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This Disclaimer Statement is being issued by KWSC in relation to the Project. Further to the request of various Interested Parties during the Pre-Bid Meeting dated September 4, 2024, KWSC has elected to provide the following technical studies (collectively, the **Technical Studies**) conducted by the technical advisors for the Project on behalf of KWSC:

1. Bathymetric Study;
2. Climatic Data;
3. Geotechnical Investigation Report;
4. Seawater Intake Drawings;
5. Geography & Topography Survey;
6. Water Sample Report; and
7. Environmental Impact Assessment Report

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NOVEMBER 2022

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

5 MGD SEAWATER DESALINATION PROJECT

EMC Pakistan
Private Limited

Karachi Water and Sewerage Board

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

5 MGD SEAWATER DESALINATION PROJECT

Final Report
November 2022
Ref: EIA/02/11/22

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Disclaimer:

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Executive Summary

The Project

The Karachi Water and Sewerage Board, GoS intends to setup a desalination plant of 5 MGD capacity to supply water to users in the South of Karachi and adjoining areas.

The proposed Project will have the capacity of five Million gallons per day (MGD) to supply water to the users in district South and adjoining areas. The proposed project will be located at Ibrahim Hyderi, Korangi Creek, over an area of 10 acres, which is about one and a half kilometers away from Dhari Island., as shown in the figure below. The EIA has been carried out as part of Letter of Award to consultants for "feasibility study & transaction advisory services for 5 MGD Sea Water Desalination Project". Advisory Consortium (AC) includes EY Ford Rhodes (financial advisor), Techno Consult International (technical advisor), EMC Pakistan (technical advisor), and FKM Law (Legal advisor). The Proponent/Executing Agency of the Project is Karachi Water and Sewerage Board, Government of Sindh (GoS).

The proposed route for water pipeline from desalination plant to Ghazi Pumping Station is passing through the Creek Road, Coast Guard Chowrangi, Korangi Qabristan Road and then Ghazi Pumping Station is about 6 km in length.

Project Location

The proposed desalination plant site is located in District Malir at Korangi Creek near small town of Bangali Dagga, in north east of Deh Ibrahim Hyderi, Karachi. The latitude and longitude of the project site is 24°47'37.39"N, 67° 9'18.94"E respectively, as shown in the figure below.

In a north direction of the proposed desalination plant, salt works are found, and in south it has Korange Creek & Charran Jetty in east it has Korangi Creek and in west some industrial plots are found. Proposed desalination plant site is approachable through Korangi Crossing Road after Nasir Jump Bus stop, double metalled road of Landhi starts at left side, on opposite corner the building of Indus Hospital is situated. After travelling approx. 4 km on Landhi Road towards Landhi after deputy commissioner office, at right hand side, a double metalled road crosses the Landhi road. This road leads to the Creek Road by crossing the Coast Guard Chowrangi. After turning a right-hand side at Creek Road, Fidatiqa International Kanta is present here. In opposite direction a kacha track is found here, which leads to the proposed plant site.

Legal Requirement

The EIA study is a mandatory requirement under the provisions of Sindh Environmental Protection Act 2014 and the rules made thereunder. Sindh Environmental Protection Act, 2014 under section 17 (1) mandatorily requires proponent of project to file an IEE or EIA, as the case may be, and obtain approval from the SEPA before commencing construction or operation of the project. Section 17 (1) of the 2014 Act is reproduced herein under for reference:

"17. (1) No proponent of a project shall commence construction or operation unless he has filed with the agency an initial environmental examination or environmental impact assessment and has obtained from the Agency."

Sindh EPA Environmental Assessment Regulations, 2021 categorize projects into three separate schedules depending on whether a project requires an Environmental Checklist (Schedule-I) or an IEE (Schedule-II) or EIA (Schedule III). The Regulations also require that all projects located in environmentally sensitive areas need submission of an EIA.

On the basis of the nature and scope of project, it has been accordingly categorized into **Schedule-III**

Category G: Water Supply and Filtration

- *Public water supply schemes and filtration plants*

This Environmental Impact Assessment (EIA) report presents the evaluation of environmental impacts of the construction and operation phases of the project.

Figure ES.1: Location of Proposed Desalination Plant

Desalination Plant Components

A desalination plant has five main components which are shown in the following flow chart;

1. Intake

The purpose of the intake system is to get the seawater from the sea to the plant. The intake water from this location would supply water to the Ghazi Pumping Station via Coast Guard Chowrangi where another pumping facility is available as a backup in case of a failure or other emergent circumstances at Ghazi Pumping Station.

2. Pre-Treatment

The purpose of the pre-treatment system is to prepare the seawater for the next stage of treatment. The pretreatment system removes all the suspended material in the seawater, effectively converting ‘dirty’ seawater into ‘clean’ seawater. The pretreatment system is really two or more treatment systems all performing specialised functions, with the selection being solely dependent upon the quality of the seawater.

3. Treatment

The purpose of the treatment system is to produce water ready for post-treatment. The treatment system removes the salt from the saline water and has two output steams, which are a pure water stream and a brine stream. There are several available technologies for removing salt from a saline water. By far the most energy efficient is reverse osmosis and this is now very widely used. The reverse osmosis membranes are cleaned each day using concentrated sulphuric acid and biocides.

4. Post-Treatment

The purpose of the post-treatment system if to prepare water for transfer and consumption. The posttreatment system prepares the pure water from the treatment system ready for its

transfer to customers. The water produced from a reverse osmosis system is very pure, and pure water is a very aggressive liquid. If not posttreated it would destroy pipelines and would be harmful to consumers. Chemicals (normally lime which is calcium carbonate) are added to the pure water to make it suitable for transfer and use. Chlorine is also added to ensure the water remains safe from contamination.

5. Waste Disposal

The purpose of the waste disposal system is to prepare and dispose of the waste material from the treatment processes. The waste disposal system disposes of the waste produced from the treatment processes. There are two waste streams, namely liquid waste and solid waste. The liquid waste stream comprises the brine solution, chemicals used to keep all the treatment systems clean and any liquid wastes from the pre-treatment system. Estimated brine output will be 7 MGD and shall be pumped and conveyed to sea through pipes for dispersion.

The solid waste stream comprises sludges from the pre-treatment process and the spent filter media and membranes. The solid waste will be disposed in environmentally friendly manner.

Baseline

The proposed seawater desalination Plant is located in Deh Ibrahim Hyderi, District Korangi, Karachi.

Currently, the project site is a waste dump, primarily covered with old, dry waste. Land use in surroundings of project site is depicted in figure below;

Photographs of project area

Project Site

The project site is relatively isolated from urban centers of the city. To ascertain the current concentration of pollutants in microenvironment, ambient air quality montoring was conducted at two locations in the microenvironment. Noise levels were measured at five locations.

Results of ambient air monitoring show that average concentration of pollutants are within SEQS limits and the airshed of microenvironment appears to be unpolluted. However, average noise readings exceed the SEQS limits for residential area but are with the limits set for commercial area.

Ambient air and Noise monitoring

Korangi Creek is an important creek for biodiversity having dense mangrove forest which provides sites for cetaceans, water birds, particularly the Waders such as Herons, Egrets, Redshank, Godwits, Curlews, Whimbrel, Stints, Gulls, Terns. Korangi Creek faces severe problem of aquatic pollution due to entering of untreated municipal and industrial waste in the area.

Public Consultation

The social team from EMC carried out consultations in the project area on 4th week of July 2022 after an initial site visit. Consultations were conducted with the residential and commercial stakeholders in the vicinity of project site. The following major issues and concerns were raised by the primary stakeholders:

Concern & Suggestions

- The residents of Hyderi Village were happy to see new development in the area. They commented that developmental projects will increase the property value and quality of infra-structure in the area and also provide few job opportunities for the locals.
- The residents of the neighborhood complained about the unavailibilty of fresh water in the area, they usually rely on water tankers for drinking and cooking purposes. They are under the impression that the proposed desalination plant would provide them the source of pure drinking water.
- The residents in the area complained about the lack of public transportation facilities in the locality.
- The residents of the neighborhood requested to have a proper hospital facility in the area, they have to travel in other subdivisions of District Malir to get proper medical help.
- The residents were also concerned about the garbage disposal system in the locality, they had to throw garbage in an empty plot and burn it after.
- The fishing community near the project was concerned about the fishing that could get affected due to the salts running back into the sea.

- The residents of the neighborhood also complained about not having a school facility for the children of poor fishermen community, they requested the officals for a non-profit or government school in the immediate neighborhood.
- The residents of the area said that there is a lot of pollution in the surroundings, the empty plots are frequently used for garbage disposals and the fish feed factories generate unpleasant odore in the surrounding.

<table>
<tr><th colspan="2">Stakeholders Consultation Pictures</th></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consultation with a Fisherman, Jamot Jetty No. 4</td><td>Consultation with a Resident, Hydari Village</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consultation with Fishermen, Jetty No. 4</td><td>Consultation with Fishermen, During Ice Filling</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consultation with Supervisor, Mashallah Godown</td><td>Consultation with Residents, Hydari Village</td></tr>
</table>

Screening of Potential Environmental Impacts & Mitigations

The potential environmental impacts of the project have been screened for construction and operation phase. Mitigation Measures will have to be adopted in order to reduce, minimize or compensate for the negative impact as far as possible.

Marine life preventer and anti-fouling device shall be installed to minimize accumulation, impingment and entrapment of marine life in the intake system.

Typical construction waste generated during construction activity includes wasted concrete, steel and wooden scaffolding, empty cement bags, excavated soil, wood remains etc. This waste has the potential to cause negative impact on the surroundings and especially marine environment if not properly managed and disposed to approved dumpsites.

Site-specific occupational health and safety hazards are also critical to be identified based on job safety analysis or comprehensive hazard or risk assessment. Detailed OHS and community health and safety measures have been provided to ensure worker safety.

The proposed project will create job opportunities during construction and operation phases. Unskilled and semi-skilled employment opportunities that are likely to be created, will be for a short period while the project is constructed. As persons with relevant skills may not be available locally, people from the project area are likely to fill a significant number of the semi-skilled and unskilled jobs while skilled labor will be arranged by proponent.

The proposed project involves construction activities like civil construction, mechanical construction, handling and stocking of construction materials, etc. Fugitive dust emission from construction sites is usually a concern predominantly for the habitants in the microenvironment. Mitigation measures such as Water sprinkling will be done on all exposed surfaces to suppress emission of dust. Construction and transportation equipment will raise dust and emit combustion gases including carbon dioxide, carbon monoxide, sulphur dioxide and nitrogen oxides. All vehicles, generators and other equipment used during the construction will be properly tuned and maintained in good working condition in order to minimize emission of pollutants.

There is no major odour expected from the operation of seawater desalination plants. Noise levels with the plant room will be high because of number of operational pumps and workers will therefore be required to wear earplugs.

Anti-scaling agents and chemicals are used in the desalination plant for pre-treatment of RO inlet water. Chlorine gas may also be used to treat water that is being supplied from desalination plant. Although the chemicals to be used are applied in small doses when applied into the system proper handling shall be practiced to minimize health risks to workers and the public. Hazardous chemicals shall be adequately labelled, stored safely and handling procedures should be visibly displayed at appropriate locations.

Risks to marine water quality are related to the discharge of brine, if it is not properly disposed of. The Project's use of the new outfall pipe for brine discharge is not expected to impact coastal marine water quality in an area that is already designated for such activities and operations. A

low toxicity antiscalant will be specified. Outfall pipe will be designed in a manner to ensure good dispersion of brine in seawaters.

Environmental Management Plan (EMP)

The EMP includes mitigation, enhancement, compensation and contingency measures for each of the two phases of the project – construction and post construction/ operation. Scope of management plan will adopt pollutants abatement measures in different phases of the plant. Some of the pollution abatement measures take account of inbuilt construction and some of them are external. Inbuilt measures include Occupational health and safety and regular training and motivations to the employees. External measures include brine monitoring, water quality monitoring and regular training and monitoring to the respective management plan.

The implementation and monitoring of EMP shall have to be ensured. Therefore, a team of Third-party consultant along with EPA Certified Laboratory may be engaged with responsibility of environmental monitoring during implementation of EMP.

Conclusion

The EIA study finds that the impacts of the project activities at the pre-construction, construction and operation stages have been adequately addressed and mitigation measures duly proposed wherever needed. Adoption of mitigation measures will ensure reduction of impact on the micro and macroenvironment as well as socio-economic conditions to acceptable levels and discharge of emissions to comply with the SEQS. The development of this project will be compatible with the requirements of the Sindh Environmental Protection Act 2014 as well as other regulatory requirements of Government of Pakistan. The issue of safety has been duly incorporated in the design and operations phases of the project.

On the basis of the findings of the EIA Study, it is possible to conclude that the proposed Seawater Desalination Plant Project will thus respond to all aspects of sustainability: Economic, social and environmental and will thus be a sustainably viable project.

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ANNEXURES

Chapter 1 Introduction

1.1 Overview of the Project

A total of about 600 MGD water is supplied to the residents of Karachi against a demand of 1,200 MGD resulting in a shortfall of 535 MGD. Out of the total water supplied, 210 MGD is not filtered. The gap is currently filled by water tankers supplying water to residents of South region.

The KWSB intends to setup a desalination plant of 5 MGD capacity to supply water to users in the South of Karachi and adjoining areas.

The proposed Project will have the capacity of five MGD to supply water to the users in district South. The proposed project will be located at Ibrahim Hyderi, Korangi Creek which is one and a half kilometers away from Dhari Island., as shown in the figure below. The EIA has been carried out as part of Letter of Award to consultants for “feasibility study & transaction advisory services for 5 MGD Sea Water Desalination Project”. Advisory Consortium (AC) includes EY Ford Rhodes (financial advisor), Techno Consult International (technical advisor), EMC Pakistan (technical advisor), and FKM Law (Legal advisor).. The Proponent/Executing Agency of the Project is Karachi Water and Sewerage Board, Government of Sindh (GoS).

Figure 1.1: Location of Proposed Desalination Plant

Table 1.1: Project Consortium		
A)	EY Ford Rhodes, Karachi (Transaction advisory services)	
B)	Techno-Consult International (PVT.) Limited (Feasibility Study)	
C)	EMC Pakistan Private Limited (Environmnetal Study)	
D)	FKM – Farooq, Khan & Mirza (Legal advisor)	

1.2 The Proponent[1]

Karachi Water and Sewerage Board (KWSB)
Address: Head office behind civic center old KBCA Building, Gulshan Iqbal
Phone: (+021) - 99230317
E-mail: info@kwsb.gos.pk

1.3 Objectives of EIA

The main purpose of this EIA Study is to provide and analyze information on the nature and severity of physical, biological, and socioeconomic environmental aspects and propose

[1] https://www.kwsb.gos.pk/contact-us/

mitigation measures in case of negative impacts arising from the construction and operation of the project and related activities that would take place concurrently or subsequently. The Study has:

→ Identified all major and minor impacts, negative as well as positive, on the environment (physical and ecological) during its different stages viz. pre-construction, construction and operation of Project
→ Proposed mitigation measures for negative impacts through specified design and construction procedures
→ Identified Socioeconomic aspects, and
→ Devised Environmental Management Plan (EMP) for sustainable operation of the Project

This EIA report has been prepared after identifying the environmental aspects and screening the potential impacts to ensure that the proposed activities pertaining to construction and operation of proposed seawater desalination plant are environment friendly and evaluated through environmental assessment carried out in accordance with applicable laws and regulations of Sindh Environmental Protection Act 2014.

1.4 Categorization of Project

The EIA study is a mandatory requirement under the provisions of Sindh Environmental Protection Act 2014 and the rules made thereunder. Sindh Environmental Protection Act, 2014 under section 17 (1) mandatorily requires proponent of project to file an IEE or EIA, as the case may be, and obtain approval from the SEPA before commencing construction or operation of the project. Section 17 (1) of the 2014 Act is reproduced herein under for reference:

"17. (1) No proponent of a project shall commence construction or operation unless he has filed with the agency an initial environmental examination or environmental impact assessment and has obtained from the Agency."

Sindh EPA Environmental Assessment Regulations, 2021 categorize projects into three separate schedules depending on whether a project requires an Environmental Checklist (Schedule-I) or an IEE (Schedule-II) or EIA (Schedule III). The Regulations also require that all projects located in environmentally sensitive areas need submission of an EIA.

On the basis of the nature and scope of project, it has been accordingly categorized into **Schedule-III**

Category G: Water Supply and Filtration

- *Public water supply schemes and filtration plants*

This Environmental Impact Assessment (EIA) report presents the evaluation of environmental impacts of the construction and operation of the project.

1.5 Project Need and Background

Karachi is located at the southernmost edge of the country and is the city furthest downriver in the Indus River system. As Indus flows have decreased in the past few decades, they have triggered intense political tensions between the upriver and downriver populations across the country.

Karachi's share of water is also under strain within the city. Home to almost 20 million people, Karachi is Pakistan's largest city, its financial hub, and (until recently) its only coastal city. Currently, only half of the city's needs are met—the city has approximates 550 million gallons per day, but the population size requires 1.1 billion gallons per day. This is unsustainable, especially considering how approximately 0.6 million people migrate to Karachi annually.[2]

Karachi's water supply and sewage system needs immediate attention from the government and adequate planning to accommodate the rapidly increasing population and urbanization of the city to avoid a severe crisis in the future.

1.6 EIA Methodology

This environmental impact assessment was conducted in the following manner:

Scoping: A scoping exercise was undertaken to identify the potential issues that are to be considered in the EIA. The scoping exercise included the following tasks:

→ Data Compilation: A generic description of the proposed activities relevant to this environmental assessment was compiled with the help of the Project proponent.
→ Review of Published literature: Secondary data on climate, soil, water resources, wildlife and vegetation were reviewed.
→ Review of applicable Legislation: Information on relevant legislation, regulations, guidelines, and standards was reviewed and compiled.
→ Identification of potential impacts: The information collected in the above procedures was reviewed and potential environmental issues identified.
→ Initial site visit: An initial site visit was conducted to get an overview of site conditions and the surrounding areas.
→ Stakeholder consultation: A stakeholder consultation was undertaken to document the concerns of the local community and other stakeholders, and to identify issues that may require additional assessment in order to address these concerns.

Baseline Data Collection: Detailed environmental baseline surveys were conducted to collect primary data on the Project Area to help identify sensitive receptors. The primary data were

[2] Water Mafia and Governance in Karachi, By Noman Ahmed & Nazia Hussain, February 14, 2022 https://www.newsecuritybeat.org/2022/02/water-mafia-governance-karachi

examined & compared with secondary data available from earlier environmental studies in the region.

Identification of Aspects: Identification of environmental aspects and their significance is fundamentally important for determination of severity of incidence of impacts at different stages of the project. This step is aimed at obtaining an inventory of the aspects. The aspects identified during this step cover all activities during construction, installation and operation, in order to determine those which, have or can have significant impact on the environment. The aspects that were covered during the surveys included:

→ Community and socioeconomic indicators
→ Air quality
→ Traffic
→ Sensitive receptors
→ Marine ecology
→ Water quality, and
→ Soil.

Impact Assessment & EMP: Environmental experts at EMC analyzed and assessed the anticipated impacts that are likely to arise due to the identified aspects. Each of the potential impacts identified during the scoping session was evaluated using the environmental, socioeconomic, and project information collected. In general, the impact assessment discussion covers the following aspects:

→ Present baseline conditions
→ Potential change in environmental parameters likely to be affected by Project- related activities
→ Prediction of potential impacts
→ Evaluation of the likelihood and significance of potential impacts
→ Defining of mitigation measures to reduce impacts to as low as practicable
→ Prediction of any residual impacts, including all long- and short-term, direct and indirect, and beneficial and adverse impacts
→ Monitoring of residual impacts.

An environmental management plan (EMP) was developed to oversee the environmental performance of the project and adoption of proposed mitigation measures. A monitoring plan has also been incorporated in the EMP to monitor impact of all activities and performance of mitigation measures and to identify the residual impact if any, and also the positive/negative changes in the physical, and socioeconomic environment.

Documentation & Review: This is the final step of the EIA study. The data generated during and for the study are compiled and examined by experts of the respective field. Sections of this report were prepared as the study progressed, by EMC office staff in consultation with experts.

The report was finally reviewed by Team Leader, who analyzed the information, assessed the potential environmental impacts in the light of national and international guidelines, examined the alternatives in the light of observations on the field as well as meetings with the stakeholders, before organizing the Report in the present form.

1.7 Organization of the EIA Report

Section 2 (Policy, Statutory & Institutional Framework) briefly discusses existing national policy and resulting legislation for sustainable development and environmental protection, and then presents the legislative requirements that need to be followed while conducting the EIA.

Section 3 (Description of Project) describes the proposed Project.

Section 4 (Environmental & Social Baseline) documents in detail the existing physical, biological, and socioeconomic conditions at the microenvironment and macroenvironment of the project area.

Section 5 (Stakeholders Consultation) presents the objectives and outcomes of the public stakeholder consultation that was conducted during the present study.

Section 6 (Potential Environmental Impacts and Mitigation Measures) presents an assessment of the Potential Environmental Impacts on the physical, biological, and socioeconomic environment, besides the measures required to mitigate the negative impacts.

Section 7 (Environmental Management and Monitoring Plan) presents the measures proposed for implementation of the environmental mitigation measures, and

Section 8 (Conclusion) presents the conclusions of this EIA Study.

1.8 EIA Study Team

EMC Pakistan Private Limited has been commissioned for conducting the Environmental Impact Assessment (EIA). EMC formulated the following team of experts for conducting the EIA study and preparing the report:

Table ES-1: EIA Study Team

S. No.	Name	Position in Project
1.	Engr. Syed Nadeem Arif	Project Director/Team Lead
2.	Dr. Shahid Amjad	Senior Marine Biologist
3.	Mr. Tanveer Arif	Senior Sociologist
4.	Engr. Omar Arif	Environmental Engineer
5.	Engr. Sohaib Tariq	Environmental Engineer
6.	Ms. Saira Tariq	Environmentalistal Scientist
7.	Mr. Wajai Kumar	Sociologist
8.	Mr. Ather Adil	Field Officer

Chapter 2 Policy, Statutory & Institutional Framework

This section describes the current legal responsibilities of the Project proponent in the context of the environment and sustainable development, and the institutions that exist in the country that may influence the environmental management of the proposed Project.

2.1 National Policy and Legal Framework

The Pakistan National Conservation Strategy (NCS) that was approved by the federal cabinet in March 1992 is the principal policy document on environmental issues in the country (EUAD/IUCN, 1992). The NCS outlines the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the proposed project are pollution prevention and abatement and increasing energy efficiency while conserving biodiversity.

Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The Federal list covered the subjects over which the federal government had exclusive legislative power, while the 'Concurrent List' contained subjects regarding which both the federal and provincial governments could enact laws. The subject of 'environmental pollution and ecology' was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject. However, as a result of the 18th Amendment this subject is now in the exclusive domain of the provincial government. As a result, the Ministry of Environment at the federal level has been abolished. Its functions related to the national environmental management have been transferred to the provinces. The international obligations in the context of environment will be managed by the Ministry of Climate Change.

2.2 Sindh Environmental Protection Act, 2014

The following articles of the SEPA 2014 have a direct bearing on the proposed Project;

Article 11(1): ‘Subject to the provisions of this Act and the rules and regulations therein, no person shall discharge or emit or allow the discharge or emission of any effluent, waste, pollutant, noise or any other matter that may cause or likely cause pollution or adverse environmental effects, as defined in Section 2 of this Act, in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards.

Article 11(2): ‘All persons, in industrial or commercial or other operations, shall ensure compliance with the Environmental Quality Standards for ambient air, drinking water, noise or any other Standards established under section 6(1)(g)(i); shall maintain monitoring records for such compliances; shall make available these records to the authorized person for inspection;

and shall report or communicate the record to the Agency as required under any directions issued, notified or required under any rules and regulations.

Section 11(3): Monitoring and analysis under sub-section (1) and (2), shall be acceptable only when carried out by the Environmental Laboratory certified by the Agency as prescribed in the rules. All stipulated tests will be regularly performed from designated laboratories approved by Sindh EPA.

Article 14 (1): 'Subject to the provisions of this Act and the rules and regulations, no person shall cause any act, deed or any activity', including; (b) disposal of solid and hazardous wastes at unauthorized places as prescribed; (c) dumping of wastes or hazardous substances into coastal waters and inland water bodies; and (d) release of emissions or discharges from industrial or commercial operations as prescribed.

Article 15 (1): 'Subject to the provisions of this Act, no person shall operate or manufacture a motor vehicle or class of vehicles from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the Sindh Environmental Quality Standards or, where applicable, the standards established under sub-clause (i) of clause (g) of sub-section (1) of section 6'.

Article 17(1): 'No proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or environmental impact assessment, and has obtained from the Agency approval in respect thereof.

Article 17(2): The agency shall; a) review the initial environmental examination and accord its approval, subject to such terms and conditions as it may prescribe, or require submission of an environmental impact assessment by the proponent; or (b) review the environmental impact assessment and accord its approval subject to such terms and conditions as it may deem fit to impose or require that the environmental impact assessment be re-submitted after such modifications as may be stipulated or decline approval of the environmental impact assessment as being contrary to environmental objectives.

Article 17(3): 'Every review of an environment impact assessment shall be carried out with public participation and, subject to the provisions of this Act, after full disclosure of the particulars of the project'.

Article 17(4): 'The Agency shall communicate its approval or otherwise within a period of two months from the date that the initial environmental examination is filed, and within a period of four months from the date that the environmental impact assessment is filed complete in all respects in accordance with the regulations, failing which the initial environmental examination or, as the case may be, the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations'.

Article 20(1): 'The Agency shall from time to time require the person in charge of a project to furnish, within such period as may be specified, an environmental audit or environmental review

report or environmental management plan containing a comprehensive appraisal of the environmental aspects of the project'.

Article 20(2): The report of a project prepared under sub-section (1) shall include: (a) analysis of the predicted qualitative and quantitative impact of the project as compared to the actual impact; (b) evaluation of the efficacy of the preventive, mitigation and compensatory measures taken with respect to the project; and (c) Recommendations for further minimizing or mitigating the adverse environmental impact of the project.

Article 20(3): 'Based on its review of the environmental audit report, the Agency may, after giving the person in charge of the project an opportunity of being heard, direct that specified mitigation and compensatory measures be adopted within a specified time period and may also, where necessary, modify the approval granted by it under section 17'.

Section 31(1): The Agency shall cause relevant details of any proposed project regarding which an Environmental Impact Assessment has been received to be published, along with an invitation to the public to furnish their comments thereon within a specified period. (2) In accordance with such procedure as may be prescribed, the Agency shall hold public hearings to receive additional comments and hear oral submissions. (3) All comments received under sub-sections (1) and (2) shall be duly considered by the Agency while reviewing the environmental impact assessment or strategic impact assessment, and decision or action taken thereon shall be communicated to the persons who have furnished the said comments.

2.3 Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021

The Regulations classifies projects on the basis of expected degree of adverse environmental impacts and lists them in three separate schedules. Schedule I lists projects that may not have significant environmental impacts and therefore require an Environmental Checklist. Schedule II lists projects of considerable environmental impacts requiring preparation of an IEE report. Schedule III lists projects of potentially adverse environmental impacts requiring preparation of an EIA report. The regulation also requires that all projects located in environmentally sensitive areas require preparation of an EIA.

On the basis of the nature and scope of project, it has been accordingly categorized into **Schedule-III**

Category G: Water Supply and Filtration

- *Public water supply schemes and filtration plants*

2.4 Other Relevant Laws, Regulations and Guidelines

There is a long list of legislation that falls in the category of or is relevant to environmental law. Some of the more important ones are as follows:

Legislation	Summary of the key objectives & requirements of the Legislation, Plan or Programme relevant to the proposed Desalination Project
1. IFC General Environmental Health and Safety (EHS) Guidelines	The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry specific examples of Good International Industry Practice (GIIP).: 1.1 Air Emissions and Ambient Air Quality 1.2 Energy Conservation 1.3 Wastewater and Ambient Water Quality 1.4 Water Conservation 1.5 Hazardous Materials Management 1.6 Waste Management 1.7 Noise 1.8 Contaminated Land and Safety 3.1 Water Quality and Availability 3.2 Structural Safety of Project Infrastructure 3.5 Transport of Hazardous Materials 3.6 Disease Prevention 3.7 Emergency Preparedness and Response
2. World Bank EHS guidelines for Water and Sanitation	The EHS Guidelines for Water and Sanitation include information relevant to the operation and maintenance of (i) potable water treatment and distribution systems, and (ii) collection of sewage in centralized systems (such as piped sewer collection networks) or decentralized systems (such as septic tanks subsequently serviced by pump trucks) and treatment of collected sewage at centralized facilities.
3. IFC Performance Standards on environmental & social sustainability 2012	Performance Standards providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities for IFC. The Performance Standards Consist of: 1: Assessment and Management of Environmental and Social Risks & Impacts 2: Labour & Working Conditions 3: Resource Efficiency and Pollution Prevention 4: Community Health, Safety, and Security 5: Land Acquisition and Involuntary Resettlement 6: Biodiversity Conservation & Sustainable Management of Living Natural Resources 7: Indigenous Peoples 8: Cultural Heritage
4. World Bank Environmental Assessment Resource Book	Designed to facilitate the environmental assessment process – aimed at those involved in Environmental Assessment (EA), primarily the EA practitioner, but also groups managing them, project designers, task managers and environmentalists in general. A reference manual which contains the information needed to manage the process of environmental assessment according to the requirements of the World Bank's Operational Directive (OD) on EA 4.01, October 1991
5. Equator Principles (EPs)	The EPs as based on the IFCs Performance Standards on social and environmental sustainability and on the World Bank Group EHS Guidelines. They are intended to serve as a common baseline and framework for the implementation by each adopting institution of its own internal social & environmental policies, procedures and standards related to its project financing activities.

Legislation	Summary of the key objectives & requirements of the Legislation, Plan or Programme relevant to the proposed Desalination Project
6. World Bank Pollution Prevention and Abatement Handbook 1998	Good for giving basic principles for policy formulation and EA process and more specific advice on management of air quality, water quality, industrial pollution and finance as well as transboundary issues. Designed principally to support the World Bank's EA process. Discusses reasoning behind EAs and decisions, such as environmental externalities and determination of the economic boundaries of analysis (i.e. valuation and extents).
7. UN Framework Convention on Climate Change (1992)	The stated objective is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities.
8. Medium Term Development Framework (MTDF) 2005-2010	The first medium term development framework to enable Pakistan to cross the threshold of sustained higher growth. One of the key objectives is to move, in an organized and disciplined manner, towards an efficient, balanced, internationally competitive, environment friendly, and technologically driven knowledge economy for rapid & sustainable growth to become an industrialized nation in 25 years.
9. Constitution of the Islamic Republic of Pakistan (As Amended)	Articles 172 and 173 confirm that primarily all land in a province is owned by that provincial government unless owned privately, and that all mineral oil and natural gas within the province or adjacent territorial waters vest jointly in equal proportions to that province and the federal government (i.e. no constitutional basis for private mineral rights so appropriate agreements are needed). The Federal Government & Provincial Government can grant, sell, dispose or mortgage this property and purchase or acquire property.
10. Land Acquisition Act 1894	Regulates acquisition of land for public purposes and provides for compensation or alternate land allocation or other equitable arrangement.
11. The National Environmental Policy, 2005 NEP	The NEP aims to protect, conserve, and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development. Broad guidelines are set under the following headings: ▪ Sectoral guidelines: Water Supply and Management, Air Quality & Noise, Waste Management, Forestry, Biodiversity and Protected Areas, Climate Change and Ozone Depletion, Energy Efficiency and Renewables, Agriculture and Livestock and Multilateral Environmental Agreements ▪ Cross-sectoral guidelines: Linking the Environment to Poverty, Population, Gender, Health Trade, Local Governance, & Natural Disaster Management
12. The National Conservation Strategy, Mid-term review 2000	Achievements under the NCS have been primarily awareness raising and institution building rather than actual improvements in the quality and productivity of environment and natural resources. The NCS was not designed and is not adequately focused as a national sustainable development strategy. The NCS process has strengthened civil society institutions and their influence, and enhanced the capacity of public institutions. NCS implementation capacity requires much improvement. NCS continues to have a major catalytic role in furthering Pakistan's Sustainable

Legislation	Summary of the key objectives & requirements of the Legislation, Plan or Programme relevant to the proposed Desalination Project
	development agenda. However, it needs refocusing and closer link to achievable development outcomes; this should constitute the agenda of the next phase of NCS, here referred to as NCS-2.
13. The Sindh Environmental Quality Standards, 2015	The SEQS specify standards for industrial and municipal effluents, gaseous emissions, ambient air quality requirements, vehicular emissions, noise levels and drinking water quality. The SEPA specifies the imposition of pollution charge in case of non-compliance with the SEQS.
14. Pakistan Penal Code 1860 (as amended)	The Penal Code is a penal code for all offences charged in Pakistan. Chapter XIV relates to offences affecting the public health, safety, convenience, decency and morals. Environmental harm is contained within sections 268 (public nuisance), 277 (fouling water of public spring or reservoir), 278 (making atmosphere noxious to health), 284 (negligent conduct with respect to poisonous substance), 285 (negligent conduct respect to fire or combustible matter), 286 (negligent conduct respect to explosive substance) alongside their corresponding penalties associated with non-compliance.
15. Biodiversity Action Plan, 2000 BAP	To promote the conservation and sustainable use of Pakistan's biodiversity, and the equitable sharing of benefits arising there from, for the well-being and security of the nation. Confirms Pakistan (as at 2000) had a network of 225 Protected Areas comprising 14 National Parks, 99 Wildlife Sanctuaries, 96 Game Reserves, and 16 unclassified (Private, proposed or recommended). Sets out the issues (direct and indirect causes) driving the country's biodiversity loss. Sets out a series of policy objectives for the future development of the legal framework relating to wildlife, forestry, ecosystem services and sustainable use of resources. Includes a BAP implementation schedule.
16. The National Drinking Water Policy 2009	Drinking water means "water using for domestic purposes including drinking, cooking, hygiene and other domestic uses". Includes recommending rainwater harvesting, protection of surface water and ground water supplies through PEPA 1997 and NEP 1997, community water management and IWRM, consideration of impact of climate change on drinking water supplies, encouraging community participation and awareness raising and capacity building.
17. National Water Policy 2018	Council of Common Interests unanimously approved the country's first-ever National Water Policy (NWP) in April 2018. It addresses almost all relevant issues concerning the management of water resources and responds to the concerns of stakeholders and reflects the inputs provided by Pakistani and external experts during the past decade and a half. It covers many water-related issues affecting Pakistan, including: water use and the allocation of water according to economic priorities; the environmental integrity of water basins; agriculture; the impact of climate change; drinking water and sanitation; hydropower; groundwater; water rights and obligations; sustainable water infrastructure; conservation; water-related hazards; and legal frameworks.
18. National Climate Change Policy, 2012	The National Climate Change Policy provides a framework for addressing the issues that Pakistan faces or will face in future due to the changing climate. In view of Pakistan's high vulnerability to the adverse impacts of climate change, in particular extreme events, adaptation effort is the focus of the policy document. The vulnerabilities of various sectors to climate change have been

Legislation	Summary of the key objectives & requirements of the Legislation, Plan or Programme relevant to the proposed Desalination Project
	highlighted and appropriate adaptation measures spelled out. These cover policy measures to address issues in various sectors such as water, agriculture, forestry, coastal areas, biodiversity and other vulnerable ecosystems. Notwithstanding the fact that Pakistan's contribution to global greenhouse gas (GHG) emissions is very small, its role as a responsible member of the global community in combating climate change has been highlighted by giving due importance to mitigation efforts in sectors such as energy, forestry, agriculture and livestock.
19. Pakistan Climate Change Act, 2017	Pakistan is a party to UNFCCC, 1992 and Kyoto Protocol to the UNFCCC, 1997. It also initiated the process for ratifying the Paris Agreement, 2015 which recognizes that Climate Change represents an urgent and potentially irreversible threat to human societies and the planet and thus is a global challenge. The Act calls for establishment of independent Pakistan Climate Change Authority under the guidance of high-powered Pakistan Climate Change Council to provide a framework for mitigating and adapting to the effects of the changing climate on various sectors of the economy and developing response strategies to climate change. The Act also establishes Pakistan Climate Change Fund. Money from Fund will also be utilized for financial assistance to suitable adaptation and mitigation projects.
20. Hazardous Substances Rules 2014	These Rules were notified to streamline procedures for issuance of licenses to industries/ businesses that generate hazardous waste, safety precautions for workers and devise them methods for the removal of hazardous wastes in an environmentally friendly manner. The rules also specify procedures to be adopted for import, transport and disposal of hazardous waste; and identify two hundred and forty-three hazardous substances and synthetic chemicals.
21. Labour Policy 2010	Government's fundamental commitment today is to create an enabling environment for the application of universal principles of equality and social justice as well as the constitutional and international rights of workers
22. Sindh Wildlife Protection Ordinance, 1972	This ordinance provides for the preservation, protection and conservation of wildlife by the formation and management of protected areas and prohibition of hunting of wildlife species declared protected under the ordinance. The ordinance also specifies three broad classifications of the protected areas; national parks, wildlife sanctuaries and game reserves. Activities such as hunting and breaking of land for mining are prohibited in national parks, as are removing vegetation or polluting water flowing through the park. Wildlife sanctuaries are areas that have been set aside as undisturbed breeding grounds and cultivation and grazing is prohibited in the demarked areas. Nobody is allowed to reside in a wildlife sanctuary and entrance for the general public is by special dispensation. However, these restrictions may be relaxed for scientific purpose or betterment of the respective area on the discretion of the governing authority in exceptional circumstances. Game reserves are designated as areas where hunting and shooting is not allowed except under special permits.
23. Sindh Wildlife Protection, Preservation,	The Sindh Wildlife Protection, Preservation, Conservation and Management Act, 2020 aims to enhance protection for wildlife. Its

Legislation	Summary of the key objectives & requirements of the Legislation, Plan or Programme relevant to the proposed Desalination Project
Conservation and Management Act, 2020	passing marked the repealing of a weaker law, hardly providing any protection to wild animals, for the first time since 1972. The new legislation has wider coverage, protecting even those wild animals that enter Sindh via trans-boundary migration or as a result of human activity.
24. Sindh Municipal Water Act, 2012	Municipal Water: (1) Upon the coming into force of this Act, all water used, or intended to be used for drinking, domestic, recreational, horticultural, industrial or commercial purposes and such other purposes as may be prescribed shall be declared as municipal water. (2) Use of water for drinking purposes shall take precedence over all other water uses. Constitution of Commission: (1) Upon commencement of this Act, but not later than twelve months thereafter, the Government shall establish the Sindh Municipal Water Commission. (2) The Commission shall be a body corporate, having perpetual succession and common seal with power to enter into contract; and it may sue or be sued by the said name.
25. The Karachi Water and Sewerage Board (amendment) Act, 2015	An Act created to provide and maintain the safe and secure water supply for drinking and domestic use to residents of Karachi, it is expedient to assure smooth and uninterrupted flow from the source to destination and take stern action against water theft, illegal hydrants, outlet connections and damaging to water trunks. Amendment in the KWSB Act,1996, after section 14, the following new section shall be inserted: - "14-A. (1) If any person who – (a) damages, punctures water trunk mains ranging from eighteen inch dia to eighty-four inch dia, canals, pumping stations, conduits, siphons, reservoirs and chambers of the Board for any purpose including selling of water or taking illegal connections; (b) establishes illegal hydrant for industrial, commercial or residential use; and (c) encroaches upon the land of the Board; shall be punished with imprisonment of either description for a term which may extend to ten years and with fine which may extend to rupees one million or with both. (2) The offences committed under sub-section (1) shall be cognizable. (3) The offences punishable under sub-section (1)
26. The Sindh Water Management (amendment) Act, 2015	The Sindh Water Management Ordinance 2002 was amended in 2005 and called The Sindh Water Management (Amendment) Act, 2005. This Ordinance provides for the establishment of public systems for the distribution and delivery of irrigation water, the removal of drainage water and the management of flood waters. The Ordinance provides for the establishment of the Sindh Irrigation and Drainage Authority (SIDA) and defines its composition.

Chapter 3 Description of Project

3.1 Project Brief

The Karachi Water and Sewerage Board, GoS has decided to establish 05 MGD seawater desalination plants on the coast of Karachi to partially overcome the acute shortage of potable water for the residents of the provincial capital.

Table 3.1: Project Details	
Project Name	5 MGD Seawater Desalination Project
Project Proponent	Karachi Water and Sewerage Board, GoS
Project Location	Deh Ibrahim Hyderi, Korangi Creek, Karachi
Scope and Scale	Installation of 05 MGD Seawater Desalination Plant
Construction Period	About 10 months

Table 3.2: Project Cost		
A	Mechanical	6,360,027,945
B	Sea Water Intake and Civil Works for Sump Pumping Station	1,070,198,090
C	Civil Work - Plant	1,430,700,000
D	Electrical	1,700,000,000
Total Cost of Project		**10,560,926,035**

3.2 Comparative Evaluation of Project Sites

Intake Location 1 (Ibrahim Hyderi)

The intake from this location will supply water to the Ghazi Pumping Station via Coast Guard Chowrangi where another pumping facility is available as a backup in case of a failure or other emergent circumstances at Ghazi Pumping Station.

Intake Location 2 (Ayesha Masjid - DHA Phase VII)

This intake would supply water to the Delivery Point at the location 24°49'10.10"N 67° 5'8.78"E through a pipe running along the creek road on the embankment.

Intake Location 3 (Sea View – Village Restaurant)

The intake here is supposed to supply the water to the same Delivery Point as the Intake Location 2 by following the Abdul Sattar Edhi Avenue to the Clock Tower and then Khayaban-e-Ittehad Road to the Ayesha Masjid.

Selection Parameter	Weight	Rating		
		Intake Location 1(Ibrahim Hyderi)	Intake Location 2(Ayesha Masjid - DHA Phase VII)	Intake Location 3 (Sea View – Village Restaurant)
Availability of space for RO plant	20	16	8	12
Conditions for intake construction, O&M	20	16	10	8
Quality of source water	20	14	8	16
Transmission line route	10	7	8	7
Disposal of rejected water from RO plant	20	16	12	14
Power Supply	10	10	10	10
Total Score	**100**	**79**	**56**	**67**

Conclusively, Location-1, Ibrahim Hydari stands highest in the evaluation and is recommended as the most desirable site for intake location. Area for desalination plant is approx.10 acres.

3.3 Project Location

The proposed desalination plant site is located in District Malir at Korangi Creek near small town of Bangali Dagga, in north east of Deh Ibrahim Hyderi, Karachi. The latitude and longitude of the project site is 24°47'37.39"N, 67° 9'18.94"E respectively, as shown in the figure below.

In a north direction of the proposed desalination plant, salt works are found, and in south it has Korange Creek & Charran Jetty in east it has Korangi Creek and in west some industrial plots are found. Proposed desalination plant site is approachable through Korangi Crossing Road after Nasir Jump Bus stop, double metalled road of Landhi starts at left side, on opposite corner the building of Indus Hospital is situated.

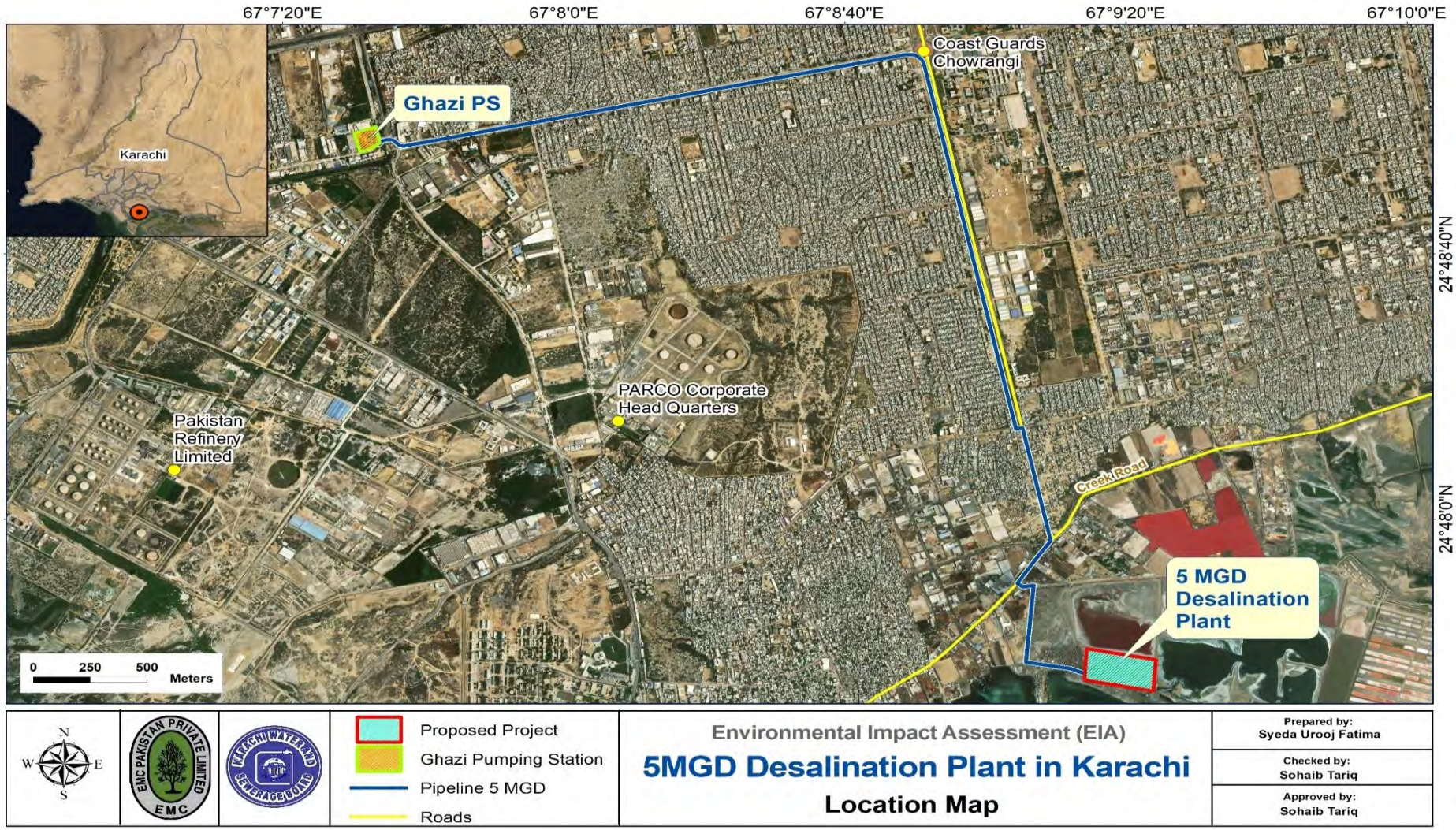


Figure 3.1: Location of Proposed Desalination Plant

After travelling approx. 4 km on Landhi Road towards Landhi after deputy commissioner office, at right hand side, a double metalled road crosses the Landhi road. This road leads to the Creek Road by crossing the Coast Guard Chowrangi. After turning a right-hand side at Creek Road, Fidatiqa International Kanta is present here. In opposite direction a kacha track is found here, which leads to the proposed plant site.

Photographs of Project Site

3.4 Desalination Plant Components

A desalination plant has five main components which are shown in the following flow chart;

1. Intake

The purpose of the intake system is to get the seawater from the sea to the plant. The intake water from this location would supply water to the Ghazi Pumping Station via Coast Guard Chowrangi where another pumping facility is available as a backup in case of a failure or other emergent circumstances at Ghazi Pumping Station. Water intake for plant will be approx. 13 MGD. Approx.1.3 km long intake will be laid to achieve 2m deep water.

Parameters Relevant to Sea Water Intake;

- pH
- Conductivity/TDS/Salinity
- Suspended Solids
- Turbidity
- Chlorine
- ORP
- Oil in Water
- Total Organic Carbon

2. Pre-Treatment

The purpose of the pre-treatment system is to prepare the seawater for the next stage of treatment. The pretreatment system removes all the suspended material in the seawater, effectively converting 'dirty' seawater into 'clean' seawater. The pretreatment system is really two or more treatment systems all performing specialised functions, with the selection being solely dependent upon the quality of the seawater.

Parameters Relevant to Pre-treatment;

- pH
- Conductivity/TDS/Salinity
- Turbidity
- Total Organic Carbon
- Hardness
- Alkalinity
- Chlorine

3. Treatment

The purpose of the treatment system is to produce water ready for post-treatment. The treatment system removes the salt from the saline water and has two output steams, which are a pure water stream and a brine stream. There are several available technologies for removing salt from a saline water. By far the most energy efficient is reverse osmosis and this is now very widely used. The reverse osmosis membranes are cleaned each day using concentrated sulphuric acid and biocides.

Parameters Relevant to Reverse Osmosis;

- Chlorine ULR
- Conductivity High Range & Low Range
- Turbidity ULR
- Total Organic Carbon
- Boron
- Alkalinity
- pH/ORP
- Temperature
- SDI (Silt Density Index)

4. Post-Treatment

The purpose of the post-treatment system if to prepare water for transfer and consumption. The posttreatment system prepares the pure water from the treatment system ready for its transfer to customers. The water produced from a reverse osmosis system is very pure, and pure water is a very aggressive liquid. If not posttreated it would destroy pipelines and would be harmful to consumers. Chemicals (normally lime which is calcium carbonate) are added to the pure water to

make it suitable for transfer and use. Chlorine is also added to ensure the water remains safe from contamination.

Parameters Relevant to Post-treatment;

- pH
- Chloride
- Manganese
- Iron
- Fluoride
- Aluminum
- Hardness
- Total Alkalinity
- Boron
- Chlorine
- Sodium
- Potassium
- Conductivity
- Turbidity
- Sulphate
- Nitrate
- Phosphate
- Silica
- ATP
- LSI
- TOC

Water conveyance system to the Ghazi Pumping Station will be approx.6km long.

5. Waste Disposal

The purpose of the waste disposal system is to prepare and dispose of the waste material from the treatment processes. The waste disposal system disposes of the waste produced from the treatment processes. There are two waste streams, namely liquid waste and solid waste. The liquid waste stream comprises the brine solution, chemicals used to keep all the treatment systems clean and any liquid wastes from the pre-treatment system. Estimated brine output will be approx.7 MGD and shall be pumped and conveyed to sea through pipes.

The solid waste stream comprises sludges from the pre-treatment process and the spent filter media and membranes. The solid waste is sent to a landfill.

3.5 Route for Water Pipeline

The proposed route for water pipeline from desalination plant to Ghazi Pumping Station is passing through the Creek Road, Coast Guard Chowrangi, Korangi Qabristan Road and then Ghazi Pumping Station is about 6 km in length.

Proposed Route for Water Pipeline

3.6 Bathymetric surveys

The objective of the Hydrographic Survey is to have the knowledge of seabed contours undersea terrain information for water intake with head of 2m in lowest low water. The survey line was designed at North-South directions with line apart of 25m up to 8m depth on southern site.

Hypack/HYSWEEP Software Version 2020 used for single-beam bathymetric survey, the said software was used for planning of survey lines and precise navigation with the help of Trimble R2 GPS for positioning in real-time mode.

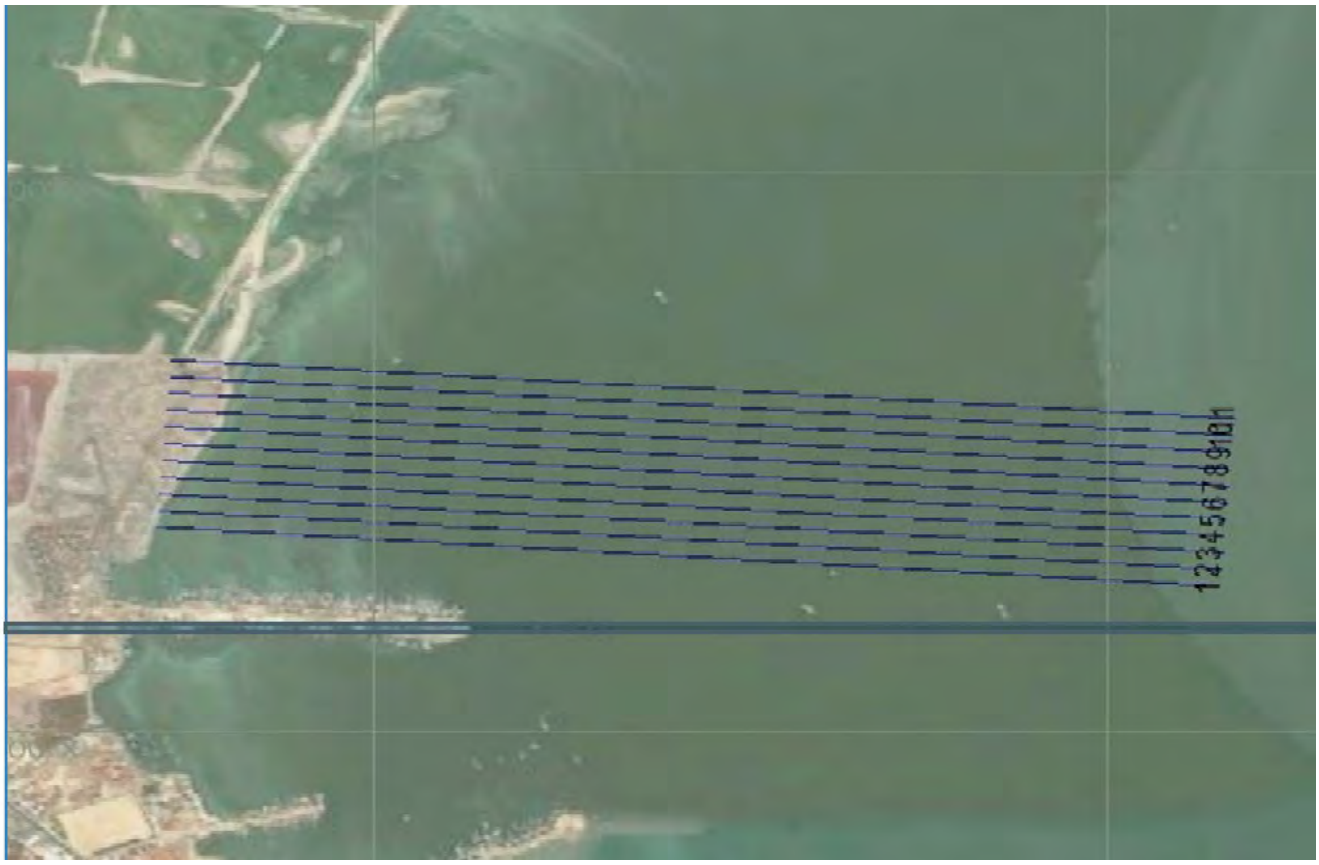


Figure 3.2: Bathymetry Planned Lines

Survey Duration

The survey was conducted from 16th August 2022 to 31st August 2022 by using TCI survey boat Enterprise using IHO Standards and followed by the following survey:

- Conductivity Temperature & Depth
- Beach Profiling
- Grab Sampling

Location of Survey

Bathymetric survey of area North-East of Ibrahim Hyderi, Karachi.

Survey Parameter

Spheroid	WGS-84
Semi-Major axis	6378137.0m
Flattening	298.257223563

Survey Projection

Projection	UTM
Zone	42North
Origin of Latitude	00N
Origin of Longitude	69E
False Easting	500,000
False Northing	0
Scale Factor	0.9996

Control Point

The coordinates of control points are as under:

Marina Club

Latitude: 24°47'44.16940"N

Longitude: 67°04'48.98814"E

Height: 9.981m above Chart Datum

KWSB Project Site (BM1)

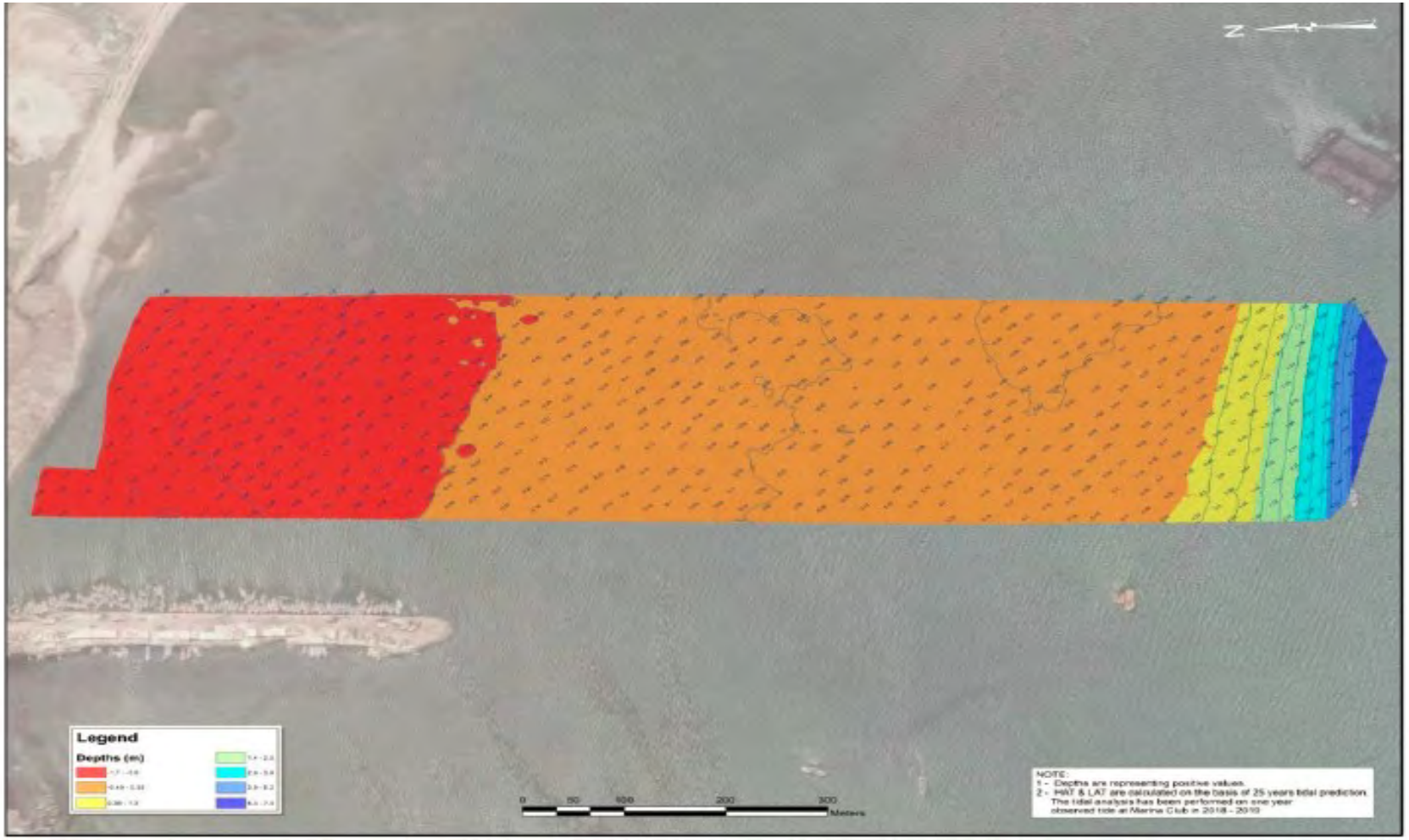
Latitude: 24°47'34.65163"N

Longitude: 67°09'21.90531"E

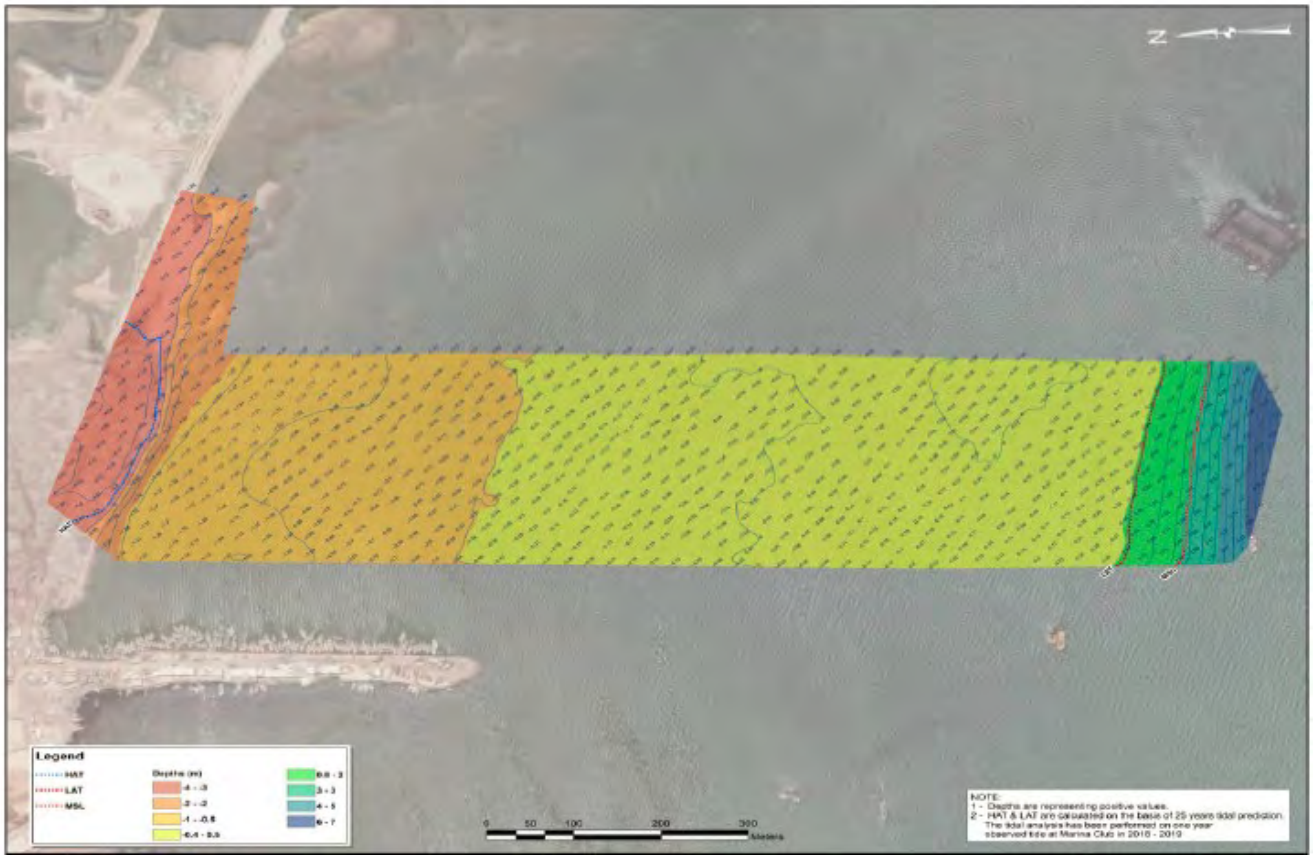
Height: 4.249m above Chart Datum

Weather Condition

Fair weather was observed during conduct of survey wind direction was west-southwest wind speed 2-8 north, sea state was 1-2, visibility was 6-10Kms, swell height 0.01m-0.5m.



Depth Measurement - Bathymetry Sounding with reference to local datum



Combined Bathymetry and Beach Profile marked with High water and Low water lines

In accordance with schedule of survey works, the required CTD (Conductivity, Temperature, Depth) Water Column Stratification measurement obtained at locations where minimum depth of 2m in lowest low water are available.

The CTD survey was carried out in SW Monsoon season in the month of August 2022. The total of12 hours observations have been carried out at every 01-hour interval during ebbing and floodingtide.

Location for CTD measurement

3.7 Utilities

3.7.1 Power Supply

Desalination requires a significant amount of energy to overcome the naturally occurring osmotic pressure exerted on the reverse osmosis membranes. This in turns makes reverse osmosis desalination several times more energy intensive than conventional treatment of freshwater resources.

3.7.2 Water Supply

The purpose of the intake system is to get the seawater from the sea to the plant. The intake from this location would supply water to the Ghazi Pumping Station via Coast Guard Chowrangi. Water intake for plant will be about 13 MGD.

3.7.3 Fire Control

Automatic control of the revolving speed and active power, voltage and reactive power of the diesel generator and various operating and protection devices.

Chapter 4 Environmental & Social Baseline

This section establishes a profile of the environmental and social conditions which prevail in the project area. Baseline conditions are necessary to determine in order to evaluate the sensitive receptors which might be impacted as a result of project activities. Description of geographical and social profile of the Project area includes information on the existing resources of its microenvironment and macro-environment, including the following:

a) Physical Resources

b) Ecological Resources

c) Socioeconomic environment

The proposed seawater desalination Plant is located in Deh Ibrahim Hyderi, District Korangi, Karachi. Coordinates of nearby landmarks of the project site are as follows;

Table 4.1: Nearby landmarks at Project site

S. No	Landmark	Distance from project Site (m)
1	Creek Road	Approx. 500
2	Ibrahim Hyderi Community	Approx. 640
3	Salt Works	Approx. 50
4	Bangali Dagga	Approx. 90

Currently, the project site is a waste dump, primarily covered with old, dry waste.

Land use in surroundings of project site is depicted in figure below;

Photographs of project area

Photographs of project area

Project Site

Community west of project site

Photographs of project area

Fishing Jetty southwest of project site

Figure 4.1: Project Location Map

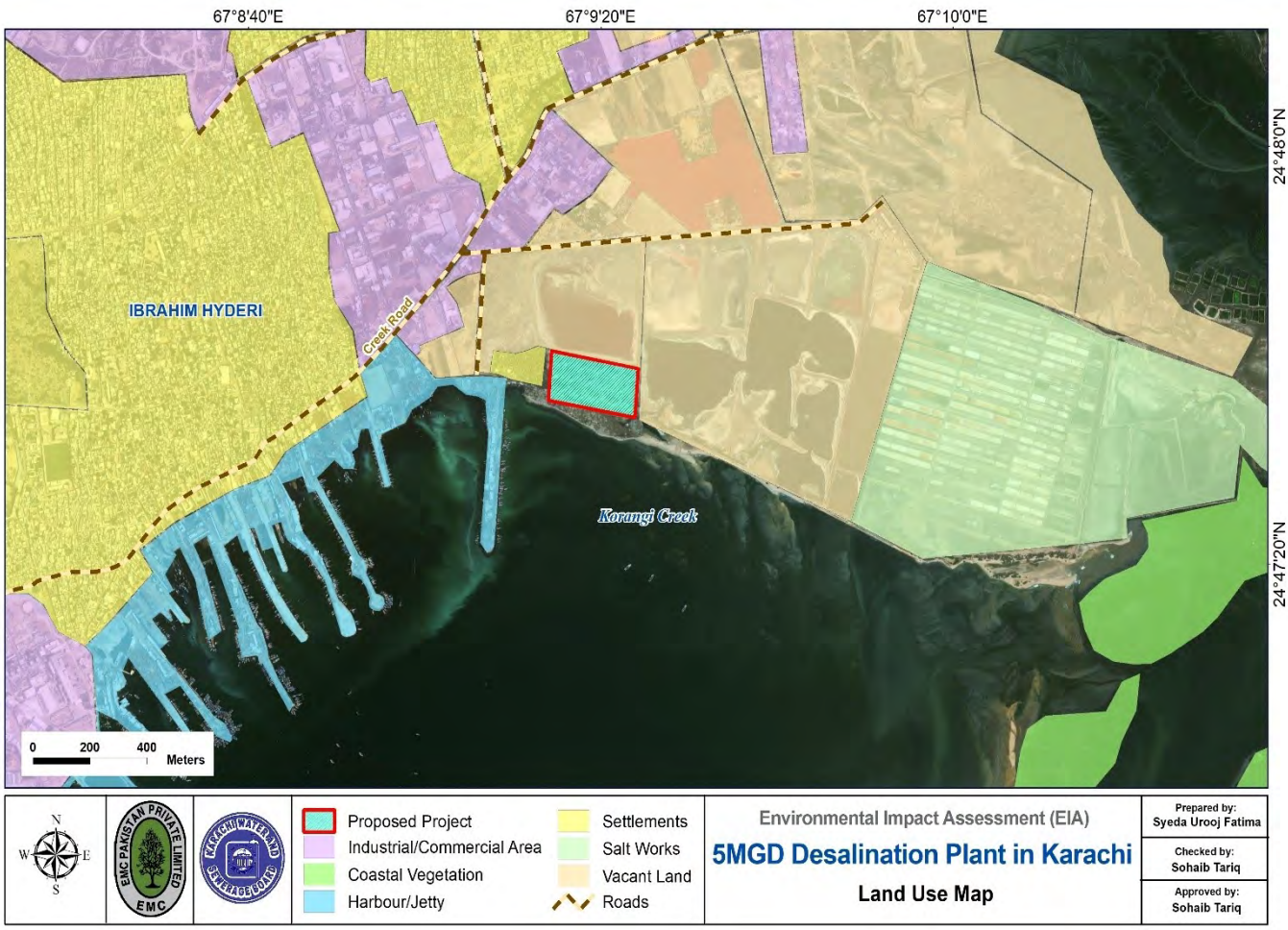


Figure 4.2: Land Use Map

4.1 Physical Environment

The physical environment of project area has been described here with respect to the terrestrial environment, water resources and airshed. Detailed description of the physical resources existing in the area is stated in the subsequent sections. Major areas covered under physical resources are; topography, geology, soil conditions, climate, surface and ground water resources and seismology. Information has been collected from primary and secondary resources. Other studies and reports were referred and reviewed for the verification of information. The climatic condition, geology and topography of Karachi has been described as the macro-environment of the project site.

4.1.1 Meteorology and Climate

Karachi has an arid climate (Köppen Climate Classification: BWh) dominated by long summer season but moderated by marine influence from the Arabian Sea. There is a minor seasonal intervention of a mild winter from mid-December to mid-February followed by a long hot and humid

summer extending from April to September, with monsoon rains from July to mid- September. The characteristic climatic feature of the four seasons of Karachi is presented in Table 4.1.

