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Ports and Logistics

Karaikal Port Private Limited (KPPL)

Comprehensive EIA for Master Plan of Karaikal Port, Thirumalairayan Pattinam Commune Panchayat, Keezha Vanjore village, Karaikal district, Puducherry

Draft EIA/EMP Report

Study Period Winter, Summer and Pre-monsoon 2025

Volume -II

April, 2026

Submitted by

QCI-NABET Accredited EIA Consultant

FALCON RESILIENT
INFRA CONSULTANTS

NABET/EIA/23-26/SA 0236

Appendices

Appendix A

Existing Environmental, CRZ Clearances and CTO

No.10 3/2006 IA-III
Government of India
Ministry of Environment and Forests
(IA-III Division)

Paryavaran Bhavan,
CGO Complex, Lodhi Road,
New Delhi – 110003.

Dated the 6th May, 2006

Sub: Development of Karaikal Port by Department of Industrial Development (Port), Government of Pondicherry at Karaikal under BOT basis by M/s Marg Constructions Limited, Chennai – Coastal Regulation Zone Clearance – regarding.

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Reference is invited to your letter No.448/DSTE/PCZMA/NOC/JE-II/2005/245, dated 6.2.2006 and No.448/DSTE/PCZMA/NOC/JE/2006/720, dated 23.3.2006 from Environment and Forest Department, Government of Pondicherry regarding the above project. Subsequent letters dated 13.2.2006, dated 11.2.2006, dated 13.3.2006, dated 23.3.2006 from M/s Marg Constructions has also been taken into account. No Objection Certificate from Pondicherry Pollution Control Committee vide their letter No.PPCC/NOC/KKL/JE/2006/303, dated 9.2.2006 has also been obtained.

The project involves construction of a minor port declared by Government of Pondicherry at Karaikal under BOT basis by M/s Marg Constructions Limited, Chennai. The Project is located 9 kms from Karaikal town near Vanjiyur village. The above port is to be developed as all weather port. The land requirement of the project is 500 acres of which 60 acres is under the possession of Government of Pondicherry and the remaining area is under process of acquisition. The project proponent indicated that the Government of Pondicherry has issued a notification regarding the acquisition of the land. Further, the 500 acres of land is free from human habitation; hence, no rehabilitation and resettlement. The port is located close to NH45A. A railway line is also proposed connecting Nagore and Karaikal. The project involves development of breakwater namely,-

(i) South breakwater 600 mts and
(ii) North breakwater 600 mts.

The project involves dredging for creation of a draft varying between -12 m CD to 13.5 m CD covering turning circle, berthing areas, inner navigation channel and outer navigational channel through capital dredging. The total dredging volume in the immediate phase development is estimated to be around 8.0 million cum, will be pumped on to the shore for refilling the breakup area. Based on the marine geotechnical investigations in the harbour basin and navigational channel area, it can be seen that the type of dredged material is predominantly sandy in nature and therefore suitable to be used for refilling purposes.

Since the port back up area is low lying, it is proposed to raise the general ground level so as to enable planning of stack yards and other storages. It is proposed to raise this land uniformly using the dredged materials as reclamation fill. Hence, no disposal of dredged material into the sea and no requirement of borrow material from external sources.

The project also involves construction of two berths one for coal and other for general cargo. The water requirement of the project is around 105 m cu per day which will be drawn from the river Vellar.

For the short term development it is proposed that a channel width of one way of 160 m will be developed with channel depth of outer channel of 13 m and inner channel of 12 m. the manuring area dimension is 280 mts radius and 13 m depth. It was indicated that all navigational facilities cargo handling equipments and utilities and services will be provided. The water will be recycled and used for plantation.

As per the Coastal Regulation Zone map the area is classified as CRZ-III and the HTL/LTL has been demarcated by Anna University.

The proposal has been examined in the Ministry of Environment & Forests and environmental clearance to this project is hereby accorded under Coastal Regulation Zone, Notification, 1991 subject to effective implementation of the following conditions:

A. SPECIFIC CONDITIONS:

(i) All the conditions stipulated in the No Objection Certificate from Pondicherry Pollution Control Committee vide their letter No.PPCC/NOC/KKL/JE/2006/303, dated 9.2.2006 should be strictly implemented.

(ii) The reclamation of the port area should be carried out with the dredged material, dredged material should not be dumped into the sea. No reclamation should be carried outside the port limits.

(iii) Quarry material should be transported from the identified quarries at Pudukottai. The quarry material will be transported in close trucks in order to prevent spills.

(iv) The coastal protection works should be carried out after detailed hydrodynamic modelling studies and it should be ensured that no erosion or accretion takes place in other areas due to the shore protection works.

(v) Reclamation of 500 acres should be carried out only for port development. The height of the reclaimed area will be maintained above the maximum flood level.

(vi) No groundwater should be tapped for the project. The water should be sourced from Vettar river after obtaining necessary permission from the concerned agencies.

(vii) The wave tranquillity study and the ship manuring studies carried out should be taken into account while operating the port.

(viii) The revetment should be designed after conducting flume studies and the section designed based on this study.

(ix) The project proponent should ensure that during construction and operation of the port there will been impact on the livelihood of the fisherman. The fishermen should be provided free access to carry out the fishing activity.

(x) Al necessary procaution while undertaking construction and operation of the port should be taken keeping in view the bathymetric changes caused due to tsunami.

(xi) All development in the port should be carried out in accordance with the Coastal Regulation Zone Notification, 1991 and approved Coastal Zone Management Plan of Pondicherry.

(xii) The ecological and terrestrial studies should be carried out by recognised scientific institutions and report submitted to this Ministry every six months.

(xiii) The project proponent should get the Coastal Regulation Zone map re-examined by Pondicherry Coastal Zone Management Authority with regard to the High Tide Line and Low Tide Line demarcation and submit the correct version of the Coastal Regulation Zone map to this Ministry within three months from the date of receipt of this letter.

(xiv) The project proponent should undertake a comprehensive hydrodynamic modelling study with regard to river diversion and submit the report to the Ministry within 6 months from the date of receipt of this letter. Further, the unit should comply with all the findings/recommendations of the study.

(xv) Construction labour camps should be located outside Coastal Regulation Zone areas and should be provided with adequate cooking and sanitation facilities.

B. GENERAL CONDITIONS:

(i) Development of the proposed channel should be undertaken meticulously conforming to the existing Central/local rules and regulations including Coastal Regulation Zone Notification, 1991 and its amendments. All the construction designs/drawings relating to the proposed development activities must [illegible]

(ii) A well-equipped laboratory with suitable instruments to monitor the quality of air and water shall be set up as to ensure that the quality of ambient air and water conforms to the prescribed standards. The laboratory will also be equipped with qualified manpower including a marine biologist so that the marine water quality is regularly monitored in order to ensure that the marine life is not adversely affected as a result of implementation of the said project. The quality of ambient air and water shall be monitored periodically in all the seasons and the results should be properly maintained for inspection of the concerned pollution control agencies. The periodic monitoring reports at least once in 6 months must be send to this Ministry (Regional Office at Bangalore) and Pollution Control Committee.

(iii) Adequate provisions for infrastructure facilities such as water supply, fuel for cooking, sanitation etc. must be provided for the laborers during the construction period in order to avoid damage to the environment. Colonies for the laborers should not be located in Coastal Regulation Zone area. It should also be ensured that the construction workers do not cut trees including mangroves for fuel wood purpose.

(iv) To prevent discharge of sewage and other liquid wastes into the water bodies, adequate system for collection and treatment of the wastes must be provided. No sewage and other liquid wastes without treatment should be allowed to enter into the water bodies.

(v) Appropriate facility should be created for the collection of solid and liquid wastes generated by the barges/vessels and their safe treatment and disposal should be ensured to avoid possible contamination of the water bodies.

(vi) Necessary navigational aids such as channel markers should be provided to prevent accidents. Internationally recognized safety standards shall be applied in case of barge/vessel movements.

(vii) The project authorities should take appropriate community development and welfare measures for villagers in the vicinity of the project site, including drinking water facilities. A separate fund should be allocated for this purpose.

(viii) The quarrying material required for the construction purpose should be obtained only from the approved quarries/borrow areas. Adequate safeguard measures shall be taken to ensure that the overburden and rocks at the quarry site do not find their way into water bodies.

(ix) For employing unskilled, semi skilled and skilled workers for the project, preference should be given to local people.

(x) The recommendations made in the Environmental Management Plan and Disaster Management Plan, as contained in the Environmental Impact Assessment and Risk Analysis Reports of the project shall be effectively implemented.

(xi) A separate Environmental Management Cell with suitable qualified staff to carry out various environment should be set up under the charge of a Senior Executive who will report directly to the Chief Executive of the Company.

(xii) The project affected people, of any should be properly compensated and rehabilitated.

(xiii) The funds earmarked for environment protection measures should be maintained in a separate account and there should be no diversion of these funds for any other purpose. A year-wise expenditure on environmental safeguards should be reported to this Ministry.

(xiv) Full support should be extended to the officers of this Ministry's Regional Office at Bangaloe and the officers of the Central and State Pollution Control Boards by the project proponent during this inspection for monitoring purposes, by furnishing full details and action plans including the action plans including the action taken reports in respect if mitigative measures and other environmental protection activities.

(xv) In case there is an intention of deviation or alternation in the project including the implementing agency, a fresh reference should be made to this Ministry for modification in the clearance conditions or

imposition of new ones for ensuring environmental protection. The project proponents should be responsible for implementing the suggested safeguard measures.

(xvi) This Ministry reserves the right to revoke this clearance, if any of the conditions stipulated are not complied with to the satisfaction of this Ministry.

(xvii) This Ministry or any other competent authority may stipulate any additional conditions subsequently, if deemed necessary for environmental protection, which shall be complied with.

(xviii) The project proponent should advertise atleast in two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the State Pollution Control Board and may also be seen at Website of the Ministry of Environment & Forests at http://www.envfornic.in. The advertisement should be made within 7 days from the date of issue of the clearance letter and a copy of the same should be forwarded to the Regional Office of this Ministry at Bangalore.

(xix) The project proponents should 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.

The above mentioned stipulations will be enforced among others under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, the Hazardous Chemicals (Manufacture, Storage and Import) Rules, 1989, the Coastal Regulation Zone Notification, 1991 and its subsequent amendments and the Public Liability Insurance Act, 1991 and the Rules made thereunder from time to time. The project proponents should also ensure that the proposal complies with the provisions of the approved Coastal Zone Management Plan of Pondicherry and Supreme Court's order dated 18th April, 1996 in the Writ Petition No.664 of 1993 to the extent the same are applicable to this proposal.

(A. Senthil Vel)
Additional Director

To

Chairman,
Pondicherry Coastal Zone Management Authority,
Government of Pondicherry,
Department of Science, Technology and Environment,
Anna Nagar, Pondicherry – 5.

Copy to:

1. The Chairman, Pondicherry Pollution Control Committee, 3rd Floor, Housing Board Building, Anna Nagar, Nellithope, Pondicherry – 5. Ph:0413 – 2201256 (O).
2. The Chief Conservator of Forests (Central), Ministry of Environment & Forests, Regional Office (SZ), Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, I Block, Koramangla, Bangalore – 560034.
3. The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, Delhi – 110032.
4. M/s Marg Constructions, 501, apex Chambers, 5th Floor, 20, Thiyagarnya Road, T. Nagar, Chennai - 600017.
5. DIG (SU), Regional Office Cell, Ministry of Environment & Forests, New Delhi.
6. Guard File.
7. Monitoring Cell.
8. Director (EI), Ministry of Environment & Forests, New Delhi.

(A. Senthil Vel)
Additional Director

No.10-2/2006-IA-III
Government of India
Ministry of Environment and Forests
(IA-III Division)

Paryavaran Bhavan,
CGO Complex, Lodhi Road,
New Delhi - 110003.

Dated the 15th October, 2008

Sub: Development of Karaikal Port by Department of Industrial Development (Port), Government of Pondicherry at Karaikal under BOT basis by M/s Marg Limited, Chennai – Coastal Regulation Zone Clearance – regarding.

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Reference is invited to the letter No.Nil, dated 28.6.2008, dated 5.7.208 and 15.7.2008 and No.KPPL/ENVT/11/2008, dated 15.9.2008 from the M/s MARG Limited and the clearance issued by the Ministry vide letter No.10-2/2006, dated 6.5.2006 on the above subject.

2. The project proposal is for amendment of the Specific Condition No.(ii) of the environmental clearance dated 6.5.2006 as the proponent expressed his inability to use all the dredged material for reclamation in view of the increase in the dredging so as to provide for navigation by bigger vessels. It was indicated that the capital dredging is in progress in the turning circle and harbour basin areas and the dredged materials are presently being put to use for reclamation of land within the port limits. Although substantial quantity of the dredged material to an extent of 5.5 million cu m would be sufficient for the land filling, the remaining 2.5 to 3 million cu m is proposed to be dumped in the Sea. At present, 65% of the Phase-I project has been completed. Some of the deviations with regard to the earlier clearance are as follows:-

Description	As per Environmental clearance	Proposed presently
Port Traffic	4 MMTPA	4 MMTPA

Depths
• Inner Channel
  • Immediate
  • Ultimate
• Outer Channel
  • Immediate
  • Ultimate
	
	(-) 12.0 m
	(-) 15.3 m
	
	(-) 13.5 m
	(-) 16.0 m
		
		(-) 14.5 m
		(-) 15.3 m
		
		(-) 14.5 m
		(-) 16.0 m

Capital Dredging • Immediate Phase • Ultimate Phase	8.0 mcbm 14.5 mcbm	10.0 mcbm 14.5 mcbm
Reclamation Immediate Phase Ultimate Phase	8.0 mcbm 14.5 mcbm	(10-6.2=3.8) 6.2 mcbm (14.5-10=4.5) 14.5 mcbm

3. The entire dredged material obtained during the proposed dredging activity would be around 10 m cu m, of which 6.20 m cu m is proposed to be utilised for reclamation of 441 acres within the Port limits and the balance 3.8 m cu m would be disposed of into the sea. For the Phase-II of the project, which will involve a total dredging of 14.5 m cu m inclusive of the above dredging would be treated as a separate application by the Ministry. It was indicated that no additional cargo handling capacity is envisaged in the Phase-I of the Project. DHI have carried out the model studies with regard to the dumping sites and accordingly, three following sites:

Location	Latitude	Longitude
1.	10°52.8' N	80°0.5' E
2.	10°50.4' N	80°0.5' E
3.	10°48.0' N	80°0.5' E

4. The dumping site shall be between the site No.1 and 2 above, within the port limits. Further, the area for the dumping shall be such that the height of the dredged material shall not exceed more than 30 cms.

5. The proposal was considered by Expert Appraisal Committee at its meeting held on 30th & 31st July, 2008 and 18th & 19th September, 2008 and has recommended.

6. The proposal has been examined in this Ministry and environmental clearance under the provisions of Environmental Impact Assessment Notification 2006 and Ministry hereby agrees to amend A. Specific Condition No.(ii) by substituting the following two conditions which are as follows:-

(iia) It shall be ensured that during dredging and disposal the fishermen communities shall not be affected.
(iib) The dredged material shall be continuously monitored for its dispersion. In case there is an evidence of shoreline changes due to the dredging and disposal the project proponent shall immediately undertake detailed scientific studies and take necessary mitigative steps under intimation to this Ministry.

7. It may be noted that all conditions stipulated in the environmental clearance dated 6.5.2006 shall be adhered to. Further, any appeal against this environmental clearance shall lie with the National Environment Appellate Authority, if preferred, within a period of 30 days as prescribed under Section 11 of the National Environment Appellate Act, 1997.

(E. Thirunavukkarsu)
Deputy Director

To

Chairman,
Pondicherry Coastal Zone Management Authority,
Government of Pondicherry,
Department of Science, Technology and Environment,
Anna Nagar, Pondicherry – 5.

Copy to:

1. The Chairman, Pondicherry Pollution Control Committee, 3rd Floor, Housing Board Building, Anna Nagar, Nellithope, Pondicherry – 5. Ph:0413 – 2201256 (O).
2. The Chief Conservator of Forests (Central), Ministry of Environment & Forests, Regional Office (SZ), Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, I Block, Koranmangla, Bangalore – 560034.
3. The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, Delhi – 110032.
4. M/s Marg Limited, "Marg Axis", 4/318, Rajiv Gandhi Road, Kottivakkam, Chennai-600041.
5. DIG (SU), Regional Office Cell, Ministry of Environment & Forests, New Delhi.
6. Guard File.
7. Monitoring Cell.
8. Director (EI), Ministry of Environment & Forests, New Delhi.

(E. Thirunavukkarsu)
Deputy Director

SW. 4(D)

282

No. 10-42/2009-IA.III
Government of India
Ministry of Environment & Forests
(IA Division)

Paryavaran Bhawan,
CGO Complex, Lodhi Road,
New Delhi - 110 003.

Dated: 22nd September, 2009.

To
M/s. Karaikal Port Private Limited,
'Marg Axis', 4/318, Rajiv Gandhi Road,
Kottivakkam,
Chennai – 600 041,
Tamil Nadu.

Subject: Environmental and CRZ clearance for expansion of Karaikal Port (Phase-II) at Puducherry by M/s. Karaikal Port Pvt. Ltd. – Reg.

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This has reference to your application No: nil, dated 06.05.2009 seeking prior Environmental and CRZ Clearance for the above project under the EIA Notification – 2006 and CRZ Notification, 1991. The proposal has been appraised as per prescribed procedure in the light of provisions under the EIA Notification – 2006 and CRZ Notification, 1991 on the basis of the mandatory documents enclosed with the application viz., the Questionnaire, EIA, EMP and the additional clarifications furnished in response to the observations of the Expert Appraisal Committee constituted by the competent authority in its meetings held on 20th – 22nd July, 2009.

2. The Environmental Clearance for the development of Phase-I of Karaikal Port was accorded on 06.05.2006. The total area of the Port is 243 ha. The location is 10°50'N latitude and 79°51'E longitude. There are two rivers joining the sea near the Port, river Pravadayanar on the North and river Vettar on the South. The Phase-I of the project involved the construction of breakwaters, berths, a dredged navigational channel, construction of various buildings including warehouses and control tower in the first phase of development.

3. The present proposal (Phase-II) involves the construction of additional 3 berths, enhancement of handling capacity from 4 MMTPA to 20.5 MMTPA. Deepening and widening of the navigational channel, turning circle and berthing area. The total length of the additional 3 berths is approximately 705 m (Berth No.3 – Coal Berth, 300 m.; Berth No.7 – Edible Oil/Multipurpose, 255 m.; Berth No.9 – OSV/PSV, 150 m.). In the present development, the diameter of the turning circle will be increased to 500 m. and the depth to 15.5 m. The length of the approach channel will be increased to 9750 m. upto -16.5 m. contour.

Issued 23/9/09

2.3.2

The inner and the outer channel will be dredged upto -15.5 / -16.5 m. respectively. The width of the approach channel will be extended to 250 m. It is proposed to carry out dredging in the dock basin, turning circle and inner, outer channel areas. The total quantity of dredging to be done under phase II is estimated to be 20.5 m cbm (including 1.8 m cbm of maintenance dredging which is capitalized). Out of which 15 million m^3 is proposed to be disposed offshore and 5 million m^3 for reclamation and beach nourishment. The total water requirement proposed is 350 KLD. Desalination RO water will be sources for port use for Phase-II. The capacity of STP proposed is 50 KLD. Waste water treatment facility is being set up within the port area and the treated water will be used for green belt development. Solid waste will be disposed off as per the prescribed solid waste management guidelines. The total energy requirement for the port will be 6 – 8 MW and will be sourced from the State Electricity Board. The proposal does not involve any further acquisition of land. About 50,000 trees are proposed within the port limits and 1,00,000 trees around the port.

4. The project falls under activity 7(e) "Port and Harbours" of EIA Notification 2006 and also attracts CRZ Notification 1991, falls under CRZ-III. The Puducherry Coastal Zone Management Authority has discussed the project in its meeting held on 12.02.2009 and recommended for the issue of CRZ Clearance vide letter No. DSTE/PCZMA/NOC/JE/2009/3092, dated 20.02.2009.

5. The Expert Appraisal Committee, after due consideration of the relevant documents submitted by the project proponent and additional clarifications furnished in response to its observations, have recommended for the grant of Environmental and CRZ Clearance for the project. Accordingly, the Ministry hereby accord necessary Environmental and CRZ Clearance for the above project as per the provisions of EIA Notification, 2006 and CRZ Notification, 1991 and its subsequent amendments, subject to strict compliance of the terms and conditions as follows:

6. **Specific Conditions:**

(i) The quality of river water of both the rivers shall be re-assessed and report shall be submitted to the Ministry within three months.

(ii) No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.

(iii) Washing from Auction Hall /Sewage shall be treated and the Treatment Facility shall be provided in accordance with the Coastal Regulation Zone Notification, 1991. The disposal of treated water shall confirm the regulation of Puducherry Pollution Control Board.

(iv) Putrefied and discarded parts of fishes shall be removed and disposed off in the approved landfill/used as manure/poultry feed.

(v) Oil spills if any shall be properly collected and disposed as per the Rules.

(vi) The approach channel shall be properly demarcated with lighted buoys for safe navigation and adequate traffic control guidelines shall be framed. The fishermen shall be suitably educated and informed about the traffic guidelines.

(vii) The project proponent shall set up separate environmental management cell for effective implementation of the stipulated environmental safeguards under the supervision of a Senior Executive.

(viii) The project proponent shall take up mangrove plantation/green belt in the project area, wherever possible. Adequate budget shall be provided in the Environment Management Plan for such mangrove development.

(ix) The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.

7. General Conditions:

(i) 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.

(ii) Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.

(iii) 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.

(iv) 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.

(v) Adequate precautions shall be taken during transportation of the construction material so that it does not affect the environment adversely.

(vi) 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.

(vii) 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.

(viii) The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with the satisfaction of the Ministry.

(ix) 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 and Forests.

(x) The project proponents 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.

(xi) Puducherry 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.

8. 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 1994, including the amendments and rules made thereafter.

9. 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.

10. 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 Environmental Clearance and copies of clearance letters are available with the Puducherry Pollution Control Board and may also be seen on the website of the Ministry of Environment and Forests 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.

11. Environmental 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.

12. Any appeal against this Environmental Clearance shall lie with the National Environment Appellate Authority, if preferred, within a period of 30 days as prescribed under Section 11 of the National Environment Appellate Act, 1997.

13. A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zilla Parisad/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.

14. The proponent shall upload the status of compliance of the stipulated EC conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM, SO_2, NOx (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.

15. The project proponent shall also submit six monthly reports on the status of compliance of the stipulated EC 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.

16. 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 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 EC conditions and shall also be sent to the respective Regional Offices of MoEF by e-mail.

(Bharat Bhushan)
Director (IA-III)

Copy to:

(1) The Secretary, Department of Environment, Government of Puducherry, Puducherry.
(2) The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi – 110 032.
(3) The Member Secretary, Puducherry Coastal Zone Management Authority and Department of Science, Technology & Environment, Government of Puducherry, Anna Nagar, Puducherry – 5.
(4) The Member Secretary, Puducherry Pollution Control Board, Puducherry.
(5) The CCF, Regional Office, Ministry of Environment & Forests(SZ), Kendriya Sadan, IVth floor, E&F wings, 17th Main Road, Koramangala II Block, Bangalore – 560 034.
(6) IA - Division, Monitoring Cell, MOEF, New Delhi – 110 003.
(7) Guard file.

(Bharat Bhushan)
Director (IA-III)
22.09.2009

F. No. 11-35/2010-IA.III

Government of India
Ministry of Environment & Forests
(IA-III Division)

Paryavaran Bhawan,
CGO Complex, Lodhi Road,
New Delhi - 110 003,

Dated: 25th October, 2010

To
M/s Karaikal Port Private Ltd.,
Devs Ark, No. 284/1136,
Rajiv Gandhi Road, Kottivakkam,
Chennai – 600 096

Subject: CRZ clearance for permission to handle crude oil and petroleum products connecting Chidambaranar Oil Jetty at Nagore and KPPL jetty M/s Karaikal Port Private Trust - Reg.

This has reference to letter dated 15.04.2010 seeking prior CRZ Clearance under the Coastal Regulation Zone (CRZ) Notification, 1991. The proposal has been appraised as per prescribed procedure in the light of provisions under the Coastal Regulation Zone Notification, 1991 on the basis of the mandatory documents enclosed with the application viz., the Questionnaire, recommendation of Coastal Zone Management Authority, the additional clarifications furnished in response to the observations of the Expert Appraisal Committee constituted by the competent authority in its meetings held on 18th –20th August, 2010.

2. It is interalia, noted that the proposal involves Chennai Petroleum Corporation Limited (An subsidiary of IOCL) owns and operates Chidambaranar Oil Jetty at Nagapatinam for transporting Crude Oil to their refinery. For better capacity utilization and efficiency in operation, Chennai Petroleum Corporation Limited proposes to transport Crude Oil by laying pipeline interconnecting Karaikal Port Berth facilities and their existing Chidambaranar Oil Jetty pipeline in Nagapatinam, Tamilnadu. Initial estimation of handling will be one million metric tonnes of Crude Oil and other petroleum products per annum. Karaikal Port Private Limited has identified Berth No. 1 for the above purpose. The Berth No. 1 is presently used for general and bulk cargo. The above change in use does not involve any additional construction activities.

3. Puducherry Coastal Zone Management Authority discussed the proposal in the 23rd meeting of the Puducherry Coastal Zone Management Authority held on 25.06.2010 and recommended the proposal for CRZ Clearance vide letter no. 448/DSTE/PCZMA/CLR/JE/2010/526 dated 16th July, 2010.

4. The Expert Appraisal Committee, after due consideration of the relevant documents submitted by the project proponent and additional clarifications furnished in response to its observations, have recommended for the grant of CRZ Clearance for the project. Accordingly, the Ministry hereby accords necessary CRZ Clearance for the above project as per the provisions of CRZ Notification, 1991 and its subsequent amendments, subject to strict compliance of the terms and conditions as follows:

5. SPECIFIC CONDITIONS:

Construction Phase

(i) "Consent for Establishment" shall be obtained from Puducherry Pollution Control Committee under Air and Water Act and a copy shall be submitted to the Ministry before start of any construction work at the site.

(ii) Oil contingency plan shall be implemented.

(iii) Risk Assessment & Emergency Management Plan shall be prepared.

(iv) Construction shall be carried out strictly as per the provisions of CRZ Notification, 1991. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area

(v) There shall be no disposal of solid and liquid wastes in to the Coastal areas.

(vi) Sewage Treatment facility should be provided in accordance with the CRZ Notification. Treated sewage shall be reused for flushing of toilets and horticulture purposes.

(vii) The solid waste shall be properly collected, segregated and disposed as per the provision of Solid Waste (Management and Handling) Rules, 2000.

(viii) Installation and operation of DG set if any shall comply with the guidelines of CPCB.

(ix) Under the provisions of Environment (Protection) Act, 1986, legal action shall be initiated against the project proponent if it was found that construction of the project has been started without obtaining environmental clearance.

6. General Conditions:

(i) The construction of the structures should be undertaken as per the plans approved by the concerned local authorities/local administration, meticulously conforming to the existing local and Central rules and regulations including the provisions of Coastal Regulation Zone Notification dated 19.02.1991 and the approved Coastal Zone Management Plan of Puducherry.

(ii) In the event of any change in the project profile a fresh reference shall be made to the Ministry of Environment and Forests.

(iii) This Ministry reserves the right to revoke this clearance, if any, of the conditions stipulated are not complied with to the satisfaction of this Ministry.

(iv) This Ministry or any other competent authority may stipulate any additional conditions subsequently, if deemed necessary, for environmental protection, which shall be complied with.

(v) Full support should be extended to the officers of this Ministry's Regional Office at Bangalore and the offices of the Central and State Pollution Control Board by the project proponents during their inspection for monitoring purposes.

7. 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 Municipal Solid Wastes (Management and Handling) Rules, 2000 including the amendments and rules made thereafter.

8. 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.

9. The project proponent should 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 Environmental Clearance and copies of clearance letters are available with the Puducherry Pollution Control Board and may also be seen on the website of the Ministry of Environment and Forests 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.

10. Environmental 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.

11. Any appeal against this Environmental Clearance shall lie with the National Environment Appellate Authority, if preferred, within a period of 30 days as prescribed under Section 11 of the National Environment Appellate Act, 1997.

12. A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zilla Parisad/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.

13. Status of compliance to the various stipulated environmental conditions and environmental safeguards will be uploaded by the project proponent in its website.

14. The project proponent shall also submit six monthly reports on the status of compliance of the stipulated EC 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.

15. 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 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 EC conditions and shall also be sent to the respective Regional Offices of MoEF by e-mail.

(Bharat Bhushan)
Director (IA-III)

Copy to:

The Secretary, Department of Environment & Forests, Department of Science, Technology and Environment, Housing Board Building, Annanagar, Puducherry – 605 001.

The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD-cum- Office Complex, East Arjun Nagar, Delhi – 110 032.

The Chairman, Puducherry Coastal Zone Management Authority & The Director, Department of Science, Technology and Environment, Housing Board Building, Annanagar, Puducherry – 605 001.

The Chief Conservator of Forests, Ministry of Environment and Forests, Regional Office, Western Region, Kendriya Paryavaran Bhavan, Link Road No. 3, Ravishankar Nagar, Bangalore – 462016 Karnataka.

The Chairman, Puducherry Pollution Control Committee, Department of Science,Technology & Env Housing Board Complex, IIIrd Floor Pondicherry-600 005
Director (EI), Ministry of Environment and Forests.
Guard File.

(Bharat Bhushan)
Director (IA-III)

F.No. 10-42/2009-IA-III
Government of India
Ministry of Environment and Forests
(IA-III Division)

Paryavaran Bhavan,
CGO Complex, Lodhi Road,
New Delhi – 110003,

Dated: 20th May, 2011

To
M/s Karaikal Port Ltd
Kheezhavanjoor Village, T R Pattinam, P B No. 33,
Karaikal – 609 606

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

Reference is invited to this Ministry's environment clearance letter of 10-42/2010-IA-III dated 19.04.2010 regarding the subject mentioned above.

2. The present proposal includes replacing Berth no. 7 by Berth No. 4. for 10 MTPA Coal handling instead of for the edible oil/ multipurpose. It has been observed from the EIA studies that the proposed expansion activities have insignificant impact on the environment. The baseline environmental data measured/recorded are well within the prescribed CPCB standards. No Rehabilitation and Re-settlement issues are involved.

3. The Puducherry Coastal Zone Management Authority has discussed the proposal in its 23rd meeting held on 25.06.2010 and recommended the proposal vide letter No. 448/DSTE/PCZMA/CLR/JE/2010/525 dated 06.07.2010.

4. The Expert Appraisal Committee, after due consideration of the relevant documents submitted by the project proponent and additional clarifications furnished in response to its observations, have recommended for the grant of CRZ Clearance for the project. Accordingly, the Ministry hereby accords necessary CRZ Clearance for the above project as per the provisions of CRZ Notification, 2011, subject to strict compliance of the terms and conditions as follows:

(i) The shore line map prepared by Institute for Ocean Management, Chennai with regard to the stretch at Karaikal Port has bee examined and it is observed that on the southern side of the port, the area is shown as medium accretion while, on the northern side the area is shown as medium erosion. This is because the net littoral drift is towards the northern side and due to the breakwater at the southern port there seems to be accretion at the southern breakwater and medium erosion on the northern side. This reveals that the existing measures for beach nourishment maintenance of shore line are insufficient. Those have to be rectified by adopting suitable measures viz. sand bypass system from south breakwater to the northern side of

the north breakwater. The Port shall submit the details of action taken to the Ministry within 2 months.

(ii) The Port shall adopt suitable measures viz. sand bypass system from south breakwater to the northern side of the north breakwater. The Port shall submit the details of action taken to the Ministry within 2 months

(iii) There shall be regular monitoring on the shoreline changes and report be submitted to the Ministry at Regional Office, Bangaluru with six-monthly monitoring report.

(iv) "Consent for Establishment" shall be obtained from Puducherry Pollution Control Committee under Air and Water Act and a copy shall be submitted to the Ministry before start of any construction work at the site.

(v) Construction shall be carried out strictly as per the provisions of CRZ Notification, 1991. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area

(vi) There shall be no disposal of solid and liquid wastes in to the Coastal areas.

(vii) Dust control measures shall be installed wherever required in the coal handling areas.

(viii) The leachate from the coal yard shall be properly collected and passed through settling tanks before reuse/recycling.

5. All other conditions shall remain unchanged.

(Bharat Bhushan)
Director
20.05.2011

Copy to:

1. The Secretary, Environment/ Chairman, Puducherry Coastal Zone Management Authority/ Chairman, Puducherry Pollution Control Committee, Chief Secretariat, Puduchery-605 001.
2. The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD-cum- Office Complex, East Arjun Nagar, Delhi – 110 032.
3. The Chief Conservator of Forests, Ministry of Environment and Forests, Regional Office, Western Region, Kendriya Paryavaran Bhavan, Link Road No. 3, Ravishankar Nagar, Bangaluru – 462016 Karnataka.
4. Director (EI), Ministry of Environment and Forests.
5. Guard File.

(Bharat Bhushan)
Director

F.No.10-42/2009-IA.III
Government of India
Ministry of Environment, Forests & Climate Change
(IA-III Section)

Indira Paryavaran Bhawan,
Jor Bagh Road,
New Delhi - 110 003

Dated: 3rd February, 2015

To
The Assistant Vice President
(Port Operations),
M/s. Karaikal Port Pvt. Ltd.,
Keezhavanjore Village, T R Pattinam,
Karaikal – 609 606, Puducherry
E-mail:vetrivelramadoss@marggroup.com

Subject: Expansion of Karaikal Port (Phase-II) at Puducherry by M/s. Karaikal Port Pvt. Ltd. – Extension of validity of Environmental and CRZ Clearance reg.

***

Reference may be made to the letter No: KPPL/ENV/MoEF/025 dated 08.09.2014 and subsequent letter dated 08.10.2014 seeking extension of validity of Environmental and CRZ Clearance granted vide letter no. F.No.10-42/2009-IA-III dated 22.09.2009.

2. The proponent informed that while majority of the works in Phase II construction activities have been completed, some activities such as the completion of the Coal Mechanisation got delayed due to some unavoidable reasons such as the Right of Way (RoW) issues, availability of enhanced power allotment by the Puducherry Electricity Department (PED), the erection, testing, commissioning and the operation of the fully Mechanised coal Handling system. These issues have however been closed now with the PED having agreed to allot 5 MVA of power immediately. The balance dredging is also in progress. After the receipt of the power the Coal Mechanisation Project will be completed and parallely the remaining dredging requirements will be met.

3. The issue was discussed by the EAC in its 138th meeting held on 29th September, 2014 – 1st October, 2014 and committee recommended for the extension of validity of the clearance dated 22.09.2009 for a period of three years. The Ministry of Environment, Forests & Climate Change hereby extends the validity of the Environmental and CRZ Clearance up to 21.09.2017.

4. All other conditions in the Environmental and CRZ Clearance no. 10-42/2009-IA-III dated 22.09.2009 remain unchanged.

03 Feb 2015

(Dr. Manoranjan Hota)
Director

Received 17/02/15

Copy to:

1. The Secretary, Environment/Chairman, Puducherry Coastal Zone Management Authority/ Chairman, Puducherry Pollution Control Committee, Chief Secretariat, Puduchery-605 001.
2. The Chairman, CPCB, Parivesh Bhavan, CBD-cum- Office Complex, East Arjun Nagar, Delhi – 110 032.
3. Additional Principal Chief Conservator of Forests (C), Ministry of Environment, Forests and Climate Change, RO, 1st Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai – 34.
4. Director (EI), Ministry of Environment, Forests and Climate Change.
5. Guard File.

03/03/2015

(Dr. Manoranjan Hota)
Director

F. No. 10-42/2009-IA-III
Government of India
Ministry of Environment, Forest and Climate Change
(IA.III Section)

Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi - 3

Date: 14th May, 2018

To,

Capt. Prasad Rebala,
Chief Operating Officer,
Karaikal Port Pvt. Ltd.,
Keezhavanjore Village, T R Pattinam,
Karaikal - 609606,
Puducherry.

Phone: 04365-25600(05 Lines); **Fax:** 04365-256603
Email: prasad.rebala@karaikalport.com

Subject: Expansion of Karaikal Port Phase II at Puducherry by M/s Karaikal Port Pvt. Ltd. - Extension of validity of Environmental and CRZ Clearance – reg.

Sir,

This has reference to your online proposal No. IA/PY/MIS/26984/2009 dated 07.08.2017, submitted to this Ministry for grant of extension of validity of Environmental Clearance and CRZ Clearance in terms of the provisions of the Environment Impact Assessment (EIA) Notification, 2006 under the Environment (Protection) Act, 1986.

2. The proposal for grant of Extension of validity of Environmental Clearance and CRZ Clearance to the project *'Expansion of Karaikal Port Phase II at Puducherry by M/s Karaikal Port Pvt. Ltd. - Extension of validity of Environmental and CRZ Clearance'* was considered by the Expert Appraisal Committee (Infra-2) in its meetings held on 21st - 24th August, 2017. The details of the project, as per the documents submitted by the project proponent, and also as informed during the above meeting, are under:-

(i) The Karaikal Port is a Greenfield, deepwater, multi-purpose all weather sea port being developed on Build, Operate and Transfer format under Public Private Partnership with the Government of Puducherry in terms of concession agreement awarded by the Government of Puducherry to M/s Karaikal Port Pvt. Ltd.

(ii) The port is being developed in phases and as a part of the Phase II development, three more berths have been added and the handling capacity enhanced to 20.5 MMTPA. The Environmental Clearance for the development of Phase II of Karaikal Port was accorded vide letter 10-42/2009-IA-III dated 22.09.2009, to which an extension for a further period of three years was granted vide letter F-10-42/2009/IA-III dated 03.02.2015.

(iii) Phase II implementation got delayed due to some unavoidable reasons such as the Right of Way (RoW) issues, availability of enhanced power allotment by the Puducherry Electricity Department (PED), and as result the erection, testing, commissioning and the operation of the fully mechanized coal handling system.

(iv) Above issues have been resolved now and project proponent are in the process of remobilization of the contractors to start the held up project. The task will require about 12 to 18 months more to complete.

(v) Therefore, project proponent requested for the time extension of the validity of the EC dated 22.09.2009 extended upto 21.09.2017 be extended further for a period of two years to complete the various components of the Phase II project.

3. The EAC, in its meeting held on 21st-24th August, 2017 noted that maximum validity for any project may be 10 years and Environmental & CRZ Clearance was granted vide letter No. 10-42/2009-IA-III dated 22.09.2009 for the project. The MOEF&CC vide order dated 03.02.2015 have extended validity of the E&CRZC for the project by 3 (three) years from 22.09.2014 to 21.09.2017. EAC after detailed deliberations on the proposal has recommended for grant of Extension of validity of Environmental and CRZ Clearance dated 22.09.2009 to the project.

As per recommendations of the EAC, the Ministry of Environment, Forest and Climate Change hereby accords Extension of the validity of Environmental and CRZ Clearance dated 22.09.2009 for 2 more years i.e. from 22.09.2017 to 21.09.2019.

4. All other terms and conditions mentioned in this Ministry's EC letter no. 10-42/2009-IA.III dated 22.09.2009 shall remain the same.

5. This issues with the approval of the Competent Authority.

(Kushal Vashist)
Director

Copy to:

1. The Principal Secretary, Department of Science, Technology and Environment, Government of Puducherry, Near Indira Gandhi Statue, 1st Cross, Nellithope, Anna Nagar, Puducherry, 605003.
2. Addl. Principal Chief Conservator of Forests (Central), Ministry of Environment, Forests and Climate Change, Ist and IInd Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai-34, (E-mail: roefccc@gmail.com).
3. The Chairman, Central Pollution Control Board Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi - 110 032.
4. The Member Secretary, Department of Science, Technology & Environment, Puducherry Coastal Zone Management Authority, IIIrd -Floor, Pondicherry Housing Board, Anna Nagar, Puducherry -605 005
5. The Member Secretary, Puducherry Pollution Control Committee, Department of Science, Technology and Environment, Government of Puducherry, Near Indira Gandhi Statue, 1st Cross, Nellithope, Anna Nagar, Puducherry, 605003.

6. Monitoring Cell, MoEF&CC, Indira Paryavaran Bhavan, New Delhi.

7. Guard File/ Record File/ Notice Board.

(Kushal Vashist)
Director

File No. 10-42/2009-IA.III
[Proposal No. IA/PY/MIS/26984/2009]
Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj
New Delhi - 110 003
Dated: 5th August, 2021

To

M/s Karaikal Port Private Limited
Keezhavanjore Village, T R Pattinam,
Karaikal -609 606
Puducherry

Subject: Expansion of Karaikal Port (Phase-II) at Puducherry by M/s Karaikal Port Pvt. Ltd. – Further consideration for Amendment in Environmental and CRZ Clearance -Amendment to Environmental and CRZ Clearance.

Sir,

This has reference to your online proposal No. IA/PY/MIS/26984/2009 submitted to this Ministry on 16th Sept. 2018, seeking Amendment in Environmental and CRZ Clearance for the aforementioned project as per the provisions of the Environment Impact Assessment (EIA) Notification, 2006 and subsequent amendments under the Environment (Protection) Act, 1986.

2. The above mentioned proposal was considered by the Expert Appraisal Committee (EAC) for Infrastructure, CRZ and other miscellaneous projects in its 265th meeting during 23rd - 24th June, 2021, in the Ministry of Environment, Forest and Climate Change, New Delhi.

3. The project proponent M/s Karaikal Port Pvt. Ltd made a presentation through video conferencing and provided the following information before the Committee:

(i) Karaikal Port started commercial operations during the year 2009. Phase II EC was obtained from MoEF vide letter No. 10-42/2009-IA.III dated 22nd September 2009 with enhancement in cargo handling capacity from 4.0 MMTPA to 20.5 MMTPA.

(ii) The request for EC Amendment was made due to the conditions prescribed by Puducherry Pollution Control Committee (PPCC) while renewal of consent to operate issued under Air and Water Acts in 2018. The condition explicitly mentioned that the categorization of cargoes shall be made by way of Amendment made in EC and it shall be categorised as per EIA Guidance Manual on Ports & Harbours, prepared by Administrative Staff College of India, Hyderabad published in February 2010. As per the Guidance Manual, the cargoes which are being handled at Karaikal Port have been categorized as Dry Bulk and Break Bulk and Liquid Cargo.

(iii) Details of Cargo permitted by MoEF&CC in various EC/CRZ clearance letters and as permitted by PPCC and the request of PP for Categorization and Nomenclature Change are as following:

EC 2006 (4 MMTPA)	EC 2009 (20.5 MMTPA)	PPCC permitted Cargo - CTO	Categorization as per ASCI Ports & Harbour Manual	Nomenclature as recommended by 36th EAC , Nov 2018
Coal	Coal	Coal	Dry Bulk	Coal, Fertilizer, Clay, Iron Ore, Gypsum, Limestone, Dolomite, Aggregate, Clinker, Agro Products (Corn, Wheat, Sugar, Red Chillies), Wood Chips, Cement in Bulk, Sand
General Cargo	General Cargo	General Cargo (Textiles, Machinery, Timber, Steel, Containers, Granite, Marble slabs, Iron Ore, Fertilizers, Clay, Gypsum, Limestone, Agro Products like Sugar, Red Chillies, Wheat, Corn, Salt & Cement in Bags, Wood Chips, Aggregates, Dolomite & Clinkers	Break Bulk/General Cargo	Textiles, Machinery, Timber, Steel, Containers, Granite, Marble slabs, Fertilizers in Bags, Agro Products such as Corn in Bags, Wheat , Red Chillies, Wood Chips, Cement in Bags, Salt
		Sand		
		Cement in Bulk		
	EdibleOil/Multi purpose	Edible Oil	Liquid Cargo	Edible Oil
Note – PPCC – Puducherry Pollution Control Committee; CTO – Consent to Operate				

(iv) Based on the above, the following cargo categorization of Cargo has been requested for-

Bulk Cargoes (18.0 MTPA)		**Liquid Cargoes (2.5MTPA)**
Dry Bulk	**Break Bulk/General Cargo**	
Coal	Textiles	Edible Oil
Fertilizers	Machinery	
Clay	Timber	
Iron Ore	Steel	
Gypsum	Containers	
Lime Stone	Granite	
Dolomite	Marble Slabs	
Aggregates	Fertilizers in Bags	
Agro Products such as Corn, Wheat, Sugar, Red Chillies, wood chips	Agro Products such as corn in bags, wheat, red chilliesetc	
Clinker	Wood chips	
Cement in Bulk	Cement (in Bags)	
Sand	Salt	

4. Based on the deliberations in the meeting and information provided by the proponent in support of the project, the EAC recommended for amendment in Environmental and CRZ Clearance during its 265th meeting during 23rd - 24th June, 2021. As per the recommendation of the EAC, the Ministry of Environment, Forest and Climate Change hereby **accords Amendment in Environmental and CRZ Clearance** for "Expansion of Karaikal Port (Phase-II) at Puducherry by M/s Karaikal Port Pvt. Ltd." as mentioned at point 3(iv) above. with the additional specific conditions

a. The cargo which are permitted by the Ministry vide its letter No.10-2/2006 dated 06th May 2006 and letter No. 10-42/2009-IAIII dated 22nd September 2009 and the cargo which are permitted by Puducherry Pollution Control Committee vide its letter No. PPCC/CON/AIR/TRP/KKL/JE/2019/800 dated 7th November, 2019 is only permissible. No other cargo other than permissible cargos as mentioned in the above letters and as per the revised nomenclature is permitted.

b. All other conditions mentioned in the letter No. 10-2/2006 dated 06th May 2006, letter No. 10-42/2009-IAIII dated 22nd September 2009 and letter No. PPCC/CON/AIR/TRP/KKL/JE/2019/800 dated 7th November, 2019 shall remain unchanged.

5. This issues with the approval of the Competent Authority.

(Amardeep Raju)
Scientist 'E'

Copy to:

1. The Secretary, Department of Science, Technology and Environment, Government of Puducherry, III Floor, PHB Building, Anna Nagar, Puducherry – 5.
2. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi - 110 032.
3. The Member Secretary, Puducherry Coastal Zone Management Authority and Department of Science, Technology & Environment, Government of Puducherry, Anna Nagar, Puducherry - 5.
4. The Member Secretary, Puducherry Pollution Control Board, III FLOOR, PHB Building, Anna Nagar, Puducherry-5.
5. The CCF, Regional Office, Ministry of Environment & Forests(SZ), Keridriya Sadan, IVth floor, E&F wings, 17th Main Road, Koramangala II Block, Bangalore - 560 034.
6. IA- Division, Monitoring Cell, MOEF, New Delhi - 110 003.
7. Guard File/Monitoring File/Record File..

(Amardeep Raju)
Scientist 'E'

By **Registered Post with Acknowledgement Due**
(This document contains 07 (Seven) Pages)

PUDUCHERRY POLLUTION CONTROL COMMITTEE PPCC

AIR CONSENT ORDER (RENEWAL)

Ref. : No. (R19KAR654931)/(2022)/731

Date : 09 JUN 2022

Sub : Puducherry Pollution Control Committee - **M/s. Karaikal Port Private Limited** - Air Consent Order (Renewal), under Section 21 of The Air (Prevention and Control of Pollution) Act, 1981, as amended - Issued - Reg.

Ref : R19KAR654931 dated 29/11/2021 of **Capt. Vijay Nicodemus Venkataramanan B**

****

Consent to Operate is hereby **renewed** under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981, as amended (hereinafter referred to as 'The Act') and the Rules and Orders made there under for emission / continuation of emission to **Capt. Vijay Nicodemus Venkataramanan B, The Chief Operating Officer, M/s. Karaikal Port Private Limited, Keezhavanjore Village, T.R.Pattinam Commune, Karaikal.**

CATEGORY : RED **SIZE : LARGE** **LOCATION : MIXED** **AREA : 602 ACRES**

(hereinafter referred to as 'The Applicant') authorizing them to **Operate the industry, @ Keezhavanjore Village, T. R. Pattinam Commune, Karaikal**, subject to following special and general conditions:

Validity of the Consent :

(i) This Consent order is valid upto 31.03.2026.

(ii) The Project Proponent shall apply for obtaining Renewal of this Air Consent Order (Renewal), before Sixty (60) days of the expiry of the same, as imposed in (i) above, via www.ponocmms.nic.in, duly filled in, remitting Consent Fees and uploading relevant and required documents, as per prevailing orders. No other mode of application shall be entertained.

DEPT OF SCIENCE TECHNOLOGY & ENVIRONMENT • PUDUCHERRY •

Member Secretary

MEMBER SECRETARY
PUDUCHERRY POLLUTION
CONTROL COMMITTEE
PUDUCHERRY.

To,

Capt. Vijay Nicodemus Venkataramanan B, The Chief Operating Officer, M/s. Karaikal Port Private Limited, Keezhavanjore Village, T.R.Pattinam Commune, Karaikal - 609 606.

Copy to :

1.The Assistant Director, Departmnent of Industries and Commerce, Rural Industrial Estate, Kottucherry Commune, Karaikal - 609 609.

2. The Commissioner, T.R.Pattinam Commune Panchayat, T.R.Pattinam, Karaikal - 606 606.

3. Standing Guard File.

Received on 10/Jun/2022

SPECIAL CONDITIONS

1. Notwithstanding anything contained in any other Act or Rules or Notifications this clearance isgiven from pollution angle only.

2. **Details of the Cargoes permitted to be handled :** Multi - purpose port, permitted to handle different types of cargo, in MMTPA, as mentioned below :

Column 1	Column 2	Column 3
Dry Bulk Cargoes	**Break Bulk / General Cargoes – 3.5 MMTPA**	**Liquid Cargoes**
Coal – **10.0 MMTPA**	Textiles	Edible Oil – **0.5 MMTPA**
* Fertilizers	Machinery	**Crude Oil & Other Petroleum Products – **1.0 MMTPA**
* Clay	Timber	** LNG (To be handled by M/s. AGP Karaikal LNG Pvt. Ltd., **1.0 MMTPA**
* Iron Ore	Steel	
* Gypsum	Containers	
* Limestone	Granite	
* Dolomite	Marble Slabs	
* Aggregates	Fertilizers in Bags	
*Agro Products such as, Corn, Wheat, Sugar, Red Chillies, Wood Chips.	Agro Products such as, Corn, Wheatm Red Chillies etc., (in Bags only)	
* Clinker	Wood Chips	
Cement in Bulk (Handled by M/s. Penna Cement Industries Ltd.,) – **0.5 MMTPA**	Cement (in Bags)	
Sand – **1.0 MMTPA**	Salt	

Note :

(i) The Total Capacity of the Cargoes permitted to be handled by this Committee is only **17.5 MMTPA,** as imposed above, as against the Total Capacity of the Cargoes permitted to be handled by the MoEF&CC, *viz.*, 21.5 MMTPA.

(ii) The above table is in accordance with the EC Amendment issued by the MoEF&CC, vide No. 10-42/2009-IA.III dated 05.08.2021, except Items marked ** in the Column No. 3, above.

(iii) Items marked * in the Column 1 of the above table and the items mentioned in the Column 2 of the same, collectively shall be handled upto **3.5 MMTPA** only.

(iv) Items marked ** in the Column 3 of the above table has been classified as Liquid Cargoes in the Table at Page No. 37, of the EIA Guidance Manual, prepared by the Administrative Staff College, Hyderabad, for MoEF&CC, New Delhi.

3. The applicant shall erect the chimney(s)/stack(s) of the following specifications:

S.No.	Chimney / Stack attached to	Height of the stack in metre	Diameter, m	Volume Nm3/hr
1	Stack 1 - DG Set 1 - 500 KVA (Manufacturing Year 2008)	8	0.15	853
2	Stack 2 - DG Set 2 - 500 KVA (Manufacturing Year 2008)	8	0.15	853

4. The applicant shall install a comprehensive air pollution control system consisting of control equipment as detailed below and operate and maintain the same continuously so as to achieve the level of pollutants to the following standards:

Chimney / Stack	Control Equipment	Relevant - parameters & standard limits
Stack 1 - DG Set 1 - 500 KVA (Manufacturing Year 2008)	Acoustic Enclosure & Stack	Oxides of Nitrogen + Hydrocarbon (NOx + HC) - <= 4.0 g/kW-Hr ; Carbon Monooxide (CO) - <= 3.5 g/kW-Hr ; Particulate Matter (PM) - <= 0.2 g/kW-Hr ; Smoke Limit (Light Absorption Co-efficient) - <= 0.7 1/m
Stack 2 - DG Set 2 - 500 KVA (Manufacturing Year 2008)	Acoustic Enclosure & Stack	Oxides of Nitrogen + Hydrocarbon (NOx + HC) - <= 4.0 g/kW-Hr ; Carbon Monooxide (CO) - <= 3.5 g/kW-Hr ; Particulate Matter (PM) - <= 0.2 g/kW-Hr ; Smoke Limit (Light Absorption Co-efficient) - <= 0.7 1/m

5. The applicant shall observe the following fuel consumption:

S.No	Type of fuel	Maximum quantity T/day
1	Diesel (in LPD) (Density - 0.85 Kg/l)	40

6. The proponent shall take measures to comply with the provisions laid down under Noise pollution (Regulation and Control) Amendment Rules, 2010 and control the noise to the prescribed levels.

7. The industry shall take adequate measures for control of noise from its own source so as to comply with the standards as may be applicable. Noise Level should not exceed 65 dB (A) and 55 dB (A) during daytime and night times respectively.

8. DG Sets shall meet the noise and air emission standards prescribed under The Environment (Protection) Rules, 1986 and shall be provided with integral acoustic enclosure. The applicant shall comply with order of Hon,ble National Green Tribunal dated 11.05.2015 in Appeal No. 12(THC) of 2013, Original Application No. 17(THC) of 2013 and Original Application No. 32(THC) of 2013 and implement all conditions in the CPCB Guidelines for DG Set. The DG set which are 15 years old or completed 50,000 Hours of Operation shall not be used.

9. The unit shall provide minimum stack height (H) to the DG sets as per the formula H = h + 0.2 SQRT (KVA) where KVA= total generation capacity and h= Height of the building where DG set is installed.

10. The Industry shall take appropriate measures to ensure that the ground level concentration shall comply with revised National Ambient Air Quality Standards dated 16.11.2009 notified by MoEF&CC, GOI.

11. There shall not be any be perceptible odour outside the industry's premises.

12. Any change in the emission source / process / Air Pollution Control System / fuel shall be brought to the notice of this Authority in writing and fresh consent has to be obtained, as required.

13. The unit shall submit the Environmental Statement in Form V before 30th September every year as per the Rule No.14 of the E(P) Rules, 1986 & Amendments.

14. Specific Conditions :

(a) The unit shall handle only cargoes permitted, as permitted vide Clause 2 of Section "Special

Conditions" of this Consent Order and the quantity of cargoes handled by the unit shall not exceed 17.5 MMTPA, at any point of time. Any other goods / cargoes, intended to be handled, by the unit, shall be done only after obtaining prior consent from this Committee.

(b) Cement in Bulk, as mentioned in the Column 1 of Annexure I, of this Consent Order, shall be handled by M/s. Penna Cement Industries only, as per the Consent to Operate, issued by PPCC.

(c) LNG, as mentioned in the Column 3 of Annexure I, of this Consent Order, shall be handled by M/s. AGP Karaikal LNG Pvt., Ltd., only after obtaining Consent to Operate, from this Committee.

(d) For handling of Dry Bulk Cargoes : To control fugitive emission at the Coal Stockyard and other Dry Bulk Cargoes, the following shall be regularly utilized / practiced to meet the applicable standards:

(i) Coal shall not be handled more than 10.0 MMTPA, as specified in the Column 1 of Clause 2 of Section "Special Conditions", of this Consent Order. Most of the Coal shall be handled through Mechanization of Coal Handling System Only. Coal upto 1.5 MMTPA, shall be handled by Semi Mechanized Mode, using Hoppers and Conveyors, for small customers.

(ii) Dry Bulk Cargoes viz., Fertilizers, Clay, Iron Ore, Gypsum, Limestone, Dolomite, Aggregates, Agro Products such as, Corn, Wheat, Sugar, Red Chillies, Wood Chips, etc., which are handled in Bulk, shall be handled within the capacity of 3.5 MMTPA, allocated for Break Bulk / General Cargoes, as specified Clause 2 of Section "Special Conditions", of this Consent Order.

(iii) Water Sprinklers shall be provided all along the Coal and Iron ore Stockyard area, wherever applicable, for constantly wetting the Coal and Iron ore heaps.

(iv) Water Tanker with rear spreading bars and high pressure sprinkler nozzles, shall be deployed for constant wetting of the Roads, areas in the Coal and Iron ore Stock Yard inside the premises of the unit.

(v) Dust Separation Wall, with high resistant polymer meshes, shall be provided around the Coal and Iron ore Stock Yard and along the Railway sidings and shall be immediately mended / replaced, as and when damaged.

(vi) Coal and Iron Ore shall be loaded in the trucks only in the wet condition after sprinkling water.

(vii) The height of the Coal and Other Dry Bulk Cargoes heaps shall not exceed 10 metres from the Ground Level, at any cost.

(viii) Mobile mistifiers shall be operated throughout the time of handling Coal and Iron ore.

(ix) The trucks transporting Coal out of the premises shall be subjected to wash using the Automated Tyre Wash System, before exiting the premises.

(x) The trucks transporting Coal and Other Dry Bulk Cargoes, out of the premises shall be covered using tarpaulins to avoid spillage on the roads and the unit shall ensure that, the tarpaulins cover of the trucks are locked till the delivery point is reached.

(xi) The Automated Continuous Ambient Air Quality Monitoring stations (3 Nos.) connected to the server of this Committee, for parameters, PM10, PM2.5 and CO, shall be operated and maintained, at all times and any corrective actions, if required, shall be carried out immediately and the same shall be reported to this Committee.

(xii) The Ambient Air Quality, in and around the unit, shall be maintained within the prescribed standards and if exceeded at any point of time, the Committee shall review / revoke the handling capacity of Coal, awarded herewith, in this Consent Order.

(e) For **Handling of Dry Bulk Cargoes other than Coal and Iron ore** : Dry Bulk Cargoes that are likely to be affected by sprinkling of water shall be handled, such that, there are no dust emissions arising, at any point of time and shall be stored in closed sheds only, such that, wind action is minimized to near zero.

(f) **For Handling of General Cargo, the following systems shall be regularly utilized to meet the** standards:

(i) The Total Handling Capacity of the General Cargo permitted to be handled by the unit shall not exceed 3.5 MMTPA, including Items marked * in Column 1 of Clause 2 of the Section "Special Conditions" of this Consent Order.

(ii) Cargoes as specified alone shall be handled and clearance from this Committee shall be obtained in case of any other items to be handled, afresh.

(iii) Cargoes mentioned under Break Bulk Cargoes / General Cargoes in Column 3 of Table of Clause 2 of Section "Special Conditions" of this Consent Order, shall only be handled in only in Bags and / or countable units and shall be carried to the closed warehouses in trucks covered by tarpaulins without any spillage due to transportation, inside the premises.

(iv) Agro Products such as, Red Chillies, Sugar, Wheat, Corn etc., shall be handled with utmost care, with closed Hoppers and Closed Baggings in warehouses.

(v) There shall be no increase in the pollution load due to the handling process.

(g) For Liquid Bulk Cargoes :

(i) Crude Oil and Other Petroleum Products:

(1) There shall be no storage of crude oil at any point of time in the premises of the Port except other petroleum products including Bitumen.

(2) No Construction activities shall be carried out and the applicant shall not undertake any expansion, modernization, diversification, change of location, storage etc., without the prior approval / clearance from this authority.

(3) Coast Guard approved Oil Spill Contingency Plan (OSCP) shall be strictly adhered to.

(4) All the measures adopted in Oil Spill Risk Assessment (OSRA) and Environmental Management Plan (EMP) shall be strictly adhered to.

(5) Fire fighting systems OISD (Oil Industries Safety Directorate) – 156 Standards shall be strictly adhered to.

(6) Provisions of Public Liability Insurance Act, 1991 to provide immediate relief in the event of any fire hazard to human beings, other living creatures, plants and properties while handling hazardous substances shall be strictly adhered to.

(7) Periodical mock drills, for all personnel to be involved in transportation of crude oil and petroleum products through pipeline, by updating their technical skills from time to time, so as to control actual leakage of hazardous materials in the quickest possible time, is mandatory.

(8) The unit shall comply with the provisions of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

(ii) For Edible Oil:

(1) Certified storage tanks shall be utilized for storing edible oil. The validity of the certifications, if any, shall be reviewed and updated, periodically.

(2) There shall be no spillage of Oil, on land, in and around the premises.

(h) The unit shall engage an NABL Accredited Laboratory, for collection and analysis of samples, for Parameters of Ambient Air Quality and Noise, as imposed vide this Consent Order and the reports of the same, shall be submitted to this Committee, once every Six (06) Months, as per the Monitoring Frequency for Red Category Units, recommended by the Central Pollution Control Board, New Delhi. This is for Strict Compliance.

(i) The unit shall submit compliance statement of the conditions imposed, in this Air Consent Order, in tabulated form, along with necessary annexures, once in every six (06) months, to this Committee.

(j) The revised standards mentioned under the Special Conditions, shall be applicable for the whole production capacity of the unit and shall be in force, in accordance with the Rules / Laws / Notifications, issued under the Environment (Protection) Act, 1986 and its amendments till date.

(k) The unit shall be liable to environmental compensation charges henceforth, in accordance with the above point (n), which is proportional to the no. of non-compliances and the period of the same. Hence, compliance of all conditions, of this Consent order shall be immediately effected, unless any specified timelines are applicable and are strictly enforced henceforth.

(l) **Implementation Schedules :**

(i) The unit shall submit six monthly report on the dredging operations including the quantity of sand dredged, utilized and the balance stored as per the EC conditions of MoEF&CC.

(ii) The above said 1 No. of implementation schedule shall be followed with due diligence, failing which, the unit shall be liable to be levied with environmental compensation, since inception of the Port, as per the prevailing Acts / Rules / Notifications, as applicable and also the enforcement action, as deemed fit shall be initiated against the unit, as applicable.

(i) **For Better Environmental Management** :

(i) Energy conservation measures like installation of energy efficient lighting systems, like LED's for lighting the areas inside and outside the building should be integral part of the design. Used CFL's/TFL's/LED's should be properly collected and disposed off / sent to for recycling as per the prevailing guidelines / rules of the regulatory authority to avoid toxic contamination.

(ii) Use of Solar panels may be adopted to the maximum extent possible, especially for streetlights within the campus.

(iii) Energy Audit and annual reduction pattern to be planned and intimated to this committee.

(iv) Systematic Plantation of suitable varieties of trees, shrubs and climbers etc., shall be done in phased manner, with plan budget over a period of years covering the entire available vacant area.

(v) Appropriate rainwater harvesting structures and Farm Ponds shall be established on scientific basis.

(vi) The unit shall declare itself an "Single Use Plastic Free Zone" and maintain the same, in compliance with the Notification issued by this Committee on Ban of Single Use Plastics, G.O. Ms. No. 18/Envt./2019 dated 30.07.2019, published in the Gazette of Puducherry, Part I Extraordinary, dated 02.08.2019.

DEPT OF SCIENCE TECHNOLOGY & ENVIRONMENT • PUDUCHERRY •

Member Secretary

MEMBER SECRETARY
PUDUCHERRY POLLUTION
CONTROL COMMITTEE
PUDUCHERRY.

GENERAL CONDITIONS

1. Notwithstanding anything contained in this No-Objection Certificate from Pollution Angle, the Puducherry Pollution Control Committee hereby reserves its right and power under Section 27 (2) of the Water (Prevention and Control of Pollution) Act, 1974 and Section 21 (4) of the Air (Prevention and Control of Pollution) Act, 1981 to Review / Revoke any or all the conditions imposed herein and to cancel, refuse, modify or stipulate additional conditions for the purpose of the Act by the Committee, if conditions of the consent granted are not fulfilled.

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

3. The applicant shall take all possible measures to create pollution free surroundings.

4. Sufficient green belt shall be provided all around the unit.

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

6. Housekeeping shall be maintained clean.

7. All the conditions shall be enforced under the provisions of the Environment (Protection) Act, 1986, along with its amendments, from time to time.

DEPT OF SCIENCE TECHNOLOGY & ENVIRONMENT * PUDUCHERRY *

Member Secretary

MEMBER SECRETARY
PUDUCHERRY POLLUTION
CONTROL COMMITTEE
PUDUCHERRY.

By Registered Post with Acknowledgement Due
(This document contains 09 (Nine) Pages)

PUDUCHERRY POLLUTION CONTROL COMMITTEE ★ PPCC

WATER CONSENT ORDER (RENEWAL)

Ref. : No. (R19KAR654931)/(2022)/732 Date 09 JUN 2022

Sub : Puducherry Pollution Control Committee - **M/s. Karaikal Port Private Limited** - Water Consent Order (Renewal) under Section 25 / 26 of The Water (Prevention and Control of Pollution) Act, 1974, as amended - Issued - Reg.

Ref : R19KAR654931 **dated 29/11/2021** of **Capt. Vijay Nicodemus Venkataramanan B**

****

Consent to Operate is hereby **renewed** under Section 25 / 26 of the Water (Prevention and Control of Pollution) Act, 1974, as amended (hereinafter referred to as 'The Act') and the Rules and Orders made there under for discharge or continuation of discharge of sewage or trade effluent to **Capt. Vijay Nicodemus Venkataramanan B, The Chief Operating Officer, M/s. Karaikal Port Private Limited, Keezhavanjore Village, T.R.Pattinam Commune, Karaikal.**

CATEGORY : RED SIZE : LARGE LOCATION : MIXED AREA : 602 ACRES

(hereinafter referred to as 'The Applicant') authorizing them to **Operate the industry, @ Keezhavanjore Village, T. R. Pattinam Commune, Karaikal,** subject to following special and general conditions:

Validity of the Consent :

(i) This Consent order is valid upto 31.03.2026.

(ii) The Project Proponent shall apply for obtaining Renewal of this Air Consent Order (Renewal), before Sixty (60) days of the expiry of the same, as imposed in (i) above, via www.ponocmms.nic.in, duly filled in, remitting Consent Fees and uploading relevant and required documents, as per prevailing orders. No other mode of application shall be entertained.

DEPT OF SCIENCE TECHNOLOGY & ENVIRONMENT * PUDUCHERRY *

Member Secretary

MEMBER SECRETARY
PUDUCHERRY POLLUTION CONTROL COMMITTEE
PUDUCHERRY.

To,

Capt. Vijay Nicodemus Venkataramanan B, The Chief Operating Officer, M/s. Karaikal Port Private Limited, Keezhavanjore Village, T.R.Pattinam Commune, Karaikal - 609 606.

Copy to :

1. The Assistant Director, Departmnent of Industries and Commerce, Rural Industrial Estate, Kottucherry Commune, Karaikal - 609 609.

2. The Commissioner, T.R.Pattinam Commune Panchayat, T.R.Pattinam, Karaikal - 606 606.

3. Standing Guard File.

Received on 10/Jun/2022

SPECIAL CONDITIONS

1. Notwithstanding anything contained in any other Act or Rules or Notifications this clearance is given from pollution angle only.

2. **Details of the Cargoes permitted to be handled :** Multi - purpose port, permitted to handle different types of cargo, in MMTPA, as mentioned below :

Column 1	Column 2	Column 3
Dry Bulk Cargoes	**Break Bulk / General Cargoes – 3.5 MMTPA**	**Liquid Cargoes**
Coal – **10.0 MMTPA**	Textiles	Edible Oil – **0.5 MMTPA**
* Fertilizers	Machinery	**Crude Oil & Other Petroleum Products – **1.0 MMTPA**
* Clay	Timber	** LNG (To be handled by M/s. AGP Karaikal LNG Pvt. Ltd., **1.0 MMTPA**
* Iron Ore	Steel	
* Gypsum	Containers	
* Limestone	Granite	
* Dolomite	Marble Slabs	
* Aggregates	Fertilizers in Bags	
*Agro Products such as, Corn, Wheat, Sugar, Red Chillies, Wood Chips.	Agro Products such as, Corn, Wheatm Red Chillies etc., (in Bags only)	
* Clinker	Wood Chips	
Cement in Bulk (Handled by M/s. Penna Cement Industries Ltd.,) – **0.5 MMTPA**	Cement (in Bags)	
Sand – **1.0 MMTPA**	Salt	

Note :

(i) The Total Capacity of the Cargoes permitted to be handled by this Committee is only **17.5 MMTPA,** as imposed above, as against the Total Capacity of the Cargoes permitted to be handled by the MoEF&CC, *viz.*, 21.5 MMTPA.

(ii) The above table is in accordance with the EC Amendment issued by the MoEF&CC, vide No. 10-42/2009-IA.III dated 05.08.2021, except Items marked ** in the Column No. 3, above.

(iii) Items marked * in the Column 1 of the above table and the items mentioned in the Column 2 of the same, collectively shall be handled upto **3.5 MMTPA** only.

(iv) Items marked ** in the Column 3 of the above table has been classified as Liquid Cargoes in the Table at Page No. 37, of the EIA Guidance Manual, prepared by the Administrative Staff College, Hyderabad, for MoEF&CC, New Delhi.

3. Details of **Water Consumption** :

Water Requirement for	Quantity in KLD	Water Source
Process	170.0	Desalination Plant and PASIC Borewell
Cooling	0.0	NIL
Boiler	0.0	NIL
Floor and Vessel Washing	0.0	NIL
Domestic Use	140.0	Desalination Plant and PASIC Borewell

Garden	40.0	Desalination Plant, PASIC Borewell and STP Treated Water
Total	**350**	

4. The applicant shall have the following outlets with maximum discharge quantities and disposal point as specified in the table for discharge of sewage / trade effluent. Any change in the outlets has to be brought to the notice of the Board and fresh consent has to be obtained if necessary.

Outlet No.	Description of Outlet	Maximum daily discharge in KLD	Point of disposal
1	Sewage	32.0	**Sewage Treatment Plant :** Treated in 25 KLD STP and the treated Water after conforming to the standards, used for gardening.
2	Trade Effluent	16.0	**Vehicle Wash System ETP :** The Vehicle wash water is treated in Vehicle Wash ETP of 16 KLD and the treated water is reused / recycled.
3	Trade Effluent	25.0	**Tyre Wash System ETP :** The Tyre wash water is treated in Tyre Wash ETP of 25 KLD and the treated water is reused /recycled.
4	Trade Effluent	50.0	**Storm Water ETP No. 1 :** Dedicated to Storm Water Drain System and are operated during Monsoon. The Storm Water are collected and filtered for impurities and the clear water are drained in Sea.
5	Trade Effluent	50.0	**Storm Water ETP No. 2 :** Dedicated to Storm Water Drain System and are operated during Monsoon. The Storm Water are collected and filtered for impurities and the clear water are drained in Sea.

5. The applicant shall provide comprehensive effluent treatment plant consisting of Primary/ Secondary and/or Tertiary treatment as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of the treated effluent to the following standards before disposal (If applicable).

S.No	Name	Concentration Standard	Mass standard (if applicable)
1	pH	5.5 - 9.0	-
2	Suspended Solids (mg/l)	100 mg/l	-
3	BOD, 3 days, 27 deg.C	30 mg/l	-
4	C.O.D	250 mg/l	-
5	Oil & Grease	10 mg/l	-

6. The applicant shall provide, comprehensive sewage treatment plant as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of treated waste water to the following standards before disposal (If applicable):

S.No	Name	Concentration Standard	Mass standard to be complied (if applicable)
1	pH	5.5 - 9.0	-
2	TSS	20 mg/l	-
3	BOD, 3 days, 27 deg.C	10 mg/l	-
4	COD	50 mg/l	-
5	N- Total	10 mg/l	-
6	Fecal Coliform (MPN/100 ml - Most Probable Number per 100 ml)	Desirable 100 MPN/100ml ; permissible 230 MPN/100 ml	-
7	Surfactants	1.0 mg/l	-
8	Free Ammonia	1.2 mg/l	-

7. The details of STP / ETP to be provided is as follows:

S.No.	Treatment unit name	No. of unit	Dimension (in meter)
Sewage Treatment Plant Capacity : 30 KLD			
1	Sewage Treatment Plant	1	20 X 20 X 3
Effluent Treatment Plant Capacity: 141 KLD			
1	Vehicle Wash System	1	20 X 16 X 3
2	Tyre Wash System	1	20 X 16 X 3
3	Strom Water ETP 1	1	12 X 10
4	Storm Water ETP 2	1	12 X 10

8. The ETP/STP units shall be impervious to prevent ground water pollution.

9. There shall be no perceptible odour outside the industry's premises.

10. The unit shall provide digital flow meter to the inlet and outlet of the treatment plant and proper records shall be maintained in log book.

11. Separate energy meter shall be provided for the ETP / STP and proper records shall be maintained in log book.

12. The unit shall provide an alternate power source along with separate energy meter for the Effluent Treatment Plant / Sewage Treatment Plant to ensure continuous operation of the Treatment Plant.

13. The applicant shall submit the Environmental Statement in Form V before 30th September every year as per the Rule No.14 of the E(P) Rules, 1986 & Amendments.

14. **Specific Conditions :**

(a) The unit shall handle only cargoes permitted, as per Clause 2 of Section "Special Conditions", of this Consent Order and the total quantity of cargoes handled by the unit shall not exceed 17.5 MMTPA, at any point of time. Any other goods / cargoes, intended to be handled, by the unit, shall be done only after prior clearance from this Committee.

(b) Cement in Bulk, as mentioned in the Column 1 of the table of Clause 2 of Section "Special Conditions", of this Consent Order, shall be handled by M/s. Penna Cement Industries only, as per the Consent to Operate, issued by PPCC.

(c) LNG, as mentioned in the Column 3 of the table of Clause 2 of Section "Special Conditions", of this Consent Order, shall be handled by M/s. AGP Karaikal LNG Pvt., Ltd., only after obtaining Consent to Operate, from this Committee.

(d) **For handling of Dry Bulk Cargoes :** To control fugitive emission at the Coal Stockyard and other Dry Bulk Cargoes, the following shall be regularly utilized / practiced to meet the applicable standards:

(i) Coal shall not be handled more than 10.0 MMTPA, as specified in the Column 1 of the table of Clause 2 of Section "Special Conditions", of this Consent Order. Most of the Coal shall be handled through mechanization of Coal Handling System Only. Coal upto 1.5 MMTPA, shall be handled by Semi Mechanized Mode, using Hoppers and Conveyors, for small customers.

(ii) Dry Bulk Cargoes *viz.*, Fertilizers, Clay, Iron Ore, Gypsum, Limestone, Dolomite, Aggregates, Agro Products such as, Corn, Wheat, Sugar, Red Chillies, Wood Chips, etc., which are handled in Bulk, shall be handled within the capacity of 3.5 MMTPA, allocated for Break Bulk / General Cargoes, as specified in the table of Clause 2 of Section "Special Conditions", of this Consent Order.

(iii) Water Sprinklers shall be provided all along the Coal and Iron ore Stockyard area, wherever applicable, for constantly wetting the Coal and Iron ore heaps.

(iv) Water Tanker with rear spreading bars and high pressure sprinkler nozzles, shall be deployed for constant wetting of the Roads, areas in the Coal and Iron ore Stock Yard inside the premises of the unit.

(v) Dust Separation Wall, with high resistant polymer meshes, shall be provided around the Coal and Iron ore Stock Yard and along the Railway sidings and shall be immediately mended / replaced, as and when damaged.

(vi) Coal and Iron Ore shall be loaded in the trucks only in the wet condition after sprinkling water.

(vii) The height of the Coal and Other Dry Bulk Cargoes heaps shall not exceed 10 metres from the Ground Level, at any cost.

(viii) Mobile mistifiers shall be operated throughout the time of handling Coal and Iron ore.

(ix) The trucks transporting Coal out of the premises shall be subjected to wash using the Automated Tyre Wash System, before exiting the premises.

(x) The trucks transporting Coal and Other Dry Bulk Cargoes, out of the premises shall be covered using tarpaulins to avoid spillage on the roads and the unit shall ensure that, the tarpaulins cover of the trucks are locked till the delivery point is reached.

(xi)The Automated Continuous Ambient Air Quality Monitoring stations (3 Nos.) connected to the server of this Committee, for parameters, PM_{10}, $PM_{2.5}$ and CO, shall be operated and maintained, at all times and any corrective actions, if required, shall be carried out immediately and the same shall be reported to this Committee.

(xii) The Ambient Air Quality, in and around the unit, shall be maintained within the prescribed standards and if exceeded at any point of time, the Committee shall review / revoke the handling capacity of Coal, awarded herewith, in this Consent Order.

(e) **For Handling of Dry Bulk Cargoes other than Coal and Iron ore:** Dry Bulk Cargoes that are likely to be affected by sprinkling of water shall be handled, such that, there are no dust emissions arising, at any point of time and shall be stored in closed sheds only, such that, wind action is minimized to near zero.

(f) For Handling of General Cargo, the following systems shall be regularly utilized to meet the standards:

(i) The Total Handling Capacity of the General Cargo permitted to be handled by the unit shall not exceed 3.5 MMTPA, including Items marked * in Column 1 of the table of Clause 2 of Section "Special Conditions", of this Consent Order.

(ii) Cargoes as specified alone shall be handled and clearance from this Committee shall be obtained in case of any other items to be handled, afresh.

(iii) Cargoes mentioned under Break Bulk Cargoes / General Cargoes in Column 3 of the table of Clause 2 of Section "Special Conditions", of this Consent Order, shall only be handled in only in Bags and / or countable units and shall be carried to the closed warehouses in trucks covered by tarpaulins without any spillage due to transportation, inside the premises.

(iv) Agro Products such as, Red Chillies, Sugar, Wheat, Corn etc., shall be handled with utmost care, with closed Hoppers and Closed Baggings in warehouses.

(v) There shall be no increase in the pollution load due to the handling process.

(g) For Liquid Bulk Cargoes :

(i) Crude Oil and Other Petroleum Products:

(1) There shall be no storage of crude oil at any point of time inside the premises of the Port except other petroleum products including Bitumen.

(2) No Construction activities shall be carried out and the applicant shall not undertake any expansion, modernization, diversification, change of location, storage etc., without the prior approval / clearance from this authority.

(3) Coast Guard approved Oil Spill Contingency Plan (OSCP) shall be strictly adhered to.

(4) All the measures adopted in Oil Spill Risk Assessment (OSRA) and Environmental Management Plan (EMP) shall be strictly adhered to.

(5) Fire fighting systems OISD (Oil Industries Safety Directorate) – 156 Standards shall be strictly adhered to.

(6) Provisions of Public Liability Insurance Act, 1991 to provide immediate relief in the event of any fire hazard to human beings, other living creatures, plants and properties while handling hazardous substances shall be strictly adhered to.

(7) Periodical mock drills, for all personnel to be involved in transportation of crude oil and petroleum products through pipeline, by updating their technical skills from time to time, so as to control actual leakage of hazardous materials in the quickest possible time, is mandatory.

(8) The unit shall comply with the provisions of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

(ii) For Edible Oil:

(1) Certified storage tanks shall be utilized for storing edible oil. The validity of the certifications, if any, shall be reviewed and updated, periodically.

(2) There shall be no spillage of Oil, on land, in and around the premises.

(h) For Water Management :

(i) The accounts of water consumption, with the source of water, shall be maintained separately for the above usage requirements and discharge along with treated water. The copy of the above said records shall be submitted to this committee on a monthly basis.

(ii) The operation of the R.O.System shall be recorded in a log book, indicating the quantity of intake and reject, source of water, discharge of the reject, along with their qualitative analysis data tested by a NABL accredited laboratories and the report of the same shall be submitted to this Committee on a monthly basis.

(iii) The domestic wastewater treated in Sewage Treatment Plant (1 X 25 KLD) shall be used for gardening purpose. The accounts of water treated and reused shall be recorded in a logbook and the same shall be submitted to this committee on a monthly basis, along with the qualitative analysis data tested by a NABL accredited laboratories.

(iv)The Storm Water Drain system shall be maintained regularly. The Effluent Treatment Plant (2 X 50 KLD) linked to the Storm Water Drain System shall be ensured for its operability and shall be used for the very purpose. The records of the water treated and reused of the same shall be submitted to this Committee, on a monthly basis.

(v) The Effluent Treatment Plants, connected to the Vehicle Wash Area (1 X 16 KLD) and the Tyre Wash System (1 X 25 KLD), shall be ensured for its operability and shall be used for the very purpose. The records of the water treated and reused of the same shall be submitted to this Committee, on a monthly basis.

(i) The unit shall engage an NABL Accredited Laboratory, for collection and analysis of samples, for Parameters of inlet and outlet of the Effluent and Sewage Treatment Plants, as imposed vide this Consent Order and the reports of the same, shall be submitted to this Committee, every month, so as to enable the Committee, to submit Compliance report to the Central Pollution Control Board, New Delhi, as per the orders of NGT, on STPs / ETPs, in the country. This is for Strict Compliance.

(j) The unit shall submit compliance statement of the conditions imposed, in this Air Consent Order, in tabulated form, along with necessary annexures, once in every six (06) months, to this Committee.

(k) The revised standards mentioned under the Special Conditions, shall be applicable for the whole production capacity of the unit and shall be in force, in accordance with the Rules / Laws /Notifications, issued under the Environment (Protection) Act, 1986 and its amendments till date.

(l) The unit shall be liable to environmental compensation charges henceforth, in accordance with the above point (i), which is proportional to the no. of non-compliances and the period of the same. Hence, compliance of all conditions, of this Consent order shall be immediately effected, unless any specified timelines are applicable and are strictly enforced henceforth.

(m) Implementation Schedules :

(i) The unit shall submit six monthly report on the dredging operations including the quantity of sand dredged, utilized and the balance stored as per the EC conditions of MoEF&CC.

(ii) The above said 1 No. of implementation schedule shall be followed with due diligence, failing which, the unit shall be liable to be levied with environmental compensation, since inception of the Port, as per the prevailing Acts / Rules / Notifications, as applicable and also the enforcement action, as deemed fit shall be initiated against the unit, as applicable.

(n) For Better Environmental Management:

(i) Energy conservation measures like installation of energy efficient lighting systems, like LED's for lighting the areas inside and outside the building should be integral part of the design. Used CFL's/TFL's/ LED's should be properly collected and disposed off / sent to for recycling as per the prevailing guidelines /rules of the regulatory authority to avoid toxic contamination.

(ii) Use of Solar panels may be adopted to the maximum extent possible, especially for streetlights within the campus.

(iii) Energy Audit and annual reduction pattern to be planned and intimated to this committee.

(iv) Systematic Plantation of suitable varieties of trees, shrubs and climbers etc., shall be done in phased manner, with plan budget over a period of years covering the entire available vacant area.

(v) Appropriate rainwater harvesting structures and Farm Ponds shall be established on scientific basis.

(iv) The unit shall declare itself an "Single Use Plastic Free Zone" and maintain the same, in compliance with the Notification issued by this Committee on Ban of Single Use Plastics, G. O. Ms. No. 18/ Envt./2019 dated 30.07.2019, published in the Gazette of Puducherry, Part I Extraordinary, dated 02.08.2019.

DEPT OF SCIENCE TECHNOLOGY & ENVIRONMENT • PUDUCHERRY •

Member Secretary

MEMBER SECRETARY
PUDUCHERRY POLLUTION
CONTROL COMMITTEE
PUDUCHERRY.

GENERAL CONDITIONS

1. Notwithstanding anything contained in this Certificate from Pollution Angle, the Puducherry Pollution Control Committee hereby reserves its right and power under Section 27 (2) of the Water (Prevention and Control of Pollution) Act, 1974 and Section 21 (4) of the Air (Prevention and Control of Pollution) Act, 1981 to Review / Revoke any or all the conditions imposed herein and to cancel, refuse, modify or stipulate additional conditions for the purpose of the Act by the Committee, if conditions of the consent granted are not fulfilled.

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

3. The applicant shall take all possible measures to create pollution free surroundings.

4. Sufficient green belt shall be provided all around the unit.

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

6. Housekeeping shall be maintained clean.

7. All the conditions shall be enforced under the provisions of the Environment (Protection) Act, 1986, along with its amendments, from time to time.

DEPT OF SCIENCE TECHNOLOGY & ENVIRONMENT * PUDUCHERRY *

Member Secretary

MEMBER SECRETARY
PUDUCHERRY POLLUTION
CONTROL COMMITTEE
PUDUCHERRY.

GOVERNMENT OF PUDUCHERRY
DEPARTMENT OF SCIENCE, TECHNOLOGY AND ENVIRONMENT
PUDUCHERRY POLLUTION CONTROL COMMITTEE
III FLOOR, PHB BUILDING, ANNA NAGAR, PUDUCHERRY – 605 005
PH: 2201256 / 2203494; FAX: (0413) 2203494

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FORM – II

30 AUG 2021

RENEWAL OF AUTHORISATION TO THE OCCUPIER FOR MANAGEMENT OF HAZARDOUS AND OTHER WASTE

1. Number of authorisation and date of issue : 7162/PPCC/HWM/AEE/2021/918
2. Reference of application (No. and date) : 5103 and 26.10.2020
3. The Occupier of **M/s Karaikal Port Private Limited.**, is hereby granted an authorisation based on the enclosed signed inspection reportfor Generation, Collection, Storage, Utilization and Disposal of hazardous wastes on the premises situated at **Keezhavanjore village, T.R Pattinam Commune, Karaikal District, Puducherry - 609 606.**

Details of Authorisation

(i) **Hazardous waste generated through port operations:**

Schedule No.	Name of the HW Wastes	Quantity in TPA	Method of storage / Disposal
5.1 of schedule I	Used or spent oil	23	Shall be stored under the shed over an impervious flooring and authorised for activity such as generation, collection, storage and disposed through authorised recyclers.
5.2 of Schedule I	Waste residues containing oil (including foam pigs)	0.37	Shall be stored under the shed over an impervious flooring and authorised for activity such as generation, collection, storage and disposed through authorised pre-processing.

(ii) **Hazardous waste generated from ship collected by waste reception facilities:**

Schedule No.	Name of the HW Wastes	Quantity in TPA	Method of storage / Disposal
3.1 of schedule I	Chemical sludge from waste water treatment	500	Reception and disposed through authorised recyclers
3.3 of schedule I	Sludge and filters contaminated with oil	2000	Reception and disposed through authorised recyclers
3.4 of schedule I	Ballast water containing oil from ships	500	Reception and disposed through authorised recyclers

4. The authorisation shall be valid for a period upto 07.12.2025
5. The authorisation is subject to the following general and specific conditions

A. General conditions of authorisation:

1. The authorised person shall comply with the provisions of the Environment (Protection) Act, 1986, and the rules made there under.
2. The authorisation or its renewal shall be produced for inspection at the request of an officer authorised by the PPCC.
3. The person authorised shall not rent, lend, sell, transfer or otherwise transport the hazardous and other wastes except what is permitted through this authorisation.
4. Any unauthorised change in personnel, equipment or working conditions as mentioned in the application by the person authorised shall constitute a breach of his authorisation.
5. The person authorised shall implement Emergency Response Procedure (ERP) for which this authorisation is being granted considering all site specific possible scenarios such as spillages, leakages, fire etc. and their possible impacts and also carry out mock drill in this regard at regular interval of time;
6. The person authorised shall comply with the provisions outlined in the Central Pollution Control Board guidelines on "Implementing Liabilities for Environmental Damages due to Handling and Disposal of Hazardous Waste and Penalty"..
7. It is the duty of the authorised person to take prior permission of the PPCC to close down the facility.
8. An application for the renewal of an authorization shall be made 90 days before the date of expiry.
9. Any other conditions for compliance as per the Guidelines issued by the Ministry of Environment, Forest and Climate Change or Central Pollution Control Board from time to time.
10. The occupier handling hazardous and other wastes shall submit annual returns containing the details specified in Form 4 to PPCC on or before the 30th day of June of every year for the preceding period April to March.
11. The unit shall file annual returns in Form-3 as per E-waste Management Rules, 2016 on 30th June of every year.
12. The unit shall submit half yearly returns for battery waste to PPCC in Form-1 by 30th June and 31st Decemeber of every year

B. Specific conditions of Authorization:

1. The occupier/generator shall be responsible for safe and environmentally sound management of hazardous and other waste.
2. The occupier shall follow the following steps for the management of hazardous and other wastes. (a) Prevention (b) minimization (c) reuse (d) recycling (e) recovery, utilisation including co-processing and (f) safe disposal.
3. The occupier shall store the hazardous and other wastes for a period not exceeding ninety days.

4. The hazardous and other wastes shall be stored temporarily in an isolated area earmarked for the purpose within the occupier's premises (it shall not be accessible to rain water) till scientific disposal.

5. The storage area shall be provided with impervious flooring with separate provision for individual category of waste and a sign of danger shall be placed at the storage site.

6. The occupier handling hazardous or other wastes shall maintain records of such operations of generation, handling, storage and disposal as per Form 3 on daily basis.

7. The occupier handling hazardous or other wastes shall ensure that the hazardous and other wastes are packaged in a manner suitable for safe handling, storage and transport as per the guidelines issued by the Central Pollution Control Board from time to time.

8. The labelling of package of hazardous or other wastes shall be done as per Form 8. The label shall be of non-washable material, weather proof and easily visible.

9. The occupier shall provide the transporter with the relevant information in Form 9, regarding the hazardous nature of the wastes and measures to be taken in case of an emergency and shall label the hazardous and other wastes containers as per Form 8.

10. The transporter/sender of the hazardous and other wastes shall prepare and maintain manifest in Form 10. The unit shall ensure submission of green or grey copies of Manifest by the receiver to PPCC for every consignment.

11. Transit of hazardous and other waste for recycling, utilisation including co-processing or disposal through a State other than the States of origin and destination, the sender shall give prior intimation to the concerned State Pollution Control Board of the States of transit before handing over the wastes to the transporter.

12. The unit shall enter agreement with authorised recycler and pre-processor for disposal of hazardous waste category 5.1 & 5.2. The unit shall submit the copy of agreement along with consent and authorisation copy of the authorised facility within three months from receipt of this authorisation.

13. The occupier or the operator, or the transporter shall immediately intimate PPCC through telephone, e-mail about the accident and subsequently send a report in Form-11, where an accident occurs at the facility of the occupier handling hazardous or other wastes and operator of the disposal facility or during transportation.

14. Any increase in quantity of handling of hazardous and other wastes, any change in category of hazardous and other wastes and any change in method of handling operations shall be brought to the notice of the PPCC and fresh authorization shall be obtained.

15. The unit shall provide online display board (English & Tamil) showing hazardous waste details as per the Hon'ble Supreme Court directions (Board of size 6' x 4' installed outside the main gate) and update on daily basis.

16. The authorization is subject to the conditions mentioned above and also to such conditions as specified in the Hazardous and Other waste (Management & Transboundary Movement) Rules, 2016 as amended from time to time framed under the Environment (Protection) Act 1986.

For and on behalf of PPCC

(S.DINESH KANNAN., IFS)
Member Secretary
Puducherry Pollution Control Committee

To

M/s Karaikal Port Private Limited
Keezhavanjore village, T.R. Pattinam Commune, Karaikal District,
Puducherry – 609 606.

Copy to: Guard file

Appendix B
ToR Grant Order

File No: 10-42/2009-IA.III
Government of India
Ministry of Environment, Forest and Climate Change
IA Division
****

Dated **16/12/2024**

To,

Dr Anil Kumar Trivedi
karaikal port private limited
Adani Corporate House, 3rd Floor, North Wing Adani Shantigram, Near Vaishno Devi Circle, SG Highway, Khodiyar, Ahmedabad, AHMADABAD, GUJARAT, 382421
env.kppl@adani.com

Subject: **The proposal is for the Master Plan Development of Karaikal Port for cargo handling capacity of 100.3 MMTPA in an Area of 506 Ha at Vanjore Village, Karaikal District, Union Territory of Puducherry by M/s Karaikal Port Private Limited (KPPL)–Terms of Reference regarding.**

Sir/Madam,

This is in reference to your application for Grant of Terms of Reference under the provision of the EIA Notification 2006 in respect of project of Master Plan of Karaikal Port, Vanjore village, Karaikal district, Puducherry submitted to Ministry vide proposal number IA/PY/INFRA1/500606/2024 dated 15/10/2024.

2. The particulars of the proposal are as below :

(i) TOR Identification No.	TO24A3501PY5387211N
(ii) File No.	10-42/2009-IA.III
(iii) Clearance Type	TOR
(iv) Category	A
(v) Project/Activity Included Schedule No.	7(e) Ports, harbors, breakwaters, dredging
(vi) Sector	INFRA-1
(vii) Name of Project	Master Plan of Karaikal Port, Vanjore village, Karaikal district, Puducherry
(viii) Name of Company/Organization	karaikal port private limited
(ix) Location of Project (District, State)	KARAIKAL, PUDUCHERRY
(x) Issuing Authority	MoEF&CC
(xii) Applicability of General Conditions	yes
(xiii) Applicability of Specific Conditions	no

3. The proposed project is for ‘Master Plan Development of Karaikal Port for cargo handling capacity of 100.3 MMTPA

in an Area of 506 Ha (existing 243 ha and proposed development 263 ha) at Vanjore Village, Karaikal District, Union Territory of Puducherry by M/s Karaikal Port Private Limited (KPPL)'. The Karaikal Port is an all-weather multipurpose deep-water port located southeast of Vanjore Village and falls in the Thirumalairayan Pattinam Commune Panchayat of Karaikal district in Puducherry Union Territory. The geographic location of the port is at Latitude 10°50' N and Longitude 79°51' E.

4. Existing port is located in an area of 243 ha along with 6.07 ha of railway corridor which is completely in possession of KPPL. An area of 137.14 ha is proposed to be reclaimed and an area of 119.79 ha is proposed to be acquired for master plan development. Thus, the master plan for Karaikal port will be in an area of 506 ha.

5. The proposed project activity is listed at schedule S.No.7(e) Ports, harbors, breakwaters, dredging under Category- 'A,' of the schedule of the EIA Notification, 2006 and its amendments and also General Condition applicable as the project site is 20m from the Puducherry Union Territory and Tamil Nadu state boundary, required to be appraised by sectoral EAC at the Central level. Total Project Cost is Rs. 19743.88 Cr.

6. Environmental & CRZ Clearance for expansion of Karaikal Port (Phase-II) has been obtained from MoEFCC dated 22.09.2009 vide letter No. F.No.10-42/2009–IA.III, and Amendment were obtained dated 20.05.2011, 03.02.2015, 14.05.2018, and 05.08.2021. Consent to Operate for 17.5 MMTPA dry bulk, break bulk and liquid cargoes obtained from Puducherry Pollution Control Committee (Consent Order No.(R19KAR654931)/(2022)/731 dated 09.06.2022 having validity up to 31.03.2026. In order to accommodate the master plan development, the Chief Secretariat (Port), Govt. of Puducherry has issued G.O. Ms.No.03 dated 01.08.2024.

7. Karaikal port is already an operational port and handling around 21.5 MMTPA cargo of varied cargoes like coal, fertilizers, cement, sugar, gypsum, iron scrap, timber, granite, etc., general cargo, containers and liquid bulk cargoes such as edible oil, crude and petroleum products, OSV and PSV vessels, etc. from the existing berths. Currently, the port has an 1165 m long quay length (Total of five berths) that is developed and under operation, out of which 710 m quay length berths are handling multipurpose cargo. The details of berths are as following:

S. No.	Name of the Berth	Length (m)	Width (m)	Draft (m CD)
1	Multipurpose berth-1 & 2	460	20.8	-14.5
2	Coal Berth-3	300	24	-14.5
3	Coal Berth-4	255	24	-14.5
4	OSV/ General cargo/ Container	150	10	11.0

Along with these berths, other supporting infrastructures have been developed, such as areas for godowns, coal & iron ore yards, and other related utilities and amenities.

8. Details of the existing port infrastructure and proposed master plan details are as follows:

S. No.	Description	Unit	Existing	Proposed	Total	Remarks
1	Berths	Number	5	9	14	2 out of 5 Existing Berth Need modification to cater bigger vessel.
2	Breakwater	Meter	2295	4646	6941	Some portion of existing breakwater need to be dismantled

						and extension will be taken.
3	Diaphragm Wall	Meter	0	227	227	-
4	Cargo handling	MMTPA	21.5	78.8	100.3	Total 100.3 MMTPA
5	Port Backup area & associated facilities	Ha	243.0	263.0	506.0	Railway corridor- 6.07 ha. Reclamation Required 137.14 ha. Land to be Acquired is 119.79 ha.
6	Capital Dredging	M. Cum	0	42	42	Channel, Berth pocket & Turning circle Detailed quantity will be provided during EIA stage after the modelling studies.
7	Maintenance Dredging	M. Cum	1.5	4.2	4.2	Detailed quantity will be provided during EIA stage after the modelling studies.
8	Reclamation	M. Cum	0	16	16	Development of backup area
9	Reclamation area	Ha	0	137.14	137.14	Reclamation Required 137.14 Ha
10	Water requirement	MLD	0.55	10.00	10.55	Source: Existing 350 KLD approval from PASIC. Existing 200

						KLD RO plant. Proposed desalination plant with a capacity of 50 MLD on modular basis to meet the freshwater demand.
11	Power	MVA	4.0	10.0	14.0	66 KV grid power supply is being drawn from electricity board. Power enhancement will be applied. Backup power through DG sets to the tune of 1.5 to 2.0 MVA will be provided.
12	Effluent Treatment Plant	KLD	182	134	316	Currently ETPs of 182 KLD (2x50 KLD storm water treatment + 50 KLD coal yard run off treatment + 16 KLD vehicle wash treatment + 16 KLD tyre wash treatment) have been installed and in operation.
13	Sewage Treatment Plant	KLD	25	30	55	Currently STP of 25 KLD has been installed and

						in operation.

9. Currently 5 berths are existing for cargo handling at KPPL. 2 out of 5 existing berths need modification to cater bigger vessels. In the master plan, 9 no.s of new berths are proposed for capacity enhancement of Karaikal port. Equipment's used for Cargo Handling are Mobile Harbour Cranes (LHM 400) of Capacity 2000TPH, 1 Gottwald crane, Mobile Hoppers, 2 Stack cum reclaimer for coal cargo, 1 wagon loading station with capacity 3800 TPH with T Silo, Truck loading station 900 TPH with 200 T Silo, Conveyor System of capacity 4000 TPH. Mechanical Dust suppression systems like sprinklers/ nozzles will be installed to control dust. Fishing activity in port premises is restricted. It is observed that most local people at nearby areas are found to be engaged in fishing activity in deep sea. Navigation Channel Dimensions.
10. Existing port is located in an area of 243 ha along with 6.07 ha of railway corridor which is completely in possession of KPPL. An area of 137.14 ha is proposed to be reclaimed and an area of 119.79 ha is proposed to be acquired for master plan development. Thus, the master plan for Karaikal port will be in an area of 506 ha. The proposed land use for master plan development of Karaikal port is as follows:

Sl.No.	Details of activities	Area in Ha
1	Multipurpose back up area	130.86
2	Existing Multipurpose backup	55.99
3	Multi Liquid, Gas, Cryogenic cargo	91.55
4	In bound Parking	15.2
5	Out bound Parking	6.23
6	Green belt	18.28
7	Others (roads, rail, Buildings + Workshops, Misc. (Open storage + recreation facilities + etc.) Desalination Plant + ETP + STP)	187.89
Total		506

11. Terrain and Topographical Features: The terrain of the proposed development is varying between (+) 3.0 m CD to (+) 4.0 m CD level.

12. Land use/ Land cover of project site:

Sl.No	Description	Area in Ha	Percentage (%)
1	Port Area	189.0	37%
2	Transportation	25.0	5%
3	Scrub land Open	96.0	19%
4	Scrub land Dense	52.0	10%
5	River/ Stream/ Drain	6.9	1%
6	Sea Area	137.1	27%
Total		506.0	100%

13. Details of water bodies, impact on drainage: Puravadaiyanar River/ creek is located within the site, Vettar river is located at 0.09 km towards south, Tirumalarajan river is located at 3.07 km towards north, Uppanar river is located at 7.80 km towards south and Arasalar river is located at 6.27 km towards north from the site. Natural creek Puravadaiyanar river/ creek traverses through the port area and discharge into the sea. The water depth in this creek is shallow with minimal tidal exchange. The creek discharge point is proposed to be realigned along with diversion of its path by 1.30 km towards north

of the project boundary, for which a detailed model study such as flood vulnerability assessment, long term shoreline assessment will be conducted during EIA study. Other alternatives shall also be explored while preparing the detailed plan.

14. Water requirements: Water required during construction activity will be met through the bowsers and existing water supply system. Water requirement during construction activity will be approximately 700 KLD. Water requirement during the operation phase will be approximately 10000 KLD. The Port has an existing water allocation of 350 KLD from Puducherry Agro Service and Industries Corporation Limited (PASIC) and also has an existing Sea Water Based Reverse Osmosis of total capacity 200 KLD. Desalination Plant: KPPL envisages developing the desalination Plant with a capacity of 50 MLD on modular basis to meet the freshwater demand to the consumers within the port, port backup area and downstream users. Sea water intake of 125 MLD and reject brine of 75 MLD will be discharged through marine outfall identified through model studies. Desalination plant will be located in the port backup area.

15. Waste Management: Karaikal Port is an existing operational port, and all the waste management practices are in place and the same will be extended for the Master plan of the Karaikal port. Currently Sewage treatment Plant (STP) of capacity 25 KLD is in operation. Sewage Treatment Plant (STP) and Effluent Treatment Plant (ETP) Plants based on MBBR technology would be developed to treat the various effluents generated from the port terminal and its port user's facilities. It is proposed to have an ETP of 134 KLD and STP of 30 KLD to treat the wastewater treated water will be reused for green belt development and dust suppression. Hazardous wastes generated at the port shall be disposed off through authorized vendors duly adhering under guidelines of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and its amendment. Detailed information of different types of the waste to be generated as a part of development and waste management practices will be provided in the EIA study.

16. Details of Tree Cutting and Green Belt Development: The total of 80 trees enumerated to remove from the proposed master plan development, out of which 40 trees are proposed for transplantation. Further, area under green belt with the existing port is having around 8.28ha and under the proposed master plan development proposed 10 ha of green belt the total 18.6 Ha will be developed under green cover. The details and layout will be submitted along with the EIA/ EMP report.

17. Diversion of forestland: The instant proposal does not involve any forest land and not require forest diversion. The project is not located within 10km of Protected Areas (PA) including National Parks, Sanctuaries and Tiger Reserves etc. The project is also not located within the Eco-Sensitive Zone (ESZ) or Eco-Sensitive Area (ESA) notified by the MoEF&CC.

18. The proposed project Site is not located in the proximity to the Critically Polluted area as identified by the CPCB.

19. CRZ Area Details: The proposed development falls under CRZ IB, CRZ III, CRZ IVA & CRZ IVB. Demarcation of coastal regulation zone, High Tide Line/ Low Tide Line & Land Use map, CRZ maps imposing the project layout will be prepared through MoEFCC authorized/ accredited institute & the same will be presented in EIA/ EMP Report.

20. Breakwater: KPPL has an existing approach channel of 9.75 km in length, which will be extended to 12.5 km during the master plan. Breakwaters: The existing North and South breakwater length is 2295 m and a length of 4646m breakwaters are proposed in the master plan. Capital dredging of around 42 M. cum will be carried out at proposed berthing & approach channel areas and around 16 M. cum of dredge material will be utilized for reclamation on the North & South sides of the port. The remaining dredge material will be disposed of at designated offshore dumping locations per the modeling study's recommendations.

21. Details of shore line change: According to the "National Shoreline Changes along the Indian Coast, Volume 1-East Coast" by the National Centre for Coastal Research, Karaikal Port features low eroding coast and this is represented in map no: NCCR (SCM) 338.

22. Handling of each cargo: KPPL is proposing for Master Plan of Karaikal Port with handling capacity of 100.3 MMTPA with 14 berths. The following list of cargoes are proposed to be handled:

Sl. No.	Cargo type	Cargo Mix	Cargo Handling Capacity (MMTPA)–Long Term
1	Multipurpose (Including Liquid)	Multipurpose Cargoes including Coal/ Iron ore/ limestone/ Mines & Minerals & other dry bulk/ Fertilizers and raw materials for manufacture of fertilizer/ food grains/ sugar/ clinker/ cement/ Project cargo/ timber & wood/ machines/ Iron steel products/ Bulk/ Break Bulk etc./ Container, Ro–Ro & Automobiles and any other non-hazardous cargo. All Class A, B, C chemical products, excluded petroleum products, Petrochemical products, Hazardous, Toxic and Non-Hazardous chemicals/ Liquids and other Liquid cargos. Tentative list of hazardous liquid cargo but not limited to are as follows: Ethylene, Propylene (Propene), Butadiene, Pentane, Ethyl Mercaptan Motor Spirit, Propylene Oxide, Hexane, Naphtha, Acetone, Methyl Chloride/ Chloro Methane, Cyclohexane, Benzene, Ethyl Acetate, Acrylonitrile Acetonitrile, Methyl Methacrylate, Methacrylonitrile, Methanol (Methyl Alcohol), Isopropyl Alcohol, Ethyl Alcohol (Ethanol), Ethylene dichloride, Methyl Isobutyl Ketone, Ethyl Benzene, N-Butyl Acetate, Isobutyl Alcohol (Iso Butanol), N-Butyl Alcohol (N-Butanol), Epichlorohydrine, Styrene, O-Xylene, Acetic Acid, Acetic Anhydride, Nonedible/ Mentha Oil Low Sulphur Heavy Stock/ Furnace oil, Aniline, Methyl Ethyl Ketone Peroxide, Ethyl Hexanol-2, Vinyl Chloride, Phenol, Naphthalene, Ethylene Glycol, Mono Ethylene Glycol, Toluene 2.4-di isocyanate.	59.3

2	Gas/ Cryogenics/ Liquid	LNG, Propane, Butane, n-Butane, Ethane, LPG, CNG, NG and All Class A, B, C chemical products, excluded petroleum products Including Petrochemical products, Hazardous, Toxic and Non-Hazardous chemicals/ Liquids and other Liquid cargos.	41.0
Total			100.30

23. Equipment's used for Cargo Handling are Mobile Harbour Cranes (LHM 400) of Capacity 2000 TPH, 1 Gottwald crane, Mobile Hoppers, 2 Stack cum reclaimer for coal cargo, 1 wagon loading station with capacity 3800 TPH with T Silo, Truck loading station 900 TPH with 200 T Silo, Conveyor System of capacity 4000 TPH. Mechanical Dust suppression systems like sprinklers/ nozzles will be installed to control dust. Break bulk/ General Dry Cargo terminals have multipurpose terminals to cater cargo demand. The terminal will have an open storage area, this terminal shall be used as a multipurpose facility for dry bulk cargo, handled in conventional manner. The Liquid & Gas Terminals proposed to have 4 nos. liquid & gas terminals. The berth shall connect with tank terminal via a Pipe rack running along the breakwater up to common user manifold equipped with sufficient loading and unloading arms. Also proposed to have 1 no. SPM system at -30 m CD and 17.9 km of sub-sea pipeline for transport of crude oil. The VLCC is moored on the SPM, which enables the vessel to weathervane adjusting its alignment along the resultant of the forces exerted on the vessel because of wind, wave and current etc. Crude oil flows from the tanker to the body of the buoy and then through under buoy hoses to PLEM and the submarine pipeline. A Catenary Anchor Line Mooring (CALM) buoy is a type of SPM which is a floating unit permanently anchored to the sea floor with chains. The CALM buoy utilizes floating hoses to subsea manifold and pipelines to shore.

24. Energy conservation measures with estimated saving: Renewable Solar energy (10 kW) will be utilized in the proposed project.

25. Details of Rain Water Harvesting: 5 Nos. RWH pits with storage capacity of 1.5m3 will be provided in backup area. Total Quantity of water requirements met from water harvesting will be 0.5 KLD.

26. Land acquisition and R&R issues involved: Existing port is located in an area of 243 ha along with 6.07 ha of railway corridor, which is completely in possession of KPPL. An area of 137.14 ha is proposed to be reclaimed and an area of 119.79 ha is proposed to be acquired for master plan development. Thus, the master plan for Karaikal port will be in an area of 506 ha. The land required for acquisition is devoid of any habitation and is a mix of government & private land. Hence, no rehabilitation and resettlement (R&R) is envisaged.

27. Employment Potential: The proposed development will provide the employment to approximately 500 workers during the construction phase, and around 1050 people will get an employment opportunity during operational phase.

28. Benefits of the project: Employment generation, people will have higher income due to direct employment as well as indirect employment and will have higher earning, buying capacities. Enhancement in Regional Economy and Socio-Economic Conditions of the people. KPPL will carry out CSR activities in nearby villages for enhancing the social infra and health infra by providing necessary support. The proposed master plan development of Karaikal Port has following key advantages: Strategic location, all weather deep draft availability, possibility of multi-modal connectivity through Rail & Road network, availability of reliable power, no rehabilitation & relocation of existing settlements, large stretches of non-agricultural/ highly saline barren land available for development.

29. Details of Court cases: The instant proposal does not involve any court cases/ litigation.

30. The EAC based on the information submitted and clarifications provided by the project proponent and detailed discussions held on all the issues during 380th meeting held on 8th November, 2024 recommended the project for grant of

Terms of Reference (ToR) with stipulated specific conditions along with other Standard ToR Conditions.

31. The Ministry of Environment, Forest and Climate Change has considered the proposal based on the recommendations of the Expert Appraisal Committee (Infrastructure, CRZ and other Miscellaneous projects) and hereby decided to grant Terms of Reference for 'Master Plan Development of Karaikal Port for cargo handling capacity of 100.3 MMTPA in an Area of 506 Ha at Vanjore Village, Karaikal District, Union Territory of Puducherry by M/s Karaikal Port Private Limited (KPPL)' and for preparation of EIA/EMP report with public consultations under the EIA Notification, 2006 as amended, subject to strict compliance of the following specific conditions, in addition to all standard ToR conditions applicable for such projects.

32. A detailed draft EIA/EMP report shall be prepared in terms of the above additional TOR and should be submitted to the State Pollution Control Board for Public Hearing. Public Hearing to be conducted for the project in accordance with the provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public should be addressed in the Environmental Management Plan. The Public Hearing shall be conducted based on the TOR letter issued by the Ministry and not on the basis of Minutes of the Meeting available on the website.

33. The project proponent shall submit the detailed final EIA/EMP report prepared as per TOR including issues raised during Public Hearing to the Ministry for considering the proposal for environmental clearance before expiry of validity of ToR.

34. The consultants involved in preparation of EIA/EMP report after accreditation with Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and data provided by other Organization(s)/Laboratories including their status of approvals etc. vide notification of the MoEF dated 19th July, 2013.

35. The prescribed TOR would be valid for a period of four years for submission of the EIA/EMP Reports.

36. This issues with the approval of Competent Authority.

Copy To

1. The Regional Officer, Ministry of Environment, Forest and Climate Change (MoEF&CC),
Integrated Regional Office Chennai, 1st Floor, Additional Office Block for GPOA, Shastri Bhawan, Haddows Road, Nungambakkam,
Chennai–600006, Tamil Nadu.
2. The Member Secretary, Puducherry Pollution Control Committee, 3rd Floor, PHB Building, Anna Nagar, Puducherry-605 005.
3. Parivesh Portal.
4. Guard File/ Monitoring File/ Record File.

Annexure 1

Specific Terms of Reference for (Ports, Harbors, Breakwaters, Dredging)

1. Specific Conditions

S. No	Terms of Reference
1.1	Detailed modelling studies be carried out to understand whether the selected site can withstand severe cyclones and develop the design in accordance with due safety measures.

S. No	Terms of Reference
1.2	The ecologically fragile area including CRZ 1A area etc. shall be demarcated and superimposed on the layout plan and submitted.
1.3	Submit a copy of layout superimposed on the HTL/LTL map demarcated by an authorized agency on 1:4000 scales.
1.4	Recommendation of the Puducherry Coastal Zone Management Authority (CZMA) shall be obtained and submitted.
1.5	Submit superimposing of latest CZMP as per CRZ Notification (2011) on the CRZ map.
1.6	Submit a complete set of documents required as per para 4.2 (i) of CRZ Notification, 2011.
1.7	PP shall also explore the option of retaining the river/creek at its original position by suggesting some mitigative measures like developing structures like bridge/channel/ underpass/floating jetties etc. over the creek as an alternative to the realignment of the creek. The impact of diversion can have repercussions and can affect the backwater ecosystem, creating the possibility of erosion/siltation, discharge issues, impacting the dynamics of reclamation, clogging and flood-like situations that may also arise due to port material residue, etc. The diversion of creek may also cause closure of the mouth of the creek. All these aspects shall be explored and a detailed modelling studies shall be conducted.
1.8	The Committee also suggested that the Karaikal Port is an old port, and the instant proposal is for the development of the Masterplan. Thus, PP shall explore the option to keep the coal stack storage outside the existing place and to keep the newly developed area with proper mitigation measures, it may help reduce the dust pollution.
1.9	PP shall conduct the flood modelling studies with the historical flood data (100 Years) concerning the creek, and the details shall be submitted along with the EIA/EMP report.
1.10	A replenishment study for Puravadaiyanar River/ creek before the monsoon and after the monsoon is required to know the direct impact on the stream's physical characteristics, such as channel geometry, bed elevation, substratum composition and stability, in-stream roughness of the bed, flow velocity, discharge capacity, sediment transport capacity, turbidity, temperature, etc.
1.11	Hydrodynamics study on the impact of dredging on flow characteristics impact on the Puravadaiyanar River/creek and other water bodies shall be carried out and submitted along with the detailed EIA Report.
1.12	Salt water intrusion studies, nearshore bathymetry changes (within 5 km on both sides), sand deposition studies (before and after), shoreline changes, and river morphology studies shall be carried out and submitted along with the detailed EIA Report.
1.13	PP shall obtain permission from the Indian Railways before proceeding with the expansion activities for the proposed project.
1.14	Since the proposed Master plan development overlays on the existing Marine Terminal Facility of M/s Chemplast Cuddalore Vinyls Limited. Therefore, the issue may be discussed with M/s

S. No	Terms of Reference
	Chemplast Cuddalore Vinyls Limited and Puducherry Maritime Board, and details shall be provided in the EIA report.
1.15	Inflammable cargoes (Coal, LPG, LNG etc.) shall not be stored close to each other. There is a high risk when petroleum jetty is allowed near coal jetty or vice-versa. In this case, the distance between the coal jetty and LNG jetty of PPL shall be maintained appropriately.
1.16	Socio-economic plan shall be submitted for the livelihood of local fishermen residing near the port area.
1.17	The PP shall ensure that LPG and LNG berths are not located together to mitigate the risk of a boiling liquid expanding vapor explosion (BLEVE) and more rapid flame spread associated with LPG.
1.18	The PP shall develop a separate handling process for LPG, LNG, and Coal to manage safety risks effectively.
1.19	The PP is required to conduct a risk assessment study, including an evaluation of the potential for BLEVE related to petroleum products.
1.20	The cargo mix shall be revised/ shifted after rigorous risk analysis and consideration of parameters like wind-rose diagrams, safe distance, etc. Further, a risk analysis and its management plan for handling different types of cargo (if handling) shall be conducted and submitted with the EIA/ EMP report.
1.21	The Committee also suggested that the Karikal port, being an old port, has the potential for significant development. The instant proposal for a master plan presents an opportunity to explore innovative solutions. For instance, the option to relocate the coal stack storage outside the existing place and to develop the new area with proper mitigation measures could lead to a significant reduction in dust pollution. Dust-generating cargoes like coal, phosphate, etc., shall be handled and stored in an area earmarked after analysing the wind situation. Further, dust suppression and mitigation measures shall also be implemented.
1.22	Detailed modelling studies shall conducted to understand the impact of past 100 years and future 30 years sea level rise related inundation, erosion and safety of the proposed jetty and storage units.
1.23	Importance and benefits (socio-economic and environmental) of the project shall submitted along with the detailed EIA/ EMP Report.
1.24	A detailed study on the impact of the proposed activity on marine ecology and marine biodiversity with a specific focus on the corals, mangroves, and Mud flats in the proximity of the site should be conducted, including a mitigation plan through a nationally recognized institution or university.
1.25	A bathymetric survey of the existing dumping site used for dredged material shall be conducted, and the availability of the dumping area for the proposed dredging activity shall be evaluated and submitted. A sediment budget for the adjoining areas is to be conducted, and mitigation measures for shoreline management are to be drawn.
1.26	Details of shoreline changes, erosion etc. shall be submitted along the detailed EIA Report.

