Vizhinjam International Seaport Limited

(A Government of Kerala Undertaking)

VISL/2014-15/EE&EI-9

28th November 2017

Additional Director (S)
Ministry of Environment, Forest & Climate Change, Regional Office (Southern Zone)
KendriyaSadan, IV Floor, E&F Wings 17th Main Road, IInd Block, Kormangala,
Bangalore – 560 034
PH: 080-25532577, Fax: 080-25537184

Dear Sir,

Sub: Vizhinjam International Multipurpose Deepwater Seaport – Environmental Clearance – Half Yearly Compliance Report

Ref: 1) F.No.11-122/2011-IA.III dated 3rd January 2014 of MoEF issuing Environmental Clearance

2) No.1285/A3/13/KCZMA/S&TD dated 24th August 2013

This has reference to the Environmental & CRZ Clearance (EC) issued on 3rd January 2014 (Ref 1) by the Ministry of Environment, Forest & Climate Change (MoEF&CC) to the proposed Vizhinjam International Multipurpose Deepwater Seaport at Vizhinjam in Thiruvananthapuram District of Kerala State based on the recommendation of KCZMA vide the reference cited (2).
The compliance report of the conditions stipulated in the cited reference for the half yearly period from April 2017 to September 2017 is enclosed herewith, in both hard and soft copy for record and reference.

Yours Sincerely
For Vizhinjam International Seaport Ltd

Managing Director& CEO

Encl: Compliance Report (hard & soft copy)

Copy to: (1)The Director (Monitoring-IA II Division, Ministry of Environment, Forest & Climate Change, IndraParyavaranBhavan, JorBagh, New Delhi)
(2)The Scientist D * in charge, Central Pollution Control Board (CPCB), Zonal Office, 1st& 2nd Floors, NisargaBhavan, A Block, Thimmiah Main Road, 7th D Cross Shivanagar, Opp. Pushpanjalai Theatre, Bengluru – 560 010.
(3)Chief Environmental Engineer, Kerala State Pollution Control Board, Thiruvananthapuram Regional Office, Plamoodu, Pattom P.O., Thiruvananthapuram – 695 004
(4)Member Secretary, KCZMA, ShatraBhavan, Pattom P.O. Thiruvananthapuram – 695 004
(5) Shri. SantoshkumarMohapatra, Director & CEO AdaniVizhinjam Port Private Ltd. (AVPPL), 2nd Floor, Vipanchika Tower, Near Govt. Guest House, Thycaud P.O., Thiruvananthapuram- 14

VIZHINJAM INTERNATIONAL SEAPORT LIMITED

(A Government of Kerala Undertaking)

Vizhinjam International Deepwater Multipurpose Seaport

Half yearly Compliance report of conditions of Environmental and CRZ Clearance

Period: April 2017 to September 2017

November 2017

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

Preface

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

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

Pursuant to the Environmental Clearance, the Government of Kerala has entered into a concession agreement with M/s Adani Vizhinjam Port Private Ltd. (AVPPL), on 17th August 2015 for development and operation of the project for a concession period of 40 years. The preliminary works for the development of the project were initiated at the site on 16th November 2015, followed by official inauguration on 5th December 2015. As required under the Environmental & CRZ clearance, monitoring works were initiated by VISL and is being continued by AVPPL. This report contains the half yearly monitoring report for the period from April 2017 to September 2017.

Managing Director & CEO

Vizhinjam International Seaport Ltd.(VISL)

Thiruvananthapuram

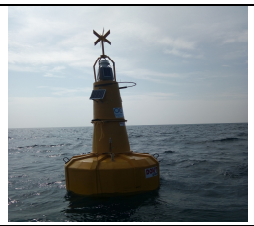
28th November 2017

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017
Vizhinjam International Deepwater Multipurpose Seaport Status of conditions stipulated in Environmental and CRZ clearance.		

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
1	**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" has been obtained from Kerala State Pollution Control Board (KSPCB) vide Consent No. PCB/HO/TVM/ICE/08/2015 dated 15.09.2015. Copy submitted to MoEF&CC with the compliance report submitted for the period October15-March'16 dated 27.05.2016 (Ref No: VISL/2014-15/EE&EI-9/229)
(ii)	Project Proponent shall carry out intensive monitoring with regulatory reporting six monthly on shore line changes to the Regional Office, MoEF.	Complied 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 MoEF&CC as part of Six monthly compliance report. Report for the period April 2017 to September 2017 is enclosed as **Annexure I** in CD. The shoreline data from February 2015 to February 2017 was submitted to LnTIEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. Mathematical modelling report thus prepared shows that there is no significant impact on shoreline. This is in line with the predictions in the EIA. The Shoreline modelling report is attached as **Annexure II** in CD.
(iii)	The capital dredged material (7.6 Mm^3) shall be utilized for reclamation of berths.	Being Complied The dredged materials till 30th September 2017 amounting to 2.26Mm^3 has been utilized for reclamation of 33 Ha area. The dredged material has been used for reclamation only.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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 and the fishery breakwater has been initiated as part of the funded work component of the concession agreement with AVPPL. The EPC contactor for development of aforesaid activity has been finalized and work orders has been issued. A budgetary provision of 16 crores for Fish Landing Centre and 131.12 crore for fishery breakwater has been kept. 565 meter length of breakwater has been completed which forms part of the new fishing harbor. Since at present fishing boats are docked in the proposed area the works for fishery berth could not be initiated.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)

Sl. No.	Conditions	Compliance Status as on 30-09-2017
(v)	The project shall be executed in such a manner that there is minimum disturbance to fishing activity.	Being Complied Following is being practiced to ensure minimum disturbance to fishing activity • Works are planned in such a way that the movement of fishing boats is not hindered due to project construction. • Signboards have been placed for demarcation of construction area • For mutual understanding of the developmental activities with the local fishing community an exclusive CSR team has been assigned, details are given in **Annexure III**. • Turbidity buoys at 3 locations identified by NIOT have been deployed and periodic monitoring is carried out to assess the turbidity. The turbidity details are given in Table 13 of **Annexure I** (OSaS/P21716/ AVPPL /PSR-(14 to 19)/118) reports show that the turbidity is congenial to the designated use. • Marine Water Quality is being monitored regularly and reports are submitted as part of compliance report. No abnormal results were observed during the monitoring period. (**Refer Annexure XI**)  Turbidity Buoy - 1  Turbidity Buoy - 2  Turbidity Buoy - 3

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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 As per the EIA report 7.1 crores was set apart as compensation as livelihood affected fisherman. However an enhanced amount of 23.80 crore was sanctioned by GoK. Till date an amount of Rs. 18.14 crores have been disbursed to a total number of 456 Livelihood Affected Persons (LAP's) whose verification was complete in all respects. Verification of the documents of balance LAP's is in progress. The status of the CSR activities envisaged in the fisheries sector is as follows. **Water supply**: Scheme has been commissioned in April, 2013 by VISL by spending an amount of Rs. 7.33 crores. For O&M of the same an amount of 0.80 crores has been spent during the compliance period. (Up to date O&M expenses 6.75 crores) **Fish Landing centre**: Construction of the fish landing centre (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated as a part of funded work of the phase 1 project. 565 meter length of breakwater has been completed which forms part of the new fishing harbor. Since at present fishing boats are docked in the proposed area the works for fishery berth could not be initiated. **Existing fishing harbor**: Tenders for modernization of the existing fishing harbor was invited by HED and work awarded. However the works could not be initiated due to sectoral protests among different fishermen groups. **Seafood park**: Procurement of land for seafood park (Rs.26 crores) by VISL has been completed. Actions for development of sea food park are planned so as to commission the same along with the completion of the new fishing harbor. Relating to the activities carried out for skill development, environmental sanitation and solid waste management refer **Annexure III** for the period of April 2017 to September–2017.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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 The same will be taken into consideration while designing the railway line.
(viii)	Compensation packages in accordance with the Central/State Government norms shall be given to all the authorized-cum-affected (having valid clearances as applicable) resort owners.	Based on G.O,(Rt) No.2021/2017/RD dated 27-04-2017, government ordered to pay compensation for land and not for the structures since they were in violation of CRZ notification. Action in this respect is being taken.
(ix)	The port shall ensure that all ships under operation follow the MARPOL convention regarding discharge or spillage of any toxic, hazardous or polluting material like ballast water, oily water or sludge, sewage, garbage etc. The emission of NOx & SOx shall remain within permissible limits.	Will be complied Currently project is under construction. This shall be complied during operational phase.
(x)	CSR activities shall cover villages within 10 km radius of the project.	Complied All CSR activities on livelihood development health, sanitation, education etc. are being implemented after receiving formal demand from social controlled institutions; Government controlled institution and recognized platforms. As indicated in EIA report during Phase I implementation of the project, CSR activities will be carried out in 5 wards namely; Mulloor, Kottapuram, Vizhinjam, Harbour and Venganoor. During the compliance period an amount of 168.65 Lacs has been spent on CSR activities. Details on CSR activities carried out by AVPPL during compliance period (April 2017 to September 2017) is enclosed as **Annexure III**
(xi)	Oil Contingency Management Plan shall be put in place.	Will be complied Oil Contingency Management Plan will be prepared prior to completion of the project and shall be implemented prior to operation.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(xii)	All the recommendations /conditions stipulated by Kerala Coastal Zone Management Authority (KCZMA) shall be complied with.	Complied Compliance report of KCZMA is enclosed as **Annexure IV**
(xiii)	The responses/commitments made during public hearing shall be complied with in letter and spirit.	Complied The status of the commitments made during Public Hearing & actions on the same is enclosed as **Annexure V**
(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, in limited way in PAF (Project Annex Facility) and Warehouse Area (Only boundary wall) only. Recommendations of the Construction stage EMP for these areas are being implemented. Status of construction stage EMP is enclosed as **Annexure VI**
(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 VISL in coordination with Town Planning department, Tourism department and related stakeholders are in the process of preparing an integrated Area Development Plan. The finalized plan would have implementable projects for tourism enhancement.
(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

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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. The water supply scheme had already been commissioned with the source as Vellayani Lake. 3.00 MLD of raw water will be available for treatment with a net availability of 2.49 MLD of potable water. Out of this 1.49 MLD of water shall be distributed to the locality as part of social welfare measures of VISL. The balance 1.0 MLD is for the port use. Water requirement during construction is being met from the above source.
(xviii)	The Hazardous waste generated shall be properly collected and handled as per the provision of Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008.	Complied During this compliance period (April 2017 to September 2017) 4.1KL of used oil is generated and it has been stored as per Hazardous Waste Rules, and shall be disposed to authorized (CPCB/SPCB) waste oil handlers.
(xix)	No hazardous chemicals shall be stored in the Coastal Regulation Zone area.	Complied No hazardous chemical is being stored in the Coastal Regulation Zone area.
(xx)	The waste water generated from the activity shall be collected, treated and reused properly.	At present a settling tank is constructed and used for collecting, settling and recycling all wash water generated. 
(xxi)	Sewage Treatment facility should be provided in accordance with the CRZ Notification.	Will be complied The detailed port facility layout planning is under progress. Provision for installing sewage treatment facility in phased manner has been kept and will be implemented in line to CRZ Notification.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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.	Noted No solid waste is being disposed of in the Coastal Regulation Zone area. Solid waste is being properly collected, segregated and disposed as per the Solid Waste Management Rules, 2016   Solid Waste Management
(xxiii)	Installation and operation of DG set if any shall comply with the guidelines of CPCB. Oil spills if any shall be properly collected and disposed as per the Rules. Project proponent shall install necessary oil spill mitigation measures.	Complied 23 DG sets are present at site. 16 DGs are operational and 7 DGs are standby. These are compliant to CPCB guidelines. A brief summary of DG sets present at site is attached as **Annexure VII**
(xxiv)	No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	Noted Construction of the project is as per the approvals obtained.
(xxv)	The approach channel shall be properly demarcated with lighted buoys for safe navigation and adequate traffic control guidelines shall be framed.	Will be complied The project is in construction phase. The same shall be complied during operational phase

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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 Although Natural green belt exist, the Greenbelt of adequate width with suitable species in consultation with forest department as identified in EIA will be developed in all possible areas including Cargo storage areas and along the boundary of expansion project area. Currently reclamation of back up area is under progress. Greenbelt development plan has been considered in the Master Plan and adequate Budgetary provision has been kept for this purpose. A budgetary provision of 2.08 Crore has been kept for Greenbelt development.
(xxvii)	The fund earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.	Noted An amount of 40 Crores has been kept solely for EMP implementation The breakup of EMP fund activity wise is enclosed as **Annexure VIII** An amount of 1.44 Cr has been utilized towards implementation EMP measures during compliance period.
(xxviii)	The project proponent shall set up an organizational mechanism/institutional structure for Environment, Health & Safety & CSR under the supervision of a General Manager as outlined in the EIA Report for effective implementation of the stipulated EHS safeguards & CSR activities.	Complied An officer of VISL has been designated as Head (EHS & CSR) for effective implementation of the stipulated EHS safeguards & CSR activities. AVPPL, the concessionaire executing the project has also appointed officers for EHS & CSR. In addition to the above, independent environment, health and safety consultants have been appointed as required in the concession agreement signed with AVPPL. It is also ensured that contractors executing the work also deploy EHS personnel for effective implementation of EMP measures Organizational Structure for Environment, Health, Safety & CSR 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**	

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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 the proposed construction as mentioned hereunder. • Consent to Establish from State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE/08/2015, dated 15.09.2015. • All permits required for construction of buildings as per building by laws will be obtained. • Airport Authority of India NOC vide NOC no AAI/SR/NOC/RHQ dated 7.12.2015 **(**Submitted along with the compliance report for the period ending June 2016**)**
(ii)	Adequate provision for infrastructure facilities including water supply, fuel and sanitation must be ensured for construction workers during the construction phase of the project to avoid any damage to the environment.	Complied On an average 450 nos. of construction worker were engaged in the said activity on a daily basis, during the compliance period and were housed in a labor camp near to the project site as well as nearby resorts and were provided with all the necessary infrastructure facilities including water, electricity, fuel, sanitation etc. A brief write-up highlighting the facilities given to construction workers along with photographs is attached as **Annexure X**
(iii)	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.	Complied No digging activities other than dredging undertaken during the compliance period. Marine water quality is monitored on a monthly basis and analysis reports are enclosed as **Annexure XI.** There are no significant changes observed in the marine water quality during the compliance period.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(iv)	Borrow sites for each quarry sites for road construction material and dump sites must be identified keeping in view the following: (a) No excavation or dumping on private property is carried out without written consent of the owner. (b) No excavation or dumping shall be allowed on wetlands, forest areas or other ecologically valuable or sensitive locations. (c) Excavation work shall be done in close consultation with the Soil Conservation and Watershed Development Agencies working in the area, and (d) Construction spoils including bituminous material and other hazardous materials must not be allowed to contaminate water courses and the dump sites for such materials must be secured so that they shall not leach into the ground water.	Complied Quarry material is being obtained from approved quarry sites only. The road so far constructed (a temporary road for construction purposes) has been made with material available on site and • No excavation has been carried out in private property • No excavation or dumping has been carried out in wetlands, forest area etc. • No major excavation has been undertaken • 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.	Complied The construction material was obtained from approved quarries. No new quarries have been opened for construction materials. In case of new quarries, necessary approvals will be obtained from the local competent authority.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)

<table>
<tr><th>Sl. No.</th><th>Conditions</th><th>Compliance Status as on 30-09-2017</th></tr>
<tr><td>(vi)</td><td>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.</td><td>Being complied
• No solid waste is being disposed of in the Coastal Regulation Zone area.
• Solid waste is handled as per the Solid Waste Management Rules, 2016
• Sewage Treatment Plant (STP) will be installed in phased manner along with the project.
• Environment Monitoring is being carried out as per Environment Monitoring Plan prescribed in EIA by NABL and MoEF&CC accredited agency; M/s. Ashwamedh Engineers & Consultant. Summary of the Ambient Air Quality Monitoring (AAQM) for duration from April-September 2017 is mentioned below.
Total Monitoring Location 5
<table>
<tr><th>Parameter</th><th>Unit</th><th>Max</th><th>Min</th><th>Perm. Limit</th></tr>
<tr><td>PM_{10}</td><td>$\mu g/m^3$</td><td>98</td><td>36</td><td>100</td></tr>
<tr><td>$PM_{2.5}$</td><td>$\mu g/m^3$</td><td>50</td><td>12</td><td>60</td></tr>
<tr><td>SO_2</td><td>$\mu g/m^3$</td><td>6.8</td><td>3.9</td><td>80</td></tr>
<tr><td>NO_x</td><td>$\mu g/m^3$</td><td>13</td><td>3.02</td><td>80</td></tr>
<tr><td>CO</td><td>mg/m^3</td><td>BDL</td><td>BDL</td><td>4</td></tr>
<tr><td>HC</td><td>ppm</td><td>BDL</td><td>BDL</td><td>--</td></tr>
</table>
• Detailed Monitoring Reports for the period April-September 2017 is attached as Annexure XI).
• All the monitored parameters were found within the prescribed limit.</td></tr>
<tr><td>(vii)</td><td>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.</td><td>Will be complied
Consent To Operate (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 Kerala State Pollution Control Board before commissioning of the project.

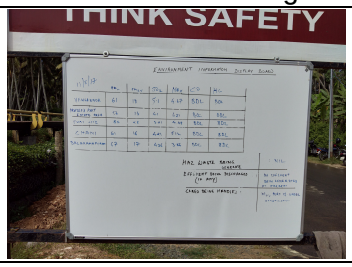
Copy of the CTO will be sent to Ministry on receipt.</td></tr>
</table>

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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 kmph • 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  Water Sprinkling in progress  Tarpaulin cover on trucks
(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. However the NGT appointed committee visited the site in May & June-2017 and reviewed the compliance status of EC & CRZ clearance. All necessary support was extended to the committee members. The suggestion given by committee is being implemented.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(x)	Ministry of Environment & Forests or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.	Noted.
(xi)	The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied to the satisfaction of the Ministry.	Noted.
(xii)	In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry of Environment & Forests.	Will be complied Adani Vizhinjam Port Private Ltd (AVPPL) is the concessionaire for implementing the project and operating it for the next 40 years, based on concession agreement signed between the Government of Kerala &, AVPPL on 17th August 2015. 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 M/s AVPPL was signed on 17th August 2015. The layout of the port has been approved by Govt. of Kerala by letter No.308799/E1/15/F&PD dated 30th October 2015 (Submitted along with the Compliance Report of the period ending June 2016).The preliminary construction activities commenced at site on 16th November 2015 followed by official inauguration on 5th December 2015. Financing agreement forming part of financial closure was submitted by the concessionaire on 13th May 2016.
(xiv)	Kerala State Pollution Control Board shall display a copy of the clearance letter at the Regional Office, District Industries Center and Collector's Office/Tehsildar's office for 30 days.	Noted This condition does not pertain to project proponent. However, it is learnt that KSPCB has complied with the same.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
13.	These stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991 and EIA Notification 2006, including the amendments and rules made thereafter.	Noted for compliance
14.	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities.	Complied All required clearances will be obtained before start of operation. However necessary approvals from concerned Statutory Departments / Agencies have been obtained for the construction designs/drawings relating to the proposed construction as mentioned below. • Consent to Establish from State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE/08/2015, dated 15.09.2015. • All permits required for construction of buildings as per building by laws will be obtained. • Airport Authority of India NOC vide NOC no AAI/SR/NOC/RHQ dated 7.12.2015

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
15.	The project proponent shall advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded Environment Clearance and copies of the clearance letters are available with the Kerala State Pollution Control Board and may also be seen on the website of the Ministry of Environment & Forest at http://www.envfor.nic.in. The advertisement should be made within 10 days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional office of this Ministry at Bangalore.	Complied Complied and intimated (with copy of advertisement) to the regional office of MoEF &CC, vide letter No. VISL/EC/MoEF/2013 dated 20-01-2014 Copy of the environment clearance is available on VISL website at http://www. vizhinjamport.in/eia-30-5-13.php.The same is also uploaded on APSEZ website at http://www.adaniports.com/ports-downloads?port=Vizhinjam-Port
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 Environment Clearance granted to the project vide its judgment dated 2nd September 2016

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
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 Clearance Letter were 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
19.	The proponent shall upload the status of compliance of the stipulated Clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM, SO2, NOx (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.	Complied The copy of the last compliance report (Oct 2016-March 2017) has been uploaded in company's web site http://www.vizhinjamport.in and also on Adani Ports website http://www.adaniports.com/ports-downloads?port=Vizhinjam-Port and submitted to the MoEF & CC Regional Office (Bangalore), Zonal office of CPCB (Bangalore), KSPCB, KCZMA vide letter No. VISL/2014-15/EE&EI-9/266 dated 8th June 2017. Environment Monitoring is being carried out as per the Environment Monitoring Plan prescribed in EIA by Ashwamedh Engineers & Consultant (NABL Accredited & MoEF&CC approved laboratory).Detailed Monitoring repots (Air, Water, Noise, Marine Water, Sediment) are enclosed as **Annexure XI**. The critical pollutant is being displayed at a location near the main gate.   Critical Pollutant displayed near main gate

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance (Period: April 2017 to September 2017)		
Sl. No.	**Conditions**	**Compliance Status as on 30-09-2017**
20.	The project proponent shall also submit six monthly reports on the status of compliance of the stipulated Clearance conditions including results of monitored data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB.	Compliance Report for the period Oct 2016- March 2017 has been submitted to the MoEF&CC, Regional Office (Bangalore),Zonal office of the CPCB (Bangalore), KSPCB & KCZMA vide letter No. VISL/2014-15/EE&EI-9/266 dated 8th June 2017 in hard copy as well through e-mail.
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 I: Report on Shoreline monitoring April 2017 – September 2017 (in CD)

Annexure II: Shoreline Mathematical Modelling Report (in CD)

Annexure III: CSR Activities by AVPPL

Annexure IV: Report on compliance of conditions of KCZMA recommendation for Environmental / CRZ clearance

Annexure V: Compliance of the response/commitments made during Public Hearing

Annexure VI: Status of Environment Management Plan

Annexure VII: DG Set Details

Annexure VIII: EMP Budgetary Provision

Annexure IX: Organizational Structure-EMP Implementation

Annexure X: Details of Labour Camp

Annexure XI: Environment Monitoring Report (April 2017 – September 2017)

Annexure I

Report on Shoreline monitoring April 2017 – September 2017 (in CD)

Annexure II

Shoreline Mathematical Modelling Report (in CD)

Annexure III

CSR Activities by AVPPL

Annexure III

CSR Activities from April 2017 to September 2017 by Adani Vizhinjam Port Pvt Ltd (AVPPL) – Adani Foundation (AF)

1. Skill Development

a. Conducted Skill registration drives in all five wards and more than 1600 youth have participated in the registration drive. The youth registered for the courses of Assistant Electrician, Assistant Plumber, Assistant Beautician, Nursing Assistance, Computer Executive, Embroidery & Tailoring, Finance & Accounting, Fitness Trainer and Trainee Associate Retail. As per the registration and requirement, AVPPL-AF has identified three NSDC partners for conducting 9 placement linked courses under CSR.

b. The Skill training on Assistant Beauty Therapist was started on 11th September 2017 with a batch size of 35 students from Vizhinjam. This was an NSDC certified course with certificate and placement assistance. The training provider was IL&FS.

c. The Second batch of Skill training on Assistant Plumber started on 26th September 2017 with a batch of 30 students.

d. The other skill courses streamlined for the youth of Vizhinjam are Assistant Electrician, Nursing Assistance, Computer Executive, Embroidery & Tailoring, Finance & Accounting, Fitness Trainer, and Trainee Associate Retail.

e. Banker's Meeting of Financial institutions was conducted for 17 livelihood projects proposed by 110 women of CSR intervening area.

f. Five livelihood groups - two Hi-tech Poultry Unit, one Hi-Tech Cleaning Unit one canteen unit and one Big Shopper Unit, are started and the proposal for 15 groups is under process.

g. Two Agri groups, one for men and one for women are formed during the month of August from Venganoor and Muloor wards. The objective of agri groups for women is to promote kitchen garden, whereas that of men is to introduce High Tech farming/ Precision farming/ Organic farming according to the local requirement. The project with the technical support of Agriculture University is under progress.

h. A total of 9 Skill Development courses are planned, to be conducted in 2017 – 18, out of these 2 courses have already been started and other 7

are planned to start in the coming months the details of the same are given in table below.

Sl. No.	Course	Number of candidates Approved for training	No. of batches	Duration (in hours)	Training Provider	Status
1	Asst. Beauty Therapist	50	2	290	IL&FS	Started 11.09 35 students
2	Asst. Plumber	30	1	350	SB Global	Started 26.09 30 students
3	GDA(Nursing Assistant)	50	2	420	IL&FS	Will Start in November
4	Trainee Associate Retail	30	1	320	IL&FS	Will Start in November
5	Fitness Trainer	25	1	290	IL&FS	Will Start in November
6	Asst. Electrician	30	1	440	Labour net	Will Start in November
7	Computer – Keyboard executive	50	2	180	Labour net	Will Start in November
8	Embroidery & Tailoring	50	2	150	Labour net	Will Start in November
9	Finance & Accounting	30	1	180	Labour net	Will Start in November
Total		**345**	**13**			

2. Solid Waste Management

a. 450 sessions of Sanitation campaign was conducted covering 7992 people. Focus group discussions were conducted as a follow up to the awareness programmes of solid waste management. Each FGD consist of 25 – 30 families to discuss debate and come up with an action plan for cleaning of existing waste in their locations and developing long term strategy with community ownership to handle the issues of solid waste. A draft plan of action for cleaning and disposal of waste within the locality has been prepared by the community itself. Cost effective solutions with the participation of local youth and local self-government institutions have been evolved through this FGD.

b. The Thumboormuzhi Aero Bins (21 numbers) installed at Kottappuram, Vizhinjam and Harbour wards of CSR intervening area, have started its operation. Trivandrum Corporation has appointed 8 staff to manage the

Aero bins. The time of operation of Aero bins is from 7 in the morning to 6 pm in the evening. The installation of five more bins at Kottappuram started.

c. A proposal has been prepared with Kerala Agriculture University for waste to manure viz. "Suchitha". The plant could convert 250kg of waste into manure in couple of hours' time. Proposed on a model owned by the community.

3. Public Sanitation

a. Cleaned 19 public wells in the wards of Kottappuram, Vizhinjam, Harbour, Venganoor and Mulloor. The work has been undertaken on a cost sharing model between AVPPL-AF and VISL under the guidance of Trivandrum Corporation. The scope of work include cleaning the well, bailing out water-using Oxygen Cylinder ,Earth work, excavation for platform fixing ,wash wall using Cement Concrete , plastering ,supplying and fixing 2000 Lt. Water tank ,supplying and fixing 2 H P Jet pump and other accessories , supplying and fixing of grill for covering the well. Testing of water quality and erecting motor pumps are under progress.

b. Details of the work carried out are summarized in the table below.

Sl. No	Ward	Well	Status
01	Kottappuram	Thulavila Radio Park	Civil Work completed (Including Cleaning , Earth Work, Platform, Washing Wall, Grill Cover and Earth Filling)
02		Kadakulam colony	
03		Kadakulam colony	
04		Charuvila Colony	
05		Karipallikkara	
06		Sai Gramam Kudivella Pathathy	
07		Osavila Colony	
08		Alphonsamma Kurisadi	
09		Thulavila	
10		St. Joseph Kurishadi	Cleaned the well; however the repair work was not initiated as the ward councillor requested to change the well work to Nellikunnu Lekshamveedu colony. Need approval for

Sl. No	Ward	Well	Status
			change in work
11	Venganoor	Mullumukku Junction	Civil Work completed (Including Cleaning , Earth Work, Platform, Washing Wall, Grill Cover and Earth Filling)
12		Kaithavilakom	
13		Pechottukonam	
14	Harbour	Cherumannu Kuzhi	
15		Valiyavila Muslim Colony	
16	Mulloor	KVLP School, Mukkola	
17		Kuzhivilakom Colony	
18	Vizhinjam	Kunchu Veedu Purayidom	
19		Vaduvachal	

4. Drinking Water Supply

a. Continued the supply of 50,000 litres of drinking water every day through tanker Lorries to the communities under CSR. For the same, 16 water tanks are provided in the wards. The treated water from the Water Treatment Plant of VISL operated by KWA is used for this purpose.

5. Community Health & Medical Camps and Community Volunteering Programme

a. A Mobile Health Care Unit (MHCU) with a Doctor, Pharmacist, Social Worker along with a mobile van and medicines started its operation under the CSR of AVPPL-AF since 1st June 2017 in five wards of CSR intervention area. Help-age India is the contracted agency for executing MHCU. Every month 1600 to 1800 people were consulted and the medicines provided. Number of patients treated from June to September is given in table below.

No. of Site	Name of Sites	No. of Patients covered during the Month of				Total
		June	July	Aug	Sept	
1	Kottappuram New Church	179	148	157	82	566
2	Kadakkulam Residence Association	158	136	117	70	481

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
CSR Activities by Adani Vizhinjam Port Private Limited

No. of Site	Name of Sites	No. of Patients covered during the Month of				Total
		June	July	Aug	Sept	
3	Karayadivila Colony	189	127	191	96	603
4	Thulavila	176	137	217	119	649
5	Vizhinjam Theruvu Nehru Memmorial Lib	253	207	265	87	812
6	SNDP Hall Kovalam	149	102	154	42	447
7	Gate way Residence Association	149	168	190	119	626
8	Near Harbour Engineering Department/Cost Guard	57	59	131	21	268
9	Marian Nagar	239	140	162	30	571
10	Peoples Hall/Township	100	208	231	137	676
Total		**1649**	**1432**	**1815**	**803**	**5699**

b. A cancer detection camp under the CSR of AVPPL-AF is planned on 21st October 2017 & 11th December 2017 at Kottappuram ward with a team of more than 10 professionals including three doctors from the Community Oncology department of RCC (Regional Cancer Centre) and the MHCU of AVPPL-AF.

c. As part of calendar of different medical camps proposed under CSR, three eye camps were conducted during the reporting period. The camps were organised in association with Residence Associations, Kudumbashree groups and local voluntary development organization. Team of doctors and technicians from Regional Institute of Ophthalmology and from Pvt. Eye hospital like Aradhana supported the camp. Referral services have been arranged for cataract surgery at Govt. Eye hospital, Thiruvananthapuram. Details of the camp are given in table below.

Sl. No.	Date	Programme	Venue	No. People Benefited
1	28/07/17	Eye Camp - 1	Parish Hall Kottappuram	47
2	18/08/17	Eye Camp - 2	Sneha Counselling Centre Kottappuram	65
3	13/09/17	Volunteers Training on Cancer Detection	Livelihood Hatching Centre, Mukkola	38
4	28/09/17	Eye Camp - 3	C.V. Smaraka Grandhasala, Thennoorkonam	60
Total				**210**

d. A plan for up gradation of Community Health Centre – Vizhinjam has been provided to Health/Harbour department and agreed to support for construction of one floor and necessary equipment for the hospital. The work has been undertaken by Harbour Engineering Department.

6. Community Volunteering Programme

a. A team of 40 community volunteers are trained to initiate the second phase of SWM on waste segregation and collection mechanism.
b. 16 Community Volunteers are trained as Sanginis to promote Suposhan Programme, the community nutrition programme for the community.
c. Another health volunteers training was provided to 38 youths from five wards for pre detection camp before the cancer detection camps and also to volunteer in the calendar of medical camps – proposed during the year.

7. Suposhan : A project of Adani Foundation to eradicate malnutrition and anaemia from children, lactating mother and pregnant women

a. Conducted 108 village level events through 16 community volunteers
b. Completed 615 Focus Froup Discussion (FGD's) and done 1865 family counselling and formed women's group and adolescent's groups in all the 49 Anganvadis.
c. Completed HB screening tests of 1236 women and 3250 adolescent girls.
d. Identified 36 SAM children and providing with Ready to Use Therapeutic Food.
e. Converted 17 numbers of children from Severe Acute Malnourished Children to Healthy and 112 children from Moderate Acute Malnourished Children to Healthy.

Sl. No.	Activities Conducted (Up to September 2017)	Achievements
1	No of Working Community Health Volunteers (Sanginies)	16
2	Focus Group Discussions conducted in the community	615
3	Family Counselling done	1865
4	Village level Events – conducted	108
5	Formation of women's Group (in Anganvadies)	49
6	Formation of adolescent's Groups (In Anganvadies)	49
8	No of SAM children providing with Ready to Use Therapeutic Food	36
9	No of total HB screening - Women in reproductive age	1236
10	No of total HB screening - Adolescent girls	3250
11	Number of Severe Acute Malnourished Children to Healthy	17

Sl. No.	Activities Conducted (Up to September 2017)	Achievements
12	Number of Moderate Acute Malnourished Children to Healthy	112

7. Education

a. Knowledge-YAN (K-Yan) the Smart Class room device provided to nine Government schools at Vizhinjam. List of the school provided with K-Yan is given below.

Sl. No.	School
1	Govt. UPS, Mulloor
2	Govt. KV LPS, Mulllor
3	Govt. L.V. LPS, Mulloor
4	Govt. LPS, Kidarakuzhy
5	Govt. LPS, Vizhinjam
6	Govt. SVLPS, Vizhinjam
7	Govt. LPS, Mudippuranada
8	Govt. HALPS, Vizhinjam
9	HALP School, Harbour

b. The construction of two storied school building started with 10 class rooms at HALP School.
c. Construction of two storied building at Mulloor Govt. School being planned.
d. A toilet block for Ayyankali School at Veganoor ward also planned.
e. 65 students are selected for merit scholarship of Rs. 10,000/- per annum under the CSR for the year 2017-18 from 11^{th} and 12^{th} standard.
f. Separate 60 hour courses on Soft skill Training and on English Language skill courses started for the students from 8^{th} to 12^{th} standard at Kottappuram St.Mary's School.
g. Evening classes for the student from fishing community started at Kottapuram.

8. Infrastructure/ Other projects

a. The construction of 140 meters of new drain and the repair work of about 1 Km stretch of Marian Nagar drain completed.
b. Renovation work of public library at Vizhinjam is scheduled.
c. A playground at Kottappuram has been planned
d. A community resource center at Kottappuram is planned
e. A public bathing facility at Mariyan Nagar, Kotappuram has been planned
f. A community toilet at Kottappuram is planned.

9. Expenditure Incurred

Amount already paid		
Sl. No.	Particular	Amount (Rs. In Lacs)
1.	Community Development	03.00
2.	Education	15.20
3.	Sanitation	00.70
4.	Skill and Livelihood	05.75
5.	Infrastructure Development	11.50
	Sub Total (A)	**36.15**
Works started during April to September 2017 (Bills to be raised)		
1.	HALP school project (20%) of total cost	20.00
2.	Skill Development & Livelihood	42.00
3.	Water Supply	08.00
4.	CHC – Building (20% of cost for one floor)	30.00
5.	Language lab. Soft skill and Evening classes (30%)	04.00
6.	K –Yan	07.00
7.	Medical Camps	03.00
8.	Aero Bins	05.00
9.	Public Well cleaning (50% of total cost)	13.50
	Sub Total (B)	**132.50**
	Total	**168.65**

Fig – 1: Skill Training imparted to local youth towards becoming Asst. Beauty therapist and Asst. Plumber course



Fig – 2: Thumboormuzhi Aerobin Inauguration on 11.05.2017


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Fig – 3: Wells cleaned in the month of May



Fig – 4: Focus group discussions on SWM conducted in the month of April



Fig – 5: Foundation stone laying of HALP school construction & 140 meters of new drain and the repair work of about 1 K.m stretch of Marian Nagar drain.



Fig – 6: Eye Camps



Fig – 7: Cancer Detection Camp



Fig – 8: MHCU



Annexure IV

Report on compliance of conditions of KCZMA recommendation for Environmental / CRZ clearance

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017
Vizhinjam International Deepwater Multipurpose Seaport Report on compliance of conditions of KCZMA recommendation for Environmental / CRZ clearance.		

Annexure IV

Half yearly compliance report of conditions stipulated in KCZMA recommendation for Environment and CRZ Clearance		
Sr. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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 Necessary approvals from concerned Statutory Departments / Agencies have been obtained • Consent to Establish from State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE/08/2015, dated 15.09.2015. • All permits required for construction of buildings as per building by laws will be obtained as and when required. • Airport Authority of India NOC vide NOC no AAI/SR/NOC/RHQ dated 7.12.2015
(ii)	Since the project envisages development of roads, infrastructural facilities, dredging of the lake and kayals proper environmental safety measures must be ensured.	Complied All safety measures are being adopted. Full time Environment & Safety professionals are employed by AVPPL, contractors & subcontractors to oversee the implementation of environmental safety measures. Third party IMS audit is being carried out by principal contractor and the report is shared with AVPPL. All work plans are executed after assessing the defined HSE 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 "Consent for Establishment" has been obtained from Kerala State Pollution Control Board vide Consent No. PCB/HO/TVM/ICE/08/2015, dated 15.09.2015.