Table 4.1: Seasonal Characteristics of the Climate of Karachi

Season	Temperature	Rainfall	Wind
Summer (Mid-March to Mid-June)	The summer is hot with temperature increasing from 26.2 °C in March, rising up to 40 °C in June.	There are less frequent rain showers in summer with no more than 1 or 2 rainy days in summer. Average total amount of rain in summer is around 10 mm	The wind speed in summer is variable. It is around 2.5 m/s in March and rises up to 18 m/s in April and drops to 4 m/s for the rest of the season. The direction mostly remains blowing from West
Monsoon (Mid-June to mid-September)	The temperature in monsoon remains high but relatively lower than summer and oscillates around 32°C.	Almost 80 % of the yearly rain occurs in the monsoon with July and August being the wettest month.	The wind direction in the monsoon is mostly blowing from East.
Post-Monsoon Summer (Mid-September to November)	The average temperature post monsoon drops and average min temperature may reach 12 °C in November.	The post-monsoon period remains mostly dry and rainfall in November is around 1.8 mm.	The wind speed in September is around 3.7 m/s and drops to 1.4 m/s in November.
Winter (December to mid-March)	The winter is mild with January being the coolest month where average minimum temperature falls to 6 °C.	Like the other seasons, except monsoon, there is little occasional rainfall. The rainfall in winter is less than 50 mm.	The wind speed in the winter season increases from 1.4 m/s in December to 2.6 m/s in March. The wind direction for most part winter season is blowing from NE and changes its course to blowing from West in early March

I. Temperature

The air temperature in Karachi Division and its coastal areas are generally moderate throughout the year due to presence of sea. Climate data generated by the meteorological station at Karachi

Air Port represents climatic conditions for the region. The mean monthly maximum and minimum temperatures, recorded during the last 21 years in Karachi to describe the weather conditions are shown in Table 4.2(a) and 4.2(b) respectively.

Table 4.2(a): Mean Monthly Maximum Temperatures (°C) in Karachi

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	27.2	29.6	33.1	34.6	35.1	34.9	32.2	32.3	33.1	36.0	33.5	30.4	32.7
2002	27.0	28.2	33.3	35.4	35.6	35.1	32.2	31.6	31.4	36.5	32.7	28.1	32.3
2003	27.6	28.5	32.4	36.6	35.7	34.9	34.1	32.6	32.5	37.0	32.2	28.3	32.7
2004	26.6	29.9	36.2	35.4	36.8	35.6	33.8	32.7	32.8	33.7	33.1	29.4	33.0
2005	24.9	26.3	31.5	35.3	35.4	36.0	33.2	32.2	34.2	35.2	33.1	28.4	32.1
2006	26.0	31.3	31.8	34.0	34.6	35.3	33.8	31.0	34.2	35.0	33.4	26.3	32.2
2007	26.9	29.4	31.4	37.7	36.0	36.4	N/A	N/A	N/A	N/A	N/A	N/A	33.0
2008	24.4	26.9	34.3	34.4	33.9	35.1	33.5	31.9	34.7	35.5	32.5	27.2	32.0
2009	26.2	29.8	33.0	36.0	36.8	35.7	34.5	33.0	32.8	35.9	33.0	28.6	32.9
2010	27.5	29.2	34	35.7	36.5	34.7	34.6	33.2	34.5	35.9	32.7	28	33.0
2011	26.9	28.5	33.2	35.8	35.3	35.3	34.2	32.8	32.9	N/A	N/A	N/A	N/A
2012	25.7	26.9	31.7	35.1	35.5	34.6	33.2	32.7	33.2	35.0	32.7	28.2	32.0
2013	26.7	28.0	33.3	34.0	35.1	36.5	33.8	32.1	33.0	35.7	32.3	28.3	32.4
2014	25.5	28.0	31.7	35.1	35.9	36.5	34.0	33.7	33.8	36.3	32.9	28.7	32.7
2015	26.3	28.9	31.5	35.9	36.0	37.7	34.1	32.3	34.6	35.8	33.0	28.6	32.9
2016	27.8	30.3	33.3	34.7	35.7	36.1	33.6	33.0	32.9	34.0	33.3	31.0	33.0
2017	25.4	30.2	32.8	35.5	36.2	36.3	33.1	33.8	33.4	36.6	32.3	28.2	32.8
2018	28.5	30.4	34.4	36.2	38.7	35.4	33.8	31.9	32.6	36.8	33.8	28.2	33.4
2019	26.3	26.8	31.3	35.4	36.0	37.2	34.7	32.5	35.7	35.8	31.5	27.1	32.5
2020	24.3	30.1	31.2	36.2	36.6	37.3	36.7	34.6	35.0	36.2	31.4	28.1	33.1
2021	26.6	31.3	34.6	37.3	37.5	36.1	34.5	32.6	36.3	34.8	34.0	27.6	33.6

Source: *Pakistan Meteorological Department*

Table 4.2(b): Mean Monthly Minimum Temperatures (°C) in Karachi

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	11.5	14.9	19.6	23.8	28.1	29.0	27.1	26.5	25.9	24.4	18.6	15.8	22.1
2002	12.8	13.8	19.5	23.9	27.0	28.2	29.6	25.6	24.8	22.5	17.7	14.9	21.7
2003	12.7	16.9	19.8	24.2	26.5	28.2	23.6	27.0	25.3	20.9	15.2	12.0	21.0
2004	12.9	14.5	19.1	24.8	27.3	28.8	27.5	26.3	25.3	22.4	18.0	15.4	21.9
2005	12.3	11.3	20.3	23.0	26.4	28.3	27.2	26.6	26.6	22.9	18.9	13.0	21.4
2006	11.7	18.1	19.6	24.5	27.5	28.5	28.3	26.3	26.8	25.7	19.4	14.0	22.5
2007	13.0	17.3	19.7	24.7	27.6	28.6	N/A	N/A	N/A	N/A	N/A	N/A	21.8
2008	10.1	11.1	19.6	24.0	27.3	29.1	27.9	26.8	26.6	23.8	17.6	14.9	21.6
2009	14.7	16.5	20.8	23.8	27.6	28.7	28.1	27.5	26.5	22.6	17.0	13.9	22.3
2010	12.2	14.7	21.3	25.1	28	28.2	28.3	27.2	25.8	23.9	17.4	11.1	21.9
2011	11	14.5	19.7	23.1	27.1	28.8	27.8	28.6	26.5	N/A	N/A	N/A	N/A
2012	11.2	11.9	19.1	24.5	27.2	28.0	27.9	26.9	26.4	22.7	18.6	14.2	21.5
2013	11.6	15.1	19.2	24.2	27.1	29.3	28.0	26.6	25.5	25.4	18.1	13.0	21.9
2014	9.9	13.1	18.9	24.4	27.0	29.2	28.3	27.1	26.8	23.3	19.5	13.1	21.7
2015	12.6	16.4	19.2	25.7	27.7	29.8	28.4	26.9	26.3	24.9	18.6	12.6	22.4
2016	14.8	14.9	21.7	24.6	27.9	27.9	28.1	27.1	26.4	24.0	17.1	15.5	22.5
2017	12.5	18.2	20.3	24.4	27.8	29.2	27.7	27.0	26.2	23.5	16.8	13.0	22.2
2018	12.9	15.8	20.9	25.3	27.7	28.8	28.1	26.3	25.5	23.0	19.3	13.1	22.2

Table 4.2(b): Mean Monthly Minimum Temperatures (°C) in Karachi													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2019	13.3	15.3	19.0	24.0	26.6	28.9	28.1	26.8	27.2	24.0	19.4	13.7	22.2
2020	10.8	15.3	19.1	24.7	27.7	29.7	29.4	28.1	27.3	22.7	16.0	12.5	21.9
2021	9.2	15.0	21.6	25.1	28.9	29.6	28.5	27.4	28.0	23.1	17.6	13.9	22.3
Source: *Pakistan Meteorological Department*													

II. Precipitation

The main source of precipitation is rainfall which is received mostly in the months of July to September during SW Monsoon winds. It is very erratic as some years are very dry and there is no rain.

Table 4.3: Monthly Amount of Precipitation (mm) at Karachi Airport													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2001	0	0	0	0	0	10.6	73.6	16.2	N/A	0	0	0	100.4
2002	0	2.4	0	0	0	N/A	N/A	52.2	N/A	0	0.5	0.4	55.5
2003	6.4	21.8	0	0	0	16.3	270.4	9.8	N/A	0	0.2	0	324.9
2004	13.7	0	0	0	0	N/A	3	5.6	N/A	39.3	0	4.3	65.9
2005	6.6	12.8	N/A	0	0	N/A	N/A	0.3	54.9	0	0	17.1	91.7
2006	N/A	0	N/A	0	0	0	66.2	148.6	21.9	0	3.1	61.3	301.1
2007	0	13.2	33.4	0	0	110.2	N/A	N/A	N/A	N/A	N/A	N/A	156.8
2008	8	Trace	1.1	0	0	0	54	37.5	Trace	0	0	21	121.6
2009	3	Trace	0	Trace	0	2.6	159.9	44	68.9	0	0	1.5	279.9
2012	0.2	0	0	0	0	Trace	Trace	8.1	121	0	0	22.8	152.1
2013	Trace	20	2.8	30	0	Trace	5.5	105.4	4	1.2	0	0	168.9
2014	Trace	0	12.4	0	1.3	Trace	1.1	9.9	1.4	0	4.6	0	30.7
2015	0.3	2.1	2.8	0	0	Trace	46.6	1.4	Trace	0	0	0	53.2
2016	3.1	0	Trace	0	0	65.8	1.9	96.9	Trace	0	0	0	167.7
2017	41.5	Trace	0	0	0	58.8	33.3	65.6	26.4	0	0	6.6	232.2
2018	Trace	Trace	0	0	0	Trace	Trace	0.8	Trace	0	0	Trace	0.8
2019	39.4	Trace	2.2	0	0	1.6	66.3	204	51.7	1.2	Trace	Trace	367.3
2020	Trace	2.6	0.5	0	0	Trace	101.2	366.8	Trace	0	3.1	0	474.2
2021	0	0	0	0	0	Trace	45.4	Trace	88.3	17.2	0	16.9	167.8

Source: Pakistan Meteorological Department

The wet years have been found to follow a 3-year cycle during the first 9 years of the 3rd Millennium. The year 2010 was among the wettest years since Karachi City had witnessed more than 5 spells of 50 mm each during the month of July, three major spells of 60 to 100 mm in August and two spells of 25 and 10 mm each in the month of September. In July and August 2011 again, there was heavy rainfall all over Sindh. Hyderabad received about 74 to 103 mm rain in 24 hours and the same amount poured in Karachi and the villages in its outskirts. Among the other August 2020 was considered to be the wettest month among the others and the total annual rainfall records in 2020 higher than other past 19 years.

III. Wind Speed and Direction

The wind direction and speed between the summer and winter monsoon seasons are rather unsettled and large variations are noted both with respect to speed and direction. The Tables 4.4 and 4.5 show the wind speed and direction respectively.

Table 4.4: Wind Speed (m/s) at 12:00UTS

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	2.6	3.4	4.3	5.6	7.5	8.1	6.8	7.3	5.5	3.7	2.0	2.4	4.9
2002	3.6	3.9	4.0	6.5	8.5	8.2	9.8	7.3	7.7	3.3	2.9	3.2	5.7
2003	4.0	5.0	5.4	5.2	7.7	8.8	6.7	7.1	6.0	3.2	3.1	3.0	5.4
2004	3.4	3.7	4.0	6.0	8.0	9.0	10.0	9.5	7.3	3.8	1.0	2.5	5.7
2005	3.6	4.2	4.8	5.1	7.1	7.5	9.0	6.9	6.4	3.9	2.0	1.5	5.2
2006	2.0	3.0	3.0	6.2	8.0	7.7	8.3	6.2	4.7	4.2	2.2	3.0	4.9
2007	2.0	3.7	4.0	4.0	6.0	6.3	N/A	N/A	N/A	N/A	N/A	N/A	4.3
2008	4.3	7.6	8.2	10.5	12.6	7.6	11.0	9.3	8.7	6.6	5.1	3.9	7.9
2009	7.0	7.2	7.9	9.3	9.8	9.7	9.5	9.3	9.1	6.1	5.0	3.9	7.8
2012	5.8	6.6	9.3	9.8	12.3	12.8	13.1	11.2	8.4	7.1	5.7	5.8	9.0
2013	5.2	6.9	9.0	10.3	11.5	10.8	12.0	11.2	10.3	7.7	5.1	4.5	8.7
2014	5.9	8.9	8.6	11.5	12.4	13.4	12.8	11.6	11.7	8.3	6.0	4.5	9.6
2015	6.9	10.3	10.1	11.5	12.8	12.3	13.7	12.3	10.5	8.7	5.6	5.8	10.0
2016	7.5	8.7	4.8	1.1	13.0	11.7	11.8	10.5	12.1	9.2	5.5	5.2	8.4
2017	7.0	8.0	10.8	12.1	12.8	11.5	12.1	10.3	8.7	8.5	5.4	7.4	6.9
2018	6.3	7.0	9.5	10.2	10.8	11.1	12.3	12.4	12.2	8.7	6.1	6.8	9.4

Table 4.4: Wind Speed (m/s) at 12:00UTS

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2019	6.7	8.9	10.2	11.7	12.1	11.7	13.7	9.1	8.5	8.0	6.9	7.4	9.6
2020	9.0	9.4	9.0	10.5	13.3	10.9	10.1	8.9	9.4	7.3	6.2	5.5	9.1
2021	6.1	7.6	9.7	8.5	11.7	12.7	12.6	11.1	8.8	8.1	6.7	6.6	9.2

Source: *Pakistan Meteorological Department*

Table 4.5: Wind Direction at 12:00UTS

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	S54W	S43W	S42W	S45W	S46W	S45W	N52W	S59W	S44W	N56W	S45W	S06W
2002	S67W	S52W	S51W	S55W	S51W	S42W	S54W	S45W	S48W	S56W	N54W	S41W
2003	S60W	N50W	S45W	S48W	S45W	S68W	S60W	S47W	S43W	S54W	S50W	S27W
2004	N27E	S46W	S53W	S49W	S52W	S54W	S54W	S62W	S56W	S47W	S45W	N86E
2005	N63E	S51W	S50W	S52W	S63W	S48W	S54W	S49W	S87W	S54W	S52W	N23W
2006	S48W	S62W	S50W	S57W	S64W	S60W	S67W	S78W	S51W	S53W	S49W	N79E
2007	S30W	S62W	S47W	S55W	S58W	S47W	S41W	S55W	S60W	S48W	S48W	N45E
2008	N45E	S47W	S54W	S51W	S52W	S39W	S50W	S52W	S46W	S39W	S38W	N
2009	N45E	S45W	S41W	S58W	S46W	S46W	S56W	S49W	S56W	S42W	S39W	S45E
2012	S3E	N56E	S62W	S46W	S61W	S51W	S66W	S51W	S53W	S41W	S41W	N9W
2013	N39W	S54W	S56W	S54W	S61W	S40W	S53W	S52W	S55W	S47W	S17W	N50W
2014	S72E	S54W	S43W	S46W	S46W	S45W	S54W	S48W	S85W	S45W	S49W	S45E
2015	S72E	S54W	S43W	S48W	S50W	S40W	S54W	S55W	S50W	S41W	S	S58W
2016	S43W	S36W	S48W	S54W	S54W	S45W	S48W	S36W	S51W	S45W	S43W	S36W
2017	S83E	S56W	S51W	S45W	S45W	S44W	S66W	S57W	S48W	S51W	S59W	N45E
2018	S54W	S43W	S42W	S45W	S46W	S45W	N52W	S59W	S44W	N56W	S45W	S06W
2019	S67W	S52W	S51W	S55W	S51W	S42W	S54W	S45W	S48W	S56W	N54W	S41W
2020	N31E	S12W	S52W	S55W	S49W	S44W	S47W	S55W	S47W	S38W	S4E	N35E
2021	S21W	S38W	S44W	S42W	S52W	S53W	S55W	S48W	S40W	S41W	S22E	S40E

Source: *Pakistan Meteorological Department*

IV. Humidity

The relative humidity typically ranges from 25% (dry) to 70% (humid) over the course of a year, rarely dropping below 20% (very dry) and reaching as high as 90% (very humid).

Table 4.6: Mean Monthly Relative Humidity (Mean) at 1200 UTC (%)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2014	25.0	27.0	35.0	47.0	57.0	61.0	64.0	61.0	60.0	36.0	36.0	31.0	45.0
2015	38.0	41.0	37.0	45.0	60.0	56.0	69.0	67.0	56.0	47.0	28.0	31.0	47.9
2016	46.0	25.0	41.0	47.0	60.0	60.0	68.0	70.0	63.0	57.0	34.0	38.0	50.8
2017	38.0	25.0	36.0	44.0	59.0	62.0	70.0	67.0	63.0	44.0	29.0	20.0	46.4
2018	36.0	37.0	33.0	45.0	46.0	65.0	65.0	68.0	63.0	40.0	32.0	30.0	46.7
2019	40.4	33.9	36.6	48.0	55.6	58.8	64.8	72.6	67.6	41.1	34.6	29.7	48.6
2020	29.9	28.1	34.2	44.4	57.1	56.8	65.0	74.8	62.4	38.1	32.9	29.1	46.1
2021	31.3	34.1	41.2	43.3	54.3	60.3	67.5	64.5	63.0	46.5	27.6	38.7	47.7

Source: *Pakistan Meteorological Department*

4.1.2 Impacts of Climate Change – Karachi

Exceptional changes in the temperatures in Pakistan as a whole in the coming years are expected. Karachi may however face the threat of rising sea levels by the year 2100, at about 8 feet below sea level. climate change could influence monsoon dynamics and cause summer precipitation levels to drop, as well delays in the start of the monsoon season. While another report said that the impact of climate change in Karachi will deepen by 2030. Due to global warming the coastline of Karachi is likely to be flooded due to rising sea levels. Many seminars and public gathering are held in the city to make the government and public fully aware of global warming, speakers at the seminar have urged the government to prepare long and short-term plans to reduce the impact of global warming on natural resources. Karachi also faces the threat from super cyclones which are said to increase their intensity and momentum in years to come.

Karachi faces impacts of climate change in the form of increasing minimum and average temperatures, increasingly erratic precipitation pattern with torrential rains and urban flooding during typical monsoon season and drought-like conditions during most of the reaminder year. Lacking of construction and infrastructure planning in the city has also exacerbated the climate-related impacts and have substantial raised risk of urban flooding as witnessed during monsoon rains of 2020 and the ongoing monsoon season of 2022.

4.1.3 Geology

Geology: Karachi is the part of major synclinorium stretching from Ranpathani River in the east to Cape Monze in the west, Mehar and Mole Jabal (Mountains) in the north. Within the synclinorium a number of structures such as Pipri, Gulistan-e-Jauhar, Pir Mango and Cape Monze are exposed. The presence of concealed structures under the Malir River valley, Gadap and Maripur plains can fairly be deduced.

Rock aggregates, sand, limestone and clay are some of the potentials for gainful utilization. Gulistan-e-Jauhar member of the Gaj formation offers groundwater potential for limited use. The area is underlain by rocks of sedimentary origin ranging in age from Eocene to Recent. Major structural trends and the basin axis strike generally south but with a “bulge” to the east also called Karachi Arc (Bender and Raza 1995).

Geomorphology of Karachi: Karachi is located in the south of Sindh, on the coast of the Arabian Sea. It covers an area of approximately 3,600 km2, comprised largely of flat or rolling plains, with hills on the western and northern boundaries of the urban sprawl. The city represents quite a variety of habitats such as the sea coast, islands, sand dunes, swamps, semi-arid regions, cultivated fields, dry stream beds, sandy plains, hillocks. Classified according to physiographic features, Karachi City District can be divided into three broad categories: Hilly Region (Mountain Highland), Alluvial Plain (Piedmont Plain) and Coastal Areas (Valley Floor). The metropolitan area is divided by two non-perennial river streams namely Lyari and Malir Rivers. The Malir River flows from the east towards the south and centre, and the Lyari River flows from north to the south west. Gujjar and Orangi are the two main tributaries of the Lyari River while Thaddo and Chakalo are the main tributaries of the Malir River. The dry weather flow of both rivers carries urban sewage that is ultimately drained in the Arabian Sea. Among the various physiographic features, low flat-topped parallel hills devoid of vegetation, interspersed with widespread plains and dry riverbeds are the main topographic characteristics of the city.

The greatest height of the region is 250 ft. that gradually decreases to 5 ft. above mean sea level along the coastline. The Karachi Harbor is a sheltered bay to the south-west of the city, protected from storms by the Sandspit Beach, the Manora Island and the Oyster Rocks.

The Arabian Sea beach lines the southern coastline of Karachi. Dense mangroves and creeks of the Indus delta can be found towards the south east side of the city. Towards the west and the north is Cape Monze, an area marked with projecting sea cliffs and rocky sandstone promontories.

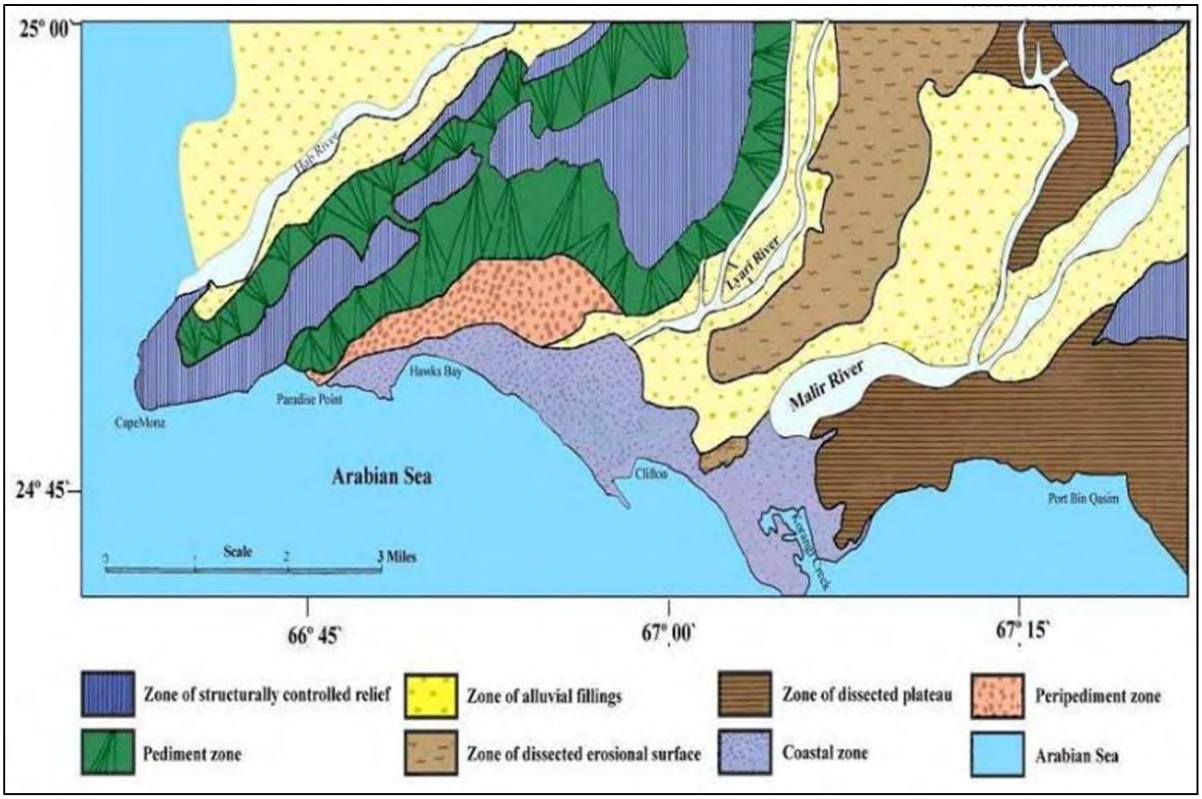


Figure 4.3: Geomorphological Zones of Karachi Region
(Source: Hamid et al., 2019[3])

The underlying rocks are mostly of marine origin, highly folded, faulted and fissured everywhere. They consist mainly of limestone and clay. The soil of the islands is alluvium with plenty of clay derived from land drainage and river discharge. It is rich in salts like sodium chloride, sodium carbonate and nitrates with some calcium, which comes from shell fragments. The muddy and clay-based soil is poor in other mineral substances. It is very badly drained and is not permeable.

The pH of the soils ranges from 8.2 to 8.4. The subsoil water table is at a depth of 5 to 10 feet, which conforms to the sea. The subsoil water is completely brackish. The particular soil formation in and around the project area revealed the presence of (Qsb) sand bar deposits (which is occupying around 60 % of the DHA proposed area) comprising of medium to coarse sand, and micaceous shifting sand dunes. The second largest formation is (Qcsd) coastal sand dune deposits and beach sand deposits (Qbs) and whereas (Qms) mangroves swamp deposits are also found in the area.

[3] Hamid et al. (2019). Soil Classification as a Tool for Evaluating Soil Behavior as Foundation Materials. International Journal of Economic and Environmental Geology, 41-46.

4.1.4 Coastal Physiography

Most of the parts of the coastal areas of Pakistan are sparsely inhabited except for Karachi city which is the largest industrial and business center of the country. The city is also the most densely populated city of Pakistan with a population of over 16 million. There are more than 6000 various industrial units in Karachi which include almost all sorts of industries such as chemical industries, metal industries, oil refineries, textile, fish processing etc. As such, the city of Karachi generates more than 400 million gallons per day of domestic and industrial wastewater (Qureshi et al. 2001), which is drained into the sea without any prior treatment via natural outfalls namely the Lyari River and Malir River and partly through sewers and drains along the coast. In addition, the oil discharges from oil tankers and cargo vessels entering the Karachi Port and Port Qasim and fishing boats also pollute the coastal environment along Karachi. Being the dumping ground of untreated industrial and sewage wastes generated from the city of Karachi, the coastal areas of Karachi including Manora channel, Sandspit, Clifton, Gizri creek, and Korangi creeks are severely polluted. The increasing coastal pollution in the vicinity of Karachi is having significant adverse effects on biodiversity of the intertidal and subtidal regions, forest, and fisheries. Furthermore, reclamation continues to be a significant means in providing land to meet the needs of expanding population particularly by DHA along Karachi coast.

Figure 4.4- Physiographic features of coastal areas of Karachi

4.1.5 Topography

Karachi may be broadly divided into two parts; the hilly areas in the north and west and an undulating plain and coastal area in the south-east. The hills in Karachi are the off-shoots of the Kirthar Range. The highest point of these hills in Karachi is about 528 m in the extreme north. All these hills are devoid of vegetation and have wide intervening plains, dry river beds and water channels. The topography of Karachi includes the large shallow intertidal and sub-tidal areas spreading out to 1-5 km with a very gentle surface gradient of about 1:50. The Cape Monze cliff that projects into the Arabian Sea is part of the 3 to 9-meter contour that characterizes the coastline up to the Rann of Kutch. In the sand mass along the coastline there are 30 to 60m high cliffs that have been undercut by storm surges. Intense erosion resulted in cliffs, sea caves, arches and blow holes that can be observed on the coastline from Hawkes Bay to Manora Channel and onwards to Korangi Creek.

The coastal region of the synclinorium is seismically active and has been undergoing continuing uplift. The uplift has already resulted in the formation of rocky headlands and in exposing portions of continental shelf. Protected pocket bays and lagoons between the nearly formed headlands have been rapidly filled by alluvial and fluvial deposits. The material brought to the coast was taken over by currents and wind for the formation of wide sandy beaches, and migrating sand dunes.

Topographic Survey

Construction near the seashore has a direct impact on the regular rise and fall of sea levels. Chart Datum has selected for the whole project. The Trimble Differential GPS solution has been used to transfer the survey data from Marina Club to the project site, as the TCI has already installed permanent BM in Marina Club for some other projects.

Trimble R8s GNSS, Positioning is as follows;

- STATIC H: 3.0 mm + 0.5 ppm V: 10.0 mm + 1.0 ppm
- RTK H: 10.0 mm + 1.0 ppm V: 20.0 mm + 1.0 ppm

To maintain the contour interval of 0.1 m intermediate and 0.5 m index, a spot survey with a grid size of 1 m x 1 m was carried out. The electronic distance measurement (EDM) total station of SOKKIA CX 105c was used to carry out the spot levelling. Easting, Northing, and elevation were observed at each spot point and stored in the surveying machine. Later, the stored data was downloaded, processed, and used to develop the contours.

A detailed cross section of the proposed pipeline route was carried out at an interval of 50 m for the width of property to property on both sides by covering the double carriage way. All existing ground features along the proposed route were observed and marked, including electric poles, telephone poles, light poles, manholes/chambers, connecting streets etc. Open drains (nullah) were also observed with their invert level.

A detailed report has been attached as an annexure.

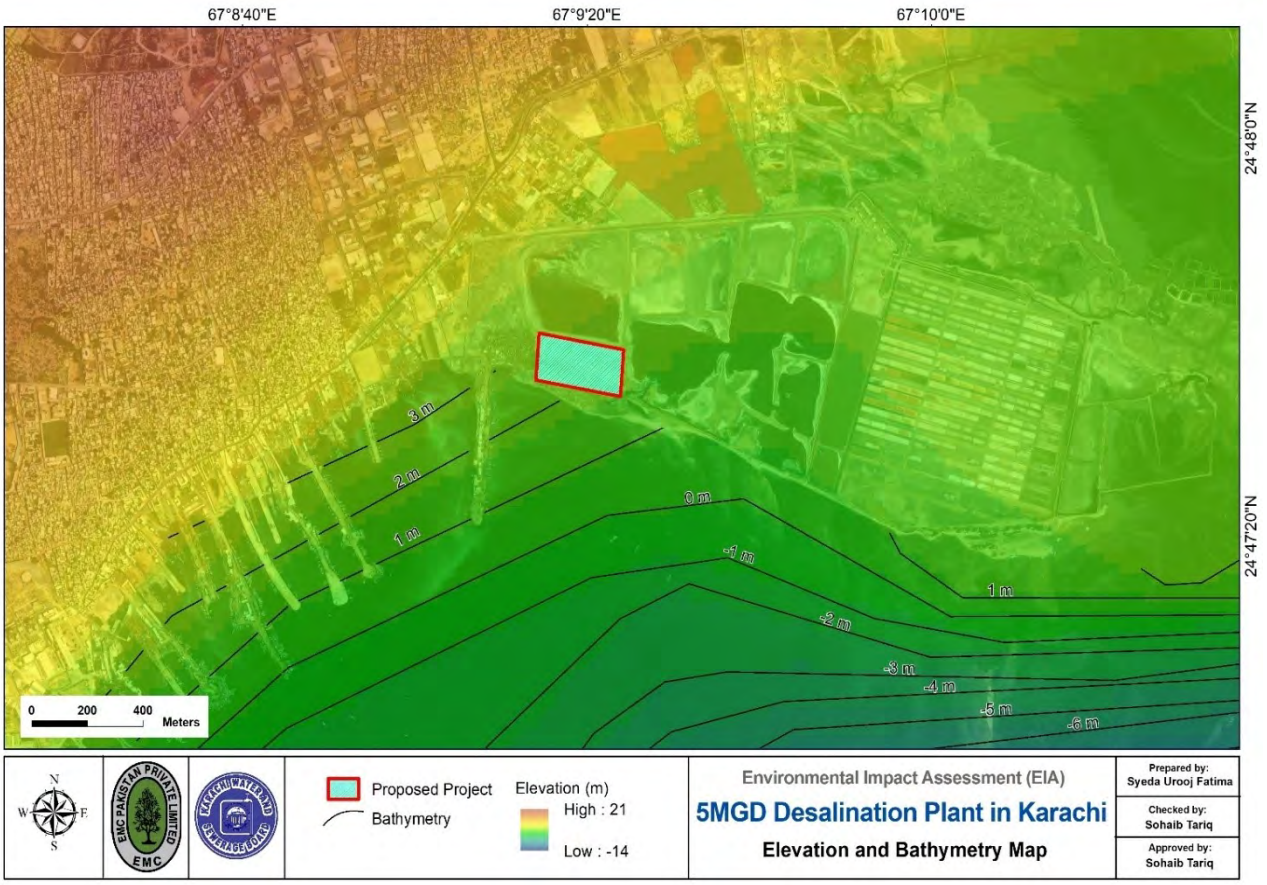


Figure 4.5: Elevation & Bathymetry Map

4.1.6 Seismicity

Seismotectonic Study for macro-environment of Project site aims at elucidating the impact of tectonic movement induced seismicity on the microenvironment. Karachi is Pakistan's largest city with population exceeding 18 million and is amongst the top five most congested cities in the world. Karachi has experienced no earthquake related damage in the recorded history of past ~ 175 years. Yet, Karachi is located in a seismically active tectonic setting often compared to Los Angeles with active plate boundary faults and triple junctions within a radius of ~ 150 km. This discrepancy in earthquake history and seismotectonic setting has led to diverse seismic hazard

assessments for Karachi ranging from assignment of seismic hazard zones I (least severe) to IV (most severe). Recent assessment adopted in Building Code of Pakistan (2007) assigns an intermediate seismic hazard value of 0.16–0.24 g (Zone IIB) to Karachi, which is broadly accepted but sometimes criticized to be an underestimation.

A recent study entitled "*Seismic sources for southern Pakistan and seismic hazard assessment of Karachi*"[4], based on a new active fault's compilation and seismic sources definition together with incorporation of maximum possible information on historical earthquakes (up to 893AD), has led to a re-assessment of seismic hazard for Karachi using probabilistic and deterministic seismic hazard assessment approaches. The main findings of this study are:

- Karachi is assessed to be prone to ground motions ~ 0.25 g with metropolitan areas having hazard values between 0.21 and 0.25 g for 10% probability of exceedance in 50 years (475-year return period).
- The deterministic seismic hazard analysis suggests maximum that peak ground acceleration (PGA) varies from 0.19 to 0.99 g in Karachi and its higher values are concentrated around the Nagar Parker fault that is controlling and hazardous for Karachi.

Despite a safe seismic history spanning past about 175 years, Karachi is located in a tectonic setting, which is considered amongst the most active in the world. The active Chaman transform fault marking plate boundary between the Indian and Eurasian plates is located only 120 NW of Karachi. Karachi itself is located at the southern tip of N–S trending Kirthar active foreland thrust-fold belt at the western deformed edge of the Indian plate. The triple junction between the Indian, Arabian and Eurasian Plates is located 110 km to the SW of Karachi.

[4] Waseem, M., Khan, M. A., & Khan, S. (2019). Seismic sources for southern Pakistan and seismic hazard assessment of Karachi. *Natural Hazards*, *99*(1), 511-536.

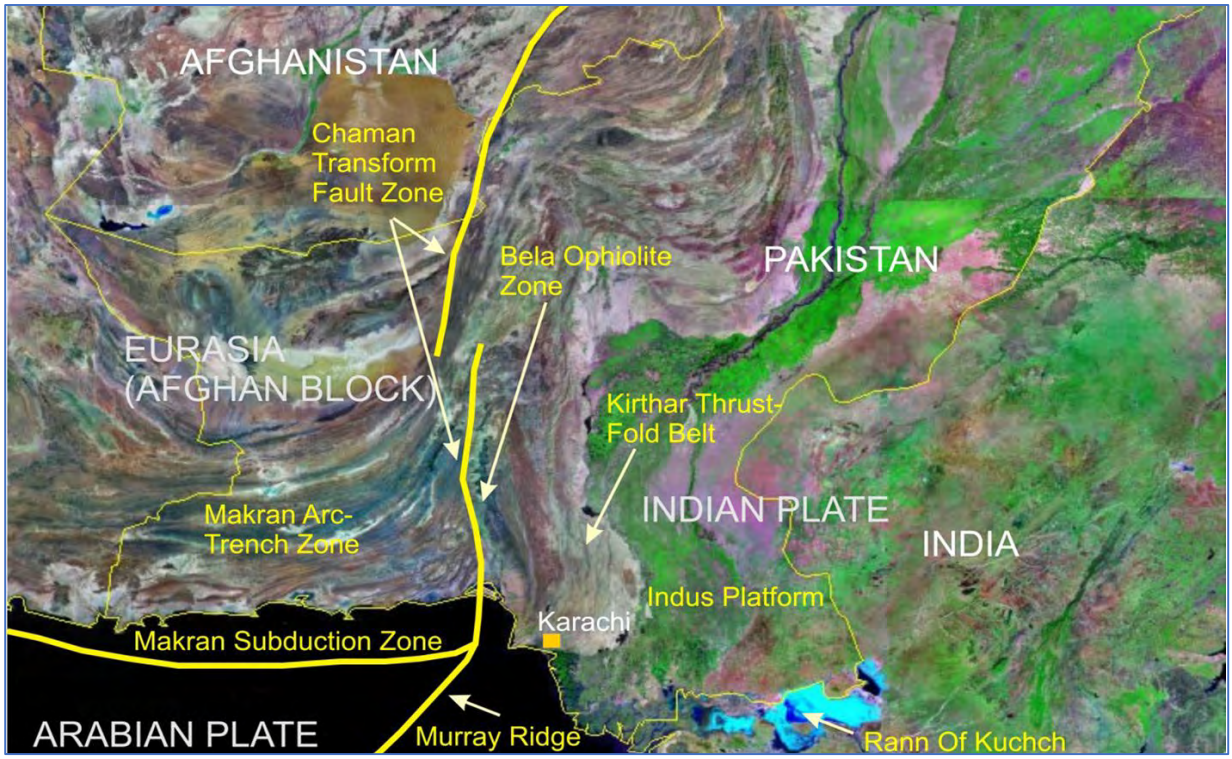


Figure 4.6: Tectonic setting of Karachi[5]

Seismic activity in the region is the result of the triple junction as well as the Karachi Arc, located in southeastern Pakistan, as a large fold and thrust belt that shows Neogene thin-skinned eastward movement. Seismic activity in and around the region shows that the Karachi Arc has been active since long in prompting the eastward movement of the delta. It is possible that the movement is related to the rebound that takes place after mass shift. Sarwar has suggested that the eastward creep of Karachi Arc is directly related to active subsidence of the Hyderabad graben that underlies it and also defines the northern and southern limits of the Karachi Arc.[6]

It may be added that subsidence such as that on Southern coast of Sindh, occurs naturally as a result of plate tectonic activity above active faults, and in places where fluid is expelled from underlying sediments and is common at river deltas that may have receded. Earthquakes arise and result from the release of the force along the growth fault plane. As a result, many different growth faults are created as sediment loads shift basin ward and landward.

Seismic Coefficient: According to uniform building code (1997) the soil profile type of the project falls in category "Sc" corresponding to "Soft Rock/Very Dense Soil". Details are annexed in Subsoil Geotechnical Investigation Report. Following parameters can be adopted: Seismic Zone

[5] Waseem, M., Khan, M. A., & Khan, S. (2019). Seismic sources for southern Pakistan and seismic hazard assessment of Karachi. *Natural Hazards*, *99*(1), 511-536.
[6] (Sarwar, G., 2004. Earthquakes and the Neo-Tectonic Framework of the Kutch-Hyderabad-Karachi Triple Junction Area, Indo-Pakistan. Pakistan Journal of Hydrocarbon Research, 14, 35-40).

= 2B, Zone Factor = 0.2, Soil Profile Type = Sc, Seismic Coeff "Ca" = 0.24 and Seismic Coeff "Cv" = 0.32

Earthquakes: Historically the coastal region has suffered a number of earthquakes. Detailed review of the geological history including the modern time reveals the occurrence of deep-sea earthquakes at different times, throughout history in the North Arabian Sea, as presented below:

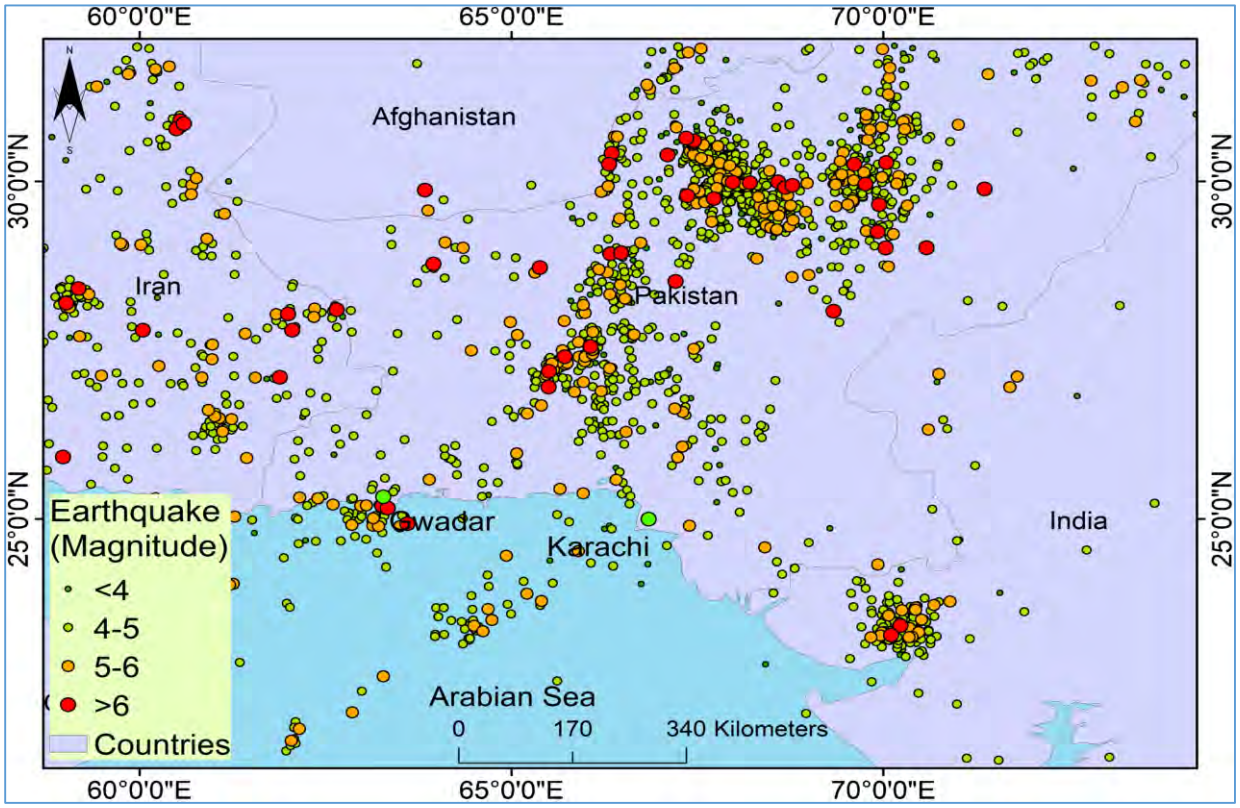


Figure 4.7: Earthquake recorded (1950–2019) in the Arabian Sea and its surroundings[7]

Seismicity of the Site: According to the Uniform Building Code (1997), Karachi and its adjoining areas fall in Seismic Zone-2B.

[7] Aslam, B., Ismail, S., & Maqsoom, A. (2020). Geospatial mapping of Tsunami susceptibility of Karachi to Gwadar coastal area of Pakistan. *Arabian Journal of Geosciences*, *13*(17), 1-12.

[7] (Sarwar, G., 2004. Earthquakes and the Neo-Tectonic Framework of the Kutch-Hyderabad-Karachi Triple Junction Area, Indo-Pakistan. Pakistan Journal of Hydrocarbon Research, 14, 35-40).

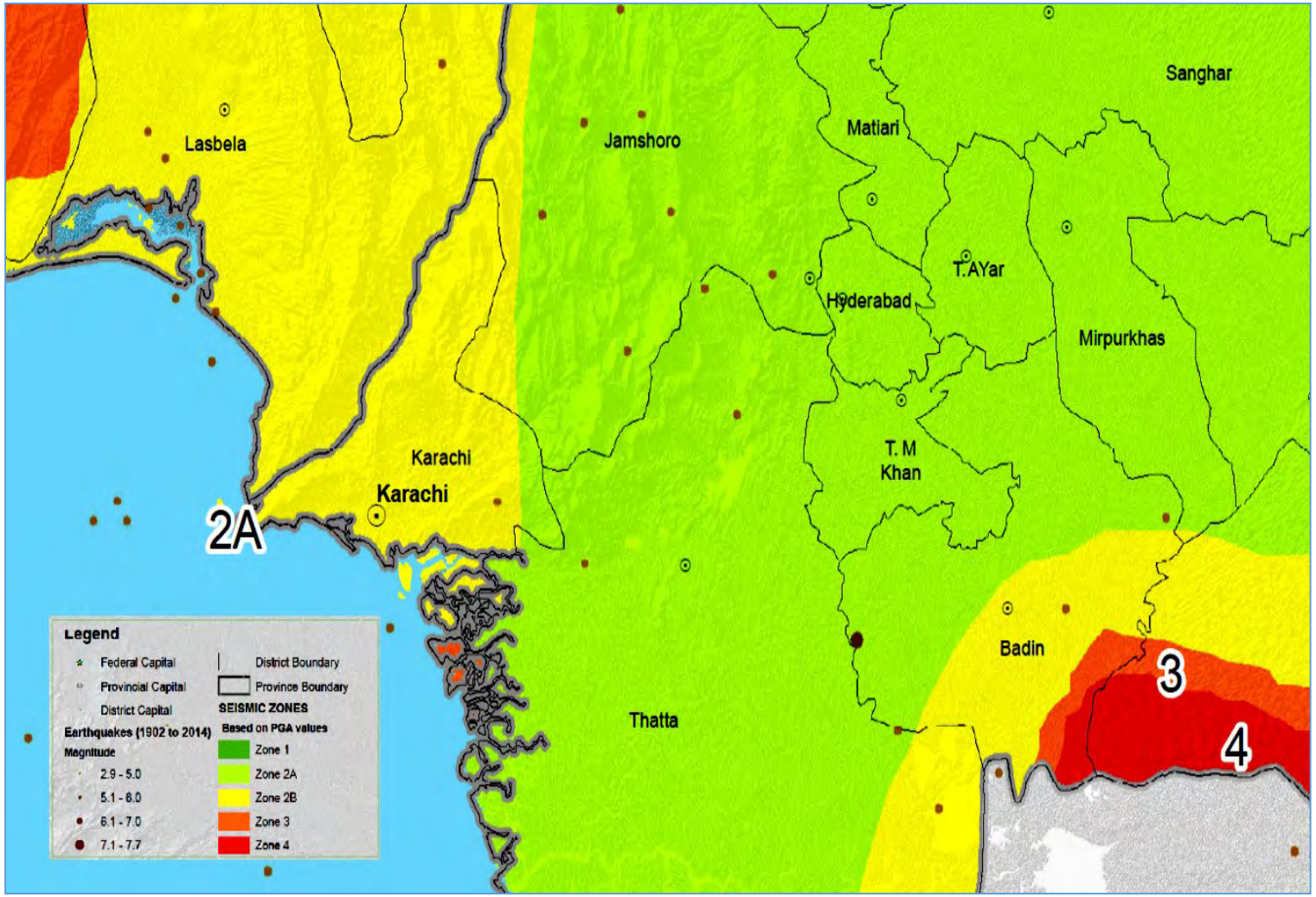


Figure 4.8: Seismic Zones in Karachi[8]

[8] Map data source(s): PMD, GSP, Pakistan Engineering Council – Prepared by Al Hasan Systems Private Ltd.

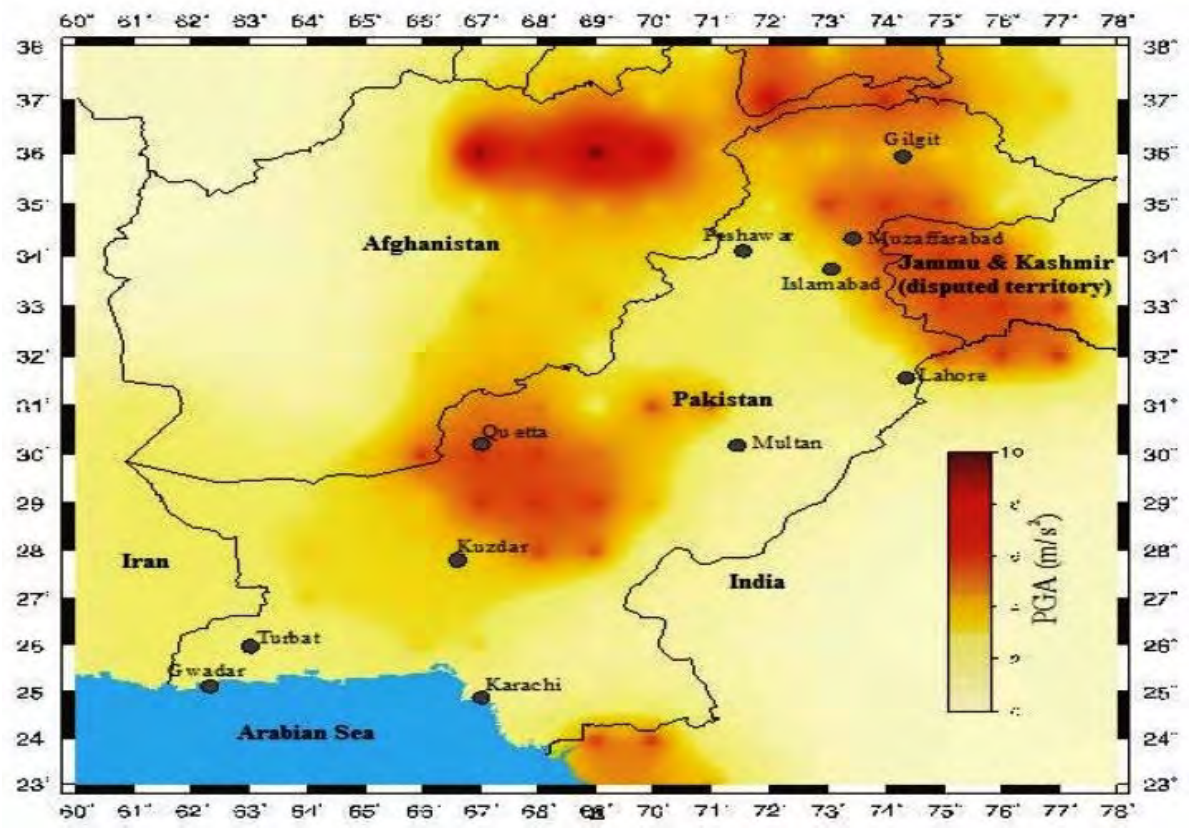


Figure 4.9: Seismic Hazard for Pakistan in terms of Peak Ground Acceleration (PGA)[9]

4.2 Ambient Air Quality and Noise Levels

Inefficient transportation system and indiscriminate burning of garbage are the dominant sources of air pollution in Karachi. Operation of defective vehicles, use of low-quality fuel, and increase in the number of vehicles beyond the capacity of roads leading to frequent traffic jams are the main reasons for deterioration of ambient air quality. Emissions from stationary sources e.g., residential & business districts associated with fuel combustion for domestic use and power generation are also significant.

The environmental impact from vehicular exhaust emission is often neglected in Pakistan due to the lack of awareness in our society, which is the major factor contributing to vehicle emission that includes NO2 (Nitrogen Oxide), Carbon dioxide (CO2), Carbon Monoxide (CO) and other pollutants. The implementation of CNG vehicles in Karachi must count as a significant achievement by any standards. It is perhaps the first instance, after Brazil and India, of alternative transport fuels being implemented on such a large scale in a low-income country. However due

[9] PMD Seismic Monitoring and Early Tsunami Warning Centre - http://seismic.pmd.gov.pk/seismicnew/map2.html

to adhoc attitude and lack of long-term policies, demand of natural gas including CNG outstripped supply, leading to curtailment of CNG supply in urban centers.

The project site is relatively isolated from urban centers of the city. To ascertain the current concentration of pollutants in microenvironment, ambient air quality montoring was conducted at two locations in the microenvironment. Noise levels were measured at five locations, as shown in the figure below;

Figure 4.10: Air Quality (AQ) and Noise (N) Monitoring Locations

Results of ambient air quality monitoring are shown below;

Ambient Air Quality Monitoring Results								
S. No	Parameter	Unit	Monitoring Duration	Average Obtained Concentration		SEQS	LDL-Limits	Methodology/Instrument
				AQ1	AQ2			
1	**Carbon Monoxide (CO)**	mg/m^3	08 Hours	**1.1**	**1.3**	5.0	0.0	Non-Dispersive Intra Red (NDIR)
2	**Nitrogen oxide (NO)**	µg/m^3	24 Hours	**17.0**	**17.4**	40.0	0.0	Chemiluminescence

3	**Nitrogen Dioxide (NO_2)**	µg/m³	24 Hours	**24.6**	**25.2**	80.0	0.0	
4	**Sulphur Dioxide (SO_2)**	µg/m³	24 Hours	**13.0**	**13.2**	120.0	0.0	Ultraviolet Fluorescence Method
5	**Ozone (O_3)**	µg/m³	01 Hour	**16.8**	**14.1**	130.0	0.0	Non-Dispersive UV Absorption Method
6	**Particulate Matter (PM_{10})**	µg/m³	24 Hours	**134.3**	**122.8**	150.0	10.0	β Ray Absorption Method
7	**Particulate Matter ($PM_{2.5}$)**	µg/m³	24 Hours	**54.8**	**57.1**	75.0	2.5	
8	**Suspended Particulate Matter (SPM)**	µg/m³	24 Hours	**381.6**	**385.3**	500.0	1.0	
9	**Lead (Pb)**	µg/m³	24 Hours	**ND**	**ND**	1.5	-	ASS Method

Results of ambient air monitoring show that average concentration of pollutants are within SEQS limits and the airshed of microenvironment appears to be unpolluted.

Noise levels were measured at five locations. Results are shown below;

NOISE TEST REPORT					
S.NO.	**LOCATION/SOURCE**	**SEQS Limits: *65dB(A)/55dB(A) Leq**			
		Noise Level Readings			
		Coordinates	**Minimum**	**Maximum**	**Average**
1	Noise Monitoring Location No: (N-01)	**24° 4'7 48.59-N 67° 9'4.44"E**	58.9	60.1	59.5
2	Noise Monitoring Location No: (N-02)	**24 47 38.30-N 67 9 5.57-E**	60.6	62.2	61.4
3	Noise Monitoring Location No: (N-03)	**24 47 38.24-N 67 9 14.55-E**	59.9	60.9	60.4
4	Noise Monitoring Location No: (N-04)	**24 47 34.75-N 67 9 23 .04-E**	62.4	63.3	62.8
5	Noise Monitoring Location No: (N-05)	**24 47 28.75-N 67 9 8.06-E**	63.1	64.5	63.8

*65dB(A): day time noise for commercial area (B) *55dB(A): day time noise for residential area (A)

Average noise readings exceed the SEQS limits for residential area but are with the limits set for commercial area.

Ambient air and Noise monitoring	
	

4.3 Water Resources

4.3.1 Surface Water Resources

According to Karachi Water and Sewerage Board (KWSB), there are two sources of water supply in Karachi, i) Kinjhar Lake supplied 1,200 cusecs daily equal to 645 MGD; and ii) Hub dam supplies about 50 MGD. The Hub dam supply is rain fed so it fluctuates between about 30 – 15 MGD. By realizing the growing demand of water in Karachi city, the KW&SB is expending water supply system with an additional 650 MGD, known as K-IV water supply project, which will supply additional water from the Indus River through Kinjhar Lake by a different route of approximately 130-km length. The main components of the project include canals, two-phase pumping, three urban water storage reservoirs, and links with existing networks.

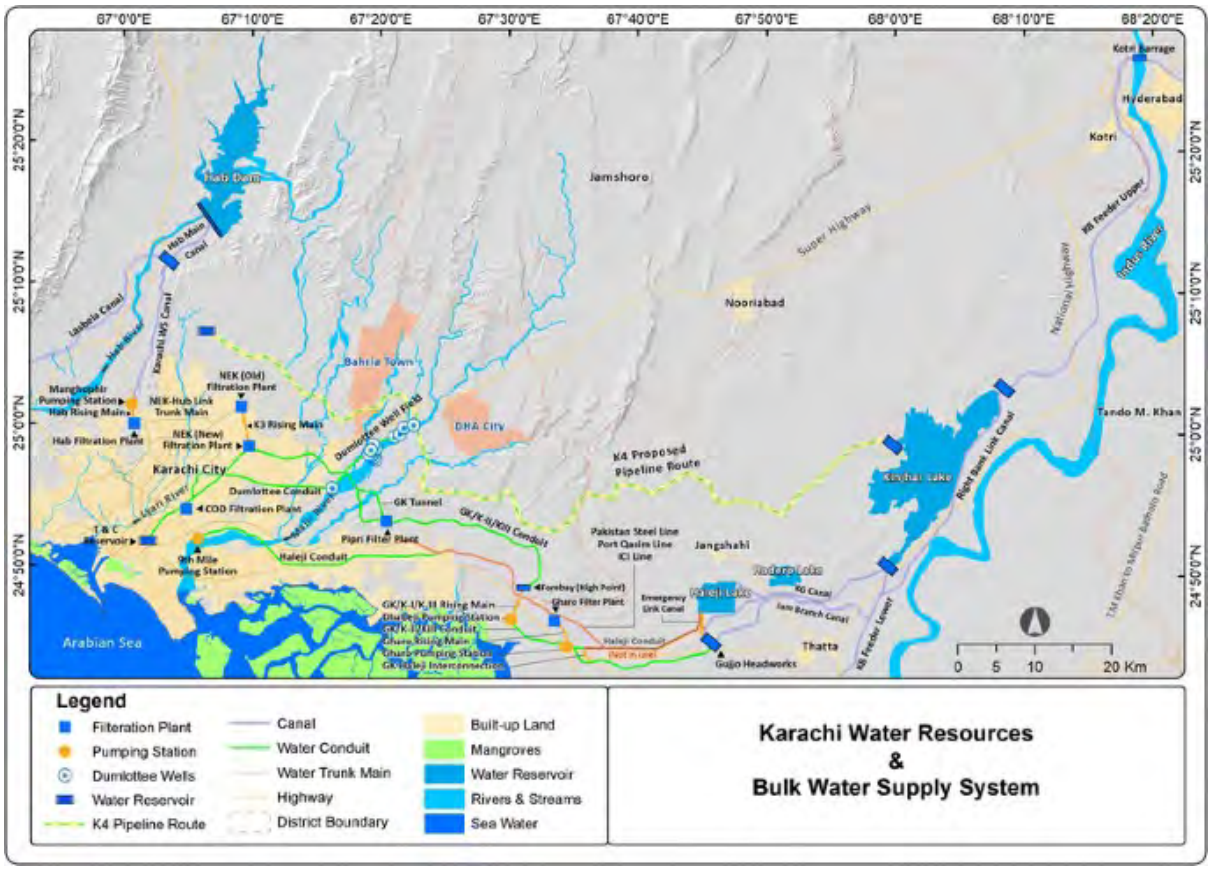


Figure 4.11: Water Resources in Karachi

(Source: Ihsanullah, 2009[10])

The World Bank is providing support to Karachi for the improvement of water and sewerage services and the governance through water supply and sewerage improvement project. The proponent of the project is the 'Karachi Water and Sewerage Board (KWSB)'.

The Project is divided into three implementation phases and every phase shall consists of three components as given below:

Component-1: Reforms This component of project comprises of those activities which will support to reform the KWSB institution for better service delivery in the Karachi city.

Component-2: Securing Sustainable Water Supply and Sanitation The water supply and sewerage system improvement will be carried out under this component. Various activities will be carried out for the maintenance of the existing and the installation of new water supply and sewerage infrastructure.

[10] Ihsanullah (2009) Evaluation and prospects of scientific management of water resources in Karachi city: A GIS perspective. Department of Geography, University of Karachi, Karachi, Karachi

Component-3: Project Management and Studies Under this component, various feasibility studies and tender documents of water / wastewater projects will be prepared for the current and the next phase of the Project.[11]

4.3.2 Ground Water Resources

Groundwater resources in this division are limited. The aquifers close to the coastal belt are mostly saline and unusable for domestic purposes. The aquifers near the Hub River bed are well developed and are source of water for agriculture and other domestic purposes. Generally, the aquifers in Karachi are estimated to lie at depth of 50m to 100m.

Groundwater Recharge Characteristics/Sea water Intrusion: Presently, coastal Karachi is known to have five sources of recharge to its groundwater reserves.

i. Rainfall,
ii. Indus River water supply
iii. Hub-River & Hub Lake water supply
iv. Polluted Lyari and Malir rivers/ contributory channels draining mixtures of domestic industrial and agricultural wastewater, composed of pre-said three sources
v. Seawater.

The possibilities of major contribution to groundwater recharge of shallow/phreatic aquifer directly by local rainfall seems very small, due to very poor frequency of rainfall events and rainfall intensities in the Karachi and high evaporation rates. The long-term (15 years annual record) mean monthly average precipitation for Karachi is between 0-15 mm during the months of January to June, 23 - 91 mm during the months of July to September, and 0-7 mm during the months of October to December. The remaining four sources play a significant role in recharge of the shallow aquifer-system and deep groundwater system (confined aquifer) in coastal Karachi. Unpolluted seawater of Karachi coast is characterized by a δ 18O value of ~ +1 ‰ VSMOW and a chloride content of ~23000 ppm. Both the Lyari River and Malir River waters, as well as the Indus River water and the Hub Lake water, have extremely very low aqueous contents of chloride and sulfate ions as compared to seawater. The average mean value of δ 18O in polluted river waters is ~ 5 ‰ V-SMOW and in shallow groundwater is -5.9 ‰ V-SMOW. The relatively deeper ground waters representing confined aquifer have a mean δ 18O value of -4.3 ‰ VSMOW and excessively high values of aqueous chloride and sulfate.

4.3.3 Water Water Supply, Demand and Sewerage System

Recent studies suggest that population will grow by 30 per cent from 2017 to 2030 in Karachi. This will translate in an increased water demand which will in turn put pressure on the already

[11] https://www.kwsb.gos.pk/wp-content/uploads/2020/07/DRAFT-EMF-FOR-KWSSIP.pdf

scarce water resources. The Water supply provided by Karachi Water and Sewerage Board (KWSB) is approximately 665 MGD against a demand of 820-1200 MGD resulting in a shortfall of 155-535 MGD. Unfortunately, an estimated 35 per cent (232 MGD) of the supplied water is lost during transmission thus decreasing the water availability to a mere 433 MGD[12].

The water supplied to Karachi fails to meet the water demand of the city. Therefore, the use of groundwater has increased for certain domestic and industrial purposes within the city. The available groundwater resources are mostly saline in nature as the city is located near coastal belt and excessive extraction of groundwater has resulted in seawater intrusion into the available water aquifers located in the areas near the sea[13].

The table below shows water supply and demand gap till the year 2017.

Table 4.1: Water Supply and Demand Gap till the Year 2017

Year	Population (Million)	Demand (MGD)	Supply (MGD)	Gap (MGD)
1998	11.3	567	410	157
2017	14.9	820	650	170

Source: WWF (2019)[12]

In January 2018, the Supreme Court appointed Honorable Justice Amir Hani Muslim, a retired Supreme Court judge, the new head of the water commission with a mandate to 'implement" the recommendations of the previous commission that the apex court had formed in December 2016 in response to my constitutional petition. The commission turned into a forum of first choice for many water-starved people, whether living in Tharparker's deserts or Karachi's posh localities. Treatment of sewage, a much-neglected issue, saw a revival under the commission. Thus, Sewage Treatment Plant-III (77MGD) was restored in June 2018. STP-I (100MGD) would start by end of 2019. Five industrial effluent treatment plants are scheduled to be built in the SITE, Trans-Lyari, F.B, Landhi and Superhighway areas.

Table 4.2: Present Water Supply Capacity

Supplied from		**Rated Capacity**	**Actual Supply**
Gharo Filtration Plant		20 MGD	30 MGD
Pipri Filtration Plant	with Filtration	100 MGD	102 MGD
	without Filtration	-	32 MGD
Dumlottee Conduit (without Filtration)	from Wells	20 MGD	0 MGD
	from GK/K-III Systems	-	17 MGD

[12] WWF. (2019). Situational Analysis of Water Resources in Karachi. https://d2ouvy59p0dg6k.cloudfront.net/downloads/report situational analysis of water resources of karachi.pdf

[13] Khattak, M. I., & Khattak, M. I. (2013). Ground water analysis of Karachi with reference to adverse effect on human health and its comparison with other cities of Pakistan. *Journal of Environmental Science and Water Resources*, 2(11), 410-418.

NEK Old Filtration Plant		25 MGD	5 MGD
NEK New Filtration Plant		100 MGD	100 MGD
COD Filtration Plant	with Filtration	115 MGD	104 MGD
	without Filtration	-	48 MGD
Hub Filtration Plant		80 MGD	80 MGD
Supply without Filtration (from K-III System)		100 MGD	95 MGD
Supply without Filtration (from GK System)		-	17 MGD
Total		560 MGD	630 MGD

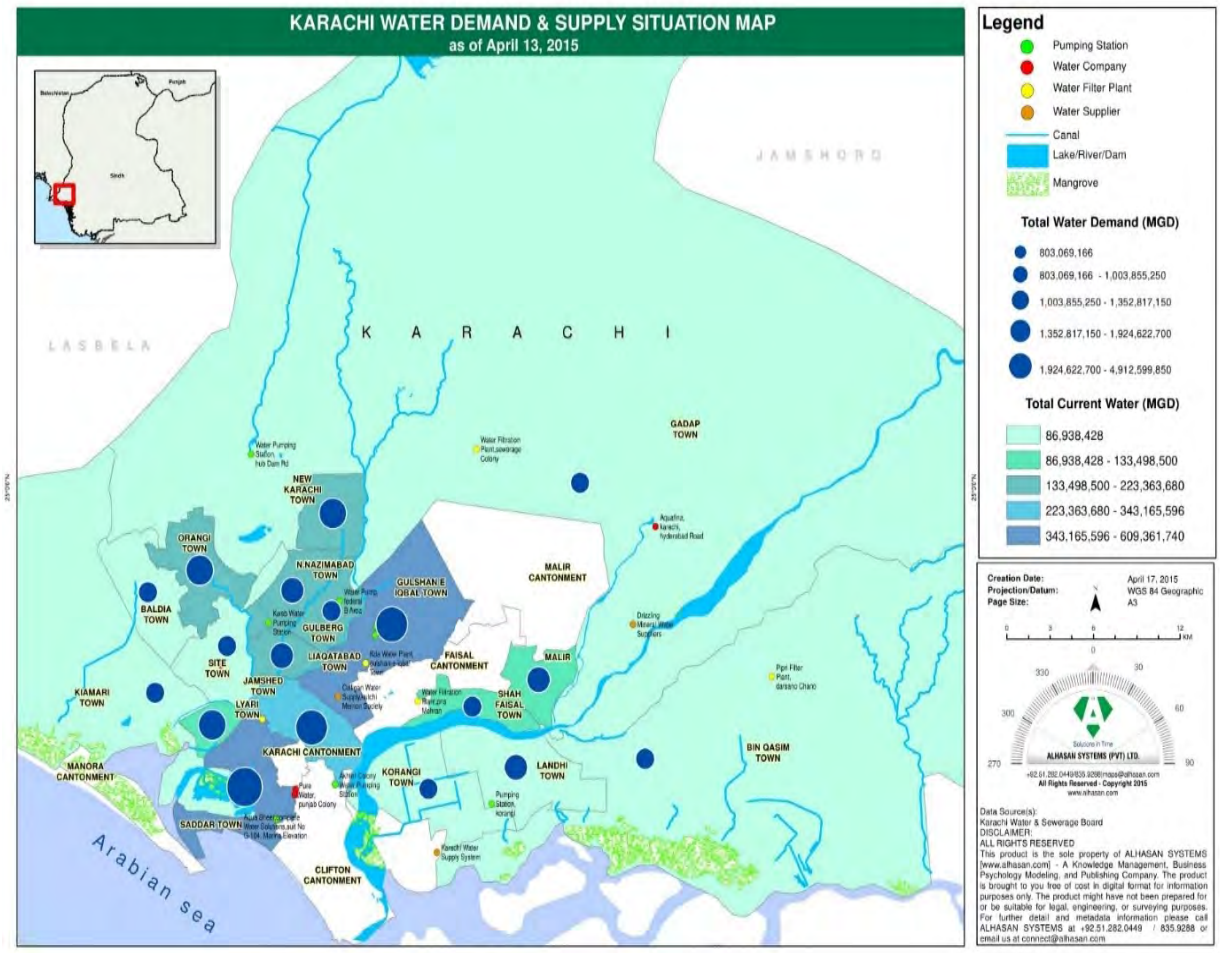


Figure 4.12: Karachi Monthly Water Demand (Source: KW&SB)

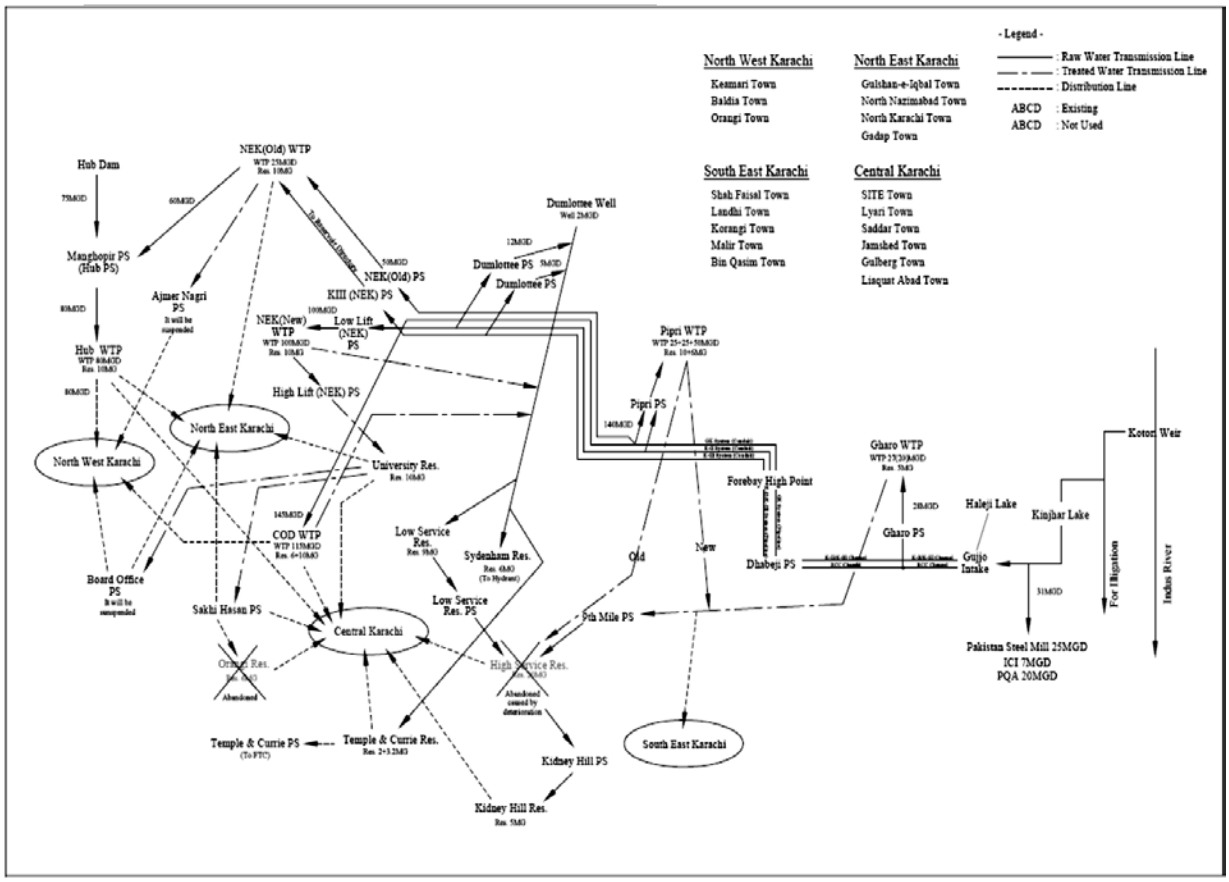


Figure 4.13: Water Transmission System

The Sewerage System: The existing sewerage catchment area which covers 18 towns in Karachi city is divided into three districts, namely: respective catchment area of T.P-1, T.P-2 and T.P-3. KW&SB formulated the Master Plan of the water supply and sewerage system in cooperation with JICA in 2008. However, most of the projects for rehabilitation and augmentation proposed in the Master Plan study, etc. have not been carried out due to financial constraint of KW&SB. Due its negligence to maintain and operationalize the treatment plants, not only municipal effluent but industrial effluent also is directly going into sea destroying marine life.