S. No	Terms of Reference
1.27	Erosion and accretion study at the mouth of the creek and adjoining areas of port site be carried out and submitted in the EIA/EMP report.
1.28	An assessment of the cumulative impacts of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in the core area shall be made for traffic densities and parking capabilities in a 05 km radius of the site. A detailed traffic management and a traffic decongestion plan drawn up through an organization of repute and specializing in Transport Planning shall be submitted in the EIA/EMP report.
1.29	Some fishermen's boats were visible in the KML file render near the proposed development area. Port construction can impact fishing habitats; PP shall conduct the impact study on fishing activity due to port construction, and operational time shall also draw the mitigation in the EIA/ EMP report.
1.30	A socio-impact assessment study shall also be conducted for the fisherman community, and the sustainable development plan shall be drawn, and the same should be submitted along with the EIA/ EMP report.
1.31	The details of the effluent generated and treatment methodology involved in STP/ ETP shall be clearly mentioned in the EIA/ EMP Report.
1.32	Risk analysis and its management plan for handling different types of liquid cargos (if handling) shall be conducted and submitted.
1.33	Disaster Management Plan for the project shall be prepared and submitted.
1.34	Details and status of pending court cases against the project, if any shall be submitted.
1.35	Requirement of water, power, with source of supply, status of approval, water balance diagram, man-power requirement (regular and contract) shall be submitted.
1.36	A certificate from the local body supplying water, specifying the total annual water availability with the local authority, the quantity of water already committed the quantity of water allotted to the project under consideration and the balance water available. This should be specified separately for ground water and surface water sources, ensuring that there is no impact on other users.
1.37	A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project shall be submitted.
1.38	A certificate from the competent authority handling municipal solid wastes shall be submitted, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from the project.
1.39	A management plan for the area under which mangroves are or likely to be removed and compensatory mangrove plantation plan be submitted if any.
1.40	Desalination Plant: KPPL envisages developing the desalination Plant with a capacity of 50 MLD on modular basis to meet the freshwater demand to the consumers within the port, port backup area and downstream users; the location of the 50 MLD desalination plant developed to meet the freshwater demand same shall be demarcated in the layout.

S. No	Terms of Reference
1.41	Public hearing to be conducted and issues raised, commitments made by the project proponent on the same should be included in EIA/ EMP Report in the form of tabular chart with financial budget for complying with the commitments made.
1.42	A tabular chart with index for point-wise compliance of above ToRs. The specific ToRs as recommended above are in addition to all the relevant information as per the 'Generic Structure of EIA' given in Appendix III and IIIA of the EIA Notification, 2006.
1.43	As per the Ministry's Office Memorandum F. No. 22-65/2017-IA.III dated 30th September, 2020, the project proponent, based on the commitments made during the public hearing, specific studies as stated in xiv and xv shall include all the activities required to be taken to fulfill these commitments in the Environment Management Plan along with cost estimates of these activities, in addition to the activities proposed as per recommendations of EIA Studies and the same shall be submitted to the ministry as part of the EIA Report. The EMP shall be implemented at the project cost or any other funding source available with the project proponent.
1.44	In pursuance of Ministry's OM No. stated above, the project proponent shall add one annexure in the EIA Report indicating all the commitments made by the PP to the public during public hearing and submit it to the Ministry and the EAC.

Standard Terms of Reference for (Ports, harbors, breakwaters, dredging)

1. Project Details

S. No	Terms of Reference
1.1	Reasons for selecting the site with details of alternate sites examined/rejected/selected on merit with comparative statement and reason/basis for selection.
1.2	The examination should justify site suitabilityin terms of environmental angle, resources sustainability associated with selected site as compared to rejected sites.
1.3	The anlysis should include parameters considered along with weightage criteria for short-listing selected site.
1.4	Submit the status of shore line change at the project site
1.5	A detailed draft EIA/EMP report should be prepared in accordance with the above additional TOR and should be submitted to the Ministry in accordance with the Notification.
1.6	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.
1.7	Any further clarification on carrying out the above studies including anticipated impacts due to theproject and mitigative measure, project proponent can refer to the model ToR available on Ministry.

2. Land Use,land Acquisition And R&r

S. No	Terms of Reference
2.1	Details of the land use break-up for the proposed project. Details of land use around 10 km radiusof the project site.
2.2	Submit details regarding R&R involved in the project

3. Esz, Crz, International Boundary And Acts

S. No	Terms of Reference
3.1	Examine and submit detail of land use around 10 km radius of the project site and map of the project area and 10 km area from boundary of the proposed/existing project area, delineating project areas notified under the wild life (Protection) Act, 1972/critically polluted areas as identifiedby the CPCB from time to time/notified eco-sensitive areas/interstate boundaries and international boundaries.
3.2	Erosion and accretion study at the mouth of the creek which is adjacent to the proposed site be carried out and submitted
3.3	Detailed modelling studies to understand whether the selected site can withstand severe cyclones and develop design in accordance to due safety measures.
3.4	Submit superimposing of latest CZMP as per CRZ Notification (2011) on the CRZ map. And also submit a copy of layout superimposed on the HTL/LTL map demarcated by an authorized agency on 1:4000 scales.
3.5	Submit a complete set of documents required as per para 4.2 (i) of CRZ Notification, 2011.
3.6	Hydrodynamics study on impact of dredging on flow characteristics shall be carried out.
3.7	A detailed study on the impact of proposed activity on marine ecology and marine biodiversity with specific focus on the corals, mangroves and Mud flats in the proximity of the site should be conducted and required mitigation plan be submitted.
3.8	A management plan for the area under which mangroves are or likely to be removed and compensatory mangrove plantation plan be submitted.

4. Remote Sensing & Gis

S. No	Terms of Reference
4.1	Analysis should be made based on latest satellite imagery for land use with raw images.

5. Forest And Wildlife

S. No	Terms of Reference
5.1	Submit the present land use and permission required for any conversion such as forest, agriculture

S. No	Terms of Reference
	etc.
5.2	land acquisition status, rehabilitation of communities/ villages and present status of acquiring Forest and Agricultural activities.
5.3	Submit details of the trees to be cut including their species and whether it also involves any protected or endangered species.
5.4	Measures taken to reduce the number of the trees to be removed should be explained in detail.
5.5	Submit the details of compensatory plantation.
5.6	Explore the possibilities of relocating the existing trees.
5.7	Examine the details of afforestation measures indicating land and financial outlay
5.8	Landscape plan, green belts and open spaces may be described. A thick green belt should be planned all around the nearest settlement to mitigate noise and vibrations.
5.9	The identification of species/ plants should be made based on the botanical studies.

6. Water Environment/quality Analysis/ Hydrology And Water Bodies

S. No	Terms of Reference
6.1	Examine the details of water requirement, impact on competitive user, treatment details, use oftreated waste water. Prepare a water balance chart.
6.2	Examine and submit the water bodies including the seasonal ones within the corridor of impactsalong with their status, volumetric capacity, quality likely impacts on them due to the project.
6.3	Submit the details of fishing activity and likely impacts on the fishing activity due to the project.
6.4	Specific study on effects of construction activity and pile driving on marine life

7. Waste Management, Drainage And Stps

S. No	Terms of Reference
7.1	Submit a copy of the contour plan with slopes, drainage pattern of the site and surrounding area
7.2	Examine details of Solid waste generation treatment and its disposal.
7.3	Details of oil spill contingency plan.
7.4	Details of the layout plan including details of channel, breakwaters, dredging, disposal and reclamation.

8. Terrain And Topography

S. No	Terms of Reference
8.1	Submit the details of terrain, level with respect to MSL, filling required, source of filling materials and transportation details etc.
8.2	Submit a copy of layout superimposed on the HTL/LTL map demarcated by an authorized agencyon 1:4000 scale along with the recommendation of the SCZMA.
8.3	Details of bathymetry study.
8.4	Details of ship tranquillity study.
8.5	The ecologically fragile area including CRZ 1A area etc. shall be demarcated and superimposed on the layout plan and submitted.

9. Road/transport Connectivity And Traffic Measures

S. No	Terms of Reference
9.1	Examine road/rail connectivity to the project site and impact on the existing traffic network due tothe proposed project/activities
9.2	A detailed traffic and transportation study should be made for existing and projected passenger and cargo traffic.
9.3	Details of handling of each cargo, storage, transport along with spillage control, dust preventivemeasures.
9.4	In case of coal, mineral cargo, details of storage and closed conveyance , dust suppressionand prevention filters.
9.5	An assessment of the cumulative impact of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in the core area, shall be made for traffic densities and parking capabilities in a 05 kms radius from the site. A detailed traffic management and a traffic decongestion plan drawn up through an organization of repute and specializing in Transport Planning shall be submitted with the EIA.

10. Rain Water Harvesting

S. No	Terms of Reference
10.1	Details of rainwater harvesting and utilization of rain water.

11. Baseline Data

S. No	Terms of Reference
11.1	Examine baseline environmental quality along with projected incremental load due to the proposedproject/activities.

12. Air Environment

S. No	Terms of Reference
12.1	The air quality monitoring should be carried out according to the notification issued on 16th November, 2009.

13. Environment Management/ Monitoring, Mitigative Measures And Riskassessment Details

S. No	Terms of Reference
13.1	Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters.
13.2	Submit details of a comprehensive Risk Assessment and Disaster Management Plan includingemergency evacuation during natural and man-made disasters.
13.3	Details of desalination plant and the study for outfall and intake

14. Court/ Litigation Records

S. No	Terms of Reference
14.1	Details of litigation pending against the project, if any, with direction /order passed by any Court ofLaw against the Project should be given.

15. Environment Responsibility

S. No	Terms of Reference
15.1	As per the Ministry's Office Memorandum F. No. 22-65/2017-IA.III dated 30th September, 2020, the project proponent, based on the commitments made during the public hearing, specific studies shall include all the activities required to be taken to fulfill these commitments in the Environment Management Plan along with cost estimates of these activities, in addition to the activities proposed as per recommendations of EIA Studies and the same shall be submitted to the ministry as part of the EIA Report. The EMP shall be implemented at the project cost or any other funding source available with the project proponent.

Additional Terms of Reference

GENERAL GUIDELINES

i. The EIA document shall be printed on both sides, as for as possible.

ii. All documents should be properly indexed, page numbered.

iii. Period/date of data collection should be clearly indicated.

iv. Authenticated English translation of all material provided in Regional languages.

v. The letter/application for EC should quote the MoEF&CC and also attach a copy of the letter prescribing the TOR.

vi. The copy of the letter received from the Ministry on the TOR prescribed for the project should be attached as an annexure to the final EIA-EMP Report.

vii. The final EIA-EMP report submitted to the Ministry must incorporate the issues in TOR and that raised in Public Hearing. The index of the final EIAEMP report, must indicate the specific chapter and page no. of the EIA-EMP Report where the specific TOR prescribed by Ministry and the issue raised in the P.H. have been incorporated. Questionnaire related to the project (posted on MoEF&CC website) with all sections duly filled in shall also be submitted at the time of applying for EC.

viii. Grant of TOR does not mean grant of EC.

ix. Grant of TOR/EC to the present project does not mean grant of approvals in other regulations such as the Forest (Conservation) Act 1980 or the Wildlife (Protection) Act, 1972.

x. Grant of EC is also subject to Circulars and Office Memorandum issued under the EIA Notification 2006 and subsequent amendments, which are available on the MoEF&CC website: www.envfor.nic.in.

xi. The status of accreditation of the EIA consultant with NABET/QCI shall be specifically mentioned. The consultant shall certify that his accreditation is for the sector for which this EIA is prepared.

xii. On the front page of EIA/EMP reports, the name of the consultant/consultancy firm along with their complete details including their accreditation, if any shall be indicated. The consultant while submitting the EIA/EMP report shall give an undertaking to the effect that the prescribed TOR (TOR proposed by the project proponent and additional TOR given by the MoEF) have been complied with and the data submitted is factually correct (Refer MoEF office memorandum dated 4th August, 2009).

xiii. While submitting the EIA/EMP reports, the name of the experts associated with/involved in the preparation of these reports and the laboratories through which the samples have been got analysed should be stated in the report. It shall clearly be indicated whether these laboratories are approved under the Environment (Protection) Act, 1986 and the rules made there under (Please refer MoEF office memorandum dated 4th August, 2009). The project Coordinator of the EIA study shall also be mentioned.

xiv. All the TOR points as presented before EAC shall be covered.

Address: IA Division, Ministry of Environment, Forest and Climate Change,
Indira Paryavaran Bhawan, Jor Bagh New Delhi - 110003
Signed by
Amardeep Raju
Date: 16-12-2024 11:14:38
Reason: Verified and
signed

Appendix C
Chemplast MoM with KPPL

Karaikal Port - Master Plan Development Plan

Joint Discussion - Chemplast Sanmar Ltd & Karaikal Port (P) Ltd

Date : 06th June 2025 Time: 1100 Hrs – 1300 Hrs

Venue : Chemplast Corporate Office, Chennai

KPPL Team Members:

Capt Sachin Srivastava – Chief Operating Officer

Dr. Anil Kumar Trivedi – Associate Vice President - Head - Environment

Capt Dharam Prakash – Head Marine

Mr. Gunjan Joshi - Deputy General Manager- Project

Mr. Anurag Mishra – Head HR & Admin

Mr. B Muralidhar - Deputy General Manager- Business Development

Mr. Anbalagan – Consultant IR

Mr. Anshul Sanduja- Manager – Environment, Head Office

Mr. Tarang Fajaliya - C&MD office

Mr. Periasamy A – Lead Environment, Kairakal

Chemplast Team Members:

Mr. K Satyanarayana Rao – MD Central Technical Department (ksr9@sanmargroup.com & 9940155222)

Mr. Sankara Subramanium - President project

Mr M S Ananth. -Deputy Managing Director

Mr. K.Kumaresen - Vice President Project

Mr.A.Kumaran -PRO

Mr.R.Rajesh

S No	M/s Chemplast Statement / Queries	KPPL Reply
1	CSL Land overlapping in Karaikal Master plan (Survery Nos - 41-2, 42-1, 42-2, 42-3, 42-4, 43-1, 43-1, 43-4, 43-5, 43-6, 47-3, 55-SA, 205-1, 205-2, 206-2, 207-1 and 208-3.)	It will be ensured that the land belongs to CSL will be removed from Master Plan of Karaikal port. However, for further streamlining the layout of Master Plan w.r.t land is under discussion with

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	Corridor in Survey No. 215 Plot no 55 - SA	senior management of Adani group and the same will be communicated accordingly to CSL. As agreed, CSL will take the pipelines of new Desalination plant within 22.5 m corridor on survey no. 215 allotted to CSL by GoP. Other than the corridor, the land belongs to KPPL. A joint survey will be undertaken by KPPL and CSL to understand the extent of land under this survey number.
2	Existing Desalination Plant's (3 MLD capacity) intake & outfall	The location of existing Desalination plant intake will not be affected with river diversion as are located upstream of the location from where diversion is proposed. However, an alternative location for the outfall will be identified (as it is present in River Puravadaiyanar after the diversion point) within the re-routed river prior to execution of river diversion activity.
3	New Desalination plant 06 MLD intake and outfall	Gravity flow intake system has been proposed for the new desalination plant at a depth of -6.6 m at 650 m from the shore. This system will not be affected due to reclamation proposed by KPPL in Master Plan. The outfall diffuser is proposed further upstream at a depth of -7.7 m at 1100 m from the shore. CSL is of opinion that due to the reclamation proposed by KPPL in Master Plan, there is a possibility of sediment transport and problem of siltation problem may arise at the diffuser point. CSL shall provide the design study report along with GA & engineering drawings of the desalination plant to KPPL and KPPL will scientifically check this possibility with CWPRS through modelling

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		study. If siltation is scientifically proven, then CSL will shift its outfall system either towards south or north of existing location, which will be finalized after understanding outcome of study.
4	North railway Siding of KPPL to be developed as a part of Master Plan	Two options will be explored, and details are as follows: (1) Swapping of land between KPPL and CSL for the development of Railway siding for KPPL and desalination plant for CSL. CSL will check and get back at the earliest possible. Also, for further streamlining the layout of Master Plan w.r.t land is under discussion , with senior management of Adani group and the same will be communicated accordingly to CSL. (2) Possibility of shifting of railway siding will be checked by KPPL after seeking guidance from management.
5	RoW to be provided to CSL	KPPL will maintain the existing RoW and will provide new RoW at the jointly identified location.
6	Development plan of KPPL and CSL	KPPL agreed to share its Master plan with CSL. Similarly, CSL will share its future development plan along with drawings and engineering details with KPPL. This is required to avoid any conflict in the future.

M/s Karaikal Port

Authorized Signatory
Captain Dharam Prakash
Head-Marine, Deputy Port Conservator
Karaikal Port Private Limited

KARAIKAL PORT PVT. LTD. MARINE OPS

M/s Chemplast Sanmar

K.Satyanarayana Rao
Managing Director & Corporate Technical Department
Authorized Signatory

CHEMPLAST SANMAR LIMITED No. 9 CATHEDRAL ROAD CHENNAI 600 086

Appendix D
Port Limits G.O

GOVERNMENT OF PUDUCHERRY

Abstract

Chief Secretariat (Port) – Extension of Port Limits of Karaikal Port under the Indian Ports Act, 1908 (Central Act 15 of 1908) – Orders – Notified.

CHIEF SECRETARIAT (PORT)

G.O.Ms.No. 03 Puducherry, dtd. - 1 AUG 2024

READ: 1. G.O.Ms.No.01 of the Chief Secretariat (Port), Puducherry dated 17.03.2005.

2. FTS No. 516/Port/EE/KPPL/Gen/2024 dated 12.06 .2024 from the Director, Port Department, Puducherry.

ORDER:

The following Notification shall be published in the Ensuing issue of the Gazette of Puducherry:-

NOTIFICATION

In exercise of the powers conferred by sub-section (1) read with sub-section (2) of Section 5 of the Indian Ports Act, 1908 (Central Act 15 of 1908), the Lieutenant Governor, Puducherry is pleased to revise and extend the limits of Karaikal Port with effect from the date of issue of this notification in lieu of the entry specified in Column No. 3 of the schedule in the G.O first read above as mentioned below:

SCHEDULE

REGION	PORT	PORT LIMITS		
(1)	(2)	(3)		
Union Territory of Puducherry	Karaikal	A	Lat 10°52'00" North and Long 79°51'09" East	**Existing co-ordinates (A,B,C,D).**
		B	Lat 10°50'00" North and Long 79°51'09" East	
		C	Lat 10°52'00" North and Long 79°57'23" East	
		D	Lat 10°50'00" North and Long 79°57'23" East	
		A	Lat 10°52'00" North and Long 79°51'09" East	**Extended co-ordinates (A,A2,B1, C1,D1).**
		A2	Lat 10°55'30.78" North and Long 79°54'58.87" East	
		B1	Lat 10°49'46.54" North and Long 79°51'06.55" East	
		C1	Lat 10°55'30.78" North and Long 80°02'53.54" East	
		D1	Lat 10°49'46.54" North and Long 80°02'53.54" East	

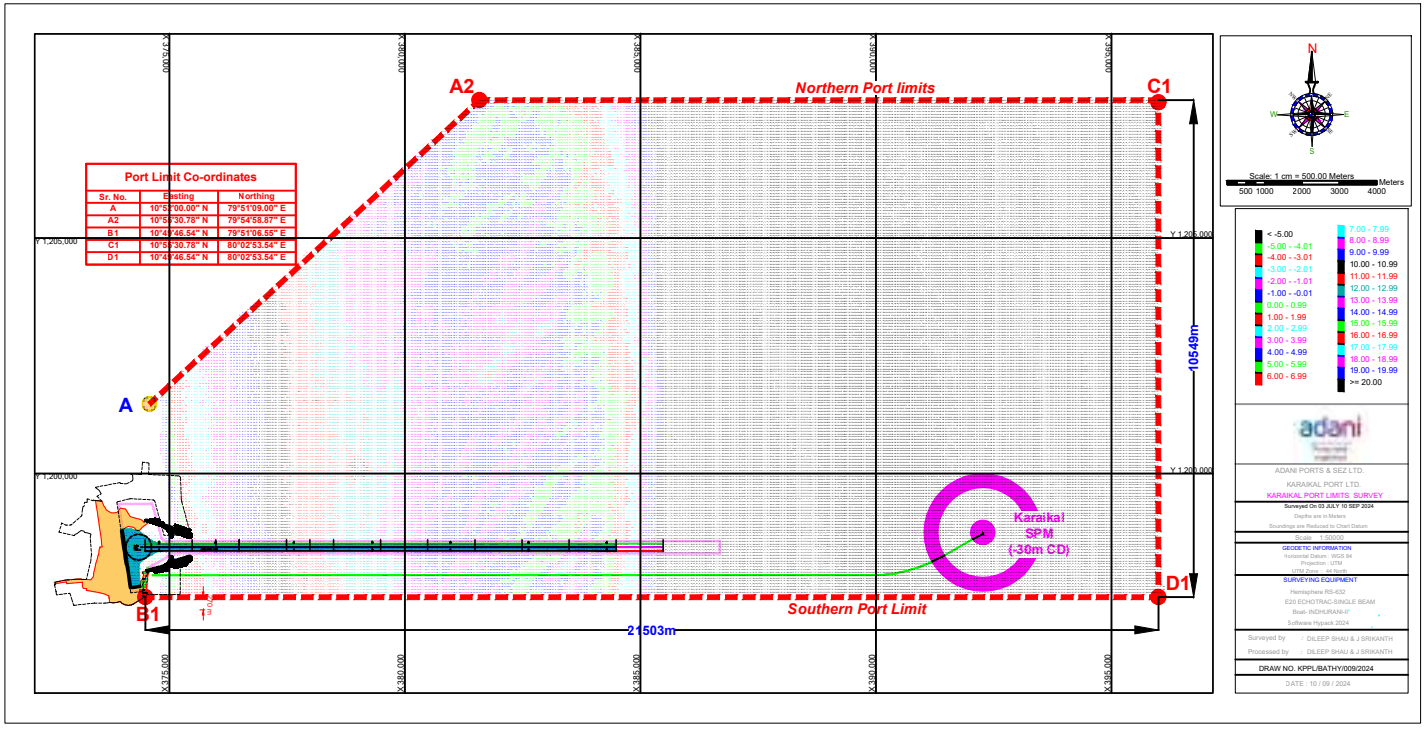
// BY ORDER OF THE LIEUTENANT GOVERNOR//

(S.MURUGESAN)
UNDER SECRETARY TO GOVT (PORTS)

To
The Director,
Department of Stationery and Printing,
Puducherry.

with a request to publish the said Notification in the ensuing issue of the Official Gazette and to supply 20 copies of the same to this Department for reference and records.

Appendix E
Bathymetry of Port Limits


Port Limit Co-ordinates
Sr. No. | Easting | Northing
A | 10°5'00.00" N | 79°51'09.00" E
A2 | 10°5'30.78" N | 79°54'58.87" E
B1 | 10°4'46.54" N | 79°51'06.55" E
C1 | 10°5'30.78" N | 80°02'53.54" E
D1 | 10°4'46.54" N | 80°02'53.54" E
A2
Northern Port limits
C1
A
B1
D1
Southern Port Limit
10549m
21503m
Karaikal SPM (-30m CD)
Y 1,205,000
Y 1,200,000
X 375,000
X 380,000
X 385,000
X 390,000
X 395,000
N
S
E
W
Scale: 1 cm = 500.00 Meters
500 1000 2000 3000 4000 Meters
< -5.00
-5.00 - -4.01
-4.00 - -3.01
-3.00 - -2.01
-2.00 - -1.01
-1.00 - -0.01
0.00 - 0.99
1.00 - 1.99
2.00 - 2.99
3.00 - 3.99
4.00 - 4.99
5.00 - 5.99
6.00 - 6.99
7.00 - 7.99
8.00 - 8.99
9.00 - 9.99
10.00 - 10.99
11.00 - 11.99
12.00 - 12.99
13.00 - 13.99
14.00 - 14.99
15.00 - 15.99
16.00 - 16.99
17.00 - 17.99
18.00 - 18.99
19.00 - 19.99
>= 20.00
adani
ADANI PORTS & SEZ LTD.
KARAIKAL PORT LTD.
KARAIKAL PORT LIMITS SURVEY
Surveyed On 03 JULY 10 SEP 2024
Depths are in Meters
Soundings are Reduced to Chart Datum
CHART DATUM
GEODETIC INFORMATION
Horizontal Datum : WGS 84
Projection : UTM
UTM Zone : 44 North
SURVEYING EQUIPMENT
Hemisphere RS-632
E20 ECHOTRAC-SINGLE BEAM
Boat- INDHURANI-II
Software Hypack 2024
Surveyed by : DILEEP SHAU & J SRIKANTH
Processed by : DILEEP SHAU & J SRIKANTH
DRAW NO. KPPL/BATHY/009/2024
DATE : 10 / 09 / 2024

Appendix F
Bathymetry of Puravadaiyanar river/creek

NORTH RIVER AND LAND AREA RTK SURVEY

RAILWAY TRACK

NORTH BREAK WATER

< -5.00
-5.00 - -4.01
-4.00 - -3.01
-3.00 - -2.01
-2.00 - -1.01
-1.00 - -0.01
0.00 - 0.99
1.00 - 1.99
2.00 - 2.99
3.00 - 3.99

Scale: 1 cm = 20.00 Meters

25 50 100 150 200 Meters

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW

X 373,400 X 373,600 X 373,800 X 374,000 X 374,200 X 374,400 X 374,600 X 374,800

Y 1,199,600 Y 1,199,400 Y 1,199,200 Y 1,199,000 Y 1,198,800

Appendix G
Power Letter

No.495/ED/EE-EHV/AEE-EHV/F.KPPL 15MVA/2024-25
GOVERNMENT OF PONDICHERRY
ELECTRICITY DEPARTMENT

Pondicherry, dt. 09/04/2025

To
M/s. Karaikal Port Private Limited,
Keezhavanjore Village, Karaikal,
Nagore post, 611 002.

Sir,

Sub: Electricity Department, Puducherry – EHV Division - Enhancement of load from the CMD of 5MVA to 15MVA to M/s. Karaikal Port Private Limited, Keezhavanjore Village, Karaikal - Preliminary inspection report - Reg.

Ref: No KPPL/ELE/HT/2024-25/13 Dt 04-01-2025.

*****

Adverting to the letter, vide, cited under reference, requesting Enhancement of load from the CMD of 5MVA to 15MVA to M/s Karaikal Port Private Limited, Keezhavanjore Village, Karaikal and the subsequent inspection at your installation and at 230/110KV Auto SS at Pillaitheruvasal, Karaikal, it is informed that in order to consider your request, the following conditions are to be met by the applicant at first instance:-

i) Separate new 110 KV dedicated bay with all necessary equipments including the EHT metering arrangement at the existing 230/110KVPillaitheruvasal SS by way of 110KV bus/bay extension to be provided.
ii) Establishment of 110KV Pooling switchyard with double main bus with associated indoor and outdoor equipments and control room building at PIPDIC growth center Polagam, Karaikal by dismantling the existing KPPL tapping point switchyard (This work to be executed on cost sharing basis).
iii) Erection of new 110KV line or laying of 110KV UG Cable, as the case may be, from the 230/110KV Pillaitheruvasal SS to the proposed 110KV Pooling switchyard at PIPDIC growth center Polagam, Karaikal. (The consumer may execute this work alone or on cost sharing basis with other intending entrants)
iv) Provision of 110KV line bay with Circuit Breaker, EHT metering and other equipments at proposed110KV Pooling switchyard at PIPDIC growth center Polagam, Karaikal.
v) Interconnection of the existing 110KV KPPL line with the proposed 110KV line bay with EHT metering arrangements at the Pooling switchyard at PIPDIC growth center Polagam, Karaikal by laying of cable or erection of line as the case may be.
vi) Necessary communication facility between the proposed 110 KV line bay at the consumer premises up to the 230/110KV Pillaitheruvasal SS to be established as per the department specification.
vii) If the consumer willing to execute the above said work at their own cost, the estimate and other drawings/documents required for the above said work be prepared by appointing a consultant and furnish the same to the department for further processing/approvals and to obtain Government sanction. After completion of the work, the consumer shall hand over the infrastructure to the Department. The consumer must deposit 15% of the labour cost of the estimate and applicable GST for the above said works as supervision charges before issuing the in-principle approval to execute the work as per clause 5.16 of chapter 5 of JERC supply code 2018.

viii) The connected load particulars of the proposed plant shall be furnished.

ix) Any Row issue during the erection of line/laying of cables and after energisation of proposed 110KV line/UG cable has to be sorted out by the consumer by such means at consumer cost. Only the consumer is solely responsible for the time delay for the completion of the entire work due to the Row and other issues.

x) Power supply shall be extended only after considering the power position at the time of availing the power and not at the readiness of the consumer.

xi) All the required particulars shall be arranged to be furnished with valid EHV Grade Licence Holder who will carry out the proposed work.

viii) The consumer should provide Harmonic Filters for preventing generation of Harmonics, if any, from being injected into the system.

ix) This following clearances from the department/office concerned has to be obtained and furnished by the applicant before issuing the in-principle approval and before energization as the case may be :-

a) Local Commune Panchayat license incorporated with CMD and the connected load should be valid upto date at the time of availing the power supply.

b) Clearance from the Electrical Inspectorate, Central Electricity Authority, Chennai.

c) Approval of Superintending Engineer – MP/OR, Electricity Department, Puducherry for installation of DG set, if any, should be obtained.

2. The electrical works should be carried out by an electrical contractor having valid Grade A contractor license issued by Licensing Board, Puducherry or equivalent license obtained from neighboring state and endorsed by the Electricity Department.
3. Power of attorney for authorized signatory has to be furnished by the consumer for further correspondence.
4. Should employ an Electrical Supervisor exclusively to supervise your electrical installation. The person should possess Supervisor Grade A permit issued by the Puducherry Licensing Board.
5. You are advised to take adequate energy conservation measures and ensure that the power factor during any month shall be maintained in accordance with new supply code regulation 2018.
6. You should ensure that adequate fire protection equipments are provided before obtaining power supply.
7. The consumer is requested to furnish an undertaking in a stamped paper of not less than Rs 100/-comprising all of the above said measures as per the format enclosed in order to obtain Government sanction.
8. The consumer is requested to apply in the prescribed format for the enhancement of load. Your application will be registered only after receipt of concurrence to fulfill the above said conditions at first instance.

// By order//

Yours faithfully,

EXECUTIVE ENGINEER-EHV

Appendix H
Waste Management Letter

SRI KATHAYEE AMMAN SERVICES

No: 3, North Street, Keelavanjore, T.R.Pattinam,
Karaikal-609606 Cell: 91 9843255626

Proprietor K. R.Rajendran Pan: ATCPR9969E

Date: 10.02.2025

Certificate of Waste Management Services

To Whom It May Concern

This certificate is issued on behalf of M/s KATHAYEE AMMAN SERVICE, a waste management entity company, providing comprehensive waste management services to Karaikal Port Pvt. Ltd. (KPPL).

We offer waste management services that cover the entire scope of domestic solid waste generated by the Port project. This includes the collection, transportation, processing, and disposal of various types of municipal solid waste such as plastic, paper, tin, glass, cardboard, food waste, etc.

We use advanced technologies such as windrow composting, vermi-composting, etc. to ensure effective waste management solutions. We have dedicated maintain 3 vehicles for waste collection and transportation including specialized containers and trucks for various waste streams.

Our company actively participates in a range of waste management projects, contributing to the development and implementation of effective waste management strategies, and; especially we are also tied up with having valid license used by the Commissioner, Thirumalairayan Pattinam Commune Panchayat, Karaikal , Puducherry. for residue disposal.

Our processes prioritize waste reduction, recycling, and responsible disposal methods to minimize the environmental impact. Our team of waste management professionals has extensive experience in managing waste for diverse projects, including port facilities and industrial zones.

We continually invest in employee training and development to ensure the highest standards of service quality and safety. We, M/s KATHAYEE AMMAN SERVICE, hereby certify that our waste management services are capable of handling municipal solid waste generated from the Karaikal Port project at its present capacities and also for the future requirements of Port development. We are fully prepared to support and manage all waste-related aspects to facilitate the project's success.

For M/s KATHATEE AMMAN SERVICES.

For SRI KATHAYEE AMMAN SERVICES

Proprietor K.R. Rajendran

K.R Rajendran

(K.R. RAJENDRAN)
Proprietor

Appendix I
Letter from Railways

भारत सरकार / GOVERNMENT OF INDIA
रेल मंत्रालय / MINISTRY OF RAILWAYS
दक्षिण रेलवे / SOUTHERN RAILWAY

ம. ரமேஷ் பாபு ஐ.ஆர்.டி.எஸ்.
एम. रमेश बाबू, भा.रे.या. से.
M. RAMESH BABU, I.R.T.S.
முதுநிலை கோட்ட இயக்கவியல் மேலாளர்
वरिष्ट मंडल परिचालन प्रबंधक
SENIOR DIVISIONAL OPERATIONS MANAGER

मंडल कार्यालय/Divisional Office,
परिवहन शाखा/Transportation Branch,
तिरुच्चिरापल्लि/Tiruchchirappalli.

No. T/T.563/KIKP/Port expansion

दिनांक/Dt: As signed.

Shri. Sachin Srivastava
Chief Operations Officer,
M/s Karaikal Port Private Ltd.
T R Pattinam

विषय/Sub: Provision of additional loading line as a part of Master plan of KIKP – Reg.

संदर्भ/Ref: Your office Lr. No. KPPL/Additional Line/01/2025 dated 10.04.25.

******

We are happy to note that the Port has plans for expansion of 21.5 MMTPA to 100.3 MMTPA handling capacity and we assure you that we will extend our co-operation for the same. The arrangements shown in the proposed Port expansion submitted was examined and it is advised that details of Railway alignment submitted are not sufficient to give In Principle Approval.

It is requested to submit detailed plans on proposed Rail facilities as it is observed that the take off point of the new siding line (proposed new line adjacent to the Chemplast area) from the NCR – KIK main line infringe the upcoming new station of KIKP North station. In connection with this, a master plan with the exact chainages may be submitted to the Division for further scrutinization.

It is further advised that Port may submit the proposal for the proposed Port Rail expansion with Conceptual plan and Feasibility Study Report (FSR) with requisite fees so to process for IPA from HQ.

Thanking you and assuring you of all assistance. Awaiting for further response.

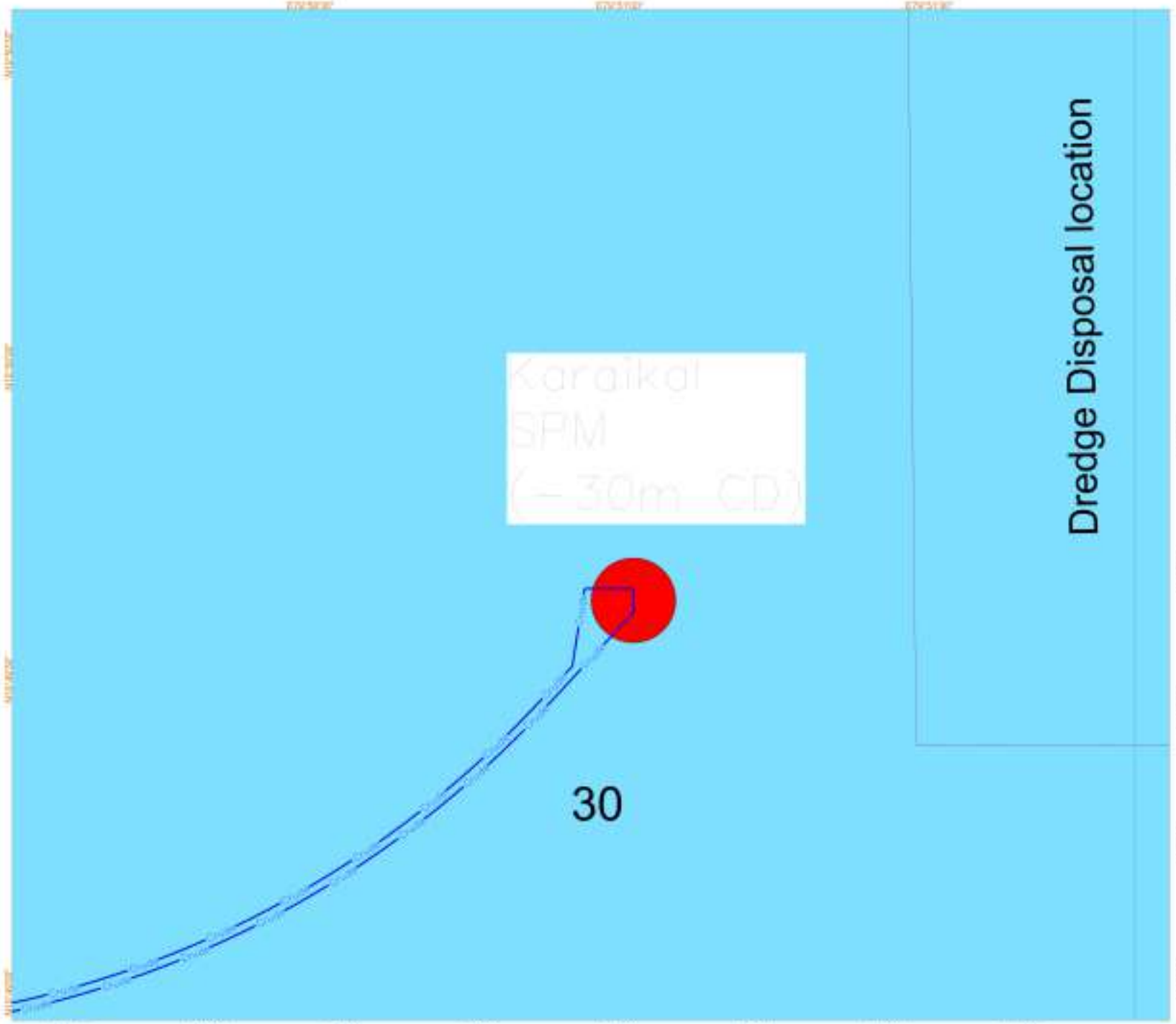
Sr. DOM/TPJ
05/05/2025

C/- CTPM – For kind information.
DRM – For kind information.

V. O. Chidambaram
Velu Nachiyar
Subramania Bharati

Azadi Ka Amrit Mahotsav

Appendix J
CRZ Map



LEGEND:
CRZ Details

- PORT
- FISH LANDING CENTRE
- HTL
- LTL
- ROAD
- RAILWAY LINE
- DISTRICT BOUNDARY
- SURVEY PLOTS
- BREAKWATER OR JETTY
- PORT LIMIT
- HAZARD LINE
- 100M LINE IN CRZ III AREA
- 200M CRZ LINE-NDZ
- CRZ BOUNDARY
- CRZ III
- NO DEVELOPMENT ZONE
- 200 TO 500M FROM HTL
- CRZ-II
- CRZ-IVA
- CRZ-IVB
- PROJECT BOUNDARY
- DREDGE DISPOSAL LOCATION

LOCATION MAP:(Not to scale)

GEODETIC DETAILS:

SPHEROID : WGS 84
PROJECTION : UTM ZONE 44

SURVEY AND CRZ AUTHORISED AGENC:

CSIR-NATIONAL INSTITUTE OF OCEANOGRAPHY
DONA PAULA-403 004 ,
GOA, INDIA

SCALE 1:4000 PROJECT NO SSP 3682

CLIENT:

FALCON RESILIENT INFRASTRUCTURE & CONSULTANCY SERVICES

DRAWING TITLE MAP2-CRZ MAP-PART-C

PREPARATION OF CRZ MAPPING INDICATING LTL,HTL AND CRZ SETBACK LINES FOR THE PROPOSED MASTER PLAN DEVELOPMENT OF KARAIKAL PORT ON APPROVED CZMP AS PER CRZ NOTIFICATION 2011.

Prepared By	Approved By	Forwarded By

LEGEND:
CRZ Details

- PORT
- FISH LANDING CENTRE
- HTL
- LTL
- ROAD
- RAILWAY LINE
- DISTRICT BOUNDARY
- SURVEY PLOTS
- BREAKWATER OR JETTY
- PORT LIMIT
- HAZARD LINE
- 100M LINE IN CRZ III AREA
- 200M CRZ LINE-NDZ
- CRZ BOUNDARY
- CRZ III
- NO DEVELOPMENT ZONE
- 200 TO 500M FROM HTL
- CRZ-II
- CRZ-IVA
- CRZ-IVB

PROJECT BOUNDARY

LOCATION MAP:(Not to scale)

GEODETIC DETAILS:

SPHEROID : WGS 84
PROJECTION : UTM ZONE 44

SURVEY AND CRZ AUTHORISED AGENC:

CSIR-NATIONAL INSTITUTE OF OCEANOGRAPHY
DONA PAULA-403 004 ,
GOA, INDIA

SCALE 1:4000 PROJECT NO SSP 3682

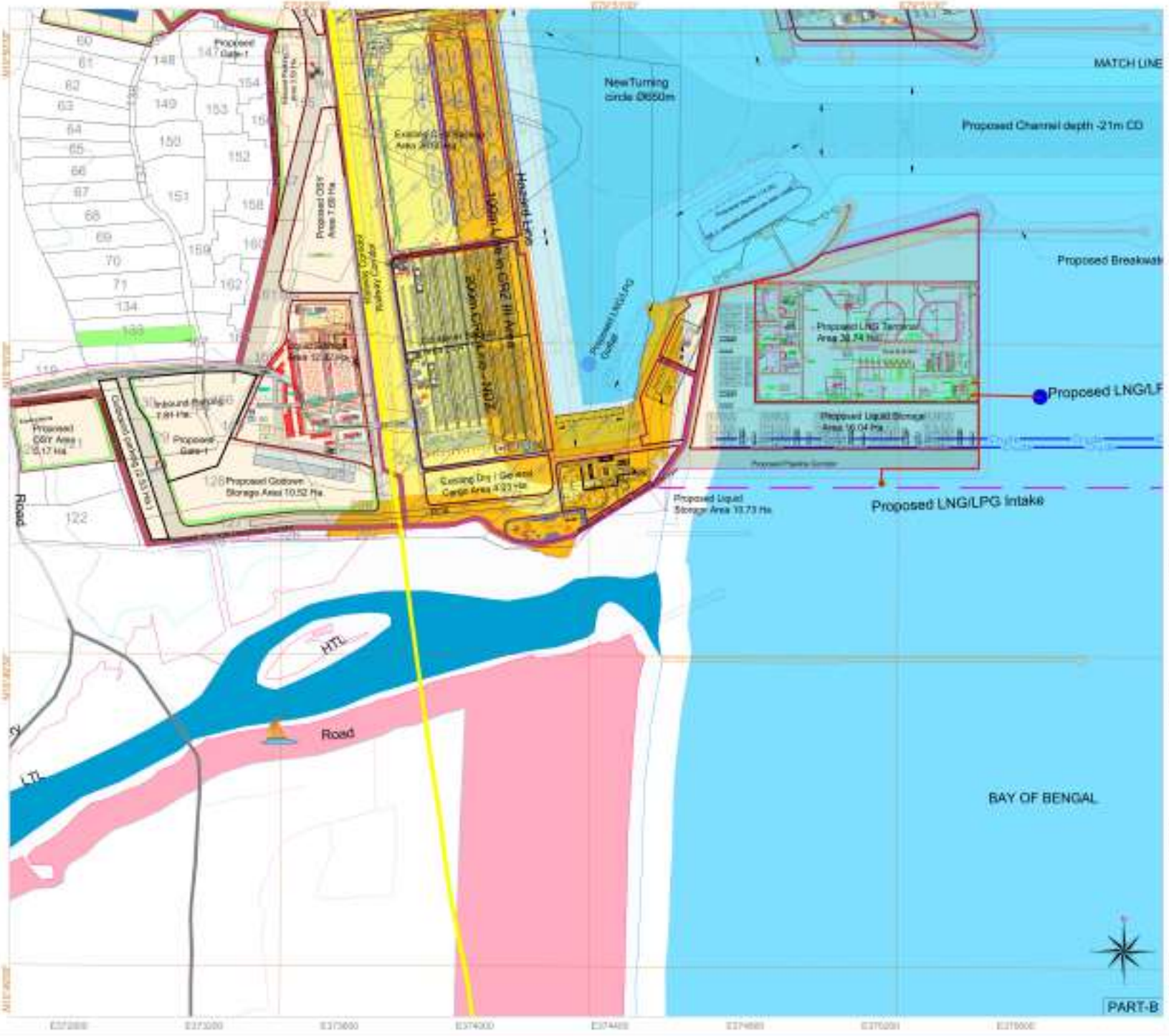
CLIENT:

FALCON RESILIENT INFRASTRUCTURE & CONSULTANCY SERVICES

DRAWING TITLE MAP2-CRZ MAP-PART-A

PREPARATION OF CRZ MAPPING INDICATING LTL,HTL AND CRZ SETBACK LINES FOR THE PROPOSED MASTER PLAN DEVELOPMENT OF KARAIKAL PORT ON APPROVED CZMP AS PER CRZ NOTIFICATION 2011.

Prepared By	Approved By	Forwarded By



LEGEND:
CRZ Details

- PORT
- FISH LANDING CENTRE
- HTL
- LTL
- ROAD
- RAILWAY LINE
- DISTRICT BOUNDARY
- SURVEY PLOTS
- BREAKWATER OR JETTY
- PORT LIMIT
- HAZARD LINE
- 100M LINE IN CRZ III AREA
- 200M CRZ LINE-NDZ
- CRZ BOUNDARY
- CRZ III
- NO DEVELOPMENT ZONE
- 200 TO 500M FROM HTL
- CRZ-II
- CRZ-IVA
- CRZ-IVB
- PROJECT BOUNDARY

LOCATION MAP:(Not to scale)

GEODETIC DETAILS:

SPHEROID : WGS 84
PROJECTION : UTM ZONE 44

SURVEY AND CRZ AUTHORISED AGENC:

CSIR-NATIONAL INSTITUTE OF OCEANOGRAPHY
DONA PAULA-403 004 ,
GOA, INDIA

SCALE 1:4000 PROJECT NO SSP 3682

CLIENT:

FALCON RESILIENT INFRASTRUCTURE & CONSULTANCY SERVICES

DRAWING TITLE MAP2-CRZ MAP-PART-B

PREPARATION OF CRZ MAPPING INDICATING LTL,HTL AND CRZ SETBACK LINES FOR THE PROPOSED MASTER PLAN DEVELOPMENT OF KARAIKAL PORT ON APPROVED CZMP AS PER CRZ NOTIFICATION 2011.

Prepared By	Approved By	Forwarded By

LEGEND:
CRZ Details

- PORT
- FISH LANDING CENTRE
- HTL
- LTL
- ROAD
- RAILWAY LINE
- DISTRICT BOUNDARY
- SURVEY PLOTS
- BREAKWATER OR JETTY
- PORT LIMIT
- HAZARD LINE
- 100M LINE IN CRZ III AREA
- 200M CRZ LINE-NDZ
- CRZ BOUNDARY
- CRZ III
- NO DEVELOPMENT ZONE
- 200 TO 500M FROM HTL
- CRZ-I
- CRZ-IVA
- CRZ-IVB
- PROJECT BOUNDARY
- DREDGE DISPOSAL LOCATION

LOCATION MAP:(Not to scale)

GEODETIC DETAILS:

SPHEROID : WGS 84
PROJECTION : UTM ZONE 44

SURVEY AND CRZ AUTHORISED AGENC:

CSIR-NATIONAL INSTITUTE OF OCEANOGRAPHY
DONA PAULA-403 004 ,
GOA, INDIA

SCALE:1:25000 PROJECT NO:SSP 3682

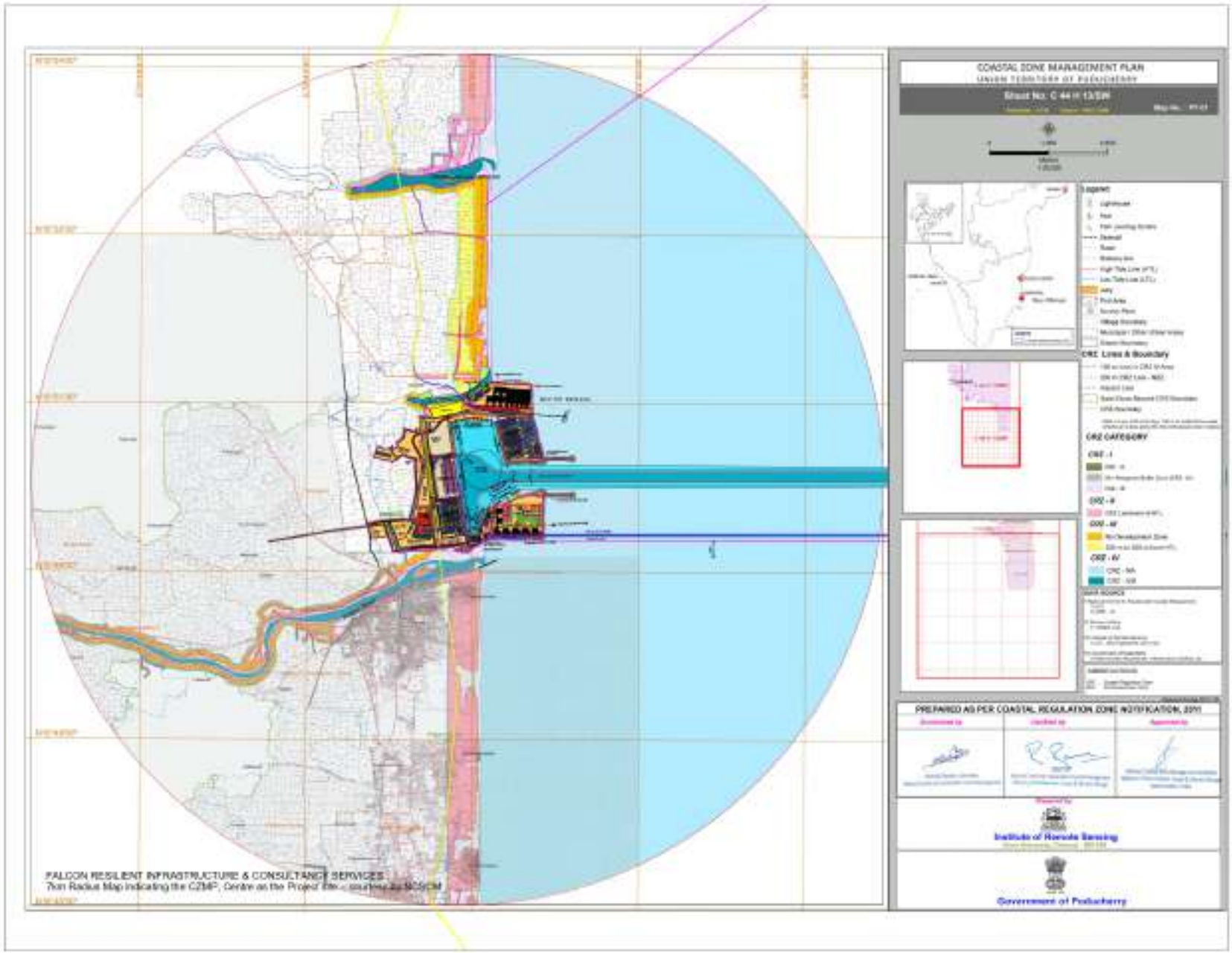
CLIENT:

FALCON RESILIENT INFRASTRUCTURE & CONSULTANCY SERVICES

DRAWING TITLE MAPS-CRZ MAP

PREPARATION OF CRZ MAPPING INDICATING LTL,HTL AND CRZ SETBACK LINES FOR THE PROPOSED MASTER PLAN DEVELOPMENT OF KARAIKAL PORT ON APPROVED CZMP AS PER CRZ NOTIFICATION 2011.

Prepared By	Approved By	Forwarded By


COASTAL ZONE MANAGEMENT PLAN
UNION TERRITORY OF PUDUCHERRY
Sheet No. C 44 H 13/SW
CRZ Lines & Boundary
CRZ CATEGORY
CRZ - I
CRZ - II
CRZ - III
CRZ - IV
PREPARED AS PER COASTAL REGULATION ZONE NOTIFICATION, 2011
Prepared by
Institute of Remote Sensing
Government of Puducherry
FALCON RESILIENT INFRASTRUCTURE & CONSULTANCY SERVICES
7km Radius Map indicating the CZMP, Centre as the Project Site - courtesy as NCSCM

Appendix K
Flora and fauna checklist

Appendix-K

1 Flora and Fauna

1.1 Flora

Sl. No.	Botanical Name	Tamil Name	Family	Local Status	IUCN Status	Core	Buffer
Trees							
1	*Acacia auriculiformis* Benth.	Kaththik Karuvel	Leguminosae	C	LC		*
2	*Acacia leucophloea* (Roxb.) Willd.	Velvelam	Leguminosae	C	LC	*	*
3	*Acacia nilotica* (L.) Delile.	Karuvelai	Leguminosae	C	LC	*	*
4	*Alangium salviifolium* (L.f.) Wangerin.	Alincil	Cornaceae	C	LC		*
5	*Albizia amara* (Roxb.) B.Boivin.	Usilai	Leguminosae	C	LC	*	*
6	*Alstonia scholaris* (L.) R. Br.	Ezhilai Paalai	Apocynaceae	C	LC	*	*
7	*Ailanthus excelsa Roxb.*	Pee maram	Simaroubaceae	C	LC		*
8	*Annona squamosa* L.	Seetha maram	Annonaceae	C	LC		*
9	*Annona reticulata* L.	Ramaseetha palam	Annonaceae	C	LC		*
10	*Azadirachta indica* A.Juss.	Vaeppa maram	Meliaceae	C	LC	*	*
11	*Anacardium occidentale* L.	munthiri kottai	Anacardiaceae	C	LC		*
12	*Artocarpus heterophyllus Lam.*	Palapazham	Moraceae	C	LC		*
13	*Barringtonia acutangula Gaertn.*		Lecythidaceae	C	LC		*
14	*Bauhinia purpurea* L.	Nilattiruvatti	Leguminosae	C	LC		*
15	*Borassus flabellifer* L.	Panaimaram	Arecaceae	C	LC	*	*
16	*Cassia fistula* L.	Kondrai	Leguminosae	C	LC	*	*
17	*Cassia siamea* Lam.	Manjal Konnai	Leguminosae	C	LC		*
18	*Ceiba pentandra* (L.) Gaertn	Panju Maram	Malvaceae	C	LC		*
19	*Cocos nucifera L.*	Thennai	Palmae	C	LC		*
20	Conocarpus erectus L.	Konokarpas	Combretaceae	C	LC		*
21	*Cordia dichotoma* G.Forst.	Naruvili	Boraginaceae	C	LC	*	*

Sl. No.	Botanical Name	Tamil Name	Family	Local Status	IUCN Status	Core	Buffer
22	*Casuarina equisetifolia L.*	Chavukku	Casuarinaceae	C			*
23	*Dalbergia sissoo* DC.	Totakatti	Leguminosae	C	LC		*
24	*Delonix regia (Hook.) Raf.*		Leguminosae		LC	*	*
25	*Dichrostachys cinerea* (L.) Wight & Arn.	Vidathther	Mimosaeae	C	LC		*
26	*Eucalyptus globulus* Labill.	Thaila maram	Myrtaceae	C	LC	*	*
27	*Ficus benghalensis* L.	Alai	Moraceae	C	LC		*
28	*Ficus hispida* L.f.	Chona-atthi	Moraceae	C	LC		*
29	*Ficus religiosa* L.	Arasamaram	Moraceae	C	LC		*
30	*Flacourtia indica* (Burm.f.) Merr.	Katukalai	Salicaceae	C	LC		*
31	*Gliricidia maculata (Kunth) Steud.*		Fabaceae				*
32	*Holoptelea integrifolia* Planch.	Aavimaram	Ulmaceae	C	LC		*
33	*Lannea coromandelica* (Houtt.) Merr.	Othiyan	Anacardiaceae	C	LC		*
34	*Leucaena leucocephala* (Lam.) de Wit	Periya-takarai	Leguminosae	C	LC	*	*
35	*Mangifera indica* L.	Maa maram	Anacardiaceae	C	LC		*
36	*Maytenus emarginata* (Ruiz & Pav.) Loes.	Thandarasa	Celastraceae	C	LC		*
37	*Millingtonia hortensis* L.f.	Kattumalli	Bignoniaceae	C	LC		*
38	Morinda pubescens Sm.	Majanathi	Rubiaceae	C		*	*
39	*Moringa oleifera* Lam.	Murungai	Moringaceae	C	LC		*
40	*Peltophorum pterocarpum* (DC.) K.Heyne	Iyal Vaagai	Leguminosae	C	LC	*	*
41	*Phoenix sylvestris* (L.) Roxb.	Inthupaanai	Arecaceae	C	LC		*
42	*Phyllanthus emblica* L.	Nelli	Phyllanthaceae	C	LC		*
43	*Pithecellobium dulce* (Roxb.) Benth.	Kodukkaapuli	Leguminosae	C	LC	*	*
44	*Plumeria rubra* L.	Nela Sampangi	Apocynaceae	C	LC		*
45	*Pongamia pinnata* (L.) Pierre	Pungai	Leguminosae	C	LC	*	*
46	*Prosopis chilensis* (Molina) Stuntz	Vaelikkaruvai	Leguminosae	C	LC		*
47	*Psidium guajava* L.	Koyya	Myrtaceae	C	LC		*
48	*Pterospermum xylocarpum* (Gaertn.) Oken	Masapoondi	Malvaceae	C	LC		*

Sl. No.	Botanical Name	Tamil Name	Family	Local Status	IUCN Status	Core	Buffer
49	*Samanea saman*	Seemai Vaagai	Mimosaceae	C	LC	*	*
50	*Sapindus emarginatus* Vahl	Ponnankottai	Sapindaceae	C	LC		*
51	*Semecarpus anacardium* L.f.	cen-kottai	Anacardiaceae	C	LC		*
52	*Syzygium cumini* (L.) Skeels	Naaval	Myrtaceae	C	LC		*
53	*Tamarindus indica* L.	Puzhiya Maram	Leguminosae	C	LC		*
54	*Tectona grandis* L.f.	Thaekku	Lamiaceae	C	LC		*
55	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Vellamaruthu	Combretaceae	C	LC		*
56	*Terminalia alata*	Karru marudhu					*
57	*Wrightia tinctoria* R.Br.	Irumpaalai	Apocynaceae	C	LC		*
58	*Ziziphus jujuba* Mill.	Elanthai	Rhamnaceae	C	LC	*	*
59	*Thespesia populnea (L.) Sol. ex Corrêa*	Puvarasu Puvarasu	Malvaceae	C	LC	*	*
Shrubs							
60	*Abutilon indicum* (L.) Sweet	Thuthi	Malvaceae	C	LC	*	*
61	*Agave americana* L.	yaanai kattralai	Asparagaceae	C	LC		*
62	*Azima tetracantha* Lam.		Salvadoraceae	C	LC		*
63	*Caesalpinia bonduc* (L.) Roxb.	Kalichikai	Leguminosae	C	LC		*
64	*Caesalpinia pulcherrima* (L.) Sw.	Mayil Kontai	Leguminosae	C	LC	*	*
65	*Calotropis gigantea* (L.) Dryand.	Erukku	Apocynaceae	C	LC	*	*
66	*Canna indica* L.	Kalvazhai	Cannaceae	C	LC		*
67	*Catunaregam spinosa* (Thunb.) Tirveng.	Matukkarai	Rubiaceae	C	LC	*	*
68	*Canthium coromandelicum* (Burm.f.) Alston.	Mullukaarai	Rubiaceae	C	LC	*	*
69	*Cadaba fruticosa* (L.) Druce	Vizhuthi	Capparaceae	C	LC		*
70	*Clerodendrum inerme* (L.) Gaertn.		Lamiaceae.	C	LC		*
71	*Dodonaea viscosa* Jacq.	Virali	Sapindaceae	C	LC	*	*
72	*Datura stramonium* L.test	Oomattai	Solanaceae	C	LC		*
73	*Euphorbia caducifolia* Haines	ilai-k-kalli	Euphorbiaceae	C	LC		*
74	*Grewia flavescens* Juss.	Semparandai	Malvaceae	C	LC		*

Sl. No.	Botanical Name	Tamil Name	Family	Local Status	IUCN Status	Core	Buffer
75	*Hyptis suaveolens* (L.) Poit.		Lamiaceae	C	LC	*	*
76	*Ixora coccinea* L.	Vedchi	Rubiaceae	C	LC		*
77	*Jasminum roxburghianum* Wall. ex C.B.Clarke		Oleaceae	C	LC		*
78	*Jatropha curcas* L.	Kattukkotai	Euphorbiaceae	C	LC		*
79	*Jatropha glandulifera* Roxb.	Vellaikattukottai	Euphorbiaceae	C	LC	*	*
80	*Lantana camara* L.	Unnichedi	Verbenaceae	C	LC	*	*
81	*Leonotis nepetifolia* (L.) R.Br.	kasitumpai	Lamiaceae	C	LC		*
82	*Martynia annua* L.	Pulinakam	Martyniaceae	C	LC		*
83	*Opuntia dillenii* (Ker Gawl.) Haw.	Sappathikalli	Cactaceae	C	LC	*	*
84	*Pandanus fascicularis* Lam.	Tazhai	Pandanaceae	C	LC		*
85	*Plumbago zeylanica* L.	Chithiramoolam	Plumbaginaceae	C	LC		*
86	*Sarcostemma acidum* (Roxb.) Voigt	Kodikkalli	Apocynaceae	C	LC		*
87	*Senna auriculata* (L.) Roxb.	Avaram	Leguminosae	C	LC	*	*
88	*Senna occidentalis* (L.) Link	Paayavarai	Leguminosae	C	LC		*
89	*Vitex negundo L.*		Lamiaceae			*	
90	*Solanum* pubescens.Willd.	Kaattu sundai kaai	Solanaceae	C	LC		*
91	*Ziziphus oenopolia* (L.) Mill.	Surai mullu	Rhamnaceae	C	LC		*
92	*Dichrostachys cinerea (L.) Wight & Arn.*	Vedathala	Leguminosae			*	*
93	*Ziziphus jujuba* Mill.	Elanthai	Rhamnaceae				
94	*Ricinus communis* L.	Amanakku	Euphorbiaceae	C	LC		*
95	Chromolaena odorata (L.) R.M.King & H.Rob.	Phulgandhuri	Compositae	C	LC	*	*
Herbs							
96	*Acalypha indica* L.	Kuppaimeni	Euphorbiaceae	C	LC	*	*
97	*Achyranthes aspera* L.	Nayuruvi	Amaranthaceae	C	LC		*
98	*Aerva lanata* (L.) Juss.	Poolaippoo	Amaranthaceae	C	LC	*	*
99	*Aeschynomene aspera* L.		Leguminosae	C	LC		*
100	*Ageratum conyzoides* (L.) L.	Appakkoti	Compositae	C	LC		*

Sl. No.	Botanical Name	Tamil Name	Family	Local Status	IUCN Status	Core	Buffer
101	*Aloe vera* (L.) Burm.f.	kattraazhai	Asparagaceae	C	LC		*
102	*Alternanthera sessilis* (L.) R.Br. ex DC.	Ponnanganni Keerai	Amaranthaceae	C	LC	*	*
103	*Amaranthus viridis* L.	Kuppaikkeerai	Amaranthaceae	C	LC	*	*
104	*Andrographis paniculata* (Burm.f.) Nees	Nilavembu	Acanthaceae	C	LC		*
105	*Andropogon pumilus* Roxb.	Kaavattam Pillu	Poaceae	C	LC		*
106	*Apluda mutica* L.f.	Mungil pul	Poaceae	C	LC		*
107	*Aristida fasciculata* Torr.		Poaceae	C	LC		*
108	*Bacopa monnieri* (L.) Wettst.	Brami	Plantaginaceae	C	LC		*
109	*Barleria prionitis* L.	Sulli Malar	Acanthaceae	C	LC		*
110	*Blepharis maderaspatensis* (L.) B.Heyne ex Roth	Kozhimookkan	Acanthaceae	C	LC		*
111	*Boerhavia diffusa* L.	Mookkaratti	Nyctaginaceae	C	LC	*	*
112	*Brachiaria ramosa* (L.) Stapf	Chama pothaval	Poaceae	C	LC		*
113	*Cassia obtusa* Clos	Nilavakka	Leguminosae	C	LC		*
114	*Catharanthus roseus* (L.) G.Don	Nithyakalyani	Apocynaceae	C	LC		*
115	*Celosia argentea* L.	Pannai keerai	Amaranthaceae	C	LC		*
116	*Chloris barbata* Sw.	Mayir Kondai Pul	Poaceae	C	LC		*
117	*Cleome viscosa* L.	Naikadugu	Cleomaceae	C	LC	*	*
118	*Commelina benghalensis* L.	Kanavalai	Commelinaceae	C	LC		*
119	*Corchorus aestuans* L.	Pinnaaku Keerai	Malvaceae	C	LC		*
120	*Crotalaria juncea* L.	Sanappu	Leguminosae	C	LC		*
121	*Croton bonplandianus* Baill.	Rail Poondu	Euphorbiaceae	C	LC		*
122	*Cyanotis axillaris* (L.) D.Don ex Sweet	Vazhukai Pul	Commelinaceae	C	LC		*
123	*Cymbopogon citratus* (DC.) Stapf	karppurappul	Poaceae	C	LC		*
124	*Cyperus rotundus* L.		Cyperaceae	C	LC	*	*
125	*Dactyloctenium aegyptium* (L.)Beauv.	Makraa	Poaceae	C	LC		*
126	*Datura stramonium* L.	ummathai	Solanaceae	C	LC		*

Sl. No.	Botanical Name	Tamil Name	Family	Local Status	IUCN Status	Core	Buffer
127	*Desmodium triflorum* (L.) DC.	sirupullati	Leguminosae	C	LC		*
128	*Dipteracanthus prostratus* (Poir.) Nees		Acanthaceae	C	LC		*
129	*Ecbolium viride* (Forssk.) Alston	Neelaambaram	Acanthaceae	C	LC	*	*
130	*Eclipta prostrata* (L.) L.	Karisalankanni	Compositae	C	LC		*
131	*Eupatorium odoratum* L.		Compositae	C	LC		*
132	*Euphorbia hirta* L.	Amman Pacharisi	Euphorbiaceae	C	LC		*
133	*Evolvulus alsinoides* (L.) L	Vishnukranthi	Convolvulaceae	C	LC	*	*
134	*Fimbristylis cymosa* R.Br.		Cyperaceae	C	LC		*
135	*Glinus oppositifolius* (L.) DC.	Siruseruppadai	Molluginaceae	C	LC		*
136	*Gomphrena serrata* L.		Amaranthaceae	C	LC		*
137	*Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.	Oosipullu	Poaceae	C	LC		*
138	*Indigofera linnaei* Ali	Sheppunerunji	Leguminosae	C	LC		*
139	*Justicia procumbens* L.	Kotakacalai	Acanthaceae	C	LC		*
140	*Leucas aspera* (Willd.) Link	Thumbai	Lamiaceae	C	LC	*	*
141	*Leucas biflora* (Vahl) R.Br. ex Sm.	Eyt Tumpai	Lamiaceae	C	LC		*
142	*Ludwigia perennis* L.	Kattucheeragam	Onagraceae	C	LC		*
143	*Mimosa pudica* L.	Thottach surungi	Leguminosae	C	LC		*
144	*Mollugo nudicaulis* Lam.	Parpaadagam	Molluginaceae	C	LC		*
145	*Ocimum tenuifolium* L.	Tulasi	Lamiaceae	C	LC	*	*
146	*Oldenlandia umbellata* L.		Rubiaceae	C	LC		*
147	*Parthenium hysterophorus* L.		Compositae	C	LC	*	*
148	*Pavonia zeylanica Cav.*	Mammatti	Malvaceae	C	LC		*
149	*Pedalium murex* L.	Yanai Nerunjil	Pedaliaceae	C	LC		*
150	*Phyllanthus amarus* Schumach. & Thonn.	Keezhanelli	Phyllanthaceae	C	LC		*
151	*Portulaca oleracea* L.	Pulikkirai	Portulacaceae	C	LC		*
152	*Rhynchosia capitata* (Roth) DC.		Leguminosae	C	LC		*

Sl. No.	Botanical Name	Tamil Name	Family	Local Status	IUCN Status	Core	Buffer
153	*Saccharum spontaneum* L.	Pekkarimpu	Poaceae	C	LC		*
154	*Sida acuta* Burm.f.	Ariva-mooku keerai	Malvaceae	C	LC	*	*
155	*Sida cordifolia* L.	Bala	Malvaceae	C	LC		*
156	*Sida cordata*	Palampasi	Malvaceae	C	LC	*	*
157	*Tephrosia purpurea* (L.) Pers.	Kolinchi	Leguminosae	C	LC	*	*
158	*Tribulus terrestris* L.	Nerunji	Zygophyllaceae	C	LC	*	*
159	*Tridax procumbens* (L.) L.	Vettukkaayappoondu	Compositae	C	LC		*
160	*Typha angustata* Bory & Chaub		Typhaceae	C	LC		*
161	*Urena lobata* L.	Ottatti	Malvaceae	C	LC		*
162	*Vernonia cinerea* (L.) Less.	Sahadev	Compositae	C	LC		*
163	*Waltheria indica* L.	Sengalipoondu	Malvaceae	C	LC		*
164	*Launaea sarmentosa* (Willd.) Sch.Bip. ex Kuntze	centam	Compositae	C	LC		*
165	*Ipomoea pes-caprae* (L.) R. Br.	Attukkal	Convolvulaceae	C	LC	*	*
166	*Ruellia tuberosa* L.	Pattaskai	Acanthaceae	C	LC	*	*
Climbers							
167	*Abrus precatorius* L.	Kunduman	Leguminosae	C	LC	*	*
168	*Aristolochia indica* L.	Perumarunthukodi	Aristolochiaceae	C	LC	*	*
169	*Asparagus racemosus* Willd.	Tanneer vittaann	Asparagaceae	C	LC		*
170	*Caesalpinia bonduc* (L.) Roxb.	Kalichikai	Leguminosae	C	LC		*
171	*Capparis zeylanica* L.	Atontai	Oleaceae	C	LC		*
172	*Cissus quadrangularis* L.	Pirandai	Vitaceae	C	LC	*	*
173	*Cuscuta reflexa* Roxb.	Akasavalli	Convolvulaceae	C	LC		*
174	*Hemidesmus indicus* (L.) R. Br. ex Schult	Nannari	Apocynaceae	C	LC		*
175	*Tinospora cordifolia* (Willd.) Miers.	Amirtavalli	Menispermaceae	C	LC	*	*
176	*Passiflora foetida* L.	Siruppunaikkali	Passifloraceae	C	LC		*

Sl. No.	Botanical Name	Tamil Name	Family	Local Status	IUCN Status	Core	Buffer
177	*Pergularia daemia* (Forssk.) Chiov.	veliparuthi	Apocynaceae	C	LC	*	*
178	*Cardiospermum halicacabum* L.	Mudakathan	Sapindaceae	C	LC		*
		Hydrophytes					
180	Aponogeton *natans* (L.) Engl. & K.Krause		Aponogetonaceae	C	LC		*
181	Lemna obscura (Austin) Daubs		Araceae	C	LC		*
182	Hydrilla Rich.	Velampasi	Hydrocharitaceae	C	LC		*
183	Marsilea quadrifolia L.	aalaik keerai	Marsileaceae	C	LC		*
184	Nymphoides hydrophylla (Lour.) Kuntze		Menyanthaceae	C	LC		*
185	Nymphaea nouchali Burm. f.	Neelotpalam	Nymphaeaceae	C	LC		*
186	Limnophila *heterophylla* R. Br.	Bagga patti	Plantaginaceae	C	LC		*
187	Pontederia crassipes Mart.	Vengaayatthaamarai	Pontederiaceae	C	LC		*

Herbs & Climbers seasonal appearance

Sl. No.	Botanical Name	Tamil Name	Family	Local	IUCN Status	Core	Buffer	Winter	Summer	Pre-Monsoon
	Herbs									
1	*Acalypha indica* L.	Kuppaimeni	Euphorbiaceae	C	LC	*	*	*	*	
2	*Achyranthes aspera* L.	Nayuruvi	Amaranthaceae	C	LC		*	*	*	
3	*Aerva lanata* (L.) Juss.	Poolaippoo	Amaranthaceae	C	LC	*	*	*	*	*
4	*Aeschynomene aspera* L.		Leguminosae	C	LC		*	*		
5	*Ageratum conyzoides* (L.) L.	Appakkoti	Compositae	C	LC		*	*	*	
6	*Aloe vera* (L.) Burm.f.	kattraazhai	Asparagaceae	C	LC		*	*	*	*
7	*Alternanthera sessilis* (L.) R.Br. ex DC.	Ponnanganni Keerai	Amaranthaceae	C	LC	*	*	*	*	*

Sl. No.	Botanical Name	Tamil Name	Family	Local	IUCN Status	Core	Buffer	Winter	Summer	Pre-Monsoon
8	*Amaranthus viridis* L.	Kuppaikkeerai	Amaranthaceae	C	LC	*	*	*	*	
9	*Andrographis paniculata* (Burm.f.) Nees	Nilavembu	Acanthaceae	C	LC		*	*	*	
10	*Andropogon pumilus* Roxb.	Kaavattam Pillu	Poaceae	C	LC		*	*		
11	*Apluda mutica* L.f.	Mungil pul	Poaceae	C	LC		*	*	*	
12	*Aristida fasciculata* Torr.		Poaceae	C	LC		*	*	*	
13	*Bacopa monnieri* (L.) Wettst.	Brami	Plantaginaceae	C	LC		*	*		*
14	*Barleria prionitis* L.	Sulli Malar	Acanthaceae	C	LC		*	*	*	*
15	*Blepharis maderaspatensis* (L.) B.Heyne ex Roth	Kozhimookkan	Acanthaceae	C	LC		*	*	*	*
16	*Boerhavia diffusa* L.	Mookkaratti	Nyctaginaceae	C	LC	*	*	*		*
17	*Brachiaria ramosa* (L.) Stapf	Chama pothaval	Poaceae	C	LC		*	*	*	
18	*Cassia obtusa* Clos	Nilavakka	Leguminosae	C	LC		*			*
19	*Catharanthus roseus* (L.) G.Don	Nithyakalyani	Apocynaceae	C	LC		*		*	*
20	*Celosia argentea* L.	Pannai keerai	Amaranthaceae	C	LC		*	*	*	*
21	*Chloris barbata* Sw.	Mayir Kondai Pul	Poaceae	C	LC		*		*	
22	*Cleome viscosa* L.	Naikadugu	Cleomaceae	C	LC	*	*	*	*	
23	*Commelina benghalensis* L.	Kanavalai	Commelinaceae	C	LC		*	*		*
24	*Corchorus aestuans* L.	Pinnaaku Keerai	Malvaceae	C	LC		*		*	
25	*Crotalaria juncea* L.	Sanappu	Leguminosae	C	LC		*			*
26	*Croton bonplandianus* Baill.	Rail Poondu	Euphorbiaceae	C	LC		*	*	*	*
27	*Cyanotis axillaris* (L.) D.Don ex Sweet	Vazhukai Pul	Commelinaceae	C	LC		*	*		*
28	*Cymbopogon citratus* (DC.) Stapf	karppurappul	Poaceae	C	LC		*	*	*	*
29	*Cyperus rotundus* L.		Cyperaceae	C	LC	*	*	*		
30	*Dactyloctenium aegyptium* (L.)Beauv.	Makraa	Poaceae	C	LC		*	*		
31	*Datura stramonium* L.	ummathai	Solanaceae	C	LC		*	*		
32	*Desmodium triflorum* (L.) DC.	sirupullati	Leguminosae	C	LC		*	*	*	

Sl. No.	Botanical Name	Tamil Name	Family	Local	IUCN Status	Core	Buffer	Winter	Summer	Pre-Monsoon
33	*Dipteracanthus prostratus* (Poir.) Nees		Acanthaceae	C	LC		*	*	*	
34	*Ecbolium viride* (Forssk.) Alston	Neelaambaram	Acanthaceae	C	LC	*	*	*	*	
35	*Eclipta prostrata* (L.) L.	Karisalankanni	Compositae	C	LC		*	*		
36	*Eupatorium odoratum* L.		Compositae	C	LC		*	*	*	*
37	*Euphorbia hirta* L.	Amman Pacharisi	Euphorbiaceae	C	LC		*	*	*	*
38	*Evolvulus alsinoides* (L.) L	Vishnukranthi	Convolvulaceae	C	LC	*	*	*	*	
39	*Fimbristylis cymosa* R.Br.		Cyperaceae	C	LC		*	*		
40	*Glinus oppositifolius* (L.) DC.	Siruseruppadai	Molluginaceae	C	LC		*	*		
41	*Gomphrena serrata* L.		Amaranthaceae	C	LC		*	*		
42	*Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.	Oosipullu	Poaceae	C	LC		*	*	*	
43	*Indigofera linnaei* Ali	Sheppunerunji	Leguminosae	C	LC		*	*	*	
44	*Justicia procumbens* L.	Kotakacalai	Acanthaceae	C	LC		*	*	*	*
45	*Leucas aspera* (Willd.) Link	Thumbai	Lamiaceae	C	LC	*	*	*	*	
46	*Leucas biflora* (Vahl) R.Br. ex Sm.	Eyt Tumpai	Lamiaceae	C	LC		*	*	*	
47	*Ludwigia perennis* L.	Kattucheeragam	Onagraceae	C	LC		*	*		
48	*Mimosa pudica* L.	Thottach surungi	Leguminosae	C	LC		*	*	*	*
49	*Mollugo nudicaulis* Lam.	Parpaadagam	Molluginaceae	C	LC		*	*	*	
50	*Ocimum tenuifolium* L.	Tulasi	Lamiaceae	C	LC	*	*	*	*	*
51	*Oldenlandia umbellata* L.		Rubiaceae	C	LC		*	*	*	
52	*Parthenium hysterophorus* L.		Compositae	C	LC	*	*	*	*	*
53	*Pavonia zeylanica Cav.*	Mammatti	Malvaceae	C	LC		*		*	
54	*Pedalium murex* L.	Yanai Nerunjil	Pedaliaceae	C	LC		*	*	*	
55	*Phyllanthus amarus* Schumach. & Thonn.	Keezhanelli	Phyllanthaceae	C	LC		*	*	*	*
56	*Portulaca oleracea* L.	Pulikkirai	Portulacaceae	C	LC		*	*		*
57	*Rhynchosia capitata* (Roth) DC.		Leguminosae	C	LC		*		*	

Sl. No.	Botanical Name	Tamil Name	Family	Local	IUCN Status	Core	Buffer	Winter	Summer	Pre-Monsoon
58	*Saccharum spontaneum* L.	Pekkarimpu	Poaceae	C	LC		*		*	
59	*Sida acuta* Burm.f.	Ariva-mooku keerai	Malvaceae	C	LC	*	*	*	*	*
60	*Sida cordifolia* L.	Bala	Malvaceae	C	LC		*	*	*	*
61	*Sida cordata*	Palampasi	Malvaceae	C	LC	*	*	*	*	*
62	*Tephrosia purpurea* (L.) Pers.	Kolinchi	Leguminosae	C	LC	*	*	*	*	*
63	*Tribulus terrestris* L.	Nerunji	Zygophyllaceae	C	LC	*	*			*
64	*Tridax procumbens* (L.) L.	Vettukkaayappoondu	Compositae	C	LC		*	*	*	*
65	*Typha angustata* Bory & Chaub		Typhaceae	C	LC		*	*		
66	*Urena lobata* L.	Ottatti	Malvaceae	C	LC		*	*		
67	*Vernonia cinerea* (L.) Less.	Sahadev	Compositae	C	LC		*	*	*	
68	*Waltheria indica* L.	Sengalipoondu	Malvaceae	C	LC		*	*	*	*
69	*Launaea sarmentosa* (Willd.) Sch.Bip. ex Kuntze	centam	Compositae	C	LC		*			
70	*Ipomoea pes-caprae* (L.) R. Br.	Attukkal	Convolvulaceae	C	LC	*	*		*	
71	*Ruellia tuberosa* L.	Pattaskai	Acanthaceae	C	LC	*	*	*	*	
	Climbers									
72	*Abrus precatorius* L.	Kunduman	Leguminosae	C	LC	*	*	*		
73	*Aristolochia indica* L.	Perumarunthukodi	Aristolochiaceae	C	LC	*	*	*	*	
74	*Asparagus racemosus* Willd.	Tanneer vittaann	Asparagaceae	C	LC		*	*		
75	*Caesalpinia bonduc* (L.) Roxb.	Kalichikai	Leguminosae	C	LC		*			
76	*Capparis zeylanica* L.	Atontai	Oleaceae	C	LC		*			
77	*Cissus quadrangularis* L.	Pirandai	Vitaceae	C	LC	*	*	*	*	
78	*Cuscuta reflexa* Roxb.	Akasavalli	Convolvulaceae	C	LC		*	*		
79	*Hemidesmus indicus* (L.) R. Br. ex Schult	Nannari	Apocynaceae	C	LC		*	*		
80	*Tinospora cordifolia* (Willd.) Miers.	Amirtavalli	Menispermaceae	C	LC	*	*	*		
81	*Passiflora foetida* L.	Siruppunaikkali	Passifloraceae	C	LC		*	*	*	

Sl. No.	Botanical Name	Tamil Name	Family	Local	IUCN Status	Core	Buffer	Winter	Summer	Pre-Monsoon
82	*Pergularia daemia* (Forssk.) Chiov.	veliparuthi	Apocynaceae	C	LC	*	*	*	*	
83	*Cardiospermum halicacabum* L.	Mudakathan	Sapindaceae	C	LC		*	*		

1.2 Fauna

Check list of Mammals recorded in the Study area (Core and Buffer area)

S.No.	Family/Scientific Name	Common Name	IUCN	IWPA Schedule	Core	Buffer
	Herpestidae					
1	*Urva edwardsii*	Kiri	LC	III	+	+
	Leporidae					
2	*Lepus nigricollis*	Indhiya kuzhi muyal	LC	IV	+	+
	Muridae					
3	*Bendicota bengalensis*	Chinna Eli	LC	V	+	+
4	*Mus booduga*	sundeli	LC	V	+	+
5	*Rattus rattus*	vittu eli	LC	V	+	+
	Sciuridae					
6	*Funambulus palmarum*	Urundai Anil	LC	V	+	+
	Pteropodidae					
7	*Pteropus giganteus*	Vowval	LC	IV	--	+
	Suidae					
8	*Sus scrofa cristatus*	kattu panri	LC	III	+	+
	Hystricidae					
9	*Hystrix indica*	Mullampanri	LC	IV	--	+

Check list of Birds recorded in the Study area (Core and Buffer area)

Sl No	Order/Family/Common name	Species name	IUCN	IWPA Schedule	Core	Buffer	Migration type
	Ardeidae						
1	Cattle Egret	*Bubulcus ibis*	LC	IV	+	+	
2	Grey Heron	*Ardea cinerea*	LC	IV	--	+	
3	Indian pond heron	*Ardeola greyii*	LC	IV	+	+	
4	yellow bittern	*Ixobrychus sinensis*	LC	IV	--	+	Local Winter migrant
	Anseriformes:Anatidae						
5	Eurasian teal	*Anas crecca*	LC	IV	--	+	European Winter migrant
	Falconiformes:Accipitridae						
6	Black Kite	*Milvus migrans*	LC	IV	+	+	
	Corvidae						
7	shikra	*Accipiter badius*	LC	IV	--	+	
	CoraciiformesAlcedinidae						
8	Common Kingfisher	*Alcedo atthis*	LC				
	Galliformes:Phasianidae						
9	Grey Francolin	*Francolinus pondicerianus*	LC	IV	+	+	
	Rallidae						
10	Eurasian coot	*Pulica atra*	LC	IV	--	+	
11	common moorhen	*Gallinula chloropus*	LC	IV	--	+	
	Columbiformes:Columbidae						
12	Rock dove	*Columba livia*	LC	IV	+	+	
13	Spotted Dove	*Streptopelia chinensis*	LC	IV	--	+	
	Psittaciformes:Psittacidae						
14	Rose-ringed Parakeet	*Psittacula krameri*	LC	IV	+	+	
15	Alexandrine Parakeet	*Psittacula eupatria*	NT	IV	--	+	

Sl No	Order/Family/Common name	Species name	IUCN	IWPA Schedule	Core	Buffer	Migration type
	Cuculiformes:Cuculidae						
16	Asian Koel	*Eudynamys scolopacea*	LC	IV	+	+	
17	Greater Coucal	Centropus sinensis	LC	II	--	+	
	Strigiformes:Strigidae						
18	Spotted Owlet	*Athene brama*	LC	IV	--	+	
	Upupiformes:Upupidae						
19	Common Hoopoe	*Upupa epops*	LC	IV	--	+	
	Apodiformes:Apodidae						
20		*Cypsiurus unicolar*	LC	IV	+	+	
21	Little Swift	*Apus affinis*	LC	IV	--	+	
	Charadriiformes:Recurvirostridae						
22	Black-winged Stilt	*Himantopus himantopus*	LC	II	–	+	Local Winter migrant
	Coraciformes:Meropidae						
23	Green Bee-eater	*Merops orientalis*	LC	IV	+	+	
	Coraciidae						
24	Indian Roller	*Coracias benghalensis*	LC	IV	+	+	
	Passeriformes:Alaudidae						
	Laniidae						
25	Long-tailed Shrike	Lanius schach	LC	II	--	+	Local Winter migrant
26	Ashy-crowned Sparrow-Lark	*Eremopterix grisea*	LC	IV	--	+	
	Dicruridae						
27	Black Drongo	*Dicrurus macrocercus*	LC	IV	--	+	
	Cisticolidae						
28	Ashy Prinia	*Prinia socialis*	LC	IV	+	+	
	Sturnidae						
29	Common Myna	*Acridotheres tristis*	LC	IV	+	+	

Sl No	Order/Family/Common name	Species name	IUCN	IWPA Schedule	Core	Buffer	Migration type
30	Asia Pied Myna	*Gracupica contra*	LC	IV	--	+	Local Winter migrant
	Timaliidae						
31	Yerllow billed Babbler	*Turdoides caudatus*	LC	IV	+	+	
	Aegithinidae						
32	Common Iora	*Aegithina tiphia*	LC	IV	--	+	
	Cisticolidae						
33	plain priniya	*Prinia inornata*	LC	IV	+	+	
	Oriolidae						
34	Eurasian golden oriole	*Oriolus oriolus*	LC	IV	--	+	
	Corvidae						
35	House Crow	*Corvus splendens*	LC	IV	+	+	
36	Rufous Treepie	*Dendrocitta vagabunda*	LC	IV	--	+	
	Passeridae						
37	House sparrow	*Passer domesticus*	LC	IV	+	+	
	Estrildidae						
38	Scaly-breasted Munia	*Lonchura punctulata*	LC	IV	--	+	
39	Indian Silverbill	*Lonchura malabarica*	LC	IV	--	+	
	Nectariniidae						
40	Purple-rumped Sunbird	*Nectarinia zeylonica*	LC	IV	+	+	
	Motacillidae						
41	Paddy field Pipit	*Anthus rufulus*	LC	IV	--	+	
42	White-browed Wagtail	*Motacilla madarasapatanensis*	LC	IV	--	+	
	Pycnonotidae						
43	Red-vented Bulbul	*Pycnonotus cafer*	LC	IV	+	+	
	Campephagidae						

Sl No	Order/Family/Common name	Species name	IUCN	IWPA Schedule	Core	Buffer	Migration type
44	Small Minivet	*Pericrocotus cinnamomeus*	LC	IV	--	+	Local Winter migrant
	Phalacrocoracidae						
45	Indian Cormorant	*Phalacrocorax fuscicollis*	LC	IV	--	+	
46	Little Cormorant	*Microcarbo niger*	LC	IV	--	+	
	Phasianidae						
47	Indian peafowl	*Pavo cristatus*	LC	I	--	+	
	Jacanidae						
48	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	LC	IV	+	--	
49	Bronze-winged Jacana	*Metopidius indicus*	LC	IV	--	+	
	Accipitridae						
50	Brahminy Kite	*Haliastur indus*	LC	I	--	+	
	Ploceidae						
51	Baya Weaver	*Ploceus philippinus*	LC	IV	+	+	
	Podicipedidae						
52	Little Grebe	*Tachybaptus ruficollis*	LC	IV	--	+	
	Rallidae						
53	White-breasted Waterhen	*Amaurornis phoenicurus*	LC	IV	--	+	
	Ciconiidae						
54	Asian Openbill	*Anastomus oscitans*	LC	IV	--	+	Local Winter migrant

Winter migratory birds:

S.No	Scientific Name	Common Name	Migration Type
1	Ixobrychus sinensis	yellow bittern	Local winter migrant
2	Anas crecca	Eurasian teal	Europian migrant

S.No	Scientific Name	Common Name	Migration Type
3	Himantopus himantopus	Black-winged Stilt	Local winter migrant
4	Lanius schach	Long-tailed Shrike	Local winter migrant
5	Gracupica contra	Asia Pied Myna	Local winter migrant
6	Small Minivet	Pericrocotus cinnamomeus	Local winter migrant
7	Asian Openbill	Anastomus oscitans	Local winter migrant

Check list of Herpeto fauna recorded in the Study Area (Core and Buffer area)

Sl No	Order/Family/Common name	Species name	IUCN	IWPA Schedule	Core	Buffer
	Squamata:Agamidae					
1	Onaan	*Calotes versicolor*	LC	NL	--	+
2	Kalatti	*Calotes rouxii*	LC	I	+	+
3	Naga Pambu	*Naja naja*	LC	I	--	+
	Anura:Ranidae					
4	Thavalai	*Fejervarya limnocharis*	LC	IV	--	+
5	Thavalai	*Polypedates maculatus*	LC	NL	--	+
6		*Bufo melanostictus*	LC	NL	--	+
	Squamata: Viperidae					
7	kannaadi viriyan paambu	*Daboia russelii*	LC	II	--	+
	Squamata: Elapidae					
8	Kattu Viriyan	*Bungarus caeruleus*	LC	NL	--	+
	Squamata;Varanidae					
9	Udumbu	*Varanus bengalensis*	LC	I	--	+
	Squamata;Chamaeleonidae					
10	pachchonti	*Chamaeleo zeylanicus*	LC	II	--	+
	Colubridae					
	Komberi Mookan	*Dendrelaphis tristis*	LC	IV	--	+

Sl No	Order/Family/Common name	Species name	IUCN	IWPA Schedule	Core	Buffer
11	Saraipambu	*Ptyas mucosa*	LC	II	+	+
	Scincidae					
12	Arana	*Mabuya carinata*	LC	NL	+	+

Check list of Invertebrates recorded in the Study Area (Core and Buffer area)

Sl No	Order/Family/ Common name	Species name	IUCN	IWPA Schedule	Core	Buffer
	Araneae:Lycosidae					
1	Common Funnel Web Spider	*Hippasa agelenoides*	NA	NL	+	+
	Vespidae					
2	Paper wasp	*Ropalidia marginata*	NA	NL	+	+
	Apidae					
3	Carpenter bee		NA	NL	+	+
4	Honey Bee	*Apis millifera*	NA	NL	+	+
5	Honey Bee	*Apis indica*	NA	NL	--	+
	Lepidoptera:Lycaenidae					
6	Grass Jewel	*Freyeria trochylus*	NA	NL	--	+
7	Tiny grass blue	*Zizula hylax*	NA	NL	--	+
	Nymphalidae					
8	Blue Pancy	*Junonia orithya*	NA	NL	--	+
9	Blue tiger	*Tirumala hamata*	NA	NL	+	+
10	Common castor	*Ariadne merione*	NA	NL	--	+
11	Danaid egg fly	*Hypolimnas misippus*	NA	NL	+	+
12	Lemon Pansy	*Junonia lemonias*	NA	NL	--	+
13	Peacock Pansy	*Precis almana almanac*	NA	NL	--	+
14	Plain Tiger	*Danaus chrysippus*	NA	NL	--	+
15	Tawny Coster	*Acraea violae*	NA	NL	+	+
	Pieridae					

Sl No	Order/Family/ Common name	Species name	IUCN	IWPA Schedule	Core	Buffer
16	Plain Orange Tip	*Colotis eucharis*	NA	NL	--	+
17	Mottled emigrant	*Catopsilia pyranthe*	NA	NL	--	+
	Papilionidae					
18	Common Mormon	*Papilio polytes*	NA	NL	+	+
	Hesperiidae					
19	Indian skipper	*Pelopidas sp*	NA	NL	--	+
	Odonata:Libellulidae					
20	Blue Marsh Hawk	*Orthetrum glaucaum*	NA	NL	--	+
	Aeshnidae					
21	Blue-tailed Green Darner	*Anax guttatus*	LC	NL	--	+
	Gomphidae					
22	Common Clubtail	*Ictinogomphus rapax*	LC	NL	+	+
	Libellulidae					
23	Dragon fly	*Urothemis signata signata*	NA	NL	--	+
	Nymphalidae					
24	Stripped tiger	*Danaus genutia*	NA	NL	--	+
	Pieridae					
25	Common gull	*Cepora nerissa*	NA	NL	--	+
	Nymphalidae					
26	Common Indian Crow	*Euploea core*	NA	NL	+	+
	Pieridae					
27	Common jezebel	*Delias eucharis*	NA	NL	--	+
	Libellulidae					
28	Diplacodes trivialis	*Dragon fly*	NA	NL	--	+
	Aeshnidae					
29	Anax guttatus	*Dragon fly*	NA	NL	--	+

Checklist of Fishes recorded in the study area (Buffer area)

S.No.	Vernacular name	Family/Scientific name	IUCN	IWPA Schedule	Core	Buffer
		Cichlidae				
1	Gift Tilepia	Oreochromis niloticus	LC	NL	--	+
		Channidae				
2	Tilapia	Oreochromis niloticus	LC	NL	--	+
3	Murrel	*Channa striata*	LC	NL	--	+
4	Channa pandita	*Channa punctatus*	LC	NL	--	+
		Cyprinidae				
5	Calbasu	Labeo calbasu	LC	NL	--	+
6	Common Barbel	Barbus barbus	LC	NL	--	+
7	Mirkal Meen	Cirrhinus cirrhosus	LC	NL	--	+
8	Kannadi Kendai	*Labeo rohita*	LC	NL	--	+
9	Katla meen	*Catla catla*	LC	NL	--	+
		Bagridae				
10	Katta-keluthi	*Mystus gulio*	LC	NL	--	+
11	Cutta	*Mystus cavasius*	LC	NL	--	+
		Cyprinidae				
12	Saani podi	*Puntius sophore*	LC	NL	--	+
13	Pethia ticto	*Pethia ticto*	LC	NL	--	+

Appendix L
Half Yearly Compliance Report

karaikal port

ISO 9001
ISO 14001
ISO 45001
ISO 50001

KPP/ENV/MoEF&CC/EC-CRZ /2024/01 Date 30.04.2024

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

Subject: Submission of Compliance Report by end of 31st March 2024 – Regarding

Reference:
Environmental & CRZ Clearance letter (No.10 - 42/2009 - IA - III, dated 22.09.2009 and its amendment dated 05th August 2021), from Govt of India, Ministry of Environment, Forest and Climate Change

Respected Sir,

As per the conditions stipulated in Environmental & CRZ Clearance letter (No.10 - 42/2009 - IA – III, dated 22.09.2009 and its amendment dated 05th August 2021), from Govt of India, Ministry of Environment, Forest and Climate Change IA.III Section (MOEF&CC, IA.II. Section), herewith we are submitting the status of compliance reports including results of monitored data for the period of October 2023 to March 2024

Thanking you,

Yours faithfully,

(Muralidhar.B)

Authorized Signatory

Cc:

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

Index

Sl.No	Particulars	Remarks
1	Compliance report	Attached
	Annexures	
1	Details of Project Cost	Attached
2	Year Wise Expenditure / EMP Expenses	Attached
3	River Reassessment Report	Attached
4	Permission from PCZMA	Attached
5	STP analysis report upto 2024	Attached
6	Indian Coast Guard Approval for OSCP	Attached
7	Photographs of Navigational Aids (Lighted buoys)	Attached
8	Environment Management Cell	Attached
9	Certificate for the procurement of quarry materials	Attached
10	License from PESO	Attached
11	Advertisement in Newspaper for the EC issuance	Attached
12	Copy of Compliance Report & Monitoring Reports Oct to Mar 2024	Attached
13	Annual Environment Statement in Form V	Attached
14	Present Status of Project	Attached
15	Joint Committee Recommendations	Attached

-Sd-

(Muralidhar.B)

Authorized Signatory

KARAIKAL PORT PRIVATE LIMITED

KARAIKAL DISTRICT, PUDUCHERRY U.T

Environmental and CRZ clearance for expansion of Karaikal Port (Phase II) at Puducherry by M/s. Karaikal Port Pvt. Ltd.

MoEF&CC EC letter of No. 10-42/2009-IA. III dated 22nd September, 2009 and its amendment dated 05th August 2021

Compliance Report for the Period of

October 2023 to March 2024

Karaikal Port Private Limited- Six Monthly EC Compliance Report

for the Period of October 2023 to March 2024

Subject: Environmental and CRZ clearance for expansion of Karaikal Port (Phase II) at Puducherry by M/s. Karaikal Port Pvt. Ltd.

Reference: MoEF&CC's EC letter of No. 10-42/2009-IA. III dated 22nd September, 2009.

PART I

DATA SHEET

1		Project Type River valley / Mining / Industry / Thermal / Nuclear / Other Specify	:	Infrastructure Project – Port Operations
2		Name of the project	:	Environmental and CRZ Clearance for expansion of Karaikal Port (Phase II) at Puducherry.
3		Clearance letter(s) / OM No. and dated	:	MoEF EC Letter No.10-42/2009-IA.III dated 22nd Sep 2009 ; 03rd Feb 2015 and 14th May, 2018 & 05th Aug, 2021.
4		Locations	:	
	a.	Taluk(s) District	:	KaraikalTaluk and District
	b.	State (s)	:	Puducherry
	c.	Latitudes / Longitudes	:	10° 50' N and 79° 51' E
5		Address of correspondence		
	a.	Address of concerned project Chief Engineer (with Pin Code & telephone / telex / fax numbers		Karaikal Port Pvt. Ltd., Keezhavanjore Village T.R.Pattinam 609606Karaikal+91-4365 256600 Fax: +91-4365 256603
	b.	Address of Executive Project Engineer/ Manager (with Pin Code/fax numbers)	:	Same as above.
6		Salient features:		
	a.	of the project		Green field multi cargo , all weather Port Project

	b.	of the environmental management plans	:	Port has Mechanized Coal Handling System which includes Ship Unloaders, Conveyors, Stacker cum Reclaimers, Wagon Loading & Truck Loading Systems etc are in place and operational. This infrastructure helps in achieving efficient operations and in maintaining clean environment. Highly efficient water sprinkling/ spraying system for dust suppression have been installed to address the coal dust emission Corrugated sheets of various heights have been put along the Coal Stock yards, boundary & Railway sidings In the Southern side of the Port, permanent corrugated wind screen at a height of 12 Meters 24/7 online continuous ambient air quality monitoring systems have been installed at three locations. The CAAQMS are linked to the PCC servers and the GLens servers which are the authorized servers for the CPCB for monitoring the results State of the art Tyre wash system is in place where the effluent after treatment is reused in the same unit. Dedicated Tankers & Tractors are engaged for wetting the coal yards, Roads etc., Rain water harvesting pond developed at 3 locations in the port Premises. Rain water Harvesting Pits at 15 locations (Roof water) are made available. Guard Pond covering the open storage yard inside the port to collect runoff water has been developed at Mechanization Area. Monitoring of Marine water, Marine sediment and Marine environment is in place. Hazardous Waste is being disposed to the registered recyclers as per the Hazardous Waste Management Rules, 2016. Biodegradable Solid waste is segregated and used in producing compost for in house nursery and Gardening and promotion of Green Belt.
7		Breakup of the project area:		
	a	Project area	:	Total Area 243 Hectares
8		Break up of project affected population with enumeration of those losing houses / dwelling units only, agricultural land only, both dwelling units and agricultural land and landless labourers / artisans		Nil
	a	SC/ST/Adivasis	:	Nil
	b	Others	:	Nil

9		Financial Details:		
	a	Project cost as originally planned and subsequent revised estimates and the years of price reference	:	Project Cost (Phase II) is Attached at Annexure 1.
	b	Allocations made for environmental management plans, with item wise and year wise breakup	:	The detailed item wise and year wise allocations made for environmental management plan is attached at Annexure 2
	c	Benefit cost ratio / internal rate of return and the years of assessment	:	Cargo ramp- up has not happened as envisaged. In view of this cost benefit and internal rate of return has not been assessed so far.
	d	Whether (c) includes the cost of environmenta management as shown in (b) above.	:	In view of above nil information.
	e	Total expenditure on the Project so far	:	Attached at Annexure 1 above.
	f	Actual expenditure incurred on the Environmental management plans so far.	:	Detailed item wise and year wise expenditure is attached at Annexure 2 as above
10		Forest land requirement:	:	NA
	a	The status of approval for a diversion of forest land for non-forestry use	:	NA
	b	The status of compensatory afforestation, if any	:	Nil
	c	The status of clear felling	:	Nil
	d	Comments on the viability and sustainability of compensatory afforestation programme in the light of actual field experience so far	:	Nl
11		The status of clear felling in non-forest area (such as submergence area of reservoir, approach road), if any, with quantitative information	:	NA
12		Status of construction:		
	a	Date of commencement	:	30th September, 2009.
		Date of completion (actual and / or planned)	:	30^Sep 2019
13		Reasons for the delay if the project is yet to start.	:	NA
14		Date of site visit:		
	a	The dates on which the project was monitored by the Regional Office on previous occasions, if any	:	The said project was monitored on 01.03.2022 by an official from Integrated Regional Office of Ministry of Environment, Forest & Climate Change , Chennai
	b	Date of site visit for this monitoring report		NA

15		Details of correspondence with project authorities for obtaining action plans, information and status of compliance to safeguards	:	Compliance reports sent on regular basis to the regulatory authorities.

PART II

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

Subject: Environmental and CRZ clearance for expansion of Karaikal Port (Phase II) at Puducherry by M/s. Karaikal Port Pvt. Ltd.

Reference:MoEF&CC'sEC letter of No. 10-42/2009-IA.III dated the 22nd September, 2009.

6. Specific Conditions:

Sl.No	Conditions stipulated	Compliance Status
(I)	The quality of both the rivers shall be re assessed and report shall be submitted to the Ministry within three months	Complied. The quality of two rivers joining the sea near the Port i.e. river Pravadanayar on the North and the river Vettar on the South were reassessed and Report submitted to the Ministry within three months. Report is at Annexure 3.
(II)	No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	Complied. In Coastal Regulation Zone Area, as per the permission received from PCZMA the requisite constructions were made. The same is attached at Annexure 4.
(III)	Washing from Auction Hall/Sewage shall be treated and the treatment facility shall be provided in accordance with the Coastal Regulation Zone Notification, 1991. The disposal of treated water shall conform the regulation of	Complied. The provision of Auction Hall is not required for the Project. In respect of Sewage Treatment Plant (STP), with a capacity of 25 KLD is installed for treatment of domestic sewage. Report containing treated water

Sl.No	Conditions stipulated	Compliance Status
	Puducherry Pollution Control Board.	quality conforming to the regulation of PPCC/CPCB/MoEF&CC is at Annexure 5.
(IV)	Putrefied and discarded parts of fishes shall be removed and disposed off in the approved landfill/used as manure/poultry feed.	Not Applicable
(V)	Oil Spills if any shall be properly collected and disposed as per the Rules.	Being Complied. Till date there is no Oil Spill occurrence. However, the provisions containing the Oil Spill Contingency Plan is in place with the requisite equipment procured. Annexure 6. The validity of Indian Coast Guard Approved OSCP is due. KPPL has applied for the renewal of the same. However, KPPL will have to submit a revised plan & Once the revised OSCP is approved by Indian Coast Guard, copy of the same will be submitted to Ministry.
(VI)	The approach channel shall be properly demarcated with lighted buoys for safe navigation and adequate traffic control guidelines shall be framed. The fishermen shall be suitably educated and informed about the traffic guidelines.	Complied. In accordance with International norms requisite provisions are in place thereby following Navigation and traffic control guidelines. Photograph containing lighted buoys for safe navigation is at Annexure 7. Through Department of Fisheries, Govt. of Puducherry awareness and Education are regularly imparted to the fishermen including the said traffic

Sl.No	Conditions stipulated	Compliance Status
		guidelines.
(VII)	The project proponent shall set up separate environmental management cell for effective implementation of the stipulated environmental safeguards under the supervision of a Senior Executive	Complied. EMC meets to discuss the implementation of the stipulated Environment Safeguards. The EMC is attached at Annexure 8.
(VIII)	The project proponent shall take up mangrove plantation/green belt in the project area, wherever possible. Adequate budget shall be provided in the Environment Management Plan for such mangrove development.	Being Complied. At the project site a Nursery of indigenous variety of plantation is maintained with adequate personnel including specialist of draught resistance and fruit yielding Palm species. Requisite funds allocation is provided annually as a part of Environment Management Plan. Beyond the routine maintenance around 7569 Saplings/Trees were planted during this financial year 2023-24.
(IX)	The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.	Being Complied. The funds earmarked for Environment Management Plan will not be diverted for any other purposes. The funds allocated for the following purposes. Mechanized Coal handling facility, Wind Screen , CAAQM, Display Board, Monitoring, recurring expenses of nursery and maintenance of plantation, O&M of Dust Suppression System, Truck Tyre Wash System, STP, ETP, Environment Infrastructure; Road

Sl.No	Conditions stipulated	Compliance Status
		Cleaning and procurement of miscellaneous and other contingent requirements.

7.General Conditions

Sl.No	Conditions stipulated	Compliance Status
(i)	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. The workers involved for Construction were habituated nearby areas of the Project site. During construction phase, potable water supply and sanitation was arranged. However, for the skilled construction workers make shift arrangement of accommodation to the requisite period was provided and adequate provisions were made so as to maintain sanitation.
(ii)	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.	Complied. Appropriate measures which includes advanced technological practices with least digging areas so as to avoid any likely degradation of water quality
(iii)	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	Complied. The existing roads in the Project area is made use of for implementation of Phase II of the Project. No excavation or dumping is carried out and in the Project area no wetlands and forest area is in place.

Sl.No	Conditions stipulated	Compliance Status
	(b) No excavation or dumping shall be allowed on wetlands, forest areas or other ecologically valuable or sensitive locations	No excavation was necessary to implement the Project.
	(c)Excavation work shall be done in close consultation with the Conservation and watershed Development Agencies working in the area, and	As reported at (a), (b) and (c) above, this condition is not applicable.
	(d) Construction spoils including bituminous material and other hazardous materials must not be allowed to contaminate water courses and the damp sites for such materials must be secured so that they shall not leach into the ground water.	
(IV)	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 in this regard.	Complied. M/s MARG Constructions Limited was assigned the Construction activity of this Project the quarries obtained from authorized agency outside the Project area only. A certificate to this effect is at Annexure 9.
(V)	Adequate precautions shall be taken during transportation of the construction material so that it does not affect the environment adversely.	Complied. Necessary precautionary measures were taken during transportation.

Sl.No	Conditions stipulated	Compliance Status
(VI)	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	Complied Full support is being extended for the said activities.
(VII)	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.	Agree to comply.
(VIII)	The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with the satisfaction of the Ministry	Noted and Agreed upon.
(IX)	In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry of Environment & Forests.	Noted and Agreed upon.
(X)	The project proponents 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. On 12th June 2009, the Financial Closure was achieved.

Sl.No	Conditions stipulated	Compliance Status
(xi)	Puducherry 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.	Complied by Puducherry Pollution Control Committee
8	These stipulations would be enforced among others under the provisions of water (Prevention & 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 1994, including the amendments and rules made thereafter.	Being complied.
9	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. Requisite Clearances obtained from the concerned Competent Authorities by the M/s. Karaikal Port Private Limited. The same are at Annexure 10.
10	The project proponent shall advertise in at two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing, that the project has been accorded Environmental Clearance and copies of Clearance letters are available with the Puducherry Pollution Control Board and may also	Complied. Copy is enclosed at Annexure 11.

Sl.No	Conditions stipulated	Compliance Status
	be seen on the website of the Ministry of Environment & Forests at http://www.enfor.nic.in. The advertisement should be made within 10 days from the date of the receipt of the Clearances letter and a copy of the same should be forwarded to the Regional Office of this Ministry	
11	Environmental Clearance is subject to final order of the Hon'ble Supreme Court of India in the matter of Goa Foundations Vs. Union of India in Writ Petition (Civil)No.460 of 2004 as may be applicable to this project.	Agreed upon.
12	Any appeal against the Environment Clearance shall be with the National Environment Appellate Authority, if preferred, within a period of 30 days as prescribed under Section 11 off the National Environment Appellate Act, 1997.	Noted
13	A copy of Clearance letter shall be sent by the proponent to concerned Panchayat, ZillaParisad /Municipal Corporation, Urtan 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. Copy of the Clearance letter sent by Karaikal Port to the said concerned Agencies. The clearance letter also put on the website (www.karaikalport.com) of the company.

Sl.No	Conditions stipulated	Compliance Status
14	The proponent shall upload the status of compliance of the stipulated EC 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 level namely SPM, RSPM, SO_2, NOx (Ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.	Being complied.
15	The project proponent shall also submit six monthly reports on the status of compliance of the stipulated EC conditions including results of monitored data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB	Complied. Compliance reports submitted regularly to the Integrated Regional Office of MoEF&CC at Chennai, CPCB Regional Directorate / Project Office at Chennai & PPCC at Puducherry. Latest report is attached at Annexure 12
16	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 State Pollution Control Board as prescribed under the Environment (Protection)	Complied. The environmental Statement for each Financial Year ending 31st March in Form-V submitted regularly to PPCC, Puducherry & RO/MoEF&CC at Chennai Latest Statement ending 31st March 2024 is at Annexure

Sl.No	Conditions stipulated	Compliance Status
	Rules, 1986 as amended subsequently shall also be put on the website of the company along with the status of compliance of EC conditions and shall also be sent to the respective Regional Offices of MoEF by e-mail.	13.

Present Status of Project: Project construction has been completed and operations have started (Annexure at 14)

(Muralidhar. B)

Authorized Signatory

Subject: Environmental and CRZ clearance for expansion of Karaikal Port (Phase II) at Puducherry by M/s. Karaikal Port Pvt Ltd. – Further Consideration for Amendment in Environmental and CRZ Clearance – Amendment to Environmental & CRZ Clearance

Reference: MoEF&CC's EC letter of No. 10-42/2009-IA III dated 05th August 2021

Sl.No	Additional Specific Conditions stipulated	Compliance Status
(4a.)	The Cargo which are permitted by the Ministry vide its letter No. 10-2/2006 dated 06th May 2006 and letter No 10-42/2009-IA-III dated 22nd September 2009 and the Cargo which are permitted by Puducherry Pollution Control Committee vide its letter No. PPCC/CON/AIR/TRP/KKL/JE/2019/800 dated 07th November, 2019 is only permissible. No other cargo other than permissible cargoes as mentioned in the above letters and as per the revised nomenclature is permitted	Being Complied. Cargo is being handled as per the said Environmental & CRZ Clearances from MoEF&CC and Air & Water Consent from Puducherry Pollution Control Committee (PPCC).
(4b.)	All other conditions mentioned in the letter No 10-2/2006 dated 06th May 2006, letter No 10-42/2009-IA-III dated 22nd September 2009 and letter No PPCC/CON/AIR/TRP/KKL/JE/2019/800 dated 07th November, 2019 shall remain unchanged.	Noted for compliance.

(Muralidhar.B)

Authorized Signatory

Karaikal Port Private Limited				
KPPL Project Assests Cost				
Pariculars	**Project Cost In Crore**	**Projects work & Direct capitalized / completed in crores**	**Balance Work**	**Asset Capitalized**
Project Cost	2,500.52	2,500.52	NIL	2,500.52

Year wise		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
	Activities												
Air Pollution Equipments,Oil Spill Equipments, STP, ETP, Tyre wash, Dust Suppression Systems, Wind screens,Aagash Ganga,Green Belt Development, Waste Mangement, , Road Cleaning etc.	Environment Pollution Monitoring	19.2	12.6	20	37.7	40.8	75.1	91.2	59.2	66.5	68.8	41.5	38.5
	GBD Maintenance	18.1	7.8	7.1	16.5	15.6	36.7	30.4	34.2	36.3	36.7	15.5	14
	EMC Running Exp Excl salary part and misc	8.9	9.3	17.2	15.1	12.7	15.8	24.2	21.8	19	24.8	18.6	13.5
	Dust Suppression System (Incl Wind Screen Road wetting, Coal Wetting etc.)	8.5	14.9	18.2	55.4	62.8	76.2	76.5	84.65	80	76.8	48.5	120
	Waste Management	7.5	4.1	6.03	14.3	12.9	10.3	14.7	12.58	14.89	14.98	9.5	8.5
	STP, ETP ,Tyre Wash, Oil Spill equipment	7.6	8.1	15.5	12.1	14.9	33.6	38.3	43.5	46	39.5	28.5	15.8
		50.7 lakh	44.3 lakh	64.03 lakh	151.10 lakh	159.7 lakh	247.7 lakh	275 lakh	242.2 lakh	261.1 lakh	261.58 Lakh	162.1 Lakh	210.3 Lakh

To,

The Director (IA.III)
Ministry of Environment and Forest
Govt. of India
New Delhi

Sir,

Ref: Phase II Environmental Clearance No 10-42/2009-IA.III dated 22.9.2009
Sub: Re assessment of River water quality

With reference to Environmental Clearance specific conditions no (i), water quality of both the rivers (Pravadanayar and Vettar) has been re assessed and enclosed herewith for your record.

