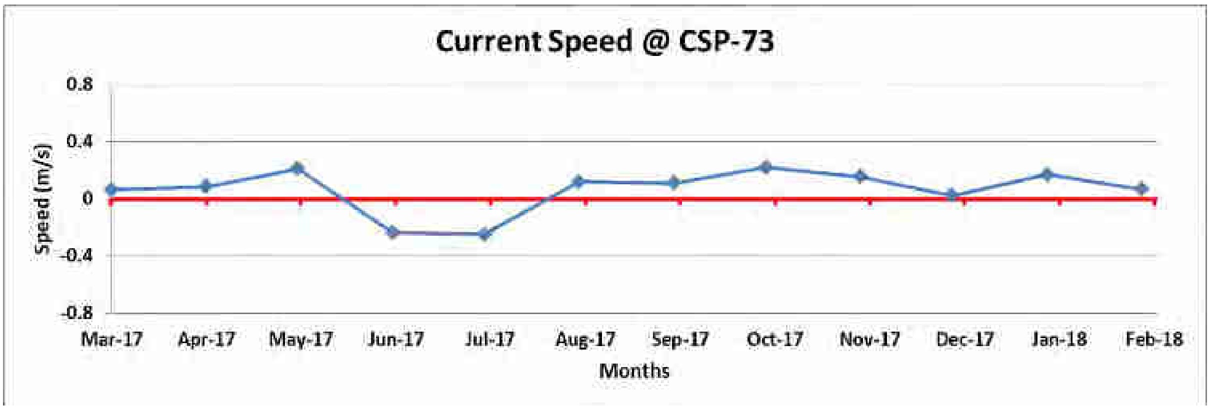


Figure 2-196 Time series of current speed at Vettucaud (March 2017 – February 2018)

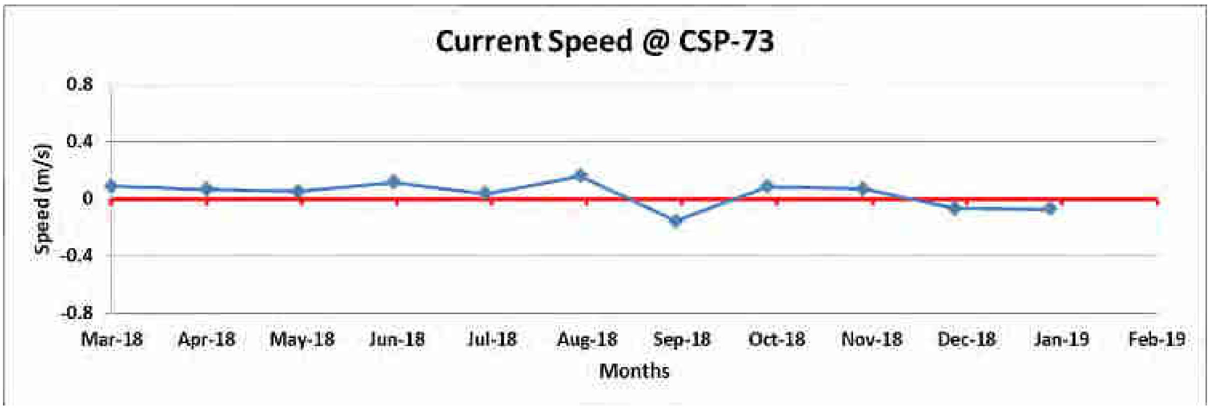


Figure 2-197 Time series of current speed at Vettucaud (March 2018 – February 2019)

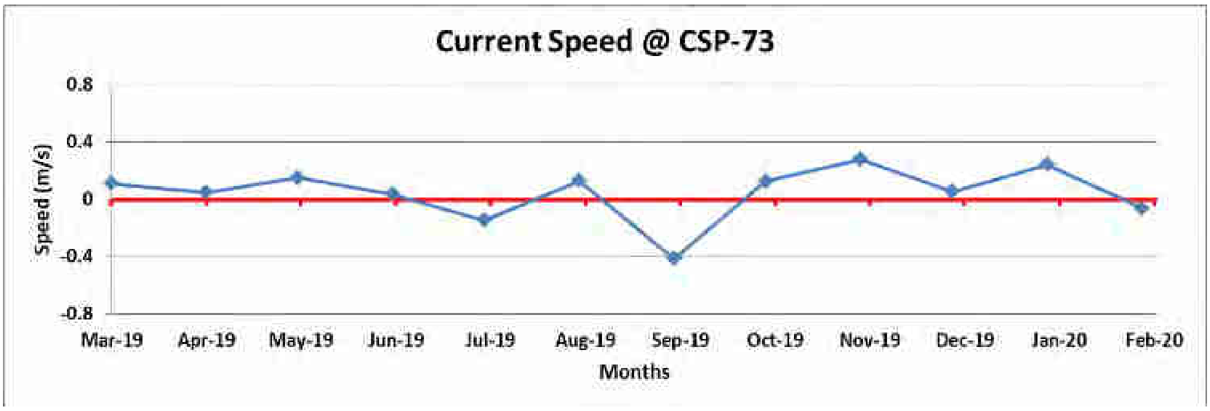


Figure 2-198 Time series of current speed at Vettucaud (March 2019 – February 2020)

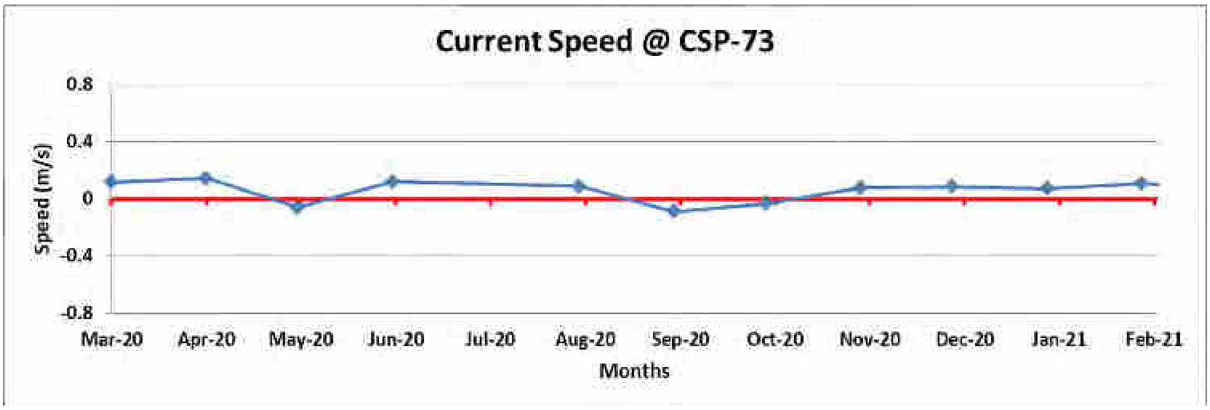


Figure 2-199 Time series of current speed at Vettucaud (March 2020 – February 2021)

From the LEO data, it can be observed that the movement is towards south during monsoon and from earlier analysis, it was found that erosion on the northern side of the port takes place during the monsoon times.

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):

$$\frac{\partial N}{\partial t} + \nabla_{\vec{x}}.\left[\left(\overrightarrow{c_g} + \vec{U}\right)N\right] + \frac{\partial c_\sigma N}{\partial \sigma} + \frac{\partial c_\sigma N}{\partial \theta} = \frac{S_{tot}}{\sigma}$$

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

$$\overrightarrow{c_g} = \partial\sigma/\partial\vec{k}$$

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 Domain

Using the inputs of bathymetry data discussed in Section 2.6, the model bathymetry was prepared. The bathymetry covered a large area of around 100X90km^2, ensuring the proper propagation of the incident waves from all the possible directions. The model bathymetry is shown in Figure 3-1.

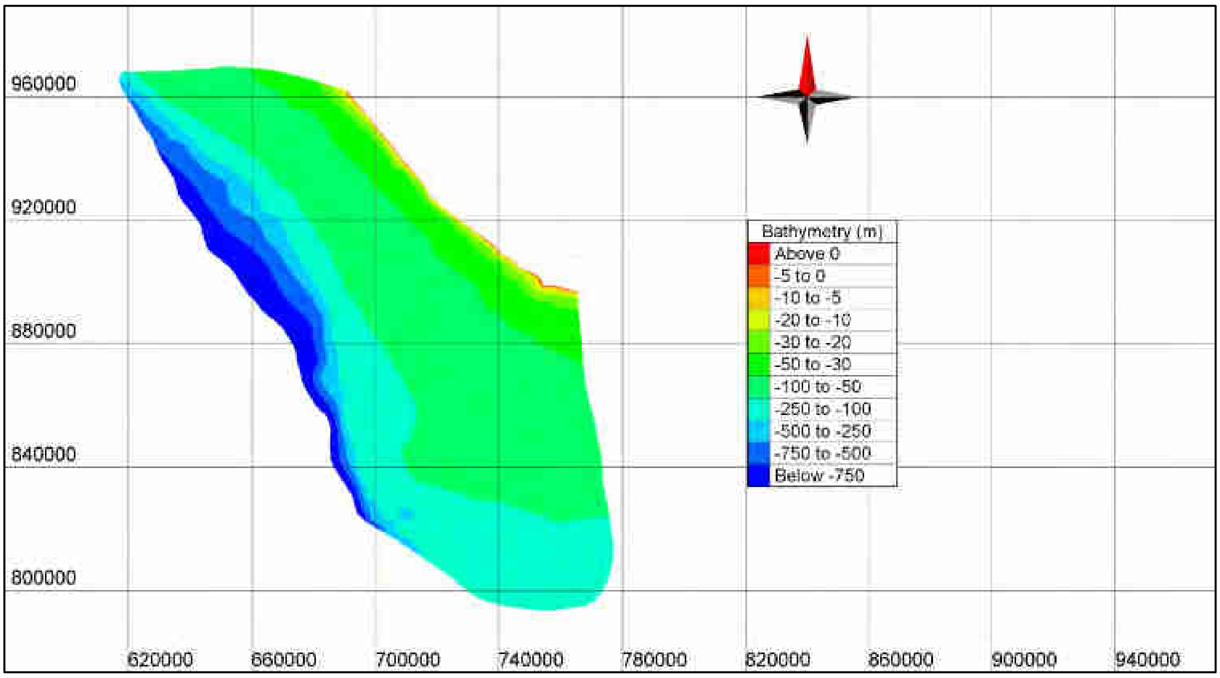


Figure 3-1 Model bathymetry

3.1.3 Model simulations and results

Offshore wave data at 08°00' 00" N, 76°00'00" E were obtained from NCEP. The time frame of data 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. A typical result from the wave transformation simulations is shown in Figure 3-2.

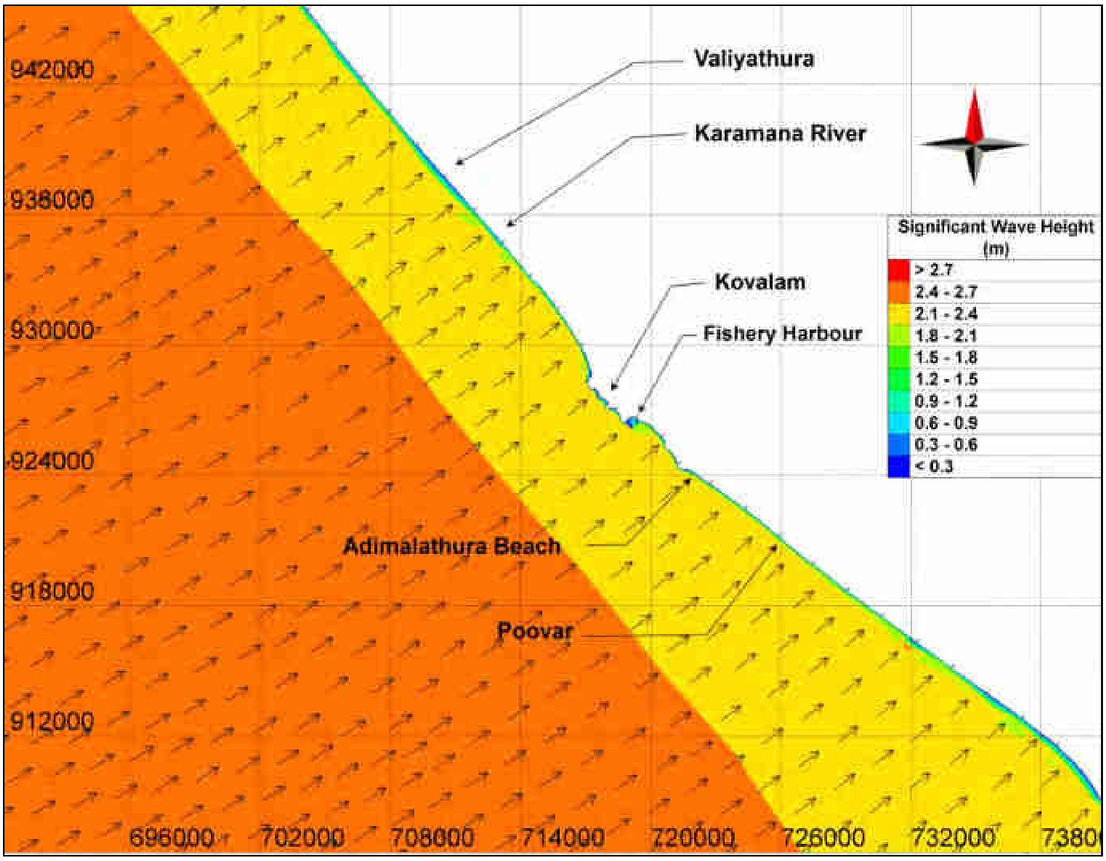


Figure 3-2 Wave transformation for H_s = 2.8m, T_p = 7.8s, Direction - WSW (247.5^0)

The modelled near shore wave data were extracted at the point (08° 21' 42.3"N, 76° 59' 33.9"E, depth -23.2m CD) where the wave observation was carried out. The comparison of modelled wave data and the observed wave data is plotted and shown from Figure 3-3 to Figure 3-5.

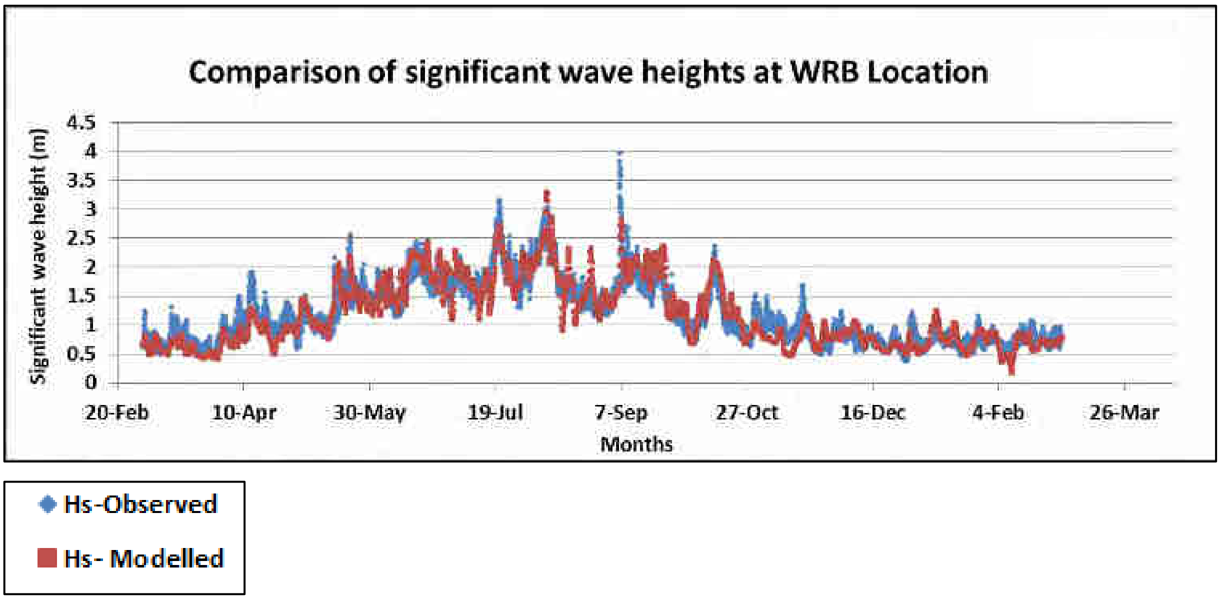


Figure 3-3 Comparison of significant wave heights (March 2020 to February 2021)

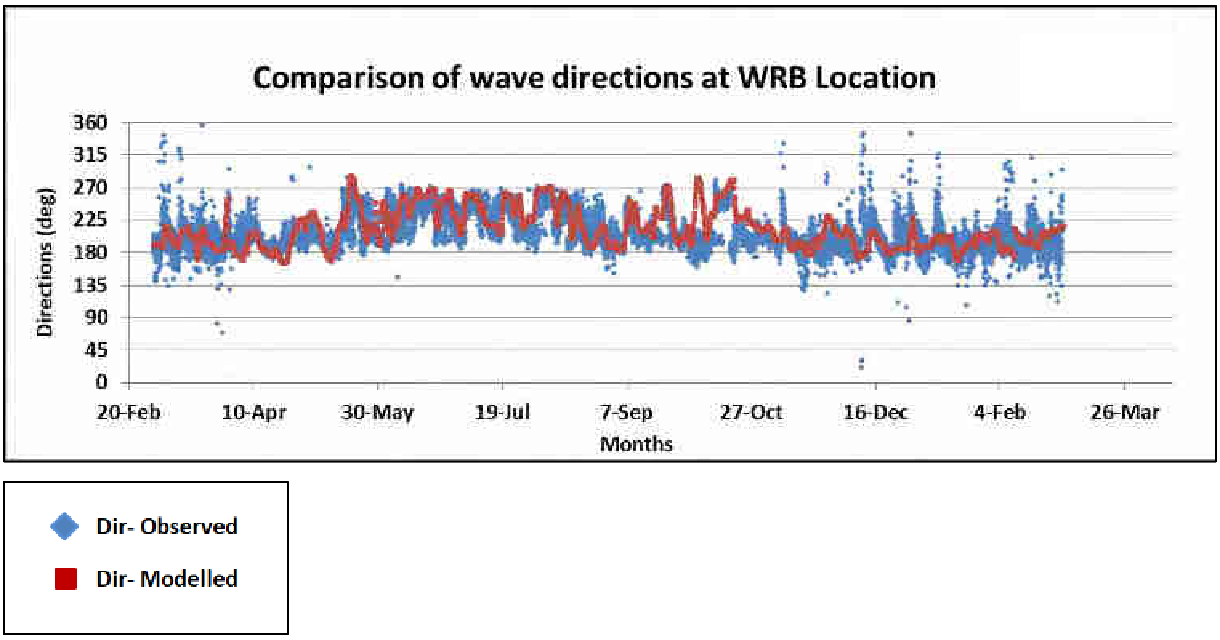


Figure 3-4 Comparison of wave directions (March 2020 to February 2021)

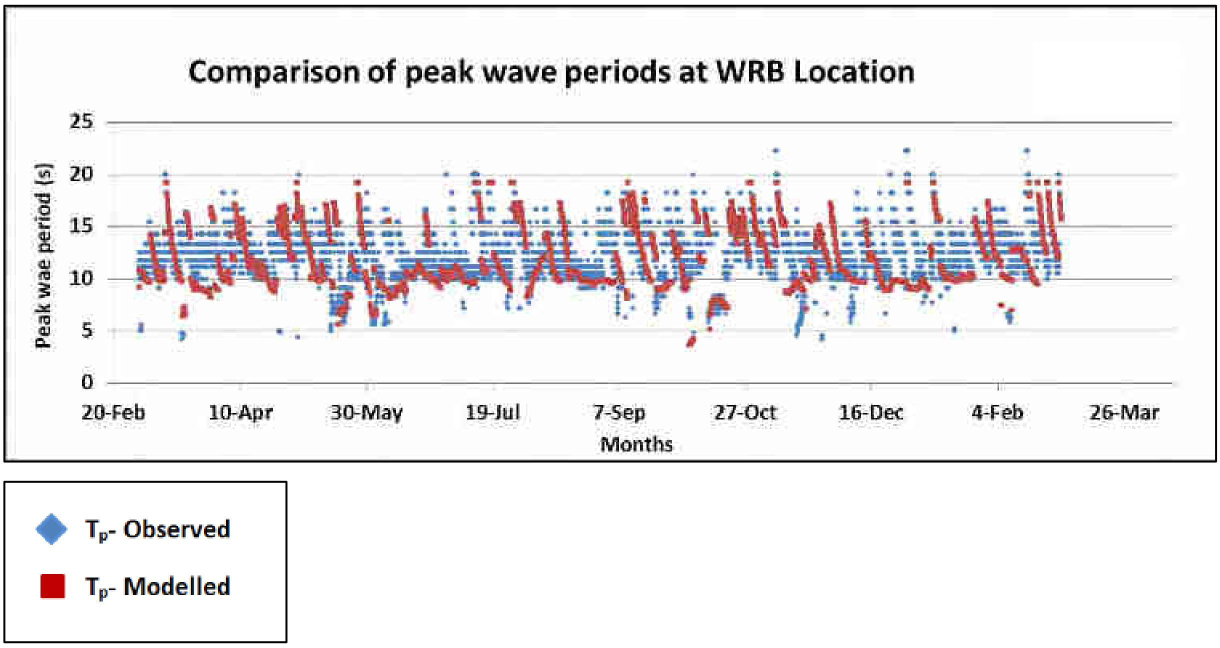


Figure 3-5 Comparison of peak wave periods (March 2020 to February 2021)

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 significant wave height, peak wave period and wave direction (True North) 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 phenomena 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 2021 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 3-6. The model bathymetry was prepared using the available primary and secondary data and is shown in Figure 3-7. The latest length of breakwater, as on February 2021, is included in the model for hydrodynamic modelling.

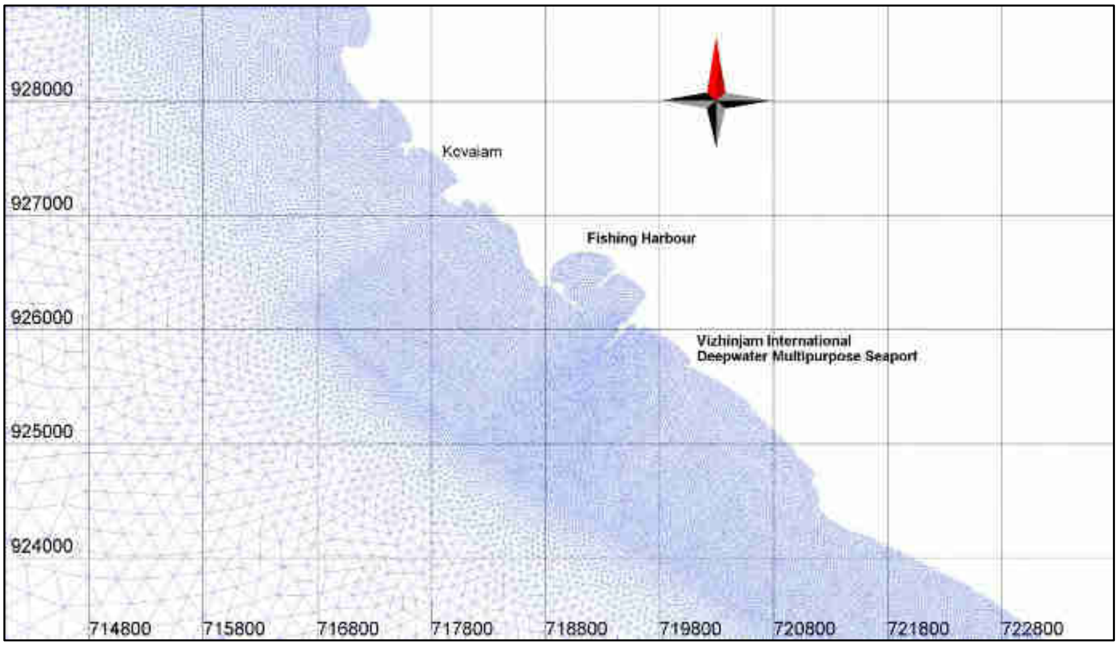


Figure 3-6 Fine mesh near project location

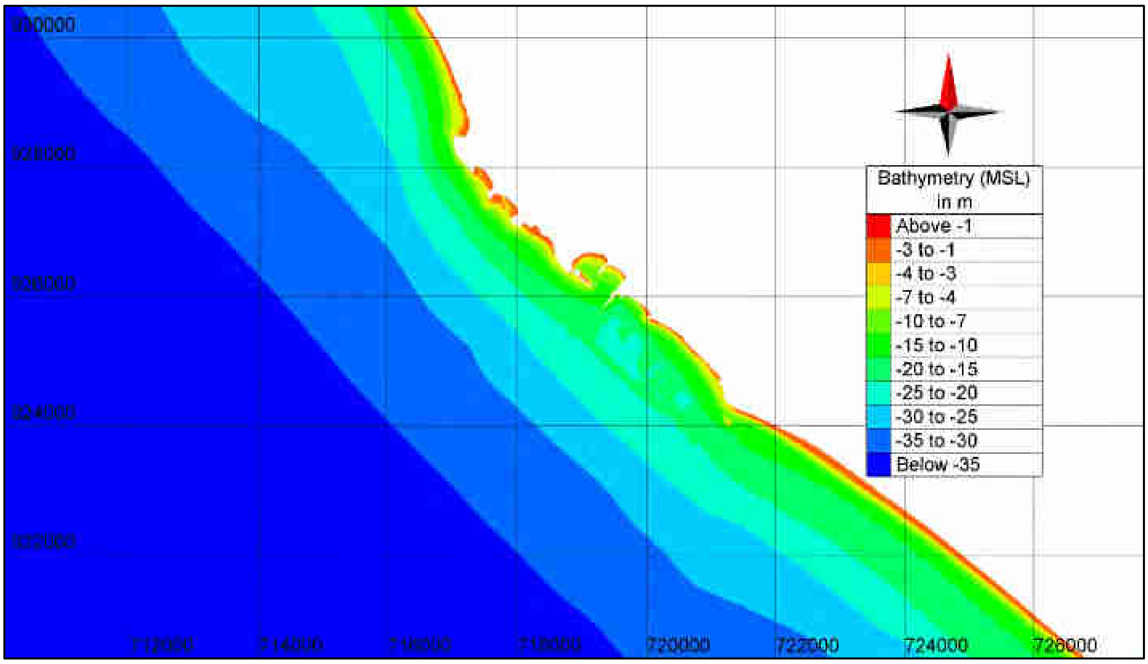


Figure 3-7 Pre-monsoon (2020) bathymetry with respect to MSL

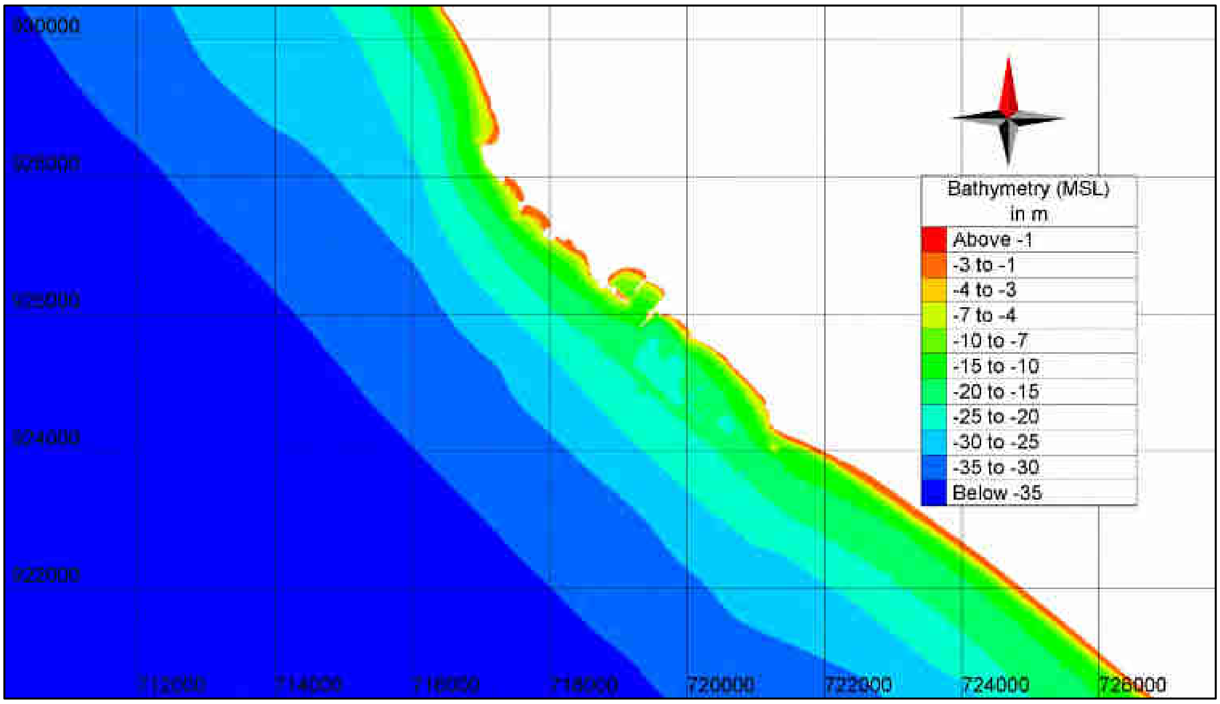


Figure 3-8 Post-Monsoon (2020) bathymetry with respect to MSL

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. The open boundary of the HD model setup is as shown in Figure 3-9.

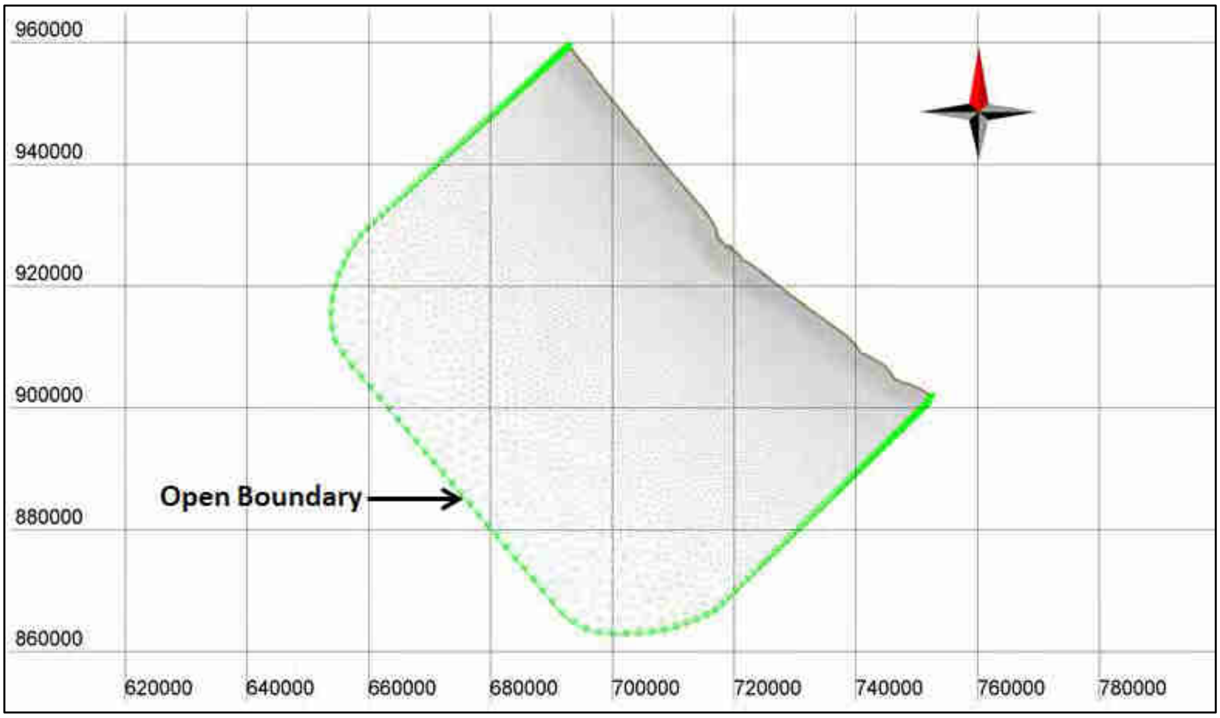


Figure 3-9 Open boundary conditions – HD model

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 were 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, 2018, 2019 & 2020 and simulations were carried out with the same parameters used in 2013.

Comparison between the tide and currents simulated by the models were done. Figure 3-10 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.

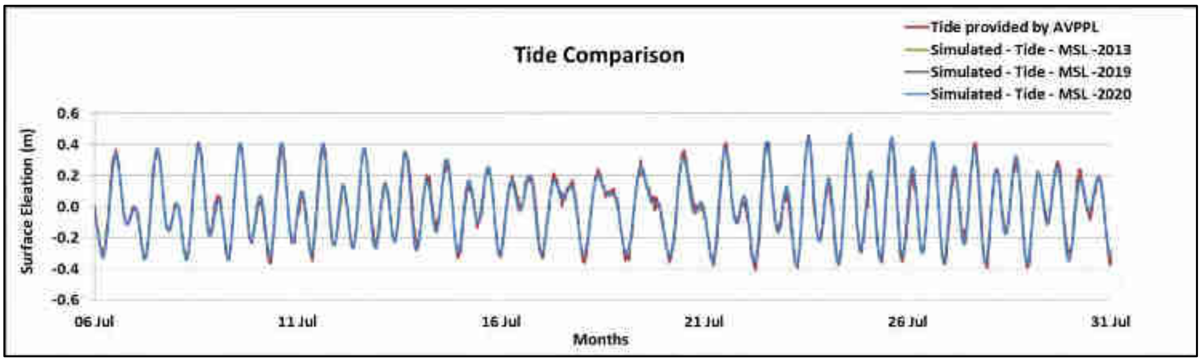
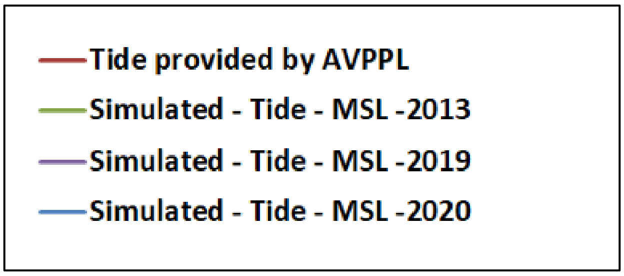
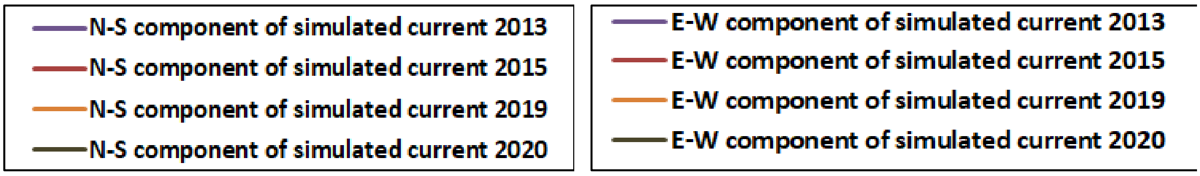


Figure 3-10 Comparison of simulated tide with AVPPL data 2013 (SW Monsoon)



Legend of Tide comparison plot

Figure 3-12 to Figure 3-17 shows the comparison of N-S and E-W components of simulated currents (2013, 2015, 2016, 2017, 2018 and 2019) at the measurement locations put on a similar time scale. As in the case of tides, 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 3-18 and Figure 3-19 shows typical plots from the simulation.



Legend of current comparison plots at CM locations

Figure 3-11 Current meter locations (2013)

Table 3-1 Current meter locations – Mulloor (2013)

Name	Depth – CD (m)	Location	UTM – Zone 43 – WGS84	
CM1	13.0	Mulloor	720043 E	925377 N
CM2	18.0		719621 E	925034 N
CM3	24.0		719013 E	924545 N

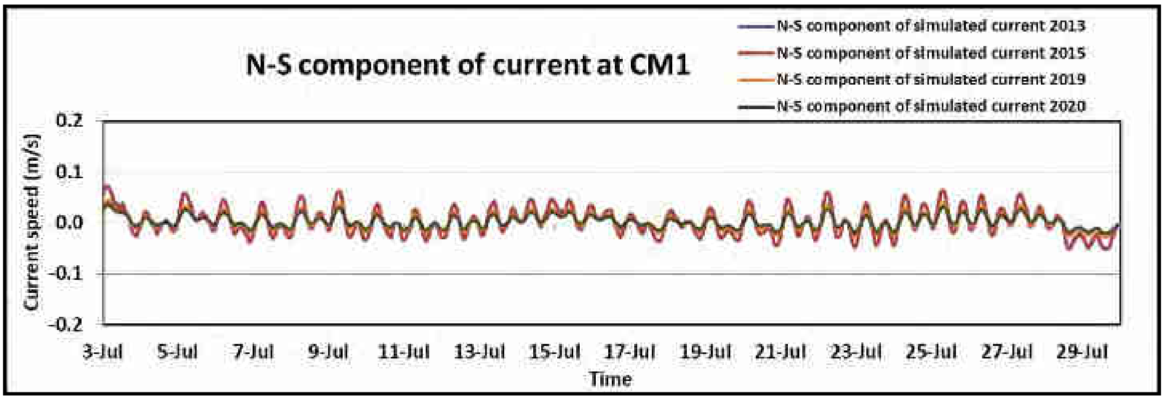


Figure 3-12 Comparison of N-S component of current at CM1 during SW-monsoon

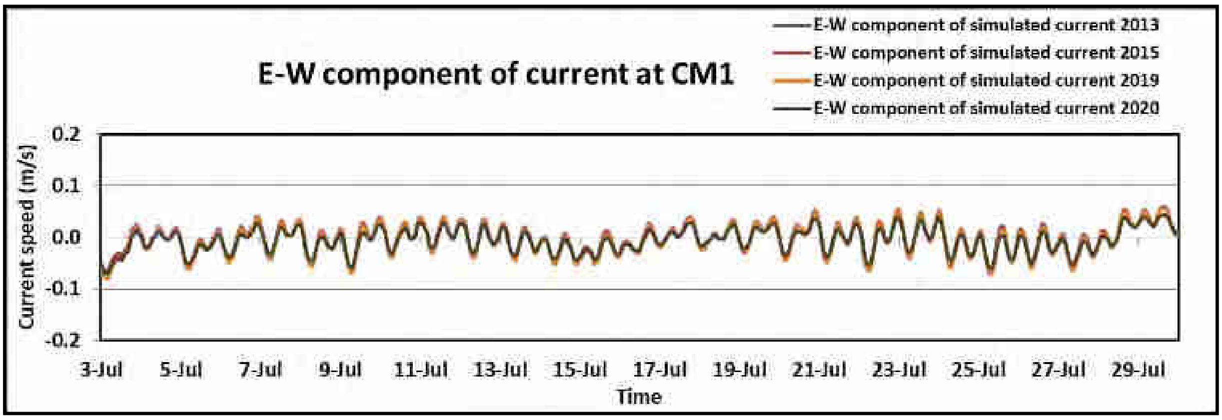


Figure 3-13 Comparison of E-W component of current at CM1 during SW-monsoon

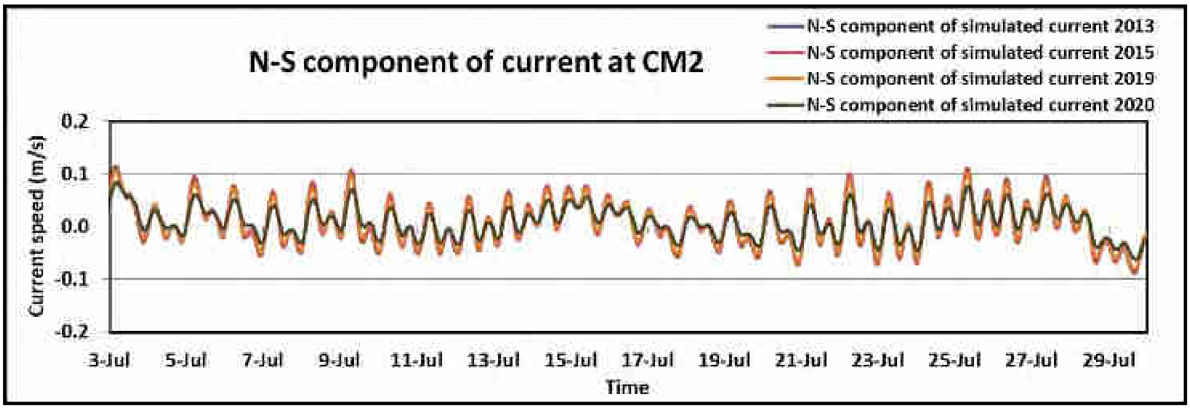


Figure 3-14 Comparison of N-S component of current at CM2 during SW-monsoon

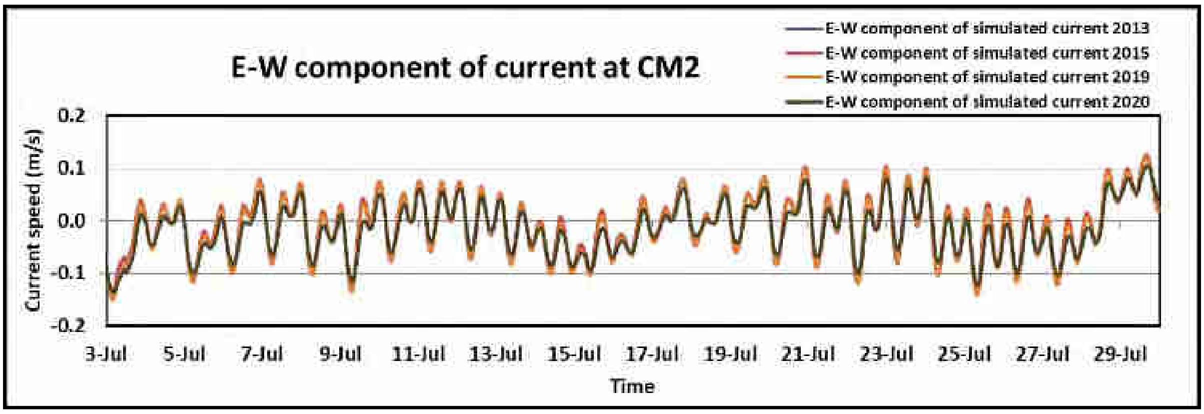


Figure 3-15 Comparison of E-W component of current at CM2 during SW-monsoon

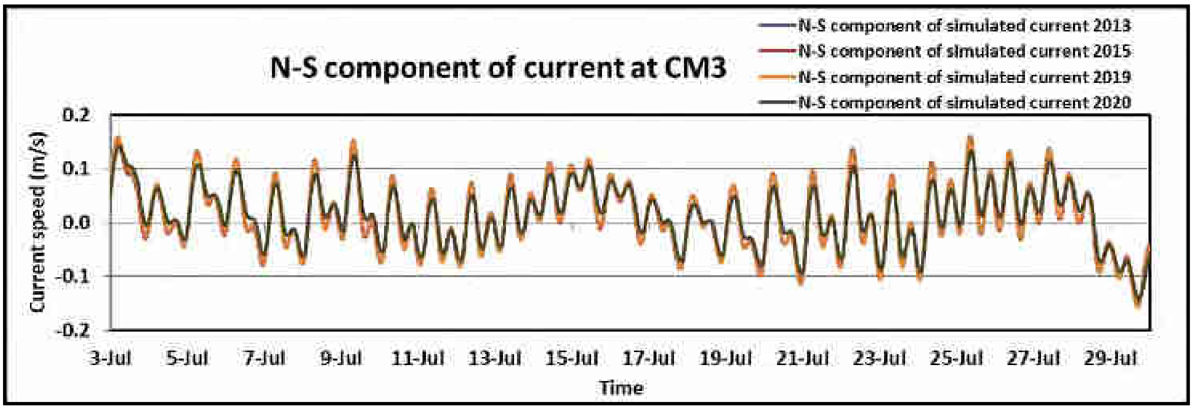


Figure 3-16 Comparison of N-S component of current at CM3 during SW-monsoon

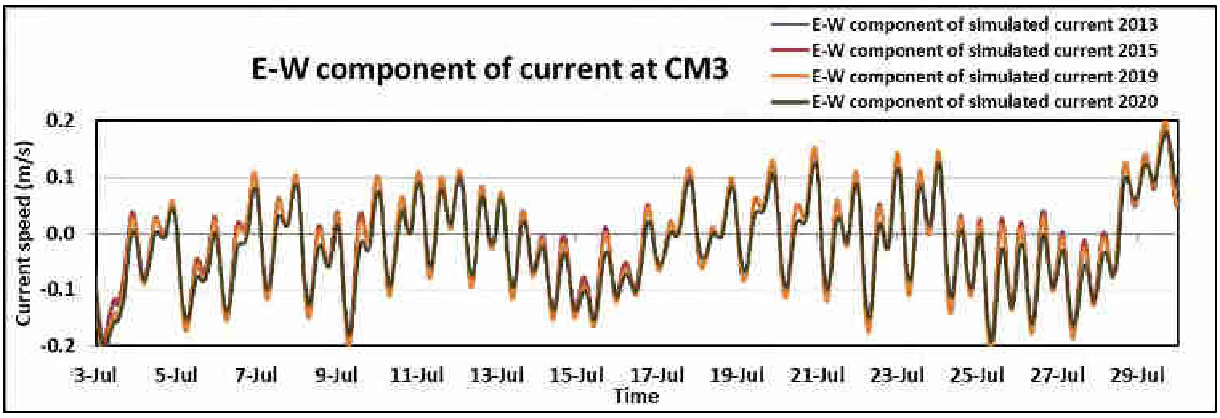


Figure 3-17 Comparison of E-W component of current at CM3 during SW-monsoon

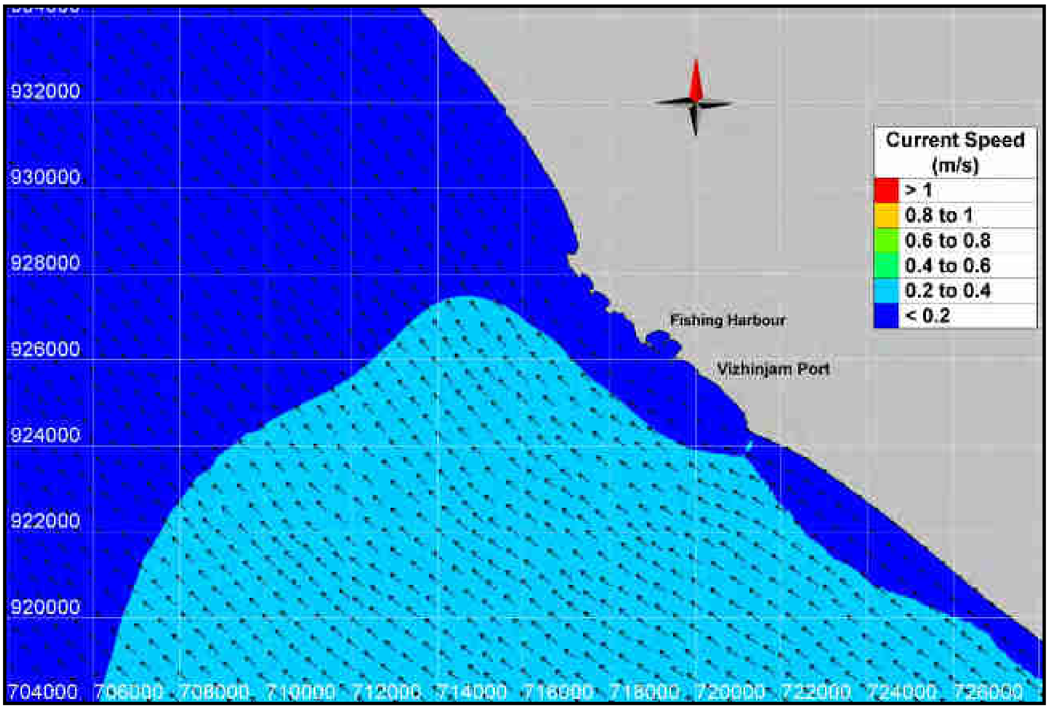


Figure 3-18 Current pattern showing north-westerly flow (typical during monsoon) for pre-monsoon bathymetry

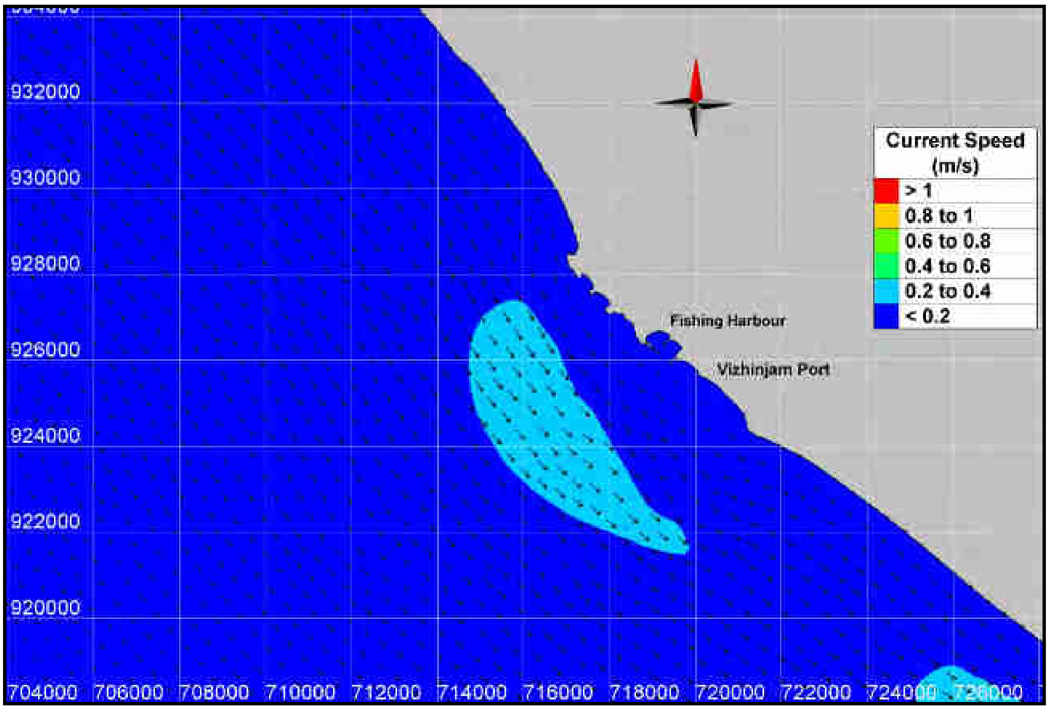


Figure 3-19 Current pattern showing south-easterly flow (typical during monsoon) for pre-monsoon bathymetry

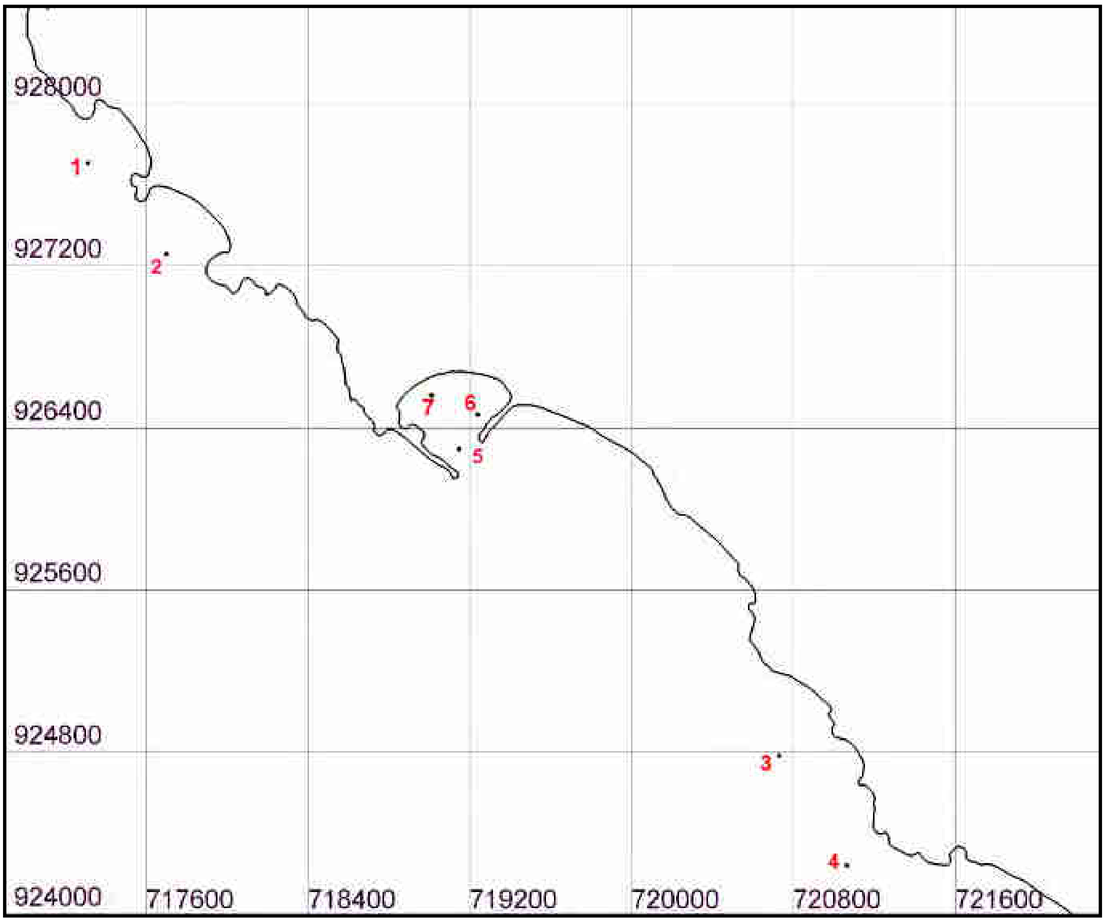
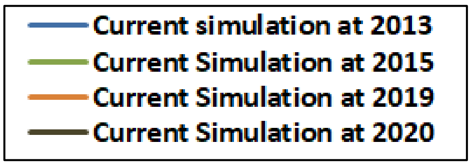


Figure 3-20 Current comparison points location (near shoreline)

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 3-20. The current comparison plots were shown in Figure 3-21 to Figure 3-27. 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.



Legend of current comparison plots at points

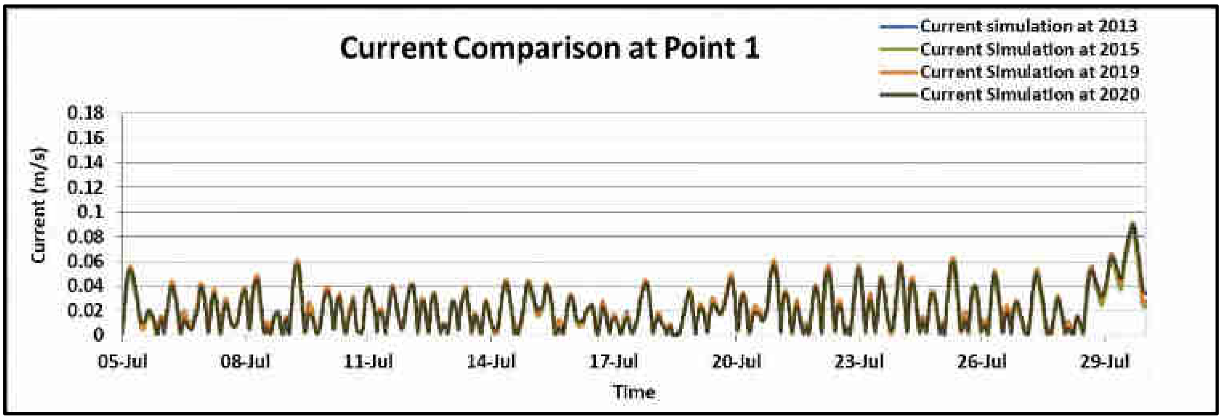


Figure 3-21 Current comparison at point 1

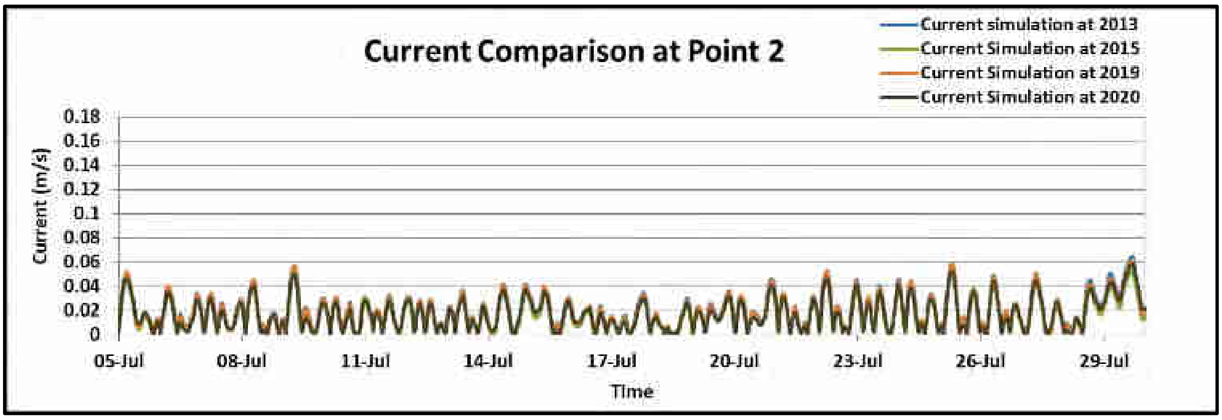


Figure 3-22 Current comparison at point 2

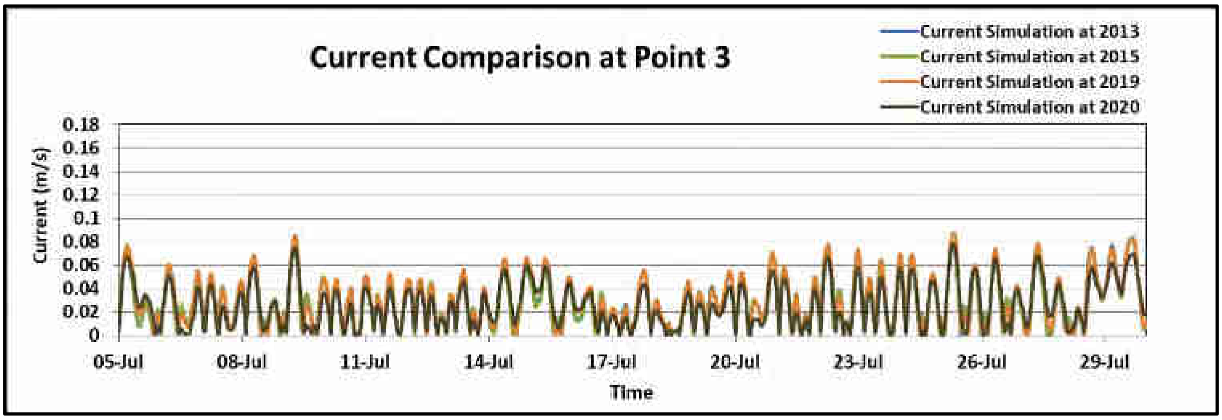


Figure 3-23 Current comparison at point 3

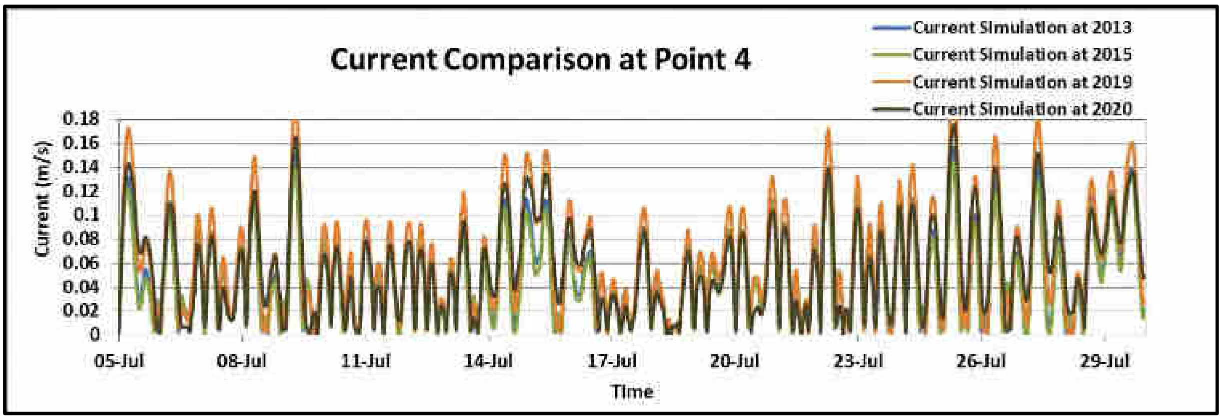


Figure 3-24 Current comparison at point 4

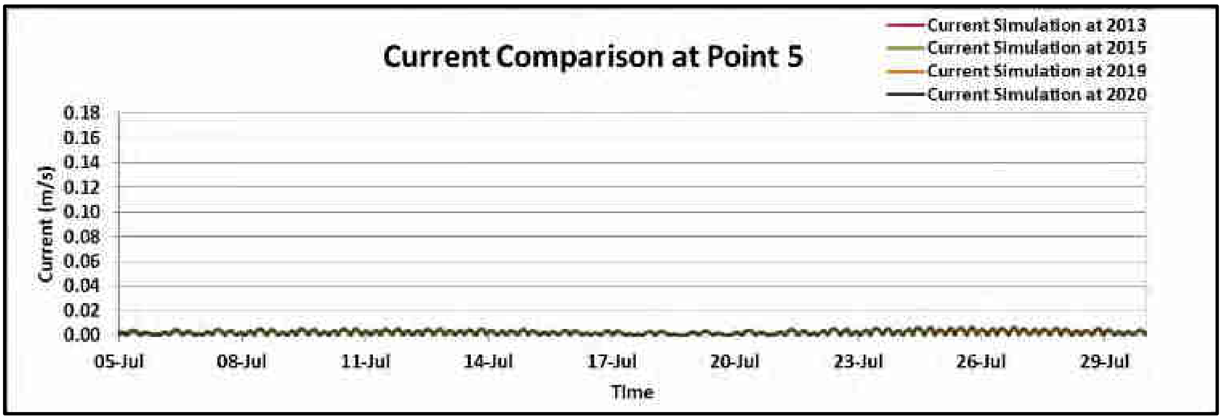


Figure 3-25 Current comparison at point 5

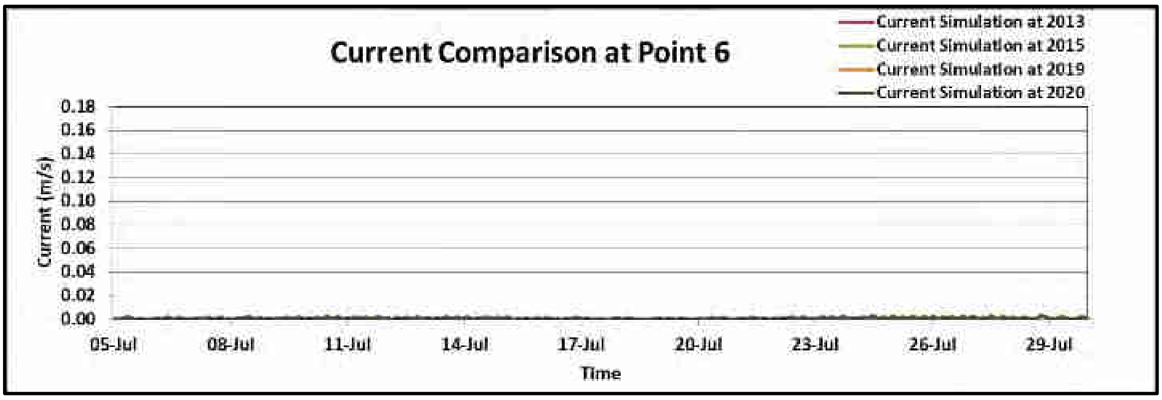


Figure 3-26 Current comparison at point 6

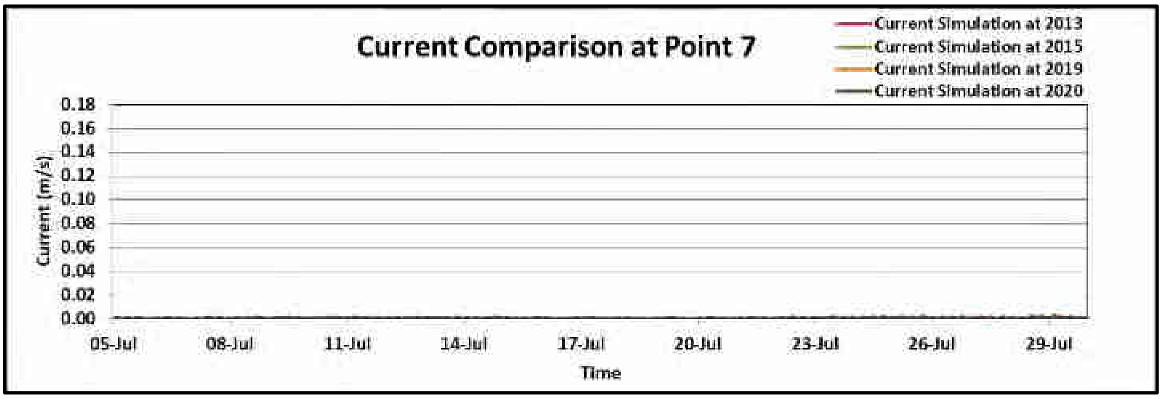


Figure 3-27 Current comparison at point 7

Also, model was setup using latest surveyed bathymetry as on date i.e. Pre monsoon 2020 and Post Monsoon 2020. The same calibration parameters and boundary conditions as discussed in earlier sections are used to simulate hydrodynamics. The model bathymetry (post monsoon) prepared using the available primary and secondary data is shown in Figure 3-7 and Figure 3-8.

Comparison between the simulated and observed tide and currents were done. Figure 3-28 and Figure 3-29 show the comparison between the modelled tide and observed tide measured 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.

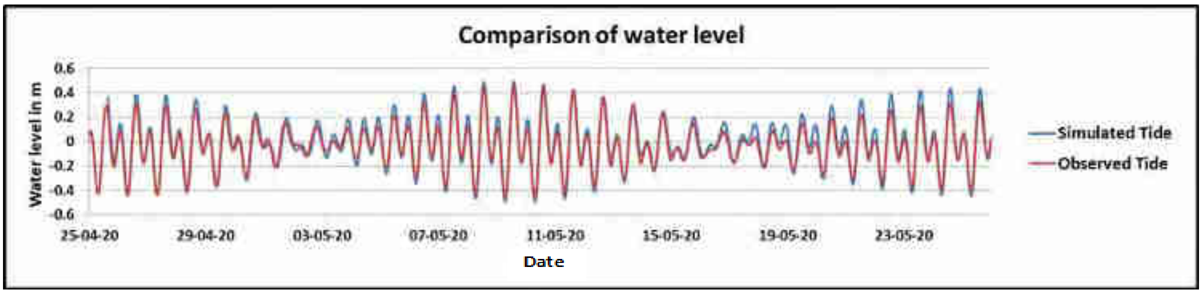


Figure 3-28 Comparison of simulated tide with observed tide (Pre Monsoon 2020)

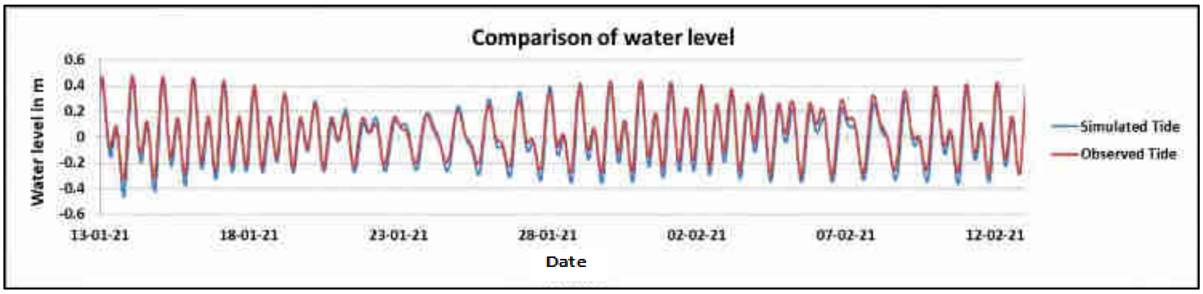


Figure 3-29 Comparison of simulated tide with observed tide (Post Monsoon 2020)

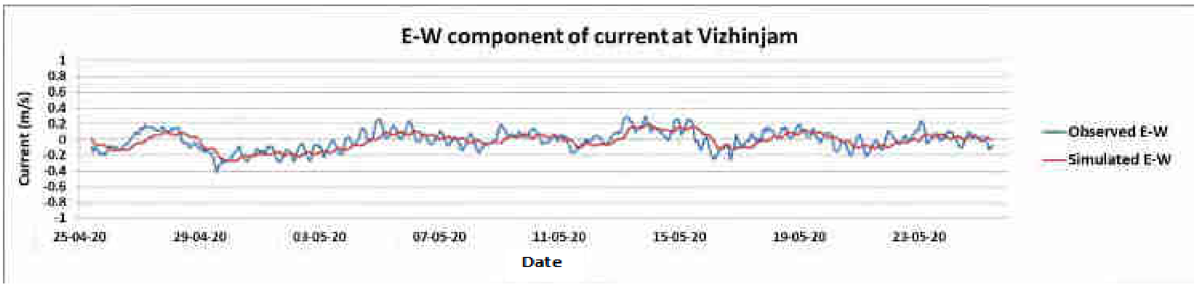


Figure 3-30 Comparison of E-W component of current at Vizhinjam (Pre Monsoon 2020)

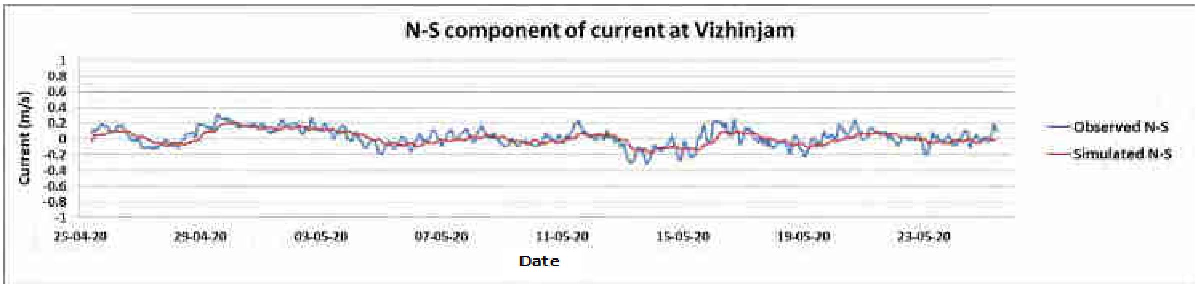


Figure 3-31 Comparison of N-S component of current at Vizhinjam (Pre Monsoon 2020)

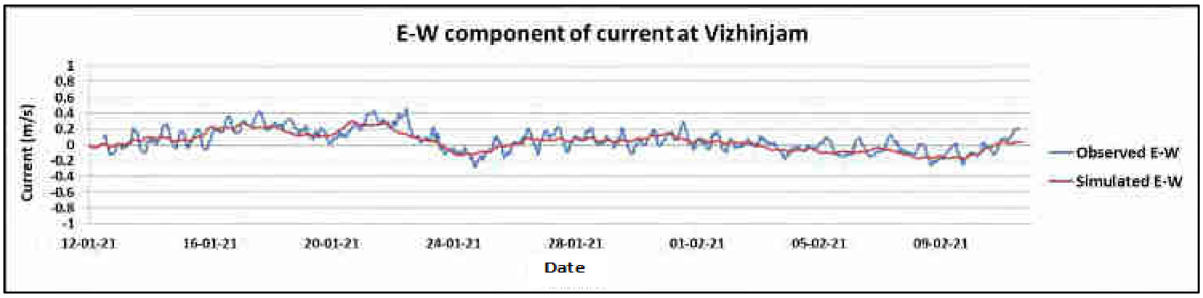


Figure 3-32 Comparison of E-W component of current at Vizhinjam (Post Monsoon 2020)

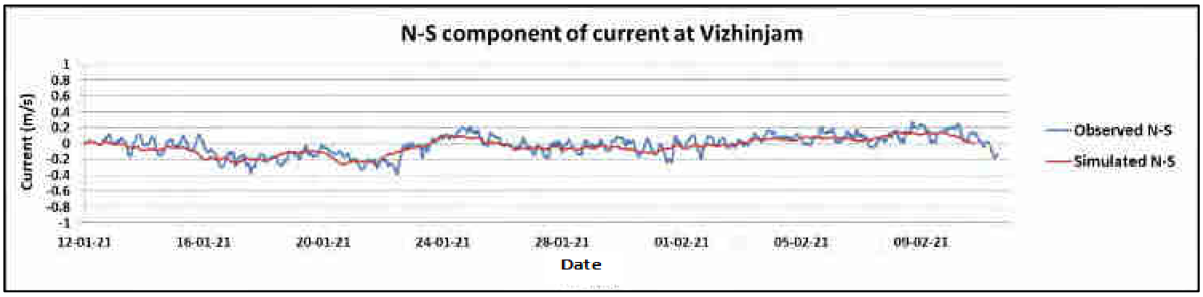


Figure 3-33 Comparison of N-S component of current at Vizhinjam (Post Monsoon 2020)

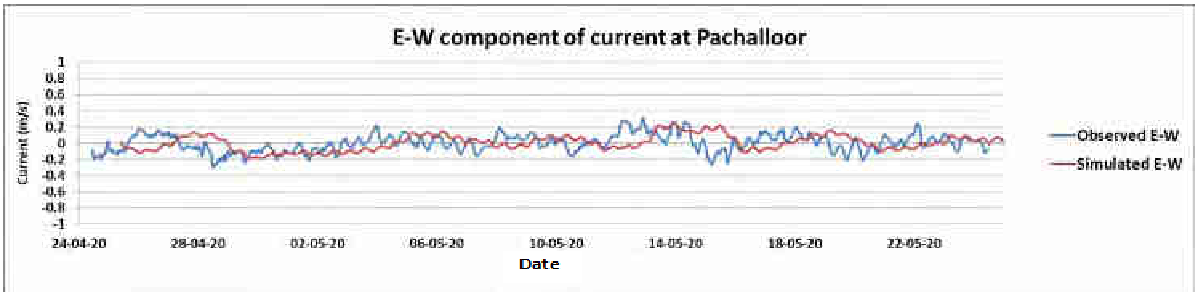


Figure 3-34 Comparison of E-W component of current at Pachalloor (Pre Monsoon 2020)

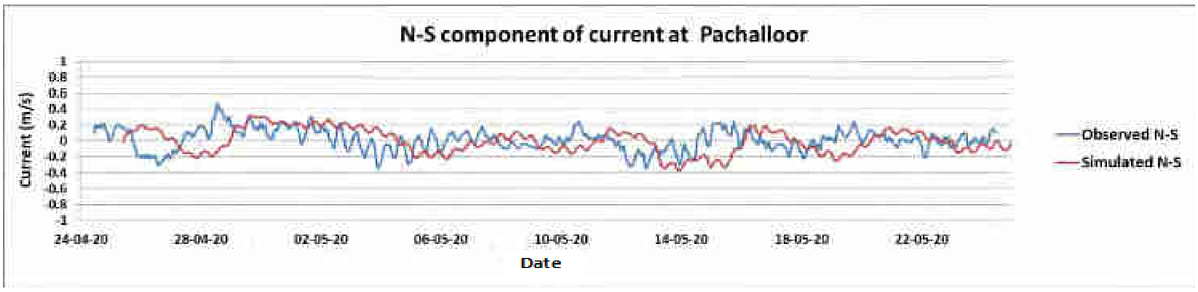


Figure 3-35 Comparison of N-S component of current at Pachalloor (Pre Monsoon 2020)

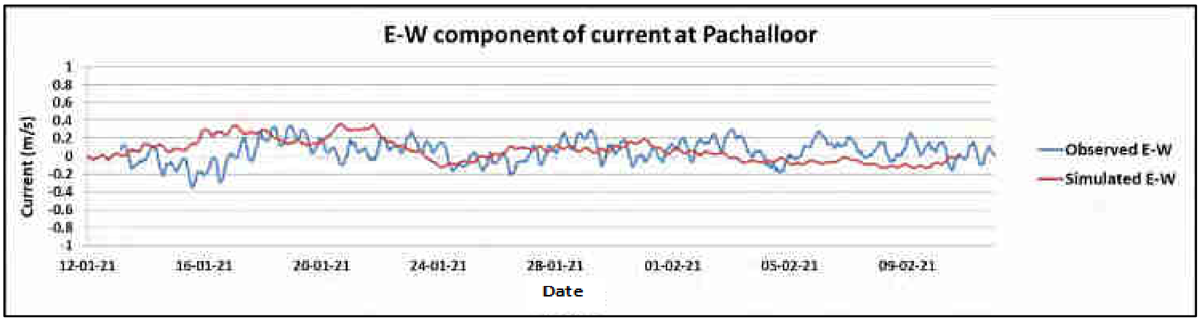


Figure 3-36 Comparison of E-W component of current at Pachalloor (Post Monsoon 2020)

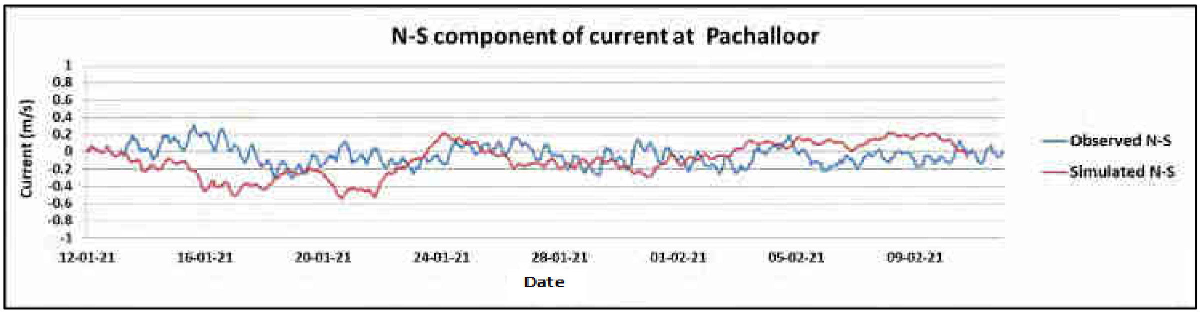


Figure 3-37 Comparison of N-S component of current at Pachalloor (Post Monsoon 2020)

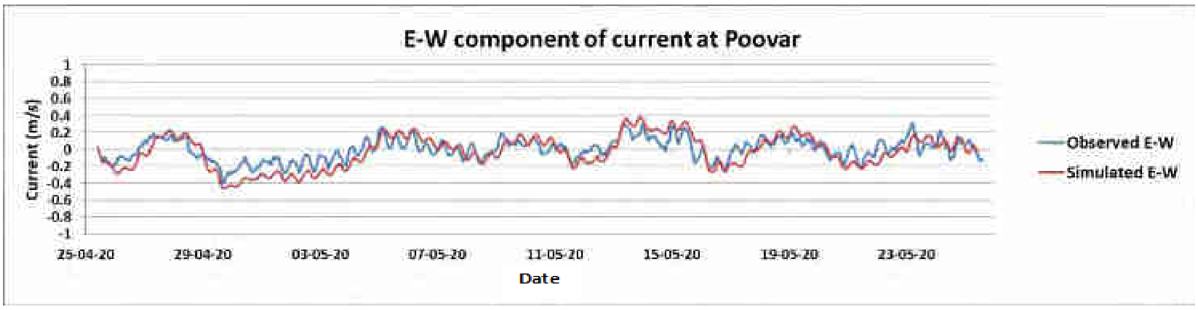


Figure 3-38 Comparison of E-W component of current at Poovar (Pre Monsoon 2020)

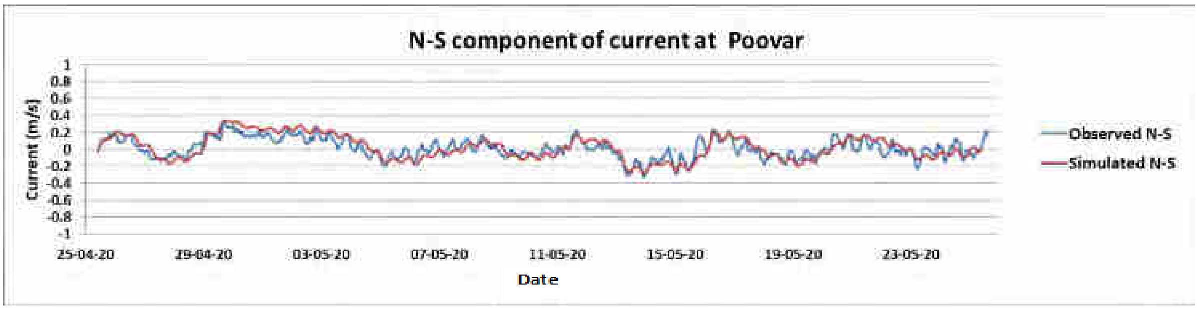


Figure 3-39 Comparison of N-S component of current at Poovar (Pre Monsoon 2020)

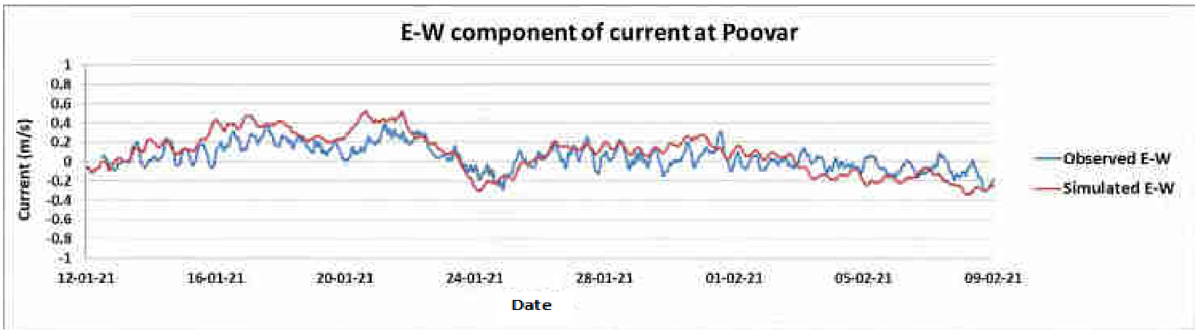


Figure 3-40 Comparison of E-W component of current at Poovar (Post Monsoon 2020)

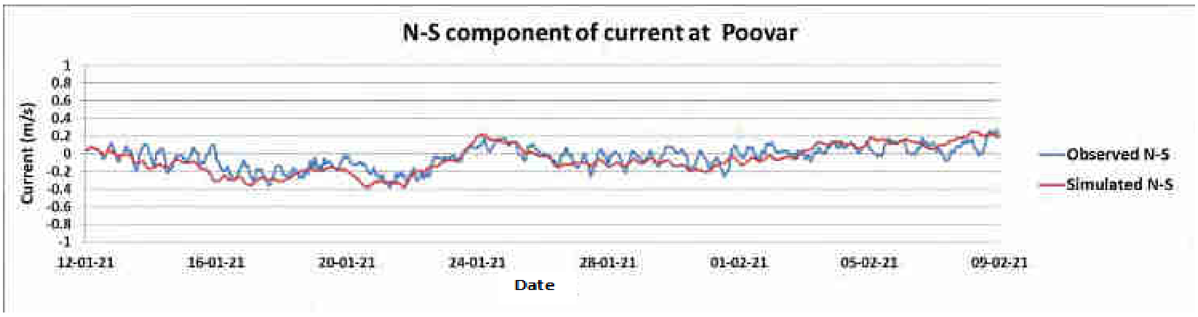


Figure 3-41 Comparison of N-S component of current at Poovar (Post Monsoon 2020)

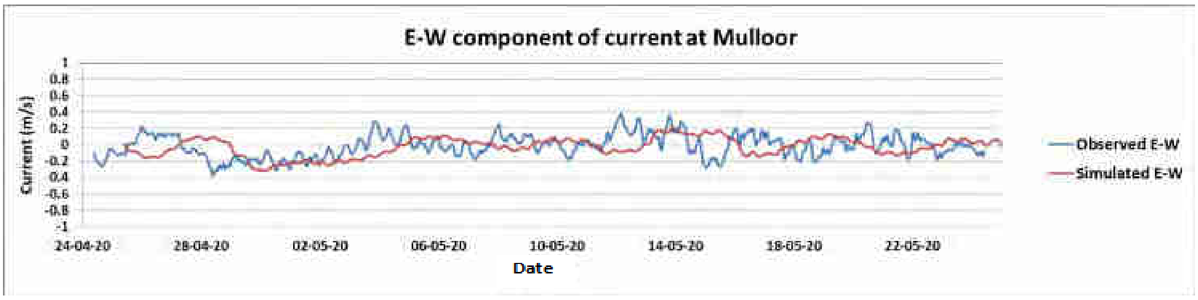


Figure 3-42 Comparison of E-W component of current at Mulloor (Pre Monsoon 2020)

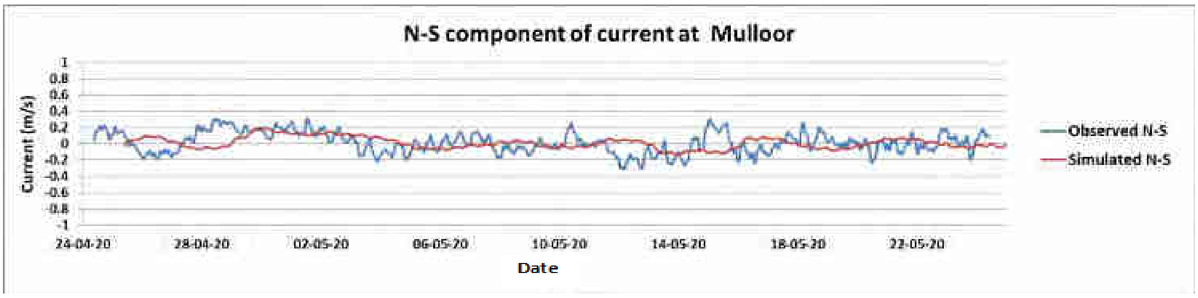


Figure 3-43 Comparison of N-S component of current at Mulloor (Pre Monsoon 2020)

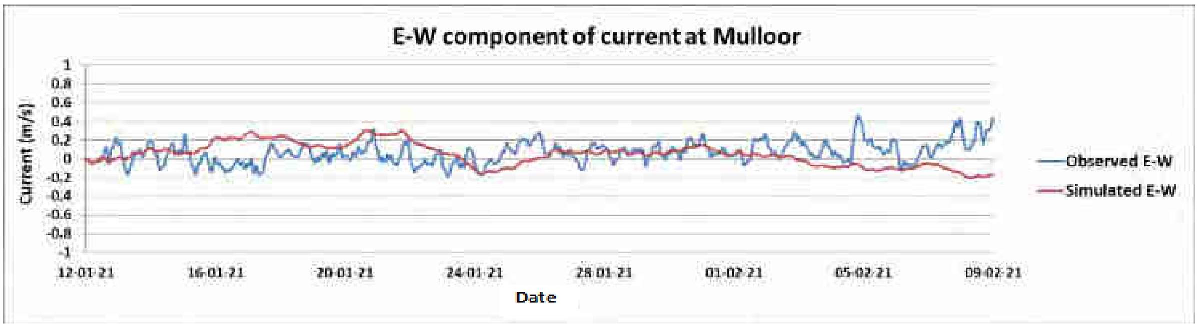


Figure 3-44 Comparison of E-W component of current at Mulloor (Post Monsoon 2020)

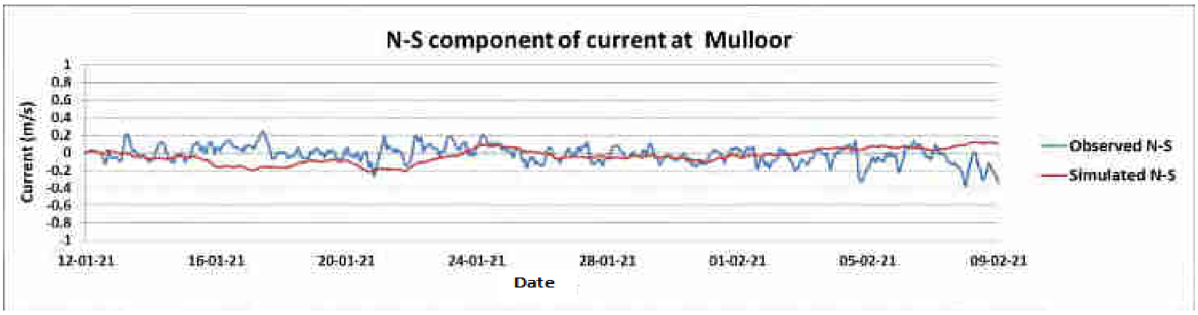


Figure 3-45 Comparison of N-S component of current at Mulloor (Post Monsoon 2020-2021)

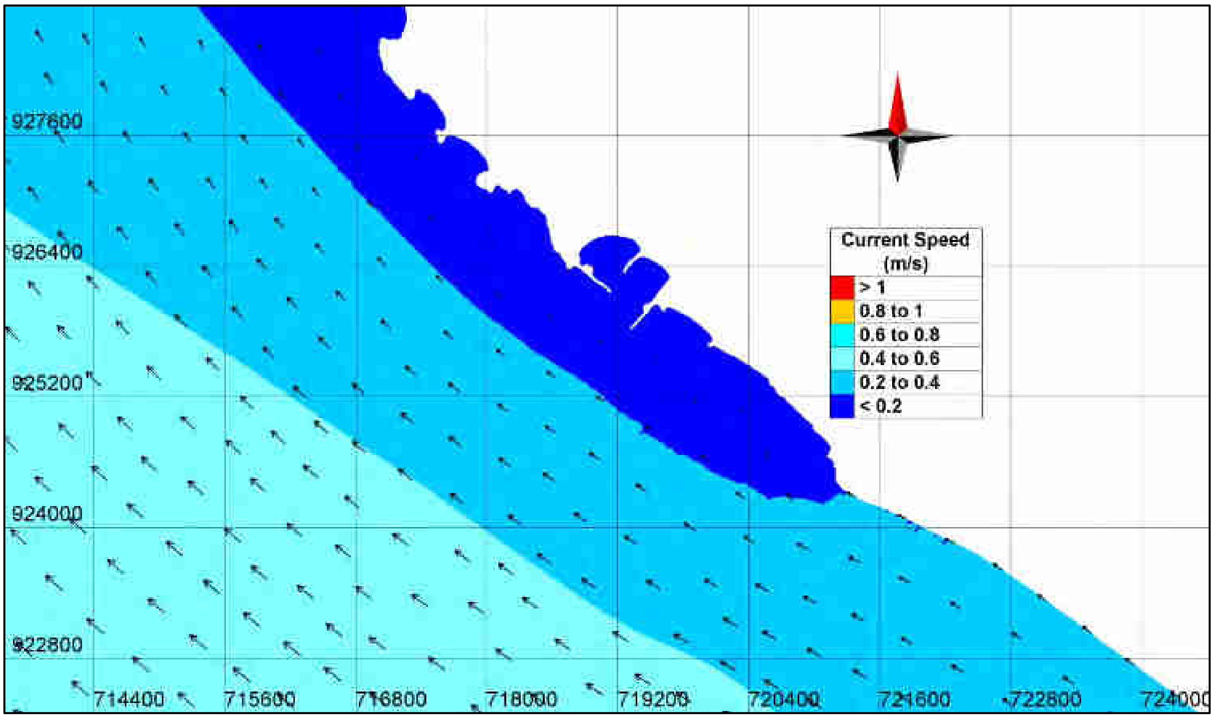


Figure 3-46 Typical plot of current pattern showing north-westerly flow

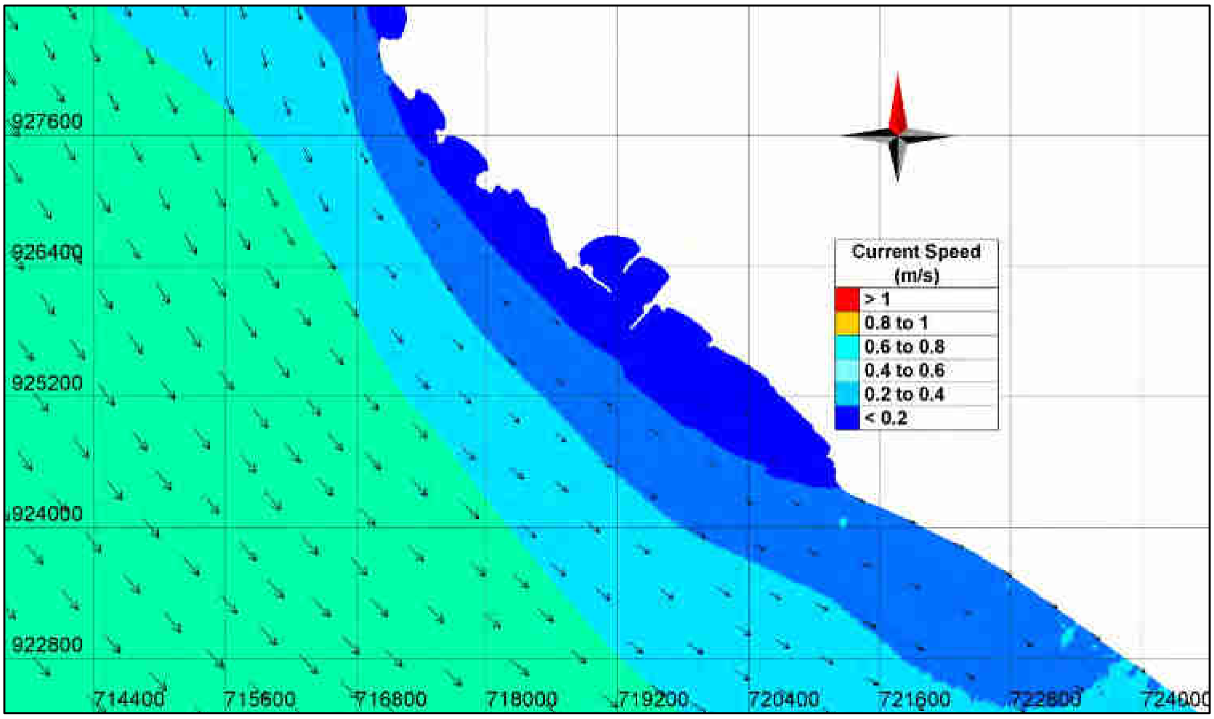


Figure 3-47 Typical plot of current pattern showing south-easterly flow

Figure 3-32 to Figure 3-45 represents the comparison of E-W and N-S components of current during Post monsoon 2019 at different locations (Vizhinjam, Pachalloor, Poovar and Mulloor). From the comparison plots it can be noticed that there is a good correlation between simulated and observed current at all the locations. Figure 3-46 and Figure 3-47 shows typical plots from simulation. This shows that the model is able to replicate the actual scenario well.

3.3 Longshore sediment transport

Longshore sediment transport refers to the cumulative movement of beach and near shore material parallel to the shore due to wave induced currents in the surf zone. 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 3-48. 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 3-49. This change in orientation will have effect on long shore sediment transport and its behaviour.

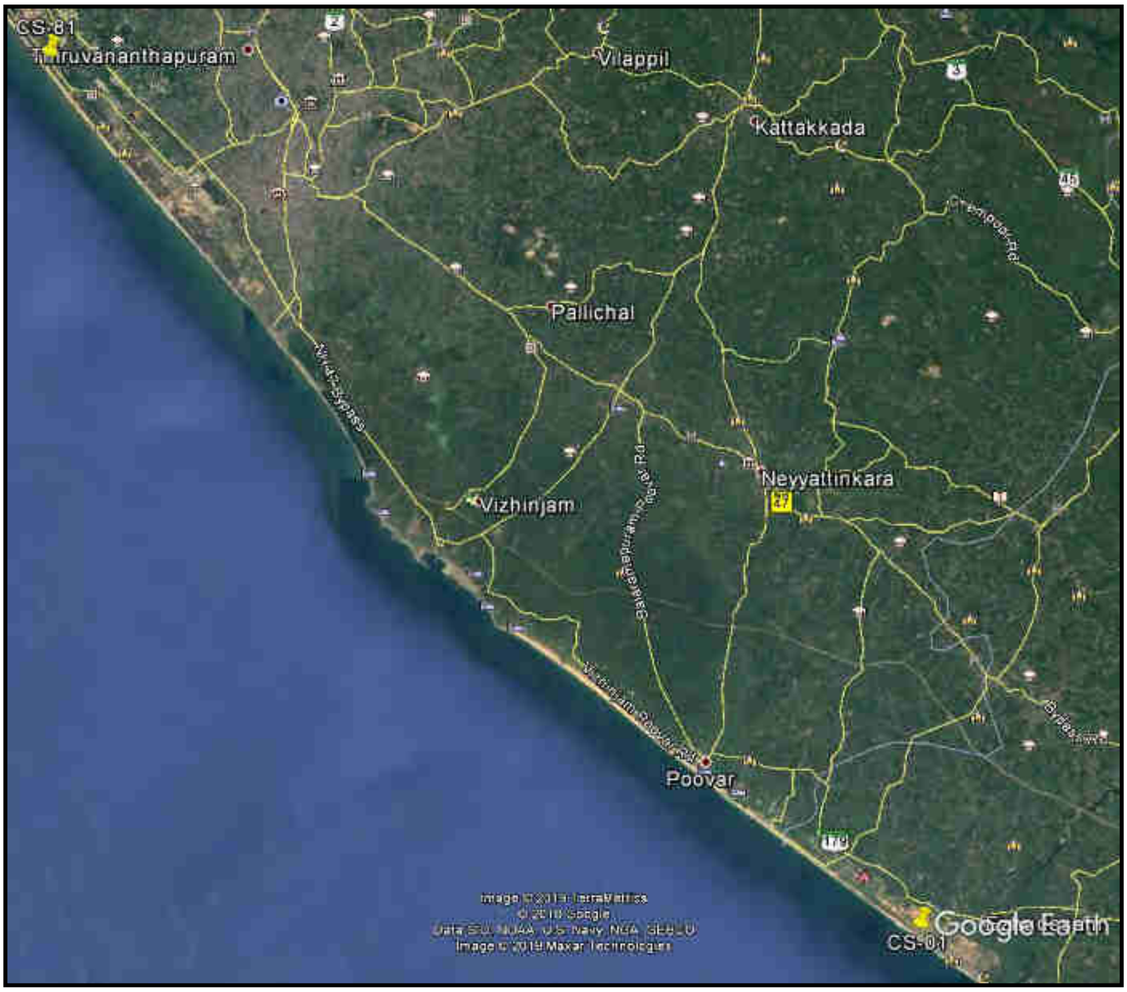
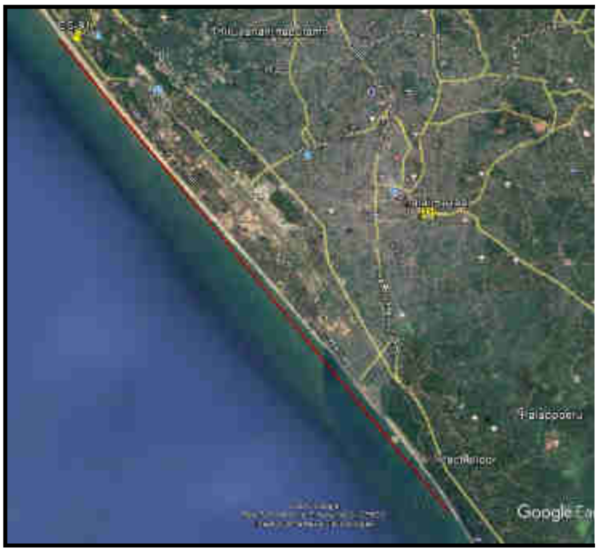
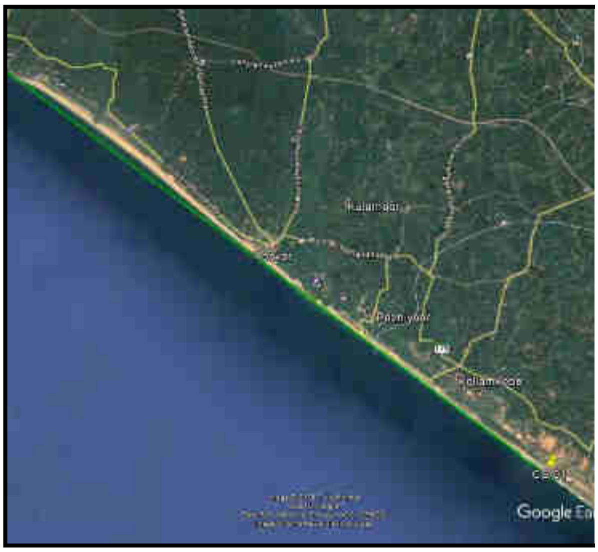


Figure 3-48 Study area



Orientation north of the port



Orientation south of the port

Figure 3-49 Coast orientations

3.3.1 Longshore sediment transport due to breaking waves

In order to compute longshore 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

$$Q = (H^2 C_g)_b [a_1 sin2\Theta_{bs} - a_2 cos\Theta_{bs} \frac{\partial H}{\partial x}]_b$$

$$a_1 = \frac{K_1}{16(s-1)(1-p)(1.416)^{5/2}}$$

$$a_2 = \frac{K_2}{8(s-1)(1-p)tan\beta(1.416)^{7/2}}$$

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 longshore 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.

As explained earlier, depending on the coast orientation two average LSTR estimates were calculated based on available 5 years data (Feb 2015 – Feb 2021). The northerly and southerly (annual average) longshore 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 longshore 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).

4 Analysis of Beach Volume

An analysis was done to calculate the sediment volume from the available beach profile data. This section provides the details of the analysis carried out for the volume analysis.

The cross shore profiles comprise of beach profiles and sea bed profiles collected at every 0.5 km interval along 40 locations to the north of the port, 40 locations to the south of the port and 1 location near port, representing the elevations with respect to chart datum. One limitation with the cross profiles used in this project is that there is a data gap in between the beach profile and the sea bed profiles owing to the intertidal zone where data collection is tricky. To overcome this limitation to certain extent, LNTIEL used interpolation technique of finding difference between profile and average profiles and filled data gaps. The resulting profiles were used to compute the beach volume.

The beach profile volume and sea bed profile volume combined together represents the net volume (m^3/m alongshore). The Feb 2015 (start of survey) profile is considered as baseline to estimate the volume changes. Figure 4-1 shows the volume change along the coast during Feb 2021. Abscissa (X – axis) represents the cross sections or stations and ordinate (Y – axis) represents the volume change in m^3/m alongshore. The positive values indicate accretion and negative values indicate erosion. The Brown line on the graph represents beach profile volume, the green line on the graph represents sea bed profile volume and the pink line on the graph represents net volume. It can be noted that the volumes on beach and sea side mirror each other in the erosion and accretion. However, these are not exact opposite in quantities due to which the net volume shows either erosion or accretion. The reasons could be the limitation in calculation of beach profile volume as survey data does not cover active/dynamic beach width entirely at all the locations and limitation in calculation of sea bed profile volume as lack of extension of profile deeper up to the depth of closure. Other reason could be due to longshore sediment transport. In such a case, general tendency observed shall be both beach side and sea side shall show same trend i.e. either accretion or erosion which is not in this case. So it can be due to combination of above limitations.

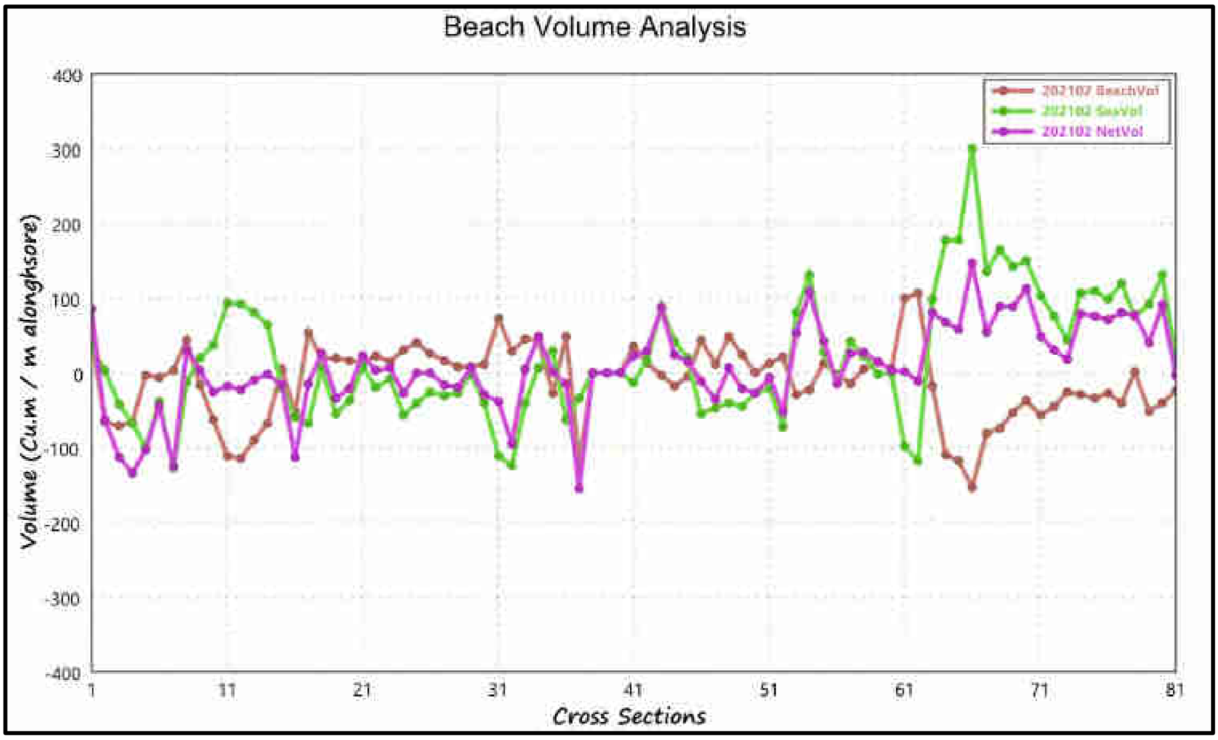


Figure 4-1 Volume change alongshore – Feb 2021

From the volume analysis it was found that near the port, the net volume change is minimal and it remains so for stretches near the port location. Only net volume change seems to be higher in stretches of Valiyathura, Shangumugham and beyond towards Northern Kerala.