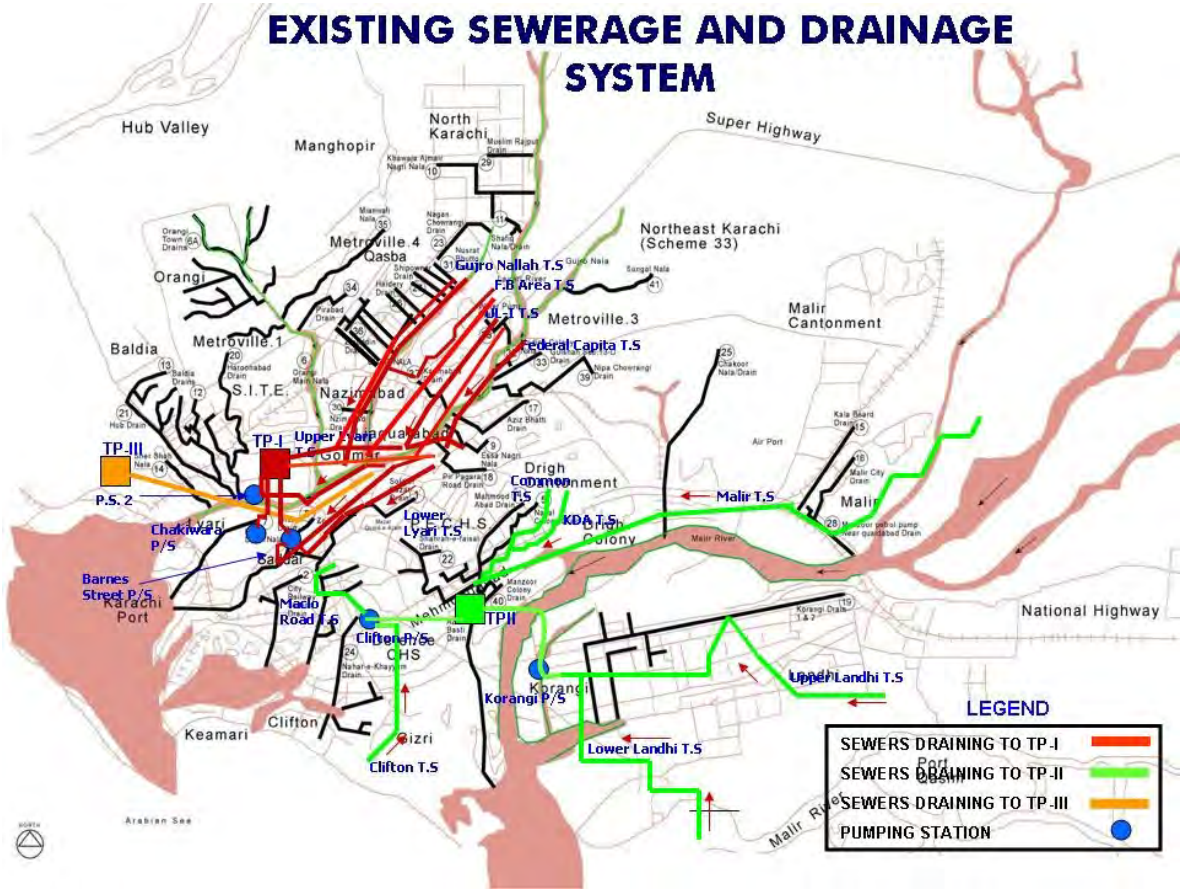


Figure 4.14: Existing Sewerage System of Karachi

4.3.4 Storm Water Drainage

Following Table outlines storm water drainages and nallahs under each (former) township administration. Drainages are artificial water channels for storm water drainage; on the contrary, nallahs are natural water channels. Many drainages are connected to nallahs and some drainages connected to river directly; Nallahs discharge into rivers such as Lyari River and Malir River receiving storm water. As sewage collection system in Karachi City is not enough and its maintenance is not satisfactory, storm water drainage and nallahs have to receive sewage all year long in addition to storm water in rainy season.

Table 4.3: Town-wise Storm water Drainage/Nallah Length

Town	Depth (m)	Width (m)	Length (km)
1. Keamari Town	1.21	0.91~3.04	7.62
2. SITE Town	2.13	3.65	16.08
3. Baldia Town	1.22	2.43	11.77
4. Orangi Town	1.52	2.43~3.65	34.1
5. Lyari Town	1.37	0.6~13.7	19.4

Table 4.3: Town-wise Storm water Drainage/Nallah Length			
Town	**Depth (m)**	**Width (m)**	**Length (km)**
6. Saddar Town	1.37	3.05	11.14
7. Jamshed Town	1.5	2.43	33.8
8. Gulshan -e- Iqbal Town	3.64	2.4~15.2	28.0
9. Faisal Town	1.22~4.57	1.52~24.0	20.1
10. Landhi Town	1.22	2.43	35.36
11. Korangi Town	1.52	2.74	36.4
12. North Nazimabad Town	1.22	2.4	30.7
13. North Karachi Town	1.22	2.4	45.1
14. Gulberg Town	1.37	2.4	22.1
15. Liaquatabad Town	1.52	3.65	19.5
16. Malir Town	1.22	3.04	6.15
17. Bin Qasim Town	1.22	3.64	14.63
18. Gadap Town	1.22	3.65	24.43
Total			416.38
Source: KWSB			

4.3.5 Water Quality Testing in Microenvironment

Three seawater samples were taken from proximity of project site and were tested for selected parameters. Locations of sampling is depicted in figure below;

Figure 4.15: Seawater Sampling Locations

Results of seawater testing is shown below;

ANALYTICAL TEST REPORT – Seawater							
S.NO.	**PARAMETERS TO BE ANALYZED**	**LDL**	**UNITS**	**RESULTS**			**TEST METHOD**
				SW1	SW2	SW3	
1	Temperature	1.0	^{0}C	29	30	31	Thermometer
2	pH value	0.01	-	7.41	7.47	7.55	USEPA 150.1
3	Biochemical Oxygen Demand $(BOD)_5$ at 20^0C	0.1	mg/L	543	621	508	Hach 8043
4	Chemical Oxygen Demand (COD)	1.0	mg/L	2734	3056	2544	Hach 8000
5	Total Suspended Solids (TSS)	1.0	mg/L	33	26	29	Hach 8006
6	Total Dissolved Solids (TDS)	1.0	mg/L	31,105	31,340	30,855	Hach 8160
7	Fluoride (as F^-)	0.01	mg/L	0.024	0.052	0.038	USEPA 340.1
8	Ammonia (NH_3)	0.1	mg/L	2.3	2.80	2.29	Hach 10031
9	Chloride (as Cl^-)	0.01	mg/L	9,440	10,310	9.180	Hach 8206
10	Iron	0.01	mg/L	0.014	0.022	0.012	Hach 8008
11	Manganese	0.1	mg/L	0.031	0.040	0.030	Hach 8034
12	Sulphate (SO_4^{-2})	1.0	mg/L	1024	1121	1013	USEPA 375.4
13	Barium	0.1	mg/L	0.09	0.09	0.05	Hach 8014
14	Total Hardness as $CaCO_3$	0.1	mg/L	10,330	12,350	11,280	EDTA Titration.Hach-8213
15	Turbidity	0.01	NTU	1.21	1.30	1.18	APHA-2130 B
16	Nitrate (NO_3)	0.01	mg/L	0.012	0.028	0.023	Hach -8039
17	Odour	-	Physical	Acceptable	Acceptable	Acceptable	Physical

Results show TDS is approx.31000 mg/l in seawaters near project area.

One drinking water sample was also taken from Ibrahim Hyderi and was tested for parameters and compared with SEQS, as shown below;

ANALYTICAL TEST REPORT – Drinking water						
S.NO.	**PARAMETERS TO BE ANALYZED**	**STANDARD SEQS**	**LDL**	**UNITS**	**RESULTS**	**TEST METHOD**
1	Temperature	40	1.0	^{0}C	29	Thermometer
2	pH value	6.5 – 8.5	0.01	-	7.50	USEPA 150.1
3	Total Dissolved Solids(TDS)	< 1000	1.	mg/L	363	Hach 8160

4	Fluoride(as F^-)	≤ 1.5	0.01	mg/L	0.081	USEPA 340.1
14	Odour	Non Objectionable / Acceptable	-	Physical	Acceptable	Physical
6	Chloride(as Cl^-)	< 250	0.01	mg/L	127	Hach 8206
7	Iron	-	0.01	mg/L	0.06	Hach 8008
8	Manganese	≤ 0.5	0.1	mg/L	0.04	Hach 8034
9	Sulphate(SO_4^{-2})	-	1.0	mg/L	BDL	USEPA 375.4
10	Barium	0.7	0.1	mg/L	BDL	Hach 8014
11	Total Hardness as $CaCO_3$	< 500	0.1	mg/L	155	EDTA Titration.Hach-8213
12	Turbidity	< 5	0.01	NTU	0.02	APHA-2130 B
13	Nitrate (NO_3)	≤ 50	0.01	mg/L	0.049	Hach -8039
MICROBIOLOGICAL ANALYSIS REPORT						
14	Total Coliform	0cfu/100ml		cfu	>250*	APHA-SM9221B
15	Fecal Coliform	0cfu/100ml		cfu	>110*	APHA-SM9221F
16	Escherichia Coli(E-Coli)	0cfu/100ml		cfu	>90*	APHA-SM9221F

Results show presence of coliforms in drinking water sample.

4.4 Solid Waste Management

Karachi city generates more than 10,000 ton / day of municipal solid waste and dumped at the landfill site without proper planning and segregation. Out of the total amount of municipal solid waste 60% of the total amount of municipal solid waste are dumped on the landfill site and rest of 40% remain on the street and did not collect from the towns.

Out of 18 former towns, only eleven towns such as, Gulshan, Gulberg, Gaddap, Korangi, Liaquatabad, Landhi, Malir, North-Nazimabad, North Karachi, Shah Faisal and Bin Qasim towns dumped their garbage at the Jam Chakro landfill site and too much without any proper planning and segregation of the garbage. Rest of four towns dumped their waste at the Gond Pass landfill town near Hub River due to its being much near to the town as compared to Jam Chakro landfill site. Three towns of them i.e., Jamshed town, Saddar town and S.I.T.E town are those that dumped their waste at both landfill sites.

Out of the total municipal solid waste generated, 80% contains recyclable material and the remaining 20% is organic type waste. On the basis of analysis of the municipal solid waste, the study reveals that pH is slightly alkaline, moisture content is less than 50% and the amount of

heavy metal like, Lead, Cadmium, Chromium and Nickel are beyond the permissible limits. They are responsible for casting adverse impacts on the environment as well as for contaminating groundwater in the vicinity of the landfill site sites through leaching formation.

The existing system of solid waste management in the city is inefficient and inadequate to cope with the present and future need of increasing solid waste quantities. There are no planned disposal sites for the city. The current practice of the illegal dumping of solid waste in and around the city has created a serious environmental and public health problem. For sustainable development, it is essential to establish sound, economical and technical methods of solid waste management.

Sindh Solid Waste Management Board – SSWMB has been established under the Sindh Solid Waste Management Board Act 2014 for effective Integrated Solid Waste Management in Sindh including Karachi. SSWMB is embarking in garbage collection from door to door and construction of garbage transfer stations, material recovery facilities, construction of composting facilities and energy generation etc.

SSWMB has launched Solid Waste Emergency & Efficiency Project (SWEEP), financed by World Bank. The project involves setting up six garbage transfer stations (GTS) at selected dumpsites of karachi and setting up new landfill cells at Jam Chakro landfill site.

4.5 Coastal Environment

The coast located at the east of Karachi Harbor entrances (at Clifton) is very flat. The sand is very fine and quite different from the sand found at Manora. A significant accretion takes place at the Clifton beaches. This coastline has for the period of last 100 years been reported to advance at an average rate of 30 ft/year. The sediments consist of very fine silt with varying contents of coarser mica flakes. The coast east of Clifton Beach is sandy and extends up to Ghizri Creek where the Malir River carrying the industrial effluents from the Landhi Industrial Area and Korangi Industrial Area, mixed with untreated urban wastewater, drains into the sea.

4.5.1 Sediment Budget

The coastal areas of Karachi get sand supplements from both the ocean and the land sources. Ocean currents can move sediments form the open oceanic area along the coast to build beaches. Unrestricted movement of dry silt/fine sand dunes on the coast and other landward sand deposits provide sand to coastal areas and beaches in response to the forces of wind and waves. Coastal lands may experience long-term erosion under some conditions. For instance, if sea level is rising, the beach must eventually migrate landward or drown. This causes coastal land behind the beach to erode. Also, if the supply of sand from the landward or seaward side is reduced, the

beach will erode the land behind it to maintain a constant sediment supply. This creates a condition called coastal erosion.

High energy waves during the SW Monsoon period of June July and August will cause the beach to change its shape (or profile). This is due to the fact that the additional wave energy has to be absorbed, the beaches and dunes will give-up sand to the waves which carry it seaward and drop it on the bottom. This raises the seafloor and flattens the overall profile of the beach. Waves then shoal and break further offshore, minimizing their erosive effects. This typically happens is response to seasonal shifts in wave energy, from SW to NE Monsoon periods. Beaches recover from these natural changes when smaller waves move the sand back onto the beach and winds blow it into the dunes to be captured by coastal vegetation.

4.5.2 Coastline of Karachi

The coastline of Karachi is about 90 Km long. It is generally oriented NW-SE. On the west it is bounded by the Hub River and on the east by the mangrove swamp and creeks of the Port Qasim area. Karachi coast shows the characteristic features of a sub-tropical semi desert. The prominent features of the Karachi coast are the large number of shallow lagoons, break water, sea cliffs, sea stacks, raised beaches, marine terraces, and dune fields. The coastline is broken by four major inlets viz. Karachi Harbor, Korangi Creek, Phitti Creek, and Khuddi Creek. Karachi coastal area can be broadly divided in to three sections: west coast, south coast, and southeast coasts.

West coast of Karachi: The west coast lies between Hub River Fall, Cape Monze up to the Manora Break water wall. It can be divided into two sections viz. Hub River Fall up to Buleji coast, and Hawks Bay-Sandspit coast up to Manora Break water wall. The rocky shores with terraces, cliffs and boulders are common features between Hub River Fall and the Cap Monze, Pacha, Paradise Point up to the Buleji coasts. Cap Monze has high cliffs projecting from the Arabian Sea. Close to Cap Monze there are frequently occurring raised beaches in between the riverbeds and the low slopes of the adjoining hill sand dunes are frequent. There are sandy beaches conceivable between Paradise Point and Pacha coast. The shore terraces and sea cliffs are common form Buleji towards the west. There is bay (Hawks Bay) between Buleji and Manora coast with sandy beaches along Sandspit coast.

South coast: The front south coast lies between Keamari coast and Korangi Creek mouth and has fine sandy beaches of Clifton and DHA with a very low angle of beach slope resulting in large shallow inter-tidal and sub-tidal area spreading up to 1-5 Km. Karachi Harbor, Boat Basin and western backwaters are also located in the south cost. Karachi harbor inlets and the Korangi

Creek inlets are situated at the western and eastern boundaries of south coast, respectively. The coast front along Clifton and DHA beach is about 14 Km long extending up to the Gizri creek at the eastern end. It has very gentle surface gradient of about 1:50 and a beach slope with a very low angle resulting in large shallow inter tidal and sub tidal areas spreading up to 1-5 Km offshore. The beach sediments are composed of gray colored fine micaceaus sand. A small crescent shaped bar exists at the mouth of the Korangi creek.

Southeast cost: The southeast coast lies between Korangi creek inlet and Khuddi creek. It borders the front coastline of four islands i.e., Bundal island, Buddo Island, Miran Island and Khuddi Island and has two large and deep openings namely Phitti creek mouth (approaching the channel of port Qasim) and the Khuddi Creek mouth. The eastern coast has tidal creek with mangrove and mudflats which are linked with a network of creeks of Indus delta and cover the most extensive and ecologically sensitive area of Karachi coast. The seabed, at the eastern and south-eastern coast, is generally smooth and regular as depicted by the bed contours. The bed slope is gentle, usually being in the order of 1:500 to 1:1000.

Seabed Material

The seabed material at the inshore area of Karachi and its adjoining coast varies from coarse sand, gravel, shelly and coral fragment, to micaceaus fine sand, silt, and mud. At several locations hard conglomerate rock occurs, such as those forming the Oyster Island, the Monora point and the protruding point of the sandy coast west of Monora point. In general, the coast and the seabed are covered with loose sediment. In the west of the Monora the beach sediment and near shore sediment consists of coarse sand brown in color and well sorted with little or no silt. The mica content is negligible and at the offshore site only a trace of mica is found and that too up to water depth of about 10 meters. Coral exposure occurs in the inshore of Hawks Bay area. Unconsolidated sediment is relatively coarser than in the east. These are composed of sand, shelly gravel, coral. Sand, silt, mud, and gravels occurring as thin veneers over rock and in the patches between coral heads. Sub-bottom profiling records revealed a sequence of thinly bedded lithologies. The lithologies consist of loosely consolidated friable sandstones, siltstones, and conglomerate.

The beach and bottom material in the vicinity of Clifton and Korangi creek is relatively fine grained and characterized by high content of black mica flakes. The mica content decreases as the depth increases from 10-20% at 5 meters depth to less than 10 % at 10 meters depth.

Geomorphological Processes at Deltaic Coast:

The coastal zone of Karachi is highly dynamic area where several marine and terrestrial processes are responsible for changes taking place along the coastal belt.

The coast of Karachi is situated between the Cape Monze, a high cliff projecting into the Arabian Sea and the Korangi Creek. The coastline of Karachi metropolitan is about 70 km long. It is generally oriented NW-SE. On the western side, it is bounded by the Hub River and on the east by the mangrove swamps and creeks of the Port Qasim area. The Lyari and Malir rivers are the seasonal streams which flow during SW monsoon. The rainwater from Karachi and its adjoining area drains in the Arabian Sea.

The prominent feature of Karachi coast are shallow lagoons, raised beaches, marine terraces, and dune fields. Four major inlets, Manora Channel (Karachi Harbor), Korangi Creek, Phitti Creek, and Khuddi Creek invigilate the coastline. A small crescent shaped sand bar exists at the mouth of the Korangi creek. The Cape Monze beach is an example of raised beaches along the coast of Karachi. The eastern coast has tidal creeks with mangrove and mud flats. In the region the seabed is generally smooth. The bed slope has a low gradient and is in the order of 1:500 to 1:1000.

The coast, west of Manora breakwater to Buleji, consists of sand beaches, (Manora, Sandspit and Hawks Bay). Rocky protruding points separate these beaches form each other. From Bulleji to Cape Monze the coast consists of hard conglomerate and shale cliffs.

Beyond Hawks Bay towards west up to the Cape Monze, the unconsolidated sandy clays are exposed to coastal weathering and erosion. Small rivers supply sediments to the coast during the rainy periods. The rivers are the predominant sources of sediment to the sandy beaches The Lyari delta is well protected from the direct influence of the ocean surf by the belt of sand.

The southern coast of Karachi lies between Keamari to Korangi Creek mouth and includes fine sandy beaches of Clifton and Defence Housing Authority (DHA) with a very low angle of beach slope resulting in large shallow inter-tidal and subtidal areas spreading up to 1-5 km. The coastal features of Clifton and DHA beach have been greatly modified and considerable area from Korangi - Clifton has been reclaimed by filling, low, marshy lands. The coastal belt of Karachi from Karachi Harbor inlet at Keamari along Clifton and DHA Beach extending up to Gizri Creek is 14 km long.

It has a very gentle surface gradient of about 1:50. The Clifton beach is largely composed of dark, grey silty materials with minute flakes of mica. The fine micaceous sand drifted from the mouth of

the river Indus by the strong littoral currents. The sand, after it compiles on the beach by the waves is blown inland in large quantity by wind action. Further east of Clifton are agglomerations of Ghizri hills. The beaches of Karachi are a source of recreation for the local habitants and attract large number of people.

4.5.3 Sea Level Rise

Sea level rise, caused either by climate change or manmade structure could increase the, flood related deaths, damage to property as well as the environment, including the loss to territorial sea resulting in the negative change in the relative value of the coastal areas of the society.

It has been concluded by several researchers that extreme events may become more frequent because of sea level rise, the increased ocean temperature may result in the change in the frequency, duration, and intensity of tropical cyclones. Moreover, the effect of storm surges could be intensified by higher sea levels. Inundation of coastal areas is already common during tropical cyclones and any increase in the extent or frequency of inundation may render numerous densely populated areas to become marginal or inhabitable altogether.

Sindh coastal zone is more vulnerable to sea level rise than Balochistan coast; the area nearby Karachi is more vulnerable to coastal erosion and accretion than the other deltaic regions mainly due to human activities combined with the natural phenomenon such as wave action, strong tidal currents, and the rise in sea level.

The UNEP in its regional sea's program of 1989 has included Pakistan in a group of countries, which are vulnerable to an impact of rising sea level. The increasing trend was observed in various studies conducted for this purpose which notified that, If the present trend of sea level rise (SLR) at Karachi continues that way, the sea level rise along the Pakistan Coast will become 50 mm in the next 50 years. Since the rising rates of sea level at Karachi happen to be within the global range of 1-2 mm/year, the trends may be treated as eustatic sea level rise i.e., the rise is due to thermal expansion of sea water. However, the higher base provided by SLR for storm surges and tides would be particularly important for the Indus delta, where the beach slope is only about 0.1 degree (Wells and Coleman, 1984).

Historical air temperature and sea surface temperature (SST) data of Karachi also show an increasing pattern and has registered rising trend of about 0.67^{o}C in the air temperature over the past 35 years, whereas the mean SST in the coastal waters of Karachi has also registered an increasing trend of about 0.3 ^{o}C in a previous decade [9]. The long-term trend of mean sea level for Karachi Harbor is taken from the study conducted by Quraishee in 1988 wherein the increasing

pattern in sea level about 1.1 mm/year at Karachi Harbor has been taken as a base reference to study the impact of sea level rise along Pakistan coast. The graphical representation of tidal behavior with trend line is shown in Figure 3.2.

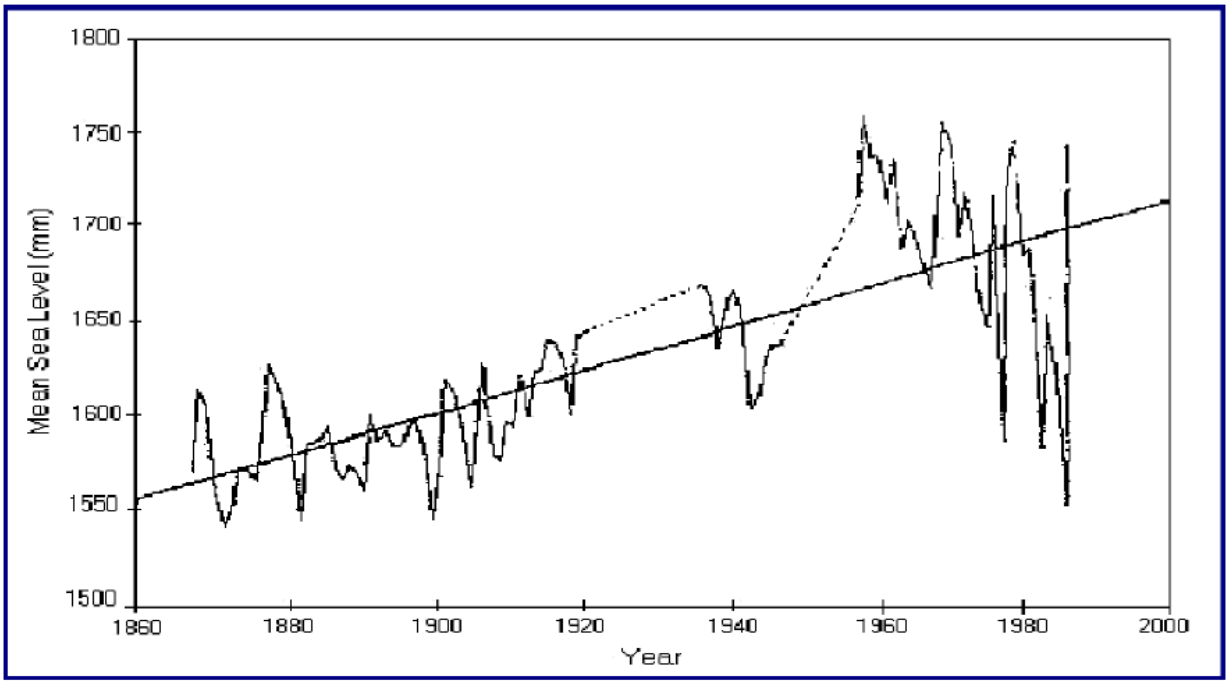


Figure 4.16 - Historical trend of Mean Sea level along Karachi Coast

4.6 Biological Environment[14]

Karachi coast forms the part of the outer Indus Delta. Indus Delta is a Ramsar Site. The outer part of the Delta includes a vast complex of creeks and channels, mangrove and mudflats areas are stretching for more than 150 kilometers, Korangi Creek to Sir Creek at the Border of India. Thus, the Karachi coast is important due to its important biodiversity features such as mangroves and many suitable habitats which provide feeding, resting, roosting, and staging places for a wide variety of birds particularly during the migratory season. In spite of changing ecology of the coastal area, Karachi coast is stronghold of waterbirds particularly the waders.

Korangi Creek is an important creek for biodiversity having dense mangrove forest which provides sites for cetaceans, water birds, particularly the Waders such as Herons, Egrets, Redshank, Godwits, Curlews, Whimbrel, Stints, Gulls, Terns. Korangi Creek faces severe problem of aquatic pollution due to entering of untreated municipal and industrial waste in the area.

[14] Khan, M. Z., Ubaid, U., Roohi, K., Afsheen, Z., & Salman, Z. (2018). Distribution and status of the vertebrate biodiversity of Korangi and Phitti Creeks, Karachi Coast, Sindh, Pakistan. *International Journal of Biology and Biotechnology*, *15*(4), 751-764.

List of mammals recorded from Korangi Creek Area

S.No.	Order	Family	Scientific Name	Common Name	Korangi Creek
1	Rodentia	Muridae	*Mus musculus*	House Mouse	+
2	Rodentia	Muridae	*Rattus rattus*	Common Rat	+
3	Rodentia	Sciuridae	*Funambulus pennantii*	Northern Palm Squirrel	+
4	Rodentia	Hystericidae	*Hystrix indica*	Indian Porcupine	+
5	Insectivora	Erinaceidae	*Hemiechinus collaris*	Long-eared Desert Hedgehog	+
6	Eulipotyphyla	Soricidae	*Suncus murinus*	Asian House Shrew	+
7	Chiroptera	Pteropodidae	*Rousettus aegyptiacus*	Egyptian Fruit Bat	+
8	Chiroptera	Pteropodidae	*Rousettus leschenaultii*	Fulvous Fruit Bat	+
9	Carnivora	Felidae	*Prionailurus viverrinus*	Fishing Cat	+
10	Carnivora	Felidae	*Felis chaus*	Jungle Cat	+
11	Carnivora	Herpestidae	*Herpestes javanicus*	Small Indian Mongoose	+
12	Carnivora	Herpestidae	*Herpestes edwardsii*	Indian Grey Mongoose	+
13	Carnivora	Canidae	*Canis aureus*	Indian Jackal	+
14	Artiodactyla	Suidae	*Sus scrofa*	Indian Wild Boar	+
15	Cetacea	Delphinidae	*Sousa plumbea*	Indian Humpback Dolphin	+

List of birds recorded from Korangi Creek Area

S.No.	Order	Family	Scientific Name	Common Name	Korangi Creek
1	Accipitriformes	Accipitridae	*Milvus migrans*	Black Kite	+
2	Accipitriformes	Accipitridae	*Elanus caeruleus*	Black-shouldered Kite	+
3	Accipitriformes	Accipitridae	*Haliastur Indus*	Brahminy Kite	+
4	Accipitriformes	Accipitridae	*Buteo buteo*	Common Buzzard	+
5	Accipitriformes	Accipitridae	*Accipiter badius*	Central Asian Shikra	+
6	Accipitriformes	Accipitridae	*Circus aeruginosus*	Marsh Harrier	+
7	Accipitriformes	Accipitridae	*Aquila rapax*	Tawny Eagle	+
8	Accipitriformes	Accipitridae	*Aquila nipalensis*	Steppe Eagle	+
9	Accipitriformes	Accipitridae	*Aquila clanga*	Greater Spotted Eagle	+
10	Accipitriformes	Accipitridae	*Neophron percnopterus*	Egyptian Vulture	+
11	Accipitriformes	Pandionidae	*Pandion haliaetus*	Osprey	+
12	Falconiformes	Falconidae	*Falco tinnunculus*	Kestrel	+
13	Falconiformes	Falconidae	*Falco peregrines*	Peregrine Falcon	+
14	Anseriformes	Anatidae	*Anas acuta*	Pintail	+
15	Anseriformes	Anatidae	*Anas crecca*	Common Teal	+
16	Anseriformes	Anatidae	*Anas cylpeata*	Shoveller	+
17	Anseriformes	Anatidae	*Anas Penelope*	Wigeon	+
18	Anseriformes	Anatidae	*Anas platyrhynchos*	Mallard	+
19	Anseriformes	Anatidae	*Anas strepera*	Gadwall	+
20	Anseriformes	Anatidae	*Aythya ferina*	Common Pochard	+
21	Anseriformes	Anatidae	*Tadorna tadorna*	Common Shelduck	+
22	Pelecaniformes	Pelecanidae	*Pelecanus crispus*	Dalmatian Pelican	+
23	Pelecaniformes	Pelecanidae	*Pelecanus onocrotalus*	White or Rosy Pelican	+
24	Pelecaniformes	Phalacrocoracidae	*Phalacrocorax fuscicollis*	Indian Shag	+
25	Pelecaniformes	Phalacrocoracidae	*Phalacrocorax carbo*	Large Cormorant	+
26	Pelecaniformes	Phalacrocoracidae	*Phalacrocorax niger*	Little Cormorant	+
27	Ciconiiformes	Ardeidae	*Ardea cinerea*	Grey heron	+
28	Ciconiiformes	Ardeidae	*Ardea purpurea*	Purple Heron	+
29	Ciconiiformes	Ardeidae	*Ardeola grayii*	Indian Pond Heron	+

30	Ciconiiformes	Ardeidae	*Bubulcus ibis*	Cattle Egret	+
31	Ciconiiformes	Ardeidae	*Egretta alba*	Large or Great white Egret	+
32	Ciconiiformes	Ardeidae	*Egretta garzetta*	Little Egret	+
33	Ciconiiformes	Ardeidae	*Butorides striatus*	Little Green Heron	+
34	Ciconiiformes	Ardeidae	*Egretta gularis*	Indian Reef Heron	+
35	Ciconiiformes	Ardeidae	*Egretta intermedia*	Intermediate Egret	+
36	Ciconiiformes	Ardeidae	*Nycticorax nycticorax*	Night Heron	+
37	Ciconiiformes	Threskiomithidae	*Plegadis falcinellus*	Glossy Ibis	+
38	Ciconiiformes	Threskiomithidae	*Platalea leucorodia*	Eurasian Spoon Bill	+
39	Phoenicopteriformes	Phoenicopteridae	*Phoenicopterus roseus*	Greater Flamingo	+
40	Charadriiformes	Burhinidae	*Esacus recurvirostris*	Great Stone Plover/Great Thick-Knee	+
41	Charadriiformes	Haematopodidae	*Haematopus ostralegus*	Eurasian Oyster catcher	+
42	Charadriiformes	Rostratuliidae	*Rostratula benghalensis*	Painted Snipe	+
43	Charadriiformes	Dromadidae	*Dromas ardeola*	Crab Plover	+
44	Charadriiformes	Recuvirostridae	*Himantopus himantopus*	Black-winged Stilt	+
45	Charadriiformes	Recuvirostridae	*Recurvirostra avosetta*	Pied Avocet	+
46	Charadriiformes	Charadriidae	*Vanellus malabaricus*	Yellow-wattled Lapwing	+
47	Charadriiformes	Charadriidae	*Vanellus indicus*	Red-wattled Lapwing	+
48	Charadriiformes	Charadriidae	*Vanellus leucurus*	White -tailed Lapwing	+
49	Charadriiformes	Charadriidae	*Pluvialis squatarola*	Grey Plover	+
50	Charadriiformes	Charadriidae	*Charadrius hiaticula*	Ringed Plover	+
51	Charadriiformes	Charadriidae	*Charadrius dubius*	Little-ringed Plover	+
52	Charadriiformes	Charadriidae	*Charadrius alexandrinus*	Kentish Plover	+
53	Charadriiformes	Charadriidae	*Charadrius mongolus*	Lesser Sand Plover	+
54	Charadriiformes	Scolopacidae	*Limosa limosa*	Black-tailed Godwit	+
55	Charadriiformes	Scolopacidae	*Limosa lapponica*	Bar-tailed Godwit	+
56	Charadriiformes	Scolopacidae	*Numenius phaeopus*	Whimbrel	+
57	Charadriiformes	Scolopacidae	*Numenius arquata*	Eurasian Curlew	+
58	Charadriiformes	Scolopacidae	*Tringa erythropus*	Spotted Redshank	+
59	Charadriiformes	Scolopacidae	*Tringa nebularia*	Green Shank	+
60	Charadriiformes	Scolopacidae	*Tringa ochropus*	Green Sandpiper	+
61	Charadriiformes	Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper	+

62	Charadriiformes	Scolopacidae	*Tringa tetanus*	Red Shank	+
63	Charadriiformes	Scolopacidae	*Xenus cinereus*	Terek Sandpiper	+
64	Charadriiformes	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	+
65	Charadriiformes	Scolopacidae	*Limicola falcinellus*	Broad-billed Sandpiper	+
66	Charadriiformes	Scolopacidae	*Philomachus pugnax*	Ruff	+
67	Charadriiformes	Scolopacidae	*Arenaria interpres*	Ruddy Turnstone	+
68	Charadriiformes	Scolopacidae	*Calidris alba*	Sanderling	+
69	Charadriiformes	Scolopacidae	*Calidris alpine*	Dunlin	+
70	Charadriiformes	Scolopacidae	*Calidris minuta*	Little Stint	+
71	Charadriiformes	Scolopacidae	*Calidris temminckii*	Temminck's Stint	+
72	Charadriiformes	Scolopacidae	*Calidris tenuirostris*	Great Knot	+
73	Charadriiformes	Scolopacidae	*Calidris ferruginea*	Curlew-Sandpiper	+
74	Charadriiformes	Stercorariidae	*Stercorarius parasiticus*	Arctic Skua	+
75	Charadriiformes	Laridae	*Larus argentatus*	Herring Gull	+
76	Charadriiformes	Laridae	*Larus hemprichii*	Sooty Gull	+
77	Charadriiformes	Laridae	*Larus fuscus*	Lesser Black-backed Gull	+
78	Charadriiformes	Laridae	*Larus ichthyaetus*	Great Black-headed or Pallas Gull	+
79	Charadriiformes	Laridae	*Larus brunnicephalus*	Brown-headed Gull	+
80	Charadriiformes	Laridae	*Larus ridibundus*	Black-headed Gull	+
81	Charadriiformes	Laridae	*Larus genei*	Slender-billed Gull	+
82	Charadriiformes	Sternidae	*Gelochelidon nilotica*	Gull-billed Tern	+
83	Charadriiformes	Sternidae	*Sterna caspia*	Caspian Tern	+
84	Charadriiformes	Sternidae	*Chlidonias leucopterus*	White-winged Black Tern	+
85	Charadriiformes	Sternidae	*Chilonias hybridus*	Indian Whiskered Tern	+
86	Charadriiformes	Sternidae	*Sterna hirundo*	Common Tern	+
87	Charadriiformes	Sternidae	*Sterna repressa*	White-cheeked Tern	+
88	Charadriiformes	Sternidae	*Sterna albifrons*	Little Tern	+
89	Charadriiformes	Sternidae	*Sterna bergii*	Great Crested Tern	+
90	Charadriiformes	Sternidae	*Sterna acuticauda*	Black-bellied Tern	+
91	Charadriiformes	Sternidae	*Sterna bengalensis*	Lesser Crested Tern	+
92	Charadriiformes	Sternidae	*Sterna sandvicensis*	Sandwich Tern	+
93	Coraciiformes	Meropidae	*Merops superciliosus*	Blue cheeked Bee-eater	+
94	Coraciiformes	Meropidae	*Merops orientalis*	Little Green Bee-eater	+
95	Coraciiformes	Upupidae	*Upupa epops*	Common Hoopoe	+
96	Coraciiformes	Alcedinidae	*Ceryle rudis*	Pied Kingfisher	+

97	Coraciiformes	Alcedinidae	*Alcedo atthis*	Common Kingfisher	+
98	Coraciiformes	Alcedinidae	*Halcyon smyrnensis*	White-brested Kingfisher	+
99	Coraciiformes	Coraciidae	*Coracias benghalensis*	Indian Roller or Blue Jay	+
100	Apodiiformes	Apodidae	*Apus affinis*	House Swift	+
101	Cuculiformes	Cuculidae	*Eudynamys scolopacea*	Asian Koel	+
102	Columbiformes	Columbidae	*Columba livia*	Blue Rock Pigeon	+
103	Columbiformes	Columbidae	*Streptopelia senegalensis*	Little Brown Dove/Laughing Dove	+
104	Columbiformes	Columbidae	*Streptopelia decaocto*	Eurasian Collard Dove	+
105	Galliformes	Phasianidae	*Francolinus pondicerianus*	Grey Partridge	+
106	Passeriformes	Sturnidae	*Acridotheres tristis*	Common Myna	+
107	Passeriformes	Sturnidae	*Acridotheres ginginianus*	Bank Myna	+
108	Passeriformes	Sturnidae	*Sturnus vulgaris*	Common Starling	+
109	Passeriformes	Hirundinidae	*Hirundo rustica*	Common or Barn Swallow	+
110	Passeriformes	Hirundinidae	*Hirundo daurica*	Redrumped Swallow	+
111	Passeriformes	Hirundinidae	*Riparia paludicola*	Indus Sand Martin	+
112	Passeriformes	Motacillidae	*Motacilla alba*	White Wagtail	+
113	Passeriformes	Motacillidae	*Motacilla cinerea*	Grey Wagtail	+
114	Passeriformes	Motacillidae	*Motacilla citreola*	Citrine Wagtail	+
115	Passeriformes	Motacillidae	*Motacilla flava*	Yellow Wagtail	+
116	Passeriformes	Nectariniidae	*Nectarinia asiatica*	Purple Sunbird	+
117	Passeriformes	Dicruridae	*Dicrurus macrocercus*	Black Drongo	+
118	Passeriformes	Sylviidae	*Orthotomus sutorius*	Tailor Bird	+
119	Passeriformes	Turdidae	*Laticilla burnesii*	Long-tailed Grass Warbler	+
120	Passeriformes	Turdidae	*Saxicoloides fulicata*	Indian Robin	+
121	Passeriformes	Timallidae	*Turdoides caudatus*	Common Babbler	+
122	Passeriformes	Pyconotidae	*Pycnonotus leucogenys*	White-cheeked Bulbul	+
123	Passeriformes	Pyconotidae	*Pycnonotus cafer*	Red-vented Bulbul	+
124	Passeriformes	Pyconotidae	*Prinia buchanani*	Rufousfronted Wren-Warbler	+
125	Passeriformes	Laniidae	*Lanius excubitor*	Southern Grey Shrike	+
126	Passeriformes	Laniidae	*Lanius vittatus*	Bay-backed Shrike	+
127	Passeriformes	Laniidae	*Lanius isabellinus*	Isabelline Shrike / Rufous tailed Shrike	+
128	Passeriformes	Corvidae	*Corvus splendens*	Sind House Crow	+
129	Passeriformes	Alaudidae	*Alaemon alaudipes*	Hoopoe Lark	+

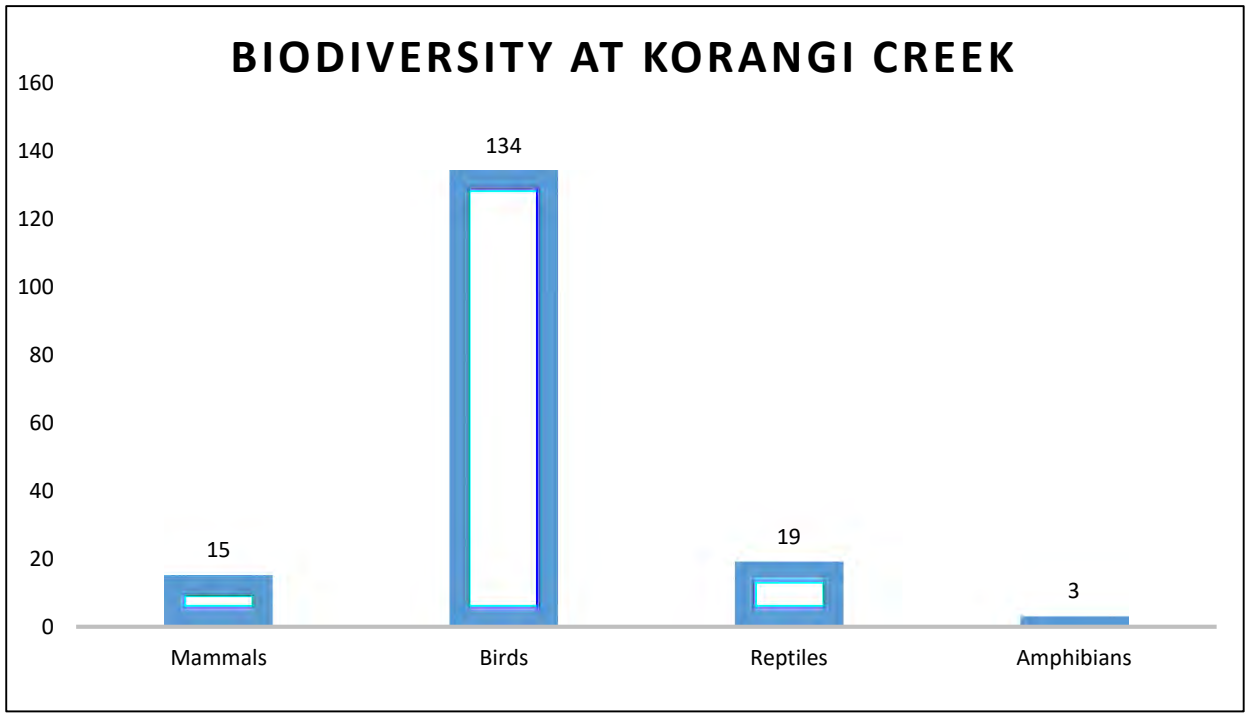
130	Passeriformes	Alaudidae	*Galerida cristata*	Crested Lark	+
131	Passeriformes	Alaudidae	*Galerida raytal*	Indus Sand Lark	+
132	Passeriformes	Passeridae	*Passer domesticus*	House Sparrow	+
133	Passeriformes	Passeridae	*Passer pyrrhonotus*	Sind Jungle Sparrow	+
134	Passeriformes	Passeridae	*Zosterops palpebrosa*	White Eye	+

List of Reptiles recorded from Korangi Creek Area

S.No.	Order	Family	Scientific Name	Common Name	Korangi Creek
1	Squamata	Agamidae	*Calotes versicolor*	Common Tree Lizard	+
2	Squamata	Gekkonidae	*Hemidactylus brookii*	Spotted Barn Gecko	+
3	Squamata	Gekkonidae	*Hemidactylus flaviviridis*	Yellow-belly Gecko	+
4	Squamata	Gekkonidae	*Hemidactylus persicus*	Persian House Gecko	+
5	Squamata	Lacertidae	*Agamura persica*	Blunt-tailed spider Gecko	+
6	Squamata	Lacertidae	*Crossobamon orientalis*	Sindh Gecko	+
7	Squamata	Lacertidae	*Acanthodactylus cantoris*	Blue-tail Sand Lizard	+
8	Squamata	Lacertidae	*Mesalina watsonana*	Spotted Lacerta	+
9	Squamata	Scincidae	*Ophiomorus raithmati*	Three-finger Sand Swimmer	+
10	Squamata	Varanidae	*Varanus bengalensis*	Bengal Monitor	+
11	Squamata	Boidae	*Eryx conicus*	Sindh Sand-Boa	+
12	Squamata	Boidae	*Eryx johnii*	Red Sand-Boa	+
13	Squamata	Colubridae	*Platyceps rhodorachis*	Cliff Racer	+
14	Squamata	Colubridae	*Sphalerosophis diadema*	Blotched Diadem Snake	+
15	Squamata	Colubridae	*Ptyas mucosus*	Indian Rat Snake	+
16	Squamata	Colubridae	*Xenochrophis cerasogaster*	Red-belly Marsh Snake	+
17	Squamata	Colubridae	*Naja naja*	Black Cobra	+
18	Squamata	Viperidae	*Echis carinatus*	Saw-scaled Viper	+
19	Squamata	Hydrophidae	*Hydrophis spiralis*	Yellow Sea Snake	+

List of Amphibians recorded from Korangi Creek Area

S.No.	Order	Family	Scientific Name	Common Name	Korangi Creek
1	Anura	Bufonidae	*Bufo stomaticus*	Indus Toad	+
2	Anura	Ranidae	*Euphlyctis cyanophlyctis*	Skittering Frog	+
3	Anura	Ranidae	*Hoplobatrachus tigerinus*	Bull Frog	+



The area is quite important due to the presence of mangroves and serves also as a breeding place for fishes and shrimps whose large-scale netting takes place in the mangrove area. There is high level of aquatic pollution in the area which needs to be controlled.

4.7 Social Baseline

The successful implementation of a development project rests upon understanding and integrating the socio-economic influences in the project environs. This social baseline chapter provides a comprehensive review of the socio-economic conditions of the project area. This socio-economic profile is based on a literature review and several primary data gathering activities including site visits, sample socio-economic survey of stakeholders in the area and consultations with primary and secondary stakeholders.

This social baseline provides an overview of the socio-economic conditions of the people who reside and work in the project vicinity of Installation of 5 MGD Desalination Plant. It also includes an assessment of public utilities and social services (education and health facilities) of these areas.

The social baseline is broadly divided in to macro-environment and microenvironment to establish the socio-economic conditions in the district as a whole as compared to the prevailing social influences in the environs of the target health facilities. The data collated in this section is mostly from validated government and NGO publications and engagements with nearby communities, Local Government representatives, local and international health professionals directly or indirectly involved in managing health sector issues in the area.

4.7.1 Macro Environment

4.7.1.1 Administrative Context

Karachi City and capital of Sindh is located on South-Eastern tip of the country. It is the country's largest city, principal seaport and major industrial area. There have been a lot of changes in the administration. Previously, there was The Karachi Division and each division had five districts. This Division system was abolished in 2000 and five districts of Karachi were merged in City District Karachi. The City District Karachi was divided into 18 Towns and 178 union councils. On 11th July 2011, Sindh Government restored 5 districts of Karachi division and abolished City District Government Karachi.

In November 2013, a new District Korangi was formed by splitting District Karachi East. Furthermore, on 04 September 2020, a new district (7th) was formed by splitting District West. Now Karachi Division has District Central, District East, District Malir, District South, District Korangi, District West and District Kemari. These districts form the Karachi Division now. All districts have subdivisions. There are also six military cantonments, which are administered by the Pakistan Army.

Table: Area, Density and Population of Karachi's Districts (2017)

Name	Area (Sq. km)	Density (2017) Sq. km	Population Census (2017)
District Malir	2,160	891	1,924,346
District West	929	4,206	3,907,065
District East	139	20,686	2,875,315
District Korangi	108	23,866	2,577,556
District South	122	14,502	1,769,230

Source: Finalized Census Results of Karachi 2017 – Pakistan Bureau of Statistics Govt. of Pakistan

4.7.1.2 Demography

Karachi City is rich with multicultural ethnicities. People from all over the country migrate to Karachi for better income and good opportunities. The districts comprise people from several ethnic groups including Pakhtuns, Hazarawals, Seraikis, Sindhis, Urdu Speaking, Memon, Punjabi and Balouchis. Karachi also hosts illegal immigrants from Bangladesh, Burma, and Afghanistan. The total population of Karachi in 1998 was 9,856,318. An increase of 62.9% has been seen since last census in 2017 which concluded the population of Karachi to 16,054,988.

The following table provides a comparison of population of districts between 1998 and 2017 census. All districts show significant increase in population.

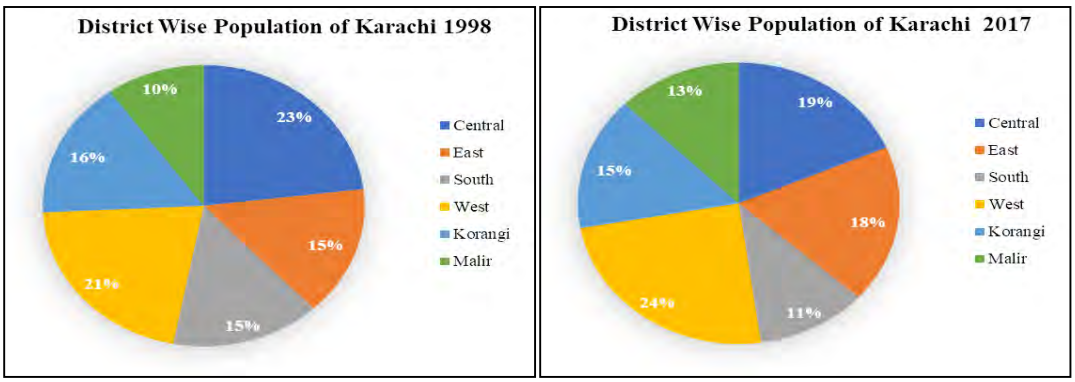


Table: District-Wise Population according to the 1998 and 2017 Census

The total population of Ibrahim Hyderi was 476,795 according to the 1998 census and 1,055,780 according to the 2017 census. The population of the city is exponentially increasing with the passage of time due to rapid development activities such as new residential, town are being developed to reduce the burden of overpopulation on the central city. According to the 1998 census, District Malir was the mostly lowest populated District of Karachi comprising 10% of the entire population. There are several ethnic groups in Ibrahim Hyderi including Muhajirs, Sindhis, Kashmiris, Seraikis, Pakhtuns, Balochis, Ismailis and Hazara community etc. Over 85% of the population is Muslim.

The populations reported in 1998 and 2017 census are reported below.

1998 census population	**2017 census population**
DISTRICT MALIR	
914,765	1,924,346
Ibrahim Hyderi Sub-division	
476,795	1,055,780
Source: Pakistan Bureau of Statistics	

4.7.1.3 Education

According to School Education Statistics 2015-16, District Malir and District Central have highest number of schools i.e., 613 schools in each district. Out of the 613 schools in District Malir, 280 have electricity and 333 schools do not have electricity. A total of 398 schools has washroom facility while 215 schools do not have any washroom facility. Meanwhile 305 schools do not have access to drinking water and 127 schools do not have boundary walls. The school numbers are good and equivalent to Central district. A big number of schools having without electricity, wash rooms, drinking water and boundary wall as compare to other five districts.

According to the recent study of RSU-Sindh Management Information System the Karachi division has total 2,915 schools including Primary, Middle, Secondary and Higher Secondary schools. District Malir has a total of 488 primary schools, 75 Middle Schools, 43 Secondary schools and 7 Higher Secondary schools. It has an enrolment rate of 32,795 at the primary level secondary level is 5,061. Enrollment ratio is comparatively lower than to other districts.

District wise School data and enrolment stratus for 2015-2016 is presented below

Table 4.16: District wise School data in Karachi 2015-16							
Type of School	**Central**	**East**	**South**	**West**	**Malir**	**Korangi**	**Total**
Primary	372	169	331	280	488	377	2,017
Middle	100	30	75	42	75	57	379
Secondary	132	62	88	47	43	112	484
Higher Secondary	9	6	5	3	7	5	35
Total	613	267	499	372	613	551	2,915
Source: RSU-Sindh Management Information System (SEMIS)							

4.7.1.4 Health Facilities

Only few hospitals and health care facilities are available within the proposed project area. In addition, only one hospital is well equipped within the Bin Qasim Town namely Pakistan Steel Hospital. The residents nearby Goths of the proposed project sites have only one public health facility namely Rural Health Center, which is public facility. Other facilities in surrounding towns include Al-Hadeed Medical Center, Child and Mother Clinic and Family Health Care Hospitals. The public health facilities in Karachi are highly centralized in a few locations and cannot cater to a large part of the population, which cannot afford private healthcare.

According to Health Profile of Sindh 2016, the total number of physicians in Karachi has been estimated to be 285 while the total count of general practitioners is 5320. This shows that the doctor to patient ratio is 3,029 people for each doctor. According to the Health Profile there are total 15 government hospitals, 9 Departmental hospitals, 643 dispensaries and 134 private hospitals in Karachi. The population of Karachi is increasing rapidly and is expected to increase more in the coming years. The number of beds in private and government hospitals is limited to 7249 and 4807 beds respectively.

The details of health facilities in Karachi are given in the following table.

Table: Health Facilities in Karachi

Health Facilities	No.	Beds
Government Hospitals	15	4807
Departmental Hospitals	9	1185
Private Hospitals	134	7249
Local Bodies Hospitals	7	1109
Dispensaries (Govt./Local Bodies/ Private/Missionaries)	643	267
SMCHC (Govt./Local Bodies/ Private/Missionaries)	85	26
TB Clinic	23	-
BHUs	37	76

RHCs	6	94
Govt. Urban Health Centre	5	-
Govt. Urban Health Unit	10	-
Other Govt. (Trauma Centre/ Homeo /Unani Shifa khana)	15	-
Source: Health Profile of Sindh 2016 (BOS-Sindh)		

4.7.1.5 Poverty

Pakistan's first ever official report on multidimensional poverty was today launched by the Ministry of Planning, Development and Reform. The report details Pakistan's official Multidimensional Poverty Index (MPI) which was earlier published in the Economic Survey of Pakistan 2015–2016. The report has been compiled with technical support from UNDP Pakistan and the Oxford Poverty and Human Development Initiative (OPHI), University of Oxford.

According to the report, nearly 39 percent of Pakistanis live in multidimensional poverty, with the highest rates of poverty in FATA and Balochistan. Pakistan's MPI showed a strong decline, with national poverty rates falling from 55% to 39% from 2004 to 2015. However, progress across different regions of Pakistan is uneven. Poverty in urban areas is 9.3 percent as compared to 54.6 percent in rural areas. Disparities also exist across provinces.

4.7.1.6 Land Use

The city of Karachi has been through astringent urbanization during last two decades and many studies have been performed for its land use analysis. According to the Pakistan Economic Survey 2013-2014, Karachi is the largest and fastest growing urban center of Pakistan offering the most complex set of urban development challenges with a population of about 20 million having annual growth.

The proposed project area lies in the Malir district of Karachi at Port Qasim to the south where a major portion (65%) of the notified area of Port Qasim comprises of saline channels and creeks of the inactive Indus Delta. The remaining portion is occupied largely by mangroves, mudflats and beaches and other areas such as industrial, commercial, residential and agriculture.

4.7.2 Micro Environment

Ibrahim Hyderi is approximately a four hundred years old settlement of fishermen. It is one of the neighborhoods of Bin Qasim Town in Karachi, Pakistan. Ibrahim Hyderi is located on the Arabian Sea coast and has a large community of fishermen.

There are several ethnic groups in the area of Rehri and Ibrahim Hyderi including Sindhi, Baloch, Urdu, Punjabi, Kashmiris, Seraikis, Pakhtuns, Memons, Bohras, Ismailis and Bangali. Over 99% of the population is Muslim. The population of Bin Qasim Town is estimated to be nearly one million.

Fishing is the main occupation of the inhabitants of all villages and the sole source of income. In Rehri & Ibrahim Hyderi a small percentage are employed as labourers, work in hotels, shops, etc.

and a small number in government and private jobs. In rest of the villages almost the entire populations are engaged in fishing. Fish catch varies seasonally but the main complaints were regarding to a) the marketing of fish; b) the rising costs entailed in fishing of boats, nets, diesel for the bigger sea-faring boats, etc. and c) the relationship of bondage with the contractors who finance the fishing and bind them to sell the catch to them at prices they set. The result is a lifelong indebtedness of all fishermen.

4.7.2.1 Education

The educational institutes in the project area include:

- Government College for girls and boys
- 5 Government boys' primary schools (combine)
- 3 Government girls' primary schools
- High schools for girls and boys
- Vocational Schools for girls
- 5 private schools including TCF, Model School, English Grammar school and etc.

The education condition is good. Primary schools looked well decorated and student found in well dressed. Conditions of school building are satisfactory. Around 11000 children's girls and boys acquire education at primary to higher level. Girl's education has been stopped due to culture barriers and poverty. Poverty is big cause to increase the dropout rates.

4.7.2.2 Healthcare Facilities

Healthcare facilities in the project area include Civil Hospital Ibrahim Hyderi which is running in collaboration of HANDS. Aga Khan Child and Mother Health Unit is also established in the town where poor people get the free medicine and they also handle the normal delivery. This center is also provided transportation facility in emergency to the poor people of area.

There are many small private hospitals and clinics in the project area and one major government hospital (Sindh Government Hospital New Karachi). The most common diseases reported in the area include skin, hepatitis, eye, and cancer. The residents of the area mainly avail the facility of government hospitals in normal disease. In emergency they move to nearest hospital of Karachi.

4.7.2.3 Waste Management

Dumping places are allocated for garbage in the areas. Most of this waste is dumped on the streets, gutters, holes and in nearby bushes. It is illegal waste dumping has been widely regarded as one of the biggest source of environmental damage. District council vehicle twice carried the garbage from dumping places. Sweepers sweep roads on daily basis.

4.7.2.4 Water Supply

There is not available the drinking water in the area so they purchase the water tankers. They purchase the water tankers on communal basis. They cannot afford to water tankers regularly so people of area compel to drink the brackish water which is harmful for their health.

4.7.2.5 Electricity

The electricity is available in the areas but the load problems have been faced by community persons. Load-shedding is a day for 5 to 6 hours sometimes have the over load shading in the area. Influence persons have alternate source of energy such as generators and solar.

4.7.2.6 Gas Facility

The gas is available in the areas but due to misuse/steal by some households its supply is to be insufficient for all villagers. In winter seasons, villagers face more difficulty, if gas pressure has been low and people feel difficulty in cooking, and bathing etc.

Chapter 5 Stakeholders Consultation

5.1 General

The participation of project stakeholders in project planning, design and implementation is now universally recognized as an integral part of environmental & social impact assessment. Local communities, their representatives, government departments, national and international NGOs and the civil society at large may all be able to contribute to and benefit from, the dialogue directed at identifying and resolving key project-related issues. Stakeholder consultation has become an important requirement of the EIA study after the enactment of the guidelines for public consultation under the Pakistan Environmental Protection Act (PEPA) 1997. After the 18th Amendment to the Constitution, the Government of Sindh passed the Sindh Environmental Protection Act 2014, which also stresses the importance of engaging with the concerned primary and secondary stakeholders during the EIA study.

The proposed project "5MGD Desalination Plant" will be a modern plant planned to be used for removing salts from sea water to make it fit for drinking purpose. The project is planned to be constructed on land measuring exactly 10 Acres situated right before Jamot Jetty No. 4 which falls under the jurisdiction of Ibrahim Hyderi Sub-Division of District Malir, Karachi. New developments in the area will change the overall landscape and can create both challenges and opportunities for the existing and new residents and businesses in the area. In addition, the project activities involve the installation of water pipe line of 5.5km from Desalination Plant to Ghazi Pumping Station. The route of pipeline is passing through the Creek Road, Coast Guard Chowrangi, Korangi Qabristan Road before entering to Ghazi PS.

While in the short-term, the impacts might be felt only in the microenvironment of the project, in the long-term, the impacts may also spread to other nearby neighbourhoods and activities including traffic management, the swift passageway for fire tenders and ambulance and stress on existing utilities. Instead of these perceived impacts, meaningful engagement with the project stakeholders has been carried out to identify the potential positive and negative impacts, assess the magnitude of these impacts from a social perspective and prescribe solutions for the construction and operations phase of the proposed project.

5.2 Stakeholder Mapping

To better understand the different stakeholder groups for this project, a stakeholder mapping exercise has been carried out whereby the different stakeholder groups and their interests in the project are discussed in this section:

1. **Local People/Neighborhood:** Individuals or groups in the vicinity of the project site are informed regarding the project background and context. Due to their proximity to the project site, they are often the most vulnerable stakeholders and therefore, consultation with these stakeholders is carried out throughout the project life. The consultation exercise provides an opportunity to appraise the stakeholders regarding the consultation process, identify likely project impacts, and record concerns of local communities. Moreover, intensive stakeholder engagement during the planning stage of the project provides a basis for reducing the trust deficit and encourages confidence-building.
2. **Proponents:** The main aim of the project proponent "Karachi Water and Sewerage Board - Government of Sindh (GoS)" is to accomplish the objectives of the project through cost-effective and sustainable project activities. To this end, the project proponent has to recognize that strong associations and responsive relations with stakeholders would go a long way to achieve the project objectives. Therefore, the proponent has to strive to engage stakeholders

at all levels from the outset; inform them regarding project goals, design and alternatives. Moreover, they have to keep trying to create public understanding and acceptance of the proposal through a commitment to implement the promised objectives. They have to accomplish the project through general acceptance of the design and keep improving through the use of public inputs on alternatives and mitigation measures.

3. **Government Agencies:** The government agencies involved in the EIA process is mandated to have their policy and regulatory responsibilities addressed in impact analysis and mitigation consideration. For the competent authority, an effective public involvement program will ensure a project proposal that effectively incorporates environmental and social concerns. During the EIA review, the most important concern for SEPA is a transparent public consultation process and a strong stakeholder engagement plan that can address the concerns and suggestions of all stakeholders.
4. **NGOs/Interest groups:** Comments from NGOs and specific interest groups often provide a useful policy perspective on the project's methodology and implementation mechanisms. For example, due to the vast exposure of certain NGOs and interests groups, alternative measures for reaching the project goals may be advised that is more environmentally friendly and socially acceptable.

5.3 Primary and Secondary Stakeholders

Primary stakeholders are those who have a direct interest in the project which includes residents, commercial entities and institutions falling in the immediate environs of the project area. Secondary stakeholders include the relevant government agencies and public interest groups which may indirectly influence or be influenced by the project. The concerns and input from both primary and secondary stakeholders are important to identify the issues arising from the construction and/or operation phase of the project and propose mitigation measures that minimize the negative project impacts and enhance the positive ones.

Within the project vicinity, the primary stakeholders are the residential, commercial and institutional entities in the immediate vicinity, that include Hyderi Village, Fishermen Community of Jamot Jetty no. 4, Mashallah Godown, Haider Pan Shop, Fish Feed Factory and Fisherman's Cooperative Society Limited. The secondary stakeholders for this project include the utility companies that operate in the area including K-Electric, SSGC, as well as the regulatory authorities, mandated to ensure environmental protection in the city, which falls under the remit of SEPA and compliance with building and construction laws which is looked after by SBCA. The primary and secondary stakeholders for this 5MGD Desalination Plant project have been identified in the table below.

Table 5.2: Stakeholders for 5MGD Desalination Plant	
Neighbourhood	*Residential Interests* • Hyderi Village • Fishermen of Jamot Jetty No. 4 *Commercial Interests* • Mashallah Godown • Haider Pan Shop • Fishmeal Feed Factory *Institutional/Governmental Interests* • Fisherman's Cooperative Society Limited
Government Agencies & Other Service Providers	Sindh Environmental Protection Agency (SEPA) District Muncipal Corporation Malir (DMC Malir) K-Electric Sui Sothern Gas Company (SSGC)
NGOs/Interest groups	Shehri-CBE National Forum for Environment & Health (NFEH) Citizens for Environment (NGO)

5.4 Consultation Approach & Methodology

5.4.1 Consultation with Primary Stakeholders

A Neighborhood Survey was conducted to identify the residential and commercial interests in the area that may face direct impacts from the proposed development. The survey was conducted in two stages. In the first stage, several site visits were carried out to identify all stakeholders that either reside or work in the project vicinity and conduct an initial identification of potential positive and negative impacts. Relevant public service institutions directly involved in service provision in the areas were also identified.

During the second stage, a social survey field team used a pre-designed semi-structured template to engage the area residents, commercial interests and public service institutions. Those stakeholders, who were not available at the first attempt, were re-visited on the same day or followed-up for their comments during the next few days. During each meeting, the project team introduced the project to the stakeholders, explained the project, recorded their concerns, suggestions and provided contact details to enable stakeholders to share further comments via email or hand over or post in writing. A 'Project Brief' providing the salient features of the project were also handed over to the available stakeholders as part of the information disclosure process.

Moreover, the team inquired about the current situation of the area such as the status of utilities, security and law and order situation in the project area from the residents near the project site. Several open-ended questions were also included in the questionnaire to ensure that the respondents could openly share their opinions and suggestions relevant to the study.

The following table shows the stakeholders that were approached during the Neighborhood Survey.

Table 5.3: Consultation with Primary Stakeholders

S. No	Respondents	Stakeholders	Stakeholder Type	Date
1	Mr. Allah Baksh (Fisherman)	Jetty No. 4	Residential	21-07-2022
2	Mr. Abdul Samad (Resident)	Hyderi Village	Residential	
3	Mr. Haider Ali (Owner)	Haider Pan Shop	Commercial	
4	Mr. Noor Nabi (Fish Net Maker)	Jetty No. 4	Commercial	
5	Mr. Ahmed Mamdani (Supervisor)	Mashallah Godown	Commercial	
6	Mr. Mushtaq Jamot (Resident)	Jetty No. 4 Village	Residential	
7	Mr. Mohmmad Hassan (Resident)	Hyderi Village	Residential	
8	Mr. Irfan Ahmed (Marketing Officer)	Fisherman's Cooperative Society Limited	Governmental	
9	Mr. Bilal (Worker)	Feed Factory	Commercial	

5.5 Consultation Feedback

The social team from EMC carried out consultations in the project area on 4th week of July 2022 after an initial site visit. Consultations were conducted with the residential and commercial stakeholders in the vicinity of project site. The following major issues and concerns were raised by the primary stakeholders:

Concern & Suggestions

- The residents of Hyderi Village were happy to see new development in the area. They commented that developmental projects will increase the property value and quality of infra-structure in the area and also provide few job opportunities for the locals.
- The residents of the neighborhood complained about the unavailibilty of fresh water in the area, they usually rely on water tankers for drinking and cooking purposes. They are under the impression that the proposed desalination plant would provide them the source of pure drinking water.
- The residents in the area complained about the lack of public transportation facilities in the locality.
- The residents of the neighborhood requested to have a proper hospital facility in the area, they have to travel in other subdivisions of District Malir to get proper medical help.
- The residents were also concerned about the garbage disposal system in the locality, they had to throw garbage in an empty plot and burn it after.
- The fishing community near the project was concerned about the fishing that could get affected due to the salts running back into the sea.

- The residents of the neighborhood also complained about not having a school facility for the children of poor fishermen community, they requested the officals for a non-profit or government school in the immediate neighborhood.
- The residents of the area said that there is a lot of pollution in the surroundings, the empty plots are frequently used for garbage disposals and the fish feed factories generate unpleasant odore in the surrounding.

<table>
<tr><th colspan="2">Stakeholders Consultation Pictures</th></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consultation with a Fisherman, Jamot Jetty No. 4</td><td>Consultation with a Resident, Hydari Village</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consultation with Fishermen, Jetty No. 4</td><td>Consultation with Fishermen, During Ice Filling</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consultation with Owner, Hyder Pan Shop</td><td>Consultation with a Fishing Net Maker</td></tr>
</table>

	
Consultation with Supervisor, Mashallah Godown	Consultation with Residents, Hydari Village
	
Consultation with Villagers, Jetty No. 4	Village Childern, While Playing
	
Consultation with the Houses, Jetty No. 4	Consultation with Residents, Jetty No. 4

Consultation with Owner, Pan Shop

Cosultation with Residents, Jetty No. 4

Consultation with Workers, Feed Factory

Consultation with Officer, Fisherman's Cooperative Society Limited

Consultation with Feed Manufacturer Factory

Chapter 6 Screening of Potential Environmental Impacts & Mitigation Measures

This section presents that screening of potential alternatives and environmental impacts of pre-construction, construction and operation activities of proposed power plant. Project activities will be initiated after obtaining the environmental approval from the Sindh Environmental Protection Agency (SEPA). A sequence of activities from the pre-construction to operation stage will follow the Implementation schedule.

