ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT

PROPOSED COMBINED CYCLE POWER PLANT (CCPP)

OF LAYYAH POWER STATION

ELSEWEDY POWER

MHPS

for

Sharjah Water and Electricity Authority

Layyah Power Station, Sharjah

Environmental Solutions and Consultancy

Environmental Solutions and Consultancy
Sharjah, United Arab Emirates

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PROJECT PROPONENT	**PROJECT**
هيئة كهرباء ومياه الشارقة Sharjah Electricity & Water Authority	Proposed combined cycle power plant of Layyah Power Station

ENGINEERING CONSULTANT	**ENGINEERING, PROCUREMENT AND CONSTRUCTION CONTRACTOR - CONSORTIUM**
EDF	ELSEWEDY POWER MHPS

Environmental and Social Impact Assessment (ESIA) study for the proposed combined cycle power plant of Sharjah Electricity and Water Authority (SEWA) at Layyah Power Station, Sharjah - United Arab Emirates (UAE).

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This report was produced by **Environmental Solutions and Consultancy (ESC)** for the specific purpose of ESIA study for the proposed combined cycle power plant of Sharjah Electricity and Water Authority (SEWA). The details of the facility is provided by the consortium and reviewed to be factual at time of reporting.

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ABBREVIATIONS

AAQ	Ambient Air Quality	LPS	Layyah Power Station
ABG	Abgina	LT	Long Term
AJP	Aparna Jaya Padman	m^3	Cubic Meter
ANQ	Ambient Noise Quality	ME	Marine Ecology
APM	Arunprasad Muthu	µg	microgram
BAT	Best Available Technology	MHPS	Mitsubishi Hitachi Power Systems Ltd.
BOD	Biological Oxygen Demand	MIGD	Million Imperial Gallons per Day
BS	British Standard	mm	millimeter
CCPP	Combined Cycle Power Plant	MM	Monalisha Murmu
CIP	Clean In Place	MoCCAE	Ministry of Climate Change and Environment
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora	MS	Marine Sediment
cm	centimeter	MSDS	Material Safety Data Sheet
CO	Carbon monoxide	MSF	Multistage Flash
CO_2	Carbon dioxide	MW	Mega Watt
COD	Chemical Oxygen Demand	NCMS	National Center of Meteorology and Seismology
COMAH	Control of Major Accident Hazard	NE	North East
DAF	Dissolved air floatation	ng	nanogram
dBA	A weighted decibels	nm	nanometer
DG	Diesel Generator	Nm^3	Normal cubic meter
DM	Dubai Municipality	NO_2	Nitrogen Dioxide
DO	Dissolved Oxygen	NOAA	National Oceanic and Atmospheric Administration
EDI	Electro Deionization	NOx	Oxides of Nitrogen
EG	Elangovan Ganesan	OSHA	Occupational Safety and Health Administration
EMoP	Environmental Monitoring Plan	PM	Particulate Matters
EMP	Environmental Management Plan	POP	Persistent Organic Pollutants
EN	European Standard	PPE	Personal Protective Equipment
ENAS	Emirates National Accreditation System	PPM	Parts per million
EPAA	Environment and Protected Areas Authority	Rev	Revision
EPCC	Engineering, Procurement and Construction Contractor - Consortium	RO	Reverse Osmosis
EPDA	Environmental Protection and Development Authority	RPM	Respirable Particulate Matters
EPS	Environmental Protection Section	RS	Ramesh Suyambu
EPSS	Environmental Planning and Studies Section	SDS	Safety Data Sheet
ESC	Environmental Solutions and Consultancy	SE	Southeast
ESIA	Environmental and Social Impact Assessment	SEWA	Sharjah Electricity and Water Authority
ESM	Environmental Sound Management	SM	Sharjah Municipality
ESMP	Environmental and Social Management Plan	SO_2	Sulphur dioxide
ESP	Elsewedy Power S.A.E	SOP	Standard Operating Procedures
ETP	Effluent Treatment Plant	SOx	Oxides of Sulphur
EU	European Union	Sq.km	Square Kilometer
FEA	Federal Environment Agency	Sq.m	Square meter
g	gram	SSW	South of South West
GCC	Gulf Cooperation Council	ST	Short Term
GHG	Green House Gas	STEL	Short Term Exposure Level
HC	Hydrocarbon	STP	Sewage Treatment Plant
HCl	Hydro Chloric Acid	SW	Southwest
HF	Hydrogen Fluoride	SWQ	Sea Water Quality
HP	High Pressure	TDS	Total Dissolved Solids
hr	hour	TEQ	Total Equivalent Quantity
HRSG	Heat Recovery Steam Generators	TLV	Threshold Limit Value

HSE	Health, Safety and Environment	TOC	Total Organic Carbon
HVS	High Volume Sampler	ToR	Terms of Reference
IFC	International Financial Corporation	TSP	Total Suspended Particulates
ISO	International Standard Organization	TSS	Total Suspended Solids
kg	kilogram	TVOC	Total Volatile Organic Compounds
km	kilometer	TWA	Time Weighted Average
KV	Karthik Venkatesan	UAE	United Arab Emirates
KVA	Kilo Volt Amphere	UF	Ultrafiltration
KW	Kilo Watt	UN	United Nations
KWH	Kilo Watt Hour	US-EPA	United States - Environment Protection Agency
KWH	Kilowatt hour	VEC	Valuable Ecosystem Component
l	litres	VOC	Volatile Organic Compounds
Leq	Equivalent Continuous Noise Level		

GLOSSARY OF TERMS

Area of probable impact (Study area) — The extent of a physical area occupied by an environmental component that is likely to be impacted by at least one of the phases of the proposed project (i.e., construction, operation, and decommissioning activities and processes). The boundary of the area of probable impact is determined by measurements, previous studies, models, or best professional judgment and may vary by environmental component.

Assessment area — The physical area that the consultant and proponent have identified for assessment of potential environmental impacts.

Construction— The time period corresponding to any event, process, or activity that occurs during the construction phase (e.g., building of site, buildings, processing units) of the proposed project. This phase terminates when the project goes into full operation or use.

Consortium – Group of organizations for the development, design, engineering, procurement, manufacturing, financing, insurance, construction, permitting, completion, testing, commissioning, operation and maintenance of the proposed project

Environmental Component — Attribute or constituent of the environment (i.e., Air Quality, Marine Water, Waste Management, Geology, Seismicity, Soil, and Groundwater, Marine Ecology, Terrestrial Ecology, Noise, Traffic, Socio-economic) that may be impacted by the proposed project.

Environmental Impact — Positive or negative impact that occurs to an environmental component as a result of the proposed project. This impact can be directly or indirectly caused by the project's different phases (i.e., construction, operation, and decommissioning).

Hazardous Waste — Waste that poses potential harm to human health and the environment.

Maximum Absolute Temperature - The Highest maximum temperature observed in a specific month, measured by (°C)

Minimum Absolute Temperature - The lowest minimum temperature observed in a specific month, measured by (°C)

Mean Daily Maximum Temperature for a Month - Mean of daily maximum temperatures observed during a specific month, measured by (°C)

Mean Daily Minimum Temperature for a Month - Mean of daily minimum temperatures observed during a specific month measured by (°C)

Mean Daily Temperature - Mean of the temperatures observed at 24 equidistant times in the course of a continuous interval of 24 hours, measured by (°C)

Mean Monthly Maximum Temperature - Mean of the monthly maximum temperature observed during a specific month over a specific period of years, measured by (°C)

Mean monthly minimum Temperature - Mean of the monthly minimum temperature observed during a specific month over a specific period of years, measured by (°C)

Maximum Relative Humidity - The Highest daily maximum relative humidity observed in a specific month (%).

Average Maximum Relative Humidity - Mean of daily maximum relative humidity observed during a specific month (%).

Minimum Relative Humidity - The lowest daily minimum relative humidity observed in a specific month (%).

Operation—The time period corresponding to any event, process, or activity that occurs during the operation phase (fully functioning) of the proposed project (operation phase follows the construction phase, and then terminates when the project goes into the decommissioning phase).

Project Area — The physical area of the proposed project in which construction, operation and decommissioning phase take place referred as project area. It also includes processes and activities of the proposed project. The project area (boundary of project area is defined by titled property boundary) is equivalent to the project site.

Proponent— The owner, company or agency associated with the proposed project.

1. EXECUTIVE SUMMARY

1.1. INTRODUCTION

Executive Summary presents the brief statement of the findings of the environmental and social impacts assessment (ESIA) study for the development of 1,100 MW Combined Cycle Gas Turbine (CCGT) power plant as an extension of Layyah Power Station (SEWA) of Sharjah Electricity and Water Authority (SEWA) at Layyah, Sharjah – United Arab Emirates (UAE).

Sharjah Electricity and Water Authority (SEWA) is the responsible entity for the generation and distribution of electricity, water & gas to the Emirate of Sharjah – United Arab Emirates (UAE. Layyah power station is one of the key generation facilities for power and potable, located right in the city center area of Sharjah. It was started to build in 1977 and completed in several stages, which is currently producing approximately 896 MW of electric power capacity from steam turbine and gas fired combustion turbines and approximately 51 million gallons per day (MIGD) [231,800 m^3 per day] of water from desalination plant.

The proposed project is an expansion in the power generation capacity of Layyah Power Station with a natural gas fired combined cycle power plant of a total installed capacity of 1,100 MW. The project also includes the development of additional offshore intake and outfall pipelines. The proposed project will be developed by SEWA in association with Engineering, Procurement and Construction Contractor (EPCC) Consortium (**Elsewedy Power S.A.E [ESP]** and **Mitsubishi Hitachi Power Systems Ltd. [MHPS])**.

The proposed project is envisaged to be funded by **Japan Bank for International Cooperation (JBIC).** The projects which are funded by International finance institutions requires strict adherence to environmental and social principles. The Environmental and Social Impact Assessments (ESIA) has to be carried in line with The Equator Principles III (EPs), World Bank Group - International Finance Corporation (IFC) Policies and Standards, before start of the project.

Environmental Solutions and Consultancy (ESC) has been appointed to conduct the ESIA study. The ESIA study was carried out in accordance with the UAE federal legislation, regulations of Sharjah Emirate, World Bank Group - International Finance Corporation (IFC) Policies and Standards, The Equator Principles III and other relevant international environmental and social standards.

1.2. PROJECT SITE DESCRIPTION

The proposed project is planned within the existing Layyah Power Station (LPS) premises of SEWA located at Layyah, Sharjah – UAE. The total plot area of LPS is approximately 250,000 sq. m, in which 35,000 sq. m area will be utilized for the proposed project. There is no additonal land requirement for the proposed project. The land proposed for the project is already reclaimed during the time of LPS previous developments. The land is sandy and flat without any vegetation and currently left barren which is used for temporary storage. The ground level is in between +3 to +4 m MSL.

1.3. PROJECT DESCRIPTION

The proposed power plant will generate power by combined-cycle generation which is a configuration using both gas turbines and steam generator. The scheme of the power generation process comprises the following major components:

- Two Gas Turbine (GT) units.
- Two heat recovery steam generators (HRSGs).
- One condensing steam turbine (ST) unit.
- Two Gas Turbine Generator (GTGs)
- One Steam Turbine Generator (STG)

In the combined-cycle gas turbine (CCGT), the hot exhaust gases from the gas turbines will be the heat source for the steam boiler. The steam produced from the steam boiler will be used to run the steam turbine. The gas turbine drives an electric generator and the steam from the HRSG drives a steam turbine which also drives an electric generator. This combination increases the thermal efficiency. Salient features of the proposed project are hereby presented.

Table 1 – Salient features of the proposed project

S. No.	Description	Details
1	Proposed Activity	Power generation by Combined Cycle Power Plant (CCPP)
2	Capacity of plant	1,100 MW of electric power
3	Location of the project	Layyah Power Station (Extension), Sharjah - UAE
4	No. of man power to be deployed	45 - 55
5	Auxiliary power requirement	35 MW (Approx.)
6	Source of water	Portable water – Desalinated water from existing SWRO plant of LPS.

S. No.	Description	Details
		Industrial purposes – Sea
7	Water requirement	Desalinated water – 5,100 m^3/day Sea water – 1,873,225 m^3/day (78,050 m^3/hr)
8	Fuel requirement	Natural Gas (Primary fuel) - 189.4 Ton/hr Light Fuel Oil (Supplementary fuel) - 160 m^3/hr
9	Liquid waste generation and management	Domestic wastewater (sewage) will be collected in underground septic tank and discharge to existing Sharjah Municipality drainage system. The industrial wastewater to be generated from the proposed project will be neutralized and neutralized wastewater will be discharged to sea through outfall discharge system.

The Man power required for the operation of the power plant will be approximately 45-55 number. The auxiliary power requirement will be 35 MW and desalinated water of 5100 m^3/day, which will be met by existing Layyah power and desalination facility. Natural gas will be the primary fuel (189.4 Ton/hr) and fuel oil as supplementary fuel (160 m^3/hr). The waste generated during construction and operation phase will be managed and disposed as per regulatory requirement. The domestic solid waste will be disposed through municipal solid waste disposal means such as Bee'ah disposal mechanisms. The domestic liquid waste will be collected in septic tanks and disposed through Sharjah sewerage system and industrial liquid waste will be disposed through outfall after chemical neutralization.

1.4. BASELINE STUDIES AND SURVEY

The baseline environmental survey (terrestrial and marine environment) was conducted during the month of **July 2018 and August 2018**. The terrestrial sampling was carried out under supervision of ESC and analyses of environmental components were carried out by RAK Lab which is an accredited Laboratory by Emirates National Accreditation System (ENAS). The Marine Ecological Study and Sampling was done by the team of **Dr. Shahid Mustafa** and the lab analysis was carried out in M/s Lonestar technical services, Dubai. The secondary data for baseline environmental and social components are collected from authenticated web sources, published articles and books. Studies and surveys undertaken to determine the baseline conditions in the study area are hereunder presented.

Table 2 – Details of baseline studies and survey

Aspect	Study	Survey period	Primary Location	Carried out by
Air quality	Ambient air quality monitoring	July, 2018	4 locations in project site	RAK Lab LLC
Noise quality	Ambient noise quality monitoring	July, 2018	4 locations in project site	RAK Lab LLC
Land quality	Topographic survey	August, 2018	Project site	Middle East Survey Engineering
	Soil quality testing	July, 2018	6 locations in project site	RAK Lab LLC
	Soil investigation	August, 2018	Project site	Al Mawazeen soil testing
Water	Ground water quality testing	July, 2018	2 locations in project site	RAK Lab LLC
	Outfall effluent quality	July, 2018	2 samples from outfall channel	Lonestar Technical Services
Marine Environment	Marine water quality	July, 2018	12 locations in Arabian Gulf	
	Marine sediment quality	July, 2018	10 locations in Arabian Gulf	
	Marine Ecology	July, 2018 and October, 2018	10 locations in Arabian Gulf	Innovation Delta Environmental Consultants, Dubai
	Bathymetry survey	August, 2018	7 × 3 km area	Geomark Survey Services (FZE)
	Water current and tide data	August, 2018	1 location in Arabian Gulf	

Modeling studies carried out to assess the potential impacts during construction and operation phase of the project are hereunder presented.

Table 3 – Details of modeling studies

Aspect	Modeling	Modeler
Air quality	Air quality dispersion study using Lakes-AERMOD	ESC
Noise level	Sound propagation modeling - ISO 9613-2:1996	ESC
Marine environment	Hydro-dynamic modeling and plume dispersion study	KPB Consultants, Abu Dhabi - UAE

1.5. IMPACT ON AIR ENVIRONMENT

Baseline conditions – Ambient air quality survey was conducted at 4 locations in the project site continuously for 24 hours. The results of the ambient air quality survey in the project area indicate that levels of particulate matter (TSP and PM_{10}) and ozone are found to be significant in the ambient air. Levels of TSP in ambient air of project site ranged from 196 to 223 $\mu g/Nm^3$ which are in compliance with maximum allowable limit (230 $\mu g/Nm^3$) prescribed by Ministry of Climate Change and Environment (MoCCaE), UAE, while those values are in near borderline. Levels of PM_{10} ranged from 83 to 115 $\mu g/Nm^3$ which are in compliance with maximum allowable limit (150 $\mu g/Nm^3$). Higher levels of particulate matter in the ambient air may be contributed by wind-blown dust, fugitive dust emissions by vehicular movement in paved/unpaved roads in the project site/adjacent roads etc. Ozone levels in ambient air are insignificant which ranged from 58.9 to 78.5 mg/Nm^3 which are in compliance with maximum allowable limit (150 mg/Nm^3). Higher levels of O_3 may be associated with high sunny periods where the pollutants are indirectly formed by the action of sunlight on nitrogen dioxide. Other pollutants in the ambient air are well within maximum allowable limits prescribed by UAE-MoCCaE.

Perusal on last 5 years data, most prevalent wind flowing directions in Sharjah region is North-western directions, East, West & South-eastern and average wind speed is 7.5 miles per hour (breeze – constantly moving air).

Impact during construction phase – The various activities during construction phase include site preparation, approach roads, excavation, drilling, foundation, deployment of machinery, erection, transportation; dumping and nature of site condition may generate dust and gaseous emissions. During construction activities there is a potential to create dust, however not all construction activities have a high dust-raising potential and therefore it can be considered that potential dust episodes which may occur only over short periods. There are no sensitive receptors in the 250 m dust buffer zone and Golden beach hotel, which is attributed to be a sensitive receptor, is situated in the 500m dust buffer zone. As the construction activities lead to the generation of large particles that are unable to travel large distances and therefore usually deposit with 100-250m, impact to the nearby commercial destination will be moderate. CEMP (Construction Environmental Management Plan) will be developed and implemented which will detail about the dust management plan.

Impact during operation phase – The main environmental aspect affecting air environment during operation phase is stack emissions from gas turbines. The major air pollutants of concern for a fuel gas/fuel oil-fired combined cycle power plant are nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matters (PM) and Green House Gases (GHGs). The contributions of stack (combustion) emissions from the proposed project have been quantitatively assessed using an air dispersion model, Lakes Environmental – AERMOD.

According to the modeled results, the maximum GLC is found occurring at a distance of about 0.49-km in the SE direction which is in project site boundary. The perusal of the modeled results, stack emissions from the proposed project contributes more SO_2 to ambient air than other pollutants. The contribution levels of pollutants to the ambient are in the order of SO_2>CO>NO_2>PM. It is also predicted that maximum increase of pollutant level within project boundary will be 30% as of SO_2 standard, and the resultant AAQ levels after implementation of the proposed project based on baseline air quality will remain within the permissible limits. The identified impact on air environment at project site will be assessed as minor effect.

The World Bank Group – IFC EHS guidelines suggests that emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same air shed. To confirm that the project meet the requirements of guidelines, project contributions to the sensitive receptors are also analyzed. It is estimated that impact due to the increase of pollutant level in the sensitive receptors will be negligible to minor (16.5% increase of SO_2 as of the standard in Layyah and Marijah residential area), which complies with the recommended norms of World Bank Group – IFC EHS guidelines. The identified impact on air environment at nearby sensitive receptors will be minor magnitude.

1.5.1. GREEN HOUSE GAS EMISSIONS

The Project is expected to have emissions of GHG, principally CO_2, during operation. These emissions mainly arise from the combustion of the fuel gas and fuel oil used as fuel to produce electricity. It is anticipated that the daily emission of GHG is estimated to be 12,252 tonnes of CO_2 by fuel gas combustion and 13,605 tonnes of CO_2 by fuel oil combustion. An annual emission of GHG is estimated to be 4,472,155 tonnes of CO_2 by fuel gas combustion and 4,965,781 tonnes of CO_2 by fuel oil combustion.

The Project's carbon intensity is estimated to be is 464 g CO_2/kWh, if combusting fuel gas and 512 g CO_2/kWh, if combusting light fuel oil. According to UAE state of green economy report 2017, the intensity of electricity generation recorded was 643 gCO_2/kWh in 2014 as reported by International Energy Agency (IEA).

The estimated GHG emissions from the proposed project during operation will exceed the threshold that defines significant emitters of GHGs and EP III (100,000 tonnes CO_2e per year) and IFC PS3 (25,000 tonnes CO_2e per year). Therefore, the project is required to implement measures for GHG reduction, and report annual GHG emissions as per the applicable reference framework.

1.6. IMPACT ON NOISE ENVIRONMENT

Baseline conditions – Noise quality survey was carried out at 4 locations in project site continuously for 24 hours. Noise levels (Leq) in project site during day time ranged from 64.3 to 80.9 dBA and night time noise levels (Leq) ranged from 61.6 to 76.4 dBA. The results of ambient noise level monitoring shows noise levels (Leq) during day and night times are significantly higher in the project areas and those levels are higher than maximum allowable limits prescribed by UAE-MoCCAE except day time noise level recorded at ANQ1 & ANQ 3 monitoring location. The higher noise levels during day and night times in the project area could be attributed to adjacent activities such as of ongoing industrial activity, and vehicular traffic. However, the measured noise levels in the project areas are less than maximum guideline value of WHO [Lmax – 110 dB(A)] for community noise specified for industrial environment.

Impact during construction phase – The identified sources of noise emissions during construction phase are mainly from the cranes, drilling equipment, compressors, generators, pneumatic tools and traffic & transportation. It was observed from the modeling results within project site boundary area that increase of the noise level (above baseline) will be in the range 0.0 to 1.1 dB (A) during day time and 0.0 to 2.5 dB (A) during night time and it is estimated that impact due to the increase of ambient noise level within project boundary will be minor which is less than 5% as of the noise standard (1.6% as of the standard during day time and 3.6% during night time). The identified impact on noise level at sensitive receptors will be minor effect.

The increase of resultant noise level in the nearest sensitive receptors (above baseline) will be 0.1 to 0.4 dB (A) during day time and 0.6 to 2.7 dB(A) during night time. It comply with the recommended norms of World Bank Group – IFC EHS noise guidelines, which says that maximum increase of resultant noise level at the nearest receptor location off-site shall be less than 3 dB (A). It is estimated that impact due to the increase of ambient noise level in the sensitive receptor will be negligible to minor (0.7% as of the standard during day time and 5.4% during night time).

1.7. IMPACT ON MARINE WATER ENVIRONMENT

Impact during construction phase – The construction of offshore intake and outfall structures and the laying of pipelines in the seabed may cause the following environmental impacts on marine water environment:

- Displacement or disturbance of sediments and sediment layering, or a compaction of sediments or wave refractions or changes to long shore currents may occur

- Accidental spills of chemicals, oils or fuels, or the leakage of these substances from underwater construction machinery may cause localized sediment contamination.
- The disturbance of sediments may lead to a re-suspension of material into the water column and a temporarily increased turbidity in the vicinity of the construction site.
- The construction of intake and outfall structures and the laying of pipelines in the seabed may lead to a destruction of benthic habitats. The mechanical impact is usually lethal for benthic organisms in the immediate construction site.
- Disturbance of sediments may have short term indirect effects on marine life.

Impact during operation phase – The key issue and potential impact associated with the operational phase of proposed project will be the effect of the discharged effluent potentially having a higher temperature and salinity than the receiving environment. Impact on seawater quality was assessed based on hydro-dynamic modeling and plume dispersion study. Modeled results indicate that extents of plume are almost similar with tidal currents but it is influenced by velocity of diffusion and wind speed and direction. When compared between the both outfall options, option 2 (Southern) is recommended, since the chances of recirculation is not existing during a normal tidal cycle and is sufficiently away from the intake location as outfall option-1 (close the intake) may affect near shore coastal water quality due to the proximity of the existing outfall point.

The perusal on thermal plume dispersion results that the temperature excess (above ambient) does not exceed 0.25 °C from ambient temperature level beyond initial zone of dilution (300 m radius). The recommended norm for excess temperature as per marine water quality objectives of DM-EPSS (Environmental Standards and Allowable Limits of Pollutants on Land, Water and Air Environment, 2003) is 2°C from background (ambient) level. The modeled results clearly indicates that the excess temperature outside the mixing zone complies with recommended norms, and the impact because of the increase in temperature in the sea water quality of Arabian Gulf will be negligible.

The perusal of the salinity plume dispersion results shows the increase of salinity concentration do not exceed 0.25 ppt from the ambient salinity with in the initial zone of dilution (300 m radius) and it is less than 0.25 ppt than the ambient salinity outside of the initial zone of dilution. The recommended norm for excess salinity as per article 22 of DM Local order 61 of 1991 is increased or decreased salinity of receiving water greater than 2ppt from ambient values. The modeled results clearly indicate that salinity change outside mixing zone comply with recommended norms, and impact due to the salinity increase in the sea water quality will be negligible.

1.8. IMPACT ON MARINE ECOLOGY

Baseline conditions – Marine Ecology survey was carried out in marine area of project vicinity by qualified divers and marine ecologist – Dr. Shahid Mustafa. Ten stations were selected to be representative within the study area. The epibenthic communities were dominated by oyster bed, corals, sandy and silty sand areas. Moderate diverse condition with potential importance of corals and oyster beds was found especially on stationME-05 and ME-08. Phytoplankton density in terms of cell counts varied from 22-83 $\times 10^3$ No./L with an overall average population density of 40.6×10^3 No./L. The dominant class of the phytoplankton was Dinophyceae (dinoflagellates) (45.8%) followed by Bacillariophyceae (Diatoms) (36%) and Cyanophyceae (Cyanobacteria) (18.2%). Harmful Algal blooms were absent in the phytoplankton samples. The zooplankton population had an average population of 172 individuals in no./m^3. A total of 12 taxa were recorded. Acartia fossae (22.3%), Copepods (19.7%), Oikupleura sp (14.8%), Sagitta (12.9%) and Lucifer sp. (10.12%) were the major group and species of the zooplankton. Fish eggs and fish larvae were not found in the samples collected. The perusal of the present levels of planktonic communities indicates that it was found in moderate population density along the project area. The macro-benthic infauna along the project area had population values ranging from 1200-3880 No./m^2 (average 2772 No./m^2). Moderately high diversity index of Margalef (d) and Shannon-Wiener (H’) at stations ME-01, ME-02, ME-04, ME-05, ME-06, ME-07, ME-08 & ME-09 shows moderate healthy statues of macro-benthic in-fauna in this project area.

Impact during construction phase – The construction of offshore intake and outfall structures and the laying of pipelines in the seabed may cause impact that displacement or disturbance of sediments and sediment layering, or a compaction of sediments or wave refractions or changes to long shore currents may occur.

Impacts during operation phase – During operation phase of the facility, the following are the key issues and major potential impacts.

- Altered flows at the intake and discharge resulting in ecological impacts (e.g. entrainment and impingement of biota at the intake, flow distortion/changes at the discharge, and effects on natural sediment dynamics);
- Potential for habitat health impacts/losses resulting from elevated salinity in the vicinity of the outfall effluent discharge; and
- The effect of the discharged effluent potentially having a higher temperature than the receiving environment.

The perusal of the hydro-dynamic modeling and plume dispersion study results, there is no significant increase in temperature and salinity outside mixing zone (300m). According to the ecological survey, habitat in the mixing zone (ME-07) is dominated by sandy with broken shells. Coral communities are not identified in the zone. Hence, impact on marine ecology will be minor a due to the discharge of outfall effluent.

1.9. PROJECT ALTERNATIVES

The management of SEWA planned for future power plant units and desalination units during initial development stage and areas are allocated accordingly. The land allocated for the proposed project is plain in topography and adjacent to the shoreline. Since the proposed project will be established in the existing Layyah Power Station, which was developed with good infrastructure, alternate sites are not considered. The chosen intake location is potential to provide a good and reliable water quality, with minimum danger of pollution or contamination, which helps to avoid performance problems of the plant.

In reference to the outfall discharge locations, two locations were considered. Hydrodynamic modeling and plume dispersion study was performed to select the suitable location for better dispersion of outfall effluent and lesser recirculation effect on intake sea water. The perusals of the modeled results shows that dispersion patterns of both outfall locations are observed to be more or less similar. Plume dissipates within 1 km of the outfall in both cases throughout the tidal cycle. However outfall option-1 (close the intake) may affect near shore coastal water quality due to the proximity of the existing outfall point. Outfall option 2 (Southern) is recommended as the chances of recirculation is not existing during a normal tidal cycle and is sufficiently away from the intake location.

Combined Cycle technology can provide high electrical efficiency that means electricity generation on the basis of more competitive prices in comparison with other technologies. Moreover, natural gas produces energy with the lowest rate emissions per produced kWh and the CCPP does not need additional expenditure for emissions control and fuel storage in comparison with coal. Combined cycle technology is chosen for the power generation, from the environmental point of view and its efficiency.

1.10. RESIDUAL EFFECTS

With effective implementation of CEMP (as per requirement of IFC EHS guideline), the dust emission impacts on onsite environment and adjacent commercial destination are likely to lead to minor residual effects. Although residual impacts are expected to be of minor significance, efficient monitoring shall be implemented.

Impacts from stack emissions from combustion process, operational traffic emissions and noise from operational equipment & vehicles are likely to lead to minor residual effects on human and ecological receptors which cannot be fully mitigated. Residual effects on air and noise quality associated with the operational phase will be minor adverse.

Impacts from discharge of outfall effluent are likely to have residual effects on marine biota health (Arabian Gulf). Although all residual impacts associated with the outfall effluent discharge are expected to be of minor significance

1.11. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The present ESIA study identified and assessed of various environmental and social impacts likely to be caused on the surrounding nature and society during the construction and operation phase of the project. The appropriate control/mitigation measures were also incorporated in the Environmental and Social Management Plan (ESMP) for implementation in order to minimize the adverse effects thereof. SEWA and EPCC have proposed to provide necessary preventive mitigation/control measures during implementation of the project. The details of potential impact and mitigation measures towards environment and social management system during operation phase are hereunder summarized.

Table 4 – Environmental and Social Management Plan during operation phase of the project

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Discharge of outfall effluent into the Arabian Gulf will impact on marine biota.	• Use only anti-scalants with low toxicity to aquatic invertebrate and fish species; avoid the use of a polyphosphate anti-scalants. • Suitably neutralize residual chlorine with sodium bisulfite (SBS) in an emergency when intake water needs to be bypassed directly to the outfall, residual chlorine in the outfall discharge must be below 0.2 mg/l. • Monitor the outfall effluent characteristics to check the compliance with Sharjah Municipality sea discharge limits.	Minor effect - Residual impacts can be reduced to acceptable level	Outfall effluent quality shall be periodically checked	Operation of the project Plant Manager
Impingement and Entrainment adversely affect biotic productivity in the Arabian Gulf	• Keep reduced velocity in intake tower by velocity cap structure to ensure that fish and other organisms can escape the intake current.	Minor Effect - Residual impacts can be reduced to acceptable level	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Dust deposition and air pollution at project site	• All the internal roads/working areas shall be paved by feasible materials (cement/asphalt/interlock) to avoid fugitive dust emissions. • The movement of heavy trucks over unpaved or dusty surfaces should be restricted. In case of unavoidable situation, unpaved or dusty surfaces should be controlled by good maintenance and wetting of the road surface by water sprinkling. • Speed Limit (20 km/hr) inforce on unpaved roads.	Minor effect - Residual impacts can be reduced to acceptable level	--	Operation of the project Plant Manager
Operational Combustion emissions in the study area	• Regular maintenance of vehicles for appropriate functioning of engine • Company vehicles should undergo emission test to ensure emissions are within permissible limits. • Commercially available Low sulphur diesel shall be used for vehicles/fuel fired equipment/machinery, in order to reduce excessive emissions of sulphur dioxides.	Minor effect - Residual impacts can be reduced to acceptable level	Undertake daily visual inspections and regular repairs, when appropriate, to ensure that equipment does not emit excessive fumes. If excessive fume, exhaust emission monitoring	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	• Specification of fuel supply to turbine combustion shall be strictly monitored and followed • Periodic monitoring of stack emissions to ensure that air emission characteristic is within the allowable limit for stationary sources		shall be conducted Stack emission main and bypass stack shall be regularly monitored	
Operational noise can cause nuisance to onsite workers	• Roadside tree plantation to be developed at a possible extent and maintained as a noise barrier • Keep internal haul routes well maintained. • Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications. • Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications. • All plant onsite should be low noise	Residual impacts can be reduced to acceptable level	Ambient noise levels shall be monitored regularly	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	versions, and where needed, acoustic enclosure shall be provided according to manufacturer's recommendations. • The use of damping material such as thin rubber/sheet for shielding the work places like DG sets, compressor etc., • Ear plugs/muffs for workers who are exposed to higher noise shall be provided and enforcement for its use by the workers.			
Improper dispersal of domestic wastewater may deteriorate the soil and groundwater quality at project site	• Toilets and septic tank facilities are to be appropriately designed and monitored. • Monitoring of internal sewerage system to ensure all pipelines and septic tanks are properly functioning. • Drainage systems from wash areas and other sources must be strictly monitored. • Regular vacuuming/ siphoning of septic tanks as needed by Sharjah Municipality authorized service providers for	Neutral – There is no residual impacts	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	transport to the designated municipal sewage treatment plant.			
Improper management of operation waste may deteriorate the soil and ground water quality at project site	• Storage of leachable operation materials and solid waste will be in an impervious area separately to avoid any soil contamination; • The generated solid wastes will be collected segregated as domestic wastes, recyclable solid wastes, non-hazardous solid waste and hazardous wastes and these wastes will be stored properly in the separate area in different coloured bins. • The domestic wastes and non-hazardous solid wastes will be properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal. • Recyclable solid wastes will be sold to Sharjah Municipality authorized recyclers for recycling. • Hazardous wastes will be collected separately and properly disposed to	Neutral – There is no residual impacts	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	Sharjah Municipality authorized service providers after obtaining NOC from Sharjah Municipality.			
Spills and Leaks	• Spill prevention and management plan shall be developed and effectively implemented. • All hazardous/flammable material, including fuels, will be stored at designated sites in accordance with MSDS requirements best practice procedures. • MSDS to be available for hazardous materials stored on site. • Hazardous materials will need to be suitably stored to prevent leaks and spills. • Adequate bunding for fuel storage. • Drip trays will be required to be used to intercept leaks and spills from equipment and during refueling.	Neutral – There is no residual impacts	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Health issues	• All hazardous chemicals and materials must be stored in a protected /secured place with limited access. • Chemicals handling, storage and instructions given in Material Safety Data Sheets & product manuals, supplied by the manufacturer or supplier, must be understood and observed strictly. • There shall be no open storage of any type of chemical in the premises. • Hazardous chemicals shall be stored appropriately based on the compatibility of the chemical to avoid any reaction. • Flammable and other highly flammable products storage should be stored in a controlled temperature and all the electrical fittings should be under classified category as per International standards. • Fire protection requirements shall be as per UAE Civil Defense Code, 2017 in the	Residual risk can be reduced as low as reasonably practicable	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	chemicals/hazardous materials storage areas • Appropriate training shall be provided to workers and Trained/competent persons shall be deployed for critical tasks such as handling of hazardous/flammable chemical, first aid, fire-fighting etc., • Appropriate Personal Protective Equipment shall be provided to workforce involved with hazardous/flammable chemical handling.			
Labour management	• Labour management (Project labour commitment, Workers Code of Conduct, Labour Grievance Mechanism) shall be strictly followed as per UAE Federal Labour Law • Labour accommodation strategies with welfare facilities shall be provided as UAE Federal Labour Law • Occupational Health and Safety Management shall be developed and	Neutral - There is no residual risk	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	effectively implemented.			
Traffic	• Smooth entry and exit of vehicle shall be provided at the entry and ensure smooth transition for merging of vehicles. • Proper footpath provided for pedestrian movement along with interlocking and barricaded for safety. • Safety precautionary measures are ensured. • Adequate Lighting will be providing as per norms.	There is no residual risk	--	Operation of the project Plant Manager

2. INTRODUCTION

2.1. PREAMBLE

In the past, development endeavors have not considered environmental issues in the evaluation of development projects. Decision making on the implementation of development projects was merely focused on short-term technical feasibility and economic benefits. This negligence and unwise utilization of the natural resources resulted in the degradation of the environment and scarcity of the resources. The trend toward natural resource and environmental degradation stimulated the concept of sustainable development. According to the World Commission of the Environment and Development (1987), sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It encompasses three pillars namely: economy, environment and society. An assessment of potential impacts on the environment before the approval of investment proposals provides a means of harmonizing and integrating the three pillars of sustainable development *(Mekuriaw and Teffera, 2013[1])*. Realizing the strong connection between development and the environment, and the need to keep up environmental protection efforts, United Arab Emirates formulated Federal Law No. (24) of 1999 for the protection and development of the environment. According to Articles 3 & 4 of Section 1 in Chapter I of Federal Law, impact on the environment should be assessed before the establishment of any new activity or expanding the existing activity.

The projects which are funded by International finance institutions require adherence to environmental and social principles and environmental impact assessments in line with The Equator Principles III (EPs), which in turn require adherence to the World Bank Group - International Finance Corporation (IFC) Policies and Standards to be carried out before a project can proceed.

Sharjah Electricity and Water Authority (SEWA) supply reliable and cost-effective electricity and water to the Emirate of Sharjah. It is still undergoing expansion as the demand for water and electricity increases in the Emirate of Sharjah. In this regard, SEWA proposed to develop combined cycle power plant as an extension of Layyah Power Station in the Emirate of Sharjah – United Arab Emirates (UAE). In accordance with requirements, **Environmental and Social Impact Assessment (ESIA) study** will be required for the proposed development.

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[1] *Makuriaw, A. and Teffera, B., 2013. IAIA13 Conference Proceedings – Impact Assessment the Next Generation, 33rd Annual Meeting of the International Association for Impact Assessment (13-17 May 2013), Canada.*

[2] *Leopold, L.B., Clarke F.E., Hanshaw, B.B. and Balsley, J.R. 1973. A Procedure for evaluating*

In this regard, **Environmental Solutions and Consultancy (ESC)** has been appointed to conduct the **Environmental and Social Impact Assessment (ESIA) study** for the proposed project as per the pre-requisite requirement of Federal Environment Law, Environment and Protected Areas Authority (EPAA) and Sharjah City Municipality.

2.2. BACKGROUND OF PROJECT

Sharjah Electricity and Water Authority (SEWA) own and operate Layyah Power Station (LPS) located at Layyah, Emirate of Sharjah – United Arab Emirates (UAE). The Layyah power and desalination station were built in several stages at the beginning of the year, 1977. SEWA fulfills this obligation primarily through the integrated Layyah power and water station by producing approximately 896 MW of electric power capacity from steam turbine and gas-fired combustion turbines and a nominal 51 million gallons per day (MIGD) [231,800 m^3 per day] of water from the desalination plant.

Layyah power station uses steam and gas turbines to generate electricity with the total capacity of 900 MW. It has nine gas turbines with the total installed capacity of 464 MW and eight steam turbines with the total installed capacity of 432 MW. Layyah operates its gas & steam turbines on natural gas to comply with environmental standards, and fuel oil is used as a supplementary and back up fuel. Layyah power station also has seven Heat Recovery Steam Generators (HRSGs) that are connected to gas turbines to reduce the flue gas emission temperature and produce steam for the desalination plants. The Layyah desalination plant has 9 units consisting of 5 units of Multistage Flash (MSF) each of 5 MIGD capacity, 2 Multi Effect Distillation units of 5 MIGD capacity and 2 Multi Effect Distillation units of 8 MIGD capacities. As part of the expansion**,** SEWA intends to develop a 1,100 MW Combined Cycle Power Plant (CCPP) as an extension at Layyah Power Station (LPS). Basic information of the proposed project is given in **Table 5**.

Table 5 – Basic information of the proposed project

Description	**Details**
Name of the project	Combined Cycle Power Plant (CCPP)
Design capacity of the project	1,100 MW
Location of the project site	Layyah Power Station of SEWA, Layyah, Sharjah – UAE
Name of the owner	Sharjah Electricity and Water Authority (SEWA)
Name of the Engineering Consultant	EDF Energy
Name of the Engineering, Procurement and Construction (EPC) Contractor	Consortium [Elsewedy Power S.A.E (ESP) and Mitsubishi Hitachi Power Systems (MHPS)]

2.3. DETAILS OF PROJECT PROPONENT AND EPC CONTRACTOR

Sharjah Electricity and Water Authority (SEWA) is a financially and administratively independent entity to generate electricity, water and to distribute electricity, water & gas to the Sharjah Emirate. SEWA appointed a consortium consisting of Elsewedy Power S.A.E (ESP) and Mitsubishi Hitachi Power Systems Ltd. (MHPS) as an EPC contractor for the proposed project. The contact information for the project proponent and developer is presented in Table 2.

Table 6 - Contact information for project proponent and developer

Organization	Contact Information
Project Proponent	
Sharjah Electricity and Water Authority (SEWA) Government of Sharjah P O Box. 135 Sharjah - UAE	**Eng. Ali Sani** Manager of Projects Development Sharjah Electricity and Water Authority Tele: +971 6 5021935 Mobile: +971 50 429 3003 E-mail: ali.yousif@sewa.gov.ae
EPC Consortium Members	
Elsewedy Power S. A. E (ESP) Plot No. 246, Second Sector of City Center 5th Settlement, New Cairo Egypt	**Mr. Ramy Emam** Project Manager Tele: + 20 22 322 0240 Mobile: +971 556 711 617; +201066818188 Fax: +20 223 220 240 E-mail: ramy.emam@psp.com.eg
Mitsubishi Hitachi Power Systems Ltd. (MHPS) Dubai Airport Free Zone Phase 8WB, Office No. 229 P O Box. 54319, Dubai - UAE	**Mr. Elie Rizk** Business Development Director Tele: +971 506 684 121 Fax: +971 422 834 23 E-mail: Elie_rizk@mhps.com

2.4. DETAILS OF ENVIRONMENTAL CONSULTANT

Environmental Solutions and Consultancy (ESC) provides comprehensive solutions to industries in areas such as environment, sustainability, health and safety etc. ESC extends their services using our competent staff as well as through association with proficient companies worldwide. With an emphasis on sustainability and compliance with the relevant regulations, ESC delivers strategic services including environmental consulting, engineering design and knowledge management. ESC is a wholly-owned subsidiary of **Paradigm Pioneers Group** which focuses on offering high-quality and perfect services to clients as the name denotes, using its professional expertise and global talent pool.

Table 7 – Contact details of environmental consultant

Details	Contact Information
Environmental consultant Environmental Solutions and Consultancy PO Box: 68595, Sharjah-UAE	Mr. Arun Senior consultant & Business manager Mobile : + 971 55 9071 305 Tele : +971 6 5688683 E. mail : arun@esc-me.com projects@esc-me.com;

ESC has carried out 100+ Environmental Impact Assessment/Risk Assessment (EIA/RA) studies in the UAE and overseas for diversified fields such as infrastructure developmental projects and industries like Power Plant, Desalination Units, Oil & Gas, Chemicals, Petro Chemicals, Steel Manufacturing, Steel Fabrication, and Ship Building. ESC has technical resourcefulness in the Environment, Water and Energy sectors offering overall Design, Erection, commissioning of Wastewater Treatment Plants (STPs and ETPs) and water treatment plants. Along with ESC's multidisciplinary team and renowned partners, ESC conduct soil investigations, ecological studies, noise assessments, energy efficiency analyses, safety studies (including full Quantitative Risk Analysis, Hazard and Operability studies, COMAH), evaluations of Best Available Technologies (BAT), socio-economic assessments, Air Quality modeling studies, Bathymetry studies, Marine Ecological Studies and Pollutant transport in groundwater modeling. ESC is fully committed to quality and implements its quality policy through the application of quality management system, which is based on the primary operating process and fulfills Local, National and International legal compliance. ESC also carries out Third Party Inspection of Equipment and Machinery. ESC's experience on similar projects (Major Projects in the UAE region) is hereunder presented.

- Environmental and Social Impact Assessment (ESIA) Study for Sharjah Water and Electricity Authority for the proposed expansion of Sea Water Reverse Osmosis (SWRO) Plant – Hamriyah Independent Water Project, Hamriyah Sharjah UAE. – (Client - International Power SA (ENGIE), SUEZ & Mubadala)
- Environmental Impact Assessment Study for the proposed expansion of seawater Reverse osmosis plant at Hamriyah Free Zone Phase 1, Sharjah, UAE – (Client - Alpha Utilities FZE)
- Environmental and Impact Assessment and Risk Assessment (EIA/RA) Study for the proposed Ship Building Facility –at Hamriyah Free Zone Phase 1, Sharjah, UAE – (Client - Damen Shipyards Sharjah FZE)
- EIA/RA Study for the proposed Storage Terminal –at Hamriyah Free Zone Phase 1, Sharjah, UAE (Client- GP Global HMT Terminal FZE)
- ESIA Study for the proposed Sea Water Reverse Osmosis Plant – King Abdulla Economic City, Jeddah, KSA. – Client (Sogreah Gulf FZCO-EMAAR)

- EIA Study for the proposed Logistic Village Development at Hamriyah Free Zone Phase 2, Sharjah, UAE (Client - Hamriyah Free Zone Authority, Government of Sharjah)
- EIA Study for the Cement Manufacturing, Co-Generation Plant and Quarry (Client -Fujairah Cements Industries PJSC)
- EIA Study for the Cement Manufacturing and Quarry (Client –Sharjah Cement Factory)
- EIA for Sharjah Sustainable City for the Proposed Mixed Development, Sharjah UAE (Client- Atif & Bintoak)
- EIA Study for Proposed Shipbuilding Facility and Marine Services Facility, Ras Al Khaimah UAE (Client- Van Oord)

ESC has a technically proficient and experienced in-house team as well as the external professional expertise to carry out ESIA study. The details of the study team are presented in **Table 8**.

Table 8 – Details of the study team

Name & Designation	Qualification	Scope of Work
ENVIRONMENTAL SOLUTIONS AND CONSULTANCY		
Dr. Ramesh Suyambu (RS) Manager – Technical	M.Sc., Ph. D in Environmental Biotechnology	• Description of Project • Assessment of Environmental Impacts – Air, Noise, Water and Ecology • Mitigation Measures and Environmental Management Plan • Project Alternatives
Mrs. Aparna Jaya Padman (AJP) Project Manager	Master Degree in Environmental Technology	• Project Management • Marine Impact Assessment • Mitigation Measures and Environmental Management Plan
Mr. Arunprasad Muthu (APM) Sr. Consultant and Business Manager	Master of Technology in Environmental Science & Technology	• Assessment of Environmental and Social Impacts – Soil, Waste Management • Review and quality assurance
Mr. Elangovan Ganesan (EG) HSE Manager	Diploma in Mechanical Engineering	• Construction phase – Aspects, Impacts and mitigation measures • Occupation Health and Safety

Name & Designation	Qualification	Scope of Work
		• Socio-economic elements
Mr. Karthik Venkatesan (KV) Sr. Environmental Engineer	Master of Technology in Environmental Science & Technology	• Reference Laws, regulations and standards • Description of the environment
Mrs. Brindha Ram (BR) Sr. Environmental Engineer	Master of Technology in Environmental Science & Technology	• Description of Project • Description of the environment • Project Alternatives
Ms. Monalisha Murmu (MM) Sr. Environmental Engineer	Master of Science in Energy & Sustainability and Bachelor of Engineering in Civil	• Description of Project • Description of the environment • Project Alternatives

Curriculum vitae's of study team is presented in **ANNEXURE 10.**

3. ESIA STUDY PROCESS

3.1. NEED FOR AN ESIA STUDY

Construction and Infrastructure are vital for supporting economic growth and improving the quality of life. Around half of all non-renewable resources mankind consumes are used in construction, making it one of the least sustainable industries in the world.

However, these sectors have environmental impacts that the affect quality of life, including both biophysical and social aspects. The former affect geological and biological conditions such as land quality, water management, biodiversity, etc. the latter affect health and other social conditions due to air and water quality, resettlement, etc. Well-designed infrastructure projects can produce positive environmental impacts, e.g., by reducing water pollution or mitigate adverse environmental impacts, e.g., through emission control measures.

Environmental and Social Impact Assessment (ESIA) study is a planning tool generally accepted now as an integral component of sound decision-making. Early identification and characterization of critical environmental impact and risk allows stakeholders to form a view about the environmental acceptability of a proposed development project and what conditions should be applied to mitigate or reduce those risks and impact.

3.2. OBJECTIVES OF ESIA STUDY

The primary objective of the Environmental and Social Impact Assessment (ESIA) Study is that it supports the goals of health, safety and environmental protection and sustainable development; integrates environmental protection and economic decisions; predicts environmental, social, and economic consequences of an activity and assesses plans to mitigate any adverse impacts resulting from the proposed activity. Main objectives of the ESIA study are as follows:

- Assessment of baseline conditions before the development;
- Assessment of the projects critical environmental and social risks/impacts and mitigation & management measures and ensuring that potential impacts are avoided or minimized to the acceptable level through the recommendation of mitigation & management measures;
- Exploration of alternatives that can be used for the project leading to more significant social and environmental gains.
- The analysis of the physical, natural and social environment has considered the immediate site as well as a well-defined buffer surrounding the project site, relating to the likely extent of project impacts.

3.3. ESIA STUDY METHODOLOGY

The ESIA Study report has been prepared according to UAE Federal, Sharjah Government environmental laws, regulations & guidelines and International reputed regulations & guidelines, most notably:

- Federal Law No. (24) of 1999 for the Protection and Development of the Environment and associated Decrees/Executive Orders
- Guidelines for preparation & presentation of EIA reports – EIA Committee, Directorate of Environmental Services, Sharjah Municipality, Sharjah
- Technical Guidelines of DM - Environmental Planning and Studies Section (EPSS) - Environmental Impact Assessment, January 2017
- Equator Principles
- World Bank Group – International Finance Corporation (IFC) – Environmental, Health and Safety Guidelines.

The EIA study involves the following stages:

Stage I	Scoping
Stage II	Baseline Scenario
Stage III	Assessment of Environmental Impacts
Stage IV	Mitigation Measures
Stage V	Environmental Management and Monitoring Plan

3.4. SCOPING AND STAKEHOLDERS CONSULTATION

The key issues and concerns of stakeholders of the project have been identified in this phase. Consultations are an essential process in the overall ESIA study. ESC conducted consultations with the relevant organizations, departments and stakeholders in fulfilling the tasks related to the ESIA study. Formal and informal consultations have been carried out with EPAA and other relevant parties. The meetings are aimed at soliciting the comments and concerns of government agencies concerning technical, scientific and socio-economic understanding of the project. The scope of work for the consultation involves

- To provide a decision-making process by a systematic assessment of the environmental implications of the project

- To identify the negative and positive impacts of the development during its operational phase;
- To recommend mitigation and enhancement measures
- To plan and coordinate an EIA that satisfies the requirement of the Authority
- To provide an EMP consists of mitigation and enhancement measures and EMoP during the operational phase.

In perspective of the project, the stakeholders include the project proponent, consortium members, Environment & Protected Areas Authority and other agencies. The consultant has approached the owner to guide on the public engagement, considering the sensitivity of the project. In the initial stage of the project, the consultant had consulted with the proponent and other consultants involved in the project, and in consensus developed the scope of work/Terms of Reference for the ESIA Study Report, which was submitted to EPAA. EPAA issued a term of Reference for the ESIA study and it is enclosed as **ANNEXURE 2.**

3.4.1. SELECTION OF STUDY AREA

The study area is chosen as the project area and a primary impact area of at least 2 km within its radius. The impact areas have been delineated before the collection of baseline data. The factors considered includes but not limited to physical attributes of the project site, prevailing meteorological conditions, Valued Ecosystem Components (VECs), adjacent facilities and distance of the nearest community etc. The secondary impact areas cover a radius of about 5 km from the project site. The details of the project study area are discussed in **Section 6.2** of this report.

3.4.2. COLLECTION OF PRIMARY AND SECONDARY DATA COLLECTION

The baseline environmental survey (terrestrial and marine environment) was conducted during **July 2018 and August 2018**. The primary survey on terrestrial environmental components was carried out under the supervision of ESC and the sample analysis was done by RAK Lab, which is an accredited Laboratory by the Emirates National Accreditation System (ENAS). The marine ecology survey was done by the team lead by Dr. Shahid Mustafa and the lab analysis was carried out in **Lonestar Technical Services, Dubai.** The secondary data for baseline environmental and social components are collected from authenticated web sources, published articles and books. Secondary data on meteorology were collected from 2 National Center of Meteorology & Seismology (NCMS) monitoring stations (Sharjah International Airport station, and Dubai International Airport Station).

3.4.3. ASSESSMENT OF ENVIRONMENTAL IMPACTS

The impact of the proposed project is anticipated by using Environment and Social Impact Assessment Matrix in accordance with the procedure for evaluating environmental impacts by *Leopold et al., 1971*[2] and EIA guidelines of RAK- EPDA (Ras Al Khaimah – Environment Protection and Development Authority). An Environmental and Social Impact Assessment Matrix has been prepared to identify the potential impacts and to identify the impacts which are to be mitigated. An ESIA matrix ranks the significance of the environmental and social impacts before mitigation measures are implemented. This matrix has been divided according to the phases of the project (i.e., pre-construction, construction and operation, if relevant); and all of the impacts that require mitigation are included in this matrix and assessed according to the following criteria and associated scores. The environmental and social impact assessment matrix considers the three essential elements:

- Listing of the effects on the environment and society which would be caused by the proposed development, and an estimate of the *magnitude* of each.
- Evaluate the relative *importance* of the potential (sensitive) receptors.
- Effect – Significance of the impact - combining of *magnitude* and *importance* estimates concerning a summary evaluation.

For each aspect, the assessment identifies impacts and reports the likely significant environmental effects. In broad terms, it can be characterized as the interaction of the impact and the sensitivity or value of the receptor that is affected. For each aspect, the likely magnitude of the impact and the sensitivity of the receptor are defined, quantitatively to the extent possible. Generic criteria for the definition of magnitude and sensitivity are presented below.

3.4.3.1. Magnitude of Impact

It is categorized as beneficial or adverse, and it is assessed as major, moderate, minor or negligible based on consideration of parameters such as:

Spatial extent of the impact – for instance, within the site, boundary to regional, national and international;

Compliance – the margin by which an impact meets or fails to meet international, national and local standards, limits or guidance.

Duration of the impact – short/temporary to long-term/permanent;

[2] *Leopold, L.B., Clarke F.E., Hanshaw, B.B. and Balsley, J.R. 1973. A Procedure for evaluating environmental impact, Geological Survey Circular 645, US Geological Survey, Washington.PP.13.*

Reversibility – whether environmental conditions return to baseline or not;

Likelihood –regularly occurring under typical conditions to unlikely to occur; and

Nature of impact – the measure of whether the effect has a single direct effect or whether there is a cumulative effect over time or a synergic effect with other conditions

Generic criteria for determining impact magnitude (for both beneficial and adverse impacts), permanence, reversibility and nature of impact is hereunder described.

Table 9 – General criteria for determining the magnitude of the impact

Category	Description
Major	Environmental effects are noticeable and are sufficient to destabilize the resource. Change to the specific conditions assessed resulting in long term/permanent change, typically widespread and requiring significant intervention to return to baseline; exceeds national standards and limits.
Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific condition assessed
Negligible	No perceptible change to the specific condition assessed.

Table 10 – General criteria for determining permanence

Category	Remarks
Permanent	Effect of Impact on permanent (Long-term) manner.
Temporary	The only effect of impact on temporary (Short-term) duration.
None	None

Table 11 – General criteria for determining reversibility

Category	Remarks
Irreversible	An irreversible impact is one from which recovery is not possible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it.
Reversible	A reversible impact is one from which spontaneous recovery is possible or, for which effective mitigation is both possible and an enforceable commitment has been made.
None	None

Table 12 – General criteria for determining extent of the impact

Category	Remarks
Cumulative effect	Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project or synergistic effect with other conditions
Single effect	Impact that result from single direct or indirect impact.
None	None

In addition to the general criteria, additional criteria for determining the magnitude of impact for specific environmental components are presented in **Section 7 of the report.**

3.4.3.2. Sensitive receptors

Sensitive receptors can be described as features that are notable in some way, whether due to their local or national importance or if they are especially sensitive to changes. Typically, sensitive receptors relate to ecological or human receptors (habitats, species, population centres) as well as geographical phenomenon or structures. The framework for assigning sensitivity to receptors is presented in **Table 13.**

Table 13 - Description and features of sensitive receptors area

Features of the Receptors area	Type of Area	Sensitivity
Protected areas for conservation of national or international importance	1	High
Water supply reserves	1	High
Hospitals, and school premises	1	High
Contagious high-density residential block, town center	1	High
Vital utilities such as electricity and energy sources, natural wealth reserves, and state-protected economic zones	2	Moderate
Light density residential blocks, public parks	2	Moderate
Natural bodies of water	2	Moderate
Place of cultural heritage	2	Moderate
Commercial buildings, offices, and other public areas	3	Light
Food products manufacturing premises	3	Light
Agricultural crops farmland	3	Light
Industrial	4	Marginal
Animal farmland but without food, milk or meat products processing	4	Marginal

Source: DM EPSS – TG02 (August 2018)

3.4.3.3. Determining the significance of the effect

Likely impacts are assessed taking into account the interaction between the magnitude and sensitivity criteria to determine the significance of any effect, which may be adverse or beneficial, as presented in **Table 14.** Major or moderate effects are considered as significant.

Table 14 – Criteria for determining the significance

Magnitude of Impact	Sensitivity			
	Marginal	Light	Moderate	High
Negligible	Neutral	Neutral	Neutral	Neutral
Minor	Negligible	Negligible	Minor	Minor
Moderate	Negligible	Minor	Moderate	Moderate
Major	Negligible	Minor	Moderate	Major

3.5. STRUCTURE OF ESIA REPORT

The ESIA report is outlined as follows:

Chapter 1	Executive Summary
Chapter 2	Introduction – Basic project information, Project proponent, study team, project rationale
Chapter 3	Description of ESIA study methodology
Chapter 4	Reference Laws, Regulations, and Standards
Chapter 5	Project Description- - Location, process and resource requirements
Chapter 6	Description of Environment – Terrestrial and Marine Baseline Study – Air, Water, Noise, Solid waste, Biological, Socio-Economic environment
Chapter 7	Assessment of environmental impacts
Chapter 8	Project Alternatives
Chapter 8	Mitigating Measures and Enhancement Plan
Chapter 9	Environmental Management and Monitoring Program
Chapter 10	Conclusion
Chapter 11	Annexures

4. REFERENCE LAW, REGULATIONS AND STANDARDS

The 1972 UN Conference on Human Development at Stockholm influenced the need for a well-developed legal mechanism to conserve resources, protect the environment and ensures the health and well-being of the people. Over the years, issues concerning the environment are regulated in the UAE through a system of Federal Laws and Executive Regulations. The principal Federal Law covering environmental protection is Federal Law No.24 of 1999, for the Protection and Development of the Environment. This law established the framework for environmental protection in the UAE and is enforced on a country-wide scale by the Federal Environment Agency (FEA) [Now it is enforced by Ministry of Climate Change and Environment (MoCCAE)]. The Emirate of Sharjah, led by His Highness Sheikh Dr Sultan bin Mohammed Al Qasimi, Supreme Council Member and Ruler of Sharjah, established an Environment and Protected Areas Authority (EPAA) in charge of environmental affairs. EPAA aims to protect the environment, and the wildlife and its biodiversity through scientific research, setting appropriate policies to raise awareness, supporting the principle of sustainable development to preserve natural environmental resources and by guaranteed exploitation of natural resources to the benefit of the present generation without wasting the right of future generations. Statutory Environmental obligations for the Sharjah Emirate are regulated by Environment and Protected Areas Authority (EPAA) and Environment Protection Section (EPS) – Sharjah City Municipality (SM). The activities of the proposed project shall be governed by the regulations enforced by EPAA and comply with standards/guidelines of EPAA, Sharjah City Municipality, Federal laws/regulations, standards/guidelines prescribed by UAE-MoCCaE. Equator Principles (EPs), World Bank Group – International Financial Corporation (IFC) regulations and the Japan Bank for International Cooperation (JBIC) guidelines have complied.

4.1. FEDERAL LAWS, REGULATIONS AND STANDARDS

4.1.1. UAE - FEDERAL ENVIRONMENTAL LAW (FEDERAL LAW NO. 24 OF 1999 AND AMENDMENTS)[3]

The Federal Law No. 24 of the year 1999 on protection and development of the environment for the United Arab Emirates (UAE) was signed by the late His Highness Sheikh Zayed Bin Sultan Al Nahyan, President of the United Arab Emirates and published

[3] *English translated version of Federal Law No. (24) of 1999 published in http://faolex.fao.org/docs/pdf/uae67811E.pdf.*

in the UAE official gazette, vol. XXVIII, issue no. 340, October 1999, pp. 97-116. This federal legislation has been implemented to specifically overcome the recent growth and inconsistent application of environmental regulations. Under the new legislative arrangements, the Federal Environmental Agency (FEA) [Now it is enforced by Ministry of Climate Change and Environment (MoCCaE)] has assumed the overall responsibility for the EIA process within the UAE, with provisions for bilateral agreements between the FEA and the municipalities. Projects should generally be administered by the relevant authority where the project is to be undertaken. The main objectives of Federal Law No. 24 of 1999 are:

- Protection and conservation of the quality and natural balance of the environment;
- Control of all forms of pollution to avoid harmful effects resulting from developments;
- Conserve biodiversity and resources with consideration of present and future generations;
- Protection of society and human health from environmentally harmful activities; and
- Compliance with international and regional environmental agreements ratified or approved by the UAE.

Chapter I - Development and the Environment [Section 1 - Environmental Impact of Establishments] - Article (3): The agency, in consultation with the competent authorities and concerned parties shall set the standards, specifications, principles and regulations for the assessment of environmental impact of projects and establishments applying for license and shall undertake the following:

- Identification of categories of projects, which due to their nature may cause harm to the environment;
- Identification of areas and sites which have particular environmental importance or sensitivity such as historical and archaeological sites, wetlands, coral reefs, natural reservations and public parks; and
- Identification of natural resources and major environmental problems of special importance.

Article 4: The concerned agency and authorities are authorized bodies for assessing the environmental impact assessment reports. No activities should be carried out without the approval of the EIA study.

Article 7: Owners of the project or establishment is required to conduct regular analysis and monitoring of waste and effluent discharged.

Article 9: All concerned parties especially parties responsible for planning, economic and construction development shall consider aspects of protection of the environment, control of pollution and rational use of natural resources when developing economic and social plans and when establishing and executing of projects.

Chapter I - Development and the Environment [Section 3 - Environmental Monitoring] - Article (13): The agency, in coordination with the competent authorities and concerned parties, develop a national system for environmental monitoring. The competent authorities shall undertake the establishment, operation and supervision of the environmental monitoring networks.

Article 14: The environmental monitoring networks shall notify the agency, competent authorities and concerned parties of any violation of the permissible limits of environmental pollutants and should submit periodic reports of the results following the provision of the executive order.

Chapter 2 - Protection of Water Environment [Section 1 - The scope of Environmental Protection] - Article (17): Protection of water environment from pollution aims to achieve the following:

- Protection of the coasts, beaches and seaports of the state from all kinds and forms of pollution.
- Protection of the marine environment and its living and non-living natural resources by prevention, reduction and control of pollution regardless of its source.
- Protection of drinking water and groundwater and development of water resources.

Chapter 2 - Protection of Water Environment [Section 2 - Protection of the Marine Environment (Part II - Pollution from Land Sources] - Article (35): All establishments including public premises and commercial, industrial, agricultural, tourism and service establishments are prohibited from discharging untreated substances, wastes or liquid which may directly or indirectly cause pollution to the water environment.

Article (36): Licensing for the establishment of premises or shops on or near the coastline discharging pollutants in contradiction to the terms of this law and its executive order, is subject to conducting studies on environmental impact by the applicant and providing waste treatment units and undertake to start their operation immediately.

Article (37): Executive order shall determine the specifications and standards to be observed by industrial establishments authorized to discharge degradable polluting substances after treatment.

Executive order shall also specify persistent polluting substances that industrial establishments are prohibited from discharging into the marine environment.

Chapter 2 - Protection of Water Environment [Section 3 - Protection of Drinking and Underground water] - Article (39): The concerned parties shall consult and coordinate with the agency and the competent authorities in all matters related to drinking and underground water including the preservation and development of the sources of water resources.

Chapter 3 - Soil Protection - Article (43): It is prohibited under the executive order to undertake any activity contributing directly or indirectly to damaging, disturbing the natural properties or polluting the soil in any way that may affect its productivity.

Chapter 4 - Protection of air from pollution - Article (48): Establishments during operation shall ensure that air pollutants must not exceed the permissible limits specified in the Executive Order.

Article (49): Machines, engines or vehicles producing exhaust gases that exceed the limits specified in the Executive Order shall not be used.

Article (50): It is prohibited to throw, treat or burn garbage and solid wastes except in places designated for such purposes away from residential, industrial and agricultural areas and the water environment. The executive order shall determine the specifications, regulations and the minimum distance of the designated places from such areas.

Article (52): All parties and individuals shall, at the time of exploration, drilling, construction, demolition or transportation of wastes or dusts produced as a result, during these activities, undertake the necessary precautions in addition to the precautions required for storage or safe transportation to prevent dispersion of such wastes and dusts as specified in the executive order.

Article (56): Closed and semi-closed public spaces should have adequate ventilation proportionate to the size, capacity and activity.

Chapter 6 – Natural Reserves - Article (63): Reserve areas in the State and the boundaries of each area shall be determined by a decree issued by the Cabinet of Ministers or the Competent Authorities. Certain areas may be considered reserve areas in accordance with a proposal from the agency.

Article (64): Work, activities and acts prohibited in reserve areas which may lead to damage or deterioration of the natural environment cause harm to wild or marine life or affect their aesthetic value, shall be determined by a decree issued by the Cabinet of Ministers or the Competent Authorities in accordance with Agency.

It is also prohibited to set up establishments, buildings or construct roads, drive vehicles or practice any agricultural, industrial or commercial activities in reserve areas without the permission of the Competent Authorities.

Article (65): Wild and marine animals and birds using reserves for resting, hatching or habitation shall be protected in accordance with the provision of this Law.

Article (66): It is prohibited to practice any activities, acts or works in areas surrounding the reserves if such practices affect the environment of the reserves or their natural phenomena without permission from the Competent Authorities in consultation with the Agency.

4.1.2. UAE – FEDERAL LABOR LAW (FEDERAL LAW 8 OF 1980 AND AMENDMENTS)

Chapter 5: Safety, Protection and Health and Social Care of the employees.

Article (91) - Every employer shall provide adequate preventive equipment to protect workers against the dangers of employment accidents and occupational diseases that may occur during the work, and also against fire hazards and other hazards that may result from the use of machines and other equipment. He shall also adopt all other preventive methods ordered by the Ministry of Labour and Social Affairs. Every worker shall use the protective equipment, and the clothing supplied to him for this purpose, shall comply with all instructions given by the employer to protect him against hazards, and shall not take any action liable to hamper compliance with such instructions.

Article (92) - Every employer shall display detailed instructions in a conspicuous position at the workplace indicating the measures to be taken to prevent fire and protect the workers against hazards to which they may be exposed while performing their work. Such instructions shall be in Arabic and if necessary in another language understood by the worker.

Article (93) - Every employer shall provide one or more first-aid boxes containing medicines, bandages, antiseptics and such other first-aid material as may be ordered by the Ministry of Labour and Social Affairs. There shall be one first-aid box for every 100 workers. The box shall be located in a conspicuous place and within easy reach of the workers. Use of the box shall be entrusted to a person specialized in giving first aid.

Article (94) - Without prejudice to the provisions of the regulations and orders issued by the competent government authorities, an employer shall ensure perfect cleanliness and ventilation in each workplace and shall provide each workplace with adequate lighting, drinking water and toilets.

Article (95) - The employer shall entrust one or more physicians with the complete examination of the workers thereof liable to contract an occupational disease set in the schedule enclosed herewith once every six months at most in a periodic manner. The employer shall also record the result of such examination in the records thereof and the files of such workers.

The physicians must notify the employer and the labor department immediately of the cases of occupational diseases appearing among workers, and the deaths resulting from there-form after verification thereof through necessary medical and practical researches. The employer shall, in turn, notify the labor department thereof.

The physician undertaking the periodic examination may request the re-examination of any worker having contracted an occupational disease after a period shorter than the periodic period provided for in the first paragraph of the present article, should he find that his condition so requires.

Article (96) - An employer shall provide his workers with medical care facilities corresponding to the standards laid down by the Minister of Labour and Social Affairs in co-operation with the Minister of Health.

Article (97) - The Minister of Labor and Social Affairs in consultation with Minister of Health shall determine suitable general precautions and health safety measures to be taken against fire and electrical current for all establishments.

Article (98) - The employer or the representative thereof shall inform the worker upon the employment thereof of the hazards of the job and safety measures by which he must abide. He shall post detailed written instructions in this regard in the workplace.

Article (100) - The worker shall abide by the orders and instructions related to industrial security and safety precaution. He shall use safety measures and commit for treatment such devices in his possession with due care. The worker shall be prohibited from carrying out any actions entailing the non-execution of the said instruction, the ill use of the means set for the protection of the health and safety of the workers or the harm and destruction of such means.

4.1.3. EXECUTIVE REGULATIONS

In addition to the requirements of Federal Law No. 24 of 1999, the numbers of executive regulations have been published dealing with specific environmental aspects. A brief review of the main provisions of these regulations is provided below.

4.1.3.1. Regulation for Environmental Impact Assessment of Establishments

The regulation requires that an Environmental Impact Assessment (EIA) study shall be conducted for specific projects before the competent authority issues a license to develop/operate the project. The procedures for applying for an environmental license and the information requirements are specified in the regulation. Any person, who wants to set up or modify any project or activity, must obtain an environmental license from the competent authority. An application for the license for specific projects listed in the regulations must include an assessment of the environmental effects of the project, including specific information identified in Appendix 2 of the regulations. The specified information to be covered in the environmental assessment is:

- description of the project in its preliminary phases;
- Statement of the objectives of the project;
- description of the current environmental situation which may be affected by the project, if executed;
- Environmental aspects of the project in all phases (preliminary, construction, operation);
- Analysis of the expected environmental consequences of the project, including the use of power;
- Management measure for the protection of the environment and an assessment of their efficiency;
- The consequences of not executing the project;
- Commitments to continuing observation and controlling of environmental contamination resulting from the project.

4.1.3.2. Regulation for the Protection of Marine Environment

Chapter 2 of the Federal Law No. 24 of 1999 (Protection of Water Environment) - [Section 2 - Protection of the Marine Environment (Part II - Pollution from Land Sources] addresses the issues of pollution from land sources (Articles 35-37). This regulation describes the specifications and standards to be observed by industrial establishments authorized to discharge degradable polluting substances after treatment. These are as follows:

Chapter 4 – Contamination by Land Sources - Article 21 – Industrial installations authorized for discharging degradable contaminants to the marine environment must treat the same without exceeding the allowable limits stated under Appendix No. (8) of the regulation.

Article 22 – No industrial installation is allowed to discharge or dispose of any non-degradable contaminants as stated under Appendix No. (9) of the regulation.

4.1.3.3. Regulation concerning Protection of Air from Pollution

Chapter 4 of the Federal Law No. 24 of 1999 for the "Protection and Development of the Environment" addresses the issue of Air Pollution (Articles 48-57). The Executive Bye-Law (Cabinet decree 12 of 2006) regarding "Regulation concerning Protection of Air from Pollution" specifies several conditions that an operating industrial unit has to comply with the regulation.

Article 2 – All facilities shall not exceed the maximum allowable limits specified in Annex (1) of the regulation (Table 15 of the report) regarding the emission or the leakage of the gaseous and solid pollutants and vapours to the ambient air.

Table 15 - Air Pollutants Emission Limits for Stationary Sources

Substance	Symbol	Sources	Emission Limits (mg/ Nm^3)
Visible Emissions		Combustion sources Other sources	250 None
Carbon Monoxide	CO	All sources	500
Nitrogen Oxides (expressed as Nitrogen dioxide)	NO_X	Combustion sources Material producing industries Other sources	See **Table 16** of this report 1500 200
Sulphur Dioxide	SO_2	Combustion sources Material producing industries Other sources	500 2000 1000
Sulphur Trioxide Including Sulphuric Acid Mist (express as sulphur trioxide)	SO_3	Material producing industries Other sources	150 50
Total Suspended Particulates	TSP	Combustion sources Cement industry Other sources	250 50 150
Ammonia and Ammonium Compounds (expressed as ammonia)	NH_3	Material producing industries Other sources	50 10
Benzene	C_6H_6	All sources	5
Iron	Fe	Iron & steel foundries	100
Lead and its Compounds (expressed as lead)	Pb	All sources	5
Antimony and its Compounds (expressed as antimony)	Sb	Material producing industries Other sources	5 1
Arsenic and its Compounds (expressed as arsenic)	As	All sources	1
Cadmium and its Compounds	Cd	All sources	1

Substance	Symbol	Sources	Emission Limits (mg/ Nm^3)
(expressed as cadmium)			
Mercury and its Compounds (expressed as mercury)	Hg	All sources	0.5
Nickel and its Compounds (expressed as nickel)	Ni	All sources	1
Copper and its Compounds (expressed as copper)	Cu	All sources	5
Hydrogen Sulphide	H_2S	All sources	5
Chloride	Cl^-	Chlorine works Other sources	200 10
Hydrogen Chloride	HCl	Chlorine works	200
		Other sources	20
Hydrogen Fluoride	HF	All sources	2
Formaldehyde	CH_2O	Material producing industries Other sources	20 2
Carbon	C	Odes production Waste incineration	250 50
Total Volatile Organic Compounds (expressed as total organic carbon (TOC)	VOC	All sources	20
Dioxins & Furans		All sources	1 (ng TEQ/m^3)

Article 4 – All authorities and facilities shall take into account, during the combustion of any hydrocarbon fuels, that smoke, gases, and vapor emitted shall be within the allowable limits specified in Annex (2) of the regulation (Table 12 of this report). All authorities and facilities shall take the necessary precautions to reduce the level of pollutants resulting from combustion as follows:

- The diesel fuel which contains more than 0.05% of its weight of sulphur shall be banned. The competent authorities in each of the UAE Emirates shall lay down the phased policies, work plans, and the detailed mechanism for the gradual subrogation of clean fuel until the internationally approved percentage which is (10) parts in a million of weight is reached, in coordination with the State's producing authorities.
- The competent authorities in each of the Emirates shall lay down the phased policies, work plans, and the detailed mechanisms achieving the use of the compressed natural gas (or any other clean fuel/energy) as an alternative fuel in a certain percentage of the general vehicles following them.
- Emissions shall be reduced to control air pollution by specific tools and equipment which comply with the techniques of control and cleaner production.

Table 16 - Air Pollutants Emission Limits for Stationary Combustion Sources Using Hydrocarbon Fuel

Substance	Symbol	Sources	Emission Limits (mg/Nm^3)
Visible Emissions		All sources	250
Nitrogen Oxides (expressed as Nitrogen Dioxide – NO_2)	NO_X	**Fuel combustion units**	
		- Gas fuel	350
		- Liquid fuel	500
		Turbine units;	
		- Gas fuel	70
		- Liquid fuel	150
Sulphur di-oxide	SO_2	All sources	500
Total Suspended Particles	TSP	All sources	250
Carbon Monoxide	CO	All sources	500

Article 7 – All authorities and facilities, according to the business requirements of each, shall consider the following elements on designing the chimneys used for the emission of air pollutants:

1- The chemical and physical nature of emissions.
2- Height from the surface of the earth.
3- The height of facilities and buildings in the surrounding area.
4- The external diameter.
5- The internal diameter.
6- The materials used for construction.
7- The size of the materials and the speed of emission.
8- The temperature of emissions.
9- The current wind direction.
10- Humidity in the ambient air.

As for chimneys serving public places like restaurants, hotels and other commercial purposes, its height should be no less than 3 meters higher than the height of the building in which the commercial activity is carried out, or that of the surrounding buildings, whichever is higher.

Article 11 - While carrying out the productive and service activities or any other activities and specially when operating the equipment, and using horns and microphones, all authorities, facilities, and people may not exceed the maximum allowable levels of noise and maximum span for exposure, specified in **Annex (6)** of the regulation (Table 17 of this report).

Table 17 - Allowable Noise Limits in Different Areas

Area	Allowable Limits For Noise Level (dBA)*	
	Day (7 a.m. – 8 p.m.)	Night (8 p.m. – 7 a.m.)
Residential Areas With Light Traffic	40 - 50	30 – 40
Residential Areas In The Downtown	45 - 55	35 – 45
Residential Areas Which Include Some Workshops & Commercial Business or Residential Areas Near The Highways	50 - 60	40 – 50
Commercial Areas & Downtown	55 - 65	45 – 55
Industrial Areas (Heavy Industry)	60 - 70	50 – 60

*dBA means decibels adjusted. dBA is used for determining the sound exposure to humans.

Article 12 – All authorities and facilities must ensure enough ventilation inside the sites of work, taking the necessary precautions and measures to prevent the leakage or emission of air pollutants, except within the specified allowable limits specified in Annex 7a & 7b of the regulation (**Table 18** and **Table 19** of this report).

Table 18 - Maximum allowable limits for air pollutants in the working areas (Dust)

Substance	Max. Allowable limits (mg/m^3)
Respirable Dust Crystalline silica (Quartz)	0.05
Un-crystalline silica (Asbestos)	2.5
Asbestos (Crysotile)	0.1(fiber/cm^3)
Total Dust Un-crystalline silica (Graphite)	10
Stone wool	5
Silica gel	6
Portland cement	10
Dust from biological sources Hardwood vapors	1
Softwood vapors	5
Inorganic lead	0.05

Table 19 – Maximum allowable limits of air pollutants in working areas (chemical substances)

S. No.	Substances*	Threshold Limit Values (TLV)		Unit
		TWA	STEL	
1	Aluminium	10	--	mg/m^3
2	Ammonia	17	24	mg/m^3

S. No.	Substances*	Threshold Limit Values (TLV)		Unit
		TWA	STEL	
3	Arsenic (elemental)	0.01	--	mg/m^3
4	Asphalt (fumes)	5	--	mg/m^3
5	Benzene	3	16	mg/m^3
6	Butane	1900	--	mg/m^3
7	Arsenic (elemental)	0.02	-	mg/m^3
8	Carbon dioxide	5000	30000	ppm
9	Carbon monoxide	29	--	mg/m^3
10	Chlorine	1.5	2.9	mg/m^3
11	Copper (Dust)	1.0	--	mg/m^3
12	Copper (Fumes)	0.2	--	mg/m^3
13	Cotton Dust	0.2	0.6	mg/m^3
14	Ethylbenzene	434	543	mg/m^3
15	Fluorides (as F)	2.5	--	mg/m^3
16	Fluorine	1.6	3.1	mg/m^3
17	n-Hexane	176	--	mg/m^3
18	Lead elemental	0.05	--	mg/m^3
19	Mercury (Fumes)	0.05	--	mg/m^3
20	Nitrogen Dioxide	5.6	9.4	mg/m^3
21	Ozone	--	0.2	mg/m^3
22	Sulphur dioxide	5.2	13	mg/m^3
23	Silica (Inhalable particles)	10	--	mg/m^3
24	Silica (Respirable particles)	3	--	mg/m^3
25	Toluene	188	--	mg/m^3
26	Welding Fumes	5	--	mg/m^3
27	Xylene (all isomers)	434	651	mg/m^3
28	Yttrium compounds (as Y)	1	--	mg/m^3
29	Zirconium Compounds (as Zr)	5	10	mg/m^3

***** Some of the substances are only presented as the reference.

Article 14 – Environment Observatories shall notify the Agency, the competent and the concerned authorities of any violation of the allowable limits of air pollutants, as specified in **Annex (8)** of the regulation (Table 20 of this report) and undertake to provide periodical reports for such authorities summing up the results of their work.

Table 20 - Ambient Air Quality Standards (Air Pollutants Limits in the Ambient Air)

Substance	Symbol	Max. Allowable Limits ($\mu g/m^3$)	Average Time
Sulphur Dioxide	SO_2	350 150 60	1 hour 24 hour 1 year
Carbon Monoxide	CO	30 (mg/m^3) 10 (mg/m^3)	1 hour 8 hour
Nitrogen Dioxide	NO_2	400	1 hour

Substance	Symbol	Max. Allowable Limits (μg/m^3)	Average Time
		150	24 hour
Ozone	O_3	200 120	1 hour 8 hour
Total Suspended Particles	TSP	230 90	24 hour 1 year
Particulate Matter (within 10 microns or less in diameter)	PM_{10}	150	24 hours
Lead	Pb	1	1 year

Article 15 – The owner of the facility or the activity shall carry out a periodic analysis of the air pollutants emitted and shall observe the specifications of such emissions emitted from such facility or activity. The report of such results shall be sent to each of the agency and the competent authorities. The owner of the facility shall also keep a registrar to record the amounts of air pollutants for five years as of each analysis, giving access to the employees of the agency and the competent authorities who shall enjoy the power of judicial seizure to be informed of such records over such span of time.

4.1.3.4. Regulation for Handling Hazardous Materials, Hazardous Wastes and Medical Wastes

Article 4 – It details the requirement for obtaining the license for handling and dealing operation in hazardous material, hazardous wastes and medical wastes. The license is issued for five years by the competent regularity unit (competent authority). Any party purporting to undertake any business or works related to handling or dealing in hazardous material, hazardous waste and medical waste shall submit its application to the regularity authority for obtaining business or work license. The application submitted to the regulatory authority must contain information about:

- Characteristics of the hazardous materials, hazardous wastes and medical wastes handled and the nature and concentration of hazardous elements therein as per international classifications
- The quantity of hazardous waste generated and the description of packing methods (barrels, tanks, bulk).
- Description of intended storage methods and their respective storage periods with an undertaking for making a clear statement on the packages disclosing the contents thereof and the extent of their dangers and actions to be taken in emergency cases.
- The Indication of transport means.
- The method intended to be adopted for treating and disposing of wastes.

- Moreover, to maintain such records for five years from the date of their compilation.
- Previous experience certificate in the field of handling hazardous materials, hazardous wastes and medical wastes.

Article 6 and **7** specifies the packing requirement of hazardous chemical materials and transport of hazardous chemical materials respectively.

Article 8 describes the various storage practices to be followed by the licensed owner for hazardous chemical materials.

Article 10 specifies general rules and procedures for hazardous waste management. The rules and procedures cover generation, collection & storage, transport and treatment & disposal of hazardous wastes. Annexe (1) under the regulation classifies different schedule for defining hazardous waste and its storage:

Schedule 1.1: Classifies Hazardous Materials into 9 different categories of waste.

Schedule 1.2: Hazardous Materials Segregation Requirements

Schedule 1.3: Minimum Segregation Requirements between Hazardous Materials and Public

Transport of hazardous waste is prohibited in the UAE except by licensed carriers who comply with specified conditions.

Article 11 - No installations shall be constructed for treating hazardous wastes without obtaining the license to this effect from the competent authorities in coordination with the Federal Environmental Agency ensuring such installation to have met all environment and personnel safety conditions.

Article 12 - Transport and disposal of locally produced hazardous wastes through land borders, marine environment limits and airspace shall be controlled following the rules, procedures and controls mentioned and specified in Basel Agreement and coordination with Federal Environmental Agency.

Article 13 - Parties producing or handling hazardous wastes, whether, in liquid, the gaseous or solid state shall take all precautions necessary for evading causing any environmental damages shall, in particular, observe the following:

1. Selection of the site on which such materials shall be produced or stored under necessary conditions following the quality and quantity of such materials.
2. Buildings inside which such materials are produced or stored shall be designed following the engineering standards and criteria which must be observed for each kind of such materials. Such buildings shall be subject to periodical inspection by the competent unit.

3. The technology used for the production of such materials as well as all suitable equipment and systems shall not be causing any damage to the installations, environment or personnel.
4. Buildings shall include security, safety, alarm, firefighting and first aid systems and equipment in proper quantities and numbers in coordination with the Ministry of Health, Civil Defense Directorate and the competent regularity unit.
5. The emergency plan shall be set for facing any expected accidents during production, storage, transport or handling operations of such materials provided; competent regularity unit shall approve such plan.
6. The staff of hazardous wastes handling parties shall be subject to periodical medical check-up provided the results of such medical checkup shall be kept in the file of each person and provided they shall be treated from all occupational diseases under the U.A.E. applied laws, rules and regulations.

Article 14 - The owners of installations generating hazardous wastes under the provisions of this Law shall maintain a record for such wastes including:

- A full description of the waste including physical and chemical characteristics and hazards;
- Quantities;
- Sources;
- Collection rates and periods;
- Transport and treatment methods;
- Name of the waste contractor to which these wastes are delivered

The regulation also contains provisions for handling/disposal of medical wastes. Any handling of hazardous materials and wastes throughout the construction and operation of the project need to adhere to this regulation, with all responsible parties undertaking appropriate practice.

4.2. UAE REGIONAL STANDARDS

Environmental agencies of different emirates of UAE have issued regulations/ guidelines and standards for EIA study as well as allowable pollutant levels. Given below is a list of guidelines/regulations available within the UAE that referred to this report:

- Sharjah Municipality guidelines and standards
- Abu Dhabi Environmental Agency (EAD) guidelines for EIA
- Dubai Municipality - Technical guidelines for EIA, 2017
- EHS guidelines and guidelines of Ports, Customs and Free Zone Corporation (PCFC)-Trakhees, Government of Dubai.

4.2.1. EMIRATE OF SHARJAH - ENVIRONMENTAL STANDARDS AND ALLOWABLE LIMITS OF POLLUTANTS

All concerned parties, agencies and establishments operating in Sharjah Emirate are required to comply with environmental standards mentioned below:

Table 21 – Specification & Standard of Effluent Water for Land Irrigation and to Dispose into Sea

S. No.	Parameters	Units	Maximum Allowable Limits for Discharge to		
			Sludge to Land (mg/kg)	Land Irrigation	Sea Disposal
1.	pH		--	6 - 9	6 - 9
2.	Suspended Solids		--	15	30
3.	Biochemical Oxygen Demand (5 Days)	mg/l	--	15	30
4.	Turbidity	NTU	--	--	75
5.	Chemical Oxygen Demand	mg/l	--	100	150
6.	Oil & Grease (Non-soluble)	mg/l	--	5.0	10.0
7.	Phenols	mg/l	--	1.0	0.5
8.	Ammonia as NH_3-N	mg/l	--	5.0	5.0
9.	Aluminium (Al)	mg/l		5.0	--
10.	Arsenic (As)	mg/l	--	0.2	0.05
11.	Beryllium (Be)	mg/l	--	2.0	--
12.	Barium (Ba)	mg/l	--	0.3	--
13.	Boron (B)	mg/l	--	2.0	--
14.	Cadmium (Cd)	mg/l	30	0.03	0.05
15.	Chromium (Cr)	mg/l	1000	0.50	0.50
16.	Cobalt (Co)	mg/l	100	0.5	0.50
17.	Copper (Cu)	mg/l	1000	0.5	0.50
18.	Iron (Fe)	mg/l	--	5	2.0
19.	Lead (Pb)	mg/l	1000	0.1	0.1
20.	Lithium (Li)	mg/l	--	10.0	--
21.	Manganese (Mn)	mg/l	--	1.0	--
22.	Mercury (Hg)	mg/l	10.0	0.001	0.001
23.	Nickel (Ni)	mg/l	200	0.5	0.1
24.	Zinc (Zn)	mg/l	1000	0.5	0.1
25.	Total Coliforms	MPN/ 100 ml	--	20	100

Table 22 – Recommended Water Quality Criteria of Industrial Effluent Acceptable to Sewage Treatment Works

S. No.	Parameters	Units	Max. Allowable Limits	Comments
1.	Temperature	°C	45	After balancing
2.	Color	--	Wastewater containing dyes shall be discharged if decolorization in the wastewater treatment plant is ensured.	
3.	Total Dissolved Solids (TDS)	mg/l	3000	--
4.	Total Suspended Solids (TSS)	mg/l	500	--
5.	pH	--	6 - 10	--
6.	Chemical Oxygen Demand (COD)	mg/l	*1000 - 3000	*For small industries limit typically
7.	Biochemical Oxygen Demand (BOD)	mg/l	1000	--
8.	Total Hydrocarbons	mg/l	20	--
9.	Phenols	mg/l	10	--
10.	Fat & Grease	mg/l	100	--
11.	Oil & Grease (Non-soluble)	mg/l	50	--
12.	Detergent	mg/l	30	--
13.	Active Chlorine (Cl)	mg/l	0.5 – 3.0	--
14.	Active Bromine (Br_3)	mg/l	1- 3	--
15.	Ammonia Nitrogen (NH_3-N)	mg/l	75	--
16.	Total Kjeldahl Nitrogen (N)	mg/l	125	--
17.	Chlorine Dioxide (ClO_2)	mg/l	0.5 – 3.0	--
18.	Chlorides	mg/l	600	--
19.	Fluorides (F)	mg/l	10	--
20.	Nitrates (NO_3)	mg/l		As low as possible
21.	Nitrites (NO_2)	mg/l	10	--
22.	Sulphates (SO_4)	mg/l	500	--
23.	Sulphide(S^{2-})	mg/l	10	--
24.	Aluminium (Al)	mg/l	20	--
25.	Arsenic (As)	mg/l	0.1	--
26.	Boron (B)	mg/l	1.0	--
27.	Cadmium (Cd)	mg/l	0.1	--
28.	Chromium (Cr^{+3})	mg/l	2.0	Lower levels for major discharges
29.	Chromium (Cr^{+4})	mg/l	0.5	
30.	Cobalt (Co)	mg/l	0.5	--
31.	Copper (Cu)	mg/l	1.0	Lower levels for major discharges
32.	Lead (Pb)	mg/l	1.0	--
33.	Mercury (Hg)	mg/l	0.01	--
34.	Nickel (Ni)	mg/l	2.0	Lower levels for major discharges
35.	Silver (Ag)	mg/l	0.01	--

S. No.	Parameters	Units	Max. Allowable Limits	Comments
36.	Tin (Su)	mg/l	2.0	--
37.	Zinc (Zn)	mg/l	2.0	--

4.2.2. DUBAI MUNICIPALITY - ENVIRONMENTAL STANDARDS AND ALLOWABLE LIMITS OF POLLUTANTS ON LAND, WATER AND AIR ENVIRONMENT, 2003

The bulletin features quick reference of the various environmental standards issued by the Dubai Municipality - Environment Protection and Safety Section (EPSS) of the Environment Department. The below tables indicate the allowable and objective values with supplementary notes. All concerned parties, agencies and establishments operating in Dubai are required to comply with these environmental standards.

Table 23 – Dubai Wastewater Discharge Limits

S. No.	Indicators	Units	Maximum Allowable Limits for Discharge to		
			Sewerage System	Land as for Irrigation	
				Drip	Spray
1.	Biochemical Oxygen Demand	mg/l	1,000	20	10
2.	Chemical Oxygen Demand	mg/l	3,000	100	50
3.	Chlorides	mg/l	--	500	350
4.	Chlorine – residual	mg/l	10	Not less than 0.5 mg/l after 30 min contact time	
5.	Cyanides as CN	mg/l	1	0.5	0.5
6.	Detergents	mg/l	30	--	--
7.	Fluorides	mg/l	--	1	1
8.	Nitrogen,	mg/l	40	5	1
9.	Nitrogen, ammoniacal	mg/l	--	10	5
10.	Nitrogen, organic	mg/l	--	50	30
11.	Oil total	mg/l	150	--	--
12.	Oil	mg/l	50	5	5
13.	pH (range)		6 - 10	6 - 8	6 - 8
14.	Pesticides, non-chlorinated	mg/l	5	--	--
15.	Phenols	mg/l	50	0.1	0.1
16.	Phosphorous (P)	mg/l	30	20	20
17.	Sulfates, total	mg/l	500	200	200
18.	Sulfides as S	mg/l	10	0.05	0.05
19.	Suspended Solids	mg/l	500	50	10
20.	Temperature	°C	45 or <5 of ambient	--	--

S. No.	Indicators	Units	Maximum Allowable Limits for Discharge to		
			Sewerage System	Land as for Irrigation	
				Drip	Spray
21.	Total Dissolved Solids	mg/l	3,000	1,500	1,000
22.	Total Metals	mg/l	10	--	--
23.	Aluminium (Al)	mg/l		2	2
24.	Arsenic (As)	mg/l	0.5	0.05	0.05
25.	Barium (Ba)	mg/l	--	1	1
26.	Beryllium (Be)	mg/l	--	0.1	0.1
27.	Boron (B)	mg/l	2	2	2
28.	Cadmium (Cd)	mg/l	0.3	0.01	0.01
29.	Chromium (Cr)	mg/l	1	0.1	0.1
30.	Cobalt (Co)	mg/l	--	0.1	0.1
31.	Copper (Cu)	mg/l	1	0.2	0.2
32.	Iron (Fe)	mg/l	--	2	2
33.	Lead (Pb)	mg/l	1	0.5	0.5
34.	Magnesium (Mg)	mg/l	--	100	100
35.	Manganese (Mn)	mg/l	1	0.2	0.2
36.	Mercury (Hg)	mg/l	0.01	0.001	0.001
37.	Molybdenum (Mo)	mg/l	--	0.01	0.01
38.	Nickel (Ni)	mg/l	1	0.2	0.2
39.	Selenium (Se)	mg/l	--	0.02	0.02
40.	Silver (Ag)	mg/l	1		
41.	Sodium (Na)	mg/l	--	500	200
42.	Zinc (Zn)	mg/l	2	0.5	0.2
43.	Faecal Coliforms	MPN/ 100 ml	500	20	--

** Discharge limits to marine environment will be determined on the case basis and through a mathematical modeling study. Based on the result of the modeling study, the EPSS would issue Disposal Permit specifying the allowable limits which, in no case, shall compromise the Marine Water Quality Objectives as given below.*

Table 24 – Marine Water Quality Objectives

S. No.	Indicators	Unit	Sea and Coastal Zone	Dubai Creek
1.	Biochemical Oxygen Demand	mg/l	20	10
2.	Chlorine – Total residual	mg/l	0.01	0.01
3.	Dissolved Oxygen	mg/l	Not less than 5 mg/l or 90% saturation	
4.	Nitrogen - ammonia (NH_3-N)	mg/l	0.1	0.1
5.	Nitrogen – Nitrate	mg/l	0.5	0.5
6.	Nitrogen – Total	mg/l	2.0	2.0
7.	Petroleum Hydrocarbons	mg/l	0.001 (Aromatic fraction)	0.001 (Aromatic fraction)

S. No.	Indicators	Unit	Sea and Coastal Zone	Dubai Creek
8.	pH	mg/l	1 pH unit from ambient levels	
9.	Phosphate - Phosphorous	mg/l	0.05	0.05
10.	Temperature	°C	2°C from the background level	
11.	Total Dissolved Solids (TDS)	mg/l	2% from the background level	
12.	Turbidity/Color	NTU	75 NTU or none that reduce light penetration by more than 20% from the background level	
13.	Surfactants	mg/l	0.02	0.02
14.	Suspended Solids	mg/l	10 – Mean 25 - Maximum	10 – Mean 15 - Maximum
15.	Aluminium (Al)	mg/l	0.2	0.2
16.	Arsenic (As)	mg/l	0.01	0.01
17.	Cadmium (Cd)	mg/l	0.003	0.003
18.	Chromium (Cr)	mg/l	0.01	0.01
19.	Copper (Cu)	mg/l	0.005	0.005
20.	Iron (Fe)	mg/l	0.2	0.2
21.	Mercury (Hg)	mg/l	0.001	0.001
22.	Zinc (Zn)	mg/l	0.02	0.02
23.	E. Coli	Nos./ 100 ml	200	200

Table 25 – Land Contamination Indicator Levels

S. No.	Indicator	Unit	Concentration
1.	Arsenic	mg/kg	50
2.	Barium	mg/kg	400
3.	Cadmium	mg/kg	5
4.	Chromium	mg/kg	250
5.	Copper	mg/kg	100
6.	Lead	mg/kg	200
7.	Manganese	mg/kg	700
8.	Mercury	mg/kg	2
9.	Selenium	mg/kg	2
10.	Zinc	mg/kg	500
11.	Pesticides(total)	mg/kg	2
12.	Cyanide	mg/kg	10
13.	Fluoride	mg/kg	500
14.	Phenol	mg/kg	1
15.	Benzene	mg/kg	1
16.	BTEX (total)	mg/kg	100
17.	Chlorinated Hydrocarbons	mg/kg	1
18.	Polychlorinated Biphenyls	mg/kg	0.5
19.	Total Petroleum Hydrocarbons		
	<C9	mg/kg	1,000
	>C9	mg/kg	10,000

4.2.3. REGULATION BUREAU OF ABU DHABI EMIRATE – WATER QUALITY REGULATIONS

Water Quality Regulations was issued in July 2013 and came into force on 1 January 2014. The Regulations are intended to provide for the supply of wholesome drinking water to consumers throughout the Emirate of Abu Dhabi and reflect the current guidance by the World Health Organization (WHO) and Gulf Cooperation Council (GCC).

Table 26 - Drinking Water Quality Guidelines of Regulation Bureau of Abu Dhabi

S. No.	Parameter	Unit	Guideline value
1.	Temperature	°C	**--**
2.	pH	-	7.0 - 9.2
3.	Colour	pt/Co scale	15.0
4.	Turbidity	NTU	4.0
5.	Total Suspended Solids (TSS)	mg/l	--
6.	Total Dissolved Solids (TDS)	mg/l	100 - 1000
7.	Total Hardness	mg/l	300
8.	Total Alkalinity	mg/l	--
9.	Sodium	mg/l	150
10.	Potassium	mg/l	12.0
11.	Calcium as Calcium Hardness	mg/l	200
12.	Magnesium	mg/l	30
13.	Chloride	mg/l	250
14.	Sulphate	mg/l	250
15.	Fluoride	mg/l	1.5
16.	Total Phosphorous	mg/l	2.2
17.	Nitrate	mg/l	50
18.	Nitrite	mg/l	3.0
19.	Ammonia	mg/l	0.5
20.	Arsenic	mg/l	0.01
21.	Barium	mg/l	0.7
22.	Boron	mg/l	2.4
23.	Cadmium	mg/l	0.003
24.	Chromium	mg/l	0.05
25.	Copper	mg/l	1.0
26.	Cyanide	mg/l	--
27.	Iron	mg/l	0.2
28.	Lead	mg/l	0.01
29.	Manganese	mg/l	0.4
30.	Mercury	mg/l	0.003
31.	Nickel	mg/l	0.07
32.	Selenium	mg/l	0.04
33.	Zinc	mg/l	5.0
34.	Total Organic Carbon	mg/l	1.0

S. No.	Parameter	Unit	Guideline value
35.	Phenols	mg/l	0.5
36.	Residual Chlorine	mg/l	0.2 - 0.5
37.	Total Coliforms	mg/l	0

4.3. INTERNATIONAL CONVENTIONS AND STANDARD

According to UAE - State of environment report (2015) published by MoCCaE, UAE join the world in recognizing environmental problems by signing and ratifying environmental agreements such as:

- Vienna Convention for the protection of the Ozone layer and the Montreal Protocol on substances that deplete the ozone Layer
- Basel Convention on the control of trans-boundary movements of hazardous wastes and their disposal
- United Nations convention to combat desertification,
- Rotterdam convention on hazardous pesticides and hazardous chemicals in International trade
- Convention on biological diversity and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Stockholm convention on persistent organic pollutants
- United Nations framework convention on climate change and the Kyoto Protocol
- Ramsar convention on wetlands of International importance
- Convention on the conservation of migratory species of wild animals
- Kuwait Regional Convention for cooperation and protection of the marine environment from pollution and its protocols
- International Convention for the prevention of pollution from ships (1973G.) as amended by protocol MARPOL (1978G).

4.4. INTERNATIONAL REQUIREMENTS

The ESIA study conducted in line with The Equator Principles III (EPs), which in turn require adherence to the World Bank Group - International Finance Corporation (IFC) Policies and Standards. The EPs are based on the International Finance Corporation Performance Standards of social and environmental sustainability and relevant World Bank Group/IFC Environmental, Health and Safety Guidelines (EHS Guidelines). The lender of the project is **Japan Bank for International Cooperation (JBIC)**, and it has a set of 'Guidelines for Confirmation of Environmental and Social Considerations' which they use to determine compliance of projects and their eligibility to receive funding for development. The requirements for ESIA study are hereunder briefly described.

4.4.1. THE EQUATOR PRINCIPLES

International finance institutions including the World Bank and other lending institutions require adherence to environmental and social principles and environmental impact assessments to be carried out before a project can proceed. The World Bank and the International Finance Corporation (IFC) follow the IFC's Environment, Health and Safety guidelines which were developed over an extended period, with significant collaboration between the World Bank and IFC. The Equator Principles are a financial industry benchmark for determining, assessing and managing environmental and social risk in projects. Equator Principles Financial Institutions (EPFIs) have adopted the Equator Principles to ensure that the Projects seek finance and advise on are developed in a manner that is socially responsible and reflects sound environmental management practices. EPFIs recognize the importance of climate change, biodiversity, and human rights, and believe negative impacts on project-affected ecosystems, communities, and the climate should be avoided where possible. If these impacts are unavoidable, they should be minimized, mitigated, or offset. The principles are hereunder summarized.

Principle 1: Review and Categorization - The project categorizes it based on the magnitude of its potential environmental and social risks and impacts. Such screening is based on the environmental and social categorization process of the International Finance Corporation (IFC), and it will be categorized as A, B and C. The categorization of the proposed project based on IFC and JBIC is hereunder discussed.

IFC's Policy on Environmental and Social Sustainability, 2012 requires initial screening and categorization of the proposed project to determine the appropriate extent and type of environmental assessment needed. The resulting category also specifies IFC's institutional requirements for disclosure following with IFC's access to information policy. Projects can be placed into one of three categories, depending on the type, location, sensitivity, and scale of the project, as well as the nature and magnitude of its potential environmental impacts. JBIC has a similar procedure for the project, and they determine the extent of assessment required using the same labels as IFC. The different categories and descriptions for both IFC and JBIC are presented in **Table 66**.

Table 27 – Description about project categorization

Category	IFC Description	JBIC Description
A	Projects with potential significant adverse environmental and social risks and/or impacts are diverse, irreversible or unprecedented;	A proposed project is likely to have a significant adverse impact on the environment and/or with complicated impact or impact which is difficult to assess due to lack of precedence. The impact of the project may affect an area broader

Category	IFC Description	JBIC Description
		than the sites or facilities and includes projects in sensitive sectors or with sensitive characteristics, and projects located in or near sensitive areas.
B	Projects with potential limited adverse environmental and social risks and/or impacts that are few, generally site-specific, largely reversible and readily addressed through mitigation measures; and	The potential adverse environmental impact of the proposed project is less adverse than that of Category A. Typically, its impacts are site-specific, few if any are irreversible, and mitigation measures are more readily available.
C	Projects with minimal or no adverse environmental and social risks and/or impacts.	The proposed project is likely to have minimal or no adverse environmental impact, including projects for which JBIC's share is less than Special Drawing Rights equals (SDR) 10 million; sectors or projects in which no particular environmental impact is normally expected; cases in which JBIC's involvement is minor.

The proposed project has the potential to cause adverse impacts on the environment and the adjacent community. It may impact on sensitive areas and receptors and has the potential to have diverse types of impacts. However, this project is considered to be a "Category B project" under both IFC and JBIC categorization criteria. The impacts are not expected to be unprecedented in their nature, and it is considered feasible to mitigate and manage the majority of impacts associated with the project through appropriate, readily available, and commercially proven environmental and social management techniques, together with the monitoring to be specified in the Environmental and Social Management Plan and related plans that are in the outcome of this ESIA process.

Principle 2: Environmental and Social Assessment - For all Category A and Category B Projects, the EPFI requires the project proponent to conduct an Assessment process to address the relevant environmental and social risks and impacts of the proposed Project. The Assessment Documentation should propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.

Principle 3: Applicable Environmental and Social Standards - The EPFI requires that the assessment process evaluates compliance with the applicable standards. For projects located in Non-Designated countries, the assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines).