Therefore, since around the port and upto a significant distance (at least 10km to the north of the port) the net volume change is minimal, the port cannot have effects on what is happening in Valiyathura, Shangumugham and beyond otherwise the effects would have shown in the nearby regions as well.

4.1.1 Principal Component analysis

Principal Component Analysis (PCA) is the process of computing the principal components and using them to perform a change of basis on the data, sometimes using only the first few principal components and ignoring the rest. This can be used to decompose the profiles into the basic functions that most efficiently explain the data variance. The first mode explains more variance than any other mode. Figure 4-2 shows the temporal variation of principal component 1. Most of the sections follow this pattern. This shows the beach profile is oscillating between bar (negative value) and berm (positive value). During Ockhi, the berm formation is disturbed and the beach has not recovered fully. In other terms, the beach profile shows seasonal variation of erosion and accretion.

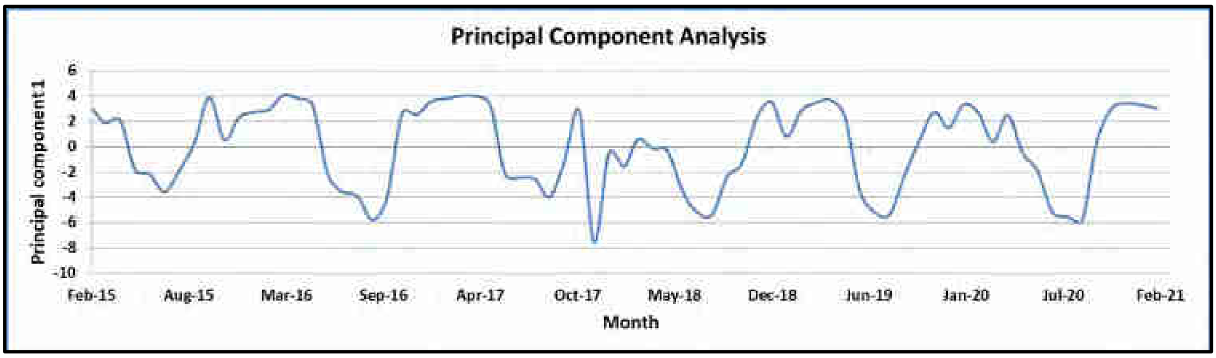


Figure 4-2 Temporal variation of principal component 1

The following graph represents the square of the Hs versus time. The square of the Hs is relatable to the energy of the wave. This shows inverse correlation with the principal component 1 temporal plot as we can notice the berm formation during calm period and bar formation during rough season.

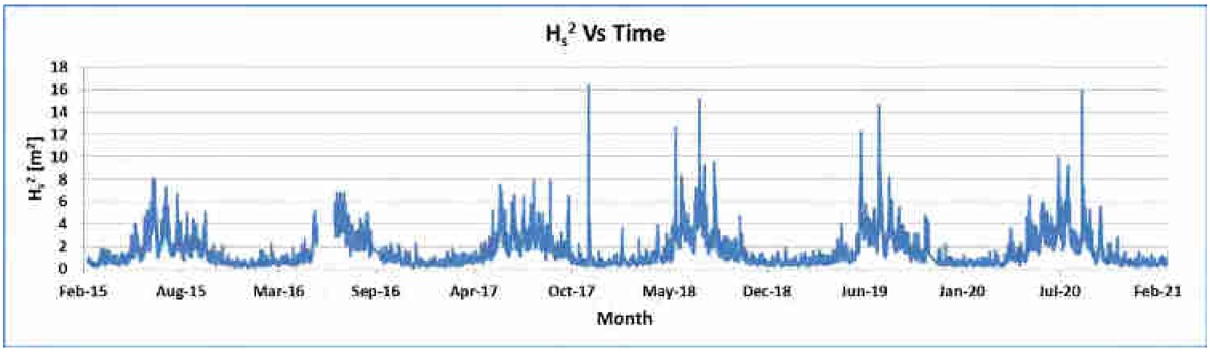


Figure 4-3 H_s^2 versus Time plot

The following graph shows temporal variation of H_s^2 and principal component. It can be noted from this graph that the higher the H_s^2, the lower the principal component and vice versa.

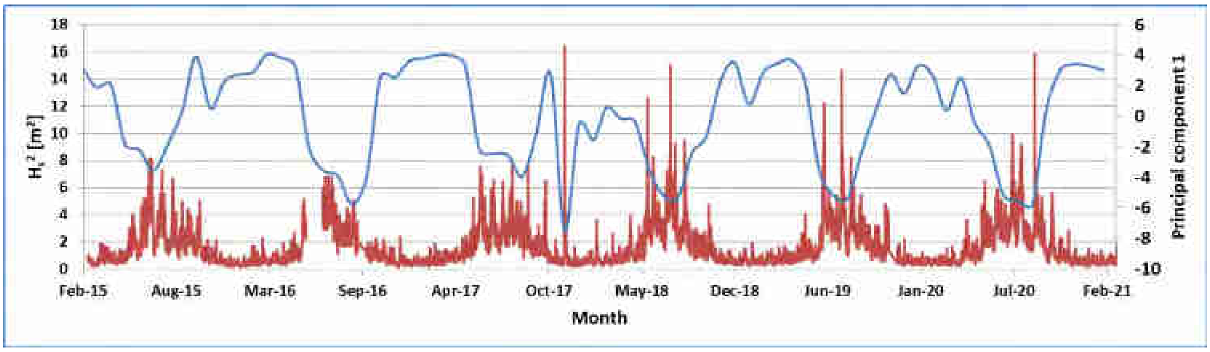


Figure 4-4 Graph showing temporal variation of H_s^2 and principal component 1

5 Conclusion

Following are the summary of the work carried out by LNTIEL:

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 7 transect lines perpendicular to the shore; four on the North of port, two on the South of port and one near the port. Cross sections of bathymetries from Pre monsoon 2015 to Post monsoon 2020 were compared. From the analysis, no significant change in bathymetry is observed even though some localized changes have occurred due to dredging and reclamation near the port.
- The observed wave data provided by AVPPL for the period of March 2020 to February 2021 is analysed and compared with the observed wave data for February 2018 to February 2020. Majority of the waves observed at the project location fall in the range of 0.5-1.5 m. From these comparisons, the variability of wave heights and directions are within expected ranges. It was also noted that some of the higher events were as a direct result of the moving storms & depressions in the sea and that these events caused a direct impact on the wave heights.
- The current data was provided for the pre-monsoon, monsoon and post-monsoon of 2020 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 0.8 m/s. However, occasionally maximum current speed observed during all the seasons is in the range of 0.8 to 1.0 m/s.
- Continuous monitoring of turbidity using buoys has been carried out during March 2020 to February 2021 in three locations. It is perceptible from time series plots that the turbidity fluctuates all year round, though the values were lower than 5 NTU for almost all the time showing that the water is clear. A spike during March 2020 was attributed to erroneous reading due to lack of maintenance of the machines due to lockdown for Covid 19.
- 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 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. Furthermore, the increase in

wave heights due to storm events in subsequent years is making the beach recovery more difficult.

- Further LNTIEL extracted (+) 2 m contour from cross shore profile data. The time series plot of (+) 2 m contour over four years 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 not much accretion was noticed during fair weather 2017 and pre-monsoon 2018. In addition, because of monsoon 2018 and 2019 the beach got further eroded compared to previous monsoon seasons.
- From the LEO data, it can be observed that the movement is towards south during monsoon and from earlier analysis, it was found that erosion on the northern side of the port takes place during the monsoon times. So therefore, the results of this analysis suggest that the erosion in the north during monsoon is not due to the port.

2) Model Studies

a) Near Shore Wave Transformation

- Offshore wave data from March 2020 to February 2021 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, 2019 and 2020) 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) 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.
- To compute longshore 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

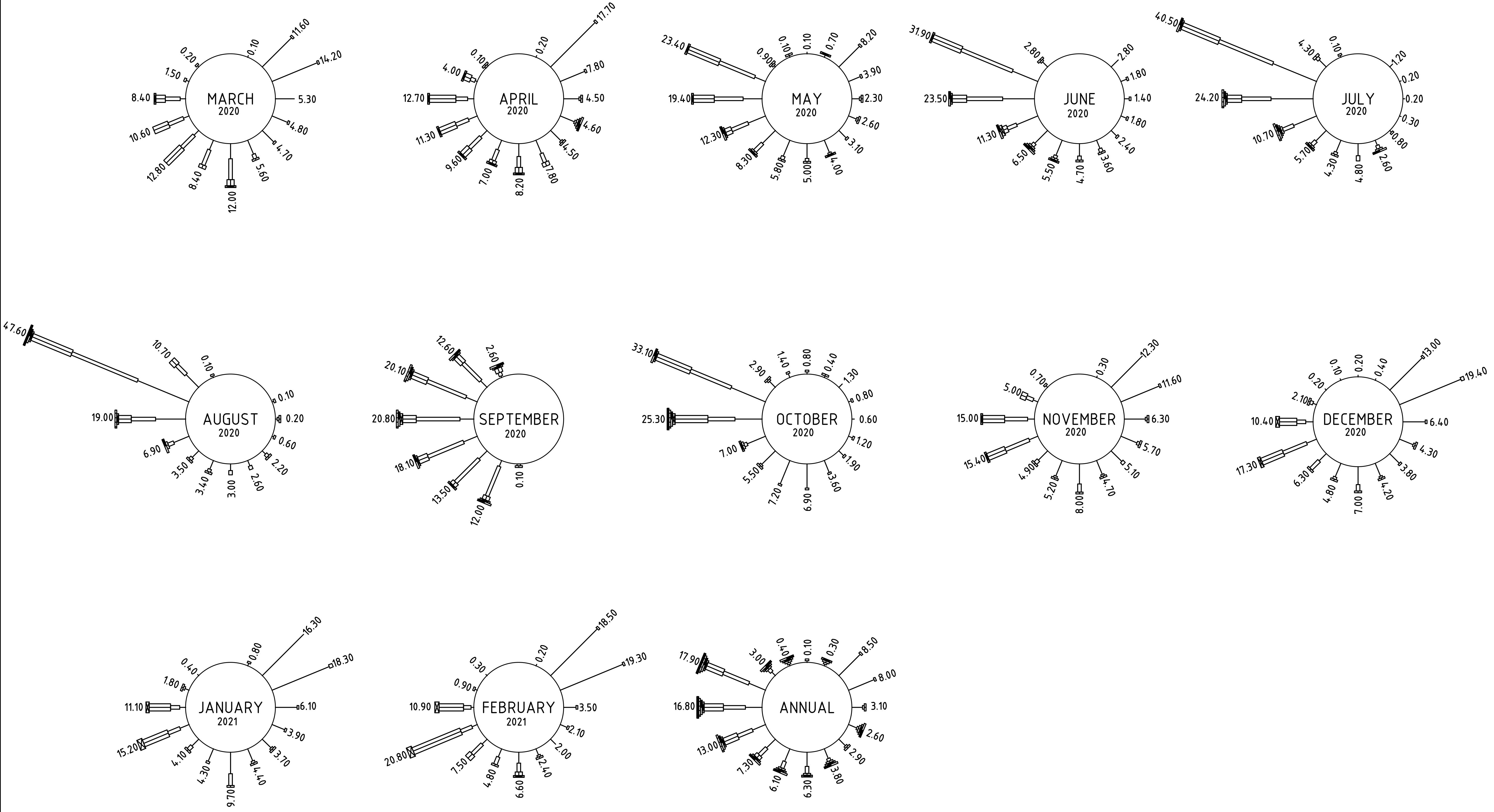
parameters were collected from WRB deployed at 23.2 m water depth and the breaking characteristics of waves were determined by combining wave refraction and shoaling calculations with wave breaking criteria.

- Depending on the coast orientation two average LSTR estimates were calculated based on available 5 years data (Feb 2015 – Feb 2020). 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).

d) Analysis of beach volume

- An analysis was done to calculate the sediment volume from the available beach profile data. LNTIEL used average profiles and filled data gaps using an interpolation technique to carry out the analysis.
- The beach profile volume and seabed profile volume combined represents the net volume (m^3/m alongshore). The Feb 2015 (start of survey) profile is considered as baseline to estimate the volume changes.
- From the volume analysis it was found that near the port, the net volume change is minimal and it remains so for stretches near the port location. Only net volume change seems to be higher in stretches of Valiyathura, Shangumugham and beyond towards Northern Kerala. Therefore since around the port and upto a significant distance (at least 10km to the north of the port) the net volume change is minimal, the port cannot have effects on what is happening in Valiyathura, Shangumugham and beyond otherwise the effects would have shown in the nearby regions as well

LNTIEL carried out data analysis and model studies for the aforementioned project and it was found that wave activity has increased in this location in past three years post Ockhi Cyclone. The beaches that are trying to form back are not getting formed to its prior position because of the increased activity. Also, from the model studies it was found that the bathymetry of the port location has no effect on the current patterns and the current patterns have remained fairly the same. The port has no effect on the erosion and accretion at Valiyathura & Shangumugham, hence concluded from all the analyses.



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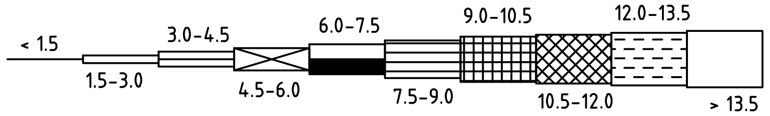

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TITLE: OBSERVED WIND ROSE DIAGRAM (MAR 2020-FEB 2021)

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PROJECT NO: C1211502

DATE: 09/09/21

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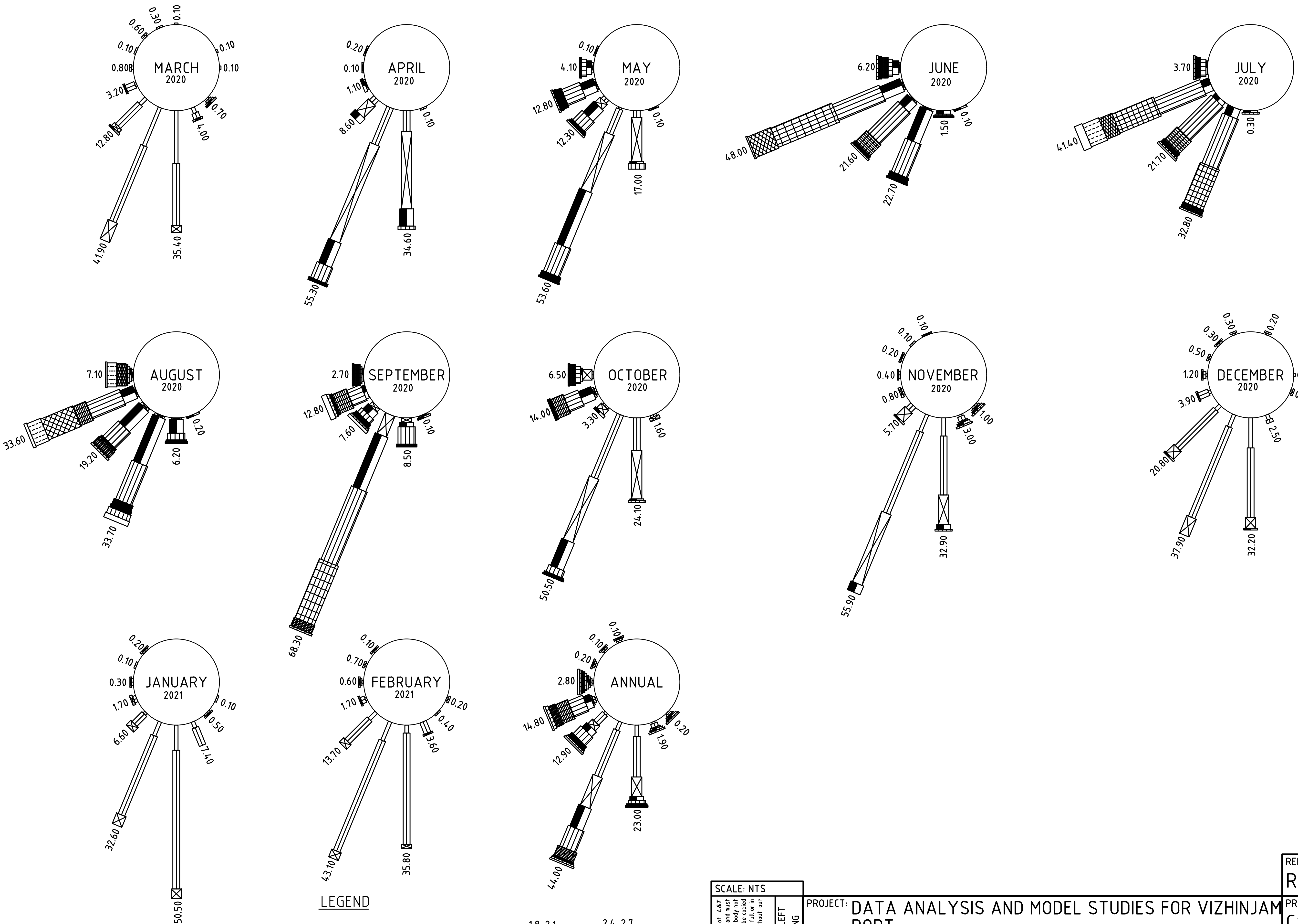

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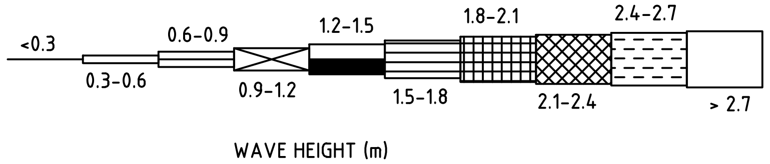

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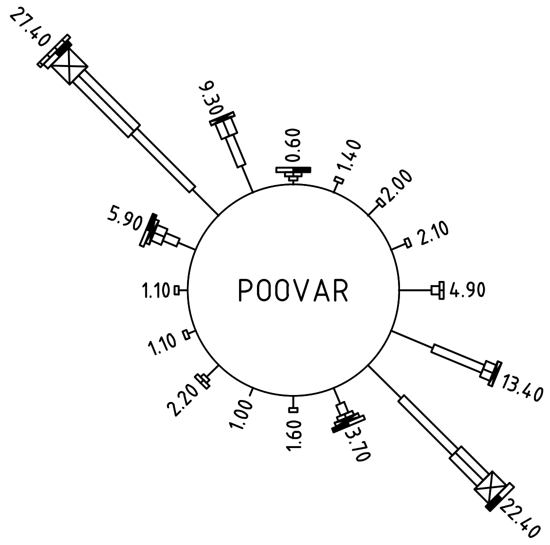

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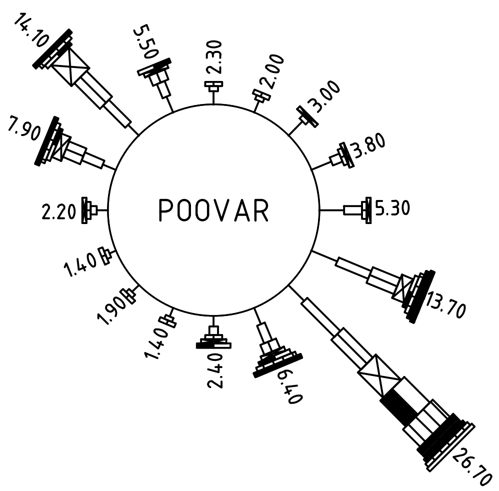

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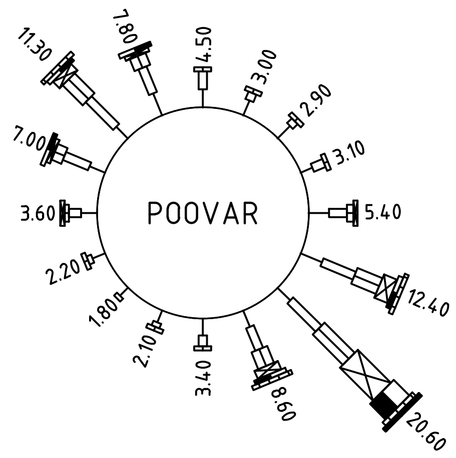

POST-MONSOON (2020)

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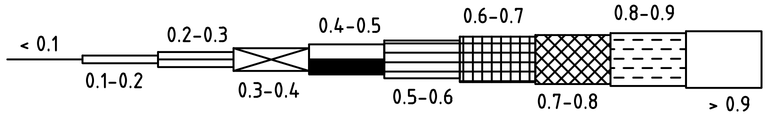

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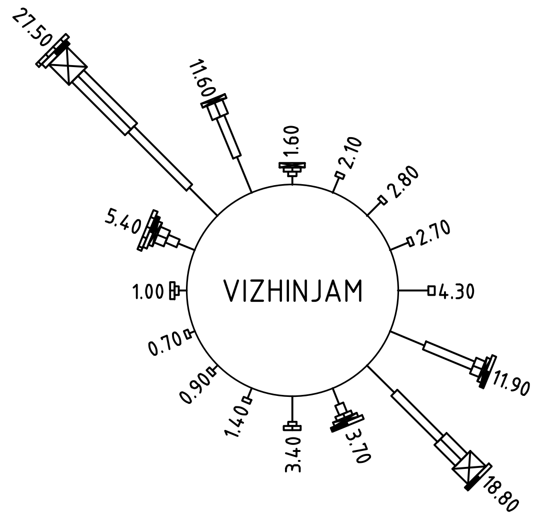

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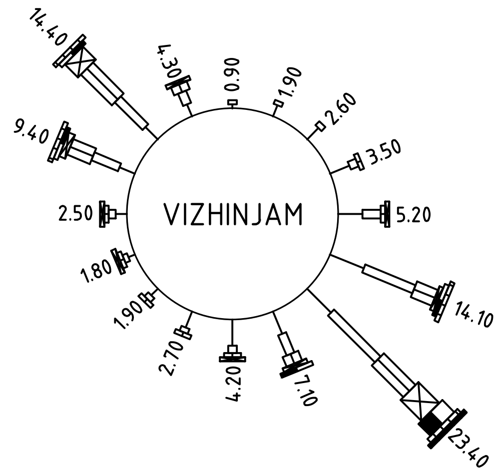

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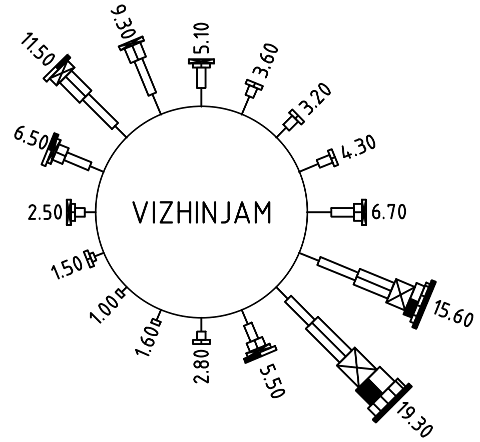

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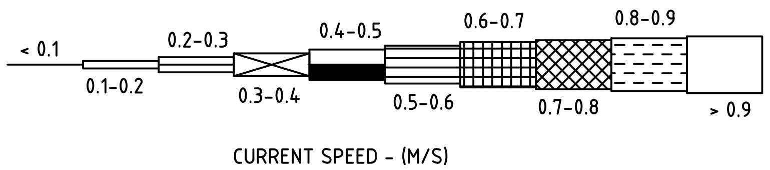

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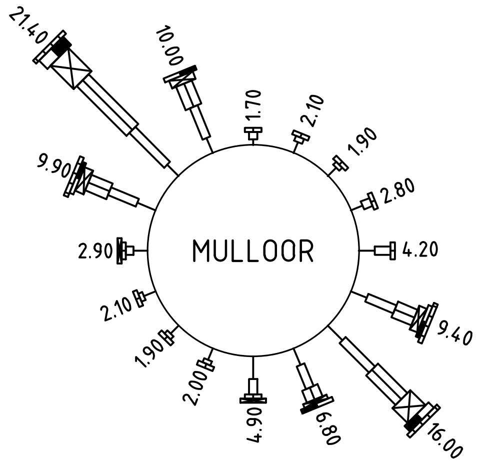

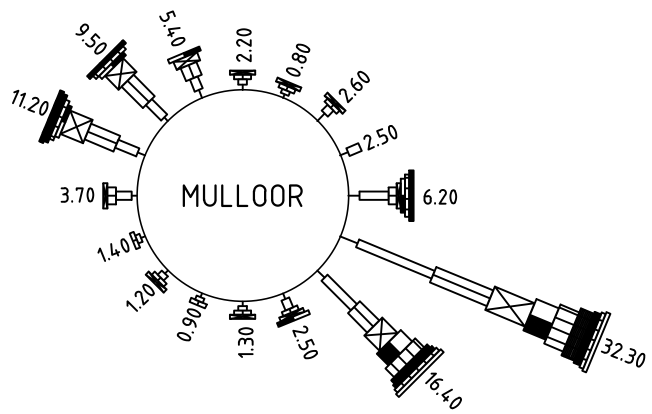

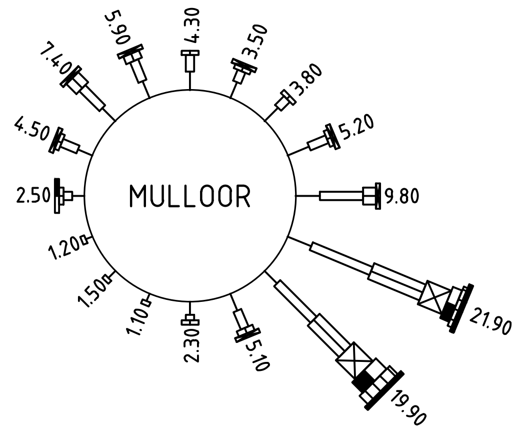

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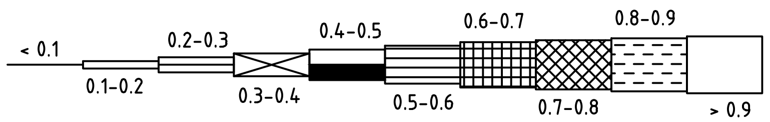

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TITLE:	OBSERVED CURRENT ROSE DIAGRAM AT MULLOOR (MAR 2020-FEB 2021)

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REPORT NO:	RP003
PROJECT NO:	C1211502
DATE:	09/09/21
MADE:	VVY
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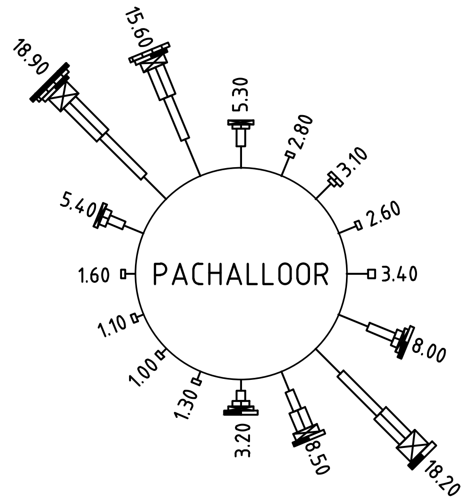
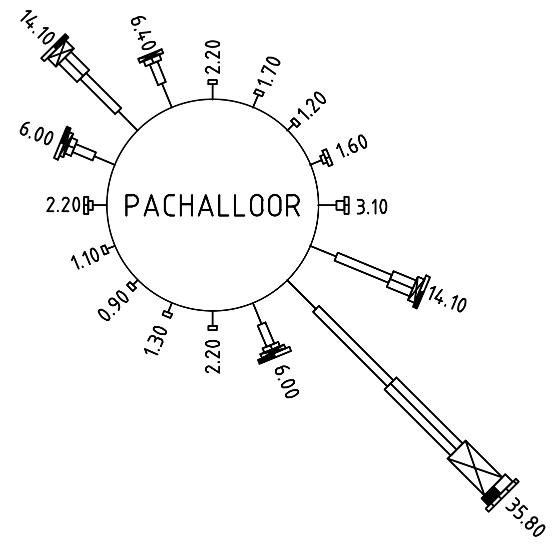
TBA

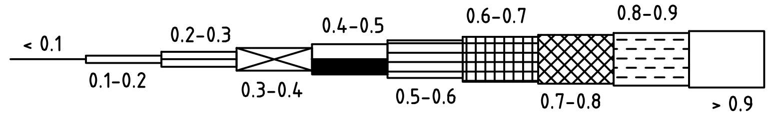


PRE-MONSOON (2020)



POST-MONSOON (2020)

LEGEND



CURRENT SPEED - (M/S)

SCALE: NTS

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PROJECT: DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT	REPORT NO: RP003
	PROJECT NO: C1211502
TITLE: OBSERVED CURRENT ROSE DIAGRAM AT PACHALLOOR (MAR 2020-FEB 2021)	DATE: 09/09/21
	MADE: VVY
L&T Infra Engineering — **L&T Infrastructure Engineering Ltd.**	FIGURE NO: FD0006 REV: 0

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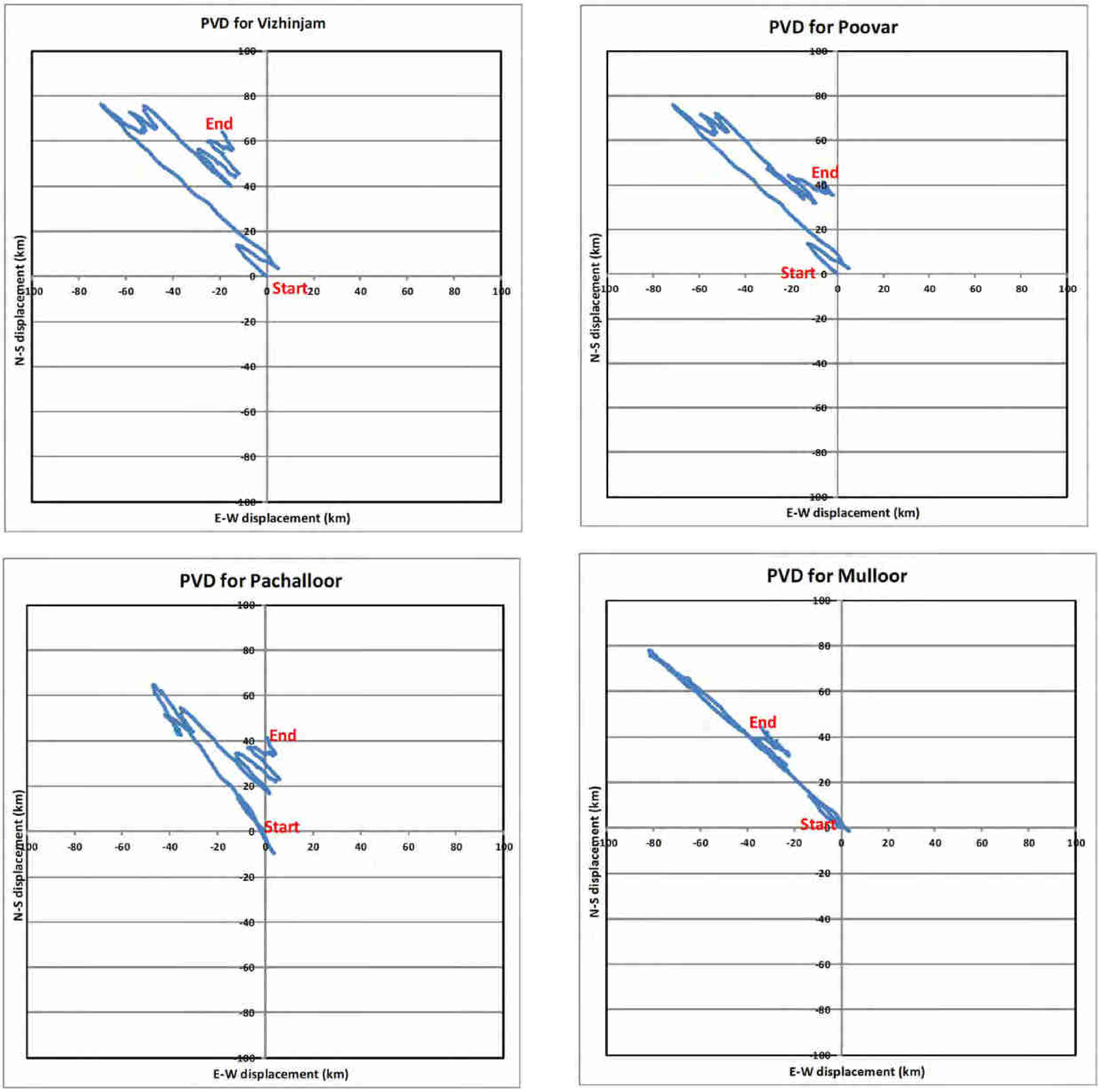

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PROJECT: DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT	PROJECT NO: C1211502
TITLE: PVD FOR OBSERVED CURRENTS DURING PRE-MONSOON (2020-2021)	DATE: 09/09/21
	MADE: VVY
L&T Infra Engineering — L&T Infrastructure Engineering Ltd.	FIGURE NO: FD0007 — REV: 0

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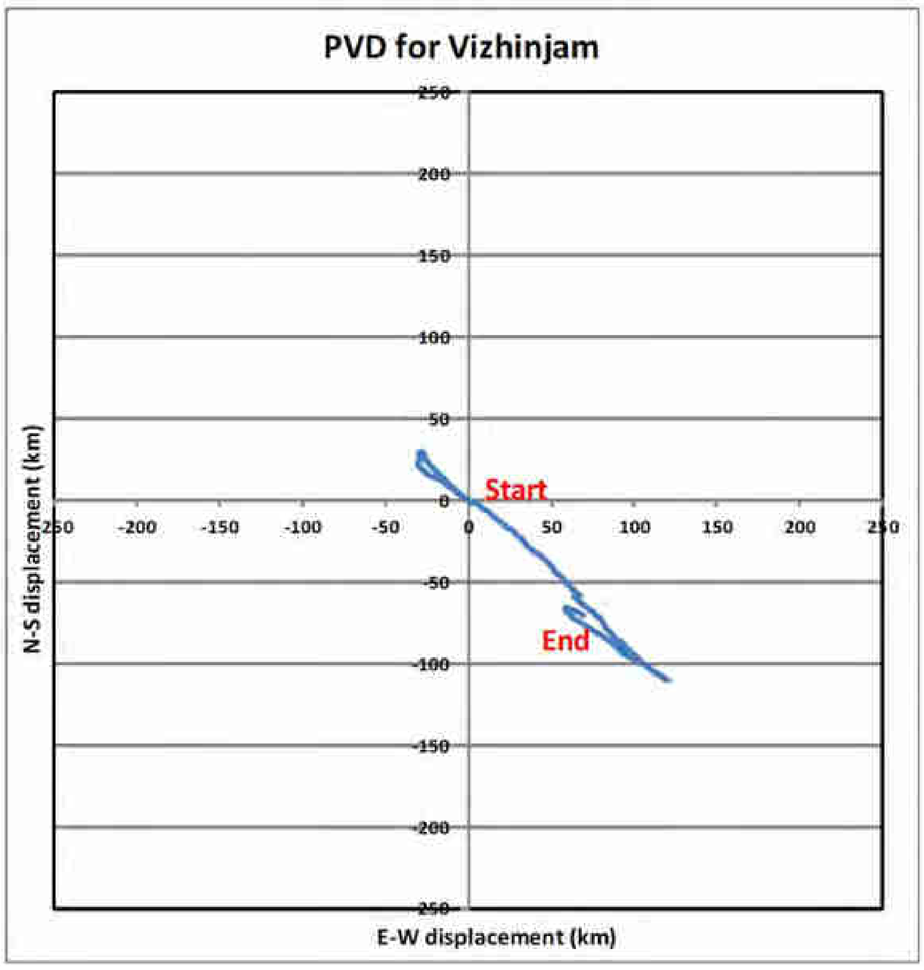

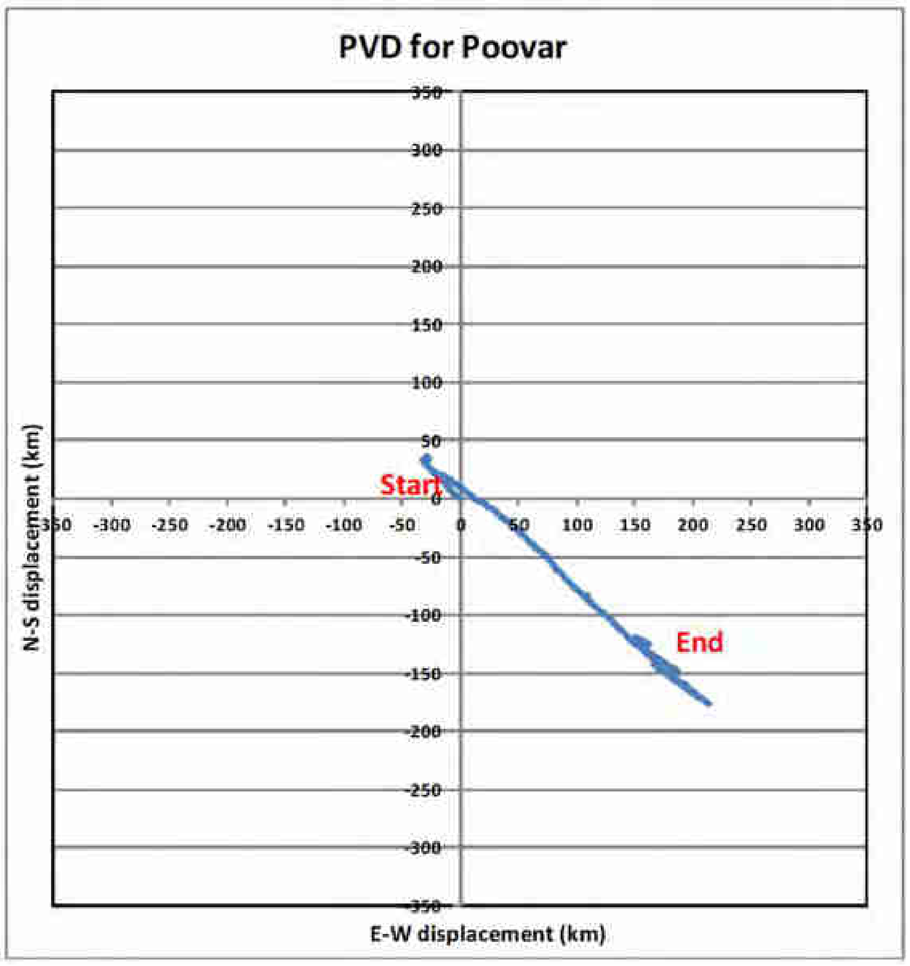

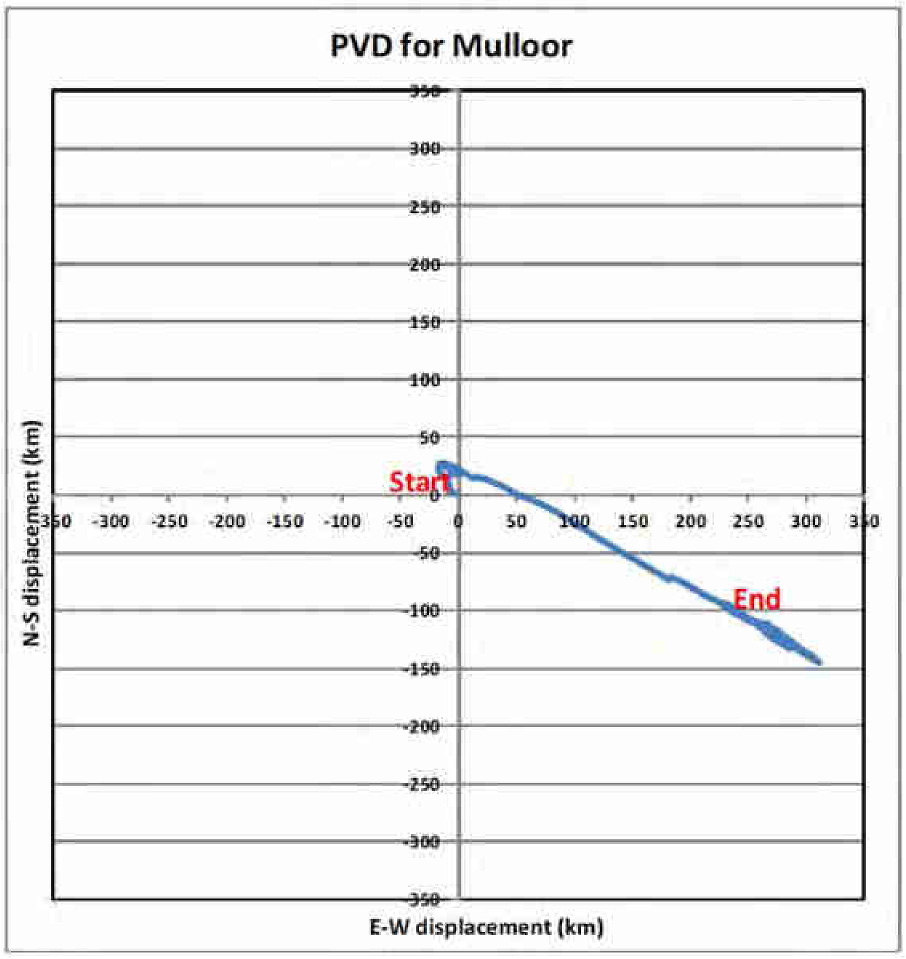

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PROJECT: DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT

TITLE: PVD FOR OBSERVED CURRENTS DURING MONSOON (2020-2021)

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REPORT NO: RP003

PROJECT NO: C1211502

DATE: 09/09/21

MADE: VVY

FIGURE NO: FD0008

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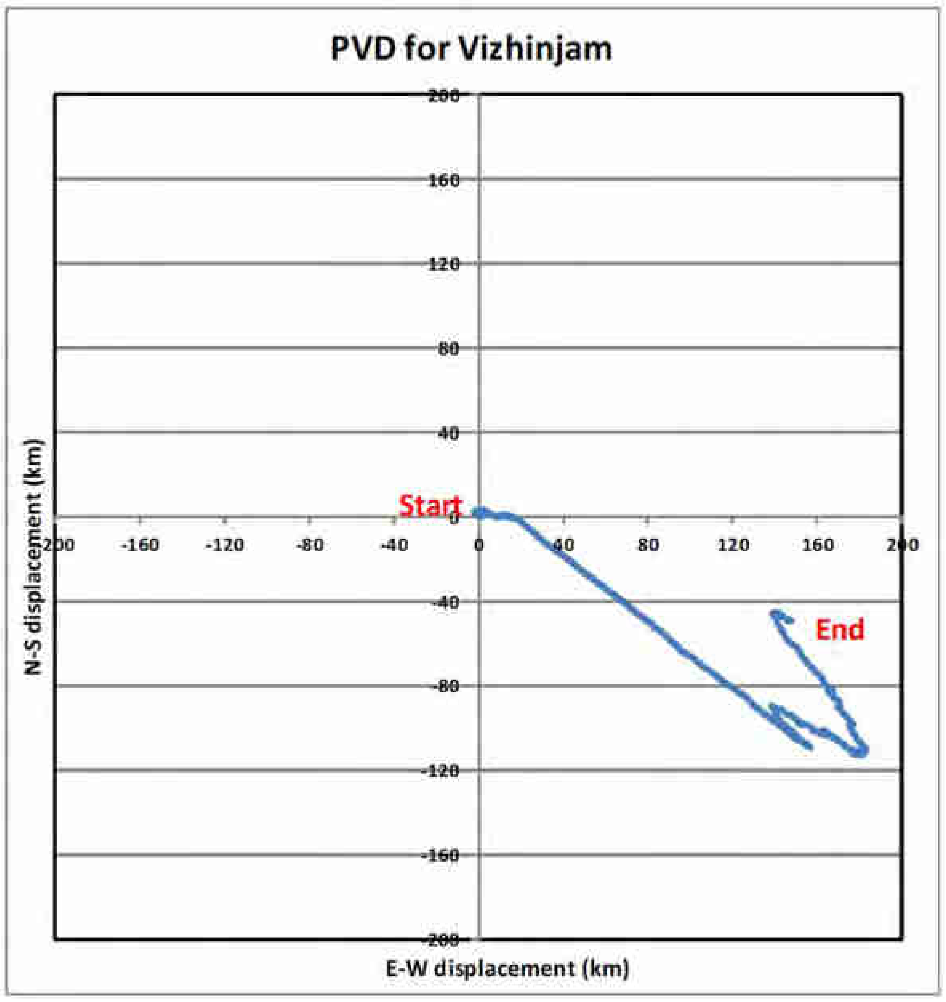

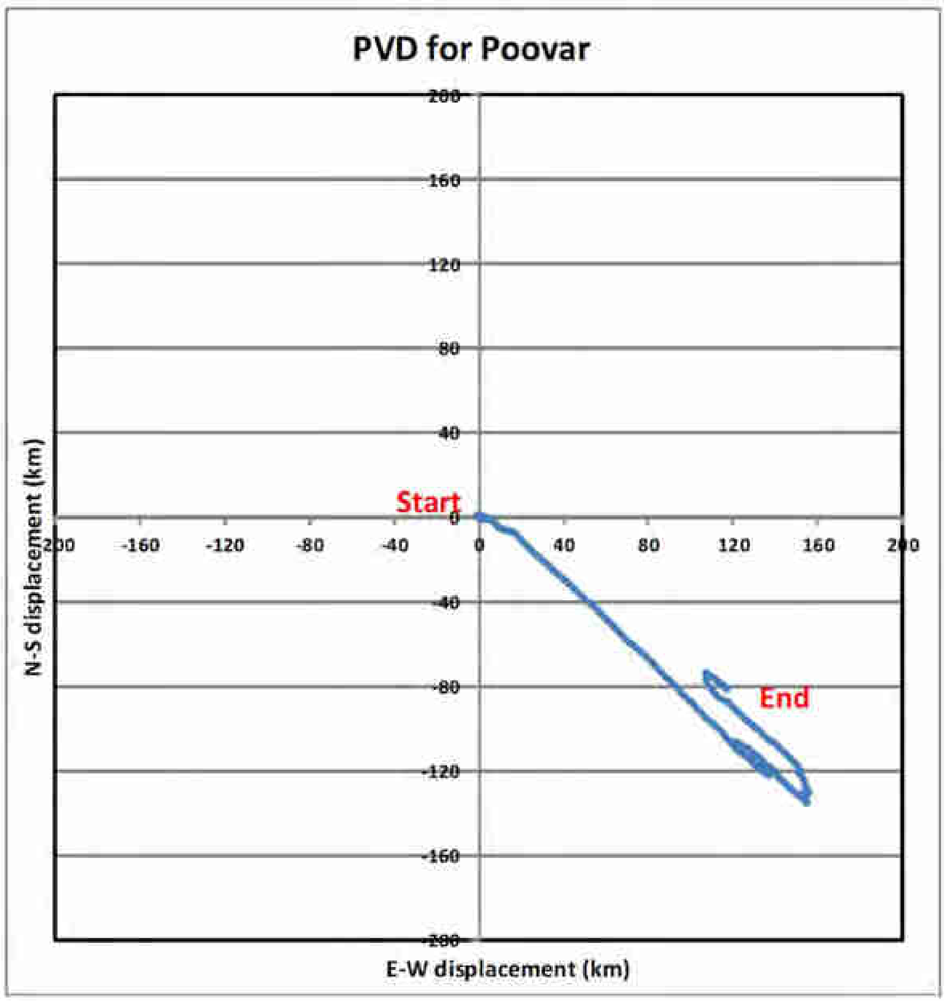

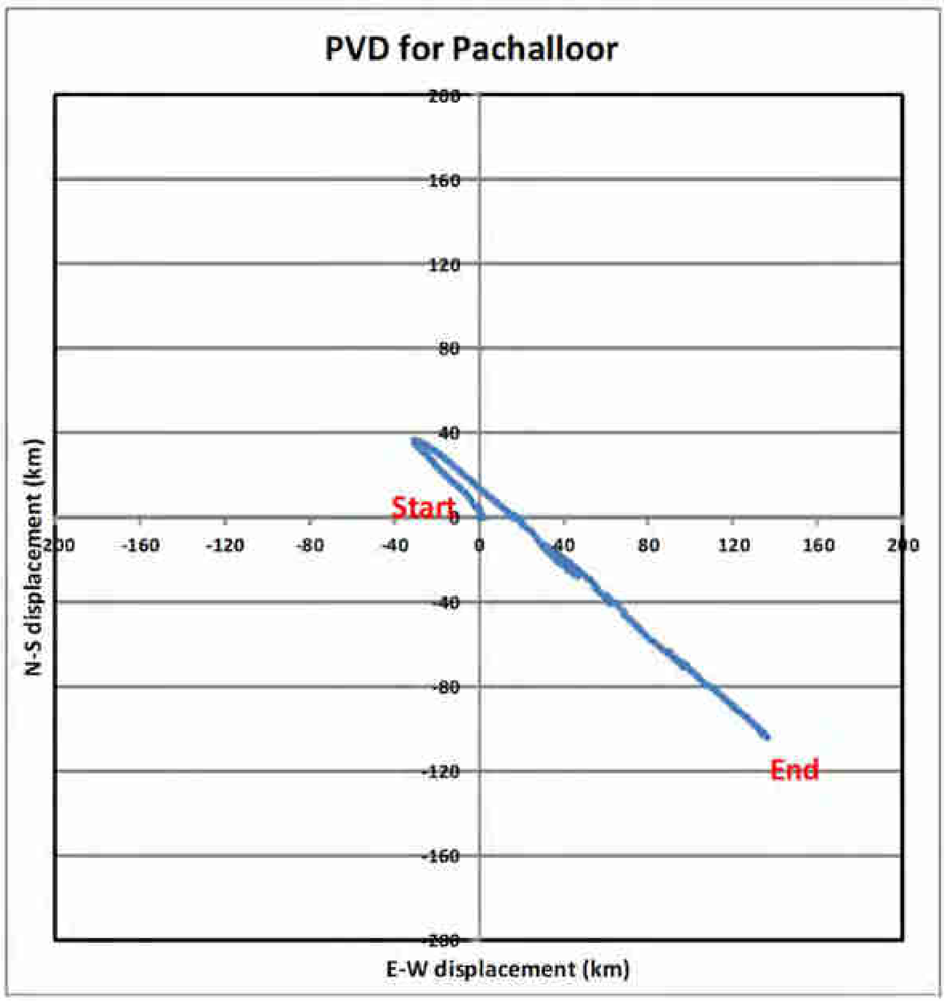

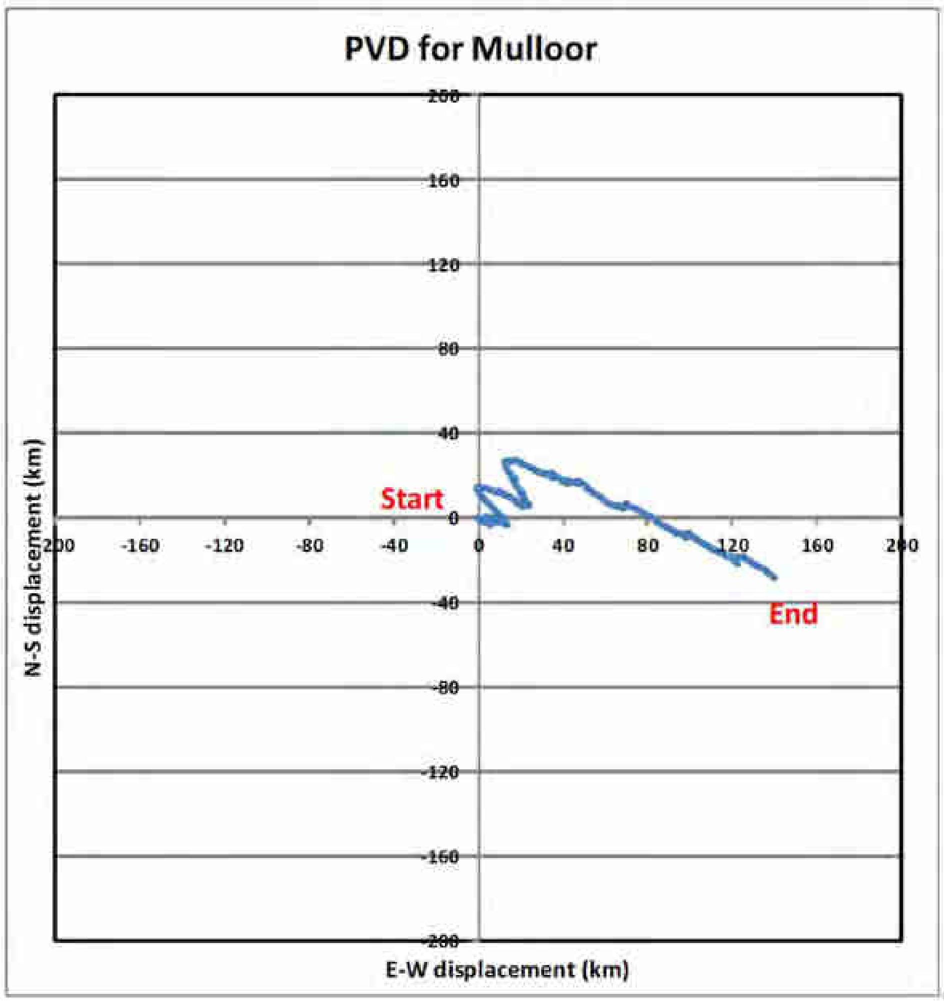

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REPORT NO: RP003

PROJECT: DATA ANALYSIS AND MODEL STUDIES FOR VIZHINJAM PORT

PROJECT NO: C1211502

TITLE: PVD FOR OBSERVED CURRENTS DURING POST-MONSOON (2020-2021)

DATE: 09/09/21

MADE: VVY

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L&T Infrastructure Engineering Ltd.

FIGURE NO: FD0009

REV: 0

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TBNA

Annexure III

Environment Monitoring Report

(April 2021 to September 2021)

HALF YEARLY ENVIRONMENT MONITORING REPORT

For the period

April 2021 to July 2021

Adani Vizhinjam Port Pvt. Ltd.

Vizhinjam, Kerala

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 with affiliates established all over India and overseas. AEC 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 the organization is the years of hard work, dedication and contribution made by the staff who are experts in their respective fields and they produce innovative ideas for the growth of the organization.

AEC has made itself capable of testing of water, waste water, air, noise monitoring, hazardous and non-hazardous waste testing, fuel, food and agriculture testing. The state-of-art Laboratory set-up of AEC for Chemical, Biological and Mechanical Testing is at Nashik. The Laboratory is accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with ISO/IEC 17025:2017 in the Chemical, Biological and Mechanical Testing disciplines (Certificate number: TC-5509). The Laboratory is recognized by the Ministry of Environment, Forests & Climate Change (MoEF&CC), Govt. of India (GoI), New Delhi under Environment (Protection) Act, 1986. AEC is also ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 certified organization.

The Laboratory is recognized by Bureau of Indian Standards for Packaged Drinking Water and Packaged Natural Mineral Water, also recognised by Agricultural and Processed Food Products Export Development Authority (APEDA). The laboratory is approved by Food Safety & Standards Authority of India (FSSAI) for food testing and also approved by Agricultural Marketing (AGMARK) and State Agriculture Department.

AEC had been 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. 5700273929 dated: 07.08.2019 and S.O. No. 5700288999 dated: 21.08.2020 which mentions the matrix, parameters and frequency of environmental monitoring and this service contract has ended in July 2021. AEC carried out said environmental monitoring strictly as per above mentioned service order, viz. 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 conditions mentioned in service order.

This present report is the consolidated half yearly report over the Four-month period of April 2021 to July 2021.

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 as 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 and 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 samples, appropriate preservation techniques with respect to parameters analysed are followed and samples are transported with due care to the laboratory.

2. Chain of Custody:

First, after receiving the samples at the laboratory, assigning Sample ID is a very systematic and methodical way of representing sample identification. Sample ID is a Permanent Identification Number of a samples 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 on which the analysis was started and date on 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. 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 the 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 follows 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: Checklist format for sampling

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: Incharge Sampling	Yes	

Note: It is not necessary that this form be filled for each sample/sampling point. It is sufficient if the deviations, if any are recorded in the logbooks.

Table 2.2: Checklist 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: Executive-Customer Support		

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 logbooks.

Table 2.3: Checklist 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: Technical Manager		

Note: It is not necessary that this form be filled for each sample/sampling point. It is sufficient if the deviations, if any are recorded in the logbooks.

Table 2.4: Checklist 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	
Has the preservative has been added after sampling or preserved as per sampling/ Test method?	Yes	
Are proper storage conditions maintained?	Yes	
Is the sample quantity is adequate?	Yes	
Is sample properly identified?	Yes	
Is proper type of container used?	Yes	
Checked By: Incharge Sampling		

Note: It is not necessary that this form be filled for each sample/sampling point. It is sufficient if the deviations, if any are recorded in the log books.

Table 2.5: Checklist format for quality check in the lab

Parameters	Comments (Yes/No)	Remarks
Are 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 for each sample/sampling point. It is sufficient if the deviations, if any are recorded in the logbooks.

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 samples. 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 Balarampuram during April, June & July 2021 and in the month of May 2021 Ambient Noise Monitoring was not carried out due to Covid-19 lockdown restrictions imposed by the Government of Kerala.

Table 3.1: Ambient Air Quality Monitoring Locations

Sr. No.	Location	Latitude	Longitude[JBF1]
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′,13.46″ N	77^0,00′,08.25″ E
4.	Chani	8^0,20′,56.86″ N	77^0,03′,16.19″ E
5.	Balarampuram	8^0,25′,37.60″ N	77^0,02′,43.80″ E

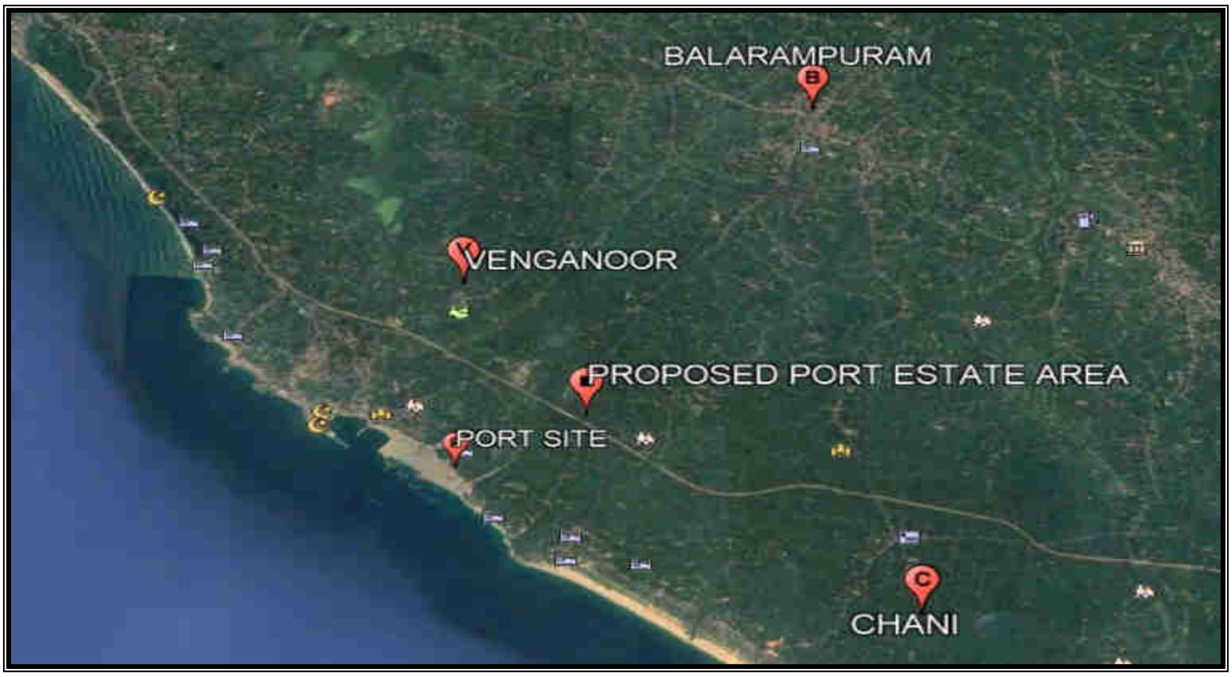


Figure 3.1: Google earth view of AAQM stations

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}	µg/m³	2	IS 5182 (Part 23): 2006,RA 2017
2.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	µg/m³	0.4	USEPA CFR 40,Part 50, Appendix L
3.	Sulphur Dioxide (SO_2)	µg/m³	4.0	IS 5182 (Part 2): 2001, Reaffirmed 2016
4.	Nitrogen Dioxide (NO_2)	µg/m³	6.5	IS 5182 (Part 6): 2017
5.	Carbon Monoxide (CO)	mg/m³	1.0	By portable CO meter
6.	Hydrocarbon (HC)	ppm	1.0	By portable HC meter

3. National Ambient Air Quality Standards (NAAQS):

Table 3.3: National Ambient Air Quality Standards dated 16th November 2009

Sr. No.	Pollutant, Unit	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural & other areas	Ecologically Sensitive Areas
1.	Sulphur dioxide (SO_2), µg/m³	Annual	50	20
		24 h	80	80
2.	Nitrogen Dioxide (NO_2), µg/ m³	Annual	40	30
		24 h	80	80
3.	Particulate matter (size less than 10µm) or PM_{10}, µg/ m³	Annual	60	60
		24 h	100	100
4.	Particulate matter (size less than 2.5µm) or $PM_{2.5}$, µg/m³	Annual	40	40
		24 h	60	60
5.	Carbon Monoxide(CO), mg/m³	8 h	02	02
		1 h	04	04
6.	Hydrocarbon (HC), ppm	-	-	-

4. **Ambient Air Quality Monitoring Results for the period April 2021 to July 2021:**

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
01.04.2021	60	22	4.2	6.8	<1	<1
05.04.2021	45	15	<4.0	<6.5	<1	<1
08.04.2021	51	16	<4.0	<6.5	<1	<1
12.04.2021	42	14	<4.0	<6.5	<1	<1
15.04.2021	54	20	4.2	7.2	<1	<1
19.04.2021	46	16	<4.0	<6.5	<1	<1
22.04.2021	42	14	<4.0	<6.5	<1	<1
26.04.2021	60	20	4.7	6.8	<1	<1
29.04.2021	58	18	4.8	7.1	<1	<1
03.05.2021	45	12	<4.0	<6.5	<1	<1
06.05.2021	48	14	<4.0	<6.5	<1	<1
03.06.2021	48	11	4.94	7.77	<1	<1
07.06.2021	40	9	<4.0	<6.5	<1	<1
10.06.2021	42	7	4.2	6.6	<1	<1
14.06.2021	46	8	5.2	6.8	<1	<1
17.06.2021	42	6	<4.0	<6.5	<1	<1
21.06.2021	34	5	<4.0	<6.5	<1	<1
24.06.2021	38	6	<4.0	<6.5	<1	<1
28.06.2021	40	8	<4.0	<6.5	<1	<1
01.07.2021	50	12	5.3	7.8	<1	<1
05.07.2021	40	9	<4.0	<6.5	<1	<1
08.07.2021	41	10	<4.0	<6.5	<1	<1
12.07.2021	38	8	<4.0	<6.5	<1	<1
15.07.2021	48	7	<4.0	<6.5	<1	<1

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
19.07.2021	42	8	<4.0	<6.5	<1	<1
22.07.2021	40	6	<4.0	<6.5	<1	<1
26.07.2021	36	5	<4.0	<6.5	<1	<1
29.07.2021	45	10	4.6	6.9	<1	<1
NAAQS 2009[JBF2] **Limit**	**100**	**60**	**80**	**80**	**4**	**-**

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
01.04.2021	62	22	4.2	6.8	<1	<1
05.04.2021	52	17	<4.0	<6.5	<1	<1
08.04.2021	54	18	4.2	6.8	<1	<1
12.04.2021	50	16	<4.0	<6.5	<1	<1
15.04.2021	60	20	4.7	6.8	<1	<1
19.04.2021	52	15	<4.0	<6.5	<1	<1
22.04.2021	48	14	4.2	<6.5	<1	<1
26.04.2021	52	18	4.7	7.1	<1	<1
29.04.2021	56	20	5	7.2	<1	<1
03.05.2021	46	14	<4.0	<6.5	<1	<1
06.05.2021	50	16	<4.0	<6.5	<1	<1
03.06.2021	41	10	6.9	10.1	<1	<1
07.06.2021	38	6	<4.0	<6.5	<1	<1
10.06.2021	40	7	4.2	8.2	<1	<1
14.06.2021	44	8	5.8	8.3	<1	<1
17.06.2021	40	5	<4.0	<6.5	<1	<1

Date	Parameters					
	PM10	PM2.5	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
21.06.2021	38	8	<4.0	<6.5	<1	<1
24.06.2021	45	10	4.2	6.6	<1	<1
28.06.2021	48	14	4.1	6.7	<1	<1
01.07.2021	45	9	6.5	10.4	<1	<1
05.07.2021	40	6	<4.0	<6.5	<1	<1
08.07.2021	42	7	<4.0	<6.5	<1	<1
12.07.2021	44	9	<4.0	<6.5	<1	<1
15.07.2021	50	12	<4.0	<6.5	<1	<1
19.07.2021	52	14	<4.0	<6.5	<1	<1
22.07.2021	48	10	<4.0	<6.5	<1	<1
26.07.2021	45	8	4.2	6.6	<1	<1
29.07.2021	50	12	4.4	6.8	<1	<1
NAAQS 2009[JBF3] **Limit**	**100**	**60**	**80**	**80**	**4**	-

Table 3.6: Location - Port Site

Date	Parameters					
	PM10	PM2.5	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
01.04.2021	85	36	5.6	6.8	<1	<1
05.04.2021	78	30	5.8	<6.5	<1	<1
08.04.2021	92	38	6.1	6.8	<1	<1
12.04.2021	70	20	5.2	<6.5	<1	<1
15.04.2021	88	34	7	6.6	<1	<1
19.04.2021	72	22	5.3	<6.5	<1	<1
22.04.2021	58	16	<4.0	<6.5	<1	<1
26.04.2021	80	30	6.1	7.2	<1	<1
29.04.2021	82	34	5.3	7.4	<1	<1
03.05.2021	58	20	4.4	6.8	<1	<1

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
06.05.2021	54	18	4.7	7.2	<1	<1
03.06.2021	51	13	7.4	10.2	<1	<1
07.06.2021	42	8	4.2	7.1	<1	<1
10.06.2021	48	10	8.1	11.2	<1	<1
14.06.2021	50	12	7.9	12.4	<1	<1
17.06.2021	48	16	7.1	11.8	<1	<1
21.06.2021	40	8	<4.0	<6.5	<1	<1
24.06.2021	46	14	6.8	10.6	<1	<1
28.06.2021	52	20	7	12.1	<1	<1
01.07.2021	55	14	7.8	8.4	<1	<1
05.07.2021	50	10	4.8	7.3	<1	<1
08.07.2021	52	12	8.2	11.6	<1	<1
12.07.2021	45	8	4.2	6.6	<1	<1
15.07.2021	52	10	4.8	6.8	<1	<1
19.07.2021	45	8	<4.0	<6.5	<1	<1
22.07.2021	40	12	<4.0	<6.5	<1	<1
26.07.2021	38	7	4.2	6.8	<1	<1
29.07.2021	35	6	4.5	7.1	<1	<1
NAAQS 2009[JBF4] **Limit**	**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
01.04.2021	58	20	<4.0	6.8	<1	<1
05.04.2021	44	14	<4.0	<6.5	<1	<1
08.04.2021	56	18	4.2	7.2	<1	<1
12.04.2021	42	12	<4.0	<6.5	<1	<1
15.04.2021	51	20	4.2	6.8	<1	<1
19.04.2021	42	14	<4.0	<6.5	<1	<1

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
22.04.2021	48	12	4.2	<6.5	<1	<1
26.04.2021	58	22	4.4	6.8	<1	<1
29.04.2021	51	20	4.6	6.9	<1	<1
03.05.2021	46	16	<4.0	<6.5	<1	<1
06.05.2021	48	14	<4.0	<6.5	<1	<1
03.06.2021	42	10	6.21	8.2	<1	<1
07.06.2021	38	7	<4.0	<6.5	<1	<1
10.06.2021	40	8	4.2	6.8	<1	<1
14.06.2021	44	10	4.3	7.1	<1	<1
17.06.2021	35	5	<4.0	<6.5	<1	<1
21.06.2021	40	8	<4.0	<6.5	<1	<1
24.06.2021	45	16	4.2	6.7	<1	<1
28.06.2021	42	14	<4.0	<6.5	<1	<1
01.07.2021	48	12	6.5	8.6	<1	<1
05.07.2021	40	8	4.2	6.8	<1	<1
08.07.2021	42	10	4.3	7	<1	<1
12.07.2021	40	8	<4.0	<6.5	<1	<1
15.07.2021	45	10	<4.0	<6.5	<1	<1
19.07.2021	38	6	4.2	6.8	<1	<1
22.07.2021	36	6	4.4	7	<1	<1
26.07.2021	40	10	4.6	6.8	<1	<1
29.07.2021	45	14	4.8	7.6	<1	<1
NAAQS 2009[JBF5] **Limit**	**100**	**60**	**80**	**80**	**4**	-

Table 3.8: Location - Balarampuram[JBF6]

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
01.04.2021	70	22	4.7	6.8	<1	<1
05.04.2021	58	19	<4.0	<6.5	<1	<1

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
08.04.2021	70	28	5	7.2	<1	<1
12.04.2021	45	14	<4.0	<6.5	<1	<1
15.04.2021	54	20	4.7	8.1	<1	<1
19.04.2021	46	16	<4.0	<6.5	<1	<1
22.04.2021	50	14	<4.0	<6.5	<1	<1
26.04.2021	64	22	4.2	7.2	<1	<1
29.04.2021	66	20	5.1	6.8	<1	<1
03.05.2021	50	14	4.2	6.4	<1	<1
06.05.2021	52	16	4.4	6.8	<1	<1
03.06.2021	50	12	5.2	7.8	<1	<1
07.06.2021	42	10	4.2	8.1	<1	<1
10.06.2021	40	9	7.9	10.2	<1	<1
14.06.2021	52	14	8.2	13.2	<1	<1
17.06.2021	42	12	4.8	6.9	<1	<1
21.06.2021	45	14	4.6	7.1	<1	<1
24.06.2021	56	18	5.1	8.1	<1	<1
28.06.2021	46	10	4.8	6.2	<1	<1
01.07.2021	55	10	5.6	8.1	<1	<1
05.07.2021	48	12	4.5	8.6	<1	<1
08.07.2021	45	11	7.2	9.5	<1	<1
12.07.2021	50	13	<4.0	<6.5	<1	<1
15.07.2021	40	8	<4.0	<6.5	<1	<1
19.07.2021	38	8	<4.0	<6.5	<1	<1
22.07.2021	42	10	<4.0	<6.5	<1	<1
26.07.2021	48	12	4.4	6.8	<1	<1
29.07.2021	42	8	<4.0	<6.5	<1	<1
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

5. Monthly Average Results of Ambient Air Quality Monitoring

Table 3.9: Monthly Average Results

Parameter, Unit of Measurement	NAAQS 2009	Month	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
Particulate matter (size less than 10µm) or PM_{10}, µg/m^3	100	Apr-21	51	54	78	50	58
		May-21	47	48	49	42	48
		Jun-21	41	42	47	41	47
		Jul-21	42	46	46	42	45
Particulate matter (size less than 2.5µm) or $PM_{2.5}$, µg/m^3	60	Apr-21	17	18	29	17	19
		May-21	13	15	13	15	13
		Jun-21	8	9	13	10	12
		Jul-21	8	10	10	9	10
Sulphur dioxide (SO_2), µg/m^3	80	Apr-21	4.48	4.50	5.80	4.32	4.74
		May-21	<4.0	<4.0	6.33	<4.0	5.40
		Jun-21	4.78	5.04	6.93	4.73	5.60
		Jul-21	4.95	5.03	5.50	4.71	5.43
Nitrogen dioxide (SO_2), µg/m^3	80	Apr-21	6.98	6.94	6.96	6.90	7.22
		May-21	<6.5	<6.5	9.66	<6.5	8.29
		Jun-21	7.06	7.98	10.77	7.20	8.45
		Jul-21	7.35	7.93	7.80	7.23	8.25
Carbon Monoxide (CO), µg/m^3	4	Apr-21	<1	<1	<1	<1	<1
		May-21	<1	<1	<1	<1	<1
		Jun-21	<1	<1	<1	<1	<1
		Jul-21	<1	<1	<1	<1	<1
Hydrocarbon (HC), ppm	-	Apr-21	<1	<1	<1	<1	<1
		May-21	<1	<1	<1	<1	<1
		Jun-21	<1	<1	<1	<1	<1
		Jul-21	<1	<1	<1	<1	<1

6. Graphical representation of Results

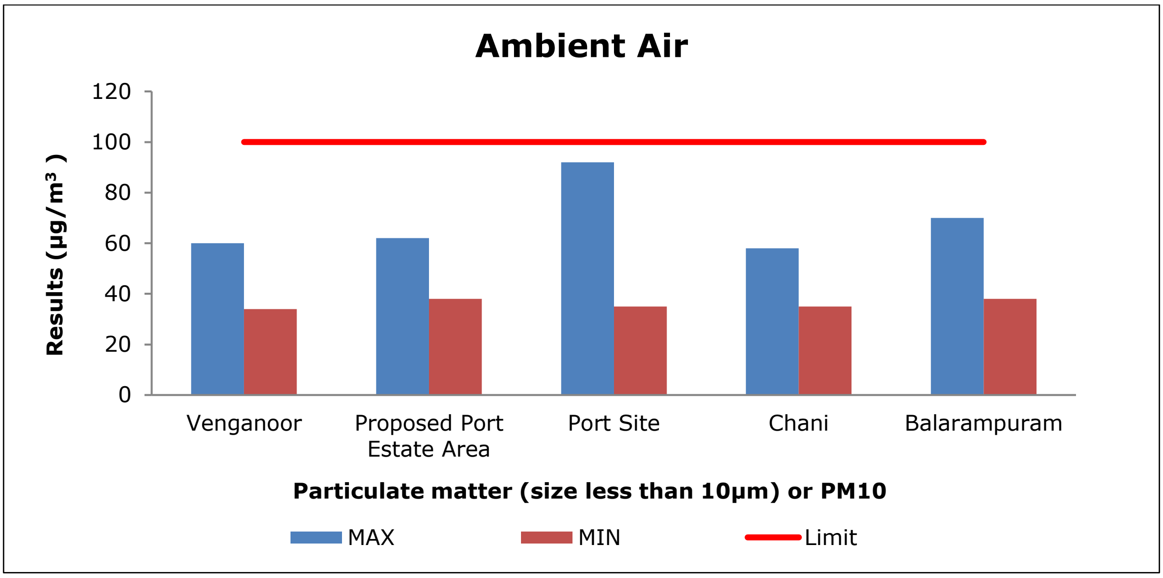


Figure 3.2: Particulate matter (size less than 10µm) (PM_{10})

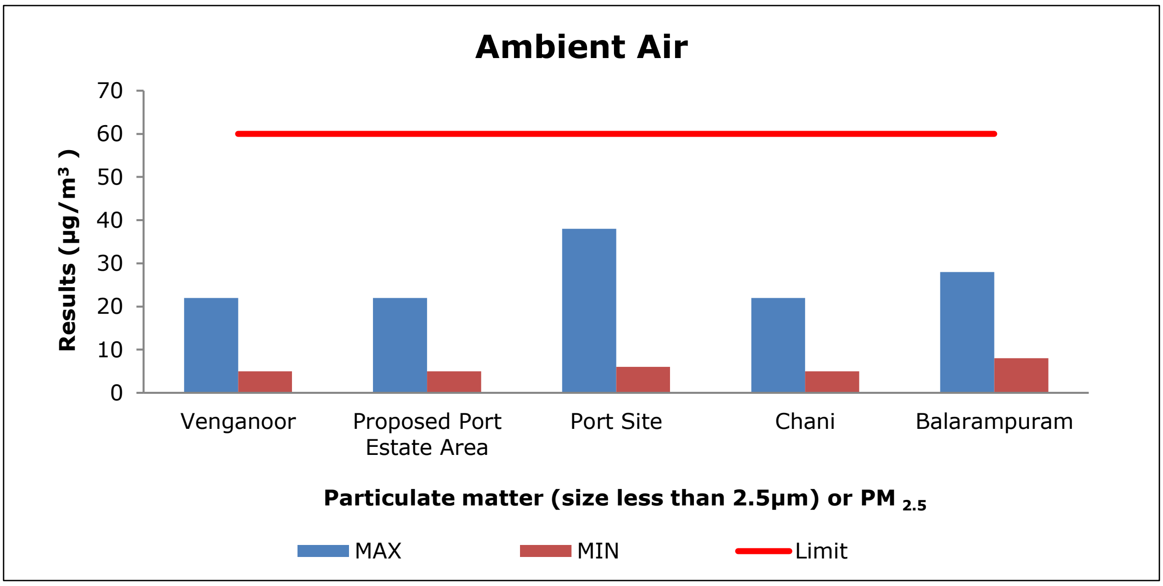


Figure 3.3: Particulate matter (size less than 2.5µm) ($PM_{2.5}$)

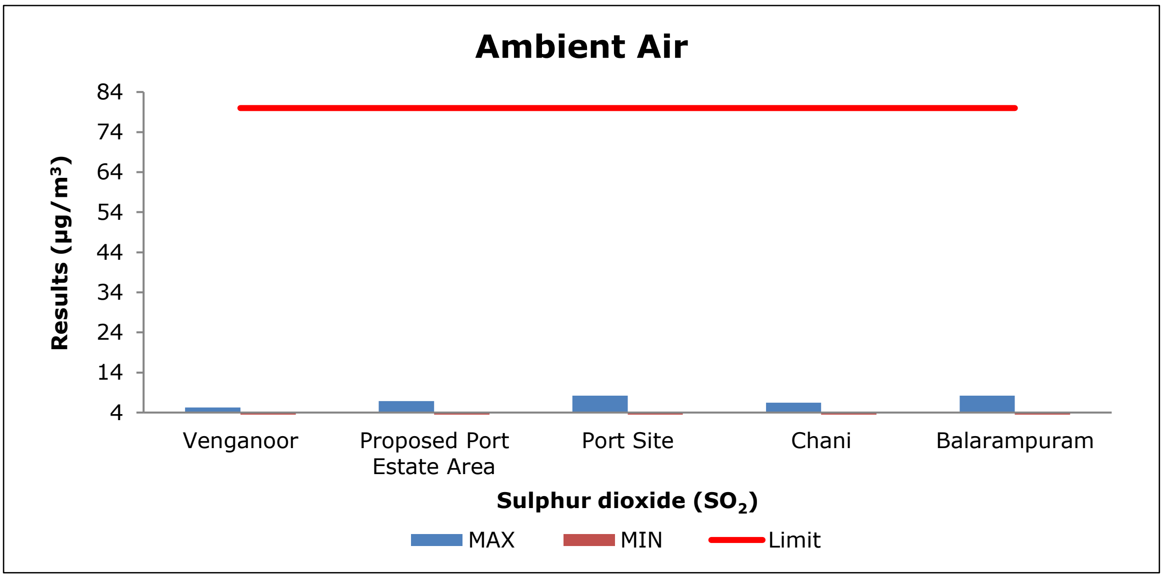


Figure 3.4: Sulphur dioxide (SO_2)

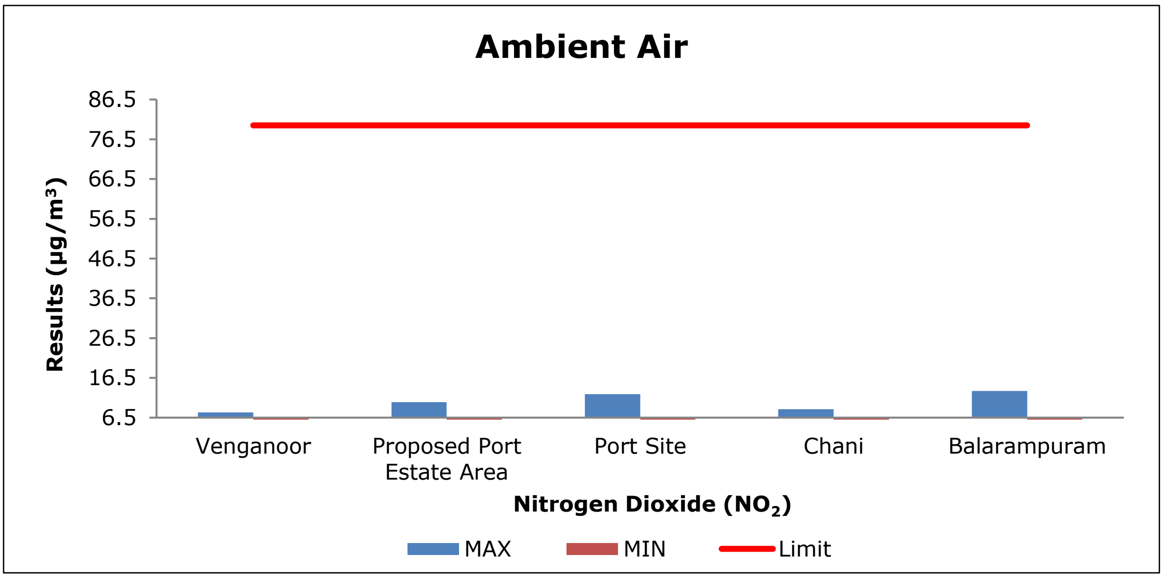


Figure 3.5: Nitrogen Dioxide (NO_2)

7. Summary - Ambient Air Quality

During the period of April 2021 to July 2021, at the location **Venganoor**, the concentration of PM_{10} was observed in the range between 34-60 µg/m^3 with an average of 45 µg/m^3, $PM_{2.5}$ was observed in the range between 5.0-22 µg/m^3 with an average of 11 µg/m^3, SO_2 was observed in the range between <4.0-5.30 µg/m^3 with an average of 4.68 µg/m^3, NO_2 was observed in the range between <6.5-7.80 µg/m^3 with an average of 7.09 µg/m^3, CO was observed <1 mg/m^3 and HC was observed <1 ppm for all Four months.

At the location **Proposed Port Colony**, concentration of PM_{10} was observed in the range between 38-62 µg/m^3 with an average of 48 µg/m^3, $PM_{2.5}$ was observed in the range between 5-22 µg/m^3 with an average of 12 µg/m^3, SO_2 was observed in the range between <4.0-6.90 µg/m^3 with an average of 4.81 µg/m^3, NO_2 was observed in the range between <6.5-10.40 µg/m^3 with an average of 7.57 µg/m^3, CO was observed <1 mg/m^3 and HC was observed <1 ppm for all Four months.

At the location **Port site**, concentration of PM_{10} was observed in the range between 35-92 µg/m^3 with an average of 57 µg/m^3, $PM_{2.5}$ was observed in the range between 6-38 µg/m^3 with an average of 17 µg/m^3, SO_2 was observed in the range between <4.0–8.20 µg/m^3 with an average of 5.94 µg/m^3, NO_2 was observed in the range between <6.5-12.4 µg/m^3 with an average of 8.51 µg/m^3, CO was observed <1 mg/m^3 and HC was observed <1 ppm for all Four months.

At the location **Chani**, concentration of PM_{10} was observed in the range between 35-58 µg/m^3 with an average of 44 µg/m^3, $PM_{2.5}$ was observed in the range between 5-22 µg/m^3 with an average of 12 µg/m^3, SO_2 was observed in the range between <4.0 –6.50 µg/m^3 with an average of 4.59 µg/m^3, NO_2 was observed in the range between <6.5-8.60 µg/m^3 with an average of 7.12 µg/m^3, CO was observed <1 mg/m^3 and HC was observed <1 ppm for all Four months.

At the location **Balarampuram**[JBF7], concentration of PM_{10} was observed in the range between 38-70 µg/m^3 with an average of 50 µg/m^3, $PM_{2.5}$ was observed in the range between 8-28 µg/m^3 with an average of 14 µg/m^3, SO_2 was observed in the range between <4.0-8.20 µg/m^3 with an average of 5.20 µg/m^3, NO_2 was observed in the range between <6.5–13.20 µg/m^3 with an average of 7.89 µg/m^3, CO was observed <1 mg/m^3 and HC was observed <1 ppm for all Four 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 during the monitoring months (April 2021 to July 2021).

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, June & July 2021 was carried out at Venganoor, Proposed Port Estate Area, Port Site, Chani and Balarampuram and in the month of May 2021 Ambient Noise Monitoring was not carried out due to Covid-19 lockdown restrictions imposed by the Government of Kerala. 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′,13.46″ N	77^{0},00′,08.25″ E
2.	Balarampuram	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

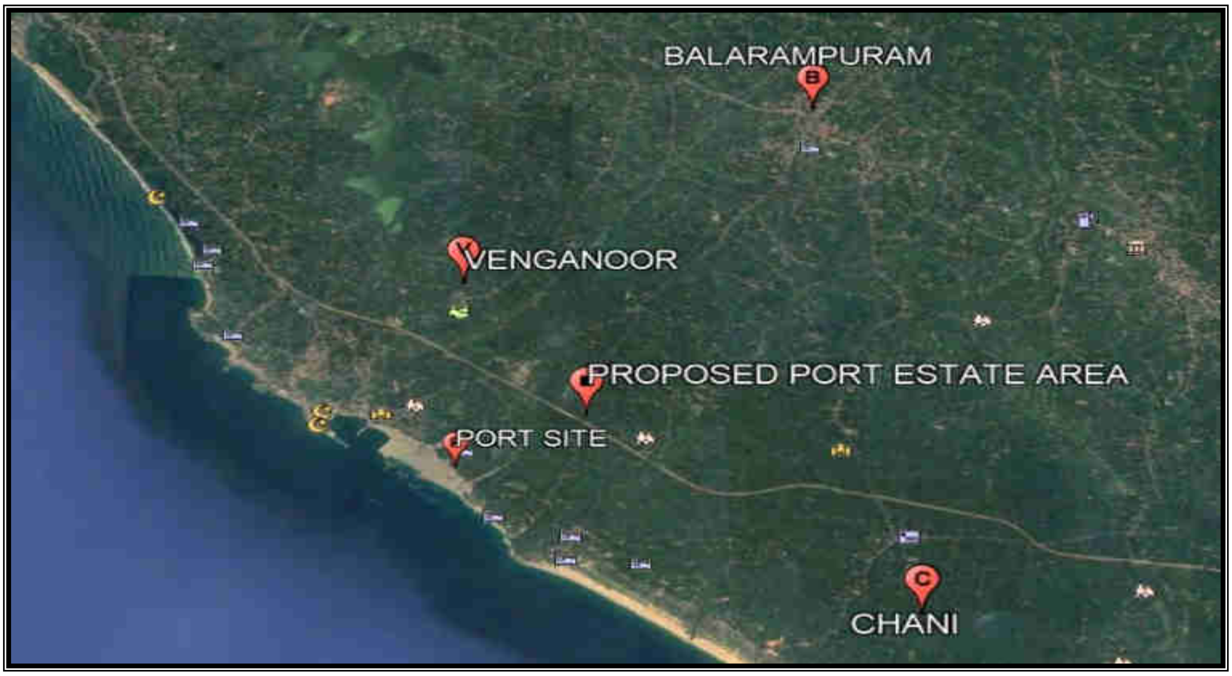


Figure 4.1: Google earth view of Ambient Noise Monitoring Stations

2. Methodology of Sampling

Ambient Noise Monitoring is being carried out as per CPCB Protocol for Ambient Level Noise Monitoring, July 2015 & AEC/C/SAP/SAM/35 & 36.

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 2021 to July 2021.

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)					
Apr-21	08.04.2021	70.3	66.4	54.3	56.8	67.1	63.3
	22.04.2021	72.0	64.3	64.7	57.4	66.9	61.0
May-21	06.05.2021	70.4	62.8	55.1	52.5	65.7	60.2
Jun-21	03.06.2021	70.5	59.5	55.9	54	67.6	56.8
	17.06.2021	70.5	59.5	55.9	54	67.5	56.4
Jul-21	08.07.2021	68.8	60.7	59.7	56.3	65.8	59
	22.07.2021	70.5	59.5	55.9	54	66.9	56.4
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						75	70

Table 4.4: Location - Balarampuram (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)					
Apr-21	12.04.2021	66.8	53.8	47.4	45.1	59.4	48.6
	26.04.2021	65.8	48.8	44	45.6	56.5	47.7
Jun-21	07.06.2021	64.5	55.3	38.5	37.3	57.1	47.2
	21.06.2021	63.5	50.5	48	46.7	58.2	48.8

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)					
Jul-21	12.07.2021	64.5	55.6	38.5	37.3	57.1	47.6
	26.07.2021	67.7	56.6	46	45.3	61	50.8
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	Lmax Day time	Lmax Night time	Lmin Day time	Lmin Night time	Leq Day time	Leq Night time
		dB (A)					
Apr-21	09.04.2021	64.5	48.5	40.3	39.5	54.5	44
	23.04.2021	60.3	46.7	43	43.4	54.8	44.4
May-21	07.05.2021	58.7	48.7	44.3	41.1	53.8	43.9
Jun-21	04.06.2021	60.9	47.1	40.5	38.7	53.8	42.0
	18.06.2021	65.3	48	40.6	38.2	54.7	43.8
Jul-21	09.07.2021	63.8	47.7	42.3	39.5	54.6	44.7
	23.07.2021	65.4	48	39.7	38.8	54.4	43.6
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)					
Apr-21	10.04.2021	62.4	49.5	40.9	39.5	53.8	44.8
	24.04.2021	60.1	47.3	50.6	43.3	54.0	44.0
Jun-21	05.06.2021	56.2	46.1	45.1	38.1	51.5	41.9
	19.06.2021	60.8	47.1	40.5	38.9	53.4	42.1
Jul-21	10.07.2021	60.8	47.1	40.5	38.7	53.3	42.0
	24.07.2021	58.6	47.1	40.9	39.1	51.8	42.1
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)					
Apr-21	11.04.2021	52.7	43.2	37.9	38.3	47	39.8
	25.04.2021	56.8	43.8	38.5	37.3	47.3	40.6
May-21	07.05.2021	49.5	38.7	37.8	36.9	45.3	37.9
Jun-21	06.06.2021	56	38.5	37.4	36.7	47.6	37.5
	20.06.2021	55.7	44.2	42	38.8	48.3	40.9
Jul-21	11.07.2021	48.4	39.9	36.3	35.5	46.1	37
	25.07.2021	55.4	44.2	39.5	38.8	47.7	40.8
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	Balarampuram
		Residential	Residential	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	65.4	62.4	56.8	72.0	67.7
	Min	58.7	56.2	48.4	68.8	63.5
	Avg.	62.7	59.8	53.5	70.4	65.5
L_{max} Night time dB (A)	Max	48.7	49.5	44.2	66.4	56.6
	Min	46.7	46.1	38.5	59.5	48.8
	Avg.	47.8	47.4	41.8	61.8	53.4
L_{min} Day time dB (A)	Max	44.3	50.6	42.0	64.7	48.0
	Min	39.7	40.5	36.3	54.3	38.5
	Avg.	41.5	43.1	38.5	57.4	43.7
L_{min} Night time dB (A)	Max	43.4	43.3	38.8	57.4	46.7
	Min	38.2	38.1	35.5	52.5	37.3
	Avg.	39.9	39.6	37.5	55.0	42.9

Parameter		Proposed Port Estate Area	Chani	Venganoor	Port Site	Balarampuram
		Residential	Residential	Residential	Industrial	Commercial
		Day Time (55) Night Time (45)			Day Time (75) Night Time(70)	Day Time (65) Night Time (55)
Leq Day time dB (A)	Max	54.8	54.0	48.3	67.6	61.0
	Min	53.8	51.5	45.3	65.7	56.5
	Avg.	54.4	53.0	47.0	66.8	58.2
Leq Night time dB (A)	Max	44.7	44.8	40.9	63.3	50.8
	Min	42.0	41.9	37.0	56.4	47.2
	Avg.	43.8	42.8	39.2	59.0	48.5

6. Graphical representation of Results

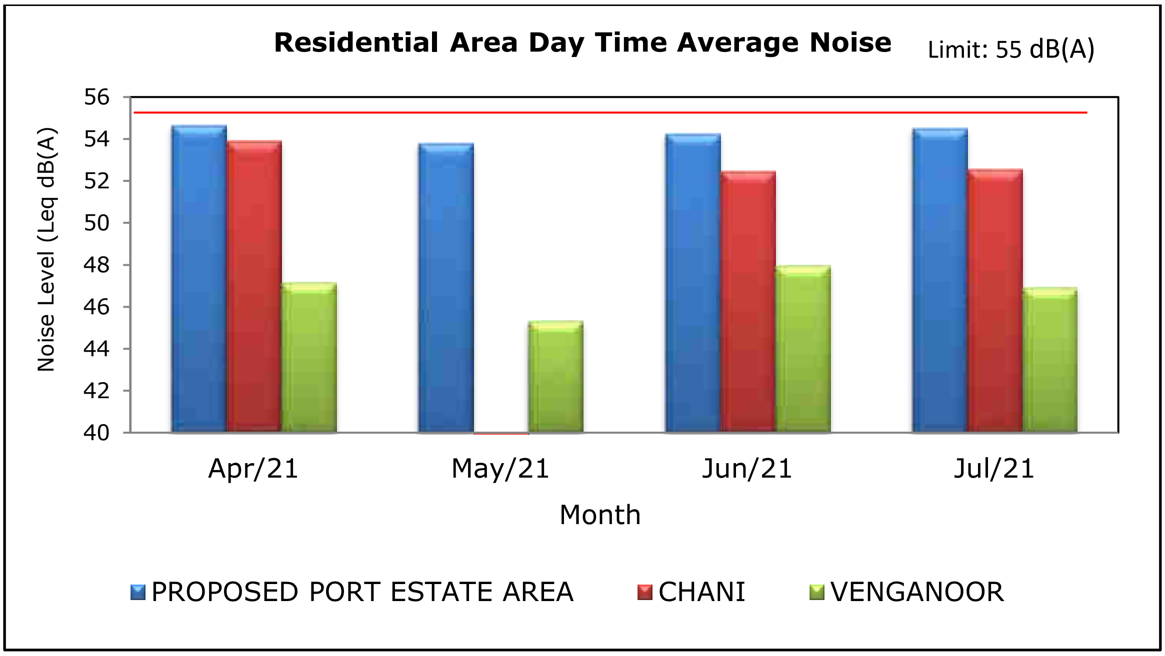


Figure 4.2: Residential Area Noise Level at day time

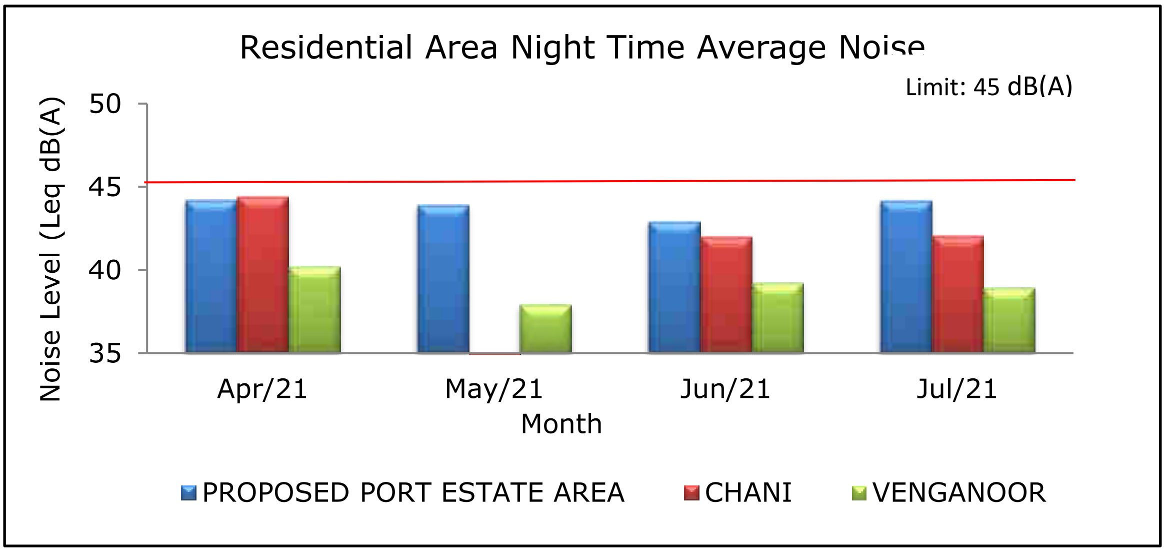


Figure 4.3: Residential Area Noise Level at Night time

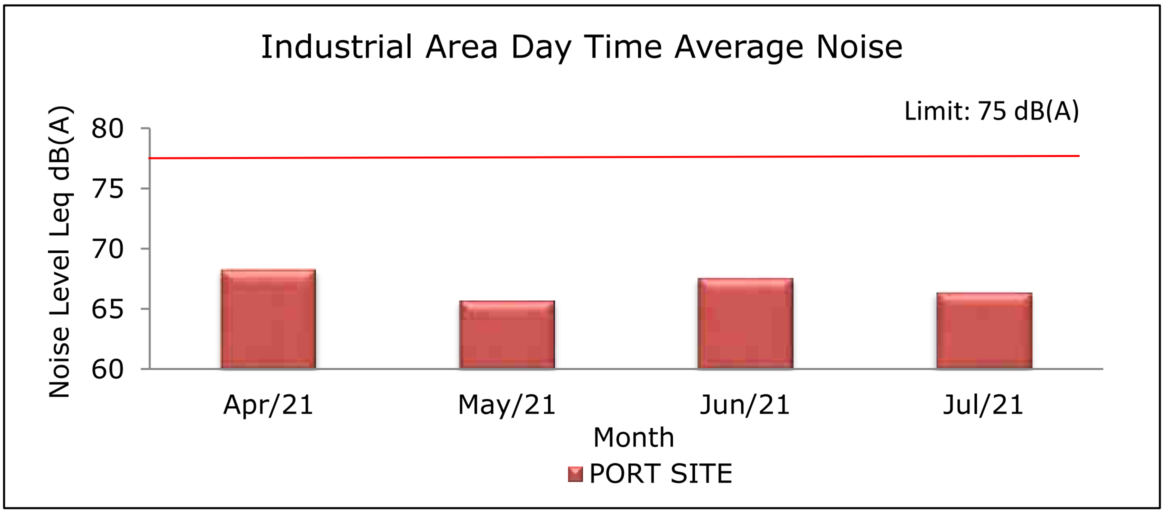


Figure 4.4: Industrial Area Noise Level at day time

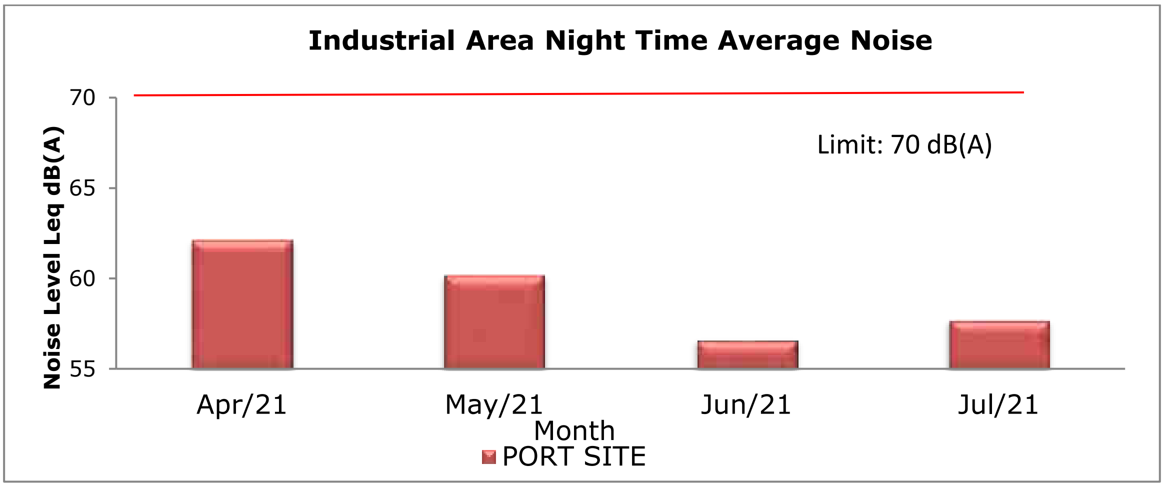
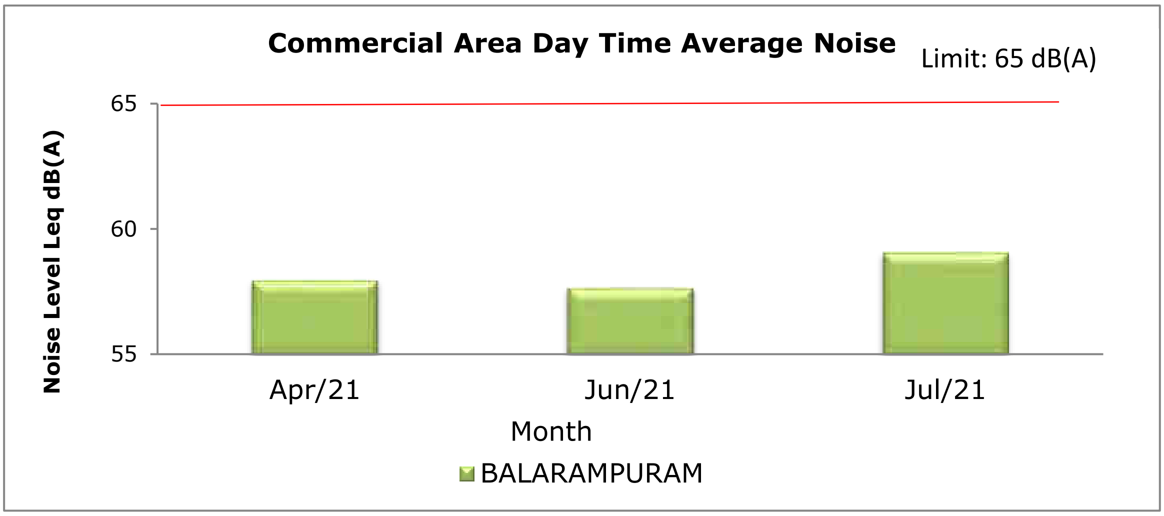


Figure 4.5: Industrial Area Noise Level at night time



[JBF8][AN9]**Figure 4.6: Commercial Area Noise Level at day time**

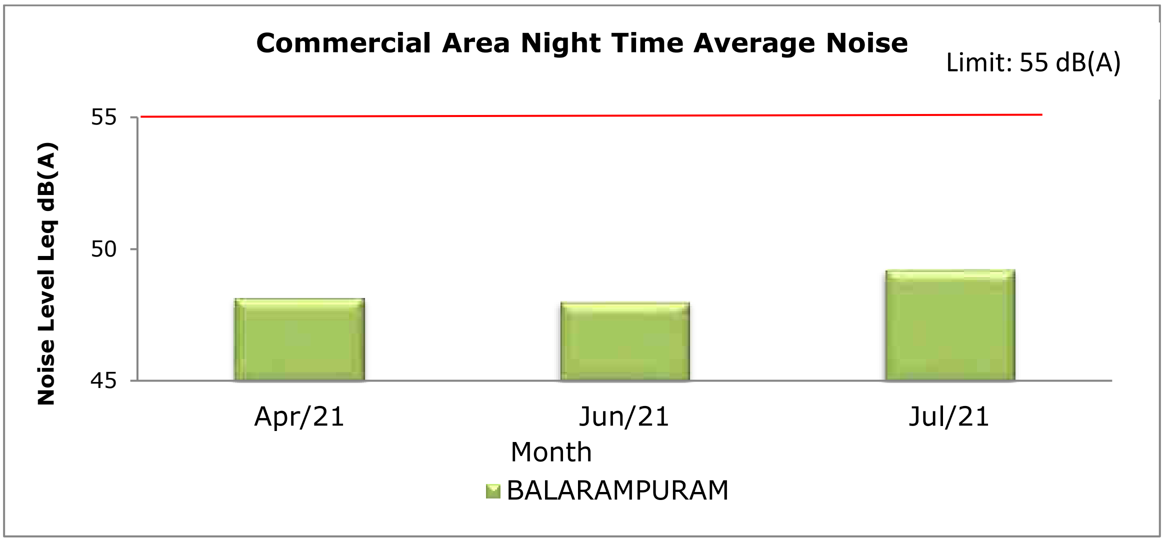


Figure 4.7: Commercial Area Noise Level at night time

7. Summary - Ambient Noise Monitoring

During the period April 2021 to July 2021 average noise level observed at residential areas i.e. at Proposed Port Estate Area, Chani and Venganoor during day time were 54.3 dB(A), 53.0 dB(A) and 46.8 dB(A) respectively and during night time 43.8 dB(A), 42.8 dB(A) and 39.1 dB(A) respectively.

At industrial area i.e. at Port Site area average noise level observed at day time 66.7 dB (A) and at night time 59.2 dB (A).

At commercial area i.e. Balarampuram area average noise level observed at day time 58.2 dB (A) and at night time 48.5 dB (A).[JBF10]

The results obtained were compared with Noise Pollution (Regulation & Control) Rule, 2000 (Rule 3(1) and 4(1)) and it is observed that noise reading were within limits at all locations on all monitoring days during the monitoring months (April 2021 to July 2021).