The process of screening has applied the checklist method for assessment of significant impact by professional judgment. Mitigation Measures will have to be adopted in order to reduce, minimize or compensate for the negative impact as far as possible. The screening process also identifies the residual impact after adoption of mitigation measures that may be needed at the outset of activities. Rapid Environmental Assessment Checklist for the project is presented in table 6.1.

Table 6.1: Rapid Environmental Assessment Checklist

Screening Questions	Yes	No	Remarks
B. Project Siting Is the project area…			
▪ Densely populated?		√	Currently, the project site is a waste dump, primarily covered with old, dry waste. It is not densely populated.
▪ Heavy with development activities?		√	Not expected.
▪ Adjacent to or within any environmentally sensitive areas?			
• Cultural heritage site		√	Not applicable.
• Protected Area		√	Not applicable.
• Wetland		√	Not applicable.
• Mangrove		√	Not applicable.
• Estuarine		√	Not applicable.
• Buffer zone of protected area		√	Not applicable.

Table 6.1: Rapid Environmental Assessment Checklist			
Screening Questions	**Yes**	**No**	**Remarks**
• Special area for protecting biodiversity		√	Not applicable.
• Bay		√	Not applicable.
A. Potential Environmental Impacts Will the Project cause…			
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		√	No sites of historical or cultural significance are located in project area.
▪ interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?		√	Not expected.
▪ dislocation or involuntary resettlement of people?		√	No dislocation or involuntary resettlement of people is expected.
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		√	No such impacts are expected.
▪ impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?		√	Not expected from project.
▪ overflows and flooding of neighboring properties with raw sewage?	√		It is small scale plant however mitigation measures will be implemented to minimize overflows.
▪ environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?	√		Sludge is generated from project, mitigation measures for sludge disposal will be undertaken.
▪ noise and vibration due to blasting and other civil works?	√		The construction works will involve earth works such as excavation and use of heavy machinery, which may result in high noise and vibration levels.

Table 6.1: Rapid Environmental Assessment Checklist			
Screening Questions	**Yes**	**No**	**Remarks**
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?	√		Occupational health and safety risks will exist, particularly during the construction works as well as to a lesser extent during the operation phase of the project.
▪ discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers?	√		It is not likely, but still possible, that hazardous materials could be discharged into sewers, even though this will be a properly designed plant in line with international standards and operated as per strict SOPs.
▪ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities?		√	Not envisaged.
▪ road blocking and temporary flooding due to land excavation during the rainy season?		√	Road blocking not expected, Flooding not expected as such as not large-scale construction is involved.
▪ noise and dust from construction activities?	√		The proposed works will involve construction and equipment installation activities and thus will generate noise and dust emissions from the earth works and resulting civil works to be conducted.
▪ traffic disturbances due to construction material transport and wastes?		√	Not traffic disturbances expected from the project activities.
▪ temporary silt runoff due to construction?	√		It is possible that silt run off could take place from the work sites during construction works.
▪ hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?		√	Not expected.

Table 6.1: Rapid Environmental Assessment Checklist			
Screening Questions	**Yes**	**No**	**Remarks**
▪ deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?		√	Not expected.
▪ contamination of surface and ground waters due to sludge disposal on land?		√	Not expected.
▪ health and safety hazards to workers from toxic gases and hazardous materials which maybe contained in confined areas, sewage flow and exposure to pathogens in untreated sewage and unstabilized sludge?		√	Project does not involve such consequences. Hazardous materials will be stored and managed in accordance with SOPs.
▪ large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)?		√	Scale of project is small. Population changes on large scale not envisaed
▪ social conflicts between construction workers from other areas and community workers?	√		Minor conflicts may happen. Will be managed through better communication.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		√	There is no community at risk of imminent danger adjacent to site from project activities.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	Not envisaged.

6.1 Screening of Impacts at Pre-construction Stage

The pre-construction phase will provide the basis for siting the plant and its ancillary structures, which will include the methodology to be adopted and technologies to be involved. The pre-construction phase will span over the following aspects:

6.1.1 Location of Labor Camps

The construction contractor will develop his own camp & offices for construction purposes within the project site. Development of campsite will include the following activities:

- Leveling and compaction of the area for office and campsite
- Provision of drainage works in and around the campsite
- Laying and compaction of the gravel topping in the office and campsite
- Construction of fuel storage tank area and water tank
- Provision of fence, access and emergency gates
- Construction of septic tanks
- Installation of membrane liner for fuel storage
- Installation of security guard cabins
- Installation of sewerage pipeline with manholes for the septic system & connecting it with Sewer line
- Provision of signage for each activity center

Mitigation Measures

- In order to prevent a nuisance, specific locations shall be designated for development of the labor camp(s). All necessary facilities and amenities shall be provided in these camps such as provision of electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc.
- The use of proper planning while identifying locations for the labor camps will ensure that traffic and pedestrians are not disrupted by labor camps being set up next to the construction site(s).

6.2 Screening of Impacts at Construction Stage

6.2.1 Site Clearance Impacts

No trees are to be cut for the proposed desalination plant as the project site is a paved area and deprived of natural or planted vegetation. Earthworks, however, may be associated with increase sediment runoff entering the coastal marine environment that may impact marine water quality.

Mitigation Measures

- Erosion and sediment control plan shall be completed prior to the commencement of civil works and mitigation measures implemented accordingly.
- Use of sediment retention fencing, berms, and sandbags around excavations to restrict the release of sediment from the construction site;
- Use of siltation curtains to contain the site area around trenching works on the near shore reef to prevent the release of sediment onto the surrounding reef area
- Immediately re-vegetate and/or stabilize exposed surfaces and stockpiles of excavated materials

6.2.2 Impacts from Installation of Seawater Intake Pumps

Approximately 1.30 km long intake would be laid to achieve 2 meters deep water even at Low astronomical tide (LAT). A pump station shall be built equipped with deep well turbine to pump sea water to RO plant.

Mitigation Measures

Marine life preventer and anti-fouling device shall be installed to minimize accumulation, impingment and entrapment of marine life in the intake system. An indicative diagram of anti-fouling device, along with screen to prevent entrapment of marine life, is shown in figure below;

Fig 6.1: A sample Anti-Fouling Device

6.2.3 Construction Waste

Typical construction waste generated during construction activity includes wasted concrete, steel and wooden scaffolding, empty cement bags, excavated soil, wood remains etc. This waste has the potential to cause negative impact on the surroundings and especially marine environment if not properly managed and disposed to approved dumpsites. Irregular storage of this waste may have posed hazards to the workers at site, residents in the neighborhood and

contamination of sea water and nearby beaches. Poor waste management practices may have short term as well as long term negative impact. The following measures will be adopted to manage the disposal of construction wastes:

- Unusable wastes will be transported to be approved dumpsites.
- Excavated soil will be disposed of through the regular channel of the waste contractor.
- Proper solid waste containers of adequate capacity will be provided to cater to daily waste generation.

Other Mitigation Measures

Some other mitigation measures laid down as under will help to mitigate the impacts posed due to the construction phase of the proposed project:

- A comprehensive waste disposal plan to be developed to effectively manage the wastes in considerable quantities.
- The construction waste which will be sent for recycling or sold to waste collection vendors like damage pipes left over steel, wooden and plastic pieces. While, the rest of the left-over waste will then be taken away to the dumping sites for disposal.
- The construction material will be kept in a covered area, especially during the rainy season.
- The excavated soil will be re-used by adopting different methods, which will be used as a filling material in other part of the project or in nearby development activities.
- Various waste containers for different types of waste will be deployed, in order to treat the waste in accordance with its nature.
- The waste bins will be properly marked for each type of waste produced during the constructional activities.
- The project area will contain the sewage and litter facility to overcome the problem of unchecked dumping of waste.
- Use of construction materials that have minimal packaging to avoid the generation of excessive packaging waste.
- Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time

6.2.4 Occupational Health and Safety

Site-specific occupational health and safety hazards are also critical to be identified based on job safety analysis or comprehensive hazard or risk assessment. Health and safety management planning should include the adoption of a systematic and structured approach for prevention and control of physical, chemical, and biological health and safety hazards. Contractor shall ensure that Job Hazard Analysis (JHA) is performed prior to commencing jobs. It shall also be ensured that the JHA is reviewed after the following:

- Whenever work is stopped

- Every time work conditions or the job scope changes
- Persons working or visiting the job shall review and acknowledge the JHA by their signature Crane and Lifting Operations

For all Crane & Lifting Operations Contractor shall ensure full compliance with standard operating procedures. Contractor shall develop a site-specific pre-lift checklist which includes the following at minimum:

- Crane rigging capacity adequately for load
- Condition of slings
- Rigging condition adequate for load
- Area of swing or travel unobstructed
- Multiple crane use
- Power line approach distance maintained
- Stability and footing
- Taglines and spotters
- Illumination and weather
- Signal operator
- Job hazard analysis and other permits

All lifting and rigging activities shall be supervised and conducted by a competent person or team, Contractor shall maintain a lifting gear registry for all lifting gear on-site inclusive of a listing of all lifting gear, copies of equipment certificates (manufacturer, safe working load, serial number) and the inspection/recertification frequency.

Forklifts and Non-Road Vehicles

Contractor should ensure forklift and non-road vehicles are fit for purpose and operated according to manufacturer's requirements. Only competent operators are permitted to operate forklifts and non-road vehicles.

At minimum, all forklifts and non-road vehicles shall be equipped with following equipment:

- Seat belts
- Horn
- Emergency Brake
- Wheel chock
- Labeled Controls
- Fire Extinguishers
- First Aid Kit
- Back-up Alarm

Annual inspection shall be completed by a qualified third party, records of which shall be readily available at site.

Hazardous Substance Handling and Storage

Contractor should ensure that chemicals are handled and stored in accordance with the manufacturer recommendations found in the MSDS. Chemicals should be stored in a manner which will minimize releases to soil, groundwater or the atmosphere.

Containers and tanks which are used to store hazardous substances shall be,

- In good conditions
- Compatible with the material stored inside
- Closed when material is not being transferred into or withdrawn from them
- Flammable or combustible liquids shall not be stored in areas used for exits, stairways, or normally used for safe passages.
- Flammable chemicals shall be stored in flammable storage cabinets, room or building when the volume stored exceeds 25 gallons (95 liters).
- Electrical pumps shall not be used to transfer flammable or combustible liquids. Toxic chemicals shall be stored and handled as defined in the chemical MSDS. Explosive products should be handled and stored according to applicable regulations. Explosive storage shall be located away from corrosives, flammable, oxidizers, or acids.

Scaffolding

Contractor is responsible to establish periodic inspection, certification and recertification program for scaffold works. Only qualified worker is authorized to erect, inspect and certify scaffold. All scaffolds should have a guardrail system on each open side, up to the access point. It should be equipped with toe boards having suitable access ladder.

Over-exertion

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries at construction site.

Mitigation Measures

Recommendations for their prevention and control include:

- Workers will be trained with lifting and materials handling techniques before the construction of the project, including the placement of weight limits above which mechanical assists or two-person lifts are necessary.
- Work site layout will be planned to minimize the need for manual transfer of heavy loads.
- Administrative controls, such as job rotations and rest or stretch breaks will be implemented into the work processes.

Slips and falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction site.

Mitigation Measures

Recommended methods for the prevention of slips and falls from, or on, the same elevation include:

- Good house-keeping practices, such as the sorting and placing loose construction materials in established areas away from walking paths, would be implemented.
- Excessive waste debris and liquid spills will be cleaned up regularly.
- Electrical cords and ropes will be located in common areas.
- Slip retardant footwear will be used where required.

Work at Heights

Falls from elevation associated with working with ladders and scaffolding are among the most common cause of fatal or permanent disabling injury at construction site. If fall hazards exist, a fall protection plan will be in place which includes one or more of the following aspects, depending on the nature of the fall hazard.

Mitigation Measures

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface.
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards as well as fall rescue procedures to deal with workers whose fall has been successfully arrested.
- Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces.

Struck by Objects

Construction activities of the project may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.

Mitigation Measures

Techniques for the prevention and control of these hazards include:

- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap.
- Temporary fall protection measures in scaffolds and out edges of elevated work surfaces would be used, such as hand rails and toe boards to prevent materials from being dislodged.
- Appropriate PPE such as safety glasses with side shields, face shields, hard hats, and safety shoes, would be wore.

Other Site Hazards

Construction of site may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms.

Mitigation Measures

- It can be prevented through the implementation of project specific plans and other applicable management practices, including:
    - Use of waste-specific PPE based on the results of an occupational health and safety assessment, including respirators, clothing/protective suits, gloves and eye protection.

Summary of Recommended Personal Protective Equipment According to Hazard		
Objective	**Workplace Hazards**	**Suggested PPE**
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.
Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or ear muffs).
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.

Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.
Source: IFC Environmental, Health, and Safety General Guidelines		

COVID-19 Prevention

Prevention measures are listed below;

- Assess the hazards to which the workers may be exposed; evaluate the risk of exposure; and select, implement, and ensure workers use controls to prevent exposure.
- Conducting a job hazard analysis can help to determine whether work activities require close contact (within 6 feet) between workers, visitors, or other members of the public.
- When a job hazard analysis identifies activities with higher exposure risks, and those activities are not essential, consider delaying them until they can be performed safely.
- Use closed doors and walls, whenever feasible, as physical barriers to separate workers from any individuals experiencing signs and/or symptoms consistent with COVID-19.
- Use administrative controls, when feasible, to reduce or eliminate the risk of exposure.
- Training for employees on the spread of the disease in the geographic areas in which they work.
- Screening calls when scheduling indoor construction work to assess potential exposures and circumstances in the work environment, before worker entry.
- Appropriate cleaning practices (i.e., washing hands frequently with soap and water for at least 20 seconds, or, if soap and water are not immediately available, using alcohol-based hand sanitizer that contains at least 60% alcohol and rubbing hands until they are dry; sanitizing all surfaces workers will touch).
- The proper way to cover coughs and sneezes following Ministry of Health and WHO recommendations (i.e., sneezing or coughing into a tissue or into the upper sleeve).
- Alternatives to shaking hands upon entry, and the importance of workers not touching their own faces (mouth, nose, eyes).

- Wearing masks over their noses and mouths to prevent them from spreading the virus.
- The need to continue using other normal control measures, including PPE, necessary to protect workers from other job hazards associated with construction activities.
- To the extent possible, screen all visitors on all construction sites in advance of their arrival on the job site for signs and symptoms of COVID-19.
- Adopt staggered work schedules, e.g., provide alternating workdays or extra shifts, to reduce the total number of employees on a job site at any given time and to ensure physical distancing.
- Keep in-person meetings (including toolbox talks and safety meetings) as short as possible, limit the number of workers in attendance, and use social distancing practices.
- Ensure clean toilet and handwashing facilities. Clean and disinfect portable job site toilets regularly. Fill hand sanitizer dispensers regularly. Disinfect frequently touched items (i.e., door pulls and toilet seats) regularly.

6.2.5 Employment Conflicts

The proposed project will create job opportunities during construction and operation phases. Unskilled and semi-skilled employment opportunities that are likely to be created, will be for a short period while the project is constructed. As persons with relevant skills may not be available locally, people from the project area are likely to fill a significant number of the semi-skilled and unskilled jobs while skilled labor will be arranged by proponent.

Mitigation measures

- The Construction Contractor will adopt a transparent hiring policy. Prior to the commencement of the construction activity, the local community will be informed of the employment policy in place and number of people that can be employed for this project.
- It will be ensured that maximum number of unskilled and semi-skilled jobs will be provided to the residents of Karachi city.

6.2.6 Community Health and Safety

General Site Hazards

Projects should implement risk management strategies to protect the community from physical, chemical, or other hazards associated with sites under construction.

Risks may arise from inadvertent or intentional trespassing, including potential contact with hazardous materials, contaminated soils and other environmental media, structures that are under construction or excavations and structures which may pose falling and entrapment hazards.

Mitigation Measures

Risk management strategies may include:

- Access to the site will be restricted through a combination of institutional and administrative controls.
- Removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials.

Disease Prevention

Increased incidence of communicable and vector-borne diseases attributable to construction activities represents a potentially health threat to project personnel, particularly in the wake of Covid-19.

Mitigation Measures

- The mobility of the workers should be restricted to construction sites and timings.
- Covid-19 SOPs should be followed.
- Any labor found to catch any type of disease will leave the site immediately; and would be given proper medical facilities.

Traffic Safety

Construction activities may result in significant increase in the movement of heavy vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents and injuries to workers and local communities.

Mitigation Measures

- The incidence of road accidents involving project vehicles during construction will be minimized through a combination of education and awareness-raising, and the adoption of procedures.
- Buffer strips or other methods of physical separation around the project sites shall be ensured to protect the public from major hazards associated with hazardous materials incidents or failure of the structure being constructed. In addition, nuisance issues related to noise, odors or other emissions would also be avoided as a result.

6.2.7 Soil Contamination

Spills during refueling, discharges during vehicle and equipment maintenance, traffic-related incident and leakages from equipment and vehicles often result in contamination of soil at the construction site. A significant impact on soil will be interpreted if visible amount of hydrocarbon is observed in soil.

Mitigation Measures:

The following control measures are proposed to mitigate the impact on soil resources:

- Spill prevention trays will be provided and used at refueling locations.
- During on-site maintenance of construction vehicles and equipment, tarpaulin or other impermeable material will be spread on the ground to prevent contamination of soil.
- Regular inspections will be carried out to detect leakages in construction vehicles and equipment.
- Fuels, lubricants, and chemicals will be stored in covered banded areas, underlain with impervious lining.
- Appropriate arrangements, including shovels, plastic bags and absorbent materials, will be available near fuel and oil storage areas.
- Contaminated soil will be collected and disposed safely.
- Regular inspection of soil of the project area will be undertaken.
- Incident record of all moderate and major spills will be maintained. The record will include the location of spill; estimated quantity; spill material; restoration measures; photographs; description of any damage to vegetation, water resource, or community asset; and corrective measures taken.

6.2.8 Air Quality

Fugitive dust emissions (Construction Phase): The proposed project involves construction activities like civil construction, mechanical construction, handling and stocking of construction materials, etc. Fugitive dust emission from construction sites is usually a concern predominantly for the habitants in the microenvironment.

PM_{10} and $PM_{2.5}$ are finer fractions of dust (10um and 2.5um respectively) that are known to have human health impacts. Due to the human health issue, these two particulate sizes are most commonly measured in ambient monitoring programs. PM_{10}, particles of less than 10 microns in diameter (one micron equals one-millionth of a meter). PM_{10} particles are very small and are invisible to the naked eye. By comparison a human hair is approximately 60 microns (µm) in diameter. PM_{10} particles can arise from combustion processes (e.g., motor vehicle engines) and mechanical processes (e.g. windblown dust). Health effects associated with elevated levels of fine particle exposure include coughing, sneezing, wheezing and increased breathlessness.

Construction and transportation equipment will raise dust and emit combustion gases including carbon dioxide, carbon monoxide, sulphur dioxide and nitrogen oxides. Construction activities, such as clearing, grubbing, and similar earth moving activities, resulting in fugitive dust and particulate matter emissions and operational activities that includes vehicular movement, are momentary in nature and depend on various factors such as moisture in the soil, the level of activity at a particular site and meteorological condition at the time of construction and operational activities. Combustion exhaust from increasing number of vehicles and construction can affect the ambient air quality of the project area.

Dust fall already exceeds 1gm/m^2 in the arid regions of the earth. It will therefore be mandatory on the proponent to protect the already dusty environment from additional dust fall. It is

necessary to adopt management plan for controlling the fugitive particulate matter during construction activities. However, this ground sourced generation will be limited to the project boundary and the impact might be for short period, only during the construction activities.

Mitigation Measures:

The following mitigation measures will be implemented during construction to control emission of particulate matter:

- Water sprinkling will be done on all exposed surfaces to suppress emission of dust.
- Dust emission from soil piles and aggregate storage stockpiles will be reduced by appropriate measures. These may include:

→ Keeping the material moist by sprinkling of water at appropriate frequency

→ Erecting windshield walls on three sides of the piles such that the wall project 0.5 m above the pile, or

→ Covering the pile, for example with tarpaulin or thick plastic sheets, to prevent emission.

- All roads within the plant site that are to be paved or appropriately sealed will be paved as early as possible after the commencement of construction work. Until the roads are paved, they will be sprinkled regularly to prevent dust emission. Other temporary tracks within the site boundary will be compacted and sprinkled with water during the construction work.
- Construction materials that are susceptible to dust formation will be transported only in securely covered trucks to prevent dust emission during transportation.
- Aggregate material will be delivered to the batching plant in a damp condition, and water sprays will be applied, if needed, to reduce dust emissions.
- Project traffic will maintain a maximum speed limit of 20 km/h on all unsealed roads within the proposed plant site.
- Aqeduate distance will be maintained between potential sources of the dust such as material stockpiles and batching plant and the community.
- The measures to be adopted during the periods when strong wind is blowing and producing high level of air borne dust would be either wetting or avoiding works that will aggravate the adverse impacts.
- All vehicles, generators and other equipment used during the construction will be properly tuned and maintained in good working condition in order to minimize emission of pollutants.

6.2.9 Noise Impacts

Impact during construction phase: The major noise generating sources during the construction phase are vehicular traffic, construction equipment like, dozer, scrapers, concrete mixers, cranes, generators, pumps, compressors, pneumatic tools, vibrators etc. The operation of these equipment will generate noise ranging between 75-90 dB (A). The World Bank guidelines for noise require that the sound level in residential areas should not exceed 55 dB(A) during the day and 45 dB(A) during the night. The noise abatement measures should either achieve these targets or a maximum increase in background noise of 3dB (A). An alternate criterion is the World Health Organization (WHO) guidelines. The WHO guidelines, in addition

to specifying the energy-average sound level L_{eq}, also prescribe the maximum noise level L_{max}. The maximum noise level is important when there are distinct events to the noise.

However, it is very unlikely that the local people will be affected by the noise which might be produced from point sources (construction activities) as the nearest settlement is located >5 km away from the sources. Also, since the study area is completely rural no major point source of noise exists within the vicinity of the study area.

The peak noise levels of all main construction equipment are shown in Table below. The list includes all equipment except vehicles and some minor pieces of equipment. Using this data, the expected noise level, $L_{eq(8\text{-}hr)}$, is calculated. According to the noise assessment[15] the highest equivalent noise level for an 8-hour shift due to a single piece of equipment at a receptor 500 m from the source will be about 60 dB(A). This is under no-mitigation conditions and assuming no attenuation due to ground features. The noise will be further attenuated by 3-5 dB(A) due to topographic factors and installation of noise reducing devices. The resultant noise levels at the receptor (at 500 m) be in the range 50-55 dB(A). In this scenario, the noise level in immediate environs due to construction activities will meet the WHO and World Bank guidelines for daytime noise levels.

Construction Equipment Noise Ranges (dBA)						
Equipment	**Peak Noise Range at 15.2 m**	**Typical Peak Sound Level in a Work Cycle[a]**	**Typical 'Quieted Equipment' Sound Level[b]**	**Construction Phase**		
				Earthworks	**Structures**	**Installation**
Batching plant	82-86	84	81		Y	
Concrete mixers	76-86	85	82		Y	
Cranes	70-94	83	80		Y	Y
Excavators	74-92	85	82	Y		
Tractors & trolleys	77-94	88	85	Y	Y	Y
Water bowsers	85-93	88	85	Y	Y	Y
Graders	72-92	85	82	Y		
Bulldozers	65-95	80	75	Y		
Paver	87-89	88	80	Y		
Pumps	68-72	76	75	Y	Y	Y
Diesel generators	72-82	78	75	Y	Y	Y
Vibrators	68-82	76	75	Y	Y	
Drilling machines	82-98	90	87		Y	Y
Compressors	74-84	81	71		Y	
Dumpers	77-96	88	83	Y	Y	Y
Road rollers	73-77	75	72	Y		

Sources: Bolt, Beranek, and Newman, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances. USEPA, 1971; http://www.waterrights.ca.gov/EIRD/text/Ch11-

[15] Reagan, J. A. and C. A. Grant. Highway Construction Noise: Measurement, Prediction, and Mitigation. Special Report. US. Department of Transportation, Federal Highway Administration. Available from <http://www.fhwa.dot.gov/environment/noise/highway/index.htm>

Noise.pdf; http://www.lacsd.org/LWRP%202020%20Facilities%20Plan%20DEIR/4_6_Noise.pdf; http://newyorkbiz.com/DSEIS/CH18Construction.pdf
Notes:
a. Where typical value is not cited in literature, mean of the peak noise range is assumed
b. Quieted equipment can be designed with enclosures, mufflers, or other noise-reducing features. Where data is not available, a 3 dB reduction is assumed.

Mitigation Measures: The following mitigation and control measures will be implemented to minimize the intensity of the above impacts:

- All construction activities will be conducted in accordance with the principles of Best Practicable Means (BPM). BPM describes methods of working and equipment usage to ensure that potential construction noise nuisance is prevented wherever possible.
- Engineered noise control measures will be implemented in order to reduce noise during the construction phase. This may involve:
  - → All vehicles, equipment and machinery used during construction phase will be in good condition and will be regularly maintained to avoid generation of unnecessary noise.
  - → Vehicles, power generators, pneumatic tools etc will be fitted with acoustic silencers or mufflers.
  - → The generators during construction phases will be kept within enclosures to minimise noise.
- The construction workers will be provided with adequate hearing protection devices for working in high noise areas;
- Vehicles will not be fitted with pressure horns.
- Where required, local hoarding, screens or barriers will be erected to shield noisy activities.
- The generator sets shall be installed in the canopy in safe area under a shed. The noise limits of the total skid shall not be more than 85dB (A) at 1-meter distance from the edge of the canopy.
- The sound proofing shall be provided together with weatherproofing as unique enclosure for personnel sound protection and machine's protection against sand storms and rainfall.
- Compliance monitoring will be done by the proponent and its contractors to check and ensure compliance with mitigation measures outlined above.

6.2.10 Hazardous and Non-Hazardous Waste Management

The construction phase of the project is expected to generate construction waste; packing waste; scrap waste and excess materials waste. Besides being an eyesore, the waste can also pose a health hazard if disposed of improperly and pollute ground, and waterways. An adverse impact on the environment will be interpreted if,

- Any person is exposed to potentially hazardous waste generated by the project
- Project generates waste that can be avoided through practicable means (waste minimization)
- Reusable waste generated by the project is discarded
- Recyclable waste instead of separation at the source is dumped at the trash bins

- Any waste generated by the project is scattered at any place outside the designated bins, or
- Non-recyclable and non-reusable waste ends up at any place other than the designated landfill site.

The operations phase will require use of process chemicals some of which are hazardous. These chemicals have a potential to harm human health and contaminate soil and groundwater if not handled correctly. A significant impact will be interpreted if the material is handled in manner other than that prescribed in the Material Safety Data Sheets (MSDS), without a valid justification.

Mitigation Measures:

- Depending on the nature and quantity of the hazardous waste, it will be disposed of by licensed hazardous waste contractors (mainly for oily waste)
- Fuels, oils, and other hazardous substances to be handled and stored according to standard safety practices outlined in Safety Manuals for handling petroleum products.
- Fuel tanks to be appropriately marked with regard to their contents.
- Fuels, oils, and chemicals to be stored in areas lined by an impervious base and containing dykes, sufficient in size to contain 125% volume of the largest tank.
- Spills to be avoided during fuel and oil transfer operations. Appropriate arrangements, such as drip pans, will be used to circumvent the impact of any spills.
- Fuels, oil and chemical storage will be checked daily for any leakage.
- Appropriate arrangements, including shovels, plastic bags and absorbent materials, will be kept available near fuel and oil storage areas.
- Refueling of vehicles to be planned on a daily basis to minimize travel and chances of spills.
- All operating vehicles will be checked for any fuel, oil, or battery fluid leakage
- Contaminated soil will be removed for appropriate disposal (e.g. bioremediation).
- A daily leak/spill record will be maintained for each vehicle and repairs effected at the earliest opportunity. Leaking vehicles not be operated unless repaired.
- Soil contaminated by minor spills or leaks (defined as contaminated soil covering an area up to 0.1 m2 and 75 mm deep) will be collected and sent for appropriate disposal (e.g. bioremediation).
- Soil contaminated by moderate spills or leaks (defined as the spill or leakage having a volume of up to 200 litres) will be contained using shovels, sand and soil.
- Contaminated soil will be removed from the site and sent for appropriate disposal (e.g. bioremediation).
- Soil contaminated as a result of a major spill (defined as having a volume of more than 200 litres, requiring initiation of the emergency response procedures) also will be removed from the site and subjected to special treatment such as bioremediation.
- An emergency response plan will be developed for the hazardous waste (and substances).
- Training will be provided to personnel for identification, segregation, and management of waste.
- All containers of hazardous waste will be appropriately labeled.

- Equipment and material containing asbestos, poly-chlorinated biphenyls (PCBs), and ozone depleting substances (ODSs) will not be used.
- Materials suitable for recycling will be stored separately and sold to approved recycling contractors.
- Non-combustible, non-recyclable garbage will be land filled.
- Medical waste will be transported to an approved facility for incineration.
- Solid residue from the septic tanks to be transported to the nearest municipal sewage treatment facility.
- Records of all waste generated during the construction period will be maintained.
- Quantities of waste disposed, recycled, or reused will be logged on a Waste Tracking Register.
- On-site audits of the waste management will be undertaken on a regular basis.
- Audits of the waste disposal contractors and waste disposal facilities will be undertaken on a regular basis to check that procedures are being followed.
- The areas around the construction camps and the construction site will be periodically inspected to verify that no project related waste is scattered in these areas.
- A Hazardous Materials Management Plan will be prepared that contains the following management and mitigation measures:

→ Storage and handling of hazardous materials will be in accordance with international standards and appropriate to their hazard characteristics. Storage and liquid impoundment areas for fuels and hazardous process chemicals will be designed with secondary containment to prevent spills and contamination of soil and groundwater. The secondary containment will be impervious with a capacity of at least 110% of the largest single container.

→ Labels will be placed on all storage vessels as appropriate to national and international standards. The labeling will clearly identify the stored materials.

→ Supporting information such as MSDS will be available for all hazardous materials.

→ A Hazardous Materials Register will be in place that covers:

  - Hazardous Material name
  - HAZCHEM/United Nations Code
  - MSDS
  - Summary of maximum inventory
  - Storage requirements and precautions
  - Location, physical properties of the materials where they are used
  - Approved disposal methods

6.3 Potential Impacts during Pre-Commissioning and Commissioning of Pipeline

Following completion of construction work, pipeline commissioning will be carried out to check whether pipeline and associated facilities are complete in all respect. Activities performed during commissioning would include:

Pre-commissioning

- Hydrotesting of pipeline
- Flushing and cleaning of pipeline;
- System dry-out; and
- Inerting.

Commissioning

- Systematic conformity checks of equipment;
- Static, de-energized test of equipment;
- Preliminary check;
- Functional check;
- Operational test; and
- Pre-start-up activities

During pre-commissioning and commissioning activities, the main environmental concerns pertain to:

- Wastewater from hydrotesting
- Noise

6.3.1 Wastewater from Hydrostatic Testing

Hydrotesting (or hydrostatic testing) is the most common method for testing the integrity of the pipeline and checking for any potential leaks (e.g., from faulty welds or cracked pipe) prior to commissioning. The test involves placing water inside the pipeline at a certain pressure to check that the pipeline is not damaged and will not leak during operation. After hydrostatic testing the pipeline will be dewatered and dried.

IFC has issued guidelines for Hydrostatic Testing Water and recommends meeting following requirements for Hydrostatic Testing:

- Water sourcing for hydrotesting purposes should not adversely affect the water level or flow rate of a natural water body, and the test water withdrawal rate (or volume) should not exceed 10 percent of the water source.
- The disposal alternatives for test waters following hydrotesting include (1) injection into a disposal well if one is available or (2) discharge to surface waters or land surface.
- If a disposal well is unavailable and discharge to surface waters or land surface is necessary, the following pollution prevention and control measures should be considered:
  - Reduce the need for chemicals by minimizing the time that test water remains in the equipment or pipeline;
  - If chemical use is necessary, carefully select chemical additives in terms of dose concentration, toxicity, biodegradability, bioavailability, and bioaccumulation potential;
- Hydrostatic test water quality should be monitored before use and discharge and should be treated to meet the discharge limits of local environmental quality standards (in this case SEQS) for effluents.

Mitigation Measures

The water required for hydrotesting will probably be local groundwater. It is planned that no chemical additives will be added to the hydrotesting water. Hence, water after hydrotesting

can be safely disposed of without treatment. Other measures that will be adopted in this regard include the following:

- Water source will be carefully selected so as not to impact water availability for the local users.
- It will be ensured that the used water from hydrotesting is not discharged in nearby canals or other surface water body.

6.3.2 Noise

During cleaning, Gauging and Hydrostatic Testing activities, ambient noise levels may significantly increase from baseline noise levels. The increase is due to the noise emissions expected from the equipment used during the commissioning and start-up activities.

The impact from noise during commissioning activities will be temporary since the high-pressure discharges during hydrotesting are one-off events at a given testing pipeline section and in general the commissioning and start-up works would be moving along the pipeline route alignment and thus would be at a single location for a short period of time.

Mitigation Measures

- It is recommended the IFC guidelines for Hydrotesting activity be considered and adopted.
- The contractor should not exceed scheduled period for hydrotesting and this should be minimized as far as practicable.

6.4 Potential Environmental Impacts during Operation Phase

6.4.1 Odour Impacts

There is no major odour expected from the operation of seawater desalination plants. No impacts are therefore expected.

6.4.2 Noise Impacts

Noise associated with the high-pressure pump in the desalination plant will be a nuisance if noise is not contained within the plant. Noise reduction or acoustic packages are recommended and should be installed to reduce noise emitted from the plant. Workers will be required to wear proper hearing protection.

Industrial Noise Standards: The OSHA has recommended permissible noise exposure limit for Industrial worker which is based on 90 dB (A) for 8 hours exposure a day with 5 dB (A) trading rates. The limits are given in Table 6-11.

Table 6-11 - Permissible Exposure Noise Limits

Total time of exposure per day in hours	Sound Pressure Level dB(A)
8	90
6	92
4	95
3	97
2	100
1	105
½	110
¼	117

Mitigation Measures:

- To control the noise sources is the most effective method to reduce environmental impact of noise
- For all kinds of pumps, vibration insulating foundations shall be provided to prevent vibration of the pump bodies. For the windows of the pump room, materials that have a good airtightness and sound insulation performance will be used.
- Adequate protective measures in the form of ear muffs/ear plugs will be provided to the workers working in high noise areas.

6.4.3 Risk Associated with Chemical Use and Disposal

Anti-scaling agents and cleaning chemicals such as citric acid and alkaline detergent will be used in the desalination plant. Chlorine gas will also be used to treat water from the desalination plant. Although the chemicals to be used are applied in small doses when applied into the system proper handling should be practiced to minimize health risks to workers and the public. Hazardous chemicals should be adequately labelled, stored safely and handling procedures should be visibly displayed at appropriate locations. Staff should be trained on how the chemicals are handled safely, specifically chlorine gas cylinders.

The wastewater from the chemical cleaning process will be discharged. It is proposed to hold the spent cleaning solution in a sump and slowly bleed the neutralized solution into the continuous flow of brine so that the pH of the blended stream complies with environmental requirements. The brine does exhibit good buffering capability because of the high alkalinity and it is expected that the pH will not change significantly.

Mitigation measures

- Proper handling practices e.g., lifting chemicals on ladders or temporary platforms is not permissible
- Proper chemical labelling
- Safe storage practices e.g., in lockable sealed building;
- Signs showing correct procedures;
- Staff handling training
- Slowly discharge neutralized solution into the brine so that discharge complies with environmental requirements
- Chemicals will be handled, stored and disposed in accordance to their MSDS

6.4.4 Risk Associated with Failure of Desalination Plant

Failure of the desalination plant, especially the desalination membranes or post treatment system, will result in the discharge of seawater and chemicals entering the water distribution system. The failure of chlorination system can also affect the quality of reticulated water. Water leakage is another long-term problem that is often associated with the plants.

These risks can be reduced with regular inspection and maintenance. Risks of failure can be further reduced if the installations are properly protected to avoid accidents, and the damaging, or unauthorized removal of the technical equipment.

It is proposed that unauthorized access to the RO plant (as well as the PV modules structures and exposed water supply infrastructures) is prohibited by means of fences with lockable gates, lockable manholes for underground water valves, and that visible signs indicating danger and no-go-areas are displayed visibly. The desalination plants will have full SCADA controls and associated alarms.

Mitigation measures

- Regular inspection and maintenance
- Relevant training program should be provided for operations
- Use of automated controls and alarms
- The desalination plant will have full SCADA controls and associated alarms.

6.4.5 Quality of Supplied Water

The quality of water produced from the desalination plant must still be routinely tested for consumption suitability to assure public health. Samples from all storage tanks should be taken monthly for testing. Assets such as tanks and pump stations are to be regularly inspected to ensure the integrity of the system.

Chemical dosing has been integrated in the project; pH will be balanced by HCl and NaOH dosing and chlorination will be ensured by NaClO dosing.

Mitigation measures

- Regular inspection and maintenance
- Regular testing of drinking water from the plant to ensure it is safe for consumption
- Promptly provide remedy to rectify the salinity of the reticulated water
- Inform the local authorities and public if chlorination system fails and the presence of pathogen is detected

6.4.6 Risk to Marine Water Quality from Brine Outfall

Risks to marine water quality are related to the discharge of brine, if it is not properly disposed of. The brine from the desalination process will be discharged to sea, resulting in locally raised concentrations of salt in the seawater. The process produces a clear water permeate accounting for approximately 43% of feed water, while the remaining 57% becomes the brine solution to be disposed. Salinity levels above or below ambient salt water levels can alter the species composition of benthic formations and affect the behavior of demersal and pelagic species. The significance of this effect is governed by the rate at which the brine is mixed with the surrounding waters and the movement of the plume on exit from the diffuser through which the brine is

discharged. The effect of brine on the marine environment depends on the dilution factors attained when discharged.

A low toxicity antiscalant will be specified. An alkaline cleaner with low phosphorous content will be specified. It is proposed to use citric acid to neutralise the cleaning solution. These can only be confirmed after the detailed design. Given that there must be a disposal route for the brine stream and a very small mixing zone is specified, the impact on local fauna and flora is minimal.

Typical ocean conditions allow for rapid dilution, minimizing potential environmental impacts. In addition, brine can be diluted before release, for example, with another stream of water entering the ocean,

such as the outfall of a wastewater treatment or a power plant. Another method to dilute the brine is to mix it via a diffuser in a mixing zone. For example, once a pipeline containing the brine reaches the seafloor, it can be discharged via many orifices of a long pipe (diffusers) to minimize the concentrated impact of the brine on the discharge area[16].

Keeping in view the smaller magnitude of the project, the Project's use of the new outfall pipe for brine discharge is not expected to impact coastal marine water quality in an area that is alreadyd disturbed and designated for Port activities and operations.

Additional Mitigation measures

- Disposal in high energy environment
- Salinity Testing (within 50-100m of outfall)

6.4.7 Impact on Biological Environment

Brine effluent is known to have some negative effects on benthic ecosystem. Due to higher concentration of salt levels the effluent is denser and tends to sink to the bottom when discharged, directly impacting the benthic organisms such as Sea Grass, etc. around the discharged location. High salinity, if allowed to persist within the water column, can also influence water turbidity.

It is worth mentioning here that the existing desalination plants in Free Zone and Terminal area have been operational for about four years, however, neither verbal or written complaints have been received to the operators from local fisherman regarding specific detrimental effect on fish-catch from brine discharge.

Mitigation measures

- Disposal in high energy environment
- Optimal velocity for dilution and mixing
- Salinity Testing (at outfall and within 50-100m of outfall)

[16] World Bank. 2019. "The Role of Desalination in an Increasingly Water-Scarce World." World Bank, Washington, DC.

- Benthic Survey in Operational Phase

6.4.8 Solid Waste Generation

Wastes from the desalination plant include spent filters and general waste. Spent filter cartridges may be returned to the supplier or disposed through EPA certified contractor in environmental friendly manner. and other solid wastes from the desalination plant will be disposed to approved landfill site.

6.5 Socio Economic Aspects

6.5.1 Health of Population & Workers

The main source of pollution will be noise & vibration generated from RO plant. The work force of the project will not be greatly affected by these emissions as it will be confined in the plant room. However, the auditory system of workers engaged in the impact zone can be affected by these emissions if timely preventive and control measures are not provided.

Mitigating Measures:

- The workers at places where above limit (85dBA) noise levels are incident over long periods must be equipped with personal protective measures.
- All cabins must have proper noise insulation, and they must be air conditioned.
- All workers, who are mainly at seating position and where the vibrations are K>1 shall be equipped with vibration isolating space/seats so that K<1 can be ensured.
- In those areas where it would be impossible to meet the requirements for noise and vibrations, reasonable work and leisure hours shall be observed.
- Set of rules to be followed to guarantee operational safety.
- Periodical health monitoring of workers to register the changes in health status before significant symptoms of certain diseases could be observed.

6.5.2 Social Abnormalities

Because of the influx of workers during the relatively short time period, conflicts may happen. However, since the scale of the project is small and the construction period is expected to be several months, chances of incidences of major conlift are low. Conflicts among workers will be dealt and controlled through better communication and administrative practices.

6.5.3 Employment Opportunities

The project is expected to generate employment during the construction phase of Project. Semi-skilled and unskilled workers may also be trained so that they may be able to retain their employment during the operational phase as well. It is estimated that about 50 people will be employed during construction phase. A workforce of 10 people will be required during operation phase to effectively run the plant.

Chapter 7 Environmental Management Plan (EMP)

7.1 Introduction

This section provides the Environmental Management Plan for the proposed Seawater Desalination Plant at Ibrahim Hyderi - Korangi Creek. The rationale of this EMP is to propose environmental protection measures to protect the areas of environment that may be affected by the development of the project and to assist the regulatory agency (EPA) in deciding the appropriate approval conditions for the project. This EMP aims to provide a mechanism for managing and monitoring environment-related issues during the various phases of the project.

The previous section has identified the potential environmental impacts from different activities during the design, construction and operation stages of project and mitigation measures to reduce the magnitude of impacts to an acceptable level. For practical implementation and management of the mitigation measures suggested in earlier section, an Environmental Management Plan (EMP) has been prepared.

7.2 Purpose of EMP

The Environmental Management Plan for the proposed plant in Ibrahim Hyderi - Korangi Creek aims to ensure that the project:

→ Complies with all applicable national legislations and international guidelines/standards or operating procedures.
→ Incorporates and implements best management/industry practices and best available techniques to minimize potential environmental and social impacts during the construction, operation, and maintenance phases.
→ Complies with the commitments/provisions made in the EIA study to minimize the expected potential environmental and social impacts.
→ Adheres to high standards of safety and care for the protection of the employees and public;
→ Promotes its policies through training, supervision, regular reviews and consultation
→ Maximizes the use of local and regional labor forces to the extent feasible, to maximize local socio-economic benefits;
→ Implements a stakeholder engagement/consultation program to engage the local community in the Project activities at all phases;
→ Supports and participates to any regionally decided protection, mitigation and monitoring plans such mangrove rehabilitation plans, development of fisheries sector or coastal communities' development plans etc.

7.3 Scope of EMP

This Environmental Management Plan provides detailed strategy to be implemented for achieving improved environmental performance in the following areas:

1. **Pollution prevention:** Those aspects of planning and management which support minimization of air and water pollution and contamination of land resulting from Plant operations.
2. **Protection of ecosystems:** Those aspects of management and maintenance which support conservation and enhancement of biodiversity and environmentally sustainable use of open space in the project area.
3. **Resource management:** Those services or activities which support the resource minimization, resource recovery (e.g., reuse and recycling) and environmentally sound disposal of solid and liquid waste.
4. **Contingency Planning:** Development of plans to tackle emergency situations likely to arise during project operation such fire, natural calamities etc.

7.4 Contents of EMP

The EMP has been structured to cover the following key areas:

→ Legislations and guidelines
→ Organizational structure; roles and responsibilities of project personnel;
→ Mitigation matrix
→ Monitoring plan
→ Emergency Response Plan
→ Communication and Documentation

In the preparation of this plan several aspects concerning the siting, designing, construction, and operation of the proposed desalination plant have been taken into consideration.

The proponent will establish an Environment, Health & Safety (EHS) department which will handle all environment related concerns and issues. The Environmental Management Representative (EMR) will hold the responsibility to oversee all issues pertaining to the Health, Safety, and Environment. To support EHS management system, an EHS officer will be appointed to coordinate with the contractor during construction process and also monitor the activities at all the sensitive areas during the construction and operations stages of desalination plant. The EHS Manager can also act as EMR.

7.5 Legislation and Guidelines

Section 3 of the EIA report for the proposed Project has discussed in detail the national and international legislations and guidelines that are relevant to the project. The proponent of the project will ensure that the project is conducted in conformance with national legislation and relevant international conventions and that guidance is sought form national and international guidelines. It will also be ensured that key project management of the company and all its assigned contractors are aware of these legislation and guidelines prior to start of the project activities. All discharges from the plant should comply with the limits prescribed in SEQS.

7.6 Organization Roles and Responsibilities

Organizational structure for the proposed project comprises following key players:

Proponent: The proponent and owner of the EMP during construction and operation

Contractor: Key player for implementation of EMP during construction

Sindh Environmental Protection Agency (SEPA): The regulatory body responsible for mandating the project proponents for ensuring compliance with the EIA provisions including EMP and NOC.

Third-party Consultant: Third party that may be contracted by the proponent to monitor independently the construction and operation activities of the project as per EMP.

Overall responsibility for the project's environmental performance shall rest with the Project Manager while the daily management EHS issues will be performed under the directions of EHS Manager. The EHS Manager will be constantly involved at all stages of the project to ensure that all project related environmental aspects are being properly cared for as the project progresses and that the same are communicated for necessary actions, to the senior project management.

All the Contractor and sub-contractor (if any) activities will be supervised by the site supervisor authorized by the project management/EHS Manager who will oversee implementation of EMP during construction work. The site supervisor in conjunction with the EHS manager and /or project manager will facilitate the regulatory agencies e.g., Sindh EPA during field visits by SEPA as and when required.

The Environment, Health & Safety (EHS) department shall be responsible for the planning, coordination, implementation, and monitoring of the measures, identified in the light of the environmental objectives and policies. It is possible that one member of the project team undertakes two responsibilities at a time depending on the nature of the job.

Responsibilities of key players are outlined below.

7.6.1 Project Manager

The Project Manager will be responsible for overseeing the environmental performance of the project. His key responsibilities include the following:

→ To ensure that EMS requirements for the project are met.
→ To report on performance of the EMS to top management for review and improvement.
→ To ensure that compliance with applicable national environmental legislations and international guidelines is undertaken without negligence which will ultimately ensure compliance with the approval conditions and EIA provisions.

7.6.2 EHS Department and EHS Manager

EHS department shall carry out the following functions:

→ Defining roles, responsibilities, and tasks of other departments and the staff in context of environmental and health safety management.
→ Developing procedures for environmental management including waste management, air quality management, and spill control plans etc.

→ Establishing procedures for emergency events that pose serious threats to the environment or to the surrounding community.
→ Carry out training of all the facility personnel for promoting awareness on EHS issues.
→ Facilitating the EPA in site visits.
→ Reporting on non-compliances and suggesting and implementing corrective actions.

7.6.3 Site Supervisor

During the construction phase, the role of site supervisor will be critical in implementation of EMP and contingency plans. The site supervisor will work to:

→ Coordinate between the contractor and the EHS manager. Important environmental issues will be communicated by the Site Supervisor to the EHS manager for further consideration and necessary action. In case of any undesirable event, the site supervisor will document the details of event and report it to the EHS manager.
→ Ensure that necessary PPEs, work permits/SOPs are adopted as required.
→ Supervise the environmental compliance and inspection process as instructed by the EHS department/manager.
→ Ensure smooth construction work and provide necessary support where required.

7.6.4 Construction Contractor

Construction Contractor will have certain liabilities under the environmental laws of the country, which will be specified in the contract document with the management. He will be supervised by site supervisor during implementation of Construction Environmental Management Plan (CEMP).

The construction contractor will be responsible:

→ To carry out construction activities in environmentally sound manner in accordance with the EMP
→ To coordinate with the site supervisor to address environmental issues arising during construction phase
→ To manage and implement environmental management practices as suggested in EIA as well as the plans developed by EHS department of proponent or the contractor itself.

7.6.5 General Manager (GM)

Key roles and responsibilities of GM would be to:

→ Consider and react to issues and solutions proposed by the EHS Department for environmental management;
→ Coordinate with EHS Department in implementation of EMP and other EHS procedures.
→ Approve any change in decision making and authorities in consultation with Manager EHS, if appropriate.

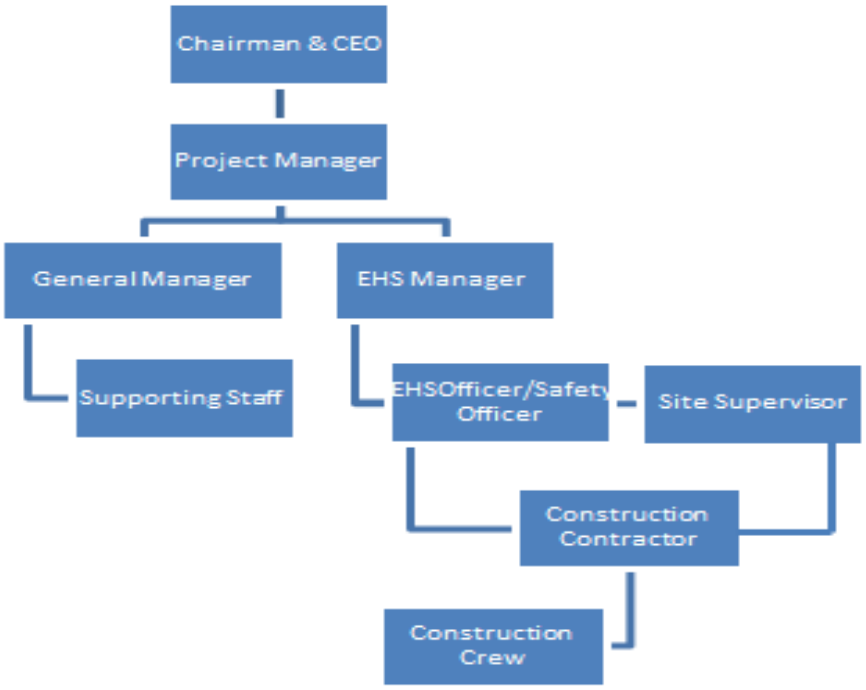


Figure 1: Proposed Organogram for Environmental Management

7.6.6 Third-party Consultant

The proponent may appoint a third-party consultant who will monitor to ensure that the construction is in accordance with the EMP and EIA approval conditions. The results of the periodic monitoring will be compiled in monitoring reports which will be submitted to the project management for review and necessary action. The consultant will maintain monitoring records and any deviations from or changes to the contract plans.

7.7 Environmental Management Program

Plans for environmental management during development/design, construction, and operation phase of the project are mentioned in sections below.

7.7.1 Planning and Design of the Desalination Plant

All of the project facilities will be designed in accordance with the latest standards and specifications, incorporating a high level of safety into the proposed designs consistent with the guidelines.

Provisions will be made for the installation of alarms, controls, emergency isolation and other critical equipment, as would typically be part of modern installations. Ancillary services items such as fire extinguishers, personnel safety clothing, and basic medical supplies will also be arranged.

If any design parameter changes at the time of approval, the proponent will ensure to assess the environmental impacts that may arise from such changes. If the impacts are found to be different and additional to those mentioned in the report, effective mitigation measures will be developed to address the changes to minimize the residual impacts. Approval for the required changes will be obtained from SEPA and any other regulatory authority, if required.

7.7.2 Approvals

The proponent is required to obtain a No Objection Certificate (NOC) from Sindh Environmental Protection Agency (SEPA) for its project before commencing the project activities. However, acquiring NOC does not relieve the proponent or its appointed contractors or suppliers of any other legal obligations and hence the proponent and its contractors and suppliers will obtain all other relevant clearances and necessary approvals required by the Government of Pakistan or Government of Sindh where required.

7.7.3 Environmental Trainings

Necessary training on environmental and other safety issues will be provided to the technical and supporting staff before start of activities to ensure that all the staff is well acquainted with the nature of job, inherent risks, hazards, requirements of job safety and EMP. The EHS Manager will determine the training requirements.

During the training, the following areas of knowledge and experience are considered essential:

→ Understanding the properties (e.g., flammability, corrosiveness, toxicity, reactivity) of hazardous substances, as well as the levels at which they pose a significant danger requiring protective measures.
→ Awareness of early-warning indicators, hazards/risk identification, and ability to recognize potentially hazardous situations.
→ Familiarity with engineering controls to avoid occurrence of hazardous situations.
→ Familiarity with capabilities and limitations of the facility to respond to hazardous emergencies: ventilation system, plumbing systems, shut-off systems, containment devices, and emergency response procedures.
→ Knowledge of the use and maintenance of emergency response equipment, as well as routine equipment for health and safety monitoring and protection.
→ Knowledge of methods and procedures for decontaminating equipment, and facility, following potential chemical contamination.

Records of all trainings should be maintained. It is recommended that in case of any undesirable event or emergency situation, a follow-up session should be arranged to review the weaknesses ad gaps in the existing system and possible reasons which caused the event. This would enable the management in keeping such events from recurring by placing additional and more efficient controls.

7.7.4 Communications

For effective management and monitoring of the environmental performance during the construction and operation phase, communication will be maintained by the Site Supervisor and EHS Manager who will coordinate with the project management and regulatory agency on necessary matters.

Construction Phase: Site supervisor will be responsible for coordinating the project progress to the EHS Manager during construction phase. He will supervise the construction work to ensure that provisions of EMP/EIA are not violated at any stage. If any undesirable event such as work-related injury, death, or any other emergency situation arises during construction, the Site Supervisor shall report this to the EHS manager. Any issues that require attention of higher management will be communicated to them for action by the EHS manager. The site supervisor should report to the EHS Manager on weekly basis during the construction phase.

Operation Phase: Following is suggested for an effective communication of project's EHS performance during the operation phase of the project.

→ **Kick-off Meeting** to define the environmental responsibilities, awareness of EMP to the managing staff and to streamline the work plan according to the EMP. This meeting is to be arranged prior to commencement of activities.
→ **Quarterly Meetings** to review the progress of activities performed and effectiveness of measures in place for pollution control. Deadlines are re-evaluated in it and if necessary, the project program is revised in these meetings. In the end of quarterly meetings, minutes will be issued to include the outcome of the meeting, issues discussed, and decisions. The minutes of meeting will also be provided to the project manager and the contractor for their own record.
→ **Peer Review** for professional opinion and evaluation of the project performance, recommendations for innovation such as new available pollution controls, waste minimization strategies etc.

7.7.5 Contractual Provisions

The requirements of EIA with respect to mitigation measures shall be incorporated in the construction and operations plans and procedures. This will make it mandatory for the contractor to follow procedures and comply with environmental regulations.

1. Site Restoration

The Site Supervisor will ensure that the restoration of the site after the end of construction activities is carried out according to the requirements of the EIA and EMP.

2. Construction Monitoring

An Independent monitoring consultant will be hired to monitor the construction work and EMP compliance which would also include monitoring of waste management.

7.7.6 Protection Criteria for Building

Buildings that are permanently manned by personnel and/or that must remain operational shall be designed in such a way to protect personnel from the effects of accidental releases (i.e. explosions, fires, or toxic concentrations).

Critical buildings (i.e., central/local control room, electrical substation, offices, etc.) will be located as far as possible from highly congested process units containing large amounts of flammable gases. If spacing criteria are not applicable/sufficient, a certain degree of protection shall be provided, according to international standard requirements and/or defined on the basis of risk assessment studies. In order to limit the damage to these buildings in case of explosion and to guarantee a minimum protection without special additional requirements, the following minimum design criteria shall be considered:

- Buildings shall be supported by a steel or reinforced concrete frame; structural details should allow a large plastic deformation before collapse;
- Roofs and ceilings shall be designed such that they cannot easily collapse during an explosion; the structural integrity of the roof must not be endangered by damage to the supporting walls;
- Buildings should preferably be rectangular shaped and single storey with flat roof. The roof should not be charged with heavy equipment;
- Windows should be avoided, or their surface should be minimized (not exceeding 0.5m^2 per wall per room), and should be fitted with suitable glass (i.e. laminated glass or equivalent);
- Doors, frames, and fixings should ensure the same structural resistance as the rest of the cladding.

In addition, the following features shall be considered in building design, to allow a rapid and safe evacuation in case of emergency:

- Access to the building areas (doors, etc.) shall be located onto the side opposite from process areas
- Emergency exit doors of buildings shall be equipped with anti-panic bars
- Minimum door dimensions shall be 2.10m height and 0.9m width
- Doors from enclosed areas shall open outwards, in the direction of escape
- No locking facilities shall be provided for doors along escape routes

Other specific requirements regarding HVAC (room pressurization), fire resistance, emergency systems and fire detection and extinction equipment shall be detailed in the building dimensioning criteria.

7.7.7 Construction Phase

1. Construction Work Management

All construction related work including campsite establishment, operation, and management of waste streams, equipment and material mobilization etc. shall be in compliance with the (1) agreed procedures (if) provided by the proponent to the contractor and (2) provisions of NOC. The contractors will abide by the relevant contractual provisions relating to the environment.

Performance of contractor and subcontractor will be monitored by IMC periodically and site supervisor constantly. All the construction crew particularly the technical staff will be provided with necessary PPEs and other safety equipment as required by their job. Site supervisor and contractor will ensure that each job is being performed in safe and sound manner and in accordance with the safe work procedures.

Solid waste during construction will be removed on daily basis either through a local waste contractor or by the construction contractor himself who will engage some workers for removal of construction waste from site and disposal to a waste collection facility.

Proper drainage will be provided to construction camp and construction site, especially near excavations. The wastewater will be initially treated by sedimentation technique to remove suspended solids and reused if it meets the desired quality. If the effluent cannot be reused, it will be discharged to local sewers after ensuring that it does not contain any solid debris which can choke the sewer lines. Where possible, wastewater will be used for watering the vegetation nearby.

Type of construction material for the GSDP shall meet the seismic design requirements for buildings located in seismic zone 2B. Since the project is to be located close to port, the design consultant also needs to consider other safety aspects for events like cyclones, Tsunami etc.

2. Site Restoration

The Site Supervisor will ensure that the restoration of the site after the end of construction activities is carried out according to the requirements of the EIA and EMP.

3. Construction Monitoring

An Independent monitoring consultant will be hired to monitor the construction work and EMP compliance which would also include monitoring of waste management.

7.7.8 Operation Phase

1. Co-ordination with Stakeholders

The proponent will ensure that co-ordination required with the project stakeholders on environmental and social matters as required by the EMP is maintained throughout the operation of the project.

2. **Management of waste streams**

3. **Wastewater:** Risks to marine water quality are related to the discharge of brine, if it is not properly disposed of. The Project's use of the new outfall pipe for brine discharge is not expected to impact coastal marine water quality.

The brine from the desalination process will be discharged to sea, resulting in locally raised concentrations of salt in the seawater. The process produces a clear water permeate accounting for approximately 43% of feed water, while the remaining 57% becomes the brine solution to be disposed. Salinity levels above or below ambient salt water levels can alter the species composition of benthic formations and affect the behavior of demersal and pelagic species. The significance of this effect is governed by the rate at which the brine is mixed with the surrounding waters and the movement of the plume on exit from the diffuser through which the brine is discharged. The effect of brine on the marine environment depends on the dilution factors attained when discharged.

A low toxicity antiscalant will be specified. An alkaline cleaner with low phosphorous content will be specified. It is proposed to use citric acid to neutralise the cleaning solution. These can only be confirmed after the detailed design (by contractor) is received. Given that there must be a disposal route for the brine stream and a very small mixing zone is specified the impact on local fauna and flora is minimal.

Solid Waste: Wastes from the desalination plant include spent filters and general waste. Spent filter cartridges may be returned to the supplier or disposed through EPA certified contractor in environmentally friendly manner and other solid wastes from the desalination plant will be disposed to approved landfill site.

4. Monitoring

The proponent will ensure that the mitigation measures mentioned in the EIA are adhered to and organizational EHS Management Systems are implemented during the proposed project.

5. Emergency Procedures

The EHS department will prepare contingency plans to deal with any emergency situation that may arise during the operation e.g., fire, major oil spills, medical evacuation and communicate these to the regulatory agencies if required by these agencies.

The EHS department will also implement necessary measures to prevent fire hazards, contain oil spills, and perform soil remediation as needed. At the place of ground flaring, the overhead flaring stack with knockout drums will be installed to minimize gaseous emissions during flaring.

6. Occupational health and safety risk management

During routine GSDP operations, workers can get exposed to chemicals used in the refining process and may develop occupational diseases of the lungs, skin, and other organs, depending on the amount and length of time of exposures. Workers exposed to hazardous noise levels may develop noise-induced hearing loss. Other dangers include confined spaces, in which untrained workers may get seriously injured or killed.

In view of the existence of the occupational health and safety risks in the GSDP, the EHS department needs to develop an Occupational Health and Safety Risk Management Plan for exposure control in situations when workers may be overexposed to chemical hazards. This plan should provide a detailed approach for protecting workers against chemical exposures, including health hazard information, engineering controls, safe work procedures, worker training, and record keeping.

It is recommended that the Occupational Health and Safety Risk Management Plan should necessarily include the following elements:

1. Statement of purpose
2. Responsibilities of employers, supervisors, and workers
3. Risk identification and assessment
4. Risk controls
5. Worker education and training
6. Written safe work procedures
7. Hygiene facilities and decontamination procedures
8. Documentation
9. Health monitoring (may also be required, depending on the nature of the chemicals being used)

7. Standard Operating Procedures

Contractors, sub-contractors, and contract workers will be made aware of environmental aspects and Emergency Response Plan prior to commencing the work. Prior to leaving the site contractors, sub-contractors and contract workers will ensure that their work area is in safe position. Written procedures or standards will be prepared for all activities, where the absence of such procedures and standards could result in not following EHS policy, the law or the contract.

In addition to Standard Operating Procedures (SOP) for project operations, the EHS department will also develop safe working procedures for activities that have the potential to create a risk or hazard if not undertaken in safe manner. The safe working procedures will be based on the following four aspects of job safety:

Safe Place: Work site will be designed and controls set up to ensure that working environment provides no significant risk to personnel, property and the environment.

Safe Equipment: All equipment for any job, including tools, machinery, and protective equipment will be specified and/or designed to ensure that it poses no significant risk to personnel, property, or the environment. All equipment will comply with legislative standards for conformity and test.

Safe Procedure: Procedures will be designed for all aspects of the job to facilitate safe use of equipment at the work site to complete tasks with no significant risk to personnel, property, or the environment. Design of procedure will be based on step-by-step analysis of the tasks involved (Job Safety Analysis), identification of associated hazards and elimination of control of those hazards. Procedures should allow for work in ideal conditions as well as under aggravating conditions e.g., adverse weather.

Trained Personnel: Suitable job-specific, safety skills and supervision training will be provided to personnel involved in construction and operation activities so that they are able to use the procedure and equipment at the worksite with no significant risk to personnel, property, and environment.

Safe Working Procedures will be available to contractors and sub-contractors, technical and relevant nontechnical staff.

8. Engineering Controls

a) Layout Design

Unit operations being laid out in such a manner that incompatible substances and incompatible operations are not located within the proximity of each other.

b) Resources Substitution

Within the processing operations, substitutions of a hazardous material with a non- hazardous material or changing the form of the material if the resulting form would be less hazardous.

c) Resource Minimization

Recovery and recycling of chemicals.

d) Access Control

Limitations of personnel to those specifically trained in the work conditions present within a potentially hazardous are, including use of personnel identification, double lock, security services, and barriers.

Labeling

Complete hazard label on all switch's valves, containers, and unit operations; complete identification of specific hazardous substances by name and type (e.g. toxic, reactive, ignitable, explosive).

e) Monitoring

Monitoring of the environment in the immediate vicinity of potential hazards, as well as at the fence –line of the installation, provides an early warning of a hazard occurring. For example, air quality monitoring for oxygen levels, combustible gas levels, and/or specific air constituents could be conducted on a regular basis using portable equipment or on a continuous basis with stationary equipment.

f) Secondary Containment

Provision of appropriate systems to contain releases-these could include water curtains to restrict gas release, dikes to contain spills, emergency response equipment to collect spilled material, fire-proofing to limit the spread of fire, absorbents to absorb hazardous substance, and buffer zones.

9. Administrative Controls

Administrative controls need to be exercised in situations where it is not possible to reduce hazards through engineering controls. It is recommended that administrative controls should be implemented in the form of rearrangement of work schedules so as to minimize the duration of exposure to hazards and transfer or rotation of personnel who have, over a period of time, reached a maximum allowable exposure limit.

Administrative Controls should also be exercised to ensure the easy access to and availability of personnel protection equipment for use within the vicinity of potential hazards. Such equipment could include chemical resistant gloves, safety shoes, ear protection plugs, safety glasses, etc. Special clothing should be provided as well as basic items for use in emergencies such as portable light, safety belt, two-way radio, etc. should be easily accessible at all times, for 24 hours a day.

Summary of Recommended Personal Protective Equipment According to Hazard		
Objective	**Workplace Hazards**	**Suggested PPE**
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.
Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or ear muffs).

Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.
Source: IFC Environmental, Health, and Safety General Guidelines		

10. Protocols for COVID-19 Prevention

Safety of workers during construction and operation is critical in the backdrop of COVID-19. Accordingly, prevention measures are listed below for implmementation during construction and operation activities;

- Assess the hazards to which the workers may be exposed; evaluate the risk of exposure; and select, implement, and ensure workers use controls to prevent exposure.
- Conducting a job hazard analysis can help to determine whether work activities require close contact (within 6 feet) between workers, visitors, or other members of the public.
- When a job hazard analysis identifies activities with higher exposure risks, and those activities are not essential, consider delaying them until they can be performed safely.
- Use closed doors and walls, whenever feasible, as physical barriers to separate workers from any individuals experiencing signs and/or symptoms consistent with COVID-19.
- Use administrative controls, when feasible, to reduce or eliminate the risk of exposure.
- Training for employees on the spread of the disease in the geographic areas in which they work.
- Screening calls when scheduling indoor construction work to assess potential exposures and circumstances in the work environment, before worker entry.

- Appropriate cleaning practices (i.e., washing hands frequently with soap and water for at least 20 seconds, or, if soap and water are not immediately available, using alcohol-based hand sanitizer that contains at least 60% alcohol and rubbing hands until they are dry; sanitizing all surfaces workers will touch).
- The proper way to cover coughs and sneezes following Ministry of Health and WHO recommendations (i.e., sneezing or coughing into a tissue or into the upper sleeve).
- Alternatives to shaking hands upon entry, and the importance of workers not touching their own faces (mouth, nose, eyes).
- Wearing masks over their noses and mouths to prevent them from spreading the virus.
- The need to continue using other normal control measures, including PPE, necessary to protect workers from other job hazards associated with construction activities.
- To the extent possible, screen all visitors on all construction sites in advance of their arrival on the job site for signs and symptoms of COVID-19.
- Adopt staggered work schedules, e.g., provide alternating workdays or extra shifts, to reduce the total number of employees on a job site at any given time and to ensure physical distancing.
- Keep in-person meetings (including toolbox talks and safety meetings) as short as possible, limit the number of workers in attendance, and use social distancing practices.
- Ensure clean toilet and handwashing facilities. Clean and disinfect portable job site toilets regularly. Fill hand sanitizer dispensers regularly. Disinfect frequently touched items (i.e., door pulls and toilet seats) regularly.

Table 7.1: Environmental Management Plan for Construction Phase (Mitigation Matrix)			
Environmental Aspect	**Potential Hazards / Environmental Impacts**	**Suggested Mitigation Measures**	**Responsibility**
Procurement of construction material and storage on site	Dust emissions	• Construction material will be transported only in securely covered trucks to prevent dust emission during transportation. The drivers will be advised to cover the material before starting off. • Other temporary tracks within the site boundary will be compacted and sprinkled with water during the construction work. • Project traffic will maintain a maximum speed limit of 20 km/h on all unpaved roads within the plant site.	Contractor
Fuel storage on site	Soil contamination from leakages and spills	• Fuels, lubricants, and chemicals will be stored in covered bunded areas, underlain with impervious lining. • Appropriate arrangements, including shovels, plastic bags and absorbent materials, will be available near fuel and oil storage areas. • Contaminated soil will be removed and properly disposed after treatment such as bioremediation or incineration.	Contractor
Civil Construction	1. Vehicular and exhaust emissions	• Fugitive dust will be controlled through the use of water on areas of exposed soils, if necessary; and final grading and landscaping of exposed areas as soon as possible. • Proper servicing of vehicles and provision of exhaust mufflers will be ensured. • Only the equipment in good condition will be used. • Generators will be turned off when not in use to prevent excess emissions. • Face masks will be used when handling soil, preparing construction material and during excavation work.	Contractor

Table 7.1: Environmental Management Plan for Construction Phase (Mitigation Matrix)			
Environmental Aspect	**Potential Hazards / Environmental Impacts**	**Suggested Mitigation Measures**	**Responsibility**
	2. Dust Emissions	Dust emission from soil piles and aggregate storage stockpiles will be reduced by appropriate measures. These may include: • Keeping the material moist by sprinkling of water at appropriate frequency • Erecting windshield walls on three sides of the piles such that the wall project 0.5 m above the pile, or • Covering the pile, for example with tarpaulin or thick plastic sheets, to prevent emissions.	
	3. Construction noise	Noisy construction equipment will be operated with canopies. Where this is inevitable, workers will use PPEs. Prolonged exposure to high noise will be prevented through work breaks or change of shift. Working hours will be adjusted so as not to exceed 8 hours exposure in a single shift.	
	4. Wastewater	• Proper drainage will be provided to construction camp and construction site, especially near excavations. • Sedimentation technique will be used to remove solids from wastewater. • Wastewater will be discharged to sewers only after removing solids and debris. • Activities requiring water will be controlled to avoid excess water consumption and wastewater generation. • The project site will be provided with storm water drainage system.	