Half yearly compliance report of conditions stipulated in KCZMA recommendation for Environment and CRZ Clearance		
Sr. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(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 is no mangrove in the vicinity of the project area.
(v)	The project proponent must take necessary arrangements for disposal of solid wastes and for the treatment of effluents / wastes. It must be ensured that the effluents/solid wastes are not discharged into the backwater area/sea.	Being Complied Necessary arrangement has been made for collection, segregation and disposal of Solid Waste as per Solid Waste Management Rules, 2016 • No solid waste is being disposed of in the Coastal Regulation Zone area. • Currently no effluent is generated
(vi)	The project proponent should provide necessary facilities for official of the Kerala Coastal Zone Management Authority (KCZMA) for inspection of the project site and its premises at any time.	Being complied During the compliance period KCZMA officials visited in May & June 2017 for review of compliance condition as part of NGT constituted committee. All the necessary facilities/support to officials of KCZMA for inspection of the project site and its premise were provided
(vii)	The KCZMA may be duly informed of any construction/developmental works/major activities undertaken in the CRZ area of the project	Complied Following construction activities are in progress: • Temporary approach road of 1.2 KM • Till 30th September 2017 2.26 Mm^3 dredging has been done and by using dredge material 33 Ha area has been reclaimed. • As per the directions of NGT quarterly/half yearly reports are being furnished to KCZMA including the details of the development works • Breakwater – 565 meter length of breakwater has been completed which forms part of the new fishing harbour.

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017
Vizhinjam International Deepwater Multipurpose Seaport Report on compliance of conditions of KCZMA recommendation for Environmental / CRZ clearance.		

Half yearly compliance report of conditions stipulated in KCZMA recommendation for Environment and CRZ Clearance		
Sr. No.	**Conditions**	**Compliance Status as on 30-09-2017**
(viii)	Environmental clearance must be obtained from the Ministry of Environment & Forests.	Complied Environment & CRZ Clearance has been obtained from Ministry of Environment & Forest vide MoEF letter dated 03rd January, 2014 (F.No.11-122/2011-IA.III)
(ix)	An adequate financial provision has to be made for environmental protection measures.	Complied A total of Rs. 40 Crore has been set aside for environmental protection measures as per the EIA report. For the details of the amount spent for the compliance period refer **Annexure VIII**
(x)	Scrutiny fee of Rs. 10,00,000/- (Rupees Ten lakh only) to be remitted under the head account 1425-800-97 applications for scrutiny fee etc. for CRZ clearance, in the district/Sub Treasury concerned, if private parties are involved in the project and the chalan receipt in original be forwarded to the Science & Technology Department quoting this letter.	Not Applicable The condition is not applicable since the application for CRZ/Environmental clearance was submitted by Vizhinjam International Seaport Ltd.(VISL), a Government of Kerala undertaking

Annexure V

Compliance of the response/commitments made during Public Hearing

Annexure V

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
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, an enhanced livelihood compensation package amounting to Rs. 23.80 crores was sanctioned by GoK, instead of Rs.7.1 crores suggested earlier in the EIA stage. Out of this amount, Rs.18.14 crores have been disbursed till 30th September 2017 for a total number of 456 Livelihood Affected Persons (LAPs) whose verification was complete in all respects. Verification of the documents of balance LAPs is in progress.
2	Land under the Jamaath which includes Karimppaly, Magham, Varuthari Pally, etc. need to be protected and should not be acquired.	Complied
3	Compensation for the land acquired (rail/road connectivity and back up areas) are paid promptly and any for additional land required also will be paid in the same way.	Complied Compensation for all the procured land has been disbursed along with R&R package. Same policy will be followed for the remaining extent of land also.
4	Additional fish landing centre will be constructed	Being Complied The work for construction of the fish landing centre (Rs.16 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. 565 meter length of breakwater has been completed which forms part of the new fishing harbour. Since at present fishing boats are docked in the proposed area the works for fishery berth could not be initiated.
5	Existing harbour will be improved under the CSR provisions of the project	Being Complied Tenders for modernization of the existing fishing harbor was invited by HED and work awarded. However the works could not be initiated due to sectoral protests among different fishermen groups.
6	Fisherman will get first preference	Will be complied as per the applicable

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
	to cross the ship channel	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 Year round status of the shoreline is being mapped from Feb 2014 for a stretch of 40km. Change monitoring is being continued for the construction phase. As per the mathematical modelling report based on Shoreline data (Feb 2015-Feb 2017) there's no significant impact on shoreline and the same is in line as predicted in EIA.
8	Water supply provision to the Vizhinjam fishing village	Complied Scheme has been commissioned in April, 2013 by VISL by expending an amount of Rs. 7.33 crores. For O&M of the same an amount of Rs. 6.75 crores has been spent till 30th September 2017 by VISL. AVPPL have installed 20 water tanks in the water scarce areas in the project neighbourhood and water is being supplied on a daily basis on mobile water tankers. An amount of Rs 19.84 lakhs has been spent by AVPPL on this account till date.
9	Construction of the new fishing harbour will be simultaneously completed with the port project	Being Complied The work for construction of the fish landing centre (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated as part of the funded work component of the concession agreement with AVPPL. 565 meter length of breakwater has been completed which forms part of the new fishing harbour. Since at present fishing boats are docked in the proposed area the works for fishery berth could not be initiated.
10	Railway work will be initiated after Environment Clearance (EC)	Complied To minimize the impacts, tunnelling methods are being explored for the rail route through Konkan Railway Corporation Limited.

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
11	Job Opportunity - Preference will be given to local people during construction stage	Being complied. Out of the total persons employed at site, 101 numbers are from the locality.
12	Rehabilitation measures ensures employment opportunities for fishermen	Being Complied Refer point No. 1
13	Take all possible measures for judicial use of lighting system as part of the Green Port concept to reduce the carbon footprint	Will be Complied Will be considered with appropriate planning.
14	Appropriate action like providing compensation or alternate employment etc to fishermen will be implemented wherever applicable after the Environment Clearance	Being Complied Refer point No. 1
15	Compensation, Resettlement and Rehabilitation benefits to all the livelihood affected and displaced fisherman will be implemented after the Environment Clearance	Being Complied Refer point No. 1
16	Waste management is included in the EMP and E&E waste management is part of the SWMP.	Being Complied A budgetary provision has been included for waste management. All contractors working at site are following the waste management practices in line to waste management rules 2016. As per the MoU signed with Municipal Corporation of Thiruvananthapuram, 21 Thumboormozhi Aero Bins were installed under CSR in the areas of Vizhinjam Market, Kottappuram and Harbour areas. Each bin has a capacity to treat 1.5 tons of waste. 395 classes on better Solid Waste Management practices were carried out in the communities covering 10000 people. This included importance of segregation of waste, issue of burning of waste and different at-source treatment of waste.

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
17	Upgradation of PHC at Vizhinjam will be carried out	Being Complied Revised Plan for upgrading Community Health Centre (CHC) –Vizhinjam was presented to the Department of Health, Government of Kerala by Adani Foundation. As per the revised plan Adani Foundation would construct the second floor in the upcoming building at CHC with necessary equipment support, whereas the basement and first floor would be constructed by harbour department.
18	New fishing harbour with all the infrastructural facilities will be constructed with reserved rights to mooring/berthing the boats	Being Complied Refer point No. 9
19	Appropriate compensation will be given to the resort owners as per the regulatory advice of KCZMA and MoEF since the resorts are seen to be located in No Development Zone (NDZ) as per CRZ Notification 2011	Being Complied Based on G.O,(Rt) No.2021/2017/RD dated 27-04-2017, government ordered to pay compensation for land and not for the structures since they were in violation of CRZ notification. Action in this respect is being taken.
20	Rail, Road, Coastal and Inland Waterways connectivity will be ensured to the rest of Kerala and other Indian Peninsula Ports	Being Complied This is one of the objectives of the project and this will be fully materialised once all phases of the project are implemented.
21	Waste Management, Water Treatment plants, etc. will be part of an operational EMP	Being Complied Waste Management & Decentralized waste water management techniques as per EMP is being carried out.
22	Shoreline monitoring on 15 km both sides on regular basis during construction and operation as suggested in EIA report will be carried out	Being Complied Refer point No. 7
23	VISL will ensure that appropriate dredging and reclamation methodology as suggested in EIA report will be adopted to contain the turbidity within applicable	Being complied. 3 Continuous turbidity monitoring station are installed to measure turbidity on real time basis. Turbidity results are within the applicable limit

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
	limits.	
24	Appropriate measures relating to maintenance of health, hygiene, safety and security will be implemented as per EIA report	Being complied. An officer of VISL has been designated as Head (EHS & CSR) for effective implementation of the stipulated EHS safeguards & CSR activities. AVPPL, the concessionaire executing the project has also appointed officers for EHS & CSR. In addition to the above, independent environment, health and safety consultants have been appointed as required in the concession agreement signed with AVPPL. It is also ensured that contractors working at site also deploy EHS professional to implement suggested EMP measures
25	VISL will ensure that livelihood issues of Mussel collectors are addressed as per the EIA report	Being Complied Till date 271 Mussel collectors have been compensated for Livelihood loss expending an amount of 12.65 crores. Although they were offered alternate livelihood plan through cage fishing they opted for one time settlement siting the risks involved in such fishing.
26	VISL will ensure all the project components i.e., including road/rail connectivity are implemented in time. In addition the planned CSR and EMP measures will also be implemented and monitored to ensure the socio-economic development of the region.	Being complied
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 is being carried out. Six monthly compliance reports are submitted to all concerned regulatory authorities.
28	Special care will be taken to minimise the tree felling in the backup area and to plan the	Being complied to the extent possible, but in line with the technical requirements of the project

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
	development in tune with the topography.	
29	The livelihood restoration measures for fishermen affected during construction phase as reported in the EIA has to be implemented	Being complied Refer point No. 1 and point No. 25
30	Dredging materials will be used for reclaiming (filling) the sea and additional materials are not required	Being complied The dredged materials till 30th September 2017 amounting to 2.26Mm^3 has been utilized for reclamation of 33 Ha area. The dredged material has been used for reclamation only
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	Will be complied As and when the works in this stretch is initiated, appropriate compensation will be disbursed during the affected period
32	There will be no erosion on the shoreline on account of dredging the deep sea at (-) 18m to (-) 20m	Being complied Year round status of the shoreline is being mapped for a stretch of 40km a (Last Six month Monitoring Report is attached as **Annexure I**.). The shoreline data from February 2015 to February 2017 was submitted to LnTIEL for mathematical modelling to assess the impact on shoreline under the guidance of NIOT. Mathematical modelling report thus prepared shows that there is no significant impact on shoreline. This is in line with the predictions in the EIA.
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 VISL in coordination with Town Planning department, Tourism department and related stakeholders are in the process of preparing an integrated Area Development Plan. Scheduled to be completed by June 2018.
34	Maximum 3 ships are expected per day in phase I. Appropriate traffic mechanism to cross the ship channel for fisherman with first	Will be complied During the operation phase

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
	priority will be practised as is happening in Cochin Port where fishing harbour, container berth, navy, shipyard, inland water transport etc are co-existing	
35	An additional fish landing centre has been suggested at Vizhinjam to decongest the existing harbour, and to cater to the needs of the fisherman in the 15 km vicinity including Pozhiyur & Poovar, considering the suitability of the site having natural bay, increased tranquillity and operational / infrastructural convenience than location like Pozhiyur–Poovar estuary	Being complied Refer point No. 1
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 Refer point 33 above
37	“Inconvenience Allowances” during construction period of three years to the fisherman (As per EIA Report)	Being complied Inconvenience allowance in the form of kerosene for outboard engines for circumventing the construction site will be provided to affected boats during the construction period. An amount of 27.2 crores is planned to be sanctioned by the GoK on this account in November 2017. Kerosene will be supplied from December 2017 till December 2019, i.e. the breakwater construction period.
38	As per the Entitlement Framework, Hardship Allowance is suggested in the EIA/EMP for resort workers who lost their job due to acquisition of the resort	Complied Compensation for livelihood loss; Rs 6.08 Crores out of allocated 6.11 Crores has been disbursed to 211 out 211 number of resort workers.
39	During the construction period of three years livelihood assistance to the shore seine fisherman in the 2km ship channel foot print beach	Will be complied As and when the works in this stretch is initiated, appropriate compensation will be disbursed during the affected period

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
	has been suggested although they can move further southward and continue with their activity.	
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
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
42	Rail connectivity is proposed along the outer side of the stream running parallel to the harbour road and that too on elevated structures without affecting the entry to the fishing harbour	Will be complied
43	The port project will not affect the inflow of Neyyar river and AVM canal	Noted for compliance This is a fact, since both are away from the project site
44	The port road will be access controlled for the exclusive use of container and related port movements. The suggestion for a new approach road can be considered on technical feasibility and subject to surrendering of adequate land by the beneficiaries	Will be complied Scope of providing connectivity for the local residents to the nearest Vizhinjam-Poovar road will be considered subject to surrendering of adequate land by the beneficiaries
45	The Master Plan has already included a reservoir/ground water recharge facility adjoining the road for water-shed management	Will be complied
46	Where ever possible and based on eligibility, local people will be employed	Will be complied
47	Reconstruction of Roads in the nearby area- Adequate provisions have been made for the old fishing harbour and its linkage roads as it will be adopted as a part of best practice and beautification process	Will be complied through HED the maintenance agency for the fishing harbour and the coastal road network.
48	The development of the warehouse	Will be complied

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
	area will be taken up	This is part of the proposed port estate development.
49	Livelihood Compensation considered for those who were affected at Adimalathura during construction phase and those affected in the project foot print area at Mulloor and Valiyakadappuram during construction/ operation phase	Will be complied Refer point No. 1 As and when the works in Adimalathura stretch is initiated, appropriate compensation will be disbursed during the affected period
50	CSR activity suggested a skill development centre to equip the local people to adapt to the industrial needs of port/tourism and fisheries so that they can be appropriately 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 A Skill registration drives in all five wards was conducted during the compliance period and more than 1600 youth have participated in the registration drive. A total of 9 Skill Development courses are planned, to be conducted in 2017 – 18, out of these 2 courses have already been started and other 7 are planned to start in the coming months.
51	Loss of livelihood to the traditional fisherman who do shell fishing in the Mulloor beach area is a real issue/impact. All necessary provisions for livelihood assistance have been considered in the EIA Report.	Being complied Refer point No. 25
52	Only prohibited area for fishing is inside the breakwater. However fishing will be restricted along ship channel and port limits subject to safety norms and operational requirements.	Will be complied During operation phase
53	The existing notification of the Vizhinjam Port includes the Vizhinjam Fishing harbour. The revised Notification will include the Vizhinjam Deep Water Port based on revised Port limit provided in the EIA report. Except inside the breakwater of the Deep Water Port	Will be complied Revised port limits for (i) fishing harbour/minor port and (ii) Vizhinjam seaport will be notified. Restrictions on fishing will be as per the applicable laws.

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
	in all other areas of the port limit fishing is allowed with all safety and operational restrictions.	
54	There will only be a movement of 8 barges per day during the construction period of 3 years and the same will not be a hindrance for the fisherman to cross since this is far less than the number of ships being crossed by them daily in the international ship channel.	Will be complied Inconvenience, if any, to fishing will be monitored during the construction phase.
55	The maximum rate of accretion at southern side of the harbour will be 21.6 m/year in the 1st year and by the end of tenth year it reduces to 0.5 m/year. The shoreline evolution along the south side of the port will get stabilized in the initial years. On stabilization, the maximum net increase in the shoreline accretion would be around 27m immediately south of the port which reduces to negligible levels within 2.3km alongshore. There will not be any impact on the shoreline along Poovar-Pozhiyar sector which is about 7km away from the proposed port.	Being complied Refer Point 32
56	The 8 resorts affected will be compensated in line with R&R package in place but subject to the advice of the KCZMA/MoEF considering that all these resorts are in NDZ as per CRZ Notification, 2011	Being complied Refer point No. 19
57	The cruise terminal proposed in the project, will promote tourism in the Kovalam-Poovar belt and the region may become the cruise hub/tourism gate way of India in future	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

Compliance of the Response/Commitments made during Public Hearing		
Sl. No.	**Responses/Commitments**	**Status as on 30.09.2017**
		taken in consultation with the State tourism department, to design port linked tourism packages covering the Kovalam-Vizhinjam- Poovar tourism corridor
58	CSR activity considers training the local people to adapt to the new economic development of the area	Being complied Refer point No. 50
59	The Coast Guard & Navy Berth are as per the needs of the Ministry of Defence on national security	Being complied Specific conditions have been included in the concession agreement relating to use of berths by Navy/Coast Guard.

Annexure VI

Status of Environment Management Plan

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Annexure VI

Status of Environment Management Plan- Port site- Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
1	Capital dredging	Marine water quality	o Check turbidity levels with baseline levels as reference during entire monitoring programme o Preparation of Dredge/reclamation Management plan o Discharge of waste into sea will be prohibited o Oil Spill control measures will be adopted o Ensure that slop tanks will be provided to barges/ workboats for collection of liquid/ solid waste o Marine environmental monitoring as per environmental monitoring programme	o Capital dredging has started since Dec 2015 with the use of a cutter suction dredger. o Till 30th September 2017, Dredge Material amounting to 2.26 Mm^3 has been utilized for reclamation of 33 Ha. o Turbidity level is being monitored continuously at three locations by establishing 3 Real Time Turbidity Monitoring Stations and found comparable to baseline figures o Discharge of waste into sea is prohibited o Marine Environmental Monitoring at 5 locations as per the Environment Monitoring Plan prescribed in EIA has commenced since August 2016 and the parameters are within permissible limits. o Six monthly monitoring reports are regularly submitted to regulatory authorities.
		Marine ecology		
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. o To reduce impacts from exhausts, emission	o Rejected rocks being cleared as part of quarry closure plan is being used for Breakwater Construction. Fugitive emission during transportation is contained by water sprinkling on approach roads and tarpaulin covering of the transport trucks o It is ensured that all vehicles entering the Port have a valid PUC certification

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Status of Environment Management Plan- Port site- Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
			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 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	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 adherence to speed limit
		Noise	o Noise levels will be maintained below threshold levels stipulated by Central/Kerala State Pollution Control Board (CPCB)/KSPCB	o Noise levels are being monitored every fortnight and are found to be well within the permissible limits within the project

Status of Environment Management Plan- Port site- Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
			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 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	area. o Contractors are also monitoring the Noise level in their work area and results are within the stipulated limit. o Protective gear like earplugs, muffs are provided to workers exposed to noise level beyond threshold limits
		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	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. A mix of water harvesting pond with appropriate drains are planned for the operational

Status of Environment Management Plan- Port site- Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
			drainage & management plan o Existing drains / Streams that are passing in ware house area will not be closed/ diverted. And these streams will be de-silted and enhanced to improve their carrying capacities	phase
		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.	o Care is taken to limit the felling of trees to the bare minimum. Plantation of saplings along the road margins and port boundary are planned as part of the master plan development o Temporary Worker camps with all necessary infrastructure facilities (Water, Electricity, Sanitation, Fuel, etc.) has been provided
		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 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 Traffic monitoring & regularization is being carried out for maximum efficiency

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Status of Environment Management Plan- Port site- Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
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.	o The existing drains are maintained for unhindered disposal of surface drainage water.
4.	Solid Waste Management	Soil quality	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. o Other recyclable wastes will be sold. o 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. o General refuse generated on-site will be collected in waste skips and separated from construction waste. o Burning of refuse at construction sites will be prohibited. o All control measure will be taken to avoid the contamination of groundwater during construction phase	o Construction waste will be used within port site for filling of low lying areas. o Burning of refuse at construction sites is prohibited. o There is no disposal of waste in the project area which may lead to groundwater contamination
5.	Handling of hazardous wastes	Human safety and property loss	o Adequate safety measures as per OSHA standards will be adopted 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	o Adequate safety measures as per OSHA standards are adopted as and when necessary as per the HSE Plan o Construction site is being secured by fencing with controlled/limited entry points o Medical facilities including first aid are available for attending to injured

Status of Environment Management Plan- Port site- Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			stored as per the prescribed/approved safety norms. o Construction site will be secured by fencing with controlled/ limited entry points 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.	workers. o Handling and storage as per statutory guidelines. o Hazardous wastes will be 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 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	o The water supply scheme had already been commissioned with the source as Vellayani Lake. 3.00 MLD of raw water will be available for treatment with a net availability of 2.49 MLD of potable water. Out of this 1.49 MLD of water shall be distributed to the locality as part of social welfare measures of VISL. The balance 1.0 MLD is for the port use. Water requirement during construction will be met from the above quantity. The tapping point has already been provided by KWA at a distance of approximately 50m from the port site. Water requirement during construction is being met from the above source.

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Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Status of Environment Management Plan- Port site- Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
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	o Signboards have been placed for demarcation of construction area. o Continuous interaction being done with fishing community for mutual understanding of construction activity
8.	Tourism	Effect on tourism	o 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. o A cruise terminal and related facilities is part and parcel of the project. This is to largely compensate the losses made o For all acquired properties and land adequate compensation will be provided based on legally valid documents	o The tourism activity in the nearby Kovalam area is not impacted by the construction of the port. o 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 o Based on G.O,(Rt) No.2021/2017/RD dated 27-04-2017, government ordered to pay compensation for land and not for the structures since they were in violation of CRZ notification. Action in this respect is being taken.

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Status of Environment Management Plan- Port site- Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
9	Breakwater	Change in shoreline	o Shoreline monitoring shall be carried out o Suitable Shoreline protection measures will be implemented based on the observations	Comprehensive Shoreline Monitoring is being carried out under the technical Guidance of NIOT and Six monthly monitoring reports are being submitted regularly as part of EC & CRZ Compliance The existing Shoreline Monitoring arrangement consists of: o Engaging of M/s Ocean Science & Surveying for Cross Shore Beach Profiling perpendicular to the shoreline 20 KM on either side of the port at 500 meter intervals which includes bathymetry survey upto CD -10 and landside survey upto HTL + 100 meter and photographic documentation of morphological changes, seasonal beach sediment sampling and analysis at 81 locations, bathymetry survey of 40 km x 15 km twice in a year, monthly monitoring of littoral zone, seabed sediment sampling per sq.km in 80 sq.km, current measurement with ADCP at 4 locations for 3 seasons, tide measurement, continuous wave measurement by wave rider buoy, water sampling and analysis, continuous turbidity monitoring at 3 locations, bathymetry and cross section survey of 6 rivers debouching into the sea

Status of Environment Management Plan- Port site- Construction Stage Potential Impacts and Mitigation Measures of Various Project Activities				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
				in 40 Km stretch study area, continuous weather monitoring by Automatic Weather Station. o Engaging of L&T Infra Engineers Ltd (formerly L&T Ramboll) for numerical modelling analysis of the shoreline changes based on data collected by M/s Ocean Science Surveying as described above. o Comparison of analyzed data with satellite image and drawing of conclusions
10	Effect on existing fishing harbour	Movement of fishing boats	o Detailed modelling studies have been carried out on tranquillity conditions in the fishing harbour with port development. The studies reveal that the tranquillity conditions will be improved in fishing harbour with construction of the port. Further minor accretion happening within the fishing harbour will be arrested o Traffic of Marine vessel/ fishing boats will be planned without affecting each other o Adoption of fishing harbour to manage it to perform as per International standard o A new fishing harbour provided under CSR initiatives because of additional tranquillity creator. o Loss of livelihood will be either taken care of	o Wave, current and tide data are being monitored along with the shoreline monitoring of 40 km stretch. Based on the above, the modelling studies done at the EIA stage has been further evaluated. o The shoreline data from February 2015 to February 2017 has been submitted to LnTIEL for mathematical modelling to assess the impact on shoreline. As per the mathematical modelling report there's no significant impact on shoreline and the same is in line to the shoreline evolution predicted as part of EIA o Traffic of Marine vessel/ fishing boats will be planned without affecting each other

Status of Environment Management Plan- Port site- Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
			in the new port premises or adequately compensated mostly in the form of employment	o The work for construction of the fish landing center (Rs.16 crores) and the fishery breakwater (Rs.131.12 crores) has been initiated as part of the funded work component of the concession agreement with AVPPL. 565 meter length of breakwater has been completed which forms part of the new fishing harbor. Since at present fishing boats are docked in the proposed area the works for fishery berth could not be initiated. o In consultation with the fishermen, an enhanced livelihood compensation package amounting to Rs. 23.80 crores was sanctioned by GoK, instead of Rs.7.1 crores suggested earlier in the EIA stage. Out of this amount, Rs.18.14 crores have been disbursed till 30th September 2017 for a total number of 456 livelihood affected persons (LAP's) whose verification were complete in all respects. Verification of the documents of balance LAP's is in progress.
11	Shoreline changes	erosion/accretion	Final shoreline Impact management plan will be prepared in consultation with agencies like CESS/INCOIS, NGO and local bodies and will implemented. The draft shoreline impact	o NIOT has been engaged to give technical advice on technical aspects related to shoreline monitoring & shoreline evolution.

Status of Environment Management Plan- Port site- Construction Stage
Potential Impacts and Mitigation Measures of Various Project Activities

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
			management plan is given in Appendix 6.6.	o 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. o Wave, current and tide data are being monitored along with the shoreline monitoring of 40 km stretch. Based on the above, the modelling studies done at the EIA stage has been further evaluated. o The shoreline data from February 2015 to February 2017 has been submitted to LnTIEL for mathematical modelling to assess the impact on shoreline. As per the mathematical modelling report there's no significant impact on shoreline and the same is in line to the shoreline evolution predicted as part of EIA.

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Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Environmental Management Plan - Road/Rail Corridors*
***Construction work has not commenced in this area**

Sl. No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Status as on 30.09.2017
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.	During and after construction (Five Years)	As a Project specific action this will have to be incorporated	o An Environment Management Cell has been established to look after day to day affairs like Monitoring, Training o An officer of VISL has been designated as Head (EHS & CSR) for effective implementation of the stipulated EHS safeguards & CSR activities. AVPPL, the concessionaire executing the project has also appointed officers for EHS & CSR. In addition to the above, independent environment, health and safety consultants have been being appointed as required in the concession agreement signed with AVPPL. o Necessary equipment will be purchased. o Third party environmental monitoring has commenced since August 2016 and the monitoring results are satisfactory
2	Altered Road embankment	Retaining walls and gabions should be provided	During construction	Design standard requirement	Will be complied as and when required
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	During the Constructio n phase	Design standard requirement	Will be Complied

Environmental Management Plan - Road/Rail Corridors*
***Construction work has not commenced in this area**

Sl. No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Status as on 30.09.2017
		carried out at regular intervals to prevent dust. o Vehicles delivering materials should be covered to reduce spills and dust blowing off the load.			
4	Air Pollution	o Vehicles and machinery are to be maintained so that emissions conform to National and State standards. o All vehicles and machineries should obtain Pollution Under Control Certificates (PUC).	Beginning with and continuing throughout construction phase	MORTH's Specifications	Will be Complied
5	Noise	o Machinery and vehicles will be maintained to keep their noise to a minimum. o Construction of noise barriers of an average length of 100m and eight feet height where ever necessary. o Proper maintenance of the rail track and rail wagon, by frequent lubrication to avoid frictional noise.	Beginning and throughout constructio n phase	MORTH's Specifications	Will be Complied

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Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Environmental Management Plan - Road/Rail Corridors*
***Construction work has not commenced in this area**

Sl. No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Status as on 30.09.2017
		o Regular monitoring shall be carried out as per the Environmental Monitoring Plan.			
6	Loss of low lying land and ponds	o Impacted ponds can be enhanced by constructing bridged structures like Gabions to avoid plugging of springs. o Mitigation/Compensation shall be affected for the completely impacted ponds. o At Chainage km 6.500 the Railway alignment goes below the Existing NH and then at km 6.600 it will hit pond. The pond will be excavated partially and the soil material shall be used to fill in the western part and an equivalent area lost may be excavated to compensate the loss of effective pond area.	During Construction phase	MORTH's Specifications	Will be complied
7	Flood Impacts and Cross Drainage	Formation level should be raised according to the design	During constructio	MORTH's Specifications	Will be complied

Environmental Management Plan - Road/Rail Corridors* *Construction work has not commenced in this area					
Sl. No.	**Environmental Impacts and Issues**	**Mitigation Measures**	**Time Frame**	**Contractual Clause**	**Status as on 30.09.2017**
	Structures	and the cross drainage structures suitably planned for the flood events.	n phase		
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 irrigation and drainage systems in conformity to the Contractors visual integration and management plan and EMP.	During construction phase	MORTH's Specifications	Will be complied
9	Contamination from Wastes	All justifiable measures will be taken to prevent the wastewater produced during construction from entering directly into rivers and	Throughout constructio n phase	MORTH's Specifications	Will be complied

Environmental Management Plan - Road/Rail Corridors*
***Construction work has not commenced in this area**

Sl. No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Status as on 30.09.2017
		irrigation systems			
10	Borrow pits	Borrow pits are to be identified, opened and closed after consultations and proper documentation	During construction phase	MORTH's Specifications	Will be complied as and when required
11	Quarrying and Material sources	o Quarrying will be carried out at approved and licensed quarries only. o Details of Quarrying material sources are given in Chapter 4.	During construction phase	MORTH's Specifications	Will be complied
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 are damaged, they will be suitably repaired. o Retaining walls and gabions shall be suitably provided.	During construction and upon completion of construction activities at these sites.	MORTH's Specifications	Will be complied
13	Loss of	o Arable land should not be	During	MORTH's	

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Environmental Management Plan - Road/Rail Corridors*
***Construction work has not commenced in this area**

Sl. No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Status as on 30.09.2017
	agricultural topsoil	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.	construction phase	Specifications	Will be Complied
14	Compaction of Soil and Damage to Vegetation	Construction vehicles should operate within the Corridor of Impact avoiding damage to soil and vegetation.	During construction	MORTH's Specifications	Will be Complied
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.	After completion of construction activities	MORTH's Specifications	Will be complied alongside the road and port boundaries
16	Vegetation clearance	Tree clearing within the ROW should be avoided beyond that which is directly required for construction activities and/ or to reduce accidents. Especially in plantation and house garden areas both along road and rail alignment.	During cleaning operations	MORTH's Specifications	Will be complied
17	Fauna	Construction workers should protect natural resources and	During construction	MORTH's Specifications	Will be complied

Environmental Management Plan - Road/Rail Corridors*
***Construction work has not commenced in this area**

Sl. No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Status as on 30.09.2017
		animals. Hunting of birds and other local animals is prohibited.	phase		
18	Traffic Jams and congestion	If there is traffic congestion during construction, measures should be taken to relieve it as far as possible with the co-operation of the traffic police.	During construction phase	MORTH's Specifications	Will be complied
19	Health and Safety	All contractors' staff and workers must wear high visibility purpose made overalls or trousers/a waist coat at all times All operators working with any materials above head height (even in trenches) must wear hard hats all at times on the worksite.	Health and Safety	MORTH's Specifications	Will be complied
20	Pollution of Streams parallel or along the alignments	Construction material /waste should be disposed of properly so as not to block or pollute streams or ponds with special attention to confining concrete work.	During construction phase	MORTH's Specifications	Will be Complied
21	Cultural Remains	Construction should be stopped until authorised department assess the remains to preserve Archaeological	Throughout Constructio n phase	ASI Acts	Will be complied

Environmental Management Plan - Road/Rail Corridors*
***Construction work has not commenced in this area**

Sl. No.	Environmental Impacts and Issues	Mitigation Measures	Time Frame	Contractual Clause	Status as on 30.09.2017
		relics and cultural structures like Temples, mosques and churches. Archaeologists will supervise the excavation to avoid any damage in the relics.			

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Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Environment Management Plan – Warehouse Area* (Construction Phase) ***Only Boundary Wall Construction in limited way has started in this area during the compliance period**				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
WAREHOUSE AREA (Construction Phase)				
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	o Monthly Environment Monitoring is being carried out and all the parameters are within the stipulated limit 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 in vehicles

Environment Management Plan – Warehouse Area* (Construction Phase) *Only Boundary Wall Construction in limited way has started in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			out at regular intervals to prevent dust. o Vehicles delivering materials should be covered to 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	Ambient Noise is being monitored fortnightly for Day & Night time and results are within the prescribed limit. Construction equipment machinery procurement is done in accordance with specifications conforming prescribed standard. Personnel engaged in construction activity are provided with appropriate PPE's (Earplugs/muffs)

Environment Management Plan – Warehouse Area* (Construction Phase) *Only Boundary Wall Construction in limited way has started in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			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. 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.	Will be Complied
		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. Another option is to divert through the boundary wall- an application was filed with the irrigation dept.	Will be appropriately planned in consultation with the concerned departments

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Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Environment Management Plan – Warehouse Area* (Construction Phase) *Only Boundary Wall Construction in limited way has started in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			o Another option is to divert the stream through the boundary o An application has been filed with the irrigation department for permission.	
			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 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	Will be appropriately planned in consultation with the concerned departments
			o Construction waste such as cement, paint, and other construction waste will flow into the downstream parts of the streams and Karichal River. Construction will be avoided during rainy season. Good housekeeping practices, such as cement being stored in dry areas will be taken care of. Labour camps will be provided with proper support services.	Will be complied
		Disturbance to Natural Drainage pattern	o As mentioned above, formidable measures will be taken to avoid the disturbance to the natural flow of water. If some structure or building comes in the way of the existing flow of water, the flow will be redirected to the	Will be complied

Environment Management Plan – Warehouse Area* (Construction Phase) *Only Boundary Wall Construction in limited way has started in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			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.	
		Existing Traffic	o Transportation of construction materials will be carried out during non- peak hours. o Regularization of truck movement. o Existing roads shall be strengthened and shall be used for the construction material transportation.	Being complied
3	Solid Waste Management	Soil quality	o Construction waste will be used within warehouse 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. o Excavated soil will be stockpiled in a corner of the site in bunded area to avoid run off with storm water.	Will be complied

adani	**Adani Vizhinjam Port Private Ltd**	**From : April 2017** **To : September 2017**

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Environment Management Plan – Warehouse Area* (Construction Phase) ***Only Boundary Wall Construction in limited way has started in this area during the compliance period**				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			o General refuse generated on-site will be collected in waste skips and separated from construction waste. o Burning of refuse at construction sites will be prohibited.	

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

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Status of Environmental Management Plan.

Project Auxiliary Facility (PAF)* ZONE - Construction Phase
***Only Boundary Wall Construction in limited way has started in this area during the compliance period**

Sl. No.	Activity	Relevant Environmental Components likely to be impacted	Proposed Mitigation Measures	Status as on 30.09.2017
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 Monthly Environment Monitoring is being carried out and all the parameters are within the stipulated limit 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 Environment awareness programme is provided to the personnel engaged in development work

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Project Auxiliary Facility (PAF)* ZONE - Construction Phase *Only Boundary Wall Construction in limited way has started in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			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. 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	Ambient Noise is being monitored fortnightly for Day & Night time and results are within the prescribed limit. Construction equipment machinery procurement is done in accordance with specifications conforming prescribed standard. Personnel engaged in construction activity are provided with appropriate PPE's (Earplugs/muffs)

Project Auxiliary Facility (PAF)* ZONE - Construction Phase *Only Boundary Wall Construction in limited way has started in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			possible, will be oriented so that the noise is directed away from sensitive receptors. o Noise attenuation will be practised for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers. o High noise generating activities such as piling and drilling will be scheduled at daytime (6.00 am to 10 pm) to minimise noise impacts. o Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. o Ambient noise levels will be monitored at regular intervals	
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 complied alongside the road and port boundaries

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Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

Project Auxiliary Facility (PAF)* ZONE - Construction Phase *Only Boundary Wall Construction in limited way has started in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			will be acquired and people in that area will be rehabilitated.	
		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.	Will be complied
		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. o Excavated soil will be stockpiled in a corner of the site in bunded area to avoid run off with storm water. o General refuse generated on-site will be collected in waste skips and separated from construction waste. o Burning of refuse at construction sites will be prohibited.	Will be complied

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

BACK UP AREA* – Construction Phase *Construction work has not commenced in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
1	Material transport and construction activities	Air Quality	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 suppress fugitive dust o Environmental awareness program will be provided to the personnel involved in developmental works	Will be complied

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

BACK UP AREA* – Construction Phase *Construction work has not commenced in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			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 minimise noise impacts o Personnel exposed to noise levels beyond	Will be complied

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

BACK UP AREA* – Construction Phase *Construction work has not commenced in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			threshold limits will be provided with protective gear like earplugs, muffs, etc. o Ambient noise levels will be monitored at regular intervals	
2	Construction Activities	Water Environment	o Formation level should be raised according to the design and the cross drainage structures suitably planned for the flood events. o All justifiable measures will be taken to prevent the wastewater produced during construction from entering directly into the water bodies.	Will be complied
		Land Environment	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 are damaged, they will be suitably repaired. o Retaining walls and gabions shall be suitably provided.	Will be complied
			o Arable land should not be used for topsoil borrowing.	Will be complied

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Status of Environmental Management Plan.

