BOARD OF INVESTMENT (BOI) OF SRI LANKA
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SUPPLEMENTARY ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED TEXTILE ZONE AT PUNNAIKUDAH, ERAVUR, BATTICALOA

ANNEXES
ඇමුණුම
பின்னிணைப்புக்கள்



MAY - 2026

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Submitted By:

Board of Investment of Sri Lanka
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ANNEXURE I

CEA Environmetal Approval

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மத்திய சுற்றாடல் அதிகாரசபை
Central Environmental Authority

පරිසර පියස, 104, ඩෙන්සිල් කොබ්බෑකඩුව මාවත, බත්තරමුල්ල, ශ්‍රී ලංකාව.
"பரிசர பியச", 104, டென்சில் கொப்பேகடுவ மாவத்தை, பத்தரமுல்லை, இலங்கை.
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අපේ යොමුව / எமது தொடர்பு / Our Ref. 08/EIA/IND/07/2019

ඔබේ යොමුව / உமது தொடர்பு / Your Ref.

දිනය / திகதி / Date 07 September 202

Chairman
Board of Investment of Sri Lanka
West Tower
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PROPOSED TEXTILE ZONE AT PUNNAIKUDAH, ERAVUR, BATTICALOA

This is to inform you that the Central Environmental Authority (CEA), being the Project Approving Agency (PAA) having carefully and extensively reviewed the Environmental Impact Assessment Report (EIAR) dated February 2021, comments received from the Technical Evaluation Committee (TEC) appointed by the CEA and your responses for the clarifications sought by the TEC submitted as an Addendum to EIAR dated June 2021 has decided in terms of regulation 13 (i) of the National Environmental (Procedure for Approval of Projects) Regulations No. 01 of 1993, to grant approval for implementation of the above project subject to following terms and conditions.

1 GENERAL CONDITIONS

1.1 This environmental approval is valid for implementation of the proposed textile zone at Punnaikudah, Eravur, Batticaloa as indicated in the EIAR dated February 2021 and the Addendum to the EIAR dated June 2021.

1.2 Board of Investment of Sri Lanka (BOI SL), hereinafter referred to as the Project Proponent (PP) should ensure that the terms and conditions given in this environmental approval letter are strictly adhered to by a third party that may be involved in project implementation. The CEA should have access to the contract documents pertaining to environmental aspects entered into by the PP and the third party.

1.3 The environmental approval is valid for three (03) years from the date of issuance unless upon written application to CEA within thirty days prior to the expiry date the validity period is extended.

1.4 The PP where necessary shall obtain a fresh approval in respect of any alterations or extensions that are intended to be made to the project as indicated in the EIAR dated February 2021 and the Addendum to the EIAR dated June 2021.

1.5 The industries/activities to be accommodated in the proposed textile zone shall be limited to industries/activities given in section B.2.2 of the EIAR dated February 2021.

1.6 It is the duty of the PP to inform the CEA of any environmental impacts which are not anticipated at this stage. In such an event, relevant guidelines and mitigatory measures shall be implemented as directed by the CEA.

1.7 The PP should intimate to CEA the date of commencement of project construction activities inclusive of phased implementation schedule.

1.8 All physical developments at the project site should have written approval of the Urban Development Authority (UDA) and the Pradeshiya Sabha, Eravurpattu.

1.9 The PP shall be bound to adhere to any additional conditions given by the CEA.

1.10 A copy of this environmental approval, EIAR dated February 2021 and the Addendum to the EIAR dated June 2021 should be kept at the project site at all times for the purpose of perusal by the concerned agencies.

1.11 This approval is granted on the basis that all information provided by the PP in the EIAR dated February 2021 and the Addendum to the EIAR dated June 2021 is true and accurate.

1.12 All costs to be incurred in giving effect to the implementation of the terms and conditions of this approval shall be borne by the PP as project implementation costs.

2 WATER REQUIREMENT

2.1 Water requirement of the proposed textile zone shall be met from the main supply of NWSDB as indicated in the letters dated 15.11.2019 and 24.07.2020 attached to the EIAR dated February 2021.

2.2 PP shall ensure that a Water Conservation Plans of individual industries are available in selection of industries for the proposed textile zone as indicated in the section E.1.5.1 of the EIAR dated February 2021.

3 WASTEWATER TREATMENT AND DISPOSAL OF TREATED WASTEWATER

3.1 The PP shall ensure that all process wastewater (pre-treated with appropriate industry specific pretreatment via individual Effluent Treatment Plants - ETPs) and domestic wastewater are directed to Common Wastewater Treatment Plant (CWWTP) and treated to conform to the standards stipulated by the CEA, prior to disposal.

3.2 All wastewater generated from the textile zone shall not be mixed with any domestic wastewater/sewage streams. The process wastewater and domestic wastewater conveyance pipe lines shall be established with different RAL colour code.

3.3 The PP shall ensure that the individual industries are pre-treated their wastewater to comply with the Tolerance Limits of Industrial wastewaters to meet BOI SL pre-treatment standards prior to discharge into the CWWTP as indicated in the EIAR dated February 2021.

3.4 The PP shall ensure to adopt new and well-designed equipment and efficient processes for individual industries to use less water and to reduce pollutant loads in the wastewaters as mentioned in the EIAR dated February 2021 and the Addendum to the EIAR dated June 2021.

3.5 The PP shall ensure that the individual industries are encompassing with best available technologies in order to ensure Zero Liquid Discharge (ZLD) for specific industry types which comprise of high toxic chemicals and discoloration plants to remove rhodamine or other dye types.

3.6 The PP shall obtain an operation and maintenance plan of individual industries in order for use of auditing/ monitoring purposes as indicated in the EIAR dated February 2021.

3.7 The PP shall ensure that every necessary measures have been employed by the industries to contain and collect contaminated wastewater generated from floor washing, spillages and or vehicle washings and to direct such wastewater to the CWWTP. Such contaminated wastewater shall not be discharged into storm water drains at any time including "Thonas".

3.8 PP shall ensure to design both individual ETPs and CWWTP in such a way to accommodate excess volume of wastewater loads during peak level of operations and design the CWWTP to make sure the adequacy to receive such loads achieving required dilution levels in order to ensure efficient operations of the treatment system as mentioned in the Addendum to the EIAR dated June 2021.

3.9 The treated wastewater from the CWWTP shall conform to the "Proposed Tolerance limits for discharge of wastewater into Marine Waters through short sea outfall" and should maintain a minimum dilution factor of 1:10 at a distance of 10 meters from the point of exist of the pipeline prior to discharge treated wastewater to the sea via a short sea outfall (vide annexure I).

3.10 The treated wastewaters from the CWWTP shall be further treated to remove nutrients through appropriate technologies in order to maintain favourable sea water quality for sensitive receptors.

3.11 A detailed mathematical modeling study shall be undertaken during the detailed design stage to assess / verify the effluent dilution process and dispersion patterns to determine the exact, feasible location of the treated wastewater disposal via a short sea outfall. The impacts on the marine environments need to be accurately assessed and appropriate mitigation measures need to be proposed. The report of the model study should be submitted to the CEA and approval should be obtained prior to construction of the sea outfall with a diffuser system.

3.12 In such a case where sufficient dilution cannot be maintained, further treatment of wastewater shall be carried out at the CWWTP to reduce pollution load appropriately to minimize impact on the receiving waters and sensitive ecosystems of marine environment.

3.13 No wastewater shall be discharged without treatment and therefore maximum utilization (recovery & reuse options) of water resource should take place in the zone premises.

3.14 Treated wastewater under any circumstances shall not be discharged to the pocket of water available in "Thona"s within the zone.

3.15 The PP shall ensure to establish "Thona" water quality and monitoring programme to ensure any changes during construction and operation phase considering seasonal variations. It shall ensure the surface waters within "Thonas" shall not be affected by project activities and shall be maintained to Tolerance Limits described under National Environmental (Ambient Water Quality) Regulations, No. 01 of 2019 – limits for Category C (water suitable for aquatic life) as indicated in the EIAR dated February 2021.

3.16 The establishment of composite sampler controlled at 4 degrees Centigrade (4^0C) just outside the property boundary of each industry for the purpose of inspection of treated process wastewater quality monitoring prior to connection to CWWTP shall be ensured and the composite sampler is to be provided for independent monitoring by PP or CEA in case of incidents of non-compliance.

3.17 The PP shall carryout continuous online monitoring of the quality of treated wastewater periodically from CWWTP to ensure the wastewater quality by incorporating a sampling point just prior to final disposal. The records of such monitoring data shall be maintained and submitted to the CEA where necessary.

3.18 The length and depth of the proposed short sea outfall shall ensure to satisfy the Proposed Tolerance limits for discharge of wastewater into Marine Waters through short sea outfall standards with respect to near-field and far-field dispersion.

3.19 The construction details of the short sea outfall such as pipe details, anchoring details and diffuser descriptions should be submitted to the Coast Conservation and Coastal Resource Management Department (CC&CRMD) and the Marine Environmental Protection Authority (MEPA) and written approvals should be obtained prior to finalization of the detailed design.

3.20 The outlet pipeline shall be buried in order to avoid potential interception of the prevailing natural sediment movement process and to with stand extreme sea conditions to avoid instability of the outfall structure while designing the multi-port diffuser to prevent clogging and to reduce consequences of bio-fouling as indicated in the EIAR dated February 2021 and the Addendum to the EIAR dated June 2021.

3.21 The PP shall obtain approval from MEPA prior to commencement of discharging of treated wastewater into the sea via the short sea outfall.

3.22 The PP shall ensure to monitor the quality of the sea water in the affected area periodically during operation as a continuous marine environmental monitoring program paying special attention on identified sensitive marine receptors. The reports of such monitoring data shall be submitted to the CEA where necessary.

3.23 PP shall encourage individual industries to use biodegradable/ natural dyes and metal free chemicals where possible.

3.24 The PP shall ensure that all individual industries within the textile zone are adopting circular economy concepts paying special attention on Resource Efficient Cleaner Production (RECP) concepts, water conservation strategies, techniques to minimize generation of wastewater, reusing/ recycling of treated wastewater and Zero Discharge of Hazardous Chemicals (ZDHC) programs etc. as indicated in the EIAR dated February 2021 and the Addendum to the EIAR dated June 2021.

4. AIR EMISSION

4.1 Emissions from stationary sources such as stacks of the industrial boilers, thermic fluid heaters and the high-temperature incinerator shall be controlled according to the National Environmental (Stationary Source Emission Control) Regulations where the order published under the Gazette Notification No. 2126/36 dated 05.06.2019.

4.2 The minimum height of stacks and air emission control systems shall be well designed, well operated and well maintained in such a manner in order to maintain the ambient air quality in the surrounding area within the National Ambient Air Quality Standards aspublished in the Gazette NotificationNo. 1562/22 dated 15.08.2008.

4.3 Air emission sampling ports shall be installed with the stacks prior to commencing operations of the industrial boilers, thermic fluid heaters and the high-temperature incinerator.

4.4 The PP shall ensure the VOC producing units, sand blasting operation areas and / or any other processes (operations), machinery and equipment that generate large amounts of dust, fumes, gases or vapours to be isolated and install local exhaust ventilation systems to trap at or near the source as to prevent contaminants from reaching the worker's breathing zones as indicated in the EIAR dated February 2021.

4.5 Real time concentrations of ambient air quality monitoring shall be carried out periodically covering the seasonal wind pattern in the area. Copies of such monitoring reports should be submitted to the CEA on regular basis.

4.6 Fugitive dust emission during the construction phase (due to excavation, material loading, transportation, unloading etc.) shall be controlled by adopting appropriate measures.

4.7 The PP shall ensure that each and every industry within the textile zone incorporate in built fugitive emission control measures at locations susceptible to generate such fugitive emissions.

5 SOLID (HAZARDOUS & NON HAZARDOUS) WASTE SEGREGATION, COLLECTION, STORAGEAND DISPOSAL

5.1 The PP shall ensure adoption of proper solid waste management and disposal system for domestic waste, construction wastes, unsuitable material, etc. generated during construction phase of the textile zone in consultation with the Pradeshiya Sabha, Eravurpattu.
Disposal of construction wastes, unsuitable materials etc. shall be done only in designated sites for which prior approval of the CEA is obtained.

5.2 Necessary arrangements/guidance shall be provided to segregate the waste at the point of generation as indicated in the section of B.2.2.11 of the EIAR dated February 2021.

5.3 The segregated non-hazardous wastes such as organic waste, all other recyclable waste such as fabric, cardboard, metal, polythene, plastic and paper and shall be collected and stored separately in a central well designed storing facility of the project site/ and dispatched through CEA approved waste collectors and recyclers in consultation with Pradeshiya Sabha, Eravurpattu as indicated in the EIAR dated February 2021.

5.4 The PP shall ensure the guidelines for operation of the Material Recovery Centre (MRC) are implemented effectively for any non-hazardous mixed waste that cannot be effectively reused and recycledwithin the textile zone as indicated in the section E 1.11.6 in the EIAR dated February 2021.

5.5 The PP shall ensure that all individual industries to segregate hazardous wastes from non-hazardous wastes of the point of generation and store hazardous wastes in separate, enclosed storage areas with implementation of active fire-fighting mechanisms and spill containment provisions following specific criteria for the hazardous waste storage areas specified under section E.1.11.3 ofthe EIAR dated February 2021.

5.6 The PP shall ensure that the dried sludge from individual ETPs and CWWTP are disposed of in a high-temperature incinerator incorporated with air pollution control systems as indicated in the EIAR dated February 2021 and the Addendum to the EIAR dated June 2021.

5.7 The PP shall ensure that the scheduled wastes other than the dried sludge shall be disposed ofthrough any services of CEA registered third party collectors who have obtained a Scheduled Waste Management License (SWML) issued by the CEA and entered into an agreement in such party in this regard.

5.8 Empty chemical containers and contaminated packing material shall be transported and disposed of through a hazardous waste disposal facility having a SWML issued by the CEA and the PP shall ensure that individual industries enter into an agreement in this regard with the service provider.

5.9 Fly ash and bottom ash generated due to high-temperature incineration shall be stored properly in an enclosed area with side walls and cemented floor within the zone premises until co-processing.

5.10 In case of any co-processing of incinerated ash will be employed, it shall be analyzed before initiation of the process.

5.11 Necessary technical assistance shall be obtained in case for the production of bricks and paving stones using incinerated ash adhering to the Best Environmental Practices (BEPs) under section E.1.9 of the EIAR dated February 2021 and the Addendum to the EIAR dated June 2021.

5.12 In case of disposal of incinerated ash, a separate approval shall be obtained from the CEA when a secured landfill will be established within premises.

5.13 The PP shall ensure to obtain an updated comprehensive Waste Management Plan from individual industries and to monitor the effectiveness of such plan as indicated in the section E.1.11.5 of the EIAR dated February 2021.

5.14 The PP shall agree upon with individual industrialists to minimize generation of solid wastes, recycle and reuse in order to minimize environmental impacts due to disposal of such solid wastes and to adopt RECP strategies as indicated in the EIAR dated February 2021.

5.15 The PP shall take every action to minimize environmental impacts due to storage, handing and disposal of solid wastes including solid wastes which contain hazardous constitutions exhibiting hazardous characteristics, during operational phase of the textile zone.

5.16 Solid waste shall not be open burnt and/or disposed into a water body within or at a site where it is likely to enter a water body at any time.

6 CONTROL OF NOISE AND VIBRATION

6.1 During Construction

a Noise levels at boundary of the project shall not exceed 75 dB (A) from 0600 hrs. to 1800 hrs. and 50 dB (A) from 1800 hrs. to 0600 hrs. during construction stage as per the National Environmental (Noise Control) Regulations published in the Gazette Extra Ordinary No. 924/12 dated 23rd May 1996 under the National Environmental Act.

6.2 During Operation

a The noise levels during operation shall be maintained at or below 70 dB (A) from 0600 hrs. to 1800 hrs. and 60 dB (A) from 1800 hrs. to 0600 hrs. at boundaries of the site as per Gazette Extra Ordinary No. 924/12 dated 23rd May 1996. All buildings which contain noise generating machinery shall be designed in such a way to reduce noise levels outside the project areas.

b Installation of machinery/equipment which generates high noise shall be done in a sound proof area to prevent emission of excessive noise.

6.3 Vibration generated during the construction and operation phases of the project should be complied with the Interim Vibration Standards of the CEA (vide annexure II).

All machinery shall be installed on a resilient foundation in order to prevent generation of vibration.

7 STORAGE AND HANDLING OF FUEL OIL, RAW MATERIALS, CHEMICALS, BYPRODUCTS AND FINISHED PRODUCTS

7.1 The PP shall ensure that storing of raw materials/chemicals/finished products shall be done only in areas especially designated for the same without provision to accessible by the general public, unauthorized persons, animals, insects & rodents and adverse weather conditions such as vulnerable floods, wind and sun as indicatedin the EIAR dated February 2021.

7.2 The PP shall ensure that the individual industries will maintain the storage spaces to keep chemicals such as different dyes, pigments, inks, needed for the textile processing works by regular monitoring as indicated in the section E.1.13.7 of the EIAR dated February 2021.

7.3 The PP shall ensure that the incompatible chemicals, which have possibility of reaction, oxidizing, flammable or combustible, detonation are stored in separate areas. Chemical storage operations should be part of the monitoring plan.

7.4 The PP shall ensure all chemicals shall be stored in properly designed chemical room where provisions available to collect accidental spills of chemicals. The PP shall ensure the provision of necessary containments to avoid any accidentally released fuel oil, raw materials, chemicals, by-products, finished products etc.

7.5 All chemicals shall be properly labelled provided with secondary containment and any spillage shall be cleaned up immediately using chemically inactive absorbent material/ spill kit material and contained within labelled puncture proof bins until properly disposed as indicated in the EIAR dated February 2021.

7.6 The PP shall ensure to establish a technical committee in order to review the Safety Data Sheets (SDS) of chemicals and inventories of such details prior to establishment of each industryas indicated in the EIAR dated February 2021.

7.7 The PP shall ensure that the chemicals are handled, stored, used in accordance with guidelines given in the chemical Safety Data Sheets (SDSs) and PP shall ensure that the most recent and the updated SDSs are used.

7.8 The PP shall ensure that the fuel storage area shall have containments made of concrete slab with bund wall of concrete constructed "in one mould" to collect any spillage or accidental discharges. The retainment bund volume equals 100% of tank volume + 10% of volume. No connection from bund area to the outside is allowed.

7.9 The PP shall maintain documentary records of raw materials / chemicals within the zone and ensure that rules pertaining to chemical reporting shall be adhered by individual industries.

7.10 The PP shall ensure the employees to strictly adhere the safety precautions in handling of raw materials. Transportation of chemicals within individual industries shall use break-resistant secondary containmentunder section E.1.13.3 of the EIAR dated February 2021.

7.11 Usage of any corroded, broken, rusted, or leaking containers shall be avoided for storing fuel oil/raw materials/chemicals in order to prevent spillage of raw materials/chemicals into the environment.

8. FIRE CONTROL

8.1 Adequate fire extinguishers/ facilities shall be made available at strategic points within the textile zone to control accidental initiation through friction, fire and or other mechanical stimuli during loading, unloading, handling and storing of raw materials, chemicals, by products, end products, fuel oil, etc. and manufacturing process etc. in consultation with Fire Department of Batticaloa Municipal Council.

8.2 A suitable arrangement shall be made to collect, treat and disposal of any contaminated wastewater arising due to use of water in an emergency fire incident.

8.3 A buffer zone of an appropriate extent shall be established around the textile zone as well as around the individual industries in order to minimize inter and intra impacts due to operation of the textile zone.

8.4 The employees of the project should be trained and required facilities provided to fight any accidental or other fires until the outside assistance is received in this respectas indicated in the EIAR dated February 2021.

9 TRANSPORTATION AND TRAFFIC IMPACTS

9.1 The PP shall implement a suitable traffic management plan to avoid the traffic impact to Eravur intersection/junction during the construction and operation phase in consultation with the Road Development Authority (RDA).

9.2 The PP shall ensure the facilities for safe transportation of raw material, chemicals and products.

9.3 The PP shall ensure transport, loading and unloading of materials shall be carried out in such a way so as not to cause nuisance to the public.

9.4 The PP shall ensure that the work force (permanent as well as on contract) understands well the relevant international transportation guidelines for any hazardous chemicals, fuels etc.

10 OCCUPATIONAL HEALTH & SAFETY MEASURES

10.1 Advice shall be obtained from the Deputy Commissioner of Occupational Health of the Labour Department on maintaining the health and safety requirements of the workers and shall fulfill the requirements specified by him.

10.2 The PP shall ensure that a qualified officer on Safety, Health and Environment shall be employed by the individual industries in order to supervise and coordinate all activities connected with the management of environmental aspects of the project.

10.3 All employees shall be given adequate training and awareness by the Environment Health & Safety (ESH) Department regarding safe management of hazardous chemicals as indicated in the EIAR dated February 2021.

10.4 The PP shall ensure that the waste handlers and transporters shall be equipped with mandatory personal protective equipment.

11 HYDROLOGY, DRAINAGE MANAGEMENT AND CONTROL OF FLOOD

11.1 A Drainage Management Plan for the overall project development shall be worked out and approval obtained from the relevant agency/s prior to commencement of the construction workas indicated in the EIAR dated February 2021.

11.2 Approved Drainage Management Plan shall be implemented and maintained properly ensuring sustainability of already existing "Thonas".

11.3 Drainage canals and canal reservations in the project area should be maintained on a regular basis under section E.1.16 of the EIAR dated February 2021.

11.4 The PP shall ensure implementation of proposed development without disturbing the existing drainage pattern and allowing reservations to all natural drainage paths including two main "Thonas' 'to avoid risks of floods.

11.5 The PP shall pay special concern on the natural phenomena of opening and closure of beach outfalls of "Thonas" with the synchronization of the onset of inter-monsoonal/ northeast rains and ensure not to disturb the natural process in consultation with the CC&CRMD.

11.6 Any modifications/improvements to the existing drainage paths to facilitate the storm water drainage of the coastal belt shall be submitted to the CC&CRMD and the prior approval shall be obtained on this regard.

11.7 Required precautionary measures shall be adopted in designing of all physical developments of the site such as waste management areas, storage areas of materials locating above the high flood level by considering the maximum flood levels in the area. Required precautionary measures shall be adopted in designing the physical developments of the site in such a way in order to avoid any contamination with storm waters in vulnerable climatic conditions as indicated in the EIAR dated February 2021.

11.8 The PP shall ensure protective measures will be adopted to mitigate soil erosion and related issues in order to conserve surface water including planting native riparian flora around the banks of the "Thonas" or natural slopes, turfing the ground which may be subjected to severe soil erosion etc. under section E.1.16 of the EIAR dated February 2021.

11.9 The Palm trees and water front vegetation around "Thona" and outlet areas shall be protected and preserved by PP while developing the site in order to protect from soil erosion under section E.1.16 of the EIAR dated February 2021.

12 FISHERY AND OTHER SOCIAL ASPECTS

12.1 A comprehensive assessment on fisheries activities of the project-influenced area shall be carried out, and in case of curtailment of the fisheries activities due to the proposed project which leads to a loss of income of the fishing community, a suitable compensation mechanism should be implemented to ease the burden on the affected fishers with the Department of Fisheries and Aquatic Resources under section E.2.2 of the EIAR dated February 2021.

12.2 Proper consultation shall be initiated to address the social issues relevant to the livelihood of the fishing community. Regular discussions should be held with the fishing communities in the area in close consultation with the Department of Fisheries and Aquatic Resources to resolve any issues of the fishing community as indicated in the EIAR dated February 2021.

12.3 The PP shall ensure a declaration of a temporary fishing exclusion zone during the construction period if trace of outfall route overlaps with fishing grounds under section E.2.2 of the EIAR dated February 2021.

12.4 PP shall ensure the establishment of a proper and clearly visible signage both during day and night time by positioning floating and illuminated buoys around the entire perimeter /length of the outfall and regularly maintain them to minimize the issues related to fishing community under section E.1.4 of the EIAR dated February 2021.

12.5 Grievances redress mechanism shall be established to address grievances of the fishery community in close consultation with the Department of Fisheries & Aquatic Resources and a suitable settlement reached prior to commencing construction activities of the project.

13 ECOLOGICAL ASPECTS

13.1 The PP shall ensure all the project activities shall be adhered to the provisions of the Fauna and Flora Protection Ordinance and they should be implemented under the guidance of the Department of Wildlife Conservation (DWC) and Forest Department (FD) as indicated in the EIAR dated February 2021.

13.2 The PP shall ensure not to disturb the existing Casuarina plantations far towards to the east of the project site managed by the Forest Department (FD).

13.3 The removal and re-plantation of Palmyrah trees during the land development phase shall be initiated as approved by the Palmyrah Development Board (PDB) according to the letter dated on 08. 04. 2021.

14 RISK ASSESSMENT & EMERGENCY PREPARENDESS PLAN

14.1 Each individual industry shall be mandated to prepare and implement a Facility Specific Emergency Response Plan (ERP)/ Contingency Management Plan and to be updated where necessary as indicated in the EIAR dated February 2021.

14.2 The PP shall ensure that the facility specific ERP must furnish the proactive and reactive strategies that will be taken in the event of ETP failures and mandate individual ETPs to maintain emergency holding tanks of sufficient capacity to collect the wastewater in case the plant's ETP failures until it is rectified as indicated in the EIAR dated February 2021.

14.3 The PP shall ensure that all employees are trained and aware of the plan and their responsibilities in executing the plan. Copies of such plan shall be placed at suitable locations and consulted on a regular basis.

15 ENVIRONMENTAL PROTECTION LICENCE AND SCHEDULED WASTE MANAGEMENT LICENCE

15.1 The PP shall apply for and obtain an Environmental Protection Licence in terms of the National Environmental (Protection and Quality) Regulations No. 1 of 2008 published in the Gazette Extra Ordinary No. 1533/16 of 25th January 2008, for the textile zone one month prior to the operations of the project activities.

15.2 The PP shall apply for and obtain a SWML as per the regulations stipulated under the Section 23 (A) of the National Environmental act No. 47 of 1980 published in the Gazette Extraordinary 1534/18 dated 1st August 2008 prior to commence the operations.

16 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

16.1 The PP shall forward to the CEA a detailed EMP incorporating the mitigatory measures proposed precisely and the monitoring plan. It should contain the significant impacts of the project, site specific mitigation measures to be implemented for each significant impact, schedule of implementation of mitigation measures, parameters to be monitored with intervals/frequencies and the responsible parties for implementation of the EMP.

16.2 Periodic compliance report shall be submitted by the PP on progress of the implementation of the EMP.

16.3 It is the responsibility of the PP to establish an in-house monitoring team with qualified persons to implement the Environmental Management Plan (EMP) and to monitor implementation of the EMP.

16.4 A monitoring committee consisting of representatives of CEA, NWSDB, MEPA, CC&CRMD, Department of Fisheries & Aquatic Resources, National Aquatic Resource Research & Development Agency (NARA), Palmyrah Development Board, RDA, FD, UDA, Eravurpattu Pradeshiya Sabha, and Divisional Secretary, Chankalady and any other relevant member will be appointed by the CEA.

16.5 All costs incurred by the monitoring committee appointed by the CEA to oversee implementation of the EMP shall be borne by the PP.

16.6 An Environment Health and Safety Management System (EHS-MS) shall be in place at the facility to ensure a proper management, process and operational data collection and record maintenance. EHS-MS must ensure that the highest level of management attention is given to EHS.

16.7 The PP shall comply with any other requirements communicated from time to time by the CEA.

The CEA reserves the right to cancel/suspend/withdraw this approval in the event that major environmental and/or social problems arise due to the operation of the project or in a situation where the surrounding environment has been altered or changed due to the natural factors or otherwise.

P B Hemantha Jayasinghe
Director General

CC:
Conservator General of Forest/ Forest Department
General Manager, National Water Supply & Drainage Board
General Manager, Marine Environment Protection Authority
Director General/ National Aquatic Resources Research & Development Agency
Director General/ Department of Fisheries & Aquatic Resources
Director General/ Department of Wildlife Conservation
Director General/ Urban Development Authority
Director General/ Road Development Authority
Director (CRM), Coast Conservation & Coastal Resource Management Department
Divisional Secretary, Divisional Secretariat, Chenkalady
Chairman, Pradeshiya Sabha, Eravurpattu
Deputy Director General (EPC)/CEA
Director (HW&CM/Lab Services/ Eastern Province)/ CEA

Annexure II
Extension to the CEA Approval

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மத்திய சுற்றாடல் அதிகாரசபை
Central Environmental Authority

"පරිසර පියස", 104, ඩෙන්සිල් කොබ්බෑකඩුව මාවත, බත්තරමුල්ල, ශ්‍රී ලංකාව
"பரிசர பியச" , 104, டென்சில் கொப்பேகடுவ மாவத்தை, பத்தரமுல்லை, இலங்கை.
"Parisara Piyasa", 104, Denzil Kobbekaduwa Mawatha, Battaramulla, Sri Lanka. Web : www.cea.lk

අපේ යොමුව / எமது தொடர்பு / Our Ref. 08/EIA/IND/07/2019 Vol. II

ඔබේ යොමුව / உமது தொடர்பு / Your Ref.

දිනය / திகதி / Date 4 April 2025

Chairman
Board of Investment of Sri Lanka
West Tower
World trade Center
Echelon Square
Colombo 01

PROPOSED TEXTILE ZONE AT PUNNAIKUDAH, ERAVUR, BATTICALOA

This has reference to the letter No. EC/18/GEN/220 (Eravur) dated 06.08.2024 sent by Director (Environment Management), Board of Investment of Sri Lanka (BOISL) requesting an extension to environmental approval letter issued by the CEA to BOISL on 07.09.2021 for the above project and to the joint monitoring site inspection held on 24.01.2025 in this regard.

This is to inform you that the environmental approval issued to Board of Investment of Sri Lanka No. 08/EIA/IND/07/2019 dated 07.09.2021 is hereby extended subject to following conditions;

I. The validity of the environmental approval is extended until 06th September 2027.

II. The following conditions of the Sections 3 & 15 of the aforesaid environmental approval letter dated 07.09.2021 are replaced with the following new conditions.

SECTION 3

WASTEWATER TREATMENT AND DISPOSAL OF TREATED WASTEWATER

3.9. The treated wastewater from the CWWTP shall conform to the "Tolerance limits for the discharge of wastewater or effluent into Marine Waters through a short sea outfall" as stipulated in the Gazette Extraordinary No. 2264/17 dated 27th January 2022.

SECTION 15

ENVIRONMENTAL PROTECTION LICENSE & SCHEDULED WASTE MANAGEMENT LICENSE

15.1. The PP shall apply for and obtain an Environmental Protection License from the CEA in terms of the National Environmental (Protection and Quality) Regulations published in the Gazette Extra Ordinary No. 2264/18 of 27th January 2022 for the project one month prior to the operations of the project activities.

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III. An updated Environmental Management Plan (EMP) covering ongoing & pending project activities/ actions related to construction & operation of the project shall be submitted to the CEA within three (03) months from the date of this letter. The BOISL shall ensure the compliance of EMP's requirement in implementing the individual industries within the Zone.

IV. Compliance reports on progress of the implementation of the EMP shall be submitted to this authority within every six (06) months.

V. Any alterations that are intended to be made to the original project shall obtain a fresh approval from the CEA.

VI. The implementation of actions/ activities related to ongoing Supplemental EIA Proposed Alteration in the Arrangement for Managing Wastewater in the Textile Zone, Eravur, Batticaloa shall not be carried out until obtain an approval.

VII. All the other terms and conditions given in environmental approval No. 08/EIA/IND/07/2019 dated 07.09.2021 are remain unchanged.

Padmasiri Moonamale
Director General
CC:

1. Conservator General of Forest/ Forest Department
2. General Manager/National Water Supply and Drainage Board
3. General Manager/ Marine Environment Protection Authority
4. Director General/ National Aquatic Resources Research & Development Agency
5. Director General/ Department of Fisheries & Aquatic Resources
6. Director General/ Department of Wildlife Conservation
7. Director General/Urban Development Authority
8. Director General/ Road Development Authority
9. Director (CRM)/ Coast Conservation & Coastal Resource Management Department
10. Divisional Secretary/ Divisional Secretariat/Chenkalady
11. Secretary/Pradeshiya Sabha/Eravurpattu
12. Director (EPC)/ CEA
13. Director (HW&CM)/ CEA
14. Director (Eastern Province)/ CEA- *to include the relevant conditions of the environmental approval in issuing the EPL and for monitoring the project as appropriate*

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Annexure III
Terms of Referance

TERMS OF REFERENCE

TERMS OF REFERENCE (TOR) FOR THE SUPPLEMENTAL ENVIRONMENTAL IMPACT ASSESSMENT (SEIA) OF THE PROPOSED ALTERATION IN THE ARRANGEMENT FOR MANAGING WASTEWATER IN THE TEXTILE ZONE IN ERAVUR, BATTICALOA

Project Title	:	**Supplemental Environmental Impact Assessment (SEIA) for the Proposed Alteration in the Arrangement for Managing Wastewater in the Textile Zone in Eravur, Batticaloa**
Project Proponent	:	Board of Investment of Sri Lanka (BOISL)
Project Approving Agency	:	Central Environmental Authority
Date of issue	:	15.06.2023

Outline of the SEIA Report:

Executive Summary

Chapters

1. Introduction
2. Description of the individual industries to be established & wastewater management system, alteration to the originally approved Common Wastewater Treatment system
3. Existing environment of the area identified for individual industries within the main plan of the project site
4. Environmental Impacts due to operation of individual industries and proposed changes made to the originally approved common wastewater treatment system
5. Proposed Mitigation Measures
6. Emergency preparedness and response Plan
7. Environmental Monitoring Programme
8. Conclusion and Recommendations

Annexures

1. Terms of Reference
2. References
3. Sources of data & information
4. List of preparers including their work allocation (the report should be authenticated by the preparers)
5. Complete set of relevant maps, tables, charts, layout plans and other details
6. Complete modeling study reports

1. INTRODUCTION

- Background
- Objective and justification of the proposed alteration
- Preliminary approvals/permits needed and any conditions laid down for the implementation of the proposed alteration by state agencies (e.g. consent of the Department of Coast Conservation & Coastal Resource Management & Marine Environmental Protection Authority for discharge of treated wastewater to the sea.
- Any government policies applicable in this regard

2. DESCRIPTION OF THE INDIVIDUAL INDUSTRIES TO BE ESTABLISHED & WASTEWATER MANAGEMENT SYSTEM, ALTERATION TO THE ORIGINALLY APPROVED COMMON WASTEWATER TREATMENT SYSTEM

- A revised layout plan indicating the proposed industries & types of industries which are altered/ omitted/ added from the originally proposed industry type related components together with remaining industries of the original proposal.
- Details of the individual industries to be established with type, industrial process along with process flow diagrams, production capacities by products, waste etc. of each product / product type, rejected raw material management strategy
- Types of dyes to be used and MSDS
- Detailed description of the adoption of cleaner production techniques (if any)
- Details of proposed wastewater stream (domestic and process) to be provided separately indicating types and quantities generated by each industrial and domestic activities.

- Volume of wastewater, pollution load and level of treatment by individual Effluent Treatment Plants (ETPs) covering toxicants and dyes which are needed additional/industry specific treatment process prior to connect to the common system. Details of Toxicants removal techniques & method of verification of such removal prior to discharge to the common wastewater treatment system.
- Details of the total wastewater quality and volume to be treated at the common wastewater treatment system proposed for the newly identified industries. The following details to be provided related to this system;
    - Treatment process description and flow diagrams (any additions to the process/ system should be clearly indicated)
    - Spillage management strategy and storm water separation
    - Capacity and dimensions of each unit
    - Total quantity of the domestic wastewater (to be proposed)
    - Total quantity of the process wastewater (to be proposed)
    - Quality of the wastewater to be treated
    - Quality & quantity of treated wastewater to be discharged
    - Retention time of wastewater within the treatment system and discharge mechanism
    - Monitoring mechanism of treated wastewater prior to discharge to the sea via short sea outfall
    - Details of any recovery/reuse options for treated effluent (if so, provide details)

- Disposal of treated wastewater
    - Details of the alterations made to the previously proposed wastewater disposal system, including;
    - Changes in quality & quantity of the treated effluent to be discharged into sea via short sea out fall and dispersion model should be calibrated based number of industries are to be connected and number of diffusers to be opened to meet velocity criterion along with number of industries to be in operational based on increase in effluent generation.
    - Any alteration for the previously proposed outfall/pathway/location (if any)
    - Any alteration in the components of the established wastewater disposal system (pipes, diffusers, other components etc.)
    - Rate of discharge of treated wastewater to the sea via short sea outfall

- Sludge management (sludge generated from industry specific pre treatment (dewatering, storage and ultimate disposal) and sludge generated from common wastewater treatment system)
    - Quantity and quality of sludge generation and method of handling/management of sludge generated.
- Any provisions for amalgamation / connectivity of the Proposed Common Wastewater Treatment System with already approved proposal.
- Anticipated water requirement & source for the proposed alteration and for future developments of the zone. The details on estimated water balance taking into account conservation measures, reuse and recycling of treated effluents should be given.
- Details on estimated energy requirement and source including electricity and auxiliary energy source such as renewable energy if proposed alteration & for future developments. A consent from the relevant authority in this regard is required.
- Establishment of drainage management system of the zone along with new drainage plan and other infrastructure while ensuring conservation of surface water bodies within the site (e.g. "thona" etc.)
- Phase implemental schedule
- Duration of operation of the new proposal unit establishment of approved proposal.
- Arrangement or proposal for accommodating of additional industries which can be proposed by different time intervals.
- Details on operational and maintenance activities and procedures within the zone together with institutional arrangement/responsibility for such activities. **Role and responsibilities of the BOISL for such arrangement need to be indicated clearly.**

3. **EXISTING ENVIRONMENT OF THE AREA IDENTIFIED FOR INDIVIDUAL INDUSTRIES WITHIN THE MAIN PLAN OF THE PROJECT SITE**

- Details on the hydrological / hydraulic conditions of the receiving water body.
    - Baseline surface water quality of "thona" /drains / canals / sea considering present context (please note that the locations shall be selected considering the distribution pattern of the effluent plume based on the findings as described in item 4 a indicated below supported by GPS co-ordinates)

The water quality parameters to be covered shall include Total Suspended Solids, pH, BOD, COD, Temperature, Oil and grease, heavy metals (Lead, Chromium, Cadmium), Colour and other applicable parameters.

- Any alterations for existing storm water drainage pattern/ pathways / "thona" to facilitate wastewater disposal/ discharge.
- Details of maximum observed floods in the area including water spread areas.
- Details of the existing fishing activities of the area.

4. ENVIRONMENTAL IMPACTS DUE TO OPERATION OF INDIVIDUAL INDUSTRIES AND PROPOSED CHANGES MADE TO THE ORIGINALLY APPROVED COMMON WASTEWATER TREATMENT SYSTEM

Special attention should be given to,

- Quantity and quality of treated effluent to be discharged to the sea via short sea outfall and anticipated impacts due to discharges on quality of receiving waters.

  (Note : If alterations have been proposed to the previously proposed wastewater disposal system by a sea outfall, impacts on the marine environment needs to be based on the result of a dispersion modeling study carried out for the newly proposed disposal system).

- Impacts of handling and disposal of all types of sludge.
- Impacts on surrounding neighborhoods due to odour and gaseous emissions.
- Possible environmental risk due to storage of raw materials/chemicals/oil/ by products, accidental spillage, industrial discharges, leakages, surface run off of raw materials/ chemicals/oil/by products, breakdown of emission control systems, waste water treatment systems etc.
- Impacts on fishing activity due to wastewater discharge to the sea
- Impacts on beach and beach activities in the area
- Impacts on drainage / drainage pattern
- Any other impacts

5. PROPOSED MITIGATION MEASURES

This section should provide proposed measures to minimize the impacts identified in above item no. 4 to acceptable levels. The focus here should be more on circular economy concepts with Life Cycle Assessment considering adoption of cleaner technology/waste minimization practices rather than end of pipe treatment.

6. EMERGENCY PREPAREDNESS AND RESPONSE PLAN

- **Identified emergency situations;**

This plan should be evolved covering discharge of untreated wastewater from the individual industries and common wastewater treatment system, accidental spills, accidental ruptures of pipelines, fire hazards and explosions, breakdown of treatment plants / disposal system(s) etc., operation of the wastewater treatment system during the pandemic period, labour unrest and natural disasters such as floods, cyclone / tornadoes, tsunami, lightning, earth quakes etc. – establishment of emergency holding tanks with adequate retention times.

7. ENVIRONMENTAL MONITORING PROGRAMME

- A monitoring programme should be submitted to monitor the implementation of mitigatory measures and the status of environment.
- An internal monitoring mechanism should be developed and presented.
- List the parameters to be monitored, frequency of monitoring, sampling locations, responsible agencies and reporting procedure.
- Availability of expertise technically competent staff engaged, facilities and equipment proposed should be indicated.

8. CONCLUSION AND RECOMMENDATIONS

The environmental acceptability of the proposed alteration to the project, key findings and recommendations of the assessment should be given.