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 2021 and July 2021 carried out at different locations such as; Near Kovalam Beach, Proposed Dredging site, South of Break Water, Port Basin, Inner Approach Channel and Kovalam Beach and in month of May sampling was not carried out due to Covid-19 lockdown restrictions imposed by government of Kerala and in July due rough sea condition.. [JBF11]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′,22.542″ N	76^0,58′,50.421″ E
2.	Proposed Dredging Site	8^0,21′,48.789″ N	76^0,59′,14.919″ E
3.	South of Break Water	8^0,21′,37.680″ N	77^0,00′,44.861″ E
4.	Port Basin	8^0,22′,1.438″ N	76^0,59′,44.487″ E
5.	Inner Approach Channel	8^0,21′,00.195″ N	77^0,00′,27.918″ E
6.	Kovalam Beach	8^0,23′,2.358″ N	76^0,58′,22.560″ E

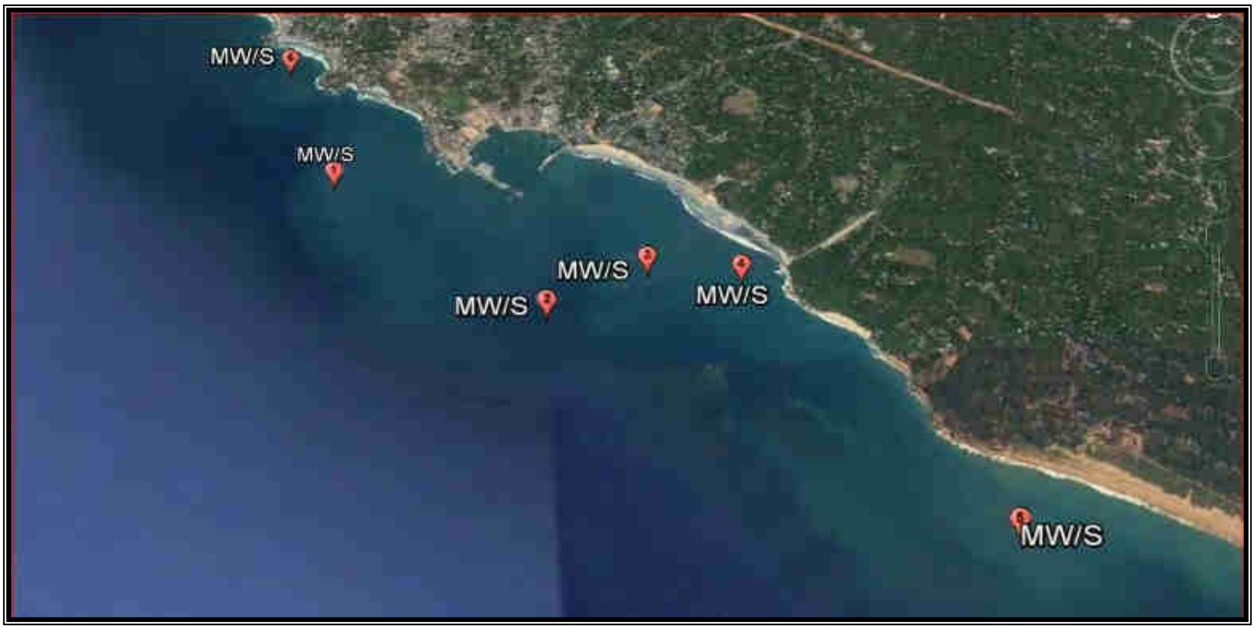


Figure 5.1: Google earth view of Marine Water and Sediment Sampling Locations

2. Methodology of Sampling and Analysis

Table 5.2: Sampling and Analysis Methodology

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
Marine Water Analysis				
1.	Temperature	^0C	0	IS 3025 (Part 9):1984, RA 2009
2.	pH Value	-	1	IS 3025 (Part 11):1983, RA 2017
3.	Turbidity	N.T.U.	0.1	IS 3025 (Part 10):1984, RA 2017
4.	Electrical Conductivity (at 25^{o}C)	µmho/cm	0.1	IS 3025(Part 14): 1984, RA 2006
5.	Total Suspended Solids	mg/L	5	IS 3025 (Part 17): 1984, RA 2017
6.	Total Dissolved Solids	mg/L	5	IS 3025 (Part 16):1984, RA 2006,E.d2.1(1999-1)
7.	Dissolved Oxygen	mg/L	0.05	IS 3025 (Part 38): 1989, RA 2014
8.	Biochemical Oxygen Demand (3 days, 27^{o}C)	mg/L	1	IS 3025 (Part 44): 1993, RA 2014
9.	Floating Materials – Oil, Grease and Scum (Including Petroleum Products)	mg/L	0.1	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-NO_2-B, 4-124
11.	Nitrate (as NO_3)	mg/L	0.2	APHA, 23rd Ed., 2017, 4500-NO_3 B-4-127
12.	Phenolic Compounds (as C_6H_5OH)	mg/L	0.001	APHA, 23rd Ed., 2017, 5530- B & C, 5-50
13.	Ammonical Nitrogen (as NH_3-N)	mg/L	5	APHA, 23rd Ed., 2017, 4500 NH_3, B & C, 4 -114, 4-119
14.	Total Nitrogen (as N)	mg/L	0.1	APHA, 23rd Ed., 2017, 4500 NH_3, B & C, 4 -114, 4-116
15.	Total Phosphorous (as P)	mg/L	0.1	APHA, 23rd Ed., 2017, 4500 P,E, 4-164
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	ppt	0.01	CPCB ADSORBS /8/1983-84
19.	Total Chlorophyll	mg/L	ND	APHA, 23rd Ed.,2017, 10200 H
20.	Total Coliforms	MPN Index /100 ml	1.8	APHA, 23rd Ed., 2017, 9221-B, 9-69

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
21.	Faecal Coliforms	MPN Index /100ml	1.8	APHA, 23rd Ed., 2017, 9221-E, 9-77
22.	Phytoplankton	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 Standards

As per the Environment (Protection) Rules, 1986 Schedule I.

Table 5.3: Marine Water Standard

Parameter	Unit	# E(P)A Rules, 1986
pH Value	-	6.5-9.0
Dissolved Oxygen	mg/L	3.0 mg/L or 40% saturation value; whichever is higher
Colour and Odour	-	No visible colour or offensive odour
Floating Materials(Oil, Grease and Scum) (Including Petroleum Products)	mg/L	*Max.* 10

Parameter	Unit	# E(P)A Rules, 1986
Faecal Coliforms	/100ml	*Max.* 500
Biochemical Oxygen Demand (3 days, 27°C)	mg/L	*Max.* 5
#: Environment (Protection) Rules, 1986, Schedule I, Table 1.4, Primary Water Quality Criteria for Class – IV Water (For Harbour Waters).		

4. **Marine Water Analysis Results for the period April 2021 & June 2021**

Table 5.4: Marine Water Analysis Results

Sr. No.	Parameter /unit	Month/Tide		Near Kovalam Beach	Proposed Dredging Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
1	Temperature (°C)	April 21	High tide	28.2	27.9	28.1	27.8	27.8	27.9
			Low tide	28	27.8	27.9	27.7	27.7	28.1
		June 21	High tide	28.1	27.4	27.5	27.8	27.6	27.9
			Low tide	27.9	27.2	27.3	27.6	27.3	27.7
2	Colour and Odour	April 21	High tide & Low tide	No visible colour or offensive odour					
		June-21	High tide & Low tide	No visible colour or offensive odour					
3	pH Value	April 21	High tide	7.72	7.84	7.8	7.91	7.95	7.81
			Low tide	7.92	7.9	8.02	8.03	8.06	7.64
		June 21	High tide	6.93	7.53	6.81	7.31	7.38	7.13
			Low tide	7.1	7.33	7.48	7.1	7.38	7.28
4	Turbidity (N.T.U.)	April 21	High tide	<0.2	0.59	<0.2	1.5	2.1	<0.2
			Low tide	<0.2	0.93	1.5	1.09	1.5	0.5
		June 21	High tide	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
			Low tide	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
5			High tide	49900	49600	49600	49400	49800	50000

Sr. No.	Parameter /unit	Month/Tide		Near Kovalam Beach	Proposed Dredging Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
	Electrical Conductivity (at 25°C) (μmho/cm)	April 21	Low tide	50000	49400	50500	49900	50000	50400
		June 21	High tide	45161	45564	42700	42580	43548	46161
			Low tide	45483	46600	42903	42900	43951	45484
6	Total Suspended Solids (mg/L)	April 21	High tide	7	<5	7	7	8	6
			Low tide	<5	8	6	6	8	6
		June 21	High tide	<5	7	5	<5	<5	8
			Low tide	8	10	<5	<5	<5	10
7	Total Dissolved Solids (mg/L)	April 21	High tide	31940	31744	31740	31610	31870	31360
			Low tide	32010	31610	32320	31936	32000	32260
		June 21	High tide	28000	28250	26500	26400	27000	28620
			Low tide	28200	28800	26600	26600	27250	28200
8	Dissolved Oxygen (mg/L)	April 21	High tide	4.8	5.2	4.9	5.3	4.8	5
			Low tide	5.4	5.1	5.1	5.5	4.6	5.5
		June 21	High tide	5.8	6.1	6.5	7.0	6.6	5.9
			Low tide	5.4	5.8	6.2	6.8	6.2	5.6
9	Biochemical Oxygen Demand (3 days, 27°C) (mg/L)	April 21	High tide	1	<1	<1	<1	1	<1
			Low tide	<1	<1	<1	<1	1	<1
		June 21	High tide	<1	<1	<1	<1	<1	<1
			Low tide	1	<1	<1	<1	<1	<1

Sr. No.	Parameter /unit	Month/Tide		Near Kovalam Beach	Proposed Dredging Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
10	Floating Materials (Oil, Grease and Scum) (Including Petroleum Products) (mg/L)	April 21	High tide	<1	<1	<1	<1	<1	<1
			Low tide	<1	<1	<1	<1	<1	<1
		June 21	High tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
			Low tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
11	Nitrite (as NO_2) (mg/L)	April 21	High tide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
			Low tide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
		June 21	High tide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
			Low tide	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
12	Nitrate (as NO_3) (mg/L)	April 21	High tide	1.5	1.8	1.9	1.58	1.7	1.51
			Low tide	1.38	1.8	2	1.7	1.94	1.32
		June 21	High tide	1.2	1.56	1.3	1.4	1.8	1.3
			Low tide	1.64	1.7	1.5	1.6	2	1.5
13	Phenolic Compounds (as C_6H_5OH) (mg/L)	April 21	High tide	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
			Low tide	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
		June 21	High tide	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
			Low tide	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
14	Ammonical Nitrogen (as NH_3-N)	April 21	High tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
			Low tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Sr. No.	Parameter /unit	Month/Tide		Near Kovalam Beach	Proposed Dredging Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
	(mg/L)	June 21	High tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
			Low tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15	Total Nitrogen (as N) (mg/L)	April 21	High tide	0.89	0.94	1.3	0.91	1.04	0.83
			Low tide	0.75	0.95	1.06	1.15	0.97	0.85
		June 21	High tide	1.2	1.4	1.19	1.14	1.25	1.2
			Low tide	1.42	1.04	1.22	1.13	1.22	1.43
16	Total Phosphorous (as P) (mg/L)	April 21	High tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
			Low tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
		June 21	High tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
			Low tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
17	Reactive Phosphorous (mg/L)	April 21	High tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
			Low tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
		June 21	High tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
			Low tide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
18	Polycyclic Aromatic Hydrocarbon (mg/L)	April 21	High tide	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007
			Low tide	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007
		June 21	High tide	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007
			Low tide	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007
19			High tide	33	32	34	33	35	33

Sr. No.	Parameter /unit	Month/Tide		Near Kovalam Beach	Proposed Dredging Site	South of Break Water	Port Basin	Inner Approach Channel	Kovalam Beach
	Salinity (ppt)	April 21	Low tide	33	33	33	34	35	34
		June 21	High tide	32	33	33	33	33	34
			Low tide	32	32	34	34	34	35
20	Total Chlorophyll (mg/m^3)	April 21	High tide	1	0.9	1	1	0.9	1
			Low tide	1.1	1.2	1.1	0.8	0.8	1
		June 21	High tide	0.9	0.8	0.8	0.8	0.9	0.9
			Low tide	1.2	1.1	1.2	1.1	1.2	1.2
21	Total Coliforms (MPN Index/100 mL)	April 21	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
		June 21	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 (MPN Index/100 mL)	April 21	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
		June 21	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

5. Graphical representation of Results for marine water

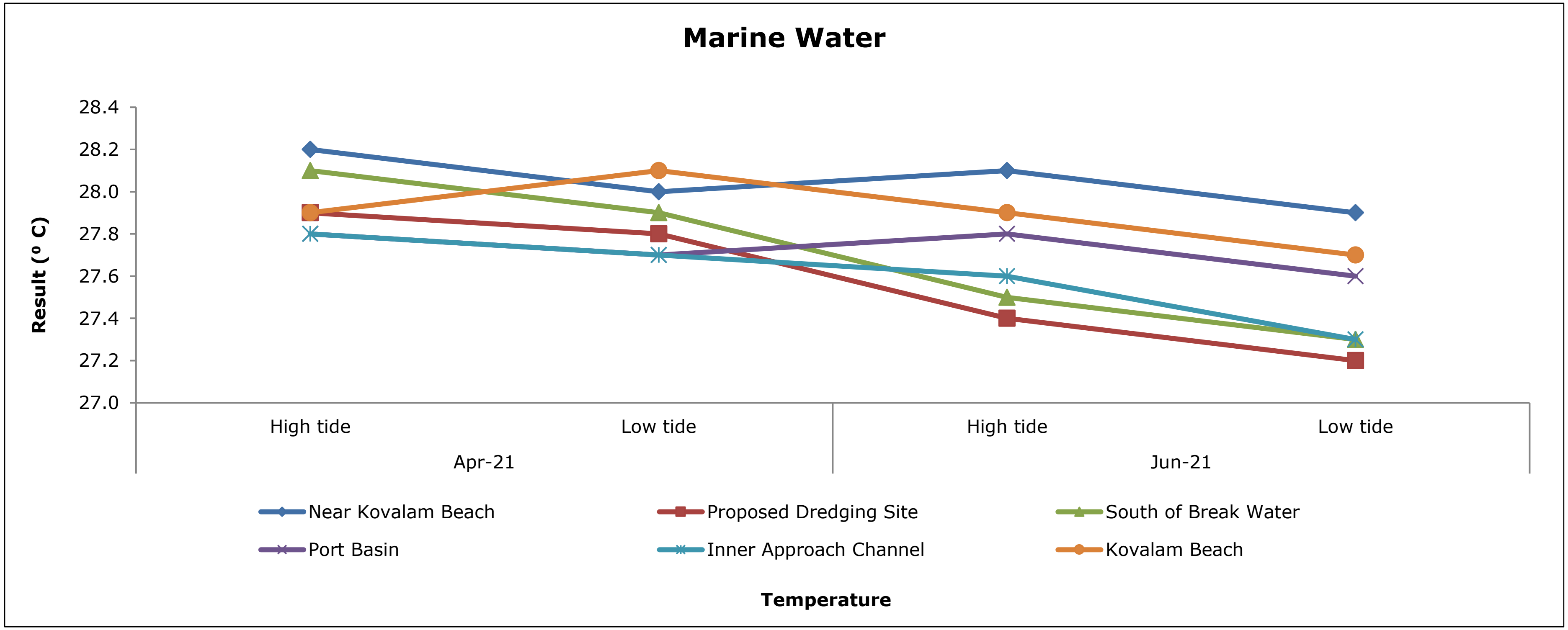


Figure 5.2: Marine Water Analysis for Temperature

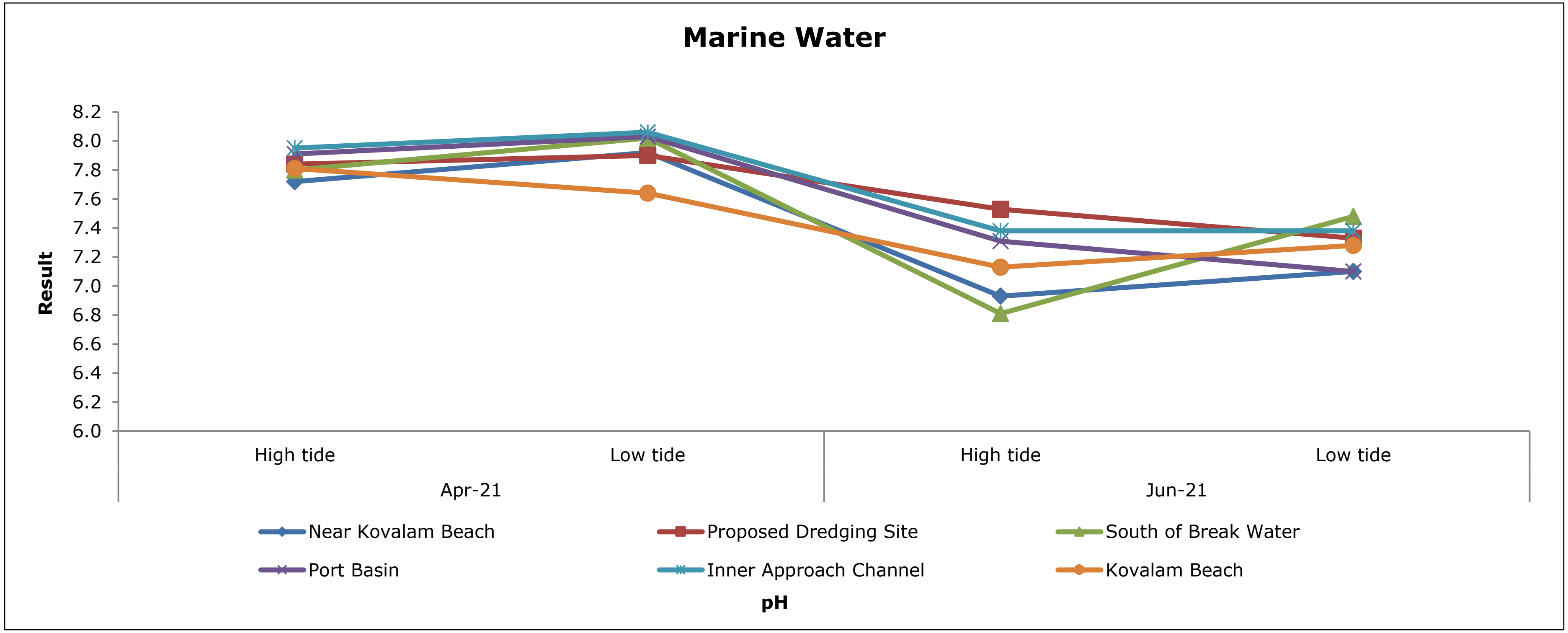
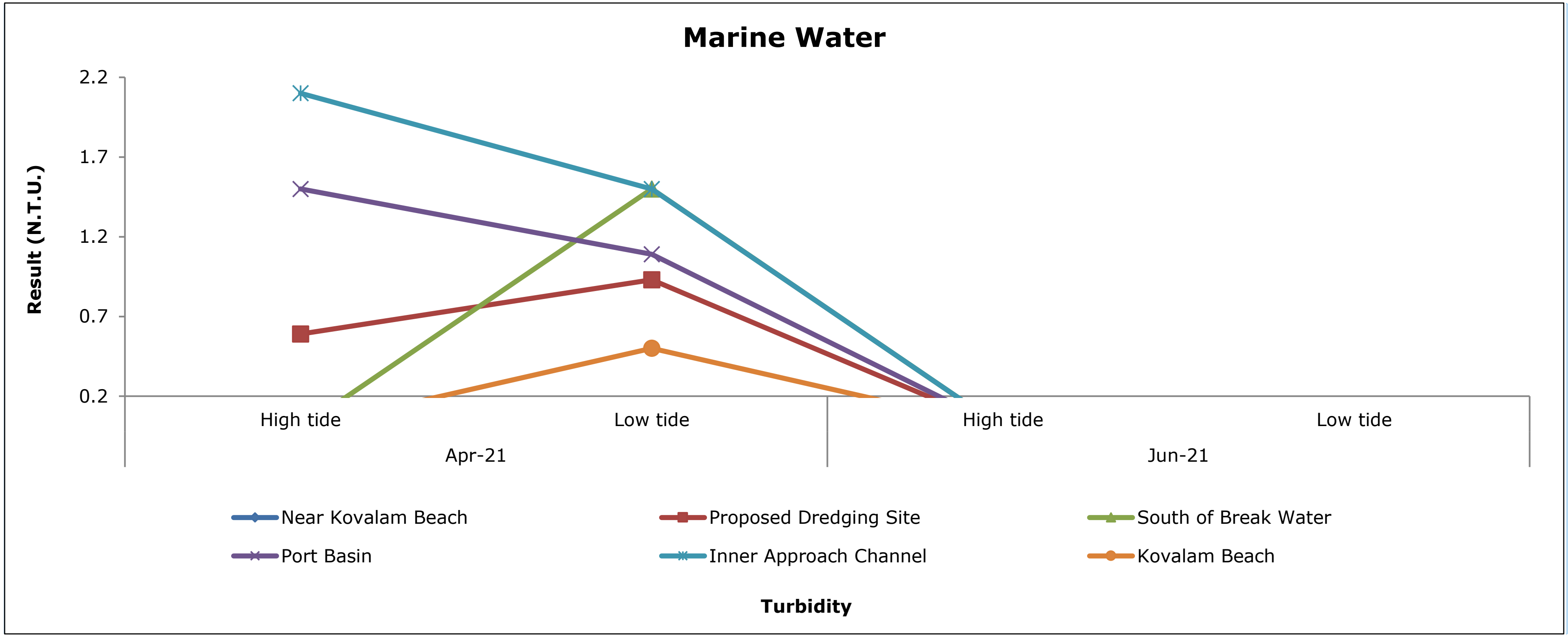
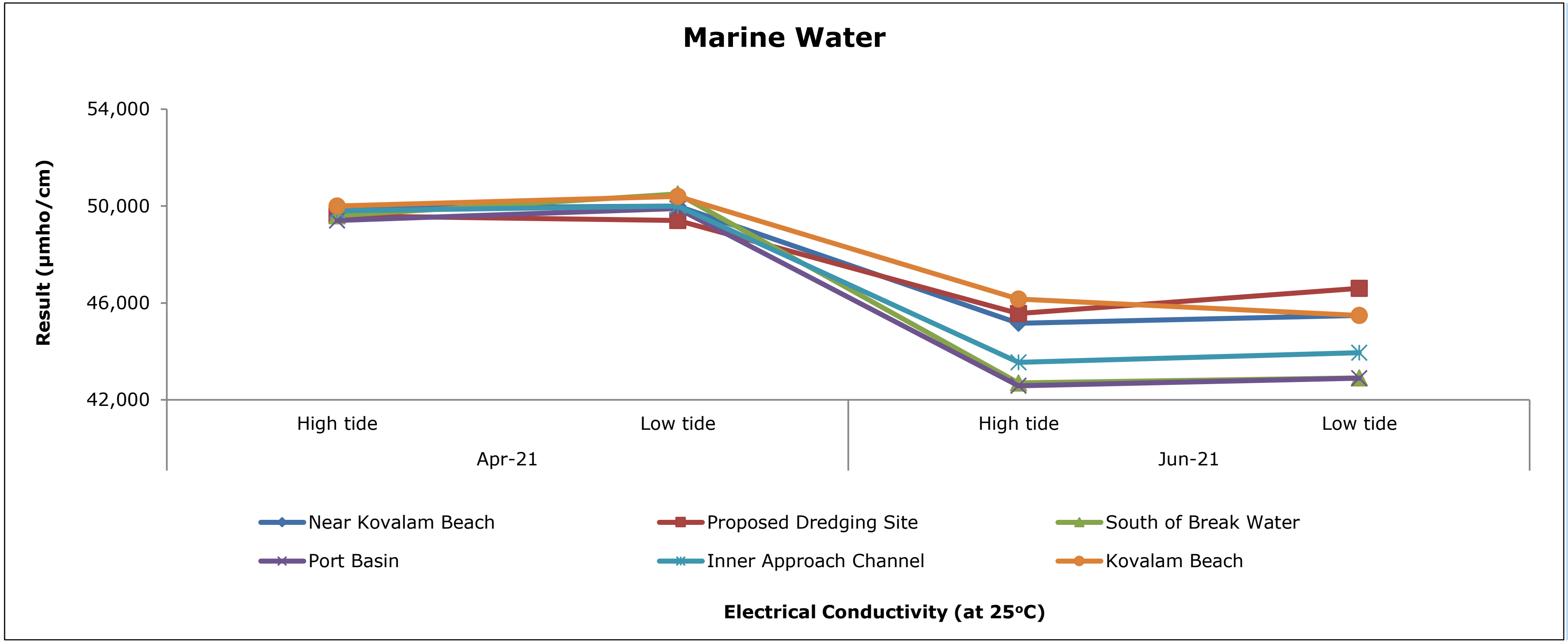


Figure 5.3: Marine Water Analysis for pH



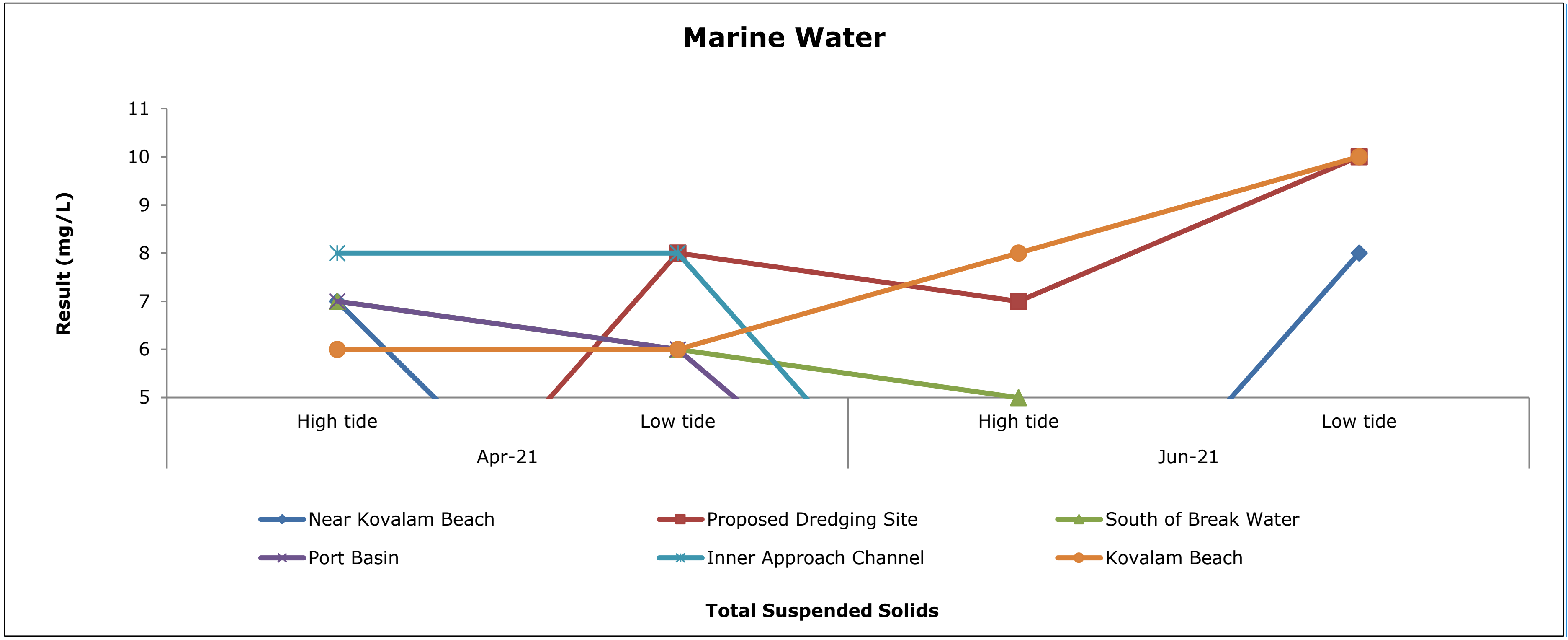
[JBF12]

Figure 5.4: Marine Water Analysis for Turbidity



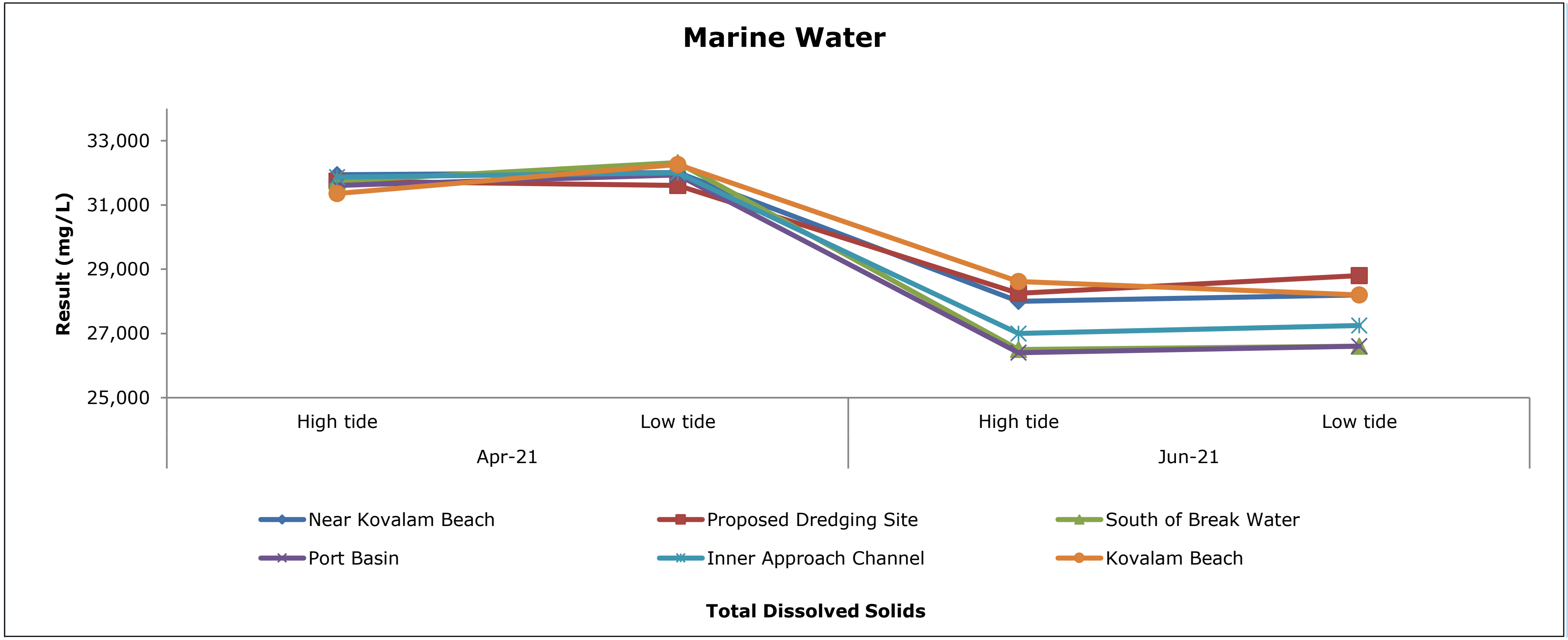
[JBF13]

Figure 5.5: Marine Water Analysis for Electrical Conductivity



[JBF14]

Figure 5.6: Marine Water Analysis for Total Suspended Solids



[JBF15]

Figure 5.7: Marine Water Analysis for Total Dissolved Solids

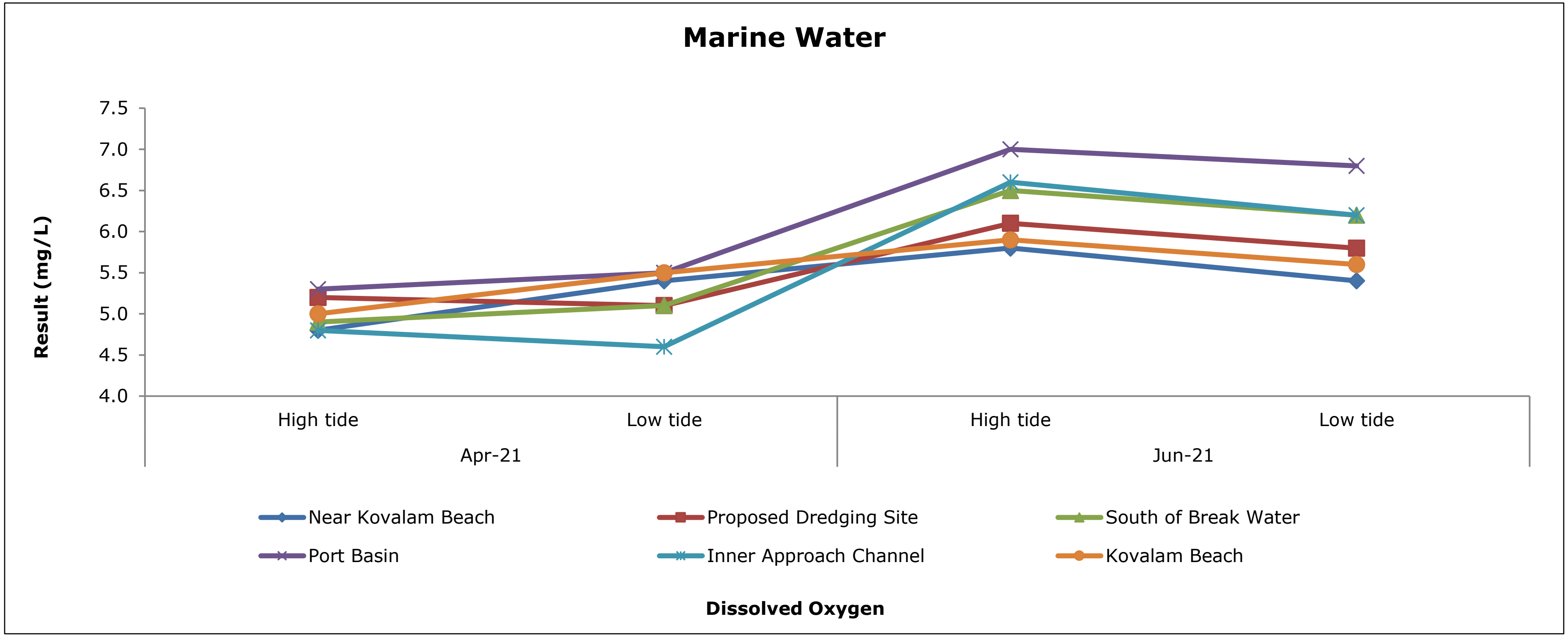
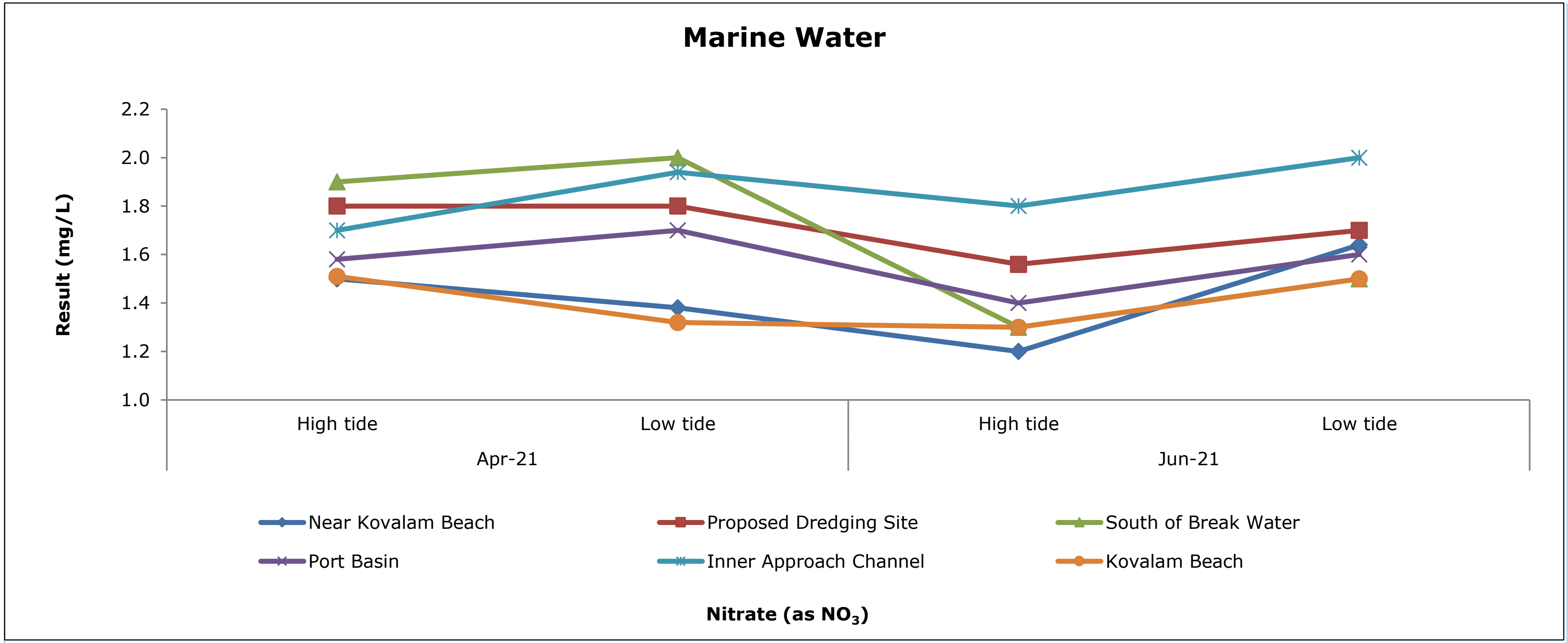
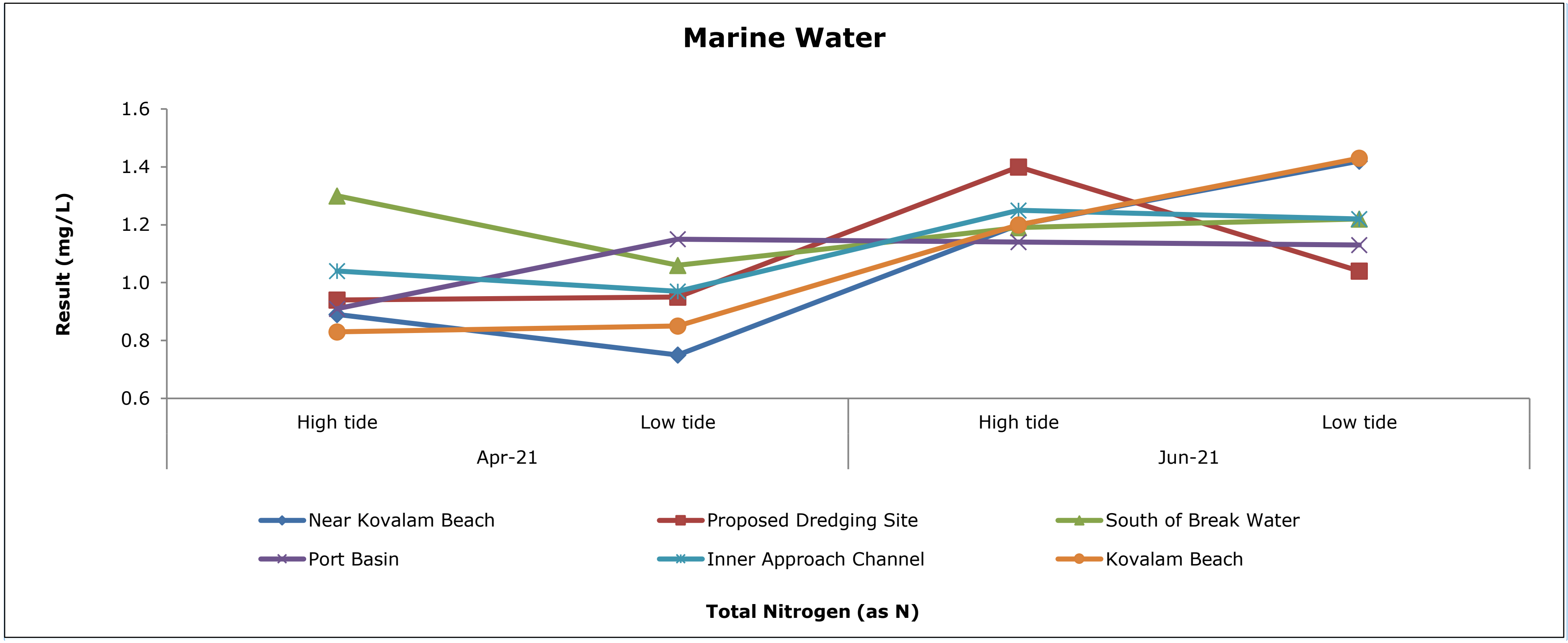


Figure 5.8: Marine Water Analysis for Dissolved Oxygen



[JBF16]

Figure 5.10: Marine Water Analysis for Nitrate as NO_3



[JBF17]

Figure 5.11: Marine Water Analysis for Total Nitrogen as N

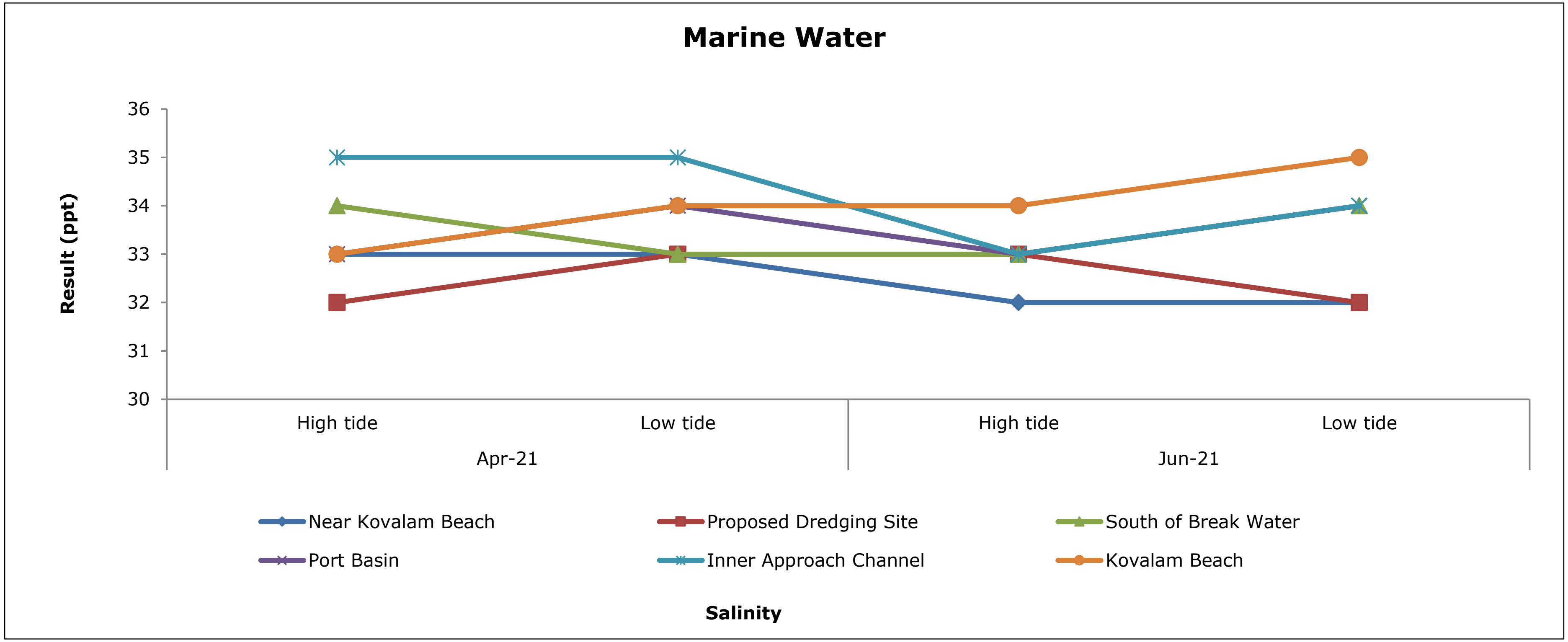
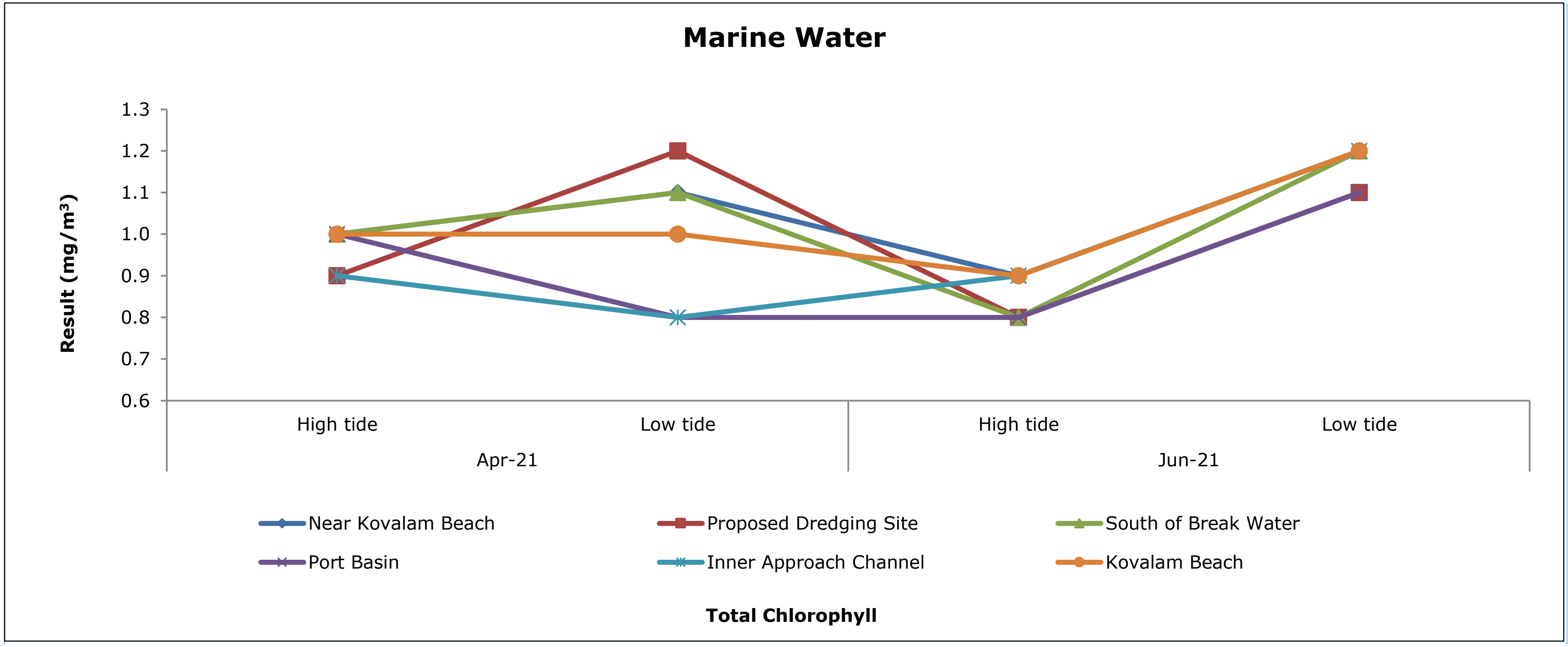


Figure 5.12: Marine Water Analysis for Salinity



[JBF18]

Figure 5.13: Marine Water Analysis for Total Chlorophyll

6. Summary - Marine water analysis:

During the months of April 2021 & June 2021, following is the summary of the marine water analysis:

At the location **Near Kovalam Beach**, the low tide and high tide Temperature was observed in the range between 27.9-28.2^{0}C, no visible colour or offensive odour was observed, concentration of pH were observed in the range between 6.93-7.92, Turbidity was observed <0.2 N.T.U, Electrical Conductivity (at 25^{o}C) was observed in the range between 45161-50000 μmho/cm, Total Suspended Solids were observed in the range between <5-8 mg/L, Total Dissolved Solids were observed in the range between 28000-32010 mg/L, Dissolved Oxygen was observed in the range between 4.8-5.8 mg/L, Biochemical Oxygen Demand (3 days, 27^{o}C) was observed in the range <1-1 mg/L, Nitrite (as NO_2) was observed <0.01 mg/L, Nitrate (as NO_3) was observed in the range between 1.20-1.64 mg/L, Total Nitrogen (as N) was observed in the range between 0.75-1.42 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 32-33 ppt, Total Chlorophyll was observed in the range between 0.9-1.2 mg/m^3, Total Coliforms and Faecal Coliforms were observed <1.8 MPN Index/100 mL.

At the location **Proposed Dredging Site**, the low tide and high tide Temperature was observed in the range between 27.2-27.9^{o}C, no visible colour or offensive odour was observed, concentration of pH were observed in the range between 7.33-7.90, Turbidity was observed in the range between <0.2-0.93 N.T.U, Electrical Conductivity (at 25^{o}C) was observed in the range between 45564-49600 μmho/cm, Total Suspended Solids were observed in the range between <5-10 mg/L, Total Dissolved Solids were observed in the range between 28250-31744 mg/L, Dissolved Oxygen was observed in the range between 5.1-6.1mg/L, Biochemical Oxygen Demand (3 days, 27^{o}C) was observed <1 mg/L, Nitrite (as NO_2) was observed <0.01 mg/L, Nitrate (as NO_3) was observed in the range between 1.56-1.8 mg/L, Total Nitrogen (as N) was observed in the range between 0.94-1.4 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 32-33 ppt, Total Chlorophyll was observed in the range between 0.8-1.2 mg/m^3, Total Coliforms and Faecal Coliforms were observed <1.8 MPN Index/100 mL.

At the location **South of Break Water**, the low tide and high tide Temperature was observed in the range between 27.3-28.1°C, no visible colour or offensive odour was observed, concentration of pH were observed in the range between 6.81-8.02, Turbidity was observed in the range between <0.2-1.5 N.T.U, Electrical Conductivity (at 25°C) was observed in the range between 42700-50500 µmho/cm, Total Suspended Solids were observed in the range between <5-7 mg/L, Total Dissolved Solids were observed in the range between 26500- 32320 mg/L, Dissolved Oxygen was observed in the range between 4.9-6.5 mg/L, Biochemical Oxygen Demand (3 days, 27°C) was observed <1 mg/L, Nitrite (as NO_2) was observed <0.01 mg/L, Nitrate (as NO_3) was observed in the range between 1.30-2.0 mg/L, Total Nitrogen (as N) was observed in the range between 1.06-1.3 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 33-34 ppt, Total Chlorophyll was observed in the range between 0.8-1.2 mg/m^3, Total Coliforms and Faecal Coliforms were observed <1.8 MPN Index/100 mL.

At the location **Port Basin**, the low tide and high tide Temperature was observed in the range between 27.6 - 27.8°C, no visible colour or offensive odour were observed, concentration of pH were observed in the range between 7.1-8.03, Turbidity was observed in the range between 1.09-1.5 N.T.U, Electrical Conductivity (at 25°C) was observed in the range between 42580 - 49900 µmho/cm, Total Suspended Solids were observed in the range between <5-7 mg/L, Total Dissolved Solids were observed in the range between 26400 - 31936 mg/L, Dissolved Oxygen was observed in the range between 5.3-7.0 mg/L, Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between <1 mg/L, Nitrite (as NO_2) was observed <0.01 mg/L, Nitrate (as NO_3) was observed in the range between 1.40-1.7 mg/L, Total Nitrogen (as N) was observed in the range between 0.91-1.15 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 33-34 ppt, Total Chlorophyll was observed in the range between 0.8-1.1 mg/m^3, Total Coliforms and Faecal Coliforms were observed <1.8 MPN Index/100 mL.

At the location **Inner Approach Channel**, the low tide and high tide Temperature was observed in the range between 27.3-27.8°C, no visible colour or offensive odour was observed, concentration of pH were observed in the range between 7.38-8.06, Turbidity was observed in the range between <0.2-2.1 N.T.U, Electrical Conductivity (at 25°C) was observed in the range between 43548-50000 µmho/cm, Total Suspended Solids were observed in the range between <5-8 mg/L, Total Dissolved Solids were observed in the range between 27000-32000 mg/L, Dissolved Oxygen was observed in the range between 4.6-6.6 mg/L, Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between <1-1 mg/L, Nitrite (as NO_2) was observed in the range between <0.01 mg/L, Nitrate (as NO_3) was observed in the range between 1.70 - 2 mg/L, Total Nitrogen (as N) was observed in the range between 0.97-1.25 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 33-35 ppt, Total Chlorophyll was observed in the range between 0.8 - 1.2 mg/m^3, Total Coliforms and Faecal Coliforms were observed <1.8 MPN Index/100 mL.

At the location **Kovalam Beach**, the low tide and high tide Temperature was observed in the range between 27.7-27.9°C, no visible colour or offensive odour was observed, concentration of pH were observed in the range between 7.13-7.81, Turbidity was observed in the range between <0.2-0.50 N.T.U, Electrical Conductivity (at 25°C) was observed in the range between 45484-50400 µmho/cm, Total Suspended Solids were observed in the range between 6-10 mg/L, Total Dissolved Solids were observed in the range between 28200-32260 mg/L, Dissolved Oxygen was observed in the range between 5-5.9 mg/L, Biochemical Oxygen Demand (3 days, 27°C) was observed <1 mg/L, Nitrite (as NO_2) was observed <0.01 mg/L, Nitrate (as NO_3) was observed in the range between 1.30-1.51 mg/L, Total Nitrogen (as N) was observed in the range between 0.83-1.43 mg/L, Floating materials, Phenolic Compounds (as C_6H_5OH), Ammonical Nitrogen (as NH_3-N), Total Phosphorous (as P), Reactive Phosphorous, Polycyclic Aromatic Hydrocarbon were observed below the detection limits. Salinity was observed in the range between 33-35 ppt, Total Chlorophyll was observed in the range between 0.9-1.2 mg/m^3, Total Coliforms and Faecal Coliforms were observed <1.8 MPN Index/100 mL.

7. Sediment Analysis Results

Table 5.5: Near Kovalam Beach

Parameter	Unit	Apr-21	Jun-21
Texture	-	Sandy	Sandy
Organic Matter	%	0.138	0.25
Total Phosphorus (as P)	mg/kg	46.1	22.9
Aluminium (as Al)	mg/kg	710	835
Chromium (as Cr)	mg/kg	24.9	32.2
Copper (as Cu)	mg/kg	1.87	<1
Iron (as Fe)	mg/kg	4500	2600
Lead (as Pb)	mg/kg	20.4	11.1
Manganese (as Mn)	mg/kg	15.1	15.6
Mercury (as Hg)	mg/kg	<0.04	<0.04
Zinc (as Zn)	mg/kg	16.3	5.97
Nickel (as Ni)	mg/kg	6.09	4.5
Benthic Organism			
Micro Benthic Organism	$/m^2$	94000	89500
Macro Benthic Organism	$/m^2$	80000	72600
Total	**$/m^2$**	**174000**	**162100**

Table 5.6: Proposed Dredging Site

Parameter	Unit	Apr-21	Jun-21
Texture	-	Sandy	Sandy
Organic Matter	%	0.662	0.58
Total Phosphorus (as P)	mg/kg	40.5	16.8
Aluminium (as Al)	mg/kg	543	480
Chromium (as Cr)	mg/kg	15.3	15.6
Copper (as Cu)	mg/kg	2.69	14.6
Iron (as Fe)	mg/kg	2100	2200
Lead (as Pb)	mg/kg	13.2	33.1
Manganese (as Mn)	mg/kg	12.4	14.2

Parameter	Unit	Apr-21	Jun-21
Mercury (as Hg)	mg/kg	<0.04	<0.04
Zinc (as Zn)	mg/kg	5.3	3.2
Nickel (as Ni)	mg/kg	7.07	4.21
Benthic Organism			
Micro Benthic Organism	$/m^2$	15000	14900
Macro Benthic Organism	$/m^2$	96000	95000
Total	**$/m^2$**	**111000**	**109900**

Table 5.7: South of Breakwater

Parameter	Unit	Apr-21	Jun-21
Texture	-	Sandy	Sandy
Organic Matter	%	0.279	0.59
Total Phosphorus (as P)	mg/kg	12.5	23.6
Aluminium (as Al)	mg/kg	1037	1081
Chromium (as Cr)	mg/kg	13.9	34.3
Copper (as Cu)	mg/kg	<1	<1
Iron (as Fe)	mg/kg	2866	3047
Lead (as Pb)	mg/kg	11.8	13.2
Manganese (as Mn)	mg/kg	14.5	16
Mercury (as Hg)	mg/kg	<0.04	<0.04
Zinc (as Zn)	mg/kg	5.34	5.3
Nickel (as Ni)	mg/kg	2.27	3.66
Benthic Organism			
Micro Benthic Organism	$/m^2$	35000	31000
Macro Benthic Organism	$/m^2$	27000	25000
Total	**$/m^2$**	**62000**	**56000**

Table 5.8: Port Basin

Parameter	Unit	Apr-21	Jun-21
Texture	-	Sandy	Sandy
Organic Matter	%	0.207	0.6
Total Phosphorus (as P)	mg/kg	60.5	16.2
Aluminium (as Al)	mg/kg	1544	589
Chromium (as Cr)	mg/kg	19.8	14.8
Copper (as Cu)	mg/kg	1.16	<1
Iron (as Fe)	mg/kg	3630	1497
Lead (as Pb)	mg/kg	17.3	3.4
Manganese (as Mn)	mg/kg	17.6	16.2
Mercury (as Hg)	mg/kg	<0.04	<0.04
Zinc (as Zn)	mg/kg	7.08	<2.5
Nickel (as Ni)	mg/kg	3.73	2.91
Benthic Organism			
Micro Benthic Organism	/m^2	73500	74600
Macro Benthic Organism	/m^2	70000	72000
Total	**/m^2**	**143500**	**146600**

Table 5.9: Inner Approach Channel

Parameter	Unit	Apr-21	Jun-21
Texture	-	Sandy	Sandy
Organic Matter	%	2.76	0.81
Total Phosphorus (as P)	mg/kg	11.4	26.1
Aluminium (as Al)	mg/kg	935	644
Chromium (as Cr)	mg/kg	14.6	10.2
Copper (as Cu)	mg/kg	1.67	<1
Iron (as Fe)	mg/kg	5940	1714
Lead (as Pb)	mg/kg	13.5	10.8
Manganese (as Mn)	mg/kg	20.7	15.9
Mercury (as Hg)	mg/kg	<0.04	<0.04
Zinc (as Zn)	mg/kg	10.9	5.08

Parameter	Unit	Apr-21	Jun-21
Nickel (as Ni)	mg/kg	5.82	3.25
Benthic Organism			
Micro Benthic Organism	$/m^2$	34700	33000
Macro Benthic Organism	$/m^2$	9000	8000
Total	**$/m^2$**	**43700**	**41000**

Table 5.10: Kovalam Beach

Parameter	Unit	Apr-21	Jun-21
Texture	-	Sandy	Sandy
Organic Matter	%	1.29	0.81
Total Phosphorus (as P)	mg/kg	59.6	19.3
Aluminium (as Al)	mg/kg	780	720
Chromium (as Cr)	mg/kg	32.1	36.2
Copper (as Cu)	mg/kg	1.22	1.91
Iron (as Fe)	mg/kg	4224	2270
Lead (as Pb)	mg/kg	25.5	26.7
Manganese (as Mn)	mg/kg	15.6	10.1
Mercury (as Hg)	mg/kg	<0.04	<0.04
Zinc (as Zn)	mg/kg	16.4	5.81
Nickel (as Ni)	mg/kg	5.64	4.11
Benthic Organism			
Micro Benthic Organism	$/m^2$	94500	92000
Macro Benthic Organism	$/m^2$	82500	82200
Total	**$/m^2$**	**177000**	**174200**

8. Graphical representation of Results for sediment analysis

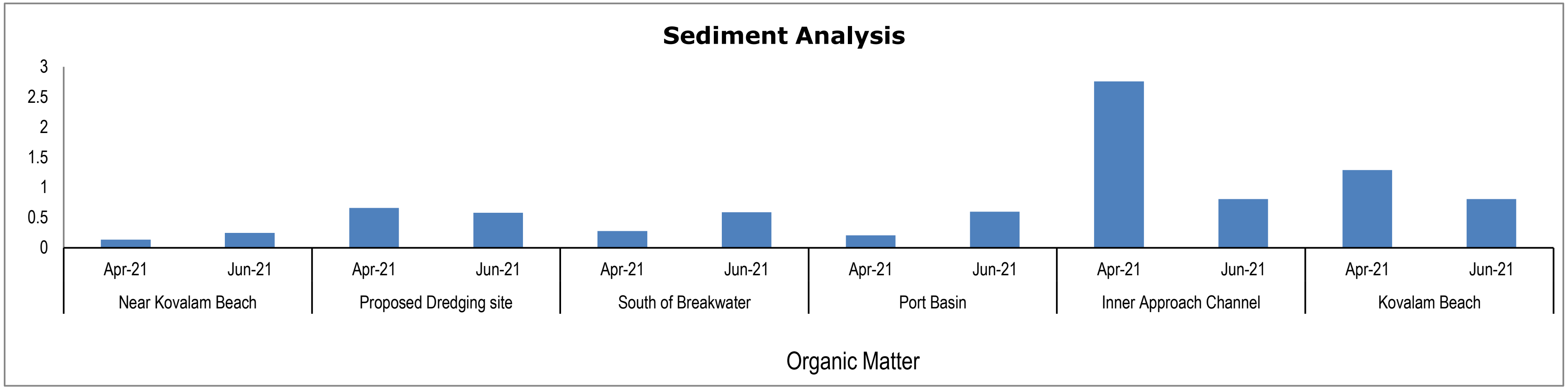


Figure 5.14: Sediment analysis for Organic Matter

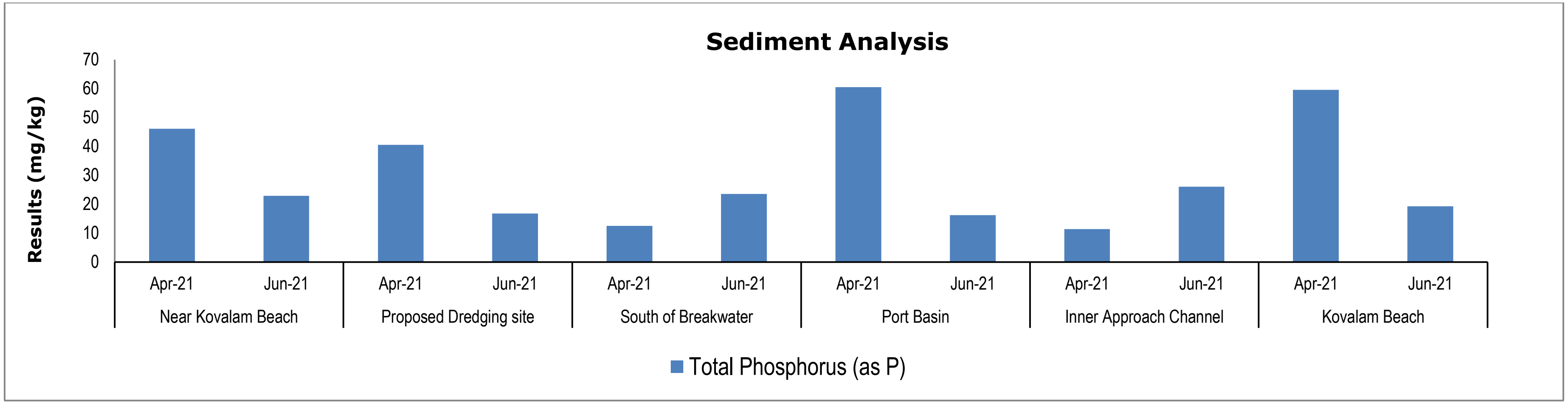


Figure 5.15: Sediment analysis for Total Phosphorus

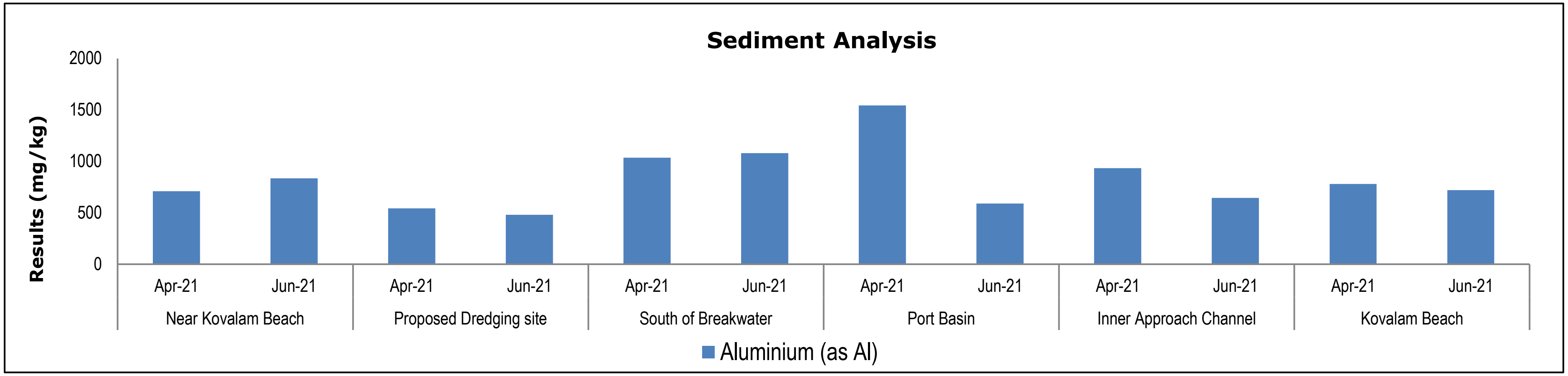


Figure 5.16: Sediment analysis for Aluminium

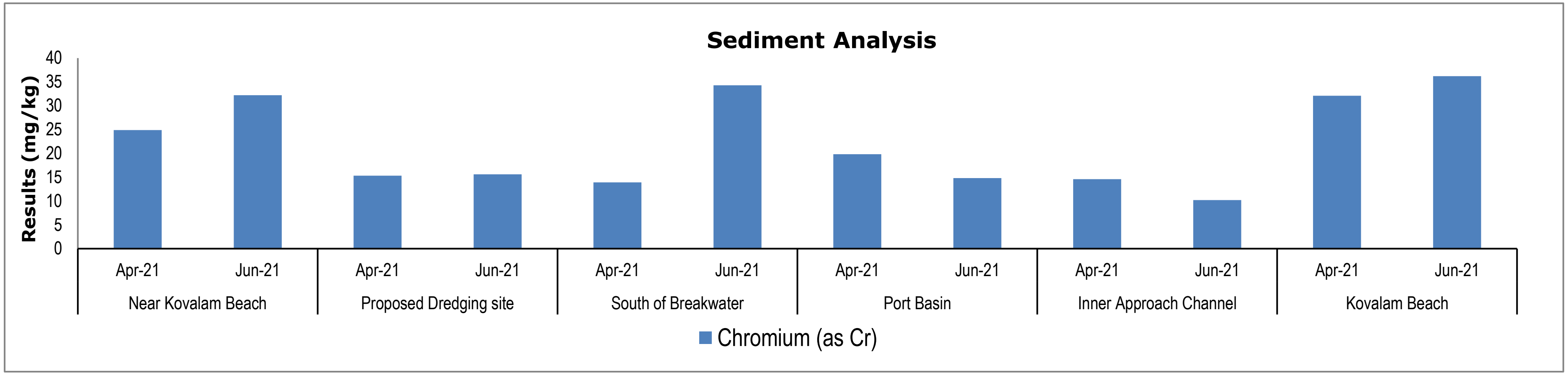


Figure 5.17: Sediment analysis for Chromium

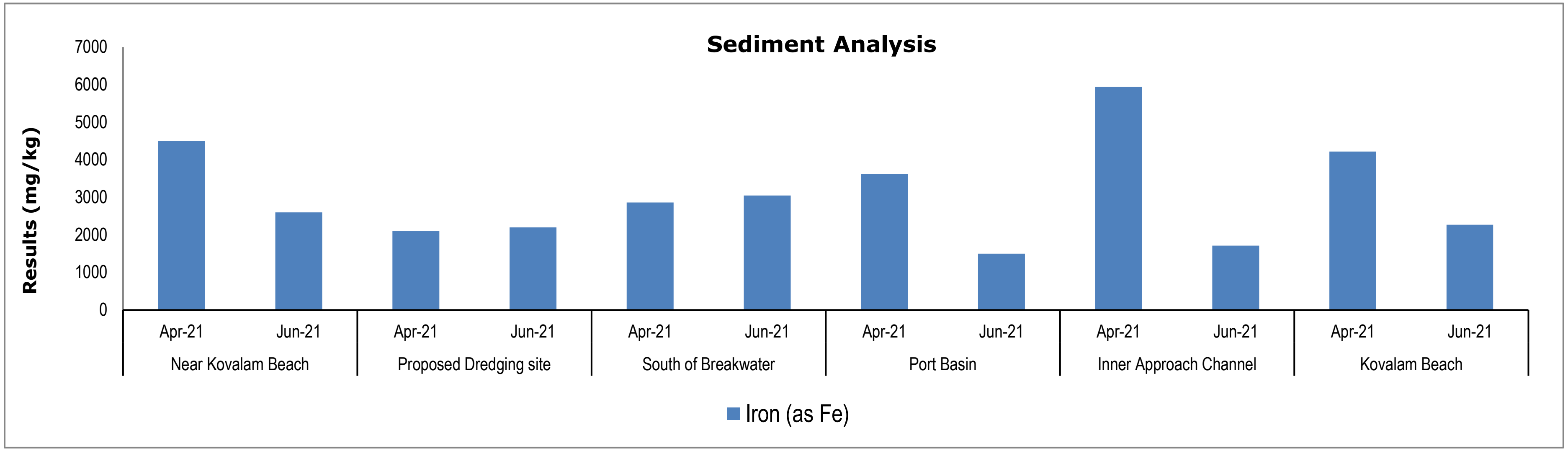


Figure 5.18: Sediment analysis for Iron

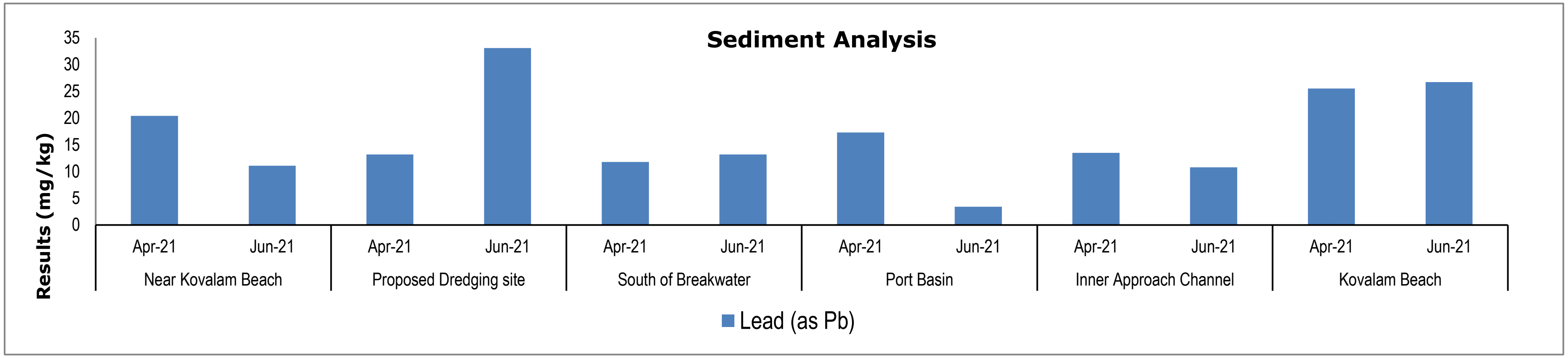


Figure 5.19: Sediment analysis for Lead

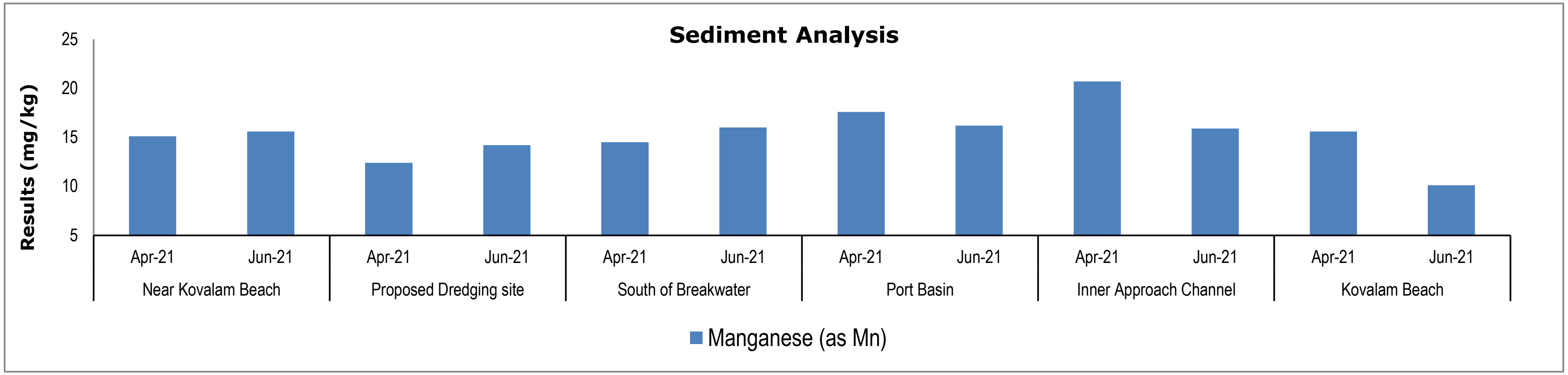


Figure 5.20: Sediment analysis for Manganese

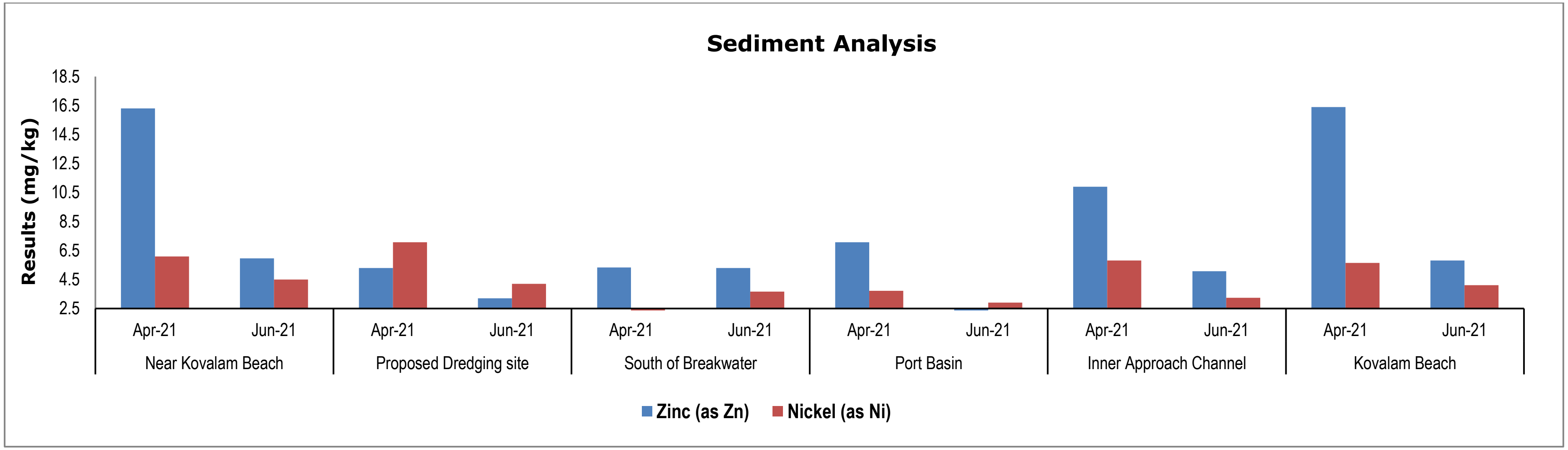


Figure 5.21: Sediment analysis for Zinc and Nickel

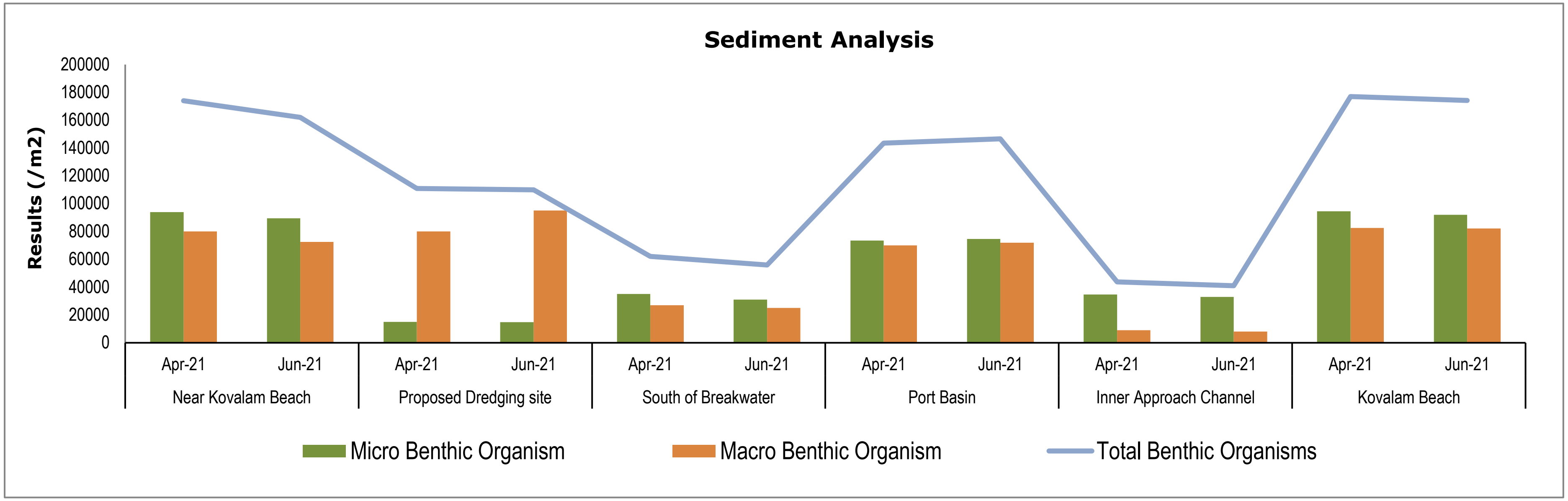


Figure 5.22: Sediment analysis for Benthic Organism

9. Summary - Sediment Analysis:

During the months of April 2021 & June 2021, following is the summary of sediment analysis:

At the location **Near Kovalam Beach**, the observed texture was sandy, Organic matter was observed in the range between 0.138-0.25%, Total Phosphorus (as P) was observed in the range between 22.9-46.1 mg/kg. Aluminium (as Al) was observed in the range between 710-835 mg/kg. Chromium (as Cr) was observed in the range between 24.9-32.2 mg/kg. Copper (as Cu) was observed in the range between <1-1.87 mg/kg. Iron (as Fe) was observed in the range between 2600-4500 mg/kg. Lead (as Pb) was observed in the range between 11.1-20.4 mg/kg. Manganese (as Mn) was observed in the range between 15.1-15.6 mg/kg. Mercury (as Hg) was observed <0.04 mg/kg. Zinc (as Zn) was observed in the range between 5.97-16.3 mg/kg. Nickel (as Ni) was observed in the range between 4.5-6.09 mg/kg. Micro benthic organisms were observed in the range between 89500-94000/m^2 and macro benthic organisms were observed in the range between 72600-80000/m^2.

At the location **Proposed Dredging site**, the observed texture was sandy, Organic matter was observed in the range between 0.58-0.662%, Total Phosphorus (as P) was observed in the range between 16.80-40.5 mg/kg. Aluminium (as Al) was observed in the range between 480-543 mg/kg. Chromium (as Cr) was observed in the range between 15.3-15.6 mg/kg. Copper (as Cu) was observed in the range between 2.69-14.6 mg/kg. Iron (as Fe) was observed in the range between 2100-2200 mg/kg. Lead (as Pb) was observed in the range between 13.2-33.1 mg/kg. Manganese (as Mn) was observed in the range between 12.4-14.2 mg/kg. Mercury (as Hg) was observed <0.04 mg/kg. Zinc (as Zn) was observed in the range between 3.2-5.3 mg/kg. Nickel (as Ni) was observed in the range between 4.21-7.07 mg/kg. Micro benthic organisms were observed in the range between 14900-15000/m^2 and macro benthic organisms were observed in the range between 95000-96000/m^2.

At the location **South of break water**, the observed texture was sandy, Organic matter was observed in the range between 0.279-0.59%, Total Phosphorus (as P) was observed in the range between 12.5-23.6 mg/kg. Aluminium (as Al) was observed in the range between 1037-1081 mg/kg. Chromium (as Cr) was observed in the range between 13.9-34.3 mg/kg. Copper (as Cu) was observed <1 mg/kg. Iron (as Fe) was observed in the range between 2866-3047 mg/kg. Lead (as Pb) was observed in the range between 11.8-13.2 mg/kg. Manganese (as Mn) was observed in the range between 14.5-16 mg/kg. Mercury (as Hg) was observed <0.04 mg/kg. Zinc (as Zn) was observed in the range between 5.3-5.34 mg/kg. Nickel (as Ni) was observed in the range between below 2.27-3.66 mg/kg. Micro benthic organisms were observed in the range between 31000-35000/m^2 and macro benthic organisms were observed in the range 25000-27000/m^2.

At the location **Port Basin**, the observed texture was sandy, Organic matter was observed in the range between 0.2-0.6%, Total Phosphorus (as P) was observed in the range between 16.2-60.5 mg/kg. Aluminium (as Al) was observed in the range between 589-1544 mg/kg. Chromium (as Cr) was observed in the range between 14.8-19.8 mg/kg. Copper (as Cu) was observed in the range between <1-1.16 mg/kg. Iron (as Fe) was observed in the range between 1497-3630 mg/kg. Lead (as Pb) was observed in the range between 3.4-17.3 mg/kg. Manganese (as Mn) was observed in the range between 16.2-17.6 mg/kg. Mercury (as Hg) was observed <0.04 mg/kg. Zinc (as Zn) was observed in the range between <2.5-7.08 mg/kg. Nickel (as Ni) was observed in the range between 2.91-3.73 mg/kg. Micro benthic organisms were observed in the range between 73500-74600/m^2 and macro benthic organisms were observed in the range between 70000-72000/m^2.

At the location **Inner Approach Channel**, the observed texture was sandy, Organic matter was observed in the range between 0.81-2.76%, Total Phosphorus (as P) was observed in the range between 11.4-26.1 mg/kg. Aluminium (as Al) was observed in the range between 644-935 mg/kg. Chromium (as Cr) was observed in the range between 10.2-14.6 mg/kg. Copper (as Cu) was observed in the range between <1-1.67 mg/kg. Iron (as Fe) was observed in the range between 1714-5940 mg/kg. Lead (as Pb) was observed in the range between 10.8-13.5 mg/kg. Manganese (as Mn) was observed in the range between 15.9-20.7 mg/kg. Mercury (as Hg) was observed <0.04 mg/kg. Zinc (as Zn) was observed in the range between 5.08-10.9 mg/kg. Nickel (as Ni) was observed in the range between 3.25-5.82 mg/kg. Micro benthic organisms were observed in the range between 33000-34700/m^2 and macro benthic organisms were observed in the range between 8000-9000/m^2.

At the location **Kovalam Beach**, the observed texture was sandy, Organic matter was observed in the range between 0.81-1.29%, Total Phosphorus (as P) was observed in the range between 19.3-59.6 mg/kg. Aluminium (as Al) was observed in the range between 720-780 mg/kg. Chromium (as Cr) was observed in the range between 32.1-36.2 mg/kg. Copper (as Cu) was observed in the range between 1.22-1.91 mg/kg. Iron (as Fe) was observed in the range between 2270-4224 mg/kg. Lead (as Pb) was observed in the range between 25.5-26.7 mg/kg. Manganese (as Mn) was observed in the range between 10.1-15.6 mg/kg. Mercury (as Hg) was observed <0.04 mg/kg. Zinc (as Zn) was observed in the range between 5.81-16.4 mg/kg. Nickel (as Ni) was observed in the range between 4.11-5.64 mg/kg. Micro benthic organisms were observed in the range between 92000-94500 /m^2 and macro benthic organisms were observed in the range between 82200-82500 /m^2.

10.Marine Water Analysis for Phytoplankton and Zooplankton

Table 5.11: Total Phytoplankton and Zooplankton Results

Parameter	Month	Near Kovalam Beach	Proposed Dredging Site	South of Break water	Port Basin	Inner Approach Channel	Kovalam Beach
Total Phytoplankton No/100 mL	Apr-21	4237000	386100	1367300	129500	1314600	4252800
	Jun-21	4130100	372600	1360400	124200	1296800	4234800
Total Zooplankton No/100 mL	Apr-21	8830	9118	9685	5705	11205	9110
	Jun-21	9006	9178	9178	5802	11288	9202

11. Graphical representation of Results for Marine Phytoplankton and Zooplankton

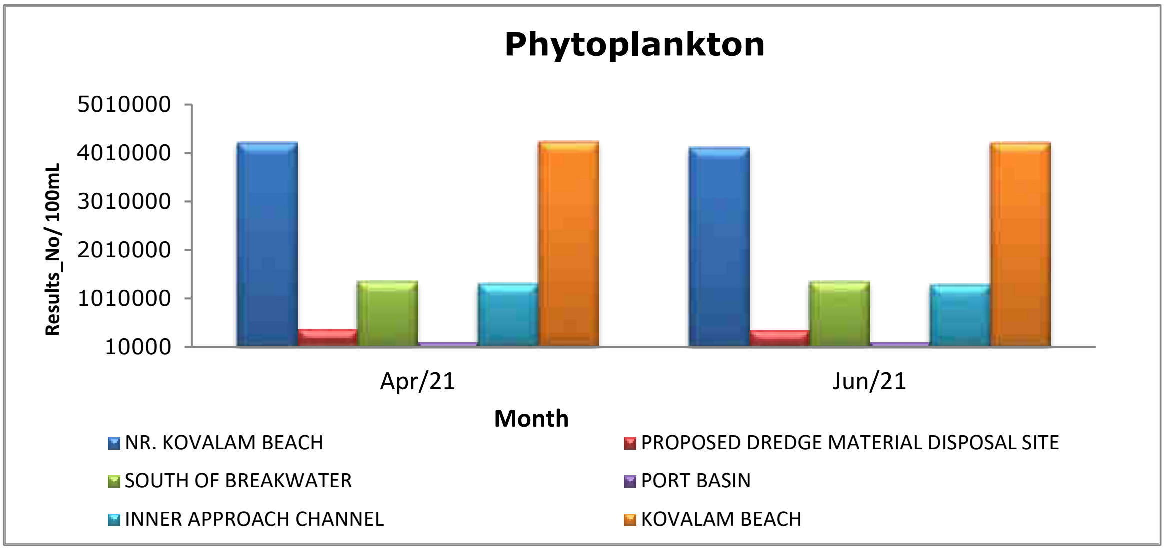


Figure 5.23: Marine Water Analysis for Total Phytoplankton

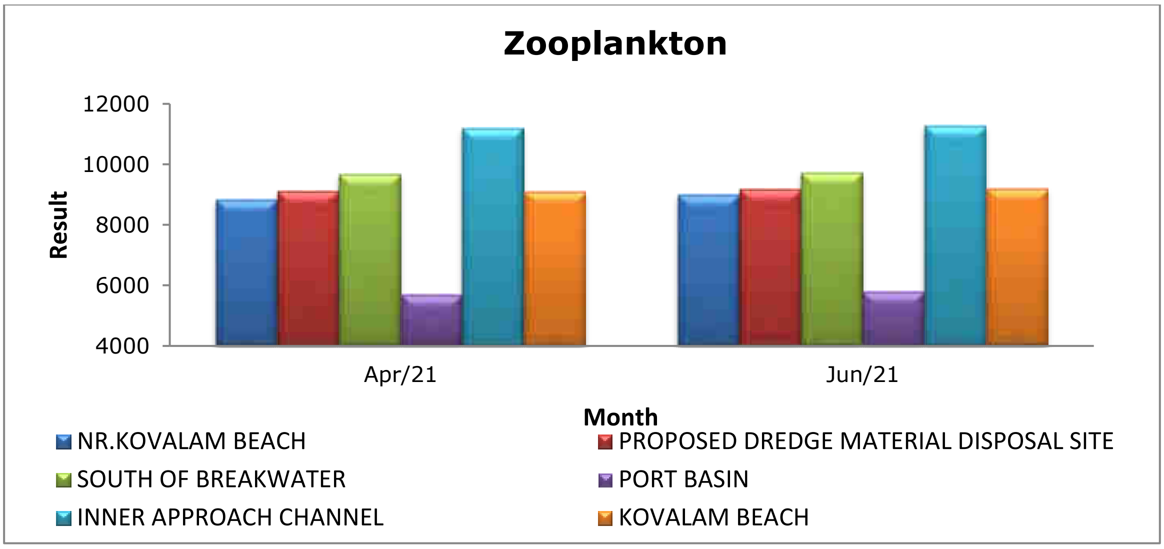


Figure 5.24: Marine Water Analysis for Total Zooplankton

12.Summary-Marine Water Analysis for Phytoplankton and Zooplankton

During the months April 2021 to July 2021, following is the summary of Marine Water Analysis for Phytoplankton and Zooplankton:

At the location **Near Kovalam Beach**, Phytoplankton were observed in the range between 4130100-4237000 No/100 mL and Zooplanktons were observed in the range between 8830-9006 No/100 mL.

At the location **Proposed Dredging site**, Phytoplankton were observed in the range between 372600-386100 No/100 mL and Zooplanktons were observed in the range between 9118-9178 No/100 mL.

At the location **South of Breakwater**, Phytoplankton were observed in the range between 1360400-1367300 No/100 mL and Zooplanktons were observed in the range between 9685-9738 No/100 mL.

At the location **Port Basin**, Phytoplankton were observed in the range between 124200-129500 No/100 mL and Zooplanktons were observed in the range between 5705-5802 No/100 mL.

At the location **Inner Approach Channel**, Phytoplankton were observed in the range between 1296800-1314600 No/100 mL and Zooplanktons was observed in the range between 11205-11288 No/100 mL.

At the location **Kovalam Beach**, Phytoplankton were observed in the range between 4234800-4252800 No/100 mL and Zooplanktons was observed in the range between 9110-9202 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, June and July 2021, in month of May sampling was not carried out due to Covid-19 lockdown restrictions imposed by government of Kerala. 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°,22'02.10" N	77°,00'17.96" E
2.	PAF Area	8^0,22',14.86" N	77^0,00',9.20" 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

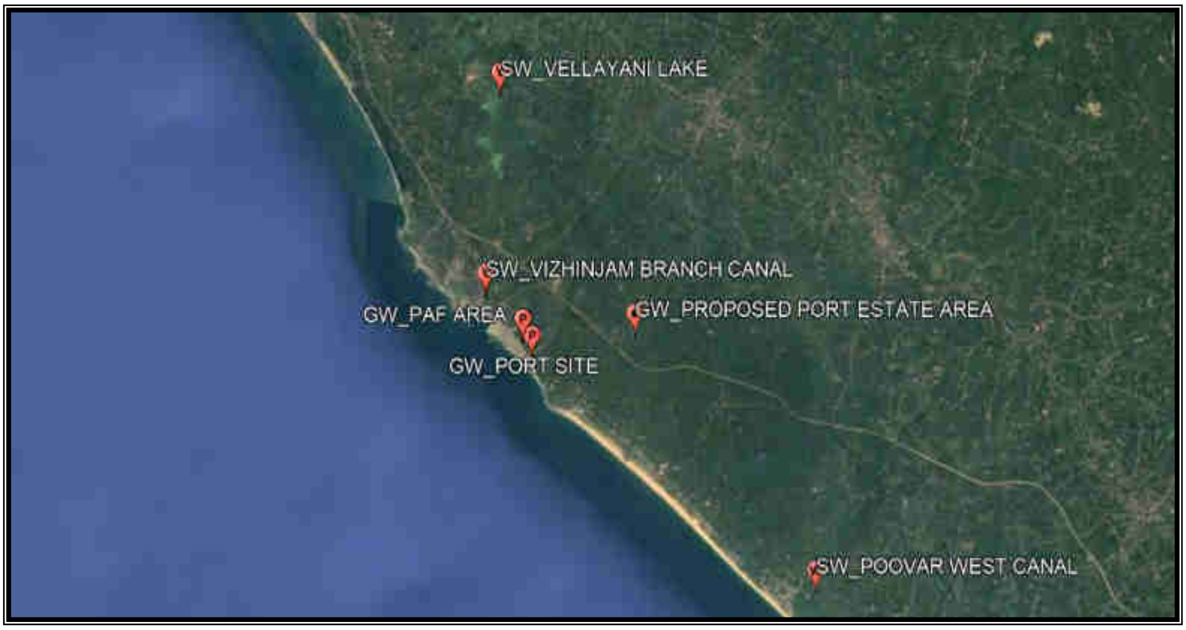


Figure 6.1: Google earth views of Ground water and Surface water sampling locations

2. Methodology of Sampling and Analysis:

Table 6.2: Ground Water and Surface Water methodology

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
1.	Colour	Hazen Units	1	IS 3025 (Part 4):1983, RA 2017
2.	Odour	-	Qualitative	IS 3025 (Part 5): 1983, RA 2017
3.	p^H Value	-	1-14	IS 3025 (Part 11):1983, RA 2017
4.	Turbidity	N.T.U.	0.1	IS 3025 (Part 10):1984, RA 2017
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, RA 2017
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, RA 2014
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 & C5-53 & 5-55
13.	Barium (as Ba)	mg/L	0.1	IS 3025 (Part 2): 2004, RA 2014/ISO 11885:1996
14.	Boron (as B)	mg/L	0.1	Annex H of IS 13428:2005, RA 2014
15.	Calcium (as Ca)	mg/L	0.4	IS 3025 (Part 40): 1991, RA 2014,
16.	Chloramines (as Cl_2)	mg/L	0.05	APHA, 23rd Ed., 2017, 4500-Cl-G, 4-80
17.	Chloride (as Cl)	mg/L	0.25	IS 3025 (Part 32):1988, RA 2014
18.	Copper (as Cu)	mg/L	0.02	IS 3025 (Part 2): 2004, RA 2014/ISO 11885:1996
19.	Fluoride (as F)	mg/L	0.05	IS 3025 (Part 60):2008, RA 2013
20.	Iron (as Fe)	mg/L	0.06	IS 3025 (Part 2): 2004, RA 2014/ISO 11885:1996
21.	Magnesium (as Mg)	mg/L	0.02	IS 3025 (Part 46):1994, RA 2014, Amds.2
22.	Manganese (as Mn)	mg/L	0.02	IS 3025 (Part 2): 2004, RA 2014 / ISO 11885:1996

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
23.	Mineral Oil	mg/L	0.005	IS 3025 (Part 39):1991,RA 2014
24.	Nitrate (as NO_3)	mg/L	0.2	APHA, 23rd Ed., 2017, 4500-NO3, B-4-127
25.	Phenolic Compounds (as C_6H_5OH)	mg/L	0.001	APHA, 23rd Ed., 2017, 4500-NO3, B-4-127
26.	Selenium (as Se)	mg/L	0.005	IS 3025 (Part 2): 2004, RA 2014 / ISO 11885:1996
27.	Silver (as Ag)	mg/L	0.005	IS 3025 (Part 2): 2004, RA 2014 / ISO 11885:1996
28.	Sulphate (as SO_4)	mg/L	2	IS 3025 (Part 24): 1986, RA 2014
29.	Sulphide (as H_2S)	mg/L	0.025	IS 3025 (Part 29):1986, RA 2014
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, RA 2014, Amds.2
32.	Total Hardness (as $CaCO_3$)	mg/L	0.5	IS 3025(Part 23):1986, RA 2014, Amds.2
33.	Calcium Hardness (as $CaCO_3$)	mg/L	-	IS 3025(Part 21): 1983
34.	Zinc (as Zn)	mg/L	0.05	IS 3025 (Part 2): 2004, RA 2014/ ISO 11885:1996
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, RA 2014/ ISO 11885:1996
39.	Cyanide (as CN)	mg/L	0.001	IS 3025(Part 27):1986
40.	Lead (as Pb)	mg/L	0.008	IS 3025 (Part 2): 2004, RA 2014/ ISO 11885:1996
41.	Mercury (as Hg)	mg/L	0.0008	IS 3025 (Part 2): 2004, RA 2014/ ISO 11885:1996
42.	Molybdenum (as Mo)	mg/L	0.002	IS 3025 (Part 2): 2004, RA 2014 / ISO 11885:1996
43.	Nickel (as Ni)	mg/L	0.01	IS 3025 (Part 2): 2004, RA 2014 / ISO 11885:1996
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

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
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, RA 2014
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, RA 2014/ ISO 11885:1996
48.	Total Chromium (as Cr)	mg/L	0.02	IS 3025 (Part 2): 2004, RA 2014 / ISO 11885:1996
49.	**Trihalomethanes**			
a)	Bromoform	mg/L	0.01	USEPA 551.1.REV 1.1995,1 AEC/C/SAP/INS/5-16
b)	Dibromochloromethane	mg/L	0.01	USEPA 551.1.REV 1.1995,1 AEC/C/SAP/INS/5-16
c)	Bromodichloroethane	mg/L	0.01	USEPA 551.1.REV 1.1995,1 AEC/C/SAP/INS/5-16
d)	Chloroform	mg/L	0.01	USEPA 551.1.REV 1.1995,1 AEC/C/SAP/INS/5-16
50.	*E. coli*	MPN Index /100 ml	1.8	APHA, 23rd Ed., 2017, 9221-E, G, 9-80
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 2021-July 2021:

Table 6.3: Location - Port Site

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-21	Jun-21	July-21[JBF19]
Colour	Hazen Units	*Max.* 5	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
pH Value	-	6.5 to 8.5	6.81	7.81	6.87
Turbidity	N.T.U.	*Max.* 1	<0.2	0.4	<0.2
Total Dissolved Solids	mg/L	*Max.* 500	230	286	280
General Parameters concerning substances undesirable in excessive amounts					
Aluminum (as Al)	mg/L	*Max.* 0.03	<0.025	<0.025	<0.025
Ammonia (as NH_3- N)	mg/L	*Max.*0.5	<0.1	<0.1	<0.1
Anionic Detergents (as MBAS) Calculated as LAS mol. wt. 288.38	mg/L	*Max.* 0.2	<0.1	<0.1	<0.1
Barium (as Ba)	mg/L	*Max.* 0.7	<0.1	<0.1	<0.1
Boron (as B)	mg/L	*Max.* 0.5	<0.1	<0.1	<0.1
Calcium (as Ca)	mg/L	*Max.* 75	50	25.7	24.8
Chloramines (as Cl_2)	mg/L	*Max.* 4.0	<0.05	<0.05	<0.05
Chloride (as Cl)	mg/L	*Max.*250	47	87	90
Copper (as Cu)	mg/L	*Max.*0.05	<0.02	<0.02	<0.02
Fluoride (as F)	mg/L	*Max.* 1	0.3	0.1	0.3
Iron (as Fe)	mg/L	*Max.*0.3	0.28	0.119	<0.06
Magnesium (as Mg)	mg/L	*Max.* 30	16	14.1	14
Manganese (as Mn)	mg/L	*Max.*0.1	0.083	<0.02	<0.02
Mineral Oil	mg/L	*Max.*0.5	<0.005	<0.005	<0.005
Nitrate (as NO_3)	mg/L	*Max.*45	12	9.96	8.2
Phenolic Compounds (as C_6H_5OH)	mg/L	*Max.* 0.001	<0.001	<0.001	<0.001
Selenium (as Se)	mg/L	*Max.* 0.01	<0.005	<0.005	<0.005
Silver (as Ag)	mg/L	*Max.* 0.1	<0.005	<0.005	<0.005

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-21	Jun-21	July-21[JBF19]
Sulphate (as SO_4)	mg/L	*Max.* 200	6	35.3	36.1
Sulphide (as H_2S)	mg/L	*Max.* 0.05	<0.025	<0.025	<0.025
Total Alkalinity (as $CaCO_3$)	mg/L	*Max.*200	150	100	100
Total Hardness (as $CaCO_3$)	mg/L	*Max.* 200	190	122	120
Zinc (as Zn)	mg/L	*Max.* 5	<0.05	<0.05	0.087
Cadmium (as Cd)	mg/L	*Max.* 0.003	<0.002	<0.002	<0.002
Cyanide (as CN)	mg/L	*Max.*0.05	<0.001	<0.001	<0.001
Lead (as Pb)	mg/L	*Max.* 0.01	<0.008	<0.008	<0.008
Mercury (as Hg)	mg/L	*Max.* 0.001	<0.0008	<0.0008	<0.0008
Molybdenum (as Mo)	mg/L	*Max.* 0.07	<0.002	<0.002	<0.002
Nickel (as Ni)	mg/L	*Max.*0.02	<0.01	<0.01	<0.01
Alachlor	µg/L	20	<0.01	<0.01	<0.01
Atrazine	µg/L	2	<0.01	<0.01	<0.01
Aldrin/Dieldrin	µg/L	0.03	<0.01	<0.01	<0.01
Alpha HCH	µg/L	0.01	<0.01	<0.01	<0.01
Beta HCH	µg/L	0.04	<0.01	<0.01	<0.01
Butachlor	µg/L	125	<0.01	<0.01	<0.01
Chlorpyrifos	µg/L	30	<0.05	<0.05	<0.05
Delta HCH	µg/L	0.04	<0.01	<0.01	<0.01
2,4D chlorophenoxyacetic acid	µg/L	30	<0.07	<0.07	<0.07
DDT (o, p & p,p- Isomers of DDT, DDE, DDD)	µg/L	1	<0.01	<0.01	<0.01
Endosulfan (a, b & Sulphate)	µg/L	0.4	<0.01	<0.01	<0.01
Ethion	µg/L	3	<0.05	<0.05	<0.05
γ HCH (Lindane)	µg/L	2	<0.01	<0.01	<0.01
Isoproturon	µg/L	9	<0.07	<0.07	<0.07
Malathion	µg/L	190	<0.05	<0.05	<0.05
Methyl Parathion	µg/L	0.3	<0.05	<0.05	<0.05
Monocrotophos	µg/L	1	<0.05	<0.05	<0.05
Phorate	µg/L	2	<0.07	<0.07	<0.07
Polychlorinated Biphenyls (PCB)	mg/L	*Max.*0.0005	<0.00007	<0.00007	<0.00007

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-21	Jun-21	July-21[JBF19]
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	*Max.*0.0001	<0.00007	<0.00007	<0.00007
Total Arsenic (as As)	mg/L	*Max.* 0.01	<0.005	<0.005	<0.005
Total Chromium (as Cr)	mg/L	*Max.* 0.05	<0.02	<0.02	<0.02
Trihalomethanes					
Bromoform	mg/L	*Max.* 0.1	<0.01	<0.01	<0.01
Dibromochloro Methane	mg/L	*Max.* 0.1	<0.01	<0.01	<0.01
Bromodichloroethane	mg/L	*Max.* 0.06	<0.01	<0.01	<0.01
Chloroform	mg/L	*Max.* 0.2	<0.01	<0.01	<0.01
Bacteriological Analysis					
E. coli	MPN Index/ 100 mL	Not Detectable	15	7.8	220
Total Coliforms	MPN Index/ 100 mL	-	540	13	350

Table 6.4: Location - Proposed Port Estate Area

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-21	Jun-21	July-21[JBF20]
Organoleptic & Physical Parameters					
Colour	Hazen Units	*Max.* 5	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
pH Value	-	6.5 to 8.5	6.87	7.0	6.58
Turbidity	N.T.U.	*Max.* 1	<0.2	0.8	0.93
Total Dissolved Solids	mg/L	*Max.* 500	156	126	88
General Parameters concerning substances undesirable in excessive amounts					
Aluminum (as Al)	mg/L	*Max.* 0.03	<0.025	<0.025	<0.025
Ammonia (as NH_3- N)	mg/L	*Max.*0.5	<0.1	<0.1	<0.1
Anionic Detergents (as MBAS) Calculated as LAS mol. wt. 288.38	mg/L	*Max.* 0.2	<0.1	<0.1	<0.1
Barium (as Ba)	mg/L	*Max.* 0.7	<0.1	<0.1	<0.1
Boron (as B)	mg/L	*Max.* 0.5	<0.1	<0.1	<0.1

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-21	Jun-21	July-21[JBF20]
Calcium (as Ca)	mg/L	*Max.* 75	14.4	16	7.21
Chloramines (as Cl_2)	mg/L	*Max.* 4.0	<0.05	<0.05	<0.05
Chloride (as Cl)	mg/L	*Max.*250	44.4	30	26.5
Copper (as Cu)	mg/L	*Max.*0.05	<0.02	<0.02	<0.02
Fluoride (as F)	mg/L	*Max.* 1	0.2	0.2	<0.05
Iron (as Fe)	mg/L	*Max.*0.3	0.143	0.136	<0.06
Magnesium (as Mg)	mg/L	*Max.* 30	6.0	8.74	3.4
Manganese (as Mn)	mg/L	*Max.*0.1	<0.02	<0.02	0.028
Mineral Oil	mg/L	*Max.*0.5	<0.005	<0.005	<0.005
Nitrate (as NO_3)	mg/L	*Max.*45	6.0	6.78	5.0
Phenolic Compounds (as C_6H_5OH)	mg/L	*Max.* 0.001	<0.001	<0.001	<0.001
Selenium (as Se)	mg/L	*Max.* 0.01	<0.005	<0.005	<0.005
Silver (as Ag)	mg/L	*Max.* 0.1	<0.005	<0.005	<0.005
Sulphate (as SO_4)	mg/L	*Max.* 200	16.1	19.2	16.4
Sulphide (as H_2S)	mg/L	*Max.* 0.05	<0.025	<0.025	<0.025
Total Alkalinity (as $CaCO_3$)	mg/L	*Max.*200	60	45	25
Total Hardness (as $CaCO_3$)	mg/L	*Max.* 200	60	76	32
Zinc (as Zn)	mg/L	*Max.* 5	<0.05	<0.05	<0.05
Cadmium (as Cd)	mg/L	*Max.* 0.003	<0.002	<0.002	<0.002
Cyanide (as CN)	mg/L	*Max.*0.05	<0.001	<0.001	<0.001
Lead (as Pb)	mg/L	*Max.* 0.01	<0.008	<0.008	<0.008
Mercury (as Hg)	mg/L	*Max.* 0.001	<0.0008	<0.0008	<0.0008
Molybdenum (as Mo)	mg/L	*Max.* 0.07	<0.002	<0.002	<0.002
Nickel (as Ni)	mg/L	*Max.*0.02	<0.01	<0.01	<0.01
Alachlor	µg/L	20	<0.01	<0.01	<0.01
Atrazine	µg/L	2	<0.01	<0.01	<0.01
Aldrin/Dieldrin	µg/L	0.03	<0.01	<0.01	<0.01
Alpha HCH	µg/L	0.01	<0.01	<0.01	<0.01
Beta HCH	µg/L	0.04	<0.01	<0.01	<0.01
Butachlor	µg/L	125	<0.01	<0.01	<0.01