BACK UP AREA* – Construction Phase *Construction work has not commenced in this area during the compliance period				
Sl. No.	**Activity**	**Relevant Environmental Components likely to be impacted**	**Proposed Mitigation Measures**	**Status as on 30.09.2017**
			o Topsoil will be kept and reused after excavation is over. o Any surplus to be used on productive agricultural land.	
			o Construction vehicles should operate within the Backup Areas avoiding damage to soil and vegetation.	Will be complied alongside the road and port boundaries
			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.	
			o Tree clearing within the backup areas should be avoided beyond that which is directly required for construction activities and / or to reduce accidents.	Will be complied to the extent possible considering the technical requirements

Annexure VII

DG Set Details

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
D.G Set Details.

Annexure VII

D.G Set Details				
Sl. No.	**P & M Number**	**Working Status**	**Capacity KVA**	**Location**
In Use				
1	G005082/14353	In use	82.5	Test Pile 01
2	D3.9616/1600141	In use	5	At zero point
3	D3.5301/1600135	In use	5	Near approach jetty 2
4	15890	In use	250	DG shed (Fabrication Yard)
5	22655	In use	160	DG shed (Fabrication Yard)
6	4535	In use	125	DG shed (Fabrication Yard)
7	22208	In use	20	Labour Camp
8	22654	In use	160	CP 30 Batching Plant
9	G005082/9125	In use	82.5	Loadout Jetty 02
10	22206	In use	20	Labour Camp
11	N7F250734	In use	62.5	Near B & R site office
12	G00125/10622	In use	125	Loadout Jetty 02
13	16292	In use	82.5	P G 01
14	G005082/10617	In use	82.5	Test Pile 01
15	1720916	In use	125	Near to batching plant
16	1720624	In use	25	Site office
Not In Use				
17	G005040/7836	Not in use	40	Test Pile 01
18	SGL-15/1704X285	Not in use	15	Site office
19	G00 5040/15492	Not in use	40	Test Pile 01
20	G005125/15504	Not in use	125	Fabrication Yard
21	G005082/4462	Not in use	82.5	Loadout Jetty 02
22	5637	Not in use	40	Loadout Jetty 02
23	G17I30803	Not in use	62.5	Fabrication Yard

Annexure VIII

Environmental Management Plan Budgetary Provision

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017
Vizhinjam International Deepwater Multipurpose Seaport Environmental Management Plan Budgetary Provision		

Annexure VIII

	Environmental Management Plan	Commitment in EIA (in Crores)
1	Cost of Contractors EMP for all planned EMP implementation measures (Action plan report)	1.00
4	Cost of Capacity building- Training and Institutional strengthening (Training workshop)	0.20
5	Compensatory afforestation for the green cover lost for the port and its associated facilities (2500 plants per Ha for 25 Ha area)	1.25
6	Air quality monitoring at sensitive locations	0.252
7	Water quality monitoring at major water bodies	0.054
8	Noise monitoring at sensitive locations	0.009
9	Soil quality monitoring at sensitive locations	0.002
10	Marine water quality and sediment and marine biology	1.08
11	Shoreline changes	0.30
14	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
15	Solid waste management (sector wise)-Collection disposal system	2.50
16	Storm water Management	5.00
17	Marine Life Protection out of Oil Spill(Provision for scavenger boat)One tugboat with booms and skimmer and dust exhausting equipment	20.00
18	Cost of scavenger boat including manpower(Cost of boat)	0.20
19	Dust Sweeper (2 nos)	0.60
20	Air Pollution Control (Four water tankers for wetting of road surface and springing system)	1.00
21	Water and waste water treatment plants	4.00
22	Battery of toilets with bimonthly maintenance provision	1.00
23	Desilting and strengthen of Streams	0.50
24	Enhancement of water bodies (ponds along road & rail)	0.10
25	Enhancement of religious structures (Temple)	0.05
26	Cultural property rehabilitation cost for sacred grove	0.01
	TOTAL	**39.937 (Rounded off to 40 Crores)**

adani	**Adani Vizhinjam Port Private Ltd**	**From : April 2017 To : September 2017**
Vizhinjam International Deepwater Multipurpose Seaport Environmental Management Plan Budgetary Provision		

Actual Expenditure:

Activity	Expenditure in Crores (INR)
Shoreline Monitoring	0.73
Turbidity Monitoring	0.18
Air, Noise, Surface Water, Ground Water & Marine Water Monitoring	0.28
Due Diligence & Assessment	0.08
Modelling Studies	0.17
Total	**1.44**

Annexure IX

Organizational Structure-EMP Implementation

Annexure – IX

Environment Health, Safety & CSR Organizational Structure

Name	Designation	Experience	Qualification	Organization
Ajit. S	Chief Project Coordinator & Head (EHS & CSR)	25 Years' experience in EIA studies, Env. monitoring	B Tech (Civil Engg.); M Tech (Env.Engg.)	VISL
Anil Balakrishnan	Head – CSR	19 Years	MSW, Phd.	AVPPL
Y D Manmohan	Environment Specialist	28 Years	PG in Env. Engg.	STUP
Sebastian Britto	Project Officer	20 Years	MA , Economics	AVPPL
Stephen Vinod	Community Mobilizer	12 Years	BA, Economics	AVPPL
George Zen	Community Mobilizer	31 Years	BA, Sociology	AVPPL
Maya Mohan	Community Mobilizer	5 Years	MSW	AVPPL
Hebin C	Head – Environment	11 Years	MS, Oceanography & Coastal area studies.	AVPPL
Harsh Yadav	Deputy Manager –Environment	7 Years	B Tech (Chem. Engg.); M tech in Environment process design	AVPPL
Amrendra Sinha	Head – Safety	17 Years	Diploma in Industrial Safety and Fire Safety	HOWE
Shaji Joseph	Safety Executive	8 Years	Diploma in mechanical & Diploma in fire and safety	HOWE

Annexure X

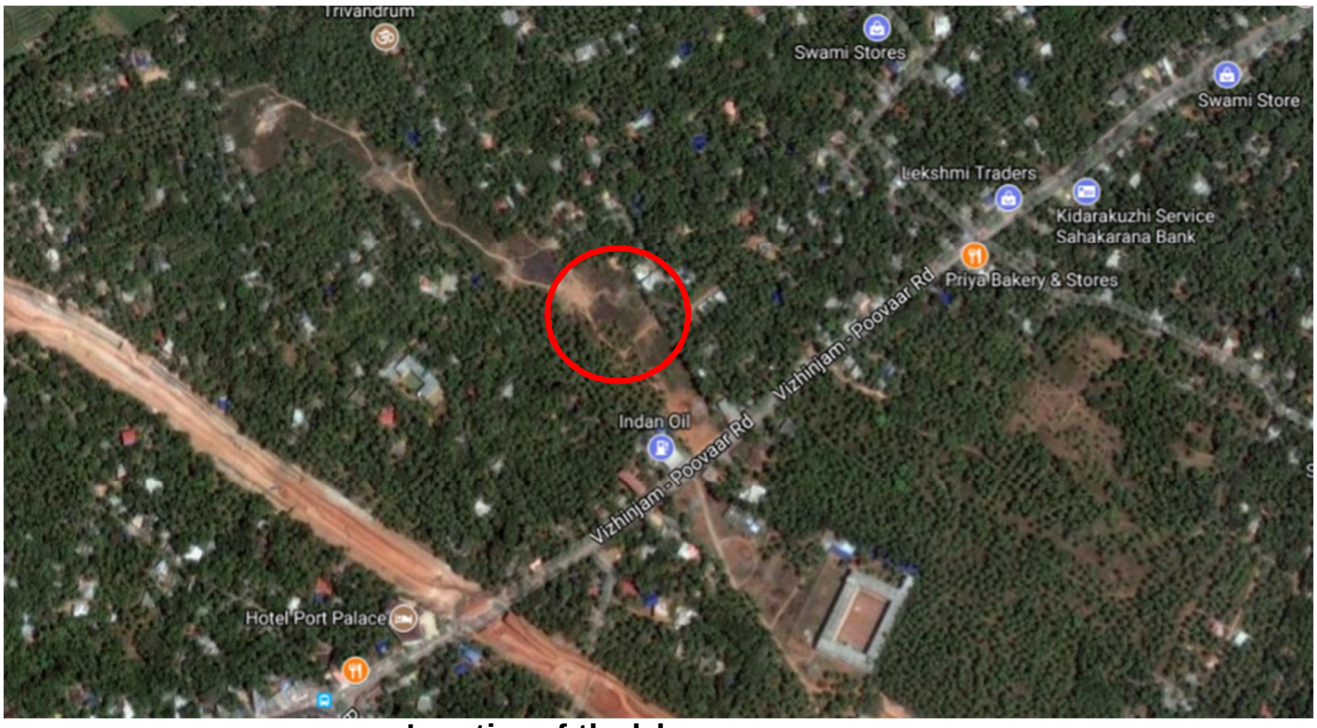
Details of Labour Camp

Annexure X

Details of Labour Camp

Location of the Labour Camp

We have put up accommodation for our workmen amidst the naturally beautiful landscape at Mukkola-Vizhinjam, Kerala. The location of the camp is such that, Mukkola, the nearby small town is situated at walkable distance from the camp. Also, the surrounding greenery presents a comfortable environment to the inhabitants during all weather conditions.



Location of the labour camp

Facilities Inside the Camp

Welfare for the workmen

Workmen are provided with beds and cots. Adequate lighting and ventilation is ensured in each room. Workmen in the colony are provided with potable drinking water. The drinking water tanks are cleaned at frequent intervals and water is tested once in a quarter through authorized laboratory. Individual kitchen is provided for each subcontractor accommodated. Cooking gas provided for our employees in kitchen and a separate dining room is also made available near to the kitchen.

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017
Vizhinjam International Deepwater Multipurpose Seaport Details of Labour Camp.		

Adequate number of toilets, bathing and cloth washing facility is also ensured at the camp.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Inside room</td><td>Drinking water</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Separate kitchens for individual contractors</td><td>Cooking gas provided in the kitchen</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Dining facility</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Toilet and washing facility</td></tr>
</table>

adani	**Adani Vizhinjam Port Private Ltd**	**From : April 2017** **To : September 2017**
Vizhinjam International Deepwater Multipurpose Seaport **Details of Labour Camp.**		

Housekeeping arrangement

Dedicated cleaning staff is deployed for daily housekeeping in the camp. Brooming around the camp premises, collection of waste in colour coded dust bins, daily disposal of collected food waste etc. are ensured during housekeeping. Bleaching powder is sprinkled around the camp premises as and when required. The waste water from kitchen, bathroom and washing facilities are transferred through closed conduits to the soak pit. The septic tank waste is disposed through Govt./ authorized agency at regular intervals.

Health, Safety and Environment Management

Adequate number of **colour coded dust bins** are kept inside the camp premises for collection and segregation of waste. Information posters / signage's are displayed throughout the camp regarding health, hygiene, first aid, safety, environment etc. The posters are displayed in different languages for understanding of workmen from diverse locations. For mosquito control, chemical spraying and fogging is done. Adequate fire extinguishers are provided around the camp, giving due consideration to the kitchen and diesel generator. First aid box is readily available inside the camp. The camp bosses are trained for first aid as well as ensures security and welfare of workmen. In addition, the camp is surrounded by fencing with single entry gate controlled by security guard at all times to prevent entry of intruders and stray animals. Health camp is also organized for the inhabitants periodically.

	
Daily housekeeping by cleaning staff	**Colour coded dust bin inside the camp**

adani	Adani Vizhinjam Port Private Ltd	From : April 2017 To : September 2017

Vizhinjam International Deepwater Multipurpose Seaport
Details of Labour Camp.

	
Health poster inside the camp	**Fogging for mosquitoe control**
	
Fire extinguisher inside the camp	**Camp boss with first aid box in his table**
	
Medical camp on detection and prevention of filaria	**Security guard deployed at the gate**

Gardening inside the Camp

The soil inside the camp premises is naturally rich in nutrients. Gardening and farming is done inside the camp with the help of workmen from initiative of the camp boss. Banana tree, tapioca, chilly, pumpkin etc. are so far planted and growing healthy. The flowering plants grown in between the buildings add beauty to our camp.

Gardening inside the camp

Annexure XI

Environment Monitoring Report

(April 2017 – September 2017)

Annexure XI

SIX MONTHLY ENVIRONMENT MONITORING REPORT

For the period

April 2017 to September 2017

Adani Vizhinjam Port Pvt. Ltd.

Vizhinjam, Kerala

CONTENET

- Introduction
- QA/QC Procedure
- Ambient Air Quality Monitoring
- Noise Level Monitoring
- Marine water & Sediment
    - Marine water Analysis Report
    - Sediment Analysis Report
    - Phytoplankton Analysis from Marine Samples
    - Zooplankton Analysis from Marine Samples
- Groundwater Analysis Report
- Surface water Analysis Report
- Wind rose Diagram

CHAPTER 1

Introduction

Ashwamedh Engineers and Consultants was established in May 1986. The company is engaged in providing Environmental pollution testing, Food and agriculture testing and Consultancy Services. Our affiliates are established all over India and overseas. Ashwamedh has steadily achieved growth up to such an extent that, it has become India's foremost analytical laboratory with several branch offices. The well-equipped laboratory and office set up of about 28000 sq ft is at Nashik, Maharashtra. The strength of our organization is the years of hard work, dedication and contribution made by our staffs who are experts in their respective fields and they produce innovative ideas for the growth of the organization.

Ashwamedh has made itself capable of testing of water, waste water, air, food, noise monitoring, hazardous and non-hazardous waste testing, fuel and agriculture testing. We have a state-of-art Laboratory set-up for Chemical, Mechanical and Microbiological Analysis at Nashik. Our Laboratory is accredited by NABL in accordance with ISO/IEC 17025:2005 in the Chemical, Biological and Mechanical Testing fields (Certificate numbers: T-5509). Our Laboratory is recognized by the Ministry of Environment, Forests & Climate Change, Govt. of India, New Delhi under Environment (Protection) Act, 1986. We are also ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007 certified organization.

Laboratory is recognized by Bureau of Indian Standard for Packaged Drinking Water and Packaged Natural Mineral Water also recognised by APEDA. Our laboratory is approved by Food Safety & Standards Authority of India (FSSAI) for food testing also approved by AGMARK and State Agriculture Department.

Ashwamedh Engineers and Consultants (AEC) engaged by Adani Vizhinjam Port Pvt. Ltd. (AVPPL) for the Post EIA Environmental Monitoring as per Environmental Monitoring Plan mentioned in EIA and EC. AVPPL issued service order no. 5700182233 dated: 31.05.2016. Which is mentioned the matrix, parameters and frequency of environmental monitoring. AEC carried out said environmental monitoring strictly as per above mention service order. As per service order

Ambient Air Monitoring (twice in a week), Ambient Noise Monitoring (fortnight), 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 consolidated report of Environmental Monitoring which includes details of sampling locations, methodology used, analytical results and summary of reports. The monthly environmental monitoring report serves the information about the present environmental status as per terms and condition mentioned in service order.

CHAPTER 2

Quality Assurance /Quality Control Procedure

The quality assurance and quality control plan includes following elements:

1. Sample collection, preservation and transportation of sample
2. Chain of custody
3. Laboratory Analysis
4. Data evaluation and validation

1. Sample collection, preservation and transportation of sample:

The Team leader ensures that selected members of the study team meet all the selection criteria identified. Prior to the starting of the study, individual team members were put to test in the laboratory for their competency in carrying out typical environmental sampling/monitoring for different parameters as per the requirements of the project.

The team leader has ensured that the selected procedures are documented and the study team members are familiar with the sampling and analytical procedures. Before commencement of work, the team leader has checked for availability of all the items required for sampling at site and in the laboratory. In case of any missing items, suitable alternate arrangements have been made and required materials were procured.

Precautions are taken to protect the samples, the material being sampled, the sampling instruments and containers for samples from contamination. Samples are sufficient in volume and frequency is decided based on scope of work. Samples are collected, packed and transported prior to analysis in a manner that safeguards against change in the particular constituents or properties to be examined.

For the collection of samples appropriate containers are used with respective sample matrix and parameters analysed as per the method reference.

Labelling of samples is done at site only and it includes the name of location, date of sample collection. Sampling sheet is filled at site with required information. The sample is sent along with the sampling sheet to laboratory for further analysis.
For the preservation of sample appropriate preservation techniques w.r.t. parameters analysed is followed and samples are transported with due care to laboratory.

2. Chain of Custody:

After receiving the samples in the laboratory, first Assigning Sample ID is a very systematic and methodical way of representing samples identification as Sample ID is a Permanent Identification Number of a sample and it maintains traceability and transparency throughout the process.

It is the format for communication between Sample Receipt Department and the Laboratory. Laboratory also communicates to the Sample Receipt Department. It gives all details of sample except its company name. It includes parameters to be analysed, method reference for each parameter analysed, units in which the analytical results to be expressed, results of each parameter analysed, date at which the analysis was started and date at which the analysis got completed.

After completion of analysis, analytical values duly filled in by respective analyst with the help of test data in respective report format. This draft report is verified and approved by Technical Manager. Final reports are prepared and authorised by Technical Manager and sent to client.

3. Laboratory Analysis:

As per the scope of work, all physiochemical and biological analysis carried out at our permanent facility at Nashik, Maharashtra. For the sampling and analysis of samples standard reference methods are used.

4. Data evaluation and validation:

For the quality control and validation laboratory follow the following procedures:

1. Participation in Inter-laboratory Comparison (ILC) with NABL accredited laboratories.
2. The results obtained from all laboratories are recorded and reviewed for performance by Quality Manager and acceptance criteria is satisfactory ≤ 2.
3. The laboratory also participates in Proficiency testing (PT) programmes conducted by NABL/CPCB/other Proficiency testing (PT) providers depending on the availability of the programme.
4. The results received from nodal laboratory are recorded and reviewed for performance.
5. Replicate testing is done on received samples in a planned manner as per schedule. Replicate testing is done by same/different analysts or using same/different methods.
6. Reviewing the results of replicate testing for performance evaluation is done by Quality Manager.
7. Acceptance criteria in case of replicate/duplicate testing is </20 % relative standard deviation.
8. Testing of retained samples is carried out, by allotting a new sample ID and sending it to laboratory for retesting done by same/different analyst or using same/different methods.
9. Reviewing the results of retesting for performance evaluation is done by Quality Manager.
10. Acceptance criteria in case of retesting is </20 % relative standard deviation.
11. Correlation of results for different characteristics like TDS/EC ratio. Anion/cation balance, COD/BOD correlation is carried out.
12. The quality control data is analysed and where they are found to be outside predefined criteria, planned action is taken to correct the problem and to prevent incorrect results from being reported.

Table 2.1 Check list format for sampling

Item	Yes or No	If No, reason and Justification for acceptance
Was the sampling point correctly located?	Yes	
Permanent facility available?	Yes	

Item	Yes or No	If No, reason and Justification for acceptance
Was the correct sample used?	Yes	
Were the proper types of sample containers used?	Yes	
Were the replicates or multiple samples taken as required?	Yes	
Were adequate quantities of samples taken?	Yes	
Were the sample containers properly labelled?	Yes	
Were the preservatives added and sample containers sealed as required?	Yes	
Were the sealed sample containers maintained at required storage condition?	Yes	
Checked by: Team In-charge		

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

Table 2.2 Check list for sample Integrity

Item	Yes or No	If No, reason and Justification for acceptance
Is the chain of custody record attached?	Yes	
Is the chain of custody record filled in properly	Yes	
Is the sample received within the holding time?	Yes	
Is the sample seal on sample containers intact?	Yes	
Is the sample received in proper storage condition?	Yes	
Is the sample quantity adequate for required analysis?	Yes	
Checked By: Team In - charge		

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

Table 2.3 Check list format for analysis

Item	Yes or No	If No, reason and Justification for acceptance
Was the correct method used for the analysis?	Yes	
Were the correct instruments, equipment and apparatus used for the analysis?	Yes	
Was the competence of the analyst deployed for the analysis verified?	Yes	
Were the instruments, equipment and apparatus used pre calibrated as required?	Yes	
Was the sample correctly and adequately identified and described in the analysis logbook?	Yes	
Were all the raw data properly recorded?	Yes	
Were the correct equations and units used?	Yes	
Checked By: Lab Manager		

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

Table 2.4 Check list format for quality check in the field

Parameters	Comments (Yes/No)	Remarks
Sample bottle labelled?	Yes	
Sample container rinsed with D.D. water?	Yes	
Field equipment blanks are identified	Yes	
Is the preservative has been added after sampling or preserved as per sampling/ Test method?	Yes	
Are proper storage conditions are maintained?	Yes	
The sample quantity is adequate?	Yes	
Is sample properly identified?	Yes	
Is proper type of container used?	Yes	
Checked By: Lab Manager		

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

Table 2.5 Check list format for quality check in the lab

Parameters	Comments (Yes/No)	Remarks
Is the sample details entered into Raw data register?	Yes	
Sample quantity measured?	Yes	
Glassware is calibrated?	Yes	
Balance/equipment is calibrated?	Yes	
Data entered in the analyst work book or not?	Yes	

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

CHAPTER 3

Ambient Air Quality Monitoring

1. Ambient Air Quality Monitoring location details:

This chapter describes the sampling location, methodology adopted for monitoring ambient air quality and analysis of Ambient Air Quality results. The prime objective of the environment monitoring with respect to ambient air quality is to establish the present air quality and its conformity to ambient air quality standards. Ambient Air quality monitoring was carried out at five locations including Venganoor, Proposed Port Estate Area, Port Site, Chani and Balaramapuram during April 2017 to September 2017.

Table 3.1 Ambient Air Quality Monitoring Locations

Sr. No.	Location	Latitude	Longitude
1.	Venganoor	8^0,23',55.10"N	77^0,00',11.30"E
2.	Proposed Port Estate Area	8^0,22',41.47"N	77^0,01',02.94"E
3.	Port Site	8^0,22',06.03"N	77^0,00',17.03"E
4.	Chani	8^0,20',56.86"N	77^0,03',16.19"E
5.	Balaramapuram	8^0,25',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/m^3	2	CPCB Guidelines, Volume I,36/2012-13, Page no.11 WI/SAP-AA/5/1,Issue no.: 03 Issue date: 01.04.2014 (Gravimetric Method)
2.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	µg/m^3	0.4	CPCB Guidelines, Volume I,36/2012-13, Page no. 15 and Instrument Manufacturer Operating Manual WI/SAP-AA/5/1,Issue no.: 03 Issue date: 01.04.2014 (Gravimetric Method)
3.	Sulphur Dioxide (SO_2)	µg/m^3	4.0	CPCB Guidelines, Volume I, 36/2012-13, Page no.1, WI/SAP-AA/5/2, Issue no.: 03 Issue date: 01.04.2014 (Improved West &

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
				Gaeke Method)
4.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	3.0	CPCB Guidelines, Volume I, 36/2012-13, Page no.7, WI/SAP-AA/5/3, Issue no.: 03 Issue date: 01.04.2014 (Modified Jacob & Hochheiser Sodium Arsenite Method)
5.	Carbon Monoxide (CO)	mg/m^3	0.5	By portable CO meter
6.	Hydrocarbon (HC)	ppm	1.0	By portable HC meter

3. National Ambient Air Quality Standards:

Table 3.3 National Ambient Air Quality Standards Dated 16th November 2009

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

4. Ambient Air Quality Monitoring Results for the period April 2017 to September 2017:

Table 3.4 Location: Venganoor

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
03.04.2017	61	15	4.02	6.14	BDL	BDL
06.04.2017	65	17	4.59	3.72	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
10.04.2017	58	13	4.22	3.42	BDL	BDL
13.04.2017	50	13	4.41	3.07	BDL	BDL
17.04.2017	68	19	5.97	3.89	BDL	BDL
20.04.2017	80	30	4.98	5.12	BDL	BDL
24.04.2017	64	16	5.78	5.34	BDL	BDL
27.04.2017	55	15	5.75	3.42	BDL	BDL
01.05.2017	45	14	5.74	6.08	BDL	BDL
04.05.2017	94	25	4.65	5.06	BDL	BDL
08.05.2017	58	16	4.41	5.04	BDL	BDL
11.05.2017	61	18	5.1	4.67	BDL	BDL
15.05.2017	56	13	4.12	5.19	BDL	BDL
18.05.2017	76	21	4.58	4.65	BDL	BDL
22.05.2017	66	17	5.42	4.05	BDL	BDL
25.05.2017	71	18	4.78	3.24	BDL	BDL
29.05.2017	80	19	6.77	4.3	BDL	BDL
01.06.2017	70	16	6.22	5.54	BDL	BDL
05.06.2017	80	24	4.78	4.05	BDL	BDL
08.06.2017	78	18	5.09	6.88	BDL	BDL
12.06.2017	64	17	5.1	3.24	BDL	BDL
15.06.2017	56	14	4.78	3.64	BDL	BDL
19.06.2017	64	16	5.73	5.26	BDL	BDL
22.06.2017	73	20	4.56	3.89	BDL	BDL
26.06.2017	57	15	4.26	4.83	BDL	BDL
29.06.2017	51	13	4.12	4.58	BDL	BDL
03.07.2017	61	15	4.12	3.24	BDL	BDL
06.07.2017	48	14	BDL	5	BDL	BDL
10.07.2017	57	17	BDL	BDL	BDL	BDL
13.07.2017	50	13	4.28	3.65	BDL	BDL
17.07.2017	66	18	BDL	BDL	BDL	BDL
20.07.2017	49	14	BDL	BDL	BDL	BDL
24.07.2017	55	12	BDL	BDL	BDL	BDL
27.07.2017	50	15	4.1	5.79	BDL	BDL
31.07.2017	69	21	BDL	3.64	BDL	BDL
03.08.2017	52	12	4.24	6.55	BDL	BDL
07.08.2017	60	14	4.72	4.67	BDL	BDL
10.08.2017	61	16	BDL	4.53	BDL	BDL
14.08.2017	75	21	BDL	3.44	BDL	BDL
17.08.2017	80	24	BDL	3.03	BDL	BDL
21.08.2017	71	16	BDL	BDL	BDL	BDL
24.08.2017	76	18	BDL	3.56	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
28.08.2017	74	20	BDL	3.04	BDL	BDL
31.08.2017	44	14	BDL	3.03	BDL	BDL
04.09.2017	51	19	4.4	4.3	BDL	BDL
07.09.2017	54	23	BDL	BDL	BDL	BDL
11.09.2017	48	17	4.1	3.04	BDL	BDL
14.09.2017	50	21	BDL	3.03	BDL	BDL
18.09.2017	57	27	4.53	BDL	BDL	BDL
21.09.2017	63	29	BDL	3.1	BDL	BDL
25.09.2017	45	18	BDL	3.2	BDL	BDL
28.09.2017	49	20	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

Table 3.5 Location: Proposed Port Estate Area

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
03.04.2017	65	18	4.9	6.63	BDL	BDL
06.04.2017	72	20	4.05	3.78	BDL	BDL
10.04.2017	76	22	4.3	3.99	BDL	BDL
13.04.2017	62	15	4.06	3.78	BDL	BDL
17.04.2017	43	12	4.77	3.82	BDL	BDL
20.04.2017	57	14	5.56	3.07	BDL	BDL
24.04.2017	70	19	5.17	3.77	BDL	BDL
27.04.2017	66	17	5.52	4.56	BDL	BDL
01.05.2017	78	23	6.69	6.88	BDL	BDL
04.05.2017	67	18	4.35	5.96	BDL	BDL
08.05.2017	80	32	5.5	5.75	BDL	BDL
11.05.2017	56	14	4.1	4.21	BDL	BDL
15.05.2017	91	28	5.23	4.23	BDL	BDL
18.05.2017	63	16	4.34	4.41	BDL	BDL
22.05.2017	73	20	5.1	3.64	BDL	BDL
25.05.2017	60	19	5.1	3.24	BDL	BDL
29.05.2017	82	26	5.18	3.76	BDL	BDL
01.06.2017	64	15	4.18	3.38	BDL	BDL
05.06.2017	74	20	5.71	3.42	BDL	BDL
08.06.2017	69	15	5.78	4.49	BDL	BDL
12.06.2017	70	20	5.43	3.65	BDL	BDL
15.06.2017	80	21	5.94	4.19	BDL	BDL
19.06.2017	70	18	5.43	3.45	BDL	BDL
22.06.2017	65	15	4.82	4.23	BDL	BDL
26.06.2017	56	11	4.91	4.62	BDL	BDL
29.06.2017	58	14	4.29	3.84	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
03.07.2017	60	18	BDL	4.35	BDL	BDL
06.07.2017	51	17	4.12	4.21	BDL	BDL
10.07.2017	67	19	BDL	5.39	BDL	BDL
13.07.2017	74	18	4.41	4.73	BDL	BDL
17.07.2017	47	12	BDL	4.35	BDL	BDL
20.07.2017	63	14	BDL	4.46	BDL	BDL
24.07.2017	57	16	4.2	4.68	BDL	BDL
27.07.2017	51	13	4.32	5.46	BDL	BDL
31.07.2017	43	11	BDL	4.27	BDL	BDL
03.08.2017	61	16	4.15	4.34	BDL	BDL
07.08.2017	57	14	4.25	5.04	BDL	BDL
10.08.2017	44	10	BDL	3.03	BDL	BDL
14.08.2017	63	18	BDL	BDL	BDL	BDL
17.08.2017	78	20	4.09	5.2	BDL	BDL
21.08.2017	66	15	BDL	3.22	BDL	BDL
24.08.2017	49	13	BDL	BDL	BDL	BDL
28.08.2017	45	12	BDL	3.48	BDL	BDL
31.08.2017	36	10	BDL	3.22	BDL	BDL
04.09.2017	58	21	4.1	4.1	BDL	BDL
07.09.2017	47	17	4.5	3.95	BDL	BDL
11.09.2017	50	19	BDL	3.48	BDL	BDL
14.09.2017	65	25	BDL	BDL	BDL	BDL
18.09.2017	62	32	4.21	3.03	BDL	BDL
21.09.2017	60	23	4.32	3.9	BDL	BDL
25.09.2017	55	20	4.2	3.2	BDL	BDL
28.09.2017	41	16	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

Table 3.6 Location: Port Site

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
03.04.2017	79	22	4.2	5.69	BDL	BDL
06.04.2017	56	16	4.44	3.09	BDL	BDL
10.04.2017	93	32	4.6	5.12	BDL	BDL
13.04.2017	98	50	4.19	3.55	BDL	BDL
17.04.2017	90	42	5	4.12	BDL	BDL
20.04.2017	82	24	6.12	4.36	BDL	BDL
24.04.2017	88	35	5.43	3.79	BDL	BDL
27.04.2017	96	46	5.62	4.82	BDL	BDL
01.05.2017	89	32	5.42	7.28	BDL	BDL
04.05.2017	60	19	4.68	6.38	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
08.05.2017	96	36	5.6	5.42	BDL	BDL
11.05.2017	86	28	5.21	4.48	BDL	BDL
15.05.2017	83	30	6.88	3.89	BDL	BDL
18.05.2017	81	22	4.34	4.41	BDL	BDL
22.05.2017	57	15	4.46	4.85	BDL	BDL
25.05.2017	77	21	4.21	3.39	BDL	BDL
29.05.2017	53	16	4.16	3.26	BDL	BDL
01.06.2017	80	26	5.47	4.09	BDL	BDL
05.06.2017	86	30	4.94	4.19	BDL	BDL
08.06.2017	66	17	5.21	4.14	BDL	BDL
12.06.2017	78	20	4.26	3.64	BDL	BDL
15.06.2017	73	30	4.51	3.69	BDL	BDL
19.06.2017	50	14	5.78	3.67	BDL	BDL
22.06.2017	61	24	4.68	4.22	BDL	BDL
26.06.2017	55	15	4.11	4.68	BDL	BDL
29.06.2017	63	18	4.18	4.49	BDL	BDL
03.07.2017	56	15	BDL	BDL	BDL	BDL
06.07.2017	86	28	4.26	3.8	BDL	BDL
10.07.2017	63	15	BDL	BDL	BDL	BDL
13.07.2017	48	13	4.22	BDL	BDL	BDL
17.07.2017	75	21	BDL	3.52	BDL	BDL
20.07.2017	60	16	BDL	3.74	BDL	BDL
24.07.2017	69	19	4.82	3.62	BDL	BDL
27.07.2017	78	23	5.12	4.53	BDL	BDL
31.07.2017	53	15	BDL	BDL	BDL	BDL
03.08.2017	89	25	4.65	4.47	BDL	BDL
07.08.2017	78	22	4.22	5.64	BDL	BDL
10.08.2017	81	26	5.05	4.53	BDL	BDL
14.08.2017	76	21	BDL	13	BDL	BDL
17.08.2017	57	14	4.21	3.54	BDL	BDL
21.08.2017	53	12	BDL	BDL	BDL	BDL
24.08.2017	69	18	BDL	3.47	BDL	BDL
28.08.2017	66	17	BDL	3.04	BDL	BDL
31.08.2017	70	16	BDL	BDL	BDL	BDL
04.09.2017	66	22	4.4	3.03	BDL	BDL
07.09.2017	69	24	4.12	4.45	BDL	BDL
11.09.2017	63	21	BDL	3.46	BDL	BDL
14.09.2017	80	31	4.22	4.5	BDL	BDL
18.09.2017	58	19	4.7	BDL	BDL	BDL
21.09.2017	82	26	4.31	3.49	BDL	BDL
25.09.2017	87	29	4.21	3.12	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
28.09.2017	53	17	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

Table 3.7 Location: Chani

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
03.04.2017	60	18	4.4	6.4	BDL	BDL
06.04.2017	63	20	4.03	4.1	BDL	BDL
10.04.2017	51	10	4.4	4.63	BDL	BDL
13.04.2017	53	12	4.54	3.51	BDL	BDL
17.04.2017	89	25	5.56	4.44	BDL	BDL
20.04.2017	58	16	5.29	4.18	BDL	BDL
24.04.2017	74	20	5.64	3.46	BDL	BDL
27.04.2017	80	21	5.37	4.44	BDL	BDL
01.05.2017	77	23	4.77	5.66	BDL	BDL
04.05.2017	86	26	3.9	5.79	BDL	BDL
08.05.2017	80	20	5.74	6.08	BDL	BDL
11.05.2017	61	16	4.21	5.12	BDL	BDL
15.05.2017	54	11	4.35	5.53	BDL	BDL
18.05.2017	84	23	4.75	3.02	BDL	BDL
22.05.2017	67	18	5.7	6.4	BDL	BDL
25.05.2017	89	28	6.41	4.05	BDL	BDL
29.05.2017	52	14	4.32	3.38	BDL	BDL
01.06.2017	75	28	4.86	4.12	BDL	BDL
05.06.2017	84	30	5.76	4.88	BDL	BDL
08.06.2017	83	28	4.79	3.25	BDL	BDL
12.06.2017	80	28	4.78	4.85	BDL	BDL
15.06.2017	76	24	4.8	3.25	BDL	BDL
19.06.2017	79	26	5.41	3.23	BDL	BDL
22.06.2017	70	22	4.68	3.67	BDL	BDL
26.06.2017	53	16	4.17	4.82	BDL	BDL
29.06.2017	56	18	4.73	4.31	BDL	BDL
03.07.2017	71	19	BDL	4.42	BDL	BDL
06.07.2017	62	16	4.31	3.7	BDL	BDL
10.07.2017	73	18	4.13	3.61	BDL	BDL
13.07.2017	49	12	BDL	3.53	BDL	BDL
17.07.2017	42	10	BDL	5.72	BDL	BDL
20.07.2017	55	12	4.41	4.45	BDL	BDL
24.07.2017	69	17	4.39	5.12	BDL	BDL
27.07.2017	67	14	4.11	4.51	BDL	BDL
31.07.2017	78	23	BDL	BDL	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
03.08.2017	89	24	4.57	5.23	BDL	BDL
07.08.2017	84	26	4.24	3.47	BDL	BDL
10.08.2017	75	20	4.55	5.42	BDL	BDL
14.08.2017	48	12	4.44	4.09	BDL	BDL
17.08.2017	63	15	BDL	BDL	BDL	BDL
21.08.2017	82	20	BDL	3.57	BDL	BDL
24.08.2017	62	16	BDL	3.9	BDL	BDL
28.08.2017	57	15	BDL	3.04	BDL	BDL
31.08.2017	47	12	BDL	3.47	BDL	BDL
04.09.2017	46	14	4.18	3.89	BDL	BDL
07.09.2017	61	22	4.11	3.9	BDL	BDL
11.09.2017	56	20	4.31	4.07	BDL	BDL
14.09.2017	69	26	BDL	BDL	BDL	BDL
18.09.2017	52	16	4.27	3.07	BDL	BDL
21.09.2017	57	18	BDL	3.35	BDL	BDL
25.09.2017	62	21	4.1	3.1	BDL	BDL
28.09.2017	71	23	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