ANNEXURE IV

Permit for a development activity issued by coast conservation and coastal resource management department

PERMIT FOR A DEVELOPMENT ACTIVITY ISSUED UNDER PART III - SECTION 14 OF THE COAST CONSERVATION & COASTAL RESOURCE MANAGEMENT ACT No. 57 OF 1981

Permit No. : P/22/160

Name of Permit Holder : Executive Director (EA&SP) , Board of Investment of Sri Lanka.
(*Surname*) (*Other Names*)

Postal Address : BOI, Level 19, World Trade Center - West Tower, Echelon Square, Colombo- 01.

Nature of Development Activity : Construction of a beach chamber box, 410 m Short Sea out fall, laying of the pipeline and related facilities to dispose treated waste water of BOI Textile Manufacturing Zone, Punnaikuda , Eravurpattu to the sea

Location of Development Activity : Punnaikuda, Eravurpattu, Baticaloa

Province : Eastern

District : Batticaloa

Local Authority : Chenkalady

Particulars of Survey Plan submitted by Applicant :

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Duration of Permit : 29.11.2022 to 28.11.2023

Conditions Attached : (1) All activities related to the sea outfall, laying of outfall pipes and beach chamber should be confined to the preliminary layout plan dated 17.03.2021 submitted by the developer to the Coast Conservation & Coastal Resource Management Department

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Director General
Coast Conservation &
Coastal Resource Management.

Date : 30 . 11 . 2022

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2) All mitigation measures & recommendations as indicated in the EIA report and the conditions the approval No.08/EIA/IND/07/2019 dated 07.09.2021 issued by the Central Environment Authority should be implemented during the construction and operation period of the proposed project.

3) All activities of the proposed project should be carried out in accordance with the recommendations of the EIA report- February 2021 and the Addendum to the EIA dated June 2021 and conceptual design and numerical model study report-January 2021 by Lanka Hydraulic Institute Ltd. submitted by the developer to the Coast Conservation & Coastal Resource Management Department.

4) Length and depth of the proposed short sea outfall shall ensure to satisfy the proposed tolerance limits for discharge of waste water into marine waters through short sea outfall standards with respect to near-field and far-field dispersion as indicated in the numerical model study report-January 2021 by the Lanka Hydraulic Institute Ltd.

5) The outer pipeline of the sea outfall shall be buried in order to avoid potential interception of the prevailing natural sediment movement process and to with stand extreme sea conditions to avoid instability of the outfall structure while designing the multi port diffuser to prevent clogging and to reduce consequences of bio fouling as indicated in the EIA report and addendum to the EIA report.

6) Developer should inform to the Coast Conservation & Coastal Resource Management Department to monitor the construction activities of the project prior to commencement of the proposed construction.

7) All proposed constructions activities of the project should be carried out under the supervision of Area Engineer – Baticaloa of this CC&CRMD.

8) Any alterations / extensions of the structures should not be carried out without a prior approval of the Coast Conservation and Coastal Resource Management Department.

9) Necessary clearances and approvals from the Pradeshiya Sabawa– Chenkalady, Divisional Secretariat–Chenkalady, Central Environmental Authority, Marine Environmental Protection Authority, Department of Fisheries & Aquatic Resources, Urban Development Authority, Land Commissioner General's Department and other relevant Government Agencies should be obtained prior to commencement of the proposed constructions.

10) Environmental Protection License (EPL) should be obtained from the Central Environmental Authority prior to commencement of operation of the proposed project.

11) Sewage or untreated wastewater should not be emitted into the beach and the coastal and marine waters, water ways (thona) in the area or any storm water drainage system in the area.

12) The natural drainage pattern of the area should not be obstructed by any activity of the proposed project.

Permit No. : P/22160

23) Eravur Textile Manufacturing Zone Management of the BOI shall monitor and ensure that the individual industries are pre treated their waste water to comply with the "Tolerance limits of industrial waste waters to meet BOI SL pre treatment standards prior to discharge into the Common wastewater treatment plant as indicated EIA Report

24) Eravur Textile Manufacturing Zone Management of the BOI shall ensure the proper functioning & maintenance of the sea outfall and alternative mechanism shall be identified for any damages occur during the operation of sea outfall.

25) The Coast Conservation and Coastal Resource Management Department / Central Environmental Authority reserve the right to change the standards of the treated waste water to be discharged into the sea through a sea out fall at any time, if the receiving environment has been altered or changed due to natural factors or continued irrigation using treated waste water.

26) Sludge generated from the waste water treatment plant should be disposed as indicated in the EIA Report.

27) All precautionary measures should be taken to protect structural stability as indicated in the EIA Report, The structural stability of the proposed structures should be monitored regularly in particularly after storm periods of high wave action and submit reports to the Coast Conservation & Coastal Resource Management Department.

28) Risk of potential damages to the proposed structures due to natural disasters should be borne by the developer.

29) The existing fishing activities and beach access should not be obstructed by any means of the proposed project and necessary approval should be obtained from relevant agencies / owners for laying pipelines of the sea outfall

30) The developer should coordinate with the Department of Fisheries and Aquatic Resources Development on fishing activities in the area in order to avoid user conflicts during construction and operation period of the proposed project.

31) Fishing community of the area should be aware on proposed project activities prior to commencement of the proposed project activities with coordination of Department of Fisheries and Aquatic Resources Development.

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Permit No. : P/22/160

13) Developer should obtain necessary approval from the CC&CRMD for any modification/improvements to the existing waterways (thona), drainage system within the coastal area

14) All precautionary measures should be taken to prevent soil erosion, siltation / sedimentation due to proposed project activities.

15) Proposed dredging activities for the purpose of laying of pipelines should be within the dredging limits as indicated in the design submitted by the developer to this department.

16) All dredged material, excavated soil, sand should be disposed only for the approved dumping sites and dredging material should not be used for commercial and any other purpose.

17) The wastewater generated from the operations of the BOI Eravur Textile Manufacturing Zone should be treated to comply the standards as indicated EIA approval.

18) Treated waste water from the Common Wastewater Treatment plant of the Eravur Textile Manufacturing Zone should be discharged into the sea through the sea outfall as indicated in the EIA approval and should not be discharged into the any storm water drainage system, waterways (thona) in the area.

19) Project Proponent shall establish sampling points to monitor periodic variation of the each components of the proposed project such as outlet of the sewerage treatment plant, final point of discharge in to sea out fall etc.

20) **Water quality of the sea (Inseline)** should be tested and established covering the seasonal variations at the area of the sea outfall for the following parameters prior to disposal the wastewater into the sea through the sea outfall and analytical reports of the same should be submitted to the Coast Conservation & Coastal Resource Management Department, Central Environmental Authority, and Marine Environmental Protection Authority.
(Total suspended solids, Total dissolved Solids, BOD, COD, Oils and greases, Ammonical Nitrogen (as N), Organo Phosphorus Compounds, Fecal Coliform etc.)

21) Project proponent should carry out periodic study of the coastal water quality of the proposed project area and the analytical reports should be submitted to the CC&CRMD, Central Environmental Authority, and Marine Environmental Protection Authority once in three months.

22) Project Proponent should monitor quality of the treated waste water of the Central Sewage treatment plant of Eravur Textile Manufacturing Zone regularly and analytical monthly reports of the same should be submitted to the Coast Conservation & Coastal Resource Management Department, Central Environmental Authority, and Marine Environmental Protection Authority.

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Permit No.....

32) The fauna and flora in the Coastal & Marine Environment should not be affected due to proposed project activities. All mitigation measures should be taken to mitigate the impacts on coastal and marine resources and associated ecosystem in the area including coral reef, sand stone reef and coastal vegetation during construction and operation period of the proposed project as indicates in the EIA Report.

33) Common Waste water treatment plant and proposed structures of the sea outfall should be managed and monitored with the assistant of relevant agencies to mitigate possible environmental impacts due to proposed project.

34) All precautionary measures should be taken to mitigate anticipated impacts on noise, vibration, during the construction and operation period.

35) All mitigation measures proposed in the EIA Report should be implemented to mitigate all possible Environmental and Socio Economic impacts which could arise during the construction and operation periods of the proposed project.

36) Project Proponent should conduct the awareness programmes to create the awareness on proposed project for all the stakeholders including fishing community, public, private entities, NGO, CBO and general public in the area.

37) Mitigation measures suggested in the EIA report, model study report and any other mitigation measures included in this approval should be elaborated in the Environment Management plan in order to facilitate monitoring of the implementation of the EMP. Routine biological monitoring regarding marine habitats in the study area before, during and after implementation of proposed project activities shall be carried out.

38) Adequate amount of funds should be allocated to make necessary arrangements to pay compensation for affected parties or property due to any emergency situation directly due to proposed project as indicated in the EIA Report.

39) In addition to the above monitoring programme, the Project Proponent should carry out self-monitoring programme of all the project activities and submit reports to the CEA, CC&CRMD & MEPA.

40) Project proponent should implement contingency plan as indicated in the EIA report for all potential emergency events such as accidental rupture of pipelines, breakdown of treatment plants/disposal systems, fire hazards, power failures, natural disasters etc. and ensure that all relevant parties are trained and made aware of the plan and their responsibilities in executing the plan.

41) It is the duty of the Project Proponent (PP) to promptly inform CC&CRMD, CEA, if any unforeseen environmental hazard/ impact arose during the construction and operation period. In such an event, relevant guidelines and mitigation measures should be implemented as directed by CEA , CC&CRMD and other relevant government agencies.

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Permit No. : P/ee/160

42) The Project Proponent is bound to strictly adhere to any additional conditions that could be imposed by the CC&CRMD.

43) A copy of this permit should be kept in the project site at all times for the purpose of perusal by concerned parties/agencies.

44) If the developer is unable to complete the approved construction within the period of the permit, developer should apply for renewal the permit one month before expiring the permit.

45) This permit will be invalid if there is a violation of any of the conditions given in this permit. In such a case, this department will consider relevant structures as unauthorized and will take legal action according to the Coast Conservation and Coastal Resource Management Act No.57 of 1981.

46) This permit will not be considered the ownership of the land.

Eng.R.A.S.Ranawaka
Director General / Coast Conservation & Coastal Resource Management

Copies

1. Chairman, Pradeshiya Sabha, Eravurpattu
2. Divisional Secretary, Divisional Secretariat, Chenkalady.
3. Director General, Fisheries & Aquatic Resources Development, Colombo 10
4. General Manager, Marine Environment Protection Authority, Colombo 05.
5. Deputy Director General (EPC), Central Environmental Authority, Battaramulla.
6. Director (EIA), Central Environmental Authority, Battaramulla.
7. Director, Urban Development Authority, District Office, Baticaloa
8. Area Engineer, Coast Conservation & Coastal Resource Management Department, Baticaloa

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ANNEXURE V

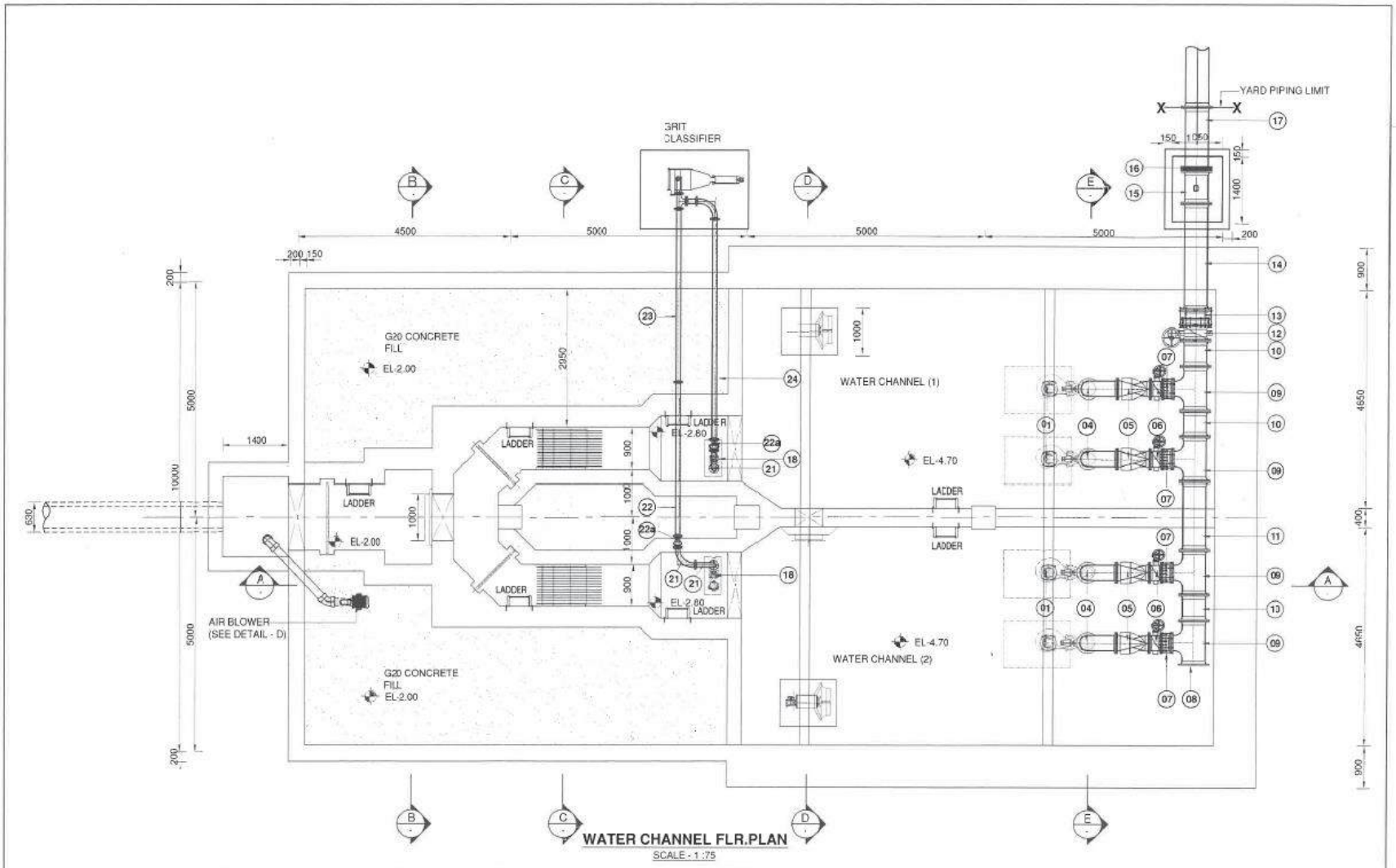
ZDHC listed materials

Chemicals	Remarks
Alkylphenol (AP) and Alkylphenol Ethoxylates (APEOs): including all isomers	APEOs can be used as or found in: detergents, scouring agents, spinning oils, wetting agents, softeners, emulsifier/dispersing agents for dyes and prints, impregnating agents, de-gumming for silk production, dyes and pigment preparations, polyester padding and down/feather fillings
Anti-microbials and biocides	These substances have biocidal properties, making it useful for Multiple preservation applications. E.g., triclosan (CAS No. 3380-34-5) and o-Phenylphenol (+salts) (CAS No. 90-43-7)
Chlorinated paraffins	These are used occasionally as flame retardants in certain industries. In leather formulations, these are also used as fat liquoring agents.
Chlorophenols	Used as preservatives or pesticides. Pentachlorophenol (PCP) and tetrachlorophenol (TeCP) have been used in the past to prevent mould when storing/ transporting raw hides and leather; e.g., Pentachlorophenol (CAS No. 87-86-5) and its salts and esters (PCP)
Azo dyes	Azo dyes and pigments are colourants that incorporate one or several azo groups (-N=N-) bound with aromatic compounds. Thousands of azo dyes exist, but only those that degrade to form the listed cleavable amines are restricted. Azo dyes that release these amines are regulated and should no longer be used for the dyeing of textiles. examples are 4-chloroaniline (CAS No. 106-47-8), 2,4,5- trimethylaniline (CAS No. 137-17-7) and Benzidine (CAS No. 92-87-5)
Carcinogenic dyes	Example, C.I. Basic Violet 14 (CAS No. 632-99-5), C.I. Direct Black 38 (CAS No. 1937-37-7), C.I. Direct Blue 6 (CAS No. 2602-46-2), C.I. Acid Red 26 (CAS No. 3761-53-3), C.I. Direct Red 28 (CAS No. 573-58-0), C.I. Basic Red 9 (CAS No. 569-61-9), C.I. Disperse Blue 1 (CAS No. 2475-45-8), C.I. Basic Blue 26 (with Michler's Ketone > 0.1%)(CAS No. 2580-56-5), C.I. Disperse Blue 3 (CAS No. 2475-46-9), C.I. Basic Green 4 (Malachite Green Oxalate) (CAS No. 2437-29-8), C.I. Basic Green 4 (Malachite Green Chloride)(CAS No. 569-64-2), Disperse Orange 11 (CAS No. 82-28-0), C.I. Basic Green 4 (Malachite Green) (CAS No. 10309-95-2), C.I. Acid Violet 49 (CAS No. 1694-09-3) and Basic violet 3 with >0.1% of Michler´s Ketone (CAS No. 548-62-9)
Dyes – disperse (sensitizing)	Disperse dyes are a class of water- insoluble dyes that penetrate the fibre system of synthetic or manufactured fibres and are held in place by physical forces without forming chemical bonds. Disperse dyes are used in synthetic fibre (e.g. polyester, acetate, polyamide). Restricted disperse dyes are suspected of causing allergic reactions. Examples are Disperse Yellow 39 (CAS No 12236-29-2) and Disperse Blue 102 (CAS No 12222-97-8)

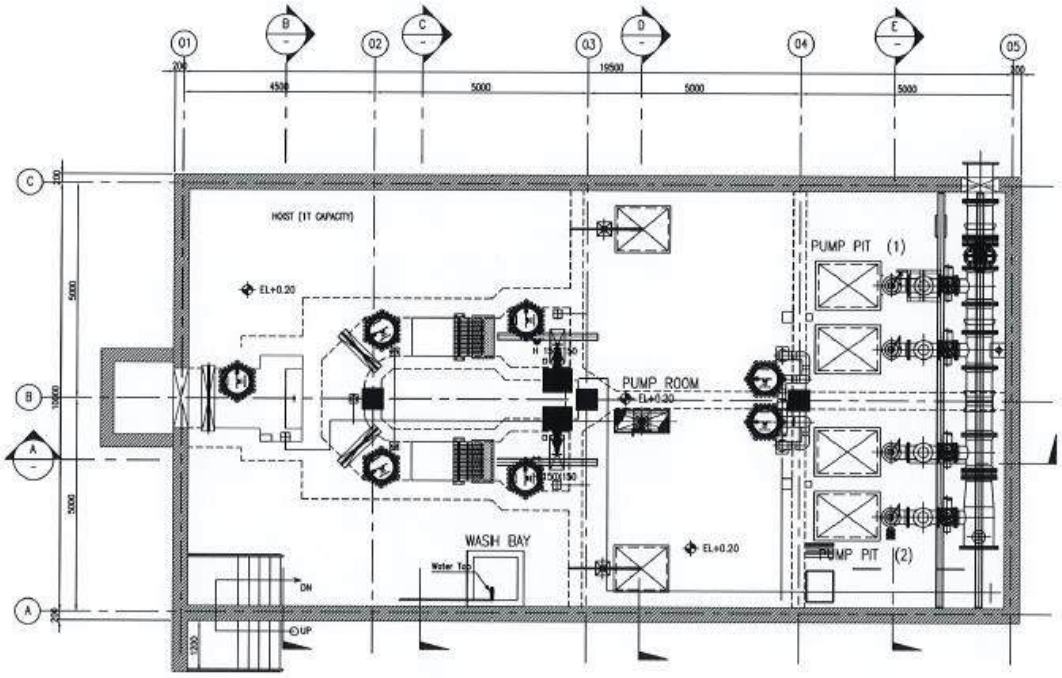
Navy blue colourant dyes	Examples are Component 1: C39 H23Cl-CrN7O12S2Na (CAS No. 118685-33- 9) and Component 2: C46 H-30CrN10O20S23Na (CAS No. Not allocated)
Flame retardants	Flame retardant chemicals are rarely used to meet flammability requirements in children's clothing and adult products. Examples are Tris (2-chloroethyl) phosphate (TCEP) (CAS No 115-96-8), Diboron trioxide (CAS No. 1303-86-2), Disodium octaborate (CAS No. 12008-41-2), Tetrabromobisphenol A (TBBPA) (CAS No. 79-94-7) and Boric acid (CAS No. 10043-35-3/ 11113-50-1)
Glycols/glycol ethers	These have a wide range of uses including as solvents for finishing/ cleaning, printing agents, and dissolving/ diluting fats, oils, and adhesives (e.g. in degreasing or cleaning operations).Examples are Ethylene glycol dimethylether (CAS No. 110-71-4), 2-ethoxyethanol (CAS No. 110-80-5), 2-methoxyethanol (CAS No. 109-86-4), 2-methoxypropylacetate (CAS No. 70657-70-4) and Triethylene glycol dimethyl ether (CAS No. 112-492)
Halogentated solvents	In apparel and footwear, halogenated solvents are used as finishing/ cleaning and printing agents, for dissolving/diluting fats, oils and adhesives (e.g. in degreasing or cleaning operations). They will also include volatile organic compounds (VOCs); example, Methylene chloride (CAS No. 75-09-2), Trichloroethylene (CAS No. 79-01-6), Tetrachloroethylene (CAS No 127-18-4), Benzylchloride (CAS No. 100-44-7) and 1,2-dichloroethane (CAS No. 107-06-2)
Organotin compounds	Organotins are a class of chemicals combining tin and organics such as butyl and phenyl groups. Organotins are pedominantly found in the environment as antifoulants in marine paints, but they can also be used as biocides (e.g. antibacterials), catalysts in plastic and glue production and heat stabilisers in plastics/rubber. In textiles and apparel, organotins are associated with plastics/rubber, inks, paints, metallic glitter, polyurethane products and heat transfer material. examples are Dibutyltin (DBT), Mono-, di- and trimethyltin derivatives and Tripropyltin Compounds(TPT)
Perfluorinated and Polyfluorinated Chemicals (PFCs)	PFOA and PFOS may be present as unintended by-products in long-chain commercial water, oil and stain repellent agents. PFOA also may be in used in the production for polymers like polytetrafluoroethylene(PTFE)

Phthalates (including all other esters of ortho-phthalic acid)	Esters of ortho-phthalic acid (phthalates) are a class of organic compounds commonly added to plastics to increase flexibility. They sometimes are used to facilitate moulding of plastic by decreasing its melting temperature.Phthalates can be found in: Flexible plastic components (e.g. PVC) Print pastes Adhesives Plastic buttons Plastic sleevings Polymeric coatings
Polycyclic Aromatic Hydrocarbons (PAHs)	Oil containing PAHs are added to rubber and plastics as a softener or extender and may be found in rubber, plastics, lacquers, and coatings. Within the footwear producing industry, PAHs are often found in the outsoles of footwear and in printing pastes for screen prints. PAHs can be present as impurities in carbon black dyestuffs
Toxic heavy metals	Although typically associated with leather tanning, chromium VI also may be used in the dyeing of wool (after the chroming process). Examples are Hg, Pb, Cr, Ba, Cu, Co, Ni, Se, Sn and Ag
UV absorbers	These are frequently used in formulations to be stable to the influences of light and UV. Examples are 2- (2Hbenzotriazol-2-yl)-4- (tert-butyl) -6-(sec-butyl) phenol (UV-350) (CAS No. 36437-37-3), 2-benzotriazol-2-yl-4,6-di-tertbutylphenol (UV-320) (CAS No. 3846-71-7), 2,4-Di-tert-butyl-6-(5-chlorobenzotriazole-2-yl) phenol(UV-327) (CAS No 3864-99-1) and 2-(2Hbenzotriazol-2-yl) -4,6-itertpentylphenol (UV-328) (CAS No. 25973-55-1)
VOCs	They are associated with solvent-based processes like solvent-based polyurethane coatings and glues/ adhesives. Examples are Benzene (CAS No. 71-43-2), Xylene (CAS No. 1330-20-7), o-cresol (CAS No. 95-48-7), p-cresol (CAS No. 106-44-5) and m-cresol (CAS No 108-39-4)
Borate, Zn salt	CAS No. 12767-90-7. used as a flame retardant but also in paints, pigments, and adhesives
AEEA [2- (2-aminoethylamino) ethanol]	CAS No. 111-41-1. used a.o. in chelating agents, surfactants and fabric softeners
Quinoline	CAS No. 91-22-5. Contaminant of dispersing agents in disperse dyes
Bisphenol A	CAS No. 80-05-7. A precursor chemical used along with other chemicals to create some plastics and resins. It is commonly used to harden plastics.
Thiourea	CAS No. 62-56-6. Used in many formulations to increase the solubility

Annex VI
Waste Water Collection and Pumping System



CLIENT : BOI	CONSULTANTS :	ජාතික ජලසම්පාදන හා ජලාපවහන මණ්ඩලය தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை NATIONAL WATER SUPPLY AND DRAINAGE BOARD	CONSTRUCTION OF WASTEWATER COLLECTION AND PUMPING SYSTEM FOR PROPOSED TEXTILE MANUFACTURING ZONE AT ERAVUR , BATTICALOA MAIN PUMPING STATION PUMPING LINE INSTALLATION ARRANGEMENT SHEET - 01	REV.	DESCRIPTION	DATE	SIGN.	DRAWN / D.O.A.	BOI/WWCS/ER/MPS/ME/01 Drg.No.
								ENGINEER / C.E.	15 - 11 - 2023 DATE
								A.G.M. / D.G.M. / TEAM LEADER	

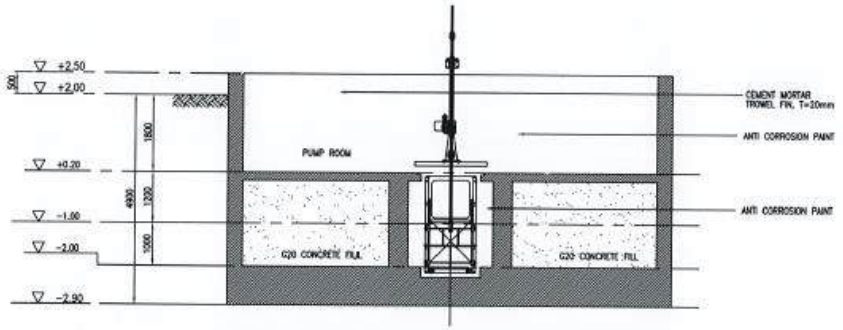


2 OPERATION FLOOR PLAN (ELEV. +0.20)

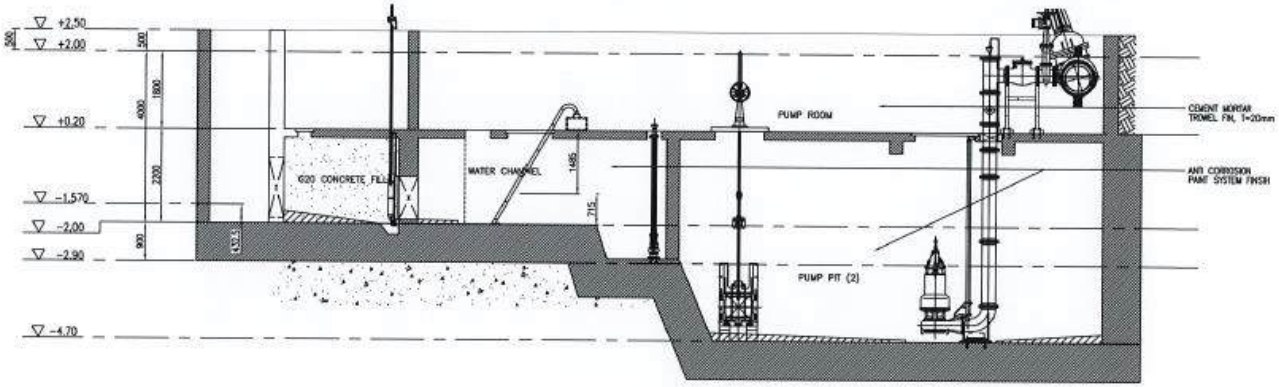
NOTE:-

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.

CLIENT :	CONSULTANTS :								
BOI		ජාතික ජලසම්පාදන හා ජලාපවහන මණ්ඩලය தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை NATIONAL WATER SUPPLY AND DRAINAGE BOARD	CONSTRUCTION OF WASTEWATER COLLECTION AND PUMPING SYSTEM FOR PROPOSED TEXTILE MANUFACTURING ZONE AT ERAVUR , BATTICALOA MAIN PUMPING STATION OPERATION FLR. PLAN	REV.	DESCRIPTION	DATE	SIGN.	G.B.A. DRAWN	D.O.A.	BOI/MPS/ER/03 Drg.No.
								ENGINEER	C.E.	17.07.2023 DATE
								A.G.M. / D.G.M. / TEAM LEADER		



F SECTION B
SCALE 1:100

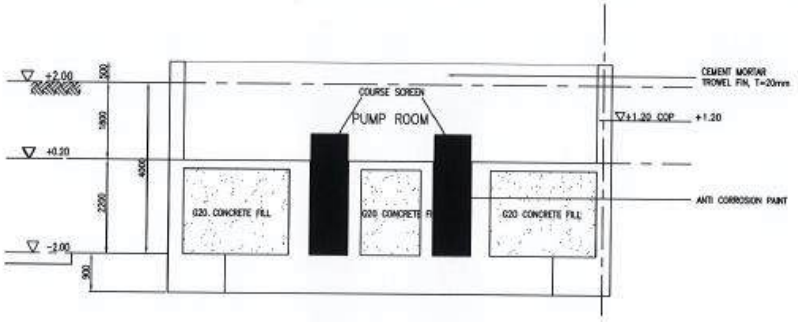


E SECTION A
SCALE 1:100

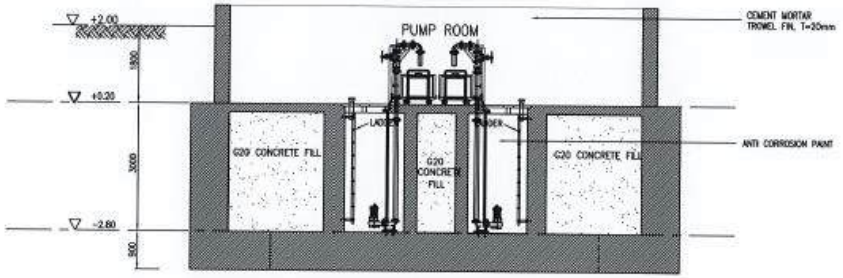
NOTE:-

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.

CLIENT : BOI	CONSULTANTS :	ජාතික ජලසම්පාදන හා ජලාපවහන මණ්ඩලය தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை NATIONAL WATER SUPPLY AND DRAINAGE BOARD	CONSTRUCTION OF WASTEWATER COLLECTION AND PUMPING SYSTEM FOR PROPOSED TEXTILE MANUFACTURING ZONE AT ERAVUR , BATTICALOA MAIN PUMPING STATION SECTION A , B	REV.	DESCRIPTION	DATE	SIGN.	G.B.A. DRAWN / D.O.A. / BOI/MPS/ER/04 Drg.No.
								ENGINEER / C.E. / 18.07.2023 DATE
								A.G.M. / D.G.M. / TEAM LEADER



SECTION C
SCALE 1:100

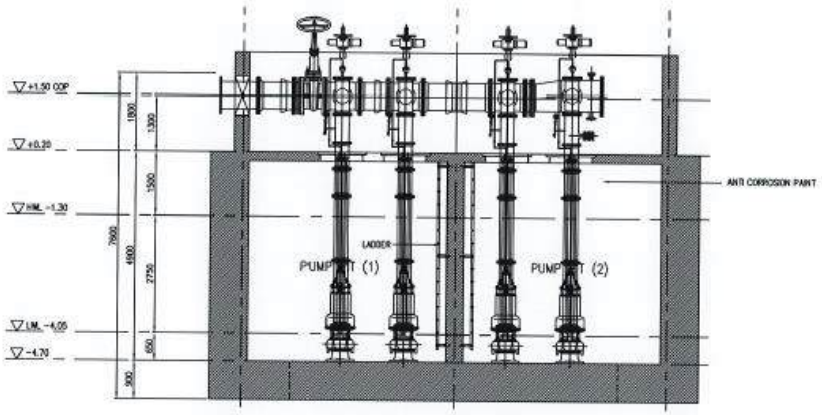


SECTION D
SCALE 1:100

NOTE:-

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.

CLIENT :	CONSULTANTS :								
		ජාතික ජලසම්පාදන හා ජලාපවහන මණ්ඩලය தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை NATIONAL WATER SUPPLY AND DRAINAGE BOARD	CONSTRUCTION OF WASTEWATER COLLECTION AND PUMPING SYSTEM FOR PROPOSED TEXTILE MANUFACTURING ZONE AT ERAVUR , BATTICALOA MAIN PUMPING STATION SECTION C , D	REV.	DESCRIPTION	DATE	SIGN.	G.B.A. DRAWN	D.O.A	BOI/MPS/ER/05 Drg.No,
								ENGINEER	C.E.	18.07.2023 DATE
								A.G.M. / D.G.M. / TEAM LEADER		



SECTION E
SCALE 1:100

NOTE:-

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.

CLIENT: BOI	CONSULTANTS:	ජාතික ජලසම්පාදන හා ජලාපවහන මණ්ඩලය தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை NATIONAL WATER SUPPLY AND DRAINAGE BOARD	CONSTRUCTION OF WASTEWATER COLLECTION AND PUMPING SYSTEM FOR PROPOSED TEXTILE MANUFACTURING ZONE AT ERAVUR , BATTICALOA MAIN PUMPING STATION SECTION E	REV.	DESCRIPTION	DATE	SIGN.	G.B.A. DRAWN	D.O.A.	BOI/MPS/ER/06 Drg.No.
								ENGINEER	C.E.	19.07.2023 DATE
								A.G.M. / D.G.M. / TEAM LEADER		

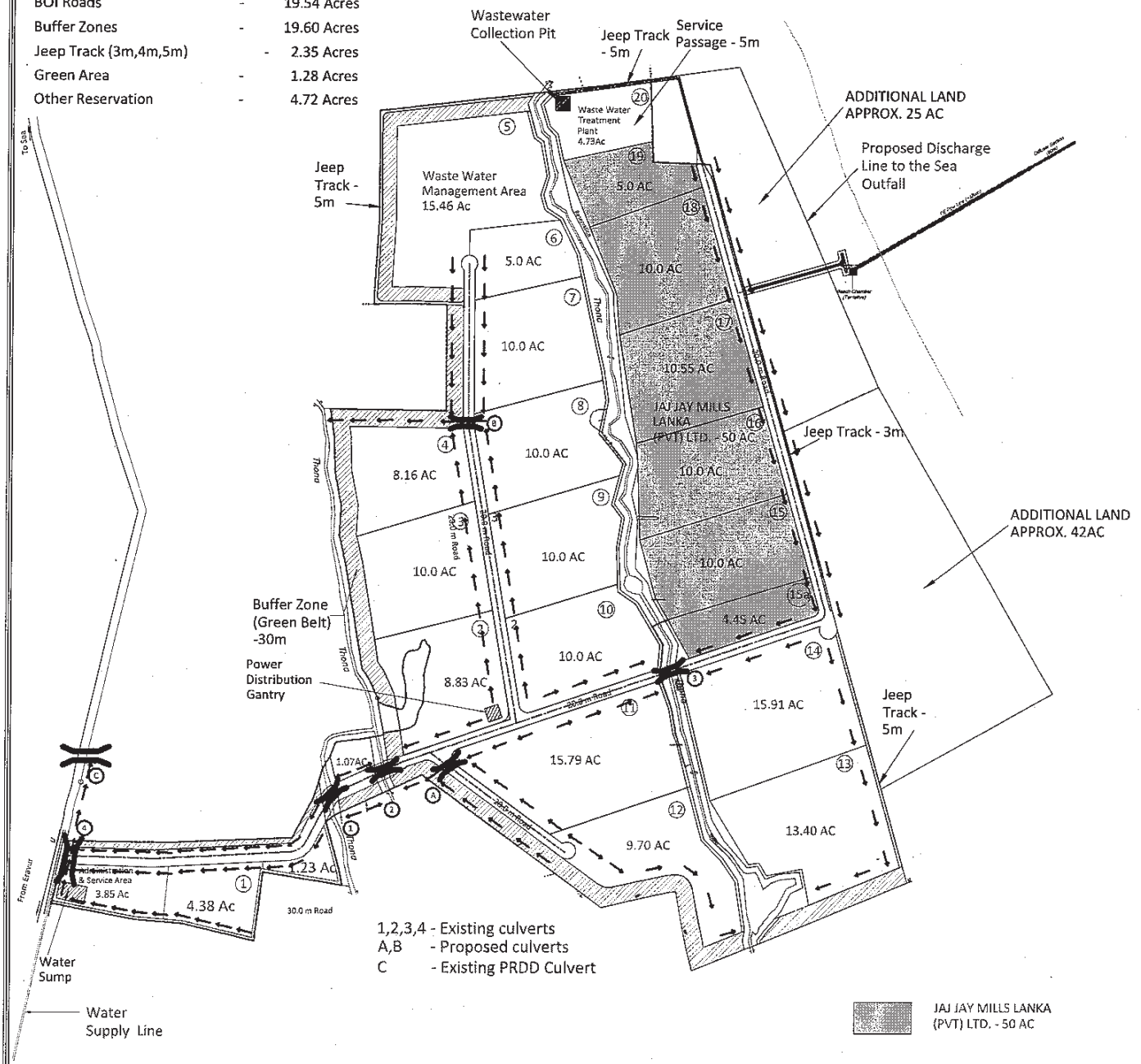
Annexure VII
Drainage Management Plan

PRELIMINARY LAYOUT PLAN FOR

PROPOSED TEXTILE MANUFACTURING ZONE- PUNNAIKUDAH,ERAVUR PATTU,BATTICALOA

TOTAL LAND AREA -103.31Ha / 255.28 Ac

Total industrial Area	-	181.17 Acres
Waste Water Management Area	-	15.46 Acres
Treated Wastewater collection area	-	4.73Acres
Service Area	-	6.15 Acres
BOI Roads	-	19.54 Acres
Buffer Zones	-	19.60 Acres
Jeep Track (3m,4m,5m)	-	2.35 Acres
Green Area	-	1.28 Acres
Other Reservation	-	4.72 Acres



BOARD OF INVESTMENT OF SRI LANKA COLOMBO TECHNICAL SERVICES DEPARTMENT	TITLE : PROPOSED SRTORMWATER DRAINAGE LAYOUT TEXTILE MANUFACTURING ZONE - PUNNIKUDAH, ERAVUR PATTU,BATTICALOA	DESIGNED BY : R Suhanthan-(A/D-ETMZ) DRAWN BY : G.N.Madhuranga-(T/A-ETMZ) CHECKED BY : R.Suhanthan-(A/D-ETMZ) APPROVED BY :	REVISION :	DRG. NO. : DATE : 21.03.2025

Annexture VIII
water Quality Report

ආරක්ෂක අමාත්‍යාංශය
பாதுகாப்பு அமைச்சு
Ministry of Defence

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பணிப்பாளர் நாயகம்
Director General
011-2505149

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தேசிய கட்டிட ஆராய்ச்சி நிறுவனம்
NATIONAL BUILDING RESEARCH ORGANISATION

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தொலைநகல்
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011-2502611

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இணையத்தளம்
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99/1, Jawatta Road, Colombo 5

මගේ අංකය
எனது இல.
Our Ref.
ESD-INV-0385-2025

ඔබේ අංකය
உமது இல.
Your Ref.

දිනය
திகதி
Date
12th March 2026

REPORT ON
Water Quality
for
Proposed Textile Zone, Eravur, Batticaloa

(Baseline Stage - January 2026)

Report No : NBRO/ESSD/25/490 – WQ

Issued to:

Board of Investment of Sri Lanka
P. O. Box 1768, World Trade Center – West Tower
Echelon Square, Colombo 01

Issued by:

Environmental Studies and Services Division
Email: essd@nbro.gov.lk

ISO/IEC 17025
TL 064-02

THE TEST REPORT IS ISSUED SUBJECT TO CONDITIONS MENTIONED OVERLEAF.

This report contains 6 pages

The report is issued under the following Terms & Conditions;

These Terms and Conditions apply to all dealings, tests and analytical services offered from the Environmental Studies and Services Division (ESSD) of National Building Research Organisation (NBRO).

Confidentiality
NBRO maintains strict confidentiality of all customer information. Reports are provided only to the customer or to those designated by the customer.

Customer must agree not to use the report or data in any manner that may harm the reputation or the service of NBRO.

Test Methods
The ESSD of NBRO warrants that the tests are performed in accordance with national, and international standard methods. In the absence/non availability of standard methods, ESSD uses any other published test or follow a validated method developed by other reputed bodies. On request, ESSD may follow customer specified methods as appropriate.

Test Report
The laboratory will provide only the original of the report. Customized reports that differ from the laboratory's normal format may include additional charges.

Conformities to a standard specification may be mentioned as required by the standard specification on request by the customer.

Reproduction of Reports
No report may be reproduced, except in full entirely, without prior written approval from the Director General, NBRO.

Retention of Reports
Reports will be archived for a period of 03 years after results have been reported to the customer. The customer can query or requests additional copies of their reports within 01 year except in litigation from the date of first issue, and additional charges apply.

Queries on Report
Customer queries on reports will be entertained only up to a period of 01 year from the date of issue of the report.

