Vijayasankar K

From: Sathish Kumar R
Sent: Monday, June 01, 2020 9:53 PM
To: 'eccompliance-tn@gov.in'
Cc: 'monitoring-ec@nic.in'; 'suresh.cpcb@nic.in'; cpcbsuresh@gmail.com; Member Secretary, TNPCB (tnpcbmembersecretary@gmail.com); DEE Gummidipoondi (deegummidipoondi@gmail.com); 'tndoe@nic.in'; Cherian Abraham; Shalin Shah; Shabdendu Pathak; Vijayasankar K
Subject: Half yearly Compliance report of Environment and CRZ Clearance for the development of proposed Port at Kattupalli, Tiruvallur District of Tamil Nadu by M/s Marine Infrastructure Developer Pvt. Limited for the period of October 2019 to March 2020 – R
Attachments: MIDPL - EC Six months Compliance (Oct'19 to Mar'20).pdf

Importance: High

MIDPL/TNPCB/GMP/EC-HYC Date: 31-05-2020

Additional Principal Chief Conservator of Forests (C),
Ministry of Environment, Forest and Climate Change, Regional Office (South Eastern Zone),
Ist and IInd Floor, Handloom Export Promotion Council,
34, Cathedral Garden Road, Nungambakkam,
Chennai – 600 034. Email : eccompliance-tn@gov.in

Dear Sir,

Sub : Half yearly Compliance report of Environment and CRZ Clearance for the development of proposed Port at Kattupalli, Tiruvallur District of Tamil Nadu by M/s Marine Infrastructure Developer Pvt. Limited for the period of October 2019 to March 2020 – Reg.

Ref : CRZ & Environmental Clearance for the development of proposed Port at Katupalli, Tiruvallur District of Tamilnadu by M/s Marine Infrastructure Developer Pvt. Limited – bifurcation of EC&CRZ Clearance vide F. No 10-130/2007 – IA.III dtd . 9th February 2018

With reference to the captioned subject and cited reference above; we herewith submitting the Half yearly compliance report for the compliance period **October 2019 to March 2020** to the conditions stipulated in the cited reference for your kind information.

Thanking you,

For, M/s. Marine Infrastructure Developer Ltd

Authorized Signatory.

Encl: As above
Copy to:

1. The Director (Monitoring –IA-III Division), Ministry of Environment, Forest & Climate Change, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi – 110003 (Email : monitoring-ec@nic.in **)**
2. Zonal Office, Central Pollution Control Board, A-Block, Nisarga Bhavan, 1st and 2nd Floors, 7th D Cross, Thimmaiah Road, Shivanagar, Bengaluru, Karnataka 5600879 (Email : suresh.cpcb@nic.in)
3. The Member Secretary, Tamil Nadu Pollution Control Board, 76, Mount Salai, Guindy, Chennai - 600 032 (Email : tnpcbmembersecretary@gmail.com)

4. The District Environmental Engineer, Tamil Nadu Pollution Control Board, EPIB Building, A.O Block, Gummipoondi Industrial Complex, Gummipoondi – 601201. (Email : deegummidipoondi@gmail.com)
5. Member Secretary TNCZMA & Director – Dept of Environment, No.1, Jeenis Road, Panagal Building, Ground Floore, Saidapet, Chennai -600 015. (Email : tndoe@nic.in)

Thanks and Regards

Sathish Kumar R
Head - Environment
Marine Infrastructure Developer Private Limited **|** Adani Ennore Container Terminal Private Limited **|**
Adani Vizag Coal Terminal Private Limited **|** Adani Mormugao Port Terminal Private Limited **|**

Mob +91 91760 00959 **|** Direct: +91 44 2796 8177 | Extn. 69177 |

adani

KATTUPALLI PORT
CHENNAI's NEW GATEWAY

MIDPL/EC-HYC/2020/11 Date: 31-05-2020

Additional Principal Chief Conservator of Forests (C),
Ministry of Environment, Forest and Climate Change, Regional Office (South Eastern Zone),
Ist and IInd Floor, Handloom Export Promotion Council,
34, Cathedral Garden Road, Nungambakkam,
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Thanking you,

For, M/s. Marine Infrastructure Developer Ltd

Authorized Signatory.

Marine Infrastructure Developer Pvt Ltd. Chennai 600 120

Encl: As above

Copy to:

1. The Director (Monitoring –IA-III Division), Ministry of Environment, Forest & Climate Change, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi – 110003 (Email : monitoring-ec@nic.in **)**
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3. The Member Secretary, Tamil Nadu Pollution Control Board, 76, Mount Salai, Guindy, Chennai - 600 032 (Email : tnpcbmembersecretary@gmail.com)
4. The District Environmental Engineer, Tamil Nadu Pollution Control Board, EPIB Building, A.O Block, Gummipoondi Industrial Complex, Gummipoondi – 601201. (Email : deegummidipoondi@gmail.com)
5. Member Secretary TNCZMA & Director – Dept of Environment, No.1, Jeenis Road, Panagal Building, Ground Floore, Saidapet, Chennai -600 015. (Email : tndoe@nic.in)

Marine Infrastructure Developer Pvt Ltd
(Kattupalli Port)
Kattupalli Village, Ponneri Taluk,
Tirivalluvar District 600 120,
Tamil Nadu, India

Tel +91 44 2824 3062

CIN: U74999TN2016PTC103769

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
Specific Conditions		
(i)	The proponent shall comply all the conditions stipulated in the letter R.C.No. P1/2004/2008, dated 21.10.2008 of the Department of Environment, Chennai.	**Complied.** Compliance to letter R.C.No. P1/2004/2008, dated 21.10.2008, is enclosed as **Annexure -I**
(ii)	The proponent shall comply all the commitment made vide his letter No. D/Shipyard/00/07 dated 20.03.2009.	**Complied** This EC is just a bifurcation of original EC of LTSB in name of MIDPL & LTSB. All applicable commitments, w.r.t letter No. D/Shipyard/00/07 dated 20.03.2009 like provision of fire station, independent port connectivity, and no reclamation on areas outside port, non-usage of Tri Butyl Tin [TBT] and treatment of waste water in STP and recycling, disposal of hazardous waste to authorised recyclers are being complied.
(iii)	Provision shall be made for the housing of Construction labour within the site with all necessary infrastructure and facilities such as fuel or cooking, mobile toilets, mobile STP, safe drinking water, medical health care, creche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.	**Complied.** All the construction works are completed and the port is in operation phase.
(iv)	There shall be no withdrawal of groundwater in Coastal Regulation Zone area, for this project. In any case any ground water is proposed to be withdrawn from outside the CRZ area, specific prior permission from the concerned State /Central Groundwater board shall be obtained in this regard.	**Complied.** No groundwater is withdrawal from CRZ Area. Presently unit is procuring water from M/s. Chennai Metropolitan Water Supply and Sewerage Board, Chennai. In case of Groundwater withdrawal outside CRZ Area prior permission will be obtained for from State/Central Groundwater Board
(v)	No dumping of dredging materials in the sea shall be undertaken. In case of sea dumping required, an integrated Modelling study to be carried out to locate the dump site so that it does not cause any problem to Ennore port.	**Complied.** No dumping of dredging material was carried out during the compliance period October 2019 to March 2020. Dredge material dumping location has already been identified by LTSB through modelling studies.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
(vi)	Shoreline changes due the project shall be monitored continuously nourishment of northern shoreline shall be carried out using the sediments from beach acceleration on the southern shoreline.	**Being Complied** MIDPL has engaged Institute of Ocean Management, Anna University, Chennai for shoreline Change study. Report of the same is attached as **Annexure – II.**
(vii)	Suitable Screens shall be installed between the construction area and the intakes so that operations of the intakes are not affected by the construction activity.	**Complied** All the construction works is completed and the port is in operation phase. No impact envisaged.
(viii)	At least a distance of 100 meter shall be provided between intake of Chennai Water Desalination Ltd. (CWDL) and north edge of the northern breakwater as agreed in the meeting between the proponent and CWDL	**Complied** Distance maintained as agreed.
(ix)	Independent port connectivity shall be developed.	**Complied** An independent port connectivity has been developed.
(x)	Rehabilitation if any shall be carried out as per law / State Government.	**Complied** Rehabilitation was carried out completely as per law / State Government at the time of project implementation.
(xi)	Fire station shall be located within the project area	**Complied** MIDPL is having dedicated fire station with fire tender and fire crew. 
(xii)	The Hazardous waste generated shall be properly collected and handled as per the provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.	**Complied.** Hazardous wastes generated are properly collected and handled inline to Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as amended. Details of the same are submitted to TNPCB as a part of Hazardous waste annual return (Form 4) on regular basis. Annual return for FY 2018-19 is attached as **Annexure – III.**
(xiii)	The waste water generated from the activity shall be collected, treated and reused properly.	**Complied** Domestic waste water generated are being collected, treated in STP and the

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
		treated water is reused for green belt maintenance.
(xiv)	Sewage Treatment Facility should be provided in accordance with the CRZ Notification.	**Complied** Sewage Treatment Plants are provided in accordance with the CRZ notification.
(xv)	No Solid Waste will be disposed of in the Coastal Regulatory Zone area. The Solid Waste shall be properly collected segregated and disposed as per the provision of Solid Waste Management Rules, 2016.	**Complied** No solid waste is being disposed of in the CRZ area. All the solid waste generated is properly collected, source segregation of all types of Solid Waste is practised and are disposed as per the provision of Solid Waste Management Rules 2016, as amended. Integrated waste Management system is in place and all wastes are being handled inline to 5R principle (Reduce, Reuse, Reprocess, Recycle & Recover).  
(xvi)	Installation and operation of DG set if any shall comply with the guidelines of CPCB.	**Complied** 02 no of DG set with 2000 kVA capacity is installed inline to CPCB guideline. Flue gas analysis report of the DG Set stack for the period Oct-2019 to Mar-2020 is attached as **Annexure IV**
(xvii)	Air quality including the VOC shall be monitored regularly as per the guidelines of CPCB and reported.	**Complied** Ambient Air Quality Monitoring is being carried out through NABL accredited laboratory. Air Quality Monitoring Reports for the period Oct-2019 to Mar-2020 is enclosed as **Annexure-IV.** We have also installed Continuous Ambient Air Quality Monitoring Station (Including BTX analyser to monitor VOC). CAAQMS has been connected to TNPCB server and data is transferred on real-time basis. All the parameters are well with the prescribed standards.

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
(xviii)	The project proponent shall undertake green belt development all along the periphery of the project area and also alongside the road.	**Complied** Greenbelt of adequate size has been developed along the periphery of the project area and also alongside the road and are being maintained by MIDPL. As on date, 6,050 Nos. of trees has been planted and are maintained.    
(xix)	All necessary clearances from the	**Complied**

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
	concerned agencies shall be obtained before initiating the project.	All the necessary clearances from the concerned agencies have been obtained.
(xx)	Project proponent shall install necessary oil spill mitigation measures in the shipyard. The details of the facilities provided shall be informed to this Ministry within 3 months from the date of receipt of this letter.	**Complied** All necessary precaution has been taken to avoid any kind of spillages. Oil spill contingency plan along with list of available oil spill equipment submitted vide our Letter No. MIDPL/TNPCB/GMP/EC-HYC dated 14.05.2018.
(xxi)	No hazardous chemicals shall be stored in the Coastal Regulation Zone area.	**Noted for Compliance**. No hazardous chemical is stored in CRZ Area.
(xxii)	The project shall not be commissioned till the requisite water supply and electricity to the project are provided by the PWD/ Electricity Department.	**Complied** Requisite permission for Water Supply and Electricity has been obtained from Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) and Tamil Nadu Electricity Board respectively before commissioning
(xxiii)	Specific arrangements for rainwater harvesting shall be made in the project design and the rain water so harvested shall be optimally utilized.	**Being Complied** Water table is observed to be high in and around the Port area. Feasibility of rainwater harvesting will be explored.
(xxiv)	The facilities to be constructed in the CRZ area as part of this project shall be strictly in conformity with the provisions of the CRZ Notification, 2011 and its amendment. The facilities such as office building and residential buildings which do not require water front and foreshore facilities shall not be constructed within the Coastal Regulation Zone area.	**Complied.** All construction has been done in line to CRZ Notification, 2011 & EC&CRZ clearance obtained.
General Conditions:		
(i)	Construction of the proposed structures shall be undertaken meticulously conforming to the existing Central/local rules and regulations including Coastal Regulation Zone Notification 1991	**Complied** All construction has been done in line to CRZ Notification, 2011 & EC & CRZ clearance obtained

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
	& its amendments. All the construction designs /drawings relating to the proposed construction activities must have approvals of the concerned State Government Departments /Agencies.	
(ii)	Adequate provisions for infrastructure facilities such as water supply, fuel, sanitation etc. shall be ensured for construction workers during the construction phase of the project so as to avoid felling of trees/mangroves and pollution of water and the surroundings.	**Complied** The project is in operation phase. During the construction phase labours deployed were from nearby villages. Construction activities are being carried out in daytime and worker leave the site on daily basis
(iii)	The project authorities shall make necessary arrangements for disposal of solid wastes and for the treatment of effluents by providing a proper wastewater treatment plant outside the CRZ area. The quality of treated effluents, solid wastes and noise level etc. must conform to the standards laid down by the competent authorities including the Central/State Pollution Control Board and the Union Ministry of Environment and Forests under the Environment (Protection) Act, 1986, whichever are more stringent.	**Complied** No solid waste is being disposed of in the CRZ area. Integrated waste Management system is in place. All the solid waste generated is properly collected, source segregation of all types of Solid Waste is practised and are disposed as per the provision of Solid Waste Management Rules 2016, as amended. Sewage Treatment Plants (STPs) are provided for treatment of wastewater in line to CRZ Notification 2011. Environment Monitoring is being carried out by NABL accredited agency, Reports for the period Oct-2019 to Mar-2020 are enclosed as **Annexure –IV** All the monitoring results are well within the prescribed standard.
(iv)	The proponent shall obtain the requisite consents for discharge of effluents and emissions under the Water (Prevention and Control of Pollution) Act, 1974 and the Air (prevention and Control of Pollution) Act, 1981 from the Tamil	**Complied.** Requisite Consents for discharge of effluents and emissions under the Water (Prevention and Control of Pollution) Act, 1974 and the Air (prevention and Control of Pollution) Act, 1981 were obtained before commissioning of the project and

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
	Nadu State Pollution Control Board before commissioning of the project and a copy of each of these shall be sent to this Ministry.	submitted to Ministry. Project is in operation phase and Consent To Operate has been obtained from the Tamil Nadu State Pollution Control Board vide **Consent Order No. 1908121257901 & 1908221257901 dated 14/05/2019 valid till 31.03.2021.**
(v)	In order to carry out the environmental monitoring during the operational phase of the project, the project authorities shall establish an environmental laboratory well equipped with standard equipment and facilities and qualified manpower to carry out the testing of various environmental parameters.	**Complied** MIDPL is having Environmental Management Cell, staffed with qualified personnel at site supported by team at Head Office in Ahmedabad. Environment monitoring is being carried out through NABL accredited Laboratory.
(vi)	The proponents shall provide for a regular monitoring mechanism so as to ensure that the treated effluents conform to the prescribed standards. The records of analysis reports must be properly maintained and made available for inspection to the concerned State/Central officials during their visits.	**Complied.** Domestic Waste water is being treated in STP and inlet and outlet characteristic of water is regularly analysed by NABL accredited laboratory, the monitoring results for the period Oct-2019 to Mar-2020 is enclosed as **Annexure - IV**. All the results are found well within the prescribed standard. Records are made available at site for inspection of State / Central officials during their visit.
(vii)	The sand dunes and mangroves, if any, on the site shall not be disturbed in any way.	**Complied** No Sand dune and mangroves are present on the site.
(viii)	A copy of the clearance letter will be marked to the concerned Panchayat / local NGO, if any, from whom any suggestion / representation has been received while processing the proposal.	**Complied** This EC is just a bifurcation of original EC of LTSB.
(ix)	The Tamil Nadu Pollution Control Board shall display a copy of the clearance letter at the Regional Office, District Industries Centre and	**Complied** The condition does not pertain to project proponent

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance

<table>
<tr><th>S. No.</th><th>Conditions</th><th>Compliance Status</th></tr>
<tr><td></td><td>Collector's Office/Tehsildars Office for 30 days.</td><td></td></tr>
<tr><td>(x)</td><td>The funds earmarked for environment protection measures shall be maintained, in a separate account and there shall be no diversion of these funds for any other purpose. A year-wise expenditure on Environmental safeguards shall be reported to this ministry</td><td>Complied.

Separate budget for the Environment Protection is earmarked every year. All the expenses are recorded in advanced accounting system of the organization.

Expenditure for Environment Management measures during Oct-2019 to Mar-2020 is Rs. 37.1 Lakhs. The breakup details are as follows;
<table>
<tr><th>S. No.</th><th>Description of Work</th><th>Cost (Rs.)</th></tr>
<tr><td>1</td><td>Comprehensive Environmental Monitoring</td><td>4.07</td></tr>
<tr><td>2</td><td>AAQ/NL/SM Survey & STP Treated Water Quality analysis</td><td>0.64</td></tr>
<tr><td>3</td><td>Training and Awareness program</td><td>1.8</td></tr>
<tr><td>4</td><td>Integrated Waste Management & Pollution Under Check Facility</td><td>2.27</td></tr>
<tr><td>5</td><td>Hazardous Waste Management</td><td>0.32</td></tr>
<tr><td>6</td><td>Environmental Studies</td><td>28.0</td></tr>
<tr><td>7</td><td>STP"s O&M</td><td>7.24</td></tr>
<tr><td>8</td><td>House Keeping</td><td>23.29</td></tr>
<tr><td>9</td><td>Greenbelt Maintenance</td><td>10.75</td></tr>
</table></td></tr>
<tr><td>(xi)</td><td>Full support shall be extended to the officers (this Ministry's Regional Office at Chennai and the officers of the Central and State Pollution Control Boards by the project proponents during their inspection for monitoring purposes, by furnishing full details and action plans including the action taken</td><td>Noted for Compliance.
Full support will be extended to the officers of RO-MoEF & CC Chennai, CPCB & TNPCB during their inspection and site visit. During the compliance period monthly visit was made by TNPCB Officials to monitor the compliance and all the necessary support were extended and the same shall be continued in future</td></tr>
</table>

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
	reports in respect of mitigative measures and other environmental protection activities.	also.
(xii)	In case of deviation or alteration in the project including the implementing agency, a fresh reference shall be made to this ministry for modification in the clearance conditions or imposition of new ones for ensuring environmental protection.	**Noted for Compliance** There is no deviation or alteration in the project including implementing agency.
(xiii)	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.	**Noted for Compliance.**
(xiv)	This Ministry or any other competent authority may stipulate any other additional conditions subsequently, if deemed necessary, for environmental protection, which shall be complied with.	**Noted for Compliance.**
(xv)	The Project proponents shall inform the Regional Office at Chennai 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** The same has been Complied by LTSB before bifurcation itself.
EC & CRZ Amendment letter No. 10-130/2007- A.III dated 12.05.2010:		
(i)	The details of combined effect on both the Ports (i.e. Ennore Port and Kattupalli Port) shall be carried out to monitor the impact of the post-dumping. This model study shall be carried out for a period of one year.	**Complied** M/s LTSB has already carried out detailed modelling study to understand impact of post dumping and report was submitted to Ministry. No dumping was being carried by MIDPL during the period Oct-2019 to Mar-2020. MIDPL has engaged Institute of Ocean Management, Anna University, Chennai for shoreline Change study. Report of the same is attached as **Annexure – II.**
(ii)	A comparison between model study and actual dumping shall be carried out to examine the impacts both on North-East and South-West of the	**Complied** Comparison between model study and actual dumping was made to examine the impacts and report was submitted to

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
	Ports and shall be submitted to the Ministry,	Ministry by LTSB. No dumping was being carried by MIDPL during the period Oct-2019 to Mar-2020. MIDPL has engaged Institute of Ocean Management, Anna University, Chennai for shoreline Change study. Report of the same is attached as **Annexure – II.**
(iii)	No reclamation of the areas outside the Port limit and Buckingham Canal shall be carried out.	**Being Complied** No reclamation of the areas outside Port Limit and Buckingham Canal is being carried out.
EC & CRZ Extension of validity letter No. 10-130/2007- XIII dated 17.12.2014:		
(i)	The cargo should only include (i) Container 21.60 MTPA, (ii) Ro-Ro – 0.22 MTPA, (iii) Project cargo – 0.44 MTPA, (iv) Break bulk/General cargo (Barytes/Gypsum/Limestone/Granite/ Steel cargo) – 1.82 MTPA and (v) Edible oil, CBFS, Base oil and Lube oil and non-hazardous liquid cargo - 0.57 MTPA	**Being Complied**.
(ii)	All the conditions stipulated by the Tamil Nadu Coastal Zone Management Authority (TNCZMA) vide letter no. 6064/EC.3/2014-1 dated 26.06.2014, shall be strictly complied with.	**Complied** All the conditions stipulated by the Tamil Nadu Coastal Zone Management Authority (TNCZMA) vide letter no. 6064/EC.3/2014-1 dated 26.06.2014 are being complied. Compliance status of the same is enclosed as **Annexure – V**
(iii)	No additional land should be utilized for the proposed development.	**Complied**
(iv)	As committed, the local traffic should not be disturbed.	**Complied** Separate road available for local traffic.
5	These stipulations would be enforced among other 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, 991, the Hazardous Chemical (Manufacture, storage and Import) Rules, 1989, Solid Waste Management Rules,	**Noted for Compliance.**

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
	2016 and the Coastal Regulation Zone Notification, 2011 and its subsequent amendments made there under from time to time.	
6	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act 1972, etc shall be Obtained, as applicable by project proponents from the respective competent authorities.	**Complied.** All the statutory approvals as applicable have been obtained. Clearance from Chief Controller of Explosives, Fire Department, Civil Aviation Department has been obtained.
7	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 Tamil Nadu Pollution Control Board and may also be seen on the website of the Ministry of Environment and Forests at http://envfonnic.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 Chennai.	**Complied**. Copy of the same is already submitted along with the Compliance report for the period Oct-2018 to Mar-2019.
8	Any appeal against this Environmental Clearance shall lie with the National Environment Appellate Authority, if preferred, within a period of 30 **day** as prescribed under section 11 of the National Environment Appellate Act, 1997.	**Noted.**
9	Status of compliance to the various stipulated environmental conditions	**Being complied**. Six monthly Compliance Report of CRZ &

Half yearly Compliance report on conditions stipulated in Environmental & CRZ Clearance		
S. No.	**Conditions**	**Compliance Status**
	and environmental safeguards will be uploaded by the project proponent in its website.	EC Clearance is uploaded on company website regularly (https://www.adaniports.com/ports-downloads)
10	This Environmental and CRZ Clearance is valid till 2" July, 2019.	**Noted.**
11	This issue with the approval of the Competent Authority.	**Noted.**

Enclosures:

Annexure Number	Details of Annexure
Annexure I:	Compliance to RC No. P1/2004/2008, dated 21.10.2008 of Department of Environment, Chennai
Annexure II:	Shoreline Changes Study Report, Institute of Ocean Management, Anna University
Annexure III:	Annual Hazardous Waste Returns – Form IV (2018-19)
Annexure IV:	Environmental Monitoring reports for the period Oct-2019 to Mar-2020
Annexure V:	Compliance to TNSCZMA conditions during Oct-2019 to Mar-2020
Annexure VI:	Mock Drills carried out during Oct-2019 to Mar-2020

adani Ports and Logistics	Marine Infrastructure Developer Pvt Ltd	From : October 2019 To : March 2020

Status of Compliance to RC No. P1/2004/2008, dated 21.10.2008 of Department of Environment, Chennai

Annexure -1

Sl. No	Conditions	Compliance
i	The unit shall carry out dumping/ land filling at dredged material only on land which is not covered under CRZ	**Noted for Compliance**
ii	The unit shall not carry out any ship breaking activity	**Not applicable**
iii	The unit should design that the waste water should be recycled 100% and to be used for developing greenery etc., and there should not be any waste water let out.	**Complied** Domestic waste water generated is being treated in STP's. Treated water is being reused for Horticulture / green belt purpose
iv	The unit should tie - up with institutions like Centre for Environmental Studies or IIT for the periodical monitoring during construction phase so as to ensure the adoption of Safety measures as per the Environmental Management Plan [EMP].	**Complied.** LTSB carried out the studies during Construction Phase.
v	Before commencing construction activities, Proper resettlement for the local the unit should ensure the proper resettlement of local inhabitants residing at the project area to the satisfaction of District Collector and submit a report to the Department of Environment.	**Not applicable.** Complied by M/s. LTSB. Rehabilitation & resettlement was carried out completely as per law / State Government at the time of project implementation. Bifurcation of original CRZ & EC of LTSB obtained vide File no: 10-130/2007- A.III dated 09/02/2018
General Conditions		
a	There should not be any extraction of Ground Water in CRZ.	**Noted for compliance.** Presently unit is procuring desalinated water from M/s. Chennai Metropolitan Water Supply and Sewerage Board, Chennai.
b	The unit should obtain planning permission for their constructions from the CMDA/Department of Environment before commencing the constructions	**Not applicable.** Required permission from concerned authorities was taken by M/s. LTSB before commencing the constructions.

adani Ports and Logistics	Marine Infrastructure Developer Pvt Ltd	From : October 2019 To : March 2020

Status of Compliance to RC No. P1/2004/2008, dated 21.10.2008 of Department of Environment, Chennai

c	The proposed activities should not cause coastal erosion and alter the beach configuration	**Complied.** To ascertain the same regular Shore line analysis is being carried out. MIDPL has engaged Institute of Ocean Management, Anna University, Chennai for shoreline Change study. Report of the same is attached as **Annexure – II.**
d	No fencing or barricading along the pipeline alignment and parallel to the coast is permissible in CRZ.	**Agreed for compliance.** All activities permissible as per CRZ notification 2011 & EC&CRZ clearance will only be carried out.
e	No blasting or drilling activities in CRZ is permissible.	**Agreed for compliance.** All activities permissible as per CRZ notification 2011 & EC&CRZ clearance will only be carried out.
f	The proponent should not prevent public from easy access to the beach.	**Being complied.** MIDPL will not block the access point to beach for the public.
g	Chemical waste generated and the sewage generated, if any should not be discharged in to the sea.	**Complied.** No chemical waste generated. Sewage waste water generated is being treated in STP's and treated water is used in horticulture / greenbelt maintenance.
h	The proponent should implement the EMP including the Green Belt as envisaged in the EIA report.	**Complied.** The EMP is being implemented in letter & spirit. Adequate Greenbelt has been developed & is being maintained in the port area 6,050 Nos. of trees has been planted as on date. 

adani Ports and Logistics	Marine Infrastructure Developer Pvt Ltd	From : October 2019 To : March 2020
Status of Compliance to RC No. P1/2004/2008, dated 21.10.2008 of Department of Environment, Chennai		

i	The project activity should not affect the coastal ecosystem including marine flora and fauna.	**Complied** Marine water & Sediment quality are being monitored through NABL accredited laboratory on monthly basis. There is no impact on water quality in the vicinity. The details of Marine Water quality monitoring report for the period October 2019 to March 2020 is enclosed as **Annexure-3**.
j	The proponent should not undertake any activity, which is violate of provisions of CRZ Notification 1991 and the subsequent amendments.	**Being complied.** All activities permissible as per CRZ notification 2011 & EC&CRZ clearance will only be carried out.
k	The CRZ Clearance will be revoked if any of the conditions stipulated in not complied with.	**Noted for compliance**

Annexure - II

PROJECT REPORT ON

SHORELINE CHANGE STUDY IN AND AROUND KATTUPALLI PORT, PONNERI TALUK, TAMIL NADU

Prepared for

M/S MARINE INFRASTRUCTURE DEVELOPER PRIVATE LIMITED (MIDPL)
KATTUPALLI PORT, KATTUPALLI.

Prepared By

INSTITUTE FOR OCEAN MANAGEMENT

ANNA UNIVERSITY

CHENNAI-60002.

MARCH - 2020

PROJECT SUMMARY

The shoreline is continually affected via sea level variation, climate change and ecosystem systems that happen over a wide scope of time-scales. The blend of natural and manmade activities often exacerbates the shoreline change and increases the risk factors to coastal community. The changing situation of shoreline after some time is of basic significance to coastal scientists, engineers, and managers for coastal management and engineering design for coastal development. Exact shoreline data is required for the plan of structure designing, structures alignment/confirmation of numerical models, Coastal developmental activities, assessment of sea-level rise, preparation of hazard zones, formulation of policies, the regulation of coastal developmental activities, etc. A systematic long-term shoreline change study can provide information on shoreline reorientation due to structures, changes in beach width, land loss, land gain and historical rate of changes. Major causes for shoreline change Shoreline is subject to change due to natural and manmade activities

Procedures used to delineate the shoreline changes depend on Remote Sensing and land-based Surveying techniques. The present project is done for the shoreline length of approximately 69 km from Ennore Creek to Sriharikota Coast. Demarcation of shorelines and profile information has been collected using Real-time Kinematic-Global Positioning System (RTK-GPS) technology. This method includes the accumulation of exact shore-parallel and shore-typical GPS positions by walk along the shore, so that accurate shoreline and profile information was captured. The shoreline vectors were contrasted with one another to decide shoreline change along this coast. The application of GPS surveying techniques combined with the refinement of appropriate methods for data collection and analysis provides a better understanding of beach changes, sediment transport, and other

Shoreline change analysis was attempted in order to calculate the rate of change of the shoreline from the time series of multiple shoreline positions. The spatial and temporal analysis of shoreline analysis for the Kattupalli Port indicates for the period between

1988 to 2019. Remote Sensing Data used are derived from 1988 Landsat 4- 5 TM to Landsat 8 OLIS data of 2019, the data has been categorized into 1988 to 2019 (32 years), 1988 to 1999 (12 years), 2000 to 2009, (10 years) and 2010 to 2019 (10 years) . To derive the Shoreline from the satellite data, band ratio of Red band to IR band is done. The shorelines are digitized and saved along with the appropriate MM/DD/YYYY added to the attribute table.

Long-term rates of change are calculated using Arc-GIS, DSAS Version 4 (Digital Shoreline Analysis System (DSAS) is an extension for the ArcGIS, developed by USGS), LRR (Linear Regression Rate) statistics for all 32 different shorelines positions used for the classification of the shoreline according to erosion/accretion. The rates of change presented in this report represent conditions up to the date of the most recent shoreline data and therefore are not intended for predicting future shoreline positions or rates of change. The results are classified in three categories i.e. erosion, stable and accretion.

Using the extension, transects are laid for every 150 m using LRR statistics method. The results of Linear Regression Rate (LRR) presents the classification of the shoreline according to erosion/accretion for every 150 meter with a transect length of 2000 meter is analyzed and stored into attribute table. The coastal region of study area coast (69 km) is undergoing a rapid change due to the presence of the river mouth in both the northern and southern part of the study area. A maximum accretion rate of 1.2 m/year has been observed in the vicinity of the Kosasthalaiyar River, causing sedimentation in River mouth. The study region was divided into 3 zones according to the coastal morphology. The average erosion is − 1.66 m/year (Fig. 8), and the accretion trend is around + 2.5 m/year.

1. INTRODUCTION

Coastal shorelines, the interface between land and sea, change variably in response to one or more factors, which may be morphological, climatologically or geological in nature. Shoreline geometry depends on the interactions between and among waves, tides, rivers, storms, tectonic and physical processes. They have been under hard pressure throughout history and the situation is likely to continue in the future.

Shoreline change is an after effect of a procedure called littoral transport, which is in charge of moving eroded material in the coast by means of waves and currents in the close shore zone. Erosion and Accretion can both present challenges to coastal communities, coastal infrastructures and the adjacent estuarine systems. Knowledge and assessment of the changes in shoreline position have proved crucial in the overall understanding of dynamics in coastal areas and the morpho dynamic processes driving the change.

Shorelines are vulnerable to change driven by sea-level rise, varying coastal climates including marine, astronomical or other meteorological factors. Changes (whether short-term or long-term) in the position and geometry of shorelines are very important in the understanding of coastal dynamism and the management of coastal areas. Therefore, quantitative analysis of shoreline changes at different timescales is very important in understanding and establishing the processes driving erosion and accretion, computing sediment budget, identification of hazard zones, as a basis for modeling of morpho dynamics, and for coastal management and interventions.

Shoreline change is an issue of concern in coastal management. It is well known that the shoreline along Chennai coast is subjected to oscillations due to natural and manmade activities. Significant erosion has observed in northern side of Ennore over the last 2 decades. The study region located north of Chennai city on the East coast of India is facing shoreline erosion/accretion related problems after the

introduction of both Ennore and Kattupalli Ports.

The focus of this study is to monitor and characterize the variability of the shoreline's position and to identify seasonal, annual, and long-term trends. The Land based surveys were carried out from March 2019 to June 2019. This report describes an application of Real-time Kinematic-Global Positioning System (RTK-GPS) technology and digitizing of shorelines from satellite images to detect and analyze the spatial changes as well as quantify the result of shoreline change due to the construction of Kattupalli Port.

2. STUDY AREA

The study area is located in between Tamil Nadu Coast to Andhra Pradesh Coast (Ennore Creek to Sri Harikota) approximately 69 km as shown in fig 2.1. It is located in between 13º15'18.58"N & 80º20'44.92" E to 13º18'54.79" & 80º20'59.72". The Study area covers Kamarajar Port, Kattupalli Port, Sriharikota, and Six Coastal area (Kattupalli, Kalanji, Karungali, Thangalperumbalam, Gunangkuppam, Pulicat) in Tamil Nadu.

Kamarajar Port is located on the east coast at Latitude 13° 15' 30" N and Longitude 80° 21' 00" E, Kamarajar Port Limited, formerly Ennore Port, is located on the Coromandel Coast about 18 km north of Chennai Port, Chennai, it is the 12th major port of India, and the first port in India which is a public company. Ennore port construction started in the year of 1996-1997 and commencement of operation since 2001.The Kamarajar Port Limited is the only corporatized major port and is registered as a company. Chennai Port Trust acquired around 67% stake of Centre in the Kamarajar Port Limited on 27 March 2020. The remaining 23 percent was held by the Chennai Port Trust.

Kattupalli Port is a modern port in north Chennai and a tailor made alternative for cargo owners over the congested Chennai Port. Kattupalli Port commencement of

construction in the year of 2007-2008 and operational since 2013. Kattupalli Port lies 24 km north of Chennai Port, and can handle 24.6 MMT cargo, including containers, break bulk and project cargo. It can berth fully loaded capesize vessels and container vessels.

TEMPERATURE

The average maximum monthly air temperature varies between 37° C in May and June to about 29° C during December and January. The average minimum temperature varies between 28° C in May and June to 21° C in January and February. The highest recorded temperature is 43° C and the lowest recorded temperature is 15° C.

OCEANOGRAPHY

TIDES

The tides at Ennore are semi-diurnal in nature with a tidal range, relative to the Chart Datum (CD), as follows: Highest high water level (HHWL) + 1.50 m , Mean high water springs (MHWS) + 1.10 m , Mean high water neaps (MHWN) + 0.80 m , Mean Sea Level (MSL) + 0.69 m , Mean low water neaps (MLWN) + 0.40 m , Mean low water springs (MLWS) + 0.10 m , Lowest low water level (LLWL) - 0.10 m.

CURRENTS

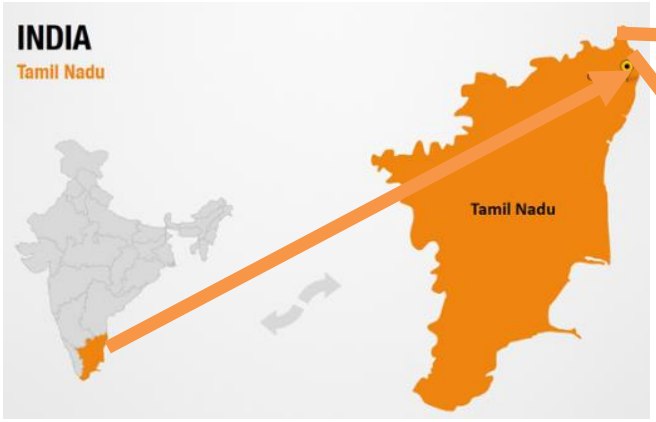
During the NE monsoon, the current is directed southwards while during the SW monsoon the current is directed northwards. The currents in the coastal zone are approximately 0.15 to 0.20 m/s at a water depths of 15 m and 10 m, measurements.

WAVES

As the near-shore area off Ennore is sheltered from the westerly winds by the mainland, the strong southerly to westerly winds during the SW monsoon do not

cause high waves due to the limited fetch available. Consequently, the wave conditions at Ennore are moderate. Waves at Ennore, approach predominantly from two directions - 135° N during March - September and 90° N during November – January. During the transition period (February and October), waves approach from 115° N.