United Arab Emirates (UAE) is a non-designated country, and as such, the assessment process for the Project must evaluate compliance with the applicable IFC PS on Environmental and Social Sustainability.

Principle 4: Environmental and Social Management System and Equator Principles Action Plan - For all Category A and Category B Projects, the EPFI requires the project proponent to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) shall be prepared by the project proponent to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the Project Proponent and the EPFI agree an Equator Principles Action Plan (AP). The Equator Principles is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.

Principle 5: Stakeholder Engagement - For all Category A and Category B Projects, the EPFI requires the project proponent to demonstrate active stakeholder engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, other Stakeholders.

Principle 6: Grievance Mechanism - For Category A and as appropriate Category B Projects, the EPFI requires the project proponent, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. The grievance mechanism is required to be scaled to the risks and impacts of the project and has affected communities as its primary user.

Principle 7: Independent Review - For all Category A and as appropriate Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the project proponent carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.

Principle 8: Covenants - An essential strength of the Equator Principles is the incorporation of covenants linked to compliance. For all projects, the project proponent covenants in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects. Furthermore, for all category A and category B projects, the project proponent covenants the financial documentation:

- To comply with the ESMPs and Equator Principles (where applicable) during the construction and operation of the project in all material respects;
- To provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), that:
    - Document compliance with the ESMPs and Equator Principles (where applicable)
    - Provide the representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits and
- To decommission the facilities, where applicable and appropriate, following an agreed decommissioning plan.

Principle 9: Independent Monitoring and Reporting - EPFI requires for the appointment of an Independent E&S Consultant, or the project proponent retains qualified and experienced external experts to assess the project compliance with the Equator Principles and ongoing monitoring and reporting after financial close and over the life of the loan.

Principle 10: Reporting and Transparency - For all category A and as appropriate category B Projects, project proponent will ensure that, at a minimum, a summary of the ESIA is accessible and available online. The Project Proponent will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually.

4.4.2. WORLD BANK GROUP – INTERNATIONAL FINANCIAL CORPORATION (IFC) – POLICIES AND STANDARDS

4.4.2.1. Environmental and Social Performance Standards

The World Bank procedures for EA study cover policies, guidelines and good practices. Such guidelines, therefore, follow the national best practices in undertaking any development project in Bangladesh. The environment safeguards policies applicable to the proposed project are the following:

***Environmental Assessment (EA) (OP 4.01/BP/GP 4.01)*:** An Environmental Assessment is conducted to ensure that IFC-financed projects are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. Any IFC-funded project that is likely to have potential adverse environmental risks and impacts in its area of influence requires an EA indicating the potential risks, mitigation measures and environmental management framework or plan.

***Natural Habitats (OP/BP 4.04)*:** Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and native species. The Natural habitats policy is triggered by any project (including any subproject under aspect or investment or intermediary financial loan) with the potential to cause significant conversion (loss) or degradation of natural habitats, whether directly (through construction) or indirectly (through human activities induced by the project). The policy has separate requirements for critical (either legally or proposed to be protected or high ecological value) and non-critical natural habitats. World Bank's interpretation of "significant conversion or degradation" is on a case-by-case basis for each project, based on the information obtained through the EA.

***Forestry (OP/GP 4.36)*:** Forest sector activities trigger this policy, and World Bank sponsored other interventions, which have the potential to impact significantly upon forested areas. The World Bank does not finance commercial logging operations but aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty and encourage economic development.

***Cultural Property (OPN 4.11)*:** Physical, cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical, cultural resources may be located in urban or rural settings, and may be above ground, underground, or underwater. The Bank seeks to assist countries to manage the physical, cultural resources and to avoid or the mitigate adverse impact of development projects on these resources. This policy is triggered for any project that requires an EA.

***Policy on Disclosure of Information, 2002*:** There are disclosure requirements at every part of the project preparation and implementation process. Consultation with affected groups and local community should take place during scoping and before Terms of references (ToRs) are prepared; when the draft EA is prepared; and throughout project implementation as necessary. The Borrower makes the draft EA and any separate EA report available in the country in a local language and at a public place accessible to project-affected groups and the local community before appraisal. Besides, IFC has set out 8 (eight) performance standards in respect of various parameters of the proposed project. These eight performance standards of IFC with their corresponding parameters as under:

- Performance Standard 1: Social and Environmental Assessment and Management System
- Performance Standard 2: Labour and Working Conditions
- Performance Standard 3: Pollution Prevention and Abatement
- Performance Standard 4: Community Health, Safety and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage.

Of the above eight performance standards set by IFC, the Performance Standard 1 envisages establishing the importance of (i) integrated assessment to identify the social and environmental impacts, risks and opportunities; (ii) active community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the project proponent's management of social and environmental impacts throughout the life of the project. The rest seven of the performance standards, i.e., Performance Standards 2 through 8 seek to ascertain establishing requirements to avoid, reduce, mitigate or compensate the impacts on people and the environment, and to improve conditions where appropriate.

4.4.2.2. General Environment, Health and Safety Guidelines

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project by the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account.

4.4.2.2.1. Ambient Air Quality

Projects with significant sources of air emissions and potential for significant impacts to ambient air quality should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines or other internationally recognized sources

- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests per cent of the applicable air quality standards to allow additional, future sustainable development in the same air-shed.

Table 28 –WHO Ambient Air Quality Guidelines

S. No.	Indicators	Averaging Period	Guideline value in $\mu g/m^3$
1.	Sulphur dioxide (SO_2)	24-hour 10 minute	125 (Interim target 1) 50 (Interim target 2) 20 (guideline) 500 (guideline)
2.	Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
3.	Particulate matter – PM_{10}	1-year 24-hour	70 (Interim target 1) 50 (Interim target 2) 30 (Interim target 3) 20 (Guideline) 150 (Interim target 1) 100 (Interim target 2) 75 (Interim target 3) 50 (guideline)
4.	Particulate matter – $PM_{2.5}$	1-year 24-hour	35 (Interim target 1) 25 (Interim target 2) 15 (Interim target 3) 10 (Guideline) 75 (Interim target 1) 50 (Interim target 2) 37.5 (Interim target 3) 25 (guideline)
5.	Ozone	8-hour daily Maximum	160 (Interim target 1) 100 (guideline)

Point sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as nitrogen oxides (NOx), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM), as well as other air pollutants including certain volatile organic compounds (VOCs) and metals that may also be associated with a wide range of industrial activities. Emissions from point sources should be avoided and controlled according to good international industry practice (GIIP) applicable to the relevant industry sector, depending on ambient conditions, through the combined application of process modifications and emissions controls.

4.4.2.2.2. Good International Industry Practice (GIIP) Stack Height

Stack heights shall be designed according to Good International Industry Practice (GIIP) to avoid excessive ground level concentrations and minimize impacts, including the acid deposition. It is based on United States 40 CFR, part 51.100 (ii) by the following formula.

$$H_G = H + 1.5L \quad \text{.......} \quad (1)$$

Where,

H_G = GEP stack height measured from the ground level elevation at the base of the stack

H = Height of nearby structure(s) above the base of the stack.

L = Lesser dimension, height (h) or width (w), of nearby structures (“Nearby structures” = Structures within/touching a radius of 5L but less than 800 m).

4.4.2.2.3. Noise Level Guideline

Noise impacts should not exceed the levels presented in **Table 29** or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 29 – Noise Level Guidelines

S. No.	Receptor	One hour L_{Aeq} (dBA)	
		Daytime 07:00 – 22:00	Nighttime 22:00 – 07:00
1.	Residential; institutional; educational	55	45
2.	Industrial; commercial	70	70

4.4.2.2.4. General Effluent Water Quality – Discharge to Surface water

Discharge of process wastewater, sanitary wastewater, wastewater from utility operations or storm water or surface water should not result in contaminant concentrations more than local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality (Eg. US EPA National Recommended Water Quality Criteria). Additional considerations that should be included in the setting of project-specific performance levels for wastewater effluents include:

- Process wastewater treatment standards consistent with applicable industry sector EHS guidelines. Projects for which there are no industry-specific guideline should reference the effluent quality guidelines of an industry sector with suitably analogous processes and effluents;
- Compliance with national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater prescribed by IFC general EHS guidelines.
- The temperature of wastewater before discharge does not increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.

4.4.2.3. Environmental, Health and Safety (EHS) guidelines for thermal power plants

The development of an environmental assessment (EA) for a thermal power project should take into account any government energy and/or environmental policy or strategy including strategic aspects such as energy efficiency improvements in existing power generation, transmission, and distribution systems, demand-side management, project siting, fuel choice, technology choice, and environmental performance.

4.4.2.3.1. Effluents – Thermal Discharge

Thermal power plants with steam-powered generators and once-through cooling systems use significant volume of water to cool and condense the steam for the return to the boiler. The heated water is typically discharged back to the source water or the nearest surface water body. In general thermal discharge should be designed to ensure that discharge water temperature does not result in exceeding relevant ambient water quality temperature standards outside a scientifically established mixing zone. The mixing zone is typically defined as the zone where initial dilution of a discharge takes place within which relevant water quality temperature standards are allowed to exceed and takes into account cumulative impact of seasonal variations, ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations. Establishment of such a mixing zone is project specific and may be established by local regulatory agencies and confirmed or updated through the project's environmental assessment process. Thermal discharges should be designed to prevent adverse impacts to the receiving water taking into account the following criteria:

- The elevated temperature areas because of thermal discharge from the project should not impair the integrity of the water body as a whole or endanger sensitive areas (such as recreational areas, breeding grounds, or areas with sensitive biota);
- There should be no lethality or significant impact to breeding and feeding habits of organisms passing through the elevated temperature areas; and
- There should be no significant risk to human health or residual levels of water treatment chemicals.

4.4.2.3.2. Performance Indicators and Monitoring – Emissions and Effluent Guidelines

Effluent guidelines are described in **Table 30**. Effluent guidelines are applicable for direct discharges of treated effluents to surface waters for general use. Site-specific discharge levels may be established based on the availability and conditions in the use of publicly operated sewage collection and treatment systems or, if discharged directly to surface waters, on the receiving water use classification as described in general EHS guidelines.

Table 30 – Effluent Guidelines

S. No.	Parameter	Unit - mg/L except pH and Temperature
1.	pH	6 - 9
2.	TSS	50
3.	Oil and Grease	10
4.	Total residual chlorine	0.2
5.	Chromium – Total (Cr)	0.5
6.	Copper (Cu)	0.5
7.	Iron (Fe)	1.0
8.	Zinc (Zn)	1.0
9.	Lead (Pb)	0.5
10.	Cadmium (Cd)	0.1
11.	Mercury (Hg)	0.005
12.	Arsenic (As)	0.5
13.	Temperature increase by thermal discharge from the cooling system	• Site-specific requirement to be established by the Environmental Assessment (EA) • Elevated temperature areas due to the discharge of once-through cooling water (e.g. 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting the intake and outfall design through the project-specific EA depending on the sensitive aquatic ecosystems around the discharge point.

4.4.3. JAPAN BANK FOR INTERNATIONAL COOPERATION (JBIC) GUIDELINES FOR CONFIRMATION OF ENVIRONMENTAL AND SOCIAL CONSIDERATION

The guidelines have the objective of contributing to the sound development of the international economy and society through environmental and social considerations in all projects subject to lending, equity participation, and guaranteed by JBIC. Environmental and social considerations refer not only to the natural environment but also to social issues such as involuntary resettlement and respect for the human rights of indigenous peoples. JBIC confirms, through various measures, that project proponents undertake appropriate environmental and social considerations to prevent or minimize the impact on the environment and local communities, and not bring about unacceptable impacts which may be caused by the projects for which JBIC provides funding. Basic principles regarding confirmation of environmental and social considerations are as follows:

(1) Parties Responsible for Environmental and Social Considerations - It is the project proponents that are responsible for environmental and social considerations for the project, and JBIC confirms such considerations in light of the Guidelines;

(2) Confirmation of Environmental and Social Considerations by JBIC - For confirmation of environmental and social considerations, JBIC undertakes:

a) **Screening**

b) **Categorization –** It is discussed in **Section 4.4.1 of the report**.

c) **Environmental Reviews for each category -** After the screening process, JBIC carries out environmental reviews according to the following procedures for each category. The environmental reviews for Category B projects are similar to those of Category A projects in that JBIC examines the potential negative and positive environmental impact of the projects, and evaluate measures necessary to prevent, minimize, mitigate, or compensate for the potential negative impact. As part of the review process, JBIC also conducts measures to improve the environment if any such measures are available. JBIC undertakes its environmental reviews based on information provided by borrowers and related parties. Where an environmental impact assessment procedure has been conducted, JBIC may refer to the ESIA reports and permit certificates. However, this is not a mandatory requirement.

Monitoring For category A and B projects - JBIC in principle confirms through the borrower the results of monitoring undertaken by the project proponents on the items which have a significant environmental impact over a specified period.

5. PROJECT DESCRIPTION

5.1. LOCATION OF PROJECT SITE

The proposed project will be facilitated in the existing Layyah Power Station of SEWA located at Layyah, Sharjah – UAE. The location of the project site is represented in **Figure 1.** The environmental settings of the project are given in **Table 31.**

Table 31 - Environmental settings of the project site

S. No.	Particulars	Details	
1	Location	Layyah, Sharjah - UAE	
2	**Site GPS Co-ordinates**	**Latitude**	**Longitude**
	Corner A	25°21'27.03"N	55°22'4.27"E
	Corner B	25°21'20.80"N	55°22'7.52"E
	Corner C	25°21'27.17"N	55°22'12.68"E
	Corner D	25°21'21.75"N	55°22'23.13"E
	Corner E	25°21'14.47"N	55°22'21.39"E
	Corner F	25°21'6.46"N	55°22'15.94"E
	Corner G	25°21'5.81"N	55°22'14.31"E
	Corner H	25°21'11.10"N	55°22'4.04"E
	Corner I	25°21'25.86"N	55°22'2.50"E
	Corner J	25°27'39" N	55°28'27" E
3	Site Elevation above MSL	Approx. 0 - 6 m	
4	Nearest Habitation	Al Layyah – 0.45 km (S) Al Marijah – 0.70 km (E)	
5	Nearest Airport	Dubai International Airport – 9.5 km (SSW) Sharjah International airport – 12.5 km (E)	
6	Nearest Port	Sharjah Khalid Port – Adjacent	

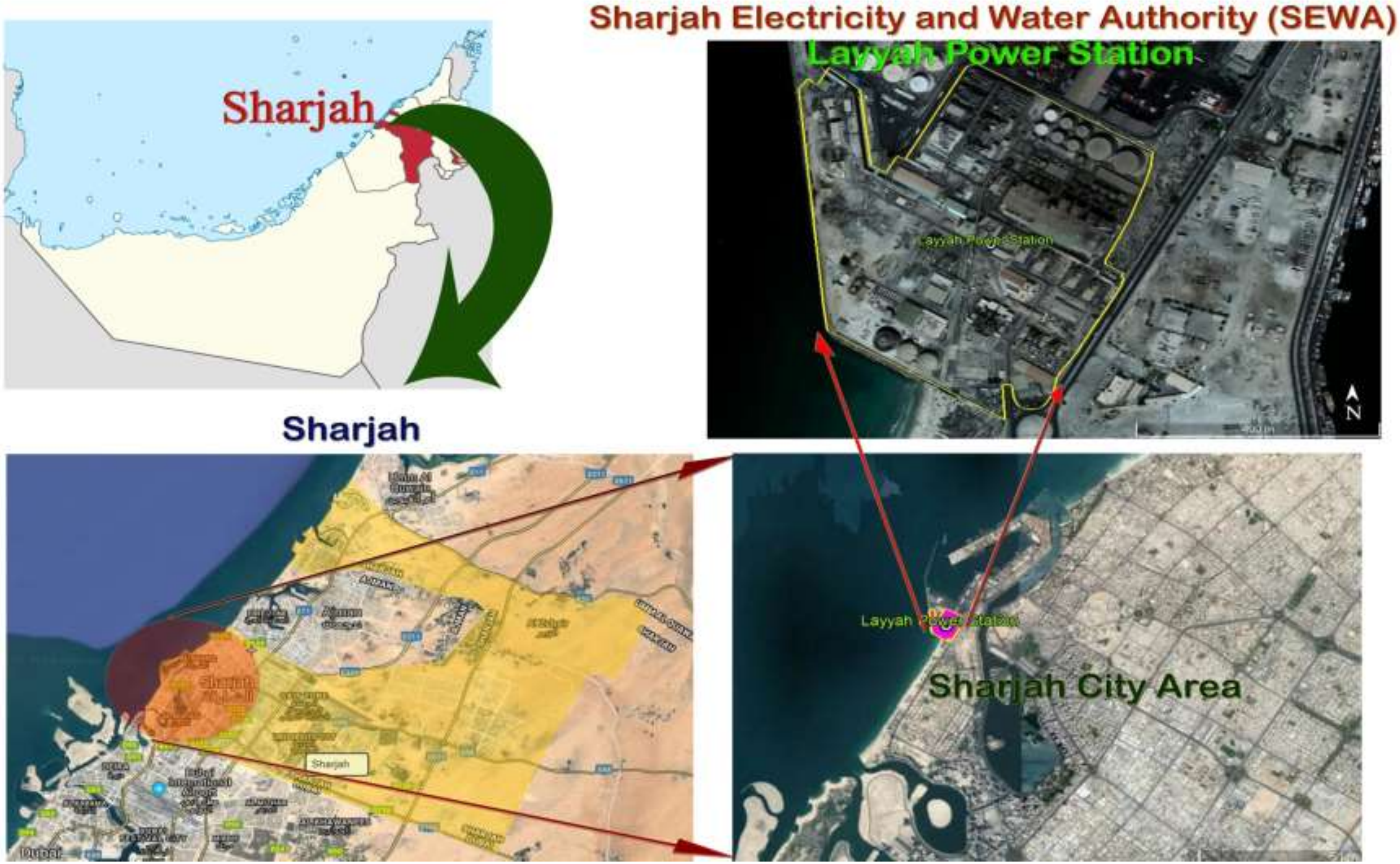


Figure 1 - General Location map of the project site

Figure 2 - Google Image showing the project site

Figure 3 - Google Image showing the project site with proposed development with tentative intake and outfall locations

5.2. TYPE AND MAGNITUDE OF THE PROJECT

The proposed project will be developed for producing electric power which will be distributed in the Emirate of Sharjah. It is designed to produce 1,100 MW electric power. The Man power required for the operation of the power plant will be approximately 45-55 number, working in 3 shifts.

Salient features of the project are given in **Table 32**.

Table 32 – Salient features of the proposed project

S. No.	Description	Details
1	Total plot area	250,000.00 m^2 (Approx.)
2	Plot area of the proposed project	35,0000 m^2 (Approx.)
3	**Proposed Activity**	
	Proposed Activity	Power generation by Combined Cycle Power Plant (CCPP)
5	**The Magnitude of the project**	
	Name of the product	**Capacity of Generation**
	Electric Power	1,100 MW
6	**Manpower details**	
	No. of manpower	45 - 55
	Working shifts	3 shifts (8 hours/shift)

5.3. FACILITY DESCRIPTION

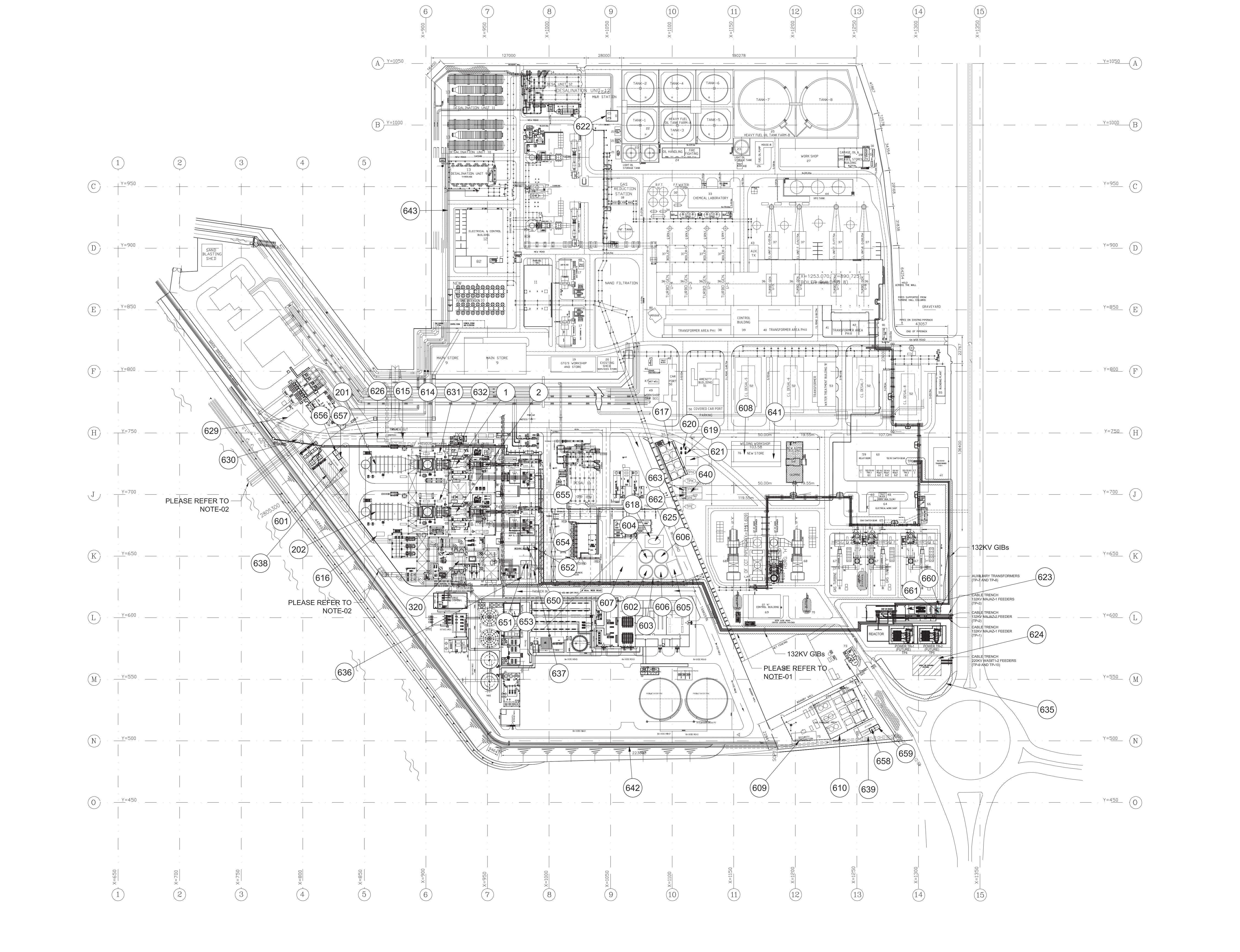
The proposed project, of Combined Cycle Power Plant (CCPP) is planned in the existing Layyah Power Station (LPS) of SEWA. Total plot area of LPS is approximately 250,000 m^2, in which 35,000 m^2 areas will be utilized for the proposed project. Layyah Power Station is one of the major power and water source of Sharjah. LPS has power station as well as desalination plants . Site setting layout plan showing existing facilities and proposed facilities is presented in **Figure 4**.

The proposed land area for the project is already reclamed during the time of LPS previous developments and there is no need for additonal land developed for the proposed project. The proposed land is sandy without any vegetation and currently left barren which is used for temporary storage. In addition to the existing intake pipeline and Outfall channel, offshore Intake and outfall HDPE pipelines will be installed for this project. . The details of the proposed facility and its area statement are given in **Table 33**.

Table 33 – Proposed Facility details and its area statement

S. No.	Details	Area in Sq.m (Approximate)
1	Combined cycle power plant (including internal road, miscellaneous facilities etc.,)	18,000.00
2	Central Control Building and 132 KV Gas Insulated Substation (GIS)	2,000.00
3	Fuel Gas Treatment and Fuel Gas Compressor	1,500.00
4	Water Treatment plant, wastewater treatment plant and associated facilities	1,500.00
	Total build-up Area for the proposed facility	**23,000.00**

Figure 4 – Site setting layout plan of the project



NOTES:

1- SWITCHYARD AND GIB CONNECTING BETWEEN GENERATOR STEP UP TRANSFORMER AND SWITCHYARD ARE ON HOLD AND EXCLUDED FROM EPCC'S TECHNICAL AND COMMERCIAL OFFER UPON FURTHER INFORMATION FROM SEWA/EDF.

2- OFFSHORE STRUCTURE (INTAKE AND OUTFALL) CONCEPT DESIGN WILL BE DETAILED AFTER FURTHER INVESTIGATION.

LEGEND:

No.	EQUIPMENT LIST
1	NO.1 GAS TURBINE
2	NO.2 GAS TURBINE
201	NO.1 HEAT RECOVERY STEAM GENERATOR
202	NO.2 HEAT RECOVERY STEAM GENERATOR
320	CONDENSER
601	PUMPING STATION BUILDING
602	OSMOTIZED WATER TANK
603	OSMOTIZED WATER PUMPS (2x100%)
604	DEMI WATER TANK
605	FIRE FIGHTING CONTAINER
606	SERVICE AND FIRE FIGHTING WATER TANK (2x50%)
607	WATER TREATMENT PLANT
608	WORKSHOP / STORE
609	FUEL GAS TREATMENT
610	FUEL GAS COMPRESSORS (3x100%)
614	CO2 TANKS
615	H2 MANIFOLDS
616	N2 MANIFOLDS
617	GT FIN FAN COOLER
618	NEUTRALIZATION PIT
619	GT CLOSED COOLING PUMPS (2x100%)
620	ST CLOSED COOLING PUMPS (2x100%)
621	ST HEAT EXCHANGER CCW
622	FUEL OIL TRANSFER PUMPS / FUEL OIL TREATMENT PLANT
623	132KV GIS-CONTROL BUILDING
624	220KV GIS-CONTROL BUILDING (FUTURE)
625	OIL SEPARATOR
626	CEMS
629	CHLORINATION BUILDING
630	INTAKE
631	ELECTRICAL HEATER NO.1 GAS TURBINE (1x100%)
632	ELECTRICAL HEATER NO.2 GAS TURBINE (1x100%)
635	BOUNDARY WALL (NEW)
636	EMERGENCY DIESEL GENERATOR CONTAINER
637	EMERGENCY DIESEL GENERATOR TANK
638	CIRCULATING WATER - ELECTRICAL BUILDING
639	GAS COMPRESSOR - ELECTRICAL BUILDING
640	WATER TREATMENT - ELECTRICAL BUILDING
641	STORE
642	FUEL GAS PIPE LINE
643	FUEL OIL LINE
650	10BFT10 MV-LV TRANSFORMER COMMON SERVICES 1
651	10BFT20 MV-LV TRANSFORMER COMMON SERVICES 2
652	10BFT71 MV-LV TRANSFORMER COMMON SERVICES 1
653	10BFT81 MV-LV TRANSFORMER COMMON SERVICES 2
654	11BFT10 MV-LV TRANSFORMER GT1
655	12BFT20 MV-LV TRANSFORMER GT2
656	10BFT31 MV-LV TRANSFORMER CCRT 1
657	10BFT41 MV-LV TRANSFORMER CCRT 2
658	10BFT51 MV-LV TRANSFORMER FUEL GAS 1
659	10BFT61 MV-LV TRANSFORMER FUEL GAS 2
660	10BFT52 MV-LV TRANSFORMER SUBSTATION 1
661	10BFT62 MV-LV TRANSFORMER SUBSTATION 2
662	10BFT13 MV-LV TRANSFORMER WATER TREATMENT 1
663	10BFT23 MV-LV TRANSFORMER WATER TREATMENT 2

PIPE RACK
SLEEPER
TRENCH

SCALE 1:3000 — 0, 50, 100, 200, 300m

Rev.	Date	Name	Note
C	27-06-2018	M.M.T.	ISSUED FOR TENDER

Project: Layyah Power Station

Sharjah Electricity and Water Authority
Layyah Power Station
Sharjah U.A.E

Engineer: EDF

Contractor: ELSEWEDY POWER

	Date	Name
Drawn:	27-06-2018	M.M.T.
Checked:		

Supersedes:
Superseded by:
System:

Drawing Title: OVERALL PLANT LAYOUT

Scale: 1:3000
Sheet: 1/2

Size: A0
Annex:
RFx No: 2131600070
File:
Document no.:

5.3.1. MAJOR COMPONENTS OF POWER GENERATION

The scheme of the power generation process comprises the following major components:

- Two Gas Turbine (GT) units.
- Two heat recovery steam generators (HRSGs).
- One condensing steam turbine (ST) unit.
- Two Gas Turbine Generator (GTGs)
- One Steam Turbine Generator (STG)

5.3.1.1. Gas Turbine System

The M701F gas turbine is a large utility frame machine. The gas turbine consists of three main components: high-efficiency compressor, combustor and a high-efficiency turbine. Air is drawn through the inlet into the compressor where it is pressurized and fed into the combustors. The compressed air mix with fuel, and ignites in the combustors. The high-temperature mixture of thus formed combustion products then expands through the turbine, dropping in pressure and temperature as the heat energy is absorbed and converted into mechanical work. A portion of the power thus developed by the turbine is used for driving the compressor, and the balance of the power is used to drive the generator. Dry Low NOx (DLN) burner system is provided for the gas turbine system which controls nitrogen oxide emissions.

5.3.1.2. Heat Recovery Steam Generators (HRSGs)

Two (2) outdoor type HRSGs will be installed to generate the steam by the heat of the exhaust gas from each MHPS 701F gas turbine. Hot exhaust gas discharged from the gas turbine is channeled through a HRSG in order to heat incoming feed water and subsequently generate saturated and superheated steam. The exhaust gas exits the HRSG through an exhaust stack via damper and silencer located in HRSG stack. HRSGs contain an array of equipment, including interconnected banks of tubes, steam drums, headers, connecting pipes, and other components.

The tube banks within the HRSG are arranged in a particular order to optimize the heat exchange process. The various tube banks included in an HRSG are preheaters, economizers, evaporators, super-heaters and re-heaters. The steam production process starts with water entering the HRSG from condensate system via condensate pumps. The condensate water enters preheater tube bank and sent to external de-aerator. Preheater recirculation pumps are installed to recirculate preheater outlet water to preheater inlet so that preheater inlet water temperature can be controlled to avoid low-temperature corrosion.

In the de-aerator, preheated condensate water is mixed with returned water from steam extraction where dissolved oxygen in the returned water from steam extraction is separated. The de-aerated feed water then enters Low Pressure (LP), Intermediate Pressure (IP) and High Pressure (HP) economizer tube banks via HP BFP/IP BFP/LP BFP which take suction from the external de-aerator. The economizer heats the water to a temperature slightly below the saturated temperature.

The water leaving the economizer enters a steam drum via the feedwater control valve. A portion of the water, which flows through the evaporator tube bank, is converted into steam (or evaporated). The resulting steam/water mixture exits the evaporator tubes and enters the steam drum via riser pipes. The steam drums are large diameter cylindrical vessels, which are located above the evaporator banks. In the super-heater, the steam is "superheated" above the saturated temperature and then leads to the steam turbine.

The tube banks located within an HRSG consist of fin tubes. The hot gas turbine exhaust at the inlet flows toward the HRSG outlet of the gas side, and heat transfer sections (tube banks) are arranged appropriately in the gas flow to absorb the heat effectively. Low-temperature fluid is fed from the HRSG outlet side of the gas flow toward the HRSG inlet side of gas flow.

The superheated steam from HP super-heater then expands through the HP steam turbine - turning it and the electrical generator to which it is connected, and in the process losing both pressure and temperature. A portion of the HP steam turbine exhaust steam is extracted to be sent to the external system. Rest of the exhaust steam flows back to the HRSG, and after mixed with IP super-heater outlet steam, it is reheated at an intermediate pressure by passing through re-heater tube banks. This "reheat" steam then returns to power a different part of the IP steam turbine. The exhaust steam from IP steam turbine then mixed with LP super-heater outlet steam and fed to LP steam turbine to further generate electricity. When the steam has completed its work in the steam turbine, the steam is turned back into water in the condenser following the steam turbine outlet and returned to the preheater section of the HRSG. This condensate is fed to HRSG by condensate water pumps.

A duct burner system for gas firing will be provided for supplementary firing, using excess oxygen in the gas turbine exhaust gas to burn natural gas, rising the exhaust gas temperature and increasing steam output.

5.3.1.3. Steam Turbine System

The proposed turbine generator unit is a "two cylinder tandem-compound double-exhaust, condensing reheat" type turbine, which consists of one combined High pressure-Intermediate pressure (HIP) turbine and one double flow Low Pressure (LP) turbine.

The HP steam from the combined main valve enters HP turbine through the inlet pipe. The steam flows through the HP blading producing power, decreasing its pressure and temperature, and leaves HP turbine through a HP exhaust opening, thence flows to re-heater. The steam from the re-heater enters IP turbine through combined reheat valve and inlet pipe. The steam flows through the IP blading producing power, decreasing its pressure and temperature, and leaves IP turbine through an IP exhaust opening, thence flows to cross-over pipe and enters LP turbine. The LP steam from the LP stop valve and LP control valve is mixed with the IP turbine exhaust steam at cross-over piping between HP-IP and LP turbine. LP turbine is a double exhaust flow type, and the steam enters LP turbine at the center of the blade path and flows through the LP blading toward an exhaust opening at each end, thence to a condenser. The low-pressure element incorporating high efficiency blading, and diffuser-type exhaust, and improved exhaust hood design has resulted in a significant improvement in turbine heat consumption

5.3.1.4. Gas Turbine Generator

The proposed gas turbine generator unit is enclosed, self-ventilated, forced lubricated, H_2 cooled, cylindrical rotor type, synchronous alternator. A hydrogen-cooled turbogenerator is a turbogenerator with gaseous hydrogen as a coolant (Stator winding is indirectly cooled by H_2 gas, and rotor winding is directly cooled by H_2 gas). Four (4) horizontal hydrogen coolers will be provided for cooling circulating hydrogen gas in the generator. Cold hydrogen cools stator windings, stator core, field windings and other parts in the generator.

Hydrogen-cooled turbo generators provide a low-drag atmosphere and cooling for combined-cycle applications. This is most common type due to the high thermal conductivity and other favourable properties of hydrogen gas.

Hydrogen-cooled turbo generators are designed to provide a low-drag atmosphere and cooling for single-shaft and combined-cycle applications in combination with the gas turbine with steam turbines. Because of the high thermal conductivity and other favorable properties of hydrogen gas, this is the most common type in its field.

5.3.1.5. Steam Turbine Generator

The proposed steam generator unit is enclosed, self-ventilated, forced lubricated, H_2 cooled, cylindrical rotor type, synchronous alternator. A hydrogen-cooled turbo generator is a turbogenerator with gaseous hydrogen as a coolant (Stator winding is indirectly cooled by H_2 gas, and rotor winding is directly cooled by H_2 gas). Four (4) horizontal hydrogen coolers will be provided for cooling circulating hydrogen gas in the generator. Cold hydrogen cools stator windings, stator core, field windings and other parts in the generator.

5.3.2. DETAILS OF EQUIPMENT/MACHINERY

The details of major equipment/machinery to be utilized for the proposed project are hereunder provided. Equipment layout for the proposed facility is enclosed as ANNEXURE 5**.**

Table 34 – Details of Equipment/ Machinery

S. No.	Description	Quantity to be installed (Nos.)
1.	Gas Turbine	2
2.	Gas Turbine Auxiliary Components	
	GT Main Lube Oil Pump Motor	
	GT Control Oil Pump Motor	
	GT Lube Oil Vapor Extractor Motor	
	GT Enclosure Ventilation Fan Motor	
	GT Exhaust Gas Damper System	
	HP Purge Air Compressor	
	GT Fuel Gas Calorie Meter	
	GT Control Oil Cleaning Unit	
	Evaporative Cooler	
	By-Pass Stack Aircraft Obstruction Lighting	
	GT CO_2 Fire Fighting	
	Temporary GT Closed Cooling Water Pumps	
	GT Main Fuel Oil Pump Motor	
	GT Water Injection Pump Motor	
3.	Steam Turbine	1
4.	Heat Recovery Steam Generators (HRSG) - Triple pressure, Reheat Type	2
5.	Steam Turbine and HRSG Auxiliary Components	
	ST Main lube Oil Pump Motor	
	ST Main Oil Tank Vapor Extractor Motor	
	ST Control Oil Pump Motor	
	ST lube Oil Purifier Circulation Pump	
	Gland Steam Condenser Exhauster Fan Motor	
	Duct Burner Scanner Cooling Air Blower	

S. No.	Description	Quantity to be installed (Nos.)
	Duct Burner Control Panel	
	Preheater Recirculation Pump Motor	
	Stack Aircraft Obstruction Light	
	HP/IP Feedwater Pumps	
	LP Feedwater Pumps	
	Condensate Pumps	
	ST Closed Cooling Water Pumps	
6.	Gas Turbine Generator (GTG)	2
7.	Steam Turbine Generator (STG)	1
8.	Generators Auxiliary Components	
	Generator Main Seal Oil pump for GTG	
	Generator Main Seal Oil pump for STG	
	H_2 GAS SUPERVISORY RACK for GTG	
	H_2 GAS SUPERVISORY RACK for STG	
	GCRP for GTG	
	GCRP for STG	
9.	Others Equipment	
	Gas Compressors	
	Chemical Dosing System	
	Compressed Air System	
	Fire Fighting System (Pumps)	
	HVAC System	
	Electro-chlorination Plant	
	Demineralized Water Plant	
	Fuel System Metering Station	
	CEMS	
	Sampling	
	Mechanical Intake Screening	
	Circulating Water Pumps	
	Circulating Water Priming Pumps	
	Demineralized Water Pumps	
	Demineralized Water GT injection Pumps (Fuel Oil)	
	Sewage Water Pumps	
	Flash Tank Pumps	
	Potable/Service Water Pumps	
	Vacuum pumps	
	Fuel oil forwarding pumps	
	Auxiliary cooling pumps	
	Sump pumps	
	Desalinated water booster pumps	
	Condensate return booster pumps	
	GT FFC	
	Fuel Oil electrical Heater	
	Heat Tracing fuel oil	
10	Main Transformer	

5.3.3. SUPPORT FACILITIES

The following facilities will be established as support facilities to enhance the power generation process and to manage environment, health and safety system.

5.3.3.1. Electro-Chlorination System

The raw feed intake water will be undergone for disinfection. Shock disinfection will be applied at suitable intervals in the intake water system to deal with marine growth in the system. The disinfectant used is sodium hypochlorite from an electro chlorination system.

Pressurized seawater will be delivered to the electro-chlorination system where it is strained to remove suspended solids larger than 0.5 mm. The de-strained seawater passes through the electrolyzer cells and exits as sodium hypochlorite solution with the byproduct, hydrogen gas. This two-phase solution is piped to a tank where hydrogen gas is removed from the solution. The hydrogen is typically diluted with air using a set of redundant blowers to a safe level (typically less than 1% by volume which is 25% of the explosive limit). Finally, the sodium hypochlorite solution is injected as shock-dose rates.

5.3.3.2. Brackish Water Reverse Osmosis (BWRO) plant

The received desalinated water will be softened/ osmotized by BWRO plant. The osmotized water will be further de-ionized by electro deionization system for obtaining de-ionized water.

5.3.3.3. Electro Deionization (EDI) plant

The process of EDI is combines semi-impermeable membrane technology with ion-exchange media to provide a high-efficiency demineralization. Electrical current and semi-permeable membrane will be used to reduce the ions based on the charge, electrical current and ability. An electrical potential generated through electrodialysis transports and segregates charged aqueous species. There is no need of periodical regeneration, and the electrical current can continuously regenerate the resin. The de-ionized water will be used for power generation process.

5.3.3.4. Neutralization Pit

The wastewater generated from BWRO plant, EDI, backwash, membrane clean in process, laboratory etc., will be collected in neutralization pit in which collected wastewater will be neutralized by acid/alkali dosing. Then, neutralized wastewater will be disposed to sea through outfall pipelines. A list of chemicals expected to be used in the proposed project is listed in **Table 35.**

Table 35 – Details of chemicals to be used for the proposed project

S. No.	Name of the Chemical	Nature	Purpose of usage	Storage
1	Sodium Hydroxide (NaOH) (50%)	Liquid	Neutralization and Membrane cleaning	Drums
2	Sulphuric Acid (H_2SO_4)	Liquid	Neutralization	Drums
3	EDTA disodium salt (0.8%)	Liquid	Membrane cleaning	Drums
4	Sodium Tripolyphosphate (STTP – 2.0%)	Liquid	Membrane cleaning	Drums
5	Citric Acid (2.0 %)	Liquid	Membrane cleaning	Drums
6	Sodium Bisulfite (1.0 %)	Liquid	Membrane cleaning	Drums

In the neutralization process, pH of wastewater to be generated from BWRO plant, EDI, backwash, membrane clean in process, laboratory will be neutralized (pH 6 - 8) in the neutralization process by alkali/acidic dosing.

5.4. PROCESS DESCRIPTION

The proposed power plant will generate power by the combined-cycle generation which is a configuration using both gas turbines and a steam generator. A combined cycle gas turbine is a gas turbine with a Heat Recovery Steam Generator (HRSG) applied at electric utility sites. In the combined-cycle gas turbine (CCGT), the hot exhaust gases of the gas turbines will be used to provide all, or a portion of, the heat source for the boiler, which produce steam for the steam turbine. This combination increases the thermal efficiency. The thermal efficiency of a combined cycle gas turbine is between 38% and 60%.Scheme of the production process is shown in the process flow diagram shown in **Figure 5.**

A gas turbine is an internal combustion engine that operates with rotary rather than reciprocating motion. The gas turbine drives an electric generator, and the steam from the HRSG drives a steam turbine which also drives an electric generator. Gas turbines are essentially composed of three major components: compressor, combustor, and power turbine. In the compressor section, air is drawn through the inlet into the compressor where it is pressurized and fed into the combustors. The compressed air mix with fuel, and ignites in the combustors. The combustion process in a gas turbine is lean premix staged combustion. In lean-premix combustors, fuel and air are thoroughly mixed in an initial stage resulting in a uniform, lean, unburned fuel/air mixture which is delivered to a secondary stage where the combustion reaction takes place. Gas turbines using staged combustion are also referred to as Dry Low NOx combustors. Dry Low NOx (DLN) burner system will be used for gas turbine system which controls nitrogen oxide emissions *(US EPA, 2009*[4]*)*.

Hot gases from combustor enter to the power turbine section. The high-temperature mixture of thus formed combustion products then expands through the turbine, dropping in pressure and temperature as the heat energy is absorbed and converted into mechanical work. A portion of the power thus developed by the turbine is used for driving the compressor, with the balance of the power used to drive the generator. Gas turbines have a shaft to transmit power among the inlet air compression turbine, the power turbine, and the exhaust turbine. The expanded gases are then exhausted into the HRSG for the bottoming cycle energy exchange. The heat content of the exhaust gases exiting the turbine will be recovered in a heat recovery steam generator to raise process steam, with supplementary firing (duct burner) (cogeneration) using excess oxygen in the gas turbine exhaust gas to burn natural gas to raise the exhaust gas temperature and increasing steam output, (Rankine cycle - combined cycle) *(US EPA, 2009)*.

[4] *U. S. Environmental Protection Agency-Compilation of Air Pollutant Emission Factors (AP 42 - Fifth Edition), 2009. Section 3.1 – Stationary gas turbines.*

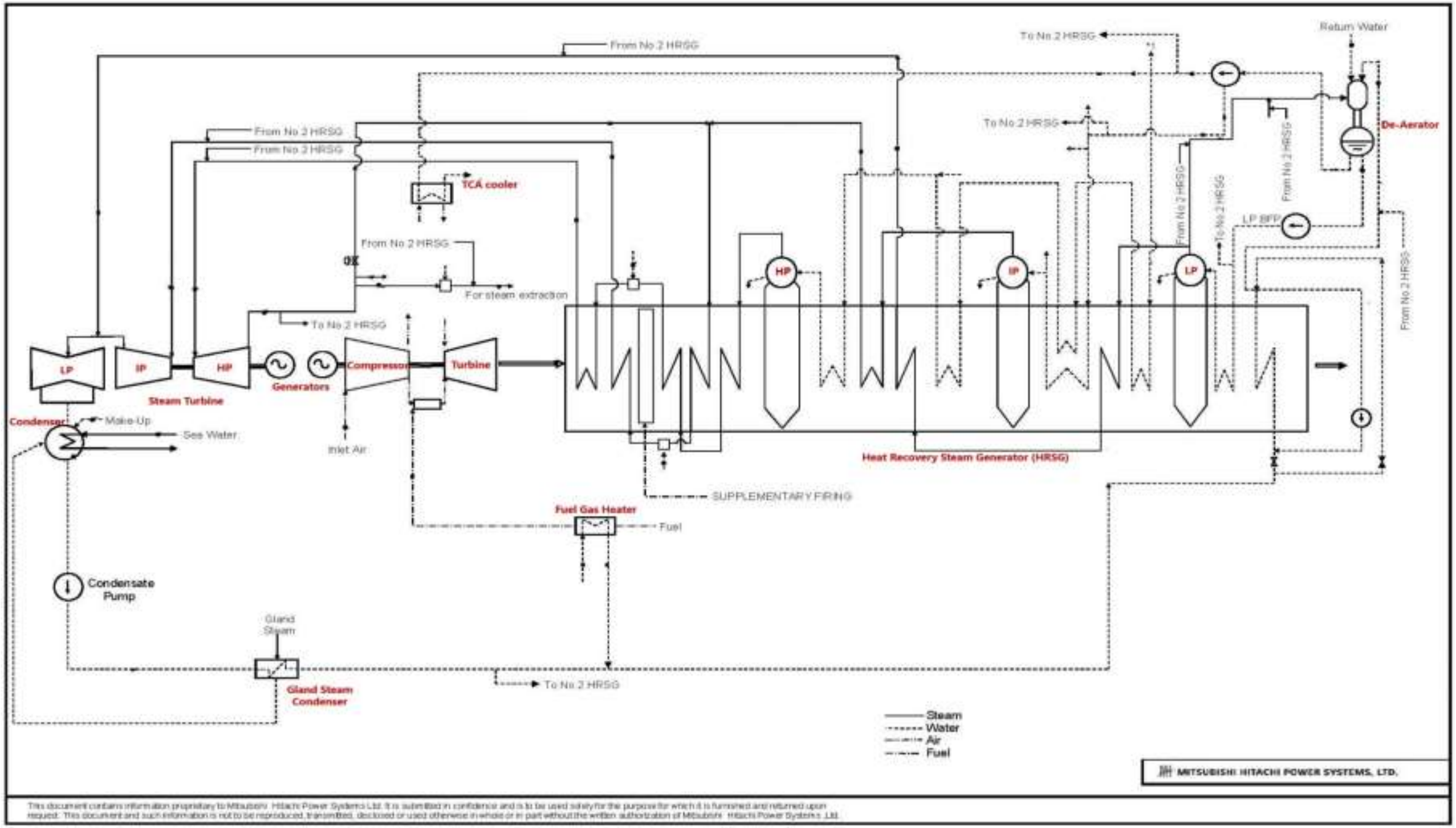


Figure 5 – Schematic Diagram of power generation process

5.5. RESOURCES, INFRASTRUCTURE AND UTILITIES

5.5.1. MAN POWER REQUIREMENT

The total manpower requirement for operating the facility will be around 45 - 55 employees including staff and labourers. The facility will be operated for 24 hours with 3 shift (8 hour each) basis.

5.5.2. POWER REQUIREMENT

The auxiliary power requirement for the proposed project will be 35 MW (approx.)

5.5.3. WATER SUPPLY AND REQUIREMENT

Seawater and desalinated water from existing desalination unit of LPS will be used for the operation of power plant. Sea water will be directly taken from sea (Arabian Gulf) through pipelines to be installed.

5.5.3.1. Water requirement

The water balance diagram of the project indicating water requirement and wastewater generation is presented in **Figure 6**. The required sea water for proposed project will be 1,873,225 m^3/day (78,050 m^3/hr).

5.5.3.2. Sea water intake structure

Sea water to be required for the proposed project will be directly taken from sea through pipelines (HDPE). The tentative location of intake tower and pipeline route is represented in Google image (**Figure 3**) and layout **(ANNEXURE 3).** The seawater drawn by pipeline will be pumped by onshore intake pumping station. The pumping station will have stop logs, band screen and bar screen. Screened sea water will be collected in the pumping chambers. Pumping station will also be equipped with pumps including standby. Each pump will be equipped with a variable speed drive (VSD) for flexibility purpose. Sea water in the pumping chamber will be pumped to pre-treatment system by pumps. Each pump has individual discharge pipe.

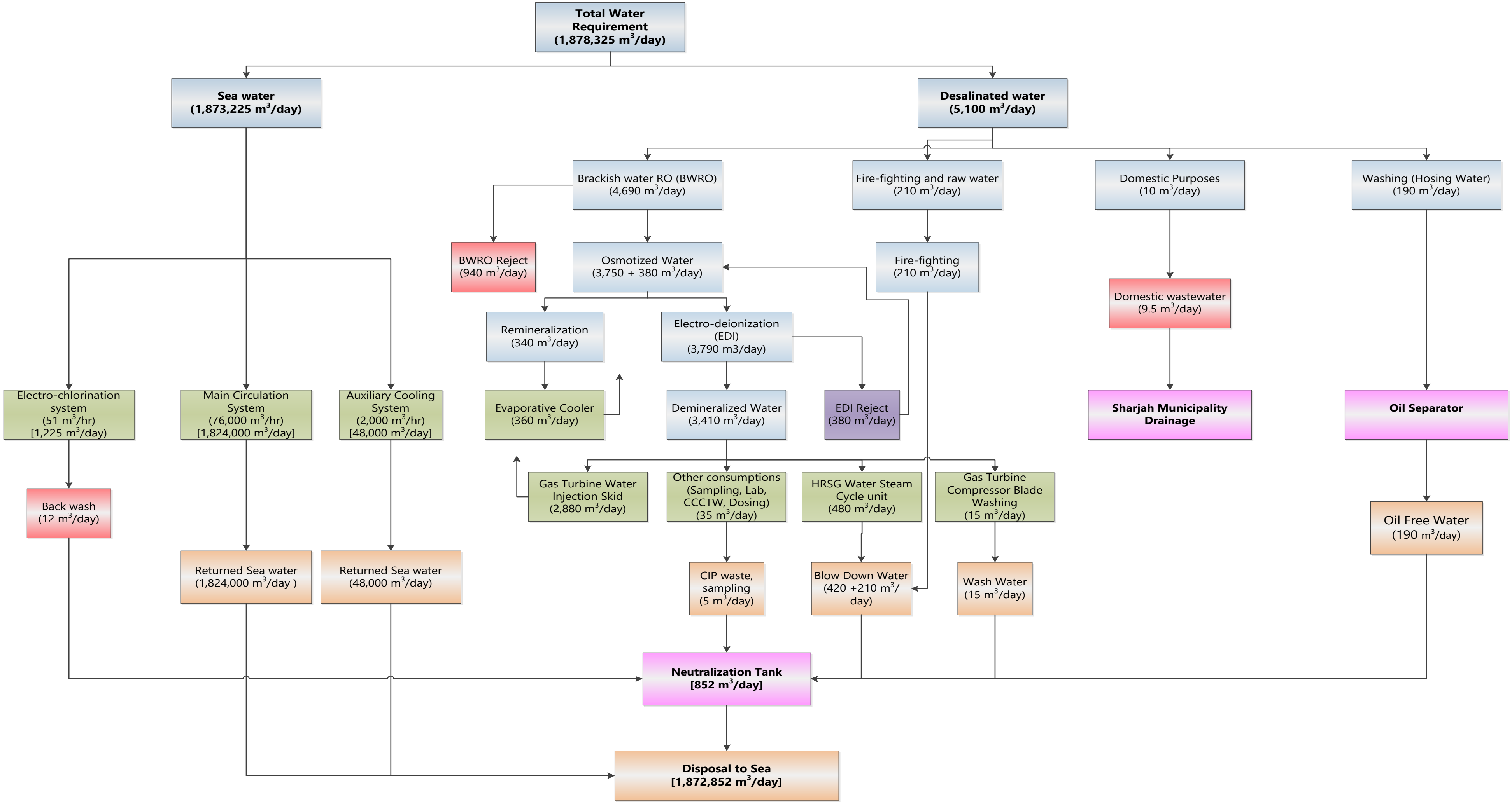


Figure 6 – Water Balance Diagram

Table 36 – Details of the Intake System

<table>
<tr><th>S. No.</th><th>Description</th><th colspan="2">Details</th></tr>
<tr><td colspan="4">Details of the Intake System</td></tr>
<tr><td>1</td><td>Details of the intake system</td><td colspan="2">Seawater intake pumping station with screens, chlorination system and pumps</td></tr>
<tr><td>2</td><td>Maximum intake quantity</td><td colspan="2">1,873,225m^3/day</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Intake seawater quality</td><td>Parameter</td><td>Value</td></tr>
<tr><td>Total Suspended Solids (TSS)</td><td>5 – 20 mg/l</td></tr>
<tr><td>Total Dissolved Solids (TDS)</td><td>38,000 – 45,000 mg/l</td></tr>
<tr><td>Temperature (Min. – Average – Max.)</td><td>18 – 28 – 35 °C</td></tr>
</table>

5.5.4. FUELS, CONSUMABLES

The raw materials, consumables used during the normal operation of the plant are given in **Table 37**.

Table 37 – Details of fuels/consumables to be used for the proposed project

S. No.	Name of the Chemical	Nature	Quantity to be required	Purpose of usage	Storage
1	Natural Gas	Gas	189.4 Ton/hr	Fuel	Existing Distribution system
2	Light Fuel Oil	Liquid	160 m^3/hr	Fuel	Tanks

5.5.4.1. Specifications of Fuel Gas

Fuel Gas to be utilized for the proposed project shall comply with the following quality specifications:

- Gross Heating Value of fuel gas shall not be less than 950 BTU/SCF and not more than 1100 BTU/SCF;
- Water dew point shall be below 32°F at the Delivery Pressure;
- Hydrocarbon dew point shall be below 50°F at the Delivery Pressure;
- Hydrogen sulphide shall not be more than 1.0 grain or more than 10 grains of total sulphur, per 100 SCF

- Carbon dioxide shall not be more than 3.5% carbon dioxide, on a molar basis and Nitrogen shall not be more than 6.0% nitrogen, on a molar basis;
- Net Heating Value shall not be less than 89% of the GHV;
- Specific gravity shall not be less than 0.5 and not more than 0.7. Reference to determine specific gravity is air, and air shall be deemed to have a specific gravity of 1;
- Wobbe Index value shall not be less than 1090BTU/SCF and not more than 1210 BTU/SCF;
- Temperature shall not be greater than 130 degrees Fahrenheit; provided, however, that during summer time when extreme ambient air temperatures prevail the temperature shall not exceed 140 degrees Fahrenheit.

5.6. WASTE STREAMS

5.6.1. AIR EMISSIONS

The primary pollutants from gas turbine engines are nitrogen oxides (NOx), Carbon Monoxide (CO), and to a lesser extent, volatile organic compounds (VOC). Particulate matter (PM) is also a primary pollutant for gas turbines using liquid fuels. Nitrogen oxide formation is strongly dependent on the high temperatures developed in the combustor. Carbon monoxide, VOC, hazardous air pollutants (HAP), and PM are primarily the result of incomplete combustion. Trace to low amounts of HAP and sulfur dioxide (SO_2) are emitted from gas turbines. Ash and metallic additives in the fuel may also contribute to PM in the exhaust. Oxides of sulfur (SO_X) will only appear in a significant quantity if heavy oils are fired in the turbine. Emissions of sulfur compounds, mainly SO_2, are directly related to the sulfur content of the fuel *(US EPA, 2009)*.

The following main control mechanisms will be installed to reduce the emissions generated from the gas turbine system.

- Hot exhaust gas discharged from the gas turbine is channeled through an HRSG in order to heat incoming feed water and subsequently generate saturated and superheated steam. The exhaust gas exits the HRSG through an exhaust stack via damper and silencer located in HRSG stack.
- Gas turbine system will be equipped with Dry Low NOx (DLN) burner system which controls nitrogen oxide emissions.

Hot exhaust gas discharged from the gas turbine is channeled through bypass stack and HRSG system. The exhaust gas exits the HRSG through HRSG (main) stack. During normal operation, the plant will be operated in combined cycle mode, and the main HRSG stack will be in operation. Bypass stack may be operated in single cycle mode during maintenance of HRSG. The main HRSG stack (2 Nos. – each one per HRSG) and the bypass stack (2 Nos. – each one per GT) will not be operating concurrently at any time. The details of main HRSG stack and bypass stack are presented in **Table 38**.

Table 38 – Details of Emissions from HRSG main stack and bypass stack

S. No.	Parameters	Unit	HRSG Main Stack		Bypass Stack	
1	Operation Mode	--	CC - Fuel Gas	CC - Fuel Oil	SC - Fuel Gas	SC - Fuel Oil
2	Internal Diameter of stack	m	6.9		6.4	
3	Flue gas temperature	°C	87	171	639	464
4	Flue gas exit velocity	m/s	21.8	28.0	64.1	54.0
5	Flue gas exit pressure	bar	1.013	1.013	1.013	1.013
6	**Flue gas Pollutant Emission Rates (Maximum)**					
(i)	Particulate matter	mg/Nm^3	<30	<30	<30	<30
		g/s	3.32	3.6	3.32	3.6
(ii)	Oxides of nitrogen (NO_x)	mg/Nm^3	<70	<150	<70	<150
		g/s	8.2	11.88	8.2	11.88
(iii)	Sulphur di-oxide	mg/Nm^3	<500	<500	<500	<500
		g/s	41.6	37.2	41.6	37.2
(vi)	Carbon mono-oxide (CO)	mg/Nm^3	<500	<500	<500	<500
		g/s	15.96	13.78	15.96	13.78

Green House Gases - Carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions are produced during natural gas and distillate oil combustion in gas turbines. Nearly all of the fuel carbon is converted to CO_2 during the combustion process. Methane (CH_4) is also present in the exhaust gas and is thought to be unburned fuel in the case of natural gas or a product of combustion in the case of distillate fuel oil. Although the formation of CO acts to reduce CO_2 emissions, the amount of CO produced is insignificant compared to the amount of CO_2 produced. The majority of the fuel carbon not converted to CO_2 is due to incomplete combustion. A complex series of reactions govern the Formation of N_2O during the combustion process, and its formation is dependent upon many factors. However, the formation of N_2O is minimized when combustion temperatures are kept high (above 1475°F), and excess air is kept to a minimum (less than 1 %) *(US EPA, 2009)*.

Besides, the air quality of the surrounding area will be influenced by fugitive dust emissions generated from vehicular movement on unpaved roads, exhaust emissions from vehicular traffic and fuel-fired equipment/machinery used for the proposed project.

5.6.2. NOISE EMISSIONS

The sources of noise pollution in the proposed facility will be the operation of pumps, turbines, compressors, generators, movement of vehicles and other routine activities in the facility. Noise can be reduced through planning, plant and equipment design & selection, processing equipment within buildings and acoustic enclosures to comply with the norms of noise exposure guidelines as per Occupational Safety and Health Administration (OSHA). The followings are the noise emission levels generated by equipment/machinery to be utilized during the operation of the facility.

Table 39 – Assumed Noise Emission Levels of Equipment/Machinery

Name of Equipment/Machinery/ Building	Noise Emission Level - dB (A)
Gas Turbine and Enclosure	85.0
Steam Turbine	85.0
HRSG Enclosure	80.0
Fuel Gas Heater	75.0
Cooling Air Cooler	80.0
Purge Air Compressor	85.0
GT Casing Cooling Fan	85.0
Plant Air Compressor	90.0
GT Generator	95.0
HRSG Recirculation pump	95.0
ST Oil Cooler	85.0
Condenser	85.0
Condenser Vacuum Pump	95.0
Condensate Extraction Pump	95.0
HP Feed Water Pump	95.0
LP Feed Water Pump	95.0
Outfall Chamber	90.0
Intake water pumping station	95.0

5.6.3. LIQUID WASTE GENERATION AND MANAGEMENT

The sources of water pollution in the proposed project will be domestic wastewater, industrial wastewater generated from the power generation process and used/waste oil generation. The estimated quantity of domestic wastewater generation is in the range of

12.0 – 14.5 m^3/day. The generated domestic wastewater (sewage) will be collected in the underground septic tank and discharge to existing Sharjah Municipality drainage system**.** Sources and quantity of industrial wastewater generated from the process are presented in **Figure 6**. The industrial wastewater to be generated from the proposed project will be neutralized, and neutralized wastewater will be discharged to the sea through the outfall discharge system. The expected characteristics of outfall effluent are hereunder presented.

Table 40 – Characteristic of outfall effluent

S. No.	Parameters	Units	*Concentration Levels (Maximum)*
1)	pH	--	6 - 9
2)	Turbidity	NTU	75
3)	Chlorine (Residual)	mg/L	0.2
4)	Nitrogen - Ammonia	mg/L	5.0
5)	Total Suspended Solids (TSS)	mg/L	30
6)	Biochemical Oxygen Demand (BOD)	mg/L	30
7)	Chemical Oxygen Demand (BOD)	mg/L	150
8)	Oil and Grease	mg/L	10
9)	Phenols	mg/L	0.5
10)	*Total Coliforms*	CFU/100 ml	100
11)	Arsenic (As)	mg/L	0.05
12)	Cadmium (Cd)	mg/L	0.05
13)	Chromium (Cr)	mg/L	0.5
14)	Cobalt (Co)	mg/L	0.5
15)	Copper (Cu)	mg/L	0.5
16)	Iron (Fe)	mg/L	2.0
17)	Lead (Pb)	mg/L	0.1
18)	Zinc (Zn)	mg/L	0.1
19)	Nickel (Ni)	mg/L	0.1
20)	Mercury (Hg)	mg/L	0.001

The used/waste oil will be disposed to the authorized waste oil recyclers/re-processors. The estimated quantity of used/waste oil generation from the facility will be 10,000 – 15,000 litres/Annum.

5.6.3.1. Outfall Discharge System

Layyah Power Station has existing outfall channel for discharging the effluent generated from existing desalination plant and power plant in the premises. The estimated quantity of discharge through the existing outfall channel is around 125,500 m^3/hr (Max.).

Presently, two (2) options are proposed for outfall discharge systems. The considered options are the following:

Option 1: Outfall discharge to be conveyed through a pipeline to a multiport diffuser located offshore; multiport diffuser to be located north side from the existing intake head structures;

Option 2: Outfall discharge to be conveyed through a pipeline to a multiport diffuser located offshore; multiport diffuser to be located south side from the existing intake head structures;

The suitable option will be finalized based on hydro-dynamic modeling & re-circulation study. The estimated outfall discharge by the proposed project will be approximately 1,872,852 m^3/day (78,035 m^3/hr). The tentative locations considered are represented in Google image (**Figure 3**) and layout **(ANNEXURE 3)**.

5.6.4. SOLID WASTE GENERATION AND MANAGEMENT

The details of the solid waste generation are given in **Table 41.**

Table 41 – Solid waste generation and management

S. No.	Type of Waste	Quantity	Management
1	Domestic solid waste	1.0 – 2.0 Tons/month	Disposed to SM authorized service providers
2	Paper, packing materials, wood scraps	2.0 – 4.0 Tons/Annum	Disposed to SM authorized service providers
3	RO membranes and catridges	5 – 10 Tons/Annum	Disposed to authorized recyclers/re-processors
4	Hazardous waste (Waste chemicals/Paints/ Oil sludge/ oil soaked cotton, rags etc.,)	2.0 – 4.0 Tons/ Annum	Disposed to SM authorized service providers

5.7. PROJECT STATUS AND SCHEDULE

The present status of the project is in design finalization and getting necessary approval/permit from concerned regulatory authorities. Site photos of the project site are presented in **ANNEXURE 4.** The construction phase is planned for around 39 months. The proposed project will be expected to start the operation in July 2021. The tentative project implementation schedule with major milestone is enclosed as **ANNEXURE 6.**

5.8. CONSTRUCTION PHASE

It is proposed to construct a built-up area of 23,000m^2 for the proposed power project and its support facilities. The duration of the construction phase is planned to be around 34 months with a requirement of man power of 750-1250 numbers of people. During the construction, it is approximated that there will be a total water requirement of 140 – 265 m^3/day which will be supplied by SEWA or private water supplier. The required power will be met through DG sets or SEWA according to the availability. The waste generated will be disposed through Sharjah Municipality approved disposal mechanisms. The main activities to be carried out during construction are detailed in **Table 42**.

Table 42 – Main activities to be carried out during construction phase

Construction Activity	Details
Site Clearance	This will include clearance of materials and dismantling of existing structures at the expansion site. Since there is no major vegetation at the site, vegetation clearance will not be required. This will allow for excavation, compaction and grading of the expansion site.
Excavation works	Excavation works including compaction and grading will be undertaken to prepare the site for the fill required to raise the site as required. Excavation works will also be required to establish foundations.
Site enabling works	Vehicle access to the site will be required for the frequent delivery of soil and other materials during construction. To allow this, access roads and tracks must be of sufficient quality, and so the main access route on the approach to the proposed site must be appropriately developed.
Foundation construction	Once the site is suitably prepared. Bar cage reinforcement and shuttering will be installed prior to concrete pouring. Concrete raft, piled foundations, or a combination of both will be used.
Erection of mechanical and electrical equipment	This stage mainly involves construction of the major power plant components including gas turbines, steam turbine and condenser. Concrete and steel will be the primary construction materials for this stage.
Construction of transmission line	Towers will be erected and transmission line will be strung, connecting the GIS substation to the substation for wider distribution throughout Sharjah.
Construction of offshore intake and out fall pipelines	The main execution and installation activities are as follows: • Assemble and prepare HDPE pipe strings. • Onshore works; o Removing revetment o Sheet piling o Excavation o Re-instatement

Construction Activity	Details

	• Marine trenching and backfilling.
	• Pipeline installation.
	• Finalizing installation works;
	  o Intake structures (Marine)
	  o Diffuser structures (Marine)
	The supplier will fabricate individual pipeline sections and transported to the site. The pipe sections will be welded together into long strings. Above stringing and manholes installation activities will be either done from a quay-side or on a marine crane-barge after which process the pipe strings will be floating. All pipe string ends being closed by blind flanges. Concrete collars around HDPE pipe strings will be installed. Concrete collar installation will be done from either a crane barge or quay-side. The HDPE pipe strings will remain floating during this process and could be lifted partly out of the water for easy collar installation. Appendages on each pipe string end for the flooding process will be installed.
	
	Onshore works - Onshore works will be supported by regular earth moving equipment and carnage. Due to the depth of the onshore trench 6 m below reference level and consequently in the order of 8m below surface level, temporary sheet piling will be installed to assure a stable trench and limit the top-width of the onshore trench. The trenches will be kept wet so no groundwater extraction will be required. After installation of the different pipe strings the trench will be backfilled with trenched materials after which sheet piling will be removed. The revetment will be re-instated using the original materials.
	
	Marine trenching - Marine trenching works are based on Backhoe dredger supported by split hopper barges for the disposal of dredged materials.
	
	Pipeline installation - The pipeline installation process can be summarized in the following typical working steps;
	• A prepared pipe string will be collected from the assembled location. Due to the length, this towage operation will involve multiple work vessels.
	• After arrival on site the pipe string is maneuvered on its future center axis by support of multiple work vessels.
	• At shore a flooding hose is connected to the appendages on the pipe string end.
	• At offshore end of the pipe string, the marine construction barge will hold the pipe end in place and

Construction Activity	Details
	some tension is introduced to the system to assist alignment on the center axis. • During the flooding operation air will be released at offshore end of the string. • The flooded section of the HDPE pipeline will sink to the seabed and an S-shaped transition section will arise between flooded and non-flooded section. • When the first pipe string is almost flooded to the offshore end the next pipe string is delivered and coupled to the pipe string already installed. • This is a repetitive installation process up to installation of the overall pipe length. **Marine backfilling** - Backfilling operations will be carried out in two different spreads of equipment; 1. The first step is backfilling with sand around the installed pipelines with a top level just above the concrete collars. 2. Step 2 is the placement of rock on top of the sand layer. Backfilling with sand will be done with a small Trailing Suction Hopper Dredger (TSHD). Due to the limited water depth, a discharge pipeline will be used during backfilling is connected to the bow coupling of the TSHD and ending on a spray-pontoon on the other end. The mooring pontoon could be either the marine construction barge or other similar anchored pontoon. Rock is delivered by rock transport barges which will be moored alongside the main mooring barge. Rock placement is done by wheel loader(s) and/or excavators operating from the rock transport barges. During shift to the next rock cargo barge, the earth moving equipment will be parked on the main mooring barge. **Various installation works -** Installation works of both Intake structure and Diffuser will be done by the marine construction barge. The marine construction barge will be equipped with a typically 250mT crawler crane. Consequently, it is assumed that the ultimate weight of both Intake and Diffuser structures (could be modular will be within lifting capabilities of such a crane. After positioning on the seabed the structures will be flanged to the HDPE pipelines by divers.

The salient features of construction Phase is detailed **Table 43**

Table 43 – Salient features of the construction phase of the project

<table>
<tr><th>S. No.</th><th>Description</th><th colspan="2">Details</th></tr>
<tr><td>1</td><td>Duration of the construction phase</td><td colspan="2">Around 34 Months</td></tr>
<tr><td>2</td><td>Maximum manpower to be deployed at peak construction</td><td colspan="2">750 - 1250</td></tr>
<tr><td>3</td><td>Proposed built-up area of construction</td><td colspan="2">23,000 m^2 (Approx.)</td></tr>
<tr><td>4</td><td colspan="3">Water supply and requirement</td></tr>
<tr><td></td><td>Water Supply</td><td colspan="2">SEWA Water supply/Private water suppliers</td></tr>
<tr><td rowspan="3"></td><td rowspan="3">Water requirement</td><td>Domestic purposes</td><td>40 – 65 m^3/day</td></tr>
<tr><td>Construction purposes</td><td>100 – 200 m^3/day</td></tr>
<tr><td>Total</td><td>140 – 265 m^3/day</td></tr>
<tr><td>5</td><td>Power supply</td><td colspan="2">SEWA /DG sets</td></tr>
<tr><td>6</td><td colspan="3">Waste generation and management</td></tr>
<tr><th></th><th>Type of waste</th><th>Quantity of Generation (Approx.)</th><th>Management</th></tr>
<tr><td>a</td><td>Domestic solid waste</td><td>25 – 35 CBM/month</td><td rowspan="2">Disposed to SM authorized service providers</td></tr>
<tr><td>b</td><td>Construction & demolition waste</td><td>15 – 25 Tons/month</td></tr>
<tr><td>c</td><td>Hazardous waste (paint drums, construction chemicals, oil-soaked rags, cotton etc.,)</td><td>0.5 – 1 Tons/month</td><td>Disposed to SM authorized hazardous waste service providers after obtaining NOC</td></tr>
<tr><td>d</td><td>Domestic wastewater (sewage)</td><td>35 – 60 m^3/day</td><td>Collected in the septic tank and discharged to SM drainage system</td></tr>
<tr><td>e</td><td>Dredged waste from dredging activity</td><td>25,000m^3</td><td>Disposed to SM authorized service providers</td></tr>
</table>

6. DESCRIPTION OF ENVIRONMENT

6.1. GENERAL METHODOLOGY

In order to carry out environmental and social impact assessment study, it is first necessary to delineate and define the existing environmental and social factors in and around the project site on the existing environmental and social scenario which will include various environs like ecology, socioeconomic profiles and environmental quality in respect of air, water, noise & soil etc. This section incorporates the description of the existing environmental and socioeconomic settings around the project site. A description focused on the aspects of the environment and society likely to be significantly affected by the project.

The baseline environmental survey (terrestrial and marine environment) conducted during **July 2018** and **August, 2018.** The sampling was done under supervision of ESC and analysis of terrestrial environmental components was carried out by **RAK Lab LLC, Ras Al Khaimah**. The sampling was done by marine ecology team led by Dr. Shahid Mustafa and analysis of marine environmental components was carried out by **Lonestar Technical Services, Dubai.** The secondary data for baseline environmental and social components are collected from web sources, articles and books. Secondary data on meteorology were collected from monitoring stations of National Center of Meteorology & Seismology (NCMS) (Sharjah International Airport station and Dubai International Airport Station). The summaries of sources used for data collection of environmental components are presented in **Table 44**.

Table 44 – Summary on baseline environmental and social components data collection

S. No.	Environmental Components	Parameters & Source	Details on Primary Survey		Source of Secondary Data
			Method of Sampling	Frequency & No. of Samples	
Terrestrial Environmental Components					
1	Climatology & Meteorology	Wind Speed, Wind direction, Relative humidity, dew point and Temperature – Primary & Secondary data	Micro-controller based automatic weather station with data logger was used	Project Site	Secondary data on meteorology were collected from National Center of Meteorology & Seismology (NCMS) for the years, 2007 to 2017. Wind data sourced from Lowa Environmental Mesonet Site. (http://mesonet.agron.iastate.edu)
2	Air Environment	Air Quality – TSP, PM_{10}, SO_2, NOx, CO, O_3, Pb, TVOC – Primary data	High flow-rate respirable dust sampler (Model AAS 217 BL) was used along with calibrated multi-gases sensors (electro-chemical, infra-red, photo ionization detectors)	24 hours continuous – 4 locations at project site.	
3	Noise levels	Noise levels in dB (A) - Min, Max and Average – Primary data	Calibrated integrating sound level meter was used	13 hours for day time & 11 hours for night time – 4 locations at project site	
4	Water Environment	Primary data - Groundwater quality – pH, Temp, Turbidity, Colour, EC, Alkalinity, TDS, TSS, O&G, BOD,	Sampling & Analysis as per standard methods given in APHA, AWWA-2012	One time sampling – 2 groundwater samples at project site	

S. No.	Environmental Components	Parameters & Source	Details on Primary Survey		Source of Secondary Data
			Method of Sampling	Frequency & No. of Samples	
		COD, Chlorides, Sulphates, Fluorides, Hardness, Ca and Mg Hardness, Na, K, Total Nitrogen, Phosphorus, Fe, Cu, Zn, Pb, Cd, Mn, Cr, Ni, Phenols			
		Water Resources – Secondary data	--	--	**Zein, S.R. and Abdulrahman, S.A.** 2003. Water resources in the UAE. In: Water Resources Perspectives: Evaluation, Management and Policy. Edited by A.S. Alsharhan and W.W. Wood. Published by Elsevier Science, Amsterdam, The Netherlands, p. 245-264.
5	Ecology	Existing terrestrial flora and fauna within the study area – Primary & Secondary data	Field Observations	Project site	IUCN – Red Data Book on Red listed species. Federal Law 24 of 1999 Chapter VI Natural Resources Article 64. Tribulus – Journal of Emirates Natural History Group.
6	Geology & Soil	Primary data - Soil samples analyzed for physical and chemical parameters - pH, Moisture content,	Sampling and Analysis as per British Standard (BS 1377:1990)	Composite soil sampling - 4 Locations at project site	--

S. No.	Environmental Components	Parameters & Source	Details on Primary Survey		Source of Secondary Data
			Method of Sampling	**Frequency & No. of Samples**	
		Chlorides, Nitrogen, Phosphorus, Potassium, Alkalinity, Electrical Conductivity and Heavy Metals (As, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, Zn) and Total Petroleum Hydrocarbon			
		Geological Resources – Secondary data	--	--	Holocene coastal carbonates and evaporites of the southern Arabian Gulf and their ancient analogues by Alsharhan and Kendall (2003).
Marine Environmental Components					
1	Oceanography	Hydrographic survey - Bathymetry, tide levels and current	Single beam Echo sounder integrated with differential GPS is used for bathymetry survey. Acoustic Doppler Current Profiler (ADCP) and tide gauge is used for current and tide levels measurement.	Project Study area – 7 × 3 km 1 location at Arabian Gulf.	--
2	Marine water (Sea)	**In-situ parameters** - pH, Temperature,	In-situ water quality profiling measurements was carried out in using calibrated	One time sampling & 12 sea water samples at marine	--

S. No.	Environmental Components	Parameters & Source	Details on Primary Survey		Source of Secondary Data
			Method of Sampling	**Frequency & No. of Samples**	
		Turbidity, Dissolved Oxygen (DO), Salinity **Ex-situ parameters -** Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Calcium, Magnesium, Sodium, Potassium, Carbonates, Chloride, Sulphate, Fluoride, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total residual chlorine, Total Nitrogen, Nitrate Nitrogen, Ammonia Nitrogen, Nitrite Nitrogen, Boron, Bromide, Heavy Metals (Al, As, Cd, Cr, Cu, Fe, Hg, Zn), Surfactants,	probes. For ex-situ parameters, water samples were collected in middle depth in the water column using Niskin water sampler. Sampling and Analysis as per APHA, 2017 – Sharjah Municipality recognized Laboratory	impact area and 2 samples from existing outfall channel	

S. No.	Environmental Components	Parameters & Source	Details on Primary Survey		Source of Secondary Data
			Method of Sampling	**Frequency & No. of Samples**	
		Total Petroleum Hydrocarbons, Chlorophyll, and *E. coli*.			
3	Marine Sediment	Particle size analysis, Total Organic Carbon,, Total Nitrogen, Nitrate Nitrogen, Ammonia Nitrogen, Phosphate, Sulphate Heavy Metals (Al, As, Cd, Cr, Cu, Fe, Hg, Zn), Total Petroleum Hydrocarbons	Stainless steel Van Veen grab sampler was used for the collection of bottom sediments. Sampling and Analysis as per APHA, 2017 – Sharjah Municipality recognized Laboratory	One time sampling & 10 samples at marine impact area	
4	Marine Ecology (Flora, Fauna, epi-benthic and in-fauna communities)	Species identification, Taxonomic classification, Abiotic characteristics including substrate type and any other notable features, Relative abundance, diversity index	Marine Ecology study was carried out underwater, by qualified divers (marine ecologist) in the study area. The observations are also documented using media tools such as videography and photographs.	One time sampling & 10 samples at marine impact area	

S. No.	Environmental Components	Parameters & Source	Details on Primary Survey		Source of Secondary Data
			Method of Sampling	Frequency & No. of Samples	
Socio-Economic Components					
1	Socio-economic Aspects	Socio-Economic Components of the study area – Secondary data • Labour and working conditions • Community health, safety and security • Land acquisition and involuntary resettlement • Indigenous peoples • Cultural Heritage	--	--	Data collected from Federal Competitiveness and Statistics Authority (FCSA) and Department of statistics and community development of Sharjah

6.2. STUDY AREA – PROBABLE IMPACT AREA

Prior to the collection of baseline data, the impact areas have been delineated. Establishing the coverage of the impact areas can be difficult. There are a lot of factors to be considered such as physical attributes of the project site, prevailing meteorological conditions, Valued Ecosystem Components (VECs), adjacent facilities and distance of the nearest community, among others. The primary impact areas cover the existing sites and areas at least a 2 kilometer within its radius. The secondary impact areas are a radius of about 5 kilometer from the project site. Initially, the coverage of the impact areas is limited to ensure accuracy in the identification of impacts. The coverage may be expanded once the impact assessment shows that the project will have impact to a much larger area as initially delineated. The map showing the primary and secondary impacts areas are represented in **Figure 7** and **Figure 8**.

6.2.1. ENVIRONMENTAL SENSITIVITY OF THE STUDY AREA

Sensitive receptors (Valuable ecosystem components) in the primary impact and secondary impact areas are identified. Sensitive receptors can be described as features that are notable in some way, whether due to their local or national importance or if they are especially sensitive to changes. Typically, sensitive receptors relate to ecological or human receptors (habitats, species, population centres) as well as geographical phenomenon or structures. Sensitive receptors are the specially protected resources and those vulnerable people in a given area at the receiving end of the discharges, emissions and pollutions from a project or activity. VECs normally require the most attention for protection against the harmful effects of project implementation. The details of receptors and its sensitivity are described in **Table 45**.

Table 45 - Details of sensitive receptors in and around the project site

S. No.	Name of the Receptor	Sensitivity*	Distance from Project Site (km)	Direction from Project site
1.	Al Layyah suburb – Residential area	High	0.45	S
2.	Al Marijah suburb – Residential area	High	0.70	E
3.	Al Khaleidia suburb – Residential area	High	1.0	S
4.	American School of Creative Science - School premises	High	0.60	S
5.	Manar Al Sabeel Quran Center –	High	0.90	S

S. No.	Name of the Receptor	Sensitivity*	Distance from Project Site (km)	Direction from Project site
	School premises			
6.	Canadian Montessari Nursery – School premises	High	1.00	SSW
7.	Arabian Gulf School - School Premises	High	1.10	SSE
8.	British Islamic Nursery - School Premises	High	1.15	S
9.	Al Khan School – School Premises	High	1.20	S
10.	Al Zahra Hospital	High	2.00	ENW
11.	Zuleka Hospital	High	3.25	ENW
12.	Sharjah Creek	Moderate	0.40	E
13.	Arabian Gulf (Sea)	Moderate	Adjacent	--
14.	Sharjah Khalid Port	Moderate	Adjacent	--
15.	Khalid Lagoon	Moderate	1.50	SSE
16.	Al Khan Lagoon	Moderate	2.60	S
17.	Sharjah Heritage Area	Moderate	0.90	E
18.	Sharjah Art Museum	Moderate	1.40	ENW
20.	Wasit Natural Reserve	High	8.5	E
21.	Golden Beach Motel – Other public place	Moderate	0.20	S
22.	Sahara Beach Resort - Other public place	Moderate	0.40	SSW
23.	Marhaba Resort - Other public place	Moderate	0.50	S

** Sensitivity based on Dubai Municipality technical guidelines no. 2 - EIA Requirements for Land Development, Infrastructure, and Utility Projects – Aug., 2017 and importance of the receptor in the particular context.*

Figure 7 – Map showing the surrounding features of project site covering 1 km radius

Sharjah Khalid Port
Sharjah Court
Sharjah Creek
Sharjah Heritage Area
Al Marijah
500 m radius
Project Site - Layyah Power Station
1 km radius
Golden Beach Motel
Sahara Beach Resort
Jubail Bus station
Sharjah Museum Authority
American School of Creative Science
Sharjah Government Buildings
Flag Island
Al Layyah Suburb
Manar Al Sabeel Quran Center
Canadian Montessari Nursery

Figure 8 – Map showing the surrounding features of project site covering 5 km radius

2km radius
5km radius
Project Site -
Layyah Power Station
Sharjah Khalid Port
Sharjah Creek
Sharjah Art Museum
Sharjah Heritage Area
Al Marijah
Al Zahra Hospital
Zuleka Hospital
Kuwait Hospital
Residential Areas
Wasit Natural Reserve
Jubail Bus Station
Yarmook
Al Layyah Suburb
Islamic Nursery
British
Al Khan School
Arabian Gulf School
Flag Island
Al Jazeera Park
Al Qasimia
Al Khaledia Suburb
Al Majaz Island
Al Majaz
Abu Sahara
Sharjah Aquarium
Al Majaz 3
Al Khan
Khalid Lagoon
Sharjah Industrial Area - 01
Al Majaz 2
Al Khan Lagoon
Al Mamzar Lagoon
vy, NGA, GEBCO
6 km
N

6.3. GEOGRAPHY AND TOPOGRAPHY OF THE STUDY AREA

The United Arab Emirates is a Sovereign federal monarchy (Wikipedia, accessed in 30th October,2018)) , constituting of seven emirates (states) namely : Abu Dhabi, Dubai, Al Sharjah, Ras Al Khaimah, Al Fujairah, Umm al Qaiwain, and Ajman. It has geographic boundary of Arabian Gulf in West and North, The south has the sandy plains of Saudi Arabia with oasis of Al Liwa. UAE is mostly arid, characterized with sand dunes, oasis, rock mountains, valleys, marshes and mangroves and salt plain. The salt plan, called sebkha is in the west, and Hajar mountains on the east, bordering the country with Oman.

Sharjah is in between the co-ordinates 25° 26′ 0″ N, 55° 23′ 0″ E, with access to west coast and East coast and has islands as well. It is the third largest emirate, with flat plain lands in between the both coast (www.nationsencyclopedia.com, 2018), typically of 3 main ecosystem- desert ecosystem, mountain ecosystem and coastal and marine ecosystem. The Khor fakkan- kalba region in the western coast is identified with rich biodiversity and fertile areas suitable for cultivation (www.government.ae, 2018)

6.3.1. TOPOGRAPHY OF PROJECT SITE

The proposed land area for the project is already reclaimed during the time of LPS previous developments. The proposed land is sandy without any vegetation and currently left barren which is used for temporary storage.

Topographic survey was carried out in the project site of Layyah Power Station. The survey area consists of buildings, desalination plant, substation, Tank, and Existing Roads. The following features are surveyed at site during the Topographic Survey:

- Linear features for substation, gates, sheds in the work area, kerbs, bollards, walls, tanks, buildings and fence.
- Street furniture such as road signs, traffic lights and street lights.
- The location & cover levels of all the Existing Utility Details are recorded to represent in the Survey Drawing.
- Spot heights observed @ 5m grid

Perusal on topographical survey data, ground level at the proposed project region is in between +3 to +4 m MSL. Topographic survey map are presented in **Annexure 7.**

6.4. BASELINE TERRESTRIAL ENVIRONMENTAL SURVEY

The baseline survey on terrestrial environment was conducted during the month of **May, 2018** by RAK Lab LLC, Ras Al Khaimah. The details of baseline terrestrial environmental survey (ambient air quality, ambient noise quality, ground water quality and soil quality) are presented in **Table 46.**

Table 46 – Details of Environmental Monitoring/Sampling Locations

Location Code	GPS Coordinates		Period of Survey
	Latitude	Longitude	
Ambient Air Quality & Ambient Noise Quality			
AAQ 1 & ANQ 1	25° 21' 21" N	55°22' 03"E	24 hours (05th July, 2018 @11.45 am to 06th July, 2018 @11.45 am)
AAQ 2 & ANQ2	25° 21' 12" N	55° 22' 06" E	24 hours (05th July, 2018 @11.00 am to 06th July, 2018 @11.00 am)
AAQ 3 & ANQ 3	25° 21' 10" N	55° 22' 18" E	24 hours (06th July, 2018 @12.00 am to 07th July, 2018 @12.00 am)
AAQ 4 & ANQ 4	25° 21' 18" N	55° 22' 21"E	24 hours (06th July, 2018 @11.30 am to 07th July, 2018 @11.30 am)
Groundwater Quality			
GWQ 1	25° 21' 16" N	55° 22' 03" E	05th July, 2018
GWQ 2	25° 21' 15" N	55° 22' 08" E	09th July, 2018
Soil Quality			
SQ 1	25°21'18.93"N	55°22'3.73"E	05th July, 2018
SQ 2	25°21'16.53"N	55°22'3.94"E	05th July, 2018
SQ 3	25°21'19.45"N	55°22'5.59"E	05th July, 2018
SQ 4	25°21'16.96"N	55°22'6.21"E	05th July, 2018
SQ 5	25°21'15.23"N	55°22'8.10"E	05th July, 2018
SQ 6	25°21'17.52"N	55°22'8.44"E	05th July, 2018

Baseline terrestrial environmental survey locations are represented in Figure 9 – Google image showing the locations of ambient air and ambient noise quality monitoring at project site Figure 9 and Figure 10**.**

Figure 9 – Google image showing the locations of ambient air and ambient noise quality monitoring at project site

Figure 10 – Google image showing ground water (borehole) and soil sampling locations at project site

6.4.1. CLIMATE AND METEOROLOGY OF THE STUDY AREA

UAE is generally warm and dry in the winter, however during summer months coastal weather brings in humidity along with very high temperatures. Due to the presence of the Al Hajar al Gharbi Mountains in the proximity, high altitudes lead to generally cooler weather conditions. UAE climate can be broadly classified as two main seasons' summer and winter. Summers are between April to September with very dry weather conditions. Where in the temperature rise to about 48 degrees Centigrade in coastal cities – with accompanying humidity levels reaching as high as 90%. In the southern desert regions, temperatures can increase to as high as 50° Centigrade. Major part of the country is subject to violent dust storms with rainfall being infrequent and irregular. The description of regional climate data of UAE is presented in **ANNEXURE 8.**

This section describes the weather of project study region based on primary data collected at the project site, and secondary data collected at the **Sharjah International Airport** (Sharjah, United Arab Emirates) weather station (which is located 12.5 km away from project site on Eastern direction. The results of weather data collected at the project site are presented in **Table 47.**

Table 47 – Micrometeorology data at the project site

Parameters		Units	Micrometeorology	
			05th July @ 11 am – 06th July, 2018 @ 11am	06th July @ 11 am – 07th July, 2018 @ 11am
Ambient Temperature	Min	°C	33.00	34.52
	Mean		38.53	39.10
	Max		44.28	45.16
Relative Humidity	Min	%	23.52	26.45
	Mean		51.57	50.21
	Max		79.15	69.11
Wind Speed		m/s	1.20	1.30
Wind Direction		(°)	1.44	199
Solar Radiation		w/m^2	455	447

6.4.1.1. Temperature

The Arabian Gulf has substantial impact to the climate and temperature at the project site due to the proximity to the coast. Data on Sharjah International Airport is presented in **ANNEXURE 8.**

The perusal of the Sharjah International Airport (SIA) data indicates that lowest minimum absolute temperature (Min.) observed in a specific month during 2013 – 2017 was 5.2°C in January, 2013 and highest maximum absolute temperature (Max.) was 48.8°C in July, 2013. The lowest average temperature (Mean) observed in a specific month during 2013 – 2017 was 18.4°C in January, 2014 and highest average temperature was 37.7°C in July, 2017.

The perusal of the primary data collected at the project site during the survey indicates that lowest minimum temperature observed was 33°C, and highest maximum temperature was 45.16°C. The average temperature (Mean) observed was around 39°C.

6.4.1.2. Relative humidity

The perusal on Sharjah International Airport (SIA) data on relative humidity indicates that lowest minimum absolute relative humidity (Min.) observed in a specific month during 2013 – 2017 was 4% in October, 2014 and highest maximum absolute relative humidity (Max.) was 99% in the months of January to April, 2013 and March, 2016. The lowest value of mean minimum relative humidity (Mean Min.) observed in a specific month during 2013 – 2017 was 15% in May, 2015 and highest value of mean maximum relative humidity (Mean Max.) was 89% in February, 2013.

The perusal of the primary data collected at the project site during the survey indicates that lowest minimum relative humidity observed was 23.52%, and highest maximum relative humidity was 79.15%. The average relative humidity (Mean) observed was around 51%.

6.4.1.3. Wind speed and wind direction

The wind speed and wind direction for Sharjah International Airport is represented by wind rose diagram which is given in Figure 11**.** The wind rose diagram indicates that North-western directions, East, West & South-eastern are the most prevalent wind flowing directions. The average wind speed for the last 5 years is 7.5 miles per hour at Sharjah International Airport.

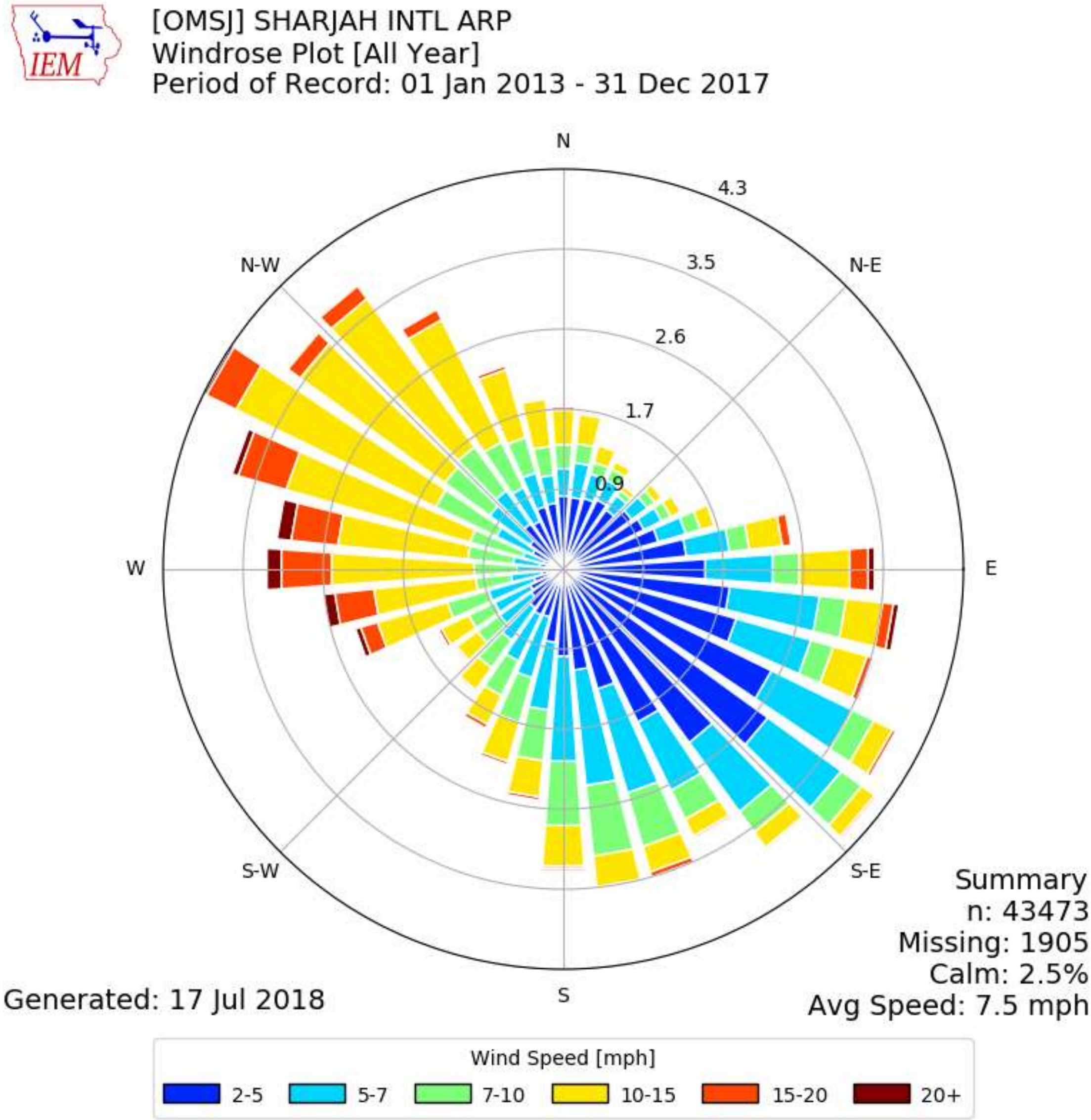


Figure 11 - Wind rose diagram of Sharjah International Airport for 2013 – 2017

(Source: Iowa Environmental Mesonet Web - http://mesonet.agron.iastate.edu/)

6.4.1.4. Rainfall

The rainfall in the UAE is known in its fluctuation during 2007-2017 and there is variation in the average of rainfall from one area to another also. The higher level of rainfall received in Sharjah was 135.5mm during 2009 when compared with last 11 years data (2007 – 2017). The average rainfall received in Sharjah during 2007 – 2017 was 63.4mm and number of rainy days was 22.6. Rainfall received in Sharjah during 2017 was 61.7mm and number of rainy days for the year was 31. Rainfall is not recorded during the survey.

6.4.1.5. Solar radiation

The perusal of the UAE data recorded in 2017 showed that the mean of sunshine hours, in almost all the months of the year to be more than 8 sunshine hours and in average of 10 hours daily. The highest value of average daily solar radiation was in June, (8420 wh/m^2) and the lowest was in February (3191 wh/m^2). There is no available data for Sharjah emirate from NCMS.

6.4.2. AMBIENT AIR QUALITY

Baseline ambient air quality in the project site was determined by establishing four (4) monitoring stations at the project site. The locations of ambient air quality monitoring locations are represented in Google image which is given in Figure 9**.** The measured ambient air quality parameters are Total Suspended Particulates (TSP), Respirable Suspended Particulate Matter less than 10 microns (PM_{10}), Sulfur Dioxide (SO_2), Carbon Monoxide (CO), Ozone (O_3), Carbon Dioxide (CO_2) Nitrogen Dioxide (NO_2) and Total Volatile Organic Compounds (TVOC). The monitoring was conducted for twenty-four (24) hours on-site.

6.4.2.1. Monitoring and Test Method for AAQ

Air quality was monitored using a calibrated high flow-rate respirable dust sampler (Model AAS 217 BL). The volumetric flow rates of the sampling were maintained at 0.9 - 1.4 m^3/min for TSP and PM_{10} parameters. The sampling and analysis of air quality parameters were carried out by the procedures described in the relevant parts of US EPA–eCFR, the United States Environment Protection Agency-electronic Code of Federal Regulations: Title 40: Part 50 and 53.

Meteorological data of the day was collected using an Automatic Weather Station which is a micro-controller based weather station. All sensors (wind speed, direction, temperature, humidity, dew point and solar radiation) are attached with the data logger for the collection of real-time data automatically.

Gas pollutants were monitored using calibrated multi gases sensors (electrochemical, infrared, photoionisation detector) attached gas detectors (model-dragger Xam7000 and dagger Xam5000). The sensors detect the gases in different concentration. The sampling and analysis of gaseous pollutants were carried out following the procedures described in the relevant parts of BSEN 60079-29-2; 2007, BSEN 45544-1; 2000 and BSEN 50271; 2010.

6.4.2.2. Results and observation of AAQ

The results of ambient air quality monitoring are given in Table 48**.** The obtained results are compared with ambient air quality limits prescribed by UAE-MoCCaE and WHO air quality guidelines[5].

Table 48 - Ambient Air Quality Monitoring results at project site

Parameters	Units	AAQ Results				UAE MoCCaE AAQ limits	WHO AQGs
		AAQ 1	AAQ 2	AAQ 3	AAQ 4		
Total Suspended Particulates (TSP)	µg/Nm^3	217	204	223	196	**230**	**--**
Respirable Particle Matter (PM_{10})	µg/Nm^3	83	98	115	89	**150**	**150*** **50#**
Sulphur dioxide (SO_2)	µg/Nm^3	<0.1	<0.1	26.2	<0.1	**150**	**--**
Nitrogen dioxide (NO_2)	µg/Nm^3	18.8	<0.1	18.8	<0.1	**150**	**125*** **20#**
Carbon monoxide (CO)	mg/ Nm^3	<1	<1	<1	<1	**10**	**--**
Ozone (O_3)	µg/Nm^3	58.9	78.5	78.5	58.9	**120**	**160*** **100#**
Total Volatile Organic Compounds	ppm	0.05	<0.01	0.03	<0.01	--	--
Lead (Pb)	ppm	<0.01	<0.01	<0.01	<0.01	--	--

**Interim target 1; #Guideline value (Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines)*

The results of the ambient air quality survey indicate that levels of particulate matter (TSP and PM_{10}) and ozone are found to be significant in the ambient air. Levels of TSP in ambient air of project site ranged from 196 to 223 µg/Nm^3 which comply with maximum allowable limit (230 µg/Nm^3) prescribed by UAE - MoCCaE while those values are in near borderline of the maximum allowable limits. Levels of PM_{10} ranged from 83 to 115 µg/Nm^3 which comply with maximum allowable limit (150 µg/Nm^3). Higher levels of particulate matter in the ambient air may be contributed by wind-blown dust, fugitive dust emissions by vehicular movement in paved/unpaved roads in the project site/adjacent roads.

Ozone levels in ambient air ranged from 58.9 to 78.5 mg/Nm^3 which are also in compliance with maximum allowable limit (150 mg/Nm^3). Higher levels of O_3 may be

[5] *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide - Global update 2005 - Summary of risk assessment, World Health Organization*

associated with high sunny periods where the pollutants are indirectly formed by the action of sunlight on nitrogen dioxide. Other pollutants in the ambient air are less or not detectable and comply with maximum allowable limits prescribed by UAE-MoCCaE.

6.4.3. AMBIENT NOISE LEVEL

The baseline status of noise environment is accessed through noise level monitoring programme. The existing noise level in the project site was determined by establishing four (4) ambient noise level monitoring stations. The locations of ambient noise level monitoring locations are represented in Google image which is given in Figure 9**.** The monitoring was conducted for twenty four (24) hours on-site. Equivalent Continuous Sound Level was measured at site in A-weighting using calibrated integrating noise data logger sound level meters. The measurement was according to the standard ISO 1996-2: 2007. Sinus Tago (Class 1) sound level meter and Casella 63 (Class 1) sound level meter are used for ambient noise quality monitoring along with acoustic calibrator (Class 1).

6.4.3.1. Results and Observations

The results of ambient noise level monitoring are given in Table 49 The results of ambient noise quality are compared with the limits of UAE-MoCCAE and World Health Organization (WHO) guideline values for community noise.

Table 49 – Results of Ambient Noise Quality in the project site

Locations	Day Time (7 am – 8 pm)			Night time (8 pm – 7 am)		
	Noise levels (dB (A))					
	LMin.	Leq. (Avg.)	LMax.	LMin.	Leq. (Avg.)	LMax.
ANQ 1	56.4	**69.7**	89.5	52.9	**65.4**	75.8
ANQ 2	58.7	**72.7**	96.6	54.5	**69.6**	92.3
ANQ 3	50.2	**64.3**	93.8	48.3	**61.6**	91.2
ANQ 4	58.5	**80.9**	96.1	54.7	**76.4**	93.7
UAE-MoCCAE Limit*	--	**6 0 - 70**	--	--	**50 - 60**	--
WBG-IFC Guideline	--	**70**	--	--	**70**	--
WHO Guideline value#	Leq value = 70 dB (A) for 24 hours at Industrial, commercial, shopping and traffic areas. LMax = 110 dB(A)					

**MoCCAE, UAE - Allowable Limits for Noise Level (dBA) in Industrial Areas*
#Table 4.1 – Guideline values for community noise in specific environment

The recorded daytime noise level (Leq) at the project site ranged from 64.3 to 80.9 dB(A), and nighttime noise level (Leq) ranged from 61.6 to 76.4 dB(A). As apparent from the results, noise levels at the project site are significantly higher than maximum allowable limits prescribed by UAE-MoCCAE except day time noise level recorded at ANQ1 & ANQ 3 monitoring location. However, measured noise levels in the project areas are less than guideline value of WHO [Lmax – 110 dB(A)] for community noise specified for industrial environment. The higher noise levels during day and night times in the project area are contributed by adjacent activities of ongoing industrial activity, port and vehicular traffic.

6.4.4. WATER ENVIRONMENT

The common water sources of United Arab Emirates (UAE), are ground water, falajs, springs and seasonal floods. Ground water is being used for cultivation as well. However Desalination water is the main source of potable water.