Retention of Samples
Perishable samples will be destroyed immediately after testing.

Samples will be routinely retained for a period of 10 days after report is issued.

Return of Sample Containers and Test Items
Sample containers and/or test items will be returned to the customer only on a written request by the customer.

Loss or Damage
The NBRO will not be responsible for indirect loss/es of his documents, any belongings which might happen under unavoidable circumstances during the period of customer service.

Litigation
The customer shall be responsible for all costs associated with documents or testimony in the court of law for the purposes relating to the customer's sample/s. Such costs include but not limited to the hourly charges, transport for persons involved in responding to the court of law.

ISO/IEC 17025
TL 064-02

1.0 SAMPLE PARTICULARS

Customer: Board of Investment of Sri Lanka P. O. Box 1768, World Trade Center – West Tower Echelon Square, Colombo 01	**Test item:** Ground water, Surface water & Sea water
	Service requested: Parameters as per the customer's request dated 23/09/2025 **Project Name:** Proposed Textile Zone, Eravur, Batticaloa
Number of samples: 07	**Quantity of sample:** Each approximately, 2 L of water in a plastic bottle for chemical parameter analysis, 1 L of water in a glass bottle for oil & grease analysis and 300 ml of water in a glass bottle for microbiological analysis
Sample collected by: NBRO – ESSD Laboratory Mr. P D Liyanaarachchi – Scientist Mr. K D P Malshan – Technical Officer Mr. W A Weerasinghe – Field Assistant	**Witnessed by:** Board of Investment of Sri Lanka Mr. R Suhanthan – Assistant Director Ms. L D R Samarawickrama – Environmental Officer
Date of Sampling: 28/01/2026	**Time of Sampling:** 09.30 hrs to 14.30 hrs.
Date receipt to the laboratory: 29/01/2026	**Date of analysis:** 28/01/2026 to 25/02/2026

2.0 SAMPLE IDENTIFICATION

2.1 GROUNDWATER SAMPLE IDENTIFICATION

Customer's sample reference	Sample description	Laboratory reference
Tube well close to Punyaramaya temple 7.821559N 81.610300E	Appearance of water was clear and there was a mild saline smell. The depth of well was about 6 m and temple buildings could be seen in the vicinity. Water was used for gardening and washing purposes.	W1
Dug well close to concrete quarrying yard 7.807921N 81.613601E	Appearance of water was clear. The depth of well was about 1.5 m and concrete yard could be seen in the vicinity.	W2
Dug well close to the sea area 7.800901N 81.632852E	Appearance of water was turbid and there was a mild saline smell. The depth of well was about 2 m and concrete yard could be seen in the vicinity. Water was used for drinking and washing purposes.	W3

2.2 SURFACE WATER SAMPLE IDENTIFICATION

Customer's sample reference	Sample description	Laboratory reference
Seasonal canal close to the industrial zone 7.812483N 81.620590E	Appearance of water was slightly turbid. Leaves and floating plants could be seen on water surface. Water flowed at a low velocity. The depth of the canal was less than 1 m and width was about 6 m. Bank was vegetated.	W4

ISO IEC 17025
TL 054-02

2.3 SEA WATER SAMPLE IDENTIFICATION

Customer's sample reference	Sample description	Laboratory reference
Water was taken from 1 km upstream to the proposed outfall Punnaikudah - north 7.833593N 81.624505E	Appearance of water was clear and boat operation for fishing was carried out.	W5
Water was taken 1 km away from the shore 7.825088N 81.627481E	Appearance of water was clear and boat operation for fishing was carried out.	W6
Water was taken 1 km downstream from the proposed outfall towards Saikkadi 7.816734N 81.630784E	Appearance of water was clear and boat operation for fishing was carried out.	W7

Weather: Sunny weather prevailed during the sampling period

3.0 TEST PARAMETERS AND METHODS

Parameter	Test Method
pH	APHA- 4500-H^+ B
Temperature	APHA 2550 B
Turbidity	APHA-2130-B
Free residual chlorine	APHA-4500-Cl G
Free ammonia (as NH_3)	Photometric method
Nitrite (as NO_2^-)	Photometric method
Nitrate (as NO_3^-)	APHA-4500 NO_3^- B
Colour	Photometric method
Biochemical Oxygen Demand	APHA -5210 B
Chemical Oxygen Demand	APHA -5220 B & Laboratory Developed Validated Method Using $KMnO_4$ (for sea water)
Total Dissolved Solids	APHA -2540 C
Total Suspended Solids	APHA -2540 D
Total Alkalinity (as $CaCO_3$)	APHA 2320 B
Total Hardness (as $CaCO_3$)	APHA-2340 C
Total Phosphate (as P)	APHA-4500 P B&D
Oil and Grease	APHA- 5520 B
Sulfate (as SO_4^{2-})	APHA-4500-SO_4^{2-} E
Chloride (as Cl^-)	APHA 4500-Cl^- B
Fluoride (as F^-)	APHA 4500-F^- C
Iron (as Fe)	APHA-3500 Fe C
Arsenic (as As)	APHA 3120 B
Cadmium (as Cd)	
Total Chromium (as Cr)	
Chromium (as Cr(VI))	US-EPA-3060 A

ISO/IEC 17025
TL 064-02

3.0 TEST PARAMETERS AND METHODS CONTD...

Parameter	Test Method
Lead (as Pb)	APHA 3120 B, ICP-OES
Copper (as Cu)	
Selenium (as Se)	
Nickel (as Ni)	
Zinc (as Zn)	
Mercury (as Hg),	
Total Coliform Bacteria	SLS 1461 Part I Section 3:2013
E.Coli	

APHA - Standard Methods for the Examination of Water and Wastewater, APHA AWWA WEF, 24th Edition – 2023

US EPA 3060A – Test Method for Alkaline Digestion for Hexavalent Chromium, 1996

SLS 1461 Part I Section 3 - Microbiological test method for water, Part I Detection and enumeration of Escherichia coli and coliform bacteria, Section 3 Reference method

4.0 TEST RESULTS

4.1 GROUNDWATER TEST RESULTS

Parameter/Unit	Results			LOD	EU (k=2)
	W1	W2	W3		
*#pH	5.9	7.6	7.6	-	-
*#Temperature, ^{0}C	29.4	28.5	27.6	-	-
*#Turbidity, NTU	1.40	0.76	16.4	-	-
*#Free residual chlorine, mg/L	0.1	0.04	0.08	-	-
*#Free ammonia (as NH_3), mg/L	0.13	0.11	0.34	-	-
*#Nitrite (as NO_2^-), mg/L	0.08	ND	0.05	0.03	-
#Nitrate (as NO_3^-), mg/L	ND	ND	ND	0.03	-
#Colour, Pt-Co	89	126	30	-	-
Chemical Oxygen Demand, mg O_2/L	23	21	27	-	*12%*
Total Dissolved Solids, mg/L	572	403	445	-	*14%*
Total Alkalinity (as $CaCO_3$), mg/L	95	45	90	-	*4%*
Total Hardness (as $CaCO_3$), mg/L	384	104	244	-	*1%*
Total Phosphate (as P), mg/L	0.5	0.4	0.3	-	*8%*
Oil and Grease, mg/L	ND	ND	ND	0.5	*5%*
Sulfate (as SO_4^{2-}), mg/L	23.3	0.04	0.6		*17%*
Chloride (as Cl^-), mg/L	41	24	23	-	*1%*
#Fluoride (as F^-), mg/L	0.35	0.12	0.11	-	-
#Iron (as Fe), µg/L	2614	62	1926	-	-
#Arsenic (as As), mg/L	0.11	0.01	0.03	-	-
#Cadmium (as Cd), mg/L	ND	ND	ND	0.005	-
#Total Chromium (as Cr), mg/L	ND	ND	ND	0.005	
#Lead (as Pb), mg/L	ND	ND	ND	0.005	
#Mercury (as Hg), mg/L	ND	ND	ND	0.01	
#Total Coliform Bacteria /100mL	7×10^2	6×10^2	76	-	-
#E.Coli/100mL	70	65	33	-	-

ISO/IEC 17025 TL 064-02

4.2 SURFACE WATER TEST RESULTS

Parameter/Unit	Results	LOD	EU (k=2)
	W4		
*#pH	7.1	-	-
*#Temperature, ^{0}C	30.4	-	-
*#Free ammonia (as NH_3), mg/L	0.15	-	-
#Nitrate (as NO_3^-), mg/L	ND	0.03	-
Biochemical Oxygen Demand (BOD_5) at 20^{0}C, mg/L	16	-	*4%*
Chemical Oxygen Demand, mg O_2/L	22	-	*12%*
Total Suspended Solids, mg/L	1.6	-	*14%*
Total Phosphate (as P), mg/L	0.2	-	*8%*
Oil and Grease, mg/L	0.6	-	*5%*
#Cadmium (as Cd), mg/L	ND	0.005	-
#Total Chromium (as Cr), mg/L	ND	0.005	
#Chromium (as Cr(VI)), mg/L	ND	0.005	
#Lead (as Pb), mg/L	ND	0.005	
#Copper (as Cu), mg/L	ND	0.005	
#Selenium (as Se), mg/L	ND	0.01	
#Nickel (as Ni), mg/L	ND	0.005	
#Zinc (as Zn), mg/L	ND	0.001	-
#Mercury (as Hg), mg/L	ND	0.01	
#E.Coli/100mL	65	-	-

4.3 SEA WATER TEST RESULTS

Parameter/Unit	Results			LOD	EU (k=2)
	W5	W6	W7		
*#pH	8.0	7.9	7.9	-	-
*#Temperature, ^{0}C	27.5	27.6	27.6	-	-
Biochemical Oxygen Demand (BOD_5) at 20^{0}C, mg/L	ND	ND	ND	8	*4%*
Chemical Oxygen Demand, mg O_2/L	ND	ND	ND	4	*12%*
Total Suspended Solids, mg/L	106	116	114	-	*14%*
Oil and Grease, mg/L	0.8	0.6	ND	0.5	*5%*
#Cadmium (as Cd), mg/L	ND	ND	ND	0.005	-
#Total Chromium (as Cr), mg/L	ND	ND	ND	0.005	
#Chromium (as Cr(VI)), mg/L	ND	ND	ND	0.005	
#Lead (as Pb), mg/L	ND	ND	ND	0.005	
#Copper (as Cu), mg/L	ND	ND	ND	0.005	
#Selenium (as Se), mg/L	ND	ND	ND	0.01	
#Nickel (as Ni), mg/L	ND	ND	ND	0.005	
#Zinc (as Zn), mg/L	ND	ND	ND	0.001	-
#Mercury (as Hg), mg/L	ND	ND	ND	0.01	

*- measured on site #-Non-accredited Parameter **LOD**- Limit of Determination **EU**- Expanded Uncertainty
ND – Not Detected

Analysis was carried out by: K D P Malshan – Technical Officer

.....
Coordinating Scientist (Analysis)

.....
Checked by
Senior Scientist

Certified by:.....
H D S Premasiri
Director/ Environmental Studies and Services Division

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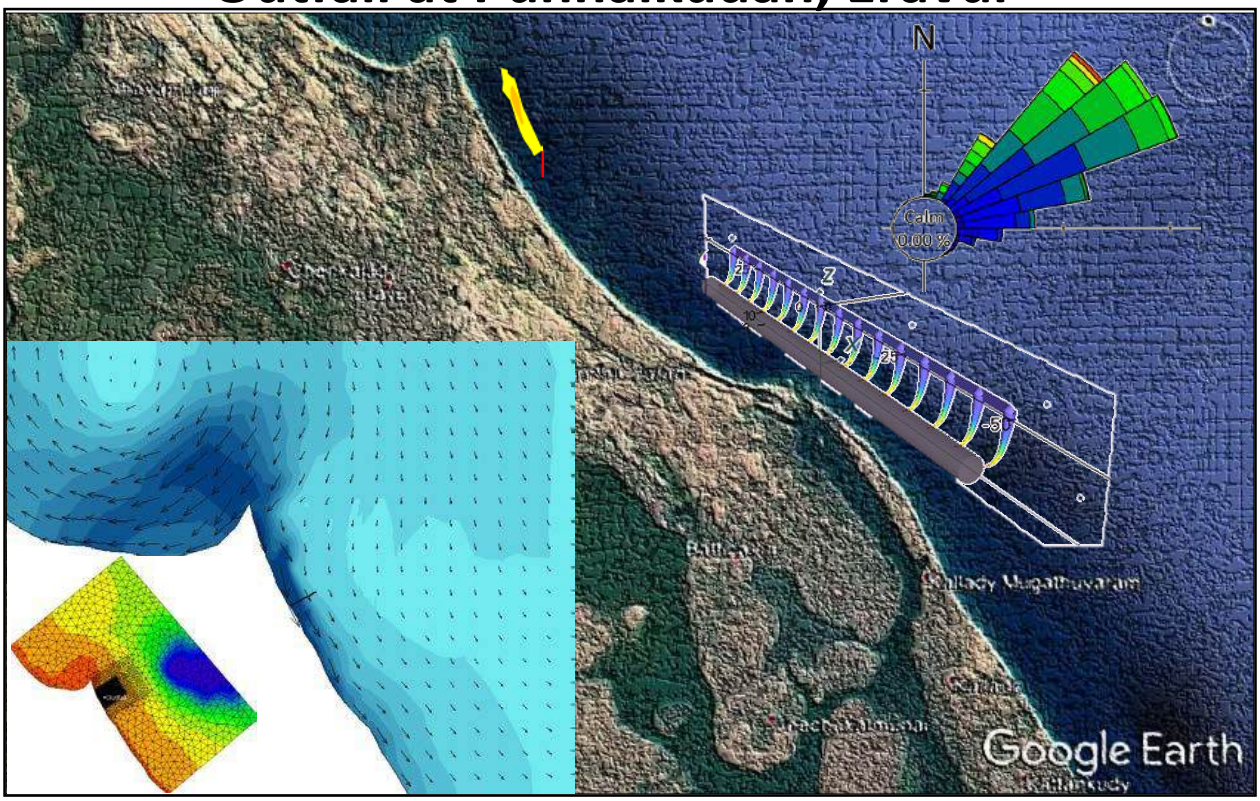
ANNEXURE IX

Dispersion Modelling for Proposed Sewerage Sea Outfall at Punnaikudah, Eravur,

Lanka Hydraulic Institute Ltd

LHI
Coast and Water

Dispersion Modelling for Proposed Sewerage Sea Outfall at Punnaikudah, Eravur



Conceptual Design and Numerical Modeling

Draft Final Report

January 2021

Prepared For:

Board of Investments (BOI) Sri Lanka

Client Board of Investments (BOI) Sri Lanka	
Project Dispersion Modelling for Proposed Sewerage Sea Outfall at Punnaikudah, Eravur Conceptual Design and Numerical Modeling	**Project No.** 2023
Authors Dr. (Ms). Prasanthi Ranasinghe Eng. (Ms). Nalika Engiliyage	**Date** Jan 2021 **Approved by** Eng. J. K. P. Kurukulasuriya Dr. K. Raveenthiran

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1 INTRODUCTION

1.1 Background

Plans are afoot to establish an industrial zone in Punnaikudah (Batticaloa) by **Board of Investments (BOI) Sri Lanka**. The zone includes heavy industrial factories and plants which are expected to discharge a considerable amount of effluents. After passing through a treatment plant, this effluent discharge is significantly 'neutralized' which is then discharged out to the sea via short sea outfall. Initially, it was planned to discharge the 15000 m^3/day of treated effluent using sea outfall and relevant dispersion modelling has been done by Lanka Hydraulic Institute Ltd (LHI) in 2016. However, currently it is proposed to discharge waste water effluent in three phases of 5000 m^3/day, 10000 m^3/day and 15000 m^3/day discharges. Therefore, the Environmental Impact Assessment is to be carried out to assess the project impacts under all three phases. Hence, Board of Investments (BOI) Sri Lanka requested **Lanka Hydraulic Institute Ltd (LHI**) to carry out the **Dispersion Modelling for Proposed Sewerage Sea Outfall at Punnaikudah, Erauvr** as a part of the EIA study in November 2020. The location map of proposed sea outfall are shown in the Figure 1.1.

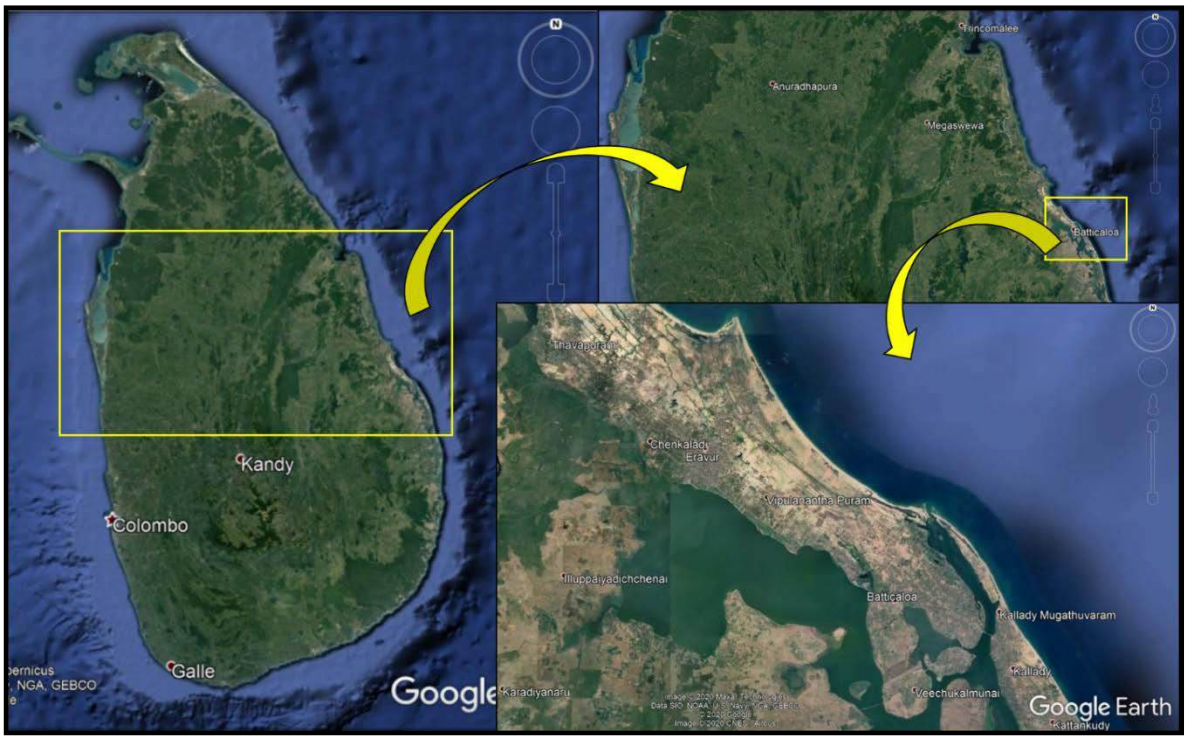


Figure 1.1: Location of the Proposed Sea Outfall, Batticaloa

1.2 Objective of the Project

The main objective of the study is to carry out the dispersion modelling of the treated effluent (Near-Field and Far-Field) from the wastewater treatment plant.

1.3 Scope of the Work

The scope of works under this project mainly focuses on carry out the Dispersion Modelling of Effluent (Near-Field and Far-Field) by considering the following discharge options which will be discharge through the short sea outfall.

- 5000 m^3/day
- 10000 m^3/day
- 15000 m^3/day

1.4 Draft Final Report

In line with the scope of work of the project, this **Draft Final Report** includes the outcome of the numerical modelling of wave climate, hydrodynamics, and dispersion modelling of effluent considering both near-field and far-field.

2 ENVIRONMENTAL CONSIDERATIONS

Similar to any engineering design, the site specific data is required and important in coastal engineering designs as well. Therefore, data availability has been analyzed and review of the available data has been done prior to the preliminary design of the sea outfall. This section is introduced to summarised available data and its usage for the current study. The aim of this exercise is to obtain the unavailable data through the numerical modelling.

- Bathymetric and Topographic Data
- Waves and Currents
- Tide Data

2.1 Bathymetric and Topographic Data

Digitized data of UK Admiralty Charts is available at a coarser grid to generate the regional bathymetry. The local bathymetric and topographic survey data has been obtained from the previous survey done for 2 km coastal stretch in 2016.

2.2 Waves and Currents

Waves and currents are the one of the significant factors to be considered while selecting the suitable location for a sea outfall. In other words following details has to be obtain using site specific wave and current conditions.

- Offshore limit of the surf zone
- Magnitude of the weak, moderate and strong currents

The Eastern coast of Sri Lanka is mainly influenced by the Northeast monsoon wind generated waves and swell component is comparatively low. In other words overall waves exhibit a similar characterises as sea waves. In the design of sea outfall site specific currents are equally important as the sea bed levels. On the other hand wave induced currents are dominant as the tidal range is small in Sri Lanka. Therefore, obtaining the site specific wave climate has to be done as the first step. However, very often such data is not available from on-site wave recordings. This deficiency in wave data base can be overcome by transforming wave data available from other locations within the region using numerical wave propagation modeling techniques. In the case of Batticaloa, on-site wave recordings were not available. Therefore, in order to establish the data base, transformation of wave data available from other locations was found to be necessary. Since the long term wave measurements are not available in the vicinity of Batticaloa, hind-cast wave data obtained at off the eastern coast is used in this study.

Six years wave data were obtained from UKMO for offshore of the proposed site during the period of Jan-2007 to Dec-2012 at 6 hourly intervals which gives total number of 8024 data. The location

for the UKMO hind-cast wave data (Geographical Coordinates _ 8° 40’ 19.2”N, 81° 54’ 50.4”E) is shown in the Figure 4.1.

2.3 Wind Data

Wind data for the model is selected based on the 30 years of measured wind data covering the period of 1961 to 1990 at Trincomalee port (8.58°N, 81.25°E).

Table 2.1: Nearshore Monthly Average Wind Data

Month	Avg. Wind Speed (m/s)	Direction (deg)	Season
Jan	4.5	30	NE
Feb	3.3	50	
Mar	2.5	90	IM2
Apr	2.3	150	
May	3.7	220	SW
Jun	5.1	230	
Jul	4.5	230	
Aug	4.2	230	
Sep	3.9	230	
Oct	3	250	IM1
Nov	3.3	360	
Dec	4.4	30	NE

2.4 Tide Data

Available Tidal Constituents at Oluvil, Trincomalee and Point Pedro in Admilarity Tide Table could be used to generate the water level time series for regional model simulations.

2.5 Effluent Standards

It is expected that the treated effluent would meet the *Industrial and Domestic Waste Effluent Standards for Marine Coastal Areas* as mention below. However, in the case of discharge effluent could not meet the required standards, the short sea outfall is designed to satisfy the *Effluent Discharge Standards for marine Coastal Area* (Table 2.2 and **Annex A**).

Table 2.2: Tolerance Limits for Wastewater or Effluents (lindustrial and/or Domestic) from a Prescribed Activity into the Marine Waters

No	Parameter	Units, Type of limit	Tolerance Limits Value for an Outfall Leading up to Nearshore Water	Tolerance Limits Value for Short Sea Outfall	Tolerance Limits Value for Long Sea Outfall
01	Total Suspended Solids(TSS~)	mg/l, max	30	**50**	250
02	Total Dissolved Solids(TDS~)	mg/l, max	1000	-	-
03	pH at ambient temperature		6.0 – 8.5	5.5 - 9.0	5.5 - 9.0
04	Biochemical Oxygen Demand(BOD) (BOD_3 in five days at 20°C)	mg/l, max	15	**75**	400
05	Temperature at the measurement point	°C, max	Ambient water temperature ± 5or 35 whichever is lesser	40	40
06	Oils and grease	mg/l, max	5	12	20
07	Phenols	mg/l, max	1	1	5
08	Chemical Oxygen Demand(COD)		50	**400**	800
09	Color (Spectral absorption coefficient-Wavelength range) 436 nm (Yellow range) 525 nm (Red range) 620nm (Blue range)	 m^{-1}, max m^{-1}, max m^{-1}, max	 7 5 3		
10	Dissolved phosphates (as P)	mg/l, max	1	5	5
11	Ammonia Nitrogen (as N)	mg/l, max	15	50	150
12	Total Cyanides (as CN)	mg/l,max	0.1	0.2	0.4
13	Total residual chlorine (as OCl^-)	mg/l, max	0.2	0.5	1.0
14	Fluorides (as F)	mg/l, max	2	2	2
15	Sulphides (as S)	mg/l, max	2	2	5
16	Arsenic - As	mg/l, max	0.08	0.1	0.2
17	Cadmium (as Cd)	mg/l,max	0.02	0.05	0.10
18	Chromium, total (as Cr)	mg/l, max	0.05	0.05	0.10
19	Chromium, hexavalent (as Cr^{6+})	mg/l, max	0.01	0.01	0.05
20	Copper (as Cu)	mg/l, max	1.0	1.0	1.0
21	Lead (as Pb)	mg/l, max	0.1	0.1	0.1
22	Mercury (as Hg)	mg/l,max	0.001	0.002	0.01
23	Nickel (as Ni)	mg/l, max	0.1	0.2	1.0
24	Selenium (as Se)	mg/l, max	0.01	0.05	0.10
25	Zinc (as Zn)	mg/l, max	3	3	5
26	Silver (as Ag)	mg/l, max	0.005	0.035	0.35
27	Pesticides (total)	mg/l, max	0.005	0.005	0.005
28	Surfactants (Total)	mg/l, max	1	5	10
29	Fecal Coliform level	MPN/100ml, max	150	**1500**	10^7
30	Radio Active material a.) Alpha emitters b.) Beta emitters	 micro curie/ml, max micro curie/ml, max	 10^{-9} 10^{-9}	 10^{-8} 10^{-7}	 10^{-8} 10^{-7}

3 DERIVATION OF NEARSHORE WAVE CLIMATE AT BATTICALOA

3.1 Basic Approach

The nearshore wave climate at sea outfall location was developed based on a wave database obtained by transformed recordings from other locations. The detailed methodology used is described in Sections 3.3 and 3.4. The wave transformation was primarily based on numerical wave propagation modelling carried out using MIKE 21's Spectral Wave Model (MIKE 21 SW). Prior to use the transformed wave data from other locations, the verification was carried out by considering the statistical behaviour wave directions of transformed wave data. This comparison was made separately for different seasons of the year. The following 4 seasons of the year were considered, which contain the two monsoon periods and two inter monsoon periods inbetween.

- South West Monsoon Season (SW) – May to September
- Inter Monsoon 1 Season (IM1) – October to November
- North East Monsoon Season (NE) – December to February
- Inter Monsoon 2 Season (IM2) – March to April

The transformed wave data which could not be statistically verified satisfactorily was not used to develop wave data base at site. Upon completion of building up of the wave data base for sea outfall site, directional wave statistics indicating the percentage occurrences in different wave height-wave direction classes and average wave periods within those classes were compiled.

3.2 Analysis of Wave Data in Eastern Offshore

Wave climate study was carried out for the proposed sea outfall location at Batticaloa by using hind-cast directional wave data Eastern offshore (2000 m depth). Wave data measured location is shown in Figure 3.1. It is important to identify the characteristics of hind cast/measured wave data prior to use them to nearshore locations. This step is useful for the comparison and qualitative validation of hind-cast wave climate in the area of interested.

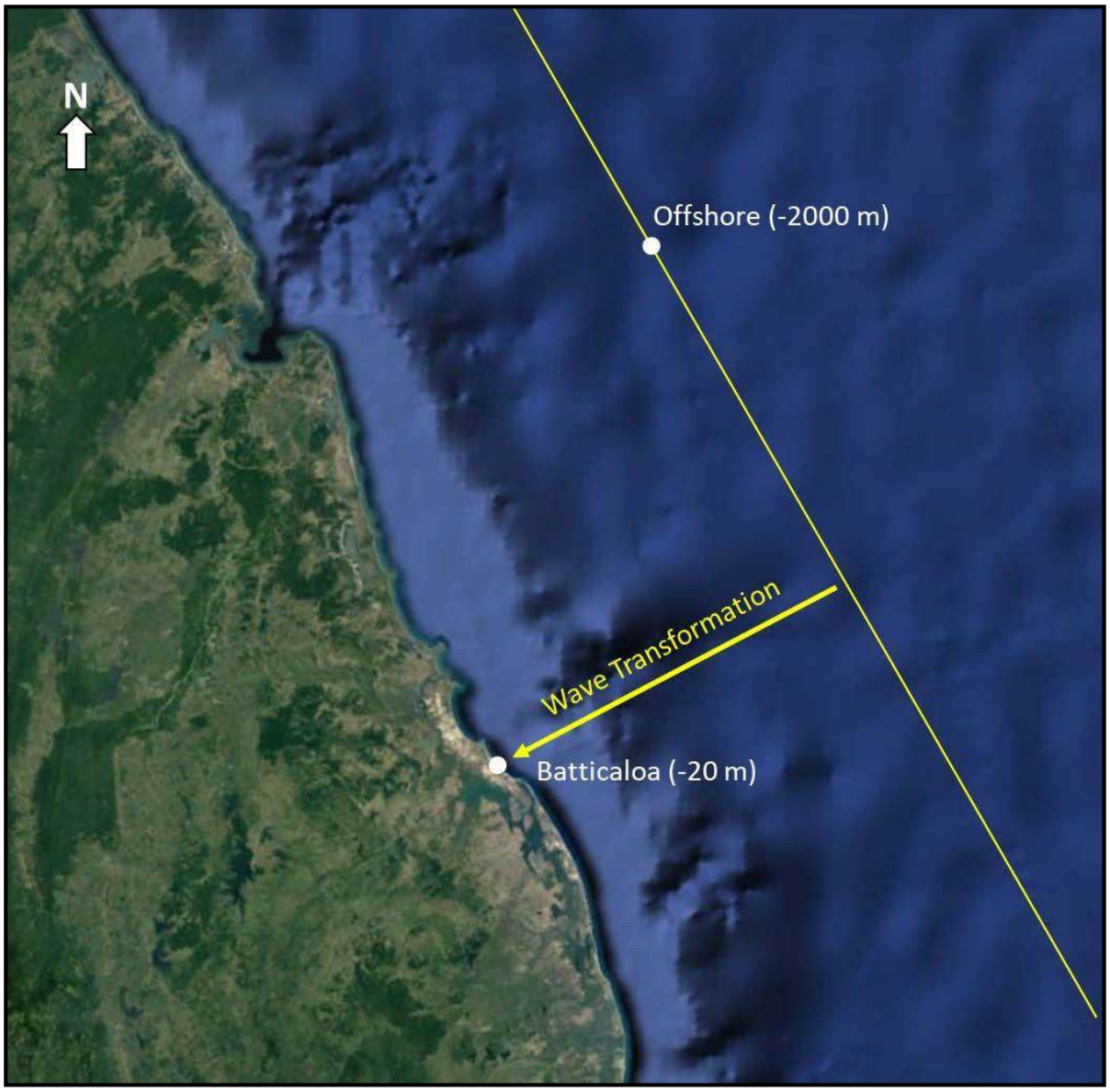


Figure 3.1: Wave Data Measurement Locations and Transformation Sequence

The analysis was carried out for seasonal and annual basis for offshore location. Relationship among main wave parameters (i.e. significant wave height, peak wave period, and directions) was examined on annual and seasonal basis**.** Wave rose diagrams for the overall wave characteristics are shown in Figure 3.2 under annual and seasonal basis.

As shown in Figures 3.2, offshore waves are extended their distribution from 1st quadrant up to the 3rd quadrant.

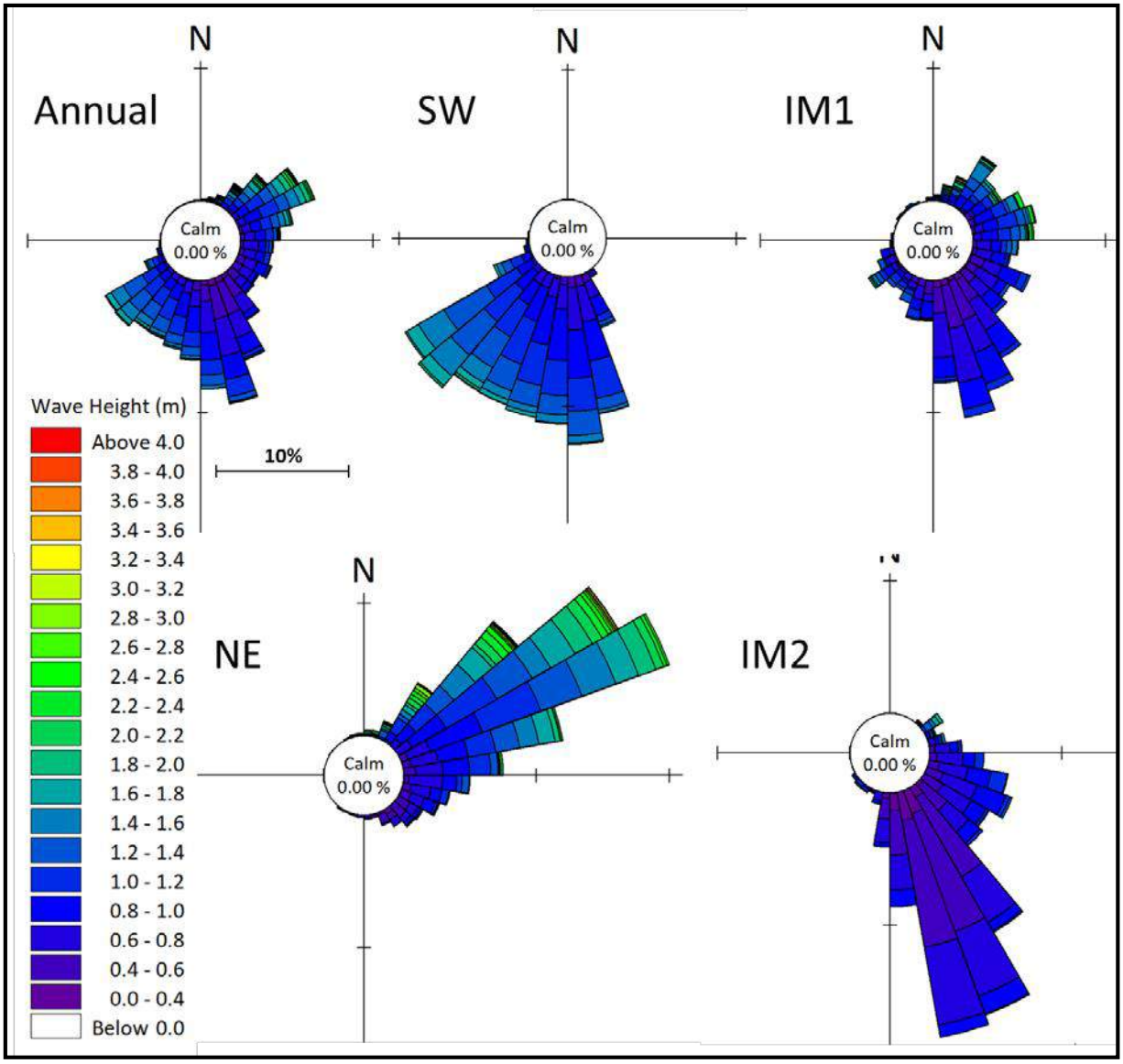


Figure 3.2: Overalls Waves - Annual and Seasonal for Eastern offshore (2000 m depth)

3.3 MIKE 21 SW (Spectral Waves) Model

Since accurate assessment of wave conditions is very important for designing structures in coastal regions wave modelling is essential. Wave induced currents play a significant role to Hydrodynamic condition and hence Advection and Dispersion process in coastal areas. Therefore, sound knowledge of wave climate is necessary in order to carry out the designs of wastewater sea outfall with the minimal impact to the existing environment.

The spectral wave module, DHI MIKE 21 SW, is a state-of-the-art spectral wind-wave model. The module enables to simulate growth, decay and transformation of wind-generated waves and swells in offshore and coastal areas. The model includes the main physical phenomena, for example, the processes of wave generation by wind, quadruplet wave-wave interactions, white- capping and bottom friction. Further, this model handles processes that only affect waves in coastal waters such as depth induced wave breaking and triad wave-wave interactions. The formulations for the wave generation processes are based on the wave action balance equation (i.e. in MIKE 21 SW the waves are represented by the wave action density spectrum). MIKE 21 SW uses an unstructured mesh for the numerical solution. An unstructured mesh has the advantage that it is highly flexible and therefore suitable for modelling projects where high resolution is needed in the area of interest and coarse resolution is sufficient in the surroundings. The necessary model Input data of MIKE 21 SW Model can be divided into groups such as domain and time parameters, equations, discretisation and solution technique, forcing parameters, source function parameters, initial conditions and boundary conditions. Model output such as significant wave height, peak wave period, mean wave direction and radiation stress tensor can be obtained from MIKE 21 SW at each mesh point for each time step.

3.4 Wave Transformation

The applied methodology to hind cast wave climate of this study is based on the application of MIKE 21 SW model to simulate wave propagation off the Eastern coast (offshore). Wave propagation modeling was carried out to transform wave recordings from 2000 m depth to representative locations in the study area. Thus, representative nearshore wave climate was established at 20 m water depth in sea outfall location (Figure 3.4).

Since waves are highly influenced by wind field, well established Beaufort Scale standard was used to incorporate the wind speed to the simulation. Accordingly, wind speed was correlated with the offshore significant wave height based on the Beaufort scale description of the marine water (Table 3.1). It is assumed that wind directions are similar to the offshore wave direction over the entire model domain.

Table 3.1: Wind Speed for Offshore Significant Wave Height

Significant Wave Height (m)	Speed (m/s)
0.5	2.9
1.5	6.6
2.5	9.8
3.5	12.5
4.5	14.8
5.5	16.9

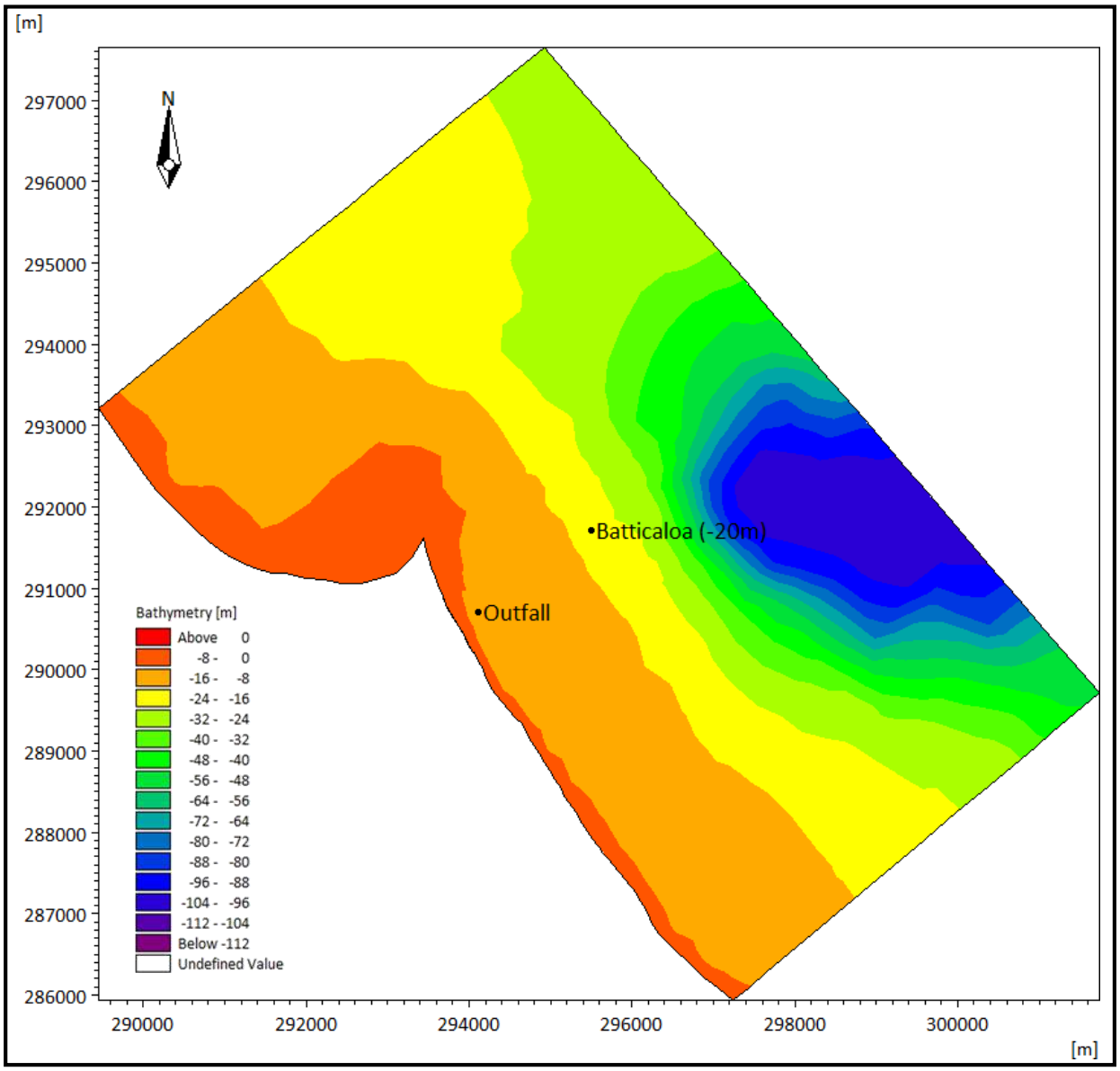


Figure 3.3: Depth Variation in the Vicinity of Proposed Outfall Location

3.5 Assessment and Verification of Wave Transformation

The verification of wave data sets obtained by transformation from different locations and on-site recordings in time domain is not possible as there is no physical overlap between different data sources. Therefore, comparison between different wave data sources was made only on a statistical sense. Such comparisons for measured and transformed data sets at the perticular location for overall seasonal waves.