Sincerely,

Manjunath
Manager

Encl: Water quality analysis report

IVC LABS & ENVIRONMENTAL SERVICES

Pollution Control People

Head Office : IVC HOUSE, No : 1048, Burma Colony, Second Street, Perungudi, Chennai - 600 096.
Ph : 044 - 2496 0600 / 2496 3939
email : ivclabs@yahoo.co.in | ivclabs@dataone.in

Branch Office : 216, 5th Street, Gandhipuram, Coimbatore - 12 Ph : 0422 - 6958580

WATER QUALITY ANALYSIS REPORT

DATE : 12.01.2010

Report No. : MARG-W-01
Sample From : KARAIKAL PORT PRIVATE LIMITED
'MARG AXIS',
4/318, OLD MAHABALIPURAM ROAD,
KOTTIVAKKAM, CHENNAI – 600 041
Sample Dated : 26.12.2009
Nature of Sample : River Water
Sampling Location : VETTAR River water (up stream)
Karaikal Port Project,
KeelaVanjoor, Karaikal

SL.No.	PARAMETERS	RESULTS
1.	Colour (hazan)	2
2.	Odour	agreeable
3.	pH	8.0
4.	Turbidity NTU	5.0
5.	Total dissolved solids mg/l	625
6.	Total Alkalinity	283
7.	Phenolphthalein Alkalinity	-
8.	Residual Chlorine (mg/l)	<0.2
9.	Total Hardness as $CaCO_3$	385
10.	Calcium as Ca mg/l	120
11.	Magnesium as Mg (mg/l)	16
12.	Chlorides as Cl (mg/l)	267

Cont

IVC LABS & ENVIRONMENTAL SERVICES Date 12/01/10 CHENNAI 600 096

13.	Sulphates as SO_4 (mg/l)	75
14.	Oil & Grease mg/l	0.3
15.	Nitrate Nitrogen (mg/l)	2.8
16.	Fluoride as Fe (mg/l)	0.17
17.	Iron as Fe (mg/l)	0.18
18.	Ammonia as NH_3 mg/l	BDL
19.	Mercury as Hg (mg/l)	BDL
20.	Cadmium as Cd (mg/l)	<0.01
21.	Copper as Cu (mg/l)	<0.01
22.	Total Chromium as Cr (mg/l)	0.03
23.	Zinc as Zn (mg/l)	<0.01
24.	Manganese as Mn (mg/l)	<0.01
25.	Aluminium as Al (mg/l)	BDL
26.	Cyanide as CN (mg/l)	NIL
27.	Selenium as Se (mg/l)	BDL
28.	Boron as Bo (mg/l)	BDL
29.	Anionic Active Surfactants MABS	NIL
30.	Total Coli forms per/100ml	7
31.	Fecal Coli forms per/100ml	2

BDL – Below detectable limit

For IVC LABS & ENVIRONMENTAL SERVICES

Chief Analyst

IVC LABS & ENVIRONMENTAL SERVICES

IVC LABS & ENVIRONMENTAL SERVICES
Pollution Control People

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Branch Office : 218, 5th Street, Gandhipuram, Coimbatore - 12. Ph : 0422 - 6958580

WATER QUALITY ANALYSIS REPORT

DATE : 12.01.2010

Report No. : MARG-W-02
Sample From : KARAIKAL PORT PRIVATE LIMITED
'MARG AXIS',
4/318, OLD MAHABALIPURAM ROAD,
KOTTIVAKKAM, CHENNAI – 600 041
Sample Dated : 26.12.2009
Nature of Sample : River Water
Sampling Location : VETTAR River water (middle)
Karaikal Port Project
KeelaVanjoor, Karaikal

SL.No.	PARAMETERS	RESULTS
1.	Colour (hazan)	2.5
2.	Odour	agreeable
3.	pH	8.1
4.	Turbidity NTU	7.0
5.	Total dissolved solids mg/l	720
6.	Total Alkalinity	290
7.	Phenolphthalein Alkalinity	6
8.	Residual Chlorine (mg/l)	<0.2
9.	Total Hardness as $CaCO_3$	392
10.	Calcium as Ca mg/l	128
11.	Magnesium as Mg (mg/l)	20
12.	Chlorides as Cl (mg/l)	272

Conti...

IVC LABS & ENVIRONMENTAL SERVICES CHENNAI 600 096 Date 12-Jan-10

13.	Sulphates as SO_4 (mg/l)	77
14.	Oil & Grease mg/l	0.3
15.	Nitrate Nitrogen (mg/l)	2.9
16.	Fluoride as Fe (mg/l)	0.17
17.	Iron as Fe (mg/l)	0.20
18.	Ammonia as NH_3 mg/l	BDL
19.	Mercury as Hg (mg/l)	BDL
20.	Cadmium as Cd (mg/l)	<0.01
21.	Copper as Cu (mg/l)	<0.01
22.	Total Chromium as Cr (mg/l)	0.03
23.	Zinc as Zn (mg/l)	<0.01
24.	Manganese as Mn (mg/l)	<0.01
25.	Aluminium as Al (mg/l)	BDL
26.	Cyanide as CN (mg/l)	NIL
27.	Selenium as Se (mg/l)	BDL
28.	Boron as Bo (mg/l)	BDL
29.	Anionic Active Surfactants MABS	NIL
30.	Total Coli forms per/100ml	9
31.	Fecal Coli forms per/100ml	3

BDL – Below detectable limit

For IVC LABS & ENVIRONMENTAL SERVICES

Chief Analyst

IVC LABS & ENVIRONMENTAL SERVICES * CHENNAI 600 041. * Date 12/09/11

IVC LABS & ENVIRONMENTAL SERVICES

Pollution Control People

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email : ivclabs@yahoo.co.in | ivclabs@dataone.in

Branch Office : 218, 5th Street, Gandhipuram, Coimbatore - 12. Ph : 0422 - 6958580

WATER QUALITY ANALYSIS REPORT

DATE : 12.01.2010

Report No. : MARG-W-03
Sample From : KARAIKAL PORT PRIVATE LIMITED
'MARG AXIS',
4/318, OLD MAHABALIPURAM ROAD,
KOTTIVAKKAM, CHENNAI – 600 041
Sample Dated : 28.12.2009
Nature of Sample : River Water
Sampling Location : VETTAR River water (Mouth)
Karaikal Port Project
KeelaVanjoor, Karaikal

SL.No.	PARAMETERS	RESULTS
1.	Colour (hazan)	9
2.	Odour	agreeable
3.	pH	8.2
4.	Turbidity NTU	9.0
5.	Total dissolved solids mg/l	22250
6.	Total Alkalinity	316
7.	Phenolphthalein Alkalinity	12
8.	Residual Chlorine (mg/l)	NIL
9.	Total Hardness as $CaCO_3$	7150
10.	Calcium as Ca mg/l	685
11.	Magnesium as Mg (mg/l)	824
12.	Chlorides as Cl (mg/l)	12153

Contd...

IVC LABS & ENVIRONMENTAL SERVICES Date. 12.01.2010 CHENNAI 600 096.

13.	Sulphates as SO_4 (mg/l)	2485
14.	Oil & Grease mg/l	1.5
15.	Nitrate Nitrogen (mg/l)	3.2
16.	Fluoride as Fe (mg/l)	0.8
17.	Iron as Fe (mg/l)	1.3
18.	Ammonia as NH_3 mg/l	BDL
19.	Mercury as Hg (mg/l)	BDL
20.	Cadmium as Cd (mg/l)	0.09
21.	Copper as Cu (mg/l)	<0.01
22.	Total Chromium as Cr (mg/l)	0.02
23.	Zinc as Zn (mg/l)	<0.5
24.	Manganese as Mn (mg/l)	<0.04
25.	Aluminium as Al (mg/l)	BDL
26.	Cyanide as CN (mg/l)	NIL
27.	Selenium as Se (mg/l)	BDL
28.	Boron as Bo (mg/l)	BDL
29.	Anionic Active Surfactants MABS	NIL
30.	Total Coli forms per/100ml	12
31.	Fecal Coli forms per/100ml	4

BDL – Below detectable limit

For IVC LABS & ENVIRONMENTAL SERVICES

Chief Analyst

IVC LABS & ENVIRONMENTAL SERVICES Date

IVC LABS & ENVIRONMENTAL SERVICES
Pollution Control People

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WATER QUALITY ANALYSIS REPORT

DATE : 12.01.2010

Report No. : MARG-W-04
Sample From : KARAIKAL PORT PRIVATE LIMITED
'MARG AXIS',
4/318, OLD MAHABALIPURAM ROAD,
KOTTIVAKKAM, CHENNAI – 600 041
Sample Dated : 26.12.2009
Nature of Sample : River Water
Sampling Location : PRAVIDAYAR River water (Up-stream)
Karaikal Port Project
KeelaVanjoor, Karaikal

SL.No.	PARAMETERS	RESULTS
1.	Colour (hazan)	2.5
2.	Odour	agreeable
3.	pH	7.9
4.	Turbidity NTU	3.0
5.	Total dissolved solids mg/l	570
6.	Total Alkalinity	185
7.	Phenolphthalein Alkalinity	-
8.	Residual Chlorine (mg/l)	<0.1
9.	Total Hardness as $CaCO_3$	335
10.	Calcium as Ca mg/l	115
11.	Magnesium as Mg (mg/l)	18
12.	Chlorides as Cl (mg/l)	155

Contd...

IVC LABS & ENVIRONMENTAL SERVICES CHENNAI Date 12.01.10

13.	Sulphates as SO_4 (mg/l)	70
14.	Oil & Grease mg/l	0.5
15.	Nitrate Nitrogen (mg/l)	2.5
16.	Fluoride as Fe (mg/l)	0.12
17.	Iron as Fe (mg/l)	0.15
18.	Ammonia as NH_3 mg/l	BDL
19.	Mercury as Hg (mg/l)	BDL
20.	Cadmium as Cd (mg/l)	<0.01
21.	Copper as Cu (mg/l)	0.02
22.	Total Chromium as Cr (mg/l)	<0.01
23.	Zinc as Zn (mg/l)	<0.01
24.	Manganese as Mn (mg/l)	BDL
25.	Aluminium as Al (mg/l)	NIL
26.	Cyanide as CN (mg/l)	BDL
27.	Selenium as Se (mg/l)	BDL
28.	Boron as Bo (mg/l)	BDL
29.	Anionic Active Surfactants MABS	NIL
30.	Total Coli forms per/100ml	3
31.	Fecal Coli forms per/100ml	1

BDL – Below detectable limit

For IVC LABS & ENVIRONMENTAL SERVICES

Chief Analyst

IVC LABS & ENVIRONMENTAL SERVICES

IVC LABS & ENVIRONMENTAL SERVICES

Pollution Control People

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WATER QUALITY ANALYSIS REPORT

Report No. :
Sample From : MARG-W-05 DATE : 12.01.2010
: KARAIKAL PORT PRIVATE LIMITED
'MARG AXIS',
4/318, OLD MAHABALIPURAM ROAD,
KOTTIVAKKAM, CHENNAI – 600 041
Sample Dated : 26.12.2009
Nature of Sample : River Water
Sampling Location : PRAVIDAYAR River water (Middle)
Karaikal Port Project
KeelaVanjoor, Karaikal

SL.No.	PARAMETERS	RESULTS
1.	Colour (hazan)	2.5
2.	Odour	agreeable
3.	pH	8.0
4.	Turbidity NTU	3.2
5.	Total dissolved solids mg/l	582
6.	Total Alkalinity	192
7.	Phenolphthalein Alkalinity	-
8.	Residual Chlorine (mg/l)	<0.1
9.	Total Hardness as $CaCO_3$	341
10.	Calcium as Ca mg/l	119
11.	Magnesium as Mg (mg/l)	20
12.	Chlorides as Cl (mg/l)	160

IVC LABS ENVIRONMENTAL SERVICES Date 12/01/10

Contd...

13.	Sulphates as SO_4 (mg/l)	73
14.	Oil & Grease mg/l	0.5
15.	Nitrate Nitrogen (mg/l)	2.6
16.	Fluoride as Fe (mg/l)	0.12
17.	Iron as Fe (mg/l)	0.16
18.	Ammonia as NH_3 mg/l	BDL
19.	Mercury as Hg (mg/l)	BDL
20.	Cadmium as Cd (mg/l)	<0.01
21.	Copper as Cu (mg/l)	0.02
22.	Total Chromium as Cr (mg/l)	<0.01
23.	Zinc as Zn (mg/l)	<0.01
24.	Manganese as Mn (mg/l)	BDL
25.	Aluminium as Al (mg/l)	NIL
26.	Cyanide as CN (mg/l)	BDL
27.	Selenium as Se (mg/l)	BDL
28.	Boron as Bo (mg/l)	BDL
29.	Anionic Active Surfactants MABS	NIL
30.	Total Coli forms per/100ml	6
31.	Fecal Coli forms per/100ml	3

BDL – Below detectable limit

For IVC LABS & ENVIRONMENTAL SERVICES

Chief Analyst

IVC LABS & ENVIRONMENTAL SERVICES * CHENNAI 600 091 * Date 16/01/...

IVC LABS & ENVIRONMENTAL SERVICES
Pollution Control People

Head Office : IVC HOUSE, No : 1048, Burma Colony, Second Street, Perungudi, Chennai - 600 096.
Ph : 044 - 2496 0600 / 2496 3939
email : ivclabs@yahoo.co.in | ivclabs@dataone.in

Branch Office : 218, 5th Street, Gandhipuram, Coimbatore - 12 Ph 0422 - 6958580

WATER QUALITY ANALYSIS REPORT

DATE : 12.01.2010

Report No. : MARG-W-06
Sample From : KARAIKAL PORT PRIVATE LIMITED
'MARG AXIS',
4/318, OLD MAHABALIPURAM ROAD,
KOTTIVAKKAM, CHENNAI – 600 041
Sample Dated : 26.12.2009
Nature of Sample : River Water
Sampling Location : PRAVIDAYAR River water (Mouth)
Karaikal Port Project
KeelaVanjoor, Karaikal

SL.No.	PARAMETERS	RESULTS
1.	Colour (hazan)	8
2.	Odour	agreeable
3.	pH	8.1
4.	Turbidity NTU	8.5
5.	Total dissolved solids mg/l	21950
6.	Total Alkalinity	310
7.	Phenolphthalein Alkalinity	9
8.	Residual Chlorine (mg/l)	NIL
9.	Total Hardness as $CaCO_3$	6936
10.	Calcium as Ca mg/l	669
11.	Magnesium as Mg (mg/l)	812
12.	Chlorides as Cl (mg/l)	11866

Contd ..

13.	Sulphates as SO_4 (mg/l)	2310
14.	Oil & Grease mg/l	1.5
15.	Nitrate Nitrogen (mg/l)	3.1
16.	Fluoride as Fe (mg/l)	0.9
17.	Iron as Fe (mg/l)	1.1
18.	Ammonia as NH_3 mg/l	BDL
19.	Mercury as Hg (mg/l)	BDL
20.	Cadmium as Cd (mg/l)	0.08
21.	Copper as Cu (mg/l)	<0.01
22.	Total Chromium as Cr (mg/l)	0.02
23.	Zinc as Zn (mg/l)	<0.5
24.	Manganese as Mn (mg/l)	<0.04
25.	Aluminium as Al (mg/l)	BDL
26.	Cyanide as CN (mg/l)	NIL
27.	Selenium as Se (mg/l)	BDL
28.	Boron as Bo (mg/l)	BDL
29.	Anionic Active Surfactants MABS	NIL
30.	Total Coli forms per/100ml	13
31.	Fecal Coli forms per/100ml	5

BDL – Below detectable limit

For IVC LABS & ENVIRONMENTAL SERVICES

Chief Analyst

IVC LABS & ENVIRONMENTAL SERVICES CHENNAI-600 041 Date: 10/01/12

GOVERNMENT OF PUDUCHERRY
DEPARTMENT OF SCIENCE, TECHNOLOGY & ENVIRONMENT
PONDICHERRY COASTAL ZONE MANAGEMENT AUTHORITY
ANNA NAGAR, PUDUCHERRY-5
Phone : (0413) 2201256 Fax : (0413) 2203494

* * *

Puducherry, the

Letter No. DSTE/PCZMA/MOC/JE/2009/3092

To
Dr. A. Senthilvel
Additional Director
Member Secretary, National Coastal Zone Management Authority
Ministry of Environment & Forests,
Room No.708, Paryavaran Bhavan, CGO Complex, Lodi Road
New Delhi - 110 003.

Sir,

Sub: DST&E – PCZMA – Recommendation of PCZMA for Extension of Karaikl Port Facilities – Reg.

Ref: i) Lr. dated 09th Feb 2009 received from M/s. Karaikal Port Pvt. Ltd.
ii) Lr. dated 20th December 2008 received from M/s. Karaikal Port Pvt. Ltd.

* * *

With reference to the above, it is informed that the proposal of M/s. Karaikal Port Pvt. Ltd. for expansion of Karaikal Port by construction of three additional berths, enhancement of cargo handling capacity from 4.0 MTPY to 20.5 MTPY and deepening of Navigational Channels, Basin and Turning Circle within the existing Port Layout has been discussed in the 19th meeting of Puducherry Coastal Zone Management Authority held on 12.02.2009 and the Authority decided that the proposal for expansion of Karaikal Port shall be recommended to MoE&F for obtaining Environmental Clearance as the proposal falls in land classified under CRZ - III.

For and on behalf of PCZMA.

(G. RAJAMOHAN)
Member Secretary
Puducherry Coastal Zone Management Authority

Copy to :
M/s. Karaikal Port Private Limited

E-mail : test@mettexlab.com
Web : www.mettexlab.com
Phone : 044-22323163, 22311034
42179490, 42179491

CHENNAI METTEX LAB PRIVATE LIMITED

Jothi Complex, 83, M.K.N. Road, Guindy, Chennai - 600 032.

TC-5589

TEST REPORT -MARCH - 2024

ISSUED TO : M/s. Karaikal Port Private Limited,
Khezhavanjoor Village,
T.R.Pattinam,
Karaikal- 609 606.

T.C Date : 03.04.2024

T.C No : CML/24-25/1161

Cust. Ref : SRF Dated :22.03.2024

Date Of Receipt : 23.03.2024

Lab No : 24144029

Analysis Commenced On :23.03.2024

Analysis Completed On : 30.03.2024

Sample Description : **STP Treated Water**
(as stated by customer)

Date of Sampling: 22.03.2024

Sl.No.	Test Parameters	Protocol	Results	CPCB Limit (Land for Irrigation)
Discipline : Chemical			**Group:** Pollution & Environment	
01	pH @ 25°C	IS: 3025 Part 11-1983 (Reaff:2017)	7.42	5.5 – 9.0
02	Total Suspended Solids	IS: 3025 Part 17-1984 (Reaff:2017)	26 mg/l	200 mg/l
03	Total Dissolved Solids	IS: 3025 Part 16-1984 (Reaff:2017)	1314 mg/l	NS
04	Chloride as Cl	IS: 3025 Part 32-1988 (Reaff:2019)	500 mg/l	NS
05	Sulphate as SO_4	IS: 3025 Part 24 -1986(Reaff:2019)	120 mg/l	NS
06	Oil & Grease	IS: 3025 Part 39-2021	6 mg/l	10 mg/l
07	BOD @ 27°C for 3 days	IS: 3025 Part 44-1993 (Reaff:2019)	18 mg/l	100 mg/l
08	COD	IS:3025 Part 58 - 2006 (Reaff:2017)	105 mg/l	NS
09	Total Kjeldahl Nitrogen	IS:3025 Part 34 - 1988 (Reaff:2019)	6.2 mg/l	NS
10	Ammonical Nitrogen	IS:3025 Part 34 – 1988 (Reaff:2019)	5.9 mg/l	NS
Discipline : Biological			**Group:** Pollution & Environment	
11	Faecal Coliforms	APHA 23rdEdn .2017 : 9221 'E'	94 MPN/100ml	NS

Abbreviation :MPN : Most Probable Number; APHA : American Public Health Association. NS : Not Specified.

End of Report

For Chennai Mettex Lab Pvt Ltd.,

Reviewed & Authorized By
B. ARUNAN
Technical Manager
Authorised Signatory

Reviewed & Authorized By
Authorised Signatory

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CHENNAI METTEX LAB PRIVATE LIMITED®

Jothi Complex, 83, M.K.N. Road, Guindy, Chennai - 600 032.

TC-5589

TEST REPORT -FEBRUARY-2024

ISSUED TO : M/s. Karaikal Port Private Limited,
Khezhavanjoor Village,
T.R.Pattinam,
Karaikal- 609 606.

Cust. Ref : SRF Dated :16.02.2024

Lab No : 24126299

Sample Description : **STP Treated Water**
(as stated by customer)

T.C Date : 06.03.2024

T.C No : CML/23-24/124180

Date Of Receipt : 17.02.2024

Analysis Commenced On :18.02.2024

Analysis Completed On : 24.02.2024

Date of Sampling: **16.02.2024**

Sl.No.	Test Parameters	Protocol	Results	CPCB Limit (Land for Irrigation)
Discipline : Chemical			**Group:** Pollution & Environment	
01	pH @ 25°C	IS: 3025 Part 11-1983 (Reaff:2017)	7.41	5.5 – 9.0
02	Total Suspended Solids	IS: 3025 Part 17-1984 (Reaff:2017)	38 mg/l	200 mg/l
03	Total Dissolved Solids	IS: 3025 Part 16-1984 (Reaff:2017)	1764 mg/l	NS
04	Chloride as Cl	IS: 3025 Part 32-1988 (Reaff:2019)	528 mg/l	NS
05	Sulphate as SO_4	IS: 3025 Part 24 -1986(Reaff:2019)	184 mg/l	NS
06	Oil & Grease	IS: 3025 Part 39-2021	7 mg/l	10 mg/l
07	BOD @ 27°C for 3 days	IS: 3025 Part 44-1993 (Reaff:2019)	20 mg/l	100 mg/l
08	COD	IS:3025 Part 58 - 2006 (Reaff:2017)	116 mg/l	NS
09	Total Kjeldahl Nitrogen	IS:3025 Part 34 - 1988 (Reaff:2019)	9.52 mg/l	NS
10	Ammonical Nitrogen	IS:3025 Part 34 – 1988 (Reaff:2019)	8.08 mg/l	NS
Discipline : Biological			**Group:** Pollution & Environment	
11	Faecal Coliforms	APHA 23rdEdn .2017 : 9221 'E'	350 MPN/100ml	NS

Abbreviation :MPN : Most Probable Number; APHA : American Public Health Association. NS : Not Specified.

End of Report

For Chennai Mettex Lab Pvt Ltd.,

Reviewed & Authorized By
G.S. RAJU
Technical Manager
Authorised Signatory

Reviewed & Authorized By
P. KAVITHA
Technical Manager
Authorised Signatory

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CHENNAI METTEX LAB PRIVATE LIMITED®

Jothi Complex, 83, M.K.N. Road, Guindy, Chennai - 600 032.
TC-5589

TEST REPORT -JANUARY -2024

ISSUED TO : M/s. Karaikal Port Private Limited,
Khezhavanjoor Village,
T.R.Pattinam,
Karaikal- 609 606.

Cust. Ref : SRF Dated :30.01.2024

Lab No : 24116833

Sample Description : **STP Treated Water**
(as stated by customer)

T.C Date : 10.02.2024

T.C No : CML/23-24/112154

Date Of Receipt : 31.01.2024

Analysis Commenced On :31.01.2024

Analysis Completed On : 10.02.2024

Date of Sampling: **30.01.2024**

Sl.No.	Test Parameters	Protocol	Results	CPCB Limit (Land for Irrigation)
Discipline : Chemical			**Group:** Pollution & Environment	
01	pH @ 25°C	IS: 3025 Part 11-1983 (Reaff:2017)	7.80	5.5 – 9.0
02	Total Suspended Solids	IS: 3025 Part 17-1984 (Reaff:2017)	16 mg/l	200 mg/l
03	Total Dissolved Solids	IS: 3025 Part 16-1984 (Reaff:2017)	1869 mg/l	NS
04	Chloride as Cl	IS: 3025 Part 32-1988 (Reaff:2019)	571 mg/l	NS
05	Sulphate as SO_4	IS: 3025 Part 24 -1986(Reaff:2019)	141 mg/l	NS
06	Oil & Grease	IS: 3025 Part 39-2021	5 mg/l	10 mg/l
07	BOD @ 27°C for 3 days	IS: 3025 Part 44-1993 (Reaff:2019)	14 mg/l	100 mg/l
08	COD	IS:3025 Part 58 - 2006 (Reaff:2017)	67 mg/l	NS
09	Total Kjeldahl Nitrogen	IS:3025 Part 34 - 1988 (Reaff:2019)	39.0 mg/l	NS
10	Ammonical Nitrogen	IS:3025 Part 34 – 1988 (Reaff:2019)	36.3 mg/l	NS
Discipline : Biological			**Group:** Pollution & Environment	
11	Faecal Coliforms	APHA 23rdEdn .2017 ; 9221 'E'	70 MPN/100ml	NS

Abbreviation :MPN ; Most Probable Number; APHA : American Public Health Association; NS : Not Specified.

End of Report

For Chennai Mettex Lab Pvt Ltd.,

Reviewed & Authorized By
G.S. RADHA
Technical Manager
Authorised Signatory

Reviewed & Authorized By
P. KAVITHA
Technical Manager
Authorised Signatory

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CHENNAI METTEX LAB PRIVATE LIMITED®

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TC-5589

TEST REPORT -DECEMBER-2023

ISSUED TO : M/s. Karaikal Port Private Limited,
Khezhavanjoor Village,
T.R.Pattinam,
Karaikal- 609 606.

Cust. Ref : SRF Dated : 14.12.2023

Lab No : 24095008

Sample Description : **STP Treated Water**
(as stated by customer)

T.C Date : 29.12.2023

T.C No : CML/23-24/92092

Date Of Receipt : 15.12.2023

Analysis Commenced On :15.12.2023

Analysis Completed On :23.12.2023

Date of Sampling: 14.12.2023

Sl.No.	Test Parameters	Protocol	Results	CPCB Limit (Land for Irrigation)
Discipline : Chemical			**Group:** Pollution & Environment	
01	pH @ 25°C	IS: 3025 Part 11-1983 (Reaff:2017)	6.30	5.5 – 9.0
02	Total Suspended Solids	IS: 3025 Part 17-1984 (Reaff:2017)	23 mg/l	200 mg/l
03	Total Dissolved Solids	IS: 3025 Part 16-1984 (Reaff:2017)	2038 mg/l	NS
04	Chloride as Cl	IS: 3025 Part 32-1988 (Reaff:2019)	640 mg/l	NS
05	Sulphate as SO_4	IS: 3025 Part 24 -1986(Reaff:2019)	185 mg/l	NS
06	Oil & Grease	IS: 3025 Part 39-2021	6 mg/l	10 mg/l
07	BOD @ 27°C for 3 days	IS: 3025 Part 44-1993 (Reaff:2019)	9 mg/l	100 mg/l
08	COD	IS:3025 Part 58 - 2006 (Reaff:2017)	52 mg/l	NS
09	Total Kjeldahl Nitrogen	IS:3025 Part 34 - 1988 (Reaff:2019)	11.8 mg/l	NS
10	Ammonical Nitrogen	IS:3025 Part 34 – 1988 (Reaff:2019)	10.6 mg/l	NS
Discipline : Biological			**Group:** Pollution & Environment	
11	Faecal Coliforms	APHA 23rdEdn .2017 : 9221 'E'	70 MPN/100ml	NS

Abbreviation :MPN : Most Probable Number; APHA : American Public Health Association. NS : Not Specified.

End of Report

For Chennai Mettex Lab Pvt Ltd.,

Reviewed & Authorized By
G.S. RADHA
Technical Manager
Authorised Signatory

Reviewed & Authorized By
P. KAVITHA
Technical Manager
Authorised Signatory

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TC-5589

TEST REPORT -NOVEMBER-2023

ISSUED TO : M/s. Karaikal Port Private Limited,
Khezhavanjoor Village,
T.R.Pattinam,
Karaikal- 609 606.

Cust. Ref : SRF Dated : 21.11.2023

Lab No : 24085902

Sample Description : **STP Treated Water**
(as stated by customer)

T.C Date : 06.12.2023

T.C No : CML/23-24/83521

Date Of Receipt : 22.11.2023

Analysis Commenced On :22.11.2023

Analysis Completed On :29.11.2023

Date of Sampling: 21.11.2023

Sl.No.	Test Parameters	Protocol	Results	CPCB Limit (Land for Irrigation)
Discipline : Chemical			**Group:** Pollution & Environment	
01	pH @ 25°C	IS: 3025 Part 11-1983 (Reaff:2017)	6.90	5.5 – 9.0
02	Total Suspended Solids	IS: 3025 Part 17-1984 (Reaff:2017)	148 mg/l	200 mg/l
03	Total Dissolved Solids	IS: 3025 Part 16-1984 (Reaff:2017)	1692 mg/l	NS
04	Chloride as Cl	IS: 3025 Part 32-1988 (Reaff:2019)	655 mg/l	NS
05	Sulphate as SO_4	IS: 3025 Part 24 -1986(Reaff:2019)	7 mg/l	NS
06	Oil & Grease	IS: 3025 Part 39-2021	8 mg/l	10 mg/l
07	BOD @ 27°C for 3 days	IS: 3025 Part 44-1993 (Reaff:2019)	55 mg/l	100 mg/l
08	COD	IS:3025 Part 58 - 2006 (Reaff:2017)	235 mg/l	NS
09	Total Kjeldahl Nitrogen	IS:3025 Part 34 - 1988 (Reaff:2019)	13 mg/l	NS
10	Ammonical Nitrogen	IS:3025 Part 34 – 1988 (Reaff:2019)	12 mg/l	NS
Discipline : Biological			**Group:** Pollution & Environment	
11	Faecal Coliforms	APHA 23rdEdn .2017 : 9221 'E'	70 MPN/100ml	NS

Abbreviation :MPN : Most Probable Number; APHA : American Public Health Association. NS : Not Specified.

End of Report

For Chennai Mettex Lab Pvt Ltd.,

Reviewed & Authorized By
G.S. RADHA
Technical Manager
Authorised Signatory

Reviewed & Authorized By
P. KAVITHA
Technical Manager
Authorised Signatory

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CHENNAI METTEX LAB PRIVATE LIMITED®

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Phone : +91 44 22323163, 22311034, 42179490, 42179491 I CIN : U74999TN2008PTC069459
Email : test@mettexlab.com I Web : www.mettexlab.com

TC-5589

TEST REPORT -OCTOBER-2023

ISSUED TO : M/s. Karaikal Port Private Limited,
Khezhavanjoor Village,
T.R.Pattinam,
Karaikal- 609 606.

T.C Date : 02.11.2023

T.C No : CML/23-24/70325

Date Of Receipt : 17.10.2023

Analysis Commenced On :17.10.2023

Analysis Completed On : 21.10.2023

Date of Sampling: 16.10.2023

Cust. Ref : SRF Dated : 16.10.2023

Lab No : 24071654

Sample Description : **STP Treated Water**
(as stated by customer)

Sl.No.	Test Parameters	Protocol	Results	CPCB Limit (Land for Irrigation)
Discipline : Chemical			**Group:** Pollution & Environment	
01	pH @ 25°C	IS: 3025 Part 11-1983 (Reaff:2017)	8.04	5.5 – 9.0
02	Total Suspended Solids	IS: 3025 Part 17-1984 (Reaff:2017)	28 mg/l	200 mg/l
03	Total Dissolved Solids	IS: 3025 Part 16-1984 (Reaff:2017)	1968 mg/l	NS
04	Chloride as Cl	IS: 3025 Part 32-1988 (Reaff:2019)	600 mg/l	NS
05	Sulphate as SO_4	IS: 3025 Part 24 -1986(Reaff:2019)	225 mg/l	NS
06	Oil & Grease	IS: 3025 Part 39-2021	3 mg/l	10 mg/l
07	BOD @ 27°C for 3 days	IS: 3025 Part 44-1993 (Reaff:2019)	7 mg/l	100 mg/l
08	COD	IS:3025 Part 58 - 2006 (Reaff:2017)	36 mg/l	NS
09	Total Kjeldahl Nitrogen	IS:3025 Part 34 - 1988 (Reaff:2019)	9.21 mg/l	NS
10	Ammonical Nitrogen	IS:3025 Part 34 – 1988 (Reaff:2019)	7.24 mg/l	NS
Discipline : Biological			**Group:** Pollution & Environment	
11	Faecal Coliforms	APHA 23rdEdn ,2017 : 9221 'E'	63 MPN/100ml	NS

Abbreviation :MPN : Most Probable Number; APHA : American Public Health Association. NS : Not Specified.

End of Report

For Chennai Mettex Lab Pvt Ltd.,

Reviewed & Authorized By
S. RADHA
Technical Manager
Authorised Signatory

Reviewed & Authorized By
P. KAVITHA
Technical Manager
Authorised Signatory

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Annexure 6

Telefax: 04368-226500
Email : cgs-kkl@indiancoastguard.nic.in
Reply should be addressed to
The Commanding Officer

BHARATIYA TATRAKSHAK AVASTHAN KARAIKAL
ICGS Karaikal
No.64, Bharathi Nagar,
Karaikal – 609 604

731/7

16 Mar 2020

The Manager
(Marine Operations)
Karaikal Port Pvt Ltd
Kheezhavanjoor Village
TR Pattinam, PB No.33
Karaikal-609606

OIL SPILL CONTINGENCY PLAN – KARAIKAL PORT PVT LTD

1. Refer to CGRHQ(E) letter 7604 dated 02 Mar 17 and this station letter 704/6 dated 17 Apr 17.

2. The revised Oil Spill Contingency Plan (OSCP) of Karaikal Port Pvt Ltd had been approved by competent Coast Guard authority w.e.f 02 Mar 17 for a period of five years.

Thanking you,

Yours faithfully,

(Praveen Kumar)
Asst Commandant
Station Ops Officer
for Commanding Officer

Encl. As above

OSR EQUIPMENT – AVAILABLE WITH KARAIKAL PORT

Sl. No.	Description	Quantity
1.	Air Inflatable Boom	250 M
2.	Air filled Light Oil Boom	500 meters
3.	Rigid Boom	500 M
4.	Sorbent Boom	200 M
5.	Sorbent Pads	1000 Nos
6.	OSD	600 Ltrs
7.	Skimmer	2 - 30 TPH
8.	Boom reel	01
9.	Power Pack with accessories	02
10.	Anchors & accessories for booms	as per set
11.	Oil Spill Dispersant	500 liters
12.	Reusable Adsorbents	For up to 1000 ltr absorption

SAFETY / SHORELINE CLEANUP EQUIPMENTS AVAILABLE WITH KARAIKAL PORT

Sl. No.	Description	Quantity
1.	PCV hand gloves – small 14”	20
2.	PCV hand gloves – small 16”	20
3.	PCV hand gloves – small 18”	20
4.	Mops with handle	20
5.	Hand shovel with wooden handle	20
6.	Wheel Barrow	10
7.	Rake with handle	10
8.	Tarpaulin-standard size 30’ X 27’	4
9.	Gunny bags	50
10.	HDPE bags	50
11.	Safety Helmets	14
12.	Liquid Soap (in canes)	50 Ltrs
13.	Water Flask 20 Liters	02
14.	Saw Dust packed in gunny bags	100 Kgs
15.	Disposable Coveralls – Small	10
16.	Disposable Coveralls – Medium	20

17.	Disposable Coveralls – Large	20
18.	Disposable Coveralls – Extra Large	20
19.	Gum boot – Small	15
20.	Gum boot – Medium	15
21.	Gum boot – Large	15
22.	Plastic Buckets – 10 liters	15
23.	Plastic Buckets – 20 liters	15
24.	Plastic Mug – 1 liter	15
25.	Cotton Rag – in bags	100 Kg.
26.	Trolley	03
27.	Detergent Powder	25 Kg
28.	Work / Lift vests	06
29.	Disposable cups / glasses	200
30.	Plastic Chairs	6
31.	Folding Tables	2
32.	First Aid Kit	01 Set

karaikal port

ISO 9001
ISO 14001
ISO 50001
OHSAS 18001

KPPL/MAR/ICGS/2021-22/006

21-Feb-2022

To,
The Commanding Officer
ICGS Karaikal

Sub:- Renewal for Oil Spill Contingency Plan – Karaikal Port.

Dear Sir,

With reference to the letter no 704/6, dtd, 13th April 2017, our revised Oil Spill Contingency Plan was approved for a period of five years from 15th March 2017, which is due to expire on 14th March 2022.

We request you to kindly renew our OSCP for further period of 5 years.

With Best Regards,

Capt Vijay Nicodemus
Chief Operating Officer
Karaikal Port Pvt Ltd.

Received by
23/02/22

KARAIKAL PORT PRIVATE LIMITED
CIN: U45203PY2006PTC001945
Registered Office

karaikal port

ISO 9001
ISO 14001
ISO 45001
ISO 50001

KPPL/MAR/CG/2023-11

22nd Feb 2023

To
The Commanding Officer
Indian Coast Guard Station,
Karaikal.

Sub: - Approval of Oil Spill Contingency Plan – Karaikal Port.

Sir,

In continuation with our letter no: KPPL/MAR/CG/2023-08, dtd, 10th Feb 2022, we hereby, submit our updated Oil Spill Contingency Plan (Soft Copy) for your vetting and approval.

Thanking You,

Yours Sincerely,
For Karaikal Port Pvt Ltd,

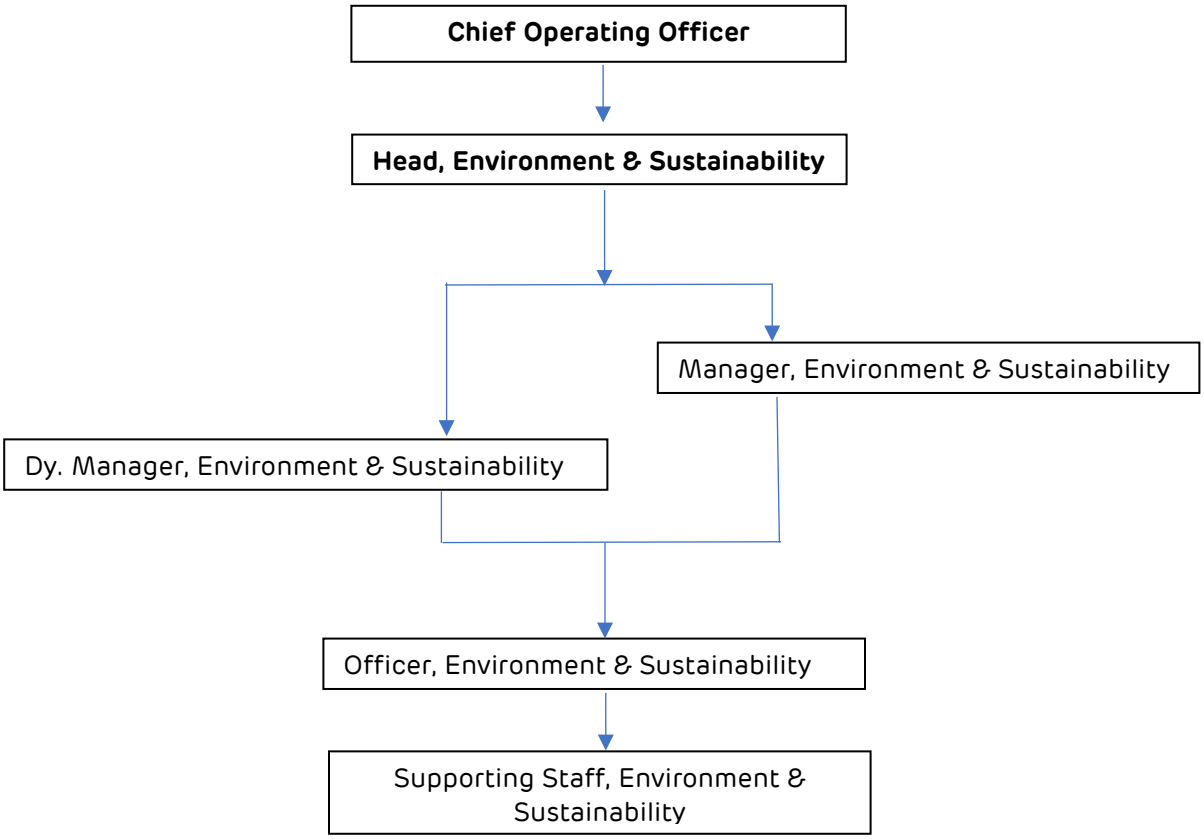
Authorized Signatory,
Port Operations Center.

BUOYS

Annexure 8

KPPL/ENV/EMC/2023/01

KARAIKAL PORT PRIVATE LIMITED
ENVIRONMENT MANAGEMENT CELL



MARG

15th October 2009

TO WHOSOVER IT MAY CONCERN

This is to certify that the construction material which shall be used in the construction in the Karaikal Port will be sourced from the approved quarries in the neighbourhood. The same shall be transported with adequate precautions in place as per the requirement.

Authorised Signatory

MARG LIMITED
KARAIKAL PORT
Keezhavanjore
T.R.Pattinam
Karaikal-609604

भारत सरकार
Government of India
वाणिज्य और उद्योग मंत्रालय
Ministry of Commerce & Industry
पेट्रोलियम तथा विस्फोटक सुरक्षा संगठन (पैसो)
Petroleum & Explosives Safety Organisation (PESO)
A और D - विंग, ब्लॉक 1-8, दूसरा तल, शास्त्री भवन, 26 हड्डोउस रोड, नुंगम्बक्कम
चेन्नै- 600006
A & D - Wing, Block 1-8, IInd Floor, Shastri Bhavan, 26 Haddous Road, Nungambakkam,
Chennai - 600006

E-mail : **jtccechennai@explosives.gov.in**
Phone/Fax No : **044 - 28287118,28281023,28281041,28287119/28284848**

संख्या /No. : **P/SC/PY/14/136 (P203909)** दिनांक /Dated : **02/01/2023**

सेवा में
/To,

M/S.Karaikal Port Private Limited,
Kheezhavanjoor Village,
T R Pattinam, PB No 33,
Karaikal,
District: KARAIKAL,
State: Pondicheri
PIN: 609606

विषय /Sub : **Plot No, R.S.166/2 of Vanjore Revenue Village in, NA, Karaikal, Karaikal, Taluka: Karaikal, District: KARAIKAL, State: Pondicheri, PIN: 609606** में स्थित विद्यमान पेट्रोलियम वर्ग **A,B** Retail Outlet की अनुज्ञप्ति संख्या **P/SC/PY/14/136 (P203909)** - नवीकरण के संदर्भ में ।
Existing Petroleum Class **A,B** Retail Outlet at **Plot No, R.S.166/2 of Vanjore Revenue Village in, NA, Karaikal, Karaikal, Taluka: Karaikal, District: KARAIKAL, State: Pondicheri, PIN: 609606** - Licence No. **P/SC/PY/14/136 (P203909)** - Reg Renewal of Licence.

महोदय
/Sir(s),

कृपया आपके उपर्युक्त विषय से संबंधित पत्र संख्या **OIN1261144** दिनांक **27/12/2022** का संदर्भ ग्रहण करें ।
Please refer to your letter No. **OIN1261144** dated **27/12/2022** on the subject.

अनुज्ञप्ति सं **P/SC/PY/14/136 (P203909)** दिनांक **02/08/2010** दिनांक **31/12/2025** तक नवीनीकृत कर लौटाई जा रही हैं ।
Licence No. **P/SC/PY/14/136 (P203909)** dated **02/08/2010** is returned herewith duly renewed upto **31/12/2025**.

कृपया पेट्रोलियम नियम,2002 के अधीन बनाए गए नियम 148 में दी गई प्रक्रिया का कडाई से पालन करें । अनुज्ञप्ति के नवीकरण हेतु समस्त दस्तावेजों को दिनांक **31/12/2025** या उससे पहले इस कार्यालय में प्रस्तुत करें ।
Please follow the procedure strictly as laid down in rule 148 of the Petroleum Rules, 2002 and submit complete documents for the Renewal of the licence so as to reach this office on or before **31/12/2025**.

कृपया पावती दें । Please acknowledge the receipt.

भवदीय /Yours faithfully,

((अहिन नंदी)
(AHIN NANDI))
उप विस्फोटक नियंत्रक
Dy. Controller of Explosives
कृते संयुक्त मुख्य विस्फोटक नियंत्रक
For Jt. Chief Controller of Explosives
चेन्नै/Chennai

(अधिक जानकारी जैसे आवेदन की स्थिति, शुल्क तथा अन्य विवरण के लिए हमारी वेबसाइट : http://peso.gov.in देखें)
(For more information regarding status,fees and other details please visit our website: http://peso.gov.in)

Note:-This is system generated document does not require signature.

अनुज्ञप्ति संख्या-(Licence No.) P/SC/PY/14/136 (P203909)

नवीनीकरण के पृष्ठांकन के लिए स्थान
SPACE FOR ENDORSEMENT OF RENEWALS

पेट्रोलियम अधिनियम, १९३४ के उपबन्धों या उनके अधीन बनाए गए नियमों या इस अनुज्ञप्ति की शर्तों का उल्लंघन न होने की दशा में यह अनुज्ञप्ति फ़िस में बिना किसी छूट के दस वर्ष तक नवीकृत की जा सकेगी। This licence shall be renewable without any concession in fee for ten years in the absence of contravention of any provisions of the Petroleum Act, 1934 or of the rules framed thereunder or of any of the conditions of this licence.	नवीकरण की तारीख Date of Renewal	समाप्ति की तारीख Date of Expiry of license	अनुज्ञापन प्राधिकारी के हस्ताक्षर और स्टाम्प Signature and office stamp of the licencing authority.
1).	12/03/2009	31/12/2011	Sd/- Dr.Karunamay Pandey
2).	14/12/2011	31/12/2013	Sd/- Dr. S K Dixit
3).	12/12/2013	31/12/2016	Sd/- Dr. P. K. Rana Dy. Chief Controller of Explosives For Jt. Chief Controller of Explosives Chennai
4).	26/12/2016	31/12/2019	Sd/- Mridul Kumar Pandey Dy. Chief Controller of Explosives For Jt. Chief Controller of Explosives Chennai
5).	12/12/2019	31/12/2022	Sd/- License Renewed Online Jt. Chief Controller of Explosives Chennai
6).	02/01/2023	31/12/2025	AHIN NANDI Dy. Controller of Explosives For Jt. Chief Controller of Explosives Chennai

यदि अनुज्ञप्ति परिसर इसमें उपाबद्ध विवरण और शर्तों के अनुरुप नहीं पाए जाते है और जिन नियमों और शर्तों के अधीन यह अनुज्ञप्ति मंजूर की गई है उनमे से किसी का उल्लंघन होने की दशा में यह अनुज्ञप्ति रद्द की जा सकती है और अनुज्ञप्तिधारी प्रथम अपराध के लिए साधारण कारावास से, जो एक मास तक हो सकता है, या जुर्माने से, जो एक हजार रुपये तक हो सकता है, या दोनों से, और प्रत्येक पश्चातवर्ती अपराध के लिए साधारण कारावास से जो तीन मास तक हो सकता है, या जुर्माने से, जो पांच हजार रुपये तक हो सकता है, या दोनों से, दण्डनीय होगा।

This licence is liable to be cancelled if the licensed premises are not found conforming to the description given on the approved plan attached hereto and contravention of any of the rules and conditions under which this licence is granted and the holder of this licence is also punishable for the first offence with simple imprisonment which may be extend to one month, or with fine which may extend to one thousand rupees, or with both and for every subsequent offence with simple imprisonment which may extend to three months, or with fine which may extend to five thousand rupees or with both.

Note:-This is system generated document does not require signature.

प्ररूप XIV
(प्रथम अनुसूची का अनुच्छेद 5 देखिए)
FORM XIV
(see Article 5 of the First Schedule)

मोटर वाहनों में ईंधन डालने के लिए पम्प आउटफिट के संबंध में टैंक या टैंकों में पेट्रोलियम भंडारकरण के लिए अनुज्ञप्ति
LICENCE TO STORE PETROLEUM IN TANK/S IN CONNECTION WITH PUMP OUTFIT FOR FUELING MOTOR CONVEYANCES

अनुज्ञप्ति सं. (Licence No.) : **P/SC/PY/14/136(P203909)** फीस रूपए (Fee Rs.) **5000**/- per year

पेट्रोलियम अधिनियम, 1934 के उपबंधों और उसके अधीन बनाए गए नियमों तथा इस अनुज्ञप्ति की अतिरिक्त शर्तों के अधीन रहते हुए **40.00 KL of Petroleum class B** को टैंक/टैंको में भण्डारकरण मात्र के लिए **M/S.Karaikal Port Private Limited, Kheezhavanjoor Village, T R Pattinam, PB No 33, Karaikal, District: KARAIKAL, State: Pondicheri, PIN: 609606** को नीचे वर्णित अनुज्ञप्त परिसरों में जो कि इससे उपबध्द नक्शा संख्यां **P/SC/PY/14/136(P203909)** तारीख **12/12/2019** में दिखाया गया है, के लिए विधिमान्य अनुज्ञप्ति अनुदत्त् की जाती हैं।

Licence is hereby granted to **M/S.Karaikal Port Private Limited, Kheezhavanjoor Village, T R Pattinam, PB No 33, Karaikal, District: KARAIKAL, State: Pondicheri, PIN: 609606** valid only for the storage of **40.00 KL of Petroleum class B** in tank/s in the licensed premises described below and shown on the plan no: **P/SC/PY/14/136(P203909)** dated **12/12/2019** attached hereto subject to the provisions of the Petroleum Act, 1934 and the rule made thereunder and to the further conditions of this Licence.

यह अनुज्ञप्ति **31st day of December 2025** तक विधिमान्य रहेगी ।
The Licence shall remain in force till the **31st day of December 2025**

February 21, 2008

For Jt. Chief Controller of Explosives
SC, Chennai

1). Amendment dated - 02/08/2010

अनुज्ञप्त परिसरों का विवरण और अवस्थान
DESCRIPTION AND LOCATION OF THE LICENSED PREMISES

अनुज्ञप्त परिसर जिसकी सीमाएं संलग्न नक्शे में दिखाई गई हैं **Plot No: R.S.166/2 of Vanjore Revenue Village in, NA, Karaikal, Karaikal, Taluka: Karaikal, District: KARAIKAL, State: Pondicheri, PIN: 609606** में स्थित हैं और उसमें निम्नलिखित सम्मिलित हैं:

The licensed premises, the boundaries of which are shown in the attached plan, are situated at **Plot No: R.S.166/2 of Vanjore Revenue Village in, NA, Karaikal, Karaikal, Taluka: Karaikal, District: KARAIKAL, State: Pondicheri, PIN: 609606** and consist of**:**

क पेट्रोलियम वर्ग क परिसर के लिए **NIL** किलोलिटर क्षमता के/क्रमश: **1** क्षमता के भूमिगत गैस टाईट टैंक, जो विद्युतचालित/हस्तचालित **NIL** डिस्पेन्सिंग पम्पो से जुडे हुए हैं ।

a **1** number(s) underground gas tight tanks of capacity **NIL** kilolitres respectively of petroleum Class A connected with **NIL** number(s) electrically/manually operated dispensing pump(s)

ख पेट्रोलियम वर्ग ख/ग परिसर के लिए **20.00+ 20.00** किलोलिटर क्षमता के/क्रमश: **2** क्षमता के भूमिगत गैस टाईट टैंक, जो विद्युतचालित/ हस्तचालित **2** डिस्पेन्सिंग पम्पो से जुडे हुए हैं ।

b **2** number(s) underground gas tight tanks of capacity **20.00+ 20.00** kilolitres respectively of petroleum Class B connected with **2** number(s) electrically/manually operated dispensing pump(s).

ग एक विक्रय कक्ष/कियोस्क

c A sales room/kiosk

घ सर्विस सम्बन्धी सुविधाएं जिनमें **Security room & BOWZER PARKING AREA** सम्मिलित हैं ।

d Servicing facilities consisting of Security room & BOWZER PARKING AREA **As per attached plan**

Note:-This is system generated document does not require signature.

भारत सरकार
Government of India
वाणिज्य और उद्योग मंत्रालय
Ministry of Commerce & Industry
पेट्रोलियम तथा विस्फोटक सुरक्षा संगठन (पैसो)
Petroleum & Explosives Safety Organisation (PESO)
A और D - विंग, ब्लॉक 1-8, दूसरा तल, शास्त्री भवन, 26 हड्डोउस रोड, नुंगम्बक्कम
चेन्नै- 600006
A & D - Wing, Block 1-8, IInd Floor, Shastri Bhavan, 26 Haddous Road, Nungambakkam,
Chennai - 600006

E-mail: **jtccechennai@explosives.gov.in**
Phone / Fax: **044 - 28287118,28281023,28281041,28287119/28284848**

संख्या /No.: **P/SC/PY/19/1001(P391570)** दिनांक /Date: **03/01/2023**

सेवा में
/To,

M/s. KARAIKAL PORT PVT.LTD.,,
Kheezhavanjoor Village,
Karaikal,
Taluka: Karaikal,
District: KARAIKAL,
State: Pondicheri
PIN: 609606

विषय /Sub : रजिस्ट्रेशन नंबर **PY-02 Q3665** के रिफ्यूलर द्वारा भू मार्ग से पेट्रोलियम उत्पादों के परिवहन के लिए अनुज्ञप्ति के नवीकरण के संबंध में ।

Licence to transport Petroleum Products on land by Refueller bearing Reg .No **PY-02 Q3665** - Renewal of licence regarding

महोदय /Sir(s),

कृपया आपके पत्र क्रमांक **OIN1261246** दिनांक **27/12/2022** का अवलोकन करें ।

Please refer to your letter No. **OIN1261246**, dated **27/12/2022**.

निम्नलिखित पेट्रोलियम पदार्थों के वर्ग तथा मात्रा के टैंक ट्रक पंजीकरण संख्या **PY-02 Q3665** द्वारा परिवहन के लिए पेट्रोलियम नियम, 2002 के अधीन प्ररूप-XIX में जारी, दिनांक **31/12/2025** तक नवीकृत अनुज्ञप्ति संख्या **P/SC/PY/19/1001 (P391570)** दिनांक **12/04/2017** अग्रेषित की जा रही हैं ।

Licence No. **P/SC/PY/19/1001 (P391570)** dated **12/04/2017** in Form XIX under the Petroleum Rules, 2002 and renewed till **31/12/2025** for the transport of the following kind and quantities of Petroleum by tank truck Reg .No **PY-02 Q3665** is forwarded herewith.

पेट्रोलियम का विवरण /Description of Petroleum	अनुज्ञप्त क्षमता (किलोलीटर में) /Total Quantity licenced in K.L.
High Speed Diesel	**11.00 KL**

कृपया पेट्रोलियम नियम,2002 के अधीन बनाए गए नियम 148 में दी गई प्रक्रिया का कडाई से पालन करें और अनुज्ञप्ति के नवीकरण हेतु समस्त दस्तावेज, अनुज्ञप्ति की वैधता समाप्ती की तारीख या उससे to **Jt. Chief Controller of Explosives, South Circle Office, Chennai**, so as to reach his कार्यालय में प्रस्तुत करें ।

Please follow the procedure strictly as laid down in rule 148 of the Petroleum Rules, 2002 and submit complete documents for further renewal of the licence to **Jt. Chief Controller of Explosives, South Circle Office, Chennai**, so as to reach his office on or before the date on which licence expires

भवदीय /Your's faithfully,

((मनमीत सिंह मन्हास)
(Manmeet Singh Manhas))
उप विस्फोटक नियंत्रक
Dy. Controller of Explosives
कृते संयुक्त मुख्य विस्फोटक नियंत्रक
For Jt. Chief Controller of Explosives
चेन्नै/Chennai

(अधिक जानकारी जैसे आवेदन की स्थिति, शुल्क तथा अन्य विवरण के लिए हमारी वेबसाइट: http://peso.gov.in देखें)
(For more information regarding status,fees and other details please visit our website http://peso.gov.in)

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Digitally signed by MANMEET SINGH MANHAS
Reason: Licence No. : P/SC/PY/19/1001
Location:South Circle Office [P391570]
Date:2023.01.03 05:21:10 +05:30

अनुज्ञप्ति संख्या-(Licence No.) P/SC/PY/19/1001 (P391570)

नवीनीकरण के पृष्ठांकन के लिए स्थान
SPACE FOR ENDORSEMENT OF RENEWALS

यह अनुज्ञप्ति पेट्रोलियम अधिनियम,1934 या उसके अधीन बनाए गए नियमों के उपबंधों या अनुज्ञप्ति की शर्तों का उल्लंघन न होने की दशा में फीस में किसी रियायत के बिना दस वर्ष के लिए नवीकरणीय होगी । This licence shall be renewable without any concession in fee for ten years in the absence of contravention of any provisions of the Petroleum Act, 1934 or of the rules framed thereunder or of any of the conditions of this licence.	नवीकरण की तारीख Date of Renewal	समाप्ति की तारीख Date of Expiry of license	अनुज्ञापन प्राधिकारी के हस्ताक्षर और स्टाम्प Signature and office stamp of the licencing authority.
1).	27/12/2019	31/12/2022	Sd/- AHIN NANDI Dy. Controller of Explosives For Jt. Chief Controller of Explosives Chennai
2).	03/01/2023	31/12/2025	Manmeet Singh Manhas Dy. Controller of Explosives For Jt. Chief Controller of Explosives Chennai

यदि परिसर, अनुज्ञप्ति के संलग्न शर्तों के अनुरूप नही पाया जाता हैं और जिन नियमों और शर्तों के अधीन यह अनुज्ञप्ति मंजूर की गई हैं उन में से किसी का उल्लंघन होने की दशा में यह अनुज्ञप्ति रद्द की जा सकती हैं और अनुज्ञप्तिधारी प्रथम अपराध के लिए साधारण कारावास से, जो एक मास तक का हो सकता हैं, या जुर्माने से, जो एक हजार रूपये तक हो सकता हैं, या दोनों से, और प्रत्येक पश्चात्वर्ती अपराध के लिए साधारण कारावास से जो तीन मास तक का हो सकता हैं या जुर्माने से, जो पांच हजार रूपए तक हो सकता हैं, या दोनो से, दण्डनीय होगा ।

This licence is liable to be cancelled if the licensed premises are not found conforming to the description given on the approved plan attached hereto and contravention of any of the rules and conditions under which this licence is granted and the holder of this licence is also punishable for the first offence with simple imprisonment which may be extend to one month, or with fine which may extend to one thousand rupees, or with both and for every subsequent offence with simple imprisonment which may extend to three months, or with fine which may extend to five thousand rupees or with both.

Note:-This is system generated document does not require signature.

Digitally signed by MANMEET SINGH MANHAS
Reason: Licence No. : P/SC/PY/19/1001
Location:South Circle Office [P391570]
Date:2023.01.03 05:21:21 +05:30

प्ररुप XIX
(प्रथम अनुसूची का अनुच्छेद 11 देखिए)
FORM XIX
(see Article 11 of the First Schedule)

यन्त्रचालित यानों अर्थात रिफ्यूलर द्वारा भू मार्ग से वर्ग क या वर्ग ख प्रपुंज पेट्रोलियम के परिवहन के लिए अनुज्ञप्ति
LICENCE TO TRANSPORT PETROLEUM CLASS A OR CLASS B IN BULK ON LAND BY MECHANICALLY PROPELLED VEHICLES VIZ. REFUELLER

(क) वायुयानो के रिफ्यूलर के लिए पेट्रोलियम वर्ग क/ख
या
(ख) वाहनों/मशीनरी/स्थिर उपस्करों में साईट पर रिफ्यूलिंग के लिए वर्ग क/ख पेट्रोलियम
(a) Petroleum Class A or B for Refueller of Aircrafts
or
(b) Petroleum Class A or B for on site refuelling of Vehicles/ Machineries/Stationery Equipments.

अनुज्ञप्ति संख्या /Licence No. : P/SC/PY/19/1001(P391570) **फीस रूपए /Fee Rs. 2000/- Per Year**

KARAIKAL PORT PVT.LTD.,, Kheezhavanjoor Village,Karaikal, Taluka: Karaikal, District: KARAIKAL, State: Pondicheri PIN: 609606 को वायुयानों/भारी यानों/मशीनरी/ स्थैतिक उपस्करों में नीचे यथा वर्णित रिफ्यूलर द्वारा स्थल पर इंधन भरने के लिए पेट्रोलियम अधिनियम, 1934 के उपबंधों और उसके अधीन बनाए गए नियमों तथा इस अनुज्ञप्ति की अन्य/ शर्तों के अधीन रहते हुए प्रपुंज में वर्ग क/ख पेट्रोलियम के भूमि पर परिवहन के लिए अनुज्ञप्ति अनुदत्त की जाती हैं ।

Licence is hereby granted to **KARAIKAL PORT PVT.LTD.,, Kheezhavanjoor Village,Karaikal, Taluka: Karaikal, District: KARAIKAL, State: Pondicheri PIN: 609606** to transport petroleum in bulk on land for onsite refueling of the Aircraft/Heavy vehicles/machinaries/stationery equipments by the refueller as described below subject to the provision of the Petroleum Act, 1934 and rules made thereunder and to the further conditions of this Licence.

यह अनुज्ञप्ति **31/12/2025** तक विधिमान्य रहेगी ।
The Licence shall remain valid upto the **31/12/2025.**

जारी करने की तारीख /Date of issue **April 12, 2017**

For Jt. Chief Controller of Explosives
SC, Chennai

विवरण /DESCRIPTION

1. यान में लदाई संलग्न अनुमोदित नक्शा संख्या **P/SC/PY/14/136(P203909)** में वर्णित विशेष रूप से तैयार किए गए क्षेत्र में अनुज्ञप्त भंडारकरण परिसरों में की जाती हैं ।
   The vehicle is loaded in the specially prepared area described in approved plan attached to Licence no. **P/SC/PY/14/136(P203909)**.
2. संक्रिया के क्षेत्र और भरे जाने वाले उपस्कर **KARAIKAL PORT.**
   The area of operation and the equipments to be filled **KARAIKAL PORT.**
3. रिफ्यूलर इससे संलग्न अनुमोदित आरेखण संख्या P/SC/PY/19/1001(P391570) दिनांक 24/04/2017 और नीचे दी गई विशिष्टियों के अनुरूप हैं :-
   The refueller conforms to the approved drawing No P/SC/PY/19/1001(P391570) Date 24/04/2017 attached hereto and to the further particulars given below :

मेक और माडल /Make and model	**ASHOK LEYLAND \1616 IL**	इंजन नंबर /Engine Number	**FVEZ423704**
चेसिस नंबर /Chassis Number	**MB1A3CFD7FETT3940**	रजिस्ट्रेशन नंबर /Registration Number	**PY-02 Q3665**
रजिस्ट्रिकृत स्वामी का नाम /Name of the registered owner	**Karaikal Port Pvt.Ltd.,**		
वाहन में ले जाने हेतु पेट्रोलियम के अधिकृत वर्ग /Class(es) of petroleum authorised to be carried in the vehicle.	**Class B**		

टैंक और कम्पार्टमेंटों की प्राधिकृत वहन क्षमता
AUTHORISED CARRYING CAPACITY OF THE TANK & COMPARTMENTS

कम्पार्टमेंट सं. (Compartment No.)	1	2	3	4	5	6	7	कुल क्षमता (किलोलीटर में) (Total Capacity in KL.)
किलोलीटर में क्षमता (Capacity in KL.)	11	0	0	0	0	0	0	11.00 KL

कुल लदा हुआ वजन **16200** किलोग्राम से अधिक नही होना चहिए ।
Gross Laden weight should not exceed **16200 Kgs**.
पार्किंग पता /Parking Address : M/S.Karaikal Port Private Limited, Keezhavanjoor Village tr Pattinam, Karaikal, District: Karaikal, State: Pondicheri, pin: 609606.

Note:-This is system generated document does not require signature.

Digitally signed by MANMEET SINGH MANHAS
Reason: Licence No. : P/SC/PY/19/1001
Location:South Circle Office [P391570]
Date:2023.01.03 05:20:59 +05:30

MARG

To,

Dr U. Sridharan,
Additional Director
Ministry of Environment and Forests
Regional Office (Southern Zone)
Bangalore- 560 034

Sir,

Sub: Environmental and CRZ clearance for the expansion of Karaikal Port (Phase II)
Ref: No 10-42/2009-IA.III, dated 22.9.2009

The Ministry of Environment and Forest has accorded Environmental and CRZ clearance for the expansion of Karaikal Port (Phase II) letter dated 22nd September 2009 (No 10-42/2009-IA.) As per the general conditions stipulated in the EC letter, an advertisement was made in two local news papers informing the public regarding Clearance and the copies are enclosed as directed by the ministry to forward the same to the regional office, Bangalore.

We are also enclosing a report on the Environmental Monitoring Program covering the period from March 2009 to August 2009 for your kind consideration and the same has been already submitted to Pondicherry Pollution Control Committee.

Sincerely,

14/10/09

Manjunath Bhat
Manager-Environment

Encl:

1. Copies of the Advertisement in the News Papet
2. Report on Environmental Monitoring Program

Sent thro' courier

KARAIKAL PORT PRIVATE LIMITED
Corp. Off.: 'Main Axis' 4/311A, Rajiv Gandhi Road, Kottivakkam, Chennai - 600 041. tel.: +91-44 - 2454 2311 (9 lines), fax : +91-44 -2454 2316

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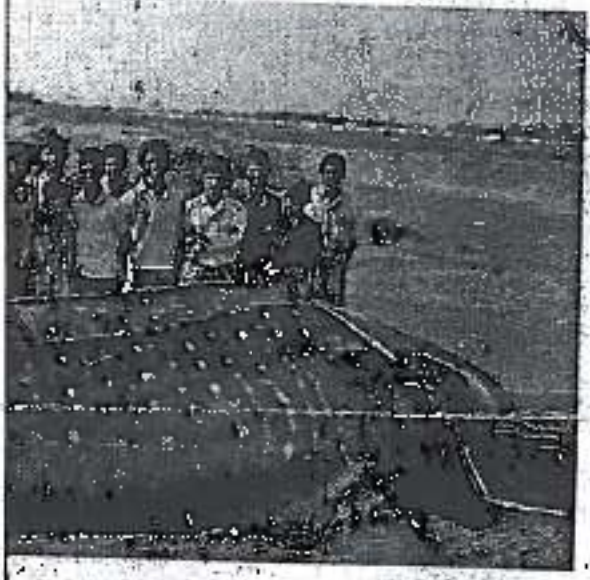

KARAIKAL PORT PRIVATE LIMITED

392 & 393, Rajiv Gandhi Salai, Kottivakkam,
Chennai - 600 041.

Wishes to inform that its Phase II expansion project for its Karaikal Port has been accorded environmental and CRZ clearance by the Ministry of Environment and Forests, Government of India and copies of clearance letters are available with the Puducherry Pollution Control Board and also on the website of the Ministry of Environment and Forests at http://www.envfor.nic.in.

Date : 13.10.2009 **EXECUTIVE DIRECTOR**

Change of Name

I, Narendran, son of Thiru N. Mariyanathan, born on 8th February 1990 (native district : Tiruchirappalli), residing at old No. 2, New No. 4, Bharathidasan Street, Ponnagaram, Tiruchirappalli - 620 008, shall hereinafter be known as **NEE ALEXTHIRAJ. A.D.**

D. NARENDIRAN.

Tiruchirappalli, 4th August 2009.

Change of Name

I, V. Sadishram, son of Thiru K. Velsamy born on 10th May 1968 (native district : Karur), residing at No. 3-227, P. Sellandipalayam, Pallapalayam Post, Karur - 639 002, shall henceforth be known as **V. SARAVANAN.**

V. SARAVANAN.

Pallapalayam, 10th August 2009.

SOUTHERN RAILWAY

ANNOUNCEMENT

As announced by Honourable Minister of Railways on 03/07/09 in the Budget Speech for 2009-10, the existing system of coupon books for accredited press correspondents is being replaced by **photo identity card based system**. Photo identification card will be issued by Railways to accredited press correspondents instead of coupon books. The photo identification card will be issued after probation of the certification by the Press Information Bureau and other competent state and central authorities as per laid down Railway Board guidelines. This new system of concession based on Photo Identity card along with increased concession (50%) on Rajdhani and Shatabdi trains is effective from 15/10/09.

For further details and enquiry, the following may be contacted :

Senior Commercial Manager,
Passenger Reservation System,
Southern Railway, Chennai.
Phone No.044-25351621

SERVING CUSTOMERS WITH A SMILE

FORM No.5
(See Rule 26)
Form of Advertisement of Petition

IN THE HIGH COURT OF JUDICATURE AT MADRAS
(Original Jurisdiction)

COMPANY PETITION NO.225 OF 2009
CONNECTED WITH COMPANY APPLICATION NO.466 OF 2009

In the matter of Companies Act, 1956
AND
In the matter of Scheme of Amalgamation of Salzer Cables Limited with Salzer Electronics Limited
AND
In the matter of Scheme of Amalgamation of Salzer Cables Limited with Salzer Electronics Limited

Salzer Electronics Limited
a Company incorporated under the Companies Act, 1956 and having its Registered office at
Kembattipalayam,
Jothipuram (Via), Coimbatore 641 007
Represented by its Director
K. Sankara Subramanian
... PETITIONER / TRANSFEREE COMPANY

FORM OF ADVERTISEMENT OF PETITION

A petition under Section 391 to 394 of the Companies Act, 1956 for amalgamation / merger of Salzer Cables Limited with Salzer Electronics Limited as presented by petitioner on the 29th day of July 2009 and the said petition is fixed for hearing before the Company Judge on 26.10.2009. Any person desirous of supporting or opposing the said petition should send to the petitioner's advocate, notice of his intention, signed by him or his advocate, with his name and address, so as to reach the petitioner's advocate not later than two days before the date fixed for the hearing of the petition. Where he seeks to oppose the petition, the grounds of opposition or a copy of the affidavit shall be furnished with such notice. A copy of the petition will be furnished by the undersigned to any person requiring the same on payment of the prescribed charges for the same.

Dated 16.9.2009.

K.J.Rebello
S. Elamchandran
A. Senthilnathan
Sunitha. K
(Advocate for petitioner)

Address : No.364, Kumaran Court
Lloyds Road, Gopalapuram,
Chennai - 600 086.

FORM No.5
(See Rule 26)
Form of Advertisement of Petition

IN THE HIGH COURT OF JUDICATURE AT MADRAS
(Original Jurisdiction)

COMPANY PETITION NO.224 OF 2009
CONNECTED WITH COMPANY APPLICATION NO.465 OF 2009

In the matter of Companies Act, 1956
AND
In the matter of Scheme of Amalgamation of Salzer Cables Limited with Salzer Electronics Limited under Sections 391 to 394 of the Companies Act
BETWEEN
In the matter of Scheme of Amalgamation of Salzer Cables Limited with Salzer Electronics Limited

Salzer Cables Limited
a Company incorporated under the Companies Act, 1956 and having its Registered office at
No.842, Coimbatore Main Road, Thondamuthur, Kasavanpalayam, Kannampalayam - 641 104.
Represented by its Director
D. Rajkumar.
... Petitioner / TRANSFEROR COMPANY

FORM OF ADVERTISEMENT OF PETITION

A petition under Section 391 to 394 of the Companies Act, 1956 for amalgamation / merger of Salzer Cables Limited with Salzer Electronics Limited as presented by petitioner on the 29th day of July 2009 and the said petition is fixed for hearing before the Company Judge on 26.10.2009. Any person desirous of supporting or opposing the said petition should send to the petitioner's advocate, notice of his intention, signed by him or his advocate, with his name and address, so as to reach the petitioner's advocate not later than two days before the date fixed for the hearing of the petition. Where he seeks to oppose the petition, the grounds of opposition or a copy of the affidavit shall be furnished with such notice. A copy of the petition will be furnished by the undersigned to any person requiring the same on payment of the prescribed charges for the same.

Dated 16.9.2009.

K.J.Rebello
S. Elamchandran
A. Senthilnathan
Sunitha. K
(Advocate for petitioner)

Address : No.364, Kumaran Court
Lloyds Road, Gopalapuram,
Chennai - 600 086.

நீடாமங்கலம் ரெயில்வே கேட் பகுதியில் சாலையோரம் கவிழ்ந்து சக்கரத்தில் சிக்கிக் கிடக்கும் உரம் ஏற்றிய லாரி.

நீடாமங்கலம் அருகே

உரம் ஏற்றிய லாரி கழிவுநீர் கால்வாயில் கவிழ்ந்தது

நீடாமங்கலம், அக்.14-

நீடாமங்கலத்தில் உரம் ஏற்றிய லாரி கழிவுநீர் கால்வாயில் கவிழ்ந்தது.

உரம் ஏற்றிய லாரி

திருவாரூர் மாவட்டம் நீடாமங்கலம் பஸ்நிலையத்தில் இருந்து நேற்று முன்தினம் மாலை ரெயில் நிலையம் செல்லும் சாலையில் ரெயில்வே கேட் அருகே வந்தபோது, லாரியின் முன்பக்க வலது சக்கரம் திடீரென கழன்று ஓடியது. இதனால் லாரி நிலைதடுமாறி சாலையோரம் இருந்த கழிவுநீர் கால்வாயில் கவிழ்ந்தது. இதனால் லாரியில் இருந்த உரமூட்டைகள் கீழே சரிந்தன.

தலைமறைவு

சம்பவ இடத்தில் இருந்து லாரி டிரைவர் தலைமறைவாகி விட்டார். இது குறித்த தகவல் அறிந்த நீடாமங்கலம் போலீஸ் இன்ஸ்பெக்டர் சரோசா மற்றும் போலீசார் சம்பவ இடத்திற்கு விரைந்து சென்று விசாரணை மேற்கொண்டனர். லாரியின் டிரைவர் தலைமறைவானதால் அவர் யார்? எந்த ஊரைச் சேர்ந்தவர்? என தெரியவில்லை.

பெரமுடையும் மன்னார்குடி அருகே உள்ள தெற்குவாக்கோட்டை வடக்கு தெருவை சேர்ந்தவர் சுந்தரராஜி (வயது 60). விவசாயி. நேற்று இரவு 8 மணி அளவில் வயலில் வீட்டுக்கு சென்று கொண்டிருந்தார். அப்போது மன்னார்குடியில் இருந்து தஞ்சாவூர் சென்ற ஆம்புலன்ஸ் வேன் ஒன்று அவர் மீது மோதியது. இதில் படுகாயம் அடைந்த சுந்தரராஜி ஆம்புலன்சிலேயே பரிதாபமாக செத்தார். இது குறித்து மன்னார்குடி போலீசார் வழக்குப்பதிவு செய்து ஆம்புலன்ஸ் டிரைவர் காமராஜை கைது செய்தனர். மேலும் விசாரணை நடந்து வருகிறது.

மன்னார்குடி அருகே

ஆம்புலன்ஸ் மோதி விவசாயி பலி

மன்னார்குடி அருகே உள்ள தெற்குவாக்கோட்டை வடக்கு தெருவை சேர்ந்தவர் சுந்தரராஜி (வயது 60). விவசாயி. நேற்று இரவு 8 மணி அளவில் வயலில் வீட்டுக்கு சென்று கொண்டிருந்தார். அப்போது மன்னார்குடியில் இருந்து தஞ்சாவூர் சென்ற ஆம்புலன்ஸ் வேன் ஒன்று அவர் மீது மோதியது. இதில் படுகாயம் அடைந்த சுந்தரராஜி ஆம்புலன்சிலேயே பரிதாபமாக செத்தார். இது குறித்து மன்னார்குடி போலீசார் வழக்குப்பதிவு செய்து ஆம்புலன்ஸ் டிரைவர் காமராஜை கைது செய்தனர். மேலும் விசாரணை நடந்து வருகிறது.

Annexure 12

KPP/ENV/MoEF&CC/EC-CRZ /2023/04 Date:18th October 2023

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

Subject: Submission of Compliance Report by end of 30th September, 2023 – Regarding

Reference:
Environmental & CRZ Clearance letter (No.10 - 42/2009 - IA – III, dated 22.09.2009 and its amendment dated 05th August 2021), from Govt of India, Ministry of Environment, Forest and Climate Change

Respected Sir,

As per the conditions stipulated in Environmental & CRZ Clearance letter (No.10 - 42/2009 - IA – III, dated 22.09.2009 and its amendment dated 05th August 2021), from Govt of India, Ministry of Environment, Forest and Climate Change IA.III Section (MOEF&CC, IA.III Section), herewith we are submitting the status of compliance reports including results of monitored data for the period of April to September 2023.

Thanking you,

Yours faithfully,

(Prabu Ananth B)

Authorized Signatory

Cc:

- **The Regional Director**, CPCB Regional Directorate/Project Office, Second Floor, No.77-A, South Avenue Road, Ambattur Industrial Estate, Ambattur Taluk, Thiruvallur District, Chennai 600 058

- **The Member Secretary,** Puducherry Pollution Control Committee (PPCC), Department of Science, Technology & Environment, 3rd Floor, PHB Building, Anna Nagar, Puducherry 605 005.

Karaikal Port Private Limited - Ambient Air Qulaity Monitoring Results from Oct 2023 to Mar 2024

Sl.No	Location	Parameter & Unit	CPCB Standard	Oct-23		Nov-23		Dec-23		Jan-24		Feb-24		Mar-24	
				16.10.2023 (10.30 AM) to 17.10.2023 (10.30 AM)	17.10.2023 (11.00 AM) to 18.10.2023 (11.00 AM)	21.11.2023 (10.15 AM) to 22.11.2023 (10.15 AM)	22.11.2023 (10.45 AM) to 23.11.2023 (10.45 AM)	13.12.2023 (10.00 AM) to 14.12.2023 (10.00 AM)	14.12.2023 (10.30 AM) to 15.12.2023 (10.30 AM)	29.01.2024 (10.30AM) to 30.01.2024 (10.30 AM)	30.01.2024 (11.00AM) to 31.01.2024 (11.00 AM)	15.02.2024 (10.15AM) to 16.02.2024 (10.15 AM)	16.02.2024 (11.00AM) to 17.02.2024 (11.00 AM)	21.03.2024 (09.45 AM) to 22.03.2024 (09.45 AM)	22.03.2024 (10.15 AM) to 23.03.2024 (10.15 AM)
1	Lat: N 10° 51´08.8012" Long: E 79° 50´49.0668"	PM10 µg/m^3	100 µg/m^3	67.1	63.7	44.9	47	45.8	46.2	40.5	38.9	47.6	46.3	48.7	49.7
2		PM2.5 µg/m^3	60 µg/m^3	36.5	34.8	21.5	22.9	20.8	21.5	18.6	17.3	21.9	21.4	22.9	23.2
3		SO2 µg/m^3	80 µg/m^3	14.7	13.9	9.2	9.5	8.4	8.2	7.8	7.5	7.1	6.8	6.5	6.7
4		NO2 µg/m^3	80 µg/m^3	15.2	14.8	11.7	11.9	10.2	10.4	9.6	9.1	9.2	8.9	8.7	9.4
5		CO mg/m^3	4 mg/m^3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sl.No	**Location**	**Parameter & Unit**	**CPCB Standard**	**16.10.2023 (11.00 AM) to 17.10.2023 (11.00 AM)**	**17.10.2023 (11.30 AM) to 18.10.2023 (11.30 AM)**	**21.11.2023 (10.45 AM) to 22.11.2023 (10.45 AM)**	**22.11.2023 (11.15 AM) to 23.11.2023 (11.15 AM)**	**13.12.2023 (10.30 AM) to 14.12.2023 (10.30 AM)**	**14.12.2023 (11.00 AM) to 15.12.2023 (11.00 AM)**	**29.01.2024 (11.00AM) to 30.01.2024 (11.00 AM)**	**30.01.2024 (11.30AM) to 31.01.2024 (11.30 AM)**	**15.02.2024 (10.45AM) to 16.02.2024 (10.45 AM)**	**16.02.2024 (11.30 AM) to 17.02.2024 (11.30 AM)**	**21.03.2024 (10.30 AM) to 22.03.2024 (10.30 AM)**	**22.03.2024 (11.00 AM) to 23.03.2024 (11.00 AM)**
1	Lat: N 10° 50´06.2628" Long: E 79° 50´23.1006"	PM10 µg/m^3	100 µg/m^3	65.2	64.3	59.5	60.6	69.7	70.3	76.5	74.5	64.4	63.6	68.4	69.5
2		PM2.5 µg/m^3	60 µg/m^3	35.3	34.9	31.4	32.9	36.8	34.7	45.7	45.2	38.6	36.8	38.1	37.3
3		SO2 µg/m^3	80 µg/m^3	14.2	14	13.6	13.9	14.1	14.6	16.8	15.9	15.4	15.6	13.7	13.9
4		NO2 µg/m^3	80 µg/m^3	15.6	15.3	14.2	14.8	15.7	15.9	19.2	18.4	17	17.1	16.2	15.8
5		CO mg/m^3	4 mg/m^3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sl.No	**Location**	**Parameter & Unit**	**CPCB Standard**	**16.10.2023 (11.30 AM) to 17.10.2023 (11.30 AM)**	**17.10.2023 (12.00 PM) to 18.10.2023 (12.00 PM)**	**21.11.2023 (11.15 AM) to 22.11.2023 (11.15 AM)**	**22.11.2023 (11.45 AM) to 23.11.2023 (11.45 AM)**	**13.12.2023 (11.00 AM) to 14.12.2023 (11.00 AM)**	**14.12.2023 (11.30 AM) to 15.12.2023 (11.30 AM)**	**29.01.2024 (11.30AM) to 30.01.2024 (11.30 AM)**	**30.01.2024 (12.00 PM) to 31.01.2024 (12.00 PM)**	**15.02.2024 (11.15AM) to 16.02.2024 (11.15 AM)**	**16.02.2024 (12.00 PM) to 17.02.2024 (12.00 PM)**	**21.03.2024 (11.00 AM) to 22.03.2024 (11.00 AM)**	**22.03.2024 (11.30 AM) to 23.03.2024 (11.30 AM)**
1	Lat: N 10°49´20.9676" Long: E 79° 50´23.3772"	PM10 µg/m^3	100 µg/m^3	52.6	49.4	55.7	57.5	62.3	65.1	76.7	73.7	63.5	61.8	64.2	64.9
2		PM2.5 µg/m^3	60 µg/m^3	30.5	27.6	27.9	28.6	30.6	32.8	38.5	36.9	34.1	32.9	30.4	30.2
3		SO2 µg/m^3	80 µg/m^3	13.4	13.2	12.3	12.8	13.4	13.1	12.9	12.2	12.3	12.1	12.9	12.4
4		NO2 µg/m^3	80 µg/m^3	15.1	14.8	14.1	14.7	14.9	15.4	14.6	14.1	15.1	14.8	15.4	15.1
5		CO mg/m^3	4 mg/m^3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sl.No	**Location**	**Parameter & Unit**	**CPCB Standard**	**16.10.2023 (12.00 PM) to 17.10.2023 (12.00 PM)**	**17.10.2023 (12.30 PM) to 18.10.2023 (12.30 PM)**	**21.11.2023 (12.00 PM) to 22.11.2023 (12.00 PM)**	**22.11.2023 (12.30 PM) to 23.11.2023 (12.30 PM)**	**13.12.2023 (12.00 PM) to 14.12.2023 (12.00 PM)**	**14.12.2023 (12.30 PM) to 15.12.2023 (12.30 PM)**	**29.01.2024 (12.15 PM) to 30.01.2024 (12.15 PM)**	**30.01.2024 (12.45 PM) to 31.01.2024 (12.45 PM)**	**15.02.2024 (12.00 PM) to 16.02.2024 (12.00 PM)**	**16.02.2024 (12.45 PM) to 17.02.2024 (12.45 PM)**	**21.03.2024 (11.30 AM) to 22.03.2024 (11.30 AM)**	**22.03.2024 (12.00 PM) to 23.03.2024 (12.00 PM)**
1	Lat: N 10° 49´23.7072" Long: E 79° 50´39.1596"	PM10 µg/m^3	100 µg/m^3	41.6	40.2	41.9	41.1	59.1	62.6	69.8	66.7	59.2	60.2	61.5	60.8
2		PM2.5 µg/m^3	60 µg/m^3	21.3	20.9	20.4	20.9	26.7	28.4	31.6	29.8	30.8	29.5	26.7	25.4
3		SO2 µg/m^3	80 µg/m^3	11.5	11.2	10.6	10.7	12.1	12.3	11.8	11.3	11.2	10.9	11.7	11.6
4		NO2 µg/m^3	80 µg/m^3	13.9	13.1	12.3	12.9	13.3	13.6	14.1	13.6	14.3	14.1	14.0	13.4
5		CO mg/m^3	4 mg/m^3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sl.No	**Location**	**Parameter & Unit**	**CPCB Standard**	**16.10.2023 (12.30 PM) to 17.10.2023 (12.30 PM)**	**17.10.2023 (01.00 PM) to 18.10.2023 (01.00 PM)**	**21.11.2023 (12.30 PM) to 22.11.2023 (12.30 PM)**	**22.11.2023 (01.00 PM) to 23.11.2023 (01.00 PM)**	**13.12.2023 (12.45 PM) to 14.12.2023 (12.45 PM)**	**14.12.2023 (01.15 PM) to 15.12.2023 (01.15 PM)**	**29.01.2024 (01.00 PM) to 30.01.2024 (01.00 PM)**	**30.01.2024 (01.30 PM) to 31.01.2024 (01.30 PM)**	**15.02.2024 (12.45 PM) to 16.02.2024 (12.45 PM)**	**16.02.2024 (01.30 PM) to 17.02.2024 (01.30 PM)**	**21.03.2024 (12.00 PM) to 22.03.2024 (12.00 PM)**	**22.03.2024 (12.30 PM) to 23.03.2024 (12.30 PM)**
1	Lat: N 10° 49´20.5860" Long: E 79° 50´46.5684"	PM10 µg/m^3	100 µg/m^3	37.9	36.9	38.4	39.1	47.9	49.8	45	42.5	50.8	49.3	53.8	52.4
2		PM2.5 µg/m^3	60 µg/m^3	19.2	18.7	16.7	17.8	21.7	23.5	22.5	20.2	24.6	23.9	24.1	23.6
3		SO2 µg/m^3	80 µg/m^3	10.9	10.8	8.9	9.4	10.7	10.4	10.3	9.7	10.8	10.6	10.2	9.7
4		NO2 µg/m^3	80 µg/m^3	13.5	12.9	11.5	11.9	12.9	12.8	12.7	11.5	13.1	12.8	12.5	12.1
5		CO mg/m^3	4 mg/m^3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Karaikal Port Private Limited 3rd Party Harbour Basin Marine Water Results from Oct 2023 to Mar 2024								
Characteristics Test	**Unit**	**Protocol**	**Oct-23**	**Nov-23**	**Dec-23**	**Jan-24**	**Feb-24**	**Mar-24**
Date of Sampling			**16.10.2023**	**21.11.2023**	**14.12.2023**	**30.01.2024**	**16.02.2024**	**22.03.2024**
Latitude:			**N 10°49'57.25"**	**N 10°49'54.57"**	**N 10°49'54.57"**	**N 10°49'54.25"**	**N 10°49'54.28"**	**N 10°49'55.23"**
Longitude:			**E 79°50'57.83"**	**E 79°50'57.06"**	**E 79°50'57.06"**	**E 79°50'56.42"**	**E 79°50'56.63"**	**E 79°50'57.45"**
Salinity	%	By Argentometric Titration	4.18	3.29	3.64	3.24	3.72	3.81
pH @ 25˚C	-	IS:3025 Part 11-1983 (Reaff:2017)	6.95	6.98	7.53	7.34	7.65	7.62
Temperature	˚C	IS:3025 Part 9-1984 (Reaff:2017)	28	28	27	25	28	30
Electrical Conductivity	µmhos/cm	IS:3025 Part 14- 2013 (Reaff:2019)	47800	34300	46400	37636	44510	44750
Turbidity	NTU	IS:3025 Part 10-1984 (Reaff:2017)	1.4	4.1	4	1.4	4.3	4.7
Total Suspended Solids	mg/l	IS:3025 Part 17-1984 (Reaff:2017)	12	12	14	7	13	16
Total Dissolved Solids	mg/l	IS:3025 Part 16-1984(Reaff:2017)	39648	27360	31294	33676	35076	35800
Dissolved Oxygen	mg/l	IS:3025 Part 38-1989 (Reaff:2019)	6.2	6.8	6.9	6.7	5.8	5.9
BOD @ 27˚C for 3 days	mg/l	IS:3025 Part 44-1993 (Reaff:2019)	2.6	2.4	6	5	7	6
COD	mg/l	IS:3025 Part 58-2006 (Reaff:2017)	12	10	19.6	14	24	23
Chloride as Cl	mg/l	IS:3025 Part 32-1988 (Reaff:2019)	22693	17894	19794	17594	20260	20737
Sulphate as SO_4	mg/l	IS:3025 Part 24-1986 (Reaff:2019)	2253	1919	2148	1880	2130	2207
Sodium as Na	mg/l	IS:3025 Part 45 - 1993 (Reaff:2019)	10525	8140	8914	10598	12126	12924
Calcium as Ca	mg/l	IS:3025 Part 40-1991 (Reaff:2019)	852	793	1424	512	1242	1322
Magnesium as Mg	mg/l	IS:3025 Part 46-1994 (Reaff:2019)	1412	1205	1415	1487	1676	1749
Potassium as K	mg/l	IS:3025 Part 45 -1993(Reaff:2019)	389	345	532	530	462	512
Oil & Grease	mg/l	IS:3025 Part 39-2021	BDL	BDL	BDL	3	BDL	BDL
Iron as Fe	mg/l	IS:3025 Part 53:2003 (Reaff:2019)	BDL	0.482	0.675	BDL	0.432	0.282
Zinc as Zn	mg/l	IS:3025 Part 2-2004 (Reaff:2019)	BDL	0.163	0.071	BDL	0.102	BDL
Manganese as Mn	mg/l	IS:3025 Part 2:2004 (Reaff:2019)	BDL	BDL	0.019	BDL	BDL	BDL
Cadmium as Cd	mg/l	IS:3025 Part 2-2004 (Reaff:2019)	BDL	BDL	BDL	BDL	BDL	BDL
Chromium as Cr	mg/l	IS:3025 Part 2-2004 (Reaff:2019)	BDL	BDL	BDL	BDL	BDL	BDL
Mercury Hg	mg/l	IS:3025 Part 48 -1994(Reaff:2019)	BDL	BDL	BDL	BDL	BDL	BDL
Nitrite as NO_2	mg/l	IS:3025 Part 34-1988 (Reaff:2019)	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate as NO_3	mg/l	IS:3025 Part 34-1988 (Reaff:2019)	2.02	1.95	8.02	2.54	2.50	2.89
Free Ammonia NH_3	mg/l	IS:3025 Part 34-1988 (Reaff:2019)	0.058	0.055	BDL	BDL	BDL	BDL
Total Kjeldahl Nitrogen	mg/l	IS:3025 Part 34-1988 (Reaff:2019)	1.8	1.6	BDL	2.24	BDL	BDL
Inorganic Phosphate	mg/l	IS:3025 Part 31-1988 (Reaff:2019)	BDL	BDL	BDL	BDL	BDL	BDL
Total Phosphate	mg/l	IS:3025 Part 31-1988 (Reaff:2019)	BDL	BDL	BDL	BDL	BDL	BDL
Silica as SiO_2	mg/l	IS:3025 Part 35-1988(Reaff:2019)	0.62	0.55	0.52	0.44	0.51	0.40
Total Coliform	MPN/100ml	APHA 23rd Edn 2017:9221 B	280	350	210	920	220	920
Faecal Coliforms	MPN/100ml	APHA 23rd Edn 2017:9221 E	46	110	70	170	58	280
PHYTOPLANKTON								
Total Cell Count	Nollit		32,200	30,700	29,200	28,100	30,900	31,800
Total Geneus	Nos		9	9	9	9	9	10
Geneus			Dianophysis	Dianophysis	Dianophysis	Dianophysis	Dianophysis	Dianophysis
			Leptocylindrus	Leptocylindrus	Leptocylindrus	Leptocylindrus	Leptocylindrus	Leptocylindrus
			Ceratium Macroceros	Ceratium Macroceros	Ceratium Macroceros	Ceratium Macroceros	Ceratium Macroceros	Ceratium Macroceros
			Bellerochea Sp	Bellerochea Sp	Bellerochea Sp	Bellerochea Sp	Bellerochea Sp	Bellerochea Sp
			Triceratium sp	Triceratium sp	Triceratium sp	Triceratium sp	Triceratium sp	Triceratium sp
			Bacillaria sp	Bacillaria sp	Bacillaria sp	Bacillaria sp	Bacillaria sp	Bacillaria sp
			Protoperdinim sp	Protoperdinim sp	Protoperdinim sp	Protoperdinim sp	Protoperdinim sp	Protoperdinim sp
			Ditylum Sp	Ditylum Sp	Ditylum Sp	Ditylum Sp	Ditylum Sp	Ditylum Sp
			Coscinodiscus sp	Coscinodiscus sp	Coscinodiscus sp	Coscinodiscus sp	Coscinodiscus sp	Coscinodiscus sp
								Rhizosolenia sp
ZOOPLANKTON								
Total Cell Count	Nollit		23,200	22,100	21,600	20,900	21,800	22,900
Total Geneus	Nos		6	6	6	6	6	7
Geneus			Brachionus	Brachionus	Brachionus	Brachionus	Brachionus	Brachionus
			Paracalanus	Paracalanus	Paracalanus	Paracalanus	Paracalanus	Paracalanus
			Favella	Favella	Favella	Favella	Favella	Favella
			Nannocalanus	Nannocalanus	Nannocalanus	Nannocalanus	Nannocalanus	Nannocalanus
			Centropages	Centropages	Centropages	Centropages	Centropages	Centropages
			Oithiona sp	Oithiona sp	Oithiona sp	Oithiona sp	Oithiona sp	Dioithona
								Oithiona sp

ZOOPLANKTON								
Population	No.m^3		31,700	30,900	28,400	27,200	29,600	30,400
Faunal Groups	Nos		5	5	5	5	5	5
Major Groups			Arthropoda Copepoda	Arthropoda Copepoda	Arthropoda Copepoda	Arthropoda Copepoda	Arthropoda Copepoda	Arthropoda Copepoda
			Arthropoda Crustacea	Arthropoda Crustacea	Arthropoda Crustacea	Arthropoda Crustacea	Arthropoda Crustacea	Arthropoda Crustacea
			Animalia Rotifera	Animalia Rotifera	Animalia Rotifera	Animalia Rotifera	Animalia Rotifera	Animalia Rotifera
			Chordata Fish Egg	Chordata Fish Egg	Chordata Fish Egg	Chordata Fish Egg	Chordata Fish Egg	Chordata Fish Egg
			Protozoa Ployhymenophora	Protozoa Ployhymenophora	Protozoa Ployhymenophora	Protozoa Ployhymenophora	Protozoa Ployhymenophora	Protozoa Ployhymenophora

Karaikal Port Private Limited 3rd Party Harbour Basin Sediment Results from Oct 2023 to Mar 2024

Parameters	Unit	Procedure	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24
Sample on			**16.10.2023**	**21.11.2023**	**14.12.2023**	**30.01.2024**	**16.02.2024**	**22.03.2024**
Latitude:			**N 10°49'57.25"**	**N 10°49'54.57"**	**N 10°49'54.35"**	**N 10°49'54.25"**	**N 10°49'54.28"**	**N 10°49'55.23"**
Longitude:			**E 79°50'57.83"**	**E 79°50'57.06"**	**E 79°50'57.08"**	**E 79°50'56.42"**	**E 79°50'56.63"**	**E 79°50'57.45"**
pH @ 25˚C (1:10 ratio)	-	IS:2720 Part 26-1987 (Reaff:2016)	7.69	7.8	8.15	7.88	8.08	7.01
Iron as Fe	%	USEPA 3050 B -1996 & USEPA 6010C - 2000	6.73	3.78	2.19	1.43	3.6	1.68
Zinc as Zn	mg/Kg		87.7	40.6	73.4	44.5	81	27.1
Manganese as Mn	mg/Kg		785	251	597	334	442	88.7
Cadmium as Cd	mg/Kg		BDL	BDL	BDL	BDL	BDL	BDL
Chromium as Cr	mg/Kg		118	40.6	91.4	137	84.8	28.9
Mercury Hg	mg/Kg		BDL	BDL	BDL	BDL	BDL	BDL
Nitrite as NO_2	mg/Kg	APHA 23rd Edn. 2017 – 4500 NO_2-B	0.78	0.85	0.79	0.99	0.76	0.46
Nitrate as NO_3	mg/Kg	APHA23rd Edn. 2017 – 4500 NO_3-B	584	561	611	612	425	484
Free Ammonia as NH_3	mg/Kg	APHA 23rd Edn. 2017 – 4500 NH_3-B,C	3.24	3.7	4.2	7.77	4.32	4.32
Total Nitrogen	mg/Kg	IS : 10158 - 1982 (Reaff:2019)	1046	963	1031	1032	991	1181
Inorganic Phosphate	mg/Kg	IS : 10158 - 1982 (Reaff:2019)	697	271	508	301	506	496
Total Phosphate as P	mg/Kg	IS : 10158 - 1982 (Reaff:2019)	706	274	512	306	519	501
Silica as SiO_2	%	IS: 1917 Part-3 – 1992 (Reaff: 2005)	60.87	54.72	58.13	60.08	59.12	72.3
OIL & Grease	mg/Kg	USEPA 9071 B - 1998	BDL	BDL	BDL	BDL	BDL	BDL
Magnesium as Mg	mg/Kg	USEPA 3050 B -1996 & USEPA 6010C - 2000	21700	5427	16613	7773	12335	2124
Nickel as Ni	mg/Kg		49.4	41.9	39.2	21.5	30.5	BDL
Lead as Pb	mg/Kg		BDL	BDL	BDL	BDL	BDL	BDL
FAUNAL GROUP								
MACROBENTHOS								
Rotaliidae,Bolivintidae,Hauerinidae,Gastropoda & Bivalvia, Nematodes & Crustaceans			150	160	140	130	150	160
MEIOBENTHOS								
Nematodes,Foraminifera sp, Gastropoda Larvae, Bivalvia Larvae & Fish eggs.			690	680	670	680	690	710

Note: BDL: Below Detection Limit **DL**: Detection Limit

Karaikal Port Private Limited - Noise Level Results from Oct 2023 to Mar 2024

Sampling Locations: 1. Location 1 2. Location 2 3. Location 3

Month			Oct-23			Nov-23			Dec-23			Jan-24			Feb-24			Mar-24		
Date of Sampling			17.10.2023 to 18.10.2023			22.11.2023 to 23.11.2023			14.12.2023 to 15.12.2023			29.01.2024 to 30.01.2024			15.02.2024 to 16.02.2024			21.03.2024 to 22.03.2024		
S.No	Time	3.Leq dB(A)	1.Leq dB(A)	2.Leq dB(A)	3.Leq dB(A)	1.Leq dB(A)	2.Leq dB(A)	3.Leq dB(A)	1.Leq dB(A)	2.Leq dB(A)	3.Leq dB(A)	1.Leq dB(A)	2.Leq dB(A)	3.Leq dB(A)	1.Leq dB(A)	2.Leq dB(A)	3.Leq dB(A)	1.Leq dB(A)	2.Leq dB(A)	3.Leq dB(A)
1	**07.00 AM**	47.9	47.3	48.3	46.9	46.8	47.5	47.2	46.2	47.1	47.6	45.9	47.5	46.9	45.7	47.2	46.5	46.2	48.3	47.1
2	8	48.5	48.6	49.6	47.3	47.9	49.1	49.6	46.9	48.6	50.2	46.7	48.9	48.5	46.5	48.6	47.9	46.9	48.9	48.2
3	9	50.3	49.1	51.3	49.5	48.5	50.6	50.2	48.4	49.7	51.3	48.4	50.2	50.7	47.9	50.9	49.2	49.2	50.7	49.6
4	10	51.7	51.4	51.7	50.4	50.3	51.2	49.3	49.6	50.9	52.7	49.1	51.2	50.2	48.6	52.3	50.3	49.6	51.9	50.5
5	11	50.6	51.6	52.3	51.2	50.9	51.8	47.6	49.5	51.3	50.1	49.3	51.6	49.5	49	52.6	50.1	49.2	52.3	50.3
6	**12.00 PM**	49.5	51.7	51.9	51.3	50.2	50.7	48.2	49.9	51.6	48.5	48.6	50.9	48.7	48.5	51.8	49.5	48.8	52.7	50.7
7	1	49.3	50.8	51.3	51.6	49.7	50.5	49.7	50.2	51.1	50.6	48.5	51.4	48.1	48.2	51.2	48.7	48.5	52	49.8
8	2	49.0	50.6	50.7	50.7	50.3	50.9	50.8	50.0	50.2	51.7	48.3	51.6	49.2	47.9	51.9	50.3	48.1	51.6	51.2
9	3	51.2	51.2	51.3	50.1	50.7	51.1	50.2	50.6	49.7	48.3	47.6	50.9	50.5	48	51.3	50.8	47.6	52.3	51.6
10	4	50.7	51.3	51.6	49.2	51.4	50.9	50.7	49.8	50.4	47.2	47.2	50.3	50.1	47.6	50.8	49.9	47.2	52.7	49.3
11	5	50.5	50.9	51.8	50.5	51.2	51.4	51.3	50.2	50.9	48.9	48.3	50.8	48.7	48.1	51.1	49.1	47.9	52.6	50.2
12	6	51.4	50.1	51.6	51.3	50.7	52.2	51.9	50.7	51.7	50.7	48.9	51.3	48.9	48.6	51.6	48.6	48.3	53.1	50.7
13	7	52.8	49.7	50.9	51.7	48.9	51.6	52.4	49.2	52.0	51.6	49.3	51.8	50.6	49.1	52	49.2	48.9	52.4	51.3
14	8	53.4	48.3	50.4	51.4	48.2	49.9	51.8	47.6	51.3	52.1	49.6	51.1	51.3	48.7	51.8	50.3	49.1	51.6	50.9
15	9	53.7	48.0	48.8	50.6	47.3	48.7	49.7	46.2	49.5	51.3	48.7	50.3	51.0	48.3	49.9	50.1	48.5	48.6	50.2
16	10	51.9	47.5	47.3	48.2	46.6	47.2	48.5	45.4	47.9	48.7	47.1	48.5	48.2	46.9	48.3	49.7	47.1	47.3	48.6
17	11	48.6	45.9	47.1	47.3	45.2	46.6	47.2	44.7	47.1	47.3	45.3	48.1	46.8	45.8	47.2	48.2	46.3	45.9	47.2
18	**12.00 AM**	45.1	44.6	46.2	45.9	44.1	45.4	44.8	44.1	45.3	45.8	44.7	47.3	44.7	44.5	46.9	46.3	45.1	44.3	45.9
19	1	44.3	45.1	44.9	45.2	44.9	44.8	43.5	43.5	44.5	44.1	43.9	45.9	43.8	44	45.2	44.2	44.6	44.6	43.8
20	2	43.2	45.3	44.6	44.1	43.7	44.1	42.7	42.7	43.8	42.9	43.6	44.8	43.1	43.8	44.3	43.4	44.1	43.7	43.1
21	3	42.9	46.1	43.8	43.2	43.2	43.5	42.8	42.6	42.9	42.6	43.5	44.1	42.9	43.2	45.2	42.5	43.7	43.9	42.8
22	4	42.7	44.2	43.2	42.8	44.5	44.2	41.6	43.2	42.6	42.1	43.9	43.7	42.7	43.5	44.8	42.9	43.1	44.8	43.4
23	5	44.8	42.7	44.9	44.6	45.7	45.6	42.3	43.9	44.5	43.5	44.5	45.9	44.1	44.1	45.3	43.8	44.6	45.7	43.9
24	6	46.1	45.3	46.1	46.2	45.9	46.7	45.1	44.7	46.2	45.7	45.2	46.8	45.9	45	46.8	45.5	46.3	47.1	46.2

Annexure 13

karaikal port

ISO 9001
ISO 14001
ISO 45001
ISO 50001

Ref No: KPPL/ENV/PPCC/AES/2024/01 Date: 29.04.2024

To

The Member Secretary,

Puducherry Pollution Control Committee,

Department of Science, Technology & Environment,

Puducherry – 605 005.

Sub: Submission of Annual Environmental Statement in Form V for the Financial Year 2023-24

Respected Sir

Please find attached an Annual Environmental Statement in Form V for the financial year ending 31st March 2024.

Thanking you.

Yours Sincerely,

(Muralidhar.B)
Authorized Signatory

Encl: Annual Environmental Statement Form V: 2023-24

Cc:

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

ENVIRONMENTAL STATEMENTS

FORM – V
(See Rule 14)

The Ministry of Environment & Forest vide its notification dated 13th March, 1992directed all industries which need to have consent under Water (Prevention & Control of Pollution) 1974 and Air (Prevention & Control of Pollution) 1981 to file the environmental statement every year. This is to be filed for the period ending March by September every year. The format for the same is as follows:

Environmental Statement for the financial year ending the 31stMarch, 2024

PART – A

i. Name and Address of the owner/occupier of the industry operation or process.

Karaikal Port Private Limited,
Keezhvanjore Village
T.R.Pattinam – 609606
Phone: +91 4365 256600
Fax: +91 4365 256603

ii. Industry category Primary : **Infrastructure**(4400) ; Secondary : **Minor Port** (SIC Code)

iii. Production capacity 21.5MMTPA(Handling Capacity)

Cargo Quantity is 17.5 MMTPA (Coal 10 MMTPA+ General Cargo 3.5 MMTPA +Crude & Petroleum 1 MMTPA+ Edible Oil 0.5 MMTPA + Sand 1 MMTPA + Cement in Bulk 0.5 MMTPA+ LNG 1 MMTPA) as per the Consent from Puducherry Pollution Control Committee.

iv. Year of Establishment:2006 with the issue of EC. Port operations started in the year 2009.

v. Date of the last environmental statement submitted, 03.04.2023

PART – B

Water and Raw Material Consumption

i. Water consumption m^3 / day:350 KL(Domestic, Supply to Ships, Gardening, Fire Service & Pollution Control & Miscellaneous) as per the water consent order.

Process: Effluent & Sewage Treatment Plants, Gardening, Miscellaneous consented quantity is 150 KLD

Cooling : Pollution Control (Dust Suppressions), Fire Services consented quantity is 160 KLD

Domestic : 40 KLD

Name of Products	Process water consumption per unit of product output.	
	During the previous financial year	During the Current financial year
	(1)	(2)
No manufacturing activities are carried out and therefore this table is not applicable. The Port activity does not involve any product to be generated except for the operation of the port in material handling. Hence there is no water consumption per product generated. However the water is consumed for the purposes as mentioned above.		

ii. Raw Material Consumption

*Name of raw materials	Name of products	Consumption of raw material per unit of output	
		During the previous financial year	During the Current financial year
No manufacturing activities are carried out and therefore this table is not applicable. The Port activity does not consume any raw materials and make any products. It is a Port infrastructure project. Hence there is no consumption of raw material involved.			

PART – C

Pollutants discharged to environment / unit of output

(Parameter as specified in the consent issued).

Pollutants		Quantity of pollutants discharged (mass/day)	Concentrations of pollutants in discharges (mass/volume)	Percentage of variation from prescribed standards with reasons
(a)	Water	No pollutant is discharged for operation of the port project.	Nil	Nil
(b)	Air (Ambient air pollutants at the site)	Not applicable No manufacturing activities are carried out.		No variations (Pollutants values are under prescribed standards of PPCC/CPCB
	PM_{10}		58.8 µg/m³	
	$PM_{2.5}$		36.5µg/m³	
	SO_2		14.3 µg/m³	
	NO_2		15.8 µg/m³	
	CO		Below Detectable Limit (Detectable limit is 1 mg/m³)	

PART – D

Hazardous Wastes

(as specified under Hazardous Waste Management and Handling Rules, 2016)

Hazardous Waste		Total Quantity (Kg.)	
		During the year 2022-23	During the current 2023-24
(a)	From process (Heavy equipment such as the Front end Loaders and other earth moving equipment)	1. Used Oil– No disposal to registered recyclers – Accumulated & Generated Qty -12700 (61 barrels approx.) 2. Waste Residue containing oil – No disposal - Accumulated & Generated Qty -0.9 Ton (192 Filters approx..)	1. Used oil Generated – 13430 (Litres) – Disposed -24972 – Stock -1169 2. Waste residue containing oil – Generation - 3
(b)	From pollution control facilities		

		Sludge and Filters contaminated with Oil from Ships – 108.2 to Southern Petro Coal; Battery – No disposal – Accumulated & Generated 182 Numbers	Foam Pigs – No disposal – Stock – (0.9 Ton) 3. Sludge and Filters contaminated with Oil – Generated & disposed off – 200.57 MT 4. Battery – Generation 161 Numbers Accumulation 182 Disposed off – 300 numbers Stock – 43 Numbers

PART – E

Solid Wastes

Solid Waste		Total Quantity (Kg.)	
		During the FY 2022-23	During the FY 2023-24
(a)	From process	Processes from this Project activity does not generate any Solid Waste	
(b)	From pollution control facilities	Nil	Nil
(c)	(1) Quantity recycled or re-utilized within the unit	988 Kg/Annum	4365 Kg/Annum
	(2) Sold	Nil	Nil

	(3) Disposed	58420 Kg/Annum	67950 Kg/Annum

Sources of Solid Waste generation are from Labour Canteen - Kitchen,Garden and Admin Office Buildings. All the recyclable waste such as Paper, Plastics are disposed as per the Solid Waste Management Rules, 2016.Biodegradable waste such as Kitchen & Garden waste are composed as manure through vermi composting method. The manure is being used for the Development of Green Belt & in the Nursery.

PART – F

Please specify the characterizations (in terms of composition of quantum) of hazardous as well as solid wastes and indicate disposal practice adopted for both these categories of wastes.

Karaikal Port generates both Bio-degradable and Non-Biodegradable Waste. Wastes generated from Kitchen, Office Buildings and Green Belt Area are bio-degradable wastes. Non Bio-degradable Hazardous waste generated from material handling systems and equipment's categorized as used oil or spent oil, waste containing oil including foam pigs. Ship related waste such as sludge containing oil, sludge and filter contaminated with oil, Ballast Water containing oil from ships are also falls under Hazardous Waste Category.

All Bio-Degradable wastes are segregated at source and the wastes which are recyclable sent as per the Solid Waste Management Rules, 2016. Wastes which are used for composting to convert in to manure and used for Horticulture and Green Belt Development.

Hazardous Waste is being disposed to the registered recyclers as per the Hazardous Waste Management Rules, 2016.

PART – G

Impact of the pollution abatement measures taken up on conservation of natural resources and on the cost of production.

Dust Suppression System: Dry Fog Dust Suppression (DFDS), Water Sprinklers, Road Wetting by dedicated Water Tankers and Tractors were installed for controlling fugitive dust emissions during bulk cargo handling which is pre-dominantly coal.

Dust Containment System: Windscreen all along the Coal Yard & Railway siding at a height of 15M to capture the air-borne dust to handling of coal.

Sewage Treatment Plant: STP of capacity 25 KL/Day have been installed to collect wash-water and kitchen water, sewage and treated using physico-chemical and biological treatment. The treated sewage has been recycled for Green Belt Development thus replacing the freshwater requirement for Green Belt Requirements.

Vehicle Wash Treatment Plants: Vehicle Wash water is collected and treated for physico-chemical treatment and the water is reused.

Tyre wash system installed for outbound coal cargo truck is in place where the wash-water after treatment is reused back in to system

For collection of rainwater during monsoon and other season, rain water harvesting pond developed at 3 locations in the port Premises

Contour bund along the arterial road inside the port have been developed for a length of 1000m which will retain and regulate the water to the green belt areas.

Guard Pond covering the open stock yard inside the port to collect runoff water has been developed at Mechanization Area.

Green Belt & Horticulture Development: Port has planted more than 2, 72,650 trees since 2010

Environment & Sustainability: - Senior Manager – Environment head the Department supported with Manager, Associate Manager, Officers. The key functions of the Department are to demonstration of environmental compliance for EC, Consent to Operate Conditions issued under Air and Water Act, Compliance to Authorization obtained under Hazardous & Other Wastes (Management and Handling) Rules, 2016. It involves operation and maintenance of Pollution Control System installed for control of fugitive dust emissions, washwater treatment, sewage treatment plant. It develops and implement the waste management system for Solid Waste, Plastic Waste and Battery Waste Rules and ensure for its compliance. 3 Continuous Ambient Air Quality Monitoring Stations installed at Port Premises for Particulate Matter ($PM_{2.5}$, PM_{10} and CO) and Gaseous Emission on 24x7 for 365 days. The server connected to PPCC Server for continuous monitoring and surveillance.

Separate Horticulture and Green Belt Development functions for making port greenery and develop in-house for seedlings, saplings for tree plantation. 30 Womens from adjoining villages are engaged for this purpose and received training on Horticulture

Waste generated from Port premises such as tree cuttings, leaf are sent for mulching, soil collected on roads are used for nursery growth, plastic rope trimmings used for tarpaulin cover for truck and rail wagon used for tying tree protection fencing, cut thorny bushes has been reused for protection of small shrubs, plants from Live Stocks thus ensuring sustainable waste management practices.

PART – H

Additional measures/investment proposal for environmental protection including abatement of pollution, prevention of pollution.

- Permanent corrugated wind screen have been erected all along the coal yards
- Efficient water spraying methods have erected and commissioned at South Coal Yard
- Efficient water spraying methods have been erected and commissioned such as the high pressure water monitors and water sprayer machines.
- Dust Suppression System Sprinklers have been installed at mechanized coal yard

- Dry Fog Dust Suppression System installed at Transfer Tower located at Material Handling System
- Road Sweeping Machine deployed for collection of road side dust
- Road Wetting done through dedicated water tankers for maintaining the road in wet condition to prevent settled road dust emission gets air-borne.

Effective Environmental Management Plan have been put in place and monitored through 24x7 (3 shifts) through deployment of manpower for monitoring and control of fugitive dust emission thus ensuring the Ambient Air Quality in and around the port premises meeting the norms and standards prescribed by PPCC.

Mechanized Coal Handling System comprises of the following

1. Ship Unloaders
2. Stacker and Redamier
3. Truck Loading System
4. Wagon Loading System
5. Conveyor System Package

The above system have been commissioned during October 2018 for efficient discharge of coal from ship and deliver to rail wagon through wagon loading system. It is considered as energy efficient, environment friendly operation, cost effective, productive and clean operation. This has prevented the manual handling of coal right from the ship to rail wagon thus eliminating fugitive dust emission and thereby compliance to the conditions stipulated by PPCC and MoEF&CC – Environmental Clearance.

PART – I

Any other particulars for improving the quality of the environment.

- Green Belt Development being implemented on a regular basis. Various variety such as Pungam, Casuarinas, Ashoka, Conocarpusetc., are planted in suitable location. Around 82 species are being maintained in & around Port.
- 30 hectares area of green belt were strengthened with variety of species.
- 8000 Sq. Feet area of landscape have been developed during
- 3000 Sq. Feet area of Vegetable garden was developed.
- Pipeline arrangement made from STP to garden area for irrigation.
- Massive tree plantation carried out for World Environment Day, International Forest Day & other special occasions a maximum of 5800 saplings

karaikal port

ISO 9001
ISO 14001
ISO 50001
OHSAS 18001

KPPL/ ENV/ MoEF&CC/2020/01

29.06.2020

To

Additional Principal Chief Conservator of Forests (C),
Ministry of Environment, Forests and Climate Change,
Regional Office (SEZ),
Chennai – 34

Sub: Environmental & CRZ Clearance letter (No.10 - 42/2009 - IA – III, dated 22.09.2009), from Govt of India (GoI), Ministry of Environment, Forest and Climate Change (MoEF&CC) – Project Completion Regarding

Ref: MoEF&CC : EC & CRZ Letter No.10 - 42/2009 - IA – III, dated 22.09.2009

Sir,

Karaikal Port Private Limited has been accorded Environmental & CRZ Clearance (Letter No.10 - 42/2009 - IA – III, dated 22.09.2009), for expansion of Karaikal Port (Phase II) from Govt of India (GoI), Ministry of Environment, Forest and Climate Change (MoEF&CC). The validity of said Environmental & CRZ Clearance had been extended for a period of three years i.e up to 21.09.2017 (Ref: MoEF&CC Letter dated 03rd Feb,2015) & subsequently extended for a period of two years i.e up to 21.09.2019 (Ref: MoEF&CC Letter dated 14th May,2018)

With reference to the above subject, it is informed that, Karaikal Port Private Limited has completed the Phase II activities as stipulated in the above said Environmental & CRZ Clearance letter (No.10 - 42/2009 - IA – III, dated 22.09.2009) issued by GoI, MoEF&CC.

The said Project (Phase II) has been completed and operations have started.