Table 7.1: Environmental Management Plan for Construction Phase (Mitigation Matrix)			
Environmental Aspect	**Potential Hazards / Environmental Impacts**	**Suggested Mitigation Measures**	**Responsibility**
	5. Construction waste	• Construction waste will be removed from site on daily basis. • Recyclable waste will be segregated to reduce the volume and be sold managed through contractor. • Food and other perishable waste will be kept in container. • Wastewater will be prevented from reaching the waste storage areas. • Inert construction waste will be used onsite as fill material.	
	6. Impact on fauna and flora	No special mitigation measures are required for protection of fauna since: • Density of fauna and flora on project site is negligible. Construction work on the project site is therefore unlikely to impact the fauna and flora of the project area. • There is no significant animal life thriving therein except for small animals which can easily relocate themselves once activities begin onsite.	Contractor
Equipment mobilization and operation of construction machinery	Vehicle and exhaust emissions from construction machinery, Soil contamination from leakages and drips.	• Transportation of construction material will be carefully programmed to avoid unnecessary trips. • Idling equipment will be turned off.	Contractor
Campsite activities	Food waste, wastewater, possible risk of disease transmission Impact on traffic from possible hindrance to traffic routes	• Land uptake will be kept to minimum required area. • Campsite will be located at a suitable area which does not cause interruption in ongoing traffic in the area. • Proper drainage will be provided to construction camp and construction site, especially near excavations. • It is recommended that construction camp effluent be treated onsite before disposal through evaporation pond.	Contractor

Table 7.1: Environmental Management Plan for Construction Phase (Mitigation Matrix)			
Environmental Aspect	**Potential Hazards / Environmental Impacts**	**Suggested Mitigation Measures**	**Responsibility**
Water sourcing	Impact on other water consumers due to source sharing	Water conservation strategies will be implemented by the contractor to prevent wastage of water and excess wastewater generation.	Contractor
Site restoration	Possible environmental degradation from improper site restoration activities	After the completion of construction phase, proper site restoration will be carried out to eliminate any safety hazards such as any excavation will be leveled to prevent falling injury to the workers.	Contractor
Hiring labor for construction	Socioeconomic impacts	Maximum number of unskilled and semi-skilled jobs will be reserved for the local communities.	Contractor

Table 7.2: Environmental Management Plan for Operation Phase (Mitigation Matrix)			
Environmental Aspect	**Potential Hazards / Environmental Impacts**	**Suggested Mitigation Measures**	**Responsibility**
Chemical usage during plant operations	Hazard to workers and public due to chemical exposure	• Proper handling practices e.g. lifting chemicals on ladders or temporary platforms is not permissible • Proper chemical labelling • Safe storage practices e.g. in lockable sealed building; • Signs showing correct procedures; • Staff handling training • Slowly discharge neutralized solution into the brine so that discharge complies with environmental requirements • Chemicals will be handled, stored and disposed in accordance to their MSDS	Proponent
Noise	Hazard to workers and public due to chemical exposure	• To control the noise sources is the most effective method to reduce environmental impact of noise • For all kinds of pumps, vibration insulating foundations shall be provided to prevent vibration of the pump bodies. For the	Proponent

		windows of the pump room, materials that have a good airtightness and sound insulation performance will be used. • Adequate protective measures in the form of ear muffs/ear plugs will be provided to the workers working in high noise areas.	
Solid Waste	Environmental degradation	• Wastes from the desalination plant include spent filters and general waste. • Spent filter cartridges may be returned to the supplier or disposed through EPA certified contractor in environmentally friendly manner, and other solid wastes from the desalination plant will be disposed to approved landfill site.	Proponent
Brine Discharge	Threat to marine life	• Disposal at depth • Disposal in high energy environment • Salinity testing	Proponent
Odor	Degradation of aesthetics of plant premises and vicinity	• Instalation of anti-fouling equipment. • Regular monitoring.	Proponent

7.8 Monitoring Plan

Environmental monitoring is a vital component of an EMP. It is the mechanism through which the effectiveness of the EMP is gauged. The feedback provided by environmental monitoring is instrumental in identifying any problems and planning corrective actions.

7.8.1 Objective of Monitoring

The main objectives of environmental monitoring during the construction phase of proposed project will be:

→ To provide a mechanism to determine whether the project construction contractors and the Owners plant management are carrying out the project in conformity with the EMP.
→ To identify areas where the impacts of the projects are exceeding the criteria of significance and, therefore, require corrective actions.
→ To document the actual project impacts on physical, biological, and socioeconomic receptors, quantitatively where possible, in order to design better and more effective mitigation measures.
→ To provide data for preparing the monitoring report to be submitted to the Sindh EPA in accordance with the national law requirement.

7.8.2 Environmental Monitoring Plan

The detailed environmental monitoring plan will be finalized prior to commencement of construction and operation. The requirements identified in the environmental assessment are presented in Table 7.3 for construction and operation phase.

Table 7.3: Environmental Monitoring Plan

Stage	Monitoring Component	Parameters and techniques to monitor	Location	Monitoring frequency	Standard	Responsibility
CONSTRUCTION	Air Emissions	Ambient air quality parameters	All construction areas	• Before start of construction activity • Quarterly	SEQS	Construction Contractor
	Solid Waste	Solid waste quality and quantity and disposal methods/locations Visual checks to assess the situation.	At contractor's camp and construction site	Continuous	N. A	Construction Contractor
	Wastewater	Primary Pollutants identified in SEQS	All effluent discharge points	Monthly	National Environmental Quality Standards (SEQS)	Construction Contractor
	Noise Levels	Noise Intensity (dBA)	All Construction Areas	• Start of construction • Monthly during construction	SEQS	Construction Contractor
	Health Safety of workers	• Accidents • PPEs • Visual checks to assess the situation.	All Construction Areas	Monthly	Monitoring of health and safety of workers	Construction Contractor

Table 7.3: Environmental Monitoring Plan						
Stage	**Monitoring Component**	**Parameters and techniques to monitor**	**Location**	**Monitoring frequency**	**Standard**	**Responsibility**
END OF CONSTRUCTION	Restoration of sites	• Visual analysis • Photographic records	All construction sites	End of construction	Previous records	Construction Contractor
OPERATIONS	Chemical handling and storage	• Visual analysis • Photographic records	Storage areas	During operation	SOPs/MSDS	Proponent
	Brine discharge	• Seawater Testing • Grab/Composite Sampling	Effluent discharge point and 50-100m of discharge point	During operation	-	Proponent
	Solid Waste	Solid waste quality and quantity and disposal methods / locations Visual checks to assess the situation.	Project Area	Quarterly	N. A	GPA

Table 7.3: Environmental Monitoring Plan						
Stage	**Monitoring Component**	**Parameters and techniques to monitor**	**Location**	**Monitoring frequency**	**Standard**	**Responsibility**
	Fire & Safety	Fire Hazards & Safety Protocols	All Operational Areas	Continuous	N. A	Proponent
	Noise	Noise intensity measurement (dBA)	All operational areas	Monthly	SEQS/OSHA	Proponent
	Hazardous spill	• Spill on Land	All operational areas	Continuous	SOPs	Proponent
	Health and Safety of workers	• Accidents • PPEs • Diseases	Operational areas	On quarterly basis	Health and safety procedures developed by EHS department	Proponent
	Accidents	Inspection and record keeping	All areas	On quarterly basis	Health and safety procedures developed by EHS department, SOPs	Proponent

7.9 Spill Management

Liquid waste spills that are not appropriately managed have the potential to harm the environment. By taking certain actions, proponent can ensure that the likelihood of spills occurring is reduced and that the effect of spills is minimized.

To enable spills to be avoided and to help the cleanup process of any spills, the contractors and the management and staff of the Owners should be aware of spill procedures. By formalizing these procedures in writing, staff members can refer to them when required thus avoiding undertaking incorrect spill procedures. A detailed spill management plan will be prepared for the construction phase. Similar, plan will also be developed for specific areas during plant operation. The plan will contain the following:

→ Identification of potential sources of spill and the characterization of spill material and associated hazards.
→ Risk assessment (likely magnitude and consequences)
→ Steps to be undertaken taken when a spill occurs (stop, contain, report, clean up and record).
→ A map showing the locations of spill kits or other cleaning equipment.

7.9.1 Avoiding spills

By actively working to prevent spills, money and time can be saved by not letting resources go to waste. In addition, the environment is protected from contaminants that can potentially cause harm. All liquids will be stored in sealed containers that are free of leakage. All containers will be on sealed ground and in an undercover area. Sharp parts will be kept away from liquid containers to avoid damage and leaks.

Bunding: To prevent spills from having an effect on the site operations or the environment, bunding will be placed around contaminant storage areas. A bund can be a low wall, tray, speed bump, iron angle, sloping floor, drain or similar and is used to capture spilt liquid for safe and proper disposal.

7.9.2 Spill Kits

Spill kits are purpose designed units that contain several items useful for cleaning up spills that could occur. Typical items are:

→ Safety gloves and appropriate protective clothing (depending on the type of chemicals held onsite)
→ Absorbent pads, granules and/or pillows
→ Booms for larger spills
→ Mops, brooms and dustpans.

Spill kits are used to contain and clean up spills in an efficient manner. Sufficient number of spill kits will be provided. Spill kits will be kept in designated areas that are easily accessible to all staff. Staff members will be trained in using the spill kit correctly.

After cleaning up a spill, the materials used to clean up will be disposed of correctly. Depending on the spill material, the used material may be disposed in the hazardous waste facility or the landfill site.

7.9.3 Responding to spills

Stop the source: If it is safe to do so, the source of the spill should be stopped immediately. This may be a simple action like upturning a fallen container.

Contain and control the flow: To stop the spill from expanding, absorbent materials and liquid barriers should be placed around the spill. Work from the outside to soak up the spill. It is vital that spilt liquid is not allowed to reach storm water drains, sewer drains, natural waterways or soil.

For large scale spills that involve hazardous materials, authorities may have to be alerted.

Clean up: Using information from Material Safety Data Sheets (MSDS) about the properties of the liquid spilled and the spill equipment available, spills should be cleaned up promptly.

Record the incident: By keeping a simple log of all spills, precautionary measures can be put in place to avoid similar accidents from occurring in the future.

7.10 Emergency Response Plan

Emergency may be defined as a sudden event causing or has the potential to cause serious human injury and/or environmental degradation of large magnitude. Prevention and remaining in preparedness are the best options in case of emergency. The Emergency situations arise in case of:

→ Serious fire or explosion;
→ Release of chemicals in large quantities;
→ Natural calamity such as heavy rain, flooding, dust storm, landslide, earthquake, etc.;
→ Threat or any sabotage / terrorist activity;
→ Any other incident involving all or large part of the premises and its workers.

A Project-specific ERP will be developed which primarily relates to the different construction activities of the project. It supports the EMP & addresses actions & required responses of personnel, employees & contractors.

Emergency response management will be provided by a small team of senior managers designated as the control committee, who in turn will direct all response activities through the Emergency Response Unit, to the mine security, plant security; communications; public relations; safety and environmental affairs, and material procurement departments. Each of these departments will have specific responsibilities to perform in the event of an emergency.

A. Objectives of ERP

The main objective of the emergency response plan is to establish the general guidelines for actions to be taken in the event of calamities such as fire, explosion, accidents or hydrocarbon spills/leaks and spills of process chemicals, natural disasters and sabotage, it aims at minimizing the impacts and consequences, and to protect the physical integrity or the lives of the following:

→ Contractor personnel or third-party personnel present in the facilities of Proposed facility
→ Community areas near the area of influence of the Project
→ Project assets;
→ Ecological systems located in the surroundings of the facility

B. Risk Situations

In the emergency conditions, there are numerous risk situations which a project may face. With respect to the project some such risk situations may arise from the following:

Table 7-7: Emergency / Risk Situations Relevant to Project

Risk Situation	Description
Internal Risks	▪ Fire/explosions ▪ Spill of stored hazardous chemicals ▪ Occupational accidents (serious or fatal) due to failure to comply with operating rules & procedures, negligence of the personnel, falls, internal traffic accidents, burns, poor use of equipment & personal protection items, etc.
Natural Risks	▪ Earthquake ▪ Land slide ▪ Floods ▪ Dust and thunder storms
External Risks	▪ Terrorism ▪ Vandalism ▪ Any other delinquent action
Personnel Transportation Risks	▪ While the personnel are traveling to/from the project area using own or third party's automobile

C. Risk Management

The management of contingencies is based on:
→ Early detection (alarms, detectors, setting off of safety elements);
→ Immediate automatic reaction (feed shut-off valves, either of the fluid, electric process or other);

→ Confinement of emergency area;
→ Application of adequate response procedure;
→ Follow-up and monitoring.

D. Evacuation Plan

The following alarm signal(s) will be used to begin evacuation of the facility (check all which applies):

• Bells
• Horns / Sirens
• Verbal (i.e. shouting)
• Other (specify)
• Evacuation map is prominently displayed throughout the facility
Note: A properly completed Site Plan will satisfy contingency plan map requirements. A drawing that shows primary and alternate evacuation routes, emergency exits, and primary and alternate staging areas, must be prominently posted throughout the facility in locations where it will be visible to employees and visitors

E. Contacts in Emergency Situation

Emergency contact numbers/details will be provided/displayed in all areas & especially in the high-risk zones.

Table 7-8: Emergency Contacts *	
Fire/Police/Ambulance Phone No.	
State Office of Emergency Services Phone No.	
National Response Centre Phone No.	
Disaster Management Authority	
* These telephone numbers are provided as a general aid to emergency notification.	

Table 7-9: Post-Incident Contacts *	
Fire Department Hazardous Materials Program Phone No.	
EPA Department of Toxic Substances Control Phone No.	
Ambulance Services	
Regional Water Quality Control Board Phone No.	
* These telephone numbers are provided as a general aid to emergency notification.	

Table 7-10: Emergency Resources	
Name of Nearest Hospital	
Phone No. of Nearest Hospital	
Address of Nearest Hospital	

F. Arrangements with Emergency Responders

If special (i.e., contractual) arrangements have been made with police department, fire department, hospital, contractor, or State or local emergency response team to coordinate emergency services, describe those arrangements on the lines below:

G. Emergency Procedures

1) Emergency Coordinator Responsibilities

Whenever there is an imminent or actual emergency situation such as an explosion, fire, or release, the emergency coordinator (or his/her designated person, when the emergency coordinator is on call) shall:

→ Identify the character, exact source, amount, and a real extent of any released hazardous materials;
→ Assess possible hazards to human health or the environment that may result from the explosion, fire, or release. This assessment must consider both direct and indirect effects (e.g. the effects of any toxic, irritating, or asphyxiating gases that are generated, the effects of any hazardous surface water run-off from water or chemical agents used to control fire, etc.);
→ Activate internal facility alarms or communications systems, where applicable, to notify all facility personnel;
→ Notify Provincial and National Disaster Management & Rescue Operations Authority as well as the Sindh Environment Protection Agency;
→ Notify the Local Authority as well as Fire Brigade/Emergency Services;
→ Notify the Coast guards and Marine & Fisheries department.
→ Monitor for leaks, pressure build-up, gas generation, or ruptures in valves, pipes, or other equipment shut down in response to the incident;
→ Take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other hazardous materials at the facility.

Before facility operations are resumed in areas of the facility affected by the incident, the emergency coordinator shall:

→ Provide for proper storage and disposal of recovered waste, contaminated soil or surface water, or any other material that results from an explosion, fire, or release at the facility;
→ Ensure that no material that is incompatible with the released material is transferred, stored, or disposed of in areas of the facility affected by the incident until cleanup procedures are completed;
→ Ensure that all emergency equipment is cleaned, fit for its intended use, and available for use;
→ Notify the Fire Department that the facility is in compliance with requirements of first two points as stated above.

2) Post-Incident Reporting/Recording

The time, date, and details of any hazardous materials incident that requires implementation of this plan shall be noted in the facility's operating record.

Within 15 days of any hazardous materials emergency incident or threatened hazardous materials emergency incident which triggers implementation of this plan, a written Emergency Incident Report, including, but not limited to a description of the incident and the facility's response to the incident, must be submitted to the Sindh Environmental Protection Agency's Department of Toxic Substances Control, Fire Department Hazardous Materials Division.

The report shall include:

→ Name, address, and telephone number of the facility's owner/operator;
→ Name, address, and telephone number of the facility;
→ Date, time, and type of incident (e.g., fire, explosion, etc.);
→ Name and quantity of material(s) involved;
→ The extent of injuries, if any;
→ An assessment of actual or potential hazards to human health or the environment, where this is applicable;
→ Estimated quantity and disposition of recovered material that resulted from the incident;
→ Cause (s) of the incident;
→ Actions taken in response to the incident;
→ Administrative or engineering controls designed to prevent such incidents in the future.

3) Emergency Equipment

The Hazardous Substances Rules of EPA requires that emergency equipment at the facility be listed. Completion of the following Emergency Equipment Inventory Table meets this requirement.

EMERGENCY EQUIPMENT INVENTORY TABLE

1. Equipment Category	2. Equipment Type	3. Locations *	4. Description**
Personal Protective, Equipment, Safety Equipment, and First Aid Equipment	☐ Cartridge Respirators		
	☐ Chemical Monitoring Equipment *(describe)*		
	☐ Chemical Protective Aprons/Coats		
	☐ Chemical Protective Boots		
	☐ Chemical Protective Gloves		
	☐ Chemical Protective Suits *(describe)*		
	☐ Face Shields		
	☐ First Aid Kits/Stations *(describe)*		
	☐ Hard Hats		
	☐ Plumbed Eye Wash Stations		
	☐ Portable Eye Wash Kits *(i.e. bottle type)*		
	☐ Respirator Cartridges *(describe)*		
	☐ Safety Glasses/Splash Goggles		
	☐ Safety Showers		
	☐ Self-Contained Breathing Apparatuses (SCBA)		
	☐ Other *(describe)*		
Fire Extinguishing Systems	☐ Automatic Fire Sprinkler Systems		
	☐ Fire Alarm Boxes/Stations		
	☐ Fire Extinguisher Systems *(describe)*		
	☐ Other *(describe)*		
Spill Control Equipment and Decontamination Equipment	☐ Absorbents *(describe)*		
	☐ Berms/Dikes *(describe)*		
	☐ Decontamination Equipment *(describe)*		
	☐ Emergency Tanks *(describe)*		
	☐ Exhaust Hoods		
	☐ Gas Cylinder Leak Repair Kits *(describe)*		
	☐ Neutralizers *(describe)*		
	☐ Overpack Drums		
	☐ Sumps *(describe)*		
	☐ Other *(describe)*		
Communications and Alarm Systems	☐ Chemical Alarms *(describe)*		
	☐ Intercoms/ PA Systems		
	☐ Portable Radios		
	☐ Telephones		
	☐ Underground Tank Leak Detection Monitors		
	☐ Other *(describe)*		
Additional Equipment *(Use Additional Pages if Needed.)*			

4) Training

Check all boxes which apply.

Personnel are trained in the following procedure:

☐ Internal alarm/notification
☐ Evacuation/ re-entry procedures & assembly point locations
☐ Emergency incident reporting
☐ External emergency response organization notification
☐ Location(s) and contents of Emergency

Chemical Handlers are annually trained in the following:

☐ Safe method for handling and storage of hazardous materials
☐ Location(s) and proper use of fire and spill control equipment
☐ Spill procedures/emergency procedures
☐ Proper use of personnel protective equipment

□ Specific hazard(s) of each chemical to which they may be exposed, including route of exposure (i.e., inhalation, ingestion, absorption)
□ Hazardous waste Handlers/Managers are trained in all aspects of hazardous waste management specific to their job duties (e.g. container time requirements, manifesting requirements, etc.)

Emergency Response Team Members are capable of and engaged in the following:

□ Personnel rescue procedures
□ Shutdown of operations
□ Use, maintenance, and replacement of emergency response equipment
□ Refresher training which is provided annually
□ Emergency response drills which are conducted at least quarterly

H. Emergency response training

Develop and practice a spill clean-up procedure including where to find emergency equipment and how to use it. Make sure all people on site are aware of emergency telephone numbers to call in the case of a large spill. Spill kit equipment on site should, in case of spill on or near a water body, include: booms to contain liquids, material to prevent spills into drains, and material to absorb spills. Keep this absorbent material in a clearly labeled and easily accessible place.

I. Response levels

Two levels of response must be contemplated:

→ With own personnel
→ With external government cooperation, such as Civil Defence, NDMA, Police, Coast Guard.

J. Response Strategy

Upon the occurrence of the emergency, the Plan will be developed under the following conditions:

→ First Stage: Notification
→ Second Stage: Initial assistance/rescue
→ Third Stage: Response operations
→ Fourth Stage: Evaluation of the Plan and damages

i- First Stage: Notification

Internal Communication: Radio communication systems, channels and frequencies will be established for the command post, alternative posts and for the personnel that forms part of the response brigade. Furthermore, message forms will be established to record at least the following information: Name of informant, location and place of the emergency, number of people affected and, if possible, an estimate of the type of injuries and/or damages, among others.

External Communication: In the event of spills, leaks or discharges, the HSE Office of the area of influence must be informed through the fastest means: telephone and fax; and also using the forms of the General Manager (operation).

→ Local Authorities will be advised by telephone, mobile phones;
→ The relatives of the injured person, as soon as he is evacuated to a hospital;
→ To the extent possible, the press will be notified after the accident has been investigated and by the person designated of Management;
→ In case of an accident that has affected the facilities; the Insurance Company will be notified in Coordination with the Administration and Finance Management.

ii- Second Stage: Initial Assistance / Rescue

A joint evaluation will be made of the status of the event, the conditions of the site, the environmental characteristics that warrant a safe development of rescue actions, first aid and transportation of the injured to a medical unit. Strategies will be adopted to determine own material and human resources to be required, the deployment of the resources to the emergency location, as well as the estimated response time.

Trained emergency teams must be prepared to act as required, and a reserve team must be available. All personnel who are not essential to fight the emergency must be evacuated to a safe place where there must be communication equipment available to count the number and condition of the personnel. In the event of fire, the execution or fighting phase will be implemented immediately.

iii- Third Stage: Response Operations

Response Operations refer to:

→ Firefighting using extinguishers or pressure water network or foam;
→ Spill control (of lubricants or fuel using absorbing material) or confinement;
→ Access control to affected area due to dispersion of gas clouds;
→ Medical assistance and evacuation of injured personnel;
→ Evacuation of all personnel if their lives are in danger (in the event of earthquakes, tsunamis or other factors);
→ Application of a monitoring program and a mitigation plan.

Response Guide: In future, the Contingency/Emergency Plan shall develop specific response procedures for each emergency. These procedures will be described in detail and in a language that is easy to understand. It will form part of the documents to be delivered during the induction process and there will be at least 2 drills per year in order to keep the personnel trained.

The communication chain with information on contacts and notifications must be established and maintained.

Furthermore, the logistic chain to replace equipment and consumables must be established, determining a minimum stock, which in the case of fire must be in line with the risk study and the list of suppliers containing the contact's name, address and telephones available on a 24-hour basis the 365 days of the year.

iv- Fourth Stage: Evaluation of the Plan and of Damages

Once response operations have concluded, the development and results of the plan must be evaluated in order to issue recommendations that allow correcting deficiencies for the purpose of improving response operations. These recommendations will then form part of revision and subsequent annual approval of the Contingency and Risk Prevention Manual.

A record of damages will be prepared as part of the final emergency report. The resources used, lost and recovered will be detailed in said register.

K. Emergency Response Manuals

Contractor will prepare written emergency plans to cover emergency situations that could occur, based on the results of a Quantitative Hazard and Risk Assessment. Manuals will be developed as well.

7.11 Environmental Budget

It is recommended that to protect the environment and strict implementation of mitigation measures a certain amount of budget should be allocated. It is proposed that certain amount of project cost shall be dedicated for environment protection.

S. No.	Environmental Heads	Budget (PKR)
01.	Sewage/Brine Waste Disposal	2,000,000/-
02.	Solid Waste Disposal	1,000,000/-
03.	Environmental Monitoring	800,000/-
04.	Environmental Trainings	250,000/-
05.	Environmental Audit	250,000/-
06.	Mitigation Measures (Construction)	500,000
07.	Mitigation Measures (Operation)	1,000,000
08.	Reporting	1,000,000
Total		**2,500,000 Two Million Five Hundred Thousand**

Chapter 8 Conclusion

The EIA study finds that the impacts of the project activities at the pre-construction, construction and operation stages have been adequately addressed and mitigation measures duly proposed wherever needed. Adoption of mitigation measures will ensure reduction of impact on the micro and macroenvironment as well as socio-economic conditions to acceptable levels and discharge of emissions to comply with the SEQS. The development of this project will be compatible with the requirements of the Sindh Environmental Protection Act 2014 as well as other regulatory requirements of Government of Pakistan. The issue of safety has been duly incorporated in the design and operations phases of the project.

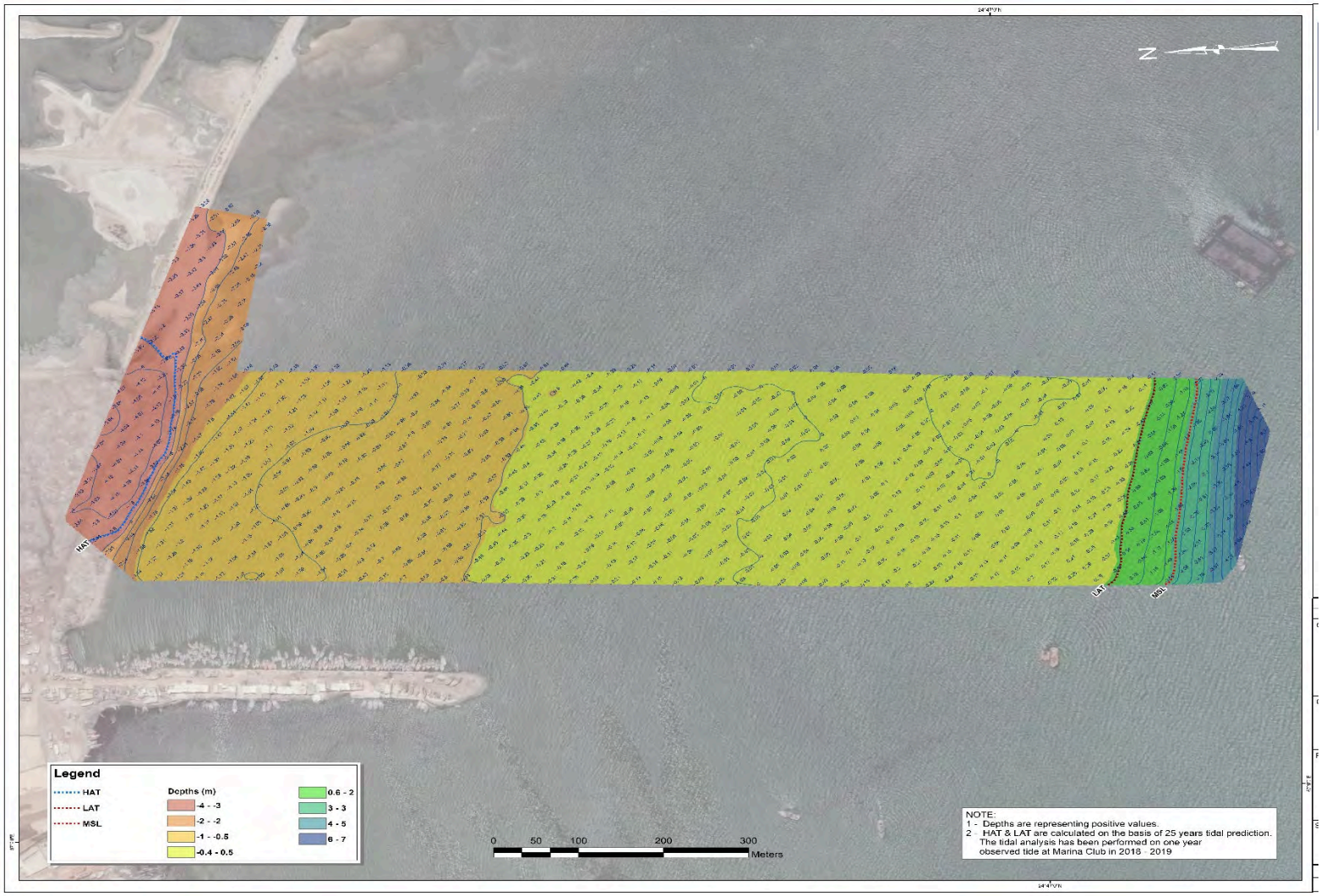
On the basis of the findings of the EIA Study, it is possible to conclude that the proposed Seawater Desalination Plant Project will thus respond to all aspects of sustainability: Economic, social and environmental and will thus be a sustainably viable project.

ANNEXURE

Annexure – I

Bathymetric Survey Report

"5 MGD DESALINATION PLANT AT IBRAHIM HYDERI"



BATHYMETRY SURVEY

Karachi Water & Sewerage Board (KW&SB).

Table of Contents

List of Annexures

1.0 Bathymetry Survey

Techno-Consult International has carried out bathymetric survey of area North-East of Ibrahim Hyderi for KW&SB for setting up the 5 MGD desalination plant. The survey was conducted from 16th August 2022 to 31st August 2022 by using TCI survey boat Enterprise using IHO Standards and followed by the following survey:

- Conductivity Temperature & Depth
- Beach Profiling
- Grab Sampling

The objective of the Hydrographic Survey is to have the knowledge of seabed contours undersea terrain information for water intake with head of 2m in lowest low water. The survey line was designed at North-South directions with line apart of 25m up to 8m depth on southern site.

Hypack/HYSWEEP Software Version 2020 used for single-beam bathymetric survey, the said software was used for planning of survey lines and precise navigation with the help of TrimbleR2 GPS for positioning in real-time mode.

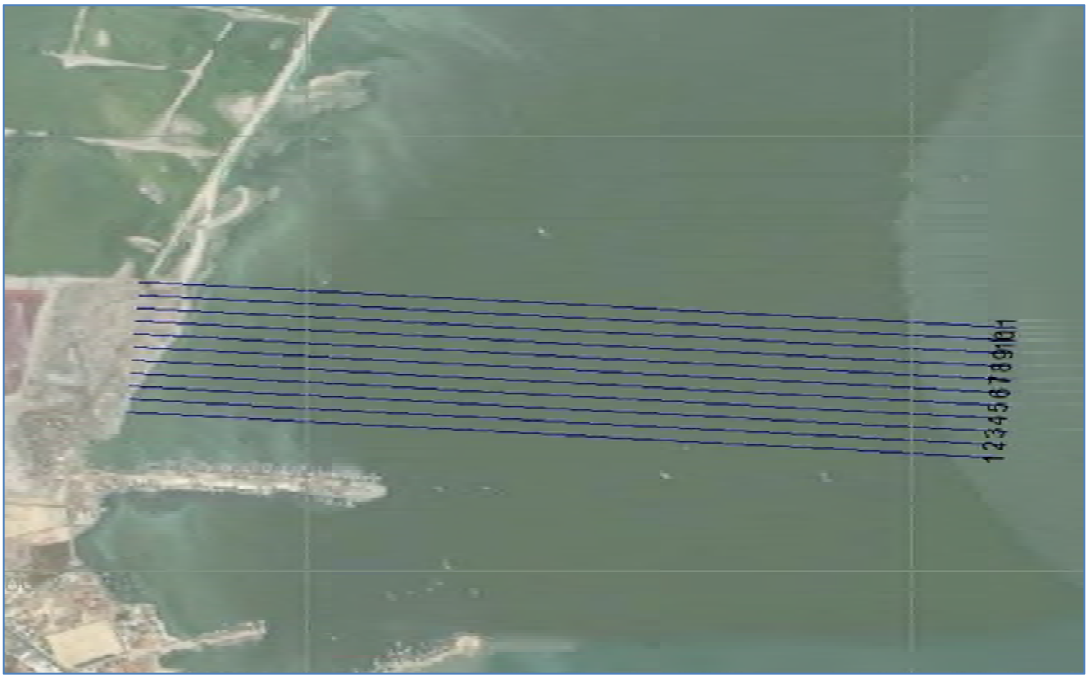


Figure 1: Bathymetry Planned Lines

1.1 Survey Parameter

Spheroid	WGS-84
Semi-Major axis	6378137.0m
Flattening	298.257223563

1.2 Survey Projection

Projection	UTM
Zone	42North
Origin of Latitude	00N
Origin of Longitude	69E
False Easting	500,000
False Northing	0
Scale Factor	0.9996

1.3 Control Point

The coordinates of control points are as under:

Marina Club

Latitude: 24°47'44.16940"N

Longitude: 67°04'48.98814"E

Height: 9.981m above Chart Datum

KWSB Project Site (BM1)

Latitude: 24°47'34.65163"N

Longitude: 67°09'21.90531"E

Height: 4.249m above Chart Datum

1.4 Weather

Fair weather was observed during conduct of survey wind direction was west-southwest wind speed 2-8 north, sea state was 1-2, visibility was 6-10Kms, swell height 0.01m-0.5m.

1.5 Conduct of Survey

The hydrographic survey was carried out by sounding with precise positioning and setting up of control point network in real time kinematic using GPS, echo sounder and real time navigation onboard survey vessel “Enterprise”. The Hypack 2020 software was used to conduct hydrographic surveying and processing of survey data. This software also in use by US corps of Engineers for hydrographic surveys. One of the useful feature of Hypack software was that it provided guidance to the survey vessel in real time for accurate positioning using a complex combination of parameters such as radio based GPS(real-time) positioning, planned survey lines, site features etc.

Information regarding vessel track guideline, design profile and plotting parameters were performed into the Hypack prior to start of survey onboard the survey vessel.

1.6 Depth Measurement

The single beam Odom equipment was deployed for measuring depth. This provided depth data every 100miliseconds which was fed in to the Hypack software the echo sounder was calibrated before start of survey with lead line, the latency check also performed before start of bathymetric survey. Figure below showing the processed single beam data with a depths reduced to local chart datum.

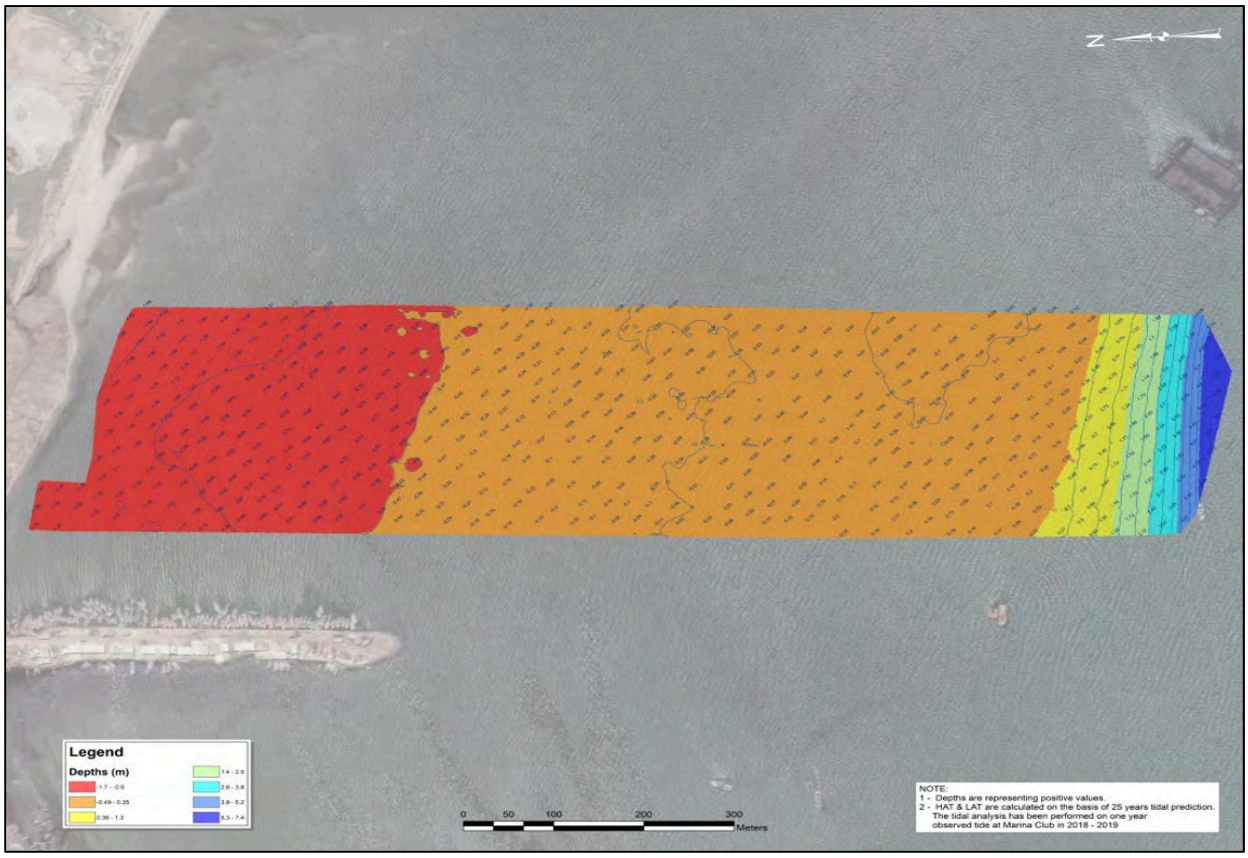


Figure 2: Bathymetry Sounding with reference to local datum

2.0 Beach Profile

GPS Post Processing Kinematic survey has been conduct for mapping of coastline to delineate High water & Low water lines during spring tides when high water reaches maximum heights and low water recedes the most.

Processed bathymetry depth at local chart datum finally been merged with beach profile and highest astronomical tide (HAT), lowest astronomical tide (LAT) and MSL has been marked over contours as shown in map below. See Annexure-B for detail Bathymetry Sounding Charts.

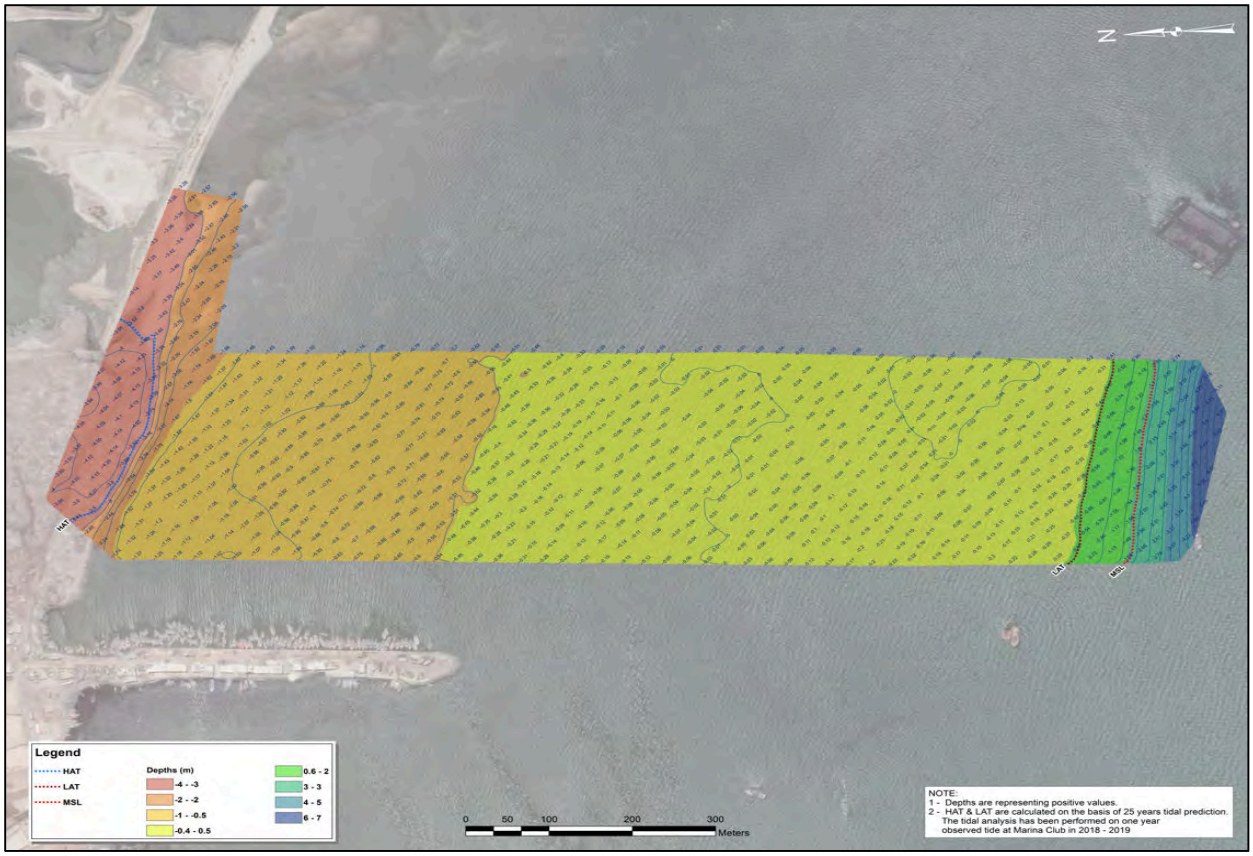


Figure 3: Combined Bathymetry and Beach Profile marked with High water and Low water lines

3.0 CTD MEASUREMENTS

In accordance with schedule of survey works, the required CTD (Conductivity, Temperature, Depth) Water Column Stratification measurement obtained at locations where minimum depth of 2m in lowest low water are available.

The CTD survey was carried out in SW Monsoon season in the month of August 2022. The total of 12 hours observations has been carried out at every 01 hour interval during ebbing and flooding tide.

The locations at which CTD measurements were conducted is given in figure below, while the observed parameters in tabular form is presented in Appendix-A

Figure 4: Location for CTD measurement

4.0 Tidal Constituents Analysis

The tide is a periodical movement in the level of the surface of the sea or ocean, due to the gravitational attraction between the Earth, Moon and Sun. Based on the one year long tidal observations at Marina Club in the year 2018 to 2019 made, the harmonic analysis has been performed to obtain tidal constituents.

The 68 numbers tidal constituents obtained from the one-year data, tide predictions were attempted for 25 years to obtain provisional HAT, LAT and MSL values. Tide prediction model purely provides tide generation as a consequence of movement of astronomical bodies alone, it does not predict the water level rise due to wind, surges or wave setup effects. Hence it can be inferred that tidal constituents and based on which datum has been computed can be used as an initial estimate to determine a first estimate of the tidal datum and MSL.

4.1 Tidal Statistics

Level of prediction in Gizri Creek is Chart Datum, which is 9.98 meter below the TCI benchmark located in Marina Club jurisdiction. Given below are the water levels derived from tidal prediction based on 64 harmonics constituents achieved through one year observed tide at marina club.

Highest Astronomical Tide (HAT): 3.47 metres
HAT occurs at 01:10 (local time) on 04/01/2014
Lowest Astronomical Tide (LAT): -0.51 metres
LAT occurs at 16:51 (local time) on 24/11/2003
Maximum Tidal Range possible: 3.94 metres
Mean High Water Spring (MHWS): 3.03 metres
Mean High Water Neap (MHWN): 2.35 metres
Mean Low Water Neap (MLWN): 1.28 metres
Mean Low Water Spring (MLWS): 0.61 metres
Tide Type: 0.50 (mixed)
Shallow Water Influence: 0.07
Selected Period: 01/01/2015 to 31/12/2040
Highest Tide in this period: 3.48 metres
Lowest Tide in this period: -0.49 metres
Largest Tidal Range in this period: 3.94 metres
Average Flood time: 6 hours 15 minutes
Average Ebb time: 6 hours 9 minutes
Quickest Flood time: 2 hours 39 minutes

Annexure-A

CTD (Conductivity, Temperature and Depth) Measurement

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	08:19:03	50.358	29.448	1.01	30.0	7.93	1539.25
8/31/2022	08:19:03	50.359	29.449	1.02	30.0	7.9	1539.25
8/31/2022	08:19:03	50.36	29.448	1.02	30.0	7.9	1539.26
8/31/2022	08:19:03	50.36	29.448	1.04	30.0	7.93	1539.26
8/31/2022	08:19:03	50.36	29.448	1.05	30.0	7.93	1539.26
8/31/2022	08:19:03	50.36	29.448	1.06	30.0	7.9	1539.26
8/31/2022	08:19:03	50.36	29.448	1.07	30.0	7.9	1539.26
8/31/2022	08:19:03	50.36	29.448	1.09	30.0	7.93	1539.26
8/31/2022	08:19:03	50.36	29.448	1.12	30.0	7.93	1539.26
8/31/2022	08:19:03	50.361	29.448	1.14	30.0	7.9	1539.26
8/31/2022	08:19:03	50.361	29.447	1.16	30.0	7.9	1539.26
8/31/2022	08:19:03	50.364	29.447	1.2	30.0	7.9	1539.26
8/31/2022	08:19:03	50.365	29.447	1.22	30.0	7.93	1539.26
8/31/2022	08:19:03	50.365	29.447	1.25	30.0	7.93	1539.26
8/31/2022	08:19:03	50.367	29.446	1.29	30.0	7.9	1539.26
8/31/2022	08:19:03	50.367	29.446	1.31	30.0	7.93	1539.26
8/31/2022	08:19:03	50.367	29.446	1.36	30.0	7.93	1539.26
8/31/2022	08:19:04	50.367	29.446	1.4	30.0	7.93	1539.26
8/31/2022	08:19:04	50.369	29.446	1.43	30.0	7.9	1539.26
8/31/2022	08:19:04	50.369	29.445	1.48	30.0	7.93	1539.27
8/31/2022	08:19:04	50.368	29.445	1.51	30.0	7.9	1539.26
8/31/2022	08:19:04	50.368	29.445	1.53	30.0	7.93	1539.26
8/31/2022	08:19:04	50.367	29.445	1.56	30.0	7.9	1539.26
8/31/2022	08:19:04	50.363	29.447	1.58	30.0	7.9	1539.26
8/31/2022	08:19:04	50.362	29.448	1.61	30.0	7.9	1539.27
8/31/2022	08:19:04	50.361	29.447	1.63	30.0	7.93	1539.27
8/31/2022	08:19:04	50.361	29.448	1.63	30.0	7.9	1539.27
8/31/2022	08:19:04	50.36	29.448	1.65	30.0	7.9	1539.27
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8/31/2022	08:19:05	50.362	29.448	1.75	30.0	7.9	1539.27
8/31/2022	08:19:05	50.361	29.448	1.78	30.0	7.93	1539.27
8/31/2022	08:19:05	50.361	29.448	1.8	30.0	7.93	1539.27
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8/31/2022	08:19:05	50.361	29.448	1.93	30.0	7.9	1539.27
8/31/2022	08:19:05	50.361	29.448	1.97	30.0	7.93	1539.27
8/31/2022	08:19:05	50.362	29.448	2	30.0	7.93	1539.27
8/31/2022	08:19:05	50.364	29.449	2.04	30.0	7.9	1539.28
8/31/2022	08:19:05	50.367	29.449	2.09	30.0	7.9	1539.28
8/31/2022	08:19:05	50.368	29.449	2.13	30.0	7.9	1539.28
8/31/2022	08:19:05	50.37	29.449	2.18	30.0	7.9	1539.28
8/31/2022	08:19:05	50.369	29.449	2.22	30.0	7.9	1539.28
8/31/2022	08:19:05	50.369	29.449	2.24	30.0	7.9	1539.28
8/31/2022	08:19:05	50.367	29.449	2.28	30.0	7.9	1539.28
8/31/2022	08:19:05	50.363	29.45	2.32	30.0	7.9	1539.28
8/31/2022	08:19:05	50.362	29.45	2.33	30.0	7.9	1539.28
8/31/2022	08:19:05	50.36	29.449	2.35	30.0	7.9	1539.28
8/31/2022	08:19:06	50.359	29.449	2.36	30.0	7.9	1539.28
8/31/2022	08:19:06	50.359	29.449	2.37	30.0	7.93	1539.28
8/31/2022	08:19:06	50.36	29.449	2.37	30.0	7.9	1539.28
8/31/2022	08:19:06	50.36	29.449	2.37	30.0	7.9	1539.28
8/31/2022	08:19:06	50.36	29.449	2.37	30.0	7.9	1539.28
8/31/2022	08:19:06	50.361	29.449	2.38	30.0	7.93	1539.28

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	08:19:06	50.361	29.449	2.38	30.0	7.9	1539.28
8/31/2022	08:19:06	50.361	29.449	2.4	30.0	7.9	1539.28
8/31/2022	08:19:06	50.362	29.449	2.4	30.0	7.93	1539.28
8/31/2022	08:19:06	50.361	29.449	2.42	30.0	7.93	1539.28
8/31/2022	08:19:06	50.362	29.449	2.44	30.0	7.9	1539.28
8/31/2022	08:19:06	50.362	29.449	2.46	30.0	7.9	1539.28
8/31/2022	08:19:06	50.361	29.449	2.48	30.0	7.9	1539.28
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8/31/2022	08:19:06	50.362	29.449	2.57	30.0	7.93	1539.28
8/31/2022	08:19:07	50.364	29.448	2.62	30.0	7.93	1539.28
8/31/2022	08:19:07	50.364	29.448	2.65	30.0	7.93	1539.28
8/31/2022	08:19:07	50.364	29.448	2.7	30.0	7.9	1539.29
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8/31/2022	08:19:07	50.369	29.446	2.87	30.0	7.93	1539.29
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8/31/2022	08:19:07	50.370	29.445	2.99	30.0	7.9	1539.29
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8/31/2022	08:19:07	50.373	29.444	3.03	30.0	7.9	1539.29
8/31/2022	08:19:07	50.374	29.443	3.04	30.0	7.9	1539.29
8/31/2022	08:19:07	50.375	29.443	3.04	30.0	7.93	1539.29
8/31/2022	08:19:07	50.373	29.443	3.05	30.0	7.9	1539.29
8/31/2022	08:19:07	50.371	29.444	3.05	30.0	7.9	1539.29
8/31/2022	08:19:07	50.371	29.444	3.05	30.0	7.9	1539.29
8/31/2022	08:19:07	50.371	29.444	3.05	30.0	7.93	1539.29
8/31/2022	08:19:08	50.372	29.444	3.06	30.0	7.9	1539.29
8/31/2022	08:19:08	50.372	29.443	3.06	30.0	7.9	1539.29
8/31/2022	08:19:08	50.373	29.443	3.07	30.0	7.9	1539.29
8/31/2022	08:19:08	50.373	29.443	3.09	30.0	7.9	1539.29
8/31/2022	08:19:08	50.374	29.443	3.11	30.0	7.9	1539.29
8/31/2022	08:19:08	50.374	29.443	3.13	30.0	7.9	1539.29
8/31/2022	08:19:08	50.375	29.443	3.15	30.0	7.9	1539.29
8/31/2022	08:19:08	50.377	29.442	3.18	30.0	7.9	1539.29
8/31/2022	08:19:08	50.375	29.442	3.21	30.0	7.9	1539.29
8/31/2022	08:19:08	50.316	29.442	3.24	30.0	7.9	1539.25
8/31/2022	08:19:08	50.302	29.441	3.27	30.0	7.9	1539.24
8/31/2022	08:19:08	50.29	29.441	3.3	30.0	7.9	1539.23
8/31/2022	08:19:08	50.287	29.441	3.34	30.0	7.9	1539.23
8/31/2022	08:19:08	50.285	29.441	3.36	30.0	7.9	1539.23
8/31/2022	08:19:08	50.345	29.441	3.4	30.0	7.9	1539.27
8/31/2022	08:19:08	50.345	29.441	3.43	30.0	7.9	1539.27
8/31/2022	08:19:08	50.345	29.442	3.46	30.0	7.9	1539.28
8/31/2022	08:19:08	50.344	29.442	3.49	30.0	7.9	1539.28
8/31/2022	08:19:08	50.344	29.442	3.52	30.0	7.9	1539.28
8/31/2022	08:19:09	50.345	29.442	3.56	30.0	7.9	1539.28
8/31/2022	08:19:09	50.346	29.441	3.61	30.0	7.9	1539.28
8/31/2022	08:19:09	50.348	29.441	3.63	30.0	7.9	1539.28
8/31/2022	08:19:09	50.349	29.441	3.66	30.0	7.9	1539.28
8/31/2022	08:19:09	50.35	29.44	3.69	30.0	7.9	1539.28
8/31/2022	08:19:09	50.35	29.441	3.7	30.0	7.9	1539.28
8/31/2022	08:19:09	50.35	29.441	3.72	30.0	7.9	1539.28
8/31/2022	08:19:09	50.35	29.441	3.73	30.0	7.93	1539.28
8/31/2022	08:19:09	50.35	29.441	3.73	30.0	7.9	1539.28
8/31/2022	08:19:09	50.35	29.441	3.74	30.0	7.9	1539.28
8/31/2022	08:19:09	50.35	29.441	3.73	30.0	7.9	1539.28
8/31/2022	08:19:09	50.349	29.441	3.74	30.0	7.9	1539.28

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	08:19:09	50.348	29.441	3.75	30.0	7.9	1539.28
8/31/2022	08:19:09	50.349	29.442	3.76	30.0	7.9	1539.28
8/31/2022	08:19:09	50.349	29.442	3.77	30.0	7.9	1539.28
8/31/2022	08:19:09	50.349	29.441	3.79	30.0	7.9	1539.28
8/31/2022	08:19:09	50.35	29.441	3.8	30.0	7.93	1539.28
8/31/2022	08:19:09	50.35	29.441	3.82	30.0	7.9	1539.28
8/31/2022	08:19:09	50.35	29.441	3.84	30.0	7.9	1539.29
8/31/2022	08:19:09	50.351	29.442	3.87	30.0	7.9	1539.29
8/31/2022	08:19:09	50.351	29.441	3.9	30.0	7.9	1539.29
8/31/2022	08:19:10	50.351	29.441	3.92	30.0	7.93	1539.29
8/31/2022	08:19:10	50.351	29.441	3.96	30.0	7.9	1539.29
8/31/2022	08:19:10	50.351	29.441	3.98	30.0	7.9	1539.29
8/31/2022	08:19:10	50.35	29.441	4.02	30.0	7.9	1539.29
8/31/2022	08:19:10	50.351	29.441	4.04	30.0	7.9	1539.29
8/31/2022	08:19:10	50.351	29.441	4.08	30.0	7.9	1539.29
8/31/2022	08:19:10	50.353	29.441	4.12	30.0	7.9	1539.29
8/31/2022	08:19:10	50.354	29.441	4.15	30.0	7.9	1539.29
8/31/2022	08:19:10	50.353	29.441	4.2	30.0	7.9	1539.29
8/31/2022	08:19:10	50.354	29.441	4.23	30.0	7.9	1539.29
8/31/2022	08:19:10	50.353	29.441	4.26	30.0	7.9	1539.29
8/31/2022	08:19:10	50.353	29.441	4.31	30.0	7.9	1539.29
8/31/2022	08:19:10	50.353	29.441	4.34	30.0	7.9	1539.3
8/31/2022	08:19:10	50.353	29.441	4.38	30.0	7.9	1539.3
8/31/2022	08:19:10	50.353	29.442	4.44	30.0	7.9	1539.3
8/31/2022	08:19:10	50.117	29.442	4.46	29.8	7.93	1539.13

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	09:00:37	50.474	29.418	1.01	30.1	7.9	1539.29
8/31/2022	09:00:37	50.476	29.418	1.04	30.1	7.9	1539.29
8/31/2022	09:00:37	50.477	29.417	1.08	30.1	7.9	1539.29
8/31/2022	09:00:37	50.479	29.418	1.13	30.1	7.9	1539.29
8/31/2022	09:00:38	50.481	29.417	1.17	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.417	1.21	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.416	1.25	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.416	1.28	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.416	1.32	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.415	1.37	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.415	1.4	30.1	7.9	1539.3
8/31/2022	09:00:38	50.482	29.415	1.42	30.1	7.9	1539.3
8/31/2022	09:00:38	50.482	29.415	1.44	30.1	7.9	1539.3
8/31/2022	09:00:38	50.482	29.415	1.46	30.1	7.9	1539.3
8/31/2022	09:00:38	50.482	29.416	1.46	30.1	7.9	1539.3
8/31/2022	09:00:38	50.482	29.417	1.46	30.1	7.9	1539.3
8/31/2022	09:00:38	50.482	29.417	1.47	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.417	1.46	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.417	1.46	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.417	1.47	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.416	1.48	30.1	7.9	1539.3
8/31/2022	09:00:38	50.481	29.416	1.48	30.1	7.9	1539.3
8/31/2022	09:00:39	50.481	29.416	1.48	30.1	7.9	1539.3
8/31/2022	09:00:39	50.481	29.416	1.49	30.1	7.9	1539.3
8/31/2022	09:00:39	50.481	29.416	1.5	30.1	7.9	1539.3
8/31/2022	09:00:39	50.481	29.416	1.51	30.1	7.9	1539.3
8/31/2022	09:00:39	50.481	29.416	1.54	30.1	7.9	1539.3
8/31/2022	09:00:39	50.481	29.416	1.55	30.1	7.9	1539.3
8/31/2022	09:00:39	50.482	29.417	1.59	30.1	7.9	1539.3
8/31/2022	09:00:39	50.482	29.418	1.62	30.1	7.9	1539.3
8/31/2022	09:00:39	50.483	29.418	1.64	30.1	7.9	1539.31
8/31/2022	09:00:39	50.484	29.418	1.68	30.1	7.9	1539.31
8/31/2022	09:00:39	50.484	29.419	1.73	30.1	7.9	1539.31
8/31/2022	09:00:39	50.483	29.419	1.77	30.1	7.9	1539.31
8/31/2022	09:00:39	50.481	29.418	1.81	30.1	7.9	1539.31
8/31/2022	09:00:39	50.481	29.417	1.87	30.1	7.9	1539.31
8/31/2022	09:00:39	50.481	29.417	1.92	30.1	7.9	1539.31
8/31/2022	09:00:39	50.48	29.416	1.97	30.1	7.9	1539.31
8/31/2022	09:00:39	50.48	29.416	2.01	30.1	7.9	1539.31
8/31/2022	09:00:39	50.481	29.416	2.04	30.1	7.9	1539.31
8/31/2022	09:00:39	50.481	29.416	2.1	30.1	7.9	1539.31
8/31/2022	09:00:40	50.481	29.415	2.13	30.1	7.9	1539.31

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	09:00:40	50.481	29.415	2.17	30.1	7.9	1539.31
8/31/2022	09:00:40	50.481	29.415	2.19	30.1	7.9	1539.31
8/31/2022	09:00:40	50.482	29.414	2.21	30.1	7.9	1539.31
8/31/2022	09:00:40	50.481	29.414	2.23	30.1	7.9	1539.31
8/31/2022	09:00:40	50.48	29.413	2.24	30.1	7.9	1539.31
8/31/2022	09:00:40	50.481	29.413	2.25	30.1	7.9	1539.31
8/31/2022	09:00:40	50.48	29.413	2.25	30.1	7.9	1539.31
8/31/2022	09:00:40	50.479	29.413	2.25	30.1	7.9	1539.31
8/31/2022	09:00:40	50.479	29.413	2.24	30.1	7.9	1539.31
8/31/2022	09:00:40	50.477	29.413	2.23	30.1	7.9	1539.3
8/31/2022	09:00:40	50.477	29.412	2.23	30.1	7.9	1539.3
8/31/2022	09:00:40	50.477	29.412	2.23	30.1	7.9	1539.3
8/31/2022	09:00:40	50.476	29.411	2.23	30.1	7.9	1539.3
8/31/2022	09:00:40	50.476	29.41	2.23	30.1	7.9	1539.3
8/31/2022	09:00:40	50.476	29.41	2.23	30.1	7.9	1539.3
8/31/2022	09:00:40	50.476	29.41	2.23	30.1	7.9	1539.3
8/31/2022	09:00:40	50.476	29.409	2.24	30.1	7.9	1539.3
8/31/2022	09:00:40	50.476	29.41	2.25	30.1	7.9	1539.3
8/31/2022	09:00:41	50.476	29.409	2.27	30.1	7.9	1539.3
8/31/2022	09:00:41	50.476	29.409	2.29	30.1	7.9	1539.3
8/31/2022	09:00:41	50.476	29.409	2.31	30.1	7.9	1539.3
8/31/2022	09:00:41	50.475	29.409	2.33	30.1	7.9	1539.3
8/31/2022	09:00:41	50.474	29.408	2.36	30.1	7.9	1539.3
8/31/2022	09:00:41	50.472	29.406	2.4	30.1	7.9	1539.29
8/31/2022	09:00:41	50.47	29.406	2.45	30.1	7.9	1539.29
8/31/2022	09:00:41	50.469	29.405	2.48	30.1	7.9	1539.29
8/31/2022	09:00:41	50.469	29.404	2.52	30.1	7.9	1539.29
8/31/2022	09:00:41	50.468	29.403	2.57	30.1	7.9	1539.29
8/31/2022	09:00:41	50.467	29.402	2.6	30.1	7.9	1539.29
8/31/2022	09:00:41	50.467	29.402	2.63	30.1	7.9	1539.29
8/31/2022	09:00:41	50.466	29.401	2.68	30.1	7.9	1539.29
8/31/2022	09:00:41	50.466	29.401	2.72	30.1	7.9	1539.29
8/31/2022	09:00:41	50.466	29.4	2.76	30.1	7.9	1539.29
8/31/2022	09:00:41	50.466	29.4	2.79	30.1	7.9	1539.29
8/31/2022	09:00:41	50.466	29.399	2.82	30.1	7.9	1539.29
8/31/2022	09:00:41	50.466	29.4	2.85	30.1	7.9	1539.29
8/31/2022	09:00:41	50.467	29.401	2.89	30.1	7.9	1539.29
8/31/2022	09:00:42	50.467	29.403	2.91	30.1	7.9	1539.29
8/31/2022	09:00:42	50.467	29.404	2.92	30.1	7.9	1539.29
8/31/2022	09:00:42	50.467	29.404	2.94	30.1	7.9	1539.3
8/31/2022	09:00:42	50.466	29.404	2.94	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.403	2.94	30.1	7.9	1539.29

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	09:00:42	50.466	29.404	2.93	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.404	2.93	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.403	2.93	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.403	2.93	30.1	7.9	1539.29
8/31/2022	09:00:42	50.467	29.403	2.93	30.1	7.9	1539.29
8/31/2022	09:00:42	50.467	29.403	2.93	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.402	2.92	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.402	2.91	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.402	2.92	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.402	2.92	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.402	2.93	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.402	2.94	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.401	2.95	30.1	7.9	1539.29
8/31/2022	09:00:42	50.466	29.402	2.98	30.1	7.9	1539.29
8/31/2022	09:00:43	50.466	29.402	3	30.1	7.9	1539.29
8/31/2022	09:00:43	50.466	29.402	3.03	30.1	7.9	1539.29
8/31/2022	09:00:43	50.466	29.402	3.07	30.1	7.9	1539.29
8/31/2022	09:00:43	50.466	29.401	3.1	30.1	7.9	1539.29
8/31/2022	09:00:43	50.467	29.403	3.12	30.1	7.9	1539.3
8/31/2022	09:00:43	50.468	29.402	3.15	30.1	7.9	1539.3
8/31/2022	09:00:43	50.469	29.402	3.18	30.1	7.9	1539.3
8/31/2022	09:00:43	50.47	29.403	3.2	30.1	7.9	1539.3
8/31/2022	09:00:43	50.47	29.403	3.23	30.1	7.9	1539.3
8/31/2022	09:00:43	50.47	29.403	3.26	30.1	7.9	1539.3
8/31/2022	09:00:43	50.47	29.405	3.29	30.1	7.9	1539.3
8/31/2022	09:00:43	50.47	29.405	3.32	30.1	7.9	1539.31
8/31/2022	09:00:43	50.47	29.405	3.34	30.1	7.9	1539.31
8/31/2022	09:00:43	50.471	29.405	3.37	30.1	7.9	1539.31
8/31/2022	09:00:43	50.47	29.404	3.39	30.1	7.9	1539.31
8/31/2022	09:00:43	50.47	29.404	3.41	30.1	7.9	1539.31
8/31/2022	09:00:43	50.47	29.404	3.43	30.1	7.9	1539.31
8/31/2022	09:00:43	50.47	29.405	3.44	30.1	7.9	1539.31
8/31/2022	09:00:43	50.47	29.405	3.45	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.406	3.46	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.406	3.47	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.405	3.47	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.406	3.48	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.407	3.49	30.1	7.9	1539.31
8/31/2022	09:00:44	50.471	29.406	3.5	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.406	3.51	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.406	3.53	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.407	3.54	30.1	7.9	1539.31

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	09:00:44	50.469	29.407	3.56	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.406	3.58	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.407	3.6	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.406	3.62	30.1	7.9	1539.31
8/31/2022	09:00:44	50.469	29.406	3.66	30.1	7.9	1539.31
8/31/2022	09:00:44	50.469	29.406	3.69	30.1	7.9	1539.31
8/31/2022	09:00:44	50.469	29.406	3.74	30.1	7.9	1539.31
8/31/2022	09:00:44	50.469	29.407	3.77	30.1	7.9	1539.31
8/31/2022	09:00:44	50.47	29.407	3.82	30.1	7.9	1539.32
8/31/2022	09:00:45	50.471	29.407	3.85	30.1	7.9	1539.32
8/31/2022	09:00:45	50.47	29.407	3.89	30.1	7.9	1539.32
8/31/2022	09:00:45	50.47	29.406	3.92	30.1	7.9	1539.32
8/31/2022	09:00:45	50.47	29.406	3.96	30.1	7.9	1539.32
8/31/2022	09:00:45	50.47	29.406	3.99	30.1	7.9	1539.32
8/31/2022	09:00:45	50.471	29.406	4.02	30.1	7.9	1539.32
8/31/2022	09:00:45	50.472	29.407	4.05	30.1	7.9	1539.32
8/31/2022	09:00:45	50.472	29.407	4.07	30.1	7.9	1539.32
8/31/2022	09:00:45	50.472	29.407	4.09	30.1	7.9	1539.32
8/31/2022	09:00:45	50.471	29.407	4.11	30.1	7.9	1539.32
8/31/2022	09:00:45	50.471	29.407	4.12	30.1	7.9	1539.32
8/31/2022	09:00:45	50.47	29.407	4.12	30.1	7.9	1539.32
8/31/2022	09:00:45	50.47	29.407	4.13	30.1	7.9	1539.32
8/31/2022	09:00:45	50.47	29.407	4.13	30.1	7.9	1539.32
8/31/2022	09:00:45	50.47	29.408	4.13	30.1	7.9	1539.32
8/31/2022	09:00:45	50.471	29.408	4.14	30.1	7.9	1539.32
8/31/2022	09:00:45	50.471	29.408	4.14	30.1	7.9	1539.32
8/31/2022	09:00:45	50.471	29.408	4.16	30.1	7.9	1539.32
8/31/2022	09:00:45	50.472	29.408	4.16	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.409	4.16	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.41	4.18	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.409	4.19	30.1	7.9	1539.33
8/31/2022	09:00:46	50.469	29.409	4.22	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.409	4.25	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.41	4.26	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.409	4.29	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.409	4.32	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.409	4.34	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.409	4.37	30.1	7.9	1539.33
8/31/2022	09:00:46	50.463	29.408	4.42	30.1	7.9	1539.32
8/31/2022	09:00:46	50.462	29.408	4.46	30.1	7.9	1539.32
8/31/2022	09:00:46	50.463	29.408	4.5	30.1	7.9	1539.32
8/31/2022	09:00:46	50.463	29.408	4.52	30.1	7.9	1539.33

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	09:00:46	50.47	29.408	4.56	30.1	7.9	1539.33
8/31/2022	09:00:46	50.471	29.409	4.59	30.1	7.9	1539.33
8/31/2022	09:00:46	50.47	29.407	4.62	30.1	7.9	1539.33
8/31/2022	09:00:46	50.469	29.408	4.65	30.1	7.9	1539.33
8/31/2022	09:00:46	50.469	29.408	4.67	30.1	7.9	1539.33
8/31/2022	09:00:47	50.469	29.407	4.68	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.407	4.7	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.408	4.71	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.408	4.73	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.408	4.74	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.408	4.75	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.408	4.76	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.408	4.77	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.408	4.78	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.408	4.79	30.1	7.9	1539.33
8/31/2022	09:00:47	50.47	29.409	4.8	30.1	7.9	1539.34
8/31/2022	09:00:47	50.47	29.408	4.82	30.1	7.9	1539.34
8/31/2022	09:00:47	50.47	29.409	4.84	30.1	7.9	1539.34
8/31/2022	09:00:47	50.466	29.408	4.85	30.1	7.9	1539.33