It is not realistic to expect similar distributions in wave heights in two data sources covering different durations. A longer duration wave data source is more likely contain high and extreme waves. However, at a given location a particular wave system is known to approach from a characteristic direction range over different seasons. Therefore, in the statistical comparison, these trends in directional distributions were looked at for different data sources. In this exercise, the two main considerations for satisfactory comparison between two data sets adopted were: similarity in dominant wave approach direction; and similarity in range of wave directions. The magnitude of percentage of waves representing the dominant wave direction is only of secondary importance, as that will vary with the time duration covered by the wave data source. Since no measured data available in the vicinity, the transformed data to Oluvil has been compared with the transformed data at Oluvil 15 m depth in a previous study done in 2005 (CRMP, 2005) which is available as a wave Rose diagram (Figure 3.4).

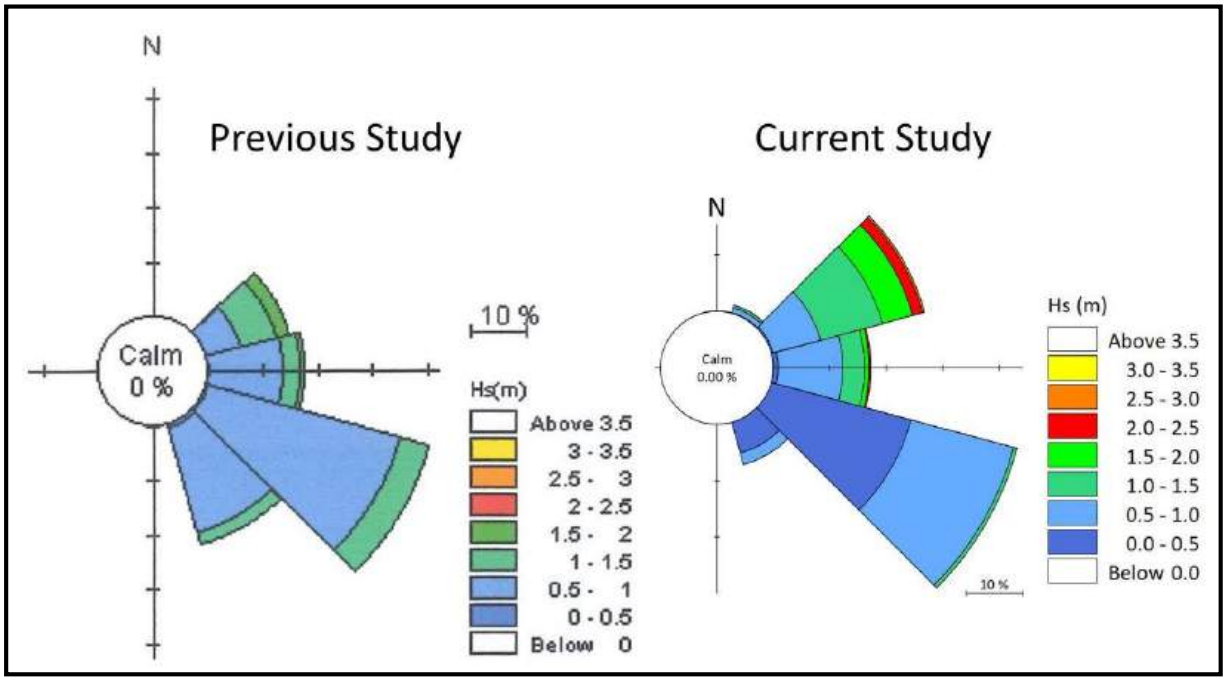


Figure 3.4: Comparison of Transformed Waves at Oluvil 15 m Depth in Previous Study and Current for Annual Overall Waves

The comparisons between both studies nearshore data clearly indicate that wave data transformed from Trincomalee offshore showed similar directional trends as obtained from CRMP transformed data. Therefore, all the transformed data from Eastern offshore could be used to develop the nearshore wave data base in Eastern coast.

3.6 Nearshore Directional Wave Statistics at Batticaloa

As concluded in Section 3.5, all the transformed wave data from Eastern offshore were combined to constitute the directional wave data bases for overall waves at Batticaloa 20 m water depth.

Wave Characteristics at 20 m Depth in Batticaloa

The established wave data series at Batticaloa nearshore 20 m depth indicates that comparatively high waves are approaching from NE direction in NE and IM1monsoons while during SW monsoon lower magnitude's wave are dominating with a narrow direction band in SE direction (Figure 3.5). Table 3.2 indicates the characteristics of high and average waves for annual and for all four seasons.

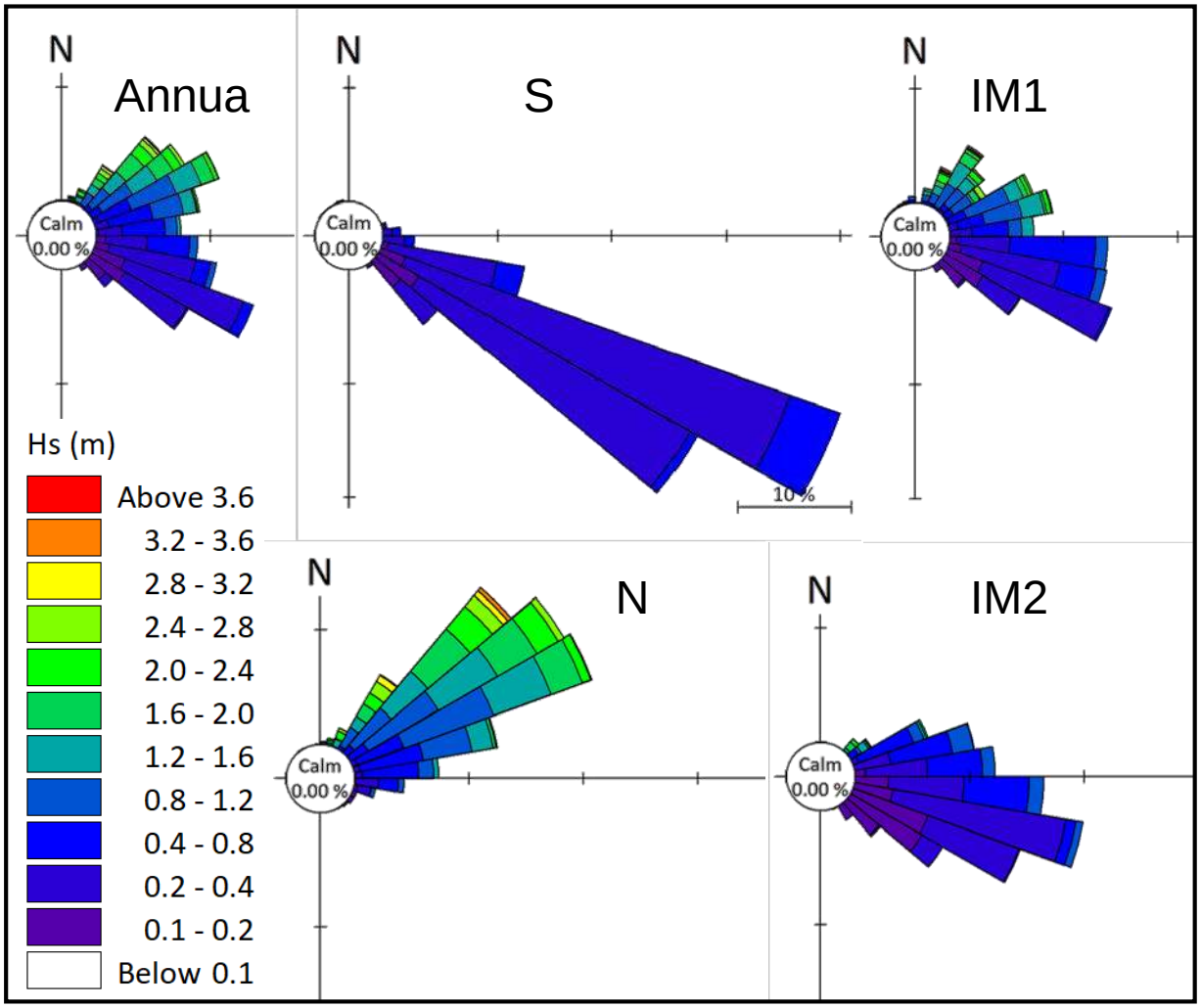


Figure 3.5: Overalls Waves - Annual and Seasonal for Batticaloa Nearshore (20 m depth)

Table 3.2: Average and High Wave Conditions at Batticaloa 20 m Depth

20 m Depth	Average (50% Exceedance)			Extreme (2% Exceedance)		
	Hs (m)	Tp (s)	MWD (°N)	Hs (m)	Tp (s)	MWD (°N)
Annual	0.55	9.0	79	2.45	8.7	47
SW	0.25	4.1	120	0.45	5.4	113
IM1	0.50	7.6	91	2.30	8.7	53
NE	1.10	5.8	59	2.70	9.1	42
IM2	0.25	5.3	104	1.05	6.0	80

Table 3.3: Summary of Approaching Directions of Waves at Batticaloa Nearshore

Season	At 20 m Depth		
	MWD	Direction Band	
		Lower & Upper Limits	%
Annual	79	30-130	94.3
SW	120	100-140	94.5
IM1	91	20-130	94.0
NE	59	30-100	94.4
IM2	104	70-130	84.3

4 HYDRODYNAMIC STUDY

4.1 Introduction

Current circulation and effluent dispersion are some of the key topics relying on a clear understanding of hydrodynamics. Thus, hydrodynamic study is essential to investigate the behaviour of water bodies subjected to a variety of natural forcing such as wave, tide and wind. Sound understanding about the hydrodynamics in the proposed sea outfall area is important as that knowledge helps to decide the configuration of sea outfall route including the discharge location (depth and distance from the shore). Additionally, near-field and far-field dispersion of the effluent is depend on the current circulation at the discharge location. Therefore, DHI MIKE 21 HD (hydrodynamic) module has been used to assess the hydrodynamic of the proposed sea outfall area and to obtain the input condition for near-field (CORMIX) and far-field (DHI MIKE 21 FM TR) dispersion modelling.

4.2 Hydrodynamic Study using MIKE 21 HD Model

The MIKE 21 HD is the basic module in the MIKE 21 package and provides the hydrodynamic basis for the computations performed in the modules for advection and dispersion processes. The hydrodynamic module simulates water level variations and flows in response to a variety of forcing functions in coastal regions. MIKE 21 HD is based on the numerical solution of full non- linear equations of *Conservation of Mass* and *Momentum* integrated over the vertical to describe flow and water level variations. Major input parameters to the module include bathymetry, simulation period, boundary data, wave radiation and wind conditions. Tide and wind information is fed into the HD model directly, whereas wave characteristics can be fed as wave radiation stresses from the MIKE 21 SW model simulations. A typical HD simulation results in water elevation and fluxes, from which water currents could be determined. The module in turn, assesses surface elevations and fluxes.

4.3 MIKE 21 Hydrodynamic Model Setup and Simulations

Computations were performed on a nested grid set-up starting from a larger regional model and gradually reducing to smaller models while moving towards the area of interest. Objective of this nested approach is to use known tidal constituents to drive the HD model and to arrive at more accurate and finer grid resolutions towards the area of interest. The boundary conditions for the larger "*Regional Model*" were based on the tidal constituents from *Point Pedro* and *Oluvil*. A small and more refined model ("*Local*") was nested within this larger model (Figure 4.1). The simulations within a sub grid model are based on boundary conditions extracted from the immediately higher model.

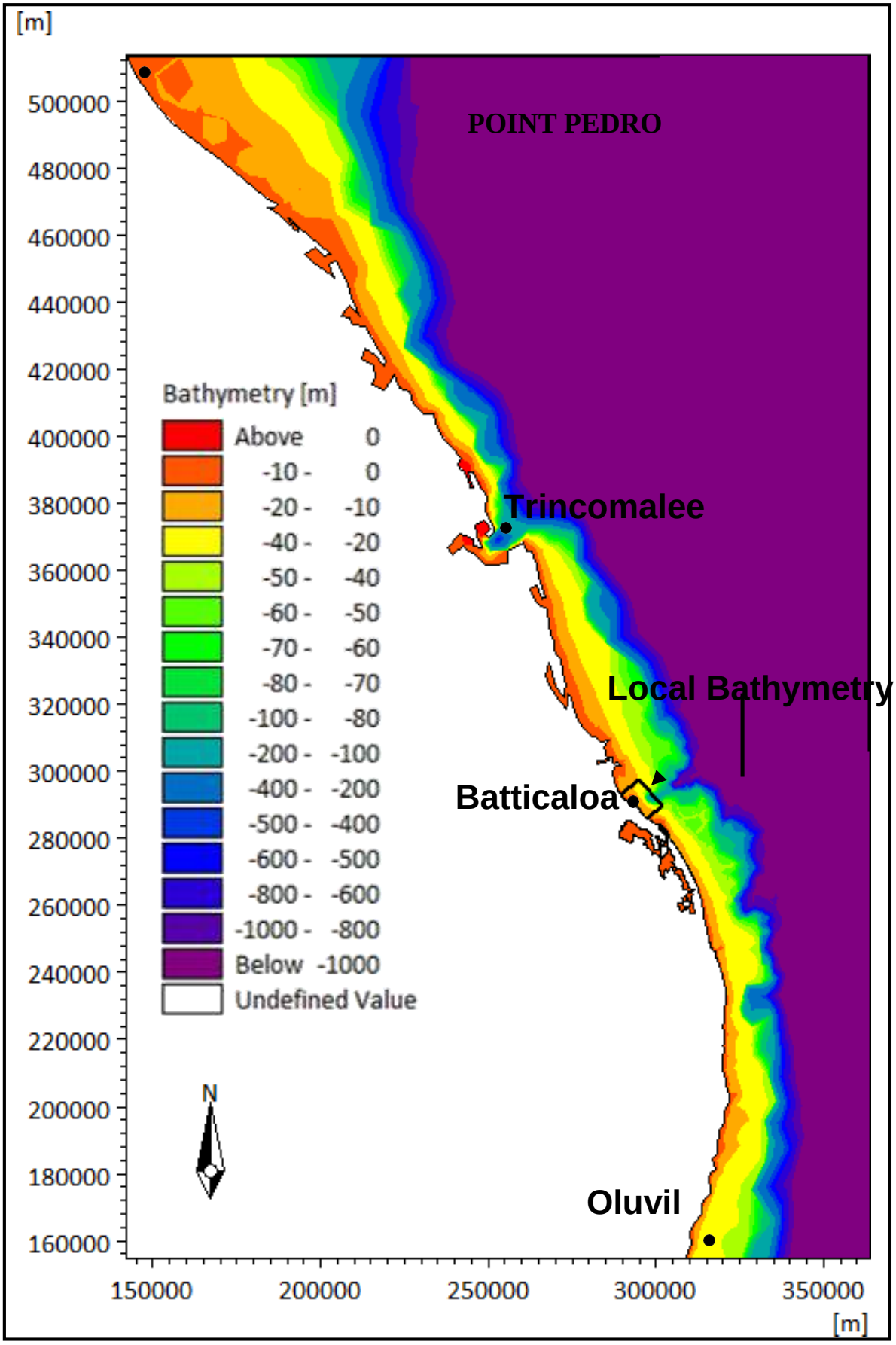


Figure 4.1: Bathymetries – Regional and Local Models

4.3.1 Model Bathymetry

Regional Model

The setting up of the hydrodynamic models originated from this "Regional Model" which extends from Point Pedro in the North, up to Oluvil in the South (Figure 4.1). The model was set-up with the area of 360 km × 140 km with water boundaries of 220 km from the North and 55 km from the South. The depth at off shore of the Regional Model bathymetry is around 1000 m. The regional bathymetry consisted three sub domains with maximum element sizes of 500,000,000 m^2, 5,000,000 m^2 and 50,000 m^2.

Local Model

The smallest hydrodynamic model created in this study is the "Local Model" with four sub domains with maximum element sizes of 100,000 m^2, 1,000 m^2 and 100 m^2. The extent of the local model is 10 km × 7 km (Figure 4.2). The boundaries of the local model were extracted from the "Regional model" as "transfer boundary conditions". The offshore limit of the local model is around 20 m depth.

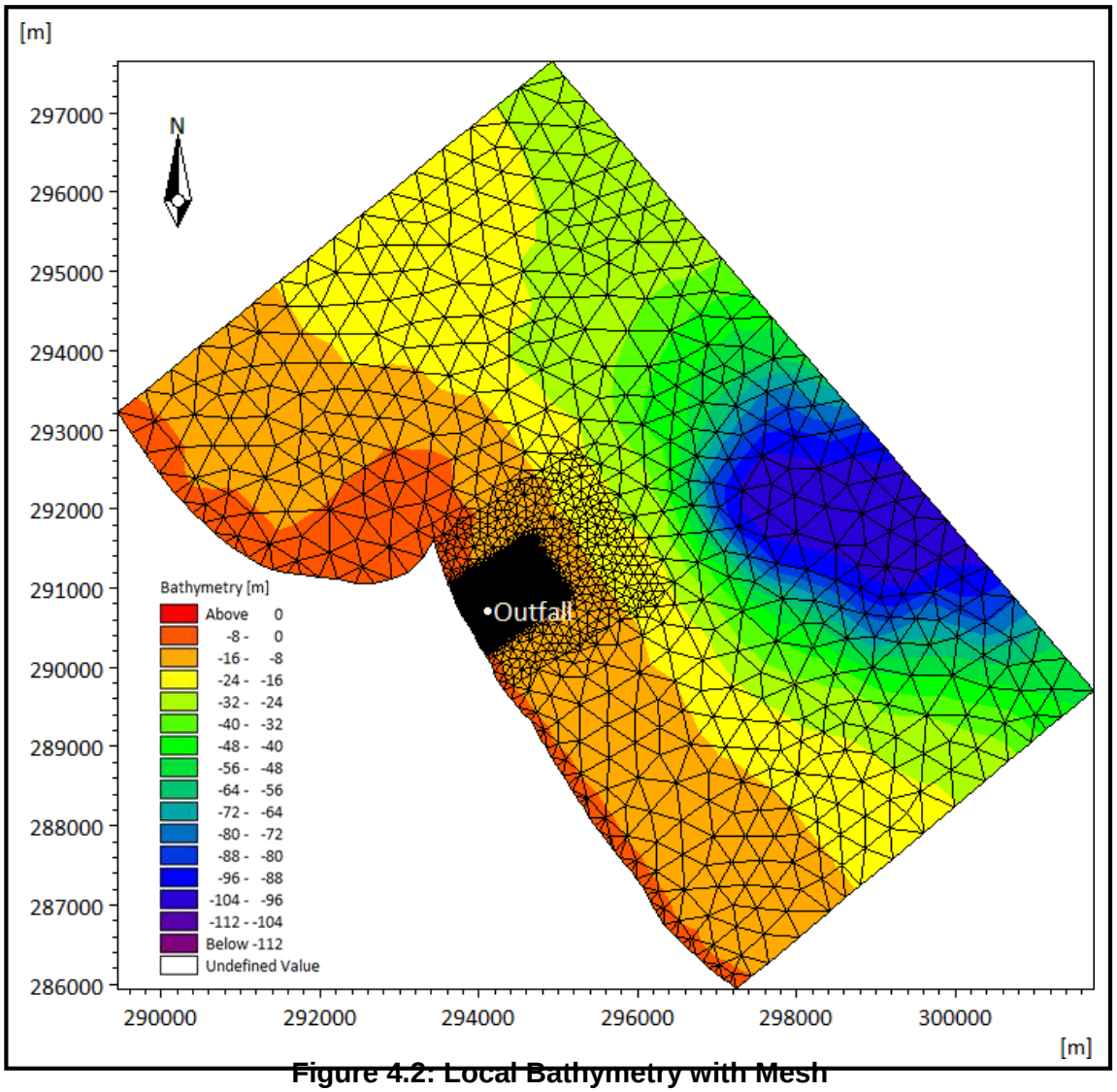


Figure 4.2: Local Bathymetry with Mesh

4.3.2 Boundary conditions

Types of boundary conditions (e.g. tide, wave radiation and wind) which were applied in hydrodynamic modeling are described in this section.

a) Tidal Boundary Conditions

Accurate definition of the open sea tidal constituents at model boundaries is essential for the simulation of tidal propagation pattern in the area of interest. The constituents adopted in the present study were extracted from a previous performed tidal hydrodynamic study in which the already established open sea tidal constituents were further refined. The established tidal constituents for the Western and Eastern boundaries of the Regional Model are listed in Table
4.1. Corresponding tidal variations are given in Figures 4.3.

Table 4.1: Derived Tidal Constituents for the Western and Eastern Boundaries

Regional Model Boundaries	**Derived Amplitudes of Tidal Constituents (m)**				**Derived Phase of Tidal Constituents (deg.)**			
	M2	***S2***	***K1***	***O1***	***M2***	***S2***	***K1***	***O1***
Point Pedro	0.21	0.09	0.05	0.01	242	270	328	003
Trincomalee	0.18	0.06	0.07	0.02	238	268	332	304
Oluvil	0.079	0.032	0.058	0.013	234	261.5	332.5	296

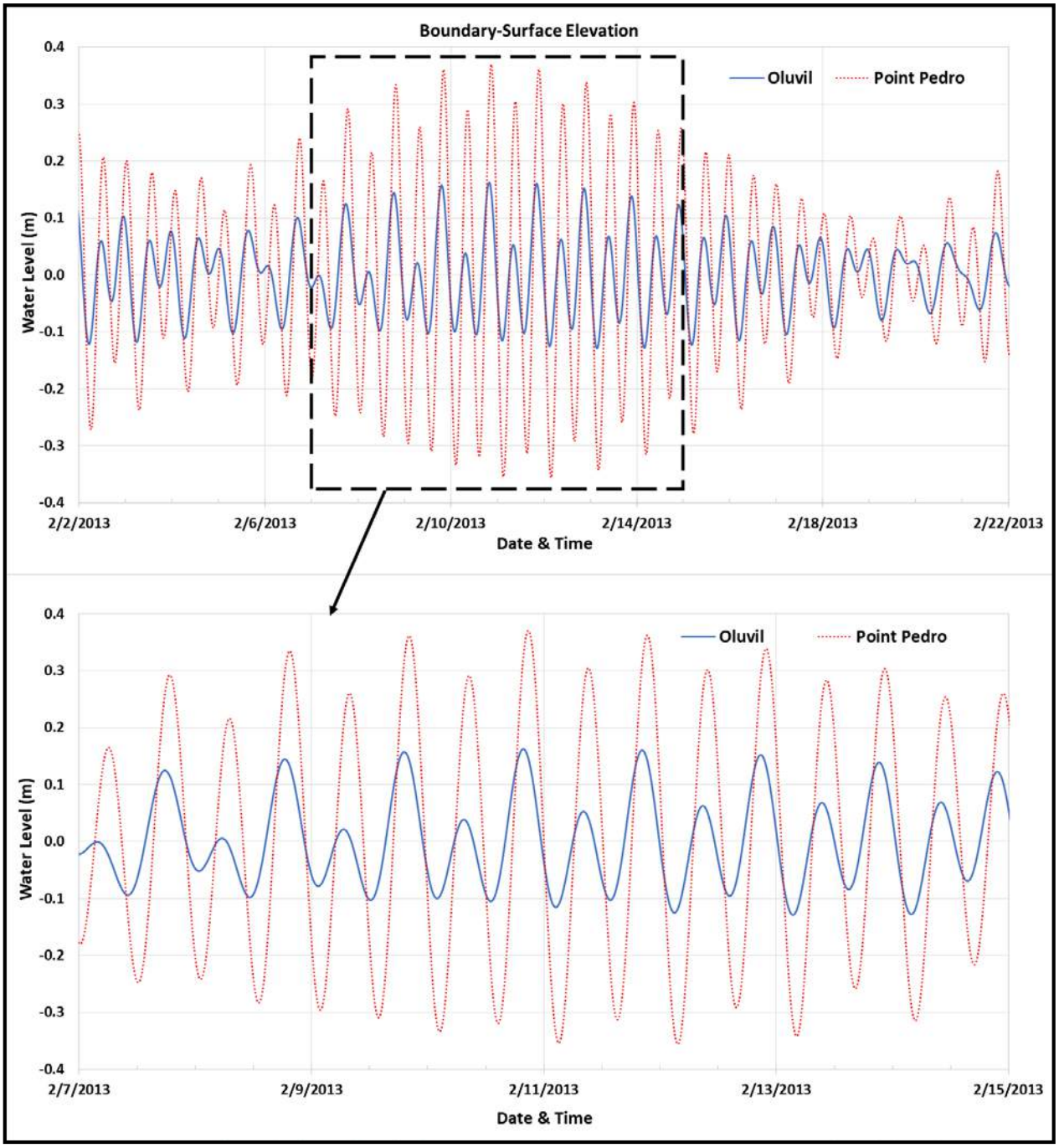


Figure 4.3: Derived Tide at Point Pedro and Oluvil

b) Wind Boundary Conditions

Application of tidal boundary for hydrodynamic model was carried out by covering spring and neap tide conditions where high and low currents can be expected respectively. Spatial wind boundary conditions under "average" and "high" wind conditions for each monsoon are presented in Table 4.2.

Table 4.2: Spatial Wind Boundary Conditions for HD Model

Season	Condition	Wind	
		Wind Speed (m/s)	Direction (°N)
SW	Average (50%)	4.3	230
	High (2%)	5.1	230
IM1	Average (50%)	3.0	305
	High (2%)	3.3	360
NE	Average (50%)	4.1	40
	High (2%)	4.5	30
IM2	Average (50%)	2.4	120
	High (2%)	2.5	90

c) Wave Conditions

MIKE 21FM SW model was used to get the wave included currents, which is the second order stresses (called wave radiation stresses) due to the breaking of short period waves. Seasonal wave conditions (Extreme and Average) at the local offshore boundary are presented in below Table 4.3. However, similar wave conditions were omitted while selecting the model scenarios to avoid the repetition and combination of wave boundary conditions and hydrodynamic conditions will be presented in Section 4.3.4 under the Model Simulations.

Table 4.3: Wave Boundary Conditions for HD Model

Season	Condition	Wave Parameters		
		Hs (m)	Tp (s)	MWD (°N)
SW	Average (50%)	0.25	4.1	120
	Extreme (2%)	0.45	5.4	113
IM1	Average (50%)	0.50	7.6	091
	Extreme (2%)	2.30	8.7	053
NE	Average (50%)	1.10	5.8	059
	Extreme (2%)	2.70	9.1	042
IM2	Average (50%)	0.25	5.3	104
	Extreme (2%)	1.05	6.0	80

d) Boundary Conditions Used for Different Model Setups

Time series of water levels predicted from derived tidal constituents (Figure 5.4) were used as Northern and Southern Boundaries. Eastern boundary was taken as no flow boundary. It should be noted that even along a model boundary tidal constituent phase do vary. As representation of such a variation is not possible from the available data, the tidal boundary conditions established for the "Regional Model" were made to be representative of average tidal variations at the boundaries. All three boundaries (Eastern, Northern and Southern) for the Local Model were extracted from the Regional Model as transfer boundaries.

Only the water level variations were included at the open boundaries for the Regional Model. Local model was run with wind forcing and radiation stresses together with the transfer boundaries extracted from the Regional model. East boundary of the Local model was specified as a land boundary whereas South and North boundaries were specified as level boundaries.

Selected constant wind was applied during the model runs and the selection was made based on the available wind measurements at Trincomalee. In all occasions wind was assumed to be constant in space and applied to entire model area.

The extracted waves at 20 m from wave climate models were used as the boundary conditions to generate the wave radiation stresses in local model.

4.3.3 Hydrodynamic Model Calibration and Verification

Available tidal constituents have been used to derive the surface elevation at Trincomalee and compared with the simulated surface elevation at the same location from the Regional Model.

Model Calibration

The model calibration has been done until the derived and simulated surface elevations are in good agreement. Figure 4.4 gives the comparison of derived (using Tidal constituents) and model simulated surface elevations for Trincomalee

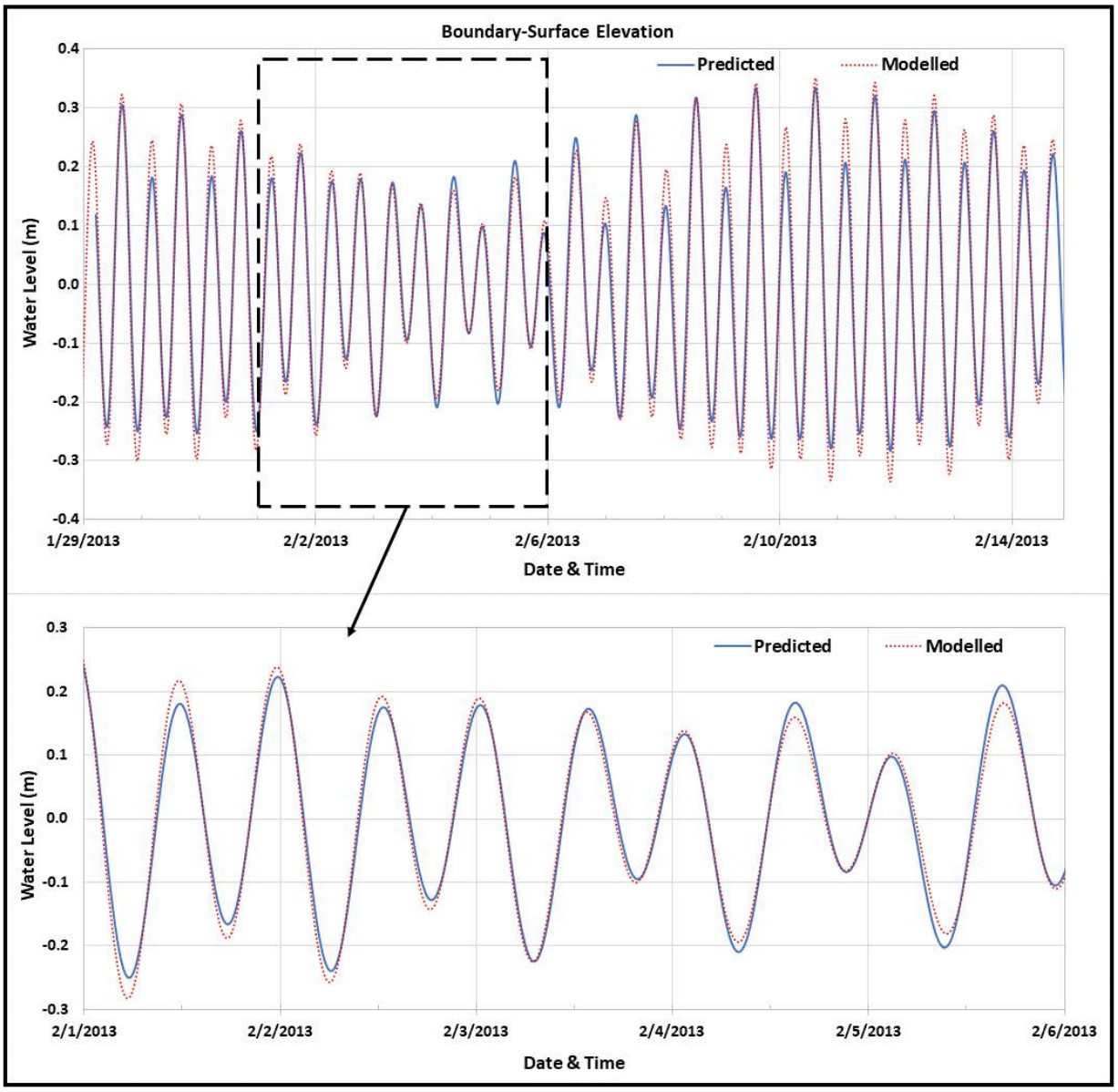


Figure 4.4: Modelled and Predicted Tide at Trincomalee

4.3.4 Model Simulation

All simulations are performed for the forcing of tide and wind conditions. Regional model and local models were simulated for a period of 1 month to cover both spring and neap periods for identified "average" and "high" wave conditions of each season. HD model scenarios (No. 1a, 2a, 3a, 4a and 5a) defined based on the wave conditions used in "Local model" are presented in Table 4.3. These wave conditions are corresponded to the wave data extracted at 20 m depth from SW model simulation results (see Section 3.4).

Table 4.4: Simulation Scenarios for MIKE 21 HD Simulations

Scenario No.	Season	Condition	Wave parameters			Wind	
			Hs (m)	Tp (s)	MWD (˚N)	Wind Speed (m/s)	Direction (˚N)
1a	SW	Average (50%)	0.25	4.1	120	4.3	230
	IM2	Average (50%)					
2a	SW	Extreme (2%)	0.45	5.4	113	5.1	230
3a	IM1	Average (50%)	0.50	7.6	91	3.0	305
4a	NE	Extreme (2%)	2.70	9.1	42	4.5	30
	IM1	Extreme (2%)					
5a	IM2	Extreme (2%)	1.05	6.0	80	2.5	90
	NE	Average (50%)					

Simulations were carried out for scenarios defined in Table 4.3 (Case 1a – 5a) for the existing condition (i.e without sea outfall) to observe the flow patterns in the study area. On the basis of identified current movements and patterns in the study area, sea outfall was designed accordingly. Same scenarios were repeated in Far-Field model (MIKE 21 TP) for "with sea outfall" condition to find out the effect of the current flow for the dispersion of the wastewater effluent. Model area for both "without sea outfall" (i.e. existing) and "with sea outfall" conditions are illustrated in Figure 3.3.

Analysis results of HD simulation under different scenarios are presented in following section (Section 4.3.5).

4.3.5 HD Model Results and Analysis

The current plots are presented for each scenarios to get a general and detailed understanding about the current pattern in and around the sea outfall area. To represent high and low tidal current impact, results are further selected from spring and neap tidal conditions separately and presented in Figures 4.4 to 4.8. Additionally, current plots will also be presented in Chapter 8 under the section of 8.2 MIKE 21 FM TR Model Results for the easy comparison of current pattern and the effluent dispersion.

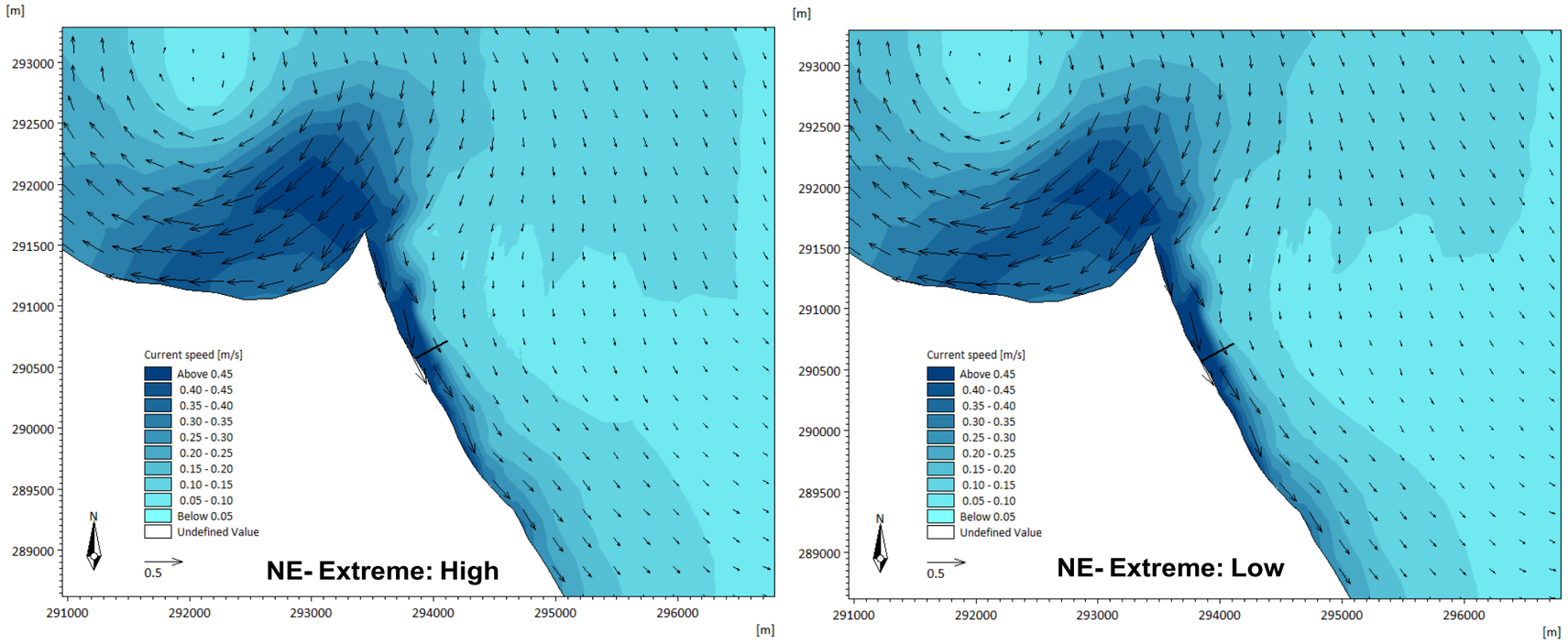


Figure 4.5: Current Pattern for NE-Extreme Condition during High (Left) and Low (Right) Tide

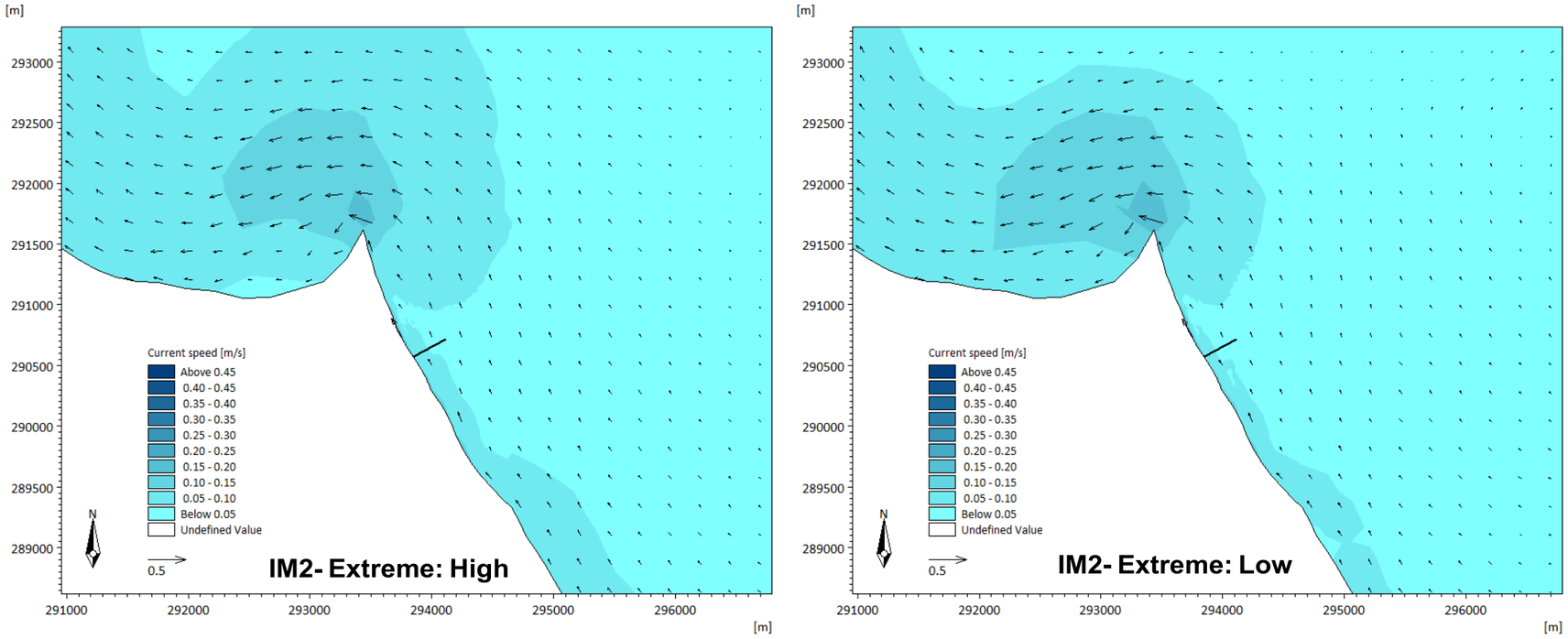


Figure 4.6: Current Pattern for NE-Average/IM-Extreme Condition during High (Left) and Low (Right) Tide