We have been submitting six monthly compliance reports on the General & Specific conditions stipulated in the said Environmental & CRZ Clearance regularly. We will continue the same.

Thanking you,

Yours faithfully,

(Capt. Vijay Nicodemus)
Chief Operating Officer
KARAIKAL PORT PRIVATE LIMITED

CIN: U45203PY2006PTC001945

Registered Office
Kheezhavanjoor Village, T.R. Pattinam, PB No. 33, Karaikal - 609 606. Tel. : +91 4365 256600 (5 Lines) Fax : +91 4365 256603

Corporate Office
New No.145 (Old No. 81) Royapettah High Road, Mylapore, Chennai - 600 004.Landmark -Tiruvalluvar Statue Bus Stop.
Tel : +91 44-4562 2000Fax : +91 44-4562 2080

www.karaikalport.com

NGT – Joint Committee Report dated 19.02.2019 to 22.02.2019-Recommendations

S.No.	Joint Inspection Report - Recommendations	Status up to 31st March 2024
1	M/s. Karaikal Port should ensure to handle most of the coal through a mechanized system	As per the Consent conditions from PPCC, most of the Coal cargo is being handled through Mechanized system only.
2	Optimized water sprinkling shall be carried out at all the points of unloading and loading from ship to conveyor, conveyor to storage	Automated Dry Fog Dust Suppression (DFDS) and Water Sprinklers are installed at Mechanized area and Coal Yards and are operated as per requirements.
3	Should minimize the intermittent interruption of the mechanized process operations and adopt sequential start and stop operations	After commissioning of mechanization in October 2018, the overall process has been stabilized and operated efficiently with sequential start and stop operations. Interruption and stoppage has been minimized based on the experience resulted in improved discharge rate from vessel.
4	Ensure all the pollution control measures are proper and continuously functioning at all times	All the Pollution Control measures are in place & being operational at all times. Operational records are maintained at site. Monthly reports of the same are being sent to PPCC regularly.
5	Green Belt should be strengthened further around the Karaikal Port premises particularly towards Keelavanjur Village.	KPPL planted around 2,85,819 No's of saplings in & around the Port premises. Around 19,645 saplings were planted towards Keezhavanjore Village since July 2017 in a phased manner. Around 7569 saplings were planted during the FY 2023-2024
6	Improved version of windscreens shall be erected and damaged windscreens shall be rectified periodically	All the damaged wind screens are being replaced immediately & records maintained at site.

S.No.	Joint Inspection Report - Recommendations	Status up to 31st March 2024
		Permanent corrugated wind screen has been made all along the Coal Yards (2023-24) Compliance report on the same is being submitted to PPCC regularly
7	All the loaded vehicles (Truck & Wagons) shall be covered by Tarpaulin before it leaves Port premises.	All the outgoing loaded trucks and rail wagons have been covered with high quality of tarpaulin to avoid the rise of fugitive dust emissions as well as spillages.
8	Additional precautionary measures shall be implemented in controlling the surge loads of the emissions emanating from the operation process by adopting backup power supply to all essential operations and dust suppression system.	Continuous Ambient Air Quality Monitoring Systems installed at Port Premises are regularly monitoring the dust concentration in ambient air quality. Port operations are carried out as per Standard Operating Procedure (SOP). In case of surge or higher dust concentration observed, cargo operations team will be alerted about the dust level in order to minimize or stoppage of specific operations. Power back up facility has been provided for on-line monitoring systems.
9	Areas like vehicles and tyre washing and its waste water collection system shall be improved without any spillage on the ground and to properly collect and adequately treat the waste water.	Improved water spray system (High quality nozzles) for vehicle and tyre wash facility has been Installed to avoid the spillages on the ground. The entire treatment facility waste water is being recycled & utilized.
10	The air quality data measured by continuous ambient air quality monitoring stations shall be Analysed time to time so as to satisfy with all plausibility checks to take action on higher concentrations measured and to display true concentration of the	All the CAAQM station data's are closely monitored and hourly time series data & day average data are being analyzed.

S.No.	Joint Inspection Report - Recommendations	Status up to 31st March 2024
	Particulate Matters to the public at large.	
11	KPPL shall continue to serve and further strengthen the corporate social response (CSR) activities in the neighborhood which includes School Buses for the School children , Tution Centres, Self Help Group (SHG) for the ladies from the neighboring villages Medical Centre camps etc. This shall improve the better confidence on their health among the public.	CSR is on-going activities as part of social welfare program. In addition to this, an amount of Rs.25 Lakhs have been deposited with District Collector- Karaikal as per the direction of NGT for welfare of village people

Appendix M
Primary Water Quality Standards for Harbor Water

Primary Water Quality Criteria for Class SW-IV Waters (For Harbor waters)			
S.No	Parameter	Standards	Rationale/Remarks
1	pH range	6.0-9.0	To minimize corrosive and scaling effect
2	Dissolved oxygen	3.0mg/l or 40% saturation value whichever is higher	Considering the biodegradation of oil and inhibition tooxygen production through photosynthesis
3	Colour and odour	No visible colour or offensive odour	None from reactive chemicals which corrode paints/metallic surfaces
4	Floating materials,	10mg/l oil, grease and scum (including petroleum products)	Floating matter should be free from excessive living organisms which may clog or coat operative parts of marine vessels/equipment
5	Fecal coliform	500/100 ml (MPN)	Not exceeding 1000/100ml in 20% of samples in the year and in 3 consecutive samples in monsoon months
6	Biochemical oxygen demand (BOD) (3 days at 27°C)	5mg/l decomposable wastes	To maintain water reactively free from pollution caused by sewage and other

Appendix N
IS10500: 2012 Drinking water standards

भारतीय मानक

पीने का पानी — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

DRINKING WATER — SPECIFICATION

(Second Revision)

ICS 13.060.20

© BIS 2012

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

May 2012 **Price Group 6**

AMENDMENT NO. 1 JUNE 2015
TO
IS 10500 : 2012 DRINKING WATER — SPECIFICATION

(Second Revision)

[*Page* 2, *Table* 2, *Sl No.* xii), *col* 3] — Substitute '1.0' *for* '0.3'.

[*Page* 3, *Table* 3, *Sl No.* x) , *col* 4] — Substitute 'No relaxation' *for* '0.05'.

(FAD 14)

Publication Unit, BIS, New Delhi, India

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Drinking Water Sectional Committee had been approved by the Food and Agriculture Division Council.

This standard was originally published in 1983. A report prepared by the World Health Organization in cooperation with the World Bank showed that in 1975, some 1 230 million people were without safe water supplies. These appalling facts were central to the United Nations decision to declare an International Drinking Water Supply and Sanitation decade, beginning in 1981. Further, the VI Five-Year Plan of India had made a special provision for availability of safe drinking water for the masses. Therefore, the standard was formulated with the objective of assessing the quality of water resources, and to check the effectiveness of water treatment and supply by the concerned authorities.

The first revision was undertaken to take into account the up-to-date information available about the nature and effect of various contaminants as also the new techniques for identifying and determining their concentration. Based on experience gained additional requirements for alkalinity; aluminium and boron were incorporated and the permissible limits for dissolved solids, nitrate and pesticides residues modified.

As per the eleventh five year plan document of India (2007-12), there are about 2.17 lakh quality affected habitations in the country with more than half affected with excess iron, followed by fluoride, salinity, nitrate and arsenic in that order. Further, approximately, 10 million cases of diarrhoea, more than 7.2 lakh typhoid cases and 1.5 lakh viral hepatitis cases occur every year a majority of which are contributed by unclean water supply and poor sanitation. The eleventh five year plan document of India (2007-2012) recognizes dealing with the issue of water quality as a major challenge and aims at addressing water quality problems in all quality affected habitations with emphasis on community participation and awareness campaigns as well as on top most priority to water quality surveillance and monitoring by setting up of water quality testing laboratories strengthened with qualified manpower, equipments and chemicals.

The second revision was undertaken to upgrade the requirements of the standard and align with the internationally available specifications on drinking water. In this revision assistance has been derived from the following:

a) EU Directives relating to the quality of water intended for human consumption (80/778/EEC) and Council Directive 98/83/EC.

b) USEPA standard — National Primary Drinking Water Standard. EPA 816-F-02-013 dated July, 2002.

c) WHO Guidelines for Drinking Water Quality. 3rd Edition Vol. 1 Recommendations, 2008.

d) Manual on Water Supply and Treatment, third edition — revised and updated May 1999, Ministry of Urban Development, New Delhi.

This standard specifies the acceptable limits and the permissible limits in the absence of alternate source. It is recommended that the acceptable limit is to be implemented as values in excess of those mentioned under 'Acceptable' render the water not suitable. Such a value may, however, be tolerated in the absence of an alternative source. However, if the value exceeds the limits indicated under 'permissible limit in the absence of alternate source' in col 4 of Tables 1 to 4, the sources will have to be rejected.

Pesticide residues limits and test methods given in Table 5 are based on consumption pattern, persistence and available manufacturing data. The limits have been specified based on WHO guidelines, wherever available. In cases where WHO guidelines are not available, the standards available from other countries have been examined and incorporated, taking in view the Indian conditions.

In this revision, additional requirements for ammonia, chloramines, barium, molybdenum, silver, sulphide, nickel, polychlorinated biphenyls and trihalomethanes have been incorporated while the requirements for colour, turbidity, total hardness, free residual chlorine, iron, magnesium, mineral oil, boron, cadmium, total arsenic, lead, polynuclear aromatic hydrocarbons, pesticides and bacteriological requirements have been modified.

In this revision, requirement and test method for virological examination have been included. Further, requirements and test methods for cryptosporidium and giardia have also been specified.

Routine surveillance of drinking water supplies should be carried out by the relevant authorities to understand the risk of specific pathogens and to define proper control procedures. The WHO Guidelines for Drinking Water Quality, 3rd Edition, Vol. 1 may be referred for specific recommendations on using a water safety approach incorporating risk identification. Precautions/Care should be taken to prevent contamination of drinking water from chlorine resistant parasites such as cryptosporidium species and giardia.

Indian Standard

DRINKING WATER — SPECIFICATION

(Second Revision)

1 SCOPE

This standard prescribes the requirements and the methods of sampling and test for drinking water.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard the following definition shall apply.

3.1 Drinking Water — Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water (treated or untreated) supplied by any means for human consumption.

4 REQUIREMENTS

Drinking water shall comply with the requirements given in Tables 1 to 4. The analysis of pesticide residues given in Table 3 shall be conducted by a recognized laboratory using internationally established test method meeting the residue limits as given in Table 5.

Drinking water shall also comply with bacteriological requirements (*see* **4.1**), virological requirements (*see* **4.2**) and biological requirements (*see* **4.3**).

4.1 Bacteriological Requirements

4.1.1 *Water in Distribution System*

Ideally, all samples taken from the distribution system including consumers' premises, should be free from coliform organisms and the following bacteriological quality of drinking water collected in the distribution system, as given in Table 6 is, therefore specified when tested in accordance with IS 1622.

4.2 Virological Requirements

4.2.1 Ideally, all samples taken from the distribution

Table 1 Organoleptic and Physical Parameters
(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to Part of IS 3025	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Colour, Hazen units, *Max*	5	15	Part 4	Extended to 15 only, if toxic substances are not suspected in absence of alternate sources
ii)	Odour	Agreeable	Agreeable	Part 5	a) Test cold and when heated b) Test at several dilutions
iii)	*p*H value	6.5-8.5	No relaxation	Part 11	—
iv)	Taste	Agreeable	Agreeable	Parts 7 and 8	Test to be conducted only after safety has been established
v)	Turbidity, NTU, *Max*	1	5	Part 10	—
vi)	Total dissolved solids, mg/l, *Max*	500	2 000	Part 16	—

NOTE — It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under 'acceptable' render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source' in col 4, above which the sources will have to be rejected.

Table 2 General Parameters Concerning Substances Undesirable in Excessive Amounts
(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Aluminium (as Al), mg/l, *Max*	0.03	0.2	IS 3025 (Part 55)	—
ii)	Ammonia (as total ammonia-N), mg/l, *Max*	0.5	No relaxation	IS 3025 (Part 34)	—
iii)	Anionic detergents (as MBAS) mg/l, *Max*	0.2	1.0	Annex K of IS 13428	—
iv)	Barium (as Ba), mg/l, *Max*	0.7	No relaxation	Annex F of IS 13428* or IS 15302	—
v)	Boron (as B), mg/l, *Max*	0.5	1.0	IS 3025 (Part 57)	—
vi)	Calcium (as Ca), mg/l, *Max*	75	200	IS 3025 (Part 40)	—
vii)	Chloramines (as Cl_2), mg/l, *Max*	4.0	No relaxation	IS 3025 (Part 26)* or APHA 4500-Cl G	—
viii)	Chloride (as Cl), mg/l, *Max*	250	1 000	IS 3025 (Part 32)	—
ix)	Copper (as Cu), mg/l, *Max*	0.05	1.5	IS 3025 (Part 42)	—
x)	Fluoride (as F) mg/l, *Max*	1.0	1.5	IS 3025 (Part 60)	—
xi)	Free residual chlorine, mg/l, *Min*	0.2	1	IS 3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l
xii)	Iron (as Fe), mg/l, *Max*	0.3	No relaxation	IS 3025 (Part 53)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
xiii)	Magnesium (as Mg), mg/l, *Max*	30	100	IS 3025 (Part 46)	—
xiv)	Manganese (as Mn), mg/l, *Max*	0.1	0.3	IS 3025 (Part 59)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
xv)	Mineral oil, mg/l, *Max*	0.5	No relaxation	Clause **6** of IS 3025 (Part 39) Infrared partition method	—
xvi)	Nitrate (as NO_3), mg/l, *Max*	45	No relaxation	IS 3025 (Part 34)	—
xvii)	Phenolic compounds (as C_6H_5OH), mg/l, *Max*	0.001	0.002	IS 3025 (Part 43)	—
xviii)	Selenium (as Se), mg/l, *Max*	0.01	No relaxation	IS 3025 (Part 56) or IS 15303*	—
xix)	Silver (as Ag), mg/l, *Max*	0.1	No relaxation	Annex J of IS 13428	—
xx)	Sulphate (as SO_4) mg/l, *Max*	200	400	IS 3025 (Part 24)	May be extended to 400 provided that Magnesium does not exceed 30
xxi)	Sulphide (as H_2S), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 29)	—
xxii)	Total alkalinity as calcium carbonate, mg/l, *Max*	200	600	IS 3025 (Part 23)	—
xxiii)	Total hardness (as $CaCO_3$), mg/l, *Max*	200	600	IS 3025 (Part 21)	—
xxiv)	Zinc (as Zn), mg/l, *Max*	5	15	IS 3025 (Part 49)	—

NOTES

1 In case of dispute, the method indicated by '*' shall be the referee method.

2 It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under ‘acceptable’ render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under ‘permissible limit in the absence of alternate source’ in col 4, above which the sources will have to be rejected.

Table 3 Parameters Concerning Toxic Substances

(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Cadmium (as Cd), mg/l, *Max*	0.003	No relaxation	IS 3025 (Part 41)	—
ii)	Cyanide (as CN), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 27)	—
iii)	Lead (as Pb), mg/l, *Max*	0.01	No relaxation	IS 3025 (Part 47)	—
iv)	Mercury (as Hg), mg/l, *Max*	0.001	No relaxation	IS 3025 (Part 48)/ Mercury analyser	—
v)	Molybdenum (as Mo), mg/l, *Max*	0.07	No relaxation	IS 3025 (Part 2)	—
vi)	Nickel (as Ni), mg/l, *Max*	0.02	No relaxation	IS 3025 (Part 54)	—
vii)	Pesticides, µg/l, *Max*	See Table 5	No relaxation	See Table 5	—
viii)	Polychlorinated biphenyls, mg/l, *Max*	0.000 5	No relaxation	ASTM 5175*	— or APHA 6630
ix)	Polynuclear aromatic hydro-carbons (as PAH), mg/l, *Max*	0.000 1	No relaxation	APHA 6440	—
x)	Total arsenic (as As), mg/l, *Max*	0.01	0.05	IS 3025 (Part 37)	—
xi)	Total chromium (as Cr), mg/l, *Max*	0.05	No relaxation	IS 3025 (Part 52)	—
xii)	Trihalomethanes:				
	a) Bromoform, mg/l, *Max*	0.1	No relaxation	ASTM D 3973-85* or APHA 6232	—
	b) Dibromochloromethane, mg/l, *Max*	0.1	No relaxation	ASTM D 3973-85* or APHA 6232	—
	c) Bromodichloromethane, mg/l, *Max*	0.06	No relaxation	ASTM D 3973-85* or APHA 6232	—
	d) Chloroform, mg/l, *Max*	0.2	No relaxation	ASTM D 3973-85* or APHA 6232	—

NOTES

1 In case of dispute, the method indicated by '*' shall be the referee method.

2 It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under ‘acceptable’ render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under 'permissible limit in the absence of alternate source’ in col 4, above which the sources will have to be rejected.

Table 4 Parameters Concerning Radioactive Substances

(*Foreword* and *Clause* 4)

Sl No.	Characteristic	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source	Method of Test, Ref to Part of IS 14194	Remarks
(1)	(2)	(3)	(4)	(5)	(6)
i)	Radioactive materials:				
	a) Alpha emitters Bq/l, *Max*	0.1	No relaxation	Part 2	—
	b) Beta emitters Bq/l, *Max*	1.0	No relaxation	Part 1	—

NOTE — It is recommended that the acceptable limit is to be implemented. Values in excess of those mentioned under ‘acceptable’ render the water not suitable, but still may be tolerated in the absence of an alternative source but up to the limits indicated under ‘permissible limit in the absence of alternate source’ in col 4, above which the sources will have to be rejected.

Table 5 Pesticide Residues Limits and Test Method

(*Foreword* and *Table* 3)

Sl No.	Pesticide	Limit µg/l	Method of Test, Ref to	
			USEPA	AOAC/ ISO
(1)	(2)	(3)	(4)	(5)
i)	Alachlor	20	525.2, 507	—
ii)	Atrazine	2	525.2, 8141 A	—
iii)	Aldrin/ Dieldrin	0.03	508	—
iv)	Alpha HCH	0.01	508	—
v)	Beta HCH	0.04	508	—
vi)	Butachlor	125	525.2, 8141 A	—
vii)	Chlorpyriphos	30	525.2, 8141 A	—
viii)	Delta HCH	0.04	508	—
ix)	2,4- Dichlorophenoxyacetic acid	30	515.1	—
x)	DDT (*o, p* and *p, p* – Isomers of DDT, DDE and DDD)	1	508	AOAC 990.06
xi)	Endosulfan (alpha, beta, and sulphate)	0.4	508	AOAC 990.06
xii)	Ethion	3	1657 A	—
xiii)	Gamma — HCH (Lindane)	2	508	AOAC 990.06
xiv)	Isoproturon	9	532	—
xv)	Malathion	190	8141 A	—
xvi)	Methyl parathion	0.3	8141 A	ISO 10695
xvii)	Monocrotophos	1	8141 A	—
xviii)	Phorate	2	8141 A	—

NOTE — Test methods are for guidance and reference for testing laboratory. In case of two methods, USEPA method shall be the reference method.

Table 6 Bacteriological Quality of Drinking Water[1)]

(*Clause* 4.1.1)

Sl No.	Organisms	Requirements
(1)	(2)	(3)
i)	*All water intended for drinking*:	
	a) *E. coli* or thermotolerant coliform bacteria[2), 3)]	Shall not be detectable in any 100 ml sample
ii)	*Treated water entering the distribution system*:	
	a) *E. coli* or thermotolerant coliform bacteria[2)]	Shall not be detectable in any 100 ml sample
	b) Total coliform bacteria	Shall not be detectable in any 100 ml sample
iii)	*Treated water in the distribution system*:	
	a) *E. coli* or thermotolerant coliform bacteria	Shall not be detectable in any 100 ml sample
	b) Total coliform bacteria	Shall not be detectable in any 100 ml sample

[1)]Immediate investigative action shall be taken if either *E.coli* or total coliform bacteria are detected. The minimum action in the case of total coliform bacteria is repeat sampling; if these bacteria are detected in the repeat sample, the cause shall be determined by immediate further investigation.

[2)]Although, *E. coli* is the more precise indicator of faecal pollution, the count of thermotolerant coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests shall be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of rural water supplies, particularly in tropical areas where many bacteria of no sanitary significance occur in almost all untreated supplies.

[3)]It is recognized that, in the great majority of rural water supplies in developing countries, faecal contamination is widespread. Under these conditions, the national surveillance agency should set medium-term targets for progressive improvement of water supplies.

system including consumers' premises, should be free from virus.

4.2.2 None of the generally accepted sewage treatment methods yield virus-free effluent. Although a number of investigators have found activated sludge treatment to be superior to trickling filters from this point of view, it seems possible that chemical precipitation methods will prove to be the most effective.

4.2.3 Virus can be isolated from raw water and from springs, enterovirus, reovirus, and adenovirus have been found in water, the first named being the most resistant to chlorination. If enterovirus are absent from chlorinated water, it can be assumed that the water is safe to drink. Some uncertainty still remains about the virus of infectious hepatitis, since it has not so far been isolated but in view of the morphology and resistance of enterovirus it is likely that, if they have been inactivated hepatitis virus will have been inactivated also.

4.2.4 An exponential relationship exists between the rate of virus inactivation and the redox potential. A redox potential of 650 mV (measured between platinum and calomel electrodes) will cause almost instantaneous inactivation of even high concentrations of virus. Such a potential can be obtained with even a low concentration of free chlorine, but only with an extremely high concentration of combined chlorine. This oxidative inactivation may be achieved with a number of other oxidants also, for example, iodine, ozone and potassium permanganate, but the effect of the oxidants will always be counteracted, if reducing components, which are mainly organic, are present. As a consequence, the sensitivity of virus towards disinfectants will depend on the *milieu* just as much as on the particular disinfectant used.

4.2.5 Viruses are generally resistant to disinfectants as well as get protected on account of presence of particulate and organic matter in water. Because the difference between the resistance of coliform organisms and of virus to disinfection by oxidants increases with increasing concentration of reducing components, for example, organic matter, it cannot be assumed that the absence of available coliform organisms implies freedom from active virus under circumstances where a free chlorine residual cannot be maintained. Sedimentation and slow sand filtration in themselves may contribute to the removal of virus from water.

4.2.6 In practice, >0.5 mg/l of free chlorine for 1 h is sufficient to inactivate virus, even in water that was originally polluted provided the water is free from particulates and organic matter.

4.2.7 MS2 phage are indicator of viral contamination in drinking water. MS2 phage shall be absent in 1 litre of water when tested in accordance with USEPA method 1602. If MS2 phage are detected in the drinking water, virological examination shall be done by the Polymerase Chain Reaction (PCR) method for virological examination as given in Annex B. USEPA method in Manual of Method for Virology Chapter 16, June 2001 shall be the alternate method. If viruses are detected, the cause shall be determined by immediate further investigation.

4.3 Biological Requirements

4.3.1 Ideally, all samples taken including consumers premises should be free from biological organisms. Biological examination is of value in determining the causes of objectionable tastes and odours in water and controlling remedial treatments, in helping to interpret the results of various chemical analysis, and in explaining the causes of clogging in distribution pipes and filters. In some instances, it may be of use in demonstrating that water from one source has been mixed with that from another.

4.3.2 The biological qualities of water are of greater importance when the supply has not undergone the conventional flocculation and filtration processes, since increased growth of methane-utilizing bacteria on biological slimes in pipes may then be expected, and the development of bryozoal growths such as *Plumatella* may cause operational difficulties.

4.3.3 Some of the animalcules found in water mains may be free-living in the water, but others such as *Dreissena* and *Asellus* are more or less firmly attached to the inside of the mains. Although these animalcules are not themselves pathogenic, they may harbour pathogenic organisms or virus in their intestines, thus protecting these pathogens from destruction by chlorine.

4.3.4 Chlorination, at the dosages normally employed in waterworks, is ineffective against certain parasites, including amoebic cysts; they can be excluded only by effective filtration or by higher chlorine doses than can be tolerated without subsequent dechlorination. *Amoebiasis* can be conveyed by water completely free from enteric bacteria; microscopic examination after concentration is, therefore, the only safe method of identification.

4.3.5 Strict precautions against back-syphonage and cross-connections are required, if amoebic cysts are found in a distribution system containing tested water.

4.3.6 The *cercariae of schistosomiasis* can be detected by similar microscopic examination, but there is, in

any case, no evidence to suggest that this disease is normally spread through piped water supplies.

4.3.7 The cyclops vector of the embryos of *Dracunculus medinensis* which causes dracontiasis or Guinea-worm disease can be found in open wells in a number of tropical areas. They are identifiable by microscopic examination. Such well supplies are frequently used untreated, but the parasite can be relatively easily excluded by simple physical improvements in the form of curbs, drainage, and apron surrounds and other measures which prevent physical contact with the water source.

4.3.8 Cryptosporidium shall be absent in 10 liter of water when tested in accordance with USEPA method 1622 or USEPA method 1623* or ISO 15553 : 2006.

4.3.9 Giardia shall be absent in 10 liter of water when tested in accordance with USEPA method 1623* or ISO 15553 : 2006.

4.3.10 The drinking water shall be free from microscopic organisms such as algae, zooplanktons, flagellates, parasites and toxin producing organisms. An illustrative (and not exhaustive) list is given in Annex C for guidance.

NOTE — In case of dispute, the method indicated by '*' in **4.3.8** and **4.3.9** shall be referee method.

5 SAMPLING

Representative samples of water shall be drawn as prescribed in IS 1622 and IS 3025 (Part 1).

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1622 : 1981	Methods of sampling and microbiological examination of water (*first revision*)
3025	Methods of sampling and test (physical and chemical) for water and waste water:
(Part 1) : 1987	Sampling (*first revision*)
(Part 2) : 2002	Determination of 33 elements by inductively coupled plasma atomic emission spectroscopy
(Part 4) : 1983	Colour (*first revision*)
(Part 5) : 1983	Odour (*first revision*)
(Part 7) : 1984	Taste threshold (*first revision*)
(Part 8) : 1984	Tasting rate (*first revision*)
(Part 10) : 1984	Turbidity (*first revision*)
(Part 11) : 1983	*p*H value (*first revision*)
(Part 16) : 1984	Filterable residue (total dissolved solids) (*first revision*)
(Part 21) : 1983	Total hardness (*first revision*)
(Part 23) : 1983	Alkalinity (*first revision*)
(Part 24) : 1986	Sulphates (*first revision*)
(Part 26) : 1986	Chlorine residual (*first revision*)
(Part 27) : 1986	Cyanide (*first revision*)
(Part 29) : 1986	Sulphide (*first revision*)
(Part 32) : 1988	Chloride (*first revision*)
(Part 34) : 1988	Nitrogen (*first revision*)
(Part 37) : 1988	Arsenic (*first revision*)
(Part 39) : 1989	Oil and grease
(Part 40) : 1991	Calcium
(Part 41) : 1992	Cadmium (*first revision*)
(Part 42) : 1992	Copper (*first revision*)
(Part 43) : 1992	Phenols (*first revision*)
(Part 46) : 1994	Magnesium
(Part 47) : 1994	Lead
(Part 48) : 1994	Mercury
(Part 49) : 1994	Zinc
(Part 52) : 2003	Chromium
(Part 53) : 2003	Iron
(Part 54) : 2003	Nickel
(Part 55) : 2003	Aluminium
(Part 56) : 2003	Selenium
(Part 57) : 2005	Boron
(Part 59) : 2006	Manganese
(Part 60) : 2008	Fluoride
13428 : 2003	Packaged natural mineral water — Specification (*first revision*)
14194	Radionuclides in environmental samples — Method of estimation:
(Part 1) : 1994	Gross beta activity measurement
(Part 2) : 1994	Gross alpha activity measurement
15302 : 2002	Determination of aluminium and barium in water by direct nitrous oxide-acetylene flame atomic absorption spectrometry
15303 : 2002	Determination of antimony, iron and selenium in water by electrothermal atomic absorption spectrometry

ANNEX B

(*Clause* 4.2.7)

POLYMERASE CHAIN REACTION (PCR) METHOD

B-1 GENERAL

The method involves the concentration of viruses from 100 litre of drinking water to 1 ml by membrane filter technique. The concentrate is subjected to amplification using polymerase chain reaction (PCR) and primers based on highly conserved regions of viral genomes. This method can detect as low as 10 genome copies. Stringent precautions are needed to avoid contamination with amplified DNA products leading to false positive reactions. Detection of hepatitis A virus (HAV) RNA and enterovirus (EV) RNA is considered as an indication of presence of viruses in water. Steps involved include concentration of water, RNA extraction, complementary DNA (cDNA) synthesis and PCR.

B-2 CONCENTRATION OF DRINKING WATER

B-2.1 Apparatus

B-2.1.1 *Pressure Pump*

B-2.1.2 *Membrane Filter Assembly with 144 mm Diameter with Tripod Stand*

B-2.1.3 *Pressure Vessel (50 litre capacity) with Pressure Gauge*

B-2.1.4 *Inter-connecting Pressure Tubes*

B-2.2 Reagents

Autoclaved double distilled water shall be used for the preparation of reagents/buffers in this study.

B-2.2.1 *Aluminium Chloride*

B-2.2.2 *HCl/NaOH Urea (Extra Pure)*

B-2.2.3 *Disodium Hydrogen Phosphate* ($Na_2HPO_4.2H_2O$) — 0.2 M, filter sterilized.

B-2.2.4 *Sodium Dihydrogen Phosphate* ($NaH_2PO_4.2H_2O$) — 0.2 M, filter sterilized.

B-2.2.5 *Citric Acid* — 0.1 M, filter sterilized.

B-2.2.6 *L-Arginine* — 0.5 M, filter sterilized.

B-2.2.7 *Urea-Arginine Phosphate Buffer* (*U-APB*) — Mix 4.5 g of urea with 2 ml of 0.2 M NaH_2PO_4 and 2 ml of 0.5 M L - Arginine and make up the volume to 50 ml with sterile distilled water. The *p*H of the eluent shall be 9.0.

B-2.2.8 *Magnesium Chloride* ($MgCl_2$) — 1 M.

B-2.2.9 *McII Vaines Buffer* (*p*H *5.0*) — Mix 9.7 ml of 0.1 M citric acid with 10.3 ml of 0.2 M $Na_2HPO_4.2H_2O$ under sterile conditions.

B-2.3 Procedure

Filter 100 litre of drinking water sample through membrane filter assembly using either positively charged membrane of 144 mm diameter or 0.22 micron diameter pore size nitrocellulose membrane. For positively charged membrane the test water *p*H need not be adjusted. But for the 0.22 micron nitrocellulose membrane adjust the *p*H to 3.5 after adding the aluminium chloride as a coagulant to a final concentration of 0.000 5 M.

At lower *p*H pass the water through the membrane. The flow rate shall be 40 litre/h approximately. After the completion of the filtration, elute the adsorbed particles using 100 ml of urea-arginine phosphate buffer (U-APB). Precipitate the suspended particles using 1 ml of magnesium chloride (1 M). Dissolve the resultant precipitate centrifuged out of the sample in 800-1.0 ml of McII vaines buffer. The processed sample can be stored at refrigerator until required.

B-3 RNA EXTRACTION

B-3.1 Apparatus

B-3.1.1 *Cooling Centrifuge*

B-3.1.2 *Deep Freezer (–20°C)*

B-3.1.3 *Vortex Mixer*

B-3.1.4 *Pipette Man*

B-3.2 Reagents

B-3.2.1 *Cetyl Trimethyl Ammonium Bromide (CTAB) Buffer*

CTAB	:	1 percent
Sodium Dodecyl Sulphate (SDS)	:	1 percent
EDTA	:	20 mM
Sodium Chloride	:	1 M

B-3.2.2 *Phenol, Chloroform and Isoamylalcohol in the ratio of 25:24:1 (PCI)*

B-3.2.3 *Ethanol*

B-3.2.4 *TE Buffer (p*H *8.0)*

Tris base	:	1 M
EDTA	:	0.5 M

B-3.2.5 *Sodium Acetate* — 3 M.

B-3.3 Procedure

Treat 300 µl of concentrated water sample with equal volume of CTAB and 1/10th volume of PCI. Vortex and centrifuge at 5 000 × g for 30 min at 4°C. Add 1/10th volume of 3 M sodium acetate and double the volume of cold ethanol to the aqueous layer. Keep the mixture at either at –20°C for overnight or in liquid nitrogen for 2-5 min. Centrifuge at 10 000 × g, for 30 min at 4°C. Discard the supernatant and air dry the pellet and dissolve it in 20 µl TE buffer.

B-4 COMPLEMENTARY DNA (c DNA) SYNTHESIS

B-4.1 Apparatus

B-4.1.1 *PCR Machine*

B-4.1.2 *Deep Freezer (–20°C)*

B-4.2 Reagents

B-4.2.1 *cDNA Synthesis Kit*

B-4.3 Procedure

Suspend the extracted RNA in 20 µl of cDNA reaction mixture, which consists of 4 µl of 5X reverse transcriptase reaction buffer [250 mM TRIS–HCl (*p*H 8.5), 40 mM KCl, 150 mM $MgCl_2$, 5 mM dithiothreitol (DTT)], 0.5 µl of 10 mM deoxynucleotide phosphate (dNTP), 2 µl of hexa nucleotide mixture, 1 µl of 25 U of Maloney Murine Leukaemia Virus (M-MuLV) reverse transcriptase, 0.5 µl of 20 U of human placental RNase inhibitor. Heat the reaction mixture to 95°C for 5 min and rapidly chill on ice, this is followed by the addition of 1 µl (25 U/µl) of M-MuLV reverse transcriptase. Incubate the reaction mixture as given by the manufacturer of the kit and quickly chill the reaction tube on ice.

B-5 PCR AMPLIFICATION

B-5.1 Apparatus

B-5.1.1 *PCR Machine*

B-5.1.2 *Deep Freezer (–20°C)*

B-5.1.3 *Micropippette*

B-5.2 Reagents

B-5.2.1 *Primers for EV and HAV*

EV sense primer, 5' — TCC TCC GGC CCC TGA ATG CG — 3'

antisense primer, 5' — ATT GTC ACC ATA AGC AGC CA — 3'

HAV sense primer, 5' — GTTTT GCTCC TCTTT ATCAT GCTAT G-3'

antisense primer, 5' — GGAAA TGTCT CAGGT ACTTT CTTTG-3'

B-5.2.2 *PCR Master Mix*

B-5.2.3 *Mineral Oil*

B-5.3 Procedure

B-5.3.1 *PCR Amplification for Hepatitis A Virus (HAV)*

In 5 µl of cDNA, add 95 µl of a PCR Master Mix (10 mM TRIS–HCl (*p*H 8.3), 50 mM KCl, 2.5 mM $MgCl_2$, 0.01 percent gelatin (1× PCR buffer), 200 µM of each dNTP, 1.5 U of *Thermus aquaticus* polymerase). Add 25 pico moles of sense and antisense oligonucleotide primers of HAV and overlay with mineral oil. Appropriate positive and negative controls shall be included with each run. Set the following reaction at thermo cycler:

Denaturation at 94°C for 2 min

Denaturation for	1.0 min	at 94°C	} 35 cycles
Annealing for	1.0 min	at 57°C	
Extension for	1.3 min	at 72°C	

Final extension at 72°C for 7 min.

B-5.3.2 *PCR Amplification for Enterovirus (EV)*

In 5 µl of cDNA, add 95 µl of a PCR Master Mix (10 mM TRIS–HCl (*p*H 8.3), 50 mM KCl, 2.5 mM $MgCl_2$, 0.01 percent gelatin (1X PCR buffer), 200 µM of each dNTP, 1.5 U of *Thermus aquaticus* polymerase). Add 25 pico moles of sense and antisense oligonucleotide primers of EV and overlay with mineral oil. Appropriate positive and negative controls shall be included with each run. Set the following reaction at thermo cycler:

Denaturation at 94°C for 2 min

Denaturation for	1.0 min	at 94°C	} 35 cycles
Annealing for	1.0 min	at 42°C	
Extension for	2.0 min	at 72°C	

Final extension at 72°C for 7 min.

B-6 AGAROSE GEL ELECTROPHORESIS

B-6.1 Apparatus

B-6.1.1 *Micropippette*

B-6.1.2 *Electrophoresis Apparatus*

B-6.1.3 *Gel Documentation System*

B-6.2 Reagents

B-6.2.1 *Running Buffer* — 50X TAE buffer

Tris base/Tris buffer : 121.00 g

Glacial acetic acid	:	28.55 ml
0.5 M EDTA	:	50 .00 ml
Distilled water (autoclaved)	:	300.45 ml

Make the final volume upto 1 000 ml with deionised distilled water, sterilize and store at 4°C. The final concentration for the preparation of agarose gel and to run the gel shall be 1X.

B-6.2.2 *Tracking Dye* — 6X bromophenol blue.

B-6.2.3 *Ethidium Bromide* — 0.5 µg/ml.

B-6.3 Procedure

Run the PCR amplified product of EV and HAV on 1.5 percent agarose gel using 1X TAE buffer. Load 10 µl of amplified product after mixing it with 1 µl 10X loading dye. Run the molecular weight marker along with the samples. Run the electrophoresis at 100 V for 30 min. Stain the gel with ethidium bromide (0.5 µl/ml) for 20 min. Wash it with distilled water and view under UV transilluminator and photograph the gel to analyse the band pattern. EV gives the band as 155 base pair and the HAV gives band as 225 base pair.

ANNEX C

(*Clause* 4.3.10)

ILLUSTRATIVE LIST OF MICROSCOPIC ORGANISMS PRESENT IN WATER

Sl No. (1)	*Classification of Microscopic Organism* (2)	*Group and Name of the Organism* (3)	*Habitat* (4)	*Effect of the Organisms and Significance* (5)
i)	Algae	a) Chlorophyceae:		
		1) *Species of* Coelastrum, Gomphospherium, Micractinium, Mougeotia, Oocystis, Euastrum, Scenedesmus, Actinastrum, Gonium, Eudorina Pandorina, Pediastrum, Zygnema, Chlamydomonas, Careteria, Chlorella, Chroococcus, Spirogyra, Tetraedron, Chlorogonium, Stigeoclonium	Polluted water, impounded sources	Impart colouration
		2) *Species of* Pandorina, Volvox, Gomphospherium, Staurastrum, Hydrodictyon, Nitella	Polluted waters	Produce taste and odour
		3) *Species of* Rhizoclonium, Cladothrix, Ankistrodesmus, Ulothrix, Micrasterias, Chromulina	Clean water	Indicate clean condition
		4) *Species of* Chlorella, Tribonema, Clostrium, Spirogyra, Palmella	Polluted waters, impounded sources	Clog filters and create impounded difficulties
		b) Cyanophyceae:		
		1) *Species of* Anacystis and Cylindrospermum	Polluted waters	Cause water bloom and impart colour
		2) *Species of* Anabena, Phormidium, Lyngbya, Arthrospira, Oscillatona	Polluted waters	Impart colour
		3) *Species of* Anabena, Anacystis, Aphanizomenon	Polluted waters, impounded sources	Produce taste and odour
		4) *Species of* Anacystis, Anabena, Coelospherium, Cleotrichina, Aphanizomenon	Polluted waters	Toxin producing
		5) *Species of* Anacystis, Rivularia, Oscillatoria, Anabena	Polluted waters	Clog filters

Sl No. (1)	*Classification of Microscopic Organism* (2)	*Group and Name of the Organism* (3)	*Habitat* (4)	*Effect of the Organisms and Significance* (5)
		6) *Species of* Rivularia	Calcareous waters and also rocks	Bores rocks and calcareous strata and causes matted growth
		7) *Species of* Agmenellum, Microcoleus, Lemanea	Clean waters	Indicators of purification
		c) Diatoms (Bacillareophyceae):		
		1) *Species of* Fragillaria, Stephanodiscus, Stauroneis	—	Cause discoloration
		2) *Species of* Asterionella, Tabellaria	Hill streams high altitude, torrential and temperate waters	Taste and odour producing clog filters
		3) *Species of* Synedra and Fragillavia	Polluted waters	Taste and odour producing
		4) *Species of* Nitzchia, Gomphonema	Moderately polluted waters	Cause discoloration
		5) *Species of* Cymbela, Synedra, Melosira, Navicula, Cyclotella, Fragillaria, Diatoma, Pleurogsigma	Rivers and streams impounded sources	Clog filters and cause operational difficulties
		6) *Species of* Pinmularia, Surinella, Cyclotella, Meridion, Cocconeis	Clean waters	Indicators of purification
		d) Xanthophyceae:		
		Species of Botryococcus	Hill streams, high altitude and temperate waters	Produces coloration
ii)	Zooplankton	a) Protozoa:		
		1) Amoeba, Giardia Lamblia Arcella, Difflugia, Actinophrys	Polluted waters	Pollution indicators
		2) Endamoeba, Histolytica	Sewage and activated sludge	Parasitic and pathogenic
		b) Ciliates:		
		Paramoecium, Vorticella, Carchesium, Stentor, Colpidium, Coleps, Euplotes, Colopoda, Bodo	Highly polluted waters, sewage and activated sludge	Bacteria eaters
		c) Crustacea:		
		1) Bosmina, Daphnia	Stagnant polluted waters	Indicators of pollution
		2) Cyclops	Step wells in tropical climate	Carrier host of guinea worm
iii)	Rotifers	a) Rotifers:		
		Anurea, Rotaria, Philodina	Polluted and Algae laden waters	Feed on algae
		b) Flagellates:		
		1) Ceratium, Glenodinium, Peridinium Dinobryon	Rocky strata, iron bearing and acidic waters	Impart colour and fishy taste
		2) Euglena, Phacus	Polluted waters	Impart colour

Sl No.	*Classification of Microscopic Organism*	*Group and Name of the Organism*	*Habitat*	*Effect of the Organisms and Significance*
(1)	(2)	(3)	(4)	(5)
iv)	Miscellaneous Organisms	a) Sponges, Hydra	Fresh water	Clog filters and affect purification systems
		b) Tubifex, Eristalls, Chironomids	Highly polluted waters, sewage and activated sludge and bottom deposits	Clog filters and render water unaesthetic
		c) Plumatella	Polluted waters	Produces biological slimes and causes filter operational difficulties
		c) Dreissena, Asellus	Polluted waters	Harbour pathogenic organisms

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This Indian Standard has been developed from Doc No.: FAD 25 (2047).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Appendix O

ISI-IS2296-1982 standards for use-based classification of surface water

Tolerance and Classification

As per ISI-IS: 2296-1982, the tolerance limits of parameters are specified as per classified use of water (Table 1,2,3,4,5 below) depending on various uses of water. The following classifications have been adopted in India.

Class of Water

Classification	Type of use
Class A	Drinking water source without conventional treatment but after disinfection
Class B	Outdoor bathing
Class C	Drinking water source with conventional treatment followed by disinfection.
Class D	Fish culture and wild life propagation
Class E	Irrigation, industrial cooling or controlled waste disposal

TOLERANCE LIMITS

TABLE-1: TOLERANCE LIMITS FOR INLAND SURFACE WATERS, CLASS – A

S. No.	Characteristic	Tolerance
(1)	(2)	(3)
(i)	pH	6.5 to 8.5
(ii)	Dissolved Oxygen, mg/l,	6.0
(iii)	Bio-chemical Oxygen Demand	2.0
(iv)	Total Coliform Organisms, MPN/100 ml, Max	50
(v)	Colour, Hazen units, Max	10
(vi)	Odour	unobjectionable
(vii)	Taste	Agreeable taste
(viii)	Total Dissolved Solids, mg/l, Max	500
(ix)	Total Hardness (as $CaCO_3$), mg/l ,Max	300
(x)	Calcium Hardness (as $CaCO_3$), mg/l, Max	200
(xi)	Magnesium (as $CaCO_3$), mg/1,Max	100
(xii)	Copper (as Cu), mg/l, Max	1.5
(xiii)	Iron (as Fe), mg/l,Max	0.3
(xiv)	Manganese (as Mn), mg/1,Max	0.5
(xv)	Chlorides (as Cl), mg/l,Max	250
(xvi)	Sulphate (as SO_4), mg/l ,Max	400
(xvii)	Nitrates (as NO_2), mg/1,Max	20
(xviii)	Fluorides (as F,) mg/l,Max	1.5
(xix)	Phenolic compounds(as C_6H_5OH), mg/l,Max	0.002
(xx)	Mercury (as Hg), mg/l ,Max	0.001
(xxi)	Cadmium (as Cd), mg/1,Max	0.01
(xxii)	Selenium (as Se), mg/l ,Max	0.01
(xxiii)	Arsenic (as As), mg/1,Max	0.05
(xxiv)	Cyanides (as CN), mg/l, Max	0.05
(xxv)	Lead (as Pb), mg/l, Max	0.1
(xxvi)	Zinc (as Zn), mg/l, Max	15
(xxvii)	Chromium (asCr^{6+}), mg/l,Max	0.05
(xxviii)	Anionic detergents, (as MBAS), mg/l ,Max .	0.2
(xxix)	Poly-nuclear aromatic hydrocarbons (PAH),	0.2
(xxx)	Mineral oil, mg/l ,Max	0.01
(xxxi)	Barium (as Ba), mg/l ,Max	1.0
(xxxii)	Silver (as Ag), mg/l Max	0.05
(xxxiii)	Pesticides	Absent
(xxxiv)	Alpha emitters, µc/ml, Max	10^{-9}
(xxxv)	Beta emitters, µc/ml, Max	10^{-8}

TABLE- 2: TOLERANCE LIMITS FOR INLAND SURFACE WATERS, CLASS – B

S. No.	Characteristic	Tolerance Limit
(1)	(2)	(3)
(i)	pH Value	6.5 to 8.5
(ii)	Dissolved Oxygen, mg/1,Max	5.0
(iii)	Biochemical Oxygen Demand (5 days at 20 °C), Max	3.0
(iv)	Total Coliform Organisms, MPN/100 ml, Max	500
(v)	Fluorides (as F)<mg/l, Max	1.5
(vi)	Colour, Hazen units, Max	300
(vii)	Cyanides (as CN), mg/l, Max	0.05
(viii)	Arsenic (as As), mg/l, Max	0.2
(ix)	Phenolic Compounds (as C_6H_5OH) mg/l, Max	0.005
(x)	Chromium (as Cr^{6+}), mg/l, Max	1.0
(xi)	Anionic detergents (as MBAS), mg/l, Max	1.0
(xii)	Alpha emitters, µc/ml, Max	10^{-8}

TABLE - 3: TOLERANCE LIMITS FOR INLAND SURFACE WATERS, CLASS – C

S.No.	Characteristic	Tolerance Limit
(1)	(2)	(3)
(i)	pH Value	6.5 to 8.5
(ii)	Dissolved Oxygen, mg/l Minimum	4.0
(iii)	Biochemical Oxygen Demand	3.0
(iv)	Total coliform organisms, MPN/100 ml, Max	5000
(v)	Colour, Hazen units, Max	300
(vi)	Fluorides (as F), mg/l ,Max	1.5
(vii)	Cadmium (as Cd), mg/l, Max	0.01
(viii)	Chlorides (as Cl), mg/l, Max	600
(ix)	Chromium (as Cr^{6+}), mg/l, Max	0.05
(x)	Cyanides (as CN), mg/l, Max	0.05
(xi)	Total Dissolved Solids, mg/l, Max	1500
(xii)	Selenium (as Se), mg/l, Max	0.05
(xiii)	Sulphates (as SO_4), mg/l, Max	400
(xiv)	Lead (as Pb), mg/l, Max	0.1
(xv)	Copper (as Cu),mg/l,Max	1.5
(xvi)	Arsenic (as As), mg/l, Max	0.2
(xvii)	Iron (as Fe), mg/l, Max	50
(xviii)	Phenolic compounds (as C_6H_5OH), mg/l, Max	0.005
(xix)	Zinc (as Zn), mg/l, Max	15
(xx)	Insecticides, mg/l, Max	Absent
(xxi)	Anionic detergents (as MBAS), mg/l, Max	1.0
(xxii)	Oils and grease, mg/l, Max	0.1
(xxiii)	Nitrates (as NO_3), mg/1,Max	50
(xxiv)	Alpha emititers, µc/mg, Max	10^{-9}
(xxv)	Beta emitters, µc/ml, Max	10^{-8}

TABLE- 4: TEOLERANCE LIMITS FOR INLAND SURFACE WATERS, CALSS – D

S.No.	Characteristic	Tolerance Limit
(1)	**(2)**	**(3)**
(i)	pH value	6.5 to 8.5
(ii)	Dissolved Oxygen, mg/l, Min.	4.0
(iii)	Free Ammonia (as N), mg/l, Max.	1.2
(iv)	Electrical Conductance at 25 °C, µS, Max	1000
(v)	Free Carbon Dioxide (as $C0_2$),mg/1, Max	6.0
(vi)	Oils and Grease, mg/l, Max	0.1
(vii)	Alpha emitters, µc/ml, Max	10^{-9}
(viii)	Beta emitters, µc/ml, Max	10^{-8}

TABLE- 5: TOLERANCE LIMITS FOR INLAND SURFACE WATERS, CLASS – E

S.No.	Characteristic	Tolerance Limit
(1)	**(2)**	**(3)**
(i)	pH value	6.0 to 8.5
(ii)	Electrical Conductance at 25°C, µS, Max	2250
(iii)	Sodium Adsorption Ratio, Max	26
(iv)	Boron (as B), mg/l, Max	2.0
(v)	Total Dissolved Solids, (inorganic), mg/l, Max	2100
(vi)	Sulphates (as SO_4), mg/l, Max	1000
(vii)	Chlorides (as Cl), Mg/l, Max	600
(viii)	Sodium Percentage, Max	60
(ix)	Alpha emitters, µc/ml, Max	10^{-9}
(x)	Beta emitters, µc/ml, Max	10^{-8}

Appendix P
National Ambient Air Quality Standards

रजिस्ट्री सं. डी.एल.- 33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

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राष्ट्रीय परिवेशी वायु गुणवत्ता मानक

केन्द्रीय प्रदूषण नियंत्रण बोर्ड

अधिसूचना

नई दिल्ली, 18 नवम्बर, 2009

सं. बी-29016/20/90/पी.सी.आई. I.—वायु (प्रदूषण निवारण एवं नियंत्रण) अधिनियम, 1981 (1981 का 14) की धारा 16 की उपधारा (2) (एच) द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए तथा अधिसूचना संख्या का.आ. 384(ई), दिनांक 11 अप्रैल, 1994 और का.आ. 935 (ई) दिनांक 14 अक्टूबर 1998 के अधिक्रमण में केन्द्रीय प्रदूषण नियंत्रण बोर्ड इसके द्वारा तत्काल प्रभाव से राष्ट्रीय परिवेशी वायु गुणवत्ता मानक अधिसूचित करता है, जो इस प्रकार है:

राष्ट्रीय परिवेशी वायु गुणवत्ता मानक

क्र. सं.	प्रदूषक	समय आधारित औसत	परिवेशी वायु में सान्द्रण		
			औद्योगिक, रिहायशी, ग्रामीण और अन्य क्षेत्र	पारिस्थितिकी य संवेदनशील क्षेत्र (केन्द्र सरकार द्वारा अधिसूचित)	प्रबोधन की पद्धति
(1)	(2)	(3)	(4)	(5)	(6)
1	सल्फर डाई आक्साइड (SO_2), $\mu g/m^3$	वार्षिक*	50	20	-उन्नत वेस्ट और गाईक
		24 घंटे**	80	80	-पराबैंगनी प्रतिदीप्ती
2	नाइट्रोजन डाई आक्साइड (NO_2), $\mu g/m^3$	वार्षिक*	40	30	-जर्मानियम जैकब और हॉचाइजर
		24 घंटे**	80	80	(सोडियम-आर्सेनाईट)
					-रासायनिक संदीप्ति
3	विविक्त पदार्थ (10माइक्रान से कम आकार)या PM_{10}, $\mu g/m^3$	वार्षिक*	60	60	-हरात्मक विश्लेषण
		24 घंटे**	100	100	-बीटा तनुकरण पद्धति

4	विविक्त पदार्थ (2.5 माइक्रान से कम आकार या $PM_{2.5}$, $\mu g/m^3$	वार्षिक*	40	40	-हरात्मक विश्लेषण
		24 घंटे**	60	50	-टेपेम
					-बीटा तनुकरण पद्धति
5	ओजोन (O_3)	8 घंटे**	100	100	-पराबैंगनी द्वीप्तिकाल
	$\mu g/m^3$	1 घंटा**	180	180	-रासायनिक संदीप्ति
					-रासायनिक पद्धति
6	सीसा (Pb)	वार्षिक*	0.50	0.50	ई.पी.एम 2000 या समरूप
	$\mu g/m^3$	24 घंटे**	1.0	1.0	फिल्टर पेपर का प्रयोग करके AAS/ICP पद्धति
					-टेफलॉन फिल्टर पेपर का प्रयोग करते हुए ED-XRF
7	कार्बन मोनोक्साइड (CO)	8 घंटे**	02	02	-अवरक्त अवशोषी अवरक्त (NDIR)
	mg/m^3	1 घंटा**	04	04	स्पैक्ट्रम मापन
8	अमोनिया (NH_3)	वार्षिक*	100	100	-रासायनिक संदीप्ती
	$\mu g/m^3$	24 घंटे**	400	400	-इण्डोफिनॉल ब्लू पद्धति
9	बैन्जीन (C_6H_6)	वार्षिक*	05	05	- गैस क्रोमेटोग्राफी आधारित सतत् विश्लेषक
	$\mu g/m^3$				-अधिशोषण तथा निशोषण के बाद गैस क्रोमेटोग्राफी
10	बैन्जो (ए) पाईरीन (BaP) केवल विविक्त कण,	वार्षिक*	01	01	-विलायक निष्कर्षण के बाद HPLC/GC द्वारा विश्लेषण
	ng/m^3				
11	आर्सेनिक (As)	वार्षिक*	06	06	-असवितरक अवरक्त स्पैक्ट्रामिती ई.पी.एम. 2000 या समरूप फिल्टर पेपर का प्रयोग करके ICP/AAS पद्धति
	ng/m^3				
12	निकिल (Ni)	वार्षिक*	20	20	ई.पी.एम. 2000 या समरूप फिल्टर पेपर का प्रयोग करके ICP/AAS पद्धति
	ng/m^3				

* वर्ष में एक समान अंतरालों पर सप्ताह में दो बार प्रति 24 घंटे तक किसी एक स्थान विशेष पर लिये गये न्यूनतम 104 मापों का वार्षिक अंकगणीतीय औसत ।

** वर्ष में 98 प्रतिशत समय पर 24 घंटे या 8 घंटे या 1 घंटा के मानीटर मापमान, जो लागू हो, अनुपालन किये जाएंगे । दो प्रतिशत समय पर यह मापमान अधिक हो सकता है किन्तु क्रमिक दो मानीटर करने के दिनों पर नहीं ।

टिप्पणी-

1. जब कभी और जहां भी किसी अपने-अपने प्रवर्ग के लिये दो क्रमिक प्रबोधन दिनों पर मापित मूल्य, उसके विनिर्दिष्ट सीमा से अधिक हो तो इसे नियमित या निरंतर प्रबोधन तथा अतिरिक्त अन्वेषण करवाने के लिये पर्याप्त कारण समझा जायेगा ।

संत प्रसाद गौतम, अध्यक्ष

[विज्ञापन III/4/184/09/असा.]

टिप्पणी: राष्ट्रीय परिवेशी वायु गुणवत्ता मानक संबंधी अधिसूचनाएँ, केन्द्रीय प्रदूषण नियंत्रण बोर्ड द्वारा भारत के राजपत्र असाधारण में अधिसूचना संख्या का.आ. 384 (ई), दिनांक 11 अप्रैल, 1994 एवं का. आ. 935 (ई), दिनांक 14 अक्टूबर, 1998 द्वारा प्रकाशित की गयी थी ।

NATIONAL AMBIENT AIR QUALITY STANDARDS

CENTRAL POLLUTION CONTROL BOARD

NOTIFICATION

New Delhi, the 18th November, 2009

No. B-29016/20/90/PCI-I.—In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No.14 of 1981), and in supersession of the Notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October, 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect, namely:-

NATIONAL AMBIENT AIR QUALITY STANDARDS

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20	- Improved West and Gaeke
		24 hours**	80	80	-Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m^3	Annual*	40	30	- Modified Jacob & Hochheiser (Na-Arsenite)
		24 hours**	80	80	- Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM_{10} µg/m^3	Annual*	60	60	- Gravimetric - TOEM
		24 hours**	100	100	- Beta attenuation
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m^3	Annual*	40	40	- Gravimetric - TOEM
		24 hours**	60	60	- Beta attenuation
5	Ozone (O_3) µg/m^3	8 hours**	100	100	- UV photometric - Chemiluminescence
		1 hour**	180	180	- Chemical Method
6	Lead (Pb) µg/m^3	Annual*	0.50	0.50	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7	Carbon Monoxide (CO) mg/m^3	8 hours**	02	02	- Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour**	04	04	
8	Ammonia (NH_3) µg/m^3	Annual*	100	100	-Chemiluminescence -Indophenol blue method
		24 hours**	400	400	

(1)	(2)	(3)	(4)	(5)	(6)
9	Benzene (C_6H_6) $\mu g/m^3$	Annual*	05	05	- Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) - particulate phase only, ng/m^3	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m^3	Annual*	06	06	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m^3	Annual*	20	20	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note. — Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

SANT PRASAD GAUTAM, Chairman
[ADVT-III/4/184/09/Extv.]

Note: The notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India, Extraordinary vide notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October, 1998.

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Appendix Q
National Ambient Noise Standards

THE NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000

(The Principal Rules were published in the Gazette of India, vide S.O. 123(E), dated 14.2.2000 and subsequently amended vide S.O. 1046(E), dated 22.11.2000, S.O. 1088(E), dated 11.10.2002, S.O. 1569 (E), dated 19.09.2006 and S.O. 50 (E) dated 11.01.2010 under the Environment (Protection) Act, 1986.)

Whereas the increasing ambient noise levels in public places from various sources, inter-alia, industrial activity, construction activity, fire crackers, sound producing instruments, generator sets, loud speakers, public address systems, music systems, vehicular horns and other mechanical devices have deleterious effects on human health and the psychological well being of the people; it is considered necessary to regulate and control noise producing and generating sources with the objective of maintaining the ambient air quality standards in respect of noise;

Whereas a draft of Noise Pollution (Control and Regulation) Rules, 1999 was published under the notification of the Government of India in the Ministry of Environment and Forests vide number S.O. 528 (E), dated the 28th June, 1999 inviting objections and suggestions from all the persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which the copies of the Gazette containing the said notification are made available to the public;

And whereas copies of the said Gazette were made available to the public on the 1st day of July, 1999;

And whereas the objections and suggestions received from the public in respect of the said draft rules have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by clause (ii) of sub-section (2) of section 3, sub-section (1) and clause (b) of sub-section (2) of section 6 and section 25 of the Environment (Protection) Act, 1986 (29 of 1986) read with rule 5 of the Environment (Protection) Rules, 1986, the Central Government hereby makes the following rules for the regulation and control of noise producing and generating sources, namely:-

The Noise Pollution (Regulation and Control) Rules, 2000

1. Short-title and commencement.-

(1) These rules may be called the 'Noise Pollution (Regulation and Control) Rules, 2000.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. **Definitions-** In these rules, unless the context otherwise requires,-

(a) "Act" means the Environment (Protection) Act, 1986 (29 of 1986);

(b) "area / zone" means all areas which fall in either of the four categories given in the Schedule annexed to these rules;

(c) "authority" means and includes any authority or officer authorized by the Central Government, or as the case may be, the State Government in accordance with the laws in force and includes a District Magistrate, Police Commissioner, or any other officer not below the rank of the Deputy Superintendent of Police designated for the maintenance of the ambient air quality standards in respect of noise under any law for the time being in force;

(d) "court" means a governmental body consisting of one or more judges who sit to adjudicate disputes and administer justice and includes any court of law presided over by a judge, judges or a magistrate and acting as a tribunal in civil, taxation and criminal cases;

(e) "educational institution" means a school, seminary, college, university, professional academies, training institutes or other educational establishment, not necessarily a chartered institution and includes not only buildings, but also all grounds necessary for the accomplishment of the full scope of educational instruction, including those things essential to mental, moral and physical development;

(f) "hospital" means an institution for the reception and care of sick, wounded, infirm or aged persons, and includes government or private hospitals, nursing homes and clinics;

(g) "person" shall include any company or association or body of individuals, whether incorporated or not;

(h) "State Government" in relation to a Union territory means the Administrator thereof appointed under article 239 of the Constitution.

(i) "public place" means any place to which the public have access, whether as of right or not, and includes auditorium, hotels, public waiting rooms, convention centres, public offices, shopping malls, cinema halls, educational institutions, libraries, open grounds and the like which are visited by general public; and

(j) "night time" means the period between 10.00 p.m. and 6.00 a.m.

3. Ambient air quality standards in respect of noise for different areas/zones.-

(1) The ambient air quality standards in respect of noise for different areas / zones shall be such as specified in the Schedule annexed to these rules.

(2) The State Government shall categorize the areas into industrial, commercial, residential or silence areas / zones for the purpose of implementation of noise standards for different areas.

(3) The State Government shall take measures for abatement of noise including noise emanating from vehicular movements, blowing of horns, bursting of sound emitting firecrackers, use of loud speakers or public address system and sound producing instruments and ensure that the existing noise levels do not exceed the ambient air quality standards specified under these rules.

(4) All development authorities, local bodies and other concerned authorities while planning developmental activity or carrying out functions relating to town and country planning shall take into consideration all aspects of noise pollution as a parameter of quality of life to avoid noise menace and to achieve the objective of maintaining the ambient air quality standards in respect of noise.

(5) An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared as silence area / zone for the purpose of these rules.

4. Responsibility as to enforcement of noise pollution control measures.-

(1) The noise levels in any area / zone shall not exceed the ambient air quality standards in respect of noise as specified in the Schedule.

(2) The authority shall be responsible for the enforcement of noise pollution control measures and the due compliance of the ambient air quality standards in respect of noise.

(3) The respective State Pollution Control Boards or Pollution Control Committees in consultation with the Central Pollution Control Board shall collect, compile and publish technical and statistical data relating to noise pollution and measures devised for its effective prevention, control and abatement.

5. Restrictions on the use of loud speakers / public address system and sound producing instruments.-

(1) A loud speaker or a public address system shall not be used except after obtaining written permission from the authority.

(2) A loud speaker or a public address system or any sound producing instrument or a musical instrument or a sound amplifier shall not be used at night time except in closed premises for communication within, like auditoria, conference rooms, community halls, banquet halls or during a public emergency.

(3) Notwithstanding any thing contained in sub-rule (2), the State Government may subject to such terms and conditions as are necessary to reduce noise pollution, permit use of loud speakers or public address system and the like during night hours (between 10.00 p.m. to 12.00 midnight) on or during any cultural or religious festive occasion of a limited duration not exceeding fifteen days in all during a calendar year. The concerned State Government shall generally specify in advance, the number and particulars of the days on which such exemption would be operative.

(4) The noise level at the boundary of the public place, where loudspeaker or public address system or any other noise source is being used shall not exceed 10 dB (A) above the ambient noise standards for the area or 75 dB (A) whichever is lower;

(5) The peripheral noise level of a privately owned sound system or a sound producing instrument shall not, at the boundary of the private place, exceed by more than 5 dB (A) the ambient noise standards specified for the area in which it is used.

5A. Restrictions on the use of horns, sound emitting construction equipments and bursting of fire crackers:-

(1**)** No horn shall be used in silence zones or during night time in residential areas except during a public emergency**.**

(2) Sound emitting fire crackers shall not be burst in silence zone or during night time.

(3) Sound emitting construction equipments shall not be used or operated during night time in residential areas and silence zones.

6. Consequences of any violation in silence zone / area.-

Whoever, in any place covered under the silence zone / area commits any of the following offence, he shall be liable for penalty under the provisions of the Act:-

(i) whoever, plays any music or uses any sound amplifiers,

(ii) whoever, beats a drum or tom-tom or blows a horn either musical or pressure, or trumpet or beats or sounds any instrument, or

(iii) whoever, exhibits any mimetic, musical or other performances of a nature to attract crowds.

(iv) whoever, bursts sound emitting fire crackers; or

(v) whoever, uses a loud speaker or a public address system.

7. Complaints to be made to the authority.-

(1) A person may, if the noise level exceeds the ambient noise standards by 10 dB (A) or more given in the corresponding columns against any area / zone or, if there is a violation of any provision of these rules regarding restrictions imposed during night time, make a complaint to the authority.

(2) The authority shall act on the complaint and take action against the violator in accordance with the provisions of these rules and any other law in force.

8 Power to prohibit etc. continuance of music sound or noise.-

(1) If the authority is satisfied from the report of an officer incharge of a police station or other information received by him including from the complainant that it is necessary to do so in order to prevent annoyance, disturbance, discomfort or injury or risk of annoyance, disturbance, discomfort or injury to the public or to any person who dwell or occupy property on the vicinity, he may, by a written order issue such directions as he may consider necessary to any person for preventing, prohibiting, controlling or regulating:-

(a) the incidence or continuance in or upon any premises of-

(i) any vocal or instrumental music,

(ii) sounds caused by playing, beating, clashing, blowing or use in any manner whatsoever of any instrument including loudspeakers, public address systems, horn, construction

equipment, appliance or apparatus or contrivance which is capable of producing or re-producing sound, or

(iii) sound caused by bursting of sound emitting fire crackers, or,

(b) the carrying on in or upon, any premises of any trade, avocation or operation or process resulting in or attended with noise.

(2) The authority empowered under sub-rule (1) may, either on its own motion, or on the application of any person aggrieved by an order made under sub-rule (1), either rescind, modify or alter any such order:

Provided that before any such application is disposed of, the said authority shall afford to the applicant and to the original complainant, as the case may be, an opportunity of appearing before it either in person or by a person representing him and showing cause against the order and shall, if it rejects any such application either wholly or in part, record its reasons for such rejection.

SCHEDULE

(see rule 3(1) and 4(1))

Ambient Air Quality Standards in respect of Noise

Area Code	Category of Area / Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Note:- 1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A “decibel” is a unit in which noise is measured.

“A”, in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specified period.

Appendix R
STP outlet standards

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
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पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

अधिसूचना

नई दिल्ली, 13 अक्तूबर, 2017

सा.का.नि. 1265(अ).—केन्द्रीय सरकार, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 6 और धारा 25 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, पर्यावरण (संरक्षण) नियम, 1986 का और संशोधन करने के लिए निम्नलिखित नियम बनाती है, अर्थात् : —

1. **संक्षिप्त नाम और प्रारम्भ :—**(1) इन नियमों का संक्षिप्त नाम पर्यावरण (संरक्षण) संशोधन नियम, 2017 है ।

(2) ये राजपत्र में उनके प्रकाशन की तारीख को प्रवृत्त होंगे ।

2. पर्यावरण (संरक्षण) नियम, 1986 की अनुसूची-1 में, क्रम संख्यांक 104 और उससे सम्बन्धित प्रविष्टियों के पश्चात्, निम्नलिखित क्रम संख्यांक और प्रविष्टियां अन्तःस्थापित की जाएगी, अर्थात् :—

क्र. सं.	उद्योग	मानदंड	मानक	
1	2	3	4	
		बहिर्स्राव निस्सारण मानक (निपटान के सभी ढंगों को लागू)		
"105	मल उपचार संयंत्र (एसटीपी)		अवस्थान	सांद्र का निम्नलिखित से अधिक न होना
			(क)	(ख)
		पीएच	देश में कहीं भी	6.5-9.0
		जैव-रासायनिक ऑक्सीजन मांग (बीओडी)	महानगर* अरूणाचल प्रदेश, असम, मणिपुर, मेघालय, मिजोरम, नागालैण्ड, त्रिपुरा, सिक्किम, हिमाचल प्रदेश, उत्तराखंड, जम्मू-कश्मीर राज्यों और	

			अंदमान और निकोबार द्वीप, दादरा और नागर हवेली, दमण और दीव और लक्षद्वीप के सिवाय, सभी राज्यों की राजधानी ।	
			ऊपर उल्लिखित से भिन्न क्षेत्र/प्रदेश	30
		कुल निलंबित ठोस पदार्थ (टीएसएस)	महानगर* अरूणाचल प्रदेश, असम, मणिपुर, मेघालय, मिजोरम, नागालैण्ड, त्रिपुरा, सिक्किम, हिमाचल प्रदेश, उत्तराखंड, जम्मू-कश्मीर राज्यों और अंदमान और निकोबार द्वीप, दादरा और नागर हवेली, दमण और दीव और लक्षद्वीप के सिवाय, सभी राज्यों की राजधानी ।	<50
			ऊपर उल्लिखित से भिन्न क्षेत्र/प्रदेश	<100
		फेकल कोलीफॉर्म (एफसी) (अतिसंभाव्य संख्या प्रति 100 मिलीलिटर एमपीएन/100 मिलीलिटर	देश में कहीं भी	<1000

*मुम्बई, दिल्ली, कोलकाता, चेन्नई, बेंगलूरू, हैदराबाद, अहमदाबाद और पुणे महानगर हैं ।

टिप्पण :

(i) पीएच और फैकल कौलीफॉर्म के सिवाय, मिलीग्राम/लिटर में सभी मूल्य ।

(ii) ये, मानक जलाशयों में निस्सारण और भूमि निपटान/अनुप्रयोगों के लिए लागू होंगे ।

(iii) फैकल कौलीफॉर्म के लिए मानक औद्योगिक प्रयोजनों के लिए उपचारित बहिर्स्राव के उपयोग के सम्बन्ध में लागू नहीं होंगे ।

(iv) ये मानक 1 जून, 2019 को या उसके पश्चात् कमीशन किए जाने वाले सभी मल उपचार संयंत्रों (एसटीपी) को लागू होंगे और पुराने/विद्यमान मल उपचार संयंत्र (एसटीपी) राजपत्र में इस अधिसूचना के प्रकाशन की तारीख से पांच वर्ष की अवधि के भीतर इन मानकों को प्राप्त करेंगे ।

(v) समुद्र में उपचारित बहिर्स्राव के निस्सारण के मामले में, इसे उचित समुद्री मुहाने के माध्यम से किया जाएगा और विद्यमान तट निस्सारण को समुद्री मुहानों में संपरिवर्तित किया जाएगा और उन मामलों में, जहां समुद्री मुहाना निस्सारण के बिन्दु पर 150 गुणा न्यूनतम आरम्भिक तनुकरण और निस्सारण बिन्दु से दूर 100 मीटर के किसी बिन्दु पर 1500 गुणा न्यूनतम तनुकरण प्रदान करता है, तब विद्यमान सन्नियम साधारण निस्सारण मानकों में विनिर्दिष्ट किए गए अनुसार लागू होंगे ।

(vi) उपचारित बहिर्स्राव का पुनःउपयोग/पुनःचक्रण तथा उन मामलों में, जहां उपचारित बहिर्स्राव के भाग का पुनःउपयोग और पुनःचक्रण किया जाता है जिसमें मानवीय सम्पर्क की सम्भावना अन्तर्वलित है, ऊपर यथा विनिर्दिष्ट मानक लागू होंगे ।

(vii) केन्द्रीय प्रदूषण नियंत्रण बोर्ड/राज्य प्रदूषण नियंत्रण बोर्ड/प्रदूषण नियंत्रण समितियां, पर्यावरण (संरक्षण) अधिनियम, 1986 की धारा 5 के अधीन स्थानीय परिवेश को ध्यान में रखते हुए, अधिक कठोर सन्नियम जारी कर सकेगा/कर सकेंगी ।

[फा. सं. क्यू-15017/2/2008/-सीपीडब्ल्यू]

अरुण कुमार मेहता, अपर सचिव

टिप्पण : मूल नियम भारत के राजपत्र, असाधारण, भाग II, खंड 3, उप-खंड (i) में का.आ. सं. 844(अ), तारीख 19 नवम्बर, 1986 द्वारा प्रकाशित किए गए थे और तत्पश्चात् उनमें निम्नलिखित अधिसूचनाओं द्वारा संशोधन किए गए थे, अर्थात् :— का.आ. 433(अ), तारीख 18 अप्रैल, 1987; सा.का.नि. 176(अ), तारीख 2 अप्रैल, 1996; सा.का.नि. 97(अ), तारीख 18 फरवरी, 2009; सा.का.नि. 149(अ), तारीख 4 मार्च, 2009; सा.का.नि. 543(अ), तारीख 22 जुलाई, 2009; सा.का.नि. 739(अ), तारीख 9 सितम्बर, 2010; सा.का.नि. 809(अ), तारीख 4 अक्तूबर, 2010; सा.का.नि. 215(अ), तारीख 15 मार्च, 2011; सा.का.नि. 221(अ), तारीख 18 मार्च, 2011; सा.का.नि. 354(अ), तारीख 2 मई, 2011; सा.का.नि. 424(अ), तारीख 1 जून, 2011; सा.का.नि. 446(अ), तारीख 13 जून, 2011; सा.का.नि. 152(अ), तारीख 16 मार्च, 2012; सा.का.नि. 266(अ), तारीख 30 मार्च, 2012; सा.का.नि. 277(अ), तारीख 31 मार्च, 2012; सा.का.नि. 820(अ), तारीख 9 नवम्बर, 2012; सा.का.नि. 176(अ), तारीख 18 मार्च, 2013; सा.का.नि. 535(अ), तारीख 7 अगस्त, 2013; सा.का.नि. 771(अ), तारीख 11 दिसम्बर, 2013; सा.का.नि. 2(अ), तारीख 2 जनवरी, 2014; सा.का.नि. 229(अ), तारीख 28 मार्च, 2014; सा.का.नि. 232(अ), तारीख 31 मार्च, 2014; सा.का.नि. 325(अ), तारीख 7 मई, 2014; सा.का.नि. 612(अ), तारीख 25 अगस्त, 2014; सा.का.नि. 789(अ), तारीख 11 नवम्बर, 2014; का.आ. 3305(अ), तारीख 7 दिसम्बर, 2015; का.आ. 4(अ), तारीख 1 जनवरी, 2016; सा.का.नि. 35(अ), तारीख 14 जनवरी, 2016; सा.का.नि. 281(अ), तारीख 7 मार्च, 2016; सा.का.नि. 496(अ), तारीख 9 मई, 2016; सा.का.नि. 497(अ), तारीख 10 मई, 2016; सा.का.नि. 978(अ), तारीख 10 अक्तूबर, 2016; और अंतिम बार अधिसूचना संख्यांक सा.का.नि. 1016(अ), तारीख 28 अक्तूबर, 2016 द्वारा संशोधित किए गए थे ।

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 13th October, 2017

G.S.R. 1265(E).—In exercise of the powers conferred by sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely:-

1. **Short title and commencement.**—(1) These rules may be called the Environment (Protection) Amendment Rules, 2017.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986, in Schedule – I, after serial number 104 and the entries relating thereto, the following serial number and entries shall be inserted, namely:—

Sl. No.	Industry	Parameters	Standards	
1	2	3	4	
		Effluent discharge standards (applicable to all mode of disposal)		
"105	Sewage Treatment Plants (STPs)		Location	Concentration not to exceed
			(a)	(b)
		pH	Anywhere in the country	6.5-9.0
		Bio-Chemical Oxygen Demand (BOD)	Metro Cities*, all State Capitals except in the State of Arunachal Pradesh, Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, and Union territory of	20

			Andaman and Nicobar Islands, Dadar and Nagar Haveli Daman and Diu and Lakshadweep	
			Areas/regions other than mentioned above	30
		Total Suspended Solids (TSS)	Metro Cities*, all State Capitals except in the State of Arunachal Pradesh, Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh, Uttarakhand, Jammu and Kashmir and Union territory of Andaman and Nicobar Islands, Dadar and Nagar Haveli Daman and Diu and Lakshadweep	<50
			Areas/regions other than mentioned above	<100
		Fecal Coliform (FC) (Most Probable Number per 100 milliliter, MPN/100ml	Anywhere in the country	<1000

*Metro Cities are Mumbai, Delhi, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad and Pune.

Note :

(i) All values in mg/l except for pH and Fecal Coliform.

(ii) These standards shall be applicable for discharge into water bodies as well as for land disposal/applications.

(iii) The standards for Fecal Coliform shall not apply in respect of use of treated effluent for industrial purposes.

(iv) These Standards shall apply to all STPs to be commissioned on or after the 1st June, 2019 and the old/existing STPs shall achieve these standards within a period of five years from date of publication of this notification in the Official Gazette.

(v) In case of discharge of treated effluent into sea, it shall be through proper marine outfall and the existing shore discharge shall be converted to marine outfalls, and in cases where the marine outfall provides a minimum initial dilution of 150 times at the point of discharge and a minimum dilution of 1500 times at a point 100 meters away from discharge point, then, the existing norms shall apply as specified in the general discharge standards.

(vi) Reuse/Recycling of treated effluent shall be encouraged and in cases where part of the treated effluent is reused and recycled involving possibility of human contact, standards as specified above shall apply.

(vii) Central Pollution Control Board/State Pollution Control Boards/Pollution Control Committees may issue more stringent norms taking account to local condition under section 5 of the Environment (Protection) Act, 1986".

[F. No. Q-15017/2/2008-CPW]

ARUN KUMAR MEHTA, Addl. Secy.

Note : The principal rules were published in the Gazette of India, Extraordinary, Part II, Section 3,Sub-section (i) *vide* number S.O. 844 (E), dated the 19th November, 1986 and subsequently amended *vide* the following notifications, namely:—

S.O. 433 (E), dated the 18th April 1987; G.S.R. 176(E) dated the 2nd April, 1996; G.S.R. 97 (E), dated the 18th February, 2009; G.S.R. 149 (E), dated the 4th March , 2009; G.S.R. 543(E), dated the 22nd July,2009; G.S.R. 739 (E), dated the 9th September, 2010; G.S.R. 809(E), dated the 4th October, 2010, G.S.R.

215 (E), dated the 15th March, 2011; G.S.R. 221(E), dated the 18th March, 2011; G.S.R. 354 (E), dated the 2nd May, 2011; G.S.R. 424 (E), dated the 1st June, 2011; G.S.R. 446 (E), dated the 13th June, 2011; G.S.R. 152 (E), dated the 16th March, 2012; G.S.R. 266(E), dated the 30th March, 2012; and G.S.R. 277 (E), dated the 31st March, 2012; and G.S.R. 820(E), dated the 9th November, 2012; G.S.R. 176 (E), dated the 18th March, 2013; G.S.R. 535(E), dated the 7th August, 2013; G.S.R. 771(E), dated the 11th December, 2013; G.S.R. 2(E), dated the 2nd January, 2014; G.S.R. 229 (E), dated the 28th March, 2014; G.S.R. 232(E), dated the 31st March, 2014; G.S.R. 325(E), dated the 7th May, 2014; G.S.R. 612, (E), dated the 25th August 2014; G.S.R. 789(E), dated the 11th November 2014; S.O. 3305(E), dated the 7th December, 2015; S.O.4(E), dated the 1st January 2016; G.S.R. 35(E), dated the 14th January 2016; G.S.R. 281 (E), dated the 7th March, 2016; G.S.R. 496(E), dated the 9th May, 2016; G.S.R.497(E), dated the 10th May, 2016; G.S.R.978(E), dated the 10thOctober, 2016; and lastly amended vide notification G.S.R. 1016(E), dated the 28th October, 2016.

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Appendix S
Representative List of Liquid and Cryogenic Gases Cargos

Appendix S: Representative List of Liquid and Cryogenic Gases Cargos

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
1	**Ethylene**	Boiling Point: -104^{0}C Melting Point: -187.6^{0}C Flash Point: -105^{0}C Lower Explosion Limit: 2.2% Upper Explosion Limit: 30% Auto Ignition Temperature: 287°C	1	4	0	**Potential acute health effects:** **Eye contact:** Liquid can cause burns similar to frostbite. **Inhalation:** Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness. **Skin contact:** Dermal contact with rapidly evaporating liquid could result in freezing of the tissues or frostbite. **Frostbite:** Try to warm up the frozen tissues and seek medical attention. **Ingestion**: Can cause central nervous system (CNS) depression. Ingestion of liquid can cause burns similar to frostbite.	**First aid measures**: **Eye contact**: Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs. **Inhalation:** Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt, or waistband. **Skin:** Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
							symptoms occur. In case of contact with liquid, warm frozen tissues slowly with lukewarm water and get medical attention. Do not rub affected area. Wash clothing before reuse. Clean shoes thoroughly before reuse. **Ingestion:** Remove victim to fresh air and keep at rest in a position comfortable for breathing. Get medical attention. If necessary, call a poison center or physician. Ingestion of liquid can cause burns similar to frostbite. If frostbite occurs, get medical attention. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. As this product rapidly becomes a gas when released, refer to the inhalation section. **Firefighting measures:** Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
							Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. For incidents involving large quantities, thermally insulated undergarments and thick textile or leather gloves should be worn.
2	**Butane**	Boiling Point: <-2°C Melting point: -138^{0}C Flash Point: -50°C Lower Explosion Limit: 1.9% Upper Explosion Limit: 9% Auto Ignition Temperature: 365°C	1	4	0	**Eye contact:** Liquid can cause burns similar to frostbite. **Inhalation:** At very high concentrations, can displace the normal air and cause suffocation from lack of oxygen. High vapour concentrations may produce symptoms of oxygen deficiency which, coupled with central nervous system depression, may lead to rapid loss of consciousness. **Ingestion:** Ingestion of liquid can cause burns similar to frostbite. **Skin contact**:	**First aid measures**: **Eye contact:** Contact with liquid: Immediately flush with plenty of tepid water (105-115° F; 41-46° C). DO NOT USE HOT WATER. Get immediate medical attention. **Inhalation:** If inhaled, remove to fresh air. Get medical attention if symptoms occur. **Skin contact:** Do not use hot water. Flush contaminated skin with plenty of water. Drench contaminated clothing with water before removing. This is necessary to avoid the risk of sparks from static electricity that could ignite contaminated clothing. Contaminated clothing is a fire hazard. Contaminated leather, particularly footwear, must be discarded. Clean shoes thoroughly before reuse. In case of contact with liquid, warm frozen tissues slowly with lukewarm water and get medical attention. Get medical attention if symptoms occur. Do not apply

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
						Dermal contact with rapidly evaporating liquid could result in freezing of the tissues or frostbite.	ointment or powders. DO NOT rub or compress the burnt area of skin. DO NOT attempt to remove portions of clothing glued to the skin but cut round them. **Ingestion:** Not applicable (gas). **Firefighting Measures**: No action shall be taken involving any personal risk or without suitable training. Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so. In case of fire, allow gas to burn if flow cannot be shut off immediately. Apply water from a safe distance to cool container and protect surrounding areas. Every precaution must be taken to keep containers cool to avoid the possibility of a boiling liquid expanding vapour explosion. Pressurised containers are liable to explode violently when subjected to high temperatures.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
							Fire-fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear. For incidents involving large quantities, thermally insulated undergarments and thick textile or leather gloves should be worn.
3	**Propane**	Boiling Point: -45°C Melting point: -187.6^{0}C Flash Point: -105°C Lower Explosion Limit: 2.2% Upper Explosion Limit: 9.5% Auto Ignition Temperature: 287°C	1	4	0	**Eye contact**: Liquid can cause burns similar to frostbite. **Inhalation:** nausea or vomiting, headache, drowsiness/fatigue, dizziness/vertigo, unconsciousness. **Skin contact:** Dermal contact with rapidly evaporating liquid could result in freezing of the tissues or frostbite. **Ingestion:** Ingestion of liquid can cause burns similar to frostbite. .	**First aid measures**: **Eye contact:** Contact with liquid: Immediately flush with plenty of tepid water (105-115° F; 41-46° C). DO NOT USE HOT WATER. Get immediate medical attention. **Inhalation:** If inhaled, remove to fresh air. Get medical attention if symptoms occur. **Skin contact:** Do not use hot water. Flush contaminated skin with plenty of water. Drench contaminated clothing with water before removing. This is necessary to avoid the risk of sparks from static electricity that could ignite contaminated clothing. Clean shoes thoroughly before reuse. In case of contact with liquid, warm frozen tissues slowly with lukewarm water and get medical attention. Get medical attention if symptoms occur. Do not apply ointment or powders. DO NOT rub or compress the burnt area of skin. DO NOT attempt to remove portions of clothing glued to the skin but cut round them.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
							Ingestion: Not applicable (gas). **Firefighting Measures**: No action shall be taken involving any personal risk or without suitable training. Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so. In case of fire, allow gas to burn if flow cannot be shut off immediately. Apply water from a safe distance to cool container and protect surrounding areas. Every precaution must be taken to keep containers cool to avoid the possibility of a boiling liquid expanding vapour explosion. Pressurised containers are liable to explode violently when subjected to high temperatures. Fire-fighters should wear positive pressure self-contained breathing apparatus (SCBA) and full turnout gear. For incidents involving large quantities, thermally insulated undergarments and thick textile or leather gloves should be worn.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
4	**M-Xylene**	Boiling Point: 138-139^{0}C Melting point: -48^{0}C Flash Point: 25°C Lower Explosion Limit: 1.1% Upper Explosion Limit: 7% Auto Ignition Temperature: 465°C	3	3	0	**Potential Acute Health Effects:** Hazardous in case of skin contact(irritant, permeator), of eye contact(irritant), of ingestion, of inhalation.	**First aid measures**: **Eye Contact:** Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention. **Skin Contact:** Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician. **Inhalation:** Remove to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur. Risk of serious damage to the lungs (by aspiration). **Ingestion:** Clean mouth with water and drink afterwards plenty of water. Do NOT induce vomiting. Call a physician or poison control center immediately. If vomiting occurs naturally, have victim lean forward. **Firefighting measures**: Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.
5	**Propylene**	Boiling Point: >-47°C Flash Point: very inflammable Lower Explosive Limit: 2.0%	1	4	0	**Potential Acute Health Effects:** Concentration in air greater than 10% causes dizziness in	**First aid measures**: **Eyes:** Flush with water for 15 min. Get medical attention.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
		Upper Explosive Limit: 11.1% Auto Ignition Temperature: 497°C				few minutes. 1% conc. gives the same symptoms in 10 mts. High concentration causes asphyxiation. Liquid on skin causes frostbite	**Skin:** Frost bite can occur and appropriate treatment for it to be given. Remove the wetted clothes. Wash with warm water & soap. **Inhalation:** Remove to fresh air. Consult a physician if irritation persists. **Firefighting measures**: Fires should not be extinguished until flow of product is not stopped. Shut off gas and allow the product to burn. Cool the surroundings with water spray. Fire fighters should wear self-breathing apparatus while fighting fire.
6	**Motor Spirit**	Flash point: <-10°C Auto Ignition temperature: 250^{0}C-280°C Lower Flammability Limit: 1.4% Upper Flammability Limit: 7.6% Boiling point: 35^{0}C-215°C	1	3	0	**Potential Acute Health Effects:** Inhalation can cause dizziness, headache and nausea, depresses central nervous system and has an anaesthetic effect. Breathing of liquid droplets may lead to chemical pneumonia. Ingestion can lead to nausea, diarrhoea and affect central nervous system. Skin irritant. Prolonged contact can	**First aid measures**: **Eyes:** Flush with water for 15 min. Get medical attention. **Skin:** Wash with warm water & soap. **Inhalation:** Remove to fresh air. Consult a physician if irritation persists. **Ingestion**: Do not induce vomiting. Do not give liquids. Get medical help at once. **Firefighting Measures:** FIRE EXTINGUISHING AGENTS: Dry powder, foam, carbon dioxide Do not use water jets, water fog should be left to experienced personnel.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
						result in skin drying and dermatitis. Eye irritant.	Fires in confined space should be dealt with by trained personnel wearing approved breathing apparatus.
7	**LPG**	Flash point: -76°C to -156^{0}C Auto Ignition temperature: 320^{0}C-405°C Lower Flammability Limit: 1.8% Upper Flammability Limit: 12.8% Boiling point: >-40^{0}C	1	4	0	**Potential Acute Health Effects:** Inhalation can cause headache, disorientation, dizziness, drowsiness and possibly Unconsciousness at concentrations that cause oxygen deficiency and asphyxiation. Rapidly expanding gas or vaporized liquid may cause frostbite to skin and eyes	**First aid measures**: **Skin:** If freeze burn occurs, gently bathe affected area in warm water (38 – 43) deg.C. Do not rub. Get medical attention. **Eye:** Immediately flush with large amounts of lukewarm water for 15 minutes, lifting upper and lower lids at intervals. Seek medical attention if irritation persists. **Inhalation:** Remove to fresh air. Give oxygen, artificial respiration, or CPR if needed. Seek medical attention. **Ingestion:** Usually no effect by this route **Firefighting measures**: Allow the fire to burn under controlled conditions. Stop leak if you can do it without risk. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Use water to cool equipment, surfaces and containers exposed to fire and excessive heat. For large fire the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
8	**LNG**	Flash point: -187.8°C Auto Ignition temperature: 537.22 Lower Flammability Limit: 5.3% Upper Flammability Limit: 15% Boiling point: -161^{0}C	2	4	0	**Potential Acute Health Effects:** **Skin:** Dermal contact can cause freezing or severe cryogenic burns. **Inhalation:** Inhalation can lead to CNS depression and Cardiac Sensitization	**Eye:** Gently flush with lukewarm water but never use hot water**.** Keep the eyelids open so the LNG can dry naturally. If the person cannot tolerate light, cover their eyes with a soft cloth or bandage. **Skin:** If freeze burn occurs, gently bathe affected area in warm water (100-105) deg. C Do not rub. Get medical attention. **Inhalation:** Remove inhalation victims to fresh air quickly. If inhalation victim is not breathing, ensure that the airways are open and administer cardiopulmonary resuscitation (CPR**).** **Ingestion:** Ingestion is rare as it is in Gas form.Seek immediate medical attention if material is ingested.
9	**Ammonia (NH3)**	Lower Flammability Limit:16 %, Upper Flammability Limit:25 % Boiling point: -28^{0}C Auto Ignition temperature: 690^{0}C	3	1	0	**Potential Acute Health Effects:** **Eyes:** Severely corrosive to the eyes. Contact with rapidly expanding gas may cause burns or frostbite. **Skin:** Contact with rapidly expanding gas may cause burns or frostbite**.** **Inhalation:** Inhalation can cause irritation, difficulty breathing and effect lungs	**Eyes**: Immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention Immediately. **Skin:** In case of contact, rinse with plenty of water for at least 15 minutes and remove contaminated clothing and shoes. **Inhalation:** Expose to fresh air and seek immediate medical attention**.** **Fire Fighting measures:** Allow fire to burn out, evacuate everyone from the danger zone immediately and Cool containers with water from a safe distance to prevent explosions.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
10	**Ethylene Glycol**	Flash Point: 111^{0}C Boiling Point: 197.6^{0}C Melting Point: -13^{0}C Lower Flammability Limit: 3.2% Auto Ignition Temperature: 398^{0}C	1	1	0	**Potential Acute Health Effects:** **Eyes:** Exposure Can cause irritation to the eyes. **Skin:** Dermal contact can cause mild irritation. **Ingestion:** Hazardous in case of ingestion and cause serious health problems.	**Eye:** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs. **Skin**: Wash the affected area with soap and water. In case of irritation get medical attention. **Inhalation:** Remove to fresh air and get medical attention immediately. **Ingestion:** Do not induce vomiting. Do not give liquids. Get medical help at once. **Fire Fighting measures**: In case of small fires use dry chemical powder and for large fires use water spray, fog or foam.
11	**Vinyl Chloride**	Flash Point: 78^{0}C Boiling Point: -13^{0}C Melting Point: -154^{0}C Lower Flammable Limit: 3.6% Upper Flammable Limit:33% Auto Ignition Temperature: 472^{0}C	2	4	1	**Potential Health Effects:** **Eyes**: Exposure can cause irritation to the eyes **Inhalation:** Inhalation can cause irritation, Nausea, headache and difficulty breathing. **Skin:** Dermal contact can cause irritation and blisters. **Ingestion**: Hazardous in case of ingestion.	**Eye:** Wash eyes immediately with large amounts of water. Get medical attention immediately. **Skin:** In case of frostbite immediately flush with plenty of lukewarm water. Do Not use hot water. **Inhalation:** Move to uncontaminated area and get immediate medical attention. **Ingestion:** Get immediate medical attention if large amount is ingested. **Fire Fighting measures:** Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. Let burn unless leak can be stopped immediately. Evacuate if fire gets out of control or containers are directly exposed to fire.
12	**Phenol**	Flash Point: 79^{0}C Boiling Point: 182^{0}C Melting Point: 42^{0}C Lower Flammable Limit: 1.7%	4	2	0	**Potential Acute Health Effects:**	**Eye:** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
		Upper Flammable Limit: 8.6% Auto Ignition Temperature: 715^{0}C				**Skin:** In case of skin contact it is very hazardous, causes irritation and inflammation **Eye:** Exposure can cause corneal damage or blindness. **Inhalation:** Inhalation can cause irritation to respiratory tract lung damage and lung damage	**Skin:** In case of contact, immediately flush skin with plenty of water for at least 15 minutes. Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention. **Inhalation**: If inhaled, remove to fresh air. Seek immediate medical attention. **Ingestion**: Do not induce vomiting. Never give anything by mouth to an unconscious person.
13	**Propylene Oxide**	Flash Point: -37^{0}C Boiling Point: 34.23°C Melting Point: -112°C Flash Point: -370C Lower Flammable Limit:2.3% Upper Flammable Limit:36% Auto Ignition Temperature: 449°C	3	4	2	**Potential Acute Health Effects:** **Eye:** In case of contact causes irritation, redness and is very hazardous for eye. **Skin:** In case of Skin contact causes irritation and can penetrate through skin.	**Eye:** Immediately flush eyes with running water for at least 15 minutes. Seek immediate medical attention. **Skin:** In case of contact, with plenty of water. Gently and thoroughly wash the contaminated skin with running water. Seek immediate medical attention. **Inhalation:** Rest in a well-ventilated area and seek an immediate medical attention. **Ingestion:** Do not induce vomiting. Seek immediate medical attention.
14	**Isobutyl Alcohol**	Flash Point: 28^{0}C Boiling Point: 108°C Melting Point: -108°C Lower Flammable Limit:1.2%	1	3	0	**Potential Acute Health Effects:** **Skin:** Hazardous in case of skin contact and causes irritation.	**Eyes:** Immediately flush eyes with running water for at least 15 minutes. Get medical attention. **Skin**: In case of contact, immediately flush skin with plenty of water. Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

S.No	Chemical	Properties	NFPA 704 codes			Health hazard	Precautionary measures
			H	F	R/I		
		Upper Flammable Limit:10.9% Auto Ignition Temperature: 415.56°C				**Eye:** Causes irritation to the eyes.	**Inhalation**: If inhaled, move to fresh air. Seek medical attention. **Ingestion:** Do NOT induce vomiting unless directed to do so. Get medical attention if symptoms appear.
15	**Acrylonitrile**	Flash Point: -1.1111^{0}C Boiling Point: 77.3°C Melting Point: -82°C Lower Flammable Limit:3.1% Upper Flammable Limit:17% Auto Ignition Temperature: 481.11°C	4	3	2	**Potential Acute Health Effects:** **Skin:** Causes irritation to the skin and very hazardous. **Eyes:** In case of eye contact causes irritation. Severe over-exposure can result in death.	**Eye:** In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention. **Skin:** case of contact, immediately flush skin with plenty of water for at least 15 minutes. Cover the irritated skin with an emollient. **Inhalation**: If inhaled, remove to fresh air. Get medical attention immediately. **Ingestion:** Do not induce vomiting and never give anything by mouth. Get medical attention immediately.

Appendix T

SOPs designed for various Disasters/Emergency incidents

SOP 1 - Vessel grounding / hitting breakwater etc

Objective:

1) The main objective of the procedure to handle the vessel grounding /hitting break water scenario in effective manner.
2) To identify and laid down procedures to the co-coordinator related to this emergencies.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To avoid /minimize any sort of pollution and ensure workers safety in port vicinity.

Team :

- Incident Commander (Head Marine)
- POC
- Marine Operator
- Coastguard /Marine police.
- Fire & Safety
- Port Medical Centre
- Security
- Public Relations Officer
- Cargo Team (If need arises).

Procedure:-

- Raise Alarm if necessary / Inform Head of Port.
- Muster the Crisis Management Team.
- Incident Commander to take charge of Emergency control room and inform HO.
- Marine craft including tugs / boats etc. to be kept standby.
- Mark vessel's position in chart.
- Monitor the weather / tide conditions on hourly basis.
- Co-ordinate with coastguard or any other related external agencies on facilities /other requirements.
- Advice vessel to Assess preliminary damage – sound her tanks, extent & point of grounding, possibility ofcargo damage / oil spill etc. In case of oil spill, follow response procedure for oil pollution.
- Log all communications.
- Initiate re-floating attempts after careful analysis and after advising vessel to close all watertight compartments.
- Assess any damage to port structure / buoys etc. and issue Liability notice to vessel.
- Ensure vessel calls H & M / P& I surveyors and assessment done prior commencing cargo discharge. Extent of cargo damage to be clearly indicated by P & I surveyor.
- Prior vessel sailing, ensure that she is seaworthy and owners have indemnified / provided guarantee to the port against damages.

SOP 2 - Vessel Collision

Objective:

1) The main objective of the procedure to handle the vessels collision scenario in effective manner.
2) To identify and laid down procedures to the co-ordinator related to this emergencies.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To avoid /minimize any sort of pollution and ensure workers safety in port vicinity.

Team:

- Incident Commander (Head Marine)
- POC
- Marine Operator
- ERT Team (IMO Level 01 Trained peoples)
- Fire & Safety
- Port Medical Centre
- Security
- Coastguard /Marine police.
- Public Relations Officer

Procedure:-

- Raise Alarm if necessary
- Inform Head of port and Muster the Crisis Management Team.
- Incident Commander to take charge of Emergency control room and inform HO.
- Warn other traffic in Vicinity.
- Marine craft including tugs / boats etc. to be kept standby.
- Mark vessel's position in chart & Bathy survey to be carried out in the surrounding area of the vessel to ascertain depths.
- Monitor the weather / tide conditions on hourly basis.
- Advice vessels to assess preliminary damage after ensuring that they are safely anchored – sound tanks,extent & point of collision, possibility of cargo damage / oil spill etc. In case of oil spill, follow response procedure for oil pollution.
- Log all communications.
- If there is a danger of vessel sinking, consider grounding her outside the channel.
- Any fire to be dealt with as per response plan for fire.
- Assess any damage to port structure / buoys etc. and issue Liability notice to vessel if any damage noticed.
- Ensure vessel calls H & M / P& I surveyors and assessment done prior commencing cargo discharge. Extent of cargo damage to be clearly indicated by P & I surveyor and notified to receivers / shippers.

Prior vessel sailing, ensure that she is seaworthy and owners have indemnified / provided guarantee to the port against damages

SOP 3 - Vessel Mooring Failure

Objective:

1) The main objective of the procedure to handle the vessel mooring failure scenario in effective manner.
2) To identify and laid down procedures to the co-ordinator related to this emergencies.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To avoid /minimize any sort of pollution and ensure workers safety in port vicinity.

Team:

- Incident Commander (Head Marine)
- POC
- Marine Operator
- ERT Team
- Fire & Safety
- Port Medical Centre
- Security
- Coastguard /Marine police.
- Public Relations Officer (IR)

Procedure

This can occur in sudden squalls, Tsunami or other conditions when vessel's mooring parts due to sudden strain on the mooring lines. Adequate warning, if available should be given to the vessel on squall / cyclone / Tsunami if & when available. Mooring crew (ashore & onboard) to be mobilized immediately if mooring failure is imminent and strengthening of mooring to be resorted to. If there is adequate warning of cyclone / Tsunami, the best action is to sail the vessel out of port. If, in spite of these precautions, vessel parts her lines, following action to be taken:

- Marine craft including tugs / boats, mooring crew, Pilot to be kept standby for assisting in re-mooring.
- Raise Alarm & stop cargo / bunkering operations.
- Inform Head of Port and Muster the Crisis Management Team.
- Incident Commander to take charge of Emergency control room and inform HO.
- On scene commander (HOD Marine) to assume charge at the jetty.
- Warn other vessels in Vicinity and ask them to prepare engines.
- Provide continued weather/ Tide conditions data to the operational team.
- Log all communications and
- Use all possible resources to prevent damage to vessels or port property.
- In case any damage occurs to the port property, assess the damage and issue Liability notice to vessel.
- Prior vessel sailing, ensure that she is seaworthy and owners have indemnified / provided guarantee to theport against damages – if applicable.

SOP 4 - Fire at vessel or other areas

Objective:

- The main objective of the procedure to handle vessel or other area's fire scenario in effective manner.
- To identify and laid down procedures to the coordinator related to this emergencies.
- To determine in sorting out the stage where external support to be rendered.
- To ensure minimum/zero disturbances to the operational requirement of the port.
- To avoid /minimize any sort of pollution and ensure workers safety in port vicinity

Team:

- Incident Commander (Head Marine)
- Fire & Rescue Team
- Port Medical Centre
- Marine Operator
- ERT Team
- Security
- Mechanical & Electrical Team.
- Coastguard (If need arises).
- Public Relations Officer (IR)

Standard Operating Procedure (SOP) for fire at vessel:

- Raise Alarm & stop all operations.
- Inform Head of Port.
- Muster the Crisis Management Team.
- Incident Commander to take charge of Emergency control room and inform HO.
- On Scene Commander to assume charge at the scene of fire.
- Remove flammable material from nearby areas as far as possible. In case of fire in a ship, towing the ship out of the port can be considered to prevent spread of fire to other areas of port.
- Isolate Electrical supply in affected area.
- Cordon off the area and remove unauthorized persons from the scene.
- Approach fire from upwind area where possible.
- Water / Foam as appropriate to be used after ensuring electrical isolation in case of cargo / vessel fire.
- Switchboard / Control room fires to be extinguished using CO2, DCP or other suitable extinguishers. (DONOT USE WATER / FOAM)
- Boundary cooling, Sprinkling system, fire curtains can be used effectively to tackle fire.
- Fire tender, Tugs, Fire extinguishers can be used to access areas where coverage of fire main is foundwanting.
- Additional fire fighting resources from Nagapattinam / Karaikal port & Town can be sought if necessary. Medical facilities to be ready at hand to treat personnel affected.

SOP 5 - Oil Spill in Port

Objective:

1) The main objective of the procedure to handle the oil pollution scenario in effective manner.
2) To identify and laid down procedures to the co-coordinator related to this emergencies.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To Comply with Oil Spill Contingency Plan.
5) To avoid /minimize any sort of pollution to the environment.

Team:

- Incident Commander (Head Marine)
- POC
- Marine Operator
- ERT Team (IMO Level 01& 02 Trained Peoples)
- Fire & Safety
- Security
- Coastguard /Marine police.
- Public Relations Officer (IR)

In all cases of oil handling operations, pollution control equipment should be kept readily available near the area of operation & should be easily deployable.

Standard Operating Procedure (SOP) for Oil pollution:

- Raise Alarm & stop all cargo / bunkering operations.
- Inform Head of Port.
- Muster the Crisis Management Team.
- Incident Commander to take charge of Emergency control room and inform HO.
- On Scene Commander to assume charge at the scene of pollution.
- Cordon off area & remove unauthorized persons.
- Inform CPCL & KPPL Tank farm to isolate all valves.
- On shore fire fighting equipments and fire fighters to be kept in standby.
- Marine crafts (tugs / Boats) to be kept on standby.
- OSR equipments to be kept in standby at jetty
- Spill removing and additional arrangements to be arranged **(Refer Oil spill Contingency Plan: Appendix-7)**
- Additional resources like booms, skimmers, power pack etc. can also be initiated from Chemplast jetties.
- Admin and operation team to be arranged necessary man power, excavating equipments and storage facilities.
- Provide continued weather/ Tide conditions, current and wind direction data's to the spill control team.

- Deploy the spill control booms appropriately to contain the spread of oil.
- Pollution from a vessel in anchorage needs careful monitoring of wind & tidal conditions to assess the flow of oil – Refer Oil Spill Contingency Plan.
- Remember that evaporating hydrocarbons can ignite if exposed to a source of fire. Hence isolate all sources of fire within at least 500mtrs of spill.
- Use of foam blanket over a pool of oil can be considered to contain evaporation of lighter elements.
- Containment, diversion, use of chemicals can be considered to prevent pollution from hitting the shore / beaches.

If pollution cannot be contained, inform Coast Guard. Use the appropriate reporting format as contained in the **Oil spill contingency plan**.

SOP 6 - Bomb or Terrorist Threat

Objective:

1) The main objective of the procedure to handle Bomb threat and terrorist attack scenario in effective manner.
2) To initiate and assist appropriate external support
3) To identify and laid down procedures as per ISPS code related to this emergencies.
4) To ensure minimum/zero disturbances to the operational requirement of the port.
5) To ensure workers safety.

Team:

- Incident Commander –Head Marine / PFSO
- On Scene Commander – Head Security
- POC
- ERT Team
- Fire & Safety
- Local police/Marine police/ Coastguard /Navy.
- Public Relations Officer (IR)

If such a threat is received by phone call (which normally is the case), try to engage the person in conversation without panic & obtain as much information as possible as to the location, size of bomb, possible extent of damage etc. Most of the informers like to talk / boast about their knowledge & this should be exploited. In any case, following actions to be taken until the bomb squad clears the area:

Standard Operating Procedure (SOP) for Bomb or Terrorist Threat:

- Raise Alarm.
- Inform Head of Port / PFSO / Dy. PFSO / Bomb Squad / Police.
- Muster the Crisis Management Team.
- Incident Commander to take charge of Emergency control room and inform HO.
- Respective On Scene Commander to assume charge at the Threatened area.
- Cordon off the area if known & remove unauthorized personnel. Otherwise assemble all personnel.
- Remove all flammable / explosive material from the suspected area. Refer Port Facility Security Plan.
- Don't touch a suspect box or cylindrical object; there is the possibility of sliding contacts, mercury switches, or balanced pendulum fusing systems.
- Don't cut a string or any other object attached to suspected package; there is the possibility of pressure release devices.
- Don't shake or jar suspect object; a bottle on its side may cause certain hypergolic chemicals to mix, causing a mechanical explosion or violent reaction.

search as rapidly as possible.

- Don't become careless and overconfident, but complete the search.
- Keep in mind that more than one object may be planted.
- Don't allow two-way radio transmission in the near vicinity of suspected object. Static Electricity can cause electric fuse caps to explode.
- Security camera can be used for surveillance of other areas & personnel.
- PA system to be used extensively along with security personnel in crowd control.
- Decision can be taken on evacuating all unnecessary personnel from Port.
- Unberth ships from port

SOP 7 - Major gas release from neighbouring Plant

Objective:

1) The main objective of the procedure to handle the poisonous gas release from neighbor industries in effective manner.
2) To identify and laid down procedures to the co-ordinator related to this emergencies.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To avoid /minimize any sort of pollution in port vicinity.
5) To ensure workers safety.

Team:

- Incident Commander Head (Marine)
- POC
- Marine Operator
- ERT Team
- Fire & Safety
- Security
- Public Relations Officer (IR)

M/s Chemplast Sanmar, situated adjacent to our port (NNW of the port) has an Ethylene storage capacity of about 7000 MT stored in a atmospheric tank. Ethylene is highly flammable. If any gas release takes place in their tank, the vapour cloud can hang over the port. The exposure limit for Ethylene is 200ppm. It is advised to evacuate about 800mtrs in case of leaks considering the wind direction and amount of discharge.

Standard Operating Procedure (SOP) for Major Gas release by Chemplast Sanmar:

- Raise Alarm. Use PA system to warn personnel of leak.
- Stop all operation in the port and Inform Head of Port.
- Muster the Crisis Management Team.
- Incident Commander to take charge of Emergency control room and inform HO.
- Shut off all windows & ventilators that have intake from outside.
- Evacuate all personnel from railway Siding & coal yard (northern part of port).
- Monitor the direction and speed of wind and pass those details to the on- scene commander.
- Eliminate all potential ignition sources from railway yard, northern coal yard and MSS.
- Communicate continuously with M/s Chemplast Sanmar and assess the situation.
- Fire main, Fire tender, Ambulance to be in a state of readiness. Remember ethylene can cause eye irritation,coma and persist effect. Fire fighters advised to wear heat resistant suit with SCBA.
- Warn vessels in port of the leak and advice them to resort to closed ventilation.
- Refer MSDS of Ethylene (Annexure I)

SOP 8 - Civil disturbance /Riots

Objective:

1) The main objective of the procedure to handle the civil disturbance/riots scenario in effective manner.
2) To identify and laid down procedures to the co-ordinator related to this emergencies.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To avoid /minimize any sort of pollution in port vicinity.
5) To ensure workers safety.

Team:

- Incident Commander PFSO
- On Scene Commander Head Security
- POC
- ERT Team.
- Fire & Safety
- Local police/ Coastguard / Marine police.
- Public Relations Officer (IR)

Standard Operating Procedure (SOP) for Civil Disturbance / Riots:

- Raise Alarm if necessary
- Inform Head of Port.
- Close down the port entrance & arrest access to port.
- Incident Commander to take charge of Emergency control room and inform HO
- Muster Crisis Management Team
- Inform the local police / Collector & seek additional help.
- Reinforce the security at the gate. Entry can be controlled by barricading with empty containers or trucks/tippers closely parked.
- Rig up fire hoses (Fire tender) at gate – to ward off unnecessary elements if required.
- Use PA system extensively to control the mob.
- Lights can also be used to effectively control the mob.
- Monitor movements with security camera from Emergency control room.
- Inform all employees / contractors of the situation at port.
- Refer Port Facility Security Plan.

SOP 9 - Cyclone

Objective:

1) The main objective of the procedure is to handle the cyclone in effective manner.
2) To identify and laid down procedures to the co-ordinator related to this emergency.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To avoid /minimize any sort of pollution in port vicinity.
5) To ensure workers safety.

Team:

- Incident Commander
- Head (Marine)
- POC
- Marine Operator
- ERT Team
- Fire & Safety
- Security
- Admin & HR team
- Public Relations Officer (IR)
- Any External agencies, if required

Adequate meteorological warning facilities are available for cyclones. In spite of that, cyclone create enough havoc. Closely monitoring the movement of cyclone is the key for action plan.

Standard Operating Procedure (SOP) for Cyclone:

- Raise Alarm and all operations
- Inform Head of Port.
- Raise appropriate cyclone signal at MCT.
- To monitor regular update on cyclone track.
- Use PA system to warn personnel to assemble at respective assembly point.
- Prepare to stop operations and put out vessels to sea, if necessary.
- Reinforce moorings of smaller crafts / dredgers in port.
- Batten down cranes, buildings and warehouses, if necessary.
- Securing Ship-unloaders and stacker cum reclaimers to parking position and applying storm anchoring system
- Check foundations of all civil structures & tall erections like High mast towers.
- Fill up fuel in Bunk, tugs, ambulance, fire tender etc. & keep them ready.
- Admin manager shall arrange transport facility for evacuation if necessary.

- Clear out drainages since cyclones are associated with lots of rain.
- Incident Commander to take charge of Emergency control room and inform HO
- Muster Crisis Management Team, if deemed necessary.
- Monitor the scouring of Vettar River as it can damage the compound wall.
- Electrocution due to high voltage lines snapping is a common problem. Check efficiency of all Circuit breakers.
- Provide continued weather/ Tide conditions and wind direction data's to on scene commander.
- On consultation with on scene commander the power supply can be cut-off.
- Labors and other weaker area people shall be shifted to safe location (If necessary)
- Establish communication with nearby ports & civic authorities.
- Other staffs standby to assist.

SOP 10 - Tsunami

Objective:

1) The main objective of the procedure to handle the Tsunami scenario in effective manner.
2) To identify and laid down procedures to the co-ordinator related to this emergencies.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To avoid /minimize any sort of pollution in port vicinity.
5) To ensure workers safety.

Team:

- Incident Commander Head (Marine)
- POC
- Marine Operator
- ERT Team
- Fire & Safety
- Security
- Admin & HR team
- Facilities team
- Coastguard /Marine police.
- Public Relations Officer (IR)

Caused due to an earthquake in the sea & often arrives without much warning. Imminent indication is sudden increasing of water level in port. Though warning centers are available, we cannot be always sure of early warning. Compared to nearby low areas, port is at + 4.0 meters level and hence it is comparatively safer.

Standard Operating Procedure (SOP) for Tsunami:

- Raise Alarm.
- Stop all operations.
- Inform Head of Port.
- Muster the Crisis Management Team.
- Evacuate people from waterfront & move them outside port.
- Incident Commander to take charge of Emergency control room and inform HO.
- Secondary Emergency control room can be established if necessary through mobile caravan/ bus.
- Pilots on standby to take out the vessels from port.
- Warn vessels & all marine crafts in port and ask them to prepare engines. If time permits, they can be put out to sea. Otherwise, they should call stations & attend to moorings.
- Cutter suction Dredgers to reinforce moorings where possible.
- Batten down warehouses / buildings / crane (MHC) lower the boom where possible.
- Securing Ship-unloaders and stacker cum reclaimers to parking position and applying storm anchoring system
- Move all equipments and others machinery from water front to safer area.
- Communicate with nearby ports & district authorities.
- Standby to assist maintaining safe distance.

SOP 11–Flood

Objective

The Main Objective of this SOP is to make sure that appropriate and effective response measures are taken during flood emergency to minimize the loss of life and property.

- Declaration of Flood Crisis
- Flood Forecasting and Warning
- Trigger Mechanism
- Response Mechanism of the concerned departments along with the roles and responsibilities

Team:

- Incident Commander Head (Marine)
- POC
- PMC
- ERT Team
- Admin & HR team
- Fire & Safety
- Security
- Respective Hospital Authorities
- Public Relations Officer

Standard Operating Procedures for Flood Risk Management

- Observe the warning from the Meteorological and District Administration
- Prior to flood ensure the River Mouth Is clear from the silt of Pravadaiyanar River in North Direction
- Clear out drainages for easy flow of water since Flood associated with lots of rain.
- Keep adequate Sand Bags in ready condition for placement to control the Flood
- Ensure adequate transportation facilities for employee evacuation
- Identify Emergency Response Team to manage the flood situations
- Inform Head of Port and raise Alarm in case of Flood
- To monitor regular update on Flood Condition in Pravadaiyan River and Vettar River through POC
- Use PA system to warn personnel to assemble at respective assembly point.
- Prepare to stop operations, if necessary.
- Observe the water flow in the River Bridge located nearby Port to ensure smooth vehicle movement. Keep close coordination with District Administration.
- Ensure No personal movement along the compound wall.
- Fill up fuel in Bunk, tugs, ambulance, fire tender etc. & keep them ready.

- Admin manager shall arrange transport facility for evacuation if necessary.
- Incident Commander to take charge of Emergency control room and inform HO
- Muster Crisis Management Team, if deemed necessary.
- Monitor the scouring of Vettar River as it can damage the compound wall.
- Electrocution due to high voltage lines snapping is a common problem. Check efficiency of all Circuit breakers.
- Securing Ship-unloaders and stacker cum reclaimers to parking position and applying storm anchoring system
- Provide continued weather/ Tide conditions and wind direction data's to on scene commander.
- On consultation with on scene commander the power supply can be cut-off.
- Labors and other vulnerable area people shall be shifted to safe location (If necessary)
- Establish communication with nearby ports & civic authorities.
- Other staffs& ERT standby to assist in case of Flood Risk poses serious threat.

SOP 12- Earth-Quake

Objective:

1) The main objective of the procedure to handle the earthquake scenario in effective manner.
2) To identify and laid down procedures to the co-ordinator related to this emergencies.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To avoid /minimize any sort of pollution in port vicinity.

To ensure workers safety.