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	10:01:17	51.057	29.31	1.1	30.6	7.88	1539.54
8/31/2022	10:01:17	51.057	29.309	1.14	30.6	7.88	1539.54
8/31/2022	10:01:17	51.055	29.308	1.18	30.6	7.88	1539.53
8/31/2022	10:01:17	51.054	29.308	1.24	30.6	7.88	1539.53
8/31/2022	10:01:17	51.054	29.307	1.28	30.6	7.88	1539.53
8/31/2022	10:01:17	51.052	29.306	1.33	30.6	7.88	1539.53
8/31/2022	10:01:17	51.051	29.305	1.39	30.6	7.88	1539.53
8/31/2022	10:01:17	51.047	29.302	1.43	30.6	7.88	1539.52
8/31/2022	10:01:17	51.045	29.3	1.46	30.6	7.88	1539.52
8/31/2022	10:01:17	51.043	29.297	1.51	30.6	7.88	1539.51
8/31/2022	10:01:17	51.042	29.297	1.54	30.6	7.88	1539.51
8/31/2022	10:01:17	51.044	29.296	1.57	30.6	7.88	1539.51
8/31/2022	10:01:17	51.046	29.296	1.59	30.6	7.88	1539.52
8/31/2022	10:01:18	51.046	29.297	1.61	30.6	7.88	1539.52
8/31/2022	10:01:18	51.048	29.297	1.61	30.6	7.88	1539.52
8/31/2022	10:01:18	51.047	29.297	1.62	30.6	7.88	1539.52
8/31/2022	10:01:18	51.047	29.297	1.63	30.6	7.88	1539.52
8/31/2022	10:01:18	51.047	29.297	1.63	30.6	7.88	1539.52
8/31/2022	10:01:18	51.046	29.297	1.63	30.6	7.88	1539.52
8/31/2022	10:01:18	51.046	29.297	1.63	30.6	7.88	1539.52
8/31/2022	10:01:18	51.046	29.298	1.64	30.6	7.88	1539.52
8/31/2022	10:01:18	51.047	29.298	1.65	30.6	7.88	1539.52
8/31/2022	10:01:18	51.047	29.299	1.66	30.6	7.88	1539.52
8/31/2022	10:01:18	51.048	29.3	1.66	30.6	7.88	1539.52
8/31/2022	10:01:18	51.047	29.3	1.66	30.6	7.88	1539.52
8/31/2022	10:01:18	51.048	29.3	1.68	30.6	7.88	1539.52
8/31/2022	10:01:18	51.047	29.301	1.69	30.6	7.88	1539.52
8/31/2022	10:01:18	51.048	29.301	1.7	30.6	7.88	1539.53
8/31/2022	10:01:18	51.046	29.301	1.73	30.6	7.88	1539.53
8/31/2022	10:01:18	51.047	29.301	1.75	30.6	7.88	1539.53
8/31/2022	10:01:18	51.047	29.3	1.78	30.6	7.88	1539.53
8/31/2022	10:01:18	51.046	29.3	1.81	30.6	7.88	1539.53
8/31/2022	10:01:19	51.049	29.301	1.84	30.6	7.88	1539.53
8/31/2022	10:01:19	51.048	29.301	1.89	30.6	7.88	1539.53
8/31/2022	10:01:19	51.048	29.301	1.92	30.6	7.88	1539.53
8/31/2022	10:01:19	51.05	29.301	1.95	30.6	7.88	1539.53
8/31/2022	10:01:19	51.05	29.3	2	30.6	7.88	1539.53
8/31/2022	10:01:19	51.05	29.302	2.03	30.6	7.88	1539.53
8/31/2022	10:01:19	51.05	29.302	2.08	30.6	7.88	1539.54
8/31/2022	10:01:19	51.05	29.302	2.13	30.6	7.88	1539.54
8/31/2022	10:01:19	51.048	29.302	2.17	30.6	7.88	1539.53
8/31/2022	10:01:19	51.046	29.3	2.21	30.6	7.88	1539.53

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	10:01:19	51.046	29.299	2.27	30.6	7.88	1539.53
8/31/2022	10:01:19	51.044	29.299	2.3	30.6	7.88	1539.53
8/31/2022	10:01:19	51.043	29.297	2.34	30.6	7.88	1539.53
8/31/2022	10:01:19	51.044	29.297	2.37	30.6	7.88	1539.53
8/31/2022	10:01:19	51.043	29.296	2.39	30.6	7.88	1539.53
8/31/2022	10:01:19	51.043	29.296	2.42	30.6	7.88	1539.53
8/31/2022	10:01:19	51.043	29.296	2.44	30.6	7.88	1539.53
8/31/2022	10:01:19	51.043	29.296	2.46	30.6	7.88	1539.53
8/31/2022	10:01:19	51.042	29.296	2.48	30.6	7.88	1539.53
8/31/2022	10:01:20	51.043	29.296	2.49	30.6	7.88	1539.53
8/31/2022	10:01:20	51.043	29.296	2.5	30.6	7.88	1539.53
8/31/2022	10:01:20	51.044	29.295	2.52	30.6	7.88	1539.53
8/31/2022	10:01:20	51.043	29.295	2.54	30.6	7.88	1539.53
8/31/2022	10:01:20	51.043	29.295	2.56	30.6	7.88	1539.53
8/31/2022	10:01:20	51.043	29.295	2.57	30.6	7.88	1539.53
8/31/2022	10:01:20	51.042	29.295	2.59	30.6	7.88	1539.53
8/31/2022	10:01:20	51.042	29.294	2.62	30.6	7.88	1539.53
8/31/2022	10:01:20	51.042	29.295	2.64	30.6	7.88	1539.53
8/31/2022	10:01:20	51.042	29.295	2.68	30.6	7.88	1539.53
8/31/2022	10:01:20	51.043	29.295	2.71	30.6	7.88	1539.53
8/31/2022	10:01:20	51.043	29.296	2.76	30.6	7.88	1539.53
8/31/2022	10:01:20	51.043	29.295	2.79	30.6	7.88	1539.53
8/31/2022	10:01:20	51.043	29.297	2.85	30.6	7.88	1539.54
8/31/2022	10:01:20	51.044	29.296	2.89	30.6	7.88	1539.54
8/31/2022	10:01:20	51.044	29.296	2.94	30.6	7.88	1539.54
8/31/2022	10:01:20	51.043	29.297	2.98	30.6	7.88	1539.54
8/31/2022	10:01:20	51.043	29.296	3.02	30.6	7.88	1539.54
8/31/2022	10:01:21	51.042	29.296	3.08	30.6	7.88	1539.54
8/31/2022	10:01:21	51.042	29.295	3.12	30.6	7.88	1539.54
8/31/2022	10:01:21	51.042	29.295	3.18	30.6	7.88	1539.54
8/31/2022	10:01:21	51.042	29.295	3.21	30.6	7.88	1539.54
8/31/2022	10:01:21	51.042	29.294	3.25	30.6	7.88	1539.54
8/31/2022	10:01:21	51.042	29.295	3.28	30.6	7.88	1539.54
8/31/2022	10:01:21	51.042	29.294	3.31	30.6	7.88	1539.54
8/31/2022	10:01:21	51.042	29.294	3.34	30.6	7.88	1539.54
8/31/2022	10:01:21	51.042	29.294	3.37	30.6	7.88	1539.54
8/31/2022	10:01:21	51.04	29.293	3.39	30.6	7.88	1539.54
8/31/2022	10:01:21	51.039	29.293	3.41	30.6	7.88	1539.54
8/31/2022	10:01:21	51.039	29.292	3.43	30.6	7.88	1539.53
8/31/2022	10:01:21	51.039	29.29	3.44	30.6	7.88	1539.53
8/31/2022	10:01:21	51.039	29.291	3.46	30.6	7.88	1539.53
8/31/2022	10:01:21	51.039	29.292	3.47	30.6	7.88	1539.54

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	10:01:21	51.038	29.291	3.49	30.6	7.88	1539.53
8/31/2022	10:01:21	51.037	29.29	3.5	30.6	7.88	1539.53
8/31/2022	10:01:21	51.037	29.29	3.52	30.6	7.88	1539.53
8/31/2022	10:01:21	51.037	29.291	3.53	30.6	7.88	1539.53
8/31/2022	10:01:22	51.036	29.29	3.56	30.6	7.88	1539.53
8/31/2022	10:01:22	51.036	29.29	3.59	30.6	7.88	1539.53
8/31/2022	10:01:22	51.036	29.289	3.61	30.6	7.88	1539.53
8/31/2022	10:01:22	51.036	29.289	3.66	30.6	7.88	1539.53
8/31/2022	10:01:22	51.035	29.289	3.69	30.6	7.88	1539.53
8/31/2022	10:01:22	51.035	29.288	3.73	30.6	7.88	1539.53
8/31/2022	10:01:22	51.034	29.285	3.77	30.6	7.88	1539.53
8/31/2022	10:01:22	51.033	29.285	3.8	30.6	7.88	1539.53
8/31/2022	10:01:22	51.032	29.283	3.85	30.6	7.88	1539.52
8/31/2022	10:01:22	51.032	29.282	3.89	30.6	7.88	1539.52
8/31/2022	10:01:22	51.034	29.282	3.92	30.6	7.88	1539.53
8/31/2022	10:01:22	51.035	29.283	3.97	30.6	7.88	1539.53
8/31/2022	10:01:22	51.036	29.284	4	30.6	7.88	1539.53
8/31/2022	10:01:22	51.039	29.287	4.02	30.6	7.88	1539.54
8/31/2022	10:01:22	51.04	29.288	4.05	30.6	7.88	1539.54
8/31/2022	10:01:22	51.041	29.291	4.07	30.6	7.88	1539.55
8/31/2022	10:01:22	51.042	29.292	4.09	30.6	7.88	1539.55
8/31/2022	10:01:22	51.042	29.293	4.1	30.6	7.88	1539.55
8/31/2022	10:01:22	51.043	29.294	4.11	30.6	7.88	1539.55
8/31/2022	10:01:23	51.043	29.295	4.13	30.6	7.88	1539.55
8/31/2022	10:01:23	51.044	29.295	4.15	30.6	7.88	1539.56
8/31/2022	10:01:23	51.044	29.296	4.16	30.6	7.88	1539.56
8/31/2022	10:01:23	51.044	29.296	4.18	30.6	7.88	1539.56
8/31/2022	10:01:23	51.044	29.295	4.2	30.6	7.88	1539.56
8/31/2022	10:01:23	51.044	29.295	4.21	30.6	7.88	1539.56
8/31/2022	10:01:23	51.044	29.295	4.23	30.6	7.88	1539.56
8/31/2022	10:01:23	51.044	29.296	4.25	30.6	7.88	1539.56
8/31/2022	10:01:23	51.045	29.295	4.27	30.6	7.88	1539.56
8/31/2022	10:01:23	51.045	29.296	4.29	30.6	7.88	1539.56
8/31/2022	10:01:23	51.044	29.295	4.31	30.6	7.88	1539.56
8/31/2022	10:01:23	51.043	29.294	4.34	30.6	7.88	1539.56
8/31/2022	10:01:23	51.039	29.292	4.39	30.6	7.88	1539.55
8/31/2022	10:01:23	51.039	29.291	4.42	30.6	7.88	1539.55
8/31/2022	10:01:23	51.038	29.289	4.47	30.6	7.88	1539.55
8/31/2022	10:01:23	51.039	29.289	4.51	30.6	7.88	1539.55
8/31/2022	10:01:23	51.04	29.289	4.57	30.6	7.88	1539.55
8/31/2022	10:01:23	51.042	29.29	4.6	30.6	7.88	1539.55
8/31/2022	10:01:24	51.042	29.29	4.63	30.6	7.88	1539.55

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	10:01:24	51.04	29.29	4.69	30.6	7.88	1539.55
8/31/2022	10:01:24	51.039	29.29	4.72	30.6	7.88	1539.55
8/31/2022	10:01:24	51.036	29.289	4.76	30.6	7.88	1539.55
8/31/2022	10:01:24	51.034	29.286	4.81	30.6	7.88	1539.55
8/31/2022	10:01:24	51.031	29.284	4.86	30.6	7.88	1539.54
8/31/2022	10:01:24	51.028	29.282	4.89	30.6	7.88	1539.54
8/31/2022	10:01:24	51.027	29.28	4.93	30.6	7.88	1539.53
8/31/2022	10:01:24	51.021	29.276	4.95	30.6	7.88	1539.52
8/31/2022	10:01:24	51.019	29.275	4.97	30.6	7.88	1539.52
8/31/2022	10:01:24	51.017	29.272	4.98	30.6	7.88	1539.52
8/31/2022	10:01:24	51.017	29.272	4.99	30.6	7.88	1539.52
8/31/2022	10:01:24	51.018	29.274	5	30.6	7.88	1539.52
8/31/2022	10:01:24	51.02	29.276	5	30.6	7.88	1539.52
8/31/2022	10:01:24	51.021	29.276	5	30.6	7.88	1539.53
8/31/2022	10:01:24	51.022	29.277	5.01	30.6	7.88	1539.53
8/31/2022	10:01:24	51.023	29.277	5	30.6	7.88	1539.53
8/31/2022	10:01:24	51.022	29.276	5	30.6	7.88	1539.53
8/31/2022	10:01:24	51.021	29.275	4.99	30.6	7.88	1539.52
8/31/2022	10:01:25	51.02	29.273	4.99	30.6	7.88	1539.52
8/31/2022	10:01:25	51.02	29.273	5	30.6	7.88	1539.52
8/31/2022	10:01:25	51.02	29.273	5	30.6	7.88	1539.52
8/31/2022	10:01:25	51.02	29.272	5	30.6	7.88	1539.52
8/31/2022	10:01:25	51.02	29.271	5.02	30.6	7.88	1539.52
8/31/2022	10:01:25	51.02	29.27	5.03	30.6	7.88	1539.52
8/31/2022	10:01:25	51.019	29.269	5.06	30.6	7.88	1539.52
8/31/2022	10:01:25	51.018	29.269	5.09	30.6	7.88	1539.51
8/31/2022	10:01:25	51.017	29.268	5.11	30.6	7.88	1539.51

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	11:01:49	51.622	29.513	1	30.8	7.88	1540.23
8/31/2022	11:01:49	51.618	29.511	1.05	30.8	7.88	1540.22
8/31/2022	11:01:50	51.616	29.508	1.09	30.8	7.88	1540.22
8/31/2022	11:01:50	51.611	29.504	1.13	30.8	7.88	1540.21
8/31/2022	11:01:50	51.611	29.502	1.17	30.8	7.88	1540.21
8/31/2022	11:01:50	51.611	29.501	1.2	30.8	7.88	1540.21
8/31/2022	11:01:50	51.613	29.501	1.24	30.8	7.88	1540.21
8/31/2022	11:01:50	51.616	29.504	1.28	30.8	7.88	1540.22
8/31/2022	11:01:50	51.618	29.505	1.3	30.8	7.88	1540.22
8/31/2022	11:01:50	51.617	29.507	1.32	30.8	7.88	1540.22
8/31/2022	11:01:50	51.617	29.507	1.34	30.8	7.88	1540.22
8/31/2022	11:01:50	51.616	29.507	1.34	30.8	7.88	1540.22
8/31/2022	11:01:50	51.614	29.506	1.34	30.8	7.88	1540.22
8/31/2022	11:01:50	51.614	29.506	1.34	30.8	7.88	1540.22
8/31/2022	11:01:50	51.616	29.508	1.34	30.8	7.88	1540.22
8/31/2022	11:01:50	51.616	29.508	1.34	30.8	7.88	1540.22
8/31/2022	11:01:50	51.615	29.508	1.33	30.8	7.88	1540.22
8/31/2022	11:01:50	51.614	29.507	1.33	30.8	7.88	1540.22
8/31/2022	11:01:50	51.614	29.507	1.34	30.8	7.88	1540.22
8/31/2022	11:01:50	51.614	29.507	1.34	30.8	7.88	1540.22
8/31/2022	11:01:50	51.614	29.507	1.34	30.8	7.88	1540.22
8/31/2022	11:01:51	51.612	29.507	1.34	30.8	7.88	1540.22
8/31/2022	11:01:51	51.612	29.507	1.35	30.8	7.88	1540.22
8/31/2022	11:01:51	51.612	29.507	1.35	30.8	7.88	1540.22
8/31/2022	11:01:51	51.611	29.508	1.35	30.8	7.88	1540.22
8/31/2022	11:01:51	51.611	29.507	1.36	30.8	7.88	1540.22
8/31/2022	11:01:51	51.611	29.507	1.38	30.8	7.88	1540.22
8/31/2022	11:01:51	51.611	29.507	1.39	30.8	7.88	1540.22
8/31/2022	11:01:51	51.611	29.506	1.42	30.8	7.88	1540.22
8/31/2022	11:01:51	51.611	29.506	1.46	30.8	7.88	1540.22
8/31/2022	11:01:51	51.611	29.507	1.49	30.8	7.88	1540.22
8/31/2022	11:01:51	51.612	29.507	1.5	30.8	7.88	1540.22
8/31/2022	11:01:51	51.611	29.505	1.55	30.8	7.88	1540.22
8/31/2022	11:01:51	51.612	29.502	1.58	30.8	7.88	1540.22
8/31/2022	11:01:51	51.613	29.502	1.63	30.8	7.88	1540.22
8/31/2022	11:01:51	51.611	29.505	1.66	30.8	7.88	1540.22
8/31/2022	11:01:51	51.608	29.505	1.7	30.8	7.88	1540.22
8/31/2022	11:01:51	51.598	29.495	1.76	30.8	7.88	1540.2
8/31/2022	11:01:51	51.592	29.487	1.79	30.8	7.88	1540.18
8/31/2022	11:01:51	51.584	29.479	1.86	30.8	7.88	1540.17
8/31/2022	11:01:52	51.574	29.463	1.92	30.8	7.88	1540.14
8/31/2022	11:01:52	51.57	29.448	1.97	30.8	7.88	1540.11

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	11:01:52	51.57	29.443	2	30.8	7.88	1540.11
8/31/2022	11:01:52	51.57	29.439	2.07	30.8	7.88	1540.1
8/31/2022	11:01:52	51.568	29.432	2.11	30.8	7.88	1540.09
8/31/2022	11:01:52	51.568	29.428	2.17	30.8	7.88	1540.09
8/31/2022	11:01:52	51.57	29.407	2.2	30.8	7.88	1540.06
8/31/2022	11:01:52	51.571	29.39	2.24	30.9	7.88	1540.03
8/31/2022	11:01:52	51.573	29.373	2.26	30.9	7.88	1540.01
8/31/2022	11:01:52	51.578	29.34	2.28	30.9	7.88	1539.96
8/31/2022	11:01:52	51.581	29.326	2.3	30.9	7.88	1539.95
8/31/2022	11:01:52	51.583	29.312	2.31	30.9	7.88	1539.93
8/31/2022	11:01:52	51.585	29.316	2.31	30.9	7.88	1539.93
8/31/2022	11:01:52	51.588	29.309	2.31	30.9	7.88	1539.93
8/31/2022	11:01:52	51.59	29.301	2.31	30.9	7.88	1539.92
8/31/2022	11:01:52	51.596	29.282	2.32	30.9	7.88	1539.89
8/31/2022	11:01:52	51.599	29.272	2.32	30.9	7.88	1539.88
8/31/2022	11:01:52	51.6	29.263	2.32	30.9	7.88	1539.87
8/31/2022	11:01:53	51.604	29.25	2.32	30.9	7.88	1539.85
8/31/2022	11:01:53	51.605	29.246	2.32	30.9	7.88	1539.84
8/31/2022	11:01:53	51.607	29.239	2.32	30.9	7.88	1539.84
8/31/2022	11:01:53	51.608	29.237	2.33	30.9	7.88	1539.83
8/31/2022	11:01:53	51.609	29.236	2.33	30.9	7.88	1539.83
8/31/2022	11:01:53	51.608	29.236	2.35	30.9	7.88	1539.83
8/31/2022	11:01:53	51.607	29.237	2.36	31	7.88	1539.83
8/31/2022	11:01:53	51.607	29.24	2.39	31	7.88	1539.84
8/31/2022	11:01:53	51.606	29.242	2.42	31	7.88	1539.84
8/31/2022	11:01:53	51.607	29.243	2.46	31	7.88	1539.84
8/31/2022	11:01:53	51.608	29.242	2.48	31	7.88	1539.84
8/31/2022	11:01:53	51.617	29.238	2.51	31	7.88	1539.84
8/31/2022	11:01:53	51.622	29.236	2.56	31	7.88	1539.85
8/31/2022	11:01:53	51.626	29.233	2.59	31	7.88	1539.85
8/31/2022	11:01:53	51.634	29.229	2.65	31	7.88	1539.85
8/31/2022	11:01:53	51.637	29.227	2.68	31	7.88	1539.85
8/31/2022	11:01:53	51.642	29.223	2.73	31	7.88	1539.84
8/31/2022	11:01:53	51.644	29.221	2.76	31	7.88	1539.84
8/31/2022	11:01:53	51.646	29.219	2.82	31	7.88	1539.84
8/31/2022	11:01:54	51.646	29.218	2.85	31	7.88	1539.84
8/31/2022	11:01:54	51.646	29.216	2.91	31	7.88	1539.84
8/31/2022	11:01:54	51.646	29.215	2.94	31	7.88	1539.84
8/31/2022	11:01:54	51.645	29.216	2.99	31	7.88	1539.84
8/31/2022	11:01:54	51.642	29.216	3.02	31	7.88	1539.84
8/31/2022	11:01:54	51.641	29.216	3.05	31	7.88	1539.84
8/31/2022	11:01:54	51.641	29.215	3.08	31	7.88	1539.84

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	11:01:54	51.642	29.215	3.09	31	7.88	1539.84
8/31/2022	11:01:54	51.644	29.214	3.11	31	7.88	1539.84
8/31/2022	11:01:54	51.645	29.214	3.14	31	7.88	1539.84
8/31/2022	11:01:54	51.645	29.214	3.15	31	7.88	1539.84
8/31/2022	11:01:54	51.645	29.214	3.16	31	7.88	1539.84
8/31/2022	11:01:54	51.645	29.214	3.18	31	7.88	1539.84
8/31/2022	11:01:54	51.645	29.215	3.19	31	7.88	1539.84
8/31/2022	11:01:54	51.644	29.215	3.21	31	7.88	1539.84
8/31/2022	11:01:54	51.645	29.215	3.22	31	7.88	1539.84
8/31/2022	11:01:54	51.645	29.215	3.23	31	7.88	1539.84
8/31/2022	11:01:54	51.646	29.215	3.24	31	7.88	1539.84
8/31/2022	11:01:55	51.646	29.214	3.26	31	7.88	1539.84
8/31/2022	11:01:55	51.647	29.214	3.29	31	7.88	1539.84
8/31/2022	11:01:55	51.648	29.214	3.31	31	7.88	1539.84
8/31/2022	11:01:55	51.65	29.212	3.33	31	7.88	1539.84
8/31/2022	11:01:55	51.651	29.211	3.36	31	7.88	1539.84
8/31/2022	11:01:55	51.653	29.21	3.41	31	7.88	1539.84
8/31/2022	11:01:55	51.657	29.209	3.44	31	7.88	1539.84
8/31/2022	11:01:55	51.658	29.208	3.5	31	7.88	1539.85
8/31/2022	11:01:55	51.662	29.206	3.54	31	7.88	1539.85
8/31/2022	11:01:55	51.665	29.205	3.57	31	7.88	1539.85
8/31/2022	11:01:55	51.666	29.204	3.63	31	7.88	1539.85
8/31/2022	11:01:55	51.666	29.203	3.68	31	7.88	1539.85
8/31/2022	11:01:55	51.666	29.202	3.74	31	7.88	1539.85
8/31/2022	11:01:55	51.664	29.201	3.8	31	7.88	1539.84
8/31/2022	11:01:55	51.664	29.201	3.84	31	7.88	1539.84
8/31/2022	11:01:55	51.667	29.2	3.88	31	7.88	1539.85
8/31/2022	11:01:55	51.669	29.2	3.94	31	7.88	1539.85
8/31/2022	11:01:55	51.671	29.199	3.98	31	7.88	1539.85
8/31/2022	11:01:55	51.673	29.199	4.03	31	7.88	1539.85
8/31/2022	11:01:56	51.673	29.199	4.06	31	7.88	1539.85
8/31/2022	11:01:56	51.673	29.198	4.09	31	7.88	1539.85
8/31/2022	11:01:56	51.673	29.198	4.12	31	7.88	1539.85
8/31/2022	11:01:56	51.673	29.198	4.14	31	7.88	1539.85
8/31/2022	11:01:56	51.672	29.198	4.16	31	7.88	1539.85
8/31/2022	11:01:56	51.673	29.198	4.18	31	7.88	1539.85
8/31/2022	11:01:56	51.672	29.197	4.19	31	7.88	1539.85
8/31/2022	11:01:56	51.673	29.197	4.21	31	7.88	1539.85
8/31/2022	11:01:56	51.673	29.197	4.21	31	7.88	1539.85
8/31/2022	11:01:56	51.674	29.196	4.22	31	7.88	1539.85
8/31/2022	11:01:56	51.675	29.196	4.23	31	7.88	1539.85
8/31/2022	11:01:56	51.674	29.196	4.24	31	7.88	1539.85

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	11:01:56	51.674	29.196	4.26	31	7.88	1539.85
8/31/2022	11:01:56	51.674	29.196	4.28	31	7.88	1539.85
8/31/2022	11:01:56	51.674	29.197	4.3	31	7.88	1539.85
8/31/2022	11:01:56	51.674	29.197	4.35	31	7.88	1539.85
8/31/2022	11:01:56	51.675	29.197	4.37	31	7.88	1539.86
8/31/2022	11:01:56	51.676	29.196	4.42	31	7.88	1539.86
8/31/2022	11:01:56	51.676	29.197	4.48	31	7.88	1539.86
8/31/2022	11:01:57	51.677	29.197	4.52	31	7.88	1539.86
8/31/2022	11:01:57	51.677	29.197	4.57	31	7.88	1539.86
8/31/2022	11:01:57	51.677	29.197	4.64	31	7.88	1539.86
8/31/2022	11:01:57	51.677	29.198	4.68	31	7.88	1539.86
8/31/2022	11:01:57	51.678	29.197	4.74	31	7.88	1539.86
8/31/2022	11:01:57	51.679	29.196	4.79	31	7.88	1539.86
8/31/2022	11:01:57	51.679	29.196	4.85	31	7.88	1539.86
8/31/2022	11:01:57	51.677	29.195	4.91	31	7.88	1539.86
8/31/2022	11:01:57	51.677	29.195	4.96	31	7.88	1539.86
8/31/2022	11:01:57	51.673	29.193	5.03	31	7.88	1539.86
8/31/2022	11:01:57	51.672	29.193	5.08	31	7.88	1539.86
8/31/2022	11:01:57	51.67	29.193	5.11	31	7.88	1539.86
8/31/2022	11:01:57	51.67	29.193	5.16	31	7.88	1539.86
8/31/2022	11:01:57	51.671	29.192	5.18	31	7.88	1539.86
8/31/2022	11:01:57	51.672	29.192	5.21	31	7.88	1539.86
8/31/2022	11:01:57	51.672	29.192	5.24	31	7.88	1539.86
8/31/2022	11:01:57	51.671	29.192	5.27	31	7.88	1539.86
8/31/2022	11:01:57	51.671	29.192	5.29	31	7.88	1539.86
8/31/2022	11:01:57	51.669	29.192	5.31	31	7.88	1539.86
8/31/2022	11:01:58	51.669	29.193	5.32	31	7.88	1539.86
8/31/2022	11:01:58	51.67	29.193	5.36	31	7.88	1539.86
8/31/2022	11:01:58	51.67	29.192	5.4	31	7.88	1539.86
8/31/2022	11:01:58	51.67	29.192	5.41	31	7.88	1539.86
8/31/2022	11:01:58	51.669	29.193	5.47	31	7.88	1539.86

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	12:00:39	51.805	29.838	1.04	30.8	7.85	1540.83
8/31/2022	12:00:39	51.814	29.832	1.09	30.8	7.85	1540.83
8/31/2022	12:00:39	51.82	29.83	1.13	30.8	7.85	1540.83
8/31/2022	12:00:39	51.838	29.82	1.17	30.8	7.85	1540.83
8/31/2022	12:00:39	51.846	29.813	1.19	30.8	7.85	1540.83
8/31/2022	12:00:39	51.867	29.802	1.21	30.8	7.85	1540.82
8/31/2022	12:00:39	51.876	29.795	1.24	30.8	7.85	1540.82
8/31/2022	12:00:39	51.879	29.789	1.25	30.8	7.85	1540.82
8/31/2022	12:00:39	51.885	29.778	1.26	30.8	7.85	1540.8
8/31/2022	12:00:39	51.886	29.773	1.28	30.8	7.85	1540.8
8/31/2022	12:00:39	51.888	29.767	1.29	30.8	7.85	1540.79
8/31/2022	12:00:39	51.889	29.769	1.29	30.8	7.85	1540.79
8/31/2022	12:00:39	51.891	29.776	1.3	30.8	7.85	1540.81
8/31/2022	12:00:39	51.894	29.778	1.3	30.8	7.85	1540.81
8/31/2022	12:00:39	51.901	29.777	1.32	30.8	7.85	1540.81
8/31/2022	12:00:39	51.904	29.776	1.32	30.8	7.85	1540.81
8/31/2022	12:00:39	51.908	29.773	1.32	30.8	7.85	1540.81
8/31/2022	12:00:39	51.915	29.762	1.33	30.8	7.85	1540.8
8/31/2022	12:00:40	51.916	29.754	1.34	30.8	7.85	1540.79
8/31/2022	12:00:40	51.918	29.741	1.34	30.8	7.85	1540.77
8/31/2022	12:00:40	51.919	29.736	1.35	30.8	7.85	1540.77
8/31/2022	12:00:40	51.92	29.731	1.37	30.8	7.85	1540.76
8/31/2022	12:00:40	51.922	29.722	1.39	30.8	7.85	1540.75
8/31/2022	12:00:40	51.926	29.719	1.41	30.8	7.85	1540.75
8/31/2022	12:00:40	51.941	29.714	1.46	30.8	7.85	1540.75
8/31/2022	12:00:40	51.948	29.71	1.51	30.8	7.85	1540.75
8/31/2022	12:00:40	51.965	29.705	1.54	30.8	7.85	1540.76
8/31/2022	12:00:40	51.97	29.702	1.6	30.8	7.85	1540.76
8/31/2022	12:00:40	51.981	29.7	1.65	30.8	7.85	1540.76
8/31/2022	12:00:40	51.982	29.697	1.7	30.8	7.85	1540.76
8/31/2022	12:00:40	51.983	29.696	1.76	30.8	7.85	1540.76
8/31/2022	12:00:40	51.99	29.693	1.81	30.8	7.85	1540.76
8/31/2022	12:00:40	51.992	29.691	1.89	30.8	7.85	1540.76
8/31/2022	12:00:40	52.003	29.686	1.94	30.8	7.85	1540.76
8/31/2022	12:00:40	52.012	29.682	1.98	31	7.85	1540.76
8/31/2022	12:00:40	52.022	29.673	2.03	31	7.85	1540.76
8/31/2022	12:00:40	52.029	29.668	2.08	31	7.85	1540.76
8/31/2022	12:00:41	52.035	29.659	2.11	31	7.85	1540.75
8/31/2022	12:00:41	52.036	29.655	2.15	31	7.85	1540.74
8/31/2022	12:00:41	52.039	29.651	2.17	31	7.85	1540.74
8/31/2022	12:00:41	52.042	29.648	2.18	31	7.85	1540.74
8/31/2022	12:00:41	52.042	29.649	2.19	31	7.85	1540.74

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	12:00:41	52.041	29.653	2.2	31	7.85	1540.75
8/31/2022	12:00:41	52.04	29.654	2.21	31	7.85	1540.75
8/31/2022	12:00:41	52.04	29.655	2.22	31	7.85	1540.75
8/31/2022	12:00:41	52.04	29.655	2.22	31	7.85	1540.75
8/31/2022	12:00:41	52.04	29.656	2.23	31	7.85	1540.75
8/31/2022	12:00:41	52.042	29.653	2.25	31	7.85	1540.75
8/31/2022	12:00:41	52.044	29.647	2.26	31	7.85	1540.74
8/31/2022	12:00:41	52.048	29.628	2.28	31	7.85	1540.71
8/31/2022	12:00:41	52.052	29.618	2.29	31	7.85	1540.7
8/31/2022	12:00:41	52.062	29.587	2.31	31	7.85	1540.67
8/31/2022	12:00:41	52.069	29.566	2.33	31	7.85	1540.64
8/31/2022	12:00:41	52.077	29.542	2.36	31	7.85	1540.61
8/31/2022	12:00:41	52.099	29.494	2.4	31	7.85	1540.56
8/31/2022	12:00:41	52.109	29.473	2.43	31	7.85	1540.53
8/31/2022	12:00:42	52.125	29.438	2.46	31	7.85	1540.49
8/31/2022	12:00:42	52.132	29.424	2.5	31	7.85	1540.48
8/31/2022	12:00:42	52.139	29.403	2.54	31.2	7.85	1540.45
8/31/2022	12:00:42	52.142	29.393	2.56	31.2	7.85	1540.44
8/31/2022	12:00:42	52.149	29.377	2.6	31.2	7.85	1540.42
8/31/2022	12:00:42	52.151	29.371	2.61	31.2	7.85	1540.42
8/31/2022	12:00:42	52.155	29.366	2.63	31.2	7.85	1540.41
8/31/2022	12:00:42	52.161	29.356	2.66	31.2	7.85	1540.4
8/31/2022	12:00:42	52.163	29.351	2.67	31.3	7.85	1540.4
8/31/2022	12:00:42	52.166	29.343	2.68	31.3	7.85	1540.39
8/31/2022	12:00:42	52.168	29.34	2.69	31.3	7.85	1540.38
8/31/2022	12:00:42	52.17	29.337	2.69	31.3	7.85	1540.38
8/31/2022	12:00:42	52.171	29.341	2.7	31.3	7.85	1540.39
8/31/2022	12:00:42	52.172	29.35	2.71	31.3	7.85	1540.4
8/31/2022	12:00:42	52.172	29.352	2.72	31.3	7.85	1540.4
8/31/2022	12:00:42	52.172	29.352	2.73	31.3	7.85	1540.41
8/31/2022	12:00:42	52.174	29.347	2.74	31.3	7.85	1540.4
8/31/2022	12:00:42	52.174	29.343	2.75	31.3	7.85	1540.39
8/31/2022	12:00:43	52.174	29.337	2.78	31.3	7.85	1540.39
8/31/2022	12:00:43	52.172	29.335	2.8	31.3	7.85	1540.38
8/31/2022	12:00:43	52.168	29.332	2.83	31.3	7.85	1540.37
8/31/2022	12:00:43	52.168	29.331	2.86	31.3	7.85	1540.37
8/31/2022	12:00:43	52.168	29.331	2.91	31.3	7.85	1540.37
8/31/2022	12:00:43	52.168	29.331	2.93	31.3	7.85	1540.38
8/31/2022	12:00:43	52.168	29.33	2.98	31.3	7.85	1540.37
8/31/2022	12:00:43	52.167	29.33	3.02	31.3	7.85	1540.37
8/31/2022	12:00:43	52.168	29.329	3.07	31.3	7.85	1540.38
8/31/2022	12:00:43	52.168	29.327	3.11	31.3	7.85	1540.37

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	12:00:43	52.168	29.326	3.16	31.3	7.85	1540.37
8/31/2022	12:00:43	52.165	29.326	3.18	31.3	7.85	1540.37
8/31/2022	12:00:43	52.163	29.325	3.2	31.3	7.85	1540.37
8/31/2022	12:00:43	52.162	29.324	3.22	31.3	7.85	1540.37
8/31/2022	12:00:43	52.161	29.324	3.23	31.3	7.85	1540.37
8/31/2022	12:00:43	52.161	29.324	3.23	31.3	7.85	1540.37
8/31/2022	12:00:43	52.163	29.324	3.22	31.3	7.85	1540.37
8/31/2022	12:00:43	52.165	29.324	3.2	31.3	7.85	1540.37
8/31/2022	12:00:43	52.165	29.325	3.18	31.3	7.85	1540.37
8/31/2022	12:00:44	52.165	29.325	3.16	31.3	7.85	1540.37
8/31/2022	12:00:44	52.164	29.324	3.15	31.3	7.85	1540.37
8/31/2022	12:00:44	52.163	29.324	3.14	31.3	7.85	1540.36
8/31/2022	12:00:44	52.164	29.324	3.13	31.3	7.85	1540.37
8/31/2022	12:00:44	52.163	29.323	3.11	31.3	7.85	1540.36
8/31/2022	12:00:44	52.165	29.323	3.11	31.3	7.85	1540.36
8/31/2022	12:00:44	52.165	29.323	3.1	31.3	7.85	1540.36
8/31/2022	12:00:44	52.164	29.323	3.1	31.3	7.85	1540.36
8/31/2022	12:00:44	52.165	29.323	3.09	31.3	7.85	1540.36
8/31/2022	12:00:44	52.165	29.324	3.08	31.3	7.85	1540.36
8/31/2022	12:00:44	52.162	29.324	3.08	31.3	7.85	1540.36
8/31/2022	12:00:44	52.162	29.324	3.08	31.3	7.85	1540.36
8/31/2022	12:00:44	52.161	29.324	3.08	31.3	7.85	1540.36
8/31/2022	12:00:44	52.161	29.323	3.08	31.3	7.85	1540.36
8/31/2022	12:00:44	52.161	29.323	3.08	31.3	7.85	1540.36
8/31/2022	12:00:44	52.162	29.324	3.08	31.3	7.85	1540.36
8/31/2022	12:00:44	52.163	29.323	3.09	31.3	7.85	1540.36
8/31/2022	12:00:44	52.164	29.324	3.12	31.3	7.85	1540.37
8/31/2022	12:00:44	52.165	29.324	3.14	31.3	7.85	1540.37
8/31/2022	12:00:45	52.163	29.325	3.16	31.3	7.85	1540.37
8/31/2022	12:00:45	52.162	29.325	3.19	31.3	7.85	1540.37
8/31/2022	12:00:45	52.161	29.326	3.21	31.3	7.85	1540.37
8/31/2022	12:00:45	52.157	29.326	3.26	31.3	7.85	1540.37
8/31/2022	12:00:45	52.156	29.326	3.31	31.3	7.85	1540.37
8/31/2022	12:00:45	52.152	29.325	3.35	31.3	7.85	1540.36
8/31/2022	12:00:45	52.15	29.325	3.38	31.3	7.85	1540.36
8/31/2022	12:00:45	52.153	29.324	3.43	31.3	7.85	1540.36
8/31/2022	12:00:45	52.154	29.323	3.47	31.3	7.85	1540.36
8/31/2022	12:00:45	52.155	29.323	3.52	31.3	7.85	1540.36
8/31/2022	12:00:45	52.157	29.322	3.56	31.3	7.85	1540.37
8/31/2022	12:00:45	52.157	29.322	3.58	31.3	7.85	1540.37
8/31/2022	12:00:45	52.154	29.321	3.62	31.3	7.85	1540.36
8/31/2022	12:00:45	52.154	29.321	3.65	31.3	7.85	1540.36

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	12:00:45	52.154	29.321	3.68	31.3	7.85	1540.36
8/31/2022	12:00:45	52.154	29.321	3.71	31.3	7.85	1540.36
8/31/2022	12:00:45	52.156	29.32	3.73	31.3	7.85	1540.36
8/31/2022	12:00:45	52.157	29.321	3.76	31.3	7.85	1540.37
8/31/2022	12:00:46	52.157	29.321	3.78	31.3	7.85	1540.37
8/31/2022	12:00:46	52.157	29.32	3.79	31.3	7.85	1540.37
8/31/2022	12:00:46	52.159	29.321	3.8	31.3	7.85	1540.37
8/31/2022	12:00:46	52.16	29.321	3.81	31.3	7.85	1540.37
8/31/2022	12:00:46	52.161	29.321	3.82	31.3	7.85	1540.37
8/31/2022	12:00:46	52.162	29.321	3.82	31.3	7.85	1540.37
8/31/2022	12:00:46	52.162	29.321	3.82	31.3	7.85	1540.37
8/31/2022	12:00:46	52.162	29.321	3.82	31.3	7.85	1540.37
8/31/2022	12:00:46	52.161	29.322	3.82	31.3	7.85	1540.37
8/31/2022	12:00:46	52.161	29.322	3.81	31.3	7.85	1540.37
8/31/2022	12:00:46	52.16	29.322	3.81	31.3	7.85	1540.37
8/31/2022	12:00:46	52.159	29.321	3.81	31.3	7.85	1540.37
8/31/2022	12:00:46	52.157	29.321	3.8	31.3	7.85	1540.37
8/31/2022	12:00:46	52.157	29.32	3.81	31.3	7.85	1540.37
8/31/2022	12:00:46	52.155	29.319	3.81	31.3	7.85	1540.36
8/31/2022	12:00:46	52.156	29.319	3.82	31.3	7.85	1540.36
8/31/2022	12:00:46	52.156	29.319	3.82	31.3	7.85	1540.36
8/31/2022	12:00:46	52.157	29.319	3.83	31.3	7.85	1540.37
8/31/2022	12:00:46	52.158	29.319	3.84	31.3	7.85	1540.37
8/31/2022	12:00:47	52.157	29.319	3.84	31.3	7.85	1540.37
8/31/2022	12:00:47	52.157	29.319	3.85	31.3	7.85	1540.37
8/31/2022	12:00:47	52.155	29.32	3.85	31.3	7.85	1540.36
8/31/2022	12:00:47	52.155	29.32	3.86	31.3	7.85	1540.37
8/31/2022	12:00:47	52.156	29.319	3.86	31.3	7.85	1540.37
8/31/2022	12:00:47	52.157	29.319	3.86	31.3	7.85	1540.37
8/31/2022	12:00:47	52.157	29.318	3.87	31.3	7.85	1540.37
8/31/2022	12:00:47	52.158	29.318	3.87	31.3	7.85	1540.36
8/31/2022	12:00:47	52.157	29.317	3.87	31.3	7.85	1540.36
8/31/2022	12:00:47	52.156	29.317	3.86	31.3	7.85	1540.36
8/31/2022	12:00:47	52.156	29.317	3.86	31.3	7.85	1540.36
8/31/2022	12:00:47	52.154	29.317	3.85	31.3	7.85	1540.36
8/31/2022	12:00:47	52.154	29.317	3.85	31.3	7.85	1540.36
8/31/2022	12:00:47	52.155	29.317	3.85	31.3	7.85	1540.36
8/31/2022	12:00:47	52.156	29.317	3.85	31.3	7.85	1540.36
8/31/2022	12:00:47	52.156	29.317	3.87	31.3	7.85	1540.36
8/31/2022	12:00:47	52.157	29.316	3.88	31.3	7.85	1540.36
8/31/2022	12:00:47	52.157	29.317	3.91	31.3	7.85	1540.36
8/31/2022	12:00:48	52.16	29.316	3.94	31.3	7.85	1540.36

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	12:00:48	52.161	29.314	3.97	31.3	7.85	1540.36
8/31/2022	12:00:48	52.166	29.309	4.01	31.3	7.85	1540.36
8/31/2022	12:00:48	52.169	29.306	4.04	31.3	7.85	1540.36
8/31/2022	12:00:48	52.174	29.299	4.08	31.3	7.85	1540.35
8/31/2022	12:00:48	52.176	29.296	4.13	31.3	7.85	1540.35
8/31/2022	12:00:48	52.179	29.293	4.16	31.3	7.85	1540.35
8/31/2022	12:00:48	52.179	29.293	4.21	31.3	7.85	1540.35
8/31/2022	12:00:48	52.179	29.293	4.24	31.3	7.85	1540.35
8/31/2022	12:00:48	52.187	29.29	4.27	31.3	7.85	1540.35
8/31/2022	12:00:48	52.189	29.286	4.31	31.3	7.85	1540.35
8/31/2022	12:00:48	52.192	29.285	4.34	31.3	7.85	1540.35
8/31/2022	12:00:48	52.191	29.286	4.36	31.3	7.85	1540.35
8/31/2022	12:00:48	52.188	29.286	4.38	31.3	7.85	1540.35
8/31/2022	12:00:48	52.186	29.285	4.39	31.3	7.85	1540.34
8/31/2022	12:00:48	52.187	29.284	4.4	31.3	7.85	1540.34
8/31/2022	12:00:48	52.189	29.284	4.41	31.3	7.85	1540.35
8/31/2022	12:00:48	52.19	29.284	4.43	31.3	7.85	1540.35
8/31/2022	12:00:48	52.191	29.283	4.44	31.3	7.85	1540.35
8/31/2022	12:00:49	52.195	29.283	4.45	31.3	7.85	1540.35
8/31/2022	12:00:49	52.217	29.276	4.47	31.3	7.85	1540.35
8/31/2022	12:00:49	52.236	29.27	4.49	31.3	7.85	1540.36
8/31/2022	12:00:49	52.254	29.263	4.51	31.3	7.85	1540.36
8/31/2022	12:00:49	52.278	29.248	4.55	31.3	7.85	1540.36
8/31/2022	12:00:49	52.28	29.245	4.58	31.3	7.85	1540.36
8/31/2022	12:00:49	52.26	29.245	4.63	31.3	7.85	1540.34
8/31/2022	12:00:49	52.259	29.246	4.67	31.3	7.85	1540.34
8/31/2022	12:00:49	52.275	29.24	4.72	31.3	7.85	1540.35
8/31/2022	12:00:49	52.291	29.232	4.76	31.5	7.85	1540.35
8/31/2022	12:00:49	52.325	29.213	4.82	31.5	7.85	1540.34
8/31/2022	12:00:49	52.331	29.206	4.85	31.5	7.85	1540.34
8/31/2022	12:00:49	52.326	29.196	4.9	31.5	7.85	1540.32
8/31/2022	12:00:49	52.321	29.195	4.94	31.5	7.85	1540.32
8/31/2022	12:00:49	52.319	29.194	4.96	31.5	7.85	1540.31
8/31/2022	12:00:49	52.325	29.191	5.01	31.5	7.85	1540.31
8/31/2022	12:00:49	52.33	29.186	5.04	31.5	7.85	1540.31
8/31/2022	12:00:49	52.347	29.178	5.07	31.5	7.85	1540.31
8/31/2022	12:00:50	52.355	29.175	5.09	31.5	7.85	1540.32
8/31/2022	12:00:50	52.363	29.172	5.11	31.5	7.85	1540.32
8/31/2022	12:00:50	52.374	29.165	5.15	31.5	7.85	1540.31
8/31/2022	12:00:50	52.383	29.158	5.16	31.5	7.85	1540.31
8/31/2022	12:00:50	52.385	29.156	5.18	31.5	7.85	1540.31
8/31/2022	12:00:50	52.385	29.153	5.21	31.5	7.85	1540.31

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	12:00:50	52.386	29.153	5.23	31.5	7.85	1540.31
8/31/2022	12:00:50	52.389	29.151	5.27	31.5	7.85	1540.31
8/31/2022	12:00:50	52.399	29.148	5.3	31.5	7.85	1540.31
8/31/2022	12:00:50	52.403	29.146	5.33	31.6	7.85	1540.31
8/31/2022	12:00:50	52.407	29.144	5.38	31.6	7.85	1540.31
8/31/2022	12:00:50	52.41	29.142	5.41	31.6	7.85	1540.31
8/31/2022	12:00:50	52.41	29.141	5.45	31.6	7.85	1540.31
8/31/2022	12:00:50	52.411	29.14	5.5	31.6	7.85	1540.31
8/31/2022	12:00:50	52.411	29.139	5.54	31.6	7.85	1540.31
8/31/2022	12:00:50	52.411	29.139	5.58	31.6	7.85	1540.31
8/31/2022	12:00:50	52.413	29.138	5.62	31.6	7.85	1540.31
8/31/2022	12:00:50	52.415	29.138	5.65	31.6	7.85	1540.31
8/31/2022	12:00:50	52.415	29.138	5.68	31.6	7.85	1540.31
8/31/2022	12:00:51	52.416	29.137	5.71	31.6	7.85	1540.31
8/31/2022	12:00:51	52.415	29.137	5.74	31.6	7.85	1540.31
8/31/2022	12:00:51	52.407	29.137	5.77	31.6	7.85	1540.31
8/31/2022	12:00:54	52.352	29.139	5.65	31.5	7.85	1540.27
8/31/2022	12:00:54	52.366	29.138	5.62	31.5	7.85	1540.28
8/31/2022	12:00:54	52.38	29.138	5.61	31.5	7.85	1540.29
8/31/2022	12:00:54	52.382	29.138	5.6	31.5	7.85	1540.29
8/31/2022	12:00:54	52.377	29.138	5.6	31.5	7.85	1540.28
8/31/2022	12:00:54	52.368	29.138	5.59	31.5	7.85	1540.28
8/31/2022	12:00:54	52.339	29.138	5.58	31.5	7.85	1540.26
8/31/2022	12:00:54	52.32	29.138	5.58	31.5	7.85	1540.24
8/31/2022	12:00:54	52.289	29.138	5.58	31.5	7.85	1540.22
8/31/2022	12:00:54	52.275	29.138	5.58	31.5	7.85	1540.21
8/31/2022	12:00:54	52.26	29.138	5.58	31.5	7.85	1540.2
8/31/2022	12:00:54	52.236	29.139	5.58	31.5	7.85	1540.19
8/31/2022	12:00:54	52.226	29.139	5.58	31.5	7.85	1540.18
8/31/2022	12:00:54	52.219	29.139	5.59	31.5	7.85	1540.17
8/31/2022	12:00:54	52.216	29.139	5.59	31.5	7.85	1540.17
8/31/2022	12:00:55	52.218	29.14	5.59	31.5	7.85	1540.18
8/31/2022	12:00:55	52.218	29.139	5.59	31.5	7.85	1540.17
8/31/2022	12:00:55	52.225	29.139	5.59	31.5	7.85	1540.18
8/31/2022	12:00:55	52.239	29.139	5.58	31.5	7.85	1540.19
8/31/2022	12:00:55	52.267	29.138	5.57	31.5	7.85	1540.21

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	13:06:45	52.024	30.078	1.02	31.4	7.82	1541.33
8/31/2022	13:06:45	52.062	30.066	1.08	31.4	7.85	1541.34
8/31/2022	13:06:45	52.09	30.059	1.12	31.4	7.82	1541.35
8/31/2022	13:06:45	52.118	30.052	1.14	31.4	7.82	1541.36
8/31/2022	13:06:45	52.172	30.038	1.17	31.4	7.82	1541.38
8/31/2022	13:06:45	52.194	30.032	1.19	31.4	7.82	1541.38
8/31/2022	13:06:45	52.215	30.027	1.21	31.4	7.82	1541.39
8/31/2022	13:06:45	52.211	30.03	1.22	31.4	7.82	1541.39
8/31/2022	13:06:45	52.188	30.037	1.23	31.4	7.82	1541.39
8/31/2022	13:06:45	52.176	30.039	1.23	31.4	7.82	1541.38
8/31/2022	13:06:45	52.16	30.041	1.24	31.4	7.82	1541.37
8/31/2022	13:06:45	52.161	30.04	1.25	31.4	7.82	1541.37
8/31/2022	13:06:45	52.173	30.039	1.28	31.4	7.82	1541.38
8/31/2022	13:06:45	52.238	30.018	1.3	31.4	7.82	1541.39
8/31/2022	13:06:45	52.282	30.004	1.34	31.4	7.82	1541.41
8/31/2022	13:06:46	52.378	29.98	1.39	31.4	7.82	1541.44
8/31/2022	13:06:46	52.421	29.971	1.43	31.4	7.82	1541.46
8/31/2022	13:06:46	52.452	29.962	1.49	31.4	7.82	1541.47
8/31/2022	13:06:46	52.489	29.948	1.55	31.4	7.82	1541.47
8/31/2022	13:06:46	52.515	29.934	1.59	31.4	7.82	1541.47
8/31/2022	13:06:46	52.532	29.929	1.64	31.3	7.82	1541.48
8/31/2022	13:06:46	52.551	29.92	1.71	31.3	7.82	1541.48
8/31/2022	13:06:46	52.585	29.898	1.75	31.3	7.82	1541.47
8/31/2022	13:06:46	52.598	29.885	1.82	31.3	7.82	1541.46
8/31/2022	13:06:46	52.612	29.86	1.86	31.3	7.82	1541.44
8/31/2022	13:06:46	52.612	29.848	1.93	31.3	7.82	1541.42
8/31/2022	13:06:46	52.605	29.829	1.96	31.3	7.82	1541.39
8/31/2022	13:06:46	52.6	29.819	1.98	31.3	7.82	1541.37
8/31/2022	13:06:46	52.595	29.808	2.02	31.3	7.82	1541.35
8/31/2022	13:06:46	52.59	29.784	2.04	31.3	7.82	1541.31
8/31/2022	13:06:46	52.594	29.766	2.05	31.3	7.82	1541.29
8/31/2022	13:06:46	52.598	29.773	2.07	31.3	7.82	1541.3
8/31/2022	13:06:46	52.601	29.782	2.07	31.3	7.82	1541.32
8/31/2022	13:06:46	52.602	29.786	2.06	31.3	7.82	1541.33
8/31/2022	13:06:47	52.603	29.778	2.07	31.3	7.82	1541.31
8/31/2022	13:06:47	52.605	29.751	2.07	31.3	7.82	1541.28
8/31/2022	13:06:47	52.609	29.736	2.08	31.3	7.82	1541.26
8/31/2022	13:06:47	52.611	29.724	2.1	31.3	7.82	1541.24
8/31/2022	13:06:47	52.617	29.711	2.11	31.3	7.82	1541.23
8/31/2022	13:06:47	52.622	29.705	2.14	31.3	7.82	1541.22
8/31/2022	13:06:47	52.635	29.673	2.16	31.3	7.82	1541.19
8/31/2022	13:06:47	52.642	29.652	2.2	31.3	7.82	1541.16

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	13:06:47	52.656	29.618	2.26	31.3	7.82	1541.12
8/31/2022	13:06:47	52.66	29.604	2.29	31.3	7.82	1541.11
8/31/2022	13:06:47	52.667	29.581	2.32	31.3	7.82	1541.08
8/31/2022	13:06:47	52.671	29.57	2.38	31.3	7.82	1541.07
8/31/2022	13:06:47	52.675	29.559	2.42	31.3	7.82	1541.05
8/31/2022	13:06:47	52.683	29.541	2.48	31.3	7.82	1541.03
8/31/2022	13:06:47	52.686	29.534	2.53	31.3	7.82	1541.03
8/31/2022	13:06:47	52.693	29.519	2.58	31.3	7.82	1541.01
8/31/2022	13:06:47	52.697	29.514	2.65	31.3	7.82	1541.01
8/31/2022	13:06:47	52.701	29.509	2.69	31.5	7.82	1541
8/31/2022	13:06:48	52.715	29.498	2.73	31.5	7.82	1541
8/31/2022	13:06:48	52.731	29.484	2.77	31.5	7.82	1540.99
8/31/2022	13:06:48	52.738	29.476	2.8	31.5	7.82	1540.98
8/31/2022	13:06:48	52.743	29.469	2.81	31.5	7.82	1540.98
8/31/2022	13:06:48	52.745	29.469	2.82	31.5	7.82	1540.98
8/31/2022	13:06:48	52.744	29.472	2.83	31.5	7.82	1540.98
8/31/2022	13:06:48	52.738	29.474	2.83	31.5	7.82	1540.98
8/31/2022	13:06:48	52.737	29.474	2.83	31.5	7.82	1540.98
8/31/2022	13:06:48	52.736	29.474	2.83	31.5	7.82	1540.98
8/31/2022	13:06:48	52.737	29.474	2.84	31.5	7.82	1540.98
8/31/2022	13:06:48	52.739	29.474	2.84	31.5	7.82	1540.98
8/31/2022	13:06:48	52.743	29.472	2.86	31.5	7.82	1540.98
8/31/2022	13:06:48	52.749	29.461	2.89	31.5	7.82	1540.97
8/31/2022	13:06:48	52.754	29.456	2.93	31.5	7.82	1540.97
8/31/2022	13:06:48	52.761	29.451	2.97	31.5	7.82	1540.97
8/31/2022	13:06:48	52.777	29.441	3.01	31.5	7.82	1540.96
8/31/2022	13:06:48	52.784	29.435	3.05	31.5	7.82	1540.96
8/31/2022	13:06:48	52.796	29.425	3.11	31.5	7.82	1540.96
8/31/2022	13:06:48	52.799	29.42	3.15	31.5	7.82	1540.95
8/31/2022	13:06:49	52.803	29.413	3.22	31.7	7.82	1540.95
8/31/2022	13:06:49	52.81	29.4	3.27	31.7	7.82	1540.93
8/31/2022	13:06:49	52.813	29.394	3.32	31.7	7.82	1540.93
8/31/2022	13:06:49	52.821	29.379	3.4	31.7	7.82	1540.91
8/31/2022	13:06:49	52.823	29.369	3.46	31.7	7.82	1540.9
8/31/2022	13:06:49	52.826	29.343	3.51	31.7	7.82	1540.87
8/31/2022	13:06:49	52.828	29.33	3.56	31.7	7.82	1540.85
8/31/2022	13:06:49	52.828	29.308	3.59	31.7	7.82	1540.82
8/31/2022	13:06:49	52.829	29.301	3.63	31.7	7.82	1540.81
8/31/2022	13:06:49	52.829	29.295	3.65	31.7	7.82	1540.8
8/31/2022	13:06:49	52.831	29.285	3.66	31.7	7.82	1540.79
8/31/2022	13:06:49	52.832	29.285	3.67	31.7	7.82	1540.79
8/31/2022	13:06:49	52.833	29.289	3.68	31.7	7.82	1540.79

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	13:06:49	52.833	29.293	3.69	31.7	7.82	1540.8
8/31/2022	13:06:49	52.833	29.296	3.7	31.7	7.82	1540.8
8/31/2022	13:06:49	52.832	29.299	3.7	31.7	7.82	1540.81
8/31/2022	13:06:49	52.833	29.299	3.72	31.7	7.82	1540.81
8/31/2022	13:06:49	52.833	29.297	3.75	31.7	7.82	1540.81
8/31/2022	13:06:50	52.833	29.294	3.77	31.7	7.82	1540.8
8/31/2022	13:06:50	52.832	29.288	3.81	31.7	7.82	1540.79
8/31/2022	13:06:50	52.83	29.285	3.84	31.7	7.82	1540.79
8/31/2022	13:06:50	52.828	29.282	3.87	31.7	7.82	1540.78
8/31/2022	13:06:50	52.828	29.281	3.91	31.7	7.82	1540.78
8/31/2022	13:06:50	52.824	29.277	3.95	31.7	7.82	1540.77
8/31/2022	13:06:50	52.822	29.274	4.01	31.7	7.82	1540.77
8/31/2022	13:06:50	52.821	29.271	4.05	31.7	7.82	1540.77
8/31/2022	13:06:50	52.818	29.265	4.1	31.7	7.82	1540.76
8/31/2022	13:06:50	52.818	29.259	4.19	31.7	7.82	1540.75
8/31/2022	13:06:50	52.819	29.258	4.23	31.7	7.82	1540.75
8/31/2022	13:06:50	52.819	29.257	4.26	31.7	7.82	1540.75
8/31/2022	13:06:50	52.816	29.255	4.31	31.7	7.82	1540.74
8/31/2022	13:06:50	52.815	29.253	4.34	31.7	7.82	1540.74
8/31/2022	13:06:50	52.81	29.25	4.37	31.7	7.82	1540.73
8/31/2022	13:06:50	52.809	29.248	4.4	31.7	7.82	1540.73
8/31/2022	13:06:50	52.808	29.246	4.42	31.7	7.82	1540.73
8/31/2022	13:06:50	52.805	29.242	4.44	31.7	7.82	1540.72
8/31/2022	13:06:50	52.803	29.237	4.45	31.7	7.82	1540.71
8/31/2022	13:06:51	52.799	29.227	4.48	31.8	7.82	1540.69
8/31/2022	13:06:51	52.798	29.223	4.51	31.8	7.82	1540.69
8/31/2022	13:06:51	52.797	29.218	4.53	31.8	7.82	1540.68
8/31/2022	13:06:51	52.796	29.217	4.55	31.8	7.82	1540.68
8/31/2022	13:06:51	52.796	29.217	4.6	31.8	7.82	1540.68
8/31/2022	13:06:51	52.796	29.216	4.63	31.8	7.82	1540.68
8/31/2022	13:06:51	52.795	29.216	4.67	31.8	7.82	1540.68
8/31/2022	13:06:51	52.794	29.215	4.71	31.8	7.82	1540.68
8/31/2022	13:06:51	52.793	29.215	4.75	31.8	7.82	1540.68
8/31/2022	13:06:51	52.792	29.214	4.8	31.8	7.82	1540.67
8/31/2022	13:06:51	52.792	29.213	4.84	31.8	7.82	1540.67
8/31/2022	13:06:51	52.791	29.212	4.89	31.8	7.82	1540.67
8/31/2022	13:06:51	52.792	29.211	4.92	31.8	7.82	1540.67
8/31/2022	13:06:51	52.792	29.211	4.95	31.8	7.82	1540.67
8/31/2022	13:06:51	52.792	29.211	4.98	31.8	7.82	1540.67
8/31/2022	13:06:51	52.792	29.21	4.99	31.8	7.82	1540.67
8/31/2022	13:06:51	52.793	29.21	4.99	31.8	7.82	1540.67
8/31/2022	13:06:51	52.794	29.21	4.99	31.8	7.82	1540.67

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	13:06:52	52.793	29.211	4.99	31.8	7.82	1540.67
8/31/2022	13:06:52	52.794	29.211	4.98	31.8	7.82	1540.67
8/31/2022	13:06:52	52.793	29.211	4.97	31.8	7.82	1540.67
8/31/2022	13:06:52	52.793	29.212	4.96	31.8	7.82	1540.67
8/31/2022	13:06:52	52.793	29.212	4.94	31.8	7.82	1540.67
8/31/2022	13:06:52	52.793	29.211	4.93	31.8	7.82	1540.67
8/31/2022	13:06:52	52.793	29.211	4.93	31.8	7.82	1540.67
8/31/2022	13:06:52	52.794	29.211	4.93	31.8	7.82	1540.67
8/31/2022	13:06:52	52.794	29.211	4.93	31.8	7.82	1540.67
8/31/2022	13:06:52	52.794	29.211	4.95	31.8	7.82	1540.67
8/31/2022	13:06:52	52.794	29.21	4.97	31.8	7.82	1540.67
8/31/2022	13:06:52	52.792	29.21	4.99	31.8	7.82	1540.67
8/31/2022	13:06:52	52.792	29.21	5.03	31.8	7.82	1540.67
8/31/2022	13:06:52	52.79	29.209	5.06	31.8	7.82	1540.67
8/31/2022	13:06:52	52.789	29.209	5.09	31.8	7.82	1540.67
8/31/2022	13:06:52	52.789	29.21	5.12	31.8	7.82	1540.67
8/31/2022	13:06:52	52.789	29.208	5.15	31.8	7.82	1540.67
8/31/2022	13:06:52	52.789	29.207	5.19	31.8	7.82	1540.67
8/31/2022	13:06:52	52.788	29.207	5.24	31.8	7.82	1540.67
8/31/2022	13:06:53	52.789	29.206	5.28	31.8	7.82	1540.67
8/31/2022	13:06:53	52.79	29.204	5.31	31.8	7.82	1540.67
8/31/2022	13:06:53	52.79	29.204	5.37	31.8	7.82	1540.67
8/31/2022	13:06:53	52.789	29.203	5.41	31.8	7.82	1540.67
8/31/2022	13:06:53	52.788	29.203	5.46	31.8	7.82	1540.67
8/31/2022	13:06:53	52.788	29.202	5.5	31.8	7.82	1540.67
8/31/2022	13:06:53	52.788	29.203	5.53	31.8	7.82	1540.67
8/31/2022	13:06:53	52.788	29.203	5.58	31.8	7.82	1540.67
8/31/2022	13:06:53	52.737	29.203	5.59	31.8	7.82	1540.63
8/31/2022	13:06:55	52.648	29.202	5.55	31.8	7.82	1540.57
8/31/2022	13:06:55	52.719	29.202	5.5	31.8	7.82	1540.62
8/31/2022	13:06:55	52.759	29.203	5.47	31.8	7.82	1540.65
8/31/2022	13:06:55	52.769	29.203	5.42	31.8	7.82	1540.65
8/31/2022	13:06:56	52.749	29.203	5.4	31.8	7.82	1540.64
8/31/2022	13:06:56	52.636	29.204	5.38	31.8	7.82	1540.56
8/31/2022	13:06:56	52.451	29.203	5.36	31.8	7.82	1540.43
8/31/2022	13:06:56	52.348	29.203	5.36	31.8	7.82	1540.36
8/31/2022	13:06:56	52.32	29.204	5.36	31.8	7.82	1540.34
8/31/2022	13:06:56	52.412	29.203	5.37	31.8	7.82	1540.4
8/31/2022	13:06:56	52.539	29.203	5.38	31.8	7.82	1540.49
8/31/2022	13:06:56	52.652	29.204	5.4	31.8	7.82	1540.57
8/31/2022	13:06:56	52.67	29.203	5.41	31.8	7.82	1540.58
8/31/2022	13:06:56	52.685	29.203	5.43	31.8	7.82	1540.59

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	13:06:56	52.717	29.202	5.44	31.8	7.82	1540.62
8/31/2022	13:06:56	52.726	29.201	5.47	31.8	7.82	1540.62
8/31/2022	13:06:56	52.748	29.201	5.51	31.8	7.82	1540.64
8/31/2022	13:06:56	52.765	29.202	5.53	31.8	7.82	1540.65
8/31/2022	13:06:56	52.77	29.202	5.55	31.8	7.82	1540.65
8/31/2022	13:06:56	52.776	29.202	5.57	31.8	7.82	1540.66
8/31/2022	13:06:56	52.781	29.201	5.59	31.8	7.82	1540.66
8/31/2022	13:06:56	52.781	29.201	5.61	31.8	7.82	1540.66
8/31/2022	13:06:56	52.783	29.201	5.62	31.8	7.82	1540.66
8/31/2022	13:06:57	52.783	29.201	5.64	31.8	7.82	1540.66
8/31/2022	13:06:57	52.783	29.201	5.64	31.8	7.82	1540.66
8/31/2022	13:06:57	52.785	29.202	5.65	31.8	7.82	1540.67
8/31/2022	13:06:57	52.785	29.201	5.65	31.8	7.82	1540.67
8/31/2022	13:06:57	52.783	29.201	5.66	31.8	7.82	1540.66
8/31/2022	13:06:57	52.779	29.201	5.65	31.8	7.82	1540.66
8/31/2022	13:06:57	52.773	29.201	5.65	31.8	7.82	1540.66
8/31/2022	13:06:57	52.77	29.202	5.64	31.8	7.82	1540.66
8/31/2022	13:06:57	52.763	29.202	5.64	31.8	7.82	1540.65
8/31/2022	13:06:57	52.762	29.203	5.63	31.8	7.82	1540.65
8/31/2022	13:06:57	52.759	29.202	5.63	31.8	7.82	1540.65
8/31/2022	13:06:57	52.757	29.202	5.63	31.8	7.82	1540.65
8/31/2022	13:06:57	52.757	29.202	5.63	31.8	7.82	1540.65
8/31/2022	13:06:57	52.761	29.202	5.63	31.8	7.82	1540.65
8/31/2022	13:06:57	52.763	29.202	5.63	31.8	7.82	1540.65
8/31/2022	13:06:57	52.768	29.202	5.64	31.8	7.82	1540.65
8/31/2022	13:06:57	52.771	29.202	5.64	31.8	7.82	1540.66
8/31/2022	13:06:57	52.772	29.201	5.64	31.8	7.82	1540.66
8/31/2022	13:06:57	52.769	29.202	5.65	31.8	7.82	1540.65
8/31/2022	13:06:58	52.759	29.202	5.65	31.8	7.82	1540.65
8/31/2022	13:06:58	52.7	29.202	5.65	31.8	7.82	1540.61
8/31/2022	13:06:58	52.678	29.202	5.65	31.8	7.82	1540.59
8/31/2022	13:06:58	52.66	29.201	5.65	31.8	7.82	1540.58
8/31/2022	13:06:58	52.667	29.202	5.65	31.8	7.82	1540.58
8/31/2022	13:06:58	52.716	29.201	5.64	31.8	7.82	1540.62
8/31/2022	13:06:58	52.737	29.202	5.64	31.8	7.82	1540.63
8/31/2022	13:06:58	52.752	29.202	5.64	31.8	7.82	1540.64
8/31/2022	13:06:58	52.766	29.202	5.63	31.8	7.82	1540.65
8/31/2022	13:06:58	52.774	29.202	5.63	31.8	7.82	1540.66
8/31/2022	13:06:58	52.778	29.202	5.62	31.8	7.82	1540.66
8/31/2022	13:06:58	52.779	29.202	5.62	31.8	7.82	1540.66
8/31/2022	13:06:58	52.782	29.202	5.61	31.8	7.82	1540.66
8/31/2022	13:06:58	52.784	29.202	5.61	31.8	7.82	1540.66

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	13:06:58	52.782	29.203	5.6	31.8	7.82	1540.66
8/31/2022	13:06:58	52.784	29.203	5.59	31.8	7.82	1540.67
8/31/2022	13:06:58	52.784	29.203	5.58	31.8	7.82	1540.67
8/31/2022	13:06:58	52.783	29.202	5.58	31.8	7.82	1540.66
8/31/2022	13:06:58	52.783	29.202	5.57	31.8	7.82	1540.66
8/31/2022	13:06:59	52.781	29.202	5.57	31.8	7.82	1540.66
8/31/2022	13:06:59	52.781	29.202	5.57	31.8	7.82	1540.66
8/31/2022	13:06:59	52.781	29.203	5.57	31.8	7.82	1540.66