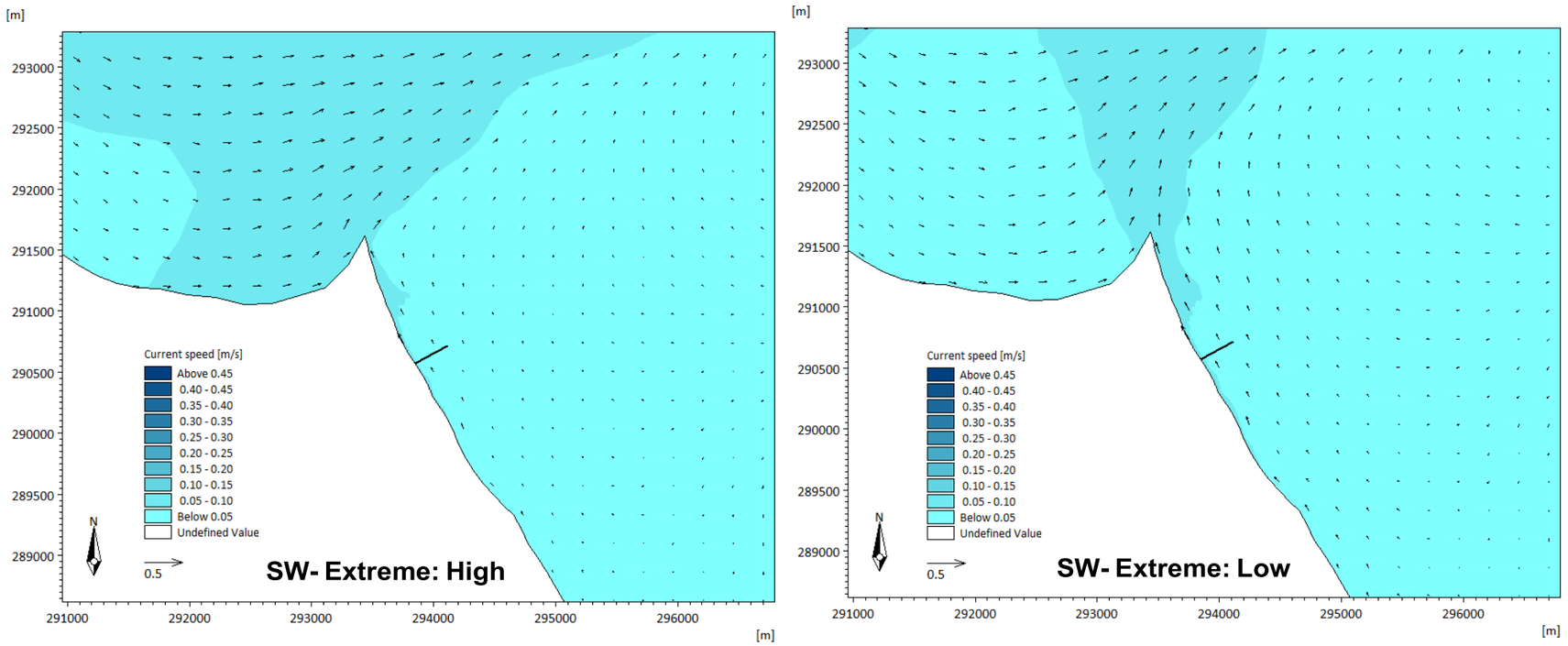


Figure 4.7: Current Pattern for SW-Extreme Condition during High (Left) and Low (Right) Tide

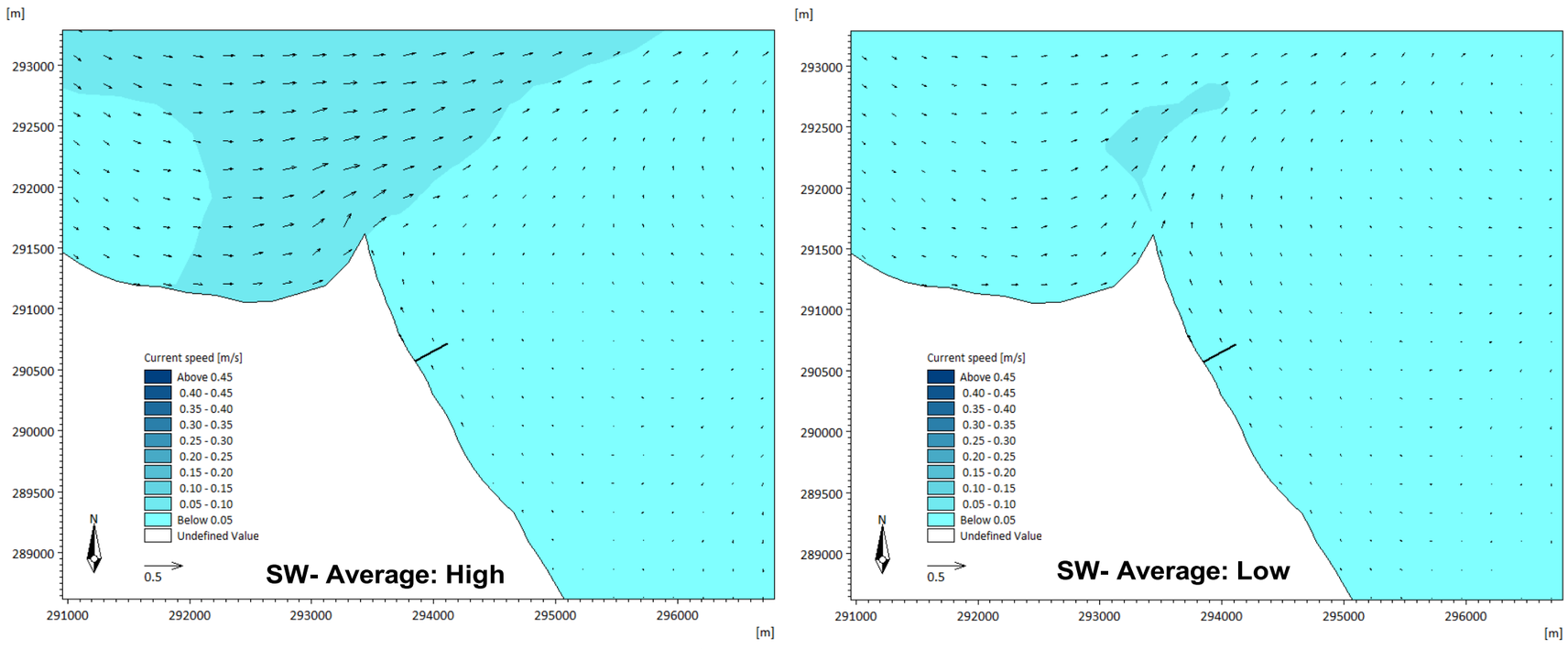


Figure 4.8: Current Pattern for SW-Average/IM2-Average Condition during High (Left) and Low (Right) Tide

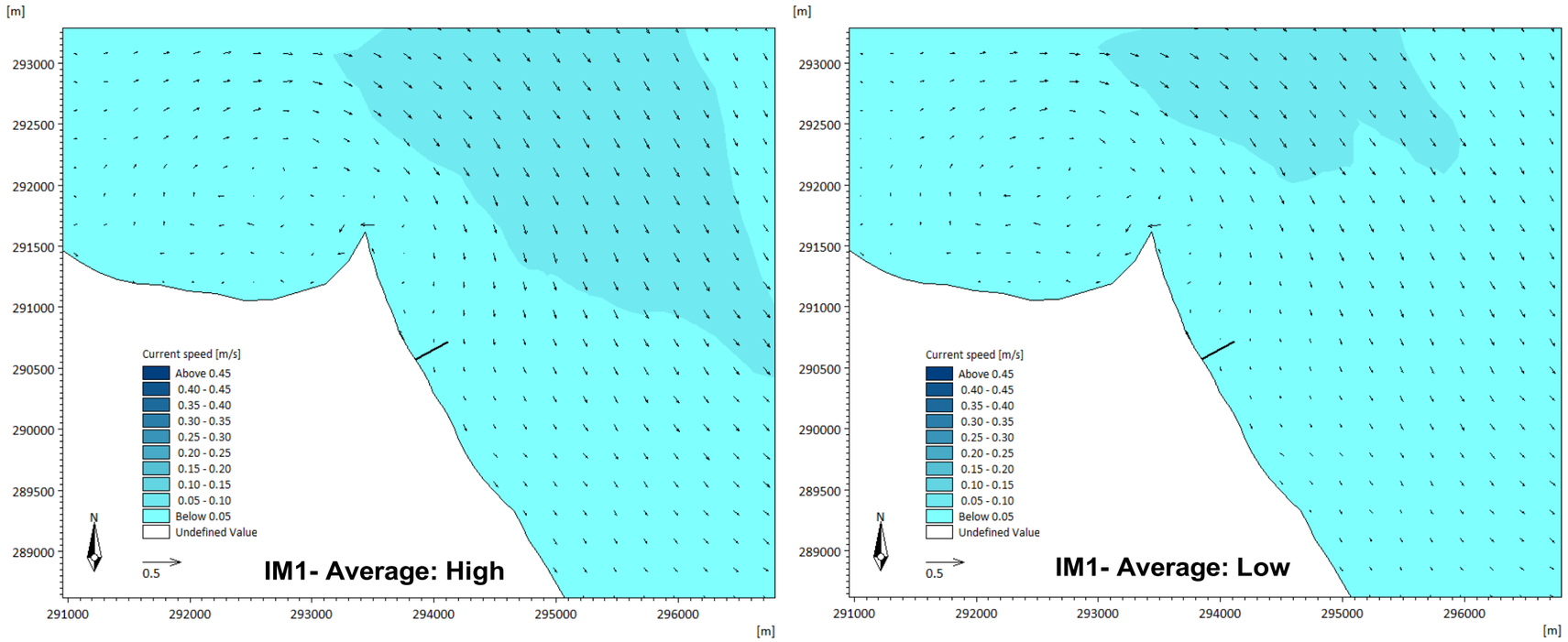


Figure 4.9: Current Pattern for IM1-Average Condition during High (Left) and Low (Right) Tide

As per the Figures 4.4 high currents are forming at the sea outfall location during the NE monsoon towards the South. Further, lower magnitude currents are existing during SW monsoon which is forming towards the North across the sea outfall (Figure 4.7). Therefore, it clearly indicates the direct correlation between dominant wave directions and the current direction at the sea outfall location.

However, detailed analysis of simulated data was carried out for further understanding of current speed and directions quantitatively. Accordingly, representative 4 locations were selected at different depths along the outfall pipe route (Figure 4.9). Summary of the characteristics of extracted current speed data is presented in Table 4.5.

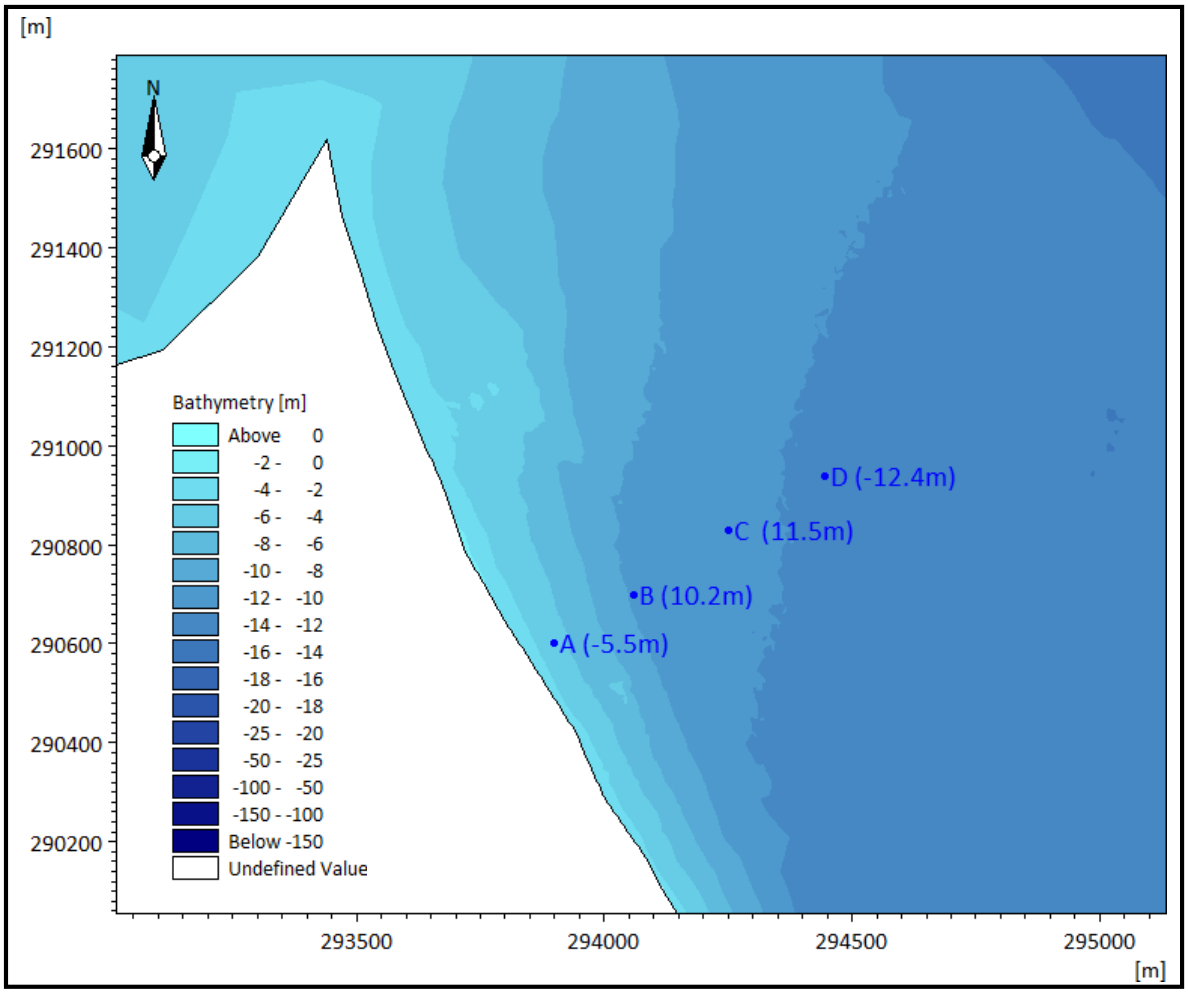


Figure 4.10: Current Data Extraction Points Table

4.5: Current Speeds at Different Depths along the Sea Outfall

Location (Depth in m)	Current Speed (m/s)				
	5.5	10.2	11.5	12.4	**10.8**
Minimum	0.010	0.010	0.010	0.010	**0.01**
Average	0.092	0.044	0.038	0.037	**0.04**
Maximum	0.504	0.193	0.134	0.118	**0.19**

Based on the required distance from the shore as well as preliminary estimation of the initial dilution, discharge depth was selected as **10.2 m**. Hence, detail analysis has been done for the existing currents at the discharge location during the different seasons. Analyzed current data (Table 4.6) has been used as the inputs for the near-field model (CORMIX).

Table 4.6: Current Speeds at the Sea Outfall Location

Scenario No.	Season	Condition	Wave parameters			Wind		Current Speed(m/s)		
			Hs (m)	Tp (s)	MWD (˚N)	Wind Speed (m/s)	Dir. (˚N)	Min.	Avg.	Max.
1a	SW	Avg (50%)	0.25	4.1	120	4.3	230	0.01	0.02	0.03
	IM2	Avg (50%)								
2a	SW	Ext (2%)	0.45	5.4	113	5.1	230	0.01	0.03	0.03
3a	IM1	Avg (50%)	0.50	7.6	91	3.0	305	0.01	0.01	0.03
4a	NE	Ext (2%)	2.70	9.1	42	4.5	30	0.01	0.18	0.19
	IM1	Ext (2%)								
5a	IM2	Ext (2%)	1.05	6.0	80	2.5	90	0.01	0.04	0.05
	NE	Avg (50%)								

Furthermore, currents rose plots for NE and SW monsoon are given in the Figure 4.10. It can be observed that currents are moving towards the Southeast direction with higher magnitude during the NE monsoon period at the discharge location. In contrast, current are propagating towards the Northwest direction during the SW monsoon and they have comparatively low magnitudes. It needs to be noted that current rose plot indicates current direction from the considered point while wave rose plots are showing the wave direction towards the considered point.

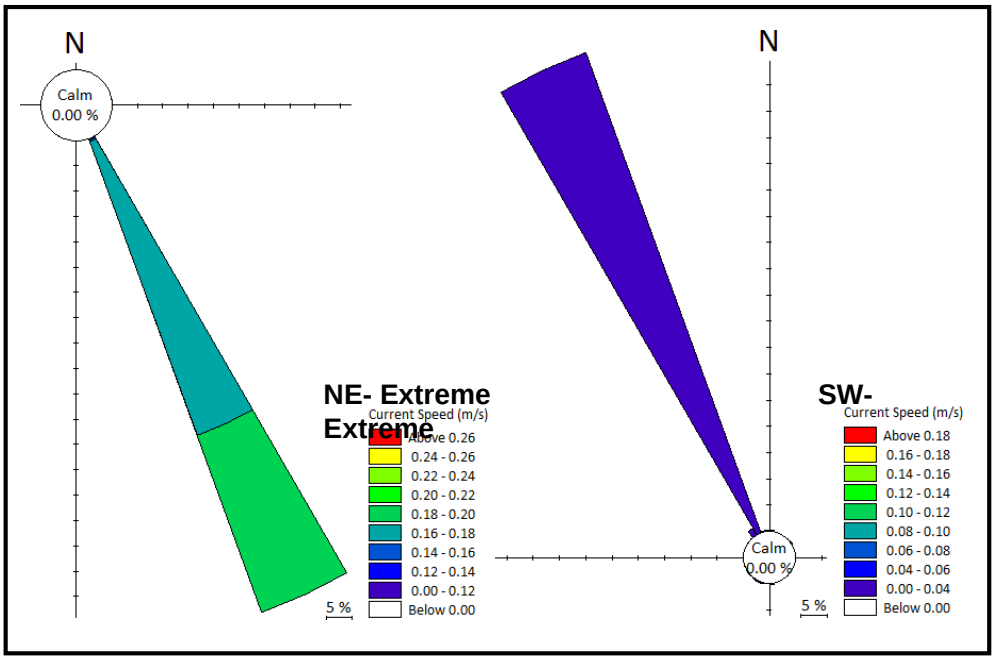


Figure 4.11: Current Rose Plot for Discharge Location during NE and SW Monsoons

5 SELECTION OF THE SEA OUTFALL LOCATION

The selection of sewage sea outfall location depends on the following considerations.

- Outfall location to be outside the surf zone to avoid the coastline to be exposed to diluted sewage due to littoral current
- Sufficient outfall depth for adequate initial dilution
- Possible short outlet pipe for economic reasons

5.1 Distance from the Shore

Even though the effluent is treated to comply with acceptable environmental norms, the discharge of effluent at very close proximity to coastline is a sensitive issue in the context of environmental conservation. On such circumstances, it is extremely essential to ensure that effluent constituent matter is diluted to acceptable levels within the receiving water in the immediate vicinity of the discharge point. Furthermore, as longshore currents are confined within the shallow water area adjacent to the beach it transports the discharged effluent over long distances if the discharge point is located within the surf zone. Therefore, outfall location to be outside the surf zone to avoid the coastline to be exposed to diluted sewage due to littoral current. Additionally, omitting of the surf zone helps to have a better function of sea outfall as there is a strong possibility for the outlet being subjected to blockage due to sediment accumulation caused by intense sediment movement in this surf zone. Hence, the calculation of the breaking depth was performed to identify the offshore limit of the surf zone. As the wave breaking has occurred around 3.0 m depth, discharge location is set to be beyond that depth which is about 50 m from the shore.

5.2 Appropriate Depth

Selection of the appropriate depth of sea outfall is the most important factor as it could directly affect the initial dilution of the effluent constituent matter. Therefore, initial dilution has been calculated for different depths to find out the suitable depth and the following constituents are considered as critical parameters while checking the initial dilution.

- Biochemical Oxygen Demand (BOD_5)
- Chemical Oxygen Demand (COD)
- Total Suspended Solids (TSS)
- Faecal Coliform (FC)

Assessment of the Initial dilution of effluent constituents

The calculation formulae applicable if effluent constituents are considered as a conservative matter for initial dilution calculations are presented below. Considering the short time taken for the effluent plume to rise to the water surface in shallow water depths these formulae are assumed to be valid for the relevant water quality constituents considered.

Single Port Discharge

For a single pipe discharging under stagnant ambient conditions, the average plume concentration (S_a) at the water surface is given by,

$$S_a = 0.089 g'^{1/3} Q^{-2/3} H^{5/3} \rightarrow (1)$$

$g' = g\Delta\rho/\rho$ in which Q is the average effluent discharge rate, H is the water depth and

Source: Ref 1

Multi-Port Diffuser

Different formulae are used for stagnant ambient, current parallel to the outfall (shore perpendicular) and current perpendicular to the outfall (shore parallel) as detailed in this section. The dilutions in these cases are expressed in terms of q, which is the discharge per unit length of the diffuser.

(a) Stagnant Ambient

The average dilution in the effluent field at the water surface S_a is given by,

$$S_a = \frac{0.54 g'^{1/3} H}{q^{2/3}} \rightarrow (2)$$

(b) Current Parallel to the Outfall

The average dilution in the effluent field at the water surface S_{aw} is given by,

$$S_{aw} = \frac{0.38 g'^{1/3} H}{q^{2/3}} \rightarrow (3)$$

It is seen that this dilution is independent of the current magnitude. However, the width of the effluent plume is dependent on the magnitude of the current and is given by,

$$b = 1.2(g' q)^{1/3} (L/U) \rightarrow (4)$$

in which, L is the length of the diffuser and U is the current speed.

Source: Ref 1

(c) Current Perpendicular to the Outfall

In this case, the average dilution in the effluent field at the water surface (S_a) under stagnant conditions given by Equation (1) is modified to take into account blocking effect of the already discharged effluent field above the outfall as follows:

$$S_{aw} = \frac{S_a}{1 + QS_a/UbH} \rightarrow (5)$$

The width (b) of the sewage plume as it reaches the water surface is taken as approximately equal to the length of the multi-port diffuser (L).

Source: Ref 1

The concentration of any constituent (C) may be determined using the computed dilution (S), if the background concentration of that constituent in the ambient sea (C_s) and the discharge concentration (C_d) are known, from the following equation.

$$S = \frac{C_d - C_s}{C - C_s} \rightarrow (6)$$

As the effluent discharge is high and hence it could not meet the required dilution, the single port (pipe) discharging has not been considered in this project.

Calculation of the initial dilution for each effluent constituents has been performed for different depths and the diffuser length to select the layout of the sea outfall. The orientation of both the main pipe and the diffuser are taken as perpendicular to the shore. As the longshore current in the study area is towards the South in general, the proposed Layout is representing the condition of current perpendicular to the outfall. Further, the initial dilution was performed considering following current conditions which have been obtained from the hydrodynamic modelling.

- Stagnant Condition (No Current)
- Weak Current Condition (0.01 m/s)
- Average Current Condition (0.05 m/s)
- High Current Condition (0.20 m/s)

The results indicates that the initial dilution for current perpendicular to the outfall is S_{aw}=38 at weak current while it is S_{aw}=162 for high currents. Further, concentrations of all the effluent constituents are within the acceptable limits given the CEA guideline for the coastal waters. Therefore, following details are used to perform the conceptual design for the short sea outfall.

- Pipe type ~ PE100, SDR22
- Main pipe diameter ~ 0.6 m
- Diffuser port diameter ~ 0.125 m
- Number of Ports ~ 15
- Discharge Depth~ 9 m
- Length of the pipe ~ 300 m
- Length of the diffuser section ~ 90 m

6 CONCEPTUAL DESIGN OF SEWAGE SEA OUTFALL

The design of sewage sea outfall is based on hydrodynamic, environmental and economic considerations and consists of the following components.

- Junction Box/Beach chamber
- Outlet pipe
- Diffuser

The selection of sewage sea outfall dimensions depends on the following considerations.

- Prevention of sedimentation within the pipe
- Ability to flush out the seawater
- Keeping the friction loss within reasonable limits
- Prevention of clogging
- High discharge velocity
- Acceptable pressure loss

6.1 Estimation of the Dimensions for the Outfall

The polyethylene-100 (PE-100) pipe with the pressure class PN6 has been selected as the material for the sea outfall. The selection of the pipe diameter is mainly depend on the minimum required velocity (0.7 m/s) through the pipe to prevent the clogging or the sedimentation inside the pipe and the value of the Densimetric Froude Number (>1) to prevent the sea water intrusion to the pipe. Hence, outer diameter for the main pipe is selected as 0.6 m as per the below calculations.

6.1.1 The Main Outlet Pipe

Data	
Peak discharge, Q , m^3/day	15000
Peak discharge, m^3/s	0.174
Sea Water density, ρ_{sea}, Kg/m^3	1025
Effluent water density, ρ_{ef}, Kg/m^3	1000
Gravitational acceleration, g , m/s^2	9.81
Pipe properties (Annex C)	
PE100	
PN 6	
SDR class 22	

Diameter Selection		
Minimum velocity though the pipe =0.7 m/s (Wilkinson and Wareham,1996)		
Area(A)	=Q/V	=0.25 m^2
Diameter (D)	=0.56 m	
	=560 mm	
Assume pipe Diameter	**=600 mm**	
Thickness of the pipe	=27.3 mm	
Internal Diameter	=545 mm	
To stop the sea water intrusion to the diffuser		
Densimetric Froude number (Wilkinson, 1988) $V/\sqrt{(Dg(\Delta\rho/\rho_0))} > 1$ $V/\sqrt{(Dg(\Delta\rho/\rho_0))}$ = **2.032 >1** $D < [16Q^2/(\pi^2 g(\Delta\rho/\rho))]^{\frac{1}{5}}$ $[16Q^2/(\pi^2 g(\Delta\rho/\rho))]^{\frac{1}{5}}$ = **1.143>D=0.545**		
Therefore, PE100 pipe with 600 mm outer diameter is selected		

6.1.2 The Diffuser Section

The Design Consideration for multi-port diffuser is mentioned below.

- A minimum port diameter of 100 mm is often used by designers in order to prevent clogging, to reduce consequences of bio-fouling and facilitate maintenance.
- It is preferable to set ports horizontal for a higher surface dilution. It is common practice in sea outfall design to have ports that discharge perpendicular to diffuser axis.
- The flow should be fairly evenly distributed among ports. The outfall pipe diameter may be varied within the diffuser section in order to accomplish equal flow distribution among ports. The total port area downstream of any section should be less than the pipe area of that section. The best area ratio (total port area/pipe area) for good flow distribution among ports is usually obtained at a value between 1/3 and 2/3.
- The port spacing should not be too close so that rising plumes from them will interact with each other before reaching the water surface. Additionally, they should not be too far so that they will function as isolated point sources thus resulting in greatly reduced dilutions compared to those computed considering the entire diffuser section as a continuous line

source. As a rule of thumb port minimum spacing equal to one-third water depth has been used but should not be considered as a precise guideline.

The head loss calculation was performed parallel with initial dilution to optimize the beach chamber height and number of diffuser ports.

The geometry of the diffuser section has been established based on results of hydraulic calculations and following the guidelines given above. The diameter of the outfall pipe is 0.6 m. In diffuser section, ports are placed at a uniform spacing of 6.43 m. The total number of ports are 15, resulting in a total diffuser section length of 90 m (Table 6.1).

Table 6.1: Summary of the Diffuser Port Selection

Pipe Diameter(outer)	0.6 m
Port Diameter(outer)	125 mm
Port Spacing	6.43 m
No. of Ports at downstream	15
Area Ratio	0.65

6.2 Required Head Calculation

The Pressure Drop (Δh) in pipeline

$\Delta h = f^*(L/D)^*(V^2/2g) + \sum k^*(V^2/2g) + (\Delta p/p_o)^*y$

f = coefficient of friction
L = length of pipe (m)
D = internal diameter (m) v
= velocity in pipe (m/s)
g = acceleration of gravity (= 9.81 m/s^2)
Σk = sum of coefficients for singular head losses
Δρ = density difference between water inside the pipe and water in recipient (kg/m3)
ρ_o = density of water inside the pipe (kg/m^3) y
= water depth at outlet point in recipient

Data

Internal Diameter of PE Pipe	0.545 m
Flow	0.174 m^3/s
Pipe Length (From Beach chamber to Diffuser Section)	300 m
Pipe Length (Diffuser Section)	90 m
Internal Diameter of Diffuser Port	0.114 m

Viscosity of Water (T=20 ^{o}C)	$1x10^{-6}$ m^2/s
Density of Water	1000 kg/m^3
Density of Sea Water	1025 kg/m^3
Receiving Water Depth (At outlet)-Option 1D	9 m
Design Tide for Port/Harbour, T_D	+ 0.8 m MSL
Elevation at the Beach chamber outlet	Not known
Absolute Roughness (k_s) of HDPE Pipe	0.0015 mm
Singular Head loss K factor	
Inlet and Outlet	0.5 and 1.0
Elbow	$1.1*(\Theta/90)^2$
Smooth Bend	0.2 Sin Θ
Calculation of Coefficient of Friction Reynolds Number (Re) Re = VD/ v V = velocity D = internal diameter (m) v = viscosity of water (m^2/s)	
Velocity Through the Main Pipe = $4Q/\pi D^2$	0.743 m/s
Reynolds Number-Main Pipe (Re)	4.05E+05
Velocity Through the Diffuser Port = $4Q/\pi D^2$	1.142 m/s
Reynolds Number- Diffuser Port (Re)	1.30E+05
$\frac{1}{\sqrt{f}} = -2.\log\left[\frac{1}{3.71}\left(\frac{k_s}{D}\right) + \frac{2.51}{Re.\sqrt{f}}\right]$	
Coefficient of friction (f) for PE pipe-Main	0.01371
Coefficient of friction (f) for PE pipe-Diffuser Port	0.01713

Head loss calculation for the pipe from the beach chamber to the discharge point	
Option	**15000 m^3/day**
Friction Head loss (Main pipe)	
$\Delta h_f = f*(L/D)*(V^2/2g)$	0.234 m
Singular Head loss (Main pipe)	
$\Delta h_s = \sum k*(V^2/2g)$	0.084 m
Density Head loss	
$\Delta h_p = (\Delta\rho / \rho_o)*y$	0.225 m
Total Head Loss in Diffuser Port; Δh_{po}	
Δh_{po}	0.261 m
Total head loss, $\Delta h=(\Delta h_f+\Delta h_s+\Delta h_p+\Delta h_{po})+T_D$	0.804 m + 0.8 m = 1.604 m
Head at the Beach Chamber $H = h_B + \frac{v_B^2}{2.g} + \frac{P_B}{\rho_w.g}$	
Considering safety margin of 1 m	
Total head required at the beach chamber	**2.60 m**

As the elevation of the proposed beach chamber is not known, the total head required for 15,000 m^3/s discharge is 2.60 m. Hence, other two options (10,000 m^3/s and 5,000 m^3/s) are able to fulfil the hydraulic design criterion with 2.6 m head at the beach chamber.

6.3 Details of Sea Outfall

The proposed outfall is to be designed for the average Wastewater Flow of 15,000 m^3/day. The predefined details of the short sea outfall system as follows. However, these details are varied at the conceptual design stage using numerical modelling results and finalized in detailed design stage. Usage of a beach chamber will be considered at the detail design stage in order to have cost effective and well-functioning sea outfall system.

- Pipe type ~ PE100, SDR22
- Main pipe diameter ~ 0.6 m
- Diffuser port diameter ~ 0.125 m
- Number of Ports ~ 15
- Port Spacing ~ 6.43 m
- Port height ~ 1.50 m
- Discharge Depth~ 9 m (Could be changed due to numerical modelling results)
- Length of the pipe ~ 300 m (Could be changed due to seabed depth details)
- Length of the diffuser section ~ 90 m

6.4 Determination of the Required Weighting for Sinking

As the PE material has less specific gravity than surrounding water, the pipe floats due to buoyancy if it is not loaded by concrete weights. Therefore, required concrete weight was calculated by using following formula and obtained dimensions for different pipe diameters are shown in **Annex C**.

$$F_B = 0.00545 D_o^2 \rho_w \left[4.24 \frac{(DR-1.06)\rho_p}{(DR)^2 \rho_w} + \left(1-\frac{2.12}{DR}\right)^2 (1-R)\frac{\rho_c}{\rho_w} - 1\right]$$

F_B = buoyant force,lbs/feet of pipe

D_0 = external diameter of pipe, in

DR = pipe dimension ratio, dimensionless

R = fraction of inner pipe volume occupiedby air

ρ_w = density of the water outside the PE pipe, lbs/cu.ft

ρ_p = density of the pipe material, lbs/cu.ft

ρ_c = density of pipe contents,lbs/cu.ft

DR = 22

R = 100%

ρ_w = 1025 kg/m^3

ρ_p = 961kg/m^3

ρ_c = 1000 kg/m^3

Concrete ballasts of 280 kg need to be placed at 10 m spacing along the proposed pipe to anchor the pipe at the sea bottom. Refer the **Drawing No.2 and No.3** in **Annex B** for the details. Other than that, the sea outfall pipe needs to be covered by 2 m protection layer and diffuser port could be protected as shown in **Drawing No.2 and No.3** in **Annex B.**

7 NEAR FIELD MODELLING

The hydrodynamics of an effluent discharging into a receiving water body can be conceptualized as a mixing process occurring in two separate regions. In the first region, the initial jet, jet trajectory and mixing influence by characteristics of momentum flux, buoyancy flux, and outfall geometry. This region will be referred to as '*Near- Field*'.

As the turbulent plume travels further away from the source, the source characteristics become less important. Conditions existing in the ambient environment will control the trajectory and dilution of the turbulent plume through buoyant spreading motions and passive diffusion due to ambient turbulence. This region is referred to as '*Far- Field*'. It needs to be considered that the division of near and far-field mixing is purely based on hydrodynamics ground.

Under the present study, *CORMIX* model was applied to study near field mixing while MIKE 21 FM Transport module was applied to assess far-field mixing and to detail study of the movement and circulation pattern of BOD_5, COD, TSS and Faecal Coliforms. Numerical model runs were performed for the given discharges 15000, 10000 and 5000 m^3/day (0.174, 0.116, 0.058 m^3/s) for both average and extreme hydrodynamic conditions, and for all four seasons. Further, it was assumed that the effluent will be treated up to the CEA standards for short sea outfall so that the concentrations of BOD_5, COD, TSS and Faecal Coliform, are 75 mg/l, 250 mg/l, 50 mg/l and 15000 MPN/l respectively. Since there was no information on the ambient water quality, the concentrations of the constituent will be assumed as zero. The above information was received from the client and the National Water Supply & Drainage Board (NWSDB).

7.1 CORMIX Modelling System

CORMIX is a comprehensive software system for the analysis, prediction, and design of outfall mixing zones resulting from discharge of aqueous pollutants into diverse water bodies. CORMIX has been developed under several cooperative funding agreements between U.S. EPA, U.S. Bureau of Reclamation, Cornell University, Oregon Graduate Institute, University of Karlsruhe, Portland State University, and MixZon Inc, during the period of 1985-2007. It is a modular, object oriented, software system with integrated CAD tools for outfall design and management. In addition to the comprehensive peer review through refereed scientific publication by its developers, CORMIX has an extensive track record of over 18 years of independent successful application by academics, regulators, and consultants. The highly user interactive CORMIX CAD system is implemented on the Windows platform and consists of four hydrodynamic models. These are CORMIX 1 for single port discharges, CORMIX2 for multiport diffuser discharges, CORMIX3 for buoyant surface discharges, and DHYDRO for the analysis of brine and sediment discharges in unbounded coastal environments (CORMIX User Manual – 2017). At the heart of CORMIX is a flow classification system contained in the classification rule base. It provides a rigorous and robust expert knowledge base that carefully distinguishes among the many

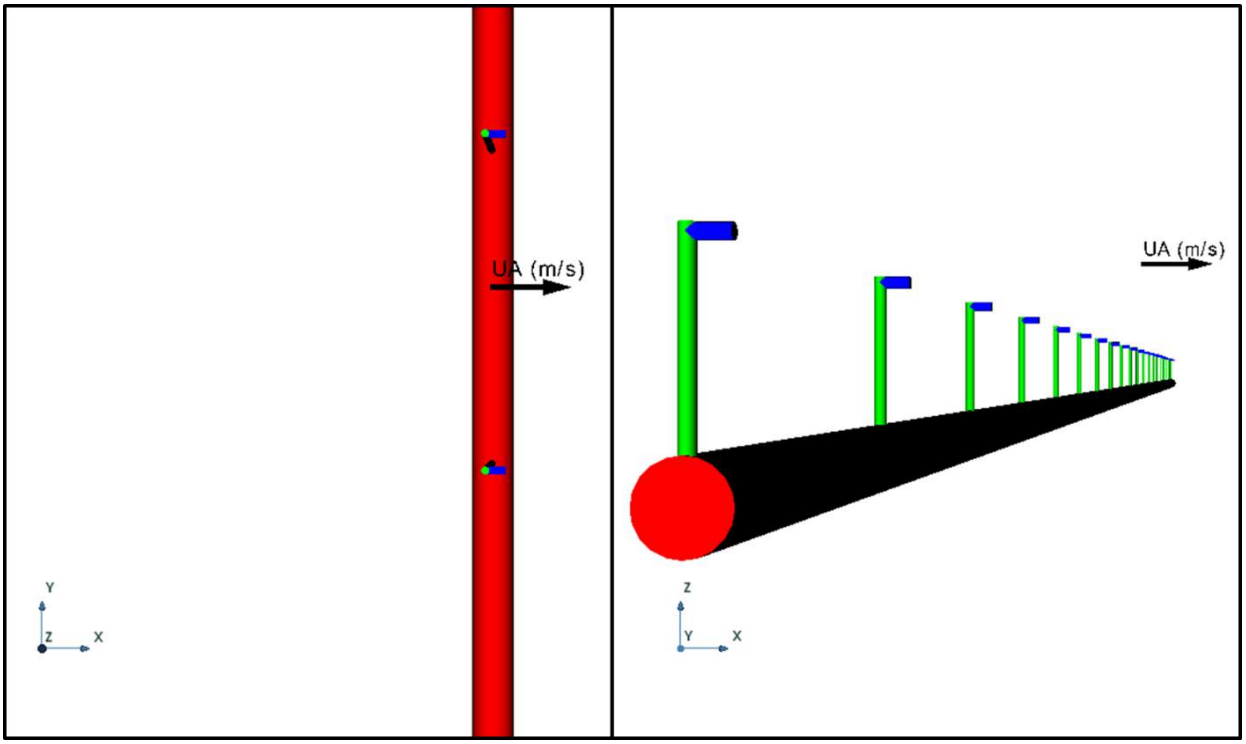
hydrodynamic flow patterns that a discharge may exhibit. There are about 160 distinguished generic flow configurations.

The major emphasis of the system is predicting geometry and dilution characteristics of the initial mixing zone, it also applicable for predicting the behaviour of the discharge plume at larger distance.

7.2 Modelling Simulations

For the estimated average and extreme wave, wind conditions and for all the four seasons, the CORMIX model runs were performed, in order to study the near-field mixing in detail. In the present study, the diffusers were modelled as a multiport diffuser, as a linear structure consisting of many closely spaced ports which inject a series of turbulent jets at high velocity into the ambient water body. Further it is assumed that the diffusers point to one direction (pointing to South), oriented normal to the diffuser line, and horizontal. See Figure 7.1 for the details of ports used in CORMIX model.

Figure 7.1: CORMIX model – Diffuser Ports (UA(m/s) shows the current direction) : (a) Plan View, (b) 3D View



Input data groups consist of project descriptions, effluent properties, ambient conditions, discharge conditions, mixing zone definitions, and output control. The discharge conditions relate to the geometric and flux characteristics of the submerged outfall installation. For multiport diffuser installations the arrangement of the individual ports along the diffuser line, the orientation of the diffuser line, port diameter, its elevation above bottom and the construction details represent geometric features. The flux characteristics are defined by the effluent discharge flow

rate, by its momentum flux and by its buoyancy flux. The buoyancy flux represents the effect of the relative density difference between the effluent discharge and ambient conditions in combination with gravitational acceleration. Buoyancy flux is a measure of the tendency for the effluent flow to rise or fall. Effluent discharge flow rate or discharge velocity, discharge density or discharge temperature, discharge concentration input data is needed. CORMIX analysis is usually carried out under the assumption of steady state ambient conditions. Even though the actual water environment is never in a true steady state, this assumption is usually adequate since mixing processes are quite rapid relative to the time scale of hydrodynamic variations. Since interaction of the effluent plume with shore is unlikely, unbound condition is considered in the present study. As stated in CORMIX manual (2017), in the present study Darcy friction factor, *f*, is set to 0.02

In the present study, BOD_5, COD, TSS and Faecal Coliform, were considered as conservative. For the CORMIX model simulations, the current data was obtained based on MIKE 21 FM HD model run results. Based on the MIKE 21 FM HD local model run, the current data was extracted at the diffuser location. Based on the extracted data minimum, average and maximum current condition were estimated and used in CORMIX model. Initially, CORMIX model was run for extracted current velocity data, and assuming the current direction to be parallel to the beach, perpendicular to the beach, and current direction estimated based on extracted data, for monsoon conditions. Based on CORMIX model results, it was realized that critical condition is when the current direction is parallel to the beach, hence all the model runs were carried out for a current which is parallel to the beach. Further, the proposed diffusers are located at average depth of

10.8 m so that the effluent is discharged at 9.0 m depth, and also the diffuser is located in a straight beach, hence the dominant current direction could be parallel to the beach. See Table

7.1 for a summary of test conditions. Since the lower current speed (<0.03 m/s) produce the unrealistic results such conditions were assumed as stagnant (no current) condition for CORMIX simulations. Therefore, out of all five monsoonal conditions (SW-Avg, High; IM1-Avg; NE-High; IM2-High) only NE and IM2 conditions were simulated considering the Min, Avg and Max current speeds.