STUDY AREA MAP



Location	In between Tamil Nadu Coast to Andhra Pradesh Coast (Ennore Creek to Sri harikota)
Length	Approximately 69 km
Latitude & Longitude	From 13º15’18.58” & 80º20’44.92”
	To 13º18’54.79” & 80º20’59.72”
Area Covers	Ennore Port, Kattupalli Port, Sriharikota, and Six Coastal areas in TamilNadu

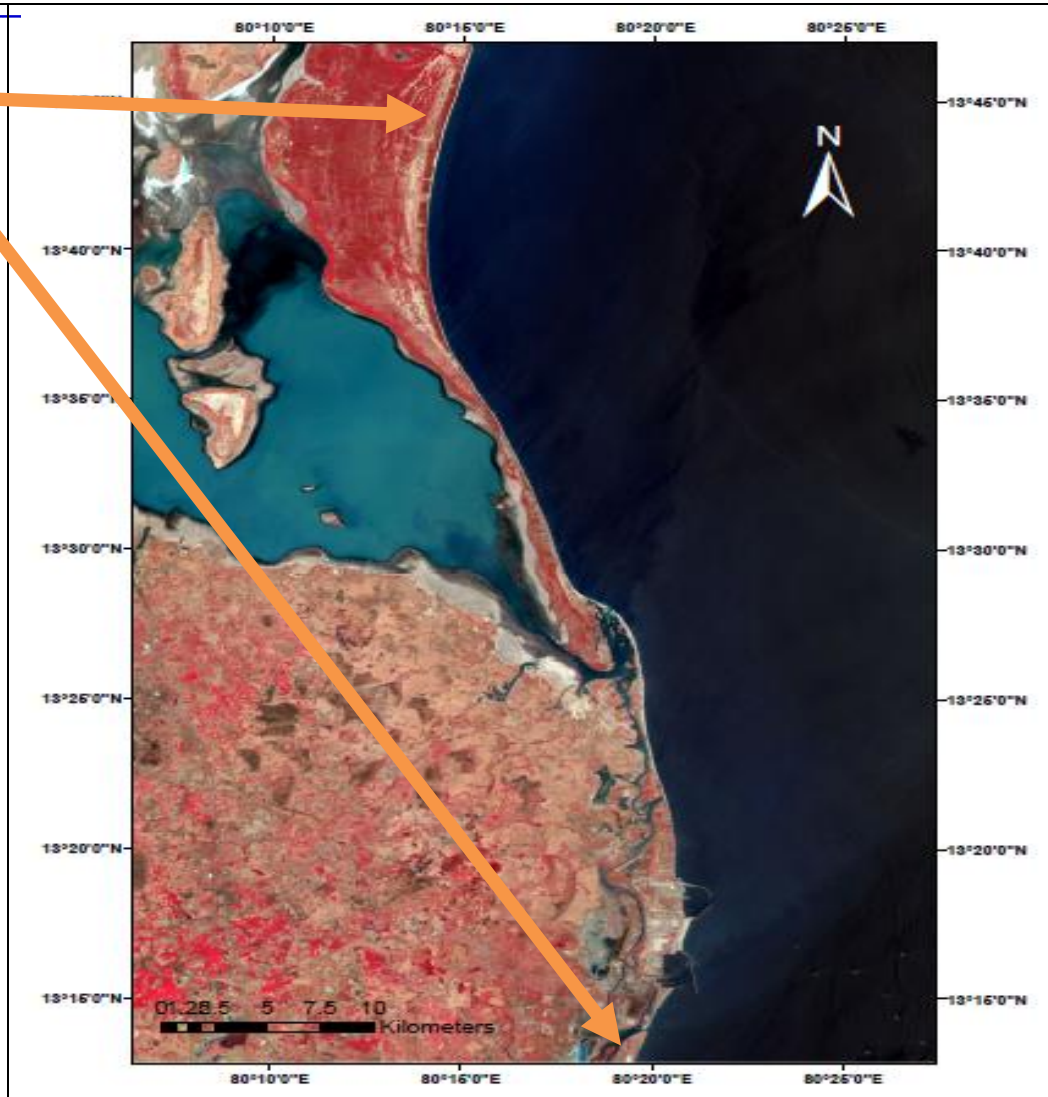


Fig. 2.1 STUDY AREA MAP

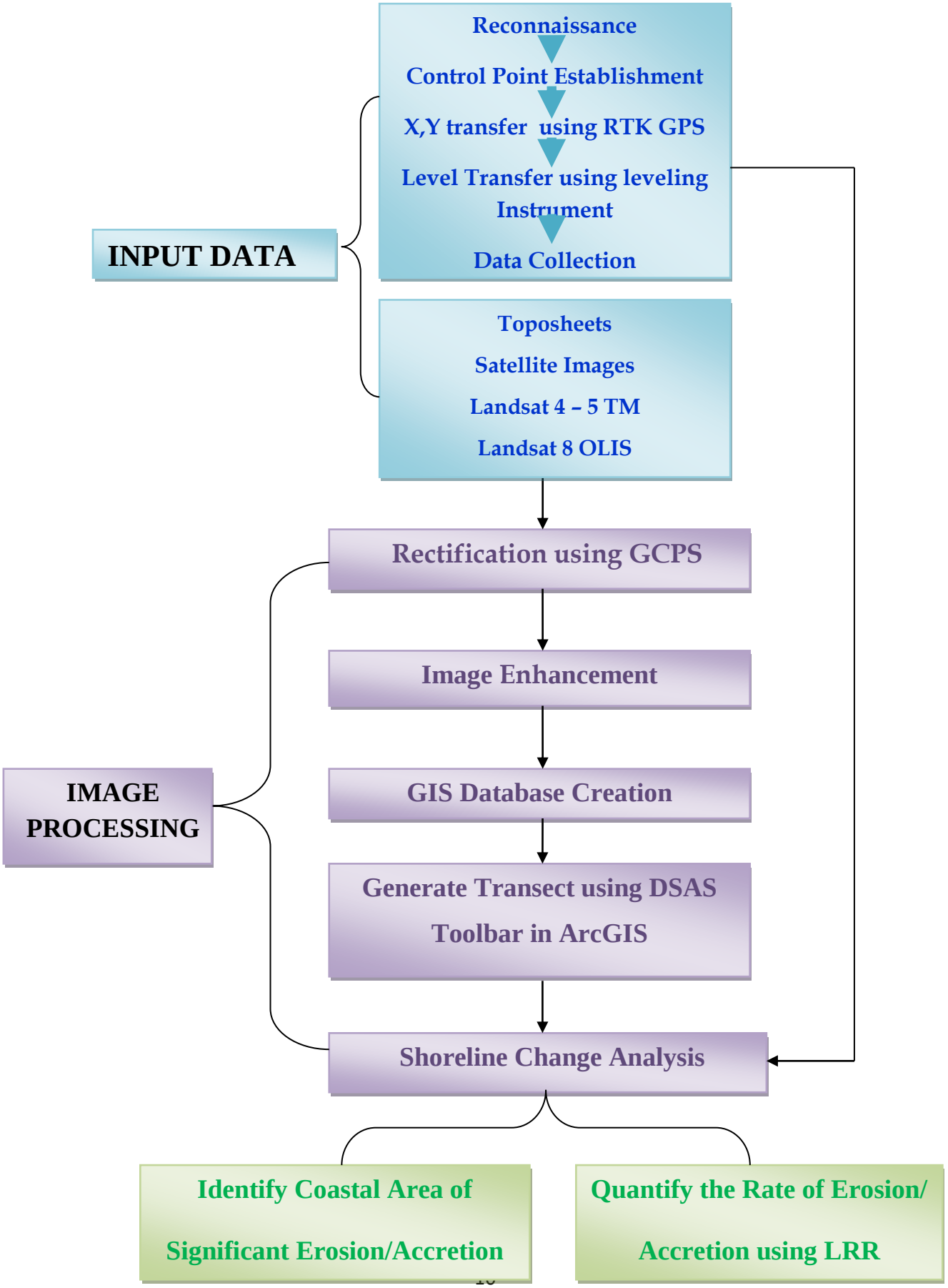
3. METHODOLOGY ADOPTED FOR SHORELINE CHANGE ANALYSIS

The following two methodologies have been adopted for extracting the shoreline information for this study (Fig 3.1). Methodologies used are as follows

1. Ground based investigation (using Real Time Kinematic GPS)
2. Satellite Remote Sensing based investigation

Demarcation of Temporal shoreline information during Pre-construction has been extracted through satellite image based Remote Sensing technology. Demarcation of shorelines and profile information during Post-construction has been collected using Real-time Kinematic-Global Positioning System (RTK-GPS) technology. This method involves the collection of precise shore-parallel and shore-normal GPS positions by walk along the shore, so that accurate shoreline and profile information was captured. The shoreline vectors were compared to each other to determine shoreline change along this coast. The application of GPS surveying techniques combined with the refinement of appropriate methods for data collection and analysis provides a better understanding of beach changes, sediment transport, and storm impacts.

Shoreline geometry and position are perhaps the most basic indicators with which to evaluate changes in coastal regions. Digital Shoreline Analysis System (DSAS) has therefore been used in investigating the dynamics of shoreline movements and changes at shorter and longer / historical time scales. However, it is only by including longer time periods (decades to centuries) of investigation that a wider range of past coastal events, magnitudes and frequencies can be linked with the shoreline morpho dynamics.



3.1 METHODOLOGY ADOPTED FOR SHORELINE CHANGE

3.1 LANDSAT IMAGE

The Landsat program is an archive of earth images and initiated by the U.S Department of Interior and NASA under the name ERTS (Earth Resources Technology Satellites). There are various images from different bands of a satellite that can be used based on the needs. Landsat represents the only source of global, calibrated, moderate spatial resolution measurements of the Earth's surface that are preserved in a national archive and freely available to the public.

3.2 ARCGIS

ArcGIS is a geographic information system (GIS) for working with maps and geographic information. It is used for creating and using maps, compiling geographic data, analysing mapped information, sharing and discovering geographic information, using maps and geographic information in a range of applications, and managing geographic information in a database.

3.3 DIGITIZING

Digitizing in GIS is the process by which coordinates from a map, image or other sources of data are converted into a digital format by tracing in a geographically correct way to obtain information from images or maps. A Shoreline change layer is prepared for the analysis of the various maps.

3.4 DIGITAL SHORELINE ANALYSIS SYSTEM (DSAS)

The Digital Shoreline Analysis System (DSAS) is an add-in to Esri ArcGIS desktop 10.4 that enables a user to calculate shoreline rate-of-change statistics from multiple historical shoreline positions. DSAS generates transects that are cast perpendicular to the reference baseline at a user-specified spacing alongshore as shown in the fig 3.2. DSAS measures the distance between the baseline and each shoreline intersection along a transect and combines date information, and positional uncertainty for each shoreline, the statistics used for DSAS has LRR (Linear Regression Rate). This project focuses on

calculation of LRR, to find out the shoreline change.

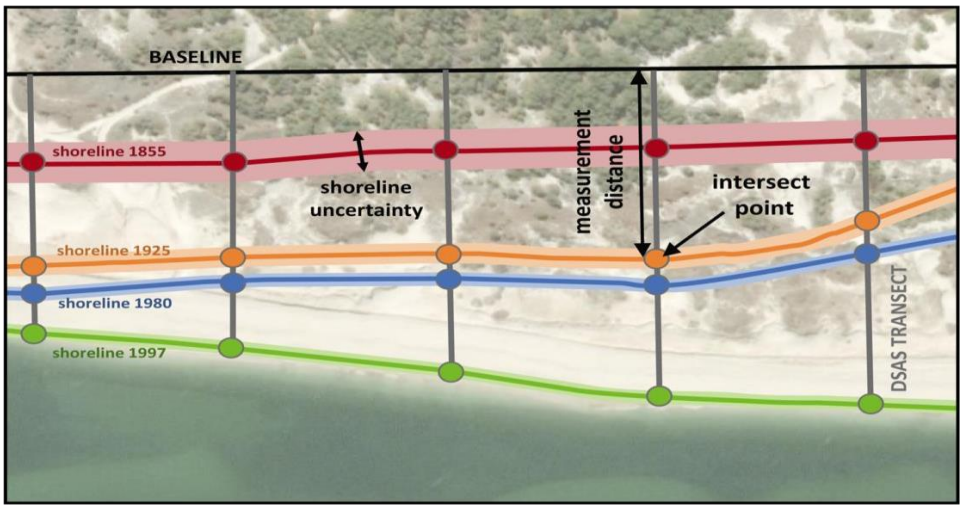


Fig 3.2 BASELINE, SHORELINE AND DSAS TRANSECT

3.5 LINEAR REGRESSION RATE (LRR)

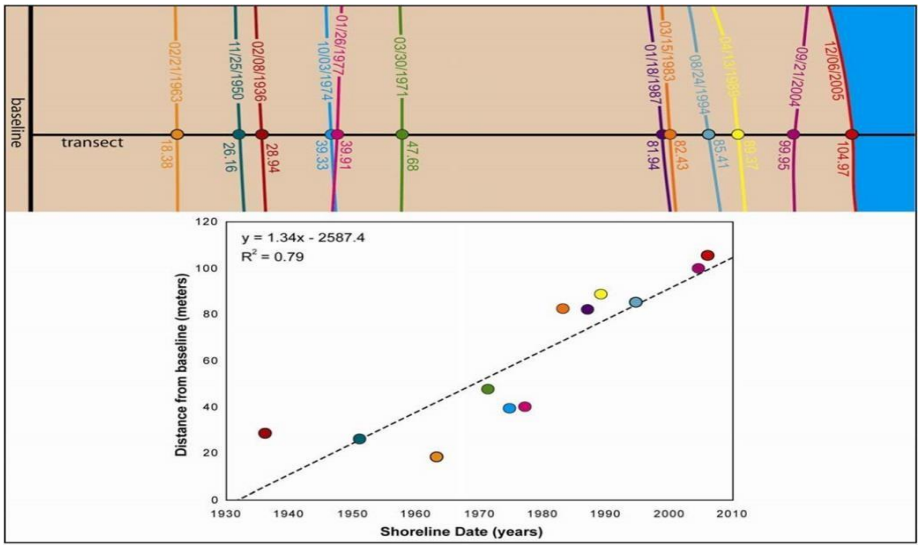


Fig 3.3 LINEAR REGRESSION RATE

A linear regression rate-of-change statistic can be determined by fitting a least-squares regression line to all shoreline points for a particular transect (fig 3.3). The regression line is placed so that the sum of the squared residuals (determined by squaring the offset distance of each data point from the regression line and adding the squared residuals together) is minimized. The linear regression rate is the slope of the line.

3.6 SHORELINE CHANGE ANALYSIS

Accretion and erosion on the shoreline can be analyzed using GIS by measuring the difference in past and present shoreline locations. The information about shoreline change is necessary for updating land cover maps and the management of natural resources. Shoreline extraction were done by using the band 5, 4, 3, 2 of the Landsat images. Erosion and accretion rate for the study area were analysed using DSAS (Digital Shoreline Analysis System). The Long-term analysis of the shoreline from the year 1988 to 1999, 2000 to 2009, 2010-2019 and 1988 to 2019 were accomplished using the Linear Regression Method.

4. RESULT & DISCUSSION

4.1 FIELD SURVEY

Ground based investigation:

The field survey started with reconnaissance survey, establishing the control points through Kattupalli Port for BenchMark and transfer Benchmark to Ennore & Karungalli, Ground Control Points (GCP) collections (fig 4.1).

RTK-GPS (GNSS) Field Survey Dates & Details:

1. March-02&03/03/2019 - Visited Kattupalli Port for BenchMark. Transfer Benchmark to Ennore & Karungalli, Ground Control Points (GCP) collections.
2. April- 05&06/04/2019 - Shoreline & Beach Profiles of First Month Survey (Ennore South, Kattupalli Port North & Karungalli).
3. May- 05 & 06/05/2019 - Shoreline & Beach Profiles of Second Month Survey(Ennore South, Kattupalli Port North & Karungalli).
4. June- 05&06/06/2019 - Shoreline & Beach Profiles of Third Month Survey (Ennore South, Kattupalli Port North & Karungalli).

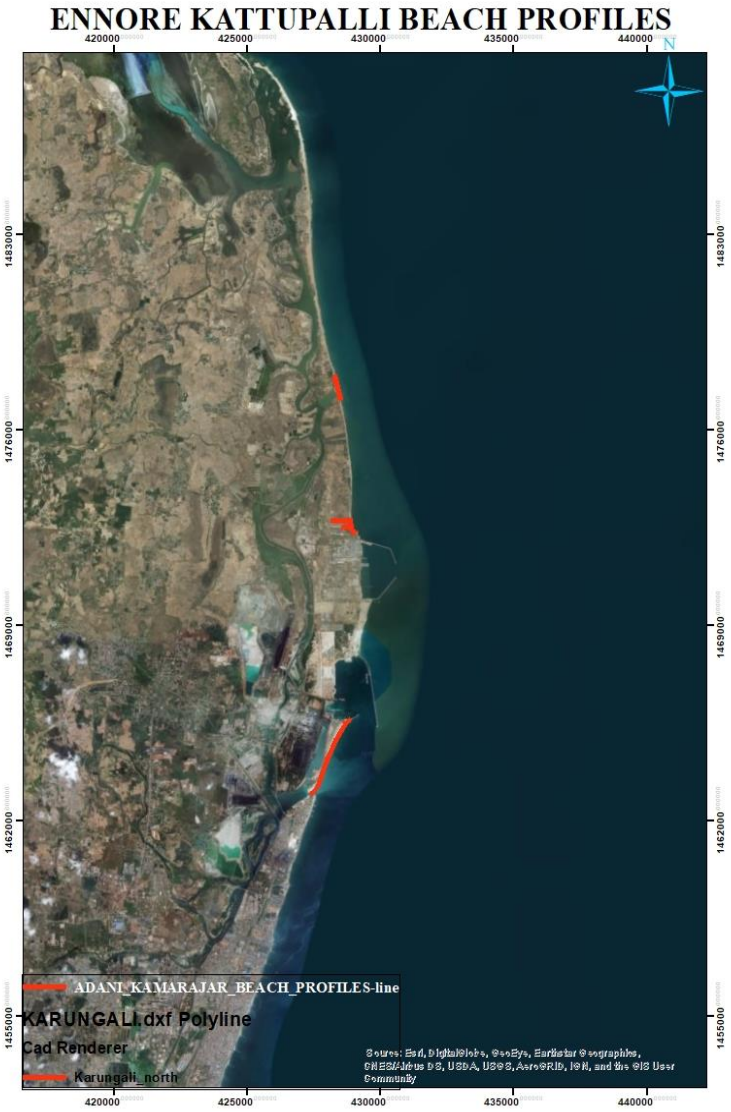


Fig 4.1 GROUND CONTROL POINTS (GCP) LOCATION

RECONNAISSANCE:

Reconnaissance was executed to understand the topography, site conditions, approach to Shoreline, RTK GPS Survey feasibility, identifying the suitable locations for Bench mark. All these information were compiled using RTK GPS by walking along the shore (fig 4.2).

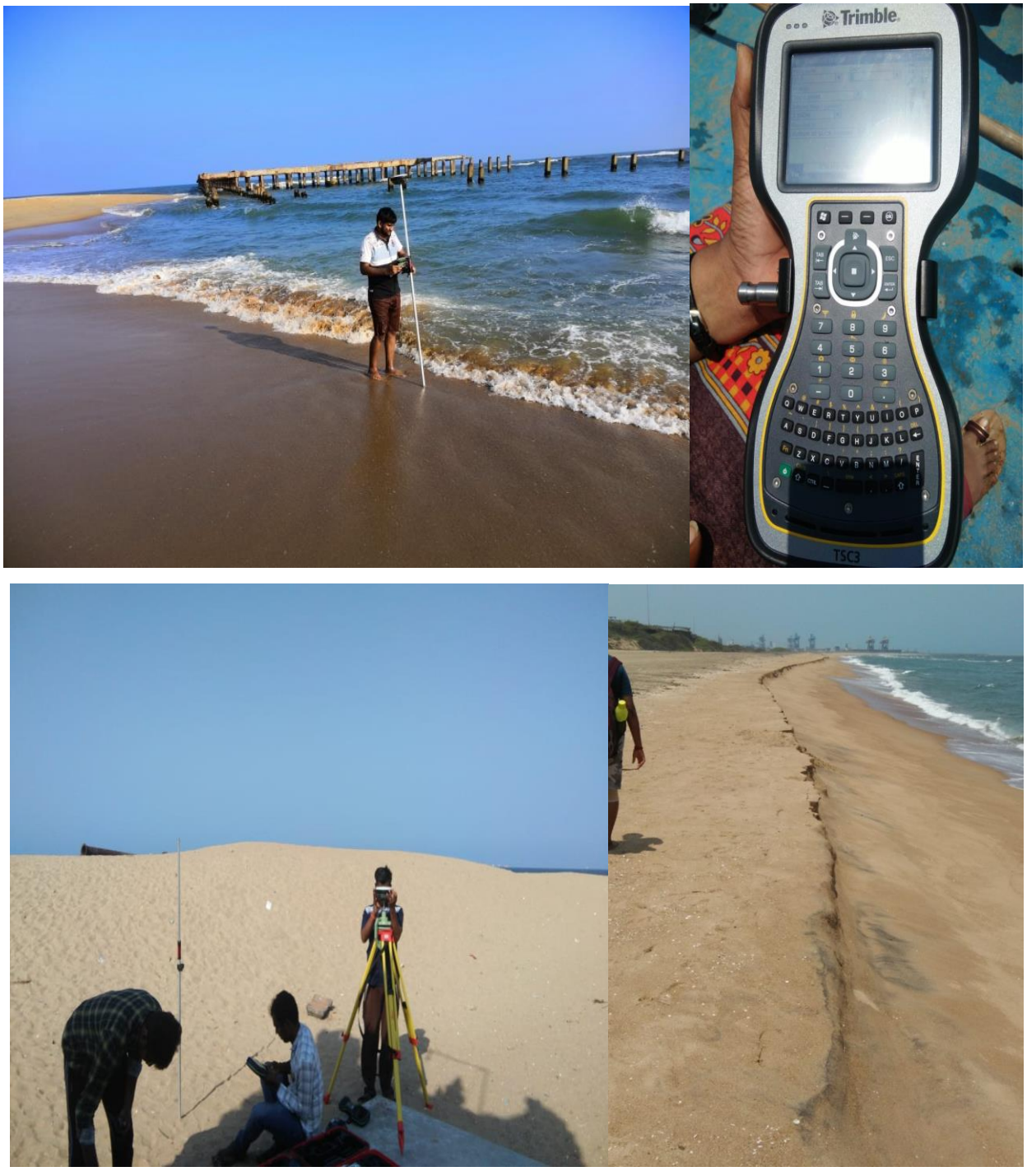


Fig 4.2 FIELD PHOTO

GROUND CONTROL POINT IN ENNORE:

This point has been established on the edge of the bridge across the Kosasthalaiyar river. This is right under the pipeline over bridge. The image below depicts the point. This point was established using the trimble R10s

Rover. The latitude, longitude and altitude values are calculated corresponding to a Fixed BenchMark established at Nettukuppam village (fig 4.3).

Fig 4.3 **GROUND CONTROL POINT IN ENNORE**

GROUND CONTROL POINT AT KATTUPALLI:

The ground control point established here is useful to survey along the coast between ennore port and L&T Ship Building works. This is located at the entrance to the L&T Ship Building. Located on top of a concrete structure, this is located in the parking lot adjacent to the wall. The underlying image depicts the location of the point (fig 4.4).

Fig 4.4 GROUND CONTROL POINT AT KATTUPALLI

GROUND CONTROL POINT AT KARUNGALI

The location of Ground Control Point at Karungali is on a bridge across the Kosasthalayar River. This point is located on a flat surface unaffected by the relaying of asphalt pavement.

Fig4.5 GROUND CONTROL POINT AT KARUNGALI

ESTABLISHMENT OF GROUND CONTROL POINTS (GCP)

Establishment of Ground Control Points (GCP) along the Ennore- Kattupalli-Karungali Stretch Using Real-time Kinematic-Global Positioning System (RTK-GPS) Technology. The following table 4.1 as shown about the latitude and longitude of the GCP.

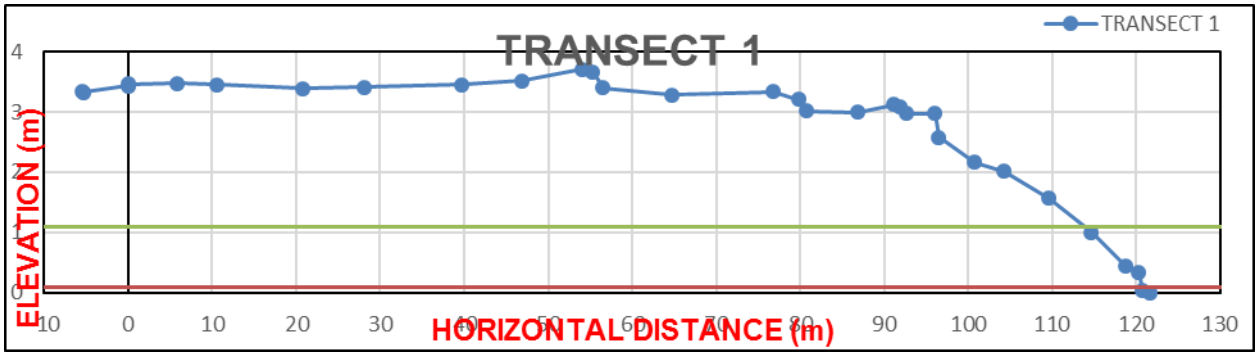
Table 4.1 ESTABLISHMENT OF GROUND CONTROL POINTS (GCP) AND TRANSECT PROFILES

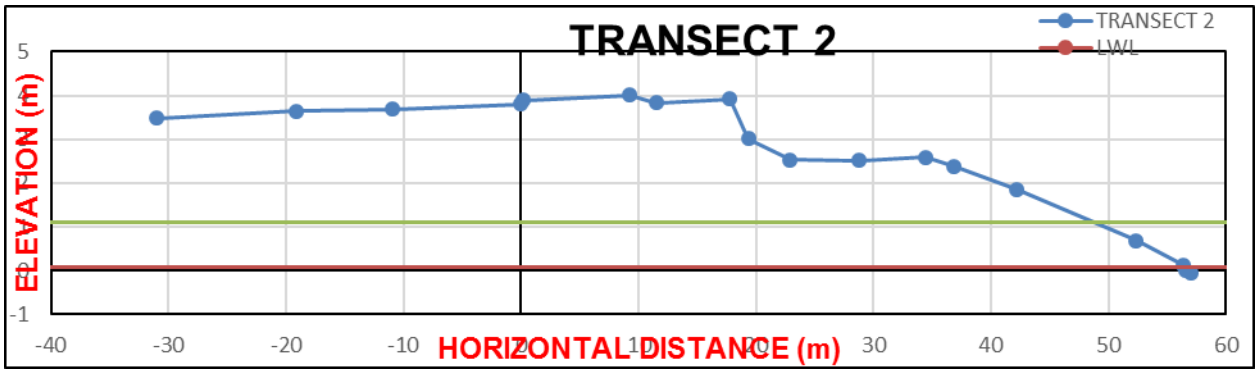
S.No	Establishment of GCP	Number of Transect Profiles	Latitute N	Longitude E
1.	Ennore South	5	13˚14'3"	80˚19'52"
			13˚14'12"	80˚19'57"
			13˚14'27"	80˚20'3"
			13˚15'00"	80˚20'17"
			13˚15'7"	80˚20'23"
2.	Kattupalli North	7	13˚19'01"	80˚20'39"
			13˚19'07"	80˚20'35"
			13˚19'17"	80˚20'34"
			13˚19'20"	80˚20'35"
			13˚20'01"	80˚20'36"
			13˚20'15"	80˚20'36"
			13˚20'26"	80˚20'37"
3.	Karungali	8	13˚21'33"	80˚20'23"
			13˚21'41"	80˚20'21"
			13˚21'47"	80˚20'19"
			13˚21'56"	80˚20'17"
			13˚22'04"	80˚20'15"
			13˚22'07"	80˚20'14"
			13˚21'14"	80˚20'13"
			13˚21'25"	80˚20'09"

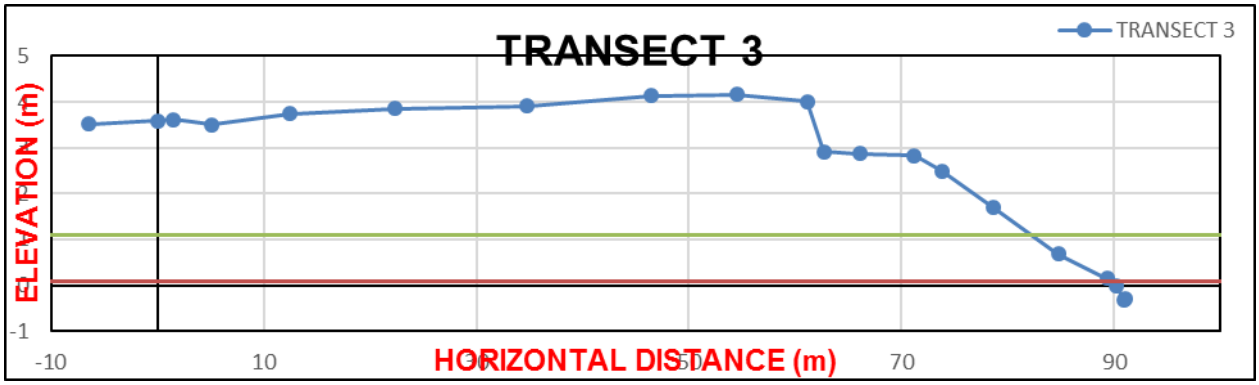
BEACH PROFILES AT ENNORE, KATTUPALLI AND KARUNGALI COAST

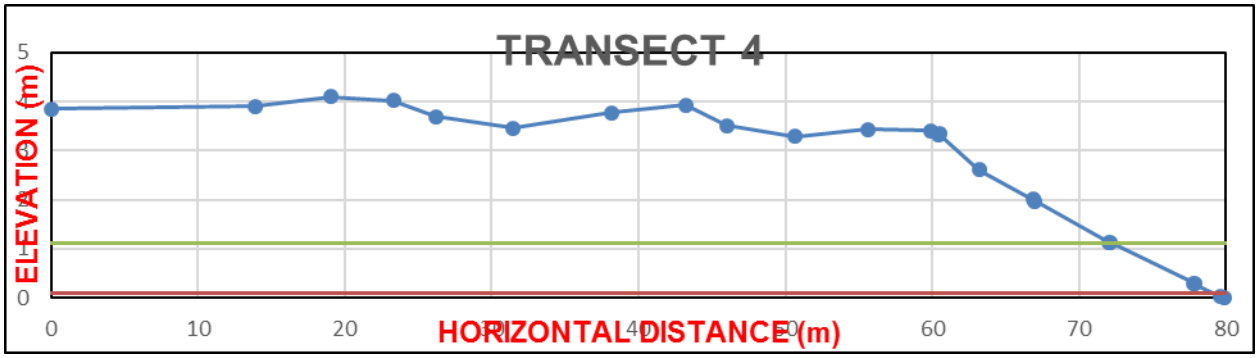
From the field survey, it has observed that the study area has subjected to highest high tide level of 3.5m and lowest low tide level of 0.10 m. The tidal currents are as 0.2m/s to 0.3 m/s during spring tides and 0.15 m/s to 0.20m/s during neap tide. The north and south trending channels of the Ennore creek connect it with Pulicat lake to the north and the south Kosasthalaiyar river. In general, during monsoon Kosasthalaiyar a river has discharged in to the sea. The combined effect of Kosasthalaiyar river discharge and the strong tidal currents induce morphological changes along the Ennore, Kattupali and Kalangi Coast irrespective of Ennore and Kattupalli Port. The graphs shows the details of beach profile at Ennore, Kattupalli and Karungali Coast.

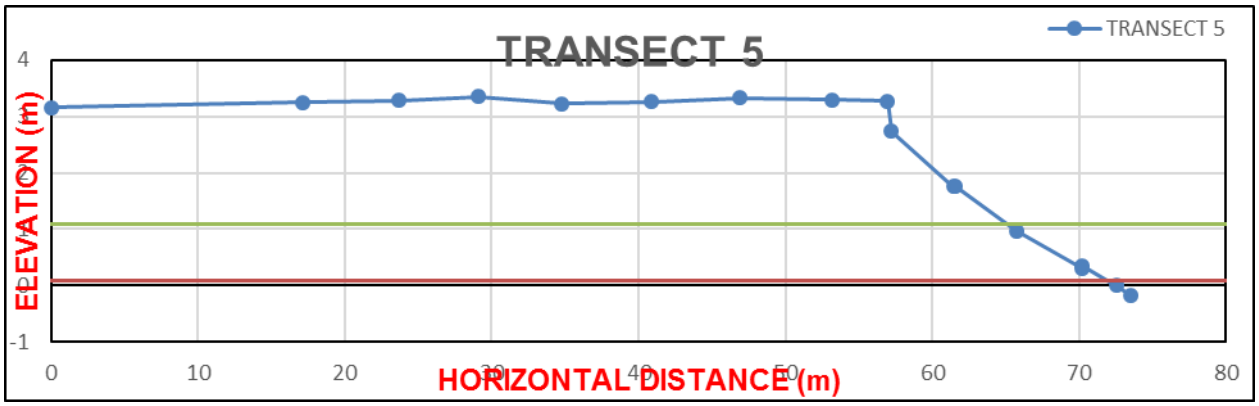
BEACH PROFILES @ ENNORE



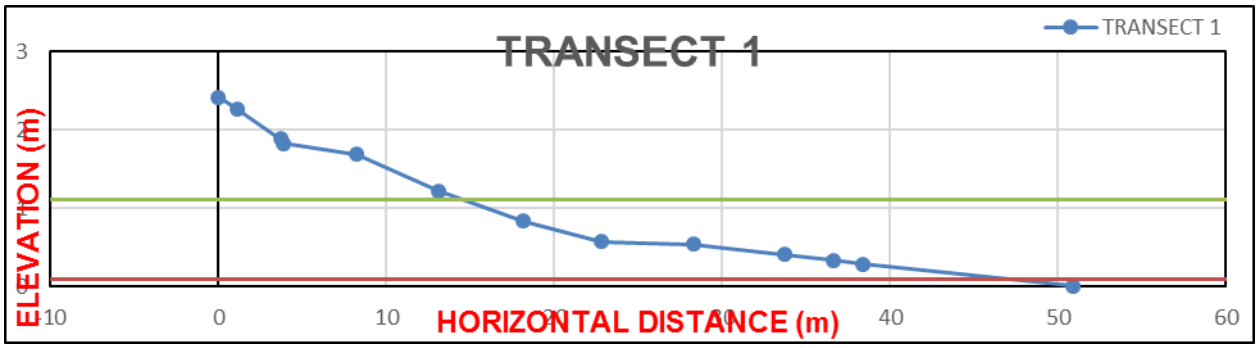


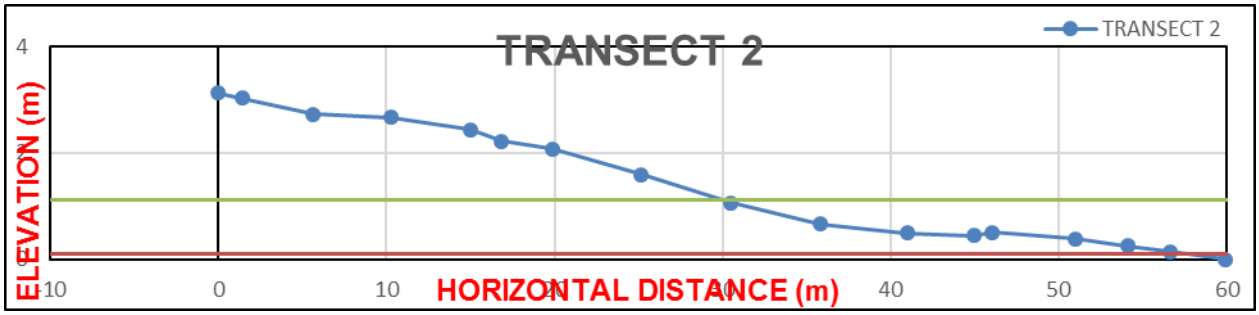


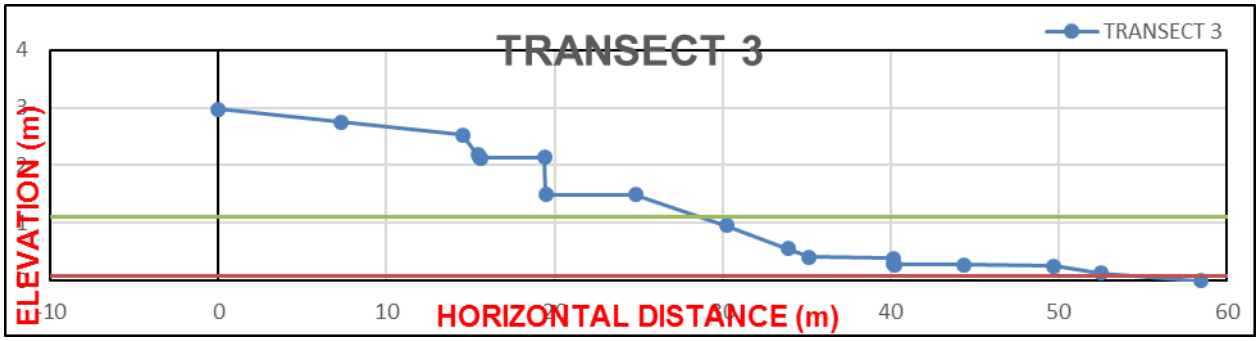




BEACH PROFILES @ NORTH of KATTUPALLI PORT




TRANSECT 2
TRANSECT 2
ELEVATION (m)
HORIZONTAL DISTANCE (m)
4
10
0
10
40
50
60


TRANSECT 3
TRANSECT 3
ELEVATION (m)
HORIZONTAL DISTANCE (m)
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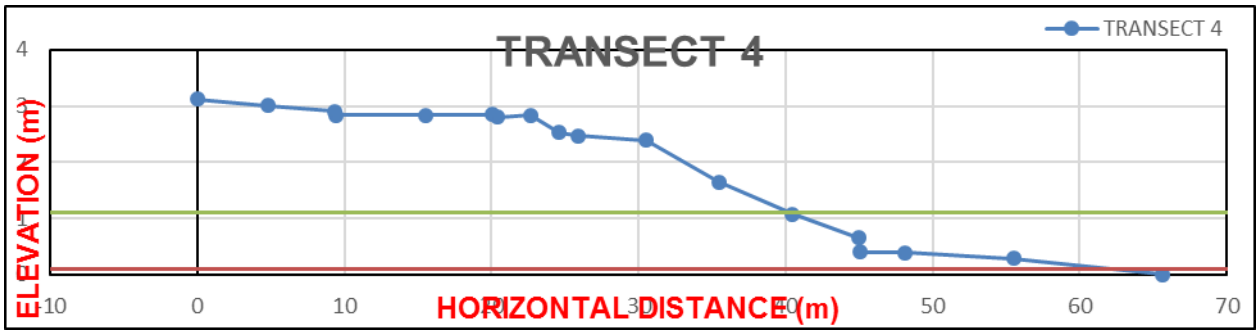
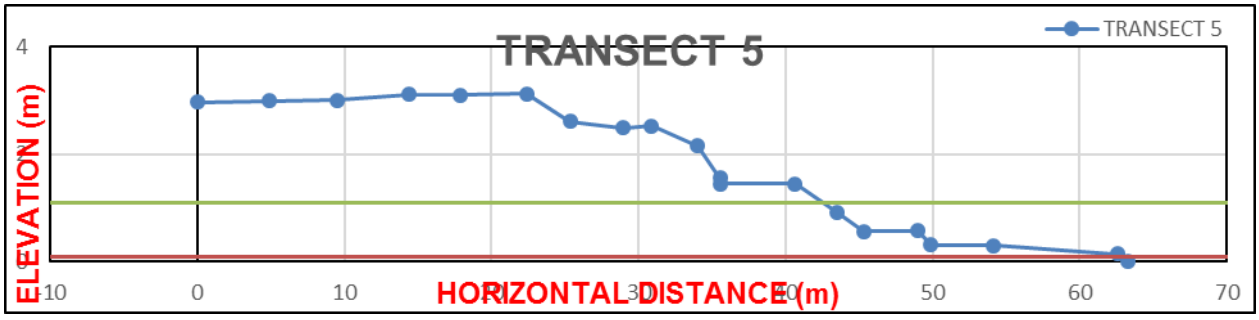
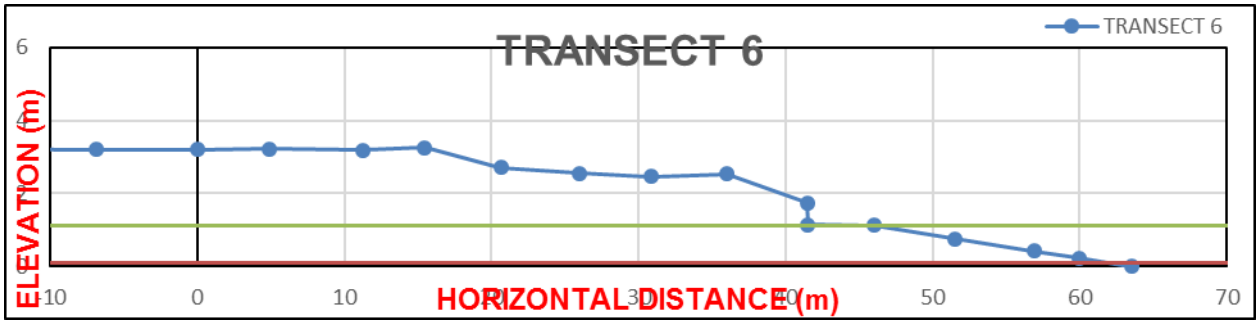
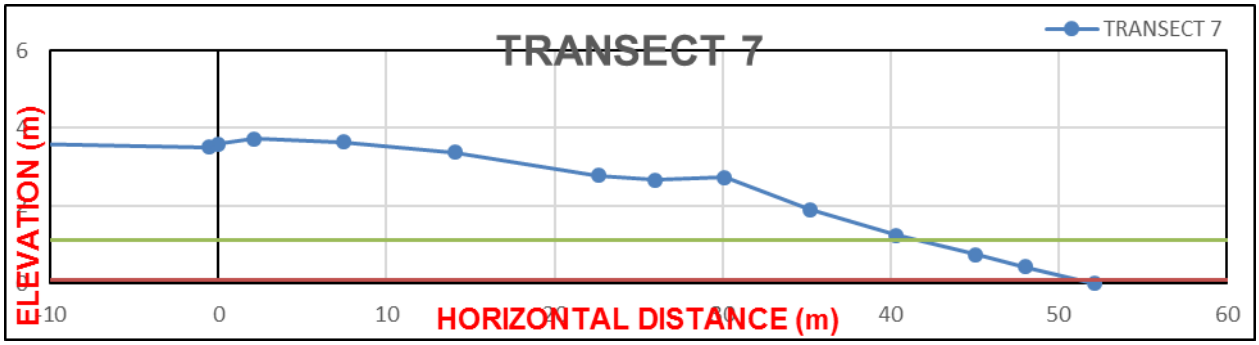
10
0
10
40
50
60