Team:

- Incident Commander Head (Marine)
- POC
- Marine Operator
- ERT Team
- Fire & Safety
- Security
- Admin & HR team
- Facilities team
- Coastguard /Marine police.
- Public Relations Officer

Standard Operating Procedure (SOP) for Earth Quake:

- Raise Alarm.
- Stop all operations.
- Inform Head of Port.
- Muster the Crisis Management Team.
- Evacuate people from high raise buildings, ware houses, jetty sides & move them to open areas.
- Incident Commander to take charge of Emergency control room (Preferably the secondary emergency control centre as prescribed with adequate communication and net work facilities) and inform HO.
- Warn vessels in port and ask them to prepare engines and standby for putting out to sea if necessary.
- Batten down all cranes
- Securing Ship-unloaders and stacker cum reclaimers to parking position and applying storm anchoring
- Shutdown electric power
- Keep ready for use, the emergency kits like helmets, whistle, torch lights, transistor and dry foods (admin role).
- Small Marine craft including tugs / boats can be put out to sea, if necessary.
- Establish communication with nearby ports & district authority.
- Fire tenders / Ambulance to be ready.

SOP 13 - Epidemic breakout

Objective:

1) The main objective of the procedure to handle the Epidemic Breakout scenario in effective manner.
2) To identify and laid down procedures to the co-ordinator related to this emergencies.
3) To ensure minimum/zero disturbances to the operational requirement of the port.
4) To avoid /minimize any spread out of disease in port vicinity.
5) To ensure workers safety.

Actors:

- Incident Commander Head (IR)
- POC
- PMC
- ERT Team
- Admin & HR team
- Fire & Safety
- Security
- Respective hospital authorities
- Public Relations Officer

Since in house shelters are provided to work force inside port vicinity, the emergency of any sort of epidemic breakout cannot be ruled out in Karaikal port. In case of such eventuality the following actions can be taken.

Standard Operating Procedure (SOP) for Epidemic Breakout:

- Muster crisis management team, if necessary.
- Incident Commander to take charge of Emergency control room, if necessary and inform HO.
- Warn all personnel of the epidemic breakout.
- Establish communication with district authorities & nearby hospitals.

  Standby to assist.

Appendix U
Replenishment and Saltwater Intrusion Study Report

REPORT

CARRYING OUT REPLENISHMENT AND SALTWATER INTRUSION STUDIES AT PURAVADAIYANAR RIVER/CREEK BEFORE MONSOON NEAR KARAIKAL PORT, PUDUCHERRY (VOLUME I)

Prepared by :
NISVO MARINE SURVEYS LLP

Prepared for :
FALCON RESILIENT INFRA CONSULTANTS

CARRYING OUT REPLENISHMENT AND SALTWATER INTRUSION STUDIES AT PURAVADAIYANAR RIVER/CREEK BEFORE THE MONSOON NEAR KARAIKAL PORT, PUDUCHERRY (VOLUME I)

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Client	:	**Falcon Resilient Infra Consultant**
Project Title	:	Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before the monsoon near Karaikal Port, Puducherry (Volume I)"
Project Code	:	202506_382
Reference	:	\\NISVOSERVER\2025\202506_0382 - CARRYING OUT REPLENISHMENT AND SALTWATER INTRUSION STUDIES AT PURAVADAIYANAR RIVER/ CREEK BEFORE AND AFTER MONSOON NEAR KARAIKAL PORT, PUDUCHERRY

ABSTRACT:

Falcon Resilient Infra Consultant has intended to conduct Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/ Creek before and after monsoon near Karaikal Port, Puducherry. To facilitate this, Falcon Resilient Infra Consultant has requested to M/s. NISVO MARINE SURVEYS LLP to conduct the required Replenishment and Saltwater Intrusion Studies in reference to the work order provided (Work Order No: 014-C24017-SRV-L-NM WO June 20,2025). Accordingly, the necessary Replenishment and Saltwater Intrusion Studies were carried out between 30.06.2025 and 18.07.2025.

This project, titled "Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the Monsoon" includes a comparative study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and seawater intrusion studies for both pre- and post-monsoon periods. Accordingly, the report is divided into three volumes, namely Volume I, Volume II, and Volume III.

The Volume I report, titled "Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before the monsoon near Karaikal Port, Puducherry (Volume I)" includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and seawater intrusion studies for the pre-monsoon.

The Volume II report, titled "Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek after the monsoon near Karaikal Port, Puducherry (Volume II)" includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and seawater intrusion studies for the post-monsoon.

The Volume III report, titled "Comparison Report of Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the monsoon" includes results and conclusions based on a comparison of the differences between the pre- and post-monsoon periods.

This report provides an overview of the Replenishment and Saltwater Intrusion Studies conducted within the designated survey area, encompassing a range of methodologies and corresponding findings.

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Date	Document		Originator	Checked by	Approved by
	Interim				
21.08.2025	Draft	✓	Dr. S. Balasingh	S.G. Singh	Dr. Mani
	Final				
	Methodology				

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Text Page	:	**68**
Figures	:	**13**
Annexure	:	**01**

CONTENT

Contents				Page
Contents				1
List of figures				3
List of Table				4
Annexure				5
Abbreviations				6
1.	**INTRODUCTION**			7
	1.1	General		7
	1.2.	Replenishment and Salt-water intrusion		8
		1.2.1.	Replenishment Study	8
		1.2.2.	Saltwater Intrusion study	8
2	**STUDY AREA**			10
	2.1.	Geographic Location and Regional Setting		10
	2.2.	Climatic Conditions		11
	2.3.	Geology and Geomorphology		11
3	**MATERIALS AND METHOD**			12
	3.1.	Survey Controls		12
		3.1.1.	Specifications and Standards	12
		3.1.2.	Coordinate systems	12
		3.1.3.	Horizontal and Vertical Control	13
	3.2.	Replenishment Study		14
		3.2.1	Terrain Analysis	14
			3.2.1.1. Aerial Topography Survey	14
			3.2.1.2. Single-beam Bathymetry Survey	18
			3.2.1.3. Sub-bottom Profiler Survey	22
		3.2.2.	Hydrodynamic Studies	26
			3.2.2.1. Flow velocity and Discharge measurement	27
			3.2.2.2. Instream roughness	30
		3.2.3.	Physico-Chemical Assessment of water and sediment	33

DRAFT

	3.3.	Saltwater Intrusion		36
		3.3.1.	Electrical Resistivity Tomography Survey	37
4.	**RESULTS**			42
	4.1.	Replenishment Studies		42
		4.1.1.	Terrain Analysis	45
		4.1.2.	Hydrodynamic Studies	45
		4.1.3.	Physico-Chemical Assessment of water and sediment	47
	4.2.	Saltwater Intrusion		61
PHOTO GALLERY				65

DRAFT

LIST OF FIGURES

Figure	Title
1.	Location Map
2.	Satellite imagery of survey region
3.	Planned lines for Aerial topography survey
4.	Planned lines for Bathymetry Survey
5.	Planned lines for Sub bottom Profiling Survey
6.	Water and sediment sample location
7.	Location of Vertical Electrical Sounding (VES) - Saltwater intrusion study
8.	Bathymetry and Topography Chart
9.	Cross section of survey region
10.	Cross section of survey region
11.	Ortho mosaic Map
12.	Land Use and Land Cover Classification
13.	Vertical Profile

DRAFT

LIST OF TABLES

Table	Title
1.	Geodetic Parameter Details

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LIST OF ANNEXURES

Annexure	Title
I.	The Analysis Data Geophysical Survey

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ABBREVIATIONS

WGS	World Geodetic System
UTM	Universal Transverse Mercator
km	Kilometer
DMS	Degrees/Minutes/Seconds
DD	Decimal Degrees
N	Northing
E	Easting
m	Metre
cumec	Cubic Metre
MCM	Million Cubic Meters
SI	System International Units
ft	Feet
w	Watt
v	Volt
USB	Universal Serial Bus
MSL	Mean Sea Level
RTK	Real-time kinematic
GSM	Global System for Mobile communication
DGPS	Differential Global Positioning Systems
PDOP	Positional Dilution of Precision
XTF	Extended Triton Format
KVA	Kilo-volt-amperes
AC	Alternating Current
kHz	Kilohertz
MHz	Megahertz
LULC	Land Use Land Cover Classification

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1. INTRODUCTION

1.1. General

Falcon Resilient Infra Consultant (FRICS) is a nascent firm founded by experienced engineers specializing in environmental engineering, master planning, infrastructure planning and financial analysis. The company delivers professional services in ports, marine structures, roads, highways, thermal power plants, industrial parks and the building sector. F` provided tailored infrastructure solution across all stages of the project life cycle for both small businesses and large enterprises. The organization is accredited by QCI-NABET as an EIA Consultant. This accreditation authorizes FRICS to conduct EIA studies and obtain environmental clearances under Ministry of Environment, Forest and Climate Change (MoEFC) guidelines.

Falcon Resilient Infra Consultant has intended to conduct Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/ Creek before and after monsoon near Karaikal Port, Puducherry. To facilitate this, **Falcon Resilient Infra Consultant** has requested to **M/s. NISVO MARINE SURVEYS LLP** to conduct the required Replenishment and Saltwater Intrusion Studies in reference to the work order provided (**Work Order No: 014-C24017-SRV-L-NM WO June 20,2025**). Accordingly, the necessary Replenishment and Saltwater Intrusion Studies were carried out between **30.06.2025 and 18.07.2025**.

This project, titled *"Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the Monsoon,"* includes a comparative study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and saltwater intrusion studies for both pre- and post-monsoon periods. Accordingly, the report is divided into three volumes, namely Volume I, Volume II, and Volume III.

The Volume I report, titled *"Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before the monsoon near Karaikal Port, Puducherry (Volume I)"* includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and saltwater intrusion studies for the pre-monsoon.

The Volume II report, titled *"Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek after the monsoon near Karaikal Port, Puducherry (Volume II)"* includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and saltwater intrusion studies for the post-monsoon.

DRAFT

The Volume III report, titled *"Comparison Report of Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the monsoon"* includes results and conclusions based on a comparison of the differences between the pre- and post-monsoon periods.

1.2. Replenishment and Salt-water intrusion

1.2.1. Replenishment Study

Replenishment in estuarine and riverine systems refers to the natural and seasonal processes through which freshwater inflows, sediment supply, and associated nutrient dynamics restore and sustain the physical, chemical, and ecological balance of the waterbody. In monsoon-influenced environments such as the Puranvadaiyar River/Creek, these processes are predominantly governed by the interaction of seasonal river discharge, tidal influences, watershed runoff, and sediment transport mechanisms. Effective replenishment ensures the maintenance of channel morphology, supports aquatic habitats, and sustains water quality necessary for ecological health and socio-economic activities including agriculture, fisheries, and navigation.

The extent and efficiency of replenishment are influenced by a combination of natural drivers such as rainfall variability, catchment topography, river basin geomorphology, and hydrodynamic conditions and anthropogenic pressures including upstream water regulation, land-use change, dredging, and port-related activities. In this study, replenishment assessment was conducted through integrated terrain analysis, hydrodynamic evaluation, and Physico-chemical characterization of water and sediment across pre- and post-monsoon periods. Such an approach enables a comprehensive understanding of how seasonal inflows and sediment deposition contribute to the resilience and sustainability of the estuarine system, while also identifying factors that may hinder its natural regenerative capacity.

1.2.2. Saltwater Intrusion study

Estuarine environments are dynamic transition zones where freshwater from rivers mixes with marine waters, creating unique and highly productive ecosystems. These semi-enclosed coastal bodies of water serve as critical ecological buffers and support diverse biological communities, while also functioning as socio-economic hubs for human settlements, agriculture, fisheries, and industry. However, estuarine systems are increasingly threatened by the phenomenon of saltwater intrusion—a process in which saline ocean water advances into

DRAFT

freshwater riverine and groundwater systems, altering the salinity regime and impacting water quality.

Saltwater intrusion in estuaries is chiefly governed by physical processes such as tidal motion, the density difference between saltwater and river water, river discharge variability, and estuarine geomorphology. The extent and intensity of saltwater penetration are modulated by natural factors (e.g., sea-level rise, climatic variability, and hydrodynamic conditions) and anthropogenic pressures such as excessive groundwater extraction, river regulation, land reclamation, and channel modifications. The consequences of saltwater intrusion are profound: increased salinity degrades the quality of water resources for drinking, irrigation, and industrial uses; stresses estuarine flora and fauna; and alters sedimentation and nutrient cycling processes.

Saltwater intrusion into estuarine environments is a multidimensional, escalating global issue that demands integrated hydrogeochemical, hydrodynamic, and management approaches. Developing a robust understanding of intrusion processes not only supports sustainable water resource planning and ecosystem conservation but is also essential for adapting estuarine communities to ongoing climatic and anthropogenic changes.

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2. STUDY AREA

2.1. Geographic Location and Regional Setting

The Puranvadaiyanar River is a distributary of the Cauvery River system flowing the Karaikal district of the Union Territory of Puducherry, India. Originating as a branch from the Cauvery River network in the deltanic plains, the river meanders eastwards across in the fertile agricultural land before draining into Bay of Bengal near Karaikal Port. The Study area for the replenishments and saltwater studies is part of Puranvadaiyanar River which falls in the latitude range of 10°49' N to 10°51' N and longitude range of 79°49' E to 79°51'E. The survey/ study area approximately covers around 0.72 Sq.km. The location map of survey region is presented below and the detailed view is depicted in **Fig. 1.** under figures.

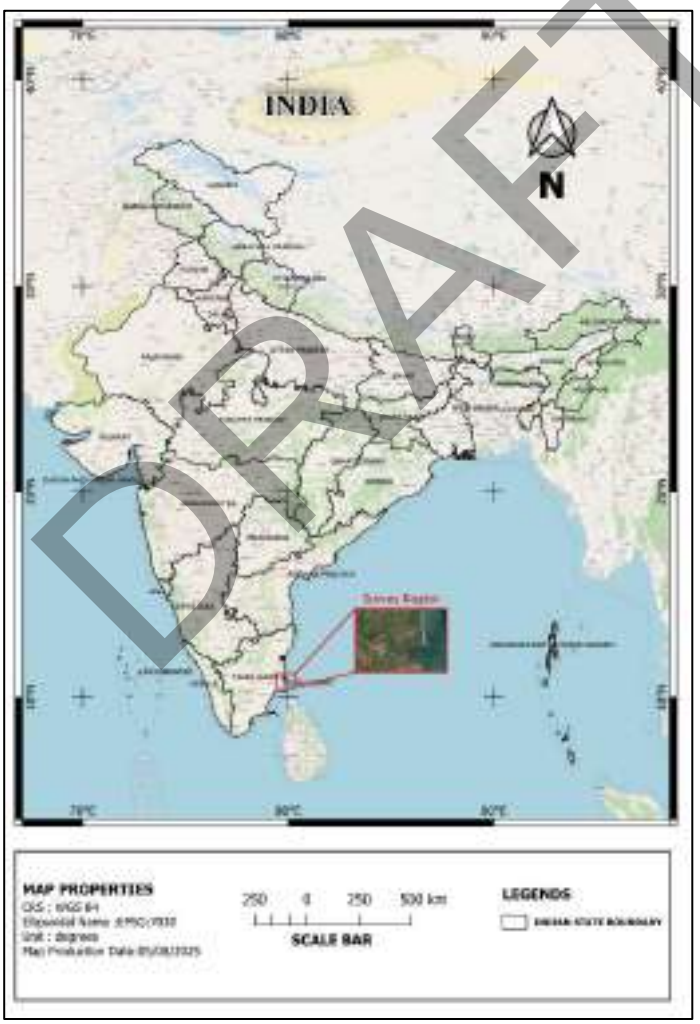

Fig. 1. Location Map

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A preview image of the survey areas on satellite image is presented below and a detailed view of the satellite image of the survey regions are presented in **Fig. 2.** under figures.

Fig. 2. Satellite imagery of survey region

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2.2. Climatic Conditions

Karaikal experiences a tropical coastal climate, marked by: Annual mean temperature: Ranges from 26°C to 34°C, with peaks often reaching ~40°C in late spring and summer months, and minimums near 20°C in winter (December–January) periods. Rainfall: The area receives an average of 1,200mm annually, predominantly during the Northeast Monsoon (October–December). This seasonality is occasionally disrupted by cyclonic events in the Bay of Bengal that can deliver intense rainfall over short periods.

2.3. Geology and Geomorphology

The geology of the Karaikal region is dominated by Quaternary alluvial and deltaic sediments, comprising fine to coarse sands, silts, and clays—products of fluvial deposition by the Cauvery and its tributaries. The nearshore and estuarine areas are underlain by unconsolidated or semi-consolidated sediments, offering high permeability and consequently high hydraulic connectivity between the estuary, shallow aquifers, and the coastal margin. The terrain is largely flat and low-lying (generally <10m above mean sea level), with geomorphological features including flood basins, tidal flats, and minor saline marshes.

3. MATERIALS AND METHOD

In this study, a combination of field surveys, laboratory analysis and spatial assessment to evaluate the seasonal dynamic of the Puranvadaiyanar River/ Creek System. The methodology encompassed terrain analysis, Hydrodynamic measurements, Physio-chemical assessment of water & sediment and saltwater intrusion study. These approaches will be applied for both pre- and post-monsoon period to enable a comparative evaluation of seasonal variation.

3.1. Survey Controls

3.1.1. Specifications and Standards

The surveys were carried out in accordance with the requirements outlined in the work procedure and terms of reference provided by the client. The units used are as per SI System i.e., System International Units. “ENGLISH” language has been used throughout the report and drawings. All calendar dates are referred in Indian style as dd.mm.yy. (Eg. 04.04.2025 for 4th April 2025).

3.1.2. Coordinate systems

The acquisition, processing, and report preparation of all data will adhere to the WGS-84, UTM Zone-44 coordinate system. The geodetic parameters pertaining to this system are outlined in the following table.

Details of Geodetic parameters

Table 1: Geodetic Parameter Details

GEODETIC PARAMETER DETAILS	
Parameters	**Value**
Grids	UTM North
Zone	Zone 44 (78E-84E)
Distance Unit	Meter
Depth Unit	Meter
Ellipsoid	WGS-84
Semi Major Axis	6378137.000
Flattening (1/f)	298.257223563
Projection	Transverse Mercator
Central Meridian	81° 00’ 00.0000” E

DRAFT

GEODETIC PARAMETER DETAILS	
Parameters	**Value**
Reference latitude	00° 00’ 00.0000” N
Scale Factor	0.9996000000
False Easting (X)	500000.0000
False Northing (Y)	0.0000

3.1.3. Horizontal and Vertical Control

The horizontal control was adopted using RTK, DGPS systems based on benchmark, provided by client. The base-station was installed on benchmark before commencement of surveys. The Rover which was used for bathymetry and topography surveys were tuned to receive the signals from base-station. The confidence checks on DGPS systems were performed before commencement and after completion of surveys in presence of Engineer in-charge. The DGPS correction age (latency), Positional Dilution of Precision (PDOP) was confirmed that they are within allowable limits.

Benchmark provided by client:

Name: KARAIKAL PORT PVT LTD (BM) **Lat:** 10° 49' 54"4’ N

Long: 79° 50’56”3’ E

Inclusive Dates: 18 Mar 09-27 Mar 09

Description of the Bench Mark:

A flat tide pole was erected on the Berth 1 jetty at Karaikal Port. In the absence of any known bench marks in the near vicinity of the survey area, the sounding datum was transferred from Nagapattinam by simultaneous tidal observations covering four consecutive low waters and three intermediate high waters at both the gauges. The sounding datum at Karaikal Port Berth 1 jetty was thereafter calculated using the method described in para 6g (i) of Chapter 2 of AMHS Vol II. The Sounding Datum at M/s Karaikal Port Pvt Ltd. was found to be 1.888m above the zero of the tide poles. The tide pole at Karaikal was levelled to the Karaikal Bench Mark as well as Temporary Local Bench Mark established by the ship. The value of Karaikal Port Pvt. Ltd. BM was found to be 4.248m above Zero of Tide Pole. Therefore, the value of Karaikal Port Pvt. Ltd. BM was found 4.250m above Sounding Datum.

DRAFT

3.2. Replenishment Study

3.2.1. Terrain Analysis

Terrain Analysis is the process of studying the physical features of the study area to understand its shape, slope, elevation, and other topographical features. In terrain analysis, the study area was examined through the integration of aerial topography, single-beam bathymetry, and sub-bottom profiler surveys. The surface terrain, including the river bund and adjoining land area at a 50 m distance from the waterline, was surveyed using aerial topography. The bathymetry survey was carried out across the river at 10 m intervals between both riverbanks below the waterline, in order to generate and study the riverbed profile and cross-section. The substrata of the riverbed were surveyed/investigated using the sub-bottom profiling method. The following section describes each survey methodology in detail.

3.2.1.1. Aerial Topography Survey

The survey methodology employed for conducting survey comprises a diverse array of Unmanned Aerial Vehicle (UAV) topography survey

Purpose of Aerial Topography Survey

The purpose of the Aerial topography survey is to comprehensively map the terrain surrounding the Puravadaiyanar River/creek, including riverbanks, floodplain surfaces, and channel margins. This survey produces a high-resolution Digital Elevation Model (DEM) of the fluvial environment, enabling detection of channel migration, bank erosion, floodplain roughness, and changes in slope geometry. The resultant topographic framework supports volumetric assessments of material loss or gains on the banks, evaluation of hydraulic boundary conditions, and integration with bathymetric data to define complete cross-sectional profiles through direct field measurements.

Principles of Aerial Topography Survey

Aerial survey provides digital information about the land elevation and features. Aerial survey is a method of collecting geomatics or other imagery by using airplanes, helicopters, UAVs, balloons or other aerial methods. Typical types of data collected include aerial photography, Lidar data, Geo-tagged videography or any raster data. It can also refer to the chart or map made by analyzing a region from the air. Aerial survey should be distinguished from satellite imagery due to its better resolution, scale and atmospheric conditions. Today, aerial survey is sometimes recognized as a synonym for aero photogrammetry, part of photogrammetry

DRAFT

where the camera is placed in the air. Measurements on aerial images are provided by photogrammetric technologies and methods.

Area of Survey

The Aerial topographic survey was carried out on pre-monsoon from the water line to 50m on both sides of riverbanks covering the entire survey area based on work order/ TOR provided by client using RTK Enabled UN-Manned Aerial Vehicle (UAV) DJI Mavic 3 Enterprise Series drone. The planned lines for aerial topography survey are shown below and detailed view is presented in **Fig. 3.**

Fig. 3. Planned lines for aerial topography

DRAFT

Sequence of Survey

- **GCP Planning:** Firstly, the data processing team was provided with location, submergence map, area details under topography survey to be conducted. According to mentioned details AOI is prepared. After GCP planning was done for the survey region with optimum number of GCPs per sq. km area for optimal ground coverage. GCPs were planned from satellite view and accordingly they are marked at relatively open ground i.e. distant from trees & tall structures.
- **GCP Fixing:** Secondly, the GCPs were placed on the coordinates provided by the data processing team using RTK rover before flying the drone/UAV.

- **RTK Enabled UN-Manned Aerial Vehicle (UAV):** The topographic survey was carried out using DJI Mavic 3 Enterprise edition survey grade drone. Before commencement of each mission, the initial inspections such as sensors, propeller, battery levels etc were carefully checked. The altitude, side overlap, front overlap and level of take-off point for each mission were planned based on local obstructions and site conditions. The data captured during flight mission and wind speed were monitored till landing of each flight. The area between water boundary and bathymetry transects were connected by the spot-levels using RTK rovers.
- **Calibration:** The rover was calibrated with reference to local bench mark using "site calibration method" available in XPAD survey software. Then, the trial data collection was performed and data acquisition carried out.
- **Data Processing:** Post aerial surveys & QC, raw data was sent to head office where it was processed. Aerial data processing refers to generating scalable Photogrammetric data outputs like Orthomosaic, DSM and DTM from overlapping aerial images. Agisoft Metashape™ was used for aerial dataset's Aero-triangulation and Bundle Block adjustments. Aerial data is processed for generating data products namely Orthomosaic, DSM and DTM.

Instrument Specification and Software

- **DJI Mavic 3 Enterprise:** The DJI Mavic 3 Enterprise Series finds widespread use across diverse industries due to its advanced capabilities and versatility. Professionals in fields such as infrastructure inspection utilize these drones for detailed visual inspections of bridges, pipelines, and buildings, leveraging high-resolution cameras to detect defects or anomalies. In agriculture, the series aids in crop

DRAFT

monitoring and management by capturing multispectral imagery, providing insights into crop health and optimizing yield. Public safety agencies employ Mavic 3 Enterprise drones for search and rescue missions, utilizing thermal imaging to locate individuals in remote or hazardous environments. Additionally, the series supports environmental monitoring efforts, facilitating the assessment of natural habitats and disaster response activities. With features like extended flight times, robust obstacle avoidance systems, and precise navigation tools, the DJI Mavic 3 Enterprise Series continues to enhance operational efficiency and safety across various professional applications.

- **Geomax Zenith 35 Pro:** Leica GeoMax Zenith 35 DGPS system has the full spectrum of satellite signals, unlimited connectivity and the unique Tilt Go functionality all compressed in a compact GNSS make the Zenith35 series the GNSS that works when you do. This unit features the same 555 channel Novatel measurement engine found in the latest Leica receivers and it absolutely blows away the competition, which helps us to collect the data fast and accurate.

- **XPAD survey software:** X-PAD Survey field software allows to manage GNSS and Total Station survey and stakeout, with all the topographic and Bathymetry functions that you need for maximum productivity in the field. It combines data collection from all GeoMax instruments and provides you with complete features, data integration and scalability.

DRAFT

3.2.1.2. Single-beam Bathymetry Survey

The bathymetry survey involves the systematic measurement and mapping of underwater depth, typically conducted using sonar technology to create detailed representations of the seabed. This process is crucial for various applications, including navigation safety, marine construction, environmental monitoring, and resource management. By providing accurate data on underwater topography, bathymetry surveys facilitate the assessment of habitats, the planning of offshore infrastructure like wind farms and pipelines, and the management of fisheries. Additionally, they play a vital role in flood risk assessment and coastal management by informing decisions related to sediment transport and shoreline erosion. Ultimately, bathymetry surveys enhance our understanding of aquatic environments and support sustainable development in marine ecosystems.

Purpose of Single-beam Bathymetry Survey

The purpose of the bathymetric survey is to accurately characterize the channel geometry and bed elevation of the Puravadaiyanar River/creek before and after the monsoon season. Using a single-beam echo-sounder mounted on a survey vessel equipped with RTK-GNSS, the survey delivers discrete depth measurements along selected transects. This enables precise mapping of the river bed, identification of localized scour and sediment deposition, and quantification of volumetric changes in bed elevation. By generating high-resolution depth profiles, the survey supports assessment of changes in channel form, bed stability, and hydraulic conveyance capacity across seasonal conditions.

Principles of Bathymetry Survey

The principles of bathymetry survey are grounded in the accurate measurement of underwater depth and the characterization of the seabed using a combination of acoustic and non-acoustic methods. Central to this process is the use of sonar technology, particularly multi-beam and single-beam echo sounders, which emit sound waves that travel through water, reflect off the seabed, and return to the instrument. By calculating the time, it takes for the sound waves to return, surveyors can determine the water depth with high precision. Additionally, positioning systems such as GPS are integrated to Geo-reference the data, ensuring accurate spatial representation. The collected depth data is then processed and visualized using specialized software to create detailed bathymetry maps, revealing features such as underwater ridges, valleys, and sediment types. These principles not only ensure the accuracy and reliability of the survey results but also enable the effective interpretation of complex underwater environments for various applications, from navigation and marine engineering to environmental studies.

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Area of Survey

The bathymetry survey was carried out on pre monsoon across the river at 10m interval between both riverbanks in order to generate and study the river bed profile and cross section using SyQwest Hydrobox Dual Frequency survey grade Echo-sounder. The planned lines for bathymetry survey are shown below and detailed view is presented in **Fig. 4.** under figures.

Fig. 4. Planned lines for bathymetry Survey

Sequence of survey

Bathymetry survey was carried out using Syqwest Hydrobox Dual Frequency Echo-sounder, Trimble DGPS system and Ellipse MRU. The Echo-sounder system and DGPS were installed and operated in accordance with the manufacturer's instructions. The transducer was installed rigidly to a bracket at star-board side on the survey boat. The transducer shoe was sufficiently deep not to experience turbulence and aeration when the vessel steams at survey speed. The depth of the transducer below water line was ascertained by reference to present marks on the pole

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Instrument Specification and Software

- **SyQwest Hydrobox Dual Frequency Echo-sounder :** It is a latest generation dual frequency survey grade echo sounder, employs the latest in technologies including a high-resolution, microprocessor and DSP techniques. The system consists of sonar transceiver, echo processor, graphical operator interface with Laptop, splash-proof case. The unit is suited to table top, bulkhead, or rack mounting and is equally at home on either small survey launches or large ships. Well suited for use in the shallows of rivers and harbors, the mission variable unit is also capable of working to depths of over 1000 meters. It operates in dual frequency consisting of 200 kHz on higher band and 33 kHz in lower band.

- **Technical Specification:**

High Band	:	*200 kHz*
Low Band	:	*33 kHz*
Input Power	:	*10-30 VDC 12 watts*
Resolution	:	*0.01 m*
Accuracy	:	*1cm @ 200khz; 5cm @ 50Khz;7cm @ 33Khz*
Depth range	:	*0-15, 30, 60, 120,240,450, 900,1500, 2400, 3000 Ft. 0-5, 10, 20, 40, 80, 150, 300, 500, 800, 1000 Meters.*
Sound Velocity	:	*1370 – 1700 m/s*
Annotation	:	*Internal – date, time, GPS position External – from RS232 Port or Ethernet*
Interfaces	:	*RS232 serial ports, baud rate selectable 4800-19200.* *Input from external computer, motion sensor, and sound velocity.* *Outputs to external computer.* *Ethernet interface. Heave – TSS1.*

DRAFT

- **Marine Grade Mobile DGPS - Trimble SPS 351:** It combines high-performance GPS reception with a DGPS-capable receiver in a lightweight, durable housing and comes with a separate antenna. The unit performs continuous RAIM calculations which enhance the integrity of the position data. The GPS receiver also contains technology enabling SBAS e.g. WAAS and EGNOS or Beacon real time differential capabilities. When used with a Real-Time Kinematic (RTK) Base station, the GPS receiver provides RTK positioning for high-accuracy, centimeter-level applications.

  A standard R4 GPS receiver provides the following features:

  - ✓ 10 Hz (10 positions per second) output rate.
  - ✓ 12 GPS (C/A-code L1, C/A code L2 (for the Omni STAR XP/HP and RTK models)) tracking channels, code carrier channels.

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

- **The system Features:**
  - ✓ *SBAS such as WAAS (Wide Area Augmentation System) differential correction*
  - ✓ *Highly versatile multifunctional display unit*
  - ✓ *Beacon differential correction*
  - ✓ *Large number of input and output ports to support highly complex and integrated bridge systems.*
  - ✓ *Channel management capability*
  - ✓ *Easy access to standardized and proprietary text messages*
  - ✓ *Fully up-gradable to support future features*
  - ✓ *NMEA-0183 output: GGA, GLL, GRS, GST, GAS, GSV, MSS, RMC, VTG, ZDA (the default NMEA messages are GGA, GSA, VTG, and RMC*
- **Motion Reference Unit (MRU) - SBG Ellipse - A:** SBG Ellipse-A is a small-sized high performance Motion Reference Unit. It provides Roll, Pitch, Heading, and Heave data. This light-weight sensor includes a MEMS-based Inertial Measurement Unit (IMU) integrating three gyroscopes, three magnetometers, and three accelerometers. Running an extended Kalman filter (EKF), the Ellipse-A provides accurate orientation data in both static and dynamic conditions.

- **Specifications:**
  - ✓ *0.1° Roll and Pitch over 360°.*
  - ✓ *1° Heading (Internal Magnetometers).*
  - ✓ *5 cm Real-time Heave, adjusted to the wave period.*
- **Key features:**
  - ✓ *Very Low Noise Gyroscopes.*
  - ✓ *IP 68 Enclosure.*
  - ✓ *200 Hz Output Rate.*
  - ✓ *RS-232, RS-422, and CAN Interfaces.*
  - ✓ *Binary, NMEA, ASCII, and TSS Protocols.*

DRAFT

3.2.1.3. Sub-bottom Profiler Survey

A sub-bottom profiler survey is a specialized geophysical technique used to investigate the layered structure beneath the seabed, providing critical insights into sub-surface geology, sediment types, and potential archaeological features. This survey employs high-frequency acoustic waves that penetrate the seafloor and reflect off various geological layers, allowing hydrographic surveyors to create detailed profiles of the sub-bottom strata. The data collected is instrumental in a variety of applications, including marine construction, where understanding sediment composition is vital for foundation design; environmental assessments, which evaluate potential impacts of projects on sensitive habitats; and resource exploration, such as identifying aggregates or hydrocarbons. By delivering high-resolution images of the subsurface, sub-bottom profilers aid in informed decision-making, ensuring sustainable practices in marine development and contributing to the broader understanding of underwater geological processes.

Purpose of Sub-bottom profile survey

The purpose of the sub-bottom survey is to non-invasively investigate the underlying stratigraphy and substrate stability of the Puravadaiyanar River/creek channel. A low-frequency chirp sub-bottom profiler is deployed from a survey vessel to emit acoustic pulses beneath the water-sediment interface. Reflections from sediment layers of varying acoustic impedance are recorded to generate high-resolution cross-sectional profiles of subsurface deposits. This method enables identification and measurement of sediment layer thicknesses, detection of any buried hardpan or gravel strata, and evaluation of substrate cohesion and compaction. By comparing pre- and post-monsoon profiles, the survey furnishes direct empirical measurements of subsurface changes such as deposition of new sediment layers or removal of bank material informing assessments of channel stability and sediment supply dynamics.

Principle of Sub-bottom profile survey

Sub-bottom profiler surveys play a crucial role in understanding the geological structure and sedimentary layers beneath the seafloor. These surveys employ principles distinct from those of echo sounding methods. Sub-bottom profilers emit low-frequency acoustic pulses that penetrate the seafloor and penetrate the sediment layers below. As these pulses encounter boundaries between different sediment types or geological formations, they are partially reflected back to the receiver. By analysing the travel time and amplitude of these reflected signals, sub-bottom profilers can delineate sediment layers, identify geological structures, and

DRAFT

detect buried objects such as shipwrecks or pipelines. The depth penetration and resolution of sub-bottom profiler surveys depend on factors such as frequency, pulse length, and the acoustic properties of the sediment. Additionally, accurate interpretation of sub-bottom profiler data requires consideration of factors like water depth, seafloor topography, and signal attenuation. Sub-bottom profiler surveys are invaluable in various fields, including marine geology, sedimentology, and offshore engineering, providing insights into past environmental conditions, sediment deposition processes, and potential geological hazards beneath the seafloor.

Area of Survey

The sub-bottom profiling survey was carried out on pre-monsoon to study the sub-strata of riverbed at four possible locations only, due to inadequate depth of water flow across the river. The planned line for sub-bottom profile survey is presented in **Fig. 4.** under figures.

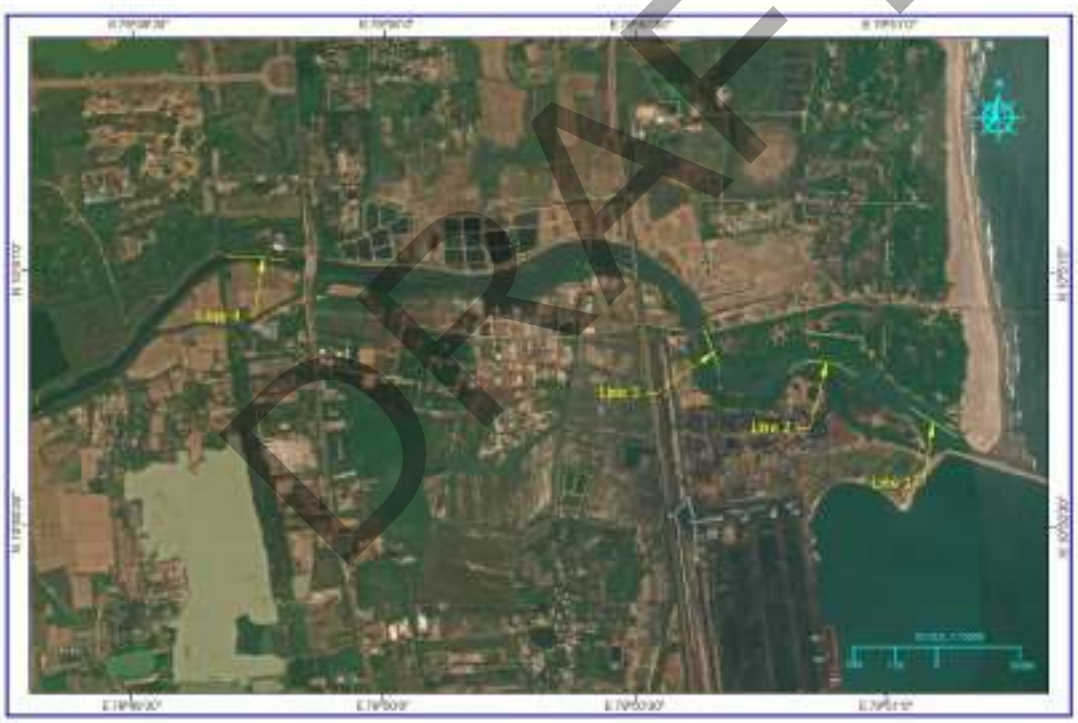


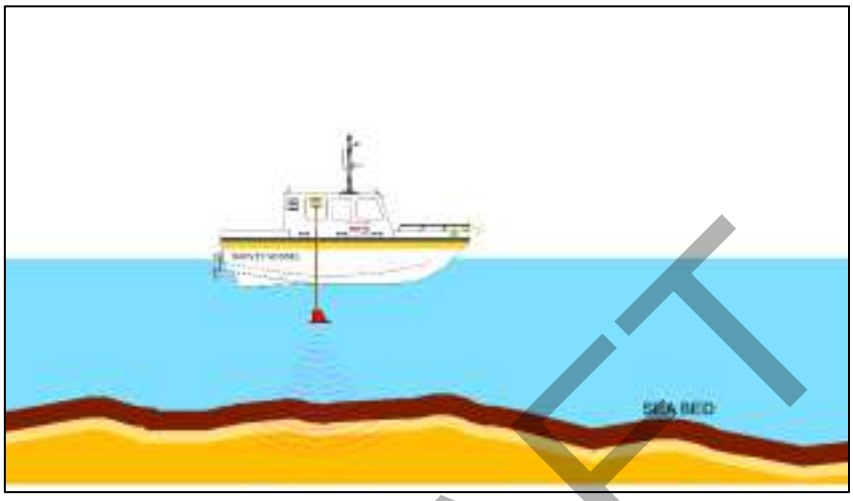
Fig. 5. Planned lines for Sub-bottom Profiling Survey

Sequence of Survey

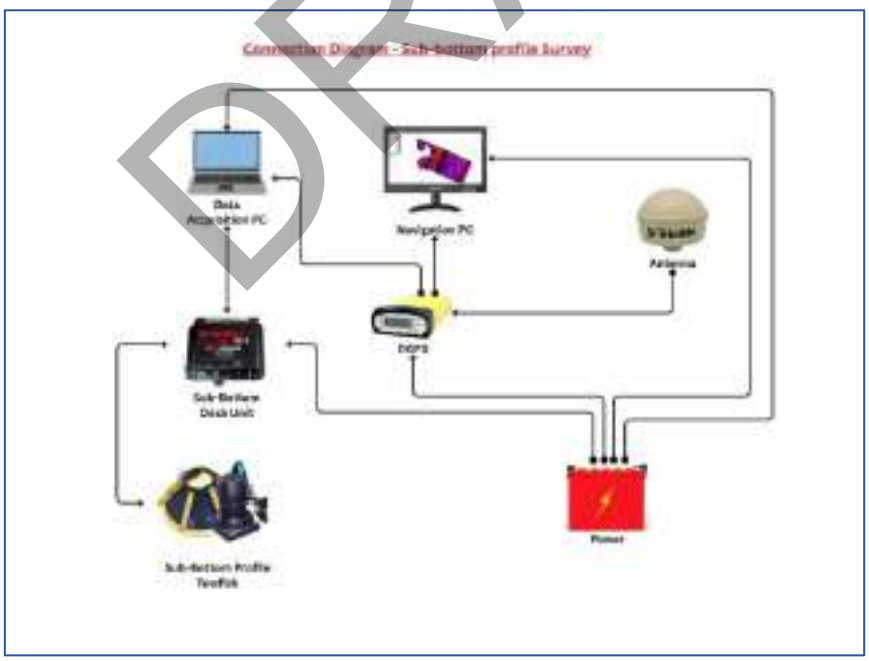
- **Data acquisition:** The transducer was installed on the port side of the survey vessel, positioned 0.3 meter below the water surface. The cable was securely connected to the top-side unit, and all necessary connections between the top-side unit, DGPS, and data acquisition system were properly established. Seismic data was recorded at a repetition pulse of 126 ms and stored in SEG-Y format, as per the standards set by the

Society of Exploration Geophysics. The DGPS data was also integrated into the data acquisition system via serial communication (RS 232). Navigation was facilitated using HYPACK software. The entire system was powered by a 4 KVA AC generator, which was reserved on the survey vessel.

The different configuration of instrument installed/towed onboard are shown below,



- **Connection Diagram:** The connection diagram of sub-bottom profile survey, Towfish, deck unit, DGPS and navigation systems are shown below.



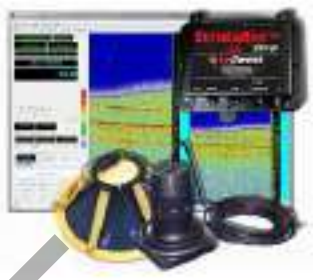
- **Data processing:** The StrataBox HD software has been employed for the comprehensive processing and interpretation of the data. The SEG-Y data collected has been transferred to StrataBox HD for processing, with a specific emphasis on the seismic records. Utilizing diverse geophysical techniques, the sub-bottom layers have

DRAFT

been analyzed and transformed into a digital format. The outcomes derived from StrataBox HD have subsequently been utilized to generate vertical cross sections and an Isopach map.

Instrument specification and software

- **SyQwest Stratabox HD 3510 sub-bottom profiler:** The StrataBox HD TM is a portable high-resolution marine sediment imaging instrument capable of delivering 6cm of marine sediment strata resolution and bottom penetration of up to 100 meters. It is designed exclusively for inshore and coastal geophysical marine survey up to 800 meters of water depth.



- **Features:**

Application	*High Resolution*
Max power consumption [W]	*16*
Power type	*DC*
Transducer weight [kg]	*3*
Transducer length [m]	*0.36*
Transducer width [m]	*0.36*
Weight of logging unit [kg]	*9*
Length of logging unit [m]	*0.15*
Width of logging unit [m]	*0.34*
Height of logging unit [m]	*0.3*
Portability of logger	*Portable*

- **Transducer deployment options:** The assembly has been specifically engineered to facilitate the operation of small boats at reduced speeds. The transducers are strategically positioned on a plate located at the extremity of a vertically oriented, gimbaled staff. This staff is further supported by a mounting pad, which offers the flexibility to securely attach it either to the boat's deck or to a transverse timber.

DRAFT

- **Technical Specifications:**

Output	*10kW with 0.75% duty cycle, continuously adjustable. 4 to 24 kHz, continuously adjustable. Short circuit proof. Impedance matched.*	
Pulse Cycles	*1, 2, 4, 8, 16 or 32 cycles of the frequency selected. The transmitted output pulse will be phase coherent within 22.5°.*	
Processor	*between approximately 1 kHz and 20 kHz.*	
Two modes of operation	*A*	*Flat gain 0 dB gain;*
	B	*Short range TVG -20 dB (10:1) of attenuation during transmit pulse and a 20 dB to 0 dB ramp within 15ms after end of transmit signal.*
Power	*115/230 VAC ± 10%, 47 to 63 Hz, 220 W maximum.*	
Auxiliary Power	*IEC connector, unfused, 6 A maximum.*	
Environmental	*Operational: -5 to 50°C, Storage: -15 to 85°C*	
Dimensions	*45.7 cm (L) x 43 cm (W) x 13 cm (H)*	
Amplifier	*Differential common mode rejection: 100 dB at 60 Hz. Sensitivity 30 µ V RMS in produces 1V RMS out at 90 dB total gain with TVG.*	
Signal to noise	*20 dB at 100 dB gain 1 kHz centre frequency and 1 kHz bandwidth.*	
Coarse gain	*40 dB maximum.*	
Fine gain	*0-30 dB in 3 dB increments.*	
Filter	*Low pass and high pass, active type, maximally flat, 24 dB/octave minimum roll-off, 0 gains, 0.02 kHz to 15 kHz adjustable in ½ octave increments. Knobs interlock to prevent overlap.*	
TVG	*Dynamic range: 30 dB Rate: approximately flat to 30 dB in 14 ms.*	
Manual delay	*vernier adjust from 1 to 14 ms with multiplier of x 1, x 10, x 100 and internal select of x 1000.*	
AGC	*Attack adjustable from 330 µs to 330 ms. Decay: adjustable from 330 µs to 330 ms.*	
Range	*20 dB.*	
Power	*115/230 VAC ± 10% (internal switch selectable), 47 to 63 Hz, 45 W maximum.*	

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3.2.2. Hydrodynamic Studies

Hydrodynamic studies of the river focus on understanding the movement of water within a river system, including its flow velocity, depth, discharge, and interaction with channel boundaries. These studies are essential for predicting river behaviour under natural and human-influenced conditions. In this study, hydrodynamic investigations were carried out to understand the movement of water and sediment in the Puranvadaiyanar River/Creek. This assessment includes flow velocity and discharge measurements to quantify the water movement, sediment transport studies to evaluate erosion and deposition, and in-stream

roughness analysis to determine resistance to the flow caused by bed materials and channel features. The following section describes each survey methodology in detail. Streamflow or discharge measurements are vital for hydrological analysis, water resource management, flood forecasting, and hydraulic design. Accurate measurements of current velocity and discharge provide critical information for understanding flow conditions in rivers, streams, and open channels.

3.2.2.1. Flow velocity and Discharge measurement

Streamflow or discharge measurement is vital for hydrological analysis, water resource management, flood forecasting, and hydraulic design. Accurate measurement of current velocity and discharge provides critical information for understanding flow conditions in rivers, streams, and open channels.

ADCP Method

The current velocity measurements were carried out across the river at a location with sufficient depth suitable for the deployment of an ADCP. The measurements were conducted using the Teledyne Marine Workhorse II Sentinel ADCP. The main objective of the survey was to measure flow velocity and discharge in the study area.

Principles of current velocity measurement

The current velocity measurements are crucial for understanding the movement and dynamics of water bodies in oceans, rivers, and estuaries. These measurements rely on principles rooted in fluid dynamics and the Doppler effect. One common method for measuring current velocity is acoustic Doppler technology. Acoustic Doppler current profilers (ADCPs) emit pulses of sound into the water, which scatter off particles suspended in the water column. By measuring the change in frequency of these scattered signals, caused by the motion of water particles relative to the profiler, the ADCP can determine current velocity at various depths. This technique is based on the principle that the frequency shift of the scattered sound waves is proportional to the velocity of the water particles along the direction of the sound beam. ADCPs can measure current velocity profiles over a range of depths with high accuracy and temporal resolution. Another method, called acoustic Doppler velocimetry (ADV), employs similar principles but focuses on measuring velocity at a single point rather than profiling. Both ADCPs and ADV systems provide essential data for studying ocean circulation, sediment transport, and pollutant dispersion, aiding in various scientific research, environmental monitoring, and engineering applications.

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Sequence of Current Velocity Measurement

The TELEDYNE MARINE Workhorse II ADCP device, powered externally, has been securely attached to a transducer pole. This pole has been mounted on a floating dock, positioned at the designated location specified by the client, with a draft of 0.8m below the water surface. Prior to deployment, thorough preparations and evaluations were conducted to properly configure the time interval using WinSc and Plan ADCP software. The sampling interval has been set at 30 seconds, ensuring that data collected at this frequency is stored on the device's internal memory. To ensure data integrity, the stored information is downloaded once a week and saved on the on-site hard disk.

Instrument specification and software

- **TELEDYNE MARINE Workhorse II**

The lightweight and adaptable Workhorse Sentinel is easily deployed on buoys, boats, or mounted on the seafloor. Real-time data can be transmitted to shore via a cable link or acoustic modem, or data can be stored internally for short or long-term deployments. By providing profiling ranges from 1 to 165m, the Workhorse II Sentinel ADCP is ideally suited for a wide variety of applications. The Workhorse II Sentinel also offers unbeatable precision, with unmatched low power consumption, allowing you to collect more data over an extended period.

- **Key Features**

Versatility	Direct reading or self-contained, moored or moving, the Sentinel provides precision current profiling data when and where you need it most.
A solid upgrade path	The Sentinel has been designed to grow with your needs. Easy upgrades include bottom tracking, and directional wave measurement.
A four-beam solution	Teledyne RDI's patented 4-beam design improves data reliability, improves data quality, and improves data accuracy.
Precision data	Teledyne RDI's patented BroadBand signal processing delivers very low-noise data, resulting in unparalleled data resolution and minimal power consumption.

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Float Ball Method

The flow velocity and discharge measurements were performed using the conventional float ball method in locations where ever the depth of water flow was inadequate for the deployment of the ADCP. The velocity measurements were conducted across various cross sections along the river to enhance accuracy. This method employs a spherical float that is released into the stream to estimate the current velocity by measuring the time taken for the float to travel a known distance. By combining velocity measurements with the stream cross-sectional area, discharge was also computed. Although the method is relatively simple and inexpensive, it remains an effective tool for practical surveys, particularly in environments where advanced or specialized equipment may not be feasible.

Sequence of Measurement

- Two suitable locations about 3m - 5m apart were identified in the river. The Distance between the two points were measured in meters(D).
- The Width (Wu) and Depth (Du) of the river at the upstream was measured. Similarly, Width (Wd) and Depth (Dd) of the river at the downstream was measured.
- The depth of flow in the two points were recorded as du and dd in meters. Bright yellow colour rubber balls of three different diameters (say50mm, 75mm, 1000mm) were selected as the floats.
- The float ball was gently lowered into the river and allowed to float on the flowing water surface.
- A stopwatch was started, the moment of the float starts moving downstream along the flowing water.
- A butterfly net kind of tool was used to retrieve the ball in the downstream, as soon as it arrives there. The stop-watch was stopped and the Float Travel Time (FTT) was recorded.
- This exercise was repeated two more times and the average travel time was worked out (Ta).
- The velocity (m/s) of the flow was calculated as below:

$$Velocity\ (m/s)\ Va\ = \frac{Distance\ between\ points\ (D\ in\ m)}{travel\ time\ (Ta\ in\ sec)}$$

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- The flow area of the drain in the upstream (Au) and downstream (Ad) was calculated as below:

$$\text{Flow Area, Au} = \text{Wu} \times \text{du}$$

$$\text{Flow Area, Ad} = \text{Wd} \times \text{dd}$$

$$\text{Average Flow Area, Aa} = \frac{(\text{Au} + \text{Ad})}{2}$$

- Discharge (Flow) = Aa x Va (m^3/s)

3.2.2.2. Instream roughness

Instream roughness refers to the resistance to flow within a river channel caused by physical elements located on or near the bed and banks. These elements include bed material grains, boulders, cobbles, submerged logs, aquatic vegetation, and other obstructions that directly interact with moving water. Instream roughness plays a critical role in dissipating flow energy and reducing velocity, thereby influencing sediment transport, habitat conditions, and channel hydraulics. The magnitude of roughness depends on the size, distribution, and protrusion of these elements relative to flow depth. In shallow channels with coarse bed material, grain resistance can dominate, while in deeper channels with large woody debris or vegetation, form drag may be more significant. Seasonal variations, such as vegetation growth or debris accumulation during floods, can alter roughness characteristics, underscoring the importance of site-specific assessment. Neglecting to quantify instream roughness accurately can lead to underestimation or overestimation of flow capacity in hydraulic models.

The Arcement and Schneider (1989) method provides a systematic, field-based framework for estimating Manning's roughness coefficient (n) by incorporating measurable channel characteristics. The procedure begins with the selection of a base n value determined from the channel's predominant bed material, using tabulated reference ranges for various substrate types such as silt, sand, gravel, cobble, or bedrock. This base value assumes a straight, uniform channel without significant irregularities or vegetation. Adjustment factors are then sequentially applied to account for surface irregularities, cross-sectional variability, obstructions, vegetation, and meandering. Surface irregularities include bedforms such as pools, riffles, and dunes, which create turbulence and increase flow resistance. Cross-sectional variation accounts for irregular depth and width distribution that induce secondary currents. Obstructions, such as boulders, large woody debris, and anthropogenic structures, add localized turbulence and energy loss. Vegetation adjustments depend on plant type, density,

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and seasonal condition, recognizing the increased resistance during periods of full foliage or high stem submergence.

Meandering is quantified through the sinuosity ratio, with greater sinuosity increasing total flow resistance Arcement and Schneider method provides a systematic, field-based framework for estimating Manning's roughness coefficient (n) by incorporating measurable channel characteristics. The procedure begins with the selection of a base n value determined from the channel's predominant bed material, using tabulated reference ranges for various substrate types such as silt, sand, gravel, cobble, or bedrock. This base value assumes a straight, uniform channel without significant irregularities or vegetation.

Adjustment factors are then sequentially applied to account for surface irregularities, cross-sectional variability, obstructions, vegetation, and meandering. Surface irregularities include bedforms such as pools, riffles, and dunes, which create turbulence and increase flow resistance. Cross-sectional variation accounts for irregular depth and width distribution that induce secondary currents. Obstructions, such as boulders, large woody debris, and anthropogenic structures, add localized turbulence and energy loss. Vegetation adjustments depend on plant type, density, and seasonal condition, recognizing the increased resistance during periods of full foliage or high stem submergence. Meandering is quantified through the sinuosity ratio, with greater sinuosity increasing total flow resistance.

$$\boldsymbol{n = (n_b + n_1 + n_2 + n_3 + n_4)m}$$

n = roughness coefficient
n_b = Base values for Manning's n (nb; adapted from Arcement and Schneider 1989).
n_1 = Degree of irregularity
n_2 = Variation in channel cross section
n_3 = Effect of obstructions
n_4 = Amount of vegetation
m = Degree of meandering and sinuosity.

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Base values for Manning's n (nb; adapted from Arcement and Schneider 1989).

Bed Material	Median Bed Material Size (mm)	Base n (n_b)
Sand	0.2	0.012
	0.3	0.017
	0.4	0.020
	0.5	0.022
	0.6	0.023
	0.8	0.025
	1.0	0.026
Concrete	-------	0.011-0.018
Rock cut	-------	0.025
Firm soil	-------	0.020-0.032
Coarse sand	1-2	0.026-0.035
Gravel	2-64	0.028-0.035
Cobble	64-256	0.030-0.050
Boulder	>256	0.040-0.070

Adjustment values for roughness (adapted from Arcement and Schneider 1989).

Channel conditions		**n-value adjustment**	**Description**
Degree of irregularity (n_1)	Smooth	0	Smoothest channel possible given the bed material
	Minor	0.001 - 0.005	Slightly eroded or scoured streambanks
	Moderate	0.006 - 0.010	Moderate to considerable bed roughness due to such features as bedforms; moderately sloughed or eroded streambanks
	Severe	0.011 - 0.020	Severely sloughed or scalloped streambanks; unshaped, jagged, and irregular surfaces in rock channels
Variation in channel cross section(n_2)	Gradual	0	Size and shape of channel changes gradually
	Alternating occasionally	0.001 - 0.005	Cross section size and shape alternate occasionally. Alternatively, channel thalw eg shifts occasionionally from one side to the other (excluding planform/sinuosity related shifts that are addressed with m).
	Alternating frequently	0.010 - 0.015	Cross section size and shape alternate frequently. Alternatively, channel thalw eg shifts frequently from one side to the other (excluding planform/sinuosity related shifts that are addressed with m).
Effect of obstructions (n_3)	Negligible	0 - 0.004	A few scattered obstructions are present (< 5% X-S area), including such features as debris deposits, stumps, exposed roots, logs, piers or isolated boulders.
	Minor	0.005 - 0.015	Obstruction occupy < 15% of X-S area, with spacing w ide enough so that spheres of influence do not overlap. Smaller adjustments recommended for smooth versus angular objects.
	Appreciable	0.020 - 0.030	Obstructions occupy 15 to 50% of X-S area, or spacing between obstructions are small enough for spheres of influence to overlap, with the obstructions additive and blocking an equivalent portion of X-S.
	Severe	0.040 - 0.050	Obstructions occupy >50% of the X-S area, or the spaces between the obstructions are small enough to cause turbulence across most of the X-S.
Amount of vegetation (n_4)	Small	0.002 - 0.010	Tree and shrub seedlings are present (such as willow, cottonwood, alder, tamarisk), with a flow depth of at least 3 times the vegetation height at the flow of interest.
	Medium	0.010 - 0.025	Tree and shub seedlings are present, with a flow depth of 2 to 3 times the vegetation height at the flow of interest. Alternatively, brushy and moderately-dense streambank woody vegetation present.
	Large	0.025 - 0.050	~10-year-old trees and shrubs present in shallow portions of the channel and lining the streambanks.
	Very large	0.050 - 0.100	Bushy willow s and other shrubs and trees are prevalent in substantial portions of the channel and inundated less than their

DRAFT

			canopy heights at the flow of interest, with brushy and dense woody vegetation on streambanks.
Degree of meandering and sinuosity (m)	Minor	1.0	Sinuosity (ratio of channel length to valley length) = 1.0 to 1.2
	Appreciable	1.15	Sinuosity = 1.2 to 1.5
	Severe	1.3	Sinuosity > 1.5

3.2.3. Physico-Chemical Assessment of water and sediment

The Physico-chemical assessment was conducted to evaluate the quality of water and sediment in the Puranvadaiyanar River/Creek. Water and sediment samples were collected from 7 different locations across the river during the pre-monsoon. A total of 18 Physico-chemical parameters were analysed as part of the replenishment study of the Puranvadaiyanar River/Creek during the pre-monsoon.

Water Sample Collection

The water samples were collected from seven different locations at the site on 05.07.2025 using a Niskin sampler. The sediment sample location map is presented in Fig. 6. under figures. During the collection of samples, a minimum of 2.5 litres of water was collected at each location and labelled with GPS coordinates and photographs for each location, with proper numbering referenced to the map. The geographical coordinates of water and sediment sample collections are presented in the table below.

Sl. No	Water and Sediment Sample Code	X(m)	Y(m)
1.	L1	374538.530	1199022.678
2.	L2	374230.493	1199241.840
3.	L3	373729.092	1199260.192
4.	L4	373422.950	1199658.965
5.	L5	373048.931	1199671.359
6.	L6	372480.437	1199628.288
7.	L7	372081.581	1199682.987

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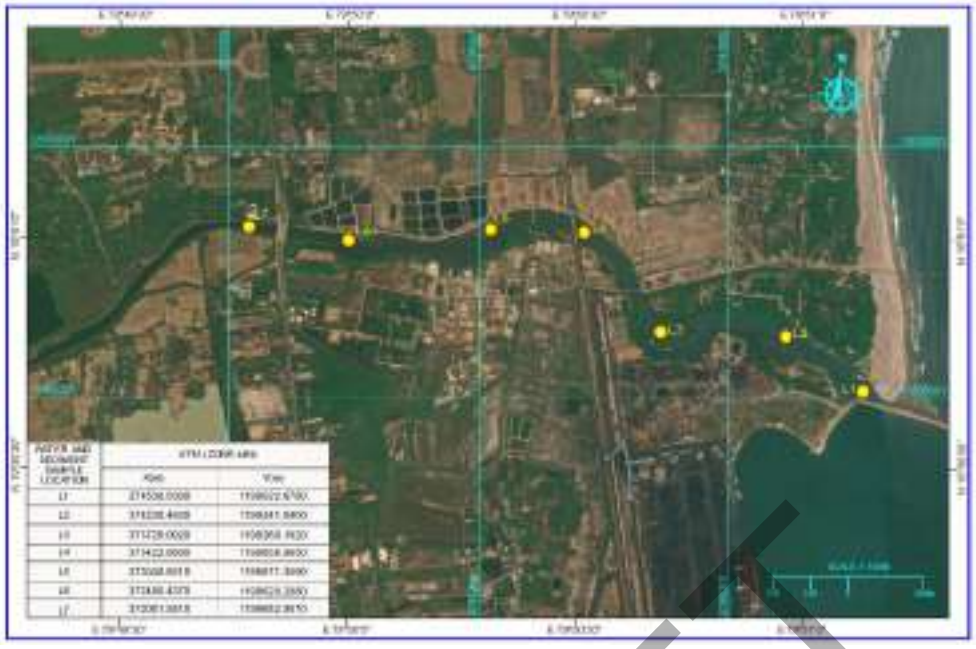

Fig. 6. Water and sediment sample location

Water Sample Analysis

The water samples collected at seven locations were analysed for parameters such as pH, electrical conductivity, total suspended solids, turbidity, nitrate, iron, manganese, dissolved oxygen, chemical oxygen demand, biological oxygen demand, phosphate, nitrite, lead, mercury, cadmium, ammonia, and chlorophyll-a. The results of the analysis are discussed in the following chapters. The following table shows the reference methods used for water sample analysis.

S.No	Description	Method of Reference
1.	pH @25°C	IS:3025 (Part-11)2022
2.	Electrical Conductivity @25°C	IS:3025 (Part-14)2013
3.	Total Suspended Solids	IS:3025 (Part-17)2022
4.	Turbidity	IS:3025 (Part-10)2023
5.	Nitrate as NO_3	APHA 24th Edition 2023-4500 NO_3-B
6.	Iron as Fe	IS:3025 (Part-53)2003
7.	Manganese as Mn	APHA 24th Edition 2023 3111 B
8.	Dissolved Oxygen	IS:3025 (Part-38)1989
9.	Chemical Oxygen Demand	IS:3025 (Part-58)2023
10.	Biochemical Oxygen Demand (3 days incubation @27°C)	IS:3025 (Part-44)2023
11.	Phosphate as PO_4	IS:3025 (Part-31) Sec 1:2022
12.	Nitrite as NO_2	IS:3025 (Part-34)1988

DRAFT

S.No	Description	Method of Reference
13.	Lead as Pb	APHA 24th Edition 2023 3111 B
14.	Mercury as Hg	APHA 24th Edition 2023 3112 B
15.	Cadmium as Cd	APHA 24th Edition 2023 3111 B
16.	Temperature	IS:3025 (Part-9)2023
17.	Ammonia as NH4	IS:3025 (Part-34)1988
18.	Chlorophyll -a	APHA 24th Edition 2023 3111 B

Sediment Sample Collection

The sediment samples were collected from seven different locations at the site on 05.07.2025 using a Van Veen Grab sampler. The sediment sample location map is presented in Fig. 6. Under figures. During the collection of samples, a minimum of 3 kg of sediment was collected at each location and labelled with GPS coordinates and photographs for each location, with proper numbering referenced to the map.

Van Veen Grab Sampler

Van Veen Grab Sampler is a handheld device that will be allowed to fall freely from the boat at each location, after reaching the sediment top the grab sampler will collect the sample by pushing the wire connected with the buckets.

Sediment Sample Analysis

The sediment samples collected at seven locations were analyzed for parameters such as sand, silt, clay, bulk density, moisture, organic matter, organic carbon, total nitrogen, total phosphate, iron, cadmium, nickel, chromium, zinc, lead, and manganese. The results of analysis are discussed in the following chapters. The following table shows the reference methods used for sediment sample analysis.

S.No	Description	Method of Reference
1	Sand	AES/EN/SLS/SOP/017
2	Slit	AES/EN/SLS/SOP/017
3	Clay	AES/EN/SLS/SOP/017
4	Bulk Density	AES/EN/SLS/SOP/001
5	Moisture	IS:2720 (Part - 2)1973
6	Organic Matter	IS:2720 (Part - 22)1972
7	Organic Carbon	AES/EN/SLS/SOP/019

DRAFT

S.No	Description	Method of Reference
8	Total Nitrogen as N	IS:14684:1999
9	Total Phosphorous as PO_4	IS:10158:1982
10	Iron as Fe	USEPA 7000B & EPA 3050 B - 1996
11	Cadmium as Cd	USEPA 7000B & EPA 3050 B - 1996
12	Nickel as Ni	USEPA 7000B & EPA 3050 B - 1996
13	Chromium as Cr	USEPA 7000B & EPA 3050 B - 1996
14	Zinc as Zn	USEPA 7000B & EPA 3050 B - 1996
15	Lead as Pb	USEPA 7000B & EPA 3050 B - 1996
16	Manganese as Mn	USEPA 7000B & EPA 3050 B - 1996

3.3. Saltwater Intrusion

Saltwater intrusion refers to the movement of seawater into freshwater aquifers, which reduces water quality and limits its use for drinking, agriculture, and industry. This phenomenon often occurs in coastal zones when the balance between freshwater and saltwater is altered by factors such as excessive groundwater withdrawal, rising sea levels, or insufficient natural recharge.

A brackish zone refers to an area where freshwater and seawater mix, creating water with salinity levels higher than freshwater but lower than seawater. These zones are typically found in estuaries, coastal wetlands, and river mouth.

An aquifer in hydraulic connection with saline water contained both saltwater and freshwater, with the saltwater occupying the lower portion and the freshwater occupying the upper portion. Because freshwater is slightly less dense than saltwater, it floated above the saltwater when both fluids were present within the aquifer. The difference in density between freshwater and saltwater was used to estimate the depth to saltwater based on the thickness of the freshwater zone above sea level. This relationship, known as the **Ghyben–Herzberg Relation**, defines the equilibrium between freshwater and saltwater in coastal aquifers. The boundary between the freshwater and saltwater zones was not distinct but instead represented a gradual transition over a finite distance, referred to as the **zone of diffusion** or the **zone of mixing**. The Ghyben–Herzberg Relation for saline water intrusion is presented below.

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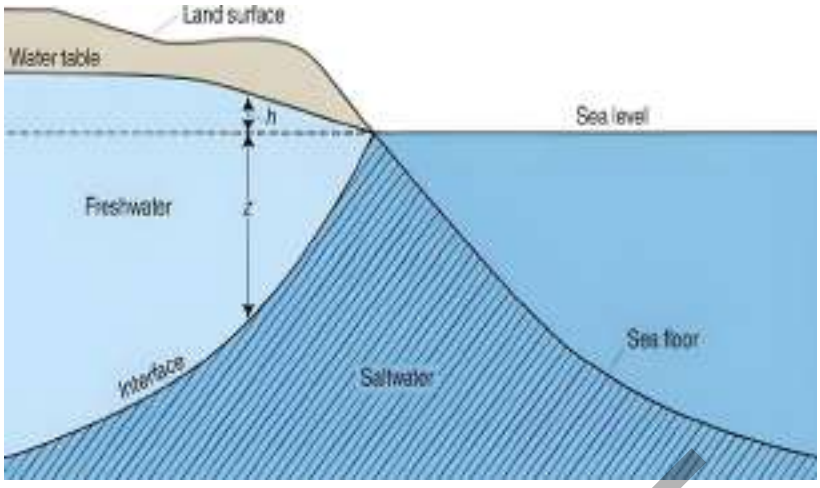

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Two mixing processes, diffusion and dispersion, continuously moved saltwater into the freshwater zone. Flow in the freshwater zone swept this mixed brackish water toward the shoreline, where it discharged at submarine seeps. The processes of recharge, flow, mixing, and discharge worked in unison to hold the interface in a roughly stationary position. A change to one or more of these processes resulted in a change in the position of the interface; an inland movement of the interface boundary was known as lateral intrusion. When a well was pumped, water levels in the vicinity of the well were lowered, creating a drawdown cone. If a saltwater zone existed in the aquifer beneath the well, the saltwater rose toward the well screen. This process, referred to as upconing, was the second type of saltwater intrusion. Saltwater intrusion into coastal aquifers led to impairment of freshwater quality in aquifers.

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3.3.1. Electrical Resistivity Tomography Survey

Electrical Resistivity Tomography Survey (ERT) is a geophysical method used to image the subsurface by measuring resistance to the flow of electrical current.

Purpose of the Survey

The present study was carried out in the Karaikal coastal zone to investigate the location and extent of the fresh–saltwater interface in the aquifers of the study area using Electrical Resistivity Tomography (ERT) techniques combined with available hydrogeological data. This geophysical method was also applied to determine the aquifer geometry of the coastal tracts within the study area.

Principle of Survey

- **Geophysical Investigation**

  Electrical resistivity tomography (ERT) is used to differentiate between fresh and saline water zones based on their resistivity values. By analyzing these values, researchers can map the extent of saltwater intrusion into freshwater aquifers.

- **Factors Affecting Resistivity**

  Resistivity values can vary depending on the specific salinity level, the type of dissolved salts, the temperature of the water, and the surrounding geological formation.

- **Saline water apparent resistivity value**

  When dealing with apparent resistivity in the context of saline water, it's crucial to understand that resistivity is inversely proportional to salinity. The more dissolved salts (ions) present in the water, the lower its resistivity and the higher its conductivity.

  Here's a general overview of apparent resistivity values and their relationship to saline water:

  - ✓ Low resistivity values (typically less than 15 Ωm or 50 Ωm, depending on the source) are generally indicative of saline water.
  - ✓ Resistivity values between 15 Ωm and 25 Ωm often suggest the presence of brackish water (a mixture of fresh and saline water).
  - ✓ Higher resistivity values, like greater than 45 Ωm, are associated with freshwater.

  For example, studies have shown that zones with saline water intrusion in sandy formations exhibit low resistivity values, ranging from less than 5 Ωm to 25 Ωm. In some cases, very low resistivity, below 5 Ωm, has been observed close to coastal areas with saline water ingress.

- **Vertical Electrical Sounding**

  Vertical (1D) Electrical Sounding (VES) are for determining the layered aquifers of different litho units. In majority of the cases, VES demarcates the number of layers, thickness and resistivity. The basic idea of resolving the vertical resistivity layering is to stepwise increase the current-injecting electrodes AB spacing, which leads to an increasing penetration of the current lines and in this way to an increasing influence of the deep-seated layers on the apparent resistivity ρA. In general, linear electrode configurations are used for resistivity measurements. The most popular configurations are Wenner and Schlumberger, which varies basically on electrodes spacing. Wenner system is used for quantitative interpretation and this method is well suited for geoelectrical profiling. Reversing/inversion are applied to reduce the number of layers, their resistivities and thickness from a measured value.

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The step-wise measured apparent resistivities are plotted against the current electrode spacing in a log/log scale and interpolated to a continuous curve. This plot is called sounding curve, that is the base of all data inversion to obtain the resistivity/depth structure of the ground. Now, varieties of software programs are available, that allow rapid inversion of resistivity layers. On the basis of resistivity values the software iterates the measured resistivity data to the theoretical data.

Area of Survey

The saltwater intrusion study using ERT was carried out in the pre-monsoon across the river at five different locations using a resistivity meter (ABEM Terrameter SAS300). The location for the Vertical Electrical Sounding was shown below, and a detailed view was presented in Fig. 7. under figures.

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Fig.7. Location of Vertical Electrical Sounding (VES) - Saltwater intrusion study

VES locations for the study are given in the below table:

VES Locations	Latitude	Longitude
1	10.847854	79.847092
2	10.850701	79.842011
3	10.850476	79.834773
4	10.850160	79.826731
5	10.846967	79.823337

Sequence of Survey

Wenner Method

The Wenner method is a common geophysical surveying technique used to determine the electrical resistivity of the ground, particularly for soil. It involves using four equally spaced electrodes in a straight line to pass a current through the ground and measure the resulting voltage difference. This data is then used to calculate the resistivity of the soil. The spacing between the electrodes is varied to investigate resistivity at different depths.

Procedure:

- Four electrodes are placed in a straight line at equal distances (denoted as 'a') from each other.
- A current (I) is introduced into the ground through the two outer electrodes.
- The voltage (V) is measured between the two inner electrodes.
- The apparent resistivity (ρ) is then calculated using the formula: $\rho = 2 * \pi * a * (V / I)$.

Instrument and specification

- **Resistivity meter ABEM TERRAMETER SAS300:**

  ABEM Terrameter SAS300, in SAS stands for Signal Averaging System and results are more reliable and it is the most popular instrument for geophysical studies. It is based on the modern technology of microprocessors and employs ingenious methods for extracting subsurface information. What makes our instrument so popular is its simple operation, deep penetration, accurate & reliable results even in adverse field conditions. In addition, a considerable reduction in survey time proves a boon when working under hot sun. The instrument has a facility to measure Self Potential (SP) which is useful in mineral prospecting and environmental studies. Terrameter SAS300 can be used in a wide variety of applications for Groundwater Exploration and Engineering purposes.

  Applications:

  ✓ Ground Water Exploration
  ✓ Bed Rock Investigations
  ✓ Mineral Investigation
  ✓ Delineation of Geological Structures
  ✓ Sand and Gravel Deposit Identification
  ✓ Saline Water Intrusion

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- ✓ Geophysical Field Training
- ✓ Ground water well logging

Specification:

Specifications	
Selectable Constant Current	0.2 mA to 20mA(7 steps) and 5 mA to 500 mA(4 steps)
Voltage max	160 V (320 Vpp)
Power	40 W
Input impedance	10 M Ohms
Input range	0 - 500 V
Precision	+/- 50 µV
Noise rejection	95 db at 50 - 60 Hz.
DV/I ranges	m Ohm, Ohm, k Ohm
DV/I precision	+/- 0.02 m Ohm at 500 mA
Cycle time	3.6 Seconds
Accuracy	2% + precision
Diagnostic display system	9 Codes
Temperature range (operating)	- 10 to 70 degrees C
Power source	12 V rechargeable battery pack
Battery capacity	3500 – 5000 single cycle measurement per charge
Weight	5.6 kg
Dimensions	L 325 mm x W 105 mm x H 300 mm

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4. RESULTS

4.1. Replenishment Studies

4.1.1. Terrain Analysis

Aerial Topography and Bathymetry Survey

The Topography and Bathymetry chart is prepared in WGS-84 spheroid with UTM coordinates supplemented by geographical coordinates indicating the latitude and longitude. The topography and bathymetry plan map prepared in 1:4000 scale is presented in **Fig. 8.** A total of 76 cross-sections were generated as part of the terrain Analysis. These cross-sections provide a detailed representation of the topographic and bathymetric features of the survey area. The graphical representation of cross-sections are presented in **Fig. 9** and **Fig.10.** The Ortho mosaic map generated using aerial topography survey is presented in **Fig. 11.** The LULC map prepared in 1:3500 scale based on Ortho mosaic map generated through aerial topography is presented in **Fig. 12**. The LULC map comprises of features such as waterbodies, roads, settlements, eyots, bridges, railway line, agricultural land, barren land, high vegetation, etc.

Channel Geometry and Bed Elevation

The Topography and bathymetry survey revealed significant observation in the study area during the pre-monsoon. The survey outputs reveals that the maximum river width measures about 125m between the cross-section CH 1.799KM and CH1.912KM. Subsequently, the river width is narrow between the cross-section CH 0.754KM and CH 0.780KM which is approximately 22 m. The computed overall bed gradient from upstream to downstream is 1: 100000 shows that river exhibit a gradual bed slope during pre-monsoon. In addition, three number of sandbars in the river were mapped and measures an area of 5267 m^2 approximately during the Pre monsoon study.

Sub-bottom Profile Survey

The sub-bottom profiling survey was carried out on pre-monsoon to study the sub-strata of riverbed at four possible locations only, due to inadequate depth of water flow across the river. The Vertical Profile chart based on Sub-bottom profiling survey is presented in **Fig. 13.** The sub-bottom profiling data reveals that the sediment thickness varies between 1.24m and 2.50m. Also, the sub-bottom profiling survey does not show any hard rock or buries rock within the acoustic basement.

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Acoustic basement: *The acoustic basement is defined as the seismic horizon below the primary; laterally continuous reflectors cease to be resolved due to lack of sufficient acoustic impedance contrast. It typically corresponds to the top of crystalline basement, metamorphic rocks or significantly compacted and deformed pre-sedimentary sequences. This surface represents the seismic limit of interpretable stratigraphy and serves as a fundamental structural boundary in basin analysis. Accurate mapping of the acoustic basement is critical for understanding basin architecture, total sediment fill, and structural evolution relevant to hydrocarbon prospectivity.*

Typical sub-bottom profile records are presented below,

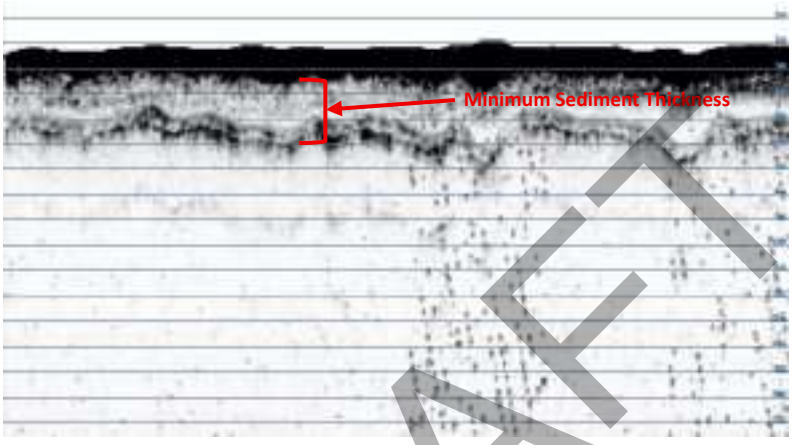

Plate No 01 – Typical Sub bottom profile along line 1

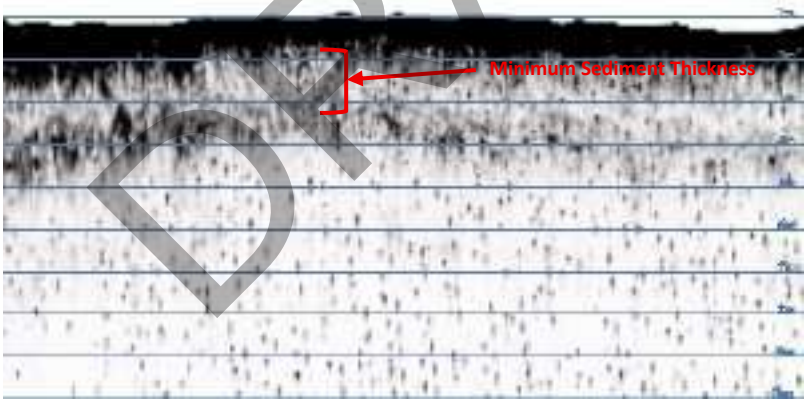

Plate No 02 – Typical Sub bottom profile along line 2

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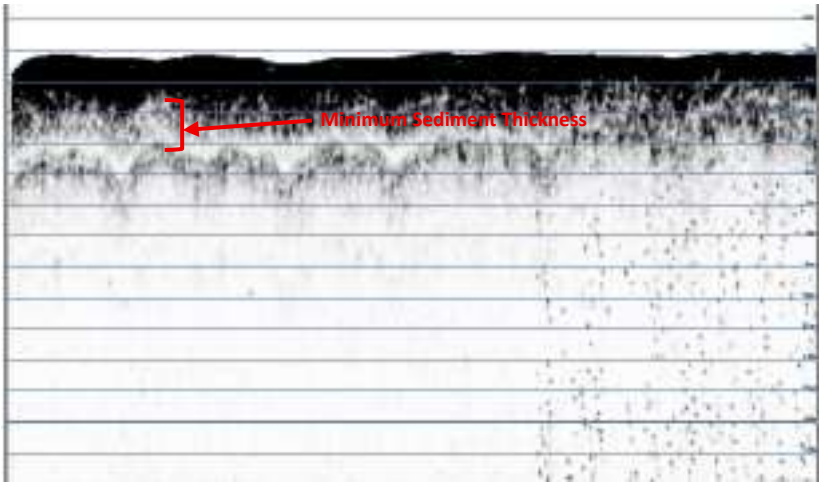

Plate No 03 – Typical Sub bottom profile along line 3

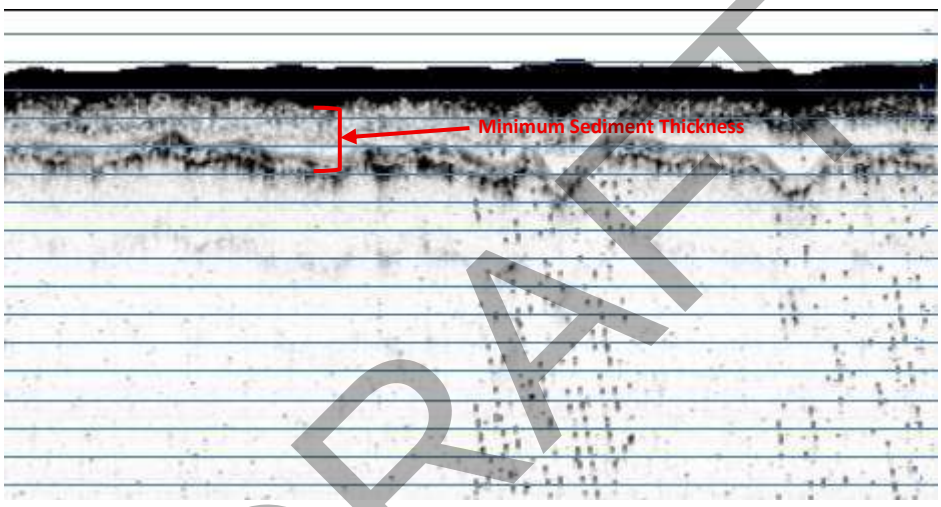

Plate No 04 – Typical Sub bottom profile along line 4

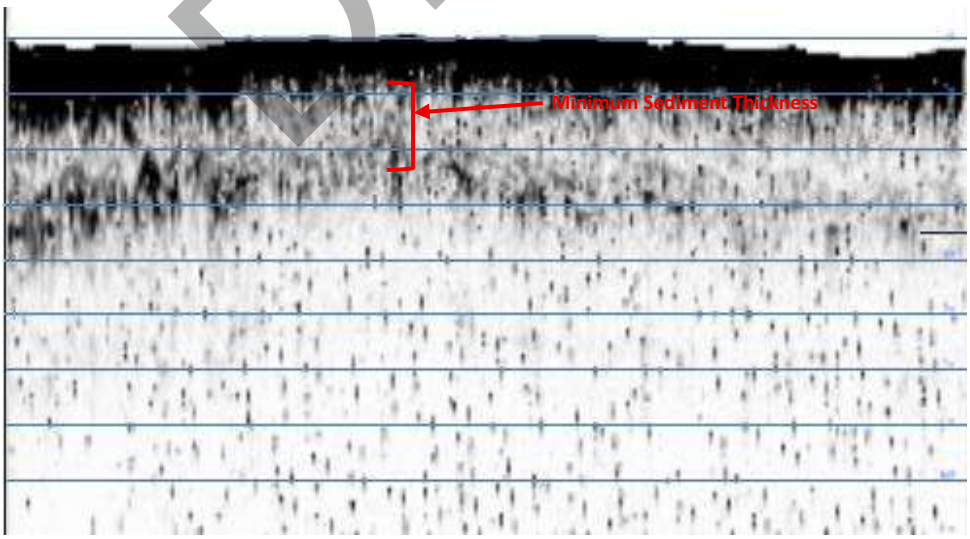

Plate No 05 – Typical Sub bottom profile along line 4

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4.1.2. Hydrodynamic Studies

Flow Velocity and Discharge Measurement

The flow velocity and discharge measurements were performed using an ADCP at locations with adequate water depth for device deployment, and the float-ball method was used at shallow-depth locations where ADCP deployment was not possible. A 12-hour observation of flow velocity and discharge was carried out across various river cross-sections, including ebb and flood tide measurements near the river mouth. The results showed a net discharge of 1.2 m^3/s directed towards the sea from the river.

In-Stream Roughness investigation

In-stream roughness investigation was done as a parallel activity during the period of survey. The In-Stream Roughness is determined with the field investigation and concluded along with the survey data outputs. The following table summarize the channel condition with respect to various parameters.

Sl.no	Parameter	Channel conditions	n-value adjustment	Description
1.	Base values (n_b)	0.2	0.012	-
	Degree of irregularity (n_1)	Moderate	0.006 - 0.010	Moderate to considerable bed roughness due to such features as bedforms; moderately sloughed or eroded streambanks
3.	Variation in channel cross section (n_2)	Alternating occasionally	0.001 - 0.005	Cross section size and shape alternate occasionally. Alternatively, channel thalw eg shifts occasionionally from one side to the other
4.	Effect of obstructions (n_3)	Negligible	0 - 0.004	A few scattered obstructions are present (< 5% X-S area), including such features as debris deposits, stumps, exposed roots, logs, piers or isolated boulders.
5.	Amount of vegetation (n_4)	Medium	0.010 - 0.025	Tree and shub seedlings are present, with a flow depth of 2 to 3 times the vegetation height at the flow of interest. Alternatively, brushy and moderately-dense streambank woody vegetation present.
6.	Degree of meandering and sinuosity (m)	Appreciable	1.15	Sinuosity = 1.2 to 1.5

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The ‘n‘ value of the study area was calculated based on the channel condition with respect to various parameters mentioned in the above table for the pre-monsoon. Similarly, the same was calculated for the post-monsoon and compared with that of the pre-monsoon to understand the behaviour of the study area.

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4.1.3. Physico-Chemical Assessment of water and sediment

Water sample analysis

A total of seven surface water samples were collected from various point along the river during pre-monsoon season to evaluate the physical and chemical characteristic of water. The results of water sample analysis are presented in tabular form below,

Sample	pH	EC	TSS	Turbidity	Nitrate	Fe	Mn	DO	COD	BOD	Phosphate	Nitrite	Pb	Hg	Cd	NH4	Chlorophyll-a
Unit	-	µS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
L1	8.1	7140	12.0	2.3	1.3	7.3	BDL	8.1	116	30.0	0.203	0.379	0.145	BDL	BDL	0.43	BDL
L2	7.9	7550	257.0	38.0	31.0	28.0	0.210	7.2	105	26.0	0.560	BDL	0.149	BDL	BDL	2.00	BDL
L3	7.7	7620	442.0	83.0	1.8	68.0	0.338	7.4	53	13.0	1.281	0.490	0.163	BDL	BDL	3.91	BDL
L4	7.7	1249	28.0	3.7	3.4	7.5	0.092	7.8	53	13.0	0.195	0.138	0.189	BDL	BDL	0.20	BDL
L5	7.7	1218	12.0	4.2	1.5	6.6	0.082	6.4	42	10.0	0.359	0.073	0.114	BDL	BDL	0.65	BDL
L6	7.6	1088	10.0	3.4	BDL	7.9	0.092	6.7	21	5.2	0.203	0.090	0.099	BDL	BDL	0.12	BDL
L7	7.5	793	2.8	2.8	1.2	8.0	BDL	7.2	42	10.0	0.267	0.410	0.114	BDL	BDL	1.15	BDL

BDL – Below Detection Level

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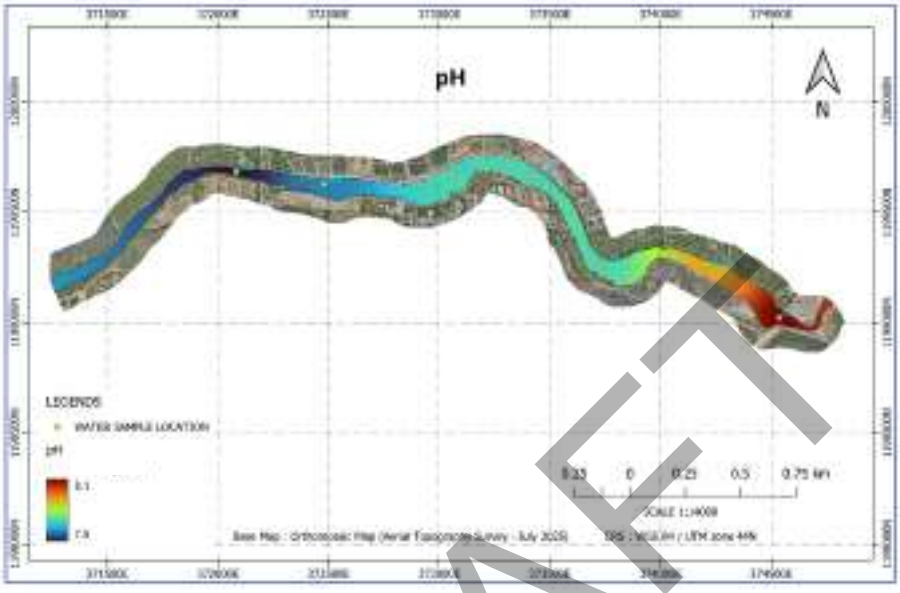
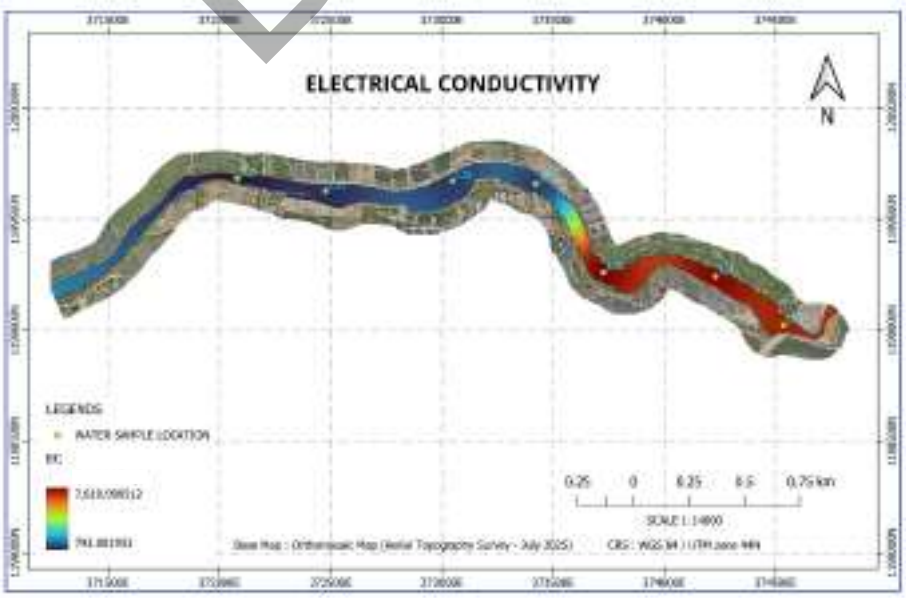
- **pH@25°C**

The pH value ranged from 7.5 to 8.1 across all samples, indication neutral to slightly alkaline. These values are within the acceptable range. The spatial distribution map of pH@25°C for the survey area is given below.



- **Electrical Conductivity (EC)**

The EC value showed a wide variation, ranging from 793 µs/cm to 7620 µs/cm. Higher conductivity in sample L1, L2 and L3 indicate the presence of high concentration of dissolved salt possible from saline water intrusion. The spatial distribution map of Electrical conductivity (EC) for the survey area is given below.



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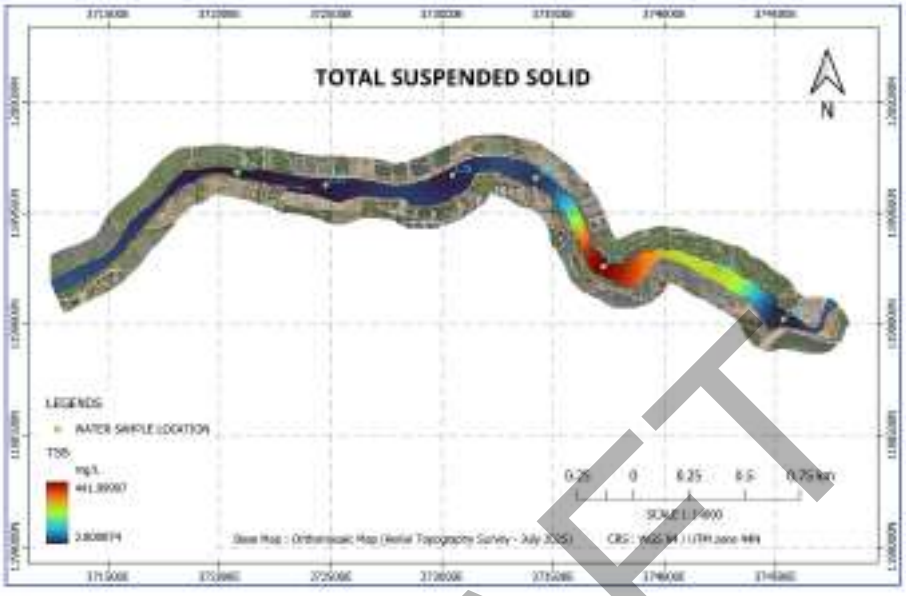
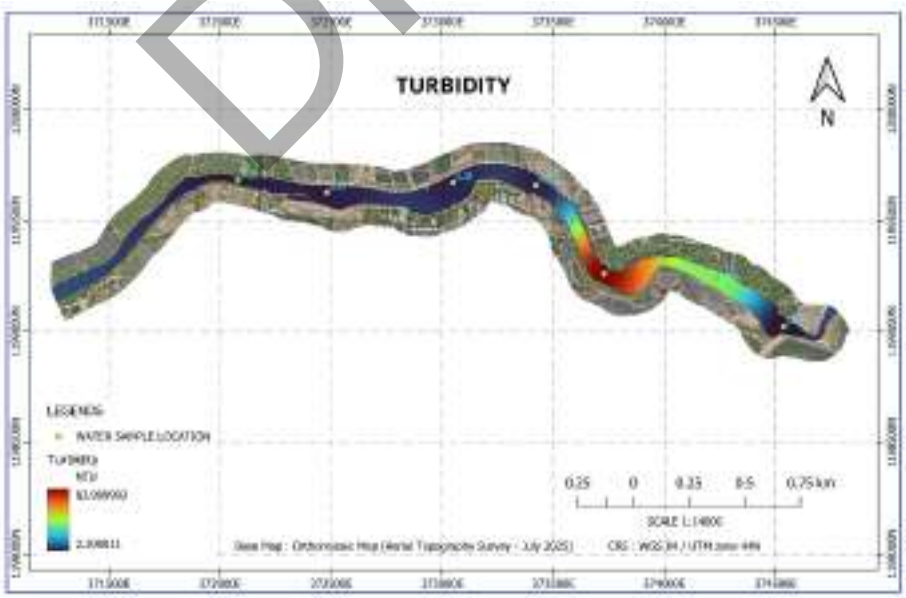
- **Total Suspended solid (TSS)**

The TSS level ranged from 2.8 mg/L to 442 mg/L. Extremely high value at L2 and L3. The spatial distribution map of Total Suspended solid (TSS) for the survey area is given below.



- **Turbidity**

Turbidity value ranged from 2.3 NTU and 83 NTU. The sample L3 exhibited the highest turbidity followed by sample L2. The remaining site are within the acceptable limit. The spatial distribution map of Turbidity for the survey area is given below.



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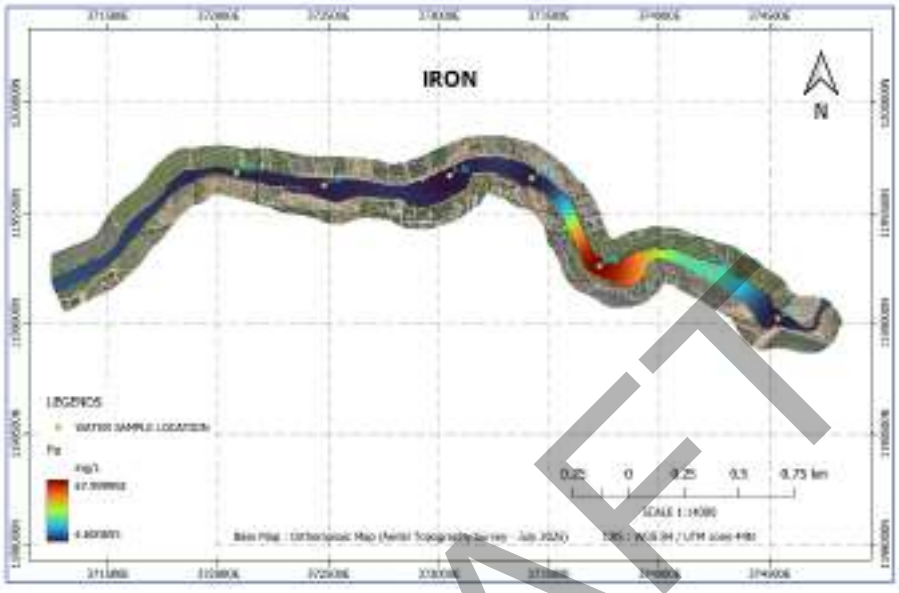
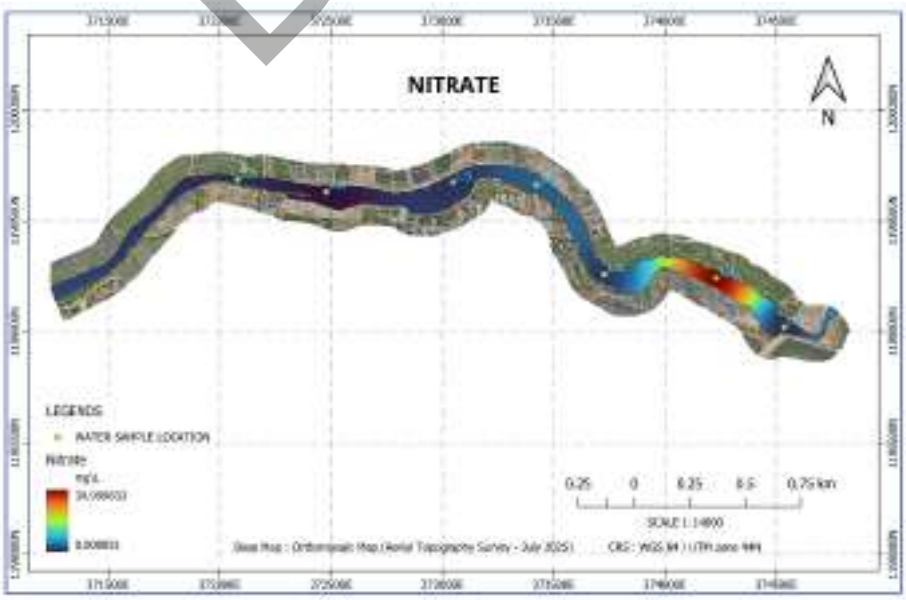
- **Iron (Fe)**

Iron levels were exceeding high in all sample ranging from 6.6 mg/L to 68 mg/L far above the acceptable limit of 0.3 mg\L. The highest concentration was recorded in L3. The spatial distribution map of Iron (Fe) for the survey area is given below.



- **Nitrate (NO_3)**

Nitrate levels ranged from below detection limits to 31 mg/L. The highest value was recorded at L2, with the second highest (3.4 mg/L) at L4. The spike at L2 suggests concentrated nutrient input from fertilizer runoff. The spatial distribution map of Nitrate (NO_3) for the survey area is given below.



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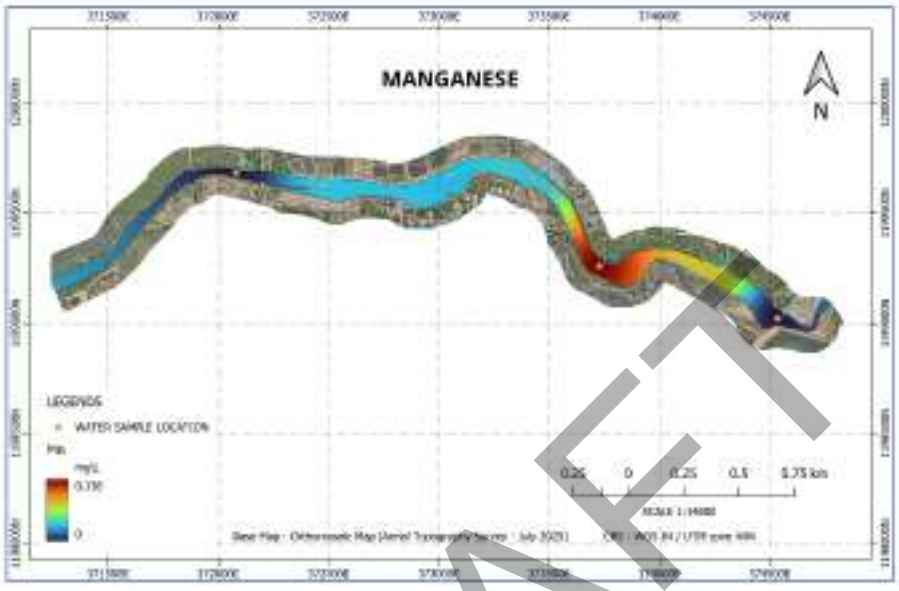
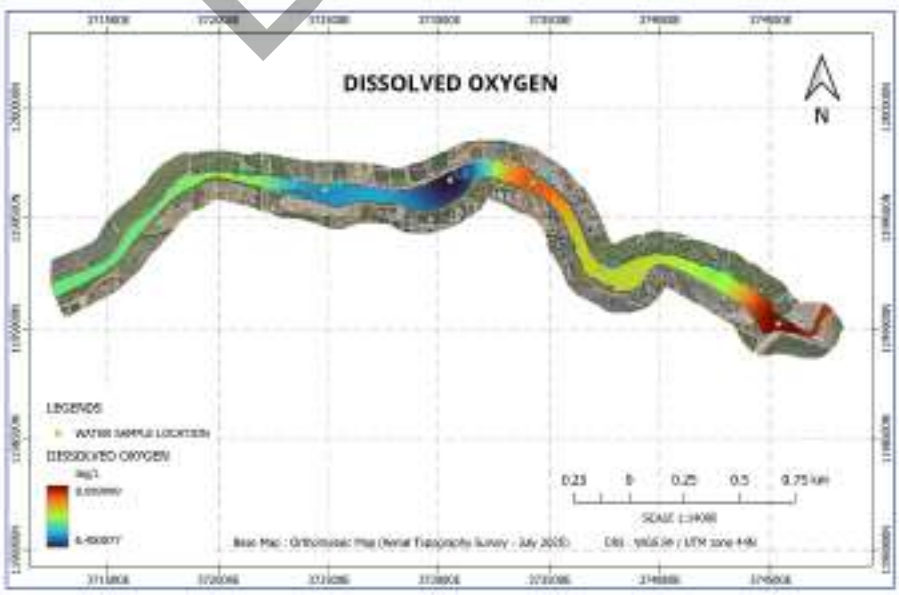
- **Manganese (Mn)**

Manganese ranged from BDL to 0.338 mg/L. The highest concentration is observed at L3 followed by L2. The spatial distribution map of Manganese (Mn) for the survey area is given below.



- **Dissolved Oxygen (DO)**

DO ranged from 6.4 mg/L to 8.1 mg/L. The highest concentration occurred at L1, followed by 7.8 mg/L at L4. Higher DO near the mouth may result from mixing with oxygen-rich tidal waters. The spatial distribution map of Dissolved Oxygen (DO) for the survey area is given below.



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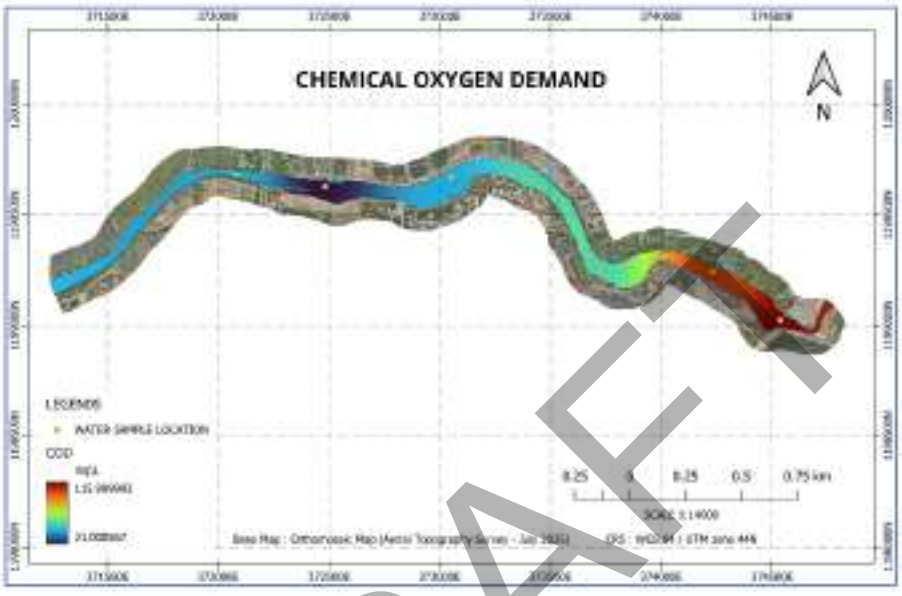
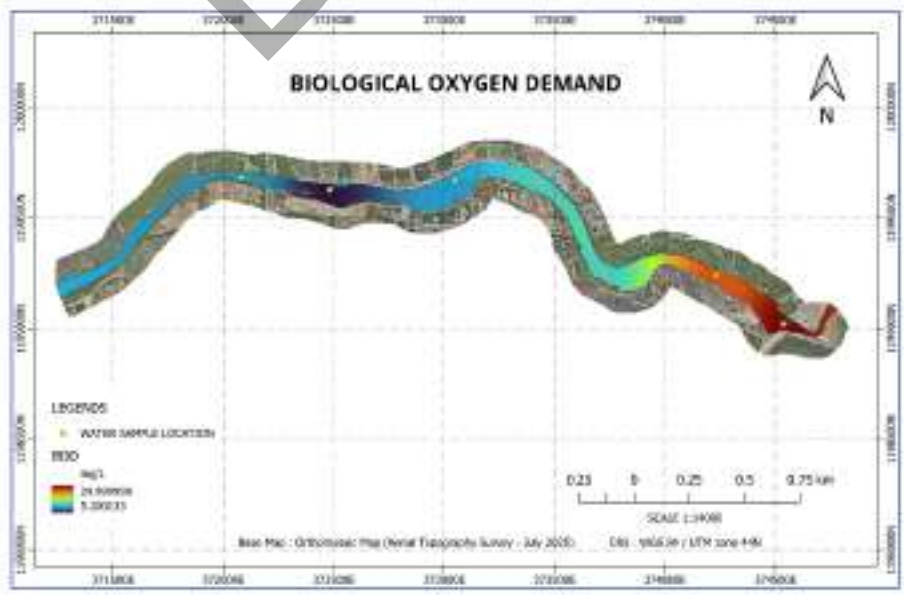
- **Chemical Oxygen Demand (COD)**

COD ranged from 21 mg/L to 116 mg/L. The highest concentration was recorded at L1, with the second highest (105 mg/L) at L2. High downstream values suggest organic matter accumulation and possible estuarine activity. The spatial distribution map of Chemical Oxygen Demand (COD) for the survey area is given below.



- **Biological Oxygen Demand (BOD)**

BOD ranged from 5.2 mg/L to 30 mg/L. The highest value was found at L1, followed by 26 mg/L at L2. These elevated values indicate substantial organic pollution near the river mouth. The spatial distribution map of Biological Oxygen Demand (BOD) for the survey area is given below.



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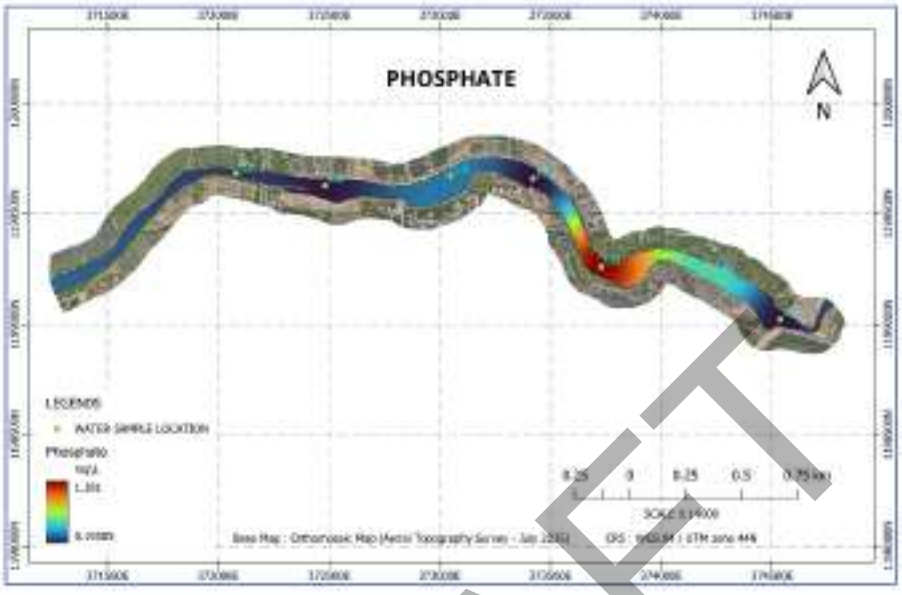
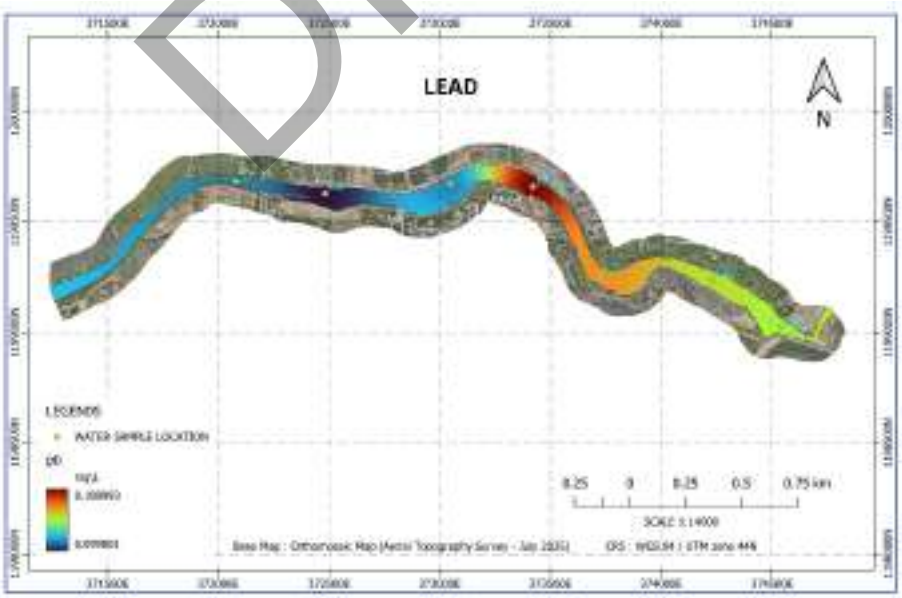
- **Phosphate as PO_4**

Phosphate PO_4 values ranged between 0.195 mg/L and 1.281 mg/L, with high concentration observed at L3. The spatial distribution map of Phosphate for the survey area is given below.



- **Lead (Pb)**

All sample contains lead concentration ranges from 0.099 mg/L to 0.189 mg/L, which is well above the permissible limit of 0.01 mg/L. The spatial distribution map of Lead (Pb) for the survey area is given below.



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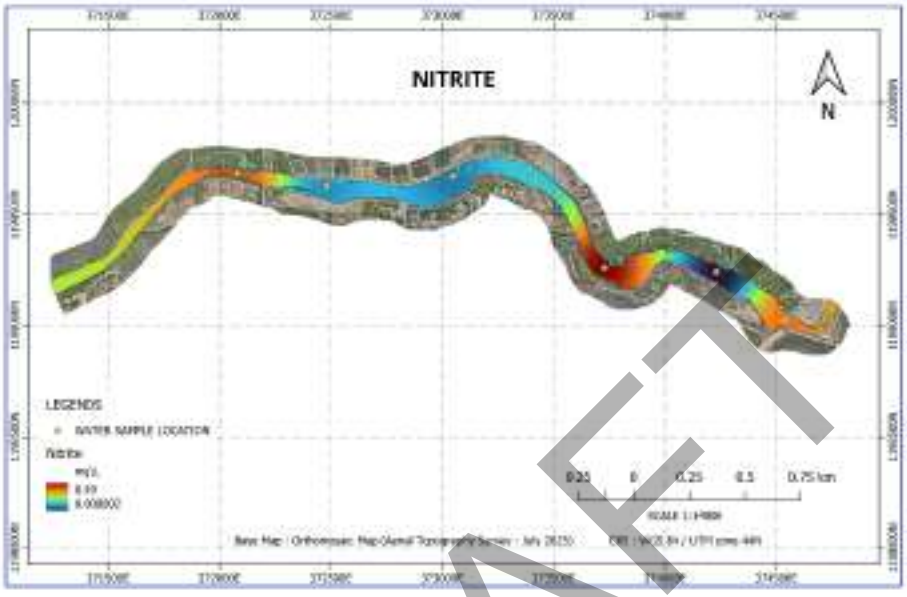
- **Nitrite as NO_2**

Nitrite was detected in most sample, ranging from below detection level to 0.49 mg/L. L3 is the highest value, while L2 had nitrite below detection limits. The spatial distribution map of Nitrite as NO_2 for the survey area is given below.



- **Mercury (Hg) and Cadmium (cd):**

Both mercury and cadmium were below detection limits in all sample, indicating the absence of contamination by these toxic heavy metals.

- **Ammonia (NH_4)**

Ammonia ranged from 0.12 mg/L to 3.91 mg/L. The highest (3.91 mg/L) occurred at L3, with the second highest (2.0 mg/L) at L2. High values indicate sewage contamination. The spatial distribution map of Ammonia (NH_4) for the survey area is given below.

- **Chlorophyll-a**

Chlorophyll-a was below detection limits in all samples. Spatial distribution insight: No algal bloom was detected during the sampling period.

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Sediment sample analysis

A total of seven sediment water samples were collected from various point along the river during pre-monsoon season. The results of sediment sample analysis are presented in tabular form below,

Sample	Sand	Silt	Clay	Bulk Density	Moisture	Organic Matter	Organic Carbon	Total Nitrogen	PO4	Fe	Cd	Ni	Cr	Zn	Pb	Mn	Texture	Hg
Unit	(%)	(%)	(%)	(g/cc)	(%)	(%)	(%)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	-	(mg/Kg)
L1	87.7	2.6	12.1	1.167	0.779	1.305	0.757	359	BDL	2110	BDL	12.07	13.128	9.621	8.9	27.19	Sand	BDL
L2	89.4	2.8	7.8	1.167	0.690	0.314	0.182	313	BDL	1969	BDL	8.027	11.48	11.733	7.596	1.275	Sand	BDL
L3	73.0	2.4	24.3	1.217	0.296	0.317	0.184	165	13.78	1660	BDL	7.01	12.489	16.047	6.1	45.67	Loamy Sand	BDL
L4	84.2	2.8	12.6	1.193	0.581	0.791	0.459	1235	BDL	2290	BDL	8.46	11.838	13.156	7.3	20.244	Sand	BDL
L5	88.0	2.7	9.1	1.257	0.336	0.289	0.168	326	26	2379	BDL	8.87	12.595	12.248	7	29.43	Sand	BDL
L6	80.5	2.6	16.6	1.217	0.457	0.455	0.265	440	BDL	4814	BDL	9.29	15.552	57.866	13.1	42.12	Loamy Sand	BDL
L7	77.0	2.7	20.1	1.098	1.298	3.415	1.981	1518	BDL	9831	BDL	3.97	10.629	2.103	5.1	26.77	Loamy Sand	BDL

BDL – Below Detection Level

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- **Sand (%)**

Sand content ranged from 73.0% to 89.4%. The highest value (89.4%) was observed at L2, followed by 87.6% at L1. Higher percentages in the lower and mid reaches indicate active transport of coarse sediments, while lower values at L3, L6, and L7 reflect deposition of finer materials.