6.4.4.1. Groundwater resources

The distribution of aquifer types in UAE is categorized as following (*Brook, M. and Dawoud, M.A., 2005*) which is represented in **Figure 12.**

- Coastal Sabkha
- Eastern Gravel aquifer
- Western Gravel Aquifer
- Ophiolite aquifer
- Northern Limestone aquifer

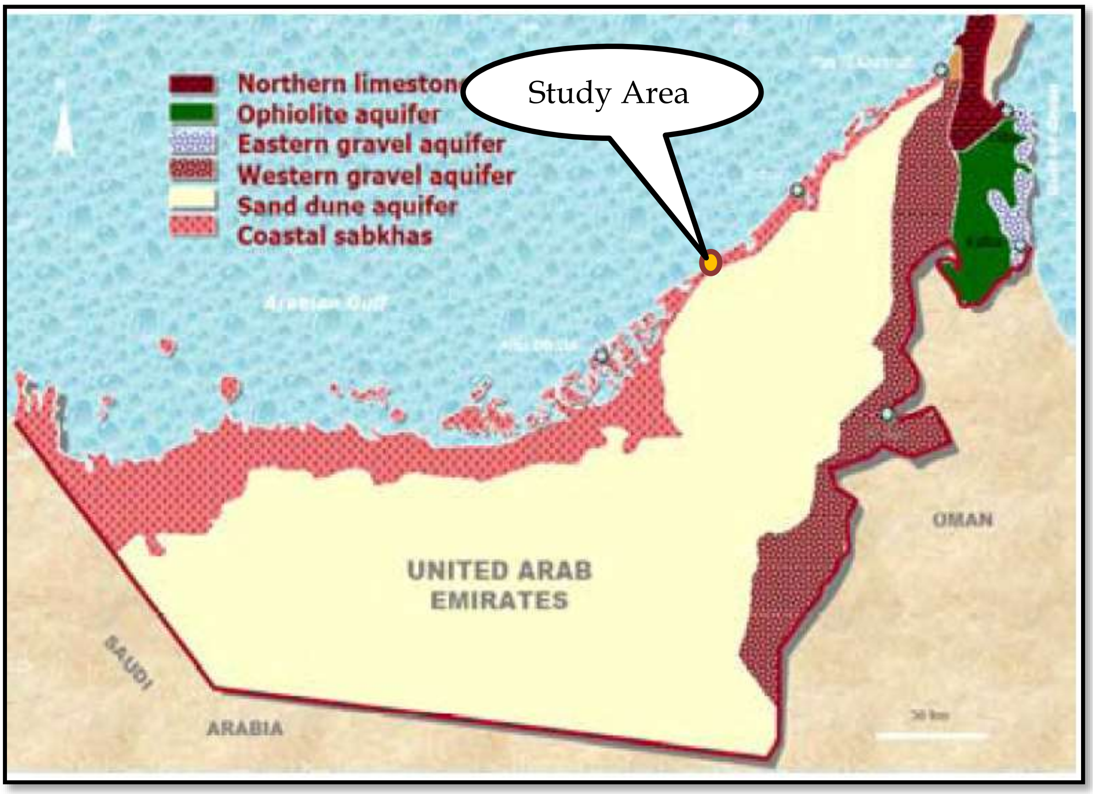


Figure 12 - Aquifer Types of United Arab Emirates (Source: Brook, M. and Dawoud, M.A., 2005)

6.4.4.2. Groundwater Quality

The borehole was made for ground water quality monitoring. Two boreholes were drilled and samples were collected. Groundwater level encountered in the boreholes was at a depth of between 1.80 to 2.20 m below existing ground level (i.e. between level +2.20m SMD (Sharjah Municipality Datum) and +1.80m SMD below Average Borehole Level of +4.00m SMD).

6.4.4.2.1. Results and observations

The results obtained for ground water quality analysis are summarized in Table 50**.**

Table 50 - Results of Ground water quality

S. No.	Parameters	Units	Results		***Dutch Intervention Values****
			GW1	GW2	
1)	Temperature	°C	29.2	28.0	
2)	Colour	Co/pt	Normal	Normal	--
3)	Turbidity	NTU	7.75	1.64	
4)	pH at 25^0 C	-	7.82	7.38	--
5)	Conductivity at 25^0C	µS/cm	5270	1242	--
6)	Total Suspended Solids (TSS)	mg/L	26	<5	--
7)	Total Dissolved Solids (TDS) at 180^0 C	mg/L	2820	602	--
8)	Chemical Oxygen Demand (COD)	mg/L	128	24	--
9)	Biochemical Oxygen Demand (BOD)	mg/L	38	11	--
10)	Oil & Grease	mg/L	<5	<5	--
11)	Chloride (Cl)	mg/L	1524	305	--
12)	Sulphate (SO_4^{2})	mg/L	95	34	--
13)	Calcium (Ca)	mg/L	58	60	--
14)	Magnesium (Mg)	mg/L	53.5	14.6	--
15)	Total Alkalinity	mg/L	80	38	--
16)	Total Hardness as $CaCO_3$	mg/L	365	210	--
17)	Phosphorous	mg/L	0.30	0.01	--
18)	Fluoride(F^-)	mg/L	0.59	0.79	--
19)	Phenols	mg/L	<0.02	<0.02	**2.0**
20)	Total Nitrogen	mg/L	8	3	--
21)	Sodium (Na)	mg/L	996	146	--
22)	Potassium (K)	mg/L	24.01	7.51	--
23)	Iron (Fe)	mg/L	0.05	0.07	--
24)	Manganese (Mn)	mg/L	0.01	0.09	--
25)	Chromium (Cr)	mg/L	<0.001	<0.001	**0.006**

S. No.	Parameters	Units	Results		***Dutch Intervention Values****
			GW1	**GW2**	
26)	Copper (Cu)	mg/L	0.01	0.01	**0.075**
27)	Lead (Pb)	mg/L	<0.01	<0.01	**0.075**
28)	Zinc (Zn)	mg/L	0.41	0.18	**0.8**
29)	Nickel	mg/L	<0.01	<0.01	**0.075**
30)	Cadmium (Cd)	mg/L	<0.001	<0.001	**0.006**

**Dutch Target and Intervention Values, 2000 - Circular on target values and intervention values for soil remediation*

The results were compared with Dutch Intervention values, levels of toxic contaminants (heavy metals) in the collected ground water samples are below the limits or not detected.

6.4.5. SOIL ENVIRONMENT

Geo-technical investigation was carried out in the project site. The investigation results are suggestive of that, the general site stratigraphy of the area and the area in general is consistent. The classification and description of soil samples has been carried out in accordance with BS 5930:1999. Based on the investigation results and interpretations, a general site stratigraphy relevant to different structure locations were developed and is given in **Table 51.**

Table 51 – General site stratigraphy of project site

Depth (m) [below existing ground level]	Description
0.0m to 0.50m	Light Brown, slightly silty to silty, gravelly, fine to medium **SAND.** (MAN MADE-FILL)
0.50m to 1.50m	Medium dense, light brownish grey, slightly silty to silty, very shelly, slightly gravelly, fine to medium **SAND** with frequent shell and shell fragments (MAN MADE-FILL).
1.50m to 5.00m	Loose to medium dense, light brownish grey, slightly silty to silty, gravelly, fine to medium **SAND** with occasional cemented sand pieces (MAN MADE-FILL).
5.0m to 12.00m	Medium dense to dense becoming very dense, light grey, very shelly, gravelly, fine to medium, fine to medium **SAND** with occasional cemented sand pieces
12.0m to 12.2/13.32m	Very dense, light grey, very shelly, gravelly, fine to medium, fine to medium **SAND** with occasional cemented sand pieces

Depth (m) [below existing ground level]	Description
12.2/13.32m to 15.4m	Very weak to weak, light grey, medium bedded, fine to coarse grained **CALCARENITE**, slightly weathered, medium spaced, sub-horizontal to inclined fracture.
15.4 to 30.0m	Very weak, light grey, locally light brown, thinly bedded and laminated, locally fragmented, fine to medium grained calcareous **SANDSTONE**, with animal burrows and boring at places, slightly to moderately weathered, closely spaced, sub-horizontal to inclined fracturing.

6.4.5.1. Soil Quality

The soil samples were collected in the four (4) locations in the proposed project area and testing was performed. The following test methods were adopted: BS 1377-3:1990, APHA 21st:2005, EPA 8015.

6.4.5.1.1. Result and Observations

Table 52 - Results of soil analysis at project site

S. No.	Parameters	Units	Soil Quality Results						DM Limit*
			SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	
1.	Moisture	%by weight	0.56	0.63	0.34	0.46	0.56	0.88	--
2.	pH @ 25°C	-	7.54	7.46	7.70	7.63	7.42	7.07	--
3.	Conductivity	µS/cm	21600	10200	2380	8610	12450	41250	--
4.	Chloride	mg/kg	6736	3120	425	2623	3758	1347	--
5.	Total Alkalinity	mg/kg	28	36	32	32	24	28	--
6.	Total Nitrogen	mg/kg	55	22	23	33	30	250	--
7.	Phosphate	mg/kg	0.5	1.0	0.5	0.6	0.9	0.9	--
8.	Potassium	mg/kg	156.5	88.73	17.49	69.27	80.79	97.84	--
9.	Nickel	mg/kg	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	--
10.	Arsenic	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**50**
11.	Copper	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**100**
12.	Iron	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--
13.	Zinc	mg/kg	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	**500**
14.	Manganese	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**700**

S. No.	Parameters	Units	Soil Quality Results						DM Limit*
			SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	
15.	Mercury	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**2**
16.	Lead	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**200**
17.	Cadmium	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**5**
18.	Chromium	mg/kg	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	**250**
19.	Selenium	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**2**
20.	Barium	mg/kg	0.09	0.07	0.05	0.04	0.08	0.24	**--**
21.	Total Petroleum Hydrocarbon (TPH)	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**1000**

**Land Contamination Indicator Levels – Dubai Municipality (DM) Environmental standards and allowable limits of pollutants on land, water, and air environment - May, 2003.*

The results of soil analysis in the project site clearly indicate that the nature of the soil is non-saline to saline. It is also observed that toxic contaminants (heavy metals and petroleum hydrocarbon) levels in the project region are well within the maximum allowable limits of Dubai Municipality. It indicates that there is no contamination in the soil samples collected in the project region.

6.4.6. ECOLOGY

The United Arab Emirates (UAE) is characterized by a wide variety of habitats (i.e., mountainous, coastal lowlands, desert and alluvial plains) that support unique diversity of plant genetic resources. Despite the UAE is regarded as floristically poor, it harbors unique plants with remarkable morphological, physiological and anatomical adaptations strategies that enable them tolerating the very harsh climatic conditions prevailing in the country (*Tourenq and Launay, 2008*[6]).

Sharjah is the third largest emirate in the United Arab Emirates, covering an area of 2,590 km^2. In addition to the area to the east and south of Sharjah city, the emirate includes four enclaves on the east coast of the UAE (Nahwa, Kalba, Dibba Al-Hisn and Khor Fakkan). As a result, a wide range of Arabian Peninsula habitats may be found within Sharjah. At the east and west coasts are salt flats, sand, gravel plains and, at Khor Kalba, a mangrove. Inland, much of the land area of Sharjah is sand desert, though the enclaves to the east extend up into the igneous Hajar Mountains, with their associated wadis.

Tourenq, C. and Launay, F., 2008. Challenges facing biodiversity in the United Arab Emirates. Management of Environmental Quality An International Journal, 19(3):283-304.

Analysis of the accounts of the UAE flora by *Karim and Fawzi (2007)* [7], suggests that some 400-450 species of plant are to be found within Sharjah, just over half the UAE's total flora. The coastline of mainland UAE including Sharjah extends for about 650 km, and comprises the Arabian Gulf coast in the north, and the Gulf of Oman coast to the east. Due to the harsh climatic conditions, soils are generally extremely poor in organic matter, and biological activity is low. The properties of the little-altered parent material (sand, silt, gravels, bedrock) therefore exert a dominant influence on species composition of the vegetation, and in turn, on the fauna in most parts of the country. Soil fertility is therefore extremely low. The severe climatic conditions, though, mean that vegetation cover is generally sparse, particularly in areas with exceptionally low rainfall, and has been further reduced by severe overgrazing. The limited number of plant species involved, the relatively broad ecological tolerances of many key perennials and the fact that some potentially suitable species do not appear for years under unfavorable rainfall conditions are factors that serve to complicate vegetation classification in many desert habitats.

The proposed project will be established in the existing site of Layyah Power Station of SEWA. The study area of project site is already developed and the project site does not have significant flora and fauna.

6.5. BASELINE MARINE ENVIRONMENTAL SURVEY

The Arabian Gulf is a semi-enclosed, shallow (average 30 m in depth), subtropical sea surrounded by a large, arid land mass. It is connected to the Gulf of Oman by the Strait of Hormuz, which restricts water exchange between these two water bodies. Due to this unusual physical environment, the Arabian Gulf experiences marked temperature extremes a typical of seas at similar latitude, with hot, dry, tropical conditions during the summer and temperate conditions during the winter. In addition to extreme variations in temperature, the Arabian Gulf also experiences substantial fluctuations in salinity levels, which can exceed 70 PSU (Practical Salinity Unit) in some embayments. High salinity levels are driven by strong evaporation, which exceeds combined rainfall and freshwater inputs by over a factor of ten *(Sheppard, 1993*[8]*)*. Circulation in the Gulf is in an anti-clockwise motion, driven primarily by density gradients, creating a reverse estuarine flow similar to the circulation of the Mediterranean Sea *(Reynolds, 1993*[9]*)*. Water enters the Gulf through the Strait of Hormuz, moves northwards along the Iranian coast, while a secondary coastal current flows southerly along the northern Iranian coast, against the

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Karim, F.M. and Fawzi, N.M., 2007. Flora of the United Arab Emirates. Vol. 1. United Arab Emirates University, Al Ain, UAE.

Sheppard, C.R.C. 1993. Physical-environment of the Gulf relevant to marine pollutionan overview. Mar. Pollut. Bull. 27: 3–8.

Reynolds, R. M. 1993. Physical Oceanography of the Gulf, Strait of Hormuz, and the Gulf of Oman: Results from the Mt Mitchell Expedition. Marine Pollution Bulletin 27: 35–59.

inflow water in the Strait of Hormuz, driven by density differences from river runoff in the northern Gulf. A southward coastal flow moves along the south-western coastline of the Arabian Gulf, where stagnation and evaporation in the southern embayments increases salinities to 40 PSU. This denser water sinks and flows towards the entrance of the Gulf, where it lies beneath the incoming water.

The baseline marine oceanography and environmental survey (bathymetry, water current, tides, sea water quality and marine sediment quality) was conducted during the month of **July, 2018**. The details of baseline marine oceanography and environmental survey (bathymetry, water current, tides, sea water quality and marine sediment quality) are presented in Table 53**.**

Table 53 – Details of Marine Environmental Survey

Location Code	GPS Coordinates		Date of Sampling/ Survey
	Latitude	Longitude	
Sea Water Quality			
SW – 01 (Harbour)	25°21'45.10"N	55°22'7.28"E	19th July, 2018
SW – 02 (Arabian Gulf)	25°22'8.76"N	55°22'19.09"E	19th July, 2018
SW – 03 (Arabian Gulf)	25°22'52.47"N	55°22'54.10"E	19th July, 2018
SW – 04 (Sharjah Creek Entry)	25°22'33.29"N	55°23'19.76"E	19th July, 2018
SW – 05 (Arabian Gulf)	25°22'58.43"N	55°22'4.79"E	19th July, 2018
SW – 06 (Arabian Gulf)	25°22'8.68"N	55°21'42.81"E	19th July, 2018
SW – 07 (Arabian Gulf)	25°21'27.02"N	55°21'48.96"E	19th July, 2018
SW – 08 (Arabian Gulf)	25°21'32.58"N	55°20'53.47"E	19th July, 2018
SW – 09 (Arabian Gulf)	25°20'34.70"N	55°21'17.83"E	19th July, 2018
SW – 10 (Al Khan Lagoon)	25°19'42.01"N	55°21'49.19"E	19th July, 2018
SW – 11 (Sharjah Creek)	25°21'40.02"N	55°22'59.22"E	19th July, 2018
SW – 12 (Khalid Lagoon)	25°20'3.09"N	55°22'52.60"E	19th July, 2018
SW – 13 (Outfall Channel)	25°21'18.17"N	55°22'11.65"E	23rd July, 2018
SW – 14 (Outfall Channel)	25°21'26.06"N	55°22'4.74"E	23rd July, 2018

Location Code	GPS Coordinates		Date of Sampling/ Survey
	Latitude	Longitude	
Marine Sediment Quality			
MS – 01 (Arabian Gulf)	25°22'17.09"N	55°22'22.80"E	19th July, 2018
MS – 02 (Arabian Gulf)	25°22'53.57"N	55°22'53.55"E	19th July, 2018
MS – 03 (Khalid Lagoon)	25°20'14.04"N	55°22'51.09"E	19th July, 2018
MS – 04 (Sharjah Creek Entry)	25°22'30.88"N	55°23'19.32"E	19th July, 2018
MS – 05 (Arabian Gulf)	25°23'5.17"N	55°22'2.70"E	19th July, 2018
MS – 06 (Arabian Gulf)	25°22'9.08"N	55°21'43.17"E	19th July, 2018
MS – 07 (Arabian Gulf)	25°21'27.65"N	55°21'49.66"E	19th July, 2018
MS – 08 (Arabian Gulf)	25°21'32.65"N	55°20'54.40"E	19th July, 2018
MS – 09 (Arabian Gulf)	25°20'34.54"N	55°21'18.08"E	19th July, 2018
MS – 10 (Al Khan Lagoon)	25°19'29.02"N	55°22'4.24"E	19th July, 2018
Marine Ecology Survey			
ME – 01 (Arabian Gulf)	25°22'17.09"N	55°22'22.80"E	19th July, 2018
ME – 02 (Arabian Gulf)	25°22'53.57"N	55°22'53.55"E	19th July, 2018
ME – 03 (Khalid Lagoon)	25°20'14.04"N	55°22'51.09"E	19th July, 2018
ME – 04 (Sharjah Creek Entry)	25°22'30.88"N	55°23'19.32"E	19th July, 2018
ME – 05 (Arabian Gulf)	25°23'5.17"N	55°22'2.70"E	19th July, 2018
ME – 06 (Arabian Gulf)	25°22'9.08"N	55°21'43.17"E	19th July, 2018
ME – 07 (Arabian Gulf)	25°21'27.65"N	55°21'49.66"E	19th July, 2018
ME – 08 (Arabian Gulf)	25°21'32.65"N	55°20'54.40"E	19th July, 2018
ME – 09 (Arabian Gulf)	25°20'34.54"N	55°21'18.08"E	19th July, 2018
ME – 10 (Al Khan Lagoon)	25°19'29.02"N	55°22'4.24"E	19th July, 2018

Table 54 – Details of Marine Oceanographic Survey

Location	GPS Coordinates		Duration of Survey
	Latitude	Longitude	
Water Current			
Arabian Gulf at Sharjah	25°21'27.74"N	55°21'37.61"E	22nd July, 2018 – 20th August, 2018
Tide (Water Level)			
Arabian Gulf at Sharjah	25°22'24.91"N	55°23'29.39"E	2nd July, 2018 – 20th August, 2018

Baseline marine environmental survey locations (sea water quality, marine sediment quality and marine ecology survey) are represented in **Figure 13, Figure 14** and **Figure 15.** Bathymetry survey in the project study area covering than 7km (long-shore) by 3km (cross-shore) which is represented in **Figure 16.** Water current and tide (water level) data was collected at one location each in the study area.

Figure 13 – Google Image showing sea water sampling locations in the project study area

Figure 14 – Google Image showing marine sediment sampling locations in the project study area

Figure 15 – Google Image showing marine ecology survey locations in the project study area

Figure 16 – Google Image showing bathymetry survey region in the project study area

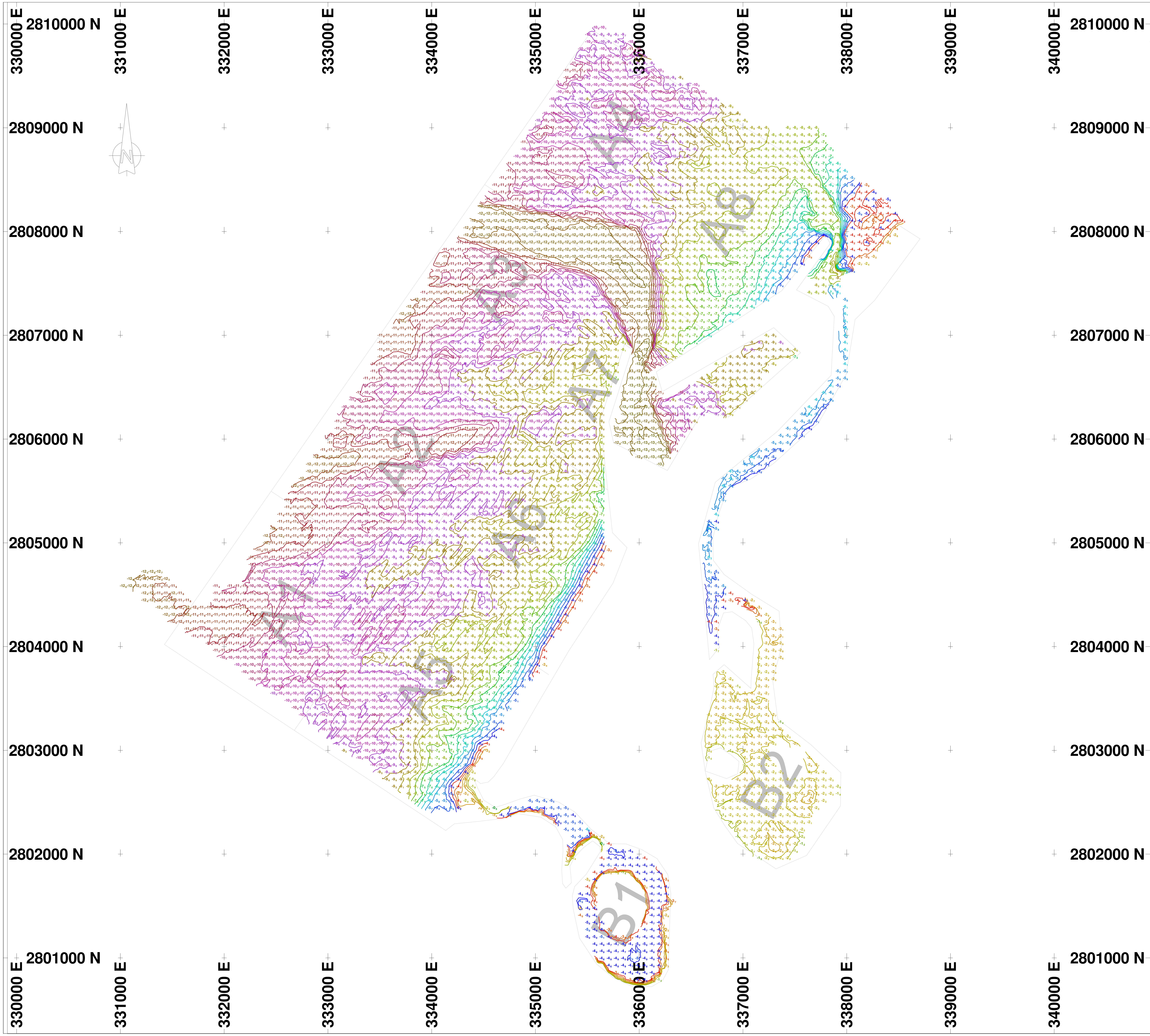
6.5.1. OCEANGRAPHIC STUDY

The Arabian Gulf, located between 24 and 30° latitude, is more than 1,000 km in length along its axis. The widest section of the Gulf spans between the coasts of UAE and Iran. Contracting the width, the peninsula of Qatar separates the northern Gulf from its central and southern part. The bathymetry is basically asymmetric along its axis with a deeper zone close to the Iranian coast and a broad, shallower shelf off the UAE coast. The southern Gulf, which is literally rocky, is characterized by marked bathymetric undulation. The contour distribution in the north becomes much smoother, probably being modified by the sediment discharges from the major rivers. Numerous islands, many of which are in the form of spikes, are dispersed all over the Gulf.

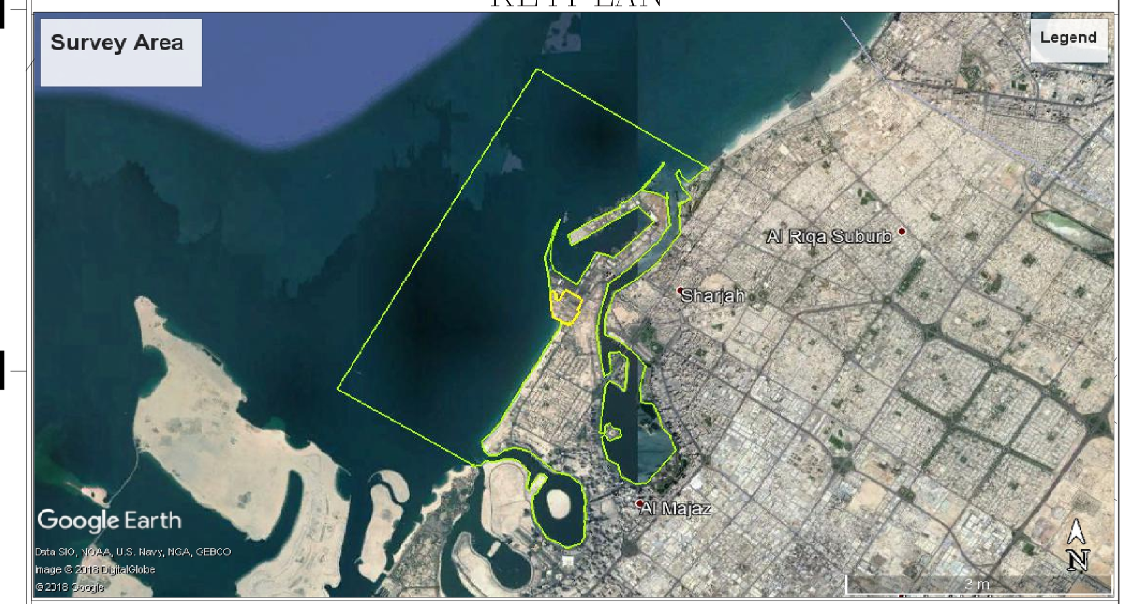
6.5.1.1. Bathymetry survey

Echo sounder integrated with DGPS (Trimble) was used during the entire surveys to record geographically referenced bathymetric data for measuring water depths. The bathymetry survey was carried out in the study region covering 7 × 3 km area. The Echo sounder system was installed and operated in accordance with the Manufacturer's instructions. Multi beam Eco sounder was used in the core region and single beam eco sounder was used in the remaining areas. Portable transducer was installed rigidly to a bracket suitable location on the survey vessel. Prior to commencing survey works, the Echo sounder was calibrated against a bar check. The procedure is to confirm accuracy of the Echo Sounder. Hypack is the real – time navigation and data acquisition software for Hydro-graphic Survey works. Hypack will receive position data from DGPS receiver and process it to provide a real time graphical navigational display for the helmsman. The data received from sensors such as Echo sounders and DGPS was displayed and logged to a file. Digital depth data was logged directly to the navigation computer along with date, time, and position for post processing and mapping.

Figure 17 – Bathymetry survey data



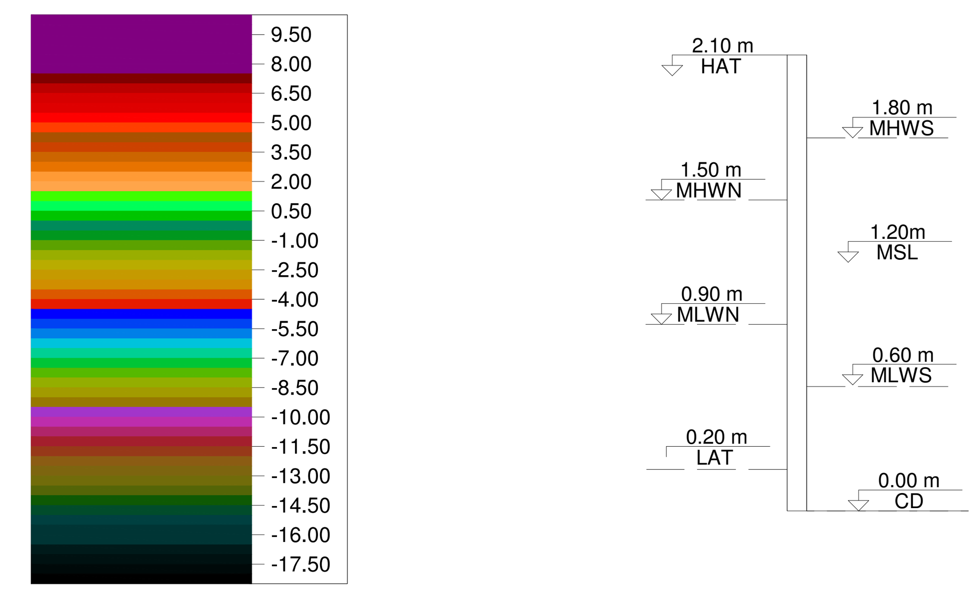
KEYPLAN



GEODETIC PARAMETERS

GEODETIC DATUM	: World Geodetic System 1984 (WGS84)
ELLIPSOID	: WGS84
Semi major axis	: 6378137
Inverse flattening	: 298.257223563
PROJECTION	: UNIVERSAL TRANSVERSE MERCATOR (UTM)
Longitude Of Central Meridian (CM)	: 57Â°00'00" East (Zone 40N)
Latitude of Origin	: 00Â°00'00" North
False Easting	: 500000 m
False Northing	: 0 m
Scale factor at CM	: 0.999600
DATUM TRANSFORMATION	: WGS84 dX: 00.00m rX: 0.00 Scale: 0.000 ppm dY: 00.00m rY: 0.00 dZ: 00.00m rZ: 00.00"
Source	: WORLD GEODATIC SYSTEM
Vertical Datum	: CHART DATUM, WHERE CD IS 1.2M BELOW MSL

LEGEND



NOTES

1. ALL DIMENSIONS AND LEVELS ARE IN METER UNLESS OTHERWISE SPECIFIED.

REV.	DATE	DESCRIPTION	DB	CHK	APD
00	05-AUG-2018	FOR REVIEW / APPROVAL	NIQ	MAK	KBG

CLIENT:-

هيئة كهرباء ومياه الشارقة

Sharjah Electricity & Water Authority

CONTRACTOR:-

ELSEWEDY ELECTRIC

PSP

CONSULTANT:-

Environmental Solutions and Consultancy

KPB CONSULTANTS

SURVEY CONTRACTOR

GEOMAK SURVEY SERVICES (FZE)
PO BOX.514886, SAIF ZONE, SHARJAH. U.A.E.
TEL +971 6 7491468 EMAIL:
INFO@GEOMAKSURVEY.COM
WEB: WWW.GEOMAKSURVEY.COM

GeoMak

PROJECT:

LAYYAH POWER PLANT EXPANSION PROJECT

TITLE:

BATHY METRIC SURVEY
COMPLETE AREA

SHEET SIZE	GSS DWG No.	Scale 1:17500
A1		0 m 200 m 400 m 600 m 800 m 1000 m

PROJECT No.	DWG No.	SHT.No.	REV.
71/2018	LPP-GSS-0718-071-001	01 of 15	00

6.5.1.2. Current measurements

The currents were measured via an onsite Acoustic Doppler Current Profiler (ADCP) deployed at location 27°47.088"N, 48°53.286"E at an approximate water depth of 9m from 22nd July 2018 to 23rd August 2018. The ADCP was recovered on 14th August 2018 and after downloading the data, it was re-deployed on 15th August 2018.

The maximum current observed during the period of observation from 22nd July to 23rd August 2018 is 366 mm/s (0.71 knots) at near surface. The bottom current is 229 mm/s (0.45 knots). The currents were predominantly in the north-south in direction.

The following histogram (**Figure 18**) indicates the current pattern at three levels (surface, mid and bottom):

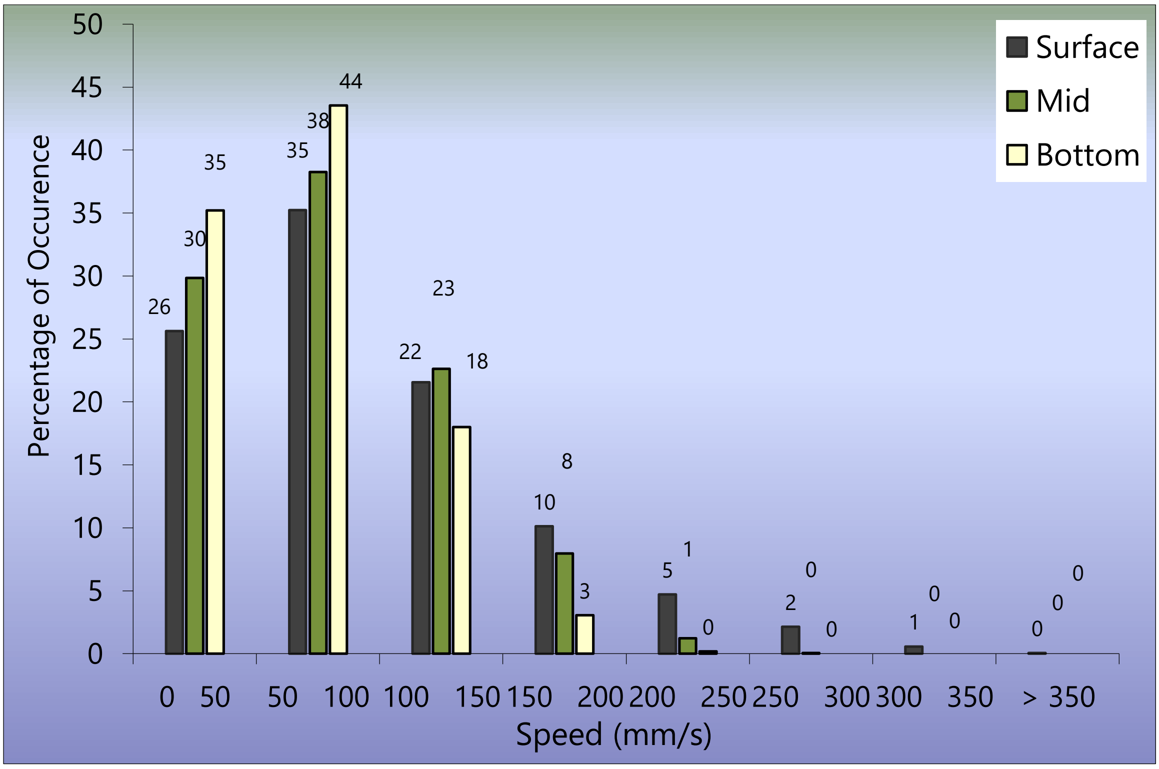


Figure 18 – Histogram of current speed (speed in mm/s)

The histogram indicates that the surface currents were less than 150mm/s about 82% of the observation. The bottom currents were less than 150mm/s (0.292 knots) about 97% of the observations, indicating less currents prevailing in the area.

Rose plots are drawn for the three levels (surface, mid and bottom), and are represented in **Figure 19, Figure 20 and Figure 21.** The rose plots indicates a northerly-southerly transport at the surface and in the subsequent layers, the currents are more to north-northeasterly and south-southwesterly.

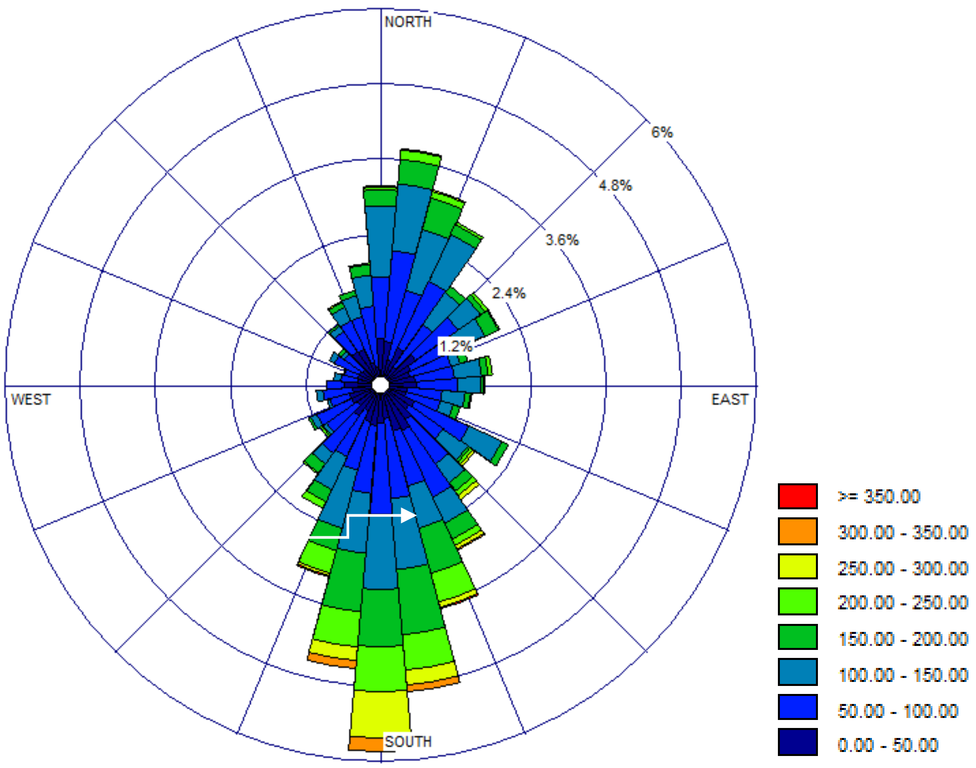


Figure 19– Rose plot -near surface current Vs direction (speed in mm/s)

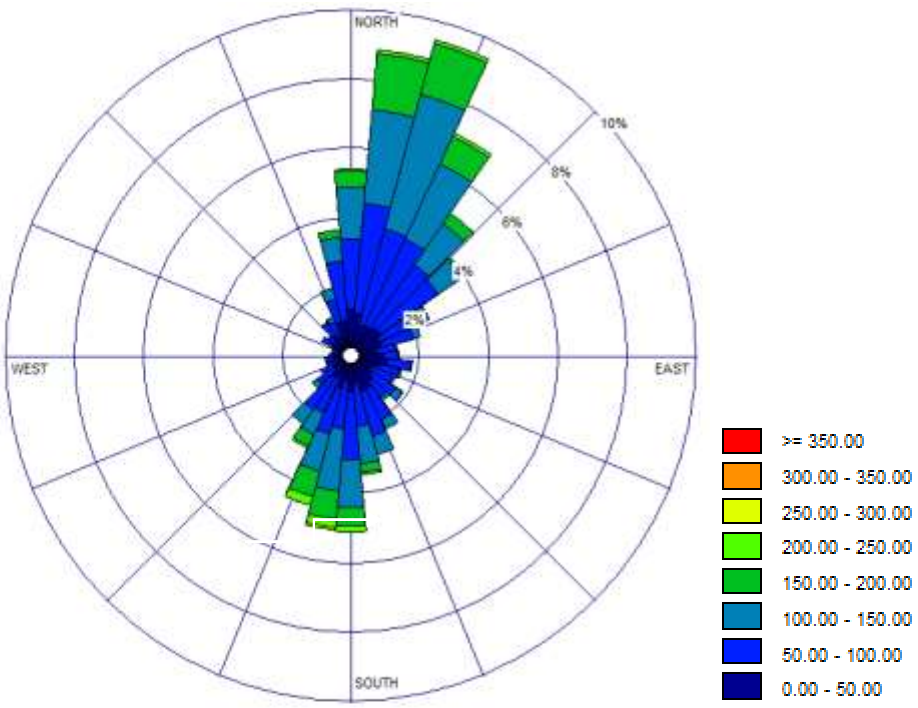


Figure 20 – Rose plot - mid-depth current Vs direction (speed in mm/s)

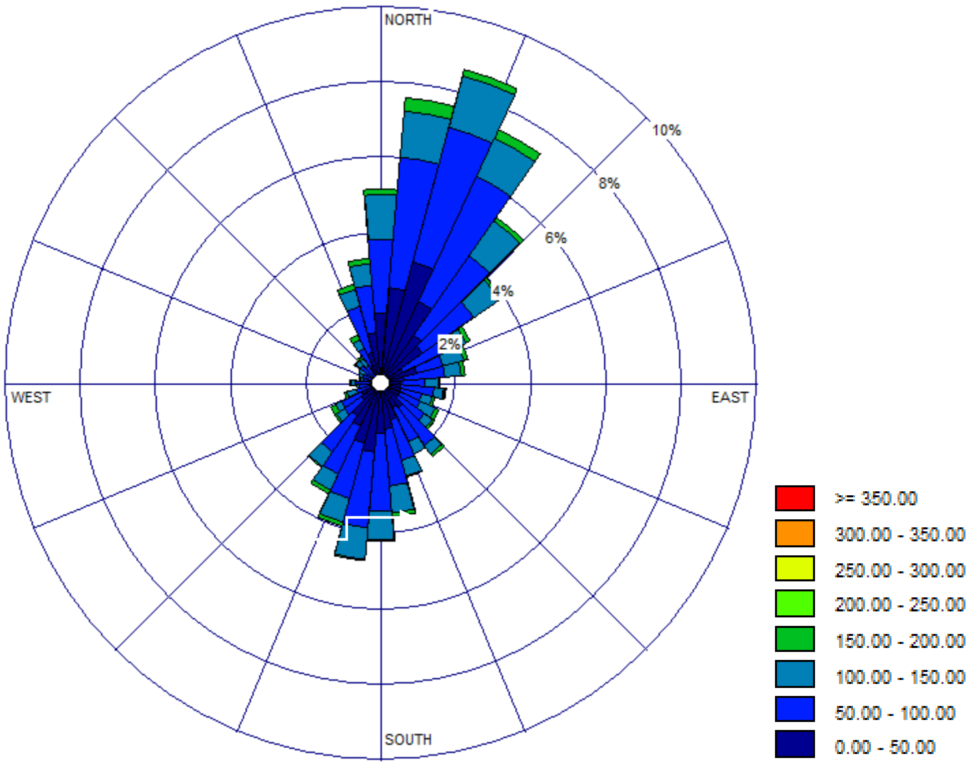


Figure 21 – Rose plot - near seabed current Vs direction (speed in mm/s)

The time series curves for the period, drawn for near surface, mid-depth and near seabed are represented in **Figure 22, Figure 23** and **Figure 24.** The surface currents were of the order of 300mm/s with a maximum of 366mm/s recorded on 10th August 2018 at 0940 hrs. The mid depth currents were of the order of 200mm/s. The near seabed currents were less compared to the surface currents.

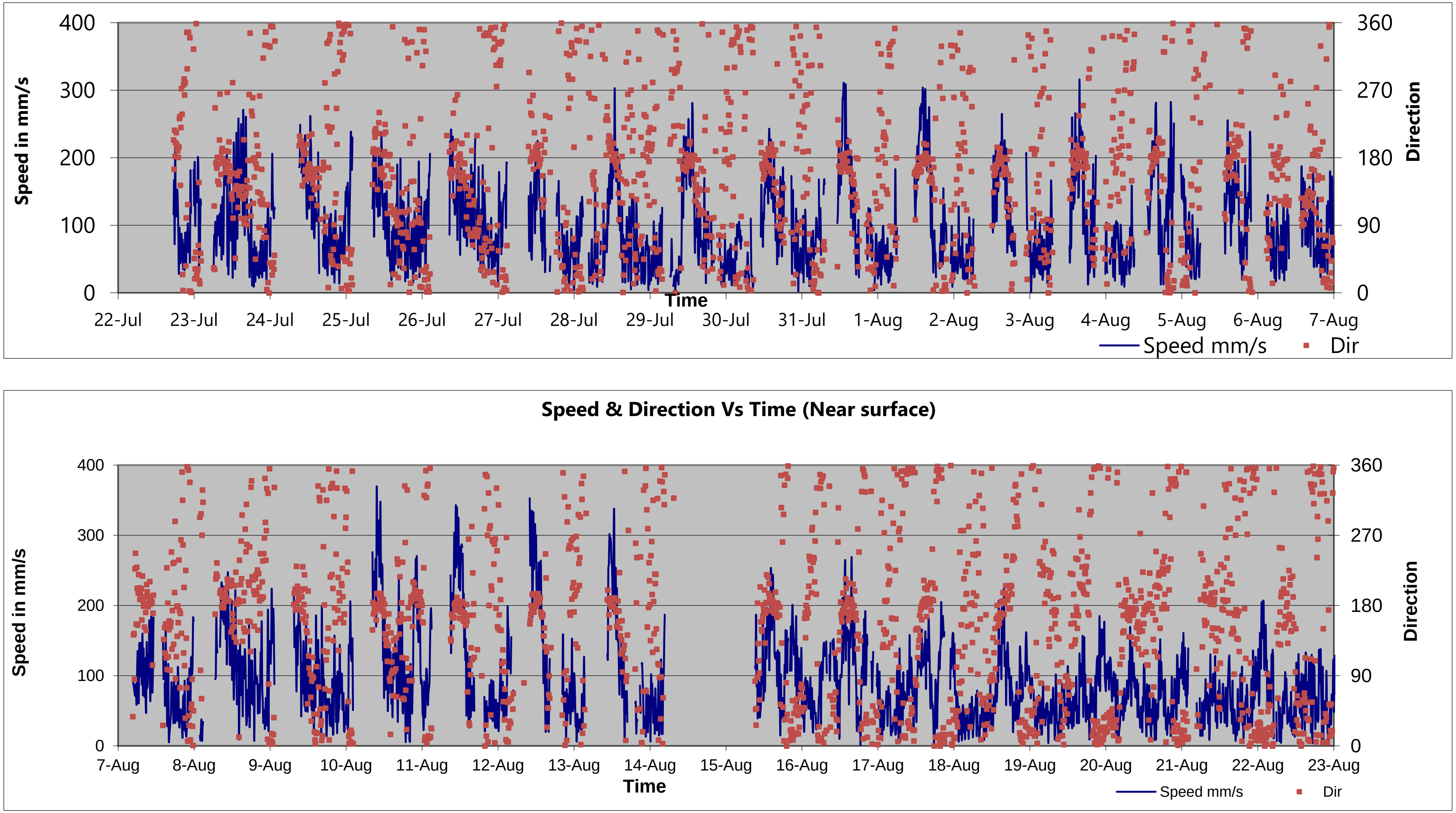
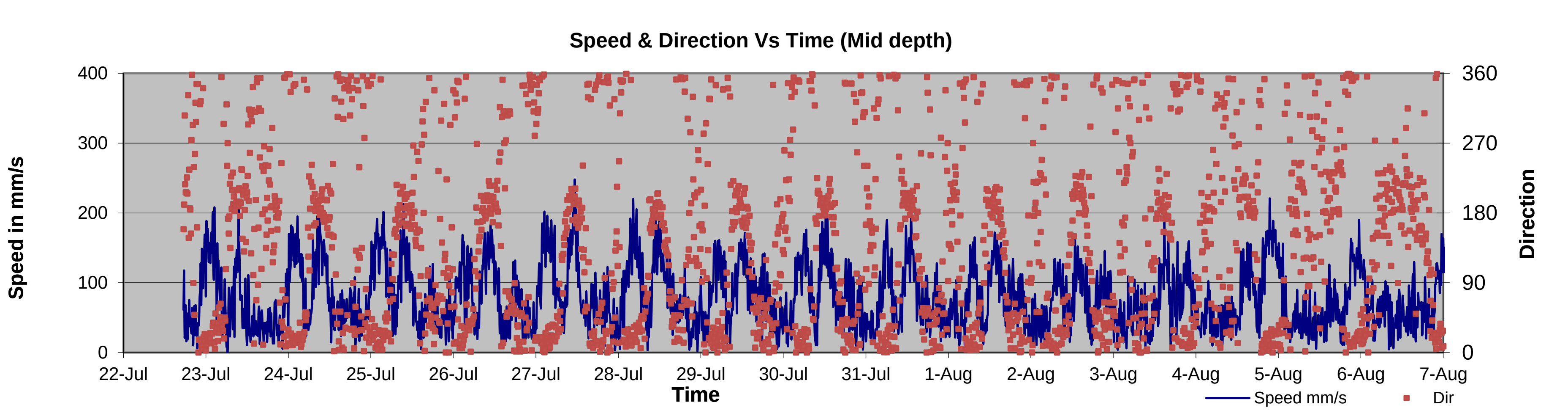


Figure 22 – Near Surface time series curves



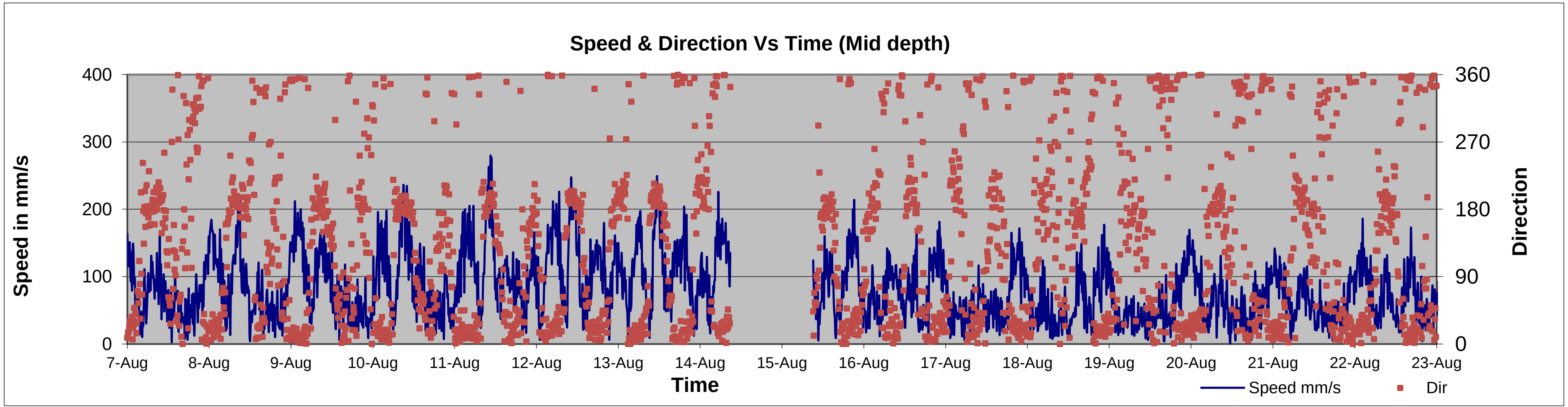
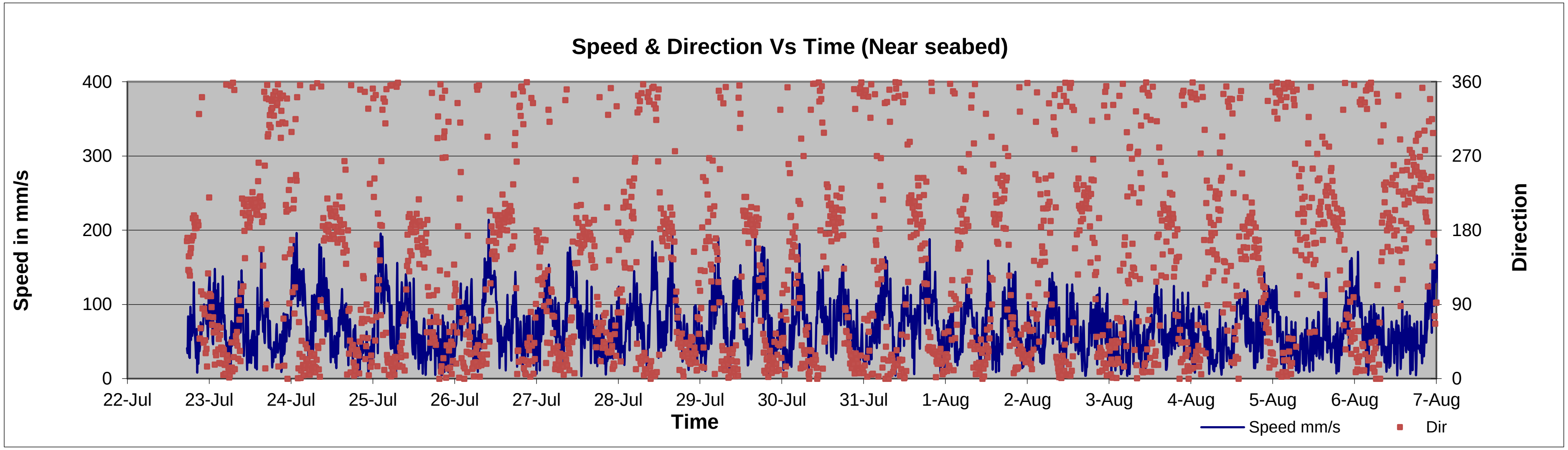


Figure 23 – Mid-depth time series curves



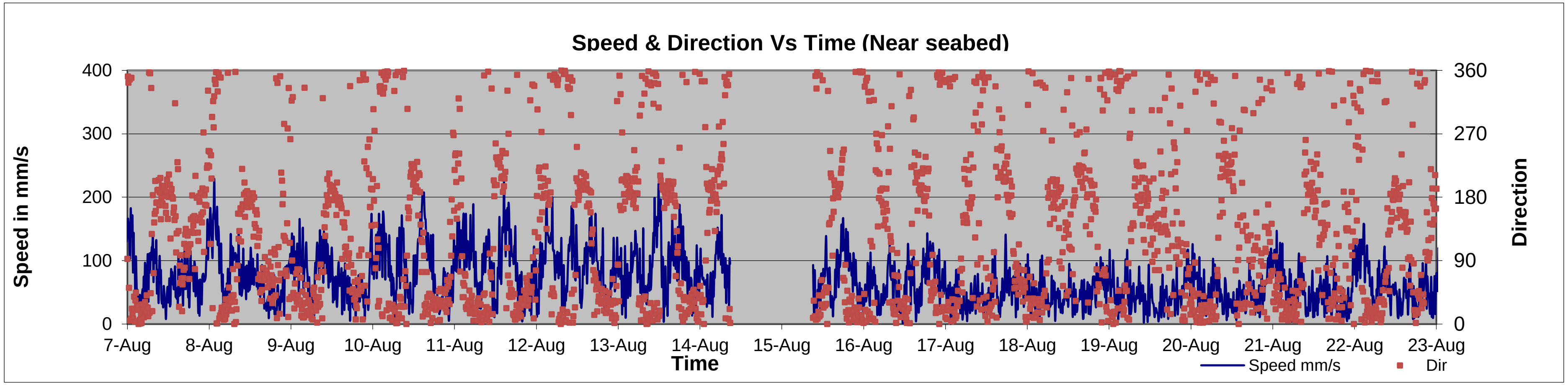


Figure 24 – Near-seabed time series curves

6.5.1.3. Wave measurements

The data from ADCP was processed in format 12 of WavesMon - the software provided by Teledyne RD Instruments. The wave data was collected at an hourly interval. The wave direction was predominantly from the west north-west direction as can be seen from the rose plots provided below:

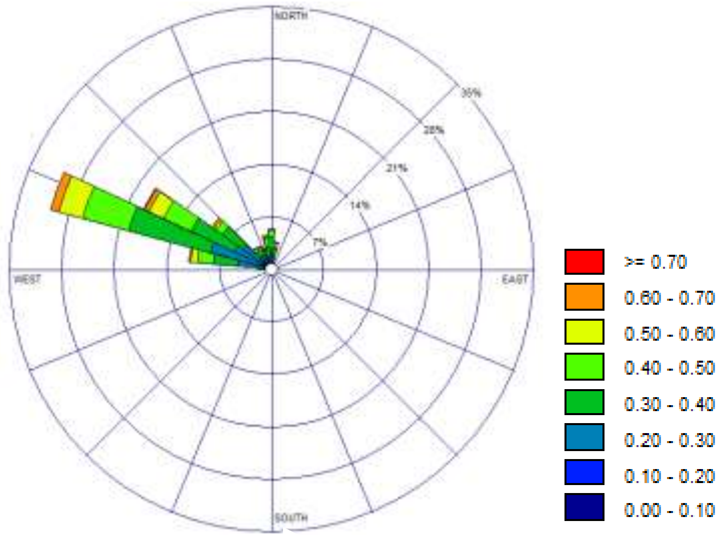


Figure 25– Rose plot - Hs Vs direction (Hs in metres)

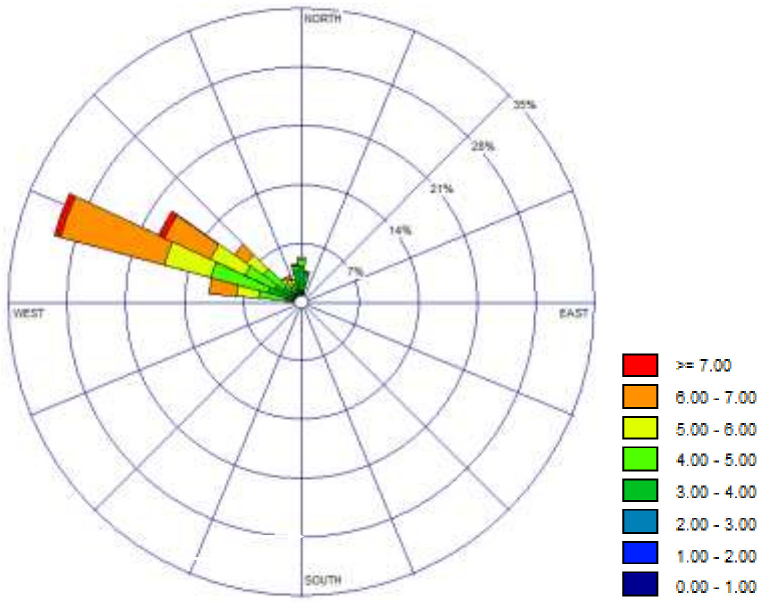
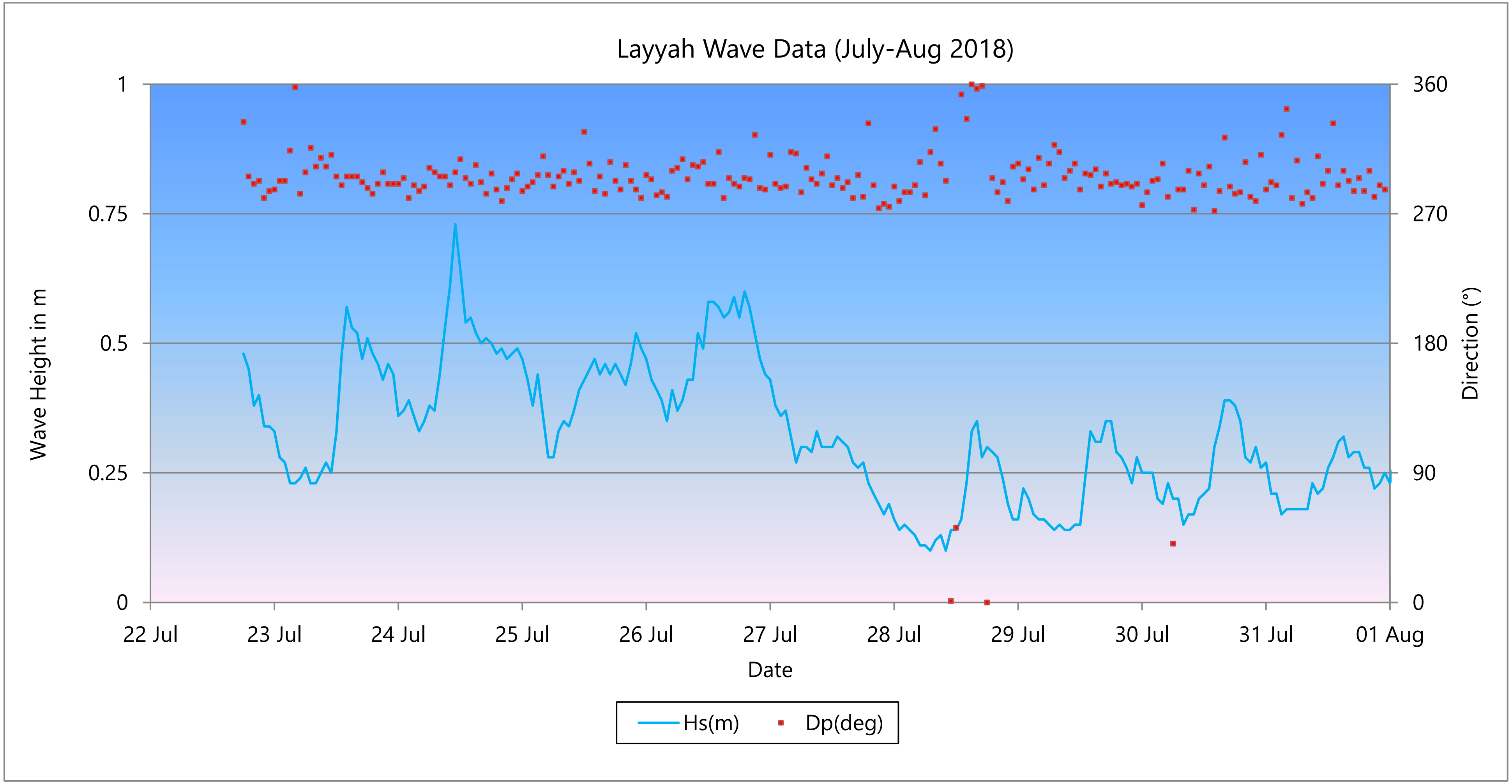
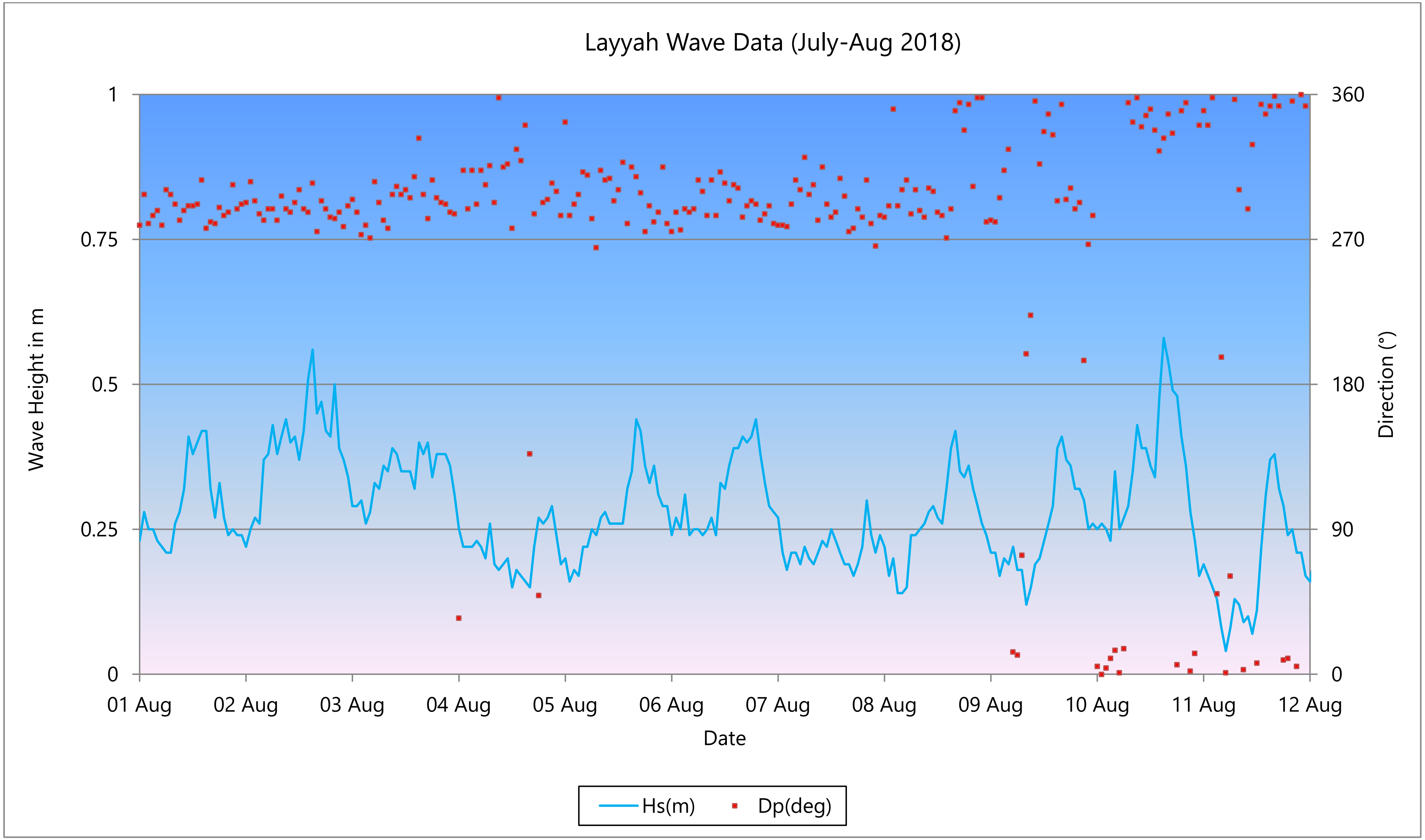


Figure 26 – Rose plot - Hs Vs direction (Hs in metres)

The wave period indicates short period waves less than 10 seconds throughout the observation period. A maximum period of 9.8 seconds was observed on 8th August 2018 at 1600 hrs. The observed wave in the area revealed calm conditions during the observation. A maximum significant wave of 0.73m was recorded on 24th July 2018 at 1100 hrs. The time series curves for the period are provided below:


Layyah Wave Data (July-Aug 2018)
Wave Height in m
Direction (°)
1
0.75
0.5
0.25
0
360
270
180
90
0
22 Jul
23 Jul
24 Jul
25 Jul
26 Jul
27 Jul
28 Jul
29 Jul
30 Jul
31 Jul
01 Aug
Date
Hs(m)
Dp(deg)


Layyah Wave Data (July-Aug 2018)
Wave Height in m
Direction (°)
1
0.75
0.5
0.25
0
360
270
180
90
0
01 Aug
02 Aug
03 Aug
04 Aug
05 Aug
06 Aug
07 Aug
08 Aug
09 Aug
10 Aug
11 Aug
12 Aug
Date
Hs(m)
Dp(deg)

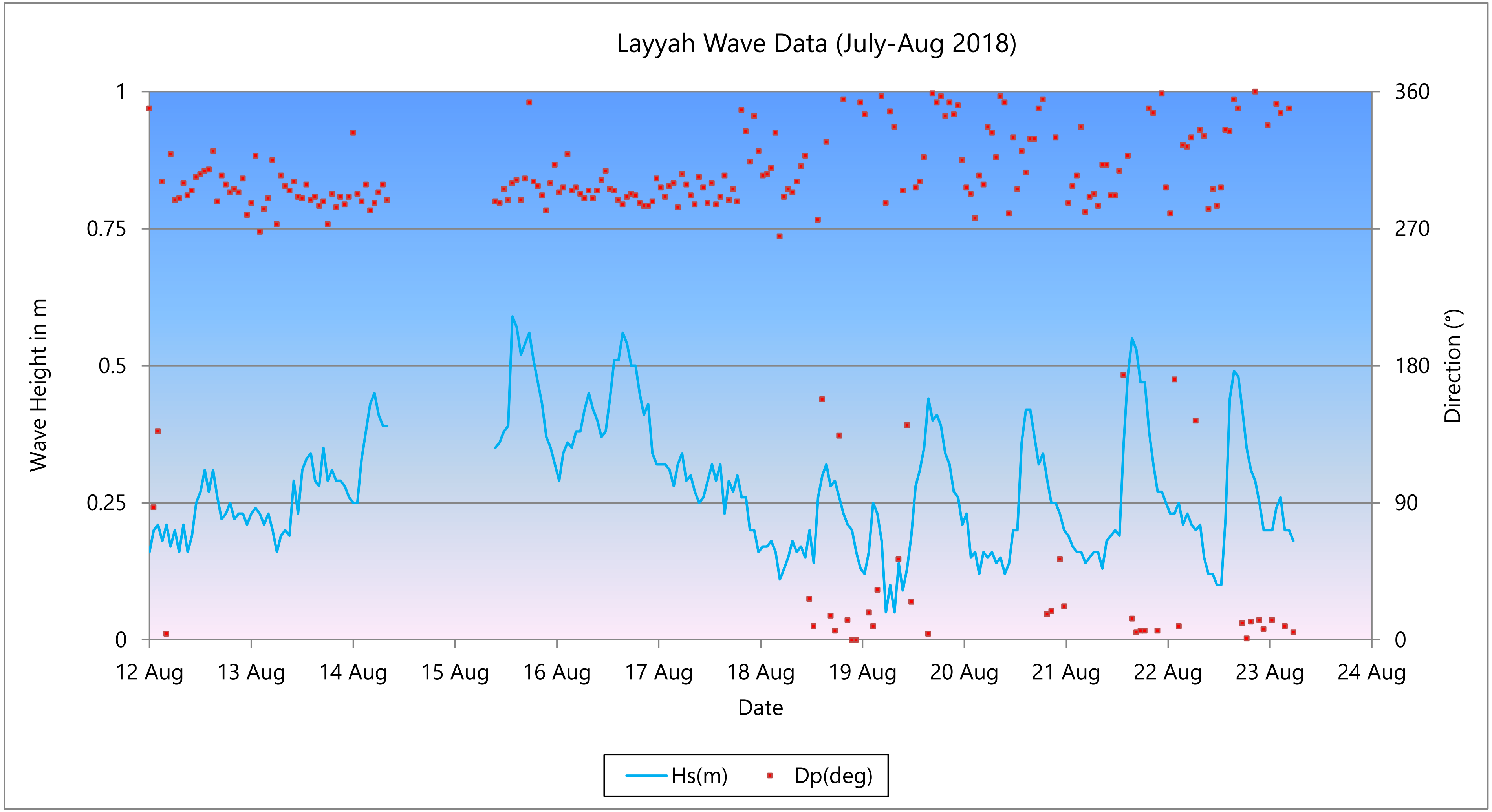
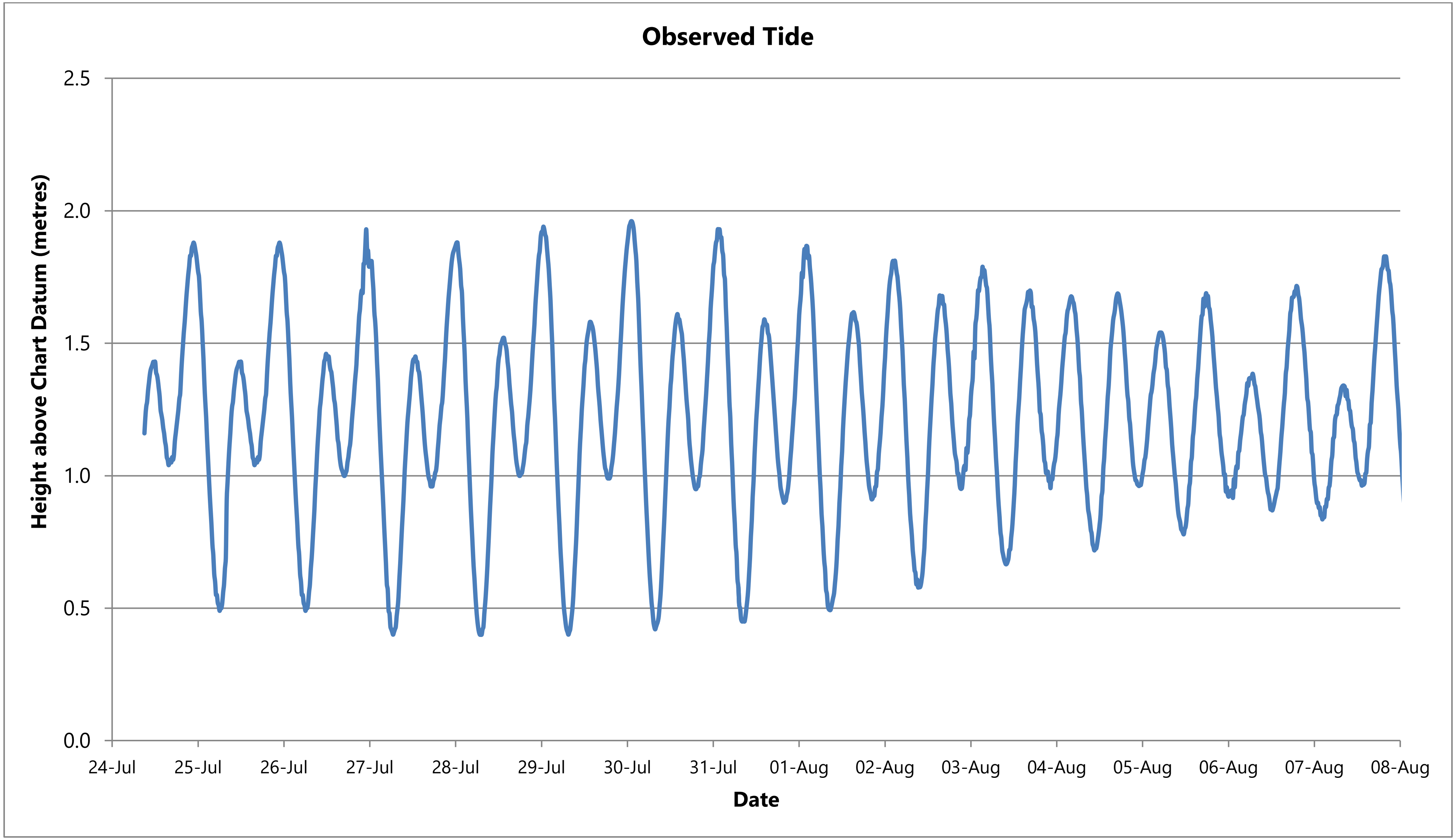


Figure 27 – Time series curves of wave parameters

The wave data revealed cam conditions with a maximum significant wave height of 0.73m. The wave period was less than 10 seconds, indicating short period waves prevailing in the area. The wave direction was predominantly from west northwest direction.

6.5.1.4. Tide Measurements

The data from Valeport ATG was downloaded and after applying corrections to level the data to the chart datum. The observed tides are semi-diurnal. The maximum tides were observed during the spring tide. The range of tide was about 1.2m during neap tide and 2m during spring tides.


Observed Tide
Height above Chart Datum (metres)
2.5
2.0
1.5
1.0
0.5
0.0
24-Jul
25-Jul
26-Jul
27-Jul
28-Jul
29-Jul
30-Jul
31-Jul
01-Aug
02-Aug
03-Aug
04-Aug
05-Aug
06-Aug
07-Aug
08-Aug
Date

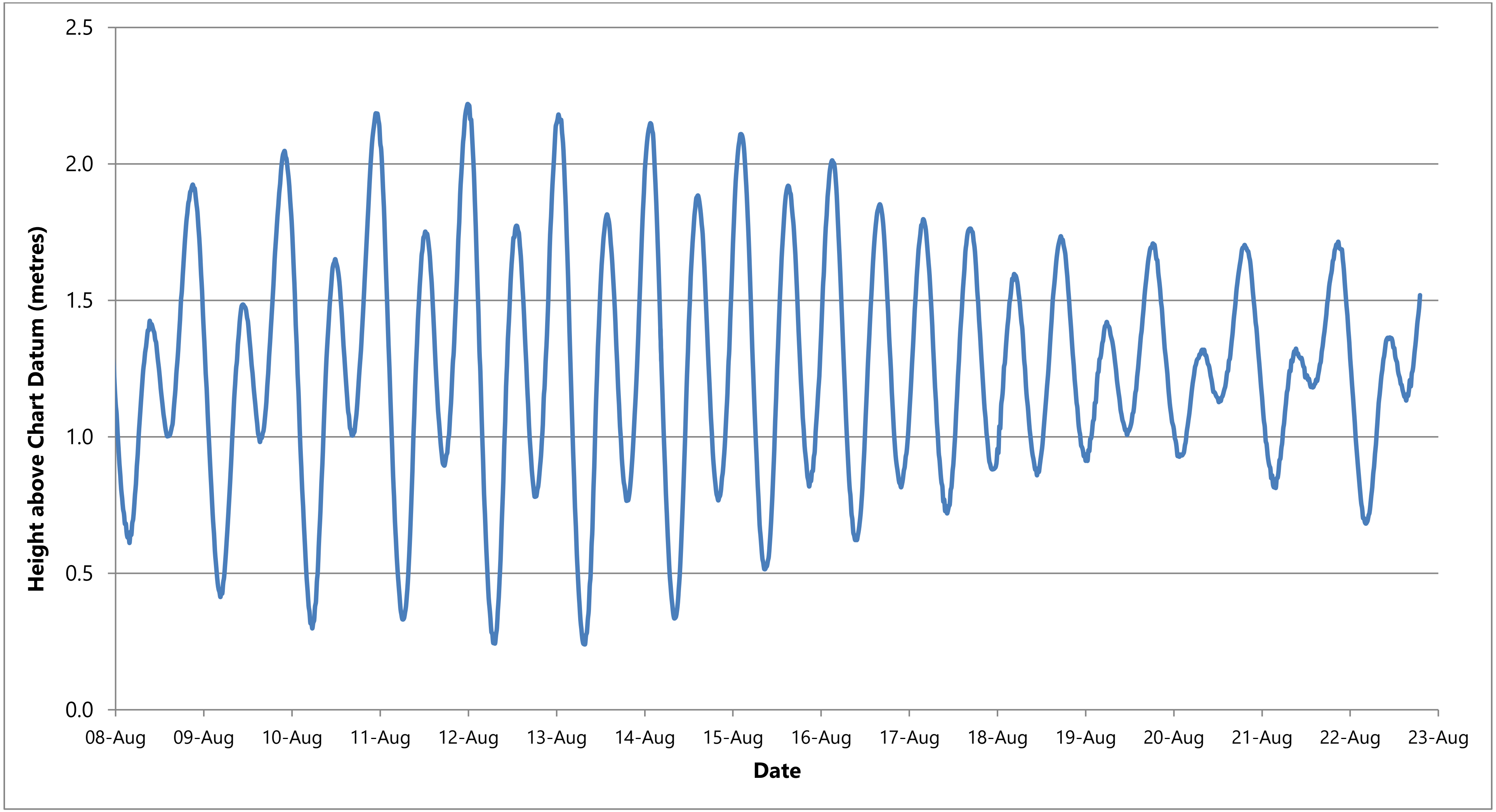


Figure 28 – Tide curves

6.5.2. SEA WATER QUALITY

6.5.2.1. Sampling and Analysis

Sea water quality samples were collected in at surface (-0.5m below) using a Niskin water sampler. Water samples were collected in Amber Glass and High Density Polyethylene plastic bottles of 1L capacity, preserved in ice box and sent to a ENAS accredited laboratory for analysis. The analyses are performed at ENAS accredited laboratory using standard methods determined by APHA (2017) - 23rd Edition.

6.5.2.2. Results and Discussion

In-situ analysis of sea water samples collected in the Arabian Gulf is presented in **Table 55.** The results obtained for quality analysis of the seawater samples collected from Arabian Gulf and lagoon area are summarized in **Table 56** and **Table 57.**

Table 55 - Results of Seawater Quality (In-situ analysis)

Station No	Sampling Time	Temp (°C)	pH	Turbidity (NTU)	Salinity %	DO (mg/l)
SW1	12.45	38.3	8.24	<1.0	43.6	5.19
SW2	8.37	33.8	8.23	<1.0	41.1	5.27
SW3	11.03	34.7	8.19	<1.0	41.4	5.20
SW4	9.16	34.3	8.14	<1.0	41.7	4.84
SW5	11.34	34.2	8.18	<1.0	41.0	5.71
SW6	8.04	33.7	8.18	<1.0	41.1	5.33
SW7	7.25	33.7	8.14	<1.0	41.0	5.39
SW8	12.10	34.0	8.18	<1.0	41.1	5.64
SW9	6.46	33.8	8.15	<1.0	41.0	5.45
SW10	13.12	38.3	8.19	<1.0	43.6	5.19
SW11	9.46	35.0	8.15	<1.0	41.2	4.84
SW12	1.23	35.2	8.26	4.36	42.3	5.52

Table 56 - Results of Seawater Quality

S. No	Parameters	Units	Harbour Area SW – 1	*Arabian Gulf*						DM-EPSS Marine Water Quality Objectives
				SW-2	*SW-3*	*SW-4 (Creek Entry)*	*SW-5*	*SW-6*	*SW-7*	
1)	pH	--	8.02	8.03	8.08	8.07	7.98	8.10	8.05	**--**
2)	Dissolved Oxygen (DO)	mg/L	6.0	6.0	5.9	5.5	5.8	5.9	5.9	**5.0**
3)	Turbidity	NTU	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**75**
4)	Temperature	°C	38.3	33.8	34.7	34.7	34.2	33.7	33.7	**--**
5)	Chlorine (Residual)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.01**
6)	Chlorides	mg/L	27,296	25,186	25,243	25,201	25,186	25,170	25,201	**--**
7)	Fluorides	mg/L	0.95	0.59	1.1	1.0	0.80	0.62	0.47	**--**
8)	Nitrogen - Ammonia	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.1**
9)	Nitrogen - Nitrite	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	**--**
10)	Nitrogen - Nitrate	mg/L	0.04	0.06	0.03	0.05	0.03	0.04	0.02	**0.5**
11)	Sulphate (SO_4^{2})	mg/L	3,435	3,124	3,144	3,177	3,118	3,105	3,155	**--**
12)	Total Hardness	mg/L	9,400	8,350	8,300	7,750	7,950	7,600	7,750	
13)	Total Dissolved Solids (TDS)	mg/L	44,300	43,400	43,200	42,800	41,800	42,100	42,600	**--**
14)	Total Suspended Solids (TSS)	mg/L	<10	<10	<10	<10	<10	<10	<10	**25**
15)	Biochemical Oxygen Demand (BOD)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	**20**
16)	Chemical Oxygen Demand (BOD)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**--**
17)	Oil and Grease	mg/L	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	**--**

S. No	Parameters	Units	Harbour Area	*Arabian Gulf*						DM-EPSS Marine Water Quality Objectives
			SW – 1	*SW-2*	*SW-3*	*SW-4 (Creek Entry)*	*SW-5*	*SW-6*	*SW-7*	
18)	Phenols	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	**--**
19)	Surfactants	µg/L	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	**20**
20)	Carbonates	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**--**
21)	Phosphates	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	**--**
22)	Total Nitrogen	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**2.0**
23)	Chlorophyll a	mg/m^3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**--**
24)	*Total Coliforms*	CFU/100 ml	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**--**
25)	*E. coli*	CFU/100 ml	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**200**
26)	Aluminum (Al)	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	**0.2**
27)	Arsenic (As)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.01**
28)	Cadmium (Cd)	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	**0.003**
29)	Calcium (Ca)	mg/L	628	546	507	457	467	443	453	**--**
30)	Chromium (Cr)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.01**
31)	Cobalt (Co)	mg/L	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	<0.066	**--**
32)	Copper (Cu)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.005**
33)	Iron (Fe)	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	**0.2**
34)	Lead (Pb)	mg/L	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	**--**
35)	Potassium (K)	mg/L	554	517	536	527	542	521	542	**--**
36)	Sodium (Na)	mg/L	14,510	13,940	14,310	14,240	14,200	14,010	14,440	**--**
37)	Zinc (Zn)	mg/L	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	**0.02**
38)	Nickel (Ni)	mg/L	<0.063	<0.063	<0.063	<0.063	<0.063	<0.063	<0.063	**--**

S. No	Parameters	Units	Harbour Area	Arabian Gulf						DM-EPSS Marine Water Quality Objectives
			SW – 1	SW-2	SW-3	SW-4 (Creek Entry)	SW-5	SW-6	SW-7	
39)	Magnesium (Mg)	mg/L	1,902	1,701	1,717	1,613	1,645	1,574	1,611	--
40)	Mercury (Hg)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.001**
41)	Gasoline Range Organics (C6 – C9)	mg/L	<0.119	<0.119	<0.119	<0.119	<0.119	<0.119	<0.119	--
42)	Diesel Range Organics (C10 – C30)	mg/L	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	<0.080	--
43)	Heavy Fractions (>C30)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--

Table 57 - Results of Seawater Quality (Continued…)

S. No	Parameters	Units	Arabian Gulf		Al Khan Lagoon	Sharjah Creek	Khalid Lagoon	DM-EPSS Marine Water Quality Objectives
			SW-8	SW-9	SW-10	SW-11	SW-12	
1)	pH	--	8.11	8.08	8.02	8.09	8.02	--
2)	Dissolved Oxygen (DO)	mg/L	6.1	5.9	5.8	5.9	5.9	**5.0**
3)	Turbidity	NTU	<1.0	<1.0	<1.0	<1.0	<1.0	**75**
4)	Temperature	°C	34.0	33.8	34.7	34.3	35.2	--
5)	Chlorine (Residual)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	**0.01**
6)	Chlorides	mg/L	25,219	24,638	25,116	25,398	25,019	--

S. No	Parameters	Units	***Arabian Gulf*** ***SW-8***	***Arabian Gulf*** ***SW-9***	***Al Khan Lagoon*** ***SW-10***	***Sharjah Creek*** ***SW-11***	***Khalid Lagoon*** ***SW-12***	***DM-EPSS Marine Water Quality Objectives***
7)	Fluorides	mg/L	1.10	0.56	0.76	0.84	0.65	--
8)	Nitrogen - Ammonia	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	**0.1**
9)	Nitrogen - Nitrite	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	--
10)	Nitrogen - Nitrate	mg/L	0.02	0.13	0.03	0.02	0.02	**0.5**
11)	Sulphate (SO_4^{2})	mg/L	3,163	2,764	3,129	3,253	3,090	--
12)	Total Hardness	mg/L	7,700	8,100	7,300	7,800	7,550	
13)	Total Dissolved Solids (TDS)	mg/L	42,100	42,500	41,900	41,500	42,200	--
14)	Total Suspended Solids (TSS)	mg/L	<10	<10	<10	<10	<10	**25**
15)	Biochemical Oxygen Demand (BOD)	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	**20**
16)	Chemical Oxygen Demand (BOD)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	--
17)	Oil and Grease	mg/L	<1.3	<1.3	<1.3	<1.3	<1.3	--
18)	Phenols	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	--
19)	Surfactants	μg/L	<10.0	<10.0	<10.0	<10.0	<10.0	**20**
20)	Carbonates	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	--
21)	Phosphates	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	--
22)	Total Nitrogen	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	**2.0**
23)	Chlorophyll a	mg/m^3	<1.0	<1.0	<1.0	<1.0	<1.0	--
24)	*Total Coliforms*	CFU/100 ml	<1.0	<1.0	<1.0	<1.0	<1.0	--

S. No	Parameters	Units	*Arabian Gulf*		*Al Khan Lagoon*	*Sharjah Creek*	*Khalid Lagoon*	*DM-EPSS Marine Water Quality Objectives*
			SW-8	*SW-9*	*SW-10*	*SW-11*	*SW-12*	
25)	*E. coli*	CFU/100 ml	<1.0	<1.0	<1.0	<1.0	<1.0	**200**
26)	Aluminum (Al)	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	**0.2**
27)	Arsenic (As)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	**0.01**
28)	Cadmium (Cd)	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	**0.003**
29)	Calcium (Ca)	mg/L	446	492	411	465	449	**--**
30)	Chromium (Cr)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	**0.01**
31)	Cobalt (Co)	mg/L	<0.066	<0.066	<0.066	<0.066	<0.066	**--**
32)	Copper (Cu)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	**0.005**
33)	Iron (Fe)	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	**0.2**
34)	Lead (Pb)	mg/L	<0.08	<0.08	<0.08	<0.08	<0.08	**--**
35)	Potassium (K)	mg/L	531	541	542	534	527	**--**
36)	Sodium (Na)	mg/L	14,330	14,290	14,680	14,580	14,360	**--**
37)	Zinc (Zn)	mg/L	<0.012	<0.012	<0.012	<0.012	<0.012	**0.02**
38)	Nickel (Ni)	mg/L	<0.063	<0.063	<0.063	<0.063	<0.063	**--**
39)	Magnesium (Mg)	mg/L	1,596	1,680	1,527	1,616	1,559	**--**
40)	Mercury (Hg)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.001**
41)	Gasoline Range Organics (C6 – C9)	mg/L	<0.119	<0.119	<0.119	<0.119	<0.119	**--**
42)	Diesel Range Organics (C10 – C30)	mg/L	<0.080	<0.080	<0.080	<0.080	<0.080	**--**
43)	Heavy Fractions (>C30)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	**--**

Owing to the sampling being carried out during the peak summer months, the surface temperature ranged from 34.0 – 38.34 °C. Sampling station SW1 was observed to have recorded the highest temperature. In general, the turbidity was low at most of the locations except at SW12 (Khalid lagoon). The salinity was invariably high ranging from 41.0 – 43.6 ppt. Dissolved oxygen concentration ranged between 4.84 and 5.71 mg/L. Overall, DO was higher in the open waters than at the closed locations at the creek. The pH values ranged from 8.14 to 8.26 without showing any trend from near shore to far shore.

The results of seawater analysis compared with marine water quality objectives of Dubai Municipality. The perusal of the results indicates that all criteria pollutants are complying with the marine water quality objectives.

The outfall effluent being discharged to sea was collected from the outfall channel and it was analyzed for physic-chemical analysis. The results are compared with Sharjah Municipality sea discharge limits and IFC effluent guidelines. The results comply with Sharjah municipality sea discharge limits and IFC effluent guidelines.

Table 58 - Results of Outfall Effluent Quality

S. No.	Parameters	Units	Outfall Channel -01	Outfall Channel - 02	*Sharjah Municipality Discharge Limits - Sea*	*IFC Effluent Guidelines*
21)	pH	--	8.04	8.09	**6 - 9**	**6 - 9**
22)	Dissolved Oxygen (DO)	mg/L	5.9	5.9	**--**	**--**
23)	Turbidity	NTU	<1.0	<1.0	**75**	**--**
24)	Temperature	°C	40.9	41.6	**--**	**--**
25)	Chlorine (Residual)	mg/L	<0.005	<0.005	**--**	**0.2**
26)	Chlorides	mg/L	27,536	25,036	**--**	**--**
27)	Fluorides	mg/L	0.77	0.57	**--**	**--**
28)	Nitrogen - Ammonia	mg/L	<0.01	<0.01	**5.0**	**--**
29)	Nitrogen - Nitrite	mg/L	<0.05	<0.05	**--**	**--**
30)	Nitrogen - Nitrate	mg/L	0.03	0.02	**--**	**--**
31)	Sulphate (SO_4^{2})	mg/L	3,551	3,095	**--**	**--**
32)	Total Hardness	mg/L	9,000	7,800	**--**	**--**
33)	Total Dissolved Solids (TDS)	mg/L	44,800	42,000	**--**	**--**
34)	Total Suspended Solids (TSS)	mg/L	<10	<10	**30**	**50**
35)	Biochemical Oxygen Demand	mg/L	<2.0	<2.0	**30**	**--**

S. No.	Parameters	Units	Outfall Channel -01	Outfall Channel - 02	***Sharjah Municipality Discharge Limits - Sea***	***IFC Effluent Guidelines***
	(BOD)					
36)	Chemical Oxygen Demand (BOD)	mg/L	<1.0	<1.0	**150**	--
37)	Oil and Grease	mg/L	<1.3	<1.3	**10**	**10**
38)	Phenols	mg/L	< 0.1	< 0.1	**0.5**	--
39)	Surfactants	µg/L	<10.0	<10.0	--	--
40)	Carbonates	mg/L	<1.0	<1.0	--	--
41)	Phosphates	mg/L	<0.03	<0.03	--	--
42)	Total Nitrogen	mg/L	<1.0	<1.0	--	--
43)	Chlorophyll a	mg/m^3	<1.0	<1.0	--	--
44)	*Total Coliforms*	CFU/100 ml	<1.0	<1.0	**100**	--
45)	*E. coli*	CFU/100 ml	<1.0	<1.0	--	--
46)	Aluminum (Al)	mg/L	<0.2	<0.2	--	--
47)	Arsenic (As)	mg/L	<0.01	<0.01	**0.05**	**0.5**
48)	Cadmium (Cd)	mg/L	<0.003	<0.003	**0.05**	**0.1**
49)	Calcium (Ca)	mg/L	585	499	--	
50)	Chromium (Cr)	mg/L	<0.01	<0.01	**0.5**	**0.5**
51)	Cobalt (Co)	mg/L	<0.066	<0.066	**0.5**	**0.5**
52)	Copper (Cu)	mg/L	<0.005	<0.005	**0.5**	
53)	Iron (Fe)	mg/L	<0.2	<0.2	**2.0**	**1.0**
54)	Lead (Pb)	mg/L	<0.08	<0.08	**0.1**	**0.5**
55)	Potassium (K)	mg/L	566	525	--	
56)	Sodium (Na)	mg/L	15,130	13,760	--	
57)	Zinc (Zn)	mg/L	<0.012	<0.012	**0.1**	**1.0**
58)	Nickel (Ni)	mg/L	<0.063	<0.063	**0.1**	
59)	Magnesium (Mg)	mg/L	1,832	1,590	--	
60)	Mercury (Hg)	mg/L	<0.0005	<0.0005	**0.001**	**0.005**
61)	Gasoline Range Organics (C6 – C9)	mg/L	<0.119	<0.119	--	--
62)	Diesel Range Organics (C10 – C30)	mg/L	<0.080	<0.080	--	--
63)	Heavy Fractions (>C30)	mg/L	<1.0	<1.0	--	--

6.5.3. MARINE SEDIMENT QUALITY

6.5.3.1. Sampling and Analysis

Stainless steel Van Veen grab sampler was used to obtain bottom sediments from 10 selected sampling stations which are represented in **Figure 14** and details of the sampling locations are given in Table 53**.** The samples collected were analyzed for benthos analysis as well as the chemical analysis. Of the 10 sediments samples, five samples had either silty sand (MS 2), fine sand (MS 4) or coarse sand (MS 5 and MS 8). Other samples were mostly made of gravels, boulder and/or broken shells.

Owing to the hard substrate sediment samples using a grab sampler could not be collected at four (MS1, MS4, MS6, MS7) of the identified locations. Accordingly, the sediment samples from the remaining six locations (MS2, MS3, MS5, MS8, MS9 and MS10) were analyzed for chemical parameters. The photos of sediment samples collected are presented in **Figure 29**.

Figure 29 – Photos of sediment samples collected in Arabian Gulf

Sediment Sample collected at sampling station (MS-4)

Sediment Sample collected at sampling station (MS-4) - Broken shells, largely of bivalves

Sediment sample at MS5 - Coarse sand with broken shells

Sediment sample at MS-6

Sediment Sample at MS 6 - Pearl oyster shells with an unidentified red alga

Photos of sediment samples collected in Arabian Gulf

Sediment Sample at MS 7 - Broken shells – Pearl Oysters

Sediment Sample at MS 8 - Coarse sand with broken shells

Sediment Sample at MS 9 - Silty sand plus shells

Sediment Sample at MS 10 -Fine sand; broken shells

Photos of sediment samples collected in Arabian Gulf

The sediment samples were collected in pre-cleaned glass containers of 1Kg capacity and sent to ENAS accredited laboratory for analysis under strict chain of custody with QA/QC procedures. Sediment samples were dried in an electric oven and powdered in agate mortar. The sediments were analyzed for the chemical parameters.

The results of sediment analysis are compared with Canadian marine sediment quality guidelines. Canadian interim sediment quality guidelines (ISQGs) and probable effect levels (PELs) can be used to evaluate the degree to which adverse biological effects are likely to occur as a result of exposure to particular toxic contaminant in sediments. The ISQGs and PELs are valuable tools for assessing the eco-toxicological relevance of concentrations in sediments. The perusal of the results, toxic contaminants in the sediment samples are well within the Canadian marine sediment quality guidelines.

Table 59 - Results of marine sediment analysis in the project study area

S. No	Parameters	Units	*Arabian Gulf*					*Canadian Sediment Quality Guidelines*[10]	
			MS – 1	*MS-2*	*MS-3*	*MS-4*	*MS-5*	*ISQG**	*PEL#*
1)	Total Organic Carbon	Wt. %	Rocky Bottom – No sediment is collected	<0.5	1.01	Rocky Bottom – No sediment is collected	0.58	--	
2)	Total Phosphate	mg/kg		<1.0	<1.0		<1.0	--	
3)	Nitrates	mg/kg		14	23		40.0	--	
4)	Nitrogen - Ammonia	mg/kg		<5.0	<5.0		8.4	--	
5)	Total Nitrogen	mg/kg		3.2	5.3		17.0	--	
6)	Sulphates	mg/kg		208.0	604.0		1798.0	--	
7)	Aluminum (Al)	mg/kg		244.0	63.0		1202.0	--	
8)	Arsenic (As)	mg/kg		<1.2	<1.2		<1.2	**7.24**	**41.6**
9)	Cadmium (Cd)	mg/kg		<2.2	<2.2		<2.2	**0.7**	**4.2**
10)	Chromium (Cr)	mg/kg		1.0	<0.95		19.0	**52.3**	**160.0**
11)	Copper (Cu)	mg/kg		<1.4	1.5		42.0	**18.7**	**108.0**
12)	Iron (Fe)	mg/kg		616.0	323.0		1820.0	--	--
13)	Lead (Pb)	mg/kg		<1.8	<1.8		<1.8	**30.2**	**112.0**
14)	Nickel (Ni)	mg/kg		<0.5	<0.5		12.0	--	--
15)	Zinc (Zn)	mg/kg		3.0	4.4		68.0	**124.0**	**271.0**
16)	Mercury (Hg)	mg/kg		<0.025	<0.025		<0.025	**0.13**	**0.70**

Canadian Council of Ministers of the Environment. 2001. Canadian sediment quality guidelines for the protection of aquatic life: Summary of Tables Updated. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Table 60 - Results of marine sediment analysis in the project study area (Continued....)

S. No	Parameters	Units	*Arabian Gulf*					*Canadian Sediment Quality Guidelines*	
			MS – 6	***MS-7***	***MS-8***	***MS-9***	***MS-10***	***ISQG****	***PEL#***
1)	Total Organic Carbon	Wt. %	Rocky Bottom – No sediment is collected		<0.5	<0.5	0.5	**--**	
2)	Total Phosphate	mg/kg			<1.0	<1.0	<1.0	**--**	
3)	Nitrates	mg/kg			39.0	33.0	41.0	**--**	
4)	Nitrogen - Ammonia	mg/kg			<5.0	9.1	9.0	**--**	
5)	Total Nitrogen	mg/kg			8.8	17.0	18.0	**--**	
6)	Sulphates	mg/kg			597.0	559.0	730.0	**--**	
7)	Aluminum (Al)	mg/kg			57.0	864.0	852.0	**--**	
8)	Arsenic (As)	mg/kg			<1.2	<1.2	<1.2	**7.24**	**41.6**
9)	Cadmium (Cd)	mg/kg			<2.2	<2.2	<2.2	**0.7**	**4.2**
10)	Chromium (Cr)	mg/kg			<0.95	7.4	6.1	**52.3**	**160.0**
11)	Copper (Cu)	mg/kg			<1.4	2.8	1.9	**18.7**	**108.0**
12)	Iron (Fe)	mg/kg			226.0	154.1	1504.0	**--**	**--**
13)	Lead (Pb)	mg/kg			<1.8	<1.8	<1.8	**30.2**	**112.0**
14)	Nickel (Ni)	mg/kg			<0.5	7.8	5.1	**--**	**--**
15)	Zinc (Zn)	mg/kg			<0.23	7.9	4.8	**124.0**	**271.0**
16)	Mercury (Hg)	mg/kg			<0.025	<0.025	<0.025	**0.13**	**0.70**

***** *Interim Marine Sediment Quality Guidelines prescribed by Canadian Sediment Quality Guidelines for the protection of aquatic life*
#Probable Effect Levels prescribed by Canadian Sediment Quality Guidelines for the protection of aquatic life

6.5.4. MARINE ECOLOGY

6.5.4.1. Survey Methodology

Marine Ecology survey was carried out underwater, by qualified divers (marine ecologist – **Dr. Shahid Mustafa**) in the study area. The observations were also documented using media tools such as videography and photographs. Qualitative and semi quantitative rapid assessment baseline surveys was performed on by underwater Drop down Camera at each site to record the bottom type, visible benthic flora and fauna where observed.

6.5.4.1.1. Survey Methodology – Epibenthic Ecology

Ten stations were selected to be representative of the shallow, open aspect, subtidal marine habitats within the study area. Two to five minute videos were taken at each station and all epibenthic characteristics encountered were counted. At each site either diver or drop-down camera was used to conducted a 25 m video transect to characterize photo-quadrats (0.25 m^2) for estimating of percentage cover of dominant substrates (Figure 3). All notable macro-invertebrate fauna and macroalgae encountered at each station were recorded. Photo-quadrats were taken at 5 m intervals (0 m, 5 m, 10 m, 15 m, 20 m & 25 m). At the stations where photo-quadrats were collected the images were subsequently analysed using Coral Point Count with Excel extensions (CPCe) *(Kohler and Gill, 2006*[11]*)* to assess percentage cover of sea grasses, macro algae, corals, macro invertebrate fauna and substrate type at each station. Percentage covers were also visually assessed at stations, not supporting significant populations of corals, where photo-qudrats were not taken.

6.5.4.1.2. Survey Methodology – Plankton community

A total of 10 samples of phytoplankton were collected and preserved in Lugol's iodine solution from the project area. The phytoplankton samples were allowed to settle and the supernatant solution was decanted, leaving a concentrated plankton volume of 50ml. A 1ml sample of settled plankton was then transferred to a Sedgwick-Rafter slide (1ml capacity) using a glass dropper. Initially the sample was examined for qualitative analysis, and then the taxa were counted. The same procedure was repeated three or four times. The number of individuals, in each taxon of phytoplankton, present per 1L of sample, was calculated.

[11] Kohler, K.E. and Gill, S., 2006. Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computer & Geosciences, 32(9):1259-1269

6.5.4.1.3. Survey Methodology – Epibenthic Ecology

A total of 10 samples of zooplankton were collected from the project area. Oblique hauls with plankton net, mesh size 200 µm, were used to sample zooplankton at all sampling stations. Porosity, or mesh transparency (= ratio of mesh aperture area to total mesh area), should be 55%. The samples were preserved in 5% formaldehyde (analytical grade) solution. Sub-samples were taken (50-100% depending upon population) using either Folsom splitter or Stemple pipette for the major groups. Before sub-sampling by Stemple pipette, samples were diluted to a known volume with filtered sea water and then mixed gently so that organisms were randomly distributed in the container. The population was calculated using following equation:

$$V = \prod r^2 d$$

Where,

V= Volume of water filtered;
r = radius of plankton net mouth; and
d = distance through which the plankton net is towed.

6.5.4.1.4. Survey methodology – Macrobenthos infauna community

Macro-benthic infauna samples were collected from 10 stations from the Project Area during October 2018 (Figure 3). At each sampling station, benthic samples were taken using a Van Veen grab, 10cm x 10cm opening ($0.01m^2$) and 10cm depth. Grab samples were taken at each location and sampling date and time were recorded. Grabs were retained only if the grab was full in order to standardize volume sampled. Immediately after collection, the samples were sieved through a 0.5 mm mesh screen, preserved in 10% buffered formalin with added Rose Bengal dye. Separation of animals from the remaining sediment was done under a dissecting microscope. All animals were identified to the lowest reliable taxonomic level, with random specimens verified by outside taxonomists. These procedures follow standard formats for benthic sampling outlined by the Environmental Protection Agency (EPA)-Environmental Monitoring and Assessment Program (*Hyland et al. 1991*[12]). Patterns of 174 infauna community composition were compared among stations for numerically common taxa (those comprising at least 1% or 3% of the total fauna collected at that station), for higher taxonomic groupings. Comparison of higher taxonomic groupings (polychaetes, amphipods, bivalves, oligochaetes) allows observation of overall patterns of distribution. The number of macro-benthic animals present in the sample was calculated using following formula:-

$$\text{no./m}^2 = \frac{\text{Number of animals present in the sample x 10,000}}{\text{Area sampled (cm}^2\text{)}}$$

[12]*Hyland, J., Baptiste, E., Campbell, J., Kennedy, J., Kropp, R. and Willliams, S. 1991. Macroinfauna communities of the Santa Maria Basin on the California outer continental shelf & slope: Mar Ecol Prog Ser 78 147-161.*

6.5.4.1.5. Univariate Analysis

The following univariate indices were selected:-

(a) Margalef Index (d):

The Margalef diversity index (d) is commonly used to characterize species diversity in a community using the following equation (Margalef 1968):

$$d = S\text{-}1/\text{Log}_e N$$

Where,

S is the number of species; and

N is the total number of individuals.

(b) Shannon-Wiener Diversity Index (H'):

The Shannon-Wiener diversity index (H') is another index that is very widely used for characterizing species diversity in a biological community (Shannon-Wiener 1949). The proportion of species i relative to the total number of species (p_i) is calculated, and then multiplied by the natural logarithm of this proportion (ln p_i). The resulting product is summed across species, and multiplied by -1:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where,

p_i is the proportion of individuals found in the species; and

ln is the natural logarithm.