Table 3.8 Location: Balaramapuram

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
03.04.2017	76	16	6.18	6.23	BDL	BDL
06.04.2017	65	18	4.12	3.14	BDL	BDL
10.04.2017	98	26	4.73	5	BDL	BDL
13.04.2017	78	19	4.47	4.17	BDL	BDL
17.04.2017	95	28	5.54	4.22	BDL	BDL
20.04.2017	75	20	5.16	3.89	BDL	BDL
24.04.2017	85	24	5.18	5.53	BDL	BDL
27.04.2017	91	34	5.81	4.97	BDL	BDL
01.05.2017	91	38	4.78	5.27	BDL	BDL
04.05.2017	72	25	4.73	6.93	BDL	BDL
08.05.2017	80	28	5.14	5.88	BDL	BDL
11.05.2017	67	17	4.36	3.86	BDL	BDL
15.05.2017	78	25	4.13	3.81	BDL	BDL
18.05.2017	86	32	5.47	5.69	BDL	BDL
22.05.2017	98	30	4.79	3.65	BDL	BDL
25.05.2017	80	24	5.62	4.84	BDL	BDL
29.05.2017	96	25	4.87	3.61	BDL	BDL
01.06.2017	91	38	4.78	5.27	BDL	BDL

Date	Parameters					
	PM_{10}	$PM_{2.5}$	SO_2	NO_X	CO	HC
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	ppm
05.06.2017	72	25	4.73	6.93	BDL	BDL
08.06.2017	80	28	5.14	5.88	BDL	BDL
12.06.2017	67	17	4.36	3.86	BDL	BDL
15.06.2017	78	25	4.13	3.81	BDL	BDL
19.06.2017	86	32	5.47	5.69	BDL	BDL
22.06.2017	98	30	4.79	3.65	BDL	BDL
26.06.2017	80	24	5.62	4.84	BDL	BDL
29.06.2017	96	25	4.87	3.61	BDL	BDL
03.07.2017	39	11	BDL	BDL	BDL	BDL
06.07.2017	91	24	5.42	3.85	BDL	BDL
10.07.2017	69	16	BDL	BDL	BDL	BDL
13.07.2017	60	14	4.62	3.61	BDL	BDL
17.07.2017	77	21	BDL	BDL	BDL	BDL
20.07.2017	48	15	BDL	BDL	BDL	BDL
24.07.2017	76	22	4.52	3.29	BDL	BDL
27.07.2017	70	15	4.34	4.78	BDL	BDL
31.07.2017	55	12	4.87	6.48	BDL	BDL
03.08.2017	75	20	4.56	4.04	BDL	BDL
07.08.2017	81	28	5.41	6.04	BDL	BDL
10.08.2017	83	30	4.14	4.72	BDL	BDL
14.08.2017	67	18	BDL	4.25	0.61	BDL
17.08.2017	94	31	4.49	5.76	BDL	BDL
21.08.2017	86	29	BDL	BDL	BDL	BDL
24.08.2017	78	26	BDL	3.23	BDL	BDL
28.08.2017	72	25	BDL	3.78	BDL	BDL
31.08.2017	80	26	BDL	3.47	BDL	BDL
04.09.2017	62	21	4.13	4.71	BDL	BDL
07.09.2017	66	24	4.29	4.4	BDL	BDL
11.09.2017	88	32	4.11	3.2	BDL	BDL
14.09.2017	52	17	BDL	BDL	BDL	BDL
18.09.2017	60	20	4.44	3.47	BDL	BDL
21.09.2017	70	23	BDL	BDL	BDL	BDL
25.09.2017	91	36	4.37	3.22	BDL	BDL
28.09.2017	63	19	BDL	BDL	BDL	BDL
NAAQS 2009	**100**	**60**	**80**	**80**	**4**	-

5. Monthly Average Results of Ambient Air Quality Monitoring

Table 3.9 Monthly Average Results

Parameter	NAAQS 2009	Month	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
Particulate matter (size less than 10µm) or PM10, µg/ m^3	100	Apr-17	62.63	58.50	85.25	66.00	82.88
		May-17	67.44	72.22	75.78	72.22	83.11
		Jun-17	65.89	67.33	68.00	72.89	83.11
		July-17	56.11	57.00	65.33	62.89	65.00
		Aug-17	68.63	57.88	71.13	70.00	79.50
		Sep-17	52.13	54.75	69.75	59.25	69.00
Particulate matter (size less than 2.5µm) or PM $_{2.5}$, µg/ m^3	60	Apr-17	17.3	17.13	33.38	17.75	23.13
		May-17	17.89	21.78	24.33	19.89	27.11
		Jun-17	17.00	16.56	21.56	24.44	27.11
		July-17	15.44	15.33	18.33	15.67	16.67
		Aug-17	17.63	14.75	19.38	18.50	25.88
		Sep-17	21.75	21.63	23.63	20.00	24.00
Sulphur dioxide (SO_2), µg/m^3	80	Apr-17	4.97	4.79	4.95	4.90	5.15
		May-17	5.06	5.07	5.00	4.91	4.88
		Jun-17	4.96	5.17	4.79	4.89	4.88
		July-17	4.17	4.26	4.61	4.27	4.75
		Aug-17	4.48	4.16	4.53	4.45	4.65
		Sep-17	4.34	4.27	4.33	4.19	4.27
Nitrogen Dioxide (NO_2), µg/ m^3	80	Apr-17	4.27	4.18	4.32	4.40	4.64
		May-17	4.70	4.68	4.82	5.00	4.84
		Jun-17	4.66	3.92	4.09	4.04	4.84
		July-17	4.26	4.66	3.84	4.38	4.40
		Aug-17	4.12	4.05	5.38	4.10	4.55
		Sep-17	3.33	3.61	3.68	3.56	3.80
Carbon Monoxide (CO),µg/m^3	4	Apr-17	BDL	BDL	BDL	BDL	BDL
		May-17	BDL	BDL	BDL	BDL	BDL
		Jun-17	BDL	BDL	BDL	BDL	BDL
		July-17	BDL	BDL	BDL	BDL	BDL
		Aug-17	BDL	BDL	BDL	BDL	BDL
		Sep-17	BDL	BDL	BDL	BDL	BDL
Hydrocarbon (HC), ppm	-	Apr-17	BDL	BDL	BDL	BDL	BDL
		May-17	BDL	BDL	BDL	BDL	BDL
		Jun-17	BDL	BDL	BDL	BDL	BDL

Parameter	NAAQS 2009	Month	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
		July-17	BDL	BDL	BDL	BDL	BDL
		Aug-17	BDL	BDL	BDL	BDL	BDL
		Sep-17	BDL	BDL	BDL	BDL	BDL

6. Graphical representation of Results for the period April 2017 to September 2017

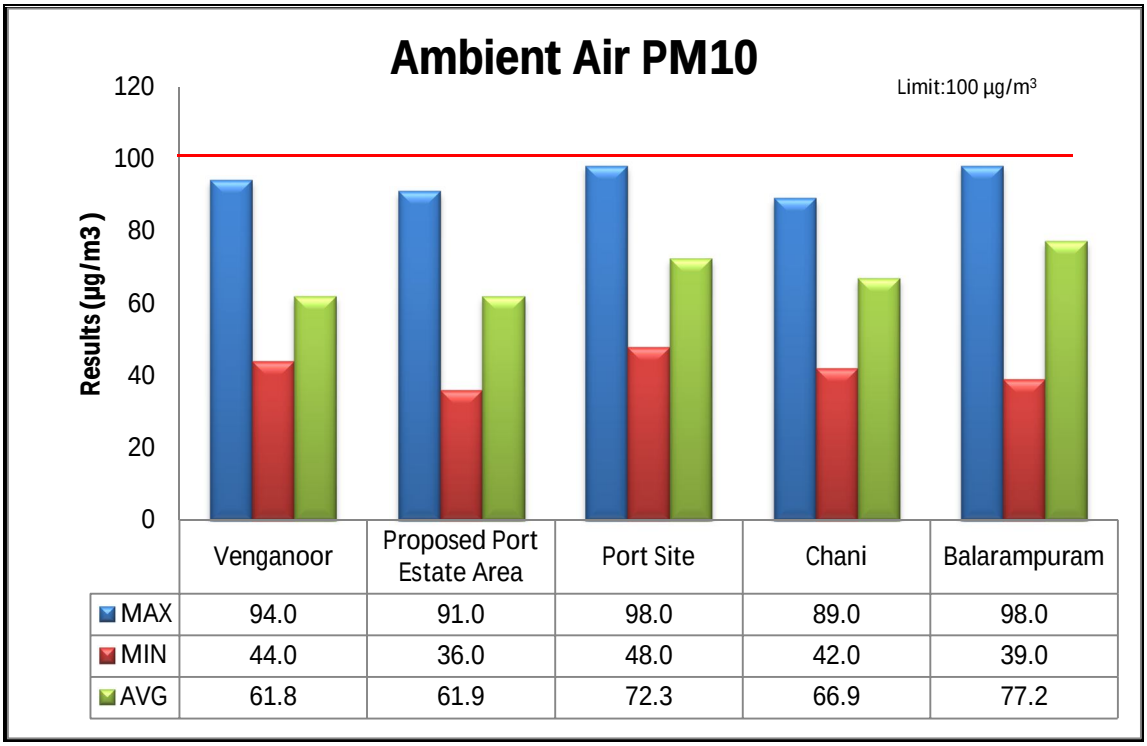
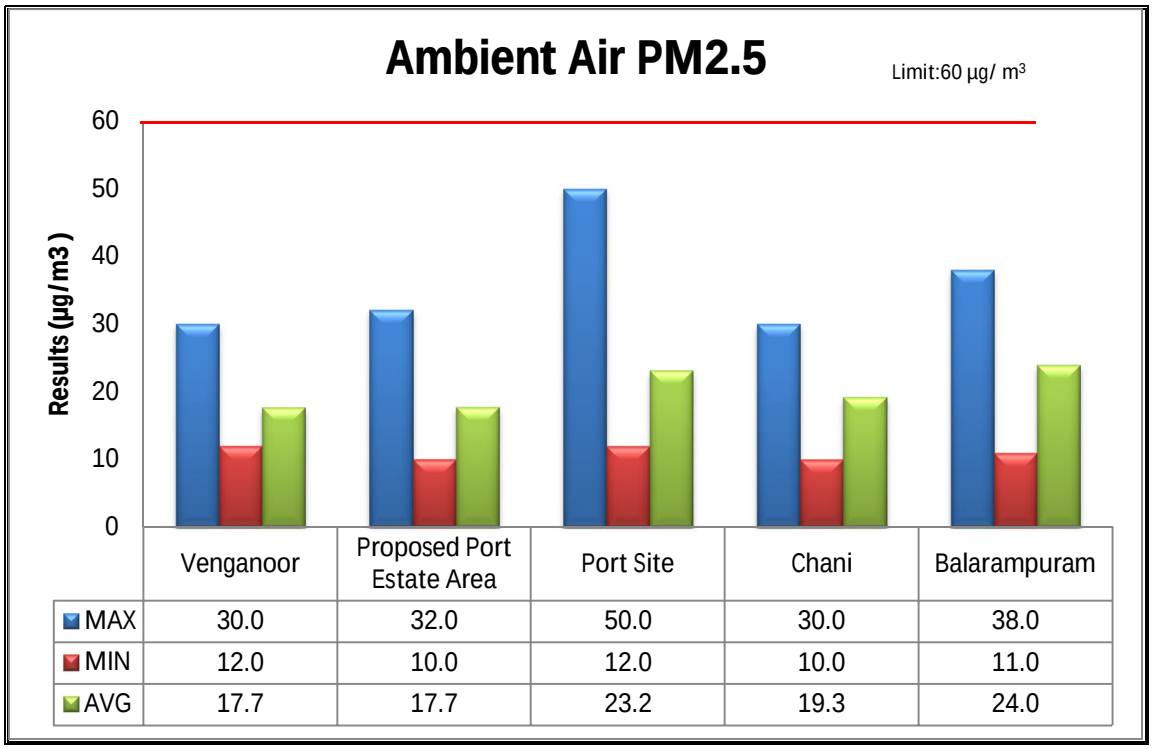
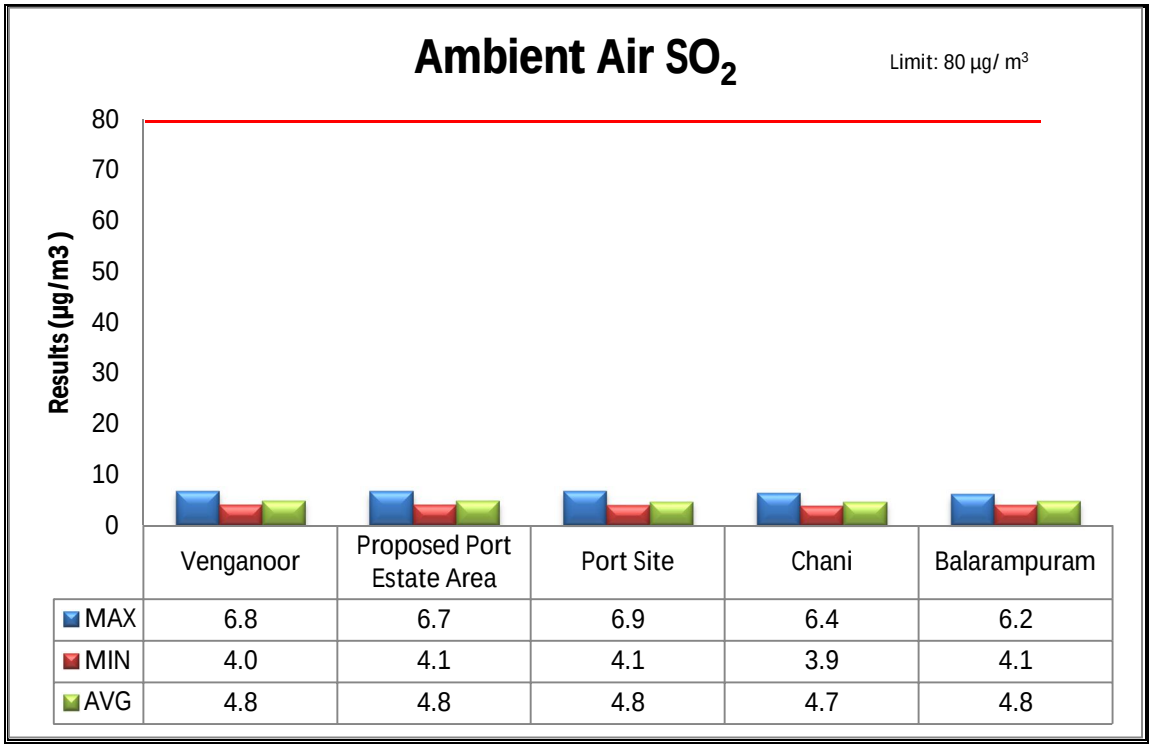


Figure 3.2 Particulate matter (size less than 10µm) (PM_{10})



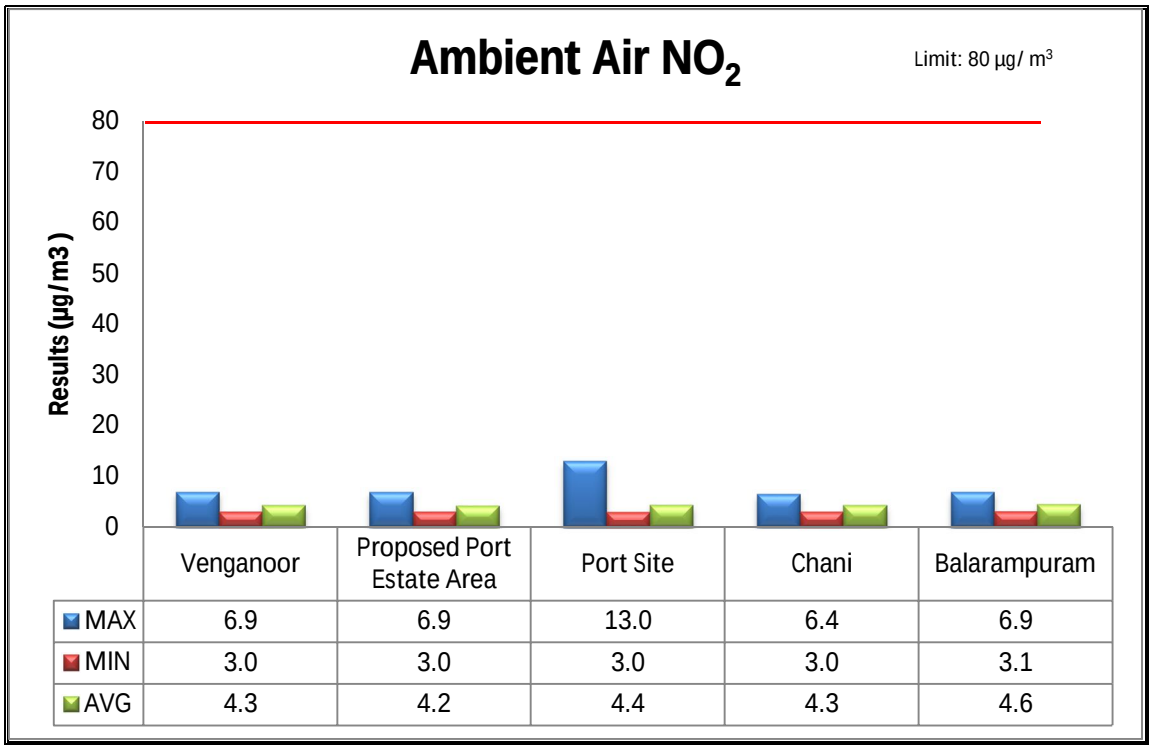
	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
MAX	30.0	32.0	50.0	30.0	38.0
MIN	12.0	10.0	12.0	10.0	11.0
AVG	17.7	17.7	23.2	19.3	24.0

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



	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
MAX	6.8	6.7	6.9	6.4	6.2
MIN	4.0	4.1	4.1	3.9	4.1
AVG	4.8	4.8	4.8	4.7	4.8

Figure 3.4: Sulphur dioxide (SO_2)



	Venganoor	Proposed Port Estate Area	Port Site	Chani	Balarampuram
MAX	6.9	6.9	13.0	6.4	6.9
MIN	3.0	3.0	3.0	3.0	3.1
AVG	4.3	4.2	4.4	4.3	4.6

Figure 3.5 Nitrogen Dioxide (NO_2)

7. Summary - Ambient Air Quality

During the period April 2017 to September 2017, at location- **Venganoor**, the concentration of PM_{10} was observed in the range between 44-94 µg/m^3 with an average of 61.8 µg/m^3, $PM_{2.5}$ was observed in the range between 12-30 µg/m^3 with an average of 17.7 µg/m^3, SO_2 was observed in the range between 4.02-6.77 µg/m^{3}with an average of 4.84 µg/m^3, NO_2 was observed in the range between 3.03-6.88 µg/m^3 with an average of 4.28 µg/m^3, CO and HC were observed below the detection limit for all six months.

At location- **Proposed Port Colony**, concentration of PM_{10} was observed in the range between 36-91 µg/m^3 with an average of 61.9 µg/m^3, $PM_{2.5}$ was observed in the range between 10- 32 µg/m^3 with an average of 17.7 µg/m^3, SO_2 was observed in the range between 4.05-6.69 µg/m^3 with an average of 4.77 µg/m^3, NO_2 was observed in the range between 3.03 - 6.88 µg/m^3 with an average of 4.21 µg/m^3, CO and HC were observed below the detection limit for all six month.

At location- **Port site**, concentration of PM_{10} was observed in the range between 48 - 98 µg/m^3 with an average of 72.3 µg/m^3, $PM_{2.5}$ was observed in the range

between 12-50 µg/m^3 with an average of 23.2 µg/m^3, SO_2 was observed in the range between 4.11-6.88 µg/m^3 with an average of 4.76 µg/m^3, NO_2 was observed in the range between 3.03-13 µg/m^3 with an average of 4.4 µg/m^3, CO and HC were observed below the detection limit for all six months.

At location- **Chani**, concentration of PM_{10} was observed in the range between 42-89 µg/m^3 with an average of 66.9 µg/m^3, $PM_{2.5}$ was observed in the range between 10 - 30 µg/m^3 with an average of 19.3 µg/m^3, SO_2 was observed in the range between 3.9 - 6.41 µg/m^3 with an average of 4.69 µg/m^3, NO_2 was observed in the range between 3.02-6.4 µg/m^3 with an average of 4.28 µg/m^3, CO and HC were observed below the detection limit for all six months.

At location- **Balaramapuram**, concentration of PM_{10} was observed in the range between 39-98 µg/m^3 with an average of 77.2 µg/m^3, $PM_{2.5}$ was observed in the range between 11-38 µg/m^3 with an average of 24 µg/m^3, SO_2 was observed in the range between 4.11 - 6.18 µg/m^3 with an average of 4.82 µg/m^3, NO_2 was observed in the range between 3.14 -6.93 µg/m^3 with an average of 4.56 µg/m^3, CO and HC were observed below the detection limit for all six months.

The obtained results were compared with National Ambient Air Quality Standards, 2009. The results were well within the limit on all monitoring days at all 5 locations.

CHAPTER 4

Ambient Noise Monitoring

1. Ambient Noise Monitoring location details

This chapter describes the sampling location, methodology adopted for monitoring ambient noise and analysis of monitored results. Ambient Noise Monitoring during April 2017 to September 2017 was carried out at Venganoor, Proposed Port Estate Area, Port Site, Chani and Balaramapuram. Classification of locations as per the Noise Pollution (Regulation & Control) Rules, 2000 (Rules 3 (1) and 4(1)) is as below:

Table 4.1 Ambient Noise Monitoring Stations details

Sr. No.	Location	Area Type	Latitude	Longitude
1.	Port Site	Industrial	8^0,22',06.03"N	77^0,00',17.03"E
2.	Balaramapuram	Commercial	8^0,25',37.60"N	77^0,02',43.80"E
3.	Proposed Port Estate Area	Residential	8^0,22',41.47"N	77^0,01',02.94"E
4.	Chani	Residential	8^0,20',56.86"N	77^0,03',16.19"E
5.	Venganoor	Residential	8^0,23',55.10"N	77^0,00',11.30"E

Figure 4.1 Google earth view of Ambient Noise Monitoring Stations

2. Methodology of Sampling

Ambient Noise Monitoring were carried out as per IS 9876: 1981, CPCB Protocol for Ambient Level Noise Monitoring, July 2015 & Manufacturer Manual, WI/S/5/35 & 36,Issue No.3, Issue date 01.09.2016

3. Ambient Noise Standards

As per the Noise Pollution (Regulation & Control) Rules, 2000 (Rules 3 (1) and 4(1))

Table 4.2 Ambient Noise Standard

Area Code	Area Type	Limits in dB (A) Leq	
		Day (6 a.m. to 10 p.m.)	Night (10 p.m. to 6 a.m.)
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45

4. Ambient Noise Monitoring Results for the period April 2017 to September 2017

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-17	06.04.2017	69.6	59.6	52	50	60	53.6
	20.04.2017	68.5	59	50.5	48.5	60.9	53.1
May-17	04.05.2017	65.3	58.6	51.2	49.9	61	55.2
	18.05.2017	63.6	54.9	50.4	48.2	59.3	52.4
Jun-17	08.06.2017	65.3	58.6	50.3	49.3	59.3	53.1
	16.06.2017	65.4	58.7	51.1	49.7	60.9	55.3
Jul-17	06.07.2017	69.4	59.9	50	47.7	59.2	52.8
	20.07.2017	65.9	58.9	50.4	49.7	60.4	55.1
Aug-17	03.08.2017	75.5	72.4	35.6	35.8	51	44.8
	24.08.2017	79.4	72.7	35	35.1	52.2	43.9
Sep-17	07.09.2017	69.4	59.9	50.9	47.7	60.5	53.1
	21.09.2017	65.9	58.9	50.4	49.7	60	55.1
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						**75**	**70**

Table 4.4 Location: Balaramapuram (Commercial)

Month	Date	L_{max} Day time	L_{max} Night time	L_{min} Day time	L_{min} Night time	L_{eq} Day time	L_{eq} Night time
		dB (A)					
Apr-17	10.04.2017	64.2	58.2	50.2	46	58.9	52.6
	24.04.2017	63.1	59.5	50.7	48	59.9	54.1
May-17	08.05.2017	64.2	58.2	51.6	46	59.7	55.2
	22.05.2017	64.8	58.9	50.6	52.3	62	55.4
Jun-17	12.06.2017	66.7	59.5	52.3	50.2	59.5	54.1
	28.06.2017	64.4	58.4	51.4	45.8	59.8	54.8
Jul-17	10.07.2017	66.1	59.6	50.2	6	59.4	54.3
	24.07.2017	65.1	59.6	50.6	51.3	60.1	55.4
Aug-17	07.08.2017	63.9	57.9	52.1	45	59	51.9
	28.08.2017	63.9	58.2	51	44.5	58.3	51.8
Sep-17	11.09.2017	66.1	59.6	50.2	6	59.6	54.3
	25.09.2017	65.1	59.6	50.6	51.3	60.1	55.4
As per the Noise Pollution (Regulation & Control) Rules, 2000 [Rules 3 (1) and 4(1)]						65	55

Table 4.5 Location: Proposed Port Estate Area (Residential)

Month	Date	L_{max} Day time	L_{max} Night time	L_{min} Day time	L_{min} Night time	L_{eq} Day time	L_{eq} Night time
		dB (A)					
Apr-17	07.04.2017	57.9	46.2	49.5	41	53.4	42.6
	21.04.2017	57.5	50.2	49.5	41	53.5	43.1
May-17	05.05.2017	57.9	44.2	48.2	41.2	52.7	42.1
	19.05.2017	58.4	46.9	49.6	41.3	55.2	44.1
Jun-17	09.06.2017	57.9	46.6	5.3	40.2	52.9	42.4
	17.06.2017	58	44.4	48	41	52.9	42.4
Jul-17	07.07.2017	58	46.5	40	40.1	53.2	42.9
	21.07.2017	58.3	46.9	49	38	53.2	42.2
Aug-17	04.08.2017	58.2	47.6	49.5	41.3	55.5	43.5
	25.08.2017	58.9	54.7	50.5	46	55.4	49.8
Sep-17	08.09.2017	58	46.5	40	40.1	53.5	42.8
	22.09.2017	58.3	46.9	49	38	53.2	42.2
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-17	08.04.2017	54.2	45	50.4	41	52.6	42.8
	22.04.2017	55.2	47	46.8	40.6	52.2	42.7
May-17	06.05.2017	54.2	45	50.2	41	52.5	42.8
	20.05.2017	55.6	45.8	42.8	41.6	53.1	43
Jun-17	10.06.2017	56.6	46.6	50.1	41	52.8	42.9
	19.06.2017	54.4	45.2	50	40.8	52.8	42.9
Jul-17	08.07.2017	55.5	44.9	49.4	40	52.5	42.5
	22.07.2017	55.9	45.8	42.8	41.6	52.6	43
Aug-17	05.08.2017	46.9	44.7	41.4	40.2	43.6	42.6
	26.08.2017	56	45.1	50.6	40.5	53.2	43.1
Sep-17	09.09.2017	55.5	44.9	49.4	40	52.5	42.5
	23.09.2017	55.9	45.8	42.8	41.6	52.6	43
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-17	09.04.2017	56.3	46.1	50	41.2	52.5	43.5
	23.04.2017	57	46.9	46.2	41	51.4	43.3
May-17	07.05.2017	55.2	49.9	49.5	42.2	52.6	43.8
	21.05.2017	54.8	49	45.9	42.3	52.6	43.5
Jun-17	11.06.2017	54.9	46.6	49.6	40.1	52.4	42
	24.06.2017	55.3	50	49.4	42	52.3	44.2
Jul-17	09.07.2017	56	46.1	43.8	4	52	42.4
	23.07.2017	58.7	49	45.5	40	52.6	43.8
Aug-17	06.08.2017	54.2	53.2	45.2	43.8	50.2	48.8
	27.08.2017	46.8	44.9	41.8	40.5	44	42.6
Sep-17	10.09.2017	56	47.5	46.3	4	52	42.5
	24.09.2017	58.7	49	45.5	40	52.6	43.8
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	Balaramapuram
		Residential	Residential	Residential	Industrial	Commercial
		Day Time (55) Night Time (45)	Day Time (55) Night Time (45)	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	58.9	56.6	58.7	79.4	66.7
	Min	57.5	46.9	46.8	63.6	63.1
	Avg	58.1	54.7	55.3	68.6	64.8
L_{max} Night time dB (A)	Max	54.7	47.0	53.2	72.7	59.6
	Min	44.2	44.7	44.9	54.9	57.9
	Avg	47.3	45.5	48.2	61.0	58.9
L_{min} Day time dB (A)	Max	50.5	50.6	50.0	52.0	52.3
	Min	5.3	41.4	41.8	35.0	50.2
	Avg	44.0	47.2	46.6	48.2	51.0
L_{min} Night time dB (A)	Max	46.0	41.6	43.8	50.0	52.3
	Min	38.0	40.0	4	35.1	6.0
	Avg	40.8	40.8	35.1	46.8	41.0
Leq Day time dB (A)	Max	55.5	53.2	52.6	61.0	62.0
	Min	52.7	43.6	44	51.0	58.3
	Avg	53.7	51.9	51.4	58.7	59.7
Leq Night time dB (A)	Max	49.8	43.1	48.8	55.3	55.4
	Min	42.1	42.5	42	43.9	51.8
	Avg	43.3	42.8	43.7	52.3	54.1