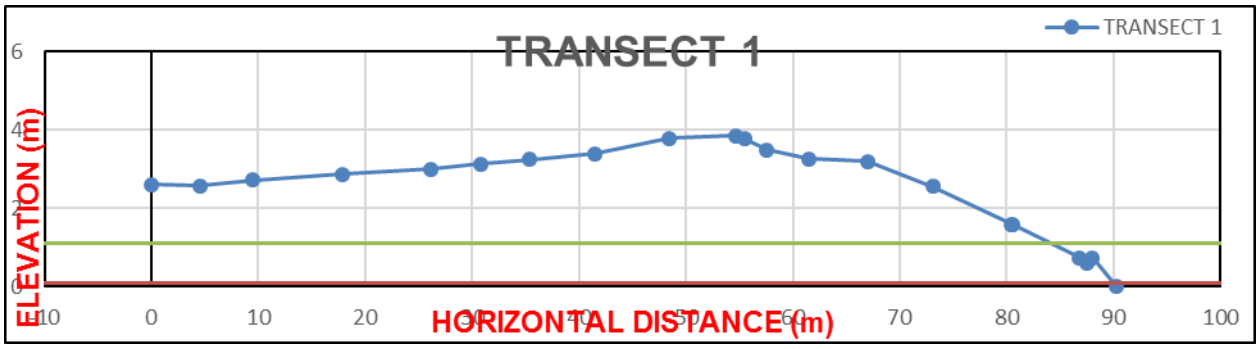

TRANSECT 4
TRANSECT 4
ELEVATION (m)
HORIZONTAL DISTANCE (m)
4
10
0
10
50
60
70

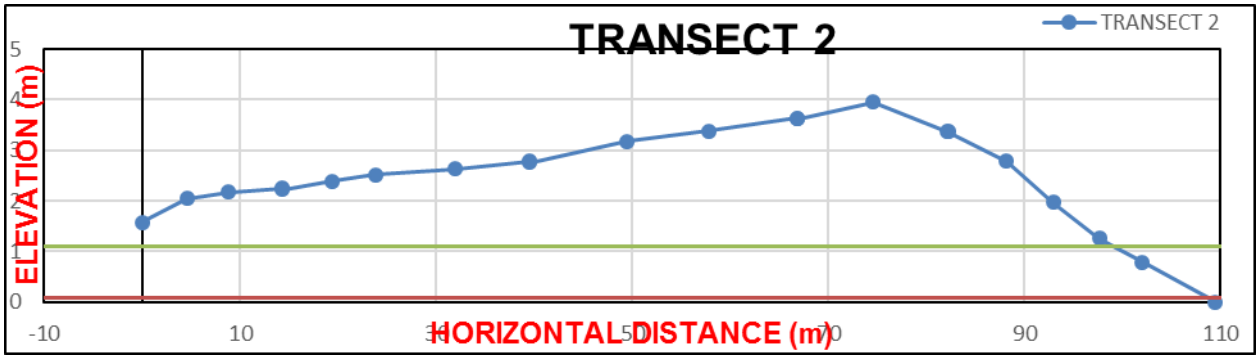

TRANSECT 5
TRANSECT 5
ELEVATION (m)
HORIZONTAL DISTANCE (m)
4
10
0
10
50
60
70

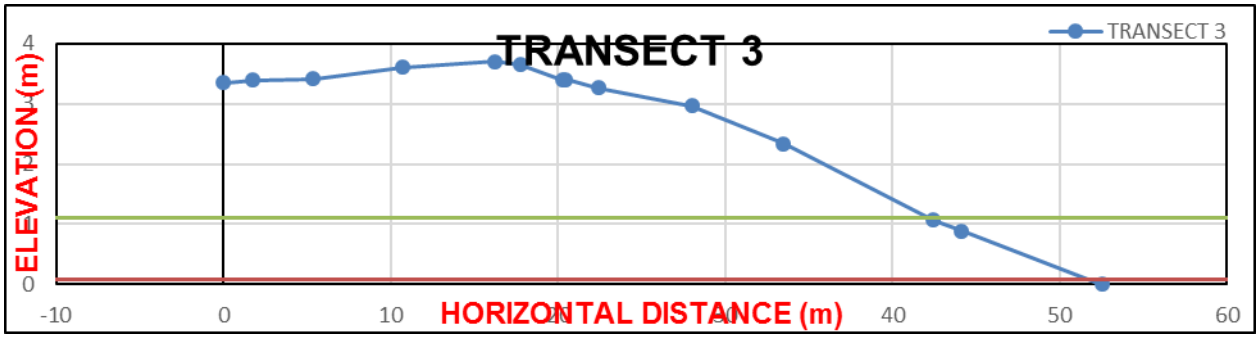




BEACH PROFILES @ KARUNGALI



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TRANSECT 3
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HORIZONTAL DISTANCE (m)
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0
10
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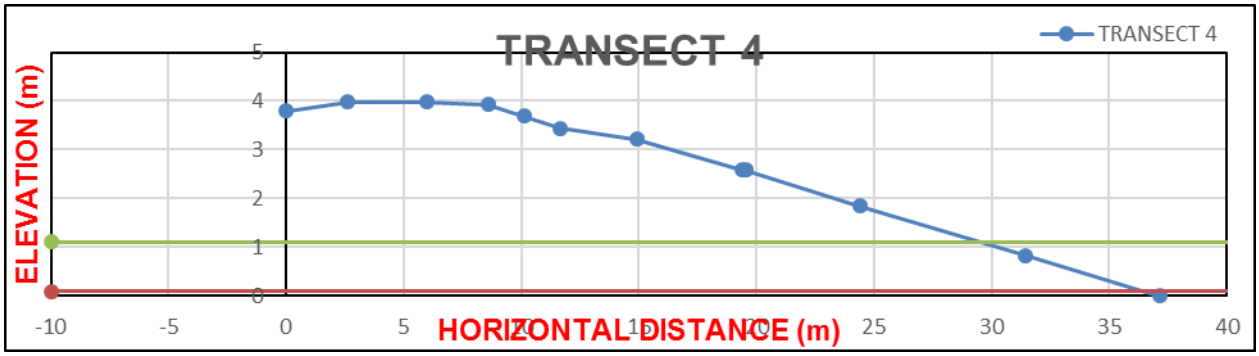
50
60


TRANSECT 4
TRANSECT 4
ELEVATION (m)
HORIZONTAL DISTANCE (m)
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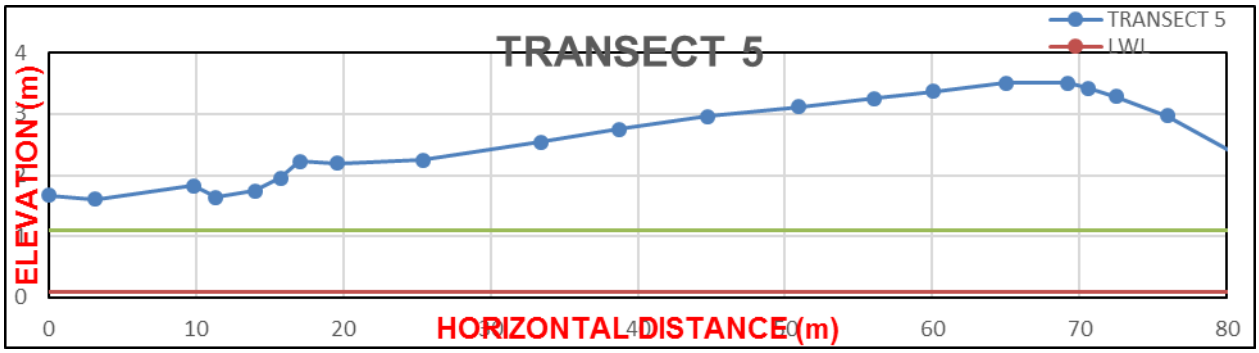
-10
-5
0
5
25
30
35
40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TRANSECT 5
LWL
ELEVATION (m)
HORIZONTAL DISTANCE (m)
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70
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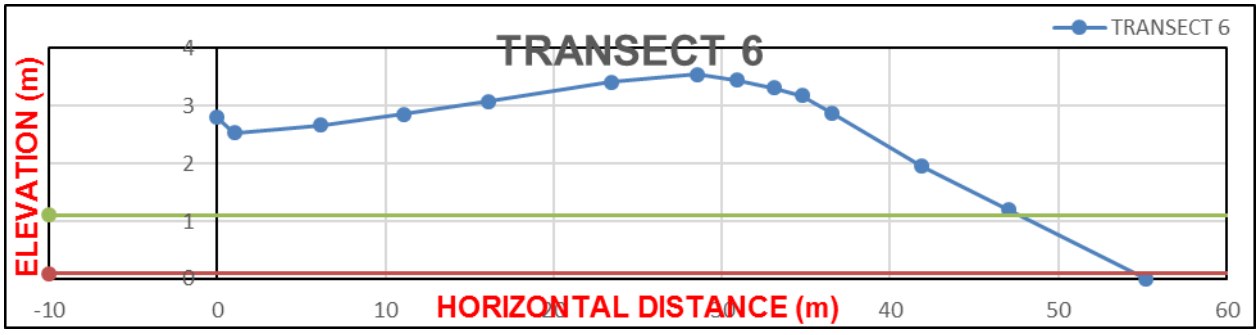
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TRANSECT 6
ELEVATION (m)
HORIZONTAL DISTANCE (m)
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-10
0
10
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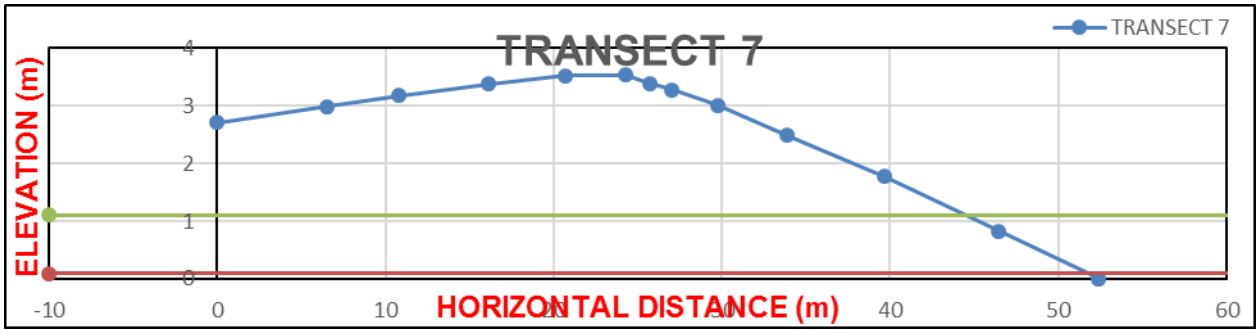
50
60


TRANSECT 7
TRANSECT 7
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HORIZONTAL DISTANCE (m)
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3
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0
-10
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10
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50
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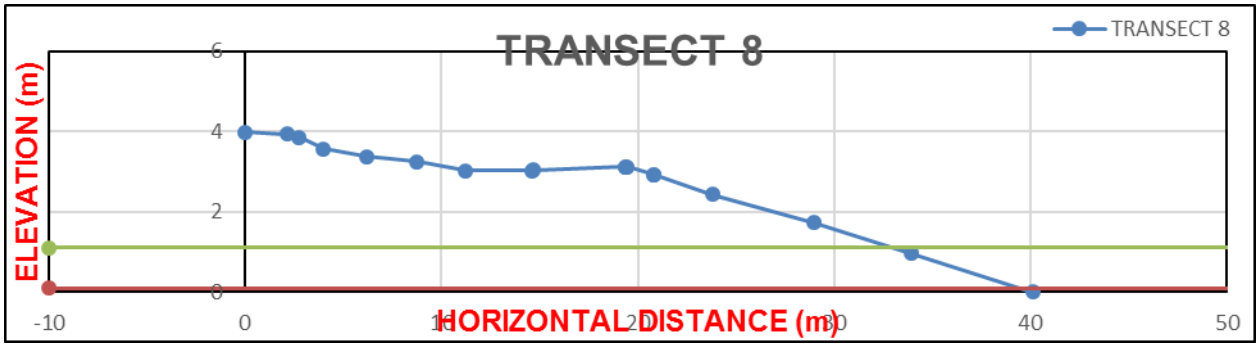
TRANSECT 8
TRANSECT 8
ELEVATION (m)
HORIZONTAL DISTANCE (m)
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4
2
0
-10
0
40
50

4.2 SHORELINE ANALYSIS IN ARCGIS - DSAS

Shoreline is often dynamic in nature. The change in shoreline was analysed using Digital Shoreline Analysis System (DSAS) tool in ArcGIS. The shoreline position covers a variety of time periods ranging from 1988 to 2019. The spatial and temporal analysis of shoreline analysis for the Kattupalli Port indicates for the period between 1988 to 2019. Shoreline change analyses are based on a comparison of different shoreline positions digitized from satellite images (Landsat 4-5 & Landsat 8). Long-term rates of change are calculated using Arc-GIS, DSAS Version 4 for all 32 different shorelines positions i.e. For the year 1988 to 2019, LRR (Linear Regression Rate) statistics used for the classification of the shoreline according to erosion/accretion. The rates of change presented in this report represent conditions up to the date of the most recent shoreline data and therefore are not intended for predicting future shoreline positions or rates of change. The results are classified in three categories i.e. erosion, stable and accretion. The shoreline of the study area was divided into 3 zones for the purpose of analysis and shoreline changes were reported zone wise. Each zone contains approximately 100 to 150 transects with 150 m transects spacing and 2000m transect length.

DATA COLLECTION

Landsat 4, 5, 7 and 8 satellite images of the Chennai coastline were acquired for the years 1988 to 2019. All these satellite images were obtained from USGS, Earth Explorer (fig 4.2).

Table 4.2 Details of Satellite images

S. No	Data Type	Sensors	Year	Date	Spatial Resolution (m)
1	Landsat 4-5	TM	1988	26/4/1988	30

2	Landsat 4-5	TM	1989	31/5/1989	30
3	Landsat 4-5	TM	1990	29/4/1990	30
4	Landsat 4-5	TM	1991	21/5/1991	30
5	Landsat 4-5	TM	1992	8/6/1992	30
6	Landsat 4-5	TM	1993	26/5/1993	30
7	Landsat 4-5	TM	1994	29/4/1994	30
8	Landsat 4-5	TM	1995	30/4/1995	30
9	Landsat 4-5	TM	1996	18/5/1996	30
10	Landsat 4-5	TM	1997	21/5/1997	30
11	Landsat 4-5	TM	1998	17/2/1998	30
12	Landsat 4-5	TM	1999	21/4/1999	30
13	Landsat 8	OLI_TIRS	2000	5/5/2000	30
14	Landsat 8	OLI_TIRS	2001	22/4/2001	30
15	Landsat 8	OLI_TIRS	2002	28/6/2002	30
16	Landsat 8	OLI_TIRS	2003	30/5/2003	30
17	Landsat 8	OLI_TIRS	2004	24/5/2004	30
18	Landsat 8	OLI_TIRS	2005	11/5/2005	30
19	Landsat 8	OLI_TIRS	2006	15/6/2006	30
20	Landsat 8	OLI_TIRS	2007	17/5/2007	30
21	Landsat 8	OLI_TIRS	2008	4/6/2008	30
22	Landsat 8	OLI_TIRS	2009	6/5/2009	30
23	Landsat 8	OLI_TIRS	2010	25/5/2010	30
24	Landsat 8	OLI_TIRS	2011	2/4/2011	30
25	Landsat 8	OLI_TIRS	2012	7/6/2012	30
26	Landsat 8	OLI_TIRS	2013	18/6/2013	30
27	Landsat 8	OLI_TIRS	2014	20/5/2014	30

28	Landsat 8	OLI_TIRS	2015	5/4/2015	30
29	Landsat 8	OLI_TIRS	2016	23/4/2016	30
30	Landsat 8	OLI_TIRS	2017	10/4/2017	30
31	Landsat 8	OLI_TIRS	2018	31/5/2018	30
32	Landsat 8	OLI_TIRS	2019	16/4/2019	30

GEOGRAPHICAL INFORMATION SYSTEM (GIS)

Shorelines were digitized and the layers of multiple date shorelines were prepared from 1988 to 2019 in the feature class. Continuous shoreline positions were extracted and digitized manually for 31 different periods (fig 4.7). Digital Shoreline Analysis System (DSAS) version 4, an extension of ESRI ArcGIS software was used to calculate shoreline rate-of- change statistics from a time series of multiple shoreline positions.

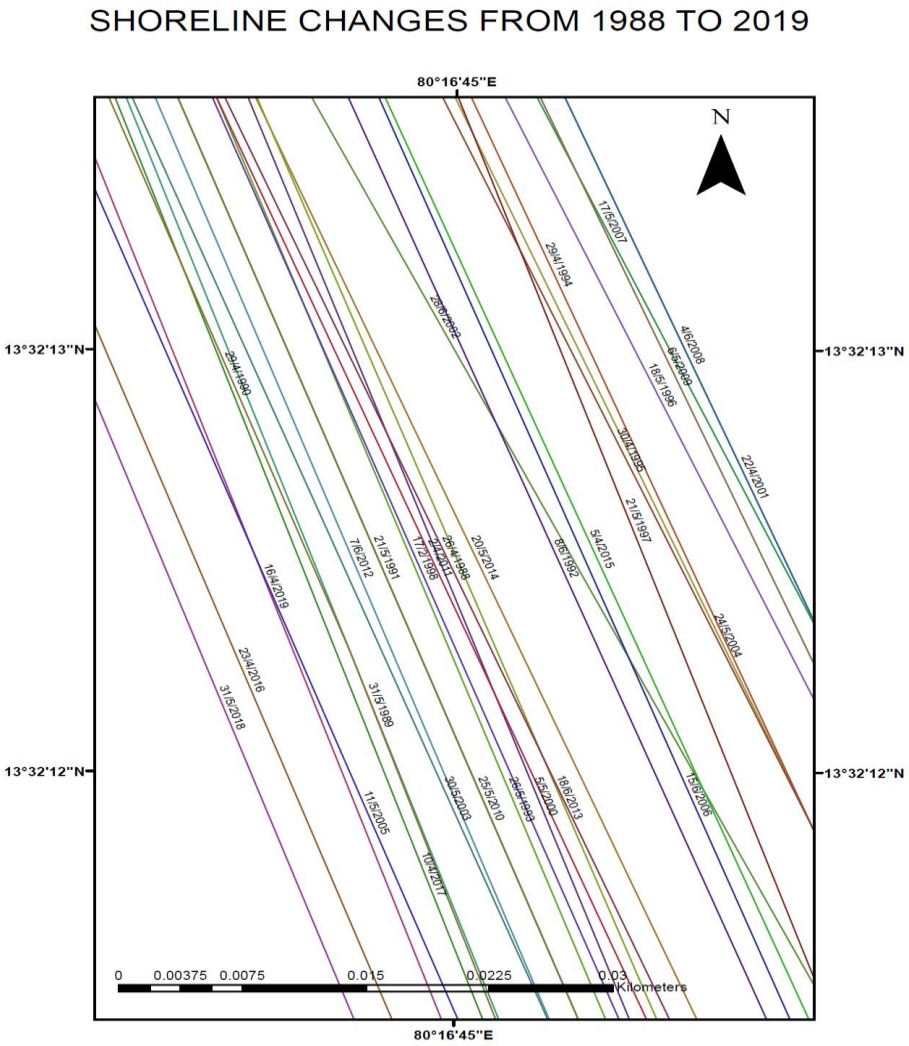


Fig 4.7 Shoreline Digitization from 1988 to 2019

ZONES AND TRANSECTS

In GIS environment the shorelines were digitized and the layers of multiple date shorelines were prepared from 1988 to 2019 in the feature class. The study area of 69km is divided into three Zone1, Zone2 and Zone 3 as follows,

i) Zone 1 – Coastal Stretch of Sriharikota (15.9 km)

ii) Zone 2 - Coastal Stretch of Pulicat Lake (31.6 km)

iii) Zone 3 - Coastal Stretch of Kattupalli Port (South & North) (21.5km)

Transect are auto- generated by DSAS perpendicular to baseline. Zone 1 is at the north and south part of Sriharikota, Zone 2 is at Pulicat lake and Zone 3 is at the north and south part of Ennore and Kattupalli Port (fig 4.8).

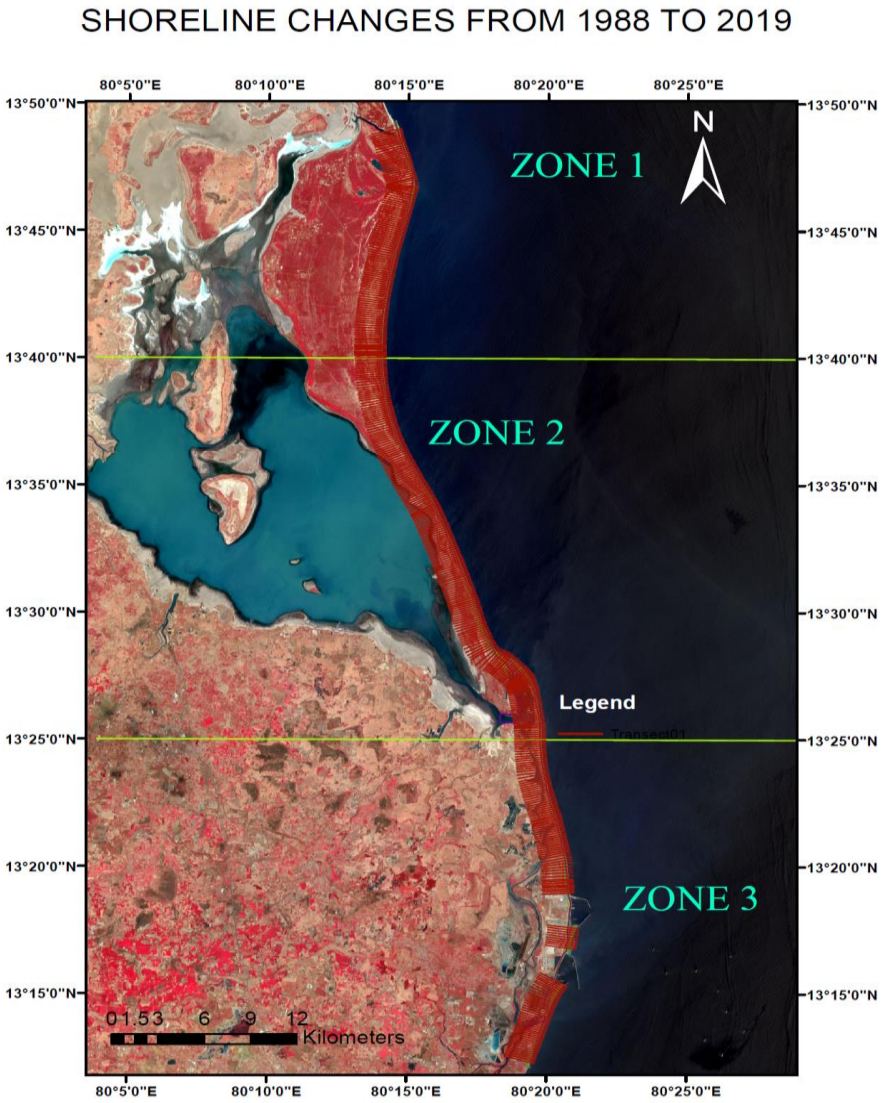


Fig. 4.8 Zones and Transects

Selection of statistical methods

Shoreline extraction errors, uncertainty in shoreline change rate have been performed using the statistical methods - Linear Regression Rate (LRR) for the long-term analysis.

The Universal Traverse Mercator (UTM) projection and World Geodetic System 1984 (WGS 84) Datum was applied so as to calculate the change rates in meters. The LRR was calculated for the entire 31 years period using all the shorelines which in fact gives the change rate based on the old (1988) and most recent (2019) shorelines and also using every successive shoreline This enables us to identify the locations and periods of recovery and segments and the periods when the erosion rate is high.

SHORELINE CHANGE CLASSIFICATION

The results were classified based on the migration direction and rate. If the shoreline migration was landward at a rate of less than -5 m/year the erosion rate was considered high and if the rate of landward migration ranges between -5 and -2 m/year, the rate of erosion was considered medium erosion. If neither the landward migration or seaward progression exceeds -0.5 to 0.5 m/year, the coast was considered as stable and if seaward shifting of shoreline was at a rate of 0.5 to 2 m/yr, 2 to +5 m/yr and more than +5 m/yr, the coasts were considered accreting coasts and status has low accretion, medium accretion and high accretion respectively (Table 4.3).

Table 4.3 **SHORELINE CHANGE CLASSIFICATION**

S.NO	Linear Regression Rates (LLR) (m/yr)	CLASSIFCATION
1	< -5	High Erosion
2	-5 to -2	Medium Erosion
3	-2 to -0.5	Low Erosion
4	-0.5 to 0.5	Stable Coast
5	0.5 to 2	Low Accretion
6	2 to 5	Medium Accretion
7	>5	High Accretion

(Reference : NCSCM, 2014)

SHORELINE CHANGES FROM 1988 to 2019

Fig 4.9 as shows the shoreline classification in DSAS - Linear Regression Rates (LLR) statistics in m/yr. The LRR statistics graph and frequency distribution graph for the shoreline analysis from 1988 to 2019 as shown in the fig 4.10. Overall, the 31 years shorelines has estimated in LRR statistics which reveals that more positive shoreline change (45%) has been experienced at an average rate of 3.5m/yr, negative shoreline change is 23% at an average rate of -2.5m/yr and the rest of 32% is stable coast.

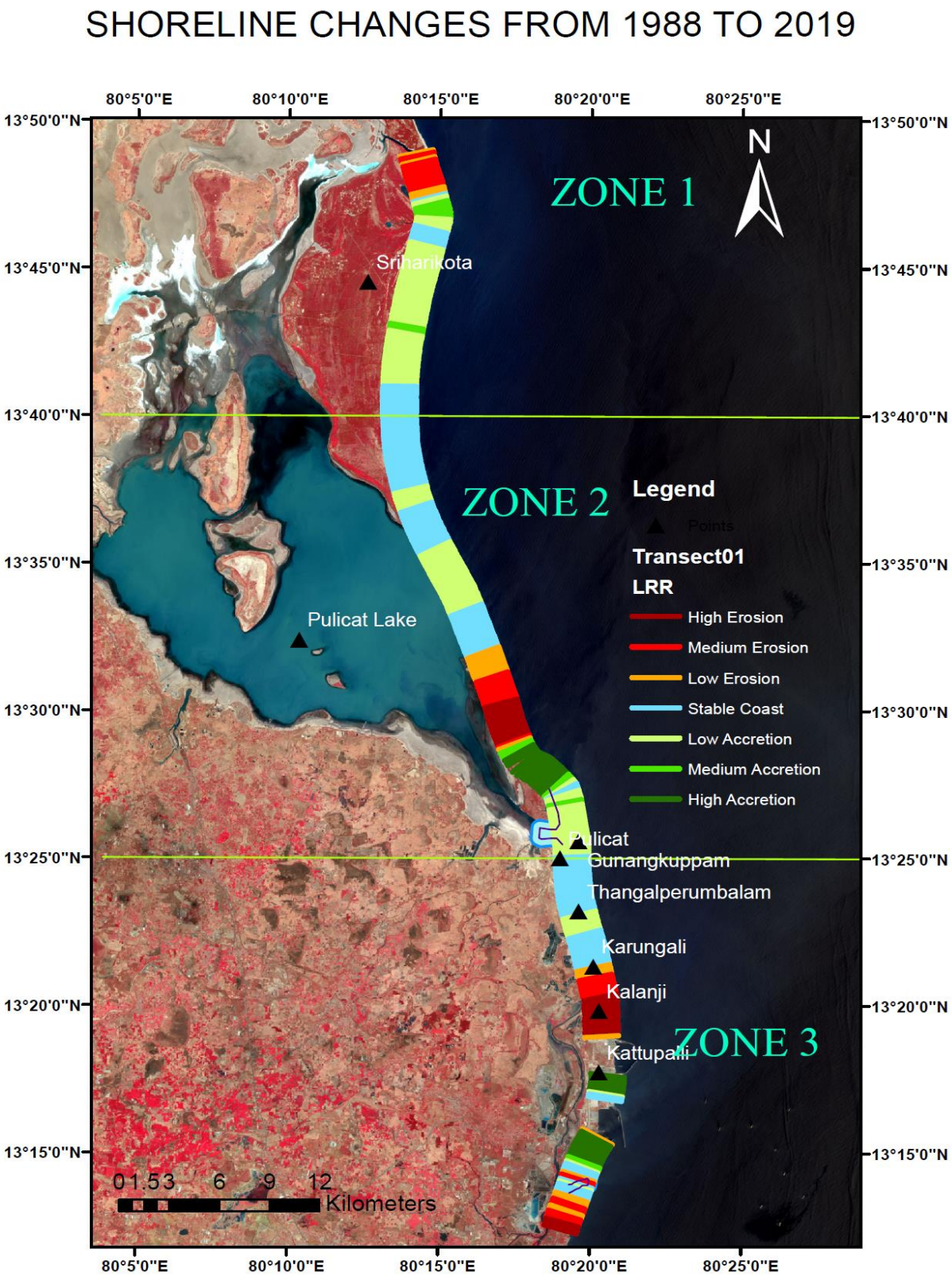


Fig 4.9 Shoreline change analysis LRR – 1988 to 2019

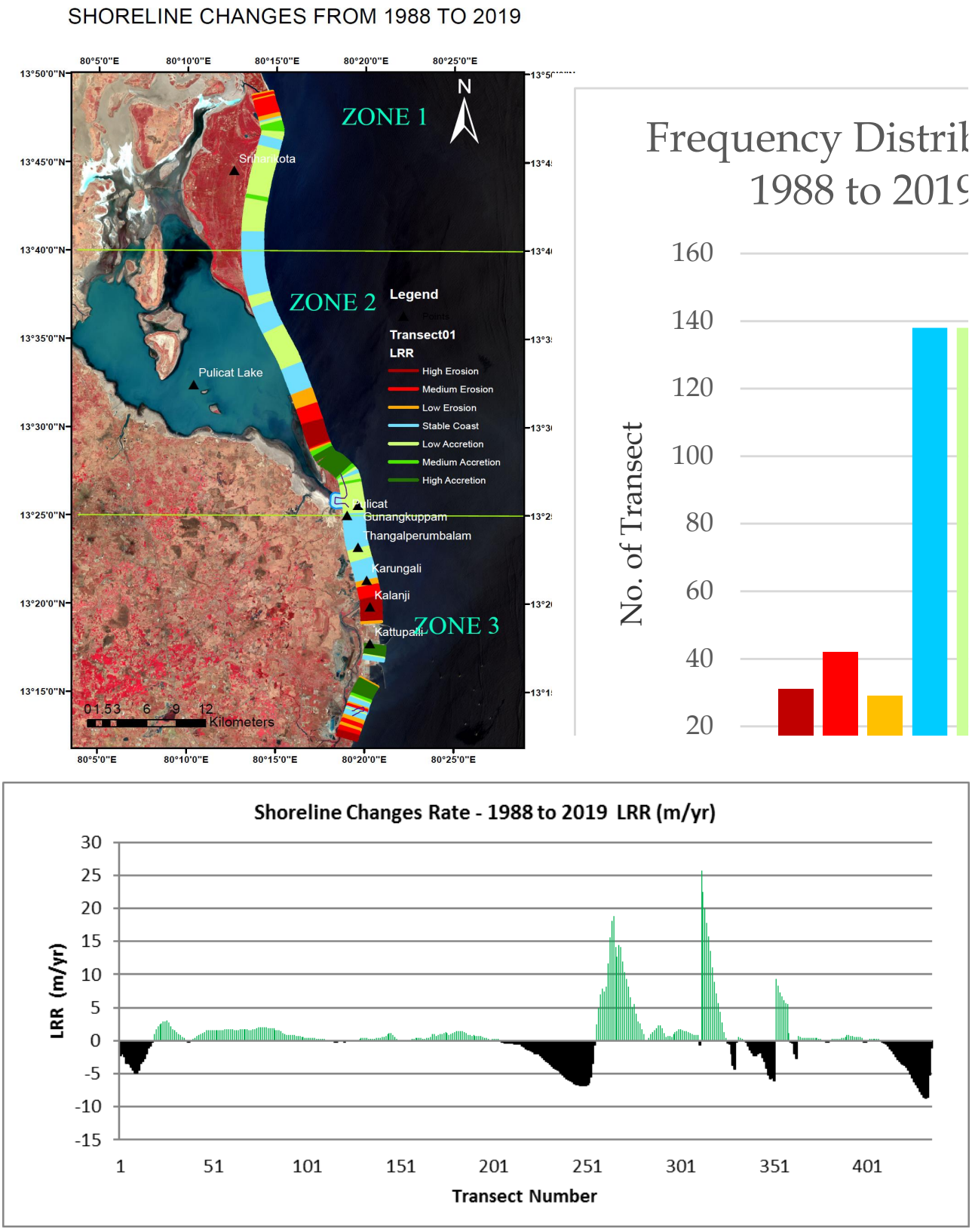


Fig 4.10 Shoreline change analysis LRR & FD – 1988 to 2019

SHORELINE CHANGES FROM 1988 to 2019 – ZONE 1

In zone 1 (fig 4.11), the period between 1988 to 2019, it is observed that about 67% of Accretion observed at the southern part of Sriharikota with an average LRR (Linear Regression Rate) of 1.55 m/yr and 17% of stable coast with an average rate of 0.27 m/yr is noticed in the Southern region of Sriharikota Coast and 16% of Erosion with an average rate of -3.08m/yr observed in Northern region of Sriharikota Coast. From LRR statistics, maximum erosion is at the rate of -4.85m/yr observed at the northern part of Sriharikota coast and the maximum accretion is at the rate of 3.06 m/yr at the Sriharikota coast as shown in below LRR statistics graph.

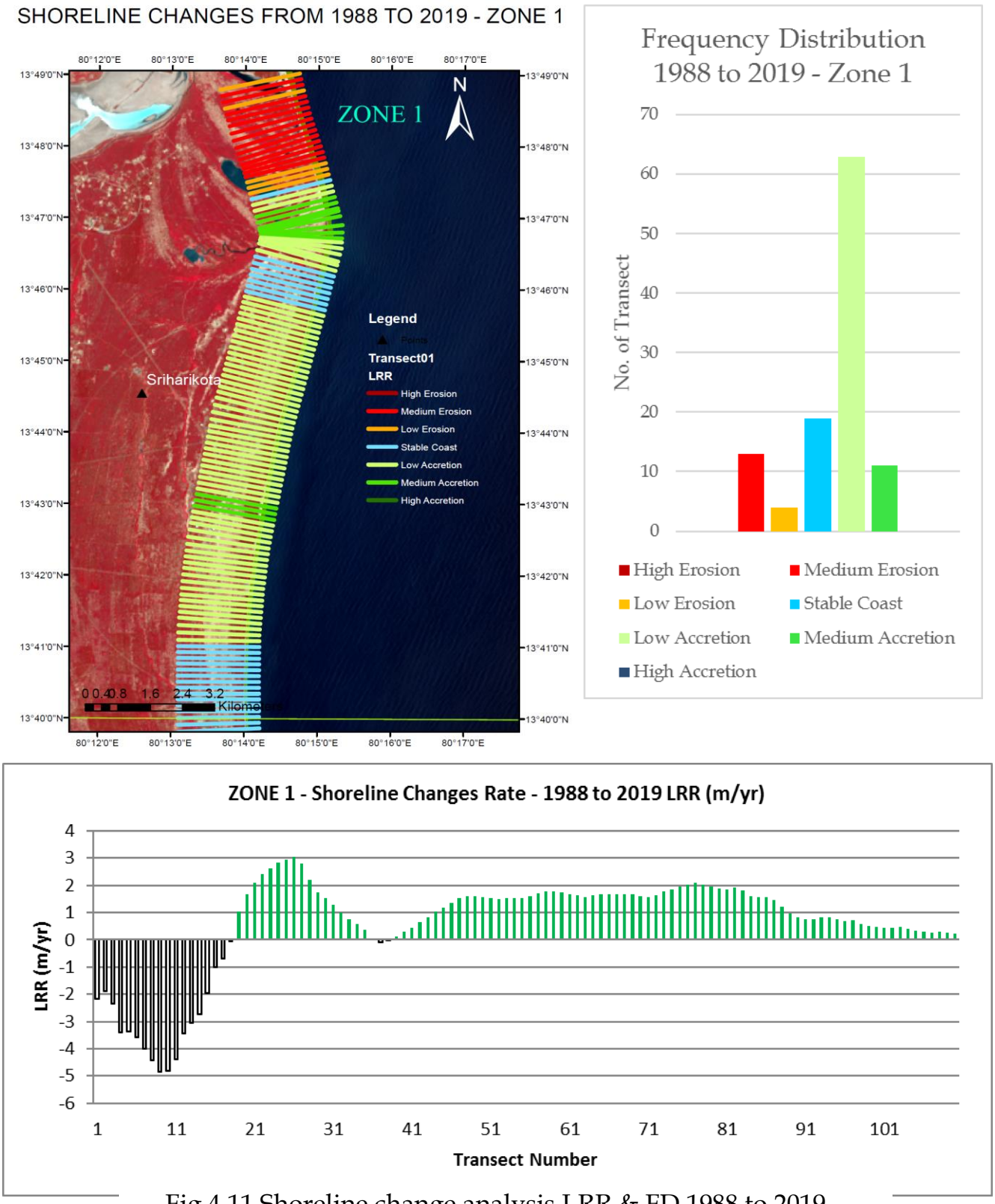


Fig 4.11 Shoreline change analysis LRR & FD 1988 to 2019 – Zone 1

SHORELINE CHANGES FROM 1988 to 2019 – ZONE 2

In zone 2 (fig 4.12), From the frequency distribution graph, the shoreline shows 44 % of the area as accreting mainly in the southern part of Pulicat lagoon which extends up to 7.95km with an average accretion rate of 2.6 m/yr, 20% of the area has experienced erosion rates (20%) with an average erosion rate of 4.5 m/yr in the northern part of Pulicat lake and the rest 36% has stable coast. Maximum erosion has been experienced in Pulicat lagoon (6.2 Km coastal stretch) at the rate of -6.82 m/yr and Maximum Accretion has been experienced in the Pulicat Bar Mouth (7.2 km stretch) at the rate of 18.75 m/yr.