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-21	Jun-21	July-21[JBF20]
Chlorpyrifos	µg/L	30	<0.05	<0.05	<0.05
Delta HCH	µg/L	0.04	<0.01	<0.01	<0.01
2,4D chlorophenoxyacetic acid	µg/L	30	<0.07	<0.07	<0.07
DDT (o, p & p,p-Isomers of DDT, DDE, DDD)	µg/L	1	<0.01	<0.01	<0.01
Endosulfan (a, b & Sulphate)	µg/L	0.4	<0.01	<0.01	<0.01
Ethion	µg/L	3	<0.05	<0.05	<0.05
γ HCH (Lindane)	µg/L	2	<0.01	<0.01	<0.01
Isoproturon	µg/L	9	<0.07	<0.07	<0.07
Malathion	µg/L	190	<0.05	<0.05	<0.05
Methyl Parathion	µg/L	0.3	<0.05	<0.05	<0.05
Monocrotophos	µg/L	1	<0.05	<0.05	<0.05
Phorate	µg/L	2	<0.07	<0.07	<0.07
Polychlorinated Biphenyls (PCB)	mg/L	*Max.*0.0005	<0.00007	<0.00007	<0.00007
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	*Max.*0.0001	<0.00007	<0.00007	<0.00007
Total Arsenic (as As)	mg/L	*Max.* 0.01	<0.005	<0.005	<0.005
Total Chromium (as Cr)	mg/L	*Max.* 0.05	<0.02	<0.02	<0.02
Trihalomethanes					
Bromoform	mg/L	*Max.* 0.1	<0.01	<0.01	<0.01
Dibromochloro Methane	mg/L	*Max.* 0.1	<0.01	<0.01	<0.01
Bromodichloroethane	mg/L	*Max.* 0.06	<0.01	<0.01	<0.01
Chloroform	mg/L	*Max.* 0.2	<0.01	<0.01	<0.01
Bacteriological Analysis					
E. coli	MPN Index/ 100 mL	Not Detectable	10	4.5	130
Total Coliforms	MPN Index/ 100 mL	-	220	7.8	1600

Table 6.5: Location - PAF Area

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-21	Jun-21	July-21
Organoleptic & Physical Parameters					
Colour	Hazen Units	*Max.* 5	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
pH Value	-	6.5 to 8.5	6.65	6.73	6.55
Turbidity	N.T.U.	*Max.* 1	0.21	0.6	<0.2
Total Dissolved Solids	mg/L	*Max.* 500	450	304	296
General Parameters concerning substances undesirable in excessive amounts					
Aluminum (as Al)	mg/L	*Max.* 0.03	<0.025	<0.025	<0.025
Ammonia (as NH_3- N)	mg/L	*Max.*0.5	<0.1	<0.1	<0.1
Anionic Detergents (as MBAS) Calculated as LAS mol. wt. 288.38	mg/L	*Max.* 0.2	<0.1	<0.1	<0.1
Barium (as Ba)	mg/L	*Max.* 0.7	<0.1	<0.1	<0.1
Boron (as B)	mg/L	*Max.* 0.5	<0.1	<0.1	<0.1
Calcium (as Ca)	mg/L	*Max.* 75	32	20	18.4
Chloramines (as Cl_2)	mg/L	*Max.* 4.0	<0.05	<0.05	<0.05
Chloride (as Cl)	mg/L	*Max.*250	220	146	156
Copper (as Cu)	mg/L	*Max.*0.05	<0.02	<0.02	<0.02
Fluoride (as F)	mg/L	*Max.* 1	0.8	0.5	0.4
Iron (as Fe)	mg/L	*Max.*0.3	0.143	0.136	<0.06
Magnesium (as Mg)	mg/L	*Max.* 30	19.4	11.2	10.6
Manganese (as Mn)	mg/L	*Max.*0.1	<0.02	<0.02	0.043
Mineral Oil	mg/L	*Max.*0.5	<0.005	<0.005	<0.005
Nitrate (as NO_3)	mg/L	*Max.*45	34.2	15.1	2.41
Phenolic Compounds (as C_6H_5OH)	mg/L	*Max.* 0.001	<0.001	<0.001	<0.001
Selenium (as Se)	mg/L	*Max*. 0.01	<0.005	<0.005	0.008
Silver (as Ag)	mg/L	*Max.* 0.1	<0.005	<0.005	<0.005
Sulphate (as SO_4)	mg/L	*Max.* 200	33.7	36.9	40.2
Sulphide (as H_2S)	mg/L	*Max.* 0.05	<0.025	<0.025	<0.025
Total Alkalinity (as $CaCO_3$)	mg/L	*Max.*200	28	20	12.5
Total Hardness (as $CaCO_3$)	mg/L	*Max.* 200	160	96	90

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-21	Jun-21	July-21
Zinc (as Zn)	mg/L	*Max.* 5	<0.05	<0.05	0.138
Cadmium (as Cd)	mg/L	*Max.* 0.003	<0.002	<0.002	<0.002
Cyanide (as CN)	mg/L	*Max.*0.05	<0.001	<0.001	<0.001
Lead (as Pb)	mg/L	*Max.* 0.01	<0.008	<0.008	<0.008
Mercury (as Hg)	mg/L	*Max.* 0.001	<0.0008	<0.0008	<0.0008
Molybdenum (as Mo)	mg/L	*Max.* 0.07	<0.002	<0.002	<0.002
Nickel (as Ni)	mg/L	*Max.*0.02	<0.01	<0.01	<0.01
Alachlor	µg/L	20	<0.01	<0.01	<0.01
Atrazine	µg/L	2	<0.01	<0.01	<0.01
Aldrin/Dieldrin	µg/L	0.03	<0.01	<0.01	<0.01
Alpha HCH	µg/L	0.01	<0.01	<0.01	<0.01
Beta HCH	µg/L	0.04	<0.01	<0.01	<0.01
Butachlor	µg/L	125	<0.01	<0.01	<0.01
Chlorpyrifos	µg/L	30	<0.05	<0.05	<0.05
Delta HCH	µg/L	0.04	<0.01	<0.01	<0.01
2,4D chlorophenoxyacetic acid	µg/L	30	<0.07	<0.07	<0.07
DDT (o, p & p,p- Isomers of DDT, DDE, DDD)	µg/L	1	<0.01	<0.01	<0.01
Endosulfan (a, b & Sulphate)	µg/L	0.4	<0.01	<0.01	<0.01
Ethion	µg/L	3	<0.05	<0.05	<0.05
γ HCH (Lindane)	µg/L	2	<0.01	<0.01	<0.01
Isoproturon	µg/L	9	<0.07	<0.07	<0.07
Malathion	µg/L	190	<0.05	<0.05	<0.05
Methyl Parathion	µg/L	0.3	<0.05	<0.05	<0.05
Monocrotophos	µg/L	1	<0.05	<0.05	<0.05
Phorate	µg/L	2	<0.07	<0.07	<0.07
Polychlorinated Biphenyls (PCB)	mg/L	*Max.*0.0005	<0.00007	<0.00007	<0.00007
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	*Max.*0.0001	<0.00007	<0.00007	<0.00007
Total Arsenic (as As)	mg/L	*Max.* 0.01	<0.005	<0.005	<0.005
Total Chromium (as Cr)	mg/L	*Max.* 0.05	<0.02	<0.02	<0.02
Trihalomethanes					

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-21	Jun-21	July-21
Bromoform	mg/L	*Max*. 0.1	<0.01	<0.01	<0.01
Dibromochloro Methane	mg/L	*Max*. 0.1	<0.01	<0.01	<0.01
Bromodichloroethane	mg/L	*Max*. 0.06	<0.01	<0.01	<0.01
Chloroform	mg/L	*Max*. 0.2	<0.01	<0.01	<0.01
Bacteriological Analysis					
E. coli	MPN Index /100 mL	Not Detectable	2	<1.8	49
Total Coliforms	MPN Index /100 mL	-	110	<1.8	220

4. Graphical representation of Results for the period April 2021 to July 2021:

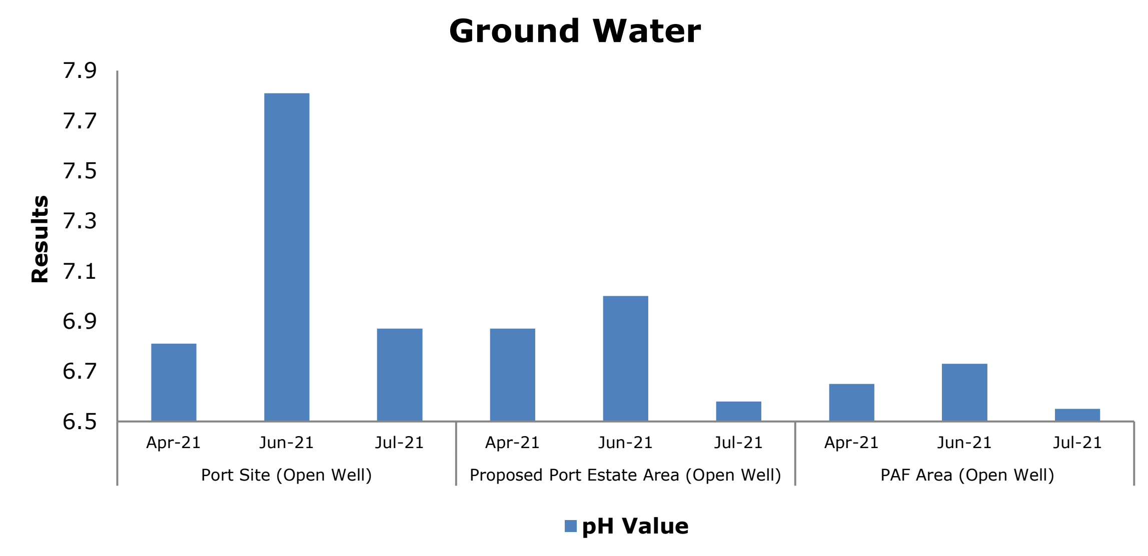
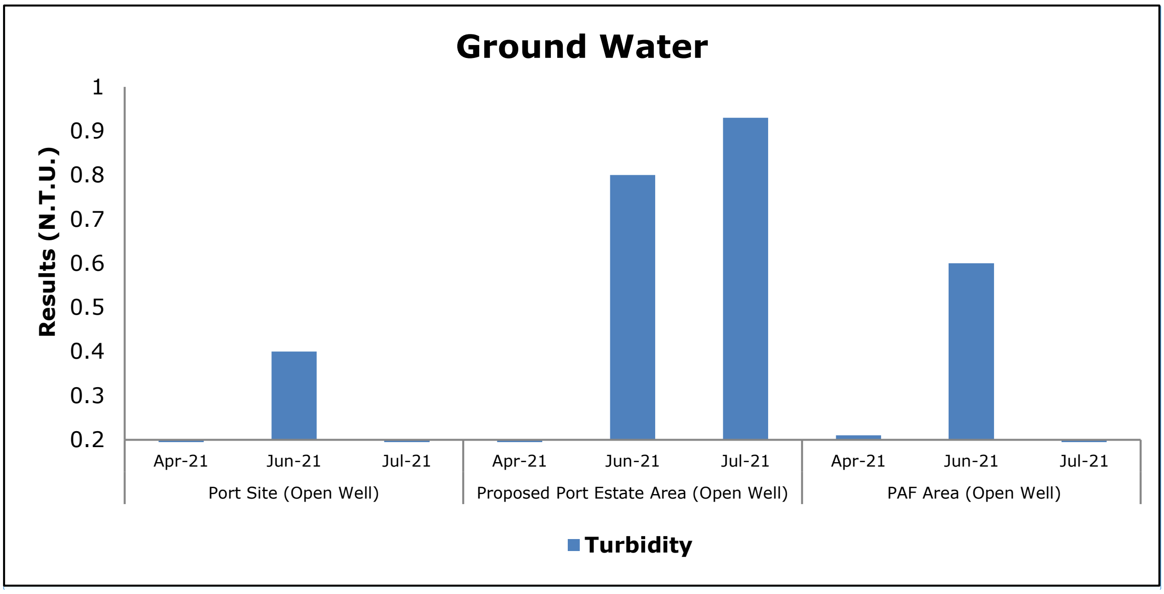


Figure 6.2: Ground Water Analysis for pH



[JBF21]

Figure 6.3: Ground Water Analysis for Turbidity

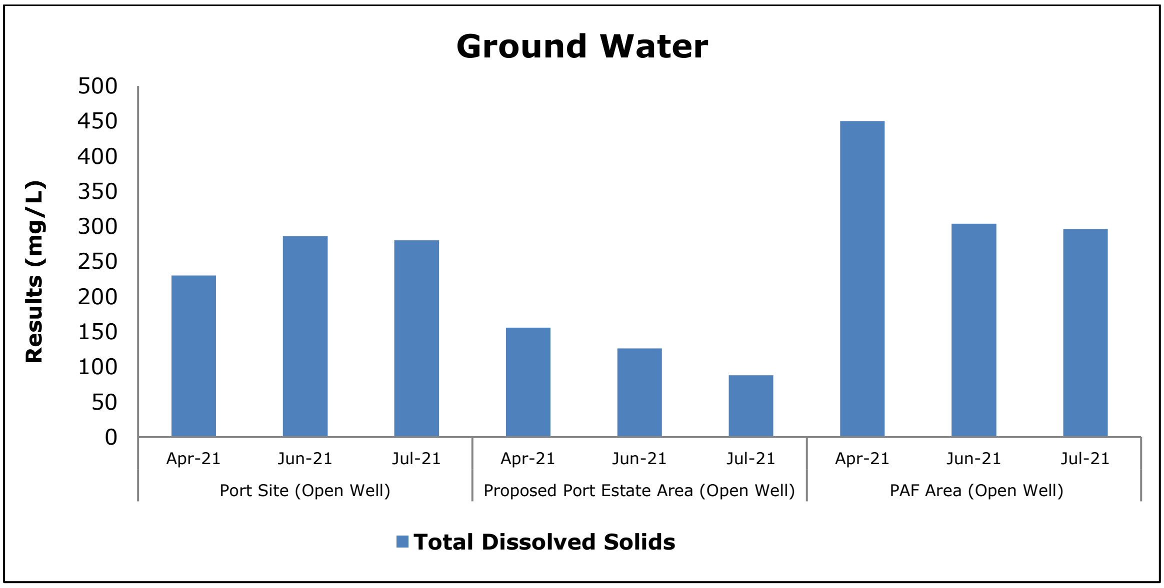


Figure 6.4: Ground Water Analysis for Total Dissolved Solids

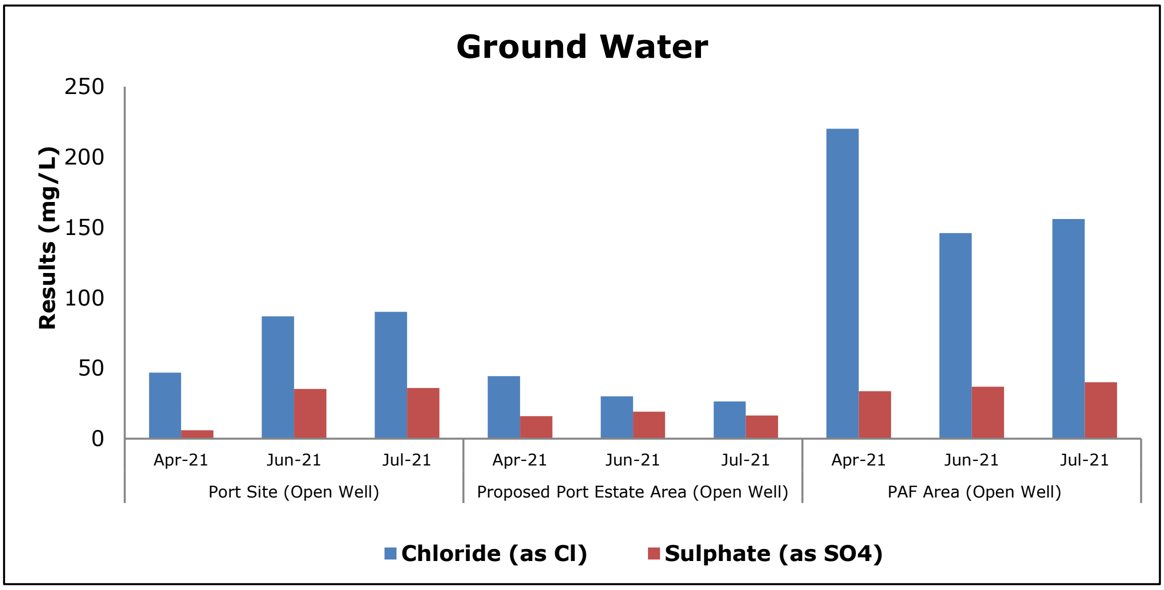


Figure 6.5: Ground Water Analysis for Chloride and Sulphate

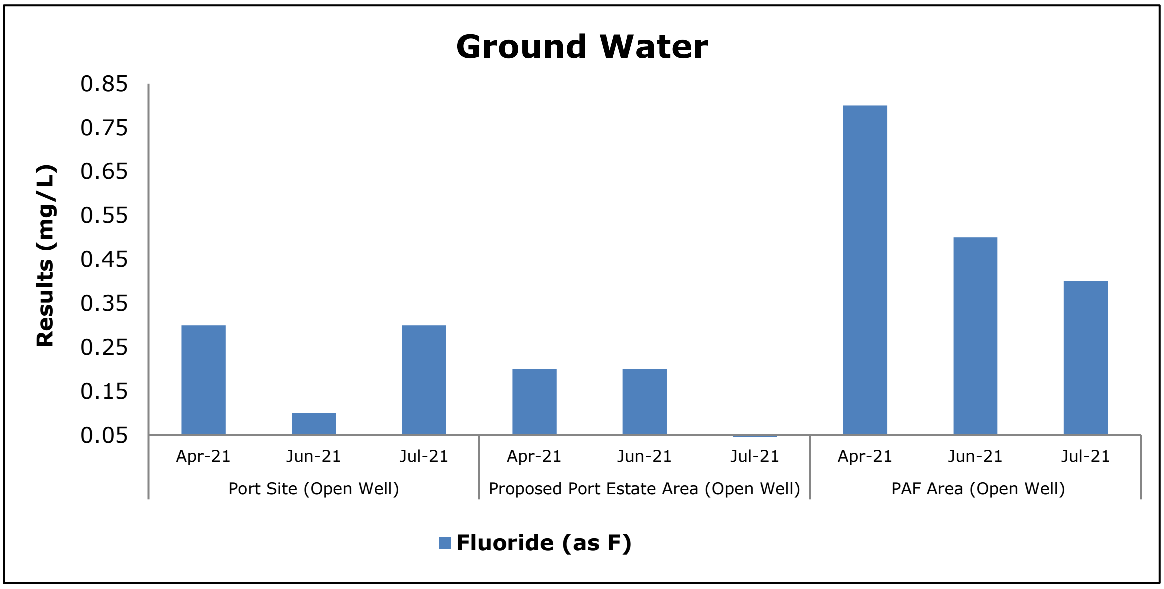


Figure 6.6: Ground Water Analysis for Fluoride

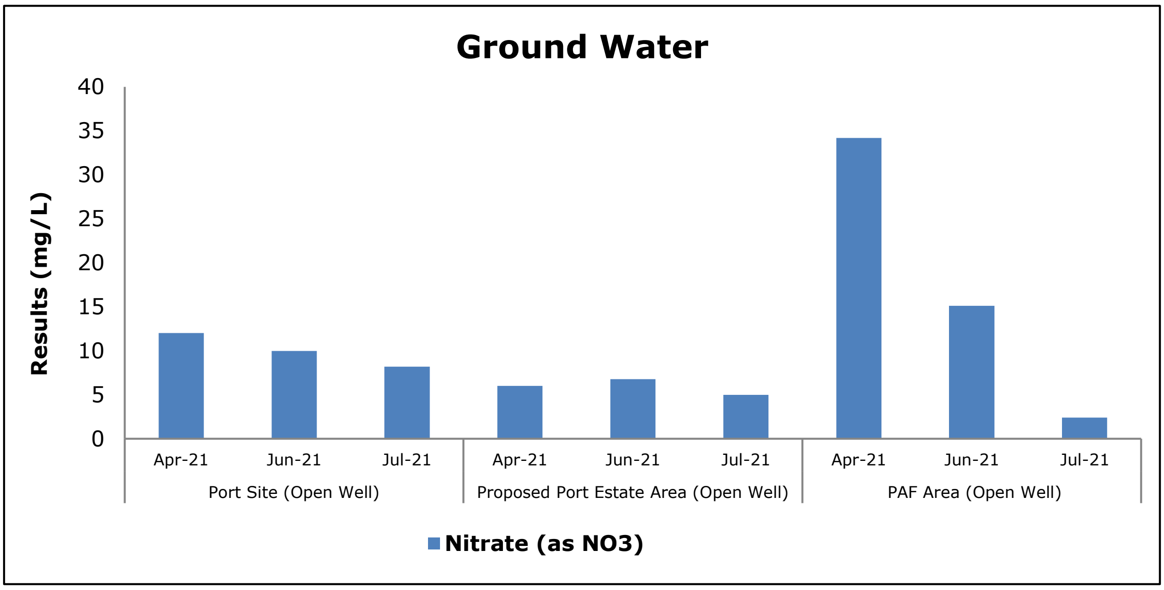


Figure 6.7: Ground Water Analysis for Nitrate

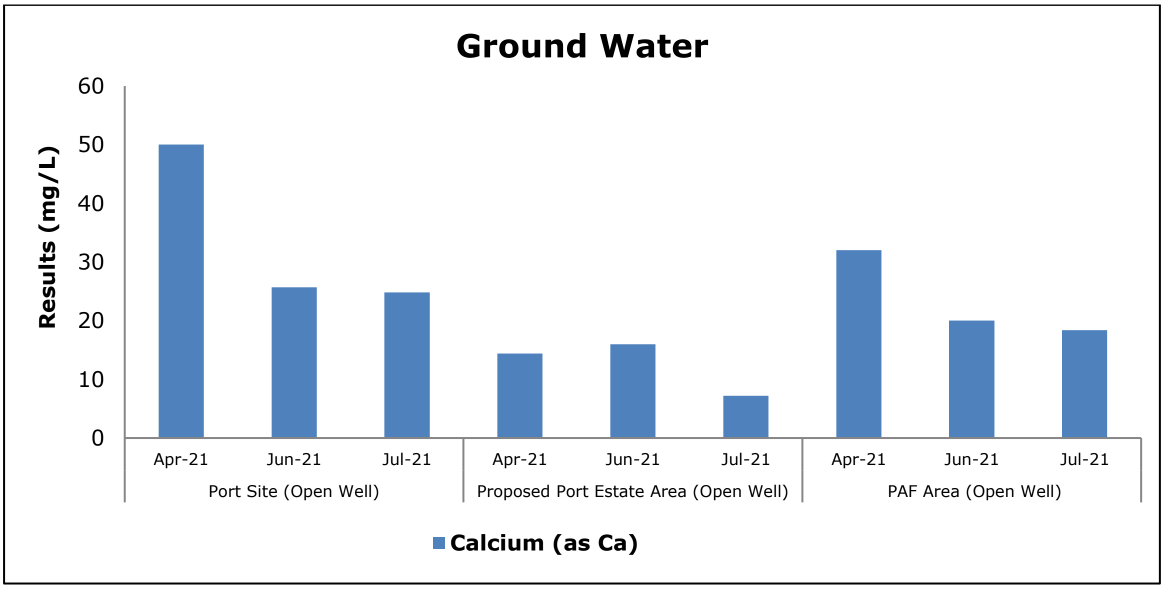


Figure 6.8: Ground Water Analysis for Calcium

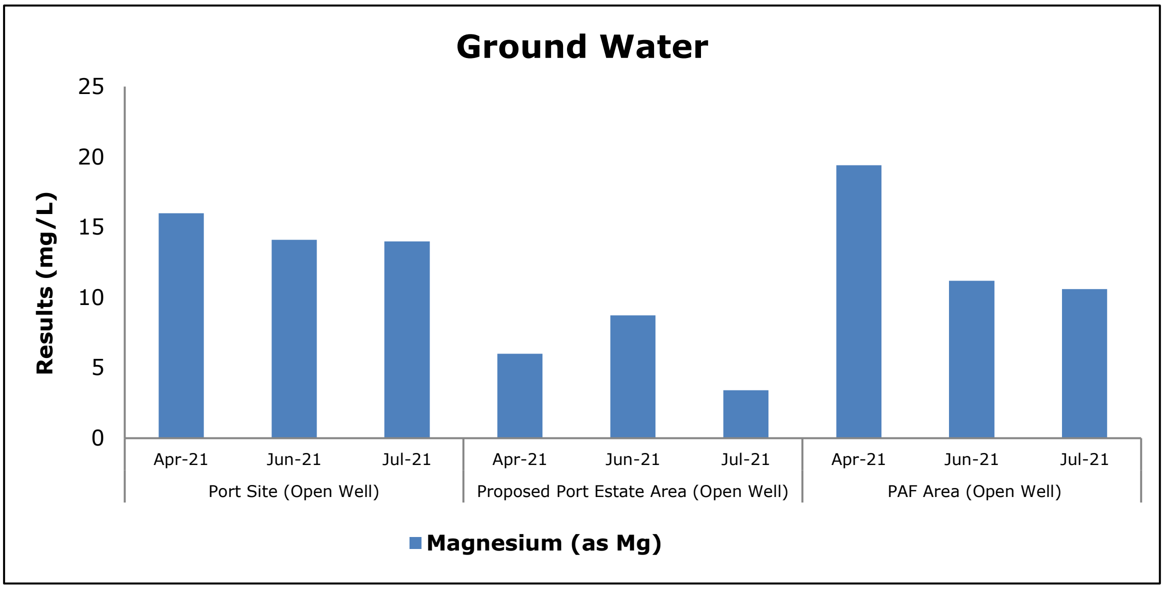


Figure 6.9: Ground Water Analysis for Magnesium

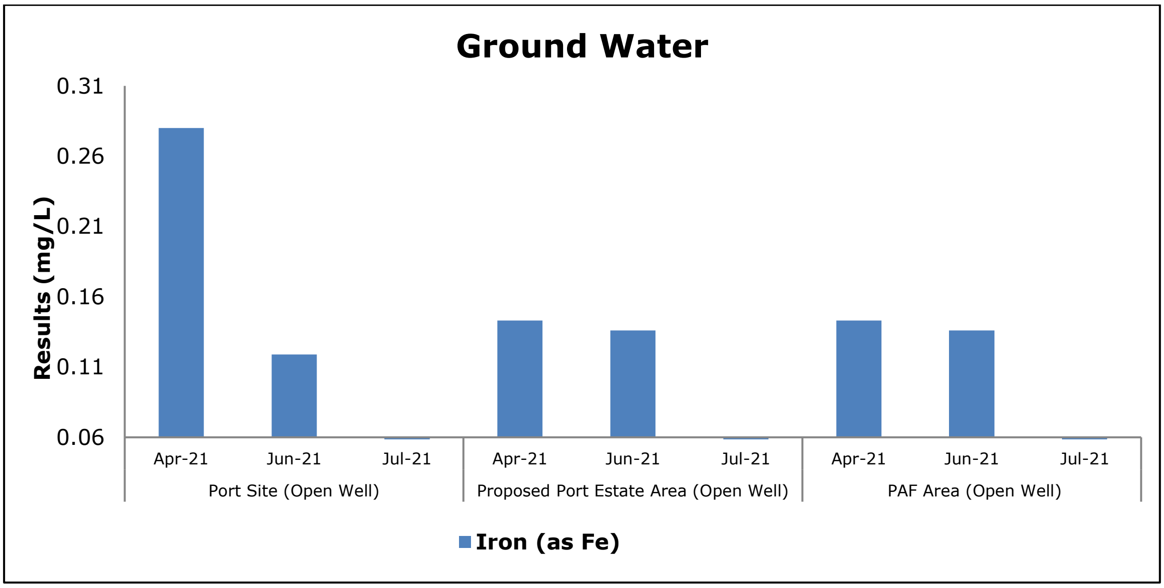


Figure 6.10: Ground Water Analysis for Iron

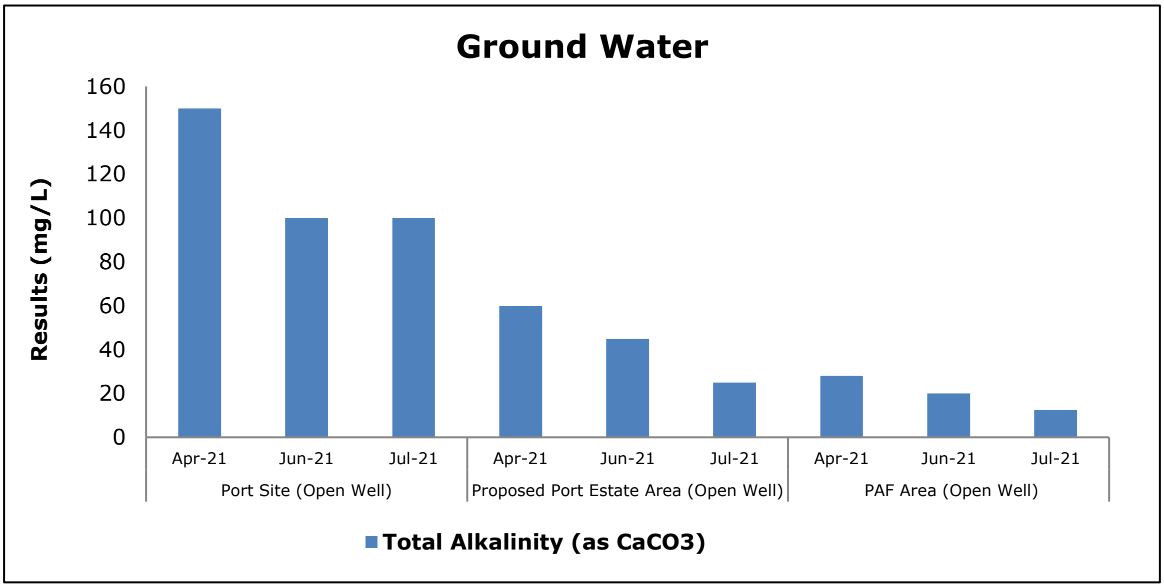


Figure 6.11: Ground Water Analysis for Total Alkalinity

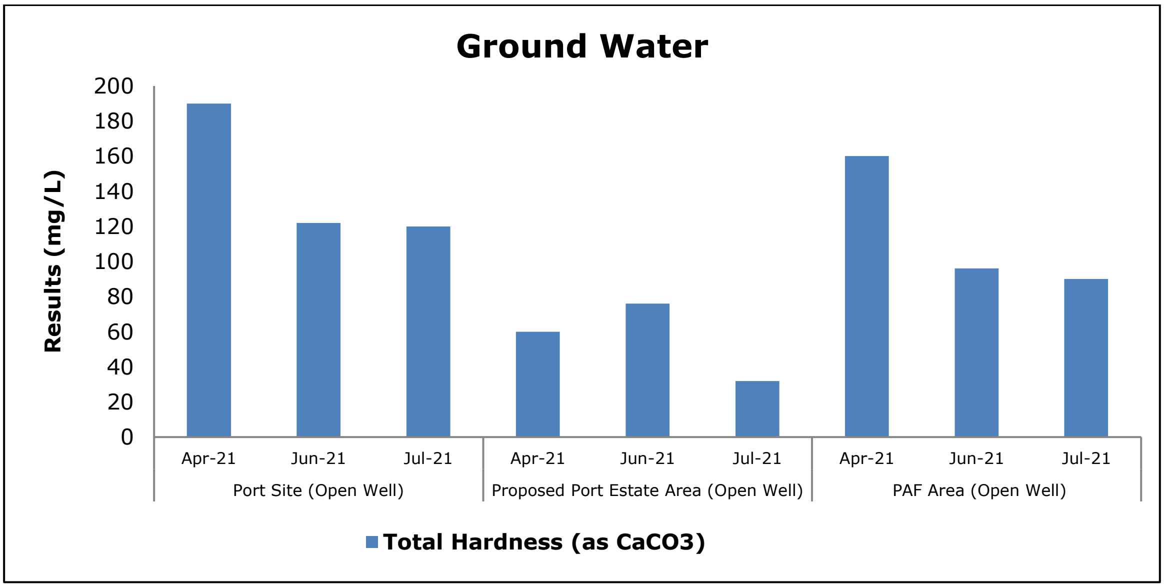


Figure 6.12: Ground Water Analysis for Total Hardness

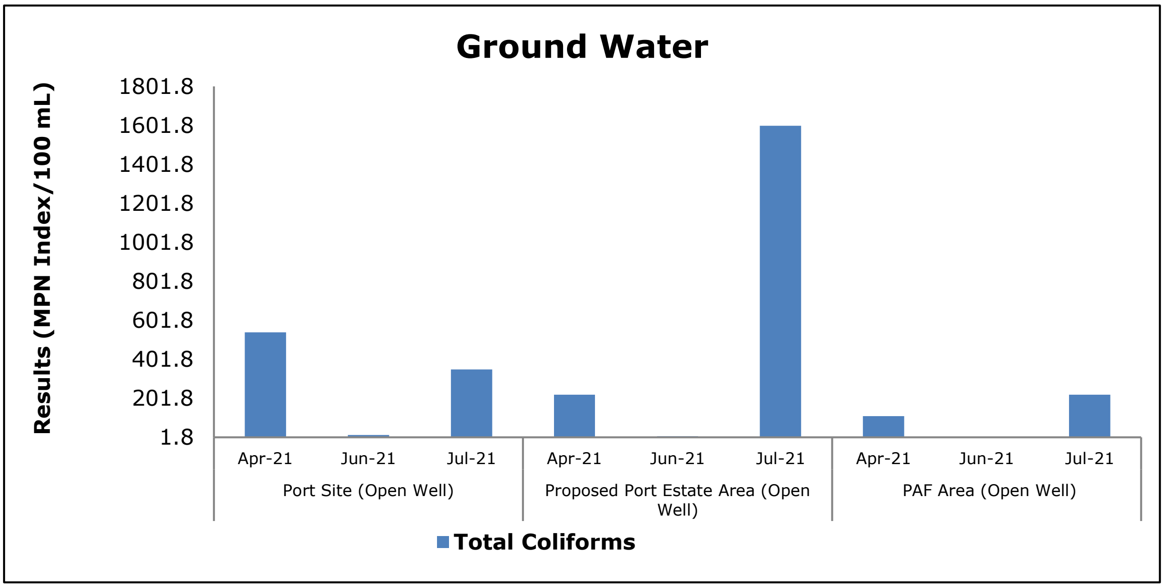


Figure 6.13: Ground Water Analysis for Total Coliforms

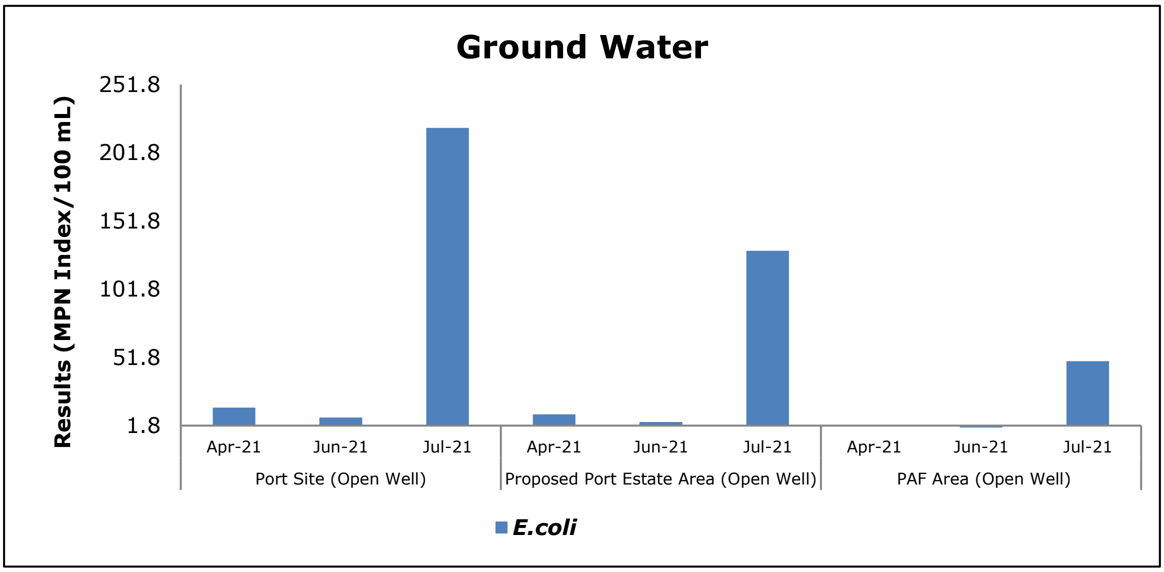


Figure 6.14: Ground Water Analysis for *E.coli.*

5. Summary- Ground Water Analysis

During the period April 2021 to July 2021, following is the summary of ground water analysis:

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 6.81- 7.81. Turbidity was observed <0.2- 0.4 N.T.U., Total Dissolved Solids were observed in the range between

230-286 mg/L. Calcium (as Ca) was observed in the range between 24.8-50 mg/L. Chloride (as Cl) was observed in the range between 47-90 mg/L. Fluoride (as F) was observed in the range between 0.1- 0.3 mg/L. Iron (as Fe) was observed in the range between <0.06- 0.28 mg/L. Magnesium (as Mg) was observed in the range between 14-16 mg/L. Manganese (as Mn) was observed in the range between <0.02-0.083 mg/L. Nitrate (as NO_3) was observed in the range between 8.2-12 mg/L. Sulphate (as SO_4) was observed in the range between 6-36.1 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 100-150 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 120-190 mg/L, Zinc (as Zn) was observed in the range between <0.05- 0.087 mg/L. Aluminium(as Al), Ammonia (as NH_3-N), Anionic Detergents, Barium (as Ba), Boron (as B), 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), 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 Below Detection Limit. Bacteriological parameters such as *E.coli* was observed in the range between 7.8- 220 MPN Index/100 mL and Total Coliforms were observed in the range between 13-540 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 6.58-7. Turbidity was observed in the range between <0.2- 0.93 N.T.U., Total Dissolved Solids were observed in the range between 88-156 mg/L. Calcium (as Ca) was observed in the range between 7.21- 16 mg/L. Chloride (as Cl) was observed in the range between 26.5- 44.4 mg/L. Fluoride (as F) was observed in the range between <0.05 -0.2 mg/L. Iron (as Fe) was observed in the range between <0.06- 0.143 mg/L. Magnesium (as Mg) was observed in the range between 3.4- 8.74 mg/L. Manganese (as Mn) was observed in the range between <0.02- 0.028 mg/L. Nitrate (as NO_3) was observed in the range between 5-6.78 mg/L. Sulphate (as SO_4)was observed in the range between 16.1- 19.2 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 25-60 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 32-76 mg/L. Zinc (as Zn), Aluminium (as Al), Ammonia (as NH_3- N), Anionic Detergents, Barium (as Ba), Boron (as B), 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), 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 Below Detection Limit. Bacteriological parameters such as *E.coli* was observed 4.5- 130 MPN Index/100 mL and Total Coliforms were observed in the range between 7.8- 1600 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 6.55- 6.73. Turbidity was observed in the range between <0.2- 0.6 N.T.U., Total Dissolved Solids were observed in the range between 296-450 mg/L. Calcium (as Ca) was observed in the range between 18.4-32 mg/L. Chloride (as Cl) was observed in the range between 146- 220 mg/L. Fluoride (as F) was observed in the range between 0.4-0.8 mg/L. Iron (as Fe) was observed <0.06-0.143 mg/L. Magnesium (as Mg) was observed in the range between 10.6- 19.4 mg/L. Manganese (as Mn) was observed <0.02-0.043 mg/L. Nitrate (as NO_3) was observed in the range between 2.41-34.2 mg/L. Sulphate (as SO_4) was observed in the range between 33.7-40.2 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 12.5- 28 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 90- 160 mg/L and Zinc (as Zn) was observed in the range between <0.05-0.138 mg/L, Barium (as Ba), Aluminium, Ammonia (as NH_3-N), Anionic Detergents, Boron (as B), 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), 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 Below Detection Limit. Bacteriological parameters such as *E.coli* was observed in the range between <1.8- 49 MPN Index/100 mL and Total Coliforms were observed in the range <1.8- 220 MPN Index/100 mL.

6. Surface Water Analysis Results for the period April 2021 to July 2021:

Table 6.6: Location - Poovar West Canal

Parameter	Unit	Apr-21	Jun-21	Jul-21
Physical Parameters				
Colour	Hazen Units	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable
pH Value	-	6.85	6.69	6.61
Turbidity	N.T.U.	<0.2	0.8	<0.2
Electrical Conductivity (at 25°C)	µmho/cm	857	714	1145
Total Dissolved Solids	mg/L	472	400	646
Chemical Parameters				
Dissolved Oxygen	mg/L	5.8	6.8	6.2
Biochemical Oxygen Demand (3 days, 27°C)	mg/L	<1	<1	2
Oil & Grease	mg/L	<1	<1	<1
Free Ammonia	mg/L	<0.1	<0.1	<0.1
Anionic Detergents (as MBAS) Calculated as LAS mol. wt. 288.38	mg/L	<0.1	<0.1	<0.1
Barium (as Ba)	mg/L	<0.1	<0.1	<0.1
Boron (as B)	mg/L	<0.1	<0.1	<0.1
Calcium (as Ca)	mg/L	9	32.1	28.9
Chloride (as Cl)	mg/L	250	160	382
Copper (as Cu)	mg/L	<0.02	<0.02	<0.02
Fluoride (as F)	mg/L	0.3	0.6	0.5
Iron (as Fe)	mg/L	0.412	0.138	0.198
Magnesium (as Mg)	mg/L	17	19.4	16.5
Manganese (as Mn)	mg/L	0.09	<0.02	0.032
Mineral Oil	mg/L	<0.005	<0.005	<0.005
Nitrate (as NO_3)	mg/L	2	3.18	2.34
Phenolic Compounds (as C_6H_5OH)	mg/L	<0.001	<0.001	<0.001
Selenium (as Se)	mg/L	<0.005	<0.005	<0.005
Silver (as Ag)	mg/L	<0.005	<0.005	<0.005
Sulphate (as SO_4)	mg/L	38	100	46.8
Total Phosphate (as PO_4)	mg/L	<0.1	<0.1	<0.1

Parameter	Unit	Apr-21	Jun-21	Jul-21
Total Alkalinity (as $CaCO_3$)	mg/L	25	100	17.5
Total Hardness (as $CaCO_3$)	mg/L	96	160	140
Calcium Hardness (as $CaCO_3$)	mg/L	24	80	72
Zinc (as Zn)	mg/L	0.142	<0.05	<0.05
Sodium (as Na)	mg/L	36	7.2	152
Potassium (as K)	mg/L	9	0.49	6
Sodium Absorption Ratio	-	1.64	0.24	5.59
Cadmium (as Cd)	mg/L	<0.002	<0.002	<0.002
Cyanide (as CN)	mg/L	<0.001	<0.001	<0.001
Lead (as Pb)	mg/L	<0.008	<0.008	<0.008
Mercury (as Hg)	mg/L	<0.0008	<0.0008	<0.0008
Pesticide Residues				
Alachlor	µg/L	<0.01	<0.01	<0.01
Atrazine	µg/L	<0.01	<0.01	<0.01
Aldrin/Dieldrin	µg/L	<0.01	<0.01	<0.01
Alpha HCH	µg/L	<0.01	<0.01	<0.01
Beta HCH	µg/L	<0.01	<0.01	<0.01
Butachlor	µg/L	<0.01	<0.01	<0.01
Chlorpyrifos	µg/L	<0.05	<0.05	<0.05
Delta HCH	µg/L	<0.01	<0.01	<0.01
2,4D chlorophenoxyacetic acid	µg/L	<0.07	<0.07	<0.07
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	<0.01	<0.01	<0.01
Endosulfan (a, b & Sulphate)	µg/L	<0.01	<0.01	<0.01
Ethion	µg/L	<0.05	<0.05	<0.05
γ HCH (Lindane)	µg/L	<0.01	<0.01	<0.01
Isoproturon	µg/L	<0.07	<0.07	<0.07
Malathion	µg/L	<0.05	<0.05	<0.05
Methyl Parathion	µg/L	<0.05	<0.05	<0.05
Monocrotophos	µg/L	<0.05	<0.05	<0.05
Phorate	µg/L	<0.07	<0.07	<0.07
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	<0.00007	<0.00007	<0.00007

Parameter	Unit	Apr-21	Jun-21	Jul-21
Total Arsenic (as As)	mg/L	<0.005	<0.005	<0.005
Total Chromium (as Cr)	mg/L	<0.02	<0.02	<0.02
Biological Analysis				
Total Coliforms	MPN Index/ 100 mL	540	22	280
Faecal Coliforms	MPN Index/ 100 mL	350	7.8	220

Table 6.7: Location - Vizhinjam Branch Canal

Parameter	Unit	Apr-21	Jun-21	Jul-21
Physical Parameters				
Colour	Hazen Units	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable
pH Value	-	6.79	6.76	6.75
Turbidity	N.T.U.	0.9	0.8	<0.2
Electrical Conductivity (at 25°C)	µmho/ cm	93.4	209	188
Total Dissolved Solids	mg/L	52	116	104
Chemical Parameters				
Dissolved Oxygen	mg/L	6	7.4	6.2
Biochemical Oxygen Demand (3 days, 27°C)	mg/L	<1	<1	<1
Oil & Grease	mg/L	<1	<1	<1
Free Ammonia	mg/L	<0.1	<0.1	<0.1
Anionic Detergents (as MBAS) Calculated as LAS mol. wt. 288.38	mg/L	<0.1	<0.1	<0.1
Barium (as Ba)	mg/L	<0.1	<0.1	<0.1
Boron (as B)	mg/L	<0.1	<0.1	<0.1
Calcium (as Ca)	mg/L	3.21	12.8	8.81
Chloride (as Cl)	mg/L	15	42.5	40.4
Copper (as Cu)	mg/L	<0.02	<0.02	<0.02
Fluoride (as F)	mg/L	0.05	0.3	0.2
Iron (as Fe)	mg/L	0.445	0.135	0.817
Magnesium (as Mg)	mg/L	3.4	6.8	4.37
Manganese (as Mn)	mg/L	0.094	<0.02	<0.02

Parameter	Unit	Apr-21	Jun-21	Jul-21
Mineral Oil	mg/L	<0.005	<0.005	<0.005
Nitrate (as NO_3)	mg/L	2.87	6.92	4.3
Phenolic Compounds (as C_6H_5OH)	mg/L	<0.001	<0.001	<0.001
Selenium (as Se)	mg/L	<0.005	<0.005	0.008
Silver (as Ag)	mg/L	<0.005	<0.005	<0.005
Sulphate (as SO_4)	mg/L	4.51	6	7.87
Total Phosphate (as PO_4)	mg/L	<0.1	<0.1	<0.1
Total Alkalinity (as $CaCO_3$)	mg/L	15	40	35
Total Hardness (as $CaCO_3$)	mg/L	22	60	40
Calcium Hardness (as $CaCO_3$)	mg/L	8	32	22
Zinc (as Zn)	mg/L	0.148	<0.05	<0.05
Sodium (as Na)	mg/L	4.1	10.4	25.4
Potassium (as K)	mg/L	1.6	3.9	3.7
Sodium Absorption Ratio	-	0.38	0.58	1.75
Cadmium (as Cd)	mg/L	<0.002	<0.002	<0.002
Cyanide (as CN)	mg/L	<0.001	<0.001	<0.001
Lead (as Pb)	mg/L	<0.008	<0.008	<0.008
Mercury (as Hg)	mg/L	<0.0008	<0.0008	<0.0008
Pesticide Residues				
Alachlor	µg/L	<0.01	<0.01	<0.01
Atrazine	µg/L	<0.01	<0.01	<0.01
Aldrin/Dieldrin	µg/L	<0.01	<0.01	<0.01
Alpha HCH	µg/L	<0.01	<0.01	<0.01
Beta HCH	µg/L	<0.01	<0.01	<0.01
Butachlor	µg/L	<0.01	<0.01	<0.01
Chlorpyrifos	µg/L	<0.05	<0.05	<0.05
Delta HCH	µg/L	<0.01	<0.01	<0.01
2,4D chlorophenoxyacetic acid	µg/L	<0.07	<0.07	<0.07
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	<0.01	<0.01	<0.01
Endosulfan (a, b & Sulphate)	µg/L	<0.01	<0.01	<0.01
Ethion	µg/L	<0.05	<0.05	<0.05

Parameter	Unit	Apr-21	Jun-21	Jul-21
γ HCH (Lindane)	µg/L	<0.01	<0.01	<0.01
Isoproturon	µg/L	<0.07	<0.07	<0.07
Malathion	µg/L	<0.05	<0.05	<0.05
Methyl Parathion	µg/L	<0.05	<0.05	<0.05
Monocrotophos	µg/L	<0.05	<0.05	<0.05
Phorate	µg/L	<0.07	<0.07	<0.07
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	<0.00007	<0.00007	<0.00007
Total Arsenic (as As)	mg/L	<0.005	<0.005	<0.005
Total Chromium (as Cr)	mg/L	<0.02	<0.02	<0.02
Biological Analysis				
Total Coliforms	MPN Index/ 100 mL	49	23	920
Faecal Coliforms	MPN Index/ 100 mL	2	7.8	130

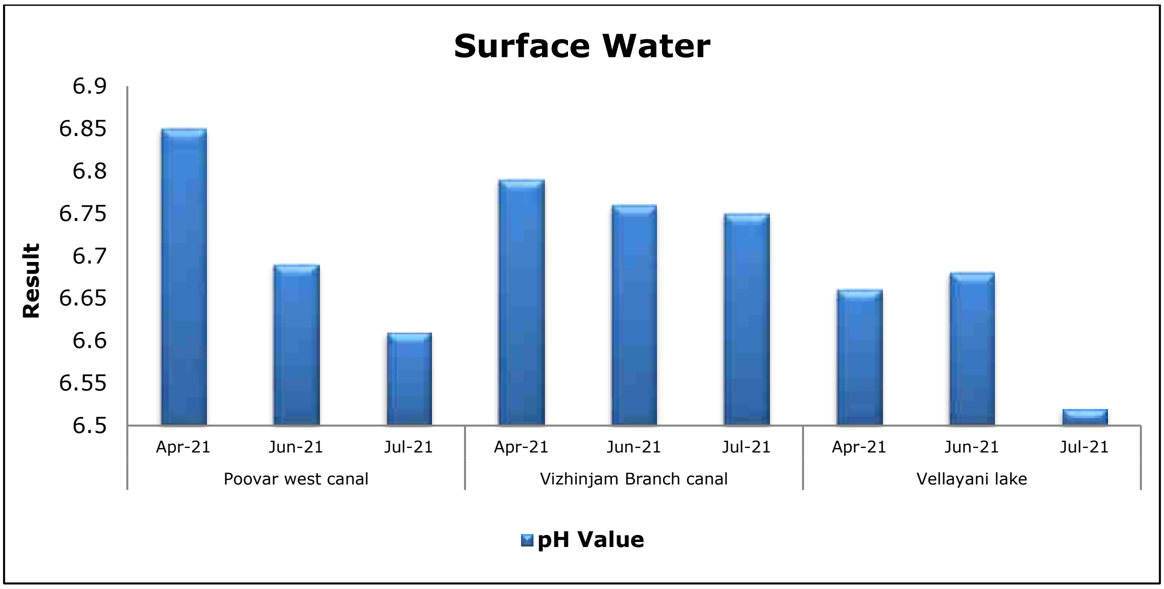
Table 6.8: Location - Vellayani Lake

Parameter	Unit	Apr-21	Jun-21	Jul-21
Physical Parameters				
Colour	Hazen Units	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable
pH Value	-	6.66	6.68	6.52
Turbidity	N.T.U.	<0.2	0.6	<0.2
Electrical Conductivity (at 25oC)	µmho/ cm	189	157	154
Total Dissolved Solids	mg/L	104	88	94
Chemical Parameters				
Dissolved Oxygen	mg/L	4.3	6.1	5.8
Biochemical Oxygen Demand (3 days, 27°C)	mg/L	<1	<1	3
Oil & Grease	mg/L	<1	<1	<1
Free Ammonia	mg/L	<0.1	<0.1	<0.1
Anionic Detergents (as MBAS) Calculated as LAS mol. wt. 288.38	mg/L	<0.1	<0.1	<0.1
Barium (as Ba)	mg/L	<0.1	<0.1	<0.1

Parameter	Unit	Apr-21	Jun-21	Jul-21
Boron (as B)	mg/L	<0.1	<0.1	<0.1
Calcium (as Ca)	mg/L	6	8.02	6.41
Chloride (as Cl)	mg/L	36	31	32.5
Copper (as Cu)	mg/L	<0.02	<0.02	<0.02
Fluoride (as F)	mg/L	0.1	0.1	0.3
Iron (as Fe)	mg/L	0.056	<0.06	0.984
Magnesium (as Mg)	mg/L	3	5.83	2.92
Manganese (as Mn)	mg/L	0.073	<0.02	0.061
Mineral Oil	mg/L	<0.005	<0.005	<0.005
Nitrate (as NO_3)	mg/L	1.77	2.19	1.69
Phenolic Compounds (as C_6H_5OH)	mg/L	<0.001	<0.001	<0.001
Selenium (as Se)	mg/L	<0.005	<0.005	<0.005
Silver (as Ag)	mg/L	<0.005	<0.005	<0.005
Sulphate (as SO_4)	mg/L	2.48	3.07	8.6
Total Phosphate (as PO_4)	mg/L	<0.1	<0.1	<0.1
Total Alkalinity (as $CaCO_3$)	mg/L	35	30	30
Total Hardness (as $CaCO_3$)	mg/L	30	44	28
Calcium Hardness (as $CaCO_3$)	mg/L	16	20	16
Zinc (as Zn)	mg/L	0.108	<0.05	<0.05
Sodium (as Na)	mg/L	15.2	3.2	19.6
Potassium (as K)	mg/L	2.8	0.6	2.9
Sodium Absorption Ratio	-	1.29	0.2	1.6
Cadmium (as Cd)	mg/L	<0.002	<0.002	<0.002
Cyanide (as CN)	mg/L	<0.001	<0.001	<0.001
Lead (as Pb)	mg/L	<0.008	<0.008	<0.008
Mercury (as Hg)	mg/L	<0.0008	<0.0008	<0.0008
Pesticide Residues				
Alachlor	µg/L	<0.01	<0.01	<0.01
Atrazine	µg/L	<0.01	<0.01	<0.01
Aldrin/Dieldrin	µg/L	<0.01	<0.01	<0.01
Alpha HCH	µg/L	<0.01	<0.01	<0.01
Beta HCH	µg/L	<0.01	<0.01	<0.01

Parameter	Unit	Apr-21	Jun-21	Jul-21
Butachlor	µg/L	<0.01	<0.01	<0.01
Chlorpyrifos	µg/L	<0.05	<0.05	<0.05
Delta HCH	µg/L	<0.01	<0.01	<0.01
2,4D chlorophenoxyacetic acid	µg/L	<0.07	<0.07	<0.07
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	<0.01	<0.01	<0.01
Endosulfan (a, b & Sulphate)	µg/L	<0.01	<0.01	<0.01
Ethion	µg/L	<0.05	<0.05	<0.05
γ HCH (Lindane)	µg/L	<0.01	<0.01	<0.01
Isoproturon	µg/L	<0.07	<0.07	<0.07
Malathion	µg/L	<0.05	<0.05	<0.05
Methyl Parathion	µg/L	<0.05	<0.05	<0.05
Monocrotophos	µg/L	<0.05	<0.05	<0.05
Phorate	µg/L	<0.07	<0.07	<0.07
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	<0.00007	<0.00007	<0.00007
Total Arsenic (as As)	mg/L	<0.005	<0.005	<0.005
Total Chromium (as Cr)	mg/L	<0.02	<0.02	<0.02
Biological Analysis				
Total Coliforms	MPN Index/ 100 mL	350	47	280
Faecal Coliforms	MPN Index/ 100 mL	94	39	79

7. Graphical representation of Results for the period April 2021 to July 2021:



[JBF22]

Figure 6.15: Surface Water Analysis for pH value

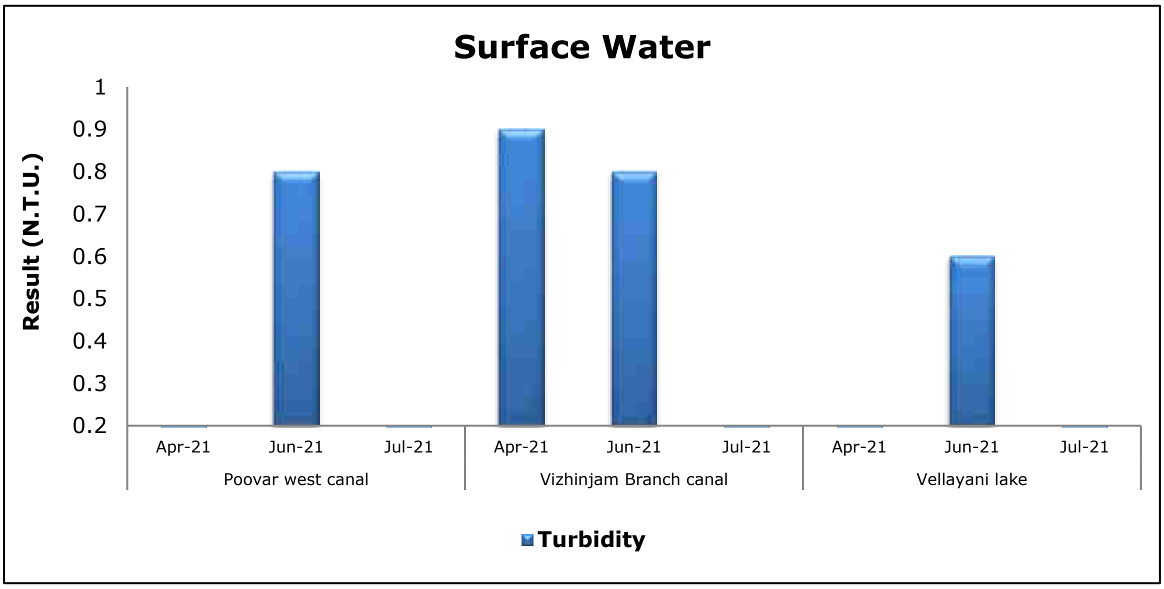


Figure 6.16: Surface Water Analysis for Turbidity

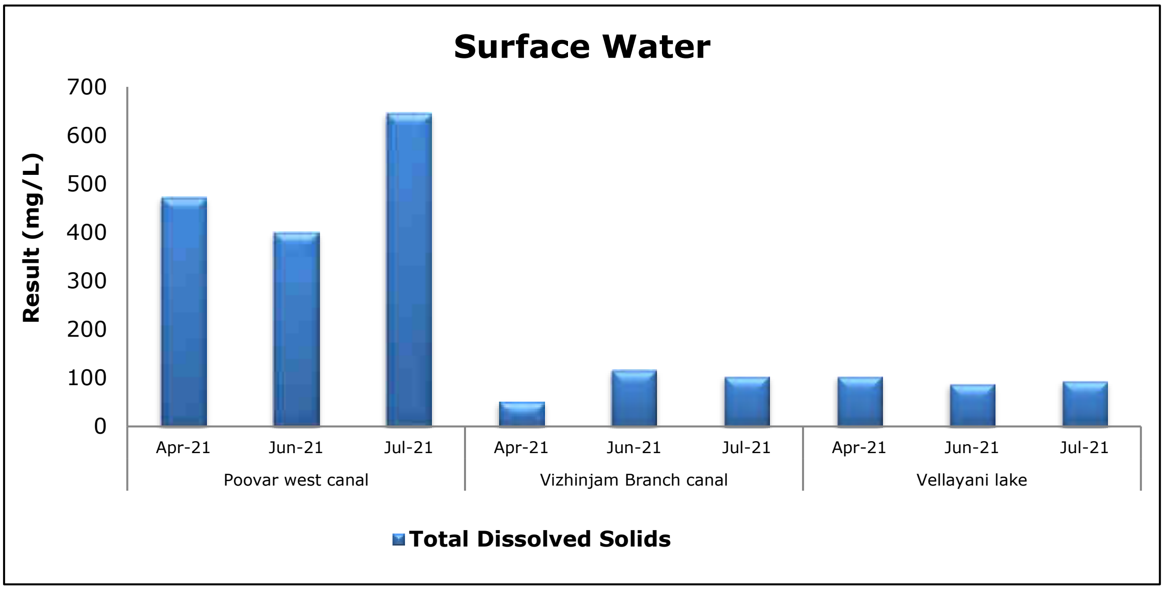


Figure 6.17: Surface Water Analysis for Total Dissolved Solids

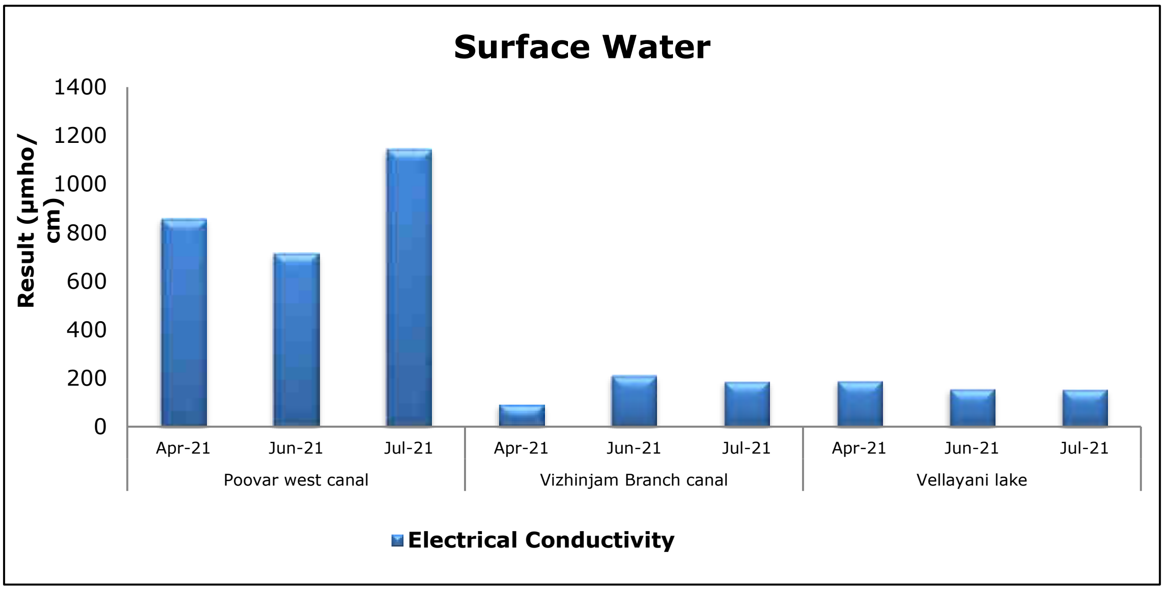


Figure 6.18: Surface Water Analysis for Electrical Conductivity

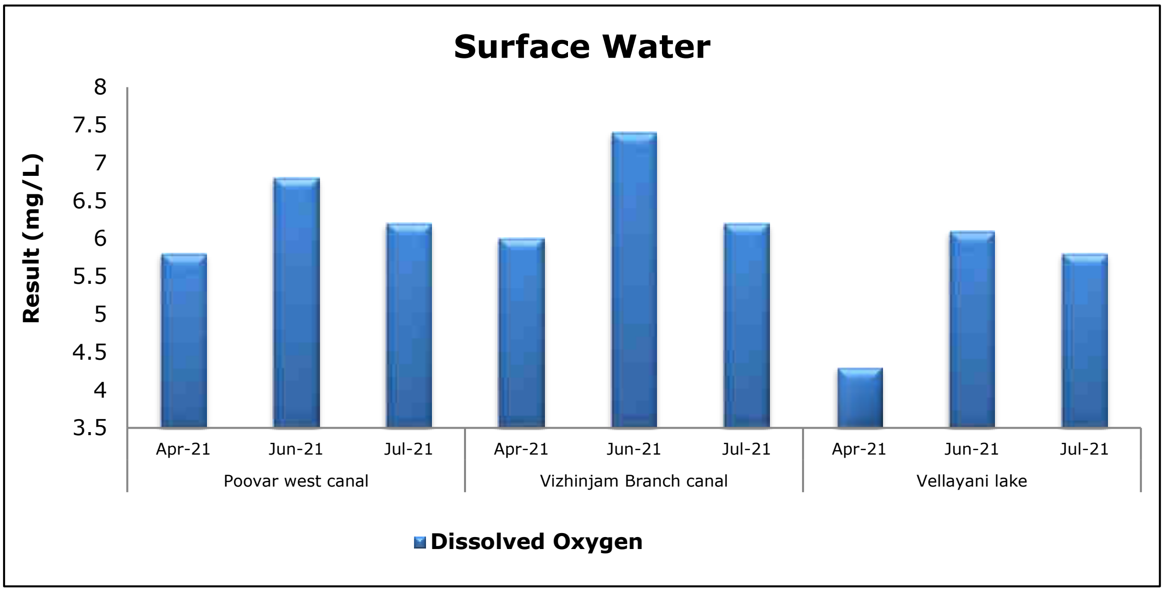


Figure 6.19: Surface Water Analysis for Dissolved oxygen

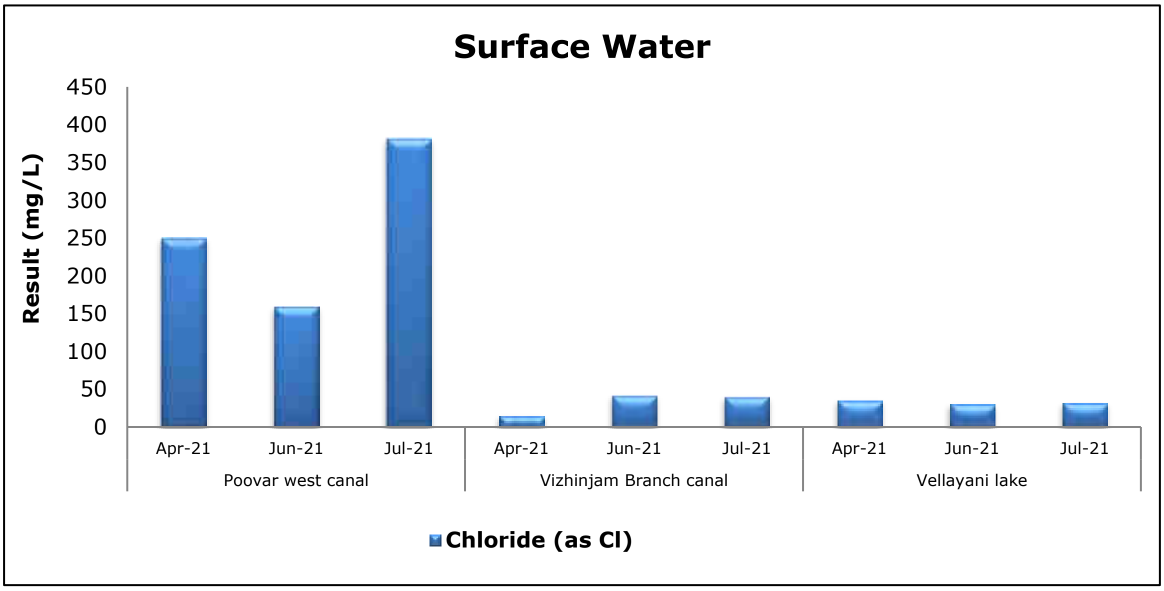


Figure 6.21: Surface Water Analysis for Chloride

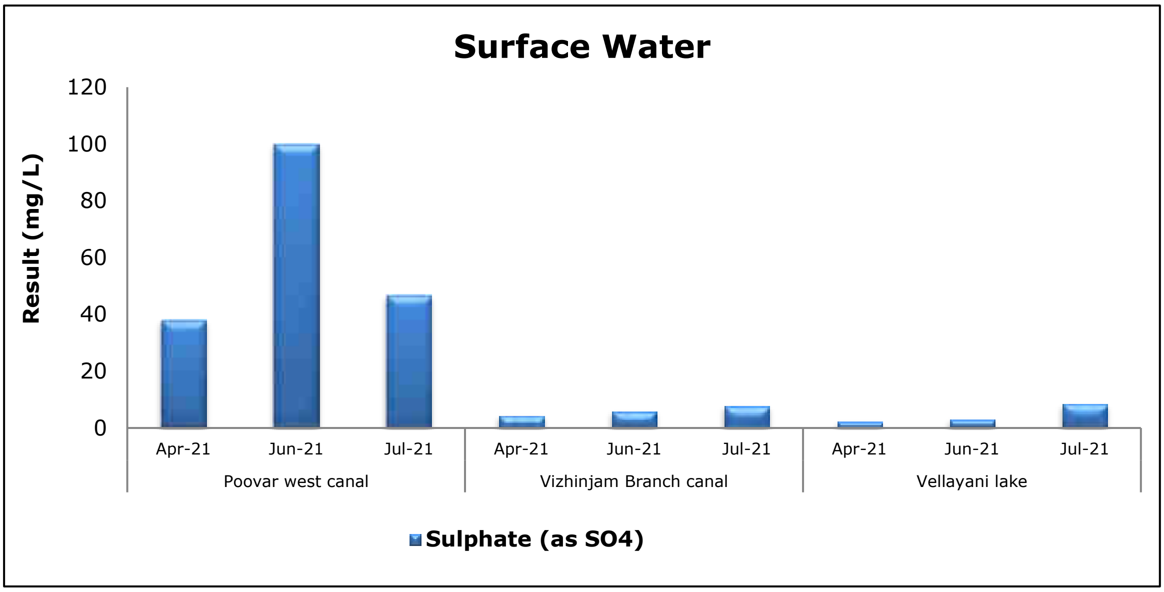


Figure 6.22: Surface Water Analysis for Sulphate

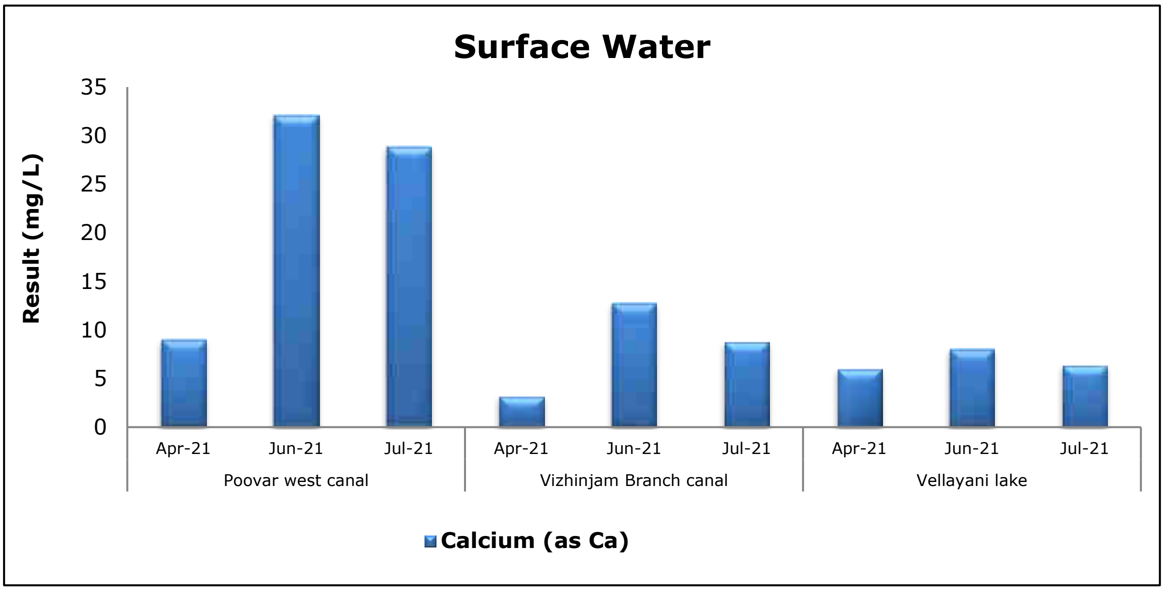


Figure 6.23: Surface Water Analysis for Calcium

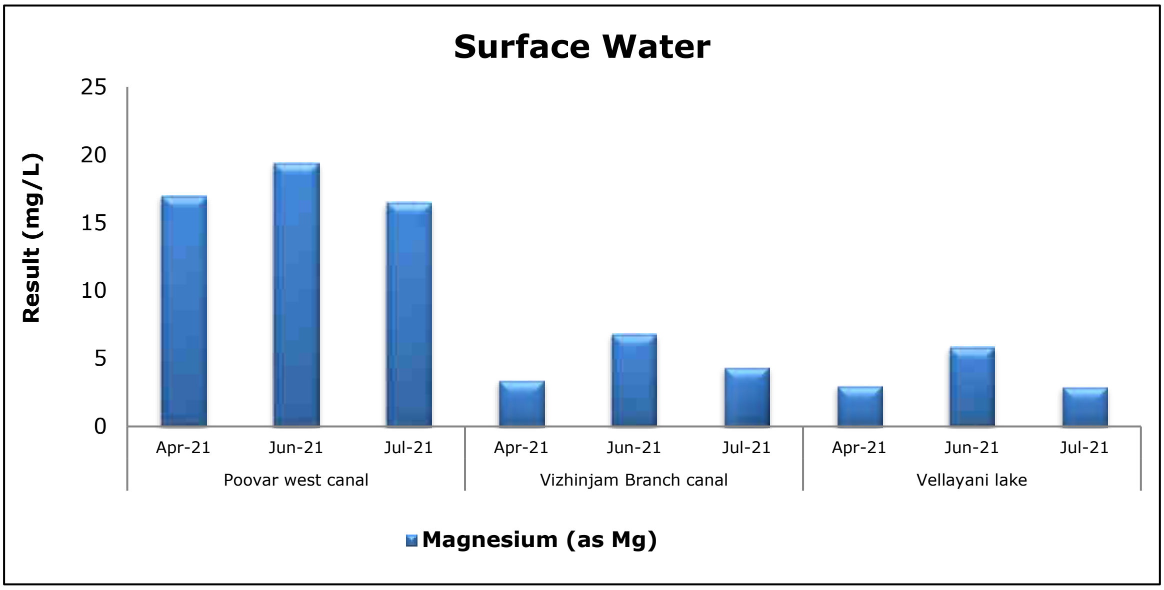


Figure 6.24: Surface Water Analysis for Magnesium

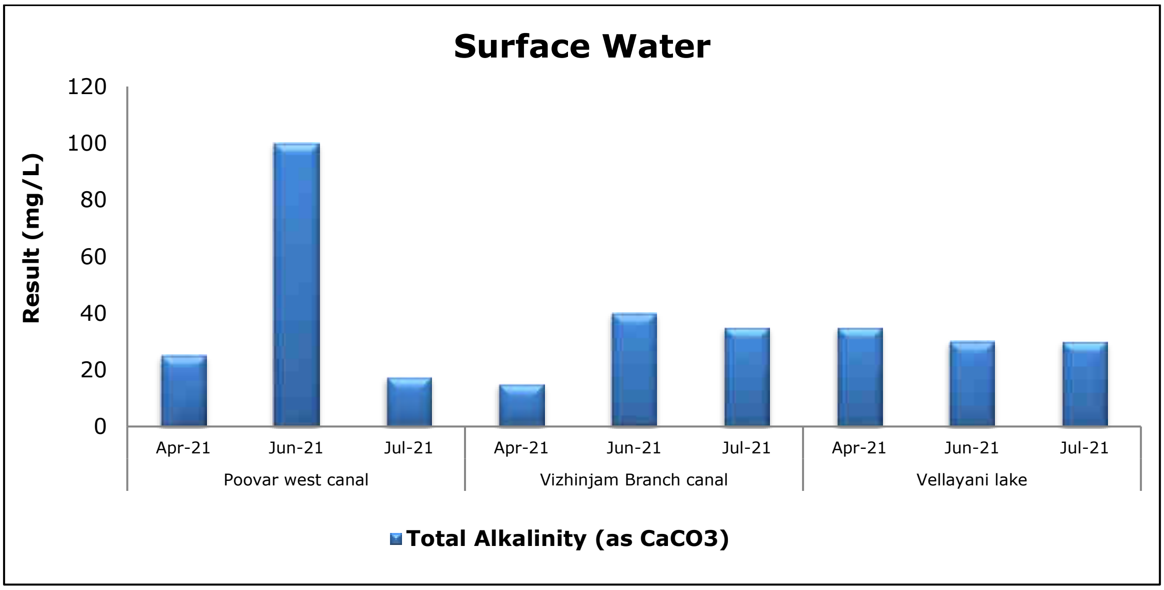


Figure 6.25: Surface Water Analysis for Total Alkalinity

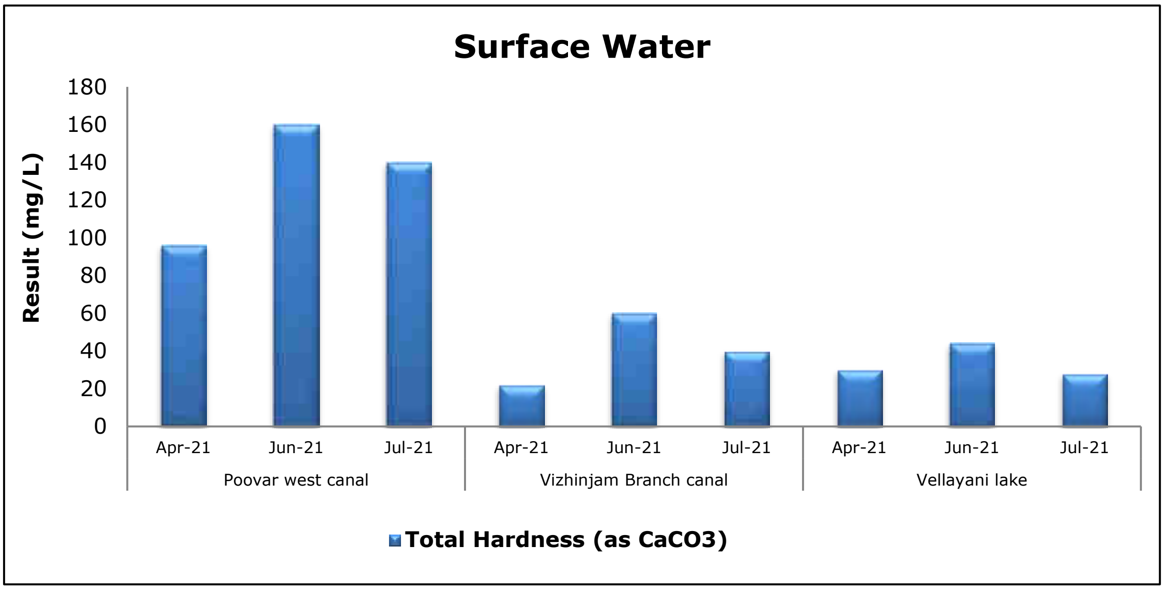


Figure 6.26: Surface Water Analysis for Total Hardness

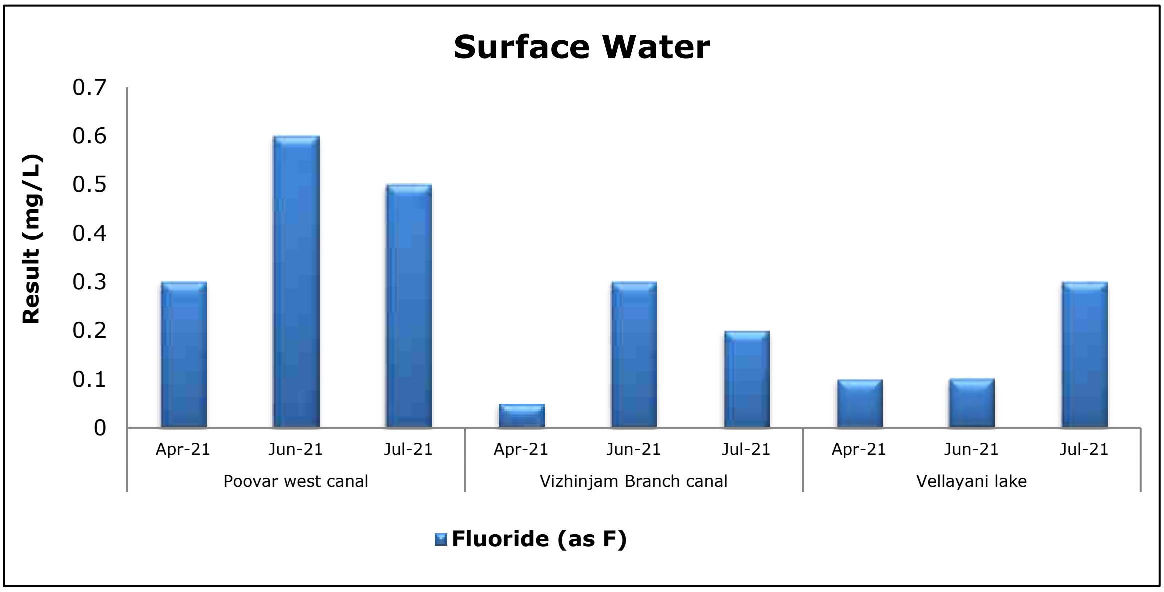
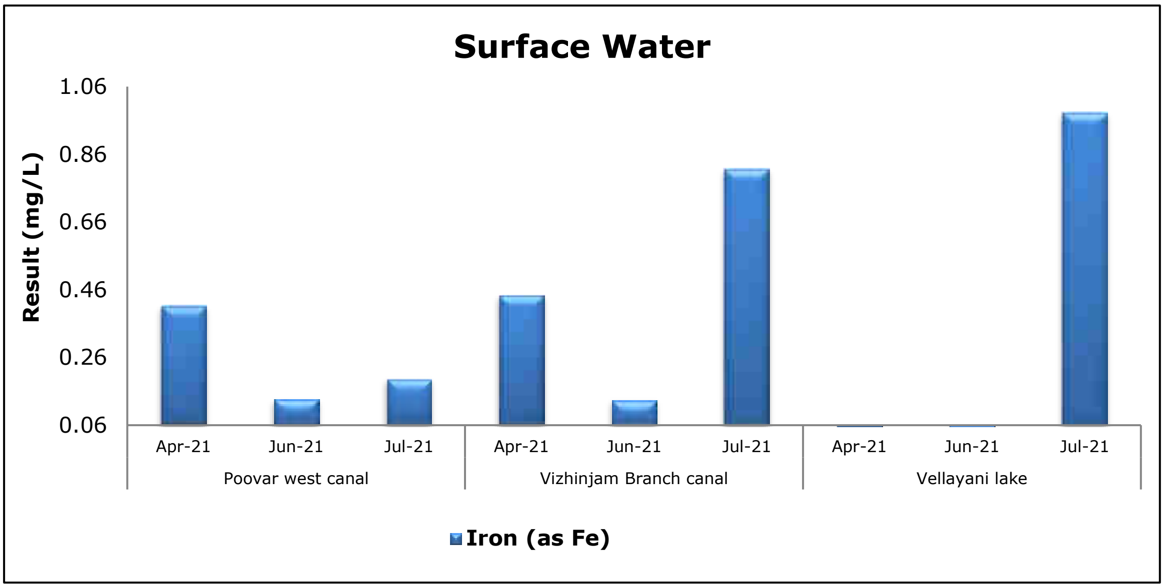


Figure 6.27: Surface Water Analysis for Fluoride



[JBF23]**Figure 6.28: Surface Water Analysis for Iron**

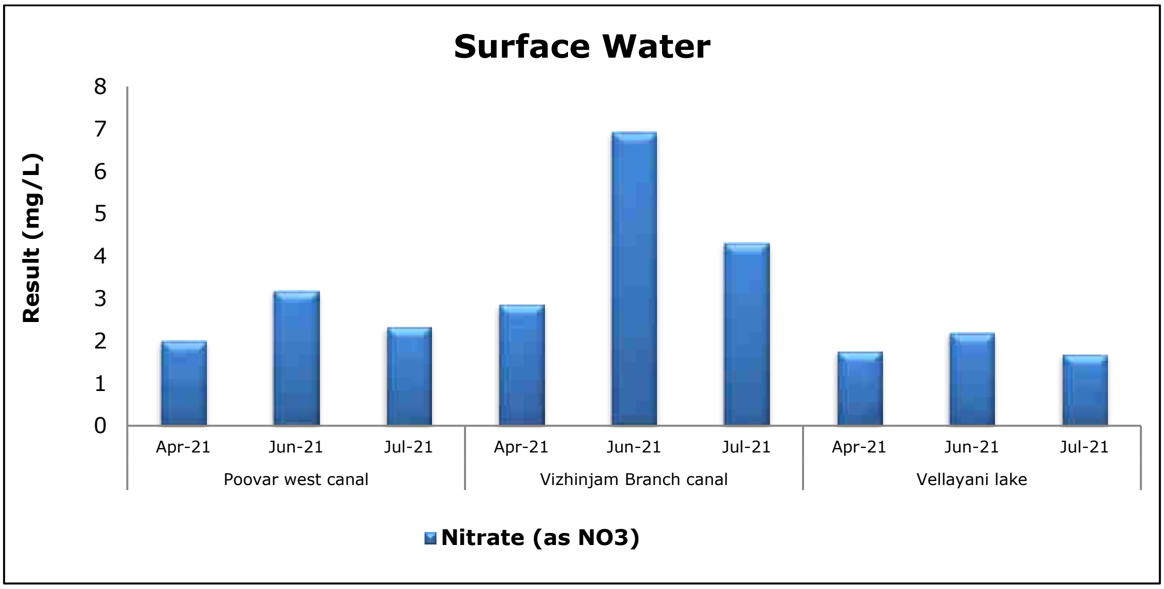


Figure 6.29: Surface Water Analysis for Nitrate

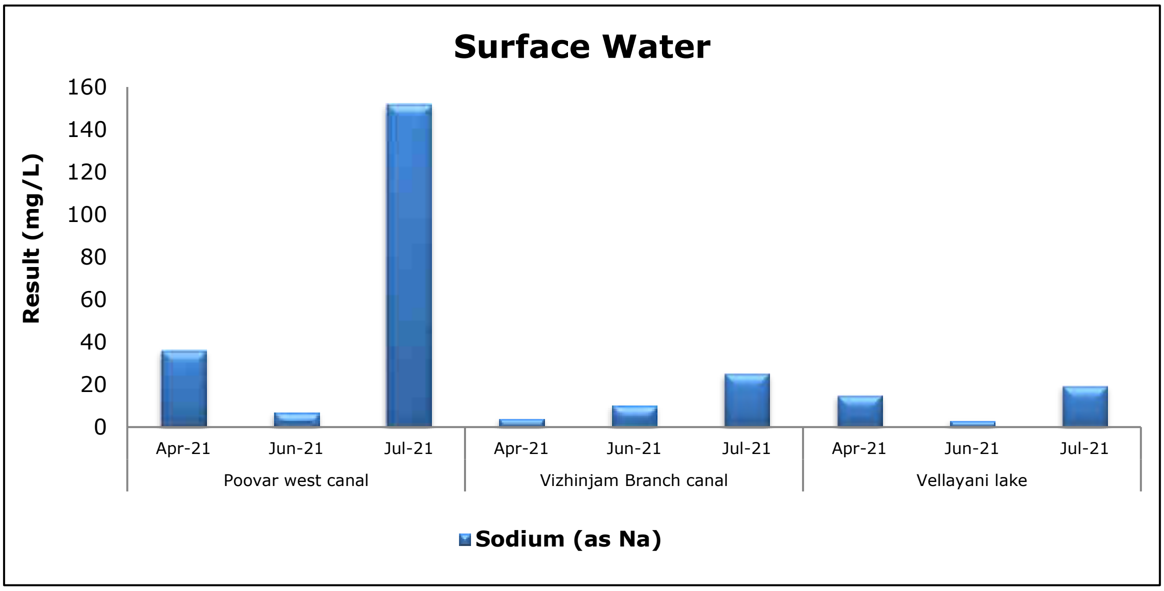


Figure 6.30: Surface Water Analysis for Sodium

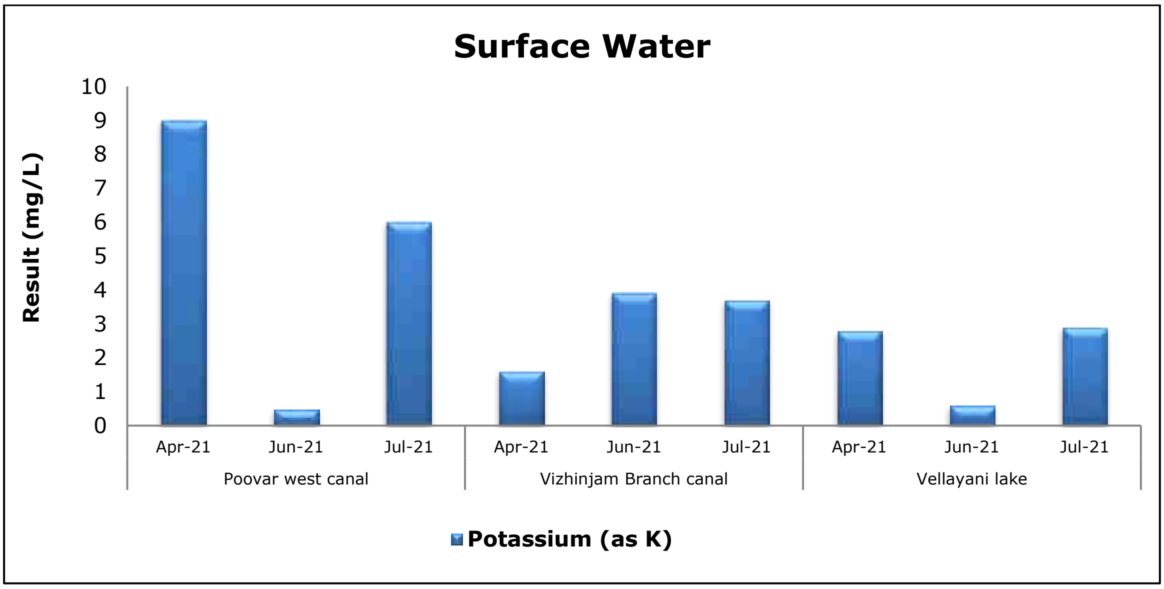


Figure 6.31: Surface Water Analysis for Potassium

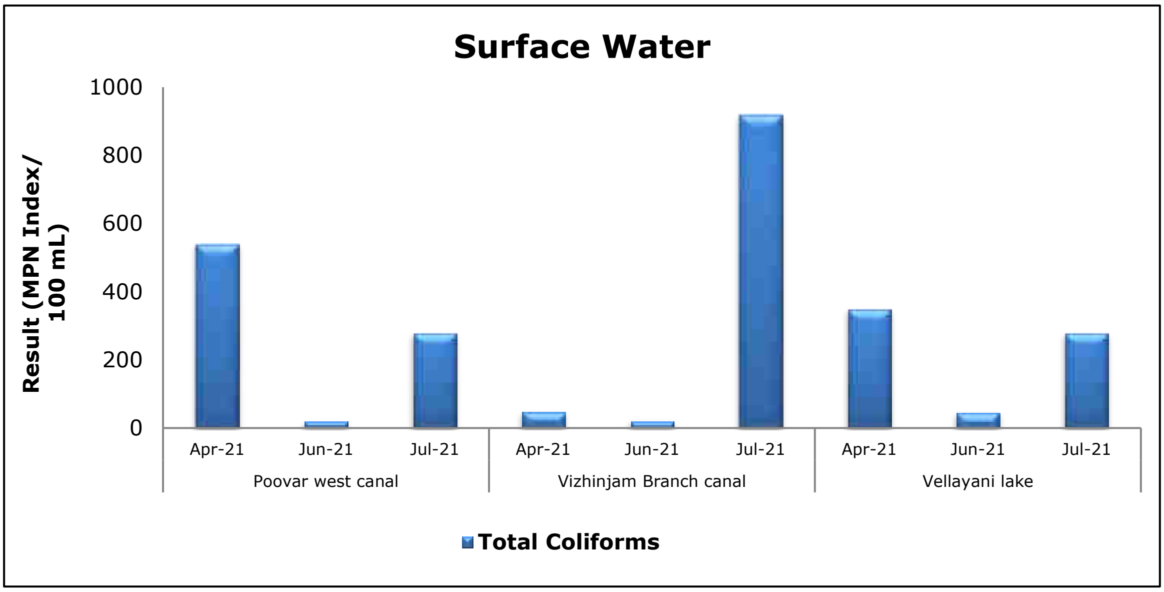


Figure 6.32: Surface Water Analysis for Total Coliforms

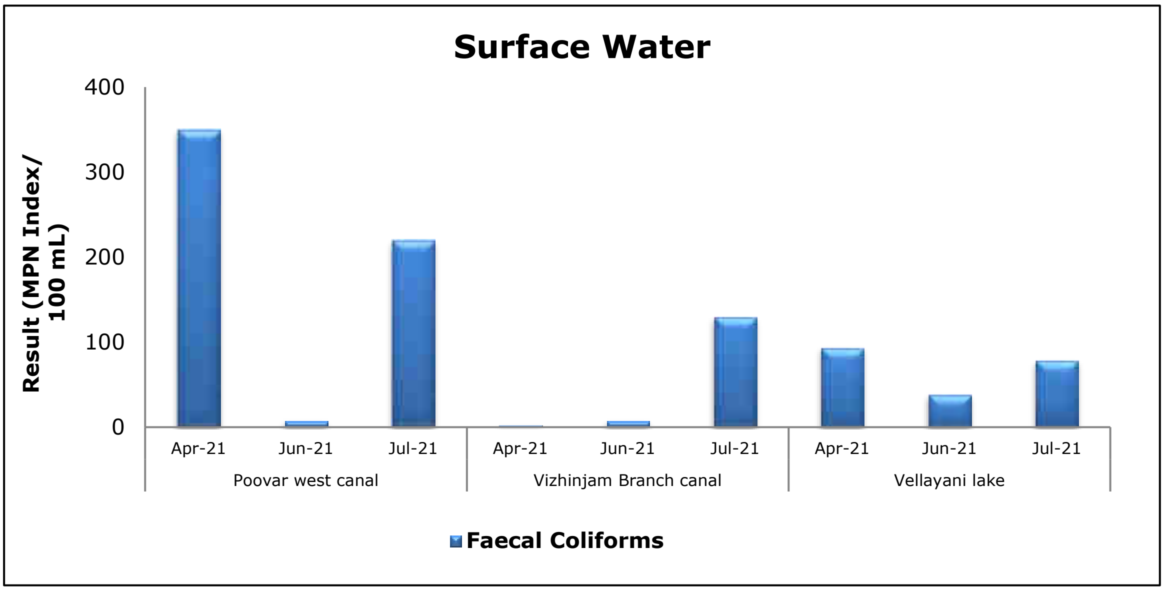


Figure 6.33: Surface Water Analysis for Faecal Coliforms

8. Summary of Surface water

During the period April 2021 to July 2021, following is the summary of surface water analysis:

At the location **Poovar West Canal**, Colour was observed 1 Hazen unit and odour was agreeable. pH was observed in the range between 6.61-6.85. Turbidity was observed in the range between <0.2-0.8 N.T.U., Total Dissolved Solids were observed in the range between 400-646 mg/L. Electrical Conductivity was observed in the range between 714-1145 µmho/cm. Dissolved Oxygen was observed in the range between

5.8-6.8 mg/L. Biochemical Oxygen Demand (3 days, 27°C) was observed in the range between <1-2 mg/L. Calcium (as Ca) was observed in the range between 9.0-32.1 mg/L. Chloride (as Cl) was observed in the range between 160-382 mg/L. Fluoride (as F) was observed in the range 0.3- 0.6 mg/L. Iron (as Fe) was observed in the range between 0.1-0.41 mg/L. Magnesium (as Mg) was observed in the range between 16.5-19.4 mg/L. Manganese (as Mn) was observed in the range between <0.02- 0.09 mg/L. Nitrate (as NO_3) was observed in the range between 2.0-3.18 mg/L. Sulphate (as SO_4) was observed in the range between 38-100 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 17.5-100 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 96-160 mg/L. Calcium Hardness (as $CaCO_3$) was observed in the range between 24-80 mg/L. Sodium (as Na) was observed in the range between 7.2-152 mg/L. Potassium (as K) was observed in the range between 0.5-9 mg/L. Sodium Absorption Ratio was observed in the range between 0.24- 5.59, Zinc (as Zn) was observed in the range between <0.05- 0.142 mg/L, Oil & Grease, Free Ammonia, Anionic Detergents, Barium (as Ba), Boron (as B), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Total Phosphate (as PO_4), Selenium (as Se), Silver (as Ag), 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 22-540 MPN Index/100 mL and Faecal Coliforms were observed in the range between 7.8-350 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 6.75-6.79. Turbidity was observed in the range between <0.2-0.9 N.T.U., Total Dissolved Solids were observed in the range between 52-116 mg/L. Electrical Conductivity was observed in the range between 93.4-209 µmho/cm. Dissolved Oxygen was observed in the range between 6-7.4 mg/L. Biochemical Oxygen Demand (3 days, 27°C) was observed <1 mg/L. Calcium (as Ca) was observed in the range between 3.21-12.8 mg/L. Chloride (as Cl) was observed in the range between 15-42.5 mg/L. Fluoride (as F) was observed in the range between 0.05-0.3 mg/L. Iron (as Fe) was observed in the range between 0.135–0.817 mg/L. Magnesium (as Mg) was observed in the range between 3.4-6.8 mg/L. Nitrate (as NO_3) was observed in the range between 2.87-6.92 mg/L. Sulphate (as SO_4) was observed in the range between 4.51-7.87 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 15-40 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 22-60 mg/L. Calcium Hardness (as $CaCO_3$) was observed in the range between 8-32 mg/L. Sodium (as Na) was observed in the range between 4.1-25.4 mg/L. Potassium (as K) was observed in the range between 1.6-3.9 mg/L. Sodium Absorption Ratio was observed in the range between 0.38-1.75. Manganese (as Mn) was observed in the range between <0.02-0.094 mg/L, Total Phosphate (as PO_4), Total Chromium (as Cr), Oil & Grease, Free Ammonia, Anionic Detergents, Barium (as Ba), Boron (as B), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se), 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 Limits. Bacteriological parameters such as Total Coliforms were observed in the range between 23-920 MPN Index/100 mL and Faecal Coliforms were observed in the range between <1.8-130 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 6.52-6.68. Turbidity was observed in the range between <0.2 to 0.6 N.T.U., Total Dissolved Solids were observed in the range between 88-104 mg/L. Electrical Conductivity was observed in the range between 154-189 µmho/cm. Dissolved Oxygen was observed in the range between 4.3-6.1 mg/L. Biochemical Oxygen Demand (3 days, 27^oC) was observed in the range between <1-3 mg/L. Calcium (as Ca) was observed in the range between 6-8.02 mg/L. Chloride (as Cl) was observed in the range between 31-36 mg/L. Fluoride (as F) was observed in the range between 0.1-0.3 mg/L. Iron (as Fe) was observed in the range between <0.06–0.984 mg/L. Magnesium (as Mg) was observed in the range between 2.92-5.83 mg/L. Manganese (as Mn) was observed in the range between <0.02-0.073 mg/L. Nitrate (as NO_3) was observed in the range between 1.69-2.19 mg/L. Sulphate (as SO_4) was observed in the range between 2.48-8.6 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 30-35 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 28-44 mg/L. Calcium Hardness (as $CaCO_3$) was observed in the range between 16-20 mg/L. Sodium (as Na) was observed in the range between 3.2-19.6 mg/L. Potassium (as K) was observed in the range between 0.6-2.9 mg/L. Sodium Absorption Ratio was observed in the range between 0.2-1.6, Total Phosphate (as PO_4), Oil & Grease, Free Ammonia, Anionic Detergents, Barium (as Ba), Boron (as B), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se), 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 47-350 MPN Index/100 mL and Faecal Coliforms were observed in the range between <1.8-94 MPN Index/100 mL.

HALF-YEARLY ENVIRONMENT MONITORING REPORT

FOR THE PERIOD AUGUST 2021 AND SEPTEMBER 2021

ADANI VIZHINJAM PORT PVT. LTD.
Vizhinjam, Kerala

Report No.: SEAAL/EMR-AVPPL-21HY-I

Report Date: 10th November, 2021

This Report presents the discussion and the results of Environmental Monitoring at Adani Vizhinjam Port. The monitoring has been conducted and the report has been prepared & issued by Standards Environmental & Analytical Laboratories, Ernakulum-683 501 to M/s Adani Vizhinjam Port Pvt Limited, Thiruvananthapuram-695 014

HYR-A	Table of Contents

HYR-1	Introduction

Standard^S Environmental & Analytical Laboratories is an organization providing Testing Services, Technical Consultancy for Environmental Pollution Control, Designing, Commissioning & Operation of Effluent & Sewage Treatment Plants to clients of various industries, Hotels, Hospitals & Building Apartments. It provides various training for the industries and for the budding scientists.

Standard^S has been established in 2013 in 2500sq.ft area in a complex located at K.J Tower, (above SBI Eloor branch), Pathalam, Udyogamandal P.O, Ernakulam District – 683 501. It has been equipped with sophisticated instruments such GC-MS, AAS, UV Spectrophotometer, Flame Photometer and other Supporting Instruments with required accuracy & precision.

Standard^S is guided and lead by highly qualified scientists with rich experiences. Its technical personnel are well trained and competent and dedicated.

Testing Laboratory of Standard^S is accredited as per ISO/IEC 17025:2017 by NABL for testing of Food & Agricultural Products, Water and Environmental Samples, Medical Accessories under Chemical & Biological Disciplines. It is an "A" Grade laboratory certified by Kerala State Pollution Control Board. It delivers reliable testing services on time to the customers after ensuring the compliance of each stage of the testing activities to the stringent Quality Control and Quality Assurance Criteria established by international forums.

Standard^S gives Technical Consultancy in the field of Water & Waste Water Treatment and has completed a number of Turn-Key projects to solve the water pollution issues for different clients and making them compliant to the statutory requirements.

Standard^S had been engaged by Adani Vizhinjam Port Pvt. Ltd. (AVPPL) for the performing Environmental Monitoring as per the Plan mentioned in EIA and EC. AVPPL issued Service Order Reference No. 5702002993 dated 30.07.2021 which mentions the matrix, parameters and frequency of environmental monitoring and this service contract starts in August 2021. Standard^{S} carried out said environmental monitoring strictly as per above mentioned service order, viz. 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).

Standard^{S} submits 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 conditions mentioned in service order.

This present report is the consolidated half yearly report over the two-month period of August 2021 and September 2021.

HYR-2	Quality Assurance & Quality Control

The quality assurance and quality control plan include following elements:

- Monitoring and Collection, Preservation & Transportation of samples;
- Sample Registration, Chain of Custody & Report Preparation;
- Laboratory Analysis & Review of Results and
- Validation of Technical Activities.

HYR-2.1. Monitoring and Collection, Preservation & Transportation of samples:

The authorized Laboratory Sampling Team prepares the checklist for the required Sampling Kits, other auxiliary equipments and Sampling Procedures including Datasheets. The team collects the required item as per the list and visits the sampling site.

The team identifies the appropriate monitoring location as per the agreement and keep the sampling kits at the identified location. The team notes down the environmental conditions of the site in the sampling data sheets and all other required information. Then the team starts the monitoring activity.

Periodically the team inspects the status of the conditions of the sampling kits and records the necessary data on the sampling data sheet as per the requirements.

After the completion of monitoring as per PCB standards, the team collect the samples and preserves them safely and securely in an appropriate labelled container as per the procedure to prevent from contamination and deterioration.

Then the team returns to the laboratory and takes due care to maintain the integrity of the samples during transport. The team submits the samples and sampling data sheets to the Executives - Sample Registration.

HYR-2.2. Sample Registration, Chain of Custody & Report Preparation:

After receiving the samples, the Executive - Sample Registration examines the sample conditions and the sampling data sheets along with the agreement as per the Checklist and records the findings.

The executive registers the samples for testing in the Sample Entry Register and assigns the unique Sample Code for each sample only if all the criteria are fulfilled. The Executive prepares the Job Card for each sample as per the agreement and enters the allotted Sample Code in the Job Card and on the Test Item. The Test Item is identified throughout its life in the laboratory only by the unique Sample Code.

The executive then delivers the sample to the respective section of the Laboratory and the Job Card along with necessary sampling details required for performing the analysis excluding the details of the origin of the samples. The delivery is recorded in the Sample Delivery Register and the same is acknowledged by the Laboratory Technical personnel.

The information available in the Job Card are the test parameters to be performed, test method to be adopted, units in which the analytical results to be expressed, the due date for completion of analysis and the details about sample storage and retention conditions.

The executive submits the other Customer information and Sample details to the Reporting Section for preparing the Test Reports.

After completion of analysis, the technical personnel enter all the results and dates of analysis in the Job Card and submit the same to Reporting Section.

The Reporting Executive decodes the Job Card with the Test Request details, prepares the Draft Report as per the respective report format and submits the draft report to the Authorized Signatory. This draft report is verified and returned back to the Reporting Section for making the final report. Final reports are prepared by the Reporting Executive with necessary corrections if any and authorized by the Authorized Signatory. Then the Final Test Report is delivered to the customer.

HYR-2.3. Laboratory Analysis & Review of Test Results:

After receiving the Test Items along with the Job Card, the Technical Manager allots the Job to the authorized Technical Personnel. The assigned Technical Personnel performs the allotted tests as per the method mentioned in the Job Card as well as the required Quality Control Checks (QC) and submits the results to the Technical Manger. The Technical Personnel conforms that all the required calibration status of the equipment is valid and the Certified Reference Material are valid. Also, the Technical Personnel ensures that the results of daily verification conforming to the specified criteria.

The Technical Manager reviews the results of samples & QC checks and approves the results only if the results of QC checks are compliance to the Acceptance Criteria. Then the Job Card is submitted to the Reporting Section.

HYR-2.4. Validation of Technical Activities:

For the validation of Technical Activities, the laboratory performs Internal Quality Assurance Check, Proficiency Testing and Inter Laboratory Comparison. Quality Assurance Team prepares Annual Internal Quality Assurance Check (IQC) Plan, Inter laboratory Comparison (ILC)/ Proficiency Testing (PT) Plan.

As per the IQA plan, Quality Assurance Team prepare and send the Test Items to the respective section of the Laboratory. After getting the results, Quality Assurance team evaluates the results against the predefined criteria. The results of evaluation are submitted and discussed during Management Review meeting.

Quality Assurance Team identify and register the suitable PT Scheme authorized by NABL. Also, Quality Assurance Team identifies suitable ILC or conducts by covering at least five NABL accredited Laboratories.

If the QA team conducts ILC, then they evaluate the performance and calculate the Z-score after getting the results of the participating laboratories.

The acceptance criteria for the ILC/PT is ±2. The summary of the PT/ILC is prepared and discussed during Management Review Meeting.

The Quality Assurance Team monitors the performance of the Laboratory activities by conducting Internal Quality Audits and Vertical Audit periodically. The Audit reports are prepared and discussed during Management Review Meeting.