(c) Pielou Evenness index (J):

The Pielou Evenness index is a measure of how evenly distributed abundance is among the species that exist in a community. The Pielou index is defined between 0 and 1, where 1 represents a community with perfect evenness, and decreases to zero as the relative abundances of the species diverge from evenness. Pielou Evenness index, J *(Pielou, 1966[13]):*

$$J' = \frac{H'}{H'_{\max}}$$

Where H' = the Shannon-Wiener information function, H' (max.) = the theoretical maximum value for H' if all species in the sample were equally abundant.

[13] *Pielou, E. C., 1966. The measurement of diversity in different types of biological collections. J. Theor. Biol., 13: 131-144.*

6.5.4.2. Results and Discussion

6.5.4.2.1. Epibenthic Ecology

The ten (10) stations sampled varied in depth from 2-8 m. The estimated percentage cover of the dominant faunal and floral groups and the main substrate types are provided in **Table 61**

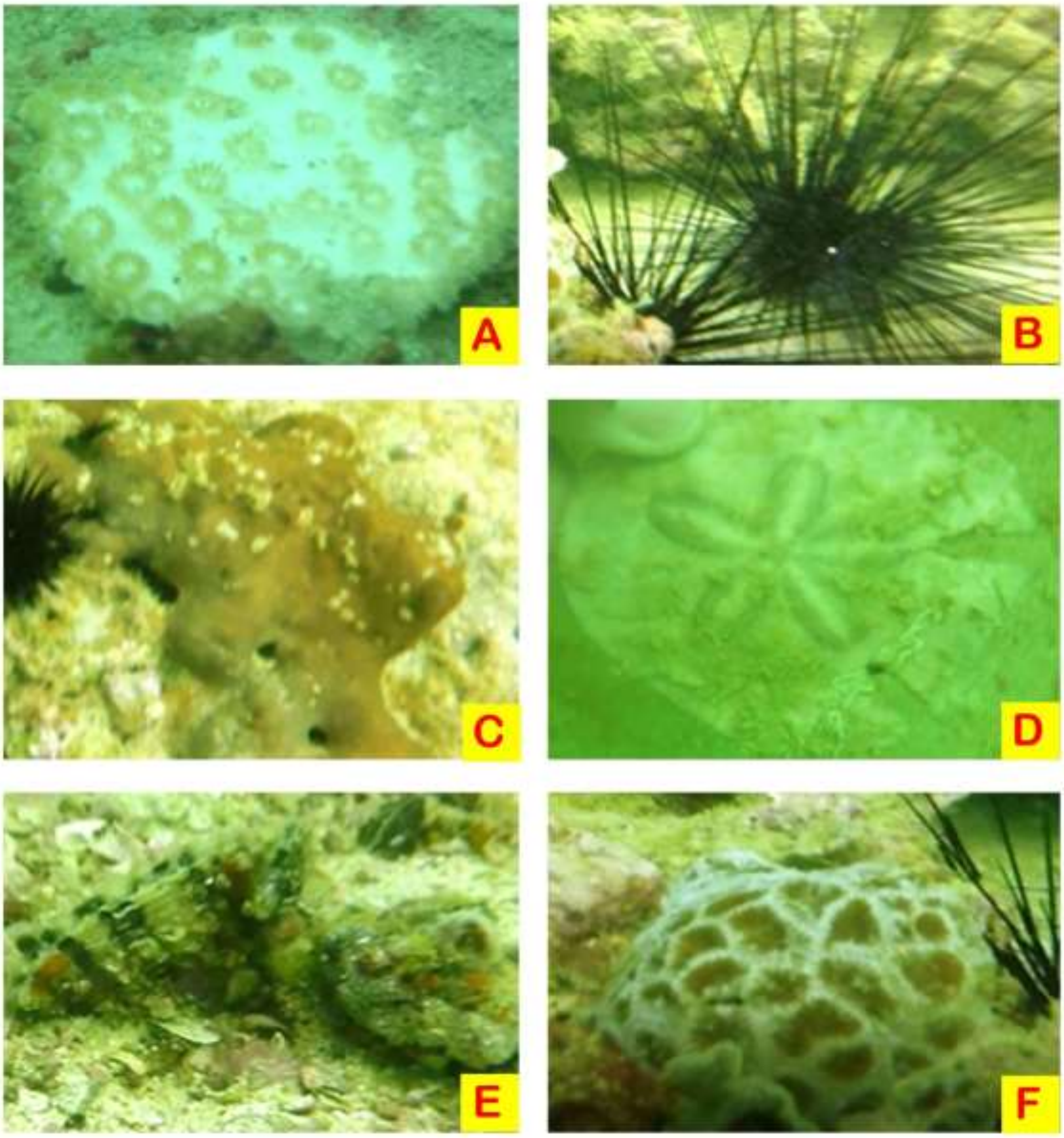


Figure 30 – *(A) Turbinaria peltata (B) Diadema setosum, (C) Porites sp, (D) Clypeaster humilis (E) Pearl oyster (Pinctada radiata)and (F) Favia sp. along stations ME-05 and* ME-08

Table 61 – Epi-benthic flora and fauna along project area

Biota (%)	**Sampling Stations**									
	ME-1	**ME-2**	**ME-3**	**ME-4**	**ME-5**	**ME-6**	**ME-7**	**ME-8**	**ME-9**	**ME-10**
Macro-Alage & Plants										
Epilithic algae		5			5	2.5	5	5		
Filamentous algae		5							5	
Turf Algae	2.5	1.5			5		5	2.5		
Hormophysa cuneiformis					5					
Porifera (Sponge)										
Actinarians sp.								10		
Callyspongia spp					2.5	1.5		1		
Ascidians sp.		25			5	5	1	2		
Cnidaria (Corals)										
Cyphastrea spp					2.5					
Siderastrea spp					1					
Favia palida					4					
Platygyra sp					1					
Favia sp					5			1		
Porites spp					5					
Turbinaria peltata					1			1		
Mollusca (%)										
Strombus sp.					0.5	1		0.5		
Hexaplex sp.					0.5	1	1	0.5		

Biota (%)	**Sampling Stations**									
	ME-1	**ME-2**	**ME-3**	**ME-4**	**ME-5**	**ME-6**	**ME-7**	**ME-8**	**ME-9**	**ME-10**
Cerithidea spp	10		2.5	2.5	0.5			4	5	2.5
Chama sp	1	1			1	1		1		
Spondylus marisrubri					1			1.5		
Pinctada radiata (Pearl oyster)		25			6.5	18	2	20		
Bivalves sp.	6.5	1.5	2.5	2.5	3	1		7.5		
Echinoderms & Sea Urchins										
Astropecten monacanthus						0.5				
Echinometra mathaei		5			5	5	1	2.5		
Diadema setosum		1			3	1				
Clypeaster humilis								5		
Chordate										
Phallusia nigra					2					
Substrate (%)										
Broken shell debris	10	10	5	5	10	22.5	30		5	7.5
Sand	70	20		90	25	40	55	35	85	40
Muddy-sand			90							50
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

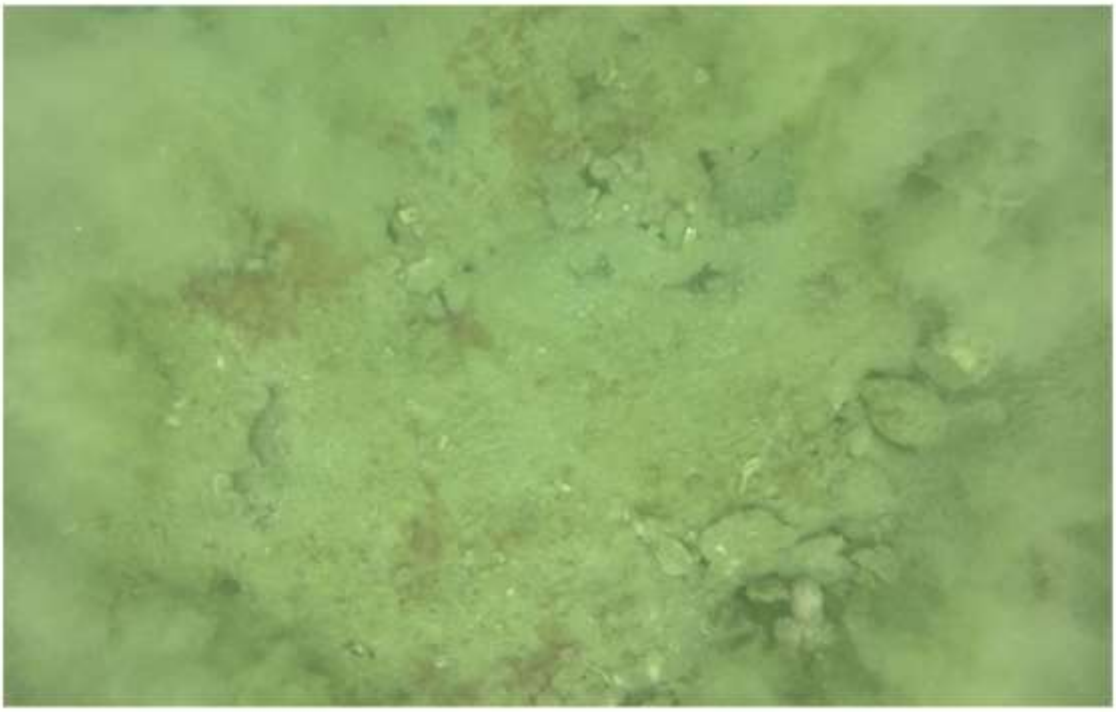
Habitat map of the study is presented in **Figure 31**. The epibenthic communities were dominated by oyster bed, corals, sandy and silty sand areas. The epi-benthic characteristics at following sites comprised of:

- Corals at station ME-5;
- Silty sand at Station ME3 and ME-10;
- Sandy Area at Station ME4, ME-7 and ME-9;
- Pearl Oyster and broken shells at Station ME-1, ME-2, ME-6 & ME-8.

Figure 31 – Habitat map along project area

The different characteristics of epibenthic community are shown in the **Figure 32** to **Figure 36**. Overall averages of all the stations show following percentage of the substratum.

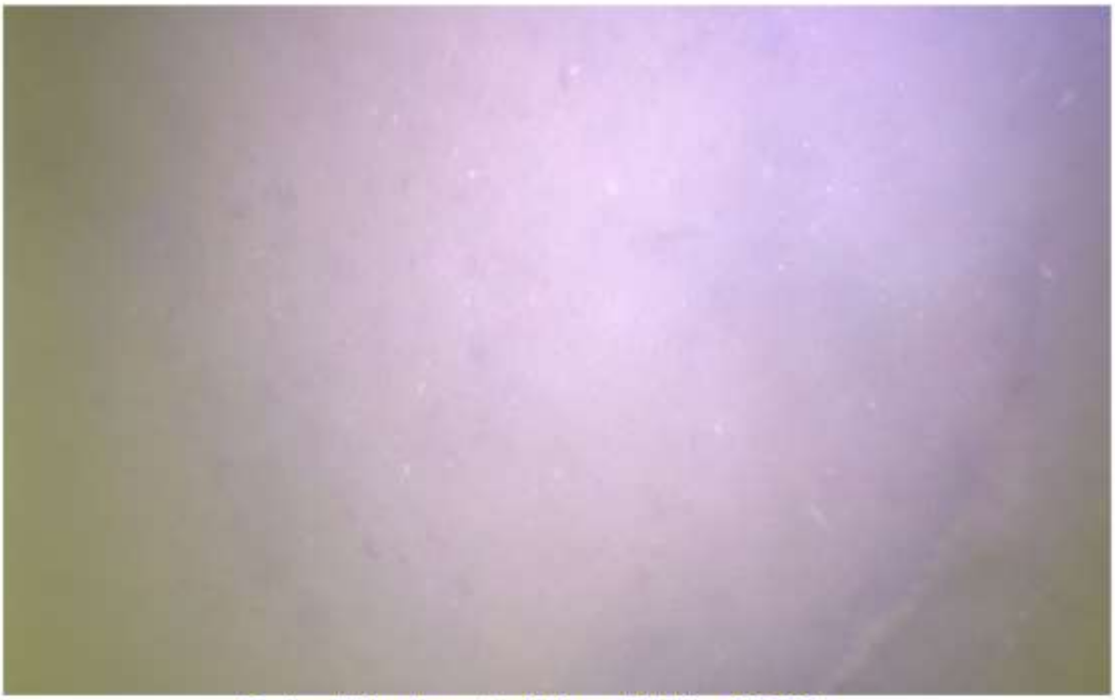
- Pearl oyster & Molluscs 13.6%
- Corals=2.2%
- Algae = 5.4%
- Actinarians (sponges)= 5.3%
- Echinodermates & Sea Urchins= 2.9%
- Chordates=0.2%
- Sand =46%
- Silty Sand=14%



Epibenthic characteristics at Station ME-01

Epibenthic characteristics at Station ME-02

Figure 32 – Epibenthic characteristics at sampling stations (ME-01 & ME-02)

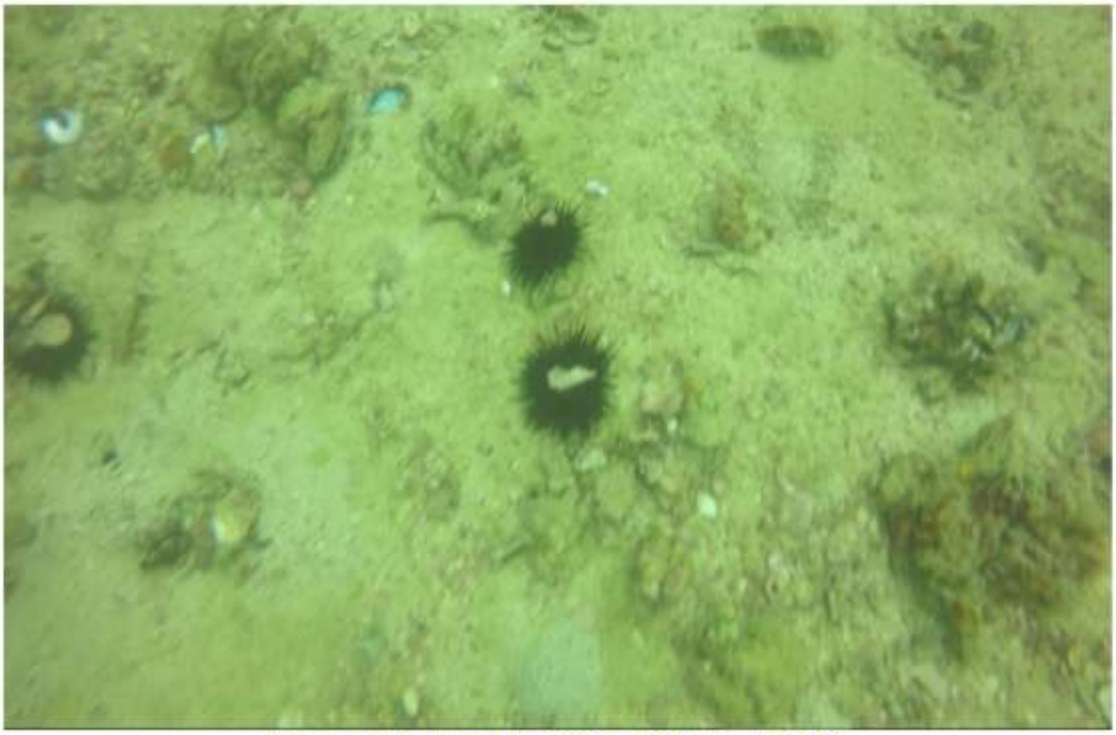


Epibenthic characteristics at Station ME-03

Epibenthic characteristics at Station ME-04

Figure 33 – Epibenthic characteristics at sampling stations (ME-03 & ME-04)

Epibenthic characteristics at Station ME-05



Epibenthic characteristics at Station ME-06

Figure 34 – Epibenthic characteristics at sampling stations (ME-05 & ME-06)

Epibenthic characteristics at Station ME-07

Epibenthic characteristics at Station ME-08

Figure 35 – Epibenthic characteristics at sampling stations (ME-07 & ME-08)

Epibenthic characteristics at Station ME-09

Epibenthic characteristics at Station ME-10

Figure 36 – Epibenthic characteristics at sampling stations (ME-09 & ME-10)

Moderately diverse coral communities have developed and more than 5 species have been recorded. Most of these corals develop at between 3 and 6 m depth. Above 3 m there is heavy grazing pressure from fishes and echinoderms on the rich algal turf that develops in shallow water, where the rocks are exposed to high sunlight intensity. It is likely that the high grazing pressure is largely responsible for the low colonisation of corals in shallow water in the UAE Arabian Gulf mainland. *Porites spp. and faviid corals* occurring in the Arabian Gulf are moderately tolerant of high temperatures and low siltation rates. The Area shows moderate diverse condition with potential importance of corals and oyster beds specially on station ME-5 and ME-8.

Multi-dimensional plot was developed, and presented in **Figure 37**. It shows the strong >60% resemblances in stations ME1, ME2 ME2, ME6, ME6, ME7 and ME8. These stations show pearl oyster sandy characteristics.

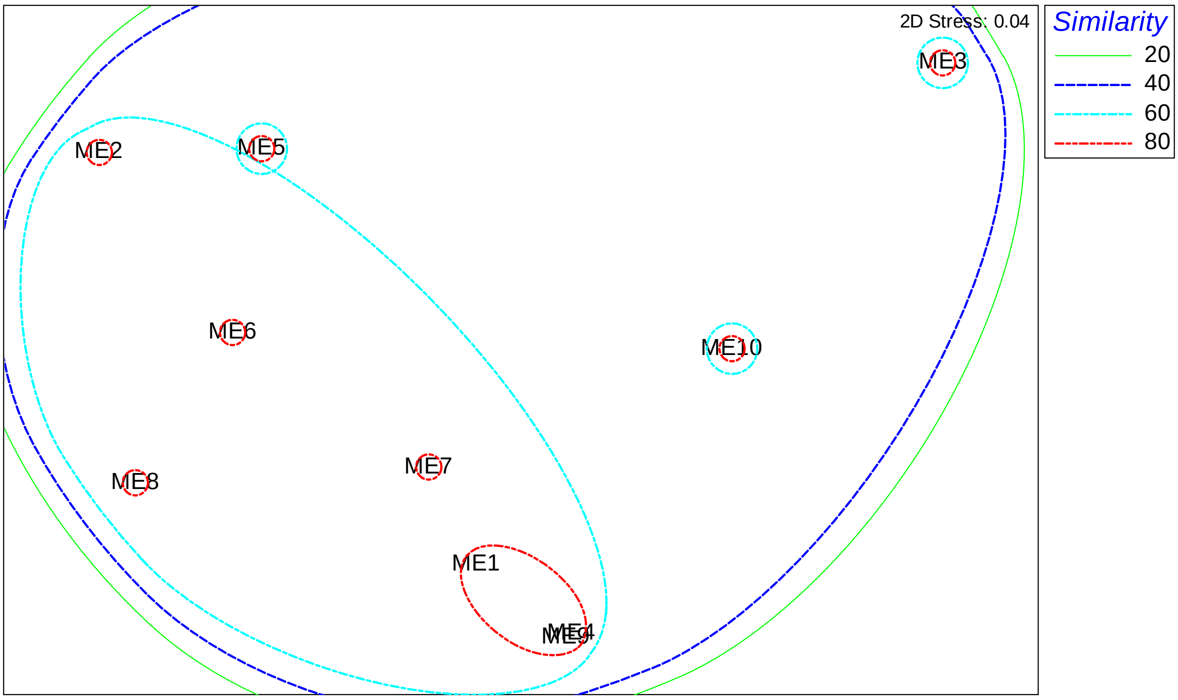


Figure 37 – Multi-Dimensional Scale plot of epibenthic community along the project area

6.5.4.2.2. Phytoplankton community

Results of the phytoplankton analysis are presented in **Table 62**. A wide variation was found within the population density of phytoplankton at the Project Area. Phytoplankton density in terms of cell counts varied from 22-83 No. $\times 10^3$/L with an overall average population density of 40.6 no. $\times$ 10^3/L.

Table 62 - Phytoplankton cell counts (no. x 10^3/L) at different sampling stations

Phytoplankton	Sampling Stations									
	ME-1	**ME-2**	**ME-3**	**ME-4**	**ME-5**	**ME-6**	**ME-7**	**ME-8**	**ME-9**	**ME-10**
Chaetoceros sp	2	3		4	2	3	2	3	2	2
Coscinodiscus radiatus		1	1			1			1	1
Proboscia alata	8	4	1	4	4	8	4	6	6	2
Rhizosolenia setigera	2	1	2	1		2		1		2
Thalassiosira eccentrica	1	1		1		1	1	2		1
Leptocylindrus minimus	2	1	2	1	2	2	2	1	2	
Pseudo-nitzschia sp.	2	3	4	3	2	1	2	1	2	4
Thalassionema bacillare	1	2	1	2	1	1	1	2	1	1
Ceratium furca	4	6		8	2	4	2	3	2	1
Prorocentrum micans	4	3	20	2	3	1	2	2	1	28
Protoperidinium sp.	12	14	4	4	8	12	6	8	12	8
Trichodesmium erythraeum			4							
Oscillatoria sp.	2		44							24
TOTAL	40	39	83	30	24	36	22	29	29	74

The dominant class of the phytoplankton was Dinophyceae (dinoflagellates) (45.8%) followed by Bacillariophyceae (Diatoms) (36%) and Cyanophyceae (Cyanobacteria) (18.2%). The most common species of phytoplankton from the Project Area were *Prtoperidinium sp* (21.7%), *Oscillatoria sp (17.2%), Prorocentrum gracile (16.3%), Proboscia alata (11.6%) and Ceratium furca (7.9%), Trichodesmium erythraeum (8.3%) and Thalassionema bacillare (5.9%).*

A total of 15 taxa of phytoplankton were recorded from the project area. Phytoplankton species, including 225 diatoms and 152 dinoflagellates have been recorded (*Dorgham and Mufatah, 1986*[14] and *Dorgham et al., 1987*[15]) in the Arabian Gulf despite possibilities of nutrient limitation (*Kimor, 1979*[16]). Planktonic organisms have been recognized as indicators of water masses and their movements (*Raymont, 1964*[17]). It has been reported that the coastal zone throughout the southern part of the Arabian Gulf is already exposed to major conflicts of resource utilization (MEPA 1992[18]). Population density was highest during the summer (*Azis, 1998*[19]) and phytoplankton blooms occurred during August and May. The present levels of phytoplankton indicate moderate population density along the Project Area. Harmful Algal blooms were absent in the phytoplankton samples.

6.5.4.2.3. Zooplankton community

Results of the zooplankton sample analysis are presented in **Table 63**. Zooplankton in the project area was comprised of 6 phyla (*Cinidaria, Chaetogantha, Annelida, Mollusca, Arthropoda and Chordata*). Arthropods represented the largest assemblage of zooplankton (64%) followed by Chordates (14%), Chaetoganth (12.2%), Molluscs (12.2%) and Cinidarians (1.2%).

An average of zooplankton density (172 no./m^3) and diversity (12 species) reflects moderate healthy conditions of zooplankton community along the project area. Fish eggs and fish larvae were not found in the samples collected.

[14] *Dorgham, M.M. and Muftah, A., 1986. Plankton studies in the Arabian Gulf. I. Preliminary list of Phytoplankton Species in Qatari Waters Arab Gulf J. Scient. Res., 4(2): 421-436.*

[15] *Dorgham, M.M., Muftah, A. and El-Deeb. 1987. Plankton Studies in the Arabian Gulf, II. Autumn Phytoplankton in the Northwestern Area. Ibid, Agric. Biol. Sci., B5(2): 215-235.*

[16] *Kimor B., Berman T., Schneller A., (1987). Phytoplankton assemblages in the deep chlorophyll maximum layers off the Mediterranean coast of Israel, J. Plankton Res. 9 (3): 433-443.*

[17] *Raymont, J.E. 1964. Plankton and Productivity of the Ocean. Wheaton and co. Exeter, Great Britain.*

[18] *Meteorology and Environmental Protection Administration (MEPA), 1992. Arabian Gulf, Report 5, Meteorology and Environment Protection Admin. In Saudi Arabia for IUCN, Switzerland.*

[19] *Abdul Azis, P.K., Ibrahim Al-Tisan, Mohammed Al-Daili, Troy N. Green, Dalvi, A. G. I. and Javeed, M. A. 1998. Ecological Evaluation Of The Depth Profile Of The Near Shore Waters Of The Al-Jubail Desalination And Power Plants . P. K. Abdul Azis, SWCC R&D Center Al Jubail.*

Table 63 - Zooplankton density (No./m^3) at different stations from the project area

Group/Species	Sampling stations									
	ME-1	ME-2	ME-3	ME-4	ME-5	ME-6	ME-7	ME-8	ME-9	ME-10
CHAETOGNATHA										
Sagitta sp.	4	20	24	22	24	26	42	32	12	4
CNIDARIA										
Obelia sp.	2		4	4	2	2	4	1	2	
ANNELIDA										
Polychaete larvae	2		2	3	2		2	2	4	
MOLLUSCA										
Bivalve veliger larvae		6	4	6	6	14	4	7	6	
Gastropod veliger larvae		8	8	12	8	12	8	6	12	
ARTHROPODA										
Acartia fossae	42	12	48	52	62	48	36	42	24	18
Copepod nauplii	12	14	10	12	8	12	12	14	1	18
Copepod sp.	140	12	14	12	10	12	8	12	10	108
Oithona brevicornis	12		8	10	12	8	10	8	12	
Lucifer sp.	17	12	35	18	12	12	10	36	12	10
Mysis larvae		4		2	2		2		2	
CHORDATA										
Oikopleura larvae	35	52	22	17	22	13	14	24	18	24
Total	**266**	**140**	**179**	**170**	**170**	**159**	**152**	**184**	**115**	**182**

6.5.4.2.4. Macrobenthic infauna community

The number and distribution of subtidal benthic species in the project area recorded is summarized in **Table 64.** Diversity indices for macro-benthic infauna communities in the project area are provided in **Table 64**. The macro-benthic infauna at 10 sampling stations had population values ranging from 1200-3880 no./m^2 (average 2772 no./m^2).

Annelida (58.4%) and Mollusca (37.2%) constituted the community of macro-benthic infauna from the Project Area. *Polychaetes spp*.(33.1%), *Cerithiidae spp*.(10.9%), *Nereidae spp*. (9.3%), *Bivalve sp*.(5.7%), *Ophelina sp* (4.8%) and *Mitrella blanda* (4.4%) comprise major community structure of the macro-benthic infauna from the Project Area.

Polychaetes (Annelida), which include 80% population in the samples, are typically dependent on their diet such as microbial, meiobial and organic substances (*Shou et al., 2009*[20]), and formed an important component in the marine food chain especially by providing important source of food for demersal fish (*Parulekar et al., 1982*[21] and *Herman et al 2000*[22]). However, salinity and sediment particle are the two significant factors effecting benthic community of the Arabian Gulf (*Stephens and McCain, 1990*[23]). Infaunal abundance commonly increases with decreasing particle size and reduced of benthic organism by increasing salinity has been quantitatively observed in the gulf at salinities above 45‰ in the gulf of Swah and Abu Dhabi barrier island (*Clark and Keij 1973*[24], *Evans et al., 1973*[25]). The high population of macro-benthic infauna at between Stations M5-M8 could be associated with particle size in this Project Area.

[20] *Shou, L., Huang, Y., Zeng, J., Gao, A., Liao, Y. and Chen, Q. 200 Seasonal changes of macrobenthos distribution and diversity in Zhoushan sea area Aquatic Ecosystem Health & Management 12(1) 110–115.*

[21] *Parulekar, A.H., Harkantra , S. N. and Ansari, Z. A. 1982. Benthic production and the assessment of demersal fishery resources of the Indian sea. Indian Journal of Marine Sciences, 11: 107-114*

[22] *Herman, P. M. J., Middelburg, J. J., Widdows, J., Lucas, C. H. and Heip, C. H. R. 2000. Stable isotopes as trophic tracers: combining field sampling and manipulative labeling of food resources for macrobenthos. Marine Ecology Progress Series, 204: 79–92 .*

[23] *Stephen, L. Coles and John, C. McCain 1990. Environmental factors affecting benthic infaunal communities of the Western Arabian gulf Research Institute, King Fahd University of Petroleum and Minerals, Dhahran 31261, Saudi Arabia*

[24] *Clark M. and Keij, A. S. 1973. Organisms as producers of carbonate element and indicators of environment in the southern Persian Gulf. The Persian Gulf ed. B. H. Purser. Springer- Verlage, New York: 32- 65.*

[25] *Evans, M.I (compiler). 1994. Important bird areas in the Middle East. Birdlife International, pp 410*

Table 64 - Abundance and diversity of macro-benthic infauna from the Project Area

Group/Genera/Species (No./m^2)	ME-01	ME-02	ME-03	ME-04	ME-05	ME-06	ME-07	ME-08	ME-09	ME-010
Annelida										
Cirratulus sp.						240		120		
Cossura sp.		120			120		360			
Glycera sp.	120	120			240	120	240	120		
Glycinde sp.					120		120			
Ophelina sp		240			240	120	240	120	360	
Nereidae spp.	240	360	240	360	360	240	120	240		360
Capitellidae spp.			640							240
Polychaetes spp.	1240	1040	240	1340	1240	840	1040	1200		840
Mollusca										
Ancilla sp.		120			120	80	120		120	
Bulla sp.		120					120		240	
Cerithiidae spp.	360	240	80	240	360	360	240	480	360	240
Loripes sp.					120		240			
Mitrella blanda	120	240			120	120	120	240	120	120
Tellina methoria	120	120			240	360	120	120	240	
Bivalve sp.	240	120		240	120	240	120	240	120	120
Gastropod sp.	240	120		240	240	120	120	240	240	120
Arthropoda										
Amplescia sp	120	120			120	120	80		40	
Amphiura sp.		120			120	120	120	120		
Total	2800	3200	1200	2420	3880	3080	3520	3240	1840	2040

Table 65 - Diversity Index of macro-benthic in-fauna from the Project Area

Stations	S	d	J'	H'(loge)
ME1	9	1.01	0.82	1.80
ME2	15	1.73	0.85	2.31
ME3	4	0.42	0.84	1.16
ME4	5	0.51	0.81	1.30
ME5	16	1.82	0.85	2.36
ME6	14	1.62	0.88	2.31
ME7	17	1.96	0.86	2.45
ME8	12	1.36	0.82	2.04
ME9	9	1.06	0.93	2.05
ME10	7	0.79	0.86	1.68

S – Number of species recorded; d – Margalef index; J' - Pielou Evenness index; H' - Shannon-Wiener Inmdex

Moderately high diversity index of Margalef (d) and Shannon-Wiener (H') at stations ME-01, ME-02, ME-04, ME-05, ME-06, ME-07, ME-08 & ME-09 shows moderate healthy statues of macro-benthic in-fauna in this project area.

Bray-Curtis similarity (**Figure 38**) and Multi-dimensional scaling (MDS) plots (**Figure 39**) of Primer 6 software graphically shows the relationship between stations (Station ME1-ME-10) along the project area. MDS plots use the similarities in community structure to graphically display the relationships between the stations. They are useful in representing the relative level of relationship between one or more stations. Bray- Curtis similarity in the present assessment show strong similarities (>80%) among Station ME1, ME2, ME4, ME5, ME6, ME7, ME8 & ME10. MDS plot also shows similarity >80% among ME1, ME2, ME4, ME5, ME6, ME7, ME8, ME9 & M10 stations (Figure 19).

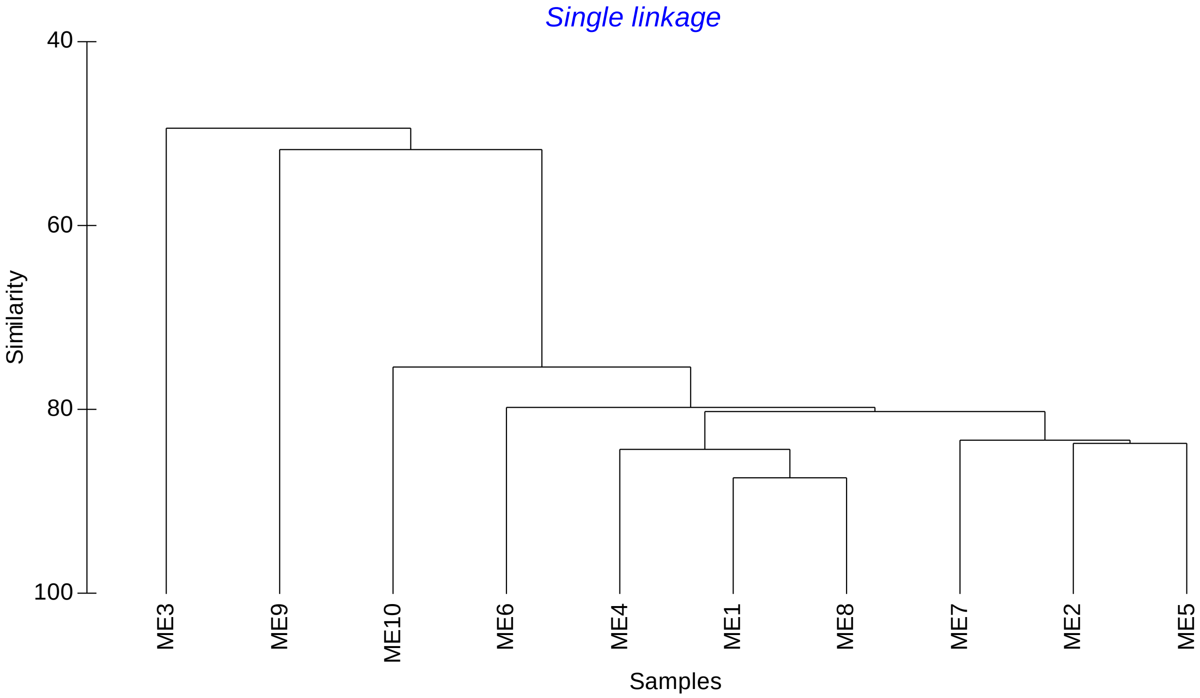


Figure 38 – Bray-Curtis similarity index of the macro-benthic infauna along the project area

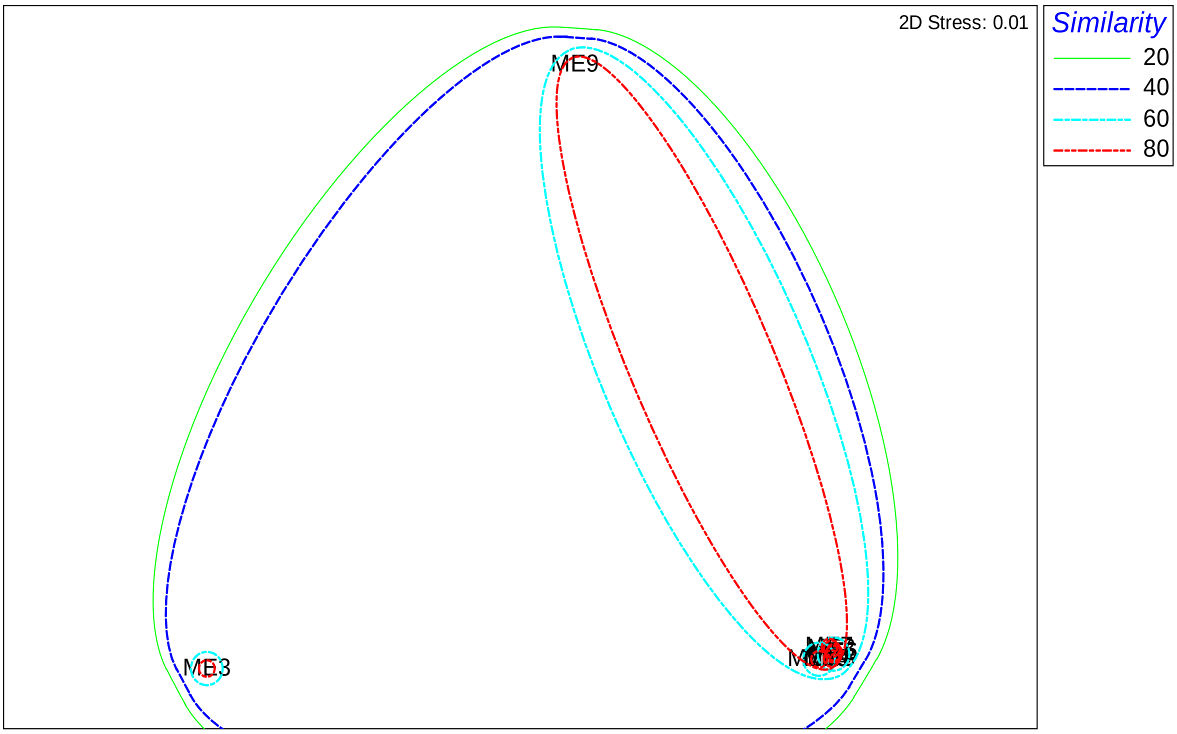


Figure 39 – Multi-Dimensional Scale (MDS) Plot of the macro-benthic infauna along the project area

6.6. SOCIO-ECONOMICS

Baseline of socio-economic presents the baseline characterization of the project area's socio-economic context prior to project implementation. The following aspects are discussed in this section:

- Land use
- Demography, including ethnicity
- Infrastructure and community access to services

6.6.1. LAND USE

The project is located in the Layyah in the Sharjah city of Sharjah Emirate, UAE. The information provided in this baseline reflects the primary area of influence by the proposed project and to the extent possible focuses on the population and communities neighboring the project.

The project site selected for proposed project is in Layyah Power Station where 900 MW power plant and 51 MIGD desalination plant are already in operation. The land allocated for the development is sandy without any vegetation and currently left barren which is used for temporary storage. The surrounding significant land use features of the project site covering 2km radius (primary impact area) are as follows:

- Power plant
- Sharjah container terminal
- Mina Khalid Port
- Arabian Gulf
- Creek and Lagoon
- Residential areas
- Hotel and Residency
- Graveyard
- Heritage area

6.6.1.1. Cultural Heritage

The following heritage receptors have been identified in the project area of influence:

- Sharjah Heritage Area (Heart of Sharjah): It is actually the epicentre and origin of Sharjah where the first families took up residence in their new stone-built homes.

Sharjah Fort, Heritage Museum are situated in the Sharjah Heritage Area. It is located 1km to the east of the project site.

- Sharjah Art Museum: The art museum is located 1.4km to the ENW of the project site.
- Sharjah Archaeological Museum: It is located 5.4 km to the east of the project site.

Cultural heritage structural or artefactual remains are not identified in the project site. The land is flat with barren land.

6.6.2. DEMOGRAPHY

Population growth in the United Arab Emirates is among the highest in world at a current 2.47% for the year of 2016. Immigration is the heaviest factor contributing to this growth. Expatriate workers in the UAE made up 90% of the country's workforce in 2013 and accounted for 7.8 million individuals out of a population of 9.2 million people. According to Federal Competitiveness and Statistics Authority (FCSA), UAE population for the year 2016 is 9,121,167 according to administrative records dated until 31 December 2016. The population administrative records also showed that 6,298,294 are male and 2,822,873 is female, making the gender split in the UAE 69% male and 31% female.

Sharjah is the third largest emirate in the United Arab Emirates, and is the only one to have land on both the Arabian Gulf and the Gulf of Oman. The emirate covers 2,590 km^2 (1,003 mi^2) which is equivalent to 3.3 per cent of the UAE's total area, excluding the islands.

6.6.2.1. Population

According to Sharjah Census 2015, total population in Emirate of Sharjah is 1,405,849. Sharjah is home to 175,432 Emirati nationals (local peoples), or 12 percent of the total population. Males and females account for 49 percent (86,325) and 51 percent (89,098) of the Emirati population respectively. Total foreign expatriates are counted at 1,230,417, making up 88 percent of the emirate's population. Males account for more than two thirds of the expatriate population totaling 834,542, with females counted at 89,098.

Project site is located in the Sharjah city and the census found 1,274,749 people living in Sharjah city, accounting for 91 percent of the emirate's total population. Sharjah's east coast city of Khorfakkan was ranked second with 39,151 residents (2.8%), followed by the east coast city of Kalba with 37,545 (2.7%). Other notable urban areas covered by the 2015 census were: Al Dhaid city with a population of 20,165 (1.4%); Dibba Al Hisn city with 12,573 (0.9%); Al Madam city with 11,120 (0.8%); Mleiha city with 4,768 (0.3%); Al Bataeh city with 3,958 (0.3%); and Al Hamriyah city with 3,297 (0.2%).

6.6.2.2. Social and employment status

Of the Emirati population, 30,424 males (56%) and 29,728 females (51%) are married, while 44 percent of males and 49 percent of females are single, divorced, widowed or abandoned. Of the expatriate population, 454,597 males (63%) and 209,818 females (73%) are married, while 37 percent of males and 27 percent of females are single, divorced or widowed.

Data from the census shows that 76 percent of the 1.12 million residents over 15 years of age are employed, while 5 percent are full-time students and 6 percent are unemployed, retired, unable to work, self-supporting or carry out domestic work only. 95.1 percent of Sharjah's 855,709 working population are employees, 1.5 percent are self-employed and 2.1 percent are business owners. About 82 percent of Sharjah's working population (575,610) have occupations in the private sector, while the federal government employs 4 percent (29,673), the local government 6 percent (45,434) and semi-government bodies 3 percent (17,688). Domestic jobs account for a further 5 percent, while diplomatic and foreign sectors less than 1 percent. According to Sharjah Census 2015, there are 253,105 male and female students enrolled in educational institutions (aged four years and above), of which 22 percent are attending university.

6.7. INFRASTRUCTURE AND COMMUNITY ACCESS TO SERVICES

6.7.1. TRANSPORTATION

Sharjah Emirate has reasonably well developed transport infrastructure. Sharjah city has a problem with vehicular traffic congestion during rush hours especially the roads leading to and from the Emirate of Dubai. The role of the Sharjah Public Transport Corporation (SPTC) is to reinforce public transportation, setting its policies and find strategic solutions for smooth traffic, providing modern and professional transport services to the passengers, driving Sharjah Emirate or on the InterCity routes, between all emirates in UAE. There are two major series of highways in Sharjah, which are "E" and "S". E represents roads connecting other emirates and S for roads within the emirates. The major roads in the emirate of Sharjah include:

- E 11 - Al Ithihad Road - connecting Dubai, Ajman and RAK.
- E 311 - Sheik Mohammad Bin Zayed Road - connecting Dubai, Ajman and RAK.
- E 611 - Emirates Road - connecting Dubai, Ajman and RAK

- E 88 - Al Dhaid Road connecting the Emirate of Fujairah.
- E 102 - Sharjah - Kalbah Road - Connecting Fujairah and Kalba.
- S 12 - Maliha Road

The project site is well connected by road network. The road S101 (Al Meena Street) leading from project site connects the road S108 (Al Khan Street) and it connects the Emirate road E11 at a distance of around 4.5 km (road distance) on ESE. The E11 emirate road connects the important cities of all emirates. The level of service of the adjacent roads is moderate during peak hours and good during non-peak hours.

The project site is well accessible by air and sea route. Sharjah Khalid Port is located adjacent to the project site. The Sharjah International Airport is located at the distance of about 12.5 km on East direction.

6.7.2. WASTE AND ITS MANAGEMENT

Sharjah set up a municipal waste management company Bee'ah (the Arabic word for environment) in 2007 in the form of a public private partnership. In 2011, the emirate announced an ambitious plan for "Zero Waste to Landfill" in line with the vision of His Highness Dr. Sheikh Sultan bin Mohammed Al Qasimi, Member of the Federal Supreme Council and Ruler of Sharjah, to be the leading environmental city in the Middle East. To attain this goal, Bee'ah developed a state-of-the-art Waste Management Centre, one of the world's largest waste management plants to process and recycle different materials including construction waste, medical waste, used vehicles, used tires, metal waste, e-waste and organic waste. Since 2012, the company has been introducing recyclable waste collection systems, along with a new tipping fee structure set in cooperation with the Sharjah City Municipality to incentivize waste reduction and to closely regulate landfill contents. It has established more than 1,700 three-stream recycling bins for residents to encourage the community to separate between paper, plastics and cans, and general waste. Tandeef, a waste collection division of Bee'ah, has distributed blue recycling bins and totes among over 4,500 offices, and introduced a range of unique services. The "You Call, We Haul" free service comes to pick up bulky waste such as furniture and appliances. Bee'ah also provides services for safely destroying and recycling confidential data and documents. The recovery rate or the diversion rate of waste in Sharjah has steadily risen from around 53% in 2012 to 70% in 2015, as waste has been recycled or recovered. The emirate is set to become the first Arab city to divert 100% of its waste from landfill within the next few years. *[Source: UAE - State of Green Economy report, 2016]*.

The wastes (domestic waste, non-hazardous & hazardous industrial wastes) generated in the emirate of Sharjah are being collected by Bee'ah for better waste management to achieve zero waste to landfill.

7. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS

7.1. GENERAL METHODOLOGY

Impact assessment describes identification and appraisal of various impacts due to the proposed project. "Environmental and Social Impact" can be defined as any alteration of environmental conditions and society or creation of a new set of environmental and social conditions, adverse or beneficial, caused or induced by the action or set of actions under consideration. Generally, the environmental and social impacts can be categorized as either primary or secondary:

- Primary impacts are those, which are attributed directly by the project
- Secondary impacts are those, which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed action

The impact of the proposed project has been assessed by using Environment and Social Impact Assessment Matrix. The environmental and social impact assessment matrix considers the three basic elements:

- A listing of the effects on the environment and society which would be caused by the proposed development, and an estimate of the *magnitude* of each.
- An evaluation of the relative *importance* of the potential (sensitive) receptors.
- Effect – Significance of the impact - combining of *magnitude* and *importance* estimates in terms of a summary evaluation.

Generic criteria for the definition of magnitude and sensitivity are presented in **Section 3.4.3** of the report**.** In addition to the general criteria for determining magnitude of impact, additional criteria are determined for specific environmental components in the report.

Sensitive receptors – It can be described as features that are notable in some way, whether due to their local or national importance or if they are especially sensitive to changes. Typically, sensitive receptors relate to ecological or human receptors (habitats, species, population centres) as well as geographical phenomenon or structures (Sensitive receptors/Valuable Ecosystem components are already identified in **Section 6.2**)

Significance of the effect - Likely impacts are assessed taking into account the interaction between the magnitude and sensitivity criteria to determine the significance of any effect, which may be adverse or beneficial, as presented in **Table 14.** Major or moderate effects are considered as significant.

7.2. ENVIRONMENTAL IMPACTS WITH EMBEDDED MITIGATIONS

Embedded mitigation measures considered while evaluating the impact. 'Embedded mitigation' describes the features of the design that avoid or reduce adverse environmental impacts. It is taken into account in the assessment of impacts. Wherever possible, mitigation for potential impacts has been identified and incorporated into the design and construction programme by SEWA and EPCC.

7.3. AIR ENVIRONMENT

The impacts of the proposed project during the construction and operation phases have been identified and evaluated using impact assessment methods. The process of air quality impact assessment hereunder described.

7.3.1. ASSESSMENT METHODS

The significance of air quality impacts are determined by the consideration of the following components:

- Regulatory requirement;
- The baseline conditions of the area – The baseline of ambient air quality is characterized based on air quality monitoring data collected in the project site;
- The sensitivity of receptors; and
- Criteria for assessment.

7.3.1.1. Regulatory requirement

In accordance with Equator principles, **United Arab Emirates (UAE)** is a non-designated country, and as such, the assessment process for the project must evaluate compliance with the applicable IFC regulations/guidelines.

The IFC General EHS Guidelines recommend that emissions of the proposed project do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognized sources. As UAE has its own nationally legislated standards (presented in **Table 20**), these have been used to determine the significance of potential ambient impacts. As described above the nationally legislated standards are considered to include suitable averaging periods for the key pollutants emitted from the project and therefore have not be supplemented with additional standards from international sources. In addition to compliance to ambient air quality standard, as a general rule, emissions should not contribute more than 25% of the relevant air quality standards to allow additional, future sustainable development in the same airshed.

7.3.1.2. Summary of air quality baseline conditions

Ambient air quality survey was conducted at 4 locations in the project site continuously for 24 hours. The results of the ambient air quality survey indicate that levels of particulate matter (TSP and PM_{10}) and ozone are found to be significant in the ambient air. Levels of TSP in ambient air of project site ranged from 196 to 223 $\mu g/Nm^3$ which comply with maximum allowable limit (230 $\mu g/Nm^3$) prescribed by UAE - MoCCaE. Levels of PM_{10} ranged from 83 to 115 $\mu g/Nm^3$ which comply with maximum allowable limit (150 $\mu g/Nm^3$). Ozone levels in ambient air ranged from 58.9 to 78.5 mg/Nm^3 which are also in compliance with maximum allowable limit (150 mg/Nm^3). Other pollutants in the ambient air are less or not detectable and are well within maximum allowable limits prescribed by UAE-MoCCaE.

Perusal on last 5 years data, most prevalent wind flowing directions in Sharjah region is North-western directions, East, West & South-eastern and average wind speed is 7.5 miles per hour (breeze – constantly moving air).

7.3.1.3. Sensitivity of the receptors

Sensitive receptors in relation to air quality are presented in **Table 66**.

Table 66 – Details of sensitive receptors in relation to air quality

Receptor Type	Sensitivity	Name of the receptor	Aspects
Construction phase			
High density residential block	High (Type 1 area)	Al Layyah suburb Al Marijah suburb Al Khaleidia suburb	Residents have the potential to be exposed by particulate matter (TSP & PM_{10}) as well as deposited dust as a result of construction activities.
School premises	High (Type 1 area)	American School of Creative Science Manar Al Sabeel Quran Center Canadian Montessori Nursery	School residents have the potential to be exposed by particulate matter (TSP & PM_{10}) as well as deposited dust as a result of construction activities.

Receptor Type	Sensitivity	Name of the receptor	Aspects
		Arabian Gulf School British Islamic Nursery Al Khan School	
Commercial buildings and other public areas	Moderate (Type 2 area)	Golden Beach Motel Sahara Beach Resort Marhaba Resort	Visitors/guests have the potential to be exposed by particulate matter (TSP & PM_{10}) as well as deposited dust as a result of construction activities.
Industry	Marginal (Type 4 area)	Onsite workers/ personnel	Exposure to dust/particulate matter generated by construction activities can cause health implications Combustion emissions generated by the operation of fuel fired construction equipment/machinery
Operation phase			
High density residential block	High (Type 1 area)	Al Layyah suburb Al Marijah suburb Al Khaleidia suburb Al Majaz Al Majaz 1	Residents have the potential to be exposed by emissions generated by operation of gas turbines.
School premises	High (Type 1 area)	American School of Creative Science Manar Al Sabeel Quran Center Canadian Montessori Nursery Arabian Gulf School British Islamic Nursery Al Khan School	School residents have the potential to be exposed by to be exposed by emissions generated by operation of gas turbines.
Hospital premises	High (Type 1 area)	Al Zahra Hospital Zuleka Hospital	Exposure of emissions generated by power plant can worsen the heath conditions of patients.
Heritage Area	Moderate (Type 2)	Sharjah Heritage Area Sharjah Art Museum	Prolonged exposure to particulates and combustion emissions produced by the power plant can deteriorate the heritage materials
		Wasit Natural Reserve	Prolonged exposure to particulates and combustion emissions produced by the power plant can deteriorate the natural

Receptor Type	Sensitivity	Name of the receptor	Aspects
			reserve.
		Golden Beach Motel	Visitors/guests have the potential to be exposed by emissions generated by operation of gas turbines.
		Sahara Beach Resort	
		Marhaba Resort	

7.3.1.4. Assessment methodology and criteria

7.3.1.4.1. Construction phase air quality impacts

Air quality impacts for the project during construction phase are assessed in a qualitative manner following WBG-IFC EHS guidelines and guidance document of Institute of Air Quality Management, London -UK[26]. Dust emission impact is assessed based on the following steps in accordance with IAQM:

STEP 1 (Screening) is to screen the requirement for a more detailed assessment. No further assessment is required if there are no receptors within a certain distance of the works. Construction impacts will be located in close proximity to the project site and will not extend beyond 500m from any construction or decommissioning activity as construction activities lead to the generation of large particles that are unable to travel large distances and therefore usually deposit with 100-250m. This assessment has assumed that particles have the potential to deposit as far as 500 m from the site boundary of access road to take account of dry conditions and to provide a conservative assessment. An assessment will normally be required where there is a 'human receptor' within 350 m of the boundary of the site; or- 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s) and an 'ecological receptor' within 50 m of the boundary of the site; or 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

STEP 2 (Dust risk assessment) is to assess the risk of dust impacts. This is done separately for each of the four activities (demolition; earthworks; construction; and track out) and takes account of the scale and nature of the works, which determines the potential dust emission magnitude, and the sensitivity of the area.

The risk of dust arising in sufficient quantities to cause annoyance and/or health and/or ecological impacts should be determined using four risk categories: negligible, minor, moderate and major risk. A site is allocated to a risk category based on the scale and nature of the works, which determines the potential dust emission magnitude as low, moderate or major, and the sensitivity of the area to dust impacts. These two factors are combined in to determine the risk of dust impacts.

[26] *Holman et al., 2014. Guidance on assessment of dust from demolition and construction. Institute of Air Quality Management, London (www.iaqm.wp-content/uploads/guidance/dust_assessment.pdf)*

7.3.1.4.2. Operation phase air quality impacts

In accordance with best practice, potential impacts of emissions from operation of the plant on ambient air quality have been assessed within 10 km of the project by atmospheric dispersion modeling system. The contributions of stack emissions from the project during operation phase have been quantitatively assessed using an air dispersion model, Lakes Environmental – AERMOD.

7.3.1.4.2.1. Green House Gas Emission Estimation

For Scope 1, GHG emissions calculation is based on the international guidelines. The main document used is Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, 2006 (2006 IPCC Guidelines).

7.3.1.4.3. Assessment criteria

Based on the assessment, criteria for determining the air quality impact is defined, and described in **Table 67**.

Table 67 – Assessment criteria to determine magnitude for air quality

Magnitude	Criteria and Increase of pollutants as % of standard
Major	Environmental effects are noticeable and are sufficient to destabilize the resource. Regional/national/international change/effect. The contribution by the proposed project to sensitive receptors may increase the pollutant level more than 50% of the limit prescribed by MoCCAE.
Moderate	Environmental effects are sufficient to noticeably alter important attributes of the resource but not to destabilize them. Change/Effect to local condition and or to areas immediately outside. The contribution by the proposed project to sensitive receptors may increase the pollutant level more than 25 - 50% of the limit prescribed by MoCCaE.
Minor	Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. Change/effect only within the project site. The contribution by the proposed project to sensitive receptors may increase the pollutant level more than 5 - 25% of the limit prescribed by MoCCaE.
Negligible	Results in an impact on feature but of insufficient magnitude to affect the use or integrity of the element. The effect would

Magnitude	Criteria and Increase of pollutants as % of standard
	lead to no observable change in the component. The contribution by the proposed project to sensitive receptors may increase the pollutant level of less than 5% of the limit prescribed by MoCCaE.

7.3.2. IMPACT ON AIR ENVIRONMENT DURING CONSTRUCTION PHASE

7.3.2.1. Identification of air quality impacts

The various activities during construction phase include site preparation, construction of approach roads, excavation, drilling, foundation, deployment of machinery, erection, transportation, dumping, and nature of site condition may generate dust and gaseous emissions. These emissions are expected to result in the change in baseline air quality, primarily in the working area and cause an immediate effect on the construction workers. Dust and other emissions are not likely to spread on the broader region, which would affect the site itself. The primary emissions during construction activities will be the following:

- Combustion emissions from vehicles and heavy equipment;
- Combustion emissions from generators;
- Dust emissions from vehicular movement and heavy equipment activities;
- Dust emissions from mechanical activities and material handling

7.3.2.2. Evaluation of air quality impacts

7.3.2.2.1. Combustion from Vehicles and Heavy Equipment

Mobile sources of emissions in the construction phase include vehicles and heavy equipment such as moving cranes, excavators, compressors etc. Vehicles for the transport of workers, materials and other resources will also contribute emissions. Emissions from these mobile sources depend on various factors such as chemical composition of fuel (e.g. sulfur), vehicle load, engine maintenance condition and travel speed.

7.3.2.2.2. Combustion Emissions from Generators

For construction activities, generators are mainly used to supply the power requirements of construction equipment (e.g. drill, welding machine). During its operation, the generator will release combustion emissions due to the consumption of diesel fuel. Expected emissions include NOx, CO, SOx and other hydrocarbons. This generator should the need be required, will be equipped with a suitable spark arrestor. If a 250-kVA generator will be used for the construction works, the expected emissions will be as follows (Ref: Caterpillar Technical Data for 250 kVA generator):

- NOx will be 25-50 mg/Nm^3;
- CO will be 90-100 mg/Nm^3; and
- SOx emissions will depend on the percentage of sulphur in the fuel used.

The construction activities are temporary in nature. In addition, mixing of the combustion emissions with the ambient air facilitates dispersion; thus, impact on air environment is considered as localized, reversible and short duration of time.

7.3.2.2.3. Dust Emissions

Dust will be generated from excavation and backfilling activities which are dust-intensive operations. The airborne dust may contain crystalline silica that can pose health hazards to construction workers exposed to these particles. Dust from vehicle and machine movements is deemed significant since paved and unpaved road network in the project study area will be utilized for the transportation of construction materials to and from the site.

Fugitive dust emissions sources include the transfer of sand and aggregate, truck loading, mixer loading, wind erosion from sand & aggregate storage piles and mechanical activities such as mixing, cutting, grinding and sawing. The amount of fugitive dust emissions generated during the transfer of sand and aggregate depends primarily on the surface moisture content of these materials. The airborne dust may contain crystalline silica that can pose health hazards to construction workers exposed to these particles. Dust emissions from truck movement on unpaved roads have been found to vary directly with the fraction of silt in the road surface materials. According to US-EPA emission factors (Chapter 13.2.2 – Unpaved roads), the estimated fugitive dust emission generated from truck movement unpaved road will be 2.5 kg of TSP/vehicle kilometer travelled (VKT) and 0.84 kg of PM_{10}/VKT (Silt content is considered as 20% in average and weight of truck is considered as 15 Ton in average).

The impact magnitude of construction activities is conservatively described as 'major' for the whole construction period in accordance with activities. However, not all construction activities have a high dust raising potential and therefore it can be considered that potential dust episodes may only occur over short periods, and not throughout the whole construction phase. **Figure 40** presents the project area with associated dust buffers.

Figure 40 – Construction dust buffers for main construction site

As shown in **Figure 40**, there are no high or moderate receptors within 250m of the dust buffer area. Golden beach hotel is situated in the 500m dust buffer zone. The expected impact on Golden beach hotel will assessed as moderate.

Construction traffic will use the local road network and therefore has the potential to generate dust in residential areas and communities.

7.3.2.3. Embedded mitigation measures during construction phase

The following dust suppression measures and good site practices are recommended for the construction phase and taken into account when assessing the significance of potential impacts:

- Erection of minimum 2m high site hoardings around the site boundary;
- Water spraying of or covering all exposed areas and stockpiles;
- Specifying transport networks and locating stockpiles as far away from the site boundary which is close to the air sensitive receptors, as practicable to minimize the impact of air pollutants and dust;
- Minimizing the size of exposed areas and material stockpiles and the periods of their existence;
- Temporary stockpiles of dusty materials will be either covered entirely by impervious sheets or sprayed with water to maintain the entire surface wet all the time;

- Covering the construction materials transported by trucks or vehicles entirely to prevent dust emissions;
- Controlling the height of unloading the fill materials during filling as far as possible. Where possible, this should be well below the height of the hoardings along the Project site boundary;
- Watering the main haul road regularly to suppress dust emissions during truck movement;
- Prohibiting the burning of waste or vegetation on site;
- Compacting the reclaimed land immediately to avoid fugitive dust emissions;
- Maintaining and checking the construction equipment regularly;
- Switching off engines when idling; and
- Using commercial available low sulphur diesel for trucks and diesel-fuelled construction equipment.

Table 68 – Summary of environmental aspects and probable impacts on air quality during construction phase

Environmental Aspects	Probable Environmental Impacts	Impacted Receptor	Magnitude of Impact	Sensitivity of Receptor	Effect (Magnitude × Sensitivity)
Generation of fugitive dust emissions due to truck transport of debris on unpaved roads; truck unloading of debris; Earthworks operations: and windblown dust from stockpiles	Dust deposition and air pollution	Project Site/ Onsite workers	Moderate	Moderate	Moderate
Exhaust emissions of combustion gases due to operation of fuel fired equipment/machinery	Air pollution - Increase in NO_X, SO_2, CO, VOCs in ambient air due to combustion emissions	Project Site/ Onsite workers	Minor	Moderate	Minor
Generation of fugitive dust emissions due to truck transport of debris on unpaved roads; truck unloading of debris; Earthworks operations: and windblown dust from stockpiles	Dust deposition and air pollution	Residential areas	Minor	High	Minor
		School premises	Minor	High	Minor
		Hospitals	Minor	High	Minor
		Heritage areas	Minor	Moderate	Minor
		Commercial Destination – Golden Beach Resort	Moderate	Moderate	Moderate

7.3.3. IMPACT ON AIR ENVIRONMENT DURING OPERATION PHASE

7.3.3.1. Identification of operation phase air quality impacts

The identified environmental aspects for causing air environment during operation phase are mainly stack emissions from gas turbines. The main air pollutant of concern for a fuel gas/fuel oil-fired combined cycle power plant are nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matters (PM) and Green House Gases (GHGs)

The proposed project consists of two sets of gas turbine & generating unit, two sets of heat recovery steam generator (HRSG) and one steam turbine generating unit with associated auxiliary equipment. The project will be designed to operate continuously throughout the year in either simple cycle or combine cycle mode. Each gas turbine is equipped with one bypass stack for simple cycle mode and one main HRSG stack for combined cycle mode. During normal operation of the proposed project, the plant will be operated in combined cycle mode and the main HRSG stack will be in operation. Bypass stack may be operated in simple cycle mode during maintenance of HRSG. The main HRSG stack (2 Nos. – each one per HRSG) and the bypass stack (2 Nos. – each one per GT) will not be operating concurrently at any time.

7.3.3.2. Evaluation of operation phase air quality impacts

The operation phase impact due to emission from stack is evaluated by air quality dispersion modeling to determine the dispersion of emissions from a stack by the emission characteristics of the source, particularly their temperature and velocity when they exit the stack.

7.3.3.2.1. Stack Height Determination

For proper dispersion to occur, it is necessary for the emissions to be released well above the top of nearby structures. In accordance with WBG-IFC requirement, stack heights shall be generally designed according to Good International Industry Practice (GIIP) formula to avoid excessive ground level concentrations and minimize impacts, including acid deposition. In line with requirement of WBG-IFC GIIP formula, a minimum height required for the stack will be **65m** considering steam turbine building which has 28m height and 24.2m lesser dimension.

7.3.3.2.2. Impact of stack emissions

Air quality dispersion modeling was performed for the dispersion of pollutants in the ambient air. The emission details of main HRSG stack and bypass stack (modeling input data) are presented in **Table 38**.

Modeling has been undertaken assuming the determined stack height for the future operational scenarios. The following scenarios have been considered for the assessment:

Scenario 1 – Combined cycle operation with fuel gas combustion – HRSG stacks are in operation and bypass stacks are on stand-by;

Scenario 2 - Combined cycle operation with fuel oil combustion – HRSG stacks are in operation and bypass stacks are on stand-by;

Scenario 3 - Simple cycle operation with fuel gas combustion – Bypass stacks are in operation and HRSG stacks are on stand-by; and

Scenario 4 - Simple cycle operation with fuel oil combustion – Bypass stacks are in operation and HRSG stacks are on stand-by.

In the present case, model simulations have been carried out for the whole year. For the short-term simulations, the concentrations have been estimated for receptors to obtain an optimum description of variations in concentrations over the site in 10-km radius covering 16 directions. Perusal on air quality modeling results reveal that the maximum incremental short-term 24 hourly ground level concentrations for particulate matter, SO_2 NOx and CO likely to be encountered in the operation of the proposed project are given in **Table 69**.

In addition to that maximum ground level concentrations, project contributions to the sensitive receptors are also analyzed for confirming the requirement of World Bank Group – IFC EHS guidelines. It suggested that emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same air shed.

According to the modeled results, the maximum GLC is found occurring at a distance of about 0.49-km in the SE direction which is in project site boundary. The perusal of the modeled results, stack emissions from the proposed project contributes more SO_2 to ambient air than other pollutants. The contribution levels of pollutants to the ambient are in the order of SO_2>CO>NO_2>PM. Based on the predicted maximum increase of pollutant level within project boundary and baseline air quality, the resultant AAQ levels after implementation of the proposed project will remain within the permissible limits. The expected impact will be minor effect. The identified impact on air environment at project site will be localized, minor magnitude, long-term and reversible.

The incremental short-term 24 hourly ground level concentrations for particulate Matter, SO_2 NO_2 and CO in the nearby sensitive receptors are given in **Table 70**. It is estimated that impact due to the increase of pollutant level in the sensitive receptors will be negligible to minor (16.5% increase of SO_2 as of the standard in Layyah and Marijah residential area). It clearly indicates that there is minor impact due to the proposed project in the nearby sensitive receptor. The project contributions to sensitive receptors comply with the recommended norms of World Bank Group – IFC EHS guidelines that emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed. Hence, identified impact on air environment at nearby sensitive receptors will be insignificant, minor magnitude, long-term and reversible.

Table 69 – Resultant Concentrations due to Maximum Incremental GLC's for combined cycle fuel gas combustion

Pollutants	Scenarios	24 hour Incremental GLC Concentration (Max.) (µg/m^3)	Location, Distance (km) and Direction from source	% of increase as of standard	Baseline Concentration (µg/m^3) - Max	Resultant Concentration (µg/m^3)	UAE-MoCCAE Prescribed Limit (µg/m^3)
Particulate Matter (PM)	Combined Cycle – Fuel Gas (CC-FG)	3.58	Project Site Boundary 0.49 (SE)	1.56	223.0	226.58	**230**
	Combined Cycle – Fuel Oil (CC-FO)	3.07		1.33		226.07	
	Simple Cycle - Fuel Gas (SC-FG)	1.16	1.28 (SE)	0.50		224.16	
	Simple Cycle - Fuel Oil (SC-FO)	1.66	0.93 (SE)	0.72		224.66	
SO_2	CC-FG	44.83	0.49 (SE)	29.89	26.2	74.72	**150**
	CC-FO	31.76		21.17		57.96	
	SC-FG	14.59	1.28 (SE)	9.73		40.79	
	SC-FO	17.16	0.93 (SE)	11.44		43.36	
NO_2	CC-FG	8.78	0.49 (SE)	5.85	18.8	27.58	**150**
	CC-FO	7.88		5.25		26.68	
	SC-FG	2.88	1.28 (SE)	1.92		21.68	
	SC-FO	5.48	0.93 (SE)	3.65		24.28	

Pollutants	Scenarios	24 hour Incremental GLC Concentration (Max.) (µg/m^3)	Location, Distance (km) and Direction from source	% of increase as of standard	Baseline Concentration (µg/m^3) - Max	Resultant Concentration (µg/m^3)	UAE-MoCCAE Prescribed Limit (µg/m^3)
CO	CC-FG	17.20	0.49 (SE)	0.17	1,000	1,017.20	**10,000**
	CC-FO	9.14		0.09		1007.14	
	SC-FG	5.60	1.28 (SE)	0.05		1005.60	
	SC-FO	6.36	0.93 (SE)	0.06		1006.36	

Table 70 – Resultant Concentrations due to Incremental GLC's in the Sensitive Receptors (Combined cycle – Fuel gas combustion)

Name of the Receptor	Pollutant	Project Contribution (PC) – 24hour (µg/m^3) [Max.]	% of AAQ Standard	Impact Magnitude	Receptor Sensitivity	Effect
Al Layyah suburb	TSP	2.0	0.86	Minor	High	Minor
	SO_2	20.8	16.5			
	NO_2	4.9	3.3			
	CO	9.5	0.10			
Al Marijah suburb	TSP	2.0	0.86	Minor	High	Minor
	SO_2	23.2	16.5			
	NO_2	4.9	3.3			
	CO	9.5	0.10			
Al Khaleidia suburb	TSP	1.2	0.53	Minor	High	Minor
	SO_2	14.1	10.2			
	NO_2	3.0	2.0			
	CO	5.9	0.06			
Al Majaz	TSP	0.4	0.18	Negligible	High	Neutral

Name of the Receptor	Pollutant	Project Contribution (PC) – 24hour (μg/m³) [Max.]	% of AAQ Standard	Impact Magnitude	Receptor Sensitivity	Effect
	SO_2	4.7	3.4			
	NO_2	1.0	0.7			
	CO	1.9	0.02			
Al Majaz 1	TSP	1.0	0.45	Minor	High	Minor
	SO_2	11.9	8.6			
	NO_2	2.5	1.7			
	CO	4.9	0.05			
American School of Creative Science	TSP	1.6	0.72	Minor	High	Minor
	SO_2	18.6	13.8			
	NO_2	4.1	2.7			
	CO	7.9	0.08			
Manar Al Sabeel Quran Center	TSP	1.2	0.52	Minor	High	Minor
	SO_2	14.1	9.9			
	NO_2	2.9	2.0			
	CO	5.7	0.06			
Canadian Montessori Nursery	TSP	0.9	0.39	Minor	High	Minor
	SO_2	10.6	7.5			
	NO_2	2.2	1.5			
	CO	4.3	0.04			
Arabian Gulf School	TSP	1.3	0.56	Minor	High	Minor
	SO_2	14.9	10.7			
	NO_2	3.2	2.1			
	CO	6.1	0.06			
British Islamic Nursery	TSP	0.8	0.37	Minor	High	Minor
	SO_2	10.2	7.0			

Name of the Receptor	Pollutant	Project Contribution (PC) – 24hour ($\mu g/m^3$) [Max.]	% of AAQ Standard	Impact Magnitude	Receptor Sensitivity	Effect
	NO_2	2.1	1.4			
	CO	4.1	0.04			
Al Khan School	TSP	0.8	0.35	Minor	High	Minor
	SO_2	9.8	6.7			
	NO_2	2.0	1.3			
	CO	3.9	0.04			
Al Zahra Hospital	TSP	0.7	0.29	Minor	High	Minor
	SO_2	7.9	5.5			
	NO_2	1.6	1.1			
	CO	3.2	0.03			
Zuleka Hospital	TSP	0.2	0.10	Negligible	High	Neutral
	SO_2	2.7	1.9			
	NO_2	0.6	0.4			
	CO	1.1	0.01			
Sharjah Heritage Area	TSP	1.7	0.74	Minor	Moderate	Minor
	SO_2	19.3	14.2			
	NO_2	4.2	2.8			
	CO	8.1	0.08			
Sharjah Art Museum	TSP	0.5	0.20	Negligible	Moderate	Neutral
	SO_2	5.5	3.8			
	NO_2	1.1	0.8			
	CO	2.2	0.02			
Wasit Natural Reserve	TSP	0.1	0.06	Negligible	High	Neutral
	SO_2	1.6	1.1			
	NO_2	0.3	0.2			

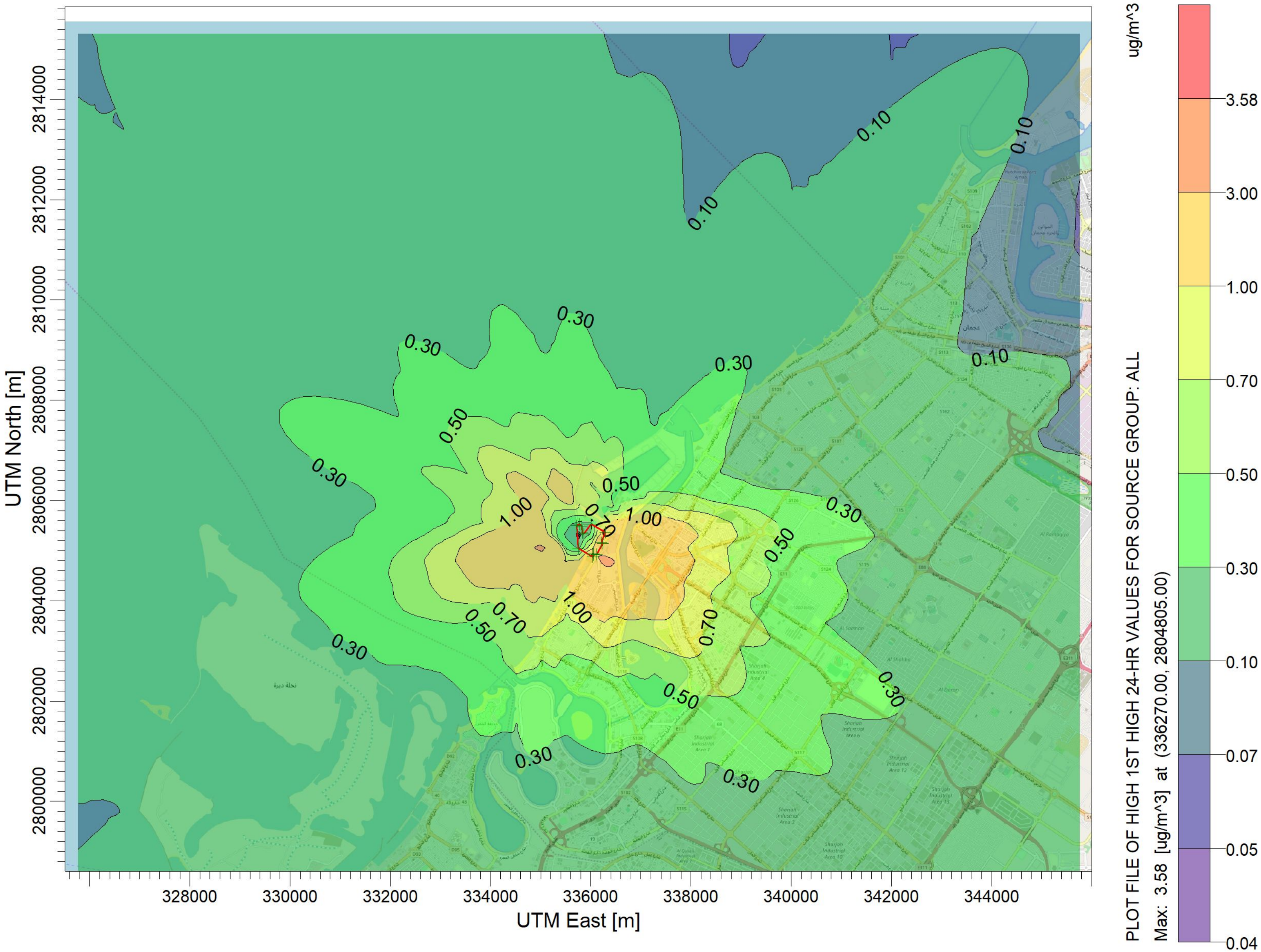
Name of the Receptor	Pollutant	Project Contribution (PC) – 24hour (μg/m^3) [Max.]	% of AAQ Standard	Impact Magnitude	Receptor Sensitivity	Effect
	CO	0.6	0.01			
Golden Beach Motel	TSP	2.3	1.00	Minor	Moderate	Minor
	SO_2	28.6	19.1			
	NO_2	5.7	3.8			
	CO	11.0	0.11			
Sahara Beach Resort	TSP	2.1	0.91	Minor	Moderate	Minor
	SO_2	26.3	17.5			
	NO_2	5.2	3.5			
	CO	10.1	0.10			
Marhaba Resort	TSP	1.8	0.80	Minor	Moderate	Minor
	SO_2	23.1	15.4			
	NO_2	4.6	3.0			
	CO	8.9	0.09			

Figure 41 – Short Term 24 Hourly Incremental GLC's of Particulate Matter (μg/m^3)

(Combined cycle – Fuel gas combustion)

PROJECT TITLE:

SEWA-Combined Cycle Power Project
Dispersion of Particulate matter



COMMENTS:

SOURCES:
2

RECEPTORS:
6595

OUTPUT TYPE:
Concentration

MAX:
3.58 ug/m^3

COMPANY NAME:
Environmental Solutions and Consultancy

SCALE: 1:120,392

0 4 km

Environmental Solutions and Consultancy

PROJECT NO.:

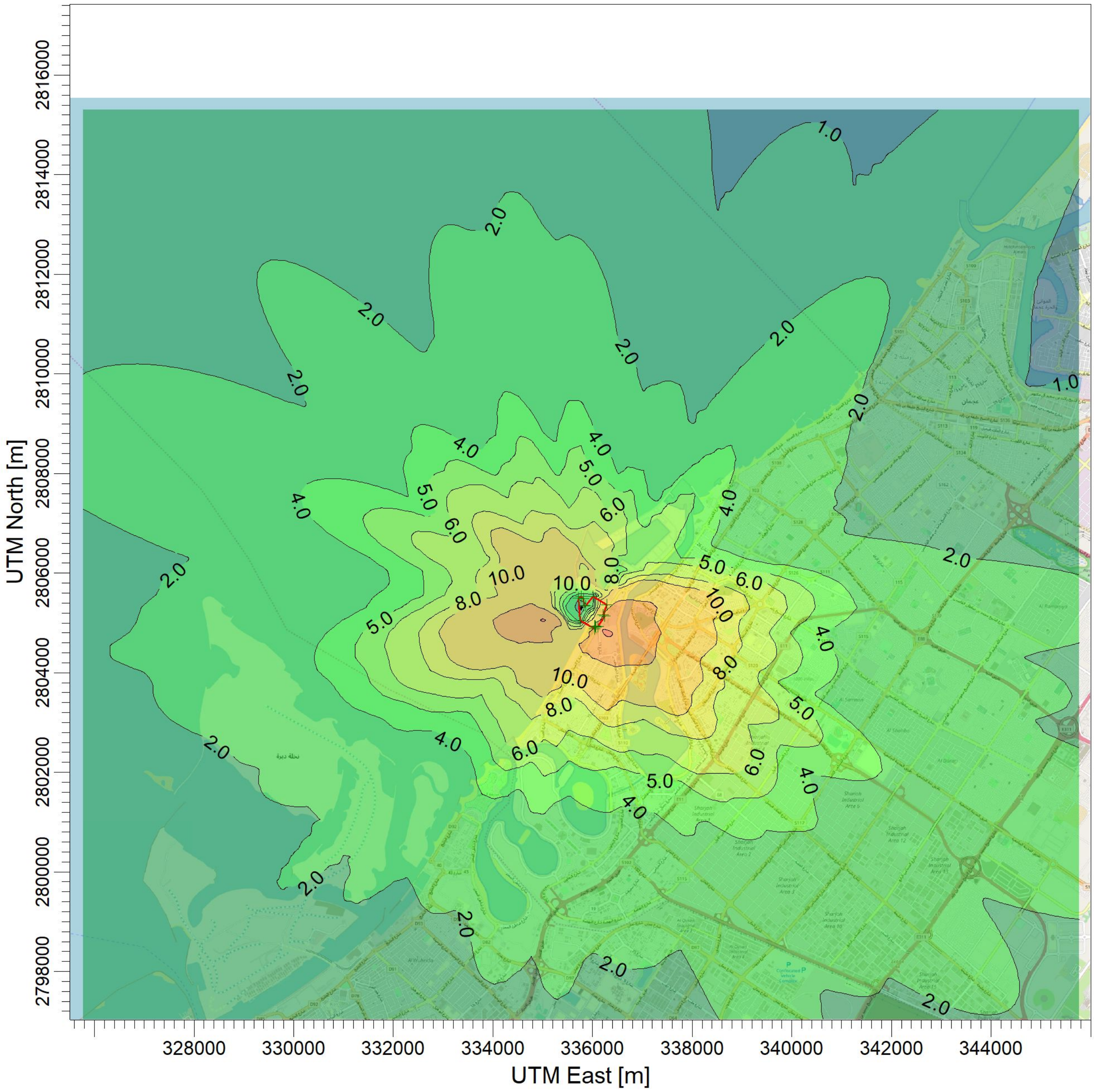
AERMOD View - Lakes Environmental Software

Figure 42 – Short Term 24 Hourly Incremental GLC's of SO_2 ($\mu g/m^3$)

(Combined cycle – Fuel gas combustion)

PROJECT TITLE:

SEWA-Combined Cycle Power Project
Dispersion of Sulphur dioxide



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 44.8 [ug/m^3] at (336270.00, 2804805.00)

0.4 | 0.5 | 0.6 | 0.8 | 1.0 | 2.0 | 4.0 | 5.0 | 6.0 | 8.0 | 10.0 | 20.0 | 40.0 | 44.8

COMMENTS:	SOURCES: **2**	COMPANY NAME: **Environmental Solutions and Consultancy**
	RECEPTORS: **6595**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:132,377 0 — 5 km
	MAX: **44.8 ug/m^3**	PROJECT NO.:

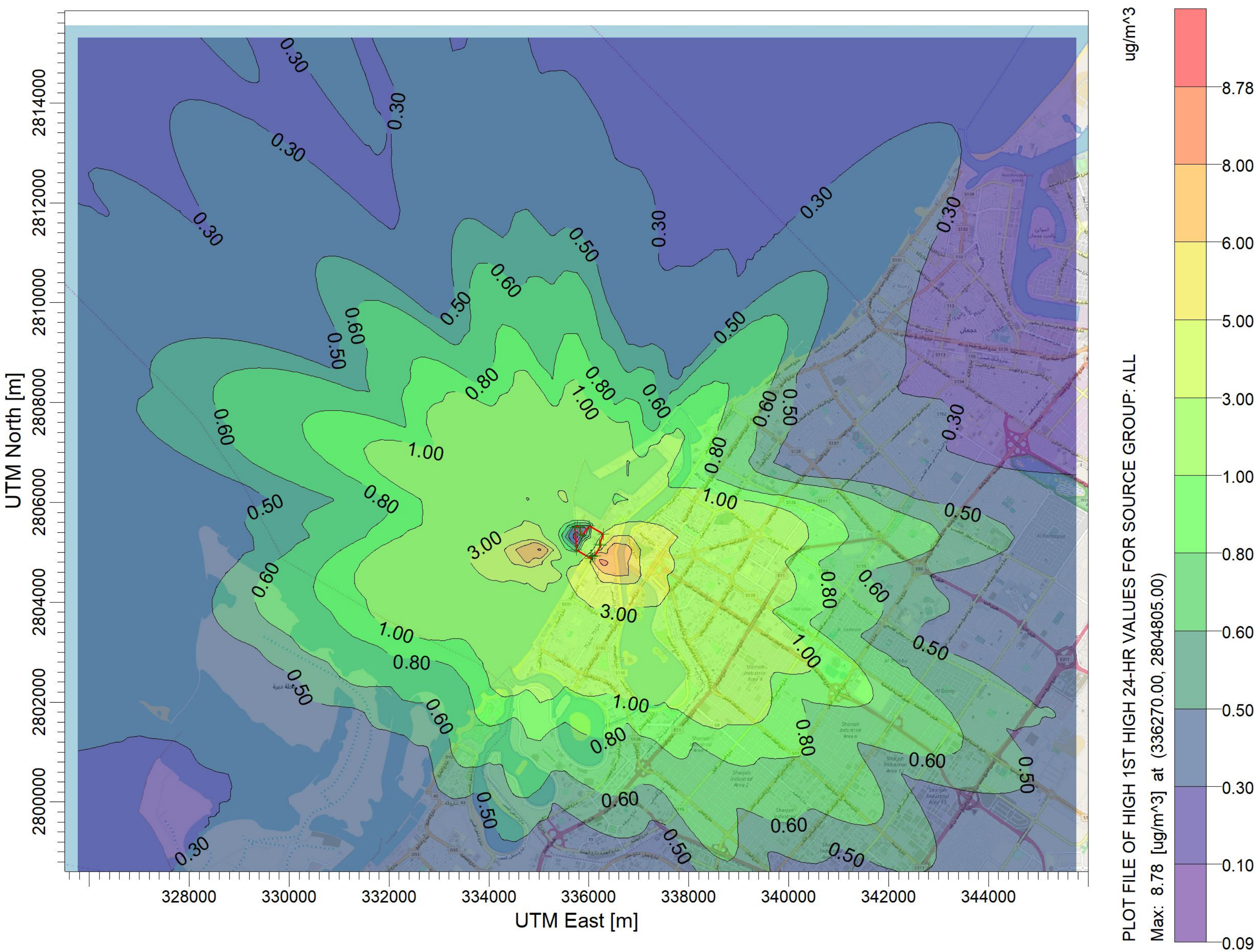
Environmental Solutions and Consultancy

AERMOD View - Lakes Environmental Software

Figure 43 – Short Term 24 Hourly Incremental GLC's of NOx ($\mu g/m^3$)
(Combined cycle – Fuel gas combustion)

PROJECT TITLE:

SEWA-Combined Cycle Power Project
Dispersion of Nitrogen dioxide



COMMENTS:

SOURCES:

2

RECEPTORS:

6595

OUTPUT TYPE:

Concentration

MAX:

8.78 ug/m^3

COMPANY NAME:

Environmental Solutions and Consultancy

SCALE: 1:120,392

0 4 km

Environmental Solutions and Consultancy

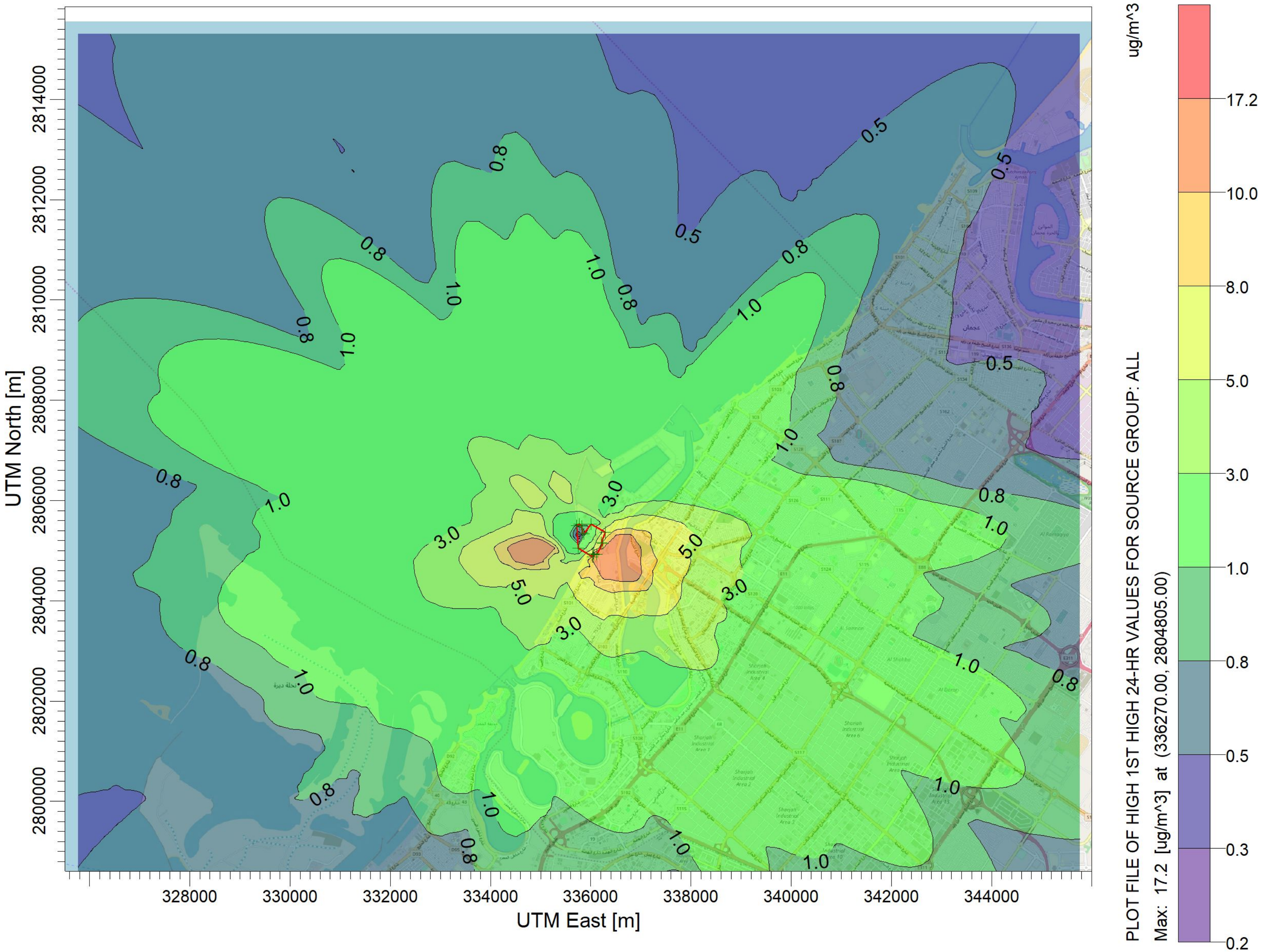
PROJECT NO.:

AERMOD View - Lakes Environmental Software

Figure 44 – Short Term 24 Hourly Incremental GLC's of CO ($\mu g/m^3$)
(Combined cycle – Fuel gas combustion)

PROJECT TITLE:

SEWA-Combined Cycle Power Project
Dispersion of Carbon dioxide



COMMENTS:

SOURCES:

2

RECEPTORS:

6595

OUTPUT TYPE:

Concentration

MAX:

17.2 ug/m^3

COMPANY NAME:

Environmental Solutions and Consultancy

SCALE: 1:120,392

0 4 km

PROJECT NO.:

AERMOD View - Lakes Environmental Software

7.3.3.2.3. Green House Gas Emissions

During operation phase, electricity for the power plant will be supplied by the Plant itself, so there would be no Scope 2 emissions to consider. Scope 1 emissions of GHG from the plant operation will mainly come from fuel gas/fuel oil-fired gas turbine generators. The gas turbine will use natural gas as the primary fuel and fuel oil as supplementary fuel. The details of fuel consumption for the operation of power plant are provided in **Table 71**.

Table 71 – Details of Fuel Consumption

S. No.	Name of Fuel	Nature	Quantity to be required
1	Natural Gas – Primary fuel	Gas	189.4 Ton/hr
2	Light Fuel Oil – Supplementary fuel	Liquid	160 m^3/hr

Greenhouse gas emissions are estimated based on the following equation:

$$\textbf{\textit{Emissions}}_{\textbf{\textit{GHG, fuel}}} = \textit{Fuel Consumption}_{\textit{fuel}} \times \textit{Emission Factor}_{\textit{GHG, fuel}}$$

Where:

Emissions $_{\text{GHG, fuel}}$ = emissions of a given GHG by type of fuel (kg GHG);

Fuel Consumption $_{\text{fuel}}$ = amount of fuel combusted (TJ)

Emission Factor $_{\text{GHG, fuel}}$ = default emission factor of a given GHG by type of fuel (kg gas/TJ). For CO_2, it includes the carbon oxidation factor, assumed to be 1.

Fuel Consumption $_{\text{fuel}}$ rate is calculated based on the following equation

$$\textbf{\textit{Fuel Consumption}}_{\textbf{\textit{fuel}}} = \textit{Fuel Consumption}_{\textit{(Gg)}} \times \textit{Net Calorific Value}_{\textit{(TJ/Gg)}}$$

Where:

Fuel Consumption $_{(Gg)}$ = amount of fuel combusted in Gigagram ($\times 10^6$ kg);

Net Calorific Value $_{(TJ/Gg)}$ = Net Calorific Value of fuel (TJ/Gg)

The result of GHG emissions calculations are shown in **Table 72**.

Table 72 – Estimated GHG emissions

S. No.	Source	Fuel Type	Fuel Consumed (TJ/hr)	GHG Emissions (kg CO_2e/hr)			
				CO_2	CH_4	N_2O	Total
Global warming potential for 100-year time horizon				**1**	**28**	**265**	
Default emission factor (kg of GHG/TJ)			**Fuel Gas**	**56,100**	**1**	**0.1**	
			Fuel Oil	**74,100**	**1**	**0.6**	
1	Turbine	Primary fuel	9.10	510,510	9.10	0.91	510,520

S. No.	Source	Fuel Type	Fuel Consumed (TJ/hr)	GHG Emissions (kg CO_2e/hr)			
				CO_2	CH_4	N_2O	Total
		– Fuel Gas					
2		Primary fuel – Fuel Oil	7.60	563,160	7.60	4.56	563,172
GHG emission (tonnes CO_2e/hr)				Fuel gas combustion			**510**
				Fuel oil combustion			**563**
GHG emission (tonnes CO_2e/day)				Fuel gas combustion			**12,252**
				Fuel oil combustion			**13,605**
GHG emission (tonnes CO_2e/year)				Fuel gas combustion			**4,472,155**
				Fuel oil combustion			**4,965,781**

It is anticipated that the daily emission of GHG is estimated to be 12,252 tonnes of CO_2 by fuel gas combustion and 13,605 tonnes of CO_2 by fuel oil combustion. An annual emission of GHG is estimated to be 4,472,155 tonnes of CO_2 by fuel gas combustion and 4,965,781 tonnes of CO_2 by fuel oil combustion.

The estimated GHG emission per kilo watt hour (kWh) electricity generation is 464g CO_2 for fuel gas combustion and 512 g CO_2 for fuel oil combustion. According to UAE state of green economy report 2017, the intensity of electricity generation recorded was 643 gCO_2/kWh in 2014 as reported by International Energy Agency (IEA).

The estimated GHG emissions from the proposed project during operation will exceed the threshold that defines significant emitters of GHGs and EP III (100,000 tonnes CO_2e per year) and IFC PS3 (25,000 tonnes CO_2e per year). Therefore, the project is required to implement measures for GHG reduction, and report annual GHG emissions as per the applicable reference framework.

Table 73 – Summary of environmental aspects and probable impacts on air quality during operation phase

Environmental Aspects	Probable Environmental Impacts	Impacted Receptor	Magnitude of Impact	Sensitivity of Receptor	Effect (Magnitude × Sensitivity)
Generation of fugitive dust emissions due to truck transport of debris on unpaved roads	Dust deposition and air pollution	Project Site/ Onsite workers	Minor	Moderate	Minor
Exhaust emissions of combustion gases due to operation of fuel fired equipment/machinery	Air pollution - Increase in NO_X, SO_2, CO, VOCs in ambient air due to combustion emissions	Project Site/ Onsite workers	Moderate	Moderate	Moderate
Exhaust emissions of combustion gases due to power generation process	Air pollution - Increase in NO_X, SO_2, CO, VOCs in ambient air due to combustion emissions	Project Site/ Onsite workers	Minor	Moderate	Minor
		Residential areas	Minor	High	Minor
		School premises	Minor	High	Minor
		Hospitals	Minor	High	Minor
		Heritage areas	Minor	Moderate	Minor
		Commercial Destination – Golden Beach Resort	Minor	Moderate	Minor

7.4. NOISE ENVIRONMENT

Impacts are considered during construction and operation of the proposed project, in particular:

- Predicted noise and vibration levels from any construction works;
- Noise from the proposed project during operation; and
- An increase in noise associated with traffic attributed to the project.

7.4.1. ASSESSMENT METHOD

The significance of noise quality impacts are determined by the consideration of the following components:

- Regulatory requirement;
- The baseline conditions of the area – The baseline of ambient air level is characterized based on noise level monitoring data collected in the project site;
- The sensitivity of receptors – sensitive receptors are identified and described in **Table 45**; and
- Assessment criteria

7.4.1.1. Regulatory requirement

UAE-MoCCaE air pollution regulation suggested that noise levels should not exceed the maximum allowable levels and maximum span for exposure as mentioned in **Table 17.**

IFC-EHS Guidelines suggested that noise impacts within the specific environments should not exceed the levels presented in **Table 29** or result in a maximum increase in background levels of 3 dB at the nearest sensitive receptors.

7.4.1.2. Summary of baseline noise level at project site

Ambient noise level survey was conducted at 4 locations in the project site continuously for 24 hours. The recorded daytime noise level (Leq) at the project site ranged from 64.3 to 80.9 dB(A), and nighttime noise level (Leq) ranged from 61.6 to 76.4 dB(A). As apparent from the results, noise levels at the project site are significantly higher and those levels are higher than maximum allowable limits prescribed by UAE-MoCCAE except day time noise level recorded at ANQ1 & ANQ 3 monitoring location.

7.4.1.3. Assessment methodology and criteria

The proposed project's contribution to surrounding environment was assessed by sound propagation modeling. Any industrial complex in general consists of several sources of noise in clusters or single. These clusters/single sources may be housed in buildings of different dimensions made of different materials or installed in open or under sheds. In order to predict ambient noise levels due to the cumulative impact of the proposed project, the propagative modeling has been done. For computing the noise levels at various distances with respect to the project, noise levels are predicted using a user friendly model the details of which are elaborated below.

7.4.1.3.1. Sound Propagation Modeling

For an approximate estimation of dispersion of noise in the ambient from the point sources, a standard mathematical model for sound wave propagation is used. The sound pressure level generated by noise source is decreasing with increasing distance from the source due to wave divergence. An additional decrease in sound pressure level with distance from the source is expected due to atmospheric effect or its interaction with objects in the transmission path. Environmental noise propagation is estimated according to ISO 9613-2:1996 - Attenuation of sound during propagation outdoors Part 2: General method of calculation. For hemispherical sound wave propagation through homogenous loss free medium, one can estimate noise levels at various locations, due to different sources using model based on first principles, as per the following equation:

$$Lp_2 = Lp_1 - 20 \text{ Log } (r_2/r_1) \ldots\ldots (1)$$

Where,

Lp_2 and Lp_1 are Sound Pressure Levels (SPLs) at points located at distances r_2 and r_1 from the source. The combined effect of all the sources then can be determined at various locations by the following equation.

$$L\rho_{(total)} = 10 \text{ Log } (10^{(Lp1/10)} + 10^{(Lp2/10)} + 10^{(Lp3/10)} \ldots\ldots) \ldots\ldots (2)$$

Where,

L_{p1}, L_{p2}, L_{p3} are noise pressure levels at a point due to different sources.

Based on the above equations, a user-friendly model has been developed. The details of the model are as follows:

* Maximum number of sources is limited to 200;
* Noise levels can be predicted at any distance specified from the source;
* Model is designed to take topography or flat terrain;
* Coordinates of the sources in meters;
* Maximum and Minimum levels are calculated by the model;

- Output of the model in the form of isopleths; and
- Environmental attenuation factors and machine corrections have not been incorporated in the model but corrections are made for the measured L_{eq} levels.

The magnitude of the impact on noise environment will be determined by the criteria mentioned in **Table 74**.

Table 74 – Assessment Criteria to determine magnitude for noise quality

Magnitude	Criteria – Change in noise level [dB(A)] as % of standard
Major	The contribution by the proposed project may increase noise level more than 10% of limit prescribed by MoCCAE
Moderate	Increase level 5 - 10%
Minor	Increase level 2 - 5%
Negligible	Increase level 1 - 2%
Insignificant	Increase level <1%

7.4.2. IMPACT ON NOISE AND VIBRATION LEVEL DURING CONSTRUCTION PHASE

The identified sources of noise emissions during construction phase are mainly from the cranes, drilling equipment, compressors, generators, pneumatic tools and traffic & transportation. It is planned to deploy the equipment/machinery with inbuilt acoustic enclosure to conform the norms of noise exposure guidelines as per Occupational Safety and Health Administration (OSHA) which is considered as embedded mitigation measure. The noise levels generated by major equipment/machinery to be utilized during the construction phase are presented in **Table 75**.

Table 75 – Assumed Noise Emission Levels of Construction Equipment/Machinery

Name of Equipment/Machinery/ Building	Noise Emission Level – Lmax dB (A) @ 50 feet
Tracked cranes (cranes, elevators, hoists, etc.)	85.0
Air compressors	85.0
Bulldozers/Excavators	85.0
Scrapers/Graders/Dump Truck	85.0
Impact Pile Driver/Vibratory Pile Driver	95.0
Concrete mix truck/pump truck	90.0
Diesel generators	85.0
Welding equipment and generators/Pneumatic tools	85.0
Grader (includes motor grader)	85.0

Name of Equipment/Machinery/ Building	Noise Emission Level – Lmax dB (A) @ 50 feet
Wheeled excavators	85.0
Jack Hammer/Man Lift	90.0
Rock Drill/Auger Drill Rig	90.0
Blasting	95.0

7.4.2.1. Presentation of Noise Model – Construction phase

The model results are discussed below and are represented through contours in **Figure 46.** The predicted model results at plant boundary are tabulated in **Table 76.**

Table 76 – Predicted Noise Levels at Receptors from the proposed project during construction phase

S. No.	Name of the Receptor	Maximum Incremental Noise Level [dB (A)]	Base Line Noise Level [dB (A)]		Resultant Noise Level - dB (A)	
			Day Time	Night Time	Day Time	Night Time
1	Plant Boundary – N	61.0	69.7	65.4	**70.2**	**66.7**
2	Plant Boundary – NE	52.9	69.7	65.4	**69.8**	**65.6**
3	Plant Boundary – E	51.3	80.9	76.4	**80.9**	**76.4**
4	Plant Boundary – SE	51.0	64.3	61.6	**64.5**	**62.0**
5	Plant Boundary – S	56.3	64.3	61.6	**64.9**	**62.7**
6	Plant Boundary – SW	62.4	72.7	69.6	**73.1**	**70.4**
7	Plant Boundary – W	66.8	72.7	69.6	**73.7**	**71.4**
8	Plant Boundary – NW	64.4	69.7	65.4	**70.8**	**67.9**
9	Al Mirjah Suburb	44.6	55.0*	45.0*	**55.2**	**46.9**
10	SHJ Heritage sites	42.5			**55.2**	**46.5**
11	SHJ Art Museum	37.2			**55.1**	**45.6**
12	Al Layyah Sub-urb	36.9	60.0#	50.0#	**60.1**	**51.1**
13	Al Al Khaleidia suburb	41.4			**60.1**	**50.6**
14	American School of Creative Science	44.4			**60.1**	**51.0**
15	Manar Al Sabeel Quran Center	42.0			**60.1**	**50.6**

S. No.	Name of the Receptor	Maximum Incremental Noise Level [dB (A)]	Base Line Noise Level [dB (A)]		Resultant Noise Level - dB (A)	
			Day Time	Night Time	Day Time	Night Time
16	Canadian Montessari Nursery	41.6			**60.1**	**50.6**
17	Golden Beach Motel	49.3			**60.4**	**52.7**
18	Sahara Beach Resort	46.6			**60.2**	**51.6**
19	Marhaba Resort	45.5			**60.2**	**51.3**

*Assumption based on UAE-MoCCAE Maximum limits for residential areas in down town

#Assumption based on UAE-MoCCAE Maximum limits for Residential Areas which include some workshops & Commercial, Business or Residential Areas near the Highways

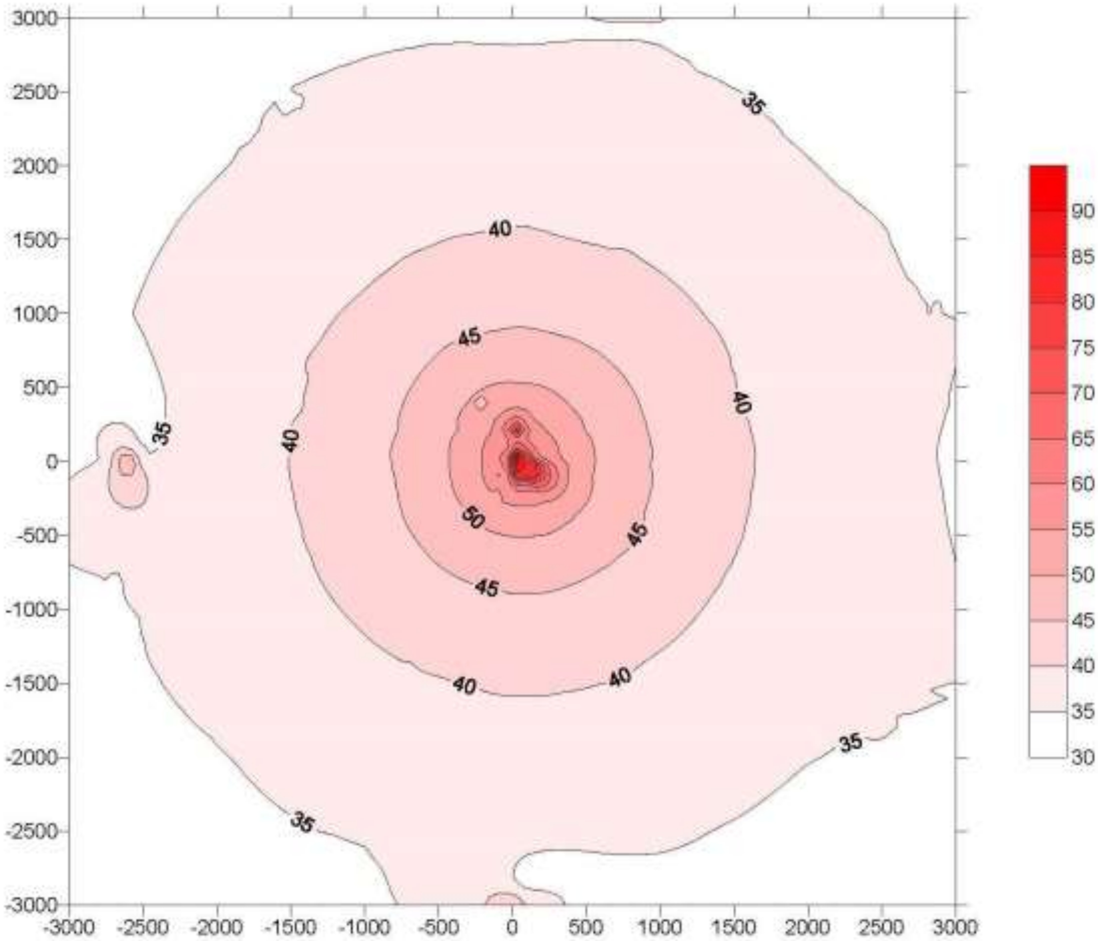


Figure 45 – Predicted Noise Dispersion Contours – dB(A) during construction phase

The predicted noise modeling results in the project boundary and sensitive receptors are presented in **Table 76.** It was observed from the modeling results within project site boundary area that predicted maximum incremental noise levels in the boundary areas of the project site are observed in between 51.0 dB (A) to 66.8 dB (A) and resultant noise level based on the baseline ambient noise level at the project site will be 64.5dB (A) to 80.9 dB (A) during day time and 62.0 dB (A) to 76.4 dB (A) which is higher than limits prescribed by UAE-MoCCAE and WHO guideline value. The noise level increase (above baseline) will be in the range 0.0 to 1.1 dB (A) during day time and 0.0 to 2.5 dB (A) during night time within the project boundary and it is estimated that impact due to the increase of ambient noise level within project boundary will be minor (1.6% as of the standard during day time and 3.6% during night time). The identified impact on noise level at project site will be localized, minor magnitude, short-term and reversible.