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	14:00:59	51.872	29.858	1.04	30.8	7.82	1540.91
8/31/2022	14:00:59	51.873	29.855	1.08	30.8	7.82	1540.9
8/31/2022	14:00:59	51.874	29.854	1.11	30.8	7.82	1540.9
8/31/2022	14:00:59	51.875	29.849	1.15	30.8	7.82	1540.9
8/31/2022	14:00:59	51.875	29.846	1.17	30.8	7.82	1540.89
8/31/2022	14:00:59	51.875	29.845	1.19	30.8	7.82	1540.89
8/31/2022	14:00:59	51.875	29.845	1.2	30.8	7.82	1540.89
8/31/2022	14:00:59	51.875	29.848	1.21	30.8	7.82	1540.9
8/31/2022	14:00:59	51.875	29.848	1.21	30.8	7.82	1540.9
8/31/2022	14:00:59	51.874	29.848	1.23	30.8	7.82	1540.9
8/31/2022	14:00:59	51.875	29.848	1.24	30.8	7.82	1540.9
8/31/2022	14:00:59	51.876	29.848	1.26	30.8	7.82	1540.9
8/31/2022	14:01:00	51.878	29.846	1.27	30.8	7.82	1540.9
8/31/2022	14:01:00	51.879	29.845	1.3	30.8	7.82	1540.9
8/31/2022	14:01:00	51.881	29.842	1.31	30.8	7.82	1540.89
8/31/2022	14:01:00	51.883	29.836	1.34	30.8	7.82	1540.89
8/31/2022	14:01:00	51.883	29.833	1.38	30.8	7.82	1540.88
8/31/2022	14:01:00	51.882	29.83	1.41	30.8	7.82	1540.88
8/31/2022	14:01:00	51.882	29.829	1.45	30.8	7.82	1540.88
8/31/2022	14:01:00	51.886	29.824	1.49	30.8	7.82	1540.88
8/31/2022	14:01:00	51.89	29.821	1.53	30.8	7.82	1540.87
8/31/2022	14:01:00	51.905	29.81	1.57	30.8	7.82	1540.87
8/31/2022	14:01:00	51.915	29.801	1.63	30.8	7.82	1540.86
8/31/2022	14:01:00	51.926	29.79	1.68	30.8	7.82	1540.86
8/31/2022	14:01:00	51.962	29.765	1.75	30.8	7.82	1540.85
8/31/2022	14:01:00	51.992	29.752	1.79	30.8	7.82	1540.85
8/31/2022	14:01:00	52.079	29.727	1.83	30.8	7.82	1540.87
8/31/2022	14:01:00	52.13	29.716	1.88	31.1	7.82	1540.89
8/31/2022	14:01:00	52.179	29.707	1.91	31.1	7.82	1540.91
8/31/2022	14:01:00	52.256	29.695	1.95	31.1	7.82	1540.95
8/31/2022	14:01:00	52.3	29.689	1.98	31.1	7.82	1540.97
8/31/2022	14:01:01	52.317	29.687	1.99	31.1	7.82	1540.98
8/31/2022	14:01:01	52.333	29.686	2.02	31.1	7.82	1540.99
8/31/2022	14:01:01	52.373	29.687	2.04	31.1	7.82	1541.02
8/31/2022	14:01:01	52.387	29.688	2.05	31.1	7.82	1541.03
8/31/2022	14:01:01	52.41	29.688	2.07	31.1	7.82	1541.05
8/31/2022	14:01:01	52.418	29.688	2.08	31.1	7.82	1541.06
8/31/2022	14:01:01	52.423	29.688	2.09	31.1	7.82	1541.06
8/31/2022	14:01:01	52.432	29.687	2.11	31.1	7.82	1541.07
8/31/2022	14:01:01	52.436	29.687	2.11	31.1	7.82	1541.07
8/31/2022	14:01:01	52.44	29.686	2.13	31.1	7.82	1541.07
8/31/2022	14:01:01	52.442	29.685	2.16	31.1	7.82	1541.07
8/31/2022	14:01:01	52.445	29.684	2.17	31.1	7.82	1541.07
8/31/2022	14:01:01	52.447	29.683	2.19	31.1	7.82	1541.07
8/31/2022	14:01:01	52.451	29.682	2.23	31.1	7.82	1541.07
8/31/2022	14:01:01	52.453	29.681	2.26	31.1	7.82	1541.07
8/31/2022	14:01:01	52.454	29.68	2.3	31.1	7.82	1541.07
8/31/2022	14:01:01	52.456	29.679	2.32	31.1	7.82	1541.07
8/31/2022	14:01:01	52.457	29.678	2.36	31.1	7.82	1541.07
8/31/2022	14:01:01	52.458	29.677	2.41	31.1	7.82	1541.07
8/31/2022	14:01:02	52.46	29.676	2.44	31.1	7.82	1541.07
8/31/2022	14:01:02	52.461	29.675	2.48	31.1	7.82	1541.07
8/31/2022	14:01:02	52.462	29.674	2.55	31.3	7.82	1541.08
8/31/2022	14:01:02	52.464	29.672	2.57	31.3	7.82	1541.07

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	14:01:02	52.464	29.672	2.59	31.3	7.82	1541.07
8/31/2022	14:01:02	52.465	29.671	2.62	31.3	7.82	1541.07
8/31/2022	14:01:02	52.465	29.671	2.63	31.3	7.82	1541.07
8/31/2022	14:01:02	52.465	29.671	2.65	31.3	7.82	1541.07
8/31/2022	14:01:02	52.465	29.671	2.66	31.3	7.82	1541.07
8/31/2022	14:01:02	52.465	29.672	2.68	31.3	7.82	1541.08
8/31/2022	14:01:02	52.465	29.672	2.7	31.3	7.82	1541.08
8/31/2022	14:01:02	52.465	29.671	2.72	31.3	7.82	1541.08
8/31/2022	14:01:02	52.465	29.67	2.74	31.3	7.82	1541.07
8/31/2022	14:01:02	52.466	29.669	2.77	31.3	7.82	1541.07
8/31/2022	14:01:02	52.467	29.669	2.8	31.3	7.82	1541.07
8/31/2022	14:01:02	52.469	29.668	2.82	31.3	7.82	1541.07
8/31/2022	14:01:02	52.469	29.667	2.85	31.3	7.82	1541.07
8/31/2022	14:01:02	52.469	29.665	2.88	31.3	7.82	1541.07
8/31/2022	14:01:03	52.469	29.665	2.92	31.3	7.82	1541.07
8/31/2022	14:01:03	52.47	29.665	2.95	31.3	7.82	1541.07
8/31/2022	14:01:03	52.47	29.664	2.98	31.3	7.82	1541.07
8/31/2022	14:01:03	52.469	29.664	3.03	31.3	7.82	1541.07
8/31/2022	14:01:03	52.469	29.662	3.06	31.3	7.82	1541.07
8/31/2022	14:01:03	52.468	29.66	3.1	31.3	7.82	1541.07
8/31/2022	14:01:03	52.468	29.659	3.16	31.3	7.82	1541.07
8/31/2022	14:01:03	52.468	29.658	3.2	31.3	7.82	1541.07
8/31/2022	14:01:03	52.467	29.659	3.23	31.3	7.82	1541.07
8/31/2022	14:01:03	52.464	29.658	3.26	31.3	7.82	1541.06
8/31/2022	14:01:03	52.462	29.657	3.28	31.3	7.82	1541.06
8/31/2022	14:01:03	52.455	29.653	3.3	31.3	7.82	1541.05
8/31/2022	14:01:03	52.453	29.651	3.33	31.3	7.82	1541.05
8/31/2022	14:01:03	52.451	29.65	3.35	31.3	7.82	1541.04
8/31/2022	14:01:03	52.451	29.649	3.37	31.3	7.82	1541.04
8/31/2022	14:01:03	52.452	29.648	3.39	31.3	7.82	1541.04
8/31/2022	14:01:03	52.454	29.645	3.4	31.3	7.82	1541.04
8/31/2022	14:01:03	52.454	29.644	3.43	31.3	7.82	1541.04
8/31/2022	14:01:03	52.454	29.643	3.46	31.3	7.82	1541.04
8/31/2022	14:01:04	52.454	29.643	3.48	31.3	7.82	1541.04
8/31/2022	14:01:04	52.454	29.642	3.52	31.3	7.82	1541.04
8/31/2022	14:01:04	52.454	29.641	3.56	31.3	7.82	1541.04
8/31/2022	14:01:04	52.455	29.64	3.59	31.3	7.82	1541.04
8/31/2022	14:01:04	52.456	29.64	3.64	31.3	7.82	1541.04
8/31/2022	14:01:04	52.458	29.64	3.68	31.3	7.82	1541.04
8/31/2022	14:01:04	52.462	29.641	3.73	31.3	7.82	1541.05
8/31/2022	14:01:04	52.463	29.64	3.77	31.3	7.82	1541.05
8/31/2022	14:01:04	52.467	29.64	3.82	31.3	7.82	1541.05
8/31/2022	14:01:04	52.469	29.64	3.87	31.3	7.82	1541.05
8/31/2022	14:01:04	52.469	29.639	3.91	31.3	7.82	1541.05
8/31/2022	14:01:04	52.473	29.637	3.98	31.3	7.82	1541.05
8/31/2022	14:01:04	52.475	29.634	4.05	31.3	7.82	1541.05
8/31/2022	14:01:04	52.477	29.632	4.09	31.3	7.82	1541.05
8/31/2022	14:01:04	52.477	29.63	4.14	31.3	7.82	1541.05
8/31/2022	14:01:04	52.481	29.626	4.19	31.3	7.82	1541.05
8/31/2022	14:01:04	52.483	29.624	4.22	31.3	7.82	1541.04
8/31/2022	14:01:04	52.487	29.621	4.27	31.3	7.82	1541.04
8/31/2022	14:01:04	52.487	29.621	4.3	31.3	7.82	1541.04
8/31/2022	14:01:05	52.487	29.621	4.34	31.3	7.82	1541.04
8/31/2022	14:01:05	52.488	29.621	4.38	31.3	7.82	1541.05

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	14:01:05	52.487	29.62	4.41	31.3	7.82	1541.05
8/31/2022	14:01:05	52.487	29.621	4.44	31.3	7.82	1541.05
8/31/2022	14:01:05	52.487	29.621	4.48	31.3	7.82	1541.05
8/31/2022	14:01:05	52.487	29.621	4.5	31.3	7.82	1541.05
8/31/2022	14:01:05	52.487	29.621	4.53	31.3	7.82	1541.05
8/31/2022	14:01:05	52.487	29.622	4.58	31.3	7.82	1541.05
8/31/2022	14:01:05	52.487	29.623	4.62	31.3	7.82	1541.05
8/31/2022	14:01:05	52.488	29.623	4.67	31.3	7.82	1541.05
8/31/2022	14:01:05	52.49	29.622	4.72	31.3	7.82	1541.06
8/31/2022	14:01:05	52.49	29.622	4.75	31.3	7.82	1541.06
8/31/2022	14:01:05	52.495	29.62	4.82	31.3	7.82	1541.06
8/31/2022	14:01:05	52.498	29.618	4.86	31.3	7.82	1541.06
8/31/2022	14:01:05	52.504	29.61	4.92	31.3	7.82	1541.05
8/31/2022	14:01:05	52.508	29.607	4.99	31.3	7.82	1541.05
8/31/2022	14:01:05	52.511	29.6	5.02	31.3	7.82	1541.04
8/31/2022	14:01:05	52.512	29.596	5.06	31.3	7.82	1541.04
8/31/2022	14:01:06	52.513	29.593	5.1	31.3	7.82	1541.04
8/31/2022	14:01:06	52.517	29.584	5.13	31.3	7.82	1541.03
8/31/2022	14:01:06	52.519	29.579	5.18	31.3	7.82	1541.02
8/31/2022	14:01:06	52.523	29.57	5.22	31.3	7.82	1541.01
8/31/2022	14:01:06	52.524	29.566	5.25	31.3	7.82	1541.01
8/31/2022	14:01:06	52.526	29.562	5.29	31.3	7.82	1541
8/31/2022	14:01:06	52.528	29.554	5.32	31.3	7.82	1540.99
8/31/2022	14:01:06	52.53	29.551	5.34	31.3	7.82	1540.99
8/31/2022	14:01:06	52.533	29.541	5.41	31.3	7.82	1540.98
8/31/2022	14:01:06	52.535	29.535	5.44	31.3	7.82	1540.97
8/31/2022	14:01:06	52.537	29.526	5.48	31.3	7.82	1540.96
8/31/2022	14:01:06	52.538	29.521	5.54	31.3	7.8	1540.96
8/31/2022	14:01:06	52.539	29.513	5.58	31.3	7.82	1540.94
8/31/2022	14:01:06	52.539	29.509	5.61	31.3	7.82	1540.94
8/31/2022	14:01:06	52.539	29.504	5.67	31.3	7.82	1540.93
8/31/2022	14:01:06	52.541	29.492	5.71	31.3	7.82	1540.92
8/31/2022	14:01:06	52.541	29.487	5.77	31.3	7.82	1540.91
8/31/2022	14:01:06	52.543	29.479	5.81	31.3	7.82	1540.9
8/31/2022	14:01:06	52.544	29.474	5.84	31.3	7.82	1540.9
8/31/2022	14:01:07	52.547	29.464	5.88	31.3	7.82	1540.88
8/31/2022	14:01:07	52.55	29.459	5.92	31.3	7.82	1540.88
8/31/2022	14:01:07	52.557	29.448	5.95	31.3	7.82	1540.87
8/31/2022	14:01:07	52.56	29.442	5.98	31.3	7.82	1540.86
8/31/2022	14:01:07	52.562	29.437	6	31.3	7.82	1540.86
8/31/2022	14:01:07	52.565	29.431	6.03	31.3	7.82	1540.85
8/31/2022	14:01:07	52.565	29.43	6.06	31.3	7.82	1540.85
8/31/2022	14:01:07	51.702	29.427	6.07	31.3	7.82	1540.24

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	15:00:31	51.721	30.164	0.96	30.6	7.8	1541.25
8/31/2022	15:00:31	51.721	30.141	1	30.6	7.8	1541.21
8/31/2022	15:00:31	51.721	30.117	1.01	30.6	7.8	1541.18
8/31/2022	15:00:31	51.721	30.099	1.03	30.6	7.8	1541.15
8/31/2022	15:00:31	51.721	30.11	1.05	30.6	7.8	1541.17
8/31/2022	15:00:31	51.719	30.151	1.05	30.6	7.8	1541.23
8/31/2022	15:00:31	51.719	30.171	1.06	30.6	7.8	1541.26
8/31/2022	15:00:31	51.719	30.197	1.07	30.6	7.8	1541.29
8/31/2022	15:00:31	51.719	30.2	1.08	30.6	7.8	1541.3
8/31/2022	15:00:31	51.72	30.199	1.09	30.6	7.8	1541.3
8/31/2022	15:00:31	51.721	30.206	1.1	30.6	7.8	1541.31
8/31/2022	15:00:31	51.72	30.213	1.11	30.6	7.8	1541.32
8/31/2022	15:00:32	51.72	30.219	1.13	30.6	7.8	1541.33
8/31/2022	15:00:32	51.719	30.221	1.15	30.6	7.8	1541.33
8/31/2022	15:00:32	51.717	30.223	1.18	30.6	7.8	1541.33
8/31/2022	15:00:32	51.717	30.215	1.22	30.6	7.8	1541.32
8/31/2022	15:00:32	51.716	30.193	1.26	30.6	7.8	1541.29
8/31/2022	15:00:32	51.715	30.125	1.3	30.6	7.8	1541.19
8/31/2022	15:00:32	51.715	30.058	1.36	30.6	7.8	1541.09
8/31/2022	15:00:32	51.717	30.03	1.4	30.6	7.8	1541.06
8/31/2022	15:00:32	51.717	30.008	1.44	30.6	7.8	1541.03
8/31/2022	15:00:32	51.719	29.978	1.49	30.6	7.8	1540.98
8/31/2022	15:00:32	51.72	29.967	1.52	30.6	7.8	1540.97
8/31/2022	15:00:32	51.719	29.957	1.54	30.6	7.8	1540.95
8/31/2022	15:00:32	51.718	29.939	1.58	30.6	7.8	1540.93
8/31/2022	15:00:32	51.72	29.929	1.59	30.6	7.8	1540.92
8/31/2022	15:00:32	51.721	29.91	1.61	30.6	7.8	1540.89
8/31/2022	15:00:32	51.722	29.899	1.63	30.6	7.8	1540.87
8/31/2022	15:00:32	51.724	29.878	1.63	30.6	7.8	1540.84
8/31/2022	15:00:32	51.724	29.873	1.64	30.6	7.8	1540.84
8/31/2022	15:00:32	51.724	29.869	1.65	30.6	7.8	1540.83
8/31/2022	15:00:33	51.724	29.869	1.65	30.6	7.8	1540.83
8/31/2022	15:00:33	51.724	29.871	1.65	30.6	7.8	1540.83
8/31/2022	15:00:33	51.724	29.874	1.65	30.6	7.8	1540.84
8/31/2022	15:00:33	51.724	29.875	1.65	30.6	7.8	1540.84
8/31/2022	15:00:33	51.724	29.872	1.66	30.6	7.8	1540.84
8/31/2022	15:00:33	51.724	29.869	1.66	30.6	7.8	1540.83
8/31/2022	15:00:33	51.724	29.868	1.68	30.6	7.8	1540.83
8/31/2022	15:00:33	51.724	29.866	1.69	30.6	7.8	1540.83
8/31/2022	15:00:33	51.724	29.866	1.71	30.6	7.8	1540.83
8/31/2022	15:00:33	51.725	29.866	1.74	30.6	7.8	1540.83
8/31/2022	15:00:33	51.725	29.866	1.79	30.6	7.8	1540.83

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	15:00:33	51.727	29.864	1.82	30.6	7.8	1540.83
8/31/2022	15:00:33	51.728	29.862	1.87	30.6	7.8	1540.83
8/31/2022	15:00:33	51.727	29.859	1.9	30.6	7.8	1540.82
8/31/2022	15:00:33	51.727	29.858	1.93	30.6	7.8	1540.82
8/31/2022	15:00:33	51.727	29.857	1.97	30.6	7.8	1540.82
8/31/2022	15:00:33	51.726	29.858	1.99	30.6	7.8	1540.82
8/31/2022	15:00:33	51.725	29.859	2.01	30.6	7.8	1540.82
8/31/2022	15:00:33	51.724	29.863	2.04	30.6	7.8	1540.83
8/31/2022	15:00:34	51.723	29.865	2.06	30.6	7.8	1540.83
8/31/2022	15:00:34	51.721	29.868	2.08	30.6	7.8	1540.84
8/31/2022	15:00:34	51.722	29.87	2.12	30.6	7.8	1540.84
8/31/2022	15:00:34	51.722	29.87	2.14	30.6	7.8	1540.84
8/31/2022	15:00:34	51.723	29.869	2.16	30.6	7.8	1540.84
8/31/2022	15:00:34	51.723	29.868	2.19	30.6	7.8	1540.84
8/31/2022	15:00:34	51.721	29.865	2.2	30.6	7.8	1540.83
8/31/2022	15:00:34	51.721	29.865	2.23	30.6	7.8	1540.83
8/31/2022	15:00:34	51.722	29.863	2.26	30.6	7.8	1540.83
8/31/2022	15:00:34	51.722	29.863	2.29	30.6	7.8	1540.83
8/31/2022	15:00:34	51.721	29.862	2.33	30.6	7.8	1540.83
8/31/2022	15:00:34	51.721	29.86	2.36	30.6	7.8	1540.83
8/31/2022	15:00:34	51.724	29.855	2.42	30.6	7.8	1540.82
8/31/2022	15:00:34	51.728	29.846	2.48	30.6	7.8	1540.81
8/31/2022	15:00:34	51.732	29.832	2.52	30.6	7.8	1540.8
8/31/2022	15:00:34	51.743	29.789	2.57	30.6	7.8	1540.74
8/31/2022	15:00:34	51.747	29.766	2.64	30.6	7.8	1540.71
8/31/2022	15:00:34	51.751	29.727	2.68	30.6	7.8	1540.66
8/31/2022	15:00:35	51.752	29.712	2.75	30.6	7.8	1540.64
8/31/2022	15:00:35	51.752	29.7	2.79	30.6	7.8	1540.62
8/31/2022	15:00:35	51.753	29.685	2.83	30.6	7.8	1540.6
8/31/2022	15:00:35	51.753	29.68	2.87	30.6	7.8	1540.6
8/31/2022	15:00:35	51.752	29.674	2.91	30.6	7.8	1540.59
8/31/2022	15:00:35	51.752	29.674	2.95	30.6	7.8	1540.59
8/31/2022	15:00:35	51.75	29.673	2.97	30.6	7.8	1540.59
8/31/2022	15:00:35	51.75	29.673	2.99	30.6	7.8	1540.59
8/31/2022	15:00:35	51.75	29.673	3	30.6	7.8	1540.59
8/31/2022	15:00:35	51.751	29.673	3.02	30.6	7.8	1540.59
8/31/2022	15:00:35	51.751	29.674	3.02	30.6	7.8	1540.59
8/31/2022	15:00:35	51.752	29.675	3.02	30.6	7.8	1540.59
8/31/2022	15:00:35	51.752	29.675	3.03	30.6	7.8	1540.59
8/31/2022	15:00:35	51.752	29.675	3.03	30.8	7.8	1540.59
8/31/2022	15:00:35	51.751	29.677	3.03	30.8	7.8	1540.59
8/31/2022	15:00:35	51.75	29.677	3.04	30.8	7.8	1540.59

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	15:00:35	51.75	29.679	3.05	30.8	7.8	1540.6
8/31/2022	15:00:35	51.75	29.678	3.07	30.8	7.8	1540.6
8/31/2022	15:00:35	51.75	29.679	3.1	30.8	7.8	1540.6
8/31/2022	15:00:36	51.75	29.679	3.13	30.8	7.8	1540.6
8/31/2022	15:00:36	51.75	29.678	3.15	30.8	7.8	1540.6
8/31/2022	15:00:36	51.75	29.676	3.18	30.8	7.8	1540.59
8/31/2022	15:00:36	51.75	29.674	3.21	30.8	7.8	1540.59
8/31/2022	15:00:36	51.749	29.669	3.27	30.8	7.8	1540.58
8/31/2022	15:00:36	51.746	29.666	3.31	30.8	7.8	1540.58
8/31/2022	15:00:36	51.744	29.664	3.34	30.8	7.8	1540.57
8/31/2022	15:00:36	51.744	29.664	3.39	30.8	7.8	1540.58
8/31/2022	15:00:36	51.744	29.664	3.43	30.8	7.8	1540.58
8/31/2022	15:00:36	51.749	29.665	3.5	30.8	7.8	1540.58
8/31/2022	15:00:36	51.749	29.667	3.55	30.8	7.8	1540.59
8/31/2022	15:00:36	51.748	29.67	3.58	30.8	7.8	1540.59
8/31/2022	15:00:36	51.748	29.672	3.62	30.8	7.8	1540.59
8/31/2022	15:00:36	51.747	29.676	3.67	30.8	7.8	1540.6
8/31/2022	15:00:36	51.747	29.678	3.7	30.8	7.8	1540.6
8/31/2022	15:00:36	51.747	29.68	3.75	30.8	7.8	1540.61
8/31/2022	15:00:36	51.747	29.68	3.78	30.8	7.8	1540.61
8/31/2022	15:00:36	51.747	29.68	3.8	30.8	7.8	1540.61
8/31/2022	15:00:36	51.747	29.68	3.84	30.8	7.8	1540.61
8/31/2022	15:00:37	51.747	29.678	3.87	30.8	7.8	1540.61
8/31/2022	15:00:37	51.749	29.671	3.9	30.8	7.8	1540.6
8/31/2022	15:00:37	51.749	29.666	3.93	30.8	7.8	1540.59
8/31/2022	15:00:37	51.75	29.658	3.99	30.8	7.8	1540.58
8/31/2022	15:00:37	51.75	29.655	4.02	30.8	7.8	1540.58
8/31/2022	15:00:37	51.74	29.652	4.08	30.8	7.8	1540.57
8/31/2022	15:00:37	51.719	29.647	4.12	30.8	7.8	1540.54
8/31/2022	15:00:37	51.719	29.645	4.16	30.8	7.8	1540.54
8/31/2022	15:00:37	51.72	29.642	4.23	30.8	7.8	1540.54
8/31/2022	15:00:37	51.731	29.64	4.27	30.8	7.8	1540.55
8/31/2022	15:00:37	51.751	29.637	4.33	30.8	7.8	1540.56
8/31/2022	15:00:37	51.754	29.626	4.37	30.8	7.8	1540.54
8/31/2022	15:00:37	51.755	29.622	4.41	30.8	7.8	1540.54
8/31/2022	15:00:37	51.757	29.61	4.47	30.8	7.8	1540.52
8/31/2022	15:00:37	51.758	29.606	4.53	30.8	7.8	1540.52
8/31/2022	15:00:37	51.758	29.598	4.57	30.8	7.8	1540.51
8/31/2022	15:00:37	51.758	29.596	4.62	30.8	7.8	1540.51
8/31/2022	15:00:37	51.758	29.592	4.67	30.8	7.8	1540.5
8/31/2022	15:00:37	51.757	29.59	4.71	30.8	7.8	1540.5
8/31/2022	15:00:38	51.757	29.585	4.77	30.8	7.8	1540.49

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	15:00:38	51.758	29.57	4.81	30.8	7.8	1540.47
8/31/2022	15:00:38	51.758	29.562	4.85	30.8	7.8	1540.46
8/31/2022	15:00:38	51.758	29.545	4.9	30.8	7.8	1540.43
8/31/2022	15:00:38	51.758	29.536	4.95	30.8	7.8	1540.42
8/31/2022	15:00:38	51.758	29.53	5.02	30.8	7.8	1540.42
8/31/2022	15:00:38	51.758	29.52	5.09	30.8	7.8	1540.4
8/31/2022	15:00:38	51.759	29.512	5.14	30.8	7.8	1540.39
8/31/2022	15:00:38	51.759	29.508	5.19	30.8	7.8	1540.39
8/31/2022	15:00:38	51.758	29.505	5.25	30.8	7.8	1540.38
8/31/2022	15:00:38	51.758	29.498	5.31	30.8	7.8	1540.37
8/31/2022	15:00:38	51.758	29.495	5.37	30.8	7.8	1540.37
8/31/2022	15:00:38	51.759	29.49	5.41	30.8	7.8	1540.36
8/31/2022	15:00:38	51.759	29.487	5.43	30.8	7.8	1540.36
8/31/2022	15:00:38	51.759	29.484	5.49	30.8	7.8	1540.36
8/31/2022	15:00:38	51.76	29.481	5.51	30.8	7.8	1540.35
8/31/2022	15:00:38	51.76	29.479	5.56	30.8	7.8	1540.35
8/31/2022	15:00:38	51.76	29.476	5.6	30.8	7.8	1540.35
8/31/2022	15:00:39	51.76	29.474	5.63	30.8	7.8	1540.35
8/31/2022	15:00:39	51.759	29.472	5.66	30.8	7.8	1540.34
8/31/2022	15:00:39	51.758	29.471	5.7	30.8	7.8	1540.34
8/31/2022	15:00:39	51.758	29.47	5.74	30.8	7.8	1540.34
8/31/2022	15:00:39	51.759	29.468	5.81	30.8	7.8	1540.34

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	16:01:07	51.163	30.095	1	30.2	7.78	1540.77
8/31/2022	16:01:07	51.163	30.092	1.06	30.2	7.78	1540.76
8/31/2022	16:01:07	51.163	30.092	1.1	30.2	7.78	1540.76
8/31/2022	16:01:07	51.163	30.092	1.13	30.2	7.78	1540.76
8/31/2022	16:01:07	51.164	30.092	1.19	30.2	7.78	1540.76
8/31/2022	16:01:07	51.165	30.092	1.23	30.2	7.78	1540.77
8/31/2022	16:01:07	51.164	30.094	1.26	30.2	7.78	1540.77
8/31/2022	16:01:07	51.165	30.094	1.33	30.2	7.78	1540.77
8/31/2022	16:01:07	51.166	30.091	1.36	30.2	7.78	1540.77
8/31/2022	16:01:07	51.167	30.089	1.42	30.2	7.78	1540.77
8/31/2022	16:01:07	51.167	30.088	1.49	30.2	7.78	1540.77
8/31/2022	16:01:07	51.168	30.089	1.53	30.2	7.78	1540.77
8/31/2022	16:01:07	51.168	30.089	1.58	30.2	7.78	1540.77
8/31/2022	16:01:08	51.168	30.088	1.62	30.2	7.78	1540.77
8/31/2022	16:01:08	51.168	30.086	1.67	30.2	7.78	1540.77
8/31/2022	16:01:08	51.168	30.082	1.74	30.2	7.78	1540.76
8/31/2022	16:01:08	51.169	30.081	1.77	30.2	7.78	1540.76
8/31/2022	16:01:08	51.137	30.08	1.81	30.2	7.78	1540.74
8/31/2022	16:01:08	51.137	30.08	1.87	30.2	7.78	1540.74
8/31/2022	16:01:08	51.137	30.08	1.91	30.2	7.78	1540.74
8/31/2022	16:01:08	51.138	30.081	1.97	30.2	7.78	1540.74
8/31/2022	16:01:08	51.17	30.081	2.02	30.2	7.78	1540.77
8/31/2022	16:01:08	51.17	30.082	2.05	30.2	7.78	1540.77
8/31/2022	16:01:08	51.169	30.083	2.08	30.2	7.78	1540.77
8/31/2022	16:01:08	51.168	30.082	2.15	30.2	7.78	1540.77
8/31/2022	16:01:08	51.168	30.082	2.18	30.2	7.78	1540.77
8/31/2022	16:01:08	51.167	30.082	2.23	30.2	7.78	1540.77
8/31/2022	16:01:08	51.168	30.081	2.27	30.2	7.78	1540.77
8/31/2022	16:01:08	51.168	30.082	2.31	30.2	7.78	1540.77
8/31/2022	16:01:08	51.168	30.083	2.35	30.2	7.78	1540.77
8/31/2022	16:01:08	51.168	30.084	2.39	30.2	7.78	1540.78
8/31/2022	16:01:09	51.167	30.085	2.44	30.2	7.78	1540.78
8/31/2022	16:01:09	51.167	30.085	2.5	30.2	7.78	1540.78
8/31/2022	16:01:09	51.167	30.085	2.54	30.2	7.78	1540.78
8/31/2022	16:01:09	51.168	30.085	2.58	30.2	7.78	1540.78
8/31/2022	16:01:09	51.169	30.085	2.63	30.2	7.78	1540.78
8/31/2022	16:01:09	51.17	30.083	2.67	30.2	7.78	1540.78
8/31/2022	16:01:09	51.17	30.083	2.73	30.2	7.78	1540.78
8/31/2022	16:01:09	51.171	30.083	2.77	30.2	7.78	1540.78
8/31/2022	16:01:09	51.17	30.083	2.81	30.2	7.78	1540.78
8/31/2022	16:01:09	51.17	30.084	2.88	30.2	7.78	1540.78
8/31/2022	16:01:09	51.169	30.084	2.93	30.2	7.78	1540.78

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	16:01:09	51.168	30.084	2.99	30.2	7.78	1540.79
8/31/2022	16:01:09	51.168	30.083	3.05	30.2	7.78	1540.79
8/31/2022	16:01:09	51.169	30.083	3.09	30.2	7.78	1540.79
8/31/2022	16:01:09	51.171	30.083	3.14	30.2	7.78	1540.79
8/31/2022	16:01:09	51.171	30.083	3.2	30.2	7.78	1540.79
8/31/2022	16:01:09	51.171	30.083	3.24	30.2	7.78	1540.79
8/31/2022	16:01:09	51.171	30.084	3.3	30.2	7.78	1540.79
8/31/2022	16:01:09	51.171	30.083	3.35	30.2	7.78	1540.79
8/31/2022	16:01:09	51.171	30.083	3.39	30.2	7.78	1540.79
8/31/2022	16:01:10	51.171	30.083	3.44	30.2	7.78	1540.79
8/31/2022	16:01:10	51.171	30.084	3.49	30.2	7.78	1540.8
8/31/2022	16:01:10	51.171	30.083	3.55	30.2	7.78	1540.8
8/31/2022	16:01:10	51.171	30.083	3.62	30.2	7.78	1540.8
8/31/2022	16:01:10	51.171	30.083	3.66	30.2	7.78	1540.8
8/31/2022	16:01:10	51.171	30.081	3.7	30.2	7.78	1540.8
8/31/2022	16:01:10	51.172	30.081	3.76	30.2	7.78	1540.8
8/31/2022	16:01:10	51.171	30.082	3.81	30.2	7.78	1540.8
8/31/2022	16:01:10	51.172	30.081	3.87	30.2	7.78	1540.8
8/31/2022	16:01:10	51.172	30.081	3.91	30.2	7.78	1540.8
8/31/2022	16:01:10	51.172	30.081	3.96	30.2	7.78	1540.8
8/31/2022	16:01:10	51.172	30.081	4.03	30.2	7.78	1540.8
8/31/2022	16:01:10	51.172	30.081	4.08	30.2	7.78	1540.8
8/31/2022	16:01:10	51.173	30.081	4.12	30.2	7.78	1540.8
8/31/2022	16:01:10	51.172	30.081	4.2	30.2	7.78	1540.8
8/31/2022	16:01:10	51.173	30.081	4.27	30.2	7.78	1540.81
8/31/2022	16:01:10	51.172	30.081	4.32	30.2	7.78	1540.81
8/31/2022	16:01:10	51.171	30.08	4.39	30.2	7.78	1540.81
8/31/2022	16:01:11	51.172	30.08	4.44	30.2	7.78	1540.81
8/31/2022	16:01:11	51.171	30.079	4.49	30.2	7.78	1540.81
8/31/2022	16:01:11	51.172	30.078	4.56	30.2	7.78	1540.81
8/31/2022	16:01:11	51.172	30.078	4.62	30.2	7.78	1540.81
8/31/2022	16:01:11	51.172	30.078	4.69	30.2	7.78	1540.81
8/31/2022	16:01:11	51.173	30.078	4.74	30.2	7.78	1540.81
8/31/2022	16:01:11	51.172	30.079	4.79	30.2	7.78	1540.81
8/31/2022	16:01:11	51.171	30.078	4.86	30.2	7.78	1540.81
8/31/2022	16:01:11	51.167	30.075	4.93	30.2	7.78	1540.8
8/31/2022	16:01:11	51.166	30.072	4.98	30.2	7.78	1540.8
8/31/2022	16:01:11	51.163	30.067	5.06	30.2	7.78	1540.79
8/31/2022	16:01:11	51.163	30.065	5.1	30.2	7.78	1540.79
8/31/2022	16:01:11	51.163	30.063	5.14	30.2	7.78	1540.79
8/31/2022	16:01:11	51.162	30.061	5.21	30.2	7.78	1540.78
8/31/2022	16:01:11	51.161	30.06	5.26	30.2	7.78	1540.78

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	16:01:11	51.16	30.059	5.34	30.2	7.78	1540.78
8/31/2022	16:01:11	51.16	30.058	5.38	30.2	7.78	1540.78
8/31/2022	16:01:11	51.16	30.057	5.42	30.2	7.78	1540.78
8/31/2022	16:01:11	51.161	30.056	5.49	30.2	7.78	1540.78
8/31/2022	16:01:12	51.162	30.056	5.57	30.2	7.78	1540.78
8/31/2022	16:01:12	51.161	30.055	5.62	30.2	7.78	1540.78
8/31/2022	16:01:12	51.16	30.055	5.69	30.2	7.78	1540.78
8/31/2022	16:01:12	51.16	30.055	5.75	30.2	7.78	1540.78

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	17:00:57	51.146	30.396	1.04	30.2	7.78	1541.19
8/31/2022	17:00:57	51.152	30.393	1.08	30.2	7.78	1541.19
8/31/2022	17:00:57	51.17	30.389	1.13	30.2	7.78	1541.2
8/31/2022	17:00:57	51.178	30.388	1.19	30.2	7.78	1541.2
8/31/2022	17:00:57	51.196	30.385	1.23	30.2	7.78	1541.21
8/31/2022	17:00:57	51.203	30.384	1.28	30.2	7.78	1541.22
8/31/2022	17:00:57	51.208	30.381	1.31	30.2	7.78	1541.22
8/31/2022	17:00:57	51.212	30.381	1.33	30.2	7.78	1541.22
8/31/2022	17:00:57	51.214	30.381	1.37	30.2	7.78	1541.22
8/31/2022	17:00:57	51.215	30.381	1.39	30.2	7.78	1541.22
8/31/2022	17:00:57	51.215	30.381	1.43	30.2	7.78	1541.22
8/31/2022	17:00:57	51.215	30.38	1.44	30.2	7.78	1541.22
8/31/2022	17:00:58	51.215	30.38	1.46	30.2	7.78	1541.22
8/31/2022	17:00:58	51.214	30.379	1.48	30.2	7.78	1541.22
8/31/2022	17:00:58	51.215	30.378	1.49	30.2	7.78	1541.22
8/31/2022	17:00:58	51.215	30.378	1.49	30.2	7.78	1541.22
8/31/2022	17:00:58	51.214	30.377	1.5	30.2	7.78	1541.22
8/31/2022	17:00:58	51.214	30.377	1.5	30.2	7.78	1541.22
8/31/2022	17:00:58	51.211	30.379	1.51	30.2	7.78	1541.22
8/31/2022	17:00:58	51.211	30.379	1.54	30.2	7.78	1541.22
8/31/2022	17:00:58	51.211	30.38	1.56	30.2	7.78	1541.22
8/31/2022	17:00:58	51.212	30.38	1.6	30.2	7.78	1541.22
8/31/2022	17:00:58	51.213	30.38	1.63	30.2	7.78	1541.22
8/31/2022	17:00:58	51.215	30.38	1.69	30.2	7.78	1541.23
8/31/2022	17:00:58	51.215	30.378	1.73	30.2	7.78	1541.22
8/31/2022	17:00:58	51.215	30.378	1.79	30.2	7.78	1541.22
8/31/2022	17:00:58	51.215	30.378	1.82	30.2	7.78	1541.22
8/31/2022	17:00:58	51.211	30.378	1.87	30.2	7.78	1541.22
8/31/2022	17:00:58	51.211	30.378	1.91	30.2	7.78	1541.22
8/31/2022	17:00:58	51.209	30.379	1.96	30.2	7.78	1541.22
8/31/2022	17:00:59	51.207	30.38	1.99	30.2	7.78	1541.23
8/31/2022	17:00:59	51.205	30.38	2.02	30.2	7.78	1541.23
8/31/2022	17:00:59	51.203	30.381	2.06	30.2	7.78	1541.23
8/31/2022	17:00:59	51.201	30.382	2.09	30.2	7.78	1541.23
8/31/2022	17:00:59	51.196	30.383	2.14	30.2	7.78	1541.22
8/31/2022	17:00:59	51.194	30.384	2.19	30.2	7.78	1541.23
8/31/2022	17:00:59	51.189	30.385	2.22	30.2	7.78	1541.22
8/31/2022	17:00:59	51.187	30.385	2.26	30.2	7.78	1541.22
8/31/2022	17:00:59	51.186	30.386	2.32	30.2	7.75	1541.23
8/31/2022	17:00:59	51.187	30.386	2.35	30.2	7.78	1541.23
8/31/2022	17:00:59	51.188	30.386	2.4	30.2	7.78	1541.23
8/31/2022	17:00:59	51.189	30.386	2.45	30.2	7.78	1541.23

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	17:00:59	51.189	30.386	2.49	30.2	7.78	1541.23
8/31/2022	17:00:59	51.188	30.387	2.55	30.2	7.78	1541.23
8/31/2022	17:00:59	51.188	30.387	2.6	30.2	7.78	1541.23
8/31/2022	17:00:59	51.187	30.386	2.67	30.2	7.78	1541.23
8/31/2022	17:00:59	51.188	30.386	2.74	30.2	7.78	1541.23
8/31/2022	17:00:59	51.189	30.386	2.78	30.2	7.78	1541.24
8/31/2022	17:00:59	51.191	30.385	2.84	30.2	7.78	1541.24
8/31/2022	17:01:00	51.192	30.384	2.88	30.2	7.78	1541.24
8/31/2022	17:01:00	51.191	30.384	2.92	30.2	7.78	1541.24
8/31/2022	17:01:00	51.191	30.384	2.98	30.2	7.78	1541.24
8/31/2022	17:01:00	51.196	30.383	3.03	30.2	7.78	1541.24
8/31/2022	17:01:00	51.201	30.383	3.09	30.2	7.78	1541.24
8/31/2022	17:01:00	51.208	30.38	3.13	30.2	7.78	1541.25
8/31/2022	17:01:00	51.214	30.379	3.18	30.2	7.78	1541.25
8/31/2022	17:01:00	51.215	30.378	3.24	30.2	7.78	1541.25
8/31/2022	17:01:00	51.216	30.376	3.3	30.2	7.78	1541.25
8/31/2022	17:01:00	51.219	30.374	3.34	30.2	7.78	1541.25
8/31/2022	17:01:00	51.219	30.374	3.41	30.2	7.78	1541.25
8/31/2022	17:01:00	51.22	30.373	3.45	30.2	7.78	1541.25
8/31/2022	17:01:00	51.222	30.372	3.49	30.2	7.78	1541.25
8/31/2022	17:01:00	51.222	30.371	3.56	30.2	7.78	1541.25
8/31/2022	17:01:00	51.222	30.37	3.6	30.2	7.78	1541.25
8/31/2022	17:01:00	51.222	30.37	3.67	30.2	7.78	1541.25
8/31/2022	17:01:00	51.223	30.369	3.71	30.2	7.78	1541.25
8/31/2022	17:01:00	51.226	30.367	3.75	30.2	7.78	1541.25
8/31/2022	17:01:01	51.226	30.366	3.79	30.2	7.78	1541.25
8/31/2022	17:01:01	51.227	30.365	3.82	30.2	7.78	1541.25
8/31/2022	17:01:01	51.227	30.364	3.87	30.2	7.78	1541.25
8/31/2022	17:01:01	51.227	30.363	3.91	30.2	7.78	1541.25
8/31/2022	17:01:01	51.227	30.363	3.94	30.2	7.78	1541.25
8/31/2022	17:01:01	51.228	30.364	3.96	30.2	7.78	1541.25
8/31/2022	17:01:01	51.229	30.364	4	30.2	7.78	1541.25
8/31/2022	17:01:01	51.232	30.362	4.02	30.2	7.78	1541.25
8/31/2022	17:01:01	51.238	30.359	4.06	30.2	7.75	1541.25
8/31/2022	17:01:01	51.241	30.356	4.08	30.2	7.78	1541.25
8/31/2022	17:01:01	51.248	30.351	4.11	30.2	7.75	1541.25
8/31/2022	17:01:01	51.252	30.346	4.16	30.2	7.78	1541.24
8/31/2022	17:01:01	51.259	30.341	4.19	30.2	7.78	1541.24
8/31/2022	17:01:01	51.27	30.33	4.24	30.2	7.78	1541.23
8/31/2022	17:01:01	51.281	30.319	4.3	30.2	7.78	1541.23
8/31/2022	17:01:01	51.281	30.316	4.35	30.2	7.78	1541.22
8/31/2022	17:01:01	51.282	30.312	4.39	30.2	7.78	1541.22

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	17:01:01	51.285	30.304	4.46	30.2	7.75	1541.21
8/31/2022	17:01:01	51.287	30.3	4.5	30.2	7.78	1541.21
8/31/2022	17:01:02	51.292	30.292	4.57	30.2	7.78	1541.2
8/31/2022	17:01:02	51.294	30.289	4.61	30.2	7.78	1541.2
8/31/2022	17:01:02	51.295	30.286	4.66	30.2	7.78	1541.19
8/31/2022	17:01:02	51.294	30.28	4.74	30.2	7.78	1541.19

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	18:00:22	52.027	30.786	1.05	30.8	7.75	1542.35
8/31/2022	18:00:22	52.025	30.786	1.08	30.8	7.75	1542.35
8/31/2022	18:00:22	52.025	30.786	1.12	30.8	7.75	1542.35
8/31/2022	18:00:22	52.025	30.786	1.15	30.8	7.75	1542.35
8/31/2022	18:00:22	52.026	30.788	1.19	30.8	7.75	1542.35
8/31/2022	18:00:22	52.027	30.788	1.22	30.8	7.75	1542.35
8/31/2022	18:00:22	52.027	30.789	1.27	30.8	7.75	1542.35
8/31/2022	18:00:22	52.026	30.788	1.31	30.8	7.75	1542.35
8/31/2022	18:00:22	52.026	30.788	1.38	30.8	7.75	1542.35
8/31/2022	18:00:22	52.025	30.788	1.42	30.8	7.75	1542.36
8/31/2022	18:00:23	52.025	30.787	1.48	30.8	7.75	1542.35
8/31/2022	18:00:23	52.025	30.786	1.52	30.8	7.75	1542.35
8/31/2022	18:00:23	52.025	30.787	1.55	30.8	7.75	1542.36
8/31/2022	18:00:23	52.025	30.786	1.61	30.8	7.75	1542.36
8/31/2022	18:00:23	52.027	30.788	1.64	30.8	7.75	1542.36
8/31/2022	18:00:23	52.027	30.788	1.68	30.8	7.75	1542.36
8/31/2022	18:00:23	52.027	30.788	1.7	30.8	7.75	1542.36
8/31/2022	18:00:23	52.027	30.788	1.73	30.8	7.75	1542.36
8/31/2022	18:00:23	52.024	30.786	1.74	30.8	7.75	1542.36
8/31/2022	18:00:23	52.023	30.784	1.76	30.8	7.75	1542.35
8/31/2022	18:00:23	52.022	30.782	1.77	30.8	7.75	1542.35
8/31/2022	18:00:23	52.02	30.782	1.78	30.8	7.75	1542.35
8/31/2022	18:00:23	52.02	30.782	1.78	30.8	7.75	1542.35
8/31/2022	18:00:23	52.02	30.784	1.79	30.8	7.75	1542.35
8/31/2022	18:00:23	52.02	30.784	1.82	30.8	7.75	1542.35
8/31/2022	18:00:23	52.021	30.784	1.84	30.8	7.75	1542.35
8/31/2022	18:00:23	52.022	30.783	1.88	30.8	7.75	1542.35
8/31/2022	18:00:23	52.022	30.782	1.91	30.8	7.75	1542.35
8/31/2022	18:00:23	52.022	30.778	1.94	30.8	7.75	1542.35
8/31/2022	18:00:24	52.022	30.777	1.99	30.8	7.75	1542.35
8/31/2022	18:00:24	52.02	30.776	2.05	30.8	7.75	1542.34
8/31/2022	18:00:24	52.02	30.775	2.09	30.8	7.75	1542.34
8/31/2022	18:00:24	52.021	30.775	2.16	30.8	7.75	1542.35
8/31/2022	18:00:24	52.021	30.775	2.21	30.8	7.75	1542.35
8/31/2022	18:00:24	52.02	30.777	2.25	30.8	7.75	1542.35
8/31/2022	18:00:24	52.021	30.777	2.32	30.8	7.75	1542.35
8/31/2022	18:00:24	52.022	30.778	2.36	30.8	7.75	1542.35
8/31/2022	18:00:24	52.02	30.777	2.43	30.8	7.75	1542.35
8/31/2022	18:00:24	52.019	30.777	2.46	30.8	7.75	1542.35
8/31/2022	18:00:24	52.018	30.776	2.51	30.8	7.75	1542.35
8/31/2022	18:00:24	52.016	30.775	2.57	30.8	7.75	1542.35
8/31/2022	18:00:24	52.017	30.775	2.61	30.8	7.75	1542.35

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	18:00:24	52.018	30.775	2.65	30.8	7.75	1542.35
8/31/2022	18:00:24	52.022	30.779	2.67	30.8	7.75	1542.36
8/31/2022	18:00:24	52.025	30.78	2.71	30.8	7.75	1542.36
8/31/2022	18:00:24	52.027	30.781	2.74	30.8	7.75	1542.37
8/31/2022	18:00:24	52.029	30.784	2.79	30.8	7.75	1542.37
8/31/2022	18:00:25	52.031	30.785	2.81	30.8	7.75	1542.38
8/31/2022	18:00:25	52.028	30.785	2.85	30.8	7.75	1542.38
8/31/2022	18:00:25	52.028	30.784	2.9	30.8	7.75	1542.38
8/31/2022	18:00:25	52.028	30.783	2.94	30.8	7.75	1542.37
8/31/2022	18:00:25	52.026	30.782	3	30.8	7.75	1542.37
8/31/2022	18:00:25	52.027	30.782	3.06	30.8	7.75	1542.37
8/31/2022	18:00:25	52.027	30.782	3.1	30.8	7.75	1542.37
8/31/2022	18:00:25	52.028	30.782	3.14	30.8	7.75	1542.38
8/31/2022	18:00:25	52.03	30.784	3.2	30.8	7.75	1542.38
8/31/2022	18:00:25	52.033	30.786	3.23	30.8	7.75	1542.39
8/31/2022	18:00:25	52.034	30.79	3.28	30.8	7.75	1542.39
8/31/2022	18:00:25	52.036	30.794	3.31	30.8	7.75	1542.4
8/31/2022	18:00:25	52.037	30.794	3.34	30.8	7.75	1542.4
8/31/2022	18:00:25	52.041	30.798	3.38	30.8	7.75	1542.41
8/31/2022	18:00:25	52.044	30.802	3.4	30.8	7.75	1542.42
8/31/2022	18:00:25	52.046	30.806	3.43	30.8	7.75	1542.43
8/31/2022	18:00:25	52.052	30.812	3.45	30.8	7.75	1542.44
8/31/2022	18:00:25	52.052	30.817	3.47	30.8	7.75	1542.45
8/31/2022	18:00:25	52.051	30.818	3.48	30.8	7.75	1542.45
8/31/2022	18:00:26	52.051	30.819	3.5	30.8	7.75	1542.45
8/31/2022	18:00:26	52.05	30.819	3.52	30.8	7.75	1542.45
8/31/2022	18:00:26	52.05	30.819	3.56	30.8	7.75	1542.45
8/31/2022	18:00:26	52.051	30.819	3.59	30.8	7.75	1542.45
8/31/2022	18:00:26	52.051	30.819	3.61	30.8	7.75	1542.45
8/31/2022	18:00:26	52.051	30.819	3.66	30.8	7.75	1542.45
8/31/2022	18:00:26	52.051	30.819	3.7	30.8	7.75	1542.45
8/31/2022	18:00:26	51.917	30.819	3.72	30.8	7.75	1542.36

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	18:58:06	50.95	30.437	1	30.1	7.75	1541.12
8/31/2022	18:58:06	50.95	30.437	1.05	30.1	7.75	1541.12
8/31/2022	18:58:06	50.949	30.437	1.08	30.1	7.75	1541.12
8/31/2022	18:58:06	50.949	30.437	1.13	30.1	7.75	1541.12
8/31/2022	18:58:06	50.948	30.437	1.16	30.1	7.75	1541.12
8/31/2022	18:58:06	50.949	30.439	1.19	30.1	7.75	1541.12
8/31/2022	18:58:06	50.95	30.44	1.24	30.1	7.75	1541.13
8/31/2022	18:58:07	50.95	30.44	1.26	30.1	7.75	1541.13
8/31/2022	18:58:07	50.952	30.441	1.29	30.1	7.75	1541.13
8/31/2022	18:58:07	50.954	30.442	1.32	30.1	7.75	1541.13
8/31/2022	18:58:07	50.958	30.441	1.33	30.1	7.75	1541.13
8/31/2022	18:58:07	50.961	30.44	1.35	30.1	7.75	1541.14
8/31/2022	18:58:07	50.963	30.439	1.36	30.1	7.75	1541.14
8/31/2022	18:58:07	50.962	30.438	1.36	30.1	7.75	1541.13
8/31/2022	18:58:07	50.961	30.438	1.37	30.1	7.75	1541.13
8/31/2022	18:58:07	50.959	30.439	1.38	30.1	7.75	1541.13
8/31/2022	18:58:07	50.958	30.44	1.38	30.1	7.75	1541.13
8/31/2022	18:58:07	50.956	30.441	1.38	30.1	7.75	1541.13
8/31/2022	18:58:07	50.955	30.441	1.39	30.1	7.75	1541.13
8/31/2022	18:58:07	50.952	30.442	1.39	30.1	7.75	1541.13
8/31/2022	18:58:07	50.952	30.441	1.39	30.1	7.75	1541.13
8/31/2022	18:58:07	50.954	30.44	1.4	30.1	7.75	1541.13
8/31/2022	18:58:07	50.958	30.437	1.4	30.1	7.75	1541.13
8/31/2022	18:58:07	50.961	30.435	1.4	30.1	7.75	1541.13
8/31/2022	18:58:07	50.961	30.436	1.4	30.1	7.75	1541.13
8/31/2022	18:58:08	50.961	30.439	1.4	30.1	7.75	1541.13
8/31/2022	18:58:08	50.957	30.441	1.41	30.1	7.75	1541.13
8/31/2022	18:58:08	50.958	30.442	1.42	30.1	7.75	1541.14
8/31/2022	18:58:08	50.958	30.441	1.42	30.1	7.75	1541.14
8/31/2022	18:58:08	50.958	30.441	1.43	30.1	7.75	1541.14
8/31/2022	18:58:08	50.96	30.44	1.44	30.1	7.75	1541.14
8/31/2022	18:58:08	50.96	30.439	1.45	30.1	7.75	1541.13
8/31/2022	18:58:08	50.961	30.437	1.46	30.1	7.75	1541.13
8/31/2022	18:58:08	50.963	30.434	1.47	30.1	7.75	1541.13
8/31/2022	18:58:08	50.965	30.433	1.47	30.1	7.75	1541.13
8/31/2022	18:58:08	50.972	30.431	1.47	30.1	7.72	1541.13
8/31/2022	18:58:08	50.976	30.43	1.47	30.1	7.75	1541.13
8/31/2022	18:58:08	50.987	30.426	1.47	30.1	7.75	1541.13
8/31/2022	18:58:08	50.991	30.423	1.48	30.1	7.75	1541.13
8/31/2022	18:58:08	50.993	30.421	1.5	30.1	7.75	1541.13
8/31/2022	18:58:08	50.994	30.42	1.52	30.1	7.75	1541.13
8/31/2022	18:58:08	51	30.42	1.54	30.1	7.75	1541.14

CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	18:58:08	51.024	30.415	1.56	30.1	7.75	1541.15
8/31/2022	18:58:08	51.042	30.407	1.58	30.1	7.75	1541.15
8/31/2022	18:58:09	51.063	30.4	1.6	30.1	7.75	1541.15
8/31/2022	18:58:09	51.103	30.386	1.62	30.1	7.75	1541.16
8/31/2022	18:58:09	51.125	30.376	1.63	30.1	7.75	1541.16
8/31/2022	18:58:09	51.132	30.372	1.64	30.1	7.75	1541.16
8/31/2022	18:58:09	51.136	30.367	1.65	30.1	7.75	1541.15
8/31/2022	18:58:09	51.135	30.363	1.67	30.1	7.75	1541.15
8/31/2022	18:58:09	51.131	30.363	1.7	30.1	7.75	1541.14
8/31/2022	18:58:09	51.12	30.366	1.71	30.1	7.75	1541.14
8/31/2022	18:58:09	51.114	30.369	1.73	30.1	7.75	1541.14
8/31/2022	18:58:09	51.105	30.373	1.74	30.1	7.75	1541.14
8/31/2022	18:58:09	51.105	30.375	1.76	30.1	7.75	1541.14
8/31/2022	18:58:09	51.108	30.375	1.78	30.1	7.75	1541.15
8/31/2022	18:58:09	51.12	30.373	1.81	30.1	7.75	1541.15
8/31/2022	18:58:09	51.128	30.372	1.83	30.1	7.75	1541.16
8/31/2022	18:58:09	51.149	30.368	1.85	30.1	7.75	1541.17
8/31/2022	18:58:09	51.166	30.365	1.86	30.1	7.75	1541.17
8/31/2022	18:58:09	51.204	30.357	1.88	30.1	7.75	1541.19
8/31/2022	18:58:09	51.221	30.353	1.9	30.1	7.75	1541.19
8/31/2022	18:58:10	51.248	30.348	1.92	30.1	7.75	1541.21
8/31/2022	18:58:10	51.256	30.345	1.94	30.1	7.75	1541.21
8/31/2022	18:58:10	51.261	30.342	1.95	30.1	7.75	1541.21
8/31/2022	18:58:10	51.275	30.338	1.96	30.1	7.75	1541.21
8/31/2022	18:58:10	51.281	30.336	1.98	30.1	7.75	1541.21
8/31/2022	18:58:10	51.291	30.333	2	30.1	7.75	1541.22
8/31/2022	18:58:10	51.293	30.332	2.01	30.1	7.75	1541.21
8/31/2022	18:58:10	51.293	30.331	2.04	30.1	7.75	1541.21
8/31/2022	18:58:10	51.291	30.331	2.05	30.1	7.75	1541.21
8/31/2022	18:58:10	51.292	30.329	2.07	30.1	7.75	1541.21
8/31/2022	18:58:10	51.295	30.328	2.1	30.1	7.75	1541.21
8/31/2022	18:58:10	51.301	30.327	2.12	30.1	7.75	1541.22
8/31/2022	18:58:10	51.318	30.324	2.14	30.1	7.75	1541.22
8/31/2022	18:58:10	51.326	30.322	2.15	30.1	7.75	1541.23
8/31/2022	18:58:10	51.339	30.32	2.16	30.1	7.75	1541.23
8/31/2022	18:58:10	51.342	30.32	2.18	30.1	7.72	1541.23
8/31/2022	18:58:10	51.343	30.321	2.19	30.1	7.75	1541.24
8/31/2022	18:58:10	51.348	30.321	2.21	30.1	7.72	1541.24
8/31/2022	18:58:10	51.352	30.319	2.23	30.1	7.75	1541.24
8/31/2022	18:58:11	51.354	30.318	2.24	30.1	7.75	1541.24
8/31/2022	18:58:11	51.355	30.318	2.26	30.1	7.75	1541.24
8/31/2022	18:58:11	51.369	30.316	2.29	30.1	7.75	1541.25

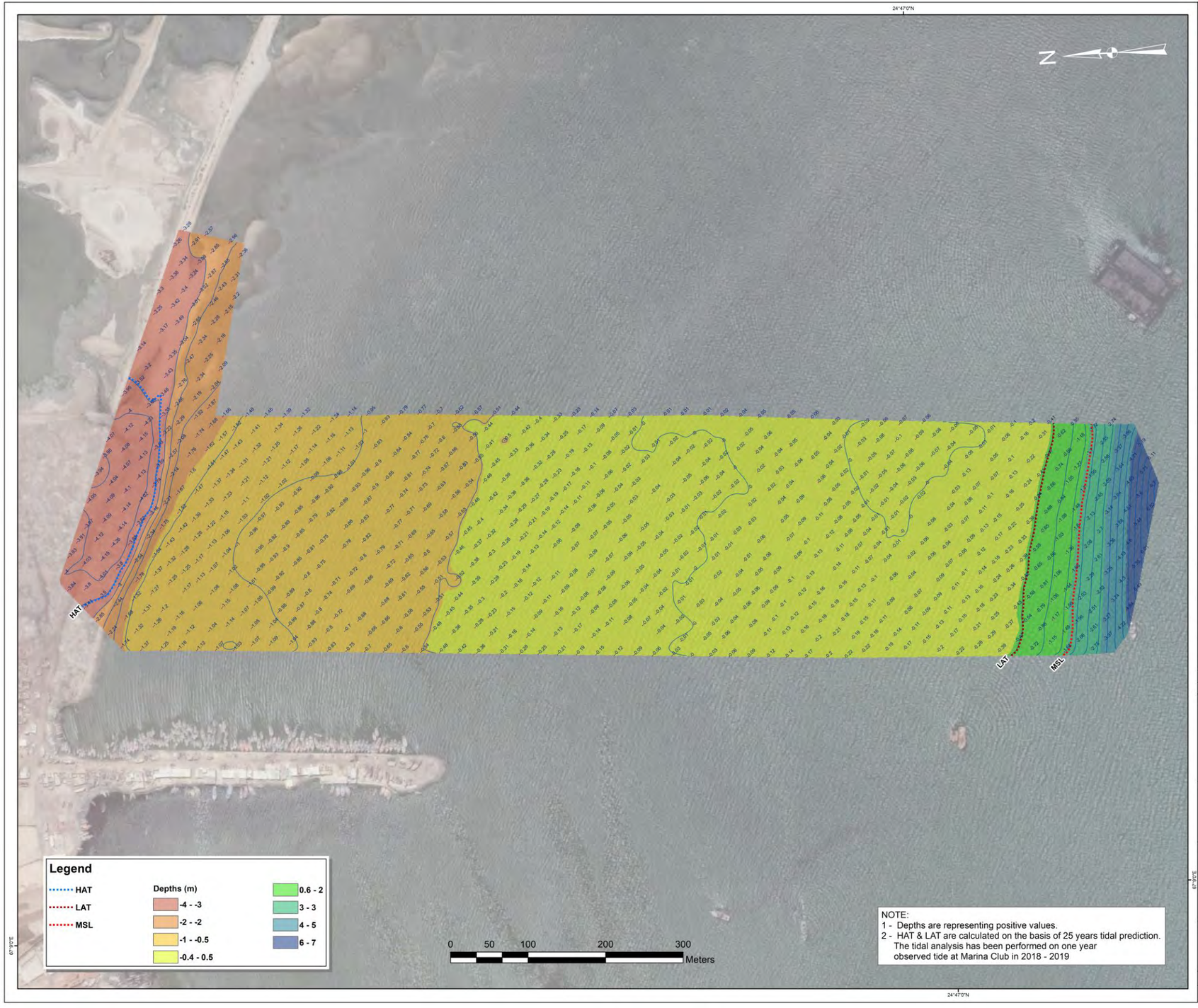
CTD Measurments							
Observer:	Khurshid						
Location:	E 313402 N 2741987						
Season	Summer Moonson (Rainy Season)						
Date	Time	Conductivity (mS/cm)	Temperature (C)	Depth (m)	Salinity (PSU)	Battery (V)	Calc. SV (m/s)
8/31/2022	18:58:11	51.383	30.314	2.31	30.1	7.75	1541.26
8/31/2022	18:58:11	51.419	30.31	2.33	30.1	7.75	1541.27
8/31/2022	18:58:11	51.438	30.308	2.35	30.1	7.72	1541.28
8/31/2022	18:58:11	51.453	30.305	2.38	30.1	7.75	1541.29
8/31/2022	18:58:11	51.471	30.301	2.4	30.1	7.75	1541.3
8/31/2022	18:58:11	51.475	30.299	2.42	30.1	7.75	1541.3
8/31/2022	18:58:11	51.48	30.296	2.46	30.1	7.72	1541.3
8/31/2022	18:58:11	51.482	30.295	2.49	30.1	7.75	1541.3
8/31/2022	18:58:11	51.484	30.295	2.51	30.1	7.75	1541.3
8/31/2022	18:58:11	51.487	30.294	2.54	30.1	7.75	1541.3
8/31/2022	18:58:11	51.497	30.294	2.56	30.1	7.75	1541.31
8/31/2022	18:58:11	51.508	30.295	2.59	30.1	7.75	1541.32
8/31/2022	18:58:11	51.527	30.295	2.63	30.1	7.72	1541.33
8/31/2022	18:58:11	51.567	30.299	2.65	30.1	7.75	1541.36
8/31/2022	18:58:11	51.588	30.301	2.69	30.1	7.75	1541.38
8/31/2022	18:58:11	51.623	30.304	2.72	30.1	7.75	1541.41
8/31/2022	18:58:12	51.629	30.305	2.75	30.1	7.75	1541.42
8/31/2022	18:58:12	51.638	30.306	2.8	30.1	7.75	1541.43
8/31/2022	18:58:12	51.647	30.306	2.84	30.1	7.75	1541.43
8/31/2022	18:58:12	51.68	30.309	2.87	30.1	7.75	1541.46
8/31/2022	18:58:12	51.712	30.312	2.92	30.1	7.72	1541.49
8/31/2022	18:58:12	51.783	30.318	2.95	30.6	7.75	1541.54
8/31/2022	18:58:12	51.814	30.322	2.98	30.6	7.75	1541.57
8/31/2022	18:58:12	51.836	30.326	3.01	30.6	7.75	1541.59
8/31/2022	18:58:12	51.875	30.333	3.04	30.6	7.75	1541.63
8/31/2022	18:58:12	51.886	30.336	3.08	30.6	7.75	1541.64
8/31/2022	18:58:12	51.912	30.341	3.11	30.6	7.75	1541.67
8/31/2022	18:58:12	51.926	30.343	3.14	30.6	7.75	1541.68
8/31/2022	18:58:12	51.935	30.346	3.17	30.6	7.75	1541.69
8/31/2022	18:58:12	51.945	30.349	3.21	30.6	7.72	1541.7
8/31/2022	18:58:12	51.952	30.352	3.23	30.6	7.72	1541.71
8/31/2022	18:58:12	51.956	30.353	3.26	30.6	7.75	1541.72
8/31/2022	18:58:12	51.961	30.354	3.28	30.6	7.75	1541.72
8/31/2022	18:58:12	51.974	30.357	3.31	30.6	7.75	1541.74
8/31/2022	18:58:13	51.982	30.358	3.33	30.6	7.75	1541.74
8/31/2022	18:58:13	51.996	30.359	3.35	30.6	7.75	1541.76
8/31/2022	18:58:13	52.004	30.36	3.38	30.6	7.75	1541.76
8/31/2022	18:58:13	52.011	30.361	3.4	30.6	7.72	1541.77
8/31/2022	18:58:13	52.021	30.362	3.43	30.6	7.75	1541.78
8/31/2022	18:58:13	52.025	30.363	3.46	30.6	7.75	1541.78
8/31/2022	18:58:13	52.034	30.364	3.49	30.6	7.75	1541.79
8/31/2022	18:58:13	52.038	30.364	3.52	30.6	7.72	1541.79

CTD Measurments							
Observer:	**Khurshid**						
Location:	**E 313402 N 2741987**						
Season	**Summer Moonson (Rainy Season)**						
Date	**Time**	**Conductivity (mS/cm)**	**Temperature (C)**	**Depth (m)**	**Salinity (PSU)**	**Battery (V)**	**Calc. SV (m/s)**
8/31/2022	18:58:13	52.046	30.365	3.55	30.6	7.75	1541.8
8/31/2022	18:58:13	52.049	30.366	3.58	30.6	7.75	1541.8
8/31/2022	18:58:13	52.055	30.366	3.62	30.6	7.75	1541.81
8/31/2022	18:58:13	52.06	30.366	3.64	30.6	7.75	1541.81
8/31/2022	18:58:13	52.066	30.365	3.66	30.6	7.75	1541.82
8/31/2022	18:58:13	52.077	30.366	3.7	30.6	7.75	1541.83
8/31/2022	18:58:13	52.082	30.367	3.73	30.6	7.72	1541.83
8/31/2022	18:58:13	52.09	30.368	3.77	30.6	7.72	1541.84
8/31/2022	18:58:13	52.092	30.369	3.8	30.6	7.75	1541.84
8/31/2022	18:58:13	52.097	30.368	3.84	30.6	7.75	1541.85
8/31/2022	18:58:13	52.098	30.368	3.88	30.6	7.72	1541.85
8/31/2022	18:58:14	52.095	30.369	3.89	30.6	7.72	1541.85
8/31/2022	18:58:14	51.643	30.369	3.9	30.6	7.75	1541.54

Annexure-B

Bathymetric and Beach Profile

Drawing No. G-001:	Depth Representation with reference to Chart Datum (CD)
Drawing No. G-002:	Depth Representation with reference to Lowest Astronomical Tide (LAT)
Drawing No. G-003:	Depth Representative with reference to Highest Astronomical Tide (HAT)



Key Plan

Pakistan East Coast
Bathymetric Survey (North East of Ibrahim Hyderi)

Date of Survey

Single Beam : 16-31 August 2022

Datum Projection Parameters

Datum Name: WGS - 84
Ellipsoid: 6378137.00 m
Ellipsoid 1/F: 298.2572235630
Projection : UTM Zone 42N
False Easting: 500,000

Horizontal & Vertical Control:
Base Point = Marina
N 24°47'44.16940" E 67°04'48.98814" Elp. Ht. -35.679m
UTM = N 2743679.211, E 305938.104
Height: 9.981m above CD

Base Point = KWSB (BM-1)
N 24°47'34.65163" E 67°09'21.90531" Elp. Ht.-41.411
UTM = N 2743280.751, E 313599.454
Height : 4.249m above CD

Equipment Details

Survey Boat, Single Beam Echosounder SB,
Dual Frequency GPS

Data Processing

Single Beam Line Intervel 25m
Trajectory : Precise Positioning Calculation
Data Cleaning: Hypack Max
Data Presentation: ArcGIS

Weather During Conduct of Survey

Wind Direction = W / SW
Wind Speed = 02 to 08 Kts
Sea State = 1-2
Swell Height = 0.01 - 0.5m

Tidal Statistics

HAT: 3.47 m LAT: -0.51 m
MHWS: 3.03 m MHWN: 2.35 m
MLWN: 1.28 m MLWS: 0.61 m

Accuracy : As per IHO S44 Standards

Rev.		Drawn	Checked	Date

Client:

KARACHI WATER AND SEWERAGE BOARD

Consultant:

Techno-Consult International

Project:

Feasibility Study & Transaction Advisory Services for Development of 5 MGD Desalination Project Under The Public-Private Partnership Mode

Subject:

Bathymetry Chart
Depth Representation with Reference to Chart Datum (CD)

Size	Scale	Project number	Drawing No.
A1	1:2,200	ED-GIS-262	G-001

24°47'0"N

N

67°3'0"E

67°3'0"E

24°47'0"N

0 50 100 200 300 Meters

Legend

Depths (m)

-4.8 - -3.5
-3.4 - -2.1
-2 - -1
-0.9 - -0.056
-0.055 - 1.2
1.3 - 2.6
2.7 - 4.3
4.4 - 6.7

NOTE:
1 - Depths are representing positive values.
2 - HAT & LAT are calculated on the basis of 25 years tidal prediction. The tidal analysis has been performed on one year observed tide at Marina Club in 2018 - 2019

Key Plan

Pakistan East Coast
Bathymetric Survey (North East of Ibrahim Hyderi)

Date of Survey

Single Beam : 16-31 August 2022

Datum Projection Parameters

Datum Name: WGS - 84
Ellipsoid: 6378137.00 m
Ellipsoid 1/F: 298.2572235630
Projection : UTM Zone 42N
False Easting: 500,000

Horizontal & Vertical Control:
Base Point = Marina
N 24°47'44.16940" E 67°04'48.98814" Elp. Ht. -35.679m
UTM = N 2743679.211, E 305938.104
Height: 9.981m above CD

Base Point = KWSB (BM-1)
N 24°47'34.65163" E 67°09'21.90531" Elp. Ht.-41.411
UTM = N 2743280.751, E 313599.454
Height : 4.249m above CD

Equipment Details

Survey Boat, Single Beam Echosounder SB, Dual Frequency GPS

Data Processing

Single Beam Line Intervel 25m
Trajectory : Precise Positioning Calculation
Data Cleaning: Hypack Max
Data Presentation: ArcGIS

Weather During Conduct of Survey

Wind Direction = W / SW
Wind Speed = 02 to 08 Kts
Sea State = 1-2
Swell Height = 0.01 - 0.5m

Tidal Statistics

HAT: 3.47 m LAT: -0.51 m
MHWS: 3.03 m MHWN: 2.35 m
MLWN: 1.28 m MLWS: 0.61 m

Accuracy : As per IHO S44 Standards

Rev.		Drawn	Checked	Date

Client:

KARACHI WATER AND SEWERAGE BOARD

Consultant:

Techno-Consult International

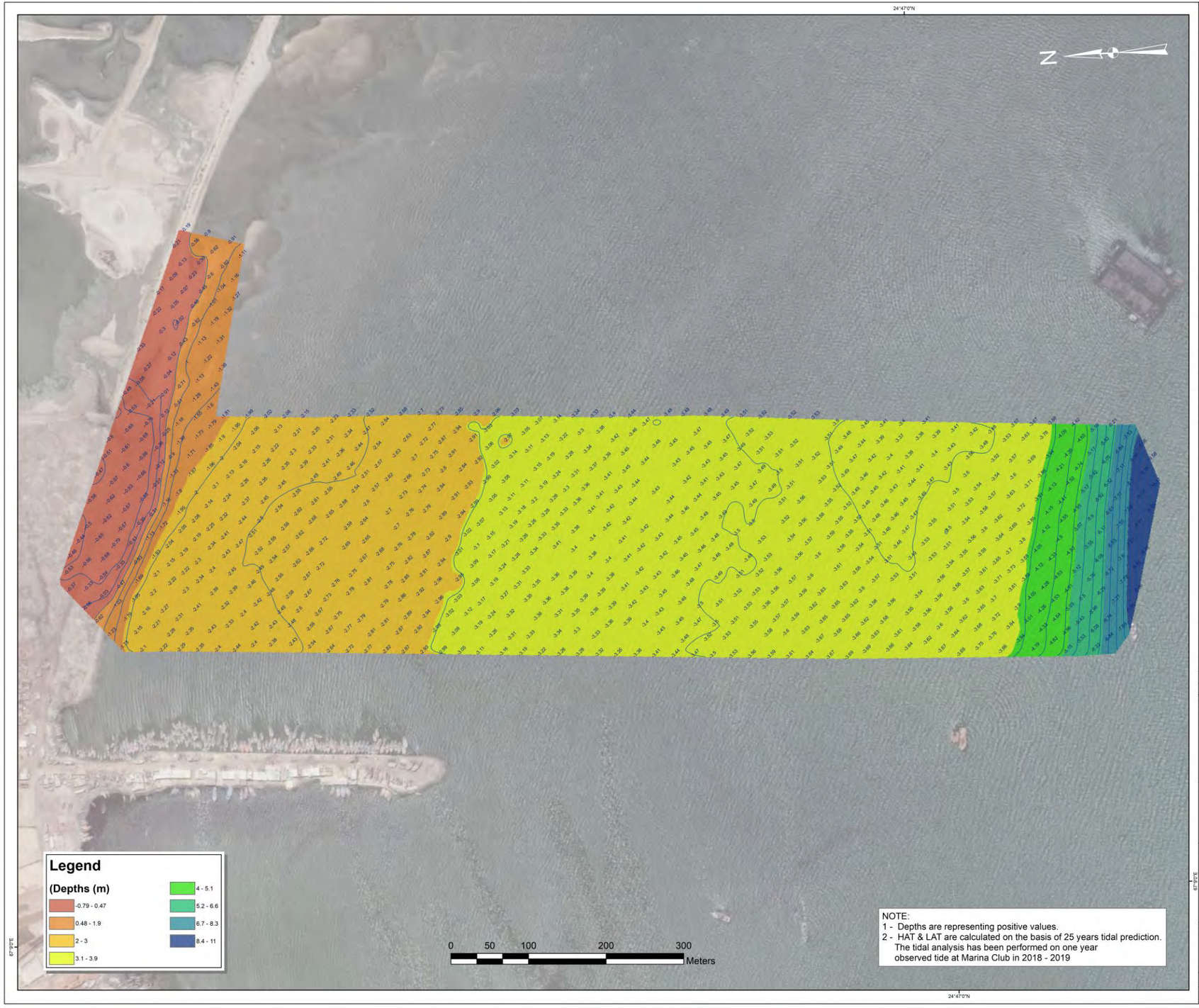
Project:

Feasibility Study & Transaction Advisory Services for Development of 5 MGD Desalination Project Under The Public-Private Partnership Mode

Subject:

Bathymetry Chart
Depth Representation with Reference to Lowest Astronomical Tide (LAT)

Size	Scale	Project number	Drawing No.
A1	1:2,200	ED-GIS-262	G-002



Key Plan

Pakistan East Coast
Bathymetric Survey (North East of Ibrahim Hyderi)

Date of Survey

Single Beam : 16-31 August 2022

Datum Projection Parameters

Datum Name: WGS - 84
Ellipsoid: 6378137.00 m
Ellipsoid 1/F: 298.2572235630
Projection : UTM Zone 42N
False Easting: 500,000

Horizontal & Vertical Control:
Base Point = Marina
N 24°47'44.16940" E 67°04'48.98814" Elp. Ht. -35.679m
UTM = N 2743679.211, E 305938.104
Height: 9.981m above CD

Base Point = KWSB (BM-1)
N 24°47'34.65163" E 67°09'21.90531" Elp. Ht.-41.411
UTM = N 2743280.751, E 313599.454
Height : 4.249m above CD

Equipment Details

Survey Boat, Single Beam Echosounder SB,
Dual Frequency GPS

Data Processing

Single Beam Line Intervel 25m
Trajectory : Precise Positioning Calculation
Data Cleaning: Hypack Max
Data Presentation: ArcGIS

Weather During Conduct of Survey

Wind Direction = W / SW
Wind Speed = 02 to 08 Kts
Sea State = 1-2
Swell Height = 0.01 - 0.5m

Tidal Statistics

HAT: 3.47 m LAT: -0.51 m
MHWS: 3.03 m MHWN: 2.35 m
MLWN: 1.28 m MLWS: 0.61 m

Accuracy : As per IHO S44 Standards

Rev.		Drawn	Checked	Date

Client:

Consultant:

Techno-Consult International

Project:

Feasibility Study & Transaction Advisory Services for Development of 5 MGD Desalination Project Under The Public-Private Partnership Mode

Subject:

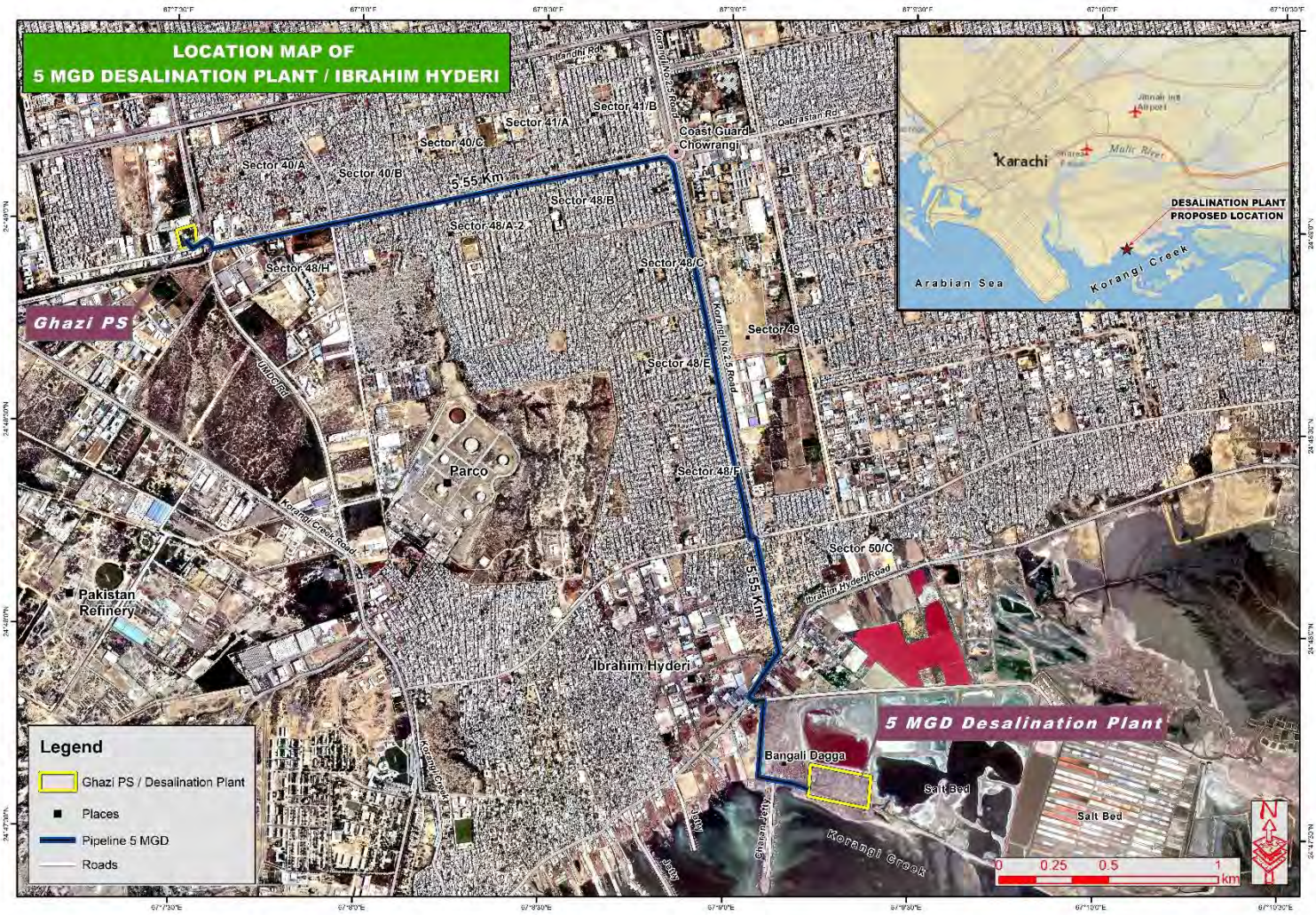
Bathymetry Chart
Depth Representation with Reference to Highest Astronomical Tide (HAT)

Size	Scale	Project number	Drawing No.
A1	1:2,200	ED-GIS-262	G-003

Annexure – II

Geotechnical and Topographic Survey Report

"5 MGD DESALINATION PLANT AT IBRAHIM HYDERI"



GEOGRAPHY & TOPOGRAPHY SURVEY

Karachi Water & Sewerage Board (KW&SB).