Table 7.1: Summary of CORMIX Model Inputs

CORMIX Parameters		Units	SW		IM-1		NE		IM-2	
			Avg	High	Avg	High	Avg	High	Avg	High
A	**Effluent Parameters**									
A.1	Type		Conservative							
A.2	BOD_5 Concentration	mg/l	75		75		75		75	
A.3	COD Concentration	mg/l	250		250		250		250	
A.4	TSS Concentration	mg/l	50		50		50		50	
A.5	Faecal Coliform Concentration	MPN/l	1500		1500		1500		1500	
A.6	Flow Rate	m^3/s	0.174/0.116/0.058							
A.7	Density	kg/m^3	1000.0		1000.0		1000.0		1000.0	
A.8	Temperature	^0C	29		29		29		29	
B	**Ambient Flow Field**									
B.1	Average Depth	m	10.8							
B.2	Depth at discharge	m	9.0							
B.3	Wind Speed	m/s	4.3	5.1	3.0	N/S	N/S	4.5	N/S	2.5
B.4	Current Velocity Steady	Min (m/s)	0.01*	0.01*	0.01*			0.01		0.01
		Avg (m/s)	0.02*	0.03*	0.01*			0.18		0.04
		Max (m/s)	0.03*	0.03*	0.03*			0.19		0.05
B.5	Darcy		0.02							
B.6	Ambient Density Uniform	kg/m^3	1025							
C	**Discharge Multiport**									
C.1	Nearest bank is on the		Right							
C.2	Diffuser Length	m	90							
C.3	Distance to the 1st diffuser	m	306							
C.4	Distance to the last diffuser	m	390							
C.5	Port height	m	1.5							
C.6	Port Diameter	m	0.125							
C.7	Contraction ratio		1							
C.8	Total NO of openings		15/10/05							
C.9	Alignment angle - GAMMA	degree	90	90	90	90	90	90	90	90
C.10	Unidirectional Configuration									
	Vertical - THETA	degree	0							
	Horizontal - SIGMA	degree	0	0	0	0	0	0	0	0
	Relative orientation - BETA	degree	90							
	Nozzel direction		Same Direction							

Note: N/S-Not Simulated; *-Simulated for Stagnant Condition

7.3 CORMIX Model Results

Figures 7.2 to 7.4 for provide the BOD_5 mixing in near field for 15000 m^3/s effluent discharge, for stagnant, NE average (IM2 Extreme) and NE extreme wave/wind conditions for maximum current condition. In the figures, the 3D view, plan view, and side view are shown. In addition, the location of end of near field is shown. The *Near Field Region (NFR),* is the zone of strong initial mixing, corresponding to the 'near – field' processes. Table 7.2 gives a summary of CORMIX model results.

As the Figures 7.2 to 7.4 show, the effluent flow from a submerged discharge port provides a velocity discontinuity between the discharged fluid and the ambient fluid causing an intense shearing action. The shearing flow breaks down rapidly into a turbulent motion. The width of the zone of high turbulence intensity increases in the direction of the flow by incorporating more from the outside, less turbulent fluid into this zone. For a diffuser in linear stratified sea water the buoyant jets will rise through the stratified environment until they reach an equilibrium level. This is often below the surface of the ocean and in this case the final diluted sewerage cloud remains submerged. During the plume rise the buoyant force is provided by the density difference between the rising effluent and the density of the surrounding fluid at the level of effluent. At equilibrium this density difference disappears and the further rise of the plume depends on the momentum flux at this level. When the rising effluent does not reach an equilibrium level it rises to the ocean surface with some density deficit remaining. At the ocean surface the density difference between the ocean and the air is large, compared to the density difference in the plume and the small elevation change at the surface provides sufficient pressure gradient to redirect the flow horizontally (Wood I.R, Bell. R.G and Wilkinson D. L. (1993).

As per the CORMIX model results, it can be seen that for most of the cases, individual jet appears, which is the desirable condition. As explained in Wood I.R, Bell. R.G and Wilkinson D. L. (1993), a decrease in the rate of average dilution starts when the jets merge. Hence having individual jets is desirable for effective/efficient BOD_5, COD, TSS and FC dispersion. The results indicate the higher concentration for stagnant condition at the NFR compared to other conditions. Further, it gives the minimum distance of 1.0 m to the NFR from the diffuser section. Since the ambient current is not considered, only the density difference between effluent and the receiving water supports the dilution in the stagnant condition. Therefore, this can be considered as worst case scenario for near-field dispersion.

Based on CORMIX model runs, it can be seen that, for all the cases, BOD_5, COD, TSS and FC levels do not violate the CEA guide line - National Environmental Act No 47 of 1980 conditions,

i.e. for short sea outfalls for 15000 m^3/s effluent discharge. 1a.

Tolerance limit value for BOD_5 at diffuser = 15 mg/l

1b. Minimum dilution factor of 1:5 at a distance 2.5 m from the diffuser for BOD_5 2a.

Tolerance limit value for COD at diffuser = 50 mg/l

2b. Minimum dilution factor of 1:5 at a distance 2.5 m from the diffuser for COD 3a.

Tolerance limit value for TSS at diffuser = 30 mg/l

3b. Minimum dilution factor of 1:1.7 at a distance 1.5 m from the diffuser for TSS 1a.

Tolerance limit value for Faecal Coliform (FC) at diffuser = 1500 MPN/l

1b. Minimum dilution factor of 1:10 at a distance 3.0 m from the diffuser for FC

The concentration values of BOD_5, COD, TSS and FC extracted from CORMIX model at end of near filed was used in MIKE 21 FM Transport model as the source value, in far field mixing study.

Table 7.2: Summary of CORMIX Model Results for 15000 m^3/s

Parameter		SW Avg			SW Ext			IM-1 Avg			NE Ext			IM-2 Ext			Annual		
	Current Condition	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Stag.	Avg	Max
Current Speed m/s		0.010	0.021	0.027	0.005	0.030	0.035	0.007	0.013	0.027	0.010	0.177	0.193	0.010	0.042	0.048	0.010	0.044	0.193
BOD_5 concentration at NFR edge (MPN) mg/ l	c	2.03									2.03	0.08		2.03	0.95		2.03	0.95	0.08
COD concentration at NFR edge (MPN) mg/ l	c	6.76									6.76	0.28		6.76	3.17		6.76	3.17	0.28
TSS concentration at NFR edge (MPN) mg/ l	c	1.35									1.35	0.06		1.35	0.63		1.35	0.63	0.06
FC concentration at NFR edge (MPN) /ml	c	403									403	16		403	186		403	186	16
Dilution at edge of NFR	s	37									37	888		37	79		37	79	888
NFR Location (centreline coordinates) (m)	x	3.56									3.56	45		3.56	8.25		3.56	8.25	45
Cumulative Travel Time (s)	t	18									18	235		18	66		18	66	235

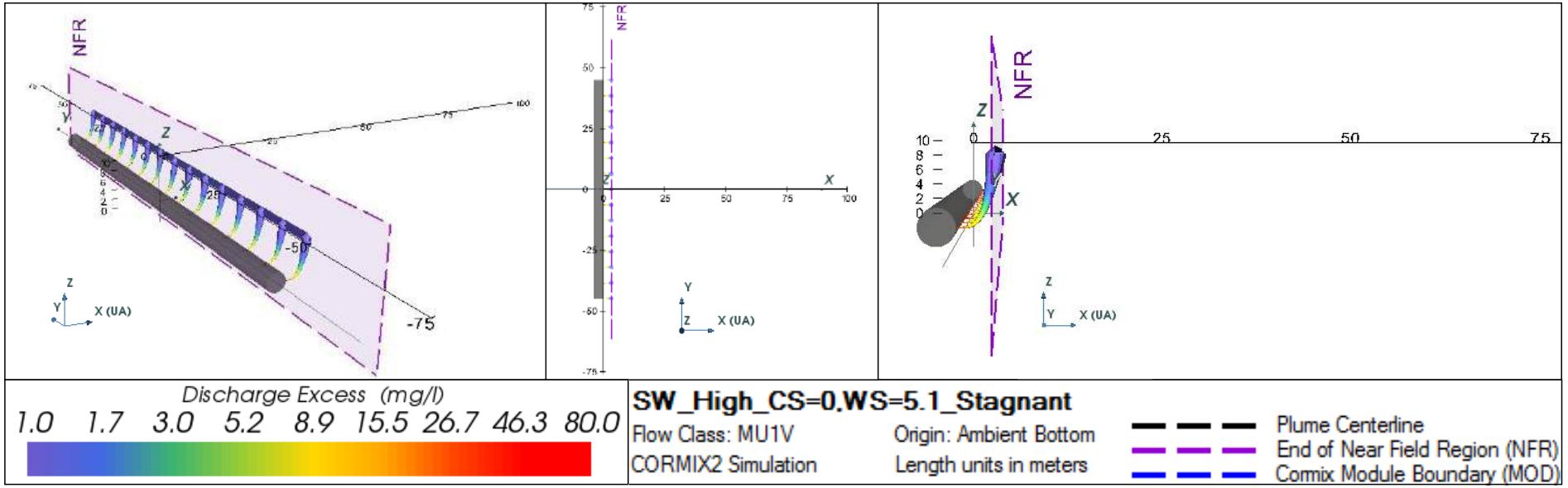


Figure 7.2: BOD_5 Concentrations for Stagnant Condition: 3D View (Left), Plan View (Middle) and Side View (Right)

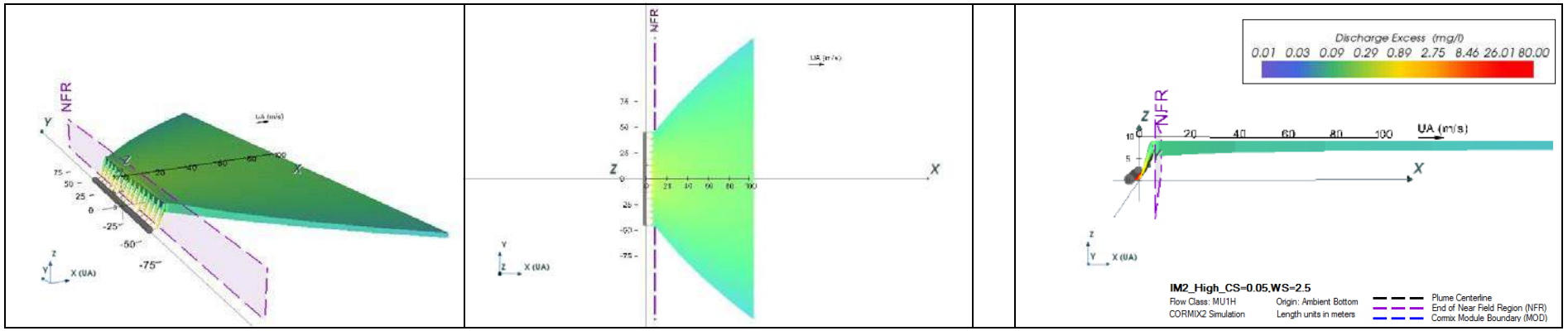


Figure 7.3: BOD_5 Concentrations for IM2-Extreme Condition: 3D View (Left), Plan View (Middle) and Side View (Right)

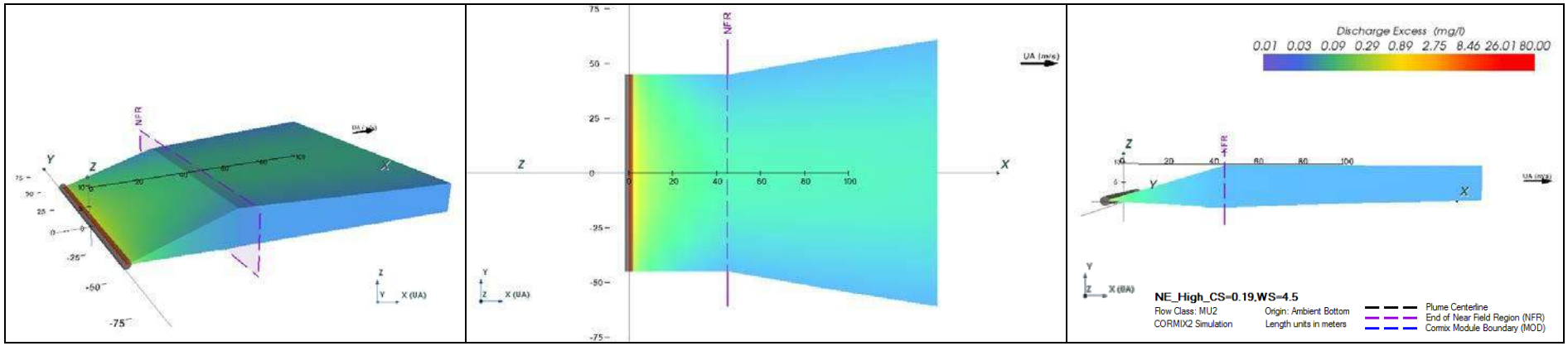


Figure 7.4: BOD_5 Concentrations for NE-Extreme Condition: 3D View (Left), Plan View (Middle) and Side View (Right)

8 FAR FIELD MODELLING

Far field is defined as the region of the receiving water where buoyant spreading motions and passive diffusion control the trajectory and dilution of the effluent discharge plume. In far field, mixing mechanisms are dominated by the ambient receiving water conditions, particularly ambient current velocity and density differences between the mixed flow and the ambient receiving water. Far field mixing processes are characterized by the longitudinal advection of the mixed effluent by the ambient current velocity. They can be effective transport mechanisms that can quickly spread a mixed effluent laterally over large distances in the transverse direction, particularly in cases of strong ambient stratification. The existing turbulence in the ambient environment becomes the dominating mixing mechanism at sufficiently large distance from the discharge point. In general, the passively diffusing flow grows in width and thickness until it interacts with the channel bottom and/or banks. In the present study, MIKE 21 Flow Model Hydrodynamics module (MIKE 21 FM HD) coupled with MIKE 21 Flow Model Transport module (MIKE 21 FM TR) was used for detail study of BOD_5, COD, TSS and faecal coliform far field mixing.

8.1 MIKE 21 FM TR Model Applications

Based on the CORMIX model results, the constituents' concentration levels at the end of near filed is extracted, and used as the source in MIKE 21 FM TR module. Two adjustments were done for the CORMIX output value while assigning the input concentrations for the TR model. Since the initial concentration was taken as the depth and area average value at the particular element of the source point these adjustments were utilized. MIKE FM TR model runs were carried out for all four seasons, and for estimated average and extreme wave/wind conditions. The local models were simulated to cover minimum of three tidal circles (7 days for each), including neap and spring tide. In the MIKE 21 FM TR model, BOD_5, COD, TSS and faecal coliform, were considered as conservative. Even though the CORMIX model simulation was given the minimum, average and maximum concentration for particular wave and wind condition (ex. NE-Ext, SW-Avg) maximum concentrations of each constituents were selected for far-field (MIKE 21 FM TR) modelling. Selected conditions for MIKE 21 FM TR modelling are given in the Table 8.1. Since the most of the parameters in 1b and 2b scenarios are almost same 2b was not simulated in far-field modelling.

Table 8.1: Selected Conditions for Far-Field Modelling

Scenario No.	Season	Condition	Wave Parameters			Wind		Concentrations at NFR (mg/l)				TR
			Hs (m)	Tp (s)	MWD (˚N)	Speed (m/s)	Dir. (˚N)	BOD	COD	TSS	FC	
1b	SW	Avg (50%)	0.25	4.1	120	4.3	230	2.03	6.76	1.35	2.03	√
	IM2	Avg (50%)										
2b	SW	Ext (2%)	0.45	5.4	113	5.1	230	2.03	6.76	1.35	2.03	×
3b	IM1	Avg (50%)	0.50	7.6	91	3.0	305	2.03	6.76	1.35	2.03	√
4b	NE	Ext (2%)	2.70	9.1	42	4.5	30	0.08	0.28	0.06	0.08	√
	IM1	Ext (2%)										
5b	IM2	Ext (2%)	1.05	6.0	80	2.5	90	0.95	3.17	0.63	186	√
	NE	Avg (50%)										

8.2 MIKE 21 FM TR Model Results

Figures, 8.1 to 8.8 for the BOD_5, COD, TSS and faecal coliform dispersion pattern in far-field model. In these figures, the images relevant to high and low tides are only shown. The upper-left hand plots show the current pattern and, upper-middle and upper-right hand plots show the relevant BOD_5 and COD concentration plots respectively. The relevant TSS and faecal coliform concentration plots are shown in the below-left and below-right respectively. Far-field modelling results also indicates that the maximum dispersion of the effluent could be obtained during the NE monsoon with lower concentrations (Figures 8.1 and 8.2). In contrast, a weak dispersion of the effluent has been observed during SW monsoon average condition as it run for the highest near-field concentration with a lower wave condition (Figure 8.7 and 8.8). Therefore, as shown in the below figures, BOD_5, COD, TSS and faecal coliform concentrations do not reach 15 mg/l, 50 mg/l, 30 mg/l and 1500 MPN/l levels respectively, the critical values based on CEA guidelines.

During a marine biological survey it was found that the presence of the coral reef at the offshore of the Eravur headland. Even though the selection of the outfall location has been done by omitting that coral reef area, the extent of the plume was examined for the worst case which is SW monsoon (Figure 8.9). It is evident that the plume is not created advise impact to the existing coral reef as the concentrations near the plume edge is negligible.

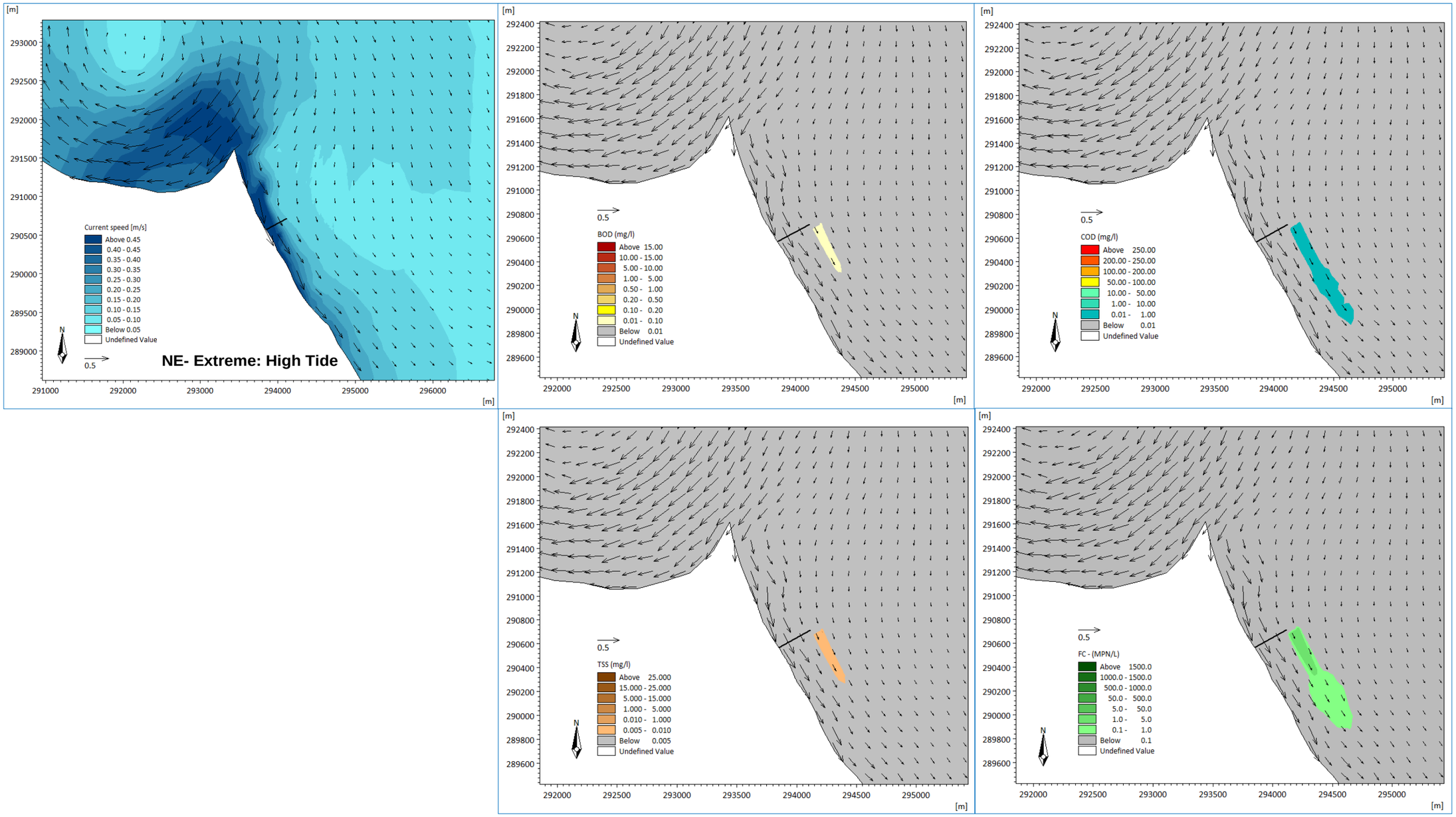


Figure 8.1: Current Pattern (Upper-Left), BOD_5 (Upper-Middle), COD (Upper-Right), TSS (Lower-Left) and FC (Lower-Right) Concentrations for NE-Extreme Condition during High Tide

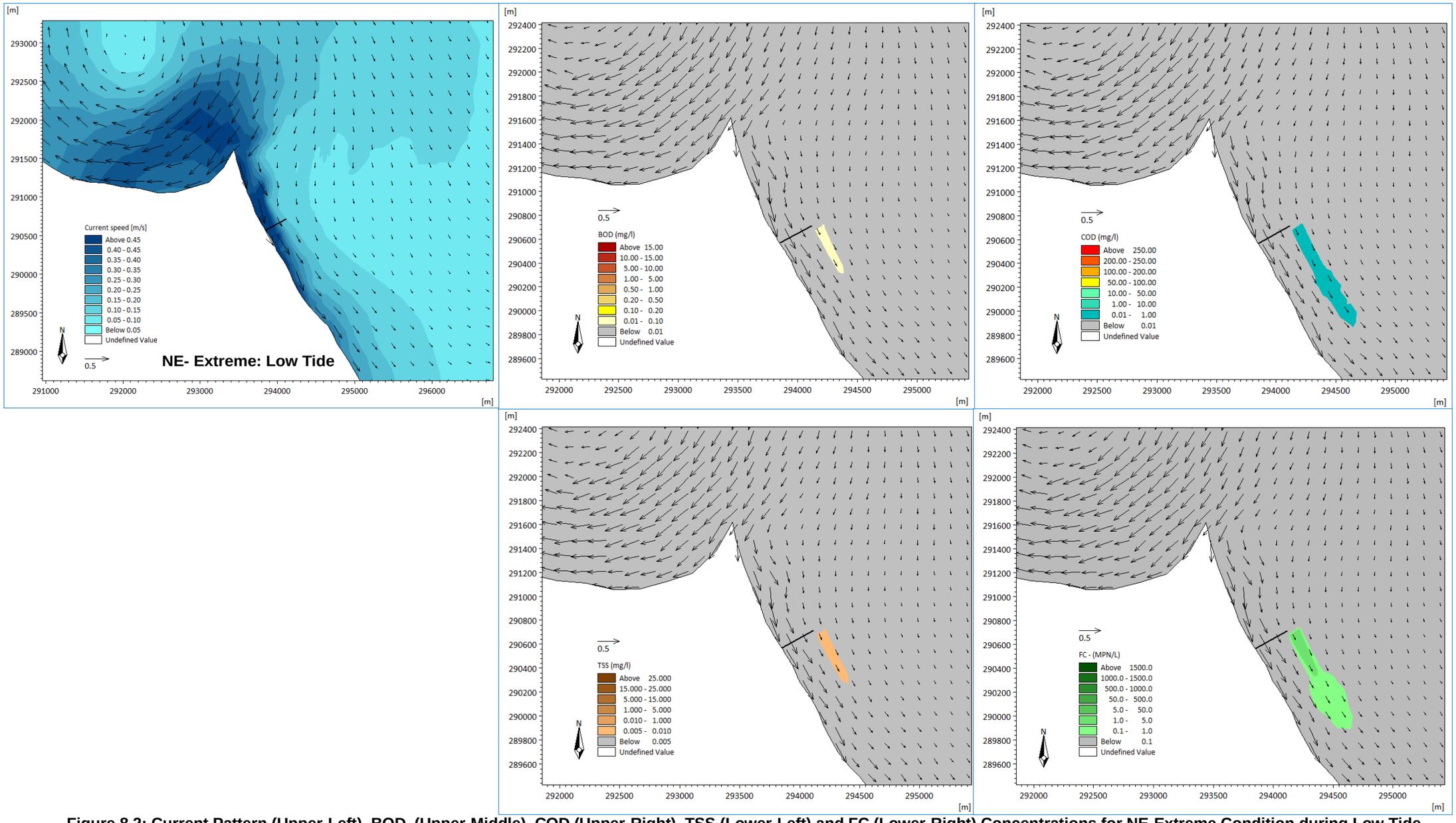


Figure 8.2: Current Pattern (Upper-Left), BOD_5 (Upper-Middle), COD (Upper-Right), TSS (Lower-Left) and FC (Lower-Right) Concentrations for NE-Extreme Condition during Low Tide

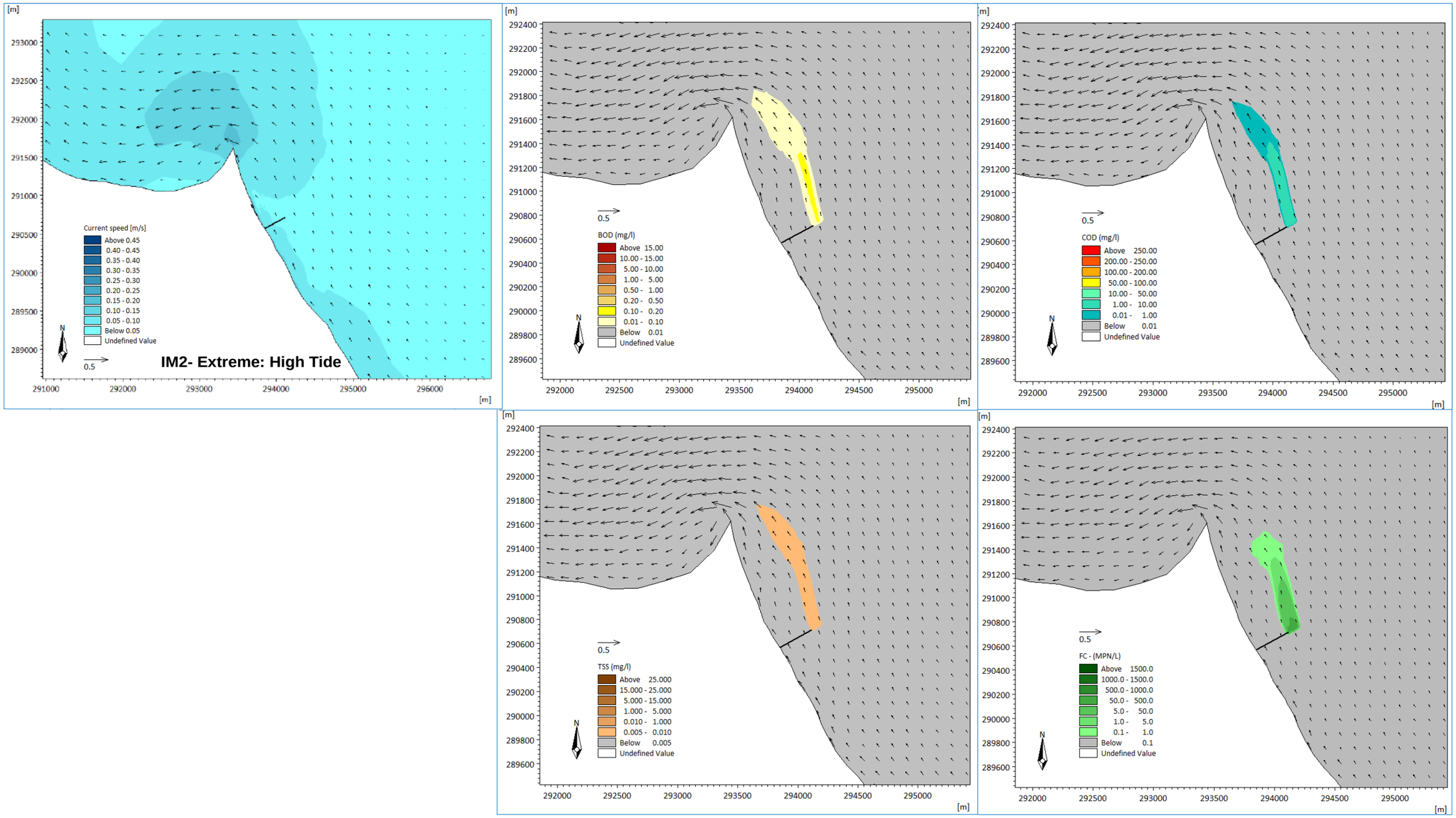


Figure 8.3: Current Pattern (Upper-Left), BOD_5 (Upper-Middle), COD (Upper-Right), TSS (Lower-Left) and FC (Lower-Right) Concentrations for IM2-Extreme Condition during High Tide

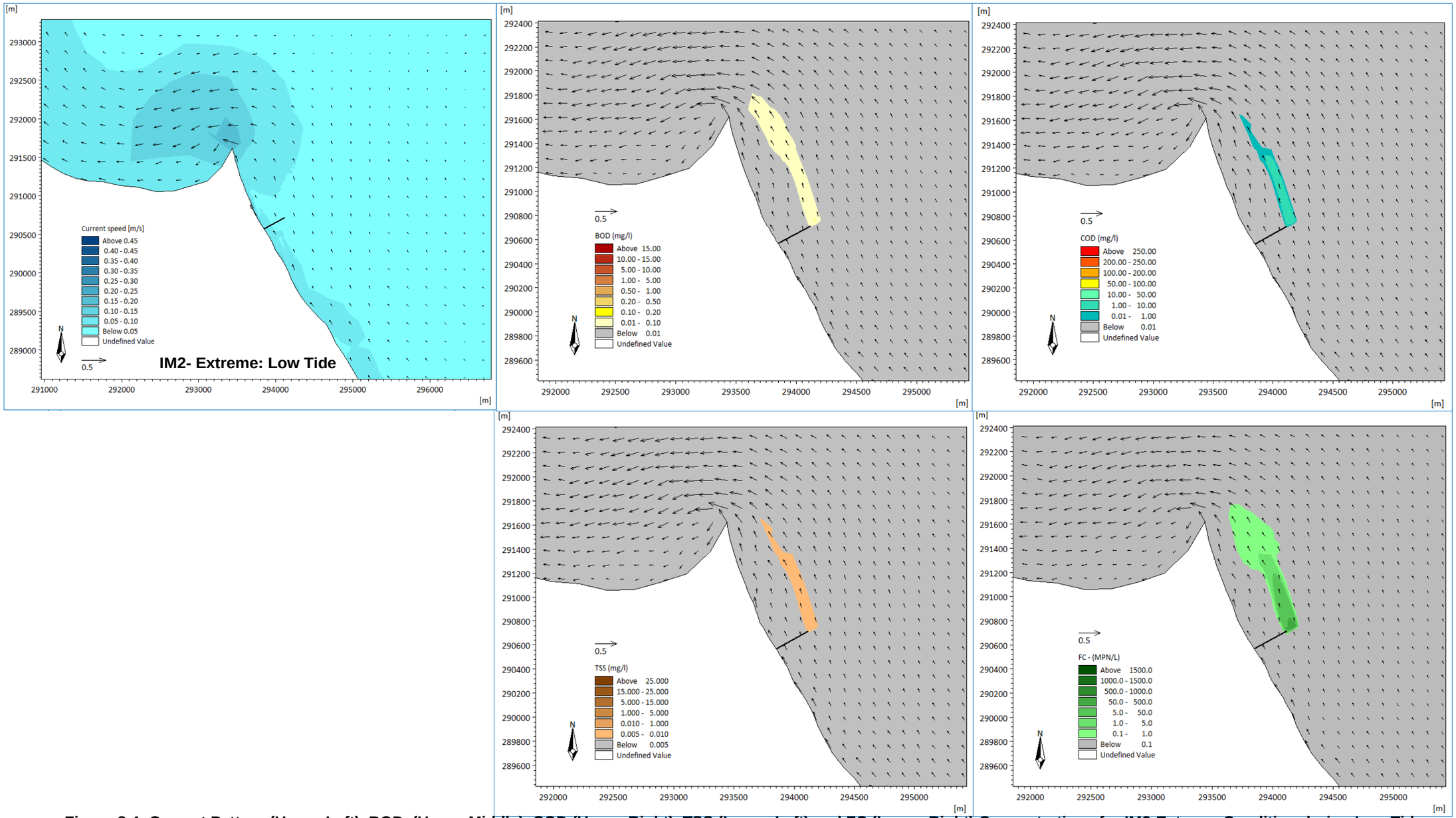


Figure 8.4: Current Pattern (Upper-Left), BOD_5 (Upper-Middle), COD (Upper-Right), TSS (Lower-Left) and FC (Lower-Right) Concentrations for IM2-Extreme Condition during Low Tide

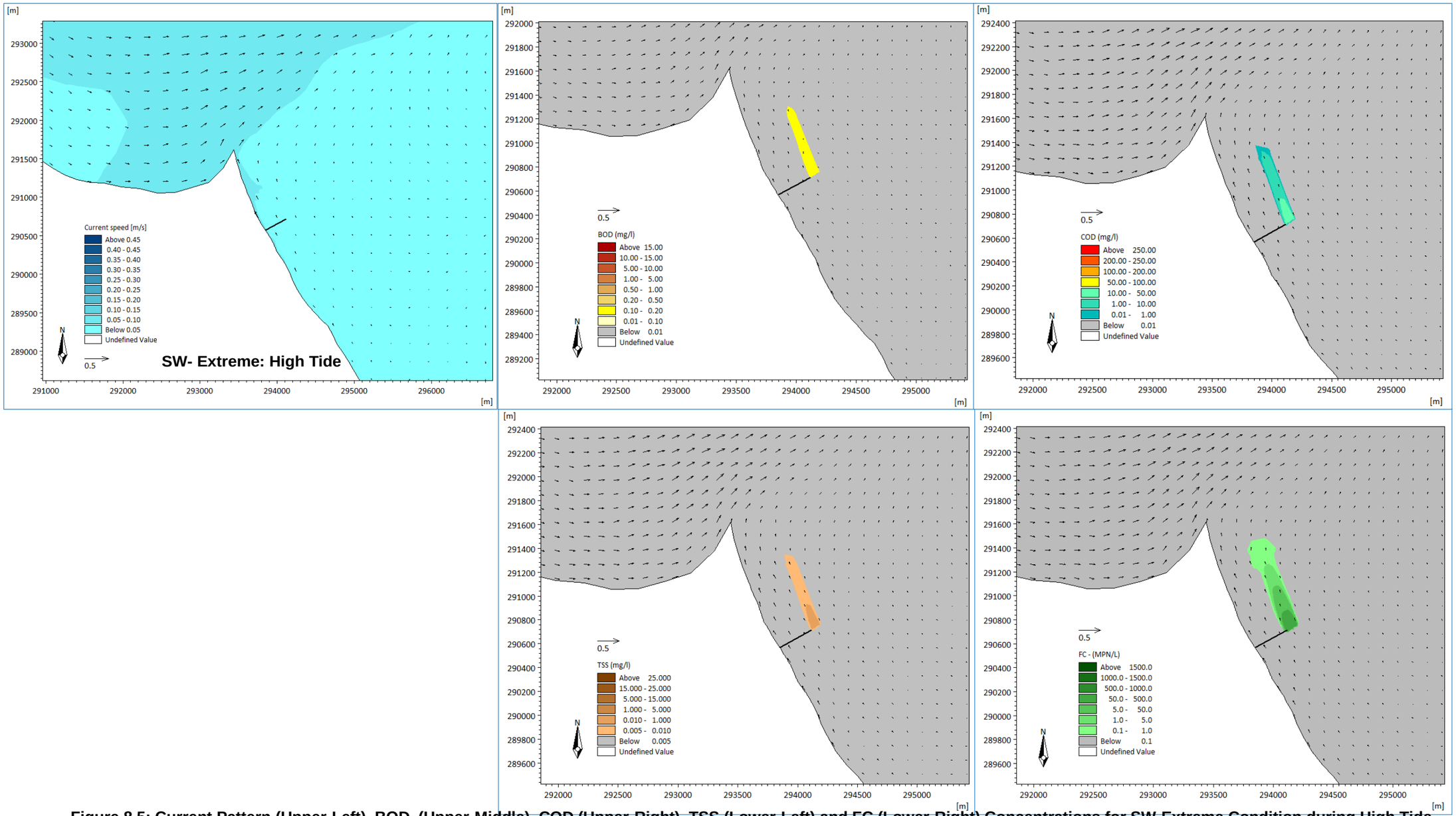


Figure 8.5: Current Pattern (Upper-Left), BOD_5 (Upper-Middle), COD (Upper-Right), TSS (Lower-Left) and FC (Lower-Right) Concentrations for SW-Extreme Condition during High Tide

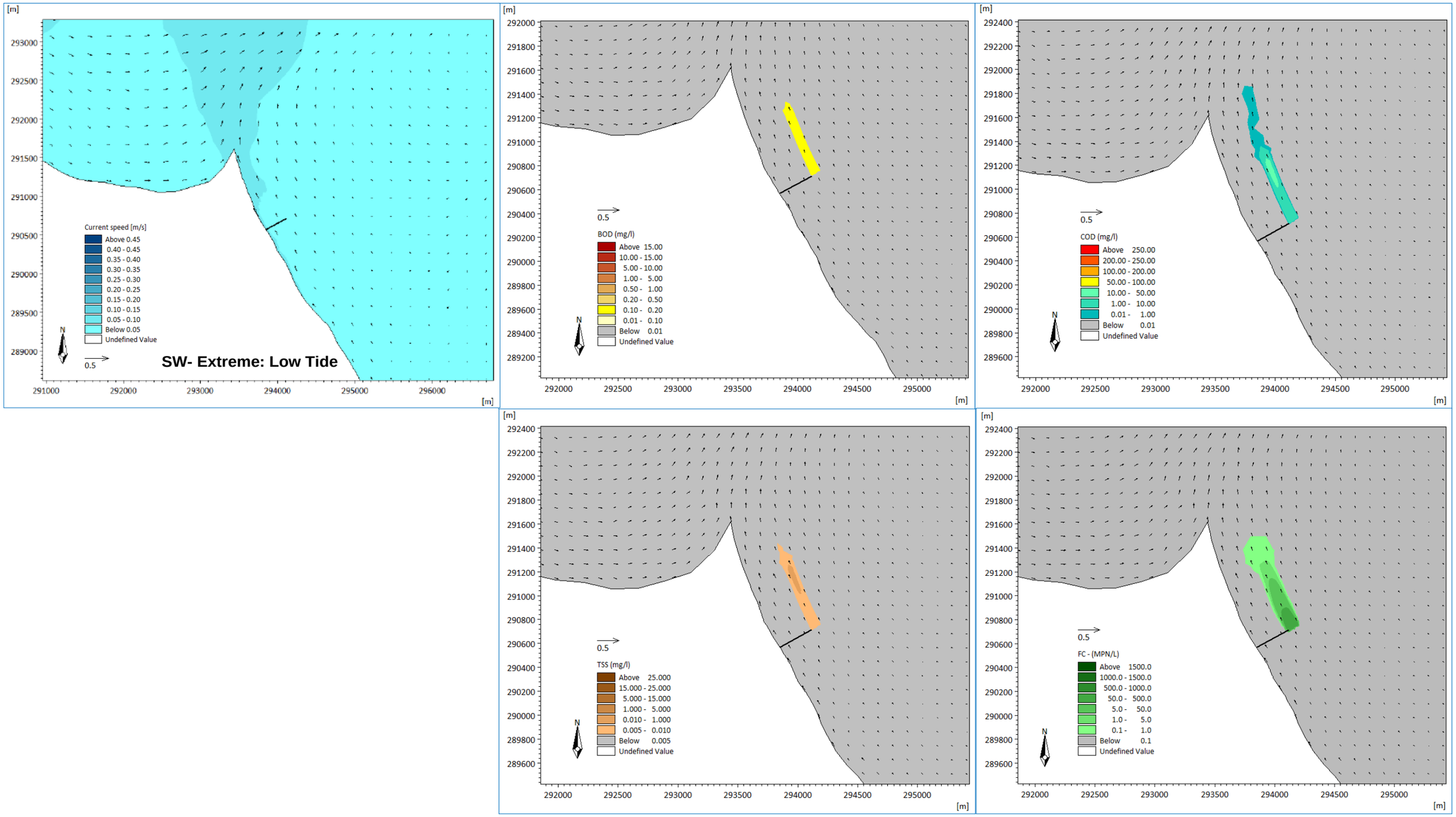


Figure 8.6: Current Pattern (Upper-Left), BOD_5 (Upper-Middle), COD (Upper-Right), TSS (Lower-Left) and FC (Lower-Right) Concentrations for SW-Extreme Condition during Low Tide