Continuous exposure of workers to high sound levels may result in annoyance, fatigue etc. The acceptable limit for each shift being of 8-hour duration, the equivalent noise level exposure during the shift is 90 dB(A) as per OSHA standards. Hence noise generation due to excavation may affect workers, if equivalent 8 hours exposure is more than the safety limit. The workers in general are likely to be exposed to an equipment noise level of 80-90 dB (A) in an 8 hour shift for which all statutory precautions as per laws will be taken into consideration.

The increase of resultant noise level in the nearest sensitive receptors based on the assumed standard will be 0.1 to 0.4 dB (A) during day time and 0.6 to 2.7 dB(A) during night time. It is estimated that impact due to the increase of ambient noise level in the sensitive receptor will be negligible to minor (0.7% as of the standard during day time and 5.4% during night time). It comply with the recommended norms of World Bank Group – IFC EHS noise guidelines that maximum increase of resultant noise level at the nearest receptor location off-site shall be less than 3 dB (A).

Construction vibrations may be harmful to adjacent and remote structures, sensitive instruments and people. Construction vibration sources have a wide range of energy, displacement, velocity and acceleration transmitted on the ground. Implementation of construction projects involves various sources of construction vibrations such as pile driving, dynamic compaction and operating heavy equipment. Vibrating, impacting, rotating, and rolling construction equipment is used for soil excavation, modification and improvement. Machinery with dynamic loads and blasting are sources of construction vibrations. The most prevalent powerful sources of construction vibrations are pile driving and dynamic compaction. The identified negative impact will be localized, moderate magnitude, short-term and reversible.

7.4.3. IMPACT ON NOISE LEVEL DURING OPERATION PHASE

The identified sources of noise emissions during operation phase are mainly from the operation of turbines, compressors, pumps, condensers, coolers, generators and traffic & transportation. It is planned to procure the equipment/machinery with inbuilt acoustic enclosure to conform the norms of noise exposure guidelines as per Occupational Safety and Health Administration (OSHA) which is considered as embedded mitigation measure. The noise levels generated by equipment/machinery to be utilized during the operation of the facility are presented in **Table 77**.

7.4.3.1. Presentation of Noise Model – Operation phase

The model results are discussed below and are represented through contours in **Figure 46.** The predicted model results at plant boundary are tabulated in **Table 77.**

Table 77 – Predicted Noise Levels at Receptors from the proposed project during operation phase

S. No.	Name of the Receptor	Maximum Incremental Noise Level [dB (A)]	Base Line Noise Level [dB (A)]		Resultant Noise Level - dB (A)	
			Day Time	Night Time	Day Time	Night Time
1	Plant Boundary – N	60.7	69.7	65.4	**70.2**	**66.7**
2	Plant Boundary – NE	53.0	69.7	65.4	**69.8**	**65.6**
3	Plant Boundary – E	51.9	80.9	76.4	**80.9**	**76.4**
4	Plant Boundary – SE	51.9	64.3	61.6	**64.5**	**62.0**
5	Plant Boundary – S	57.6	64.3	61.6	**65.1**	**63.1**
6	Plant Boundary – SW	64.6	72.7	69.6	**73.3**	**70.8**
7	Plant Boundary – W	66.7	72.7	69.6	**73.7**	**71.4**
8	Plant Boundary – NW	69.2	69.7	65.4	**72.5**	**70.7**
9	Al Mirjah Suburb	42.9	55.0*	45.0*	**55.3**	**47.1**
10	SHJ Heritage sites	41.4			**55.2**	**46.6**
11	SHJ Heritage Museum	37.7			**55.1**	**45.7**
12	SHJ Art Museum	37.3			**55.1**	**45.7**
13	Al Layyah Sub-urb	45.4	60.0#	50.0#	**60.1**	**51.3**
14	Al Al Khaleidia suburb	42.1			**60.1**	**50.7**
15	American School of Creative Science	45.1			**60.1**	**51.2**
16	Manar Al Sabeel Quran Center	42.7			**60.1**	**50.7**
17	Canadian Montessari	42.3			**60.1**	**50.7**

S. No.	Name of the Receptor	Maximum Incremental Noise Level [dB (A)]	Base Line Noise Level [dB (A)]		Resultant Noise Level - dB (A)	
			Day Time	Night Time	Day Time	Night Time
	Nursery					
18	Golden Beach Motel	50.2			**60.4**	**53.1**
19	Sahara Beach Resort	47.5			**60.2**	**51.9**
20	Marhaba Resort	46.3			**60.2**	**51.5**

*Assumption based on UAE-MoCCAE Maximum limits for residential areas in down town

#Assumption based on UAE-MoCCAE Maximum limits for Residential Areas which include some workshops & Commercial, Business or Residential Areas near the Highways

7.4.3.2. Findings of Noise Model – Operation phase

It could be seen from Figure 46 that in the facility premises most of the machinery/equipment generate noise levels around 85-95 dB (A). The personnel working within the facility, however, have to be provided with protective measures. According to the Occupational Safety and Health Administration (OSHA) Standards, the allowable noise level for the workers is 90 dB(A) for 8 hours exposure a day. Therefore, adequate protective measures in the form of ear muffs/ear plugs to the workers working in high noise areas need to be provided. In addition, reduction in noise levels in the high noise machinery areas could be achieved by adoption of suitable preventive measures such as suitable building layout in which the equipment are to be located, adding sound barriers, use of enclosures with suitable absorption material, *etc.*

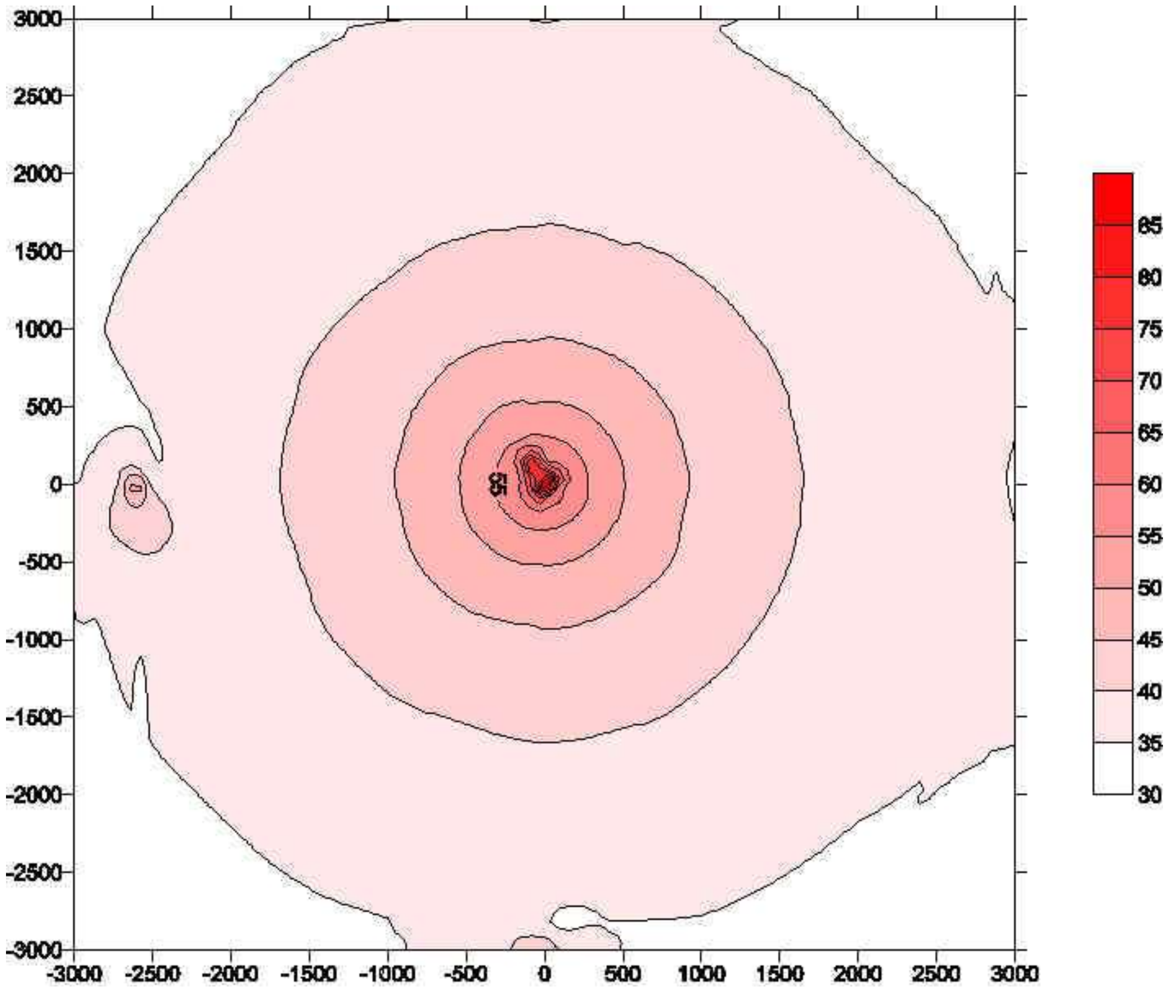


Figure 46 – Predicted Noise Dispersion Contours – dB(A) during operation phase

The predicted noise modeling results in the project boundary and sensitive receptors are presented in **Table 77.** It was observed from the modeling results within project site boundary area that predicted maximum incremental noise levels in the boundary areas of the project site are observed in between 51.9 dB (A) to 69.2 dB (A) and resultant noise level based on the baseline ambient noise level at the project site will be 64.5dB (A) to 80.9 dB (A) during day time and 62.0 dB (A) to 76.4 dB (A) which is higher than limits prescribed by UAE-MoCCAE and WHO guideline value. The noise level increase (above baseline) will be in the range 0.0 to 2.8 dB (A) during day time and 0.0 to 5.3 dB (A) within the project boundary and it is estimated that impact due to the increase of ambient noise level within project boundary will be minor to moderate (4.0% as of the standard during day time and 8.8% during night time). The identified impact on noise level at project site will be localized, moderate magnitude, long-term and reversible.

The increase of resultant noise level in the nearest sensitive receptors based on the assumed standard will be 0.1 to 0.4 dB(A) during day time and 0.7 to 2.9 dB(A) during night time. It comply with the recommended norms of World Bank Group – IFC EHS noise guidelines that maximum increase of resultant noise level at the nearest receptor location off-site shall be less than 3 dB (A). It is estimated that impact due to the increase of ambient noise level in the sensitive receptor will be negligible to minor (0.7% as of the standard during day time and 5.8% during night time). It clearly indicates that there is minor impact due to the proposed project in the nearby sensitive receptor.

7.5. WATER ENVIRONMENT

The impacts of the proposed project on water environment during the construction and operation phases have been identified and evaluated using impact assessment methods. The assessment process of impact on water environment hereunder described.

7.5.1. IMPACT ASSESSMENT METHODS

The significance of water environment (terrestrial and marine environment) impacts is determined by the consideration of the following parameters:

- Regulatory requirement
- The baseline conditions of the water resources – The baseline of terrestrial and marine environment is characterized based on ground water quality, sea water quality and marine sediment quality data collected in the study area
- The sensitivity of receptors – general sensitive receptors are identified and described in **Table 45** and specific to water environment is identified in **Table 78**.
- Criteria for assessment

7.5.1.1. Regulatory requirement

In line with the requirement of WBG-IFC, discharge of outfall effluent to Arabian Gulf should not result in contaminant concentrations more than local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality. As UAE emirates has its own nationally legislated standards, Sharjah Municipality discharge limits and Dubai Municipality (DM) marine water quality objectives have been used to determine the significance of potential impacts. Additional considerations that should be included in the setting of project-specific performance levels for wastewater effluents include:

- The temperature of wastewater before discharge does not increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations;

- In line with requirement of DM Local order 61 of 1991, the following criteria shall be met:
  - The discharge end of any effluent discharge pipe must be sited a minimum of 1m below the lowest tide level at the proposed discharge site;
  - A 300 m radius from the point of effluent discharge is set as the initial zone of dilution.
- Outfall effluent shall comply the maximum allowable limits of Sharjah Municipality for discharging to sea, and Dubai Municipality marine water quality objective shall be complied for ambient seawater quality; and
- Sharjah municipality discharge limits for sewerage treatment works shall be complied for the discharge of domestic wastewater into drainage system.

7.5.1.2. Summary of baseline conditions

7.5.1.2.1. Seawater quality

Totally 12 sea water samples from Arabian Gulf and lagoon area were collected and analyzed for quality analysis. Owing to the sampling being carried out during the peak summer months, the surface temperature of the seawater ranged from 34.0 – 38.34 °C. In general, the turbidity was low (<1 NTU) at most of the locations except at SW12 (Khalid lagoon) which is recorded as 4.36 NTU. The salinity was invariably high ranging from 41.0 – 43.6 ppt. Dissolved oxygen concentration ranged between 4.84 and 5.71 mg/L. The pH values ranged from 8.14 to 8.26.

7.5.1.2.2. Marine Sediment quality

Out of 10 identified sampling stations performed for sediment collection, 6 sediment samples were only collected from Arabian Gulf and Lagoon. Owing to the hard substrate, sediment samples using a grab sampler could not be collected at four sampling stations. The results of sediment analysis are compared with Canadian marine sediment quality guidelines. The perusal of the results, toxic contaminants in the sediment samples are well within the Canadian marine sediment quality guidelines.

7.5.1.3. Sensitivity of the receptors

Sensitive receptors in relation to water environment are presented in **Table 66**.

Table 78 – Details of sensitive receptors in relation to water environment

Receptor Type	Sensitivity	No.	Name of the receptor	Aspects
Groundwater	Moderate (Type 2 area)	WER-01	Project area	The components of the groundwater in the project region are subject to potential contamination. Various potentially hazardous materials are likely to be used on site during construction and operation of the project, which could potentially impact the groundwater quality, if not managed responsibly.
Sea	Moderate (Type 2)	WER-02	Arabian Gulf – Project region	The intake of sea water can also affect marine resources by altering natural currents in the area of the intake structure. The discharge of outfall effluent may deteriorate the seawater quality
Port	Moderate (Type 2)	WER-03	Sharjah Khalid Port	The discharge of outfall effluent may deteriorate the seawater quality
Creek and Lagoons	Moderate (Type 2)	WER-04	Sharjah Creek	The discharge of outfall effluent may deteriorate the seawater quality
		WER-05	Khalid Lagoon	
		WER-06	Al Khan Lagoon	

7.5.1.4. Assessment methodology and criteria

The potential impact of outfall effluent discharge from the proposed project is predicted through hydro-dynamic modeling and recirculation study.

7.5.1.4.1. Hydro-dynamic modeling and Re-circulation Study

The objectives of the study are the following:

- Evaluate the hydrodynamic environment at the project study area

- Simulate the dispersion of the effluent from the outfall;
- Quantify the extent of the temperature, salinity and suspended sediment plume, and;
- Investigate the potential recirculation risk between the outfall and intake systems

Hydro-dynamic modeling and re-circulation study is hereby summarized.

An outfall design screening assessment was used to asses multiple discharge designs and locations in order to ensure the selection of an optimal design based on environmental benefits. This screening assessment was carried out using the model MIKE 21 AD.

7.5.1.4.1.1. Numerical Modeling Software – MIKE 21

Typically, dispersion and mixing of pollutant concentrations on receiving waters is dependent on the ambient conditions of the receiving environment and discharge characteristics of the effluent. The ambient conditions are defined by the water body's geometry, currents, as well as its dynamic characteristics. The discharge conditions are a function of outfall geometry (diameter, height above bed, orientation) and flux characteristics (discharge rate, density, momentum and buoyancy). For the present study Danish Hydraulic Institute's MIKE 21 is considered to be best suited. Hence it is proposed to use the USEPA and FEMA approved MIKE 21 AD (Advection-Dispersion) flow model.

MIKE 21 Flow Model is a modeling system for 2D free-surface flows based on flexible mesh approach, which uses dynamically-coupled transport equations for water level, velocity and temperature simulations in water bodies under the influence of major forcing (eg. Wind, river inputs etc.). MIKE 21 Flow Model is applicable to the simulation of hydraulic and environmental phenomena in lakes, estuaries, bays, coastal areas and seas. It may be applied wherever stratification can be neglected.

The advection/dispersion module simulates the spreading of dissolved substances subject to advection and dispersion processes in lakes, estuaries and coastal regions. MIKE 21 Flow Model can be used to simulate a wide range of hydraulic and related items, including:

- Tidal exchange and currents
- Storm surges
- Heat and recirculation
- Water quality

The hydrodynamic module simulates water level variations and flows in response to a variety of forcing functions in lakes, estuaries and coastal regions. The effects and facilities include:

- Bottom shear stress
- Wind shear stress
- Barometric pressure gradients
- Coriolis force
- Momentum dispersion
- Sources and sinks
- Evaporation
- Flooding and drying
- Wave radiation stresses

Typical applications include cooling water recirculation and water quality studies. In order to setup the model, the following parameters are required:

- Bathymetry of the study area and initial and boundary conditions of water level variations in the model domain and at the boundaries;
- Tides and current measurements for validation of modeling results;
- Atmospheric parameters such as wind speed, wind direction, air temperature, and humidity for estimating the heat flux; and
- Initial and boundary temperature conditions, source and sink characteristics and locations, discharge properties (quantity, flow rate and temperature), heat dissipation, decay and heat exchange.

7.5.1.4.1.2. Model Setup

Predicted tidal elevations, water levels and currents extracted at select locations such as outfall and intake points are provided as inputs to the model. Validation of the model output is carried out with currents and water levels measured from the study region.

To simulate the spatial advection and dispersion of the discharged waste water, it is necessary to predict the regional currents driven by the winds and tides. DHI's two-dimensional ocean/coastal circulation model, MIKE21 HD, was used to predict the circulation of the receiving waters. MIKE21 simulates the 2-D flows of ocean waters within a model region due to forcing of the tides, wind stress and bottom friction. Higher resolutions are used for areas with complex bathymetry and areas of interest. To simulate the ocean circulation over the area of interest, the model was provided with the measured bathymetry for the area, which defines the shape of the seafloor. Bathymetry was defined by Survey and has a horizontal resolution of 3 m.

7.5.1.4.1.3. Hydrodynamic Model Resolution

The finest grid resolution in the area of interest was set at 10 m. This very fine resolution can be assumed to accurately reproduce the key hydrodynamic processes which is driving the movement of the plume. The model predictions compared very well with the measured data. This confirms that winds and tides used as input are capable of replicating the currents in the study area. The 2-D model was used because the waters of this area are tidally driven and therefore predominantly 2-D in structure.

7.5.1.4.1.4. Advection – Dispersion Modeling

The MIKE21 AD model was used to simulate the spreading of the plume subject to currents and wind in the coastal region. The discharge rate and salinity associated with the different scenarios are used as input in the model. The simulation period was set to 28 days, which covers one neap and spring period. The model predicts the transport and dilution of the plume by ambient currents within the model domain and therefore can accurately predict the 'rate of dilution' of the far-field mixing zone where tidal and wind induced currents determine the plume's spreading characteristics.

7.5.1.4.1.5. Methodology and approach

The 2D hydrodynamic solution is used to drive the AD module. For this purpose, a coastal grid domain has been setup and validated around area of interest with measured tides and currents. In order to have a proper examination from salinity dispersion in the vicinity of the project site, a grid resolution of 10 m was used around the two proposed outfall locations.

The time step integration was set so that the maximum Courant number was 3.1. The horizontal dispersion coefficient was specified through the spatially varying Smagorinsky formulation. A Smagorinsky coefficient of 0.38m2/s was used. The bed resistance controls water surface elevation and current speed for each point and can be introduced to model through both Chezy and Manning formula. Although there are some laboratory based relationships for calculation of bed resistance for the current study a calibrated Manning coefficient of 28 was used. The format of the wind data is specified as varying in both time and space. The wind friction is specified as a constant value of 0.001255.

The contribution of the outfall location to the continuity equation is taken into account by specifying the magnitude of the source (in m3/s). The AD module sets up additional transport equations for temperature and salinity. The calculated temperature and salinity are feed-back to the hydrodynamic equations through buoyancy forcing induced by density gradients.

7.5.1.4.2. Assessment criteria

In addition to general criteria for determining magnitude, additional criteria for assessing the water quality impact are described in **Table 79**.

Table 79 – Assessment Criteria to determine magnitude for Sea Water Quality

Magnitude	Criteria – Change in criteria pollutant concentration as % of standard – DM EPSS - Marine Water Quality Objectives*
Temperature	
Major	The contribution by the proposed project may increase the temperature level more than 7°C from ambient level
Moderate	Increase level 4 - 7°C from ambient level
Minor	Increase level 2 - 4°C from ambient level
Negligible	Increase level 0.5 - 2°C from ambient level
Insignificant	Increase level <0. 5°C from ambient level
Salinity as Total Dissolved Solids (TDS)	
Major	The contribution by the proposed project may increase the TDS level more than 10% from ambient level
Moderate	Increase level 5 – 10% from ambient level
Minor	Increase level 2 – 5% from ambient level
Negligible	Increase level 0.5 – 2% from ambient level
Insignificant	Increase level <0. 5% from ambient level

** EPSS – Dubai Municipality - Environmental Standards and Allowable Limits of Pollutants on Land, Water and Air Environment, 2003 (***Table 24***)*

7.5.2. IMPACT ON WATER ENVIRONMENT DURING CONSTRUCTION PHASE

7.5.2.1. Identification of impacts

Construction phase requires large quantities of water to be used in various processing such as material preparation etc. The entire water requirement will be met from SEWA. Hence, no adverse impact of ground water resources is envisaged.

The construction of intake and outfall structures and the laying of pipelines in the seabed may cause the following environmental impacts on marine water environment:

- Displacement or disturbance of sediments and sediment layering, or a compaction of sediments or wave refractions or changes to long shore currents may occur
- When placed above the ground, the intake and outfall structures and pipelines can act as an artificial breakwater. A breakwater may change wave and current

patterns and thereby interfere with dynamic sediment processes, such as erosion or deposition, which may cause a redistribution of sediments along the shoreline.

- Accidental spills of chemicals, oils or fuels, or the leakage of these substances from underwater construction machinery may cause localized sediment contamination.
- The disturbance of sediments may lead to a re-suspension of material into the water column and a temporarily increased turbidity in the vicinity of the construction site.

7.5.2.2. Evaluation of impacts

7.5.2.2.1. Impact on seawater quality

The supplier will fabricate individual pipeline sections and transported to the site. The pipe sections will be welded together into long strings, placed in the trenches and subsequently covered with concrete, sand and rock. Boulders and sediments will be displaced in the dredging process, and the associated biota will most likely be eliminated.

Dredging will involve the excavation of sediment from the seabed. The excavation of sediment will be undertaken mainly by the dredger. Dredging activities generate sediment plume that would result in increased suspended sediments in the water column and can remain in the water column for an extended period. The impact of the sediment plume, however, is expected to be relatively localized and of short duration (during offshore construction below seabed – approximately 2 to 3 months) within the marine construction zone. The short-term and localized increase in suspended sediments is considered unlikely to impact long-term on the broader distribution. However, a moderate short-term impact is likely.

The project construction methods incorporate the following measures to reduce potential impacts at source as embedded mitigation measures.

- All marine works will be undertaken within silt curtains;
- A site-wide CEMP and site-specific CEMPs including arrangements for turbidity monitoring will be developed including measures to limit dredging losses, trigger levels for maximum allowable suspended sediment concentrations;

Considering the embedded mitigation measures, the expected impact on seawater quality will be minor effect.

7.5.2.2.2. Impact of accidental spills on Arabian Gulf

Offshore pipeline installation would involve increased vessel traffic in the near-shore areas during marine construction period. There would thus be potential for or accidental spillage or leakage of fuel, chemicals or lubricants, litter. Any release of liquid hydrocarbons has the potential for direct, indirect and cumulative effects on the marine environment through contamination of the water and/or sediments. These effects include physical oiling and toxicity impacts to marine fauna and flora, localized mortality of plankton, eggs and fish larvae, and habitat contamination. Considering the moderate sensitivity of habitat in the marine construction area, expected impact is assessed as moderate due to accidental spill/leaks.

7.5.2.2.3. Impact of construction waste on groundwater quality

The source of groundwater contamination may be due to improper disposal of waste water generated by the workforce. Change in quality of water forms an important concern associated with the project particularly during the construction phase. It is anticipated that a proportion of construction workforce sewage will be stored in septic tank facilities and it will be disposed to existing drainage of SEWA Layyah Power Station. There is potential for degradation of groundwater quality from leaks or spills during the maintenance and use of these facilities. Impacts on water quality within groundwater are expected to be moderate. Considering the light sensitivity of receptor, expected impacts are assessed as minor.

Generation of construction waste during site preparation and construction work would include cut vegetation and typical construction waste (e.g. wasted concrete, steel, wooden scaffolding and forms, bags, waste earth materials, etc.). This waste would negatively impact the site and surrounding environment if not properly managed and disposed properly.

Following are the most susceptible locations for contamination of ground water during construction:

- Ground water resources close to construction material storage yard, concrete mixer plants and maintenance sites of construction vehicles; and may cause water pollution of ground water body.
- Accident spills may also cause water pollution and soil environment.

Impact due to poor construction waste management and accidental spills or due to bad construction practice, will be moderate in magnitude and confined to the construction period only. The effect of impact on environment will be moderate. Considering the light sensitivity of receptor, expected impacts are assessed as minor.

Any excavations below the ground water table may require dewatering. The dewatered groundwater will be discharged to storm water network. If groundwater quality is poor this has the potential to impact water quality in the designated source of discharge. The discharge may also disturb sediment increasing suspended solids and may encourage the dissolution of contaminants. Impacts on water quality are expected to be moderate and therefore the effects are assessed as moderate. Hence mitigation measures are required to avoid any contamination.

7.5.3. IMPACT ON WATER ENVIRONMENT DURING OPERATION PHASE

7.5.3.1. Identification of impacts

The following are the key issues and major potential impacts mostly associated with the operational phase of proposed project.

- The effect on seawater quality by discharge of process/treatment chemicals in the outfall effluent
- The effect of the discharged effluent potentially having a higher temperature and salinity than the receiving environment; and

7.5.3.2. Evaluation of impacts

7.5.3.2.1. Effect on seawater quality by discharging chemicals in outfall effluent

Besides high temperature and salinity, the outfall effluent contains other chemical residuals to be used for neutralization, backwash and cleaning process. A list of chemicals expected to be used in the proposed project is listed in **Table 35.**

Residuals from the above chemicals in the neutralized wastewater will be discharged along with cooling returned seawater. The volume of neutralized wastewater (852 m^3/day – 35.5m^3/hr) will be relatively small when it is compared with total outfall effluent (1,872,861m^3/day – 78,000m^3/hr) to be discharged to sea, and it will be significantly diluted with cooling returned seawater. Hence, there is no significant change in the quality of outfall effluent due to chemical residuals in the neutralized wastewater.

The quality of outfall effluent will comply with the maximum allowable limits prescribed by Sharjah Municipality and IFC effluent guidelines. The expected impact on seawater quality will be minor effect.

7.5.3.2.2. Impact on seawater quality

7.5.3.2.2.1. Hydro-dynamic modeling and plume dispersion study

The outfall effluent water discharged from the proposed project will constitute high-TDS and high temperature effluent. Although the effluent will have a higher density than the receiving water, discharge through outfall diffuser will ensure adequate dispersal throughout the water column and pooling of the effluent near the seabed, where the receiving water masses may potentially have lower temperatures than the effluent is unlikely. Insufficient mixing of the effluent with the receiving water may occur only under conditions of extreme calm. Hydro-dynamic modeling and re-circulation study was carried out to simulate the dispersion of the effluent from the outfall, quantify the extent of the temperature, salinity and suspended sediment plume and to investigate the potential recirculation risk between the outfall and intake systems. The details of the intake/outfall quantities and the outfall temperature and salinity are presented in the **Table 80.**

Table 80 - Details of Intake Sea Water and Outfall Discharge water

S. No.	Description	Details			
DETAILS OF INTAKE SEA WATER					
1	Maximum intake seawater quantity (m^3/hr)	**Existing**		**Proposed**	**After Expansion**
		125,500 (Several Intakes)		78,050	203,550
2	Intake sea water quality	**Parameter**		**Value**	
		Salinity		40 – 43 ppt	
		Temperature (Max.)		35 °C	
Details of Intake System (Proposed)					
3	Details of intake pipeline (HDPE)	No. of duty pipelines		2	
		Diameter of pipe (inner dia)		2.4 m	
	Intake velocity for HDPE	Minimum		0.8 m/s	
		Maximum		2.5 m/s	
4	Location of Intake Center Line of intake tower (UTM – 40R Coordinates in meters)	Easting (m)		334878.90	
		Northing (m)		2805237.46	
5	Depth of intake	-10m below low water level			
DETAILS OF OUTFALL DISCHARGE WASTEWATER					
1	Maximum outfall discharge quantity (m^3/hr)	**Existing**		**Proposed**	**After Expansion**
		125,500		78,050	203,550
2	Quality of outfall discharge quantity	**Parameter**		**Value**	
		Salinity – (Max.)		ΔS – 7ppt Max Temp – 50 ppt	
		Temperature (Max.)		ΔT - 7°C	
				Max Temp - 42°C	
Details of Outfall System (Proposed)					
3	Details of outfall pipeline (HDPE)	No. of duty pipelines		2	
		Diameter of pipe (inner dia)		2.4 m	
	Outfall velocity (HDPE)	Minimum		0.8 m/s	
		Maximum		2.5 m/s	
4	Details of outfall system & diffuser		**Existing outfall channel**	**Outfall pipeline option 1**	**Outfall pipeline option 2**
		Easting (m)	335701.00	334917.06	334428.81
		Northing (m)	2805915.00	2805805.71	2804877.96

7.5.3.2.2.1.1. Modeling Scenarios

Totally eight (8) modeling scenarios are considered for the two conceptual outfall locations for a maximum outfall discharge load of 78,050 m^3/hour alongside the existing intake and outfall facilities to assess the combinative effect and finalize the best outfall location from a modeling standpoint.

- Scenario 1: - Intake location with outfall at location-1 for maximum design flow velocity for normal Tidal flow
- Scenario 2: Intake location with outfall at location-1 for minimum design flow velocity for normal Tidal flow
- Scenario 3: Intake location with outfall at location-2 for maximum design flow velocity for normal Tidal flow
- Scenario 4: Intake location with outfall at location-2 for minimum design flow velocity for normal Tidal flow
- Scenario 5: - Intake location with outfall at location-1 for maximum design flow velocity for Tidal flow and annual extreme wind condition
- Scenario 6: Intake location with outfall at location-1 for minimum design flow for Tidal flow and annual extreme wind condition
- Scenario 7: Intake location with outfall at location-2 for maximum design flow velocity for Tidal flow and annual extreme wind condition
- Scenario 8: Intake location with outfall at location-2 for minimum design flow velocity for Tidal flow and annual extreme wind condition

7.5.3.2.2.1.2. Model Domain

A 7 km × 7 Km grid was selected for the modeling study. The maximum depth in the model domain is 13.6m. All bathymetric points were referred to local CD and were used for the study. The model domain is divided into 10 m X 10 m square grids for high resolution simulation of currents and water levels. The validated hydrodynamic model was used for the analyses of the plume dynamics for given criteria and locations.

7.5.3.2.2.1.3. Water Levels

Water levels at the coastal area vary reasonably due to the large tides. Given the large scale of the intertidal zone both horizontally and vertically, the actual water level acts as a significant control on the volume, duration and direction of transport of materials in this region, including the water and materials in marine discharges.

7.5.3.2.2.1.4. Tidal Currents

It is possible to examine current meter records to identify key oceanographic processes that occur at that site. Accordingly, analysis of the records from a current meter deployed from 24th July 2018 onwards off shore from the discharge location in 10 m water depth was utilized to provide a temporal view of the mechanisms generating the near-shore flow field at a single point. The analysis shows that the tides the coastal area is semi-diurnal, with tidal sea-surface height variability in excess of 2.4 m.

7.5.3.2.2.1.5. Model Calibration and validation

The hydrodynamic model was established using the available local data and is calibrated by performing a comparison of site specific measurements and modeled data. The result of this hydrodynamic modeling was used to drive the thermal and salinity profile assessments. Comparison between model simulated and measured tides is shown in **Figure 47.** Average water level during spring tide is about 2.2 m.

The maximum current observed is 0.5 m/s during the model period with an average flood current direction reverses with flood and ebb (**Figure 48** and **Figure 49**). The u-component of the current represents the along shore component and the v-component the onshore component. Both the u-component and v-component showed very good comparison with the respective model simulated current components. Red colour represents modeling results and blue colour represents measurements. Though the season is characterized with weak currents, the variations associated with the tidal oscillations and wind driven currents are well captured in the model results. As the model successfully simulated the prevailing currents, the results and the model setup are further used for simulation of thermal and salinity plumes associated with various outfall quantities and qualities.

It is to be noted that there exist an along shore current movement during the peak flood and ebb tidal conditions (Figure 48 and Figure 49) indicates the chance of recirculating and redistributing the outfall contaminants injected in a lower velocity. This can be easily mitigated by ensuring an outfall design velocity higher that of maximum current speed. The AD modeling results are presented as images. Each image shows the maximum spreading extent of the waste water plume over the two days simulation period for the different scenarios and outfall locations (see Table 81 through to Table 83). It is important to note that the results represent a composition of the minimum dilution for the period under consideration and does not represent a snapshot in time. The winds during this period originate from a south westerly direction with a mean wind speed of 10 m/s.

Figure 50 represents the depth averaged velocity plot versus in situ model. It is observed that the velocity magnitude matches reasonably well with the modeled velocity. In situ values are observed to have high disturbance which may be attributed to the day to operations and navigational activities at the port area. As expected the current follows diurnal pattern with reversal during ebb and flood (**Figure 48** and **Figure 49**).

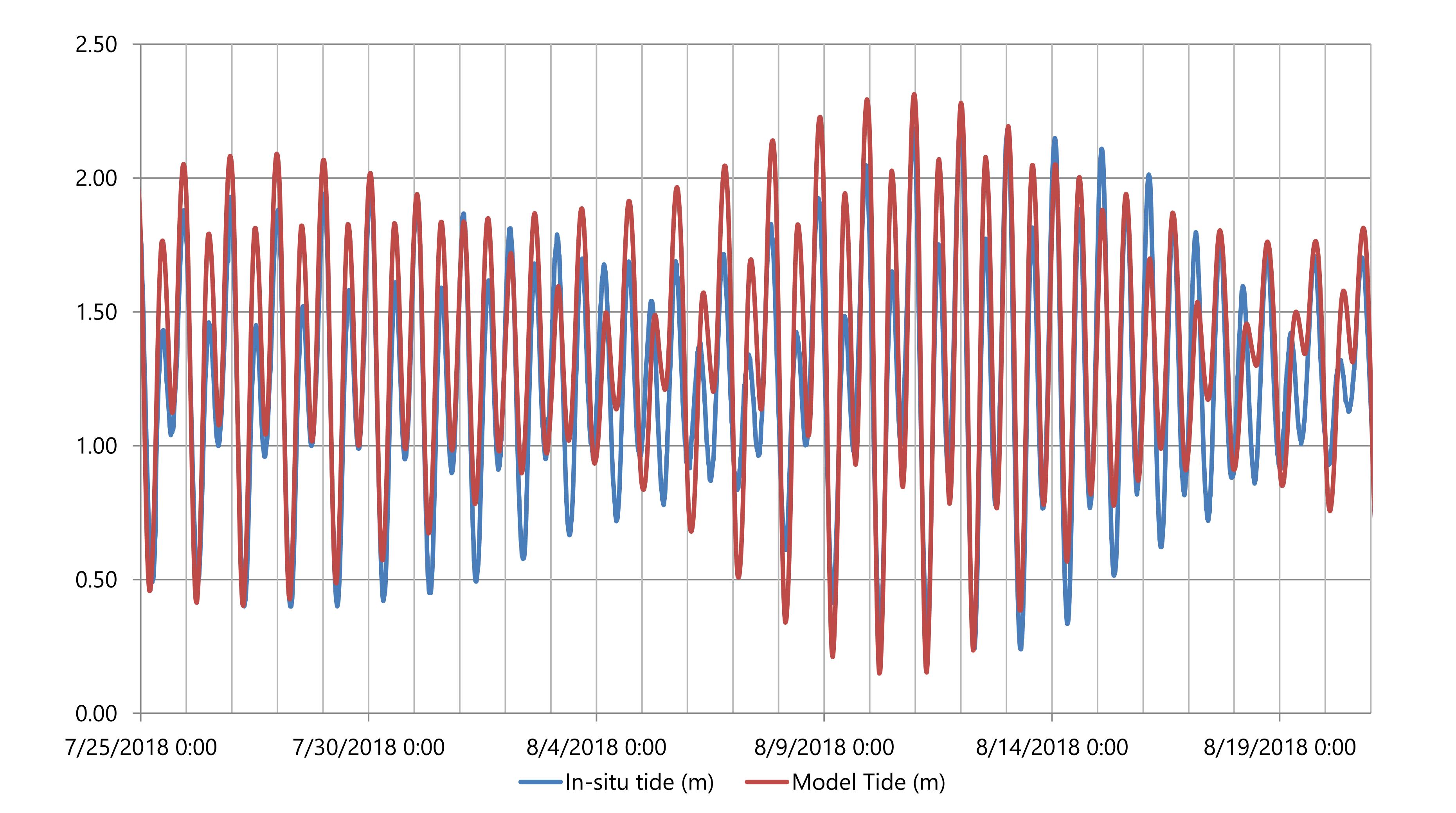


Figure 47 - Time Series Plot of modeled tide vs. measured tide

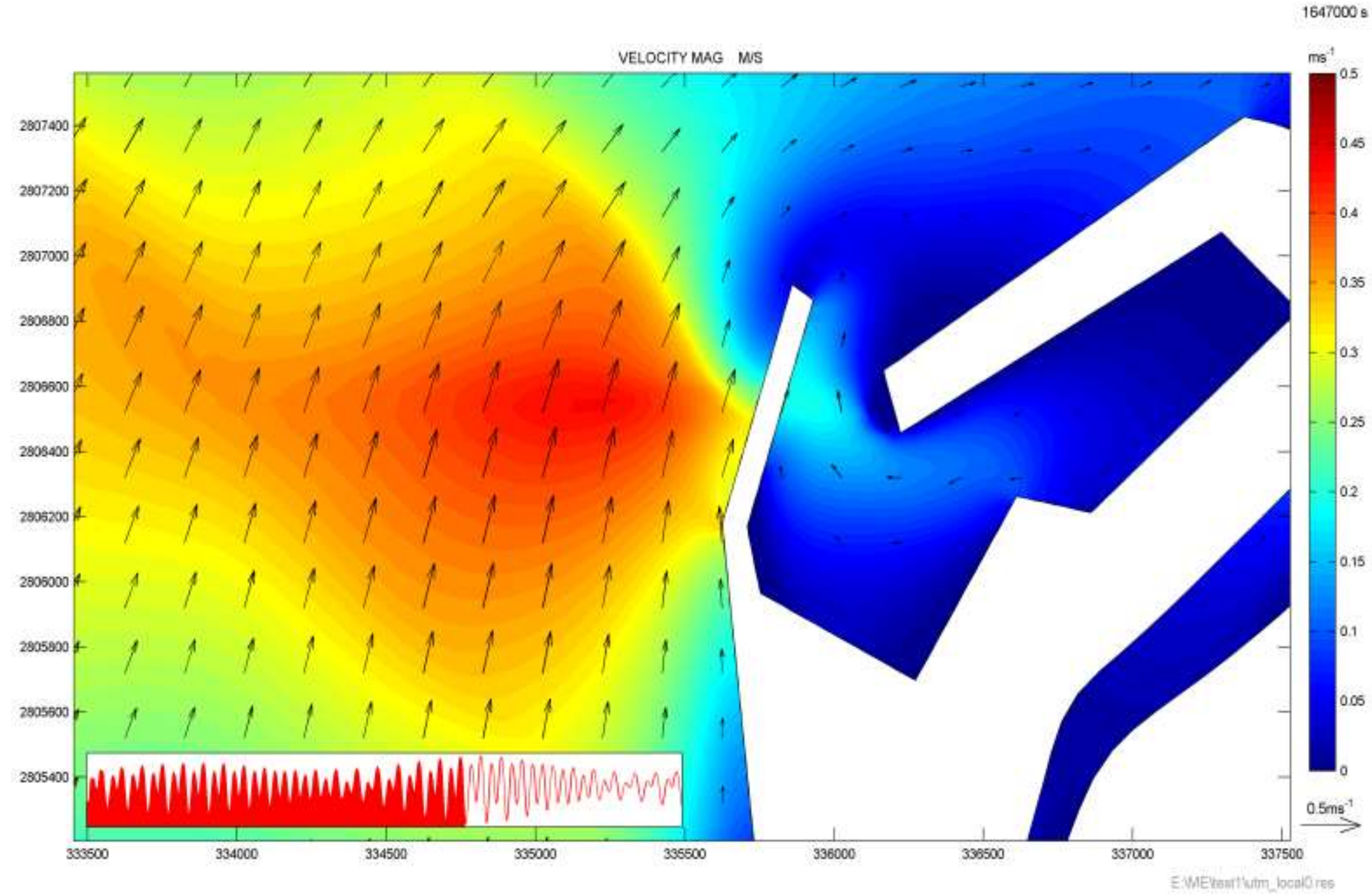


Figure 48 - Modeled flow scenario during peak flood

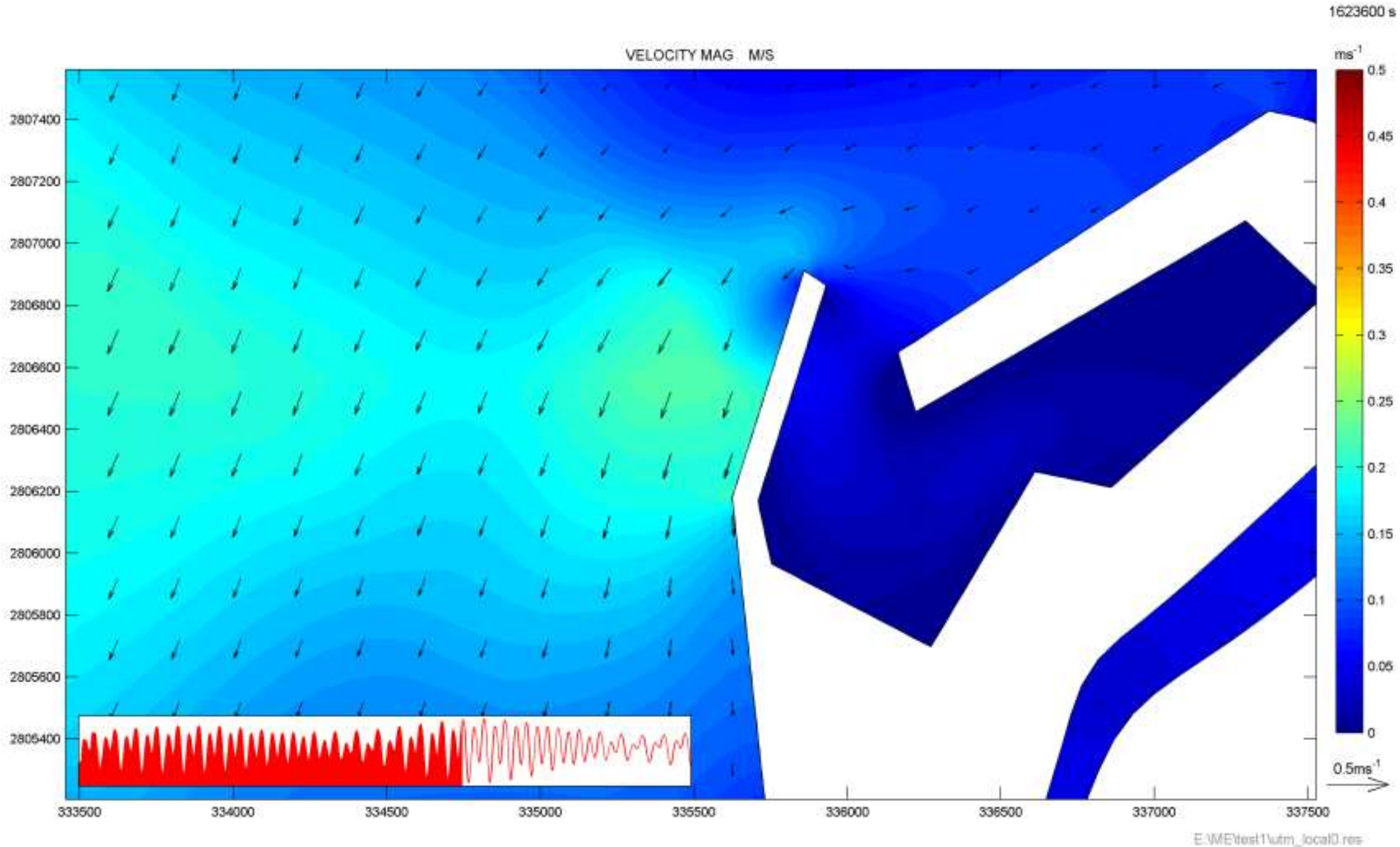


Figure 49 - Modeled flow scenario ebb

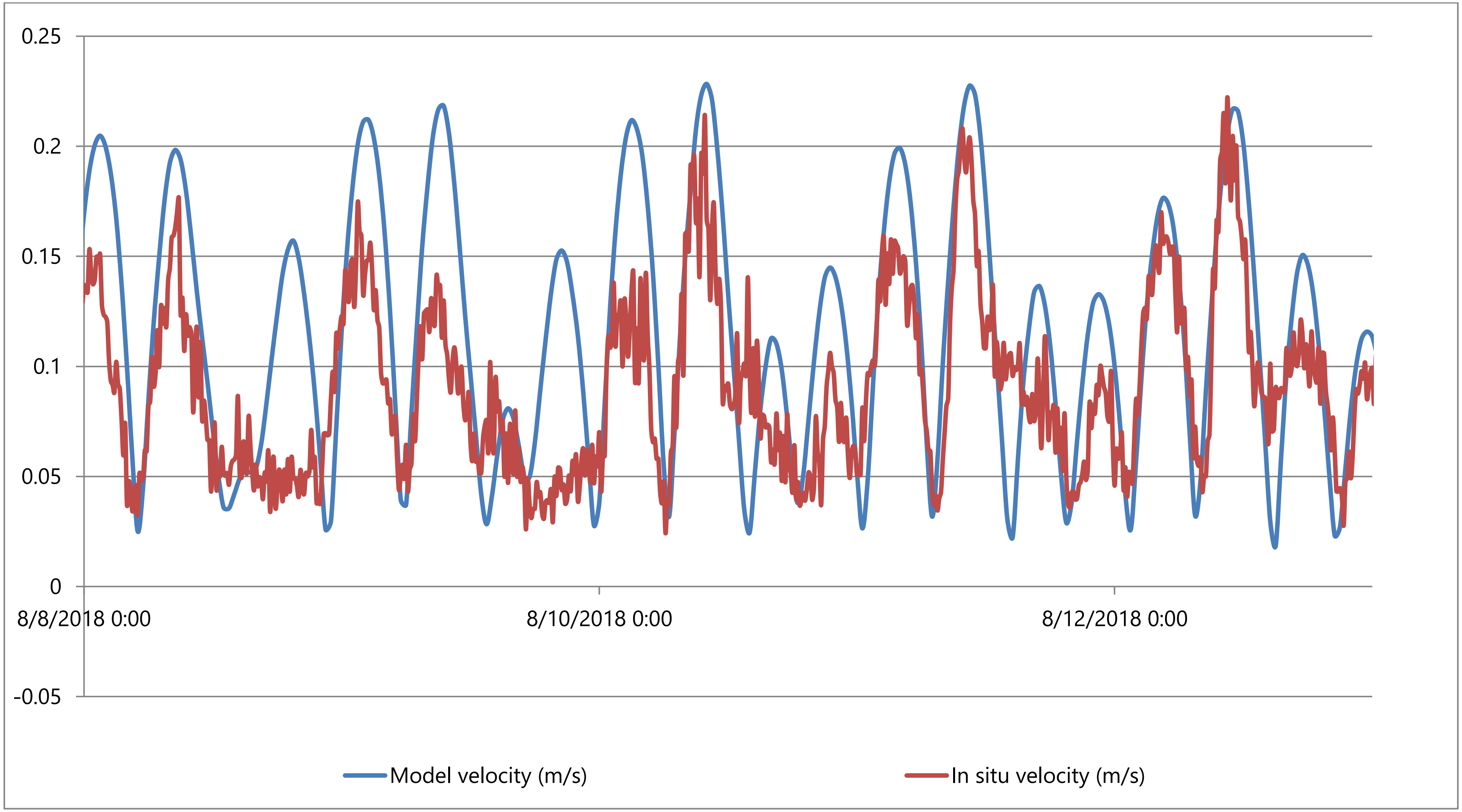


Figure 50 - Depth averaged model vs in situ velocity magnitude

7.5.3.2.2.1.6. Simulation and Dispersion Modeling Results

As explained earlier, MIKE21 AD module is used to simulate temperature and salinity dispersion of the outfall discharge. The outfall water temperatures and salinities are given below. The reference temperature and salinity are taken as 35°C and 43ppt respectively.

Parameter	Outfall location 1	Outfall location 2	Existing Outfall
Temperature	+7°C	+7°C	+7°C
Salinity	+7 ppt	+7 ppt	+7 ppt
Velocity min	0.8 m/s	0.8 m/s	-
Velocity max	2.5 m/s	2.5 m/s	-

The outfall pipeline and diffuser configurations and dimensions are based on information sourced from relevant drawings. AD model was run to simulate the plume advection-dispersion pattern for a period of 28 days. The modeling results are presented in **Table 81**, **Table 82** and **Table 83.**

Table 81 - Maximum Excess Temperature and Salinity for Outfall 1

Scenario Cases	Maximum Excess Temperature (°C)		Maximum Excess Salinity (ppt)	
	At 300 m	At 500 m	At 300 m	At 500 m
Spring Tide - Calm conditions with 2.5m/s velocity	0.25	<0.25	~0.25	<0.2
Spring Tide - With Wind and with 2.5m/s velocity	0.25	<0.25	~0.25	<0.2

Table 82 - Maximum Excess Temperature and Salinity for Outfall 2

Scenario Cases	Maximum Excess Temperature (°C)		Maximum Excess Salinity (ppt)	
	At 300 m	At 500 m	At 300 m	At 500 m
Spring Tide - Calm conditions with 2.5m/s velocity	0.25	<0.25	~0.25	<0.1
Spring Tide - With Wind and with 2.5m/s velocity	0.25	<0.25	~0.25	<0.1

Table 83 - Maximum Average Salinity for Outfalls

Scenario	Wind (knots)	Discharge location	Flow rate (m^3/hr)	Current speed	Distance to achieve 1:10 dilution level	Distance to achieve 1:100 dilution level
1	0	1	78,050	2.5m/s	<300m	<1km
2	0	1	78,050	0.8 m/s	<300m	<1km
3	0	2	78,050	2.5m/s	<300m	<1km
4	0	2	78,050	0.8m/s	<300m	<1km
5	14	1	78,050	2.5m/s	<300m	<1km
6	14	1	78,050	0.8m/s	<300m	<1km
7	14	2	78,050	2.5m/s	<300m	<1km
8	14	2	78,050	0.8m/s	<300m	<1km

The temperature and salinity plume dispersion obtained around the outfall points after during peak tidal conditions were used for the analysis and is used to analyze the dispersion pattern for different scenarios as discussed in the following sections.

7.5.3.2.2.1.6.1. Plume dispersion (Temperature and Salinity) due to tide only at Outfall at location-1

Validated tidal model was rerun with given outfall velocity condition for two locations to analyze the distribution of salt and heat with peak high water tide and peak low water tide. **Figure 51** through **Figure 54** presents the extents of heat and salt dispersion without the influence of wind from outfall 1 along with the plume dispersion from the existing outfall. Every model case was simulated for a period of 28 days. It is noticed that extents of plume is more or less similar with tidal currents but it is influenced by other parameters like velocity of diffusion and wind speed and direction.

7.5.3.2.2.1.6.2. Plume dispersion (Temperature and salinity) due to tide and wind at Outfall at location-1

The process was repeated with 1 in 1 wind derived from the global wind model by ECMWF to study the plume dispersion during a tidal cycle. This enabled to track the plume under the influence of continuous wind blow. The model runs were undertaken considering the outfall and intake points. **Figure 55 through Figure 58** presents the dispersion of plume from outfall option 1 with the influence of annual extreme wind and varying velocity considerations. As can be seen through the modeling results better dilutions are achieved with increased velocities with the plume moving in the direction of diffusion. The concentration plume reaches <0.25 within 300m from the outfall for all scenarios considered. However the lower velocity diffusion results in the sinking of dense water and while faster dilution is assured with increased velocity.

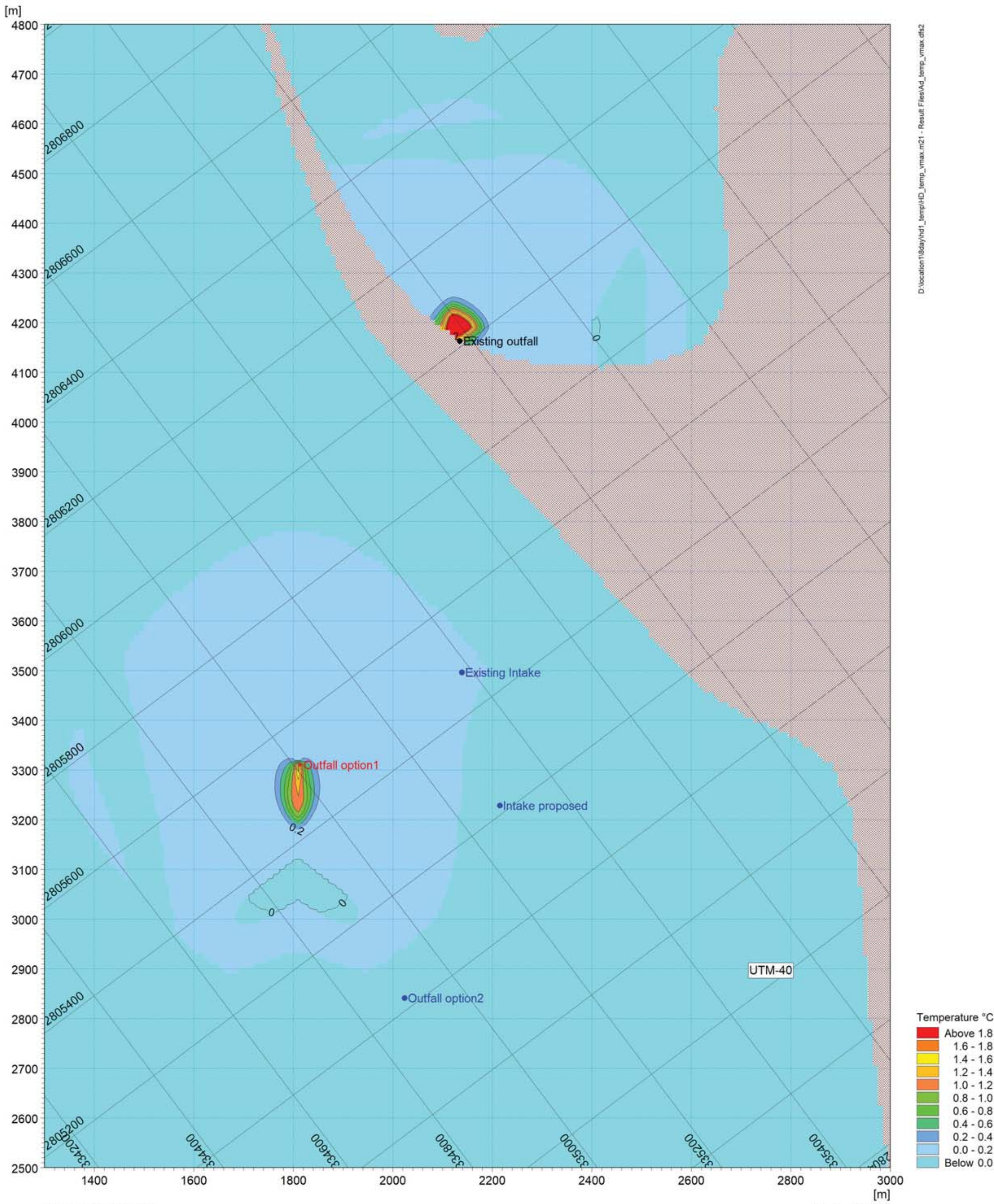
7.5.3.2.2.1.6.3. Plume dispersion (Temperature and salinity) due to tide only at Outfall at location-2

The plume patterns obtained are presented from **Figure 59** through **Figure 62.** The present test condition of maximum design flow (2.5 m/s) shows a faster dissipation mixing very well within 1km of the outfall throughout the tide. As the tidal current is relatively less compared to diffuser velocity, the plume velocity dominates the plume pattern compared to tide. Effect of wind on the plume dispersion is negligible. Salinity pattern also shows similar pattern of temperature for a distance then the pattern moves differently and vanishes faster than the temperature plume. It is noticed that the direction of diffusion plays a significant role in the dissipation and mixing.

7.5.3.2.2.1.6.4. Plume dispersion (Temperature and salinity) due to tide and wind at Outfall at location-2

As in outfall option 1, simulations of 28 days were conducted with and without the influence of wind to study the dispersion of temperature and salinity plumes. **Figure 63** to **Figure 66** shows the respective simulation results during the peak high water spring with two diffusion velocity conditions 2.5 m/s and 0/8 m/s.

Figure 51 - Dissipation of temperature plume from outfall option-1 with no wind and diffusion at a velocity of 2.5 m/s during peak high water spring (Scenario-1)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Intake proposed
Outfall option2
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Temperature °C
Above 1.8
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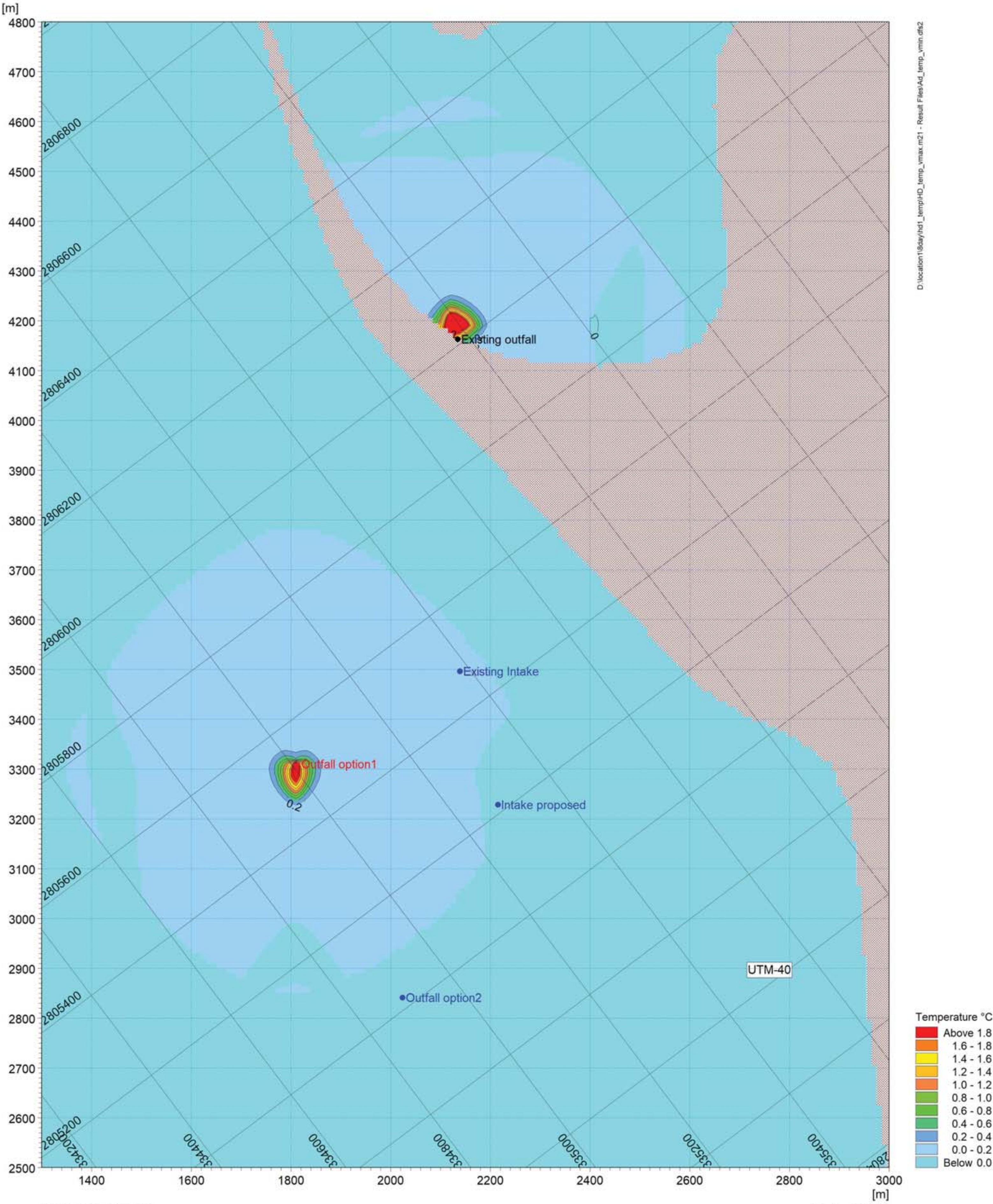
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10170

Figure 52 - Dissipation of temperature plume from outfall option1 with no wind and diffusion at a velocity of 0.8m/s during peak high water spring (Scenario-2)



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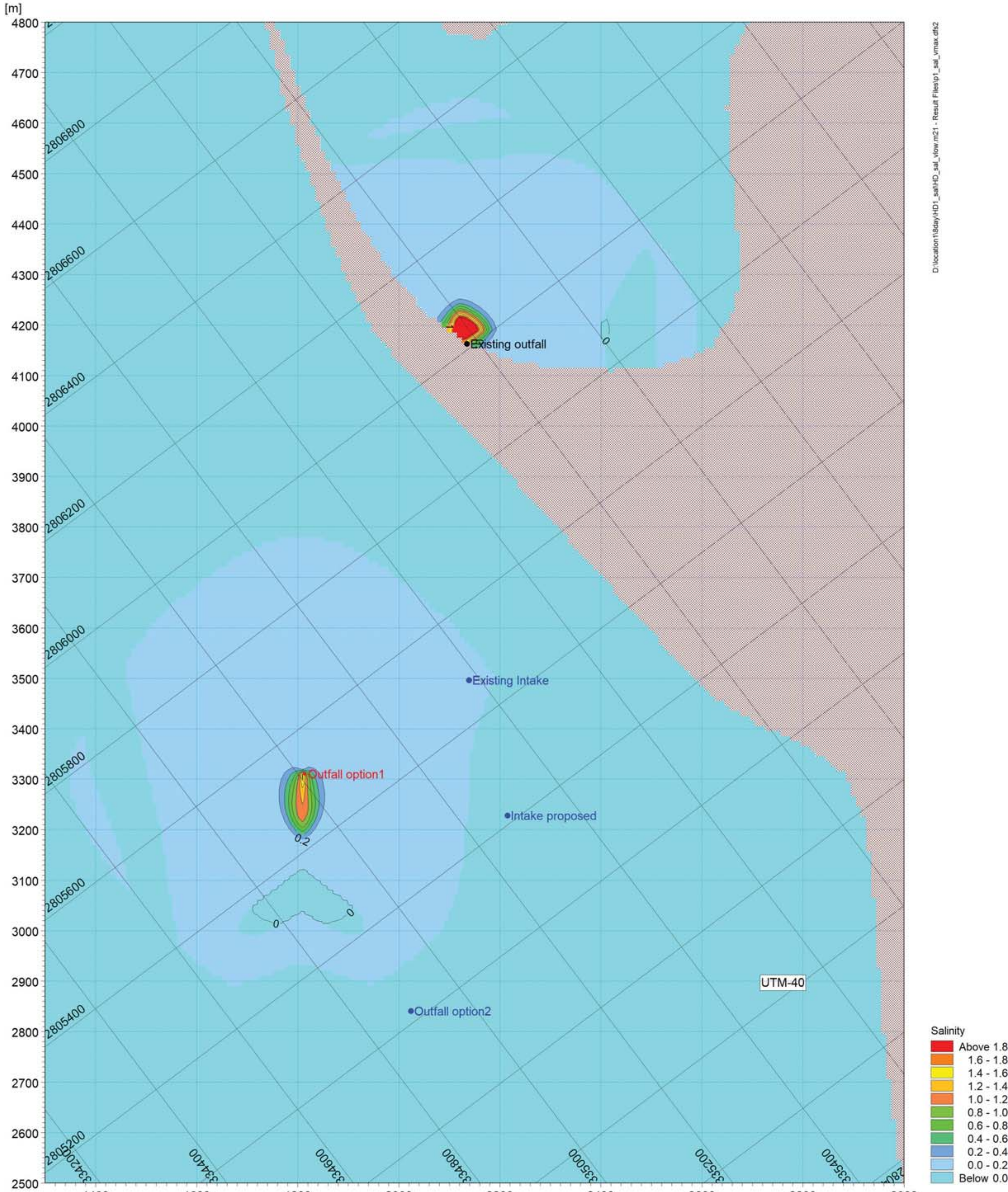
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
0.2
0
D:\location1\8day\hd1_temp\HD_temp_vmax.m21 - Result Files\Ad_temp_vmin.dfs2
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10170

Figure 53 – Dispersion of salinity plume from outfall option-1 with no wind and diffusion at a velocity of 2.5 m/s during peak high water spring (Scenario-1)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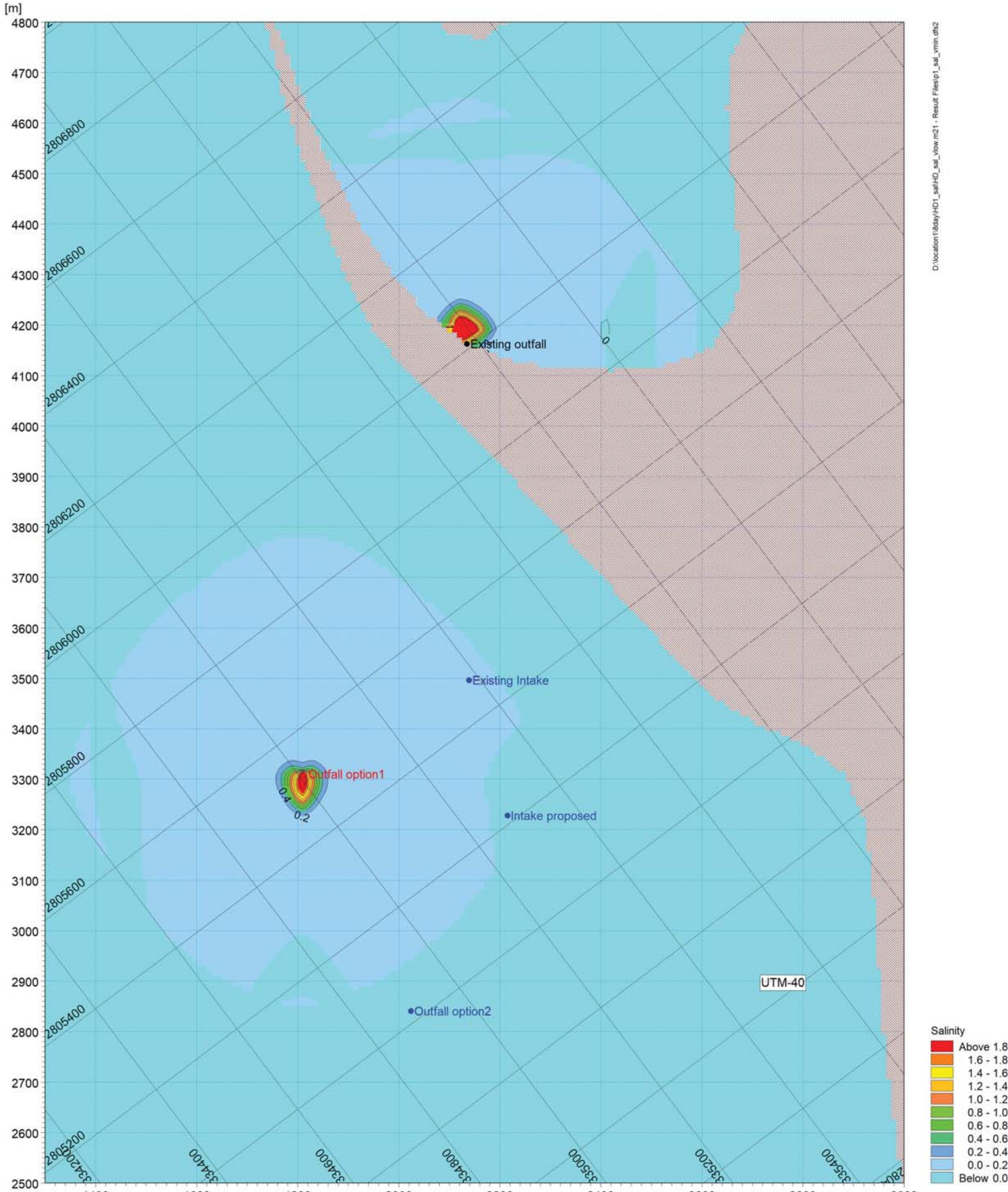
2806000
2805800
2805600
2805400
2805200
334200
334400
334600
334800
335000
335200
335400
Existing outfall
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
0.2
0
D:\location1\8day\HD1_sal\HD_sal_vlow.m21 - Result Files\p1_sal_vmax.dfs2
Salinity
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
08-08-2018 00:16:00
Scale 1:10160

Figure 54 – Dispersion of salinity plume from outfall option1 with no wind and diffusion at a velocity of 0.8m/s during peak high water spring (Scenario-2)



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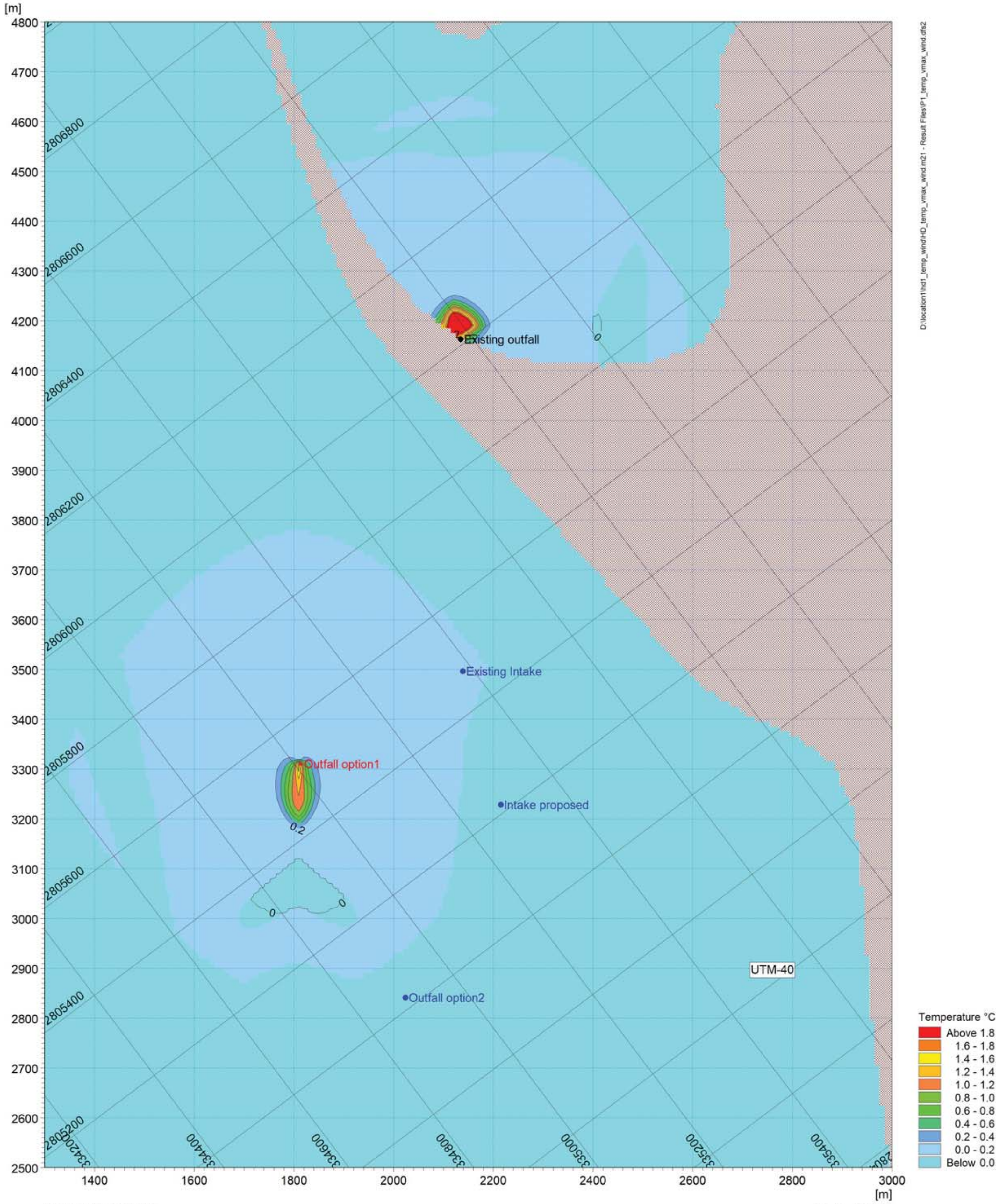
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
Salinity
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
08-08-2018 00:16:00
Scale 1:10160
D:\location1\8day\HD1_sal\HD_sal_vlow.m21 - Result Files\p1_sal_vmin.dfs2

Figure 55 - Dispersion of temperature plume from outfall option-1 during high-water spring in presence of annual extreme wind and diffusion velocity at 2.5m/s (Scenario-5)



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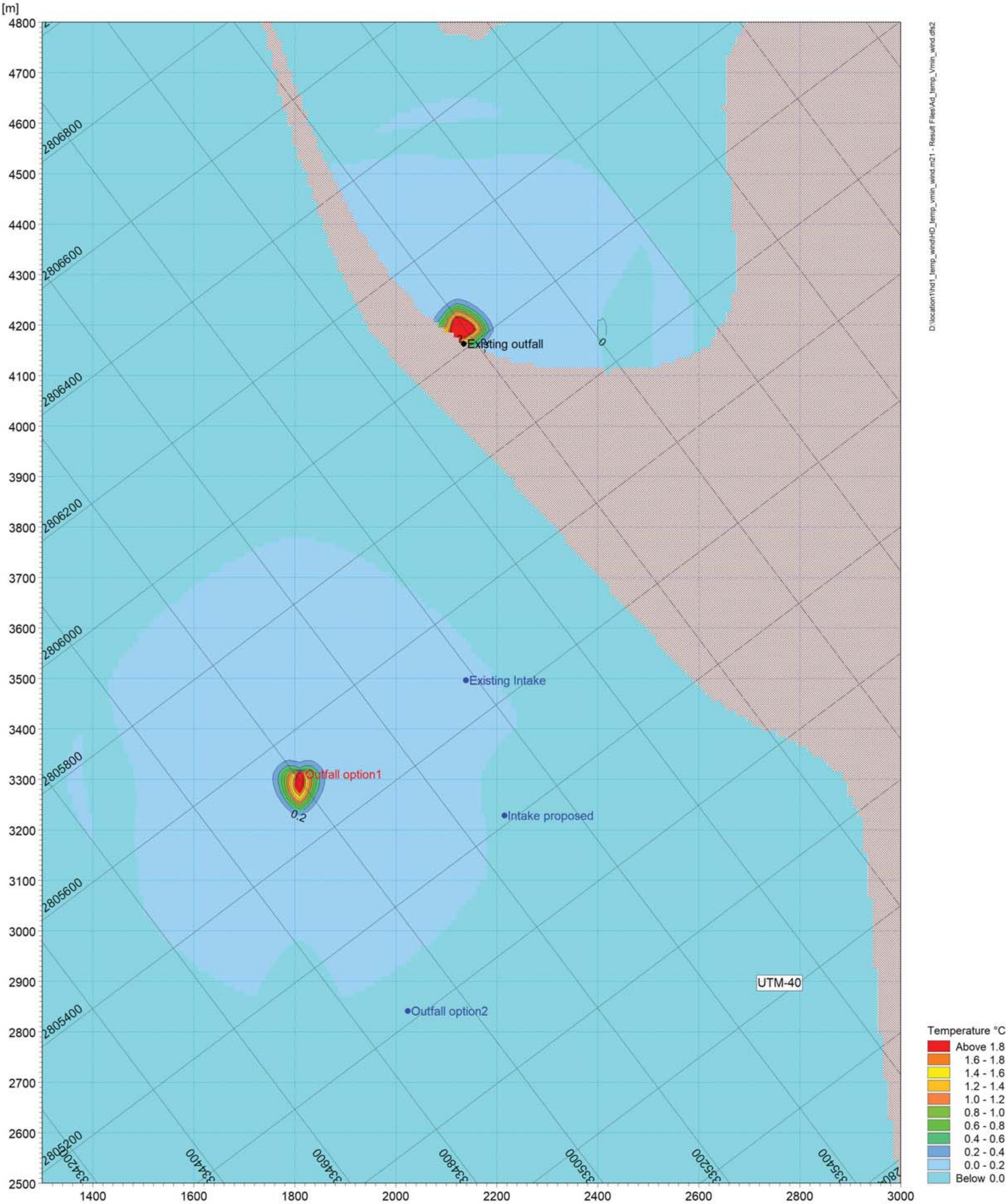
Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10170
D:\location1\hd1_temp_wind\HD_temp_vmax_wind.m21 - Result Files\P1_temp_vmax_wind.dfs2

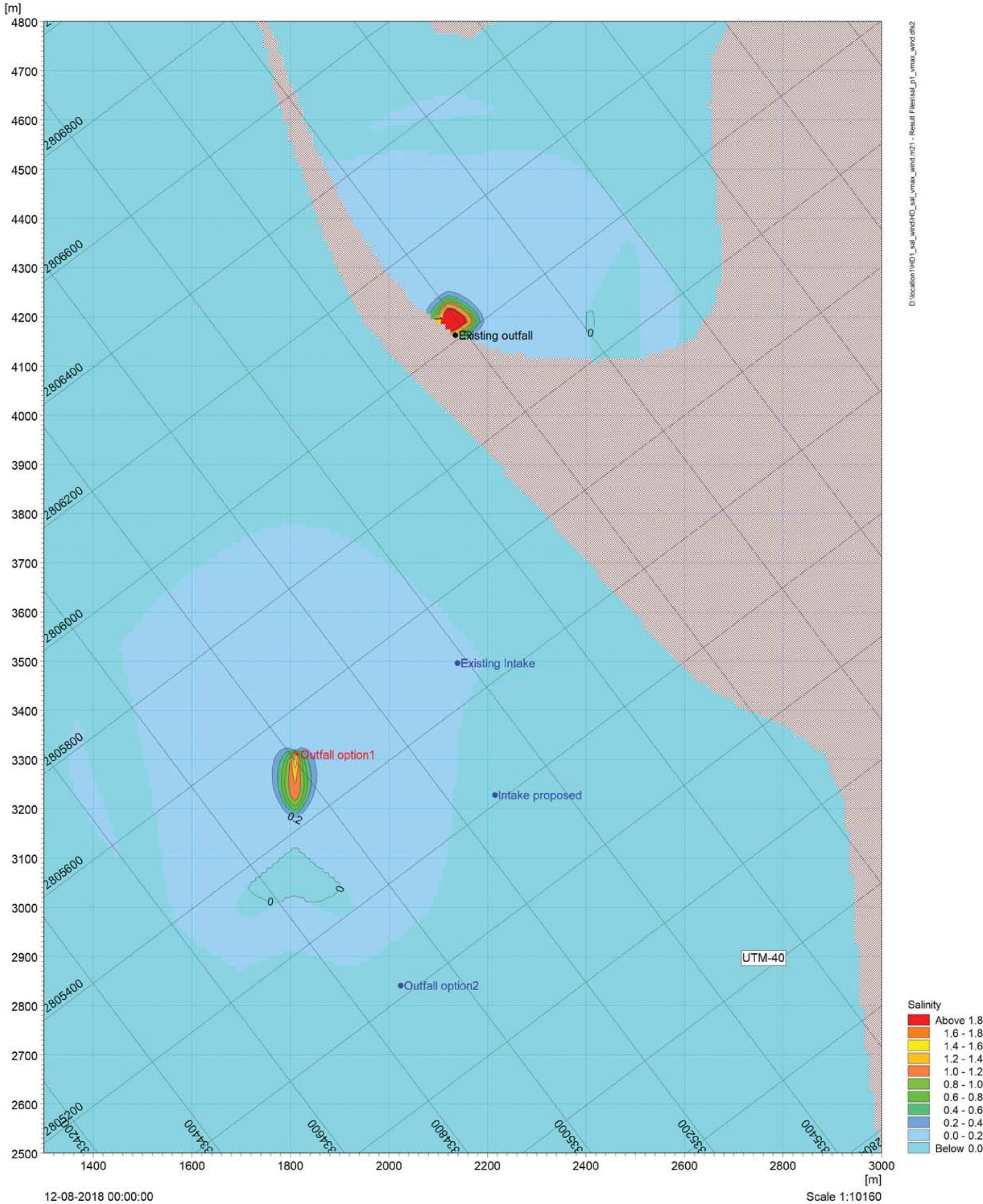
Figure 57 - Dispersion salinity plume from diffuser outfall option 1 with max velocity diffusion (2.5m/s) in presence of wind during high water spring (Scenario 5)



12-08-2018 00:00:00

Scale 1:10170

Figure 58 - Dispersion salinity plume from diffuser outfall option 1 with velocity diffusion of 0.8m/s (minimum) in presence of wind during high water spring (Scenario 6)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Intake proposed
Outfall option2
UTM-40
Salinity
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
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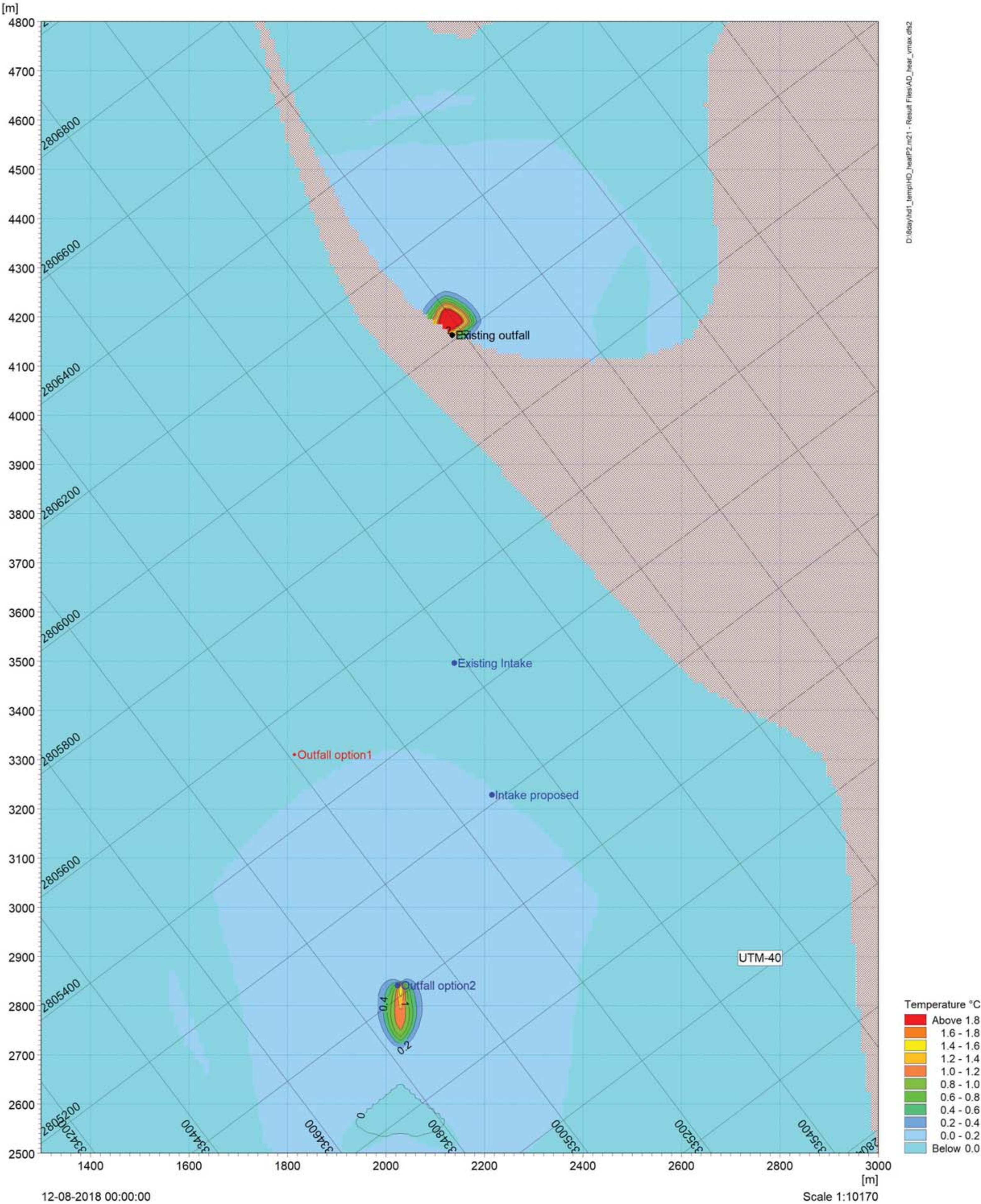
Figure 59 – Dissipation of excess temperature plume for the outfall option-2 with high velocity diffusion (2.5m/s) and without wind (Scenario 3)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Outfall option1
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Outfall option2
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Temperature °C
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1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
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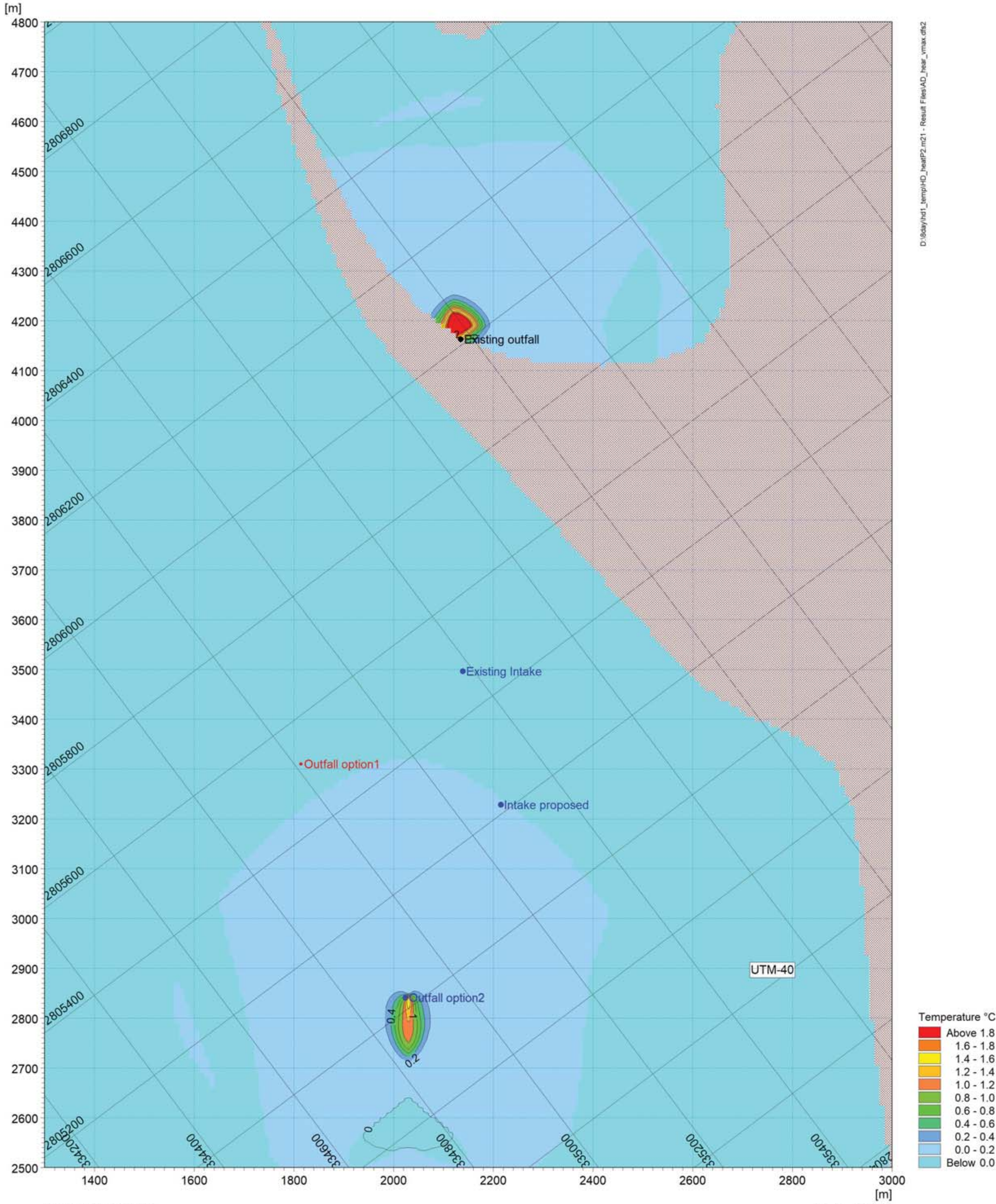
Figure 60 - Dissipation of temperature plume from outfall option-2 without wind and diffusion velocity 0.8m/s (Scenario 4)



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Intake proposed
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Temperature °C
Above 1.8
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
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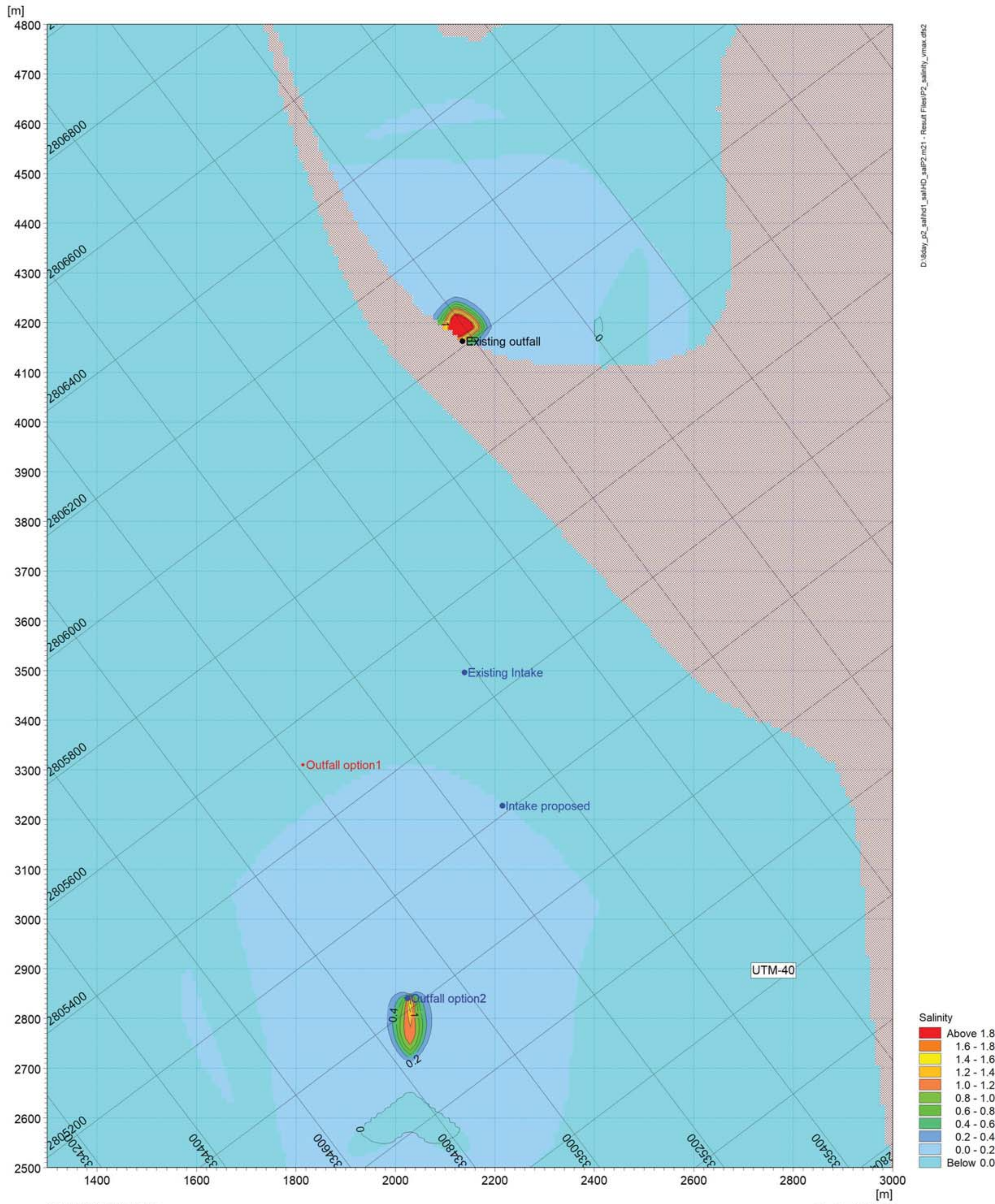
Scale 1:10170

Figure 61 - Dispersion of excess salinity plume for outfall option-2 with high velocity diffusion (2.5 m/s) and without wind (Scenario 3)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0.6 - 0.8
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0.0 - 0.2
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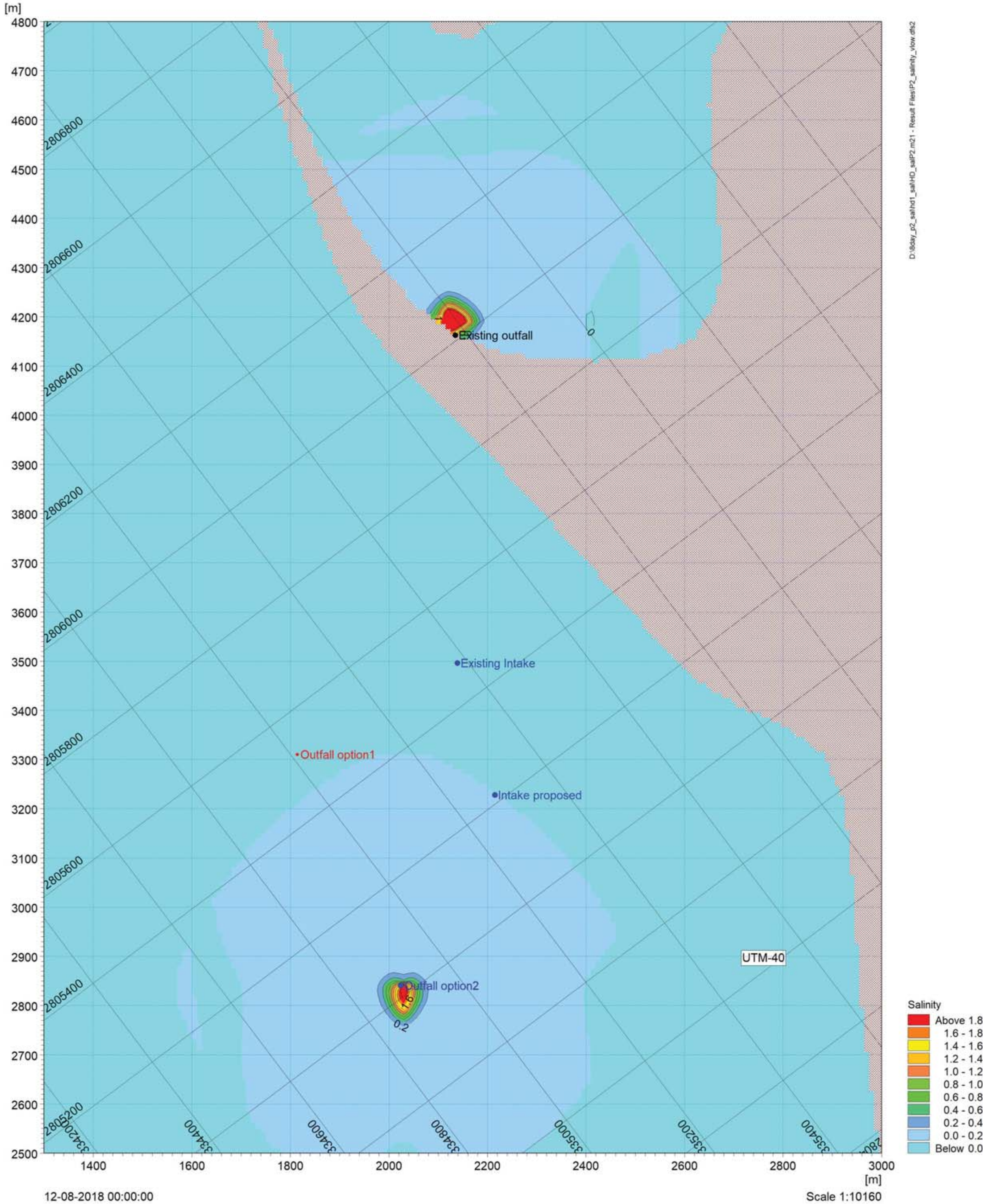
Scale 1:10160

Figure 62 - Dispersion of salinity plume from outfall option-2 without wind and diffusion velocity 0.8 m/s (Scenario 4)



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UTM-40
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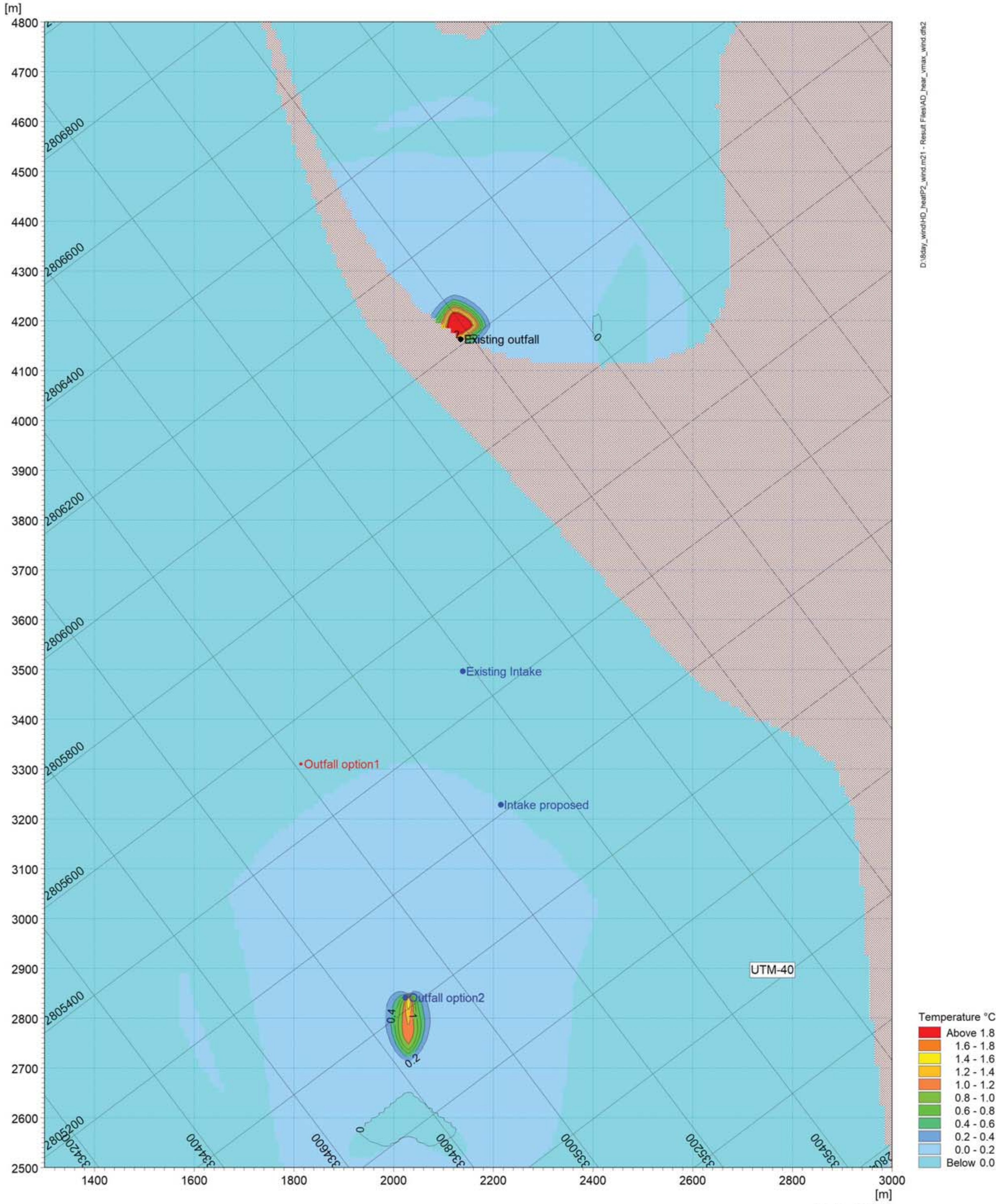
Scale 1:10160

Figure 63 - Dissipation of excess temperature plume with high velocity diffusion (2.5m/s) and annual extreme wind during High water spring - outfall option2 (Scenario 7)



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Outfall option1
Intake proposed
Outfall option2
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Temperature °C
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1.2 - 1.4
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0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
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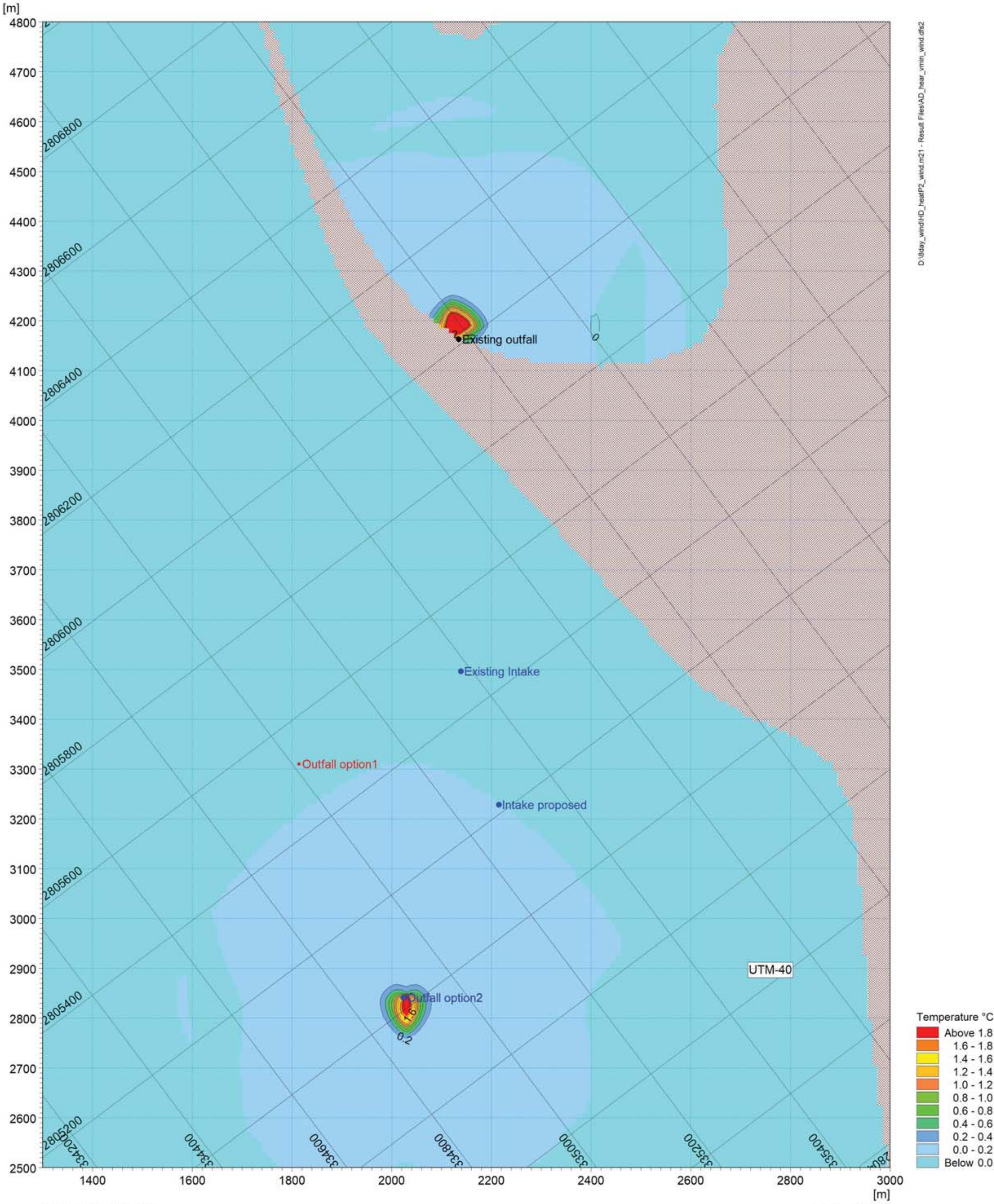
Figure 64 - Dissipation of excess temperature plume with low velocity diffusion (0.8m/s) and annual extreme wind during High water spring- outfall option2 (Scenario 8)



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Intake proposed
Outfall option2
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Temperature °C
Above 1.8
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1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
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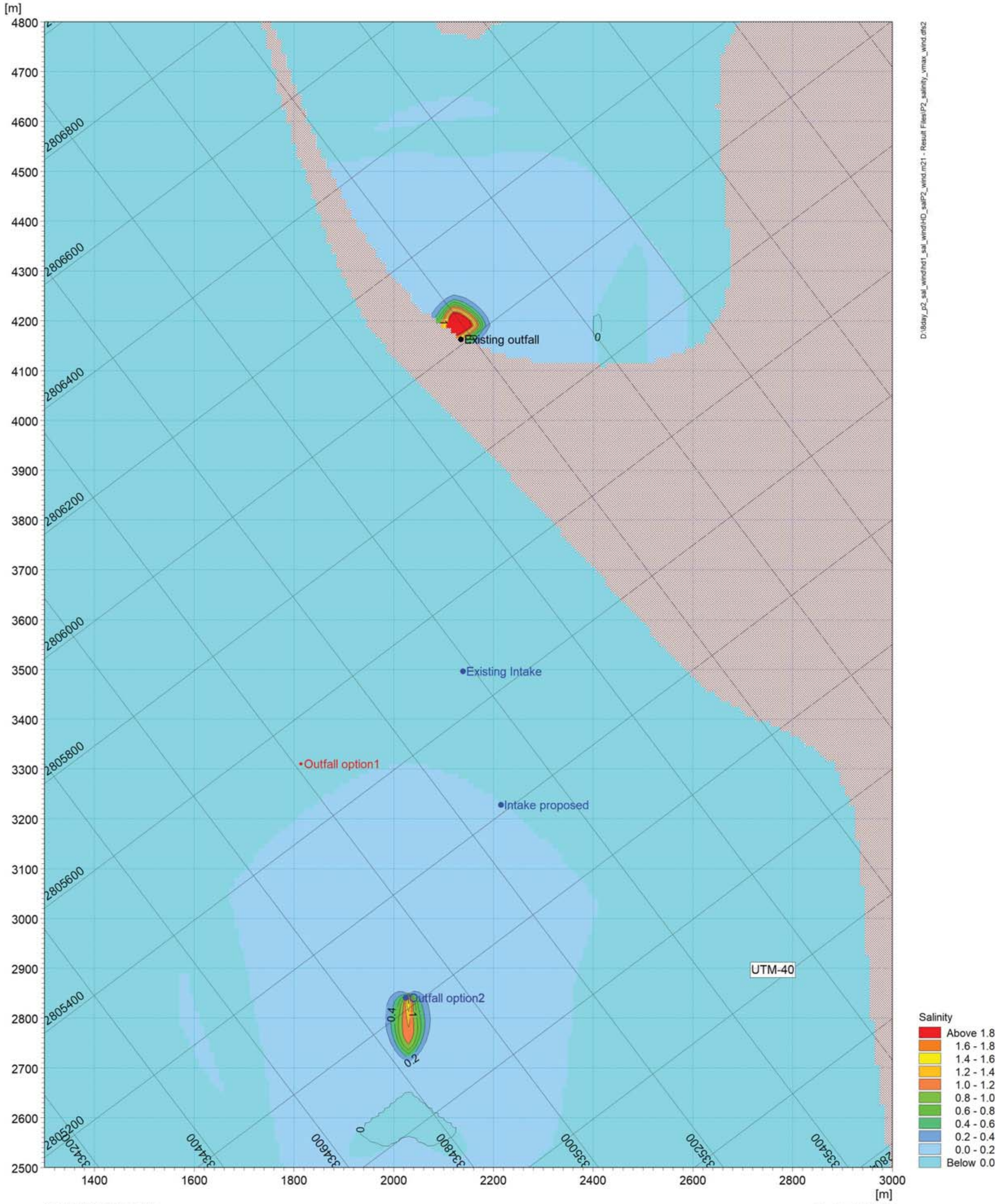
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10170

Figure 65 - Dispersion of excess salinity plume with low velocity diffusion (2.5m/s) with tide and annual extreme wind during High water spring- outfall option-2 (Scenario 7)



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Existing Intake
Outfall option1
Intake proposed
Outfall option2
UTM-40
Salinity
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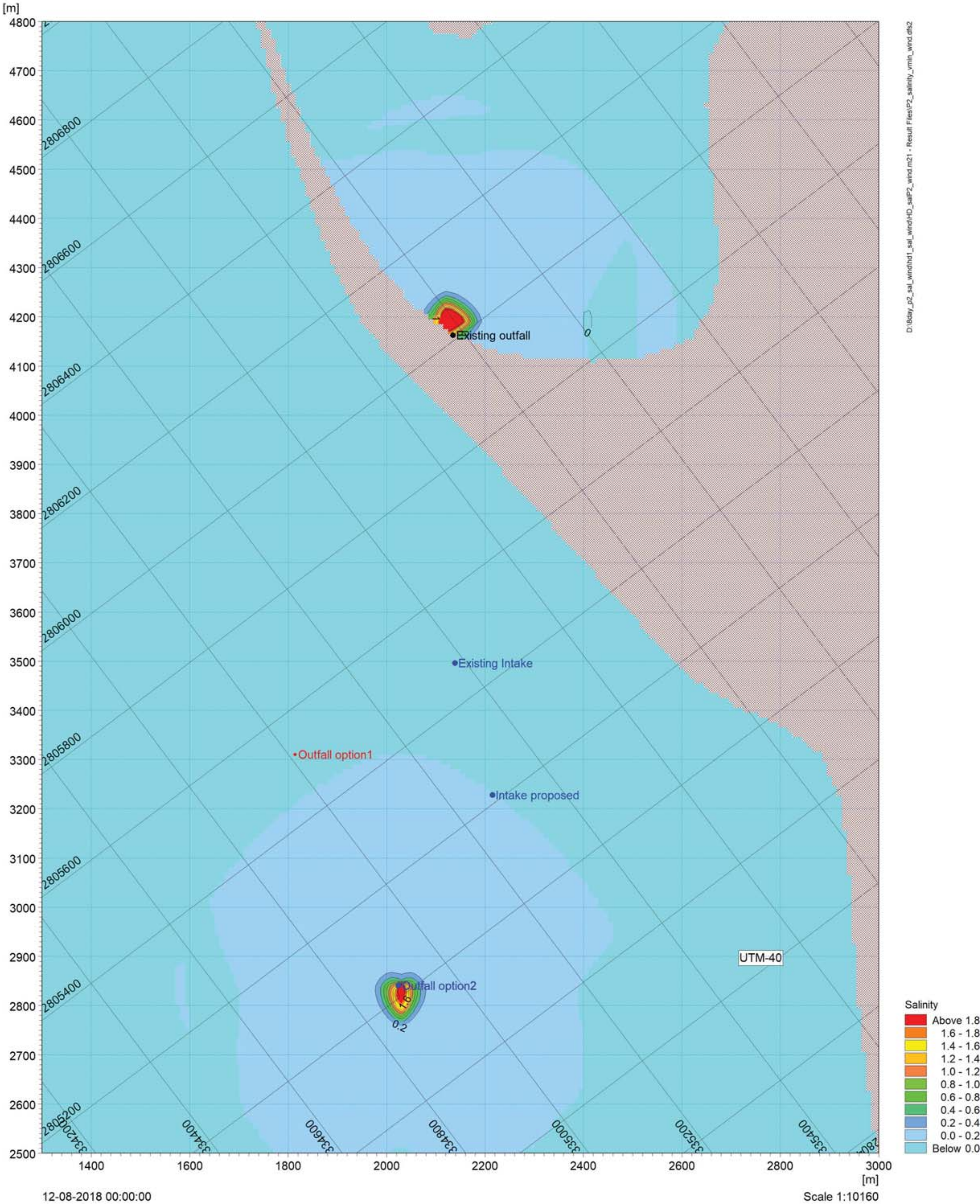
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
0.0 - 0.2
Below 0.0
12-08-2018 00:00:00
Scale 1:10160
D:\8day_p2_sal_wind\hd1_sal_wind\HD_salP2_wind.m21 - Result Files\P2_salinity_vmax_wind.dfs2

Figure 66 - Dispersion of excess salinity plume with low velocity diffusion (0.8 m/s) and annual extreme wind during High water spring - outfall option-2 (Scenario 8)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Existing Intake
Outfall option1
Intake proposed
Outfall option2
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Salinity
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Below 0.0
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7.5.3.2.2.1.7. Discussion on Thermal Plume Dispersion

The perusal on thermal plume dispersion results that the temperature excess (above ambient) does not exceed 0.25 °C from ambient temperature level beyond initial zone of dilution (300 m radius). The recommended norm for excess temperature as per marine water quality objectives of DM-EPSS (Environmental Standards and Allowable Limits of Pollutants on Land, Water and Air Environment, 2003) is 2°C from background (ambient) level. The modeled results clearly indicate that excess temperature outside mixing zone comply with recommended norms, and impact due to the increase in temperature in the sea water quality will be negligible.