- **Silt (%)**

Silt content ranged from 2.4% to 2.8%. The highest value (2.8%) was recorded at L3, with the second highest (2.6%) at L1. The minimal variation suggests limited silt retention, with much of the fine fraction transported downstream.

- **Clay (%)**

Clay content ranged from 7.8% to 24.3%. The highest value (24.3%) occurred at L3, followed by 20.5% at L7.

- **Bulk Density**

Bulk density ranged from 1.098 g/cc to 1.257 g/cc. The highest value (1.257 g/cc) was measured at L5, with the second highest (1.245 g/cc) at L2.

- **Moisture Content**

Moisture content ranged from 0.296% to 1.298%. The highest value (1.298%) was recorded at L7, followed by 1.245% at L6. Elevated moisture in upstream areas corresponds to finer, organic-rich sediments with higher water retention.

- **Total Phosphorous (PO_4^{3-})**

Total phosphorus ranged from below detection limits to 26 mg/Kg. The highest value (26 mg/Kg) was observed at L5, followed by 13.78 mg/Kg at L3. These localized enrichments may be due to agricultural or domestic inputs.

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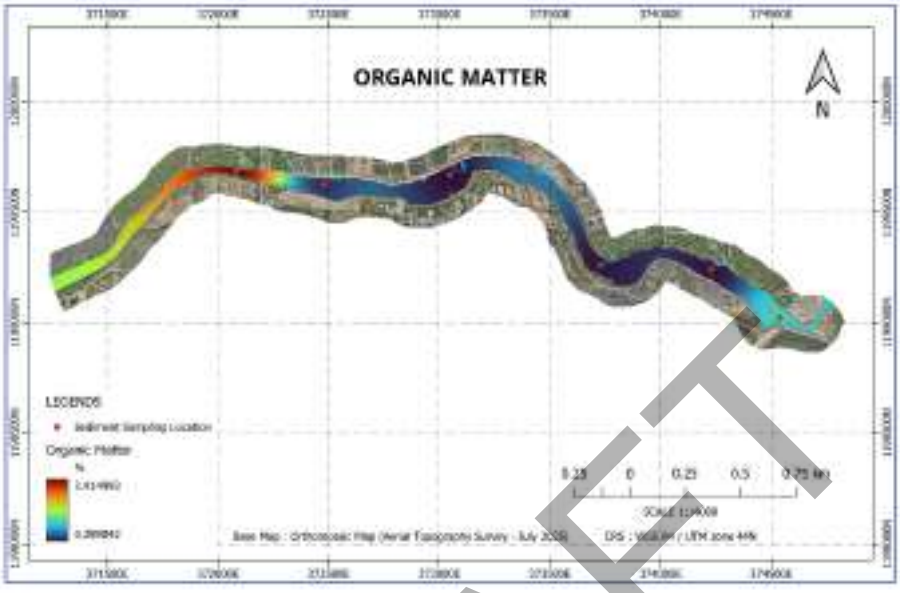
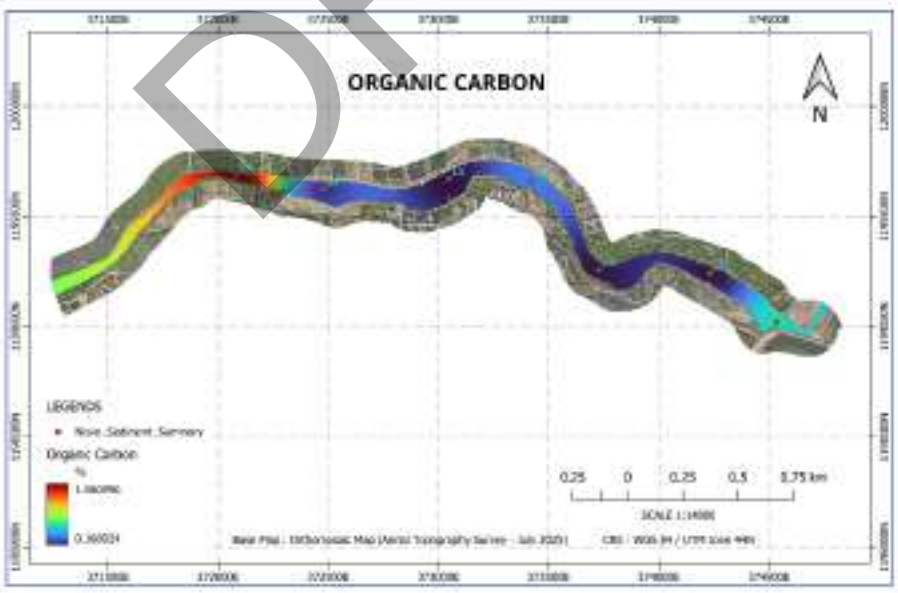
- **Organic Matter (%)**

Organic matter ranged from 0.289% to 3.415%. The highest value (3.415%) was found at L7, followed by 2.985% at L6.



- **Organic Carbon (%)**

Organic carbon ranged from 0.168% to 1.981%. The highest value (1.981%) occurred at L7, followed by 1.852% at L6.



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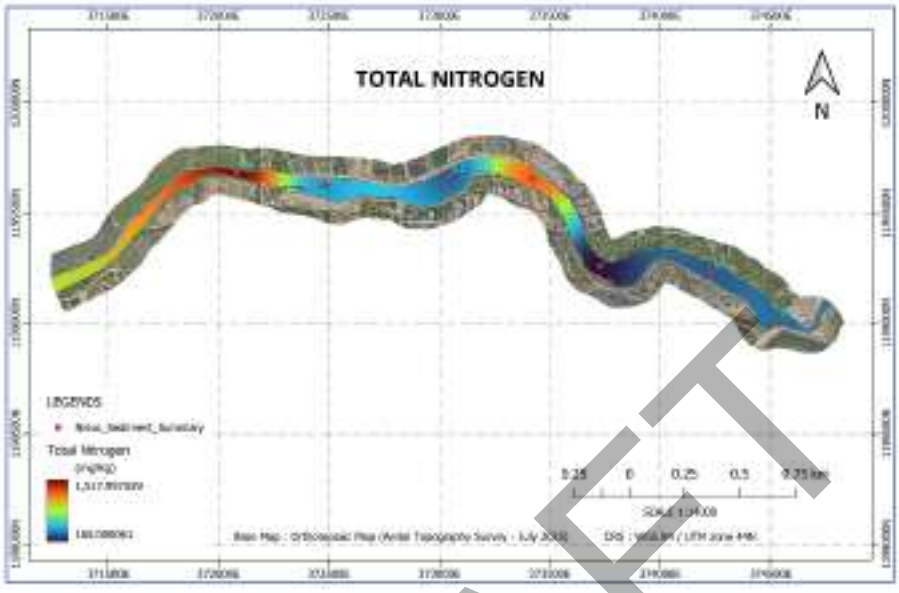
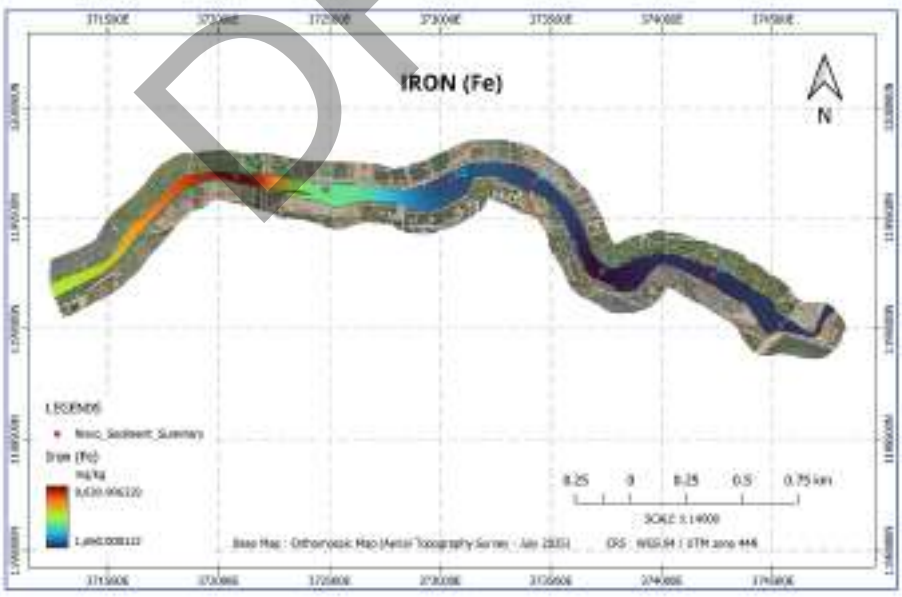
- **Total Nitrogen (N)**

Total nitrogen ranged from 165 mg/Kg to 1518 mg/Kg. The highest value (1518 mg/Kg) was at L7, followed by 1290 mg/Kg at L4.



- **Iron (Fe)**

Iron content ranged from 1660 mg/Kg to 9831 mg/Kg. The highest value (9831 mg/Kg) was at L7, followed by 8650 mg/Kg at L4.



- **Cadmium (Cd)**

Cadmium was below detection limits across all sites.

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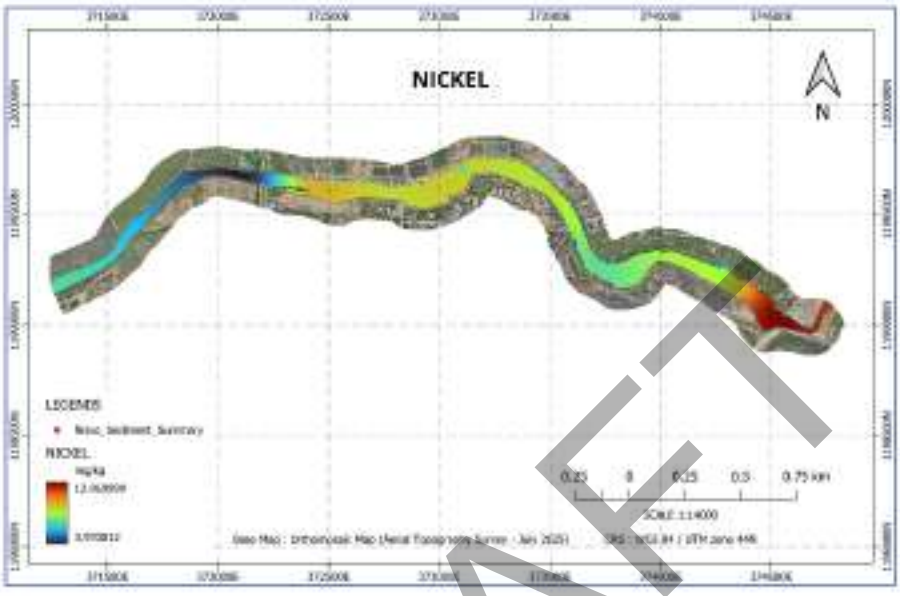
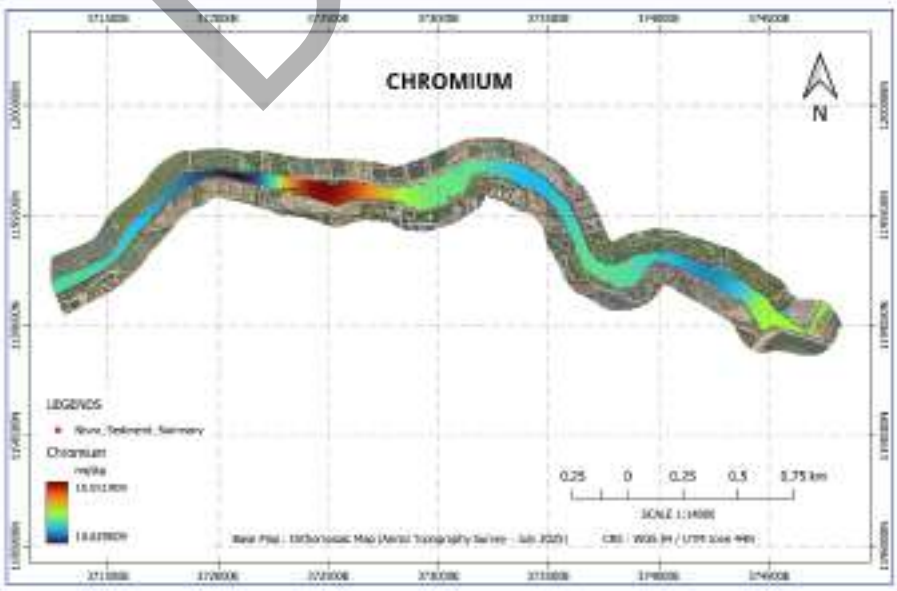
- **Nickel (Ni)**

Nickel ranged from 3.97 mg/Kg to 12.07 mg/Kg. The highest value (12.07 mg/Kg) was recorded at L1, followed by 11.52 mg/Kg at L2. The elevated concentrations in lower reaches may indicate external industrial inputs.



- **Chromium (Cr)**

Chromium ranged from 10.629 mg/Kg to 15.552 mg/Kg. The highest value (15.552 mg/Kg) was measured at L6, followed by 14.321 mg/Kg at L5. The concentrations are within safe limits and may reflect natural mineral sources.



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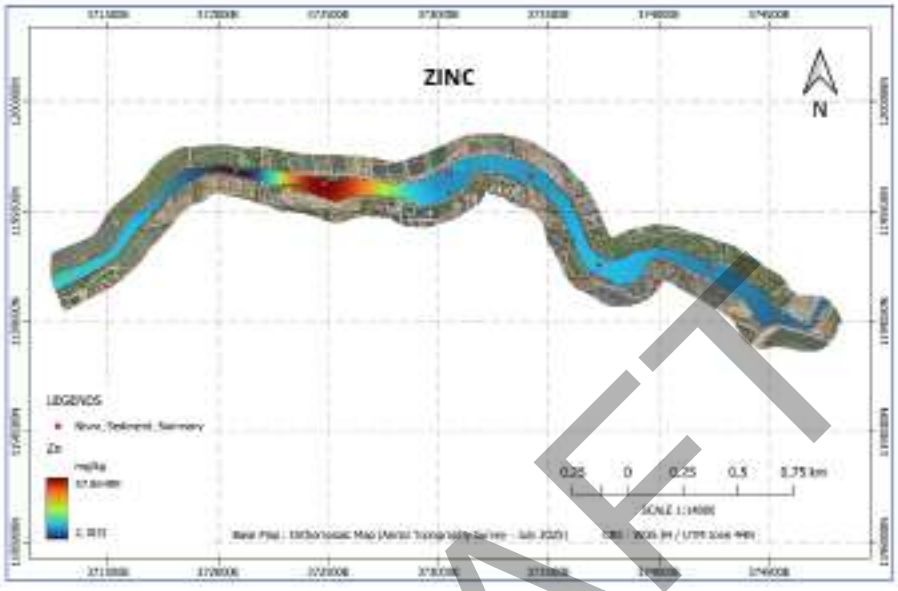
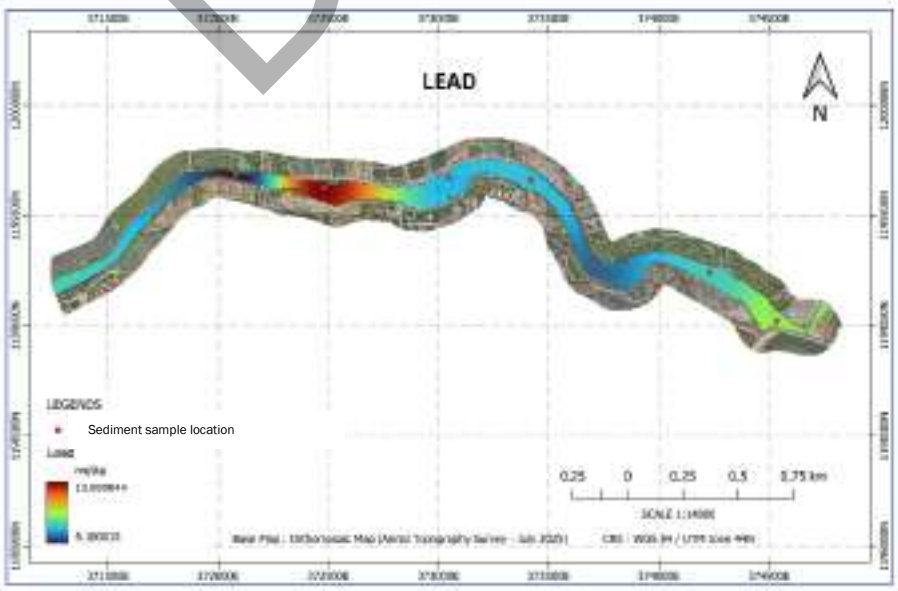
- **Zinc (Zn)**

Zinc ranged from 2.103 mg/Kg to 57.866 mg/Kg. The highest value (57.866 mg/Kg) occurred at L6, followed by 42.321 mg/Kg at L5. These midstream peaks may be linked to wastewater discharge or other anthropogenic inputs.



- **Lead (Pb)**

Lead ranged from 5.1 mg/Kg to 13.1 mg/Kg. The highest value (13.1 mg/Kg) was observed at L6, followed by 12.5 mg/Kg at L5.



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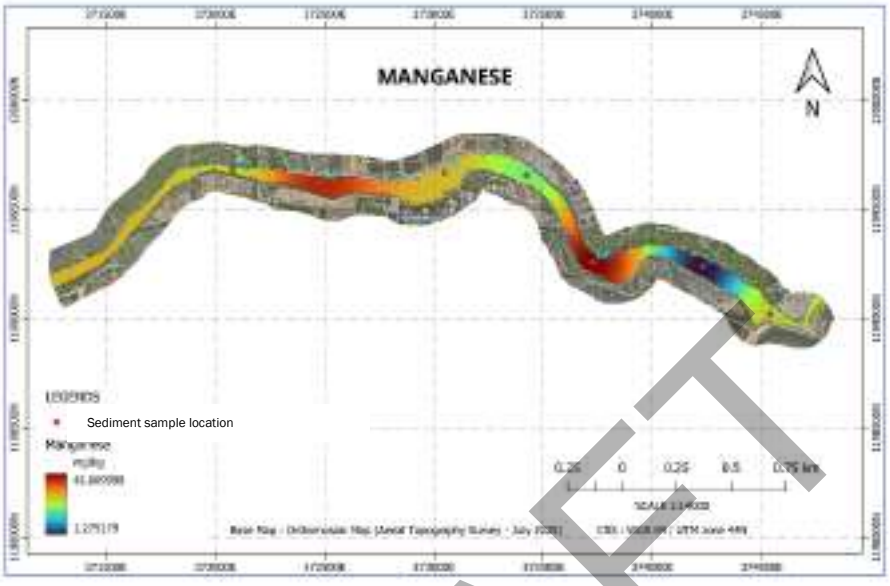
- **Manganese (Mn)**

Manganese ranged from 1.275 mg/Kg to 45.67 mg/Kg. The highest value (45.67 mg/Kg) was recorded at L6, followed by 38.92 mg/Kg at L5.



4.2. Saltwater Intrusion study

The saltwater intrusion study in the study area for pre monsoon was conducted using Geophysical method - Electrical Resistivity Tomography (ERT) in five locations along the river. The results of Electrical Resistivity Tomography are discussed below.

Location 1 (10.847854N, 79.847092E):

The First Electrical Resistivity Tomography (ERT) profile was conducted approximately 500 m westward from the coastline, within the designated buffer Zone. The geoelectrical results indicate variation in resistivity ranging from **10.7** to **153.44 Ωm.**

Notably, a lower resistivity zone, ranging between 44 and 47 Ωm, was observed at depth of 7.0-10.0m. The reduced resistivity is independent of orientation toward the sea and may be attributed to saturated strata associated with subsurface saltwater intrusion. The resistivity data from Location 1 suggest the presence of brackish to saline water with in the subsurface area.

Based on the geophysical analysis, it is inferred that Location 1 is influenced by saline water intrusion. Traces of saline water are detected below a depth of approximately 7.0m.

DRAFT

Location 2 (10.850701N, 79.842011E):

The Second Electrical Resistivity Tomography (ERT) profile was conducted approximately 1200m westward from the coastline, within the buffer zone. The geoelectrical results indicate variation in resistivity ranging from 0.6 to 1.6 Ωm.

The lower resistivity zone was detected at a shallow depth of 1.0m. The obtained resistivity values strongly suggest the presence of brackish to saline water within the subsurface strata.

Based on the geophysical analysis, it is inferred that Location 2 is influenced by saline water intrusion within the alluvium formation. Traces of saline water are detected at shallow depths, beginning at approximately 1.0m.

Location 3 (10.850476N, 79.834773E)

The third Electrical Resistivity Tomography (ERT) profile was conducted approximately 2000m westward from the coastline, within the buffer zone. The geoelectrical results indicate variation in resistivity ranging from 0.75 to 1.3 Ωm.

The lower resistivity zone was detected at a shallow depth of 1.0m. The obtained resistivity values strongly suggest the presence of brackish to saline water within the subsurface strata.

Based on the geophysical analysis, it is inferred that Location 3 is influenced by saline water intrusion within the alluvium formation. Traces of saline water are detected at shallow depths, beginning at approximately 1.0m.

Location 4 (10.850160N, 79.826731E)

The fourth Electrical Resistivity Tomography (ERT) profile was conducted approximately 2800m westward from the coastline, within the buffer zone. The geoelectrical results indicate variation in resistivity ranging from 1.4 to 15.46 Ωm.

The lower resistivity zone was detected at a depth of around 4m. Though the values recorded are slightly higher than typical saline water resistivity. The obtained resistivity values strongly suggest the presence of brackish to saline water within the subsurface strata.

Based on the geophysical analysis, it is inferred that Location 4 is influenced by saline water intrusion within the alluvium formation. Traces of saline water occurs below a depth of approximately 4.0m.

DRAFT

Location 5 (10.846967N, 79.823337E):

The fifth Electrical Resistivity Tomography (ERT) profile was conducted approximately 3000m westward from the coastline, within the buffer zone. The geoelectrical results indicate variation in resistivity ranging from 1.51 to 7.6 Ωm.

The lower resistivity zone was first observed at a depth of about 4.0m. Though the values recorded are slightly higher than typical saline water resistivity. The obtained resistivity values strongly suggest the presence of brackish to saline water within the subsurface strata.

Based on the geophysical analysis, it is inferred that Location 5 is influenced by saline water intrusion within the alluvium formation. Traces of saline water occurs below a depth of approximately 4.0m.

The geophysical resistivity investigation revealed that saltwater intrusion is prominent in all five locations, extending up to approximately 3-4 km inland from the coast. At Location 1, saline water intrusion was identified at depths greater than 7.0m, suggesting that the sand dune aquifer containing freshwater act as a partial barrier controlling the advance of saline water, a process strongly influenced by coast proximity and tidal/shoreline dynamics.

The lithological units of the alluvial aquifer are primarily composed of sand and sand clay mixtures, with predominantly fine-grain texture. Within the estuarine influence zone, lower resistivity value in the top soil suggest contamination, reflecting the direct impact of estuarine water on aquifer characteristics. Overall, the study area is largely dominated by saline water intrusion, rendering the groundwater unsuitable for domestic consumption.

The Analysis Data of Geophysical Survey is presented in ***Annexure 1.***

DRAFT

PHOTO GALLERY

DRAFT

Karaikal, Puducherry, India

Karaikal, Puducherry, India

Karaikal, Puducherry, India

DRAFT

FIGURES

MAP PROPERTIES

CRS : WGS 84
Ellipsoidal Name :EPSG:7030
Unit : degrees
Map Production Date:05/08/2025

250 0 250 500 km

SCALE BAR

LEGENDS

INDIAN STATE BOUNDARY

Fig.2. Satellite imagery of survey region

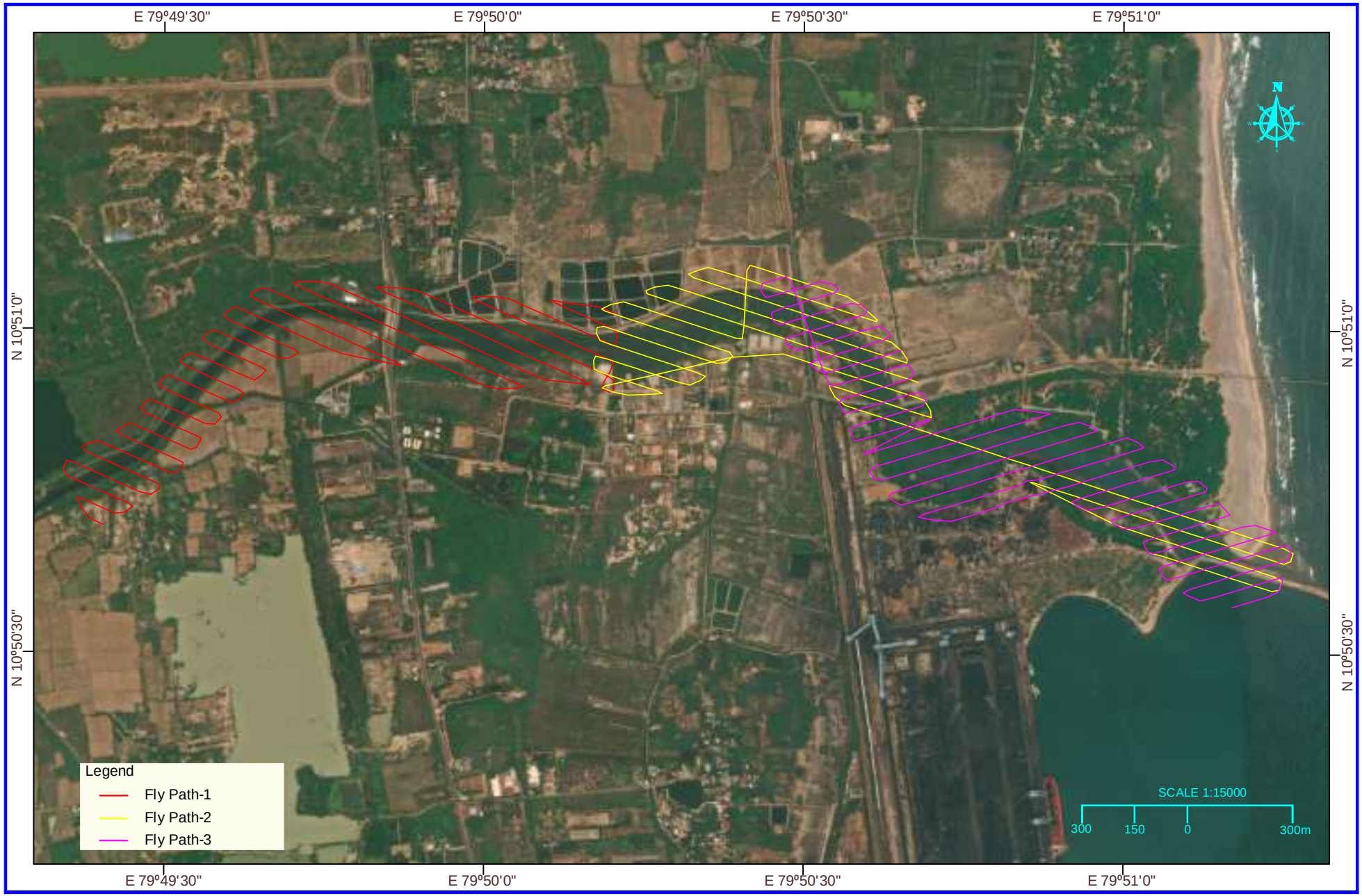


Fig.4. Planned line for Aerial topographic survey

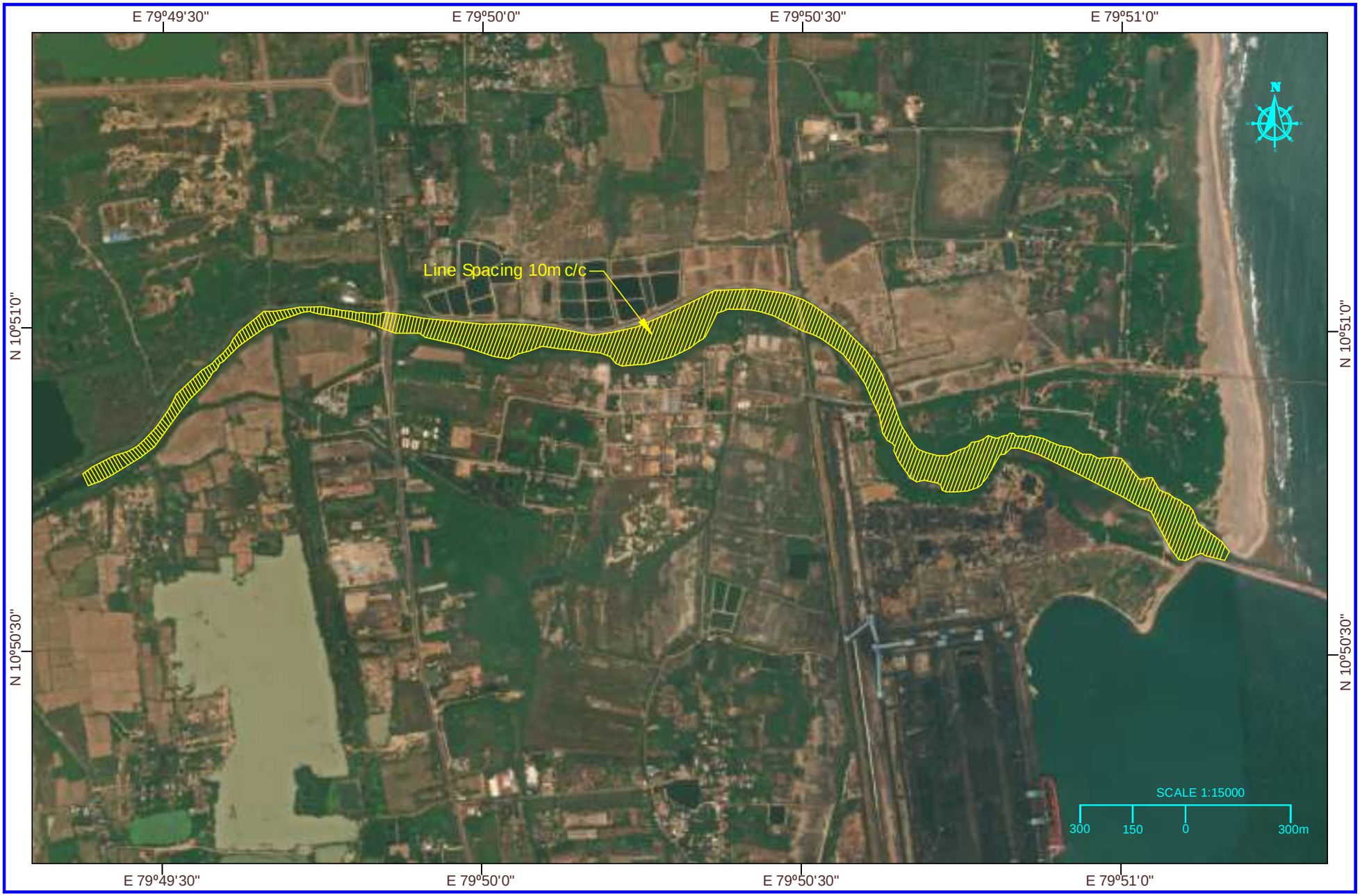


Fig. 4. Planned lines for Bathymetry Survey

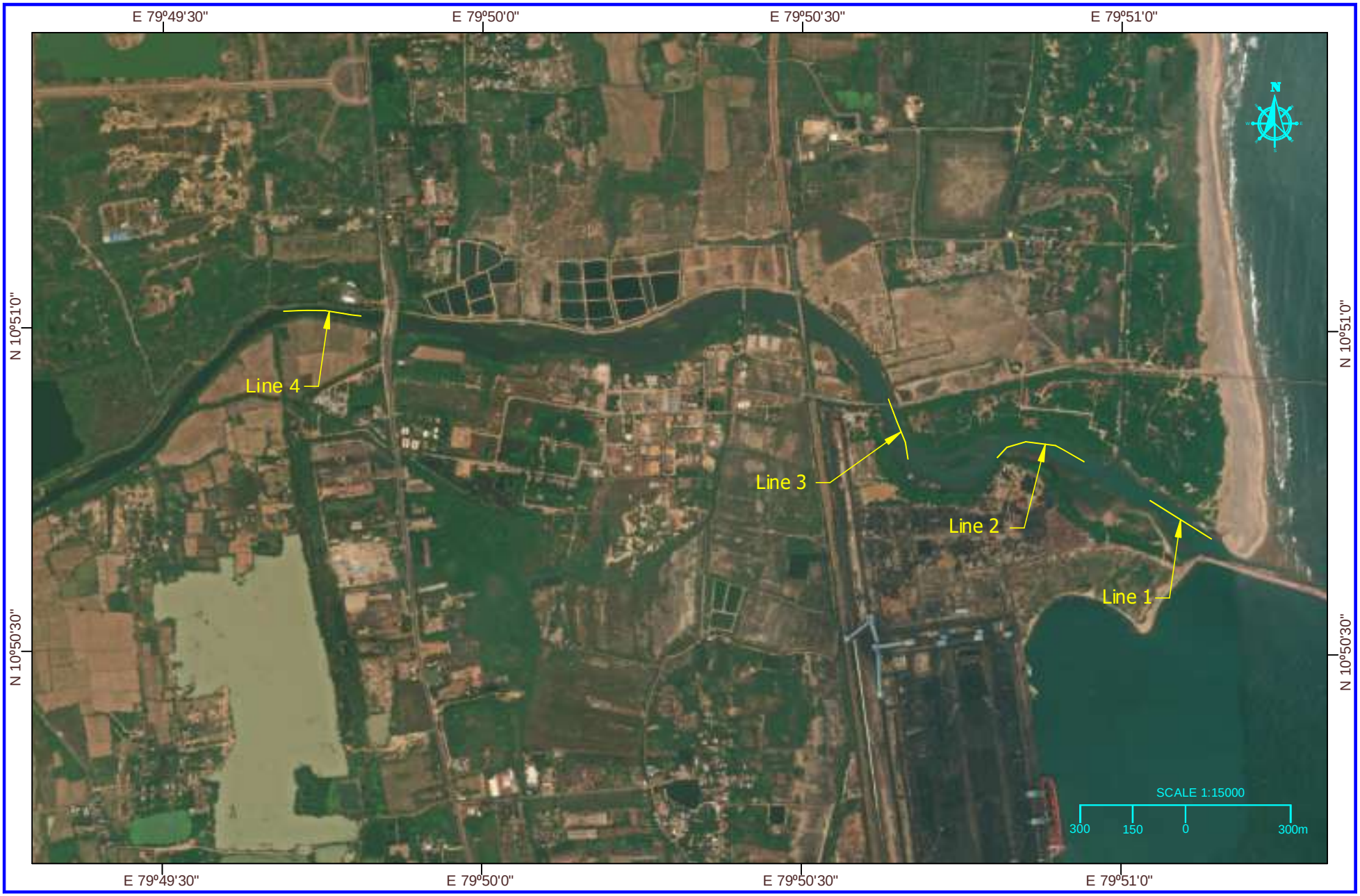
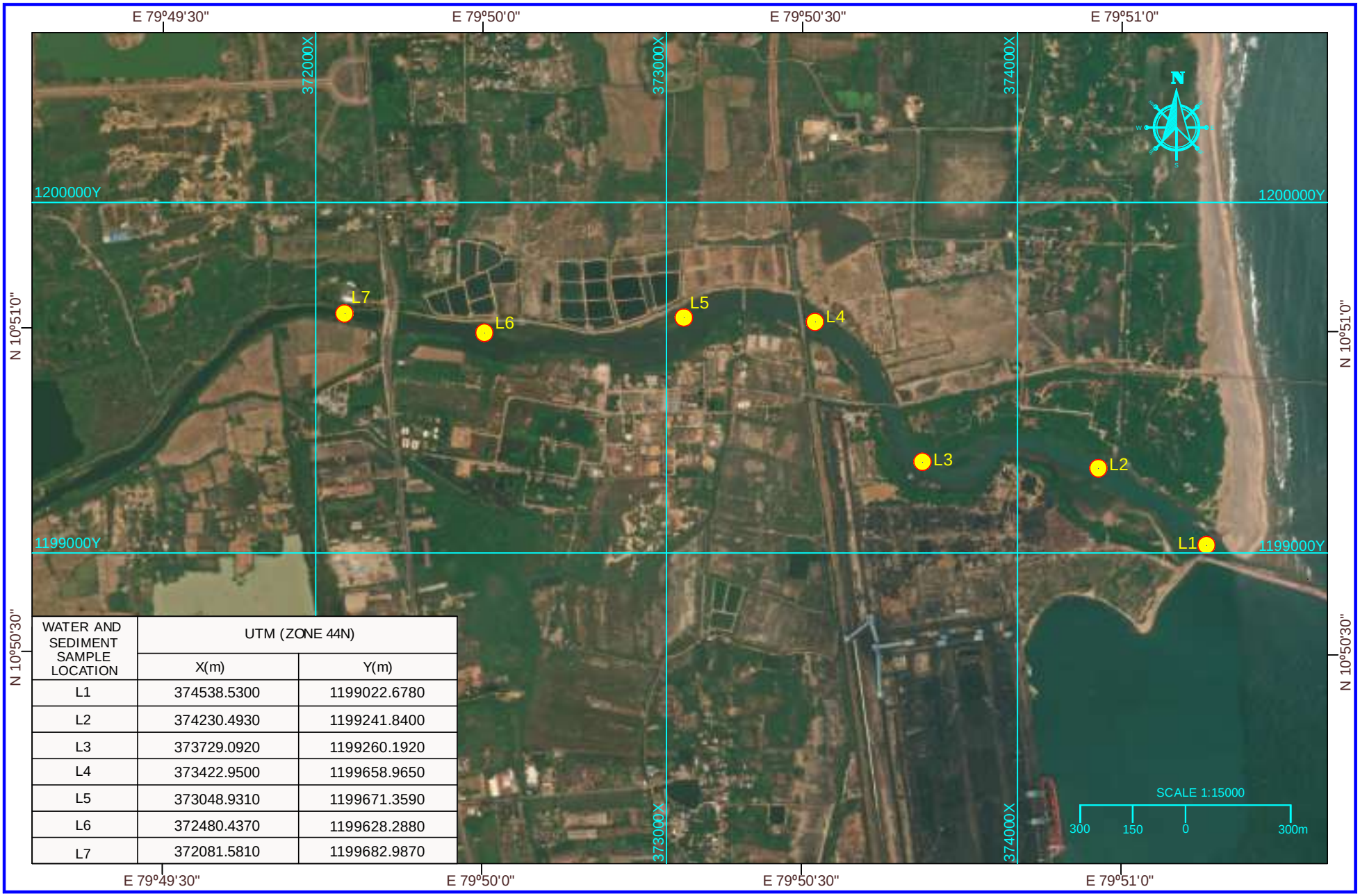
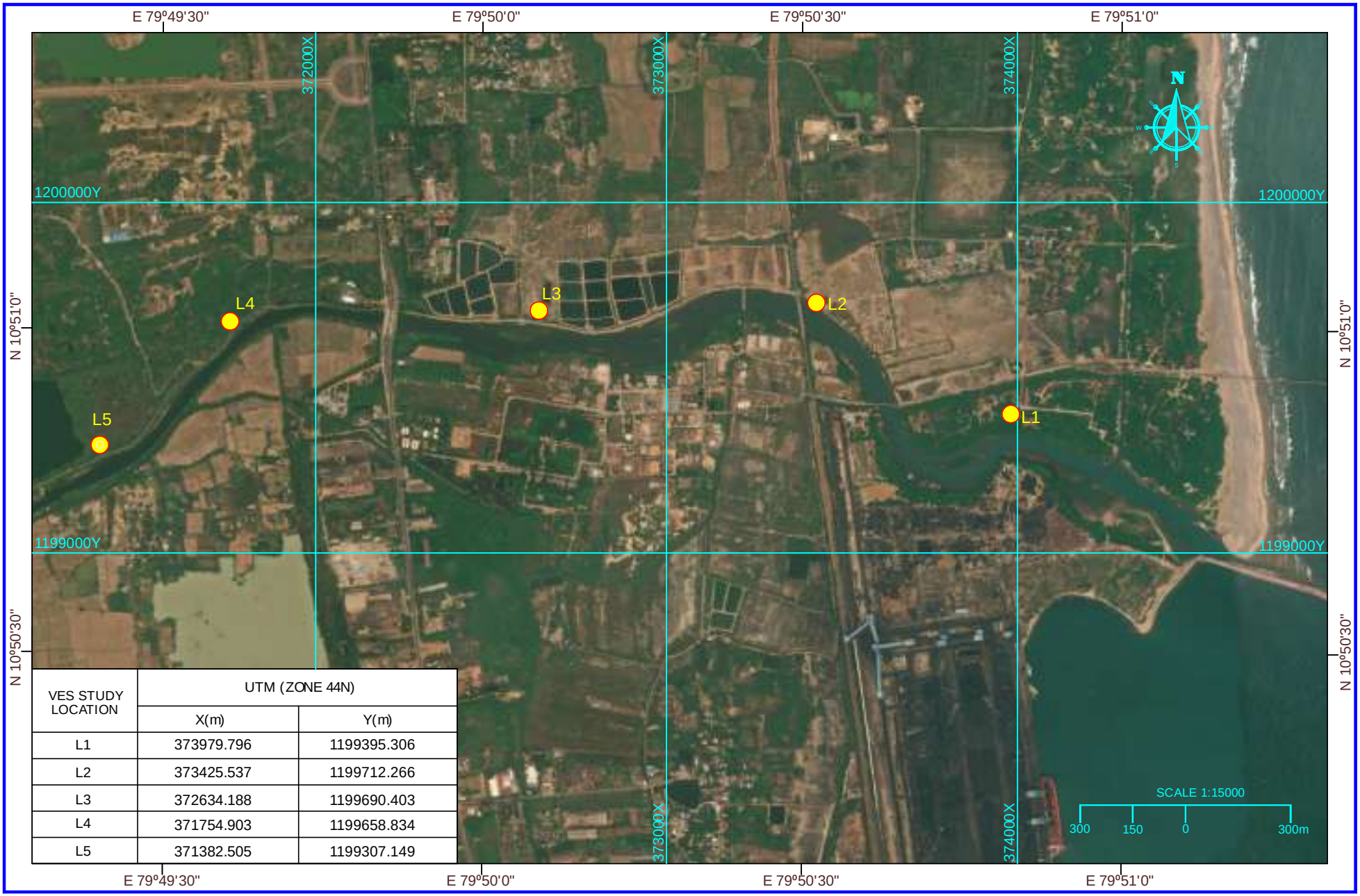


Fig. 5. Planned lines for Sub bottom Profiling Survey



WATER AND SEDIMENT SAMPLE LOCATION	UTM (ZONE 44N)	
	X(m)	Y(m)
L1	374538.5300	1199022.6780
L2	374230.4930	1199241.8400
L3	373729.0920	1199260.1920
L4	373422.9500	1199658.9650
L5	373048.9310	1199671.3590
L6	372480.4370	1199628.2880
L7	372081.5810	1199682.9870

Fig.6. Water and sediment sample location



VES STUDY LOCATION	UTM (ZONE 44N)	
	X(m)	Y(m)
L1	373979.796	1199395.306
L2	373425.537	1199712.266
L3	372634.188	1199690.403
L4	371754.903	1199658.834
L5	371382.505	1199307.149

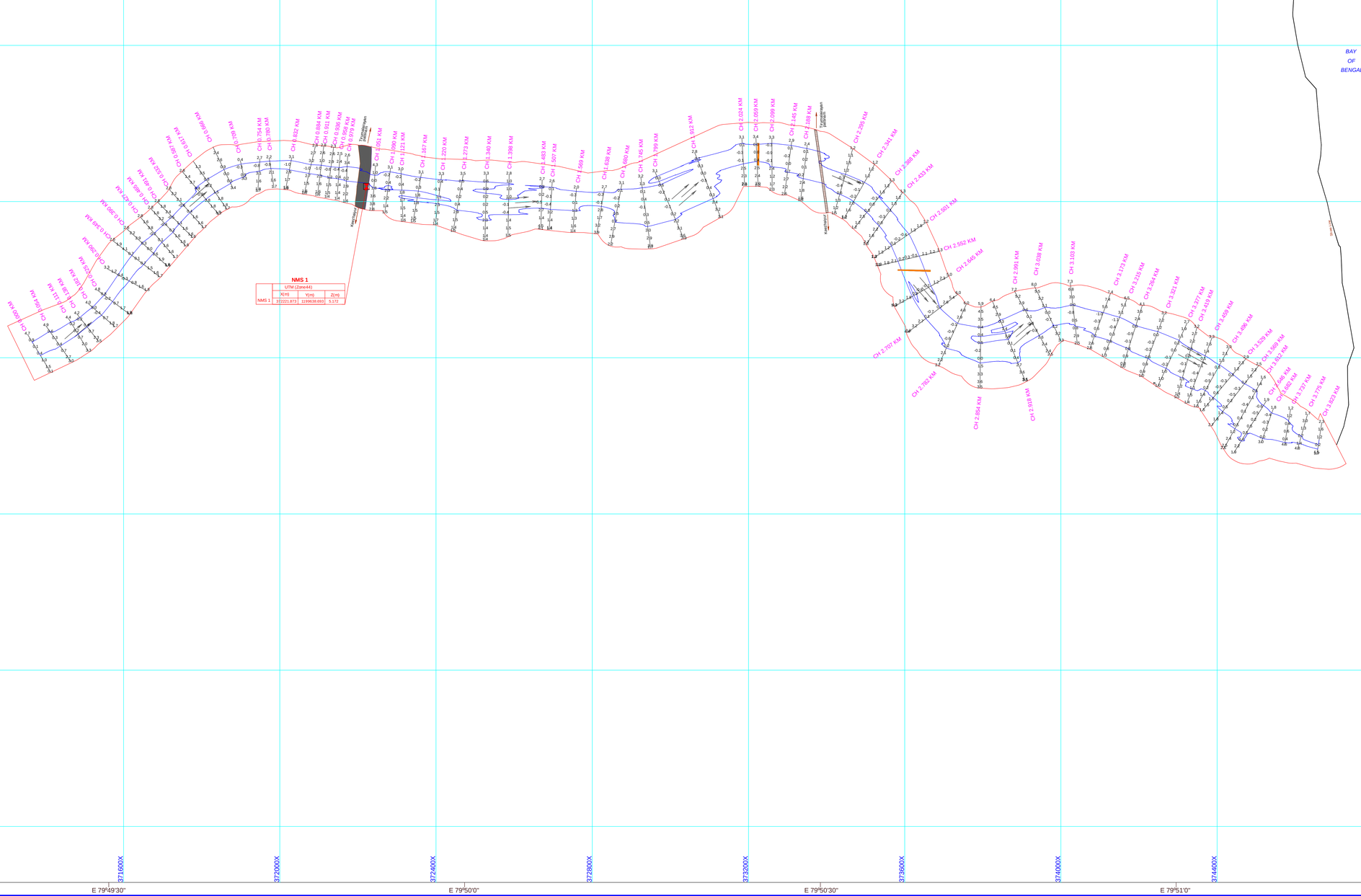
Fig.7. Location of Vertical Electrical Sounding (VES) - Salt water intrusion study

E 79°49'30" E 79°50'0" E 79°50'30" E 79°51'0" E 79°51'30"

N 10°51'30" N 10°51'10" N 10°50'50"

3708800X 3712000X 3716000X 3720000X 3724000X 3728000X 3732000X 3736000X 3740000X 3744000X 3748000X 3752000X

1200800Y 1200400Y 1200000Y 1199600Y 1199200Y 1198800Y 1198400Y 1198000Y



KEY MAP :

NOTES :

1. Levels are w.r.t. Bench mark 4.250 M provided by client.
2. Data grid - 20m X 20m
3. Bathymetry acquired using Syqwest Hydrobox Single frequency Echo-sounder.
4. Horizontal positioning acquired using TRIMBLE SPS 351

GEODETIC DETAILS :

Spheroid	:	WGS 84
Semi major axis (a)	:	6378137.00 m
Inversed Flattening (1/f)	:	298.2572
Grid Projection	:	U.T.M. Zone 44
Latitude of origin	:	0° equator
Longitude of origin (CM)	:	81° East
Scale factor on CM	:	0.9996
False easting	:	500000m E
False northing	:	0m N
Unit	:	International Metre

LEGEND :

General

- Geographical Grid Intersection
- UTM Grid Intersection
- Bridge
- Weir

BATHYMETRY

- Bathymetry contours
- Levels in metres & decimetres
- Water Line
- Railway Bridge

SURVEY PERIOD : 30.06.2025 TO 18.07.2025

100 50 0 100 200 300

SCALE 1 : 4000
Paper Size : A0

SURVEYED By :

NISVO MARINE SURVEYS LLP
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Near IMA, Bharathi Nagar,
Tambaram, Chennai, Tamil Nadu 600045
projects@nisvo.com
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CLIENT:

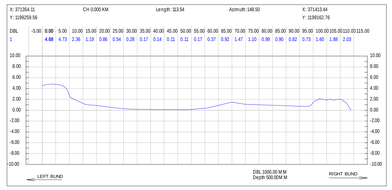
FALCON RESILIENT
INFRA CONSULTANTS

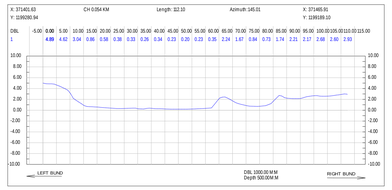
CHART TITLE :

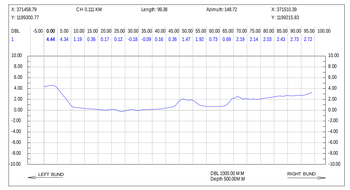
BATHYMETRY & TOPOGRAPHIC CHART

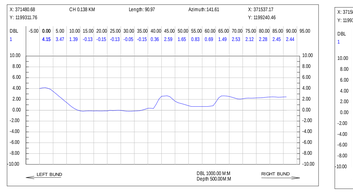
Surveyed by	Mr. Ashok Kumar
Procesed by	Mr. Gabriel Gavan
Checked by	Mr. S.P. Gunasingh
Paper Size	A0
Survey Period	30.06.2025 TO 18.07.2025
Drawn by	Mr. Gabriel Gavan

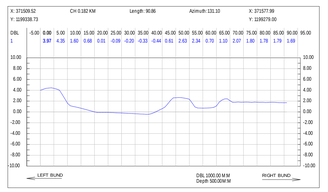
APPROVED BY NISVO
Dr. S. Balasingh John Samuel, Ph.D.,

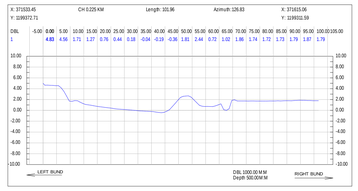


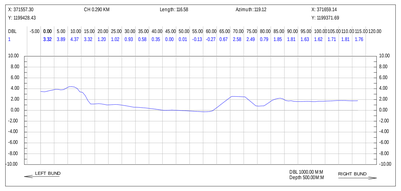


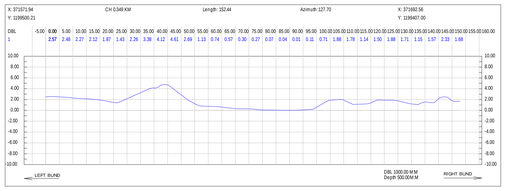


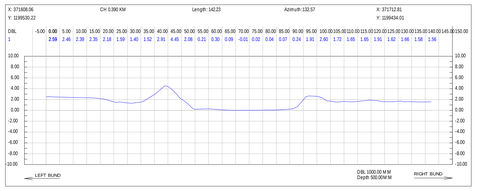


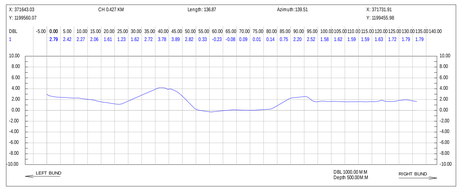


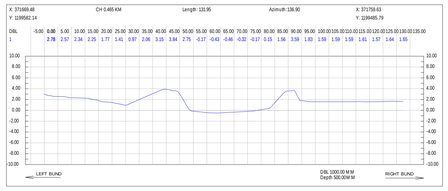


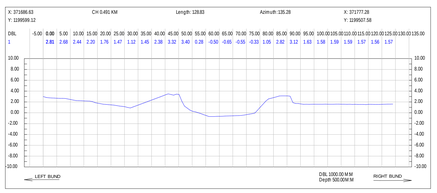


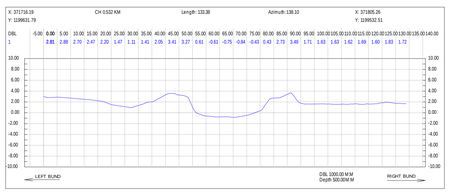


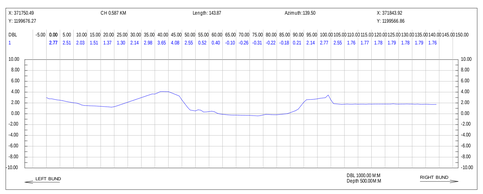


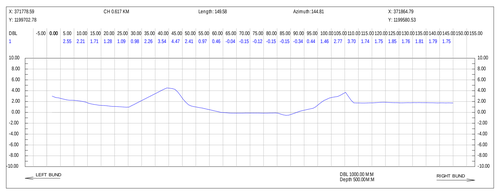


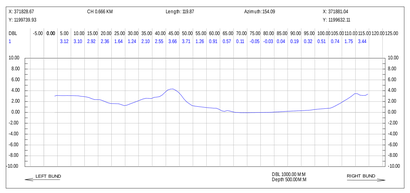


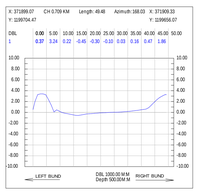


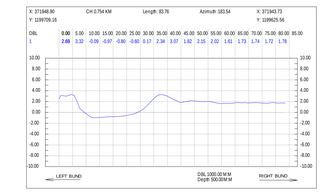


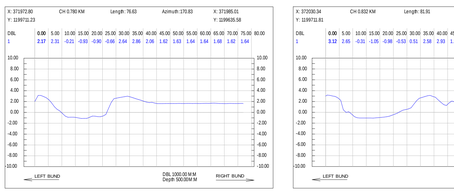


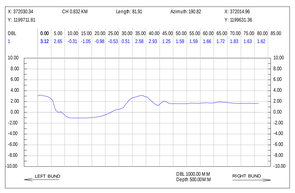


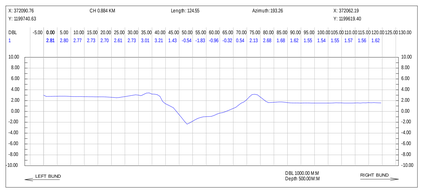


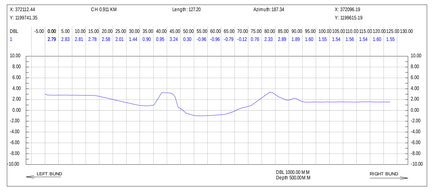


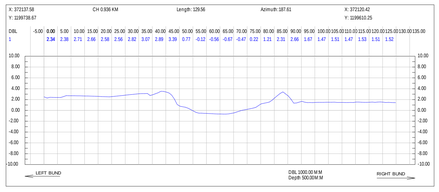


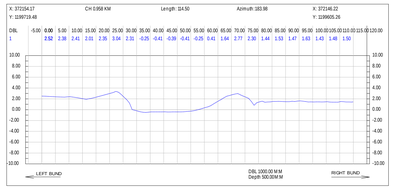


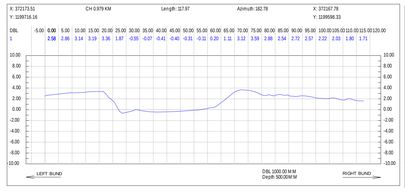


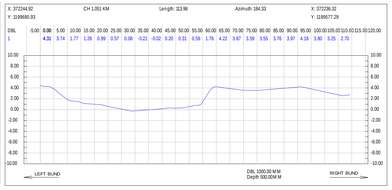


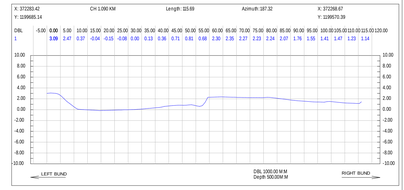


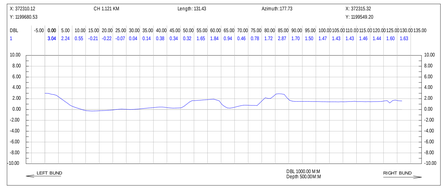


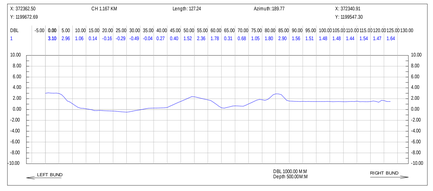


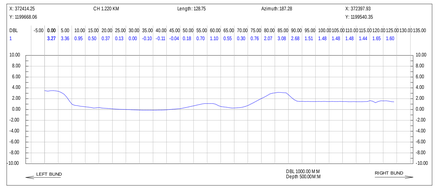


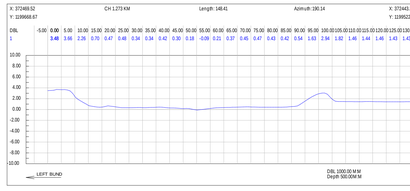


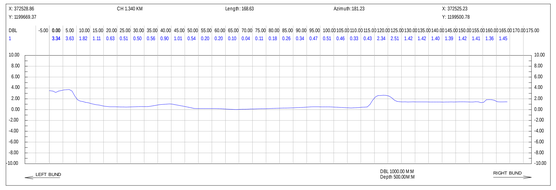


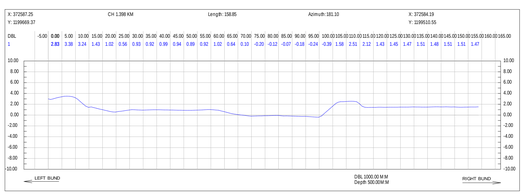


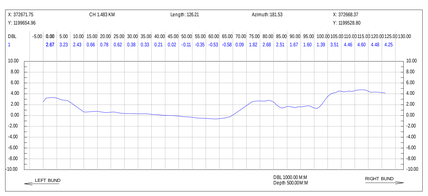


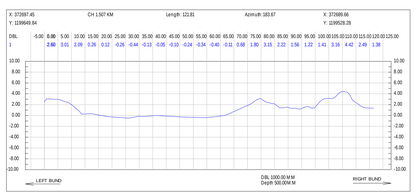


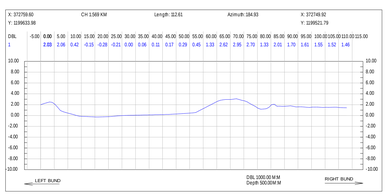


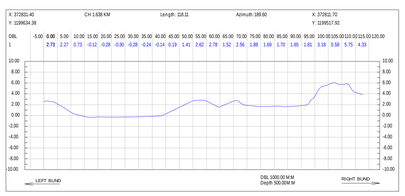


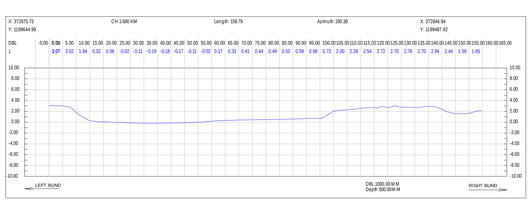


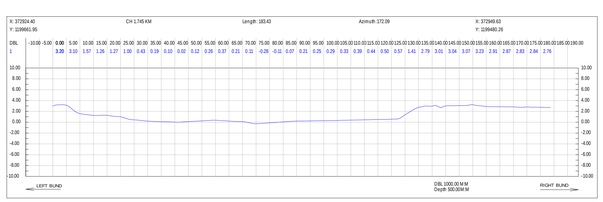


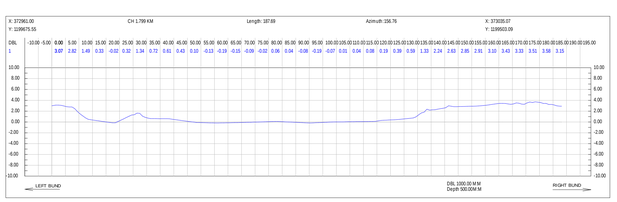




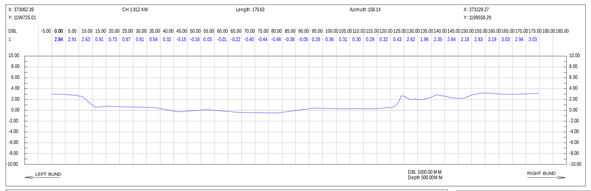


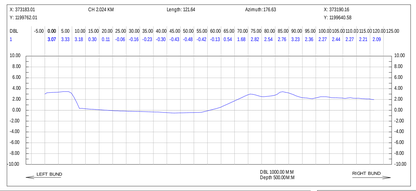


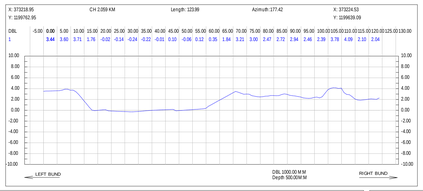


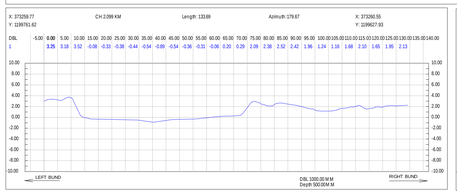


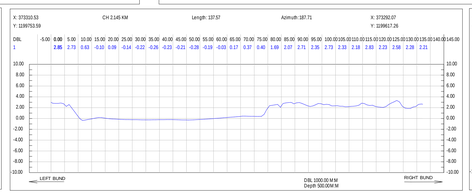
CLIENT: FALCON RESILIENT INFRA CONSULTANTS	DRAWING TITLE: CROSS SECTION OF KARAIKAL RIVER CHAINAGE : CH:0.000 km TO CH 1.799 km	SURVEYED BY: NISVO MARINE SURVEYS LLP, CHENNAI - 600045, projects@nisvo.com, www.nisvo.com	SCALE: HOR. 1:1000, VER. 1:500	SEASON: JUNE 2025	FIG NO: FIG.09 / REV.: 0
					SHEET No. 01 of 02

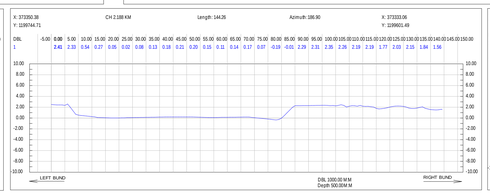


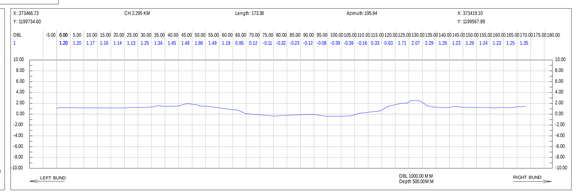


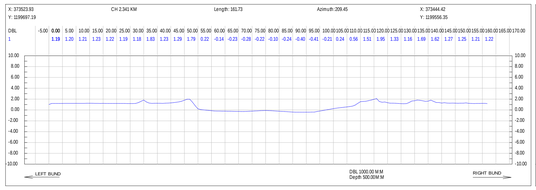


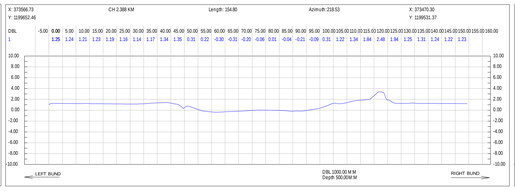


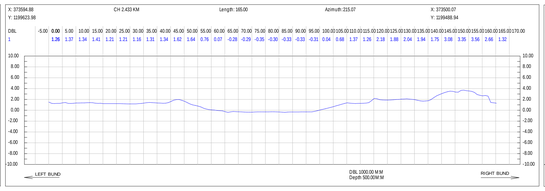


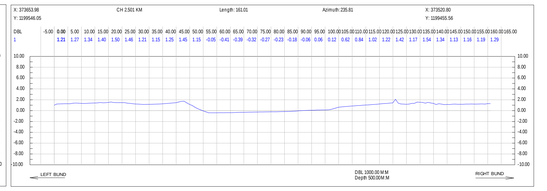


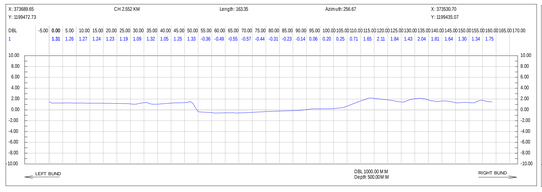


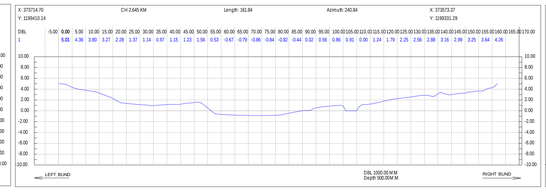


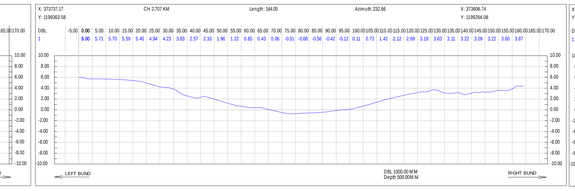


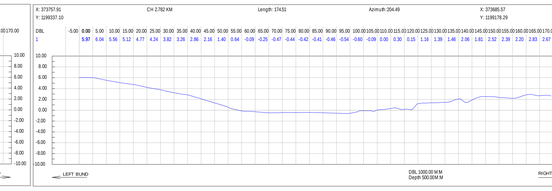


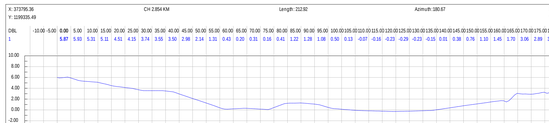


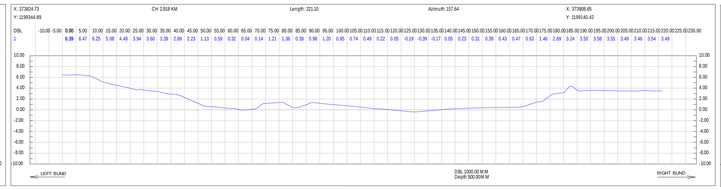


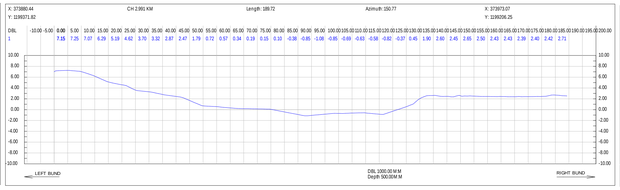


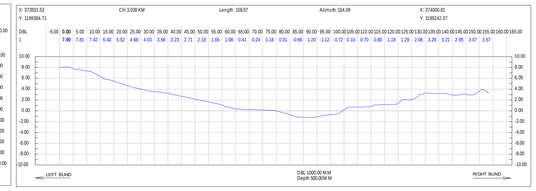


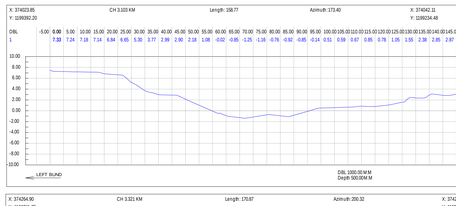


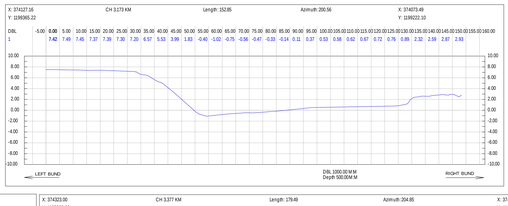


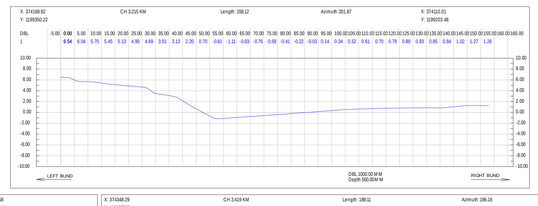


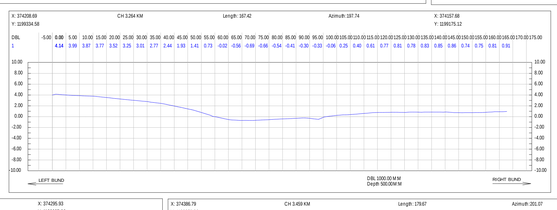


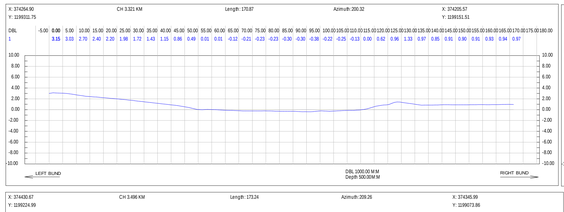


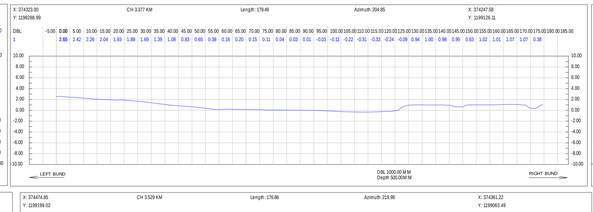


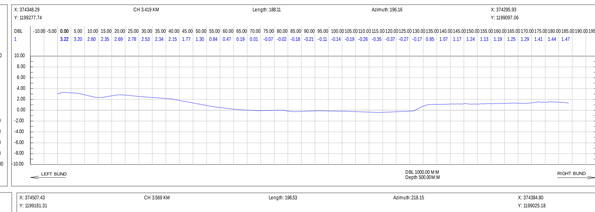


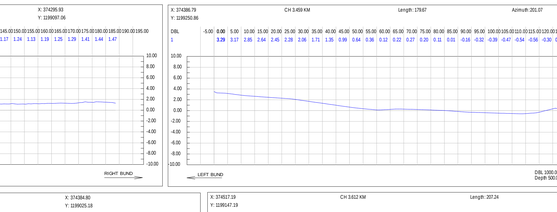


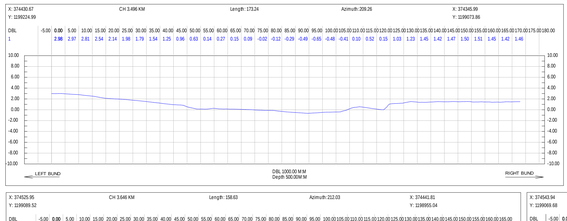


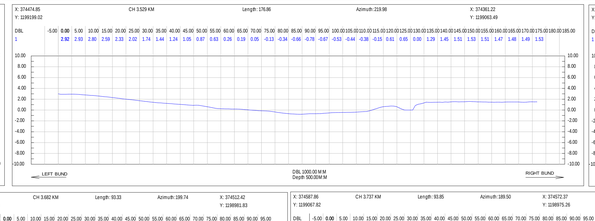


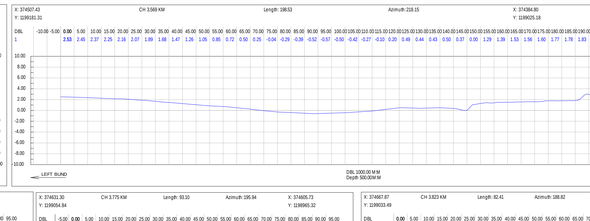


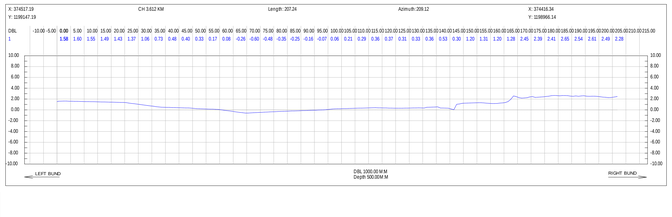


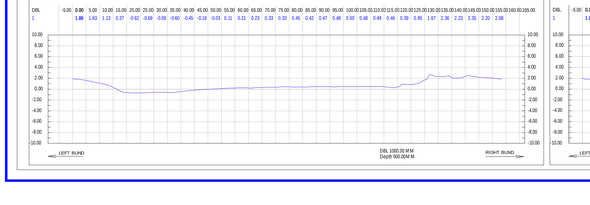


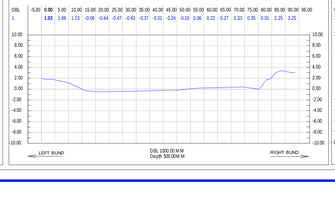


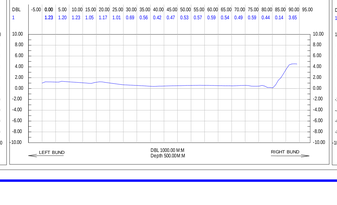


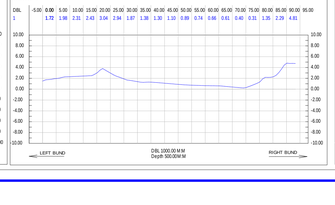


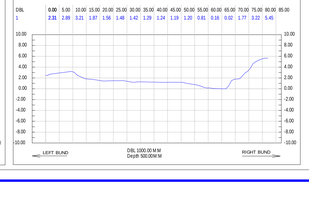












CLIENT: FALCON RESILIENT INFRA CONSULTANTS	DRAWING TITLE: CROSS SECTION OF KARIKAL RIVER CHAINAGE : CH.1.912 km TO CH 3.823 km	SURVEYED BY: NISVO MARINE SURVEYS LLP CHENNAI - 600045 projects@nisvo.com www.nisvo.com	SCALE: HOR. 1:1000, VER. 1:500 SEASON: JUNE 2025 SHEET No. 02 of 02	FIG NO: FIG.10 REV.: 0

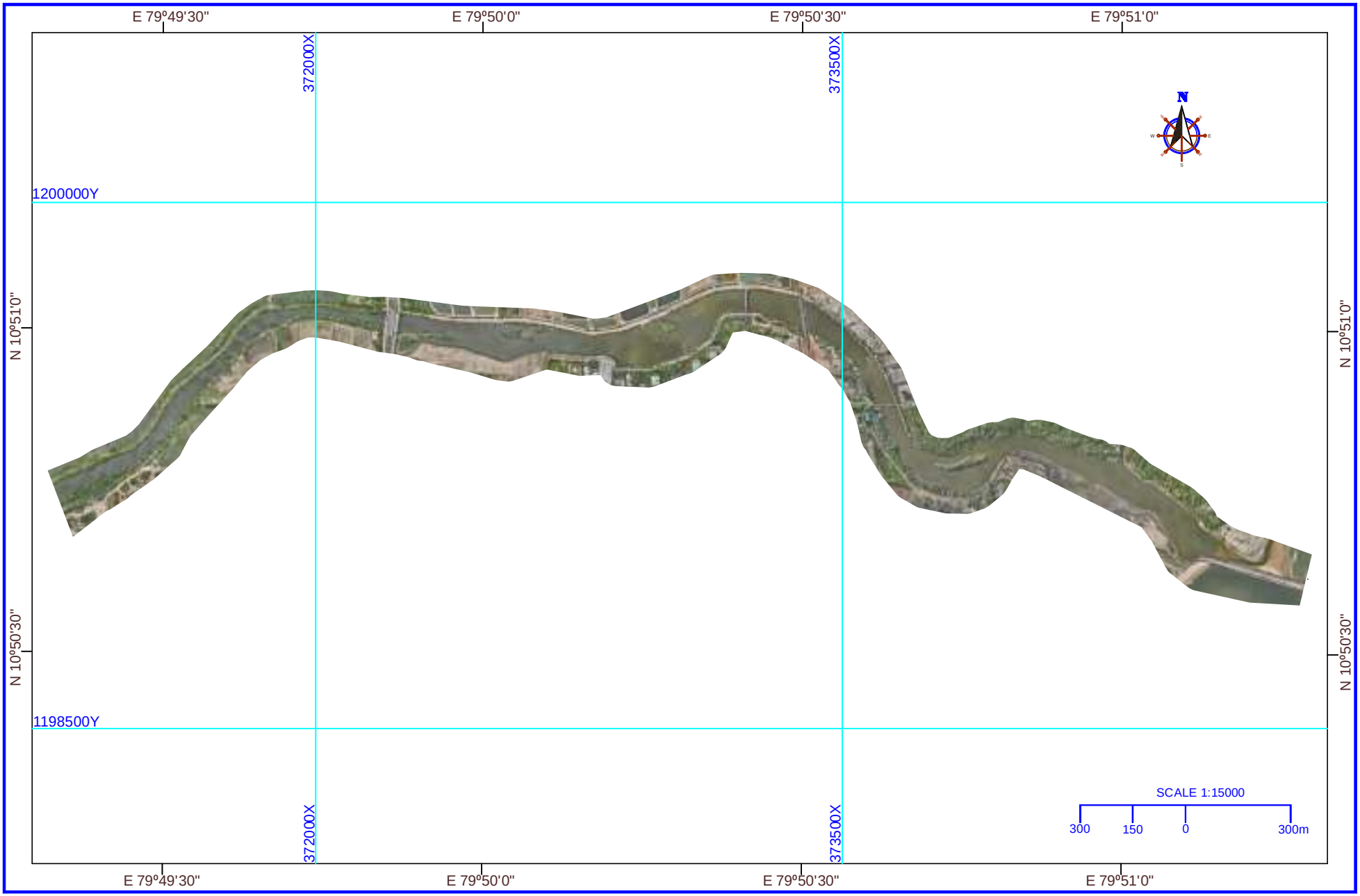


Fig. 11. Orthomosaic Map based on UAV (Unmanned Aerial Vehicle) Topographic survey - June to July

LAND USE LAND COVER CLASSIFICATION

371200E 371400E 371600E 371800E 372000E 372200E 372400E 372600E 372800E 373000E 373200E 373400E 373600E 373800E 374000E 374200E 374400E 374600E 374800E

1200200N 1200000N 1199800N 1199600N 1199400N 1199200N 1199000N 1198800N 1198600N 1198400N 1198200N 1198000N 1197800N

N

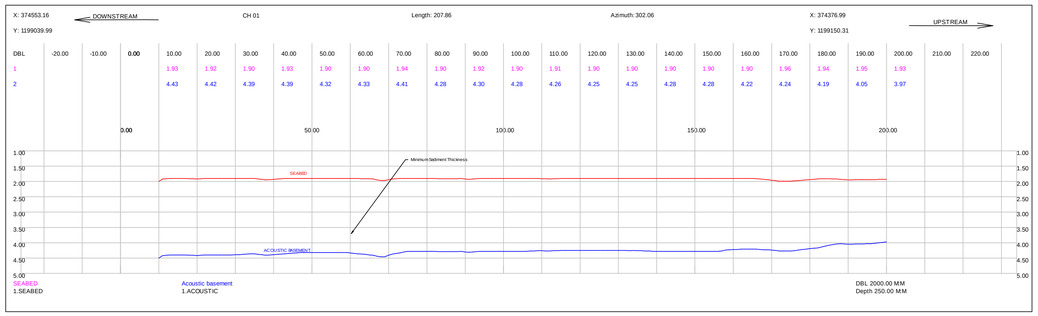
LEGEND

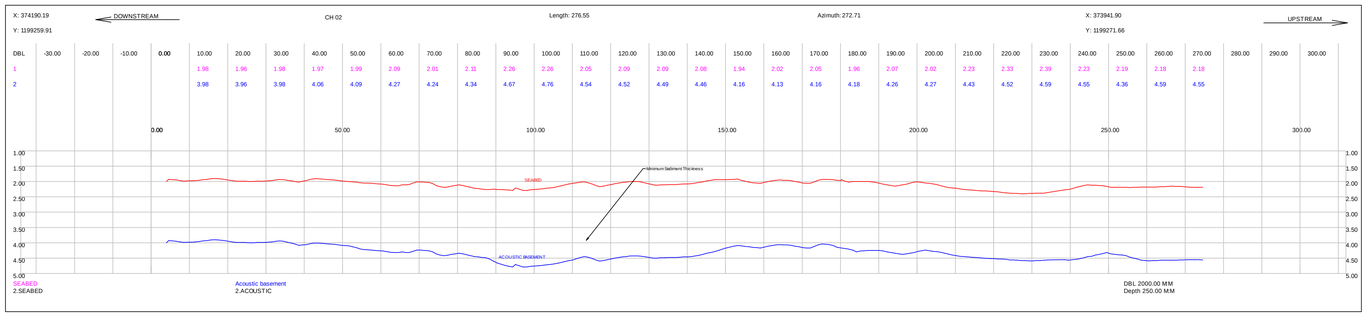
- AGRICULTURAL LAND
- SETTLEMENTS
- EYOT
- RAILWAY LINE
- ROAD
- AQUACULTURE
- INDUSTRIAL ZONE
- KARAIKAL PORT
- TREES COVER AREA
- RURAL ROAD
- BRIDGE
- MAN MADE CHANNEL
- NATURAL STREAM
- BARREN LAND
- TIDAL FLATS_FLOODPLAINS
- WATER BODIES
- RIVER
- SERVICE ROAD
- BREAKWATER
- THORN FOREST_WASTELAND
- OCEAN
- SURVEY REGION

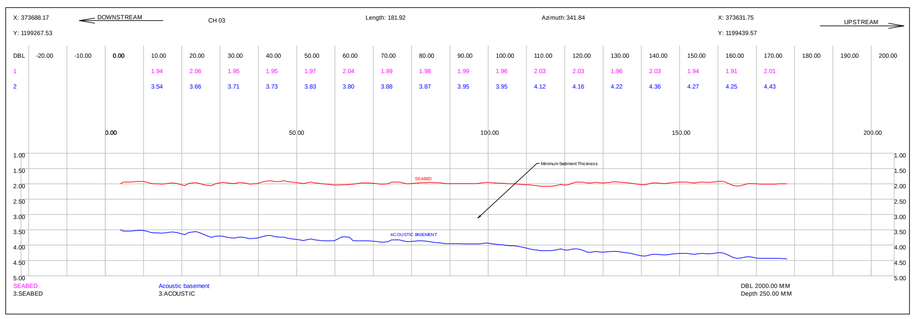
70 0 70 140 210 280 m

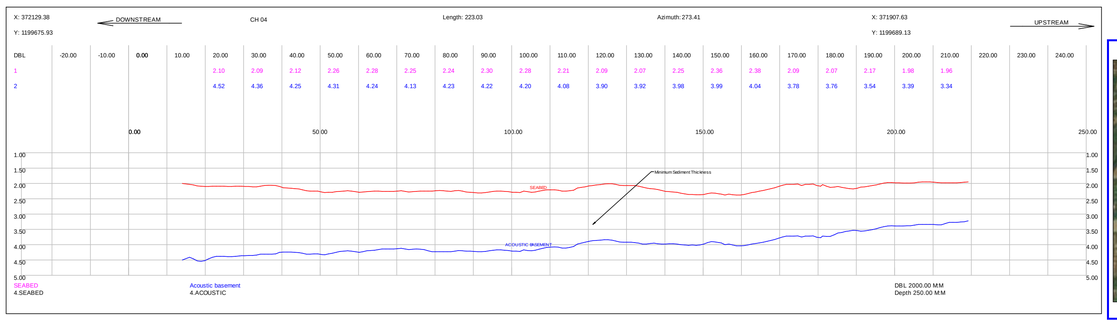
SCALE 1:3500

COORDINATE SYSTEM : WGS 84 / UTM zone 44N









KEY MAP

LEGEND

SEABED(M)

ACOUSTIC BASEMENT(M)

CLIENT

FALCON RESILIENT INFRA CONSULTANTS

DRAWING TITLE

VERTICAL PROFILE (BASED ON SUB BOTTOM PROFILING SURVEY) KARAIKAL

SURVEYED BY

NISVO MARINE SURVEYS LLP
CHENNAI 600045
projects@nisvo.com
www.nisvo.com

SCALE	SEASON	FIG NO	REV.
HOR. 1:2000 VER. 1:250	JUNE 2025	FIG. 13	0

SHEET No. 01 of 01

ANNEXURES

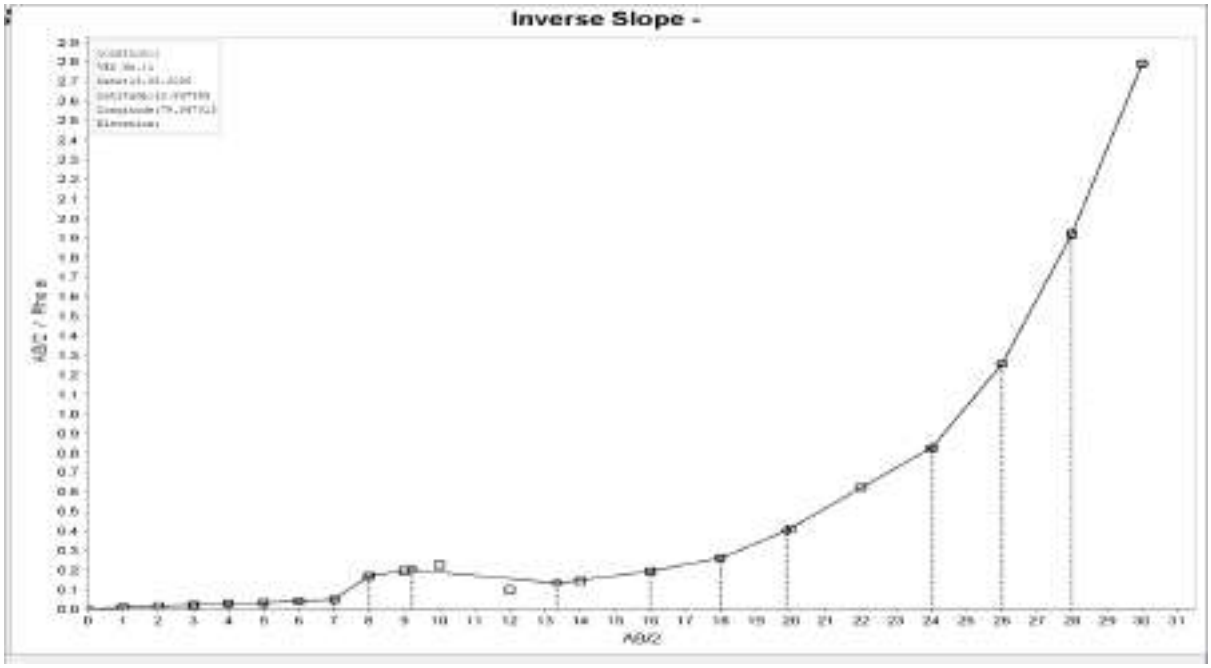
ANNEXURE I

(Analysis Data Geophysical Survey)

Electrical Resistivity test- Data sheet

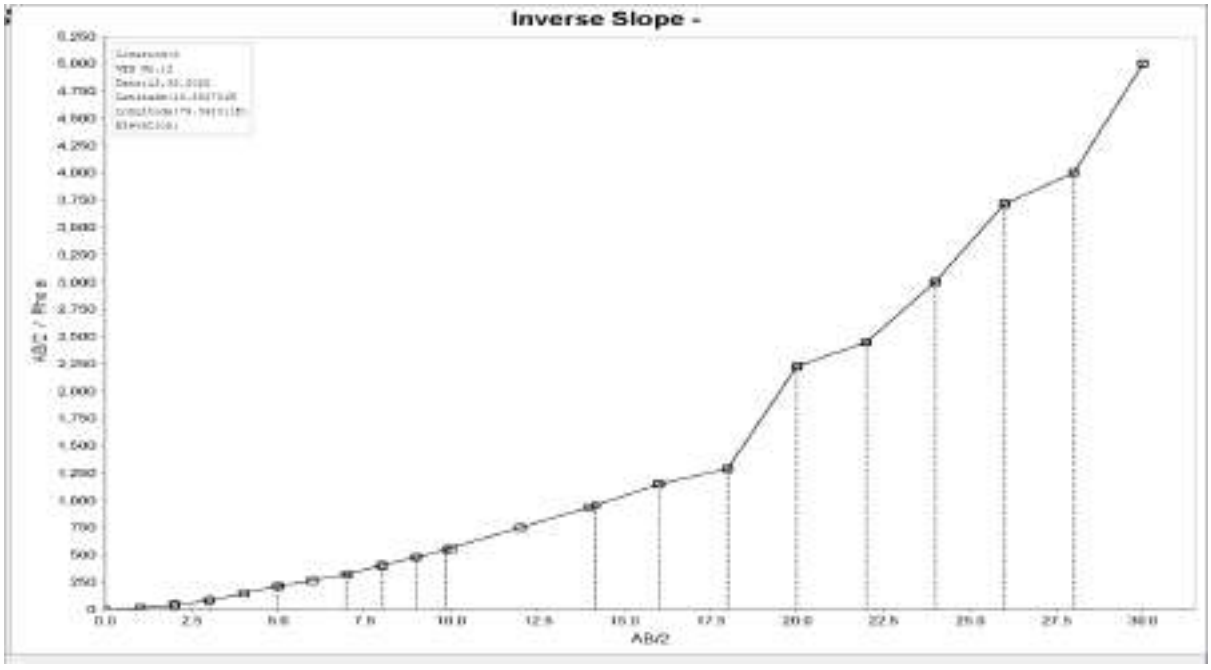
Location: 1 (10.847854N, 79.847092E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	19.770	124.22
2.0	2.0	12.57	11.420	143.51
3.0	3.0	18.85	8.140	153.44
4.0	4.0	25.13	5.680	142.75
5.0	5.0	31.42	4.850	152.37
6.0	6.0	37.70	3.920	147.78
7.0	7.0	43.98	3.190	140.30
8.0	8.0	50.27	0.936	47.05
9.0	9.0	56.55	0.818	46.26
10.0	10.0	62.83	0.701	44.05
12.0	12.0	75.40	1.614	121.69
14.0	14.0	87.96	1.089	95.79
16.0	16.0	100.53	0.830	83.44
18.0	18.0	113.10	0.612	69.22
20.0	20.0	125.66	0.389	48.88
22.0	22.0	138.23	0.255	35.25
24.0	24.0	150.8	0.194	29.3
26.0	26.0	163.4	0.127	20.7
28.0	28.0	175.9	0.083	14.6
30.0	30.0	188.5	0.057	10.7



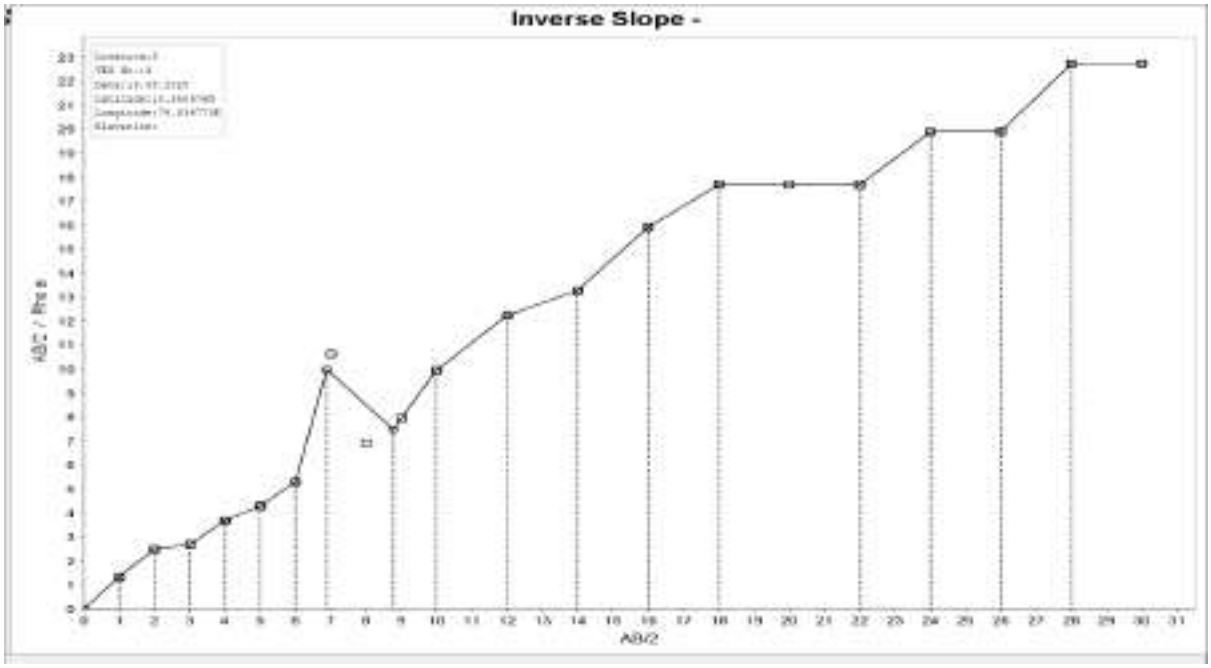
Location: 2 (10.850701N, 79.842011E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	0.098	0.6
2.0	2.0	12.57	0.051	0.6
3.0	3.0	18.85	0.037	0.7
4.0	4.0	25.13	0.028	0.7
5.0	5.0	31.42	0.024	0.8
6.0	6.0	37.70	0.023	0.9
7.0	7.0	43.98	0.022	1.0
8.0	8.0	50.27	0.020	1.0
9.0	9.0	56.55	0.019	1.1
10.0	10.0	62.83	0.018	1.1
12.0	12.0	75.40	0.016	1.2
14.0	14.0	87.96	0.015	1.3
16.0	16.0	100.53	0.014	1.4
18.0	18.0	113.10	0.014	1.6
20.0	20.0	125.66	0.009	1.1
22.0	22.0	138.23	0.009	1.2
24.0	24.0	150.8	0.008	1.2
26.0	26.0	163.4	0.007	1.1
28.0	28.0	175.9	0.007	1.2
30.0	30.0	188.5	0.006	1.1



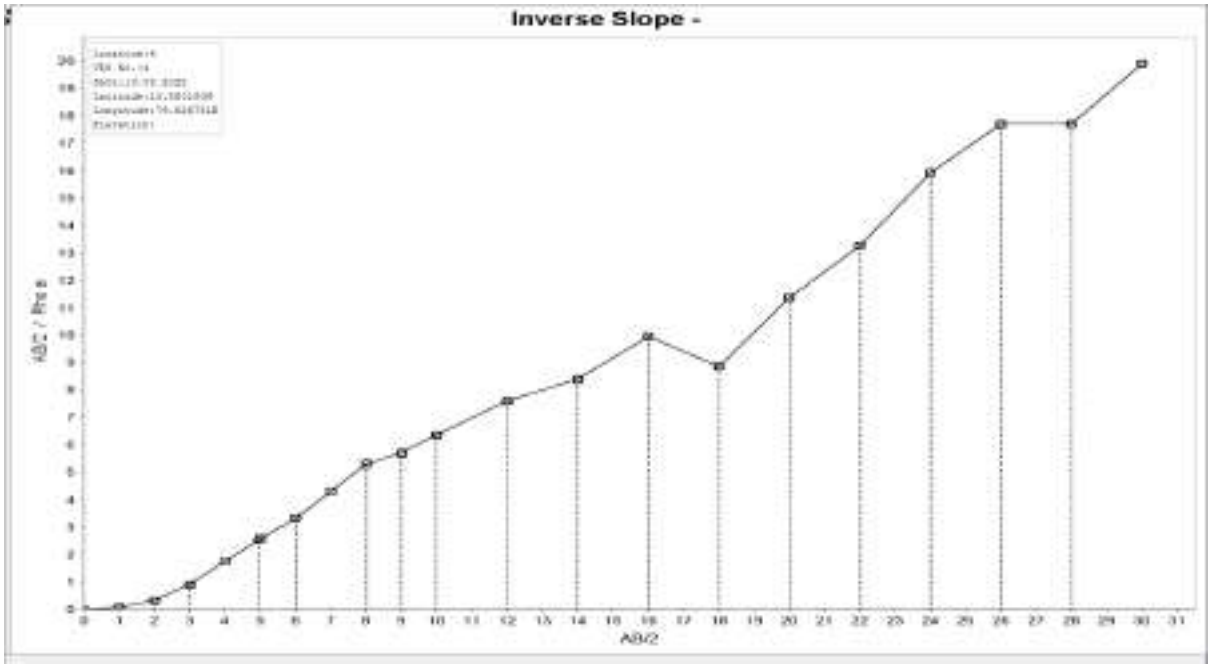
Locaion: 3 (10.850476N, 79.834773E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	0.120	0.75
2.0	2.0	12.57	0.064	0.80
3.0	3.0	18.85	0.059	1.11
4.0	4.0	25.13	0.043	1.08
5.0	5.0	31.42	0.037	1.16
6.0	6.0	37.70	0.030	1.13
7.0	7.0	43.98	0.015	0.66
8.0	8.0	50.27	0.023	1.16
9.0	9.0	56.55	0.020	1.13
10.0	10.0	62.83	0.016	1.01
12.0	12.0	75.40	0.013	0.98
14.0	14.0	87.96	0.012	1.06
16.0	16.0	100.53	0.010	1.01
18.0	18.0	113.10	0.009	1.02
20.0	20.0	125.66	0.009	1.13
22.0	22.0	138.23	0.009	1.24
24.0	24.0	150.8	0.008	1.21
26.0	26.0	163.4	0.008	1.31
28.0	28.0	175.9	0.007	1.23
30.0	30.0	188.5	0.007	1.32



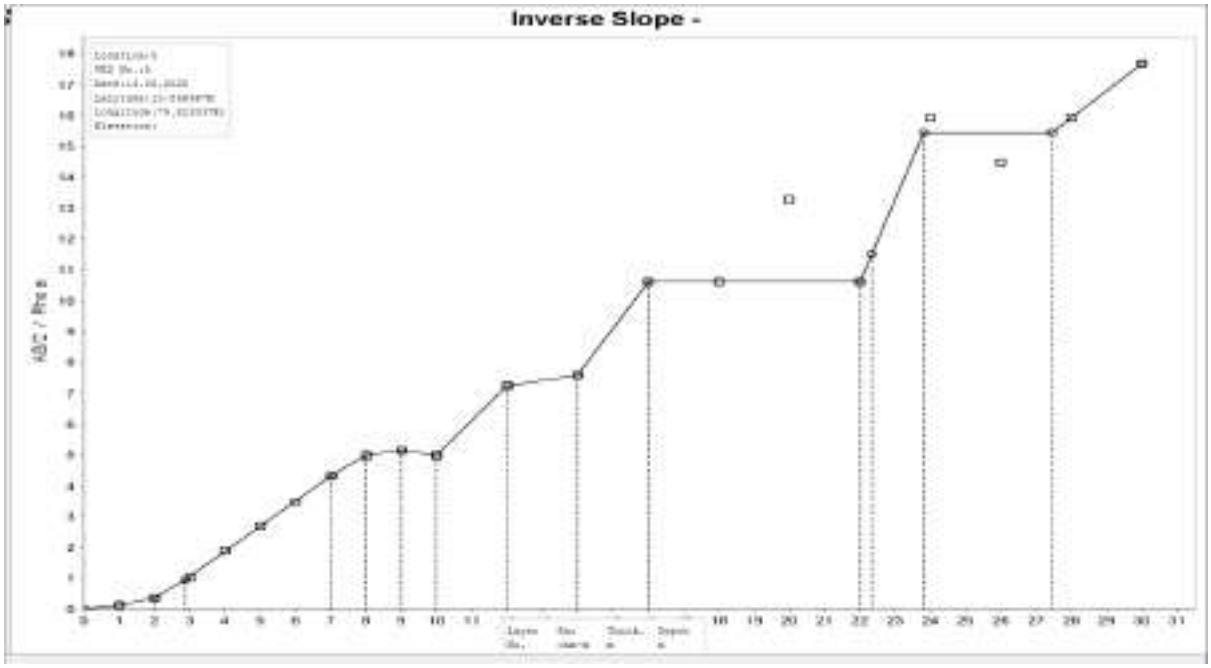
Location: 4 (10.850160N, 79.826731E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	2.460	15.46
2.0	2.0	12.57	0.507	6.37
3.0	3.0	18.85	0.177	3.34
4.0	4.0	25.13	0.091	2.29
5.0	5.0	31.42	0.062	1.95
6.0	6.0	37.70	0.048	1.81
7.0	7.0	43.98	0.037	1.63
8.0	8.0	50.27	0.030	1.51
9.0	9.0	56.55	0.028	1.58
10.0	10.0	62.83	0.025	1.57
12.0	12.0	75.40	0.021	1.58
14.0	14.0	87.96	0.019	1.67
16.0	16.0	100.53	0.016	1.61
18.0	18.0	113.10	0.018	2.04
20.0	20.0	125.66	0.014	1.76
22.0	22.0	138.23	0.012	1.66
24.0	24.0	150.8	0.010	1.51
26.0	26.0	163.4	0.009	1.47
28.0	28.0	175.9	0.009	1.58
30.0	30.0	188.5	0.008	1.51



Location: 5 (10.846967N, 79.823337E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	1.210	7.60
2.0	2.0	12.57	0.450	5.65
3.0	3.0	18.85	0.154	2.90
4.0	4.0	25.13	0.085	2.14
5.0	5.0	31.42	0.059	1.85
6.0	6.0	37.70	0.046	1.73
7.0	7.0	43.98	0.037	1.63
8.0	8.0	50.27	0.032	1.61
9.0	9.0	56.55	0.031	1.75
10.0	10.0	62.83	0.032	2.01
12.0	12.0	75.40	0.022	1.66
14.0	14.0	87.96	0.021	1.85
16.0	16.0	100.53	0.015	1.51
18.0	18.0	113.10	0.015	1.70
20.0	20.0	125.66	0.012	1.51
22.0	22.0	138.23	0.015	2.07
24.0	24.0	150.8	0.010	1.51
26.0	26.0	163.4	0.011	1.80
28.0	28.0	175.9	0.010	1.76
30.0	30.0	188.5	0.009	1.70



2026

REPORT

CARRYING OUT REPLENISHMENT AND SALTWATER INTRUSION STUDIES AT PURAVADAIYANAR RIVER/CREEK AFTER THE MONSOON NEAR KARAIKAL PORT, PUDUCHERRY (VOLUME II)

Prepared By
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Prepared For
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Client	:	**Falcon Resilient Infra Consultant**
Project Title	:	Carrying out replenishment and saltwater intrusion studies at Puravadaiyanar river/creek after the monsoon near Karaikal port, Puducherry (volume II)
Project Code	:	202601_382
Reference	:	\\NISVOSERVER\2025\202506_0382 - CARRYING OUT REPLENISHMENT AND SALTWATER INTRUSION STUDIES AT PURAVADAIYANAR RIVER/ CREEK AFTER AND AFTER MONSOON NEAR KARAIKAL PORT, PUDUCHERRY

ABSTRACT:

Falcon Resilient Infra Consultant has intended to conduct Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/ Creek before and after monsoon near Karaikal Port, Puducherry. To facilitate this, Falcon Resilient Infra Consultant has requested to M/s. NISVO MARINE SURVEYS LLP to conduct the required Replenishment and Saltwater Intrusion Studies in reference to the work order provided (Work Order No: 014-C24017-SRV-L-NM WO June 20,2025). The pre-monsoon survey (Volume I) was conducted on 30.06.2025 and 18.07.2025, and the final report was submitted on 08.12.2025. Subsequently, the required data collection for the Replenishment and Saltwater Intrusion Studies was carried out during the post-monsoon period between 07.01.2026 and 19.01.2026. The findings and analyses presented in this report correspond to the post-monsoon investigation and constitute Volume II of the study.

This project, titled "Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the Monsoon" includes a comparative study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and seawater intrusion studies for both pre- and post-monsoon periods. Accordingly, the report is divided into three volumes, namely Volume I, Volume II, and Volume III.

The Volume I report, titled "Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before the monsoon near Karaikal Port, Puducherry (Volume I)" includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and seawater intrusion studies for the pre-monsoon.

The Volume II report, titled "Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek after the monsoon near Karaikal Port, Puducherry (Volume II)" includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and seawater intrusion studies for the post-monsoon.

The Volume III report, titled "Comparison Report of Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the monsoon" includes results and conclusions based on a comparison of the differences between the pre- and post-monsoon periods.

This report provides an overview of the Replenishment and Saltwater Intrusion Studies conducted within the designated survey area, encompassing a range of methodologies and corresponding findings.

Date	Document		Originator	Checked by	Approved by
	Interim				
	Draft				
19.02.2026	Final	✓	Dr. S. Balasingh	S.G. Singh	Dr. Mani
	Methodology				

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Text Page	:	**56**
Figures	:	**11**
Annexure	:	**01**

CONTENT

Contents				Page
Contents				1
List of figures				3
List of Table				4
Annexure				5
Abbreviations				6
1.	**INTRODUCTION**			7
	1.1	General		7
	1.2.	Replenishment and Salt-water intrusion		8
		1.2.1.	Replenishment Study	8
		1.2.2.	Saltwater Intrusion study	8
2	**STUDY AREA**			10
	2.1.	Geographic Location and Regional Setting		10
	2.2.	Climatic Conditions		11
	2.3.	Geology and Geomorphology		11
3	**MATERIALS AND METHOD**			12
	3.1.	Survey Controls		12
		3.1.1.	Specifications and Standards	12
		3.1.2.	Coordinate systems	12
		3.1.3.	Horizontal and Vertical Control	13
	3.2.	Replenishment Study		14
		3.2.1	Terrain Analysis	14
			3.2.1.1. Aerial Topography Survey	14
			3.2.1.2. Single-beam Bathymetry Survey	17
		3.2.2.	Hydrodynamic Studies	21
			3.2.2.1. Flow velocity and Discharge measurement	21
			3.2.2.2. Instream roughness	24
		3.2.3.	Physico-Chemical Assessment of water and sediment	27
	3.3.	Saltwater Intrusion		30
		3.3.1.	Electrical Resistivity Tomography Survey	30

4.	**RESULTS**			36
	4.1.	Replenishment Studies		36
		4.1.1.	Terrain Analysis	36
		4.1.2.	Hydrodynamic Studies	36
		4.1.3.	Physico-Chemical Assessment of water and sediment	39
	4.2.	Saltwater Intrusion		52
PHOTO GALLERY				55

LIST OF FIGURES

Figure	Title
1.	Location Map
2.	Satellite imagery of survey region
3.	Planned lines for Aerial topography survey
4.	Planned lines for Bathymetry Survey
5.	Water and sediment sample location
6.	Location of Vertical Electrical Sounding (VES) - Saltwater intrusion study
7.	Bathymetry and Topography Chart
8.	Cross section of survey region
9.	Cross section of survey region
10.	Ortho mosaic map
11.	Land Use and Land Cover Classification

LIST OF TABLES

Table	Title
1.	Geodetic Parameter Details

LIST OF ANNEXURES

Annexure	Title
I.	*Analysis of the electrical resistivity tomography data*

ABBREVIATIONS

WGS	World Geodetic System
UTM	Universal Transverse Mercator
km	Kilometer
DMS	Degrees/Minutes/Seconds
DD	Decimal Degrees
N	Northing
E	Easting
m	Metre
cumec	Cubic Metre
MCM	Million Cubic Meters
SI	System International Units
ft	Feet
w	Watt
v	Volt
USB	Universal Serial Bus
MSL	Mean Sea Level
RTK	Real-time kinematic
GSM	Global System for Mobile communication
DGPS	Differential Global Positioning Systems
PDOP	Positional Dilution of Precision
XTF	Extended Triton Format
KVA	Kilo-volt-amperes
AC	Alternating Current
kHz	Kilohertz
MHz	Megahertz
LULC	Land Use Land Cover Classification

1. INTRODUCTION

1.1. General

Falcon Resilient Infra Consultant (FRICS) is a nascent firm founded by experienced engineers specializing in environmental engineering, master planning, infrastructure planning and financial analysis. The company delivers professional services in ports, marine structures, roads, highways, thermal power plants, industrial parks and the building sector. F` provided tailored infrastructure solution across all stages of the project life cycle for both small businesses and large enterprises. The organization is accredited by QCI-NABET as an EIA Consultant.This accreditation authorizes FRICS to conduct EIA studies and obtain environmental clearances under Ministry of Environment, Forest and Climate Change (MoEFC) guidelines.

Falcon Resilient Infra Consultant has intended to conduct Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/ Creek before and after monsoon near Karaikal Port, Puducherry. To facilitate this, **Falcon Resilient Infra Consultant** has requested to **M/s. NISVO MARINE SURVEYS LLP** to conduct the required Replenishment and Saltwater Intrusion Studies in reference to the work order provided (**Work Order No: 014-C24017-SRV-L-NM WO June 20,2025**). The pre-monsoon survey (Volume I) was conducted on 30.06.2025 and 18.07.2025, and the final report was submitted on 08.12.2025. Subsequently, the required data collection for the Replenishment and Saltwater Intrusion Studies was carried out during the post-monsoon period between 07.01.2026 and 19.01.2026. The findings and analyses presented in this report correspond to the post-monsoon investigation and constitute Volume II of the study.

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The Volume III report, titled *"Comparison Report of Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the monsoon"* includes results and conclusions based on a comparison of the differences between the pre- and post-monsoon periods.

1.2. Replenishment and Salt-water intrusion

1.2.1. Replenishment Study

Replenishment in estuarine and riverine systems refers to the natural and seasonal processes through which freshwater inflows, sediment supply, and associated nutrient dynamics restore and sustain the physical, chemical, and ecological balance of the waterbody. In monsoon-influenced environments such as the Puranvadaiyar River/Creek, these processes are predominantly governed by the interaction of seasonal river discharge, tidal influences, watershed runoff, and sediment transport mechanisms. Effective replenishment ensures the maintenance of channel morphology, supports aquatic habitats, and sustains water quality necessary for ecological health and socio-economic activities including agriculture, fisheries, and navigation.

The extent and efficiency of replenishment are influenced by a combination of natural drivers such as rainfall variability, catchment topography, river basin geomorphology, and hydrodynamic conditions and anthropogenic pressures including upstream water regulation, land-use change, dredging, and port-related activities. In this study, replenishment assessment was conducted through integrated terrain analysis, hydrodynamic evaluation, and Physico-chemical characterization of water and sediment across pre- and post-monsoon periods. Such an approach enables a comprehensive understanding of how seasonal inflows and sediment deposition contribute to the resilience and sustainability of the estuarine system, while also identifying factors that may hinder its natural regenerative capacity.

1.2.2. Saltwater Intrusion study

Estuarine environments are dynamic transition zones where freshwater from rivers mixes with marine waters, creating unique and highly productive ecosystems. These semi-enclosed coastal bodies of water serve as critical ecological buffers and support diverse biological

communities, while also functioning as socio-economic hubs for human settlements, agriculture, fisheries, and industry. However, estuarine systems are increasingly threatened by the phenomenon of saltwater intrusion—a process in which saline ocean water advances into freshwater riverine and groundwater systems, altering the salinity regime and impacting water quality.

Saltwater intrusion in estuaries is chiefly governed by physical processes such as tidal motion, the density difference between saltwater and river water, river discharge variability, and estuarine geomorphology. The extent and intensity of saltwater penetration are modulated by natural factors (e.g., sea-level rise, climatic variability, and hydrodynamic conditions) and anthropogenic pressures such as excessive groundwater extraction, river regulation, land reclamation, and channel modifications. The consequences of saltwater intrusion are profound: increased salinity degrades the quality of water resources for drinking, irrigation, and industrial uses; stresses estuarine flora and fauna; and alters sedimentation and nutrient cycling processes.

Saltwater intrusion into estuarine environments is a multidimensional, escalating global issue that demands integrated hydrogeochemical, hydrodynamic, and management approaches. Developing a robust understanding of intrusion processes not only supports sustainable water resource planning and ecosystem conservation but is also essential for adapting estuarine communities to ongoing climatic and anthropogenic changes.

2. STUDY AREA

2.1. Geographic location and regional setting

The Puranvadaiyanar River is a distributary of the Cauvery River system flowing the Karaikal district of the Union Territory of Puducherry, India. Originating as a branch from the Cauvery River network in the deltanic plains, the river meanders eastwards across in the fertile agricultural land before draining into Bay of Bengal near Karaikal Port. The Study area for the replenishments and saltwater studies is part of Puranvadaiyanar River which falls in the latitude range of 10°49' N to 10°51' N and longitude range of 79°49' E to 79°51'E. The survey/ study area approximately covers around 0.72 Sq.km. The location map of survey region is presented below and the detailed view is depicted in **Fig. 1.** under figures.

Fig. 1. Location Map

A preview image of the survey areas on satellite image is presented below and a detailed view of the satellite image of the survey regions are presented in **Fig. 2.** under figures.

Fig. 2. Satellite imagery of survey region

2.2. Climatic conditions

Karaikal experiences a tropical coastal climate, marked by: Annual mean temperature: Ranges from 26°C to 34°C, with peaks often reaching ~40°C in late spring and summer months, and minimums near 20°C in winter (December–January) periods. Rainfall: The area receives an average of 1,200mm annually, predominantly during the Northeast Monsoon (October–December). This seasonality is occasionally disrupted by cyclonic events in the Bay of Bengal that can deliver intense rainfall over short periods.

2.3. Geology and Geomorphology

The geology of the Karaikal region is dominated by Quaternary alluvial and deltaic sediments, comprising fine to coarse sands, silts, and clays—products of fluvial deposition by the Cauvery and its tributaries. The nearshore and estuarine areas are underlain by unconsolidated or semi-consolidated sediments, offering high permeability and consequently high hydraulic connectivity between the estuary, shallow aquifers, and the coastal margin. The terrain is largely flat and low-lying (generally <10m above mean sea level), with geomorphological features including flood basins, tidal flats, and minor saline marshes.

3. MATERIALS AND METHOD

In this study, a combination of field surveys, laboratory analysis and spatial assessment to evaluate the seasonal dynamic of the Puranvadaiyanar River/ Creek System. The methodology encompassed terrain analysis, Hydrodynamic measurements, Physio-chemical assessment of water & sediment and saltwater intrusion study. These approaches will be applied for both pre- and post-monsoon period to enable a comparative evaluation of seasonal variation.

3.1. Survey Controls

3.1.1. Specifications and Standards

The surveys were carried out in accordance with the requirements outlined in the work procedure and terms of reference provided by the client. The units used are as per SI System i.e., System International Units. “ENGLISH” language has been used throughout the report and drawings. All calendar dates are referred in Indian style as dd.mm.yy. (Eg. 07.01.2026 for 01ST January 2026).

3.1.2. Coordinate Systems

The acquisition, processing, and report preparation of all data will adhere to the WGS-84, UTM Zone-44 coordinate system. The geodetic parameters pertaining to this system are outlined in the following table.

Details of Geodetic Parameters

Table 1: Geodetic Parameter Details

GEODETIC PARAMETER DETAILS	
Parameters	**Value**
Grids	UTM North
Zone	Zone 44 (78E-84E)
Distance Unit	Meter
Depth Unit	Meter
Ellipsoid	WGS-84
Semi Major Axis	6378137.000
Flattening (1/f)	298.257223563
Projection	Transverse Mercator
Central Meridian	81° 00’ 00.0000” E

GEODETIC PARAMETER DETAILS	
Parameters	**Value**
Reference latitude	00° 00’ 00.0000” N
Scale Factor	0.9996000000
False Easting (X)	500000.0000
False Northing (Y)	0.0000

3.1.3. Horizontal and Vertical Control

The horizontal control was adopted using RTK, DGPS systems based on benchmark, provided by client. The base-station was installed on benchmark before commencement of surveys. The Rover which was used for bathymetry and topography surveys were tuned to receive the signals from base-station. The confidence checks on DGPS systems were performed before commencement and after completion of surveys in presence of Engineer in-charge. The DGPS correction age (latency), Positional Dilution of Precision (PDOP) was confirmed that they are within allowable limits.