6. Graphical representation of Results for the period April 2017 to September 2017

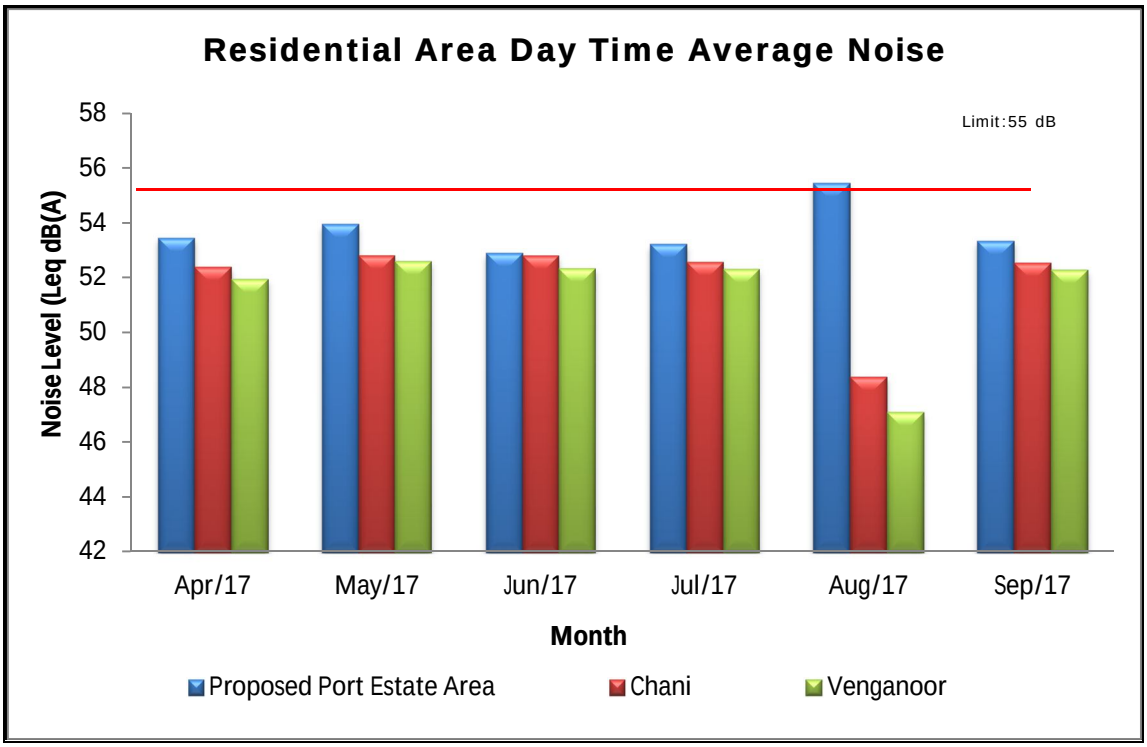


Figure 4.2 Residential Area Noise Level at day time

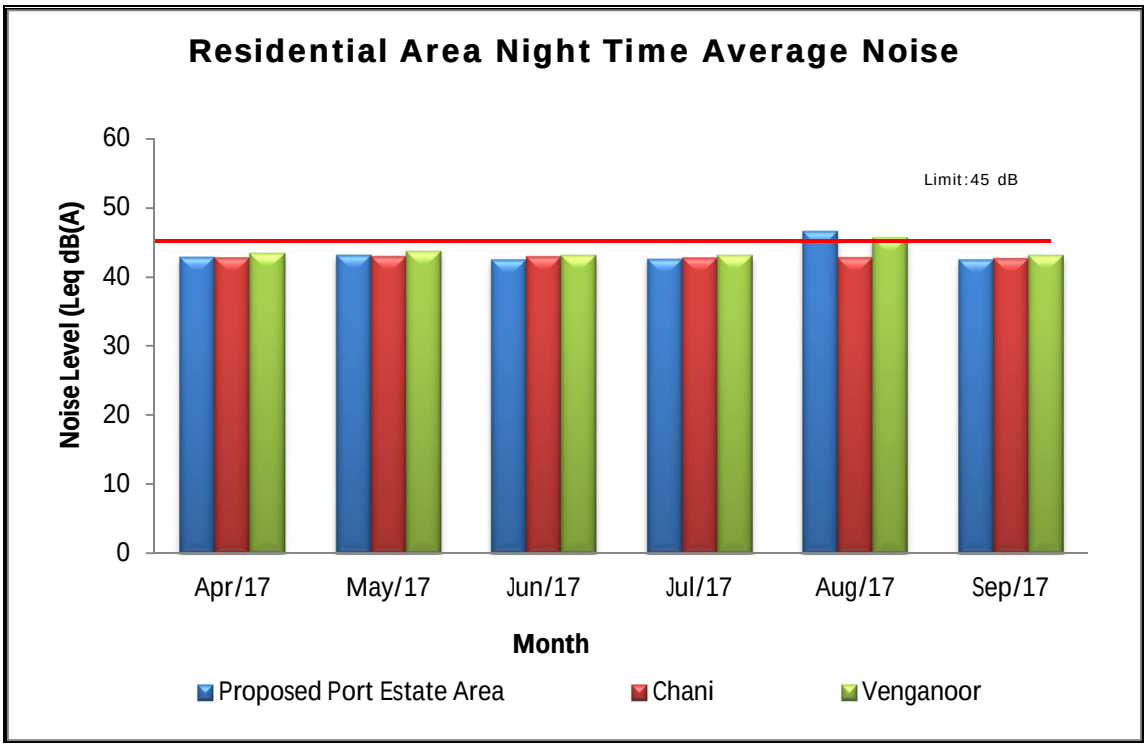


Figure 4.3 Residential Area Noise Level at night time

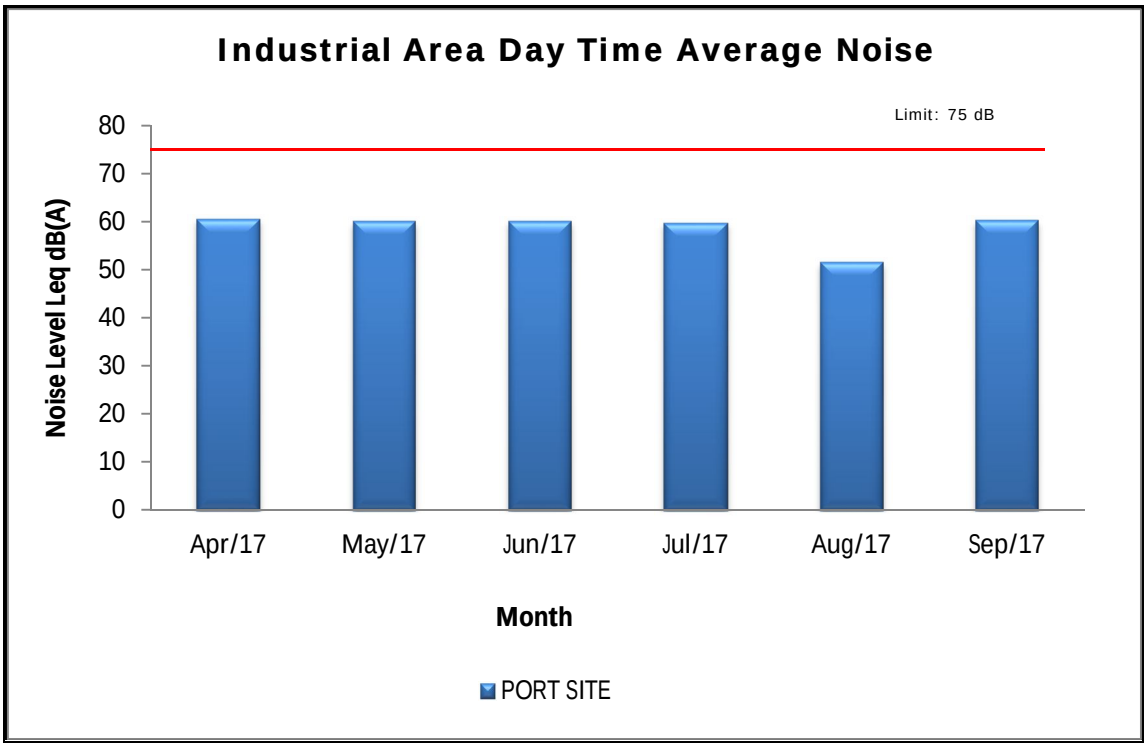


Figure 4.4 Industrial Area Noise Level at day time

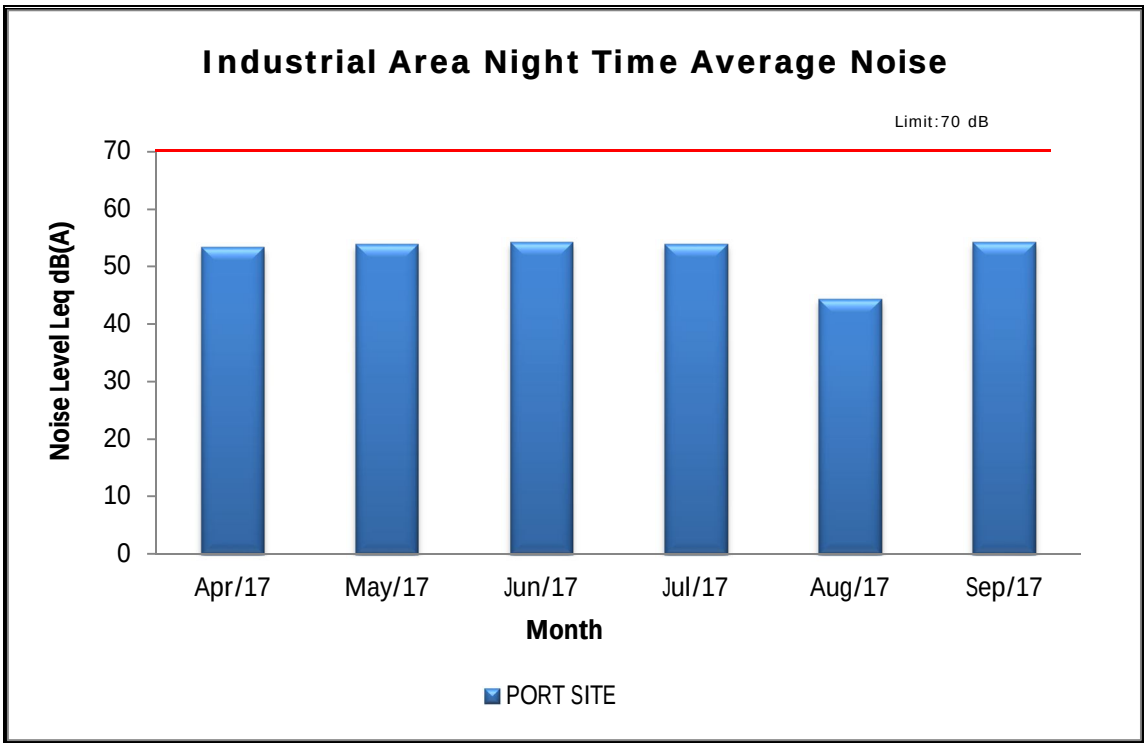


Figure 4.5 Industrial Area Noise Level at night time

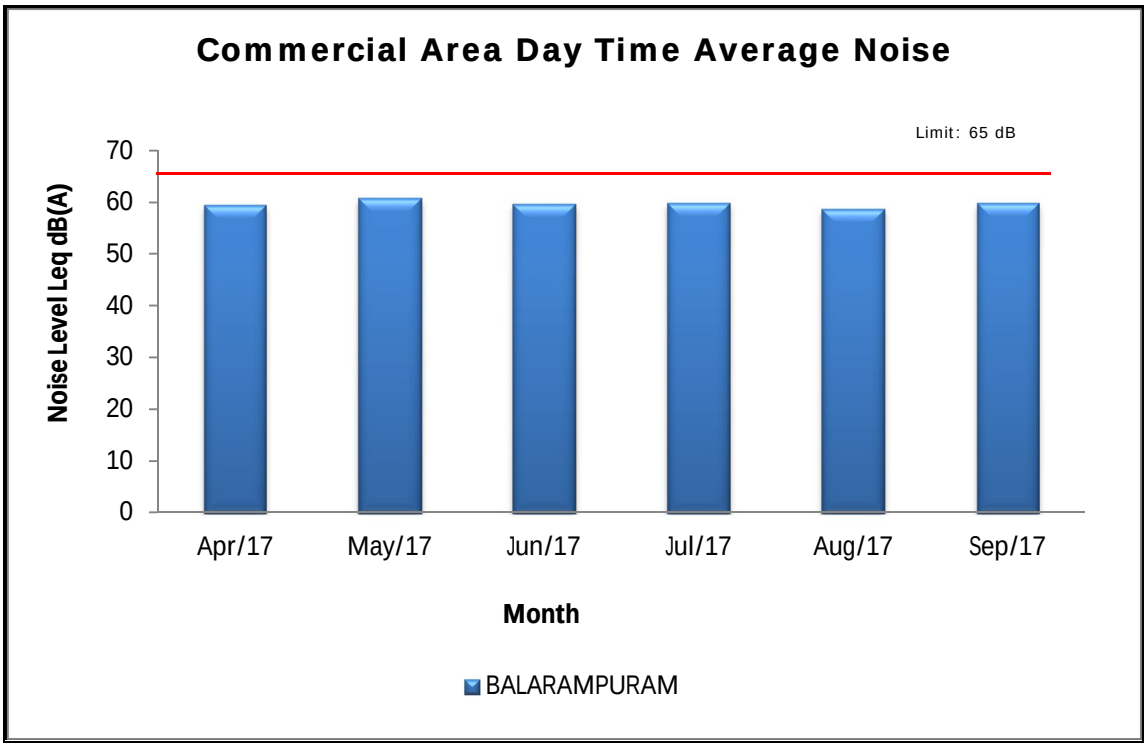


Figure 4.6 Commercial Area Noise Level at day time

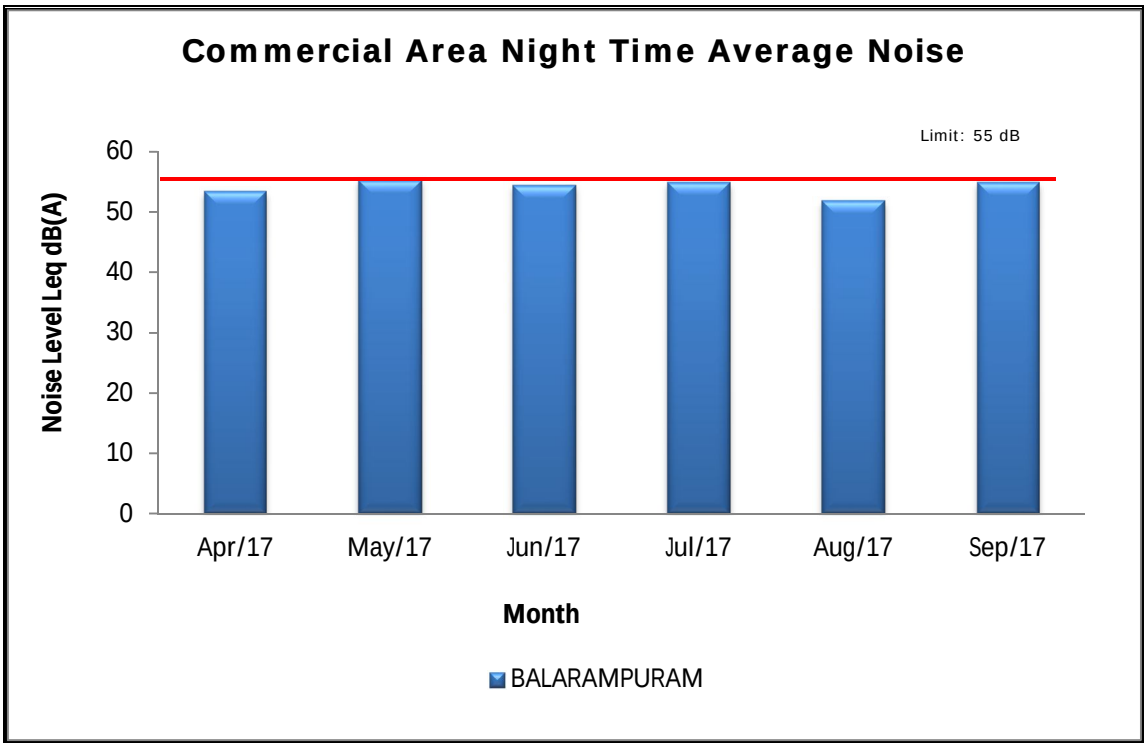


Figure 4.7 Commercial Area Noise Level at night time

7. Summary - Ambient Noise Monitoring

During the period April 2017 to September 2017, Average noise level observed at Residential area i.e. Proposed Port Estate Area, Chani and Venganoor at day time were 53.7 dBA, 51.9 dBA and 51.4 dBA respectively and at night time 43.3 dBA, 42.8 dBA and 43.7 dBA respectively. Noise levels slightly exceeded on few occasion at Venganoor & Proposed Port Estate Area which is far from the port site and may be because of other reason (Vehicular Movement/Other activities)

At industrial area i.e. Port site area average noise level observed at day time 58.7 dBA and at night time 52.3 dBA.

At commercial area i.e. Balaramapuram area average noise level observed at day time 59.7 dBA and at night time 54.1 dBA.

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 also analysis of monitored data for Marine Water and Sediment. Sampling and analysis of marine water at high tide and low tide during April 2017 to September 2017 carried out at different locations such as; Near Kovalam Beach, Proposed Dredge Material Disposal Site, South of Break Water, Port Basin and Inner Approach Channel. Classification of locations as per the Noise Pollution (Regulation & Control) Rules, 2000 (Rules 3 (1) and 4(1)) is as below:

Table 5.1 Marine Water and Sediment sampling locations details

Sr. No.	Location	Latitude	Longitude
1.	Near Kovalam Beach	8^0,22',28.20"N	76^0,58',48.70"E
2.	Proposed Dredge Material Disposal Site	8^0,21',54.40"N	76^0,59',27.90"E
3.	South of Break Water	8^0,22',03.20"N	76^0,59',46.50" E
4.	Port Basin	8^0,22',00.00"N	77^0,00',03.30"E
5.	Inner Approach Channel	8^0,21',05.90"N	77^0,00',40.70"E

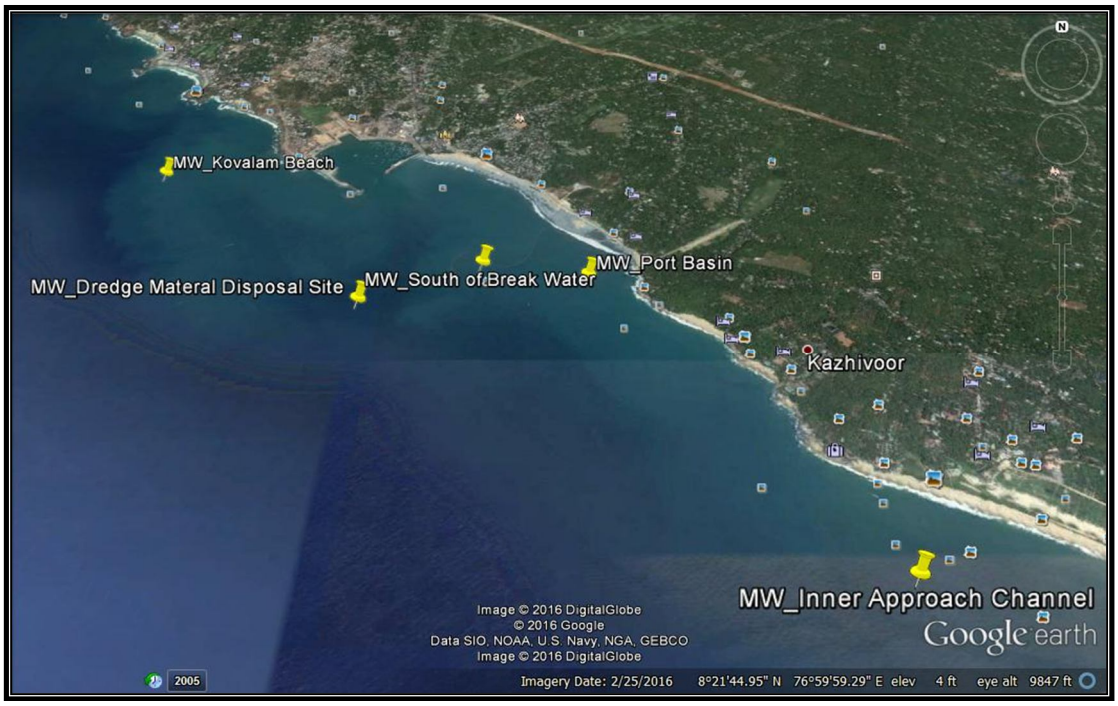


Figure 5.1 Google earth view of Marine Water and Sediment Sampling Locations

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.	pH Value	-	**1**	IS 3025(Part 11):1983, Reaffirmed 2006
2.	Dissolved Oxygen	mg/L	**0.05**	IS 3025 (Part 38): 1989, Reaffirmed 2009
3.	Colour and Odour	**-**	**Qualitative**	-
4.	Floating Materials – Oil, Grease and Scum (Including Petroleum Products)	mg/L	**0.005**	APHA,22 nd Ed.,2012,5520-B, 5-40 Clause 6 of IS: 3025 (Part 39): 1991, Amds.2, Sept 2013
5.	Faecal Coliforms	MPN Index /100ml	**1.8**	APHA, 22nd Ed., 2012,9221-E,9-74
6.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	**1**	IS 3025(Part 44): 1993, Reaffirmed 2009,Amds.1
7.	Phytoplanktons	No./100ml	**ND**	APHA, 22nd Ed., 2012
8.	Zooplanktons	No./100ml	**ND**	Microscopy APHA, 22nd Ed.,
Sediment Analysis				

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
1.	Texture	-	**Qualitative**	WI/SAP-Soil/5/03, WL II, Page No.7
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, 22nd Ed., 2012

Note:
ND: Not Detected

3. Marine Water Analysis Result for the period April 2017 to September 2017

Table 5.4 Marine Water Analysis Results

Sr. No.	Parameter	Limits as per E(P)A Rules, 1986	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel
1	pH	6.5-9.0	Apr-17	High tide	7.8	7.8	7.77	7.75	7.81
				Low tide	7.82	7.76	7.75	7.79	7.77
			May-17	High tide	7.53	7.63	7.59	7.63	7.64
				Low tide	7.54	7.57	7.51	7.6	7.1
			Jun-17	High tide	7.8	7.71	7.68	7.81	7.74
				Low tide	8	7.98	7.95	7.84	7.81
			Jul-17	High tide	7.9	7.81	7.75	7.76	7.92
				Low tide	8.07	8.05	8.06	7.84	7.98
			Aug-17	High tide	7.7	7.76	7.77	7.83	7.9
				Low tide	8.06	7.82	7.82	7.86	7.86
			Sep-17	High tide	7.72	7.7	7.76	7.79	7.77
				Low tide	7.75	7.7	7.47	7.71	7.86
2	Dissolved Oxygen (mg/L)	3.0 mg/L or 40 % saturation value, whichever is higher	Apr-17	High tide	6.2	5.6	6.3	6.5	6.1
				Low tide	5.3	5.1	4.3	5.2	5.4
			May-17	High tide	6.3	6.2	6.8	6.8	7
				Low tide	5.1	4.9	5.1	5.1	5.5
			Jun-17	High tide	6	5.8	6.4	6.2	6.3
				Low tide	5.5	5.2	5.2	5.3	5.5

Sr. No.	Parameter	Limits as per E(P)A Rules, 1986	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel
			Jul-17	High tide	5.9	6.2	6.2	6.4	6.4
				Low tide	5.6	6.1	5.8	6.1	5.8
			Aug-17	High tide	6.1	6.4	6.3	6.5	6.5
				Low tide	5.1	6.2	6.1	6.2	6.1
			Sep-17	High tide	5.8	6.1	6.1	5.9	6.2
				Low tide	5.3	5.9	5.9	5.6	6.1
3	Colour and Odour	No visible colour or offensive odour	**Apr-17**	High tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
				Low tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
			May-17	High tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
				Low tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
			Jun-17	High tide	No visible colour or	No visible colour or offensive	No visible colour or	No visible colour or	No visible colour or offensive

Sr. No.	Parameter	Limits as per E(P)A Rules, 1986	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel
					offensive odour	odour	offensive odour	offensive odour	odour
				Low tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
			Jul-17	High tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
				Low tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
			Aug-17	High tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
				Low tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
			Sep-17	High tide	No visible colour or offensive	No visible colour or offensive odour	No visible colour or offensive	No visible colour or offensive	No visible colour or offensive odour

Sr. No.	Parameter	Limits as per E(P)A Rules, 1986	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel
					odour		odour	odour	
				Low tide	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour	No visible colour or offensive odour
4	Floating Materials (Oil, Grease and Scum) (Including Petroleum Products) (mg/L)	Max. 10	**Apr-17**	High tide	BDL	BDL	BDL	BDL	BDL
				Low tide	BDL	BDL	BDL	BDL	BDL
			May-17	High tide	BD	BD	BD	BD	BD
				Low tide	BD	BD	BD	BD	BD
			Jun-17	High tide	BD	BD	BD	BD	BD
				Low tide	BD	BD	BD	BD	BD
			Jul-17	High tide	BDL	BDL	BDL	BDL	BDL
				Low tide	BDL	BDL	BDL	BDL	BDL
			Aug-17	High tide	BDL	BDL	BDL	BDL	BDL
				Low tide	BDL	BDL	BDL	BDL	BDL
			Sep-17	High tide	BDL	BDL	BDL	BDL	BDL
				Low tide	BDL	BDL	BDL	BDL	<1
5	Faecal Coliforms (/100 ml)	Max. 500	**Apr-17**	High tide	<1.8	<1.8	<1.8	<1.8	<1.8
				Low tide	<1.8	<1.8	<1.8	<1.8	<1.8
			May-17	High tide	<1.8	<1.8	<1.8	<1.8	<1.8
				Low tide	<1.8	<1.8	<1.8	<1.8	<1.8
			Jun-17	High tide	<1.8	<1.8	<1.8	<1.8	<1.8

Sr. No.	Parameter	Limits as per E(P)A Rules, 1986	Month		Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Break Water	Port Basin	Inner Approach Channel
				Low tide	<1.8	<1.8	<1.8	<1.8	<1.8
			Jul-17	High tide	<1.8	<1.8	<1.8	<1.8	<1.8
				Low tide	<1.8	<1.8	<1.8	<1.8	<1.8
			Aug-17	High tide	<1.8	<1.8	<1.8	<1.8	<1.8
				Low tide	<1.8	<1.8	<1.8	<1.8	<1.8
			Sep-17	High tide	<1.8	<1.8	<1.8	<1.8	<1.8
				Low tide	<1.8	<1.8	<1.8	<1.8	<1.8
6	Biochemical Oxygen Demand (3 days, 27°C) (mg/L)	Max. 5	Apr-17	High tide	4.1	9.6	3.6	3.8	7.5
				Low tide	8.8	7.9	12	8.2	11.2
			May-17	High tide	7.5	8	9.7	8.2	7.8
				Low tide	8.7	12.1	12	9.1	10.6
			Jun-17	High tide	4.3	6.3	3.3	2.8	2.2
				Low tide	5.2	10	5.2	4.8	4.6
			Jul-17	High tide	4.2	5.8	5.2	4.8	8.2
				Low tide	4.8	6.2	5.7	7.1	9.1
			Aug-17	High tide	4.1	5.6	4.8	4.5	7.1
				Low tide	4.6	5.7	5.1	5.2	10
			Sep-17	High tide	4.3	5.9	5.1	5.9	7.8
				Low tide	4.7	6.4	5.8	6.3	8.1

4. Graphical representation of Results for the period April 2017 to September 2017

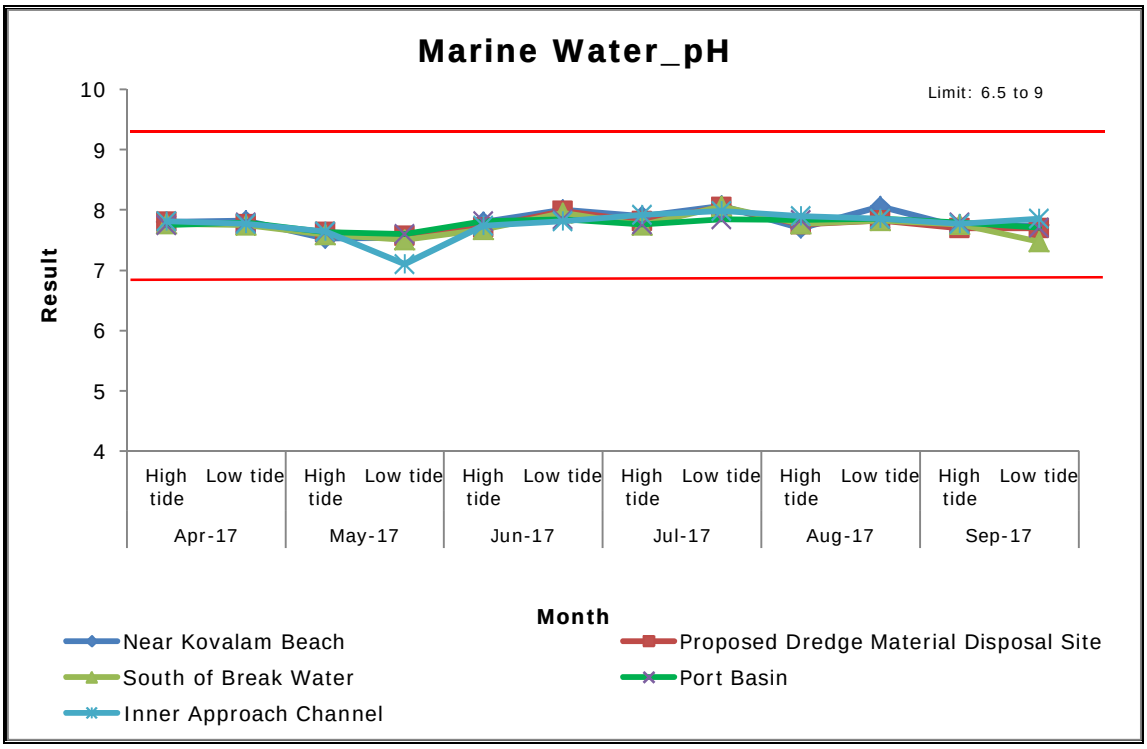


Figure 5.2 Marine Water Analysis for pH

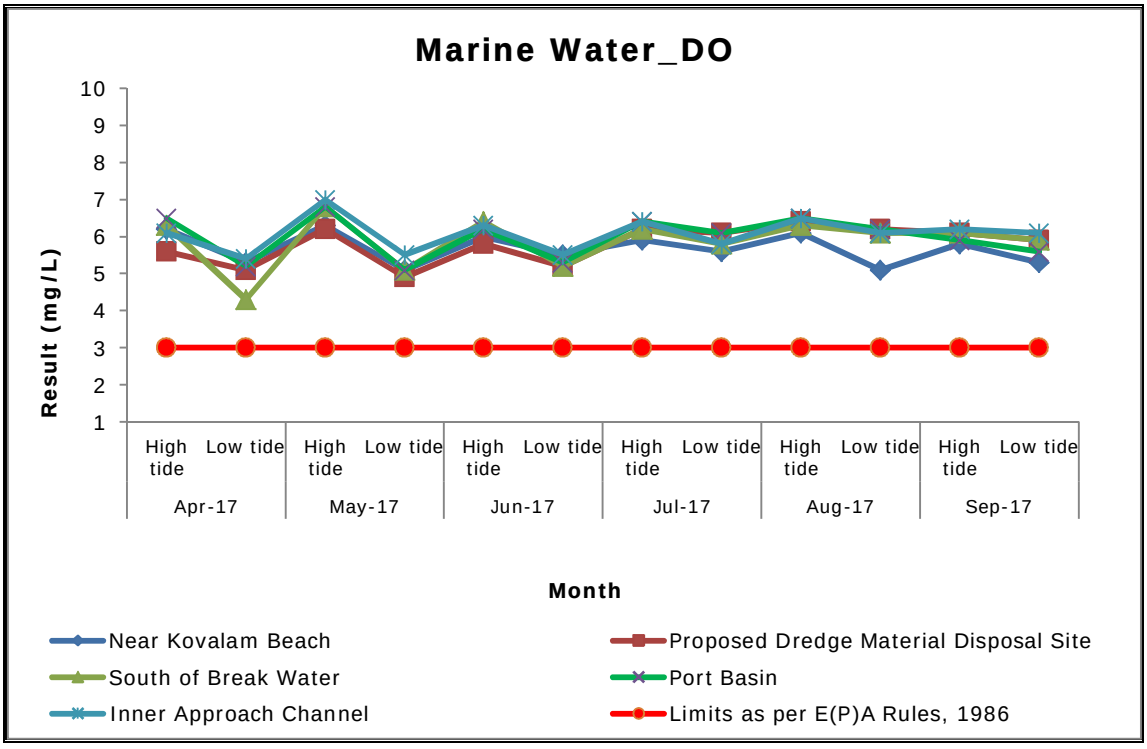


Figure 5.3 Marine Water Analysis for Dissolved Oxygen

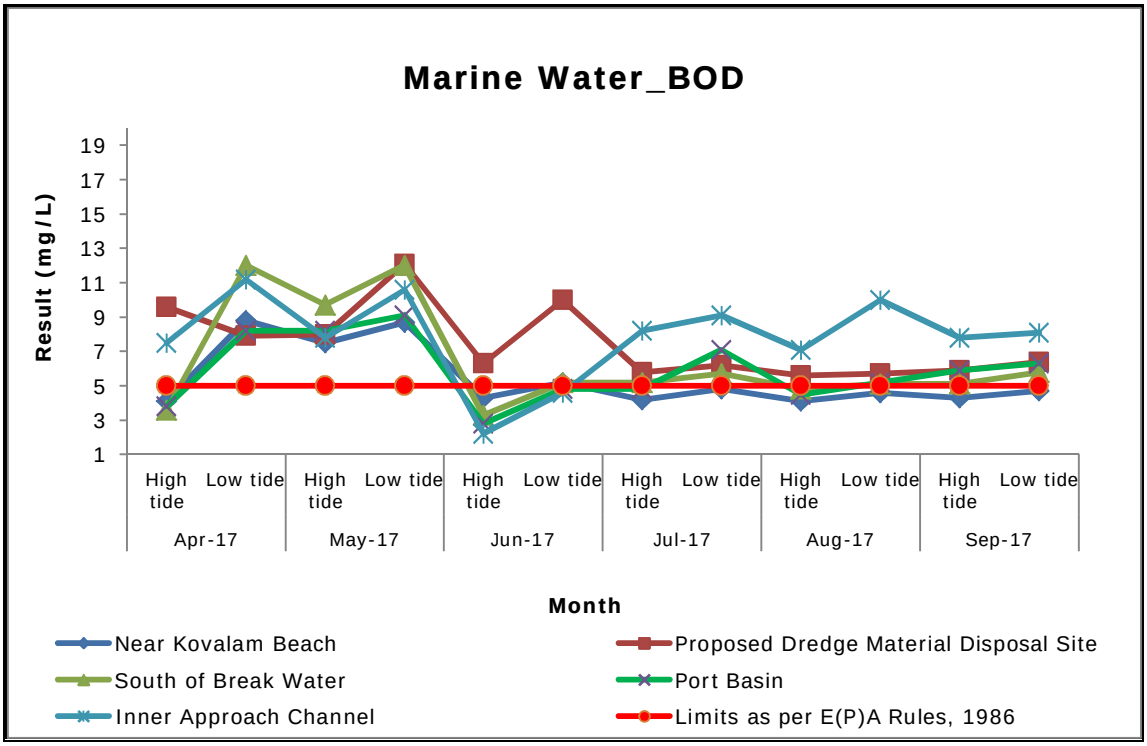


Figure 5.4 Marine Water Analysis for Biochemical Oxygen Demand

5. Summary - Marine water analysis:

During the period April 2017 to September 2017, at location- **Near Kovalam Beach**, at low tide and high tide concentration of pH was observed in the range between 7.53 - 8.07, Dissolved oxygen was observed in the range between 5.10 - 6.30 mg/L, No visible colour or offensive odour observed, Floating material were observed below the detection limit to 38.8. Faecal Coliforms were observed <1.8 /100 ml and Biochemical Oxygen Demand was observed in the range between 4.10 – 8.80 mg/L.

At location- **Proposed Dredge Material Disposal Site**, at low tide and high tide concentration of pH was observed in the range between 7.57 - 8.05, Dissolved oxygen was observed in the range between 4.90 - 6.40 mg/L, No visible colour or offensive odour observed, Floating material were observed below detection limit. Faecal Coliforms were observed <1.8 /100 ml and Biochemical Oxygen Demand was observed in the range between 5.60 – 12.1 mg/L.

At location- **South of Break Water**, at low tide and high tide concentration of pH was observed in the range between 7.47 - 8.06, Dissolved oxygen was observed in the range between 4.30 - 6.80 mg/L, No visible colour or offensive odour observed, Floating material were observed below detection limit. Faecal Coliforms were observed <1.8 /100ml and Biochemical Oxygen Demand was observed in the range between 3.30 – 12 mg/L.

At location- **Port Basin**, at low tide and high tide concentration of pH was observed in the range between 7.60 – 7.86, Dissolved oxygen was observed in the range between 5.10 - 6.80 mg/L, No visible colour or offensive odour observed, Floating material were observed below detection limit. Faecal Coliforms were observed <1.8 /100ml and Biochemical Oxygen Demand was observed in the range between 2.80 - 9.10 mg/L.

At location- **Inner Approach Channel**, at low tide and high tide concentration of pH was observed in the range between 7.10 – 7.98, Dissolved oxygen was observed in the range between 5.40 – 7.00 mg/L, No visible colour or offensive odour observed, Floating material was observed below detection limit. Faecal Coliforms was observed <1.8 /100ml and Biochemical Oxygen Demand was observed in the range between 2.20 – 11.2 mg/L.