7.5.3.2.2.1.8. Discussion on Salinity Plume Dispersion

The perusal of the salinity plume dispersion results, the salinity concentration excess (above ambient) do not exceed 0.25 ppt (less than 0.6% of the ambient salinity) beyond initial zone of dilution (300 m radius). The recommended norm for excess salinity as per article 22 of DM Local order 61 of 1991 is increased or decreased salinity of receiving water greater than 2ppt from ambient values. The modeled results clearly indicate that salinity change outside mixing zone comply with recommended norms, and impact due to the salinity increase in the sea water quality will be negligible.

7.5.4. IMPACT ON TERRESTRIAL WATER RESOURCES DURING OPERATION PHASE

The source of groundwater and soil contamination will be due to the improper management of wastewater generated by personnel and solid waste generation, spill, leaks of chemicals/hazardous materials. Since client is committed to implement effective waste management and spill prevention measures, impacts on ground water quality in the project site are expected to be minor magnitude.

7.6. LAND ENVIRONMENT

The impacts of the proposed project during the construction and operation phases have been identified using Impact Assessment Methods. The identified significant impacts which may get affected and require mitigation measures due to the proposed activities of the project has been addressed below.

7.6.1. IMPACT ON LAND USE

The project will be facilitated in the existing Layyah Power Station of SEWA which is surrounded by industrial units of Port. It is consistent with surroundings. Hence, there is no change in land use of the project area.

7.6.2. IMPACT ON LAND ENVIRONMENT DURING CONSTRUCTION PHASE

The topography of the project site is flat barren land. During construction of foundation, excavated earth will be reused for construction & re-pairing of roads and refilling of foundation. Thus the impact during the construction is low magnitude and insignificant.

The dredged materials to be generated from dredging activity will have impact on land quality. Since it is proposed to dispose the dredged wastes to the Sharjah Municipality (SM) authorized service providers in compliance with SM regulations, the impact on land quality will be minor effect.

In general, one or more of the following activities impart adverse impacts on the land environment:

- Handling of solid construction materials, where from fugitive solids may deteriorate the soil characteristics;
- Handling and disposal of construction solid wastes, which may deteriorate soil characteristics and change the physical features, drainage, etc;
- Disposal of liquid wastes on land, thereby deteriorating soil quality;
- Disposal of miscellaneous used/damaged materials and solid wastes thereby imparting negative impact on aesthetic value.

As it is committed to provide effective construction waste management for the entire construction period, expected impact on land quality will be minor effect.

7.6.3. IMPACT ON LAND ENVIRONMENT DURING OPERATION PHASE

The generated solid wastes from domestic and industrial activity will be properly collected and stored in the area specified for solid waste storage. The domestic waste generated will be collected and stored in the respective garbage bin. The general waste generated from the industrial activity will be collected and stored in the waste bin. The collected domestic and mixed waste will be properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal.

Since the facility is committed that solid wastes will be properly stored in bin and disposed to agencies for further treatment and safe disposal, impact is not envisaged on land quality (ground water and soil) due to disposal of solid wastes.

7.7. ECOLOGY

The impacts of the proposed project during the construction and operation phases have been identified using Impact Assessment Methods. The identified significant impacts which may get affected and require mitigation measures due to the proposed activities of the project has been addressed below.

The impacts on biodiversity during the construction and operation phases have been identified and evaluated using impact assessment methods. The process of ecological impact assessment hereunder described.

7.7.1. ECOLOGICAL IMPACT ASSESSMENT METHODS

The following components are considered to determine the significance of ecological impacts:

- Compliance to legal requirement;
- The baseline conditions of the area – The baseline of ecology is characterised based on marine and the terrestrial ecological survey conducted in the project region;
- The sensitivity of receptors – sensitive receptors are identified and described in **Table 85**; and
- Evaluation criteria

7.7.1.1. Legal requirements

Ecological impacts assessment comply the UAE Federal requirement and IFC. The assessment is in line with IFC PS-6 and its corresponding guidance note 6. The specific requirements are hereunder briefly discussed.

7.7.1.1.1. UAE Federal requirements

In accordance with Federal environmental law, reserve areas shall be protected from work, activities and acts which may lead to damage or deterioration of the natural environment and Setting up establishments, buildings or construct roads, drive vehicles or practice any agricultural, industrial or commercial activities in reserve areas without the permission of the Competent Authorities are also prohibited under this law. Resting, hatching or habitation shall be protected in in accordance with the provision of this Law.

7.7.1.1.2. International Requirement - International Financial Corporation

The IFC PS6 objectives are:

- To protect and conserve biodiversity
- To maintain the benefits from ecosystem services

- To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.

IFC PS6 requires that a conservation value is allocated to the ecological features (protected areas, habitats and species) which are likely to be directly or indirectly impacted in the project study area. Under the IFC guidance, the requirements of PS6 apply to projects in all habitats, whether or not those habitats have been previously disturbed and whether or not they are legally protected. Specifically a project is required to:

- Assess significance of project impacts on all levels of biodiversity as an integral part of the social and environmental assessment process
- Take into account differing values attached to biodiversity by specific stakeholders
- Assess major threats to biodiversity, especially habitat destruction and invasive alien species.

In accordance with IFC PS6, habitats are divided into modified, natural and critical habitats. Critical habitats can be either modified or natural habitats supporting high biodiversity value, including:

- Habitat of significant importance to critically endangered and/or endangered species
- Habitat of significant importance to endemic and/or restricted-range species
- Habitat supporting globally significant concentrations of migratory species and/or congregatory species
- Highly threatened and/or unique ecosystems
- Areas associated with key evolutionary processes.

Since habitat destruction is recognized as a major threat to the maintenance of biodiversity and to assess likely significance of impacts, IFC PS6 requires the following depending on habitat status:

- Modified Habitat: exercise care to minimize any conversion or degradation of such habitat, depending on scale of project, identify opportunities to enhance habitat and protect and conserve biodiversity as part of operations.
- Natural Habitat: developer will not significantly convert or degrade such habitat unless no financial/technical feasible alternatives exist, or overall benefits

outweigh cost (including those to biodiversity), and conversion or degradation is suitably mitigated. Mitigation must achieve no net loss of biodiversity where feasible; offset losses through creation of ecologically comparable area that is managed for biodiversity, compensation of direct users of biodiversity.

- Critical Habitat: in areas of critical habitat the Project Proponent will not implement Project activities unless there are no measurable adverse impacts on the ability of the critical habitat to support established populations of species described or on the functions of the critical habitat; no reduction in population of a recognized critically endangered or endangered species and lesser impacts mitigated as per natural habitats.

7.7.1.2. Summary of ecological conditions in the project area

7.7.1.2.1. Terrestrial ecological conditions

The proposed project will be established in the existing site of Layyah Power Station of SEWA. The study area of project site is already developed and the project site does not have significant flora and fauna.

7.7.1.2.2. Terrestrial Protected Areas

The nearest national protected area is Wasit natural reserve (0.86 km^2) which is located 8.5 km east from the project site. It is an essential site for bird ecology within the emirate of Sharjah and it is a unique landscape with a natural lake maintained by the upwelling of underground water. The most distinguished feature of the reserve is the diverse ecosystem since it has different habitats and types of vegetation compromising coastal sand dunes, along with salt flat (Sabkhas) linking ponds and a large open lake *(Source: http://www.epaashj.ae/protected-areas/wasit-nature-reserve/)*.

There are no other protected areas for nature conservation designated at national or international levels within the project study region.

7.7.1.2.3. Marine ecological conditions

Ten stations were selected to be representative within the study area. The epibenthic communities were dominated by oyster bed, corals, sandy and silty sand areas. Moderate diverse condition with potential importance of corals and oyster beds was found especially on station ME-05 and ME-08. Phytoplankton density in terms of cell counts varied from 22-83 $\times 10^3$ No./L with an overall average population density of 40.6×10^3 No./L. The dominant class of the phytoplankton was Dinophyceae (dinoflagellates) (45.8%) followed by Bacillariophyceae (Diatoms) (36%) and Cyanophyceae (Cyanobacteria) (18.2%). Harmful Algal blooms were absent in the phytoplankton samples. The zooplankton population had an average population of 172 individuals in no./m^3. A total of 12 taxa were recorded. Acartia fossae (22.3%), Copepods (19.7%), Oikupleura sp (14.8%), Sagitta (12.9%) and Lucifer sp. (10.12%) were the major group and species of the zooplankton. Fish eggs and fish larvae were not found in the samples collected. The perusal of the present levels of planktonic communities indicates that it was found moderate population density along the project area. The macro-benthic infauna along the project area had population values ranging from 1200-3880 No./m^2 (average 2772 No./m^2). Moderately high diversity index of Margalef (d) and Shannon-Wiener (H') at stations ME-01, ME-02, ME-04, ME-05, ME-06, ME-07, ME-08 & ME-09 shows moderate healthy statues of macro-benthic in-fauna in this project area.

7.7.1.2.4. Marine Protected Areas

There is no marine protected area for nature conservation designated at national or international levels within the project study region.

7.7.1.3. Sensitivity of the receptors

The sensitivity of the ecological receptor has been determined using the criteria presented in **Table 84.**

Table 84 – Criteria for determining sensitivity of the receptor for ecology

Sensitivity Ranking	Detail	Habitat or Site Criteria	Species criteria
Very high	Very high importance and rarity. International scale with limited potential for substitution.	Internationally designated sites (or equal status). Habitats of significant international ecological importance.	IUCN Critically Endangered and Endangered species (IUCN red list)
High	High importance and rarity, national scale, or regional scale with limited potential for substitution, species of international status but not within designated areas.	Nationally designated sites (or equal status). Areas of habitats of national ecological importance, and natural habitats of significant ecological importance and/or high biodiversity with limited potential for substitution.	IUCN Vulnerable species. Nationally protected species of significant population size and importance.
Moderate	High or medium importance and rarity, local or	Regionally important natural habitats. Natural habitats. Modified	IUCN Near Threatened species. Nationally protected

Sensitivity Ranking	Detail	Habitat or Site Criteria	Species criteria
	regional scale, and limited potential or substitution, species of national status but not within designated areas.	habitats with high biodiversity or under significant threat of loss within the region.	species or rare species, but not a significant population size and not of national importance.
Light	Very low or low importance and rarity, and local scale.	Undesignated sites and habitats of natural habitats of some local biodiversity and cultural heritage interest. Modified habitats with limited ecological value. Other sites with little or no local biodiversity and cultural interest. Modified habitats with limited biodiversity value.	IUCN Least Concern. Species of local national importance.
Marginal	Very limited ecological importance.	Highly modified habitats of no biodiversity value.	IUCN Least Concern species. Species of no national importance.

The identified receptors are assessed based on the criteria mentioned above for the sensitivity. The details of sensitive receptors concerning ecological features are presented in **Table 85**.

Table 85 – Details of sensitive receptors in relation to ecological features

Receptor Type	Name of the receptor	Distance – km (Direction)	General Sensitivity	Sensitivity to ecological features	
				Habitat or Site Criteria	Species criteria
Industrial premises	Project site	--	Marginal	Marginal	Marginal
Natural Habitat	Sharjah Creek	0.40 (E)	Moderate	Moderate	Moderate

Receptor Type	**Name of the receptor**	**Distance – km (Direction)**	**General Sensitivity**	**Sensitivity to ecological features**	
				Habitat or Site Criteria	**Species criteria**
Natural Habitat	Arabian Gulf (Sea)	Adjacent	Moderate	Moderate	Moderate
Natural Habitat	Khalid Lagoon	1.50 (SSE)	Moderate	Moderate	Moderate
Natural Habitat	Al Khan Lagoon	2.60 (S)	Moderate	Moderate	Moderate
Ecologically Protected Area	Wasit Natural Reserve	8.5 (E)	High	High	High

7.7.1.4. Criteria of ecological impact assessment

The magnitude of the potential impacts upon each ecological feature has been assessed for the construction and operation of the Project, using the criteria presented in **Table 86**.

Table 86 – Criteria for determining impact significance for ecology

Degree of Significance (Adverse/ beneficial)	**Criteria**
Major	Environmental effects are clearly noticeable and are sufficient to destabilize the resource. Change to the specific conditions assessed resulting in long term/permanent change, typically widespread in nature and requiring significant intervention to return to baseline.
Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific condition assessed
Negligible	No perceptible change to the specific condition assessed.

7.7.2. ECOLOGICAL IMPACT DURING CONSTRUCTION PHASE

7.7.2.1. Terrestrial ecology – Construction phase impact identification and evaluation

The extent of habitat to be affected by the project is approximately 25,000m^2. The project site is flat without any significant flora and fauna and currently left barren. Since there is no significant flora and fauna in the project affected area, the expected impact on terrestial ecology will be minor effect.

7.7.2.2. Marine ecology – Construction phase impact identification and evaluation

The construction of intake and outfall structures and the laying of pipelines in the seabed may cause the following environmental impacts on marine ecological environment:

- The construction of intake and outfall structures and the laying of pipelines in the seabed may lead to a destruction of benthic habitats. The mechanical impact is usually lethal for benthic organisms in the immediate construction site.
- Disturbance of sediments may have short-term indirect effects on marine life.

7.7.2.2.1. Impact of installation of offshore structures

Installation of the intake structure and pipeline would effectively eliminate any (sandy or rocky) biota in the structural footprint, and reduce the area of seabed available for colonization by marine benthic communities. The loss of substratum as a result of the offshore intake and outfall effluent pipelines would, however, is temporary, as the structures themselves would provide an alternative substratum for colonizing communities.

The physical removal of sediments or bedrock for the intake and outfall structures, and disposal of the excavated materials will destroy benthic biota within the marine construction zone.

Active rehabilitation of intertidal communities is not possible, but rapid natural recovery of disturbed habitats in the turbulent intertidal and surf-zone areas can be expected. Furthermore, the intake and marine structures will serve as a new 'hard-bottom' substrate for colonization by marine benthic communities. Recolonisation will start rapidly after cessation of trenching, and species numbers may recover within short periods (weeks) whereas biomass often remains reduced for several years.

The impact of disturbance of the intertidal and sub tidal rocky shore during installation of the intake and discharge pipelines is assessed to be of moderate effect and with the implementation of mitigation can be reduced to minor.

Increased suspended sediments in the surf zone and near shore can potentially affect light penetration and thus phytoplankton productivity and algal growth, and could also load the water with inorganic suspended particles thereby affecting the feeding and absorption efficiency of filter-feeders.

7.7.3. ECOLOGICAL IMPACT DURING OPERATION PHASE

7.7.3.1. Ecology – Operation phase impact identification and evaluation

During operation phase of the facility, the following are the key issues and major potential impacts.

- Altered flows at the intake and discharge resulting in ecological impacts (e.g. entrainment and impingement of biota at the intake, flow distortion/changes at the discharge, and effects on natural sediment dynamics);
- Potential for habitat health impacts/losses resulting from elevated salinity in the vicinity of the outfall effluent discharge; and
- The effect of the discharged effluent potentially having a higher temperature than the receiving environment.

7.7.3.2. Impingement and Entrainment

Intake of water directly from the sea will lead to a loss of marine species through impingement and entrainment. Impingement refers to injury or mortality of larger organisms (e.g. fish etc.,) trapped against intake screens, whereas entrainment affects smaller organisms which slip through the screens and are transported into the plant with the feed water. Impingement mortality is typically due to suffocation, starvation, or exhaustion due to being pinned up against the intake screens or from the physical force of jets of water used to clear screens of debris *(UNEP, 2008)*.

Impingement and entrainment of marine organisms in terms of probability and magnitude are impacted by intake location (issue of biological productivity), ambient hydraulics (low currents produce higher risk), water quality (water temperature and dissolved oxygen that impact organism mobility), species-specific morphology and physiology (dimensional attributes and geometry), and intake design and operation (*Hogan, 2015*[27])

The significance of impingement is related primarily to the location of the intake structure and is a function of intake velocity. The reduction of the average intake velocity of the feed water, which is comparable to background currents in the oceans, will allow

Hogan, T.W., 2015. Impingement and entrainment at SWRO desalination facility intakes, chapter 4, in: Missimer, T.M., Jones, B. and Maliva, R.G., (Eds.), Intakes and Outfalls for Seawater Reverse-osmosis Desalination Facilities: Innovations and Environmental Impacts, Springer International Publishing, Switzerland, 2015, pp. 57–78.

mobile organisms to swim away from the intake under these flow conditions *(UNEP, 2008)*.

Impingement mortality is typically due to suffocation, starvation, or exhaustion when pinned against intake screens or from the rakes used to clear screens of debris. Entrainment effects are likely to persist, as most of the entrained organisms are too small to be screened out without significantly reducing the intake water volume. Entrained material includes copepods, diatoms juvenile shrimps and the planktons, eggs and larvae of invertebrates and fish. Mortality rates are likely to be 100%.

Although mortality caused by entrainment may affect the productivity of coastal ecosystems, the effects are difficult to quantify. Planktonic organisms show temporal and spatial variations in species abundance, diversity and productivity, but it can be assumed that species common in the project region will be prevalent in the surface waters of the project area. Furthermore, plankton species have rapid reproductive cycles. Therefore, it is unlikely have a substantial negative effect on the ability of plankton organisms to sustain their populations. The entrainment of eggs and larvae from common invertebrate and fish species is also unlikely to adversely affect the ability of these species to reproduce successfully.

7.7.3.3. Effects of Increased Temperature and salinity

Salinity and temperature are vital environmental parameters for marine life. Similar to thermal pollution, increased salt concentrations can be harmful and even lethal to marine life. In general, toxicity depends on the sensitivity of the species to increased salinity, the natural salinity variations of their habitat, and the life cycle stage.

The perusal of the hydro-dynamic modeling and plume dispersion study results, there is no significant increase in temperature and salinity outside mixing zone (300m). According to the ecological survey, habitat in the mixing zone (ME-07) is dominated by sandy with broken shells. Coral communities are not identified in the zone. Hence, impact on marine ecology will be minor a due to the discharge of outfall effluent.

7.7.3.3.1. Effect of discharging chemicals in outfall effluent

The residual products of chlorination i.e., chloramines, halogenated compounds and bromanines, are more stable than chlorine and may be harmful to aquatic life. In addition, sodium hypochlorite is also harmful to aquatic life. As there is no significant change in the quality of outfall effluent due to chemical residuals and quality of outfall effluent complies with effluent guidelines, significance of the impact on marine biota will be minor effect. Outfall effluent quality will be continuously monitored.

7.8. SOCIO-ECONOMICS

7.8.1. CONSTRUCTION PHASE – IMPACT ON SOCIO-ECONOMY ASPECTS

The impact of construction of the proposed project would be both positive and negative impact on Socio-Economic Aspects. The beneficial impacts are significant, short term as well as long term and regional level. Whereas, the adverse impacts will be extended either within the site or extent to immediate vicinity only and it will be moderate. The mitigation measures may prevent the adverse impact on human environment.

a. Positive Impacts

- The main impact of the construction and CCGT operation project on the economy of Sharjah and the Territory on the whole will be connected to the disposition of the contracts for building and for procurement of construction materials.
- Contract with local companies for execution of work on transportation and disposal of solid domestic waste, delivery of necessary materials and facilities.
- The impact on Sharjah revenue under this project realization will be the expense of tax payment by contractors and subcontractors (indirect impact).
- This project will create additional job positions, increasing the income of workers and purchasing activity of the population due to material purchases and service providing for the construction needs.
- The important impact of the project realization must become the growth of the work position amounts as in the town so as in the region.

b. Negative Impacts

- During construction phase of the proposed project, workers are subject to Health and Safety Risks
- The foreseen transportation activities during the construction phase will have moderate impacts on the existing traffic system within Sharjah region and existing emirate roads. Since the movement of heavy truck to be deployed during construction is restricted in the project region during peak hours, the impact due to heavy trucks on adjacent roads will be minor. If the traffic will not be controlled effectively in the site, it may create traffic in the adjacent roads of residential areas. It will be controlled by the development of site traffic control plan. It is anticipated that impact on traffic will be significant with minor effect.

7.8.2. OPERATION PHASE – IMPACT ON SOCIO-ECONOMY ASPECTS

7.8.2.1. Impact on surrounding community

The project site is surrounded by commercial destinations (hotel/resorts) which are inhabited environment as it houses guests and tourists from all over world, dense residential area and heritage areas in the primary impact area. Emissions generated by power generation process and increase noise level by operation of the project may possibly impact the nearby communities. The perusal of assessments carried out that proposed project will have minor impact to the nearby communities.

Positive impacts are as follows:

- In connection with this project realization there will also an opportunity that encourages the growth of electric and thermal power supply for domestic needs of the developing town, for social and commercial economy sectors of the town, the Territory and the whole Sharjah region, the growth of salaries, the migratory population increase and the improvement of other social rates.
- Industrial sectors where power industry plays the essential role intensively develop in the Sharjah and adjacent regions due to the power available from the project.

7.8.2.2. Impact on Traffic and Transportation

The foreseen transportation activities during operation phase will have moderate impacts on the existing traffic system within Sharjah region and existing emirate roads. If the traffic will not be controlled effectively in the site, it may create traffic in the adjacent roads of residential areas. It will be controlled by the development of site traffic control plan. It is anticipated that impact on traffic will be significant with minor effect.

7.9. SUMMARY OF ASPECTS AND IMPACTS

A summary of environmental and social aspects and its impacts during construction and operation phase are presented in **Table 87** and **Table 88**.

Table 87 – Summary of Environmental Aspects and Probable Impacts during Construction Phase

Environmental Aspects	Probable Environmental Impacts	Impacted Receptor	Magnitude of Impact	Sensitivity of Receptor	Effect (Magnitude × Sensitivity)
Installation of sea water intake and outfall structures	Dredging activities generate sediment plume which may impact on marine water environment	Arabian Gulf	Moderate	Moderate	Moderate
Generation of fugitive dust emissions due to truck transport of debris on unpaved roads; truck unloading of debris; Earthworks operations: and windblown dust from stockpiles	Air pollution and dust deposition	Project site and nearby commercial destination	Moderate	Moderate	Moderate
Exhaust emissions of combustion gases due to operation of fuel fired equipment/machinery	Air pollution - Increase in NO_X, SO_2, CO, VOCs in ambient air due to combustion emissions	Project Site/Onsite workers	Moderate	Moderate	Moderate
Generation of Vibration and Noise due to operation of construction equipment/ machinery	Increase in noise and vibration levels and Health effects due to exposure of excessive noise & vibration	Project Site/Onsite workers	Moderate	Moderate	Moderate
Any excavations below the ground water table may require dewatering. Discharge of dewatered water to environment (Sea/groundwater)	The discharge of dewatered groundwater to ground water/sewerage/sea/ land environment may deteriorate the destiny environment. If groundwater quality is poor	Groundwater, Arabian sea, Project site	Moderate	Moderate	Moderate

Environmental Aspects	Probable Environmental Impacts	Impacted Receptor	Magnitude of Impact	Sensitivity of Receptor	Effect (Magnitude × Sensitivity)
	this has the potential to impact water quality in the designated source of discharge. The discharge may also disturb sediment increasing suspended solids and may encourage the dissolution of contaminants previously bound to the sediment.				
Spills, leaks and Improper disposal of workforce domestic wastewater	Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	Moderate	Minor
Spill, leaks due to improper storage and handling of fuels, chemicals/ construction materials	Possible Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	Moderate	Minor
Spills, leaks and Improper disposal of hazardous and non-hazardous construction & demolition waste	Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	Moderate	Minor
Spill, leaks due to improper storage and handling of fuels, chemicals/ construction materials and hazardous & non-hazardous construction & demolition waste	Health issues	Onsite workers	Moderate	Moderate	Moderate

Environmental Aspects	Probable Environmental Impacts	Impacted Receptor	Magnitude of Impact	Sensitivity of Receptor	Effect (Magnitude × Sensitivity)
Poor treatment of workers and Failure to establish a productive and sound worker-management relationship	Health issues	Project site workers	Minor	Moderate	Minor

Table 88 – Summary of Environmental Aspects and Probable Impacts during Operation Phase

Environmental Aspects	Probable Environmental Impacts	Impacted Receptor	Magnitude of Impact	Sensitivity of Receptor	Effect (Magnitude × Sensitivity)
Intake of raw water directly from the sea	Intake of sea water directly from the ocean results in entrainment by the system of small marine organisms and impingement on intake screens and entrainment adversely affect biotic productivity in the marine environment	Arabian Gulf	Moderate	Moderate	Moderate
		Creeks and Lagoons	Minor	Moderate	Minor
	The intake of sea water can also affect marine resources by altering natural currents in the area of the intake structure	Arabian Gulf	Moderate	Moderate	Moderate
		Creeks and Lagoons	Minor	Moderate	Minor
Discharge of outfall effluent to the sea	The discharge of outfall effluent will impact on sea water quality	Arabian Gulf	Minor	Moderate	Minor
		Creeks and Lagoons	Negligible	Moderate	Neutral
Discharge of outfall effluent to the sea	The discharge of outfall effluent will impact on marine biota.	Arabian Gulf	Minor	Moderate	Minor
		Creeks and	Negligible	Moderate	Neutral

Environmental Aspects	Probable Environmental Impacts	Impacted Receptor	Magnitude of Impact	Sensitivity of Receptor	Effect (Magnitude × Sensitivity)
		Lagoons			
Generation of fugitive dust emissions due to truck transport of debris on unpaved roads	Air pollution and dust deposition causes harmful effect on plants/trees/shrubs	Project Site/Onsite workers	Minor	Moderate	Minor
Stack emissions of combustion gases due to power generation process	Air pollution - Increase in NO_X, SO_2, CO, VOCs in ambient air due to combustion emissions	Project Site/ Onsite workers	Minor	Moderate	Minor
		Residential areas	Minor	High	Minor
		Heritage areas	Minor	Moderate	Minor
		Project Site/Onsite workers	Minor	Moderate	Minor
Generation of vibration and Noise due to operation of operational equipment/ machinery	Increase in noise and vibration levels and Health effects due to exposure of excessive noise & vibration	Project Site/ Onsite workers	Moderate	Moderate	Moderate
		Residential areas	Minor	High	Minor
		Heritage areas	Minor	Moderate	Minor
		Hotel/Resorts – Other public places	Minor	Moderate	Minor
Spills, leaks and Improper disposal of workforce domestic wastewater	Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	Moderate	Minor
Spill, leaks due to	Possible Contamination of	Groundwater and	Minor	Moderate	Minor

Environmental Aspects	Probable Environmental Impacts	Impacted Receptor	Magnitude of Impact	Sensitivity of Receptor	Effect (Magnitude × Sensitivity)
improper storage and handling of chemicals used for the project	groundwater and Soil quality	Soil/ Land			
Spills, leaks and Improper disposal of hazardous and non-hazardous wastes	Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	Moderate	Minor
Spill, leaks due to improper storage and handling of hazardous chemicals, flammables, sludge and hazardous & non-hazardous waste	Health issues	Onsite workers	Moderate	Minor	Minor
Poor treatment of workers and Failure to establish a productive and sound worker-management relationship	Health issues	Project site workers	Minor	Moderate	Minor

8. PROJECT ALTERNATIVES

The purpose of the analysis of project alternatives as part of the ESIA process is to select the best among the possible project options. The assessments and recommendations made by the ESIA Team are presented here.

8.1. LOCATION ALTERNATIVES

The site selected for the project is in Layyah Power Station of SEWA which is already developed facility. The key factors are

- Good road, sea and air connectivity
- Adequate availability of land with highly developed infrastructure (fuel supply) and telecommunications links
- Adjacent to Arabian Gulf
- No environmental sensitive places in the primary impact area

The management of SEWA is planned for future power plant units and desalination units during initial development stage and areas are allocated accordingly. The land allocated for the proposed project is plain topography and adjacent shoreline. The intake location should ideally provide a good and reliable water quality, taking seasonal changes into account, with minimum danger of pollution or contamination, in order to avoid performance problems of the plant. Since the proposed project will be established in the existing developed Layyah Power Station with good infrastructure, alternate sites are not considered.

8.1.1. OUTFALL DISCHARGE LOCATION

As mentioned earlier sections, two locations were considered for discharging outfall effluent to sea as indicated in **Figure 3**. Hydrodynamic modeling and plume dispersion study was performed to select the suitable location for better dispersion of outfall effluent and lesser recirculation effect on intake sea water. The perusals of the modeled results that dispersion patterns of both outfall locations are observed to be more or less similar. Within 100m of the outfall the concentration reduces to 80% indicates good mixing of water from the outfall. Plume dissipates within 1 km of the outfall in both cases throughout the tidal cycle. However outfall option-1 (close the intake) may affect near shore coastal water quality due to the presence of nearby existing outfall point. Effect of wind is minimal on the plume dynamics in the area. Outfall option 2 (Southern) is recommended as the chances of recirculation is not existing during a normal tidal cycle and is sufficiently away from the intake location.

8.2. TECHNOLOGY ALTERNATIVES

8.2.1. DISINFECTION

The raw feed intake water has to be disinfected to avoid bio-fouling in the membrane system. The existing RO plant in the LPS is being operated with shock chlorination at the intake. The disinfectant used is sodium hypochlorite from an electro chlorination system. The same process of disinfection will be used for the proposed project.

Ingham et al., 2009[28] and *Kader Gaid*[29] state that shock chlorination is better than continuous chlorination which promotes destabilization and more coagulation of the natural colloidal polymers as well as irritates sea organisms in the intake system allowing their division to add foulants. Instead of continuous chlorination, chlorine is more and more applied preferably periodically. Shock dosages can be extremely effective and provide a high inactivation rate of the organisms. Before the system goes into operation again, all chlorine containing feed water has to be rinsed out carefully, and the absence of chlorine must be verified (e.g., by monitoring of the oxidation-redox potential (ORP)). No algae or mussels growth was noticed in the seawater intake therefore the process appears to be very effective. In order to achieve the long membrane life that is desired for seawater desalination RO modules, optimization of the chlorine injection method becomes indispensable. Therefore, in order to reduce chlorine load to the RO module, the intermittent or shock chlorination method is more and more recommended instead continuous chlorination method.

8.2.2. COMBINED CYCLE POWER PROJECT

The following alternative technologies for power generation are discussed in order to increase efficiency and thereby effectiveness of the plant and to reduce environmental impact.

The conventional method of power generation and supply to the user is not efficient because only about one-third of the primary energy fed into the power plant is actually made to available to the user in the form of electricity. In conventional power plants, efficiency is only 35% and remaining energy is lost as heat through the stack or condenser water. The major loss in the conversion process is the heat rejected to

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Ingham, R.A., Mansour, L., Qadan, T., Al Hindi, M.H. and Attawneh, O., 2009.RO pretreatment design and performance under challenging conditions in the Arabian Gulf, IDA World Congress—Atlantis, the Palm—Dubai, UAE, 2009, pp. 7–12.

Kader Gaid, 2011. A Large Review of the Pre Treatment, Expanding Issues in Desalination, Prof. Robert Y. Ning (Ed.), ISBN: 978-953-307-624-9, InTech, Available from: http://www.intechopen.com/books/expandingissues-in-desalination/a-large-review-of-the-pre-treatment surrounding water or air due to the inherent constraints of the different thermodynamic cycles employed in power generation.

Natural gas and distilled fuel oil is the cleanest fossil fuel for producing energy and is composed mainly by methane CH_4. Before natural gas can be used as fuel, it must undergo processing to remove almost all materials other than methane, so the emissions of SO_2 are insignificant as well as the emission of particulate matter and CO_2, due to its higher molecular weight Hydrogen/Carbon (H/C). The combustion of natural gas only will produce NOx and CO_2 emissions.

The Combined Cycle technology takes advantage of the thermal energy of the exhausted gas from the gas cycle to generate water steam to be reused at the steam cycle. Due to that fact, the efficiency of the Combined Cycle technology is highly superior in comparison with other conventional thermal technology.

Combined Cycle technology can provide high electrical efficiency that means electricity generation on the basis of more competitive prices in comparison with other technologies. Moreover, natural gas produces energy with the lowest rate emissions per produced kWh and the CCPP does not need additional expenditure for emissions control and fuel storage in comparison with fuel and coal.

Based on the above, the best combustion technology chosen for the new power generation unit, from the environmental point of view, is the combined cycle option.

8.3. NO-GO ALTERNATIVE

The 'null or no-action' alternative is referred to as the 'no-go' alternative. It assumes that the activity does not go ahead, implying a continuation of the current situation or the status quo. If the project would not be undertaken in any form, existing baseline conditions would prevail long term. The implications of the "no project" alternative are that:

- There is no development at the proposed location;
- Electric power will become more expensive and scarcity of electric power in the region may be possible and energy conservation strategies will have to be enforced;
- Industrial development in the region will be stunted under the growing concern for electric power and private and public sector industries will implement their own smaller-scale power generation facilities, leading to many diesel generators.

The purpose of having a power plant at Sharjah is to meet the increasing demand of water and electricity in the emirate of Sharjah and also to supply reliable and cost effective electricity and water to the Emirate of Sharjah which reduce the already existing stress on power demand. Sharjah needs power self-sufficiency to keep up with a growing population that is set to reach almost two million by 2020, making it the second-most populous emirate. Hence SEWA proposal to develop combined cycle power plant as an extension of Layyah Power Station in the Emirate of Sharjah – United Arab Emirates (UAE) is required to meet the growing demand.

The main implication of the no go alternative is the lack of adequate electric power supply to the region and the region will face serious challenges in terms of sustaining the economic growth envisaged for the region. In order to assess the "No-Go" alternative it must be assumed that the projected inadequate assurance of electric power supply that informed the project planning will persist and power supplies would remain under increasing pressure in terms of ensuring electric power to residents and sustaining economic growth in the region.

If the project proceeds as planned, the proposed project will have certain level of marginal impacts on the local environment, certain individual risks to onsite population and minor impact on society. If the recommended environment and social management plan will be effectively implemented, the proposed project will have minor residual effects on local environment and society and it will be regularly monitored by suggested environmental monitoring plan to sustain the environment, health and safety of society.

9. MITIGATION MEASURES AND ENHANCEMENT PLAN

The following mitigation measures have been recommended for the identified significant impacts to mitigate the potential impact on environment and society.

9.1. MITIGATION MEASURES FOR AIR ENVIRONMENT

9.1.1. MITIGATION MEASURES FOR AIR ENVIRONMENT DURING CONSTRUCTION PHASE

The following mitigation measures are suggested to minimize air quality impacts during construction phase:

- As required water sprinkling shall be carried to minimize the dust emission.
- Transporting topsoil, loose material truck shall be covered properly in order to avoid dust emission to the atmosphere.
- Paved, to the extent possible, unpaved access roads, parking areas and working areas at construction sites.
- Speed Limit (20 km/hr) inforce on unpaved roads.
- Suspend construction activities that cause visible dust plumes to extend beyond the construction site.
- Continual usage of properly designed, maintained and operated equipment/ vehicles by the contractor, such as proper engine fuel mixtures, regularly serviced exhaust emission systems and proper engine tuning.
- Commercially available Low sulphur content diesel shall be used by the Contractor, in order to reduce excessive emissions of sulphur dioxides.
- Minimize height of stockpiles and profile to minimize wind-blown dust emissions and risk of pile collapse
- Locate stockpiles out of the wind to minimize the potential for dust generation
- Ensure that all vehicles with open loads of potential dusty materials are securely sheeted or enclosed
- Development of a site Construction Environmental Management Plan (CEMP) including dust management.

9.1.2. OPERATION PHASE - MITIGATION MEASURES FOR AIR ENVIRONMENT

No combustion mitigation measures in addition to those already accounted for embedded mitigation measures. The following key design features have been accounted for:

- An adequate exhaust stack height to ensure effective dispersion of emissions
- Low NOx technology
- Use of commercially available low-sulphur fuel for combustion.

The following additional mitigation measures are suggested to minimize air quality impacts during operation phase:

- The internal roads/ working areas in the project site shall be paved by feasible material (cement/asphalt/interlock) to avoid fugitive dust emissions.
- In case of truck movement in the unpaved roads, water sprinkling shall be carried to minimize the dust emissions.
- The movement of heavy trucks over unpaved or dusty surfaces in and around the plant should be restricted. In case of unavoidable situation, unpaved or dusty surfaces should be controlled by good maintenance and wetting of the road surface by water sprinkling.
- Regular maintenance of vehicles for appropriate functioning of engine and company vehicles should undergo emission test to ensure emissions are within permissible limits.
- Use of commercially available low-sulphur fuel for vehicles.

9.2. MITIGATION MEASURES FOR NOISE AND VIBRATION ENVIRONMENT

9.2.1. CONSTRUCTION PHASE - MITIGATION MEASURES FOR NOISE AND VIBRATION ENVIRONMENT

The contribution of construction activity will contribute towards noise level. However, the noise generation during the construction phase is temporary and reversible. Noise control measures like in-built acoustic enclosures for construction equipment and regular maintenance will be provided to reduce the noise levels. In addition, distant attenuation between source and receiver shall be increased by applying industries best practical means to reduce the impact. The following additional mitigation measures are recommended for better management of noise and vibration environment.

- Avoid unnecessary revving of engines and ensure that the equipment is switched off when not in use.

- Wherever practicable, construction equipment/ machinery should not be left operating at idle.
- Undertaking noisier activities during daytime hours and minimizing and avoiding, where possible, any noisy activities during night.
- Keep internal haul routes well maintained.
- Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications.
- Ear plugs/muffs for workers who are exposed to higher noise shall be provided and enforcement for its use by the workers.

9.2.2. OPERATION PHASE - MITIGATION MEASURES FOR NOISE AND VIBRATION ENVIRONMENT

The following mitigation measures are recommended for management of Noise Environment.

- Roadside tree plantation to be developed and maintained as a noise barrier
- Keep internal haul routes well maintained.
- Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications.
- Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications.
- All plant onsite should be low noise versions, and where needed, acoustic enclosure shall be provided according to manufacturer's recommendations.
- The use of damping material such as thin rubber/sheet for shielding the work places like DG sets, compressor etc.,
- Ear plugs/muffs for workers who are exposed to higher noise shall be provided and enforcement for its use by the workers.

9.3. MITIGATION MEASURES FOR WATER ENVIRONMENT

9.3.1. CONSTRUCTION PHASE - MITIGATION MEASURES FOR WATER ENVIRONMENT

The identified potential impact on water environment during construction phase will be dredging for erection of intake & outfall structures in the sea, dewatering of groundwater during excavation and spill, leaks and improper storage, handling and disposal of domestic wastewater, construction chemicals and hazardous & non-hazardous construction & demolition wastes to be generated in the premises. The following action plans are to be implemented to mitigate the water pollution.

- Appropriate dewatering effluent management system shall be installed for treatment (settlement) and disposal in line with Government of Sharjah/UAE Federal requirements.
- Dewatering systems to include flow control (sedimentation tanks).
- Undertake daily visual checks of flow control turbidity and for signs of oil and grease.
- Subject to the results of the dewatering effluent quality monitoring, re-use of dewatering effluent for wetting down and dust prevention is encouraged to minimize requirement for potable water resources.
- Toilets and septic tank facilities are to be appropriately designed and monitored.
- Monitoring of internal sewerage system to ensure all pipelines and septic tanks are properly functioning.
- Drainage systems from wash areas and other sources must be strictly monitored.
- Regular vacuuming/ siphoning of septic tanks as needed by Sharjah Municipality authorized service providers for transport to the designated municipal sewage treatment plant.

The following action plans are to be implemented to mitigate impacts due to dredging.

- The marine trenching and dredging methods must be identified in the contractor's CEMP
- Dredging equipment will be selected to minimize turbid plume formation, for example by ensuring that the type and size of the dredge head matches the characteristics of the suction pump
- Seawater quality shall be regularly monitored
- Trained operators shall be used to ensure minimal loss of turbid water from the backhoe dredge;
- Dredging is to be undertaken from well maintained and inspected vessels which are free from structural defects and potential sources of leakages
- Well-maintained barges will be used for transport of dredged material as required.
- Material placed on shore should be suitably bunded and managed to prevent the direct discharge of turbid return water and/or run-off back.
- All chemicals should be properly sorted in adequate containers and checked for leakage on a regular basis.

- All equipment shall be in good working conditions and regularly serviced. Emergency response plans and contingency plan including spill prevention and containment plan will have to put in place prior to start of works.
- Noise attenuation barriers shall be provided if required to reduce noise levels to prescribed limits.
- Barge hulls must be inspected regularly to ensure that they are completely sealed, and
- Sediment spillage can result from overfilling the barge or a leaking hull. Overfilling can be prevented by filling the barge only to the bottom of the barge coaming, and spillage while in tow can be prevented by placing removable covers over the barge coaming.
- Silt curtains shall be effectively used. Silt curtains reduce water movement in the area contained by the curtain, which then allows suspended sediment within the contained area to settle out of suspension, before the water disperses more broadly. Ensure the silt curtain is installed correctly prior to works starting adjacent to or within the water
- Ensure that silt curtain is complete with a scum boom as well

9.3.2. OPERATION PHASE - MITIGATION MEASURES FOR WATER ENVIRONMENT

Virtually all the impacts identified for the operational phase of the proposed project can and would be mitigated by the implementation of embedded mitigation measures mentioned in the impact assessment chapter. Further recommended mitigation measures include:

- ➢ Keep reduced velocity in intake tower by velocity cap structure to ensure that fish and other organisms can escape the intake current.
- ➢ If biocide dosing proves ineffective in controlling marine growth, then undertake regular pigging of the intake pipelines.
- ➢ Suitably neutralize residual chlorine with sodium bisulfite (SBS) in an emergency when intake water needs to be bypassed directly to the outfall, residual chlorine in the outfall discharge must be below 0.2 mg/l.
- ➢ Use only anti-scalants with low toxicity to aquatic invertebrate and fish species; avoid the use of a polyphosphate anti-scalants.

9.4. MITIGATION MEASURES FOR LAND ENVIRONMENT

9.4.1. CONSTRUCTION PHASE - MITIGATING MEASURES FOR LAND ENVIRONMENT

The identified potential impact on land environment is improper disposal of solid wastes to be generated from the premises. The following action plans are to be implemented to mitigate the environmental pollution during construction phase.

- Storage of leachable raw materials and solid waste will be in an impervious area separately to avoid any soil contamination;
- Curing of concrete will be carefully done by optimal usage of water to avoid leaching of contaminants which may leads to soil contamination.
- The collected solid waste should be properly disposed to authorized service providers for further treatment and safe disposal.
- Spillage of any construction materials should be avoided, if spillage will occur, the spillage area should be isolated. Spilled soil will be treated as hazardous waste and disposed for authorized service providers for further treatment and safe disposal.

9.4.1.1. Construction Waste Management Plan

The waste management in the construction sector is an important criterion for the effective environmental management system. The following action plans to be implemented for effective waste management during construction phase.

- The generated solid wastes will be collected segregated as domestic wastes, recyclable solid wastes, construction & demolition waste and hazardous wastes and these wastes will be stored properly in the separate area in different colored bins.
- The domestic wastes will be properly disposed to authorized service providers for further treatment and safe disposal.
- Recyclable solid wastes will be sold to authorized recyclers for recycling.
- Construction & demolition waste will be stock piled separately and reused for road pavement, filling of low lying areas and other repairing works in the premises at possible extent and remaining should be disposed to SM authorized service providers for safe disposal.
- Hazardous wastes will be collected separately and properly disposed to authorized service providers.
- Dredged wastes shall be disposed to the Sharjah Municipality (SM) authorized service providers in compliance with SM regulations. Dredged wastes shall be tested before disposal to comply with SM regulations.

9.4.2. OPERATIONAL PHASE - MITIGATION MEASURES FOR LAND ENVIRONMENT

The following action plans to be implemented for better management of land environment during operation phase.

- Storage of leachable operation materials and solid waste will be in an impervious area separately to avoid any soil contamination;
- Spillage of any hazardous materials/waste materials should be avoided, if spillage will occur, the spillage area should be isolated. Spilled soil will be treated as hazardous waste and disposed for Sharjah Municipality authorized service providers for further treatment and safe disposal.
- The generated solid wastes will be collected segregated as domestic wastes, recyclable solid wastes, non-hazardous solid waste and hazardous wastes and these wastes will be stored properly in the separate area in different coloured bins.
- The domestic wastes and non-hazardous solid wastes (inert waste, carton, packaging materials) will be properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal.
- Recyclable solid wastes (membranes, cartridges etc.,) will be sold to Sharjah Municipality authorized recyclers for recycling.
- Hazardous wastes (chemicals/ paints etc.,) will be collected separately and properly disposed to Sharjah Municipality authorized service providers after obtaining NOC from Sharjah Municipality.

9.5. MANGEMENT MEASURES FOR SOCIO-ECONOMY ASPECTS

9.5.1. TRAFFIC CONTROL AND MANAGEMENT PLAN

The expected flow of traffic due to the operation of the facility will not significantly affect the level of service in the existing Emirates road. If the traffic will not be controlled effectively in the site, it may create traffic in the adjacent road only. It will be controlled by the development of site traffic control plan. The exit of the site is well connected to the main roads. The following measures are followed to control and manage the traffic.

- Smooth entry and exit of vehicle, is provided at the entry and ensure smooth transition for merging of vehicles.
- Signboards are at the parking locations for drivers to control the speed.
- Security will guide the vehicles for safe parking.
- Proper footpath provided for pedestrian movement along with interlocking and barricaded for safety.

- Safety precautionary measures are ensured.
- Adequate Lighting will be providing as per norms.
- Marking of road, stop line, parking lanes, slot numbers will be painted so as guide the drivers.

9.6. RESIDUAL EFFECTS

9.6.1. AIR AND NOISE QUALITY

With effective implementation of mitigation measures in line with the requirement of IFC EHS guideline and dust management plan, dust emission impacts on onsite environment and adjacent commercial destination due to construction activities are likely to lead to minor residual effects. Although residual impacts are expected to be of minor significance, efficient monitoring shall be implemented.

Impacts from stack emissions from combustion process, operational traffic emissions and noise from operational equipment & vehicles are likely to lead to minor residual effects on human and ecological receptors which cannot be fully mitigated. Residual effects on air and noise quality associated with the operational phase will be minor adverse. Although residual impacts are expected to be of minor significance, efficient monitoring shall be implemented.

9.6.2. MARINE WATER ENVIRONMENT AND ECOLOGY

Impacts from discharge of outfall effluent are likely to have residual effects on marine biota (Arabian Gulf). Although all residual impacts associated with the outfall effluent discharge are expected to be of minor significance, the following monitoring programme is recommended:

- Continuously monitor the effluent for residual chlorine and dissolved oxygen levels.
- Regularly monitor the effluent for toxic contaminants
- Implement a monitoring program to study the effects of the discharged outfall effluent on the receiving water body, which is associated with the validation of the model results, and use the information to develop a contingency plan that examines the risk of contamination, and considers procedures that must be implemented to mitigate any unanticipated impacts.

9.6.3. LAND QUALITY

No significant residual effects are predicted for land quality during construction and operation phases.

9.7. ENVIRONMENTAL & SOCIAL ASPECTS AND IMPACTS REGISTER

A summary of environmental and social aspects, impacts, mitigation measures and its residual impacts for the significant effects during construction and operation phase are presented in **Table 89** and **Table 90.**

Table 89 – Environmental and Social Aspects and Impacts Register during Construction Phase

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
Generation of fugitive dust emissions due to truck transport of debris on unpaved roads; truck unloading of debris; Earthworks operations: and windblown dust from stockpiles	Air pollution and dust deposition	Project Site/ Onsite workers and nearby commercial destination	Moderate	• As required water sprinkling shall be carried to minimize the dust emission. • Transporting topsoil, loose material truck shall be covered properly in order to avoid dust emission to the atmosphere. • Paved, to the extent possible, unpaved access roads, parking areas and working areas at construction sites. • Speed Limit (20 km/hr) inforce on unpaved roads. • Minimise height of stockpiles and profile to minimize wind-blown dust emissions and risk of pile collapse • Locate stockpiles out of the wind to minimize the potential for dust generation • Ensure that all vehicles with open loads of potential dusty materials	Minor

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				are securely sheeted or enclosed • Development of a site Construction Environmental Management Plan (CEMP) including dust management.	
Exhaust emissions of combustion gases due to operation of fuel fired equipment/machinery	Air pollution - Increase in NO_X, SO_2, CO, VOCs in ambient air due to combustion emissions	Project Site/Onsite workers	Minor	• Continual usage of properly designed, maintained and operated equipment/ vehicles by the contractor, such as proper engine fuel mixtures, regularly serviced exhaust emission systems and proper engine tuning. • Regular maintenance of vehicles for appropriate functioning of engine • Company vehicles should undergo emission test to ensure emissions are within permissible limits. • Commercially available Low sulphur diesel shall be used for vehicles/fuel fired	Neutral

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				equipment/machinery, in order to reduce excessive emissions of sulphur dioxides.	
Generation of Vibration and Noise due to operation of construction equipment/ machinery	Increase in noise and vibration levels and Health effects due to exposure of excessive noise & vibration	Project Site/Onsite workers	Moderate	• Avoid unnecessary revving of engines and ensure that the equipment is switched off when not in use. • Wherever practicable, construction equipment/ machinery should not be left operating at idle. • Undertaking noisier activities during daytime hours and minimizing and avoiding, where possible, any noisy activities during night. • Keep internal haul routes well maintained. • Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications. • Provision of Ear plugs/muffs for workers who will be exposed to	Minor

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				higher noise and enforcement for its use by the workers.	
Any excavations below the ground water table may require dewatering. Discharge of dewatered water to environment (Sea/groundwater)	The discharge of dewatered groundwater to ground water/sewerage/ sea/ land environment may deteriorate the destiny environment. If groundwater quality is poor this has the potential to impact water quality in the designated source of discharge. The discharge may also disturb sediment increasing suspended solids and may encourage the dissolution of contaminants previously bound to the sediment.	Groundwater, Arabian sea, Project site	Moderate	• The Main Works Contractor is responsible for designing appropriate dewatering effluent management, treatment (settlement) and disposal in line with Government of Sharjah/UAE Federal requirements. • Dewatering systems to include flow control (sedimentation tanks). • Undertake daily visual checks of flow control turbidity and for signs of oil and grease. • Subject to the results of the dewatering effluent quality monitoring, re-use of dewatering effluent for wetting down and dust prevention is encouraged to minimize requirement for potable water resources.	Minor
Marine construction work require dredging of seabed to install offshore	Dredging activities generate sediment plume which may impact on	Arabian sea	Moderate	• Development of a site Construction Environmental Management Plan	Minor

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
intake/outfall pipelines	marine water environment			(CEMP) including marine construction management plan with dredged waste disposal mechanism. • The marine trenching and dredging methods must be identified in the contractor's CEMP • Dredging equipment shall be selected to minimize turbid plume formation. • Seawater quality shall be regularly monitored. • Trained operators shall be used to ensure minimal loss of turbid water from the backhoe dredge; • Dredging is to be undertaken from well maintained and inspected vessels which are free from structural defects and potential sources of leakages • Well-maintained barges shall be used for transport of dredged material as required. Barge hulls	

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				must be inspected regularly to ensure that they are completely sealed • All chemicals should be properly sorted in adequate containers and checked for leakage on a regular basis. • Sediment spillage can result from overfilling the barge or a leaking hull. Overfilling can be prevented by filling the barge only to the bottom of the barge coaming, and spillage while in tow can be prevented by placing removable covers over the barge coaming. • Emergency response plans and contingency plan including spill prevention and containment plan will have to put in place prior to start of works. • Silt curtains shall be effectively used. Ensure the silt curtain is installed correctly prior to works starting adjacent to or within the	

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				water. Ensure that silt curtain is complete with a scum boom as well.	
Spills, leaks and Improper disposal of workforce domestic wastewater	Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	• Toilets and septic tank facilities are to be appropriately designed and monitored. • Monitoring of internal sewerage system to ensure all pipelines and septic tanks are properly functioning. • Drainage systems from wash areas and other sources must be strictly monitored. • Regular vacuuming/ siphoning of septic tanks as needed by Sharjah Municipality authorized service providers for transport to the designated municipal sewage treatment plant.	Neutral
Construction activity, improper storage and disposal of hazardous & non-hazardous construction & demolition waste	Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	• Storage of leachable construction materials and solid waste will be in an impervious area separately to avoid any soil contamination; • Curing of concrete will be	Neutral

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				carefully done by optimal usage of water to avoid leaching of contaminants which may leads to soil contamination. • Spillage of any construction materials should be avoided, if spillage will occur, the spillage area should be isolated. Spilled soil will be treated as hazardous waste and disposed for Sharjah Municipality authorized service providers for further treatment and safe disposal. • Construction and Demolition Waste Management Plan as part of Construction Environmental Management Plan (CEMP) shall be developed and effectively implemented. • The generated solid wastes will be collected segregated as domestic wastes, recyclable solid wastes, construction & demolition waste and hazardous wastes and these wastes will be	

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				stored properly in the separate area in different coloured bins. • The domestic wastes will be properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal. • Recyclable solid wastes will be sold to Sharjah Municipality authorized recyclers for recycling. • Construction & demolition waste will be stock piled separately and reused for road pavement, filling of low lying areas and other repairing works in the premises at possible extent and remaining should be disposed to Sharjah Municipality authorized service providers for safe disposal. • Hazardous wastes will be collected separately and properly disposed to Sharjah Municipality authorized service providers after obtaining NOC from Sharjah	

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				Municipality. • Dredged wastes shall be disposed to the Sharjah Municipality (SM) authorized service providers in compliance with SM regulations. Dredged wastes shall be tested before disposal to comply with SM regulations.	
Spill, leaks due to improper storage and handling of fuels, chemicals/ construction materials	Possible Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	• Spill prevention and management plan shall be developed as part of CEMP and effectively implemented. • All hazardous/flammable material, including fuels, will be stored at designated sites in accordance with MSDS requirements best practice procedures. • MSDS to be available for hazardous materials stored on site. • Hazardous materials will need to be suitably stored to prevent leaks and spills.	Neutral

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				• Adequate bunding for fuel storage. • Drip trays will be required to be used to intercept leaks and spills from equipment and during refuelling.	
Spill, leaks due to improper storage and handling of fuels, chemicals/ construction materials and hazardous & non-hazardous construction & demolition waste	Health issues	Onsite workers	Moderate	• All hazardous chemicals and substances must be stored in a protected /secured place with limited access. • Chemicals handling, storage and instructions given in Material Safety Data Sheets & product manuals, supplied by the manufacturer or supplier, must be understood and observed strictly. • There shall be no open storage of any type of chemical in the premises. • Hazardous chemicals shall be stored appropriately based on the compatibility of the chemical to avoid any reaction. • Flammable and other highly	Minor

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
				flammable products storage should be stored in a controlled temperature and all the electrical fittings should be under classified category as per International standards. • Fire protection requirements shall be as per UAE Civil Defense Code, 2017 in the chemicals/hazardous materials storage areas • Appropriate training shall be provided to workers and Trained/competent persons shall be deployed for critical tasks such as handling of hazardous/flammable chemical, first aid, fire-fighting etc., • Appropriate Personal Protective Equipment shall be provided to workforce involved with hazardous/flammable chemical handling.	

Aspects	Significant Impacts	Impacted Receptor	Pre-mitigation Effect	Recommended Mitigation Measures	Residual Effect
Poor treatment of workers and Failure to establish a productive and sound worker-management relationship	Health issues	Project site workers	Minor	• Labour management (Project labour commitment, Workers' Code of Conduct, Labour Grievance Mechanism) shall be strictly followed as per UAE Federal Labour Law • Labour accommodation strategies with welfare facilities shall be provided as UAE Federal Labour Law • Occupational Health and Safety Management for construction shall be developed as part of CEMP and effectively implemented.	Neutral

Table 90 – Environmental and Social Aspects and Impacts Register during Operation Phase

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
Intake of raw water directly from the sea	Intake of sea water directly from the ocean results in entrainment by the system of small	Arabian Gulf	Moderate	• Keep reduced velocity in intake tower by velocity cap structure to ensure that fish and other organisms can escape the intake current.	Minor

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
	marine organisms and impingement on intake screens and entrainment adversely affect biotic productivity in the marine environment			• Suitably neutralize residual chlorine with sodium bisulfite (SBS) in an emergency when intake water needs to be bypassed directly to the outfall, residual chlorine in the outfall discharge must be below 0.2mg/l.	
Discharge of outfall effluent to sea	The discharge of effluent will be impact on marine biota health	Arabian Gulf	Moderate	• Use only anti-scalants with low toxicity to aquatic invertebrate and fish species; avoid the use of a polyphosphate anti-scalants. • Suitably neutralize residual chlorine with sodium bisulfite (SBS) in an emergency when intake water needs to be bypassed directly to the outfall, residual chlorine in the outfall discharge must be below 0.2mg/l.	Minor
Generation of fugitive dust emissions due to truck transport of debris on unpaved roads	Air pollution and dust deposition	Project Site/Onsite workers	Minor	• All the internal roads/working areas shall be paved by feasible materials (cement/asphalt/interlock) to avoid fugitive dust emissions. • The movement of heavy trucks over unpaved or dusty surfaces should be restricted. In case of unavoidable situation, unpaved or dusty surfaces	Neutral

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
				should be controlled by good maintenance and wetting of the road surface by water sprinkling. • Speed Limit (20 km/hr) inforce on unpaved roads.	
Exhaust emissions of combustion gases due power generation process	Air pollution - Increase in NO_X, SO_2, CO, VOCs in ambient air due to combustion emissions	Project Site/Onsite workers	Minor	• Specification of fuel supply shall be strictly monitored and followed • Periodic monitoring of stack emissions to ensure that air emission characteristic is within the allowable limit for stationary sources.	Neutral
Exhaust emissions of combustion gases due to operation of fuel fired equipment/ machinery	Air pollution - Increase in NO_X, SO_2, CO, VOCs in ambient air due to combustion emissions	Project Site/Onsite workers	Moderate	• Continual usage of properly designed, maintained and operated equipment/ vehicles by the contractor, such as proper engine fuel mixtures, regularly serviced exhaust emission systems and proper engine tuning. • Regular maintenance of vehicles for appropriate functioning of engine • Company vehicles should undergo emission test to ensure emissions are within permissible limits. • Low sulphur diesel shall be used for	Minor

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
				vehicles/fuel fired equipment/machinery, in order to reduce excessive emissions of sulphur dioxides.	
Generation of vibration and Noise due to operation of operational equipment/ machinery	Increase in noise and vibration levels and Health effects due to exposure of excessive noise & vibration	Project Site/Onsite workers	Moderate	• Careful internal and external layout designs, set back distance, noise screenings and building envelopes to be designed to conform BS 8233, WHO and local UAE noise thresholds • Roadside tree plantation to be developed and maintained as a noise barrier • Keep internal haul routes well maintained. • Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications. • All plant onsite should be low noise versions, and where needed, acoustic enclosure shall be provided according to manufacturer's	Minor

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
				recommendations. • The use of damping material such as thin rubber/sheet for shielding the work places like DG sets, compressor etc., • Ear plugs/muffs for workers who are exposed to higher noise shall be provided and enforcement for its use by the workers.	
Spills, leaks and Improper disposal of workforce domestic wastewater	Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	• Toilets and septic tank facilities are to be appropriately designed and monitored. • Monitoring of internal sewerage system to ensure all pipelines and septic tanks are properly functioning. • Drainage systems from wash areas and other sources must be strictly monitored. • Regular vacuuming/ siphoning of septic tanks as needed by Sharjah Municipality authorized service providers for transport to the	Neutral

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
				designated municipal sewage treatment plant.	
Improper storage and disposal of hazardous & non-hazardous solid wastes	Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	• Storage of leachable operation materials and solid waste will be in an impervious area separately to avoid any soil contamination; • Spillage of any waste materials should be avoided, if spillage will occur, the spillage area should be isolated. Spilled soil will be treated as hazardous waste and disposed for Sharjah Municipality authorized service providers for further treatment and safe disposal. • The generated solid wastes will be collected segregated as domestic wastes, recyclable solid wastes, non-hazardous solid waste and hazardous wastes and these wastes will be stored properly in the separate area in different coloured bins. • The domestic wastes and non-hazardous solid wastes will be	Neutral

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
				properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal. • Recyclable solid wastes will be sold to Sharjah Municipality authorized recyclers for recycling. • Hazardous wastes will be collected separately and properly disposed to Sharjah Municipality authorized service providers after obtaining NOC from Sharjah Municipality.	
Spill, leaks due to improper storage and handling of fuels, chemicals/ operation materials	Possible Contamination of groundwater and Soil quality	Groundwater and Soil/ Land	Minor	• Spill prevention and management plan shall be developed and effectively implemented. • All hazardous/flammable material, including fuels, will be stored at designated sites in accordance with MSDS requirements best practice procedures. • MSDS to be available for hazardous materials stored on site. • Hazardous materials will need to be suitably stored to prevent leaks and	Neutral

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
				spills. • Adequate bunding for fuel storage. • Drip trays will be required to be used to intercept leaks and spills from equipment and during refuelling.	
Spill, leaks due to improper storage and handling of fuels, chemicals/ water treatment materials and hazardous & non-hazardous wastes	Health issues	Onsite workers	Moderate	• All hazardous chemicals and materials must be stored in a protected /secured place with limited access. • Chemicals handling, storage and instructions given in Material Safety Data Sheets & product manuals, supplied by the manufacturer or supplier, must be understood and observed strictly. • There shall be no open storage of any type of chemical in the premises. • Hazardous chemicals shall be stored appropriately based on the compatibility of the chemical to avoid any reaction. • Flammable and other highly flammable products storage should	Minor

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
				be stored in a controlled temperature and all the electrical fittings should be under classified category as per International standards. • Fire protection requirements shall be as per UAE Civil Defense Code, 2017 in the chemicals/hazardous materials storage areas • Appropriate training shall be provided to workers and Trained/competent persons shall be deployed for critical tasks such as handling of hazardous/flammable chemical, first aid, fire-fighting etc., • Appropriate Personal Protective Equipment shall be provided to workforce involved with hazardous/flammable chemical handling.	
Poor treatment of workers and Failure to establish a productive and sound worker-	Health issues	Project site workers	Minor	• Labour management (Project labour commitment, Workers Code of Conduct, Labour Grievance Mechanism) shall be strictly followed	Neutral

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
management relationship				as per UAE Federal Labour Law • Labour accommodation strategies with welfare facilities shall be provided as UAE Federal Labour Law • Occupational Health and Safety Management shall be developed and effectively implemented.	
	Traffic	Sharjah region	Minor	• Smooth entry and exit of vehicle, is provided at the entry and ensure smooth transition for merging of vehicles. • Signboards are at the parking locations for drivers to control the speed. • Security will guide the vehicles for safe parking. • Proper footpath provided for pedestrian movement along with interlocking and barricaded for safety. • Safety precautionary measures are ensured. • Adequate Lighting will be providing	Neutral

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
				as per norms. • Marking of road, stop line, parking lanes, slot numbers will be painted so as guide the drivers.	

10. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN AND MONITORING PROGRAMME

Sharjah Electricity and Water Authority (SEWA) and Consortium of EPC Contractor shall adopt a comprehensive Environmental and Social Management Plan (ESMP) which will cover environmental protection measures, health & safety measures & precautions for the continual improvement in Health, Safety and Environment management system. The various components are outlined in the section.

10.1. COMMITMENT AND POLICY

SEWA and Consortium of EPC Contractor are committed to provide adequate mitigation measures for environmental and social management and appropriate monitoring measures for evaluating the residual effects. The management is committed to continually improving the Environmental, Health and Safety Management Systems of the proposed development.

10.2. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

A project's environmental and social management plan (ESMP) consists of the set of mitigation, management, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The plan includes compensatory measures if mitigation measures are not feasible, cost-effective, or sufficient. Specifically, ESMP

- identifies and summarizes all anticipated significant adverse environmental impacts;
- describes—with technical details—each mitigation measure, including the type of impact to which it relates and the conditions under which it is required (e.g., continuously or in the event of contingencies), together with designs, equipment descriptions, and operating procedures, as appropriate;
- estimates any potential environmental impacts of these measures; and
- provides linkage with any other mitigation plans required for the project.

Table 91 – Environmental and Social Management Plan

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Dust Emission	• Minimize height of stockpiles and profile to minimize wind-blown dust emissions and risk of pile collapse • Locate stockpiles out of the wind to minimize the potential for dust generation • Ensure that all vehicles with open loads of potential dusty materials are securely sheeted or enclosed • Prohibit activities during high winds; Pave unpaved road surfaces. • The movement of heavy trucks over unpaved or dusty surfaces should be restricted. In case of unavoidable situation, unpaved or dusty surfaces should be controlled by good maintenance and wetting of the road surface by water sprinkling. • Development of a site Construction Environmental Management Plan (CEMP) including dust management.	Residual impacts can be reduced to an acceptable level	Undertake daily visual inspections on implementing the measures. Ambient Air Quality Monitoring shall be conducted at 2 ambient locations (Upwind and downwind) – Biannual	Construction Phase Contractor/ Project Manager
Combustion Emission	• Continual usage of properly designed,	Residual impacts can	Undertake daily visual	Construction Phase

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	maintained and operated equipment/ vehicles by the contractor, such as proper engine fuel mixtures, regularly serviced exhaust emission systems and proper engine tuning. • Regular maintenance of vehicles for appropriate functioning of engine • Company vehicles should undergo emission test to ensure emissions are within permissible limits. • Commercially available low sulphur diesel shall be used for vehicles/fuel fired equipment/ machinery, in order to reduce excessive emissions of sulphur dioxides.	be reduced to acceptable level	inspections and regular repairs, when appropriate, to ensure that equipment does not emit excessive fumes. If excessive fume, exhaust emission monitoring shall be conducted	Contractor/ Project Manager
Construction Noise and Vibration	• Avoid unnecessary revving of engines and ensure that the equipment is switched off when not in use. • Wherever practicable, construction equipment/ machinery should not be left operating at idle. • Keep internal haul routes well maintained. • Undertake regular maintenance by	Residual impacts can be reduced to acceptable level	Undertake daily visual inspections and regular repairs, when appropriate, to ensure that equipment does not emit excessive noise. Undertake regular	Construction Phase Contractor/ Project Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	trained personnel to keep plant and equipment working as per manufacturer's specifications. • Provision of Ear plugs/muffs for workers who will be exposed to higher noise and enforcement for its use by the workers.		noise monitoring at project fence areas during construction periods calibrated sound level meter (e.g. Laeq over 15 minute periods). Ambient Noise Quality Monitoring shall be conducted at 4 ambient locations – Bi-annual	
Discharge of dewatered groundwater	• Appropriate dewatering effluent management system shall be installed for treatment (settlement) and disposal in line with Government of Sharjah/UAE Federal requirements. • Dewatering systems to include flow control (sedimentation tanks).	Residual impacts can be reduced to acceptable level	Undertake daily visual checks of flow control turbidity and for signs of oil and grease. Dewatered ground water quality shall be checked before disposal to conform the norms.	Construction Phase Contractor/ Project Manager
Dredging and disposal of dredged wastes	• Construction Environmental Management Plan	Residual impacts can be reduced to	Undertake daily visual checks for signs of	Construction Phase

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	(CEMP) shall be developed including marine construction management plan with dredged waste disposal mechanism and implemented • Appropriate dredging equipment shall be selected to minimize turbid plume formation. • Trained operators shall be used to ensure minimal loss of turbid water from the backhoe dredge. • Well-maintained vessels/barges shall be used. Barge hulls must be inspected regularly to ensure that they are completely sealed. • Emergency response plans and contingency plan including spill prevention and containment plan will have to put in place prior to start of works. • Silt curtains shall be effectively used. Ensure that silt curtain is complete with a scum boom as well.	acceptable level	sediment plume and oil and grease. Seawater quality shall be regularly checked in the marine construction area.	Contractor/ Project Manager
Domestic waste water	• Toilets and septic tank facilities are to be appropriately designed and	Neutral – There is no residual impacts	--	Construction Phase

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	monitored. • Monitoring of internal sewerage system to ensure all pipelines and septic tanks are properly functioning. • Drainage systems from wash areas and other sources must be strictly monitored. • Regular vacuuming/ siphoning of septic tanks as needed by Sharjah Municipality authorized service providers for transport to the designated municipal sewage treatment plant.			Contractor/ Project Manager
Construction and demolition waste	• Construction and Demolition Waste Management Plan as part of Construction Environmental Management Plan (CEMP) shall be developed and effectively implemented. • Storage of leachable construction materials and solid waste will be in an impervious area separately to avoid any soil contamination; • The solid wastes will be collected and	Neutral – There is no residual impacts	--	Construction Phase Contractor/ Project Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	segregated as domestic wastes; recyclable solid wastes, construction & demolition waste and hazardous wastes and these wastes will be stored properly in the separate area in different coloured bins. • The domestic wastes will be properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal. • Recyclable solid wastes will be sold to Sharjah Municipality authorized recyclers for recycling. • Construction & demolition waste will be stock piled separately and reused for road pavement, filling of low lying areas and other repairing works in the premises at possible extent and remaining should be disposed to Sharjah Municipality authorized service providers for safe disposal. • Hazardous wastes will be collected separately and properly disposed to Sharjah Municipality authorized			

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	service providers after obtaining NOC from Sharjah Municipality. • Dredged wastes shall be disposed to the Sharjah Municipality (SM) authorized service providers in compliance with SM regulations. Dredged wastes shall be tested before disposal to comply with SM regulations.			
Spill, leak and improper management	• Spill prevention and management plan shall be developed as part of CEMP and effectively implemented. • All hazardous/flammable material, including fuels, will be stored at designated sites in accordance with MSDS requirements best practice procedures. • MSDS to be available for hazardous materials stored on site. • Hazardous materials will need to be suitably stored to prevent leaks and spills. • Adequate bunding for fuel storage.	Neutral – There is no residual impacts	--	Construction Phase Contractor/ Project Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	• Drip trays will be required to be used to intercept leaks and spills from equipment and during refueling.			
Health issues	• All hazardous chemicals and substances must be stored in a protected /secured place with limited access. • Chemicals handling, storage and instructions given in Material Safety Data Sheets & product manuals, supplied by the manufacturer or supplier, must be understood and observed strictly. • There shall be no open storage of any type of chemical in the premises. • Hazardous chemicals shall be stored appropriately based on the compatibility of the chemical to avoid any reaction. • Flammable and other highly flammable products storage should be stored in a controlled temperature and all the electrical fittings should be under classified category as per International	Residual risks can be reduced As Low As Reasonable Practicable	--	Construction Phase Contractor/ Project Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	standards. • Fire protection requirements shall be as per UAE Civil Defense Code, 2017 in the chemicals/hazardous materials storage areas • Appropriate training shall be provided to workers and Trained/competent persons shall be deployed for critical tasks such as handling of hazardous/flammable chemical, first aid, fire-fighting etc., • Appropriate Personal Protective Equipment shall be provided to workforce involved with hazardous/flammable chemical handling.			
Discharge of outfall effluent into the Arabian Gulf will impact on marine biota.	• Use only anti-scalants with low toxicity to aquatic invertebrate and fish species; avoid the use of a polyphosphate anti-scalants. • Suitably neutralize residual chlorine with sodium bisulfite (SBS) in an emergency when intake water needs to be bypassed directly to the outfall,	Minor effect - Residual impacts can be reduced to acceptable level	Outfall effluent quality shall be periodically checked	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	residual chlorine in the outfall discharge must be below 0.2 mg/l. • Monitor the outfall effluent characteristics to check the compliance with Sharjah Municipality sea discharge limits.			
Impingement and Entrainment adversely affect biotic productivity in the Arabian Gulf	• Keep reduced velocity in intake tower by velocity cap structure to ensure that fish and other organisms can escape the intake current.	Minor Effect - Residual impacts can be reduced to acceptable level	--	Operation of the project Plant Manager
Operational dust emissions	• All the internal roads/working areas shall be paved by feasible materials (cement/asphalt/interlock) to avoid fugitive dust emissions. • The movement of heavy trucks over unpaved or dusty surfaces should be restricted. In case of unavoidable situation, unpaved or dusty surfaces should be controlled by good maintenance and wetting of the road surface by water sprinkling. • Speed Limit (20 km/hr) inforce on unpaved roads.	There is residual impact	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Operational Combustion emissions	• Regular maintenance of vehicles for appropriate functioning of engine • Company vehicles should undergo emission test to ensure emissions are within permissible limits. • Commercially available Low sulphur diesel shall be used for vehicles/fuel fired equipment/machinery, in order to reduce excessive emissions of sulphur dioxides. • Specification of fuel supply to turbine combustion shall be strictly monitored and followed • Periodic monitoring of stack emissions to ensure that air emission characteristic is within the allowable limit for stationary sources	Residual impacts can be reduced to acceptable level	Undertake daily visual inspections and regular repairs, when appropriate, to ensure that equipment does not emit excessive fumes. If excessive fume, exhaust emission monitoring shall be conducted Stack emission main and bypass stack shall be regularly monitored	Operation of the project Plant Manager
Operational noise	• Roadside tree plantation to be developed at a possible extent and maintained as a noise barrier • Keep internal haul routes well maintained. • Undertake regular maintenance by	Residual impacts can be reduced to acceptable level	Ambient noise levels shall be monitored regularly	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	trained personnel to keep plant and equipment working as per manufacturer's specifications. • Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications. • All plant onsite should be low noise versions, and where needed, acoustic enclosure shall be provided according to manufacturer's recommendations. • The use of damping material such as thin rubber/sheet for shielding the work places like DG sets, compressor etc., • Ear plugs/muffs for workers who are exposed to higher noise shall be provided and enforcement for its use by the workers.			

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Domestic wastewater	• Toilets and septic tank facilities are to be appropriately designed and monitored. • Monitoring of internal sewerage system to ensure all pipelines and septic tanks are properly functioning. • Drainage systems from wash areas and other sources must be strictly monitored. • Regular vacuuming/ siphoning of septic tanks as needed by Sharjah Municipality authorized service providers for transport to the designated municipal sewage treatment plant.	Neutral – There is no residual impacts	--	Operation of the project Plant Manager
Operation waste	• Storage of leachable operation materials and solid waste will be in an impervious area separately to avoid any soil contamination; • The generated solid wastes will be collected segregated as domestic wastes, recyclable solid wastes, non-hazardous solid waste and hazardous wastes and these wastes will be stored	Residual impacts can be reduced to acceptable level	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	properly in the separate area in different coloured bins. • The domestic wastes and non-hazardous solid wastes will be properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal. • Recyclable solid wastes will be sold to Sharjah Municipality authorized recyclers for recycling. • Hazardous wastes will be collected separately and properly disposed to Sharjah Municipality authorized service providers after obtaining NOC from Sharjah Municipality.			
Spills and Leaks	• Spill prevention and management plan shall be developed and effectively implemented. • All hazardous/flammable material, including fuels, will be stored at designated sites in accordance with MSDS requirements best practice procedures. • MSDS to be available for hazardous	There is no residual risks	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	materials stored on site. • Hazardous materials will need to be suitably stored to prevent leaks and spills. • Adequate bunding for fuel storage. • Drip trays will be required to be used to intercept leaks and spills from equipment and during 338efueling.			
Health issues	• All hazardous chemicals and materials must be stored in a protected /secured place with limited access. • Chemicals handling, storage and instructions given in Material Safety Data Sheets & product manuals, supplied by the manufacturer or supplier, must be understood and observed strictly. • There shall be no open storage of any type of chemical in the premises. • Hazardous chemicals shall be stored appropriately based on the compatibility of the chemical to avoid any reaction.	Residual risk can be reduced as low as reasonably practicable	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	• Flammable and other highly flammable products storage should be stored in a controlled temperature and all the electrical fittings should be under classified category as per International standards. • Fire protection requirements shall be as per UAE Civil Defense Code, 2017 in the chemicals/hazardous materials storage areas • Appropriate training shall be provided to workers and Trained/competent persons shall be deployed for critical tasks such as handling of hazardous/flammable chemical, first aid, fire-fighting etc., • Appropriate Personal Protective Equipment shall be provided to workforce involved with hazardous/flammable chemical handling.			

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Labour management	• Labour management (Project labour commitment, Workers Code of Conduct, Labour Grievance Mechanism) shall be strictly followed as per UAE Federal Labour Law • Labour accommodation strategies with welfare facilities shall be provided as UAE Federal Labour Law • Occupational Health and Safety Management shall be developed and effectively implemented.	There is no residual risk	--	Construction and Operation of the project Plant Manager
Traffic	• Smooth entry and exit of vehicle, is provided at the entry and ensure smooth transition for merging of vehicles. • Signboards are at the parking locations for drivers to control the speed. • Security will guide the vehicles for safe parking. • Proper footpath provided for pedestrian movement along with interlocking and barricaded for safety. • Safety precautionary measures are	There is no residual risk	--	Construction and Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	ensured. • Adequate Lighting will be providing as per norms. • Marking of road, stop line, parking lanes, slot numbers will be painted so as guide the drivers.			

10.3. IMPLEMENTATION OF ENVIRONMENT AND SOCIAL MANAGEMENT PLAN

The Environment and Social Management Plan will be implemented by Environment, Health and Safety (EHS) Team which it is formed by the project Management. EHS Team is responsible for the implementation of the ESMP & Environmental Monitoring Plan (EmoP) and will regularly coordinate with the EPAA/Government of Sharjah. The EHS Team will also be responsible for ensuring compliance with other environmental rules and regulations that the EPAA/Government of Sharjah may impose.

10.3.1. ROLES AND RESPONSIBILITIES OF EHS TEAM

The **QHSE (Quality, Health, Safety and Environment) Manager** who is directly reporting to Plant Manager will lead the team of EHS. He will be in charge of implementing company policies regarding environment, health, and safety.

Role	Recommended Environmental Responsibilities
Plant Manager	• Overall responsibility for the facility operation; • Ensure EHS Policy is adhered.
QHSE Manager	• Report to the Plant Manager on EHS issues; • Enforce compliance with EHS and all legal regulations on all levels; • Allocate sufficient personnel and financial resources to ensure compliance and effectiveness of ESMP; • Communicate with all staff on all environmental aspects; • Allocate sufficient responsibility to all staff to perform their HSE duties; • Ensure compliance with HSE Policy; • Sustain the implementation of environment, health and safety procedures; • Regularly check ESMP compliance with legal requirements and advise Operational Manager if any non-consistencies occur; • Responsible for control of HSE reports; • Responsible for reviewing HSE documents and performing reviews; • Review HSE Management Systems Manual at least every 12 months;
Operation Manager	• Overall responsibility for implementation of and

Role	Recommended Environmental Responsibilities
	compliance to relevant regulations in the operations; • Liaise with the HSE Manager in the implementation of the relevant regulations; • Ensure the implementation of all control measures; • Responsible for the incident management program; • Ensure that all avoidable incidents are reported to the HSE Manager. Initiate investigations into any reported non-compliance incidents; • Setup and implement corrective action plans for any non-compliance, including a management program for prevention of such misconduct or incident in the future;
Administration Manager	• Ensure compliance and implementation Environmental & Social Management Plan, HSE Policy and all other relevant regulations in their respective department; • Execute all tasks in accordance with HSE rules.

10.4. EMERGENCY PREPARATION AND RESPONSE PLAN

An emergency preparation and response Plan (EPRP) is pre-impact procedures and duties to be taken in response to extreme events that could endanger the lives or cause damages to the property in the worksite. An effective EPRP can reduce injuries, prevent or minimize environmental impacts, protect lives and reduce losses. In view of the safety and wellbeing of the management and the employees the client has specified a procedure which deals with potential emergency scenario and measures to be taken to monitor and control such situations. This procedure will also set minimum requirements for individuals to be able to handle emergency situations and mitigation measures.

10.4.1. SCOPE

The Emergency Response Plan (ERP) applies to emergency situations that occur at facility. To develop, implement and establish an emergency coordination procedure to be followed in an identified emergency situation. The recognized emergency plans shall be reviewed and tested regular interval to ensure its effectiveness and suitability.

10.4.2. ELEMENTS OF EPRP

Emergency Preparedness and Response Plan specifies procedures and measures to be taken in the event of Fire, Explosion, Flood, Failure or Collapse of Structure and Machinery or either probable emergency situation that could endanger lives or cause damages to property in the worksite. This plan aims to minimize the possible consequences of an emergency by

- Preventing Fatalities and Injuries
- Reducing damage to the environmental aspects
- Facilitating and accelerating business restoration and continuation

Emergency Assembly/Muster Point – Emergency assembly/muster points are a predetermined location where personnel will gather in the case of an emergency evacuation.

Emergency Evacuation and Assembly Plan – The site plot plan will indicate: access gates; streets; site offices; evacuation routes to emergency assembly/muster points; emergency meeting points, first aid room; fire extinguisher / air horn locations; controlled storage, manual call points, fire & gas detection system and Emergency Shutdown system.

Emergency Alarm System – The system will be complete with Fire & gas detection and alarm system including manual call points, automatic fire & das detectors, sounders, and control/indication equipment. Fire alarm system shall consist of several alarm call points, audio visual alarm, smoke detectors and heat detectors. An alarm from the fire detector or manual alarm box shall be transmitted to the fire control panel which in turn indicates outbreak and location of fire and gives audible alarm in the control room and outside alarm.

10.4.3. EMERGENCY RESPONSE TEAM

Emergency Coordination – HSE Manager must be able to respond to, and participate in, any emergencies that may occur. All workers/suppliers should participate by identifying their qualified first aid personnel. The main responsibility during an emergency coordination is to respond to the call for emergency help.

On-Scene Commander – A person involves in direct execution of Emergency Response Activities. He must be a trained fire warden may be in the level of Shift in-charge/ Shift supervisors/Operation Manager. He shall remain as on-scene Commander until a nominated person from Civil Defense takeover as incident commander of the scenario.

Incident Commander – A person responsible for overall management of the incident. He shall be a senior person from operations management, nominated from Civil Defense. He shall take over as Incident Commander soon after reaching the scenario. Thereafter On-Scene commander reports to incident commander. HSE Manager shall coordinate between Incident Commander and On-Scene Commander. HSE Manger shall coordinate with Control room and communicate the facility details to incident commander.

Emergency Response Team –Emergency Response Team (ERT) has been organized for quick responding to emergency.

10.4.4. EMERGENCY COMMUNICATION

All emergencies as stipulated in the plans shall be communicated to staff, client and relevant interested parties. Immediate notification of emergency shall be forwarded by verbal or any other means of communication channel in the feasible time. Communication to relevant authorities shall be determined with respect to the degree of emergency. Emergency response team leader shall be consulted before any Activation of external agency or authorities.

10.4.5. EMERGENCY RESPONSE TRAINING

The effectiveness in the emergency response mitigation requires training of personnel in the areas of:

- Fire Warden/Fire Watcher Training
- Basic Fire Fighting Skills
- Basic First-Aid Course
- Emergency response team roles and responsibilities.
- Regular emergency evacuations, drills and exercises.
- Safe handling of hazardous materials/chemicals/flammables

10.4.6. EMERGENCY RESPONSE PROCEDURES

10.4.6.1. Procedure for Notification and Rising of Alarms

- In any emergency situation, the initial responder or person discovery of the emergency situation shall notify Emergency Response Team.
- An assessment shall be conducted to evaluate the emergency situation to decide on the means and measures of mitigating the emergency situations.
- Rising of emergency alarm, activation of any emergency response team and worksite evacuation if required.
- Any emergency that would cause an impact to the adjacent project worksite shall notify accordingly as per the Emergency response flow chart.
- Worksite accident or a dangerous occurrence that does not require the action of emergency response team shall be carried out in accordance to the accident notification procedure and action plan.

10.4.6.2. Emergency Response Procedure for Fire/Explosion

On observation of fire, observer activates manual call point for alert the personnel and emergency response team for evacuation. On-site Emergency response team should immediately begin gathering information and assessing the incident. Consider the following:

- Rescue of personnel in the immediate areas.
- Life safety hazard to site personnel.
- Extension.
- Confinement.
- Extinguishment.
- Environmental impact.
- Community impact.

After addressing the immediate issues, determine the type of fire. Determining the type of fire will determine the resources required and dictate the necessary incident action plan to fight the fire.

- On observation of fire, observer activates manual call point for alert the personnel and emergency response team for evacuation.
- Emergency response team should immediately begin gathering information and assessing the incident. Based on the information, ERT should activate alarm and evacuate the personnel from the area
- Immediately call '997' for Civil defence assistance and off site emergency response team for next course of fire-fighting.
- Evacuate the residents in the area and assemble them in the assembly point
- Isolate all electrical sources in the area.

10.4.6.3. Emergency Response Procedure for Failure and Collapse of Structure

- ➢ Rising of emergency alarm, activation of any emergency response team and worksite evacuation if required.
- ➢ Evacuate residents from the affected area
- ➢ Cordon off hazard zone and disallow unauthorized entry.

- Check for structural stability before re-enter the hazard zone. Structural designer shall be consulted

- Established temporary support system to prevent further collapse or failure of immediate or adjacent structure upon consultation with structural designer

- Verify any personnel entrapment or injury, if any, try rescue operations. Do not take risk. If any conditions deemed unstable or hazardous.

- Established sequence of structural removal or rescue plan.

- Call external assistance, if necessary.

10.4.7. SPILL CONTINGENCY PLAN

The purpose of this Spill Contingency Plan is to clearly identify potential spill risks associated with the facility, and to identify the procedures to be followed to facilitate the rapid deployment of resources to minimize impacts and risks to the environment.

It is understood and expected that client will have in place relevant inspection and maintenance regimes for any machinery, equipment and storages that will be installed and used on-site. This will be the first level of preventive measures to reduce the risk of spills of substances such as chemicals, flammables, hazardous wastes etc.,.

Material Safety Data Sheets (MSDS) for all substances used to be maintained on site in a predetermined location familiar to all employees. These sheets identify: product information; hazardous ingredients; physical data; fire and explosion hazard; reactivity data; toxicological properties; preventative measures; first aid measures; Risks associated with the occurrence of spills include:

- Environmental pollution/degradation;
- Human exposure, via dermal contact or inhalation possibly resulting in illness;
- Slipping, possibly resulting in personal injury; and/or,
- Fire.

In order to minimize the occurrence/consequences of spills it is important to ensure that:

- Equipment is properly maintained, ensuring all leaks are repaired;
- All onsite fuel is properly stored within double-walled tanks or within approved secondary containment facilities;

Workers are encouraged to provide information on weaknesses in current management control and prevention systems such that improvements can be made which may eliminate the occurrence of a spill.

Cleanup operations will be dictated by the situation and circumstances but generally consist of:

- Extraction and transfer of spilled material/substance into tanks or barrels;
- Extraction and transfer of contaminated soil, material or water into tanks or drums;
- Placement of damaged drums or containers into over packs;
- Extraction and transfer of used absorbents into drums;
- Placement of labels on drums, tanks and over packs; and
- Proper storage and transfer of materials or substances.

Transfer and disposal of hazardous waste will be conducted as per Dubai Municipality requirements and only by a licensed hauler/disposal agency with properly trained employee.

10.5. ENVIRONMENTAL MONITORING PROGRAMME

The Environment and Social Management Plan should be monitored through well planned mechanism of environmental monitoring plan to comply the norms of environmental regulations. An Environmental Monitoring Plan provides feedback about the difference between actual environmental scenario and the impacts of the project on the environment and helps to judge the adequacy of the mitigation measures in protecting the environment. The purpose of Environmental Monitoring is to evaluate the effectiveness of implementation of Environmental Management Plan (EMP) by periodically monitoring the important environmental parameters within the impact area, so that any adverse effects are detected and timely action can be taken. An environmental monitoring program is important as it provides useful information and helps to:

- Evaluate the performance and effectiveness of mitigation measures proposed in the Environment Management Plan (EMP) and suggest improvements in management plan, if required,
- Identify training requirement at various levels.

10.5.1. MECHANISM OF ENVIRONMENTAL MONITORING PLAN

The Environmental Monitoring Plan for the proposed project has been developed in view of the institutional, scientific and fiscal issues pertaining to the project. For developing the monitoring plan, appropriate Value Ecosystem Components (VEC's) has been identified which are based on suggested mitigation measures. For each component, suitable measurable environmental indicators which are appropriate to the impact mechanism and scale of disturbance and have a low natural variability, broad applicability and an existing data series have been defined.