HYR-3	Ambient Air Quality Monitoring

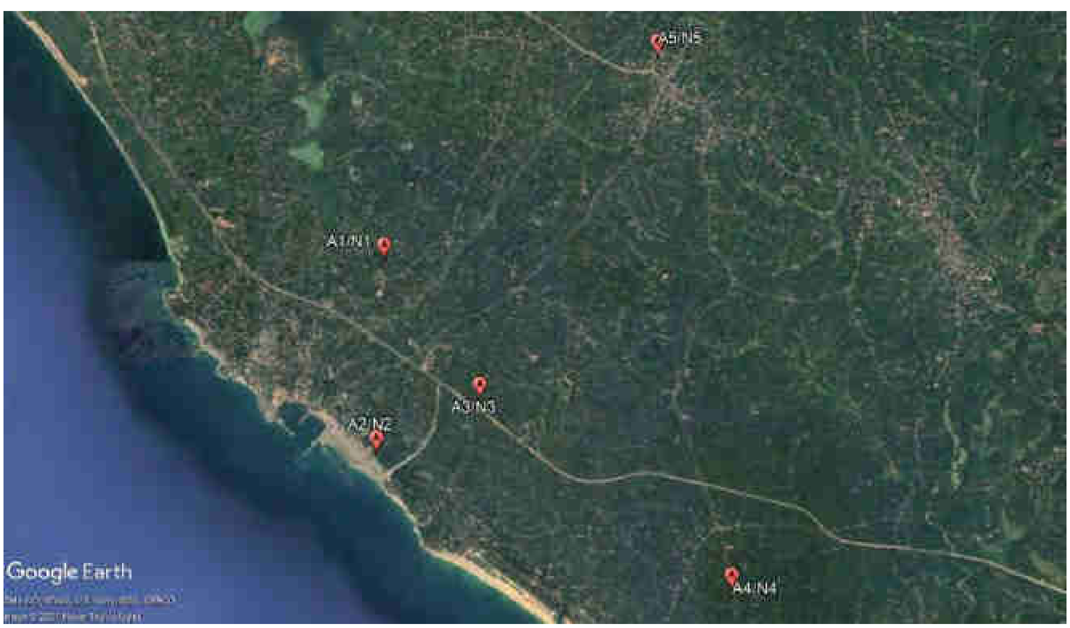
HYR-3.1. Ambient Air Quality Monitoring location details:

This section describes the sampling location, methodology adopted for monitoring and analysis of Ambient Air Quality. The prime objective of the environment monitoring with respect to Ambient Air Quality is to establish the air quality of present condition and its conformity to Applicable Standards. Ambient Air quality monitoring was carried out at five (5) locations including Venganoor, Proposed Port Estate Area, Port Site, Chani and Balarampuram during August & September 2021.

Table 3.1: Coordinates of Ambient Air Quality Monitoring Locations

Location	Legend	Latitude	Longitude
Venganoor	A1	8°23’55.10”N	77°00’12.19”E
Project Site	A2	8°22’13.73”N	77°00’08.39”E
Proposed Port Estate Area	A3	8°22’41.37”N	77°01’03.17”E
Chani	A4	8°21’01.98”N	77°03’15.11”E
Balarampuram	A5	8°25’43.73”N	77°02’39.99”E

Figure 3.1: Google Earth View of Ambient Air Quality Monitoring Locations



HYR-3.2. Methodology of Sampling and Analysis:

Table 3.2: Ambient Air Quality Monitoring Methodology

Sl. No.	Parameter	Unit	Detection Limit	Method Reference
1.	Particulate Matter (size less than 10 µm) or PM_{10}	µg/m³	5.0	IS 5182 (Part 23): 2006
2.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	µg/m³	2.0	EPA 40 CFR Part 50 Appendix-L: 1997
3.	Sulphur Dioxide (SO_2)	µg/m³	2.0	IS 5182 (Part 2): 2001
4.	Nitrogen Dioxide (NO_2)	µg/m³	2.0	IS 5182 (Part 6): 2006
5.	Carbon Monoxide (CO)	mg/m³	1.15	IS 5182 (Part 10):1999 (NDIR Method)
6.	Hydrocarbon (HC)	ppm	0.0003	IS 5182 (Part 17):1979

HYR-3.3. National Ambient Air Quality Standards (NAAQS):

Table 3.3: National Ambient Air Quality Standards dated 16th November 2009

Sl. No.	Pollutant, Unit	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural & other areas	Ecologically Sensitive Areas
1.	Sulphur dioxide (SO_2), µg/m³	Annual	50	20
		24 h	80	80
2.	Nitrogen Dioxide (NO_2), µg/ m³	Annual	40	30
		24 h	80	80
3.	Particulate matter (size less than 10µm) or PM_{10}, µg/ m³	Annual	60	60
		24 h	100	100
4.	Particulate matter (size less than 2.5µm) or $PM_{2.5}$, µg/m³	Annual	40	40
		24 h	60	60
5.	Carbon Monoxide (CO), mg/m³	8 h	02	02
		1 h	04	04
6.	Hydrocarbon (HC), ppm	-	-	-

HYR-3.4. Ambient Air Quality Monitoring Results for the period August 2021 and September 2021:

Table 3.4: Location – Venganoor (A1)

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
03-08-2021	24.7	7.95	3.16	2.24	BDL	BDL
06-08-2021	21.8	8.32	2.84	BDL	BDL	BDL
09-08-2021	32.9	11.4	2.76	BDL	BDL	BDL
13-08-2021	36.8	23.6	BDL	2.83	BDL	BDL
16-08-2021	43.6	12.6	3.57	3.18	BDL	BDL
19-08-2021	39.0	24.2	BDL	BDL	BDL	BDL
23-08-2021	38.7	25.8	2.31	2.76	BDL	BDL
26-08-2021	26.0	15.6	2.54	BDL	BDL	BDL
30-08-2021	38.3	14.3	3.22	2.65	BDL	BDL
02-09-2021	39.6	19.3	2.74	3.68	BDL	BDL
06-09-2021	35.4	18.7	2.19	3.84	BDL	BDL
09-09-2021	39.6	19.3	2.74	3.68	BDL	BDL
13-09-2021	38.6	22.5	2.97	3.54	BDL	BDL
16-09-2021	28.5	17.5	BDL	2.96	BDL	BDL
20-09-2021	43.5	21.8	2.69	3.76	BDL	BDL
23-09-2021	45.3	21.8	2.65	3.97	BDL	BDL
27-09-2021	44.8	21.5	2.66	3.98	BDL	BDL
30-09-2021	35.3	18.6	BDL	3.23	BDL	BDL
NAAQS 2009 Limits	**100**	**60**	**80**	**80**	**4**	**-**

Table 3.5: Location – Project Site (A2)

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
03-08-2021	22.7	8.28	4.65	5.22	BDL	BDL
06-08-2021	45.7	19.5	3.72	4.67	BDL	BDL
09-08-2021	28.0	17.5	3.58	5.65	BDL	BDL
13-08-2021	38.5	10.5	4.12	4.73	BDL	BDL
16-08-2021	40.5	24.0	3.39	4.66	BDL	BDL
19-08-2021	43.1	18.7	4.58	5.68	BDL	BDL
23-08-2021	48.2	17.9	3.71	5.61	BDL	BDL
26-08-2021	36.5	17.9	3.14	3.59	BDL	BDL
30-08-2021	31.1	12.7	2.76	4.14	BDL	BDL
02-09-2021	30.8	17.6	4.12	5.34	BDL	BDL
06-09-2021	41.6	19.5	3.76	4.38	BDL	BDL
09-09-2021	30.8	17.6	4.12	5.34	BDL	BDL
13-09-2021	41.7	20.9	3.26	4.53	BDL	BDL
16-09-2021	44.6	21.2	2.96	3.84	BDL	BDL
20-09-2021	37.5	18.5	BDL	3.64	BDL	BDL
23-09-2021	39.6	19.3	2.98	4.86	BDL	BDL
27-09-2021	39.4	18.7	3.86	4.36	BDL	BDL
30-09-2021	43.9	22.7	2.86	4.53	BDL	BDL
NAAQS 2009 Limits	**100**	**60**	**80**	**80**	**4**	**-**

Table 3.6: Location – Proposed Port Estate Area (A3)

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
03-08-2021	27.6	11.5	2.16	2.56	BDL	BDL
06-08-2021	21.9	9.01	BDL	BDL	BDL	BDL
09-08-2021	29.8	15.6	BDL	BDL	BDL	BDL
13-08-2021	27.6	9.59	BDL	2.36	BDL	BDL
16-08-2021	25.1	12.9	BDL	BDL	BDL	BDL
19-08-2021	27.6	14.8	BDL	BDL	BDL	BDL
23-08-2021	28.9	20.6	2.68	2.92	BDL	BDL
26-08-2021	24.3	13.8	BDL	2.33	BDL	BDL
30-08-2021	20.7	11.3	2.17	BDL	BDL	BDL
02-09-2021	27.1	13.6	BDL	3.89	BDL	BDL
06-09-2021	25.8	13.6	BDL	2.89	BDL	BDL
09-09-2021	27.1	13.6	BDL	3.89	BDL	BDL
13-09-2021	34.6	17.6	2.83	3.08	BDL	BDL
16-09-2021	25.3	13.6	BDL	2.98	BDL	BDL
20-09-2021	33.9	16.2	BDL	3.73	BDL	BDL
23-09-2021	42.7	18.3	3.11	4.58	BDL	BDL
27-09-2021	33.5	17.9	BDL	3.76	BDL	BDL
30-09-2021	39.6	19.5	BDL	3.65	BDL	BDL
NAAQS 2009 Limits	**100**	**60**	**80**	**80**	**4**	**-**

Table 3.7: Location – Chani (A4)

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
03-08-2021	27.1	7.94	BDL	BDL	BDL	BDL
06-08-2021	34.9	8.99	BDL	2.17	BDL	BDL
09-08-2021	24.5	8.20	BDL	BDL	BDL	BDL
13-08-2021	60.1	21.2	3.63	4.18	BDL	BDL
16-08-2021	55.3	27.3	3.12	4.65	BDL	BDL
19-08-2021	52.8	28.8	3.91	3.64	BDL	BDL
23-08-2021	52.6	30.0	2.74	3.14	BDL	BDL
26-08-2021	38.8	13.2	2.57	BDL	BDL	BDL
30-08-2021	34.2	16.6	BDL	BDL	BDL	BDL
02-09-2021	58.6	25.8	2.98	4.09	BDL	BDL
06-09-2021	42.9	21.8	2.97	3.56	BDL	BDL
09-09-2021	58.6	25.8	2.98	4.09	BDL	BDL
13-09-2021	49.3	27.6	BDL	3.68	BDL	BDL
16-09-2021	56.8	23.5	2.74	3.28	BDL	BDL
20-09-2021	52.9	24.6	3.11	4.59	BDL	BDL
23-09-2021	49.8	23.5	2.76	3.95	BDL	BDL
27-09-2021	52.9	23.5	2.63	3.88	BDL	BDL
30-09-2021	50.7	23.4	2.77	4.19	BDL	BDL
NAAQS 2009 Limits	**100**	**60**	**80**	**80**	**4**	**-**

Table 3.8: Location – Balarampuram (A5)

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	HC
	µg/m³	µg/m³	µg/m³	µg/m³	mg/m³	ppm
03-08-2021	18.3	7.29	BDL	BDL	BDL	BDL
06-08-2021	30.1	12.6	2.66	4.27	BDL	BDL
09-08-2021	27.0	7.69	2.34	3.96	BDL	BDL
13-08-2021	30.7	12.2	3.26	4.39	BDL	BDL
16-08-2021	33.7	18.2	3.39	4.86	BDL	BDL
19-08-2021	30.5	18.9	3.68	3.13	BDL	BDL
23-08-2021	35.0	23.9	2.95	3.26	BDL	BDL
26-08-2021	24.0	7.9	BDL	2.74	BDL	BDL
30-08-2021	25.4	12.7	BDL	BDL	BDL	BDL
02-09-2021	34.5	19.6	2.16	3.58	BDL	BDL
06-09-2021	29.8	14.5	2.86	3.65	BDL	BDL
09-09-2021	34.5	19.6	2.16	3.58	BDL	BDL
13-09-2021	29.7	15.4	2.36	3.15	BDL	BDL
16-09-2021	27.3	16.7	2.76	3.05	BDL	BDL
20-09-2021	40.4	22.8	2.07	3.86	BDL	BDL
23-09-2021	39.3	18.5	BDL	3.16	BDL	BDL
27-09-2021	40.6	21.5	2.38	3.97	BDL	BDL
30-09-2021	31.8	17.3	BDL	3.79	BDL	BDL
NAAQS 2009 Limits	**100**	**60**	**80**	**80**	**4**	**-**

HYR-3.5. Monthly Average Results of Ambient Air Quality Monitoring

Table 3.9: Monthly Average Results

Parameter, Unit	NAAQS 2009 Limits	Month	Venganoor (A1)			Port Site (A2)			Proposed Port Estate Area (A3)			Chani (A4)			Balarampuram (A5)		
			Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min
Particulate matter (size less than 10µm) or PM_{10}, µg/ m^3	100	Aug-21	43.6	33.5	21.8	48.2	37.1	22.7	29.8	25.9	20.7	60.1	42.3	24.5	35	28.3	18.3
		Sep-21	45.3	39.0	28.5	44.6	38.9	30.8	42.7	32.2	25.3	58.6	52.5	42.9	40.6	34.2	27.3
Particulate matter (size less than 2.5µm) or $PM_{2.5}$, µg/ m^3	60	Aug-21	25.8	16.0	8.0	24.0	16.3	8.30	20.6	13.2	9.00	30.0	18.0	7.90	23.9	13.5	7.30
		Sep-21	22.5	20.1	17.5	22.7	19.6	17.6	19.5	16.0	13.6	27.6	24.4	21.8	22.8	18.4	14.5
Sulphur dioxide (SO_2), µg/m^3	80	Aug-21	3.57	2.27	BDL	4.65	3.74	2.76	2.68	0.78	BDL	3.91	1.77	BDL	3.68	2.03	BDL
		Sep-21	2.97	2.07	BDL	4.12	3.10	BDL	3.11	0.66	BDL	3.11	2.55	BDL	2.86	1.86	BDL
Nitrogen dioxide (SO_2), µg/m^3	80	Aug-21	3.18	1.52	BDL	5.68	4.88	3.59	2.92	1.13	BDL	4.65	1.98	BDL	4.86	2.96	BDL
		Sep-21	3.98	3.63	2.96	5.34	4.54	3.64	4.58	3.61	2.89	4.59	3.92	3.28	3.97	3.53	3.05

Parameter, Unit	NAAQS 2009 Limits	Month	Venganoor (A1)			Port Site (A2)			Proposed Port Estate Area (A3)			Chani (A4)			Balarampuram (A5)		
			Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min
Carbon Monoxide (CO), µg/m^3	4	Aug-21	--	BDL	--	--	BDL	--	--	BDL	--	--	BDL	--	--	BDL	--
		Sep-21	--	BDL	--	--	BDL	--	--	BDL	--	--	BDL	--	--	BDL	--
Hydrocarbon (HC), ppm	-	Aug-21	--	BDL	--	--	BDL	--	--	BDL	--	--	BDL	--	--	BDL	--
		Sep-21	--	BDL	--	--	BDL	--	--	BDL	--	--	BDL	--	--	BDL	--

HYR-3.6. Graphical representation of Results

Figure 3.2: Respirable Particulate Matter (PM10)

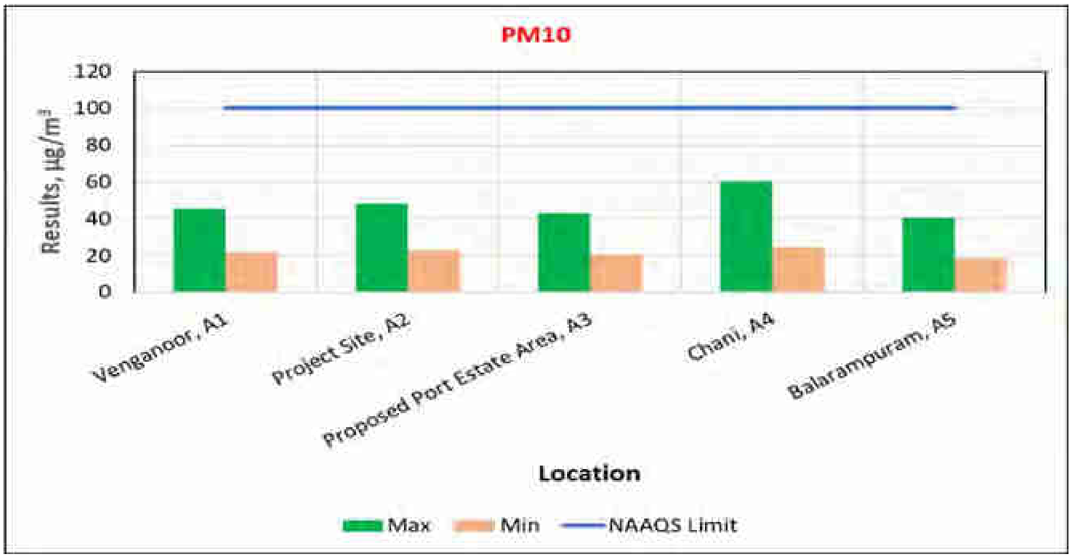


Figure 3.3: Fine Particulate matter (PM2.5)

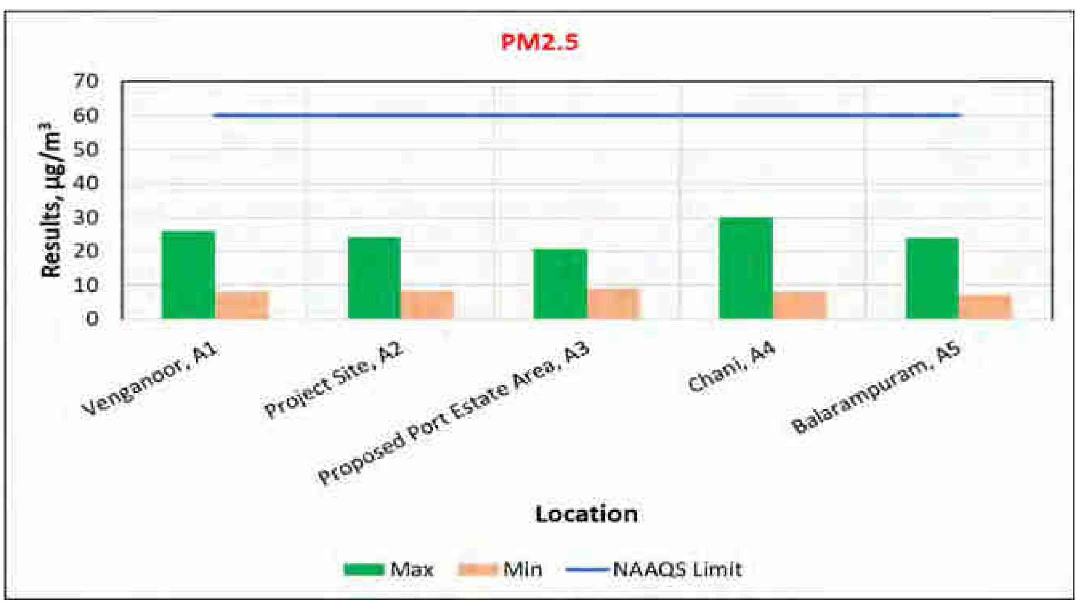


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Figure 3.4: Sulphur Dioxide as SO_2

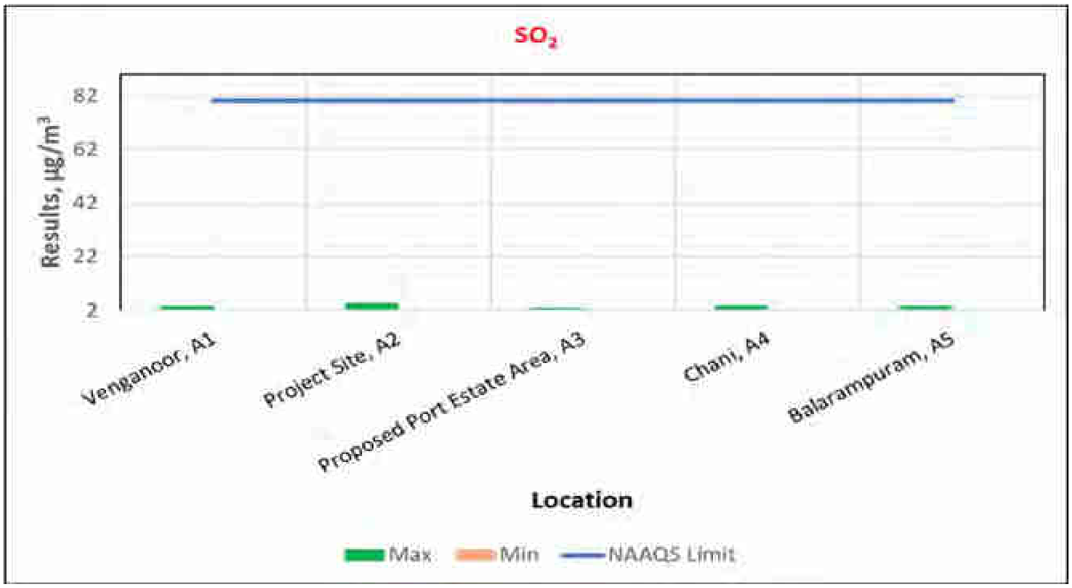
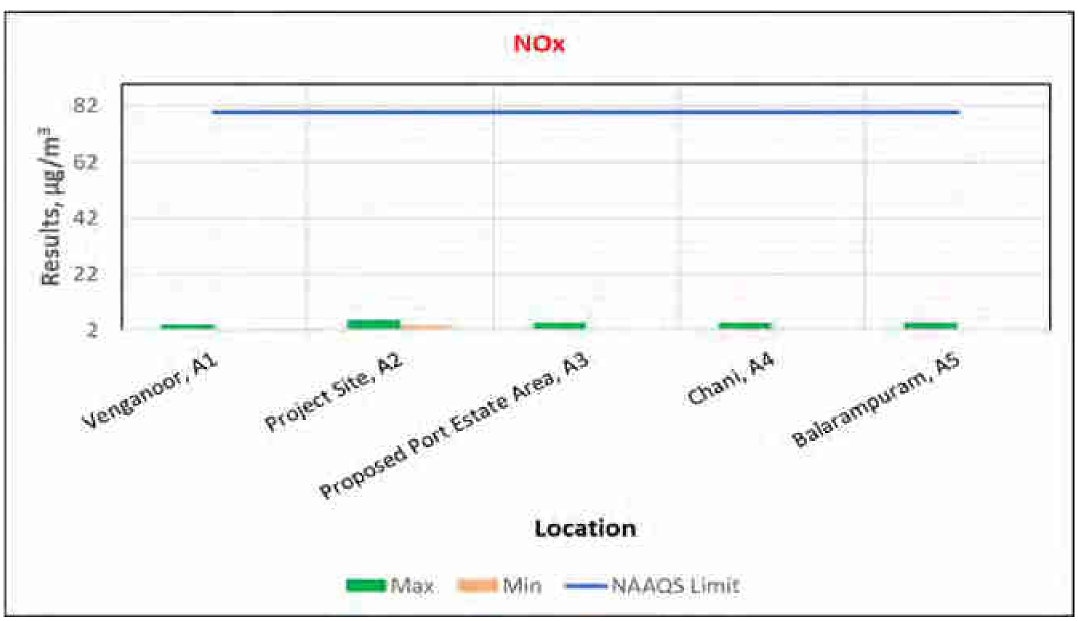


Figure 3.5: Oxides of Nitrogen as NO_x



HYR-3.7. Summary - Ambient Air Quality

During the period of August 2021 to September 2021, following is the summary of ambient air quality results:

a) At the location **Venganoor**:

- PM_{10} was observed in the range between 21.8-45.3 µg/m^3 with an average of 36.2 µg/m^3
- $PM_{2.5}$ was observed in the range between 8-25.8 µg/m^3 with an average of 18 µg/m^3
- SO_2 was observed in the range between BDL-3.57 µg/m^3 with an average of 2.2 µg/m^3
- NO_2 was observed in the range between BDL – 3.98 µg/m^3 with an average of 2.6 µg/m^3
- CO & HC were observed below detectable limits

b) At the location **Port Site**:

- PM_{10} was observed in the range between 22.7-48.2 µg/m^3 with an average of 38 µg/m^3
- $PM_{2.5}$ was observed in the range between 8.3-24 µg/m^3 with an average of 17.9 µg/m^3
- SO_2 was observed in the range between BDL-4.65 µg/m^3 with an average of 3.4 µg/m^3
- NO_2 was observed in the range between 3.59 – 5.68 µg/m^3 with an average of 4.7 µg/m^3
- CO & HC were observed below detectable limits

c) At the location **Proposed Port Area**:

- PM_{10} was observed in the range between 20.7-42.7 µg/m^3 with an average of 29.1 µg/m^3
- $PM_{2.5}$ was observed in the range between 9.0-20.6 µg/m^3 with an average of 14.6 µg/m^3

- SO_2 was observed in the range between BDL-3.11 µg/m^3 with an average of 0.7 µg/m^3
- NO_2 was observed in the range between BDL – 4.58 µg/m^3 with an average of 2.4 µg/m^3
- CO & HC were observed below detectable limits

d) At the location **Chani**:

- PM_{10} was observed in the range between 24.5-60.1 µg/m^3 with an average of 47.4 µg/m^3
- $PM_{2.5}$ was observed in the range between 7.9-30 µg/m^3 with an average of 21.2 µg/m^3
- SO_2 was observed in the range between BDL-3.91 µg/m^3 with an average of 2.2 µg/m^3
- NO_2 was observed in the range between BDL – 4.65 µg/m^3 with an average of 2.9 µg/m^3
- CO & HC were observed below detectable limits

e) At the location **Balarampuram**:

- PM_{10} was observed in the range between 18.3-40.6 µg/m^3 with an average of 31.3 µg/m^3
- $PM_{2.5}$ was observed in the range between 7.3-23.9 µg/m^3 with an average of 16.0 µg/m^3
- SO_2 was observed in the range between BDL-3.68 µg/m^3 with an average of 1.9 µg/m^3
- NO_2 was observed in the range between BDL – 4.86 µg/m^3 with an average of 3.2 µg/m^3
- CO & HC were observed below detectable limits

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 during the monitoring months (August 2021 and September 2021).

HYR-4	Ambient Noise Monitoring

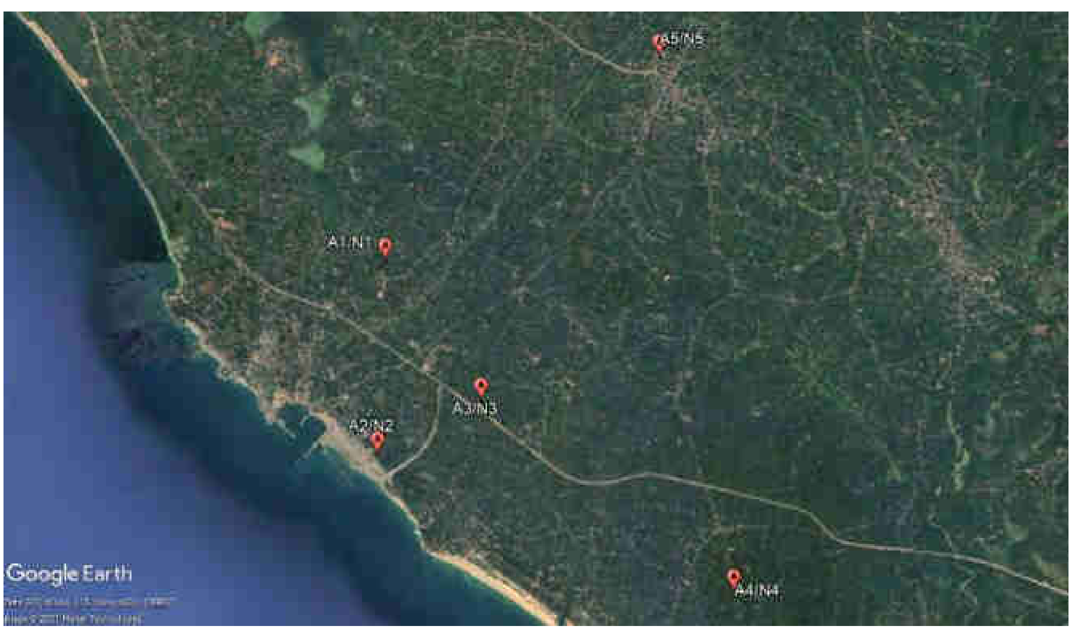
HYR-4.1. Ambient Noise Monitoring location details

This section describes the sampling location, methodology adopted for monitoring ambient noise and analysis of monitored results. Ambient Noise Monitoring during August & September 2021 was carried out at Venganoor, Proposed Port Estate Area, Port Site, Chani and Balarampuram. Classification of locations as per the Noise Pollution (Regulation & Control) Rules, 2000 (Rules 3 (1) and 4(1)) are as below.

Table 4.1: Coordinates of Ambient Noise Monitoring Locations

Location	Legend	Area Type	Latitude	Longitude
Venganoor	N1	Residential	8°23’55.10”N	77°00’12.19”E
Project Site	N2	Industrial	8°22’13.73”N	77°00’08.39”E
Proposed Port Estate Area	N3	Residential	8°22’41.37”N	77°01’03.17”E
Chani	N4	Residential	8°21’01.98”N	77°03’15.11”E
Balarampuram	N5	Commercial	8°25’43.73”N	77°02’39.99”E

Figure 4.1: Google Earth View of Ambient Noise Monitoring Locations



HYR-4.2. Methodology of Sampling

Ambient Noise Monitoring is being carried out as per IS 9989:1981.

HYR-4.3. 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

HYR-4.4. Ambient Noise Monitoring Results for the period August 2021 and September 2021.

Table 4.3: Location – Venganoor, N1 - (Residential Area)

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)					
Aug-21	12-08-2021	54.5	43.0	37.2	35.0	48.1	41.2
	25-08-2021	56.9	44.1	36.7	34.8	46.8	38.1
Sep-21	01-09-2021	57.8	42.3	38.1	35.4	47.1	37.4
	15-09-2021	56.1	43.7	37.2	34.1	46.4	36.7
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						55	45

Table 4.4: Location – Port Site, N2 - (Industrial Area)

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)					
Aug-21	12-08-2021	80.2	65.1	43.4	36.3	67.8	56.1
	26-08-2021	79.6	63.8	44.2	40.1	68.2	57.0
Sep-21	03-09-2021	78.7	64.2	42.9	37.1	65.5	56.7
	17-09-2021	77.8	62.4	43.8	38.2	69.3	56.1
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						**75**	**70**

Table 4.5: Location – Proposed Port Estate Area, N3 - (Residential Area)

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)					
Aug-21	12-08-2021	71.0	45.7	42.5	38.9	52.3	43.4
	28-08-2021	69.5	46.0	41.6	37.5	51.7	42.5
Sep-21	04-09-2021	69.8	45.2	43.1	38.6	52.4	42.5
	18-09-2021	68.3	45.4	42.4	36.8	50.9	43.2
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						**55**	**45**

Table 4.6: Location – Chani, N4 - (Residential Area)

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)					
Aug-21	20-08-2021	57.8	44.6	39.8	35.6	52.6	42.5
Sep-21	01-09-2021	54.9	43.3	35.5	34.3	53.2	41.8
	07-09-2021	56.8	43.8	39.5	36.1	53	41.6
	21-09-2021	55.4	44.1	36.8	35.3	53.5	42.2
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						**55**	**45**

Table 4.7: Location – Balarampuram, N5 - (Commercial Area)

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)					
Aug-21	19-08-2021	74.6	50.3	40.6	36.4	58.3	46.9
Sep-21	01-09-2021	74.6	47.6	42.4	39	56.8	44.6
	08-09-2021	72.3	51.2	41.1	35.8	55.3	48.4
	22-09-2021	70.7	49.8	40.8	36.0	57.2	47.3
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						**65**	**55**

HYR-4.5. Half Yearly Average Results of Ambient Noise Monitoring

Table 4.8: Half Yearly Average Results

Parameter		Venganoor (N1)	Proposed Port Estate Area (N2)	Chani (N3)	Port Site (N4)	Balarampuram (N5)
		Residential	Residential	Residential	Industrial	Commercial
		Day Time (Limit: 55) Night Time (Limit: 45)			Day Time (Limit: 75) Night Time (Limit: 70)	Day Time (Limit: 65) Night Time (Limit: 55)
L_{max} Day time dB (A)	Max	57.8	80.2	71.0	57.8	74.6
	Min	54.5	77.8	68.3	54.9	70.7
	Avg.	56.3	79.1	69.7	56.2	73.1
L_{max} Night time dB (A)	Max	44.1	65.1	46.0	44.6	51.2
	Min	42.3	62.4	45.2	43.3	47.6
	Avg.	43.3	63.9	45.6	44.0	49.7
L_{min} Day time dB (A)	Max	38.1	44.2	43.1	39.8	42.4
	Min	36.7	42.9	41.6	35.5	40.6
	Avg.	37.3	43.6	42.4	37.9	41.2
L_{min} Night time dB (A)	Max	35.4	40.1	38.9	36.1	39.0
	Min	34.1	36.3	36.8	34.3	35.8
	Avg.	34.8	37.9	38.0	35.3	36.8

Parameter		Venganoor (N1)	Proposed Port Estate Area (N2)	Chani (N3)	Port Site (N4)	Balarampuram (N5)
		Residential	Residential	Residential	Industrial	Commercial
		Day Time (Limit: 55) Night Time (Limit: 45)			Day Time (Limit: 75) Night Time (Limit: 70)	Day Time (Limit: 65) Night Time (Limit: 55)
Leq Day time dB (A)	Max	48.1	69.3	52.4	53.5	58.3
	Min	46.4	65.5	50.9	52.6	55.3
	Avg.	47.1	67.7	51.8	53.1	56.9
Leq Night time dB (A)	Max	41.2	57.0	43.4	42.5	48.6
	Min	36.7	56.1	42.5	41.6	46.9
	Avg.	38.4	56.5	42.9	42.0	47.8

HYR-4.6. Graphical representation of Results

Figure 4.2: Residential Area Noise Level

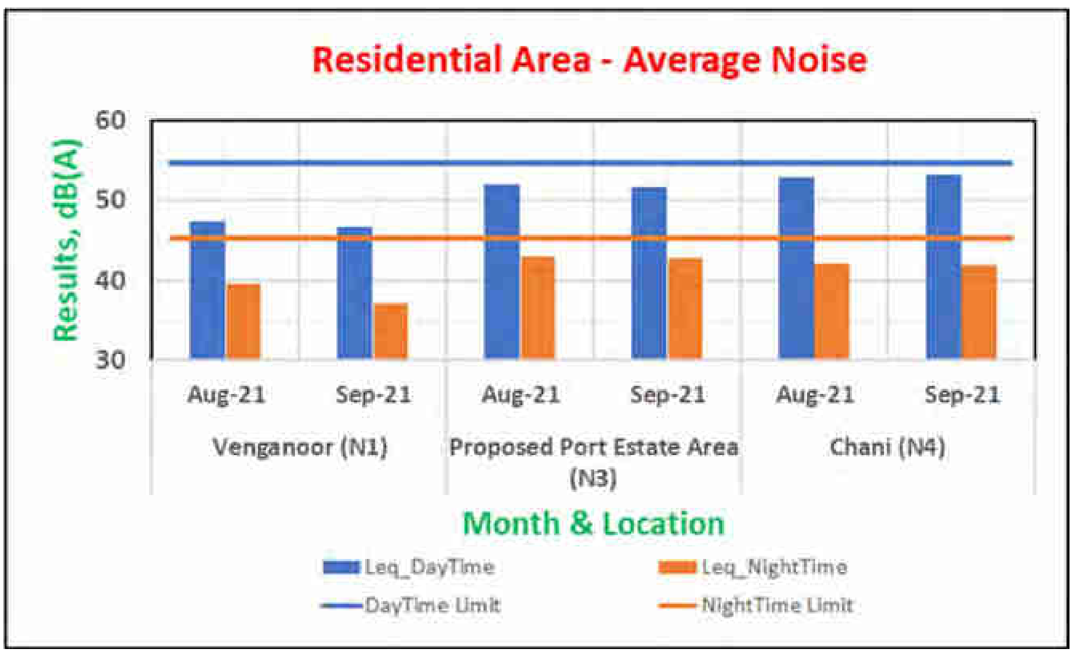


Figure 4.3: Industrial Area Noise Level

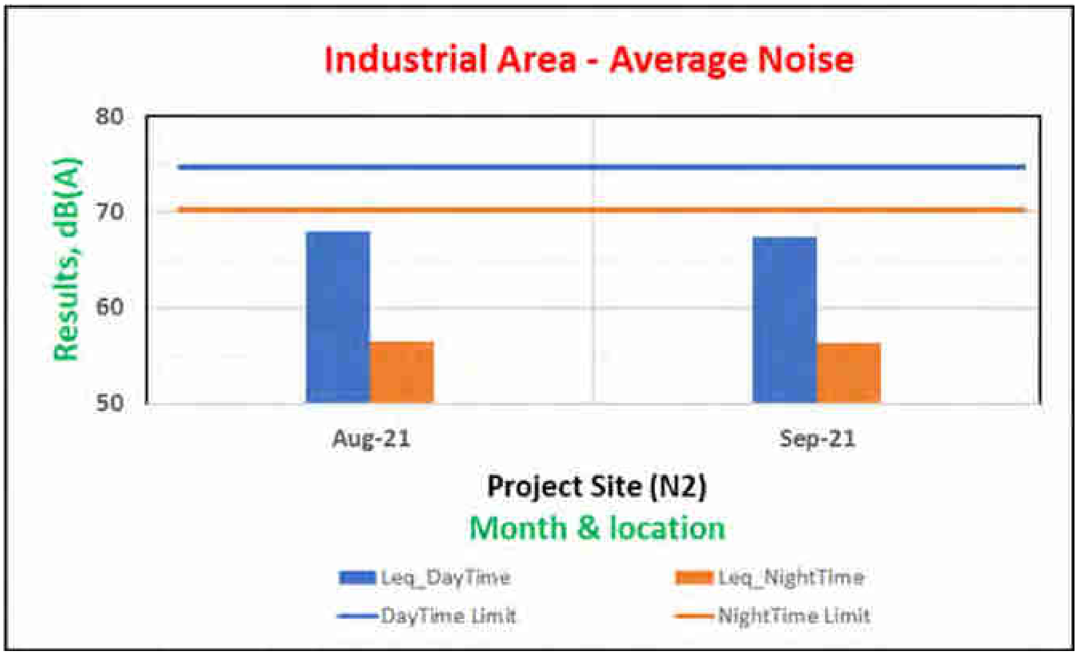
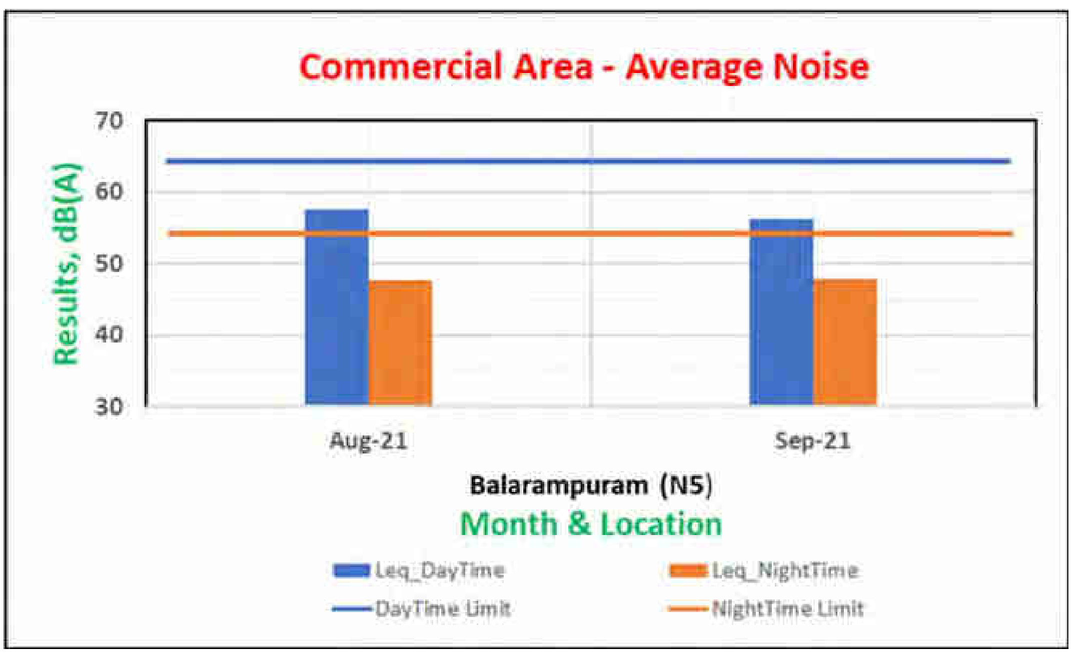


Figure 4.4: Commercial Area Noise Level



HYR-4.7. Summary - Ambient Noise Monitoring

During the period August 2021 and September 2021, the following is the average noise level observed.

Parameter		Venganoor (N1)	Proposed Port Estate Area (N2)	Chani (N3)	Port Site (N4)	Balarampuram (N5)
		Residential	Residential	Residential	Industrial	Commercial
		Day Time (Limit: 55) Night Time (Limit: 45)			Day Time (Limit: 75) Night Time (Limit: 70)	Day Time (Limit: 65) Night Time (Limit: 55)
Leq Day time dB (A)	Avg.	47.1	67.7	51.8	53.1	56.9
Leq Night time dB (A)	Avg.	38.4	56.5	42.9	42.0	47.8

The results obtained were compared with Noise Pollution (Regulation & Control) Rule, 2000 (Rule 3(1) and 4(1)) and it is observed that noise readings were within limits at all locations on all monitoring days during the monitoring months (August 2021 and September 2021).

HYR-5	Marine Water & Sediment Analysis

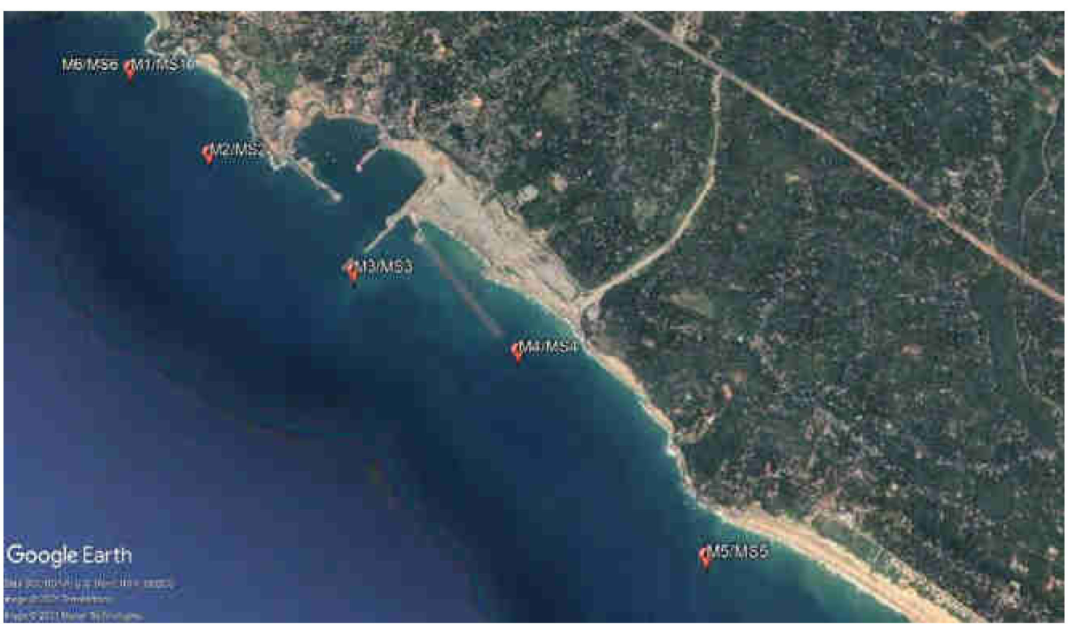
HYR-5.1. Marine Water and Sediment Sampling Location Details:

This section 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 August 2021 and September 2021 carried out at different locations such as Near Kovalam Beach, Proposed Dredging site, South of Break Water, Port Basin, Inner Approach Channel and Kovalam Beach.

Table 5.1: Coordinates of Marine Water and Sediment Sampling Locations

Location	Legend	Latitude	Longitude
Near Kovalam Beach	M1/MS1	8°22'49.29"N	76°58'40.77"E
Proposed Dredging Site	M2/MS2	8°22'31.11"N	76°58'57.92"E
Port Basin	M3/MS3	8°22'06.96"N	76°59'27.85"E
South of Breakwater	M4/MS4	8°21'51.07"N	77°00'00.21"E
Inner Approach Channel	M5/MS5	8°21'12.68"N	77°00'35.14"E
Kovalam Beach	M6/MS6	8°22'49.29"N	76°58'40.77"E

Figure 5.1: Google earth view of Marine Water and Sediment Sampling Locations



HYR-5.2. Methodology of Sampling and Analysis

Table 5.2: Sampling and Analysis Methodology

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
Marine Water Analysis				
1.	Temperature	˚C	1	IS 3025 Part 9 : 1984 RA 2017
2.	pH Value	-	1	IS 3025 Part 11: 1983 RA 2017
3.	Turbidity	N.T.U.	0.1	IS 3025 Part 10: 1984 RA 2017
4.	Electrical Conductivity (at 25°C)	µmho/cm	1	IS 3025 Part 14:1984 RA 2019
5.	Total Suspended Solids	mg/L	1	IS 3025 Part 17: 1984 RA 2017
6.	Total Dissolved Solids	mg/L	1	IS 3025 Part 16: 1984 RA 2017
7.	Dissolved Oxygen	mg/L	0.2	IS 3025 Part 38:1989 RA 2019
8.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	2	IS 3025 Part 44:1993 RA 2019
9.	Floating Materials – Oil, Grease and Scum (Including Petroleum Products)	mg/L	1	IS 3025 Part 39:1991 RA 2019
10.	Nitrite (as NO_2)	mg/L	0.02	IS 3025 Part 34:1988 RA 2019
11.	Nitrate (as NO_3)	mg/L	1	APHA 23rd Edition 4500 -NO_3 B: 2017
12.	Phenolic Compounds (as C_6H_5OH)	mg/L	0.001	IS 3025 Part 43: 1992 RA 2019
13.	Ammonical Nitrogen (as NH_3-N)	mg/L	1	IS 3025 Part 34:1988 RA 2019
14.	Total Nitrogen (as N)	mg/L	1	IS 3025 Part 34:1988 RA 2019
15.	Total Phosphorous (as P)	mg/L	0.01	IS 3025 Part 31 :1988 RA2019
16.	Reactive Phosphorous	mg/L	0.01	IS 3025 Part 31 :1988 RA2019
17.	Polycyclic Aromatic Hydrocarbon	mg/L	0.000005	SEAAL/INS/RWM/SOP/02
18.	Salinity	ppt	0.0036	APHA 23rdEdition 2520 – B : 2017
19.	Total Chlorophyll	mg/L	0.0001	APHA 23rd Edn:10200.H
20.	Total Coliforms	MPN/100 ml	2	IS 1622: 1981
21.	Faecal Coliforms	MPN /100ml	2	IS 1622: 1981
22.	Phytoplanktons	No./100ml	--	APHA 23rd Edn:10200.F
23.	Zooplanktons	No./100ml	--	APHA 23rd Edn:10200.G
Sediment Analysis				
1.	Texture	-	--	SEAAL/EN/SLS/SOP/14
2.	Organic Matter	%	0.1	IS 2720 Part 22:1972
3.	Total Phosphorus (as P)	mg/kg	10	IS 10158: 1982

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
4.	Aluminium (as Al)	mg/kg	5	USEPA 7000B : 2017
5.	Chromium (as Cr)	mg/kg	5	USEPA 7000B : 2007
6.	Copper (as Cu)	mg/kg	1.5	EPA 7000B : 2007
7.	Iron (as Fe)	mg/kg	2.5	USEPA 7000B : 2007
8.	Lead (as Pb)	mg/kg	5	EPA 7000B : 2007
9.	Manganese (as Mn)	mg/kg	1.5	EPA 7000B : 2007
10.	Mercury (as Hg)	mg/kg	0.10	SEAAL/EN/SLS/SOP/13
11.	Zinc (as Zn)	mg/kg	1	USEPA 7000B : 2007
12.	Nickel (as Ni)	mg/kg	2.5	EPA 7000B : 2007
13.	Benthic Organism	No./m^2	1	APHA 23rd Edn:10750.B

HYR-5.3. Marine Water Standards

As per the Environment (Protection) Rules, 1986 Schedule I.

Table 5.3: Marine Water Standard

Parameter	Unit	# E(P)A Rules, 1986
pH Value	-	6.5-9.0
Dissolved Oxygen	mg/L	3.0 mg/L or 40% saturation value; whichever is higher
Colour and Odour	-	No visible colour or offensive odour
Floating Materials (Oil, Grease and Scum) (Including Petroleum Products)	mg/L	*Max.* 10
Faecal Coliforms	MPN/100ml	*Max.* 500
Biochemical Oxygen Demand (3 days, 27°C)	mg/L	*Max.* 5
#: Environment (Protection) Rules, 1986, Schedule I, Table 1.4, Primary Water Quality Criteria for Class – IV Water (For Harbour Waters).		

HYR-5.4. Marine Water Analysis Results for the period August 2021 & September 2021

Table 5.4: Marine Water Analysis Results

Sl. No.	Parameter /unit	Month/Tide		Near Kovalam Beach (M1)	Proposed Dredging Site (M2)	Port Basin (M3)	South of Break Water (M4)	Inner Approach Channel (M5)	Kovalam Beach (M6)
1	Temperature (°C)	Aug-21	High tide	29.3	29.3	29.3	29.4	29.3	29.4
			Low tide	29.2	29.2	29.2	29.0	29.2	29.2
		Sep-21	High tide	28.5	28.8	28.1	28.4	28.6	28.5
			Low tide	28.4	28.3	28.3	28.6	28.6	28.6
2	Colour	Aug-21	High tide	1	1	1	1	1	1
			Low tide	1	1	1	1	1	1
		Sep-21	High tide	1	1	1	1	1	1
			Low tide	1	1	1	1	1	1
3	pH Value	Aug-21	High tide	7.65	7.65	7.63	7.65	7.67	7.66
			Low tide	7.63	7.63	7.68	7.72	7.79	7.78
		Sep-21	High tide	7.76	7.78	7.72	7.73	7.70	7.73
			Low tide	7.72	7.73	7.73	7.76	7.70	7.77

Sl. No.	Parameter /unit	Month/Tide		Near Kovalam Beach (M1)	Proposed Dredging Site (M2)	Port Basin (M3)	South of Break Water (M4)	Inner Approach Channel (M5)	Kovalam Beach (M6)
4	Turbidity (N.T.U.)	Aug-21	High tide	0.6	0.6	0.7	0.5	0.4	0.4
			Low tide	0.6	0.6	0.7	0.5	0.5	0.4
		Sep-21	High tide	2.5	1.5	1.3	2.4	1.8	1.7
			Low tide	1.6	1.5	1.6	1.7	2.0	1.1
5	Electrical Conductivity (at 25°C) (µmho/cm)	Aug-21	High tide	61110	61110	61740	61690	61650	61620
			Low tide	61610	61610	61768	61568	61160	61520
		Sep-21	High tide	61330	61600	62240	61770	62300	62530
			Low tide	60900	60890	60750	60920	61920	61210
6	Total Suspended Solids (mg/L)	Aug-21	High tide	5.62	5.62	4.36	6.54	3.65	5.14
			Low tide	4.98	4.98	3.39	5.64	2.64	4.38
		Sep-21	High tide	BDL	1.20	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
7	Total Dissolved Solids (mg/L)	Aug-21	High tide	39717	39717	40126	40092	40070	40050
			Low tide	40042	40042	40150	40016	39753	39985
		Sep-21	High tide	39860	40035	40450	40148	40490	40640
			Low tide	39580	39572	38845	39595	40240	39780

Sl. No.	Parameter /unit	Month/Tide		Near Kovalam Beach (M1)	Proposed Dredging Site (M2)	Port Basin (M3)	South of Break Water (M4)	Inner Approach Channel (M5)	Kovalam Beach (M6)
8	Dissolved Oxygen (mg/L)	Aug-21	High tide	5.1	5.1	6.1	4.8	4.8	6.8
			Low tide	6.2	6.2	6.8	6.1	6.0	5.8
		Sep-21	High tide	6.9	6.8	6.1	5.2	5.8	5.2
			Low tide	6.8	6.7	6.5	6.5	6.8	6.7
9	Biochemical Oxygen Demand (3 days, 27°C) (mg/L)	Aug-21	High tide	4.7	4.7	BDL	3.6	4.2	BDL
			Low tide	BDL	BDL	BDL	BDL	2.9	3.0
		Sep-21	High tide	BDL	BDL	3.0	5.8	6.0	4.2
			Low tide	BDL	BDL	BDL	2.0	BDL	2.0
10	Floating Materials (Oil, Grease and Scum) (Including Petroleum Products) (mg/L)	Aug-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sep-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
11	Nitrite (as NO_2) (mg/L)	Aug-21	High tide	0.06	0.06	0.10	0.08	0.04	0.07
			Low tide	0.07	0.07	0.03	0.08	0.05	0.04
		Sep-21	High tide	0.10	0.11	0.07	0.10	0.11	0.12

Sl. No.	Parameter /unit	Month/Tide		Near Kovalam Beach (M1)	Proposed Dredging Site (M2)	Port Basin (M3)	South of Break Water (M4)	Inner Approach Channel (M5)	Kovalam Beach (M6)
			Low tide	0.18	0.17	0.21	0.20	0.28	0.17
12	Nitrate (as NO_3) (mg/L)	Aug-21	High tide	3.38	3.38	4.00	3.31	3.38	3.42
			Low tide	3.32	3.32	3.42	3.89	4.01	3.72
		Sep-21	High tide	5.34	3.25	3.62	5.31	3.67	3.64
			Low tide	7.20	5.70	4.19	3.62	5.85	4.15
13	Phenolic Compounds (as C_6H_5OH) (mg/L)	Aug-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sep-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
14	Ammonical Nitrogen (as NH_3-N) (mg/L)	Aug-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sep-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
15	Total Nitrogen (as N) (mg/L)	Aug-21	High tide	4.46	4.46	10.40	9.01	4.45	6.08
			Low tide	6.60	6.60	9.65	9.14	6.55	8.43
		Sep-21	High tide	3.40	4.17	3.39	3.84	2.51	1.19

Sl. No.	Parameter /unit	Month/Tide		Near Kovalam Beach (M1)	Proposed Dredging Site (M2)	Port Basin (M3)	South of Break Water (M4)	Inner Approach Channel (M5)	Kovalam Beach (M6)
			Low tide	5.18	5.28	3.60	5.21	5.30	5.74
16	Total Phosphorous (as P) (mg/L)	Aug-21	High tide	0.18	0.18	0.12	0.14	0.12	0.19
			Low tide	0.19	0.19	0.14	0.12	0.16	0.18
		Sep-21	High tide	0.38	0.42	0.39	0.43	0.48	0.51
			Low tide	0.38	0.28	0.38	0.39	0.41	0.42
17	Reactive Phosphorous (mg/L)	Aug-21	High tide	0.07	0.07	0.06	0.07	0.06	0.06
			Low tide	0.07	0.07	0.06	0.06	0.07	0.07
		Sep-21	High tide	0.16	0.19	0.18	0.21	0.23	0.23
			Low tide	0.17	0.17	0.20	0.18	0.18	0.19
18	Polycyclic Aromatic Hydrocarbon (mg/L)	Aug-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sep-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
19	Salinity (ppt)	Aug-21	High tide	33.068	33.068	33.439	33.409	33.386	33.368
			Low tide	33.363	33.363	33.456	33.338	33.097	33.309
		Sep-21	High tide	33.574	33.745	34.153	33.854	34.191	34.338

Sl. No.	Parameter /unit	Month/Tide		Near Kovalam Beach (M1)	Proposed Dredging Site (M2)	Port Basin (M3)	South of Break Water (M4)	Inner Approach Channel (M5)	Kovalam Beach (M6)
			Low tide	33.301	33.294	33.206	33.313	33.949	33.498
20	Total Chlorophyll (mg/m^3)	Aug-21	High tide	1.20	1.20	0.06	0.08	0.07	0.09
			Low tide	0.90	0.90	0.08	0.07	0.08	0.06
		Sep-21	High tide	0.07	0.09	0.06	0.08	0.07	0.09
			Low tide	0.10	0.09	0.08	0.07	0.08	0.06
21	Total Coliforms (MPN Index/100 mL)	Aug-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sep-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
22	Faecal Coliforms (MPN Index/100 mL)	Aug-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL
		Sep-21	High tide	BDL	BDL	BDL	BDL	BDL	BDL
			Low tide	BDL	BDL	BDL	BDL	BDL	BDL

HYR-5.5. Graphical representation of Results for marine water

Figure 5.2: Marine Water Analysis for Temperature

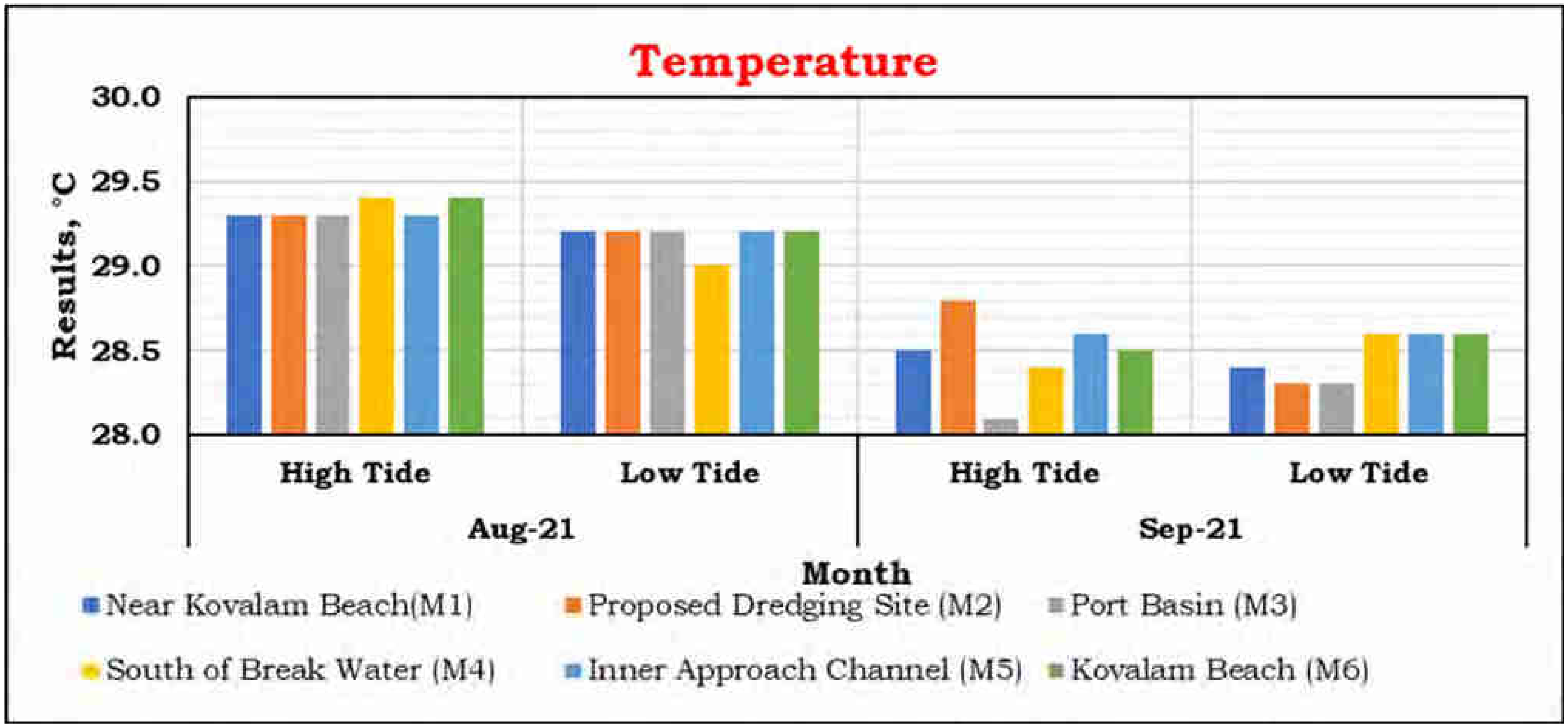


Figure 5.3: Marine Water Analysis for pH

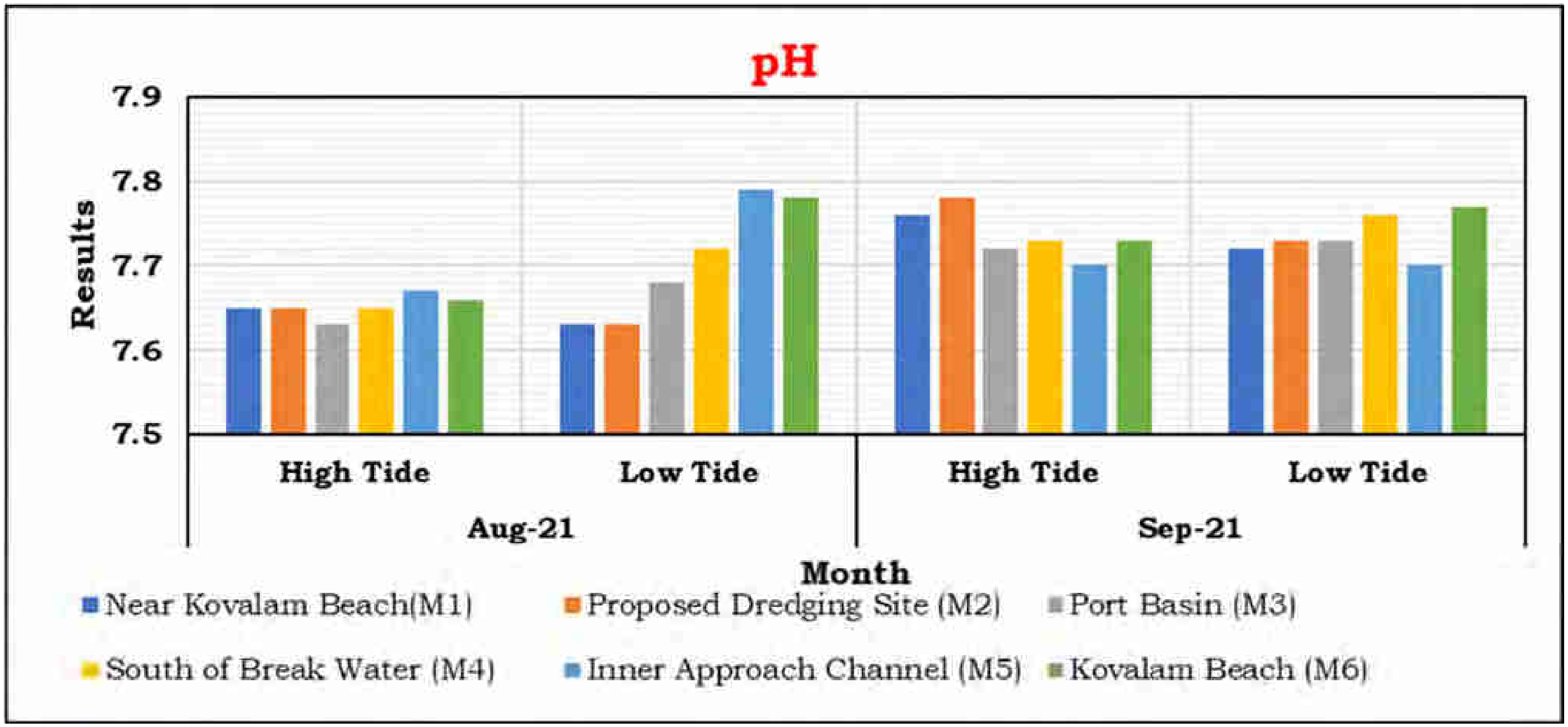


Figure 5.4: Marine Water Analysis for Turbidity

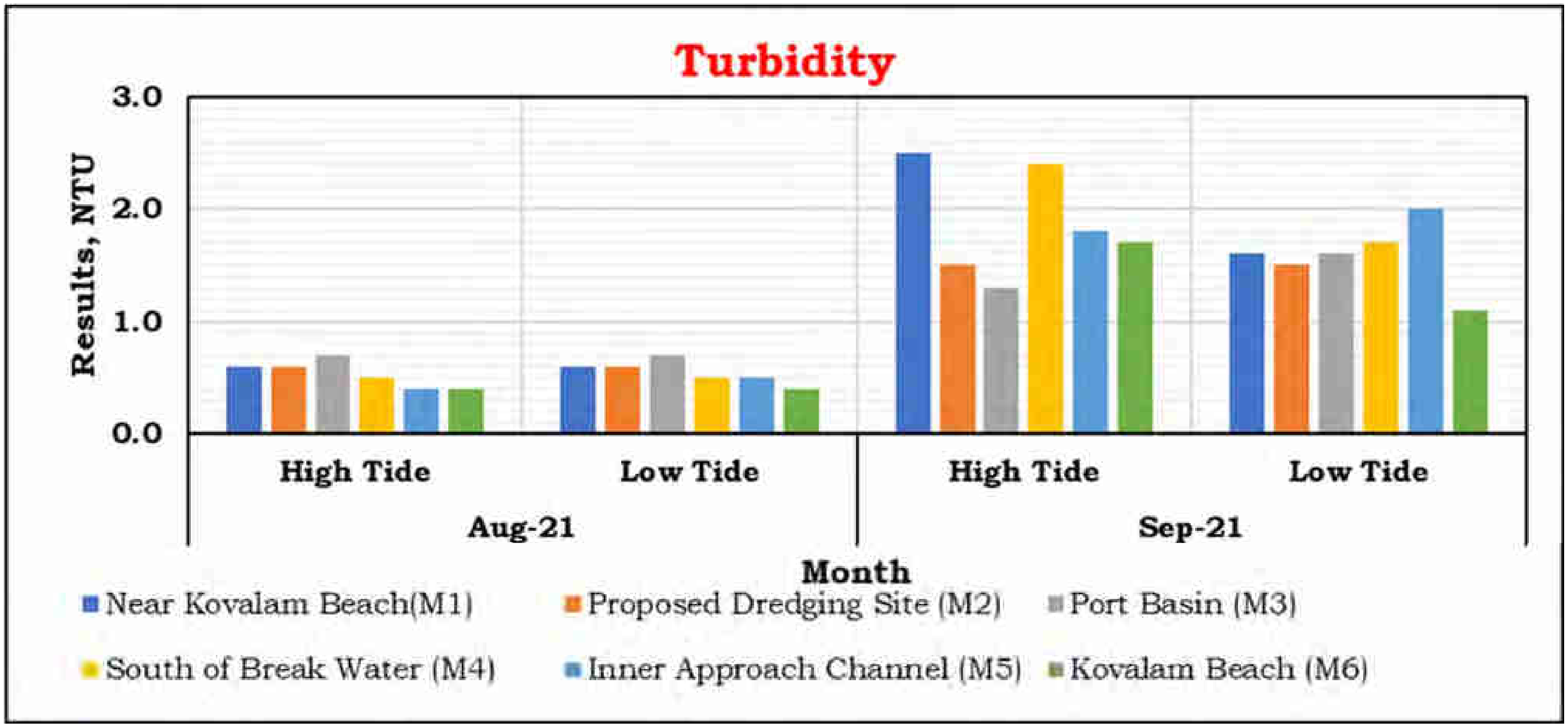


Figure 5.5: Marine Water Analysis for Electrical Conductivity

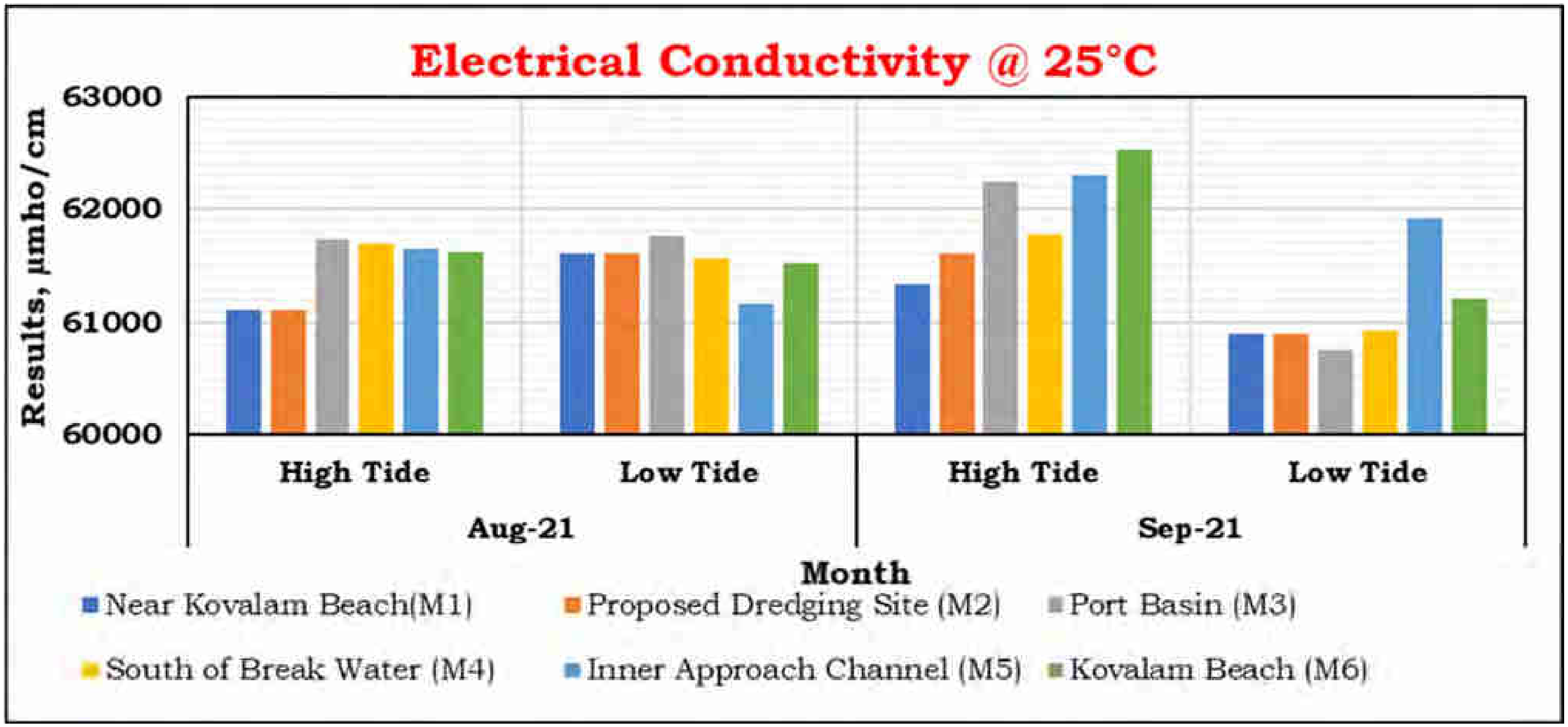


Figure 5.6: Marine Water Analysis for Total Suspended Solids

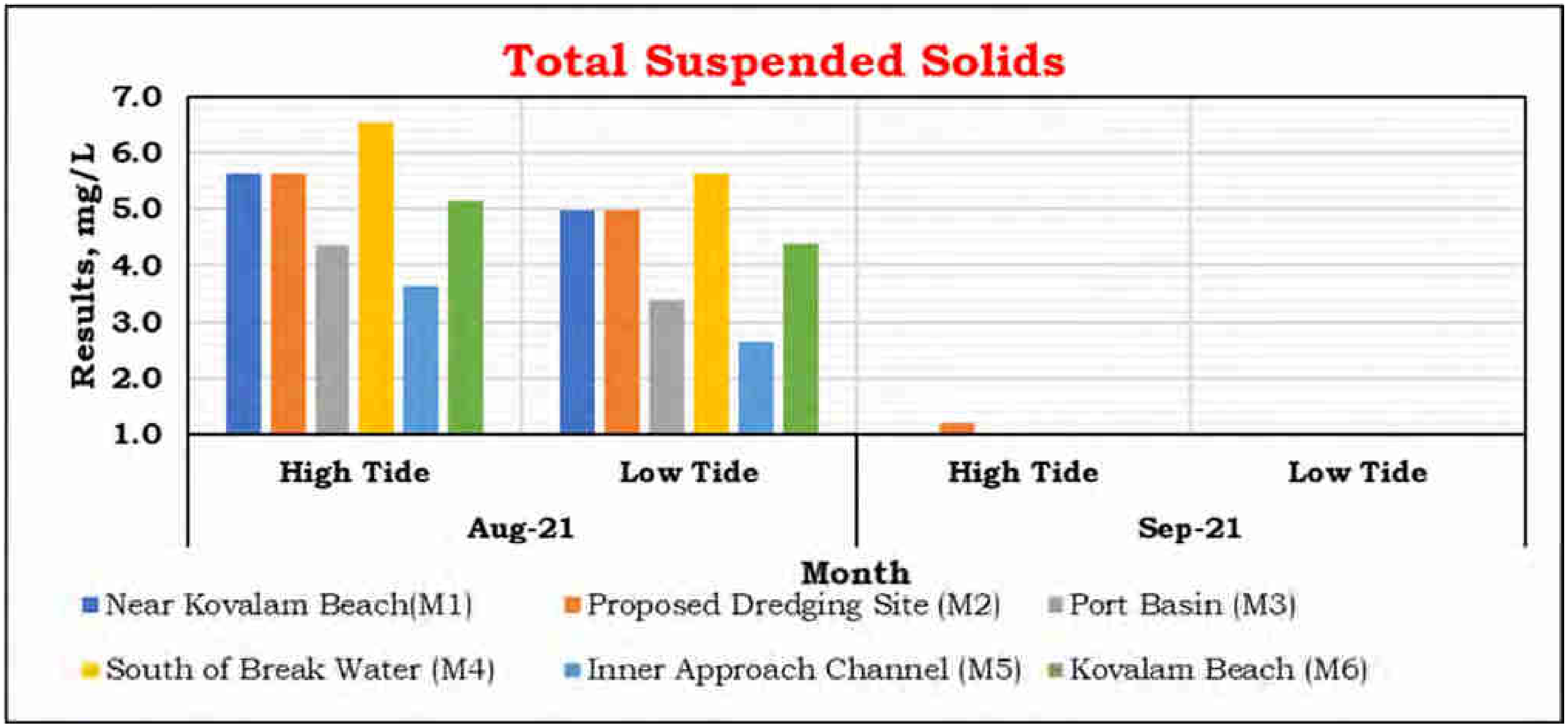


Figure 5.7: Marine Water Analysis for Total Dissolved Solids

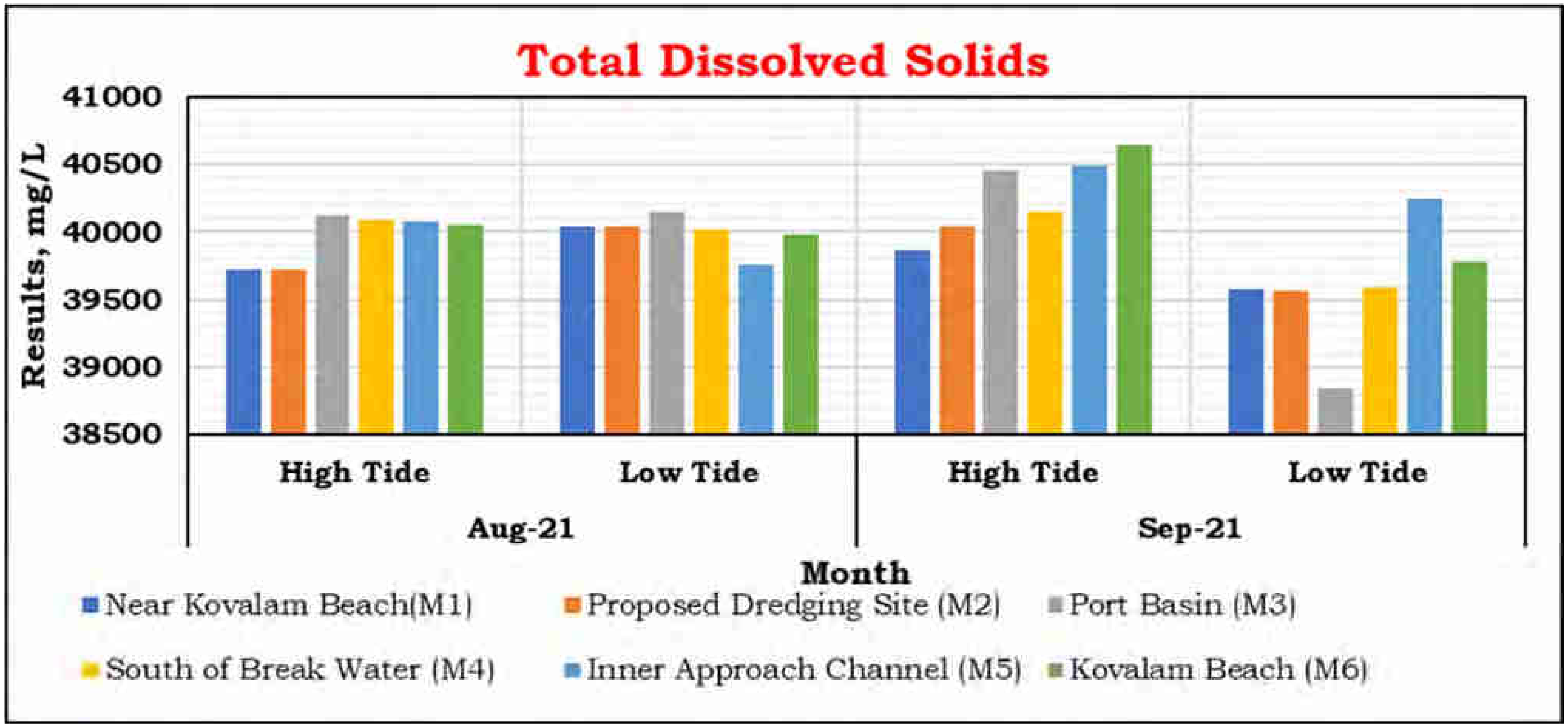


Figure 5.8: Marine Water Analysis for Dissolved Oxygen

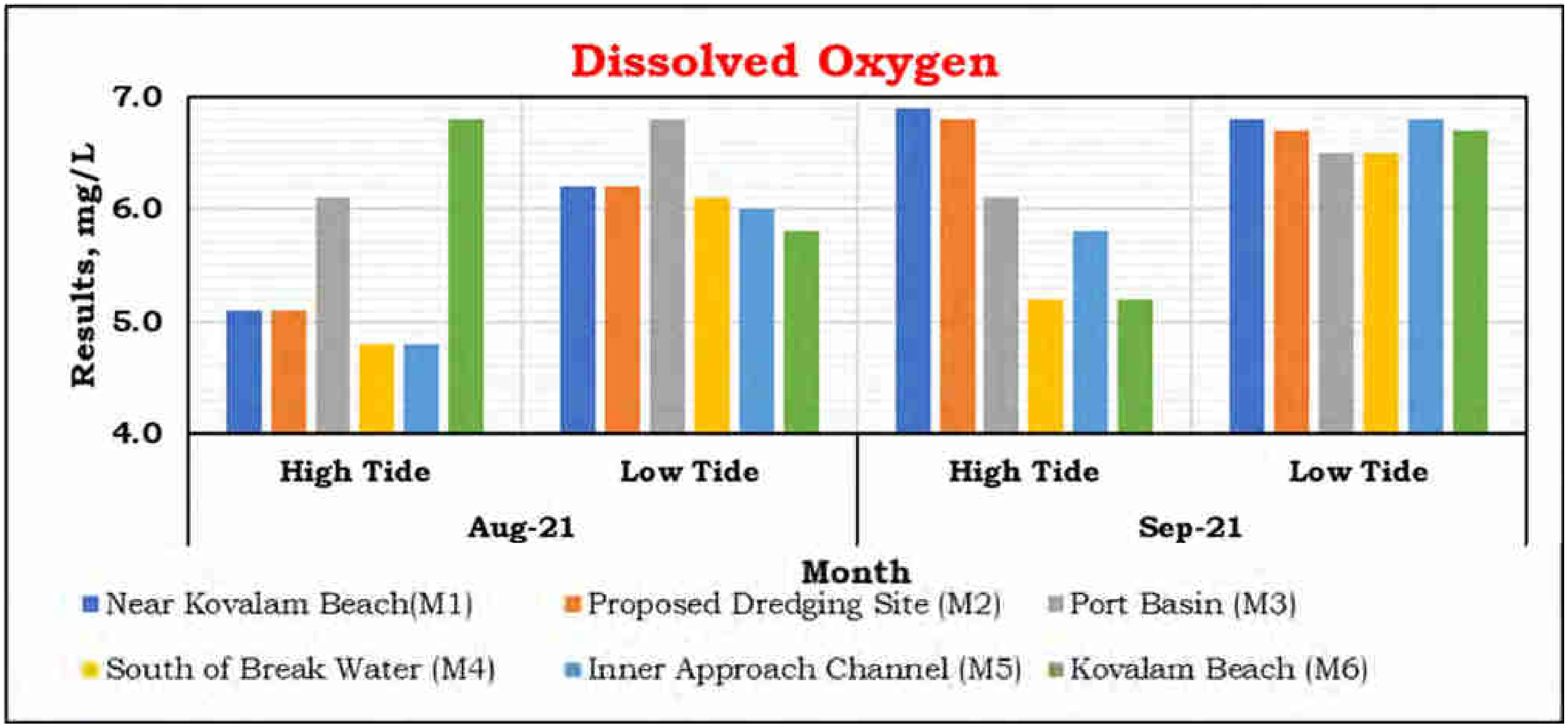


Figure 5.9: Marine Water Analysis for Nitrate as NO_3

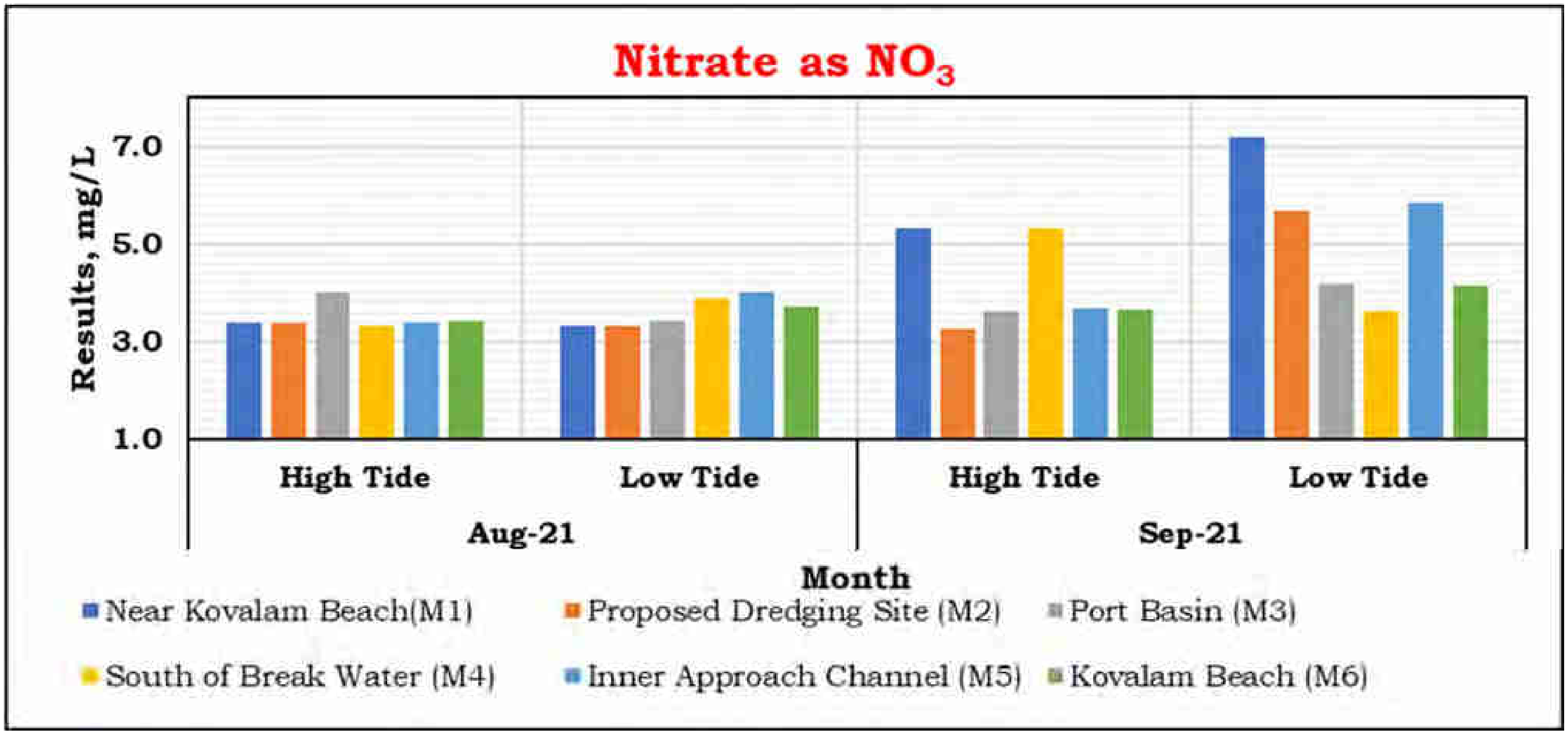


Figure 5.10: Marine Water Analysis for Total Nitrogen as N

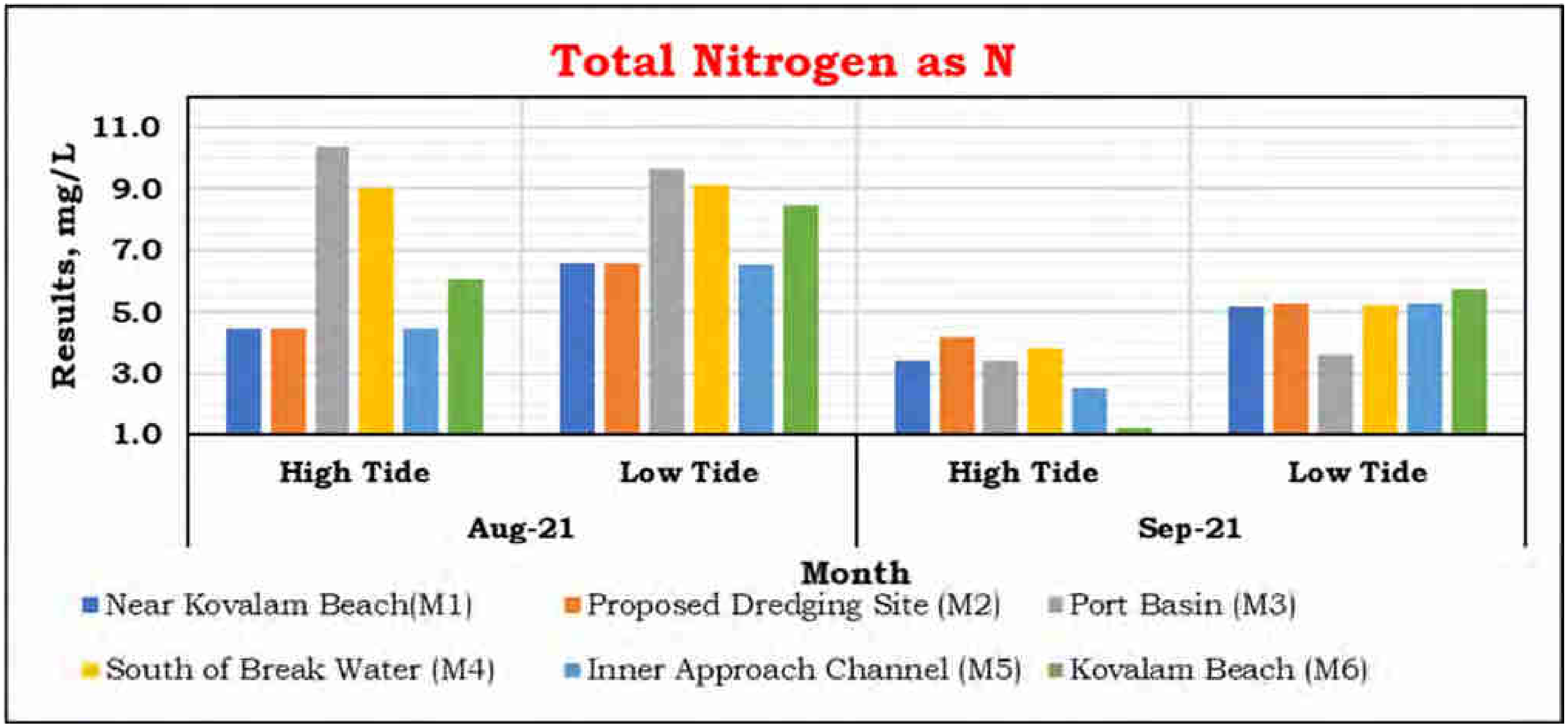


Figure 5.11: Marine Water Analysis for Salinity

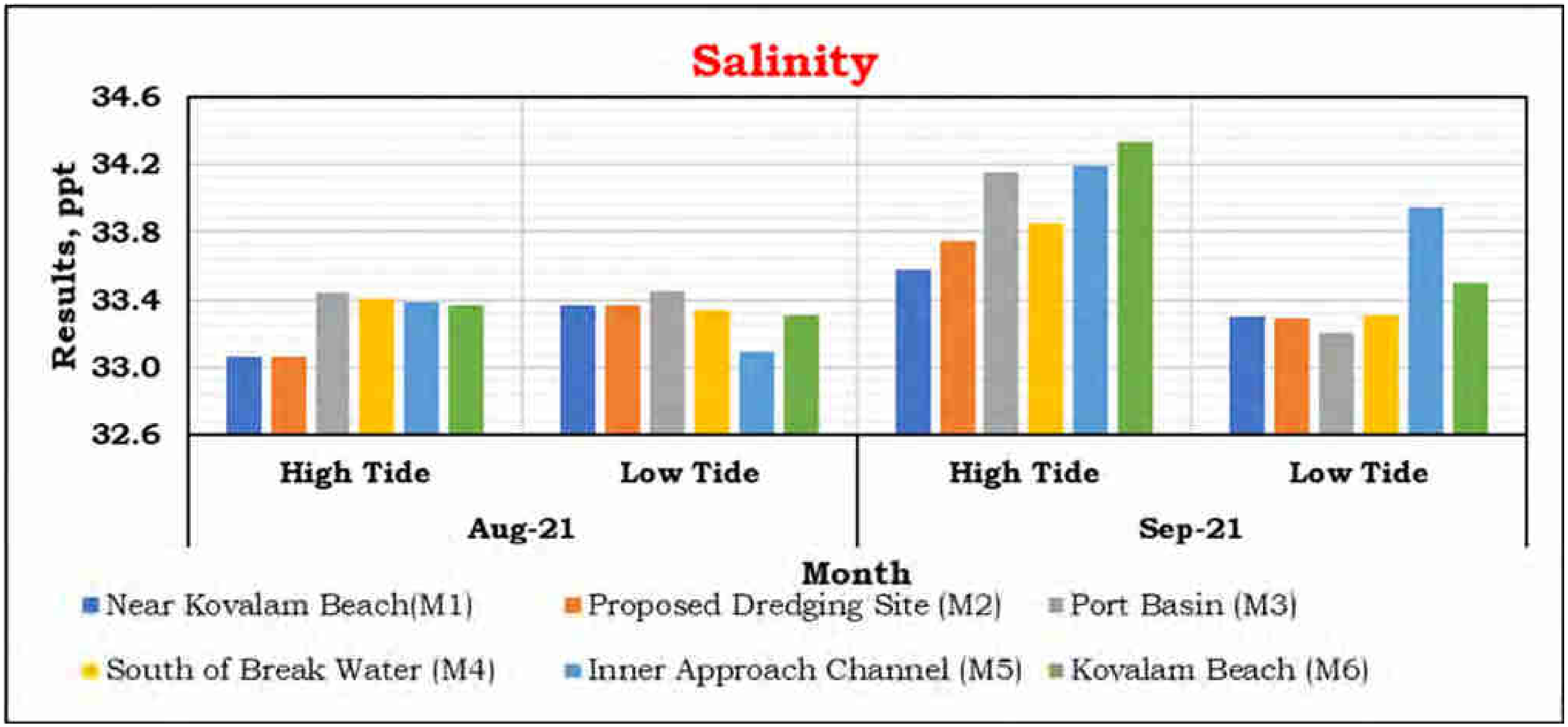
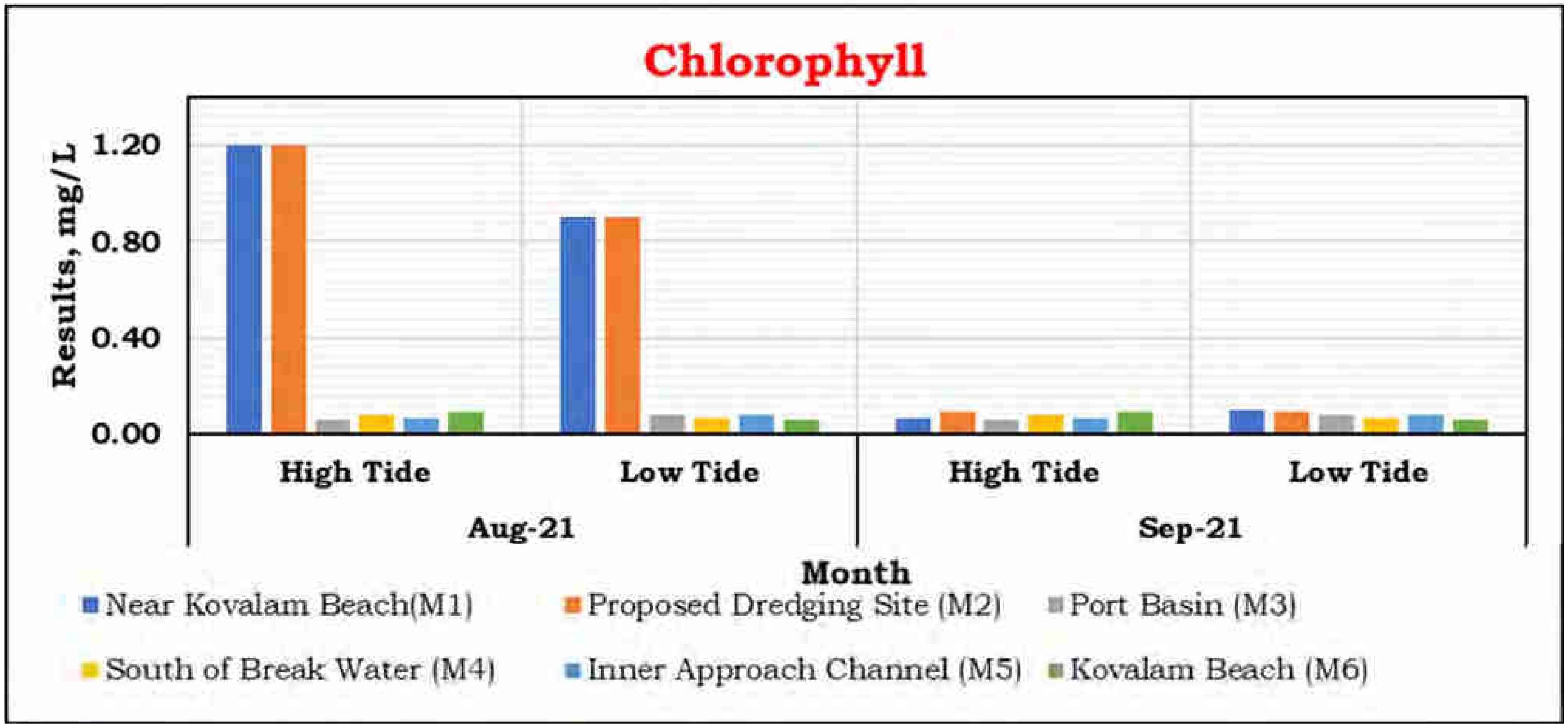


Figure 5.12: Marine Water Analysis for Chlorophyll



HYR-5.6. Summary - Marine water analysis:

During the months of August 2021 and September 2021, following is the summary of the marine water analysis:

a) At the location **Near Kovalam Beach** (low tide & high tide),

- Temperature was observed in the range from 28.4 to 29.5°C
- No visible colour was observed
- pH was observed in the range from 7.63 to 7.76
- Turbidity was observed from 0.6 to 2.5 N.T.U.
- Electrical Conductivity (at 25°C) was observed in the range from 60900 to 61610 µmho/cm
- Total Suspended Solids were observed in the range from BDL to 5.62 mg/L
- Total Dissolved Solids were observed in the range from 39580 to 40042 mg/L
- Dissolved Oxygen was observed in the range from 5.1 to 6.9 mg/L
- Biochemical Oxygen Demand (3 days, 27°C) was observed in the from BDL to 4.7 mg/L
- Nitrite (as NO_2) was observed in the range from 0.06 to 0.18 mg/L
- Nitrate (as NO_3) was observed in the range from 3.32 to 7.20 mg/L
- Total Nitrogen (as N) was observed in the range from 3.40 to 5.18 mg/L
- Total Phosphorous (as P) was observed in the range from 0.18 to 0.38 mg/L
- Reactive Phosphorous (as P) was observed in the range from 0.07 to 0.17 mg/L
- Salinity was observed in the range from 33.068 to 33.574 ppt
- Total Chlorophyll was observed in the range from 0.07 to 1.20 mg/m^3
- Floating materials, Phenolic Compounds (as C_6H_5OH), Ammonical Nitrogen (as NH_3-N), Polycyclic Aromatic Hydrocarbon, Total Coliforms and Faecal Coliforms were observed below the detection limits.

b) At the location **Proposed Dredging Site** (low tide & high tide),

- Temperature was observed in the range from 28.3 to 29.3°C
- No visible colour was observed
- pH was observed in the range from 7.63 to 7.78
- Turbidity was observed from 0.6 to 1.5 N.T.U.
- Electrical Conductivity (at 25°C) was observed in the range from 60890 to 61610 µmho/cm
- Total Suspended Solids were observed in the range from BDL to 5.62 mg/L
- Total Dissolved Solids were observed in the range from 39572 to 40042 mg/L
- Dissolved Oxygen was observed in the range from 5.1 to 6.8 mg/L
- Biochemical Oxygen Demand (3 days, 27°C) was observed in the from BDL to 4.7 mg/L
- Nitrite (as NO_2) was observed in the range from 0.06 to 0.17 mg/L
- Nitrate (as NO_3) was observed in the range from 3.25 to 5.70 mg/L
- Total Nitrogen (as N) was observed in the range from 4.17 to 6.60 mg/L
- Total Phosphorous (as P) was observed in the range from 0.18 to 0.42 mg/L
- Reactive Phosphorous (as P) was observed in the range from 0.07 to 0.19 mg/L
- Salinity was observed in the range from 33.068 to 33.745 ppt
- Total Chlorophyll was observed in the range from 0.09 to 1.20 mg/m^3
- Floating materials, Phenolic Compounds (as C_6H_5OH), Ammonical Nitrogen (as NH_3-N), Polycyclic Aromatic Hydrocarbon, Total Coliforms and Faecal Coliforms were observed below the detection limits.

c) At the location **Port basin** (low tide & high tide),

- Temperature was observed in the range from 28.1 to 29.3°C
- No visible colour was observed
- pH was observed in the range from 7.63 to 7.72
- Turbidity was observed from 0.7 to 1.6 N.T.U.
- Electrical Conductivity (at 25°C) was observed in the range from 60750 to 62240 µmho/cm

- Total Suspended Solids were observed in the range from BDL to 4.36 mg/L
- Total Dissolved Solids were observed in the range from 38845 to 40450 mg/L
- Dissolved Oxygen was observed in the range from 6.1 to 6.8 mg/L
- Nitrite (as NO_2) was observed in the range from 0.06 to 0.17 mg/L
- Nitrate (as NO_3) was observed in the range from 3.42 to 4.19 mg/L
- Total Nitrogen (as N) was observed in the range from 3.39 to 10.4 mg/L
- Total Phosphorous (as P) was observed in the range from 0.12 to 0.39 mg/L
- Reactive Phosphorous (as P) was observed in the range from 0.06 to 0.20 mg/L
- Salinity was observed in the range from 33.206 to 34.153 ppt
- Total Chlorophyll was observed in the range from 0.06 to 0.08 mg/m^3 Biochemical Oxygen Demand (3 days, 27°C)
- Floating materials, Phenolic Compounds (as C_6H_5OH), Ammonical Nitrogen (as NH_3-N), Polycyclic Aromatic Hydrocarbon, Total Coliforms and Faecal Coliforms were observed below the detection limits.

d) At the location **South of Break Water** (low tide & high tide),

- Temperature was observed in the range from 28.4 to 29.4°C
- No visible colour was observed
- pH was observed in the range from 7.65 to 7.70
- Turbidity was observed from 0.5 to 2.4 N.T.U.
- Electrical Conductivity (at 25°C) was observed in the range from 60920 to 61770 µmho/cm
- Total Suspended Solids were observed in the range from BDL to 6.54 mg/L
- Total Dissolved Solids were observed in the range from 39595 to 40148 mg/L
- Dissolved Oxygen was observed in the range from 4.8 to 6.5 mg/L
- Biochemical Oxygen Demand (3 days, 27°C) was observed in the from BDL to 3.6 mg/L
- Nitrite (as NO_2) was observed in the range from 0.08 to 0.20 mg/L

- Nitrate (as NO_3) was observed in the range from 3.31 to 5.31 mg/L
- Total Nitrogen (as N) was observed in the range from 3.84 to 9.14 mg/L
- Total Phosphorous (as P) was observed in the range from 0.12 to 0.43 mg/L
- Reactive Phosphorous (as P) was observed in the range from 0.06 to 0.21 mg/L
- Salinity was observed in the range from 33.313 to 33.854 ppt
- Total Chlorophyll was observed in the range from 0.07 to 0.08 mg/m^3
- Floating materials, Phenolic Compounds (as C_6H_5OH), Ammonical Nitrogen (as NH_3-N), Polycyclic Aromatic Hydrocarbon, Total Coliforms and Faecal Coliforms were observed below the detection limits.

e) At the location **Inner Approach Channel** (low tide & high tide),

- Temperature was observed in the range from 28.6 to 29.3°C
- No visible colour was observed
- pH was observed in the range from 7.67 to 7.79
- Turbidity was observed from 0.5 to 2.0 N.T.U.
- Electrical Conductivity (at 25°C) was observed in the range from 61160 to 62300 µmho/cm
- Total Suspended Solids were observed in the range from BDL to 3.65 mg/L
- Total Dissolved Solids were observed in the range from 39753 to 40490 mg/L
- Dissolved Oxygen was observed in the range from 4.8 to 6.8 mg/L
- Biochemical Oxygen Demand (3 days, 27°C) was observed in the from BDL to 6.0 mg/L
- Nitrite (as NO_2) was observed in the range from 0.04 to 0.28 mg/L
- Nitrate (as NO_3) was observed in the range from 3.38 to 5.85 mg/L
- Total Nitrogen (as N) was observed in the range from 2.51 to 6.55 mg/L
- Total Phosphorous (as P) was observed in the range from 0.12 to 0.48 mg/L
- Reactive Phosphorous (as P) was observed in the range from 0.06 to 0.23 mg/L
- Salinity was observed in the range from 33.097 to 34.191 ppt

- Total Chlorophyll was observed in the range from 0.07 to 0.08 mg/m^3
- Floating materials, Phenolic Compounds (as C_6H_5OH), Ammonical Nitrogen (as NH_3-N), Polycyclic Aromatic Hydrocarbon, Total Coliforms and Faecal Coliforms were observed below the detection limits.

f) At the location **Kovalam Beach** (low tide & high tide),

- Temperature was observed in the range from 28.5 to 29.4°C
- No visible colour was observed
- pH was observed in the range from 7.66 to 7.78
- Turbidity was observed from 0.4 to 1.7 N.T.U.
- Electrical Conductivity (at 25°C) was observed in the range from 61210 to 62530 µmho/cm
- Total Suspended Solids were observed in the range from BDL to 5.14 mg/L
- Total Dissolved Solids were observed in the range from 39780 to 40640 mg/L
- Dissolved Oxygen was observed in the range from 5.2 to 6.7 mg/L
- Biochemical Oxygen Demand (3 days, 27°C) was observed in the from BDL to 4.2 mg/L
- Nitrite (as NO_2) was observed in the range from 0.04 to 0.17 mg/L
- Nitrate (as NO_3) was observed in the range from 3.42 to 4.15 mg/L
- Total Nitrogen (as N) was observed in the range from 1.19 to 8.43 mg/L
- Total Phosphorous (as P) was observed in the range from 0.18 to 0.51 mg/L
- Reactive Phosphorous (as P) was observed in the range from 0.06 to 0.23 mg/L
- Salinity was observed in the range from 33.309 to 34.338 ppt
- Total Chlorophyll was observed in the range from 0.06 to 0.09 mg/m^3
- Floating materials, Phenolic Compounds (as C_6H_5OH), Ammonical Nitrogen (as NH_3-N), Polycyclic Aromatic Hydrocarbon, Total Coliforms and Faecal Coliforms were observed below the detection limits.