6. Sediment Analysis Result

Table 5.5 Near Kovalam Beach

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Texture	-	Clay	Clay	Clay	Clay	Clay	Clay
Organic Matter	%	15.7	49.5	21	14	13.2	10.5
Total Phosphorus (as P)	mg/kg	13.4	5.47	5.44	4	8.83	4.32
Aluminium (as Al)	mg/kg	765	1074	1281	560	859	1469
Chromium (as Cr)	mg/kg	16.5	10	9.75	15.1	4.6	16.8
Copper (as Cu)	mg/kg	1.38	1.45	0.722	0.97	1	0.882
Iron (as Fe)	mg/kg	2611	3219	2309	1996	1646	2945
Lead (as Pb)	mg/kg	4.5	1.98	1.07	2.12	0.386	1.65

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Manganese (as Mn)	mg/kg	6.22	7.51	8.68	6.77	19.2	20.1
Mercury (as Hg)	mg/kg	BDL	BDL	BDL	BDL	0.227	BDL
Zinc (as Zn)	mg/kg	3.74	5.74	5.03	6.36	2.88	5.97
Nickel (as Ni)	mg/kg	0.667	1.84	3.71	1.54	1.06	1.19
Benthic Organism							
Micro Benthic Organism	/m^2	114257	104580	114589	124862	115987	109889
Macro Benthic Organism	/m^2	86452	81451	78459	98452	84572	80154
Total	**/m^2**	**200709**	**186031**	**193048**	**223314**	**200559**	**190043**

Table 5.6 Proposed Dredge Material Disposal Site

Parameter	Unit	Apr-17	May-17	June-17	Jul-17	Aug-17	Sep-17
Texture	-	Clay	Clay	Clay	Clay	Clay	Clay
Organic Matter	%	9.43	6.17	7.07	4.4	9.93	13.4
Total Phosphorus (as P)	mg/kg	13.5	9.9	11	7.87	3.74	9.77
Aluminium (as Al)	mg/kg	3452	5635	3650	857	620	888
Chromium (as Cr)	mg/kg	17.7	18	11.5	23.1	1.18	18.2
Copper (as Cu)	mg/kg	4.76	5.01	0.561	0.848	0.495	0.253
Iron (as Fe)	mg/kg	4128	6048	5849	2669	915	2646
Lead (as Pb)	mg/kg	4.15	4.32	2.59	7.8	0.236	2.4
Manganese (as Mn)	mg/kg	36	48	7.02	8.46	7.11	6.87
Mercury (as Hg)	mg/kg	BDL	BDL	0.074	BDL	0.368	BDL
Zinc (as Zn)	mg/kg	10.6	13.9	2.23	3.51	2.33	3.63
Nickel (as Ni)	mg/kg	5.07	7.71	3.57	1.44	1.18	1.1
Benthic Organism							
Micro Benthic Organism	/m^2	178452	169879	178452	185672	178639	169875
Macro Benthic Organism	/m^2	94511	91489	99401	104582	93852	108452
Total	**/m^2**	**272963**	**261368**	**277853**	**290254**	**272491**	**278327**

Table 5.7 South of Breakwater

Parameter	Unit	Apr-17	May-17	June-17	Jul-17	Aug-17	Sep-17
Texture	-	Clay	Clay	Clay	Clay	Clay	Clay
Organic Matter	%	16.4	32.4	26	18	9.62	10.5
Total Phosphorus (as P)	mg/kg	19.2	3.98	4.6	3.68	3.93	4.56
Aluminium (as Al)	mg/kg	2688	4080	4228	1951	631	667
Chromium (as Cr)	mg/kg	11.5	17.5	9.4	20.8	3.43	16.9
Copper (as Cu)	mg/kg	2.4	4.9	0.39	0.708	0.655	0.693
Iron (as Fe)	mg/kg	3591	5693	3918	2579	1053	2333
Lead (as Pb)	mg/kg	2.08	3.99	1.59	4.85	0.399	2
Manganese (as Mn)	mg/kg	19.8	40	11.7	6.43	8.43	15.7
Mercury (as Hg)	mg/kg	BDL	BDL	0.093	0.115	0.052	BDL
Zinc (as Zn)	mg/kg	6.49	13.3	2.23	7.89	2.16	4.42
Nickel (as Ni)	mg/kg	3.25	7.18	3.38	1.76	1.4	1.2
Benthic Organism							
Micro Benthic Organism	/m^2	32451	31452	33845	34582	33693	32458
Macro Benthic Organism	/m^2	23548	21450	20481	21562	20358	21458
Total	**/m^2**	**55999**	**52902**	**54326**	**56144**	**54051**	**53916**

Table 5.8: Port Basin

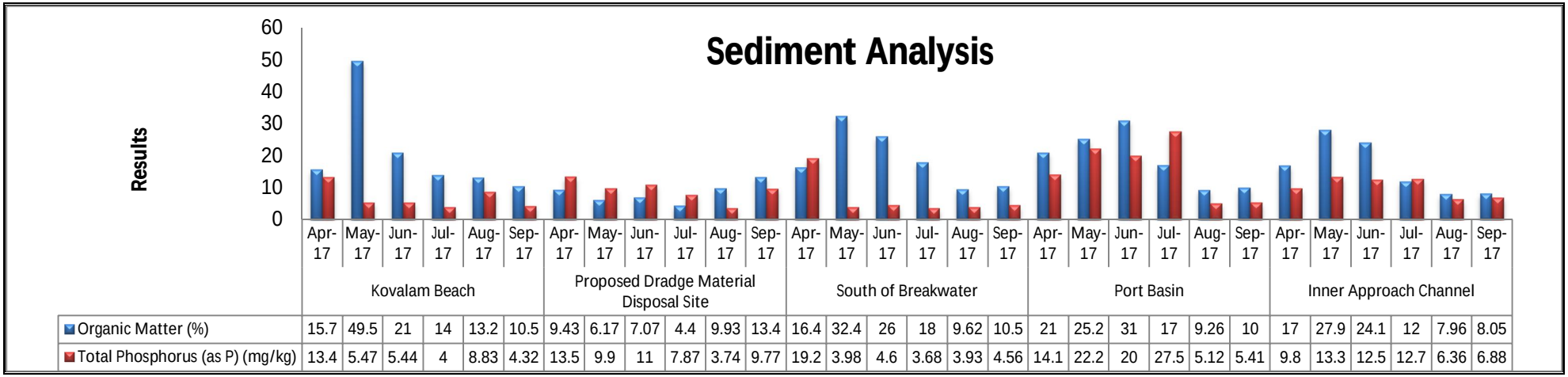
Parameter	Unit	Apr-17	May-17	June-17	Jul-17	Aug-17	Sep-17
Texture	-	Clay	Clay	Clay	Clay	Clay	Clay
Organic Matter	%	21	25.2	31	17	9.26	10
Total Phosphorus (as P)	mg/kg	14.1	22.2	20	27.5	5.12	5.41
Aluminium (as Al)	mg/kg	2458	5375	3246	1245	780	707
Chromium (as Cr)	mg/kg	14.1	17.3	7.53	19.1	2.84	18.3
Copper (as Cu)	mg/kg	3.25	4.71	0.279	0.286	0.868	0.255
Iron (as Fe)	mg/kg	2626	6626	3883	1597	1210	2661
Lead (as Pb)	mg/kg	3.34	4.06	1.39	2.02	0.64	2.41

Parameter	Unit	Apr-17	May-17	June-17	Jul-17	Aug-17	Sep-17
Manganese (as Mn)	mg/kg	15.6	56	2.49	1.7	10.5	6.91
Mercury (as Hg)	mg/kg	0.135	BDL	0.182	BDL	0.451	BDL
Zinc (as Zn)	mg/kg	9.16	12.9	0.888	1.78	3.41	3.65
Nickel (as Ni)	mg/kg	4.26	7.52	2.94	1.15	1.06	1.25
Benthic Organism							
Micro Benthic Organism	/m^2	74521	71452	74482	75468	73465	74865
Macro Benthic Organism	/m^2	71452	70830	69842	70524	69823	68451
Total	**/m^2**	**145973**	**142282**	**144324**	**145992**	**143288**	**143316**

Table 5.9: Inner Approach Channel

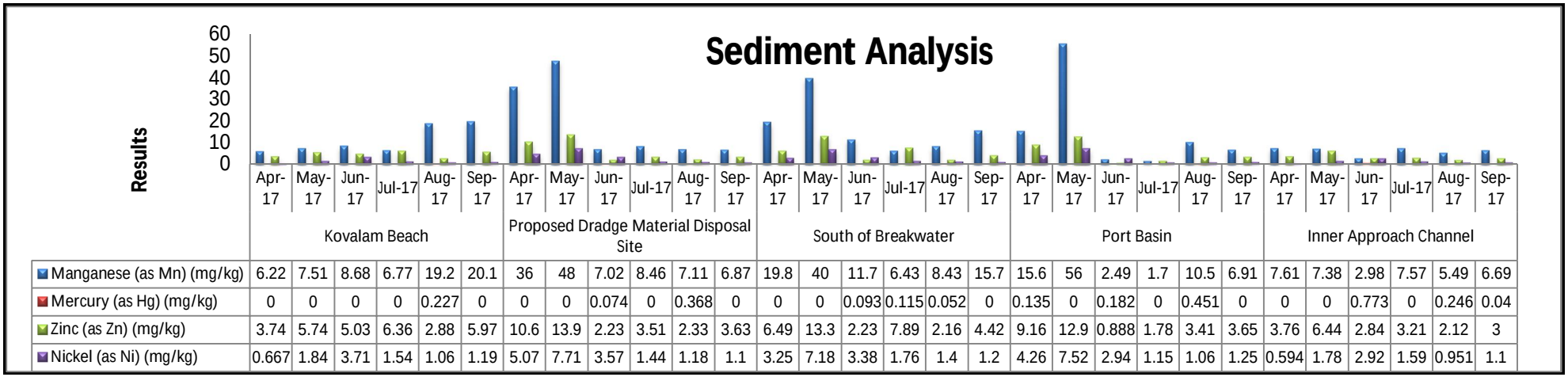
Parameter	Unit	Apr-17	May-17	June-17	Jul-17	Aug-17	Sep-17
Texture	-	Clay	Clay	Clay	Clay	Clay	Clay
Organic Matter	%	17	27.9	24.1	12	7.96	8.05
Total Phosphorus (as P)	mg/kg	9.8	13.3	12.5	12.7	6.36	6.88
Aluminium (as Al)	mg/kg	840	1174	831	612	328	707
Chromium (as Cr)	mg/kg	18.8	10	9.28	27.7	1.25	8.95
Copper (as Cu)	mg/kg	1.83	1.55	0.314	0.99	0.425	0.114
Iron (as Fe)	mg/kg	2762	3248	1177	3261	790	1981
Lead (as Pb)	mg/kg	11.2	2.82	1.99	6.52	0.84	1.33
Manganese (as Mn)	mg/kg	7.61	7.38	2.98	7.57	5.49	6.69
Mercury (as Hg)	mg/kg	BDL	BDL	0.773	BDL	0.246	0.04
Zinc (as Zn)	mg/kg	3.76	6.44	2.84	3.21	2.12	3
Nickel (as Ni)	mg/kg	0.594	1.78	2.92	1.59	0.951	1.1
Benthic Organism							
Micro Benthic Organism	/m^2	33451	31458	34812	35861	33456	32451
Macro Benthic Organism	/m^2	15423	11420	10458	11582	10385	10872
Total	**/m^2**	**48874**	**42878**	**45270**	**47443**	**43841**	**43323**

7. Graphical representation of Results for the period April 2017 to September 2017



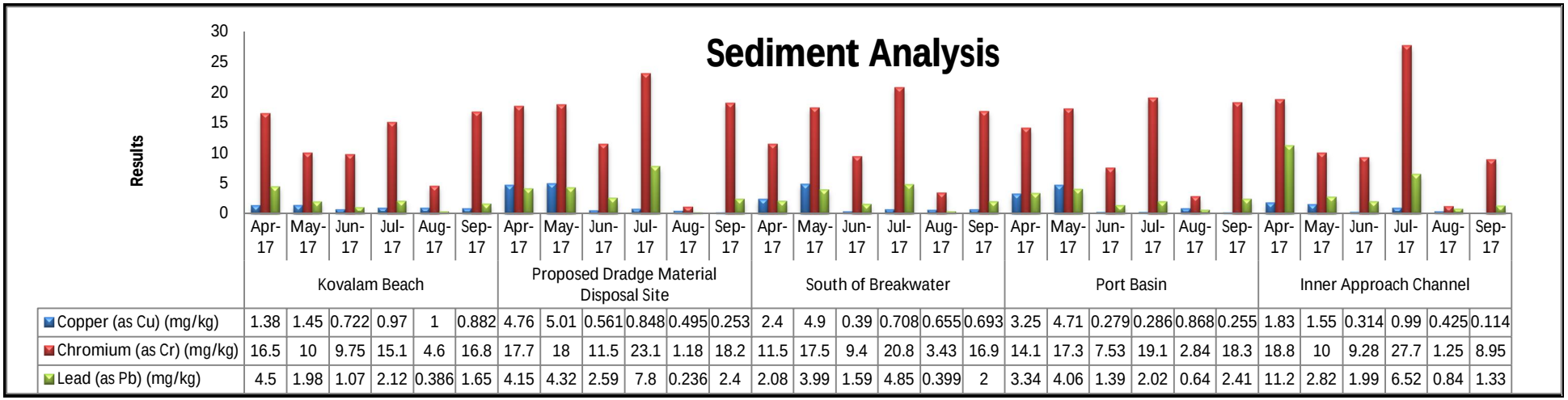
	Kovalam Beach						Proposed Dradge Material Disposal Site						South of Breakwater						Port Basin						Inner Approach Channel					
	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Organic Matter (%)	15.7	49.5	21	14	13.2	10.5	9.43	6.17	7.07	4.4	9.93	13.4	16.4	32.4	26	18	9.62	10.5	21	25.2	31	17	9.26	10	17	27.9	24.1	12	7.96	8.05
Total Phosphorus (as P) (mg/kg)	13.4	5.47	5.44	4	8.83	4.32	13.5	9.9	11	7.87	3.74	9.77	19.2	3.98	4.6	3.68	3.93	4.56	14.1	22.2	20	27.5	5.12	5.41	9.8	13.3	12.5	12.7	6.36	6.88

Figure 5.5 Sediment analysis for Organic Matter and Total Phosphorus



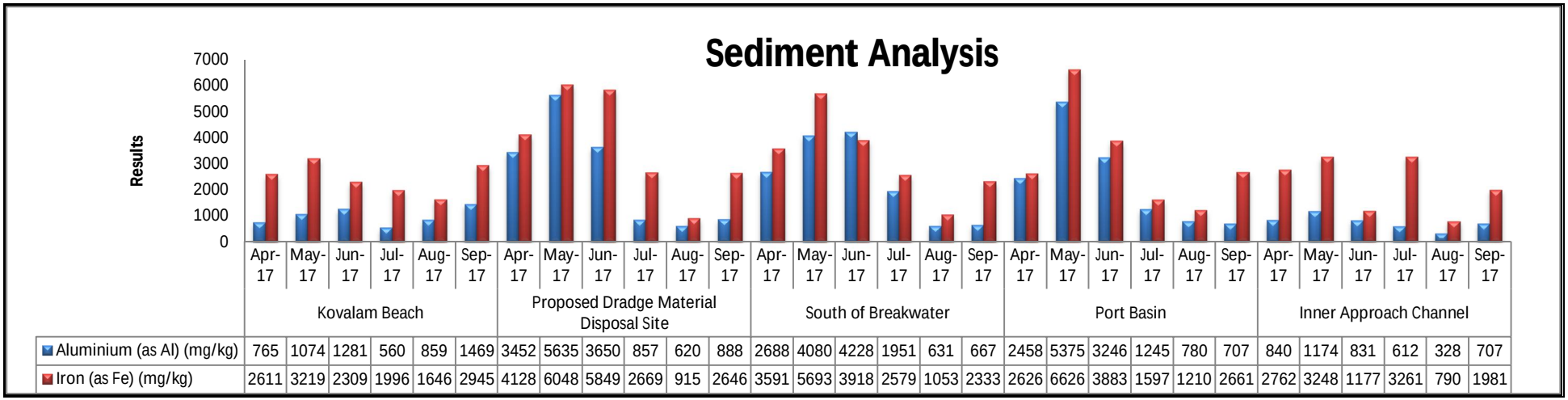
	Kovalam Beach						Proposed Dradge Material Disposal Site						South of Breakwater						Port Basin						Inner Approach Channel					
	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Manganese (as Mn) (mg/kg)	6.22	7.51	8.68	6.77	19.2	20.1	36	48	7.02	8.46	7.11	6.87	19.8	40	11.7	6.43	8.43	15.7	15.6	56	2.49	1.7	10.5	6.91	7.61	7.38	2.98	7.57	5.49	6.69
Mercury (as Hg) (mg/kg)	0	0	0	0	0.227	0	0	0	0.074	0	0.368	0	0	0	0.093	0.115	0.052	0	0.135	0	0.182	0	0.451	0	0	0	0.773	0	0.246	0.04
Zinc (as Zn) (mg/kg)	3.74	5.74	5.03	6.36	2.88	5.97	10.6	13.9	2.23	3.51	2.33	3.63	6.49	13.3	2.23	7.89	2.16	4.42	9.16	12.9	0.888	1.78	3.41	3.65	3.76	6.44	2.84	3.21	2.12	3
Nickel (as Ni) (mg/kg)	0.667	1.84	3.71	1.54	1.06	1.19	5.07	7.71	3.57	1.44	1.18	1.1	3.25	7.18	3.38	1.76	1.4	1.2	4.26	7.52	2.94	1.15	1.06	1.25	0.594	1.78	2.92	1.59	0.951	1.1

Figure 5.6 Sediment analysis for Manganese, Mercury, Zinc and Nickel



	Kovalam Beach						Proposed Dradge Material Disposal Site						South of Breakwater						Port Basin						Inner Approach Channel					
	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Copper (as Cu) (mg/kg)	1.38	1.45	0.722	0.97	1	0.882	4.76	5.01	0.561	0.848	0.495	0.253	2.4	4.9	0.39	0.708	0.655	0.693	3.25	4.71	0.279	0.286	0.868	0.255	1.83	1.55	0.314	0.99	0.425	0.114
Chromium (as Cr) (mg/kg)	16.5	10	9.75	15.1	4.6	16.8	17.7	18	11.5	23.1	1.18	18.2	11.5	17.5	9.4	20.8	3.43	16.9	14.1	17.3	7.53	19.1	2.84	18.3	18.8	10	9.28	27.7	1.25	8.95
Lead (as Pb) (mg/kg)	4.5	1.98	1.07	2.12	0.386	1.65	4.15	4.32	2.59	7.8	0.236	2.4	2.08	3.99	1.59	4.85	0.399	2	3.34	4.06	1.39	2.02	0.64	2.41	11.2	2.82	1.99	6.52	0.84	1.33

Figure 5.7: Sediment analysis for Copper, Chromium and Lead



	Kovalam Beach						Proposed Dradge Material Disposal Site						South of Breakwater						Port Basin						Inner Approach Channel					
	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Aluminium (as Al) (mg/kg)	765	1074	1281	560	859	1469	3452	5635	3650	857	620	888	2688	4080	4228	1951	631	667	2458	5375	3246	1245	780	707	840	1174	831	612	328	707
Iron (as Fe) (mg/kg)	2611	3219	2309	1996	1646	2945	4128	6048	5849	2669	915	2646	3591	5693	3918	2579	1053	2333	2626	6626	3883	1597	1210	2661	2762	3248	1177	3261	790	1981

Figure 5.8: Sediment analysis for Aluminium and Iron

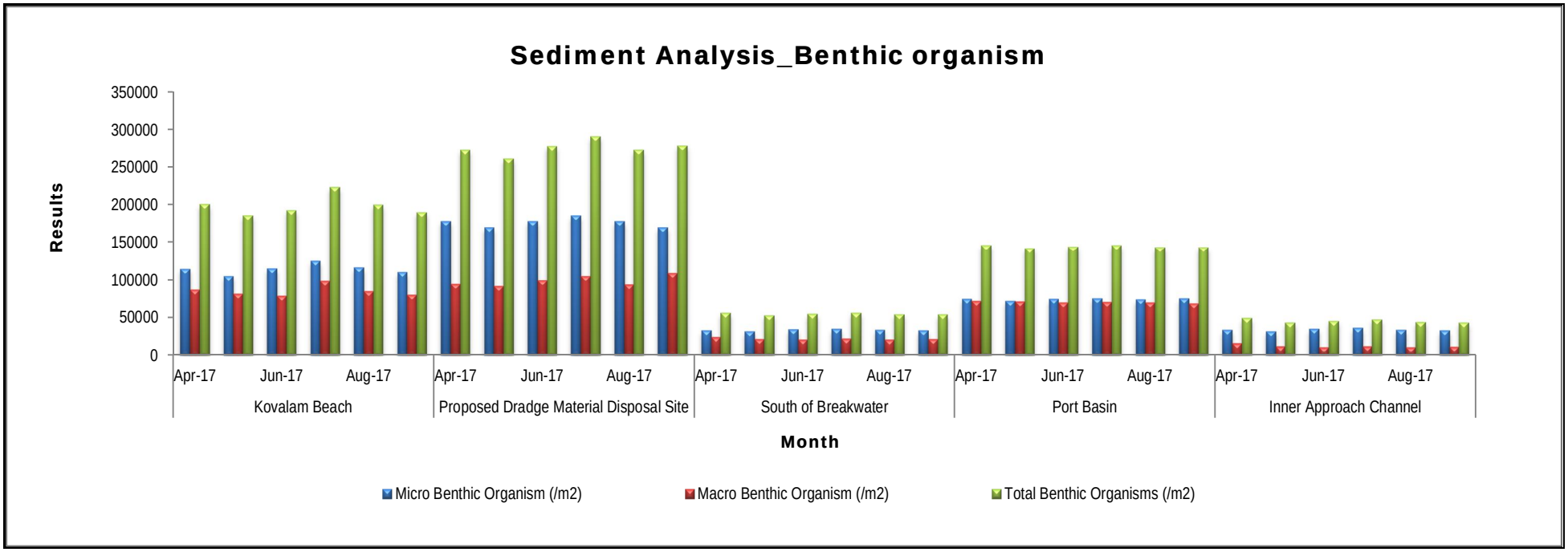


Figure 5.9: Sediment analysis for Benthic organism

8. Summary- Sediment Analysis:

During the period April 2017 to September 2017, At location- **Near Kovalam Beach**, the observed texture was clay, Organic matter was observed in the range between 10.5 – 49.5 %, Total Phosphorus (as P) was observed in the range between 4 – 13.4 mg/kg. Aluminium (as Al) was observed in the range between 560 - 1469 mg/kg. Chromium (as Cr) was observed in the range between 4.6 – 16.8 mg/kg. Copper (as Cu) was observed in the range between 0.722 – 1.45 mg/kg. Iron (as Fe) was observed in the range between 1646 - 3219 mg/kg. Lead (as Pb) was observed in the range between 0.386 – 4.5 mg/kg. Manganese (as Mn) was observed in the range between 6.22 – 20.1 mg/kg. Mercury (as Hg) was observed between below the detection limit. Zinc (as Zn) was observed in the range between 2.88 – 6.36 mg/kg. Nickel (as Ni) was observed in the range between 0.667 – 3.71 mg/kg. Micro benthic organisms were observed in the range between 104580 – 124862 /m^2 and macro benthic organisms were observed in the range between 78459 – 98452 /m^2.

At location- **Proposed Dredge Material Disposal site**, the observed texture was clay, Organic matter was observed in the range between 4.4 – 13.4 %, Total Phosphorus (as P) was observed in the range between 3.74 – 13.5 mg/kg. Aluminium (as Al) was observed in the range between 620 - 5635 mg/kg. Chromium (as Cr) was observed in the range between 1.18 – 23.1 mg/kg. Copper (as Cu) was observed in the range between 0.253 – 5.01 mg/kg. Iron (as Fe) was observed in the range between 915 - 6048 mg/kg. Lead (as Pb) was observed in the range between 0.236 – 7.8 mg/kg. Manganese (as Mn) was observed in the range between 6.87 - 48 mg/kg. Mercury (as Hg) was observed in the range between 0.074 – 0.368 mg/kg. Zinc (as Zn) was observed in the range between 2.23 - 13.9 mg/kg. Nickel (as Ni) was observed in the range between 1.1 – 7.71 mg/kg. Micro benthic organisms were observed in the range between 169875 – 185672 /m^2 and macro benthic organisms were observed in the range between 91489 – 108452 /m^2.

At location- **South of break water**, the observed texture was clay, Organic matter was observed in the range between 9.62 – 32.4 %, Total Phosphorus (as P) was observed in the range between 3.68 – 19.2 mg/kg. Aluminium (as Al) was observed in the range between 631 - 4228 mg/kg. Chromium (as Cr) was observed in the range between 3.43

– 20.8 mg/kg. Copper (as Cu) was observed in the range between 0.39 - 4.9 mg/kg. Iron (as Fe) was observed in the range between 1053 - 5693 mg/kg. Lead (as Pb) was observed in the range between 0.399 – 4.85 mg/kg. Manganese (as Mn) was observed in the range between 6.43 - 40 mg/kg. Mercury (as Hg) was observed in the range between below detection limit to 0.115 mg/kg. Zinc (as Zn) was observed in the range between 2.16 – 13.3 mg/kg. Nickel (as Ni) was observed in the range between 1.2 – 7.18 mg/kg. Micro benthic organisms were observed in the range between 31452 – 34582 /m^2 and macro benthic organisms were observed in the range 20358 – 23548 /m^2.

At location- **Port Basin**, the observed texture was clay, Organic matter was observed in the range between 9.26 - 31 %, Total Phosphorus (as P) was observed in the range between 5.12 – 27.5 mg/kg. Aluminium (as Al) was observed in the range between 707 - 5375 mg/kg. Chromium (as Cr) was observed in the range between 2.84 –19.1 mg/kg. Copper (as Cu) was observed in the range between 0.255 – 4.71 mg/kg. Iron (as Fe) was observed in the range between 1210 - 6626 mg/kg. Lead (as Pb) was observed in the range between 0.64–4.06 mg/kg. Manganese (as Mn) was observed in the range between 1.7 - 56 mg/kg. Mercury (as Hg) was observed in the range between below detection limit to 0.451 mg/kg. Zinc (as Zn) was observed in the range between 0.88 – 12.9 mg/kg. Nickel (as Ni) was observed in the range between 1.06 – 7.52 mg/kg. Micro benthic organisms were observed in the range between 71452 – 75468 /m^2 and macro benthic organisms were observed in the range between 68451 - 71542 /m^2.

At location- **Inner Approach Channel**, the observed texture was clay, Organic matter was observed in the range between 7.96 – 27.9 %, Total Phosphorus (as P) was observed in the range between 6.36 – 13.3 mg/kg. Aluminium (as Al) was observed in the range between 328 - 1174 mg/kg. Chromium (as Cr) was observed in the range 1.25 – 27.7 mg/kg. Copper (as Cu) was observed in the range between 0.114 – 1.83 mg/kg. Iron (as Fe) was observed in the range between 790- 3261 mg/kg. Lead (as Pb) was observed in the range between 0.84 – 11.2 mg/kg. Manganese (as Mn) was observed in the range between 2.98 – 7.61 mg/kg. Mercury (as Hg) was observed in the range between below detection limit to 0.773 mg/kg. Zinc (as Zn) was observed in the range between 2.12 – 6.44 mg/kg. Nickel (as Ni) was observed in the range between 0.594 – 2.92 mg/kg. Micro benthic organisms were observed in the range between 31458 –

35861 /m^2 and macro benthic organisms were observed in the range between 10385 – 15423 /m^2.

9. Marine Water Analysis for Phytoplankton and Zooplankton

Table 5.10 Total Phytoplankton and Zooplankton Results

Parameter	Month	Near Kovalam Beach	Proposed Dredge Material Disposal Site	South of Breakwater	Port Basin	Inner Approach Channel
Total Phytoplankton No/100 mL	**Apr-17**	4534136	400732	2474127	249861	989374
	May-17	4471605	392254	1809472	149207	973298
	Jun-17	4563799	404846	1886508	154309	1155700
	Jul-17	4522634	417043	1803595	137191	1142091
	Aug-17	4602970	429462	1791554	139941	1132670
	Sep-17	4502330	412546	1747354	138554	1104657
Total Zooplankton No/ 100 mL	**Apr-17**	10054	12992	9888	10102	10008
	May-17	10315	12756	9918	10229	10294
	Jun-17	10018	11801	9714	9993	9906
	Jul-17	10233	12351	9994	10247	10160
	Aug-17	10206	12115	9776	9795	10026
	Sep-17	10329	11935	9929	10052	10310

10. Graphical representation of Results for the period April 2017 to September 2017

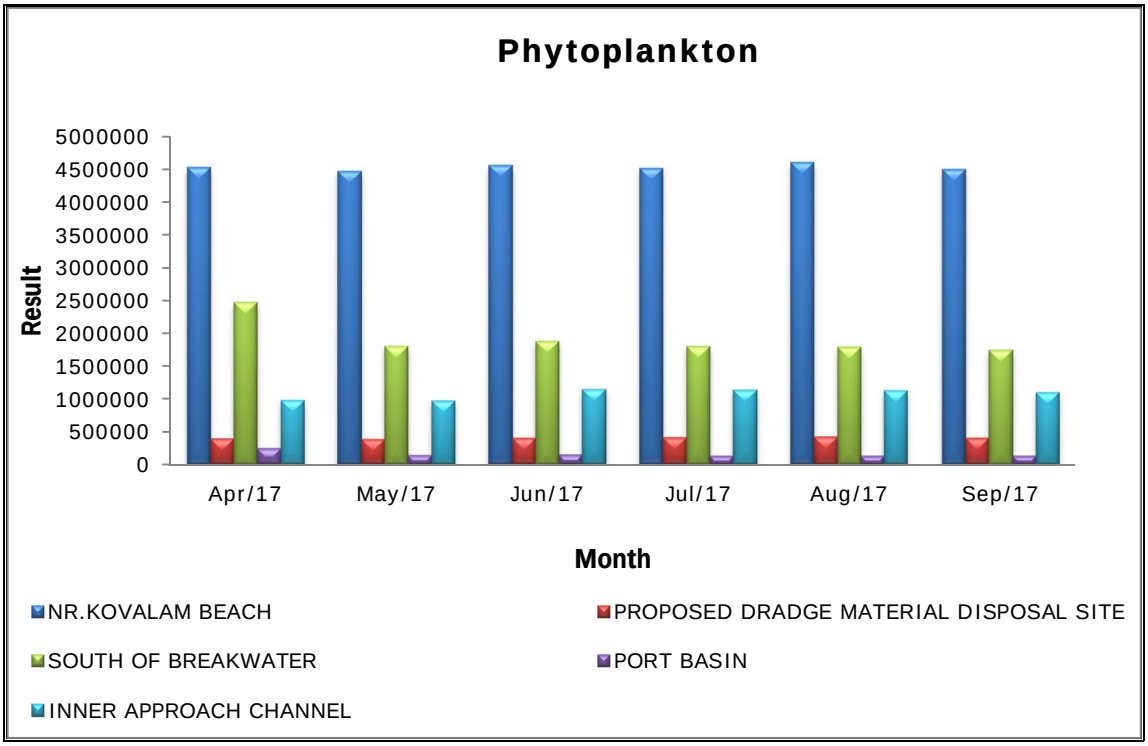


Figure 5.10 Marine Water Analysis for Total Phytoplankton

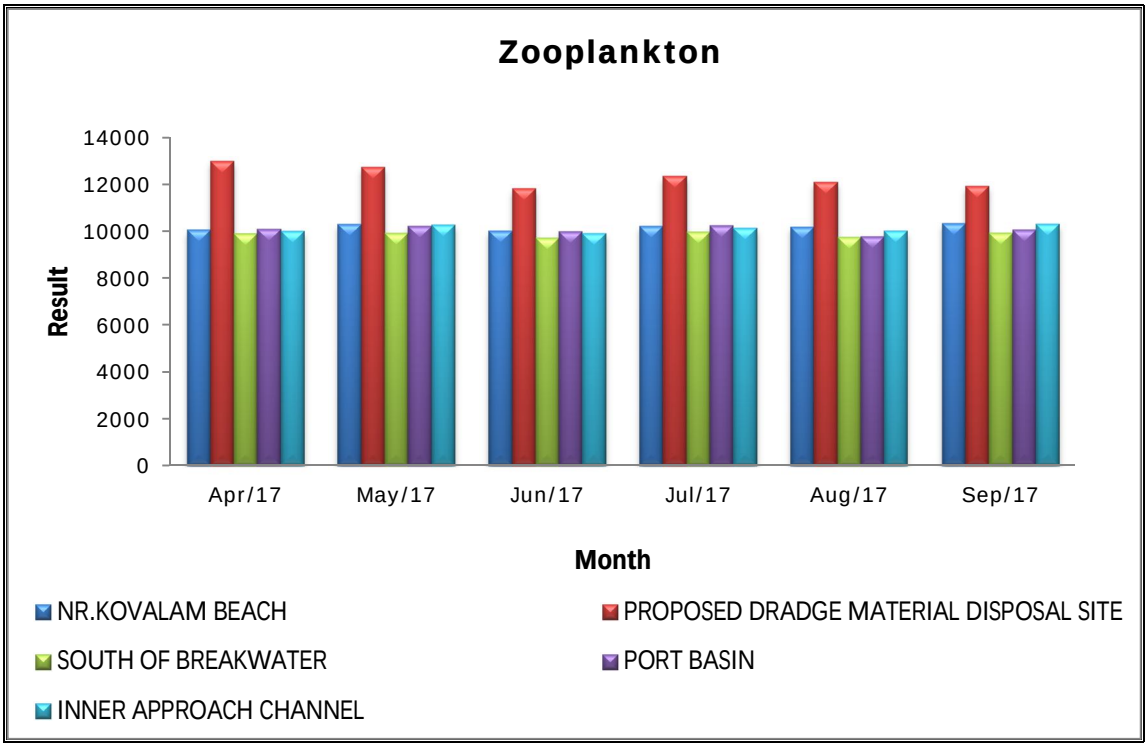


Figure 5.11 Marine Water Analysis for Total Zooplankton

11. Summary- Marine Water Analysis for Phytoplankton and Zooplanktons

During the period April 2017 to September 2017, at location- **Near Kovalam Beach**, Phytoplanktons were observed in the range between 4471605 - 4602970 No/100 mL and Zooplanktons were observed in the range between 10018 - 10329 No/100 mL.

At location- **Proposed Dredge Material Disposal site**, Phytoplanktons were observed in the range between 392254 - 429462 No/100 mL and Zooplanktons were observed in the range between 11801 - 12992 No/100 mL.

At location- **South of Break water**, Phytoplanktons were observed in the range between 1747354 - 2474127 No/100 mL and Zooplanktons were observed in the range between 9714 - 9994 No/100 mL.

At location- **Port Basin**, Phytoplanktons were observed in the range between 137191 - 249861 No/100 mL and Zooplanktons were observed in the range between 9795 -10247 No/100 mL.

At location- **Inner Approach Channel**, Phytoplanktons were observed in the range between 973298 - 1155700 No/100 mL and Zooplanktons was observed in the range between 9906 - 10310 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 2017 to September 2017. 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 during April 2017 to September 2017.

Table 6.1 Ground Water Location details

Sr. No.	Location	Latitude	Longitude
Ground Water			
1.	Port Site	8^0,22',06.03"N	77^0,00',17.03"E
2.	PAF Area	8^0,22',20.43"N	77^0,00',04.06"E
3.	Proposed Port Estate Area	8^0,22',24.64"N	77^0,01',46.27"E
Surface Water			
1.	Poovar West Canal	8^0,19',08.18"N	77^0,04',35.30"E
2.	Vizhinjam Branch Canal	8^0,22',49.55"N	76^0,59',35.01"E
3.	Vellayani Lake	8^0,25',30.71"N	76^0,59',37.70"E

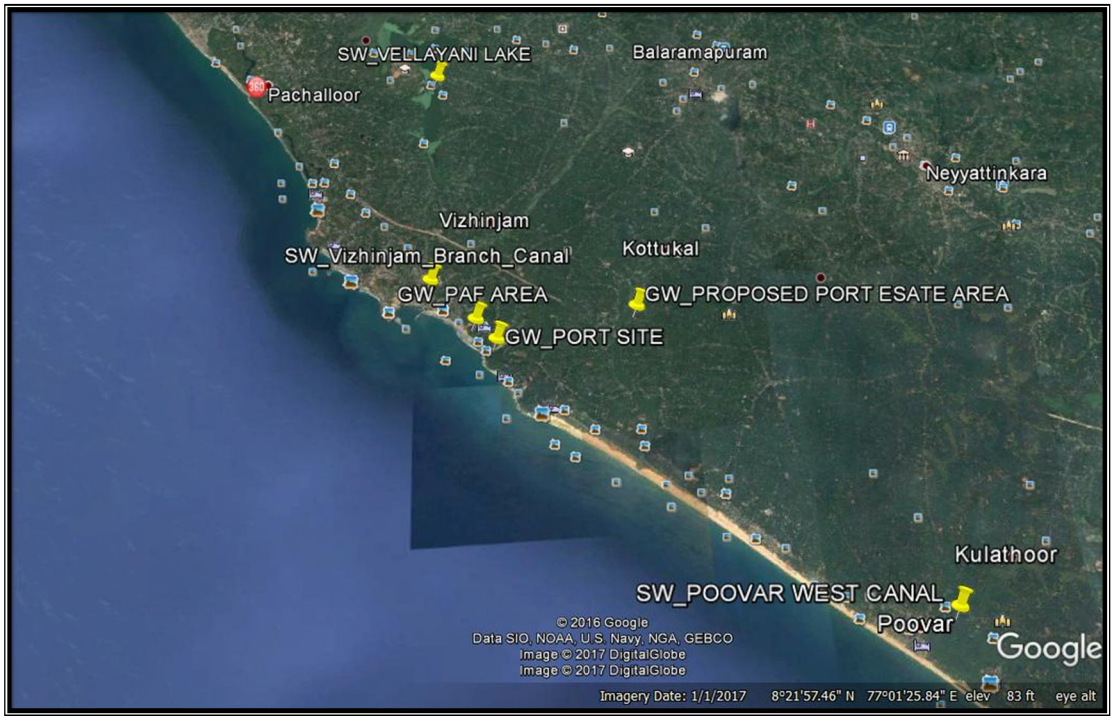


Figure 6.1 Google earth views of Ground water and Surface water sources

2. Methodology of Sampling and Analysis:

Table 6.2 Ground Water and Surface Water methodology

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
1.	Colour	Hazen Units	**1**	IS 3025(Part 4): 1983, Reaffirmed 2006
2.	Odour	-	**Qualitative**	IS 3025 (Part 5): 1983, Reaffirmed 2006
3.	pH Value	-	**1-14**	IS 3025(Part 11):1983, Reaffirmed 2006
4.	Turbidity	N.T.U.	**0.1**	IS 3025(Part 10):1984, Reaffirmed 2006
5.	Electrical Conductivity (at 25°C)	µmho/cm	**0.1**	IS 3025(Part 14): 1984 , Reaffirmed 2006
6.	Total Dissolved Solids	mg/L	**5**	IS 3025 (Part 16):1984, Reaffirmed 2006, Ed.2.1 (1999-12)
7.	Dissolved Oxygen	mg/L	**0.05**	IS 3025 (Part 38): 1989, Reaffirmed 2009
8.	Biochemical Oxygen Demand (3 days, 27°C)	mg/L	**1**	IS 3025 (Part 44): 1993, Reaffirmed 2009, Amds.1
9.	Oil & Grease	mg/L	**1**	APHA,22 nd Ed.,2012,5520-B, 5-40
10.	Aluminium (as Al)	mg/L	**0.025**	APHA, 22nd Ed., 2012, 3500-Al-B,3-61
11.	Ammonia (as NH_3- N)	mg/L	**0.1**	APHA, 22nd Ed., 2012 , 4500