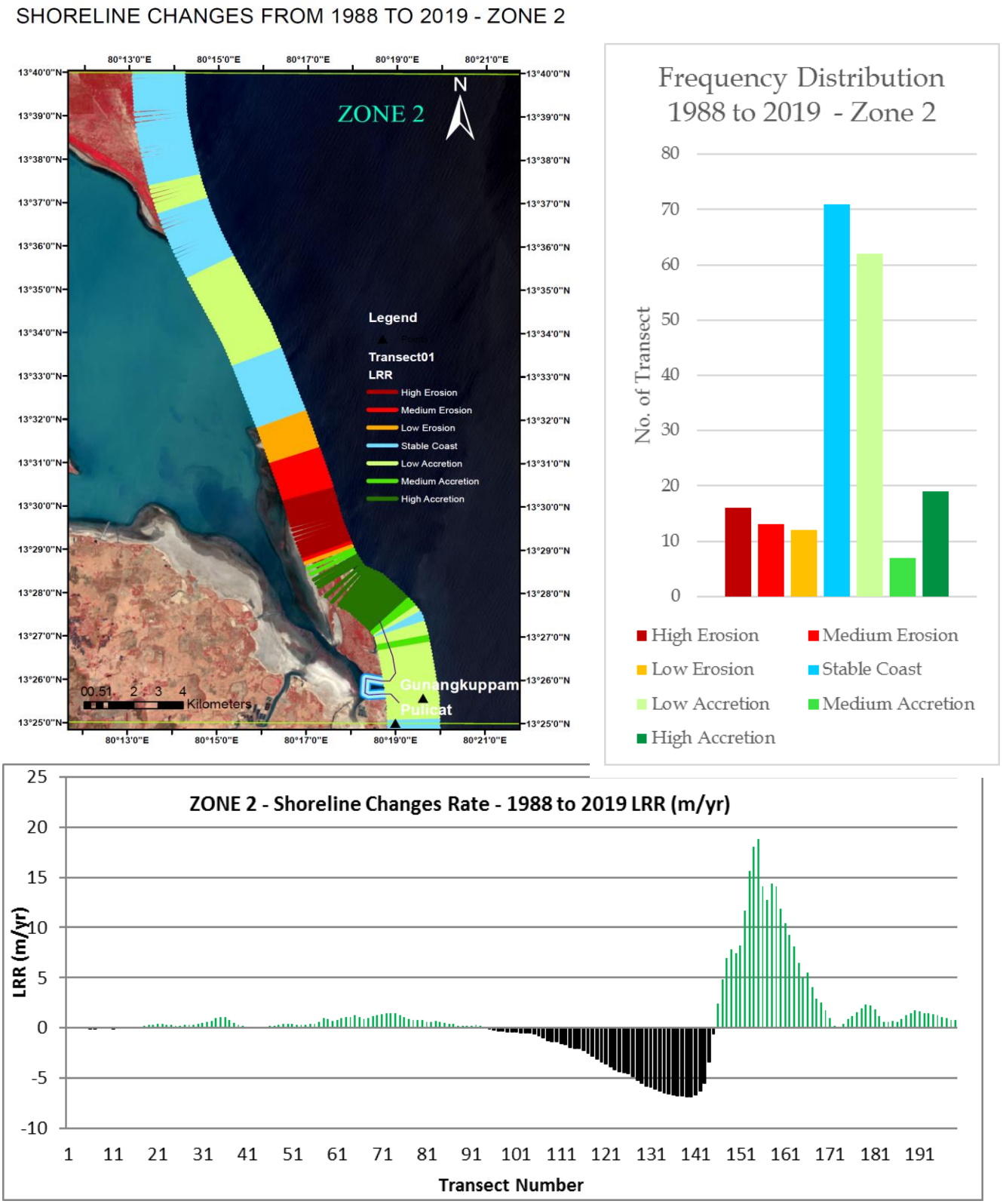


Fig 4.12 Shoreline change analysis LRR & FD 1988 to 2019 – Zone 2

SHORELINE CHANGES FROM 1988 to 2019 – ZONE 3

In zone 3 (fig 4.13), shoreline has accreted with the maximum accretion of 1 Km at immediate South of Kattupalli Port Southern breakwater. The maximum erosion is at the rate of 8.65m/yr at kalanji and the maximum accretion is at the rate of 25.67 m/yr due to land reclamation. From the frequency distribution graph, in the period between 1988 to 2019 with the zone 3 coast more percentage of the shoreline has experienced stable coast 39%), followed by negative shoreline change (35%) and positive shoreline change (26 %). Comparison of shoreline information between 1988 to 2019 reveals, in general this particular stretch of 2km coast (South of Kattupalli Port Breakwater to Ennore creek) has accreting coast with an average accretion rate of 5.9 m/year from North and South region of Ennore Port upto 2 km. During the construction of Kattupalli Port breakwater (Aug 2009 – June 2012) the combined effect of both Kattupalli and Ennore Ports has caused erosion at Kalanji to karungali and southern part of Ennore port of up to an average of 4.5 km and this 4.5 km coast was eroded at a higher rate of 8.6 m/yr.

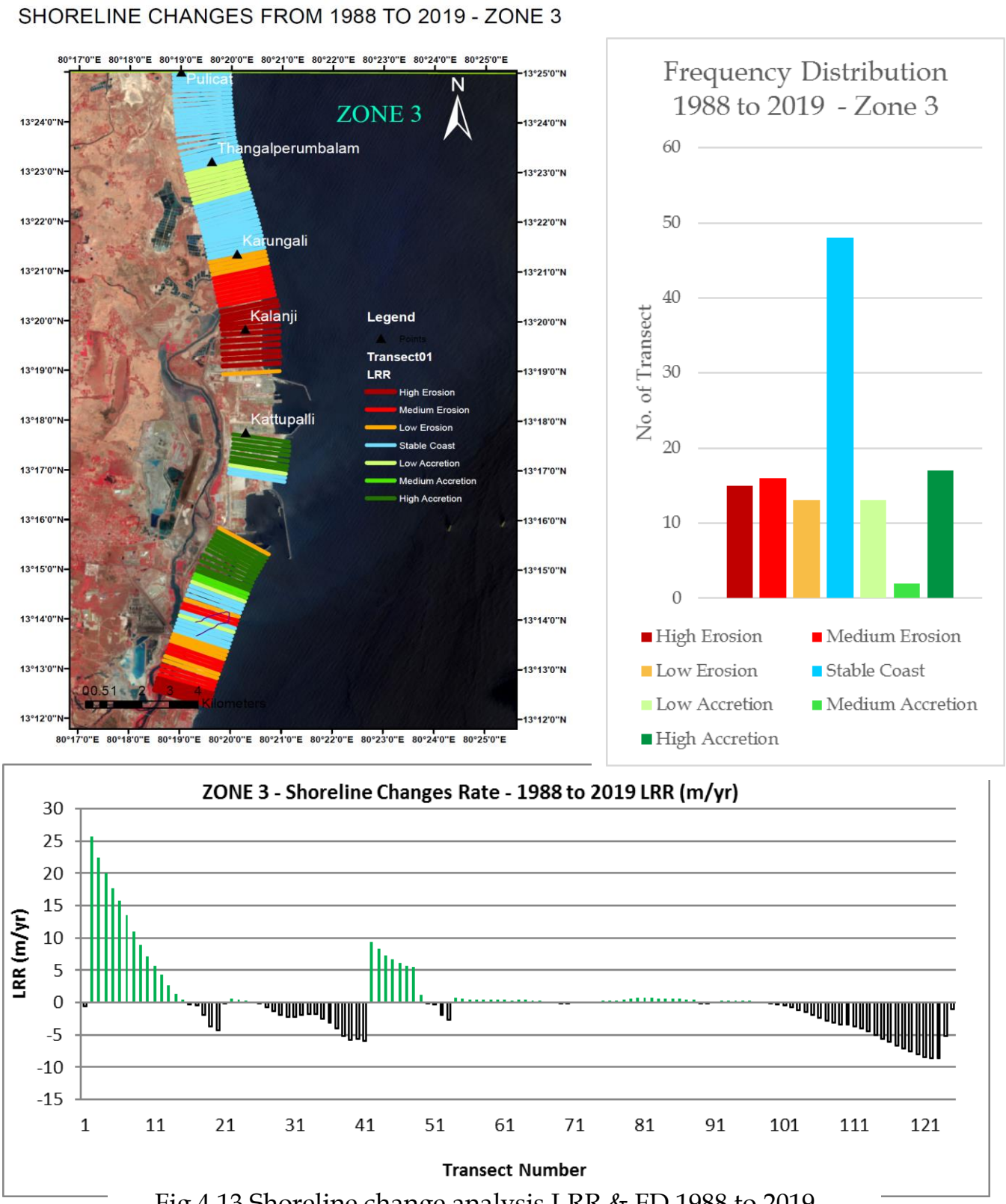


Fig 4.13 Shoreline change analysis LRR & FD 1988 to 2019 – Zone 3

SHORELINE CHANGES FROM 1988 to 1999

Fig 4.14 shows the shoreline classification in DSAS - Linear Regression Rates (LLR) statistics in m/yr. From the FD graph (fig 4.15), it has been observed that maximum negative shoreline change (42%) has been observed in this period (during pre-construction of Ennore port) at an average rate of 2 m/yr, positive shoreline change is 34% at an average rate of 4.5m/yr and the rest 24% is stable coast.

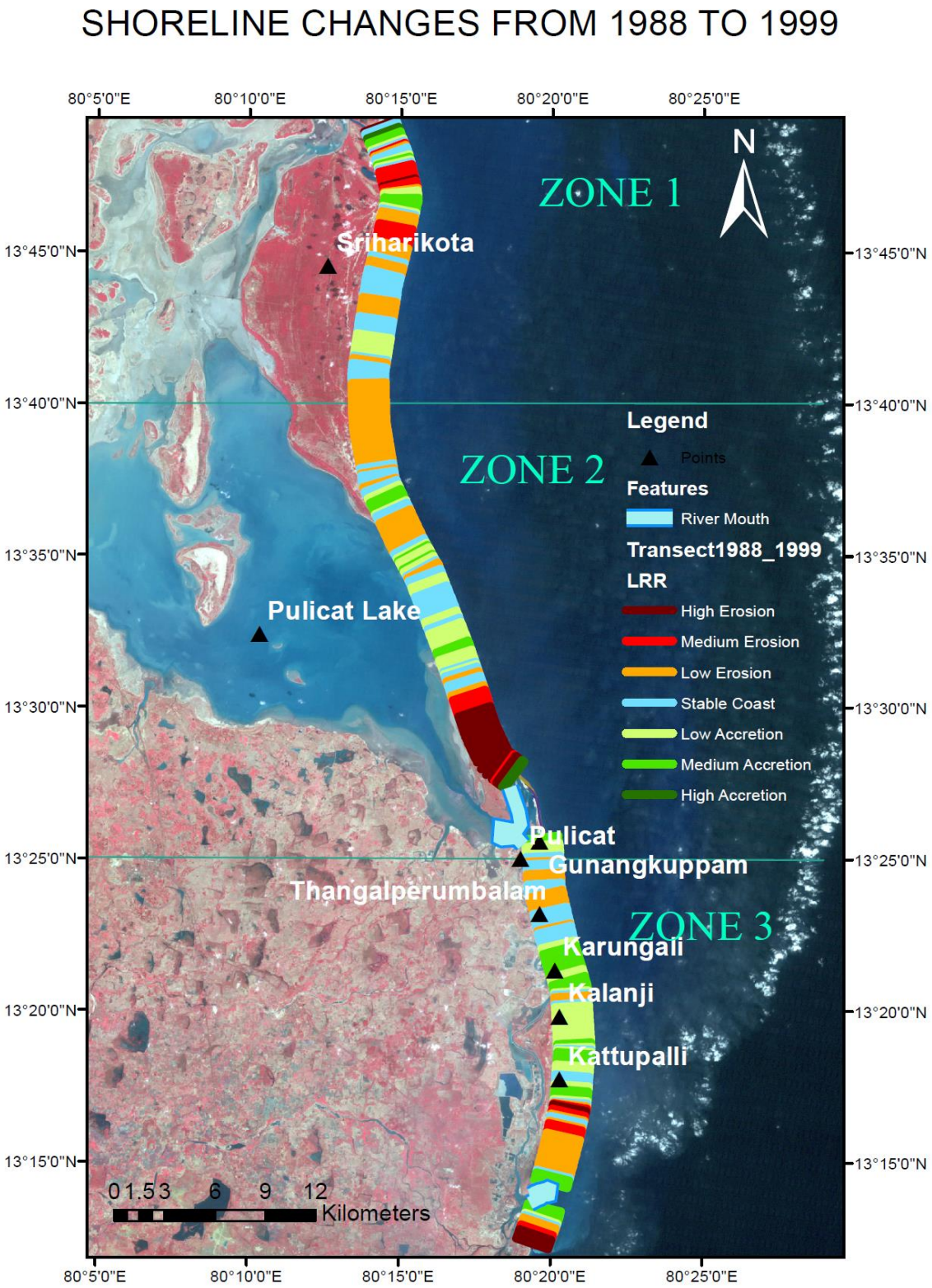


Fig 4.14 Shoreline change analysis 1988 to 1999 – Zone 3

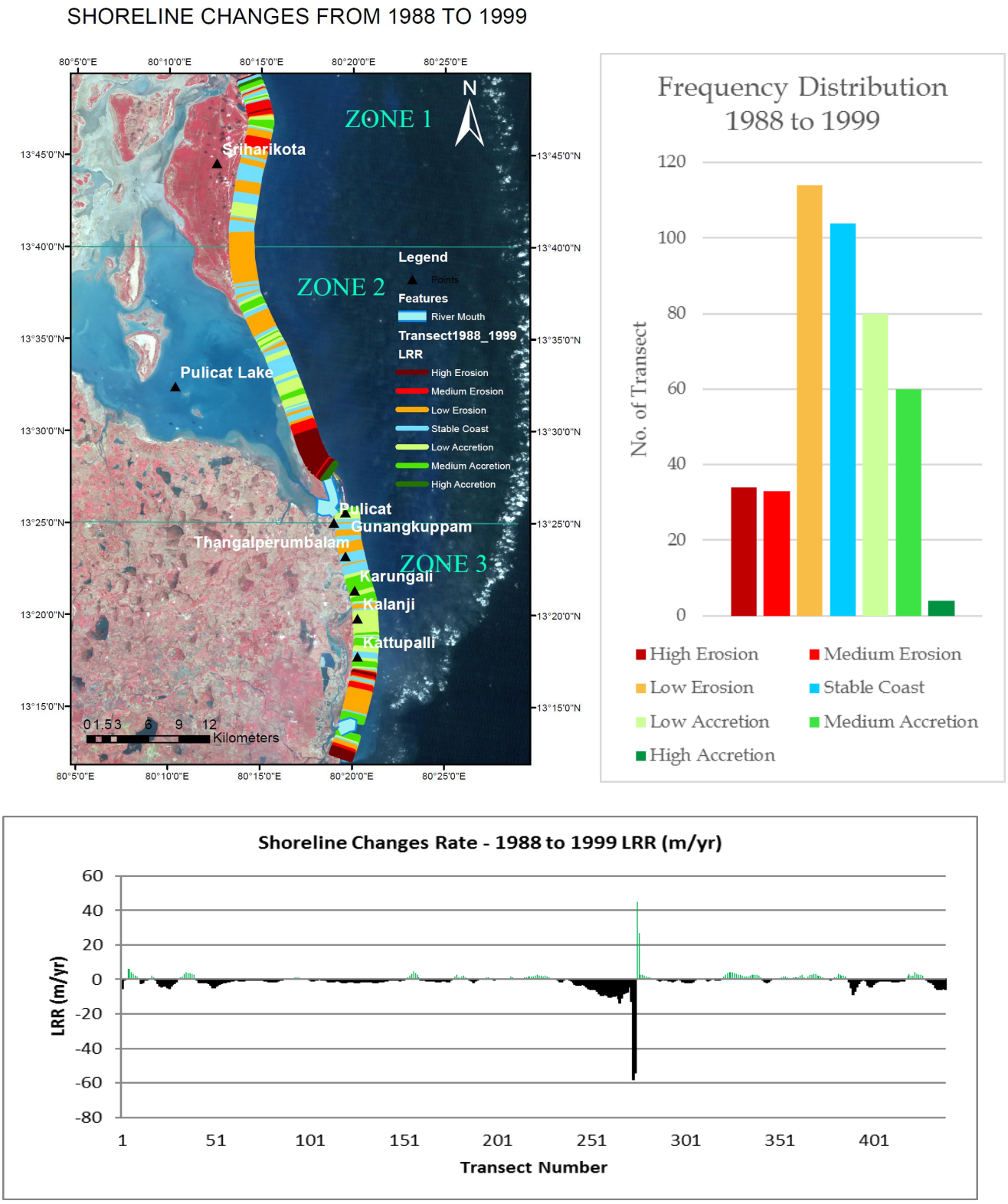


Fig 4.15 Shoreline change analysis LRR & FD 1988 to 2019

SHORELINE CHANGES FROM 1988 to 1999 – ZONE 1

The study shows that southern part of Sriharikota coast have witness both Erosion along with stable coast with 45% of erosion at average rate of -1.95 m/yr and 30% of stable coast with average rate of 0.13 m/yr and 25% of accretion has been observed in this zone at the northern part of Sriharikota coast at an average rate of 2.15 m/yr. From LRR statistics, dual action of erosion and accretion have witnessed in Northern region of Sriharikota coast at Maximun erosion rate of 5.14/yr maximum accretion is at the rate of 6.1 m/yr.

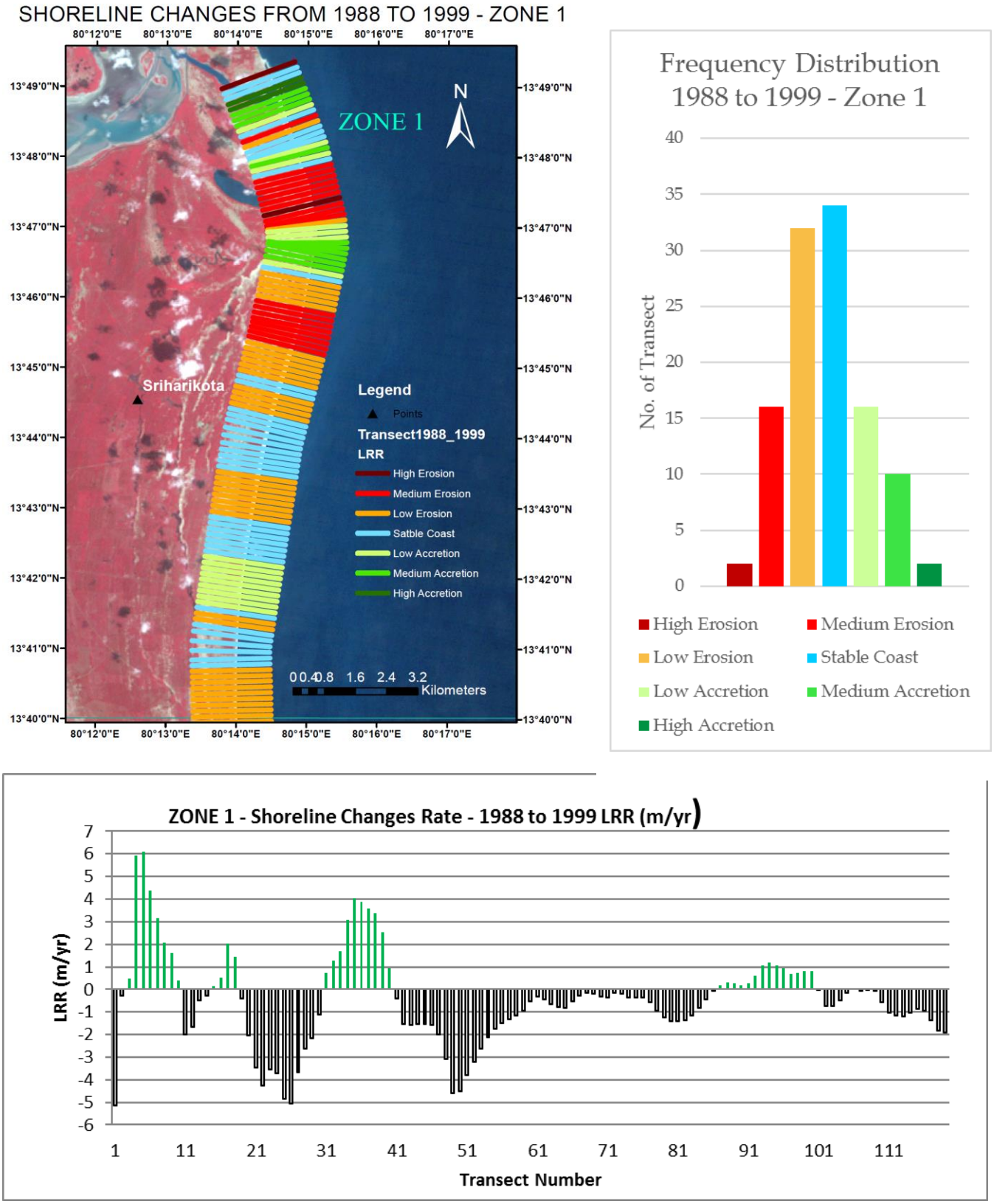
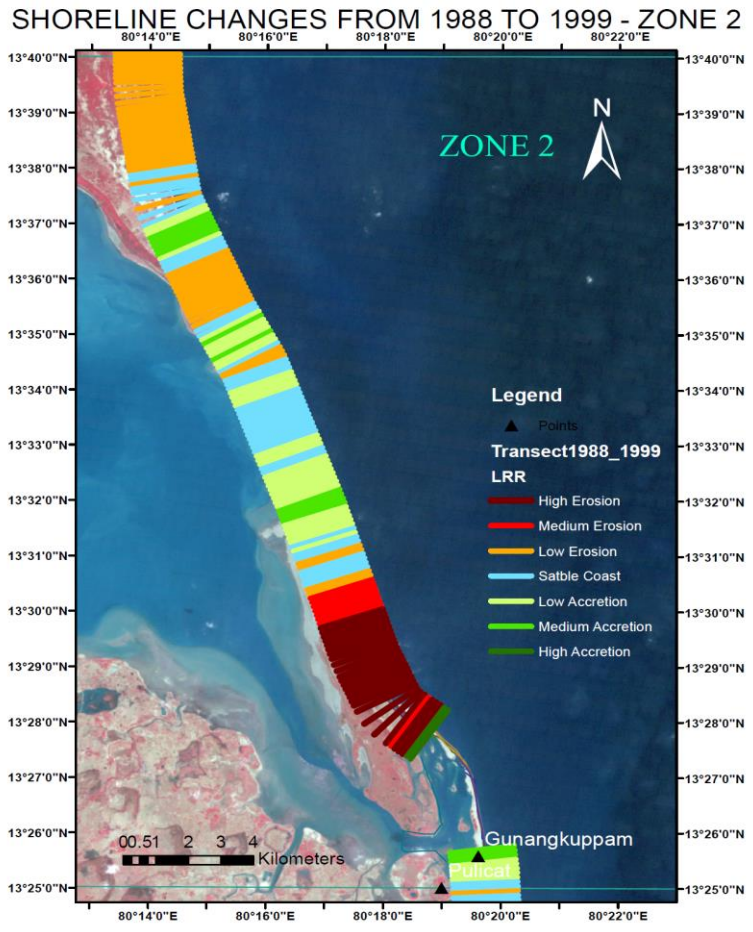
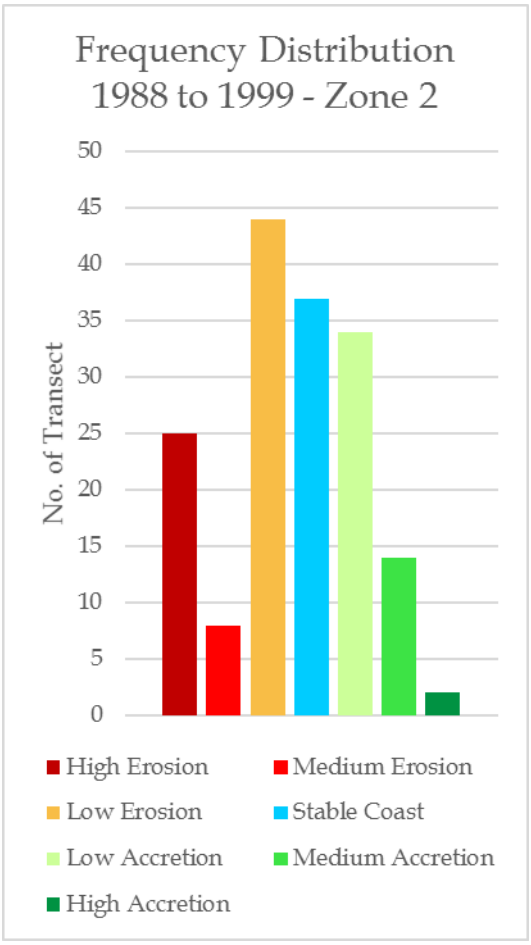


Fig 4.16 Shoreline change analysis LRR & FD 1988 to 1999 - Zone 1

SHORELINE CHANGES FROM 1988 to 1999 – ZONE 2

It has experienced more erosion of about 47% at an average rate of -5.06/yr , mainly observed at the bar mouth of Pulicat Lagoon, accretion 30% at an average rate of 2.97/yr mainly due to siltation of Pulicat lagoon and the rest 23% stable coast at an average rate of -0.004 m/yr. Maximum erosion experienced from bar mouth to a stretch of 6.2 km at a maximum rate of 58.13 m/yr and the maximum accretion is at the rate of 44.95 m/yr .(fig 4.17).





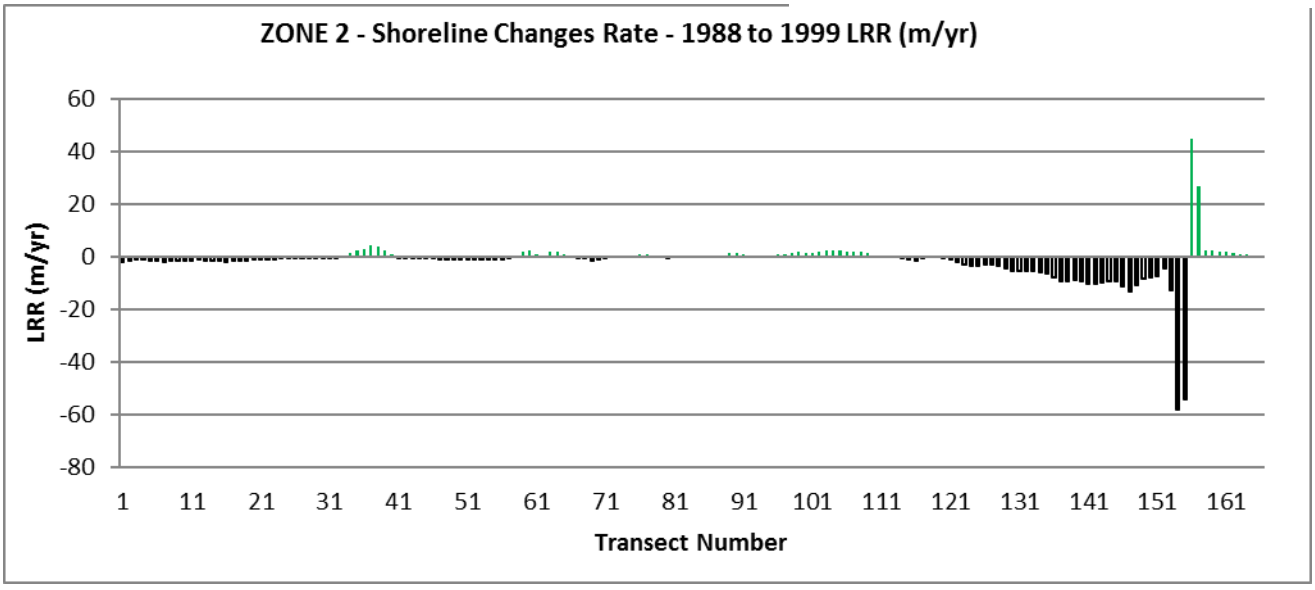
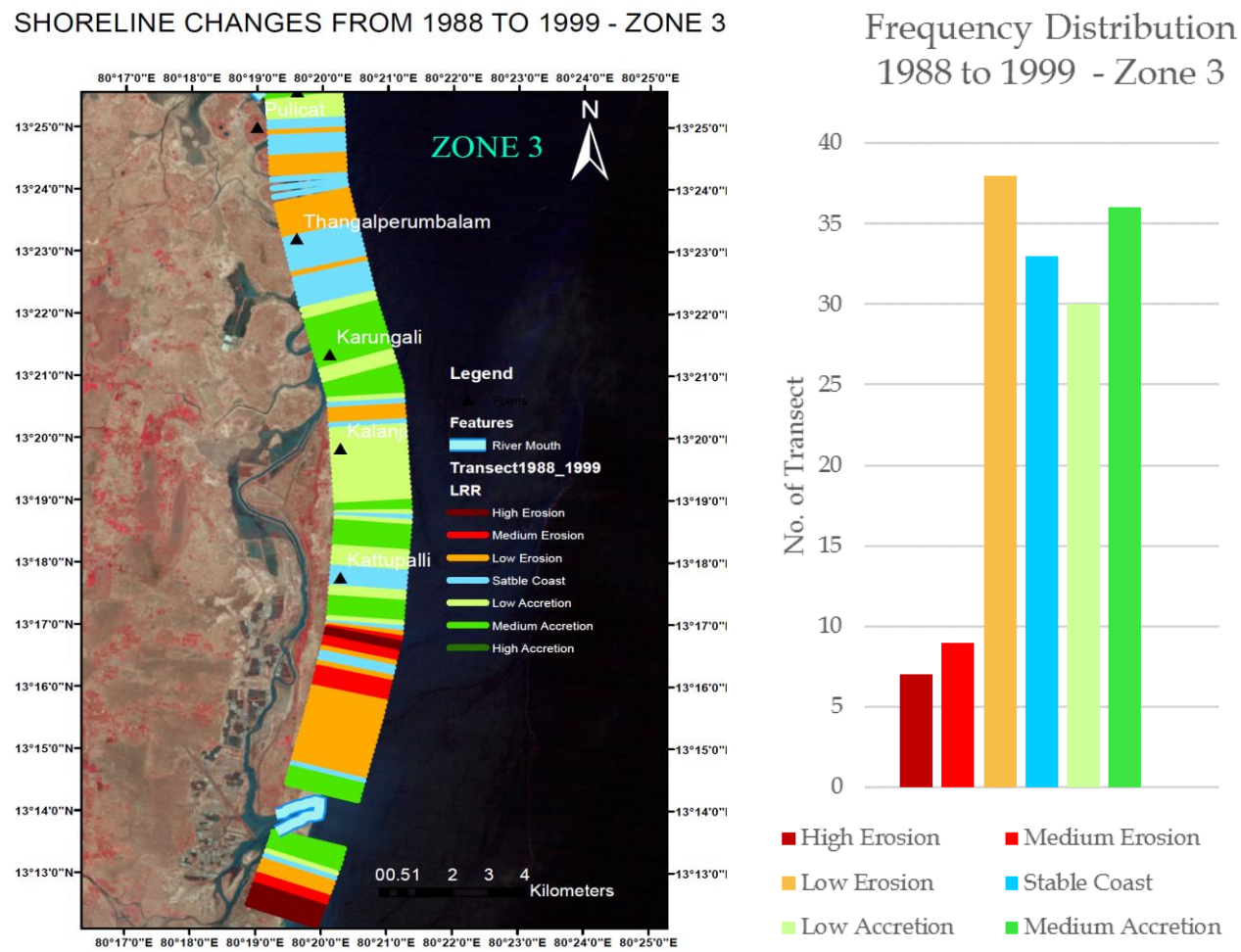


Fig 4.17 Shoreline change analysis LRR & FD 1988 to 1999 - Zone 2

SHORELINE CHANGES FROM 1988 to 1999 – ZONE 3

In this coastal stretch, [Gunangkuppam Coast (13º25'30"N) to the Ennore Creek (13º14'30"N)] 43 % of the shoreline has experienced accretion at an average rate of 2.12 m/yr noticed at the northern and southern part of Ennore port area due to land reclamation activities for the port purposes, followed by Erosion (35%) with an average rate of -2.19 m/yr and stable coast (22%) at an average rate of -0.016 m/yr.



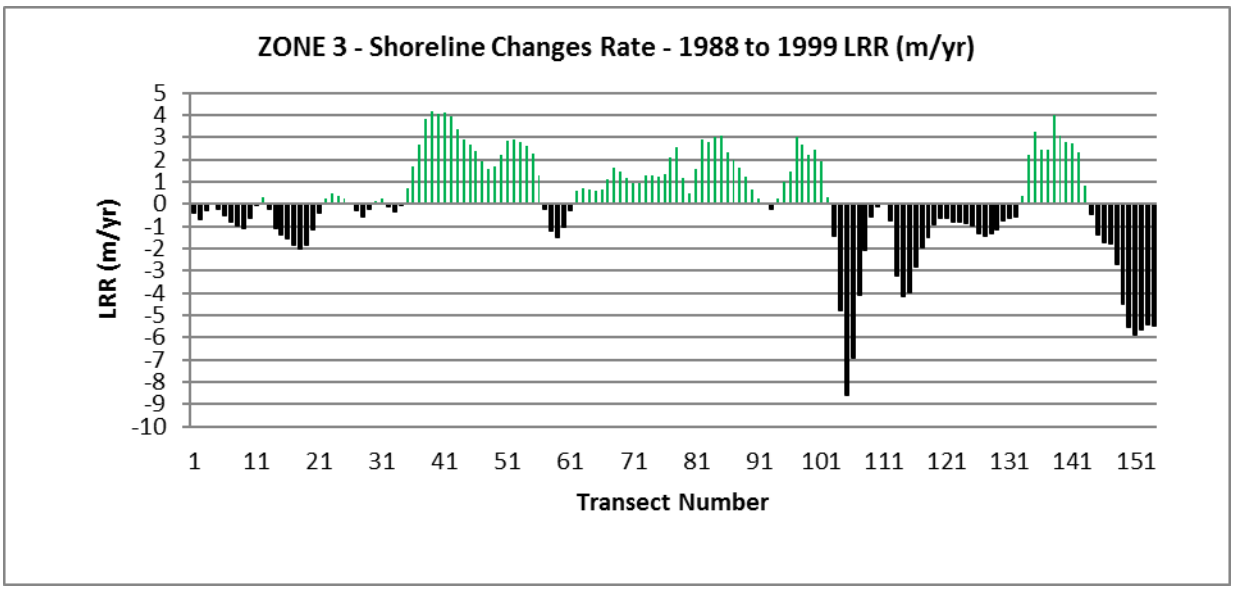


Fig 4.18 Shoreline change analysis LRR & FD 1988 to 1999 – zone 3

SHORELINE CHANGES FROM 2000 to 2009

Fig 4.19 as shows the shoreline classification in DSAS - Linear Regression Rates (LLR) statistics in m/yr. LRR statistics (fig 4.20) which reveals that more positive shoreline change (45%) has been experienced at an average rate of 3.5m/yr; majority of accretion has observed in the northern part of Sriharikota coast in the Zone 1 Coastal stretch, 41% of the area has experienced negative shoreline change with a maximum at northern and southern part of Ennore port, Kalanji, karungali and Katupali and maximum erosion has been observed in the Zone 3 coast at the northern part of Ennore port up to 3km at an average rate of 7.5m/yr and the erosion has continuous up to 6.5km.