HYR-5.7. Sediment Analysis Results

Table 5.5: Sediment Analysis Results

Sl. No.	Parameter	Unit	Month	Near Kovalam Beach (MS1)	Proposed Dredging Site (MS2)	Port Basin (MS3)	South of Break Water (MS4)	Inner Approach Channel (MS5)	Kovalam Beach (MS6)
1	Texture	-	Aug-21	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy
			Sep-21	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy
2	Organic Matter	%	Aug-21	0.45	0.46	0.5	0.48	0.51	0.5
			Sep-21	0.22	0.3	3.6	0.32	0.27	0.41
3	Total Phosphorus (as P)	mg/kg	Aug-21	38.6	27.3	46.9	28.1	32.5	37.2
			Sep-21	12.7	53.3	66.7	13.4	12	31.3
4	Aluminium (as Al)	mg/kg	Aug-21	528	710	620	530	820	545
			Sep-21	514	535	1159	226	468	1243
5	Chromium (as Cr)	mg/kg	Aug-21	BDL	BDL	BDL	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL	BDL	BDL	BDL
6	Copper (as Cu)	mg/kg	Aug-21	BDL	BDL	BDL	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL	BDL	BDL	BDL
7	Iron (as Fe)	mg/kg	Aug-21	4379	4900	4400	4600	4200	4172
			Sep-21	2217	3443	4276	4848	5334	7877
8	Lead (as Pb)	mg/kg	Aug-21	BDL	BDL	BDL	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL	BDL	BDL	BDL

Sl. No.	Parameter	Unit	Month	Near Kovalam Beach (MS1)	Proposed Dredging Site (MS2)	Port Basin (MS3)	South of Break Water (MS4)	Inner Approach Channel (MS5)	Kovalam Beach (MS6)
9	Manganese (as Mn)	mg/kg	Aug-21	12.8	14.1	12.6	11.7	11.7	10.7
			Sep-21	10.4	12.9	10.6	11.3	10.2	9.6
10	Mercury (as Hg)	mg/kg	Aug-21	BDL	BDL	BDL	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL	BDL	BDL	BDL
11	Zinc (as Zn)	mg/kg	Aug-21	9.25	8.36	5.42	6.00	5.37	9.76
			Sep-21	10.20	9.60	7.40	6.90	7.10	11.20
12	Nickel (as Ni)	mg/kg	Aug-21	BDL	BDL	BDL	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL	BDL	BDL	BDL
Benthic Organism									
13	Micro Benthic Organism	No./m2	Aug-21	71200	60900	34300	72400	46700	79600
			Sep-21	76800	65400	48600	63400	54100	73400
14	Macro Benthic Organism	No./m2	Aug-21	56300	54800	27900	59100	34800	61900
			Sep-21	61600	52300	31400	63400	46300	58300
15	**Total**	**No./m2**	Aug-21	**127500**	**115700**	**62200**	**131500**	**81500**	**141500**
			Sep-21	**138400**	**117700**	**80000**	**126800**	**100400**	**131700**

HYR-5.8. Graphical representation of Results for Sediment analysis

Figure 5.13: Sediment Analysis for Organic Matter

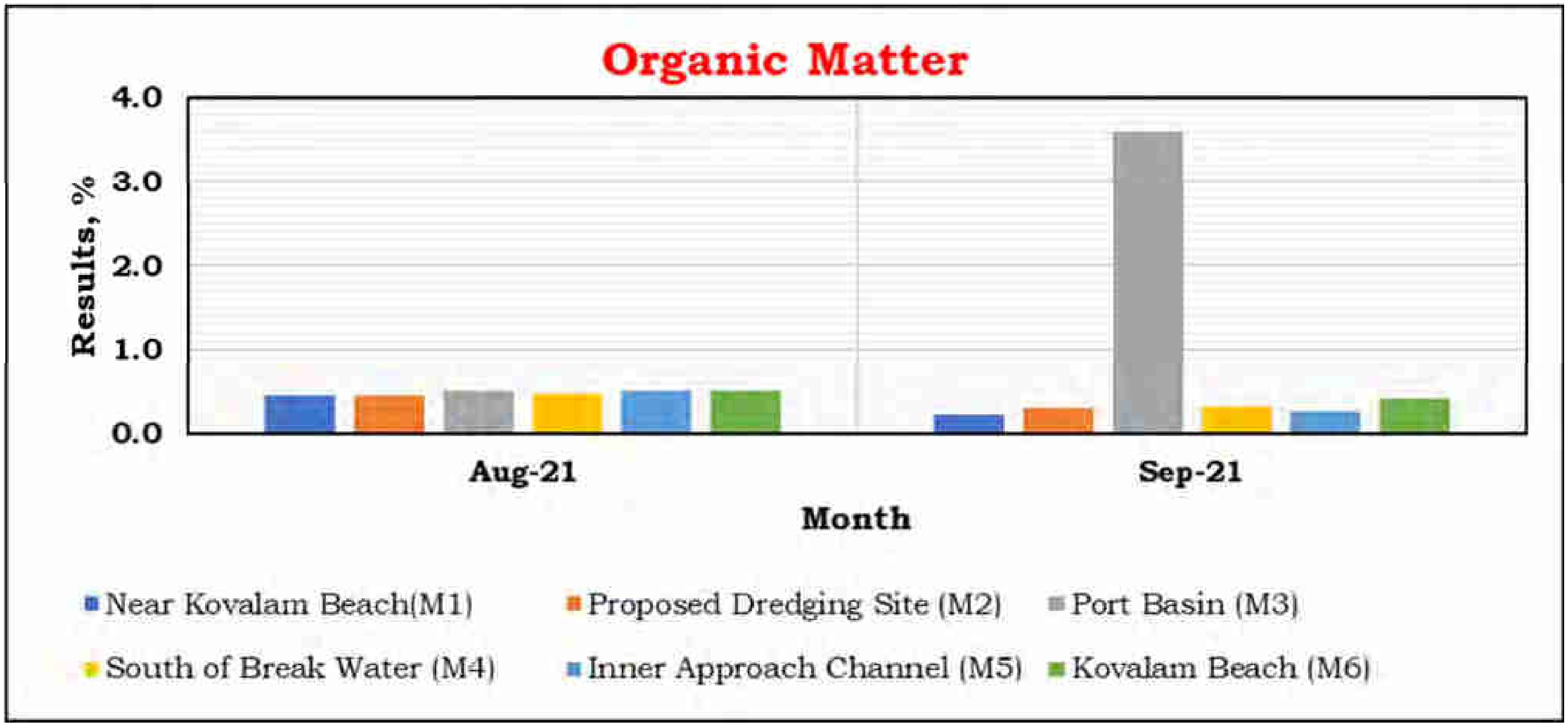


Figure 5.14: Sediment Analysis for Total Phosphorous as P

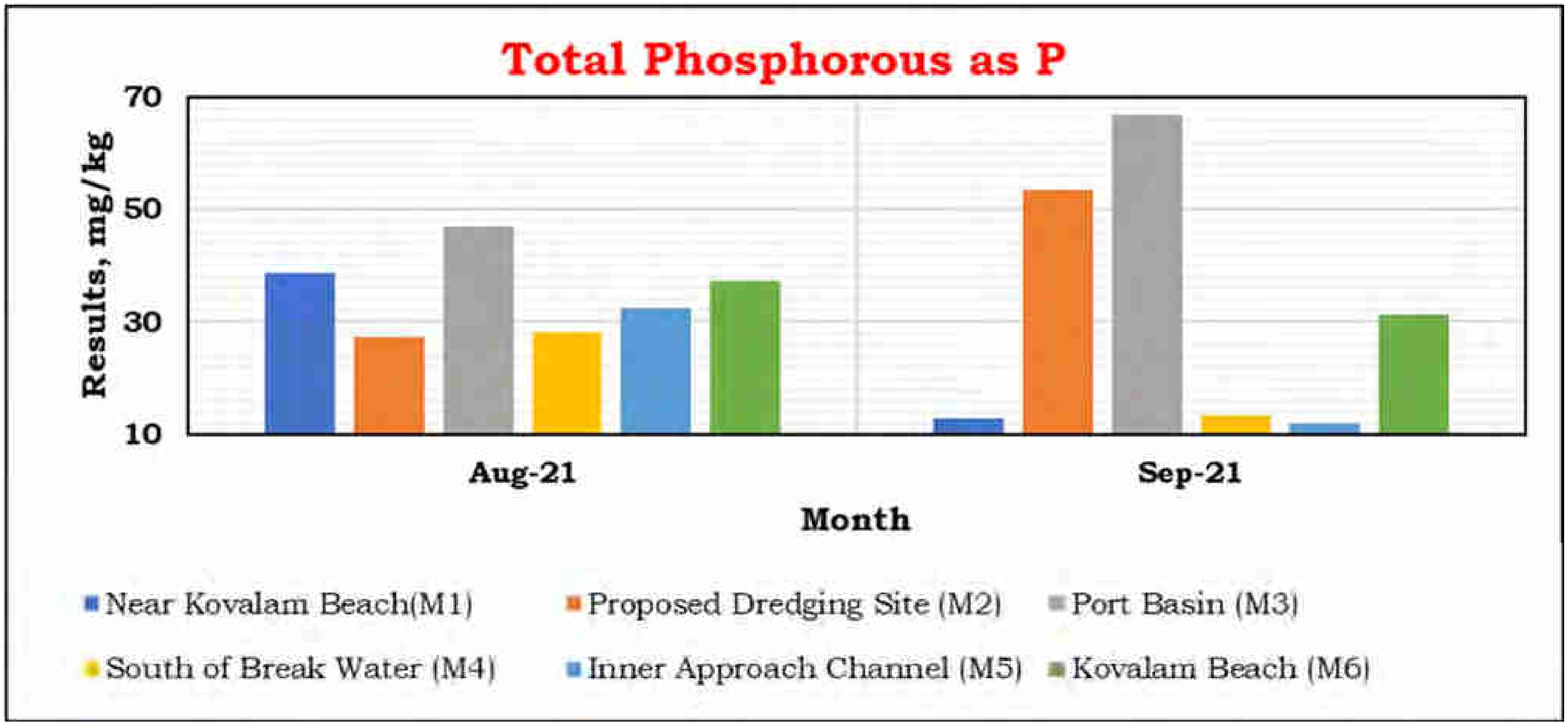


Figure 5.15: Sediment Analysis for Aluminium as Al

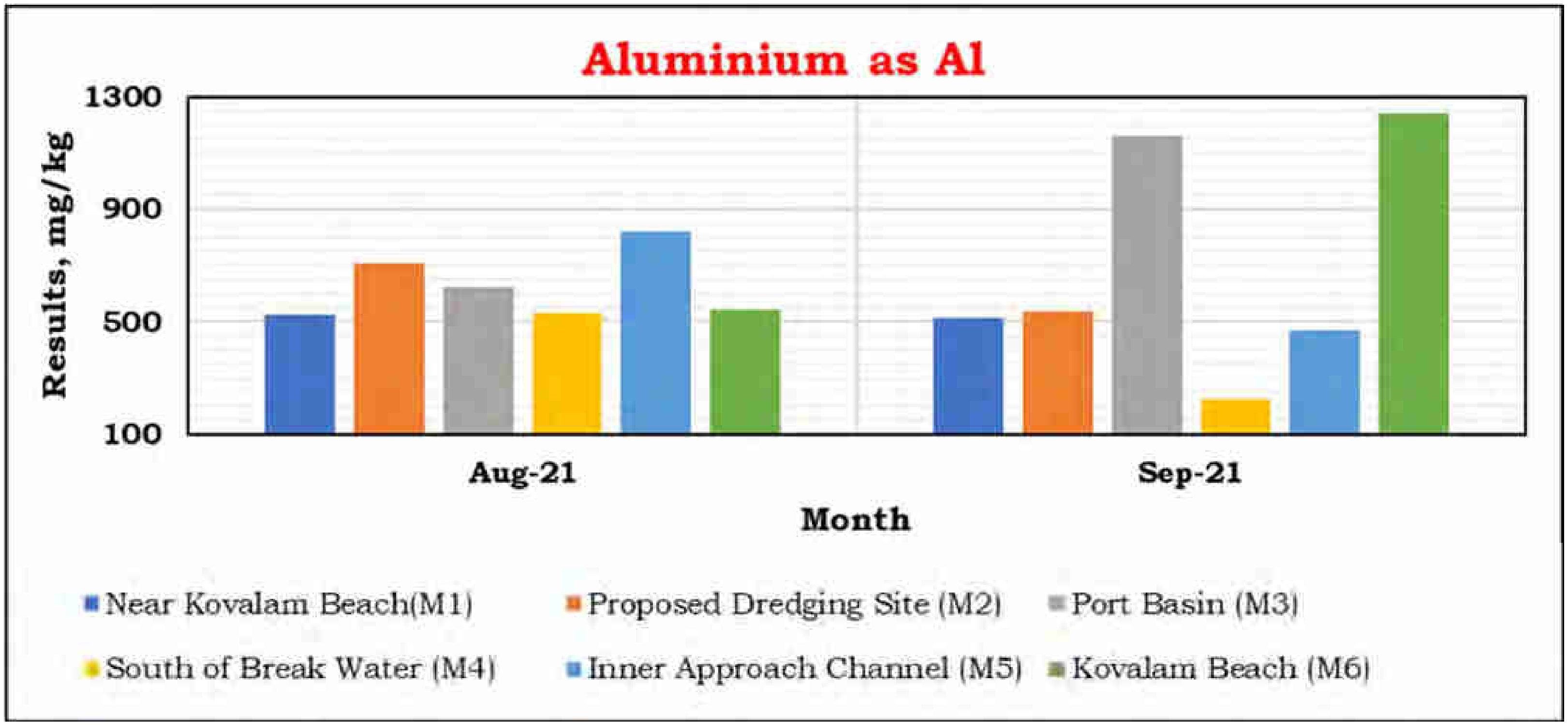


Figure 5.16: Sediment Analysis for Iron as Fe

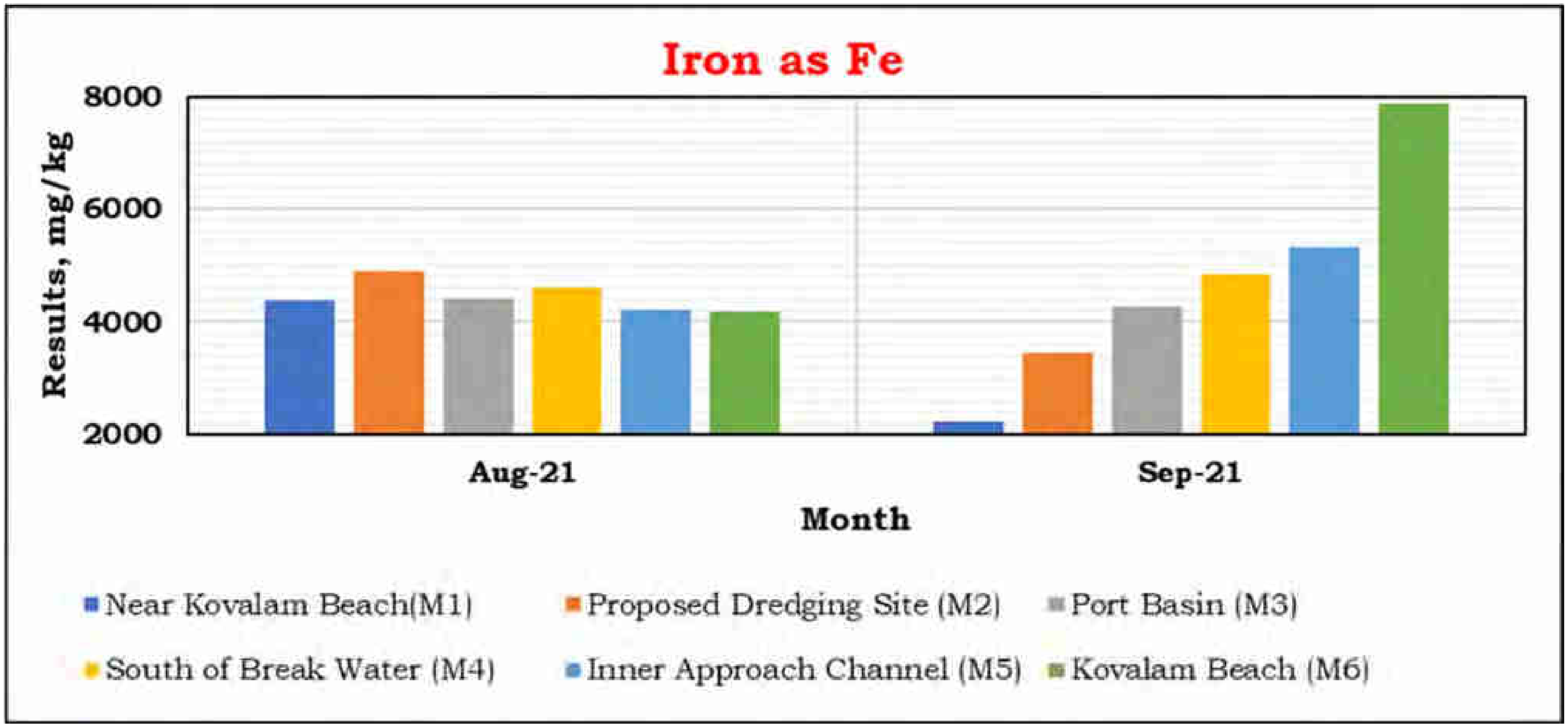


Figure 5.17: Sediment Analysis for Manganese as Mn

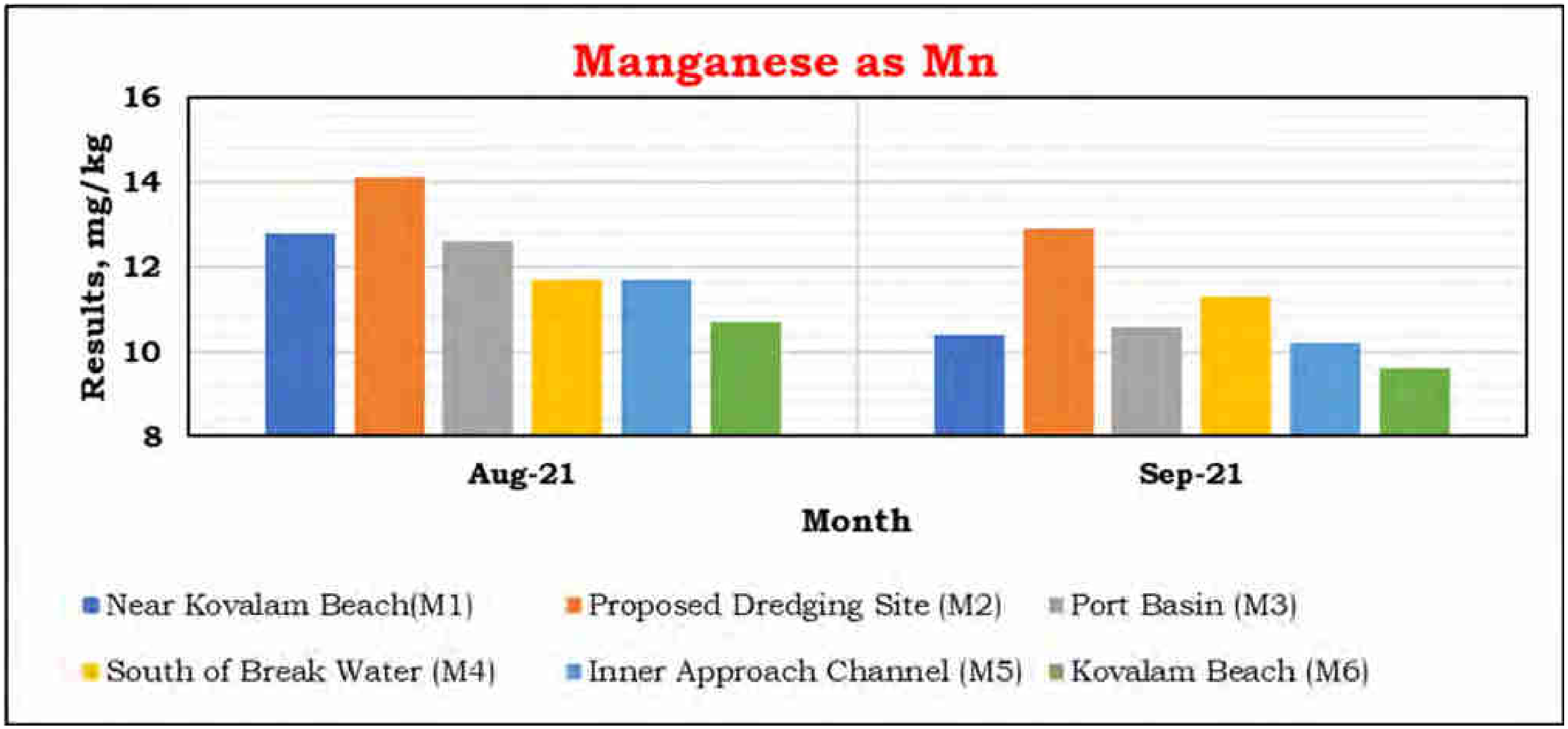


Figure 5.18: Sediment Analysis for Zinc as Zn

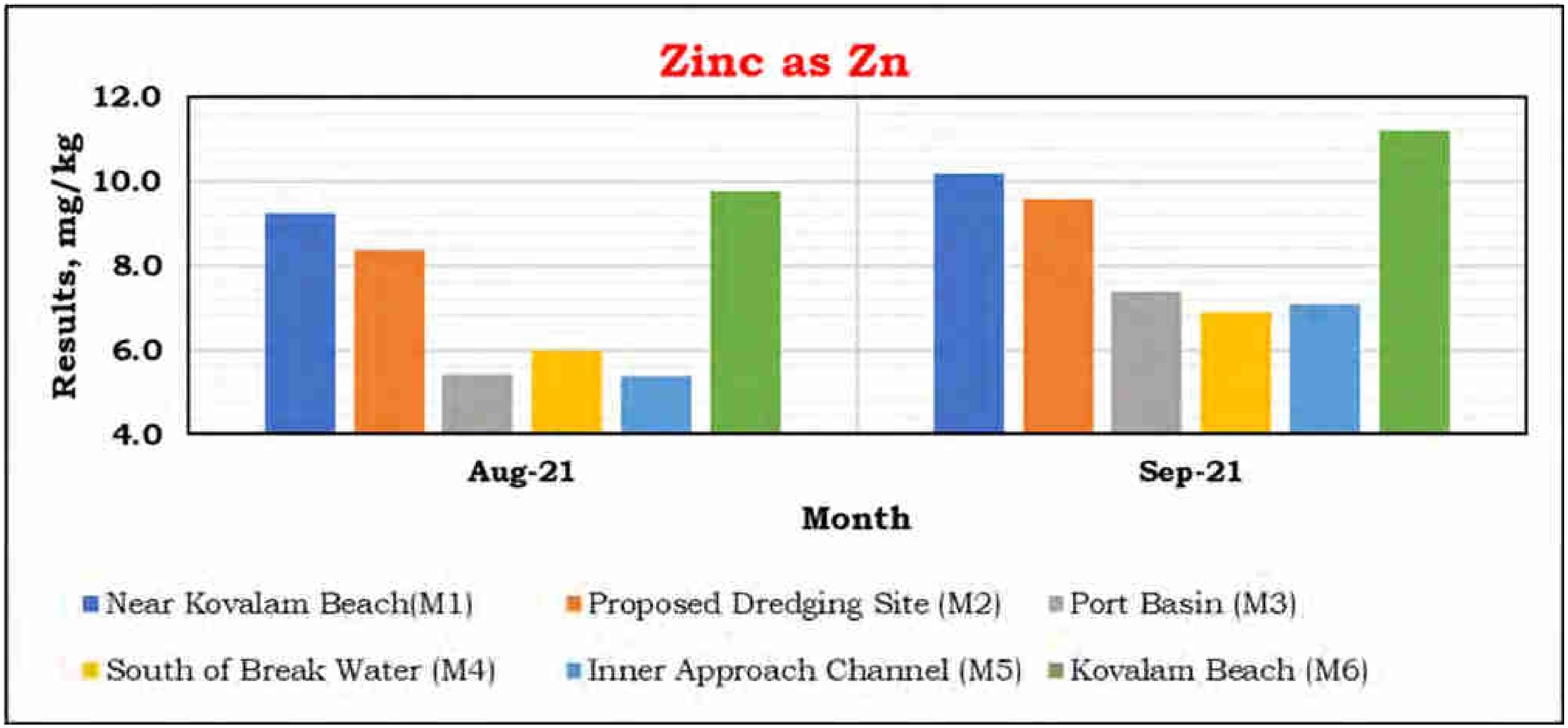
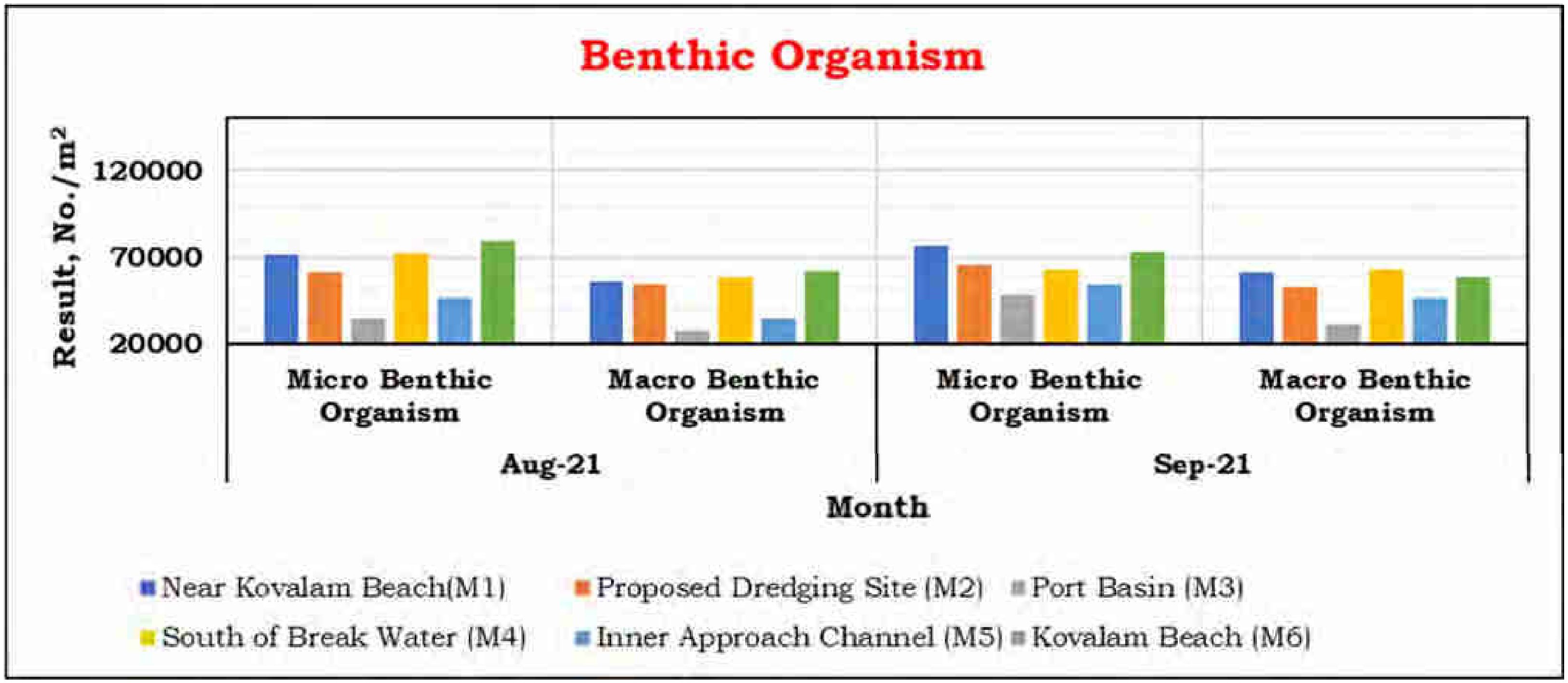


Figure 5.19: Sediment Analysis for Benthic Organism



HYR-5.9. Summary - Sediment Analysis:

During the months of August 2021 and September 2021, following is the summary of sediment analysis:

a) At the location **Near Kovalam Beach**,
- The observed texture was sandy
- Organic matter was observed in the range from 0.22 to 0.45%
- Total Phosphorus (as P) was observed in the range from 12.7 to 38.6 mg/kg
- Aluminium (as Al) was observed in the range from 514 to 528 mg/kg
- Iron (as Fe) was observed in the range from 2217 to 4379 mg/kg
- Manganese (as Mn) was observed in the range from 10.4 to 12.8 mg/kg
- Zinc (as Zn) was observed in the range from 9.25 to 10.2 mg/kg
- Nickel (as Ni) was observed in the range between 4.5-6.09 mg/kg
- Chromium (as Cr), Copper (as Cu), Lead (as Pb), Mercury (as Hg) and Nickel (as Ni) were observed below the detection limits
- Micro benthic organisms were observed in the range from 71200 to 76800/m^2
- Macro benthic organisms were observed in the range from 56300 to 61600/m^2

b) At the location **Proposed Dredging Site**,
- The observed texture was sandy
- Organic matter was observed in the range from 0.30 to 0.46%
- Total Phosphorus (as P) was observed in the range from 27.3 to 53.3 mg/kg
- Aluminium (as Al) was observed in the range from 535 to 710 mg/kg
- Iron (as Fe) was observed in the range from 3443 to 4900 mg/kg
- Manganese (as Mn) was observed in the range from 12.9 to 14.1 mg/kg
- Zinc (as Zn) was observed in the range from 8.36 to 9.60 mg/kg
- Chromium (as Cr), Copper (as Cu), Lead (as Pb), Mercury (as Hg) and Nickel (as Ni) were observed below the detection limits
- Micro benthic organisms were observed in the range from 60900 to 65400/m^2

- Macro benthic organisms were observed in the range from 52300 to 54800/m^2

c) At the location **Port Basin**,

- The observed texture was sandy
- Organic matter was observed in the range from 0.50 to 0.60%
- Total Phosphorus (as P) was observed in the range from 46.9 to 66.7 mg/kg
- Aluminium (as Al) was observed in the range from 620 to 1159 mg/kg
- Iron (as Fe) was observed in the range from 4276 to 4400 mg/kg
- Manganese (as Mn) was observed in the range from 10.6 to 12.6 mg/kg
- Zinc (as Zn) was observed in the range from 5.42 to 7.40 mg/kg
- Chromium (as Cr), Copper (as Cu), Lead (as Pb), Mercury (as Hg) and Nickel (as Ni) were observed below the detection limits
- Micro benthic organisms were observed in the range from 34300 to 48600/m^2
- Macro benthic organisms were observed in the range from 27900 to 31400/m^2

d) At the location **South of Break Water**,

- The observed texture was sandy
- Organic matter was observed in the range from 0.32 to 0.48%
- Total Phosphorus (as P) was observed in the range from 13.4 to 28.1 mg/kg
- Aluminium (as Al) was observed in the range from 226 to 530 mg/kg
- Iron (as Fe) was observed in the range from 4600 to 4848 mg/kg
- Manganese (as Mn) was observed in the range from 11.3 to 11.7 mg/kg
- Zinc (as Zn) was observed in the range from 6.00 to 6.90 mg/kg
- Chromium (as Cr), Copper (as Cu), Lead (as Pb), Mercury (as Hg) and Nickel (as Ni) were observed below the detection limits
- Micro benthic organisms were observed in the range from 63400 to 72400/m^2
- Macro benthic organisms were observed in the range from 59100 to 63400/m^2

e) At the location **Inner Approach Channel**,

- The observed texture was sandy
- Organic matter was observed in the range from 0.27 to 0.51%
- Total Phosphorus (as P) was observed in the range from 12.0 to 32.5 mg/kg
- Aluminium (as Al) was observed in the range from 468 to 820 mg/kg
- Iron (as Fe) was observed in the range from 4200 to 5334 mg/kg
- Manganese (as Mn) was observed in the range from 10.7 to 11.7 mg/kg
- Zinc (as Zn) was observed in the range from 5.37 to 7.10 mg/kg
- Chromium (as Cr), Copper (as Cu), Lead (as Pb), Mercury (as Hg) and Nickel (as Ni) were observed below the detection limits
- Micro benthic organisms were observed in the range from 46700 to 54100/m^2
- Macro benthic organisms were observed in the range from 34800 to 46300/m^2

f) At the location **Kovalam Beach**,

- The observed texture was sandy
- Organic matter was observed in the range from 0.41 to 0.50%
- Total Phosphorus (as P) was observed in the range from 31.3 to 37.2 mg/kg
- Aluminium (as Al) was observed in the range from 545 to 1243 mg/kg
- Iron (as Fe) was observed in the range from 4172 to 7877 mg/kg
- Manganese (as Mn) was observed in the range from 9.60 to 10.7 mg/kg
- Zinc (as Zn) was observed in the range from 9.76 to 11.2 mg/kg
- Chromium (as Cr), Copper (as Cu), Lead (as Pb), Mercury (as Hg) and Nickel (as Ni) were observed below the detection limits
- Micro benthic organisms were observed in the range from 73400 to 79600/m^2
- Macro benthic organisms were observed in the range from 58300 to 61900/m^2

HYR-5.10. **Marine Water Analysis for Phytoplankton and Zooplankton**

Table 5.6: Total Phytoplankton and Zooplankton Results

Parameter	Month	Near Kovalam Beach (M1)	Proposed Dredging Site (M2)	Port Basin (M3)	South of Break water (M4)	Inner Approach Channel (M5)	Kovalam Beach (M6)
Total Phytoplankton No/100 mL	Aug-21	51963	67776	60100	49931	53510	45521
	Sep-21	57020	75557	55325	53942	56694	48403
Total Zooplankton No/100 mL	Aug-21	9568	14268	9400	14817	13749	11675
	Sep-21	8561	15206	10093	15499	14553	13089

HYR-5.11. Graphical representation of Results for Marine Phytoplankton and Zooplankton

Figure 5.20: Marine Water Analysis for Total Phytoplankton

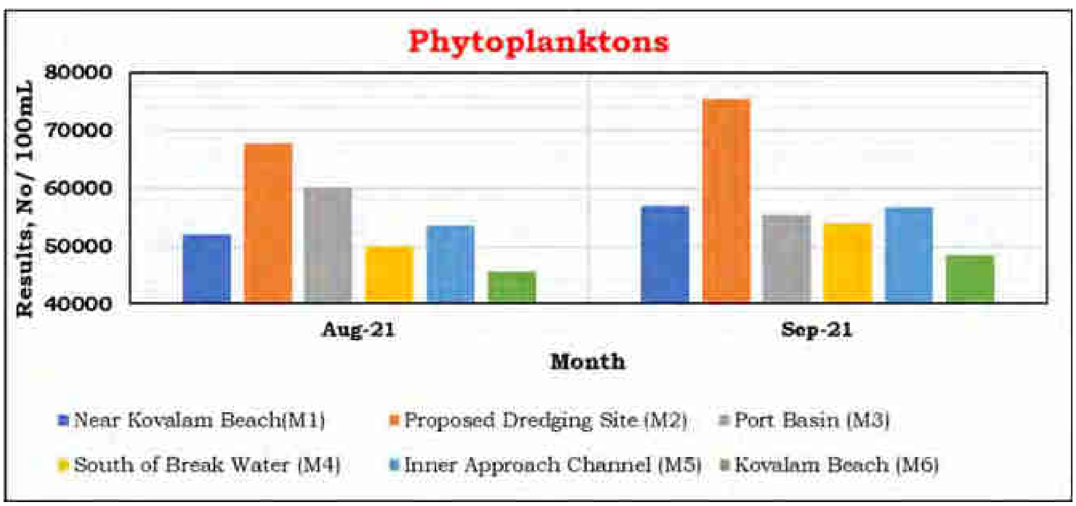
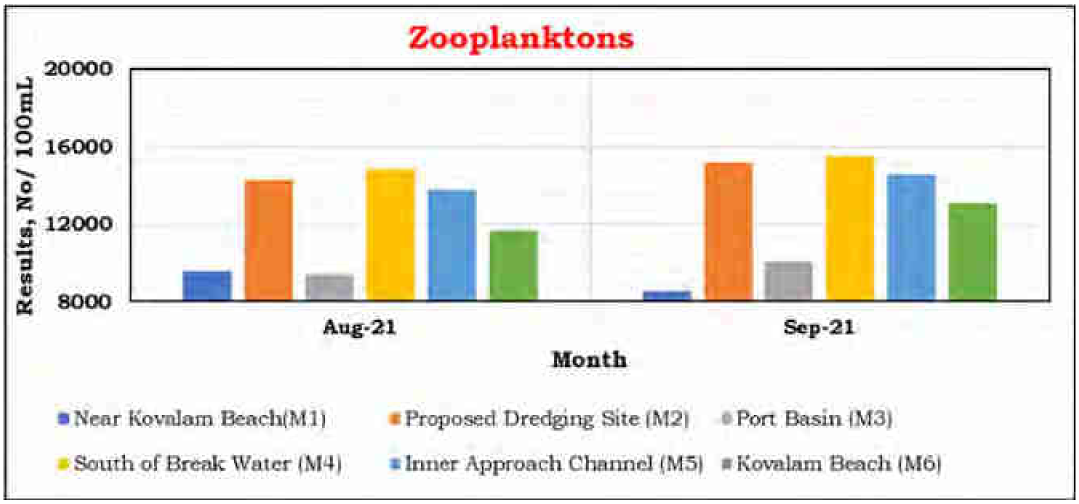


Figure 5.21: Marine Water Analysis for Total Zooplankton



HYR-5.12. Summary-Marine Water Analysis for Phytoplankton and Zooplankton

During the months August 2021 and September 2021, following is the summary of Marine Water Analysis for Phytoplankton and Zooplankton:

Parameter	Range	Near Kovalam Beach (M1)	Proposed Dredging Site (M2)	Port Basin (M3)	South of Break water (M4)	Inner Approach Channel (M5)	Kovalam Beach (M6)
Total Phytoplankton No/100 mL	From	51963	67776	55325	49931	53510	45521
	To	57020	75557	60100	53942	56694	48403
Total Zooplankton No/100 mL	From	8561	14268	9400	14187	13749	11675
	To	9568	15206	10093	15499	14553	13089

HYR-6	Ground Water Analysis

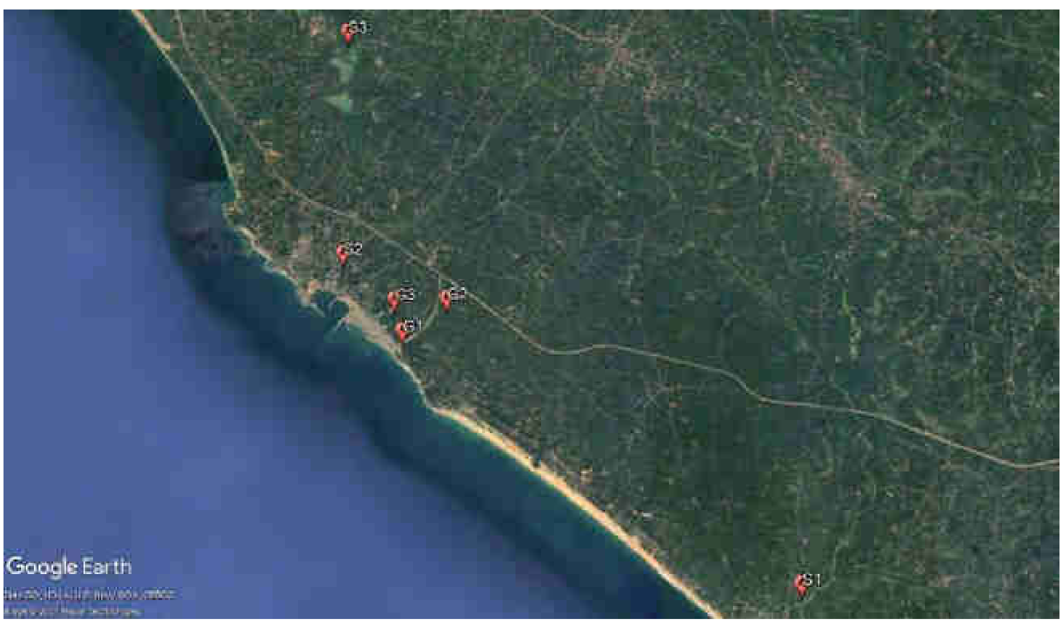
HYR-6.1. Ground Water Location Details:

This section describes the sampling location, methodology adopted for analysis and analysis results of Ground water during the period August 2021and September 2021. Ground water sampling was carried out at three locations including Port Site, PAF Area and Proposed Port Estate Area

Table 6.1: Coordinates of Ground Water Location

Location	Month	Legend	Latitude	Longitude
Project Site	--	G1	8°22'03.72"N	77°00'16.92"E
Proposed Port Estate Area	Aug-21	G2	8°22'42.27"N	77°01'02.63"E
	Sep-21	G2	8°22'24.96"N	77°00'45.84"E
PAF Area	--	G3	8°22'24.60"N	77°00'11.16"E

Figure 6.1: Google earth views of Ground Water & Surface Water Sampling Locations



HYR-6.2. Methodology of Sampling and Analysis:

Table 6.2: Ground Water & Surface Water Methodology

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
Surface and Ground Water Analysis				
1.	Colour	Hazen Units	1	IS 3025 Part 4: 1983 RA 2017
2.	Odour	-	--	IS 3025 Part 5: 1983 RA 2018
3.	pH Value	-	1	IS 3025 Part 11: 1983 RA 2017
4.	Turbidity	N.T.U.	0.1	IS 3025 Part 10: 1984 RA 2017
5.	Electrical Conductivity (at 25°C)	µmho/cm	0.001	IS 3025 Part 14:1984 RA 2019
6.	Total Dissolved Solids	mg/L	1	IS 3025 Part 16: 1984 RA 2017
7.	Dissolved Oxygen	mg/L	0.2	IS 3025 Part 38:1989 RA 2019
8.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	2	IS 3025 Part 44:1993 RA 2019
9.	Oil & Grease	mg/L	1	IS 3025 Part 39: 1991 RA 2019
10.	Aluminium (as Al)	mg/L	0.03	IS 3025 Part 55:2003 RA 2019
11.	Ammonia (as NH_3- N)	mg/L	1	IS 3025 Part 34:1988 RA 2019
12.	Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	0.01	IS 13428 Annex K:2005
13.	Barium (as Ba)	mg/L	0.17	APHA 23rd Edition 3111D:2017
14.	Boron (as B)	mg/L	0.2	IS 3025 Part 57 :2005 RA 2017
15.	Calcium (as Ca)	mg/L	1	IS 3025 Part 40: 1991 RA 2019
16.	Chloramines (as Cl_2)	mg/L	1	APHA 23rd Edition 4500 Cl,G:2017
17.	Chloride (as Cl)	mg/L	1	IS 3025 Part 32: 1988 RA 2019
18.	Copper (as Cu)	mg/L	0.016	IS 3025 Part 42: 1992 RA 2019
19.	Fluoride (as F)	mg/L	0.1	APHA 23rd Edition 4500 -F- B, D: 2017
20.	Iron (as Fe)	mg/L	0.1	IS 3025 Part 53: 2003 RA 2019
21.	Magnesium (as Mg)	mg/L	1	IS 3025 Part 46: 1994 RA 2019
22.	Manganese (as Mn)	mg/L	0.016	IS 3025 Part 59: 2006 RA 2017
23.	Mineral Oil	mg/L	0.50	IS 3025 Part 39: 1991 RA 2019
24.	Nitrate (as NO_3)	mg/L	1	APHA 23rd Edition 4500 -NO_3 B: 2017
25.	Phenolic Compounds (as C_6H_5OH)	mg/L	0.001	IS 3025 Part 43: 1992 RA 2019
26.	Selenium (as Se)	mg/L	0.001	APHA 23rd Edition 3114C:2017
27.	Silver (as Ag)	mg/L	0.03	APHA 23rd Edition 3111B:2017
28.	Sulphate (as SO_4)	mg/L	1	IS 3025 Part 24: 1986 RA 2019
29.	Sulphide (as H_2S)	mg/L	0.01	IS 3025 Part 29 : 1986 RA 2019
30.	Total Phosphate (as PO_4)	mg/L	0.1	IS 3025 Part 31:1988 RA 2019

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
31.	Total Alkalinity (as $CaCO_3$)	mg/L	1	IS 3025 Part 23: 1986 RA 2019
32.	Total Hardness (as $CaCO_3$)	mg/L	1	IS 3025 Part 21: 2009 RA 2019
33.	Calcium Hardness (as $CaCO_3$)	mg/L	1	IS 3025 Part 40: 1991 RA 2019
34.	Zinc (as Zn)	mg/L	0.008	APHA 23rd Edition 3111B:2017
35.	Sodium (as Na)	mg/L	1	IS 3025 Part 45: 1993 RA 2019
36.	Potassium (as K)	mg/L	0.5	IS 3025 Part 45: 1993 RA 2019
37.	Sodium Absorption Ratio	-	1	IS 11624 : 1986
38.	Cadmium (as Cd)	mg/L	0.003	IS 3025 Part 41: 1992 RA 2019
39.	Cyanide (as CN)	mg/L	0.01	IS 3025 Part 27: 1986 RA 2019
40.	Lead (as Pb)	mg/L	0.01	IS 3025 Part 47: 1994 RA 2019
41.	Mercury (as Hg)	mg/L	0.001	IS 3025 Part 48: 1994 RA 2019
42.	Molybdenum (as Mo)	mg/L	0.07	APHA 23rd Edition 3111D:2017
43.	Nickel (as Ni)	mg/L	0.02	IS 3025 Part 54: 2003 RA 2019
44.	***Pesticide Residues***			
i.	Alachlor	µg/L	0.005	SEAAL/INS/RWM/SOP/01
ii.	Atrazine	µg/L	0.005	SEAAL/INS/RWM/SOP/01
iii.	Aldrin/Dieldrin	µg/L	0.005	SEAAL/INS/RWM/SOP/01
iv.	Alpha HCH	µg/L	0.005	SEAAL/INS/RWM/SOP/01
v.	Beta HCH	µg/L	0.005	SEAAL/INS/RWM/SOP/01
vi.	Butachlor	µg/L	0.005	SEAAL/INS/RWM/SOP/01
vii.	Chlorpyrifos	µg/L	0.005	SEAAL/INS/RWM/SOP/01
viii.	Delta HCH	µg/L	0.005	SEAAL/INS/RWM/SOP/01
ix.	2,4D chlorophenoxyacetic acid	µg/L	0.005	SEAAL/INS/RWM/SOP/01
x.	DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	0.005	SEAAL/INS/RWM/SOP/01
xi.	Endosulfan (□,□ & Sulphate)	µg/L	0.005	SEAAL/INS/RWM/SOP/01
xii.	Ethion	µg/L	0.005	SEAAL/INS/RWM/SOP/01
xiii.	γ HCH (Lindane)	µg/L	0.005	SEAAL/INS/RWM/SOP/01
xiv.	Isoproturon	µg/L	0.005	SEAAL/INS/RWM/SOP/01
xv.	Malathion	µg/L	0.005	SEAAL/INS/RWM/SOP/01
xvi.	Methyl Parathion	µg/L	0.005	SEAAL/INS/RWM/SOP/01
xvii.	Monocrotophos	µg/L	0.005	SEAAL/INS/RWM/SOP/01
xviii.	Phorate	µg/L	0.005	SEAAL/INS/RWM/SOP/01
45.	Polychlorinated Biphenyls (PCB)	mg/L	0.000005	SEAAL/INS/RWM/SOP/03
46.	Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	0.000005	SEAAL/INS/RWM/SOP/02
47.	Total Arsenic (as As)	mg/L	0.002	IS 3025 Part 37:1988 RA 2019
48.	Total Chromium (as Cr)	mg/L	0.05	IS 3025 Part 52 :2003 RA 2019
49.				

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
a)	Bromoform	mg/L	0.005	SEAAL/INS/RWM/SOP/04
b)	Dibromochloromethane	mg/L	0.005	SEAAL/INS/RWM/SOP/04
c)	Bromodichloroethane	mg/L	0.005	SEAAL/INS/RWM/SOP/04
d)	Chloroform	mg/L	0.005	SEAAL/INS/RWM/SOP/04
50.	*E.coli*	MPN/100 ml	2	IS 1622: 1981
51.	Total Coliforms	MPN/100 ml	2	IS 1622: 1981
52.	Faecal Coliforms	MPN/100 ml	2	IS 1622: 1981

HYR-6.3. Ground Water Analysis Results for the period August 2021and September 2021:

Sl. No.	Parameters	Unit	Acceptable Limit as per IS 10500: 2012	Month	Port Site (Open well) G1	Proposed Port Estate Area		PAF Area (Open well) G3
						(Bore well) G2	(Open well) G2	
Organoleptic & Physical Parameters								
1.	Colour	Hazen Units	*Max.* 5	Aug-21	1	1	--	1
				Sep-21	1	--	1	1
2.	Odour	-	Agreeable	Aug-21	Agreeable	Agreeable	--	Agreeable
				Sep-21	Agreeable	--	Agreeable	Agreeable
3.	pH Value	-	6.5 to 8.5	Aug-21	6.68	6.73	--	6.84
				Sep-21	7.04	--	6.87	6.53
4.	Turbidity	N.T.U.	Max. 1	Aug-21	0.6	BDL	--	0.4
				Sep-21	0.7	--	0.8	0.6
5.	Total Dissolved Solids	mg/L	Max. 500	Aug-21	1424	65	--	419
				Sep-21	448	--	109	437
General Parameters concerning substances undesirable in excessive amounts								
6.	Aluminium (as Al)	mg/L	Max. 0.03	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	0.13
7.	Ammonia (as NH_3-N)	mg/L	Max.0.5	Aug-21	0.11	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL

Sl. No.	Parameters	Unit	Acceptable Limit as per IS 10500: 2012	Month	Port Site (Open well) G1	Proposed Port Estate Area (Bore well) G2	Proposed Port Estate Area (Open well) G2	PAF Area (Open well) G3
8.	Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	Max. 0.2	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
9.	Barium (as Ba)	mg/L	Max. 0.7	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
10.	Boron (as B)	mg/L	Max. 0.5	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
11.	Calcium (as Ca)	mg/L	Max. 75	Aug-21	72.7	3.23	--	12.9
				Sep-21	25.9	--	6.46	12.9
12.	Chloramines (as Cl_2)	mg/L	Max. 4.0	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
13.	Chloride (as Cl)	mg/L	Max.250	Aug-21	509	22.9	--	168
				Sep-21	93.9	--	23.9	162
14.	Copper (as Cu)	mg/L	Max.0.05	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
15.	Fluoride (as F)	mg/L	Max. 1	Aug-21	0.24	BDL	--	0.19
				Sep-21	0.17	--	BDL	BDL
16.	Iron (as Fe)	mg/L	Max.0.3	Aug-21	0.11	BDL	--	BDL
				Sep-21	0.25	--	0.68	0.21
17.	Magnesium (as Mg)	mg/L	Max. 30	Aug-21	24.6	1.42	--	11.8
				Sep-21	5.9	--	BDL	11.8
18.	Manganese (as Mn)	mg/L	Max.0.1	Aug-21	0.11	0.076	--	BDL
				Sep-21	0.13	--	0.09	BDL
19.	Mineral Oil	mg/L	Max.0.5	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
20.	Nitrate (as NO_3)	mg/L	Max.45	Aug-21	76.9	1.81	--	2.5
				Sep-21	7.42	--	6.33	20.6

Sl. No.	Parameters	Unit	Acceptable Limit as per IS 10500: 2012	Month	Port Site (Open well) G1	Proposed Port Estate Area		PAF Area (Open well) G3
						(Bore well) G2	(Open well) G2	
21.	Phenolic Compounds (as C6H5OH)	mg/L	Max. 0.001	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
22.	Selenium (as Se)	mg/L	Max. 0.01	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
23.	Silver (as Ag)	mg/L	Max. 0.1	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
24.	Sulphate (as SO_4)	mg/L	Max. 200	Aug-21	136	6.72	--	14.9
				Sep-21	20.9	--	15.5	21.1
25.	Sulphide (as H_2S)	mg/L	Max. 0.05	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
26.	Total Alkalinity (as $CaCO_3$)	mg/L	Max.200	Aug-21	26.7	8.64	--	17.6
				Sep-21	95.5	--	11.9	3.98
27.	Total Hardness (as $CaCO_3$)	mg/L	Max. 200	Aug-21	95.9	12.1	--	80.8
				Sep-21	88.9	--	18.2	80.8
28.	Zinc (as Zn)	mg/L	Max. 5	Aug-21	0.099	0.104	--	0.123
				Sep-21	0.086	--	0.093	0.119
Parameters Concerning Toxic Substances								
29.	Cadmium (as Cd)	mg/L	Max. 0.003	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
30.	Cyanide (as CN)	mg/L	Max.0.05	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
31.	Lead (as Pb)	mg/L	Max. 0.01	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
32.	Mercury (as Hg)	mg/L	Max. 0.001	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
33.	Molybdenum (as Mo)	mg/L	Max. 0.07	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL

Sl. No.	Parameters	Unit	Acceptable Limit as per IS 10500: 2012	Month	Port Site (Open well) G1	Proposed Port Estate Area (Bore well) G2	Proposed Port Estate Area (Open well) G2	PAF Area (Open well) G3
34.	Nickel (as Ni)	mg/L	Max.0.02	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
35. Pesticide Residues								
i.	Alachlor	µg/L	20	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
ii.	Atrazine	µg/L	2	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
iii.	Aldrin/Dieldrin	µg/L	0.03	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL		BDL	BDL
iv.	Alpha HCH	µg/L	0.01	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
v.	Beta HCH	µg/L	0.04	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
vi.	Butachlor	µg/L	125	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
vii.	Chlorpyrifos	µg/L	30	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
viii.	Delta HCH	µg/L	0.04	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
ix.	2,4D chlorophenoxyacetic acid	µg/L	30	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
x.	DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	1	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
xi.	Endosulfan (α,β & Sulphate)	µg/L	0.4	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
xii.	Ethion	µg/L	3	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL

Sl. No.	Parameters	Unit	Acceptable Limit as per IS 10500: 2012	Month	Port Site (Open well) G1	Proposed Port Estate Area (Bore well) G2	Proposed Port Estate Area (Open well) G2	PAF Area (Open well) G3
xiii.	γ HCH (Lindane)	µg/L	2	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
xiv.	Isoproturon	µg/L	9	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
xv.	Malathion	µg/L	190	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
xvi.	Methyl Parathion	µg/L	0.3	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
xvii.	Monocrotoph os	µg/L	1	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
xviii.	Phorate	µg/L	2	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
36.	Polychlorinat ed Biphenyls (PCB)	mg/L	Max.0.0005	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
37.	Polynuclear Aromatic Hydrocarbon s (PAH)	mg/L	Max.0.0001	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
38.	Total Arsenic (as As)	mg/L	Max. 0.01	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
39.	Total Chromium (as Cr)	mg/L	Max. 0.05	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
40.Trihalomethanes								
a)	Bromoform	mg/L	Max. 0.1	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
b)	Dibromochlor omethane	mg/L	Max. 0.1	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
c)	Bromodichlor oethane	mg/L	Max. 0.06	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL

Sl. No.	Parameters	Unit	Acceptable Limit as per IS 10500: 2012	Month	Port Site (Open well) G1	Proposed Port Estate Area (Bore well) G2	Proposed Port Estate Area (Open well) G2	PAF Area (Open well) G3
d)	Chloroform	mg/L	Max. 0.2	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
Bacteriological Analysis								
41.	E.coli	MPN Index/100 ml	Not Detectable	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL
42.	Total Coliforms	MPN Index/100 ml	Not Detectable	Aug-21	BDL	BDL	--	BDL
				Sep-21	BDL	--	BDL	BDL

HYR-6.4. Graphical representation of Results for Ground Water Analysis:

Figure 6.2: Ground Water Analysis for pH

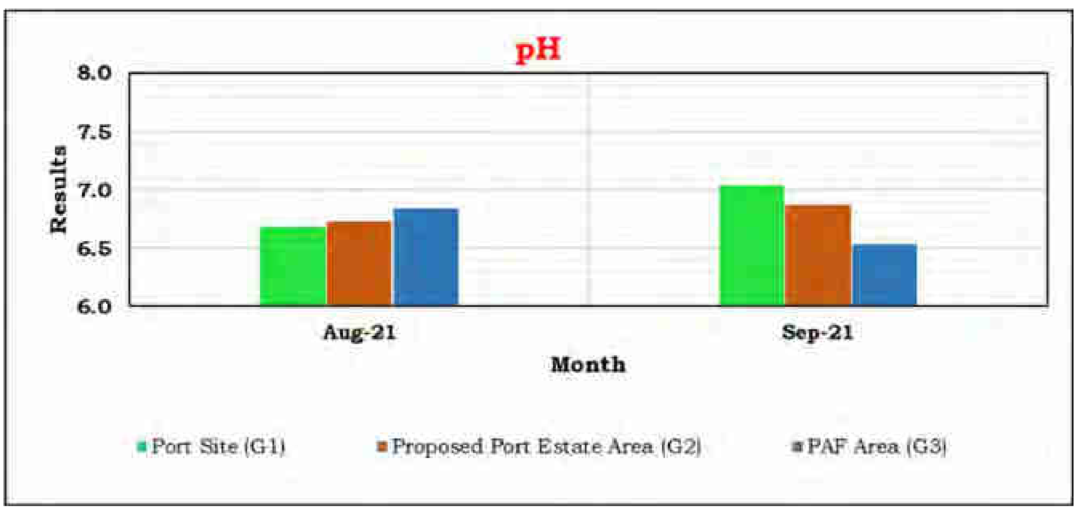


Figure 6.3: Ground Water Analysis for Turbidity

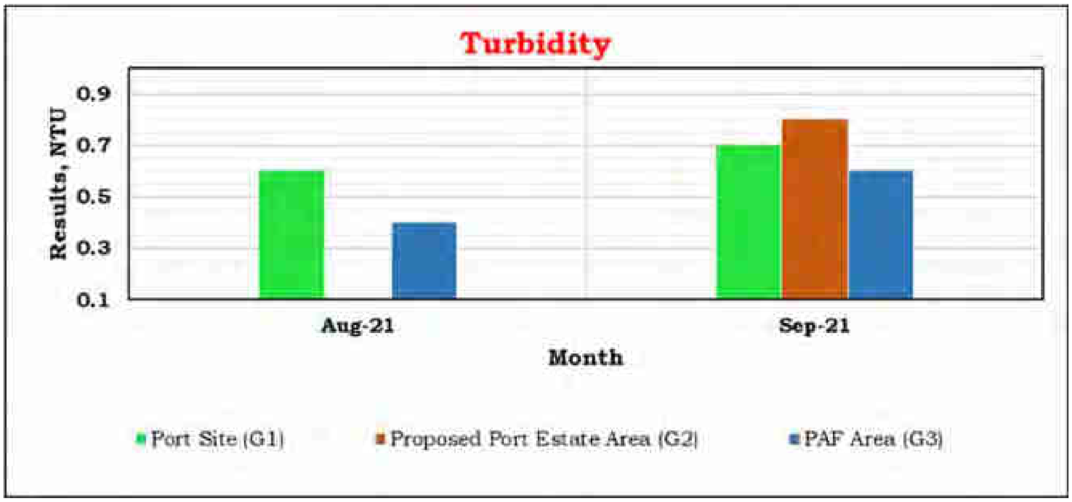


Figure 6.4: Ground Water Analysis for Total Dissolved Solids

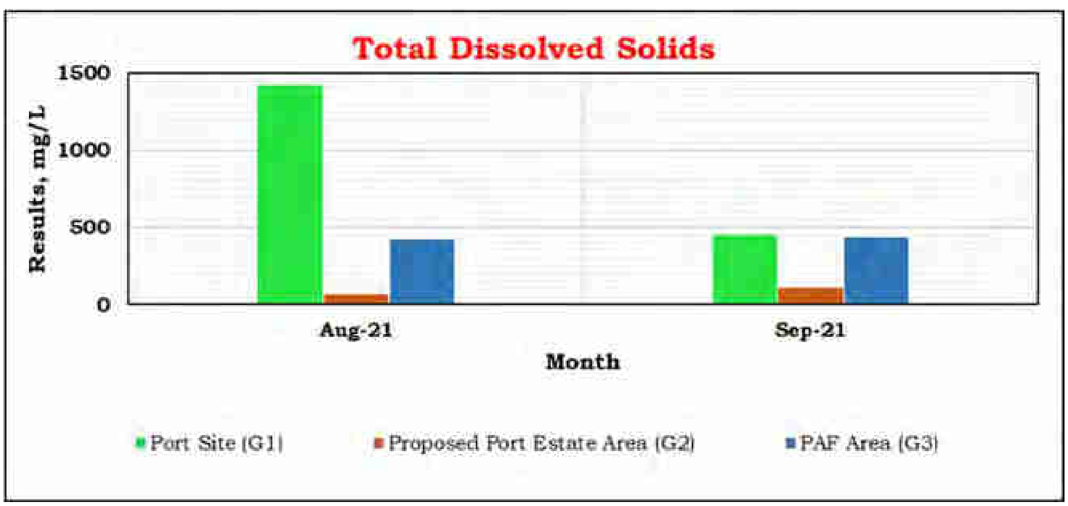


Figure 6.5: Ground Water Analysis for Chloride

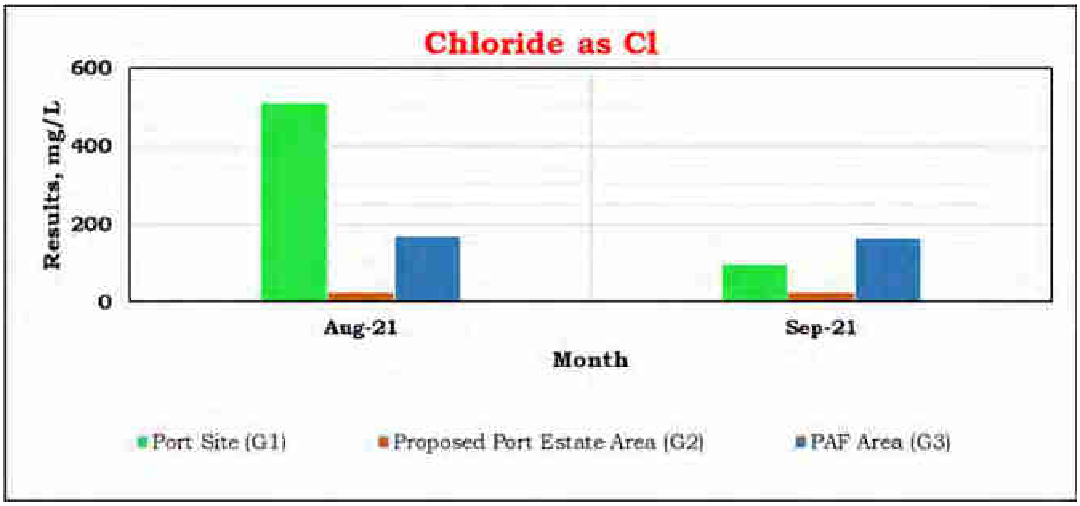


Figure 6.6: Ground Water Analysis for Sulphate as SO_4

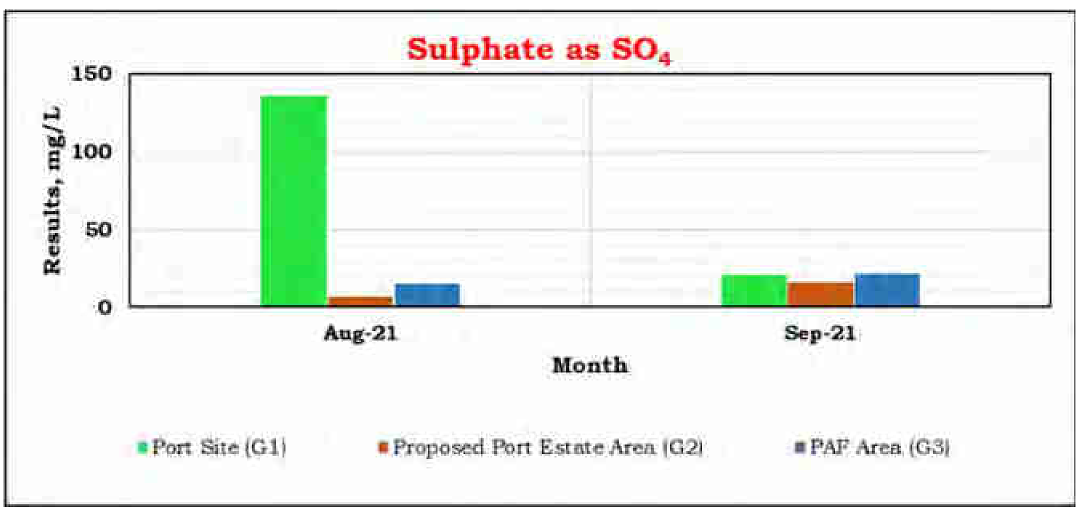


Figure 6.7: Ground Water Analysis for Fluoride as F

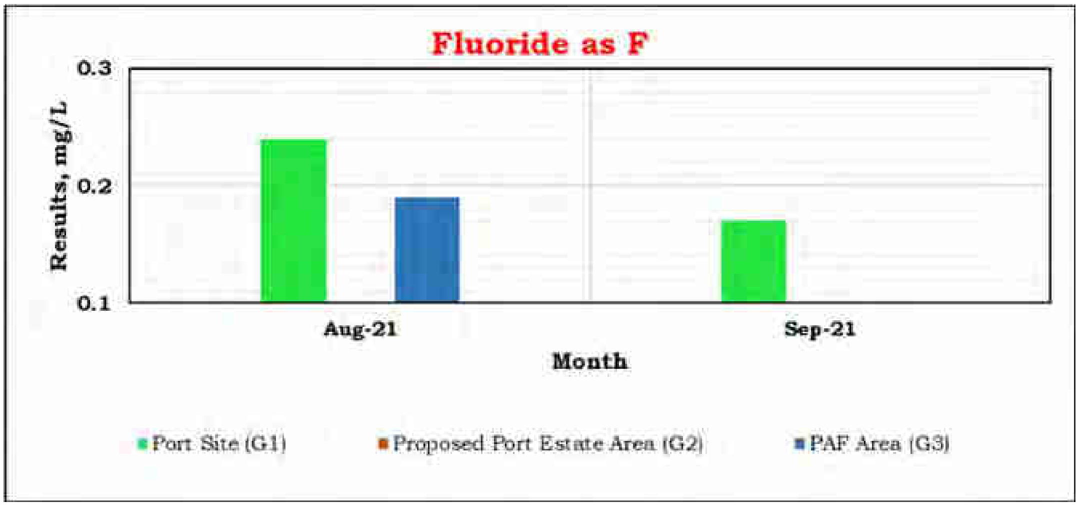


Figure 6.8: Ground Water Analysis for Nitrate as NO_3

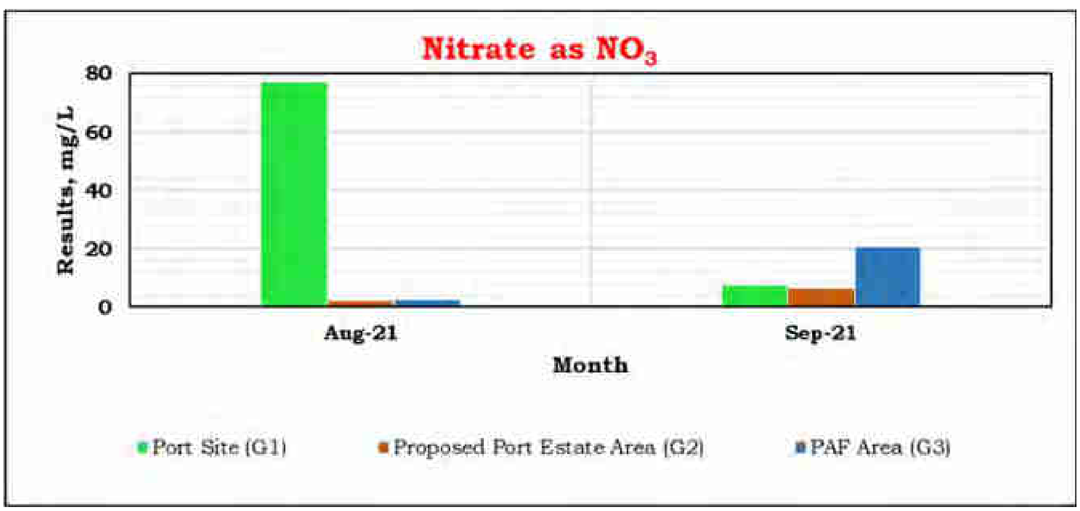


Figure 6.9: Ground Water Analysis for Calcium as Ca

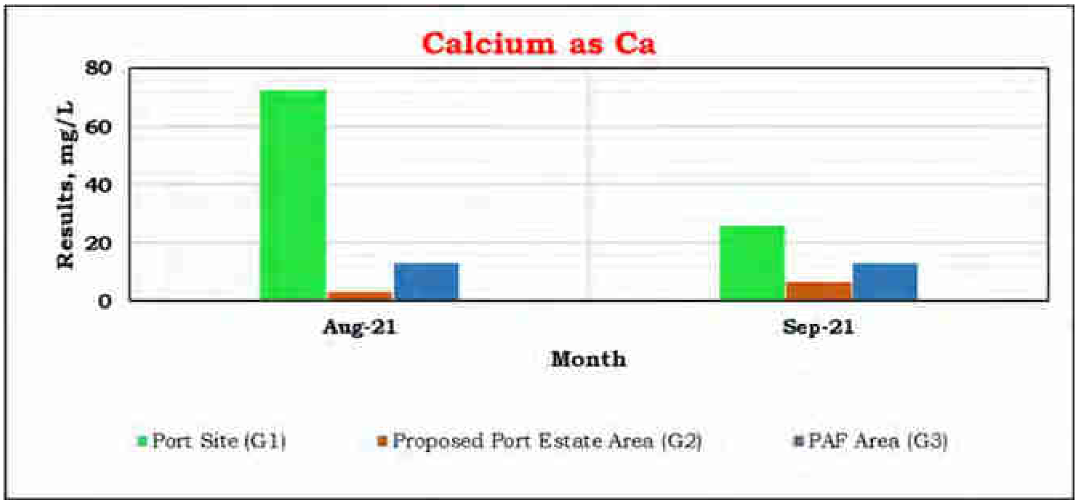


Figure 6.10: Ground Water Analysis for Magnesium as Mg

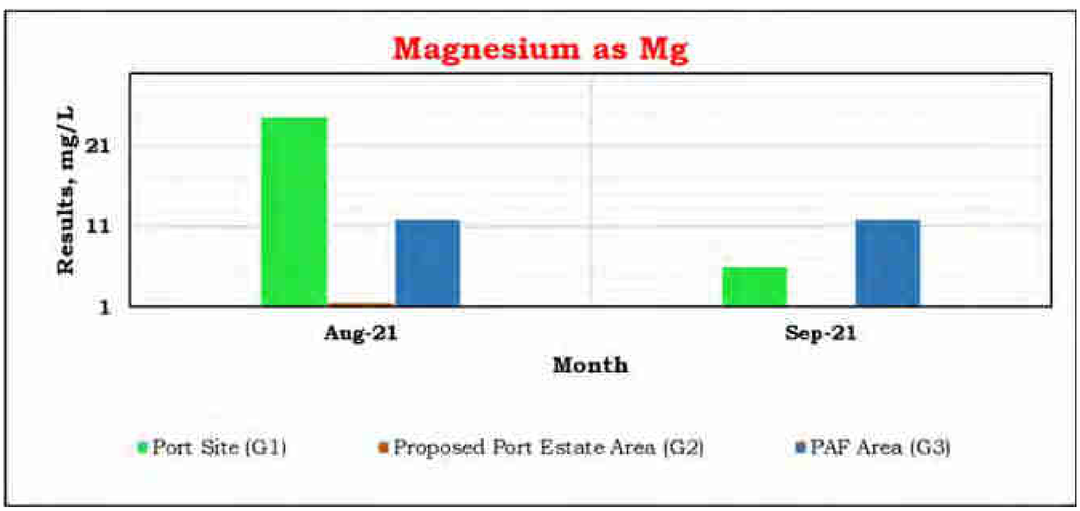


Figure 6.11: Ground Water Analysis for Iron as Fe

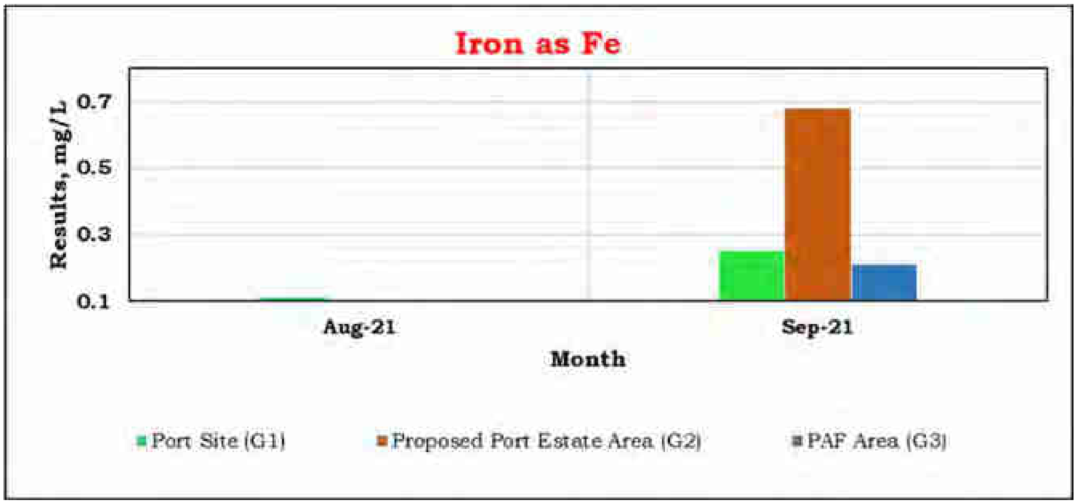


Figure 6.12: Ground Water Analysis for Total Alkalinity as $CaCO_3$

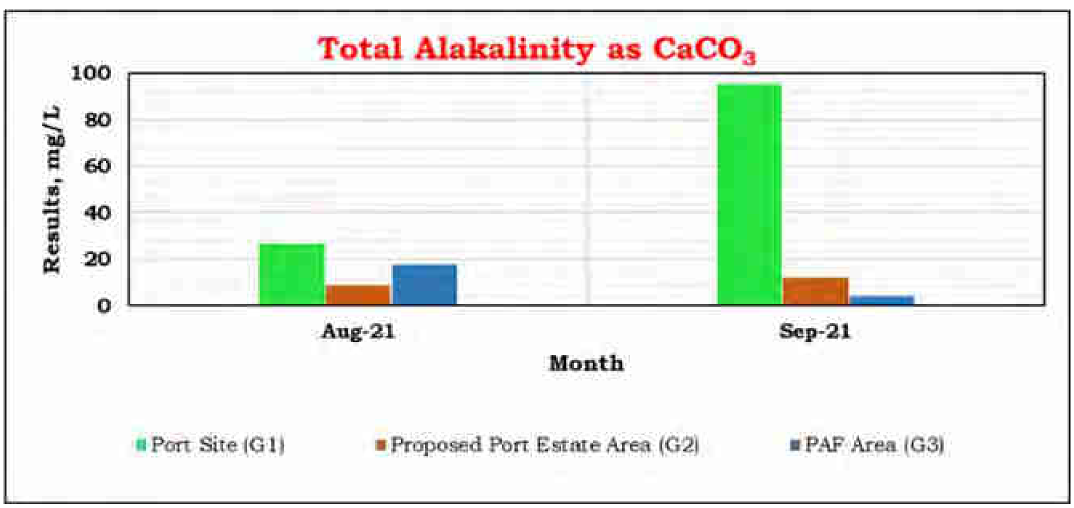


Figure 6.13: Ground Water Analysis for Total Hardness as $CaCO_3$

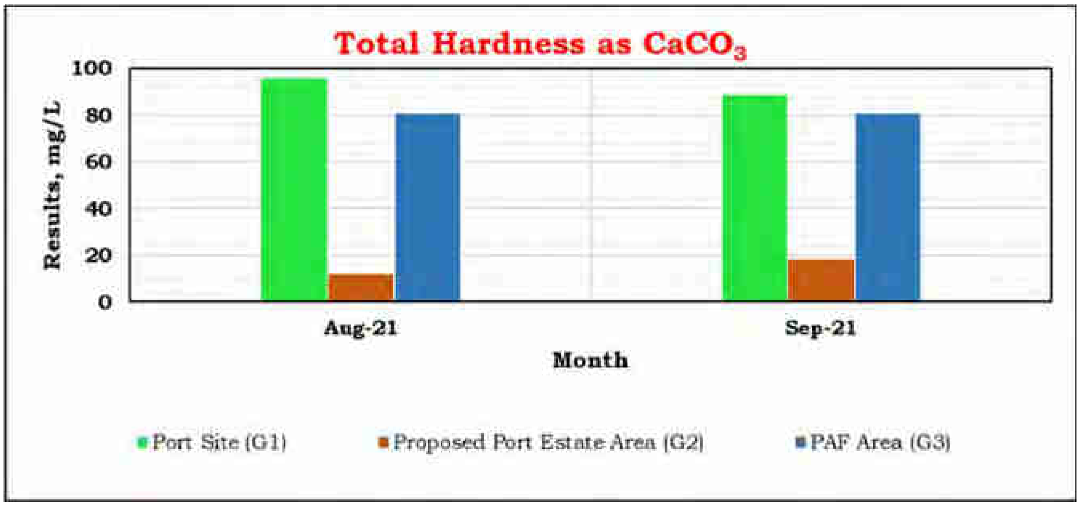


Figure 6.14: Ground Water Analysis for Total Hardness as $CaCO_3$

HYR-6.5. Summary- Ground Water Analysis

During the period August 2021 and September 2021, following is the summary of ground water analysis:

a) At the location **Port Site** (Open Well),

- Colour observed was 1 Hazen unit and the odour was agreeable
- pH was observed in the range from 6.68 to 7.04
- Turbidity was observed in the range from 0.6 to 0.7 N.T.U.
- Total Dissolved Solids were observed in the range from 448 to 1424 mg/L
- Ammonia (as NH_3-N) was observed from BDL to 0.11 mg/L
- Calcium (as Ca) was observed in the range from 25.9 to 72.7 mg/L
- Chloride (as Cl) was observed in the range from 93.9 to 509 mg/L
- Fluoride (as F) was observed in the range from 0.17 to 0.24 mg/L
- Iron (as Fe) was observed in the range from 0.11 to 0.25 mg/L
- Magnesium (as Mg) was observed in the range from 5.9 to 24.6 mg/L
- Manganese (as Mn) was observed in the range from 0.11 to 0.13 mg/L
- Nitrate (as NO_3) was observed in the range from 7.42 to 76.9 mg/L
- Sulphate (as SO_4) was observed in the range from 20.9 to 136 mg/L,
- Total Alkalinity (as $CaCO_3$) was observed in the range from 26.7 to 95.5 mg/L
- Total Hardness (as $CaCO_3$) was observed in the range from 88.9 to 95.9 mg/L
- Zinc (as Zn) was observed in the range from 0.086 to 0.099 mg/L
- Aluminium (as Al), Anionic Detergents, Barium (as Ba), Boron (as B) 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), 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 below detectable limits
- Bacteriological parameters such as *E.coli* and Total Coliforms were not detected.

b) At the location **Proposed Port Estate Area** (Borewell & Open Well),

- Colour observed was 1 Hazen unit and the odour was agreeable
- pH was observed in the range from 6.73 to 6.87

- Turbidity was observed in the range from BDL to 0.8 N.T.U.
- Total Dissolved Solids were observed in the range from 65 to 109 mg/L
- Calcium (as Ca) was observed in the range from 3.23 to 6.46 mg/L
- Chloride (as Cl) was observed in the range from 22.9 to 23.9 mg/L
- Iron (as Fe) was observed in the range from BDL to 0.68 mg/L
- Magnesium (as Mg) was observed in the range from BDL to 1.42 mg/L
- Manganese (as Mn) was observed in the range from 0.076 to 0.09 mg/L
- Nitrate (as NO_3) was observed in the range from 1.81 to 6.33 mg/L
- Sulphate (as SO_4) was observed in the range from 6.72 to 15.5 mg/L
- Total Alkalinity (as $CaCO_3$) was observed in the range from 8.64 to 11.9 mg/L
- Total Hardness (as $CaCO_3$) was observed in the range from 12.1 to 18.2 mg/L
- Zinc (as Zn) was observed in the range from 0.093 to 0.104 mg/L
- Aluminium (as Al), Ammonia (as NH_3-N), Fluoride (as F), Anionic Detergents, Barium (as Ba), Boron (as B), 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), 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 below detectable limits
- Bacteriological parameters such as *E.coli* and Total Coliforms were not detected.

c) At the location **PAF Area** (Open Well),

- Colour observed was 1 Hazen unit and the odour was agreeable
- pH was observed in the range from 6.53 to 6.84
- Turbidity was observed in the range from 0.4 to 0.6 N.T.U.
- Total Dissolved Solids were observed in the range from 419 to 437 mg/L
- Aluminium (as Al) was observed from BDL to 0.13 mg/L
- Calcium (as Ca) was observed in the range from 12.9 to 12.9 mg/L
- Chloride (as Cl) was observed in the range from 162 to 168 mg/L
- Fluoride (as F) was observed in the range from BDL to 0.21 mg/L
- Iron (as Fe) was observed in the range from BDL to 0.19 mg/L
- Magnesium (as Mg) was observed in the range from 11.8 to 11.8 mg/L
- Nitrate (as NO_3) was observed in the range from 2.5 to 20.6 mg/L

- Sulphate (as SO_4) was observed in the range from 14.9 to 21.1 mg/L
- Total Alkalinity (as $CaCO_3$) was observed in the range from 3.98 to 17.6 mg/L
- Total Hardness (as $CaCO_3$) was observed in the range from 80.8 to 80.8 mg/L
- Zinc (as Zn) was observed in the range from 0.119 to 0.123 mg/L
- Ammonia (as NH_3-N), Anionic Detergents, 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), 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) and Polynuclear Aromatic Hydrocarbons (PAH) were observed below detectable limits
- Bacteriological parameters such as *E.coli* and Total Coliforms were not detected.

HYR-7	Surface Water Analysis

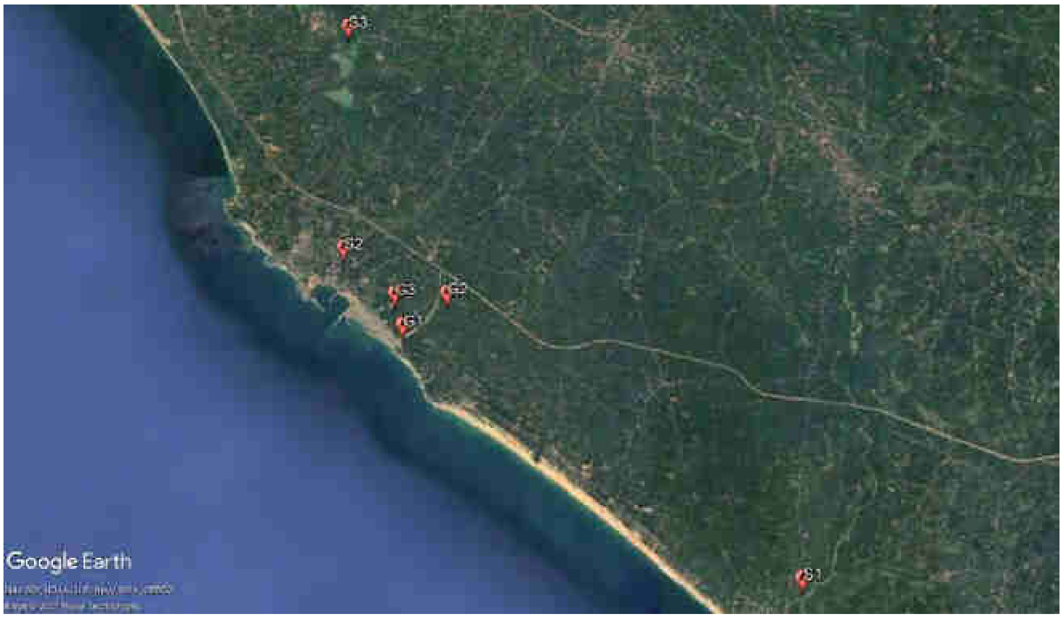
HYR-7.1. Surface Water Location Details:

This section describes the sampling location and analysis results of Surface water during the period August 2021and September 2021. Surface water sampling was carried out at three locations including Poovar West Canal, Vizhinjam Branch Canal and Vellayani Lake.

Table 7.1: Coordinates of Surface Water Location

Location	Legend	Latitude	Longitude
Poovar West Canal	S1	8°19'22.66"N	77°04'31.70"E
Vizhinjam Branch Canal	S2	8°22'55.59"N	76°59'36.29"E
Vellayani Lake	S3	8°25'32.27"N	76°59'35.29"E

Figure 7.1: Google earth views of Ground Water & Surface Water Sampling Locations



HYR-7.2. Surface Water Analysis Results for the period August 2021 and September 2021:

Sl. No.	Parameters	Unit	Month	Poovar West Canal (S1)	Vizhinjam Branch Canal (S2)	Vellayani Lake (S3)
Physical Parameters						
1.	Colour	Hazen Units	Aug-21	1	1	1
			Sep-21	5	1	1
2.	Odour	-	Aug-21	Agreeable	Agreeable	Agreeable
			Sep-21	Agreeable	Agreeable	Agreeable
3.	pH Value	-	Aug-21	6.61	7.11	6.82
			Sep-21	6.66	7.05	6.8
4.	Turbidity	N.T.U.	Aug-21	1.4	2.3	1.2
			Sep-21	64.8	16.2	15.4
5.	Electrical Conductivity (at 25°C)	µmho/cm	Aug-21	1544	232	207
			Sep-21	198	285	216
6.	Total Dissolved Solids	mg/L	Aug-21	849	151	135
			Sep-21	128	185	140
Chemical Parameters						

Sl. No.	Parameters	Unit	Month	Poovar West Canal (S1)	Vizhinjam Branch Canal (S2)	Vellayani Lake (S3)
7.	Dissolved Oxygen	mg/L	Aug-21	6.7	6.7	6.3
			Sep-21	7.2	7.2	6.9
8.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	Aug-21	BDL	4.01	4.01
			Sep-21	BDL	2.01	BDL
9.	Oil & Grease	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
10.	Free Ammonia	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
11.	Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
12.	Barium (as Ba)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
13.	Boron (as B)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
14.	Calcium (as Ca)	mg/L	Aug-21	12.1	12.1	6.46
			Sep-21	7.27	13.7	7.29
15.	Chloride (as Cl)	mg/L	Aug-21	380	38.9	36.9
			Sep-21	29.9	40.9	33.9
16.	Copper (as Cu)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
17.	Fluoride (as F)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
18.	Iron (as Fe)	mg/L	Aug-21	0.35	1.12	0.45
			Sep-21	4.98	1.39	0.99
19.	Magnesium (as Mg)	mg/L	Aug-21	29.5	3.44	3.93
			Sep-21	1.48	2.95	1.48
20.	Manganese (as Mn)	mg/L	Aug-21	0.06	BDL	0.094
			Sep-21	0.08	BDL	0.09
21.	Mineral Oil	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
22.	Nitrate (as NO_3)	mg/L	Aug-21	1.76	5.51	2.54
			Sep-21	16.3	10.1	2.69
23.	Phenolic Compounds (as C_6H_5OH)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
24.	Selenium (as Se)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
25.	Silver (as Ag)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
26.	Sulphate (as SO_4)	mg/L	Aug-21	30.6	4.25	9.46
			Sep-21	21.9	15	6.9
27.	Total Phosphate (as PO_4)	mg/L	Aug-21	BDL	0.3	0.25
			Sep-21	0.37	0.31	0.16
28.		mg/L	Aug-21	15.9	39.8	27.8

Sl. No.	Parameters	Unit	Month	Poovar West Canal (S1)	Vizhinjam Branch Canal (S2)	Vellayani Lake (S3)
	Total Alkalinity (as $CaCO_3$)		Sep-21	15.9	3.98	23.9
29.	Total Hardness (as $CaCO_3$)	mg/L	Aug-21	151	44.4	32.3
			Sep-21	24.2	46.5	24.2
30.	Calcium Hardness (as $CaCO_3$)	mg/L	Aug-21	30.3	30.3	16.2
			Sep-21	18.2	34.3	18.2
31.	Zinc (as Zn)	mg/L	Aug-21	0.084	0.074	0.099
			Sep-21	0.12	0.09	0.11
32.	Sodium (as Na)	mg/L	Aug-21	168	20.33	17.52
			Sep-21	14.56	23.1	15.86
33.	Potassium (as K)	mg/L	Aug-21	7.98	4.9	4.04
			Sep-21	5.1	6.82	4.74
34.	Sodium Adsorption Ratio	-	Aug-21	5.93	1.33	1.34
			Sep-21	6.97	8.01	7.59
35.	Cadmium (as Cd)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
36.	Cyanide (as CN)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
37.	Lead (as Pb)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
38.	Mercury (as Hg)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
39. Pesticide Residues						
i.	Alachlor	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
ii.	Atrazine	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
iii.	Aldrin/Dieldrin	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
iv.	Alpha HCH	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
v.	Beta HCH	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
vi.	Butachlor	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
vii.	Chlorpyrifos	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
viii.	Delta HCH	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
ix.	2,4D chlorophenoxyacetic acid	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
x.	DDT (o,p & p,p-Isomers of DDT, DDE, DDD)	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
xi.	Endosulfan (α,β & Sulphate)	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL

Sl. No.	Parameters	Unit	Month	Poovar West Canal (S1)	Vizhinjam Branch Canal (S2)	Vellayani Lake (S3)
xii.	Ethion	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
xiii.	γ HCH (Lindane)	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
xiv.	Isoproturon	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
xv.	Malathion	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
xvi.	Methyl Parathion	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
xvii.	Monocrotophos	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
xviii.	Phorate	µg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
40.	Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
41.	Total Arsenic (as As)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
42.	Total Chromium (as Cr)	mg/L	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
Biological Analysis						
43.	Total Coliforms	MPN Index/100 ml	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL
44.	Faecal Coliforms	MPN Index/100 ml	Aug-21	BDL	BDL	BDL
			Sep-21	BDL	BDL	BDL

HYR-7.3. Graphical representation of Results for Surface Water Analysis:

Figure 7.2: Surface Water Analysis for pH value

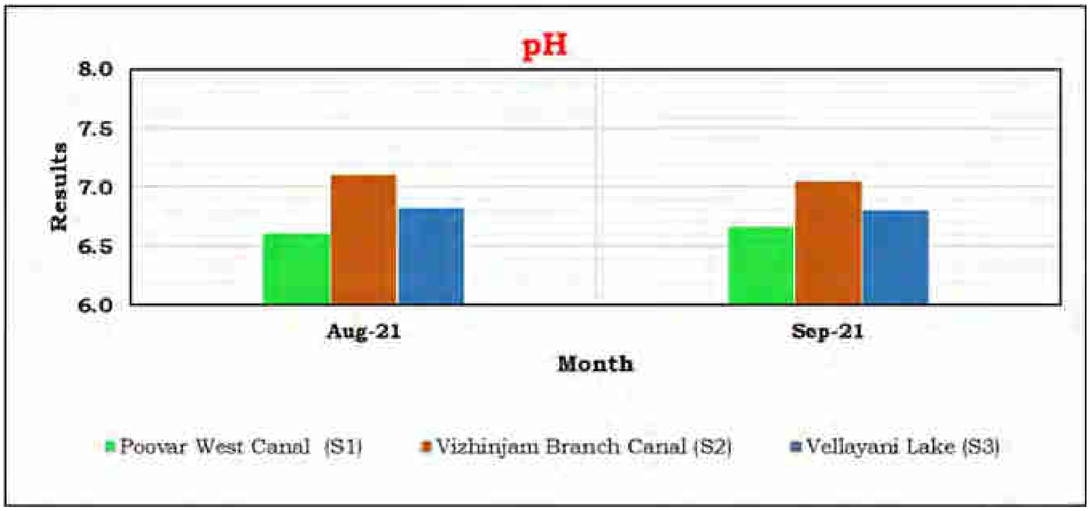


Figure 7.3: Surface Water Analysis for Turbidity

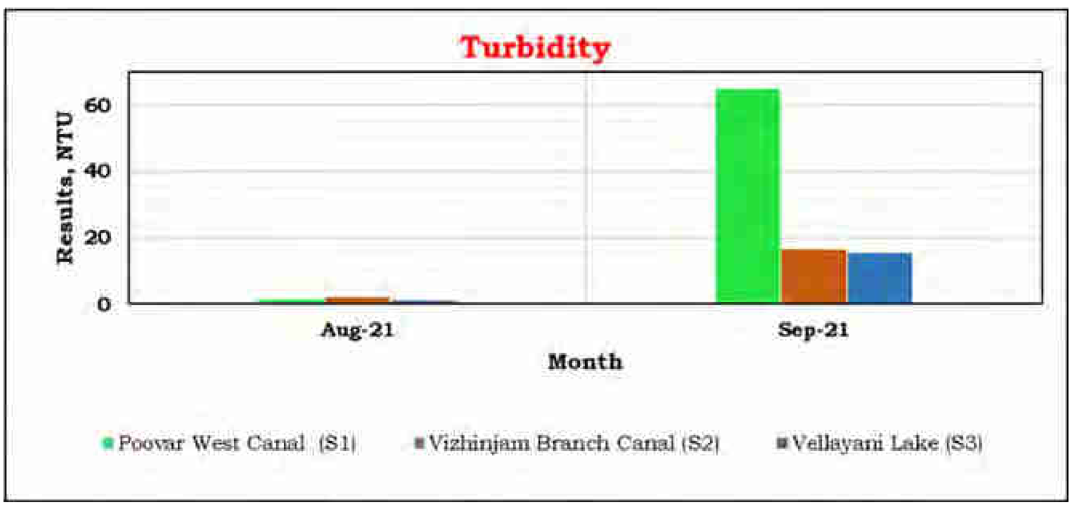


Figure 7.4: Surface Water Analysis for Electrical Conductivity @ 25 °C

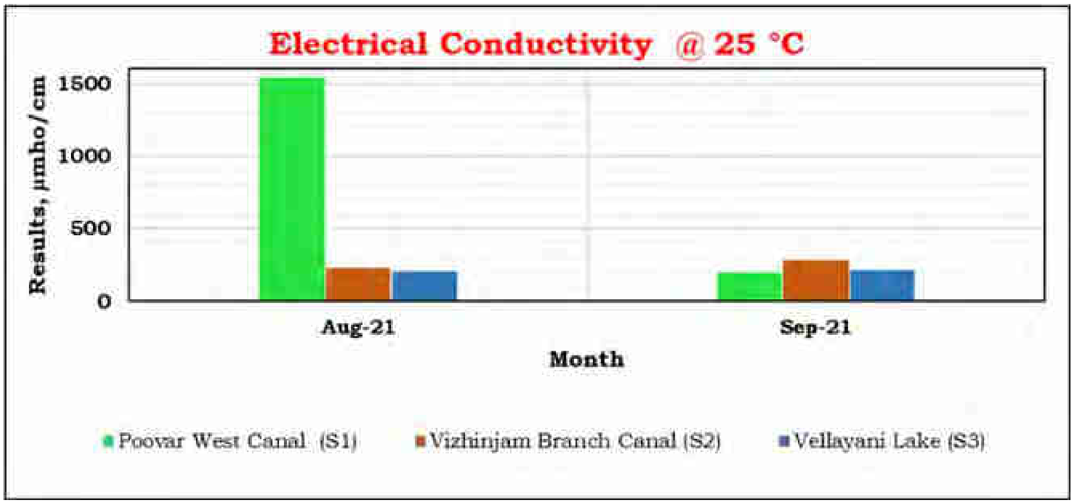


Figure 7.5: Surface Water Analysis for Total Dissolved Solids

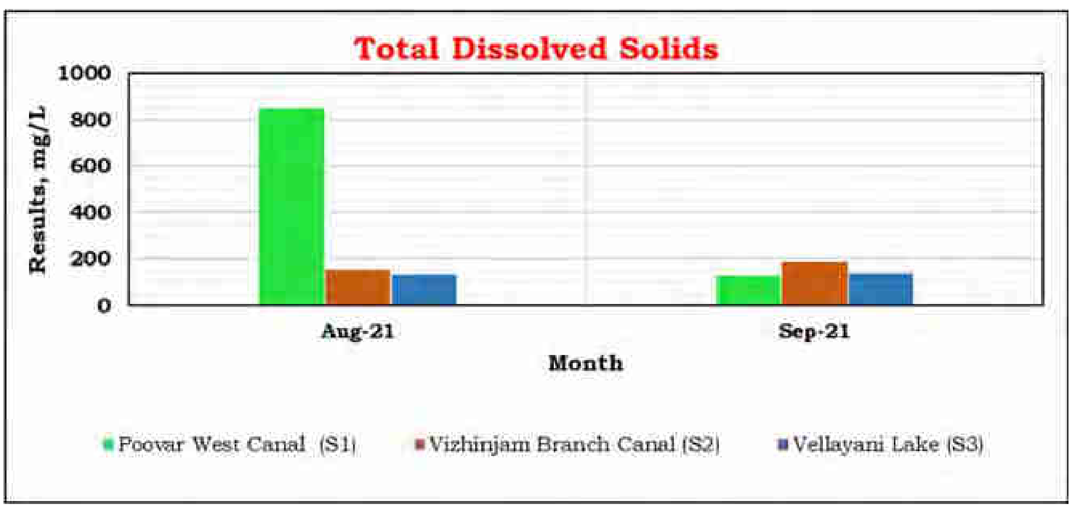


Figure 7.6: Surface Water Analysis for Dissolved Oxygen

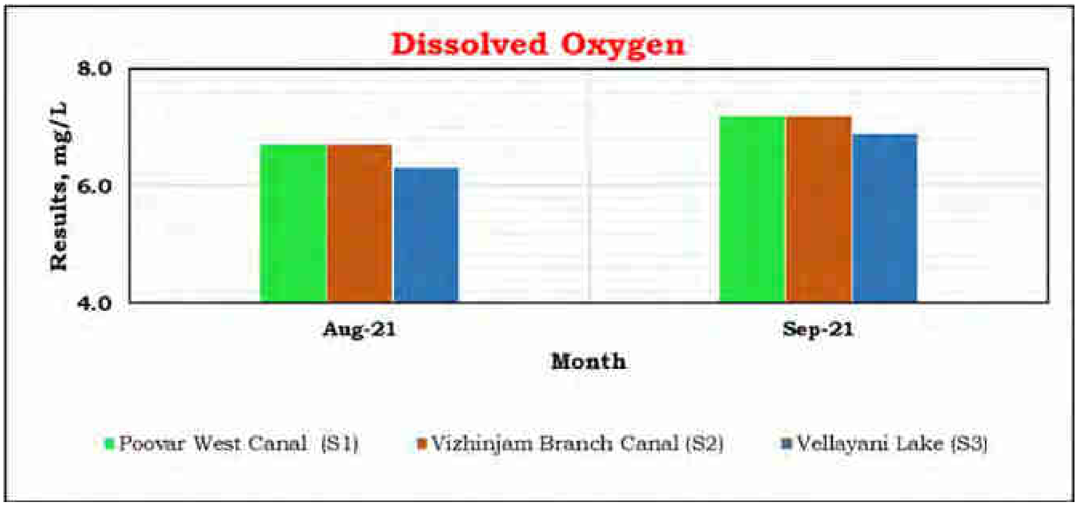


Figure 7.7: Surface Water Analysis for Chloride as Cl

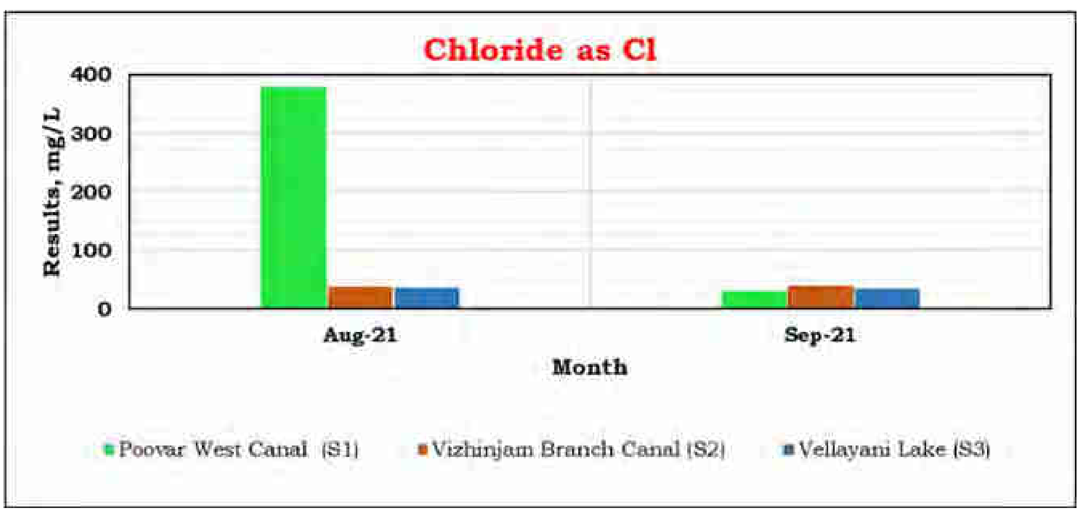


Figure 7.8: Surface Water Analysis for Sulphate as SO_4

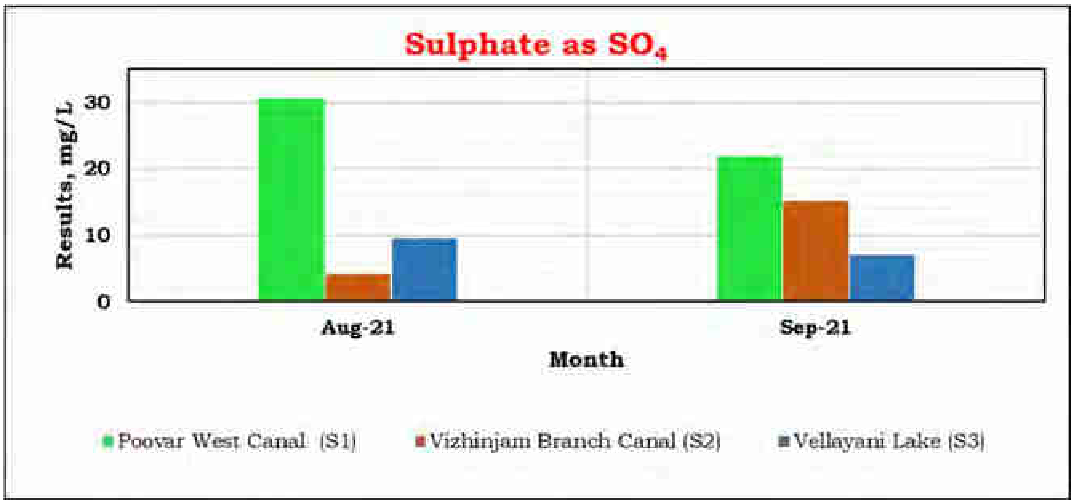


Figure 7.9: Surface Water Analysis for Nitrate as NO_3

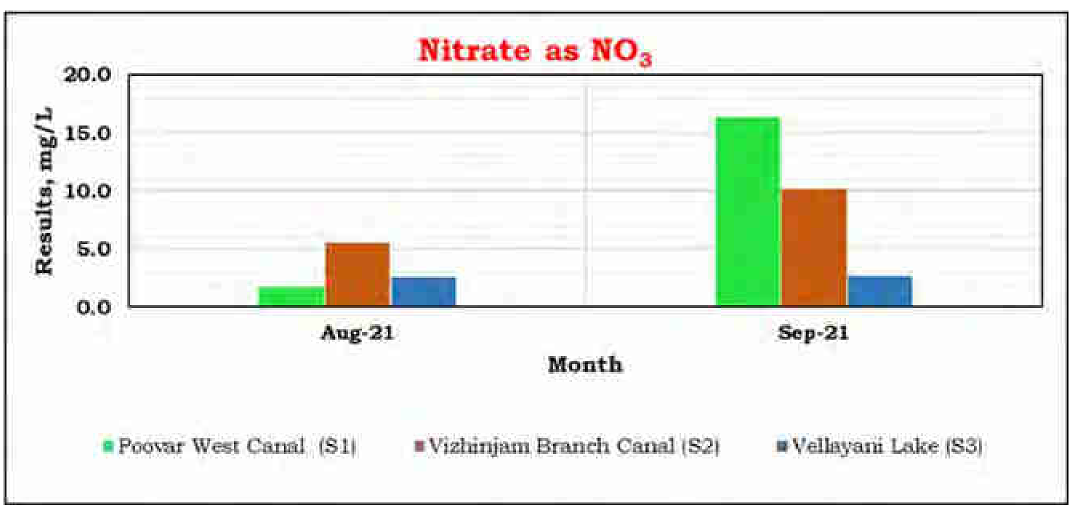


Figure 7.10: Surface Water Analysis for Calcium as Ca

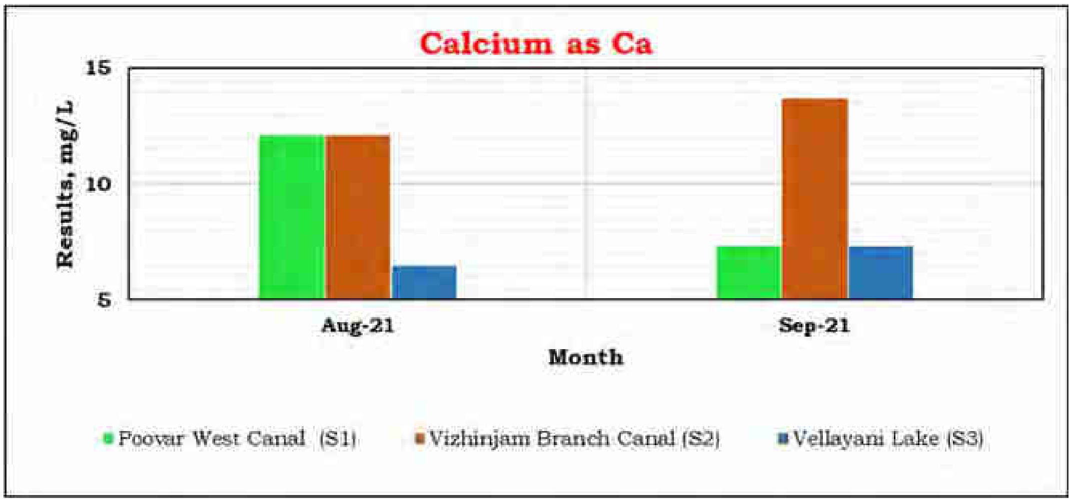


Figure 7.11: Surface Water Analysis for Magnesium as Mg

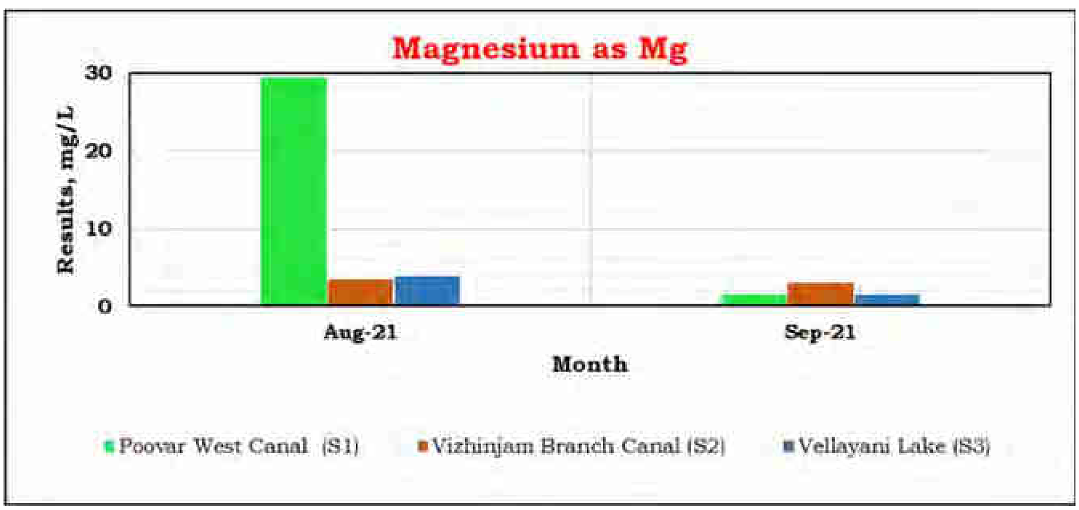


Figure 7.12: Surface Water Analysis for Manganese as Mn

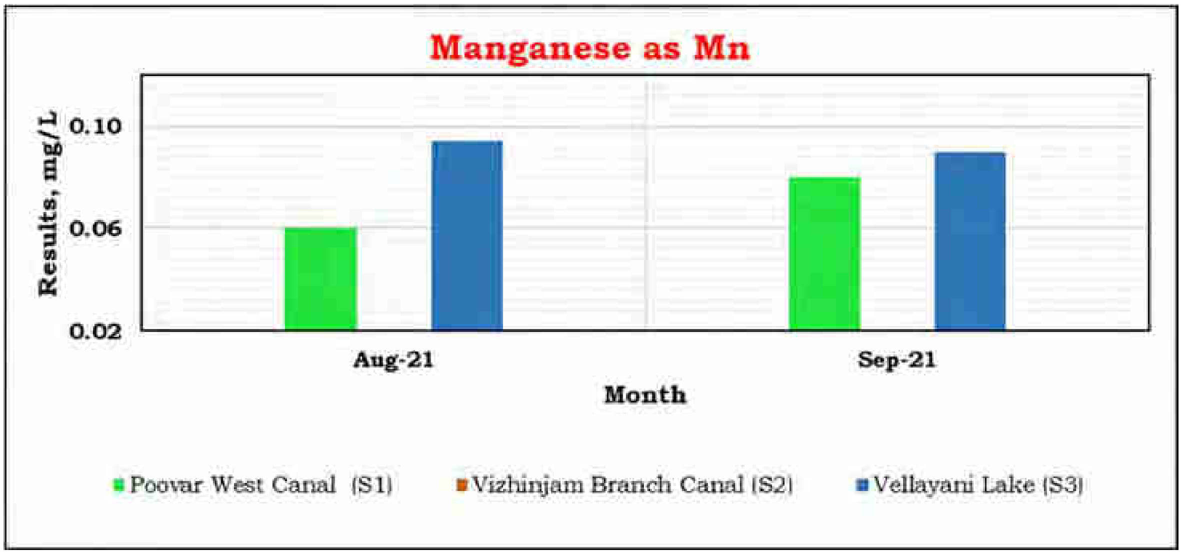


Figure 7.13: Surface Water Analysis for Iron as Fe

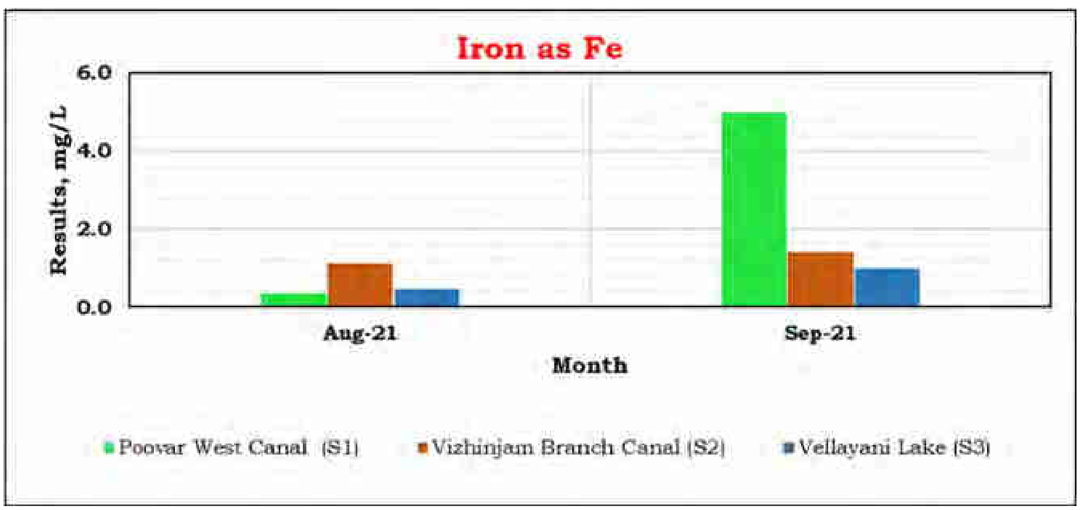


Figure 7.14: Surface Water Analysis for Zinc as Zn

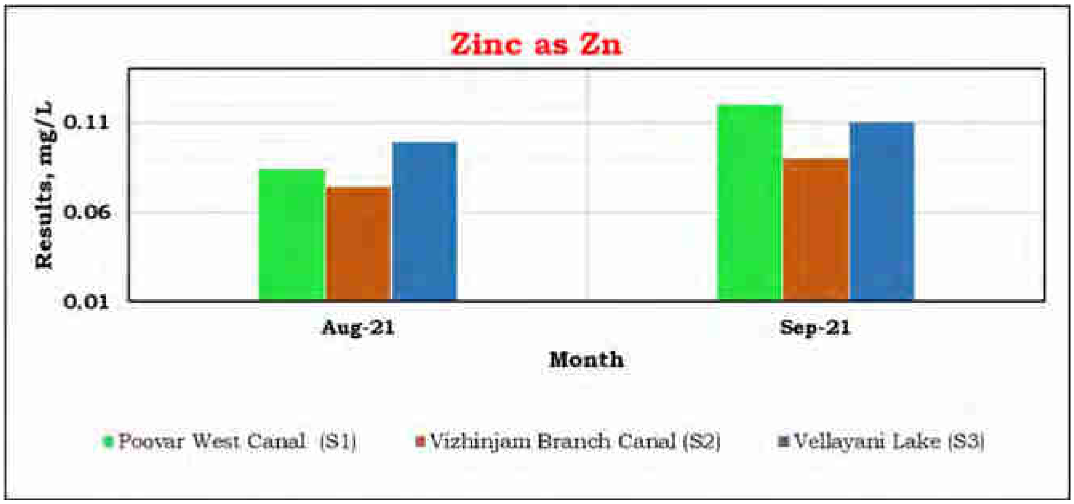


Figure 7.15: Surface Water Analysis for Total Phosphorous as P

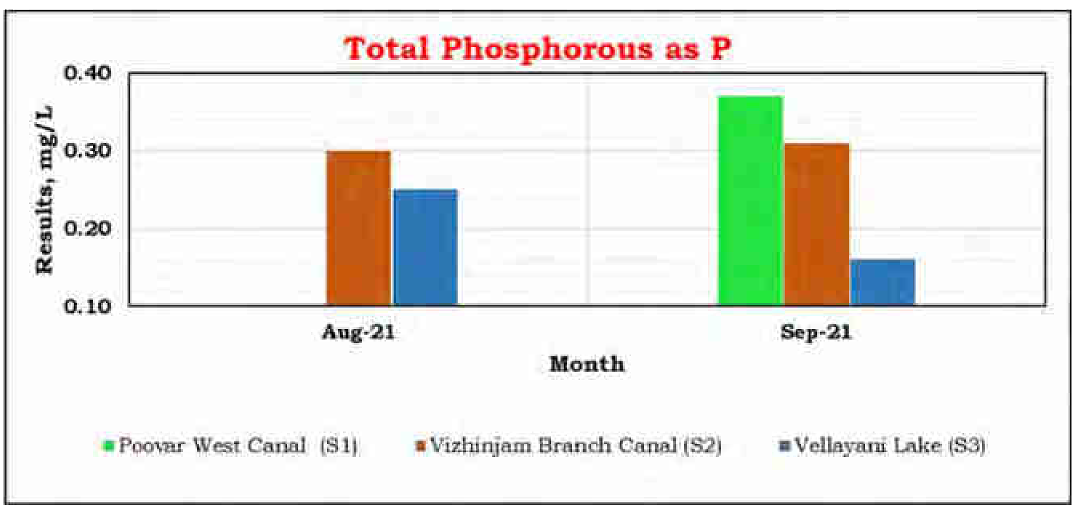


Figure 7.16: Surface Water Analysis for Total Alkalinity as $CaCO_3$

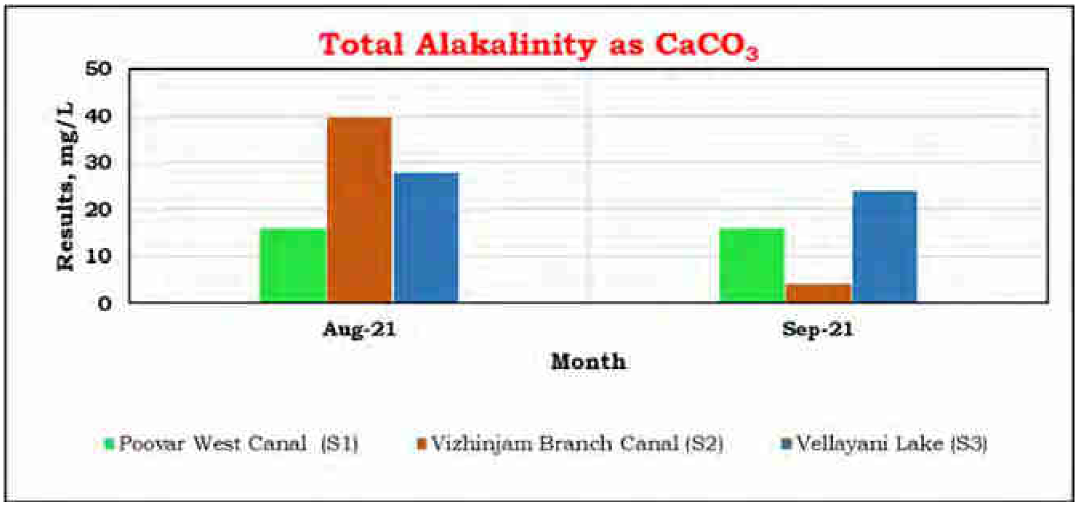


Figure 7.17: Surface Water Analysis for Total Hardness as $CaCO_3$

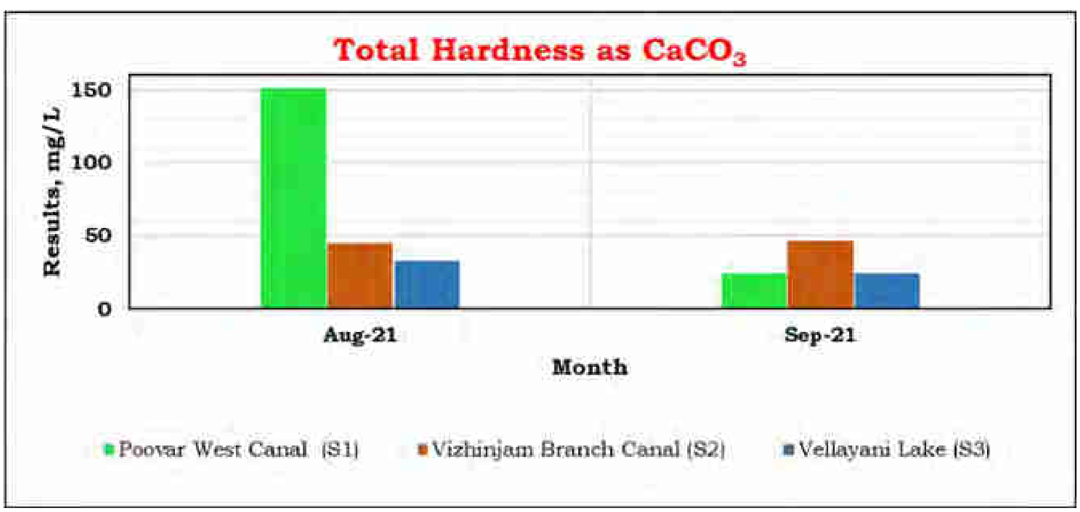


Figure 7.18: Surface Water Analysis for Calcium Hardness as $CaCO_3$

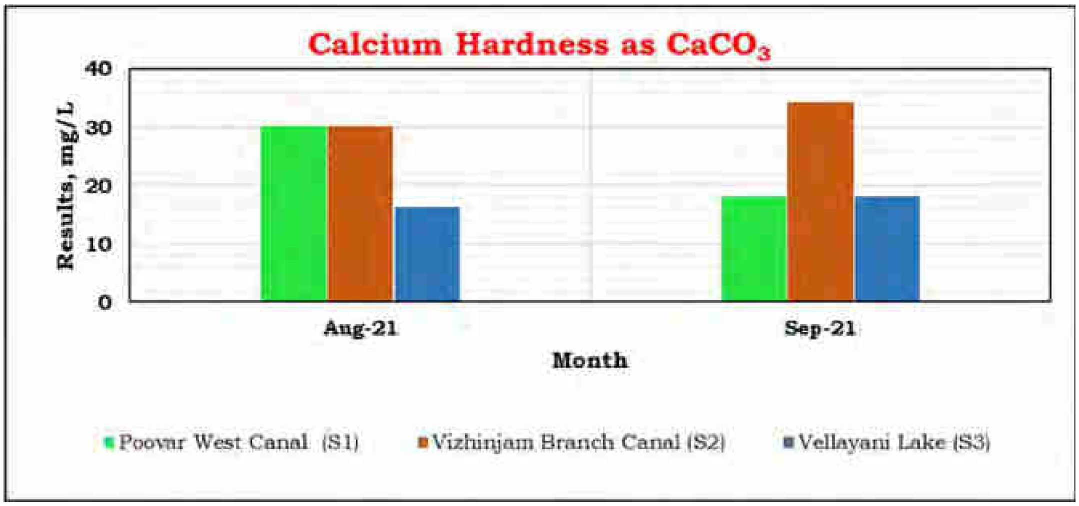


Figure 7.19: Surface Water Analysis for Sodium as Na

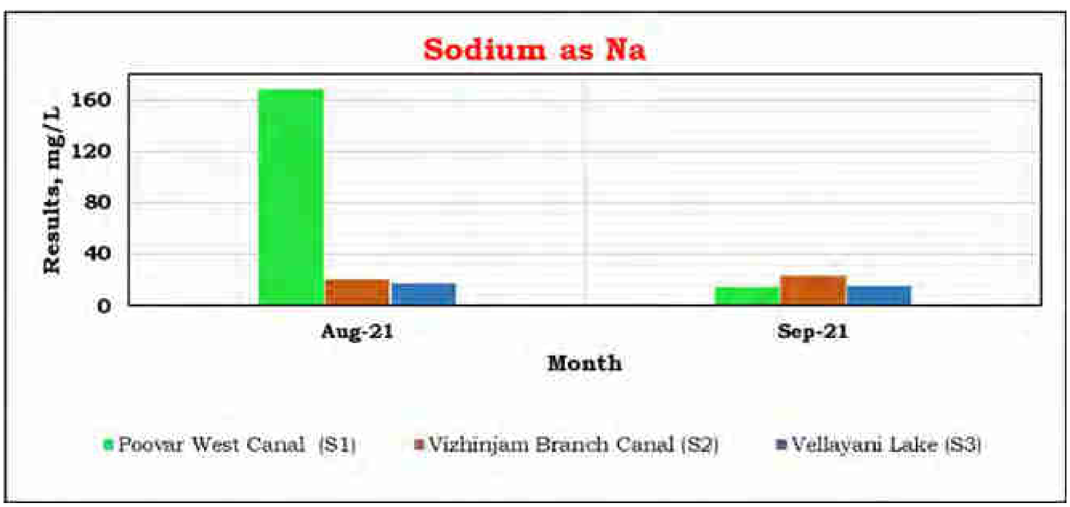


Figure 7.20: Surface Water Analysis for Potassium as K

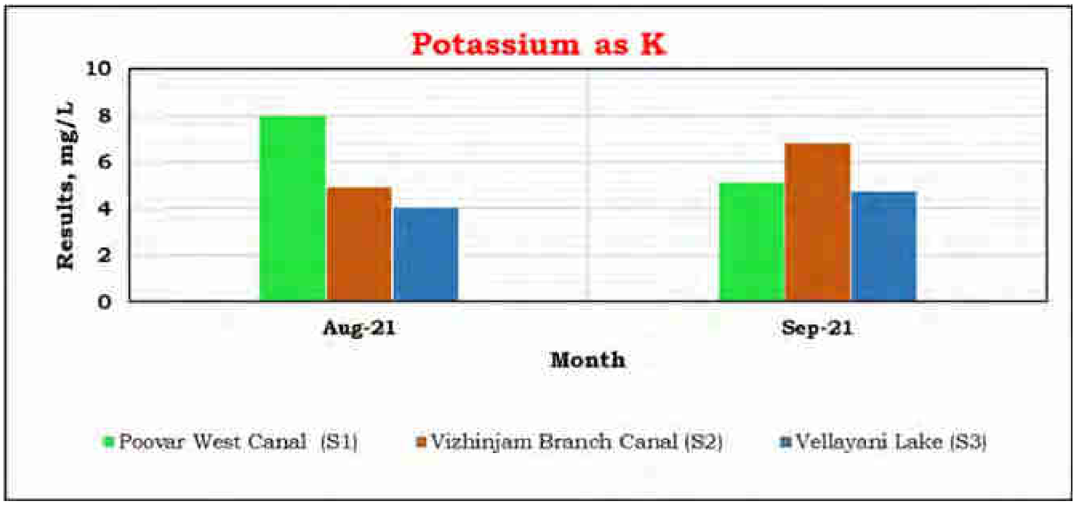
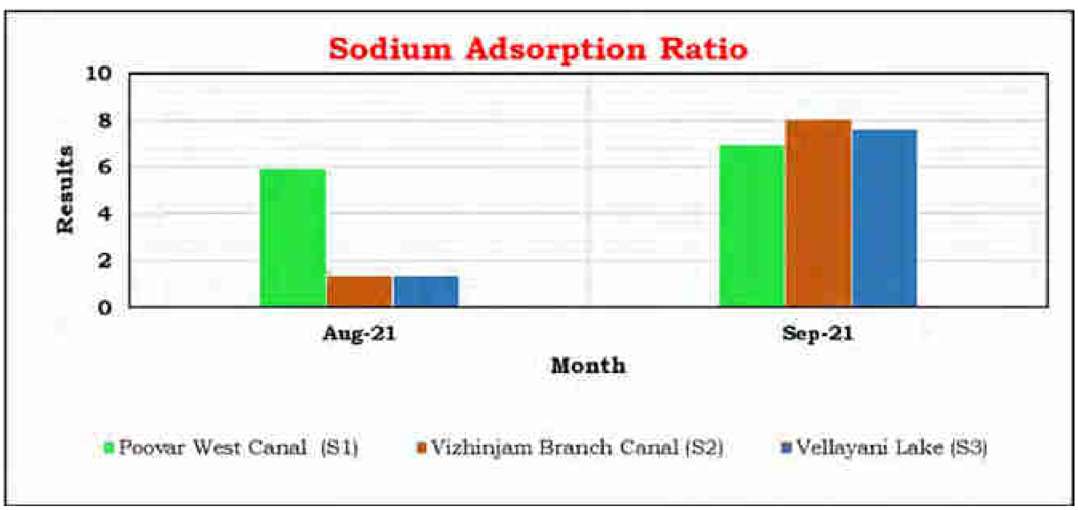


Figure 7.21: Surface Water Analysis for Sodium Adsorption Ratio



HYR-7.4. Summary of Surface water

During the period August 2021 and September 2021, following is the summary of surface water analysis:

a) At the location **Poovar West Canal**,

- Colour was observed in the range from 1 to 5Hazen unit
- Odour was agreeable
- pH was observed in the range from 6.61 to 6.66
- Turbidity was observed in the range from 1.4 to 64.8 N.T.U.
- Total Dissolved Solids were observed in the range from 128 to 849 mg/L
- Electrical Conductivity was observed in the range from 198 to 1544 µmho/cm
- Dissolved Oxygen was observed in the range from 6.7 to 7.2 mg/L
- Calcium (as Ca) was observed in the range from 7.27 to 12.1 mg/L
- Chloride (as Cl) was observed in the range from 29.9 to 380 mg/L
- Iron (as Fe) was observed in the range from 0.35 to 4.98 mg/L
- Magnesium (as Mg) was observed in the range from 1.48 to 29.5 mg/L
- Manganese (as Mn) was observed in the range from 0.06 to 0.08 mg/L
- Nitrate (as NO_3) was observed in the range from 1.76 to 16.3 mg/L
- Sulphate (as SO_4) was observed in the range from 21.9 to 30.6 mg/L
- Total Phosphate (as PO_4) was observed in the range from BDL to 0.37 mg/L
- Total Alkalinity (as $CaCO_3$) was observed in the range from 15.9 to 15.9 mg/L
- Total Hardness (as $CaCO_3$) was observed in the range from 24.2 to 151 mg/L
- Calcium Hardness (as $CaCO_3$) was observed in the range from 18.2 to 30.3 mg/L
- Sodium (as Na) was observed in the range from 14.56 to 168 mg/L
- Potassium (as K) was observed in the range from 5.1 to 7.98 mg/L
- Sodium Absorption Ratio was observed in the range from 5.93 to 6.97
- Zinc (as Zn) was observed in the range from 0.084 to 0.12 mg/L
- Biochemical Oxygen Demand (3 days, 27°C), Oil & Grease, Free Ammonia, Anionic Detergents, Barium (as Ba), Boron (as B), Copper (as Cu), Fluoride (as F), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se), Silver (as Ag), 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 detectable limits

- Bacteriological parameters such as Total Coliforms and Faecal Coliforms were not detected

b) At the location **Vizhinjam Branch Canal**,

- Colour was observed 1 Hazen unit
- Odour was agreeable
- pH was observed in the range from 7.05 to 7.11
- Turbidity was observed in the range from 2.3 to 16.2 N.T.U.
- Total Dissolved Solids were observed in the range from 151 to 185 mg/L
- Electrical Conductivity was observed in the range from 232 to 285 µmho/cm
- Dissolved Oxygen was observed in the range from 6.7 to 7.2 mg/L
- Biochemical Oxygen Demand (3 days, 27°C) was observed in the range from 2.01 to 4.01 mg/L
- Calcium (as Ca) was observed in the range from 12.1 to 13.7 mg/L
- Chloride (as Cl) was observed in the range from 38.9 to 40.9 mg/L
- Iron (as Fe) was observed in the range from 1.12 to 1.39 mg/L
- Magnesium (as Mg) was observed in the range from 2.95 to 3.44 mg/L
- Nitrate (as NO_3) was observed in the range from 5.51 to 10.1 mg/L
- Sulphate (as SO_4) was observed in the range from 4.25 to 15 mg/L
- Total Phosphate (as PO_4) was observed in the range from 0.3 to 0.31 mg/L
- Total Alkalinity (as $CaCO_3$) was observed in the range from 3.98 to 39.8 mg/L
- Total Hardness (as $CaCO_3$) was observed in the range from 44.4 to 46.5 mg/L
- Calcium Hardness (as $CaCO_3$) was observed in the range from 30.3 to 34.3 mg/L
- Sodium (as Na) was observed in the range from 20.33 to 23.1 mg/L
- Potassium (as K) was observed in the range from 4.9 to 6.82 mg/L
- Sodium Absorption Ratio was observed in the range from 1.33 to 8.01
- Zinc (as Zn) was observed in the range from 0.074 to 0.09 mg/L
- Oil & Grease, Free Ammonia, Anionic Detergents, Barium (as Ba), Boron (as B), Copper (as Cu), Fluoride (as F), Manganese (as Mn), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se), Silver (as Ag),

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 detectable limits

- Bacteriological parameters such as Total Coliforms and Faecal Coliforms were not detected

c) At the location **Vellayani Lake**,

- Colour was observed 1 Hazen unit
- Odour was agreeable
- pH was observed in the range from 6.8 to 6.82
- Turbidity was observed in the range from 1.2 to 15.4 N.T.U.
- Total Dissolved Solids were observed in the range from 135 to 140 mg/L
- Electrical Conductivity was observed in the range from 207 to 216 µmho/cm
- Dissolved Oxygen was observed in the range from 6.3 to 6.9 mg/L
- Biochemical Oxygen Demand (3 days, 27°C) was observed in the range from BDL to 4.01 mg/L
- Calcium (as Ca) was observed in the range from 6.46 to 7.29 mg/L
- Chloride (as Cl) was observed in the range from 33.9 to 36.9 mg/L
- Iron (as Fe) was observed in the range from 0.45 to 0.99 mg/L
- Magnesium (as Mg) was observed in the range from 1.48 to 3.93 mg/L
- Manganese (as Mn) was observed in the range from 0.09 to 0.94 mg/L
- Nitrate (as NO_3) was observed in the range from 2.54 to 2.69 mg/L
- Sulphate (as SO_4) was observed in the range from 6.9 to 9.46 mg/L
- Total Phosphate (as PO_4) was observed in the range from 0.16 to 0.25 mg/L
- Total Alkalinity (as $CaCO_3$) was observed in the range from 23.9 to 27.8 mg/L
- Total Hardness (as $CaCO_3$) was observed in the range from 24.2 to 32.3 mg/L
- Calcium Hardness (as $CaCO_3$) was observed in the range from 16.2 to 18.2 mg/L
- Sodium (as Na) was observed in the range from 15.86 to 17.52 mg/L
- Potassium (as K) was observed in the range from 4.04 to 4.74 mg/L
- Sodium Absorption Ratio was observed in the range from 1.34 to 7.59
- Zinc (as Zn) was observed in the range from 0.099 to 0.11 mg/L

- Oil & Grease, Free Ammonia, Anionic Detergents, Barium (as Ba), Boron (as B), Copper (as Cu), Fluoride (as F), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se), Silver (as Ag), 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 detectable limits
- Bacteriological parameters such as Total Coliforms and Faecal Coliforms were not detected

End of Report

Annexure IV

CSR Activities by AVPPL

(April 2021 to September 2021)

CSR REPORT VIZHINJAM

(APRIL 2021-SEPTEMBER 2021)

Adani Vizhinjam Port Pvt Ltd, 2nd Floor
Vipanchika Tower, Thycaud, Trivandrum-695014

CSR REPORT VIZHINJAM

(FOR THE PERIOD FROM APRIL 2021- SEPTEMBER -2021)

Amid COVID restrictions Adani Foundation has done many activities with strict COVID protocol in the following heads during the reporting period.

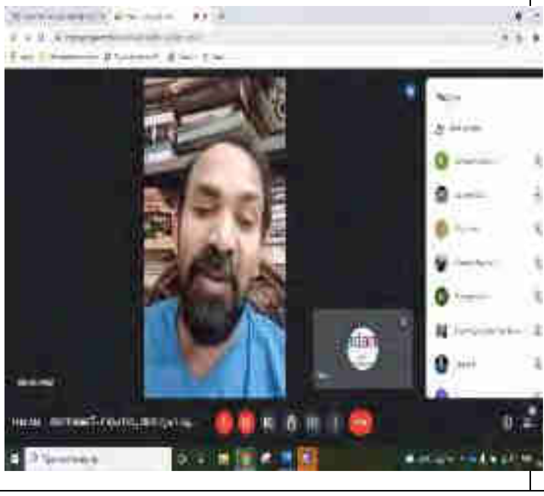
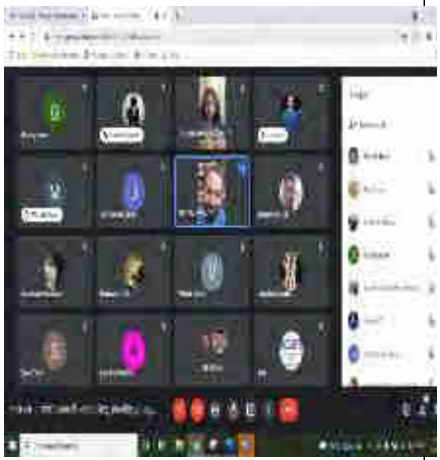
1. Education
2. Community Health
3. Sustainable Livelihood Development
4. Community Infrastructure Development
5. COVID relief activities
6. Others

1. Education

1.1. Literature Meets

A). Session on Creativity of children during pandemic period (31st July 2021)

As part of the poets and mem of literate, a webinar was organised on 31st July 2021 on the theme "Creativity of Children during COVID pandemic period". The session was handled by Mr. Jacob Abraham, Project Head, Radio Malayalam, Malayalam Mission, Govt. of Kerala. He is a famous writer honoured with many prestigious awards like Geetha Hiranyan Award by Kerala Sahithya Academy, Karoor Award by Kerala Language Institute, Mathrubhoomi award for short story etc. He mainly concentrated on the theme 'Every difficulty is an opportunity" and he explained the term imagination, curiosity and a creative diversion in daily activities. The session was very fruitful and interactive. He also ensures to telecast the creatives of children through Radio Malayalam as audio clips.

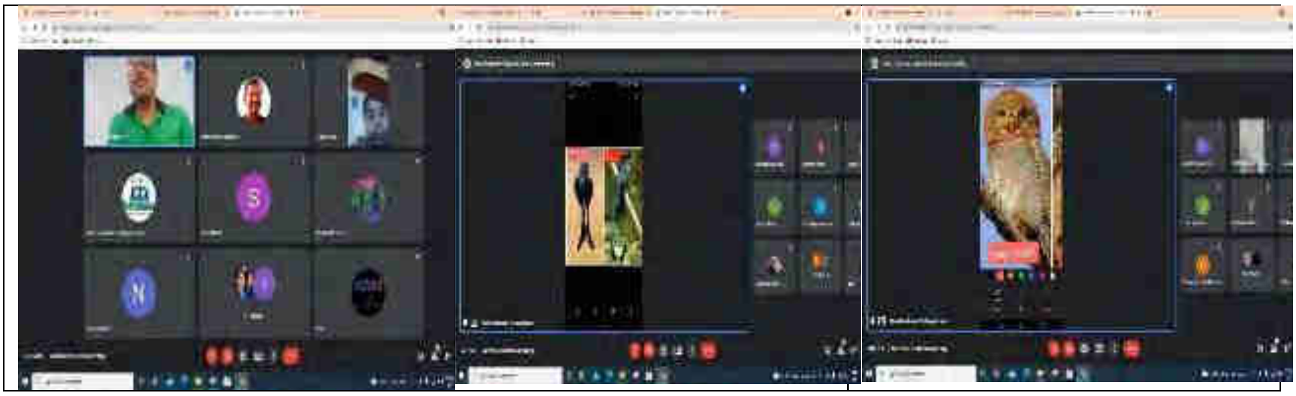
 

B). Session on Birdwatching (28th August 2021)

As part of the poets and mem of literate, a webinar on "Birdwatching" was conducted for the literature club students as a measure to provide information on different Birds species and its different characteristic. The session was handled by Mr. Ajay Kiran an expert, a professional Birder and the founder of 'Neerthadakam' an NGO, specifically aiming for reviving the 'Vellayani', Kerala's largest fresh water lake. He Made a detailed description on,

- ✓ Time & How to identify some specious of birds.
- ✓ Types & specious of birds in India & Kerala.
- ✓ Types of Migrating birds in India & Kerala.
- ✓ How to identify Male & Female birds.
- ✓ How to become a Birder etc.

The session was concluded with a mutual sharing of information from students as well as by the expert on their various doubts. The Resource Person also promised to give an opportunity for our literature club students to visit the forest and Vellayani area to get real-time experience in Bird watching. He also gives an activity to the participants as part of session to observe birds which are coming to our premises on every morning, take a photograph and get the details from internet. It will help to identify various indigenous birds in our locality.



C). Session on "Kaviya Sallapam" – A pleasant interaction of Poetry (30th September 2021)

As part of the poets and mem of literature monthly get-together, a Pleasant interaction of poetry – 'Kavya Sallapam" was organized for literature club students as a measure to provide information on different Poems of Satheesh Kidarakuzhi, Kujunni Mash, Vailoppilli Sreedhara Menon and many other Poets. The session was handled by Mr. Vinod Vellayani, a poet, translator and orator from Trivandrum. The session was concluded with mutual sharing of information from students as well as by the expert on their various doubts. The session was attended by 30 students, 6 poets and men of Literature & CSR team.

d). Felicitation of Poets & men of literature on Teachers day

The teacher's day was celebrated on 5th September 2020 at CSR office, Mukkola by honouring the Poets and men of Literature. Eight eminent poets & Teachers who have been voluntarily supporting the programme of Literature meet were honoured by CSR Team. Mr. Reaches Fernandez, one of the teacher who was specially congratulated and honoured for his honorary doctorate in social work from the University of Tolosa. Two teachers from St. Mary's School, Kottappuram, Vizhinjam was also specially congratulated for their efforts in achieving full pass in the last year SSLC examination in their school after a long year.

1.2. Benevolent Support

a). Distribution of hearing aid

Kumari. Jinisha, 12-year-old daughter of Mrs.Vimala a house wife from Kottappuram, Vizhinjam, is 50% Deaf-congenitally. She is the youngest among the three children and studying in 6th standard at St. Mary's HSS, Kottapuram. The other two children are in 10th and 9th standard respectively.

Her farther is the only earning member in the family and is a traditional fisherman.

Being consulted with a doctor at her younger age of 2.5 years, she was advised to use a hearing aid, as she was diagnosed with congenital 50% hearing loss. The hearing instrument was very costly and could not bear by her family; she was supported many times by some philanthropic people and institutions working on charity. But the low cost instruments had to change more than 12 times till the date either due faulty machines or due to wear and tear of the instrument.

As for her family it is difficult to find money for her hearing aid every time as the amount extends to thousands, thus they have approached with a request to Adani foundation. Adani foundation CSR –Vizhinjam decided to consider this request in benevolent support scheme. She was consulted @ National Institute Speech and Hearing (NISH- Trivandrum) and instrument costing 53,000/- was recommended for her after making required diagnosis. The whole funding for the instrument was supported by Adani foundation-CSR vizhinjam.

The instrument was distributed to her on 20.4.2021 by Adani Foundation officials. Her family has extended their hearty gratitude to Adani foundation for the extended help on Jinisha's hearing aid.

b). Wheel Chair Support: Two wheel chairs were distributed to the needy and an ambulance support was also provided during the reporting period. The first one is

Mrs. Lekha, 49 yrs, Uthram House, Koduvazanoor, Pulimath Panchayat in Trivandrum District, who is paralysed and having a lone son affected with Autism. She is facing much difficulty for her movement even inside her house. AVPPL/AF provided an Electronic Wheel chair as per the recommendation of Mr. P.K. Madhu IPS, District Police Chief, Thiruvananthapuram Rural. The cost of Electronic wheel chair, motorised 110A Folding was Rs. 74,509/-, Adani Foundation linked the programme with convergence of govt. grant-in-aid schemes and the family get a subsidy of Rs. 20,009/- thus the cost for the wheel chair was Rs. 54,500/-.

The second case was Mrs..Marthamma, 56 years old from Kuzhipallam Vizhinjam village, who is bedridden due to a sudden stroke which happens two years back. she is staying at a rented house along with her husband, they have two sons. The children left the parents alone and went away with their family. This is a big burden for the parents and presently they have no idea where their children are. Her husband Alby 60 years old is also a bedridden due to an accident. CSR Team visited the house, understanding their need and provided a wheel chair. Now our Mobile Health Care Unit (MHCU) is providing the required tablets for her and her husband. CSR team also linked the case with palliative professional for Physiotherapy & further treatments.

c). Ambulance Support

Mrs. Agnès, 50 years old and from Mukkola, Vizhinjam village is a bedridden patient, due to an accident happened. At present she is staying at a relative house because her two daughters and son had abandoned her. Knowing her difficult plight CSR team provide Ambulance Support for taking her to Hospital for continuing her treatment

1.3. Library Support to Schools - Distribution of Book Shelves to the schools

As part of the library support to schools 27 Book Shelves were distributed to the schools as follows in vizhinjam adhering to all COVID protocols.

Sl.No	Ward	School	No. of Shelves distributed
1	Harbour	Govt HALP Harbour	8
2	Vengaoor	HSS For Girls Venganoor	10
3	Mullor	Govt UPS Mulloor	9

1.4. Distribution of Digital Device to Community Students

A total of 41 lakh students in about 12,000 schools in Kerala state switched to virtual system of education as the new academic year began on 1st June 2021 amid COVID-19, second wave induced lockdown. There are many poor students who do not have access to television, phone or internet. Elected representatives, charitable societies, industrial firms and other likeminded individuals have been providing electronic gadgets to the students.

Minister for General Education & Employment Mr. V. Sivan Kutty, Minister for Transport Mr. Antony Raju, Local MLA Adv. M. Vincent (Kovalam Constituency), Local Ward Counsellors, School authorities have requested Adani group to help the poor students by providing digital devices to get the access to the virtual learning module of Govt. of Kerala termed **"First Bell".** Considering the urgent need AVPPL/AF decided to provide digital devices to the less privileged students, especially fishing community students.

AVPPL/AF procured 439 tables as per the below specifications from Adani Skill Development Centre for distribution.

Sl.No	Model & Brand	No. Tablets
1	Gorgeo 4GL(I-ball)	140
2	Tablets Spirit V2 (I- ball)	129
3	Tablets Sky 03 (I-ball)	170
Total		**439**

A thorough check-up was done for all the 439 tablets procured and started the distribution. A total of 196 digital devices are distributed out of 439 during the reporting period as follows.

Sl No	Requested By	Date of Distribution	No. of Devices
1	Govt ITI Manacaud – (Distribution is scheduled on 01.09.2020)	28.08.2021	75
2	St.Mary's School Vizhinjam-Adv M. Vincent –MLA	30.08.2021	50
3	Kovalam Constituency- Adv M. Vincent – MLA	31.08.2021	50
4	Govt. L.P.S, Kidarakuzhy	14.09.2021	7
5	Muthalapozhi	14.09.2021	14
Total			**196**

The distribution of the digital devices held on 30.08.2021 at St. Mary's HSS Vizhinjam was inaugurated by Adv. M. Vincent, MLA for Kovalam constituency and presided over by Rev. Dr. Micheal Thomas, Vicar, Our lady of Good Voyage Church, Vizhinjam & the Manager of the school in the presence of Dr. Anil Balakrishnan, Regional CSR head.

The distribution of the digital devices held on 31.08.2021 at Govt. HSS for girls, Venganoor was also inaugurated by Adv. M. Vincent, MLA for Kovalam constituency and presided over by Mr. Hareendran, PTA president.

The distribution of 75 digital devices to Govt ITI, Manacud, Trivandrum was held on 01.09.2021. The distribution program was inaugurated by honorable Minister for General Education & Employment Mr. V. Sivankutty and distribution was done by honorable Minister for Transport Adv. Antony Raju.

Another 21 digital devices were distributed to the poor community students during the month of September 2021. Among that the first slot of 7 tablet was distributed to the students of Govt. LPS Kidarakuzhy and the second slot of 14 tables were to the poor students at Muthalapozhy, an affected area due to the quarry related activities of Vizhinjam International Sea Port.

2. COMMUNITY HEALTH

Following are the major activities conducted under Community Health.

1. Service of Mobile Health Care Unit (MHCU)
2. SuPoshan
3. Kitchen Garden - Safe to Eat Vegetables for All Homes (SEVAH)
4. Farm School
5. Cancer Care Support
6. Community Awareness Programme
7. Patient care support programme
8. Monitoring of Oxygen level
9. Convergence of Govt. Schemes
10. Other Events

2.1. Service of Mobile Health Care Unit (MHCU)

summary

- During the period from April to September 2021, the Vizhinjam MHU has visited 10 sites weekly and has provided 6468 treatments out of which 1710 were male and 4758 were female.
- Total 500 New registrations were mark during the period
- 15 home visits were done during the period for supporting the bedridden patients.
- 311 gluco tests were done and 154 positive cases were identified.
- Facilitation was provided to PHC Mukkola for COVID vaccination to 200 elder people in the project area.

Detailed Report

Month wise patient break-up for the period from April 2021 to September 2021

SN	Month	Male	Female	Total
1	April	192	544	736
2	May	185	524	709
3	June	350	983	1333
4	July	314	904	1218
5	August	304	843	1147
6	Sept	365	960	1325
Total		**1710**	**4758**	**6468**

Month wise details of Gluco tests during the period from April 2021 to September 2021

Month	Total Tests			Total Positive cases of Blood Sugar		
	Male	Female	Total	Male	Female	Total
April	28	47	75	8	23	31
May	2	9	11	1	6	7
June	16	49	65	7	32	39

July	16	38	54	6	18	24
August	10	20	30	4	9	13
Sept	27	49	76	9	31	40
Total	**99**	**212**	**311**	**35**	**119**	**154**

Photo Gallery from the field

Regular MHU activities

OP Recieving

Consulting

Distributing medicines

Beneficiaries gathered to avail medical services

BP Checking

Home viits

Covid Vaccinations

	
With hygiene and immunity kit	Handing over the pulse oxi meter to ASHA worker

2.2. SUPOSHAN (SDG No.2 and SDG No4)

SuPoshan is the health care initiative of Adani Foundation aimed to curb malnutrition and anemia among children below 5 years of age and women in reproductive age. After the wind up process of SuPoshan activities in Vizhinjam for 3 years it is decided to extend SuPoshan project to Kottukal Gram Panchayat as the second phase of Vizhinjam international sea port expansion is progressing to that area. During the reporting period, following are the major activities planned and executed in the Vizhinjam area.

interventions in Kottukal Gram Panchayat

a). Meeting with Community Leaders

Adani Foundation team members had several round of discussions with Mr. Jerome Das, President of Kottukal Panchayath and other 18 ward members regarding the extension of CSR activities especially SuPoshan Project. The local leaders positively responded towards the initiative and suggested names from their ward to act as community volunteers.

b). Interaction with CDS

Adani Foundation team members had also done several round of discussions with the representatives of Community Development Societies (CDS) of

Kudumbhasree regarding the extension of CSR activities to the Gram Panchayat. As a result of these discussions they have been inviting the Adani Foundation team members for further ADS/CDS Meetings.

c). Meeting with ICDS

Integrated child development Services programme (ICDS) aims at total development of the child and seeks to deliver all basic essential services like health, nutrition and education to children below six years of age, mothers adolescent girls and provide services simultaneously to them in their own village /community. ICDS is a community based programme and its success depends on active Panchayat participation. Thus Adani Foundation team members met with anganwadi workers and ICDS Supervisor during the period and visited all the 32 Anaganwadies in the panchayat

d). Interaction with Community Leaders

The foundation team had several round of discussion with community leaders, office bearers of CBOs and libraries during the period. Based on these visit collected a list of 40 community volunteers

e). Transit walk in Kottukal Panchayath

AF team done transit walk to 19 wards to find out the living condition of 19 wards. The transit walk was mainly to understand the economic background, anganwadi visits, scheduled colonies, scheduled hamlets and other major institutions and societies for SuPoshan intervention.

Community outreach programmes at Vizhinjam

a). Medical Support to Anganwadi Areas

During the period, with the help of Adani Foundation's Medical Healthcare Unit, coordinated and distributed urgent medicines to 97 people in 14 Anganwadi areas This was a great help to the community people as they were stuck in their homes and cannot avail medicines of their basic needs.

b). World Breastfeeding Week celebrations

Vizhinjam site celebrated World Breastfeeding Week from August 1- August 7, 2021. The theme for this year was “Protect Breastfeeding: A Shared Responsibility”. Most of the programmes were organized in association with Department of Women & Children, ICDS, Govt. of Kerala. Following are the details of the programs:

Date & Event	**Resource Person**	**No. of Parti.**	**Subjects Covered**
Webinar on “Role of Men in Women’s Health “ 01-08-2021	Dr. N S Iyer, Retired Gynecologist, Kerala Health Services, Kerala Government	101	*Components of women empowerment *Role of men in women's empowerment *Care during pregnancy *Duties of a father-to-be during pregnancy period *Importance of breastfeeding *Role of father during wife's lactation period *Father bonding with babies *Breastfeeding vs Formula Milk *Concerns of breastfeeding * Needs and roles of men
Awareness Poster Circulation 02-08-2021	SuPoshan team	367	Protect Breastfeeding : A Shared Responsibility
webinar on “Lactation Counselling “ 03- 08-2021	Resource Person: Dr Vidhya Vimal, Pediatrician, GG Hospital, Trivandrum	87	*Benefit of breast milk *Position of breastfeeding *Foods to increase breast milk *Practices decreasing breast milk *Breastfeeding during COVID time *How to identify early childhood disabilities *Importance of Newborn screening *Vaccinations for children * Queries related to Covid Vaccination
Awareness Poster Circulation 03-08-2021	SuPoshan team	406	Protect Breastfeeding : A Shared Responsibility
Oath taking b husbands i supporting	SuPoshan Team	68	Protect Breastfeeding : A Shared Responsibility

breastfeeding 04-08-2021			
Awareness Poster Circulation 04-08-2021	SuPoshan team	341	Protect Breastfeeding : A Shared Responsibility
Awareness Poster Circulation 05-08-2021	SuPoshan team	386	Protect Breastfeeding : A Shared Responsibility
Creating awareness with Anganwadi worker and other health workers 06-08-2021	SuPoshan team	21	*Importance of support from families *Awareness on ensuring breastfeeding
Awareness Poster Circulation 06-08-2021	SuPoshan team	268	Protect Breastfeeding : A Shared Responsibility
Counselling to pregnant & lactating mother 06-08-2021	SuPoshan team	8	*Positions of holding baby for breastfeeding *Hygiene practices for Pregnant & lactating mothers *Food habits during pregnant & lactation period
Webinar on "Importance of Breastfeeding " 07-08-2021	Resource Person: Rekha Raveendran R S, Clinical Nutritionist, ICDS Project, Thiruvanatha puram Corporation	36	*Importance of breastfeeding *Importance of weaning foods *Nutritious rich foods during pregnant and lactation period * Role of families and husbands in lactation period
Awareness Poster Circulation	SuPoshan team	165	Protect Breastfeeding : A Shared Responsibility

07-08-21			
Total Coverage		2254	

c). National Nutrition Month

Vizhinjam site celebrated World Breastfeeding Week from September 1- September 30, 2021. Following are the details of the programs:

Date	Event	Number of Participants	Subjects Covered	Departments
03-09-2021	Plantation of Moringa	5	Planted moringa in the households of MAM & Pregnant women and gave awareness of Moringa on healthy eating habits in Kottapuram ward	
06-09-2021	WASH Program	36	Awareness and demo of Hand washing demo among in Harbour ward	ICDS Department
08-09-2021	Cleaning drive		Cleaning drive at Lakshamveed anganwadi	Trivandrum

		16	area in Kottapuram ward	Corporation
11-09-2021	Plantation of Moringa	5	Planted moringa in the households of MAM & Pregnant women and gave awareness of Moringa on healthy eating habits in Kottapuram ward	
13-09-2021	Training of Community Volunteers	10	A training on "Rainbow diet & Good Nutrition" for community volunteers was organized at Adani Foundation's Farm School. The session was handled by Dr. Suma Divakar, Head & Professor, College of Agriculture, Kerala Agriculture University, Trivandrum	
15-09-2021	WASH Program	12	Awareness and demo of Hand washing demo among in Kottapuram ward	
16-09-2021	Plantation of Moringa	3	Planted moringa in the households of MAM & Pregnant women and gave awareness of Moringa on healthy eating habits in Kottapuram ward	
17-09-2021	WASH Program	32	Awareness and demo of Hand washing demo among in Venganoor & Vizhinjam ward	ICDS Department
18-09-2021	Yoga Session	32	A yoga session was organized at CSR Office, Mukkola for adolescent children. The session was handled by Mrs. Sapna, Yoga Therapist and gave guidance on doing breathing exercises, body and mind flexibility exercises.	
20-09-2021	WASH Program	8	Awareness and demo of Hand washing demo among in Kovalam ward	
23-09-2021	WASH Program	11	Awareness and demo of Hand washing demo among in Mullor ward	
			Organized recipe	

24-09-2021	Recipe Competition	13	competition among mothers of children under 5 years.	
25-09-2021	Plantation of Moringa	2	Planted moringa in the households of MAM children and gave awareness of Moringa on healthy eating habits in Venganoor ward	
8-09-2021	Nutrition Kit Distribution	3	With the support of EVP distributed nutrition kits to 3 underweight children of Harbour and Venganoor wards.	
29-09-2021	Nutrition Kit Distribution	7	With the support of EVP distributed nutrition kits to 7 underweight children of Harbour, Mullor, Vizhinjam and Venganoor wards.	
30-09-2021	Webinar on Nutrition Kit	12	A webinar was organized to give awareness on the right usage of the items in Poshan kit distributed to underweight children. The session was handled by Mrs. Vichithra V T, Clinical Nutritionist, ICDS Project, and Athiyannoor. The class threw light on Healthy eating habits, benefits of healthy eating, Variety of nutritious food, balanced diet, rainbow food, My plate – children's edition.	

2.3. Safe to Eat Vegetables for All Homes (SEVAH) - 1000 Household homestead vegetable garden-2020-21

The kitchen Garden initiative of AF progressing commendably with 260 households. The process of expanding kitchen garden to another 500 households is also progressing during the reporting period. The details of the activities done as part of the kitchen garden initiative are as follows

Planting materials supply-for Phase 1

Vanitha Karshika Karma sena- a women's enterprise group were entrusted with the task of preparing quality planting material for the Kitchen garden 1st phase. An agreement is executed between Vanitha Karshika Karma Sena and SEVAH Federation (kitchen garden beneficiaries). The agreement is to ensure quality and timely supply of planting materials. A total no of 5200 seedlings of hybrid variety seedlings prepared by Karma Sena and distributed as follows.

Distribution of Vegetable Seedlings -Second season for 1st Phase

Sl No	Group Leader Name	Ward	No of Groups	No of Seedlings Distributed
1	Anitha	Venganoor	2	900
2	Chandrika	Harbor	2	900
3	Raji	Mulloor	1	500
4	Virgin Mary	Venganoor	1	500
5	Kavitha	Mulloor	2	500
6	Prasanna Kumari	Mulloor	1	500
7	Carmel	Kottappuram	1	500
8	Mercy	Kottappuram	1	500
9	Preeja	Mulloor	2	400
Total seedlings distributed			**13**	**5200**

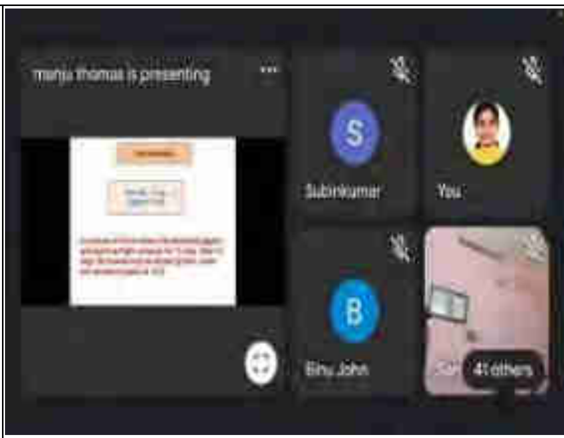
 

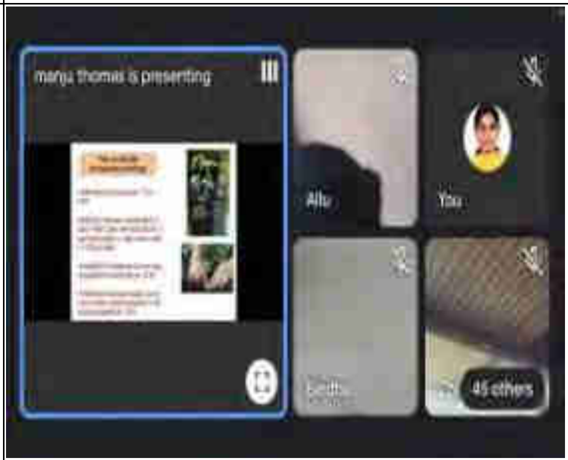
Webinar on Homestead Vegetable garden

An online orientation was conducted on 17^{th} and 18 th May 2021 on Google meet platform for the homemakers of Vizhinjam in collaboration with KVK Vellanad, Trivandrum. The training was mainly on, home nursery making, cultivation in grow bags, manuring and on Plant protection. The Cultivation aspects were handled by Mrs Manju goerge Subject matter specialist –Horticulture, and Plant protection was handled by Mrs Bindu, specialist in plant pathology.

The meeting was inaugurated by Adani foundation CSR head Dr Anil Balakrishnam and presided over by Dr Mr Binu sam KVK head . The programme started by a welcome address given By Mr sebastain brito, Center head Adani foundation CSR office vizhinjam followed by technical briefing By Mr Rakesh Nair Senior project officer (in charge of Agriculture)

A total of 100 participants joined the programme in both days programme. The meeting concluded on 18^{th} may with a note by Dr Binu sam KVK head asking for more cooperation with adani foundation in coming future.





Survey of Households second phase.

During the period the house hold survey for implementing Kitchen garden has been completed in 500 houses and formed 25 groups

Technical Training

The following groups completed Technical training for initiating professional kitchen garden for the phase II (500 families) during the period.

Technical training –completed.

Sl no	Name of group	No of persons attended	Place
1	karayadivila-Kitchen Garden -1	10	Venganoor
2	Mariyan Nagar -Kitchen Garden-1	17	Kottappuram

3	Manali-Kitchen Garden -1	16	Venganoor
4	Mulloor-Kitchen Garden-1	9	Mulloor
5	Manali-Kitchen Garden -2	10	Venganoor
6	Manali-Kitchen Garden -3	10	Venganoor
7	karayadivila-Kitchen Garden -1	10	Venganoor
8	Vayalinkara -Kitchen Garden-1	25	Kottappuram
9	Manali-Kitchen Garden -1	16	Venganoor
10	Mulloor-Kitchen Garden-1	9	Mulloor
11	Chennavila-Kitchen Garden -1	12	Vizhinjam
12	plavilai-Kitchen Garden -2	11	Vizhinjam
13	Ayyankali -Kitchen Garden	10	Venganoor
14	Vayalinkara -Kitchen Garden	10	Kottappuram
15	Mulloor-Kitchen Garden	20	Mulloor
16	Mulloor-Kitchen Garden-	9	Mulloor
17	Kottappuram-Kitchen Garden	20	Kottappuram
18	Vizhinjam -Kitchen Garden	20	Vizhinjam
19	Harbour-Kitchen Garden	20	Harbour
20	Harbour-Kitchen Garden	20	Harbour
21	Harbour-Kitchen Garden	20	Harbour
22	Kottappuram-Kitchen Gadren	20	Kottappuram
23	SNDP- Kitchen Gadren	11	Harbour
24	Kidarakuzhi-Kitchen Garden	12	Mulloor
25	Pallithura Anganwadi 1- Kitchen Gadren	15	Vizhinjam
26	Pallithura Anganwadi 2- Kitchen Gadren	24	Vizhinjam
27	Thottam- Kitchen Gadren	19	Mulloor
28	Manali- Kitchen Gadren	10	Mulloor
29	Vizhinjam Theruv- Kitchen Gadren	10	Vizhinjam
30	Kasthoorikulam- Kitchen Gadren	19	Harbour
31	Kadikulamcolony- Kitchen Gadren	20	Kottappuram
Total		**464**	









2.4. Farm school

The proposed farm school will serve as a community school for agricultural learning. It is set in a majestic landscape with a bamboo house as training house and a lawn set in the shape of a leaf, symbolizing the solar energy receptor and plant food factory, thus ultimately the factory feeding humanity, and key oxygen producing organ for mother earth. Farm school has the functional specification of 1. Horticultural garden and honey production unit, Crop museum (to house possible Crop Introduction for vizhinjam), Vegetable and nutrition Garden, Vegetable nursery, Hi tech banana Farming. The Farm school in future will train @400 Agri-aspirants on every year basis.

The following activities were done at Farm school during the reporting period

Plantation drive and farm school planting inauguration.

In connection with the birth day of Goutham Adani –chairman Adani group, Plantation drive was announced as an event for this year throughout all the institutions under Adani group in India. Adani foundation CSR of AVPPL celebrated this event, by inaugurating the planting activity of @ Farm school project site.

The birth day function of Goutham Adani sir was initiated with cutting of cake by our respected CEO of AVPPL. The programme introduction was made by Dr Anil Balakrishnan, CSR head of Adani foundation South India. This was followed by Inauguration of plantation drive by respected CEO Sri. Rajesh Jha by planting a Mango graft @ Farm school Campus. This was followed by Planting fruit trees, sowing of vegetable seeds, and planting tissue culture banana by staff members and divisional heads of AVPPL. Starting with 500 plants on the same day, a total of 5900 plants were planted till date.

The whole programme was conducted by following all SOP on Covid with limited no of officials representing Key sectors of AVPPL and Adani foundation. The programme Scheduled on 24.6.2021, Started by 3.30 pm and concluded by 4.30 pm.



Total Plant Details of farm school and fruit orchard

Sl no	Plants	Farm school	Fruit orchard	Planting type	No's
1	Fruit Plants	Annuals Banana varieties of Nendran,(Fruit and commercial), Rasakadali, Kadali,palayamthoodan, G9,Robusta, and culinary varieties like month an and leaf types.	Perineals Mango,Jack,Sapota,Rambutan, Guava,Pappaya, Mangosteen	Pits	500
2	Cereals and Pulses	Maize,Bajra, Sunflower, Soyabeene,Green gram ,Red gram	Nil	pits	500
3	Tuber crops	Sweet potato, Tapioca, Colocasia,Elephant foot yarm	Nil	Ridges	1000
5	Vegetables	Bhindi,Brinjal, Chilly, Cucurbits, Tomato,Beans	Nil	Ridges	1500

6	Millets	Ragi, Chama, Tina	Nil	Ridges	500
7	Vegetable Nursery	Bhindi ,brinjal,Cucurbits,Chilli,Tomato	Nil	Potting trays	1500
8	Ornamentals	Coleus, Jasmine,Rose,Aralia, hibiscus ,	Nil	Pits	300
	Total				5950

Harvest @ Farm School

Harvesting @ farm school started on 2nd August 2021.The items and the quantities harvested during the period is as follows

Sl No	Item	quantity
1	Amaranthus Red	95 kg
2	Amaranthus Green	45 kg
3	Yard Long Bean	105 kg
4	Bitter guard	65 kg
5	Cluster beans	6 kg
6	Bhindi light Green Long	40 kg
7	Bhindi Dark Green	55 kg
Total harvest		**411 Kg**






Sales@ Farmschool by Karmasena

The Karsheeka Karma Sena, one of the livelihood group formed under the CSR of AVPPL/AF has been coordinating the selling of harvests from school

Farm School 2 activities @ Substation site – Fruit Orchard

The land preparation leveling and pitting works completed @ substation site Mukkola. A total of 190 pits completed for various fruit orchard crops. It is expected that the permission to undertake development of water source will happen soon from the Department of Groundwater so that we could complete planting by the end of October 2021

2.5. Cancer Care Support - providing nutritious Food supplements & Medicines to the poor patients

Adani foundation has been supporting with nutritious food supplements to the following 15 terminal stage poor cancer patients who cannot eat solid food twice monthly. The nutritious food kit includes 1. Protein powder - Ensure 500 gms, 2. Milk powder - Every day 1 kg and 3. Oats 1 Kg to meet their immediate nutrient requirements. This will further support these patients to meet their daily food requirement without spending much on it. The patient's age group ranges from one year to 55 years of age, coming from various strata of society in different economic backgrounds

Following medicines recommended by Regional Cancer Centre were also monitored as per the prescription of their doctors under the strict supervision of a medical nurse working with Abhayam Charitable society.

Sl No	Medicine Name	Quantity
1	Glycolate- 1 mg	270
2	Arpizole -5 mg	90
3	Zolefres – 10mg	270
4	Ivepred -4 mg	90
5	Resebron Plus - 700mg	90
6	Shelcal with Vitamin D3-1000mg	1000
7	Tamoxifen - 20 mg	270
8	Letero -2.5 mg	180
9	Cryon -250 mcg	90
10	Lenmid-10 mg	180
11	Tenofovir-300 mg	90
12	BioD3 Plus	90
13	Eltroxin -100 mg	90

Distribution of Vegetables from kitchen garden to Cancer Patient.

Organic Vegetables growing various kitchen garden groups collected and distributed to the much needy cancer patients. The items include Amarantus, Bhindi, Brinjal, Chilli, Curry leaves, Brinjal Long, Koval, yard long Beans, Toamto and cluster beans.

2.6. Community Awareness Programme

As we are living with Covid19, it is important for all members of community to have awareness on Govt. Schemes and other COVID-19 related information. To help the community AF has started the community awareness programme in the Vizhinjam with strict COVID protocol. One of the volunteer's groups, promoted under the CSR of AVPPL/AF- Karsheeka Karma Sena is coordinating the programme. Most of the members who are actively participating in the community awareness are from widow's category as part of our Widow's engagement programme. The progress of port construction is also have been sharing in the community awareness programmes. The following community awareness programmes were conducted during this period.

Sl NO	Month	No. of Sessions	No of Participants
1	April	12	208
2	May	6	112
3	July	30	390
4	August	26	285
5	September	49	566
Total		123	1561




2.7. Patient care support programme

As part of the patient care support programme community volunteers have been visiting the houses of bedridden patients and providing medicine and Psychosocial support to the bed ridden patient. Community Volunteers visit 59 houses During the reporting period.


2.8. Monitoring of Oxygen level of community people

As part of the patient care support programme, community volunteers have been monitoring the oxygen level of the patients especially bedridden patients. During the period, community volunteers monitored the oxygen level of 883 patients.

2.9. Convergence of Govt. Schemes

The convergence of Govt. Grant-in-aids schemes in CSR activities progressing well during the reporting period. Information regarding various schemes have been shared through the WhatsApp groups named "Phoenix – for Widows & divorced" and 'Shalabhangal- Butterflies for children below 18yrs old.

2.10. Other Events

World Environment day -2021

World Environment Day is celebrated on June 5 every year to remind people about the importance of nature. It is celebrated across the globe to tell people that nature should not be taken for granted and must be respected for its values. With the coronavirus outbreak and people being confined indoors, the environment and mother earth seem to have benefitted slightly. In the absence of human activities amid the coronavirus-induced lockdown, nature is getting time to clean itself and reclaim its space. It is worth this time to think and act according what told by our father of Nation that "**What we are doing to the forests of the world is but a mirror reflection of what we are doing to ourselves and one another". - Mahatma Gandhi.**

The theme for 2021 is "Ecosystem Restoration", and was hosted by Pakistan in tune with the occasion Adani Foundation, CSR of AVPPL has conducted two different programmes to disseminate the concept and values associated with the theme of Environment day. The programme was on: -

- **A webinar on Eco restoration**
- **Selfie with the plant-Planting challenge to 1000 homes of vizhinjam.**

Webinar on Eco restoration

The webinar on Eco restoration was handled by Mr. PrakashanV.V, Assistant Director, Department of Soil conservation Govt. of Kerala. The session was inaugurated by Mr. Vasanth Gandavi, the Executive Director of Adani Foundation. On his inaugural speech he explained that at this juncture of difficulty, focus should be on coexistence of humans with other life means should be the prime focus of all environment campaigns. Webinar presentation of Mr. V.V Prakashan started with the original theme of the day for Eco restoration

The 3Rs of sustainable living recreate. Reimagine and Restore - a powerful call to action, reminding listeners that we must stop plundering and start protecting the planet's resources. It ties into the Decade on Ecosystem Restoration, a UN initiative to prevent, halt and reverse the degradation of ecosystems worldwide.

The presentation he made was simple and informative, with interesting illustrations. The main points presented were on: -

Climate Change - Climate Crisis

To limit temperature, increase to 1.5°C, we must drop our greenhouse gas emissions 7.6% each year between 2020 and 2030. Climate change is not only changing the overall weather scenario but has larger and harmful effects.

Air, Water and Land Pollution

Pollution is not only limited to water, soil, and noise but has extended to light, visual, point, and non-point sources. Human beings and their actions are majorly responsible for causing all types of pollution.

Global Warming

Global warming is another environmental issue which is an increase in the earth's temperature due to the effect of greenhouse gases called carbon dioxide, methane, water vapor, and other gases.

Deforestation & Logging

Deforestation means, clearing of forests or green cover for means of agriculture, industrial or urban use. It involves the permanent end of forest cover to make that land available for residential, commercial or industrial purposes.

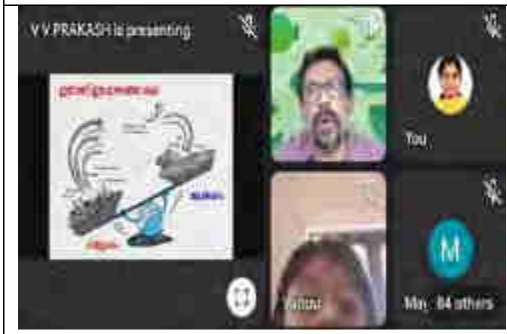
Industrial and Household Waste

Due to an increase in demand for food, shelter, and house, more goods are produced. It affects human health, degrades soil quality, affects wildlife, causes air pollution, and results in climate change.

Practical solutions to problems of environmental concern for Vizhinjam (as the part of discussion)

- Rainwater harvesting structures at possible sites
- Land preparation @ for pre-monsoon showers to conserve monsoon (formation of coconut basins and breaking of land hard pan)
- Staggered trenches in catchment to collect water from rains for percolation to improve water quality of wells.
- Stressed on scientific soil and water conservation at catchment of Gangayar canal to prevent future flooding. Department of soil conservation should be approached for.

The meeting on goggle meet was attended by near 100 participants of vizhinjam majority being youth. The meeting started by 11.30 and ends by 2.pm.



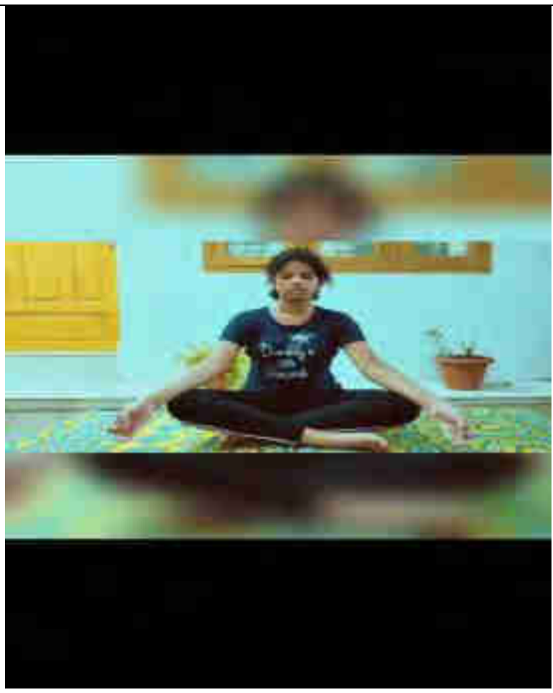
Selfie with plant – Planting challenge from 1000 homes

This was a campaign to promote planting of saplings. It was proposed to plant saplings in each one's home. The photo of plant with planter should be send to a link (whatsapped), with their phone no and address. Each sender will be awarded with an online certificate with their own photo. This was arranged in this fashion as a mass field campaign was not possible due to covid SOP (Standard Operating Protocols). The programme had an overwhelming response as near 1000 households shared photos of their planting.

International Yoga Day Celebration

Yoga is an invaluable gift of India's ancient tradition and it is serving the humanity since the ages that combines physical, mental, social and spiritual pursuits to achieve harmony of body and mind. In modern time, Yoga became popular and we have started to celebrate since the UN has declared 21st June as the International Yoga Day.

This year we were celebrated 7th International Yoga Day 2021. It was in digital platform due to the COVID-19 pandemic. The students, community volunteers and students of skill courses were participated with their family in the yoga programme conducted by Adani Foundation at their homes. This year theme was **"Be with Yoga Be at Home"**



Onam Celebration

Onam was celebrated at CSR office on 19 .08.2021 with offerings of floral tribute to Raja Mahabali by putting Athapookalam by CSR and ASDC staff Members. This was followed by various cultural programs in align with Onam.This includes Musical Chair, Thiruvathira, Onam Songs etc. The event ends with a traditional onam Feast organized atCSR office were all staff members participated and enjoyed the occasion.

Foundation Day Celebrations

Foundation Day was celebrated on August 12 by distribution of sweets and distributed among staff members and our immediate beneficiaries. This was followed by a video presentation from all foundation teams all our India's Vizhinjam also prepared a video in advance at various locations of importance including Vizmart, Farm School, ASDC with wishes from MLA, CEO, & all stakeholders. The foundation Day was inaugurated by our Honorable Chairperson Dr. Priti Adani with wishes from Executive Director Shri PN Roy Chowdhury & Executive Director Shri.Vasant Gadhavi followed by other officers of repute. The program ended with the entry of Chairman Adani Group to the session Shri.Gautham Adani for wishing all the groups gathered at various locations of the country.




3. SUSTAINABLE LIVELIHOOD DEVELOPMENT (SLD)

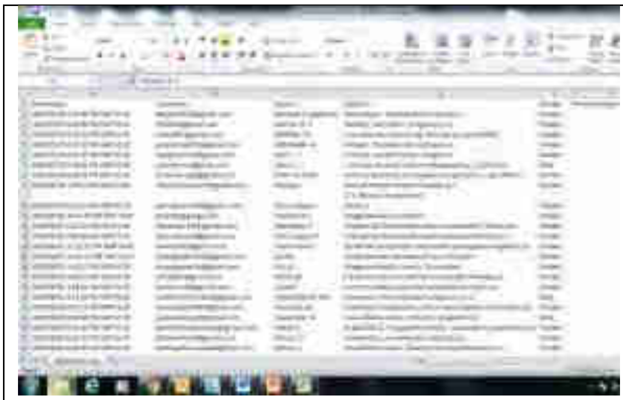
The projects under SLD included

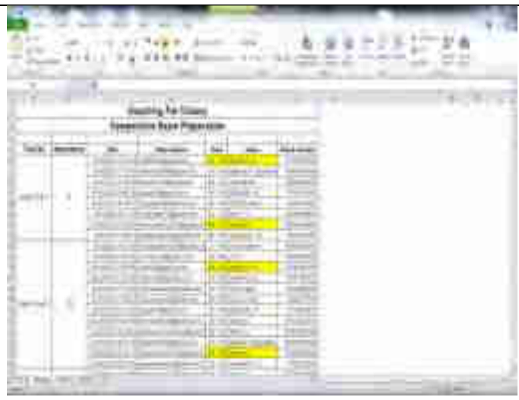
1. Competitive Exam Preparation coaching programme
2. Digital Literacy Training programme – E learning
3. Skill Development Programme &
4. Livelihood Development Programme – Group and individual support

3.1 "Coaching for success" – Competitive Exam Coaching Programme

Virtual Training Classes

Training sessions along with daily mock test is going on with an average of 114 students' participation. Weekly mock test, timetable and study materials are shared through google drive link. A total of 630 students were accessed the E-learning platform developed for Competitive Exam Preparation in the previous year and same training strategy are following in this year also for the registered candidates.





E-Learning Activities

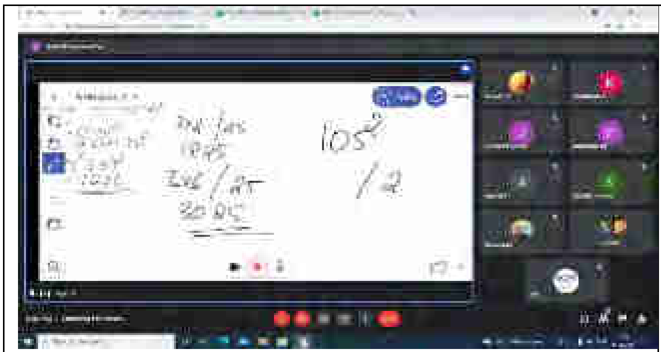
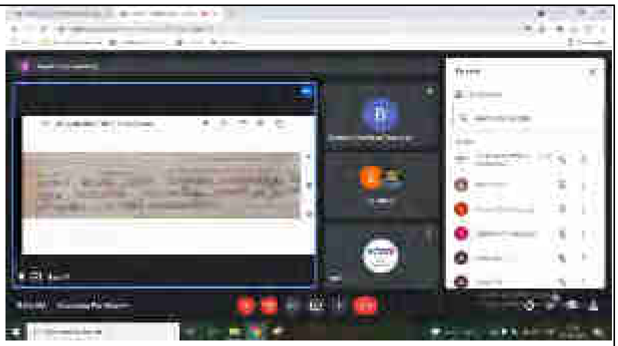
In addition to the virtual classes, other e-learning activities have been progressing simultaneously as follows.

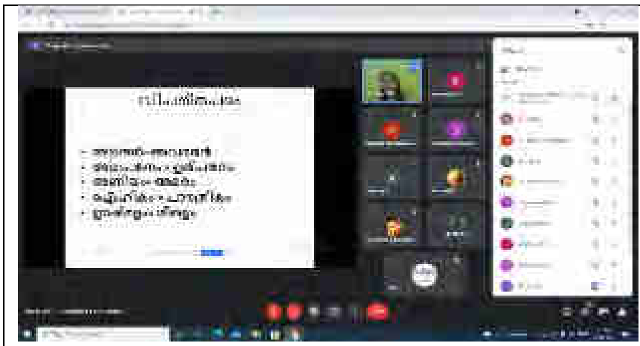
- Study materials like Rank file pages, easy study methods from You Tube and voice clips related to the daily test topics links has been shared on a regular basis.

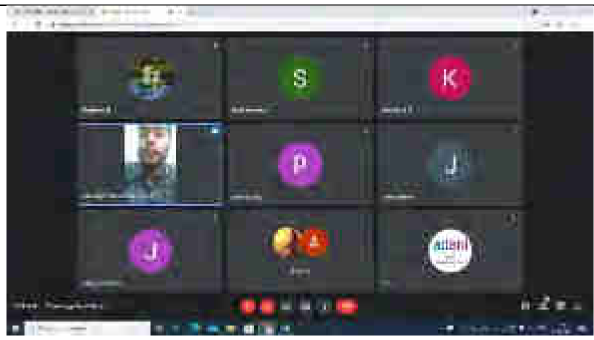
- Different vacancy announcements from Central and State government has also been circulating through online platform
- Necessary support has been provided for students, who are not having proper internet facility or devices for applying various job opportunities.
- Adani Foundation is providing G -SUITE ID for the registered students for online classes as well as for utilizing the resources in a more advanced method.
- Daily online test for a score of 30 has been conducting on a regular basis.
- After the successful completion of every day mock test the top scorers will be announced by the coordinator in the group.
- From this year onwards, a 100 marks mock test purely based on the previous question papers are conducted in regular weekends and the results will be announced through the groups.

As per the restrictions announced by the Kerala Government, Competitive Exam Preparation coaching is going on through online mode. As of now, the coaching sessions are conducting through the Google Meet virtual platform. Daily 2hr sessions are arranged with different tutors and regularly conducting mock test based on the announced topics. As of now were are focusing the coaching mainly for the following topics,

i. General English.
ii. Mathematics.
iii. Indian Constitution.
iv. Malayalam.
v. General Knowledge.





As a part of new practice, we started sharing the notification details of the new openings in Central/State Government services through WhatsApp group for making aware the candidates about the opening and remind them for applying for the same.

We are conducting daily mock with a score of 30 based on the topics provided already and based on the previous question papers a weekly mock test of 100 score is also conducting regularly.

As a result of intensive coaching, 57 candidates were selected in the plus two level preliminary examination conducted by Kerala Public Service Commission with good scores. They are regularly attending the online sessions for the upcoming main examination. In addition to regular day sessions, we are providing online classes on Saturdays also as per the candidate's request. In CSR office, we did arrangements for the combine study activities at evenings for the nearby candidates.

3.2 Digital Literacy E-Learning Programme

This year 2021-22, we are targeting 2000 beneficiaries and out of this 507 beneficiaries were registered through LMS. The programme covers internet banking, social media, mobile banking, Digi locker, MS office, cyber security, barcode etc.... The programme helped in making the people to equip on online transactions, bill payments like KSEB, water bills, school fee payments and e-commerce activities during this pandemic restriction.

The Digital Literacy Batch beneficiaries installed many useful mobile applications like BHIM App, SAKSHAM App and Digi-Locker.

Digital Literacy Certificate Distribution

Certificates for the completed Digital Literacy 223 beneficiaries were distributed through the LMS. After completing 16 modules wise assessment the beneficiaries can easily download the E-Certificates from the LMS.

3.3. SKILL DEVELOPMENT PROGRAMME

Entrepreneurial Skilling Programmes

For this FY 2021-22, ASDC is planning to conduct the Livelihood training for three different job roles.

Sl No	Job Role	Duration	Proposed Count
1	Patient Care	100 hrs.	25
2	Smart Maid	150 hrs.	25
3	Self-Employed Tailoring	320 hrs.	25

As the result of livelihood training done during the previous year following are the livelihood groups running by our beneficiaries in VizMart, Vizhinjam.

Home Nursing - SPANDHANAM – Patient Care Unit

- The beneficiaries of Patient Care training programme formed a group with name "SPANDANAM Patient Care Unit" with 7 members. This group was registered as the Charitable Trust in Registration Department, Trivandrum.

  They are conducting weekly meeting for discussing and validating the progress, reach of their group and also finding out the new opportunities.

  4 members are working in different home based openings and earning money for their family. New openings are now notified and they are taking care of the placements.

  Data Entry Operator (Batch 1) – SWAP DATA SERVICES – Livelihood Group
- Data Entry Operator batch beneficiaries formed a group and started a livelihood programme named as SWAP DATA SERVICES at VizMart. They are running the Centre with a rented Photostat machine and two PC systems and providing services to the localities. The Loan is under process in the bank, once the loan is approved then they will procure the printing machine and other needed equipment.
- **Placement - Non-Domain Batches**

  Placements of the completed domain batch trainees are still progressing. We had approached different hospitals and Patient Care Centre related to the placements of GDA trainees. Good responses are getting from the sectors regarding the placements after the pandemic Covid 19 issues. Shopping Malls, Two/Three Wheeler Showrooms are getting started after the Covid 19 situations and placement openings for the Retail Sales trainees are finding out by our Placement Officer.
- The details of the placed non domain trainees under ASDC Vizhinjam Centre is as follows,

Sl. No.	Name of the Trainees	Trade	Company Name	Offered Salary
1	Leela	Basic Home Health Care	Home Care	12,000
2	Beena	Basic Home Health Care	Home Care	10,000
3	Lissy A M	Basic Home Health	Home Care	10,000

		Care		
4	Bindu V	Basic Home Health Care	Home Care	9,000
5	Clincy	Assistant Beauty Therapist	Fairglow Beauty Parlor, Trivandrum	8,000
6	Greeshma Prabhath	Assistant Beauty Therapist	Soniya Beauty Parlor, Balaramapuram	8,000

Employability Skilling Programmes

- During the period ASDC started four different domain courses from 22nd April onwards. Due to the Covid-19 situation the regular training progressing through Google Meet online platform for the following.

Sl. No.	Course Name	Eligibility	Duration	Certification	Venue of Classes	Participants
1	General Duty Assistant-GDA	10th	460 hrs	ASDC	ASDC Building, Mukkola	41
2	Beauty Therapist - BT	8th	390 hrs	ASDC	CSR Office, Mukkola	27
3	Data Entry Operator - DEO	10th	440 hrs	ASDC	ASDC Building, Mukkola	52
4	Retail Sales Associate – RSA	10th	320 hrs	ASDC	ASDC Building, Mukkola	41

General Duty Assistant (Batch-1 & 2)

In this FY 2021-22, ASDC Vizhinjam Centre conducted 2 batches for General Duty Assistant domain course with 41 trainees. Theory portions are completed and practical sessions are conducting at Centre.

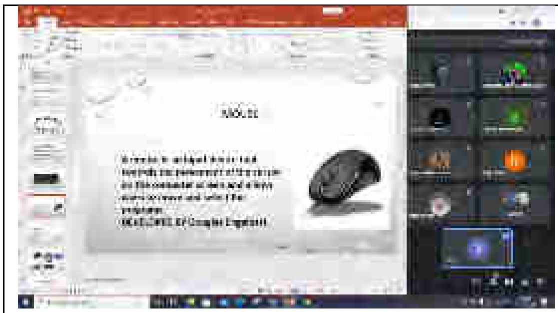
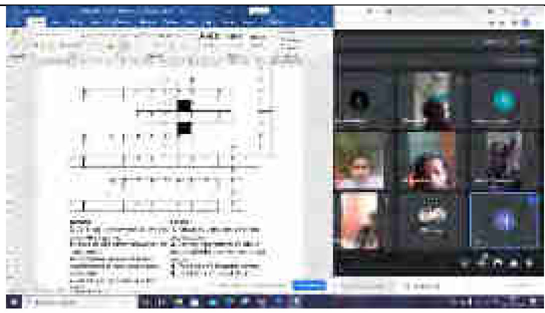

1. **Beauty Therapist (Batch 1)**

ASDC Vizhinjam Centre started training for the Beauty Therapist domain course from 22nd April 2021 with 27 beneficiaries. Theory portions were completed through the online classes and now the practical sessions are going on at Centre in different time slots. Trainees are participating and attending the module wise assessment through LMS. As part of the livelihood activity, Beauty Therapist trainees started registration process of Udyog Aadhar registration.




Data Entry Operator

After the Induction Week Programme, online sessions started for the 52 trainees of Domestic Data Entry Operator batches on 6th September 2021. As of now the training are progressing as two batches through online platform.

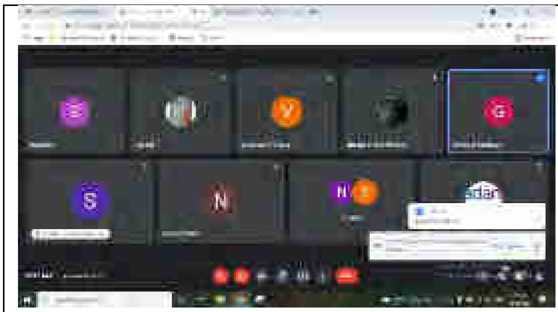
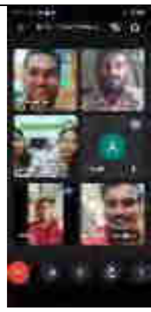
  

Retail Sales Associate

As part of better and effective identification of the trainees for attending the Retail Sale Associate domain course, we started Induction Week programme with the applied candidates on 6th September 2021. Informed 53 applied candidates from the community regarding the Induction week programme and shared the Google Meet link for the same. All the necessary details like,

- ✓ About Adani SAKSHAM.
- ✓ About Domain Courses like GDA, BT, DEO & RSA.
- ✓ Aptitude, Attitude, Necessity, Domain Knowledge tests.
- ✓ About Career Orientation & Placements activities.
- ✓ About Livelihood generation etc...

Were discussed in the upcoming days with regards to the Induction week programme. After completing the 5 days Induction week programme, 41 beneficiaries came forward for joining the training programme. As of now the online sessions are going on daily basis for the 41 trainees.

Placements

Below are the placement details of our domain batch trainees placed in different sectors during the period,

Sl. No.	Name of the Trainees	Trade	Company Name	Job Role	Offered Salary
1	Greeshma M P	General Duty Assistant	Reliance	Customer Relationship Executive	18,000
2	Vineeth	Data Entry Operator	Santhwanam, Mulloor	Cashier	14,000
3	Santhosh Kumar	General Duty Assistant	SAP Police Training Camp, Trivandrum	Gardener	18,000
4	Aravind	General Duty Assistant	ESAF, Trivandrum	Customer Relationship Executive	14,000
5	Athira Anilkumar	Data Entry Operator	Popular Vehicles, Trivandrum	Receptionist	12,500
6	Sajitha Justin	Beauty Therapist	Phoenix Beauty Parlor	Beauty Therapist	4,000
7	Mable. J	Beauty Therapist	Fairness Beauty Parlor	Beauty Therapist	6,000
8	Sabari S S	Retail Sales Associate	Travancore Titanium Products LTD	Executive	15,000
9	Akhila CB	Retail Sales Associate	Punalur Govt. Thaluk Hospital	ECG technician	12,000
10	Veena ks	Retail Sales Associate	Punalur Govt. Thaluk Hospital	ECG Technician	12,000
11	Ancysharu	Data Entry Operator	Popular Hyundai	Customer Relationship Executive	12,787
12	SARATH KUMAR S P	Data Entry Operator	Ideal Solution	Customer Relationship Executive	8,000
13	Akhila B P	Beauty Therapist	Fairness Beauty Parlor	Beauty Therapist	6,000
14	Shiny Ancy. A	Beauty	Phoenix	Beauty	4,000

		Therapist	Beauty Parlor	Therapist	
15	BINU.J	Data Entry Operator	Ideal Solution	Customer Relationship Executive	8,000
16	Anju. K. N	Data Entry Operator	Ideal Solution	Customer Relationship Executive	8,000
17	Nivya s prem	Data Entry Operator	Ideal Solution	Customer Relationship Executive	8,000
18	Primy. M	Data Entry Operator	Ideal Solution	Customer Relationship Executive	8,000
19	Salini MS	Data Entry Operator	Ideal Solution	Customer Relationship Executive	8,000
20	Baby	Data Entry Operator	Ideal Solution	Customer Relationship Executive	8,000
21	Asseba	Data Entry Operator	Ideal Solution	Customer Relationship Executive	8,000
22	Ajitha	Beauty Therapist	Deyyana beauty parlor	Beauty Therapist	6,000
23	Suchithra	Beauty Therapist	Queen Beauty Parlor	Beauty Therapist	6,000
24	Josmi	Beauty Therapist	Style Ladies Beauty Parlor	Beauty Therapist	6,000
25	Arathy Anilkumar	Data Entry Operator	Popular Hyundai	Customer Relationship Executive	10,000
26	Abdul	Data Entry Operator	ICICI	Sales Executive	10,000
27	Sruthi Chandran	General Duty Assistant	Ananthapuri Hospital	Receptionist	8,000
28	Soumya S J	General Duty Assistant	Ananthapuri Hospital	Nursing Assistant	5,000
29	Saranya Saseendran	General Duty Assistant	Ananthapuri Hospital	Nursing Assistant	5,000
30	Anju R L	General Duty Assistant	Ananthapuri Hospital	Nursing Assistant	5,000
31	Kala V S	General Duty Assistant	Ananthapuri Hospital	Nursing Assistant	5,000
32	Aswathy A S	General Duty	Ananthapuri	Nursing	5,000

		Assistant	Hospital	Assistant	
33	Anthoniamma	General Duty Assistant	Ananthapuri Hospital	Nursing Assistant	5,000
34	Preethi P	General Duty Assistant	Ananthapuri Hospital	Nursing Assistant	5,000
35	Abhilash C	RSA	Reliance SMSL Ltd	Customer Service Associate	12,566/month
36	Akhila A M	RSA	Reliance SMSL Ltd	Customer Service Associate	12,566/month
37	Shereen Ahammed	RSA	R R Donnelley	Document Specialist	19,000/month
38	Shemeer Khan	RSA	Reliance SMSL Ltd	Customer Service Associate	12,566/month
39	Vini M	RSA	Reliance SMSL Ltd	Pending	Pending
40	Navab V	RSA	Reliance SMSL Ltd	Pending	Pending
41	Vini Vincent	RSA	Reliance Fresh	Customer Service Associate	10,000/-
42	Sameer Khan	RSA	Reliance Fiber	Customer Service Associate	14,000/-
43	Prema	RSA	Jayalekshmi	Customer Service Associate	11,000/-
44	Sobha	RSA	Jayalekshmi	Customer Service Associate	11,000/-
45	Vijila	RSA	Jayalekshmi	Customer Service Associate	11,000/-
46	Ajin A	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-
47	Priya	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-
48	Jisha K	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-
49	Prema	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-

50	Baby D C	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-
51	Sajna S	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-
52	Soorya Biju	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-
53	Mahima B Satheesh	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-
54	Sithararaj R S	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-
55	Sujatha Sony	General Duty Assistant	ASHA Home Care	Healthcare Assistant	16,000/-

Soft Skill Training

Soft Skill portions like Communication skills, Language skills are providing to the domain trainees as per the SOP. M. Kavitha is handling the soft skill portions for the ongoing domain batches. We are providing half an hour session for each domain classes on regular basis. She is also giving some activities like self-introducing by the trainees, reading an English paragraph content etc. These activities may help to increase their confidence in speaking English as well as to understand Language words and meanings.



General Activities

LOI Signed with ASHA Home Care Services

An LOI (Letter of Intent) was signed in between ASDC Vizhinjam Centre and ASHA Homecare Services regarding the placements of GDA trainees on 29th September 2021. The LOI was received by Mr. Sreejith, Placement Manager in that occasion at ASHA Home Care office. They had already taken our 10 GDA trainees for their unit as Health Care Assistance. As a result of good feedback, the upcoming opportunities for GDA trainees will be taken from ASDC Vizhinjam Centre.

Monthly Learning Sessions

Training on Sales & Marketing

As part of the capacity building programme ASDC HO has been initiating monthly learning session. The following session were conducted during the period and all team members from Vizhinjam ASDC participated in all the programmes.

- Sales and Marketing
- **Impact of Right Competencies at your Work Place**
- **Physical & Mental Health in a Neo-Normal Situation"**
- Changes in the current scenario
- Digital Marketing & its imp

Success Story

Mrs Aswathy A.S, who is a native of Kottukal panchayat currently working in Ananthapuri Hospital which is one of the leading multispecialty hospitals in Trivandrum. She is married and her husband is doing painting works. Due to some personal reasons she discontinued her Higher Secondary Education. She got married in her early twenties and has been leading a happy married life. On the flip side her long cherished dream was to do a job, to be independent and support her family. She didn't get the opportunity to continue her studies.

At this time, she heard about the courses running under Adani Skill Development Centre Vizhinjam and opted the GDA course, she had an intense desire to become a nurse. She was regular and punctual to the system and very actively participated in the practical sessions.

During the OJT time, she performed very well and good feedback were reported from the supervisor. When she completed the course she got a proposal to join in the Ananthapuri hospital as General Duty Assistant. She accepted the opportunity with happiness and her dream accomplished.

For the last 6 months she is working in the same hospital very happily and recently she owned a new two wheelers. She conveyed here thanks and success to our Centre. She is a perfect example of women empowerment, and a magnificent case of SAKSHAM.

<u>Photos</u>



3.4. LIVELIHOOD UPDATES

Status of existing livelihood groups

Sl No	Group	Type of Business/ Status up to March 2020	Business Status during the Month
1	Clean 4 U (5 Members)	• Hi Tech Cleaning for Flats, Hospitals, Offices, water tank, Vehicle and Public Institutions • Hosted a new web site www.clean4u.info for the customer registration	• The clients included offices, hospitals, flats… • Average monthly turnover is close to Rs. 51,600/ • Supplied contract cleaning cum housekeeping staff to CSR, ASDC, HOWE Guest House and

		• The turnover during the year was Rs.4,10,000/-	ITD Company. • Cleaning and disinfection work were done at 5 locations and 28 houses
2	Anaswara Poultry Unit (7Members)	• Hitech poultry with 14 cages of 630 chicken for 7 member • The total revenue for the group for the financial year is Rs. 4,00,000/-	• Ongoing • Average monthly earning per family is Rs. 4,300/-
3	Thripti Poultry Unit (7 Members)	• Hitech poultry with 14 cages capacity of 630 chicken for 7-member group • The total revenue for the group for the financial year is Rs. 4,41,000/-	• Ongoing • Average monthly earning per family Rs. 4,600/-.
4	Harbour Canteen Unit (5 Members)	Canteen unit specially for traditional seafood's The total revenue for the group for the financial year is Rs. 20,19,600/-	• Only parcel service • Daily turnover of Rs. 5,200/- to Rs. 5,500/- and gets an average profit of Rs.430 per day • Canteen runs in the building of Harbour Engineering Department
5	Sreebhadra Big Shopper Unit (3 Members)	Big shopper / Cloth Bag / Nonwoven Bag Unit The group has made a turnover of Rs.1,44,000/-for the current financial year	• Supplying cloth bags face mask etc. • The facemasks have been stitching as part of the CSR activities. • Monthly turnover is close to Rs.7,500/-
6	Eco Shop unit (3 members)	Selling of fresh vegetables at VizMart • The turnover of the group for the last six months was Rs. 8,80,000/-	• Procuring vegetables from the local farmers and selling at VizMart. • Working as per COVID protocols • They have been getting Rs. 1,300 – Rs. 1,700 business daily.

7	Vizhinjam Karshika Karmasena (4 Members)	Clearing of vegetation and other agri works Turn over for the last three months was 90,000/-	• The clean Campaign including community cleaning and the cleaning of public places are coordinating by the Group. • Selling fertilizer, growbags, etc also progressing. • Monthly Turnover is close to Rs 37,800/-
8	Prime Events (5 Members)	• Power Laundry Unit and Steam Pressing • Consultancy partner for VizMart – Livelihood market	• Steam pressing and hi-tech power laundry progressing • Resume service after COVID lockdown by keeping all the protocols • Monthly Turnover is close to Rs. 24,150/-
9	Data Plus (3 Members)	• Data entry Photostat, projects, designing and online jobs • The group has made a turnover of Rs.7,40.000 for the financial year	• Digital Literacy programme has been successfully supported by the group
10	Thattukkada Unit (3 members)	• Shop for preparation & Selling of steam based snacks • The shop has made a turnover of 3,60,000/- for the financial year	• The unit provide only the breakfast. • As per Covid 19 guidelines, parcel services are still going on. • Daily turnover reached to Rs. 2600- 2800/-
11	You Me & Tea Café (3 members)	• Canteen unit, traditional Kerala Foods . • Made a turnover of Rs. 7,50,000/-in 7 months	• Concentrated in parcel service • Reopened the shop after COVID restrictions • Progressing the monthly turnover averages daily turnover reached to 2,500- 3,000. • Selling of Milk and Milk products as an outlet is also progressing .

12	SRM Stitching & Garments unit (3 Members)	• Spot stitching and garments • The group has made a turnover of Rs. 2,14,000/- in six month time	• Express stitching and selling of ladies garments are the services • Daily turnover is Rs. 1000 - 1500.
13	Turn to fresh - organic shop (3 members)	• Virgin coconut oil, natural pickles and other provisional items • The group has made a turnover of Rs. 1,00,000/- in 3 months.	• Whole sale dealer for provisions tie up with Paul Raj & Company • The Nestle Products and mineral water is also progressing as a separate counter • Monthly turnover is close to Rs. 47,810/-
14	Frozen Days (3 Members)	• Fresh juice, ice creams and milk products	• Shutdown the counter due to covid restrictions.
15	Elite Gift and Fancy shop (3 Members)	• Gift items, fancy items, handicrafts, etc. • The group has made a monthly turnover of Rs. 60,000/-. In last 4 months	Shutdown the counter due to covid restrictions
16	SWAP Data Services (3 Members)	• Providing online services like PAN card, Notice printing and designing, art works, Photostat, Money Transfer etc...	• Providing data services and Photostat • They have been getting 6300/- Monthly turnover.
17	SPANDHANAM Patient Care Unit (5 Members)	• Providing patient care services for bedridden patients in houses as well as in nearby hospitals.	• Office is functioning at Viz Mart • Four members got placed in home based patient care.
18	Samudra Activity Group	• Making of fresh fish pickles and other pickle items.	• Registration activities are under process.

VIZMART

The market for livelihood groups started regaining the business after the COVID lockdown. Two more units were added to the existing units during the period viz Tender Coconut and Kerala State Lottery selling units.




Onam kit distribution: Viz mart provided 235 grocery kit and vegetable kit worth Rs. 1000/- to AVPPL for to distribute at Kadavila quarry as part of the Environment commitment. Another 50 more kits were also distributed in the Onam season.

Onam Sales outlet: Viz Mart, Vanitha Karsheeka Karma Sena in association with Supply Co., Govt. of Kerala conducted an Onam Vipanana Mela from 16.08.2021 to 21.08.2021 at Viz Mart.

Individual- Enterprise Initiatives

AF has been supporting group enterprise since 2017 onwards, last year a new initiative of individual enterprise support programme started, under this programme the following enterprises are progressing during the reporting period.

`Sheeja-40 yrs

Mrs.Sheeja, a graduate in arts and resident of Nalukettiya Thannivila Veedu kidarakuzhi P.O Mulloor. She lives with her husband and 3 children her husband was working as a contract staff for KSRTC department lost the work due to an accident. Once the income has stopped, he started working as daily wager with a painting contractor. During the course of work, he fell down from a rooftop and got paralyzed. This really made the family hard to meet both ends. Present condition can make the two ends meet with a little bit of other savings. We have made an assessment and understand that their need is genuine and came to an inference that with the experience gained by the family the foundation supported her with a new Provision shop.

"Chinnus Stores "(Photos before & after the installation of enterprise unit)

Baby-41yrs

Mrs. Baby mother of 2 children and resident of Vayalinkara Area, Kottappuram.Her husband is a fisherman but earns very little. Currently baby has a small Pocket shop in the Vayalinkara area. This is the main shop for 39 families. Her experience of 4 years in running this shop is surely an impetus for this business to grow. The shop provides hardly sufficient income to sustain their monthly needs of working capital. Baby had expressed the requirement in the form of support for Shop renovation. The assessment has vindicated their need and do recommend the same the work on the provision store has completed for the initiation of enterprise activity.

Vishak Provision Store (Photos before & after the installation of enterprise unit)

Sindhu-39yrs.

Mrs. Sindhu a Widow from Kottappuram Mukkola P.O residing with her two children. Ten years ago, she started business. Her husband left when the children were very young. Her only source of livelihood is sewing. The family is financially too backward. Her only asset is her fifteen Years' experience in the field if sewing. The shop located in own place. But she is unable to take care of her children and their education with the existing business capacity she had. She proposes to expand her business. She was provided with furnished shop.

"Sindhu Tailoring Shop "(Photos before & after the installation of enterprise unit)

Sindhu	Tailoring Shop

Baby	Tea Shop

Sulekha	Tea Shop

3.5 Sports Support

Adani Foundation has been supporting players from Vizhinjam at Kovalam Football club. Two motivation sessions were conducted for the player during the period

The CSR team was also an invitee for the inauguration of their Team Bus provided by Federal Bank as part of their CSR. The inauguration was done by Adv. M. Vincent MLA for Kovalam constituency in the presence of CSR team. The opening ceremony was done by the local Manager of Federal Bank, Poovar, Trivandrum Branch.


4. COMMUNITY INFRASTRUCUTRE DEVELOPMENT

4.1. Pilot project on Clean drinking water for Vizhinjam

Availability of clean drinking water in Vizhinjam persists even after it was made into Corporation in 2010. To provide pure drinking water AVPPL/AF was decided to install five clean drinking ware plants in the nearby five divisions of Vizhinjam having 2000L/hour capacity each on a pilot basis. The total cost of the project is Rs. 52.5 lakhs of which the equipment cost of Rs. 30 lakhs from the CSR of Tata Chemicals whereas the infra and installation cost of Rs. 22.5 lakhs are from CSR of AVPPL/AF. The future maintenance will be the responsibility of community beneficiaries. The infra work for the water kiosk progressing at 3 locations and reached roof slab concreating during the reporting period. As two locations have some space issues, plan have to be revisited.


4.2. Community Health Centre, Vizhinjam

The construction work of Community Health Center at Vizhinjam has been resumed after the COVID restrictions. The project cost is Rs. 7.79 cr where the Government component of Rs.482 lakhs and CSR component of 297 lakhs from Adani Foundation. Adani Foundation handed over the first installment of Rs.1.18 crores to the Harbour Engineering Department on 03.10.2018.

4.3. HALP School, Harbour Road, Vizhinjam

The works of rain roof and sanitation facilities in HALP School are completed. The inauguration cum handing over ceremony will be organised, when COVID restriction over. The work included side roofing; toilet blocks for boys, washing facility for staff and installation of water pump.

4.4. LPS School, Kidarakkuzhy

In Kidarakkuzhy LP School, the following works are completed

- Toilet block for boys & staff, Urinals for boys, Soak pit & septic tank

4.5. Mudippura Nada LP School, Venganoor

The works on construction of stage platform and washing facility have been completed in Mudippuranada School under CSR. The formal handing over may be conducted immediately after the covid lockdown issues are over.

4.6. Gangayar Canal

The proposed maintenance to ensure proper water flow and desilting of Gangayar had been entrusted Minor Irrigation Department under the supervision of Harbour Engineering Department. The initial project cost was Rs.89 lakhs, in equal share of AVPPL and VISL. AVPPL transferred Rs. 45 lakhs as half share through VISL to Minor Irrigation Department. After tendering it quoted raises to Rs. 119 lakhs. Started the approval processes to provide excess half share of Rs. 15 lakhs during the period.

The proposal included the following

- Desilting of waste up to 1 km from the mouth of the canal
- Core wall (Break water) to block sand iteration at the southern side of the exiting Fishing Harbour
- Installation of three Silt breakers at a distance of 500 m & a footbridge

4.7. Other major projects under progress

Sl N	Project

<table>
<tr><td>1</td><td>Model Anaganwadi, Vizhinjam (Nr. Police Station)</td><td>1500 Sqft Montessori model Anganwadi at Govt. Vizhinjam LP School compound.
The plan and the location approved by social welfare department
Land permission received from Social Welfare department.
As the Land Contour mapping yet to receive from Social Welfare department, it is decided to prepare a detailed architectural drawing by our consultant
As the paln, estimate and BoQ are ready, started the Techno commercial procedures and the work will be awarded in the second week of August.</td></tr>
<tr><td>2</td><td>MRF</td><td>As per the request received from Trivandrum Municipal Corporation it is decided to construct an MRF at harbor ward. Land for the same will be allotted by Harbour Engineering Department. The operation of the unit will be done by Trivandrum Municipal Corporation under the technical support of Suchithwa Mission and Clean Kerala Company. A Haritha Karma Sena will be formed for the daily collection of waste after the commissioning of the proposed unit. The MRF will include
3500 sqft building
Shredding Machine
Baling Machine
Dust remover and
Conveyor belt
Estimate received and forwarded to Suchithwa Mission for vetting
A MoU is under preparation to demystify the role of all the stakeholders</td></tr>
<tr><td>3</td><td>Kottukal School</td><td>A roof top class rooms in the existing building
As per the structural certificate plan and estimate are prepared
Started TCD procedures</td></tr>
</table>

4.8. Vayalinkara – Model Village Plan

A model village development work progressing at Vayalinkara area and is in final stage of completion. The work of drainage plan, concrete pavements, drinking water pipe line extension and street light plan are progressing with HOWE. The work resumed after COVID restrictions. A village level committee constituted to support AF is monitoring the day to day progress. The villagers, especially housewives are also joined with the contractors in the construction activities. This has increased the ownership of community in the development of their areas.

5. INITIATIVES TO COMBAT AGAINST COVID -19

As part of the CSR activities, Adani Foundation under Adani Vizhinjam Port Pvt. Ltd has been supporting the government initiatives in various ways from the initial stages of outbreak of COVID-19 pandemic in Kerala. In the second wave, as part of Covid-19 defense activities, AVPPL has been continuously providing assistance to community kitchens, distributing masks and sanitizers and conducted defense awareness activities as part of its social commitment programs.

Following activities have been progressing to combat against COVID -19 during the reporting period

- Supply of food materials to community kitchens
- Supply of oxygen cylinders
- Supply of Oxygen containers

- Supply of 500 metal coats and beds to Trivandrum Municipal Corporation to setup COVID First Line Treatment Centers (CFLTC) at various part of the Corporation
- Supply of COVID care materials like sanitizers, Masks and gloves
- Disinfection of houses and public places at containment zones with the help of community volunteers
- Supply of COVID Hygiene & immunity essentials kits and oximeters
- Community Response Initiative – Tele interaction with Community People
- The Service of MHU to Vizhinjam parish

5.1. Supply of food materials to community kitchens at Vizhinjam, Kottukal, Thiruvallom, Kovalam and Kottappuram (Provisions and Coconuts)

As lock down mostly affects the daily wage earners, COVID affected patients and street vendors, CSR Vizhinjam, has taken initiatives to supply provisions and coconuts to various Community kitchen which were operational at various ward in and around Vizhinjam.

Sl no	@ward	Item	Qdty	Community kitchen –run by	Managed by
1	Vizhinjam	Raw rice (50kg bag) & Coconut	15bags 1000 Nos	Corporation of Trivandrum	Councilors committee
2	Thiruvallam	Raw Rice	10 bags	Corporation Of Trivandrum	Councilors Committee Thiruvallam
3	Kottukal Panchayath	Raw rice	15 bags	Kottukal Panchayath	Panchayaths Committee
4	Kovalam	Raw rice	17 bags	Community Kitchen – Kovalam Constituency	Panchayat committee
4	Harbour Ward	Raw rice	5 bag	Corporation Of Trivandrum	Councilors committee

5	Harbour	Pulses (green peas)	2 bag	Corporation Of trivandrum	Councilors committee
6	Mulloor	Rice	3 bags	Volunteers group	Adhoc committee
7	Muloor	Pulses (green peas)	2 bag	Volunteers Group	Adhoc committee.
8	Vizhinjam	Rice	3 bag	Volenteer group	Adhoc committee.
9	Kottukal Panchayat	Raw rice (50kg bag) &	15bags	Kottukal Panchayath	Panchayat committee
10	Vizhinjam	Raw Rice	5 bags	Corporation Of Trivandrum	Councilors Committee
11	Vizhinjam	Raw rice	2 bags	COVID brigade	Volunteers
12	Venganoor Ward	Raw rice	5 bags	Community Kitchen	Counsellor – Venganoor
13	Mulloor Ward	Raw rice	6 bag	Corporation Of Trivandrum	Councilor - Mulloor
14	Poonthura	Raw rice	15 bag	Corporation Of Trivandrum	Councilors & MLA
15	Vizhinjam	Raw Rice	6 bags	Livelihood Groups	Adhoc committee
16	Mulloor	Raw Rice	3 bags	COVID brigade	Volunteers
17	Vizhinjam	Groceries	280 kgs	Kovalam FC	Adhoc committee.
18	Vizhinjam	Groceries	1500 kg	Volunteers	Vizhinjam Parish committee.