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
				NH3, B & C, 4 -110, 4-112,
12.	Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	**0.1**	APHA, 22nd Ed.,2012, 5540-B&C,5-51& 5-53,
13.	Barium (as Ba)	mg/L	**0.1**	IS 3025(Part 2): 2004
14.	Boron (as B)	mg/L	**0.1**	APHA, 22nd Ed., 2012, 4500-B -B,4-25
15.	Calcium (as Ca)	mg/L	**0.4**	IS 3025(Part 40): 1991, Reaffirmed 2009, Ed.2.1 (2004-02)
16.	Chloramines (as Cl_2)	mg/L	**0.05**	APHA, 22nd Ed., 2012, 4500-Cl-G, 4-69
17.	Chloride (as Cl)	mg/L	**0.25**	IS 3025 (Part 32):1988, Reaffirmed 2009
18.	Copper (as Cu)	mg/L	**0.02**	IS 3025(Part 2): 2004
19.	Fluoride (as F)	mg/L	**0.05**	APHA, 22nd Ed., 2012, 4500-F-, D, 4-87
20.	Iron (as Fe)	mg/L	**0.06**	IS 3025(Part 2): 2004
21.	Magnesium (as Mg)	mg/L	**0.02**	IS 3025(Part 46):1994, Reaffirmed 2009, Amds.2
22.	Manganese (as Mn)	mg/L	**0.02**	IS 3025(Part 2): 2004
23.	Mineral Oil	mg/L	**0.005**	Clause 6 of IS: 3025 (Part 39): 1991, Amds.2, Sept 2013
24.	Nitrate (as NO_3)	mg/L	**0.2**	APHA,22nd Ed.,2012,4500-NO3,B-4-122
25.	Phenolic Compounds (as C_6H_5OH)	mg/L	**0.001**	APHA, 22nd Ed.,2012, 5530- B & C, 5-47
26.	Selenium (as Se)	mg/L	**0.005**	IS 3025(Part 2): 2004
27.	Silver (as Ag)	mg/L	**0.005**	IS 3025(Part 2): 2004
28.	Sulphate (as SO_4)	mg/L	**2**	IS 3025 (Part 24): 1986, Reaffirmed 2009
29.	Sulphide (as H_2S)	mg/L	**0.025**	IS 3025 (Part 29) 1986, Reaffirmed 2009
30.	Total Phosphate (as PO_4)	mg/L	**0.1**	APHA, 22 nd Ed. 2012 , 4500 P,E, 4-155
31.	Total Alkalinity (as $CaCO_3$)	mg/L	**0.5**	IS 3025(Part 23): 1986, Reaffirmed 2009, Amds. 1
32.	Total Hardness (as $CaCO_3$)	mg/L	**0.5**	IS 3025(Part 21): 1983, Reaffirmed 2006
33.	Calcium Hardness (as $CaCO_3$)	mg/L	**-**	IS 3025(Part 21): 1983, Reaffirmed 2006
34.	Zinc (as Zn)	mg/L	**0.05**	IS 3025(Part 2): 2004
35.	Sodium (as Na)	mg/L	**0.2**	IS 3025 (Part 45):1993, Reaffirmed 2009, Amds.1
36.	Potassium (as K)	mg/L	**0.06**	IS 3025(Part 45): 1993,

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
				Reaffirmed 2009, Amds.1
37.	Sodium Absorption Ratio	-	-	IS 11624:1986, Reaffirmed 2006
38.	Cadmium (as Cd)	mg/L	**0.002**	IS 3025(Part 2): 2004
39.	Cyanide (as CN)	mg/L	**0.001**	APHA,22nd Ed.,2012, 4500-CN, C & E, 4-41 & 4-44
40.	Lead (as Pb)	mg/L	**0.008**	IS 3025(Part 2): 2004
41.	Mercury (as Hg)	mg/L	**0.0008**	IS 3025(Part 2): 2004
42.	Molybdenum (as Mo)	mg/L	**0.002**	IS 3025(Part 2): 2004
43.	Nickel (as Ni)	mg/L	**0.01**	IS 3025(Part 2): 2004
44.	***Pesticide Residues***			
i.	Alachlor	µg/L	**0.01**	US EPA 525.2,1995
ii.	Atrazine	µg/L	**0.01**	US EPA 525.2,1995
iii.	Aldrin/Dieldrin	µg/L	**0.01**	US EPA 525.2,1995
iv.	Alpha HCH	µg/L	**0.01**	US EPA 525.2,1995
v.	Beta HCH	µg/L	**0.01**	US EPA 525.2,1995
vi.	Butachlor	µg/L	**0.01**	US EPA 525.2,1995
vii.	Chlorpyrifos	µg/L	**0.05**	US EPA 525.2,1995
viii.	Delta HCH	µg/L	**0.01**	US EPA 525.2,1995
ix.	2,4D chlorophenoxyacetic acid	µg/L	**0.07**	US EPA 515.1,1995
x.	DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	**0.01**	US EPA 525.2,1995
xi.	Endosulfan (, & Sulphate)	µg/L	**0.01**	US EPA 525.2,1995
xii.	Ethion	µg/L	**0.05**	US EPA 525.2,1995
xiii.	γ HCH (Lindane)	µg/L	**0.01**	US EPA 525.2,1995
xiv.	Isoproturon	µg/L	**0.07**	US EPA 532,2000
xv.	Malathion	µg/L	**0.05**	US EPA 525.2,1995
xvi.	Methyl Parathion	µg/L	**0.05**	US EPA 525.2,1995
xvii.	Monocrotophos	µg/L	**0.05**	US EPA 525.2,1995
xviii.	Phorate	µg/L	**0.07**	US EPA 8141B ,Rev2,Feb2007
45.	Polychlorinated Biphenyls (PCB)	mg/L	**0.00007**	Annex M of IS 13428:2005 ,Amds.4
46.	Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	**0.00007**	APHA, 22nd Ed., 2012,6440, 6-94
47.	Total Arsenic (as As)	mg/L	**0.005**	IS 3025(Part 2): 2004
48.	Total Chromium (as Cr)	mg/L	**0.02**	IS 3025(Part 2): 2004
49.	**Trihalomethanes**			
a)	Bromoform	mg/L	**0.01**	USEPA 551.1, Rev1,1995 WI/SAP-GC/5/16,
b)	Dibromochloromethane	mg/L	**0.01**	USEPA 551.1, Rev1,1995 WI/SAP-GC/5/16,

Sr. No.	Parameter	Unit	Detection Limit	Method Reference
c)	Bromodichloroethane	mg/L	**0.01**	USEPA 551.1, Rev1,1995 WI/SAP-GC/5/16
d)	Chloroform	mg/L	**0.01**	USEPA 551.1, Rev1,1995 WI/SAP-GC/5/16
50.	*E.coli*	MPN Index /100 ml	**1.8**	APHA, 22nd Ed., 2012, 9221-E, G, 9-76
51.	Total Coliforms	MPN Index /100 ml	**1.8**	APHA, 22nd Ed., 2012, 9221-B, 9-66
52.	Faecal Coliforms	MPN Index /100ml	**1.8**	APHA, 22nd Ed., 2012,9221-E,9-74

3. Ground Water Analysis Results for the period April 2017 to September 2017:

Table 6.3 Location: Port Site

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Organoleptic & Physical Parameters								
Colour	Hazen Units	*Max.* 5	1	1	1	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
pH Value	-	6.5 to 8.5	6.62	6.52	6.57	6.57	6.92	6.5
Turbidity	N.T.U.	*Max.* 1	1.8	3.3	2.2	2.2	2.4	BDL
Total Dissolved Solids	mg/L	*Max.* 500	162	188	262	304	286	260
General Parameters concerning substances undesirable in excessive amounts								
Aluminium (as Al)	mg/L	*Max.* 0.03	BDL	BDL	BDL	BDL	BDL	BDL
Ammonia (as NH_3- N)	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	*Max.* 0.7	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	*Max.* 0.5	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	*Max.* 75	24.8	15.7	34.2	33.7	33.4	15.1
Chloramines (as Cl_2)	mg/L	*Max.* 4.0	BDL	BDL	BDL	BDL	BDL	BDL
Chloride (as Cl)	mg/L	*Max.*250	61	61.5	75.9	78.8	99.9	92
Copper (as Cu)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	*Max.* 1	0.16	0.36	BDL	BDL	BDL	BDL
Iron (as Fe)	mg/L	*Max.*0.3	0.175	BDL	0.1	0.186	0.19	BDL
Magnesium (as Mg)	mg/L	*Max.* 30	7.29	9.5	10.8	10.7	13.8	8.67
Manganese (as Mn)	mg/L	*Max.*0.1	BDL	0.05	0.06	0.07	0.081	0.05

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
						8		8
Mineral Oil	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	*Max.*45	0.78	0.22	0.24	1.22	0.42	0.56
Phenolic Compounds (as C_6H_5OH)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	*Max.* 200	12.3	10.9	58.8	38	31.1	35.3
Sulphide (as H_2S)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	*Max.*200	45.5	70.7	65	76.5	78.8	87
Total Hardness (as $CaCO_3$)	mg/L	*Max.* 200	92	78.4	130	128	140	73.3
Zinc (as Zn)	mg/L	*Max.* 5	BDL	BDL	BDL	BDL	BDL	BDL
Parameters Concerning Toxic Substances								
Cadmium (as Cd)	mg/L	*Max.* 0.003	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Molybdenum (as Mo)	mg/L	*Max.* 0.07	BDL	BDL	BDL	BDL	BDL	BDL
Nickel (as Ni)	mg/L	*Max.*0.02	BDL	BDL	BDL	BDL	BDL	BDL
Pesticide Residues								
Alachlor	µg/L	20	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	0.03	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	125	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	0.4	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	3	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Isoproturon	µg/L	9	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	190	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	0.3	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Polychlorinated Biphenyls (PCB)	mg/L	*Max.* 0.0005	BDL	BDL	BDL	BDL	BDL	BDL
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	*Max.* 0.0001	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Trihalomethanes								
Bromoform	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Dibromochloro Methane	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloroethane	mg/L	*Max.* 0.06	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Bacteriological Analysis								
E.coli	MPN Index /100 mL	Not Detectable	<1.8	<1.8	11	<1.8	11	<1.8
Total Coliforms	MPN Index /100 mL	-	<1.8	220	220	<1.8	20	110

Table 6.4 Location: Proposed Port Estate Area

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Organoleptic & Physical Parameters								
Colour	Hazen Units	*Max.* 5	1	1	1	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
pH Value	-	6.5 to 8.5	6.73	6.52	6.51	6.62	6.65	6.67
Turbidity	N.T.U.	*Max.* 1	1.6	2.1	3.2	4.6	0.2	2.9
Total Dissolved Solids	mg/L	*Max.* 500	46	66	92	296	54	182
General Parameters concerning substances undesirable in excessive amounts								
Aluminium (as Al)	mg/L	*Max.*	BDL	BDL	BDL	BDL	BDL	BDL

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
		0.03						
Ammonia (as NH_3- N)	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	*Max.* 0.7	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	*Max.* 0.5	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	*Max.* 75	4.01	6.29	9.33	23.2	3.89	2.38
Chloramines (as Cl_2)	mg/L	*Max.* 4.0	BDL	BDL	BDL	BDL	BDL	BDL
Chloride (as Cl)	mg/L	*Max.*250	13.5	14	26	80.8	17.5	67
Copper (as Cu)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	*Max.* 1	0.16	0.54	0.86	BDL	BDL	BDL
Iron (as Fe)	mg/L	*Max.*0.3	0.116	0.243	0.07	0.14	0.11	BDL
Magnesium (as Mg)	mg/L	*Max.* 30	2.43	3.33	3.31	12.6	2.36	1.96
Manganese (as Mn)	mg/L	*Max.*0.1	0.011	0.024	0.021	0.025	0.036	BDL
Mineral Oil	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	*Max.*45	1.89	1.51	7.43	8.4	2.12	4.55
Phenolic Compounds (as C_6H_5OH)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	*Max.* 200	8.11	15.5	27.5	53.4	11.8	47.5
Sulphide (as H_2S)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	*Max.*200	10.1	32.8	15	30.6	7.39	32.6
Total Hardness (as $CaCO_3$)	mg/L	*Max.* 200	20	29.4	36.9	110	19.4	9.9
Zinc (as Zn)	mg/L	*Max.* 5	BDL	BDL	BDL	BDL	BDL	BDL
Parameters Concerning Toxic Substances								
Cadmium (as Cd)	mg/L	*Max.* 0.003	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Molybdenum (as Mo)	mg/L	*Max.* 0.07	BDL	BDL	BDL	BDL	BDL	BDL
Nickel (as Ni)	mg/L	*Max.*0.02	BDL	BDL	BDL	BDL	BDL	BDL
Pesticide Residues								
Alachlor	µg/L	20	BDL	BDL	BDL	BDL	BDL	BDL

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Atrazine	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	0.03	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	125	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	0.4	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	3	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	9	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	190	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	0.3	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Polychlorinated Biphenyls (PCB)	mg/L	*Max.* 0.0005	BDL	BDL	BDL	BDL	BDL	BDL
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	*Max.* 0.0001	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Trihalomethanes								
Bromoform	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Dibromochloro Methane	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloroethane	mg/L	*Max.* 0.06	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Bacteriological Analysis								
E.coli	MPN Index /100 mL	Not Detectable	<1.8	<1.8	49	<1.8	<1.8	<1.8
Total Coliforms	MPN Index /100 mL	-	<1.8	79	170	23	<1.8	49

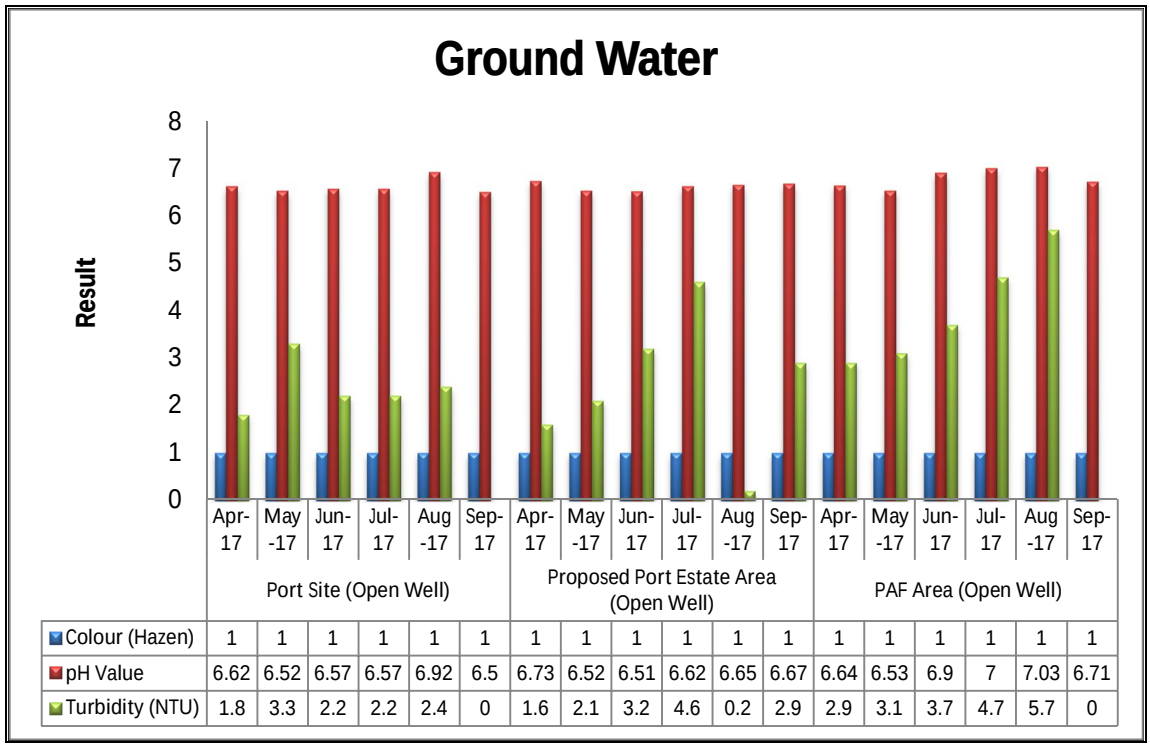
Table 6.5 Location: PAF Area

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Organoleptic & Physical Parameters								
Colour	Hazen Units	*Max.* 5	1	1	1	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
pH Value	-	6.5 to 8.5	6.64	6.53	6.9	7	7.03	6.71
Turbidity	N.T.U.	*Max.* 1	2.9	3.1	3.7	4.7	5.7	BDL
Total Dissolved Solids	mg/L	*Max.* 500	160	198	152	168	188	118
General Parameters concerning substances undesirable in excessive amounts								
Aluminium (as Al)	mg/L	*Max.* 0.03	BDL	BDL	BDL	BDL	BDL	BDL
Ammonia (as NH_3-N)	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	*Max.* 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	*Max.* 0.7	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	*Max.* 0.5	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	*Max.* 75	7.21	7.07	7.78	7.21	10.1	4.77
Chloramines (as Cl_2)	mg/L	*Max.* 4.0	BDL	BDL	BDL	BDL	BDL	BDL
Chloride (as Cl)	mg/L	*Max.*250	71	76	69.5	55.2	68.5	70.5
Copper (as Cu)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	*Max.* 1	0.22	0.56	0.4	BDL	BDL	BDL
Iron (as Fe)	mg/L	*Max.*0.3	0.242	0.285	0.232	0.06	0.08	BDL
Magnesium (as Mg)	mg/L	*Max.* 30	7.78	5.24	6.61	5.35	6.6	2.89
Manganese (as Mn)	mg/L	*Max.*0.1	BDL	BDL	0.085	BDL	BDL	BDL
Mineral Oil	mg/L	*Max.*0.5	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	*Max.*45	5.82	5.51	5.09	5.83	4.56	2.6
Phenolic Compounds (as C_6H_5OH)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	*Max.* 200	22.7	24.2	27.4	22.2	61.3	20.2
Sulphide (as H_2S)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	*Max.*200	20.2	32.8	25	25.5	25	21.5
Total Hardness (as $CaCO_3$)	mg/L	*Max.* 200	50	39.2	46.6	40	52.4	23.8
Zinc (as Zn)	mg/L	*Max.* 5	BDL	BDL	0.168	BDL	BDL	BDL

Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Parameters Concerning Toxic Substances								
Cadmium (as Cd)	mg/L	*Max.* 0.003	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	*Max.*0.05	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	*Max.* 0.001	BDL	BDL	BDL	BDL	BDL	BDL
Molybdenum (as Mo)	mg/L	*Max.* 0.07	BDL	BDL	BDL	BDL	BDL	BDL
Nickel (as Ni)	mg/L	*Max.*0.02	BDL	BDL	BDL	BDL	BDL	BDL
Pesticide Residues								
Alachlor	µg/L	20	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	0.03	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	125	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	0.04	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	30	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	0.4	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	3	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	9	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	190	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	0.3	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	1	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	2	BDL	BDL	BDL	BDL	BDL	BDL
Polychlorinated Biphenyls (PCB)	mg/L	*Max.* 0.0005	BDL	BDL	BDL	BDL	BDL	BDL
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	*Max.* 0.0001	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	*Max.* 0.01	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	*Max.* 0.05	BDL	BDL	BDL	BDL	BDL	BDL
Trihalomethanes								
Bromoform	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL
Dibromochloro Methane	mg/L	*Max.* 0.1	BDL	BDL	BDL	BDL	BDL	BDL

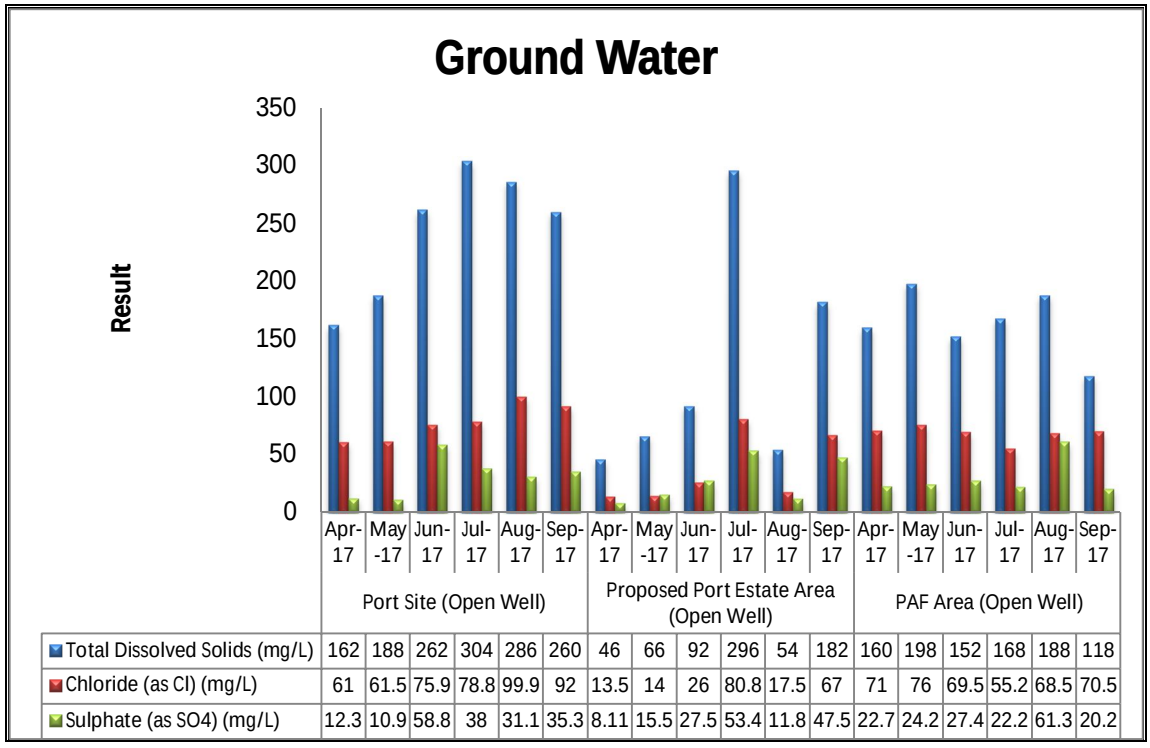
Parameter	Unit	Acceptable Limit as per IS 10500: 2012	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Bromodichloroethane	mg/L	*Max*. 0.06	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform	mg/L	*Max*. 0.2	BDL	BDL	BDL	BDL	BDL	BDL
Bacteriological Analysis								
E.coli	MPN Index/ 100mL	Not Detectable	<1.8	<1.8	<1.8	<1.8	7.8	6.8
Total Coliforms	MPN Index/ 100mL	-	79	70	70	33	13	70

4. Graphical representation of Results for the period April 2017 to September 2017:



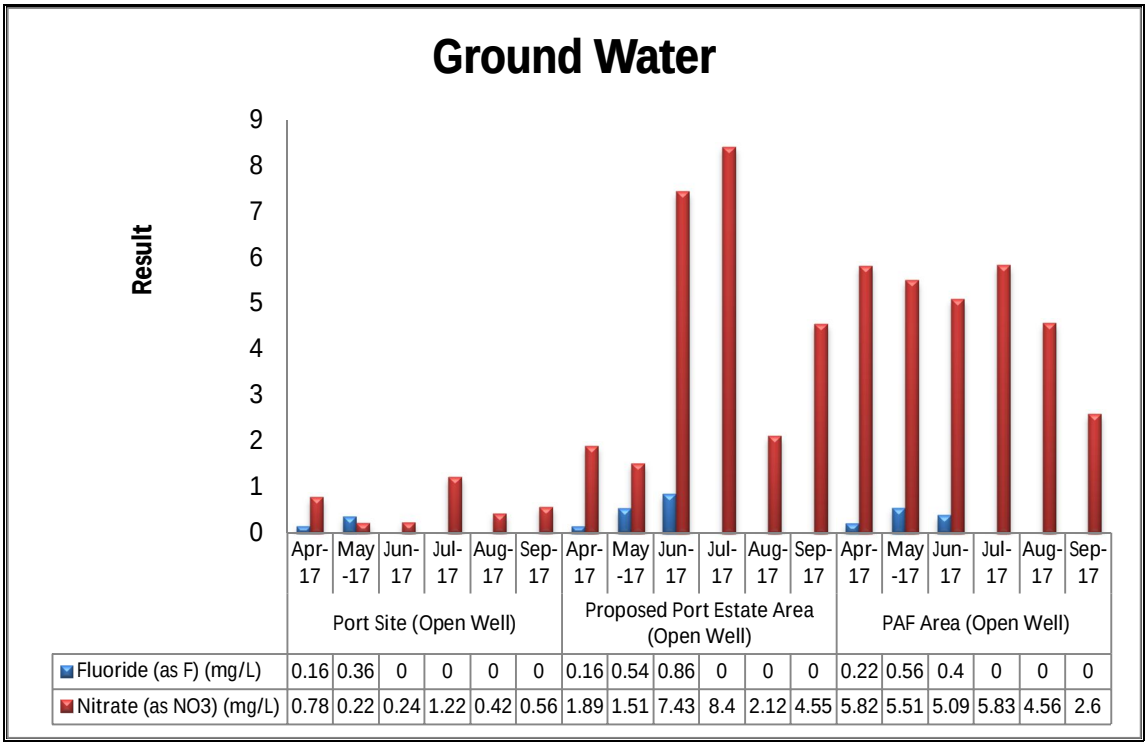
	Port Site (Open Well)						Proposed Port Estate Area (Open Well)						PAF Area (Open Well)					
	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Colour (Hazen)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
pH Value	6.62	6.52	6.57	6.57	6.92	6.5	6.73	6.52	6.51	6.62	6.65	6.67	6.64	6.53	6.9	7	7.03	6.71
Turbidity (NTU)	1.8	3.3	2.2	2.2	2.4	0	1.6	2.1	3.2	4.6	0.2	2.9	2.9	3.1	3.7	4.7	5.7	0

Figure 6.2 Ground Water Analysis for Colour, pH value and Turbidity



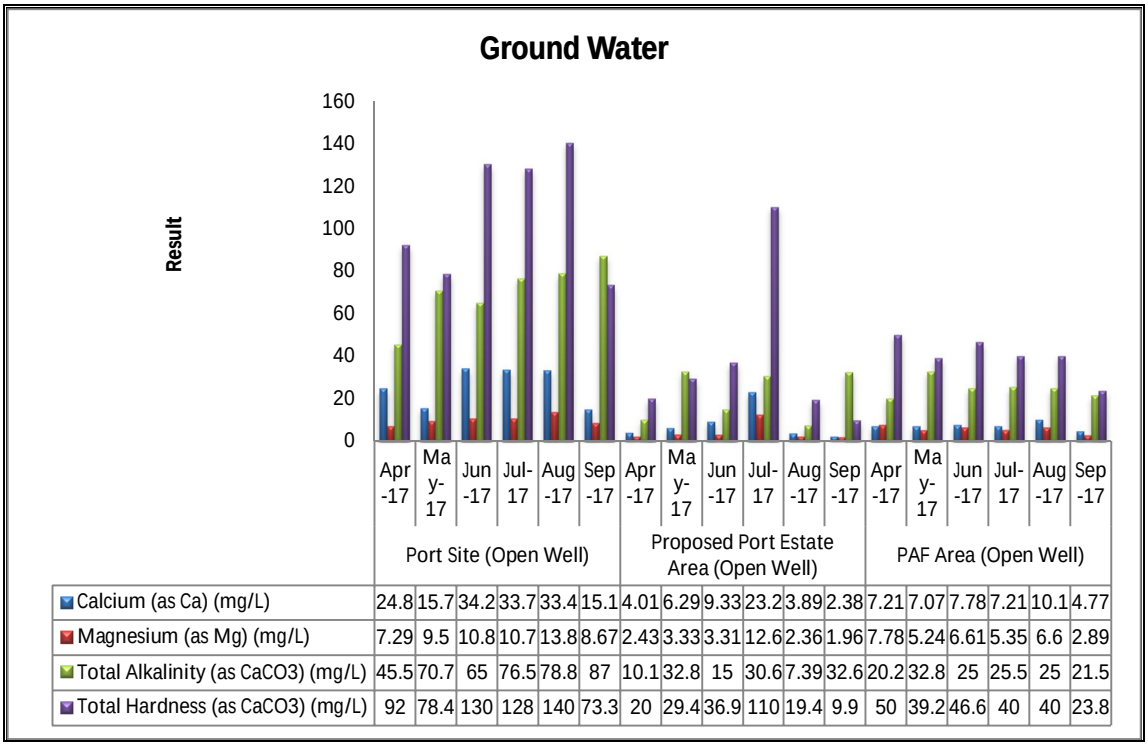
	Port Site (Open Well)						Proposed Port Estate Area (Open Well)						PAF Area (Open Well)					
	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Total Dissolved Solids (mg/L)	162	188	262	304	286	260	46	66	92	296	54	182	160	198	152	168	188	118
Chloride (as Cl) (mg/L)	61	61.5	75.9	78.8	99.9	92	13.5	14	26	80.8	17.5	67	71	76	69.5	55.2	68.5	70.5
Sulphate (as SO4) (mg/L)	12.3	10.9	58.8	38	31.1	35.3	8.11	15.5	27.5	53.4	11.8	47.5	22.7	24.2	27.4	22.2	61.3	20.2

Figure 6.3 Ground Water Analysis for Total Dissolved Solids, Chloride and Sulphate



	Port Site (Open Well)						Proposed Port Estate Area (Open Well)						PAF Area (Open Well)					
	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Fluoride (as F) (mg/L)	0.16	0.36	0	0	0	0	0.16	0.54	0.86	0	0	0	0.22	0.56	0.4	0	0	0
Nitrate (as NO3) (mg/L)	0.78	0.22	0.24	1.22	0.42	0.56	1.89	1.51	7.43	8.4	2.12	4.55	5.82	5.51	5.09	5.83	4.56	2.6

Figure 6.4: Ground Water Analysis for Fluoride and Nitrate



	Port Site (Open Well)						Proposed Port Estate Area (Open Well)						PAF Area (Open Well)					
	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Calcium (as Ca) (mg/L)	24.8	15.7	34.2	33.7	33.4	15.1	4.01	6.29	9.33	23.2	3.89	2.38	7.21	7.07	7.78	7.21	10.1	4.77
Magnesium (as Mg) (mg/L)	7.29	9.5	10.8	10.7	13.8	8.67	2.43	3.33	3.31	12.6	2.36	1.96	7.78	5.24	6.61	5.35	6.6	2.89
Total Alkalinity (as CaCO3) (mg/L)	45.5	70.7	65	76.5	78.8	87	10.1	32.8	15	30.6	7.39	32.6	20.2	32.8	25	25.5	25	21.5
Total Hardness (as CaCO3) (mg/L)	92	78.4	130	128	140	73.3	20	29.4	36.9	110	19.4	9.9	50	39.2	46.6	40	40	23.8

Figure 6.5: Ground Water Analysis for Calcium, Magnesium, Total Alkalinity and Total Hardness

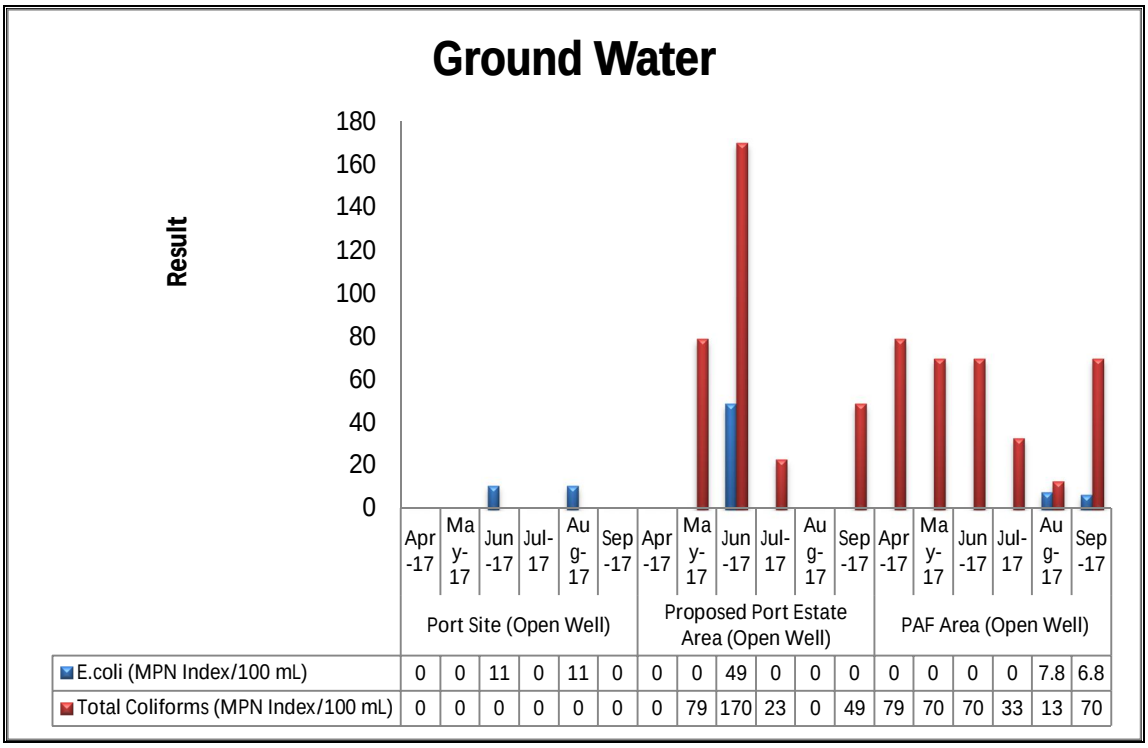


Figure 6.6: Ground Water Analysis for *E.Coli.* and Total Coliforms

5. Summary- Ground Water Analysis

During the period April 2017 to September 2017, at location- **Port Site** (Open Well), Colour was observed 1 Hazen unit, odour was observed agreeable. pH was observed in the range between 6.5 - 6.92. Turbidity was observed in the range between below detection limit to 3.3 NTU. Total Dissolved Solids was observed in the range between 162 - 304 mg/L. limit. Ammonia (as NH_3- N) was observed below the detection limit. Calcium (as Ca) was observed in the range between 15.1 – 34.2 mg/L. Chloride (as Cl) was observed in the range between 61 – 99.9 mg/L. Fluoride (as F) was observed in the range between below detection limit to 0.36 mg/L. Iron (as Fe) was observed in the range between below detection limit to 0.19 mg/L. Magnesium (as Mg) was observed in the range between 7.29 – 13.8 mg/L. Manganese (as Mn) was observed in the range between below detection limit to 0.081 mg/L. Nitrate (as NO_3) was observed in the range between below detection limit to 1.22 mg/L. Sulphate (as SO_4) was observed in the range between 10.9 - 58.8 mg/L. was observed below detection limit. Total Alkalinity (as $CaCO_3$) was observed in the range between 45.5 - 87 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 73.3 - 140 mg/L. Aluminium , Anionic

Detergents, Barium (as Ba), Boron, Chloramines (as Cl_2), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se), Silver (as Ag), Sulphide (as H_2S), Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues, Trihalomethanes, Polychlorinated Biphenyls (PCB) and Polynuclear Aromatic Hydrocarbons (PAH) were observed below detection limit. Bacteriological parameters such as *E.coli* was observed <1.8 MPN Index/100 mL and Total Coliforms were observed in the range between <1.8 - 220 MPN Index/100 mL.

At location- **Proposed Port Estate Area** (Open Well), Colour was observed 1 Hazen unit, odour was observed agreeable. pH was observed in the range between 6.51 – 6.73. Turbidity was observed in the range between below detection limit to 4.6 NTU. Total Dissolved Solids was observed in the range between 46 - 296 mg/L. Calcium (as Ca) was observed in the range between 2.38 – 23.2 mg/L. Chloride (as Cl) was observed in the range between 13.5 – 80.8 mg/L. Fluoride (as F) was observed in the range between below detection limit to 0.86 mg/L. Iron (as Fe) was observed in the range between 0.07 – 0.243 mg/L. Magnesium (as Mg) was observed in the range between 1.96 – 12.6 mg/L. Manganese (as Mn) was observed in the range between 0.011 - 0.036 mg/L. Nitrate (as NO_3) was observed in the range between 1.51 – 8.4 mg/L. Sulphate (as SO_4) was observed in the range between 8.11 – 53.4 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 7.39 – 32.8 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 9.9 - 110 mg/L. Aluminium, Ammonia (as NH_3- N), Anionic Detergents, Barium (as Ba), Boron, Chloramines (as Cl_2), Copper (as Cu), Iron (as Fe), Mineral Oil, Phenolic Compounds(as C_6H_5OH), Selenium (as Se) and Silver (as Ag), Sulphide (as H_2S) Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues, Trihalomethanes, Polychlorinated Biphenyls (PCB) and Polynuclear Aromatic Hydrocarbons (PAH) were observed below detection limit. Bacteriological parameters such as *E.coli* was observed <1.8 MPN Index/100 mL and Total Coliforms were observed in the range between <1.8 to 170 MPN Index/100 mL.