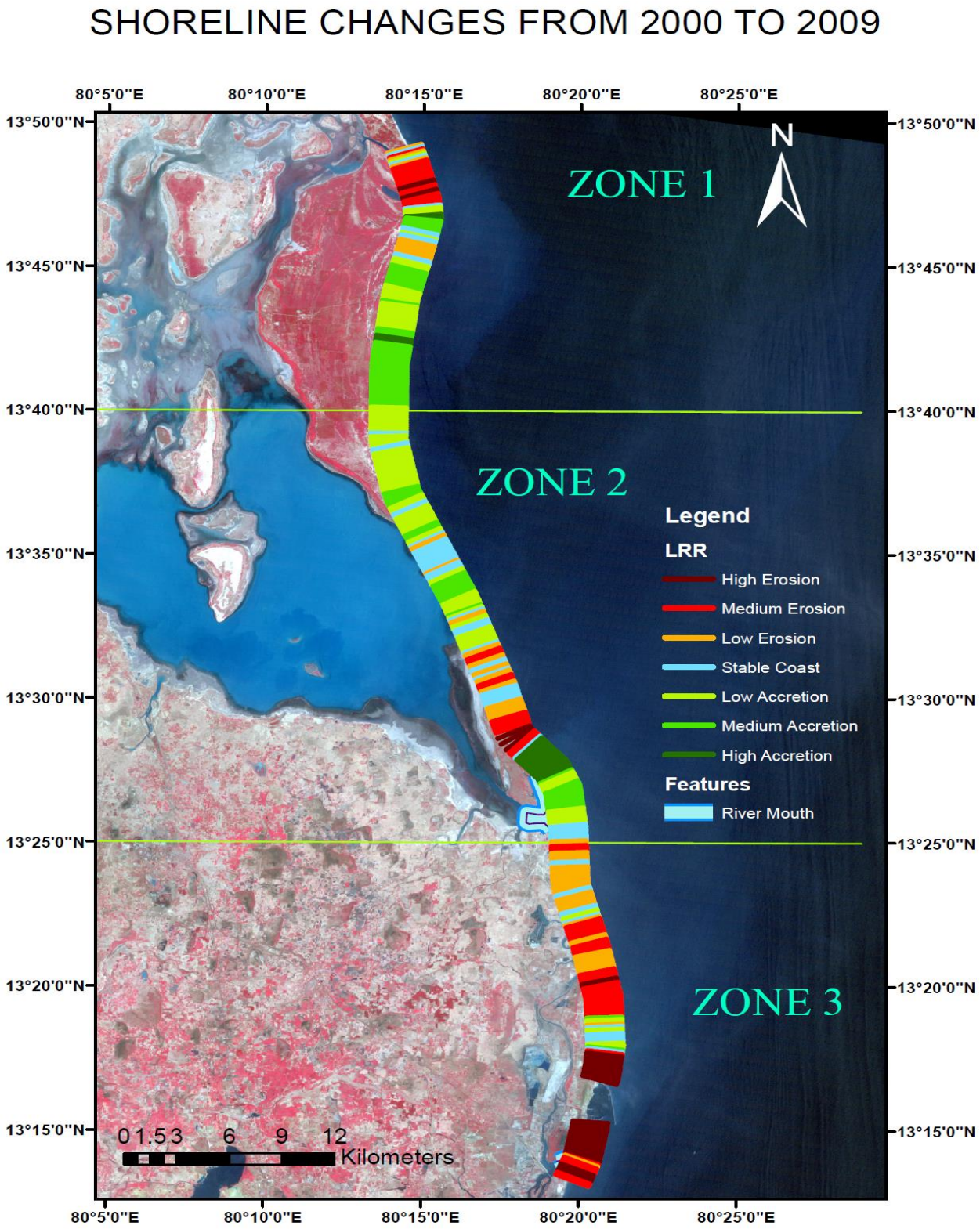


Fig 4.19 Shoreline change analysis LRR 2000 to 2009

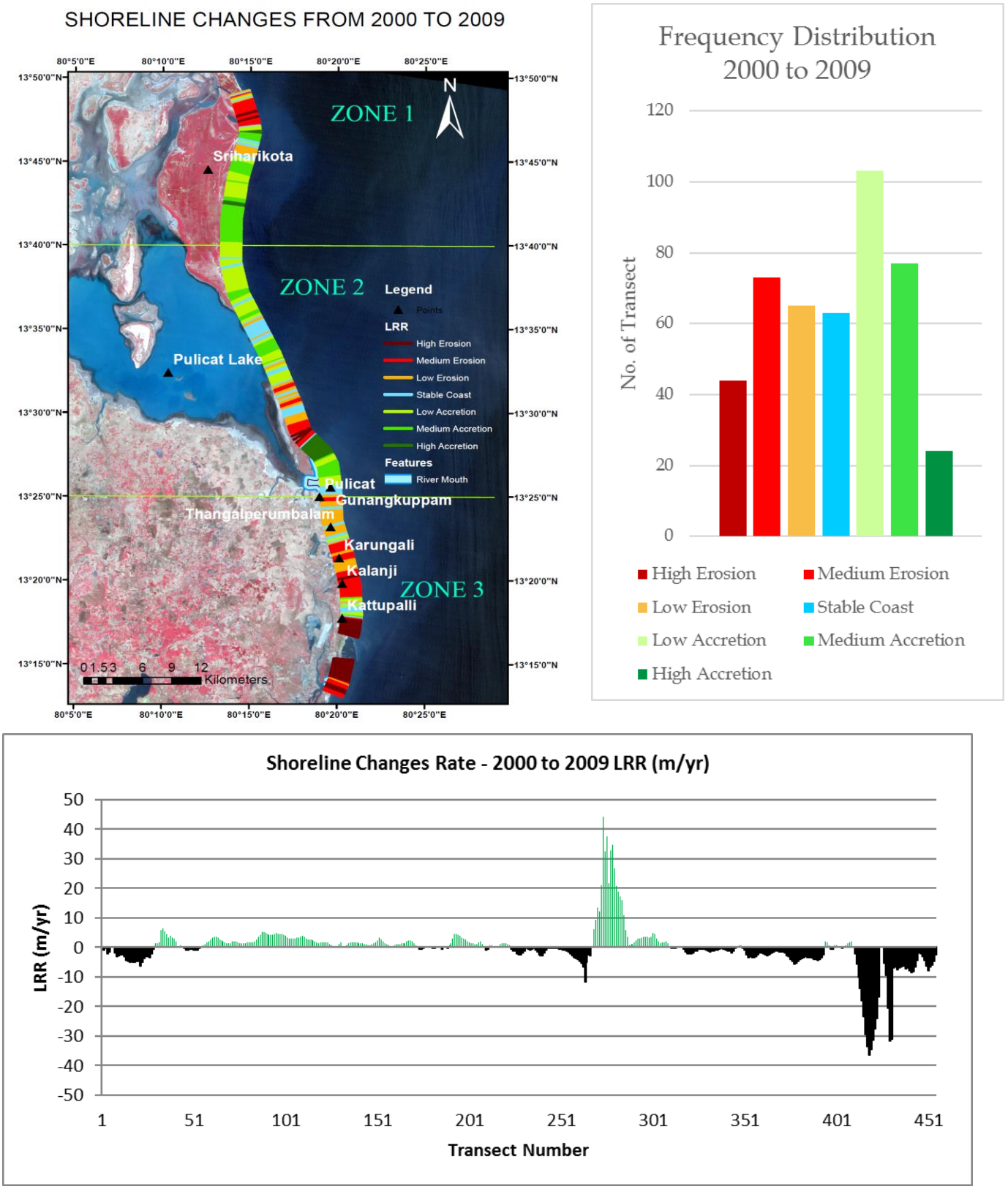
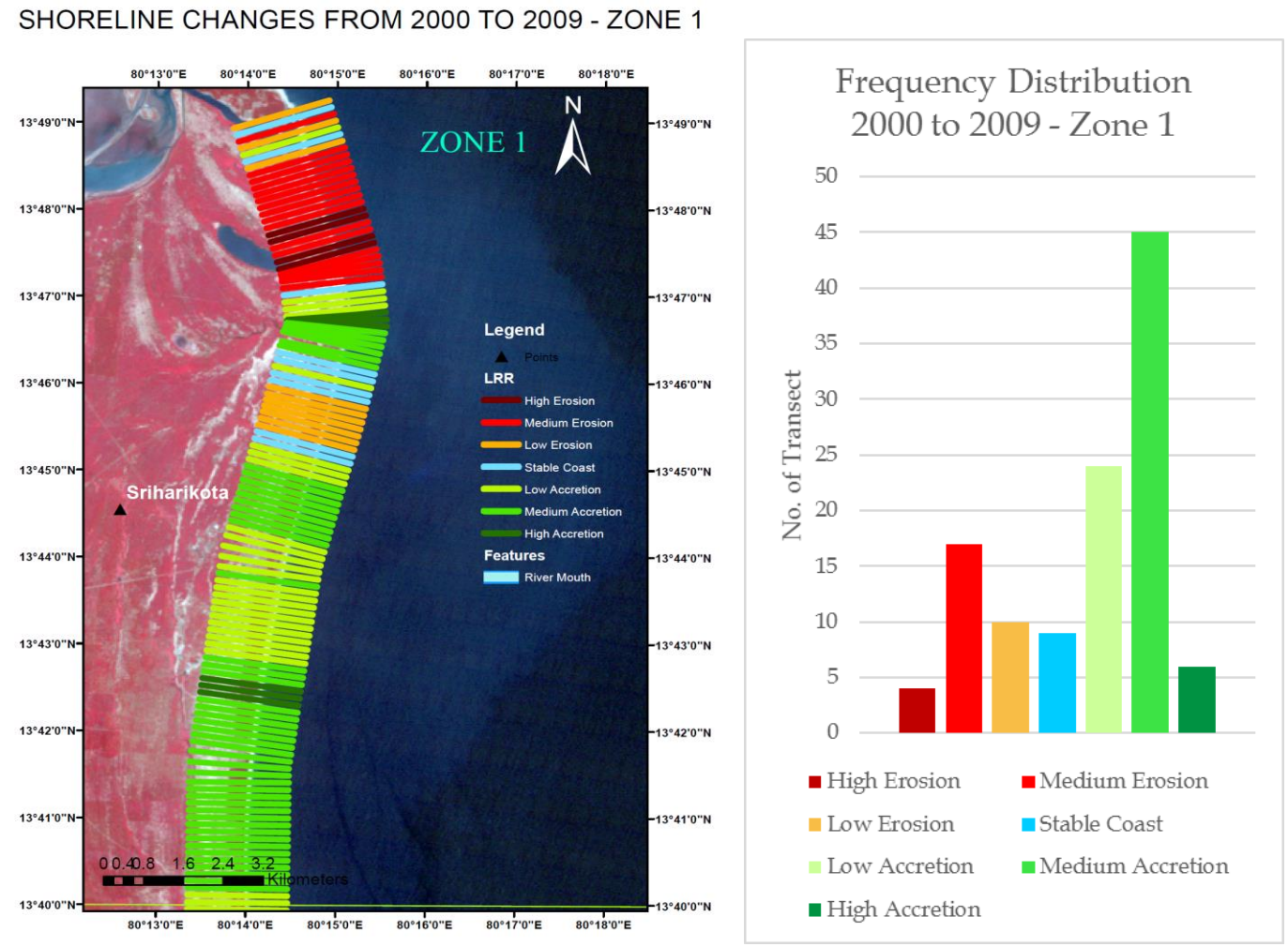


Fig 4.20 Shoreline change analysis LRR & FD 2000 to 2009

SHORELINE CHANGES FROM 2000 to 2009 – ZONE 1

From LRR statistics (fig 4.21), 69% of the coast in Zone 1, accretion is observed (in the south of Sriharikota coast at a coastal stretch of 8.6km) with an average rate of 2.90 m/yr while 27% of erosion is observed (at northern part of Sriharikota coast) at an average rate of -2.90 m/yr and the rest 8 % has been observed as stable coast at an average rate of 0.005m/yr . From LRR statistics, maximum erosion is at the rate of 6.16 m/yr observed at the northern part of Sriharikota coast and the maximum accretion is at the rate of 6.43 m/yr at the Sriharikota coast.



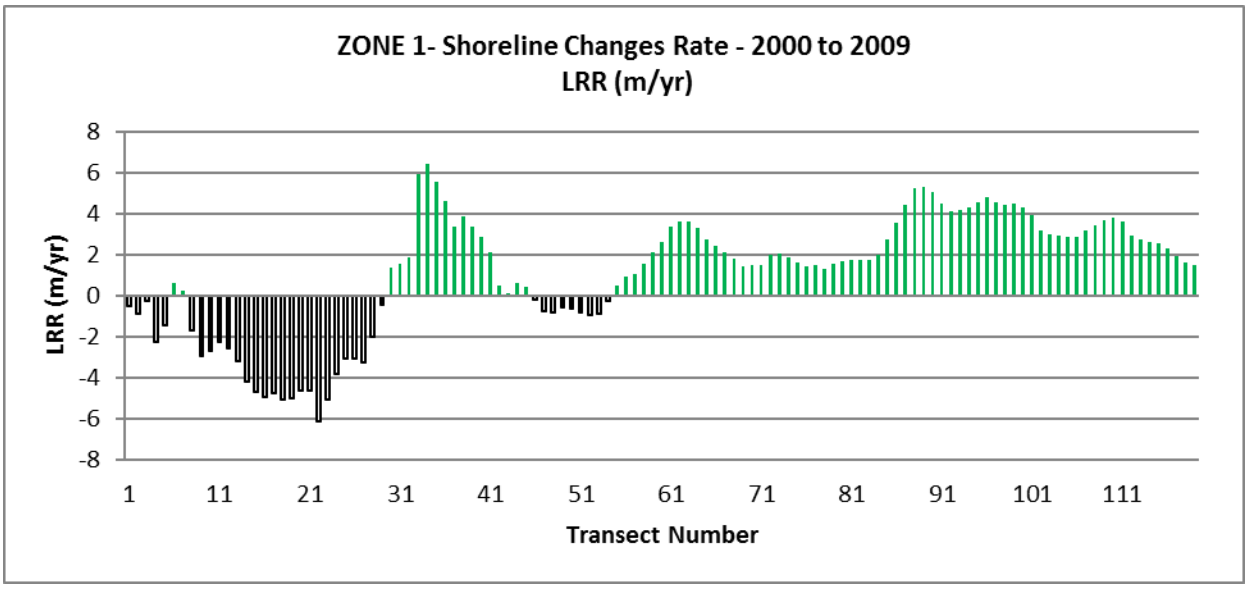


Fig 4.21 Shoreline change analysis LRR & FD 2000 to 2009 – zone

SHORELINE CHANGES FROM 2000 to 2009 – ZONE 2

The stretch, [(South Sriharikota Coast (13º40'0"N) to Gunangkuppam Coast (13º25'30"N)] has observed mainly accreting condition (59%) with an average rate of 4.89 m/yr, along with isolated pockets of eroding coast (20%) mainly in the bar mouth of Pulicat lagoon at an average rate of -2.21 m/yr and the rest has stable coast (21%) with an average rate of 0.076 m/yr. Maximum erosion is experienced in Pulicat lagoon at a rate of 11.55 m/yr and the maximum accretion is at the rate of 44.23 m/yr in the Pulicat mouth bar. (fig 4.22).

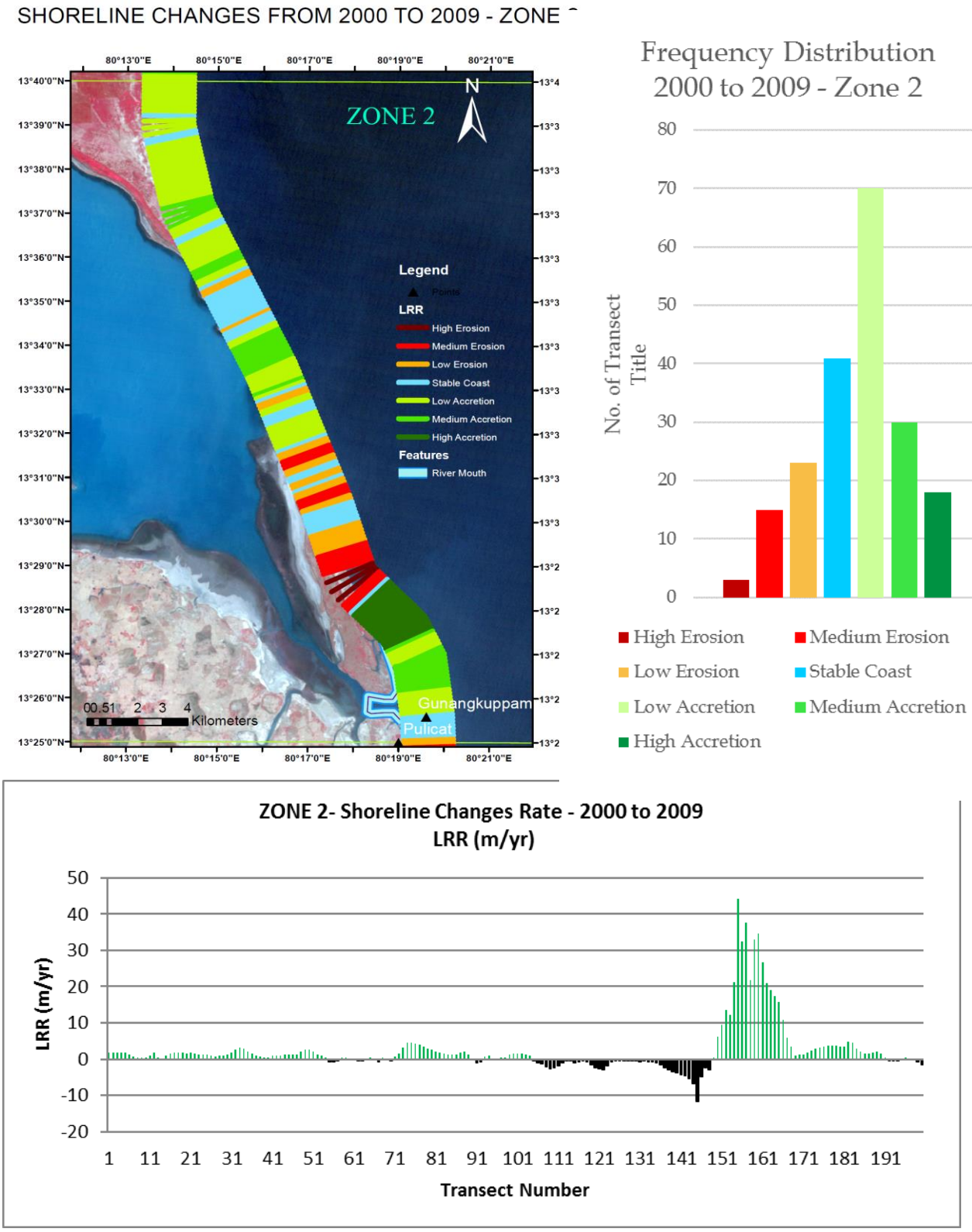


Fig 4.22 Shoreline change analysis LRR & FD 2000 to 2009 - zone 2

SHORELINE CHANGES FROM 2000 to 2009 – ZONE 3

From (fig 4.23) it has been observed that in Zone 3 [Gunangkuppam Coast (13º25'30"N) to the Ennore Creek (13º14'30"N)], during the period 2000 to 2009 more number of transects has faced erosion as about 82% at an average rate of -6.38 m/yr and maximum erosion at the rate of 36.36 m/yr as observed in the region of Ennore Port and Kattupalli port. It has observed that about 2.2km shoreline has faced severe erosion in north side of Ennore port and about 3.9km erosion at southern side of Ennore port. 8% of accretion is observed in zone 3, (noticed in the Kattupalli coastal region) at an average rate of 1.24 m/yr and the rest 10% has been observed as stable coast at an average -0.07 m/yr.

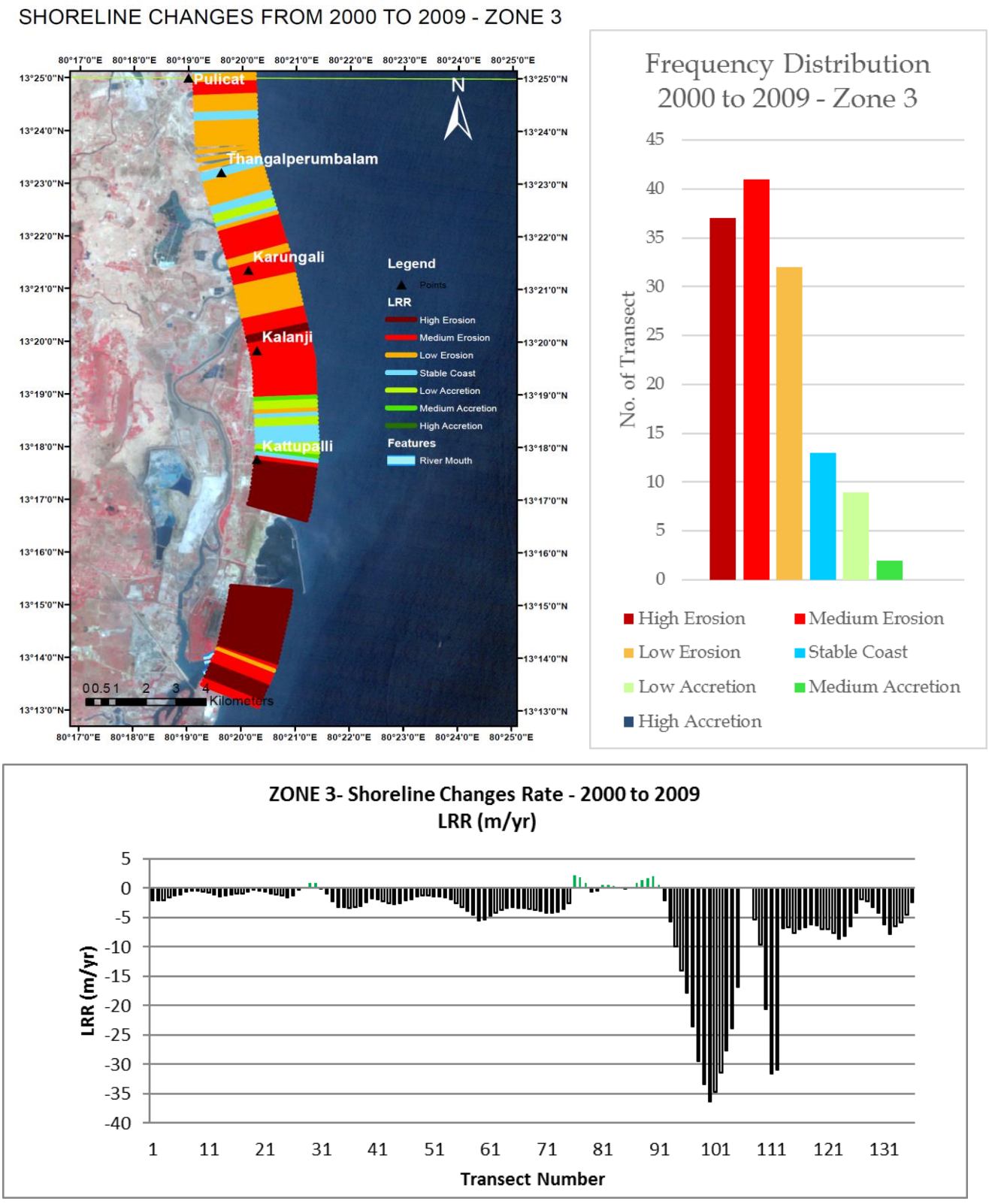


Fig 4..23 Shoreline change analysis LRR & FD 2000 to 2009 – zone 3

SHORELINE CHANGES FROM 2010to 2019

Fig 4.24 shows the shoreline classification in DSAS - Linear Regression Rates (LLR) statistics in m/yr. The LRR statistics graph and frequency distribution for the shoreline analysis from 2010to 2019 is shown in the fig 4.25. Decade 2010-2019 shows more positive shoreline change (52%) at an average rate of 3.5m/yr, negative shoreline change is observed 33% at an average rate of -2.5m/yr and the rest 15 % has been observed stable coast.

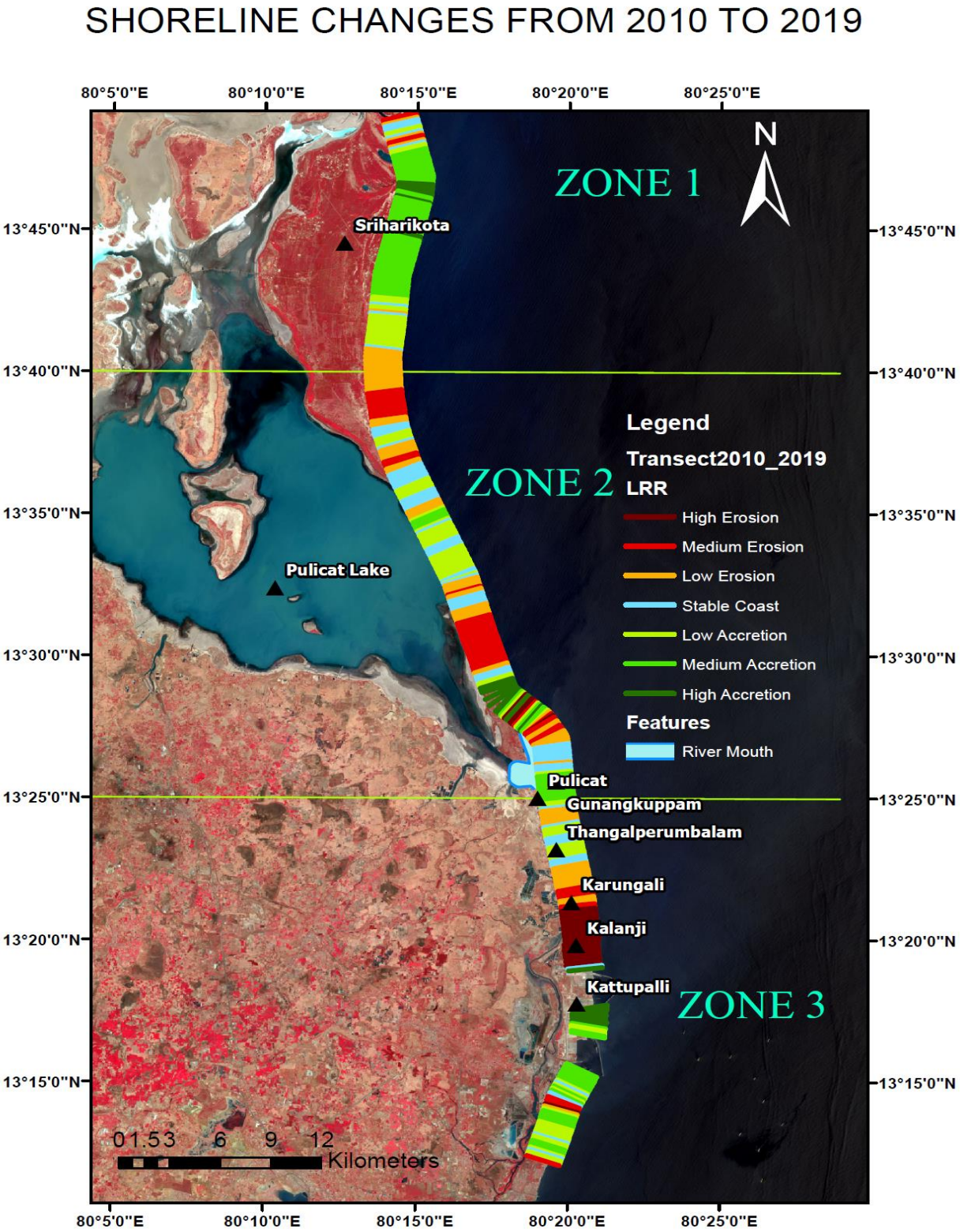


Fig 4.24 Shoreline change analysis LRR 2010 to 2019

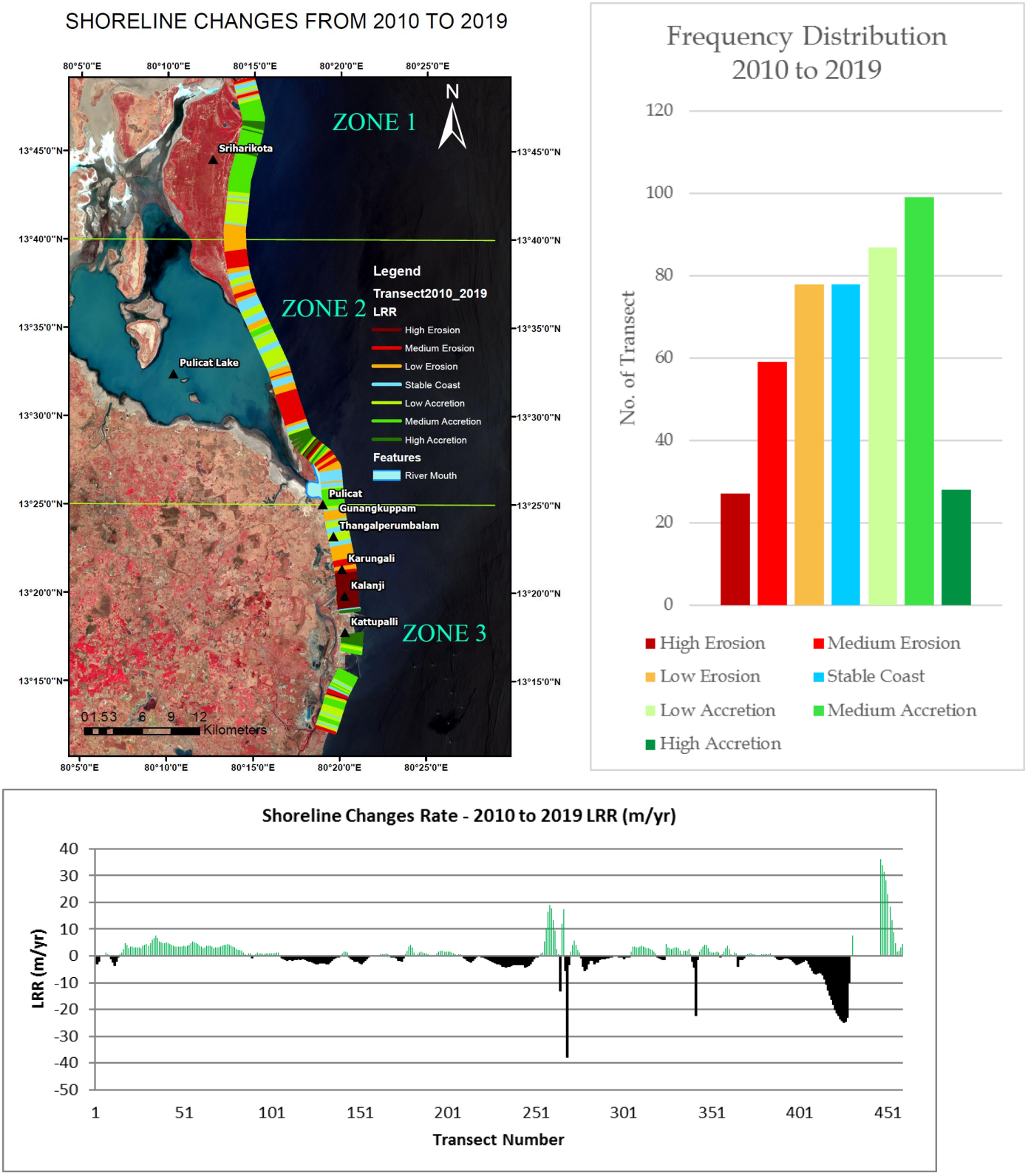


Fig 4..25 Shoreline change analysis LRR & FD 2010 to 2019

SHORELINE CHANGES FROM 2010 to 2019 – ZONE 1

From figure 4.26, It is observed that in Zone 1 [(North Sriharikota Coast (13º48'30"N) to South Sriharikota Coast (13º40'00"N)] about 85% of accretion is observed (immediate to North and South region of Sriharikota) with an average LRR (Linear Regression Rate) of 3.2 m/yr and 10% of eroding coast (at northern and southern tip of Sriharikota coast) with an average rate of -1.62 m/yr and rest 5% has been observed as stable coast with an average rate of 0.07 m/yr. Analysis of shoreline information between 2010 to 2019 reveals, in general this particular stretch (Sriharikota Coast) of 8km coast is accreting coast with an average accretion rate of 3.6 m/year from North and South region of Sriharikota.

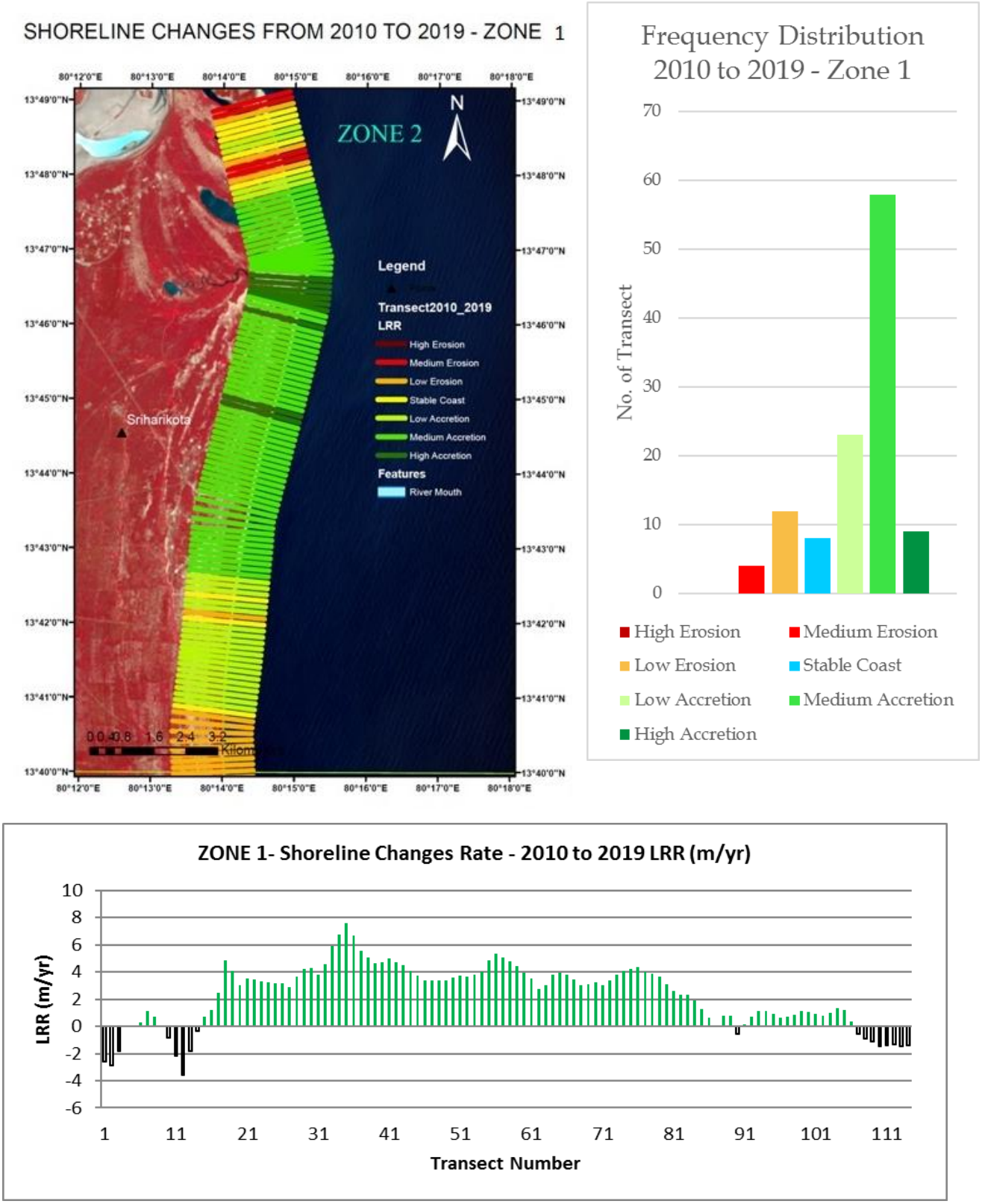


Fig 4..26 Shoreline change analysis LRR & FD 2010 to 2019 – zone 1

SHORELINE CHANGES FROM 2010to 2019 – ZONE 2

From figure 4.27, [(South Sriharikota Coast (13º40'0"N) to Gunangkuppam Coast (13º25'30"N)] it is observed that mostly eroding condition (47%) with an average rate of -2.62 m/yr is there (mainly at a mid of Pulicate lagoon and the northern part of Sriharikota coast,) along with accreting coast (32%) (mainly in the bar mouth of Pulicate lagoon) at an average rate of 3.45 m/yr due to siltation in the Pulicate Lagoon and the rest has stable coast (21%) with an average rate of 0.02 m/yr.

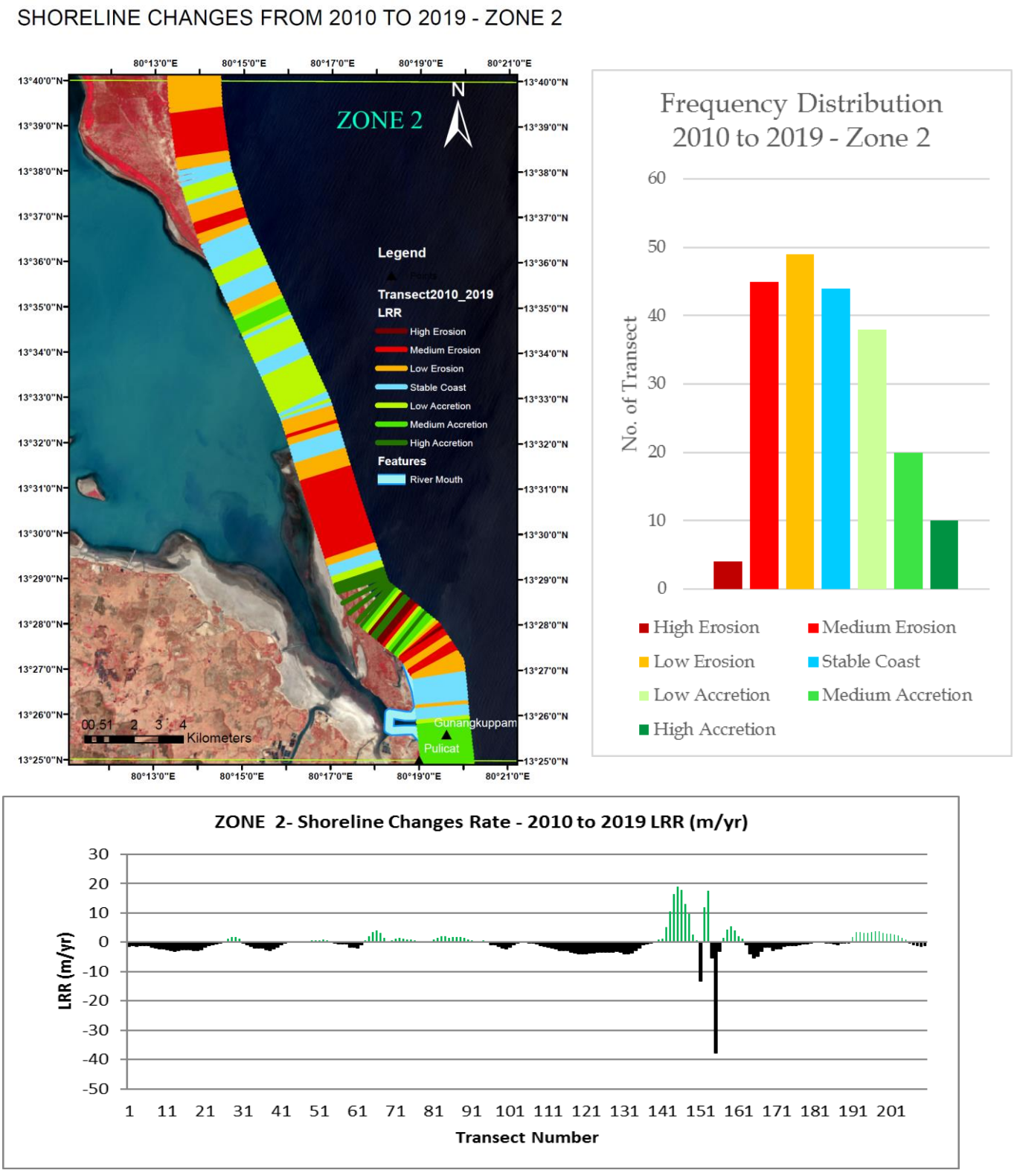


Fig 4..27 Shoreline change analysis LRR & FD 2010 to 2019 – zone 2

SHORELINE CHANGES FROM 2010 to 2019 – ZONE 3

In zone 3 (fig 4.28) Gunangkuppam Coast (13º25'30"N) to the Ennore Creek (13º14'30"N) coast more percentage of the shoreline has experienced accretion (42 %), followed by negative shoreline change (38%) and stable coast (20%). Analysis of shoreline information between 2010 to 2019 reveals, in general this particular stretch of 2km coast (South of Kattupalli Port Breakwater to Ennore creek) has accreting coast with an average accretion rate of 3.2m/year from Southern region of Ennore Port and katupalli upto 4 km till Ennore creek.

Comparison of shoreline information between 2010 to 2019 reveals, in general this particular stretch of 2km coast (South of Kattupalli Port Breakwater to Ennore creek) has accreting coast with an average accretion rate of 3.2m/year from Southern region of Ennore Port and katupalli upto 4 km till Ennore creek. During the construction of Kattupalli Port breakwater (Aug 2009 – June 2012) the combined effect of both Kattupalli and Ennore Ports has caused erosion up to an average of 4.5 km and this 4.5 km coast was eroded at a higher rate of 8.6 m/yr.

