

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, 2015²⁷)

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., 2009²⁸ and *Kader Gaid²⁹* 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

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 NO_x 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 banded 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	<ul style="list-style-type: none"> 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
				<p>are securely sheeted or enclosed</p> <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> • 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/sewage/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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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			<p>(CEMP) including marine construction management plan with dredged waste disposal mechanism.</p> <ul style="list-style-type: none"> • 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
				<p>must be inspected regularly to ensure that they are completely sealed</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
				<p>carefully done by optimal usage of water to avoid leaching of contaminants which may leads to soil contamination.</p> <ul style="list-style-type: none"> • 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
				<p>stored properly in the separate area in different coloured bins.</p> <ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
				<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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
				<p>flammable products storage should be stored in a controlled temperature and all the electrical fittings should be under classified category as per International standards.</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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			<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
				<p>should be controlled by good maintenance and wetting of the road surface by water sprinkling.</p> <ul style="list-style-type: none"> • Speed Limit (20 km/hr) in force on unpaved roads. 	
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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> 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
				<p>recommendations.</p> <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
				<p>properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal.</p> <ul style="list-style-type: none"> 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. 	
<p>Spill, leaks due to improper storage and handling of fuels, chemicals/ operation materials</p>	<p>Possible Contamination of groundwater and Soil quality</p>	<p>Groundwater and Soil/ Land</p>	<p>Minor</p>	<ul style="list-style-type: none"> 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 	<p>Neutral</p>

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
				<p>spills.</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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
				<p>be stored in a controlled temperature and all the electrical fittings should be under classified category as per International standards.</p> <ul style="list-style-type: none"> • 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. 	
<p>Poor treatment of workers and Failure to establish a productive and sound worker-</p>	<p>Health issues</p>	<p>Project site workers</p>	<p>Minor</p>	<ul style="list-style-type: none"> • Labour management (Project labour commitment, Workers Code of Conduct, Labour Grievance Mechanism) shall be strictly followed 	<p>Neutral</p>

Aspects	Significant Impacts	Impacted Receptor	Pre-Mitigation Effect	Recommended Mitigation Measures	Residual Effect
management relationship				<p>as per UAE Federal Labour Law</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> 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	<p>Undertake daily visual inspections on implementing the measures.</p> <p>Ambient Air Quality Monitoring shall be conducted at 2 ambient locations (Upwind and downwind) – Biannual</p>	<p>Construction Phase</p> <p>Contractor/ Project Manager</p>
Combustion Emission	<ul style="list-style-type: none"> 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
	<p>maintained and operated equipment/ vehicles by the contractor, such as proper engine fuel mixtures, regularly serviced exhaust emission systems and proper engine tuning.</p> <ul style="list-style-type: none"> 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. 	<p>be reduced to acceptable level</p>	<p>inspections and regular repairs, when appropriate, to ensure that equipment does not emit excessive fumes. If excessive fume, exhaust emission monitoring shall be conducted</p>	<p>Contractor/ Project Manager</p>
<p>Construction Noise and Vibration</p>	<ul style="list-style-type: none"> 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 	<p>Residual impacts can be reduced to acceptable level</p>	<p>Undertake daily visual inspections and regular repairs, when appropriate, to ensure that equipment does not emit excessive noise. Undertake regular</p>	<p>Construction Phase Contractor/ Project Manager</p>

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	<p>trained personnel to keep plant and equipment working as per manufacturer's specifications.</p> <ul style="list-style-type: none"> Provision of Ear plugs/muffs for workers who will be exposed to higher noise and enforcement for its use by the workers. 		<p>noise monitoring at project fence areas during construction periods calibrated sound level meter (e.g. Laeq over 15 minute periods).</p> <p>Ambient Noise Quality Monitoring shall be conducted at 4 ambient locations – Bi-annual</p>	
Discharge of dewatered groundwater	<ul style="list-style-type: none"> 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	<p>Undertake daily visual checks of flow control turbidity and for signs of oil and grease.</p> <p>Dewatered ground water quality shall be checked before disposal to conform the norms.</p>	Construction Phase Contractor/ Project Manager
Dredging and disposal of dredged wastes	<ul style="list-style-type: none"> 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
	<p>(CEMP) shall be developed including marine construction management plan with dredged waste disposal mechanism and implemented</p> <ul style="list-style-type: none"> • 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	<p>sediment plume and oil and grease.</p> <p>Seawater quality shall be regularly checked in the marine construction area.</p>	Contractor/ Project Manager
Domestic waste water	<ul style="list-style-type: none"> • Toilets and septic tank facilities are to be appropriately designed and 	Neutral – There is no residual impacts	--	Construction Phase