At location- **Proposed PAF Area** (Open Well), Colour was observed 1 Hazen unit, odour was observed agreeable. pH was observed in the range between 6.53 - 7.03. Turbidity was observed in the range between below detection limit to 5.7 NTU. Total Dissolved Solids was observed in the range between 118 - 198 mg/L. Boron (as B) was observed in the range between below detection limit. Calcium (as Ca) was observed in the range between 4.77 – 10.1 mg/L. was observed below detection limit. Chloride (as Cl) was observed in the range between 55.2 - 76 mg/L. Fluoride (as F) was observed in the range between below detection limit to 0.56 mg/L. Iron (as Fe) was observed in the range between 0.06 – 0.285 mg/L. Magnesium (as Mg) was observed in the range between 2.89 – 7.78 mg/L. Nitrate (as NO_3) was observed in the range between 2.6 – 5.83 mg/L. Sulphate (as SO_4) was observed in the range between 20.2 - 61.3 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 20.2 -32.8 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 23.8 – 52.4 mg/L. Zinc (as Zn) was observed in the range between below detection limit to 0.168 mg/L, Aluminium, Ammonia (as NH_3- N), Anionic Detergents and Barium (as Ba), Chloramines (as Cl_2), Copper (as Cu), Manganese (as Mn), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se) and Silver (as Ag), Sulphide (as H_2S), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues, Trihalomethanes, Polychlorinated Biphenyls (PCB) and Polynuclear Aromatic Hydrocarbons (PAH) were observed below detection limit. Bacteriological parameters such as *E.coli* was observed in the range of <1.8 to 7.8 MPN Index/100 mL and Total Coliforms were observed in the range between 13 to 79 MPN Index/100 mL.

6. Surface Water Analysis Results for the period April 2017 to September 2017:

Table 6.6 Location: Poovar West Canal

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Physical Parameters							
Colour	Hazen Units	1	1	1	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
pH Value	-	6.7	6.86	6.63	6.63	7.26	6.49
Turbidity	N.T.U.	2.1	5.6	7.4	7.9	BDL	3.2
Electrical Conductivity (at 25°C)	µmho/cm	-	-	-	-	3010	1516
Total Dissolved Solids	mg/L	1248	3300	564	260	1680	880

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Chemical Parameters							
Dissolved Oxygen	mg/L	-	-	-	-	6.6	6.1
Biochemical Oxygen Demand (3 days, 27^{o}C)	mg/L	-	-	-	-	3.1	4.7
Oil & Grease	mg/L	-	-	-	-	BDL	BDL
Aluminium (as Al)	mg/L	BDL	BDL	BDL	BDL	-	-
Ammonia (as NH_3- N)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	53	110	26.4	29.6	62.1	23.8
Chloramines (as Cl_2)	mg/L	BDL	BDL	BDL	BDL	-	-
Chloride (as Cl)	mg/L	850	1874	350	144	1060	552
Copper (as Cu)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	0.44	0.74	0.5	BDL	BDL	BDL
Iron (as Fe)	mg/L	0.072	BDL	0.29	0.179	0.121	BDL
Magnesium (as Mg)	mg/L	31.6	68.6	20.7	6.32	45	19.3
Manganese (as Mn)	mg/L	BDL	BDL	0.075	BDL	0.038	BDL
Mineral Oil	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	1.63	1.3	1.6	3.8	1.63	7.71
Phenolic Compounds(as C_6H_5OH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	113	175	68.3	42.4	130	78.5
Sulphide (as H_2S)	mg/L	BDL	BDL	BDL	BDL	-	-
Total Phosphate (as PO_4)	mg/L	-	-	-	-	0.17	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	20.2	50.5	20	15.3	25	20.4
Total Hardness (as $CaCO_3$)	mg/L	262	557	151	74	341	139
Calcium Hardness (as $CaCO_3$)	mg/L	-	-	-	-	155	59.4
Zinc (as Zn)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sodium (as Na)	mg/L	-	-	-	-	20.6	17.3
Potassium (as K)	mg/L	-	-	-	-	27.1	9.1
Sodium Absorption Ratio	-	-	-	-	-	0.68	0.9
Cadmium (as Cd)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Molybdenum (as Mo)	mg/L	BDL	BDL	BDL	BDL	-	-

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Nickel (as Ni)	mg/L	BDL	BDL	BDL	BDL	-	-
Pesticide Residues							
Alachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Polychlorinated Biphenyls (PCB)	mg/L	BDL	BDL	BDL	BDL	-	-
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform	mg/L	BDL	BDL	BDL	BDL	-	-
Dibromochloro Methane	mg/L	BDL	BDL	BDL	BDL	-	-
Bromodichloroethane	mg/L	BDL	BDL	BDL	BDL	-	-
Chloroform	mg/L	BDL	BDL	BDL	BDL	-	-
Biological Analysis							
E.coli	MPN Index/100 mL	<1.8	<1.8	27	49	-	-
Total Coliforms	MPN Index/100 mL	23	79	110	110	350	58
Faecal Coliforms	MPN Index/100 mL	-	-	-	-	4.5	33

Table 6.7 Location: Vizhinjam Branch Canal

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Physical Parameters							
Colour	Hazen Units	1	100	10	10	1	1
Odour	-	Agreeable	Disagreeable	Agreeable	Agreeable	Agreeable	Agreeable
pH Value	-	6.71	6.99	6.76	6.98	7.24	7.3
Turbidity	N.T.U.	3.1	2.3	4.6	6.3	BDL	1.2
Electrical Conductivity (at 25°C)	µmho/ cm	-	-	-	-	670	432
Total Dissolved Solids	mg/L	572	12400	226	180	376	242
Chemical Parameters							
Dissolved Oxygen	mg/L	-	-	-	-	5.6	5.5
Biochemical Oxygen Demand (3 days, 27°C)	mg/L	-	-	-	-	6.8	8.1
Oil & Grease	mg/L	-	-	-	-	BDL	BDL
Aluminium (as Al)	mg/L	BDL	BDL	BDL	BDL	-	-
Ammonia (as NH_3- N)	mg/L	BDL	2.41	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	BDL	0.208	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	BDL	1.75	BDL	BDL	0.37	BDL
Calcium (as Ca)	mg/L	46	589	29.5	30.5	42	20
Chloramines (as Cl_2)	mg/L	BDL	BDL	BDL	BDL	-	-
Chloride (as Cl)	mg/L	296	8797	58.5	62.6	151	88.1
Copper (as Cu)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	0.38	1.2	0.46	BDL	BDL	BDL
Iron (as Fe)	mg/L	0.132	2.57	0.21	0.142	0.28	BDL
Magnesium (as Mg)	mg/L	19	405	8.09	4.37	12.6	8.26
Manganese (as Mn)	mg/L	0.08	7.99	0.075	BDL	0.044	BDL
Mineral Oil	mg/L	0.45	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	6.24	4.32	4.8	2.67	2.55	0.66
Phenolic Compounds(as C_6H_5OH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	65.2	289	39.5	29.4	7.85	16.8
Sulphide (as H_2S)	mg/L	BDL	0.51	BDL	BDL	-	-
Total Phosphate (as PO_4)	mg/L	-	-	-	-	0.17	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	96	555	25	51	128	62.7
Total Hardness (as $CaCO_3$)	mg/L	192	3136	107	76	157	84
Calcium Hardness (as	mg/L	-	-	-	-	105	50

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
$CaCO_3$)							
Zinc (as Zn)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sodium (as Na)	mg/L	-	-	-	-	12	4.9
Potassium (as K)	mg/L	-	-	-	-	8.9	5.2
Sodium Absorption Ratio	-	-	-	-	-	0.59	0.33
Cadmium (as Cd)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Molybdenum (as Mo)	mg/L	BDL	BDL	BDL	BDL	-	-
Nickel (as Ni)	mg/L	BDL	BDL	BDL	BDL	-	-
Pesticide Residues							
Alachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Polychlorinated Biphenyls (PCB)	mg/L	BDL	BDL	BDL	BDL	-	-
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform	mg/L	BDL	BDL	BDL	BDL	-	-
Dibromochloro Methane	mg/L	BDL	BDL	BDL	BDL	-	-
Bromodichloroethane	mg/L	BDL	BDL	BDL	BDL	-	-
Chloroform	mg/L	BDL	BDL	BDL	BDL	-	-

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Biological Analysis							
E.coli	MPN Index/ 100 mL	<1.8	79	<1.8	70	-	-
Total Coliforms	MPN Index/ 100 mL	79	240	70	79	39	94
Faecal Coliforms	MPN Index/ 100 mL	-	-	-	-	14	70

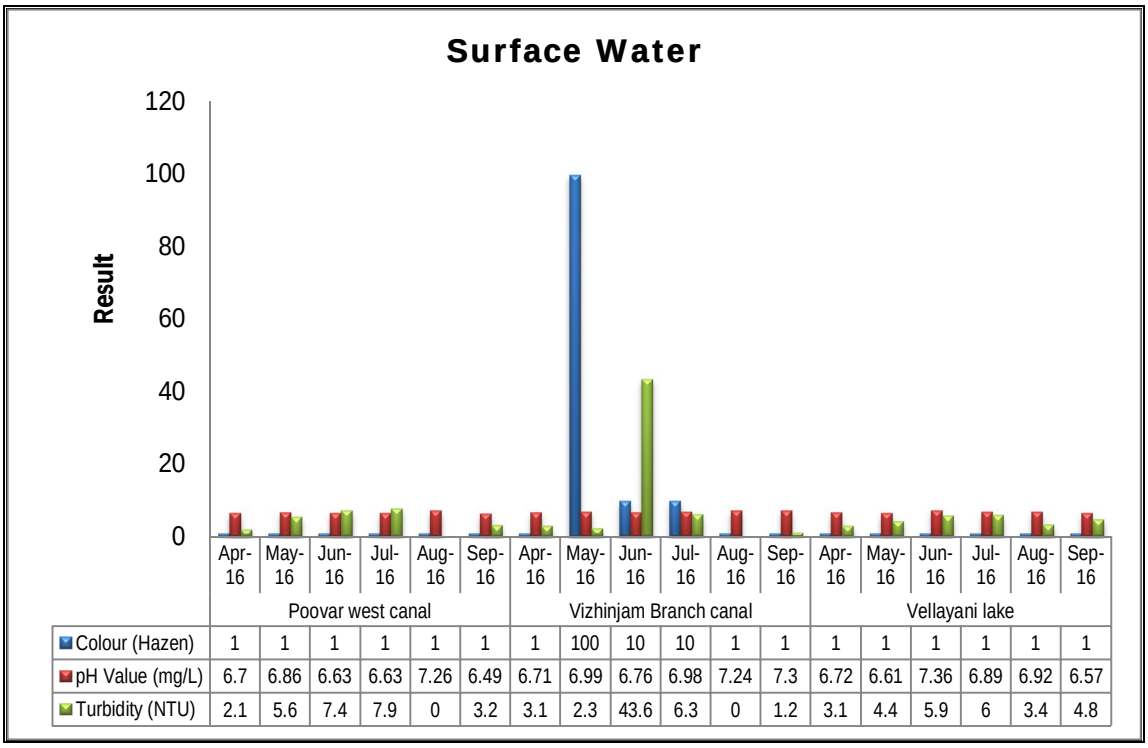
Table 6.8 Location: Vellayani Lake

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Physical Parameters							
Colour	Hazen Units	1	1	1	1	1	1
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
pH Value	-	6.72	6.61	7.36	6.89	6.92	6.57
Turbidity	N.T.U.	3.1	4.4	5.9	6	3.4	4.8
Electrical Conductivity (at 25^{o}C)	µmho/ cm	-	-	-	-	244	210
Total Dissolved Solids	mg/L	130	152	170	152	136	120
Chemical Parameters							
Dissolved Oxygen	mg/L	-	-	-	-	6.5	6.1
Biochemical Oxygen Demand (3 days, 27^{o}C)	mg/L	-	-	-	-	5.5	5.9
Oil & Grease	mg/L	-	-	-	-	BDL	BDL
Aluminium (as Al)	mg/L	BDL	BDL	BDL	BDL	-	-
Ammonia (as NH_3- N)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Anionic Detergents (as MBAS) Calculated as LAS mol.wt. 288.38	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Barium (as Ba)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Boron (as B)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Calcium (as Ca)	mg/L	9.62	7.86	9.33	11.2	12.4	4.77
Chloramines (as Cl_2)	mg/L	BDL	BDL	BDL	BDL	-	-
Chloride (as Cl)	mg/L	69.5	65	93	50.3	58.5	48.3
Copper (as Cu)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Fluoride (as F)	mg/L	0.2	0.4	0.16	BDL	BDL	BDL
Iron (as Fe)	mg/L	0.23	0.256	0.163	0.108	0.155	BDL
Magnesium (as Mg)	mg/L	4.86	2.87	6.13	4.86	4.71	6

Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Manganese (as Mn)	mg/L	0.042	0.038	0.041	BDL	0.048	0.025
Mineral Oil	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate (as NO_3)	mg/L	1.8	1.65	2.34	2.88	2.42	2.66
Phenolic Compounds(as C_6H_5OH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (as Se)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Silver (as Ag)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate (as SO_4)	mg/L	4.94	15.8	9.25	17.3	2.42	12.3
Sulphide (as H_2S)	mg/L	BDL	BDL	BDL	BDL	-	-
Total Phosphate (as PO_4)	mg/L	-	-	-	-	0.19	BDL
Total Alkalinity (as $CaCO_3$)	mg/L	22.7	25.3	30	71.4	30	38.2
Total Hardness (as $CaCO_3$)	mg/L	44	31.4	48.5	48	50.4	29.7
Calcium Hardness (as $CaCO_3$)	mg/L	-	-	-	-	31	11.9
Zinc (as Zn)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Sodium (as Na)	mg/L	-	-	-	-	7.8	6.1
Potassium (as K)	mg/L	-	-	-	-	5.6	2.4
Sodium Absorption Ratio	-	-	-	-	-	0.68	BDL
Cadmium (as Cd)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Cyanide (as CN)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Lead (as Pb)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (as Hg)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Molybdenum (as Mo)	mg/L	BDL	BDL	BDL	BDL	-	-
Nickel (as Ni)	mg/L	BDL	BDL	BDL	BDL	-	-
Pesticide Residues							
Alachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin/Dieldrin	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Alpha HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Beta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Butachlor	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Chlorpyrifos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Delta HCH	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
2,4D chlorophenoxyacetic acid	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
DDT (o,p & p,p- Isomers of DDT, DDE, DDD)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan (a,b & Sulphate)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Ethion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
γ HCH (Lindane)	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Isoproturon	µg/L	BDL	BDL	BDL	BDL	BDL	BDL

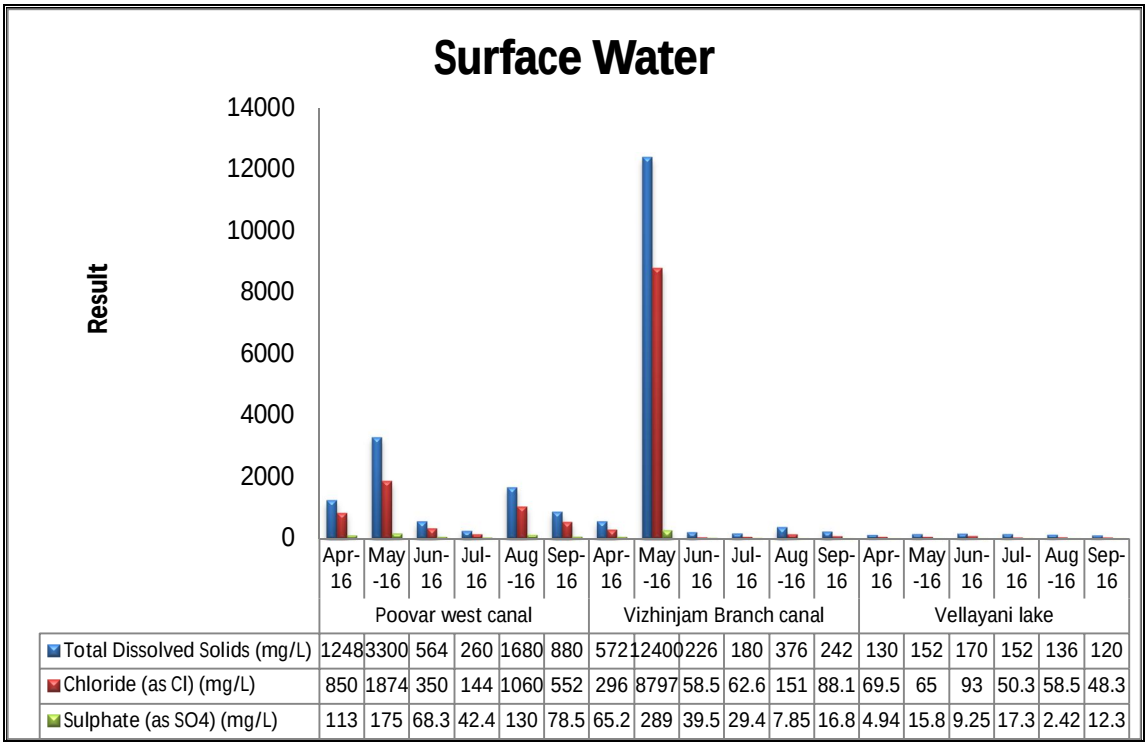
Parameter	Unit	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Malathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Parathion	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Monocrotophos	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Phorate	µg/L	BDL	BDL	BDL	BDL	BDL	BDL
Polychlorinated Biphenyls (PCB)	mg/L	BDL	BDL	BDL	BDL	-	-
Polynuclear Aromatic Hydrocarbons (PAH)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Arsenic (as As)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium (as Cr)	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform	mg/L	BDL	BDL	BDL	BDL	-	-
Dibromochloro Methane	mg/L	BDL	BDL	BDL	BDL	-	-
Bromodichloroethane	mg/L	BDL	BDL	BDL	BDL	-	-
Chloroform	mg/L	BDL	BDL	BDL	BDL	-	-
Biological Analysis							
E.coli	MPN Index/100 mL	<1.8	<1.8	4.5	13	-	-
Total Coliforms	MPN Index/100 mL	79	23	90	23	11	58
Faecal Coliforms	MPN Index/100 mL	-	-	-	-	2.8	46

7. Graphical representation of Results for the period April 2017 to September 2017:



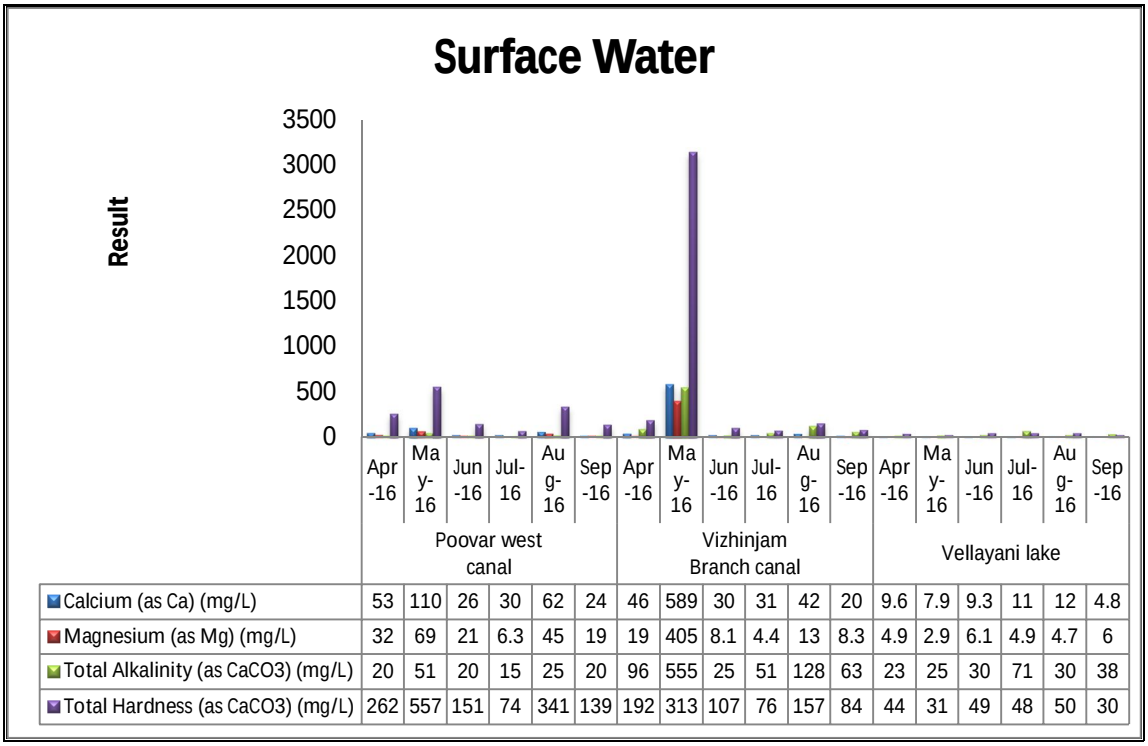
	Poovar west canal						Vizhinjam Branch canal						Vellayani lake					
	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
Colour (Hazen)	1	1	1	1	1	1	1	100	10	10	1	1	1	1	1	1	1	1
pH Value (mg/L)	6.7	6.86	6.63	6.63	7.26	6.49	6.71	6.99	6.76	6.98	7.24	7.3	6.72	6.61	7.36	6.89	6.92	6.57
Turbidity (NTU)	2.1	5.6	7.4	7.9	0	3.2	3.1	2.3	43.6	6.3	0	1.2	3.1	4.4	5.9	6	3.4	4.8

Figure 6.7: Surface Water Analysis for Colour, pH value and Turbidity



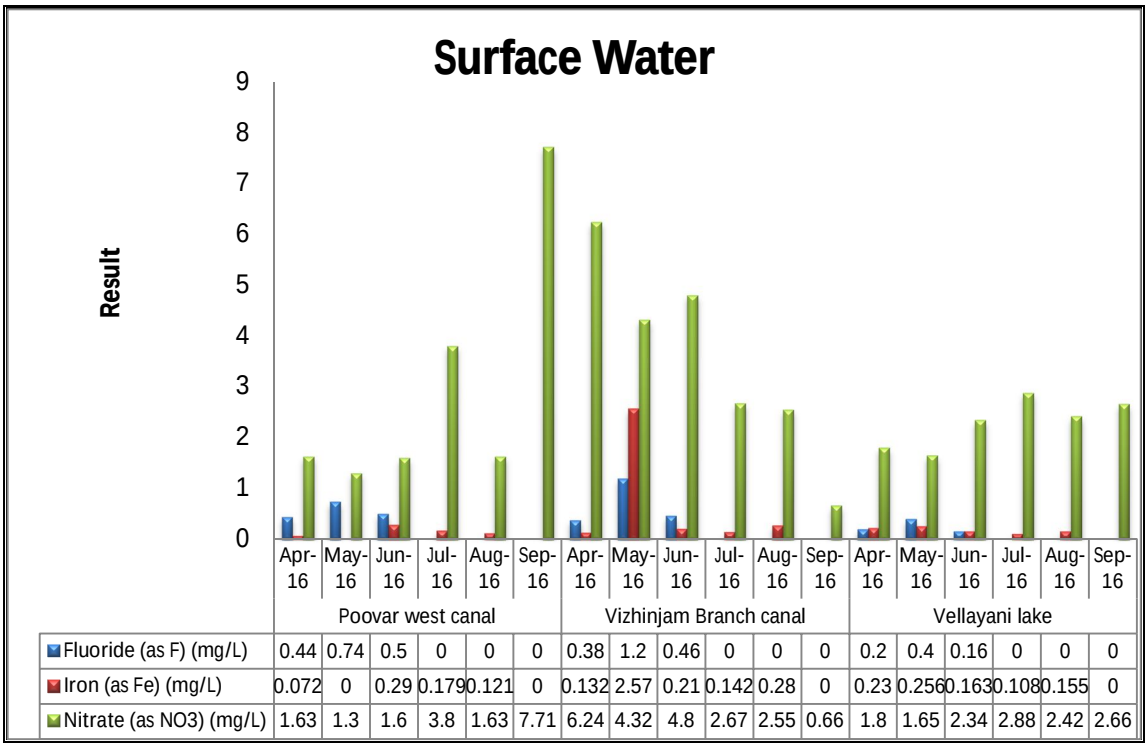
	Poovar west canal						Vizhinjam Branch canal						Vellayani lake					
	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
Total Dissolved Solids (mg/L)	1248	3300	564	260	1680	880	572	12400	226	180	376	242	130	152	170	152	136	120
Chloride (as Cl) (mg/L)	850	1874	350	144	1060	552	296	8797	58.5	62.6	151	88.1	69.5	65	93	50.3	58.5	48.3
Sulphate (as SO4) (mg/L)	113	175	68.3	42.4	130	78.5	65.2	289	39.5	29.4	7.85	16.8	4.94	15.8	9.25	17.3	2.42	12.3

Figure 6.8: Surface Water Analysis for Total Dissolved Solids, Chloride and Sulphate



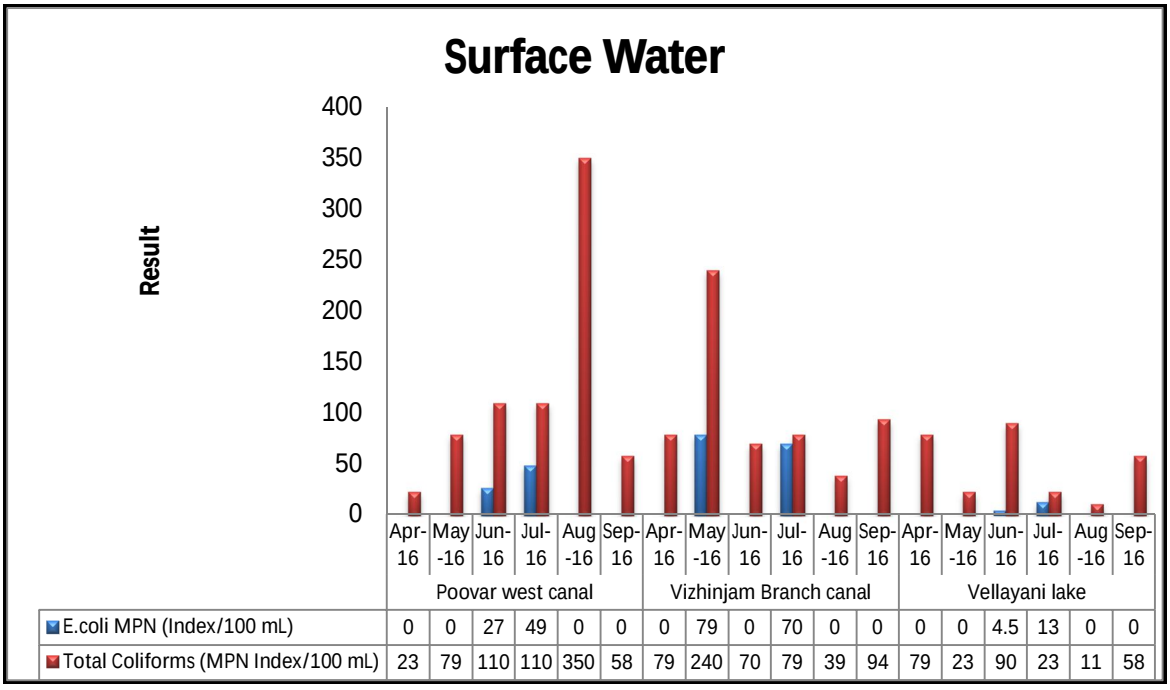
	Poovar west canal						Vizhinjam Branch canal						Vellayani lake					
	Apr -16	May- 16	Jun -16	Jul- 16	Aug- 16	Sep -16	Apr -16	May- 16	Jun -16	Jul- 16	Aug- 16	Sep -16	Apr -16	May- 16	Jun -16	Jul- 16	Aug- 16	Sep -16
Calcium (as Ca) (mg/L)	53	110	26	30	62	24	46	589	30	31	42	20	9.6	7.9	9.3	11	12	4.8
Magnesium (as Mg) (mg/L)	32	69	21	6.3	45	19	19	405	8.1	4.4	13	8.3	4.9	2.9	6.1	4.9	4.7	6
Total Alkalinity (as CaCO3) (mg/L)	20	51	20	15	25	20	96	555	25	51	128	63	23	25	30	71	30	38
Total Hardness (as CaCO3) (mg/L)	262	557	151	74	341	139	192	313	107	76	157	84	44	31	49	48	50	30

Figure 6.9: Surface Water Analysis for Calcium, Magnesium, Total Alkalinity and Total Hardness



	Poovar west canal						Vizhinjam Branch canal						Vellayani lake					
	Apr- 16	May- 16	Jun- 16	Jul- 16	Aug- 16	Sep- 16	Apr- 16	May- 16	Jun- 16	Jul- 16	Aug- 16	Sep- 16	Apr- 16	May- 16	Jun- 16	Jul- 16	Aug- 16	Sep- 16
Fluoride (as F) (mg/L)	0.44	0.74	0.5	0	0	0	0.38	1.2	0.46	0	0	0	0.2	0.4	0.16	0	0	0
Iron (as Fe) (mg/L)	0.072	0	0.29	0.179	0.121	0	0.132	2.57	0.21	0.142	0.28	0	0.23	0.256	0.163	0.108	0.155	0
Nitrate (as NO3) (mg/L)	1.63	1.3	1.6	3.8	1.63	7.71	6.24	4.32	4.8	2.67	2.55	0.66	1.8	1.65	2.34	2.88	2.42	2.66

Figure 6.10: Surface Water Analysis for Fluoride, Iron and Nitrate



	Poovar west canal						Vizhinjam Branch canal						Vellayani lake					
	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
E.coli MPN (Index/100 mL)	0	0	27	49	0	0	0	79	0	70	0	0	0	0	4.5	13	0	0
Total Coliforms (MPN Index/100 mL)	23	79	110	110	350	58	79	240	70	79	39	94	79	23	90	23	11	58

Figure 6.11: Surface Water Analysis for *E.coli.* and Total Coliforms

8. Summary of Surface water

During the period April 2017 to September 2017, at location- **Poovar West Canal**, Colour was observed 1 Hazen unit, odour was observed agreeable. pH was observed in the range between 6.49 -7.26. Turbidity was observed in the range between below the detection limit to 7.9 NTU. Total Dissolved Solids was observed in the range between 260-3300 mg/L. Electrical Conductivity was observed in the range between 1516-3010 µmho/cm. Dissolved Oxygen was observed in the range between 6.1 – 6.6 mg/L. Biochemical Oxygen Demand (3 days, 27^{o}C) was observed in the range between 3.1 – 4.7 mg/L. Calcium (as Ca) was observed in the range between 23.8 - 110 mg/L. Chloride (as Cl) was observed in the range between 144 - 1874 mg/L. Fluoride (as F) was observed in the range between below the detection limit to 0.74 mg/L. Iron (as Fe) was observed in the range between below the detection limit to 0.29 mg/L. Magnesium (as Mg) was observed in the range between 6.32 – 68.6 mg/L. Manganese (as Mn) was observed in the range between below the detection limit to 0.075 mg/L. Nitrate (as NO_3) was observed in the range between 1.3 to 7.71 mg/L. Sulphate (as SO_4) was observed in the range between 42.4 -175 mg/L. Total Phosphate (as PO_4) was observed in the range between below the detection limit to 0.17 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the

range between 15.3 – 50.5 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 74 – 557 mg/L. Calcium Hardness (as $CaCO_3$) was observed in the range between 59.4 – 155 mg/L. Sodium (as Na) was observed in the range between 17.3 – 20.6 mg/L. Potassium (as K) was observed in the range between 9.1 – 27.1 mg/L. Sodium Absorption Ratio was observed in the range between 0.68 – 0.9. Aluminium, Ammonia (as NH_3-N), Anionic Detergents and Barium (as Ba), Boron (as B), Chloramines (as Cl_2), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se) and Silver (as Ag), Sulphide (as H_2S), Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues, Trihalomethanes, Polychlorinated Biphenyls (PCB) and Polynuclear Aromatic Hydrocarbons (PAH) were observed below detection limit. Bacteriological parameters such as *E.coli* was observed in the range of <1.8 to 49 MPN Index/100 mL. Total Coliforms were observed in the range between 23 to 350 MPN Index/100 mL and Faecal Coliforms were observed in the range between 4.5 to 33 MPN Index/100 mL.

At location- **Vizhinjam Branch Canal**, Colour was observed in the range 1 to 100 Hazen unit, odour was observed agreeable during all months except the month may. pH was observed in the range between 6.71 – 7.3. Turbidity was observed in the range between below detection limit to 43.6 NTU. Total Dissolved Solids was observed in the range between 180 - 12400 mg/L. Electrical Conductivity was observed in the range between 432-670 µmho/cm. Dissolved Oxygen was observed in the range between 5.5 – 5.6 mg/L. Biochemical Oxygen Demand (3 days, 27^oC) was observed in the range between 6.8 – 8.1 mg/L. Boron (as B) was observed in the range between below the detection limit to 1.75 mg/L. Calcium (as Ca) was observed in the range between 20 - 589 mg/L. Chloride (as Cl) was observed in the range between 58.5 - 8797 mg/L. Fluoride (as F) was observed in the range between below detection level to 1.2 mg/L. Iron (as Fe) was observed in the range between below detection level to 2.57 mg/L. Magnesium (as Mg) was observed in the range between 4.37 - 405 mg/L. Manganese (as Mn) was observed in the range between below detection level to 7.99 mg/L. Nitrate (as NO_3) was observed in the range between 0.66 to 6.24 mg/L. Sulphate (as SO_4) was observed in the range between

7.85 - 289 mg/L. Total Phosphate (as PO_4) was observed in the range between below the detection limit to 0.17 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 25 - 555 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 76 - 3136 mg/L. Calcium Hardness (as $CaCO_3$) was observed in the range between 50 – 105 mg/L. Sodium (as Na) was observed in the range between 4.9 – 12 mg/L. Potassium (as K) was observed in the range between 5.2 – 8.9 mg/L. Sodium Absorption Ratio was observed in the range between 0.33 – 0.59. Aluminium, Ammonia (as NH_3-N), Anionic Detergents, Barium (as Ba), Chloramines (as Cl_2), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se) and Silver (as Ag), Sulphide (as H_2S) Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues, Trihalomethanes, Polychlorinated Biphenyls (PCB) and Polynuclear Aromatic Hydrocarbons (PAH) were observed below detection limit. Bacteriological parameters such as *E.coli* was observed in the range of <1.8 to 79 MPN Index/100 mL, Total Coliforms were observed in the range between 39 to 240 MPN Index/100 mL and Faecal Coliforms were observed in the range between 14 to 70 MPN Index/100 mL.

At location- **Vellayani Lake**, Colour was observed 1 Hazen unit and odour was observed as agreeable. pH was observed in the range between 6.57 – 7.36. Turbidity was observed in the range between 3.1 - 6 NTU. Total Dissolved Solids was observed in the range between 120 - 170 mg/L. Electrical Conductivity was observed in the range between 210-244 µmho/cm. Dissolved Oxygen was observed in the range between 6.1 – 6.5 mg/L. Biochemical Oxygen Demand (3 days, 27^oC) was observed in the range between 5.5-5.9 mg/L. Calcium (as Ca) was observed in the range between 4.77 to 12.4 mg/L. Chloride (as Cl) was observed in the range between 48.3 - 93 mg/L. Fluoride (as F) was observed in the range between below detection level to 0.4 mg/L. Iron (as Fe) was observed in the range between below detection level to 0.256 mg/L. Magnesium (as Mg) was observed in the range between 2.87 to 6.13 mg/L. Manganese (as Mn) was observed in the range between below detection level to 0.048 mg/L. Nitrate (as NO_3) was observed in the range between 1.65 to 2.88 mg/L. Sulphate (as SO_4) was observed in the range between 2.42 to 17.3 mg/L. Total Phosphate (as PO_4) was observed in the range between below the detection

limit to 0.19 mg/L. Total Alkalinity (as $CaCO_3$) was observed in the range between 22.7 – 71.4 mg/L. Total Hardness (as $CaCO_3$) was observed in the range between 29.7 – 50.4 mg/L. Calcium Hardness (as $CaCO_3$) was observed in the range between 11.9 – 31 mg/L. Sodium (as Na) was observed in the range between 6.1 – 7.8 mg/L. Potassium (as K) was observed in the range between 2.4 – 5.6 mg/L. Sodium Absorption Ratio was observed in the range between below detection level to 0.68. Aluminium, Ammonia (as NH_3-N), Anionic Detergents and Barium (as Ba), Boron (as B), Chloramines (as Cl_2), Copper (as Cu), Mineral Oil, Phenolic Compounds (as C_6H_5OH), Selenium (as Se) and Silver (as Ag), Sulphide (as H_2S), Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Total Arsenic (as As), Total Chromium (as Cr), Pesticide Residues, Trihalomethanes, Polychlorinated Biphenyls (PCB) and Polynuclear Aromatic Hydrocarbons (PAH) were observed below detection limit. Bacteriological parameters such as *E.coli* was observed in the range of <1.8 to 13 MPN Index/100 mL, Total Coliforms were observed in the range between <1.8 to 90 MPN Index/100 mL and and Faecal Coliforms were observed in the range between 2.8 to 46 MPN Index/100 mL.