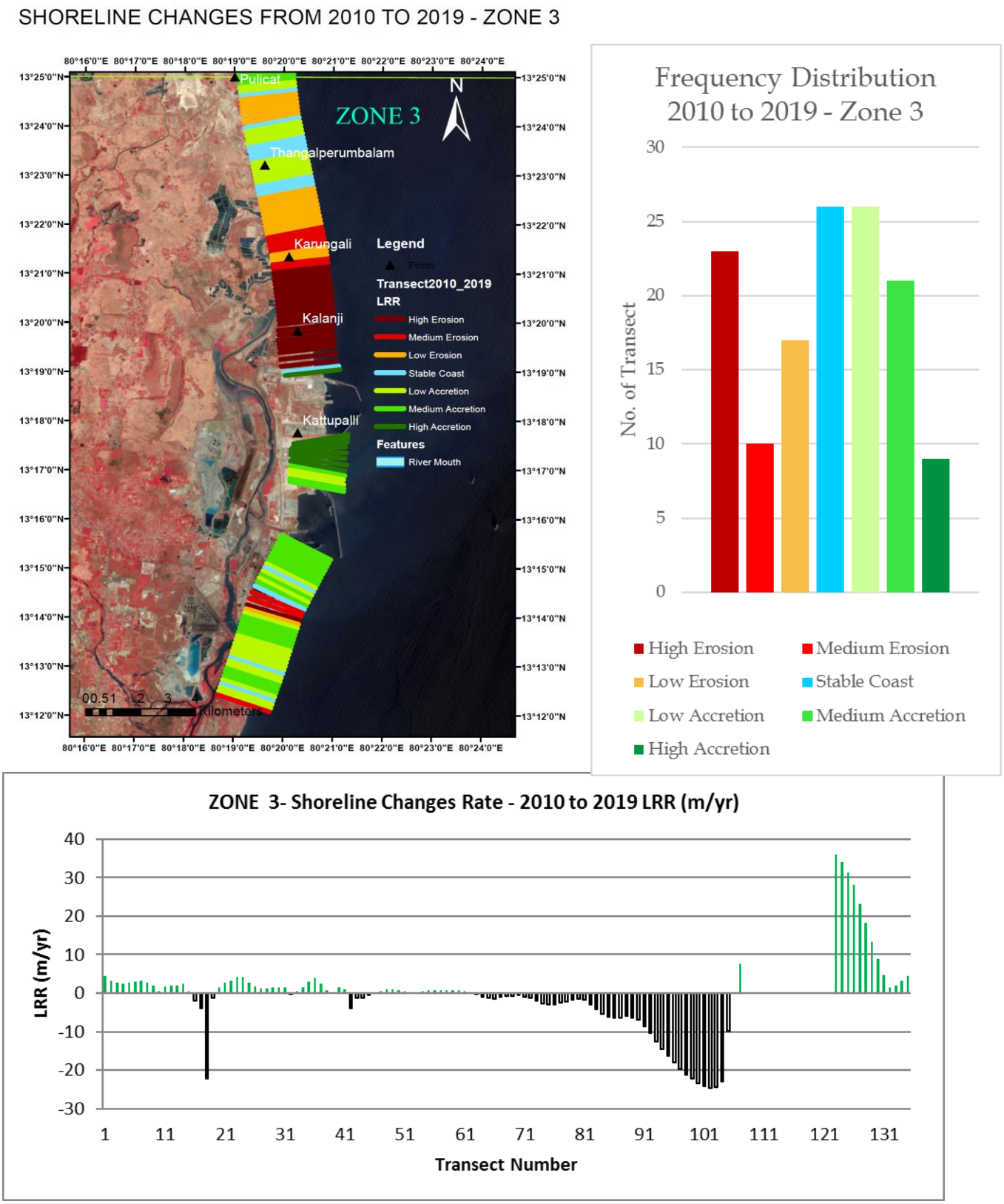


Fig 4..28 Shoreline change analysis LRR & FD 2010 to 2019 – zone 3

5. CONCLUSION

The shoreline position covers a variety of time periods ranging from 1988 to 2019. The spatial and temporal analysis of shoreline analysis for the Kattupalli Port indicates for the period between 1988 to 2019. Shoreline change analyses are based on a comparison of different shoreline positions digitized from satellite images (Landsat 4-5 & Landsat 8). Long-term rates of change are calculated using Arc-GIS, DSAS Version 4 for all 32 different shorelines positions i.e. for the year 1988 to 2019, LRR (Linear Regression Rate) statistics used for the classification of the shoreline according to erosion/accretion. The rates of change presented in this report represent conditions up to the date of the most recent shoreline data and therefore are not intended for predicting future shoreline positions or rates of change. The results are classified in three categories i.e. erosion, stable and accretion.

The zone wise analysis in the year 1988 to 2019 suggests that, zone 1 North Sriharikota Coast (13º48'30"N) to South Sriharikota Coast (13º40'00"N) about 67% of Accretion observed at the southern part of Sriharikota with an average LRR (Linear Regression Rate) rate of 1.55 m/yr and 17% of stable coast with an average rate of 0.27 m/yr is noticed in the Southern region of Sriharikota Coast and 16% of Erosion with an average rate of -3.08m/yr observed in Northern region of Sriharikota Coast. Zone 2 (South Sriharikota Coast (13º40'0"N) to Gunangkuppam Coast (13º25'30"N) mainly accreting condition (44%) with an average rate of 3.35 m/yr, along with isolated pockets of eroding coast (20%) mainly in the bar mouth of Pulicate lagoon at an average rate of -3.95 m/yr due to dredging action and siltation of Pulicate Lagoon and the rest has stable coast (36%) with an average rate of 0.14 m/yr. Zone 3 [(Gunangkuppam Coast (13º25'30"N) to the Ennore Creek (13º14'30"N)] shows mainly stable condition (39%) at an average rate of 0.16 m/yr, 35% eroding at an average rate of -3.83 m/yr has observed at kalanji amd southern part of Karungali coast due to infrastructure development, harbor, ports,

industries, anthropogenic activities and also natural phenomena. While accretion is exceeding to 26% along the Ennore port and Kattupalli Port area an average rate of 6.76 m/yr. Overall, the 32 years shorelines approximately 69 km of coastal stretch has estimated in LRR statistics which reveals that more positive shoreline change rates has experienced (45%) at an average rate of 3.5m/yr, negative shoreline change rates has 23% at an average rate of -2.5m/yr and the rest of 32 % has stable coast. The shoreline eroded is about 15.87 km, the major part of shoreline has eroded in the Zone 3 and the total shoreline accreted up to 31.05km, the major part of shoreline has accreted at the northern part of Sriharikota coast (Zone 1).

Analysis of Shoreline from 1988 to 1999 suggests that, in Zone 1 [(North Sriharikota Coast (13º48'30"N) to South Sriharikota Coast (13º40'00"N))] southern part of Sriharikota coast have witness both Erosion and stable coast with 45% of erosion at average rate of -1.95 m/yr and 30% of stable coast with average rate of 0.13 m/yr and witness of 25% accretion (at the northern part of Sriharikota coast) at an average rate of 2.15 m/yr. Zone 2 [(South Sriharikota Coast (13º40'0"N) to Gunangkuppam Coast (13º25'30"N)] has experienced more erosion of about 47% (mainly observed at the bar mouth of Pulicat Lagoon) at an average rate of -5.06/yr , accretion 30% due to siltation of Pulicat lagoon at an average rate of 2.97/yr and the rest 23% stable coast at an average rate of -0.004 m/yr. Zone 3 [(Gunangkuppam Coast (13º25'30"N) to the Ennore Creek (13º14'30"N)] coastal stretch, 43% of the shoreline has experienced accretion at an average rate of 2.12 m/yr (noticed at the northern and southern part of Ennore port area due to land reclamation activities for the port purposes), followed by Erosion (35%) with an average rate of -2.19 m/yr and stable coast (22%) at an average rate of -0.016 m/yr. Comparison of shoreline analysis between 1988 to 1999 (prior to construction of Ennore Ports) reveals, during the construction of Ennore Port breakwater in the period of 1999 has caused erosion up to an average length of 4.5 km and this

coast stretch has eroded from northern part of ennore creek to southern part of Kattupalli coast at an average erosion rate of -1.6 m/yr and maximum erosion rate of -8.6 m/yr due to infrastructure development, ports, industries, anthropogenic activities and also natural phenomena. Overall, approximately out of 69 km of coastal stretch it has been observed that 42% of shoreline experienced erosion at an average rate of -2 m/yr, 34% of shoreline has experienced accretion with an average rate of 4.5m/yr and the rest 24 % has stable coast.

From 2000 to 2009, **zone 1** (North Sriharikota Coast (13º48'30"N) to South Sriharikota Coast (13º40'00"N)) has estimated that the 69% of accretion is observed in the south of Sriharikota coast at a coastal stretch of 8.6km with an average rate of 2.90 m/yr along with 27% of erosion is observed at northern part of Sriharikota coast at an average rate of -2.90 m/yr and the rest 8 % has stable coast coast at an average rate of 0.005m/yr. Zone 2 (South Sriharikota Coast (13º40'0"N) to Gunangkuppam Coast (13º25'30"N)) mainly accreting condition (59%) with an average rate of 4.89 m/yr, along with isolated pockets of eroding coast (20%) mainly in the bar mouth of Pulicat lagoon at an average rate of -2.21 m/yr and the rest has stable coast (21%) with an average rate of 0.076 m/yr. Zone 3 (Gunangkuppam Coast (13º25'30"N) to the Ennore Creek (13º14'30"N), During the period 2000 to 2009 more number of transects has faced erosion as about 82% at an average rate of -6.38 m/yr and maximum erosion at the rate of 36.36 m/yr as observed in the region of Ennore Port and Kattupalli port. It has observed that about 2.2km shoreline has faced severe erosion in north side of Ennore port and about 3.9km erosion at southern side of Ennore port. 8% of accretion observed in zone 3, accreting coast noticed in the Kattupalli coastal region at an average rate of 1.24 m/yr and the rest 10% has stable coast at an average -0.07 m/yr.

Between 2010 to 2019, Zone 1 [(North Sriharikota Coast (13º48'30"N) to South Sriharikota Coast (13º40'00"N)] about 85% of accretion is observed immediate to North

and South region of Sriharikota with an average LRR (Linear Regression Rate) of 3.2 m/yr and 10% of eroding coast at northern and southern tip of Sriharikota coast with an average rate of -1.62 m/yr and rest 5% has stable coast with an average rate of 0.07 m/yr. **Zone 2** (South Sriharikota Coast (13º40'0"N) to Gunangkuppam Coast (13º25'30"N) mainly eroding condition (47%) with an average rate of -2.62 m/yr mainly at a mid of Pulicate lagoon and the northern part of Sriharikota coast, along with accreting coast (32%) mainly in the bar mouth of Pulicate lagoon at an average rate of 3.45 m/yr due to siltation in the Pulicate Lagoon and the rest has stable coast (21%) with an average rate of 0.02 m/yr. Zone 3 [(Gunangkuppam Coast (13º25'30"N) to the Ennore Creek (13º14'30"N)] coast more percentage of the shoreline has experienced accretion (42%), followed by negative shoreline change rates 38% and stable coast about 20%. Comparison of shoreline information between 2010 to 2019 reveals, in general this particular stretch of 2km coast (South of Kattupalli Port Breakwater to Ennore creek) has accreting coast with an average accretion rate of 3.2m/year from Southern region of Ennore Port and katupalli upto 4 km till Ennore creek.

From the field survey, it has observed that the study area is subjected to highest high water level of 3.5m and lowest low water level of 0.10 m. The tidal currents are as 0.2m/s to 0.3 m/s during spring tides and 0.15 m/s to 0.20m/s during neap tide. The north and south trending channels of the Ennore creek connect it with Pulicat lake to the north and the south Kosasthalaiyar river. During monsoon Kosasthalaiyar river discharged in to the sea. The combined effect of Kosasthalaiyar river discharge, strong tidal currents, and Construction of Ennore and Kattupalli Port induce morphological changes along the Ennore, Kattupali and Karungali Coast

The Dredge spoil disposal study for Kattupalli Port

Background

Past study by L&T Shipbuilding Limited (LTSB) (June-2011 Report)

For development of Shipyard cum Minor Port Complex by L&T Shipbuilding Limited (LTSB), Environment Clearance (EC) was issued by Ministry of Environment & Forest (MoEF) in 3rd July 2009 . Capital dredging was one of the component for the development of shipyard cum minor port complex, which has environmental implication.

One of the specific condition of EC required LTSB to carry out a detailed model study to evaluate the fate of dumped dredge spoil and formulate a monitoring scheme for evaluating the impact of dredge spoil dumping.

With the above background LTSB appointed L&T Ramball Consulting Engineers Limited (LTR) to carry out mathematical model study to evaluate the impact of dredged spoil dumping from Kattupalli and Ennore Ports on the navigation channel and basin of Kattupalli Port, and to formulate a monitoring scheme for evaluating the impact of dredge spoil dumping.

1 Scope of Studies

The detailed scope of work assigned by the client as part of the study comprises of the following:

i. Carry out mathematical study to evaluate the impact of Kattupalli Port's dredged spoil dumping on the navigational channels and basins of Kattupalli and Ennore Port for different seasons.

ii. Carry out mathematical study to evaluate the impact of Ennore Port's dredged spoil dumping on the navigational channels and basins of Kattupalli for different seasons.

iii. Formulate a monitoring scheme to evaluate the impact of dredge spoil dumping.

iv. Carryout comparison between model prediction and actual observations and suggest remedial measures as necessary.

The section i & ii of the scope was completed and report submitted vide RP001 dated 20th June 2010. The section iii of the scope was completed and reports submitted vide RP002 dated 31st June 2010. This report compiles section i, ii & iii of the scope and compares the model prediction with the actual observation at the site (section iv).

2 Mathematical model study

This section presents the extract of the mathematical model study (RP001) carried out to assess the impact of dredge spoil dumping on the navigation and basin of the Kattupalli Port.

2.1 Model Inputs

The dispersion of dredge spoil in marine environment depend on parameters like prevailing ocean currents, wind and wave pattern, characteristics of dumped materials, dumping method and location etc, based on which the following methodology was adopted for the study.

2.1.1 Bathymetry

The bathymetry of the study area was reconstructed from the Naval Hydrographic Office (NHO) chart Nos. 313 and 3028, blended with ETOPO - | data and site specific bathymetry survey by M/s Indomer Coastal Hydraulics (P) Limited, Chennai (INDOMER). Other bathymetric features like dredge channels and breakwaters were obtained from the DPR for the development of Shipyard cum Port complex at Kattupalli.

The general bathymetry of the study area was prepared with a grid resolution of 50m so that the shoals and other features like dredged channels can be reproduced with a reasonable resolution without compromising on the simulation time, covering an area of 20x25 km and extending to 80m contour off the coast. The digital bathymetry of the model domain is presented in Figure 2-1.

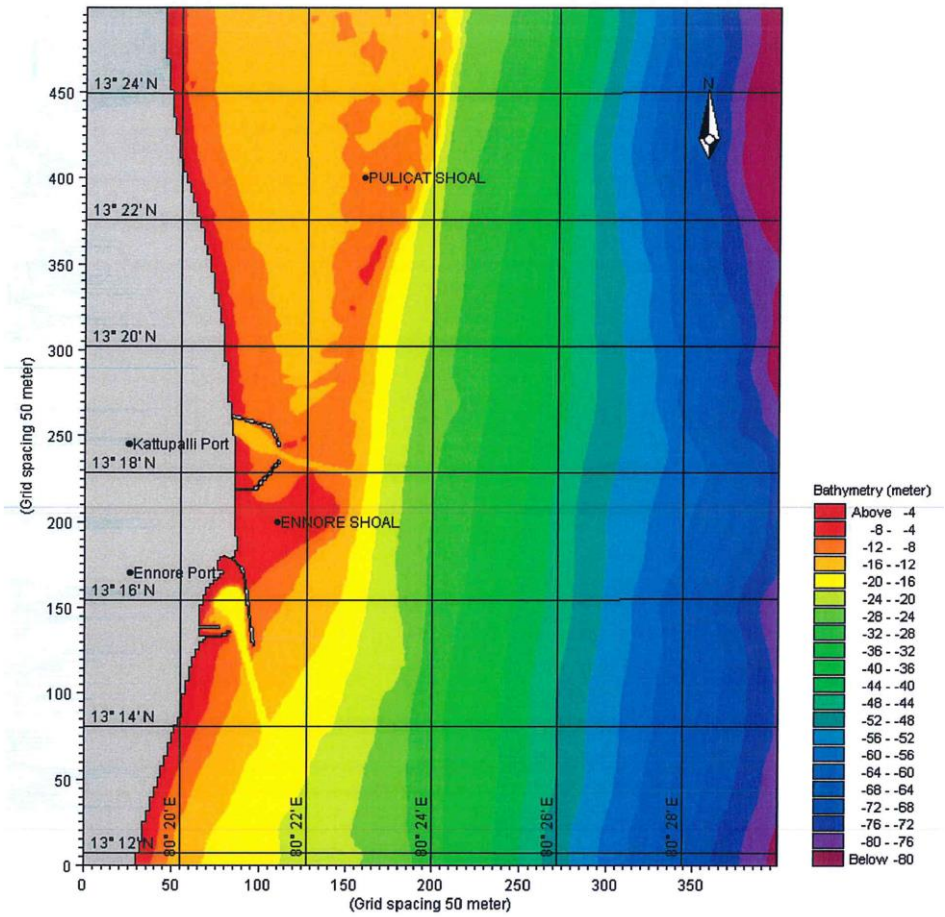


Figure2-1 Bathymetry (With respect to MSL) of the model domain

3 Simulated Results

Simulation studies for dredge spoil disposal were carried out with various parameters. Typical deposition patterns at the end of each simulations and typical sediment plume.

It is inferred from the simulated scenario that the spreading of dredge spoil is driven by the prevailing current rather than any other environmental scenario. This can be seen from the deposition pattern of the dumped dredge spoil which is north south.

It is observed that the material of Type —I (coarse sediment) with less percentage of fines tend to settle in the immediate vicinity of the dumping ground even for strong currents. Strong currents can cause depositions up to a distance of 2km away from the dumping site occasionally. High average sediment concentrations have been observed immediately after each dumping operation. When the current speeds are lower (HD Scenario-I), the materials settles locally without any significant spreading. Average thickness of the deposited material on completion of dumping operation is found to be about 0.5m within the dumping ground.

Similarly when the spoil of Type-ll material which contain more fines is dumped with lower current speed (HD Scenario-l) the fines move out of the dumping area before they finally settle, however the coarse particles settle in the immediate vicinity from the point of dumping. The average thickness of the deposited material on completion of dumping operation is found to be about 0.3m within the dumping ground, with fines in the dumped spoil settling over a stretch of 3km from the point of dumping.

4 Evaluation of deposition pattern

The deposition pattern at the disposal ground was evaluated through series of bathymetric surveys. Four sets (baseline and three post dumping survey) bathymetric surveys were carried out to evaluate the deposition pattern. The baseline bathymetry, which shows parallel contours at the disposal ground. The thickness of deposition at the disposal area after the intermediate bathymetry survey dated 11th July 2010. The quantity of deposition at the dumping area is computed to be 1.21 million cu-m. The thickness of deposition at the disposal area after the intermediate bathymetry survey dated 29th February 2011. The quantity of deposition at the dumping area is computed to be 1.87 million cu-m. The final bathymetric survey at the dumping ground was carried out on 18th April 2011. The final quantity of the dredge spoil dumped at the disposal ground was computed to be 2.07 million cu-m.

The evaluation of the deposition pattern indicates the immediate settlement of dumped material without any significant movement of particles away from the disposal area. The average thickness of deposition in the disposal ground is found to be in the range of 0.9m to 1.5m with occasional heaps of dredge spoil exceeding 2.0m.

5 Result and discussion

The scope of work assigned for the study required comparison of mathematical model results with actual field measurement at the dumping ground. Mathematical model was setup for three hydrodynamic scenarios to represent the weak current, normal current and strong current prevalent during different seasons which may occur during the course of entire dredging and dumping operation. The scenario for weak current exists for of few hours and strong current are noticed only during extreme climate during which the dredging operation was stopped.

The analysis of sediment from the dredger hopper indicated the Type-I sediment with grain size distribution in the range of fine sand to silt. The field measurement of TSS and Turbidity in the

water column conducted on 22nd July 2010 & 24th August 2010 indicated insignificant change in background values, which infers immediate settlement of sediment after dumping.

The mathematical model predicted the sediments similar to those dredged to have remained in suspension for over an hour before it has finally settled. The results obtained from the field measurements compare well with the predicted result of mathematical model study. However the TSS level does not remain high over an hour after dumping as predicted in the mathematical model study. Absence of fines and the action of flocculation might have contributed to the faster settling of dredge spoil. The series of bathymetric surveys at the dumping ground indicate dumped materials settling in the immediate vicinity of the dumping location (Figure:5-1).

From the analysis of field data and the results of mathematical model studies, it can be concluded that the impact of dredge spoil dumping at the Kattupalli port's dumping ground on the environment in the form of increased turbidity and sediment spreading is minimal.

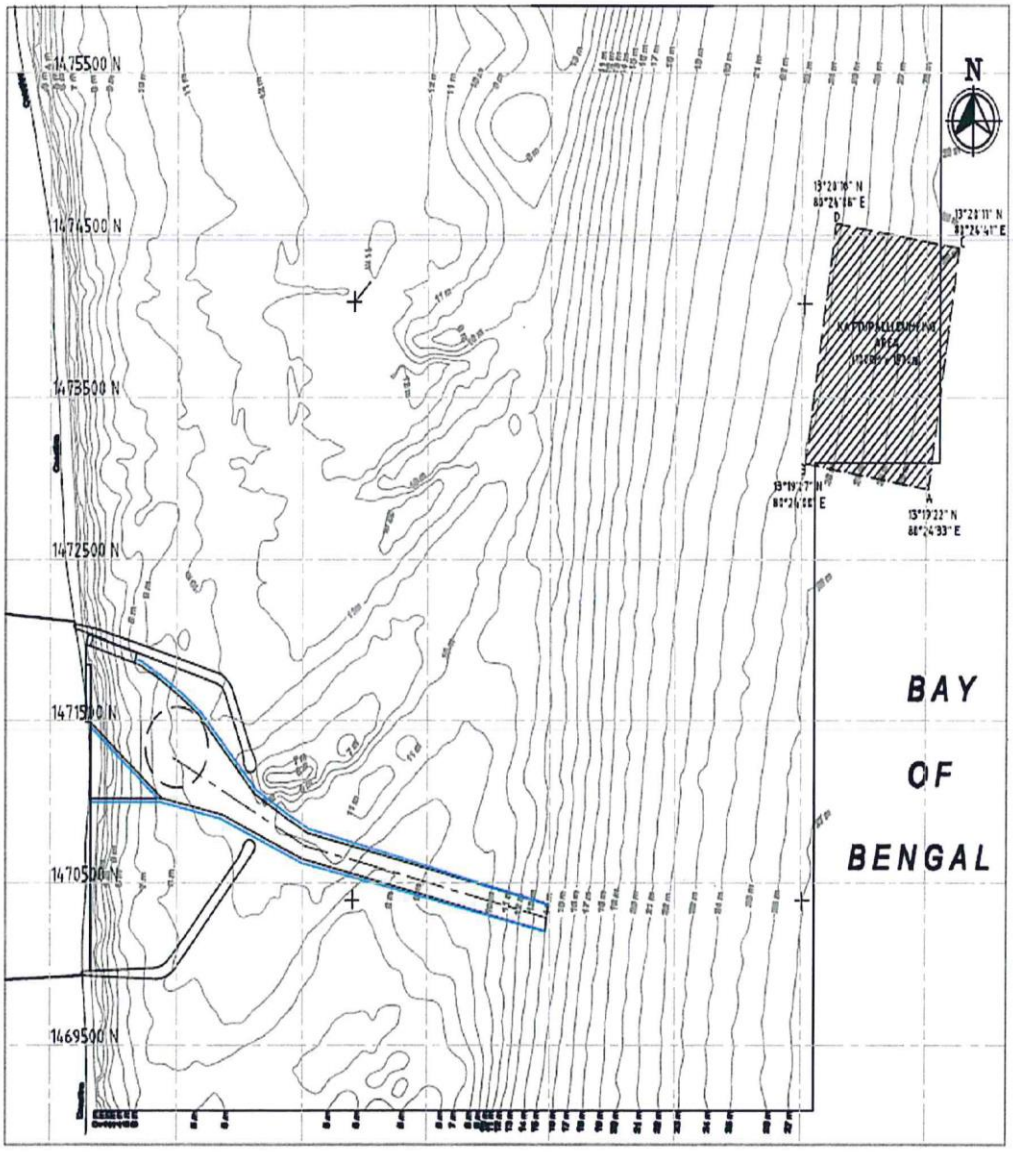


Figure:5-1 The Dumping location of the Kattupalli Shipyard superposed over the bathymetry (Reference source: Kattupalli port)

Present Status of the Dredge spoil disposal study: The new work assigned to Institute for Ocean Management(IOM), Anna University, Chennai (July2020-June2021)

I. SCOPE OF THE PROJECT:

- A comparison between model study and actual dumping shall be carried out to examine the impacts both on North-East and South-West of the Ports
- The details of combined effect on both ports (Ennore & Kattupalli) to be carried out to monitor the impact of post dumping.

II. METHODOLOGY:

a) **DESKTOP STUDY:**

***Primary** and ****Secondary** Data collections on Environmental (Geology / Geomorphology) and Engineering (Coastal Structures / Dredge Material Shore / offshore Dumping) studies, etc…

b) FIELD DATA COLLECTION:

i) ****Monthly Topography:*** (Total Station, Mobile GPS, RTKGPS, DGPS) (10 months) Latitude (Degree Decimal), Longitude (Degree Decimal), and Elevation (meter). and/or Northing (X), Easting (Y) & Z (Altitude) .

ii) ****Shoreline Mapping Demarcation (Spring/Neap):*** (10 months)

a) High Tide Line: Mobile RTKGPS Mapping.
b) LTL: Mobile RTKGPS Mapping.
c) Beach Profile: 300m spacing transects.

iii) ****Bathymetry:*** *(Using Echo Sounder): (Three)*

a) Pre Monsoon, b) Monsoon & c) Post Monsoon

iv) *****Tide:*** *Water Levels – Tide Gauge(From Each Port)*

a) Adani Port, b) Ennore Port Limited & c) Chennai Port Trust.

v) ****Wave (Directional Wave Recorder - 15 days of Observations at 2 location)***

a) Offshore: >-25m
b) Near Shore: <-10m

vi) ****Current (Currents Profile – ADCP/ADV - 15 days of Observations at 2 location)***

a) Offshore: >-15m
b) Near Shore: -<-10m

vii) ***Sediments Characteristics:** (Particle Size): Monthly Frequency (10 months)

a) Seabed Sediments: 10 samples at every 3m depth interval (i.e. -3m, -6, -9, -12, -15, -18, -21, -24, -27 & -30m).
b) Shore Sediments: 3 samples. LWL, HWL and Back Dune.

viii) ***Sea water Analysis:** (Niskin Water Sampler - Total Suspended Solids - Filter) Each locations a) Surface, b) Middle & c) Bottom (3m intervals) samplings.

ix) ****Meteorological (Weather) Data Collections: (From IMD)**

a) Wind: Speed and Directions & Rainfall

c) *MODELING: Hydrodynamic Modeling (Numerical Model Set up, Run & Analysis)

a. FIELD DATA INPUT INTO MODEL
b. SECONDARY DATA
c. VALIDATION
d. MODEL RUN (IDENTIFICATION, QUANTIFICATION OF DREDGE SPOIL DISPERSION FROM DUMPING - PATTERN)

d) *DISCUSSIONS AND RECOMMENDATION:

e) *FINAL REPORT:

III. DURATION: ONE YEAR

S.NO	ACTIVITIES / DURATION	MONTHS											
		1	2	3	4	5	6	7	8	9	10	11	12
1	DESKTOP STUDIES												
2	FIELD DATA COLLECTIONS												
3	LAB ANALYSIS												
4	NUMERICAL MODELING												
5	REPORT												

Dumping details and location:

S. No	Dumping details and location
1.	• **Volume:** Since 2016, the total dredging volume to maintain depth of 14.0 mtrs was 18,42,550 cubic meters which works out to 3,07,000 cubic meters of siltation every year • **Location:** Coordinates of dumping area: NW- 13º 20.274'N 080º 24.134'E NE- 13º 20.192' N 080º 24.683'E SW- 13º 19.471'N 080º 24.000'E SE- 13º 19.383'N 080º 24.550'E

Dumping Area Bathy Survey Data:

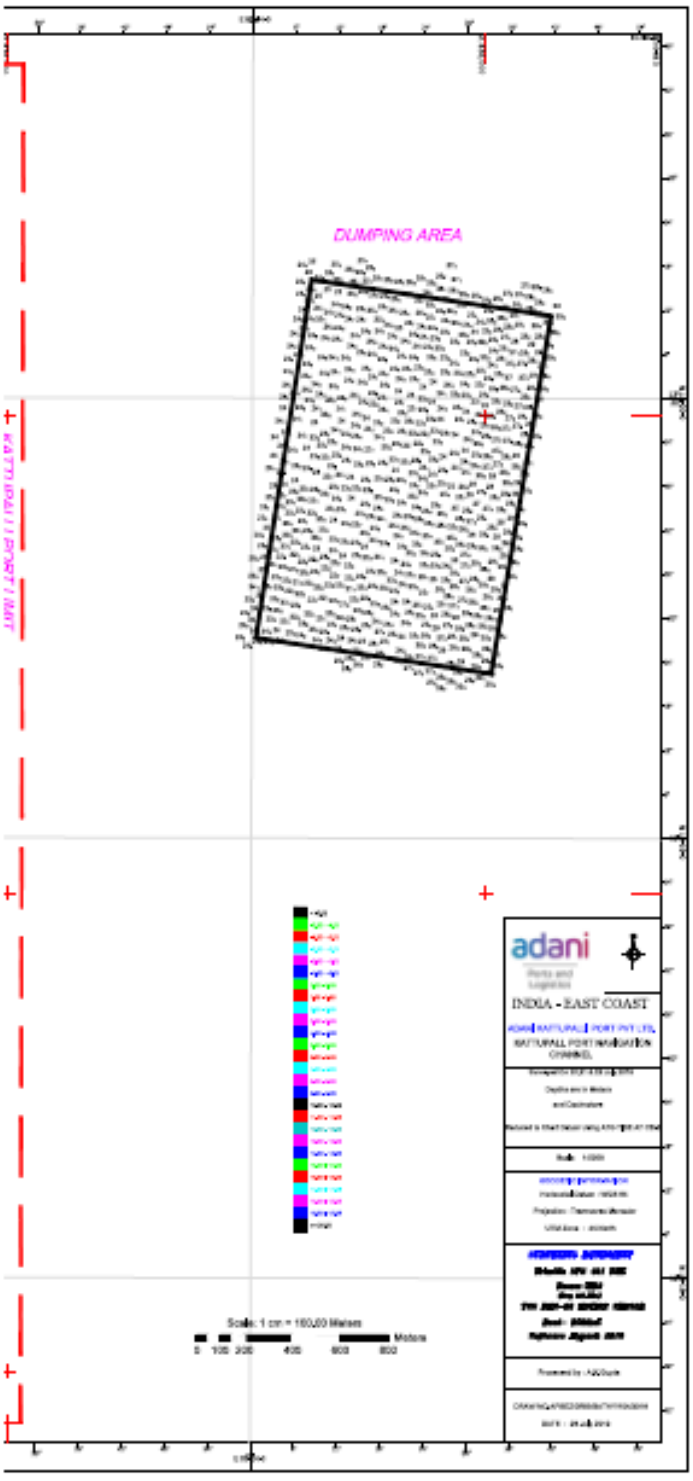


Figure: Dumping Area Survey 26-07-2019

Annexure - III

adani

KATTUPALLI PORT
CHENNAI's NEW GATEWAY

MIDPL/TNPCB/GMP/ HWR-2019/04

Date: 28/06/2019

To,

The District Environmental Engineer,
Tamil Nadu Pollution Control Board,
EPIB Building, A.O Block,
Gummidipoondi Industrial Complex,
Gummidipoondi – 601201.

Dear Sir,

Sub: Submission of Annual Hazardous Waste Returns for the period April'2018 to March'2019.

With reference to captioned subject, **M/s. Marine Infrastructure Developer Private Ltd.** is submitting the Annual Hazardous Waste Returns for the period April'2018 to March'2019.

Submitted for your kind records

Kindly acknowledge us the receipt of the same,

For, **M/s. Marine Infrastructure Developer Pvt Ltd**

R. Sathish Kumar

Head - Environment

Marine Infrastructure Developer Pvt. Ltd. Chennai 600 120

Encl: As above

Marine Infrastructure Developer Pvt Ltd
(Kattupalli Port)
Kattupalli Village, Ponneri Taluk,
Tiruvallur District 600 120,
Tamil Nadu, India

Tel +91 44 2824 3062

CIN: U74999TN2016PTC103769

Registered Office: Ramcon Fortuna Towers, 4th floor No 1/2, Kodambakkam High RoadNungambakkam, Chennai 600034

FORM 4

[See rules 6(5), 13(8), 16(6) and 20 (2)]

FORM FOR FILING ANNUAL RETURNS

[To be submitted to State Pollution Control Board by 30th day of June of every year for the proceeding period April 2018 to March 2019]

1	Name and address of facility:	Marine Infrastructure Developer Pvt Ltd Kattupalli Village, Ponneri Taluk, Tiruvallur District - 600120
2	Authorisation No. and Date of issue:	
3	Name of the authorised person and full address with telephone, fax number and e-mail:	Ennarasu Karunesan Director Marine Infrastructure Developer Pvt Ltd Kattupalli Village, Ponneri Taluk, Tiruvallur District – 600120. Tel: +91 44 2824 3062. Mail: ennarasu.karunesan@adani.com
4	Production during the year (product wise), wherever applicable	Not Applicable.

Part A. To be filled by hazardous waste generators

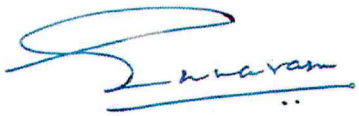
1	Total quantity of waste generated category wise	**Used oil**	**Waste containing oil**	**Oil contaminated filter element**
	Category	5.1	5.2	3.3
	Quantity	19,600 Liters	NIL	2.23 MT
2	Quantity dispatched			
	(i) to disposal facility			
	(ii) to recycler or co-processors or pre-processor			
	(iii) others			
3	Quantity utilised in-house, if any -	Used oil: **NIL** Waste containing oil: **NIL** Oil contaminated filter element: **NIL**		
4	Quantity in storage at the end of the year –	Used oil: **NIL** Waste containing oil: **NIL** Oil contaminated filter element: **NIL**		

Part B. To be filled by Treatment, Storage and Disposal Facility operators

1	Total quantity received -	NA
2	Quantity in stock at the beginning of the year -	
3	Quantity treated –	
4	Quantity disposed in landfills as such and after treatment –	
5	Quantity incinerated (if applicable) -	
6	Quantity processed other than specified above -	
7	Quantity in storage at the end of the year -	

Part C. To be filled by recyclers or co-processors or other users

1	Quantity of waste received during the year – (i) domestic sources (ii) imported (if applicable)	NA
2	Quantity in stock at the beginning of the year -	
3	Quantity recycled or co-processed or used –	
4	Quantity of products dispatched (wherever applicable) –	
5	Quantity of waste generated -	
6	Quantity of waste disposed -	
7	Quantity re-exported (wherever applicable)-	
8	Quantity in storage at the end of the year -	



Date: 28.06.2019
Place: Chennai

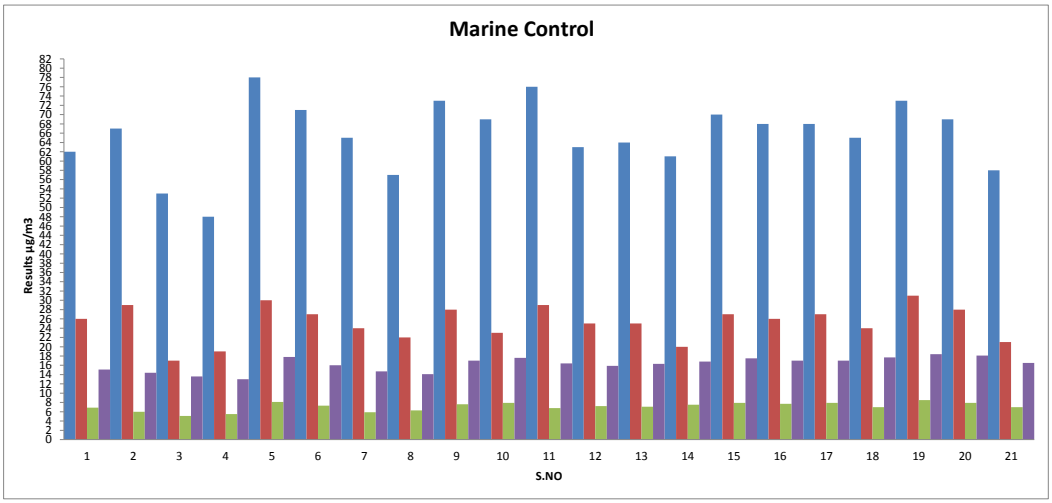
Signature of the Occupier

Annexure - IV

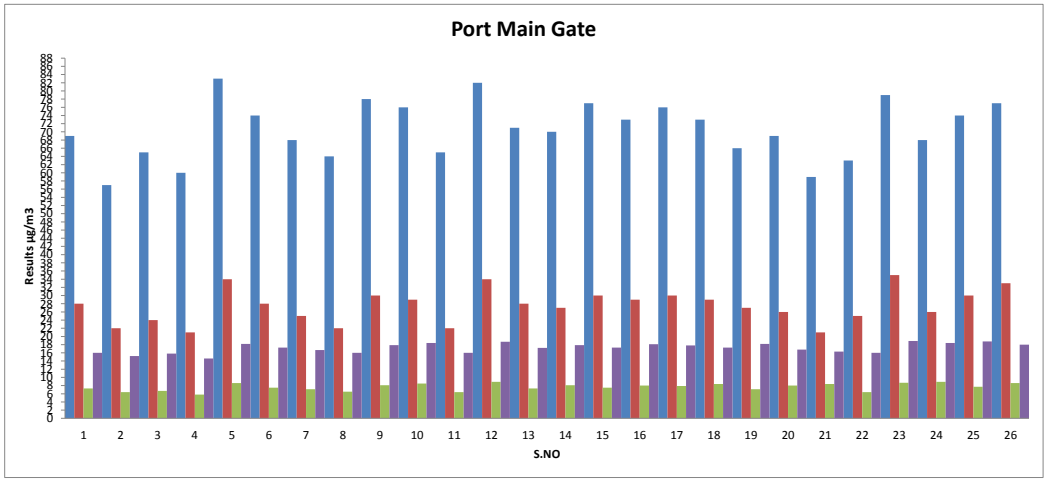
MARINE INFRASTRUCTURE DEVELOPER PRIVATE LIMITED (MIDPL)

Oct - 19 to Mar - 20

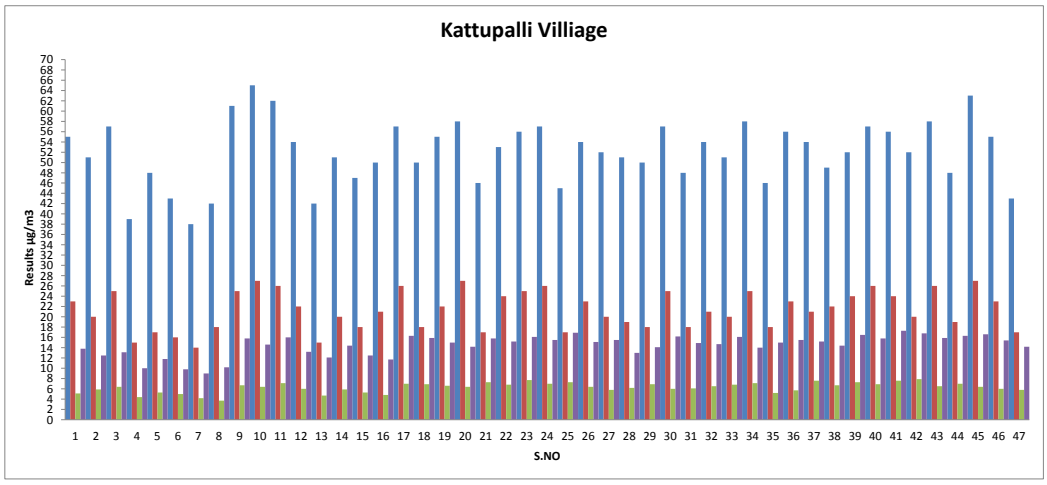
MARINE CONTROL (AAQ1)														
Parameters			Particular matter PM_{10}	Particular matter $PM_{2.5}$	Sulphur dioxide as SO_2	Nitrogen dioxide as NO_2	Lead as Pb	Carbon monoxide as CO	Ozone as O_3	Ammonia as NH_3	Arsenic as As	Nickel as Ni	Benzene as C_6H_6	Benzo (a) pyrene as BaP
Unit			$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	$\mu g/m^3$	$\mu g/m^3$	ng/m^3	ng/m^3	$\mu g/m^3$	ng/m^3
National AAQM Standard			100	60	80	80	1	4	180	400	6	20	5	1
S.No.	Sampling Date	Report Number												
1	08.10.2019	GCS/LAB/S/2065/19-20	62	26	6.9	15.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
2	11.10.2019	GCS/LAB/S/2065/19-20	67	29	6.0	14.4	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
3	21.10.2019	GCS/LAB/S/2065/19-20	53	17	5.1	13.6	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
4	25.10.2019	GCS/LAB/S/2065/19-20	48	19	5.5	13.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
5	04.11.2019	GCS/LAB/S/2138/19-20	78	30	8.1	17.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
6	08.11.2019	GCS/LAB/S/2138/19-20	71	27	7.3	16.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
7	18.11.2019	GCS/LAB/S/2138/19-20	65	24	5.9	14.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
8	22.11.2019	GCS/LAB/S/2138/19-20	57	22	6.3	14.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
9	02.12.2019	GCS/LAB/S/2231/19-20	73	28	7.6	17.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
10	06.12.2019	GCS/LAB/S/2231/19-20	69	23	7.9	17.6	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
11	16.12.2019	GCS/LAB/S/2231/19-20	76	29	6.8	16.4	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
12	20.12.2019	GCS/LAB/S/2231/19-20	63	25	7.2	15.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
13	03.01.2020	GCS/LAB/S/2317/19-20	64	25	7.1	16.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
14	13.01.2020	GCS/LAB/S/2317/19-20	61	20	7.5	16.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
15	17.01.2020	GCS/LAB/S/2317/19-20	70	27	7.9	17.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
16	27.01.2020	GCS/LAB/S/2317/19-20	68	26	7.7	17.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
17	10.02.2020	GCS/LAB/S/2384/19-20	68	27	7.9	17.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
18	14.02.2020	GCS/LAB/S/2384/19-20	65	24	7.0	17.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
19	16.03.2020	GCS/LAB/S/2481/19-20	73	31	8.5	18.4	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
20	20.03.2020	GCS/LAB/S/2481/19-20	69	28	7.9	18.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
21	23.03.2020	GCS/LAB/S/2481/19-20	58	21	7.0	16.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1