10.5.2. SUGGESTED ENVIRONMENTAL MONITORING PLAN

An environmental monitoring plan has been suggested to monitor environmental parameters. The suggested Environmental Monitoring Plan (EmoP) during construction and operation phase is given in the **Table 92** and **Table 93.**

Table 92 – Suggested Environmental Monitoring Programme during Construction Phase

Components	Parameter to be monitored	Sampling and Measurement plan			
		Method	Frequency	Location	Responsibility
Ambient Air Quality	TSP, PM_{10}, $PM_{2.5}$, SO_2, Nox, CO, TVOC, O_3, Pb	24 hour monitoring by ENAS Accredited Laboratory	Bi-Annual	2 Ambient Locations (Upwind & Downwind directions)	Project Manager
	Visible dust and emissions	Visual Inspection	Daily	Project site	Project Manager
	TSP, PM_{10}	1 hour monitoring by calibrated dust monitoring equipment	As required	Project site – As required by visual inspection	Project Manager
DG Stack Emission Monitoring	TSP, SO_2, Nox, CO, CO_2, O_2	1 hour Monitoring by ENAS Accredited Laboratory	Annual	Stacks from DG	Project Manager
Noise Quality	Noise in dBA	Calibrated sound level meter – 15 min.	Daily	Project site boundary	Project Manager
	Noise in dBA (Leq, Lmin, Lmax)	24 hour monitoring by ENAS Accredited Laboratory	Quarterly	4 Ambient Locations at Project Site	Project Manager
Soil Quality	Soil contamination	Visual Inspection	Daily	Project Site – Excavated, imported soil, spilled area, waste storage area	Project Manager
	pH, Moisture content, TOC, Cl, Nitrogen,	Sampling and Analysis as per British	As required	Project site – As required by	Project Manager

Components	**Parameter to be monitored**	**Sampling and Measurement plan**			
		Method	**Frequency**	**Location**	**Responsibility**
	Phosphorus, K, Alkalinity, EC and Heavy Metals (Fe, Ni, As, Al, Hg, Se, Cu, Zn, Pb, Mn, Cd & Cr), BTX & TPH	Standard (BS 1377:1990) and Analysis by ENAS Accredited Laboratory		visual inspection	
Sea water quality	pH, Temperature, Turbidity, Dissolved Oxygen (DO), Salinity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Boron, Bromide, Heavy Metals (Al, As, Cd, Cr, Cu, Fe, Hg, Zn), Surfactants, Total Petroleum Hydrocarbons, Chlorophyll and *E. coli*.	Sampling and Analysis by ENAS Accredited Laboratory	Weekly	2 locations at Arabian Gulf during dredging and onshore pipeline installation	Project Manager
Health & Safety	Machine failure, gaseous emission, Confined space hazard, Records of Injuries, Diseases and Dangerous Occurrences, HSE Statistics	Regular Inspection Third Party Inspection	Daily Annual/Bi-annual	Entire construction site Pressure vessels, valves, hoses, lifting equipment	Project Manager

Table 93 – Suggested Environmental Monitoring Programme during Operation Phase

Environmental Components	Parameter to be monitored	Sampling and Measurement plan			Responsibility
		Method	Frequency	Location	
Ambient Noise Quality	Noise in dBA (Leq, Lmin, Lmax)	24 hour monitoring by ENAS Accredited Laboratory	Annual	4 locations at boundary of the project site	Plant Manager
Stack Emission	Flue gas temperature, velocity, volume, SO_2, NO_2, CO, CO_2	Isokinetic sampling by ENAS Accredited Laboratory	Bi-annual	Main HRSG stack and bypass stack	Plant Manager
Ambient Air Quality	TSP, PM_{10}, SO_2, NOx, CO, O_3, Pb, TVOC	24 hour monitoring by ENAS Accredited Laboratory	Annual	4 locations at boundary of the project site	Plant Manager
Ground Water Quality	pH, Temperature, Conductivity, TSS, Ammonia – Nitrogen, Nitrate - Nitrogen, Total Organic Carbon, Phosphorous, BOD, COD, Oil & Grease, Phenol, Heavy Metals (As, Ba, Cd, Cr, CN, Pb, Hg, Se, Au, Cu, Na, Ni, Zn, Boron, Mn, Fe), VOC, PCB	Sampling and analytical method as per APHA, 2012	Annual	2 Groundwater samples (Existing boreholes) at project site	Plant Manager
Soil Quality	pH, Moisture content, TOC, Cl, Nitrogen, Phosphorus, K, Alkalinity, EC and Heavy Metals (Fe, Ni, As, Al, Hg, Se, Cu, Zn, Pb, Mn, Cd & Cr), BTX & TPH	Sampling and Analysis by ENAS Accredited Laboratory	Annual	2 locations at Project site	Plant Manager

<table>
<tr><th rowspan="2">Environmental Components</th><th rowspan="2">Parameter to be monitored</th><th colspan="3">Sampling and Measurement plan</th><th rowspan="2">Responsibility</th></tr>
<tr><th>Method</th><th>Frequency</th><th>Location</th></tr>
<tr><td>Outfall effluent</td><td rowspan="2">pH, Temperature, Turbidity, Dissolved Oxygen (DO), Salinity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Calcium, Magnesium, Sodium, Potassium, Carbonates, Chloride, Sulphate, Fluoride, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total residual chlorine, Total Nitrogen, Nitrate Nitrogen, Ammonia Nitrogen, Nitrite Nitrogen, Boron, Bromide, Heavy Metals (Al, As, Cd, Cr, Cu, Fe, Hg, Zn), Surfactants, Total Petroleum Hydrocarbons, Chlorophyll and E. coli.</td><td rowspan="2">Sampling and Analysis by ENAS Accredited Laboratory</td><td>Monthly</td><td>Outfall Channel</td><td>Plant Manager</td></tr>
<tr><td>Sea water quality</td><td>Annual</td><td>2 locations at Arabian Gulf</td><td>Plant Manager</td></tr>
<tr><td>Waste streams</td><td>Quantity of waste generated (Domestic wastewater, Non-hazardous solid waste & Hazardous solid waste) & its disposal</td><td>Inspection</td><td>Monthly</td><td>Generation & Disposal area</td><td>Plant Manager</td></tr>
<tr><td>Health & Safety</td><td>Machine failure, gaseous emission, Confined space hazard, Records of Injuries, Diseases and Dangerous Occurrences, HSE Statistics</td><td>Regular Inspection

Third Party Inspection</td><td>Daily

Bi-annual/ Annual</td><td>Entire facility

Pressure vessels, valves, hoses, lifting equipment</td><td>Project Manager</td></tr>
</table>

10.6. TRAINING AND COMPETENCE

Plant Manager shall define, assess and ensure the competency of its employees and sub-contractors based on the qualification, experience, training, technical expertise, managerial / supervisory skills and various soft skills required to perform in a manner that meets the requirements of HSE management system.

10.6.1. HSE Training Programme

SEWA identifies training needs and provides necessary training as follows

- Awareness with respect to HSE policy and procedures.
- Emergency preparedness and response requirements specific to site.
- The training shall be imparted taking into account the ability, literacy levels, the language comprehension and risk levels of the personnel to be trained.

The following training will be given to personnel working in the facility.

- Personal Protective Equipment
- Basic Fire Fighting Skills
- Fire Warden/Fire Watcher Training
- Basic First-Aid Course
- Emergency response team roles and responsibilities.
- Safe handling chemicals/hazardous materials/flammables
- Regular emergency evacuations, drills and exercises by in-house.
- Permit to Work system
- Electrical safety
- Housekeeping and waste management
- Spill response and management

10.7. COMMUNICATION

The requirements of environmental and social management plan will be effectively communicated to all personnel by induction training, tool box talk, awareness programme and instructions to ensure the effective implementation of environmental and social management plan.

10.7.1. Induction Training

All site personnel must undergo initial induction training before they commence work at the facility. A typical site induction training session should include as a minimum the following subjects:-

a. HSE responsibilities for themselves and co-workers
b. The correct Use of PPE.
c. Dress Code
d. Welfare facilities
e. Medical facilities (First Aid, medical facility etc.)
f. Restricted areas, barriers signs
g. Fire prevention and fire-fighting appliances
h. Emergency response procedures, evacuation & assembly, alarms etc.,
i. Designated smoking areas
j. Reporting of accidents, incidents and unsafe practices

10.7.2. Tool Box Training

Tool Box Training meetings will be conducted at least once a week in which supervisor and their work group will discuss about HSE procedures, safety precautions and to promote individual HSE awareness.

10.7.3. Refresher HSE Training

All employees, after a specific period and/or as designated by the HSE manager or as project conditions change or new HSE Procedures are introduced shall receive a refresher HSE Course so as to maintain their HSE awareness at the highest level possible. This course is to be held once every year or more depending on the HSE Performance.

10.8. AUDIT AND INSPECTION

HSE Manager performs inspections in the workplace for notifying that there are unsafe or unhealthy conditions or working practices, and unsatisfactory arrangements for welfare at work. General workplace inspection will be carryout on weekly basis. The weekly inspection report will be submitted to Plant Manager for review.

Some activities require regular inspection before work starts which will be identified through Job Safety Analysis (JSA)/risk register. Based on the JSA/risk register, check list will be prepared for routine inspection.

HSE Audit will be conducted annually to report and evaluate the performance of environmental and social management system and assessment of compliance monitoring.

11. CONCLUSION

Based on findings of Environmental and Social Impact Assessment (ESIA) study, proposed project will have certain level of marginal impacts on the local environment, certain individual risks to onsite population and minor impact on society. With effective implementation of recommended environment and social management plan, the proposed project will have minor residual effects on local environment and society. The effectiveness of ESMP and effects of residual impacts will be regularly monitored by suggested environmental monitoring plan to sustain the environment, health and safety of society. **Sharjah Electricity and Water Authority (SEWA)** and Consortium of EPC Contractor have committed to implement ESMP effectively. Thus implementing the proposed project has low significance of adverse impact on environment and society.

12. REFERENCES

- Abdul Azis, P.K., Ibrahim Al-Tisan, Mohammed Al-Daili, Troy N. Green, Dalvi, A. G. I. and Javeed, M. A. 1998. Ecological Evaluation Of The Depth Profile Of The Near Shore Waters Of The Al-Jubail Desalination And Power Plants . P. K. Abdul Azis, SWCC R&D Center Al Jubail.

- Alsharhan, A.S. and Kendall, C.G.St.C. 2003. Holocene coastal carbonates and evaporites of the southern Arabian Gulf and their ancient analogues. Earth-Science Reviews, v. 61, p. 191-243

- Brook, M. and Dawoud, M.A., 2005, Coastal water resources management in the United Arab Emirates. In: Proceedings of integrated coastal zone management in the United Arab Emirates Conference held on 5-8 June, 2005

- Canter, L. W., Environmental Impact Assessment, McGraw-Hill, New York, 1996

- Davis, M. L. & Cornwell, D. A., "Introduction to Environmental Engineering", 2nd Edition, McGraw-Hill, Inc., Singapore, 1991.

- Dorgham, M.M. and Muftah, A., 1986. Plankton studies in the Arabian Gulf. I. Preliminary list of Phytoplankton Species in Qatari Waters Arab Gulf J. Scient. Res., 4(2): 421-436.

- Dorgham, M.M., Muftah, A. and El-Deeb. 1987. Plankton Studies in the Arabian Gulf, II. Autumn Phytoplankton in the Northwestern Area. Ibid, Agric. Biol. Sci., B5(2): 215-235.

- Dubai Municipality – Technical Guidelines

- Engledow, H.R. and Bolton, J.J. 1994. Seaweed alpha-diversity within the lower eulittoral zone in Namibia: The effects of wave action, sand inundation, mussels and limpets. Botanica Mar., 37: 267-276.

- Environment Protection & Development Authority, RAK-EPDA standard report format

- Environmental Standards and Allowable Limits of Pollutants on Land, Water, and Air Environment, Dubai Municipality, May 2003

- Federal Law No 24 of 1999, for the Protection and Development of the Environment, UAE

- GHD Meraas Development, June 2017, Dubai Harbour Environmental Impact Assessment

- Government.ae, Topography and Ecosystems, https://government.ae/en/information-and-services/environment-and-energy/topography-and-ecosystems

- Hogan, T.W., 2015. Impingement and entrainment at SWRO desalination facility intakes, chapter 4, in: Missimer, T.M., Jones, .B and Maliva, R.G., (Eds.), Intakes and Outfalls for Seawater Reverse-osmosis Desalination Facilities: Innovations and Environmental Impacts, Springer International Publishing, Switzerland, 2015, pp. 57–78.

- https://en.wikipedia.org/wiki/United_Arab_Emirates

- Iglesias, J.I.P., Urrutia, M.B., Navarro, E., Alvarez-Jorna, P., Larretxea, X., Bougrier, S. and Heral, M. 1996. Variability of feeding processes in the cockle Cerastoderma edule (L.) in response to changes in seston concentration and composition. J. Exp. Mar. Biol. Ecol., 197: 121–143.

- Ingham, R.A., Mansour, L., Qadan, T., Al Hindi, M.H. and Attawneh, O., 2009.RO pretreatment design and performance under challenging conditions in the Arabian Gulf, IDA World Congress—Atlantis, the Palm—Dubai, UAE, 2009, pp. 7–12.

- Kader Gaid, 2011. A Large Review of the Pre Treatment, Expanding Issues in Desalination, Prof. Robert Y. Ning (Ed.), ISBN: 978-953-307-624-9, InTech, Available from: http://www.intechopen.com/books/expandingissues-in-desalination/a-large-review-of-the-pre-treatment

- Karim, F.M. and Fawzi, N.M., 2007. Flora of the United Arab Emirates. Vol. 1. United Arab Emirates University, Al Ain, UAE.

- Kohler, K.E. and Gill, S., 2006. Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computer & Geosciences, 32(9):1259-1269

- Makuriaw, A. and Teffera, B., 2013. IAIA13 Conference Proceedings – Impact Assessment the Next Generation, 33rd Annual Meeting of the International Association for Impact Assessment (13-17 May 2013), Canada.

- Meteorology and Environmental Protection Administration (MEPA), 1992. Arabian Gulf, Report 5, Meteorology and Environment Protection Admin. In Saudi Arabia for IUCN, Switzerland.

- Ministerial Decree No.12 of 2006/Protection of air from Pollution, UAE

- Ministerial Order No. 32 of 1982/ Issued by the Ministry of Labour specifies the Determination of Preventive Methods and Measures for the Protection of workers from the risks of work, UAE

- Murad, A.A., 2010. An Overview of Conventional and Non-Conventional Water Resources in Arid Region: Assessment and Constrains of the United Arab Emirates (UAE). J. Water Resource and Protection, 2: 181-190.

- Narimisa, M. R., and Ahmed Basri, N. E., A case study for environmental impact assessment of oil refinery in Iran with emphasis of Environmental and Social Action Plan (ESAP), 2011 2nd International Conference on Environmental Science and Technology, IPCBEE vol.6, Singapore, 2011

- Nations Encyclopedia, United Arab Emirates-Topography, https://www.nationsencyclopedia.com/Asia-and-Oceania/United-Arab-Emirates-TOPOGRAPHY.html

- NFPA 1600 - Standard on Disaster/ Emergency Management and Business Continuity Programs, Massachusetts, 2007

- Occupational Safety & Health Administration (OSHA), 29 CFR 1910

- Pielou, E. C., 1966. The measurement of diversity in different types of biological collections. J. Theor. Biol., 13: 131-144.

- Preparation of environmental statements for planning projects that require environmental assessment – a good practice guide, Department of the Environment, UK, 1995

- Raymont, J.E. 1964. Plankton and Productivity of the Ocean. Wheaton and co. Exeter, Great Britain.

- Sheppard, C.R.C. 1993. Physical-environment of the Gulf relevant to marine pollution an overview. Mar. Pollut. Bull. 27: 3–8.

- Technical Guidance Document for Environmental Impact Assessment (EIA), Environment Agency–Abu Dhabi, April 2010

- Tourenq, C. and Launay, F., 2008. Challenges facing biodiversity in the United Arab Emirates. Management of Environmental Quality An International Journal, 19(3):283-304.

- U. S. Environmental Protection Agency-Compilation of Air Pollutant Emission Factors (AP 42 - Fifth Edition), 2009. Published by Office of Air Quality Planning and Standards, Office of Air and Radiation, North Carolina.

- United Arab Emirates Yearbook 2000 - 2010, National Media Council, Abu Dhabi, United Arab Emirates

- Waste Statistics of Abu Dhabi Emirate, 2013, Statistics Centre of Abu Dhabi Emirate.

- WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide - Global update 2005 - Summary of risk assessment, World Health Organization.

- Workplace Health and Safety Queensland, Risk Management Code of Practice 2007, Supplement 1- Hazard Identification, Supplement 2- Risk Assessment, and Supplement 3- Control, monitor, implement and review, Queensland, 2007.

- World Health Organization – Guidelines for Community Noise Document References MNB-1Q DOC2 [Editors: Birgitta Berglund, Thomas Lindval and Dietrich H Schwela], Outcome of WHO Expert Task Force Meeting held in London – UK, April 1999.

- Zein, S.R. and Abdulrahman, S.A. 2003. Water resources in the UAE. In: Water Resources Perspectives: Evaluation, Management and Policy. Edited by A.S. Alsharhan and W.W. Wood. Published by Elsevier Science, Amsterdam, The Netherlands, p. 245-264.

- Zoutendyk, P. and Duvenage, I.R. 1989. Composition and biological implications of a nepheloid layer over the inner Agulhas Bank near Mossel Bay, South Africa. Trans. Roy. Soc. S. Afr., 47: 187-197.

13. ANNEXURES

ANNEXURE 1 – WRITTEN AUTHORIZATION FROM PROJECT OWNER/DEVELOPER

Written Authorization from Project Owner/ EPCC

هيئة كهرباء ومياه الشارقة
Sharjah Electricity & Water Authority
مكتب الرئيس

حكومة الشارقة
Government of Sharjah
Chairman's Office

المرجع: CHX000 359
التاريخ: 2/ يونيو 2018

سعادة/ هنا سيف السويدي المـوقرة
رئيس هيئة البيئة والمحميات الطبيعية بالشارقة

السلام عليكم ورحمة الله وبركاته ،،،،

الموضوع : **الأعمال الأولية الخاصة بمشروع تطوير وتوسعة محطة اللية لتوليد الطاقة**

تهديكم هيئة كهرباء ومياه الشارقة أطيب تحياتها وخالص تمنياتها لسعادتكم بدوام والتوفيق والسداد ، ونعرب لكم عن عميق شكرنا وتقديرنا لجهودكم وتعاونكم الدائم معنا في إطار الروابط والعلاقات الاستراتيجية وبعد ،

بالإشارة إلى الموضوع أعلاه ، نود إحاطة سعادتكم علماً بأن هيئة كهرباء ومياه الشارقة كلفت السادة/ إئتلاف شركتي ميتسوبيشي هيتاشي باور سيستمز والسويدي باور (اس ايه ئي) للقيام بأعمال تطوير وتوسعة محطة اللية لتوليد الطاقة بنظام الدورة المركبة بسعة (1100) ميجاواط.

وبناءً عليه فإننا نرغب في أن يقوم الإئتلاف المذكور بالقيام ببعض الأعمال الأولية والدراسات الخاصة بالمشروع والتي تشمل ما يلي :

- الدراسات البيئية و الإجتماعية و الضوضاء
- الدراسات البحرية والساحلية
- دراسات الحفر وجودة التربة
- الدراسات الجيوفيزيائية
- المسوحات الأرضية

1. 7 2018

هيئة كهرباء ومياه الشارقة
Sharjah Electricity & Water Authority
مكتب الرئيس

حكومة الشارقة
Government of Sharjah
Chairman's Office

ونظراً لأهمية المشروع وحيويته لإمارة الشارقة وإرتباطه بجدول زمني محدد، يرجى التكرم من سعادتكم بتقديم الدعم اللازم للسادة/ إئتلاف شركتي ميتسوبيشي هيتاشي باور سيستمز والسويدي باور (اس ايه ئي) فيما يخص هذا المشروع الحيوي.

ولمزيد من الاستفسار والايضاح يرجى التواصل مع المهندس/علي عباس ، عبر البريد الإلكتروني ali.yousif@sewa.gov.ae

وتفضلوا بقبول فائق التحية والاحترام

الدكتور المهندس/راشد الليم
رئيس هيئة كهرباء ومياه الشارقة

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ELSEWEDY
POWER

التاريخ: 01 يونيو 2018

السيد / رئيس هيئة البيئة و المحميات الطبيعية بالشارقة

السلام عليكم و رحمة الله و بركاته ،،،،

الموضوع : الأعمال الأولية الخاصة بمشروع تطوير و توسعة محطة اللية لتوليد الطاقة

تهديكم شركة السويدي باور أطيب التحيات وتتمنى لكم دوام التقدم والنجاح.

إيماءا إلي خطاب السيد / رئيس هيئة كهرباء و مياه الشارقة لسيادتكم المرفق. و بالاشارة إلي الموضوع أعلاه و علما بأن هيئة كهرباء و مياه الشارقة قد كلفت السادة إئتلاف شركتي ميتسوبيشي هيتاشي باور سيستمز و السويدي باور (اس ايه ئي) للقيام بأعمال تطوير و توسعة محطة اللية لتوليد الطاقة بنظام الدورة المركبة.

نحيط علم سيادتكم ان الإئتلاف قد أسند إلى السادة / الحلول البيئة للإستشارات البيئية (ص.ب. 68595، إمارة الشارقة، الإمارات العربية المتحدة) القيام بأعمال الدراسة البيئية و المجتمعية للمشروع.

و نظرا لأهمية المشروع و حيويته لإمارة الشارقة و إرتباطه بجدول زمني محدد. يرجى التكرم من سعادتكم بتقديم الدعم اللازم فيما يخص هذا المشروع الحيوي.

و تفضلوا بقبول فائق التحية و الإحترام

مهندس / رامي إمام

مـديــر المشــروع

R. Imam

1. 7. 2018

ANNEXURE 2 – EPAA's TERMS OF REFERENCE

TERMS OF REFERENCE DOCUMENT

RE: TERMS OF REFERENCE (ToR) REPORT FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY: PROPOSED LAYYAH COMBINED CYCLE THERMAL POWER PROJECT OF SHARJAH ELECTRICITY AND WATER AUTHORITY (SEWA) LAYYAH POWER STATION, SHARJAH - UAE

Environment & Protected Areas Authority Sharjah United Arab Emirates Sharjah Desert Park Intersection 9 (E88)	Author: Department: Telephone: Email: Date:	John Pereira EPAA +971 52 7208397 john.pereira@epaa.shj.ae 01-08-2017	

KEY COMMENTS:

Comment	Page No.	Document Section	Quote	Commentary
1	8	**1.Introduction**	*"It is still undergoing expansion as the demand increasing demand of water and electricity in the emirate of Sharjah"*	The introductory section of the document contains numerous grammatical errors, it is suggested that greater emphasis is placed on proofreading the document prior to release.
2	26		*"Such screening is based on the environmental and social categorization process of the International Finance Corporation (IFC) and it will be categorized as A, B and C."*	No clarity is provided as to what category this project falls in.
3	49	**3.6 Waste Streams/3.6.3. Liquid waste**	*"The generated domestic wastewater (sewage) will be collected in underground collection tank and it will*	Greater clarity needs to be provided on this process, what treatment process will be implemented. What "checks and balances" will be implemented to ensure appropriate water quality when disposed of?

		generation and management.	*be treated in Sewage Treatment Plant (STP). The treated sewage will be disposed to sea (Arabian Gulf).”*	
4	49	**3.6 Waste Streams/3.6.3. Liquid waste generation and management.**	*“The industrial wastewater to be generated from the proposed will be neutralized and neutralized wastewater will be discharged to sea through outfall channel.”*	Greater detail needs to be placed on the quality of this industrial discharge, will any contaminants or chemicals be present, what will the temperature & salinity levels be. Could this have an impact, needs serious addressing in the EIA.
5	53	**4.1.1. Environmental sensitivity of the study area**	*Sensitive receptors are the specially protected resources and those vulnerable people in a given area at the receiving end of the discharges, emissions and pollutions from a project or activity.*	Various sensitive receptors are excluded in this report, the impact of the project on these receptors need to be reviewed: ➢ No less than 5 commercially operating hotels and resorts along the Al Khan Beach Area. Golden Beach Resort is within 500m of the proposed construction site. http://www.mhgroupsharjah.com/GBM/en/hotel.html ➢ Al Khaleidia Suburb ➢ Al Khan Primary School (Within 2km) ➢ Arabian Gulf School (Within 2 km) ➢ 2 x Nurseries (Within 2 km) These stakeholders need to be considered when assessing the impacts of the projects. 30 + months of construction e.g. noise, dust and vibration could seriously impact the economic viability of hotels and resorts. Also reduced water quality could seriously impact the experience of resort visitors. See figure 1.
6	Pg 54 - 61	**4.3 Climate and Meteorology 4.4 Geology and Soil Quality 4.5 Ground Water**		This entire section is almost entirely dominated by generic National or Regional scale information and carries little relevance to the local project environment. Greater emphasis must be placed on the local environment surrounding the site, e.g. site geology, soil quality, marine environment etc. Most of this information must be site specific.

		4.6 Air Environment **4.8 Marine Environment** **4.9 Waste Management** **4.10 Socio-Economic Profile**		The socio-economic profile of the surrounding environment and communities needs to be described, Emirate scale descriptions are too vague.
7	57	**4.4 Geology and Soil Quality** **4.8 Marine Environment**	*"According to the study conducted by Alsharhan and* ***Kendall (2003)****, coast between"* *Circulation in the Gulf is in an anti-clockwise motion, driven primarily by density gradients, creating a reverse estuarine flow similar to the circulation of the Mediterranean Sea* ***(Reynolds, 1993).*** *Figure 9 - Arabian Gulf bathymetry depth contours in m* *(Source:* ***Elshorbagy et al., 2006)***	The references referred to on the left have not been cited in the document. Poor citation exists throughout the document. At all times where external resources have been utilized the source must be cited.
8	55	**4.3.2 Humidity**	*Perusal on data from National Center of Meteorology and Seismology (NCMS) during 2013-2017 for Sharjah International Airport, it indicates that lowest minimum absolute relative humidity by month (Min., - Lowest monthly minimum absolute relative humidity observed in a specific month) during 2013 – 2017 was 4% during October, 2014. While, highest*	This paragraph is confusing and hard to follow; careful revision of sentence structures is required. Similar confusing paragraphs exist through the document and will require revision.

			maximum absolute relative humidity by month (Max., - Highest monthly maximum absolute relative humidity observed in a specific month) was 99% during the months of January to April, 2013 and March, 2016. *The lowest mean of minimum monthly relative humidity (Mean Min., - Mean of daily minimum relative humidity observed during a specific month during 2013 – 2017 was 15% during May, 2015, While, highest mean of maximum monthly relative humidity (Mean Max., -Highest monthly maximum relative humidity observed in a specific month) was 89% during February, 2013.*	
9	57	**4.7 Noise Environment**	*"There are no significant sources of noise by the proposed project."*	The proposed project site is situated in an industrial zone, numerous sources of noise are present. The construction of the project will result in significant noise pollution. This will have an impact on the Adjacent Hotels and Resorts situated within 1km of the proposed project site. This statement is therefore misleading and not accurate.
10	61	**4.10.2. Traffic and Transportation**	*"The project site is well connected by road network. The level of service of that road is moderate. The project site is well accessible by air and sea route."*	On what analysis is the "level of service" determined as moderate? Sharjah is prone to severe congestion at peak hours how will the project impact or contribute to further congestion. A major shortcoming of the current road network is that all access for construction and service vehicles are forced through high to medium density urban and residential areas, the road network is ill-suited for construction machinery. 30+ Months of construction will have a negative impact on local congestion, noise and air pollution this needs to be evaluated.
11	63	**4.11 Gap Analysis**		This section places minimal emphasis on the impacts of the project on the adjacent urban and hospitality environments this needs to be addressed.

				The discharge of industrial wastewater and its associated impacts need to be included. Special focus is required on Chemical and Salinity impacts.
12	66	**Table 16 – Summary of Environmental Aspects and probable impacts during construction and operation.**		The Impacted receptors need to be carefully revised. As an example construction noise, dust and vibrations could impact adjacent resorts and residential areas. The discharge of dewatered water into the ocean's impact will determine entirely on the level of contamination at the site, which could drastically increase the impact on the local environment and adjacent hospitality stakeholders. Not only the project site will be impacted.

Final Commentary:

The EPAA requires that the following be included in the EIA:

The EIA report should give details on the:

- Impacts to the marine environment from accidental discharges of hazardous materials
- Detail design, specification and layout of surface drains for storm water disposal indicating its final exit
- Impacts on sediment transport and consequences on the coastal environment.

The EIA must contain the following:

- Prediction of the ecological impacts of the proposed development
- Direct losses of habitats, flora and fauna, natural features *(Feeding grounds, shelter, breeding sites and areas used during seasonal migration may be lost)* , including habitat fragmentation
- Negative effects on the health of biota including plants , animals and fish
- Threat to rare and endangered species
- Reduction in species diversity or disruption of food webs

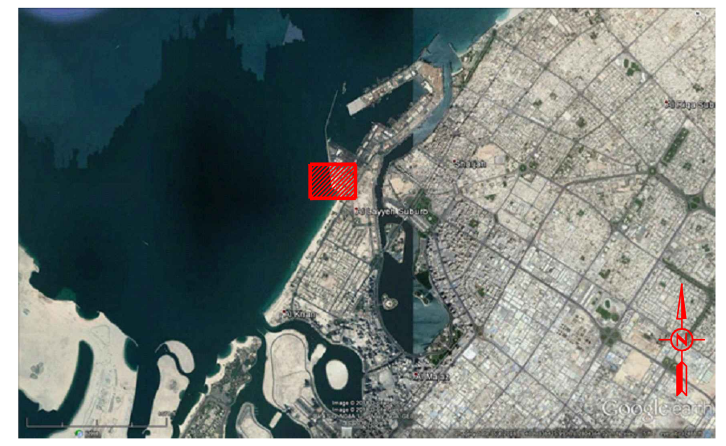
- Determining the significance of the ecological impacts. Factors include the timing of the impact, duration and frequency of the impact, timescale within which the impact is being investigated, spatial scale of an evaluation, the nature conservation value of a species or habitat
- Disturbance of aquatic organisms and aquatic habitats
- Hydrological disturbances – changes in the quality and quantity of surface and groundwater flows
  Changes in the physico-chemical environment

Figure 1 Any impacts on the marine environment could lead to detrimental consequences for adjacent stakeholders, below is a persistent Algal Bloom Experienced along the Al Khan Beaches adjacent to the project site, special emphasis needs to be placed on inspecting marine water quality impacts of the proposed project.

ANNEXURE 3 – LAYOUT SHOWING TENTATION LOCATIONS OF INTAKE AND OUTFALL DISCHARGE

Layout showing tentative locations of intake and outfall discharge

KEYPLAN



NOTES:

1. THE BATHYMETRY USED ARE BASE ON SURVEY RECEIVED BY ARTELIA ON 04/08/2018, WITH DRAWING Nos. LPP-GSS-0718-071-003 LPP-GSS-0718-071-007
2. ALL COORDINATES SHOWN ARE RELATIVE TO WGS 84, UTM ZONE 40 NORTH.
3. INTAKE TOWER AND DIFFUSER LOCATION TO BE DEFINED ON LATER STAGE.
4. DISCHARGE ON THE EXISTING CHANNEL SUBJECT TO HYDRAULIC CONDITIONS AND PERMITS.
5. EXACT LOCATION OF THE MARINE PIPELINES TO BE CONFIRMED.

LEGEND

- INTAKE PIPELINE
- OUTFALL PIPELINE (OPTION 1)
- OUTFALL PIPELINE (OPTION 3)
- OUTFALL PIPELINE (OPTION 4)

Rev	Date	Revision Memo	Issued by	Checked by	Approved by
2	08.08.18	PRELIMINARY DESIGN	CBO	HCA	CKS
1	18.07.18	PRELIMINARY DESIGN	CBO	HCA	CKS
0	16.07.18	PRELIMINARY DESIGN	CBO	HCA	CKS

CLIENT:

ELSEWEDY ELECTRIC

CONSULTANT:

ARTELIA
Passion & Solutions

PROJECT:

Layyah 900MW CCPP

DRAWING:

PRELIMINARY
BATHYMETRIC LAYOUT

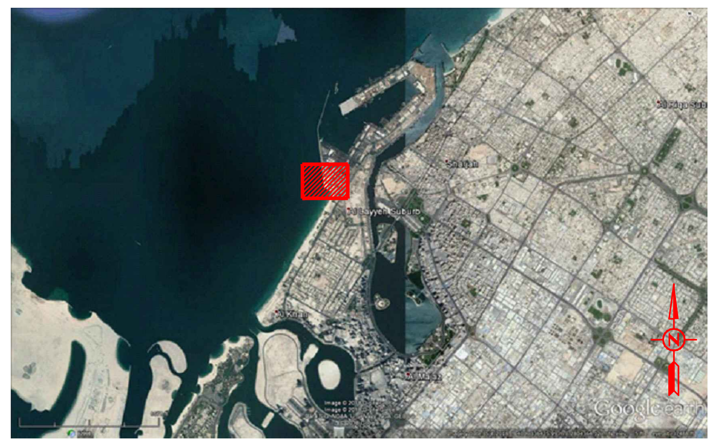
DRAWN BY :	MAA	DESIGNED BY :	CBO
CHECKED BY :	HCA	APPROVED BY :	CKS
DRAWING SCALE :	N.T.S	DATE :	05 AUGUST 2018

DRAWING NO :

JOB No	TYPE OF DOC.	DISCIPLINE	NUMBER	DWG STAGE / REV
SGF 18 100	DWG	SK	001	PRE / 2

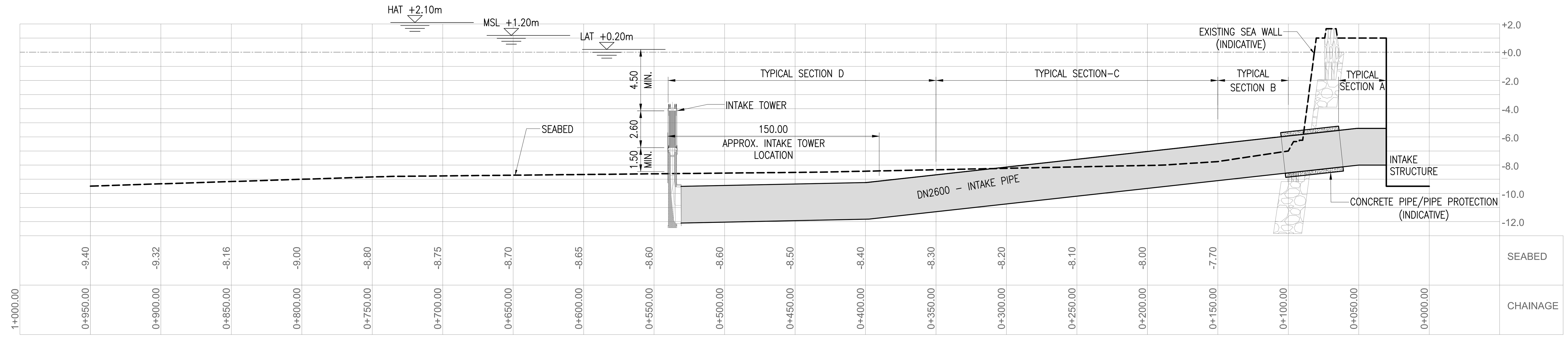
CAD File : SGF18100-DWG-SK-001_rev 2.dwg — PLOT SCALE : 1:1 — A1

KEYPLAN



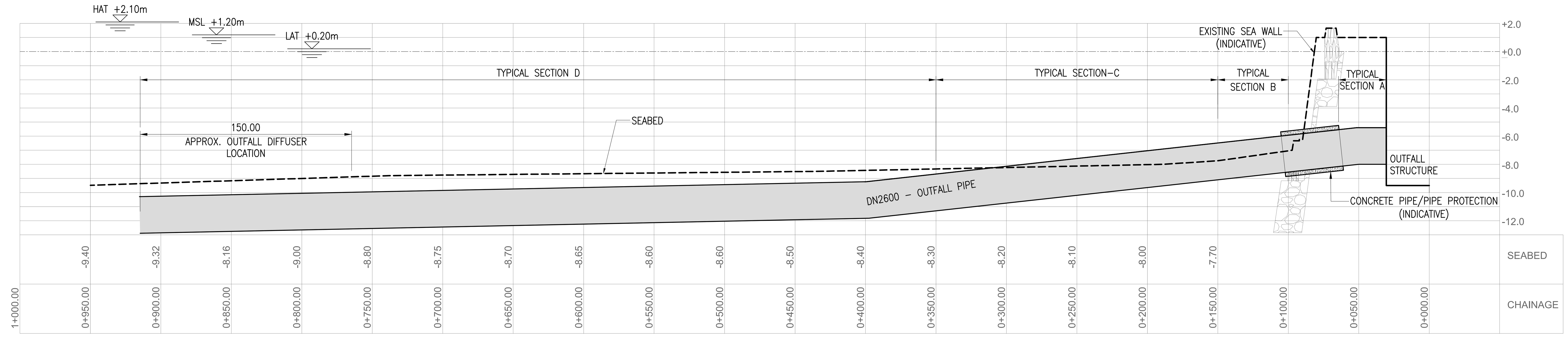
NOTES:

1. SEABED PROFILE EXTRACTED FROM SURVEY RECEIVED BY ARTELIA ON 04/08/2018, WITH DRAWING Nos. LPP-GSS-0718-071-003 LPP-GSS-0718-071-007
2. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. ALL LEVELS ARE IN METRES AND REFERECED TO CHART DATUM (CD).
4. TOWER AND DIFFUSER LOCATION TO BE DEFINED ON LATER STAGE.



INTAKE PIPELINE PROFILE

(SCALE V=1:200 , H=1:2000)



OUTFALL PIPELINE PROFILE

(SCALE V=1:200 , H=1:2000)

0 2 4 6 8 10m
VERTICAL SCALE 1:200

0 20 40 60 80 100m
HORIZONTAL SCALE 1:2000

Rev	Date	Revision Memo	Issued by	Checked by	Approved by
2	13.08.18	PRELIMINARY DESIGN	CBO	HCA	CKS
1	12.08.18	PRELIMINARY DESIGN	CBO	HCA	CKS
0	18.07.18	PRELIMINARY DESIGN	CBO	HCA	CKS

CLIENT:

ELSEWEDY ELECTRIC

CONSULTANT:

ARTELIA Passion & Solutions

PROJECT:

Layyah 900MW CCPP

DRAWING:

PRELIMINARY PIPE PROFILE

DRAWN BY :	MAA	DESIGNED BY :	CBO
CHECKED BY :	HCA	APPROVED BY :	CKS
DRAWING SCALE :	AS SHOWN	DATE :	18 JULY 2018

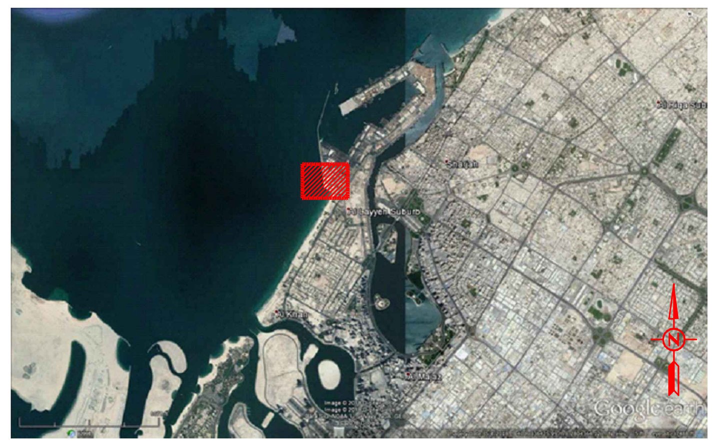
DRAWING NO : / DWG STAGE

JOB No	TYPE OF DOC.	DISCIPLINE	NUMBER	REV
SGF 18 100	DWG	SK	011	PRE 2

CAD File : SGF18100-DWG-SK-011_rev 2.dwg | PLOT SCALE : 1:1 | A1

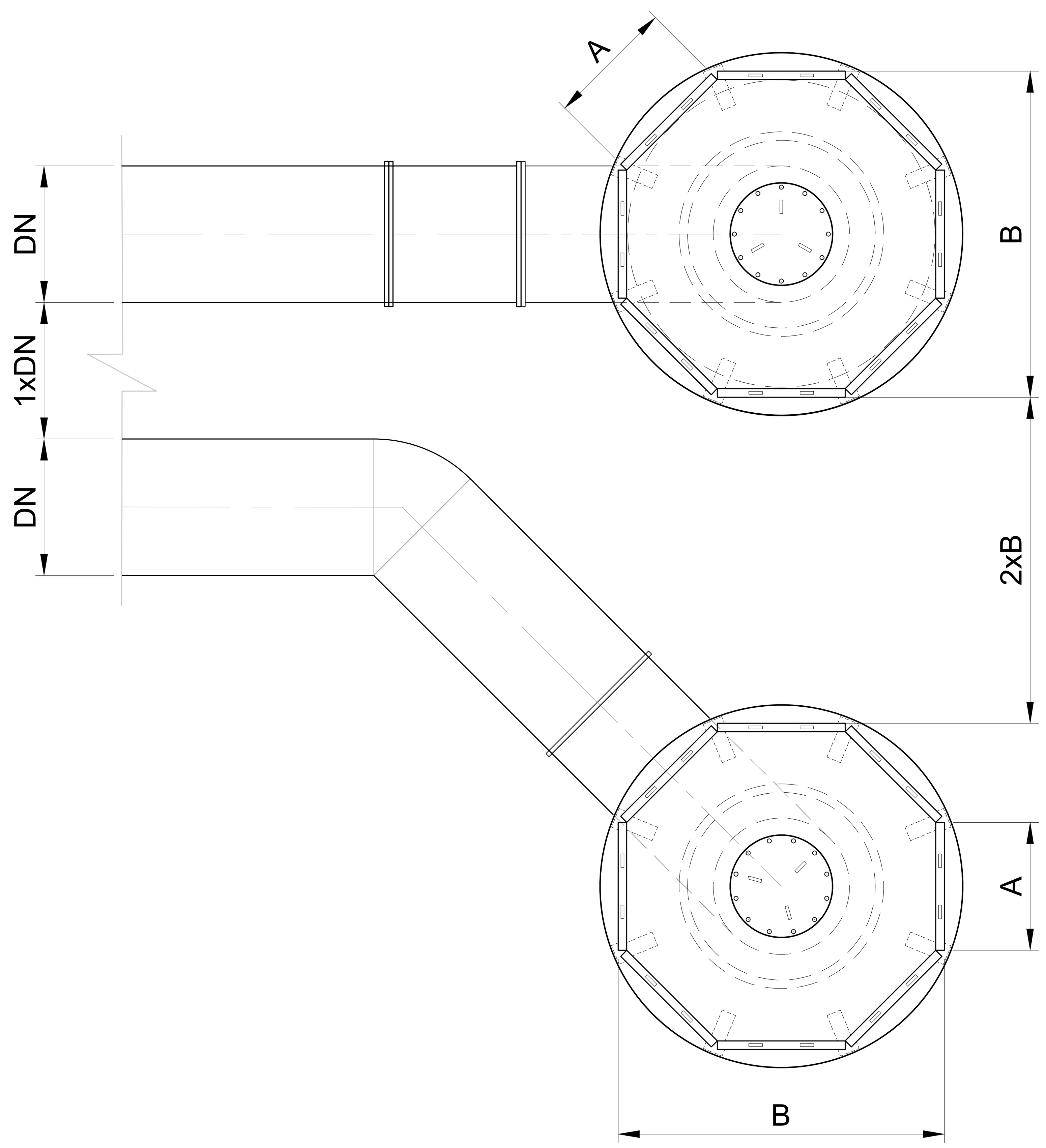
T:\2018\SGF18100 - Layyah 900MW CCPP_HCA_CBO\01 Preliminary\Sketches\SGF18100-DWG-SK-011_rev 2.dwg Aug 12, 2018 - mario.r.acosta

KEYPLAN

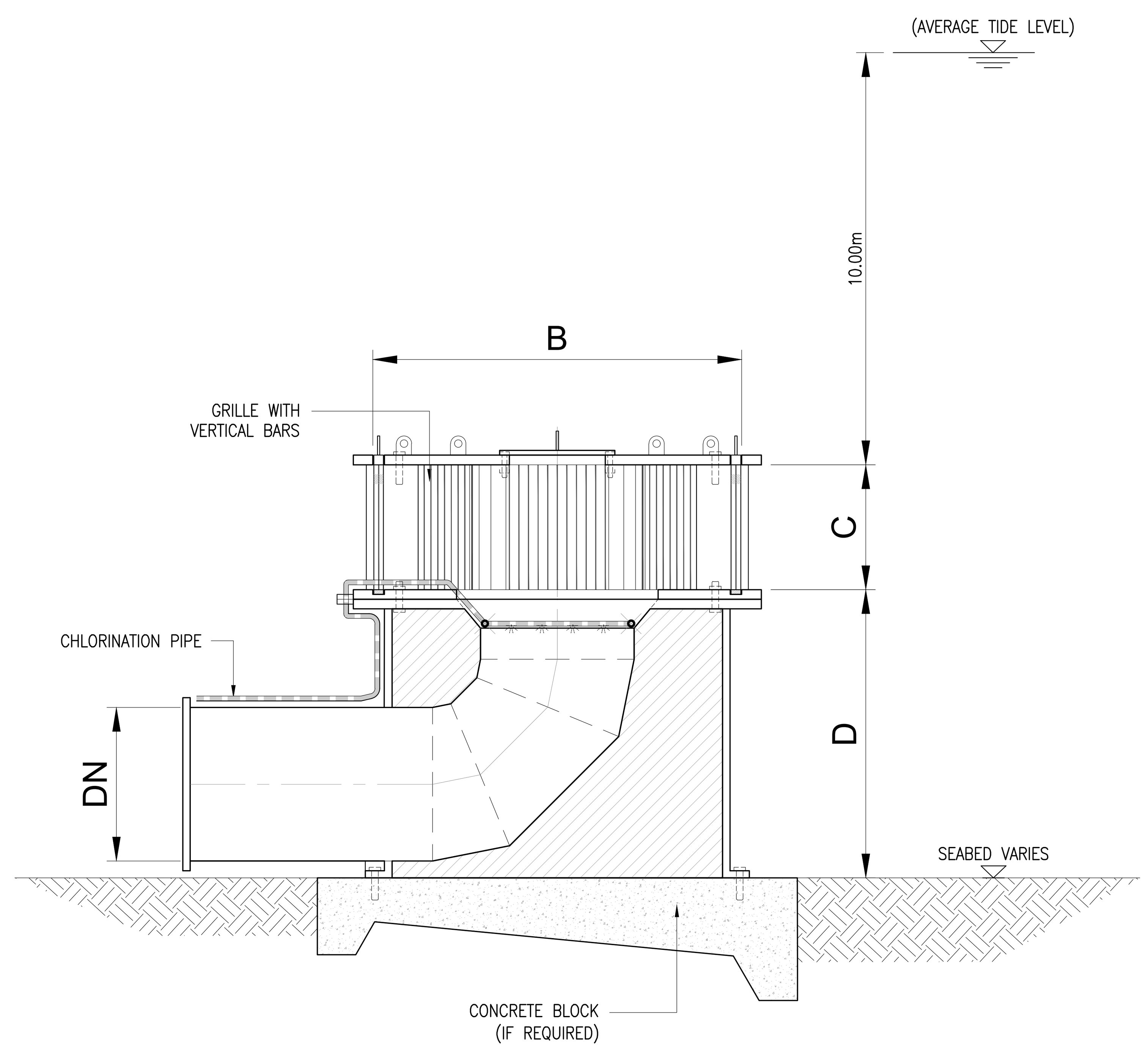


NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.



INTAKE HEAD TYPICAL LAYOUT
(SCALE N.T.S)



INTAKE HEAD SECTIONAL DETAIL
(SCALE N.T.S)

INTAKE HEAD TABLE					
LOCATION	A (m)	B (m)	C (m)	D (m)	DN (mm)
LAYYAH	3.50	8.45	2.60	1.50	2600

Rev	Date	Revision Memo	Issued by	Checked by	Approved by
0	18.07.18	PRELIMINARY DESIGN	CBO	HCA	CKS

CLIENT:

ELSEWEDY ELECTRIC

CONSULTANT:

ARTELIA
Passion & Solutions

PROJECT:

Layyah 900MW CCPP

DRAWING:

PRELIMINARY
INTAKE TOWER DETAIL

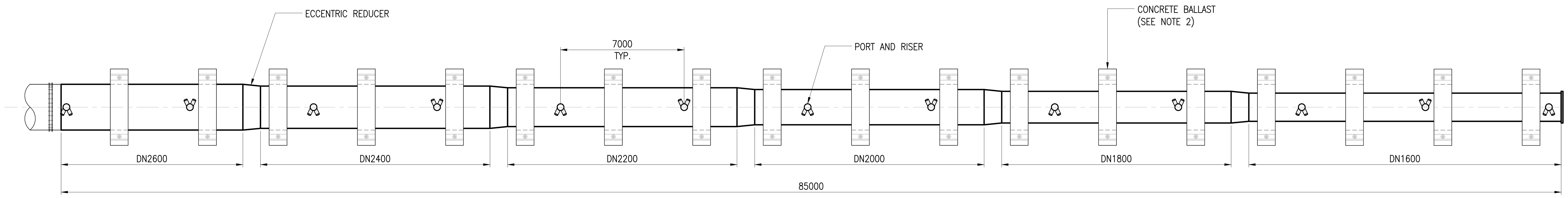
DRAWN BY :	MAA	DESIGNED BY :	CBO
CHECKED BY :	HCA	APPROVED BY :	CKS
DRAWING SCALE :	AS SHOWN	DATE :	18 JULY 2018

DRAWING NO : DWG STAGE

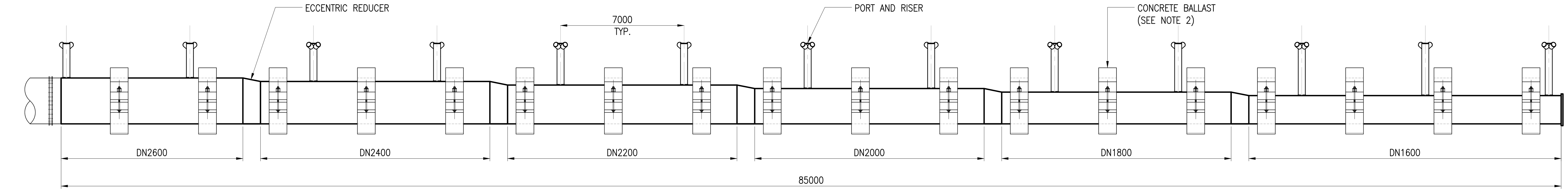
SGF 18 100	DWG	SK	012	PRE 0
JOB No	TYPE OF DOC.	DISCIPLINE	NUMBER	REV

CAD File : SGF18100-DWG-SK-012.dwg PLOT SCALE : 1:1 A1

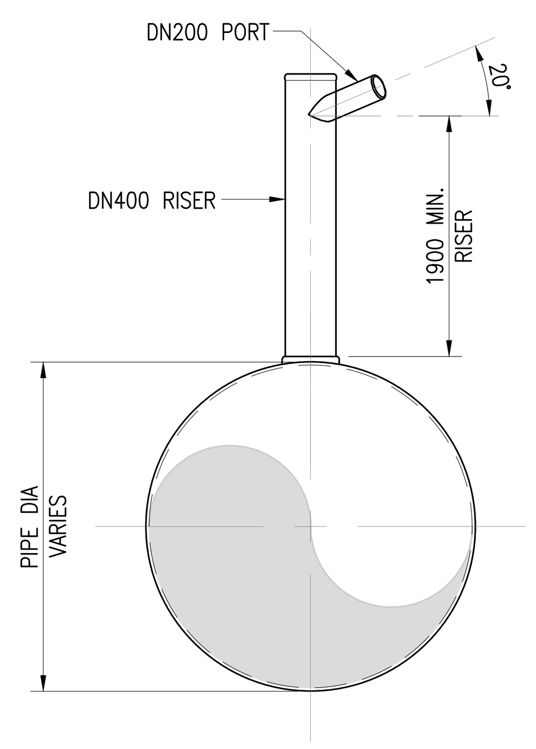
T:\2018\SGF18100 - Layyah 900MW CCPP_HCA_CBO\01 Preliminary\Sketches\SGF18100-DWG-SK-012.dwg, Jul 18, 2018 - mario-jr.acosta



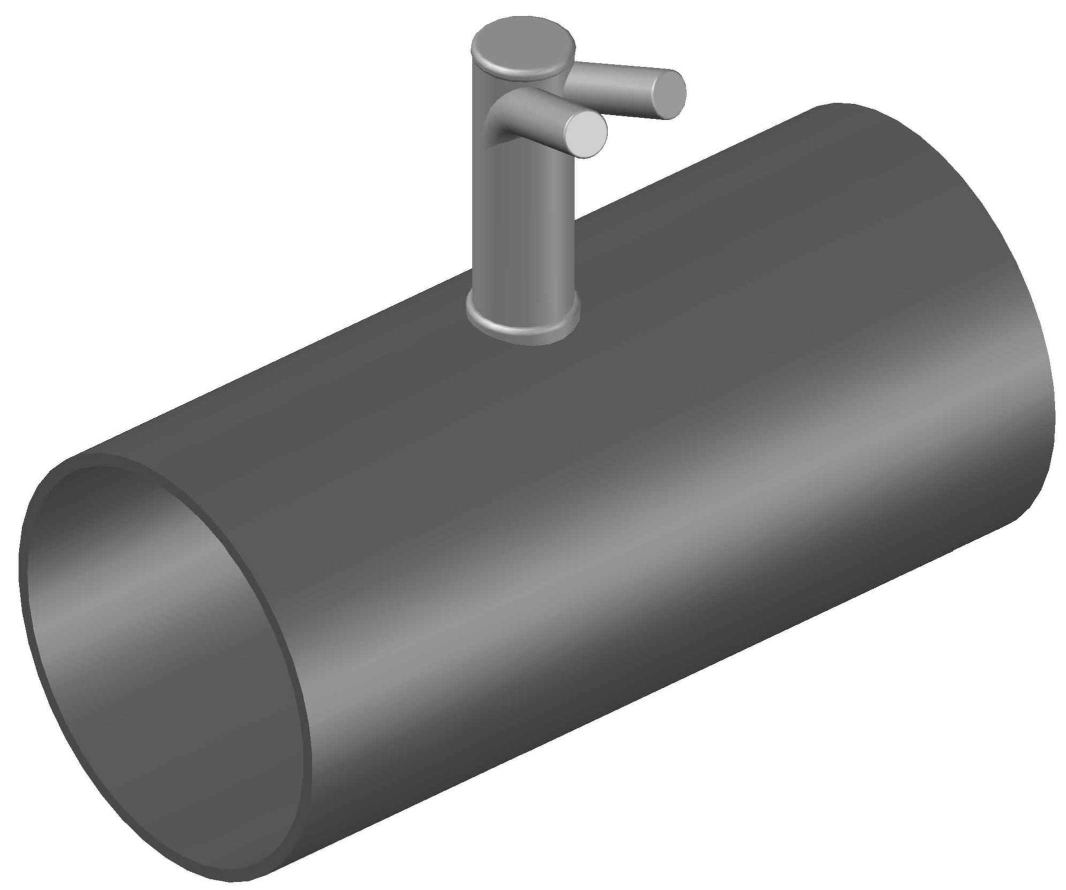
DIFFUSER LAYOUT
(SCALE 1:150)



DIFFUSER ELEVATION
(SCALE 1:150)



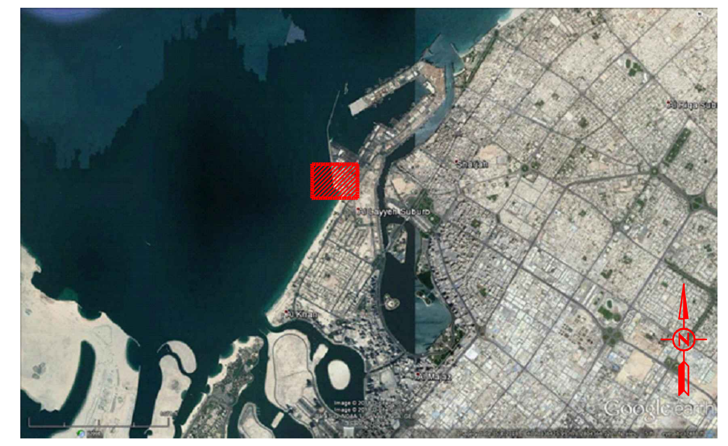
TYPICAL PORT AND RISER DETAIL
(SCALE 1:50)



TYPICAL PORT SND RISER PERSPECTIVE VIEW

NOT FOR CONSTRUCTION

KEYPLAN



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. CONCRETE BALLAST DESIGN AND SPACING TO BE DEFINED ON DETAILED STAGE.

Rev	Date	Revision Memo	Issued by	Checked by	Approved by
0	13.08.18	PRELIMINARY DESIGN	CBO	HCA	CKS

CLIENT:

ELSEWEDY ELECTRIC

CONSULTANT:

ARTELIA
Passion & Solutions

PROJECT:

Layyah 900MW CCPP

DRAWING:

PRELIMINARY
OUTFALL DIFFUSER DETAILS

DRAWN BY :	MAA	DESIGNED BY :	CBO
CHECKED BY :	HCA	APPROVED BY :	CKS
DRAWING SCALE :	AS SHOWN	DATE :	13 AUGUST 2018

DRAWING NO :

JOB No	TYPE OF DOC.	DISCIPLINE	NUMBER	REV
SGF 18 100	DWG	SK	014	0

DWG STAGE: PRE

CAD File : SGF18100-DWG-SK-014.dwg | PLOT SCALE : 1:1 | A1

ANNEXURE 4 – SITE PHOTOS















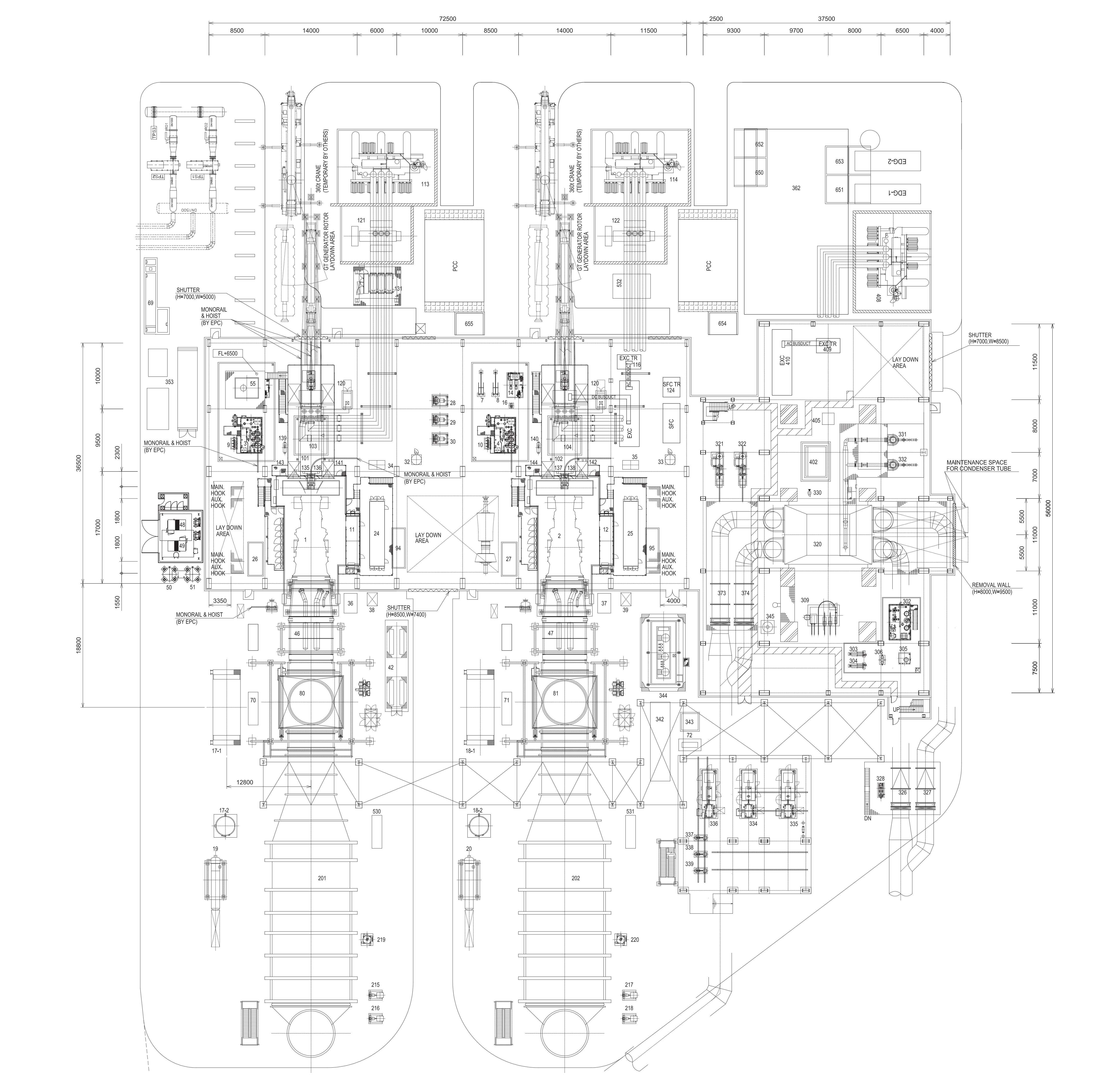
ANNEXURE 5 – EQUIPMENT LAYOUT OF THE PROPOSED FACILITY

Equipment Layout

NOTES:

1- SWITCHYARD AND GIB CONNECTING BETWEEN GENERATOR STEP UP TRANSFORMER AND SWITCHYARD ARE ON HOLD AND EXCLUDED FROM EPCC'S TECHNICAL AND COMMERCIAL OFFER UPON FURTHER INFORMATION FROM SEWA/EDF.

2- OFFSHORE STRUCTURE (INTAKE AND OUTFALL) CONCEPT DESIGN WILL BE DETAILED AFTER FURTHER INVESTIGATION.



LEGEND:

No.	EQUIPMENT LIST
1	NO.1 GAS TURBINE
2	NO.2 GAS TURBINE
3	NO.1 GT LUBE OIL RESERVOIR
4	NO.2 GT LUBE OIL RESERVOIR
5	NO.1 GT LUBE OIL COOLER (A) (NOT INDICATED)
6	NO.1 GT LUBE OIL COOLER (B) (NOT INDICATED)
7	NO.2 GT LUBE OIL COOLER (A)
8	NO.2 GT LUBE OIL COOLER (B)
9	NO.1 GT LUBE OIL ACCMULATOR
10	NO.2 GT LUBE OIL ACCMULATOR
11	NO.1 GT FUEL GAS UNIT
12	NO.2 GT FUEL GAS UNIT
13	NO.1 GT CONTROL OIL UNIT (NOT INDICATED)
14	NO.2 GT CONTROL OIL UNIT
15	NO.1 GT CONTROL OIL CLEANING UNIT (NOT INDICATED)
16	NO.2 GT CONTROL OIL CLEANING UNIT
17-1	NO.1 GT COOLING AIR COOLER (A)
17-2	NO.1 GT COOLING AIR COOLER (B)
18-1	NO.2 GT COOLING AIR COOLER (A)
18-2	NO.2 GT COOLING AIR COOLER (B)
19	NO.1 GT FUEL GAS HEATER
20	NO.2 GT FUEL GAS HEATER
24	NO.1 GT FUEL OIL UNIT
25	NO.2 GT FUEL OIL UNIT
26	NO.1 GT WATER INJECTION SKID
27	NO.2 GT WATER INJECTION SKID
28	GT PURGE AIR COMPRESSOR (A)
29	GT PURGE AIR COMPRESSOR (B)
30	GT PURGE AIR COMPRESSOR (C)
32	NO.1 GT PURGE AIR RECEIVER
33	NO.2 GT PURGE AIR RECEIVER
34	NO.1 GT CASING COOLING FAN
35	NO.2 GT CASING COOLING FAN
36	NO.1 GT FUEL GAS INLET FILTER SPACE
37	NO.2 GT FUEL GAS INLET FILTER SPACE
38	NO.1 GT FUEL OIL DRAIN TANK & PIT
39	NO.2 GT FUEL OIL DRAIN TANK & PIT
42	CO2 FIRE-FIGHTING SYSTEMS FOR GT (PACKAGE)
43	ELECTRICAL & CONTROL BUILDING FOR NO.1 GT & NO.2 GT
46	NO.1 GT EXHAUST DUCT
47	NO.2 GT EXHAUST DUCT
48	PLANT AIR COMPRESSOR (A)
49	PLANT AIR COMPRESSOR (B)
50	INS. AIR RECEIVER
51	SER. AIR RECEIVER
55	NO.1 GT LUBE OIL MIST SEPARATOR
56	NO.2 GT LUBE OIL MIST SEPARATOR (NOT INDICATED)
69	TRANS AREA OIL SEPARATOR
70	NO.1 GT FUEL GAS FLOW METER SPACE
71	NO.2 GT FUEL GAS FLOW METER SPACE
72	R-I/O PANEL
80	NO.1 GT BYPASS STACK
81	NO.2 GT BYPASS STACK
94	NO.1 GT MFOP UNIT
95	NO.2 GT MFOP UNIT
101	NO.1 GT GENERATOR
102	NO.2 GT GENERATOR
103	NO.1 GTG SEAL OIL SUPPLY UNIT
104	NO.2 GTG SEAL OIL SUPPLY UNIT
113	NO.1 GTG TRANSFORMER
114	NO.2 GTG TRANSFORMER
115	NO.1 GTG EXC. TRANSFORMER (NOT INDICATED)
116	NO.2 GTG EXC. TRANSFORMER
117	NO.1 GTG EXC. CUB. (NOT INDICATED)
118	NO.2 GTG EXC. CUB.
119	NO.1 GTG NGR CUB.
120	NO.2 GTG NGR CUB.

No.	EQUIPMENT LIST
121	NO.1 UNIT TR.
122	NO.2 UNIT TR.
123	SFC Tr. (A) (NOT INDICATED)
124	SFC Tr. (B)
127	SFC CUBICLE (A) (NOT INDICATED)
128	SFC CUBICLE (B)
131	NO.1 GTG GMCB
132	NO.2 GTG GMCB
135	NO.1 GTG COOLING WATER VALVE STATION (A)
136	NO.1 GTG COOLING WATER VALVE STATION (B)
137	NO.2 GTG COOLING WATER VALVE STATION (A)
138	NO.2 GTG COOLING WATER VALVE STATION (B)
139	NO.1 GTG LOOP SEALTANK
140	NO.2 GTG LOOP SEALTANK
141	NO.1 GTG WATER DETECTOR
142	NO.2 GTG WATER DETECTOR
143	NO.1 GTG VAPOR EXTRACTOR
144	NO.2 GTG VAPOR EXTRACTOR
201	NO.1 HEAT RECOVERY STEAM GENERATOR
202	NO.2 HEAT RECOVERY STEAM GENERATOR
215	NO.1 HRSG PREHEATER RECIRCULATION PUMP (A)
216	NO.1 HRSG PREHEATER RECIRCULATION PUMP (B)
217	NO.2 HRSG PREHEATER RECIRCULATION PUMP (A)
218	NO.2 HRSG PREHEATER RECIRCULATION PUMP (B)
219	NO.1 HRSG BLOW FLASH TANK
220	NO.2 HRSG BLOW FLASH TANK
302	ST LUBE OIL TANK
303	ST OIL COOLER (A)
304	ST OIL COOLER (B)
305	ST OIL PURIFIER
306	ST LUBE OIL FILTER
309	ST CONTROL OIL UNIT
320	CONDENSER
321	CONDENSER VACUUM PUMP (A)
322	CONDENSER VACUUM PUMP (B)
326	COND.TUBE CLEANING SYS. BALL STRAINER (A)
327	COND.TUBE CLEANING SYS. BALL STRAINER (B)
328	COND. TUBE CLEANING SYS. BALL COLLECTOR AND BALL RECIRCULATION PUMP
330	CONDENSER LEAK DETECTOR MONITORING PANEL
331	CONDENSATE EXTRACTION PUMP (A)
332	CONDENSATE EXTRACTION PUMP (B)
334	HP FEED WATER PUMP (A)
335	HP FEED WATER PUMP (B)
336	HP FEED WATER PUMP (C)
337	LP FEED WATER PUMP (A)
338	LP FEED WATER PUMP (B)
339	LP FEED WATER PUMP (C)
342	SAMPLING EQUIPMENT
343	ST BUILDING CHEMICAL DRAIN PIT
344	CHEMICAL DOSING EQUIPMENT
345	ST FLASH TANK
353	EMERGENCY D/G PACKAGE
362	COMMON ELECTRICAL & CONTROL BUILDING
373	DEBRIS FILTER (A)
374	DEBRIS FILTER (B)
402	STG SEAL OIL SUPPLY UNIT
405	STG GAS CONTROL UNIT
408	STG TRANSFORMER
409	STG EXC.TR.
410	STG EXC.CUB.
530	NO.1 BURNER SKID
531	NO.2 BURNER SKID
532	GT-01/GT-02 LOW VOLTAGE TRANSFORMER
650	10BFT10 MV-LV TRANSFORMER COMMON SERVICES 1
651	10BFT20 MV-LV TRANSFORMER COMMON SERVICES 2
652	10BFT71 MV-LV TRANSFORMER COMMON SERVICES 1
653	10BFT81 MV-LV TRANSFORMER COMMON SERVICES 2
654	11BFT10 MV-LV TRANSFORMER GT1
655	12BFT20 MV-LV TRANSFORMER GT2

PIPE RACK
SLEEPER
TRENCH

Rev.	Date	Name	Note
C	27-06-2018	M.M.T.	ISSUED FOR TENDER

Project: Layyah Power Station

Sharjah Electricity and Water Authority
Layyah Power Station
Sharjah U.A.E

Engineer: eDF

Contractor: ELSEWEDY POWER

	Date	Name
Drawn:	27-06-2018	M.M.T.
Checked:		

Supersedes:
Superseded by:
System:

Drawing Title: OVERALL PLANT LAYOUT

Scale: 1:600
Sheet: 2/2

Size: A0
Annex:
RFx No: 2131600070
File:
Document no.:

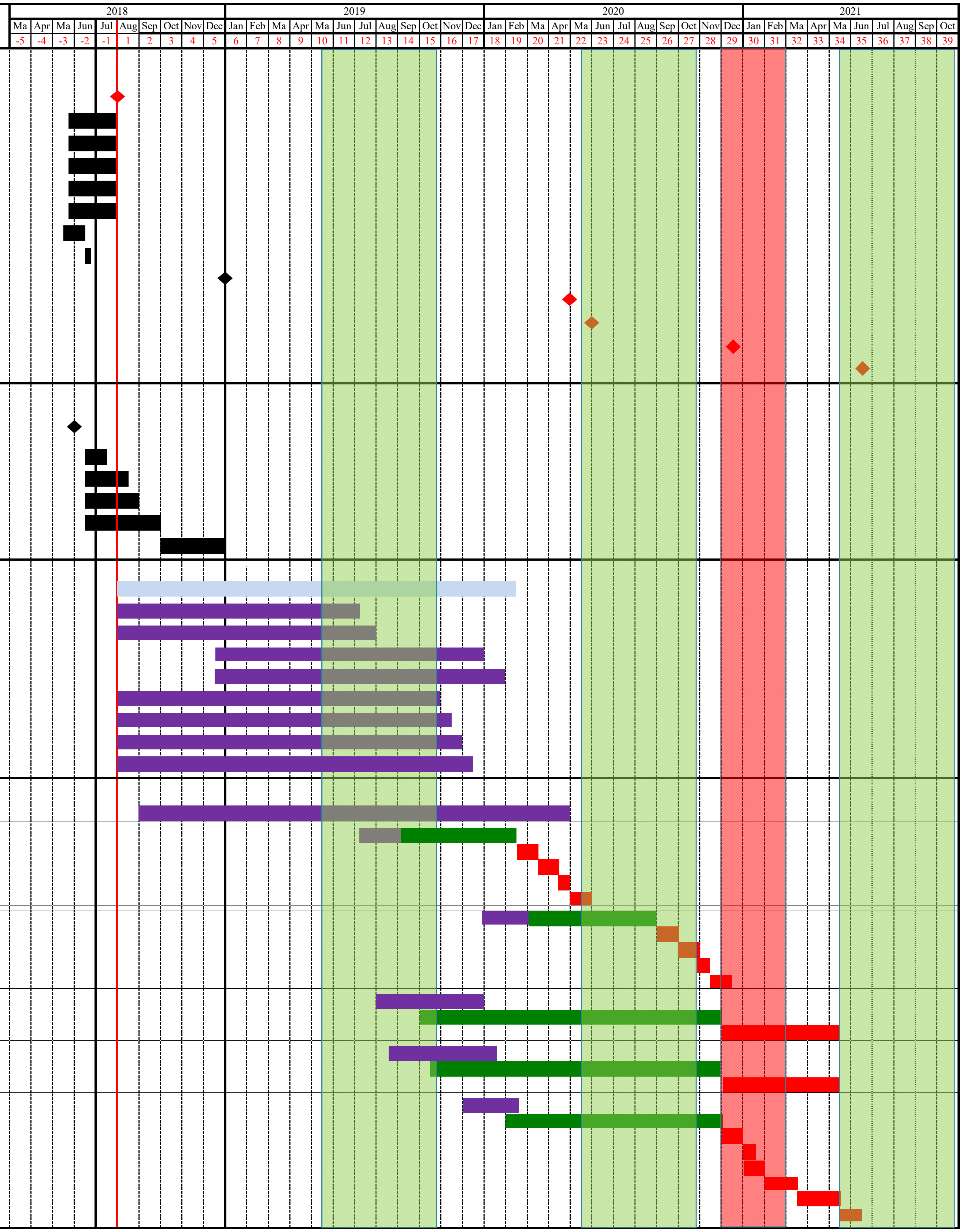
ANNEXURE 6 – PROJECT IMPLEMENTATION SCHEDULE

Project Implementation Schedule

ELSEWEDY POWER MHPS

SEWA Layyah Pre & Post LNTP Schedule (2018/05/28)

Activity Description	Dur. (Months)	Start	Finish
Target LNTP Date			**31-Jul-18**
EPC Contract Preparation		~	31-Jul-18
Limited Notice to Proceed Preparation		~	31-Jul-18
MFS・Technical Spec. Finalization		~	31-Jul-18
Subsupplier/Subcontractor List Finalization		~	31-Jul-18
Terms & Conditions of EPC Contract Finalization		~	31-Jul-18
Ramadan		17-May-18	15-Jun-18
SEWA visit in Japan		17-Jun-18	24-Jun-18
Expected Finance Close Date			31-Dec-18
GTG#1 S/C COD			1-May-20
GTG#1 30 days R/R Completion			1-Jun-20
GTG#2 S/C COD			15-Dec-20
C/C COD			15-Jun-21
Early Site Activities			
Owner Obligations / Approval (Authorization Letter From SEWA To ELSEWEDY)		31-May-18	
Topographical Survey	1	17-Jun-18	17-Jul-18
Geophysical & Soil Investigation	2	17-Jun-18	16-Aug-18
Meta Ocean Studies	2	1-Jul-18	30-Aug-18
Environmental Impact Assessment (ESIA) Study	3	17-Jun-18	30-Sep-18
JBIC/NEXI Environmental Due Diligence for Finance	3	30-Sep-18	31-Dec-18
Power Train Components (GTGs/STGs/HRSGs)			
Engineering	18.5	1-Aug-18	15-Feb-20
GT#1 Manufacturing & Procurement	11.2	1-Aug-18	7-Jul-19
GTG#1 Manufacturing & Procurement	12.0	1-Aug-18	31-Jul-19
GT#2 Manufacturing & Procurement	12.5	15-Dec-18	31-Dec-19
GTG#2 Manufacturing & Procurement	13.5	15-Dec-18	31-Jan-20
HRSG#1 Procurement	15.0	1-Aug-18	30-Oct-19
HRSG#2 Procurement	15.5	1-Aug-18	15-Nov-19
ST Manufacturing & Procurement	16.0	1-Aug-18	30-Nov-19
STG Manufacturing & Procurement	16.5	1-Aug-18	15-Dec-19
Auxilaries and BoP Procurement, Erection and Commissioning			
BOP RFQ Preparation, Procurement Cycle & Manufacturing	20	1-Sep-18	30-Apr-20
GT #11 Transportation & Installation	7	7-Jul-19	15-Feb-20
Interface & Lube Oil Flushing	1	16-Feb-20	16-Mar-20
Hot Commissioning Works	1	17-Mar-20	15-Apr-20
RTR Preparation Works	0.5	16-Apr-20	30-Apr-20
GT #1 S/C R/R (30days)	1	1-May-20	1-Jun-20
GT #12 Transportation & Installation	8	1-Jan-20	30-Aug-20
Interface & Lube Oil Flushing	1.0	1-Sep-20	1-Oct-20
Hot Commissioning Works	1.0	2-Oct-20	31-Oct-20
RTR Preparation Works	0.5	1-Nov-20	15-Nov-20
GT #12 S/C R/R (30days)	1	16-Nov-20	15-Dec-20
HRSG#11 Transportation	5	1-Aug-19	31-Dec-19
HRSG#11 Installation	14.0	1-Oct-19	1-Dec-20
HRSG#11 Commissioning	5.4	2-Dec-20	15-May-21
HRSG#12 Transportation	5	15-Aug-19	15-Jan-20
HRSG#12 Installation	13.5	15-Oct-19	30-Nov-20
HRSG#12 Commissioning	5.4	1-Dec-20	15-May-21
ST #10 Transportation	2.5	1-Dec-19	15-Feb-20
ST #10 Installation	10	1-Feb-20	30-Nov-20
Chemical Cleaning	1	1-Dec-20	31-Dec-20
Restoration After Chemical Cleaning	0.5	1-Jan-21	15-Jan-21
Combined Cycle Conversion (Outage)	1.0	1-Jan-21	31-Jan-21
Steam Blow & Restoration	1.4	1-Feb-21	15-Mar-21
Synch. Optimization and Performance Tests	2.0	16-Mar-21	14-May-21
C/C R/R (30 days)	1	15-May-21	15-Jun-21



Schedule legend

- Pre-Award Activities
- Engineering Activities
- Procurement Activities
- Erection Activities
- Startup and Commissioning Activities

ANNEXURE 7 – TOPOGRAPHIC SURVEY

Topographic Survey Report

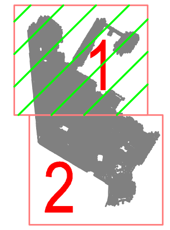
CAD FILE : \\Meseserver\mes\PROJECTS\ENVIRONMENTAL SOLUTIONS & CONSULTANCY\17013-LAYYAN-SHARJAH\Processed\REVISED REPORT-2\SURVEY_Rev2.dwg
PRINTED BY :GK -AUGUST/08/2018 - 6:24PM

LEGEND:

	BOLLARD FIRE		BRICK WALL
	BOLLARD TELEPHONE		BUILDING LINE
	BOLLARDS		BUILDING SHADE
	BUSH		CABLE TRAY
	CHEVRON		CAR PARK
	CONTROL CABIN		CENTRE LINE
	CONTROL CABIN ELECTRICITY		CONCRETE LINE
EP	EARTH PIT		CONSTRUCTION FENCE
	ELECTRIC TRANSFORMER		CONTAINER
	FIRE HYDRANT		CONTROL CABIN ELECTRICITY
	FLAG		DROP KERB
ET	MANHOLE ETISALAT		ELECTRICAL GATE
MHF	MANHOLE FIRE		FENCE
MHS	MANHOLE SEWER		FLUSH KERB
MHT	MANHOLE TELEPHONE		GUARD RAIL
MH	MANHOLE UNKNOWN CIRCULAR		GULLY LINE
MH	MANHOLE UNKNOWN SQUARE		HAND RAIL
MHW	MANHOLE WATER		HEEL KERB
	NORTH		KERB
	PALM TREE		KERB TOP
	PEDESTRIAN GATE		MARBLE LINE
	ROUTE MARKER GAS		MATERIALS
	SIDE ENTRY GULLY		MOTOR
	SIGN BOARD		PIPE
	SIGN BOARD SINGLE LEG		PLANT AREA
	SIGN BOARD SINGLE LEG		PORTABLE CABIN
	STREET LIGHT		SEWERAGE MANHOLE
	STREET LIGHT 4 LEAF		SHED
	STREET LIGHT DOUBLE		STEEL TRAY
	TELEPHONE KIOSK		STEPS
	TOP ENTRY GULLY		STOCK PILE
	TRAFFIC SIGN		TANK
	TRAFFIC SIGN SMALL		TILE LINE
	TRAFFIC SIGN TRIANGULAR		TRENCH LINE
	TREE		WALL
	VEHICULAR GATE		WASTE MATERIALS
	VENT		WATER TANK
	ASPHALT EDGE		WEIGH BRIDGE
	BARRIER		WOODEN FENCE
	BREAK LINE		YELLOW LINE
0.00	SPOT LEVELS KERB TOP	0.00	SPOT LEVELS
0.00	SPOT LEVELS TILE	0.00	SPOT LEVELS ASPHALT
0.00	CONCRETE LEVELS	0.00	SPOT LEVELS FLUSH KERB
0.00	GATE LEVELS	0.00	SPOT LEVELS HEEL KERB

0 10 20 50 1

FOR CONTINUATION REFER SHEET- 2



SHEET INDEX

NOTES

1. ALL DIMENSIONS AND CHAINAGES ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT CO-ORDINATES SYSTEM

- Map Projection : UTM 40 North
- Plan Datum : WGS 84
- Height Datum : Sharjah Town Planning & Survey Datum

SURVEY CONTROL STATIONS			
NAME	EASTING	NORTHING	ELEVATION
SS327	336090.410	2804871.604	5.616
SS326	335830.077	2804456.457	5.242

Rev.	By	Checked	Approved	Date	Description
2	SU	AR	AR	07.08.18	BENCHMARKS INCLUDED AND SURVEY UPDATED
1	SREE	AR	AR	29.07.18	COMMENTS UPDATED
–	SREE	AR	AR	24.07.18	ISSUED FOR APPROVAL

Project

Sharjah Electricity and Water Authority
Layyah Power Station
Sharjah U.A.E

Engineer:

eDF

Contractor

ELSEWEDY POWER

Consultant

Environmental Solutions and Consultancy

Surveyed By

Middle East Survey Engineering
PO BOX 34644
Dubai
U. A. E
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Email : info@middleeastsurvey.com
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Title

TOPOGRAPHIC SURVEY

SHEET 1 OF 2

Drawing No:	MES/17013/01	Revision	2
Drawing Scale:	1:800@A1		
Drawn by:	SREE	AUGUST 2018	

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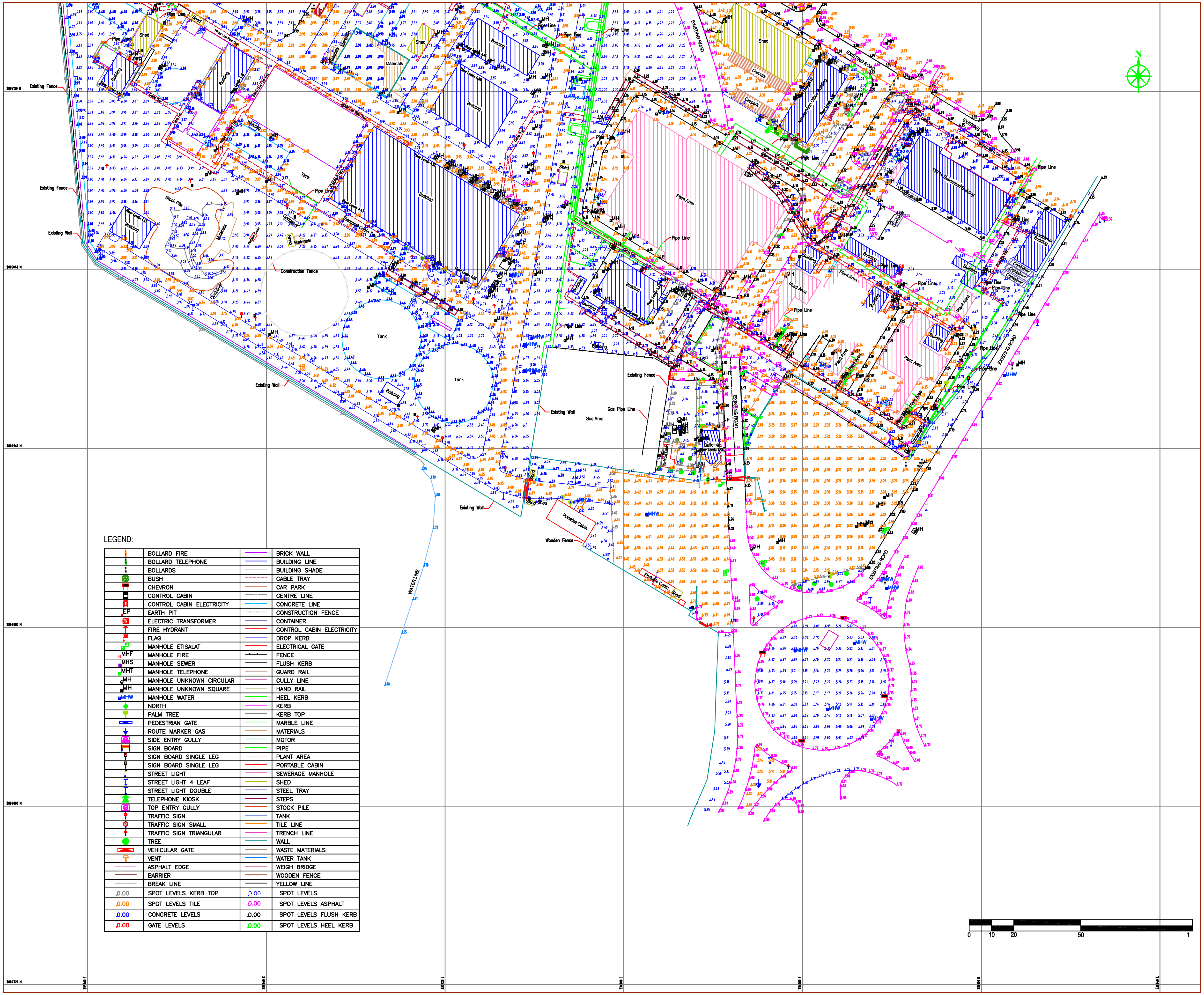
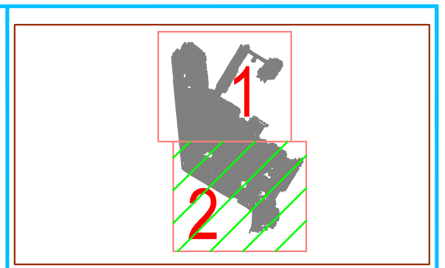


LEGEND:

	BOLLARD FIRE		BRICK WALL
	BOLLARD TELEPHONE		BUILDING LINE
	BOLLARDS		BUILDING SHADE
	BUSH		CABLE TRAY
	CHEVRON		CAR PARK
	CONTROL CABIN		CENTRE LINE
	CONTROL CABIN ELECTRICITY		CONCRETE LINE
EP	EARTH PIT		CONSTRUCTION FENCE
	ELECTRIC TRANSFORMER		CONTAINER
	FIRE HYDRANT		CONTROL CABIN ELECTRICITY
	FLAG		DROP KERB
ET	MANHOLE ETISALAT		ELECTRICAL GATE
MHF	MANHOLE FIRE		FENCE
MHS	MANHOLE SEWER		FLUSH KERB
MHT	MANHOLE TELEPHONE		GUARD RAIL
MH	MANHOLE UNKNOWN CIRCULAR		GULLY LINE
MH	MANHOLE UNKNOWN SQUARE		HAND RAIL
MHW	MANHOLE WATER		HEEL KERB
	NORTH		KERB
	PALM TREE		KERB TOP
	PEDESTRIAN GATE		MARBLE LINE
	ROUTE MARKER GAS		MATERIALS
	SIDE ENTRY GULLY		MOTOR
	SIGN BOARD		PIPE
	SIGN BOARD SINGLE LEG		PLANT AREA
	SIGN BOARD SINGLE LEG		PORTABLE CABIN
	STREET LIGHT		SEWERAGE MANHOLE
	STREET LIGHT 4 LEAF		SHED
	STREET LIGHT DOUBLE		STEEL TRAY
	TELEPHONE KIOSK		STEPS
	TOP ENTRY GULLY		STOCK PILE
	TRAFFIC SIGN		TANK
	TRAFFIC SIGN SMALL		TILE LINE
	TRAFFIC SIGN TRIANGULAR		TRENCH LINE
	TREE		WALL
	VEHICULAR GATE		WASTE MATERIALS
	VENT		WATER TANK
	ASPHALT EDGE		WEIGH BRIDGE
	BARRIER		WOODEN FENCE
	BREAK LINE		YELLOW LINE
0.00	SPOT LEVELS KERB TOP	0.00	SPOT LEVELS
0.00	SPOT LEVELS TILE	0.00	SPOT LEVELS ASPHALT
0.00	CONCRETE LEVELS	0.00	SPOT LEVELS FLUSH KERB
0.00	GATE LEVELS	0.00	SPOT LEVELS HEEL KERB



SHEET INDEX

NOTES

1. ALL DIMENSIONS AND CHAINAGES ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT CO-ORDINATES SYSTEM

- Map Projection : UTM 40 North
- Plan Datum : WGS 84
- Height Datum : Sharjah Town Planning & Survey Datum

SURVEY CONTROL STATIONS			
NAME	EASTING	NORTHING	ELEVATION
SS327	336090.410	2804871.604	5.616
SS326	335830.077	2804456.457	5.242

Rev.	By	Checked	Approved	Date	Description
2	SU	AR	AR	07.08.18	BENCHMARKS INCLUDED AND SURVEY UPDATED
1	SREE	AR	AR	29.07.18	COMMENTS UPDATED
–	SREE	AR	AR	24.07.18	ISSUED FOR APPROVAL

Project

Sharjah Electricity and Water Authority
Layyah Power Station
Sharjah U.A.E

Engineer:

eDF

Contractor

ELSEWEDY POWER

Consultant

Environmental Solutions and Consultancy

Surveyed By

Middle East Survey Engineering

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TOPOGRAPHIC SURVEY

SHEET 2 OF 2

Drawing No:	MES/17013/02	Revision	2
Drawing Scale:	1:800@A1		
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LEGEND:

	BOLLARD FIRE		BRICK WALL
	BOLLARD TELEPHONE		BUILDING LINE
	BOLLARDS		BUILDING SHADE
	BUSH		CABLE TRAY
	CHEVRON		CAR PARK
	CONTROL CABIN		CENTRE LINE
	CONTROL CABIN ELECTRICITY		CONCRETE LINE
EP	EARTH PIT		CONSTRUCTION FENCE
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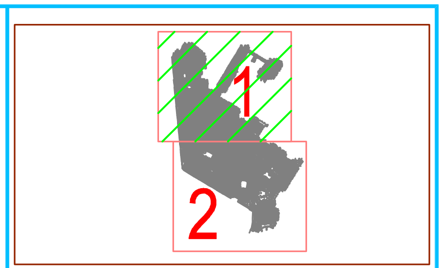
	TELEPHONE KIOSK		STEPS
	TOP ENTRY GULLY		STOCK PILE
	TRAFFIC SIGN		TANK
	TRAFFIC SIGN SMALL		TILE LINE
	TRAFFIC SIGN TRIANGULAR		TRENCH LINE
	TREE		WALL
	VEHICULAR GATE		WASTE MATERIALS
	VENT		WATER TANK
	ASPHALT EDGE		WEIGH BRIDGE
	BARRIER		WOODEN FENCE
	BREAK LINE		YELLOW LINE
0.00	SPOT LEVELS KERB TOP	0.00	SPOT LEVELS
0.00	SPOT LEVELS TILE	0.00	SPOT LEVELS ASPHALT
0.00	CONCRETE LEVELS	0.00	SPOT LEVELS FLUSH KERB
0.00	GATE LEVELS	0.00	SPOT LEVELS HEEL KERB



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SHEET 1 OF 2

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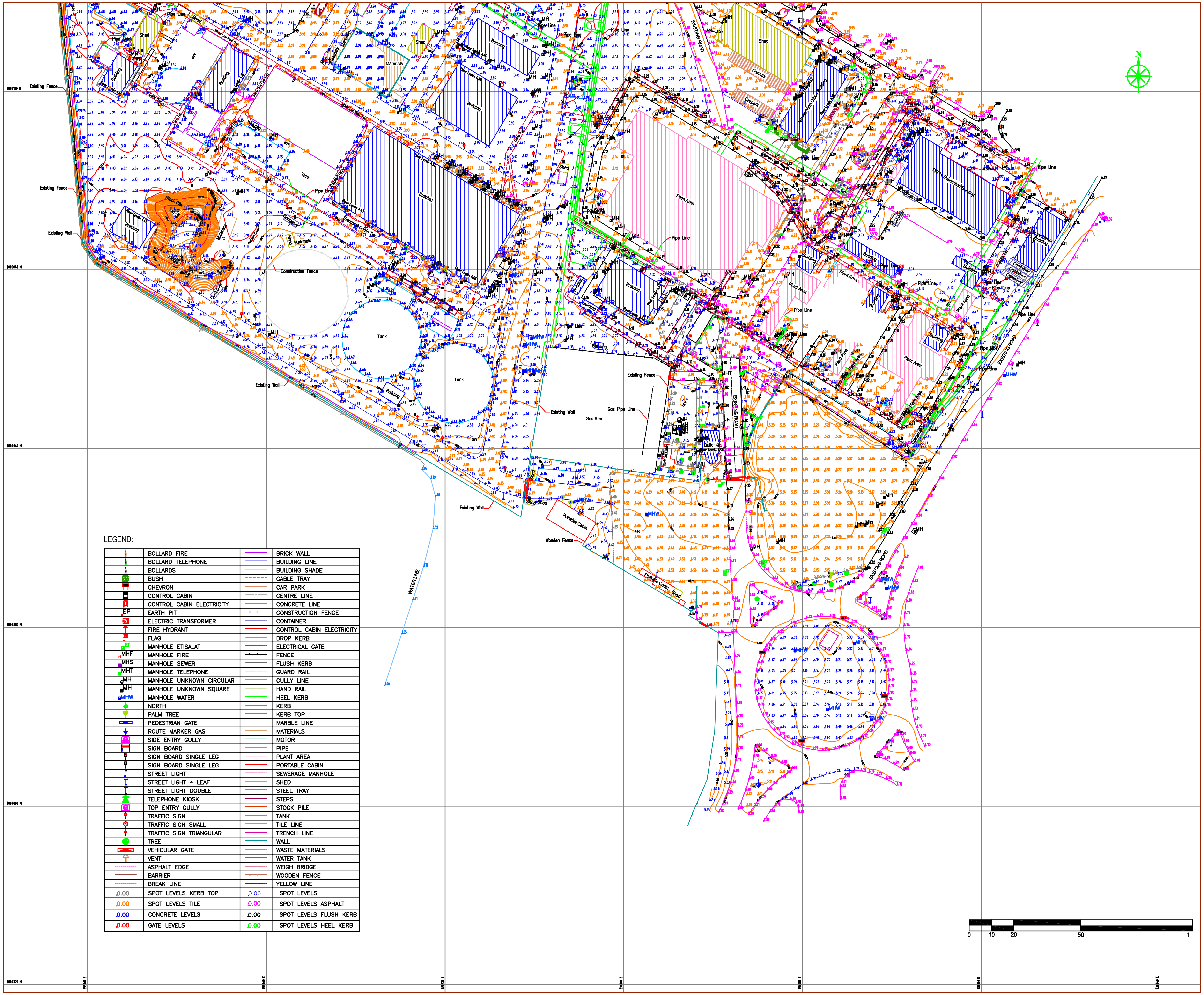

LEGEND:

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0.00	SPOT LEVELS TILE	0.00	SPOT LEVELS ASPHALT
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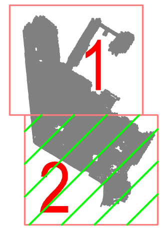

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SHEET 2 OF 2

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Drawn by:	SU	AUGUST 2018	

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ANNEXURE 8 – CLIMATE AND METEOROLOGY OF UAE REGION

Climate and Meteorology of UAE Region

CLIMATE AND METEOROLOGY OF UAE REGION

UAE is generally warm and dry in the winter, however during summer months coastal weather brings in humidity along with very high temperatures. Due to the presence of the Al Hajar al Gharbi Mountains in the proximity, high altitudes lead to generally cooler weather conditions. UAE climate can be broadly classified as two main seasons' summer and winter. Summers are between April to September with very dry weather conditions. Where in the temperature rise to about 48 degrees Centigrade in coastal cities – with accompanying humidity levels reaching as high as 90%. In the southern desert regions, temperatures can increase to as high as 50° Centigrade. Major part of the country is subject to violent dust storms with rainfall being infrequent and irregular. This report describes the typical weather at the **Sharjah International Airport** (Sharjah, United Arab Emirates) weather station (which is located at 12.5 km from project site on Eastern direction and **Dubai International Airport** weather station (which is located at 10 km from project site on Southern direction).

TEMPERATURE

The Arabian Gulf has substantial impact to the climate and temperature in project site due to the proximity to the coast. As like of project site, a large portion of Sharjah is located adjacent to coastal areas. The Arabian Gulf exerts a strong influence on Sharjah's climate, particularly in rainfall, humidity and surface wind characteristics. The temperature statistics of UAE - National Center of Meteorology and Seismology (NCMS) indicates that highest average temperature (Mean) observed in a specific month during 2003-2017 was recorded in July (it was 35.8°C) and lowest average temperature was recorded in January with 13°C. The monthly averages for minimum, maximum and average in 2017 was higher than these averages during 2003-2017 with average difference about 0.7 °C.

Data from National Center of Meteorology and Seismology (NCMS) during 2013-2017 for Sharjah International Airport and Dubai International Airport station is presented in **Table 1.**

Perusal on Sharjah International Airport (SIA) data, it indicates that lowest minimum absolute temperature (Min.) observed in a specific month during 2013 – 2017 was 5.2°C in January, 2013 and highest maximum absolute temperature (Max.) was 48.8°C in July, 2013. The lowest average temperature (Mean) observed in a specific month during 2013 – 2017 was 18.4°C in January, 2014 and highest average temperature was 37.7°C in July, 2017.

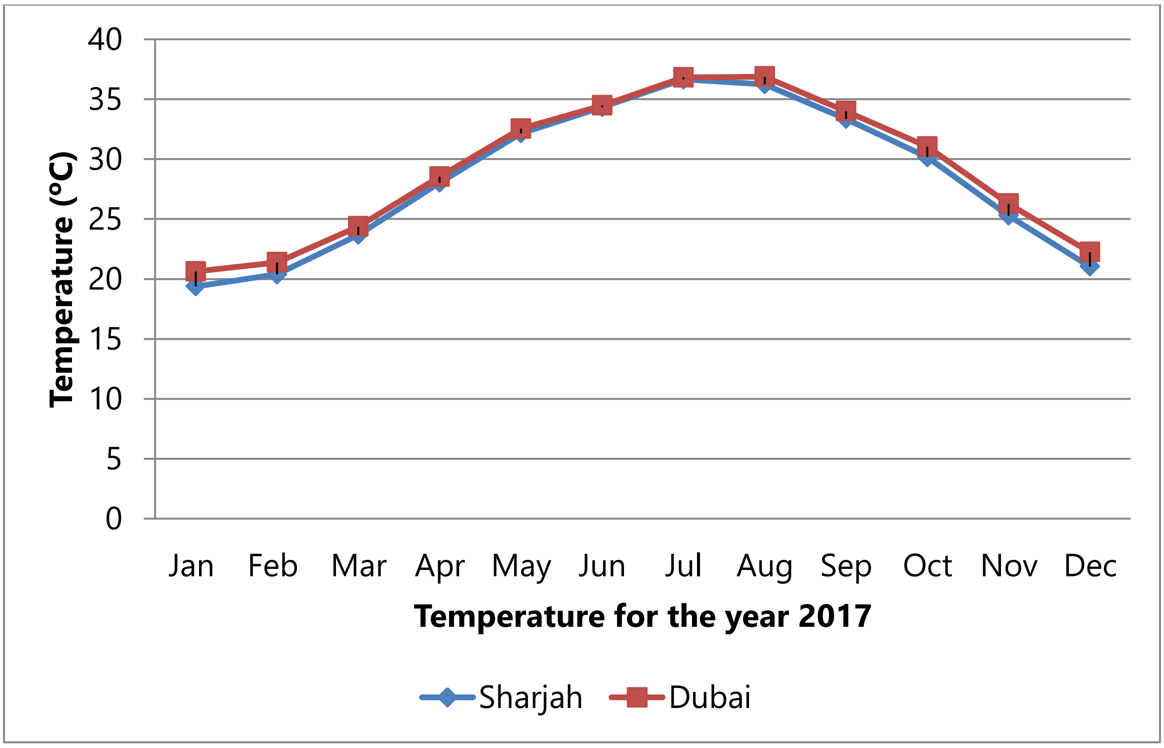

Figure 1 – Monthly Trend of Average Temperature (Mean) for the year 2017 at Sharjah International Airport and Dubai International Airport *(Source - NCMS)*

Perusal on Dubai International Airport data, lowest minimum absolute temperature observed in a specific month during 2013 – 2017 was 12.10°C in January, 2017 and highest maximum absolute temperature was 48.8°C in August, 2016. The lowest average temperature (Mean) observed in a specific month during 2013 – 2017 was 19.8°C in January, 2014 and highest average temperature was 38.3°C in August, 2016. The lowest mean of minimum temperature (Mean Min.) observed in a specific month during 2013 – 2017 was 15.9°C in January, 2013 and highest mean of maximum temperature (Mean Max.) was 44.1°C in August, 2016.

Table 1 – Min., Mean min., Mean, Mean max., and Maximum[1] of temperature (°C) during the years, 2013 – 2017 at Sharjah International Airport and Dubai International Airport station *(Source - NCMS)*

Year	Parameters	Months											
		Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Sharjah International Airport Station													
2013	**Min.**	5.2	8.9	12.8	16.1	22.0	22.7	28.4	28.4	24.0	20.7	16.0	9.1
	Mean Min.	12.8	14.4	16.7	21.6	24.0	27.2	31.0	30.8	27.9	24.0	19.5	15.4
	Mean	19.3	20.4	23.6	27.9	30.9	33.4	36.6	35.9	33.4	29.8	24.9	21.0
	Mean Max.	25.5	27.2	30.8	34.7	38.1	40.5	43.5	42.6	40.5	36.5	31.1	26.6
	Max.	30.1	32.0	36.7	40.8	44.5	43.9	48.8	45.3	44.1	40.2	37.7	31.8
2014	**Min.**	11.2	9.9	14.1	17.7	21.4	24.6	28.7	29.2	26.0	21.3	15.5	10.7
	Mean Min.	13.1	13.7	17.5	21.9	25.5	27.5	30.9	30.9	28.2	24.8	19.4	14.7
	Mean	18.4	19.4	23.4	29.0	32.4	34.1	36.4	35.9	33.7	31.0	25.0	21.0
	Mean Max.	23.8	25.6	29.7	36.4	39.3	41.7	43.2	42.6	40.9	37.5	30.7	27.2
	Max.	28.2	31.2	36.7	40.4	45.1	46.5	47.0	48.3	44.6	40.6	36.2	31.1
2015	**Min.**	9.9	11.5	10.5	18.0	17.6	25.7	26.2	28.0	23.2	19.7	18.0	9.3
	Mean Min.	13.0	16.2	17.1	21.3	25.4	29.1	30.5	30.4	27.2	24.5	21.0	15.1
	Mean	19.1	22.0	23.4	28.0	33.0	35.0	36.9	36.6	33.0	30.3	26.3	21.0
	Mean Max.	25.0	28.1	29.4	34.3	39.7	41.3	43.6	43.2	39.4	36.5	32.1	26.4
	Max.	30.1	35.6	38.0	41.0	44.0	47.9	47.5	47.0	44.0	40.8	36.1	32.9
2016	**Min.**	9.7	10.0	14.3	16.3	19.1	27.0	27.9	29.4	25.7	19.3	14.7	12.2

[1] *Min – Lowest minimum absolute temperature observed in a specific month; Mean Min – Average of minimum absolute temperature observed in a specific month; Mean – Average of daily temperature observed in a specific month; Mean Max – Average of maximum absolute temperature observed in a specific month; Max – Highest maximum absolute temperature observed in a specific month.*

Year	Parameters	Months											
		Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
	Mean Min.	14.1	14.0	18.6	20.1	25.4	32.0	31.2	25.3	28.2	23.9	19.2	16.2
	Mean	19.6	20.3	24.0	26.4	32.1	33.9	36.2	36.6	33.5	29.7	25.2	21.9
	Mean Max.	24.6	25.8	29.2	31.9	38.7	40.7	42.6	43.7	39.8	35.6	31.6	27.9
	Max.	30.9	33.4	37.3	39.9	43.9	44.5	46.1	48.5	44.0	39.2	34.8	31.9
2017	**Min.**	8.7	6.4	14.0	18.5	22.2	24.2	26.6	25.5	21.8	20.2	13.7	9.7
	Mean Min.	14.7	15.1	18.3	21.1	24.5	28.3	30.5	29.5	25.7	23.2	18.2	13.6
	Mean	20.5	19.8	24.0	28.9	32.4	35.3	37.2	36.2	33.2	30.0	25.0	20.3
	Mean Max.	26.0	24.5	30.0	37.2	40.7	42.5	44.5	43.3	41.2	37.3	31.6	27.0
	Max.	29.7	30.4	36.9	41.4	43.7	47.3	47.1	46.5	44.7	41.2	36.1	30.1
Dubai International Airport Station													
2013	**Min.**	12.1	14.0	16.1	17.6	22.4	24.3	29.2	30.4	25.5	24.3	18.4	13.5
	Mean Min.	16.6	17.2	19.6	23.9	25.8	28.4	32.6	32.5	30.2	26.6	22.4	18.2
	Mean	20.9	21.7	24.5	28.6	31.1	33.2	36.7	36.2	34.1	30.7	26.3	22.4
	Mean Max.	25.1	26.5	29.6	33.9	36.5	38.5	42.4	41.8	39.4	35.2	30.8	26.3
	Max.	30.0	31.8	36.1	40.1	43.0	42.5	48.5	44.7	44.6	39.7	38.0	31.7
2014	**Min.**	14.1	13.3	15.8	19.2	23.5	26.7	28.9	30.9	27.9	24.2	18.9	15.1
	Mean Min.	15.9	16.4	19.9	24.1	27.5	29.2	32.0	32.2	30.2	27.7	21.9	17.9
	Mean	19.8	20.6	24.1	29.3	32.6	34.1	36.2	35.9	34.1	31.8	26.1	22.6
	Mean Max.	23.6	25.0	28.9	35.0	38.4	40.4	41.3	41.2	39.7	36.6	29.9	26.7
	Max.	27.9	30.7	36.2	39.5	44.1	45.5	46.3	46.3	44.1	40.0	35.4	31.2
2015	**Min.**	12.5	15.5	15.0	18.1	22.5	28.6	30.1	31.2	25.9	25.4	19.0	15.4
	Mean Min.	16.5	19.3	20.5	23.1	28.1	30.8	33.1	33.6	30.4	27.8	23.0	18.4
	Mean	21.1	23.4	24.6	28.5	33.8	35.1	37.3	37.8	34.2	31.6	27.0	22.3
	Mean Max.	25.2	28.6	29.5	33.8	39.3	40.4	43.0	43.3	39.4	36.5	31.2	26.1
	Max.	30.1	35.8	38.0	41.1	44.7	47.9	47.1	47.3	43.5	40.2	36.2	30.8

Year	Parameters	Months											
		Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
2016	Min.	14.2	14.0	17.8	17.0	23.0	30.0	30.5	33.7	28.6	23.5	21.1	16.9
	Mean Min.	16.9	17.0	20.8	22.7	27.6	34.0	33.0	30.8	30.9	27.2	23.1	19.3
	Mean	20.8	21.4	24.7	27.4	32.8	34.7	36.7	38.3	34.4	31.1	27.0	23.6
	Mean Max.	24.6	25.6	29.0	32.0	38.4	40.6	42.5	44.1	39.5	35.2	31.3	27.8
	Max.	30.7	33.4	37.5	39.5	44.2	45.4	46.2	48.8	44.5	38.3	35.2	32.3
2017	Min.	15.4	11.4	17.7	20.1	25.4	27.2	30.9	30.6	26.5	24.5	19.8	15.8
	Mean Min.	18.2	17.5	21.1	25.5	28.2	30.8	34.0	33.0	30.5	27.1	22.8	18.1
	Mean	20.5	19.8	24.0	28.9	32.4	35.3	37.2	36.2	33.2	30.0	25.0	20.3
	Mean Max.	25.8	24.4	29.7	35.9	39.1	41.7	44.0	43.0	40.7	36.8	31.4	26.9
	Max.	29.3	30.4	37.2	41.0	42.9	46.3	47.3	46.2	44.7	41.1	35.6	30.1

RELATIVE HUMIDITY

The relative humidity statistics of UAE in 2017 indicates that highest value of mean maximum relative humidity in winter reached to 86% in January and the highest value of average relative humidity was 64% in January. The lowest value of the mean minimum was in summer months especially in June was 19% and this in consistent with high temperatures in summer.