INTRODUCTION

General

This Report is being submitted after the completion of detailed topographic survey of selected site location for **"5 MGD Desalination Plant at Ibrahim Hyderi"** project under the supervision of **Karachi Water & Sewerage Board** (KW&SB). The survey report reflects the complete topography of selected desalination plant site, and conveyance route of treated water, through pipeline from selected site plant to Ghazi Pumping Station via Coast Guard Chowrangi. The topographic survey covers alignment details of proposed route which includes all major tracks, crossing streets, electrical poles, telephone poles, light poles, manholes, nullahs that comes along the proposed route. This resultant mapping integrated through a comprehensive Geographic Information System and AutoCAD drawing files.

Geographical Location

The proposed desalination plant site is located in District Korangi at Korangi Creek near small town of Bangali Dagga, in north east of Ibrahim Hyderi, Karachi. The latitude and longitude of the project site is 24°47'37.39"N, 67° 9'18.94"E respectively. In a north direction of the proposed desalination plant, salt beds are found, and in south it has Korange Creek & Charran Jetty in east it has Korangi Creek and in west some industrial plots are found. Proposed desalination plant site is approachable through Korangi Crossing Road after Nasir Jump Bus stop, double metalled road of Landhi starts at left side, on opposite corner the building of Indus Hospital is situated. After travelling approx 4 km on Landhi Road towards Landhi after deputy commissioner office, at right hand side, a double metalled road crosses the Landhi road. This road leads to the Creek Road by crossing the Coast Guard Chowrangi. After turning a right hand side at Creek Road, Fidatiqa International Kanta is present here. In opposite direction a kacha track is found here, which leads to the proposed plant site. A detailed Geographical Map is attached here as figure-1.

Topographic Survey

Surveying is considered a vital link in the process of obtaining quality engineering in the planning and design of projects. Primary emphasis was placed on the surveys for obtaining a accurate information regarding the existing ground features for the selected desalination site and for the proposed water pipeline route. Every effort, therefore, was made to conduct the engineering surveys in a professional manner. An initial planning for survey was essential as other studies and investigations depend on the availability of accurate topographic maps of the area depicting all essential existing features.

To collect the precise measurement of the area, a comprehensive program for land survey was scheduled in the month of July. But due to the unfavorable weather condition, the schedule was disturbed many time.

In August, 2022 six field crew was mobilized to carried out the topographic survey of desalination plant project.

Methodology

Construction planning near the sea shore directly effects with the regular rise and fall of the sea waters. To keep this in mind **Chart Datum** has selected for the whole project. Trimble Differential GPS solution has used to transfer the survey datum from Marina club to project site, as the TCI has already permanent BM installed in Marina club for our some other projects.

Trimble R8s GNSS, Positioning is as follows;

- **STATIC** **H: 3.0 mm + 0.5 ppm** **V: 10.0 mm + 1.0 ppm**
- **RTK** **H: 10.0 mm + 1.0 ppm** **V: 20.0 mm + 1.0 ppm**

Horizontal & Vertical Control

Port Qasim Authority's (PQA) chart datum is the reference datum for the vertical control. While **Universal Transverse Mercator** (UTM) conformal projection that is uses 2 - dimensional Cartesian coordinates system has used to obtain and plot survey data.

For traversing or baseline processing Trimble differential GPS was used in static mode for 2 hours on each control points. **Trimble Business Center** was used for post processing of the observed points. These points were then used for the detailed topographic survey. To maintain the vertical accuracy double leveling was carried out to transfer the accurate vertical reference to the control points in first survey order form. **Nikon 32x** level machine was used along with standard quality and compatible metric leveling staves. The traversing errors and corrections was adjusted at site. Then, corrected references were used for detailed topographic survey.

Topographic Survey of Desalination Plant Site

KW&SB intends to setup a water desalination plant near the sea shore of Karachi city. For this purpose, at the shore of Korangi Creek near a small goth of Bangali Degga, a land parcel of around 10 acres was selected with the consultation of KW&SB. At first the location was identify during the desktop study, later reconnaissance site visit was carried out along with client's representatives.

To maintain the contour interval of 0.1 m intermediate and 0.5 m index, the spot survey with grid size of 1m x 1m was carried out. Electronic distance measurement (EDM) total station of *SOKKIA CX* 105c was used to carried out the spot levelling, *Easting Northing* and *Elevation* were observed at each spot point and stored in the surveying machine. Later the stored data was download and processed in the office and used to developed the contours. Contour map of proposed desalination plant site is attached as figure - 2 Sheet -1.

Topographic Survey of Water Pipeline Route

The proposed route for water pipeline from desalination plant to Ghazi Pumping Station is passing through the Creek Road, Coast Guard Chowrangi, Korangi Qabristan Road and then Ghazi Pumping Station is about 5.5 km in length. Detailed cross section of the proposed routes was carried out at an interval of 50 m for a width of property to property on both sides by covering the double carriage way. All existing ground features though out the proposed route was observed during the survey and marked in the drawing these includes (electric poles, telephone poles, light poles, manholes / chambers, connecting streets etc. Open drains / nullah were also observed during survey with their invert level and show on the drawing.

ESTABLISHMENT OF PERMENANT BENCH MARKS

Permanent Concrete Benchmarks (BM) were established, inside project boundary for

future reference. The locations of benchmark were selected at such places, which are not susceptible to disturbance or damage. The location, bearings and levels of BM, were determined and shown on layout drawings. Total 4 permanent BMs had been established for future use. List of BM is as under ;

LIST OF PERMENANT BENCHMARKS

1. **BM-1** ***E 313599.474*** ***N 2743280.774*** ***Z 4.249***
2. **BM-2** ***E 313648.262*** ***N 2743416.130*** ***Z 4.288***
3. **BM-3** ***E 310554.338*** ***N 2745844.218*** ***Z 5.654***
4. **BM-4** ***E 310547.837*** ***N 2745865.310*** ***Z 6.307***

SURVEY INSTRUMENTS

The following survey instruments has used for the baseline and topographic survey of water desalination plant project.

✓ Survey Teams	✓ 1No
✓ Survey Crew	✓ 6 No
✓ DGPS (Trimble)	✓ 1 Sets
✓ Total Stations (*SOKKIA CX* 105c)	✓ 1No
✓ Survey Vehicles	✓ 2 No
✓ HandHeld GPS (Garmin)	✓ 2 No
✓ Level Machines (NIKON 32x)	✓ 1 No
✓ Alien Computing Machine	✓ 1 No

SOFTWARE USED

Following software had been used for data processing and map making.

✓ AutoCAD Civil 3D	it was used for data processing and contour generating and drawing developing.
✓ Global Mapper 13	It was used for data interchanging from one file type to another file type.
✓ Google Earth Pro	It was used for mainly in survey planning and for field navigation.
✓ ArcGIS 10.6	It was used for developing geographical map making.
✓ Erdas Imagine 9.2	It was used for pan sharpening the satellite image and for base map making.
✓ Trimble Business Center	It was used for GPS data processing.

SURVEY TEAM AT WORK







LOCATION MAP OF
5 MGD DESALINATION PLANT / IBRAHIM HYDERI

Landhi Rd
Korangi No. 2.5 Road
Sector 41/B
Sector 41/A
Sector 40/C
Coast Guard Chowrangi
Qabristan Rd
Sector 40/A
Sector 40/B
5.55 Km
Sector 48/B
Sector 48/A-2
Sector 48/H
Sector 48/C
Ghazi PS
Sector 49
Korangi No. 2.5 Road
UMDC Rd
Sector 48/E
Parco
Sector 48/F
Korangi Creek Road
Sector 50/C
5.55 Km
Ibrahim Hyderi Road
Pakistan Refinery
Ibrahim Hyderi
5 MGD Desalination Plant
Bangali Dagga
Salt Bed
Salt Bed
Korangi Creek
Jetty

Legend

- Ghazi PS / Desalination Plant
- Places
- Pipeline 5 MGD
- Roads

0 0.25 0.5 1 km

N

LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT

Contract :

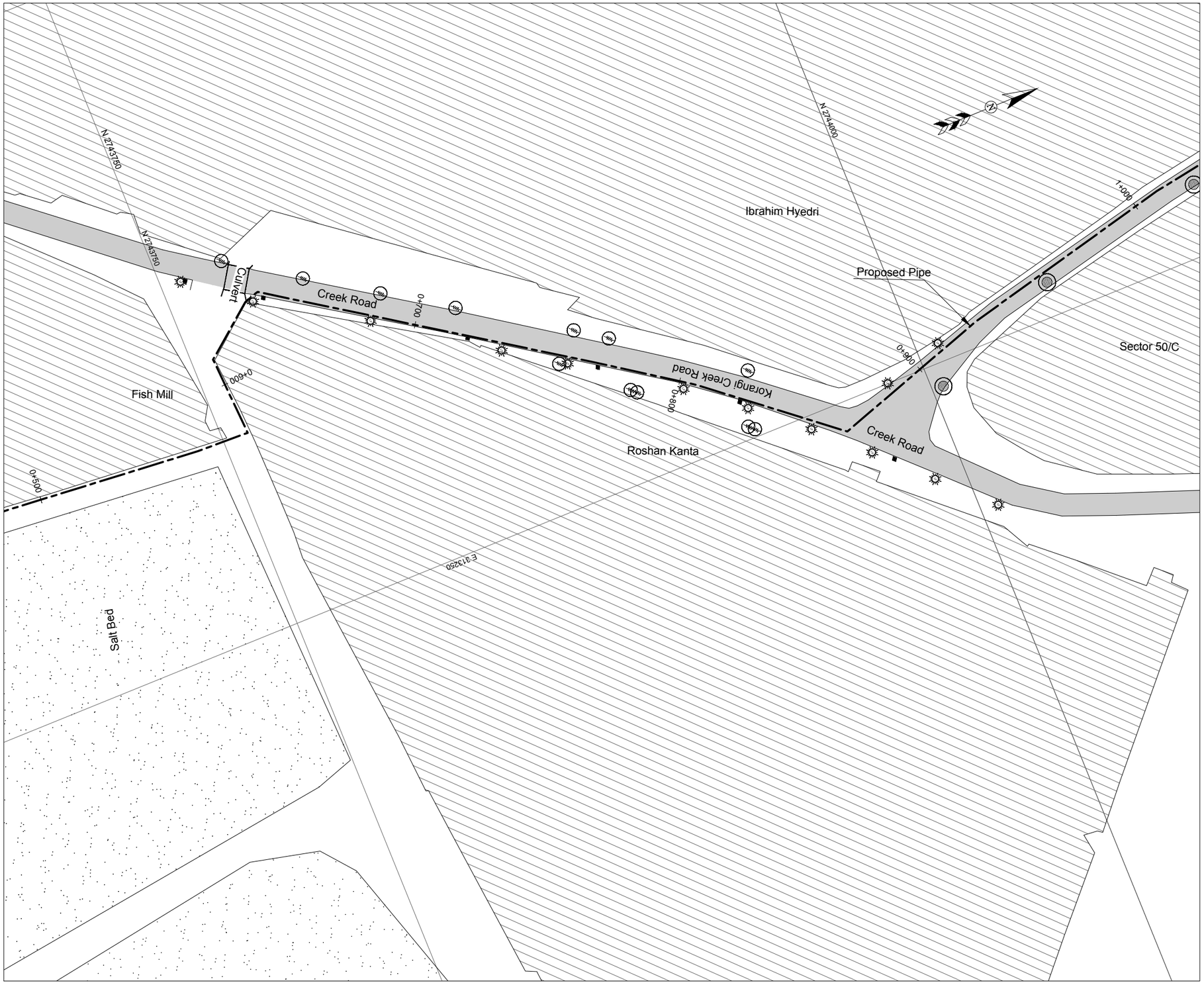
Consultants :

Techno-Consult International (Pvt) Ltd

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 0+000 to 0+500

Designed By :	Date : August 2022
Drawn By :	Sheet : 1 / 11
Checked By :	Drg No :
Approved By :	



LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT

Contract :

Consultants :

Techno-Consult International [Pvt.]Ltd

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN
0+500 to 1+000

Designed By :	Date : August 2022
Drawn By :	Sheet : 2 / 11
Checked By :	Drg No :
Approved By :	

LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT AT IBRAHIM HYDERI

Contract :

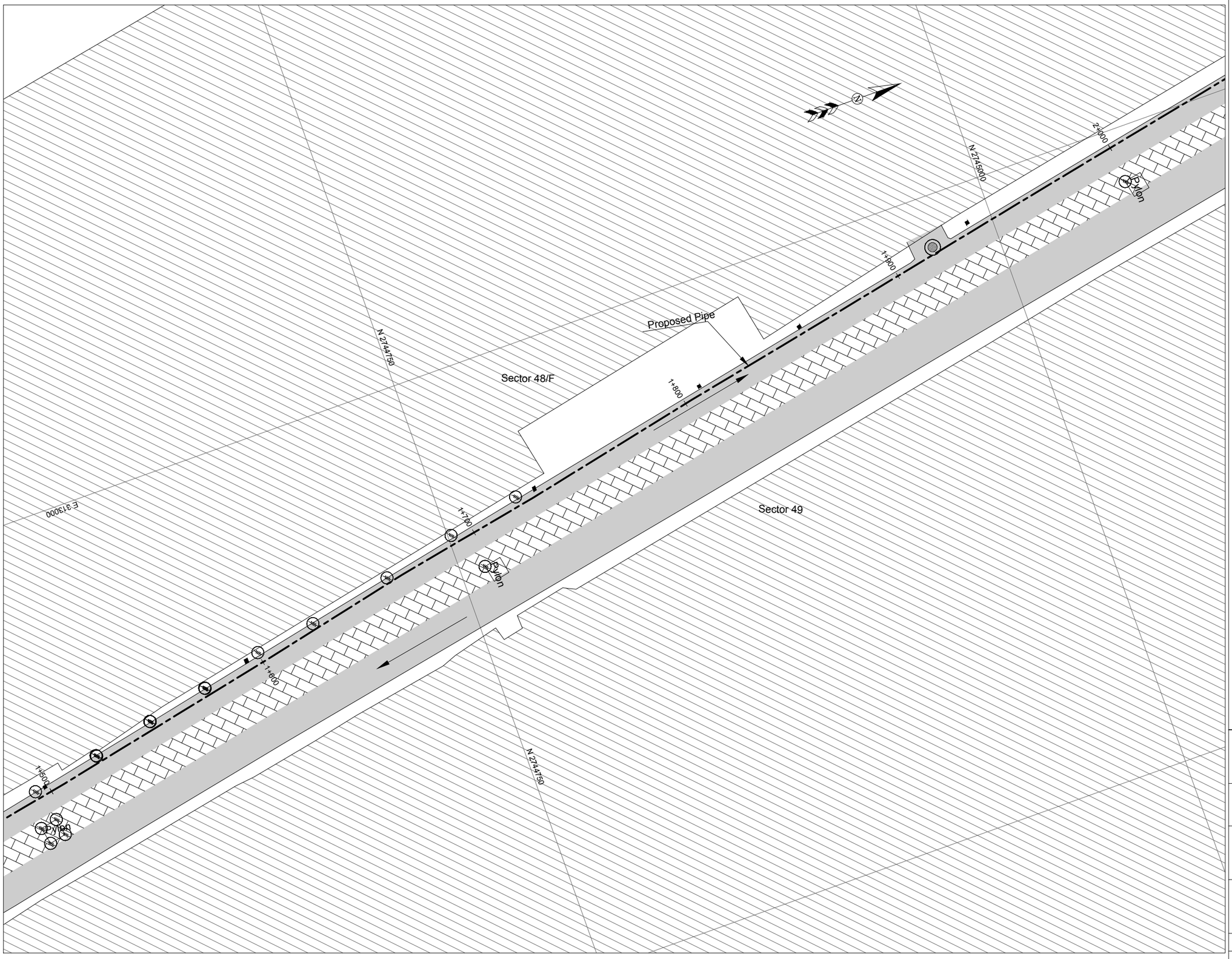
Consultants :

Techno-Consult International [illegible]

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 1+000 TO 1+500

Designed By :	Date : August 2022
Drawn By :	Sheet : 3 / 11
Checked By :	Drg No :
Approved By :	



LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

5 MGD DESALINATION PLANT

Contract :

Consultants :

Techno-Consult International [Pvt.]Co

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 1+500 TO 2+000

Designed By :	Date : August 2022
Drawn By :	Sheet : 4 / 11
Checked By :	Drg No :
Approved By :	

LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT

Contract :

Consultants :

Techno-Consult International (Pvt.)

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 2000 TO 2+500

Designed By :	Date : August 2022
Drawn By :	Sheet : 5 / 11
Checked By :	Drg No :
Approved By :	

LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT

Contract :

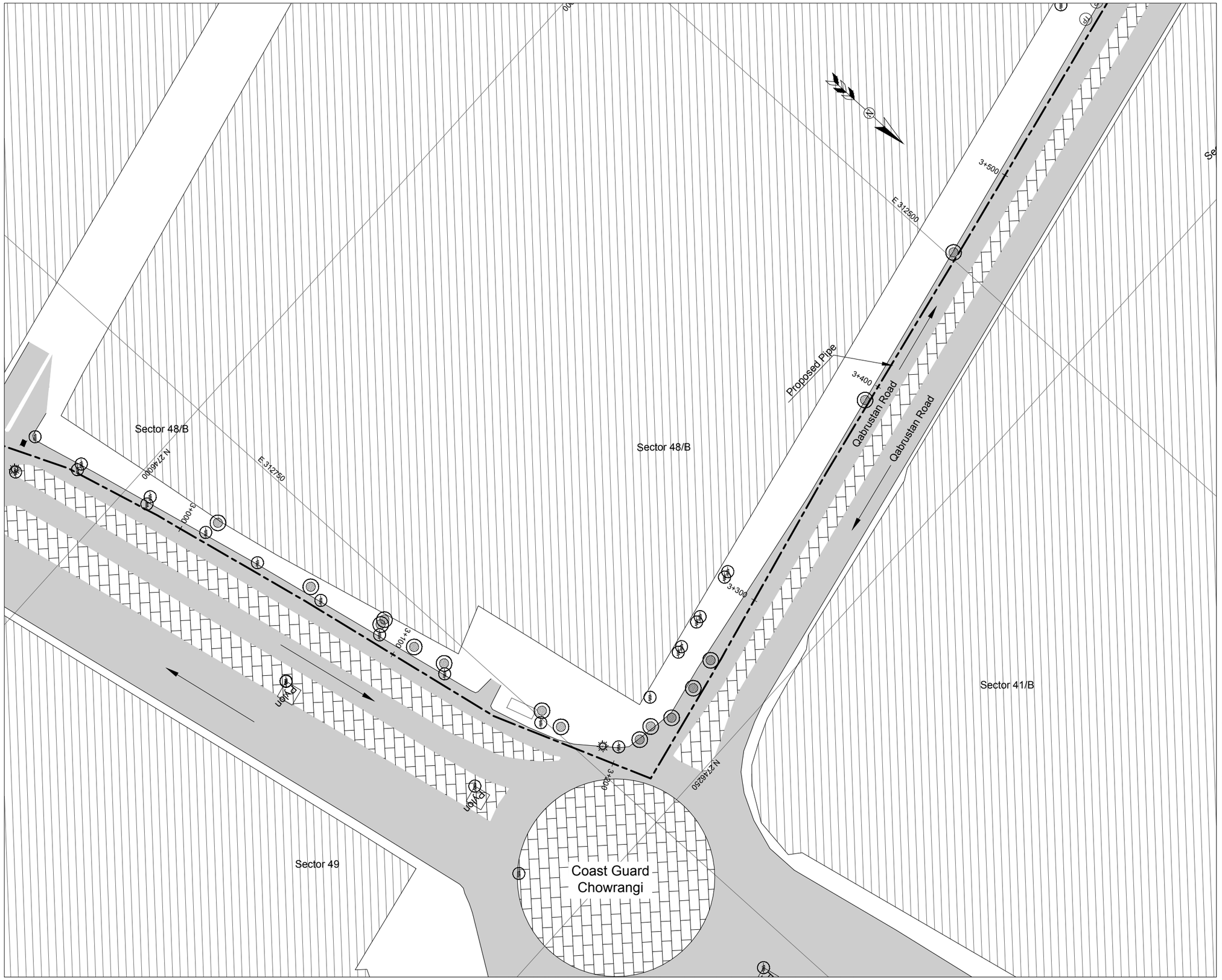
Consultants :

Techno-Consult International (Pvt.) Ltd.

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 2+500 TO 3+000

Designed By :	Date : August 2022
Drawn By :	Sheet : 6 / 11
Checked By :	Drg No :
Approved By :	



LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT

Contract :

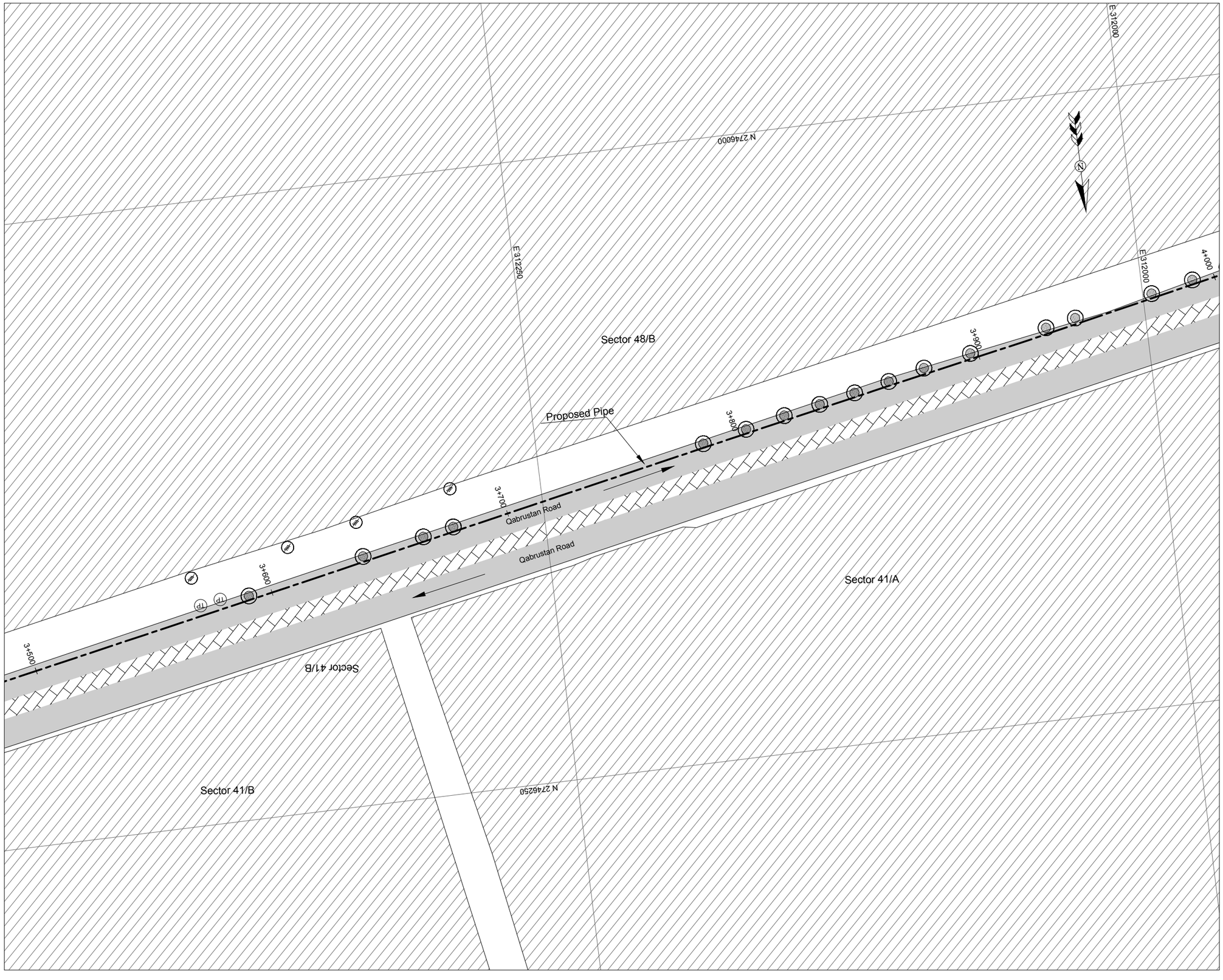
Consultants :

Techno-Consult International (Pvt.) Ltd.

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 3+000 TO 3+500

Designed By :	Date : August 2022
Drawn By :	Sheet : 7 / 11
Checked By :	Drg No :
Approved By :	



LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT

Contract :

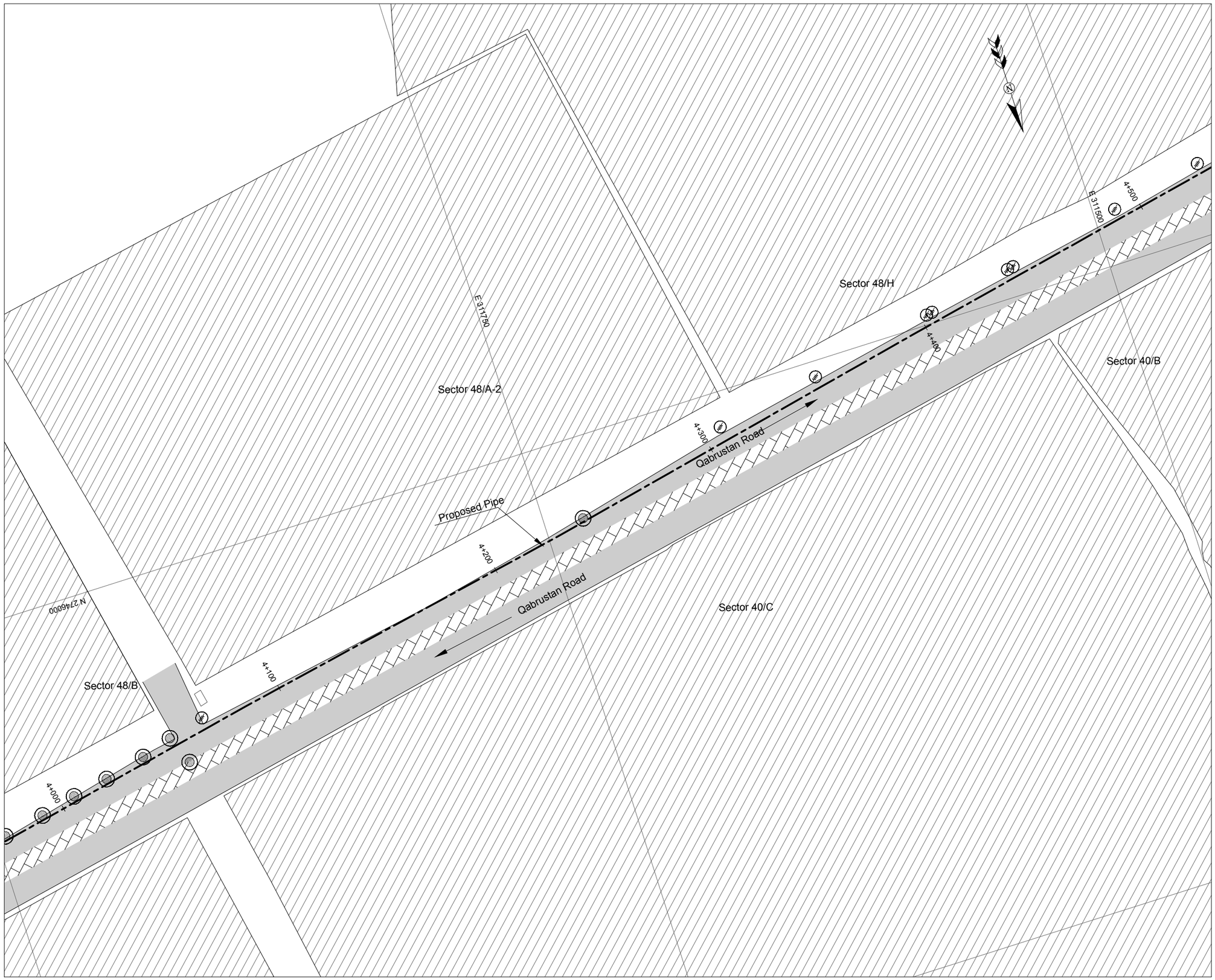
Consultants :

Techno-Consult International (Pvt.) Ltd.

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 3+500 TO 4+000

Designed By :	Date : August 2022
Drawn By :	Sheet : 8 / 11
Checked By :	Drg No :
Approved By :	



LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT

Contract :

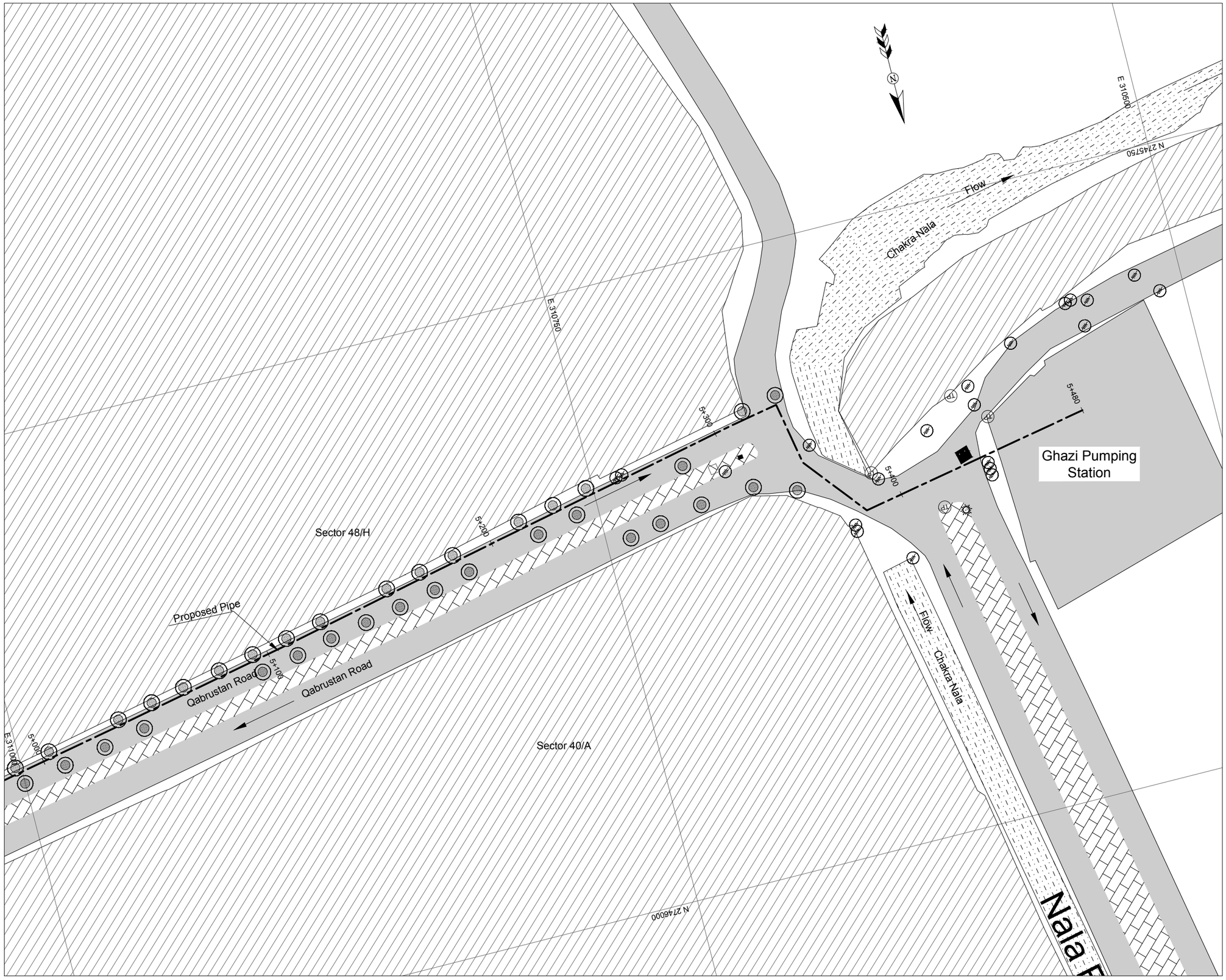
Consultants :

Techno-Consult International (Pvt.)

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 4+000 TO 4+500

Designed By :	Date : August 2022
Drawn By :	Sheet : 9 / 11
Checked By :	Drg No :
Approved By :	



LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT

Contract :

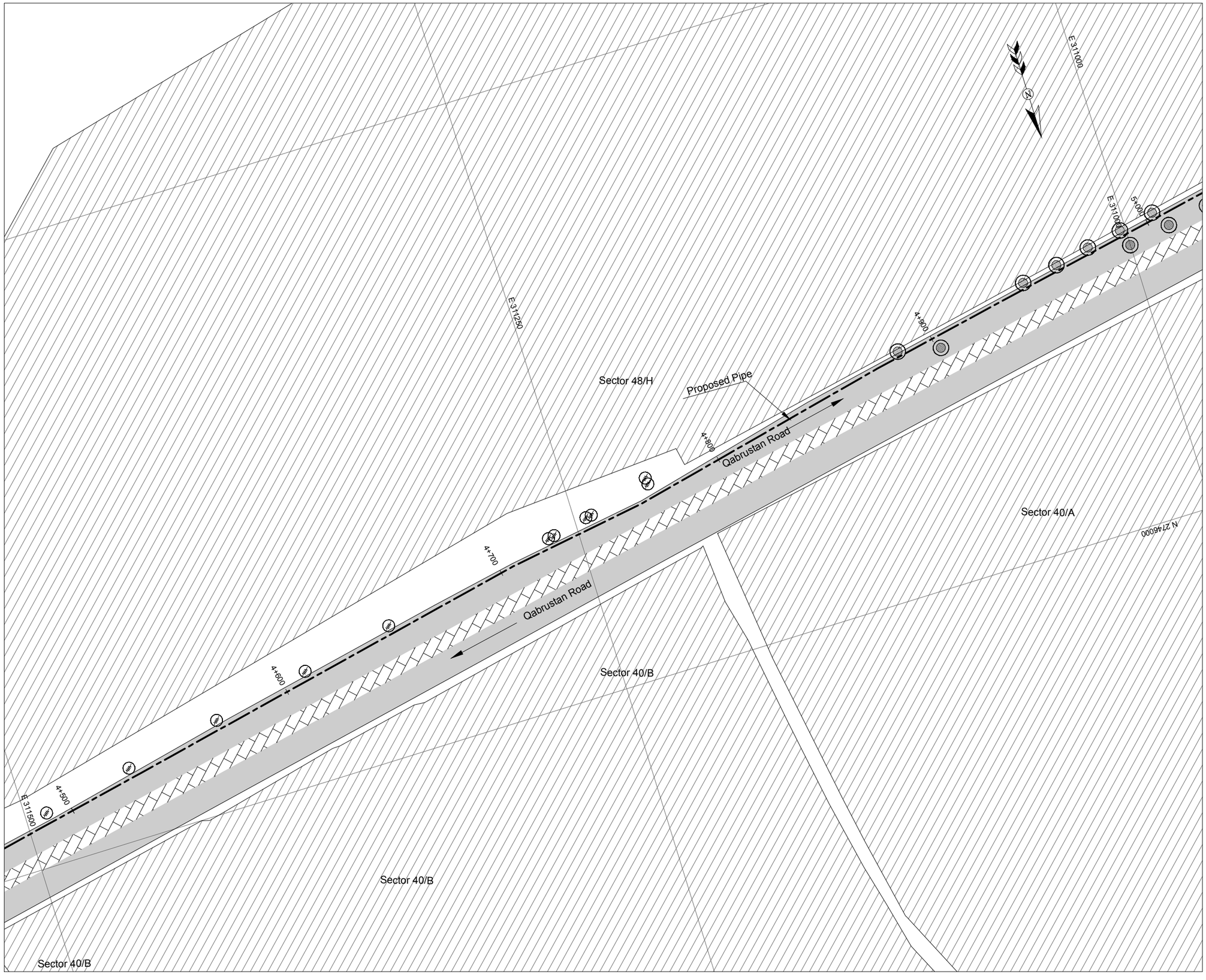
Consultants :

Techno-Consult International (Pvt.) Ltd.

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 5+000 TO 5+480

Designed By :	Date : August 2022
Drawn By :	Sheet : 11 / 11
Checked By :	Drg No :
Approved By :	



LEGEND:-

	Manhole
TP	Telephone Pole
	Electric Pole
	Light Pole
	Proposed Pipe
	Property
	Roads
	Salt Bed
	Nala / Water
	Chamber

Project :

5 MGD DESALINATION PLANT

Contract :

Consultants :

Techno-Consult International (Pvt.) Ltd.

Drawing Title :

TOPOGRAPHIC MAP OF 5MGD DESIGN 4+500 TO 5+000

Designed By :	Date : August 2022
Drawn By :	Sheet : 10 / 11
Checked By :	Drg No :
Approved By :	

Annexure – III

Environmental Monitoring Reports

Lab Report Ref. No. : QTS/SMG/22/4625-A

Reporting Date: 15/08/2022

Project : **EIA 5MGD Desalination Plant Karachi.**

SAMPLE DESCRIPTION

Sample ID: Sea water- 01
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Collected/Submitted by: EMC Representative
Sampling Date: 03/08/2022

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	LDL	UNITS	RESULTS	TEST METHOD
1	Temperature	1.0	^0C	29	Thermometer
2	pH value	0.01	-	7.41	USEPA 150.1
3	Biochemical Oxygen Demand $(BOD)_5$ at 20^0C	0.1	mg/L	543	Hach 8043
4	Chemical Oxygen Demand(COD)	1.0	mg/L	2734	Hach 8000
5	Total Suspended Solids(TSS)	1.0	mg/L	33	Hach 8006
6	Total Dissolved Solids(TDS)	1.0	mg/L	31,105	Hach 8160
7	Fluoride (as F^-)	0.01	mg/L	0.024	USEPA 340.1
8	Ammonia (NH_3)	0.1	mg/L	2.3	Hach 10031
9	Chloride(as Cl^-)	0.01	mg/L	9,440	Hach 8206
10	Iron	0.01	mg/L	0.014	Hach 8008
11	Manganese	0.1	mg/L	0.031	Hach 8034
12	Sulphate (SO_4^{-2})	1.0	mg/L	1024	USEPA 375.4
13	Barium	0.1	mg/L	0.09	Hach 8014
14	Total Hardness as $CaCO_3$	0.1	mg/L	10,330	EDTA Titration.Hach-8213
15	Turbidity	0.01	NTU	1.21	APHA-2130 B
16	Nitrate (NO_3)	0.01	mg/L	0.012	Hach -8039
17	Odour	-	Physical	Acceptable	Physical

SEQS=Sindh Environmental Quality Standards
USEPA=United State Environmental Protection Agency method
Hach USA, method
BDL=Below Detection Limit
APHA-SM = American Public Health Association- Standard Methods for Water & Waste water Examination
LDL= Least Detectable Value
NoGL=No Guideline Limits Available

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed

Sample Analyzed by: Hareem Zehra

Signature of Laboratory In charge:_____
Name : Ali Raza

Quality Testing Services Karachi Q.T.S

Lab Report Ref. No. : QTS/SMG/22/4625-B

Reporting Date: 15/08/2022

Project : **EIA 5MGD Desalination Plant Karachi.**

SAMPLE DESCRIPTION

Sample ID: Sea water- 02
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Collected/Submitted by: EMC Representative
Sampling Date: 03/08/2022

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	LDL	UNITS	RESULTS	TEST METHOD
1	Temperature	1.0	^{0}C	30	Thermometer
2	pH value	0.01	-	7.47	USEPA 150.1
3	Biochemical Oxygen Demand $(BOD)_5$ at 20^0C	0.1	mg/L	621	Hach 8043
4	Chemical Oxygen Demand(COD)	1.0	mg/L	3056	Hach 8000
5	Total Suspended Solids(TSS)	1.0	mg/L	26	Hach 8006
6	Total Dissolved Solids(TDS)	1.0	mg/L	31,340	Hach 8160
7	Fluoride (as F^-)	0.01	mg/L	0.052	USEPA 340.1
8	Ammonia (NH_3)	0.1	mg/L	2.80	Hach 10031
9	Chloride(as Cl^-)	0.01	mg/L	10,310	Hach 8206
10	Iron	0.01	mg/L	0.022	Hach 8008
11	Manganese	0.1	mg/L	0.040	Hach 8034
12	Sulphate (SO_4^{-2})	1.0	mg/L	1121	USEPA 375.4
13	Barium	0.1	mg/L	0.09	Hach 8014
14	Total Hardness as $CaCO_3$	0.1	mg/L	12,350	EDTA Titration.Hach-8213
15	Turbidity	0.01	NTU	1.30	APHA-2130 B
16	Nitrate (NO_3)	0.01	mg/L	0.028	Hach -8039
17	Odour	-	Physical	Acceptable	Physical

SEQS=Sindh Environmental Quality Standards
USEPA=United State Environmental Protection Agency method
Hach USA, method
BDL=Below Detection Limit
APHA-SM = American Public Health Association- Standard Methods for Water & Waste water Examination
LDL= Least Detectable Value
NoGL=No Guideline Limits Available

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed

Sample Analyzed by: Hareem Zehra	**Signature of Laboratory In charge:**_____ **Name : Ali Raza**

Testing Services Karachi Q.T.S

Lab Report Ref. No. : QTS/SMG/22/4625-C

Reporting Date: 15/08/2022

Project : **EIA 5MGD Desalination Plant Karachi.**

SAMPLE DESCRIPTION

Sample ID: Sea water- 03
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Collected/Submitted by: EMC Representative
Sampling Date: 03/08/2022

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	LDL	UNITS	RESULTS	TEST METHOD
1	Temperature	1.0	^0C	31	Thermometer
2	pH value	0.01	-	7.55	USEPA 150.1
3	Biochemical Oxygen Demand $(BOD)_5$ at 20^0C	0.1	mg/L	508	Hach 8043
4	Chemical Oxygen Demand(COD)	1.0	mg/L	2544	Hach 8000
5	Total Suspended Solids(TSS)	1.0	mg/L	29	Hach 8006
6	Total Dissolved Solids(TDS)	1.0	mg/L	30,855	Hach 8160
7	Fluoride (as F^-)	0.01	mg/L	0.038	USEPA 340.1
8	Ammonia (NH_3)	0.1	mg/L	2.29	Hach 10031
9	Chloride(as Cl^-)	0.01	mg/L	9.180	Hach 8206
10	Iron	0.01	mg/L	0.012	Hach 8008
11	Manganese	0.1	mg/L	0.030	Hach 8034
12	Sulphate (SO_4^{-2})	1.0	mg/L	1013	USEPA 375.4
13	Barium	0.1	mg/L	0.05	Hach 8014
14	Total Hardness as $CaCO_3$	0.1	mg/L	11,280	EDTA Titration.Hach-8213
15	Turbidity	0.01	NTU	1.18	APHA-2130 B
16	Nitrate (NO_3)	0.01	mg/L	0.023	Hach -8039
17	Odour	-	Physical	Acceptable	Physical

SEQS=Sindh Environmental Quality Standards
USEPA=United State Environmental Protection Agency method
Hach USA, method
BDL=Below Detection Limit
APHA-SM = American Public Health Association- Standard Methods for Water & Waste water Examination
LDL= Least Detectable Value
NoGL=No Guideline Limits Available

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed

Sample Analyzed by: Hareem Zehra	**Signature of Laboratory In charge:**_____ **Name : Ali Raza**

Quality Testing Services Karachi Q.T.S

Lab Report Ref. No. : QTS/SSRL/SMG/4627 Reporting Date: 15/08/2022

Report to: **EIA 5MGD Desalination Plant Karachi.**

SAMPLE DESCRIPTION

Sample ID: Drinking Water

Sampling Method: APHA 1060-A & B

Sample Type: Grab Sample

Sample Collected/Submitted by: EMC Representative

Sampling Date: 03/08/2022

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD SEQS	LDL	UNITS	RESULTS	TEST METHOD
1	Temperature	40	1.0	^0C	29	Thermometer
2	pH value	6.5 – 8.5	0.01	-	7.50	USEPA 150.1
3	Total Dissolved Solids(TDS)	< 1000	1.	mg/L	363	Hach 8160
4	Fluoride(as F^-)	≤ 1.5	0.01	mg/L	0.081	USEPA 340.1
14	Odour	Non Objectionable / Acceptable	-	Physical	Acceptable	Physical
6	Chloride(as Cl^-)	< 250	0.01	mg/L	127	Hach 8206
7	Iron	-	0.01	mg/L	0.06	Hach 8008
8	Manganese	≤ 0.5	0.1	mg/L	0.04	Hach 8034
9	Sulphate(SO_4^{-2})	-	1.0	mg/L	BDL	USEPA 375.4
10	Barium	0.7	0.1	mg/L	BDL	Hach 8014
11	Total Hardness as $CaCO_3$	< 500	0.1	mg/L	155	EDTA Titration.Hach-8213
12	Turbidity	< 5	0.01	NTU	0.02	APHA-2130 B
13	Nitrate (NO_3)	≤ 50	0.01	mg/L	0.049	Hach -8039

MICROBIOLOGICAL ANALYSIS REPORT

14	Total Coliform	0cfu/100ml	cfu	>250*	APHA-SM9221B
15	Fecal Coliform	0cfu/100ml	cfu	>110*	APHA-SM9221F
16	Escherichia Coli(E-Coli)	0cfu/100ml	cfu	>90*	APHA-SM9221F

SSDWQ = Sindh Standard for Drinking Water Quality
USEPA = United State Environmental Protection Agency method
Hach USA, method
BDL= Below Detection Limit
ND= Not Detected
LDL=Least Detectable Value

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed

Comments:
*Tested parameters are not within the SSDWQ limit.

Sample Analyzed by: Hareem Zehra	**Signature of Laboratory In charge:** _____ **Name : Ali Raza**

Quality Testing Services Karachi Q.T.S

Quality TESTING SERVICES

EPA Certified Lab
EPA/LAB/Certificate/QTS-11/2013

BUREAU VERITAS Certification

QMS/III/018 WA	
Revision : 03	Date 14.01.2021

Ambient Air Quality Test Report

Project Name:	**EIA 5MGD Desalination Plant Karachi.**	**Test Report No**	**QTS/SMG/22/4628-A**
		Sampling Duration	**24'hrs.**
		Sampling Date:	**04/08/2022**
Sampling Description	**Ambient Air, Sampling**	**Site ID = AQ-01**	**24°47'35.74"N, 67° 9'16.05"E**

S. No	Time	SO_2 (µg/m³)	NO (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	*O_3 (µg/m³)	*$PM_{2.5}$ (µg/m³)	*PM_{10} (µg/m³)	*SPM (µg/m³)	Lead (µg/m³)	Wind Speed (m/s)	Wind Direction (Deg)	Air Temperature (°C)	Humidity (%)
1	10:00	11.2	16.3	23.3	1.2						2.9	279	24	90
2	11:00	13.3	18.5	26.7	1.0						3.5	273	30	95
3	12:00	10.7	17.8	30.2	1.3						4.2	271	31	96
4	01:00	9.9	15.9	31.3	1.4						3.4	258	32	97
5	02:00	14.2	13.0	27.2	1.2						3.2	262	33	97
6	03:00	12.8	12.9	15.5	1.0						2.8	259	34	98
7	04:00	13.0	11.6	14.8	0.9						3.1	254	35	99
8	05:00	11.4	12.1	16.3	1.1						2.5	253	34	99
9	06:00	12.2	14.4	17.7	1.2						3.0	256	33	98
10	07:00	12.4	15.5	18.8	1.1						2.9	260	32	97
11	08:00	12.5	16.6	20.2	1.3						2.4	266	31	96
12	09:00	12.7	16.8	21.4	1.5						2.2	271	30	97
13	10:00	12.9	17.3	22.2	1.4	16.8	54.8	134.3	381.6	ND	2.0	272	28	99
14	11:00	13.2	17.7	24.5	1.3						1.9	275	29	95
15	00:00	13.3	18.2	25.1	1.2						1.7	281	30	96
16	01:00	13.6	18.9	26.6	1.1						1.5	274	31	94
17	02:00	13.8	19.0	27.7	1.0						1.9	279	30	98
18	03:00	14.0	19.2	28.3	0.9						2.5	274	29	101
19	04:00	14.2	19.5	29.2	0.8						2.9	272	28	97
20	05:00	14.4	19.7	29.5	0.7						3.3	265	27	98
21	06:00	14.5	19.9	31.0	0.9						3.2	270	26	95
22	07:00	14.7	20.2	29.4	1.0						3.5	267	27	92
23	08:00	14.8	20.0	29.2	1.1						3.7	263	28	94
24	09:00	14.9	19.8	28.6	1.2						3.9	258	29	95
Minimum		**9.9**	**11.6**	**14.8**	**0.7**						**1.5**	**253**	**24**	**90**
Maximum		**14.9**	**20.2**	**31.3**	**1.5**	**16.8**	**54.8**	**134.3**	**381.6**	**ND**	**4.2**	**281**	**35**	**101**
Average		**13.0**	**17.0**	**24.6**	**1.1**						**2.8**	**267**	**30**	**96**
SEQS*		**120**	**40**	**80**	**5**	**130**	**75**	**150**	**500**	**1.5**	**-**	**-**	**-**	**-**

SEQS= Sindh Environmental Quality Standards (The Gazette of Pakistan) Registered No. EPA/TECH/739/2014

*= The Average Calculation of 24'hr. , ND = Not Detected

Term & Condition:

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- This report is intended only for your guidance & not for legal purpose or for advertisement.

Remarks: The average concentration calculated for the 24 hours are well within guideline values set by SEQS.

Sample Analyzed By: Ather Adil	**Signature of Laboratory Incharge:**_____ **Name : Ali Raza**

Quality Testing Services Karachi Q.T.S

Office No.505, Anum Estate Building, Opposite Duty Free Shop, Main Shahrah-e-Faisal, Karachi.
Tel. No. 92-21-34311466, 92-21-34382860, 92-21-34321532, Fax. No. 92-21-34311467

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Ambient Air Quality Test Report

Client Name:	**EIA 5MGD Desalination Plant Karachi**	**Test Report No:**	**QTS/SMG/22/4628-A**
		Sample Duration:	**24hr's**
Sample Description:	**Ambient Air Quality Test**	**Site ID: AQ-01**	**24°47'35.74"N, 67° 9'16.05"E**
Sampling Date:	**04/08/22**		

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology/Instrument
Carbon Monoxide (CO)	mg/m³	08 Hours	**1.1**	5.0	0.0	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m³	24 Hours	**17.0**	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO_2)	µg/m³	24 Hours	**24.6**	80.0	0.0	
Sulphur Dioxide (SO_2)	µg/m³	24 Hours	**13.0**	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O_3)	µg/m³	01 Hour	**16.8**	130.0	0.0	Non-Dispersive UV Absorption Method
Particulate Matter (PM_{10})	µg/m³	24 Hours	**134.3**	150.0	10.0	β Ray Absorption Method
Particulate Matter ($PM_{2.5}$)	µg/m³	24 Hours	**54.8**	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m³	24 Hours	**381.6**	500.0	1.0	
Lead (Pb)	µg/m³	24 Hours	**ND**	1.5	-	ASS Method
Wind Speed (m/s)	**(m/s)**	24 Hours	**2.8**	-	1.0	(Haz-Scanner) EPAS
Wind Direction (Deg)	Degree	24 Hours	**267**	-	1.0	(Haz-Scanner) EPAS
Air Temperature (°C)	**(°C)**	24 Hours	**30**	-	-	Thermometer
Humidity (%)	**(%)**	24 Hours	**96**	-	1.0	(Haz-Scanner) EPAS

*SEQS= Sindh Environmental Quality Standards.
WHO= World Health Organization (WHO Air quality Guidelines 2005)
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ND= Not Detected
LDL=Least Detection Limit

Remarks:
The average concentration calculated for the 24 hours are well within guideline values set by SEQS.

Sample Analyzed By: Ather Adil

Signature of Laboratory Incharge:_____
Name : Ali Raza

Quality Testing Services Karachi Q.T.S

Quality TESTING SERVICES

EPA Certified Lab
EPA/LAB/Certificate/QTS-11/2013

BUREAU VERITAS Certification

QMS/III/018 WA	
Revision : 03	Date 14.01.2021

Ambient Air Quality Test Report

Project Name:	**EIA 5MGD Desalination Plant Karachi.**	**Test Report No**	**QTS/SMG/22/4628-B**
		Sampling Duration	**24'hrs.**
		Sampling Date:	**05/08/2022**
Sampling Description	**Ambient Air, Sampling**	**Site ID = AQ-02**	**24°47'49.82"N, 67° 9'4.48"E**

S. No	Time	SO_2 (µg/m³)	NO (µg/m³)	NO_2 (µg/m³)	CO (mg/m³)	*O_3 (µg/m³)	*$PM_{2.5}$ (µg/m³)	*PM_{10} (µg/m³)	*SPM (µg/m³)	Lead (µg/m³)	Wind Speed (m/s)	Wind Direction (Deg)	Air Temperature (°C)	Humidity (%)
1	10:00	11.4	16.6	23.8	1.3						2.8	274	28	82
2	11:00	13.6	18.9	27.3	1.1						3.4	267	29	83
3	12:00	10.9	18.2	30.8	1.5						4.1	265	30	84
4	01:00	10.1	16.2	32.0	1.6						3.3	253	31	85
5	02:00	14.5	13.3	27.8	1.4						3.1	257	32	85
6	03:00	13.1	13.2	15.8	1.1						2.7	254	33	86
7	04:00	13.2	11.8	15.1	1.0						3.0	249	34	87
8	05:00	11.6	12.3	16.6	1.3						2.5	248	33	87
9	06:00	12.4	14.7	18.0	1.4						2.9	251	32	86
10	07:00	12.6	15.8	19.2	1.3						2.8	255	31	85
11	08:00	12.7	16.9	20.6	1.5						2.4	261	30	86
12	09:00	12.9	17.1	21.8	1.7	14.1	57.1	122.8	385.3	ND	2.2	266	29	87
13	10:00	13.1	17.6	22.5	1.6						2.0	268	28	88
14	11:00	13.4	18.0	24.9	1.4						1.9	271	29	86
15	00:00	13.5	18.5	25.5	1.3						1.7	277	30	87
16	01:00	13.8	19.2	27.0	1.2						1.5	270	31	85
17	02:00	14.0	19.3	28.1	1.1						1.9	275	30	86
18	03:00	14.2	19.5	28.7	1.0						2.5	270	29	88
19	04:00	14.4	19.8	29.7	0.9						2.9	267	28	84
20	05:00	14.6	20.0	30.0	0.8						3.2	261	27	85
21	06:00	14.7	20.2	31.5	1.0						3.1	265	26	83
22	07:00	14.9	20.5	29.9	1.1						3.4	263	27	84
23	08:00	15.1	20.3	29.7	1.2						3.6	259	28	85
24	09:00	15.2	20.1	29.1	1.3						3.8	254	29	86
Minimum		**10.1**	**11.8**	**15.1**	**0.8**						**1.5**	**248**	**26**	**82**
Maximum		**15.2**	**20.5**	**32.0**	**1.7**	**14.1**	**57.1**	**122.8**	**385.3**	**ND**	**4.1**	**277**	**34**	**88**
Average		**13.3**	**17.4**	**25.2**	**1.3**						**2.7**	**262.5**	**29.7**	**85.3**
SEQS*		**120**	**40**	**80**	**5**	**130**	**75**	**150**	**500**	**1.5**	**-**	**-**	**-**	**-**

SEQS= Sindh Environmental Quality Standards (The Gazette of Pakistan) Registered No. EPA/TECH/739/2014

*= *The Average Calculation of 24'hr,* ND = Not Detected

Term & Condition:

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- This report is intended only for your guidance & not for legal purpose or for advertisement.

Remarks: The average concentration calculated for the 24 hours are well within guideline values set by SEQS.

Sample Analyzed By: Ather Adil	**Signature of Laboratory Incharge:**_____ **Name : Ali Raza**

Quality Testing Services Karachi Q.T.S

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Email: info@qts.com.pk

Ambient Air Quality Test Report

Client Name:	**EIA 5MGD Desalination Plant Karachi**	**Test Report No:**	**QTS/SMG/22/4628-B**
		Sample Duration:	**24hr's**
Sample Description:	**Ambient Air Quality Test**	**Site ID: AQ-02**	**24°47'49.82"N, 67° 9'4.48"E**
Sampling Date:	**04/08/22**		

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology/Instrument
Carbon Monoxide (CO)	mg/m^3	08 Hours	**1.3**	5.0	0.0	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	$\mu g/m^3$	24 Hours	**17.4**	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO_2)	$\mu g/m^3$	24 Hours	**25.2**	80.0	0.0	
Sulphur Dioxide (SO_2)	$\mu g/m^3$	24 Hours	**13.2**	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O_3)	$\mu g/m^3$	01 Hour	**14.1**	130.0	0.0	Non-Dispersive UV Absorption Method
Particulate Matter (PM_{10})	$\mu g/m^3$	24 Hours	**122.8**	150.0	10.0	β Ray Absorption Method
Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	24 Hours	**57.1**	75.0	2.5	
Suspended Particulate Matter (SPM)	$\mu g/m^3$	24 Hours	**385.3**	500.0	1.0	
Lead (Pb)	$\mu g/m^3$	24 Hours	**ND**	1.5	-	ASS Method
Wind Speed (m/s)	**(m/s)**	24 Hours	**2.7**	-	1.0	(Haz-Scanner) EPAS
Wind Direction (Deg)	Degree	24 Hours	**262.5**	-	1.0	(Haz-Scanner) EPAS
Air Temperature (°C)	**(°C)**	24 Hours	**29.7**	-	-	Thermometer
Humidity (%)	**(%)**	24 Hours	**85.3**	-	1.0	(Haz-Scanner) EPAS

*SEQS= Sindh Environmental Quality Standards.
WHO= World Health Organization (WHO Air quality Guidelines 2005)
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ND= Not Detected
LDL=Least Detection Limit

Remarks:
The average concentration calculated for the 24 hours are well within guideline values set by SEQS.

Sample Analyzed By: Ather Adil	**Signature of Laboratory Incharge:** _____ **Name : Ali Raza**

Quality Testing Services Karachi Q.T.S

Lab Report Ref. No. : QTS/SMG/22/4629 Reporting Date: 15/08/2022

Project: **EIA 5MGD Desalination Plant Karachi.**

SAMPLE DESCRIPTION

Sample ID: Noise Level Test
Sample Description: Ambient *Noise*
No. of samples: 05
Sample Collected/Submitted by: QTS representative
Sampling Date 03/08/2022

NOISE TEST REPORT

S.NO.	LOCATION/SOURCE	SEQS Limits : 65/55 dB(A) *Leq (Commercial/Residential)			
		Noise Level Readings			
		Coordinates	Minimum	Maximum	Average
1	Noise Monitoring Location No: (N-01)	24°47'48.59"N, 67° 9'4.44"E	58.9	60.1	59.5*
2	Noise Monitoring Location No: (N-02)	24°47'38.30"N, 67° 9'5.57"E	60.6	62.2	61.4
3	Noise Monitoring Location No: (N-03)	24°47'38.24"N, 67° 9'14.55"E	59.9	60.9	60.4
4	Noise Monitoring Location No: (N-04)	24°47'34.75"N, 67° 9'23.04"E	62.4	63.3	62.8
5	Noise Monitoring Location No: (N-05)	24°47'28.75"N, 67° 9'8.06"E	63.1	64.5	63.8

SEQS= Sindh Environmental Quality Standard
***dB (A) Leq:= Time weighted average of the level of sound in decibel on scale which is relatable to human hearing.**
***Noise Standard Limits for Category (A)-Residential Area/Zone.**
***Noise Standard Limits for Category (B)-Commercial Area/Zone.**

Terms & Conditions:

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- This report is intended only for your guidance & not for legal purpose or for advertisement.

Comments:

The Noise level from the commercial source is within acceptable level as describe in SEQS.
*The Noise level from the Residential source is not within acceptable level as describe in SEQS.

Sample Analyzed by: Ather Adil

Signature of Laboratory In charge:
Name : Ali Raza

Quality Testing Services Karachi Q.T.S