4.9. Supply of oxygen cylinders

Gautam Adani-led diversified conglomerate Adani group has joined corporate India's efforts to bolster the national effort and capacity against the surging spread of COVID-19 by importing cryogenic tanks and medical-grade oxygen cylinders from Saudi Arabia.

Adani Foundation CSR of Adani Vizhinjam Port Private Ltd (AVPPL) has been active in the fight against Covid-19 as part of its social commitment programme. Hence the responsibility of handing over vested with CSR. 1,012 oxygen cylinders were distributed to the State government of Kerala. The distribution was on 3/6/2021 attended by Honorable Ministers of Port, Museum and Archives Sri Ahamed devar Kovil and Mr Sivankutty Education & Employment minister. Among the cylinders, 20 cylinders were handed over to Kottukal Gram panchayaths, and remaining to Medical Service Corporation Government of Kerala. The meeting was attended by CEO, Corporate head, CSR head and other top officials of company. From Government side the Top officials of VISL, and medical service corporation, and local body representatives made this an event of pride.

4.10. Supply of oxygen containers to Govt. of Kerala

Adani Group on Monday, June 7 has extended support to the Kerala Government by supplying three oxygen containers to the Ernakulam district administration. They were brought in via an Indian Air Force IL-76 flight from Singapore and were handed over at the Kochi Nedumbassery Airport.

Each of these containers is capable of carrying 20 tons of oxygen. This will ensure that oxygen will be transferred to hospitals faster than before.

4.11. Supply of 500 metal coats and beds to Trivandrum Municipal Corporation to setup COVID First Line Treatment Centers (CFLTC) at various part of the Corporation

Adani Foundation Vizhinjam has distributed 500 coats, beds, pillows and bed sheets to Trivandrum Municipal Corporation to setup CFLTCs at various parts of the Corporation. The first one of its kind has been setting up at Green field sports stadium at Kazhakuttam managed by Corporation of Trivandrum. The distribution was inaugurated by honorable Minister for Higher Education Mr. V. Shivan Kutty, presided over by the Honorable Mayor Mis. Arya in the presence of honorable MLA for Kazhakootam Mr. Kadakampally Surendran. The meeting was attended by standing committee chairpersons, ward councilor, Health Inspector, Nodal offices and representatives from AVPPL.

The materials were handed over to the minister by Mr. Sushil Nair, Head, Corporate Affairs, AVPPL and Dr. Anil Balakrishnan, Head, Adani Foundation Southern Region.

4.12. Supply of COVID care materials like sanitizers, Masks and gloves

Following are the list of items distributed to the community during lock down.

Sl No	Item	ward	No:	To whom
1	Surgical Masks	5 wards	11000	Councilors, Volunteers group and COVID warriors
2	Sanitizer (50 Ml bottles)	5 wards	900	Councilors, Volunteers group and COVID warriors
3	N95 Masks	Vizhinjam	500	Police stations- Civil, costal and port site
4	Sanitizer	Vizhinjam	25 ltr	Police stations- Civil, costal and port site
5	Gloves Washable	Vizhinjam	165	Police stations- Civil, costal and port site
6	Gloves Disposable	Vizhinjam	10 box	Police stations- Civil, costal and port site





4.13. Disinfection of houses at containment zones with the help of community volunteers

The COVID Community Volunteers of AVPPL/AF disinfected 94 houses and many public places at the declared containment zones under the leadership of Clean 4 U, one of our livelihood groups

4.14. Supply of COVID -19 hygiene and immunity essentials kits and Pulse oximeters

As in the previous year Adani foundation through MHU provided 200 COVID hygiene and immunity essentials kits to old age people. The hygiene kit contains Body soap bar, detergent bar, N95 mask, Zincovit tablet and Vitamin C+ tablets. Along with that 10 pulse oximeters are also provided to community COVID volunteers. The volunteers visited the houses of COVID patients regularly and monitored the oxygen level as prescribed by the health wing. An average of 150 community people has been monitored every month.

4.15. A Community Response Initiative – Tele interaction with Community People

A COVID-19 pandemic response activity during the reporting month was '**Tele interaction with community People**". CSR team members have been interacted with community people on a daily basis during the lockdown period over phone and extended support in the form of connecting like health department, Trivandrum Corporation, Primary Health Centre, Community health Centre, ASHA workers, DISHA Health Help Line, Police Department, Political and Local leaders etc. Local volunteers are also provided support specially to distributed urgent medicines according to the instructions of CSR team members. An average of 100 cases were handling every month during the period

4.16. The Service of MHU to Vizhinjam parish

As per the request of Vizhinjam Church council, AVPPL/AF has been extending the service of the Mobile Health Care Unit round the clock to Kottappuram area since 19.05.2021 onwards. MHU is providing COVID care support as per the call of community volunteers formed by church committee in the area

6. Others

6.1. Community Grievances

- **Cleaning of "Gangayar Canal"**

The dredging department of HOWE is cleaning the sand accumulated at the mouth of Gangayar Canal joining sea at Valiyakadappuram every day.

6.2. Reporting the progress of Vizhinjam Port to community stakeholder

As per the environmental audit compliance, the progress of Port activities has been circulated to the community groups. During the reporting period informed ------community people with following progress through virtual platforms

Project Component (Phase I)	**Status**
Container Berth (800 mtr long)	Piling & Beams completed for 800 mtr. Slabs will be installed once breakwater work advances.
Breakwater(3.1 km long)	850 mtr completed. Rock sourcing and stockpiling is in progress.
Fishery berth & harbour	Work will commence in consultation with local fishermen and Government
Port yard and buildings	• Port Operation Building completed. Inauguration done on 30-09-2020 by Hon'ble Minister for Ports, GoK. • All other buildings are at advanced stage of completion. • Yard development works are in progress
Port Access Road (2 Km)	In progress. 2 nos bridge construction are in progress. Piling of bridge is completed.
Main Electrical Substation and Port Electrical System	Construction completed. Commissioning will be done soon.

6.3. NGT Meeting & Follow up

A Virtual NGT meeting was organized on 16.04.2021 and Dr. Anil Balakrishanan presented the CSR activities for the period from April 2020 to Sept 2020. Senior Scientist Dr. Anil M.K, Head, Vizhinjam Regional Centre of CMFRI, Government of India recommended to include Fish Processing and Fish farming related activities in the CSR of AVPPL AF. He also suggested doing something as permanent solution for reviving Vellayani Lake, which is the source of water for Vizhinjam Port Dr. Balakrishnan Nair, TM, Scientist INCOIS, GoI suggested including fishermen training in safety at sea in CSR activities

A follow up meeting was also done with Dr. Anil M.K, Head, Vizhinjam Regional Centre of CMFRI, GoI at his office on 21.04.2021 and discussed the following

1. Value added fish products as a livelihood venture for selected women group from the fishing community.
2. Cage Fishing
3. Muscle & Pearl culture
4. Supporting **Neerthadaka Samithi** for the protection of Vellayani Lake.
5. Seaweed farming
6. Organize awareness classes for the fishermen on safety at Sea

6.4. Employee volunteering programme – Support to a poor patient

Helping Hand to Mrs. Stella–through Employees volunteering support of AVPPL

Mrs. Stella is prominent member of Women's canteen, a micro enterprise group at Vizmart. She hails from Kottappuram area of vizhinjam, staying in a small dilapidated house of 600 sqft, inhabited by 12 family members along with her husband, her mother, grandmother, sister, sister's husband, and their children. The house is owned by her mother. Stella and her family occupy a very small portion of the house, a small room. Her husband is a daily wage earner and a fisherman. Her family monthly earnings may come close to less than 5000/-, hardly sufficient to meet the requirement of her and her three children, boys of 12 years (twins) and 10 year old girl.

Adding to her troubles, she was detected with chronic uterus impairment, on examination at RCC Trivandrum. The same was detected at a follow-up after a medical camp organized by Adani foundation @ Vizhinjam. At that point it becomes difficult for her to take care of the family and her own health. As she was advised for a periodic checkup at medical college hospital Trivandrum, it needs regular visits and need to purchase of some medicines which are not available in Government pharmacy. She at times requested to Adani foundation CSR officials, regarding certain support financially.

Helping hand was extended by Mr. Biju Thomas Mathew, Senior officer, Stores Techno commercial of AVPPL, who donated RS 15000/- to Mrs. Stella, for her health and family support. The donation was handed over to Stella on 17.4.2021 by Dr. Anil Balakrishnan, CSR head of Southern region in the presence of CSR staff members and family members of Mrs. Stella.

Press News

കോവിഡ് രണ്ടാം തരംഗത്തിൽ സഹായഹസ്തവുമായി അദാനി ഗ്രൂപ്പ്

ADANI GROUP LENDS SUPPORT FOR COVID FIGHt

Adani Foundation, the CSR wing of Adani Group, contributed 500 beds to the city corporation. The CFLTC at Green Field Stadium with 400 beds was inaugurated by Education Minister V Shivankutty. At the event, Susheel Kumar, the corporate head of the Adani Vizhinjam Port, and Dr Anil Balakrishnan, south head of the CSR wing, handed over the beds. The rest of the 100 beds are at the CFLTC centre at Government HSS, Amabalathara.

അദാനി ഗ്രൂപ്പ് 500 കിടക്ക നൽകി

തിരുവനന്തപുരം

നഗരസഭയുടെ നേതൃത്വത്തിൽ ഗ്രീൻ ഫീൽഡ് സ്റ്റേഡിയത്തിൽ പ്രവർത്തിക്കുന്ന കോവിഡ് ആദ്യഘട്ട ചികിത്സാകേന്ദ്രത്തിലേക്ക് അദാനി ഗ്രൂപ്പ് 500 കിടക്ക നൽകി. മന്ത്രി വി ശിവൻകുട്ടിയുടെ സാന്നിധ്യത്തിൽ മേയർ ആര്യ രാജേന്ദ്രൻ ഏറ്റുവാങ്ങി.

കൺട്രോൾ റൂം പ്രവർത്തനങ്ങൾക്കായി ഓൾ പൃഥ്വിരാജ് ഫാൻസ് ആൻഡ് വെൽഫയർ കൾച്ചറൽ അസോസിയേഷൻ, ഉദാര ശിരോമണി റോഡ് റസിഡൻസ് അസോസിയേഷൻ എന്നിവർ കോവിഡ് പ്രതിരോധ സാധനങ്ങൾ നൽകി. നഗരസഭയുടെ ഡ്രൈവറായ സുനിൽ കുമാറും സഹപ്രവർത്തകരും ചേർന്ന് സമൂഹ അടുക്കളയിലേക്കുള്ള അവശ്യ സാധനങ്ങൾ കൈമാറി.

വിവിധ റസിഡൻസ് അസോസിയേഷനുകളും വ്യാപാരി വ്യവസായി സമിതിയും സമൂഹ അടുക്കളയിലേക്ക് സഹായം നൽകി. പട്ടം കൈലാസ് നഗർ സ്വദേശി പി ജി എൻ വർമ 5000 രൂപ സംഭാവന നൽകിയതായും മേയർ അറിയിച്ചു.

ഫസ്റ്റ് ലൈൻ ട്രീറ്റ്മെന്റ് സെൻററുകൾ ഒരുക്കി അദാനി ഗ്രൂപ്പ്

കോവളം : കോവിഡ് പ്രതിരോധത്തിനായി നഗരസഭയുമായി കൈകോർത്ത് 500 കിടക്കകളുടെ ഫസ്റ്റ് ലൈൻ ട്രീറ്റ്മെന്റ് സെന്ററുകൾ ഒരുക്കി അദാനി ഗ്രൂപ്പ്. ആദ്യഘട്ടമായി കാര്യവട്ടം ഗ്രീൻഫീൽഡ് സ്റ്റേഡിയത്തിൽ ഒരുക്കിയ 400 കിടക്കകളുള്ള ഫസ്റ്റ് ലൈൻ ട്രീറ്റ്മെന്റ് സെന്റർ മന്ത്രി ശിവൻകുട്ടി ഉദ്ഘാടനം ചെയ്തു. മേയർ കുമാരി ആര്യാ രാജേന്ദ്രൻ അധ്യക്ഷത വഹിച്ചു. കഴക്കൂട്ടം എം.എൽ.എ . കടകംപള്ളി സുരേന്ദ്രൻ ,അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനി കോർപ്പറേറ്റ് വിഭാഗം മേധാവി സുശീൽകുമാർ, സാമൂഹ്യപ്രതിബദ്ധത വിഭാഗം ദക്ഷിണേന്ത്യൻ മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ, നഗരസഭ സ്റ്റാൻഡിങ് കമ്മിറ്റി ചെയർമാൻമാരായ . ഡി ആർ അനിൽ, എസ്.സലീം, എസ്. എം. ബഷീർ, വാർഡ് കൗൺസിലർ എൽ.എസ്. കവിത, ഹെൽത്ത് ഇൻസ്പെക്ടർ . പ്രേം നവാസ്, നോഡൽ ഓഫീസർ ഡോ.സൂരജ് എന്നിവർ പങ്കെടുത്തു. അദാനി വിഴിഞ്ഞം തുറമുഖത്തിന്റെ സാമൂഹ്യപ്രതിബദ്ധത പദ്ധതികളുടെ ഭാഗമായിട്ടാണ് ഗ്രീൻഫീൽഡ് സ്റ്റേഡിയത്തിൽ 400 കിടക്കകളുള്ള ഫസ്റ്റ് ലൈൻ ട്രീറ്റ്മെന്റ് സെന്റർ ഒരുക്കിയതെന്നും 100 കിടക്കകളുള്ള മറ്റൊരു ഫസ്റ്റ് ലൈൻ ട്രീറ്റ്മെന്റ് സെന്റർ നഗരസഭയിലെ അമ്പലത്തറ ഹയർസെക്കൻഡറി സ്കൂളിലാണ് സജ്ജമാക്കിയിട്ടുള്ളതെന്നും അദാനിഗ്രൂപ്പധികൃതർ പറഞ്ഞു.

പെരുമഴയിൽ വീട് ഇരുപതടി താഴ്ചയിലേക്ക് ഇടിഞ്ഞുവീണു

മലയിൻകീഴ്: തോരാമഴയിൽ നനഞ്ഞുകുതിർന്നിരുന്ന നിർധന കുടുംബത്തിന്റെ കിടപ്പാടത്തിന്റെ ഒരുഭാഗം ഭാഗം ഇരുപതടി താഴ്ചയിലേക്ക് ഇടിഞ്ഞ് വീണ് തകർന്നു. പേയാട്, പള്ളിമുക്ക് പ്രിയദർശിനി റോഡിൽ എം.വത്സലയുടെ വീടാണ് തകർന്നത്. കഴിഞ്ഞ ദിവസം പെയ്ത ശക്തമായ മഴയിലാണ് വീട് ഇടിഞ്ഞുവീണത്. ശേഷിയ്ക്കുന്ന ഭാഗത്തെ ചുവരുകളിൽ വിള്ളൽ വീണതിനാൽ താമസിക്കാൻ അനുയോജ്യമല്ലെന്നാണ് സ്ഥലം സന്ദർശിച്ച ജനപ്രതിനിധികളും, സാങ്കേതിക വിദഗ്ധരും അറിയിച്ചത്. കുടുംബശ്രീ മിഷന്റെ താൽക്കാലിക ഡ്രൈവറായി കാറോടിച്ച് കിട്ടുന്ന വരുമാനത്തിൽ നി

അദാനി കമ്പനി കോവിഡ് പ്രാഥമിക ചികിത്സാ കേന്ദ്രം സജ്ജമാക്കി

തുറമുഖ സംബന്ധ ജോലികൾക്കുൾപ്പെടെ കോഴ്സുകളുമായി അദാനി

തിരുവനന്തപുരം● വിഴിഞ്ഞത്തെ കമ്യൂണിറ്റി സ്കിൽ പാർക്കിൽ അടുത്ത ഏപ്രിൽ മുതൽ കോഴ്സുകൾ തുടങ്ങുമെന്ന് അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനി. തുറമുഖ സംബന്ധമായ ജോലികൾക്കുൾപ്പെടെ കോഴ്സുകൾ തുടങ്ങും. ഇതിനു മുന്നോടിയായി നഴ്സിങ് അസിസ്റ്റന്റ്, ഡേറ്റ എൻട്രി ഉൾപ്പെടെയുള്ള ട്രാൻസിറ്റ് കോഴ്സുകൾ തുടങ്ങി.
20 കോടി ചെലവിൽ നിർമിക്കുന്ന പാർക്കിന്റെ നിർമാണം അന്തിമ ഘട്ടത്തിലാണ്. പ്രദേശവാസികൾക്കായിരിക്കും മുൻഗണന.

അദാനി ഗ്രൂപ്പിന്റെ സാമൂഹിക പ്രതിബദ്ധതാ പദ്ധതിയുടെ ഭാഗമായി ഗംഗയാർ തോട് നവീകരിച്ച് നീരൊഴുക്ക് സുഗമമാക്കുന്നതിനുള്ള പദ്ധതിക്കും അന്തിമ അനുമതി ലഭിച്ചു. മഴ മാറിയാലുടൻ നവീകരണ പ്രവർത്തനങ്ങൾ ആരംഭിക്കും. ചെറുകിട ജലസേചന വകുപ്പ് തയാറാക്കിയ പദ്ധതി പ്രകാരമാണ് നവീകരണ പ്രവർത്തനങ്ങൾ നടക്കുക. അഴിമുഖത്തു നിന്ന് ഒന്നര കിലോമീറ്ററോളം ചെളിയും മാലിന്യങ്ങളും നീക്കം ചെയ്തു ബണ്ടുകൾ ബലപ്പെടുത്തും. 60 മീറ്ററോളം നീളത്തിൽ കൾവർട്ടും കാൽ നടയാത്രയ്ക്കായി മേൽപ്പാലവും നിർമിക്കും. 1.2 കോടിയാണ് ചെലവ്. പകുതി തുക അദാനി തുറമുഖ കമ്പനി വഹിക്കും.

പ്രതിവർഷം ശരാശരി 50000 പേർക്ക് സേവനം ലഭ്യമാകുന്ന രീതിയിൽ സാമൂഹിക സേവനപ്രവർത്തനങ്ങൾ നടത്തുമെന്ന് കമ്പനി അറിയിച്ചു. കോവിഡ് പ്രതിരോധത്തിനായി മുഖ്യമന്ത്രിയുടെ ദുരിതാശ്വാസ നിധിയിലേക്ക് 5 കോടി രൂപയും 1012 ഓക്സിജൻ സിലിണ്ടറുകളും 20 ടൺ ശേഷിയുള്ള 3 ഓക്സിജൻ കണ്ടെയ്നറുകളും നൽകി.

സർക്കാർ സ്കൂളുകളിൽ 14 സ്മാർട് ക്ലാസ് റൂമുകൾ നിർമിച്ചു. മൊബൈൽ ഹെൽത്ത് കെയർ യൂണിറ്റ് വഴി 55075 രോഗികൾക്ക് ചികിത്സ നൽകി. 812 പേർക്ക് നൈപുണ്യ പരിശീലനം നൽകി. സാമൂഹികാരോഗ്യകേന്ദ്രത്തിലെ കെട്ടിട നിർമാണത്തിന് 1.18 കോടി രൂപ നൽകിയെന്നും കമ്പനി അറിയിച്ചു.

10
NAUTICAL TIMES
നോട്ടിക്കൽ ടൈംസ്
കേരള

അദാനി വിഴിഞ്ഞം പോർട്ട് പ്രൈവറ്റ് ലിമിറ്റഡ് സാമൂഹിക പ്രതിബദ്ധതാ പ്രവർത്തനങ്ങൾ

2. വിദ്യാഭ്യാസം

3. ആരോഗ്യം

5. പ്രാദേശിക അടിസ്ഥാന സൗകര്യവികസനം

അദാനി ഗ്രൂപ്പ് 1000 ഓക്സിജൻ സിലിൻഡറുകൾ നൽകി

ക്കാൻ അനുവദിക്കണമെന്നും അദ്ദേഹം ആവശ്യപ്പെട്ടു.

1000 ഓക്സിജൻ സിലിണ്ടറുകൾ നൽകി

വിഴിഞ്ഞം● അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനി 1000 ഓക്സിജൻ സിലിണ്ടറുകൾ സർക്കാരിന് കൈമാറി. മന്ത്രിമാരായ അഹമ്മദ് ദേവർകോവിൽ,വി. ശിവൻ കുട്ടി എന്നിവർ ഏറ്റുവാങ്ങി. വിഴിഞ്ഞം തുറമുഖ കമ്പനി സിഇഒ രാജേഷ് ഝാ അധ്യക്ഷത വഹിച്ച ചടങ്ങിൽ വിഴിഞ്ഞം രാജ്യാന്തര തുറമുഖ കമ്പനി(വിസിൽ) സിഇഒ ഡോ. ജയകുമാർ, തുറമുഖ കമ്പനി കോർപറേറ്റ് വിഭാഗം മേധാവി സുശീൽ നായർ, ഹേറാവേ പ്രോജക്ട് ഡയറക്ടർ രാജൻ രാമചന്ദ്രൻ , അദാനി ഗ്രൂപ്പ് സാമൂഹിക പ്രതിബദ്ധതാ വിഭാഗം ദക്ഷിണ ഇന്ത്യ മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ എന്നിവർ പ്രസംഗിച്ചു.

റ്റും പമ്പും

ഡിലെ നിലവിലെ സൗകര്യങ്ങൾ കാണാനെത്തി.

അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനി 1000 ഓക്സിജൻ സിലിണ്ടറുകൾ കേരള സർക്കാരിന് കൈമാറി

വിഴിഞ്ഞം: കേരള സർക്കാരിന്റെ കോവിഡ് പ്രതിരോധ പ്രവർത്തനങ്ങളിൽ പങ്കാളിയായി കൊണ്ട് വിലപ്പെട്ട ജീവനുകൾ സംരക്ഷിക്കാൻ ആവശ്യമായ ആയിരം ഓക്സിജൻ സിലിണ്ടറുകൾ വിഴിഞ്ഞം തുറമുഖ കമ്പനി കേരള സർക്കാരിന് കൈമാറി.

കേരള സർക്കാരിനു വേണ്ടി ബഹുമാനപ്പെട്ട തുറമുഖ മ്യൂസിയം പുരാവസ്തു വകുപ്പ് മന്ത്രി ശ്രീ അഹമ്മദ് ദേവർകോവിൽ, ബഹുമാനപ്പെട്ട പൊതു വിദ്യാഭ്യാസ, തൊഴിൽ വകുപ്പ് മന്ത്രി ശ്രീ. വി. ശിവൻകുട്ടി എന്നിവർ ചേർന്ന് സിലിണ്ടറുകൾ ഏറ്റുവാങ്ങി കേരള സംസ്ഥാന മെഡിക്കൽ സർവീസ് കോർപ്പറേഷൻ, കോട്ടുകാൽ ഗ്രാമപഞ്ചായത്ത് എന്നിവർക്ക് നൽകിക്കൊണ്ട് വിതരണോദ്ഘാടനം നിർവഹിച്ചു.

കോവിഡിന്റെ ഒന്നാം വരവ് മുതൽ പ്രതിരോധ പ്രവർത്തനങ്ങളിൽ സജീവമായ പങ്കാളിത്തം ആണ് അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനി നൽകുന്നതെന്ന് ബഹുമാനപ്പെട്ട പൊതു വിദ്യാഭ്യാസ മന്ത്രി ശ്രീ. വി. ശിവൻകുട്ടി അഭിപ്രായപ്പെട്ടു.

തുടർന്ന് തുറമുഖത്തിന്റെ നിർമ്മാണ പുരോഗതി വിലയിരുത്തിക്കൊണ്ട് കേരളത്തിന്റെ സ്വപ്ന പദ്ധതിയായ വിഴിഞ്ഞം തുറമുഖം എത്രയും വേഗം സാക്ഷാത്കരിക്കാൻ കൂട്ടായി പ്രവർത്തിക്കാമെന്ന ശുഭാപ്തി വിശ്വാസവും ബഹു. തുറമുഖ, മ്യൂസിയം, പുരാവസ്തു ശ്രീ. അഹമ്മദ് ദേവർകോവിൽ പങ്കുവച്ചു.

വിഴിഞ്ഞം തുറമുഖ കമ്പനി സി.ഇ.ഒ ശ്രീ. രാജേഷ് ഝാ അദ്ധ്യക്ഷത വഹിച്ച ചടങ്ങിൽ വിഴിഞ്ഞം അന്താരാഷ്ട്ര തുറമുഖ കമ്പനി സി.ഇ.ഒ ഡോ. ജയകുമാർ, തുറമുഖ കമ്പനി കോർപ്പറേറ്റ് വിഭാഗം മേധാവി ശ്രീ. സുശീൽ നായർ, പോർട്ട് പ്രോജക്ട് ഡയറക്ടർ ശ്രീ. എ. രാജേഷ് രാമചന്ദ്രൻ, അദാനി ഗ്രൂപ്പ് സാമൂഹ്യ പ്രതിബദ്ധതാ വിഭാഗം റീജിയണൽ മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ എന്നിവർ സന്ദേശങ്ങൾ നൽകി.

പൂർണമായും കോവിഡ് മാർഗ്ഗ നിർദ്ദേശങ്ങൾ പാലിച്ചു കൊണ്ട് നടത്തിയ ചടങ്ങിൽ കഴിഞ്ഞ ന്യൂനമർദ്ദ സമയത്ത് തന്റെ ജീവൻ തന്നെ തൃണവൽഗണിച്ച് അപകടത്തിൽ പെട്ട മത്സ്യ തൊഴിലാളികളെ രക്ഷിച്ച തുറമുഖ കരാർ ജീവനക്കാരനായ ശ്രീ. സുബാഷ് ബിഗ്രാസിനെ ആദരിച്ചു കൊണ്ട് ധീരതാ പുരസ്കാരവും ക്യാഷ് അവാർഡും തുറമുഖ കമ്പനിക്കു വേണ്ടി ബഹു. തുറമുഖ വകുപ്പ് മന്ത്രി സമ്മാനിച്ചു.

തുടക്കം മുതൽ കോവിഡ് പ്രതിരോധ പ്രവർത്തനങ്ങളിൽ സജീവ സാന്നിധ്യമായ അദാനി തുറമുഖ കമ്പനി മുഖ്യമന്ത്രിയുടെ ദുരിതാശ്വാസ നിധിയിലേക്ക് അഞ്ച് കോടി രൂപ നൽകിയത് കൂടാതെ ഒന്നാം തരംഗ കോവിഡ് ചികിത്സാ കേന്ദ്രങ്ങൾ തയ്യാറാക്കുന്നതിനായി തിരുവനന്തപുരം കോർപ്പറേഷന് 100 കിടക്കകളും അനുബന്ധ സാമഗ്രികളും കഴിഞ്ഞ ദിവസം സംഭാവന ചെയ്തിരുന്നു.

കൂടാതെ കോവിഡ് പ്രതിരോധ പ്രവർത്തനങ്ങളുടെ ഭാഗമായി സാമൂഹ്യ അടുക്കളകൾക്കുള്ള സഹായം, മാസ്കുകൾ, സാനിട്ടൈസറുകൾ എന്നിവയുടെ വിതരണം, പ്രതിരോധ അവബോധ പ്രവർത്തനങ്ങൾ എന്നിവയും അദാനി തുറമുഖ കമ്പനി തുടർച്ചയായി നടത്തിവരുകയാണ്.

കേരള കൗമുദി
Trivandrum 04 Jun 2021

വിഴിഞ്ഞത്തിനായി കൂട്ടായി പ്രവർത്തിക്കും: മന്ത്രി അഹമ്മദ് ദേവർകോവിൽ

കോവളം: സ്വപ്ന പദ്ധതിയായ വിഴിഞ്ഞം തുറമുഖം എത്രയും വേഗം സാക്ഷാത്കരിക്കാൻ കൂട്ടായി പ്രവർത്തിക്കുമെന്ന് മന്ത്രി അഹമ്മദ് ദേവർകോവിൽ പറഞ്ഞു. കൊവിഡ് പ്രതിരോധത്തിനായി അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനി 1000 ഓക്സിജൻ സിലിണ്ടറുകൾ കൈമാറുന്ന ചടങ്ങിൽ സംസാരിക്കുകയായിരുന്നു അദ്ദേഹം.

വിഴിഞ്ഞം തുറമുഖ കമ്പനി സി.ഇ.ഒ രാജേഷ് ഝാ അദ്ധ്യക്ഷത വഹിച്ചു. മന്ത്രി വി. ശിവൻകുട്ടി മുഖ്യാതിഥിയായിരുന്നു. ചടങ്ങിൽ കടലിൽ അപകടത്തിൽപ്പെട്ട മത്സ്യത്തൊഴിലാളികളെ രക്ഷപ്പെടുത്തിയ തുറമുഖ കരാർ ജീവനക്കാരനായ സുബ്രദോ ബിശ്വാസിന് ധീരതാപത്രവും കാഷ് അവാർഡും നൽകി അനുമോദിച്ചു.

തുറമുഖ കമ്പനി സി.ഇ.ഒ ഡോ. ജയകുമാർ, കോർപ്പറേറ്റ് വിഭാഗം മേധാവി സുശീൽ നായർ, ഹോവേ പ്രോജക്ട് ഡയറക്ടർ രാമചന്ദ്രൻ, അദാനി ഗ്രൂപ്പ് സാമൂഹ്യ പ്രതിബദ്ധതാ വിഭാഗം ദക്ഷിണേന്ത്യാ മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ, മെഡിക്കൽ സർവീസ് കോർപ്പറേഷൻ അധികൃതർ, കോട്ടുകാൽ ഗ്രാമപഞ്ചായത്ത് അധികൃതർ തുടങ്ങിയവർ പങ്കെടുത്തു.

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തിരുവനന്തപുരം: സർക്കാരിന്റെ കോവിഡ് പ്രതിരോധപ്രവർത്തനങ്ങൾക്കായി അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനി ആയിരം ഓക്സിജൻ സിലിൻഡറുകൾ കൈമാറി.

മന്ത്രിമാരായ അഹമ്മദ് ദേവർകോവിൽ, വി.ശിവൻകുട്ടി എന്നിവർചേർന്ന് സിലിൻഡറുകൾ ഏറ്റുവാങ്ങി.

സംസ്ഥാന മെഡിക്കൽ സർവീസ് കോർപ്പറേഷൻ, കോട്ടുകാൽ ഗ്രാമപ്പഞ്ചായത്ത് എന്നിവയ്ക്കായി ഇവയുടെ വിതരണവും മന്ത്രിമാർ നിർവഹിച്ചു.

വിഴിഞ്ഞം തുറമുഖ കമ്പനി സി.ഇ.ഒ. രാജേഷ് ഝാ അധ്യക്ഷനായ ചടങ്ങിൽ വിഴിഞ്ഞം അന്താരാഷ്ട്ര തുറമുഖ കമ്പനി സി.ഇ.ഒ. ഡോ. ജയകുമാർ, തുറമുഖ കമ്പനി കോർപ്പറേറ്റ് വിഭാഗം മേധാവി സുശീൽ നായർ, ഹോവേ പ്രോജക്ട് ഡയറക്ടർ എത്തിരാജൻ രാമചന്ദ്രൻ, ഡോ. അനിൽ ബാലകൃഷ്ണൻ എന്നിവർ സംസാരിച്ചു.

ന്യൂനമർദസമയത്ത് മത്സ്യത്തൊഴിലാളികളെ രക്ഷിച്ച തുറമുഖ കരാർ ജീവനക്കാരൻ സുബ്രത് ബിശ്വാസിനെ ആദരിച്ചു.

നേരത്തേ മുഖ്യമന്ത്രിയുടെ ദുരിതാശ്വാസ നിധിയിലേക്ക് അഞ്ചുകോടി രൂപയും തിരുവനന്തപുരം കോർപ്പറേഷന് 500 കിടക്കകളും അനുബന്ധ സാമഗ്രികളും അദാനി ഗ്രൂപ്പ് നൽകിയിരുന്നു.

അദാനി വിഴിഞ്ഞം തുറമുഖ കമ്പനി 1000 ഓക്സിജൻ സിലിണ്ടറുകൾ സർക്കാരിന് കൈമാറി

മംഗളം
Fri, 04 June 2021
epaper.mangalam.com/c/50903335

Collector, Ernakulam

12h ·

ജില്ലയിലെ കോവിഡ് ചികിത്സാ രംഗത്ത് കൂടുതൽ സൗകര്യങ്ങൾക്ക് വഴിയൊരുക്കി സിങ്കപ്പൂരിൽ നിന്നും ഓക്സിജൻ ടാങ്കുകൾ എത്തി.. 20 ടൺ ഓക്സിജൻ സംഭരണ ശേഷിയുള്ള മൂന്ന് ടാങ്കുകൾ രാത്രി എട്ട് മണിയോടെ പ്രത്യേക വിമാനത്തിൽ നെടുമ്പാശ്ശേരി വിമാനത്താവളത്തിൽ എത്തി.

രണ്ട് ടാങ്കുകൾ എറണാകുളം ജില്ലയിൽ ഉപയോഗിക്കും. ജില്ലയിൽ ഓക്സിജൻ സംഭരണത്തിൽ നേരിടുന്ന പ്രതിസന്ധികൾക്ക് പരിഹാരം കാണാൻ ടാങ്കുകൾ ഉപകരിക്കും. സംസ്ഥാന സർക്കാരിന്റെ ആവശ്യപ്രകാരം അദാനി ഗ്രൂപ്പാണ് ടാങ്കുകൾ എത്തിച്ചത്.

See Translation

Write a comment... GIF

കേരളത്തിന് 3 ഓക്സിജൻ കണ്ടെയ്നറുകൾ നൽകി അദാനി ഗ്രൂപ്പ്

തിരുവനന്തപുരം● കേരളത്തിന്റെ കോവിഡ് പ്രതിരോധത്തിനു പിന്തുണയേകാൻ 3 ഓക്സിജൻ കണ്ടെയ്നറുകൾ നൽകി അദാനി ഗ്രൂപ്പ്. സിംഗപ്പൂരിൽ നിന്ന് എയർ ഫോഴ്സിന്റെ പ്രത്യേക വിമാനത്തിൽ കൊണ്ടു വന്ന കണ്ടെയ്നറുകൾ എറണാകുളം ജില്ലാ ഭരണകൂടം ഏറ്റുവാങ്ങി. 20 ടൺ സംഭരണശേഷിയുള്ള കണ്ടെയ്നറുകൾ വിവിധ മേഖലകളിലേക്ക് അയച്ചു. മുഖ്യമന്ത്രിയുടെ ദുരിതാശ്വാസനിധിയിലേക്ക് 5 കോടി രൂപ നൽകിയതിനു പുറമേ 1012 ഓക്സിജൻ സിലിണ്ടറുകളും ഫസ്റ്റ്ലൈൻ ട്രീറ്റ്മെന്റ് സെന്ററിനുള്ള കിടക്കകളും മറ്റ് ഉപകരണങ്ങളും അദാനി ഗ്രൂപ്പ് കൈമാറിയിരുന്നു.

4:20 PM

← Our Lady of Good Voyage Churc...

Our Lady of Good Voyage Church Vizhinjam

3 Jun ·

വിഴിഞ്ഞം ഇടവകയുടെ കോവിഡ് പ്രതിരോധ
പ്രവർത്തനങ്ങൾക്ക് പിന്തുണയേകി ഇടവക
കോവിഡ് പ്രതിരോധ കർമ്മസേനയുടെ
കമ്മ്യൂണിറ്റി കിച്ചണിലേയ്ക്ക് അദാനി
ഫൗണ്ടേഷൻ ഭക്ഷ്യ വസ്തുക്കൾ നൽകി....
അദാനി ഫൗണ്ടേഷന് വിഴിഞ്ഞം ഇടവകയുടെ
ഹൃദയം നിറഞ്ഞ നന്ദി രേഖപ്പെടുത്തുന്നു......❤️

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Maya G Ratheesh and 42 others

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കോവിഡ്: കേരളത്തിന് 3 ഓക്സിജൻ കണ്ടെയ്നറുകൾ നൽകി അദാനി ഗ്രൂപ്പ്

മനോരമ ലേഖകൻ
JUNE 08, 2021 07:05 PM IST

തിരുവനന്തപുരം ● കേരളത്തിന്റെ കോവിഡ് പ്രതിരോധത്തിനു പിന്തുണയേകാൻ മൂന്ന് ഓക്സിജൻ കണ്ടെയ്നറുകൾ നൽകി അദാനി ഗ്രൂപ്പ്. സിംഗപ്പൂരിൽനിന്ന് എയർഫോഴ്സിന്റെ


adani
asianet news
24 മണിക്കൂറിനിടെ 2,123പേർ കൊവിഡ് ബാധിച്ച് മരിച്ചു
asianetnews.com
FLASH

Adani Foundation

5d ·

Improving and securing a community's ways of generating income goes a long way in alleviating hunger and poverty. One of the ways to do this is to impart scientific knowledge of advanced farming methods to get better yields. With this aim, Adani Vizhinjam Port has inaugurated a community school for agriculture learning. Equipped with several functional components like horticulture, nutrition garden, medicinal garden etc, the school aims to plant close to 6000 crop-yielding varieties this year.

#SustainableDevelopment #PovertyEradication

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ലോക മുലയൂട്ടൽ വാരാചരണം

വിഴിഞ്ഞം.● അദാനി ഫൗണ്ടേഷൻ നടപ്പാക്കി വരുന്ന സുപോഷൺ പദ്ധതി ഭാഗമായി ലോക മുലയൂട്ടൽ വാരാചരണം നടത്തി. ഇതോടനുബന്ധിച്ച് ഓൺലൈൻ വെബിനാർ ക്ലാസുകൾ,പുരുഷന്മാരുടെ സത്യപ്രതിജ്ഞ, ബോധവൽക്കരണ പോസ്റ്റർ പ്രസിദ്ധീകരണം, കൗൺസലിങ് എന്നീ പരിപാടികൾ സംഘടിപ്പിച്ചു.

ഫൗണ്ടേഷൻ ദക്ഷിണ മേഖല മേധാവി ഡോ. അനിൽ ബാലകൃഷ്ണൻ ഉദ്ഘാടനം ചെയ്തു. ഡോ. എൻ. എസ്. അയ്യർ, ഡോ. വിദ്യ വിമൽ ,രേഖ രവീന്ദ്രൻ എന്നിവർ ക്ലാസുകൾ നയിച്ചു. സെബാസ്റ്റ്യൻ ബ്രിട്ടോ, രാകേഷ് നായർ ,ജോർജ് സെൻ ,സ്റ്റീഫൻ വിനോദ്, ജി. മായ, ലിംന ഗ്ലാസ്റ്റിൻ, കുമാരി മീര മറിയം സ്കറിയ എന്നിവർ നേതൃത്വം നൽകി.

Adani's schemes benefit 50,000 Vizhinjam residents

EXPRESS NEWS SERVICE

THE CSR wing of Adani Vizhinjam Port Pvt Ltd has initiated a slew of welfare activities covering around 50,000 people in five wards of Vizhinjam, falling under a 2km radius of the port project. Welfare schemes covering education, health, livelihood, skill development and community infrastructure has been initiated.

In a release issued here, the CSR wing of Adani Vizhinjam Port Private Ltd announced its initiatives to combat Covid. As part of its sustainable livelihood development, employability skill courses were conducted for 812 youths. Digital literacy courses covered 5,300 people. As part of community infrastructure development initiatives, public bathing facilities, public toilets and school infrastructure were constructed.

The other projects planned under the initiatives are solid waste management, model village farming, farm school and nutrition programmes. As part of a community health initiative, a mobile health care unit was launched, which can help over 55,079 people and continue to give treatment to around 9,362 registered patients. Around 21 medical camps were held, aiding around 2,000 people. The upcoming skill park will also offer port-related courses. As many as 17 different livelihood units for women installed around two years ago are running successfully. The community awareness programme covered around 11,000 people. As part of the kitchen garden programme, free homestead kitchen gardens were set up in 260 families and the second phase will cover 740 families.

LEARNING AND INFRASTRUCTURE

Digital literacy courses covered 5,300 people. As part of community infrastructure development initiatives, public bathing facilities and public toilets were constructed. The upcoming skill park will also offer port-related courses

A grab of TNIE report on Vizhinjam port dated August 26

Annexure V

Compliance to Conditions of KCZMA Recommendation

Annexure V

Half Yearly Compliance of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance (EC) for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
(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 construction activities 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. • CTE for consumer pump inside the Vizhinjam port premises was obtained on 07.03.2021 (Consent No.: PCB/TVM-DO/NTA/PTP/15/2021) for the period of 5 years valid up to 28.02.2026. • Consent to Operate (CTO) for Explosives Storage at Chappath area was obtained on 20.07.2021 (Consent No.: PCB/TVM-DO/ICO/NTA/HCS/49/2021) valid up to 31.12.2024 (A Copy of the CTO is Enclosed as **Annexure X**). • As per the exemption granted by 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)	Since the project envisages development of roads, infrastructural facilities, dredging of the lake and kayals proper environmental safety measures	**Complied** All safety measures are being adopted. Full time Environment & Safety professionals are employed by AVPPL, contractors & subcontractors to oversee the implementation of environmental

Half Yearly Compliance of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance (EC) for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
	must be ensured.	safety measures. Organizational Structure for Environment, Health, and Safety (EHS) & CSR for construction phase is enclosed as **Annexure IX**. All work plans are executed after assessing the defined EHS plans. 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. Provision for installing Sewage Treatment Plant (STP) facility of adequate capacity in phased manner is being

Half Yearly Compliance of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance (EC) for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
		planned and will be implemented in line with CRZ Notification along with the commissioning of the project.
(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** Shoreline monitoring cell visited the site on 14.04.2021 during the compliance period. All necessary facilities/support was extended to the officials during the compliance review/site visit; and the same will be provided during any future planned inspection of the project site. All necessary support will be extended to officials of KCZMA during inspection of the project/site visit; at any time.
(vii)	The KCZMA may be duly informed of any construction/developmental works/major activities undertaken in the CRZ area of the project	**Being 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. • HYCRs are being furnished to KCZMA including the details of the development works. Following construction activities have taken place till September 2021: • No dredging was carried out during the compliance period from April 2021 to September 2021. The dredged material till 30.09.2021 amounting to 2.90 Mm^3 has been utilized for reclamation of 36 Ha area. The dredged material has been used for reclamation. • Berth Construction: Piling (617 nos.) and casting of pile muffs (617 nos.) have been completed.

Half Yearly Compliance of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance (EC) for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
		• Breakwater construction is in progress • Boundary wall work along available front has been completed at various locations; remaining construction work is in progress, on hold due to local issues or not handed over to AVPPL due to disputes. • Following buildings construction work are completed: o Gas Insulated Substation (GIS) substation o Substation building (Inside port) o Port Operations Building (POB) o Port Canteen o Toilet Block-2 o Training Room and Custom Check Building • Following construction work is in progress: o RMU buildings-yard o RMU buildings-berth o Workshop Building o Gate Complex o Driver Rest Room o DG Shed Building o Water Tank & Pump House o Security Building o Port User Building (PUB) Building o Parking Shed for fire tenders o Storm Water Drain o Yard Development o Approach Road o Paver Blocks o Electrical Works
(viii)	Environmental clearance must be obtained from the Ministry of Environment & Forests.	**Complied** Environment & CRZ Clearance (EC) has been obtained from Ministry of Environment & Forest vide MoEF letter dated 03.01.2014 (F.No.11-122/2011-IA.III). As per EIA Notification 2006 and Office Memorandum (O.M.) dated 12.04.2016, the validity of the EC is for seven years up to

Half Yearly Compliance of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance (EC) for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
		03.01.2021. As per the provisions of MoEF&CC, the validity of the EC may be further extended for a maximum period of three years. VISL had submitted online application and required relevant documents on parivesh for extension of EC on 08.10.2020, 03.11.2020 and 19.11.2020. The Proposal (IA/KL/MIS/178082/2020) was considered in the 246th and 247th EAC meeting of Infra-1 committee of MoEF&CC held on 20.10.2020 and 23.11.2020; wherein VISL and NABET accredited consultant-L&T-IEL had made a presentation to the committee members. Thereafter, MoEF&CC vide letter No. IA/KL/MIS/178082/2020 dated 29.12.2020 (Copy of the same was submitted along with the compliance report for the period October 2020 to March 2021) have increased the validity of EC of Vizhinjam port by 3 years till 02.01.2024. Further, taking into account the outbreak of COVID-19 pandemic, MoEF&CC has amended the 2006 EIA Notification such that the period from the 01.04.2020 to the 31.03.2021 shall not be considered for the purpose of calculation of validity of existing ECs. Therefore, the EC of Vizhinjam port is valid till 02.01.2025.
(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. Till date, an amount of Rs. 19.583 Crores has been spent on environmental protection measures. The activity wise fund break up and expenditure during the compliance period April 2021 to September 2021 is enclosed as **Annexure VIII**.

Half Yearly Compliance of Conditions Stipulated in KCZMA Recommendation for Environment and CRZ Clearance (EC) for the Period April 2021 to September 2021		
S. No.	**Conditions**	**Compliance Status as on 30.09.2021**
(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 EC was submitted by Vizhinjam International Seaport Ltd. (VISL), a Government of Kerala (GoK) undertaking.

Annexure VI

Compliance of the Commitments made during Public Hearing

Annexure VI

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
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. 101.86 Crores was sanctioned by GoK, instead of Rs. 8.55 crores; as suggested earlier in the EIA stage. Till date an amount of Rs. 94.39 crores have been disbursed till 30.09.2021 for a total number of 2631 Livelihood Affected Persons (LAPs) whose verification was complete in all respects; this includes boat owners to whom kerosene is supplied free of cost as well during the port construction period. Verification of the documents of few balance LAPs is in progress. *(Source: VISL)* There are 5 identified EMP areas: Port Site, Road/Rail Corridor, Warehouse Area, PAF (Project Annex Facility) and Backup Areas. 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 VII**.
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 acquisition also viz-a-viz applicable. *(Source: VISL)*
4	Additional fish landing centre will be constructed	**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 in the form of a new fishing harbour. The EPC Contractor, in anticipation of

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
		finalising design mobilised the sub-contractor along with resources for construction of fishery harbour since March 2017. However, fishing boats docked in the proposed area need to be removed before the commencement of work. Government of Kerala (GoK) has initiated discussions with fishermen representatives for removal of the boats to facilitate construction work and these discussions are ongoing. *(Source: VISL)*
5	Existing harbour will be improved under the CSR provisions of the project	**Being Complied** Tender 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. GoK have formed a high-level committee for finalising the master plan of the old fishing harbour in consultation with all stakeholders. *(Source: VISL)*
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** Based on the Shoreline Monitoring Plan prepared by L&T Infra Engineers Ltd (L&T IEL) under the guidance of National Institute of Ocean Technology (NIOT), 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 HYCR. Broadly the scope covers: • Wave Observations • Onshore Cross beach profiling • Offshore Cross beach profiling • Littoral Environmental Observations (LEO) • Beach Sampling • Multi-beam Echo Sounder (MBES) survey • River cross section surveys • Grab Sampling • Current Observations

<table>
<tr><th colspan="3">Compliance of the Response/Commitments made during Public Hearing</th></tr>
<tr><th>S. No.</th><th>Responses/Commitments</th><th>Status as on 30.09.2021</th></tr>
<tr><td></td><td></td><td>
Tide Observations
Weather Observations
Water Sampling
Turbidity
Shoreline Monitoring Report for the period April 2021 to September 2021 is enclosed as Annexure I.

L&T IEL had prepared Mathematical Modelling Reports based on Shoreline Monitoring data; which were vetted by NIOT.

Four mathematical modelling reports have been prepared by L&T IEL so far and submitted to MoEF&CC; as detailed below:

<table>
<tr><th>Data Period</th><th>Submitted With HYCR for the Period</th></tr>
<tr><td>Feb 2015 to Feb 2017</td><td>Apr 2017 to Sep 2017</td></tr>
<tr><td>Mar 2017 to Feb 2018</td><td>Apr 2018 to Sep 2018</td></tr>
<tr><td>Mar 2018 to Feb 2019</td><td>Apr 2019 to Sep 2019</td></tr>
<tr><td>Mar 2019 to Feb 2020</td><td>Apr 2020 to Sep 2020</td></tr>
</table>
In continuation with the same practise Adani Vizhinjam Port Pvt. Ltd. (AVPPL) have submitted the shoreline data from March 2020 to February 2021 to L&T IEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. The mathematical modelling report for the period March 2020 to February 2021 vetted by NIOT is given as Annexure II.

From all the data analyses and model studies carried out by L&T IEL, 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.
</td></tr>
<tr><td>8</td><td>Water supply provision to the Vizhinjam fishing village</td><td>Complied
Water Supply Scheme for provision to the local people has been commissioned in April</td></tr>
</table>

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
		2013 by VISL by expending an amount of Rs. 8.10 crores. For Operation & Maintenance (O&M) of the same an amount of Rs. 5.38 crores has been spent up to 31.03.2021. From 04.04.2019 onwards, O&M of the scheme is being done by Kerala Water Authority (KWA). An additional amount of 1.74 crores has been sanctioned for extending water supply facilities to the community by VISL. The work is in progress by KWA. *(Source: VISL)*
10	Railway work will be initiated after Environment Clearance (EC)	**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 submitted to Southern Railway for its approval. Geophysical and geomorphological studies have also has completed. All the required clarifications have been provided to Southern Railways and the approval is expected shortly. EC amendments in this regard would be sought for once the approval of DPR is obtained. *(Source: VISL)*
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 an average of 347 persons (employees, staff and construction workers) engaged at site for different construction activities during the compliance period, 225 people are from Kerala and out of them 76 are from nearby wards of the project site.
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.
16	Waste management is included in the EMP and C&D waste management is part of the	**Being Complied** Adequate budgetary provision has been kept for waste management as part of EMP as well

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
	SWMP.	as CSR. As mentioned in EIA, contractors have been made responsible for management of Waste. 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. Additionally, as a part of CSR activities, AVPPL are taking up activities with respect to solid waste management (Refer **Annexure IV**).
17	Upgradation of PHC at Vizhinjam will be carried out	**Being Complied** The construction work of Community Health Center at Vizhinjam has been resumed after the COVID restrictions. The project cost is Rs. 7.79 Crores where the Government component of Rs. 4.82 Crores and CSR component of Rs. 2.97 Crores from Adani Foundation. Adani Foundation handed over the first instalment of Rs. 1.18 crores to the Harbour Engineering Department (HED) on 03.10.2018.
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** Resort owners evicted have been compensated for land and not for the structures since they were in violation of CRZ notification. An area of 0.728 Ha has been acquired up to 30.09.2021 under negotiated purchase. Remaining land of 2.865 Ha to be acquired by Land Acquisition (LA) process for which notification has been published and action initiated by the District Collector Thiruvananthapuram. *(Source: VISL)*
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. Presently, development of dedicated road connectivity approach road (2.0 km) from the port to the NH-47 Bypass is in progress. For Railway Connectivity, Detailed Project Report

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
		(DPR) has been completed and all the required clarifications have been provided to Southern Railways for 10.7 km rail connectivity to the present railway line running from Thiruvananthapuram Central station (TVC) to Nagercoil junction (NCJ) of Thiruvananthapuram; approval is expected shortly. Geophysical and geomorphological studies also have been completed. EC amendments in this regard would be sought for once the approval of DPR is obtained. (Source: VISL)
21	Waste Management, Water Treatment plants, etc. will be part of an operational EMP	**Being Complied** Provision for installing Sewage Treatment Plant (STP) facility of adequate capacity in phased manner is being planned and will be implemented in line with CRZ Notification along with the commissioning of the project.
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 2021 to September 2021. The dredged material till 30.09.2021 amounting to 2.90 Mm^3 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 in the month of November 2019 and continuous monitoring was carried out to assess the real time turbidity. The turbidity details for the compliance period are given in **Annexure I**.
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. In addition to the above, independent environment, health and safety consultants

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
		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 IX**. 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 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 262 Mussel collectors have collected the compensation amount totalling to Rs. 12.35 Crore. Although they were offered alternate livelihood plan through cage fishing, they opted for one-time settlement citing the risks involved in such fishing. The remaining 9 mussel collectors have not approached VISL for compensation. *(Source: VISL)*
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** 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 submitted to Southern Railway for its approval. Geophysical and geomorphological studies have also has completed. All the required clarifications have been provided to Southern Railways and the approval is expected shortly. EC amendments in this regard would be sought for once the approval of DPR is obtained. *(Source: VISL)* AVPPL had awarded the work to Kerala State Remote Sensing and Environment Centre

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
		(KSREC) to undertake study on Groundwater impact due to construction of port approach road. KSREC has submitted the final report with recommendations and AVPPL is in the process of constructing the approach road to port taking into account the recommendation given by the report. CSR activities are detailed in **Annexure IV**. Status of construction stage EMP in matrix format is enclosed as **Annexure VII**.
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 2021 to September 2021 is enclosed as **Annexure III**. Half Yearly Compliance Reports (HYCRs) which are 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 regulatory authorities/agencies. As per the MoEF&CC Notification dated 26.11.2018, wherein submission of HYCRs by email/soft copy is declared acceptable, therefore the HYCR for the period October 2020 to March 2021 has been submitted to the MoEF&CC, Regional Office (Bangalore), Zonal office of the CPCB (Bangalore), KSPCB & KCZMA via email dated 30.05.2021 (a copy of the email is enclosed as **Annexure XI**).
28	Special care will be taken to minimise the tree felling in the backup area and to plan the development in tune with the topography.	**Being Complied** Being complied with the extent possible, but in line with the technical requirements of the project. Due permission is taken for the same from concerned department (Forest Department). AVPPL, in collaboration with Forest department, have carried out compensatory afforestation of approximately 15,540 trees on

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
		12.05 Ha land; as identified by social Forest Department in Sainik School, Trivandrum (at an aerial distance of 24 km from the Vizhinjam Port project site). The plantation is now in its Third Year. Rs. 80.50 Lakhs has been spent towards Phase-I of the compensatory afforestation at Sainik School. Also, AVPPL, in collaboration with Forest department, have carried out compensatory afforestation of approximately 16,500 trees in 10.31 Ha of area at Kerala University Campus, Karyavattom (at an aerial distance of 23 km from the Vizhinjam Port project site) and approximately 8,000 trees in 5 Ha of area at KWA STP, Muttathara (at an aerial distance of 11 km from the Vizhinjam Port project site).
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 600 eligible fishermen amounting to a total of Rs. 35.13 Crore. Verification of the document of balance fishermen is in progress. *(Source: VISL)*
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, Ahmadabad 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. *(Source: VISL)*
34	Maximum 3 ships are expected	**Will be Complied**

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S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
	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	Restrictions on fishing will be as per the applicable laws.
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 IV**. Refer point 33 above for area 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 compensation in the form of kerosene in November 2017. Rs. 23.02 Crore has been given till 30.09.2021 to the disbursal agency identified for the work. *(Source: VISL)*
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 Rs. 6.11 Crores has been disbursed to 211 out of 213 number of resorts workers and settled completely. *(Source: VISL)*
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. Refer point 26 above.
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.
44	The port road will be access controlled for the exclusive use	**Not Applicable** The port road will not be access controlled

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	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	and connectivity for the local residents will not be affected.
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.
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 for improving their employability. No Objection Certificate (NoC) has been issued to ASAP to proceed with the construction of a Community Skill Park (CSP) in an area of 1.5 acres of land at Vizhinjam. It is operated as a PPP model wherein 25000 sq. ft. building with facilities for students' hostel are being constructed by GoK under ASAP with ADB assistance, whereas the operation of the centre with logistics and other high-end courses is vested with Adani Skill Development Centre. Preference is being given to local people based on skill and competency during the construction stage. *(Source: VISL).* Preference is being given to local people based on Skill & competency during the construction stage. Out of an average of 347 persons (employees, staff and construction workers) engaged at site for different construction activities during the compliance period, 225 people are from Kerala and out of

Compliance of the Response/Commitments made during Public Hearing		
S. No.	**Responses/Commitments**	**Status as on 30.09.2021**
		them 76 are from nearby wards of the project site.
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** Restrictions on fishing will be as per the applicable laws.
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.	**Will be 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. Vizhinjam fishing harbour is excluded from revised notification. 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 for Compliance** Barge movement will be planned as per the requirements in such a way that it will not be a hindrance to fishermen.
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.

Annexure VII

Status of Environment Management Plan

Annexure VII

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 30.09.2021**
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 2021 to September 2021. The dredged material till 30.09.2021 amounting to 2.90 Mm^3 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 are carrying out real time turbidity measurement. ○ Dredging Management plan has been prepared ○ Discharge of waste into sea is prohibited ○ After duly incorporating the comments of Indian Coast Guard (ICG), the final facility Level Oil Spill Disaster Contingency Plan (OSDCP) in line with the National Oil Spill-Disaster Contingency Plan (NOS-DCP) has been submitted to ICG for approval vide letter No. AVPPL/ICG/2020-21/1134 dated 22.05.2020. After final review by PRT (West), ICG has made specific remarks on the compliance of OSDCP prepared in line with NOS-DCP guidelines; directing AVPPL to submit the OSDCP for approval only after pollution response equipment are in place. Considering that the procurement of pollution response equipment will be 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 30.09.2021**
				development of the port, the final OSDCP will be submitted to ICG for approval prior to commissioning of the port; when the pollution response equipment are in place. o 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. o Six monthly monitoring reports are regularly submitted to regulatory authorities as a part of Half Yearly Environmental & CRZ clearance Compliance Reports (HYCRs).
2	Material transport and construction activities	Air Quality	o 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.	**Being Complied** o Rock placing for breakwater construction is being undertaken using the stones brought through barges from nearby harbours (Kollam and Muthulapuzhi). o It is ensured that all vehicles entering the Port have a valid PUC certification o Adequate sized construction yard has been provided for storage of construction materials, equipment tools, earthmoving equipment, etc. o The dumpers have speed governors ensuring

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 30.09.2021
			o To reduce impacts from exhausts, emission control norms will be enforced / adhered. o All the vehicles and construction machinery will be periodically checked to ensure compliance to the emission standards o Construction equipment and transport vehicles will be periodically washed to remove accumulated dirt o Providing adequately sized construction yard for storage of construction materials, equipment tools, earthmoving equipment etc. o Provide enclosures on all sides of construction site o Movement of material will be mostly during non-peak hours. o On-site vehicle speeds will be controlled to reduce excessive dust suspension in air and dispersion by traffic o Water sprinkling will be carried out to	adherence to speed limit o Signage for speed control are displayed inside port area o Water sprinkling is carried out for supressing dust o It is ensured that all trucks transporting material are covered by tarpaulin. o Regular awareness programme on various Environment aspects is being imparted to workers and employees.

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 30.09.2021**
			suppress fugitive dust o Environmental awareness program will be provided to the personnel involved in developmental works o Use of tarpaulin covers and speed regulations for vehicles engaged in transportation	
		Noise	o Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB o Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A) o Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used o Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors	**Being Complied** o Noise levels are being monitored every fortnight and are found to be well within the permissible limits within the project area. o Contractors are also monitoring the Noise level in their work area and results are within the stipulated limits. o Protective gear like earplugs, muffs are provided to workers exposed to noise level beyond threshold limits.

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 30.09.2021
			o Noise attenuation will be practiced for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers o High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am to 10pm) to minimise noise impacts o Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. o Ambient noise levels will be monitored at regular intervals	
		Disturbance to Natural Drainage pattern	o Port development is mostly on reclaimed land o Rainwater/surface water harvesting pond included in design o Existing drainage near port boundary (backup area) will be integrated with port storm water drainage & management plan o Existing drains / Streams that are passing in ware house area will not	**Being Complied** o 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. o A study has been conducted to access the rainwater harvesting potential and recommend for planning accurate, successful and implementable rainwater harvesting management system within the proposed sites for the sustainable development of existing

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 30.09.2021**
			be closed/ diverted. And these streams will be de-silted and enhanced to improve their carrying capacities	groundwater resources and thereby suitable rainwater harvesting structures are recommended. In order to capture, store and reuse a percentage of the estimated runoff, rainwater collection and storage sumps are recommended at suitable locations. o Provision for installing Sewage Treatment Plant (STP) facility of adequate capacity in phased manner is being planned and will be implemented in line with CRZ Notification along with the commissioning of the project. o Drains/streams passing through the warehouse area will not be closed/diverted.
		Vegetation and Strain on existing infrastructure	o Port development is planned mostly on reclaimed land; o Land use at backup area, PAF Zone and warehouse area will be mostly coconut plantation and low mixed plantation o Adequate green belt will be developed in port and its associated (backup area, PAF, warehouse and road & rail connectivity). o Temporary workers camp with self-sufficient infrastructure facilities.	**Being Complied** o Care is taken to limit the felling of trees to the bare minimum. Due permission is taken for trees being cut down as a result of the port development from concerned department (Forest Department). o During the meeting with Hon'ble Minister dated 05.04.2017, it was decided that Forest Department shall identify land for compensatory afforestation in lieu of trees felled at port site areas; at the rate of 1:10. AVPPL, in collaboration with Forest department, have carried out compensatory afforestation of approximately 15,540 trees on 12.05 Ha land; as identified by social Forest Department in

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 30.09.2021**
				Sainik School, Trivandrum (at an aerial distance of 24 km from the Vizhinjam Port project site). The plantation is now in its Third Year. Rs. 80.50 Lakhs has been spent towards Phase-I of the compensatory afforestation at Sainik School. o Plantation of saplings along the road margins, road medians and port boundary are planned as part of the master plan development/greenbelt development plan. o Presently, during the present compliance period, the contractors have demobilized and there are no workers residing in the labour camps. It is ensured that labourers who are staying outside the labour camps are provided with necessary infrastructure facilities.
		Existing Traffic	o 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 o Regularization of truck movement o Majority of rock for breakwater	**Being Complied** o Presently, development of dedicated road connectivity approach road (2.0 km) from the port to the NH-47 Bypass is in progress. o Traffic monitoring & regularization is being carried out for maximum efficiency. o Transportation of construction materials is being carried out taking into account the non-peak traffic timing and local restrictions during festivals, strikes, etc.

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 30.09.2021
			construction will be transported through sea route via barges from nearby quarry sites o A dedicated rail network of approximately 15 km is proposed from port to Nemom railway station	o Rock placing for breakwater construction is being carried out using the stones brought through barges from nearby harbours (Kollam and Muthulapuzhi). 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 submitted to Southern Railway for its approval. Geophysical and geomorphological studies have also has completed. All the required clarifications have been provided to Southern Railways and the approval is expected shortly. EC amendments in this regard would be sought for once the approval of DPR is obtained. *(Source: VISL)*
3.	Land Reclamation	Existing Water Resources like Groundwater and surface water	o Land to be reclaimed will be separated from adjoining land by creating containment bund. o Return sea water will be sent back to sea through appropriate channels.	**Being Complied** o No dredging was carried out during the compliance period from April 2021 to September 2021. The dredged material till 30.09.2021 amounting to 2.90 Mm^3 has been utilized for reclamation of 36 Ha area. The dredged material has been used for reclamation. o During dredging return sea water is sent back to sea through appropriate channels.

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 30.09.2021
				○ 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. ○ Burning of refuse at construction sites will be prohibited. ○ All control measure will be taken to avoid the contamination of groundwater during construction phase	**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. ○ 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 Waste Management Rules 2016, as amended. ○ An Organic Waste Converter (OWC) is planned to be procured for bio-degradable waste; output will be used as manure in greenbelt development. ○ General refuse waste is being stored separately and sent to approved recyclers and/or sold. ○ No burning of refuse at construction sites is being done. ○ There is no disposal of waste in the project area which may lead to groundwater contamination.
5.	Handling of hazardous	Human safety and property loss	○ Adequate safety measures as per OSHA standards will be adopted	**Being Complied** ○ Adequate safety measures as per OSHA standards are adopted as and when necessary as per the HSE Plan.

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 30.09.2021
	wastes		o Construction site will be secured by fencing with controlled/limited entry points. o Hazardous materials such as lubricants, paints, compressed gases, and varnishes etc., will be stored as per the prescribed/approved safety norms. o Medical facilities including first aid will be available for attending to injured workers. o Handling and storage as per statutory guidelines. o Positive isolation procedures will be adhered o Hazardous wastes will be disposed through approved KSPCB/CPCB vendors.	o Construction site is being secured by fencing wherever possible with controlled/limited entry points. Boundary wall construction is ongoing at available fronts. o 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. o Handling and storage of Hazardous Materials is being done as per statutory guidelines. o Hazardous waste is disposed through approved KSPCB/CPCB vendors.
6.	Water Resources	Water scarcity / Pollution	o Water requirement during the construction is expected to be around 0.10 MLD o Water will be sourced from Vellayani lake o Avoid/minimise the loss during	**Being Complied** o 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

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 30.09.2021**
			conveyance o Optimized utilization of the water o Care will be taken to prevent the runoff from the construction site to the nearby natural streams, if any	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 was to 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 13 KLD water is being consumed for construction related activities during the compliance period (April 2021 to September 2021). o Care is being taken to prevent the runoff from the construction site to the nearby natural streams.
7.	Fishing	Fishermen and fishing villages	o Signboards will be placed at the construction activities in order to make fishermen aware of the ongoing construction activities o Necessary marker buoys will be installed o Interactions will be initiated with the fishing community before commencement of construction works	**Being Complied** o Signboards have been placed for demarcation of construction area. o Navigational buoys/marker buoys are placed in the marine area for fishing boats to maintain a safe distance from the areas of breakwater construction. o 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. o AVPPL CSR team also provides regular updates 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 30.09.2021**
				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 ○ Resort owners evicted have been compensated for land and not for the structures since they were in violation of CRZ notification. An area of 0.728 Ha has been acquired up to 30.09.2021 under negotiated purchase. Remaining land of 2.865 Ha to be acquired by Land Acquisition (LA) process for

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 30.09.2021**
				which notification has been published and action initiated by the District Collector Thiruvananthapuram. *(Source: VISL)*

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 consists of:
				  ○ Wave Observations
				  ○ Onshore Cross beach profiling
				  ○ Offshore Cross beach profiling
				  ○ Littoral Environmental Observations (LEO)
				  ○ Beach Sampling
				  ○ Multi-beam Echo Sounder (MBES) survey
				  ○ River cross section surveys
				  ○ Grab Sampling
				  ○ Current Observations
				  ○ Tide Observations
				  ○ Weather Observations
				  ○ Water Sampling
				  ○ Turbidity Measurements
				○ L&T Infrastructure Engineering Ltd. (L&T IEL) had prepared Mathematical Modelling Reports based on

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 30.09.2021**
				Shoreline Monitoring data; which were vetted by National Institute of Ocean Technology (NIOT). ○ Four mathematical modelling reports have been prepared by L&T IEL so far and submitted to MoEF&CC. These mathematical modelling reports have affirmed that the shoreline change is in line with prediction in the EIA study. As per the latest mathematical modelling report, from all the data analyses and model studies carried out by L&T IEL, 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. ○ In continuation with the same practice Adani Vizhinjam Port Pvt. Ltd. (AVPPL) have submitted the shoreline data from March 2020 to February 2021 to L&T IEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. The mathematical modelling report for the period March 2020 to February 2021 vetted by NIOT is given as **Annexure II**.
10	Effect on existing	Movement of fishing boats	○ Detailed modelling studies have been carried out on tranquillity	**Being Complied** ○ Wave, current and tide data are being monitored along with the shoreline monitoring of 40 km stretch.

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 30.09.2021
	fishing harbour		conditions in the fishing harbour with port development. The studies reveal that the tranquillity conditions will be improved in fishing harbour with construction of the port. Further minor accretion happening within the fishing harbour will be arrested ○ Traffic of Marine vessel/ fishing boats will be planned without affecting each other ○ Adoption of fishing harbour to manage it to perform as per International standard ○ A new fishing harbour provided under CSR initiatives because of additional tranquillity creator. ○ Loss of livelihood will be either taken care of in the new port premises or adequately compensated mostly in the form of employment	Based on the above, the modelling studies done at the EIA stage has been further evaluated. ○ During operation phase traffic of Marine vessel/fishing boats will be planned without affecting each other as per the applicable laws. ○ 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 in the form of a new fishing harbour. The EPC Contractor, in anticipation of finalising design mobilised the sub-contractor along with resources for construction of fishery harbour since March 2017. However, fishing boats docked in the proposed area need to be removed before the commencement of work. Government of Kerala (GoK) has initiated discussions with fishermen representatives for removal of the boats to facilitate construction work and these discussions are ongoing. *(Source: VISL)* ○ In consultation with the fishermen, enhanced livelihood compensation of Rs. 101.86 Crores was sanctioned by GoK, instead of Rs. 8.55 crores; as suggested earlier in the EIA stage. Till date an

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 30.09.2021**
				amount of Rs. 94.39 crores have been disbursed till 30.09.2021 for a total number of 2631 Livelihood Affected Persons (LAPs) whose verification was complete in all respects; this includes boat owners to whom kerosene is supplied free of cost as well during the port construction period. Verification of the documents of few balance LAPs is in progress. *(Source: VISL)*
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 monitored a 40 km stretch. ○ L&T IEL had prepared Mathematical Modelling Reports based on Shoreline Monitoring data; which were vetted by NIOT. ○ Four mathematical modelling reports have been prepared by L&T IEL so far and submitted to MoEF&CC. These mathematical modelling reports

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 30.09.2021
				have affirmed that the shoreline change is in line with prediction in the EIA study. As per the latest mathematical modelling report, from all the data analyses and model studies carried out by L&T IEL, 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. o In continuation with the same practice Adani Vizhinjam Port Pvt. Ltd. (AVPPL) have submitted the shoreline data from March 2020 to February 2021 to L&T IEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. The mathematical modelling report for the period March 2020 to February 2021 vetted by NIOT is given as **Annexure II**.

Environmental Management Plan – Rail*/Road Corridors *No Construction work was carried out during the compliance period in the rail corridor			
S. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Status as on 30.09.2021**
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 ○ 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 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 IX**. ○ 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. ○ Necessary equipment will be purchased; adequate provisions have been made in the

Environmental Management Plan – Rail*/Road Corridors *No Construction work was carried out during the compliance period in the rail corridor			
S. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Status as on 30.09.2021**
			budget for the same. o Third party environmental monitoring has commenced since August 2016 and the monitoring results are satisfactory.
2	Altered Road embankment	o Retaining walls and gabions should be provided	**Noted for Compliance** o 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. o KSREC have studied the impact due to construction of port approach road. o Recommendations of KSREC are being implemented and suitable mitigation measures as suggested in the KSREC report are being adopted during construction.
3	Dust	o Water should be sprayed during the construction phase, at mixing sites, and temporary roads. o 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. o Vehicles delivering materials should be covered to reduce spills and dust blowing off the load.	**Being Compiled** o Regular Water Sprinkling is done on the approach road by water tankers. o Water spraying is carried out at regular intervals after compaction o Tarpaulin cover is used in vehicles delivering materials.
4	Air Pollution	o Vehicles and machinery are to be maintained so that emissions conform to National and State standards.	**Being Complied** o Ambient air quality monitoring is carried out at 5 locations as per the Environment Monitoring Plan

Environmental Management Plan – Rail*/Road Corridors

***No Construction work was carried out during the compliance period in the rail corridor**

S. No.	Environmental Impacts and Issues	Mitigation Measures	Status as on 30.09.2021
		○ All vehicles and machineries should obtain Pollution Under Control Certificates (PUC).	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 necessary. ○ Proper maintenance of the rail track and rail wagon, by frequent lubrication to avoid frictional noise. ○ Regular monitoring shall be carried out as per the Environmental Monitoring Plan.	**Being Compiled** ○ All the machinery and vehicles are maintained to keep the noise at minimum ○ Noise monitoring is being done since August 2016, and the readings are within the limits at port site ○ 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	○ Impacted ponds can be enhanced by constructing bridged structures like Gabions to avoid plugging of springs. ○ Mitigation/Compensation shall be affected for the completely impacted ponds. ○ At Chainage km 6.500 the Railway alignment goes below the Existing NH and then at km 6.600 it will hit pond. The pond will be excavated partially and the soil material shall be used to fill in the	**Will be complied** ○ AVPPL had awarded the work to KSREC to undertake study on Groundwater impact due to construction of port approach road and also suggest mitigation measures. ○ For impacted ponds in road alignment an elevated road is planned as suggested by KSREC. Other suitable mitigation measures as suggested in the KSREC report will be adopted during construction.

Environmental Management Plan – Rail*/Road Corridors *No Construction work was carried out during the compliance period in the rail corridor			
S. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Status as on 30.09.2021**
		western part and an equivalent area lost may be excavated to compensate the loss of effective pond area.	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 submitted to Southern Railway for its approval. Geophysical and geomorphological studies have also has completed. All the required clarifications have been provided to Southern Railways and the approval is expected shortly. EC amendments in this regard would be sought for once the approval of DPR is obtained. *(Source: VISL)*
7	Flood Impacts and Cross Drainage Structures	o Formation level should be raised according to the design and the cross drainage structures suitably planned for the flood events.	**Being Complied** o During the construction, care was taken such that the formation level is as per suitable design and the cross drainage structures are also being implemented.
8	Alteration of drainage	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. o All necessary measures shall be taken to prevent earthworks and stone works from impeding cross drainage at streams and canals or existing	**Will be Complied** o AVPPL had awarded the work to KSREC to undertake study on Groundwater impact due to construction of port approach road and also suggest mitigation measures. o For impacted on water quality, suitable mitigation measure as suggested in the KSREC report will be

Environmental Management Plan – Rail*/Road Corridors *No Construction work was carried out during the compliance period in the rail corridor			
S. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Status as on 30.09.2021**
		irrigation and drainage systems in conformity to the Contractors visual integration and management plan and EMP.	adopted.
9	Contamination from Wastes	o All justifiable measures will be taken to prevent the wastewater produced during construction from entering directly into rivers and irrigation systems.	**Being Complied** o Measures are being taken up to prevent the wastewater produced during construction from entering directly into rivers and irrigation systems. o An STP will be developed along with the port and the sewerage and storm water flow from two streams near the port will be treated in the proposed STP. o No waste water is disposed into the water bodies.
10	Borrow pits	o 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	o 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	o On slopes and other suitable places along the two proposed corridors, trees and grass should be planted. o On sections with filling and deep cutting their slopes should be covered by sod, or planted with grass, etc. o If existing irrigation and drainage system, ponds	**Will be Complied** o AVPPL had awarded the work to KSREC to undertake study on Groundwater impact due to construction of port approach road. KSREC has submitted the final report with recommendations and AVPPL is in the process of constructing the approach road to port.

Environmental Management Plan – Rail*/Road Corridors *No Construction work was carried out during the compliance period in the rail corridor			
S. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Status as on 30.09.2021**
		are damaged, they will be suitably repaired. o Retaining walls and gabions shall be suitably provided.	o Suitable mitigation measures as suggested in the KSREC report will be adopted during construction.
13	Loss of agricultural topsoil	o Arable land should not be used for topsoil borrowing. o Topsoil will be kept and reused after excavation is over. o Any surplus to be used on productive agricultural land.	**Being Complied** o Arable land is not being used for topsoil borrowing o The topsoil excavated is being stored and will be reused during development of greenbelt.
14	Compaction of Soil and Damage to Vegetation	o Construction vehicles should operate within the Corridor of Impact avoiding damage to soil and vegetation.	**Being Complied** o Construction vehicles are being operated only alongside the road boundary; thereby avoiding damage to soil and vegetation.
15	Loss of trees and Avenue Planting	o Areas of trees cleared will be replaced according to Compensatory Afforestation Policy under the Forest Conservation Act - 1980. o Landscaping shall be done at major junctions.	**Being Compiled** o During the meeting with Hon'ble Minister dated 05.04.2017, it was decided that Forest Department shall identify land for compensatory afforestation in lieu of trees felled at port site areas; at the rate of 1:10. AVPPL, in collaboration with Forest department, have carried out compensatory afforestation of approximately 15,540 trees on 12.05 Ha land; as identified by social Forest Department in Sainik School, Trivandrum (at an aerial distance of 24 km from the Vizhinjam Port project site). The plantation is

Environmental Management Plan – Rail*/Road Corridors *No Construction work was carried out during the compliance period in the rail corridor			
S. No.	Environmental Impacts and Issues	Mitigation Measures	Status as on 30.09.2021
			now in its Third Year. Rs. 80.50 Lakhs has been spent towards Phase-I of the compensatory afforestation at Sainik School. o Plantation of saplings along the road margins, road junctions and road medians are planned as part of the master plan development/greenbelt development plan.
16	Vegetation clearance	o Tree clearing within the ROW should be avoided beyond that which is directly required for construction activities and/ or to reduce accidents. o Especially in plantation and house garden areas both along road and rail alignment.	**Being Complied** o Care is taken to limit the felling of trees to the bare minimum. o Due permission is taken for trees being cut down as a result of the port development from concerned department (Forest Department).
17	Fauna	o Construction workers should protect natural resources and animals. Hunting of birds and other local animals is prohibited.	**Being Complied** o Regular awareness sessions are conducted for the construction workers regarding importance of natural resources and animals. o Hunting of birds & other local animals is strictly prohibited
18	Traffic Jams and congestion	o 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.	**Being Complied** o In order to avoid traffic congestion, if any, during the construction of the road, measures will be taken to relieve it as far as possible with the co-operation of the traffic police.
19	Health and Safety	o All contractors' staff and workers must wear high	**Being Complied** o All the workers are provided with Personal

Environmental Management Plan – Rail*/Road Corridors *No Construction work was carried out during the compliance period in the rail corridor			
S. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Status as on 30.09.2021**
		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.	Protective Equipment's (PPE) and it is ensured that they wear it all the time o 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	o 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.	**Being Complied** o Construction materials/waste are being disposed properly; so as not to block or pollute streams or ponds.
21	Cultural Remains	o Construction should be stopped until authorised department assess the remains to preserve Archaeological relics and cultural structures like Temples, mosques and churches. o Archaeologists will supervise the excavation to avoid any damage in the relics.	**Will be Complied** o A cultural heritage management plan including a procedure to be followed in case of chance find is being prepared. Same will be implemented for preservation of Archaeological sites and any cultural/archaeological structure found.

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 30.09.2021**
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	**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 ○ Water sprinkling is carried out to arrest dust generation. ○ Environment awareness programs are being carried out for staff/contractors on a regular basis.

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 30.09.2021
			reduce spills and dust blowing off the load. o Environmental awareness program will be provided to the personnel involved in developmental works. o Use of tarpaulin covers and speed regulations for vehicles engaged in transportation.	
		Noise	o Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB. o Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A). o Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used o Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors. o Noise attenuation will be practiced for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers. o High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am to 10 pm) to minimize noise impacts.	**Complied** o Ambient Noise is being monitored fortnightly for Day & Night time and results are within the prescribed limit. o Construction equipment machinery procurement is done in accordance with specifications conforming prescribed standard. o 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 30.09.2021**
			o Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. o Ambient noise levels will be monitored at regular intervals	
2	Construction of Buildings, Roads, Sheds, etc.	Vegetation and Strain on existing infrastructure	o 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.	**Being Complied** o Care is taken to limit the felling of trees to the bare minimum. Due permission is taken for trees being cut down as a result of the port development from concerned department (Forest Department). o During the meeting with Hon'ble Minister dated 05.04.2017, it was decided that Forest Department shall identify land for compensatory afforestation in lieu of trees felled at port site areas; at the rate of 1:10. AVPPL, in collaboration with Forest department, have carried out compensatory afforestation of approximately 15,540 trees on 12.05 Ha land; as identified by social Forest Department in Sainik School,

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 30.09.2021**
				Trivandrum (at an aerial distance of 24 km from the Vizhinjam Port project site). The plantation is now in its Third Year. Rs. 80.50 Lakhs has been spent towards Phase-I of the compensatory afforestation at Sainik School.
		Water Environment	o The streams 1 and 2 will be made to avoid entering the warehouse area by diverging them into the Karichal River. o 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. o Another option is to divert the stream through the boundary o An application has been filed with the irrigation department for permission.	**Will be Complied** o Will be appropriately planned in consultation with the concerned departments
			o The low lying area in the region is already made use by the local people, and has been degraded. There are no active ecological systems in the area. As far as possible, during operation phase the network of streams that add to the low lying area of the region	**Will be Complied** o Will be appropriately planned in consultation with the concerned departments

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 30.09.2021**
			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	
			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. o All necessary measures shall be taken to prevent earthworks and stone works from impeding cross drainage at streams and canals or existing irrigation and drainage systems in conformity EMP.	**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 30.09.2021**
		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 30.09.2021
1	Material transport and construction activities	Air Quality/Dust	o To reduce impacts from exhausts, emission control norms will be enforced / adhered. o All the vehicles and construction machinery will be periodically checked to ensure compliance to the emission standards. o Construction equipment and transport vehicles will be periodically washed to remove accumulated dirt. o Providing adequately sized construction yard for storage of construction materials, equipment tools, earthmoving equipment, etc. o Provide enclosures on all sides of construction site o Movement of material will be mostly during non-peak hours. o On-site vehicle speeds will be controlled to reduce excessive dust suspension in air and dispersion by traffic o Water should be sprayed during the construction phase, at mixing sites, and temporary roads o 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. o Vehicles delivering materials should be covered to	**Complied** o Monthly Ambient Air Monitoring is being carried out and all the parameters are within the stipulated limits. o It is ensured that all vehicles entering the area have a valid PUC certification o Vehicles entering the site have are following speed limit. o Tarpaulin cover is used for vehicles transporting the construction material o Water sprinkling is carried out on the temporary roads by contractors o 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 30.09.2021**
			reduce spills and dust blowing off the load. o Environmental awareness program will be provided to the personnel involved in developmental works. o Use of tarpaulin covers and speed regulations for vehicles engaged in transportation.	
		Noise	o Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB. o Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A). o Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used o Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors. o Noise attenuation will be practiced for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers. o High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am	**Complied** o Ambient Noise is being monitored fortnightly for Day & Night time and results are within the prescribed limits. o Construction equipment machinery procurement is done in accordance with specifications conforming prescribed standard. o 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 30.09.2021**
			to 10 pm) to minimise noise impacts. o Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. o Ambient noise levels will be monitored at regular intervals	
2	Construction of Buildings, Roads, Parking features, etc.	Vegetation and Strain on existing infrastructure	o 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. o 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.	**Being Complied** o Due permission is taken for trees being cut down as a result of the port development from concerned department (Forest Department). o During the meeting with Hon'ble Minister dated 05.04.2017, it was decided that Forest Department shall identify land for compensatory afforestation in lieu of trees felled at port site areas; at the rate of 1:10. AVPPL, in collaboration with Forest department, have carried out compensatory afforestation of approximately 15,540 trees on 12.05 Ha land; as identified by social Forest Department in Sainik School, Trivandrum (at an aerial distance of 24

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 30.09.2021**
				km from the Vizhinjam Port project site). The plantation is now in its Third Year. Rs. 80.50 Lakhs has been spent towards Phase-I of the compensatory afforestation at Sainik School. o Land acquisition is being carried out following due process.
		Existing Traffic	o Transportation of construction materials will be carried out during non-peak hours. o Regularization of truck movement. o The existing roads shall be strengthened and shall be used for the construction material transportation.	**Being Complied** o Transportation of construction materials is being carried out taking into account the non-peak traffic timing and local restrictions during festivals, strikes, etc. o Traffic monitoring & regularization is being carried out for maximum efficiency. o Existing roads are being used for transportation of construction material.
		Solid Waste	o Construction waste will be used within port site for filling of low lying areas. o Composted bio-degradable waste will be used as manure in greenbelt. Other recyclable wastes will be sold.	**Being Complied** o Construction waste is used within port site for filling of low lying areas in line to C&D Waste Management Rules 2016, as amended. o No burning of refuse at construction

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 30.09.2021**
			○ 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.	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 Waste Management Rules 2016, as amended.

BACK UP AREA – Construction Phase *Construction of buildings is ongoing in reclaimed area during the compliance period				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2021**
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 (including one location at port site) as per the Environment Monitoring Plan prescribed in EIA and has commenced since August 2016, the results obtained are within the limits prescribed by NAAQS ○ It is ensured that all vehicles entering the port have PUCs ○ Water sprinkling is being carried out at regular intervals over the temporary road during transportation of materials. ○ 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 is being regularly carried out for contractors working at site.

BACK UP AREA – Construction Phase *Construction of buildings is ongoing in reclaimed area during the compliance period				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2021**
		Noise	o Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB o Procurement of machinery/construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A) o Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used o Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors o Noise attenuation will be practiced for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers o High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am to 10 pm) to minimise noise impacts o Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. o Ambient noise levels will be monitored at regular intervals	**Being Compiled** o All the machinery and vehicles are maintained to keep the noise at minimum o Regular Ambient Noise monitoring is being carried as per the Environmental Monitoring Plan prescribed in EIA since August 2016, and the readings are within the limits at port site. o Personnel exposed to noise levels beyond threshold limits are provided with protective gear.

BACK UP AREA – Construction Phase *Construction of buildings is ongoing in reclaimed area during the compliance period				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2021**
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** ○ During the construction, care was taken such that the formation level is as per suitable design and the cross drainage structures are also being implemented. ○ An STP will be developed along with the port and the sewerage and storm water flow from two streams near the port will be treated in the proposed STP. ○ No waste 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.	**Being Complied** ○ Plantation of saplings along the port boundary are planned as part of the master plan development/greenbelt development plan. ○ Retaining walls or gabions are suitably provided.
			○ Arable land should not be used for topsoil borrowing. ○ Topsoil will be kept and reused after excavation is over.	**Will be Complied** ○ Topsoil is not being used for borrowing. ○ If any topsoil needs to be excavated, the same will be stored in a designated area

BACK UP AREA – Construction Phase *Construction of buildings is ongoing in reclaimed area during the compliance period				
S. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2021**
			○ Any surplus to be used on productive agricultural land.	and will be utilized for greenbelt development as per the greenbelt development plan.
			○ Construction vehicles should operate within the Backup Areas avoiding damage to soil and vegetation.	**Being Complied** ○ Construction vehicles are being operated only alongside the road and port boundaries; thereby avoiding damage to soil and vegetation.
			○ 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** ○ Tree clearing is done only for the purpose of development of port and/or for avoiding causalities due to natural calamities where the trees were standing very dangerously.

Annexure VIII

EMP Expenditure (April 2021 to September 2021)

EMP Expenditure: **Annexure VIII**

S. No.	Environmental Management Plan	Commitment in EIA	Oct 2016 to Mar 2017	Apr 2017 to Sep 2017	Oct 2017 to Mar 2018	Apr 2018 to Sep 2018	Oct 2018 to Mar 2019	Apr 2019 to Sep 2019	Oct 2019 to Mar 2020	Apr 2020 to Sep 2020	Oct 2020 to Mar 2021	Apr 2021 to Sep 2021	Total Cumulative till Date
		(in Rs. Crores)											
1	Cost of Contractors EMP for all planned EMP implementation measures (Action plan report)	1	0.08	0.08	0.12	0.47	0.32	-	-	-	-	-	1.07
2	Cost of Capacity building-Training and Institutional strengthening (Training workshop)	0.2	-	-	-	0.003	-	0.01	-	0.025	-	-	0.038
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	-	-	-	0.8	-	-	-	-	-	-	0.8
4	Air quality monitoring at sensitive locations	0.252	0.27	0.28	0.72	0.21	0.27	0.30	0.29	0.152	0.298	0.27	3.06
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	0.3	1.059	1.08	1.36	1.68	1.65	1.02	1.52	1.295	1.363	1.84	13.87
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	-	-	-	-	-	-	-	-	-	-	0
11	Solid waste management (sector wise)-Collection disposal system	2.5	-	-	-	-	-	0.01	-	-	-	-	0.01

Vizhinjam International Deepwater Multipurpose Seaport
EMP Expenditure

S. No.	Environmental Management Plan	Commitment in EIA	Oct 2016 to Mar 2017	Apr 2017 to Sep 2017	Oct 2017 to Mar 2018	Apr 2018 to Sep 2018	Oct 2018 to Mar 2019	Apr 2019 to Sep 2019	Oct 2019 to Mar 2020	Apr 2020 to Sep 2020	Oct 2020 to Mar 2021	Apr 2021 to Sep 2021	Total Cumulative till Date
		(in Rs. Crores)											
12	Storm water Management	5	-	-	0.05	-	-	-	-	-	-	-	0.05
13	Marine Life Protection out of Oil Spill (Provision for scavenger boat) One tugboat with booms and skimmer and dust exhausting equipment	20	-	-	-	-	-	-	-	-	-	-	0
14	Cost of scavenger boat including manpower (Cost of boat)	0.2	-	-	-	-	-	-	-	-	-	-	0
15	Dust Sweeper (2 Nos.)	0.6	-	-	-	-	-	-	-	-	-	-	0
16	Air Pollution Control (Four water tankers for wetting of road surface and springing system)	1	-	-	0.21	0.03	0.03	0.03	0.15	0.1	0.135	-	0.685
17	Water and waste water treatment plants	4	-	-	-	-	-	-	-	-	-	-	0
18	Battery of toilets with bimonthly maintenance provision	1	-	-	-	-	-	-	-	-	-		0
19	Desilting and strengthen of Streams	0.5	-	-	-	-	-	-	-	-	-		0
20	Enhancement of water bodies (ponds along road & rail)	0.1	-	-	-	-	-	-	-	-	-		0
21	Enhancement of religious structures (Temple)	0.05	-	-	-	-	-	-	-	-	-		0
22	Cultural property rehabilitation cost for sacred grove	0.01	-	-	-	-	-	-	-	-	-		0
	TOTAL	**39.937**	**1.409**	**1.44**	**2.46**	**3.193**	**2.27**	**1.37**	**1.96**	**1.572**	**1.796**	**2.11**	**19,583**

Annexure IX

Environment Health, Safety & CSR Organizational Structure

Annexure IX

Environment Health, Safety & CSR Organizational Structure:

S. No.	Name	Designation	Experience	Qualification	Organization
1.	Prasad Kurien	GM-Environment	30 years	B-Tech Civil Engg., M-Tech Env Engg., PMP	VISL
2.	Y D Manmohan	Environment Specialist	30 Years	BE – Civil Engg ME Env. Engg.	STUP
3.	Anil Balakrishnan	Head – CSR	23 Years	MSW, Phd.	AVPPL
4.	Hebin C	Head – Environment	14 Years	MS, Oceanography & Coastal Area Studies	AVPPL
5.	Jesse Benjamin Fullonton	Assistant Manager - Environment	10 Years	BSc. Chemical Tech; Msc. Env. Tech	AVPPL
6.	Kanwar P Malik	Head - Horticulture	16 Years	BSc - Agriculture	AVPPL
7.	Arumugam S	Assistant Manager - Safety, Environment and Health	2 Years	M.Tech – Industrial Safety Engineering	AVPPL
8.	Sebastian Britto. A.G	Sr. Project Officer	24 Years	MA, Economics	AVPPL
9.	Rakesh R.S	Sr. Project Officer	23 Years	MBA, Bsc Agriculture	AVPPL
10.	Stephen Vinod	Project Officer	20 Years	BA, Economics	AVPPL
11.	George Zen	Consultant – Livelihood	35 Years	BA, Sociology	AVPPL
12.	Maya G	Project Officer Community Health	11 Years	BA, IT-TTC	AVPPL
13.	Meera Mariyam Skariah	Community Mobilizer	3 Years	MSW	AVPPL
14.	Shaji Joseph	Safety Executive	13 Years	Diploma in mechanical & Diploma in fire and safety	HOWE

Annexure X

CTO For Explosives Storage

FILE NO : PCB/TVM-DO/ICO/NTA/HCS/54/2021
Date of issue : 20/07/2021

KERALA STATE POLLUTION CONTROL BOARD

CONSENT TO

OPERATE/AUTHORISATION/REGISTRATION

ISSUED UNDER

The Water (Prevention & Control of Pollution) Act, 1974
The Air (Prevention & Control of Pollution) Act, 1981

and

The Environment (Protection) Act, 1986

As per Application No. :16018095
Dated:16-07-2021

TO

M/s AVPPL- EXPLOSIVE STORAGE
Adani Vizhinjam Port Pvt ltd
Mullor Post
Vizhinjam
Trivandam

Consent No. :PCB/TVM-DO/ICO/NTA/HCS/49/2021
Valid Upto :31/12/2024

1. GENERAL

1.1. This integrated consent is granted subject to the power of the Board to withdraw consent, review and make variation in or revoke all or any of the conditions as the Board deems fit.

1	**VALIDITY**	31/12/2024
2	Name and Address of the establishment	AVPPL- EXPLOSIVE STORAGE ADANI VIZHINJAM PORT PVT LTD MULLOR POST VIZHINJAM TRIVANDAM 695521
3	Communication	Telephone :0-9099056757 Fax :- E-mail:hebin.c@adani.com
4	Occupier Details	Adani Vizhinjam Port Pvt LTD TC-24/2269 (3) 3rd Floor - Aspinwall House Kowadiar, Kuravankonam
5	Local Body	Panchayat
6	Survey Number	117/13,14,117/15-1,2
7	Village	Kottukal
8	Taluk	NEYYATTINKARA
9	District	THIRUVANANTHAPURAM
10	Capital Investment(Rs in Lakhs)	72 LAKHS
11	Scale	Small
12	Category	RED
13	Annual fee(Rs) Total Fee remitted(Rs)	18000/- 90000/-
14	RAW MATERIAL	PRODUCTS
		Magazine - 500 Kilogram Nonel Detonator - 22000 Numbers Eletric Detonator - 22000 Numbers
15	Total Power Required (HP)	NA

2. CONDITIONS AS PER
The Water(Prevention and Control of Pollution)Act, 1974

2.1 In case of generation of trade effluent from the industry, effluent treatment system consisting of treatment units having adequate capacity established as per the Integrated Consent to Establish issued shall be operational at all times during which the industry is functional. Additional facilities required, if any, to achieve the standards laid down by the Board u/s 17(1) (g) of the Water Act shall also be made along with.

2.2 Water consumption: NA

2.3 Effluent generation: NA

2.4 The characteristics of effluent after treatment shall confirm to the following tolerance limits:

SI.NO.	Characteristics	Unit	Tolerance Limit	
			Sewage	Trade Effluent

2.5 Mode of disposal of treated effluent: NA

3. CONDITIONS AS PER
The Air(Prevention and Control of Pollution)Act, 1981

3.1 Adequate air pollution control measures shall be operational at all times during the functioning of the industry. Additional facilities required, if any, to achieve the standards laid down by the Board shall also be made along with.

Stack No.	Sources of Emission	Emission Rate(Nm3/Hr)	Stack Height above		Control Equipment
			Ground Level	Roof Level	

3.2 Emission characteristics shall not exceed the following:

SI.No.	Parameter	Limiting Standards (mg/Nm3)

4. CONDITIONS AS PER
The Environment (Protection) Act, 1986.

4.1 The operation of the industry shall be strictly in compliance with the provisions of the Noise Pollution (Regulation and Control) Rules 2000.

4.2 Used lead acid batteries shall be disposed of as per the Batteries (Management and Handling) Rules, 2001

4.3 Hazardous waste generated, if any, shall be handled as per the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

4.3.1 Activities for which Authorisation is granted

Collection		**transport**	
Reception		**Storage**	
Treatment		**Reprocessing/Disposal**	

4.3.2 Type, quantity and mode of storage/collection/disposal of hazardous wastes shall be as follows:

SI.No.	Hazardous Waste	Schedule Category	Quantity Tonne/year

Mode of	
Storage	**Disposal**

4.4 E-waste shall be disposed off safely as per the E-Waste (Management)Rules, 2016.

5. SPECIFIC CONDITIONS

5.1.This consent is granted subject to the power of the Board to review and make variations in all or any of the conditions as per section 21 of the Air (Prevention and Control of Pollution) Act 1981 and section 25 of the Water (Prevention and Control of pollution) Act 1974.

5.2. .No change or alteration of the unit shall be made without the prior permission of the Board. Any change in the particulars furnished in the references and/or in the identity of the occupier/ authorized agent shall be intimated to the Board forthwith.

5.3 For renewal of the consent in case of continuance of operation of the industry, application in the prescribed form shall be submitted through the web portal of the Board http://krocmms.nic.in for renewing the Consent on or before two month in advance to expiry date. Late application will be accepted with 10% (for application before expiry date) & 50% of yearly fee as late fee for application after due date.

5.4 The applicant shall comply with the instructions that the Board may issue from time to time regarding prevention and control of air, water, land and sound pollution.

5.5 Necessary statutory clearances/NOC shall be obtained prior to commencement of operation.

5.6. Boundary of quarrying area shall be fenced and demarcated

5.7 Adequate firefighting equipment in accordance with the fire safety regulations shall be installed at salient places within the unit and necessary certificate from Fire & Rescue Services Department shall be obtained.

5.8. The concentration of parameters at the boundary of the unit shall not exceed the standard as prescribed in the National Ambient Air Quality Standard applicable to adjoin area.

5.9. A signboard shall be put up near the entrance of the unit to display the name of the unit.

5.10. This Consent is granted on the basis of the inspection, affidavit and other documents furnished by the applicant. If any statement furnished in the affidavit is found false, the consent issued will be cancelled/ revoked.

5.11The location of the unit shall be as shown in the drawing attached. No change or alteration to it shall be made without prior permission of the Board.

DATE :20/07/2021

SIGNATURE & SEAL OF ISSUING AUTHORITY

ASSISTANT ENVIRONMENTAL ENGINEER
DISTRICT OFFICE THIRUVANANTHAPURAM

BINCY. B.S
Asst. Environmental Engineer

KERALA STATE POLLUTION CONTROL BOARD

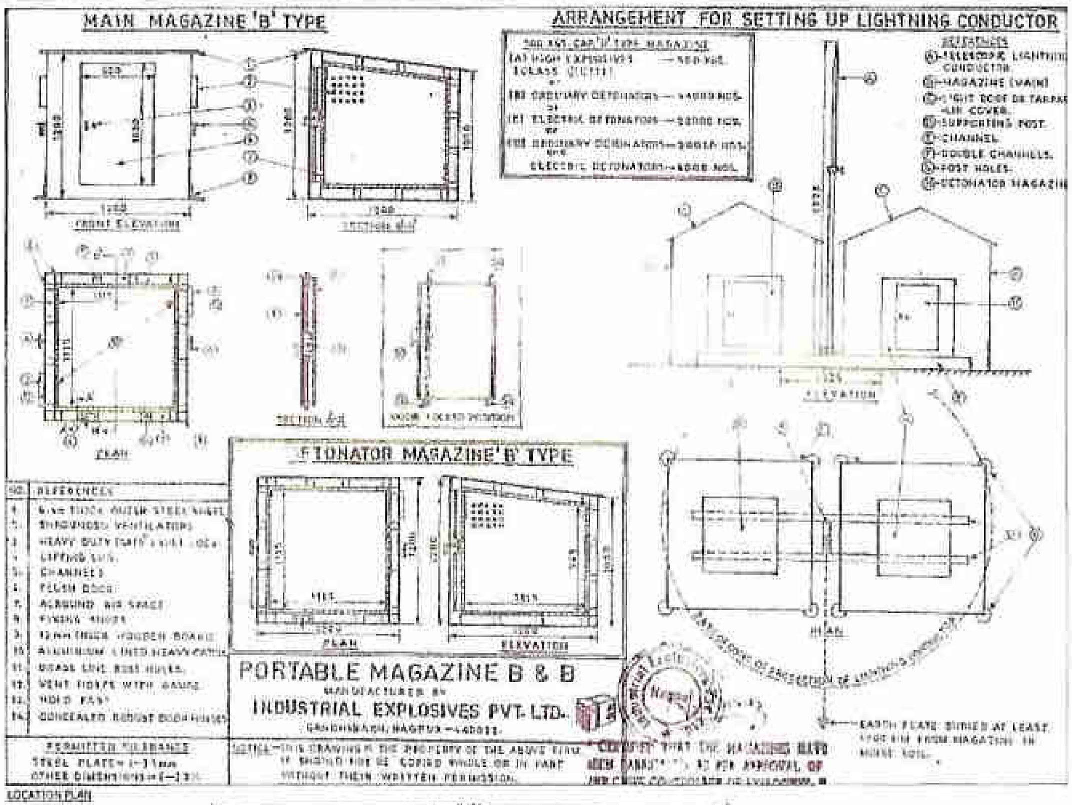
To

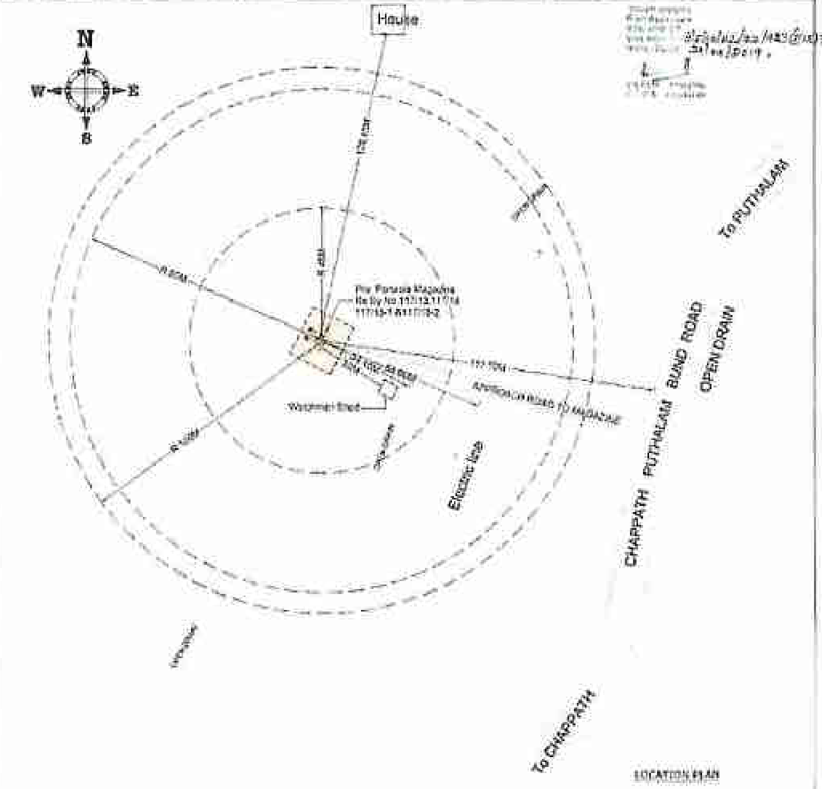
AVPPL- Explosive Storage
Adani Vizhinjam Port Pvt ltd
Mullor Post
Vizhinjam
Trivandam

1. This digitally signed document is legally valid as per the Information Technology Act 2000

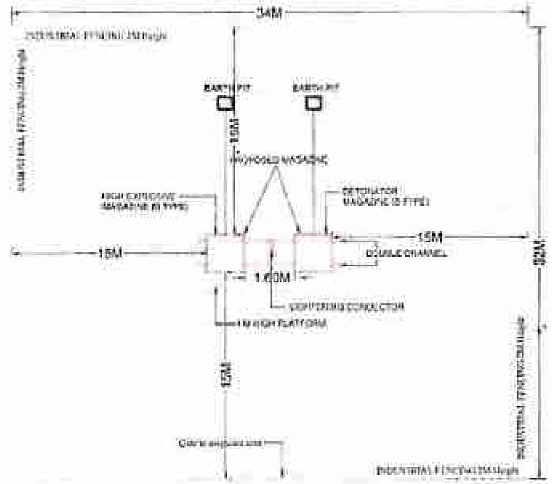
2. For verifying this document please go to krocmms.nic.in and search using date of issue/name of the unit/Application Number in “Consent Granted Applications” link in the home page of the Board’s Online Consent Management and Monitoring System.

DETAILED PLAN SHOWING PROPOSED STORAGE MAGAZINE CLASS II 500Kg, CLASS VI, DIV III 10000 Nos OF MILLI SECOND DELAY DETONATOR, CLASS VI, DIV II 10000 Nos OF NONEL (SHOCK TUBE) FOR M/S ADANI VIZHINJAM PORT PVT. LTD., THIRUVANANTHAPURAM, KERALA





LOCATION PLAN



SITE PLAN

Approved site plan

Assistant Environmental Engineer

Magazine Site Details	
Re Survey No	- 117/13,117/14,117/15-1 & 117/15-2
Re Survey Block No	- 19
Village	- Kottukal
Taluk	- Neyyattinkara
Nearest Police Station	- Vizhinjam
Nearest Railway Station	- Neyyattinkara
District	- Thiruvananthapuram
State	- Kerala

BINCY. B.S

Asst. Environmental Engineer

DETAILED PLAN SHOWING PROPOSED STORAGE MAGAZINE CLASS II 500Kg, CLASS VI, DIV III 10000 Nos OF MILLI SECOND DELAY DETONATOR, CLASS VI, DIV II 10000 Nos OF NONEL (SHOCK TUBE) FOR M/S ADANI VIZHINJAM PORT PVT. LTD., THIRUVANANTHAPURAM, KERALA

Note:

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- SECURITY ROOM AT 15M ON SOUTH EAST SIDE OF THE MAGAZINE

Approval Stamp

Signature of Engineer

Signature of Owner/Applicant

Annexure XI

Email Submission of HYCR for the Period

October 2020 to March 2021

Jesse Benjamin Fullonton

From:	prasad.kurien <prasad.kurien@vizhinjamport.in>
Sent:	Sunday, 30 May, 2021 10:52 AM
To:	rosz.bng-mefcc@gov.in
Cc:	Ssuresh.cpcb@nic.in; tvpmro@gmail.com; Kushal.vashist@gov.in; Hebin Chenthamarakshan; Rajesh Kumar Jha; MS KCZMA; zobangalore.cpcb@nic.in; Jesse Benjamin Fullonton; rosz.bng-mef@nic.in; MD & CEO
Subject:	EP12.1/7/2013-14/Ker - Oct 2020 - Mar 2021
Attachments:	EC_F. No. 11-1222011-IA.III dated 03.01.2014-HYCR-Oct2020-Mar2021_ 29.05.2021.pdf

Dear Sir/Madam

MoEF&CC had issued Environmental Clearance and CRZ Clearance (EC) on 3rd January 2014 to the proposed Vizhinjam International Multipurpose Deepwater Seaport at Vizhinjam in Thiruvananthapuram District of Kerala State. (EC No. F.No.11 - 122/2011 - IA. III) and subsequently extended the EC validity up to 2nd January 2024 with same terms and conditions.

Kindly find attached the Half yearly compliance report (HYCR) for the period from Oct 2020 to Mar 2021 for records and reference.

Acknowledgement on receipt of the email with contents is highly appreciated.

With best regards

--
Prasad Kurien
General Manager-Environment
Vizhinjam International Seaport Limited
Thiruvananthapuram

VIZHINJAM INTERNATIONAL SEAPORT LIMITED
(A Government of Kerala Undertaking)

Vizhinjam International Deepwater Multipurpose Seaport

Half Yearly Compliance Report (HYCR) of
Conditions of Environmental and CRZ Clearance
for the Period April 2021 to September 2021

November 2021