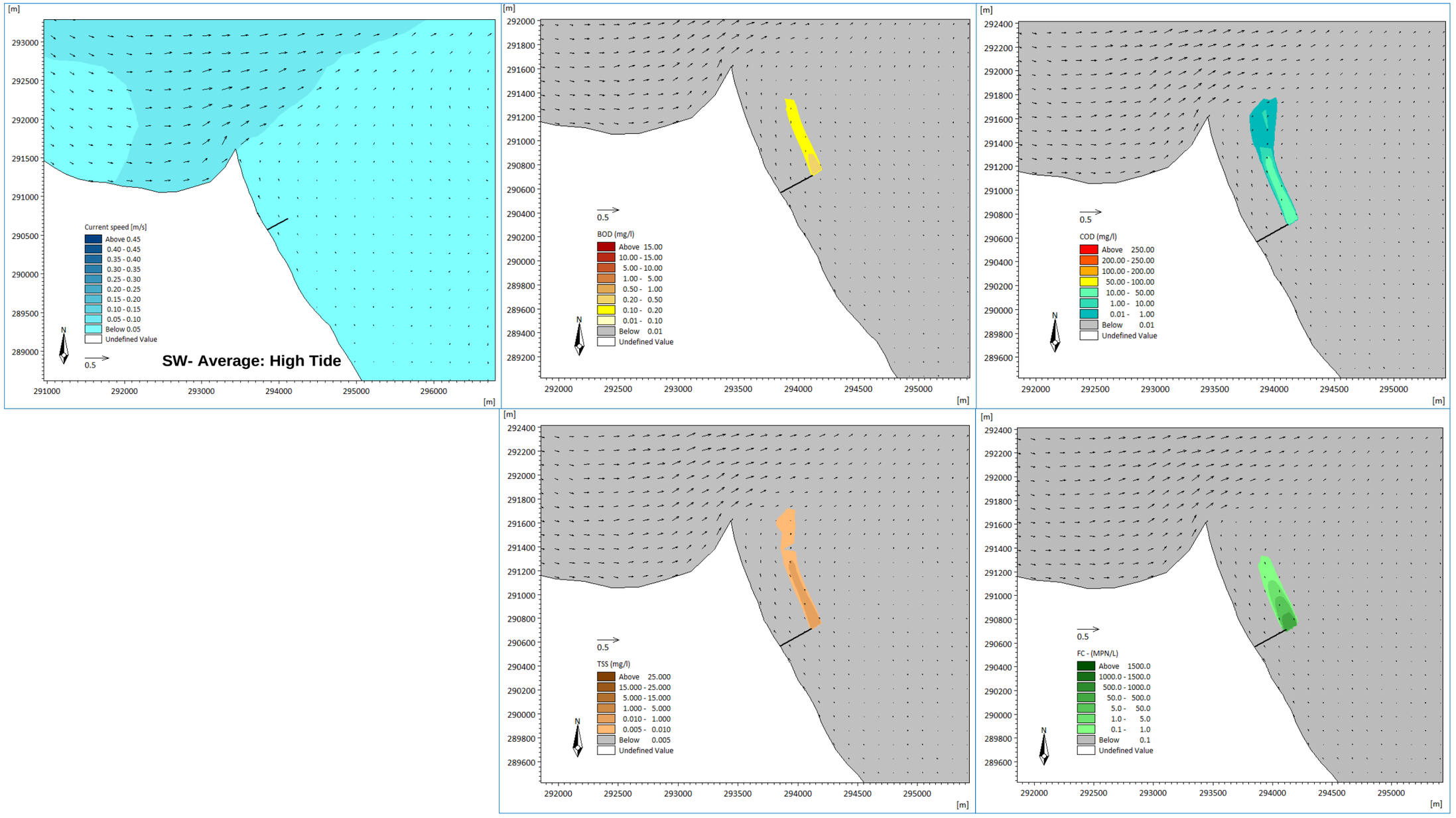


Figure 8.7: Current Pattern (Upper-Left), BOD_5 (Upper-Middle), COD (Upper-Right), TSS (Lower-Left) and FC (Lower-Right) Concentrations for SW-Average Condition during High Tide

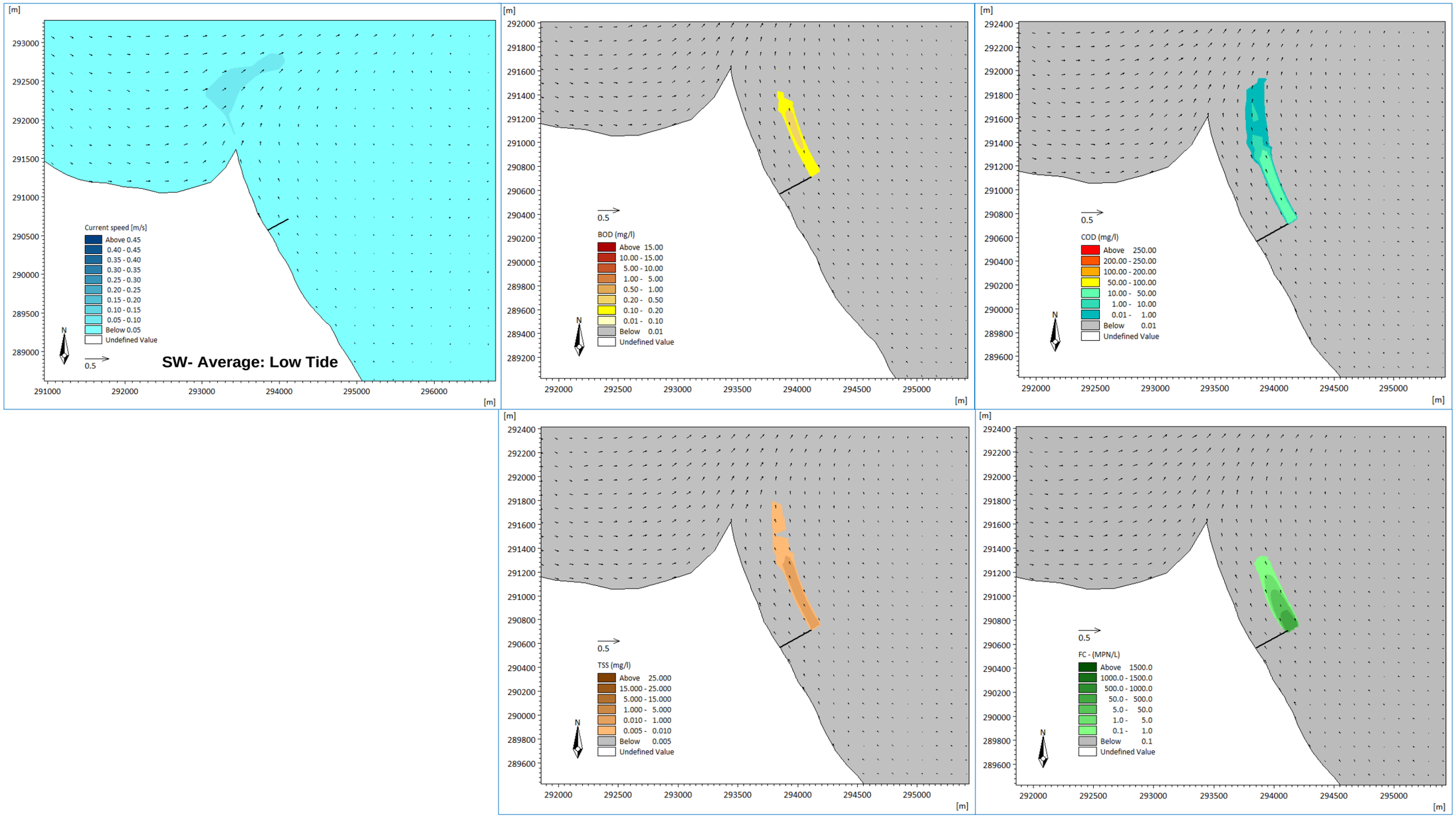


Figure 8.8: Current Pattern (Upper-Left), BOD_5 (Upper-Middle), COD (Upper-Right), TSS (Lower-Left) and FC (Lower-Right) Concentrations for SW-Average Condition during Low Tide

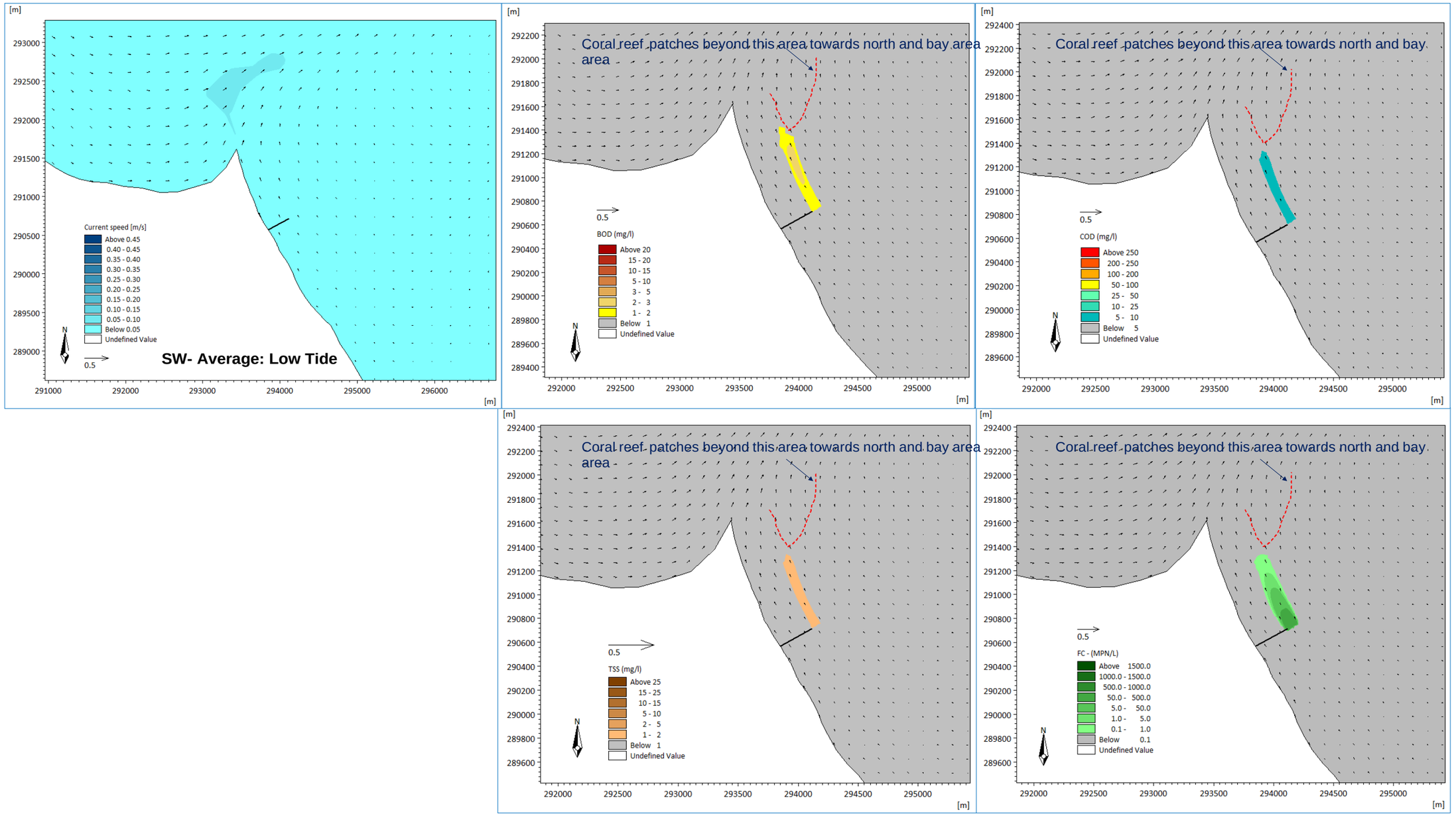


Figure 8.9: Current Pattern (Upper-Left), BOD_5 (Upper-Middle), COD (Upper-Right), TSS (Lower-Left) and FC (Lower-Right) Concentrations for SW-Average Condition with Coral Reef Boundary

9 SUMMARY AND CONCLUSIONS

This report describes the numerical model studies carried out as part of the detailed engineering design for the proposed short sea outfall in Punnaikudah, Batticaloa. Wave climate modeling has been done to obtain the nearshore input wave parameters while Hydrodynamic modeling was used to find out the existing current pattern in the vicinity of the proposed location. Manual calculations of initial dilution and the conceptual design for the short outfall has been performed to obtained pipe details of the suitable depth for the discharge. Finally, Near-Field (CORMIX) and Far-Field modeling (MIKE 21 FM TR) were perform to verify the suitability and adaptability of the proposed short sea outfall layout to the existing coastal environment. This chapter summarizes the outcomes of each modeling and the conclusions drawn out of them.

9.1 Wave Climate

The nearshore wave climate at 20 m water depth just beyond the Batticaloa sea outfall location was established in the first phase. For this purpose wave data from Trincomalee offshore (2000 m Depth) has been transformed to Batticaloa since there is no any recorded wave data at Batticaloa. This wave transformation was based on the mathematical modeling of wave propagation over a large sea extent off the Eastern coast. The numerical wave propagation calculations were performed through the application of MIKE 21's Spectral Wave Model, MIKE 21 SW. The verification of wave data sets obtained by transformation from different locations and on-site recordings in time domain is not possible as there is no physical overlap between different data sources. Therefore, comparison between different wave data sources was made only on a statistical sense. Since no measured data available in the vicinity, the transformed data to Oluvil has been compared with the transformed data at Oluvil 15 m depth in a previous study done in 2005 (CRMP, 2005) which is available as a wave Rose diagram. The comparisons between both studies nearshore data clearly indicate that wave data transformed from Trincomalee offshore showed similar directional trends as obtained from CRMP transformed data. Therefore, all the transformed data from Eastern offshore could be used to develop the nearshore wave data base in Eastern coast.

The established wave data series at Batticaloa nearshore 20 m depth indicates that comparatively high waves are approaching from NE direction in NE and IM1 monsoons while during SW monsoon lower magnitude's wave are dominating with a narrow direction band in SE direction.

9.2 Hydrodynamic Condition

Current circulation and effluent dispersion are some of the key topics relying on a clear understanding of hydrodynamics. Thus, hydrodynamic study is essential to investigate the behaviour of water bodies subjected to a variety of natural forcing such as wave, tide and wind. Sound understanding about the hydrodynamics in the proposed sea outfall area is important as that knowledge helps to decide the configuration of sea outfall route including the discharge location (depth and distance from the shore). Additionally, near-field and far-field dispersion of

the effluent is depend on the current circulation at the discharge location. Therefore, DHI MIKE 21 HD (hydrodynamic) module has been used to assess the hydrodynamic of the proposed sea outfall area and to obtain the input condition for near-field (CORMIX) and far-field (DHI MIKE 21 FM TR) dispersion modelling.

Two tidal boundaries at Point Pedro (North) and Oluvil (South) have been used for the regional model and extracted water level at Trincomalee was compared with predicted tide as a part of the calibration. The calibrated regional model has been used to extract the boundaries for the local model. Local model runs were performed selected 5 scenarios out of the 8 wave conditions (average and extreme for all four seasons) to omit the simulation with similar parameters. The extracted current conditions from the local model has been used as the input conditions for the near-field model (CORMIX). ***Based on the local model conditions suitable location for the sea outfall was selected as 10.8 m depth which is approximately 400 m away from the shore. The extracted current details reveal that the current speed has a maximum and average value of the 0.20 and 0.05 m/s respectively.***

9.3 Conceptual Design of Short Sea Outfall

9.3.1 The Beach Chamber

The beach chamber is introduced to break the connection between the onshore part and the outfall itself and allow any air in the effluent to be ventilated by using dual orifice air valve before entering the outlet pipe in order to prevent air in the outfall that could cause flotation of the pipe. As the total head loss is reach the 2.60 m at the last diffuser port, more than 2.60 m head should be maintain at the beach chamber. Tentative dimensions for the beach chamber is mentioned in the **Drawing No.2 and No.3** in **Annex B** and can be changed according to the actual treatment plant capacities while maintaining above mentioned head. The beach chamber is to be located on the shore sufficiently far from the shoreline to withstand erosion. Furthermore, the chamber need to be outside the buffer zone which is nearly 30 - 40 m from Mean High Water Level (~0.45m MSL). Refer **Drawing No.1** in **Annex B** for more details.

9.3.2 Outlet Pipe

The outer diameter of outlet pipe from the beach chamber to the sea is 600 mm and a wall thickness of around 27.3 mm. The pipe in the surf zone is vulnerable to wave, current, tide and wind forces and need to be protected. Therefore, the pipe needs to be covered by protection layer. The protection layer can be natural rock fill. The pipe material need to be selected to get required strength and stiffness for the onshore as well as offshore parts and Polythene (PE-100) with pressure classification PN6 is recommended.

The friction loss in the pipe was determined by the roughness of its inner wall and the flow velocity. In order to allow for either self-cleaning or occasional flushing of the pipe, to prevent of

sedimentation within pipe and to flush out seawater during out of operation, the pipe should be able to accommodate a flow velocity of 0.7 m/s.

Ballasting of the PE pipes is by concrete collars over the pipes at 10.0 m interval. Each concrete collar is minimum 280 kg of weight in air **(Drawing No.2 and No.3** in **Annex B)**. Connection between the PE pipes could be made by butt-fusion welding method which results in joints as strong as the pipe itself.

As per the client requirement initial dilution should meet given Effluent Discharge Standards for marine Coastal Area. Therefore, the discharge depth of 10.8 m was selected so that the ambient concentration at the sea meets the environment consideration proposed for the coastal water in Sri Lanka. Furthermore, the total distance of 390 m from the shore to discharge point is selected and hence the discharge location is well above of the offshore limit of the surf zone. Therefore, proposed sea outfall would not transport the diluted constituent matter by the alongshore current (Refer **Drawing No.1** in **Annex B**)

9.3.3 Diffuser

Mixing by jet diffusion takes place when waste water is introduced into seawater where the two fluids have different densities. The diffuser port is above seabed to avoid ingress of sand and silt in the outlet pipe. The diffuser need to be covered by at least 2 m protection layer of natural rock and /or sand fill. According to the available bathymetry, the depth at the diffuser is -10.8 m MSL and 390 m from the shore. The height of the diffuser port is 1.5 m and the minimum depth at diffuser port is -9.0 m MSL. The last 900 m of the outlet pipe is used to disperse the treated effluent into the sea and consists of 15 diffuser ports at 6.43 m interval, each 125 mm outer diameter. Each concrete collar is minimum 350 mm thick and 2000 mm wide 280 kg of weight in air (**Drawing No.2** in **Annex B**).

9.4 Near-Field and Far-Field Dispersion

9.4.1 Near-Field Dispersion

Under the present study, CORMIX model was applied to study near field mixing while MIKE 21 FM Transport module was applied to assess far field mixing and to detail study of the movement and circulation pattern of BOD5, COD, TSS and Faecal Coliform. Numerical model runs were performed for the given discharge 15000, 10000 and 5000 m^3/day (0.174, 0.116, 0.058 m^3/s) for both average and extreme hydrodynamics conditions, and for all four seasons. Further, it was assumed that the effluent will be treated up to the CEA standards for short sea outfall so that the concentrations of BOD_5, COD, TSS and Faecal Coliform are 75 mg/l, 250 mg/l, 50 mg/l and 15000 MPN/l respectively. Since there was no any information on the ambient water quality, the concentrations of the constituent will be assumed as zero. The above information were received from the client and National Water Supply & Drainage Board (NWSDB).

In the present study, the diffusers were modelled as a multiport diffuser, as a linear structure consisting of many closely spaced ports which inject a series of turbulent jets at high velocity into the ambient water body. Further it is assumed that the diffusers point to one direction (pointing to South), oriented normal to the diffuser line, and horizontal. Input data groups consist of project descriptions, effluent properties, ambient conditions, discharge conditions, mixing zone definitions, and output control. The discharge conditions relate to the geometric and flux characteristics of the submerged outfall installation. In the present study, BOD_5, COD, TSS and Faecal Coliform, were considered as conservative. Based on CORMIX model results, it was realized that critical condition is when the current direction is parallel to the beach, hence all the model runs were carried out for a current which is parallel to the beach. Further, the proposed diffusers are located at average depth of 10.8 m so that the effluent is discharged at 9.0 m depth, and also the diffuser is located in a straight beach, hence the dominant current direction could be parallel to the beach. Since the lower current speed (<0.03 m/s) produce the unrealistic results such conditions were assumed as stagnant (no current) condition for CORMIX simulations. Therefore, out of all five monsoonal conditions (SW-Avg, High; IM1-Avg; NE-High; IM2-High) only NE and IM2 conditions were simulated considering the Min, Avg and Max current speeds.

Results indicate the higher concentration for stagnant condition at the NFR compared to other conditions. Further, it gives the minimum distance of 1.0 m to the NFR from the diffuser section. Since the ambient current is not considered, only the density difference between effluent and the receiving water supports the dilution in the stagnant condition. Therefore, this can be considered as the worst case scenario for near-field dispersion.

Based on CORMIX model runs, it can be seen that, for all the cases, BOD_5, COD, TSS and FC levels do not violate the CEA guide line - National Environmental Act No 47 of 1980 conditions, i.e. for short sea outfalls for 15000 m^3/s effluent discharge.

1a. Tolerance limit value for BOD_5 at diffuser = 15 mg/l

1b. Minimum dilution factor of 1:5 at a distance 2.5 m from the diffuser for BOD_5 2a.

Tolerance limit value for COD at diffuser = 50 mg/l

2b. Minimum dilution factor of 1:5 at a distance 2.5 m from the diffuser for COD 3a.

Tolerance limit value for TSS at diffuser = 30 mg/l

3b. Minimum dilution factor of 1:1.7 at a distance 1.5 m from the diffuser for TSS 1a.

Tolerance limit value for Faecal Coliform (FC) at diffuser = 1500 MPN/l

1b. Minimum dilution factor of 1:10 at a distance 3.0 m from the diffuser for FC

Similarly, **10000 and 5000 m^3/s effluent discharges are also satisfy the required CEA guidelines when it discharge through the short sea outfall.**

The concentration values of BOD_5, COD, TSS and FC extracted from CORMIX model at end of near filed was used in MIKE 21 FM Transport model as the source value, in far field mixing study.

9.4.2 Far-Field Dispersion

Far field is defined as the region of the receiving water where buoyant spreading motions and passive diffusion control the trajectory and dilution of the effluent discharge plume. In the present study, MIKE 21 Flow Model Hydrodynamics module (MIKE 21 FM HD) coupled with MIKE 21 Flow Model Transport module (MIKE 21 FM TR) was used for detail study of BOD_5, COD, TSS and FC far field mixing. Based on the CORMIX model results, the constituents' concentration levels at the end of near filed is extracted, and used as the source in MIKE 21 FM TR module. Two adjustments were done for the CORMIX output value while assigning the input concentrations for the TR model. Since the initial concentration was taken as the depth and area average value at the particular element of the source point these adjustments were utilized. MIKE FM TR model runs were carried out for all four seasons, and for estimated average and extreme wave/wind conditions. The local models were simulated to cover minimum of three tidal circles (7 days for each), including neap and spring tide. In the MIKE 21 FM TR model, BOD_5, COD, TSS and FC, were considered as conservative. Even though the CORMIX model simulation was given the minimum, average and maximum concentration for particular wave and wind condition (ex. NE-Ext, SW-Avg) maximum concentrations of each constituent were selected for far-field (MIKE 21 FM TR) modelling.

Far-field modelling results also indicate that the maximum dispersion of the effluent could be obtained during the NE monsoon with lower concentrations. In contrast, a weak dispersion of the effluent has been observed during SW monsoon average condition as it run for the highest near- field concentration with a lower wave condition.***Therefore, as shown in the below figures, BOD_5, COD, TSS and faecal coliform concentrations do not reach 15 mg/l, 50 mg/l, 30 mg/l and 1500 MPN/l levels respectively, the critical values based on CEA guidelines.***

During a marine biological survey it was found that the presence of the coral reef at the offshore of the Eravur headland. Even though the selection of the outfall location has been done by omitting that coral reef area, the extent of the plume was examined for the worst case which is SW monsoon. ***It is evident that the plume is not created advise impact to the existing coral reef as the concentrations near the plume edge is negligible.***

The proposed sea outfall located at 10.8 m depth (Diffuser depth_9.0 m) with more than 600 m away from the shore, has satisfied the environmental standards for short sea outfalls with respect to the near-field and far-field dilution. ***Therefore, near-field and far-field modelling done in this study confirm the suitability of proposed short sea outfall at Punnaikudah, Batticaloa with a minimal negative impact to the existing environment for all three discharges (15000, 10000 and 5000 m^3/s).***

Table 9.1: Summary of Near-Field and Far-Field Modelling Scenarios and Results

Season	Condition	Wave Parameters			Wind		HD Modelling		Current		CORMIX Modelling		Near-Field Dilution							TR Modelling		Far-Field Dilution	
		Hs (m)	Tp (s)	MWD (°N)	Speed (m/s)	Dir (°N)			Condition	Speed (m/s)		Condition	Dilution @ NFR	NFR Location (m)	BOD_5 Con @ NFR	COD Con @ NFR	TSS Con @ NFR	FC Con @ NFR	BOD<15 COD<50 TSS<30 FC<1500		Condition		BOD<15 COD<50 TSS<30 FC<1500
SW	Average (50%)	0.25	4.1	120	4.3	230	√	SW-Avg	Min	0.01	√	Stagnant	37	3.56	2.03	6.76	1.35	403	Within the Limits	√	SW-Avg	⇧	Within the Limits
								IM2-Avg	Avg	0.02	√												
									Max	0.03	√												
	Extreme (2%)	0.45	5.4	113	5.1	230	√	SW-Ext	Min	0.01	√	Stagnant	37	3.56	2.03	6.76	1.35	403		X			
									Avg	0.03	√												
									Max	0.03	√												
IM1	Average (50%)	0.50	7.6	091	3.0	305	√	IM1-Avg	Min	0.01	√	Stagnant	37	3.56	2.03	6.76	1.35	403		√	IM1-Avg (SW-Ext)	⇧	
									Avg	0.01	√												
									Max	0.03	√												
	Extreme (2%)	2.30	8.7	053	3.3	360	X																
NE	Average (50%)	1.10	5.8	059	4.1	40	X																
	Extreme (2%)	2.70	9.1	042	4.5	30	√	NE-Ext	Min	0.01	√	Min	37	3.56	2.03	6.76	1.35	403	Within the Limits	√	NE-Ext	⇧	Within the Limits
									Avg	0.18	√	Avg								X			
									Max	0.19	√	Max	888	45	0.08	0.28	0.06	16		X			
IM2	Average (50%)	0.25	5.3	104	2.4	120	X																
	Extreme (2%)	1.05	6.0	80	2.5	90	√	IM2-Ext	Min	0.01	√	Min	37	3.56	2.03	6.76	1.35	403	Within the Limits	√	IM2-Ext (NE-Avg)	⇧	Within the Limits
									Avg	0.04	√	Avg								X			
								NE-Avg	Max	0.05	√	Max	79	8.25	0.95	3.17	0.63	186		X			

Note: ⇧ Shows the level of the far-field dilution; BOD_5, COD, TSS in mg/l and FC in MPN/l

10 REFERENCES

i. Beaufort Wind Scale, http://www.spc.noaa.gov/faq/tornado/beaufort.html.

ii. Central Environmental Authority (CEA) guidelines – National Environmental Act, No. 47 of 1980

iii. Danish Hydraulic Institute, (2017), MIKE 21 & MIKE 3 Flow Model FM, Hydrodynamic and Transport Module, Scientific Documentation

iv. Danish Hydraulic Institute, (2017), MIKE 21 Flow Model FM, Hydrodynamic Module, User guide

v. Danish Hydraulic Institute, (2017), MIKE 21 & MIKE 3 Flow Model FM, Hydrodynamic Module, Step – by –step training guide

vi. Danish Hydraulic Institute, (2017), MIKE 21 & MIKE 3 Flow Model FM, Transport Module, User guide

vii. Doneker, R. L. and Jirka, G. H., (2017), CORMIX User manual, A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters

viii. Lanka Hydraulic Institute Ltd. (2005), Final Report of Wave Climate and Sediment Transport (Kalpitiya-Oluvil) prepared for Coastal Resources Management Project-Component B: Institutional Strengthening

ix. Lanka Hydraulic Institute Ltd. (2014), Final Report :Thermal Dispersion Study for Sampur Thermal Power Project

x. Lanka Hydraulic Institute Ltd. (2019), Effluent Dispersion Numerical Model Report: Expansion of Pipe Borne Sewer Coverage to Moratuwa Area

xi. Ranasinghe, D.P.L. and Gunaratne, P.P., (2011), "Assessment Of Nearshore Wave Climate In Southern Coast Of Sri Lanka", Annual Research Journal of SLSAJ, Vol. 11, Japan

xii. Wood I.R, Bell. R.G and Wilkinson D. L., (1993), Ocean Disposal of Wastewater, Advanced Series on Ocean Engineering – Volume 8

Annexure X
Air Quality Report

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பாதுகாப்பு அமைச்சு
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REPORT ON
Ambient Air Quality Monitoring
for
Proposed Textile Zone, Eravur, Batticaloa

(Baseline Stage - January 2026)

Report No : NBRO/ESSD/25/490 – AQ

Issued to:

Board of Investment of Sri Lanka
P. O. Box 1768, World Trade Center – West Tower
Echelon Square, Colombo 01

Issued by:

Environmental Studies and Services Division
Email: essd@nbri.gov.lk

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1.0 SCOPE

As per the request dated 23rd September 2025 the client, Mr. Asanka Welagedara, Director (Environmental Management), Board of Investment of Sri Lanka, requested the Environmental Studies and Services Division (ESSD) of National Building Research Organisation (NBRO) to monitor ambient air quality levels at selected locations in proposed Textile Zone, Eravur, Batticaloa before start the construction activities.

In this regard, following officers of the Environmental Studies & Services Division of NBRO carried out the monitoring program on 27th & 28th January 2026.

Staff Involved:

Mr. P D Liyanaarachchi	*- Scientist*	*- ESSD, NBRO*
Mr. K D P Malshan	*- Technical Officer*	*- ESSD, NBRO*
Mr. W A Weerasinghe	*- Field Assistant*	*- ESSD, NBRO*
Mr. N Padmakumara	*- Field Assistant*	*- ESSD, NBRO*

Witness: *Ms. L D R Samarawickrama – Environmental Officer, BOI*
Mr. H S H Weerasinghe – Environmental Officer, BOI

2.0 DESCRIPTION OF THE SITE AREA

The project is the construction of a proposed textile zone at Eravur, Batticaloa within the Eravurpattu Pradeshiya Sabha area. The project area is about 262 acres. This monitoring programme is scheduled to monitor baseline ambient air quality levels in the project area to assess the environmental conditions before start the construction activities.

3.0 WEATHER CONDITION

Dry weather condition with fair north-easterly wind prevailed during the monitoring period.

4.0 MONITORING OF AMBIENT AIR QUALITY

4.1 SELECTION OF MONITORING LOCATIONS:

Four (04) locations were selected by the client, consulting the project consultants for the monitoring of ambient air quality levels to represent project activities. The location description is given in Table 01.

Table 01: Location description of Ambient Air Quality monitoring locations

Location	GPS Coordinates	Location Description
L1	7.805152° N 81.610091° E	At the premises of Mr. Thawamalon, Punnakkuda Road, Thalawai
L2	7.821581° N 81.610463° E	At the premises of Punyaramaya Viharaya, Punnakkuda, Eravur
L3	7.792125° N 81.8434808° E	At the premises of BT/Iyankerni Tamil Vidyalaya, Eravur
L4	06.8844745° N 81.8417404° E	At the premises of Savukkadi Park, Eravurpattu, Eravur

- Refer attached Google Image of Ambient Air Quality monitoring locations for further details

4.2 SAMPLING AND ANALYTICAL CONDITIONS:

Air samples were collected from selected locations on one (01) hour basis for Ozone (O_3), eight (08) hour basis for the analysis of Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO). Sampling duration for Particulate Matter (PM_{10} & $PM_{2.5}$) analysis were 24 hours. The sampling receiver height was about 1.5 m from the ground level and the sampling rates were 1.0 l/min for O_3, 0.5 L/min for SO_2 and 0.4 L/min NO_2. The sampling rate for PM_{10} and $PM_{2.5}$ was 16.7 L/min. CO levels were measured at the site. Samples collected for the analysis of SO_2, NO_2 and O_3 were stored in a cooler box and PM_{10} & $PM_{2.5}$ samples were stored in filter cassettes. Then all samples were sent to the NBRO laboratory for the analysis.

The laboratory received samples on 28th January 2026 in satisfactory condition. They were analysed on the same day for NO_2, SO_2 and O_3. PM_{10} & $PM_{2.5}$ were analysed on 30th January 2026 after drying to a constant weight in a desiccator. Sampling and analytical methods used are given in Table 02.

4.3 SAMPLING AND ANALYTICAL METHODOLOGY:

Table 02: Description of the Sampling & Analytical methods used for each parameter

Parameter	Testing Method	Minimum Detection Limits	CEA Recommended method	Instrumentation
O_3	ASTM D 5156 – 02, 2008 Neutral Buffered Potassium Iodide method (NBKI) UV Spectrometric method	4 µg/m³	NBKI UV Spectrometric method or Chemiluminescence	*Standard Personal Air Samplers * UV – Visible Spectrophotometer
SO_2	ASTM D 2914 – 95, 2015 West-Geake & Pararosaniline Spectrometric method	4 µg/m³	Pararosaniline method or equivalent (pulsed fluorescent method)	*Standard Personal Air Samplers * UV-Visible Spectrophotometer
NO_2	ASTM D 1607 - 91, 2011, Griess – Saltzman Reaction Method	4 µg/m³	Colorimetric using Saltzman method or equivalent (gas phase Chemiluminescence)	*Standard Personal Air Samplers * UV – Visible Spectrophotometer
CO	Non-Dispersive Infra-Red Sensor (NDIR)	1000 µg/m³	Non - dispersive infrared(IR) spectroscopy	* Portable Gas Analyzer (SKY2000-M5)
PM_{10} & $PM_{2.5}$	High - Volume Sampling and Gravimetric Analysis	2 µg/m³	Hi - volume sampling, and Gravimetric	* High Volume Sampler with size selective sample inlet * SHIMADZU AUW120D Analytical balance

4.4 AMBIENT AIR QUALITY MONITORING RESULTS:

Table 03: Concentration of each parameter at each sampling location

Parameter	Date of Sampling	Date of Analysis	Time Average	Concentration (µg/m³)			
				L1	L2	L3	L4
O_3	28/01/2026	28/01/2026	1 hr	12	11	11	13
SO_2	28/01/2026	28/01/2026	8 hrs	29	17	11	34
NO_2	28/01/2026	28/01/2026	8 hrs	48	21	14	56
CO	28/01/2026	28/01/2026	8 hrs	<1000	<1000	<1000	<1000
PM_{10}	27-28/01/2026	30/01/2026	24 hrs	43	38	21	19
$PM_{2.5}$	27-28/01/2026	30/01/2026	24 hrs	24	21	12	11

4.5 AMBIENT AIR QUALITY STANDARDS

Table 04: The National Ambient Air Quality standards stipulated under the Extraordinary Gazette, No.1562/22, August 15, 2008, by the stipulated by the Ministry of Environment & Natural Resources of Sri Lanka.

Pollutant	Time Average	Standard Concentration (µg/m³)
Ozone (O_3)	1 hr	200
Sulphur Dioxide (SO_2)	8 hrs	120
Nitrogen Dioxide (NO_2)	8 hrs	150
Carbon Monoxide (CO)	8 hrs	10,000
Respirable Particulate Matter (PM_{10})	24 hrs	100
Respirable Particulate Matter ($PM_{2.5}$)	24 hrs	50

5.0 CONCLUSION

Under the measured condition, the measured ambient air quality levels with respect to O_3, SO_2, NO_2, CO, $PM_{2.5}$ and PM_{10}, at all locations were lower than the Ambient Air Quality Standards stipulated by the Ministry of Environment & Natural Resources of Sri Lanka (Extraordinary Gazette No. 1562/22, August 15, 2008).

.....
Coordinating Scientist (Analysis)
Scientist (Air Quality)
Environmental Studies & Services Division
National Building Research Organisation

H.D.Kumara
.....
Checked by
Scientist
Scientist (Air Quality)
Environmental Studies & Services Division
National Building Research Organisation

Certified by:.....
H.D.S. Premasiri
Director/ Environmental Studies and Services Division

Google Images of Ambient Air Quality monitoring locations



Annexure XI
Ambient Noise level Report

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பாதுகாப்பு அமைச்சு
Ministry of Defence

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අධ්‍යක්ෂ ජනරාල්
பணிப்பாளர் நாயகம்
Director General
011-2505149

ජාතික ගොඩනැගිලි පර්යේෂණ සංවිධානය
தேசிய கட்டிட ஆராய்ச்சி நிறுவனம்
NATIONAL BUILDING RESEARCH ORGANISATION

ෆැක්ස්
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මගේ අංකය
எனது இல.
Our Ref.
ESD-INV-0385-2025

ඔබේ අංකය
உமது இல.
Your Ref.

දිනය
திகதி
Date
18th February 2026

REPORT ON
Noise Monitoring
for
Proposed Textile Zone, Eravur, Batticaloa

(Baseline Stage - January 2026)

Report No : NBRO/ESSD/25/490 – NM

Issued to:

Board of Investment of Sri Lanka
P. O. Box 1768, World Trade Center – West Tower
Echelon Square, Colombo 01

Issued by:

Environmental Studies and Services Division
Email: essd@nbri.gov.lk

THE TEST REPORT IS ISSUED SUBJECT TO CONDITIONS MENTIONED OVERLEAF.

This report contains 6 pages.

The report is issued under the following Terms & Conditions;

These Terms and Conditions apply to all dealings, tests and analytical services offered from the Environmental Studies and Services Division (ESSD) of National Building Research Institute (NBRI).

Confidentiality
NBRI maintains strict confidentiality of all customer information. Reports are provided only to the customer or to those designated by the customer.

Customer must agree not to use the report or data in any manner that may harm the reputation or the service of NBRI.

Test Methods
The ESSD of NBRI warrants that the tests are performed in accordance with national, and international standard methods. In the absence/non availability of standard methods, ESSD uses any other published test or follow a validated method developed by other reputed bodies. On request, ESSD may follow customer specified methods as appropriate.

Test Report
The laboratory will provide only the original of the report. Customized reports that differ from the laboratory's normal format may include additional charges.

Conformities to a standard specification may be mentioned as required by the standard specification on request by the customer.

Reproduction of Reports
No report may be reproduced, except in full entirely, without prior written approval from the Director General, NBRI.

Retention of Reports
Reports will be archived for a period of 03 years after results have been reported to the customer. The customer can query or requests additional copies of their reports within 01 year except in litigation from the date of first issue, and additional charges apply.

Queries on Report
Customer queries on reports will be entertained only up to a period of 01 year from the date of issue of the report.

Retention of Samples
Perishable samples will be destroyed immediately after testing.

Samples will be routinely retained for a period of 10 days after report is issued.

Return of Sample Containers and Test Items
Sample containers and/or test items will be returned to the customer only on a written request by the customer.

Loss or Damage
The NBRI will not be responsible for indirect loss/es of his documents, any belongings which might happen under unavoidable circumstances during the period of customer service.

Litigation
The customer shall be responsible for all costs associated with documents or testimony in the court of law for the purposes relating to the customer's sample/s. Such costs include but not limited to the hourly charges, transport for persons involved in responding to the court of law.

1.0 SCOPE

As per the request dated 23rd September 2025 the client, Mr. Asanka Welagedara, Director (Environmental Management), Board of Investment of Sri Lanka, requested the Environmental Studies and Services Division (ESSD) of National Building Research Organisation (NBRO) to monitor noise levels at selected locations in proposed Textile Zone, Eravur, Batticaloa before start the construction activities.

In this regard, following officers of the Environmental Studies & Services Division of NBRO carried out the noise monitoring program on 27th January 2026.

Staff Involved:

Mr. P D Liyanaarachchi	*- Scientist*	*- ESSD, NBRO*
Mr. K D P Malshan	*- Technical Officer*	*- ESSD, NBRO*
Mr. W A Weerasinghe	*- Field Assistant*	*- ESSD, NBRO*
Mr. N Padmakumara	*- Field Assistant*	*- ESSD, NBRO*

Witness: *Ms. L D R Samarawickrama – Environmental Officer, BOI*
Mr. H S H Weerasinghe – Environmental Officer, BOI

2.0 DESCRIPTION OF THE SITE AREA

The project is the construction of a proposed textile zone at Eravur, Batticaloa within the Eravurpattu Pradeshiya Sabha area. The project area is about 262 acres. This monitoring programme is scheduled to monitor noise within the project area before start the construction activities.