Benchmark provided by client:

Name: KARAIKAL PORT PVT LTD (BM) **Lat:** 10° 49' 54"4’ N

Long: 79° 50’56”3’ E

Inclusive Dates: 18 Mar 09-27 Mar 09

Description of the Benchmark:

A flat tide pole was erected on the Berth 1 jetty at Karaikal Port. In the absence of any known benchmarks in the near vicinity of the survey area, the sounding datum was transferred from Nagapattinam by simultaneous tidal observations covering four consecutive low waters and three intermediate high waters at both the gauges. The sounding datum at Karaikal Port Berth 1 jetty was thereafter calculated using the method described in para 6g (i) of Chapter 2 of AMHS Vol II. The Sounding Datum at M/s Karaikal Port Pvt Ltd. was found to be 1.888m above the zero of the tide poles. The tide pole at Karaikal was levelled to the Karaikal BenchMark as well as Temporary Local Benchmark established by the ship. The value of Karaikal Port Pvt. Ltd. BM was found to be 4.248m above Zero of Tide Pole. Therefore, the value of Karaikal Port Pvt. Ltd. BM was found 4.250m above Sounding Datum.

3.2. Replenishment Study

3.2.1. Terrain Analysis

Terrain Analysis is the process of studying the physical features of the study area to understand its shape, slope, elevation, and other topographical features. In terrain analysis, the study area was examined through the integration of aerial topography, single-beam bathymetry, and sub-bottom profiler surveys. The surface terrain, including the river bund and adjoining land area at a 50 m distance from the waterline, was surveyed using aerial topography. The bathymetry survey was carried out across the river at 10 m intervals between both riverbanks below the waterline, in order to generate and study the riverbed profile and cross-section.

3.2.1.1. Aerial Topography Survey

The survey methodology employed for conducting survey comprises a diverse array of Unmanned Aerial Vehicle (UAV) topography survey

Purpose of Aerial Topography Survey

The purpose of the Aerial topography survey is to comprehensively map the terrain surrounding the Puravadaiyanar River/creek, including riverbanks, floodplain surfaces, and channel margins. This survey produces a high-resolution Digital Elevation Model (DEM) of the fluvial environment, enabling detection of channel migration, bank erosion, floodplain roughness, and changes in slope geometry. The resultant topographic framework supports volumetric assessments of material loss or gains on the banks, evaluation of hydraulic boundary conditions, and integration with bathymetric data to define complete cross-sectional profiles through direct field measurements.

Principles of Aerial Topography Survey

Aerial survey provides digital information about the land elevation and features. Aerial survey is a method of collecting geomatics or other imagery by using airplanes, helicopters, UAVs, balloons or other aerial methods. Typical types of data collected include aerial photography, Lidar data, Geo-tagged videography or any raster data. It can also refer to the chart or map made by analyzing a region from the air. Aerial survey should be distinguished from satellite imagery due to its better resolution, scale and atmospheric conditions. Today, aerial survey is sometimes recognized as a synonym for aero photogrammetry, part of photogrammetry where the camera is placed in the air. Measurements on aerial images are provided by photogrammetric technologies and methods.

Area of Survey

The Aerial topographic survey was carried out on post-monsoon from the water line to 50m on both sides of riverbanks covering the entire survey area based on work order/ TOR provided by client using RTK Enabled UN-Manned Aerial Vehicle (UAV) DJI Mavic 3 Enterprise Series drone. The planned lines for aerial topography survey are shown below and detailed view is presented in **Fig. 3.**

Fig. 3. Planned lines for aerial topography

Sequence of Survey

- **GCP Planning:** Firstly, the data processing team was provided with location, submergence map, area details under topography survey to be conducted. According to mentioned details AOI is prepared. After GCP planning was done for the survey region with optimum number of GCPs per sq. km area for optimal ground coverage. GCPs were planned from satellite view and accordingly they are marked at relatively open ground i.e. distant from trees & tall structures.
- **GCP Fixing:** Secondly, the GCPs were placed on the coordinates provided by the data processing team using RTK rover before flying the drone/UAV.

- **RTK Enabled UN-Manned Aerial Vehicle (UAV):** The topographic survey was carried out using DJI Mavic 3 Enterprise edition survey grade drone. Before commencement of each mission, the initial inspections such as sensors, propeller, battery levels etc were carefully checked. The altitude, side overlap, front overlap and level of take-off point for each mission were planned based on local obstructions and site conditions. The data captured during flight mission and wind speed were monitored till landing of each flight. The area between water boundary and bathymetry transects were connected by the spot-levels using RTK rovers.
- **Calibration:** The rover was calibrated with reference to local benchmark using "site calibration method" available in XPAD survey software. Then, the trial data collection was performed and data acquisition carried out.
- **Data Processing:** Post aerial surveys & QC, raw data was sent to head office where it was processed. Aerial data processing refers to generating scalable Photogrammetric data outputs like Orthomosaic, DSM and DTM from overlapping aerial images. Agisoft Metashape™ was used for aerial dataset's Aero-triangulation and Bundle Block adjustments. Aerial data is processed for generating data products namely Orthomosaic, DSM and DTM.

Instrument Specification and Software

- **DJI Mavic 3 Enterprise:** The DJI Mavic 3 Enterprise Series finds widespread use across diverse industries due to its advanced capabilities and versatility. Professionals in fields such as infrastructure inspection utilize these drones for detailed visual inspections of bridges, pipelines, and buildings, leveraging

high-resolution cameras to detect defects or anomalies. In agriculture, the series aids in crop monitoring and management by capturing multispectral imagery, providing insights into crop health and optimizing yield. Public safety agencies employ Mavic 3 Enterprise drones for search and rescue missions, utilizing thermal imaging to locate individuals in remote or hazardous environments. Additionally, the series supports environmental monitoring efforts, facilitating the assessment of natural habitats and disaster response activities. With features like extended flight times, robust obstacle avoidance systems, and precise navigation tools, the DJI Mavic 3 Enterprise Series continues to enhance operational efficiency and safety across various professional applications.

- **Geomax Zenith 35 Pro:** Leica GeoMax Zenith 35 DGPS system has the full spectrum of satellite signals, unlimited connectivity and the unique Tilt Go functionality all compressed in a compact GNSS make the Zenith35 series the GNSS that works when you do. This unit features the same 555 channel Novatel measurement engine found in the latest Leica receivers and it absolutely blows away the competition, which helps us to collect the data fast and accurate.

- **XPAD survey software:** X-PAD Survey field software allows to manage GNSS and Total Station survey and stakeout, with all the topographic and Bathymetry functions that you need for maximum productivity in the field. It combines data collection from all GeoMax instruments and provides you with complete features, data integration and scalability.

3.2.1.2. Single-beam Bathymetry Survey

The bathymetry survey involves systematic measurement and mapping of underwater depth, typically conducted using sonar technology to create detailed representations of the seabed. This process is crucial for various applications, including navigation safety, marine construction, environmental monitoring, and resource management. By providing accurate data on underwater topography, bathymetry surveys facilitate the assessment of habitats, the planning of offshore infrastructure like wind farms and pipelines, and the management of fisheries. Additionally, they play a vital role in flood risk assessment and coastal management by informing decisions related to sediment transport and shoreline erosion. Ultimately, bathymetry surveys enhance our understanding of aquatic environments and support sustainable development in marine ecosystems.

Purpose of Single-beam Bathymetry Survey

The purpose of the bathymetric survey is to accurately characterize the channel geometry and bed elevation of the Puravadaiyanar River/creek before and after the monsoon season. Using a single-beam echo-sounder mounted on a survey vessel equipped with RTK-GNSS, the survey delivers discrete depth measurements along selected transects. This enables precise mapping of the riverbed, identification of localized scour and sediment deposition, and quantification of volumetric changes in bed elevation. By generating high-resolution depth profiles, the survey supports assessment of changes in channel form, bed stability, and hydraulic conveyance capacity across seasonal conditions.

Principles of Bathymetry Survey

The principles of bathymetry survey are grounded in the accurate measurement of underwater depth and the characterization of the seabed using a combination of acoustic and non-acoustic methods. Central to this process is the use of sonar technology, particularly multi-beam and single-beam echo sounders, which emit sound waves that travel through water, reflect off the seabed, and return to the instrument. By calculating the time, it takes for the sound waves to return, surveyors can determine the water depth with high precision. Additionally, positioning systems such as GPS are integrated to Geo-reference the data, ensuring accurate spatial representation. The collected data is then processed and visualized using specialized software to create detailed bathymetry maps, revealing features such as underwater ridges, valleys, and sediment types. These principles not only ensure the accuracy and reliability of the survey results but also enable the effective interpretation of complex underwater environments for various applications, from navigation and marine engineering to environmental studies.

Area of Survey

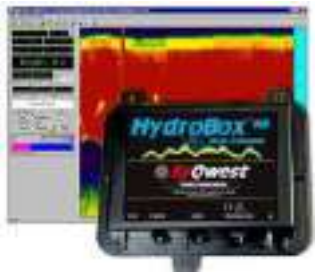
The bathymetry survey was carried out on post monsoon across the river at 10m interval between both riverbanks in order to generate and study the riverbed profile and cross section using SyQwest Hydrobox Dual Frequency survey grade Echo-sounder. The planned lines for bathymetry survey are shown below, and detailed view is presented in **Fig. 4.** under figures.

Fig. 4. Planned lines for bathymetry Survey

Sequence of survey

Bathymetry survey was carried out using Syqwest Hydrobox Dual Frequency Echo-sounder, Trimble DGPS system and Ellipse MRU. The Echo-sounder system and DGPS were installed and operated in accordance with the manufacturer's instructions. The transducer was installed rigidly to a bracket at star-board side on the survey boat. The transducer shoe was sufficiently deep not to experience turbulence and aeration when the vessel steams at survey speed. The depth of the transducer below water line was ascertained by reference to present marks on the pole

Instrument Specification and Software



- **SyQwest Hydrobox Dual Frequency Echo-sounder :** It is a latest generation dual frequency survey grade echo sounder, employs the latest in technologies including a high-resolution, microprocessor and DSP techniques. The system consists of sonar transceiver, echo processor, graphical operator interface with Laptop, splash-proof case. The unit is suited to table top, bulkhead, or rack mounting and is equally at home on either small survey launches or large ships. Well suited for use in the shallows of rivers and harbors, the mission variable unit is also capable of working to depths of over 1000 meters. It operates in dual frequency consisting of 200 kHz on higher band and 33 kHz in lower band.
- **Technical Specification:**

  High Band : 200 kHz

Low Band	:	*33 kHz*
Input Power	:	*10-30 VDC 12 watts*
Resolution	:	*0.01 m*
Accuracy	:	*1cm @ 200khz; 5cm @ 50Khz;7cm @ 33Khz*
Depth range	:	*0-15, 30, 60, 120,240,450, 900,1500, 2400, 3000 Ft. 0-5, 10, 20, 40, 80, 150, 300, 500, 800, 1000 Meters.*
Sound Velocity	:	*1370 – 1700 m/s*
Annotation	:	*Internal – date, time, GPS position External – from RS232 Port or Ethernet*
Interfaces	:	*RS232 serial ports, baud rate selectable 4800-19200.* *Input from external computer, motion sensor, and sound velocity.* *Outputs to external computer.* *Ethernet interface. Heave – TSS1.*

- **Marine Grade Mobile DGPS - Trimble SPS 351:** It combines high-performance GPS reception with a DGPS-capable receiver in a lightweight, durable housing and comes with a separate antenna. The unit performs continuous RAIM calculations which enhance the integrity of the position data. The GPS receiver also contains technology enabling SBAS e.g. WAAS and EGNOS or Beacon real time differential capabilities. When used with a Real-Time Kinematic (RTK) Base station, the GPS receiver provides RTK positioning for high-accuracy, centimeter-level applications.

  A standard R4 GPS receiver provides the following features:

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

- **The system Features:**
  - ✓ *SBAS such as WAAS (Wide Area Augmentation System) differential correction*
  - ✓ *Highly versatile multifunctional display unit*
  - ✓ *Beacon differential correction*
  - ✓ *Large number of input and output ports to support highly complex and integrated bridge systems.*
  - ✓ *Channel management capability*
  - ✓ *Easy access to standardized and proprietary text messages*
  - ✓ *Fully up-gradable to support future features*
  - ✓ *NMEA-0183 output: GGA, GLL, GRS, GST, GAS, GSV, MSS, RMC, VTG, ZDA (the default NMEA messages are GGA, GSA, VTG, and RMC*

- **Motion Reference Unit (MRU) - SBG Ellipse - A:** SBG Ellipse-A is a small-sized high performance Motion Reference Unit. It provides Roll, Pitch, Heading, and Heave data. This light-weight sensor includes a MEMS-based Inertial Measurement Unit (IMU) integrating three gyroscopes, three magnetometers, and three accelerometers. Running an extended Kalman filter (EKF), the Ellipse-A provides accurate orientation data in both static and dynamic conditions.

- **Specifications:**
  - ✓ *0.1° Roll and Pitch over 360°.*
  - ✓ *1° Heading (Internal Magnetometers).*
  - ✓ *5 cm Real-time Heave, adjusted to the wave period.*
- **Key features:**
  - ✓ *Very Low Noise Gyroscopes.*
  - ✓ *IP 68 Enclosure.*
  - ✓ *200 Hz Output Rate.*
  - ✓ *RS-232, RS-422, and CAN Interfaces.*
  - ✓ *Binary, NMEA, ASCII, and TSS Protocols.*

3.2.2. Hydrodynamic Studies

Hydrodynamic studies of the river focus on understanding the movement of water within a river system, including its flow velocity, depth, discharge, and interaction with channel boundaries. These studies are essential for predicting river behaviour under natural and human-influenced conditions. In this study, hydrodynamic investigations were carried out to understand the movement of water and sediment in the Puranvadaiyanar River/Creek. This assessment includes flow velocity and discharge measurements to quantify the water movement, sediment transport studies to evaluate erosion and deposition, and in-stream roughness analysis to determine resistance to the flow caused by bed materials and channel features. The following section describes each survey methodology in detail. Streamflow or discharge measurements are vital for hydrological analysis, water resource management, flood forecasting, and hydraulic design. Accurate measurements of current velocity and discharge provide critical information for understanding flow conditions in rivers, streams, and open channels.

3.2.2.1. Flow velocity and Discharge Measurement

Streamflow or discharge measurement is vital for hydrological analysis, water resource management, flood forecasting, and hydraulic design. Accurate measurement of current

velocity and discharge provides critical information for understanding flow conditions in rivers, streams, and open channels.

ADCP Method

The current velocity measurements were carried out across the river at a location with sufficient depth suitable for the deployment of an ADCP. The measurements were conducted using the Teledyne Marine Workhorse II Sentinel ADCP. The main objective of the survey was to measure flow velocity and discharge in the study area.

Principles of current velocity measurement

The current velocity measurements are crucial for understanding the movement and dynamics of water bodies in oceans, rivers, and estuaries. These measurements rely on principles rooted in fluid dynamics and the Doppler effect. One common method for measuring current velocity is acoustic Doppler technology. Acoustic Doppler current profilers (ADCPs) emit pulses of sound into the water, which scatter off particles suspended in the water column. By measuring the change in frequency of these scattered signals, caused by the motion of water particles relative to the profiler, the ADCP can determine current velocity at various depths. This technique is based on the principle that the frequency shift of the scattered sound waves is proportional to the velocity of the water particles along the direction of the sound beam. ADCPs can measure current velocity profiles over a range of depths with high accuracy and temporal resolution. Another method, called acoustic Doppler velocimetry (ADV), employs similar principles but focuses on measuring velocity at a single point rather than profiling. Both ADCPs and ADV systems provide essential data for studying ocean circulation, sediment transport, and pollutant dispersion, aiding in various scientific research, environmental monitoring, and engineering applications.

Sequence of current velocity measurement

The TELEDYNE MARINE Workhorse II ADCP device, powered externally, has been securely attached to a transducer pole. This pole has been mounted on a floating dock, positioned at the designated location specified by the client, with a draft of 0.8m below the water surface. Prior to deployment, thorough preparations and evaluations were conducted to properly configure the time interval using WinSc and Plan ADCP software. The sampling interval has been set at 30 seconds, ensuring that data collected at this frequency is stored on the device's internal memory. To ensure data integrity, the stored information is downloaded once a week and saved on the on-site hard disk.

Instrument specification and software

- **TELEDYNE MARINE Workhorse II**

The lightweight and adaptable Workhorse Sentinel is easily deployed on buoys, boats, or mounted on the seafloor. Real-time data can be transmitted to shore via a cable link or acoustic modem, or data can be stored internally for short or long-term deployments. By providing profiling ranges from 1 to 165m, the Workhorse II Sentinel ADCP is ideally suited for a wide variety of applications. The Workhorse II Sentinel also offers unbeatable precision, with unmatched low power consumption, allowing you to collect more data over an extended period.

- **Key Features**

Versatility	Direct reading or self-contained, moored or moving, the Sentinel provides precision current profiling data when and where you need it most.
A solid upgrade path	The Sentinel has been designed to grow with your needs. Easy upgrades include bottom tracking, and directional wave measurement.
A four-beam solution	Teledyne RDI's patented 4-beam design improves data reliability, improves data quality, and improves data accuracy.
Precision data	Teledyne RDI's patented BroadBand signal processing delivers very low-noise data, resulting in unparalleled data resolution and minimal power consumption.

Float Ball Method

The flow velocity and discharge measurements were performed using the conventional float ball method in locations wherever the depth of water flow was inadequate for the deployment of the ADCP. The velocity measurements were conducted across various cross sections along the river to enhance accuracy. This method employs a spherical float that is released into the stream to estimate the current velocity by measuring the time taken for the float to travel a known distance. By combining velocity measurements with the stream cross-sectional area, discharge was also computed. Although the method is relatively simple and inexpensive, it remains an effective tool for practical surveys, particularly in environments where advanced or specialized equipment may not be feasible.

Sequence of Measurement

- Two suitable locations about 3m - 5m apart were identified in the river. The Distance between the two points were measured in meters(D).
- The Width (Wu) and Depth (Du) of the river at the upstream was measured. Similarly, Width (Wd) and Depth (Dd) of the river at the downstream was measured.

- The depth of flow in the two points were recorded as du and dd in meters. Bright yellow colour rubber balls of three different diameters (say50mm, 75mm, 1000mm) were selected as the floats.
- The float ball was gently lowered into the river and allowed to float on the flowing water surface.
- A stopwatch was started, the moment of the float starts moving downstream along the flowing water.
- A butterfly net kind of tool was used to retrieve the ball in the downstream, as soon as it arrives there. The stop-watch was stopped and the Float Travel Time (FTT) was recorded.
- This exercise was repeated two more times and the average travel time was worked out (Ta).
- The velocity (m/s) of the flow was calculated as below:

$$Velocity\ (m/s)\ Va\ = \frac{Distance\ between\ points\ (D\ in\ m)}{travel\ time\ (Ta\ in\ sec)}$$

- The flow area of the drain in the upstream (Au) and downstream (Ad) was calculated as below:

$$\text{Flow Area, Au} = \text{Wu} \times \text{du}$$

$$\text{Flow Area, Ad} = \text{Wd} \times \text{dd}$$

$$\text{Average Flow Area, Aa} = \frac{(\text{Au} + \text{Ad})}{2}$$

- Discharge (Flow) = Aa x Va (m^3/s)

3.2.2.2. Instream roughness

Instream roughness refers to the resistance to flow within a river channel caused by physical elements located on or near the bed and banks. These elements include bed material grains, boulders, cobbles, submerged logs, aquatic vegetation, and other obstructions that directly interact with moving water. Instream roughness plays a critical role in dissipating flow energy and reducing velocity, thereby influencing sediment transport, habitat conditions, and channel hydraulics. The magnitude of roughness depends on the size, distribution, and protrusion of these elements relative to flow depth. In shallow channels with coarse bed material, grain resistance can dominate, while in deeper channels with large woody debris or vegetation, form

drag may be more significant. Seasonal variations, such as vegetation growth or debris accumulation during floods, can alter roughness characteristics, underscoring the importance of site-specific assessment. Neglecting to quantify instream roughness accurately can lead to underestimation or overestimation of flow capacity in hydraulic models.

The Arcement and Schneider (1989) method provides a systematic, field-based framework for estimating Manning's roughness coefficient (n) by incorporating measurable channel characteristics. The procedure begins with the selection of a base n value determined from the channel's predominant bed material, using tabulated reference ranges for various substrate types such as silt, sand, gravel, cobble, or bedrock. This base value assumes a straight, uniform channel without significant irregularities or vegetation. Adjustment factors are then sequentially applied to account for surface irregularities, cross-sectional variability, obstructions, vegetation, and meandering. Surface irregularities include bedforms such as pools, riffles, and dunes, which create turbulence and increase flow resistance. Cross-sectional variation accounts for irregular depth and width distribution that induce secondary currents. Obstructions, such as boulders, large woody debris, and anthropogenic structures, add localized turbulence and energy loss. Vegetation adjustments depend on plant type, density, and seasonal condition, recognizing the increased resistance during periods of full foliage or high stem submergence.

Meandering is quantified through the sinuosity ratio, with greater sinuosity increasing total flow resistance Arcement and Schneider method provides a systematic, field-based framework for estimating Manning's roughness coefficient (n) by incorporating measurable channel characteristics. The procedure begins with the selection of a base n value determined from the channel's predominant bed material, using tabulated reference ranges for various substrate types such as silt, sand, gravel, cobble, or bedrock. This base value assumes a straight, uniform channel without significant irregularities or vegetation.

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$$n = (n_b + n_1 + n_2 + n_3 + n_4)m$$

n = roughness coefficient
n_b = Base values for Manning's n (nb; adapted from Arcement and Schneider 1989).
n_1 = Degree of irregularity
n_2 = Variation in channel cross section
n_3 = Effect of obstructions
n_4 = Amount of vegetation
m = Degree of meandering and sinuosity.

Base values for Manning's n (nb; adapted from Arcement and Schneider 1989).

Bed Material	Median Bed Material Size (mm)	Base n (n_b)
Sand	0.2	0.012
	0.3	0.017
	0.4	0.020
	0.5	0.022
	0.6	0.023
	0.8	0.025
	1.0	0.026
Concrete	-------	0.011-0.018
Rock cut	-------	0.025
Firm soil	-------	0.020-0.032
Coarse sand	1-2	0.026-0.035
Gravel	2-64	0.028-0.035
Cobble	64-256	0.030-0.050
Boulder	>256	0.040-0.070

Adjustment values for roughness (adapted from Arcement and Schneider 1989).

Channel conditions		n-value adjustment	Description
Degree of irregularity (n_1)	Smooth	0	Smoothest channel possible given the bed material
	Minor	0.001 - 0.005	Slightly eroded or scoured streambanks
	Moderate	0.006 - 0.010	Moderate to considerable bed roughness due to such features as bedforms; moderately sloughed or eroded streambanks
	Severe	0.011 - 0.020	Severely sloughed or scalloped streambanks; unshaped, jagged, and irregular surfaces in rock channels
Variation in channel cross section(n_2)	Gradual	0	Size and shape of channel changes gradually
	Alternating occasionally	0.001 - 0.005	Cross section size and shape alternate occasionally. Alternatively, channel thalw eg shifts occasionionally from one side to the other (excluding planform/sinuosity related shifts that are addressed with m).
	Alternating frequently	0.010 - 0.015	Cross section size and shape alternate frequently. Alternatively, channel thalw eg shifts frequently from one side to the other (excluding planform/sinuosity related shifts that are addressed with m).
Effect of obstructions (n_3)	Negligible	0 - 0.004	A few scattered obstructions are present (< 5% X-S area), including such features as debris deposits, stumps, exposed roots, logs, piers or isolated boulders.
	Minor	0.005 - 0.015	Obstruction occupy < 15% of X-S area, with spacing w ide enough so that spheres of influence do not overlap. Smaller adjustments recommended for smooth versus angular objects.
	Appreciable	0.020 - 0.030	Obstructions occupy 15 to 50% of X-S area, or spacing between obstructions are small enough for spheres of influence to overlap, with the obstructions additive and blocking an equivalent portion of X-S.
	Severe	0.040 - 0.050	Obstructions occupy >50% of the X-S area, or the spaces between the obstructions are small enough to cause turbulence across most of the X-S.

Amount of vegetation (n_4)	Small	0.002 - 0.010	Tree and shrub seedlings are present (such as willow, cottonwood, alder, tamarisk), with a flow depth of at least 3 times the vegetation height at the flow of interest.
	Medium	0.010 - 0.025	Tree and shub seedlings are present, with a flow depth of 2 to 3 times the vegetation height at the flow of interest. Alternatively, brushy and moderately-dense streambank woody vegetation present.
	Large	0.025 - 0.050	~10-year-old trees and shrubs present in shallow portions of the channel and lining the streambanks.
	Very large	0.050 - 0.100	Bushy willow s and other shrubs and trees are prevalent in substantial portions of the channel and inundated less than their canopy heights at the flow of interest, with brushy and dense woody vegetation on streambanks.
Degree of meandering and sinuosity (m)	Minor	1.0	Sinuosity (ratio of channel length to valley length) = 1.0 to 1.2
	Appreciable	1.15	Sinuosity = 1.2 to 1.5
	Severe	1.3	Sinuosity > 1.5

3.2.3. Physico-Chemical Assessment of water and sediment

The Physico-chemical assessment was conducted to evaluate the quality of water and sediment in the Puranvadaiyanar River/Creek. Water and sediment samples were collected from 4 different locations across the river during the post-monsoon. A total of 18 Physico-chemical parameters were analysed as part of the replenishment study of the Puranvadaiyanar River/Creek during the pre-monsoon.

Water Sample Collection

The water samples were collected from four different locations at the site on 10.01.2026 using a Niskin sampler. The sediment sample location map is presented in **Fig. 5.** under figures.

Fig. 5. Water and sediment sample location

During the collection of samples, a minimum of 2.5 litres of water was collected at each location and labelled with GPS coordinates and photographs for each location, with proper numbering referenced to the map. The geographical coordinates of water and sediment sample collections are presented in the table below.

Sl. No	Water and Sediment Sample Code	X(m)	Y(m)
1.	L1	374538.530	1199022.678
2.	L2	374230.493	1199241.840
3.	L3	373729.092	1199260.192
4.	L4	373422.950	1199658.965
5.	L5	373048.931	1199671.359
6.	L6	372480.437	1199628.288
7.	L7	372081.581	1199682.987

Sample Analysis

The water samples collected at four locations were analysed for parameters such as pH, electrical conductivity, total suspended solids, turbidity, nitrate, iron, manganese, dissolved oxygen, chemical oxygen demand, biological oxygen demand, phosphate, nitrite, lead, mercury, cadmium, ammonia, and chlorophyll-a. The results of the analysis are discussed in the following chapters. The following table shows the reference methods used for water sample analysis.

S.No	Description	Method of Reference
1.	pH @25°C	IS:3025 (Part-11)2022
2.	Electrical Conductivity @25°C	IS:3025 (Part-14)2013
3.	Total Suspended Solids	IS:3025 (Part-17)2022
4.	Turbidity	IS:3025 (Part-10)2023
5.	Nitrate as NO_3	APHA 24th Edition 2023-4500 NO_3-B
6.	Iron as Fe	IS:3025 (Part-53)2003
7.	Manganese as Mn	APHA 24th Edition 2023 3111 B
8.	Dissolved Oxygen	IS:3025 (Part-38)1989
9.	Chemical Oxygen Demand	IS:3025 (Part-58)2023
10.	Biochemical Oxygen Demand (3 days incubation @27°C)	IS:3025 (Part-44)2023
11.	Phosphate as PO_4	IS:3025 (Part-31) Sec 1:2022
12.	Nitrite as NO_2	IS:3025 (Part-34)1988
13.	Lead as Pb	APHA 24th Edition 2023 3111 B
14.	Mercury as Hg	APHA 24th Edition 2023 3112 B
15.	Cadmium as Cd	APHA 24th Edition 2023 3111 B
16.	Temperature	IS:3025 (Part-9)2023
17.	Ammonia as NH4	IS:3025 (Part-34)1988
18.	Chlorophyll -a	APHA 24th Edition 2023 3111 B

Sediment Sample Collection

The sediment samples were collected from four different locations at the site on 10.01.2026 using a Van Veen Grab sampler. The sediment sample location map is presented in **Fig. 6**. Under figures. During the collection of samples, a minimum of 3 kg of sediment was collected at each location and labelled with GPS coordinates and photographs for each location, with proper numbering referenced to the map.

Van Veen Grab Sampler

Van Veen Grab Sampler is a handheld device that will be allowed to fall freely from the boat at each location, after reaching the sediment top the grab sampler will collect the sample by pushing the wire connected with the buckets.

Sediment Sample Analysis

The sediment samples collected at seven locations were analyzed for parameters such as sand, silt, clay, bulk density, moisture, organic matter, organic carbon, total nitrogen, total phosphate, iron, cadmium, nickel, chromium, zinc, lead, and manganese. The results of analysis are discussed in the following chapters. The following table shows the reference methods used for sediment sample analysis.

S.No	Description	Method of Reference
1	Sand	AES/EN/SLS/SOP/017
2	Slit	AES/EN/SLS/SOP/017
3	Clay	AES/EN/SLS/SOP/017
4	Bulk Density	AES/EN/SLS/SOP/001
5	Moisture	IS:2720 (Part - 2)1973
6	Organic Matter	IS:2720 (Part - 22)1972
7	Organic Carbon	AES/EN/SLS/SOP/019
8	Total Nitrogen as N	IS:14684:1999
9	Total Phosphorous as PO_4	IS:10158:1982
10	Iron as Fe	USEPA 7000B & EPA 3050 B - 1996
11	Cadmium as Cd	USEPA 7000B & EPA 3050 B - 1996
12	Nickel as Ni	USEPA 7000B & EPA 3050 B - 1996
13	Chromium as Cr	USEPA 7000B & EPA 3050 B - 1996
14	Zinc as Zn	USEPA 7000B & EPA 3050 B - 1996
15	Lead as Pb	USEPA 7000B & EPA 3050 B - 1996

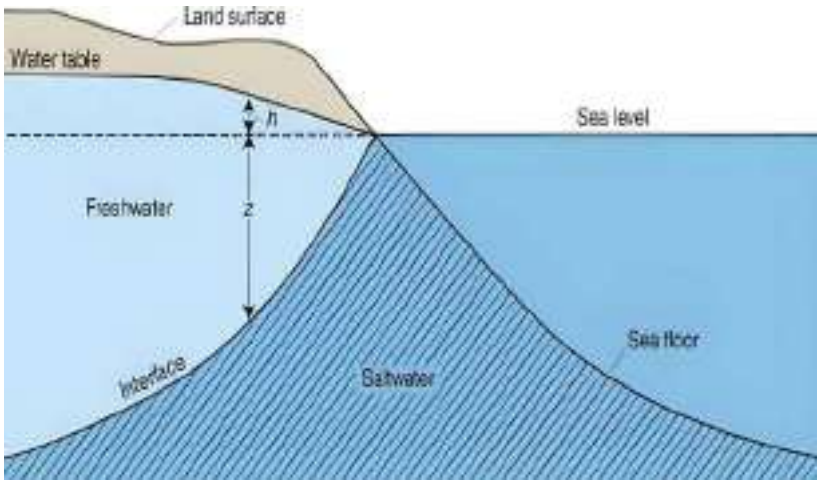
S.No	Description	Method of Reference
16	Manganese as Mn	USEPA 7000B & EPA 3050 B - 1996

3.3. Saltwater Intrusion

Saltwater intrusion refers to the movement of seawater into freshwater aquifers, which reduces water quality and limits its use for drinking, agriculture, and industry. This phenomenon often occurs in coastal zones when the balance between freshwater and saltwater is altered by factors such as excessive groundwater withdrawal, rising sea levels, or insufficient natural recharge.

A brackish zone refers to an area where freshwater and seawater mix, creating water with salinity levels higher than freshwater but lower than seawater. These zones are typically found in estuaries, coastal wetlands, and river mouth.

An aquifer in hydraulic connection with saline water contained both saltwater and freshwater, with the saltwater occupying the lower portion and the freshwater occupying the upper portion. Because freshwater is slightly less dense than saltwater, it floated above the saltwater when both fluids were present within the aquifer. The difference in density between freshwater and saltwater was used to estimate the depth to saltwater based on the thickness of the freshwater zone above sea level. This relationship, known as the **Ghyben–Herzberg Relation**, defines the equilibrium between freshwater and saltwater in coastal aquifers. The boundary between the freshwater and saltwater zones was not distinct but instead represented a gradual transition over a finite distance, referred to as the **zone of diffusion** or the **zone of mixing**. The Ghyben–Herzberg Relation for saline water intrusion is presented below.



Two mixing processes, diffusion and dispersion, continuously moved saltwater into the freshwater zone. Flow in the freshwater zone swept this mixed brackish water toward the shoreline, where it discharged at submarine seeps. The processes of recharge, flow, mixing, and discharge worked in unison to hold the interface in a roughly stationary position. A change to one or more of these processes resulted in a change in the position of the interface; an inland movement of the interface boundary was known as lateral intrusion. When a well was pumped, water levels in the vicinity of the well were lowered, creating a drawdown cone. If a saltwater zone existed in the aquifer beneath the well, the saltwater rose toward the well screen. This process, referred to as upconing, was the second type of saltwater intrusion. Saltwater intrusion into coastal aquifers led to impairment of freshwater quality in aquifers.

3.3.1. Electrical Resistivity Tomography Survey

Electrical Resistivity Tomography Survey (ERT) is a geophysical method used to image the subsurface by measuring resistance to the flow of electrical current.

Purpose of the Survey

The present study was carried out in the Karaikal coastal zone to investigate the location and extent of the fresh–saltwater interface in the aquifers of the study area using Electrical Resistivity Tomography (ERT) techniques combined with available hydrogeological data. This geophysical method was also applied to determine the aquifer geometry of the coastal tracts within the study area.

Principle of Survey

- **Geophysical Investigation**

  Electrical resistivity tomography (ERT) is used to differentiate between fresh and saline water zones based on their resistivity values. By analyzing these values, researchers can map the extent of saltwater intrusion into freshwater aquifers.

- **Factors Affecting Resistivity**

  Resistivity values can vary depending on the specific salinity level, the type of dissolved salts, the temperature of the water, and the surrounding geological formation.

- **Saline water apparent resistivity value**

  When dealing with apparent resistivity in the context of saline water, it's crucial to understand that resistivity is inversely proportional to salinity. The more dissolved salts (ions) present in the water, the lower its resistivity and the higher its conductivity.

Here's a general overview of apparent resistivity values and their relationship to saline water:

- ✓ Low resistivity values (typically less than 15 Ωm or 50 Ωm, depending on the source) are generally indicative of saline water.
- ✓ Resistivity values between 15 Ωm and 25 Ωm often suggest the presence of brackish water (a mixture of fresh and saline water).
- ✓ Higher resistivity values, like greater than 45 Ωm, are associated with freshwater.

For example, studies have shown that zones with saline water intrusion in sandy formations exhibit low resistivity values, ranging from less than 5 Ωm to 25 Ωm. In some cases, very low resistivity, below 5 Ωm, has been observed close to coastal areas with saline water ingress.

- **Vertical Electrical Sounding**

  Vertical (1D) Electrical Sounding (VES) are for determining the layered aquifers of different litho units. In majority of the cases, VES demarcates the number of layers, thickness and resistivity. The basic idea of resolving the vertical resistivity layering is to stepwise increase the current-injecting electrodes AB spacing, which leads to an increasing penetration of the current lines and in this way to an increasing influence of the deep-seated layers on the apparent resistivity ρA. In general, linear electrode configurations are used for resistivity measurements. The most popular configurations are Wenner and Schlumberger, which varies basically on electrodes spacing. Wenner system is used for quantitative interpretation and this method is well suited for geoelectrical profiling. Reversing/inversion are applied to reduce the number of layers, their resistivities and thickness from a measured value.

  The step-wise measured apparent resistivities are plotted against the current electrode spacing in a log/log scale and interpolated to a continuous curve. This plot is called sounding curve, that is the base of all data inversion to obtain the resistivity/depth structure of the ground. Now, varieties of software programs are available, that allow rapid inversion of resistivity layers. On the basis of resistivity values the software iterates the measured resistivity data to the theoretical data.

Area of Survey

The saltwater intrusion study using ERT was carried out in the post-monsoon across the river at five different locations using a resistivity meter (ABEM Terrameter SAS300). The location for

the Vertical Electrical Sounding was shown below, and a detailed view was presented in **Fig. 6.** under figures.

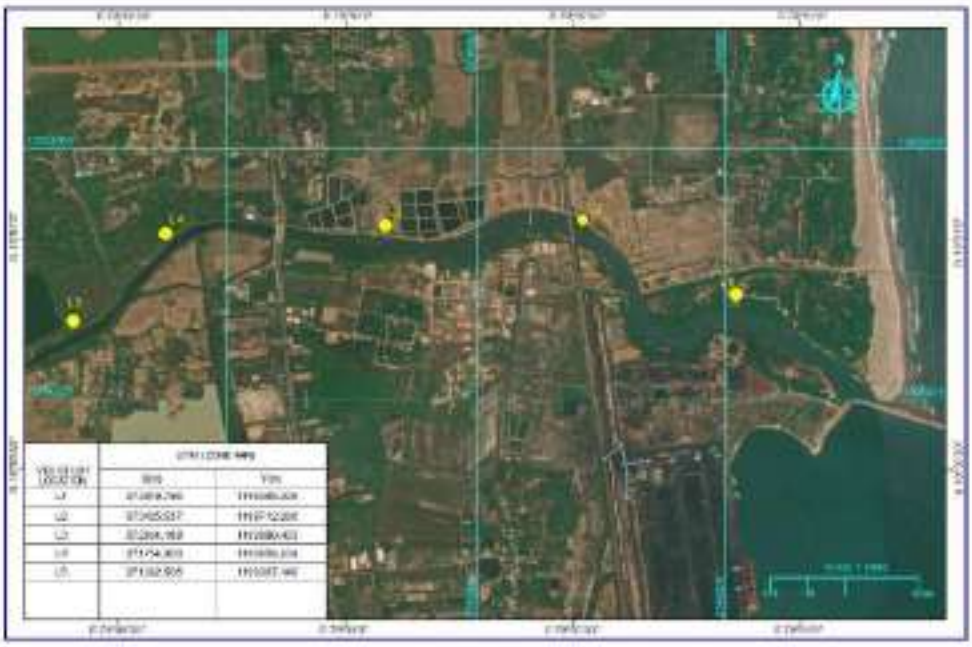


Fig.6. Location of Vertical Electrical Sounding (VES) - Saltwater intrusion study

VES locations for the study are given in the below table:

Sl. No	Water and Sediment Sample Code	UTM- Zone 44		Geographical coordinates	
		Easting X(m)	Northing Y(m)	Latitude (°)	Longitude (°)
1.	L1	373979.80	1199395.31	10°50'52.27"N	79°50'49.53"E
2.	L2	373425.54	1199712.27	10°51'2.52"N	79°50'31.24"E
3.	L3	372634.19	1199690.40	10°51'1.71"N	79°50'5.18"E
4.	L4	371754.90	1199658.83	10°51'0.58"N	79°49'36.23"E
5.	L5	371382.51	1199307.15	10°50'49.08"N	79°49'24.01"E

Sequence of Survey

Wenner Method

The Wenner method is a common geophysical surveying technique used to determine the electrical resistivity of the ground, particularly for soil. It involves using four equally spaced electrodes in a straight line to pass a current through the ground and measure the resulting voltage difference. This data is then used to calculate the resistivity of the soil. The spacing between the electrodes is varied to investigate resistivity at different depths.

Procedure:

- Four electrodes are placed in a straight line at equal distances (denoted as 'a') from each other.
- A current (I) is introduced into the ground through the two outer electrodes.
- The voltage (V) is measured between the two inner electrodes.
- The apparent resistivity (ρ) is then calculated using the formula: $\rho = 2 * \pi * a * (V / I)$.

Instrument and specification

- **Resistivity meter ABEM TERRAMETER SAS300:**

  ABEM Terrameter SAS300, in SAS stands for Signal Averaging System and results are more reliable and it is the most popular instrument for geophysical studies. It is based on the modern technology of microprocessors and employs ingenious methods for extracting subsurface information. What makes our instrument so popular is its simple operation, deep penetration, accurate & reliable results even in adverse field conditions. In addition, a considerable reduction in survey time proves a boon when working under hot sun. The instrument has a facility to measure Self Potential (SP) which is useful in mineral prospecting and environmental studies. Terrameter SAS300 can be used in a wide variety of applications for Groundwater Exploration and Engineering purposes.

  Applications:

  ✓ Ground Water Exploration
  ✓ Bed Rock Investigations
  ✓ Mineral Investigation
  ✓ Delineation of Geological Structures
  ✓ Sand and Gravel Deposit Identification
  ✓ Saline Water Intrusion
  ✓ Geophysical Field Training
  ✓ Ground water well logging

Specification:

Specifications	
Selectable Constant Current	0.2 mA to 20mA(7 steps) and 5 mA to 500 mA(4 steps)
Voltage max	160 V (320 Vpp)
Power	40 W
Input impedance	10 M Ohms
Input range	0 - 500 V
Precision	+/- 50 µV
Noise rejection	95 db at 50 - 60 Hz.

DV/I ranges	m Ohm, Ohm, k Ohm
DV/I precision	+/- 0.02 m Ohm at 500 mA
Cycle time	3.6 Seconds
Accuracy	2% + precision
Diagnostic display system	9 Codes
Temperature range (operating)	- 10 to 70 degrees C
Power source	12 V rechargeable battery pack
Battery capacity	3500 – 5000 single cycle measurement per charge
Weight	5.6 kg
Dimensions	L 325 mm x W 105 mm x H 300 mm

4. RESULTS

4.1. Replenishment Studies

4.1.1. Terrain Analysis

Aerial Topography and Bathymetry Survey

The Topography and Bathymetry chart is prepared in WGS-84 spheroid with UTM coordinates supplemented by geographical coordinates indicating the latitude and longitude. The topography and bathymetry plan map prepared in 1:4000 scale is presented in **Fig. 7.** A total of 76 cross-sections were generated as part of the terrain Analysis. These cross-sections provide a detailed representation of the topographic and bathymetric features of the survey area. The graphical representation of cross-sections is presented in **Fig. 8** and **Fig.9.** The Ortho mosaic map generated using aerial topography survey is presented in **Fig. 10.** The LULC map prepared in 1:3500 scale based on Ortho mosaic map generated through aerial topography is presented in **Fig. 11**. The LULC map comprises of features such as waterbodies, roads, settlements, eyots, bridges, railway line, agricultural land, barren land, high vegetation, etc.

Channel Geometry and Bed Elevation

The Topography and bathymetry survey revealed significant observation in the study area during the post-monsoon. The survey outputs reveals that the maximum river width measures about 100m between the cross-section CH 1.398KM and CH1.3400KM. Subsequently, the river width is narrow between the cross-section CH 0.491KM and CH 0.532KM which is approximately 19 m. The computed overall bed gradient from upstream to downstream is 1: 100000 shows that river exhibit a gradual bed slope during pre-monsoon. In addition, three number of sandbars in the river were mapped and measures an area of 7732 m^2 approximately during the Post monsoon study.

4.1.2. Hydrodynamic Studies

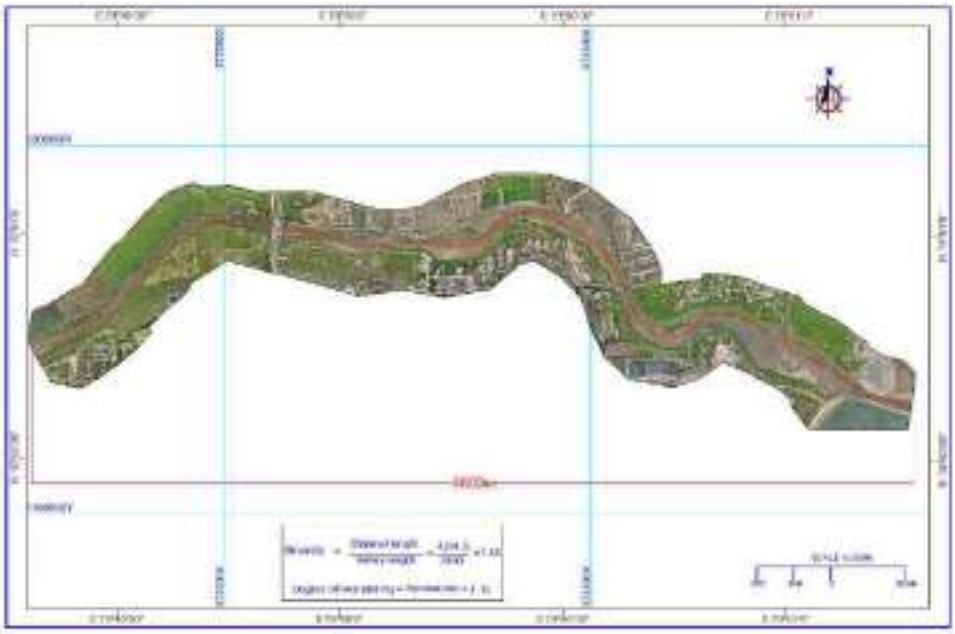
Flow Velocity and Discharge Measurement

The flow velocity and discharge measurements were performed using an ADCP at locations with adequate water depth for device deployment, and the float-ball method was used at shallow-depth locations where ADCP deployment was not possible. A 12-hour observation of flow velocity and discharge was carried out across various river cross-sections, including ebb and flood tide measurements near the river mouth. The results showed a net discharge of 1.4 m^3/s directed towards the sea from the river.

In-Stream Roughness investigation

In-stream roughness investigation was done as a parallel activity during the period of survey. The In-Stream Roughness is determined with the field investigation and concluded along with the survey data outputs. The following table summarize the channel condition with respect to various parameters.

Sl.no	Parameter	Channel conditions	n-value adjustment	Description
1.	Base values (n_b)	0.2	0.012	-
	Degree of irregularity (n_1)	Moderate	0.006 - 0.010	Moderate to considerable bed roughness due to such features as bedforms; moderately sloughed or eroded streambanks
3.	Variation in channel cross section (n_2)	Alternating occasionally	0.001 - 0.005	Cross section size and shape alternate occasionally. Alternatively, channel thalw eg shifts occasionionally from one side to the other
4.	Effect of obstructions (n_3)	Negligible	0 - 0.004	A few scattered obstructions are present (< 5% X-S area), including such features as debris deposits, stumps, exposed roots, logs, piers or isolated boulders.
5.	Amount of vegetation (n_4)	Medium	0.010 - 0.025	Tree and shub seedlings are present, with a flow depth of 2 to 3 times the vegetation height at the flow of interest. Alternatively, brushy and moderately-dense streambank woody vegetation present.
6.	Degree of meandering and sinuosity (m)	Appreciable	1.15	Sinuosity = 1.2 to 1.5



The ‘n‘ value of the study area was calculated based on the channel condition with respect to various parameters mentioned in the above table for the post-monsoon. Based on pre-monsoon, the same was calculated for the post-monsoon to understand the behaviour of the study area.

4.1.3. Physico-Chemical Assessment of water and sediment

Water sample analysis

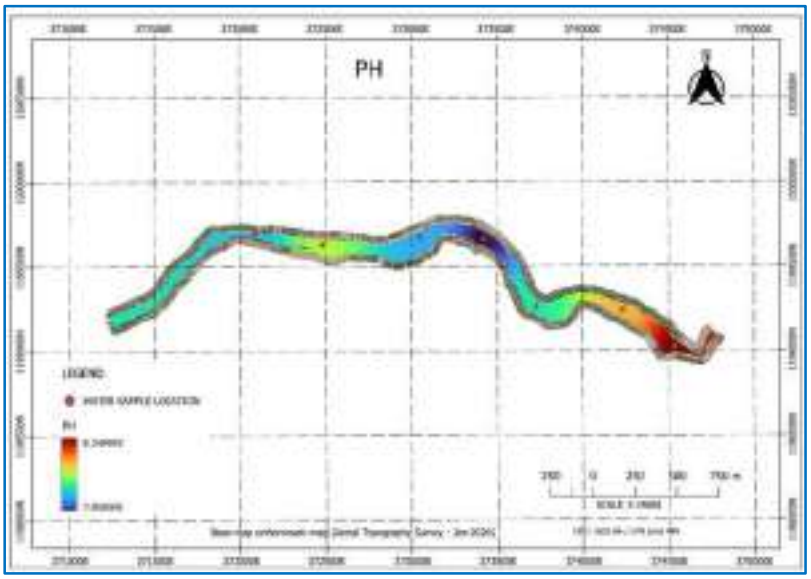
A total of seven surface water samples were collected from various point along the river during post-monsoon season to evaluate the physical and chemical characteristic of water. The results of water sample analysis are presented in tabular form below,

Sample	pH	EC	TSS	Turbidity	Nitrate	Fe	Mn	DO	COD	BOD	Phosphate	Nitrite	Pb	Hg	Cd	NH4	Chlorophyll-a
Unit	-	µS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
L1	8.25	7548	19	28.6	BDL	3.56	0.165	7.5	106	27.6	BDL	0.05	BDL	BDL	BDL	BDL	BDL
L2	8.12	7859	298	2.4	BDL	35	0.26	6.2	113	22.5	BDL	0.03	BDL	BDL	BDL	BDL	BDL
L3	7.99	7986	546	36	BDL	76	0.176	6.59	62	12.9	BDL	0.08	BDL	BDL	BDL	BDL	BDL
L4	7.85	557	22	35.5	BDL	5.42	0.254	5.9	40	10	BDL	0.07	BDL	BDL	BDL	BDL	BDL
L5	7.94	779	26	29.3	2	4.62	0.14	6	40	10	BDL	0.06	BDL	BDL	BDL	BDL	BDL
L6	8.06	674	18	25.4	BDL	1.34	0.125	6.5	30	7.6	BDL	0.2	0.268	BDL	BDL	BDL	BDL
L7	7.94	806	17	44.1	BDL	2.54	0.152	6.3	50	13	BDL	0.14	BDL	BDL	BDL	BDL	BDL

BDL – Below Detection Level

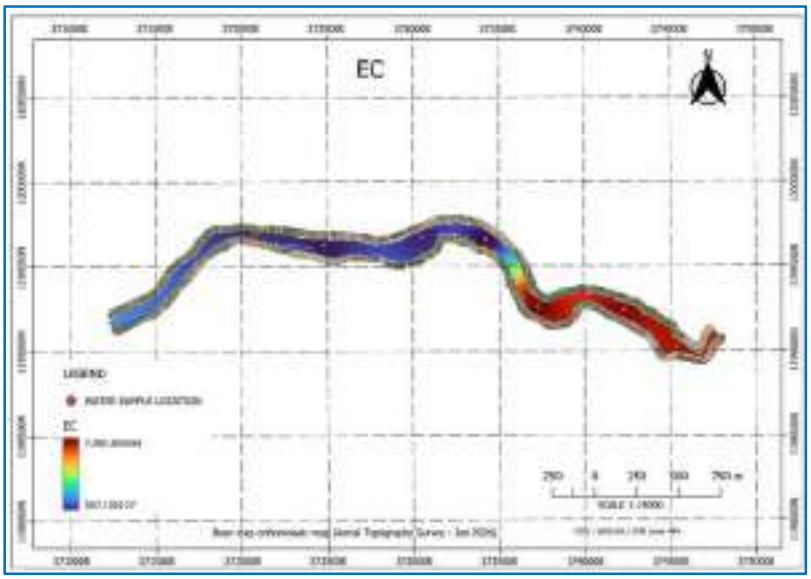
- **pH**

The pH values ranged from 7.85 to 8.25, indicating slightly alkaline conditions across all sampling locations. The highest pH was recorded at L1 (8.25), followed closely by L2 (8.12), while the lowest value was observed at L4 (7.85). The narrow pH range suggests relatively stable buffering conditions, likely influenced by carbonate minerals and limited acidic inputs.



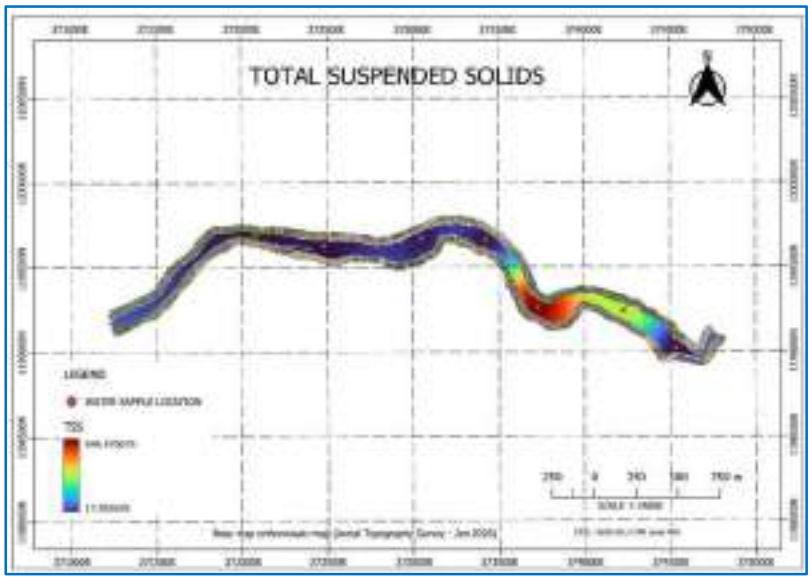
• Electrical Conductivity

Electrical conductivity varied widely from 557 µS/cm to 7986 µS/cm, reflecting significant differences in dissolved ionic content. The highest EC was recorded at L3 (7986 µS/cm), followed by L2 (7859 µS/cm) and L1 (7548 µS/cm), indicating high salinity and elevated dissolved salts at these locations. In contrast, lower EC values at L4 (557 µS/cm) and L6 (674 µS/cm) suggest comparatively lower mineralization.



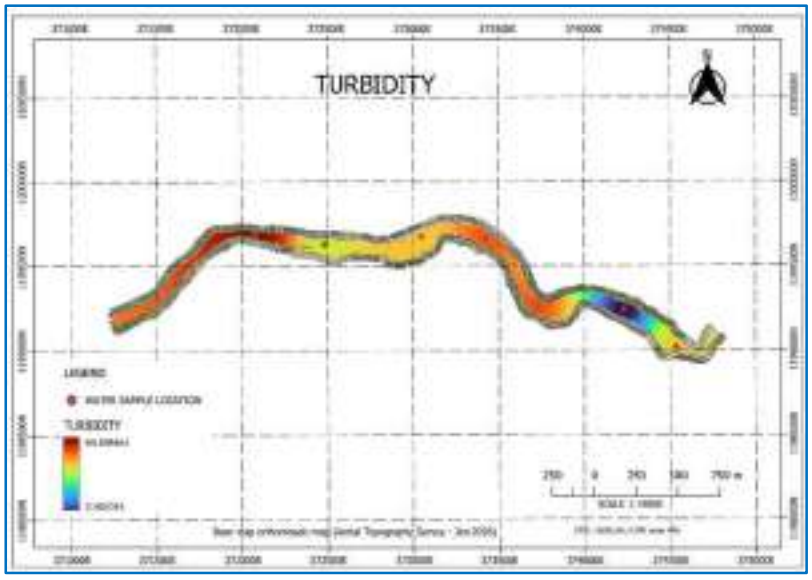
• **Total Suspended Solids**

TSS concentrations ranged from 17 mg/L to 546 mg/L. The highest TSS was observed at L3 (546 mg/L), followed by L2 (298 mg/L), indicating substantial particulate matter and possible sediment disturbance. Lower TSS values at L7 (17 mg/L) and L6 (18 mg/L) suggest clearer water conditions at these sites.



• **Turbidity**

Turbidity values varied between 2.4 NTU and 44.1 NTU. The lowest turbidity was recorded at L2 (2.4 NTU), while the highest value was observed at L7 (44.1 NTU), followed by L3 (36 NTU). Elevated turbidity levels may be attributed to increased suspended solids and organic matter.

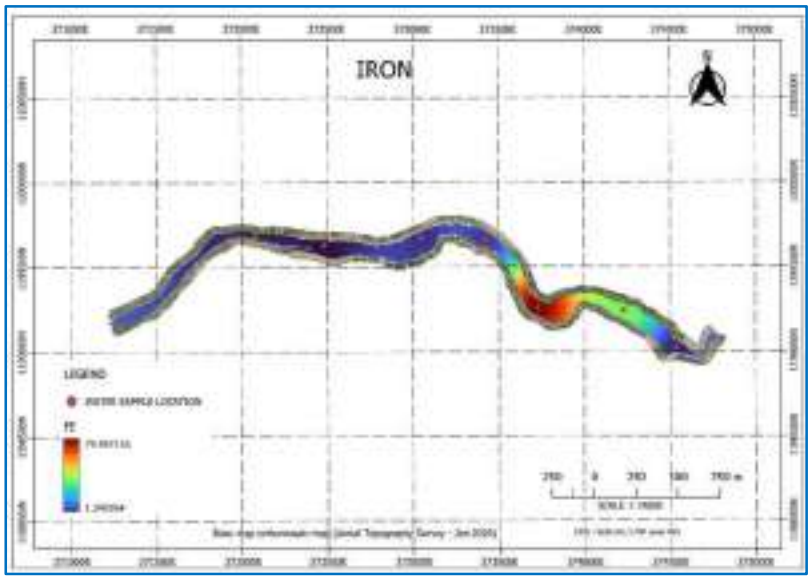


• **Nitrate**

Nitrate concentrations were below detection limit (BDL) at all locations except L5 (2 mg/L). This indicates generally low nitrate levels across the study area, suggesting limited agricultural runoff or effective nutrient assimilation.

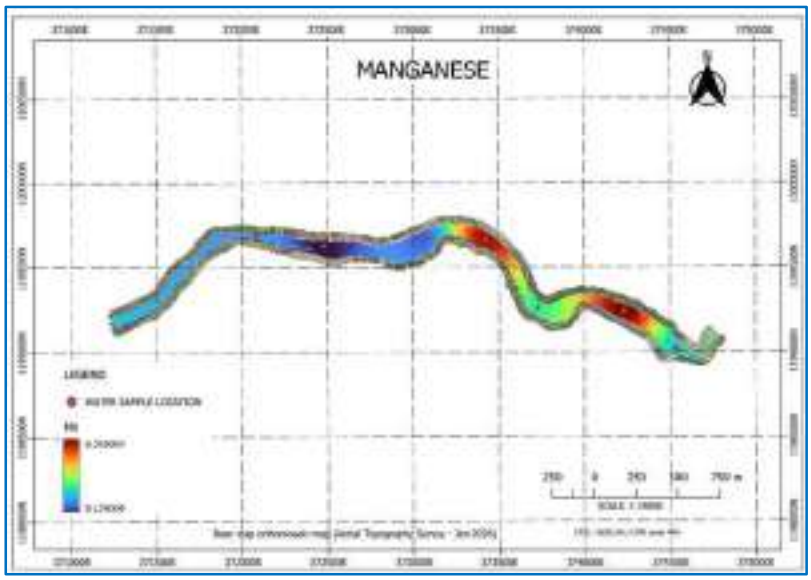
• **Iron (Fe)**

Iron concentrations showed wide variation, ranging from 1.34 mg/L to 76 mg/L. The highest Fe concentration was recorded at L3 (76 mg/L), followed by L2 (35 mg/L), indicating possible geogenic influence or mobilization under favorable redox conditions. Lower iron levels at L6 (1.34 mg/L) reflect comparatively reduced mineral dissolution.



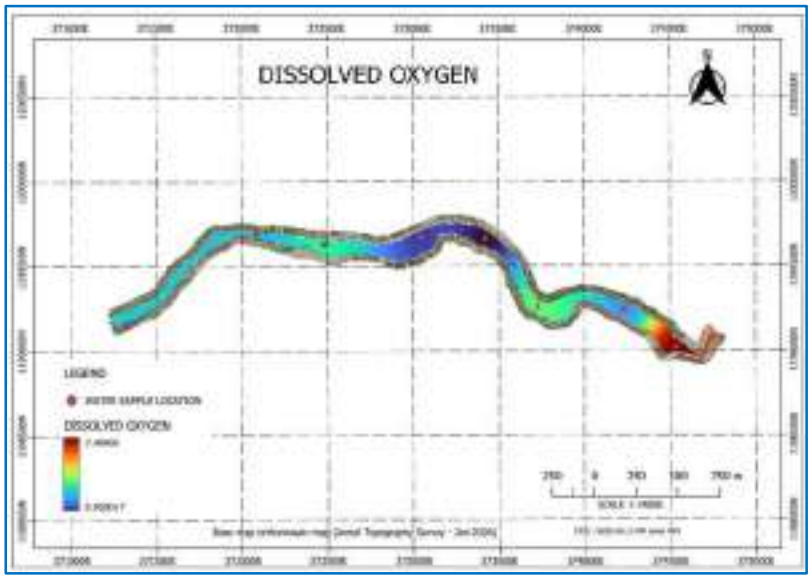
• **Manganese (Mn)**

Manganese concentrations ranged from 0.125 mg/L to 0.26 mg/L. The highest value was observed at L2 (0.26 mg/L), while the lowest was recorded at L6 (0.125 mg/L). The relatively narrow range suggests controlled Mn mobility, possibly influenced by oxidation–reduction conditions.



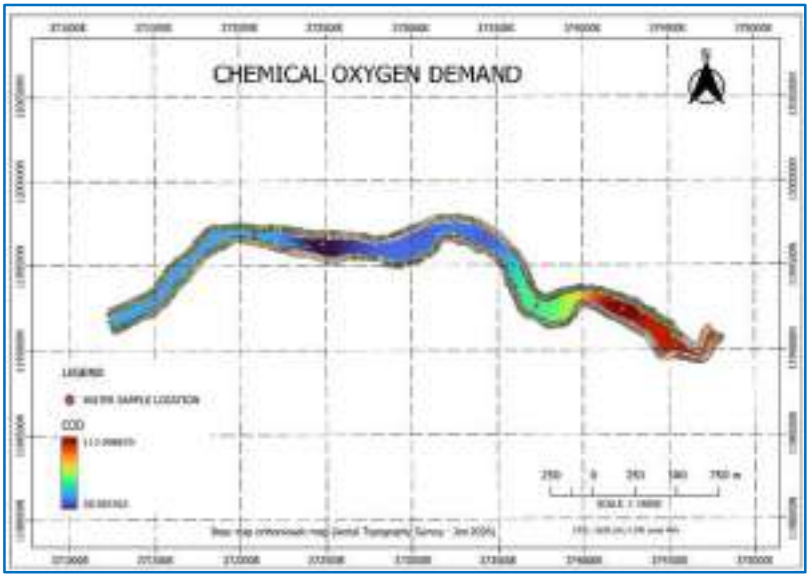
• **Dissolved Oxygen (DO)**

DO levels ranged from 5.9 mg/L to 7.5 mg/L, indicating generally well-oxygenated water. The highest DO was observed at L1 (7.5 mg/L), while the lowest was at L4 (5.9 mg/L). These values suggest favourable conditions for aquatic life.



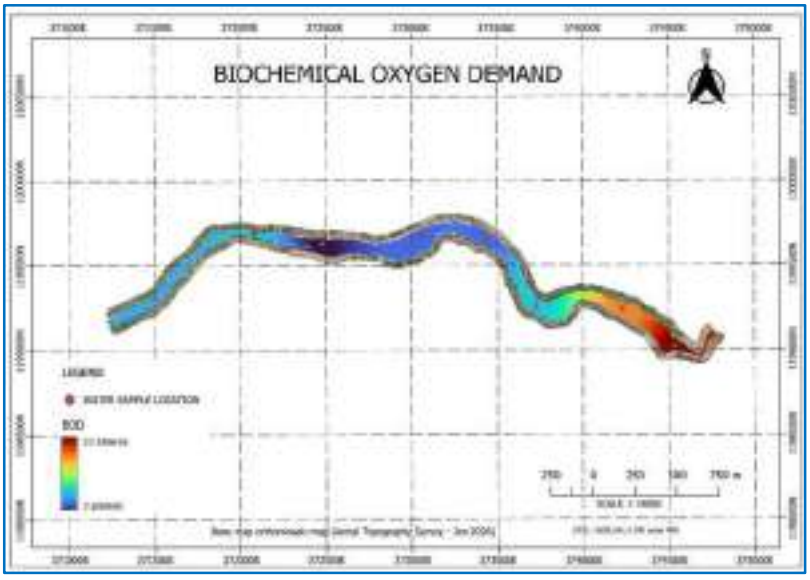
• **Chemical Oxygen Demand (COD)**

COD values ranged from 30 mg/L to 113 mg/L. The highest COD was recorded at L2 (113 mg/L), followed by L1 (106 mg/L), indicating higher organic and inorganic oxidizable matter. Lower COD at L6 (30 mg/L) reflects reduced pollution load.



• **Biochemical Oxygen Demand (BOD)**

BOD concentrations ranged from 7.6 mg/L to 27.6 mg/L. The highest BOD was observed at L1 (27.6 mg/L), followed by L2 (22.5 mg/L), suggesting elevated biodegradable organic matter. Lower BOD at L6 (7.6 mg/L) indicates comparatively cleaner water.

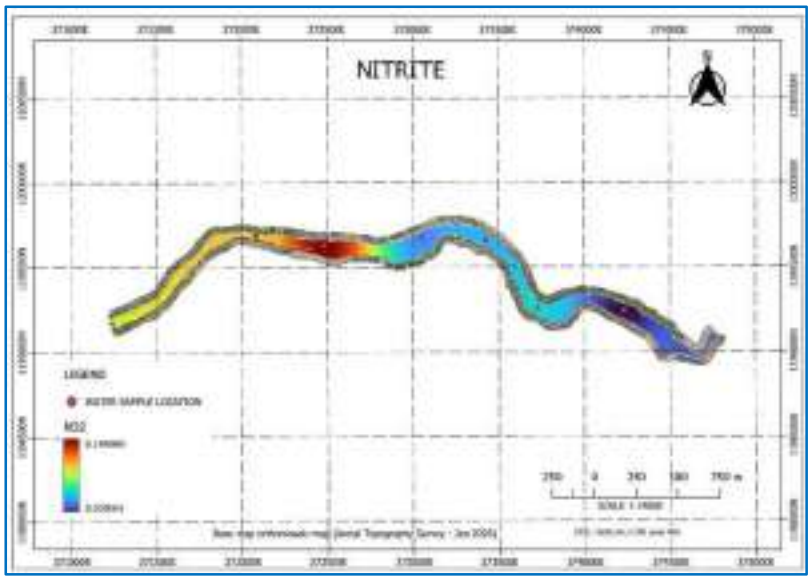


• **Phosphate**

Phosphate concentrations were below detection limit (BDL) at all sampling locations, indicating minimal phosphate enrichment and limited risk of eutrophication.

• **Nitrite**

Nitrite levels ranged from 0.03 mg/L to 0.20 mg/L. The highest concentration was recorded at L6 (0.20 mg/L), followed by L7 (0.14 mg/L). Although present in low concentrations, nitrite indicates partial nitrification processes.



• **Lead**

Lead concentrations were below detection limit (BDL) at all locations, indicating no detectable Pb contamination in the study area.

• **Mercury (Hg)**

Mercury levels were below detection limit (BDL) across all samples, suggesting the absence of Hg pollution.

• **Cadmium (Cd)**

Cadmium concentrations were below detection limit (BDL) at all sites, indicating no Cd-related contamination.

• **Ammonium (NH_4^+)**

Ammonium was below detection limit (BDL) across all locations, suggesting minimal influence of untreated sewage or recent organic pollution.

• **Chlorophyll-a**

Chlorophyll-a values ranged from 7.85 mg/L to 8.25 mg/L, with the highest concentration observed at L1 (8.25 mg/L). The relatively uniform distribution indicates moderate phytoplankton productivity across the study area.

Sediment sample analysis

A total of seven sediment water samples were collected from various point along the river during post-monsoon season. The results of sediment sample analysis are presented in tabular form below,

Sample	Sand	Silt	Clay	Bulk Density	Moisture	Organic Matter	Organic Carbon	Total Nitrogen	PO4	Fe	Cd	Ni	Cr	Zn	Pb	Mn	Texture	Hg
Unit	(%)	(%)	(%)	(g/cc)	(%)	(%)	(%)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	-	(mg/Kg)
L1	26.8	4.8	66.5	1.178	1.15	1.42	0.453	1058	9.3	2856	BDL	9.7	12.25	9.625	11.32	138	CLAY	BDL
L2	29.3	5.1	68.6	1.195	1.42	0.756	0.476	1026	8.3	568	BDL	8.95	10.56	7.367	BDL	138.2	CLAY	BDL
L3	56.5	4.7	38.2	1.225	0.759	0.859	0.658	865	10.06	1859	BDL	9.58	10.97	3.012	9.63	219.3	SAND	BDL
L4	25.6	5.4	68.9	1.26	1.19	1.04	0.606	1128	10.6	2577	BDL	9.78	10.4	8.63	BDL	119	CLAY	BDL
L5	27.5	5.2	66.9	1.27	2.33	0.99	0.577	1033	7.59	813	BDL	8.17	10.28	10.72	13.53	414	CLAY	BDL
L6	65.7	4.6	29.3	1.32	0.9	0.41	0.235	1200	2.94	1353	BDL	5.7	8.98	6.71	BDL	220	LOAMY SAND	BDL
L7	58.1	4.9	36.3	1.23	0.89	1.36	0.79	975	5.93	5470	BDL	10.62	10.07	16.97	6.9	119	SANDY CLAY	BDL

BDL – Below Detection Level

- **Sand (%)**

Sand content across the sampling locations varied widely, ranging from 25.6% to 65.7%, indicating marked heterogeneity in soil texture. The highest sand proportion was observed at L6 (65.7%), followed by L7 (58.1%), reflecting the dominance of coarse-textured soils at these sites. Such soils typically exhibit higher permeability and lower water-holding capacity. Conversely, L4 (25.6%) and L1 (26.8%) recorded the lowest sand contents, suggesting greater accumulation of fine particles and comparatively heavier soil textures.

- **Silt (%)**

Silt content showed minimal spatial variation, ranging narrowly between 4.6% and 5.4%. The highest silt percentage was recorded at L4 (5.4%), followed by L5 (5.2%). The limited variation implies relatively uniform silt distribution across the study area, likely due to silt particles being easily transported and less readily retained within the soil matrix.

- **Clay (%)**

Clay content ranged from 29.3% to 68.6%, showing pronounced variability among locations. The highest clay content was recorded at L3 (68.6%), followed closely by L2 (66.9%), indicating fine-textured, clay-dominated soils at these sites. High clay content is associated with increased surface area, enhanced nutrient retention, and greater moisture-holding capacity. In contrast, L1 (29.3%) and L4 (36.3%) exhibited relatively lower clay content, consistent with their higher sand fractions and coarser textures.

- **Bulk Density**

Bulk density values ranged from 1.23 g/cc to 1.32 g/cc. The highest bulk density was recorded at L1 (1.32 g/cc), suggesting soil compaction and reduced pore space, conditions commonly associated with sandy or structurally degraded soils. Lower bulk density values at L4 (1.23 g/cc) and L3 (1.26 g/cc) indicate better soil structure and increased porosity, which are typically influenced by higher clay and organic matter content.

- **Moisture Content**

Soil moisture content varied between 0.89% and 2.33%. The highest moisture content was observed at L2 (2.33%), followed by L3 (1.19%), reflecting the influence of higher clay content and improved water-holding capacity at these locations. In contrast, the lowest moisture values at L4 (0.89%) and L6 (0.90%) are consistent with their higher sand content, which promotes rapid drainage and reduced moisture retention.

- **Total Phosphorous (PO_4^{3-})**

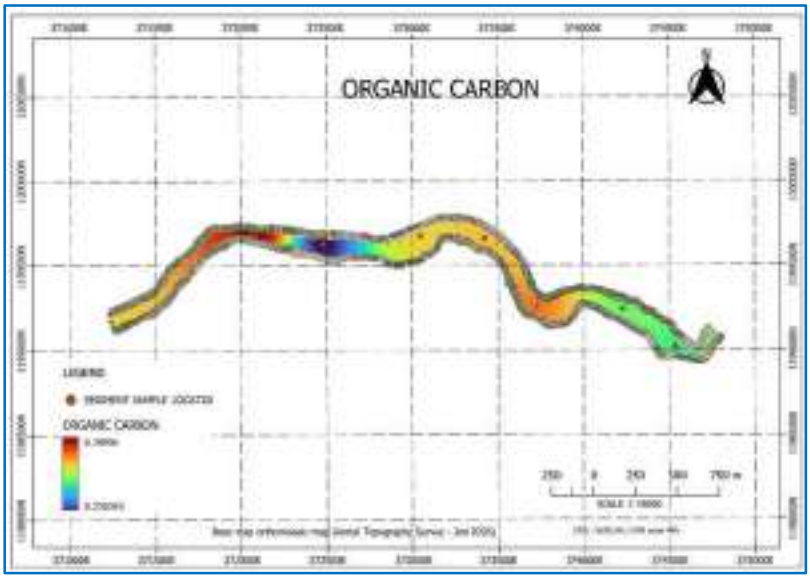
Phosphate concentrations ranged from 2.94 mg/kg to 10.6 mg/kg. The lowest concentration was recorded at L6 (2.94 mg/kg), while the highest was observed at L4 (10.6 mg/kg), followed by L3 (10.06 mg/kg) and L2 (7.59 mg/kg). Elevated phosphate levels in clay-rich soils (L2–L4) can be attributed to the greater adsorption capacity of fine particles, which enhances nutrient retention. Moderate phosphate availability at L7 (5.93 mg/kg) reflects its mixed sandy-clay texture.

- **Organic Matter (%)**

Organic matter content varied considerably, ranging from 0.41% to 1.42%. The highest organic matter was recorded at L1 (1.42%), followed by L7 (1.36%) and L4 (1.04%), suggesting greater organic inputs or reduced decomposition rates at these locations. Lower organic matter content at L6 (0.41%) corresponds with its sandy texture, which typically supports lower organic matter accumulation due to increased aeration and faster decomposition rates.

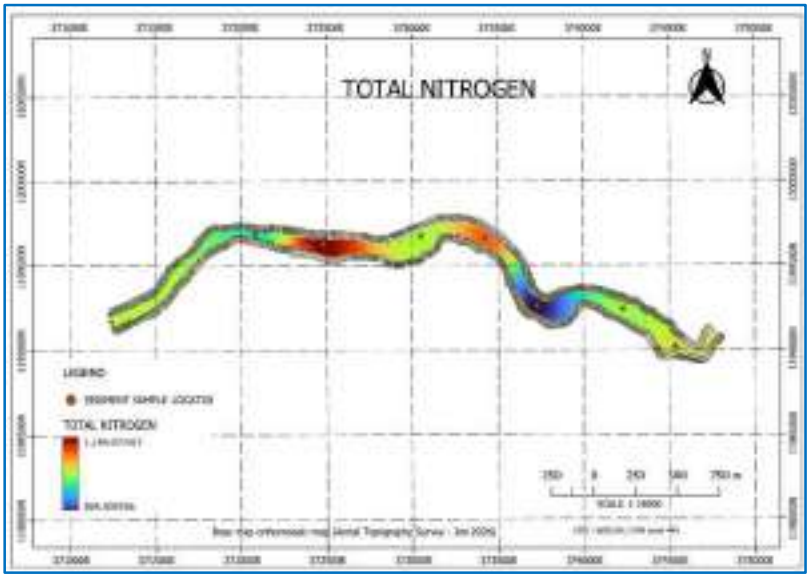
- **Organic Carbon (%)**

Organic carbon values varied from 0.235% (L6) to 0.79% (L7). The distribution closely followed organic matter trends, confirming the strong relationship between soil texture, carbon stabilization, and organic inputs.



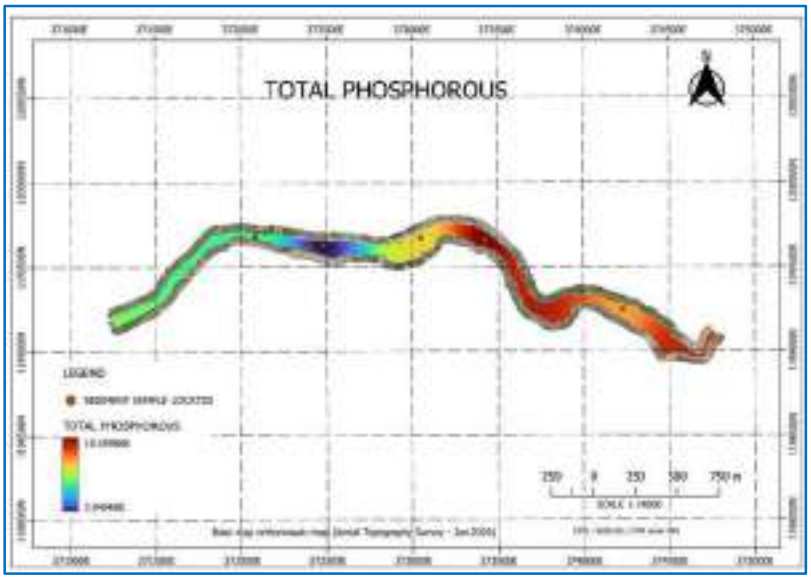
- **Total Nitrogen (N)**

Total nitrogen concentrations ranged from 865 mg/kg (L3) to 1200 mg/kg (L6). Higher nitrogen levels at L6 and L4 (1128 mg/kg) may be associated with external inputs or mineral accumulation, while lower values at L3 indicate limited nitrogen retention in sand-dominated soils.



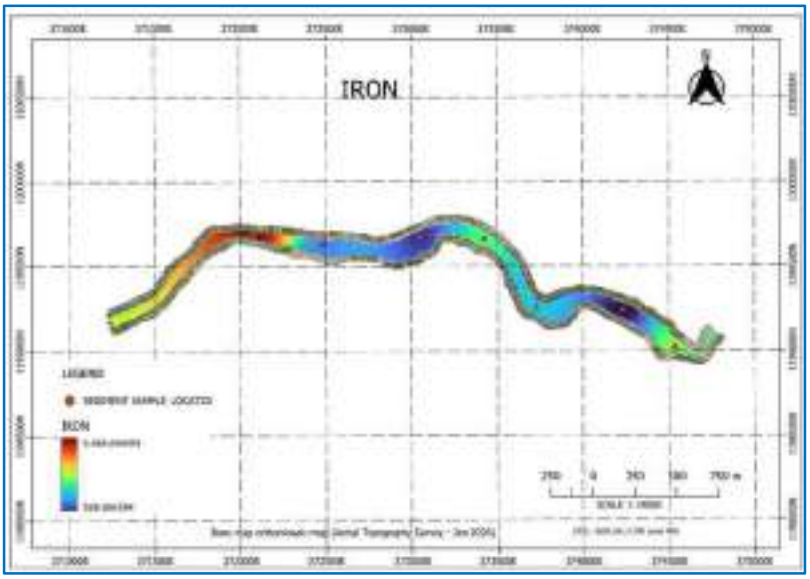
- **Phosphorus (Po4)**

Phosphate concentrations ranged from 2.94 mg/kg (L6) to 10.6 mg/kg (L4). Elevated phosphate levels at L4, L3 (10.06 mg/kg), and L2 (7.59 mg/kg) reflect enhanced adsorption by clay minerals. Lower phosphate at L6 is consistent with leaching losses in sandy soils.



- **Iron (Fe)**

Iron concentrations varied widely from 568 mg/kg (L2) to 5470 mg/kg (L7). The exceptionally high Fe level at L7 suggests lithogenic influence or accumulation under oxidizing conditions. Elevated Fe at L1, L3, and L4 further indicates strong mineralogical control.

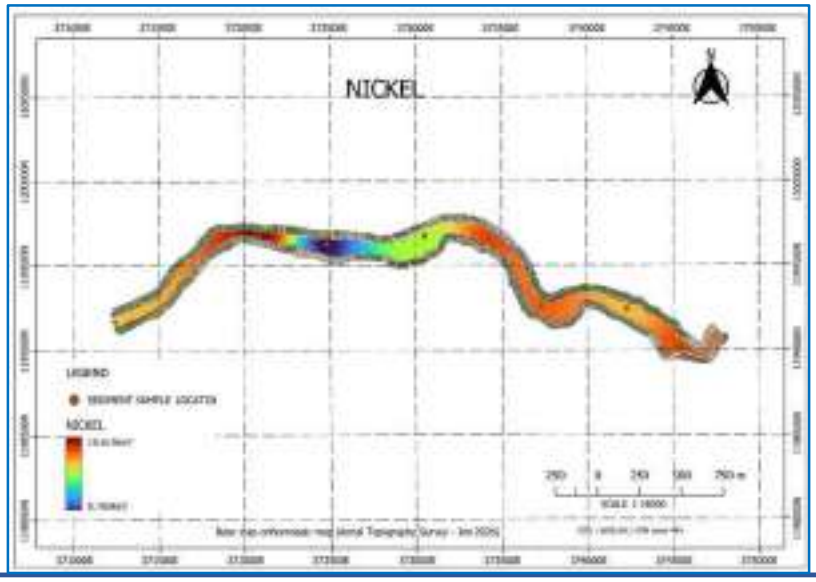


- **Cadmium (Cd)**

Cadmium levels were below detection limits (BDL) at all locations, indicating no detectable Cd contamination in the study area

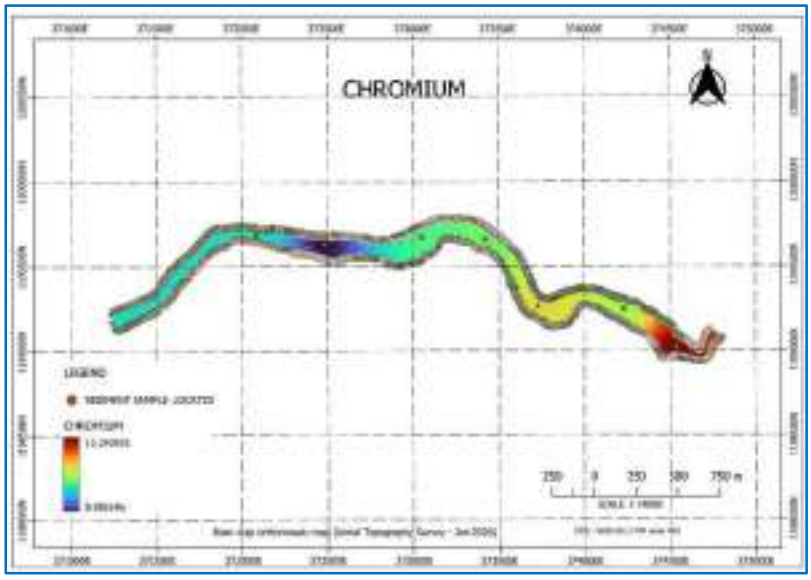
- **Nickel (Ni)**

Nickel concentrations ranged from 5.7 mg/kg (L6) to 10.62 mg/kg (L7). Higher Ni levels at L7 and L4 may reflect parent material composition rather than anthropogenic sources.



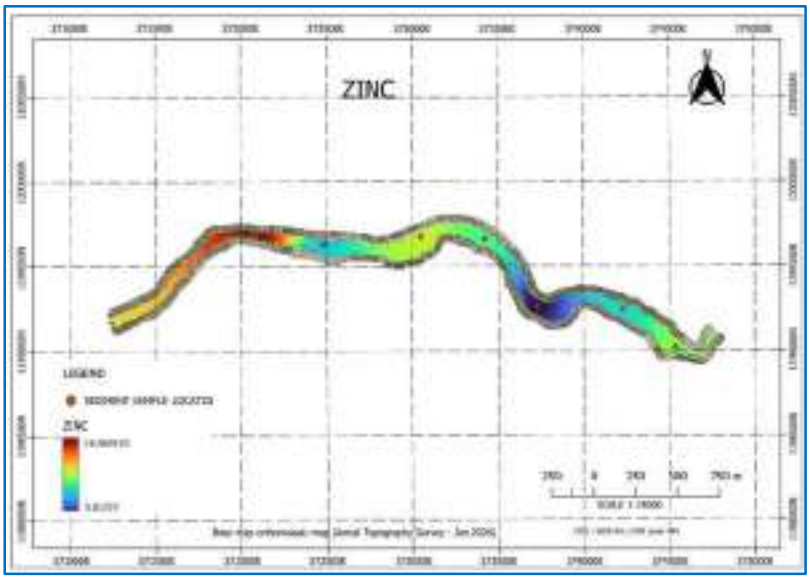
- **Chromium (Cr)**

Chromium content ranged between 8.98 mg/kg (L6) and 12.25 mg/kg (L1). The relatively uniform distribution suggests geogenic origin with minimal external contamination.



- **Zinc (Zn)**

Zinc concentrations varied from 3.012 mg/kg (L3) to 16.97 mg/kg (L7). Elevated Zn at L7 and L5 (10.72 mg/kg) may be associated with organic matter accumulation or localized anthropogenic influence.

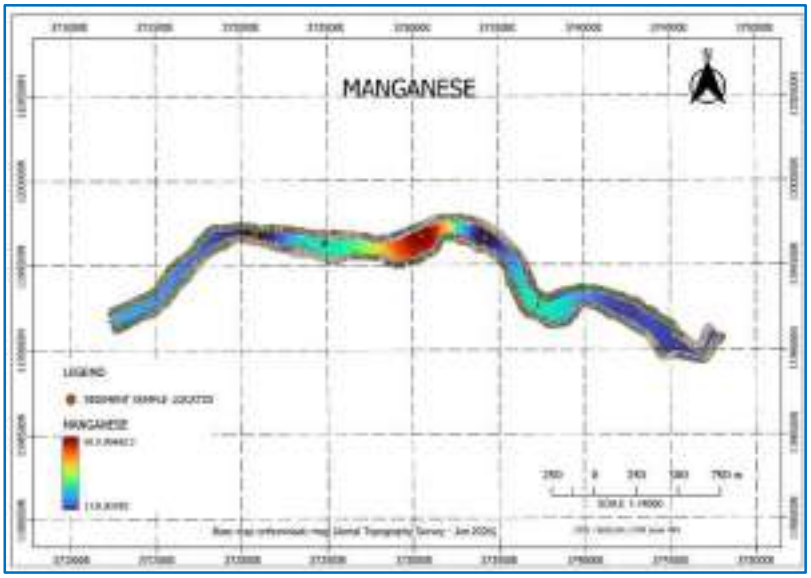


- **Lead (Pb)**

Lead levels ranged from 6.9 mg/kg (L7) to 13.53 mg/kg (L5). Although variations exist, all Pb values remain within typical background soil concentrations.

- **Manganese (Mn)**

Manganese ranged from 119 mg/Kg to 414 mg/Kg. The highest value (414 mg/Kg) was recorded at L5, followed by 220 mg/Kg at L6.



4.2. Saltwater Intrusion study

The saltwater intrusion study in the study area for post monsoon was conducted using Geophysical method - Electrical Resistivity Tomography (ERT) in five locations along the river. The results of Electrical Resistivity Tomography are discussed below.

Location 1 (10.847854N, 79.847092E):

The First Electrical Resistivity Tomography (ERT) profile was conducted approximately 500 m westward from the coastline, within the designated buffer Zone. The geoelectrical results indicate variation in resistivity ranging from **1 - 120 Ωm.**

Notably, a lower resistivity zone, ranging between 29 and 1 Ωm, was observed at depth of 7.0-30.0m. The reduced resistivity is independent of orientation toward the sea and may be attributed to saturated strata associated with subsurface saltwater intrusion. The resistivity data from Location 1 suggest the presence of brackish to saline water within the subsurface area.

Based on the geophysical analysis, it is inferred that Location 1 is influenced by saline water intrusion. Traces of saline water are detected below a depth of approximately 7.0m.

Location 2 (10.850701N, 79.842011E):

The Second Electrical Resistivity Tomography (ERT) profile was conducted approximately 1200m westward from the coastline, within the buffer zone. The geoelectrical results indicate variation in resistivity ranging from 1 to 2 Ωm.

The lower resistivity zone was detected at a shallow depth of 1.0m. The obtained resistivity values strongly suggest the presence of brackish to saline water within the subsurface strata.

Based on the geophysical analysis, it is inferred that Location 2 is influenced by saline water intrusion within the alluvium formation. Traces of saline water are detected at shallow depths, beginning at approximately 1.0m.

Location 3 (10.850476N, 79.834773E)

The third Electrical Resistivity Tomography (ERT) profile was conducted approximately 2000m westward from the coastline, within the buffer zone. The geoelectrical results indicate variation in resistivity ranging from 1 to 14 Ωm.

The lower resistivity zone was detected at a shallow depth of 1.5m. The obtained resistivity values strongly suggest the presence of brackish to saline water within the subsurface strata.

Based on the geophysical analysis, it is inferred that Location 3 is influenced by saline water intrusion within the alluvium formation. Traces of saline water are detected at shallow depths, beginning at approximately 1.5m.

Location 4 (10.850160N, 79.826731E)

The fourth Electrical Resistivity Tomography (ERT) profile was conducted approximately 2800m westward from the coastline, within the buffer zone. The geoelectrical results indicate variation in resistivity ranging from 1 to 27 Ωm.

The lower resistivity zone was detected at a depth of around 4m. Though the values recorded are slightly higher than typical saline water resistivity. The obtained resistivity values strongly suggest the presence of brackish to saline water within the subsurface strata.

Based on the geophysical analysis, it is inferred that Location 4 is influenced by saline water intrusion within the alluvium formation. Traces of saline water occurs below a depth of approximately 4.0m.

Location 5 (10.846967N, 79.823337E):

The fifth Electrical Resistivity Tomography (ERT) profile was conducted approximately 3000m westward from the coastline, within the buffer zone. The geoelectrical results indicate variation in resistivity ranging from 1 to 14 Ωm.

The lower resistivity zone was first observed at a depth of about 4.5m. Though the values recorded are slightly higher than typical saline water resistivity. The obtained resistivity values strongly suggest the presence of brackish to saline water within the subsurface strata.

Based on the geophysical analysis, it is inferred that Location 5 is influenced by saline water intrusion within the alluvium formation. Traces of saline water occurs below a depth of approximately 4.5m.

The geophysical resistivity investigation revealed that saltwater intrusion is prominent in all five locations, extending up to approximately 3-4 km inland from the coast. At Location 1, saline water intrusion was identified at depths greater than 7.0m, suggesting that the sand dune aquifer containing freshwater act as a partial barrier controlling the advance of saline water, a process strongly influenced by coast proximity and tidal/shoreline dynamics.

The lithological units of the alluvial aquifer are primarily composed of sand and sand clay mixtures, with predominantly fine-grain texture. Within the estuarine influence zone, lower resistivity value in the topsoil suggest contamination, reflecting the direct impact of estuarine water on aquifer characteristics. Overall, the study area is largely dominated by saline water intrusion, rendering the groundwater unsuitable for domestic consumption.

The analysis of the electrical resistivity tomography data is presented in Annexure 1.

PHOTO GALLERY

FIGURES

MAP PROPERTIES

CRS : WGS 84
Ellipsoidal Name :EPSG:7030
Unit : degrees
Map Production Date:05/08/2025

250 0 250 500 km

SCALE BAR

LEGENDS

INDIAN STATE BOUNDARY

Fig.2. Satellite imagery of survey region

Fig.4. Planned line for Aerial topographic survey

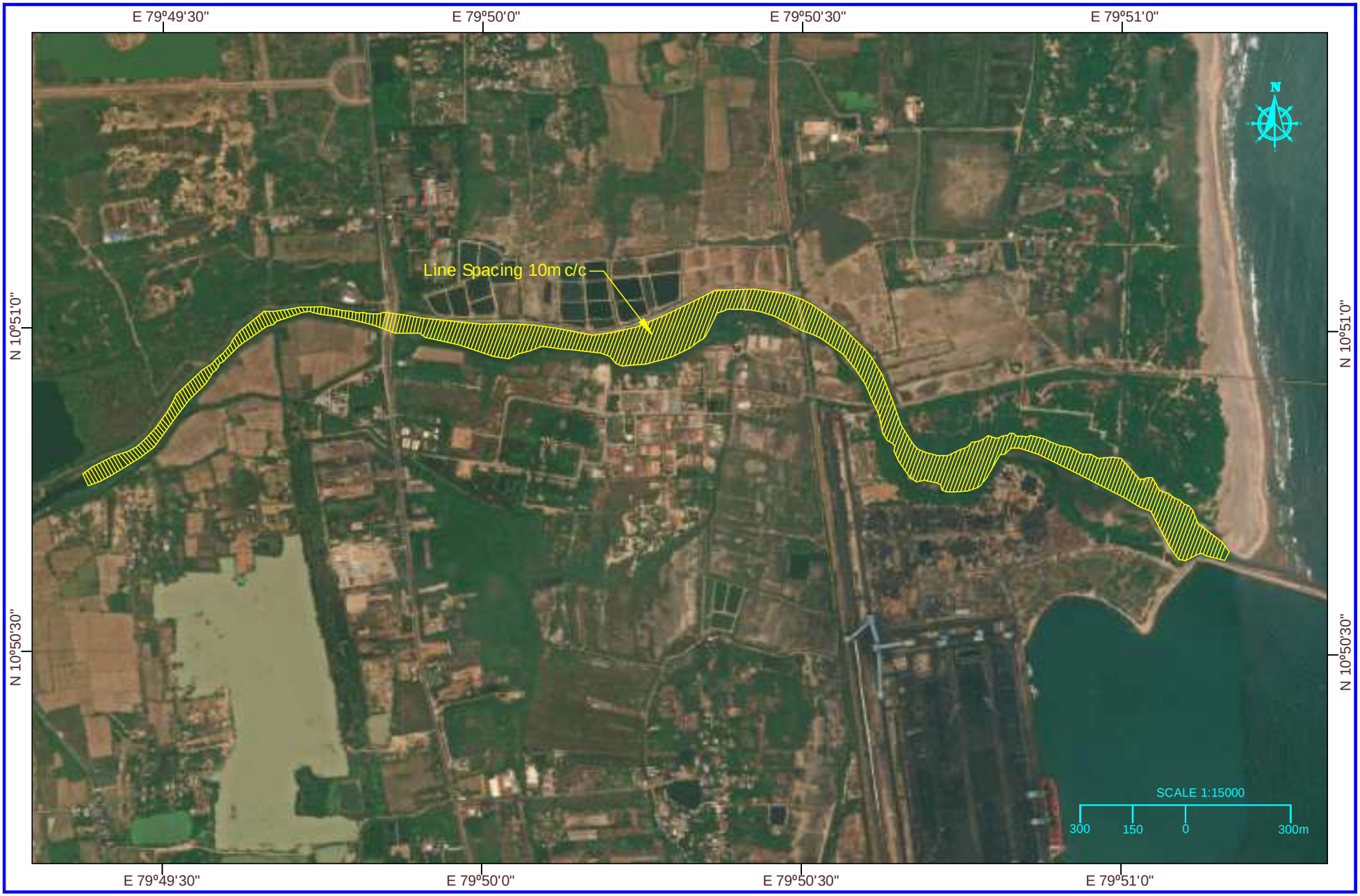
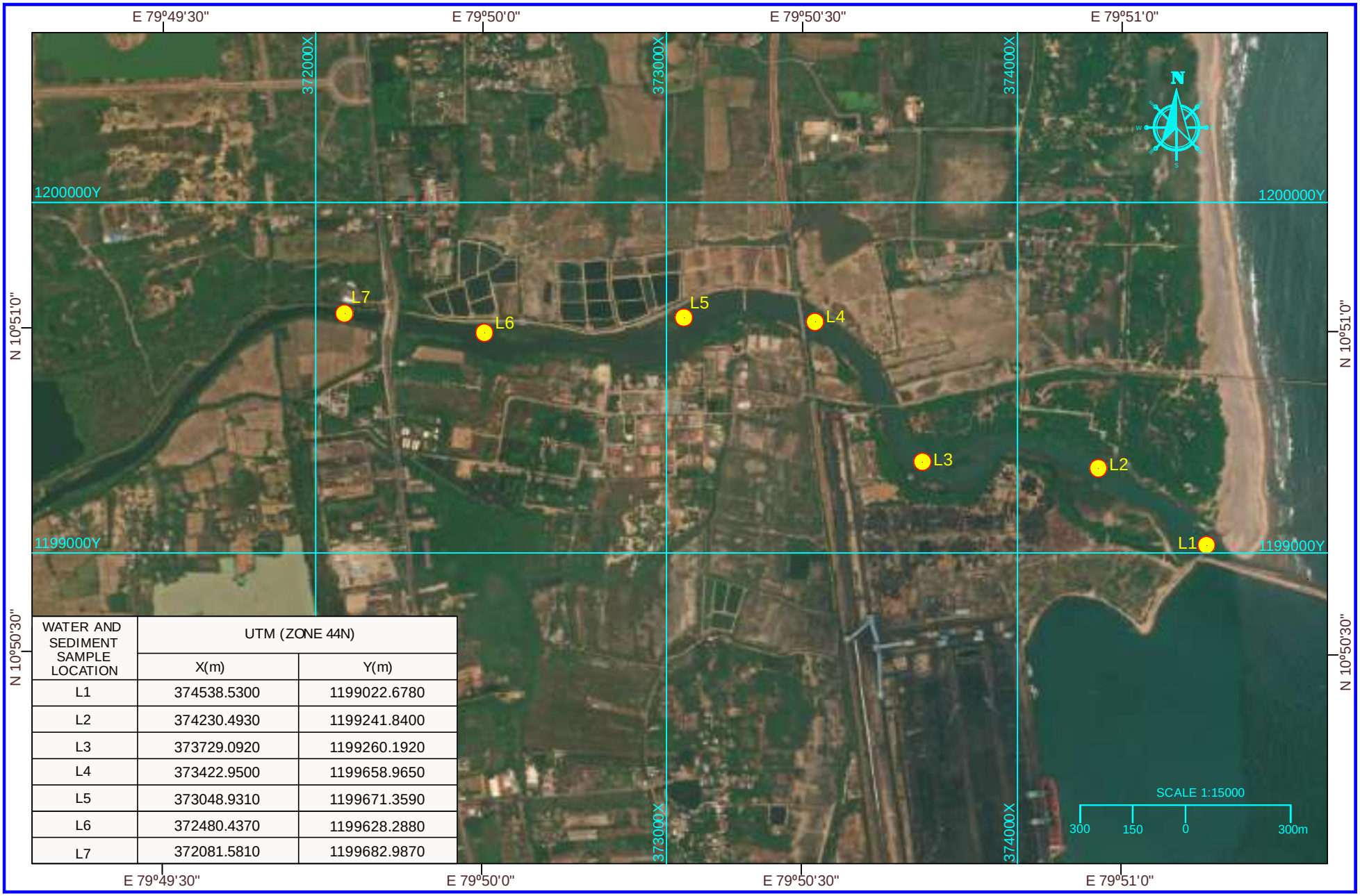
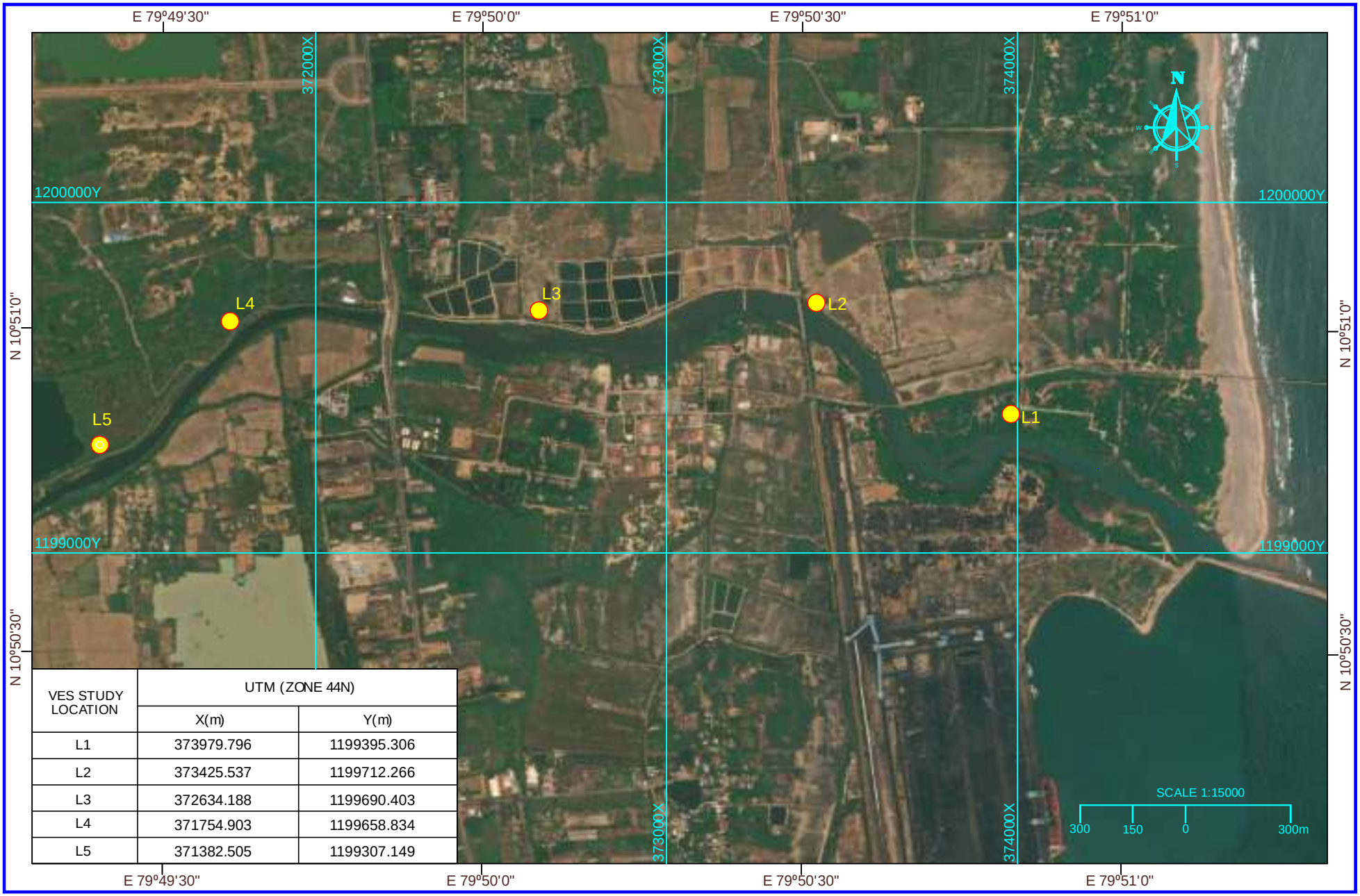


Fig. 4. Planned lines for Bathymetry Survey



WATER AND SEDIMENT SAMPLE LOCATION	UTM (ZONE 44N)	
	X(m)	Y(m)
L1	374538.5300	1199022.6780
L2	374230.4930	1199241.8400
L3	373729.0920	1199260.1920
L4	373422.9500	1199658.9650
L5	373048.9310	1199671.3590
L6	372480.4370	1199628.2880
L7	372081.5810	1199682.9870

Fig.6. Water and sediment sample location



VES STUDY LOCATION	UTM (ZONE 44N)	
	X(m)	Y(m)
L1	373979.796	1199395.306
L2	373425.537	1199712.266
L3	372634.188	1199690.403
L4	371754.903	1199658.834
L5	371382.505	1199307.149

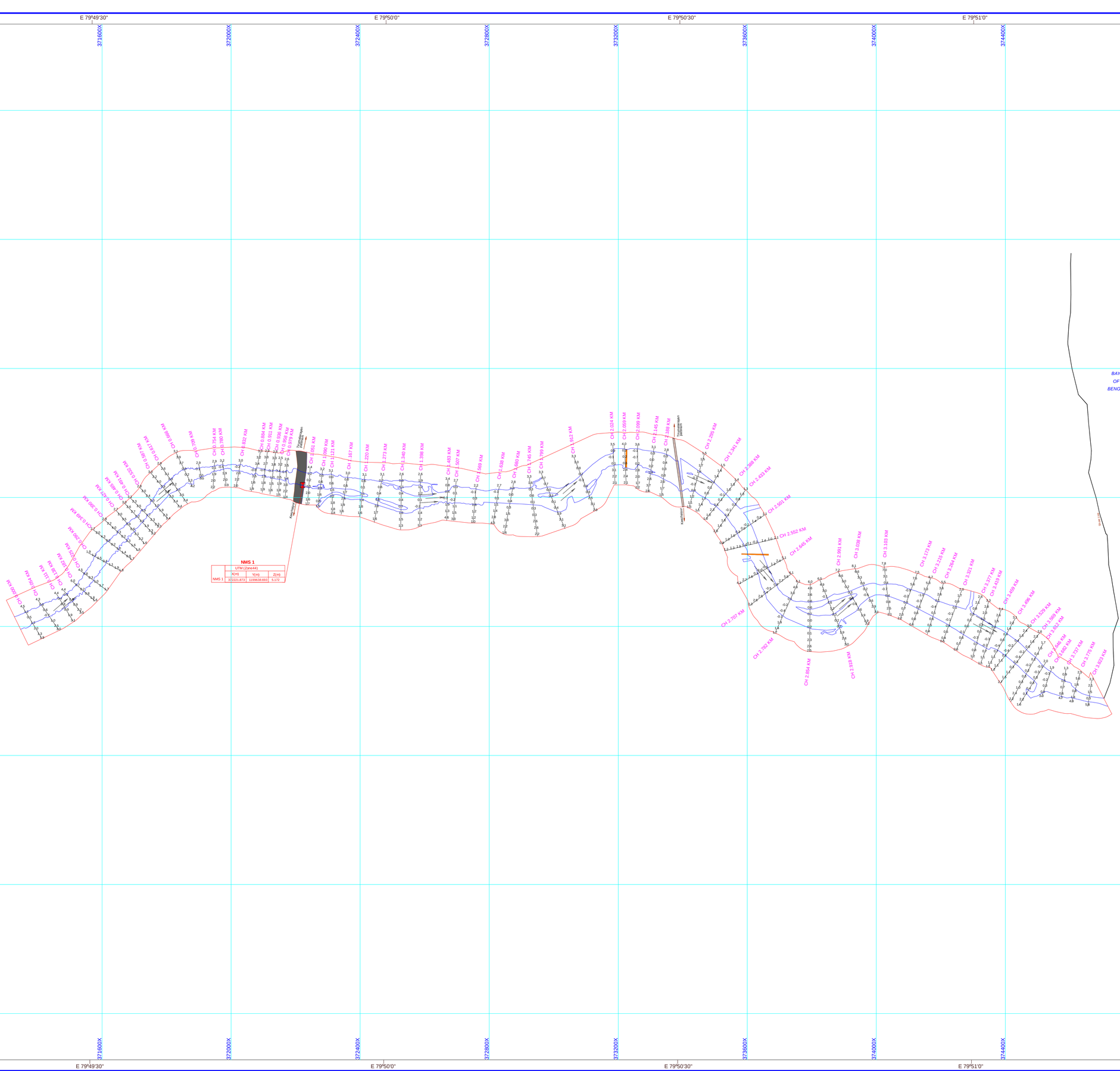
Fig.6. Location of Vertical Electrical Sounding (VES) - Salt water intrusion study

E 79°49'30" E 79°50'0" E 79°50'30" E 79°51'0" E 79°51'30"

N 10°51'30" N 10°51'10" N 10°50'30"

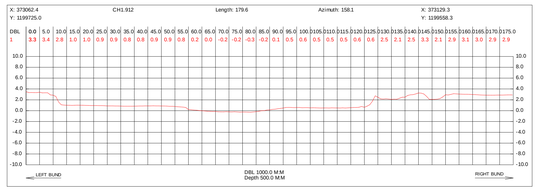
370800X 371200X 371600X 372000X 372400X 372800X 373200X 373600X 374000X 374400X 374800X 375200X

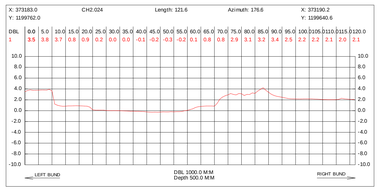
1200800Y 1200400Y 1200000Y 1199600Y 1199200Y 1198800Y 1198400Y 1198000Y

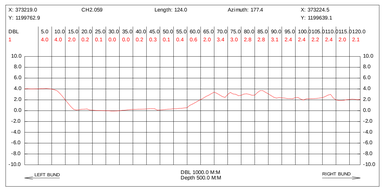


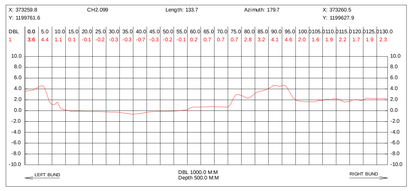
CLIENT	DRAWING TITLE	SURVEYED BY	SCALE	SEASON	SHEET No. 01 of 02	PIC NO	REV.
FALCON RESILIENT INFRA CONSULTANTS	CROSS SECTION OF KAKKAYAL RIVER CHAINAGE : CH 0.000 Km TO CH 1.799 Km	NISVO MARINE SURVEYS LLP CHENNAI - 600045 marsis@nisvocom www.nisvo.com	HOR. 1:500 VER. 1:50	JAN 2026		PIC NO	0

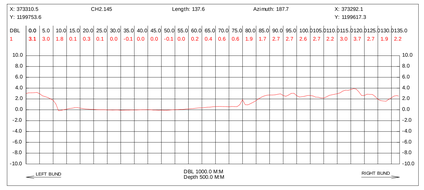
KEY MAP
NOT IN SCALE
RIVER FLOW
PROPOSED RETAINING WALL
PROPOSED RETAINING WALL
PROPOSED RETAINING WALL

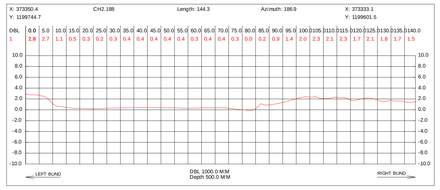


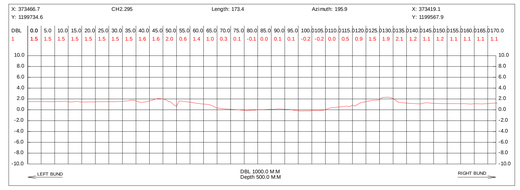


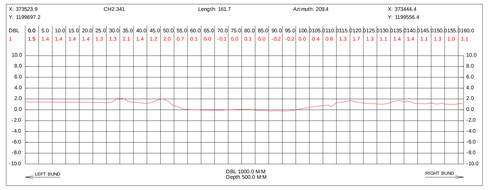


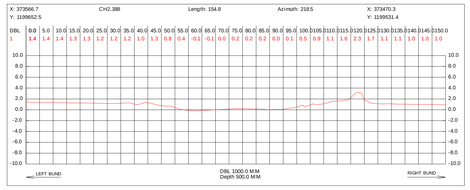


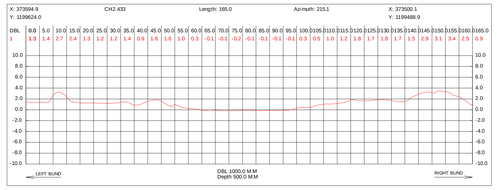


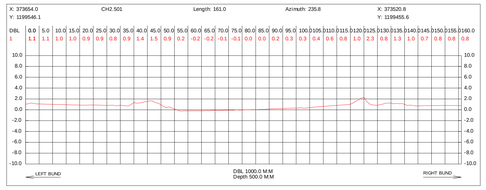


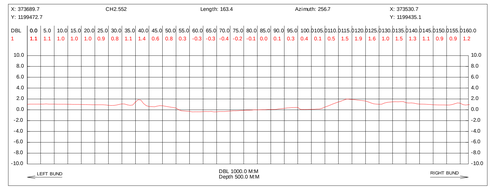


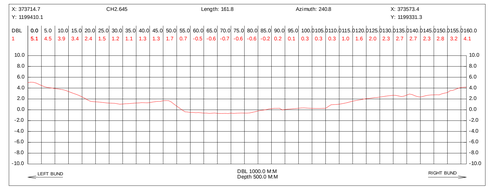


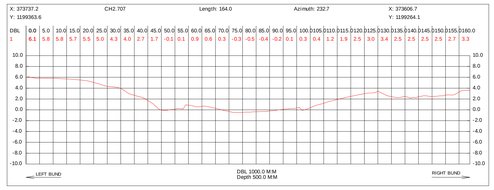


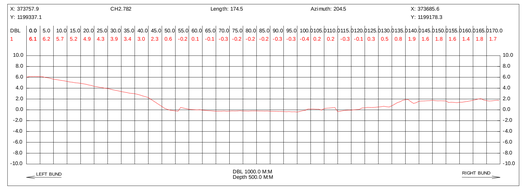


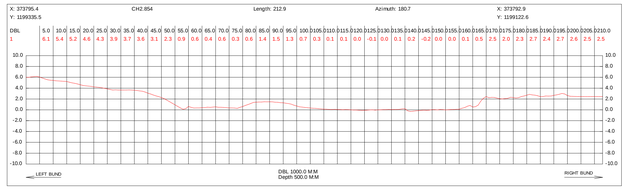


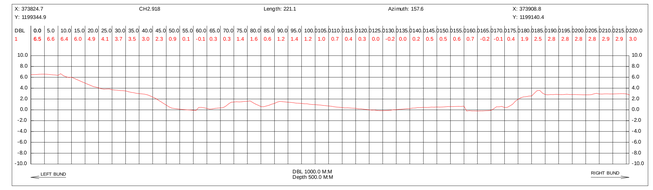


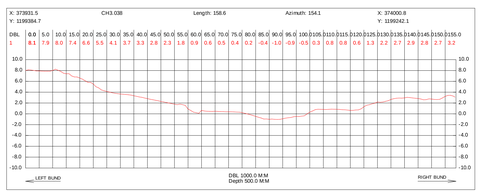


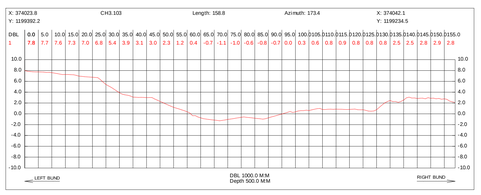


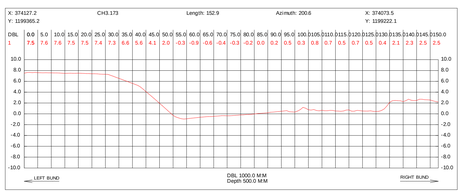


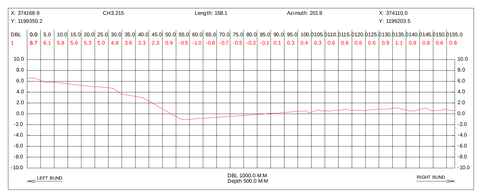


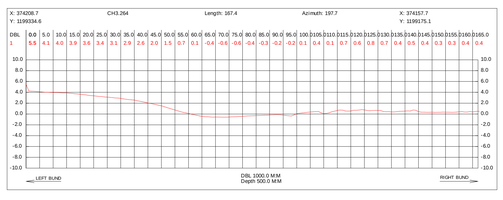


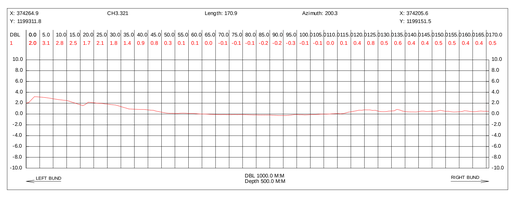


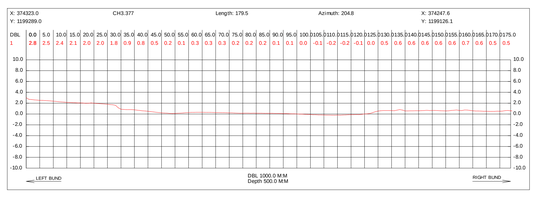


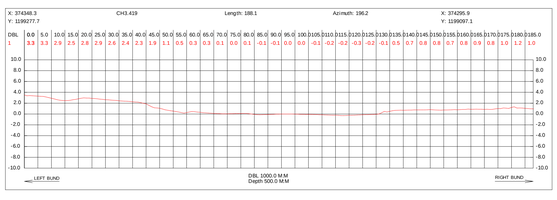


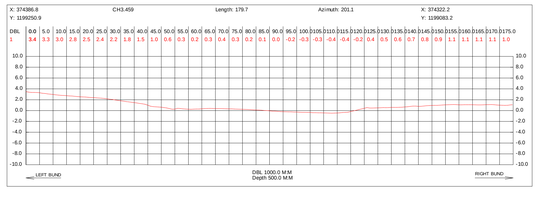


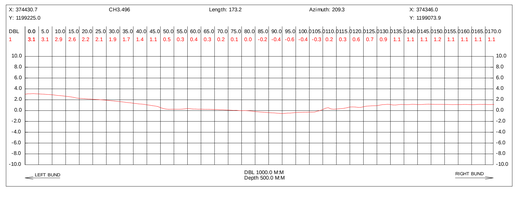


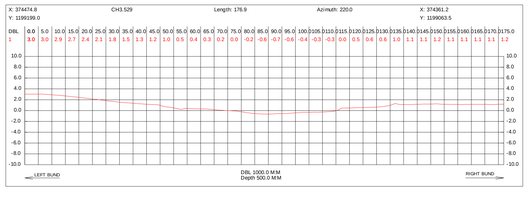


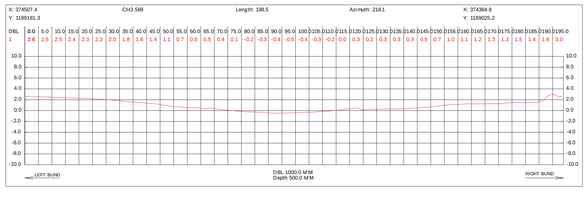


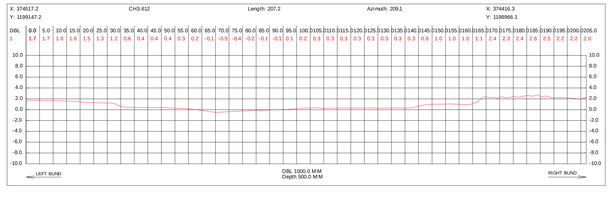


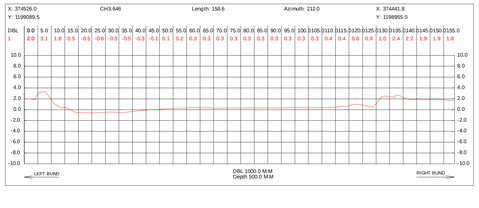


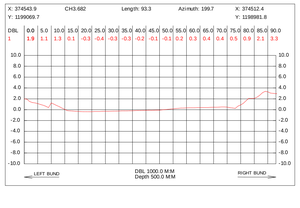


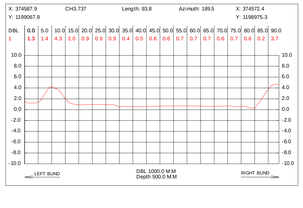


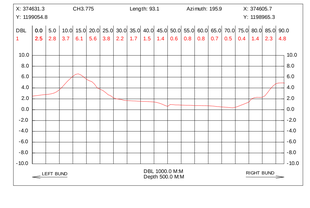


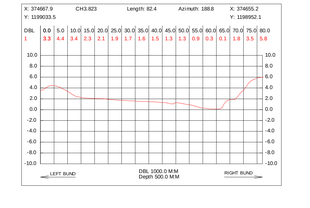












CLIENT: FALCON RESILIENT INFRA CONSULTANTS	DRAWING TITLE: CROSS SECTION OF KARIKAL RIVER CHAINAGE : CH 1.912 km TO CH 3.823 km	SURVEYED BY: NISVO MARINE SURVEYS LLP CHENNAI - 600045 projects@nisvo.com www.nisvo.com	SCALE: HOR. 1:1000 VER. 1:500	SEASON: JAN 2026	FIG NO: FIG.9 / REV.: 0
				SHEET No. 02 of 02	