Data from National Center of Meteorology and Seismology (NCMS) during 2013-2017 for Sharjah International Airport and Dubai International Airport station are presented in **Table 2.** The graphical representation of monthly trend of mean of relative humidity for the year, 2017 is presented in **Figure 2**.

Perusal on Sharjah International Airport (SIA) data on relative humidity, lowest minimum absolute relative humidity (Min.) observed in a specific month during 2013 – 2017 was 4% in October, 2014 and highest maximum absolute relative humidity (Max.) was 99% in the months of January to April, 2013 and March, 2016. The lowest value of mean minimum relative humidity (Mean Min.) observed in a specific month during 2013 – 2017 was 15% in May, 2015 and highest value of mean maximum relative humidity (Mean Max.) was 89% in February, 2013.

Perusal on Dubai International Airport data on relative humidity, lowest minimum absolute relative humidity during 2013 – 2017 was 4% in May, 2015 and highest maximum absolute relative humidity was 100% during winter season. The lowest value of mean minimum relative humidity observed in a specific month during 2013 – 2017 was 14% in July, 2016 and highest value of mean maximum relative humidity was 81% in January, 2015.

Table 2 – Min., Mean min., Mean max., and Maximum[2] of Relative Humidity (%) during the years, 2013 – 2017 at Sharjah International Airport and Dubai International Airport station

Year	Parameters	Months											
		Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Sharjah International Airport Station													
2013	Min.	7	16	10	9	9	10	8	17	13	18	19	20
	Mean Min.	38	35	30	24	24	28	27	28	28	32	37	38
	Mean Max.	87	89	83	72	70	76	67	69	74	82	81	84
	Max.	99	99	99	99	98	91	90	91	96	98	93	98
2014	Min.	8	18	12	5	11	7	16	10	8	4	16	13
	Mean Min.	51	48	48	37	35	37	37	38	39	33	38	42
	Mean Max.	82	84	88	82	75	78	77	80	82	74	69	75
	Max.	93	98	98	98	86	95	95	85	91	85	89	96
2015	Min.	18	10	7	8	6	5	9	6	10	14	15	26
	Mean Min.	33	28	26	24	15	23	17	18	24	28	30	41
	Mean Max.	83	74	75	70	57	65	62	58	74	76	71	79
	Max.	96	96	95	95	89	86	82	85	93	93	83	90
2016	Min.	11	18	16	12	10	11	14	7	19	12	11	22
	Mean Min.	43	36	36	27	23	24	33	18	34	35	38	44
	Mean Max.	84	83	85	71	62	70	70	66	81	79	79	87
	Max.	96	95	99	89	89	86	85	98	93	96	89	98

[2] *Min – Minimum absolute relative humidity by month; Mean Min – Mean of monthly minimum relative humidity; Max – Maximum absolute relative humidity by month; Mean Max – Mean of monthly maximum relative humidity.*

Year	Parameters	Months											
		Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
2017	**Min.**	7	21	16	7	10	7	6	9	6	15	11	12
	Mean Min.	41	42	36	22	22	26	21	23	21	28	30	36
	Mean Max.	84	81	81	69	70	76	66	72	78	88	76	82
	Max.	97	94	97	95	88	94	86	90	97	98	93	98
Dubai International Airport Station													
2013	**Min.**	16	14	10	8	9	7	7	13	14	18	14	18
	Mean Min.	38	35	31	24	25	30	27	25	29	34	34	38
	Mean Max.	78	80	76	65	66	73	64	63	68	74	71	73
	Max.	98	96	97	97	97	87	86	78	87	86	92	95
2014	**Min.**	25	16	6	6	10	7	11	15	7	9	13	11
	Mean Min.	43	36	36	22	21	23	28	30	26	27	36	37
	Mean Max.	76	78	79	70	65	75	72	73	78	70	67	75
	Max.	90	99	97	97	89	94	94	89	91	84	88	100
2015	**Min.**	16	9	7	7	6	4	8	6	11	14	16	21
	Mean Min.	35	29	29	27	15	25	18	17	24	30	30	39
	Mean Max.	81	72	75	73	53	64	60	54	70	72	65	70
	Max.	100	100	96	100	85	85	81	80	96	94	89	87
2016	**Min.**	10	12	12	11	9	10	11	7	15	14	10	19
	Mean Min.	41	35	34	25	23	22	26	14	30	34	36	41
	Mean Max.	75	75	76	64	57	61	65	52	72	69	68	79
	Max.	96	91	97	83	85	80	83	87	100	85	80	100
2017	**Min.**	20	24	13	6	12	10	6	10	6	13	12	12
	Mean Min.	43	40	33	22	23	27	20	22	21	30	29	37
	Mean Max.	74	71	71	57	63	68	58	63	72	79	65	73
	Max.	100	87	88	90	88	91	78	85	96	92	81	100

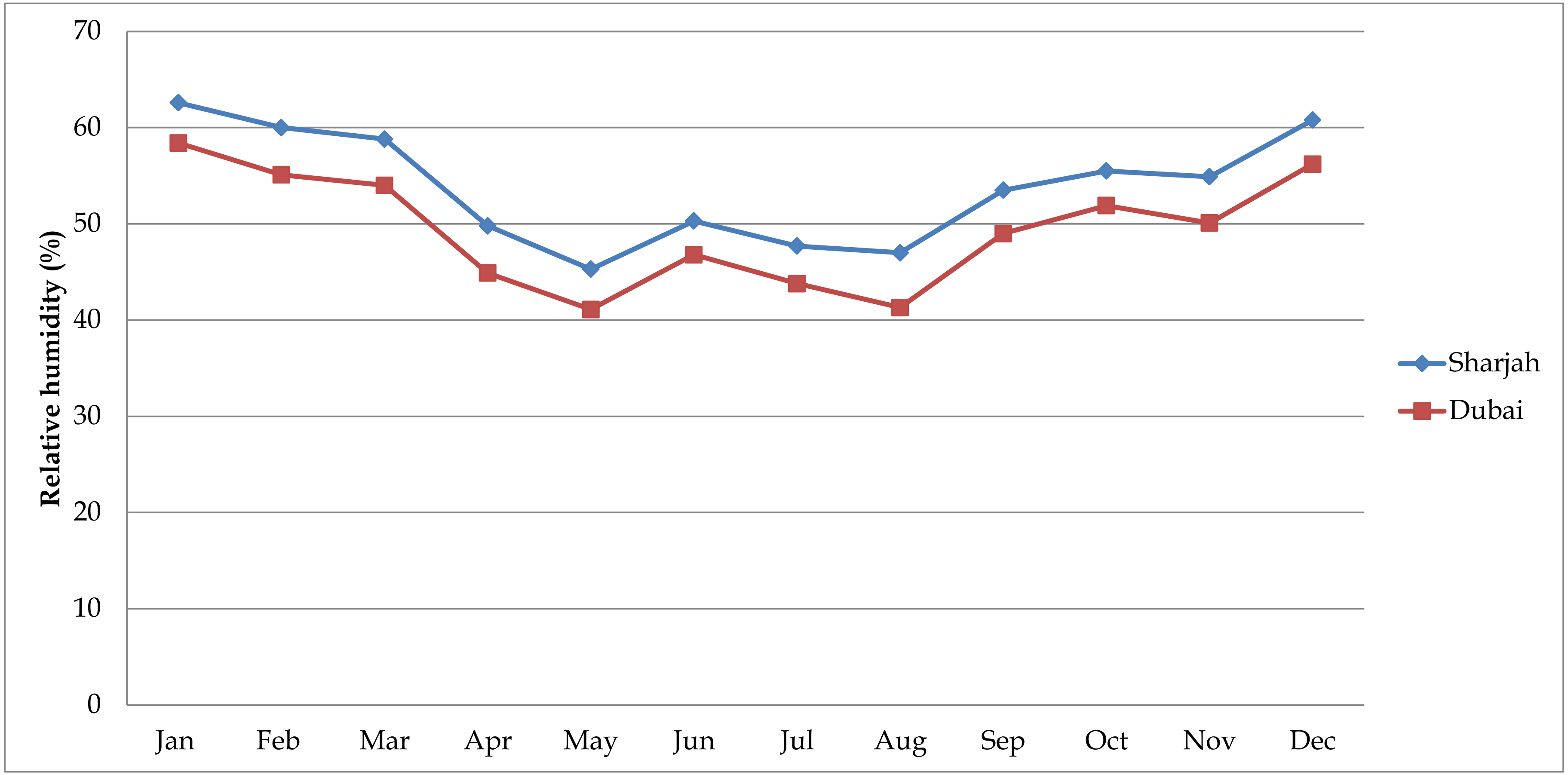

Figure 2 – Monthly Trend of average Relative Humidity (Mean) for the year 2017 at Sharjah International Airport and Dubai International Airport station

WIND SPEED AND WIND DIRECTION

The wind speed and wind direction for Sharjah International Airport is represented by wind rose diagram which is given in **Figure 3.** The wind rose diagram indicates that North-western directions, East, West & South-eastern are the most prevalent wind flowing directions. The average wind speed for the last 5 years is 7.5 miles per hour at Sharjah International Airport and 8.7 miles per hour at Dubai International Airport.

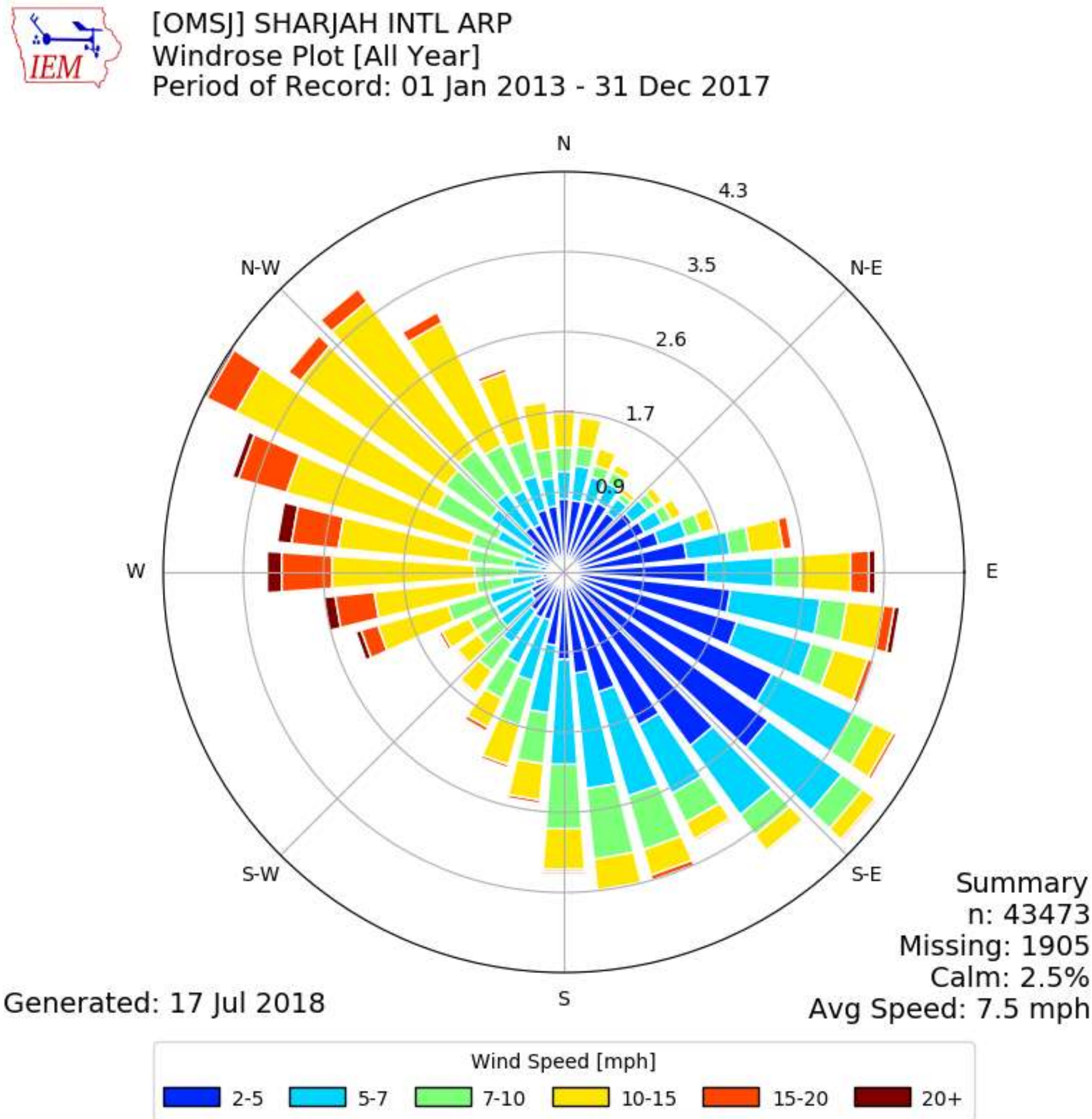

Figure 3 - Wind rose diagram of Sharjah International Airport for Jan. 2013 – Dec. 2017

(Source: Iowa Environmental Mesonet Web - http://mesonet.agron.iastate.edu/)

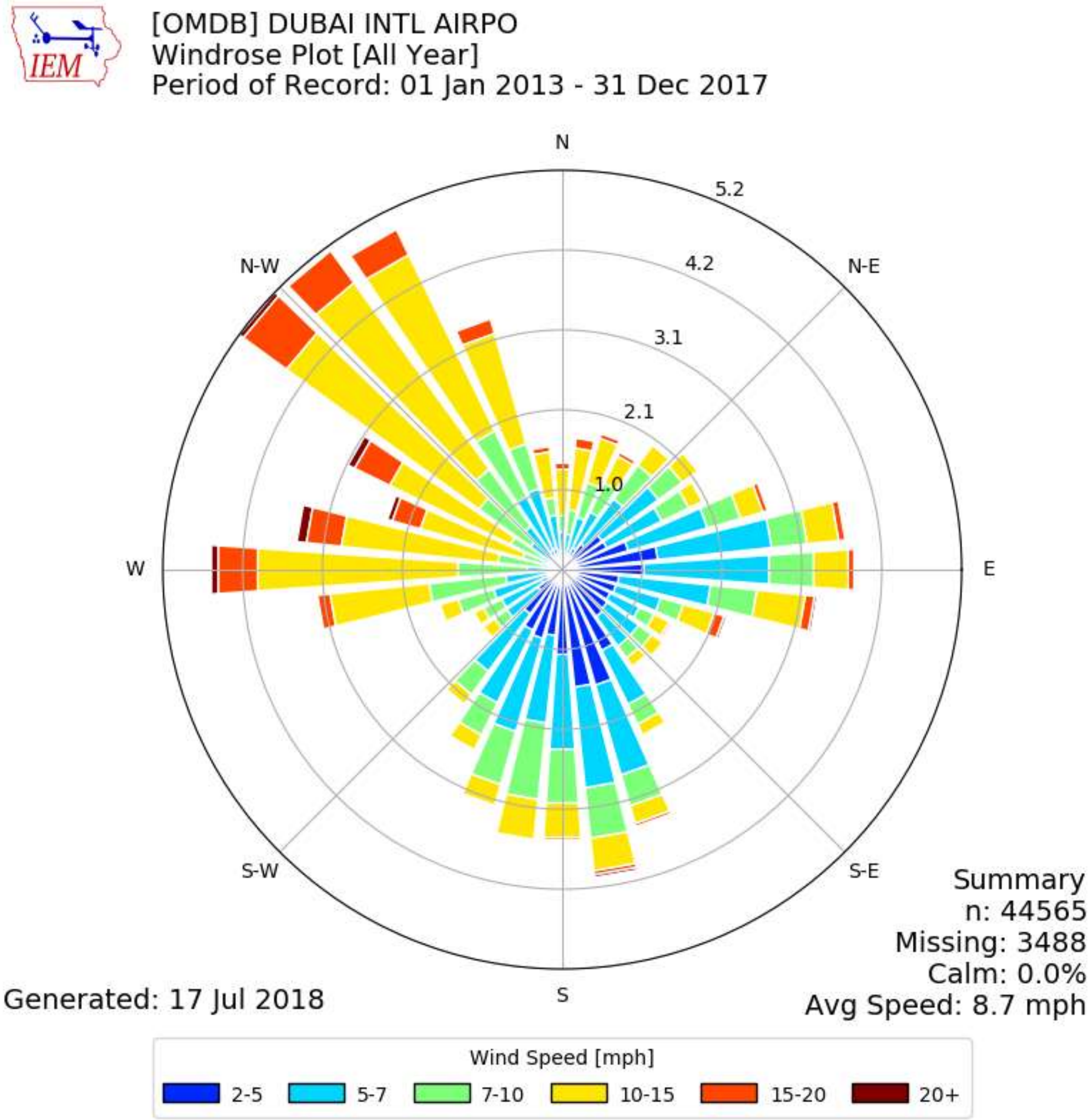

Figure 4 - Wind rose diagram of Dubai International Airport for Jan. 2013 – Dec. 2017

(Source: Iowa Environmental Mesonet Web - http://mesonet.agron.iastate.edu/)

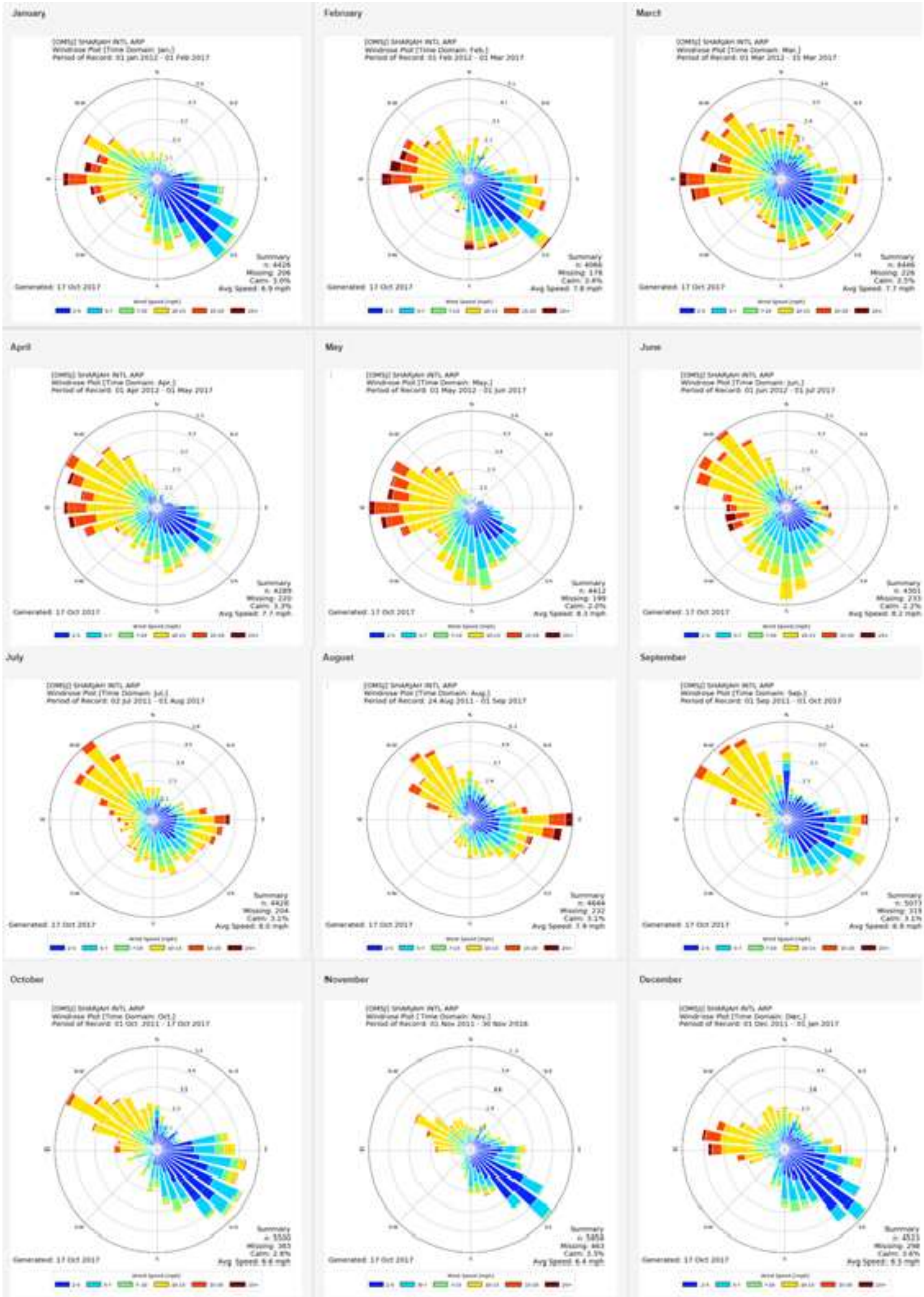

Figure 5 – Monthly wind rose diagram of Sharjah International Airport for the period of 2011-2017

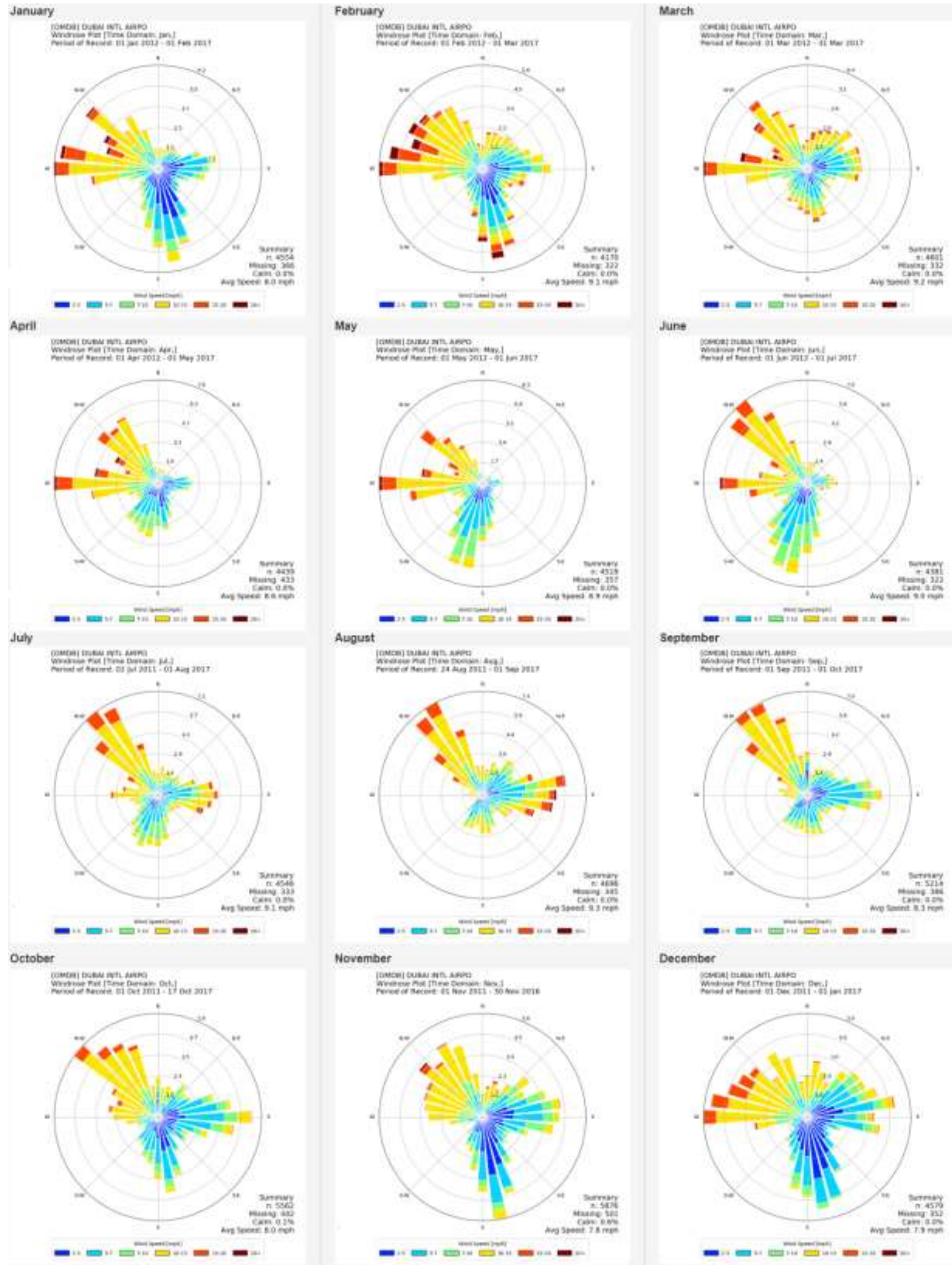

Figure 6 – Monthly wind rose diagram of Dubai International Airport for the period of 2011-2017

RAINFALL

The data on annual rainfall and number of rainy days recorded during 2007 – 2017 at Sharjah International Airport and Dubai International Airport station are presented in **Table 3.** Rainfall pattern is graphically presented in **Figure 7** and **Figure 8.**

Table 3 – Annual rainfall and number of rainy days in Sharjah and Dubai during 2007 – 2017

Years	Sharjah International Airport		Dubai International Airport Station	
	Rainfall (mm)	Rainy days	Rainfall (mm)	Rainy days
2007	13.6	20	7.68	15
2008	125.6	27	135.88	25
2009	135.5	32	107.79	31
2010	93.0	24	53.80	18
2011	18.4	21	23.91	19
2012	19.5	19	50.36	16
2013	85.9	23	55.09	18
2014	46.2	23	59.83	19
2015	49.9	14	32.86	13
2016	48.0	15	37.89	17
2017	61.7	31	62.10	31.00

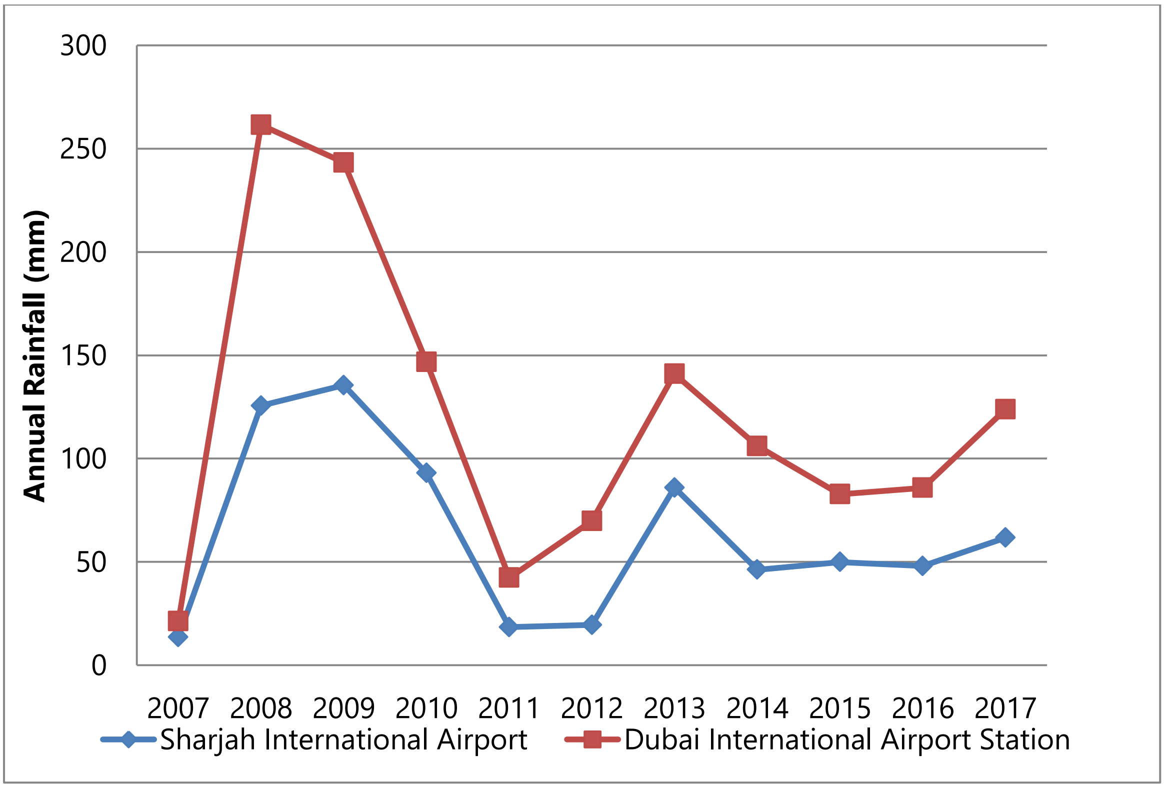

Figure 7 – Graphical representation of annual rainfall during 2007 - 2017

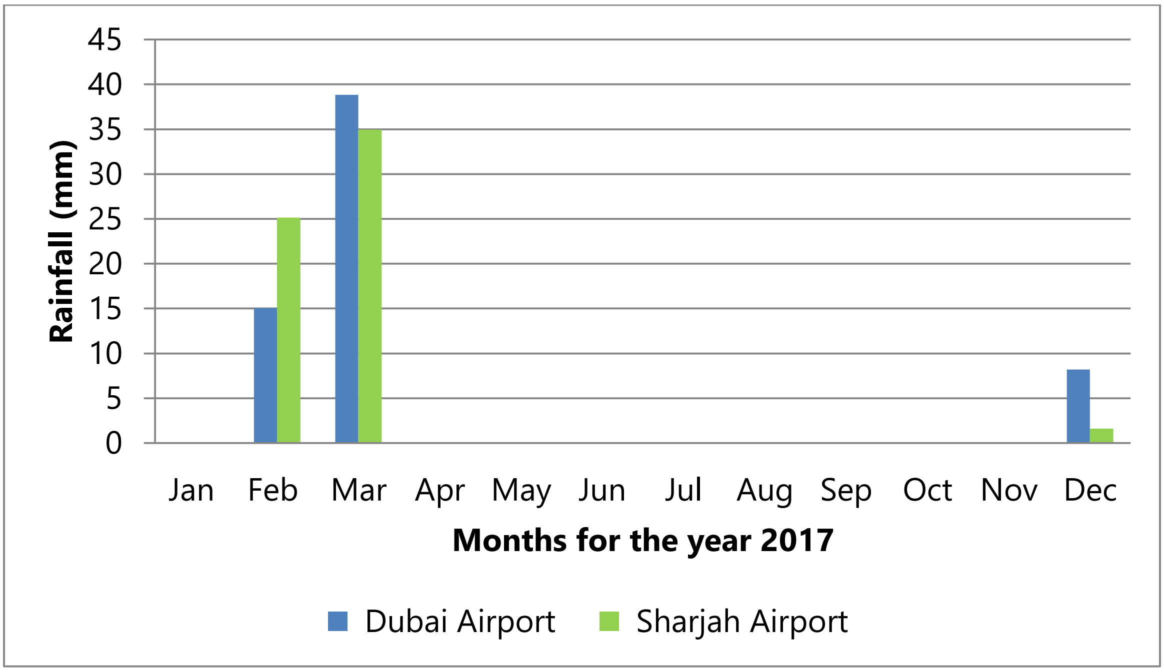

Figure 8 – Monthly rainfall pattern during 2017 at Sharjah and Dubai

The rainfall in the UAE is known in its fluctuation during 2007-2017 and there is variation in the average of rainfall from one area to another also. The higher level of rainfall received in Sharjah was 135.5mm during 2009, 135.88 in Dubai during 2008 when compared with last 11 years data (2007 – 2017).

SOLAR RADIATION

The daily average of solar radiation in Ajman and Dubai region are month-wisely presented in **Table 4.** There is no available data for Sharjah emirate from NCMS. Perusal on data recorded in Dubai international airport station, the highest value of average daily solar radiation was in May, 2016 (7,669 wh/m^2) and the lowest was in December, 2016 (3,179 wh/m^2). Perusal on data recorded in Ajman station, the highest value of average daily solar radiation was in May, 2014 (7,087wh/m^2) and the lowest was in December, 2016 (3,179 wh/m^2).

Table 4 – Month-wise daily average of solar radiation (wh/m^2) in Ajman and Dubai during 2013 – 2016

Year	Months											
	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
	Ajman Station											
2013	…	…	…	…	…	…	6,429	5,986	5,846	4,854	3,721	3,599
2014	3,400	4,505	5,219	6,580	7,087	6,712	5,715	5,140	4,655	4,055	4,318	3,806
2015	4,001	4,755	5,170	6,437	6,125	6,403	6,351	6,879	5,848	5,007	4,573	3,426
2016	3,714	4,844	4,909	6,114	6,966	6,377	6,384	6,209	5,625	4,874	3,621	3,179
2017	3,523	3,191	4,564	6,769	7,042	6,885	6,489	6,520	5,666	4,963	4,045	3,404
Dubai International Airport Station												
2013	4370	5296	6309	6228	7550	7397	7032	6356	6551	5742	4456	4393
2014	4157	5199	5793	7250	7016	7236	7034	6743	6198	5812	4924	4438
2015	4646	5301	5836	7059	7438	7419	6897	7097	6331	5644	4595	4133
2016	3758	5270	5302	6635	7669	7402	6816	6698	6091	5345	4416	4060
2017	4130	3339	4967	7072	7418	7460	7042	6866	6290	5535	4801	4021

….. Data not available

ANNEXURE 9 – BASELINE ENVIRONMENTAL SURVEY - REPORTS

Baseline Environmental Survey Reports – Terrestrial Environment

REPORT ON AIR QUALITY & NOISE MONITORING

FOR

ENVIRONMENTAL SOLUTIONS AND CONSULTANCY

SHARJAH

UNITED ARAB EMIRATES

By

Rak Lab

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Report No. : RP-245906-18 **Date: 09th July 2018**

Jo.No. : JO-262-14

PROPOSED TERRESTRIAL ENVIRONMENTAL SURVEY AT LAYYAH POWER SHARJAH UNITED ARAB EMIRATES

Report No. : RP-245906-18

Date: 09th July2018

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A	CALIBRATION CERTIFICATES	

Report No: RP-245906-18 *Date: 09th July2018*

1.0 INTRODUCTION

Environmental solution & consultancy has awarded the work of Air quality and Noise monitoring in **proposed terrestrial environmental survey at layyah power**. The test was carried out from 05th to 07th of July 2018 as per standard sampling and testing procedures.

2.0 AMBIENT AIR QUALITY

2.1 Objective

The objective of the tests was to estimate the following:

a) Total Suspended Particulate Matter (TSPM)
b) Respirable Suspended Particulate Matter (PM 10)
c) Sulfur Dioxide (SO_2)
d) Carbon Monoxide (CO)
e) Ozone (O_3)
f) Nitrogen Dioxide (NO_2)
g) Total Volatile organic compounds (TVOC)
h) Lead (Pb)

2.2 Test Methods

Air quality was monitored using a calibrated high flow-rate Respirable dust sampler (Model AAS 217 BL). The volumetric flow rates of the sampler were maintained at 0.9 - 1.4 m3/min for TSPM and RSPM parameters.

The sampling and analysis of air quality parameters was carried out in accordance with the procedures described in the relevant parts of **US EPA – eCFR, the United States Environment Protection Agency-electronic Code of Federal Regulations: Title 40: Part 50 and 53.**

Meteorological data of the day was collected using an Automatic Weather Station. Automatic Weather Station is a micro controller based weather station. All sensors (wind speed & direction, temperature, humidity, dew point and solar radiation) are attached with the data logger for the collection of real time data automatically.

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Gases quality was monitored using calibrated multi gases sensors(electro chemical , infrared , photo ionization detector)attached gas detectors (model- Gas Alert and Multi RAE Lite).The sensors is detecting the gases in different concentration. The sampling and analysis of gas monitoring was carried out in accordance with the procedures described in the relevant parts of **BSEN 60079-29-2; 2007, BSEN 45544-1; 2000 and BSEN 50271; 2010.**

2.3 Monitoring locations

The following locations were monitored for ambient air quality.

Table 2.3 Monitoring locations

Test Date	Monitoring Time (24 Hours)	Sample Number	Locations	GPS Co-ordinates
05 – 06 July 2018	11.45 – 11.45	SA-156441-18	AAQ 1	N 25°21'20.6" E 55°22'03.4"
06 – 07 July 2018	12.00 – 12.00	SA-156442-18	AAQ 2	N 25°21'20.4" E 55°22'18.6"
05 – 06 July 2018	11.30 – 11.30	SA-156443-18	AAQ 3	N 25°21'12.5" E 55°22'06.1"
06 – 07 July 2018	11.45 – 11.45	SA-156444-18	AAQ 4	N 25°21'18.9" E 55°22'22.2"

2.4 Results

2.4 (a) Average Meteorological Data

Tested Date	Temperature. Dry (°C)			Relative Humidity (%)			Wind Speed (m/s)	Wind Direction (°)	Solar Radiation (W/m²)	Dew point (°C)
	Max	Min.	Avg.	Max.	Min.	Avg.				
05 – 06 July 2018	44.28	33.0	38.53	79.15	23.52	51.57	1.2	144	455	25.82
06 – 07 July 2018	45.16	34.52	39.10	69.11	26.45	50.21	1.3	199	447	26.37

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Table 2.4 (b) Results

Parameters	Units	Sampling test method	Results				MoEW U.A.E Limits (Ref.1)
			AAQ 1	AAQ 2	AAQ 3	AAQ 4	
*Total Suspended Particulate Matter (TSPM)	µg/Nm³	USEPA eCFR Title 40 Part 50 and 53	217	204	223	196	**230**
*Respirable Suspended Particulate Matter (PM 10)			83	98	115	89	**150**
*Sulphur-dioxide (SO_2)	µg/Nm³	BSEN 60079-29 BSEN 50271;2010 BSEN 45544-1:2000	< 0.1	< 0.1	26.2	< 0.1	**150**
*Nitrogen Dioxide (NO_2)	µg/Nm³		18.8	< 0.1	18.8	< 0.1	**150**
*Carbon monoxide (CO)	µg/Nm³		< 1	< 1	< 1	< 1	**10000****
*Ozone (O_3)	µg/Nm³		58.9	78.5	78.5	58.9	**120****
*Total Volatile Organic Compounds (TVOC)	ppm		0.05	< 1	0.03	< 1	-
Lead (Pb)	ppm	ICP OES	< 0.01	< 0.01	< 0.01	< 0.01	-

Note 1: Ref1- Ministry of Environment and Water UAE
2: ppm-parts per million
3: *This test is accredited by ENAS (Emirates National Accreditation System) & GAC (GCC Accreditation Center)
4: **Indicates Limits for 8 Hrs. Monitoring (CO & O_3)

2.5. Equipment Details

Equipment Name	Equipment ID	Model	Make
Dust Sampler	RL-EN-01,04	AAS 217 BL	ECOTECH
Automatic Weather Station	RL-WE-01	AWS	ECOTECH
Gas detector	RL-GD-09,10	GAS ALERT MICRO 5	BWT
Gas detector	RL-GD-05,08	MULTIRAE LITE	RAE SYSTEMS
Gas detector	RL-GD-03	Drager Xam 5000	Drager
ICP OES	RL-ICP-01	700 series	Agilent Technologies

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2.6 Aerial View of Tested Locations.

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3.0 NOISE MONITORING

3.1 Test Method

Equivalent Continuous Sound Level was measured at site in A-weighting using calibrated integrating sound level meters manufactured by sinus tango and Casella. The measurement was according to the standard ISO 1996-2:2007.

Details of the instruments are listed below.

1. (a). Sinus Tango (Class 1), sound level meter.
   (b). Acoustic calibrator (Class 1)

2 (a) Casella 63 (Class 1), sound level meter.
   (b). Acoustic calibrator (Class 1)

The sound level meters exceed the minimum requirements of the following standards and organizations.

- IEC 61672-1 2002-5
- ANSI, S1.4 ;1983 , ANSI S1
- IEC 60651 ;1979
- IEC 60804 ;1985

The sound level meters hold valid calibration certificates issued by a qualified third party calibrating body. The meters were used in conjunction with on-site calibration equipment to ensure stability of performance.

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3.2 Monitoring locations

The following locations were monitored for noise

Table 3.2 Noise monitoring locations

Test date	Monitoring Time (Hours)	Sample number	Locations	Schedule
05 – 06 July 2018	11.00 – 11.00	SA-156445-18	ANQ 1	**24 Hours**
06 – 07 July 2018	11.30 – 11.30	SA-156446-18	ANQ 2	
05 – 06 July 2018	11.15 – 11.15	SA-156447-18	ANQ 3	
06 – 07 July 2018	11.30 – 11.30	SA-156448-18	ANQ 4	

3.3 Results

Table 3.3 Noise Monitoring Results

Locations	Day time					Night time				
	Duration (Hours)	Noise levels dB(A)			MoEW U.A.E LIMITS (ref1)	Duration (Hours)	Noise levels dB(A)			MoEW U.A.E LIMITS (ref1)
		Leq.	Lmax.	Lmin.			Leq.	Lmax.	Lmin.	
ANQ 1	**13 Hours**	69.7	89.5	56.4	**70**	**11 Hours**	65.4	75.8	52.9	**60**
ANQ 2		72.7	96.6	58.7			69.6	92.3	54.5	
ANQ 3		64.3	93.8	50.2			61.6	91.2	48.3	
ANQ 4		80.9	96.1	58.5			76.4	93.7	54.7	

Notes: 1: Ref1- Ministry of Environment and Water UAE
2: This test is accredited by ENAS (Emirates National Accreditation System) & GAC (GCC Accreditation Center)

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3.4 Equipment Details

Equipment Name	Equipment ID	Model	Make
Sound Level Meter	RL-DSM-06,07	Tango	sinus
Sound Level Meter	RL-DSM-05	Casella 63	Casella

4.0 PHOTOGRAPHS OF MONITORING

AIR QUALITY MONITORING

AAQ-1

AAQ-2

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AAQ-3

AAQ-4

NOISE MONITORING

ANQ-1

ANQ-2

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ANQ-3

ANQ-4

5 CONCLUSION

5.1 Ambient Air Quality

The levels of TSPM and PM10 measured, Concentrations of air pollutants Sulfur dioxide (SO_2), Nitrogen dioxide (NO_2), Ozone (O_3) and Carbon monoxide (CO) are below the limits of **MoEW** at the time of survey.

5.2 Ambient Noise Quality

In day time the noise level measured exceeds from the **MoEW** guidelines in location ANQ 2 and ANQ 4.
Night time noise level measured exceeds from the **MoEW** guidelines in all locations at the time of survey.

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ISO/IEC 17025:2005
ATL 0033

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REPORT ON CHEMICAL ANALYSIS OF WATER

Customer	: **ENVIRONMENTAL SOLUTIONS & CONSULTANCY**		
Address	: P.O Box 68595, Sharjah, U.A.E		
Contractor	: Not Applicable	Consultant	: Not Applicable
Project number	: Not Applicable	Client	: ENVIRONMENTAL SOLUTIONS & CONSULTANCY
Project name	: Baseline Terrestrial Environmental Survey @ Layyah Combined Cycled Thermal Power Plant	Project location	: Sharjah
Report number	: RP-247051-18	Report date	: 17/07/2018
Job order number	: JO-262-14	Date sample received	: 10/07/2018
Sample number	: SA-156300-18	Time sample received	: 08:00 Hrs
Sampling ref. #	: SC-25090-18	Sampling location	: Borehole#01 , Layyah Power Station
Sampling procedure ref.	: APHA 22nd Edition 2012/ Grab	Sampled by	: Rak lab representative
Sampling condition	: Normal	Sample brought in by	: Rak lab representative
Sampling date & time	: 09/07/2018,11:00 Hrs	Sampling method variation	: None
Sample description	: Water	Senders ref. #	: **LPO: ESC/EC/73**
Sample size	: 3 Ltr (Approximate)	Condition of sample	: Hazy
Source of sample	: Layyah Power Station		

Test Data

Date test started	: 10/07/2018	On Site Treatment	: ☐ Acid ☑ Transport in cool condition ☐ None
Date test completed	: 17/07/2018	Tested by	: NH/AH

Parameters		Test Methods	Units	Results
Temperature		APHA : 2250 : B	(°C)	29.2
Odour		APHA	-	Un Objectable
Color		APHA	Co/Pt	Normal
Oil & Grease		APHA : 5520 : B	mg/L	<5
Conductivity @ 25 °C		APHA : 2510 : B	µmhos/cm	5270
Turbidity		APHA 2130-B	NTU	7.75
pH at 25°C		APHA 4500-H^+ B	-	7.82
Total Suspended Solids	(TSS)	APHA 2540-D	mg/L	26
Total Dissolved Solids at 180°C	(TDS)	APHA 2540-C	mg/L	2820
Chemical Oxygen Demand	(COD)	APHA 5220-B	mg/L	128
Biochemical Oxygen Demand , 5 days @ 20°C	(BOD)	APHA 5210-B	mg/L	38
Chloride	(Cl)	APHA 4500-Cl^- B	mg/L	1524
Calcium	(Ca)	APHA 3500-Ca B	mg/L	58
Fluoride	(F)	APHA:4500:F D	mg/L	0.59
Phosphorus	(P)	APHA:4500:P C&E	mg/L	0.30
Sulfate	(SO_4)	APHA:4500:SO4 C&E	mg/L	95
Total Hardness as ($CaCO_3$)		APHA 2340-C/B	mg/L	365
Phenols		APHA:5530: C	mg/L	<0.02

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REPORT ON CHEMICAL ANALYSIS OF WATER

Customer : **ENVIRONMENTAL SOLUTIONS & CONSULTANCY**
Address : P.O Box 68595, Sharjah, U.A.E

Report number : RP-247051-18 Report date : 17/07/2018
Sample number : SA-156300-18 Job order number : JO-262-14

Parameters		Test Methods	Units	Results
Total Alkalinity		APHA 2320-B	mg/L	80
Magnesium	(Mg)	APHA:3500 :Mg B	mg/L	53.5
Total Nitrogen	(TN)	APHA:4500 :N B	mg/L	8

Metals (ICPOES)				
Sodium	(Na)	APHA 3120- B	mg/L	996
Potassium	(K)	APHA 3120- B	mg/L	24.01
Iron	(Fe)	APHA 3120-B	mg/L	0.05
Manganese	(Mn)	APHA 3120-B	mg/L	0.01
Chromium	(Cr)	APHA 3120-B	mg/L	<0.01
Copper	(Cu)	APHA 3120-B	mg/L	0.01
Lead	(Pb)	APHA 3120-B	mg/L	<0.01
Zinc	(Zn)	APHA 3120-B	mg/L	0.41
Nickel	(Ni)	APHA 3120-B	mg/L	<0.01
Cadmium	(Cd)	APHA 3120-B	mg/L	<0.01

APHA/AWWA/WEF: Standard Methods For the Examination of Water & Waste Water 22nd Edition 2012.

Test method variation : None
Remarks : None

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For RAK lab L.L.C., Ras Al Khaimah

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REPORT ON CHEMICAL ANALYSIS OF WATER

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Address	: P.O Box 68595, Sharjah, U.A.E		
Contractor	: Not Applicable	Consultant	: Not Applicable
Project number	: Not Applicable	Client	: ENVIRONMENTAL SOLUTIONS & CONSULTANCY
Project name	: Baseline Terrestrial Environmental Survey @ Layyah Combined Cycled Thermal Power Plant	Project location	: Sharjah
Report number	: RP-247050-18	Report date	: 17/07/2018
Job order number	: JO-262-14	Date sample received	: 05/07/2018
Sample number	: SA-155845-18	Time sample received	: 15:00 Hrs
Sampling ref. #	: SC-24984-18	Sampling location	: Borehole#02 , Layyah Power Station
Sampling procedure ref.	: APHA 22nd Edition 2012/ Grab	Sampled by	: Rak lab representative
Sampling condition	: Normal	Sample brought in by	: Rak lab representative
Sampling date & time	: 05/07/2018,11:30 Hrs	Sampling method variation	: None
Sample description	: Water	Senders ref. #	: **LPO: ESC/EC/73**
Sample size	: 3 Ltr (Approximate)	Condition of sample	: Hazy
Source of sample	: Layyah Power Station		

Test Data		On Site Treatment	: ☐ Acid ☑ Transport in cool condition ☐ None
Date test started	: 05/07/2018		
Date test completed	: 16/07/2018	Tested by	: NH/AH

Parameters		Test Methods	Units	Results
Temperature		APHA : 2250 : B	(°C)	28.0
Odour		APHA	-	Un Objectable
Color		APHA	Co/Pt	Normal
Oil & Grease		APHA : 5520 : B	mg/L	<5
Conductivity @ 25 °C		APHA : 2510 : B	µmhos/cm	1242
Turbidity		APHA 2130-B	NTU	1.64
pH at 25°C		APHA 4500-H^+ B	-	7.38
Total Suspended Solids	(TSS)	APHA 2540-D	mg/L	<5
Total Dissolved Solids at 180°C	(TDS)	APHA 2540-C	mg/L	602
Chemical Oxygen Demand	(COD)	APHA 5220-B	mg/L	24
Biochemical Oxygen Demand , 5 days @ 20°C	(BOD)	APHA 5210-B	mg/L	11
Chloride	(Cl)	APHA 4500-Cl^- B	mg/L	305
Calcium	(Ca)	APHA 3500-Ca B	mg/L	60
Fluoride	(F)	APHA:4500:F D	mg/L	0.79
Phosphorus	(P)	APHA:4500:P C&E	mg/L	0.01
Sulfate	(SO_4)	APHA:4500:SO4 C&E	mg/L	34
Total Hardness as ($CaCO_3$)		APHA 2340-C/B	mg/L	210
Phenols		APHA:5530: C	mg/L	<0.02

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REPORT ON CHEMICAL ANALYSIS OF WATER

Customer : **ENVIRONMENTAL SOLUTIONS & CONSULTANCY**

Address : P.O Box 68595, Sharjah, U.A.E

Report number : RP-247050-18
Sample number : SA-155845-18
Report date : 17/07/2018
Job order number : JO-262-14

Parameters		Test Methods	Units	Results
Total Alkalinity		APHA 2320-B	mg/L	38
Magnesium	(Mg)	APHA:3500 :Mg B	mg/L	14.6
Total Nitrogen	(TN)	APHA:4500 :N B	mg/L	3

Metals (ICPOES)				
Sodium	(Na)	APHA 3120- B	mg/L	146
Potassium	(K)	APHA 3120- B	mg/L	7.51
Iron	(Fe)	APHA 3120-B	mg/L	0.07
Manganese	(Mn)	APHA 3120-B	mg/L	0.09
Chromium	(Cr)	APHA 3120-B	mg/L	<0.01
Copper	(Cu)	APHA 3120-B	mg/L	0.01
Lead	(Pb)	APHA 3120-B	mg/L	<0.01
Zinc	(Zn)	APHA 3120-B	mg/L	1.18
Nickel	(Ni)	APHA 3120-B	mg/L	<0.01
Cadmium	(Cd)	APHA 3120-B	mg/L	<0.01

APHA AWWA WEF: Standard Methods For the Examination of Water & Waste Water 22nd Edition 2012.

Test method variation : None
Remarks : None

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REPORT ON CHEMICAL ANALYSIS OF SOIL

Customer : **ENVIRONMENTAL SOULTIONS & CONSULTANCY**
Address : P.O. Box 68595, 408, Sarah Shopping Mall, Rolla Bank Street, Sharjah, United Arab Emirates

Contractor	: Not Applicable	Consultant	: Not Applicable
Project number	: Not Applicable	Client	: SEWA
Project name	: Baseline Terrestrial Environmental Survey @ Layyah Combined Cycled Thermal Power Plant	Project location	: Sharjah
Report number	: RP-247057-18	Report date	: 17/07/2018
Job order number	: JO-262-14	Date sample received	: 08/07/2018
Sample number	: SA-155851-18	Time sample received	: 17:00 Hrs
Sampling ref. #	: SC-24990-18	Sampling location	: SQ6
Sampling procedure ref.	: ASTM D75/D75 M -14	Sampled by	: Rak Lab representative
Sampling condition	: Normal	Sample brought in by	: Rak Lab representative
Sampling date & time	: 08/07/2018 , 13:00 Hrs	Sampling method variation	: None
Sample description	: Soil	Senders ref. #	: **N#252117.52 E#55228.44**
Sample size	: 10 kg (Approximate)		
Source of sample	: Not Given	Condition of sample	: Moist

Test Data

Date test started	: 09/07/2018	Date test completed	: 16/07/2018
Tested by	: NH/AH/SC*		

PARAMETERS			UNITS	RESULTS
Moisture		-	**% by weight**	**0.88**
pH @ 25°C		**Saturated Extract**	-	**7.07**
Conductivity @ 25°C		**Saturated Extract**	**µmhos/cm**	**41250**
Chloride	**(Cl)**	-	**mg/kg**	**1347**
Total Alkalinity		-	**mg/kg**	**28**
Total Nitrogen	**(TN)**	-	**mg/kg**	**250**
Phosphate	**(PO_4)**	-	**mg/kg**	**0.9**
***Total Petroleum Hydrocarbons**		-		**<0.01**
Potassium	**(K)**	**Saturated Extract**	**mg/kg**	**97.84**
Nickel	**(Ni)**	**Saturated Extract**	**mg/kg**	**<0.01**
Arsenic	**(As)**	**Saturated Extract**	**mg/kg**	**<0.01**
Copper	**(Cu)**	**Saturated Extract**	**mg/kg**	**<0.01**
Iron	**(Fe)**	**Saturated Extract**	**mg/kg**	**<0.01**
Zinc	**(Zn)**	**Saturated Extract**	**mg/kg**	**<0.01**
Manganese	**(Mn)**	**Saturated Extract**	**mg/kg**	**<0.01**
***Mercury**	**(Hg)**	**Saturated Extract**	**mg/kg**	**<0.001**
Lead	**(Pb)**	**Saturated Extract**	**mg/kg**	**<0.01**
Cadmium	**(Cd)**	**Saturated Extract**	**mg/kg**	**<0.01**
Chromium	**(Cr)**	**Saturated Extract**	**mg/kg**	**<0.01**
Selenium	**(Se)**	**Saturated Extract**	**mg/kg**	**<0.01**
Barium	**(Ba)**	**Saturated Extract**	**mg/kg**	**0.24**

Test methods : 1. BS 1377 - 3: 1990
2. APHA 22nd : 2012
3. EPA 8015 ,3350C

Test method variation : None
Remarks : None

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REPORT ON CHEMICAL ANALYSIS OF SOIL

Customer : **ENVIRONMENTAL SOULTIONS & CONSULTANCY**

Address : P.O. Box 68595, 408, Sarah Shopping Mall, Rolla Bank Street, Sharjah, United Arab Emirates

Contractor	: Not Applicable	Consultant	: Not Applicable
Project number	: Not Applicable	Client	: SEWA
Project name	: Baseline Terrestrial Environmental Survey @ Layyah Combined Cycled Thermal Power Plant	Project location	: Sharjah
Report number	: RP-247056-18	Report date	: 17/07/2018
Job order number	: JO-262-14	Date sample received	: 08/07/2018
Sample number	: SA-155850-18	Time sample received	: 17:00 Hrs
Sampling ref. #	: SC-24989-18	Sampling location	: SQ5
Sampling procedure ref.	: ASTM D75/D75 M -14	Sampled by	: Rak Lab representative
Sampling condition	: Normal	Sample brought in by	: Rak Lab representative
Sampling date & time	: 08/07/2018 , 12:40 Hrs	Sampling method variation	: None
Sample description	: Soil	Senders ref. #	: **N#252115.23 E#55228.10**
Sample size	: 10 kg (Approximate)		
Source of sample	: Not Given	Condition of sample	: Moist

Test Data

Date test started	: 09/07/2018	Date test completed	: 16/07/2018
Tested by	: NH/AH/SC*		

PARAMETERS			UNITS	RESULTS
Moisture		-	**% by weight**	**0.56**
pH @ 25°C		**Saturated Extract**	-	**7.42**
Conductivity @ 25°C			**µmhos/cm**	**12450**
Chloride	**(Cl)**	-	**mg/kg**	**3758**
Total Alkalinity			**mg/kg**	**24**
Total Nitrogen	**(TN)**		**mg/kg**	**30**
Phosphate	**(PO_4)**		**mg/kg**	**0.9**
***Total Petroleum Hydrocarbons**				**<0.01**
Potassium	**(K)**	**Saturated Extract**	**mg/kg**	**80.79**
Nickel	**(Ni)**		**mg/kg**	**<0.01**
Arsenic	**(As)**		**mg/kg**	**<0.01**
Copper	**(Cu)**		**mg/kg**	**<0.01**
Iron	**(Fe)**		**mg/kg**	**<0.01**
Zinc	**(Zn)**		**mg/kg**	**0.02**
Manganese	**(Mn)**		**mg/kg**	**<0.01**
***Mercury**	**(Hg)**		**mg/kg**	**<0.001**
Lead	**(Pb)**		**mg/kg**	**<0.01**
Cadmium	**(Cd)**		**mg/kg**	**<0.01**
Chromium	**(Cr)**		**mg/kg**	**<0.01**
Selenium	**(Se)**		**mg/kg**	**<0.01**
Barium	**(Ba)**		**mg/kg**	**0.08**

Test methods : 1. BS 1377 - 3: 1990
2. APHA 22nd : 2012
3. EPA 8015 , 3350C

Test method variation : None

Remarks : None

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REPORT ON CHEMICAL ANALYSIS OF SOIL

Customer	: **ENVIRONMENTAL SOULTIONS & CONSULTANCY**		
Address	: P.O. Box 68595, 408, Sarah Shopping Mall, Rolla Bank Street, Sharjah, United Arab Emirates		
Contractor	: Not Applicable	Consultant	: Not Applicable
Project number	: Not Applicable	Client	: SEWA
Project name	: Baseline Terrestrial Environmental Survey @ Layyah Combined Cycled Thermal Power Plant	Project location	: Sharjah
Report number	: RP-247055-18	Report date	: 17/07/2018
Job order number	: JO-262-14	Date sample received	: 08/07/2018
Sample number	: SA-155849-18	Time sample received	: 17:00 Hrs
Sampling ref. #	: SC-24988-18	Sampling location	: SQ4
Sampling procedure ref.	: ASTM D75/D75 M -14	Sampled by	: Rak Lab representative
Sampling condition	: Normal	Sample brought in by	: Rak Lab representative
Sampling date & time	: 08/07/2018 , 12:15 Hrs	Sampling method variation	: None
Sample description	: Soil	Senders ref. #	: **N#252116.96 E#55226.21**
Sample size	: 10 kg (Approximate)		
Source of sample	: Not Given	Condition of sample	: Moist

Test Data

Date test started	: 09/07/2018	Date test completed	: 16/07/2018
Tested by	: NH/AH/SC*		

PARAMETERS			UNITS	RESULTS
Moisture		-	% by weight	0.46
pH @ 25°C		Saturated Extract	-	7.63
Conductivity @ 25°C		Saturated Extract	µmhos/cm	8610
Chloride	(Cl)	-	mg/kg	2623
Total Alkalinity		-	mg/kg	32
Total Nitrogen	(TN)	-	mg/kg	33
Phosphate	(PO_4)	-	mg/kg	0.6
*Total Petroleum Hydrocarbons		-		<0.01
Potassium	(K)	Saturated Extract	mg/kg	69.27
Nickel	(Ni)	Saturated Extract	mg/kg	<0.01
Arsenic	(As)	Saturated Extract	mg/kg	<0.01
Copper	(Cu)	Saturated Extract	mg/kg	<0.01
Iron	(Fe)	Saturated Extract	mg/kg	<0.01
Zinc	(Zn)	Saturated Extract	mg/kg	<0.01
Manganese	(Mn)	Saturated Extract	mg/kg	<0.01
*Mercury	(Hg)	Saturated Extract	mg/kg	<0.001
Lead	(Pb)	Saturated Extract	mg/kg	<0.01
Cadmium	(Cd)	Saturated Extract	mg/kg	<0.01
Chromium	(Cr)	Saturated Extract	mg/kg	<0.01
Selenium	(Se)	Saturated Extract	mg/kg	<0.01
Barium	(Ba)	Saturated Extract	mg/kg	0.04

Test methods : 1. BS 1377 - 3: 1990
2. APHA 22nd : 2012
3. EPA 8015 , 3350C

Test method variation : None
Remarks : None

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REPORT ON CHEMICAL ANALYSIS OF SOIL

Customer	: **ENVIRONMENTAL SOULTIONS & CONSULTANCY**		
Address	: P.O. Box 68595, 408, Sarah Shopping Mall, Rolla Bank Street, Sharjah, United Arab Emirates		
Contractor	: Not Applicable	Consultant	: Not Applicable
Project number	: Not Applicable	Client	: SEWA
Project name	: Baseline Terrestrial Environmental Survey @ Layyah Combined Cycled Thermal Power Plant	Project location	: Sharjah
Report number	: RP-247054-18	Report date	: 17/07/2018
Job order number	: JO-262-14	Date sample received	: 08/07/2018
Sample number	: SA-155848-18	Time sample received	: 17:00 Hrs
Sampling ref. #	: SC-24987-18	Sampling location	: SQ3
Sampling procedure ref.	: ASTM D75/D75 M -14	Sampled by	: Rak Lab representative
Sampling condition	: Sunny	Sample brought in by	: Rak Lab representative
Sampling date & time	: 08/07/2018 , 11:50 Hrs	Sampling method variation	: None
Sample description	: Soil	Senders ref. #	: **N#252119.45 E#55225.59**
Sample size	: 10 kg (Approximate)		
Source of sample	: Not Given	Condition of sample	: Moist

Test Data

Date test started	: 09/07/2018	Date test completed	: 16/07/2018
Tested by	: NH/AH/SC*		

PARAMETERS		UNITS	RESULTS
Moisture	-	% by weight	0.34
pH @ 25°C	Saturated Extract	-	7.70
Conductivity @ 25°C	Saturated Extract	µmhos/cm	2380
Chloride (Cl)	-	mg/kg	425
Total Alkalinity	-	mg/kg	32
Total Nitrogen (TN)	-	mg/kg	23
Phosphate (PO_4)	-	mg/kg	0.5
***Total Petroleum Hydrocarbons**	-		<0.01
Potassium (K)	Saturated Extract	mg/kg	17.49
Nickel (Ni)	Saturated Extract	mg/kg	<0.01
Arsenic (As)	Saturated Extract	mg/kg	<0.01
Copper (Cu)	Saturated Extract	mg/kg	<0.01
Iron (Fe)	Saturated Extract	mg/kg	<0.01
Zinc (Zn)	Saturated Extract	mg/kg	<0.01
Manganese (Mn)	Saturated Extract	mg/kg	<0.01
***Mercury (Hg)**	Saturated Extract	mg/kg	<0.001
Lead (Pb)	Saturated Extract	mg/kg	<0.01
Cadmium (Cd)	Saturated Extract	mg/kg	<0.01
Chromium (Cr)	Saturated Extract	mg/kg	0.01
Selenium (Se)	Saturated Extract	mg/kg	<0.01
Barium (Ba)	Saturated Extract	mg/kg	0.05

Test methods : 1. BS 1377 - 3: 1990
2. APHA 22nd : 2012
3. EPA 8015 , 3350C

Test method variation : None
Remarks : None

Joseph Rego, Laboratory Manager
For RAK lab L.L.C., Ras Al Khaimah

Rak Lab

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مختبر فحص مستقل
ص.ب : ٨٦، رأس الخيمة، إ.ع.م.
هـ : ٨٣٤١ ٢٦٦ ٧ ٩٧١+ ، ف : ٨٢٩٢ ٢٦٦ ٧ ٩٧١+
البريد الإلكتروني : www.raklab.com/info@raklab.com

REPORT ON CHEMICAL ANALYSIS OF SOIL

Customer	: **ENVIRONMENTAL SOULTIONS & CONSULTANCY**		
Address	: P.O. Box 68595, 408, Sarah Shopping Mall, Rolla Bank Street, Sharjah, United Arab Emirates		
Contractor	: Not Applicable	Consultant	: Not Applicable
Project number	: Not Applicable	Client	: SEWA
Project name	: Baseline Terrestrial Environmental Survey @ Layyah Combined Cycled Thermal Power Plant	Project location	: Sharjah
Report number	: RP-247053-18	Report date	: 17/07/2018
Job order number	: JO-262-14	Date sample received	: 08/07/2018
Sample number	: SA-155847-18	Time sample received	: 17:00 Hrs
Sampling ref. #	: SC-24986-18	Sampling location	: SQ2
Sampling procedure ref.	: ASTM D75/D75 M -14	Sampled by	: Rak Lab representative
Sampling condition	: Sunny	Sample brought in by	: Rak Lab representative
Sampling date & time	: 08/07/2018 , 11:20 Hrs	Sampling method variation	: None
Sample description	: Soil	Senders ref. #	: **N#252116.53 E#55223.94**
Sample size	: 10 kg (Approximate)		
Source of sample	: Not Given	Condition of sample	: Moist

Test Data

Date test started	: 09/07/2018	Date test completed	: 16/07/2018
Tested by	: NH/AH/SC*		

PARAMETERS			UNITS	RESULTS
Moisture		-	**% by weight**	**0.63**
pH @ 25°C		**Saturated Extract**	-	**7.46**
Conductivity @ 25°C			**µmhos/cm**	**10200**
Chloride	**(Cl)**	-	**mg/kg**	**3120**
Total Alkalinity			**mg/kg**	**36**
Total Nitrogen	**(TN)**		**mg/kg**	**22**
Phosphate	**(PO_4)**		**mg/kg**	**1.0**
***Total Petroleum Hydrocarbons**				**<0.01**
Potassium	**(K)**	**Saturated Extract**	**mg/kg**	**88.73**
Nickel	**(Ni)**		**mg/kg**	**0.03**
Arsenic	**(As)**		**mg/kg**	**<0.01**
Copper	**(Cu)**		**mg/kg**	**<0.01**
Iron	**(Fe)**		**mg/kg**	**<0.01**
Zinc	**(Zn)**		**mg/kg**	**<0.01**
Manganese	**(Mn)**		**mg/kg**	**<0.01**
***Mercury**	**(Hg)**		**mg/kg**	**<0.001**
Lead	**(Pb)**		**mg/kg**	**<0.01**
Cadmium	**(Cd)**		**mg/kg**	**<0.01**
Chromium	**(Cr)**		**mg/kg**	**<0.01**
Selenium	**(Se)**		**mg/kg**	**<0.01**
Barium	**(Ba)**		**mg/kg**	**0.07**

Test methods	: 1. BS 1377 - 3: 1990 2. APHA 22nd : 2012 3. EPA 8015 , 3350C
Test method variation	: None
Remarks	: None

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Rak Lab
P.O. Box : 86
RAK - UAE
RAK LAB L.L.C.

Joseph Rego, Laboratory Manager
For RAK lab L.L.C., Ras Al Khaimah

Rak Lab

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راك لاب ذ.م.م.
مختبر فحص مستقل
ص.ب : ٨٦، رأس الخيمة، إ.ع.م.
هـ : ٩٧١ ٧ ٢٦٦ ٨٣٤١+، ف : ٩٧١ ٧ ٢٦٦ ٨٢٩٢+
البريد الإلكتروني: www.raklab.com/info@raklab.com

REPORT ON CHEMICAL ANALYSIS OF SOIL

Customer : **ENVIRONMENTAL SOULTIONS & CONSULTANCY**

Address : P.O. Box 68595, 408, Sarah Shopping Mall, Rolla Bank Street, Sharjah, United Arab Emirates

Contractor	: Not Applicable	Consultant	: Not Applicable
Project number	: Not Applicable	Client	: SEWA
Project name	: Baseline Terrestrial Environmental Survey @ Layyah Combined Cycled Thermal Power Plant	Project location	: Sharjah
Report number	: RP-247052-18	Report date	: 17/07/2018
Job order number	: JO-262-14	Date sample received	: 08/07/2018
Sample number	: SA-155846-18	Time sample received	: 17:00 Hrs
Sampling ref. #	: SC-24985-18	Sampling location	: SQ1
Sampling procedure ref.	: ASTM D75/D75 M -14	Sampled by	: Rak Lab representative
Sampling condition	: Sunny	Sample brought in by	: Rak Lab representative
Sampling date & time	: 08/07/2018 , 11:00 Hrs	Sampling method variation	: None
Sample description	: Soil	Senders ref. #	: **N#252118.93 E#55223.73**
Sample size	: 10 kg (Approximate)		
Source of sample	: Not Given	Condition of sample	: Moist

Test Data

Date test started	: 09/07/2018	Date test completed	: 16/07/2018
Tested by	: NH/AH/SC*		

PARAMETERS			UNITS	RESULTS
Moisture		**-**	**% by weight**	**0.56**
pH @ 25°C		**Saturated Extract**	**-**	**7.54**
Conductivity @ 25°C			**µmhos/cm**	**21600**
Chloride	**(Cl)**	**-**	**mg/kg**	**6736**
Total Alkalinity			**mg/kg**	**28**
Total Nitrogen	**(TN)**		**mg/kg**	**55**
Phosphate	**(PO_4)**		**mg/kg**	**0.5**
***Total Petroleum Hydrocarbons**				**<0.01**
Potassium	**(K)**	**Saturated Extract**	**mg/kg**	**156.5**
Nickel	**(Ni)**		**mg/kg**	**<0.01**
Arsenic	**(As)**		**mg/kg**	**<0.01**
Copper	**(Cu)**		**mg/kg**	**<0.01**
Iron	**(Fe)**		**mg/kg**	**<0.01**
Zinc	**(Zn)**		**mg/kg**	**0.04**
Manganese	**(Mn)**		**mg/kg**	**<0.01**
***Mercury**	**(Hg)**		**mg/kg**	**<0.001**
Lead	**(Pb)**		**mg/kg**	**<0.01**
Cadmium	**(Cd)**		**mg/kg**	**<0.01**
Chromium	**(Cr)**		**mg/kg**	**<0.01**
Selenium	**(Se)**		**mg/kg**	**<0.01**
Barium	**(Ba)**		**mg/kg**	**0.09**

Test methods : 1. BS 1377 - 3: 1990
2. APHA 22nd : 2012
3. EPA 8015 , 3350C

Test method variation : None

Remarks : None

Joseph Rego, Laboratory Manager
For RAK lab L.L.C., Ras Al Khaimah

Baseline Environmental Survey Reports – Marine Environment

Lonestar Technical Services (L.L.C.)

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ATL 0042

Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08032	REPORT#	CR54926S1	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW1
Description: Sea Water
N 25°21'47.2"
E 55°22' 1.5"
Location: SW1 - Harbour
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 12:45 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.02
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	6.0
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	38.3
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	27296
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.95
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 NO_2^- B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 NO_3^- B	0.01	0.04
Sulfates, mg/L	APHA 4500 SO_4^{2-} E	1.0	3435
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	9400
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	44300
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

QC SEAL MANDATORY

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Website: www.Lonestar-Lab.com
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ATL 0042

Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08032	REPORT#	CR54926S1	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW1
Description: Sea Water
N 25°21'47.2"
E 55°22' 1.5"
Location: SW1 - Harbour
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 12:45 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	628
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	554
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14510
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1902
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
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(Engineering, Inspection, Testing & Lab Services)

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Website: www.Lonestar-Lab.com

TESTING
ATL 0042

Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08032	REPORT#	CR54926S1	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW1
Description: Sea Water
N 25°21'47.2"
E 55°22' 1.5"
Location: SW1 - Harbour
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 12:45 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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ATL D042

Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08033	REPORT#	CR54926S2	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW2
Description: Sea Water
N 25°22'08.9"
E 55°12' 19.8"
Location: SW2 - Arabian Gulf
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 08:37 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.03
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	6.0
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	33.8
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25186
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.59
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 NO_2^- B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 NO_3^- B	0.01	0.08
Sulfates, mg/L	APHA 4500 SO_4^{2-} E	1.0	3124
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	8350
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	43400
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

QC SEAL MANDATORY

* DAC Accredited Tests

° GAC Accredited Tests

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Website: www.Lonestar-Lab.com

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ATL 0042

Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08033	REPORT#	CR54926S2	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW2 Description: Sea Water N 25°22'08.9" E 55°12' 19.8" Location: SW2 - Arabian Gulf Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 08:37 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	546
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	517
Sodium, mg/L	US EPA SW 846/6010 B	1.4	13940
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1701
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

QC SEAL MANDATORY

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Lonestar Technical Services (L.L.C.)

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08033	REPORT#	CR54926S2	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW2 Description: Sea Water N 25°22'08.9" E 55°12' 19.8" Location: SW2 - Arabian Gulf Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 08:37 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

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TESTING
ATL D042

Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08034	REPORT#	CR54926S3	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW3 Description: Sea Water N 25°22'52.3" E 55°22' 52.6" Location: SW3 - Arabian Gulf Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 11:30 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.08
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.9
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	34.7
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25243
Fluorides, mg/L	APHA 4500 F^- D	0.05	1.1
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 NO_2^- B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 NO_3^- B	0.01	0.03
Sulfates, mg/L	APHA 4500 SO_4^{2-} E	1.0	3144
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	8300
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	43200
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

QC SEAL MANDATORY

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08034	REPORT#	CR54926S3	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description
Water sample . Seq. # SW3
Description: Sea Water
N 25°22'52.3"
E 55°22' 52.6"
Location: SW3 - Arabian Gulf
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 11:30 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	507
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	536
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14310
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1717
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08034	REPORT#	CR54926S3	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW3 Description: Sea Water N 25°22'52.3" E 55°22' 52.6" Location: SW3 - Arabian Gulf Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 11:30 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08035	REPORT#	CR54926S4	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW4 Description: Sea Water N 25°22'48.2" E 55°23' 30.6" Location: SW4 - Sharjah Creek Entry. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 11:15 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.07
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.5
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	34.7
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25201
Fluorides, mg/L	APHA 4500 F^- D	0.05	1.0
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 $NO2^-$ B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 $NO3^-$ B	0.01	0.05
Sulfates, mg/L	APHA 4500 $SO4^{2-}$ E	1.0	3177
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	7750
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	42800
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08035	REPORT#	CR54926S4	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW4 Description: Sea Water N 25°22'48.2" E 55°23' 30.6" Location: SW4 - Sharjah Creek Entry. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 11:15 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	75	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.07	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	457
Chromium, mg/L	US EPA SW 846/6010 B	0.068	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.07	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.8	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	527
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14240
Zinc, mg/L	US EPA SW 846/6010 B	0.15	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1613
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08035	REPORT#	CR54926S4	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW4 Description: Sea Water N 25°22'48.2" E 55°23' 30.6" Location: SW4 - Sharjah Creek Entry. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 11:15 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08036	REPORT#	CR54926S5	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW5 Description: Sea Water N 25°23'53.2" E 55°42' 27.0" Location: SW5 - Arabian Gulf. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 11:34 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	7.98
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.8
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	34.2
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25186
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.80
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 $NO2^-$ B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 $NO3^-$ B	0.01	0.03
Sulfates, mg/L	APHA 4500 $SO4^{2-}$ E	1.0	3118
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	7950
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	41800
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08036	REPORT#	CR54926S5	REVISION#	0	JOB#	82935

CLIENT			
CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW5
Description: Sea Water
N 25°23'53.2"
E 55°42' 27.0"
Location: SW5 - Arabian Gulf.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 11:34 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	467
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	542
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14200
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1645
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08036	REPORT#	CR54926S5	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW5
Description: Sea Water
N 25°23'53.2"
E 55°42' 27.0"
Location: SW5 - Arabian Gulf.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 11:34 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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ATL 0042

Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08037	REPORT#	CR54926S6	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW6 Description: Sea Water N 25°23'08.0" E 55°21' 48.0" Location: SW6 - Arabian Gulf. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 08:04 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.10
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.9
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	33.7
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25170
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.62
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 $NO2^-$ B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 $NO3^-$ B	0.01	0.04
Sulfates, mg/L	APHA 4500 $SO4^{2-}$ E	1.0	3105
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	7600
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	42100
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

QC SEAL MANDATORY

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TESTING
ATL 0042

Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08037	REPORT#	CR54926S6	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW6
Description: Sea Water
N 25°23'08.0"
E 55°21' 48.0"
Location: SW6 - Arabian Gulf.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 08:04 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	443
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	521
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14010
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1574
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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TESTING
ATL D042

Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08037	REPORT#	CR54926S6	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW6 Description: Sea Water N 25°23'08.0" E 55°21' 48.0" Location: SW6 - Arabian Gulf. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 08:04 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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TESTING
ATL 0042

Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08038	REPORT#	CR54926S7	REVISION#	0	JOB#	82935

CLIENT			
	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW7
Description: Sea Water
N 25°21'21.0"
E 55°21' 48.0"
Location: SW7 - Arabian Gulf.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 07:25 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.05
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.9
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	33.7
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25201
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.47
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 $NO2^-$ B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 $NO3^-$ B	0.01	0.02
Sulfates, mg/L	APHA 4500 $SO4^{2-}$ E	1.0	3155
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	7750
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	42600
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

QC SEAL MANDATORY

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08038	REPORT#	CR54926S7	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW7 Description: Sea Water N 25°21'21.0" E 55°21' 48.0" Location: SW7 - Arabian Gulf. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 07:25 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	453
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	542
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14440
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1611
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08038	REPORT#	CR54926S7	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW7 Description: Sea Water N 25°21'21.0" E 55°21' 48.0" Location: SW7 - Arabian Gulf. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 07:25 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08039	REPORT#	CR54926S8	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW8 Description: Sea Water N 25°21'33.8" E 55°20' 52.5" Location: SW8 - Arabian Gulf. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 12:10 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.11
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	6.1
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	34.0
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25219
Fluorides, mg/L	APHA 4500 F^- D	0.05	1.1
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 NO_2^- B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 NO_3^- B	0.01	0.02
Sulfates, mg/L	APHA 4500 SO_4^{2-} E	1.0	3163
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	7700
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	42100
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08039	REPORT#	CR54926S8	REVISION#	0	JOB#	82935

CLIENT			
	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW8
Description: Sea Water
N 25°21'33.8"
E 55°20' 52.5"
Location: SW8 - Arabian Gulf.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 12:10 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	446
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	531
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14330
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1596
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08039	REPORT#	CR54926S8	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW8
Description: Sea Water
N 25°21'33.8"
E 55°20' 52.5"
Location: SW8 - Arabian Gulf.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 12:10 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

	Approved by		Checked by
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08040	REPORT#	CR54926S9	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW9
Description: Sea Water
N 25°20'34.0"
E 55°21' 18.0"
Location: SW9 - Arabian Gulf.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 06:46 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.08
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.9
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	33.8
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	24638
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.56
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 $NO2^-$ B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 $NO3^-$ B	0.01	0.13
Sulfates, mg/L	APHA 4500 $SO4^{2-}$ E	1.0	2764
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	8100
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	42500
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

QC SEAL MANDATORY

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ATL 0042

Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08040	REPORT#	CR54926S9	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW9 Description: Sea Water N 25°20'34.0" E 55°21' 18.0" Location: SW9 - Arabian Gulf. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 06:46 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	492
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	541
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14290
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1680
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08040	REPORT#	CR54926S9	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW9 Description: Sea Water N 25°20'34.0" E 55°21' 18.0" Location: SW9 - Arabian Gulf. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 06:46 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08041	REPORT#	CR54926S10	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW10 Description: Sea Water N 25°19'42" E 55°21'49.21" Location: SW10 - AL Khan Lagoon. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 13:02 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.02
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.8
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	34.7
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25116
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.76
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 NO_2^- B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 NO_3^- B	0.01	0.03
Sulfates, mg/L	APHA 4500 SO_4^{2-} E	1.0	3129
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	7300
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	41900
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08041	REPORT#	CR54926S10	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW10 Description: Sea Water N 25°19'42" E 55°21'49.21" Location: SW10 - AL Khan Lagoon. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 13:02 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	411
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	542
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14680
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1527
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

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Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08041	REPORT#	CR54926S10	REVISION#	0	JOB#	82935

CLIENT			
	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW10
Description: Sea Water
N 25°19'42"
E 55°21'49.21"
Location: SW10 - AL Khan Lagoon.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 13:02 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08042	REPORT#	CR54926S11	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW11
Description: Sea Water
N 25°21'43.0"
E 55°22'59.2"
Location: SW11 - Sharjah Creek.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 09:46 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.09
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.9
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	34.3
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25398
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.84
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 $NO2^-$ B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 $NO3^-$ B	0.01	0.02
Sulfates, mg/L	APHA 4500 $SO4^{2-}$ E	1.0	3253
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	7800
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	41500
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08042	REPORT#	CR54926S11	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW11
Description: Sea Water
N 25°21'43.0"
E 55°22'59.2"
Location: SW11 - Sharjah Creek.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 09:46 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	465
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	534
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14580
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1616
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08042	REPORT#	CR54926S11	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW11 Description: Sea Water N 25°21'43.0" E 55°22'59.2" Location: SW11 - Sharjah Creek. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 09:46 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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TESTING
ATL D042

Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08043	REPORT#	CR54926S12	REVISION#	0	JOB#	82935

CLIENT			
	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW12
Description: Sea Water
N 25°21'43.0"
E 55°22'59.2"
Location: SW12 - Khalid Lagoon.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 10:25 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.02
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.9
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	35.2
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25019
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.65
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 NO_2^- B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 NO_3^- B	0.01	0.02
Sulfates, mg/L	APHA 4500 SO_4^{2-} E	1.0	3090
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	7550
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	42200
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section

Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08043	REPORT#	CR54926S12	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description

Water sample . Seq. # SW12
Description: Sea Water
N 25°21'43.0"
E 55°22'59.2"
Location: SW12 - Khalid Lagoon.
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 10:25 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	449
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	527
Sodium, mg/L	US EPA SW 846/6010 B	1.4	14360
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1559
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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TESTING
ATL 0042

Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08043	REPORT#	CR54926S12	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water sample . Seq. # SW12 Description: Sea Water N 25°21'43.0" E 55°22'59.2" Location: SW12 - Khalid Lagoon. Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 10:25 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

	Approved by		Checked by
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08044	REPORT#	CR54926S13	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH
Sample Description	Water Sample Collected from Out Fall Channel #1 Location: Layyah Power Station. Seq.# 13 Project Name: SEWA (P695)		

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.04
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.9
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	40.9
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	27536
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.77
Nitrogen (Ammonia), mg/L	APHA 4500 NH3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 $NO2^-$ B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 $NO3^-$ B	0.01	0.03
Sulfates, mg/L	APHA 4500 $SO4^{2-}$ E	1.0	3551
Total Hardness as CaCO3, mg/L	APHA 2340 C (Hardness EDTA)	1.0	9000
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	44800
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m³	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08044	REPORT#	CR54926S13	REVISION#	0	JOB#	82935

CLIENT			
	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description: Water Sample Collected from Out Fall Channel #1
Location: Layyah Power Station. Seq.# 13
Project Name: SEWA (P695)

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	585
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	566
Sodium, mg/L	US EPA SW 846/6010 B	1.4	15130
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1832
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

N/D = Not Detected i.e., below PQL
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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08044	REPORT#	CR54926S13	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH

Sample Description	Water Sample Collected from Out Fall Channel #1 Location: Layyah Power Station. Seq.# 13 Project Name: SEWA (P695)

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08045	REPORT#	CR54926S14	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH
Sample Description	Water Sample Collected from Out Fad Channel #2 Location: Layyah Power Station. Seq.# 14 Project Name: SEWA (P695)		

TEST	TEST METHOD	PQL	RESULT
PHYSICAL PARAMETERS			
pH Value	APHA 4500 H+	0.1	8.09
Dissolved Oxygen, mg/L	APHA 4500 O G	0.1	5.9
Turbidity, NTU	APHA 2130 B	1.0	N/D
Temperature, ° C	APHA 2550 B	0.1	41.6
CHEMICAL PARAMETERS			
Chlorine (Residual), mg/L	APHA 4500 Cl G	0.005	N/D
Chlorides, mg/L	APHA 4500 Cl^- B	1.0	25036
Fluorides, mg/L	APHA 4500 F^- D	0.05	0.57
Nitrogen (Ammonia), mg/L	APHA 4500 NH_3 F	0.01	N/D
Nitrogen Nitrites, mg/L	APHA 4500 NO_2^- B	0.05	N/D
Nitrogen Nitrates, mg/L	APHA 4500 NO_3^- B	0.01	0.02
Sulfates, mg/L	APHA 4500 SO_4^{2-} E	1.0	3095
Total Hardness as $CaCO_3$, mg/L	APHA 2340 C (Hardness EDTA)	1.0	7800
Total Dissolved Solids dried @ 180° C, mg/L	APHA 2540 C	10	42000
Total Suspended Solids dried @ 103 - 105° C, mg/L	APHA 2540 D	10	N/D
Biochemical Oxygen Demand, mg/L	APHA 5210 B	2.0	N/D
Chemical Oxygen Demand, mg/L	APHA 5220 B	1.0	N/D
Oil and Grease, mg/L	APHA 5520 B	1.3	N/D
Phenols, mg/L	APHA 5530 C&D	0.1	N/D
Surfactants, µg/L	APHA 5540 C	10	N/D
Carbonates, mg/L	APHA 2320 B	1.0	N/D
Phosphates, mg/L	APHA 4500 P E	0.03	N/D
Total Nitrogen, mg/L	APHA 4500 N C	1.0	N/D
Chlorophyll a, mg/m^3	APHA 10200 H	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08045	REPORT#	CR54926S14	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BCV/BCT/BDH
Sample Description	Water Sample Collected from Out Fad Channel #2 Location: Layyah Power Station. Seq.# 14 Project Name: SEWA (P695)		

TEST	TEST METHOD	PQL	RESULT
BACTERIOLOGICAL PARAMETERS			
Total Coliforms, cfu/100mL	APHA 9222 B	1.0	N/D
Escherichia Coli, cfu/100mL	APHA 9221 F	1.0	N/D
METALS			
Aluminum, mg/L	US EPA SW 846/6010 B	0.2	N/D
Arsenic, µg/L	US EPA SW 846/6010 B	10	N/D
Cadmium, mg/L	US EPA SW 846/6010 B	0.003	N/D
Calcium, mg/L	US EPA SW 846/6010 B	0.02	499
Chromium, mg/L	US EPA SW 846/6010 B	0.01	N/D
Cobalt, mg/L	US EPA SW 846/6010 B	0.066	N/D
Copper, mg/L	US EPA SW 846/6010 B	0.005	N/D
Iron, mg/L	US EPA SW 846/6010 B	0.5	N/D
Lead, mg/L	US EPA SW 846/6010 B	0.08	N/D
Potassium, mg/L	US EPA SW 846/6010 B	2.2	525
Sodium, mg/L	US EPA SW 846/6010 B	1.4	13760
Zinc, mg/L	US EPA SW 846/6010 B	0.012	N/D
Nickel, mg/L	US EPA SW 846/6010 B	0.063	N/D
Magnesium, mg/L	US EPA SW 846/6010 B	0.01	1590
Mercury, mg/L	US EPA SW 846/7470 A	0.0005	N/D

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Analytical Chemistry Section
Water Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08045	REPORT#	CR54926S14	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy	ATTENTION	Ms. Azra
	PO BOX:68595	TEST METHOD	As Below
	SHARJAH	ANALYSIS DATE	23-JUL-2018
	UNITED ARAB EMIRATES	ANALYST	BCS/BCV/BCT/BDH
Sample Description	Water Sample Collected from Out Fad Channel #2 Location: Layyah Power Station. Seq.# 14 Project Name: SEWA (P695)		

TEST	TEST METHOD	PQL	RESULT
TOTAL PETROLEUM HYDROCARBONS			
° Gasoline Range Organics (C6 - C9), µg/L	US EPA SW 846/8015 B	119	N/D
° Diesel Range Organics (C10 - C30), µg/L	US EPA SW 846/8015 B	80	N/D
* Heavy Fractions (>C30), mg/L	US EPA 1664	1	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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Analytical Chemistry Section
Sediment Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08046	REPORT#	CR55018S1	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BDD/BDG/BCT

Sample Description	Sediment sample . Seq. # MS 2/ SW Description: Sediment N 25°22'52.3" E 55°22' 52.6" Location: MS2 - Arabian Gulf Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 10:56 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
CHEMICAL PARAMETERS			
Sulfates, mg/Kg	US EPA SW 846/9038	5	208
Total Organic Carbon, wt. %	US EPA SW 846/9060	0.5	N/D
Total Phosphates, mg/Kg	APHA 4500 P, C (Mod)	1	N/D
Nitrates, mg/Kg	US EPA CE 81/1	1	14
Nitrogen (Ammonia), mg/Kg	APHA 4500 NH3, E (Mod.)	5	N/D
Total Nitrogen, mg/Kg	APHA 4500 Norg, B (Mod.)	0.5	3.2
METALS			
Aluminum, mg/Kg	US EPA SW 846/6010 B	7.9	244
Arsenic, mg/Kg	US EPA SW 846/6010 B	1.2	N/D
Cadmium, mg/Kg	US EPA SW 846/6010 B	2.2	N/D
Chromium, mg/Kg	US EPA SW 846/6010 B	0.95	1.0
Copper, mg/Kg	US EPA SW 846/6010 B	1.4	N/D
Iron, mg/Kg	US EPA SW 846/6010 B	0.05	616
Lead, mg/Kg	US EPA SW 846/6010 B	1.8	N/D
Nickel, mg/Kg	US EPA SW 846/6010 B	0.5	N/D
Zinc, mg/Kg	US EPA SW 846/6010 B	0.23	3.0
Mercury, mg/Kg	US EPA SW 846/7471 A	0.025	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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Analytical Chemistry Section
Sediment Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08047	REPORT#	CR55018S2	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BDD/BDG/BCT
Sample Description	Sediment sample . Seq. # MS 3 Description: Sediment N 25°20'37.2" E 55°22' 56.40" Location: MS 3 - Khalid Lagoon Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 09:15 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.		

TEST	TEST METHOD	PQL	RESULT
CHEMICAL PARAMETERS			
Sulfates, mg/Kg	US EPA SW 846/9038	5	604
Total Organic Carbon, wt. %	US EPA SW 846/9060	0.5	1.01
Total Phosphates, mg/Kg	APHA 4500 P, C (Mod)	1	N/D
Nitrates, mg/Kg	US EPA CE 81/1	1	23
Nitrogen (Ammonia), mg/Kg	APHA 4500 NH3, E (Mod.)	5	N/D
Total Nitrogen, mg/Kg	APHA 4500 Norg, B (Mod.)	0.5	5.3
METALS			
Aluminum, mg/Kg	US EPA SW 846/6010 B	7.9	63
Arsenic, mg/Kg	US EPA SW 846/6010 B	1.2	N/D
Cadmium, mg/Kg	US EPA SW 846/6010 B	2.2	N/D
Chromium, mg/Kg	US EPA SW 846/6010 B	0.95	N/D
Copper, mg/Kg	US EPA SW 846/6010 B	1.4	1.5
Iron, mg/Kg	US EPA SW 846/6010 B	0.05	323
Lead, mg/Kg	US EPA SW 846/6010 B	1.8	N/D
Nickel, mg/Kg	US EPA SW 846/6010 B	0.5	N/D
Zinc, mg/Kg	US EPA SW 846/6010 B	0.23	4.4
Mercury, mg/Kg	US EPA SW 846/7471 A	0.025	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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Analytical Chemistry Section

Sediment Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08048	REPORT#	CR55018S3	REVISION#	0	JOB#	82935

CLIENT			
CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BDD/BDG/BCT
Sample Description	Sediment sample . Seq. # MS 5/ SW 5 Description: Sediment N 25°23'53.2" E 55°42' 56.27.0" Location: MS 5 - Arabian Gulf Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018. Date and time received: 23-Jul-2018 @ 15:00 Hrs.		

TEST	TEST METHOD	PQL	RESULT
CHEMICAL PARAMETERS			
Sulfates, mg/Kg	US EPA SW 846/9038	5	1798
Total Organic Carbon, wt. %	US EPA SW 846/9060	0.5	0.58
Total Phosphates, mg/Kg	APHA 4500 P, C (Mod)	1	N/D
Nitrates, mg/Kg	US EPA CE 81/1	1	40
Nitrogen (Ammonia), mg/Kg	APHA 4500 NH3, E (Mod.)	5	8.4
Total Nitrogen, mg/Kg	APHA 4500 Norg, B (Mod.)	0.5	17
METALS			
Aluminum, mg/Kg	US EPA SW 846/6010 B	7.9	1202
Arsenic, mg/Kg	US EPA SW 846/6010 B	1.2	N/D
Cadmium, mg/Kg	US EPA SW 846/6010 B	2.2	N/D
Chromium, mg/Kg	US EPA SW 846/6010 B	0.95	19
Copper, mg/Kg	US EPA SW 846/6010 B	1.4	42
Iron, mg/Kg	US EPA SW 846/6010 B	0.05	1820
Lead, mg/Kg	US EPA SW 846/6010 B	1.8	N/D
Nickel, mg/Kg	US EPA SW 846/6010 B	0.5	12
Zinc, mg/Kg	US EPA SW 846/6010 B	0.23	68
Mercury, mg/Kg	US EPA SW 846/7471 A	0.025	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

LONESTAR

Lonestar Technical Services (L.L.C.)

(Engineering, Inspection, Testing & Lab Services)

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Email: Testing@Lonestar-Lab.com
Website: www.Lonestar-Lab.com

Analytical Chemistry Section
Sediment Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08049	REPORT#	CR55018S4	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BDD/BDG/BCT
Sample Description	Sediment sample . Seq. # MS 8 Description: Sediment N 25°21'33.8" E 55°20' 52.5" Location: MS 8 - Arabian Gulf Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 12:00 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.		

TEST	TEST METHOD	PQL	RESULT
CHEMICAL PARAMETERS			
Sulfates, mg/Kg	US EPA SW 846/9038	5	597
Total Organic Carbon, wt. %	US EPA SW 846/9060	0.5	N/D
Total Phosphates, mg/Kg	APHA 4500 P, C (Mod)	1	N/D
Nitrates, mg/Kg	US EPA CE 81/1	1	39
Nitrogen (Ammonia), mg/Kg	APHA 4500 NH3, E (Mod.)	5	N/D
Total Nitrogen, mg/Kg	APHA 4500 Norg, B (Mod.)	0.5	8.8
METALS			
Aluminum, mg/Kg	US EPA SW 846/6010 B	7.9	57
Arsenic, mg/Kg	US EPA SW 846/6010 B	1.2	N/D
Cadmium, mg/Kg	US EPA SW 846/6010 B	2.2	N/D
Chromium, mg/Kg	US EPA SW 846/6010 B	0.95	N/D
Copper, mg/Kg	US EPA SW 846/6010 B	1.4	N/D
Iron, mg/Kg	US EPA SW 846/6010 B	0.05	226
Lead, mg/Kg	US EPA SW 846/6010 B	1.8	N/D
Nickel, mg/Kg	US EPA SW 846/6010 B	0.5	N/D
Zinc, mg/Kg	US EPA SW 846/6010 B	0.23	N/D
Mercury, mg/Kg	US EPA SW 846/7471 A	0.025	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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Analytical Chemistry Section
Sediment Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08050	REPORT#	CR55018S5	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BDD/BDG/BCT

Sample Description	Sediment sample . Seq. # MS 9 Description: Sediment N 25°20'34" E 55°21' 18.0" Location: MS 9 - Arabian Gulf Project Name: SEWA (P695) Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 06:40 Hrs. Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
CHEMICAL PARAMETERS			
Sulfates, mg/Kg	US EPA SW 846/9038	5	559
Total Organic Carbon, wt. %	US EPA SW 846/9060	0.5	N/D
Total Phosphates, mg/Kg	APHA 4500 P, C (Mod)	1	N/D
Nitrates, mg/Kg	US EPA CE 81/1	1	33
Nitrogen (Ammonia), mg/Kg	APHA 4500 NH3, E (Mod.)	5	9.1
Total Nitrogen, mg/Kg	APHA 4500 Norg, B (Mod.)	0.5	17
METALS			
Aluminum, mg/Kg	US EPA SW 846/6010 B	7.9	864
Arsenic, mg/Kg	US EPA SW 846/6010 B	1.2	N/D
Cadmium, mg/Kg	US EPA SW 846/6010 B	2.2	N/D
Chromium, mg/Kg	US EPA SW 846/6010 B	0.95	7.4
Copper, mg/Kg	US EPA SW 846/6010 B	1.4	2.8
Iron, mg/Kg	US EPA SW 846/6010 B	0.05	1541
Lead, mg/Kg	US EPA SW 846/6010 B	1.8	N/D
Nickel, mg/Kg	US EPA SW 846/6010 B	0.5	7.8
Zinc, mg/Kg	US EPA SW 846/6010 B	0.23	7.9
Mercury, mg/Kg	US EPA SW 846/7471 A	0.025	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

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Analytical Chemistry Section

Sediment Analysis Report

DATE	02-AUG-2018	SAMPLE#	300 - 18-08051	REPORT#	CR55018S6	REVISION#	0	JOB#	82935

CLIENT	Environmental Solutions And Consultancy PO BOX:68595 SHARJAH UNITED ARAB EMIRATES	ATTENTION	Ms. Azra
		TEST METHOD	As Below
		ANALYSIS DATE	23-JUL-2018
		ANALYST	BCS/BDD/BDG/BCT

Sample Description

Sediment sample . Seq. # MS 10
Description: Sediment
N 25°19'40.20"
E 55°21' 49.7"
Location: MS 10 - AL Khan Lagoon
Project Name: SEWA (P695)
Sampled by: Client. Sampling date and time: 19-Jul-2018 @ 13:10 Hrs.
Date and time received: 23-Jul-2018 @ 15:00 Hrs.

TEST	TEST METHOD	PQL	RESULT
CHEMICAL PARAMETERS			
Sulfates, mg/Kg	US EPA SW 846/9038	5	730
Total Organic Carbon, wt. %	US EPA SW 846/9060	0.5	N/D
Total Phosphates, mg/Kg	APHA 4500 P, C (Mod)	1	N/D
Nitrates, mg/Kg	US EPA CE 81/1	1	41
Nitrogen (Ammonia), mg/Kg	APHA 4500 NH3, E (Mod.)	5	9.0
Total Nitrogen, mg/Kg	APHA 4500 Norg, B (Mod.)	0.5	18
METALS			
Aluminum, mg/Kg	US EPA SW 846/6010 B	7.9	852
Arsenic, mg/Kg	US EPA SW 846/6010 B	1.2	N/D
Cadmium, mg/Kg	US EPA SW 846/6010 B	2.2	N/D
Chromium, mg/Kg	US EPA SW 846/6010 B	0.95	6.1
Copper, mg/Kg	US EPA SW 846/6010 B	1.4	1.9
Iron, mg/Kg	US EPA SW 846/6010 B	0.05	1504
Lead, mg/Kg	US EPA SW 846/6010 B	1.8	N/D
Nickel, mg/Kg	US EPA SW 846/6010 B	0.5	5.1
Zinc, mg/Kg	US EPA SW 846/6010 B	0.23	4.8
Mercury, mg/Kg	US EPA SW 846/7471 A	0.025	N/D

N/D = Not Detected i.e., below PQL
PQL = Practical Quantitation Limit of the test method

LONESTAR QC 300 CHECKED

Approved by		Checked by	
Name	M.Mubin Shaikh	Name	Arun Tom Mathew
Designation	Chemistry Manager	Designation	Assistant Manager
Signature		Signature	

End Of Report

QC SEAL MANDATORY

ANNEXURE 10 – CV's OF STUDY TEAM

Curriculum Vitae's of Study Team

ANNEXURE 11 – PUBLIC ENGAGEMENT REQUEST LETTER

PUBLIC ENGAGEMENT REQUEST LETTER

MHPS CONSORTIUM OF ELSEWEDY POWER

SEWA - LAYYAH COMBINED CYCLE POWER PLANT

Mailing to:	**Sharjah Electricity and Water Authority** Al Khan Area, Government Departments Complex Sharjah, UAE	**Our Ref.:**	LAYYAH-CMEP-SEWA-L-00036
		Date:	31, Oct.2018
Attention:	Mr. Ali Abbas Yousif Sani, Project Manager Fax: +971 065288888 Email: ali.yousif@sewa.gov.ae	**Pjt. Code:**	ELE-LPS-18-002 Layyah CCGT Reply Required: ☒ Yes ☐ No Reply Date: 01,Nov.2018
Subject:	ESIA - Engagement of Stakeholders and public		
Yr. Ref.:			

Dear Sir,

The Consortium would like to seek your preliminary approval and acknowledgment to proceed on engagement of stakeholders including public through our appointed consultant ESC (Environmental Solutions Consultancy) by informing them about the impact of the project in compliance with the IFC (International financial Co-operation) guidelines and Equator principles and as a requirement.

The consortium will submit detailed plan for such engagement for your final approval at a later stage.

We will be usually remaining under your disposition.

Regards,

Consortium Project Manager

[I] MA [R] RE

Copy: - LAYYAH.CCGT

Enclosure: - ESIA - Engagement of Stakeholders and public

The final approval will be given at a later stage
The Consortium is not allowed to interact with public without written approval from SEWA.

1-11-2018
Eng. Ali Sani
Project Manager

Projects & Development