3.0 WEATHER CONDITION & INSTRUMENTATION

Dry weather condition with fair north-easterly wind prevailed during the monitoring period and details are given below in table 01.

Table 01: Weather condition and instrumentation

Parameter/ Unit	Instrument	Measurement
Temperature / ^{0}C	HAUTO Digital Hygrometer	29 - 30
Humidity / %		60 - 62
Wind / ms^{-1}	WSO232 Anemometer (C 1901839/05)	2 - 4
Wind Direction		North eastern – South western

4.0 NOISE LEVEL MEASUREMENTS

4.1 SELECTION OF MEASURING LOCATIONS:

Six (06) locations were selected by the client, consulting the project consultants for the measuring of noise levels to represent project activities. The location description is given in Table 02.

Table 02: Description of the noise measuring locations

Location	GPS Coordinates	Description of Locations
N1	7.810688° N 81.611157° E	At the western boundary of the site, near the NCC building
N2	7.808756° N 81.614218° E	At the south-west boundary of the site, close to the access road of the project site
N3	7.811178° N 81.620909° E	At the southern boundary of the site, close to Throna 3
N4	7.817258° N 81.623786° E	At the eastern boundary of the site, close to the sea outfall sump
N5	7.823285° N 81.616354° E	At the northern boundary of the site, close to the stream and outfall
N6	7.821638° N 81.610527° E	At the north-west boundary of the site, close to Punyaramaya Viharaya, Punnakkuda, Eravur

- Refer attached Google Image of Noise Level measuring locations for further details

4.2 MEASURING INSTRUMENTS:

Sound Level meter	: RION NL 52
Reference No	: NBRO/ESSD/EQ/RION NL 52 SOUND LEVEL METER-01
Calibrator	: RION NC 74 – IEC 60942 (JIS C 1515), Class 1
Reference No of Calibrator	: NBRO/ESSD/EQ/RION NL 52 SOUND LEVEL CALIBRATOR-01
Calibration due	: October 2026

The sound level meter conforms to the requirements of both IEC 61672-1:2002 class 1 and JIS C 1509-1:2005 class 1.

4.3 METHOD OF MEASUREMENTS:

Noise level measurements were carried out in accordance with the methods laid down in the BS:4142:2014+A1:2019 as National Environmental Noise Control Regulations stipulated under the Extraordinary Gazette No. 924/12- Thursday, May 23, 1996 of Sri Lanka.

The equivalent continuous (A) weighted sound pressure level (Leq,T) was measured for the period of 1 hour during day time and night time with the integrated time of one (1.0) second in the FAST selection mode of the meter. The noise level receiver height was about 1.5 m from the ground level for each measurement.

4.4 MEASURING CONDITIONS:

The measurements were conducted for the assessment of baseline noise level in the area. Noise measurements were carried out from 11.00 hr to 23.30 hr on 27th January 2026.

It was noticed that, noise sources such as vehicle noise, birds' noise and sea breeze were mainly contributed to the measured day time noise levels and noise sources such as vehicle noise, birds' & night creature's noise, sea breeze and domestic noise were mainly contributed to the measured night time noise levels.

4.5 NOISE MEASURING RESULTS:

Table 03: Noise Levels at each measuring location

Location	Time	Run time	Measured Residual Noise Level Leq (dB)	Background Noise level L90 dB(A)
N1	Day	1 hour	55	46
	Night	1 hour	44	41
N2	Day	1 hour	46	37
	Night	1 hour	40	38
N3	Day	1 hour	45	43
	Night	1 hour	45	44
N4	Day	1 hour	59	57
	Night	1 hour	57	54
N5	Day	1 hour	54	51
	Night	1 hour	55	51
N6	Day	1 hour	55	52
	Night	1 hour	46	45

Where;

- Measured Noise Level (Leq) :- The equivalent continuous baseline noise level over the measuring period.
- Background Noise Level (L_{90}):- A weighted sound pressure level of baseline noise level that is exceeded 90% of a measuring period.

5.0 CONCLUSION

Noise generated by road vehicles, birds & sea breeze are main contributing sources to the residual noise levels in the area during daytime and noise generated by road vehicles, birds & night creatures, sea breeze and domestic noise are main contributing sources to the residual noise levels in the area during nighttime. The existing residual noise level are in the range from 45 to 59 dB during day time and 40 to 57 during night time.

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Coordinating Scientist (Analysis)
Scientist (Air Quality)
Environmental Studies & Services Division
National Building Research Organisation

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Checked by
Scientist
Scientist (Air Quality)
Environmental Studies & Services Division
National Building Research Organisation

Certified by:.....
H.D.S. Premasiri
Director/ Environmental Studies and Services Division

Google Images of Noise measuring locations



Annexure XII
Ongoing Activites and Monitoring Report

Inspection is conducted on 26.01.2026, 27.01.2026 and 28.01.2026

BOI

Environmental Aspects/ Impact	Proposed Mitigatory Measures	Current Status of Mitigatoy Measures	Time Frame	Remark
Increase in ambient dust(PM), SO_2 , CO and NO_x	Sprinkling of water in the construction area and unpaved roads. Proper maintenance of vehicles shall be done.	Sprinkling of water is done in the construction area and on unpaved roads 5–6 times a day	Ongoing	Zone development activities, including road construction and drainage system construction, are being carried out. Construction of Main Internal Road - Phase 1 (St. 0+000 to St. 0+130): 75% completed. Roads are being improved up to the subbase level. BOI is in the procurement process to complete the main road up to surface stage.
	Covering heavy vehicles moving offsite.	Currently being followed		
	Restricting dust generating activities such as blasting or top soil removal to calm wind conditions.	High dust generating activities are currently not being done.		
	Isolation of the construction area with flexible enclosures/ curtains so that the air emission will not spread in the surrounding	Currently no spot type constructions are being carried out by the BOI.		
	Restricting Vehicle speed on construction roads and ensure vehicles use only dedicated construction roads and assess points.	Currently being followed		

High Noise Emissions	Develop and implement a construction noise management plan.	Currently only basic infrastructure facilities are (internal roads) under development. Heavy machinery that generates noise and vibration is currently not in use.		Buffer zone is being maintained
	Limits hours of construction where practical.	Day time operations only.		
	Where blasting occurs, pit shapes and blast campaigns will be design such that the blast phases are oriented away from noise sensitive receivers.	No blasting activities are being done		
Sea Outfall		Laying of outfall completed.		We have made a request to NWS&DB by our letter dated 21.12.2021 to established proper and clear visible signage (such as illuminater markers Buoys) both during day and night along the pipeline at the diffuser location to mitigate fishing and marine accidents
Surface Drainage		Arches/ culverts are constructed across the roads to ensure uninterrupted drainage of storm water.		Storm water drainage system is under construction. Thona are left untouched

		Construction is completed. Existing "Thona" is not be damaged or alter during the construction Sand barriers are cleared form Thona mouth during monsoon season to avoid flooding of Thonas.		

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Environmental Aspects/ Impact	Proposed Mitigatory Measures	Current Status of Mitigatoy Measures	Time Frame	Remarks
Increase in ambient dust(PM), SO_2 , CO and NO_x	Isolation of the construction area with flexible enclosures/ curtains so that the air emission will not spread in the surrounding	Construction materials covered with tarpaulin covers. Dust generating places are covered.	On going	

	Boiler operation and ash will be properly managed	Biomass boiler and thermic fluid heater emissions are routed through wet scrubbers. Boiler Ash are collected separately though cyclonic separators in a fully covered manner. Ash is also collected in a fully covered manner		Biomass boiler, thermic heater and generator stacks are properly established within the company premises. 98 % of construction work with respect to biomass boiler and thermic fluid heater are completed.
Noise emission	Limit hours of constructions where practical.	Day time operation only	On going	Soundproof generated are installed.
	Managing and restricting noise generating activities.	Main construction phase was finished (pilling activities are completed)		
WWTP	Maintain the Wastewater Treatment Plant (WWTP) to treat all effluent and sewage generated by the facility.	ETP and STP are connected via separate pipelines to a Wastewater Treatment Plant (WWTP). Chemical dosing system, aeration system, lamella clarifiers, and RO system are established.	On going	Wastewater treatment plant will use biological and chemical processes to treat the wastewater. The wastewater treatment plant construction has been completed, with 99% of civil works finalized and 95% of

	The internal factory drainage system shall be properly maintained.	An internal factory drainage system is properly constructed with covered drains to collect the effluent generated from the production activities. These drains are connected to WWTP		mechanical works completed. The wastewater treatment plant has a design treatment capacity of 7,500 m^3/day, In future they are planning to 75% present of treated water reuse and 25% of water dispose through sea outfall after the 24 hours monitoring. .
	Wastewater from the canteen/kitchen should be passed through an oil trap and directed to WWTP	Separate oil traps will be installed to trap oil generated from the canteen/kitchen.		
	Storm water shall be discharged only through designated storm water drain lines**,** without mixing with wastewater.	Storm water drains will be constructed to discharge storm water without mixing with wastewater/effluent.		
	Chemical storage tanks will be properly constructed and maintained to ensure safety and prevent leaks or spills.	Chemical storage tanks for WWTP are established in close proximity to the WWTP and are provided with appropriate secondary containments.		

		Separate room has been built to store chemicals that will be utilized for production activities.		
Solid waste	Proper solid waste management systems will be established within the factory premises	Land plot within the industry premises has been identified for collection of solid waste during the operational stage. Solid waste generated during the construction phase is given to a third party. Separate area with shelter and a concrete floor has been built to store treatment plant sludge. Sludge filter press has been installed to reduce the wet sludge volume.		During the construction phase waste is being disposed of through third-party private collectors. Treatment plant sludge will be disposed via an approved facility during the operational phase.

Photographs

BOI

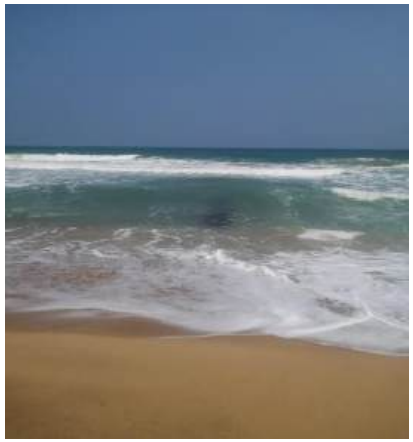
1. Ambient dust- Sprinkling of water is done in the construction area and on unpaved roads 5–6 times a day.





2. Sea Outfall- Laying of outfall completed.





3. Surface Drainage- Arches/ culverts are constructed across the roads to ensure uninterrupted drainage of storm water. Construction is completed. Existing “Thona” is not be damaged or alter during the construction and operation.





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1. Ambient dust- Dust generating places are fully covered.



2. WWTP- Currently waste water treatment plant under construction. 99% (Civil works) of waste water treatment plant is completed.





Separated pipelines for the Sewage and Effluent



Designated place for Chemical Storing



Lamella Clarifier



Designated place for Sludge Storing



Membrane Bioreactor- Biological treatment



Reverse Osmosis



Sludge Filter Press

3. Biomass boiler and Thermic fluid heater



Cyclonic filters with covered ash collecting points



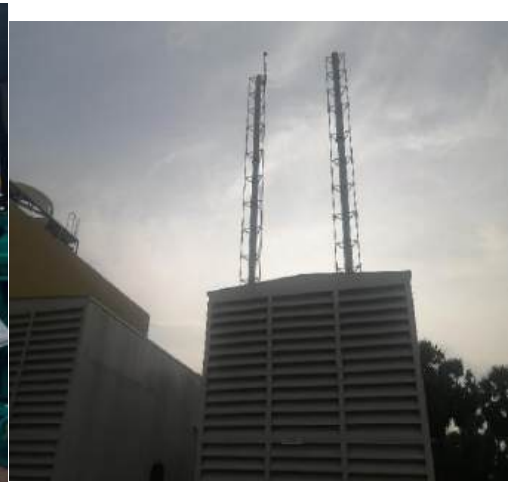
Wet Scrubber with ash depositor



Chimney for boiler unit (Chimney height is 25m)

4.Generators and fuel storage tanks





Soundproof chambers for generators with chimneys



Fuel storage tanks with secondary containers

5. Separated internal and external drainage system to connect wastewater and effluent to wastewater treatment plant.





Annex XIII
Insee Letter

Build for Life

INSEE ECOCYCLE

26th September 2025

Mr. Asanka Welagedara.
Director (Environment Management)
Board of Investment of Sri Lanka,
West Tower, World Trade Centre,
Colombo 01, Sri Lanka.

Dear Sir,

Ref. Request to undertake the waste management from the textile zone at Eravur

INSEE Ecocycle Lanka (Private) Limited is a fully owned subsidiary of Siam City Cement (Lanka) Limited. Being the country's leading waste management service provider with over 20 years of experience in the country in disposing of hazardous and non-hazardous waste and by being the only provider who can provide co-processing solutions for thermal destruction of hazardous waste in Sri Lanka, we work with over 1,000 manufacturing companies and over 100 local councils and multiple government entities in disposing of the waste on a regular basis. Every year, we dispose of over 100,000 tons of waste in an environmentally friendly and regulatory-compliant manner, utilizing cement kiln co-processing, while meeting global standards.

This is to inform you that INSEE Ecocycle is already working with numerous textile manufacturing companies nationwide to dispose of their hazardous and non-hazardous waste. We confirm that we have the required technology and capacity to manage such waste generated from the new Textile zone at Eravur as well.

Once the new zone is functional at Eravur, we will conduct sample analysis of the waste generated from different manufacturers and enter into commercial agreements with the respective waste generators. Thereafter, we will be continuing the disposal operations as we do in all other zones.

We are pleased to collaborate with BOI to offer environmentally friendly disposal solutions for the industry. If you have any other queries regarding this matter, please do not hesitate to contact us.

Sincerely,

INSEE Ecocycle Lanka (Private) Limited

Sujith Gunawardhana
Director

Sujith Gunawardhana
Director
INSEE Ecocycle Lanka (Pvt) Ltd
Level 25, Access Tower II
Union Place, Colombo - 2

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Hotline: +94 117 800 800, +94 112 030 200
E-mail: customerservice-inseeecocycle@siamcitycement.com
www.ecocycle.lk

Annexure XIV

Tolerance limits for the discharge of wastewater or effluent into Marine Waters -

Tolerance limit values fora short sea outfall

"SCHEDULE I

LIST IA

Tolerance limits for the discharge of wastewater or effluent into Marine Waters

No.	*Parameter*	*Unit, type of limit*	*Tolerance limit values for an outfall leading up to nearshore water*	*Tolerance limit values for a short sea outfall*	*Tolerance limit values for a long sea outfall*
1.	Total suspended solids	mg/1, max.	30	50	250
2.	Total dissolved solids	mg/1, max.	2100	-	-
3.	pH value at ambient temperature	-	6.0 – 8.5	5.5 – 9.0	5.5 – 9.0
4.	Biochemical Oxygen demand (BOD_5 in 5 days at 20^0C)	mg/1,max.	15	75	400
5.	Temperature at the point of discharge	^0C, max	Ambient water temperature +/- 5 or 35 whichever is lesser	Ambient water temperature +/- 5 or 35 whichever is lesser	Ambient water temperature +/- 5 or 35 whichever is lesser
6.	Oils and greases	mg/1,max.	5	12	15
7.	Phenols (as C_6H_5OH)	mg/1,max.	1	1	5
8.	Chemical oxygen demand (COD)	mg/1,max.	50	400	800
9.	Dissolved phosphates (as P)	mg/1,max.	1	5	10
10.	Ammoniacal nitrogen (as N)	mg/1,max.	15	50	150
11.	Cyanides (as CN)	mg/1,max.	0.1	0.2	0.4
12.	Total residual chlorine (as Cl_2)	mg/1,max.	0.5	0.5	1.0
13.	Fluorides (as F)	mg/1,max.	2	2	5
14.	Sulphides (as S)	mg/1,max.	2	2	5
15.	Arsenic, total (as As)	mg/1,max.	0.08	0.1	0.2
16.	Cadmium, total (as Cd)	mg/1,max.	0.02	0.05	0.10
17.	Chromium, total (as Cr)	mg/1,max.	0.05	0.05	0.10
18.	Chromium, hexavalent (as Cr^{6+})	mg/1,max.	0.01	0.01	0.05
19.	Copper, total (as Cu)	mg/1,max.	1.0	1.0	1.0
20.	Lead, total (as Pb)	mg/1,max.	0.05	0.10	0.10
21.	Mercury, total (as Hg)	mg/1,max.	0.001	0.002	0.01

22.	Nickel, total (as Ni)	mg/1,max.	0.1	0.2	1.0
23.	Selenium, total (as Se)	mg/1,max.	0.01	0.05	0.10
24.	Zinc, total (as Zn)	mg/1,max.	3	3	5
25.	Silver, total (as Ag)	mg/1,max.	0.005	0.035	0.35
26.	Pesticides (Total)	mg/1,max.	0.005	0.005	0.05
27.	Surfactants (Total)	mg/l, max.	1	5	10
28.	Faecal Coliform	MPN/100ml,max	150	1500	10^7
29.	Radioactivity Gross alpha activity +	Bq/l maximum	0.5	0.5	0.5
30.	Radioactivity Gross beta activity +	Bq/l maximum	1.0	1.0	1.0

LIST IB - Colour Parameter

No.	*Parameter*	*Unit, type of limit*	*Tolerance limit values for an outfall leading up to near shore water*
	Colour		Maximum spectral absorption coefficient
1.	400-499 nm- (Yellow range)	m^{-1}	7 max
2.	500-599 nm- (Red range)	m^{-1}	5 max
3.	600-750 nm- (Blue range)	m^{-1}	3 max

Note 1: All eff orts shall be made to remove unpleasant odour as practicable as possible.

Note 2: These limit values are based on the premise that for an outfall leading up to near-shore water with no dilution, for short sea outfalls 1:10 and for long sea outfalls 1: 100 respectively. In an event where the dilution factor for a respective category mentioned above is found to be less, the limit values given in the Lists shall be adjusted on a proportional basis so as to give rise to more stringent values.

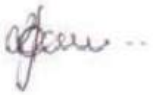
Note 3: The limit values given in the List shall be measured at the entrance of the outfall preferably at the pumping station or a manhole.

Note 4: In the case of application of this List, the design incorporating bathymetry, dilution based on actual meteorological and current data at the place of construction, construction details such as pipe details (length of the pipe), anchoring details and diff user descriptions etc. shall be approved by the Coast Conservation and Coastal Resource Management Department, the Marine Environment Protection Authority, and any other relevant authorities as the case may be, and the letter/s of approval shall be submitted to the Authority along with the application for Environmental Protection Licence.

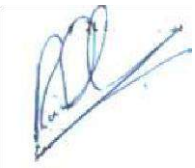
Note 5: The Authority may decide the fi nal discharge point for either near shore water, short sea out fall or long sea out fall as the case may be, on the basis of an environmental screening of the likely impacts.

Note 6: In case of the tolerance limits of radioactive materials exceeds, the standards stipulated by the Sri Lanka Atomic Energy Regulatory Council shall apply.

Annexure XV
List of Preparers

No	Name of Consultant	Designation / Area of Expertise	Qualifications	Signature
1.	Mr. A. Rajaratnam	Team Leader/ Environmental Specialist	▪ University of Colombo - MSc. Environmental Science - 1999 ▪ Bharathidhasan University, India- BSc Chemistry Special - 1st Class 1987 ▪ Charter Member of the Institute of Environmental Professionals Sri Lanka	
2	Dr. R L H L Rajapakshe	Hydrologist	▪ Saitama University Japan, 2005 - PhD, Environmental Science & Technology (Environmental Hydraulics/ Ecological Engineering) ▪ Saitama University, Japan, 1999, MSc, Civil & Environmental Engineering (Hydroscience & Geotechnology) ▪ University of Moratuwa, Sri Lanka, 1996, BSc, Civil Engineering (1st Class Honors), ▪ Chartered Engineer , Institution of Engineers, Sri Lanka	
3	Dr R R M K P Ranatunga	Maraine Ecologist	▪ PhD in Marine Biology 2003 2008 - James Cook University, Australia ▪ B.Sc. (Special) Degree in Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura 1994-1998	

No	Name of Consultant	Designation / Area of Expertise	Qualifications	Signature
4	Mr. P C Fernando	Oceanographic Specialist	▪ Master of Business Administration (MBA) Postgraduate Institute of Management (PIM), University of Sri Jayewardenepura, Sri Lanka, 2001. Extensive exposure to Project Evaluation, Capital budgeting/ Rationing, Financial & Economic Feasibility, Marketing and Managerial aspects. ▪ MSc H.E.(Delft) Research Title: Applicability of Numerical Models in Simulating Morphological Changes due to Offshore Breakwaters in the coastal environment IHE (Delft), The Netherlands, 1996 ▪ Dip. H.E.(Delft) (with Distinction) Hydraulic Engineering (field of Specialisation: Coastal & Port Engineering) International Institute for Infrastructure, Hydraulic and Environmental Engineering (IHE), Delft, The Netherlands, 1994 to 1995 ▪ B.Sc. (Hons), Civil Engineering (Second Class Upper Division), University of Moratuwa, Sri Lanka, 1990 ▪ Chartered Civil Engineer, 1994	

No	Name of Consultant	Designation / Area of Expertise	Qualifications	Signature
6	Mr R K A Kularatne	Project Manager / EHS Expert	▪ MSc Environmental Management Faculty of Graduate Studies, University of Colombo, Sri Lanka 2019 (Distinction Pass) ▪ National Diploma in Occupational Safety and Health, National Institute of Occupational Safety and Health (NIOSH), Sri Lanka 2016 (Merit Pass) ▪ Postgraduate Diploma in Environmental Management in the Tropics - Institute of Environment & Resources, Danmarks Tekniske Universitet (DTU), Denmark 2005 ▪ BSc Environmental Science, La Trobe University (Bundoora Campus), Victoria, 3083, Australia - 2000	

Annexure XVI
Responses to the Comments

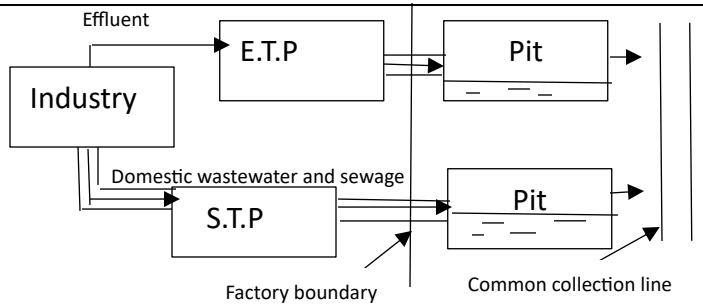
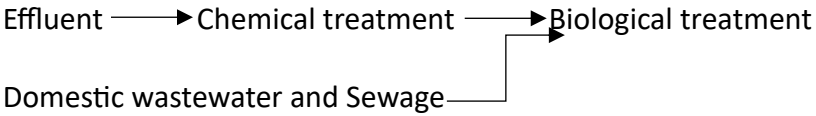
Responses to the Comments Submitted by the TEC Members

No.	Comments	Responses
1.	**Divisional Secretariate Erauvur Pattru, Chenkalady**	
	I would like to draw your kind attention that proposed textile zone in Punnaikuda, Eravurpattu, Chenkalady is one of the larger scale investment chains in Batticaloa District. Rural public of our division will be benefitted in employing in various sector in this proposed textile zone. However, discharges from the textile plant must be de-hazardous and close monitoring must be scheduled time to time. Further, livelihood of the fishing society will not to be threatened significantly, if periodical monitoring ensured.	An online monitoring system is proposed both at individual industries and at the final discharge outlet to the sea. In addition, regular monitoring of wastewater quality by the BOI and CEA is planned to ensure that the discharge does not cause pollution or adversely affect fishing activities in the area.
2.	**Central Environmental Authority**	
2.1	**A. Specific Comments**	
2.1.1	The CEA has been made to understand that the proposed alteration to the originally approved arrangement for the wastewater management is to be done by the BOISL as an interim solution until establishing WWTP as approved by the CEA based on original EIA report. However, this concern has not been indicated in the SEIA report even though this matter has been confirmed by the BOISL during the site visit	Agreed, the necessary amendments are made in the relevant section of the report.

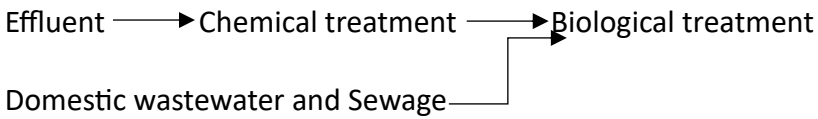
No.	Comments	Responses
	carried out by the CEA on 24.01.2025 in monitoring of the originally approved project.	
2.1.2	Details of existing/ ongoing constructions (e.g. Jay Jay Mills factory) including sea outfall and collection chamber etc.	Attached. Annexure XII
2.1.3	Revised layout plan indicating the already allocated industrial plots for establishment of industries and other facilities need to be clearly mentioned with the wastewater load and anticipated discharge quantities of each industry.	Land plots will be allocated with the arrival of the investors only. Wastewater load and actual discharge quantities of each industry will depend upon the production process of each industry. Envisaged effluent generation is indicated in “Table 2-4 : The proposed individual industries and the effluent generation” – (Page 20)
2.1.4	Indicate the specific parameters that will be considered for online monitoring system as it is mentioned that "Each industry will install an online monitoring system for selected parameters to continuous monitoring of the discharge quality of the wastewater" in page 20 of the SEIA report. The LHI study findings related sea outfall are not analyzed and discussed properly to match with the current proposal.	The LHI study was conducted for several options, including the short sea outfall standards. The short sea outfall option was accepted under the earlier EIA proposal. Since the discharge quality for the sea outfall remains unchanged, no further explanation is required. The proposed parameters to be measured by online are, Temperature, pH, Turbidity, Electrical Conductivity, Colour and the COD
2.1.5	Fulfillment of long-term water requirement is not mentioned.	The water requirement and the plan to meet this requirement are provided in **Section 2.11 Anticipated water requirement & source for the proposed alteration and for future developments of the zone. The details on estimated water balance taking into account conservation measures, reuse and recycling of treated effluents should be given.**

No.	Comments	Responses
2.1.6	Baseline data are not submitted in the SEIA study report considering the current situation of the area/ site. The data of original EIA study are attached.	Please find Annexure VIII, X, XI
2.1.7	Consent of 3rd party for incineration/ co processing of sludge and other waste.	Please refer Insee Ecocycle Lanka (Private Limited) consent letter Annexure XIII.
2.1.8	The responsible party/ ies for the sludge management is required	Please refer Insee Ecocycle Lanka (Private Limited) consent letter Annexure XIII.
2.1.9	Clarification is required for the listed waste categories, infectious waste/ expired medicines/ pharmaceuticals since such details are indicated in SEIA report.	Only a very small quantity is expected from the first aid process. As this quantity is negligible, the section has been removed from the report.
2.1.10	Submission of an EMP for the SEIA considering the proposed alteration to the already approved project and the long term solution of wastewater management. It is required to show how the proposed alteration will be accommodated with long term solutions. (i.e. common wastewater treatment plant).	The proposed alternative is a temporary basis until the Common wastewater treatment is constructed
2.2	B. **General Comments**	
2.2.1	List of all the SEIA report preparers, including their names and signatures as the SEIA report need to be authenticated.	Included Annexure XV

No.	Comments	Responses
2.2.2	The SEIA report need to be edited avoiding contradictory statements in different chapters in order to ensure consistency and connectivity between each chapter E.g. Executive summary/ Chapter 1, the date of the previous environmental approval is incorrect o In Chapter 2 o location of the sea outfall — it is not clearly mention whether the outfall location is changed or the originally proposed location is used. (Figure 2.4, Section 2.8.2 and chapter 4 mentioned that the final discharged point has been changed now).	The errors are corrected. The location considered in the original EIA has subsequently been revised. The newly proposed location is consistent with the location identified in the LHI Report. Refer to **Figure 2-4** for the updated project location details.
2.2.3	Treated effluent standard need to be clearly specified whether the coastal standards or short sea outfall standards o Some of the important data are not included and mentioned to refer the original EIA (e.g.: quantity and quality of effluent). Those are required to be incorporated, in order to get a clear understanding of the project & alteration o In Chapter 5 it is mentioned that a sub-surface wetland will be constructed. A clarification is required whether a sub-surface wetland is still to be constructed with the current proposal.	The final treated effluent standards will be Tolerance limits for the discharge of wastewater or effluent into Marine -Waters *Tolerance limit values for a short sea outfall* specified in Extraordinary Gazette Notification 2264/17 dated January 27th, 2022. Correction has been made in the relevant section. There is no artificial wet land is proposed in the new proposal
2.2.4	Under the section Environmental Management Plan (page 73), it is mentioned about Common WWTP.	Corrected
3.0	**Comments from Dinesh**	

No.	Comments	Responses
3.1	Clause 2.2.3 Page 13 Figure 2.5 Concentrated Dye recovery before mixing with other wastewater streams is recommended to be introduced as it is difficult to remove colour at low concentrations when mix with other wastewater streams.	The industrial operator shall adopt industry best practices, and dye recovery processes shall be implemented prior to the mixing of dye-containing effluent with domestic wastewater and sewage streams.
3.2	Clause 2.2.5 Page 15; 4. Safe Disposal Practices "Holcim" to change as "Siem Cement"	Corrected
3.3	Clause 2.6 Page 18 Please address following concerns in the operational strategy The report should clearly specify how the effluent from each industry after complying coastal water standards independently by individual industries with individual sampling point located outside each factory premises is collected through a common effluent collection network with one common pumping main that discharge to sea outfall beach chamber. After discussing with BOI, indicated whether BOI is maintaining this common treated water collection network and pumping station and mansion that what is the intended method of interim operation by JJ mills until common network is commissioned. Also explain how the online monitoring system (parameters to be monitored) is planned to operate and whether it is monitored centrally by the BOI Environmental Management Division officer within the	 or  The necessary corrections are done in the relevant section. The necessary corrections are done in the relevant section.

No.	Comments	Responses
	Eravur Textile Zone and whether online monitoring by each and every industry.	Sample collection can be done as per the above diagram, where effluent generated from the industry is directed to an effluent treatment plant and treated effluent is directed to a separate pit. The same procedure to be followed for domestic wastewater and sewage. Samples can be collected from these pits for testing and the pits will be located outside the industry boundary. Online monitoring system shall be implemented at each industry (page 22) - "Each industry will install an online monitoring system for selected parameters to continuous monitoring of the discharge quality of the wastewater"
3.4	Page 19; 2. Primary Treatment Primary treatment comprises of pH correction followed by Coagulation, Flocculation, Sedimentation, jar test equipment and recruiting trained qualified staff by each industry is mandatory to ensure proper operation. Depending on dye types in order to remove colour Powdered Activated Carbon (PAC) dosing prior to Chemical treatment or Granular Activated Carbon (GAC) Filtration just after final treatment/or as Emergency Management Plan may be required. Additional pretreatment techniques may be required and the industries should adopt best industry practices on treatment to suit specific dye types intended to be used in the respective textile production processes.	Following process shall be included Primary treatment (following process shall be included) pH Correction → Coagulation → Flocculation → Sedimentation Industries will be informed to adopt best practices, including the given comment by Mr. Danesh Should mention about the lab facility and availability of the qualified staff. Necessary corrections are done in the relevant section.

No.	Comments	Responses
3.5	Page 19; 3. Secondary Treatment After chemical treatment (Coagulation, Flocculation, Sedimentation) organic matter for food for the bacteria as well as macro and micro nutrients may have substantially reduced. As such it is strongly recommended to introduce sewage (black water & Grey water) generated from factory staff of individual factories prior to their respective biological treatment or else need artificial dosing to meet food and nutrient supplementation. It is also necessary to establish laboratory to monitor basic parameters including Sludge Volume Index, Food/Microorganism ratio which is referred to as F/M ratio.	Note: we have indicated that there will be sewage treatment plant and the effluent treatment plant Comment is accepted  Domestic wastewater and sewage shall be added with pre treated effluent. This will then be biologically treated with sewage and domestic wastewater The necessary corrections have been made in the relevant section
3.6	Page 20 Method of verification Please refer to comment given above under Clause 2.6 Page 18 with regard to online monitoring of effluent (what parameters) prior to common effluent network or clearly specify the strategy to ensure compliance and transparency.	No 2.6 – Periodic lab testing will be done by the BOI from the sample collection point. Parameters will be decided according to the production process carried out by the industries.
3.7	Page 21 Clause 2.7 specifies Short Outfall standards and Clause 2.7.1 Costal Water. Please specify the correct standards to be adopted uniformly throughout the report	The final treated effluent must comply with the tolerance limits for the discharge of wastewater or effluent into marine waters, as specified for a short sea outfall in the Extraordinary Gazette Notification No. 2264/17, dated January 27, 2022. The relevant sections have been updated accordingly.

No.	Comments	Responses
3.8	Page 21 Clause 2.7.2 Beach chamber monitoring is not practicable for individual factory monitoring as individual piping to beach chamber is not practical. Please refer to previous comments and propose suitable mechanism.	This is not for monitoring of individual industries but to ensure the quality of wastewater prior to discharge.
3.9	Page 21 Clause 2.7.3 Re use applications please consider other than landscape irrigation which is not permitted for industrial effluent.	Treated wastewater can be reused only for the non-portable activities or treated effluent will not be used for irrigation.
4.10	Page 22 last para Specify whether BOI is operating the common effluent network and its monitoring. Monitoring of colour standards should be mentioned appropriately in the report as compliance of colour limits are be met by each and every industry specific treatment prior to discharge to common effluent network assuming that only common pumping main is discharging to the beach chamber (Long Term) and JJ Mills as (Short Term). It is recommended that industries treat nutrients (N, P) as it may be necessary to treatment N,P limit in coastal waters in future CEA standards become likely to be stringent to avoid algal bloom formation.	BOI will provide only a treated wastewater collection and pumping station only. All wastewater including domestic wastewater/ sewage shall be treated to the proposed short sea outfall standards. Except parameter COD. In respect of COD the level shall be less than 250mg/l In terms of nutrient removal – Individual industries shall come up with a mechanism for nutrient removal as per CEA standards.
4.11	Page 24 Clause 2.9 second Para Sludge from dewatering process (mechanical dewatering or sludge drying beds) the filtrate should be re directed to inlet of the treatment plant.	– Corrected in the report

No.	Comments	Responses
4.12	Page 36 Table 5.1 it is recommended that the individual treatment plant designs along with technical staff to be deployed to treatment plant monitoring and operation including laboratory staff to be reviewed by H&M Committee prior to implementation. The EIA Consultant is requested to get CEA opinion and add to the report accordingly.	Hope this is to get the approval from HM committee each industry for the treatment plant.
4.13	Page 37 Zonal Septic Tanks Please recheck as septic tanks producers' anaerobic sludge and may not suit the operation. Further septic tanks may not contain adequate organic matter instead it is more realistic to add artificial supplementation of acetate. Nevertheless, alt BOI plants such as BEPZ and SEPZ have successfully managing holiday periods as security and other personal still working during these periods. This type of situation may arise only situations such as Pandemic periods which could start up by seeding from domestic wastewater treatment plants operated by NWSDB in worse case scenario.	We are not intended to allow industries to set up septic tanks and all domestic wastewater shall be discharged to in house treatment plant.
4.14	Page 37 Activated Sludge is Not Effective in Nutrient Removal Not agreed with this statement. Biological Nutrient Removal (BNR) can be done most effectively with Reverse A20 process (eg. JaEla & Soyzapura WWTP in operation since 2011) Maintaining Subsurface Constructed wetlands may require more or similar footprint while more wetland	Industries shall be responsible to select the treatment methodology and BOI/CEA will review the methodology.

No.	Comments	Responses
	maintenance compared to similar capacity BNR treatment. Better we not specify specific treatment processes to be adopted so that industry can propose suitable system which could be review by H&M Committee. Check with CEA	Accepted
4.15	Page 40 Table 5.2 EQ Tank Sludge EQ tank can be designed to minimize sludge accumulation by deeptnjng a sludge poket with submersible wet well pumps. EQ tank should be ventilated (preferably via odour control system) and adequate mixing not to create anaerobic conditions. Waste Activated Sludge can be considered for multipurpose biomass boiler feeding as adopted in MAS Fabric Park	Accepted Will depend upon the industry
4.16	Page 43 Dye paste for brick making Lending to third party will not ensure proper disposal or regulatory compliance unless if implemented within the Zone as a common facility under the guidance of BOI. Further leachability test for brick to be considered. However, at MAS FP they are using boiler ash with cement etc. to make interlocking brick but they do not use dye paste directly. Therefore; correct as appropriate preferable after discussing with MAS to make the practicality of the statement. Using bottom ash as mentioned in page 48 may be feasible.	All hazardous waste will be disposed via INSEE Ecocycle / CEA approved facility.

No.	Comments	Responses
4.17	Page 46 Expired medicine/Pharmaceuticals Please re check the requirement. Is it for medication for workers or intension to use Pharmaceuticals industries is not clear.	Corrected
4.18	Page 60 Aerators and Sludge Pumps in clarifier Aeration technology can be surface aerators or fine bubble aeration. In case of fine bubble aeration blowers are required. Therefore, better to generalize aeration technology. Further not that mechanical aerators produce aerosols select technology as appropriate. Sludge pumps are not installed inside the sedimentation tanks (progressive cavity type or submersible wet well). Therefore; correct as appropriate	Remove from the original report
4.19	Page 61 Environmental Management unit Please specify EMU is under BOI or at each Industry clearly after discussing with BOI	EMU will be operated under the Board of Investment (BOI). Each industry shall establish a dedicated Environmental and Social Monitoring Unit to carry out monitoring activities effectively.
5.0	Prof. Ajith de Alwis	
5.1	It is unfortunate that this report has become a necessity as proper concept of an industrial estate had not been able to be followed. This will be an estate without a common wastewater treatment plant. Now each and every industry will have their own WWTP and the estate would provide a short sea outfall. The conditions have been set for first discharge to the	The new proposal is intended as a temporary solution until the construction of the common wastewater treatment system. This does not mean that the common wastewater treatment system will not be implemented. Agreed. Necessary guidance on adopting circular economy principles has been provided in both the original EIA and this

No.	Comments	Responses
	common disposal point and then for the short sea outfall. Believe these conditions have come with scientific merit. If yes, the rigor necessary is in ensuring compliance. If industries adopt policies and systems that support technologies that support circularity there should be a rewarding mechanism.	Supplementary EIA. In addition, close monitoring of effluent and waste management practices will be carried out by the BOI. Furthermore, the proposed developers intend to cater primarily to the export market, where buyers place significant emphasis on environmental sustainability and circular economy practices. Therefore, the individual industries are expected to adopt policies, systems, and technologies that support circular economy principles and sustainable resource management.
	I have submitted comments earlier with respect to the initial EIA and still some of those are applicable. As BOI has decided to go ahead with the development, I will stay confined to the specific aspects of this single industry and its discharge process.	Agreed, and priority has been given to address these comments in both the Original EIA and this Supplementary EIA report.
	The revised land allocation needs more justification. It appears that the green cover is significantly reduced. The table should have another column with the percentage change indicated to indicate direction. If all the industries are going to have their own treatment systems the footprint calculation needs more attention. Textile and Dyeing facilities will have different systems to that of apparel industries. This should be given more attention in the adjustment presented.	Under the new land allocation plan, the waste management area has been increased by 5.46 acres, while the area allocated for the common wastewater treatment system remains unchanged. The footprint required for individual treatment facilities cannot be defined by the BOI, as it is entirely the responsibility of the respective developers. No major changes have been made to the green cover area, which also includes the designated buffer zone. In addition, each individual industry will maintain its green environment to the maximum extent possible.
	It is indicated that Activated sludge for sewage treatment. I think the on-going coindustrial estate strategy thinking should be recommended to Eravur rather than this type of 'systems of the past' recommendations.	Agreed and corrected. The proposals for the individual treatment plants will be reviewed by the CEA, BOI, and the Technical Evaluation Committee (TEC) prior to implementation.

No.	Comments	Responses
	With this condition perhaps a more detaile< presentation targeting individual industries and the specific WWTP system needs to be identified, committed to the technology configuration and presented.	
6.0	Comments from RDA	
6.1	The SEIA should give due consideration to road safety risks during both construction and operational phases, particularly in areas where project activities interface with existing road networks	Due consideration has been given to all concerns raised regarding both the construction and operational phases, particularly in areas where project activities interface with the existing road network, as addressed in the Original EIA. This Supplementary EIA mainly focuses on the construction and operation of advanced individual treatment systems by the respective industries until the common wastewater treatment system is established.
6.2	The SEIA should address potential risks associated with the transportation of hazardous materials (e.g., sludge, chemical residues) along public roads during construction and operation phases. It is essential to outline appropriate control measures such as spill prevention protocols, vehicle standards, driver safety training, and emergency response mechanisms to minimize risks to road users and surrounding communities.	
6.3	To prevent traffic congestion or obstruction, sufficient off-road parking and queuing space for project-related transport vehicles should be ensured within the project premises.	