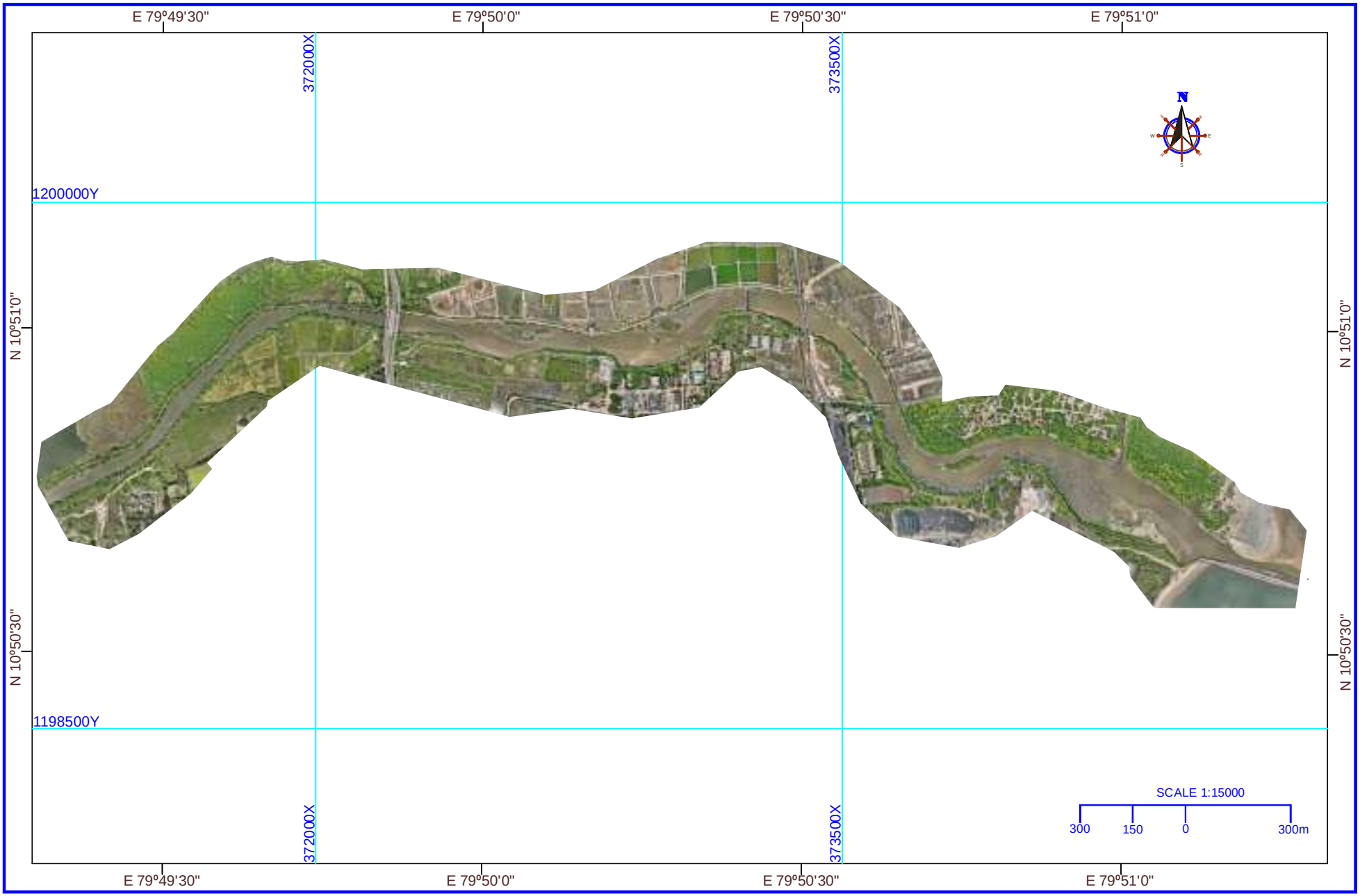


Fig. 10. Orthomosaic Map based on UAV (Unmanned Aerial Vehicle) Topographic survey

LAND USE LAND COVER CLASSIFICATION

371200E 371400E 371600E 371800E 372000E 372200E 372400E 372600E 372800E 373000E 373200E 373400E 373600E 373800E 374000E 374200E 374400E 374600E 374800E

1200200N 1200000N 1199800N 1199600N 1199400N 1199200N 1199000N 1198800N 1198600N 1198400N 1198200N 1198000N 1197800N

N

LEGEND

- AGRICULTURAL LAND
- SETTLEMENTS
- EYOT
- RAILWAY LINE
- ROAD
- AQUACULTURE
- INDUSTRIAL ZONE
- KARAIKAL PORT
- TREES COVER AREA
- RURAL ROAD
- BRIDGE
- MAN MADE CHANNEL
- NATURAL STREAM
- BARREN LAND
- TIDAL FLATS_FLOODPLAINS
- WATER BODIES
- RIVER
- SERVICE ROAD
- BREAKWATER
- THORN FOREST_WASTELAND
- OCEAN
- SURVEY REGION

70 0 70 140 210 280 m

SCALE 1:3500

COORDINATE SYSTEM : WGS 84 / UTM zone 44N

ANNEXURES

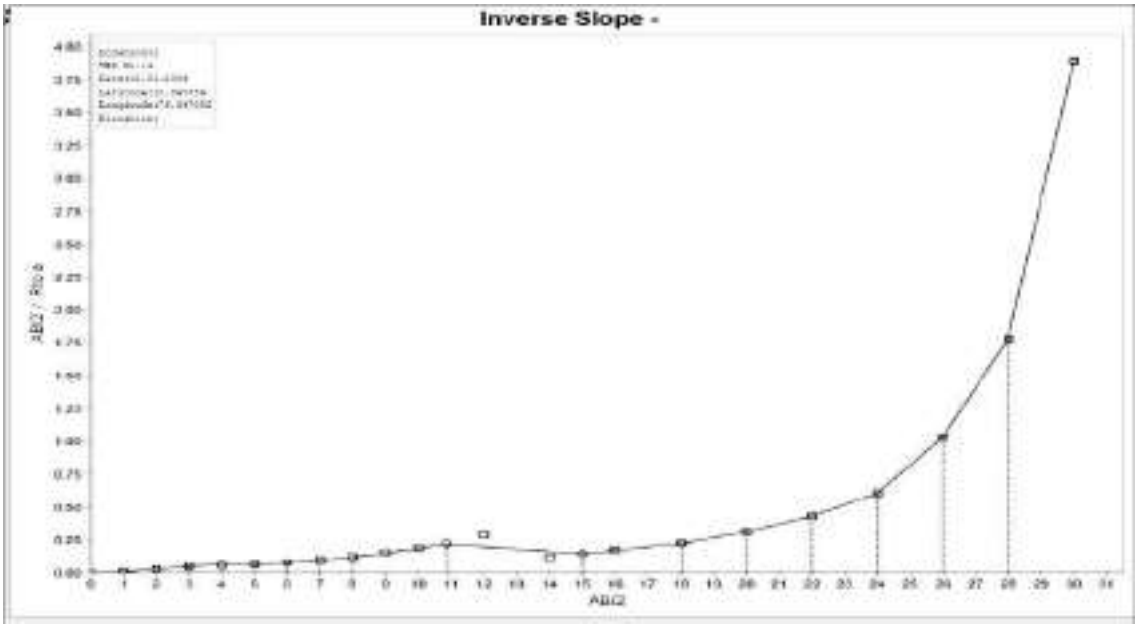
ANNEXURE I

(*Analysis of the electrical resistivity tomography data***)**

Electrical Resistivity test- Data sheet

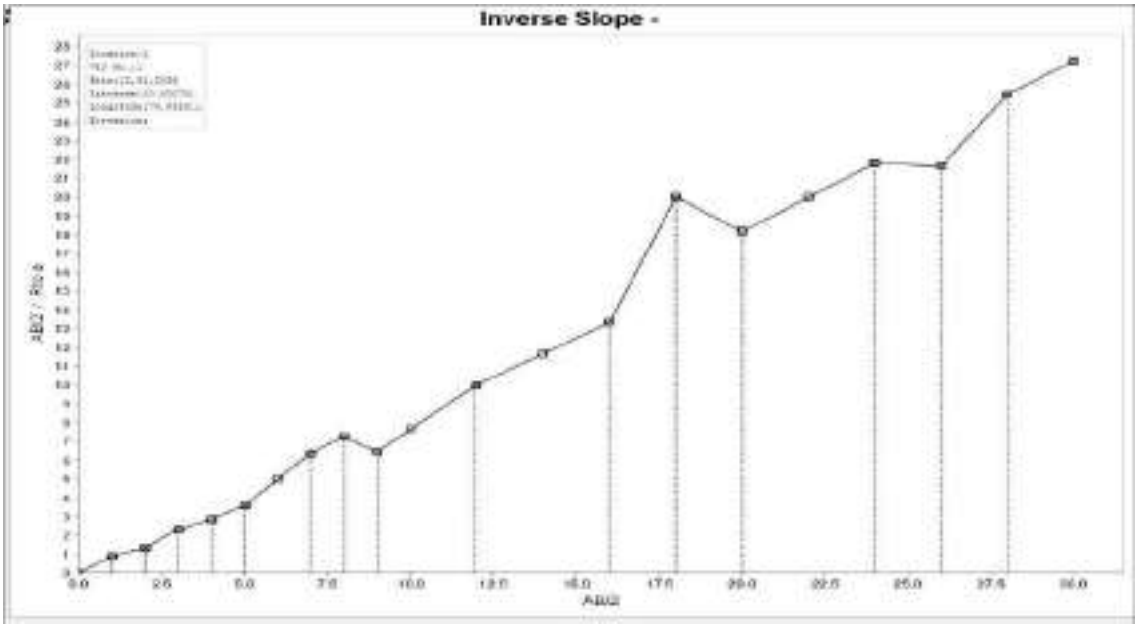
Location: 1 (10.847854N, 79.847092E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	19.080	119.88
2.0	2.0	12.57	6.070	76.28
3.0	3.0	18.85	3.290	62.02
4.0	4.0	25.13	2.660	66.85
5.0	5.0	31.42	2.330	73.20
6.0	6.0	37.70	1.974	74.42
7.0	7.0	43.98	1.618	71.16
8.0	8.0	50.27	1.313	66.00
9.0	9.0	56.55	1.015	57.40
10.0	10.0	62.83	0.833	52.34
12.0	12.0	75.40	0.543	40.94
14.0	14.0	87.96	1.358	119.46
16.0	16.0	100.53	0.921	92.59
18.0	18.0	113.10	0.712	80.53
20.0	20.0	125.66	0.506	63.59
22.0	22.0	138.23	0.370	51.15
24.0	24.0	150.8	0.262	39.5
26.0	26.0	163.4	0.154	25.2
28.0	28.0	175.9	0.089	15.7
30.0	30.0	188.5	0.041	7.7



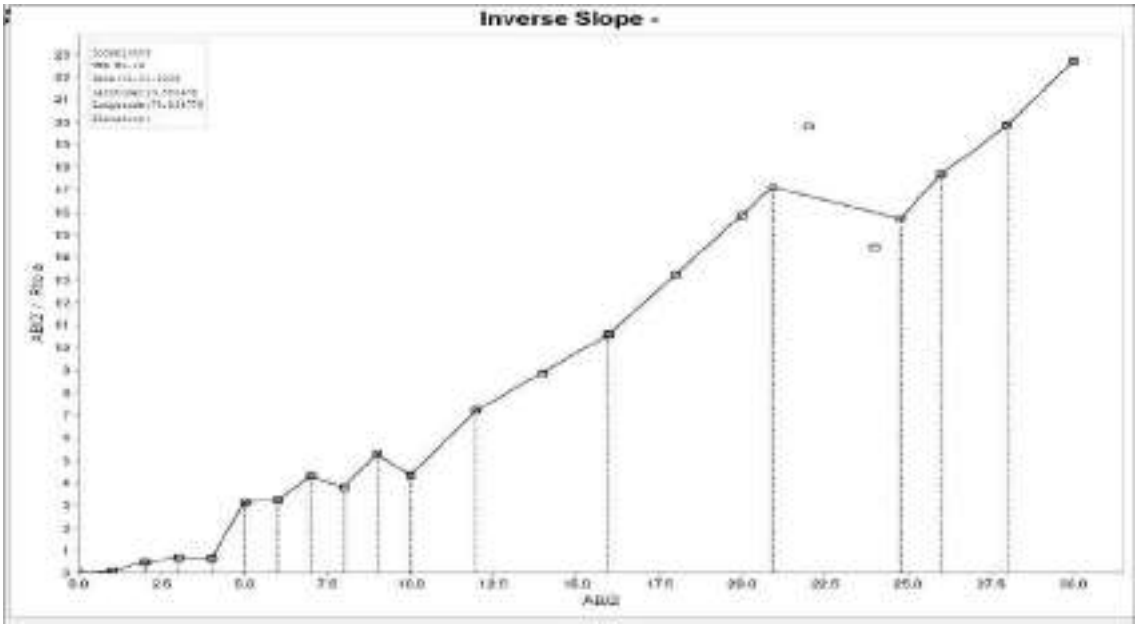
Location: 2 (10.850701N, 79.842011E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	0.175	1.1
2.0	2.0	12.57	0.119	1.5
3.0	3.0	18.85	0.071	1.3
4.0	4.0	25.13	0.057	1.4
5.0	5.0	31.42	0.043	1.4
6.0	6.0	37.70	0.031	1.2
7.0	7.0	43.98	0.026	1.1
8.0	8.0	50.27	0.022	1.1
9.0	9.0	56.55	0.024	1.4
10.0	10.0	62.83	0.011	0.7
12.0	12.0	75.40	0.015	1.1
14.0	14.0	87.96	0.014	1.2
16.0	16.0	100.53	0.012	1.2
18.0	18.0	113.10	0.008	0.9
20.0	20.0	125.66	0.009	1.1
22.0	22.0	138.23	0.008	1.1
24.0	24.0	150.8	0.007	1.1
26.0	26.0	163.4	0.010	1.6
28.0	28.0	175.9	0.007	1.2
30.0	30.0	188.5	0.006	1.1



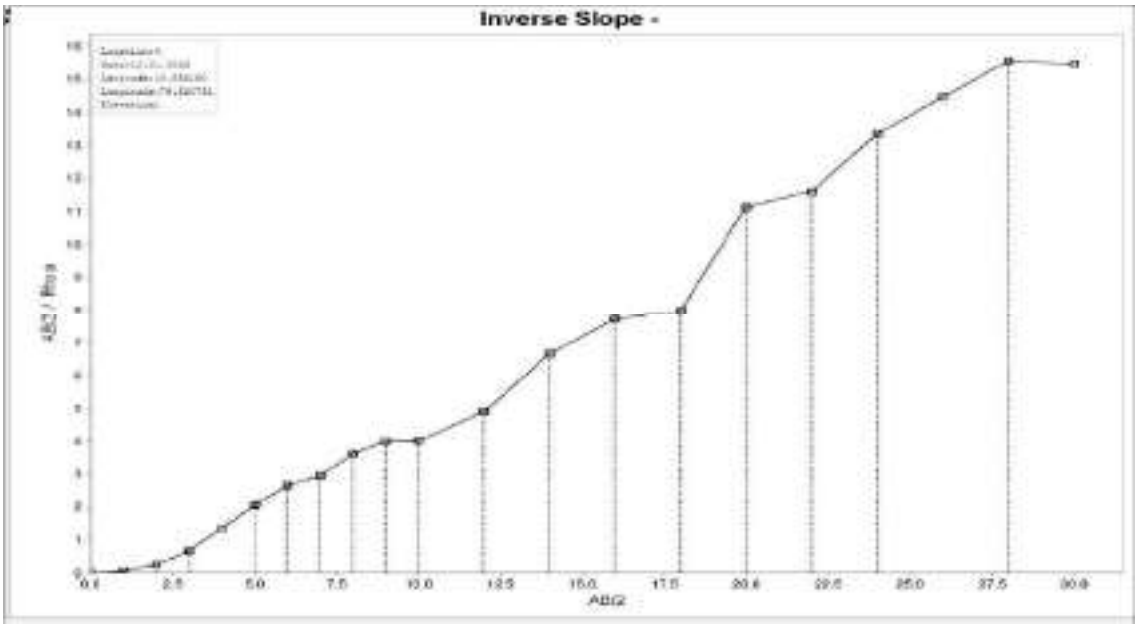
Locaion: 3 (10.850476N, 79.834773E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	2.200	13.82
2.0	2.0	12.57	0.334	4.20
3.0	3.0	18.85	0.231	4.35
4.0	4.0	25.13	0.247	6.21
5.0	5.0	31.42	0.051	1.60
6.0	6.0	37.70	0.049	1.85
7.0	7.0	43.98	0.037	1.63
8.0	8.0	50.27	0.042	2.11
9.0	9.0	56.55	0.030	1.70
10.0	10.0	62.83	0.037	2.32
12.0	12.0	75.40	0.022	1.66
14.0	14.0	87.96	0.018	1.58
16.0	16.0	100.53	0.015	1.51
18.0	18.0	113.10	0.012	1.36
20.0	20.0	125.66	0.010	1.26
22.0	22.0	138.23	0.008	1.11
24.0	24.0	150.8	0.011	1.66
26.0	26.0	163.4	0.009	1.47
28.0	28.0	175.9	0.008	1.41
30.0	30.0	188.5	0.007	1.32



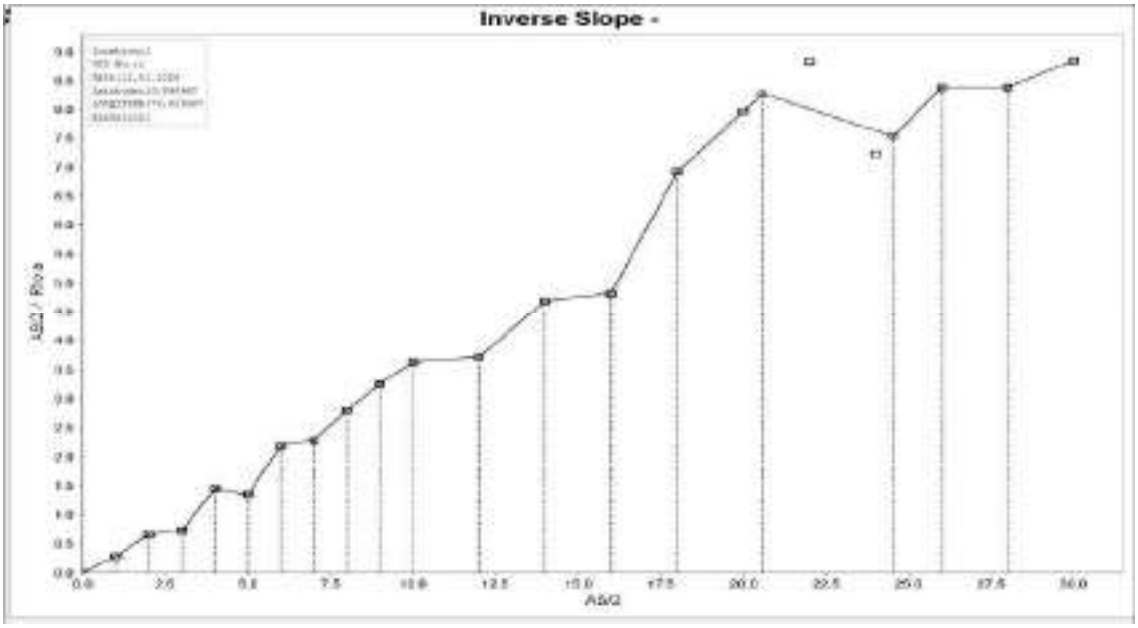
Location: 4 (10.850160N, 79.826731E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	4.370	27.46
2.0	2.0	12.57	0.659	8.28
3.0	3.0	18.85	0.236	4.45
4.0	4.0	25.13	0.118	2.97
5.0	5.0	31.42	0.078	2.45
6.0	6.0	37.70	0.060	2.26
7.0	7.0	43.98	0.054	2.38
8.0	8.0	50.27	0.044	2.21
9.0	9.0	56.55	0.040	2.26
10.0	10.0	62.83	0.036	2.26
12.0	12.0	75.40	0.033	2.49
14.0	14.0	87.96	0.028	2.46
16.0	16.0	100.53	0.021	2.11
18.0	18.0	113.10	0.017	1.92
20.0	20.0	125.66	0.018	2.26
22.0	22.0	138.23	0.013	1.80
24.0	24.0	150.8	0.020	3.02
26.0	26.0	163.4	0.011	1.80
28.0	28.0	175.9	0.011	1.94
30.0	30.0	188.5	0.010	1.88



Location: 5 (10.846967N, 79.823337E)

A (m)	Depth (m)	2πA	r (Ω)	ρ = 2πAR (Ωm)
1.0	1.0	6.28	0.561	3.52
2.0	2.0	12.57	0.242	3.04
3.0	3.0	18.85	0.218	4.11
4.0	4.0	25.13	0.110	2.76
5.0	5.0	31.42	0.118	3.71
6.0	6.0	37.70	0.073	2.75
7.0	7.0	43.98	0.070	3.08
8.0	8.0	50.27	0.057	2.87
9.0	9.0	56.55	0.049	2.77
10.0	10.0	62.83	0.044	2.76
12.0	12.0	75.40	0.043	3.24
14.0	14.0	87.96	0.034	2.99
16.0	16.0	100.53	0.033	3.32
18.0	18.0	113.10	0.023	2.60
20.0	20.0	125.66	0.020	2.51
22.0	22.0	138.23	0.018	2.49
24.0	24.0	150.8	0.022	3.32
26.0	26.0	163.4	0.019	3.10
28.0	28.0	175.9	0.019	3.34
30.0	30.0	188.5	0.018	3.39



NISVO MARINE SURVEYS LLP

COMPARISON REPORT

Comparison Report of Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek Between 2025 and 2026

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www.nisvo.com

COMPARISON REPORT OF REPLENISHMENT AND SALTWATER INTRUSION STUDIES AT PURAVADAIYANAR RIVER/CREEK BEFORE AND AFTER THE MONSOON (VOLUME III)

Prepared by

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Client	:	**Falcon Resilient Infra Consultant**
Project Title	:	Comparison report of replenishment and saltwater intrusion studies at Puravadaiyanar river/creek before and after the monsoon (Volume III)
Project Code	:	202601_382
Reference	:	\\NISVOSERVER\2025\202506_0382 - CARRYING OUT REPLENISHMENT AND SALTWATER INTRUSION STUDIES AT PURAVADAIYANAR RIVER/ CREEK AFTER AND AFTER MONSOON NEAR KARAIKAL PORT, PUDUCHERRY

ABSTRACT:

Falcon Resilient Infra Consultant has intended to conduct Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/ Creek before and after monsoon near Karaikal Port, Puducherry. To facilitate this, Falcon Resilient Infra Consultant has requested to **M/s. NISVO MARINE SURVEYS LLP** to conduct the required Replenishment and Saltwater Intrusion Studies in reference to the work order provided (Work Order No: 014-C24017-SRV-L-NM WO June 20,2025). Accordingly, the Replenishment and Saltwater Intrusion Studies were carried out during the pre-monsoon period (Volume I) from 30.06.2025 to 18.07.2025 and during the post-monsoon period (Volume II) from 07.01.2026 to 19.01.2026. The present report (Volume III) presents the comparative analysis of the results obtained during both monsoon periods

This project, titled "Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the Monsoon" includes a comparative study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and seawater intrusion studies for both pre- and post-monsoon periods. Accordingly, the report is divided into three volumes, namely Volume I, Volume II, and Volume III.

The Volume I report, titled "Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before the monsoon near Karaikal Port, Puducherry (Volume I)" includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and seawater intrusion studies for the pre-monsoon.

The Volume II report, titled "Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek after the monsoon near Karaikal Port, Puducherry (Volume II)" includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and seawater intrusion studies for the post-monsoon.

The Volume III report, titled "Comparison Report of Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the monsoon" includes results and conclusions based on a comparison of the differences between the pre- and post-monsoon periods.

This report provides an overview of the Replenishment and Saltwater Intrusion Studies conducted within the designated survey area, encompassing a range of methodologies and corresponding findings.

Date	Document		Originator	Checked by	Approved by
	Interim				
	Draft				
19.02.2026	Final	✓	Dr. S. Balasingh	S.G. Singh	Dr. Mani
	Methodology				

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Text Page	:	**32**
Figures	:	**02**

CONTENT

Contents					Page
Contents					1
List of Table					3
Abbreviations					4
1.	**INTRODUCTION**				6
	1.1	General			6
	1.2.	Replenishment and Salt-water Intrusion			6
		1.2.1.	Replenishment Study		6
		1.2.2.	Saltwater Intrusion Study		6
2	**STUDY AREA**				8
	2.1.	Geographic Location and Regional Setting			8
	2.2.	Climatic Conditions			8
	2.3.	Geology and Geomorphology			8
3	**MATERIALS AND METHOD**				9
	3.1.	Survey Controls			9
		3.1.1.	Specifications and Standards		9
		3.1.2.	Coordinate Systems		9
		3.1.3.	Horizontal and Vertical Control		10
	3.2.	Replenishment Study			10
		3.2.1	Terrain Analysis		10
			3.2.1.1.	Aerial Topography Survey	10
			3.2.1.2.	Single-beam Bathymetry Survey	10
		3.2.2.	Hydrodynamic Studies		11
		3.2.3.	Physico-Chemical Assessment of water and sediment		11
	3.3.	Saltwater Intrusion			11
	3.4.	Summary of Methodological Consistency			11
4.	**RESULTS**				12
	4.1.	Comparison Results for Replenishment and Saltwater Intrusion Studies (Pre-monsoon Vs Post- monsoon)			12
		4.1.1.	Comparative Study: Pre- monsoon and Post- Monsoon Topography and Bathymetry surveys		12

		4.1.2.	Hydrodynamic Studies	12
		4.1.3.	Replenishment Characteristics	13
		4.1.4.	Physico- Chemical Assessment of Water and Sediment	14
	4.2.	Saltwater Intrusion		24
		4.2.1.	Comparative Results (Pre-monsoon Vs Post- monsoon)	24
5.	**OVERALL SUMMARY**			28
6.	**CONCLUSION**			29
7.	**RECOMMENDATIONS**			31

LIST OF TABLES

Table	Title
1.	Differences in Water Sample Characteristics between Pre-Monsoon and Post-Monsoon Periods
2.	Differences in Sediment Sample Characteristics between Pre-Monsoon and Post-Monsoon Periods
3.	Location-wise Comparison of Saline Intrusion Depths (Pre- and Post-Monsoon)
4.	Comparative Evaluation of Saline Water Intrusion Behaviour at Study Locations

ABBREVIATIONS

WGS	World Geodetic System
UTM	Universal Transverse Mercator
km	Kilometer
DMS	Degrees/Minutes/Seconds
DD	Decimal Degrees
N	Northing
E	Easting
m	Metre
cumec	Cubic Metre
MCM	Million Cubic Meters
SI	System International Units
ft	Feet
w	Watt
v	Volt
USB	Universal Serial Bus
MSL	Mean Sea Level
RTK	Real-time kinematic
GSM	Global System for Mobile communication
DGPS	Differential Global Positioning Systems
PDOP	Positional Dilution of Precision
XTF	Extended Triton Format
KVA	Kilo-volt-amperes
AC	Alternating Current
kHz	Kilohertz
MHz	Megahertz
LULC	Land Use Land Cover Classification

1. INTRODUCTION

1.1. General

Falcon Resilient Infra Consultant (FRICS) is a nascent firm founded by experienced engineers specializing in environmental engineering, master planning, infrastructure planning and financial analysis. The company delivers professional services in ports, marine structures, roads, highways, thermal power plants, industrial parks and the building sector. F` provided tailored infrastructure solution across all stages of the project life cycle for both small businesses and large enterprises. The organization is accredited by QCI-NABET as an EIA Consultant. This accreditation authorizes FRICS to conduct EIA studies and obtain environmental clearances under Ministry of Environment, Forest and Climate Change (MoEFC) guidelines.

Falcon Resilient Infra Consultant has intended to conduct Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/ Creek before and after monsoon near Karaikal Port, Puducherry. To facilitate this, Falcon Resilient Infra Consultant has requested to **M/s. NISVO MARINE SURVEYS LLP** to conduct the required Replenishment and Saltwater Intrusion Studies in reference to the work order provided (Work Order No: 014-C24017-SRV-L-NM WO June 20,2025). Accordingly, the Replenishment and Saltwater Intrusion Studies were carried out during the pre-monsoon period (Volume I) from 30.06.2025 to 18.07.2025 and during the post-monsoon period (Volume II) from 07.01.2026 to 19.01.2026. The present report (Volume III) presents the comparative analysis of the results obtained during both monsoon periods.

This project, titled *"Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the Monsoon,"* includes a comparative study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and saltwater intrusion studies for both pre- and post-monsoon periods. Accordingly, the report is divided into three volumes, namely Volume I, Volume II, and Volume III.

The Volume I report, titled *"Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before the monsoon near Karaikal Port, Puducherry (Volume I)"* includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of water and sediments, and saltwater intrusion studies for the pre-monsoon.

The Volume II report, titled *"Carrying out Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek after the monsoon near Karaikal Port, Puducherry (Volume II)"* includes a study of terrain analysis, hydrodynamic studies, physico-chemical assessment of

water and sediments, and saltwater intrusion studies for the post-monsoon.

The Volume III report, titled *"Comparison Report of Replenishment and Saltwater Intrusion Studies at Puravadaiyanar River/Creek before and after the monsoon"* includes results and conclusions based on a comparison of the differences between the pre- and post-monsoon periods.

1.2. Replenishment and Salt-water Intrusion

1.2.1. Replenishment Study

Replenishment in estuarine and riverine systems refers to the natural and seasonal processes through which freshwater inflows, sediment supply, and associated nutrient dynamics restore and sustain the physical, chemical, and ecological balance of the waterbody. In monsoon-influenced environments such as the Puranvadaiyar River/Creek, these processes are predominantly governed by the interaction of seasonal river discharge, tidal influences, watershed runoff, and sediment transport mechanisms. Effective replenishment ensures the maintenance of channel morphology, supports aquatic habitats, and sustains water quality necessary for ecological health and socio-economic activities including agriculture, fisheries, and navigation.

The extent and efficiency of replenishment are influenced by a combination of natural drivers such as rainfall variability, catchment topography, river basin geomorphology, and hydrodynamic conditions and anthropogenic pressures including upstream water regulation, land-use change, dredging, and port-related activities. In this study, replenishment assessment was conducted through integrated terrain analysis, hydrodynamic evaluation, and Physico-chemical characterization of water and sediment across pre- and post-monsoon periods. Such an approach enables a comprehensive understanding of how seasonal inflows and sediment deposition contribute to the resilience and sustainability of the estuarine system, while also identifying factors that may hinder its natural regenerative capacity.

1.2.2. Saltwater Intrusion study

Estuarine environments are dynamic transition zones where freshwater from rivers mixes with marine waters, creating unique and highly productive ecosystems. These semi-enclosed coastal bodies of water serve as critical ecological buffers and support diverse biological communities, while also functioning as socio-economic hubs for human settlements, agriculture, fisheries, and industry. However, estuarine systems are increasingly threatened by the phenomenon of saltwater intrusion—a process in which saline ocean water advances into

freshwater riverine and groundwater systems, altering the salinity regime and impacting water quality.

Saltwater intrusion in estuaries is chiefly governed by physical processes such as tidal motion, the density difference between saltwater and river water, river discharge variability, and estuarine geomorphology. The extent and intensity of saltwater penetration are modulated by natural factors (e.g., sea-level rise, climatic variability, and hydrodynamic conditions) and anthropogenic pressures such as excessive groundwater extraction, river regulation, land reclamation, and channel modifications. The consequences of saltwater intrusion are profound: increased salinity degrades the quality of water resources for drinking, irrigation, and industrial uses; stresses estuarine flora and fauna; and alters sedimentation and nutrient cycling processes.

Saltwater intrusion into estuarine environments is a multidimensional, escalating global issue that demands integrated hydrogeochemical, hydrodynamic, and management approaches. Developing a robust understanding of intrusion processes not only supports sustainable water resource planning and ecosystem conservation but is also essential for adapting estuarine communities to ongoing climatic and anthropogenic changes.

2. STUDY AREA

2.1. Geographic Location and Regional Setting

The Puranvadaiyanar River is a distributary of the Cauvery River system flowing through the Karaikal district of the Union Territory of Puducherry, India. Originating from the Cauvery deltaic plains, the river traverses fertile agricultural lands before discharging into the Bay of Bengal near Karaikal Port. The study area for the replenishment and saltwater intrusion assessment comprises a stretch of the Puranvadaiyanar River located between latitudes 10°49′ N to 10°51′ N and longitudes 79°49′ E to 79°51′ E, covering an approximate area of 0.72 sq. km.

The geographic extent of the study area remains identical for both the pre-monsoon and post-monsoon surveys. The location maps and satellite imagery of the survey region are presented in the respective figures in Volume I (Pre-monsoon) and Volume II (Post-monsoon) reports and form the common spatial basis for the comparative analysis

2.2. Climatic Conditions

Karaikal experiences a tropical coastal climate, marked by: Annual mean temperature: Ranges from 26°C to 34°C, with peaks often reaching ~40°C in late spring and summer months, and minimums near 20°C in winter (December–January) periods. Rainfall: The area receives an average of 1,200mm annually, predominantly during the Northeast Monsoon (October–December). This seasonality is occasionally disrupted by cyclonic events in the Bay of Bengal that can deliver intense rainfall over short periods.

2.3. Geology and Geomorphology

The geology of the Karaikal region is dominated by Quaternary alluvial and deltaic sediments, comprising fine to coarse sands, silts, and clays—products of fluvial deposition by the Cauvery and its tributaries. The nearshore and estuarine areas are underlain by unconsolidated or semi-consolidated sediments, offering high permeability and consequently high hydraulic connectivity between the estuary, shallow aquifers, and the coastal margin. The terrain is largely flat and low-lying (generally <10m above mean sea level), with geomorphological features including flood basins, tidal flats, and minor saline marshes.

3. MATERIALS AND METHOD

In this study, a combination of field surveys, laboratory analysis and spatial assessment to evaluate the seasonal dynamic of the Puranvadaiyanar River/ Creek System. The methodology encompassed terrain analysis, Hydrodynamic measurements, Physio-chemical assessment of water & sediment and saltwater intrusion study. These approaches will be applied for both pre- and post-monsoon period to enable a comparative evaluation of seasonal variation.

3.1. Survey Controls

3.1.1. Specifications and Standards

Both surveys were conducted in accordance with the specifications outlined in the client's work order and applicable hydrographic and environmental survey standards. SI units were used throughout, and all observations were recorded following standardized field and reporting protocols.

3.1.2. Coordinate Systems

The WGS-84 datum with UTM Zone 44N projection was adopted for both pre- and post-monsoon surveys. This ensured uniform spatial referencing and seamless integration of datasets for comparative analysis.

3.1.3. Horizontal and Vertical Control

Horizontal and vertical control for both pre-monsoon and post-monsoon surveys was established using RTK-DGPS to ensure positional accuracy and consistency required for reliable comparative analysis. A common benchmark provided by Karaikal Port Pvt. Ltd. was used as the reference, allowing all bathymetric and topographic data to be tied to a single, stable control framework. Real-time DGPS corrections and quality checks (latency and PDOP) ensured high-precision data acquisition. In the absence of nearby standard benchmarks, the sounding datum was reliably transferred from Nagapattinam using simultaneous tidal observations, thereby maintaining datum continuity. Adoption of the same horizontal and vertical control for both survey periods eliminates positional bias and ensures that observed changes in bathymetry, hydraulics, and sediment dynamics genuinely reflect seasonal variations rather than survey inconsistencies.

3.2. Replenishment Study

3.2.1. Terrain Analysis

Terrain analysis during both survey periods comprised aerial topography surveys and single-beam bathymetry surveys. The spatial coverage, survey line spacing, and data processing workflows were kept identical to facilitate accurate detection of seasonal morphological changes.

3.2.1.1. Aerial Topography Survey

RTK-enabled UAV surveys were conducted during both pre- and post-monsoon periods covering the riverbanks and adjoining floodplain up to 50 m from the waterline. Identical UAV platforms, flight parameters, ground control point (GCP) density, and photogrammetric processing methods were employed to ensure consistency in derived Digital Elevation Models (DEM), DSM, and orthomosaics.

3.2.1.2. Single-beam Bathymetry Survey

Bathymetry surveys for both periods were conducted along fixed transects at 10 m intervals across the river channel. The same echo-sounder, DGPS configuration, and vessel setup were used, ensuring that observed variations in bed levels reflect true seasonal changes rather than methodological bias.

3.2.2. Hydrodynamic Studies

Hydrodynamic measurements, including flow velocity and discharge, were undertaken using identical methods during both survey periods. ADCP measurements were supplemented with float methods in shallow sections, ensuring continuity and comparability of hydrodynamic datasets.

3.2.3. Physico-Chemical Assessment of Water and Sediment

Water and sediment sampling locations, sampling protocols, and laboratory analysis methods were kept consistent between pre- and post-monsoon surveys. This enabled reliable assessment of seasonal variations in water quality and sediment characteristics

3.3. Saltwater Intrusion

Saltwater intrusion assessment using Electrical Resistivity Tomography (ERT) surveys was conducted using the same electrode configurations, profile locations, and interpretation techniques during both survey periods. This ensured that changes in subsurface salinity distribution could be attributed to seasonal hydrological conditions rather than survey methodology.

3.4. Summary of Methodological Consistency

Overall, the materials, methods, and survey controls adopted for the pre- and post-monsoon studies were maintained consistently across both phases. This methodological uniformity provides a robust basis for comparative evaluation of replenishment dynamics and saltwater intrusion patterns in the Puravadaiyanar River/Creek system.

4. RESULTS

4.1. Comparison Results for Replenishment and Saltwater Intrusion Studies (Pre-Monsoon vs Post-Monsoon)

4.1.1. Comparative Study: Pre-Monsoon and Post-Monsoon Topography & Bathymetry

The comparative analysis of pre-monsoon and post-monsoon topography and bathymetry surveys shows some seasonal variation in channel geometry and sediment dynamics within the study area.During the pre-monsoon period, the river exhibits a maximum width of approximately 125 m between cross-sections CH 1.799 km and CH 1.912 km, while the minimum width is about 22 m between CH 0.754 km and CH 0.780 km. In contrast, the post-monsoon survey shows a reduction in maximum river width to approximately 100 m between CH 1.398 km and CH 1.340 km, and a further narrowing of the minimum width to about 19 m between CH 0.491 km and CH 0.532 km, indicating channel adjustment due to monsoonal flow. The cross-sectional analysis of pre-monsoon and post-monsoon topographic and bathymetric surveys has been carried out using the collected topographic and bathymetric data for both periods. The comparison of cross-sections of the Karaikal River is illustrated in Figures **1 and 2**.

The overall bed gradient remains consistent at 1:100000 in both seasons, suggesting a stable longitudinal bed profile with a gradual slope and no significant long-term degradation or aggradation. However, sediment deposition patterns show a clear seasonal influence. While three sandbars were identified in both periods, their cumulative area increased from approximately 5,267 m^2 during the pre-monsoon to about 7,732 m^2 in the post-monsoon, reflecting enhanced sediment transport and deposition following monsoonal discharge. Overall, the comparative study demonstrates that monsoon flows primarily influence lateral channel geometry and sandbar development, while the longitudinal river morphology remains stable.

4.1.2. Hydrodynamic Studies

Flow Velocity and Discharge Measurement

The comparative evaluation of flow velocity and discharge measurements reveals pronounced seasonal variations in the hydrodynamic behaviour of the river. Flow measurements during both pre-monsoon and post-monsoon periods were carried out using an Acoustic Doppler Current Profiler (ADCP) at locations with adequate water depth, while the float-ball method was employed at shallow sections where ADCP deployment was not feasible. To maintain

methodological consistency, a continuous 12-hour observation, encompassing both ebb and flood tidal conditions near the river mouth, was conducted during both survey periods.

During the pre-monsoon season, the river exhibited a net seaward discharge of approximately 1.2 m^3/s, reflecting lower freshwater inflow, reduced flow velocity, and relatively greater flow depth. In contrast, the post-monsoon season recorded a higher net discharge of approximately 1.4 m^3/s, representing an increase of 0.2 m^3/s attributable to monsoonal runoff. This increase in discharge was accompanied by higher flow velocities and a relative reduction in flow depth, indicating improved channel conveyance resulting from sediment redistribution and hydraulic adjustment following replenishment. Overall, the comparative results confirm that seasonal hydrological inputs significantly influence discharge magnitude, flow velocity, and depth, while the net flow direction remains consistently seaward in both pre-monsoon and post-monsoon conditions.

4.1.3. Replenishment Characteristics

Phase-1 (Pre-Monsoon)

- River flow conditions were weak with limited freshwater availability.
- Channel bed and sediments exhibited low moisture content, indicating poor recharge.
- Reduced dilution capacity resulted in concentration of dissolved salts.
- Minimal sediment transport and absence of notable deposition features reflected low replenishment activity.

Phase-2 (Post- Monsoon)

- Monsoonal inflow significantly enhanced surface water availability and flow conditions.
- Increased sediment moisture content and formation of sand bars indicate active replenishment.
- Redistribution of fine sediments improved nutrient and moisture retention capacity.
- Overall, post-monsoon conditions demonstrate effective seasonal replenishment of the river system.

4.1.4. Physico-Chemical Assessment of Water and Sediment

Water Sample Analysis

A total of seven surface water and sediment samples were collected from various locations along the river during the pre-monsoon and post-monsoon seasons.

The differences in water sample characteristics between the pre-monsoon and post-monsoon periods are presented in tabular form below.

Sample	pH	EC	TSS	Turbidity	Nitrate	Fe	Mn	DO	COD	BOD	Phosphate	Nitrite	Pb	Hg	Cd	NH4	Chlorophyll-a
Unit	-	µS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
L1	0.15	408	7	26.3	_	-3.74	_	-0.6	-10	-2.4	_	0.329	_	BDL	BDL	BDL	0.15
L2	0.22	309	41	-35.6	_	7	0.05	-1	8	-3.5	_	_	_	BDL	BDL	BDL	0.22
L3	0.29	366	104	-47	_	8	0.162	-0.81	9	-0.1	_	0.41	_	BDL	BDL	BDL	0.29
L4	0.15	-692	-6	31.8	_	-2.08	0.162	-1.9	-13	-3	_	0.068	_	BDL	BDL	BDL	0.15
L5	0.24	-439	14	25.1	0.5	-1.98	0.058	-0.4	-2	0	_	0.013	_	BDL	BDL	BDL	0.24
L6	0.46	-414	8	22	_	-6.56	0.033	-0.2	9	2.4	_	0.11	0.169	BDL	BDL	BDL	0.46
L7	0.44	13	14.2	41.3	_	-5.46	_	-0.9	8	3	_	0.27	_	BDL	BDL	BDL	0.44

Table 1: Differences in Water Sample Characteristics between Pre-Monsoon and Post-Monsoon Periods

BDL – Below Detection Level

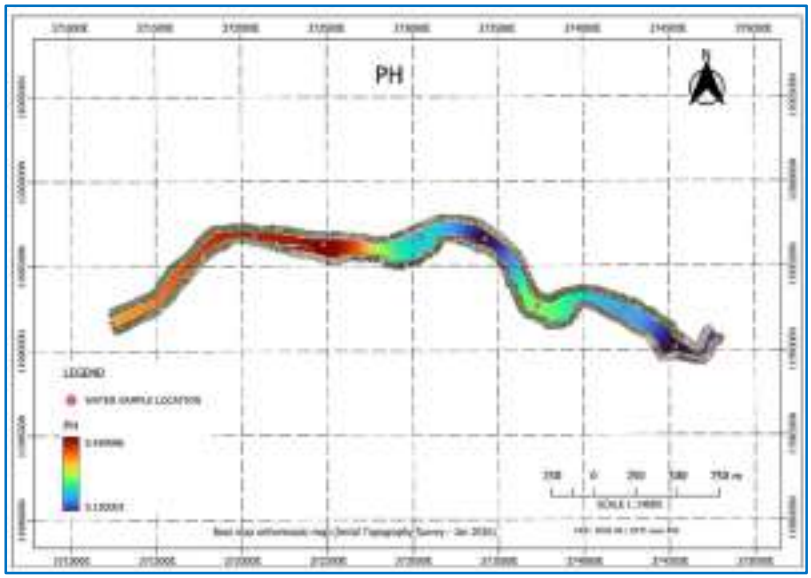
**** Negative values represent a decrease in the respective parameter.***

**** Positive values represent an increase in the respective parameter.***

- **pH**

Pre-monsoon pH values indicated slightly alkaline conditions, reflecting reduced freshwater inflow and higher ionic concentration. During the post-monsoon period, pH values remained within a similar alkaline range, but exhibited greater stability, indicating improved buffering due to freshwater replenishment and dilution effects.

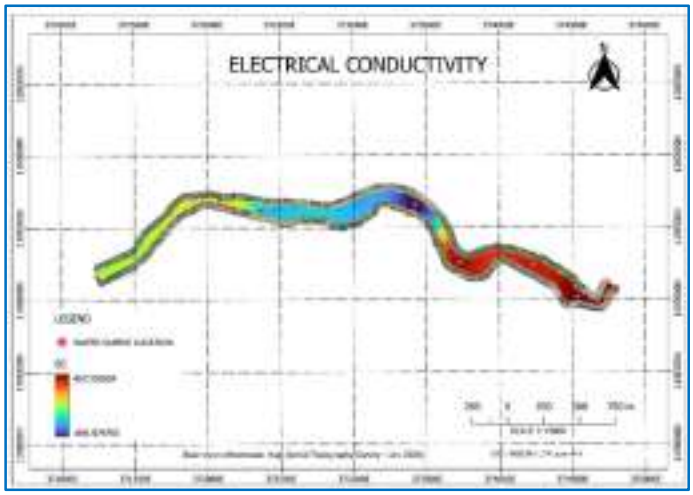
Inference: Monsoonal recharge stabilized pH conditions without causing major shifts.



- **Electrical Conductivity (EC)**

Pre-monsoon EC values were generally higher, indicating concentrated dissolved salts due to evaporation dominance and saline water influence. Post-monsoon EC values showed partial reduction at inland locations, reflecting freshwater dilution, although elevated EC persisted near the estuarine and coastal zones.

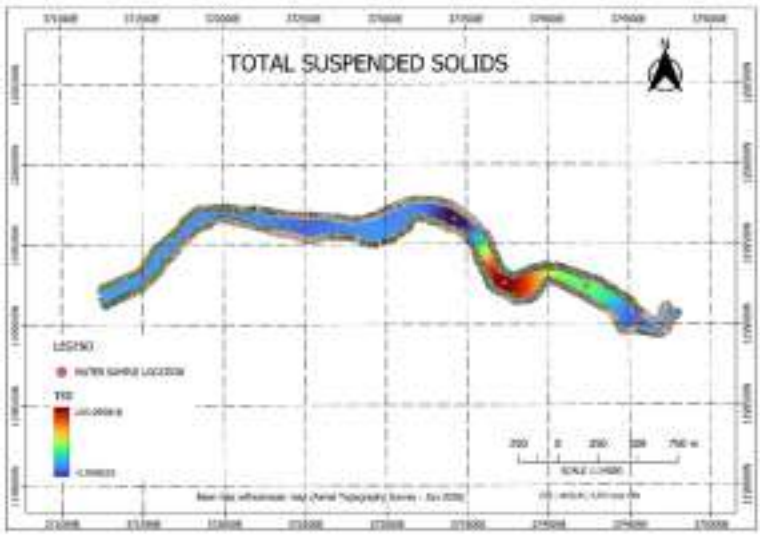
Inference: Replenishment reduced salinity intensity but did not eliminate saline influence.



- **Total Suspended Solids (TSS)**

TSS concentrations were relatively lower during pre-monsoon, reflecting limited flow and sediment transport. Post-monsoon TSS values increased significantly at several locations due to monsoon-induced runoff, channel erosion, and sediment transport.

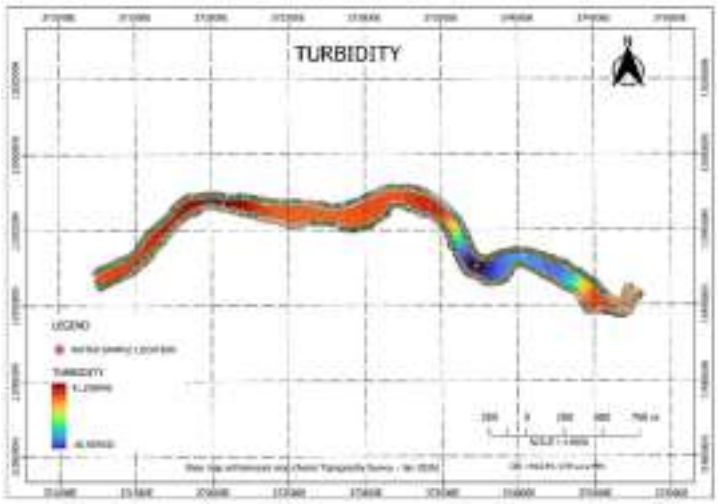
Inference: Increased TSS in post-monsoon indicates active hydrological replenishment and sediment mobilisation.



- **Turbidity**

Pre-monsoon turbidity was comparatively moderate, associated with stagnant conditions. Post-monsoon turbidity increased at several locations due to suspended sediments and organic matter influx.

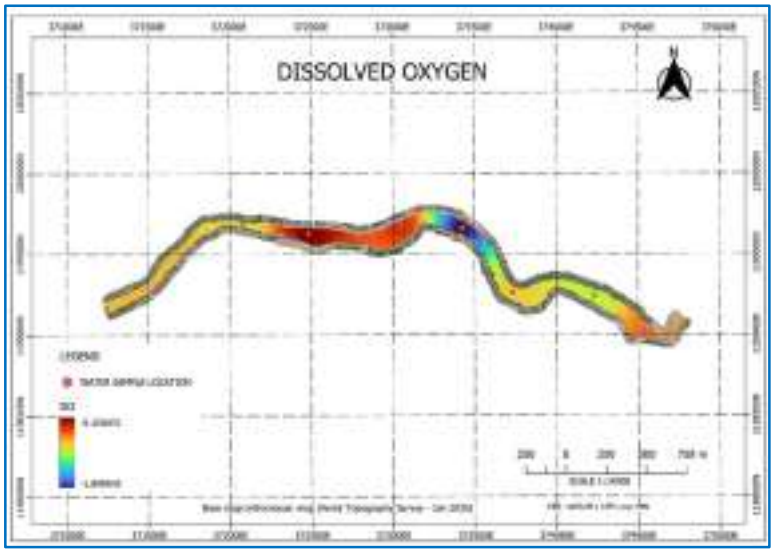
Inference: Elevated post-monsoon turbidity is a natural consequence of recharge and sediment movement.



- **Dissolved Oxygen (DO)**

Lower DO values during pre-monsoon reflected stagnant flow and organic accumulation. Post-monsoon DO levels improved across most locations due to enhanced flow, mixing, and aeration.

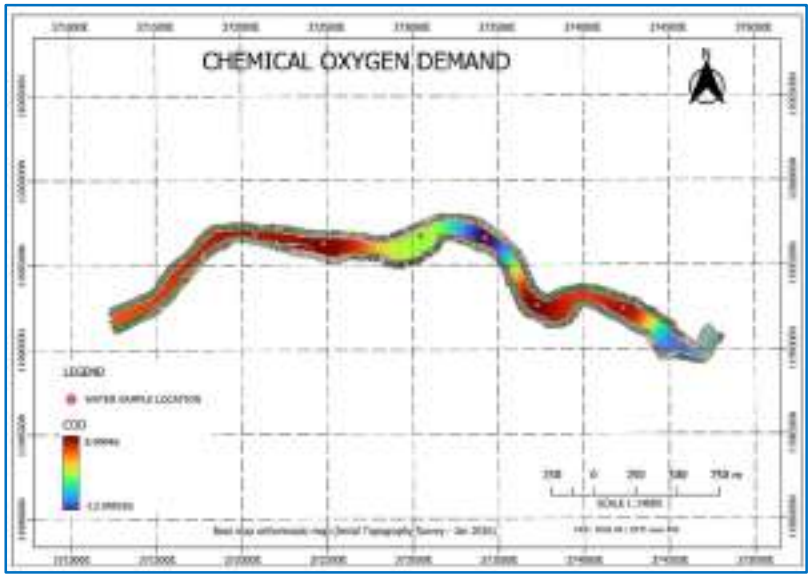
Inference: Replenishment significantly improved oxygen availability and aquatic health.



- **Chemical Oxygen Demand (COD)**

Pre-monsoon COD values were higher, indicating accumulation of oxidizable organic and inorganic matter. Post-monsoon COD values showed an overall reduction at several locations due to dilution and flushing effects.

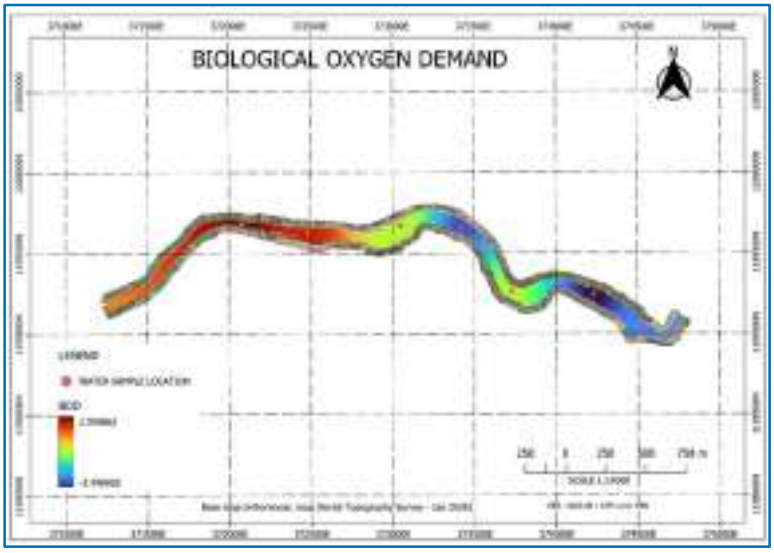
Inference: Improved water quality conditions after monsoon recharge.



- **Biochemical Oxygen Demand (BOD)**

Higher BOD values during pre-monsoon suggest greater biodegradable organic load under low-flow conditions. Post-monsoon BOD values declined at most locations, reflecting improved self-purification capacity of the system.

Inference: Replenishment reduced organic pollution stress.



- **Nutrients (Nitrate, Nitrite, Phosphate, Ammonium)**

Pre-monsoon: Most nutrient parameters were below detection limits, indicating limited external inputs.

Post-monsoon: Slight nitrate and nitrite presence at select locations suggests surface runoff contribution, while phosphate and ammonium largely remained below detection limits.

Inference: Nutrient levels increased marginally post-monsoon but remained within non-eutrophic conditions.

- **Metals (Fe, Mn, Pb, Hg, Cd)**

Iron and Manganese: Higher concentrations during post-monsoon reflect mobilisation from sediments and geogenic sources under changing redox conditions.

Lead, Mercury, Cadmium: Remained below detection limits in both seasons.

Inference: Seasonal variation affects Fe and Mn mobility, while toxic metals show no contamination concern.

- **Chlorophyll-a**

Pre-monsoon chlorophyll-a values indicated low phytoplankton productivity due to nutrient and freshwater limitation. Post-monsoon values increased slightly, indicating moderate phytoplankton growth supported by replenishment.

Inference: Monsoonal recharge enhances biological productivity without eutrophication risk.

Sediment sample analysis

A total of seven surface water and sediment samples were collected from various locations along the river during the pre-monsoon and post-monsoon seasons.

The differences in sediment sample characteristics between the pre-monsoon and post-monsoon periods are presented in tabular form below.

Sample	Sand	Silt	Clay	Bulk Density	Moisture	Organic Matter	Organic Carbon	Total Nitrogen	PO4	Fe	Cd	Ni	Cr	Zn	Pb	Mn	Texture	Hg
Unit	(%)	(%)	(%)	(g/cc)	(%)	(%)	(%)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	(mg/Kg)	-	(mg/Kg)
L1	-60.9	2.2	54.4	0.011	0.371	0.115	-0.304	699	_	746	BDL	-2.37	-0.878	0.004	2.42	110.81	_	BDL
L2	-60.1	2.3	60.8	0.028	0.73	0.442	0.294	713	_	-1401	BDL	0.923	-0.92	-4.366	_	136.925	_	BDL
L3	-16.5	2.3	13.9	0.008	0.463	0.542	0.474	700	3.72	199	BDL	2.57	-1.519	-13.035	3.53	173.63	_	BDL
L4	-58.6	2.6	56.3	0.067	0.609	0.249	0.147	-107	_	287	BDL	1.32	-1.438	-4.526	_	98.756	_	BDL
L5	-60.5	2.5	57.8	0.013	1.994	0.701	0.409	707	18.41	-1566	BDL	-0.7	-2.315	-1.528	6.53	384.57	_	BDL
L6	-14.3	2	12.7	0.103	0.443	-0.045	-0.03	760	_	-3461	BDL	-3.59	-6.572	-8.842	_	177.88	_	BDL
L7	-18.9	2.2	16.2	0.132	-0.408	-2.055	-1.191	-543	_	-4361	BDL	6.65	-0.559	6.341	1.8	92.23	_	BDL

Table 2: Differences in Sediment Sample Characteristics between Pre-Monsoon and Post-Monsoon Periods

***BDL – Below Detection Level**

*** Negative values represent a decrease in the respective parameter.**

* **Positive values represent an increase in the respective parameter.**

- **Texture (Sand, Silt, Clay)**

Pre-monsoon sediments showed higher sand dominance and compact structure at several locations. Post-monsoon sediments exhibited increased clay and fine material deposition, particularly in low-energy zones.

Inference: Post-monsoon conditions promote fine sediment replenishment and storage.

- **Bulk Density**

Higher bulk density values during pre-monsoon indicate compacted, dry sediments. Post-monsoon bulk density decreased slightly at several locations due to moisture increase and sediment loosening.

Inference: Replenishment improves sediment structure and porosity.

- **Moisture Content**

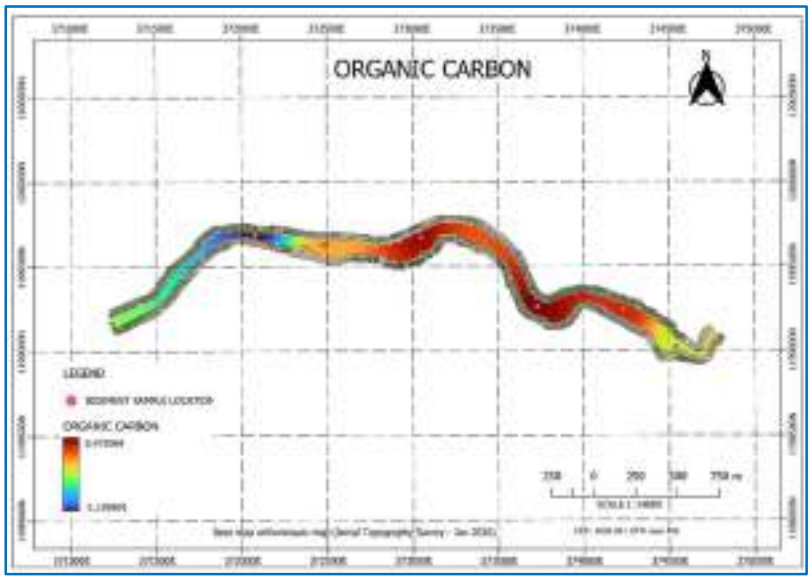
Pre-monsoon moisture content was low due to drying conditions. Post-monsoon sediments showed significantly higher moisture content, especially in clay-rich zones.

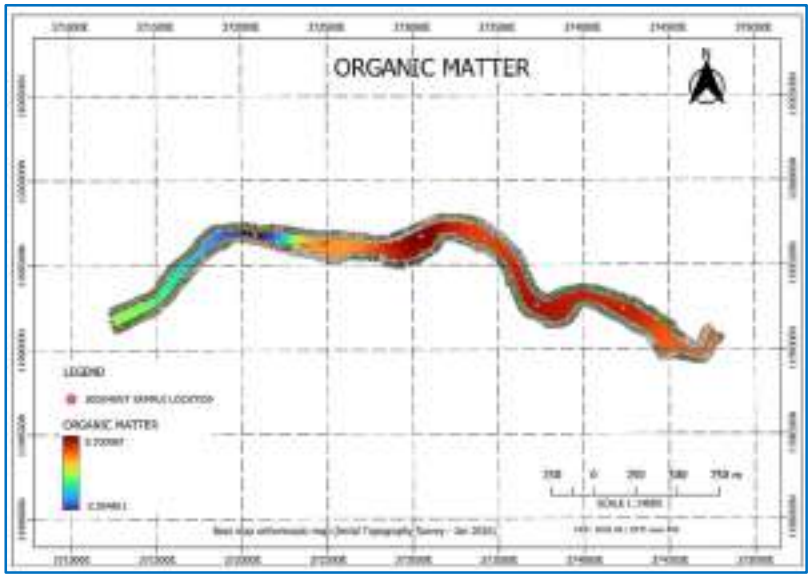
Inference: Effective recharge of sediments during monsoon.

- **Organic Matter and Organic Carbon**

Lower organic matter and carbon content during pre-monsoon reflect oxidation and limited input. Post-monsoon values increased due to fresh organic deposition and reduced decomposition rates.

Inference: Replenishment enhances sediment nutrient retention capacity.

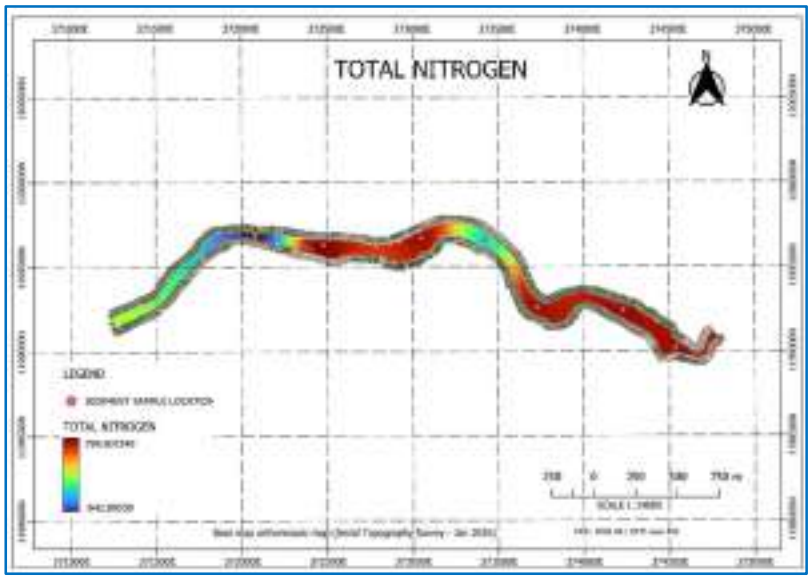




- **Total Nitrogen and Phosphorus**

Pre-monsoon nutrient content in sediments was comparatively lower. Post-monsoon sediments showed increased nitrogen and phosphorus, particularly in clay-dominated locations.

Inference: Fine sediments deposited during monsoon improve nutrient storage.



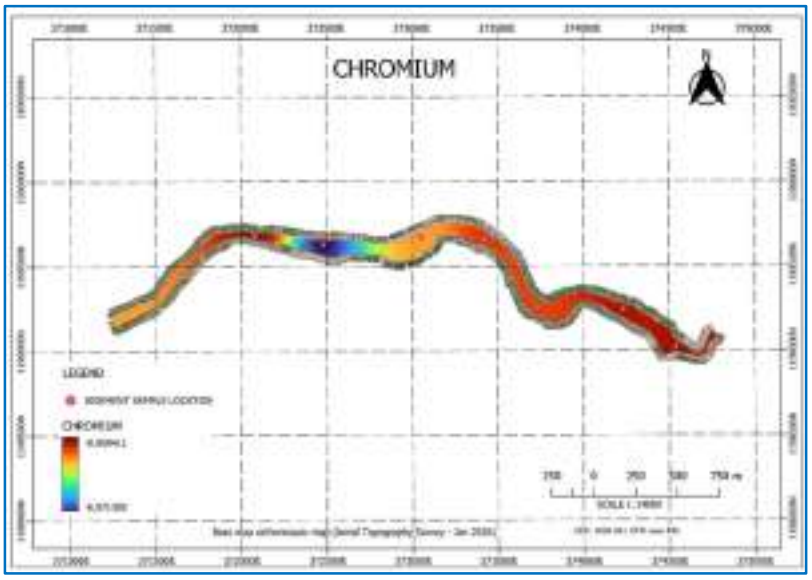
- **Heavy Metals (Fe, Ni, Cr, Zn, Pb, Mn, Cd, Hg)**

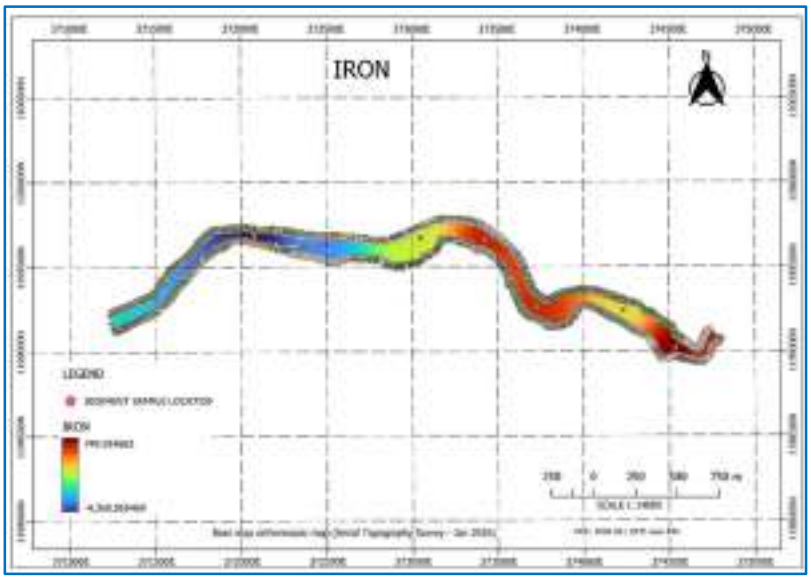
Fe and Mn: Increased post-monsoon due to geogenic mobilisation and sediment deposition.

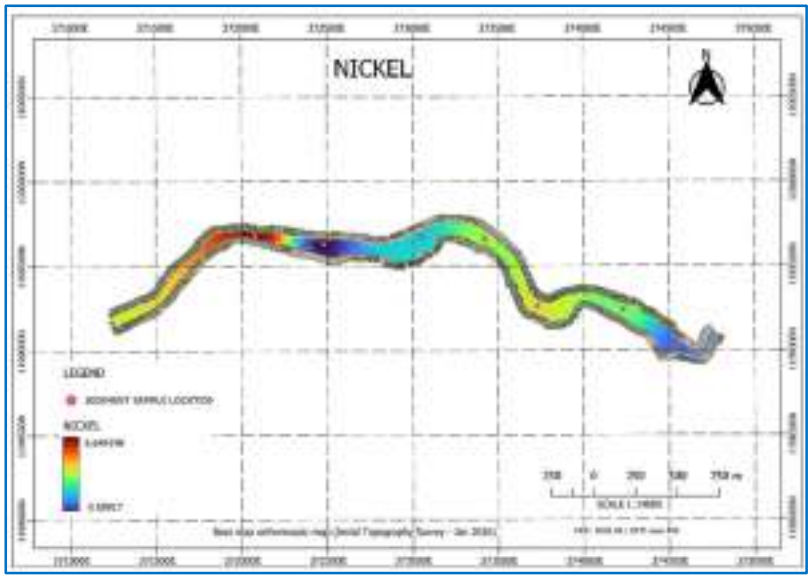
Ni, Cr, Zn, Pb: Showed minor seasonal variation but remained within background levels.

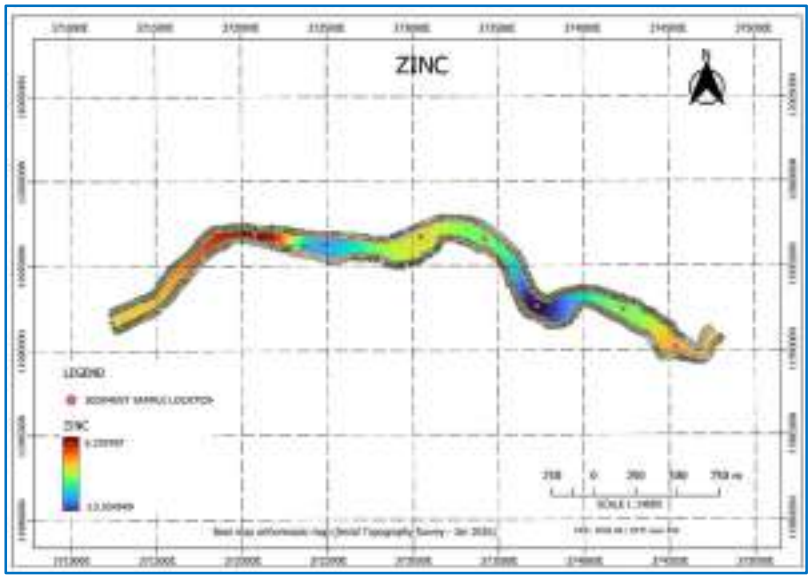
Cd and Hg: Below detection limits in both seasons.

Inference: Seasonal sediment dynamics influence metal distribution, with no significant contamination.









4.2. Saltwater Intrusion study

4.2.1. Saltwater Intrusion Study – Comparative Results (Pre-Monsoon vs post-monsoon)

Location 1 (10.847854N, 79.847092E):

Pre-Monsoon:

Saline to brackish water intrusion was observed at shallow to moderate depths, indicated by low resistivity values. Limited freshwater presence suggested weak hydraulic resistance against seawater ingress.

Post-Monsoon:

Saline water was detected at greater depths (≈ 7–30 m), while shallow layers showed relatively higher resistivity due to freshwater recharge.

Comparison Result:

Post-monsoon recharge caused a downward shift of saline water, indicating partial replenishment. However, saline intrusion persists at depth due to strong coastal influence.

Location 2 (10.850701N, 79.842011E):

Pre-Monsoon:

Low resistivity values were observed at very shallow depths, indicating strong saline intrusion within the alluvial aquifer.

Post-Monsoon:

Saline to brackish water continued to be present from ~1.0 m depth, with resistivity values remaining very low.

Comparison Result:

No significant improvement was observed after monsoon. Saltwater intrusion remains persistent and shallow, indicating limited effectiveness of replenishment at this location.

Location 3 (10.850476N, 79.834773E)

Pre-Monsoon:

Saline signatures were present at shallow depths, indicating inland advancement of saltwater under low recharge conditions.

Post-Monsoon:

Saline water was detected from ~1.5 m depth, with only minor improvement in shallow resistivity.

Comparison Result:

Monsoonal recharge resulted in minor moderation, but saline intrusion continues to dominate the subsurface, showing high aquifer vulnerability.

Location 4 (10.850160N, 79.826731E)

Pre-Monsoon:

Saline to brackish water was present at shallow to moderate depths, reflecting inland migration during dry conditions.

Post-Monsoon:

Saline water was observed below ~4.0 m depth, with slightly higher resistivity values indicating brackish conditions.

Comparison Result:

Post-monsoon recharge caused a noticeable deepening of saline zones, suggesting moderate replenishment effectiveness, though saline intrusion persists below shallow layers.

Location 5 (10.846967N, 79.823337E)

Pre-Monsoon:

Saline water intrusion occurred at shallow depths due to reduced freshwater head.

Post-Monsoon:

Saline signatures appeared from ~4.5 m depth, while shallow zones showed improved resistivity due to freshwater recharge.

Comparison Result:

Replenishment was relatively effective in improving shallow aquifer conditions; however, deeper saline water remains unaffected.

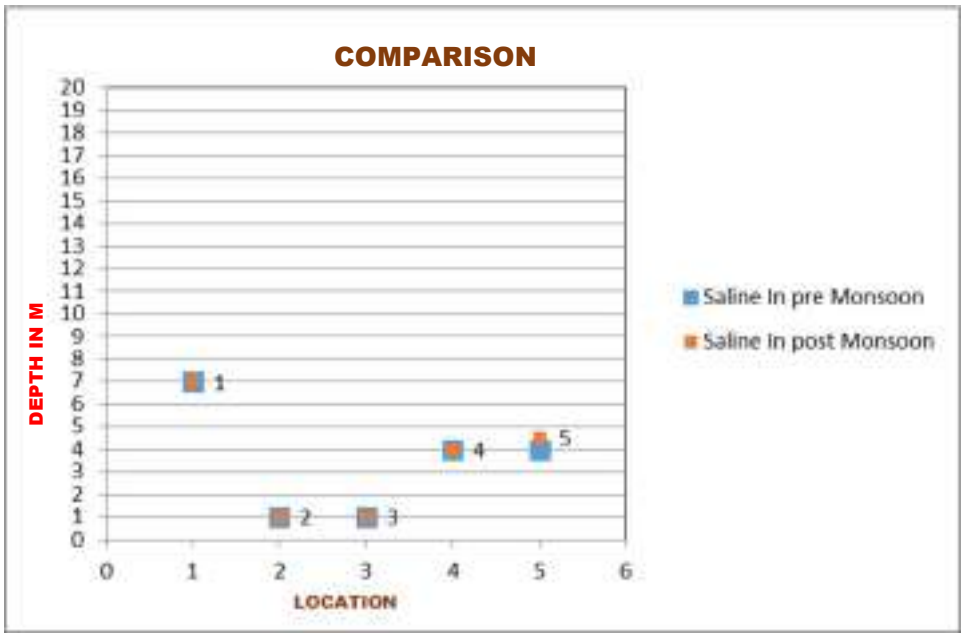
Comparison of Saline Intrusion depth from ground level in Pre monsoon and Post monsoon as follows:

Location	Latitude	Longitude	Pre monsoon Saline Intrusion Depth in M from GL	Post monsoon Saline Intrusion Depth in M from GL
L1	10.847854	79.847092	> 7	> 7
L2	10.850701	79.842011	> 1	> 1
L3	10.850476	79.834773	> 1	> 1
L4	10.850160	79.826731	> 4	> 4
L5	10.846967	79.823337	> 4	> 4.5

Table 3: Location-wise Comparison of Saline Intrusion Depths (Pre- and Post-Monsoon)

Location	Pre-Monsoon Condition	Post-Monsoon Change
L1	Shallow–moderate saline intrusion	Saline pushed deeper
L2	Shallow saline intrusion	No depth change
L3	Shallow saline intrusion	Minor depth shift
L4	Moderate saline intrusion	Deeper saline zone
L5	Shallow saline intrusion	Deeper saline zone

Table4: Comparative Evaluation of Saline Water Intrusion Behaviour at Study Locations



Final Comparative Inference

The location-wise comparison clearly shows that monsoonal replenishment improves shallow subsurface freshwater conditions, particularly at inland locations (L4 and L5). However, saltwater intrusion remains persistent at all locations, especially near the coast (L1–L3). This confirms that while seasonal recharge moderates intrusion intensity, long-term saline control measures are essential.

5. OVERALL SUMMARY

From a technical perspective, the comparative pre-monsoon and post-monsoon assessment demonstrates that monsoonal recharge is the primary controlling factor governing river replenishment and salinity dynamics within the study area. Post-monsoon conditions show measurable improvements in hydraulic, geomorphological, and hydro-chemical parameters, indicating effective short-term replenishment. Increased river discharge (1.2 to 1.4 m^3/s), enhanced flow velocity, reduced flow depth, stable bed gradient (1:100000), and expansion of sandbar area confirm active sediment redistribution and improved channel conveyance without significant longitudinal morphological alteration.

Hydro-chemical responses further validate replenishment efficiency, with dilution-driven stabilization of pH, reduction in electrical conductivity at inland locations, improved dissolved oxygen, and reduced COD and BOD levels, indicating enhanced self-purification capacity. Elevated post-monsoon TSS and turbidity are attributed to natural sediment mobilisation associated with recharge rather than anthropogenic stress. Sediment characteristics show decreased bulk density, increased moisture content, and enhanced organic matter and nutrient retention, confirming effective sediment-level replenishment and storage.

Subsurface investigations reveal that monsoonal recharge induces a downward displacement of saline interfaces, particularly at inland locations (L4 and L5), indicating partial aquifer recovery in shallow zones. However, persistent low resistivity at coastal locations (L1–L3) confirms continued saltwater intrusion controlled by marine influence and aquifer vulnerability. Overall, the study establishes that seasonal replenishment improves surface water availability and shallow groundwater quality, but is insufficient to reverse deep-seated saltwater intrusion, necessitating long-term structural and hydrogeological management interventions for sustainable freshwater security.

6. CONCLUSION

From a technical standpoint, the comparative evaluation of pre-monsoon and post-monsoon conditions clearly establishes monsoonal recharge as the dominant controlling factor influencing river replenishment processes and salinity dynamics within the study area. The post-monsoon assessment demonstrates marked improvements in surface water availability, channel hydraulics, sediment regime, and water quality, confirming the effectiveness of seasonal hydrological inputs in restoring short-term river functionality.

The observed increase in river discharge and flow velocity, enhanced sandbar development, increased sediment moisture content, and improved physico-chemical water quality parameters indicate active channel replenishment and improved hydraulic efficiency. Importantly, the absence of significant adverse morphological changes suggests that the river system possesses adequate conveyance capacity and sediment adjustment capability under replenished flow conditions. These findings provide critical technical support for the feasibility of the proposed river diversion, ensuring that increased flows can be accommodated without inducing channel instability.

Water and sediment quality analyses further confirm that monsoonal recharge enhances the river's natural self-purification capacity, as evidenced by improved dissolved oxygen levels and reduced organic pollution indicators (COD and BOD). The seasonal increase in suspended sediment concentration and turbidity is interpreted as hydraulically induced sediment mobilisation associated with recharge processes, rather than an indication of environmental degradation, thereby supporting river diversion under controlled operational conditions.

The saltwater intrusion assessment indicates that monsoonal recharge facilitates partial recovery of shallow aquifer zones, particularly at inland locations where saline interfaces were displaced to greater depths during the post-monsoon period. However, the continued presence of saline signatures at coastal and near-coastal locations confirms that deep-seated saltwater intrusion remains largely insensitive to seasonal recharge, due to strong marine boundary influence and inherent aquifer vulnerability. This aspect assumes heightened importance in the context of proposed port extension activities, which may further modify hydraulic gradients.

Overall, the study concludes that while monsoonal replenishment substantially improves surface water conditions and moderates shallow groundwater salinity, it is insufficient as a standalone mechanism for long-term control of saltwater intrusion under conditions of river diversion and port expansion. Consequently, the findings highlight the necessity for integrated

and long-term water resource management interventions, including regulated diversion flows, engineered recharge measures, controlled groundwater abstraction, and appropriate hydraulic and structural controls. Implementation of these measures is essential to ensure sustainable freshwater availability, hydraulic stability, and effective salinity management in support of the proposed river diversion and port extension.

7. RECOMMENDATIONS

Based on the findings of the replenishment and saltwater intrusion studies, and considering the proposed river diversion and port extension, the following recommendations are suggested to ensure hydraulic stability, freshwater sustainability, and effective salinity management within the study area.

- **Artificial Recharge and Aquifer Strengthening**

It is recommended to implement artificial recharge measures such as recharge pits, percolation ponds, check dams, and infiltration galleries at suitable inland locations. These measures will enhance freshwater recharge, increase aquifer storage, and strengthen hydraulic resistance against inland migration of saline water, particularly under altered flow conditions due to river diversion.

- **Regulation of Groundwater Abstraction**

Groundwater extraction, especially in coastal and near-coastal zones, should be strictly regulated and monitored. Controlled abstraction will help maintain a favourable freshwater hydraulic head, thereby limiting saltwater intrusion and safeguarding groundwater resources during and after port extension activities.

- **River Channel and Sediment Management**

River diversion works should be designed to maintain natural flow continuity and sediment transport processes. Excessive channel modification should be avoided. Periodic monitoring of sandbar formation, sediment distribution, and channel geometry is recommended to ensure that conveyance capacity and flow efficiency are not adversely impacted by diversion or port-related activities.

- **Seasonal Flow Augmentation**

Where feasible, provision of minimum environmental flows during the pre-monsoon period through regulated releases or managed storage is recommended. This will reduce stagnation, improve water quality, sustain ecological balance, and help control saltwater ingress under low-flow conditions.

- **Long-Term Monitoring and Adaptive Management**

A comprehensive long-term monitoring program should be established, including regular measurement of river discharge, flow velocity, groundwater levels, salinity, and water quality.

Continuous monitoring will enable timely assessment of seasonal and long-term impacts of river diversion and port extension, allowing for adaptive management and corrective actions.

- **Coastal Salinity Control Measures**

In highly vulnerable coastal stretches, the feasibility of subsurface salinity barriers, cutoff walls, or freshwater injection systems should be evaluated. These structural measures can provide additional protection against deep-seated saltwater intrusion that is not fully controlled by natural recharge processes.

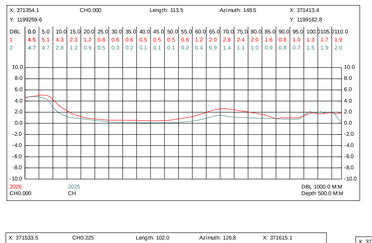
- **Integrated Water Resources Management (IWRM) Framework**

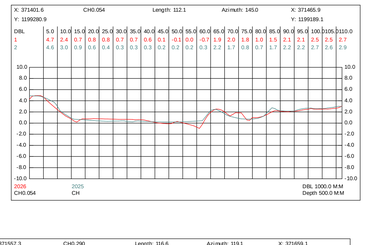
An integrated water resources management approach is recommended, combining surface water regulation, groundwater management, land-use planning, and stakeholder participation. This coordinated strategy will ensure sustainable freshwater availability, effective salinity control, and long-term resilience of the river–aquifer system in support of river diversion and port expansion.

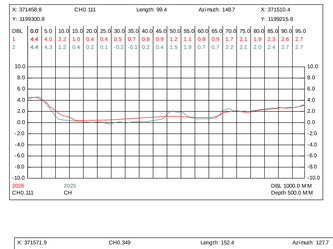
Overall Recommendation

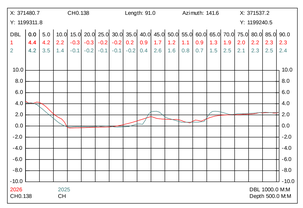
Implementation of the above measures will support safe river diversion, sustainable port development, enhanced freshwater replenishment, and effective long-term control of saltwater intrusion, thereby ensuring environmental sustainability and operational reliability for the proposed port extension.

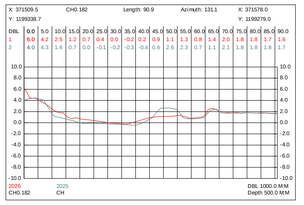
FIGURES

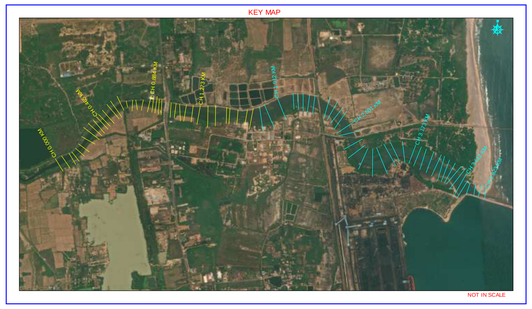


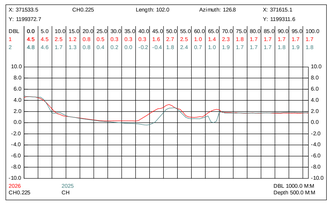


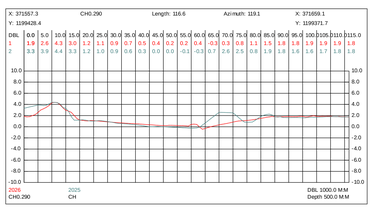


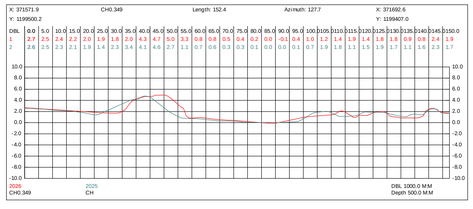


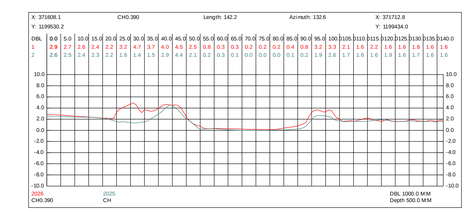


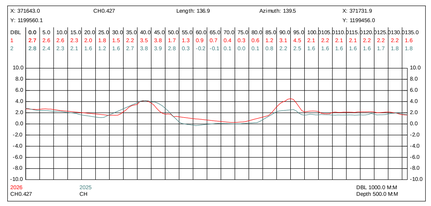


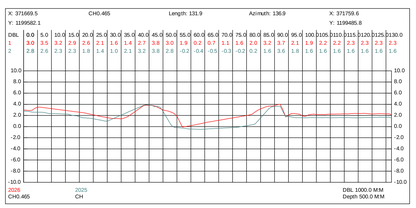


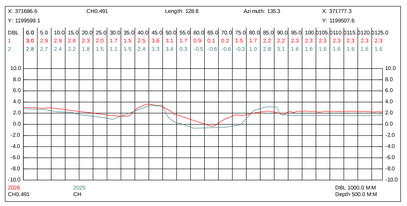


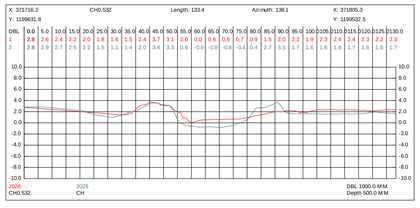


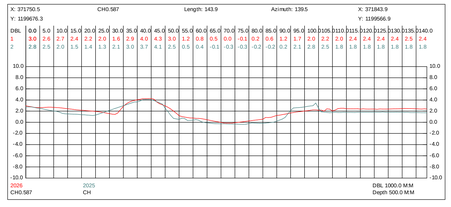


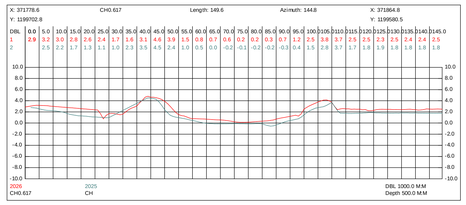


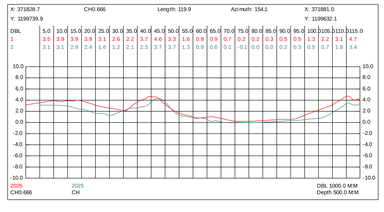


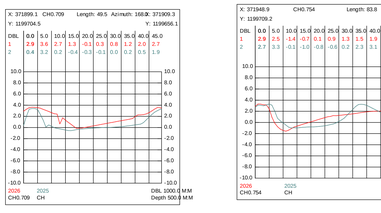


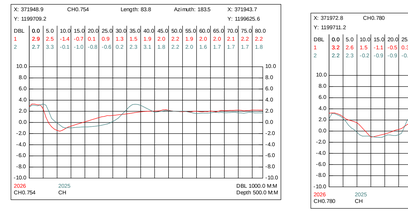


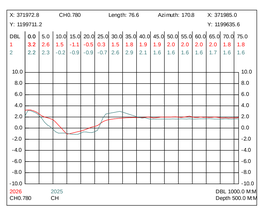


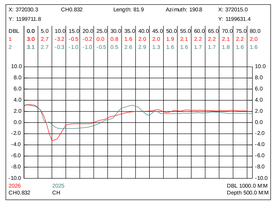


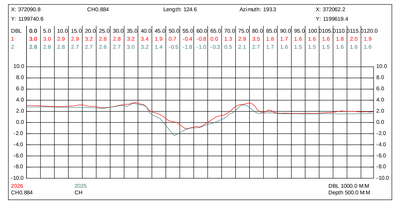


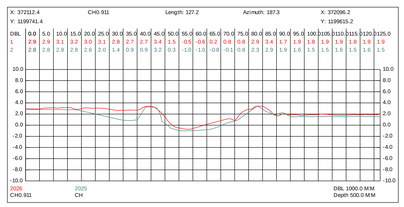


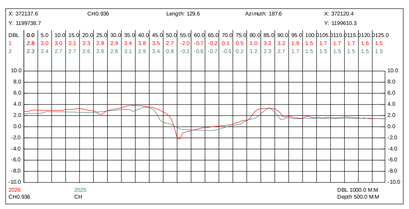


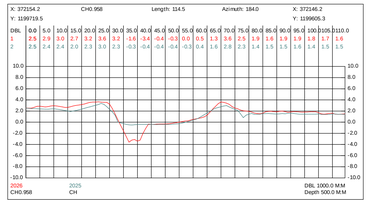


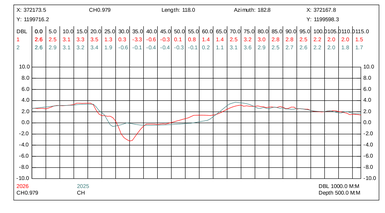


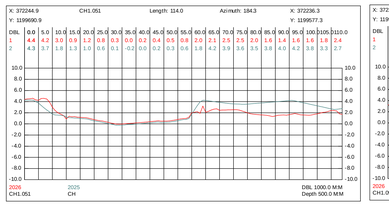


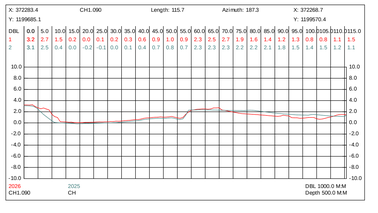


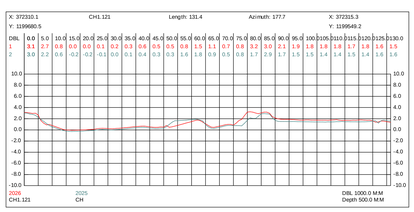


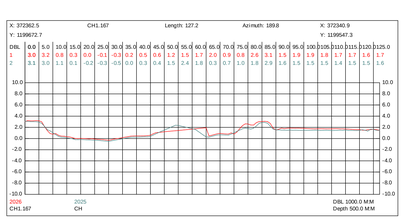


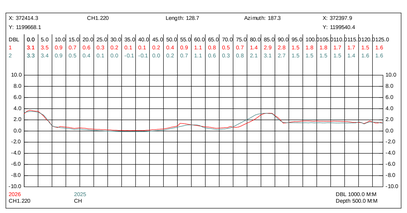


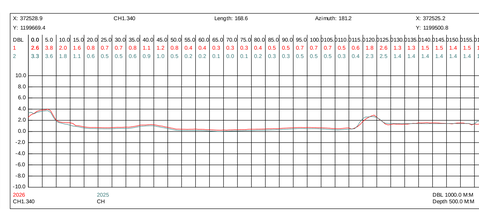


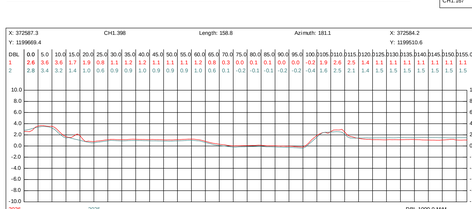


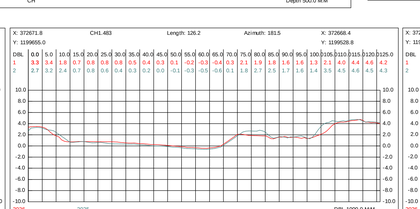


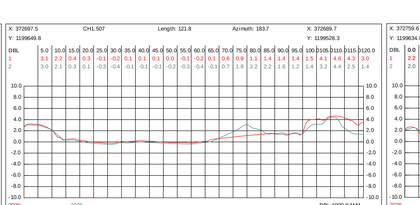


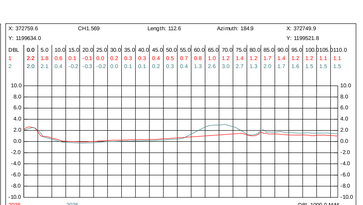


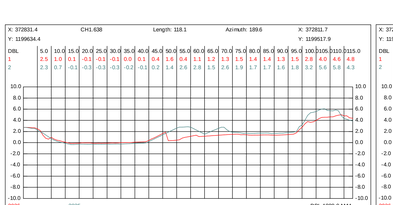


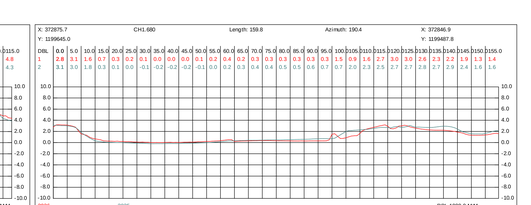












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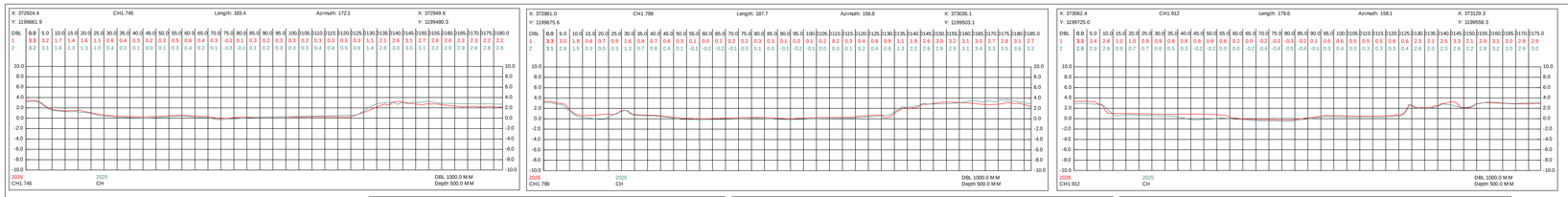
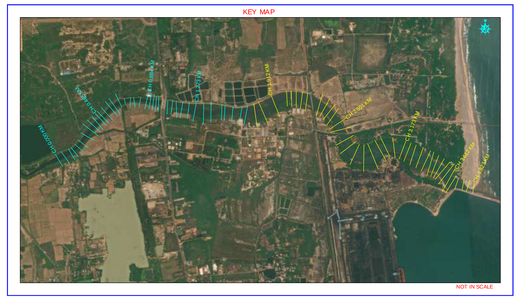
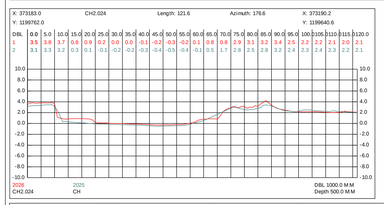
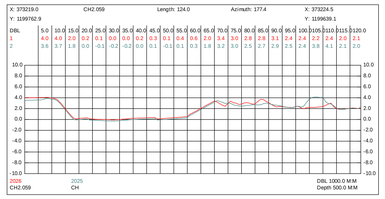
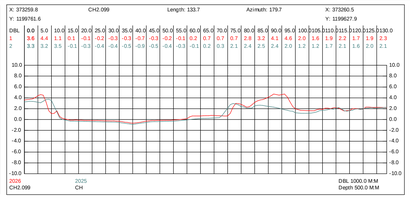
SHEET No. 01 of 02

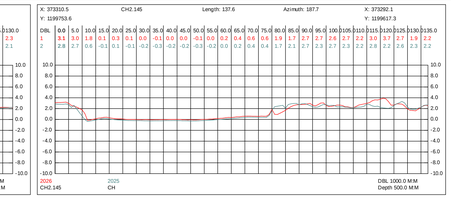


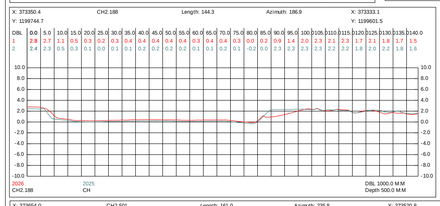


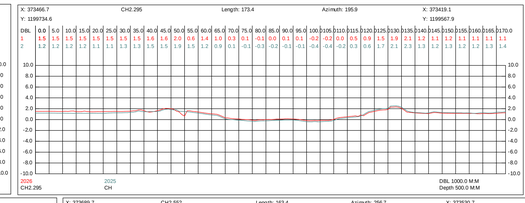


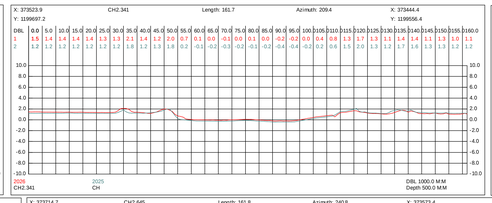


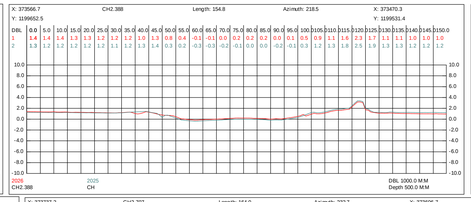


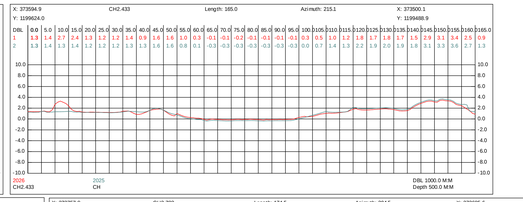


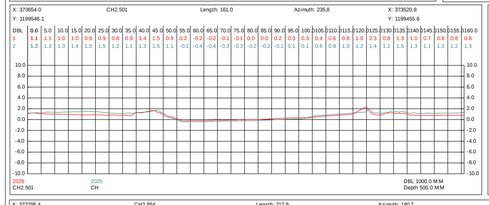


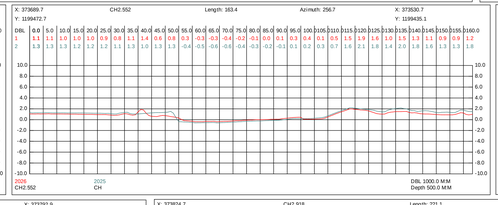


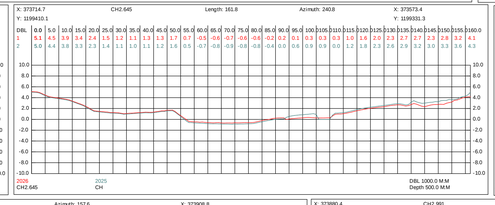


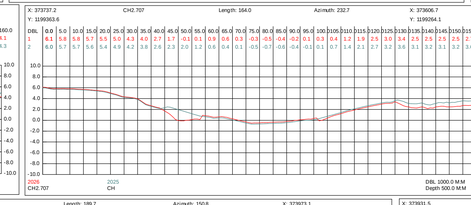


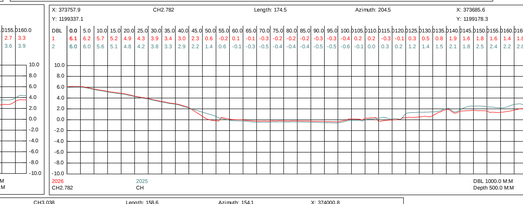


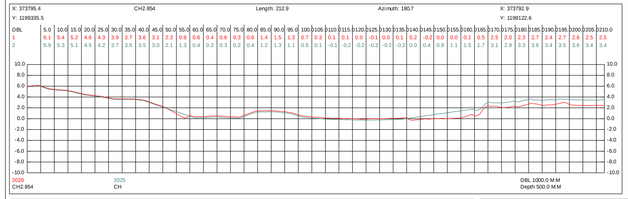


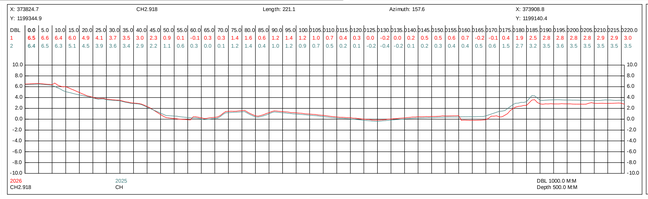


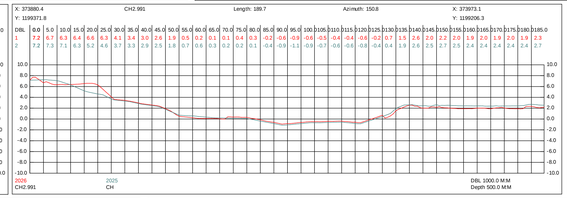


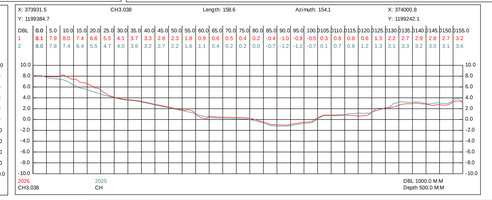


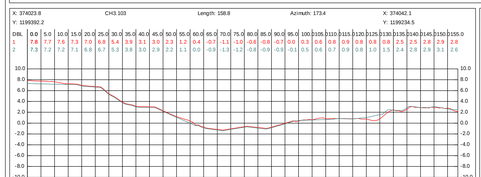


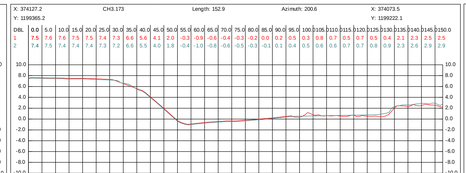


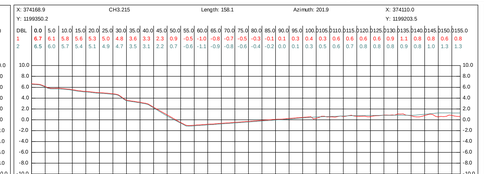


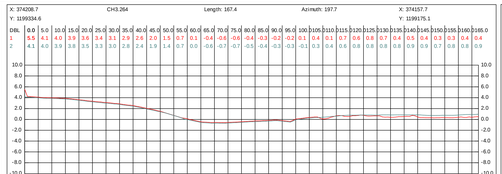


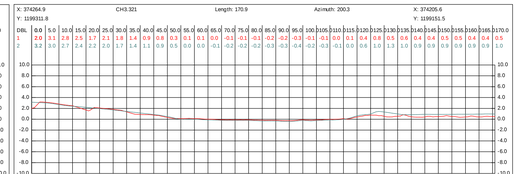


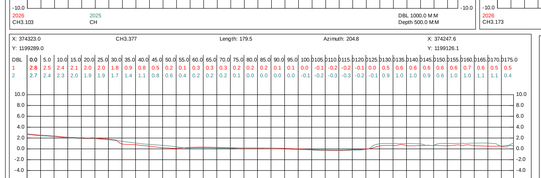


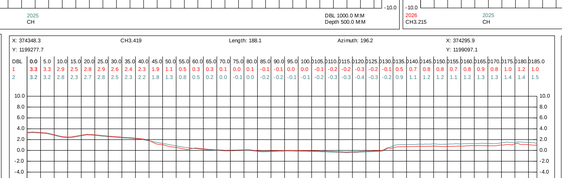


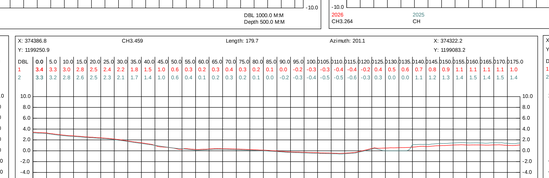


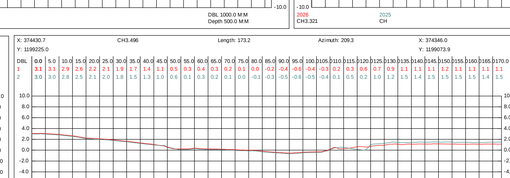


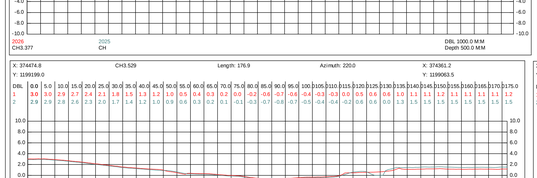


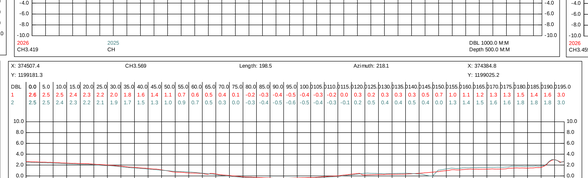


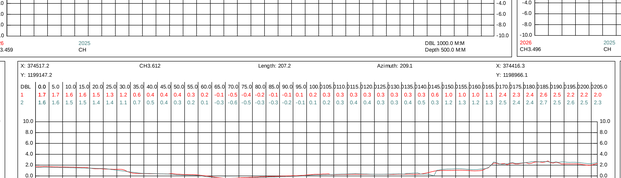


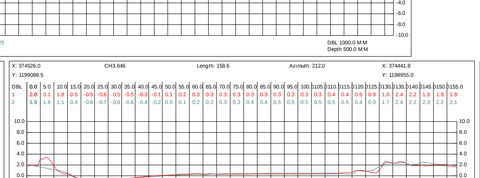


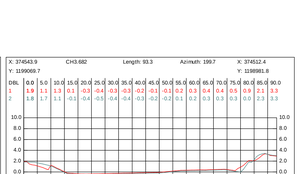


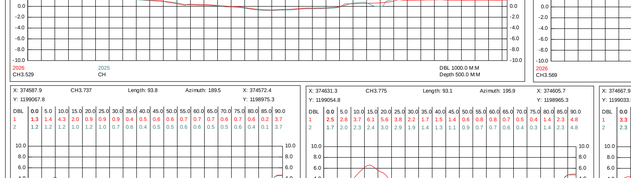


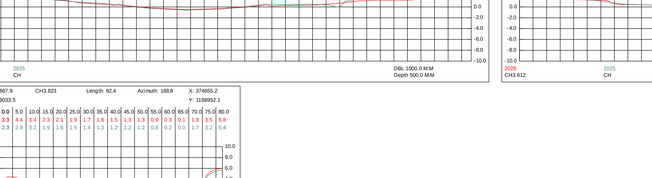


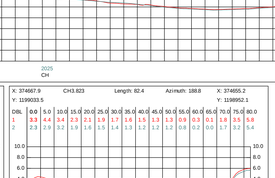












LEGEND	CLIENT	DRAWING TITLE	SURVEYED BY	SCALE	SEASON	FIG NO	REV.
2026 2025	FALCON RESILIENT INFRA CONSULTANTS	COMPARSON CROSS SECTION OF KARAIKAL RIVER CHAINAGE : CH 1.745 km TO CH 3.823 km	MISVO MARINE SURVEYS LLP CHENNAI - 600045 projects@misvo.com www.misvo.com	HOR. 1:1000 VER. 1:500	2025 - 2026	FIG.02	0

SHEET No. 02 of 02

Appendix V
FRICS NABET Certificate

भारतीय गुणवत्ता परिषद्
QUALITY COUNCIL® OF INDIA
QCI Creating an Ecosystem for Quality

NABET

National Accreditation Board for Education and Training

Certificate of Accreditation

Falcon Resilient Infra Consultants

501A, Sudheer Tapani Towers, Old MLA Quarters Road, Opp. Telugu Academy, Himayatnagar, Hyderabad- 500029, Telangana

*The organization is accredited as **Category-A** under the QCI-NABET **Scheme for Accreditation of EIA Consultant Organization, Version 3**: for preparing EIA/EMP reports in the following Sectors-*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1.	River Valley projects	3	1 (c)	A
2.	Thermal power plants	4	1 (d)	A
3.	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	21	5 (f)	A
4.	Airports	29	7 (a)	B
5.	Industrial estates/ parks/ complexes/areas, export processing Zones(EPZs), Special Eco-nomic Zones (SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
6.	Ports, harbours, break waters and dredging	33	7 (e)	A
7.	Highways	34	7 (f)	A
8.	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B
9.	Building and construction projects	38	8 (a)	B
10.	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in SAAC minutes dated March 11, 2025, posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no QCI/NABET/ENV/ACO/25/3562 dated March 18, 2025. The accreditation needs to be renewed before the expiry date of Falcon Resilient Infra Consultants, Hyderabad, following due process of assessment.

Valid up to
August 16, 2026

Issue Date
March 18, 2025

Certificate No.
NABET/EIA/23-26/SA 0236

Prof (Dr) Varinder S Kanwar
CEO - NABET

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

Appendix W

NABL Certificate of Greenchem Solutions and Chennai Mattex Lab

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

GREEN CHEM SOLUTIONS PVT. LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

PLOT NO.4, RAJIV GANDHI STREET, BALAJI AVENUE, A.N. ELUMALAI ROAD (OIL MILL ROAD), IYYAPPANTHAGAL, CHENNAI, TAMIL NADU, INDIA

in the field of

TESTING

Certificate Number: TC-6410

Issue Date: 19/08/2024 **Valid Until:** 18/08/2026

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of thislaboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity: GREEN CHEM SOLUTIONS PVT. LTD.

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

Appendix X
Letter from CASMB

ANNAMALAI UNIVERSITY

CAS in Marine Biology,
Faculty of Marine Sciences,
Parangipettai – 608 502, Tamil Nadu, India
Tel: (O) 04144-243070,243071, 243223
Cell: 09486456460
E-mail: fish_lar@yahoo.com

Dr. A. SUNDARAMANICKAM,
Associate Professor

Date:08.12.2025

To,
Falcon Resilient Infra Consultants (FRICS)
501 A, Sudheer Tapani Towers, opposite Telugu Academy,
Old MLA quarters road, Himayat Nagar,
500029, Hyderabad,
Telangana

Kind attention: Mrs. Susruta Mamidanna, Technical Director.

Subject: Submission of Marine Environmental monitoring reports of Winter (January- March), Summer(April-June) and Pre Monsoon(July-September) Seasons 2025 for Karaikal Port, Karaikal district, Puducherry -Reg.

Reference: Work order No: 001-C24021-RCP-L-AKPL- Annamalai WO, dated October 18,2024

Dear Madam,

Hereby submitting the Marine Environmental Monitoring and Management Reports pertaining to three seasons for the Master Plan Development of Karaikal Port, Karaikal district, Puducherry.

1.Winter (January- March 2025).
2.Summer (April-June 2025)
3. Pre Monsoon (July-September 2025)

The following Terms of Reference (ToR) conditions from MoEFFCC, have been addressed in the Marine Environmental Monitoring and Biodiversity Management Plan Report.

S. No	Terms of Reference (ToR) conditions
Specific Conditions	
1.24	A detailed study on the impact of the proposed activity on marine ecology and marine biodiversity with a specific focus on the corals, mangroves, and Mud flats in the proximity of the site should be conducted, including a mitigation plan through a nationally recognized institution or university.
ESZ, CRZ, International Boundary And Acts	
3.7	Management plan for the area under which mangroves are or likely to be removed and compensatory mangrove plantation plan be submitted if any.
3.8	A detailed study on the impact of proposed activity on marine ecology and marine biodiversity with specific focus on the corals, mangroves and Mud flats in the proximity of the site should be conducted and required mitigation plan be submitted.
Water Environment/quality Analysis/ Hydrology And Water Bodies	
6.4	Specific study on effects of construction activity and pile driving on marine life.

Thanking you.

Yours faithfully,

(A.SUNDARAMANICKAM)

FALCON RESILIENT
INFRA CONSULTANTS

Yours Strategic Trusted Partner

501A, Sudheer Tapani Towers
Opposite Telugu academy
Himayat Nagar, Hyderabad- 500029
Telephone:040-35607180
www.frics.in