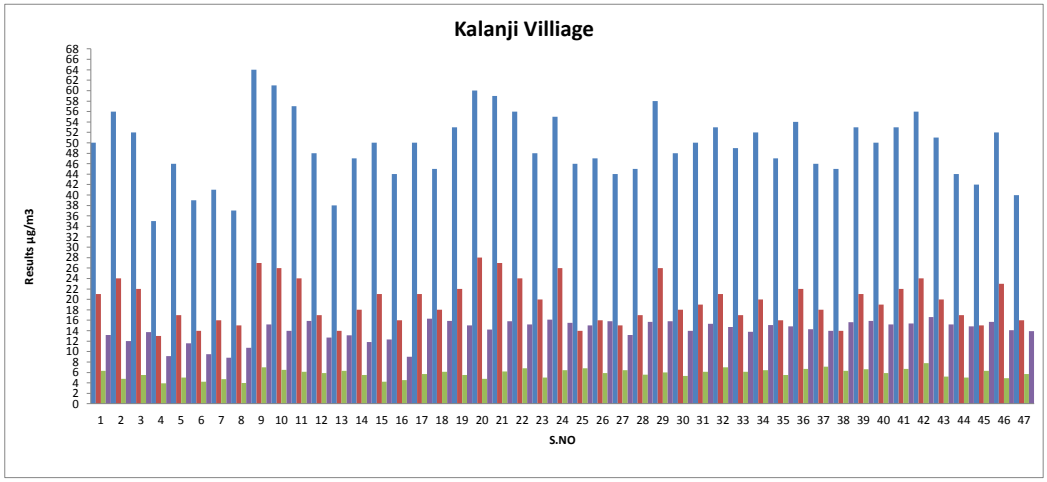
PORT MAIN GATE (AAQ2)														
Parameters			Particular matter PM_{10}	Particular matter $PM_{2.5}$	Sulphur dioxide as SO_2	Nitrogen dioxide as NO_2	Lead as Pb	Carbon monoxide as CO	Ozone as O_3	Ammonia as NH_3	Arsenic as As	Nickel as Ni	Benzene as C_6H_6	Benzo (a) pyrene as BaP
Unit			$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	$\mu g/m^3$	$\mu g/m^3$	ng/m^3	ng/m^3	$\mu g/m^3$	ng/m^3
National AAQM Standard			100	60	80	80	1	4	180	400	6	20	5	1
S.No.	Sampling Date	Report Number												
1	03.10.2019	GCS/LAB/S/2065/19-20	69	28	7.3	16.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
2	14.10.2019	GCS/LAB/S/2065/19-20	57	22	6.4	15.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
3	18.10.2019	GCS/LAB/S/2065/19-20	65	24	6.7	15.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
4	28.10.2019	GCS/LAB/S/2065/19-20	60	21	5.8	14.6	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
5	01.11.2019	GCS/LAB/S/2138/19-20	83	34	8.6	18.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
6	11.11.2019	GCS/LAB/S/2138/19-20	74	28	7.5	17.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
7	15.11.2019	GCS/LAB/S/2138/19-20	68	25	7.1	16.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
8	25.11.2019	GCS/LAB/S/2138/19-20	64	22	6.5	16.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
9	09.12.2019	GCS/LAB/S/2231/19-20	78	30	8.1	17.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
10	13.12.2019	GCS/LAB/S/2231/19-20	76	29	8.5	18.4	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
11	23.12.2019	GCS/LAB/S/2231/19-20	65	22	6.4	16.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
12	27.12.2019	GCS/LAB/S/2231/19-20	82	34	8.9	18.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
13	06.01.2020	GCS/LAB/S/2317/19-20	71	28	7.3	17.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
14	10.01.2020	GCS/LAB/S/2317/19-20	70	27	8.1	17.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
15	20.01.2020	GCS/LAB/S/2317/19-20	77	30	7.5	17.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
16	24.01.2020	GCS/LAB/S/2317/19-20	73	29	8.0	18.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
17	03.02.2020	GCS/LAB/S/2384/19-20	76	30	7.9	17.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
18	07.02.2020	GCS/LAB/S/2384/19-20	73	29	8.4	17.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
19	17.02.2020	GCS/LAB/S/2384/19-20	66	27	7.1	18.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
20	21.02.2020	GCS/LAB/S/2384/19-20	69	26	8.0	16.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
21	24.02.2020	GCS/LAB/S/2384/19-20	59	21	8.4	16.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
22	28.02.2020	GCS/LAB/S/2384/19-20	63	25	6.4	16.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
23	02.03.2020	GCS/LAB/S/2481/19-20	79	35	8.7	18.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
24	06.03.2020	GCS/LAB/S/2481/19-20	68	26	8.9	18.4	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
25	09.03.2020	GCS/LAB/S/2481/19-20	74	30	7.7	18.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
26	13.03.2020	GCS/LAB/S/2481/19-20	77	33	8.6	18.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1



KATTUPALLI VILLAGE (AAQ3)														
Parameters			Particular matter PM_{10}	Particular matter $PM_{2.5}$	Sulphur dioxide as SO_2	Nitrogen dioxide as NO_2	Lead as Pb	Carbon monoxide as CO	Ozone as O_3	Ammonia as NH_3	Arsenic as As	Nickel as Ni	Benzene as C_6H_6	Benzo (a) pyrene as BaP
Unit			$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	$\mu g/m^3$	$\mu g/m^3$	ng/m^3	ng/m^3	$\mu g/m^3$	ng/m^3
National AAQM Standard			100	60	80	80	1	4	180	400	6	20	5	1
S.No.	Sampling Date	Report Number												
1	03.10.2019	GCS/LAB/S/2065/19-20	55	23	5.1	13.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
2	08.10.2019	GCS/LAB/S/2065/19-20	51	20	5.9	12.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
3	11.10.2019	GCS/LAB/S/2065/19-20	57	25	6.4	13.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
4	14.10.2019	GCS/LAB/S/2065/19-20	39	15	4.4	10.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
5	18.10.2019	GCS/LAB/S/2065/19-20	48	17	5.3	11.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
6	21.10.2019	GCS/LAB/S/2065/19-20	43	16	5.0	9.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
7	25.10.2019	GCS/LAB/S/2065/19-20	38	14	4.2	9.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
8	28.10.2019	GCS/LAB/S/2065/19-20	42	18	3.7	10.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
9	01.11.2019	GCS/LAB/S/2138/19-20	61	25	6.7	15.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
10	04.11.2019	GCS/LAB/S/2138/19-20	65	27	6.4	14.6	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
11	08.11.2019	GCS/LAB/S/2138/19-20	62	26	7.1	16.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
12	11.11.2019	GCS/LAB/S/2138/19-20	54	22	6.0	13.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
13	15.11.2019	GCS/LAB/S/2138/19-20	42	15	4.7	12.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
14	18.11.2019	GCS/LAB/S/2138/19-20	51	20	5.9	14.4	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
15	22.11.2019	GCS/LAB/S/2138/19-20	47	18	5.3	12.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
16	25.11.2019	GCS/LAB/S/2138/19-20	50	21	4.8	11.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
17	02.12.2019	GCS/LAB/S/2231/19-20	57	26	7.0	16.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
18	06.12.2019	GCS/LAB/S/2231/19-20	50	18	6.9	15.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
19	09.12.2019	GCS/LAB/S/2231/19-20	55	22	6.6	15.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
20	13.12.2019	GCS/LAB/S/2231/19-20	58	27	6.4	14.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
21	16.12.2019	GCS/LAB/S/2231/19-20	46	17	7.3	15.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
22	20.12.2019	GCS/LAB/S/2231/19-20	53	24	6.8	15.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
23	23.12.2019	GCS/LAB/S/2231/19-20	56	25	7.7	16.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
24	27.12.2019	GCS/LAB/S/2231/19-20	57	26	7.0	15.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
25	03.01.2020	GCS/LAB/S/2317/19-20	45	17	7.3	16.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
26	06.01.2020	GCS/LAB/S/2317/19-20	54	23	6.4	15.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
27	10.01.2020	GCS/LAB/S/2317/19-20	52	20	5.8	15.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
28	13.01.2020	GCS/LAB/S/2317/19-20	51	19	6.2	13.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
29	17.01.2020	GCS/LAB/S/2317/19-20	50	18	6.9	14.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
30	20.01.2020	GCS/LAB/S/2317/19-20	57	25	6.0	16.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
31	24.01.2020	GCS/LAB/S/2317/19-20	48	18	6.1	14.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
32	27.01.2020	GCS/LAB/S/2317/19-20	54	21	6.5	14.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
33	03.02.2020	GCS/LAB/S/2384/19-20	51	20	6.8	16.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
34	07.02.2020	GCS/LAB/S/2384/19-20	58	25	7.1	14.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
35	10.02.2020	GCS/LAB/S/2384/19-20	46	18	5.2	15.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
36	14.02.2020	GCS/LAB/S/2384/19-20	56	23	5.7	15.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
37	17.02.2020	GCS/LAB/S/2384/19-20	54	21	7.6	15.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
38	21.02.2020	GCS/LAB/S/2384/19-20	49	22	6.7	14.4	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
39	24.02.2020	GCS/LAB/S/2384/19-20	52	24	7.3	16.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
40	28.02.2020	GCS/LAB/S/2384/19-20	57	26	6.9	15.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
41	02.03.2020	GCS/LAB/S/2481/19-20	56	24	7.6	17.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
42	06.03.2020	GCS/LAB/S/2481/19-20	52	20	7.9	16.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
43	09.03.2020	GCS/LAB/S/2481/19-20	58	26	6.5	15.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
44	13.03.2020	GCS/LAB/S/2481/19-20	48	19	7.0	16.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
45	16.03.2020	GCS/LAB/S/2481/19-20	63	27	6.4	16.6	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
46	20.03.2020	GCS/LAB/S/2481/19-20	55	23	6.0	15.4	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
47	23.03.2020	GCS/LAB/S/2481/19-20	43	17	5.8	14.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1

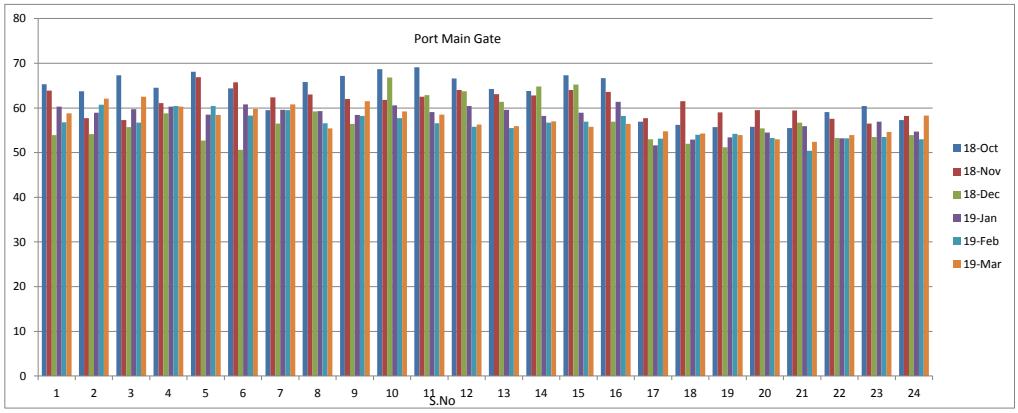


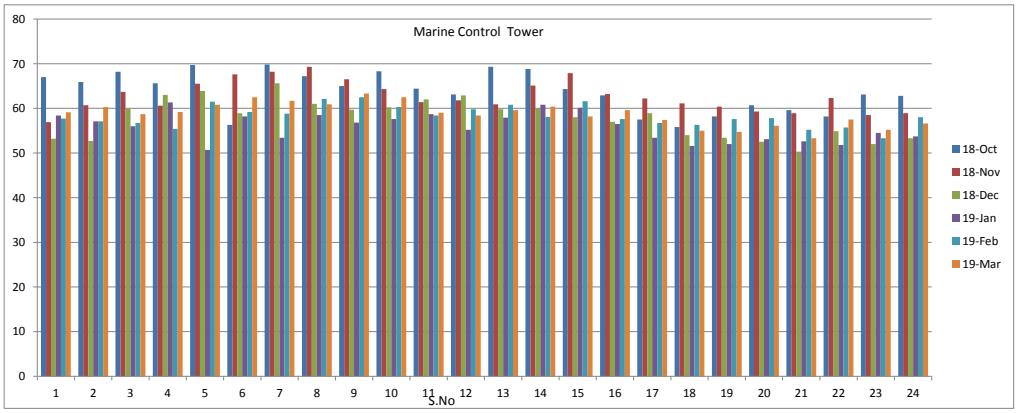
KALANJI VILLAGE (AAQ4)														
Parameters			Particular matter PM_{10}	Particular matter $PM_{2.5}$	Sulphur dioxide as SO_2	Nitrogen dioxide as NO_2	Lead as Pb	Carbon monoxide as CO	Ozone as O_3	Ammonia as NH_3	Arsenic as As	Nickel as Ni	Benzene as C_6H_6	Benzo (a) pyrene as BaP
Unit			$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	$\mu g/m^3$	$\mu g/m^3$	ng/m^3	ng/m^3	$\mu g/m^3$	ng/m^3
National AAQM Standard			100	60	80	80	1	4	180	400	6	20	5	1
S.No.	Sampling Date	Report Number												
1	03.10.2019	GCS/LAB/S/2065/19-20	50	21	6.3	13.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
2	08.10.2019	GCS/LAB/S/2065/19-20	56	24	4.8	12.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
3	11.10.2019	GCS/LAB/S/2065/19-20	52	22	5.5	13.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
4	14.10.2019	GCS/LAB/S/2065/19-20	35	13	3.9	9.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
5	18.10.2019	GCS/LAB/S/2065/19-20	46	17	5.0	11.6	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
6	21.10.2019	GCS/LAB/S/2065/19-20	39	14	4.2	9.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
7	25.10.2019	GCS/LAB/S/2065/19-20	41	16	4.7	8.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
8	28.10.2019	GCS/LAB/S/2065/19-20	37	15	4.0	10.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
9	01.11.2019	GCS/LAB/S/2138/19-20	64	27	7.0	15.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
10	04.11.2019	GCS/LAB/S/2138/19-20	61	26	6.5	14.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
11	08.11.2019	GCS/LAB/S/2138/19-20	57	24	6.1	15.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
12	11.11.2019	GCS/LAB/S/2138/19-20	48	17	5.9	12.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
13	15.11.2019	GCS/LAB/S/2138/19-20	38	14	6.3	13.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
14	18.11.2019	GCS/LAB/S/2138/19-20	47	18	5.5	11.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
15	22.11.2019	GCS/LAB/S/2138/19-20	50	21	4.2	12.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
16	25.11.2019	GCS/LAB/S/2138/19-20	44	16	4.5	9.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
17	02.12.2019	GCS/LAB/S/2231/19-20	50	21	5.7	16.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
18	06.12.2019	GCS/LAB/S/2231/19-20	45	18	6.1	15.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
19	09.12.2019	GCS/LAB/S/2231/19-20	53	22	5.5	15.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
20	13.12.2019	GCS/LAB/S/2231/19-20	60	28	4.8	14.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
21	16.12.2019	GCS/LAB/S/2231/19-20	59	27	6.2	15.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
22	20.12.2019	GCS/LAB/S/2231/19-20	56	24	6.8	15.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
23	23.12.2019	GCS/LAB/S/2231/19-20	48	20	5.0	16.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
24	27.12.2019	GCS/LAB/S/2231/19-20	55	26	6.4	15.5	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
25	03.01.2020	GCS/LAB/S/2317/19-20	46	14	6.8	15.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
26	06.01.2020	GCS/LAB/S/2317/19-20	47	16	5.9	15.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
27	10.01.2020	GCS/LAB/S/2317/19-20	44	15	6.4	13.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
28	13.01.2020	GCS/LAB/S/2317/19-20	45	17	5.6	15.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
29	17.01.2020	GCS/LAB/S/2317/19-20	58	26	6.0	15.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
30	20.01.2020	GCS/LAB/S/2317/19-20	48	18	5.3	14.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
31	24.01.2020	GCS/LAB/S/2317/19-20	50	19	6.1	15.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
32	27.01.2020	GCS/LAB/S/2317/19-20	53	21	7.0	14.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
33	03.02.2020	GCS/LAB/S/2384/19-20	49	17	6.1	13.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
34	07.02.2020	GCS/LAB/S/2384/19-20	52	20	6.4	15.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
35	10.02.2020	GCS/LAB/S/2384/19-20	47	16	5.5	14.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
36	14.02.2020	GCS/LAB/S/2384/19-20	54	22	6.7	14.3	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
37	17.02.2020	GCS/LAB/S/2384/19-20	46	18	7.1	14.0	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
38	21.02.2020	GCS/LAB/S/2384/19-20	45	14	6.3	15.6	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
39	24.02.2020	GCS/LAB/S/2384/19-20	53	21	6.6	15.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
40	28.02.2020	GCS/LAB/S/2384/19-20	50	19	5.9	15.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
41	02.03.2020	GCS/LAB/S/2481/19-20	53	22	6.7	15.4	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
42	06.03.2020	GCS/LAB/S/2481/19-20	56	24	7.8	16.6	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
43	09.03.2020	GCS/LAB/S/2481/19-20	51	20	5.2	15.2	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
44	13.03.2020	GCS/LAB/S/2481/19-20	44	17	5.0	14.8	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
45	16.03.2020	GCS/LAB/S/2481/19-20	42	15	6.3	15.7	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
46	20.03.2020	GCS/LAB/S/2481/19-20	52	23	4.9	14.1	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1
47	23.03.2020	GCS/LAB/S/2481/19-20	40	16	5.7	13.9	<0.1	<1.0	<10	<2	<2	<2	<1	<0.1



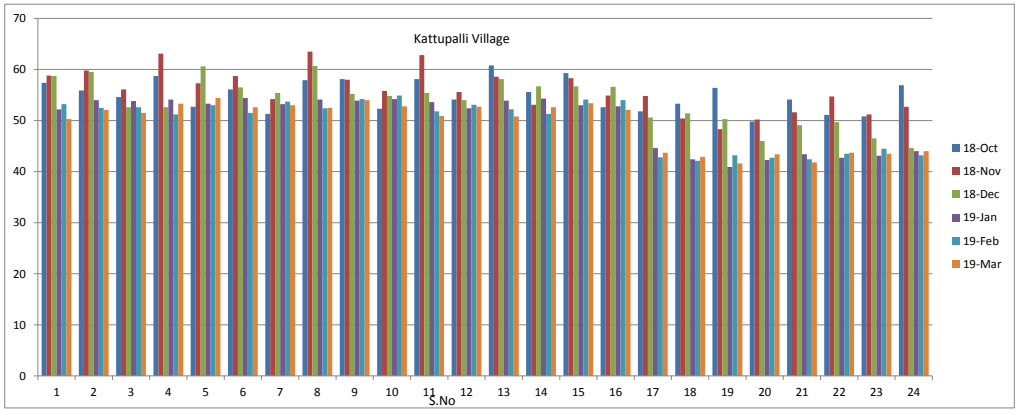
AMBIENT NOISE LEVEL MONITORING

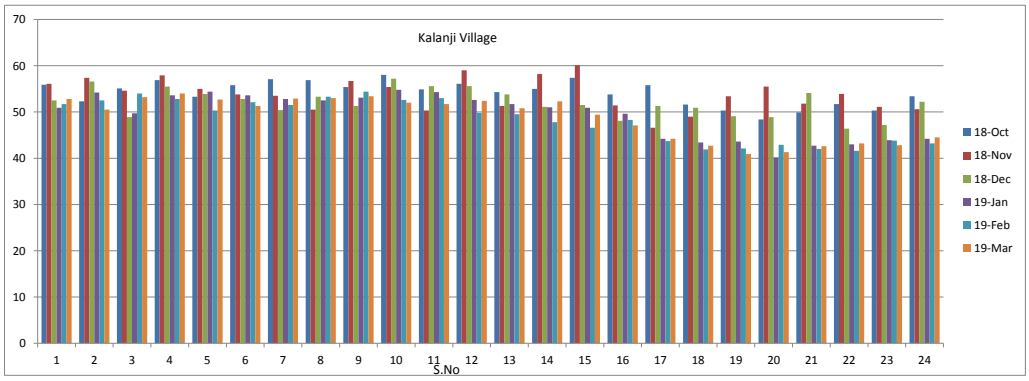
Location		PORT MAIN GATE						MARINE CONTROL					
Month & Year		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
Parameter & Unit		Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)
S.No.	Time of Sampling												
1	06.00 – 07.00 (Day)	65.3	63.9	53.9	60.3	56.8	58.8	67	56.9	53.2	58.4	57.7	59.1
2	07.00 –08.00	63.7	57.7	54.1	58.9	60.7	62.1	65.9	60.7	52.7	57.1	57.1	60.3
3	08.00 – 09.00	67.3	57.3	55.7	59.7	56.7	62.5	68.2	63.7	59.9	56	56.7	58.7
4	09.00 – 10.00	64.5	61.1	58.8	60.3	60.4	60.3	65.6	60.6	63	61.3	55.4	59.2
5	10.00 – 11.00	68.1	66.9	52.7	58.5	60.4	58.4	69.7	65.5	63.9	50.7	61.5	60.8
6	11.00 – 12.00	64.4	65.7	50.6	60.8	58.3	59.8	56.3	67.6	58.9	58.2	59.2	62.5
7	12.00 – 13.00	59.5	62.4	56.5	59.6	59.5	60.8	69.8	68.2	65.6	53.4	58.8	61.7
8	13.00 – 14.00	65.8	63	59.2	59.3	56.6	55.4	67.2	69.3	61	58.5	62.1	60.9
9	14.00 – 15.00	67.2	62	56.4	58.4	58.2	61.5	65	66.5	59.7	56.8	62.5	63.3
10	15.00 – 16.00	68.7	61.8	66.8	60.6	57.7	59.2	68.3	64.3	60.2	57.6	60.3	62.5
11	16.00 – 17.00	69.1	62.5	62.9	59.1	56.6	58.5	64.4	61.4	62	58.7	58.4	59
12	17.00 – 18.00	66.6	64	63.7	60.4	55.8	56.3	63.1	61.8	62.9	55.2	59.8	58.4
13	18.00 – 19.00	64.2	63.1	61.4	59.6	55.5	55.9	69.3	60.9	59.8	57.9	60.8	59.6
14	19.00 –20.00	63.8	62.8	64.8	58.2	56.7	57	68.8	65.1	60	60.8	58.1	60.4
15	20.00 – 21.00	67.3	64	65.2	58.9	56.9	55.8	64.3	67.9	58	60.1	61.6	58.2
16	21.00 – 22.00	66.7	63.6	56.9	61.4	58.2	56.4	62.9	63.2	57	56.5	57.6	59.6
17	22.00 – 23.00 (Night)	56.9	57.7	53	51.6	53.1	54.8	57.5	62.2	58.9	53.4	56.7	57.4
18	23.00 – 00.00	56.2	61.5	52	52.9	54	54.3	55.8	61.1	54	51.6	56.3	55
19	00.00 – 01.00	55.7	59	51.2	53.4	54.2	53.9	58.2	60.4	53.4	52	57.6	54.7
20	01.00 – 02.00	55.8	59.5	55.4	54.5	53.3	53	60.7	59.3	52.5	53.1	57.8	56.1
21	02.00 – 03.00	55.5	59.4	56.7	55.9	50.4	52.4	59.6	58.9	50.3	52.6	55.2	53.3
22	03.00 – 04.00	59.1	57.6	53.3	53.2	53.2	53.9	58.2	62.3	54.9	51.8	55.7	57.5
23	04.00 – 05.00	60.4	56.5	53.5	56.9	53.5	54.6	63.1	58.5	52	54.5	53.3	55.2
24	05.00 – 06.00	57.3	58.2	53.9	54.7	53	58.3	62.8	58.9	53.3	53.7	58	56.6



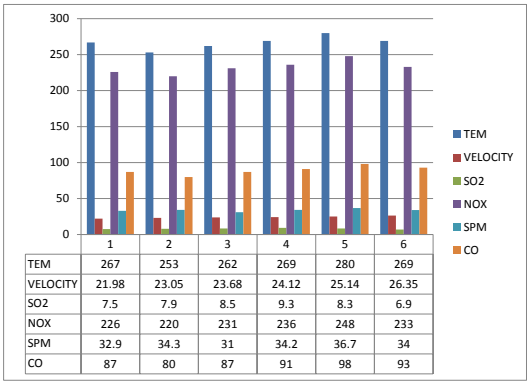


Location		KATTUPALLI VILLAGE						KALANJI VILLAGE					
Month & Year		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
Parameter & Unit		Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)	Leq dB(A)
S.No.	Time of Sampling												
1	06.00 – 07.00 (Day)	57.4	58.8	58.7	52.2	53.2	50.3	55.9	56.1	52.5	50.9	51.7	52.8
2	07.00 –08.00	55.9	59.8	59.5	54	52.5	52.1	52.3	57.4	56.6	54.2	52.5	50.5
3	08.00 – 09.00	54.6	56.1	52.6	53.8	52.6	51.5	55.1	54.6	48.9	49.7	54	53.2
4	09.00 – 10.00	58.7	63.1	52.6	54.1	51.2	53.3	56.9	57.9	55.5	53.6	52.8	54
5	10.00 – 11.00	52.7	57.3	60.6	53.3	53	54.4	53.3	55	53.9	54.4	50.3	52.7
6	11.00 – 12.00	56.1	58.7	56.5	54.4	51.5	52.6	55.8	53.8	52.8	53.6	52.1	51.3
7	12.00 – 13.00	51.3	54.2	55.4	53.2	53.7	53	57.1	53.5	50.4	52.8	51.5	52.9
8	13.00 – 14.00	57.9	63.5	60.7	54.1	52.4	52.5	56.9	50.5	53.3	52.5	53.3	53
9	14.00 – 15.00	58.1	58	55.2	53.9	54.2	54	55.4	56.7	51.3	53.1	54.4	53.4
10	15.00 – 16.00	52.3	55.8	54.8	54.2	54.9	52.8	58	55.4	57.2	54.8	52.6	52
11	16.00 – 17.00	58.1	62.8	55.4	53.6	51.8	50.9	54.9	50.3	55.6	54.3	53	51.7
12	17.00 – 18.00	54.1	55.6	54	52.4	53.1	52.7	56.1	59	55.6	52.6	49.8	52.4
13	18.00 – 19.00	60.8	58.6	58.1	53.9	52.2	50.8	54.3	51.3	53.8	51.7	49.5	50.8
14	19.00 –20.00	55.6	53.1	56.7	54.3	51.3	52.6	55	58.2	51.1	51	47.8	52.3
15	20.00 – 21.00	59.3	58.3	56.7	53	54.1	53.4	57.4	60.1	51.5	50.9	46.6	49.4
16	21.00 – 22.00	52.6	54.9	56.6	52.8	54	52.1	53.8	51.4	48.1	49.6	48.3	47.1
17	22.00 – 23.00 (Night)	51.8	54.8	50.6	44.6	42.8	43.7	55.8	46.6	51.3	44.2	43.7	44.2
18	23.00 – 00.00	53.3	50.4	51.4	42.4	42.1	42.9	51.6	49	50.9	43.4	41.9	42.7
19	00.00 – 01.00	56.4	48.3	50.3	40.9	43.2	41.6	50.3	53.4	49.1	43.6	42.1	40.9
20	01.00 – 02.00	49.8	50.2	46	42.3	42.7	43.4	48.4	55.5	48.9	40.2	42.9	41.3
21	02.00 – 03.00	54.1	51.6	49.1	43.4	42.4	41.8	49.9	51.8	54.1	42.7	42	42.6
22	03.00 – 04.00	51.1	54.7	49.7	42.7	43.5	43.7	51.7	53.9	46.4	43	41.6	43.2
23	04.00 – 05.00	50.8	51.2	46.5	43.1	44.5	43.5	50.3	51.1	47.2	43.9	43.8	42.8
24	05.00 – 06.00	56.9	52.7	44.6	44	43.2	44	53.4	50.6	52.2	44.2	43.2	44.5

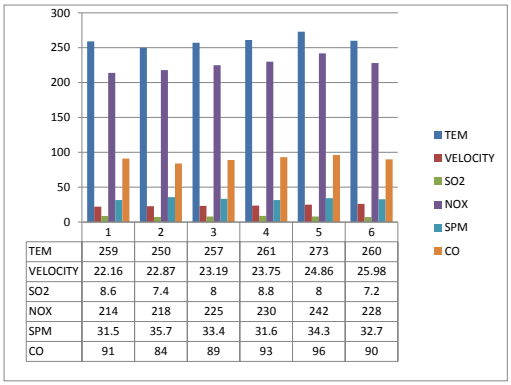




STACK MONITORING													
Location		DG 2000KVA - 1						DG 2000KVA - 2					
Month & Year		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
S.No.	Parameters												
1	Stack Temperature, °C	267	253	262	269	280	269	259	250	257	261	273	260
2	Flue Gas Velocity, m/s	21.98	23.05	23.68	24.12	25.14	26.35	22.16	22.87	23.19	23.75	24.86	25.98
3	Sulphur Dioxide, mg/Nm3	7.5	7.9	8.5	9.3	8.3	6.9	8.6	7.4	8	8.8	8	7.2
4	NOX (as NO2) in ppmv	226	220	231	236	248	233	214	218	225	230	242	228
5	Particular matter, mg/Nm3	32.9	34.3	31	34.2	36.7	34	31.5	35.7	33.4	31.6	34.3	32.7
6	Carbon Monoxide, mg/Nm3	87	80	87	91	98	93	91	84	89	93	96	90
7	Gas Discharge, Nm3/hr	5452	5871	5929	5961	6090	6512	5580	5858	5861	5957	6099	6529



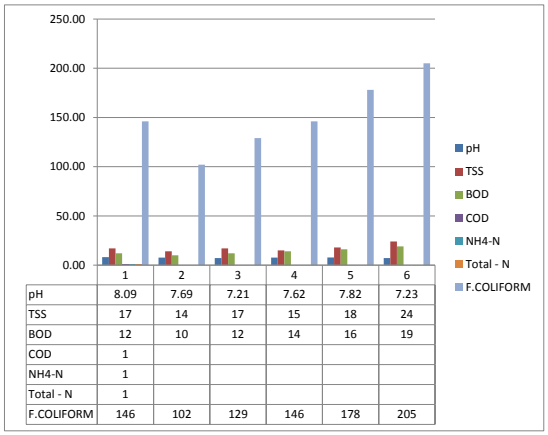
	1	2	3	4	5	6
TEM	267	253	262	269	280	269
VELOCITY	21.98	23.05	23.68	24.12	25.14	26.35
SO2	7.5	7.9	8.5	9.3	8.3	6.9
NOX	226	220	231	236	248	233
SPM	32.9	34.3	31	34.2	36.7	34
CO	87	80	87	91	98	93



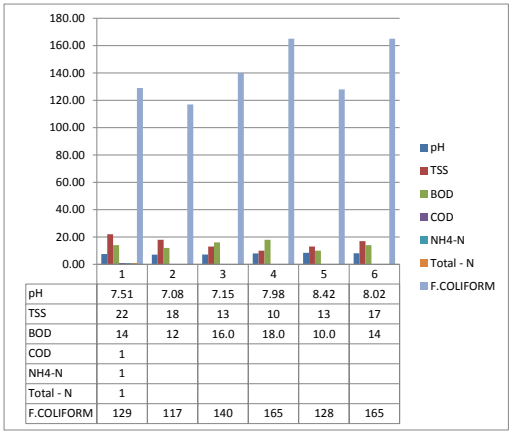
	1	2	3	4	5	6
TEM	259	250	257	261	273	260
VELOCITY	22.16	22.87	23.19	23.75	24.86	25.98
SO2	8.6	7.4	8	8.8	8	7.2
NOX	214	218	225	230	242	228
SPM	31.5	35.7	33.4	31.6	34.3	32.7
CO	91	84	89	93	96	90

STP OUTLET WATER

Location		STP 30KLD OUTLET						STP 5KLD OUTLET					
Month & Year		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
S.No.	Parameters												
1	pH @ 25°C	8.09	7.69	7.21	7.62	7.82	7.23	7.51	7.08	7.15	7.98	8.42	8.02
2	Total Suspended Solids, mg/L	17	14	17	15	18	24	22	18	13	10	13	17
3	BOD at 27°C for 3 days, mg/L	12	10	12	14	16	19	14	12	16.0	18.0	10.0	14
4	Fecal Coliform, MPN/100ml	146	102	129	146	178	205	129	117	140	165	128	165



	1	2	3	4	5	6
pH	8.09	7.69	7.21	7.62	7.82	7.23
TSS	17	14	17	15	18	24
BOD	12	10	12	14	16	19
COD	1					
NH4-N	1					
Total - N	1					
F.COLIFORM	146	102	129	146	178	205



	1	2	3	4	5	6
pH	7.51	7.08	7.15	7.98	8.42	8.02
TSS	22	18	13	10	13	17
BOD	14	12	16.0	18.0	10.0	14
COD	1					
NH4-N	1					
Total - N	1					
F.COLIFORM	129	117	140	165	128	165

DRINKING WATER

Month & Year		Unit	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
S.No.	Parameters							
1	pH @ 25°C	-	8.06	7.32	7.19	6.91	7.98	8.4
2	Total Hardness as CaCo3	mg/L	22	18	22.0	18	BDL (DL:1.0)	BDL (DL:1.0)
3	Chloride as Cl	mg/L	17	14	17	15	8	10
4	Total Dissolved Solids	mg/L	126	106	126	114	24	22
5	Calcium as Ca	mg/L	6.5	5	6	5	BDL (DL:0.4)	BDL (DL:0.4)
6	Sulphate as SO4	mg/L	6.2	3.9	5	3.5	0.75	BDL (DL:1.0)
7	Nitrate as No3	mg/L	BDL (DL:1.0)					
8	Total Alkalinity as $CaCo_3$	mg/L	76	59	47	41	15	13
9	Magnesium as Mg	mg/L	1.5	2	1.68	1.32	BDL (DL:0.24)	BDL (DL:0.24)
10	Color	Hazen	-					
11	Odour	-	Unobjectionable					
12	Taste	-	Agreeable					
13	Turbidity	NTU	<0.5					0.6
14	Iron as Fe	mg/L	BDL(DL 0.05)					
15	Total Residual Chlorine	mg/L	BDL(DL 0.1)					
16	Copper as Cu	mg/L	BDL(DL 0.05)					
17	Manganese as Mn	mg/L	BDL(DL 0.05)					
18	Fluoride as F	mg/L	BDL(DL 0.1)					
19	Phenolic compounds as C_6H_5OH	mg/L	BDL(DL 0.001)					
20	Mercury as Hg	mg/L	BDL(DL 0.001)					
21	Cadmium as Cd	mg/L	BDL(DL 0.003)					
22	Selenium as Se	mg/L	BDL(DL 0.01)					
23	Arsenic as As	mg/L	BDL(DL 0.01)					
24	Lead as Pb	mg/L	BDL(DL 0.01)					
25	Zinc as Zn	mg/L	BDL(DL 0.05)					
26	Anionic Detergents as MBAS	mg/L	Nil					
27	Total Chromium as Cr	mg/L	BDL(DL 0.05)					
28	Phenolphthalein Alkalinity as $CaCo_3$	mg/L	Nil					
29	Aluminium as Al	mg/L	BDL(DL 0.05)					
30	Boron as B	mg/L	BDL(DL 0.1)					
31	Mineral Oil	mg/L	Nil					
32	Polynuclear Aromatic Hydrocarbons as [PAH]	mg/L	Nil					
33	Pesticides	mg/L	Nil					
34	Cyanide as CN	mg/L	BDL (DL : 0.01)					
35	E. coli	MPN/100ml	Absence					
36	Total Coliform	MPN/100ml	Absence					

MARINE WATER														
Location			CB - 1 Surface Water						CB - 2 Surface Water					
Month & Year		Unit	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
S.No.	Parameters													
1	pH @ 25°C	-	7.56	7.61	7.32	7.71	8.08	8.18	7.68	7.48	7.19	7.8	8.33	8.25
2	Temperature	°C	29	29	29	29	29	29	29	29	29	29	29	29
3	Total Suspended Solids	mg/L	29	25	21	23	15	21	37	32	19	25	13	18
4	BOD at 27 °C for 3 days	mg/L	15	20	17	15	18	24	21	27	12	18	19	27
5	Dissolved oxygen	mg/L	2.8	2.6	2.6	2.8	3.1	3.5	2.4	2.1	3.1	2.6	3	3.4
6	Salinity at 25 °C	-	39.4	41.6	43.5	42.6	40.8	42.4	40.6	42.3	42.3	42.9	41.6	42.9
7	Oil & Grease	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
8	Nitrate as No_3	mg/L	9.42	9.17	6.21	7.56	6.98	7.52	8.52	7.51	7.4	7.91	7.05	7.97
9	Nitrite as No_2	mg/L	3.98	4.43	5.36	5.05	6.42	7.03	4.96	4.09	4.11	5.27	5.87	6.84
10	Ammonical Nitrogen as N	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
11	Ammonia as NH3	mg/L	BDL(DL 0.01)						BDL(DL 0.01)					
12	Kjeldahl Nitrogen as N	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
13	Total phosphates as PO4	mg/L	5.75	5.18	4.25	4.91	4.18	5.35	6.84	6.23	3.98	4.14	4.46	5.27
14	Total Nitrogen	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
15	Total Dissolved Solids	mg/L	34961	38456	41089	42864	40983	42397	35364	40235	39714	41058	41855	42180
16	COD	mg/L	115	128	82	93	114	131	130	143	73	85	98	144
17	Total bacterial count	cfu/ml	94	104	66	61	86	70	83	91	58	70	78	92
18	Coliforms	Per 100 ml	Absence						Absence					
19	Escherichia coli	Per 100 ml	Absence						Absence					
20	Salmonella	Per 100 ml	Absence						Absence					
21	Shigella	Per 100 ml	Absence						Absence					
22	Vibrio cholerae	Per 100 ml	Absence						Absence					
23	Vibrio parahaemolyticus	Per 100 ml	Absence						Absence					
24	Enterococci	Per 100 ml	Absence						Absence					
25	Octane	µg/L	181	174	142	163	154	175	194	183	158	169	161	169
26	Nonane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
27	Decane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
28	Undecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
29	Tridecane	µg/L	8.4	7.5	7	7.3	6.3	8.4	9.2	8.2	7.5	8.1	7	7.8
30	Tetradecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
31	Pentadecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
32	Hexadecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
33	Octadecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
34	Nonadecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
35	Elcosane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
36	Primary Productivity	mg C/m^3 /hr	9.56	9.01	9.56	8.78	8.91	9.45	10.46	9.83	10.46	8.03	8.09	9.12
37	Chlorophyll a	mg $/m^3$	7.05	4.25	7.05	4.21	5.26	6.39	7.94	4.51	7.94	5.64	5.73	6.88
38	Phaeophytin	mg $/m^3$	0.69	0.81	0.69	0.63	0.67	0.61	0.85	0.89	0.85	0.77	0.71	0.84
39	Oxidisable Paticular Organic	mg /L	6.01	4.67	8.01	3.98	4.93	5.74	5.92	5.02	8.92	5.48	5.05	7.43
PHYTOPLANKTON														
40	Bacteriastrum hyalinum	nos/ml	18	14	15	17	18	15	14	17	16	16	17	21
41	Bacteriastrum varians	nos/ml	15	12	16	14	12	19	10	15	18	12	15	17
42	Chaetoceros didymus	nos/ml	14	19	13	8	10	14	19	22	15	9	7	10
43	Chaetoceros decipiens	nos/ml	22	25	11	7	14	12	17	20	13	8	10	15
44	Biddulphia mobiliensis	nos/ml	17	20	14	16	9	10	12	16	17	10	16	11
45	Ditylum brightwellii	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
46	Gyrosigma sp	nos/ml	Nil	Nil	6	Nil	Nil	Nil	Nil	Nil	7	Nil	Nil	Nil
47	Cladophyxis sps	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
48	Coscinodiscus centralis	nos/ml	11	17	12	9	13	11	9	11	14	7	9	14
49	Coscinodiscus granii	nos/ml	6	8	8	12	17	13	13	16	12	11	12	9
50	Cylcotella sps	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
51	Hemidiscus hardmanianus	nos/ml	9	11	19	3	15	18	16	21	18	8	6	13
52	Laudaria annulata	nos/ml	10	13	8	10	16	9	14	19	14	14	11	15
53	Pyropacus horologicum	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
54	Pleurosigma angulatum	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
55	Leptocylindrus danicus	nos/ml	15	18	17	4	8	11	7	13	22	6	5	8
56	Guinardia flaccida	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
57	Rhizosolenia alata	nos/ml	12	14	9	6	11	15	15	17	6	15	8	11
58	Rhizosolena impricata	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
59	Rhizosolena semispina	nos/ml	16	21	18	11	17	13	22	26	20	9	10	16
60	Thalassionema nitzschioides	nos/ml	19	24	11	13	21	22	24	27	8	15	19	26
61	Triceratium reticulatum	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
62	Ceratium trichoceros	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
63	Ceratium furca	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
64	Ceratium macroceros	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
65	Ceracium longipes	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
ZOOPLANKTONS														
66	Acrocalanus gracilis	nos/ml	11	8	12	14	12	14	13	10	15	11	20	21
67	Acrocalanus sp	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
68	Paracalanus parvus	nos/ml	7	14	11	10	16	12	18	15	14	16	10	15
69	Eutintinus sps	nos/ml	5	11	17	15	5	9	15	22	8	10	12	18
70	Centropages furcatus	nos/ml	13	9	10	16	13	17	10	18	11	14	18	10
71	Corycaeus dana	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
72	Oithona brevicornis	nos/ml	10	19	9	11	15	10	16	13	11	13	11	19
73	Euterpina acutifrons	nos/ml	14	17	15	19	10	16	17	21	10	12	13	12
74	Metacalanus aurivilli	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
75	Copipod nauplii	nos/ml	21	12	16	14	19	10	10	19	17	15	13	18
76	Cirripede nauplii	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
77	Bivalve veliger	nos/ml	18	24	13	12	17	19	21	17	16	19	16	12
78	Gastropod veliger	nos/ml	25	28	19	17	11	17	14	22	18	10	9	14

Location		CB - 1 Bottom Water						CB - 2 Bottom Water					
Month & Year		Unit	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
S.No.	Parameters													
1	pH @ 25°C	-	7.79	7.8	7.5	7.82	7.71	7.95	7.87	7.62	7.55	7.89	8.01	7.78
2	Temperature	°C	29	29	29	29	29	29	29	29	29	29	29	29
3	Total Suspended Solids	mg/L	33	38	30	35	24	30	36	41	33	37	26	33
4	BOD at 27 °C for 3 days	mg/L	22	26	18	16	19	22	20	24	14	18	21	27
5	Dissolved oxygen	mg/L	2.4	2.7	2.6	2.4	2.7	2.9	2.1	2.3	3	2.7	2.9	3.2
6	Salinity at 25 °C	-	40.8	41.6	40.8	41.6	42.8	43.3	41.5	41.2	38.6	41.5	42.4	43
7	Oil & Grease	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
8	Nitrate as No_3	mg/L	7.41	8.15	7.33	8.26	7.55	8.05	7.05	7.86	6.81	7.94	7.03	8.23
9	Nitrite as No_2	mg/L	5.98	6.72	4.95	5.19	6.02	6.97	5.36	6.25	4.02	4.93	5.68	6.45
10	Ammonical Nitrogen as N	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
11	Ammonia as NH3	mg/L	BDL(DL 0.01)						BDL(DL 0.01)					
12	Kjeldahl Nitrogen as N	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
13	Total phosphates as PO4	mg/L	4.45	5.64	4.3	4.77	5.12	5.84	7.03	6.48	5.16	4.41	4.97	5.43
14	Total Nitrogen	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
15	Total Dissolved Solids	mg/L	40816	43146	40985	41677	42981	43716	37918	41842	38190	40894	42564	43942
16	COD	mg/L	146	161	118	102	126	152	137	149	123	130	137	145
17	Total bacterial count	cfu/ml	93	99	90	96	85	96	84	92	85	92	73	89
18	Coliforms	Per 100 ml	Absence						Absence					
19	Escherichia coli	Per 100 ml	Absence						Absence					
20	Salmonella	Per 100 ml	Absence						Absence					
21	Shigella	Per 100 ml	Absence						Absence					
22	Vibrio cholerae	Per 100 ml	Absence						Absence					
23	Vibrio parahaemolyticus	Per 100 ml	Absence						Absence					
24	Enterococci	Per 100 ml	Absence						Absence					
25	Colour	Hazan	20	25	15	20	10	25	25	30	10	15	10	20
26	Odour	-	Unobjectionable						Unobjectionable					
27	Taste	-	Disagreeable						Disagreeable					
28	Turbidity	NTU	29	33	41	49	30	42	34	27	47	52	32	45
29	Calcium as Ca	mg/L	471	517	577	591	610	621	418	486	538	567	586	612
30	Chloride as Cl	mg/L	22315	23014	22582	23005	23692	23953	21986	22783	21340	22969	23470	23818
31	Cyanide as CN	mg/L	BDL(DL 0.01)						BDL(DL 0.01)					
32	Fluoride as F	mg/L	0.97	0.82	0.37	0.48	0.56	0.63	0.69	0.69	0.32	0.39	0.49	0.54
33	Magnesium as Mg	mg/L	1356	1428	1156	1301	1256	1302	1291	1291	1042	1198	1231	1298
34	Total Iron as Fe	mg/L	0.74	0.93	0.53	0.61	0.68	0.81	0.8	0.8	0.57	0.64	0.55	0.74
35	Residual Free Chlorine	mg/L	BDL(DL 0.1)						BDL(DL 0.1)					
36	Phenolic Compounds as C6H5OH	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
37	Total Hardness as CaCO3	mg/L	6828	7242	6260	6898	6758	6977	6424	6683	5687	6409	6594	6938
38	Total Alkalinity as CaCO3	mg/L	415	610	317	340	379	305	395	498	289	312	363	297
39	Sulphide as H2S	mg/L	BDL(DL 0.5)						BDL(DL 0.5)					
40	Sulphate as SO4	mg/L	1685	1929	2673	2716	2598	2752	1853	2042	2540	2620	2576	2804
41	Anionic surfactants as MBAS	mg/L	BDL(DL 1.0)						BDL(DL 1.0)					
42	Monocrotophos	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
43	Atrazine	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
44	Ethion	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
45	Chiorpyrifos	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
46	Phorate	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
47	Mehyle parathion	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
48	Malathion	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
49	DDT (o,p and p,p-Isomers of DDT,DDE and DDD	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
50	Gamma HCH (Lindane)	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
51	Alppha HCH	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
52	Beta HCH	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
53	Delta HCH	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
54	Endosulfan (Alpha,beta and sulphate)	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
55	Butachlor	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
56	Alachlor	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
57	Aldrin/Dieldrin	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
58	Isoproturon	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
59	2,4-D	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
60	Polychlorinated Biphenyls (PCB)	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
61	Polynuclear aromatic hydrocarbons (PAH)	µg/L	BDL(DL 0.01)						BDL(DL 0.01)					
62	Arsenic as As	mg/L	BDL(DL 0.01)						BDL(DL 0.01)					
63	Mercury as Hg	mg/L	BDL(DL 0.001)						BDL(DL 0.001)					
64	Cadmium as Cd	mg/L	BDL(DL 0.003)						BDL(DL 0.003)					
65	Total Chromium as Cr	mg/L	BDL(DL 0.05)						BDL(DL 0.05)					
66	Copper as Cu	mg/L	BDL(DL 0.05)						BDL(DL 0.05)					
67	Lead as Pb	mg/L	BDL(DL 0.01)						BDL(DL 0.01)					
68	Manganese as Mn	mg/L	BDL(DL 0.05)						BDL(DL 0.05)					
69	Nickel as Ni	mg/L	BDL(DL 0.05)						BDL(DL 0.05)					
70	Selenium as Se	mg/L	BDL(DL 0.01)						BDL(DL 0.01)					
71	Barium as Ba	mg/L	BDL(DL 0.1)						BDL(DL 0.1)					
72	Silver as Ag	mg/L	BDL(DL 0.01)						BDL(DL 0.01)					
73	Molybdenum as Mo	mg/L	BDL(DL 0.01)						BDL(DL 0.01)					
74	Octane	µg/L	189	197	172	184	159	172	177	190	180	187	164	190
75	Nonane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
76	Decane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
77	Undecane	µg/L	8.8	9.2	7.8	8.7	8	9.5	8	8.7	8.3	8.5	7.2	9.3
78	Tridecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
79	Tetradecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
80	Pentadecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
81	Hexadecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					

Location		CB - 1 Bottom Water							CB - 2 Bottom Water					
Month & Year		Unit	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
S.No.	Parameters													
82	Heptadecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
83	Octadecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
84	Nonadecane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
85	Elcosane	µg/L	BDL(DL 0.1)						BDL(DL 0.1)					
86	Primary Productivity	mg C/m^3 /hr	9.12	8.56	9.12	7.91	7.12	7.99	10.71	9.45	10.71	8.69	8.43	8.78
87	Chlorophyll a	mg /m^3	7.31	3.98	7.31	4.86	4.08	5.41	8.05	4.39	8.05	4.27	4.47	6.64
88	Phaeophytin	mg /m^3	0.6	0.74	0.6	0.75	0.79	0.7	0.72	0.86	0.72	0.8	0.83	0.91
89	Oxidisable Paticular Organic	mg /L	6.54	4.83	7.54	4.26	5.49	6.27	6.16	4.04	8.16	5.73	5.18	6.53
	PHYTOPLANKTON													
90	Bacteriastrum hyalinum	nos/ml	12	16	17	14	16	19	10	14	20	14	14	11
91	Bacteriastrum varians	nos/ml	17	19	14	13	10	12	18	15	17	13	16	14
92	Chaetoceros didymus	nos/ml	15	18	10	10	12	17	13	17	12	10	9	12
93	Chaetoceros decipiens	nos/ml	14	15	9	11	11	14	11	10	11	11	12	16
94	Biddulphia mobiliensis	nos/ml	20	23	15	12	15	13	19	16	19	12	13	19
95	Ditylum brightwellii	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
96	Gyrosigma sp	nos/ml	Nil	Nil	5	Nil	Nil	Nil	Nil	Nil	8	Nil	Nil	Nil
97	Cladophyxis sps	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
98	Coscinodiscus centralis	nos/ml	16	21	16	15	13	10	15	18	13	15	11	8
99	Coscinodiscus granii	nos/ml	11	14	9	9	7	9	12	19	10	9	9	11
100	Cylcotella sps	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
101	Hemidiscus hardmanianus	nos/ml	12	17	22	6	12	16	17	23	15	6	8	10
102	Laudaria annulata	nos/ml	8	10	12	8	19	22	21	18	18	8	14	17
103	Pyropacus horologicum	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
104	Pleurosigma angulatum	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
105	Leptocylindrus danicus	nos/ml	17	21	18	5	7	10	14	22	21	5	10	19
106	Guinardia flaccida	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
107	Rhizosolenia alata	nos/ml	21	26	11	16	9	12	19	25	7	16	12	20
108	Rhizosolena impricata	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
109	Rhizosolena semispina	nos/ml	19	12	16	7	16	20	25	20	17	7	11	22
110	Thalassionema nitzschioides	nos/ml	13	18	13	10	18	24	27	16	11	10	17	28
111	Triceratium reticulatum	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
112	Ceratium trichoceros	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
113	Ceratium furca	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
114	Ceratium macroceros	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
115	Ceracium longipes	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	ZOOPLANKTONS													
116	Acrocalanus gracilis	nos/ml	18	13	10	13	10	12	10	18	13	15	17	21
117	Acrocalanus sp	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
118	Paracalanus parvus	nos/ml	10	17	11	18	15	19	16	22	12	9	12	15
119	Eutintinus sps	nos/ml	8	19	17	17	7	11	19	14	15	12	14	18
120	Centropages furcatus	nos/ml	17	12	10	19	16	14	8	11	13	17	15	10
121	Corycaeus dana	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
122	Oithona brevicornis	nos/ml	12	18	9	15	9	16	17	10	20	14	13	19
123	Euterpina acutifrons	nos/ml	19	11	15	14	17	13	22	15	16	18	15	12
124	Metacalanus aurivilli	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
125	Copipod nauplii	nos/ml	24	20	16	13	12	15	11	8	14	16	17	18
126	Cirripede nauplii	nos/ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
127	Bivalve veliger	nos/ml	15	16	13	15	13	17	23	14	18	13	18	12
128	Gastropod veliger	nos/ml	20	25	19	12	8	11	18	9	10	15	10	14

SEA SEDIMENT														
Location			CB - 1 Sea Sediment						CB - 2 Sea Sediment					
Month & Year		Unit	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20
S.No.	Parameters													
1	Total organic matter	%	0.72	0.65	0.61	0.65	0.59	0.53	0.61	0.58	0.54	0.6	0.54	0.55
2	% Sand	%	21	25	28	25	27	25	23	26	35	29	25	22
3	%silt	%	23	28	22	21	23	20	22	24	23	28	21	27
4	%Clay	%	56	47	50	54	50	55	55	50	42	53	54	51
5	Iron (as Fe)	mg/kg	20.9	23.1	19	17.3	19.1	22.3	22.5	24.6	18.7	16.9	18	20.6
6	Aluminium (as Al)	mg/kg	10865	9864	12080	11745	11013	10014	11437	10956	11946	12142	11562	11081
7	Chromium (as cr)	mg/kg	47	40	69	61	74	85	41	38	67	65	78	72
8	Copper (as cu)	mg/kg	65	74	62	70	93	74	60	69	71	75	86	70
9	Manganese (as Mn)	mg/kg	208	229	314	334	300	271	226	237	303	341	322	294
10	Nickel (as Ni)	mg/kg	11.3	8.6	13.6	12.7	15.5	13.6	12.1	10.4	12.9	13.3	14.9	12.8
11	Lead (as Pb)	mg/kg	29	22	58	54	42	48	25	27	50	57	49	42
12	Zinc (as Zn)	mg/kg	294	268	261	249	217	255	256	230	285	270	232	251
13	Mercury(as Hg)	mg/kg	0.68	0.62	0.6	0.68	0.55	0.63	0.63	0.53	0.64	0.71	0.68	0.7
14	Total phosphorus as P	mg/kg	170	183	159	151	174	140	164	176	147	155	163	151
15	Octane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
16	Nonane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
17	Decane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
18	Undecane	mg/kg	0.74	0.8	0.85	0.8	0.68	0.76	0.76	0.72	0.78	0.84	0.75	0.89
19	Dodecane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
20	Tridecane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
21	Tetradecane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
22	Phntadecane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
23	Hexadecane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
24	Heptadecane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
25	Octadecane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
26	Nonadecane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
27	Elcosane	mg/kg	BDL(DL 0.1)						BDL(DL 0.1)					
I. Nematoda														
28	Oncholaimussp	nos/m^2	15	11	24	21	17	21	19	15	19	17	12	18
29	Tricomasp	nos/m^2	18	16	18	15	13	15	14	20	15	19	15	17
II. Foraminifera														
30	Ammoniabeccarii	nos/m^2	0.61	19	16	14	11	17	10	14	13	20	17	19
31	Quinqulinasp	nos/m^2	23	15	13	17	14	19	18	8	17	15	11	15
32	Discorbinellasp.,	nos/m^2	22	22	15	12	10	13	22	17	14	10	14	20
33	Bolivinaspathulata	nos/m^2	55	20	12	16	20	22	16	21	16	14	16	25
34	Elphidiumsp	nos/m^2	22.5	8	20	23	25	14	20	12	18	21	19	18
35	Noniondepressula	nos/m^2	11437	10	19	18	22	20	17	13	20	19	24	16
III. Molluscs-Bivalvia														
36	Meretrixveligers	nos/m^2	20	11	17	22	19	17	24	10	18	16	22	19
37	Anadoraveligers	nos/m^2	29	9	25	27	23	26	21	16	22	20	26	27
	Total No. of individuals	nos/m^2	185	141	179	185	174	184	181	146	172	171	176	194
	Shanon Weaver Diversity Index		2.27	2.25	2.28	2.27	2.26	2.28	2.28	2.27	2.29	2.28	2.27	2.29
MARINE WATER														

Location		CB - 3 Surface Water						
Month & Year		Unit	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	
S.No.	Parameters							
1	pH @ 25°C	-	7.44	7.93	7.67	8.28	8.06	
2	Temperature	^{o}C	29	29	29	29	29	
3	Total Suspended Solids	mg/L	33	20	24	18	24	
4	BOD at 27 °C for 3 days	mg/L	18	9	11	16	20	
5	Dissolved oxygen	mg/L	2.4	3.1	2.9	3.2	3.5	
6	Salinity at 25 °C	-	40.8	43.5	41.9	40.1	42.3	
7	Oil & Grease	mg/L	BDL(DL 1.0)					
8	Nitrate as No_3	mg/L	7.14	6.27	7.08	8.16	9.42	
9	Nitrite as No_2	mg/L	4.65	3.91	4.12	5.32	6.75	
10	Ammonical Nitrogen as N	mg/L	BDL(DL 1.0)					
11	Ammonia as NH3	mg/L	BDL(DL 0.01)					
12	Kjeldahl Nitrogen as N	mg/L	BDL(DL 1.0)					
13	Total phosphates as PO4	mg/L	6.21	3.19	3.96	4.78	5.33	
14	Total Nitrogen	mg/L	BDL(DL 1.0)					
15	Total Dissolved Solids	mg/L	39684	40842	39005	40988	42034	
16	COD	mg/L	136	101	123	103	122	
17	Total bacterial count	cfu/ml	105	80	88	96	81	
18	Coliforms	Per 100 ml	Absence					
19	Escherichia coli	Per 100 ml	Absence					
20	Salmonella	Per 100 ml	Absence					
21	Shigella	Per 100 ml	Absence					
22	Vibrio cholerae	Per 100 ml	Absence					
23	Vibrio parahaemolyticus	Per 100 ml	Absence					
24	Enterococci	Per 100 ml	Absence					
25	Octane	µg/L	168	165	173	187	164	
26	Nonane	µg/L	BDL(DL 0.1)					
27	Decane	µg/L	BDL(DL 0.1)					
28	Undecane	µg/L	BDL(DL 0.1)					
29	Tridecane	µg/L	9.5	8.9	9.2	6.9	8	
30	Tetradecane	µg/L	BDL(DL 0.1)					
31	Pentadecane	µg/L	BDL(DL 0.1)					
32	Hexadecane	µg/L	BDL(DL 0.1)					
33	Octadecane	µg/L	BDL(DL 0.1)					
34	Nonadecane	µg/L	BDL(DL 0.1)					
35	Elcosane	µg/L	BDL(DL 0.1)					
36	Primary Productivity	mg C/m^3 /hr	8.56	8.91	8.79	7.08	8.55	
37	Chlorophyll a	mg $/m^3$	5.84	7.45	6.23	6.96	7.24	
38	Phaeophytin	mg $/m^3$	0.78	0.72	0.46	0.55	0.78	
39	Oxidisable Paticular Organic	mg /L	5.17	7.08	5.88	6.03	6.92	
	PHYTOPLANKTON							
40	Bacteriastrum hyalinum	nos/ml	15	19	14	18	14	
41	Bacteriastrum varians	nos/ml	12	14	6	11	16	
42	Chaetoceros didymus	nos/ml	10	16	10	14	10	
43	Chaetoceros decipiens	nos/ml	17	10	14	16	11	
44	Biddulphia mobiliensis	nos/ml	21	9	8	10	7	
45	Ditylum brightwellii	nos/ml	Nil	Nil	Nil	Nil	Nil	
46	Gyrosigma sp	nos/ml	Nil	Nil	9	12	15	
47	Cladophyxis sps	nos/ml	Nil	Nil	Nil	Nil	Nil	
48	Coscinodiscus centralis	nos/ml	16	17	7	8	10	
49	Coscinodiscus granii	nos/ml	8	15	13	10	13	
50	Cylcotella sps	nos/ml	Nil	Nil	Nil	Nil	Nil	
51	Hemidiscus hardmanianus	nos/ml	11	18	12	15	19	
52	Laudaria annulata	nos/ml	14	11	9	13	16	
53	Pyropacus horologicum	nos/ml	Nil	Nil	Nil	Nil	Nil	
54	Pleurosigma angulatum	nos/ml	Nil	Nil	Nil	Nil	Nil	
55	Leptocylindrus danicus	nos/ml	19	14	5	7	11	
56	Guinardia flaccida	nos/ml	Nil	Nil	Nil	Nil	Nil	
57	Rhizosolenia alata	nos/ml	16	20	8	6	8	
58	Rhizosolena impricata	nos/ml	Nil	Nil	Nil	Nil	Nil	
59	Rhizosolena semispina	nos/ml	20	12	16	19	17	
60	Thalassionema nitzschioides	nos/ml	23	21	12	10	12	
61	Triceratium reticulatum	nos/ml	Nil	Nil	Nil	Nil	Nil	
62	Ceratium trichoceros	nos/ml	Nil	Nil	Nil	Nil	Nil	
63	Ceratium furca	nos/ml	Nil	Nil	Nil	Nil	Nil	
64	Ceratium macroceros	nos/ml	Nil	Nil	Nil	Nil	Nil	
65	Ceracium longipes	nos/ml	Nil	Nil	Nil	Nil	Nil	
	ZOOPLANKTONS							
66	Acrocalanus gracilis	nos/ml	15	13	10	13	15	
67	Acrocalanus sp	nos/ml	Nil	Nil	Nil	Nil	Nil	
68	Paracalanus parvus	nos/ml	10	18	15	17	19	
69	Eutintinus sps	nos/ml	8	15	13	18	21	
70	Centropages furcatus	nos/ml	16	12	11	12	14	
71	Corycaeus dana	nos/ml	Nil	Nil	Nil	Nil	Nil	
72	Oithona brevicornis	nos/ml	13	14	16	10	13	
73	Euterpina acutifrons	nos/ml	18	19	17	19	17	
74	Metacalanus aurivilli	nos/ml	Nil	Nil	Nil	Nil	Nil	
75	Copipod nauplii	nos/ml	24	16	12	11	16	
76	Cirripede nauplii	nos/ml	Nil	Nil	Nil	Nil	Nil	
77	Bivalve veliger	nos/ml	22	17	19	8	11	
78	Gastropod veliger	nos/ml	17	10	14	12	18	

Location		CB - 3 Bottom Water						
Month & Year		Unit	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	
S.No.	Parameters							
1	pH @ 25°C	-	6.78	7.84	7.75	7.91	8.23	
2	Temperature	°C	29	29	29	29	29	
3	Total Suspended Solids	mg/L	38	27	32	17	26	
4	BOD at 27 °C for 3 days	mg/L	26	16	18	23	32	
5	Dissolved oxygen	mg/L	2	2.2	2.1	3	2.8	
6	Salinity at 25 °C	ppt	43.3	39.1	37.9	40.5	41.8	
7	Oil & Grease	mg/L	BDL(DL 1.0)					
8	Nitrate as No_3	mg/L	8.05	8.43	7.93	8.43	6.24	
9	Nitrite as No_2	mg/L	6.14	5.99	5.05	5.79	4.55	
10	Ammonical Nitrogen as N	mg/L	BDL(DL 1.0)					
11	Ammonia as NH3	mg/L	BDL(DL 0.01)					
12	Kjeldahl Nitrogen as N	mg/L	BDL(DL 1.0)					
13	Total phosphates as PO4	mg/L	5.68	4.05	4.73	4.02	4.82	
14	Total Nitrogen	mg/L	BDL(DL 1.0)					
15	Total Dissolved Solids	mg/L	43145	42157	40645	42483	43201	
16	COD	mg/L	155	110	96	119	130	
17	Total bacterial count	cfu/ml	110	94	91	74	85	
18	Coliforms	Per 100 ml	Absence					
19	Escherichia coli	Per 100 ml	Absence					
20	Salmonella	Per 100 ml	Absence					
21	Shigella	Per 100 ml	Absence					
22	Vibrio cholerae	Per 100 ml	Absence					
23	Vibrio parahaemolyticus	Per 100 ml	Absence					
24	Enterococci	Per 100 ml	Absence					
25	Colour	Hazan	25	10	20	15	25	
26	Odour	-	Unobjectionable					
27	Taste	-	Disagreeable					
28	Turbidity	NTU	41	18.3	21.4	24.2	38	
29	Calcium as Ca	mg/L	563	501	489	575	596	
30	Chloride as Cl	mg/L	23981	21646	20987	21759	23124	
31	Cyanide as CN	mg/L	BDL(DL 0.01)					
32	Fluoride as F	mg/L	0.56	0.66	0.6	0.48	0.53	
33	Magnesium as Mg	mg/L	1486	1510	1476	1544	1603	
34	Total Iron as Fe	mg/L	0.88	0.52	0.58	0.65	0.65	
35	Residual Free Chlorine	mg/L	BDL(DL 0.1)					
36	Phenolic Compounds as C6H5OH	mg/L	BDL(DL 1.0)					
37	Total Hardness as CaCO3	mg/L	7599	7544	7373	7870	8169	
38	Total Alkalinity as CaCO3	mg/L	484	290	305	349	302	
39	Sulphide as H2S	mg/L	BDL(DL 0.5)					
40	Sulphate as SO4	mg/L	1877	2147	2096	2146	2318	
41	Anionic surfactants as MBAS	mg/L	BDL(DL 1.0)					
42	Monocrotophos	µg/L	BDL(DL 0.01)					
43	Atrazine	µg/L	BDL(DL 0.01)					
44	Ethion	µg/L	BDL(DL 0.01)					
45	Chiorpyrifos	µg/L	BDL(DL 0.01)					
46	Phorate	µg/L	BDL(DL 0.01)					
47	Mehyle parathion	µg/L	BDL(DL 0.01)					
48	Malathion	µg/L	BDL(DL 0.01)					
49	and DDD	µg/L	BDL(DL 0.01)					
50	Gamma HCH (Lindane)	µg/L	BDL(DL 0.01)					
51	Alppha HCH	µg/L	BDL(DL 0.01)					
52	Beta HCH	µg/L	BDL(DL 0.01)					
53	Delta HCH	µg/L	BDL(DL 0.01)					
54	Endosulfan (Alpha,beta and sulphate)	µg/L	BDL(DL 0.01)					
55	Butachlor	µg/L	BDL(DL 0.01)					
56	Alachlor	µg/L	BDL(DL 0.01)					
57	Aldrin/Dieldrin	µg/L	BDL(DL 0.01)					
58	Isoproturon	µg/L	BDL(DL 0.01)					
59	2,4-D	µg/L	BDL(DL 0.01)					
60	Polychlorinated Biphenyls (PCB)	µg/L	BDL(DL 0.01)					
61	(PAH)	µg/L	BDL(DL 0.01)					
62	Arsenic as As	mg/L	BDL(DL 0.01)					
63	Mercury as Hg	mg/L	BDL(DL 0.001)					
64	Cadmium as Cd	mg/L	BDL(DL 0.003)					
65	Total Chromium as Cr	mg/L	BDL(DL 0.05)					
66	Copper as Cu	mg/L	BDL(DL 0.05)					
67	Lead as Pb	mg/L	BDL(DL 0.01)					
68	Manganese as Mn	mg/L	BDL(DL 0.05)					
69	Nickel as Ni	mg/L	BDL(DL 0.05)					
70	Selenium as Se	mg/L	BDL(DL 0.01)					
71	Barium as Ba	mg/L	BDL(DL 0.1)					
72	Silver as Ag	mg/L	BDL(DL 0.01)					
73	Molybdenum as Mo	mg/L	BDL(DL 0.01)					
74	Octane	µg/L	174	170	163	177	159	
75	Nonane	µg/L	BDL(DL 0.1)					
76	Decane	µg/L	BDL(DL 0.1)					
77	Undecane	µg/L	7	8	8.5	6.4	7.3	
78	Tridecane	µg/L	BDL(DL 0.1)					
79	Tetradecane	µg/L	BDL(DL 0.1)					
80	Pentadecane	µg/L	BDL(DL 0.1)					
81	Hexadecane	µg/L	BDL(DL 0.1)					

Location		CB - 3 Bottom Water						
Month & Year		Unit	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	
S.No.	Parameters							
82	Heptadecane	µg/L	BDL(DL 0.1)					
83	Octadecane	µg/L	BDL(DL 0.1)					
84	Nonadecane	µg/L	BDL(DL 0.1)					
85	Elcosane	µg/L	BDL(DL 0.1)					
86	Primary Productivity	mg C/m^3 /hr	9.68	9.2	9.47	8.15	9.32	
87	Chlorophyll a	mg /m^3	6.55	7.83	7.65	7.02	8.54	
88	Phaeophytin	mg /m^3	0.69	0.73	0.82	0.7	0.83	
89	Oxidisable Paticular Organic carbon	mg /L	6.02	5.99	6.76	6.99	7.45	
		PHYTOPLANKTON						
90	Bacteriastrum hyalinum	nos/ml	18	23	16	19	16	
91	Bacteriastrum varians	nos/ml	22	17	9	13	18	
92	Chaetoceros didymus	nos/ml	13	14	12	16	20	
93	Chaetoceros decipiens	nos/ml	18	11	8	11	14	
94	Biddulphia mobiliensis	nos/ml	13	16	15	13	17	
95	Ditylum brightwellii	nos/ml	Nil	Nil	Nil	Nil	Nil	
96	Gyrosigma sp	nos/ml	Nil	Nil	Nil	Nil	Nil	
97	Cladophyxis sps	nos/ml	Nil	Nil	Nil	Nil	Nil	
98	Coscinodiscus centralis	nos/ml	12	8	10	7	12	
99	Coscinodiscus granii	nos/ml	7	19	11	9	16	
100	Cylcotella sps	nos/ml	Nil	Nil	Nil	Nil	Nil	
101	Hemidiscus hardmanianus	nos/ml	16	9	14	17	21	
102	Laudaria annulata	nos/ml	19	7	7	10	15	
103	Pyropacus horologicum	nos/ml	Nil	Nil	Nil	Nil	Nil	
104	Pleurosigma angulatum	nos/ml	Nil	Nil	Nil	Nil	Nil	
105	Leptocylindrus danicus	nos/ml	14	20	9	12	8	
106	Guinardia flaccida	nos/ml	Nil	Nil	Nil	Nil	Nil	
107	Rhizosolenia alata	nos/ml	23	13	13	15	10	
108	Rhizosolena impricata	nos/ml	Nil	Nil	Nil	Nil	Nil	
109	Rhizosolena semispina	nos/ml	15	20	17	19	13	
110	Thalassionema nitzschioides	nos/ml	21	25	11	21	16	
111	Triceratium reticulatum	nos/ml	Nil	Nil	Nil	Nil	Nil	
112	Ceratium trichoceros	nos/ml	Nil	Nil	Nil	Nil	Nil	
113	Ceratium furca	nos/ml	Nil	Nil	Nil	Nil	Nil	
114	Ceratium macroceros	nos/ml	Nil	Nil	Nil	Nil	Nil	
115	Ceracium longipes	nos/ml	Nil	Nil	Nil	Nil	Nil	
		ZOOPLANKTONS						
116	Acrocalanus gracilis	nos/ml	12	18	15	17	19	
117	Acrocalanus sp	nos/ml	Nil	Nil	Nil	Nil	Nil	
118	Paracalanus parvus	nos/ml	14	15	13	14	11	
119	Eutintinus sps	nos/ml	11	10	12	10	18	
120	Centropages furcatus	nos/ml	13	8	16	19	17	
121	Corycaeus dana	nos/ml	Nil	Nil	Nil	Nil	Nil	
122	Oithona brevicornis	nos/ml	15	17	10	15	10	
123	Euterpina acutifrons	nos/ml	21	14	15	12	14	
124	Metacalanus aurivilli	nos/ml	Nil	Nil	Nil	Nil	Nil	
125	Copipod nauplii	nos/ml	26	13	9	13	20	
126	Cirripede nauplii	nos/ml	Nil	Nil	Nil	Nil	Nil	
127	Bivalve veliger	nos/ml	18	9	11	6	9	
128	Gastropod veliger	nos/ml	25	13	17	11	15	

SEA SEDIMENT

Location		CB - 3 Sea Sediment						
Month & Year		Unit	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	
S.No.	Parameters							
1	Total organic matter	%	0.74	0.5	0.57	0.51	0.57	
2	% Sand	%	22	25	23	21	23	
3	%silt	%	27	20	25	24	21	
4	%Clay	%	51	55	52	55	56	
5	Iron (as Fe)	mg/kg	20.8	14.2	15.8	17.3	21.4	
6	Aluminium (as Al)	mg/kg	11012	10917	11567	10093	10089	
7	Chromium (as cr)	mg/kg	47	44	52	67	74	
8	Copper (as cu)	mg/kg	48	60	69	79	72	
9	Manganese (as Mn)	mg/kg	201	306	320	344	315	
10	Nickel (as Ni)	mg/kg	9.4	15.7	14.2	16.1	14	
11	Lead (as Pb)	mg/kg	21	32	46	53	47	
12	Zinc (as Zn)	mg/kg	247	245	263	250	271	
13	Mercury(as Hg)	mg/kg	0.58	0.38	0.55	0.64	0.69	
14	Total phosphorus as P	mg/kg	180	121	136	159	144	
15	Octane	mg/kg	BDL(DL 0.1)					
16	Nonane	mg/kg	BDL(DL 0.1)					
17	Decane	mg/kg	BDL(DL 0.1)					
18	Undecane	mg/kg	0.75	0.56	0.69	0.77	0.85	
19	Dodecane	mg/kg	BDL(DL 0.1)					
20	Tridecane	mg/kg	BDL(DL 0.1)					
21	Tetradecane	mg/kg	BDL(DL 0.1)					
22	Phntadecane	mg/kg	BDL(DL 0.1)					
23	Hexadecane	mg/kg	BDL(DL 0.1)					
24	Heptadecane	mg/kg	BDL(DL 0.1)					
25	Octadecane	mg/kg	BDL(DL 0.1)					
26	Nonadecane	mg/kg	BDL(DL 0.1)					
27	Elcosane	mg/kg	BDL(DL 0.1)					
I. Nematoda								
28	Oncholaimussp	nos/m^2	13	15	18	15	19	
29	Tricomasp	nos/m^2	18	20	22	17	13	
II. Foraminifera								
30	Ammoniabeccarii	nos/m^2	12	18	16	22	20	
31	Quinqulinasp	nos/m^2	10	11	13	18	14	
32	Discorbinellasp.,	nos/m^2	16	17	15	11	12	
33	Bolivinaspathulata	nos/m^2	19	12	17	13	18	
34	Elphidiumsp	nos/m^2	14	16	19	14	20	
35	Noniondepressula	nos/m^2	21	13	20	10	17	
III. Molluscs-Bivalvia								
36	Meretrixveligers	nos/m^2	20	9	11	19	12	
37	Anadoraveligers	nos/m^2	17	19	23	21	24	
	Total No. of individuals	nos/m^2	160	150	174	160	169	
	Shanon Weaver Diversity Index (SWDI)		2.28	2.27	2.28	2.27	2.28	

adani Ports and Logistics	Marine Infrastructure Developer Pvt Ltd	From : October 2019 To : March 2020

Compliance to Tamil Nadu Coastal Zone Management Authority (TNCZMA) vide letter no. 6064/EC.3/2014-1 dated 26.06.2014

Annexure – 5

Sl. No	Conditions	Compliance
i	The unit shall compliance with all the conditions stipulated in Environment Clearance issued in No. 10-130/2007-IA-III, Ministry of Environment & Forest, Government of India, dated 3rd July 2009	**Being complied**
ii	The proposed activities should not cause coastal erosion and alter the beach configuration. The shoreline changes shall be monitored continuously	**Being Complied.** In past, LTSB has been continuously monitoring shoreline studies through Institute of Ocean Management, Anna University, Chennai. MIDPL has engaged Institute of Ocean Management, Anna University, Chennai for shoreline Change study. Reports of the same is attached as **Annexure – II.**
iii	Chemical waste generated and the sewage generated, if any should not be discharged in to the sea and shall be properly handled	**Complied** No chemical waste is generated. Sewage waste water generated is being treated in STP for further usage in horticulture / greenbelt.
iv	The waste water generated shall be collected, treated and reused properly	**Complied.** Domestic waste water generated is being treated in STP's. Treated water is being reused for Horticulture / green belt purpose
v	The proponent shall implement oil spill mitigation measures without fail	**Complied.** Oil Spill contingency plan (OSCP) is being implemented at site.
vi	Disaster management plan shall be implemented and mock drills shall be carried out properly and periodically.	**Complied** MIDPL has already formulated detailed Disaster Preparedness & Management Plan to handle any Natural and industrial hazards at site. Regular Mock Drills are conducted as per the Crisis Management Plan. The details of drills conducted towards dock safety for the period Oct-2019 to Mar-2020 is enclosed as **Annexure - VI.**

Mock Drills - Oct-2019 to Mar-2020

S.No.	Date	Time	Scenario	Participants
1	25.10.19	12:15	Fire in Dry Grass at the backside of CFS Warehouse	38
2	08.11.19	16:56	Two ITV's got collided at the CB-1 and CB-2 junction and a driver got un-conscious	17
3	07.12.19	18:16	Gas Leak from IMDG Container	15
4	18.12.19	15:03	Person got slipped and fell down at TLF	20
5	10.01.20	11:00	RTG 25 operator cabin got fired due to Circuit in VMT Socket.	20
6	30.01.20	12:15	Person got electric shock while switch on the Pump No:3 at TLF pump house	24